

2001 EM convergence check

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Server Runs

Look at years of no convergence and parameter bounds

```
serverTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/RandRecHCR2servertest/r
```

```
## Rows: 102 Columns: 207
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl  (200): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgCheckServerTest <- serverTest %>% select(max_grad, params_on_bound,
                                              params_stuck_low, params_stuck_high,
                                              model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)
```

```
convrgCheckServerTest
```

```
## # A tibble: 65 x 7
##       max_grad params_on_bound params_stuck_low params_stuck_hi~ model_run
##       <dbl> <lgl>           <chr>           <chr>           <chr>
## 1      59800. NA              Size_95%width_MexCal_~ <NA>           constGro~
## 2      44485. NA              <NA>           <NA>           constGro~
## 3      74277. NA              CV_old_Fem_GP_1      <NA>           constGro~
## 4      11088. NA              CV_old_Fem_GP_1      <NA>           constGro~
## 5      34558. NA              <NA>           <NA>           constGro~
## 6 1709070000 NA              Size_95%width_MexCal_~ <NA>           constGro~
## 7 4464900000 NA              Size_95%width_MexCal_~ <NA>           constGro~
## 8      40798. NA              CV_old_Fem_GP_1      <NA>           constGro~
## 9       9042. NA              <NA>           <NA>           constGro~
## 10     61030. NA              <NA>           <NA>           constGro~
## # ... with 55 more rows, and 2 more variables: iteration <dbl>, year <dbl>
```

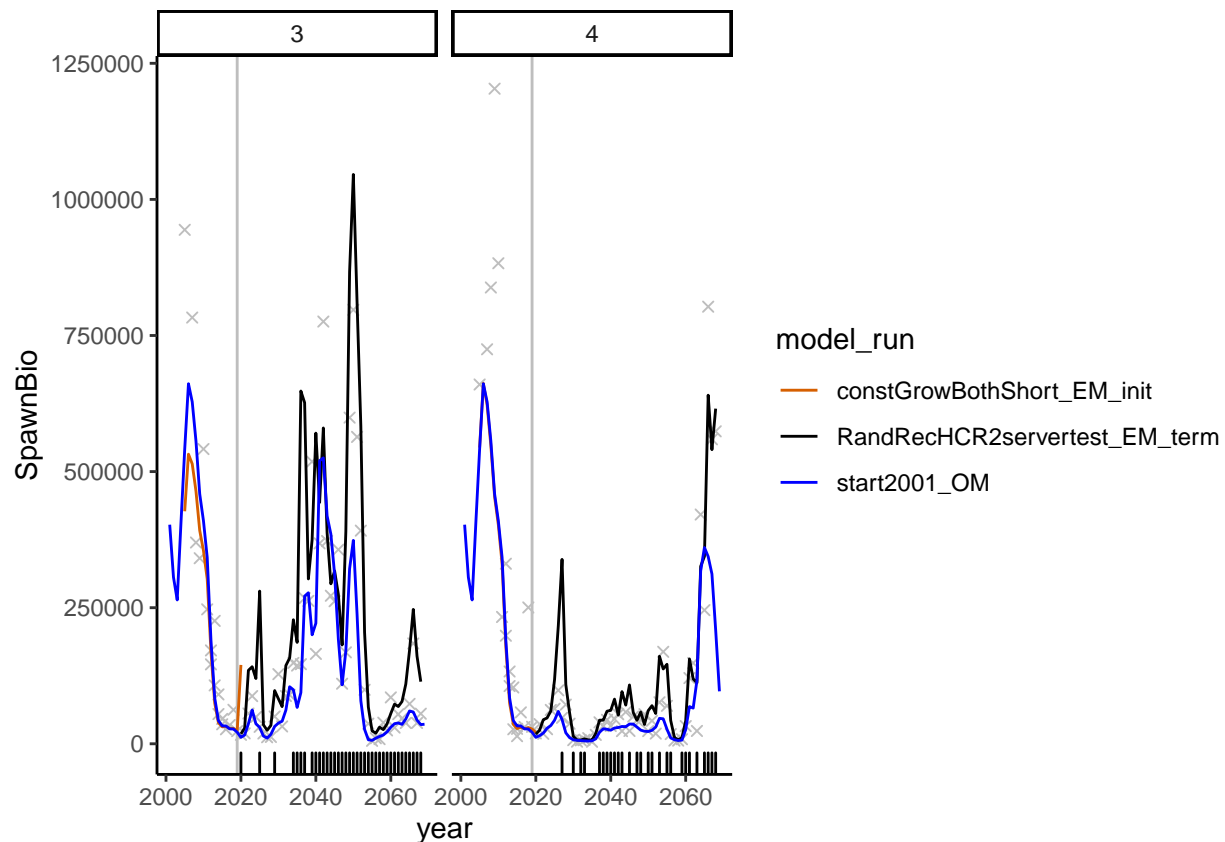
Plot diagnostics from server runs (random recruitment, HCR2)

```
# Ran just to have summary tables
# sumry <- SSMSE_summary_all("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
#                             scenarios = "RandRecHCR2servertest", # won't work for the no catch scenario
#                             run_parallel = TRUE)
```

```
srvBio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",  
                    scenario = "RandRecHCR2servertest",  
                    termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30  
## Numeric version is 3.3  
  
## Running SS_readdat_3.30  
  
## The supplied data file has 2 sections. Using section = 1.  
  
## SS_readdat_3.30 - read version = 3.30  
  
## use_meanbodywt (0/1): 0  
  
## N_lbinspop:  
  
## use_lencomp (0/1): 1  
  
## N_lbins: 39  
  
## N_agebins: 9  
  
## use_MeanSize_at_Age_obs (0/1): 0  
  
## N_environ_variables: 0  
  
## Read of section 1 of data file complete. Final value = 999  
  
## Char version is 3.30  
## Numeric version is 3.3  
  
## Running SS_readdat_3.30  
  
## The supplied data file has 2 sections. Using section = 1.  
  
## SS_readdat_3.30 - read version = 3.30  
  
## use_meanbodywt (0/1): 0  
  
## N_lbinspop:  
  
## use_lencomp (0/1): 1  
  
## N_lbins: 39  
  
## N_agebins: 9  
  
## use_MeanSize_at_Age_obs (0/1): 0  
  
## N_environ_variables: 0  
  
## Read of section 1 of data file complete. Final value = 999
```

```
srvBio[[1]] + geom_rug(data = convrgCheckServerTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
  scenario = "RandRecHCR2servertest",
  termYr = 2068, surveyInx = 4)
```

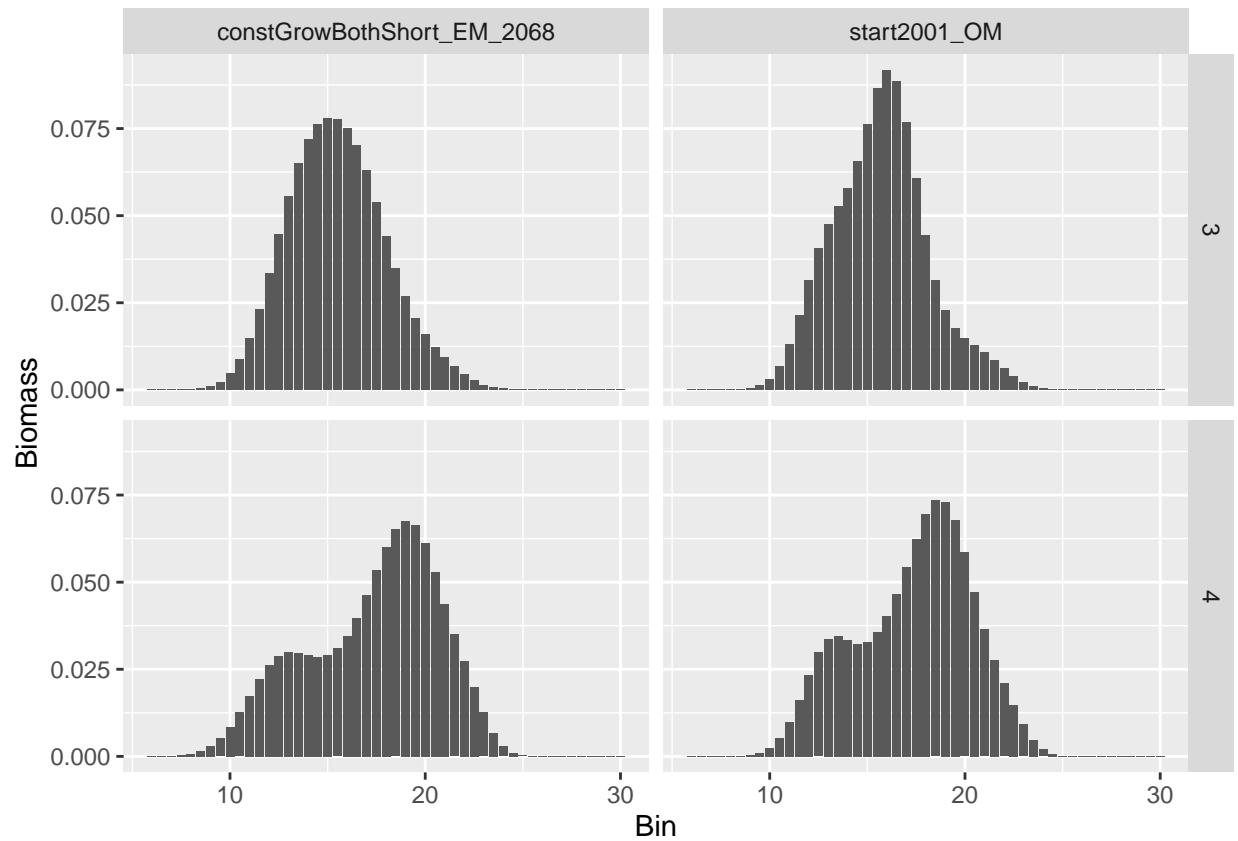
```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
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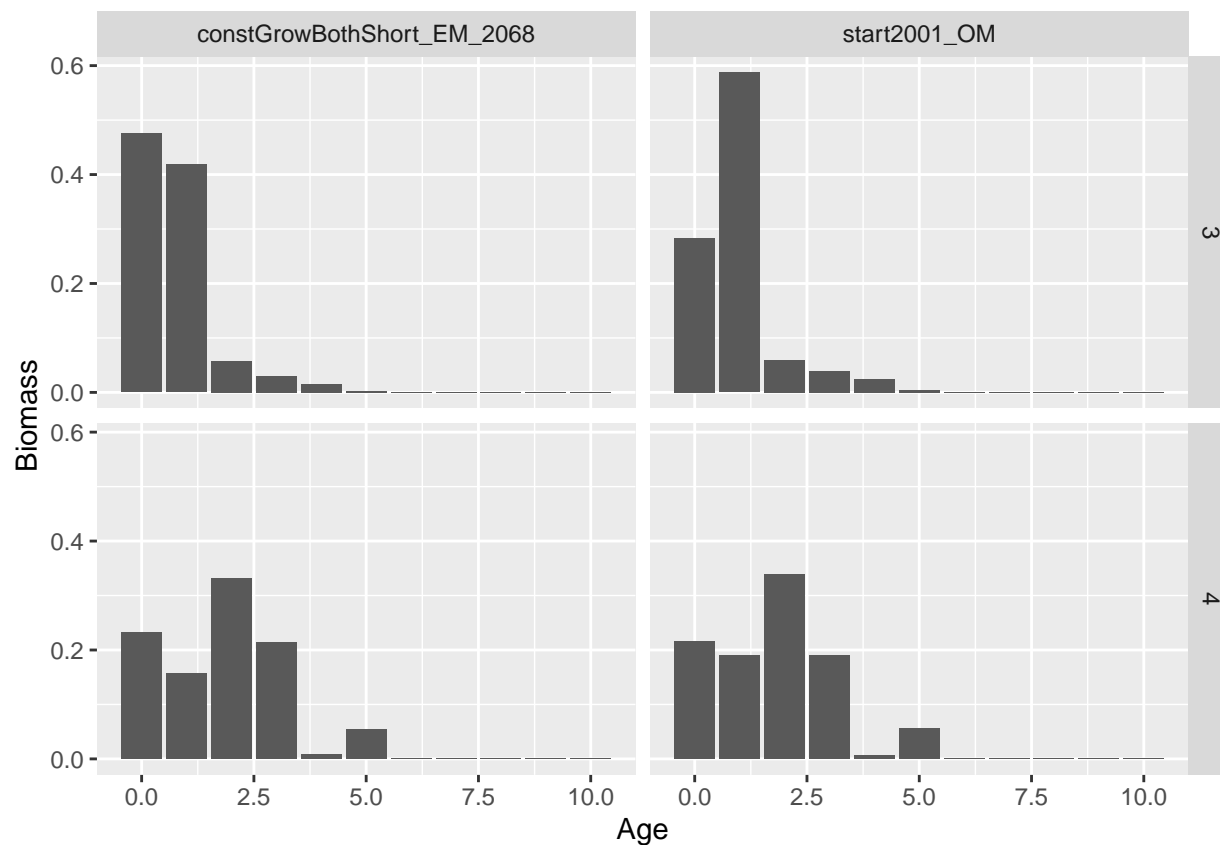
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```

```
## [[1]]
```



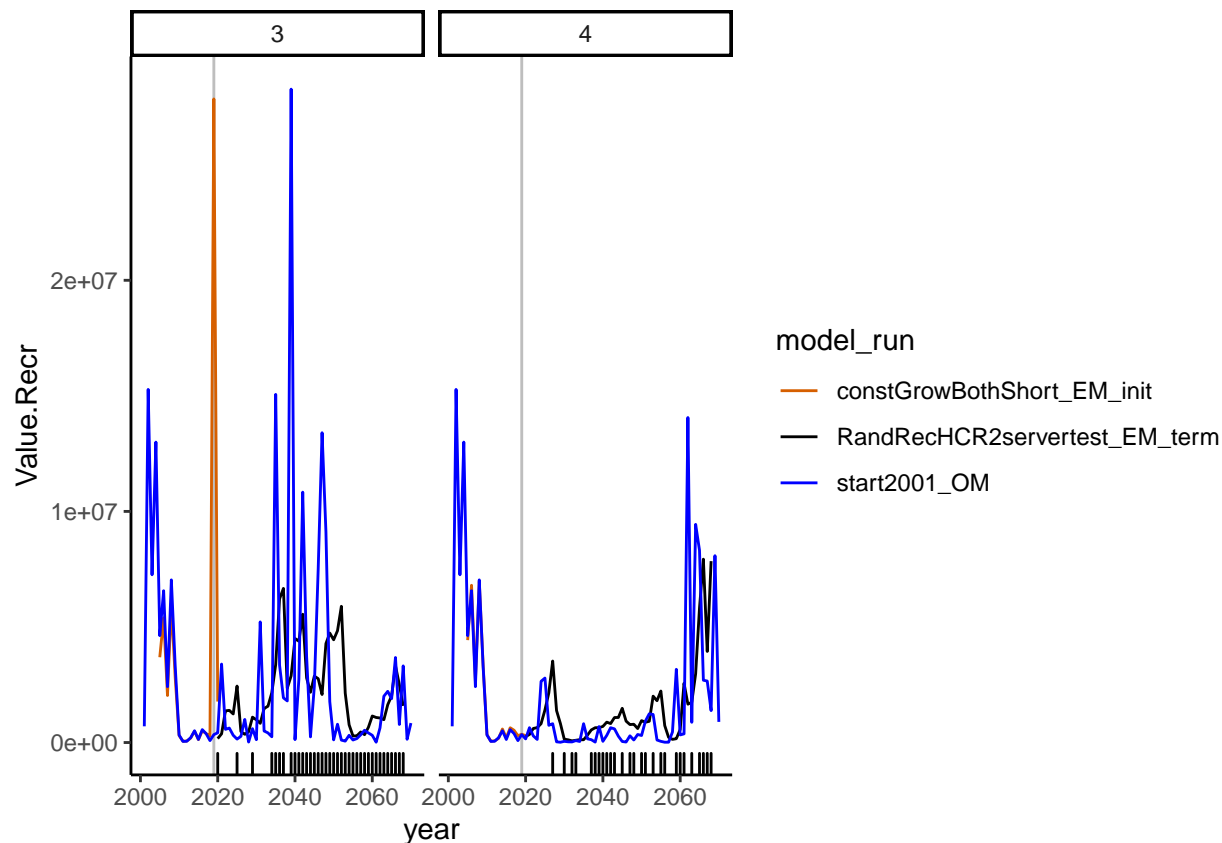
```
##
## [[2]]
```



```

srvRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
  scenario = "RandRecHCR2servertest", termYr = 2068)
srvRec[[1]] + geom_rug(data = convrgCheckServerTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)

```



```
srvAge1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
                                scenario = "RandRecHCR2servertest", termYr = 2068)
```

```
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##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

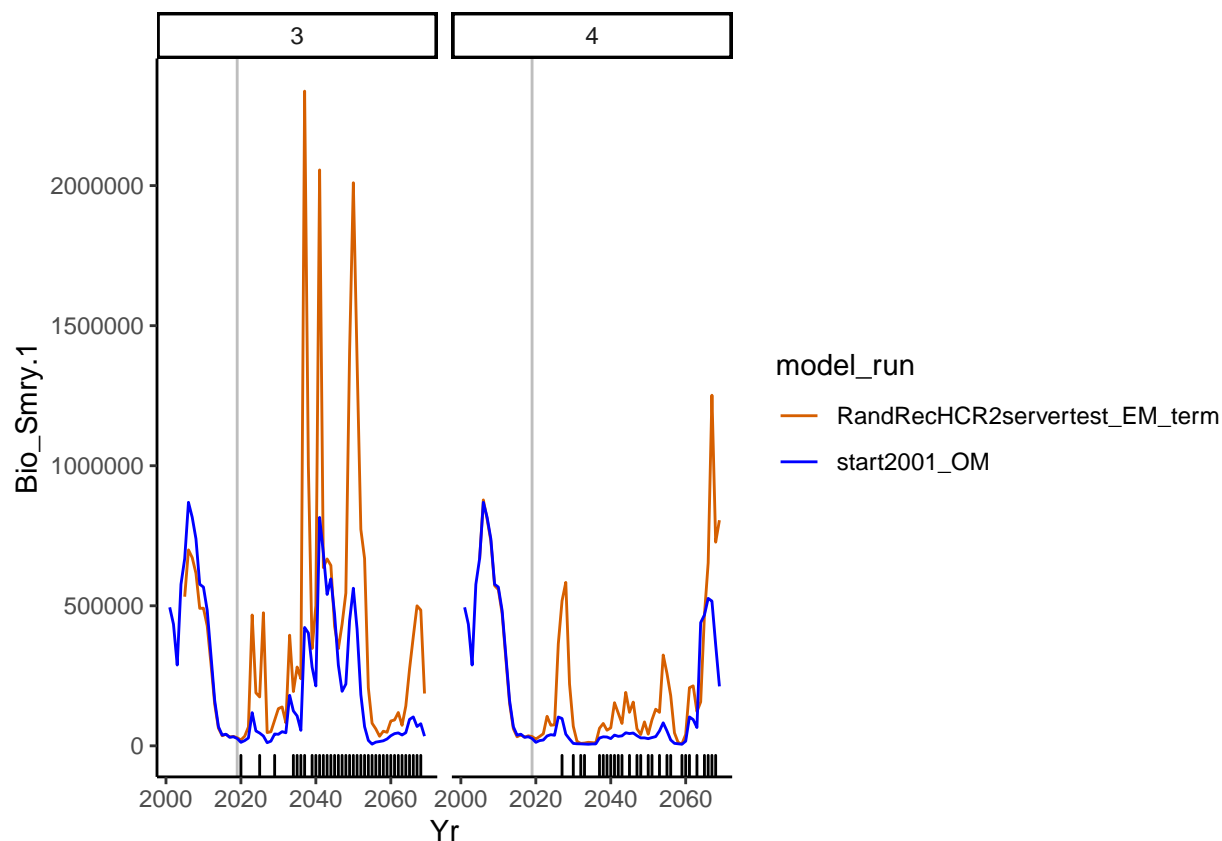
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

```

```

srvAge1Plus[[1]] + geom_rug(data = convrgCheckServerTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)

```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckServerTest <- serverTest %>% select(max_grad, SR_LN_R0, SR_regime,
                                             SR_regime_BLK1repl_2000,
                                             model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheckServerTest
```

```
## # A tibble: 65 x 7
##       max_grad SR_LN_R0 SR_regime SR_regime_BLK1repl_~ model_run iteration year
##       <dbl>   <dbl>   <dbl>   <dbl> <chr>          <dbl> <dbl>
## 1      59800.    15.1     0       NA constGro~      3 2020
## 2      44485.    17.7     0       NA constGro~      3 2025
## 3      74277.    19.3     0       NA constGro~      3 2029
## 4      11088.    19.7     0       NA constGro~      3 2034
## 5      34558.    19.3     0       NA constGro~      3 2035
## 6 1709070000    20.9     0       NA constGro~      3 2036
## 7 4464900000    17.1     0       NA constGro~      3 2037
## 8      40798.    14.8     0       NA constGro~      3 2039
## 9       9042.    15.7     0       NA constGro~      3 2040
## 10     61030.    16.1     0       NA constGro~      3 2041
## # ... with 55 more rows
```

```
# compare to OM
serverTest %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                     model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 2 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>                <dbl> <chr>          <dbl> <dbl>
## 1    14.8      0                0.546 start2001_OM      3    2001
## 2    14.8      0                0.546 start2001_OM      4    2001
```

```
serverTestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/RandRecHCR2server")
```

```
## Rows: 8376 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
serverTestFrates <- serverTestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(serverTestFrates)
```

```
##           F_1           F_2           F_3           Seas
## Min.      :0.00000   Min.      :0.0000   Min.      :0.000000   Min.      :1.0
## 1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.000000   1st Qu.:1.0
## Median :0.00000   Median :0.0000   Median :0.001973   Median :1.5
## Mean     :0.15980   Mean     :0.2632   Mean     :0.356127   Mean     :1.5
## 3rd Qu.:0.05251   3rd Qu.:0.2127   3rd Qu.:0.404972   3rd Qu.:2.0
## Max.     :4.00003   Max.     :4.0000   Max.     :4.000030   Max.     :2.0
##           year           model_run           iteration           scenario
## Min.      :2001   Length:8376   Min.      :3.0   Length:8376
## 1st Qu.:2015   Class :character   1st Qu.:3.0   Class :character
## Median :2025   Mode  :character   Median :3.5   Mode  :character
## Mean     :2028                               Mean     :3.5
## 3rd Qu.:2039                               3rd Qu.:4.0
## Max.     :2069                               Max.     :4.0
```

```
serverTestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckServerTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 1,927 x 13
##       F_1 F_2 F_3 Seas year model_run iteration scenario yearEM max_grad
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>          <dbl> <chr>          <dbl> <dbl>
## 1 0.0622 0 1.17 1 2005 constGrowB~ 3 RandRec~ 2020 59800.
```

```
## 2 0.0570      0 1.10      1 2005 constGrowB~      3 RandRec~ 2021      NA
## 3 0.0556      0 1.18      1 2005 constGrowB~      3 RandRec~ 2022      NA
## 4 0.0566      0 1.22      1 2005 constGrowB~      3 RandRec~ 2023      NA
## 5 0.0559      0 1.29      1 2005 constGrowB~      3 RandRec~ 2024      NA
## 6 0.0939      0 2.02      1 2005 constGrowB~      3 RandRec~ 2025 44485.
## 7 0.0557      0 1.20      1 2005 constGrowB~      3 RandRec~ 2026      NA
## 8 0.0546      0 1.17      1 2005 constGrowB~      3 RandRec~ 2027      NA
## 9 0.0529      0 1.17      1 2005 constGrowB~      3 RandRec~ 2028      NA
## 10 0.0883      0 4.00      1 2005 constGrowB~      3 RandRec~ 2029 74277.
## # ... with 1,917 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <chr>
```

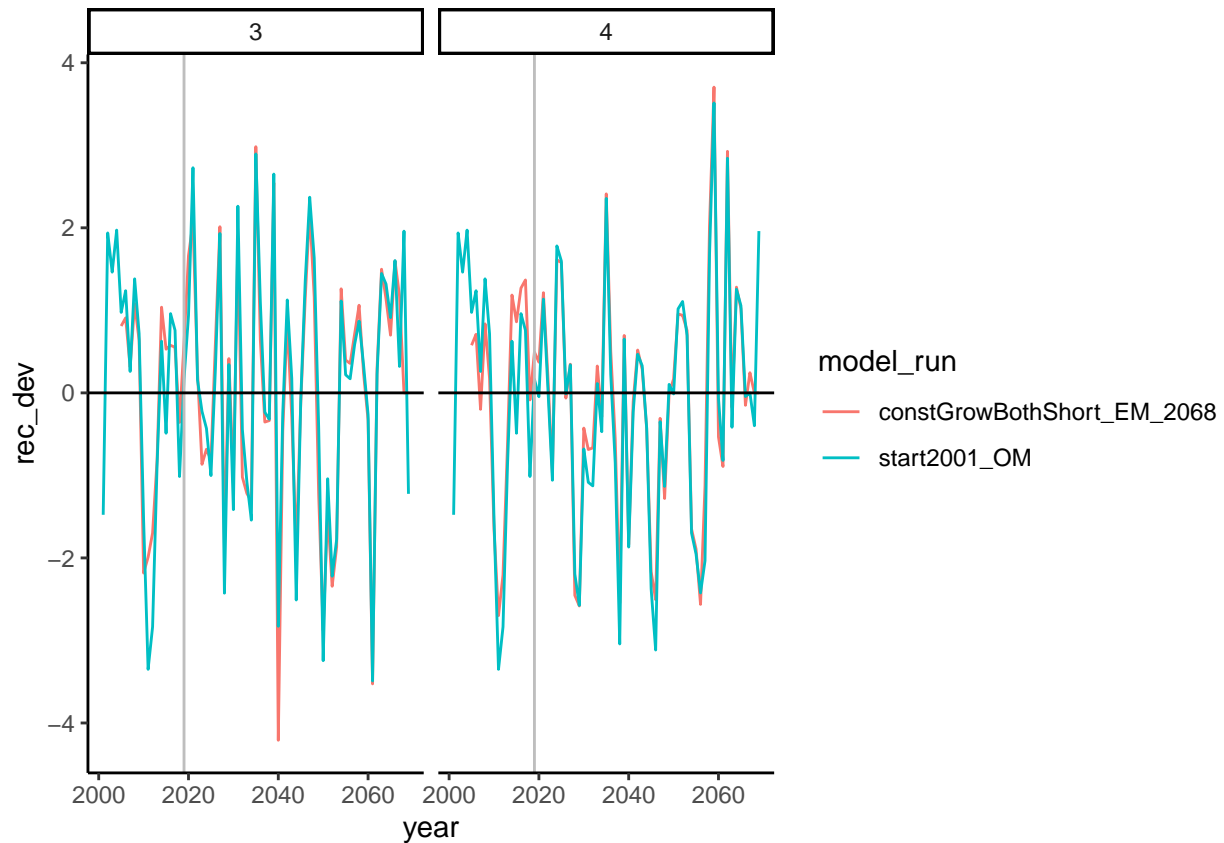
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/RandRecHCR2servertest/resu
```

```
## Rows: 8376 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr  (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_0M" | grepl("2068", model_run)) %>%
  filter(complete.cases(.))
```

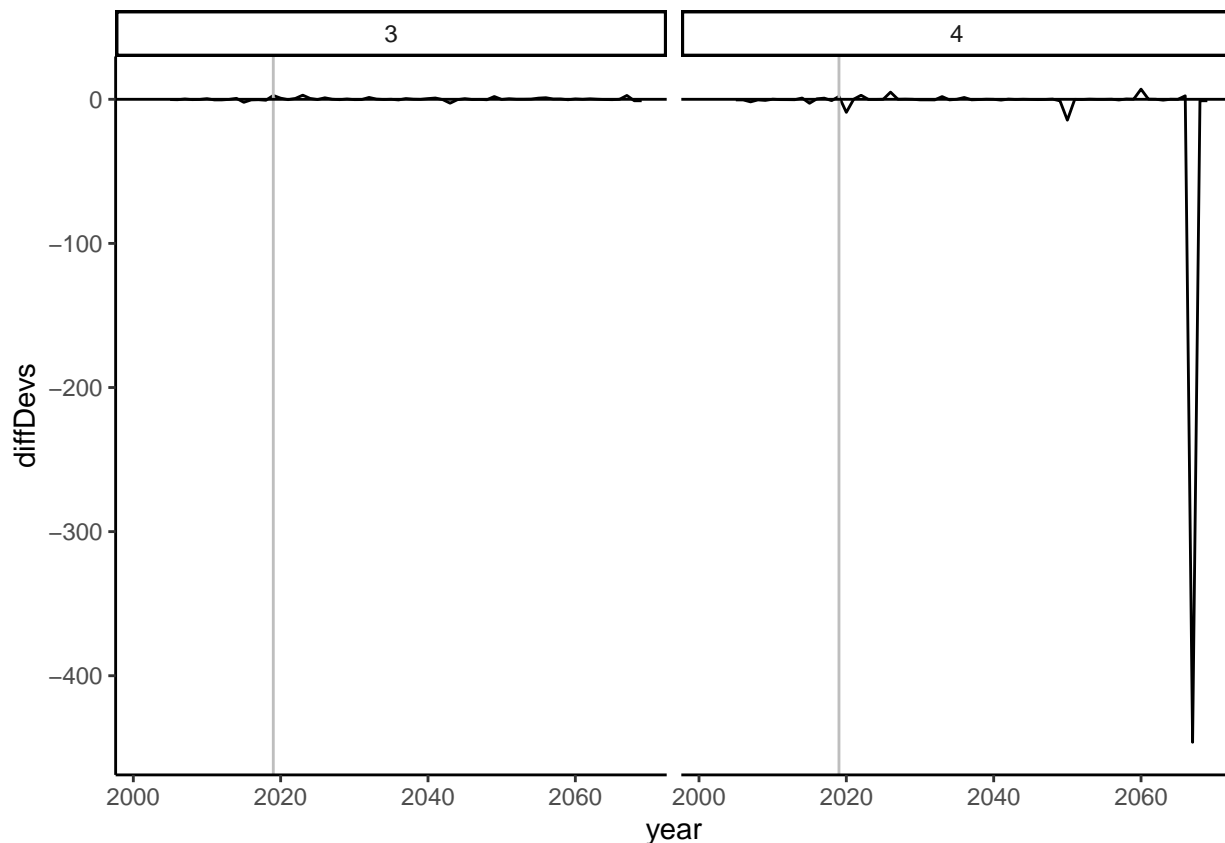
```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (constGrowBothShort_EM_2068 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```

```
## Warning: Removed 4 row(s) containing missing values (geom_path).
```



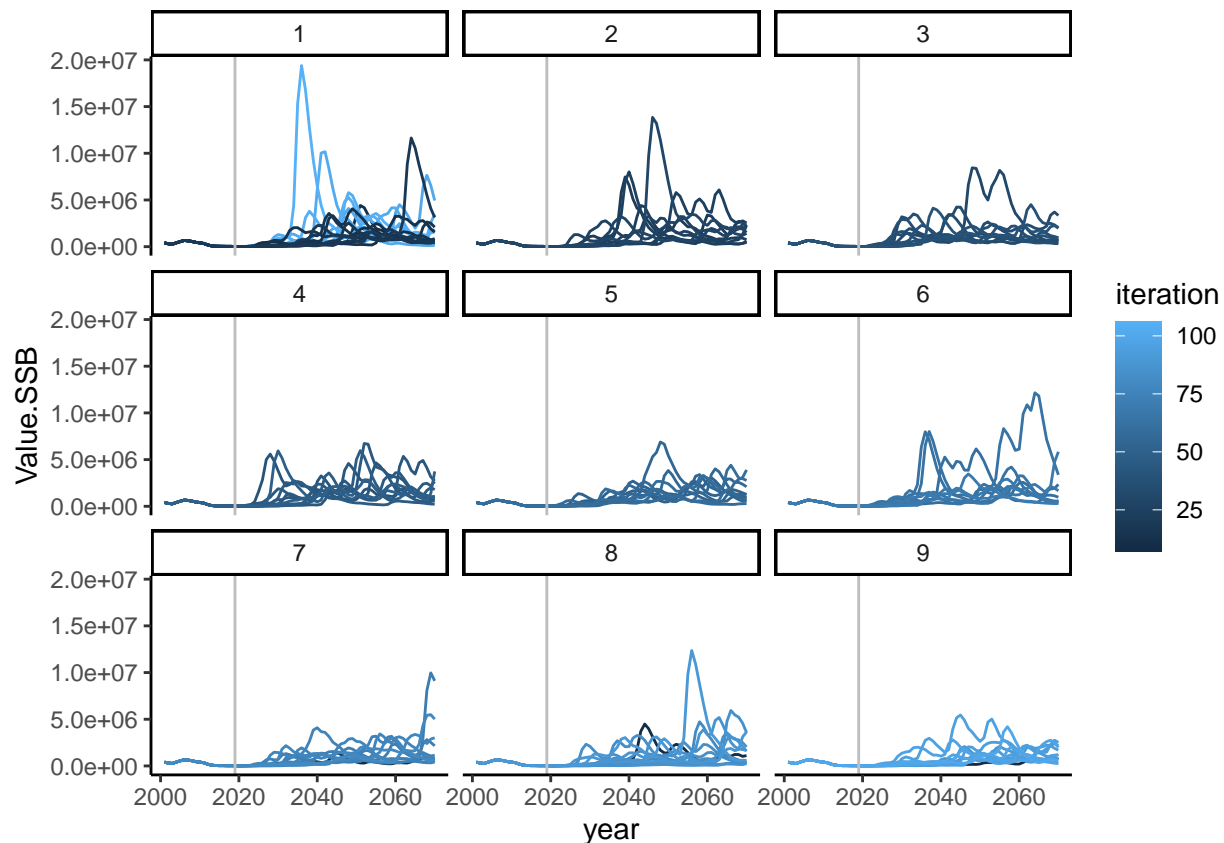
Look at dynamics of no catch runs to see if population crashes

```
srvNoCatTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/RandRecHCR2servertest,
```

```
## Rows: 1683000 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
srvNoCatTest <- srvNoCatTest %>% filter(scenario %in% c("constGrow20010M_constGrow2005EM_RandRecHCR0",
                                                         "constGrow20010M_constGrow2005EM_ARRecHCR0")) %>%
  mutate(charIt = substr(as.character(iteration), 1, 1))

srvNoCatTest %>% ggplot(aes(x=year, y=Value.SSB)) +
  geom_line(aes(color = iteration, linetype = as.character(iteration))) +
  scale_linetype_manual(values = rep("solid", nrow(srvNoCatTest))) +
  guides(linetype = "none") +
  #scale_color_manual(values = rep("black", 11))
  ggplot2::facet_wrap(. ~ charIt) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  ggplot2::theme_classic()
```

```
srvNoCatTest %>% filter(year %in% 2060:2070) %>% select(year, Value.SSB, Value.Recr, iteration)
```

```
## # A tibble: 1,100 x 4
##   year Value.SSB Value.Recr iteration
##   <dbl>   <dbl>   <dbl>     <dbl>
## 1 2060   326571   2013640         7
## 2 2061   354351    700287         7
## 3 2062   327338   9553980         7
## 4 2063   315454  11249800         7
## 5 2064   439690   3694300         7
## 6 2065   617323  14928900         7
## 7 2066   723927   3460610         7
## 8 2067   860844   2010970         7
## 9 2068   865988   3110540         7
## 10 2069   755473  38903800         7
## # ... with 1,090 more rows
```

1981 HCR6 Server Runs

Look at years of no convergence and parameter bounds

```
# Ran just to have summary tables
# sumry <- SSMSE_summary_all("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
#                             scenarios = "start1981HCR6serverRuns", # won't work for the no catch scena
```

```

#                               run_parallel = TRUE)

serv1981Test <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/start1981HCR6serverRuns

## Rows: 153 Columns: 352
## -- Column specification -----
## Delimiter: ","
## chr   (3): version, model_run, scenario
## dbl (344): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, depletion, alt...
## lgl   (5): max_grad, params_on_bound, params_stuck_low, params_stuck_high, h...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

convrgCheck1981ServerTest <- serv1981Test %>% select(max_grad, params_on_bound,
                                                    params_stuck_low, params_stuck_high,
                                                    model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

convrgCheck1981ServerTest

## # A tibble: 0 x 7
## # ... with 7 variables: max_grad <lgl>, params_on_bound <lgl>,
## #   params_stuck_low <lgl>, params_stuck_high <lgl>, model_run <chr>,
## #   iteration <dbl>, year <dbl>

Plot diagnostics from server runs (random recruitment, HCR2)

srv1981Bio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
                        scenario = "start1981HCR6serverRuns",
                        termYr = 2068, surveyInx = 4)

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

```

```

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

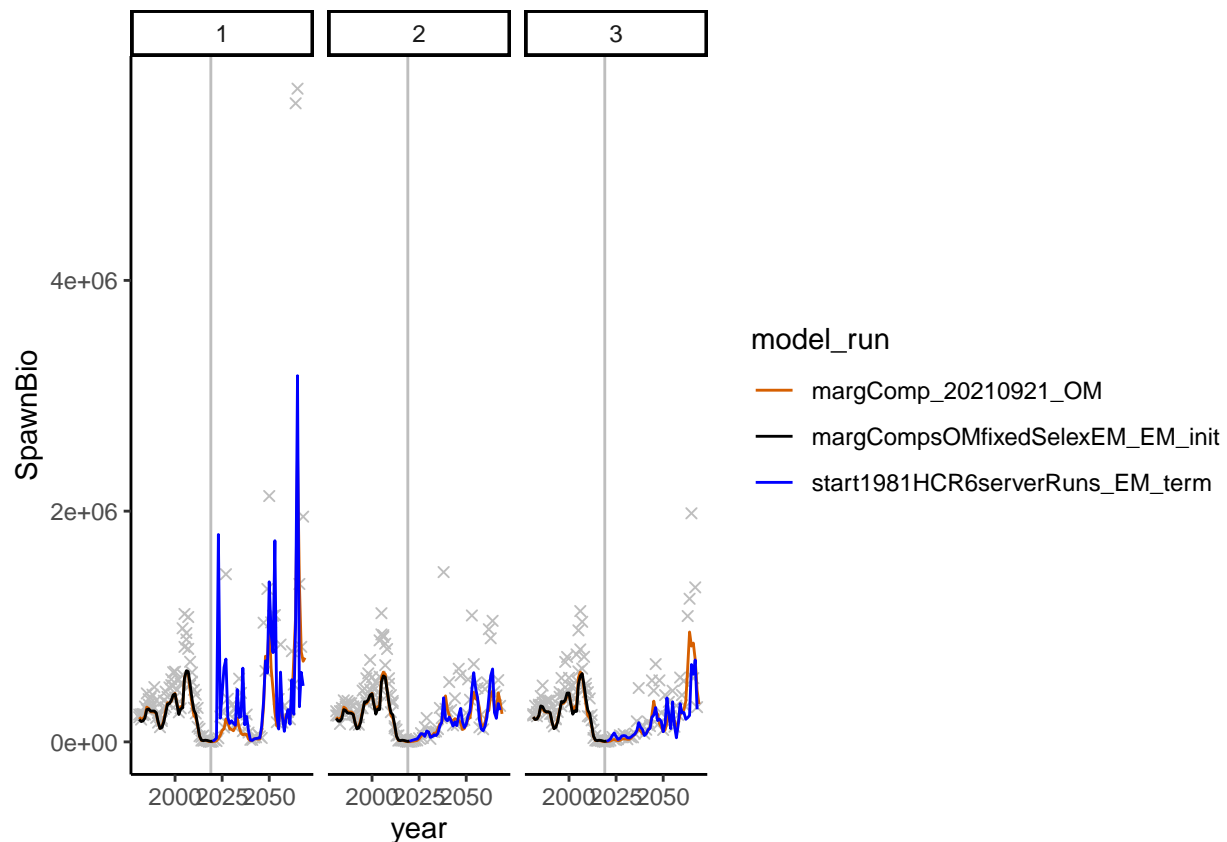
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

```

```
srv1981Bio[[1]] + geom_rug(data = convrgCheck1981ServerTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
  scenario = "start1981HCR6serverRuns",
  termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

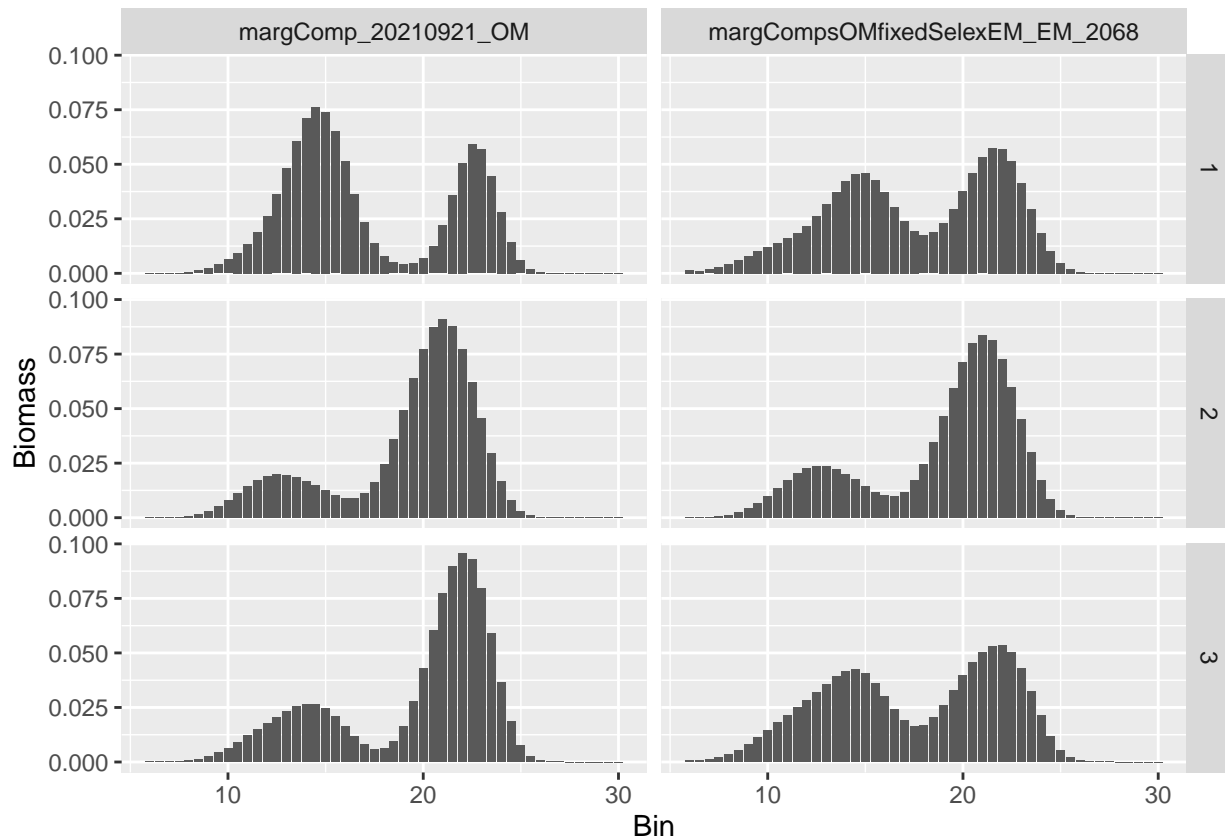
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

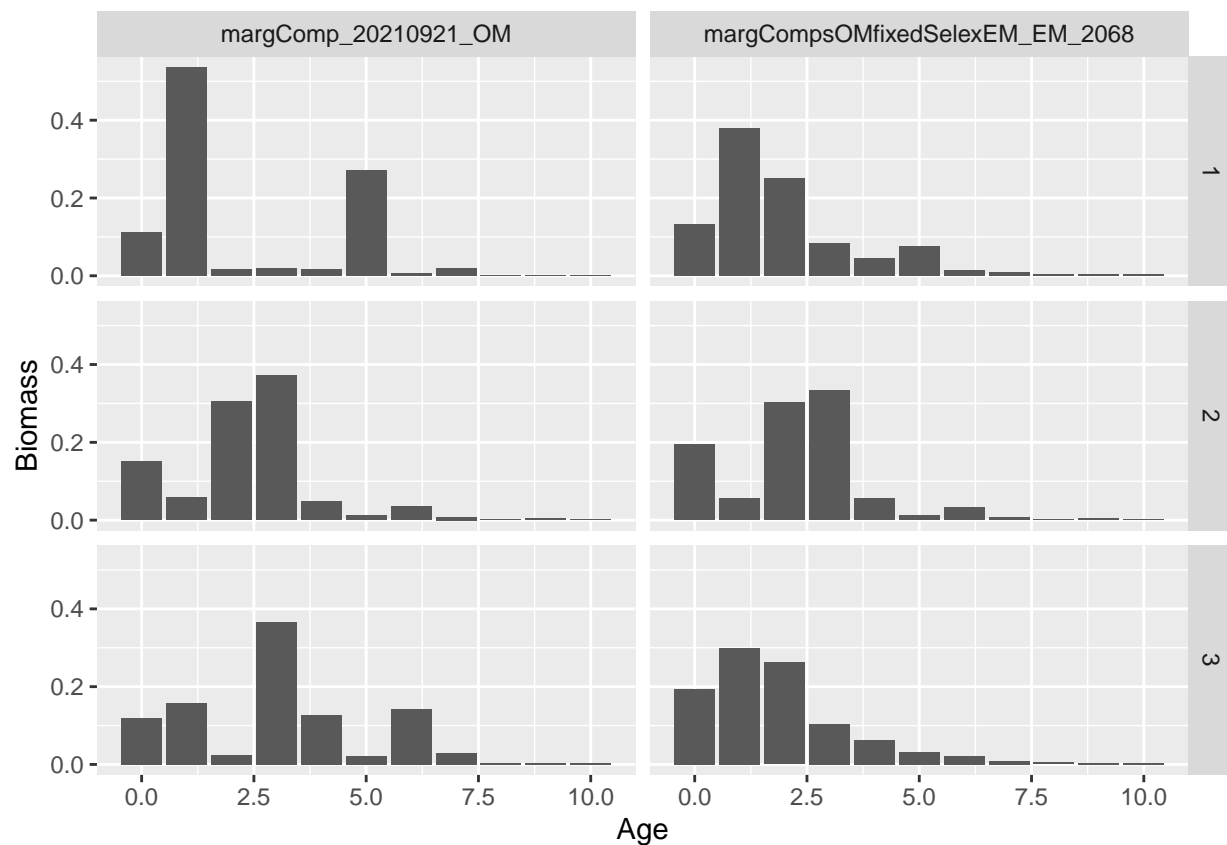
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## [[1]]
```



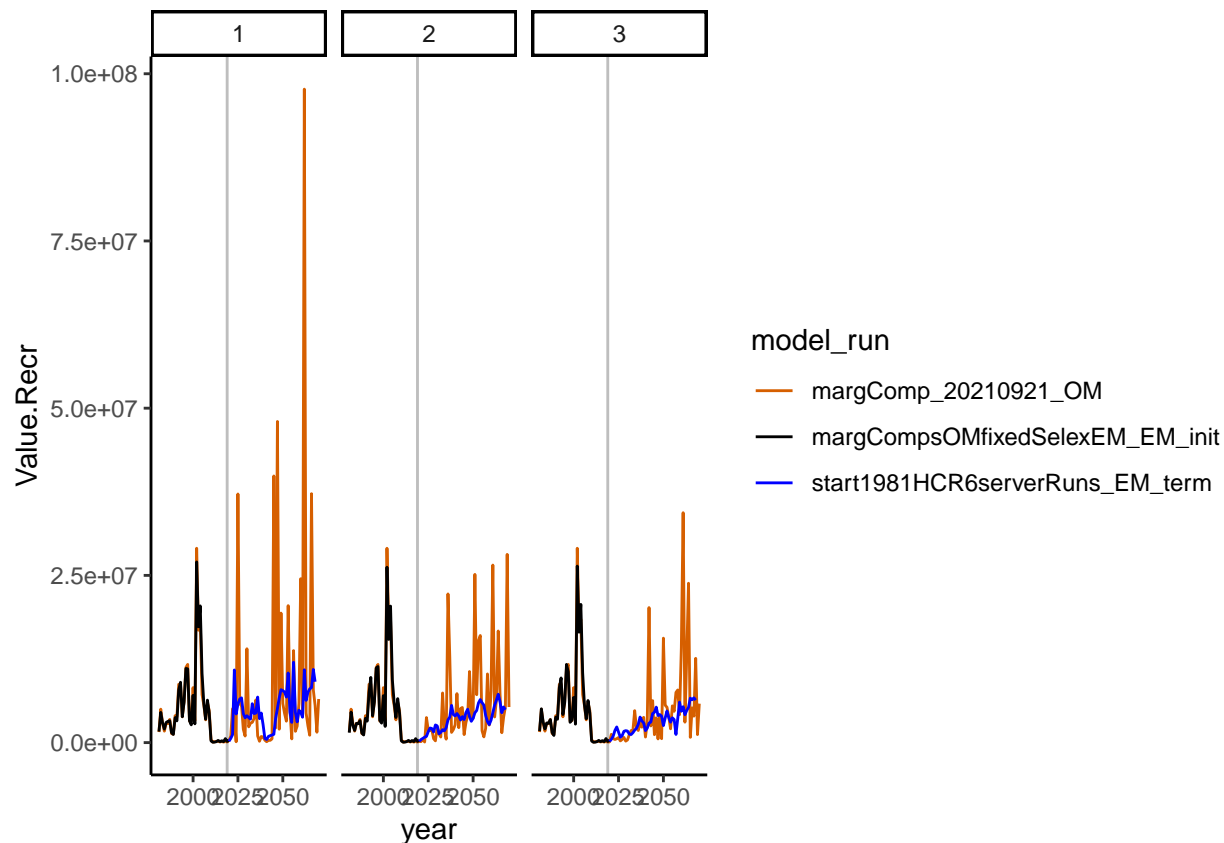
```
##
## [[2]]
```



```

srv1981Rec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
  scenario = "start1981HCR6serverRuns", termYr = 2068)
srv1981Rec[[1]] + geom_rug(data = convrgCheck1981ServerTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)

```



```
srv1981Age1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns",
                                     scenario = "start1981HCR6serverRuns", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

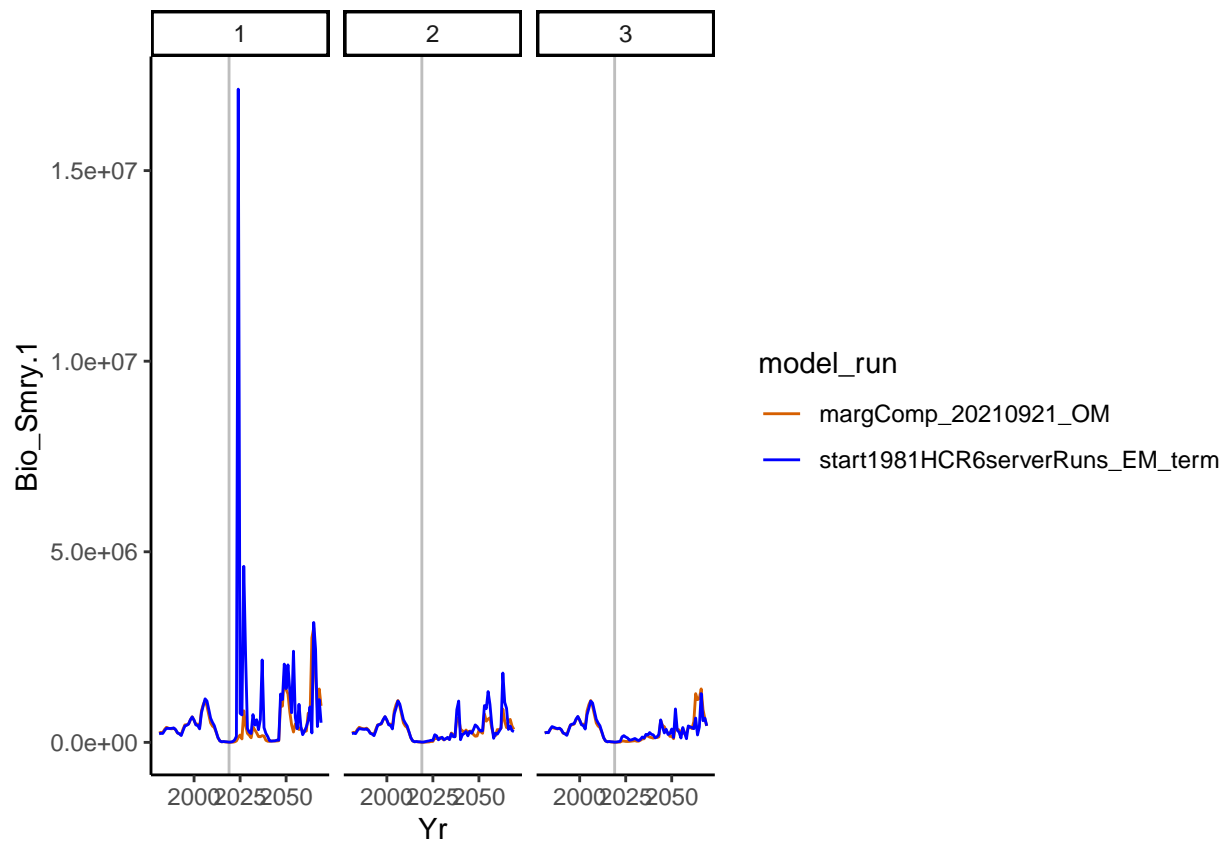
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

srv1981Age1Plus[[1]] + geom_rug(data = convrgCheck1981ServerTest, mapping = aes(x = year),
                                sides = "b", inherit.aes = FALSE)

```



Look at recruitment and fishing mortality parameter estimates

```
paramCheck1981ServerTest <- serv1981Test %>% select(max_grad, SR_LN_R0, SR_regime,
  SR_regime_BLK1repl_1980,
  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
    gregexpr("[:digit:]+", model_run)))) %>%
  #filter(max_grad > 0.01)
paramCheck1981ServerTest
```

```
## # A tibble: 153 x 7
##   max_grad SR_LN_R0 SR_regime SR_regime_BLK1repl_19~ model_run iteration   year
##   <dbl>   <dbl>   <dbl>   <dbl> <chr>         <dbl>   <dbl>
## 1 NA      15.7     0      -1.04 margComp~      1 2.02e7
## 2 NA      15.7     0      -1.21 margComp~      1 2.02e3
## 3 NA      15.7     0      -1.21 margComp~      1 2.02e3
## 4 NA      15.7     0      -1.20 margComp~      1 2.02e3
## 5 NA      16.1     0      -1.12 margComp~      1 2.02e3
## 6 NA      15.7     0      -1.20 margComp~      1 2.02e3
## 7 NA      15.7     0      -1.19 margComp~      1 2.02e3
## 8 NA      15.7     0      -1.19 margComp~      1 2.03e3
## 9 NA      15.7     0      -1.20 margComp~      1 2.03e3
## 10 NA     15.7     0      -1.19 margComp~      1 2.03e3
## # ... with 143 more rows
```

```
# compare to OM
serv1981Test %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_1980,
                      model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                      gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(model_run == "margComp_20210921_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_1980 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    15.7        0          -1.04 margComp_20210921~      1 2.02e7
## 2    15.7        0          -1.04 margComp_20210921~      2 2.02e7
## 3    15.7        0          -1.04 margComp_20210921~      3 2.02e7
```

```
serv1981TestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/start1981HCR6seas")
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
serv1981TestFrates <- serv1981TestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(serv1981TestFrates)
```

```
##      F_1      F_2      F_3      Seas
## Min.   :0.00000   Min.   :0.0000   Min.   :0.000000   Min.   :1.0
## 1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.000000   1st Qu.:1.0
## Median :0.00000   Median :0.0000   Median :0.000553   Median :1.5
## Mean   :0.10782   Mean   :0.2651   Mean   :0.144263   Mean   :1.5
## 3rd Qu.:0.07252   3rd Qu.:0.2377   3rd Qu.:0.046454   3rd Qu.:2.0
## Max.   :4.00003   Max.   :4.0000   Max.   :4.000010   Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :1981   Length:19884   Min.   :1   Length:19884
## 1st Qu.:1997   Class :character 1st Qu.:1   Class :character
## Median :2013   Mode  :character Median :2   Mode  :character
## Mean   :2015
## 3rd Qu.:2030
## Max.   :2069
##      iteration      scenario
## Mean   :2
## 3rd Qu.:3
## Max.   :3
```

```
serv1981TestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                      gregexpr("[[:digit:]]+", model_run)))) #>%
```

```
## # A tibble: 2,823 x 9
##      F_1 F_2 F_3 Seas year model_run iteration scenario yearEM
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>          <dbl> <chr>          <dbl>
## 1  1.02    0    0    1  1991 margCompsOMfixedSele~      1 start19~    2049
```

```
## 2 1.63 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2053
## 3 1.21 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2055
## 4 1.24 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2056
## 5 1.53 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2057
## 6 1.52 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2058
## 7 1.23 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2059
## 8 1.13 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2060
## 9 1.15 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2063
## 10 1.31 0 0 1 1991 margCompsOMfixedSele~ 1 start19~ 2066
## # ... with 2,813 more rows
```

```
#left_join(y = convrgCheckServerTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

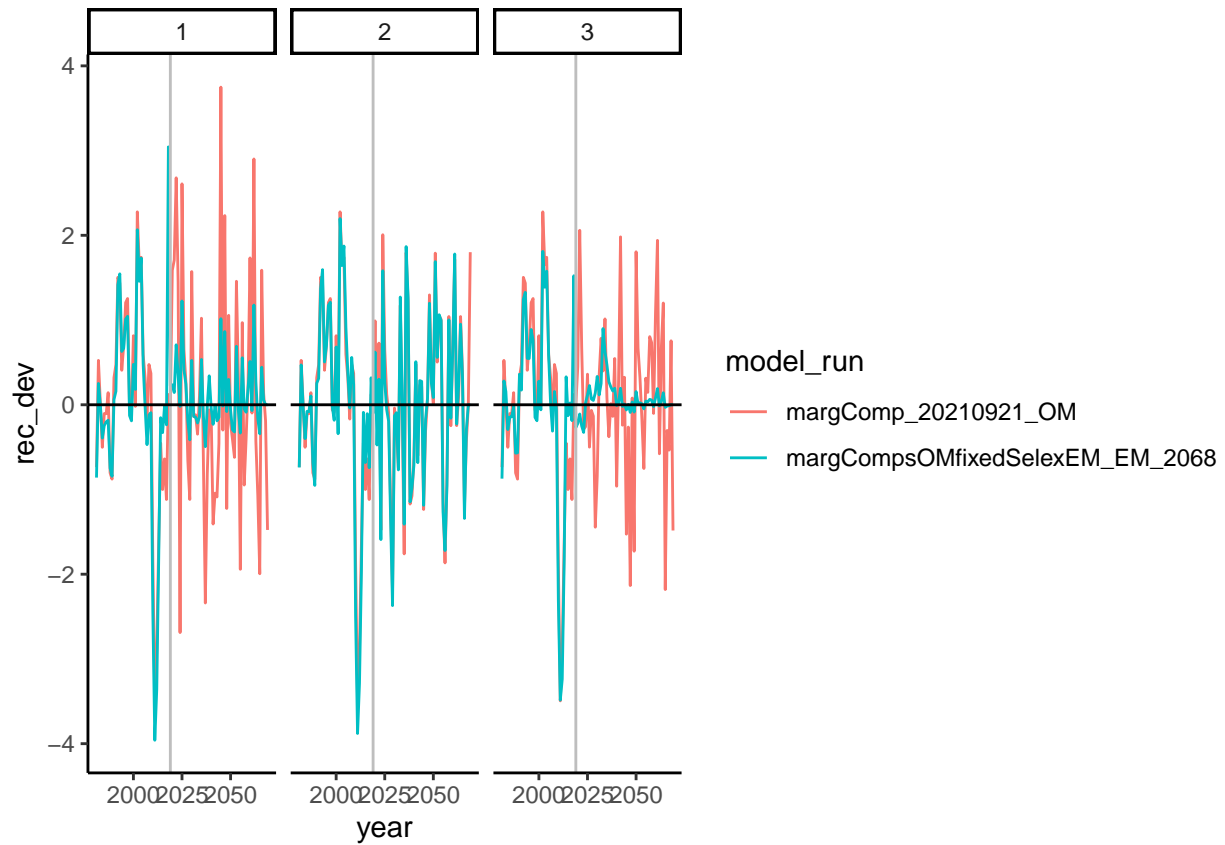
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/scenarioRuns/start1981HCR6serverRuns/r
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

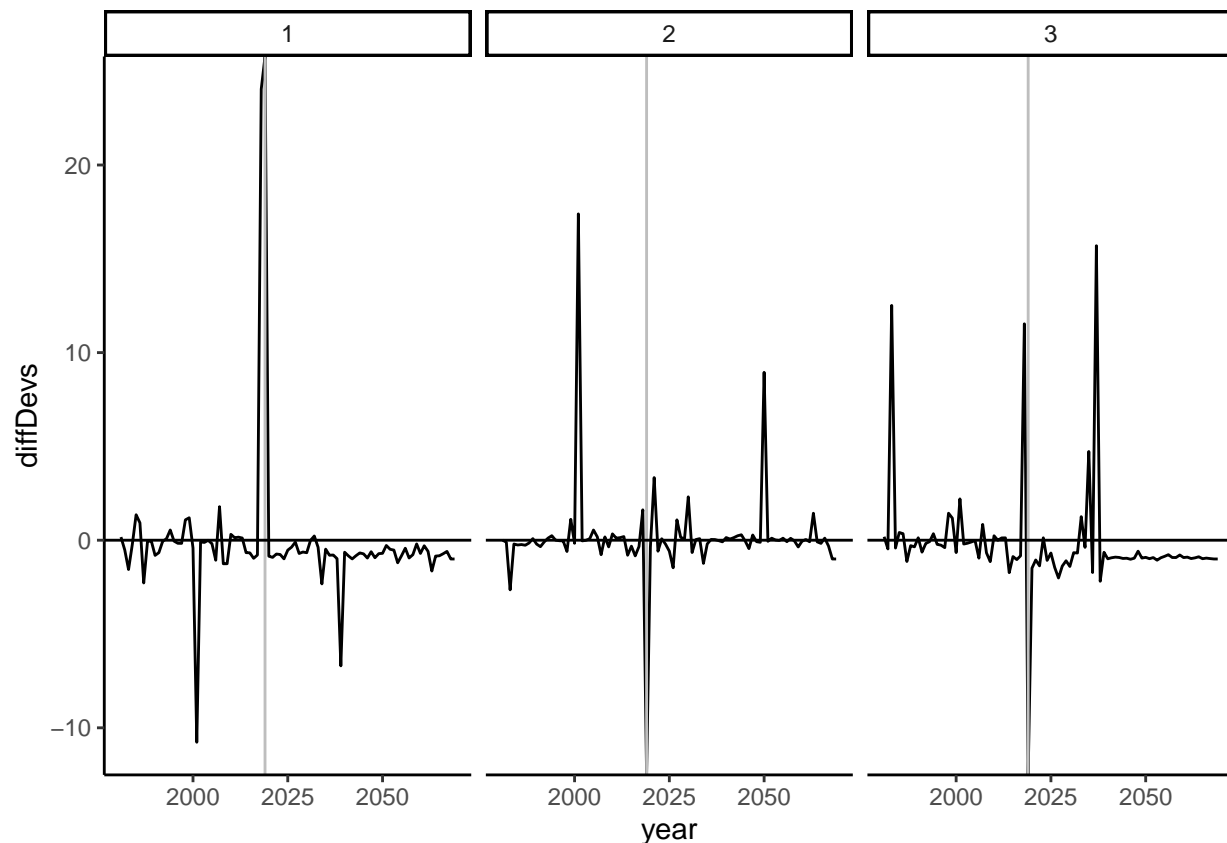
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "margComp_20210921_0M" | grepl("2068", model_run)) %>%
  filter(complete.cases(.))
```

```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (margCompsOMfixedSelexEM_EM_2068 - margComp_20210921_OM)/margComp_20210921_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



EM 2001 self test, recruitment at 0.25, perfect information

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"

scenarios <- c("constGrow20010M_selfTest_RandRecHCR0",
               "constGrow20010M_selfTest_RandRecHCR2",
               "constGrow20010M_selfTest_RandRecHCR3",
               "constGrow20010M_selfTest_RandRecHCR5",
               "constGrow20010M_selfTest_RandRecHCR6")

smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)

## Rows: 600 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
```

```
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
performanceList <- CalcPerformance(smryOutputList)
```

```
## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics
```

```
# parse out HCR and recruitment scenario
```

```

metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                   recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

hcrPal <- brewer.pal(10, "Set3")[-2]

# plot convergence frequency
metricsTbl %>% filter(HCR != "HCRO") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)

```

```

## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used

```

```

## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD

```

```

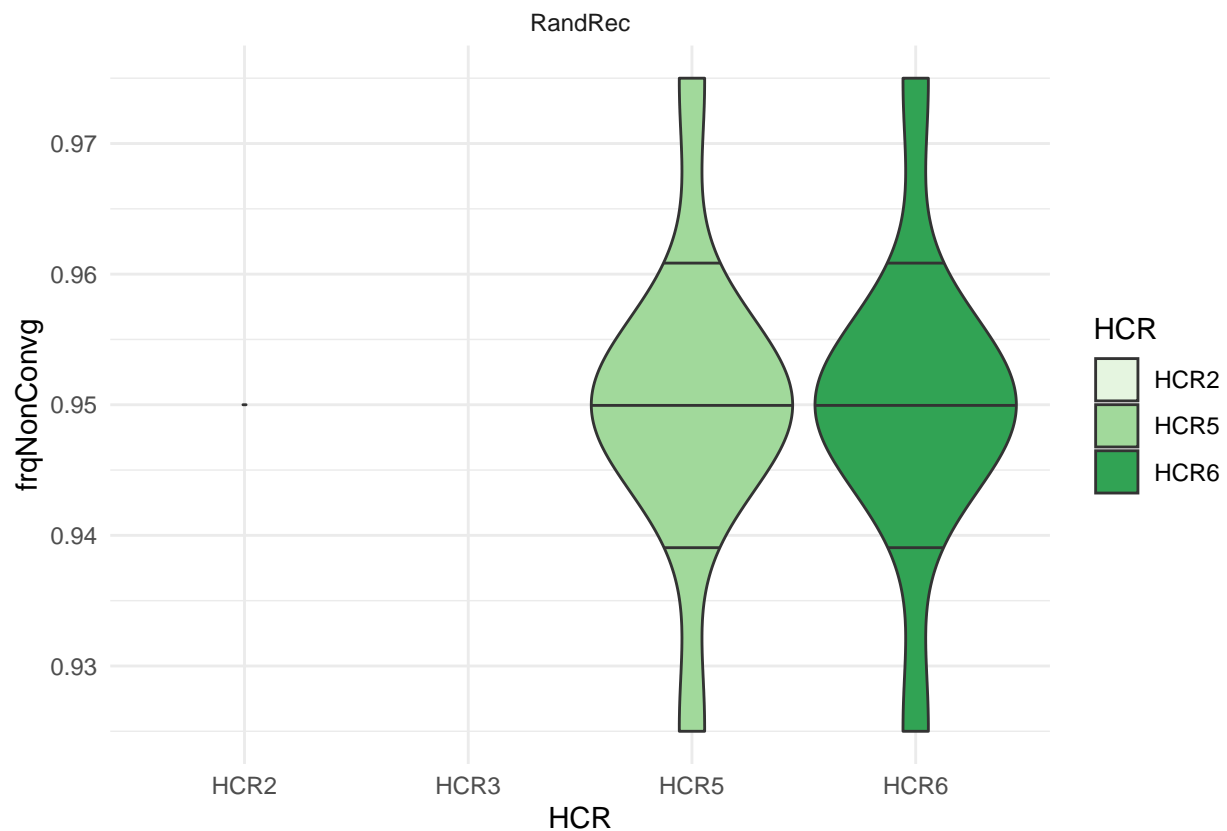
## Warning: Removed 9 rows containing non-finite values (stat_ydensity).

```

```

## Warning: Groups with fewer than two data points have been dropped.

```




```

# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

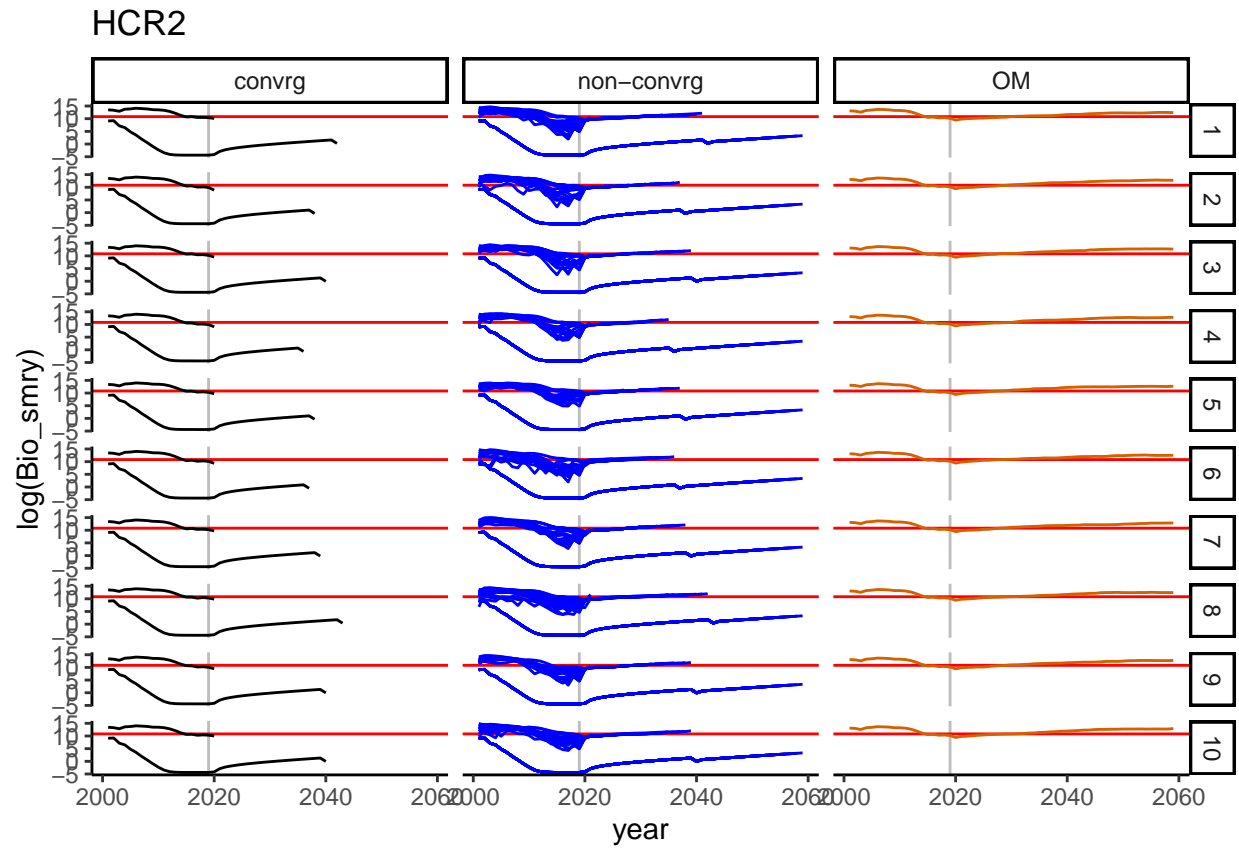
cnvrgCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[[:digit:]]+",
                                                  model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

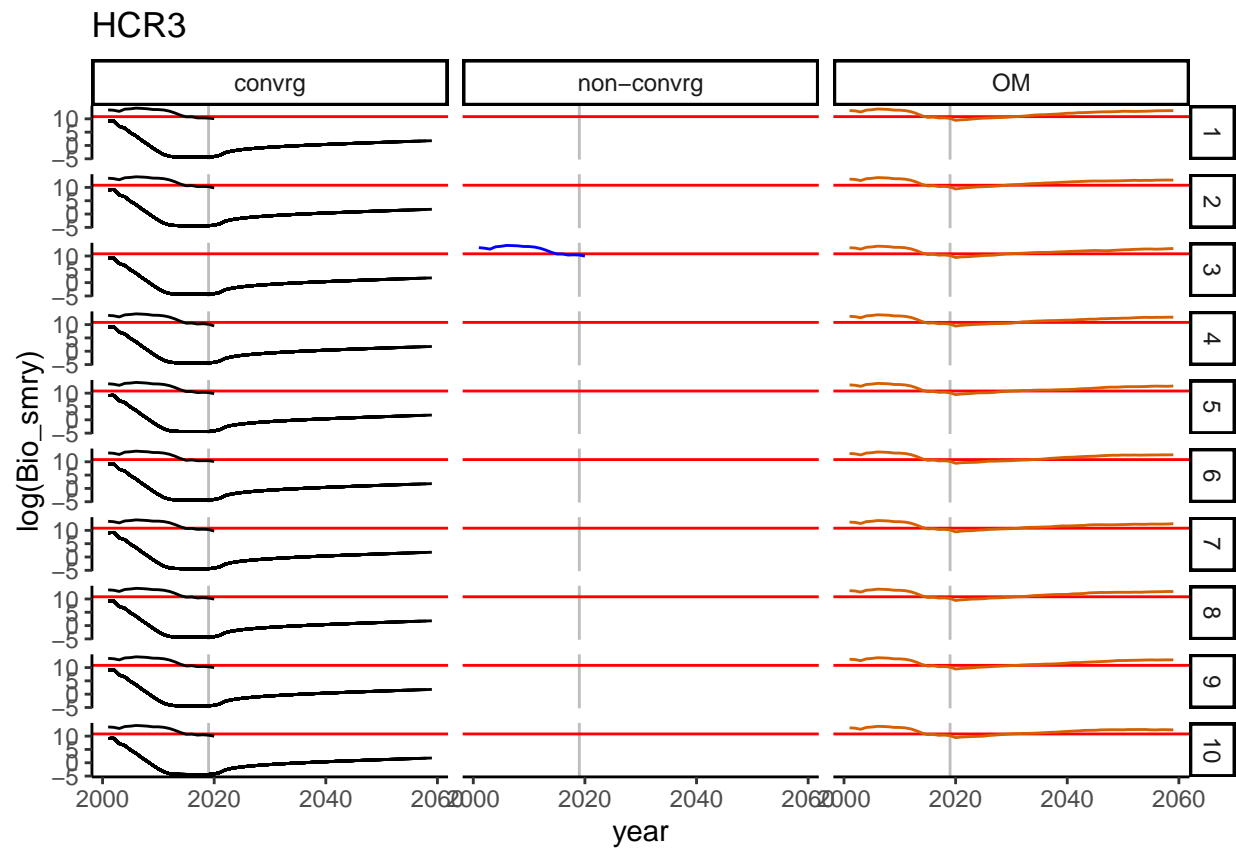
hcrs <- unique(termTS$HCR)
exIters <- sample(termTS$iteration, size = 4)

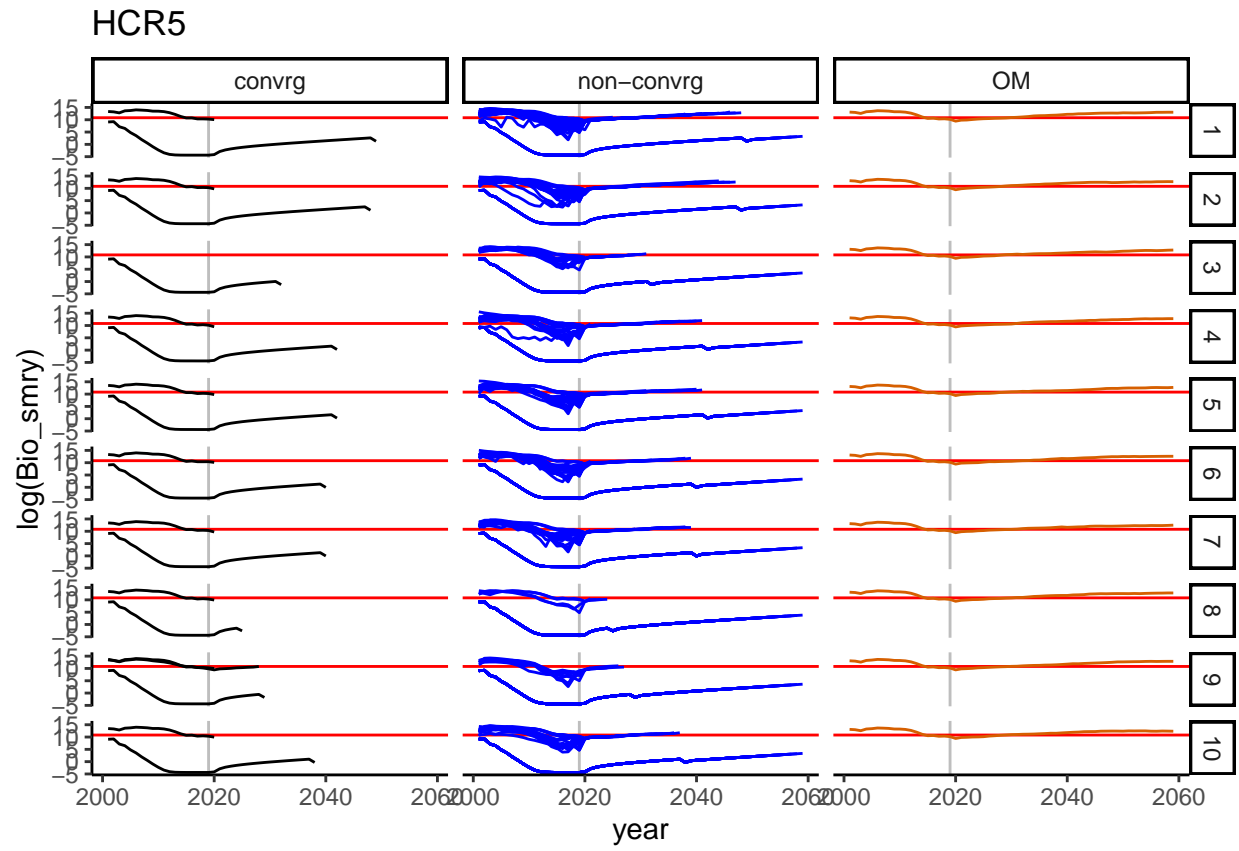
cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                           recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen)) %>%
  left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
  mutate(plotGroup = case_when(model_run == omName ~ "OM",
                               max_grad > 0.01 ~ "non-cnvrng",
                               max_grad < 0.01 ~ "cnvrng"))

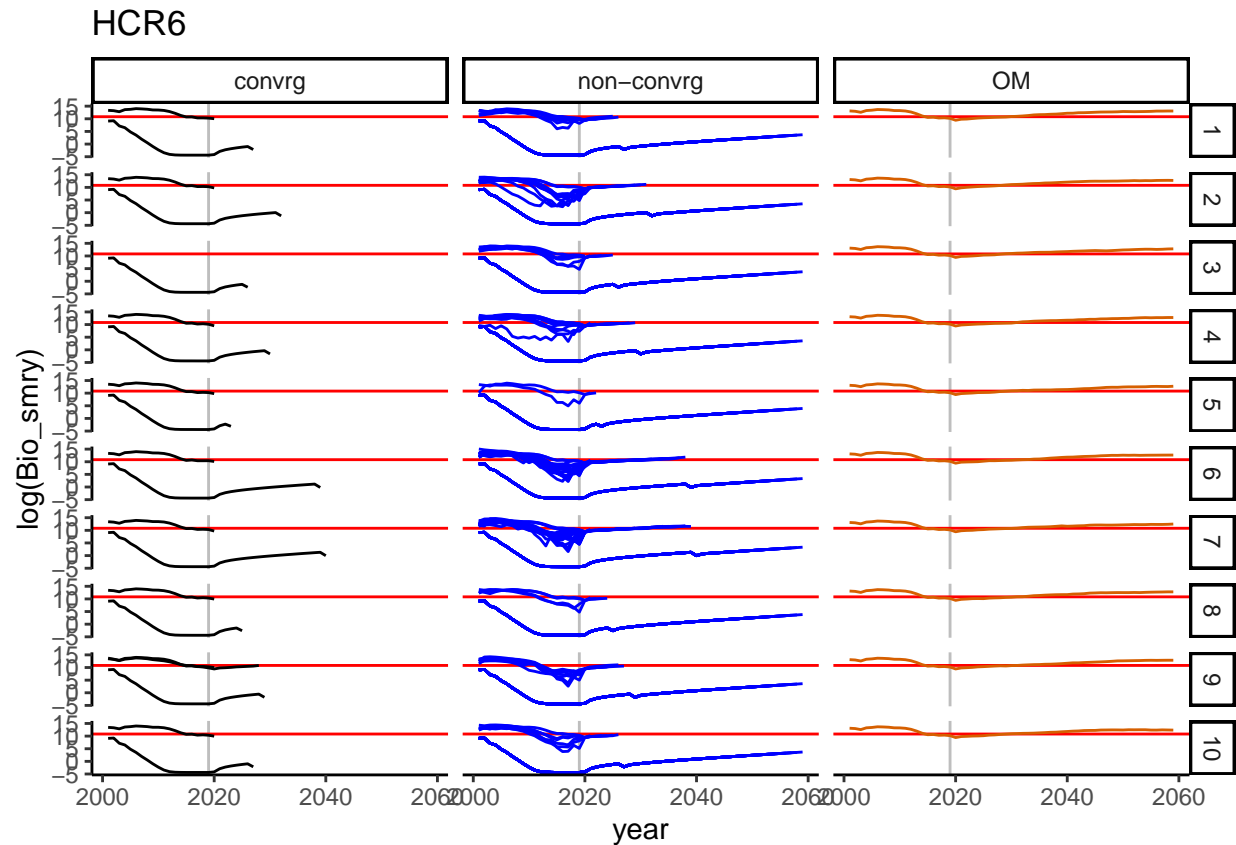
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```

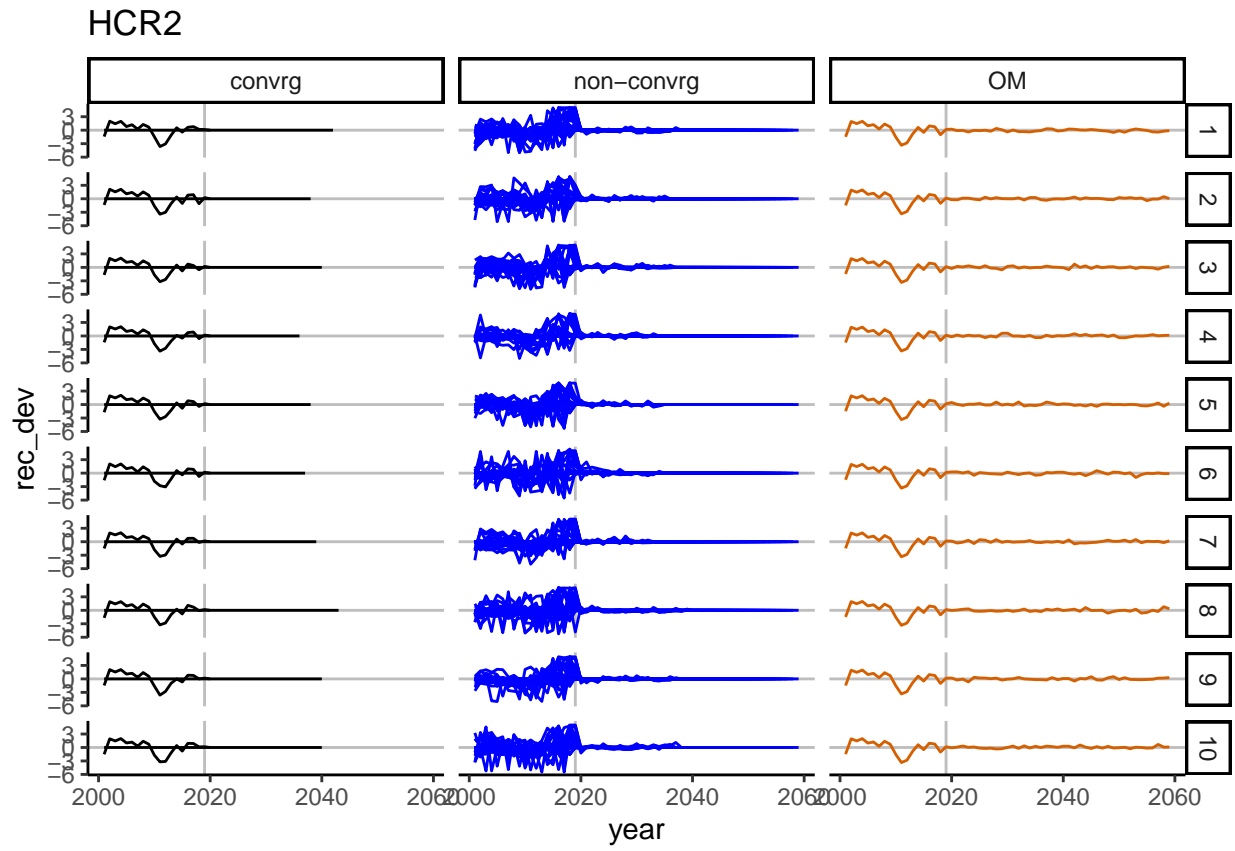


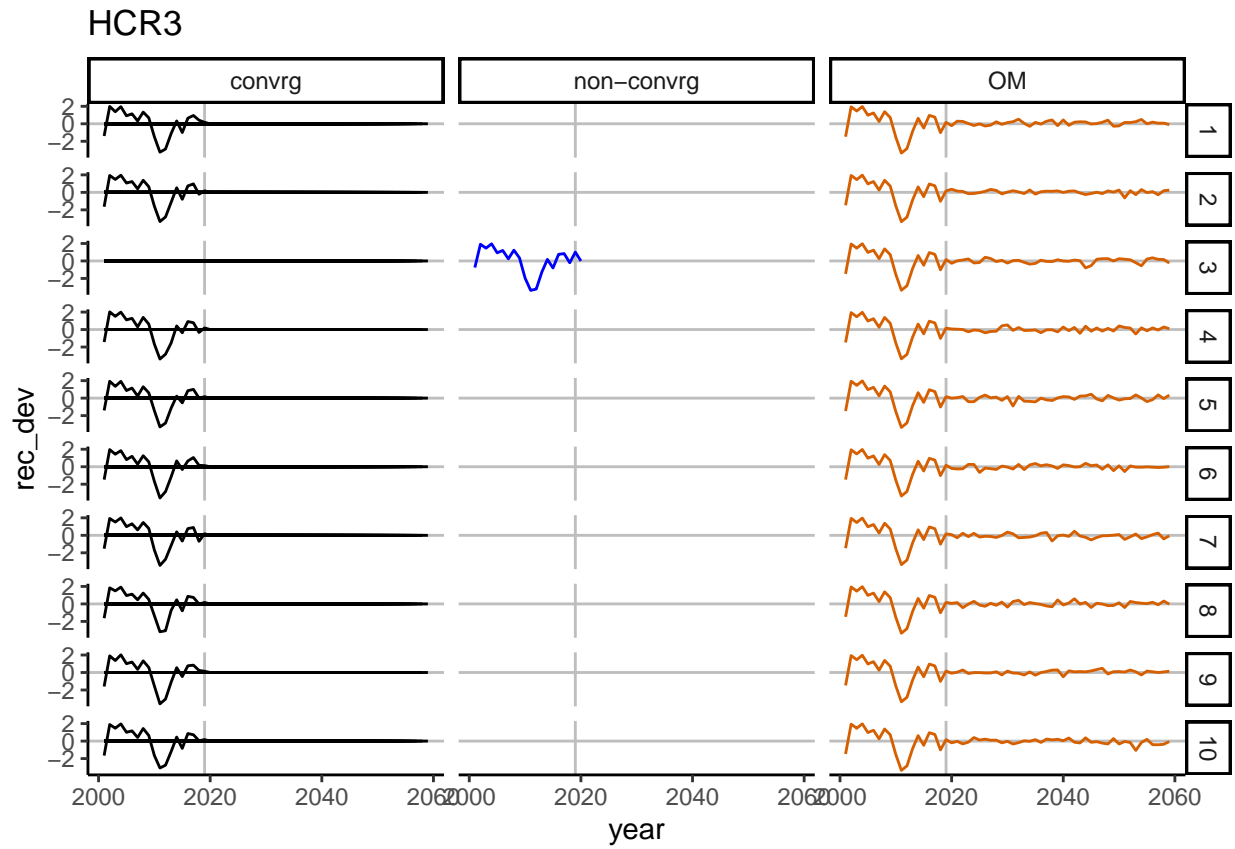


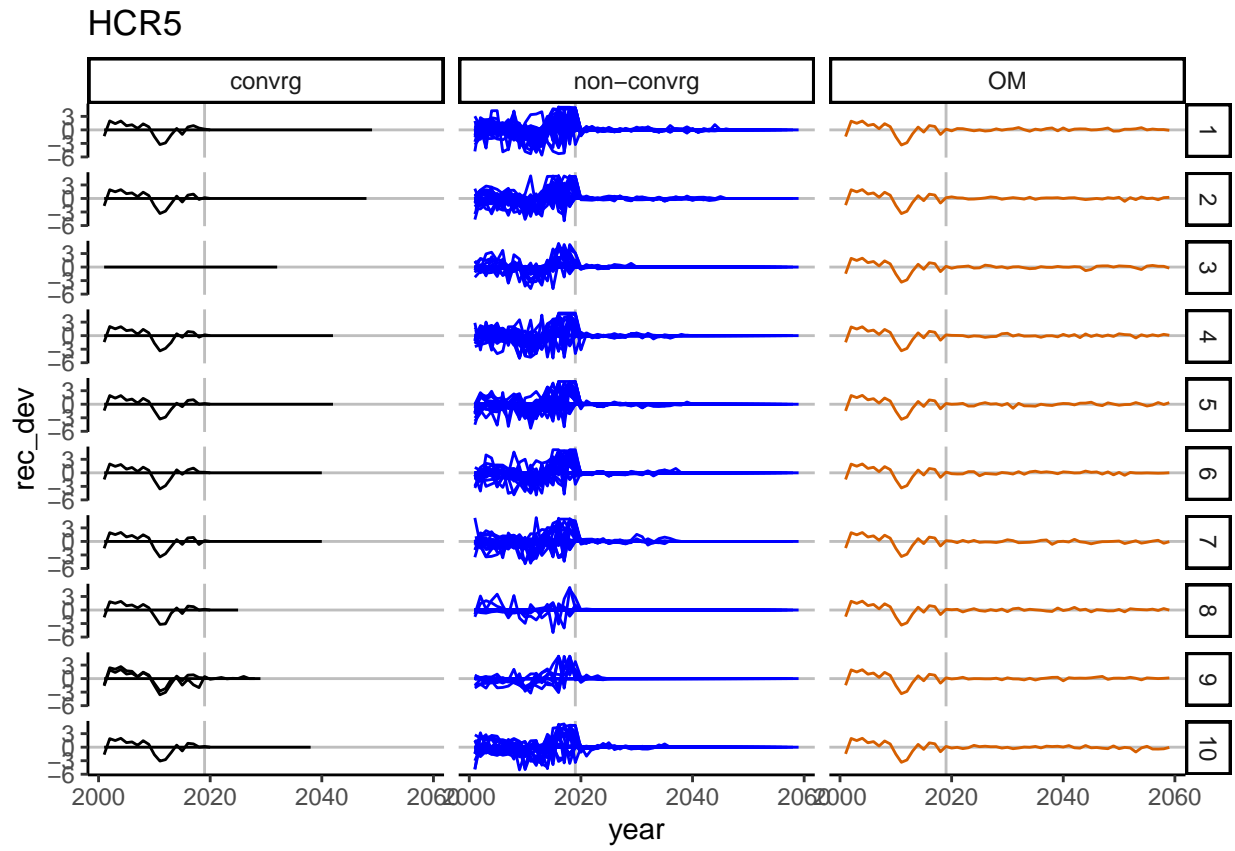




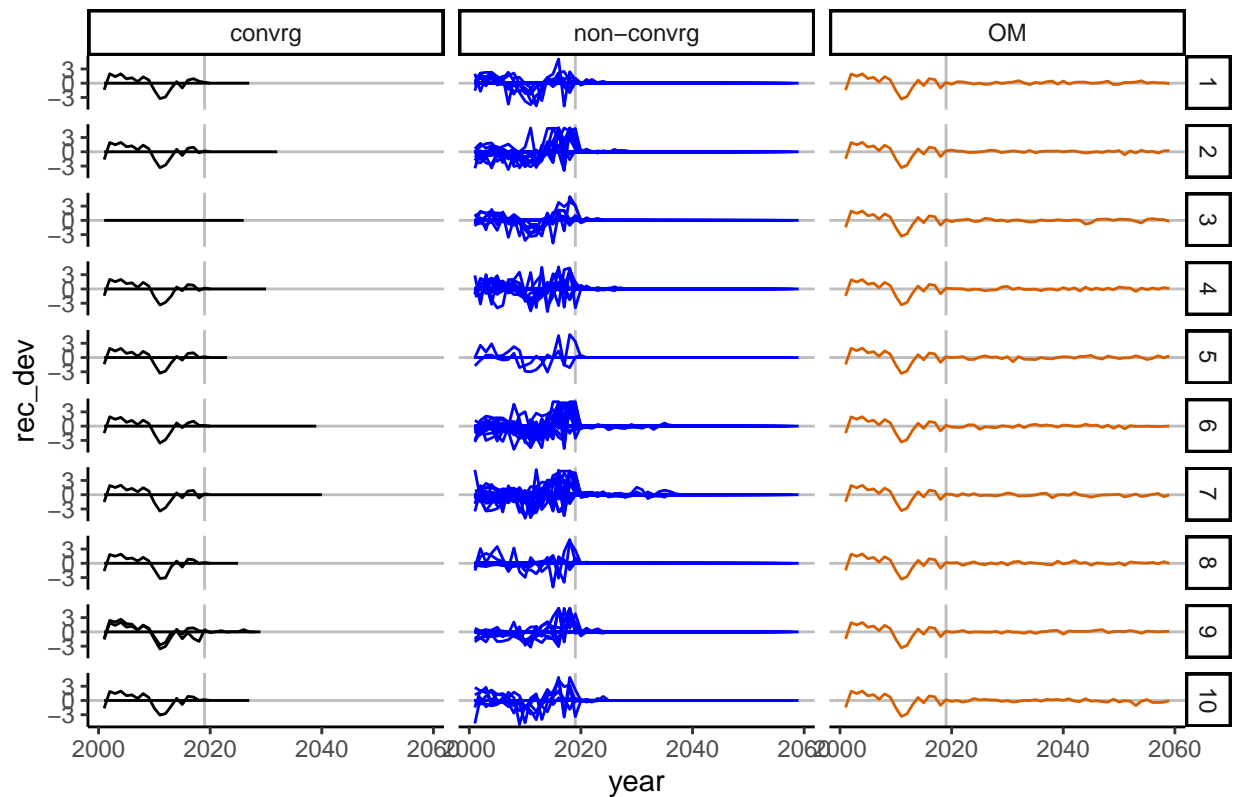
```
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```







HCR6



```
#termTS %>% filter(model_run == omName)

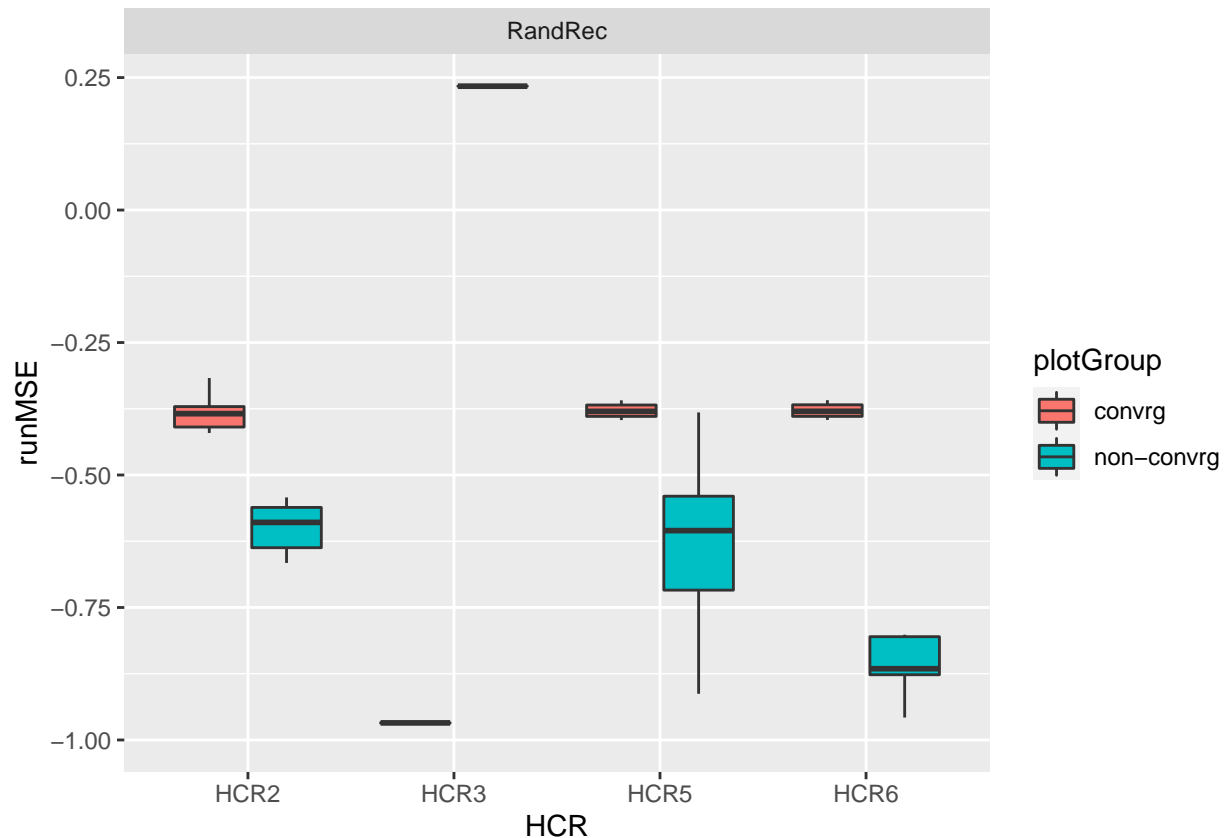
errCompare <- cnvrqTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
    by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
    age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



EM 2001 self test, recruitment at SD=0.25, perfect information & fixed params

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
```

```
scenarios <- c("fixedParams20010M_selfTestSD0.25_RandRecHCR0",
               "fixedParams20010M_selfTestSD0.25_RandRecHCR2",
               "fixedParams20010M_selfTestSD0.25_RandRecHCR3",
               "fixedParams20010M_selfTestSD0.25_RandRecHCR5",
               "fixedParams20010M_selfTestSD0.25_RandRecHCR6")
```

```
smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)
```

```
## Rows: 300 Columns: 12
```

```
## -- Column specification -----
```

```
## Delimiter: ","
```

```
## chr (2): model_run, scenario
```

```

## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

```

```
performanceList <- CalcPerformance(smryOutputList)
```

```

## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override

```

```
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics
```

```
# parse out HCR and recruitment scenario
```

```
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),  
                                   recScen = sub(pattern = "HCR.*","", scenario)) %>%  
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))
```

```
hcrPal <- brewer.pal(10, "Set3")[-2]
```

```
# plot convergence frequency
```

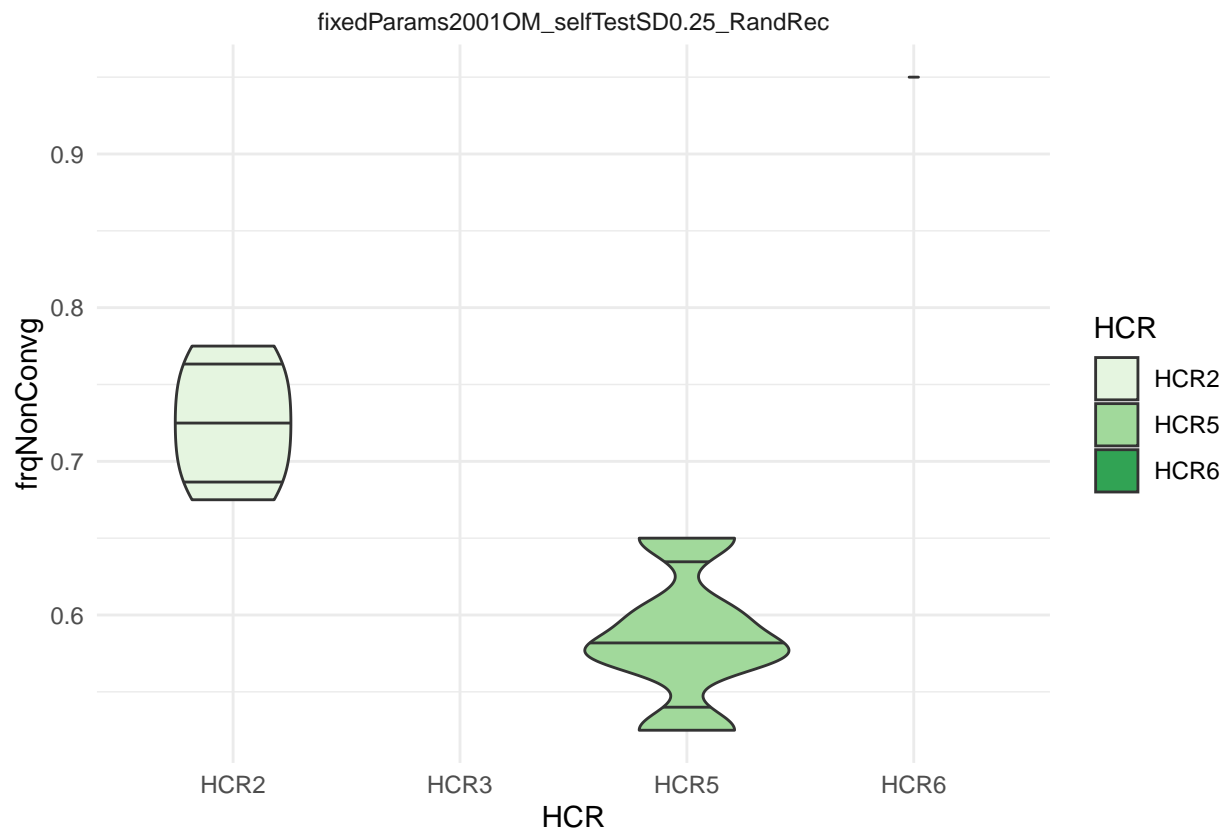
```
metricsTbl %>% filter(HCR != "HCRO") %>%  
  ggplot(aes(x = HCR, y = frqNonConv)) +  
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +  
  facet_wrap(~recScen) +  
  theme_minimal() +  
  scale_fill_brewer(palette = hcrPal)
```

```
## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and  
## only the first element will be used
```

```
## Warning in pal_name(palette, type): Unknown palette
```

```
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```

```
## Warning: Removed 5 rows containing non-finite values (stat_ydensity).
```



```

# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

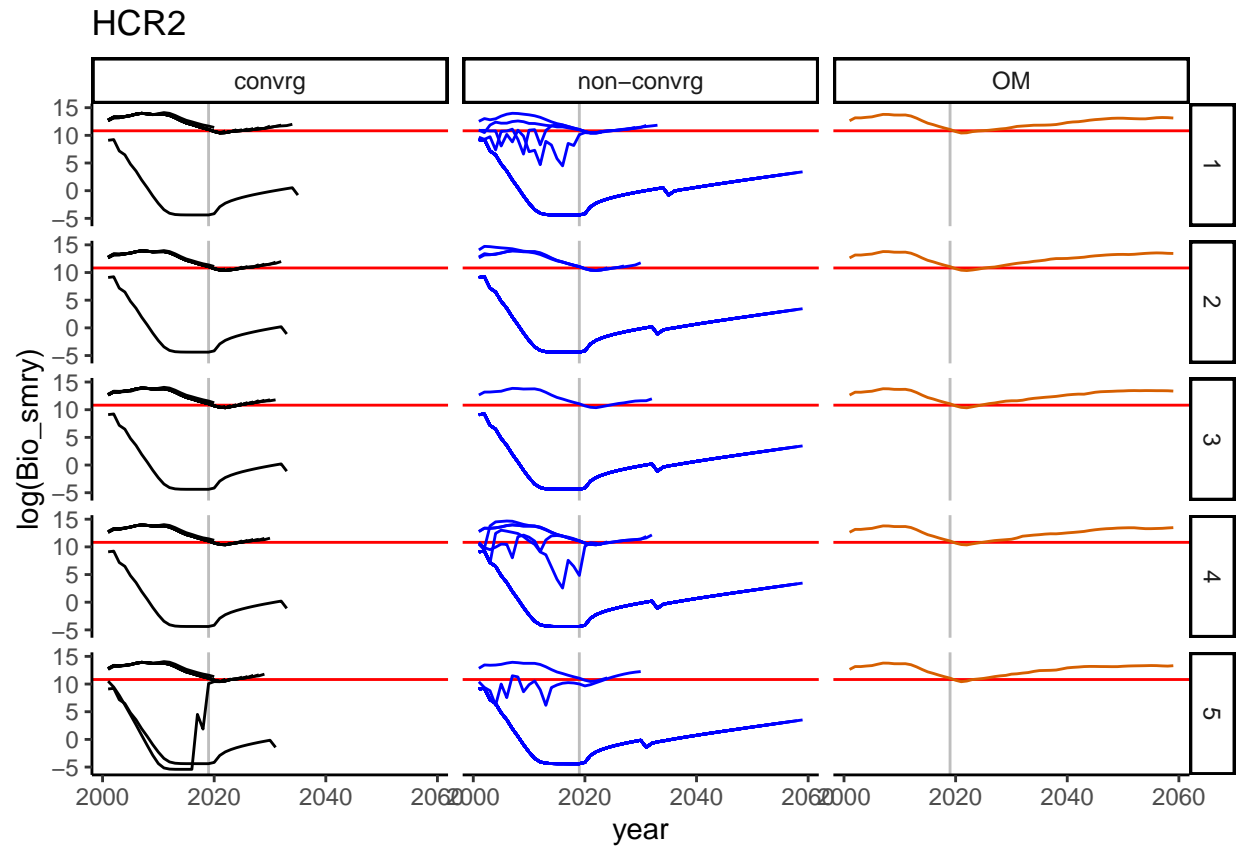
cnvrgCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[[:digit:]]+",
                                                  model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

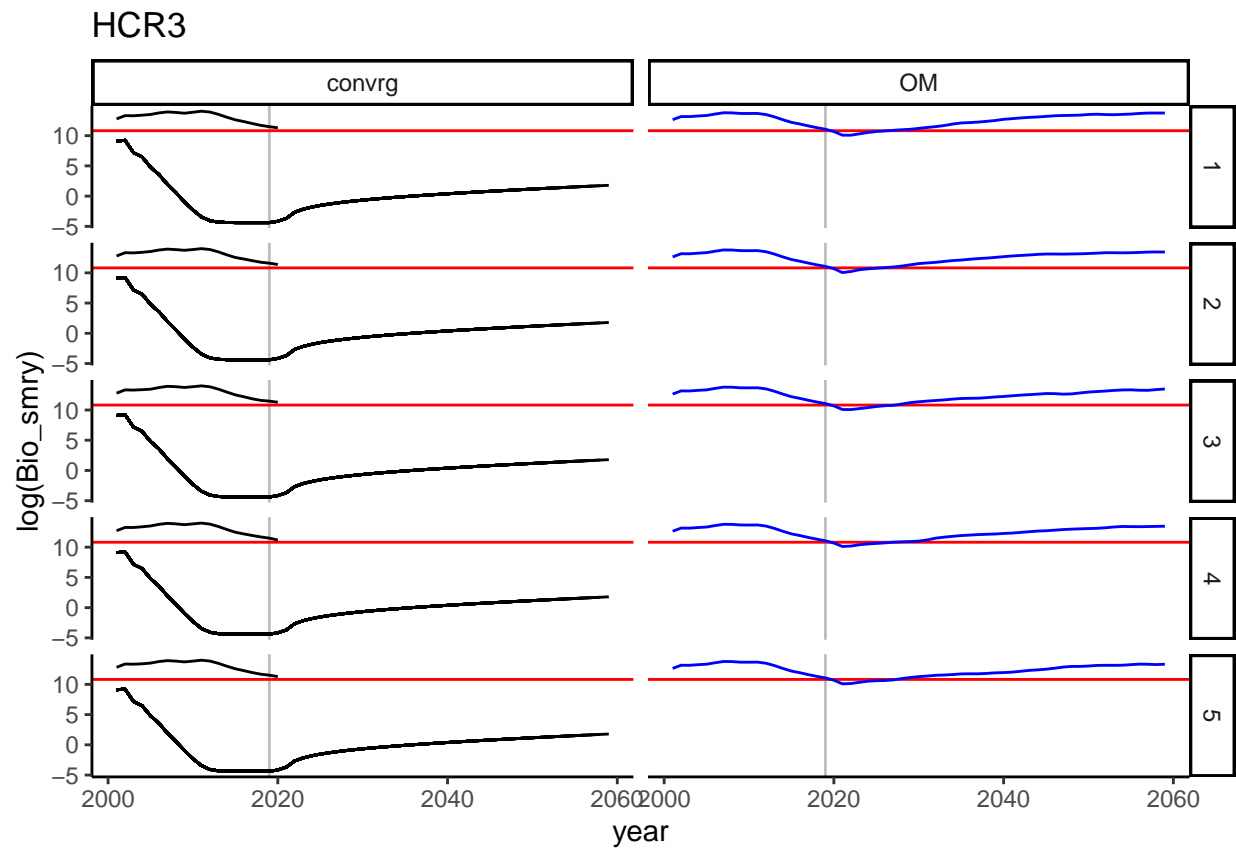
hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

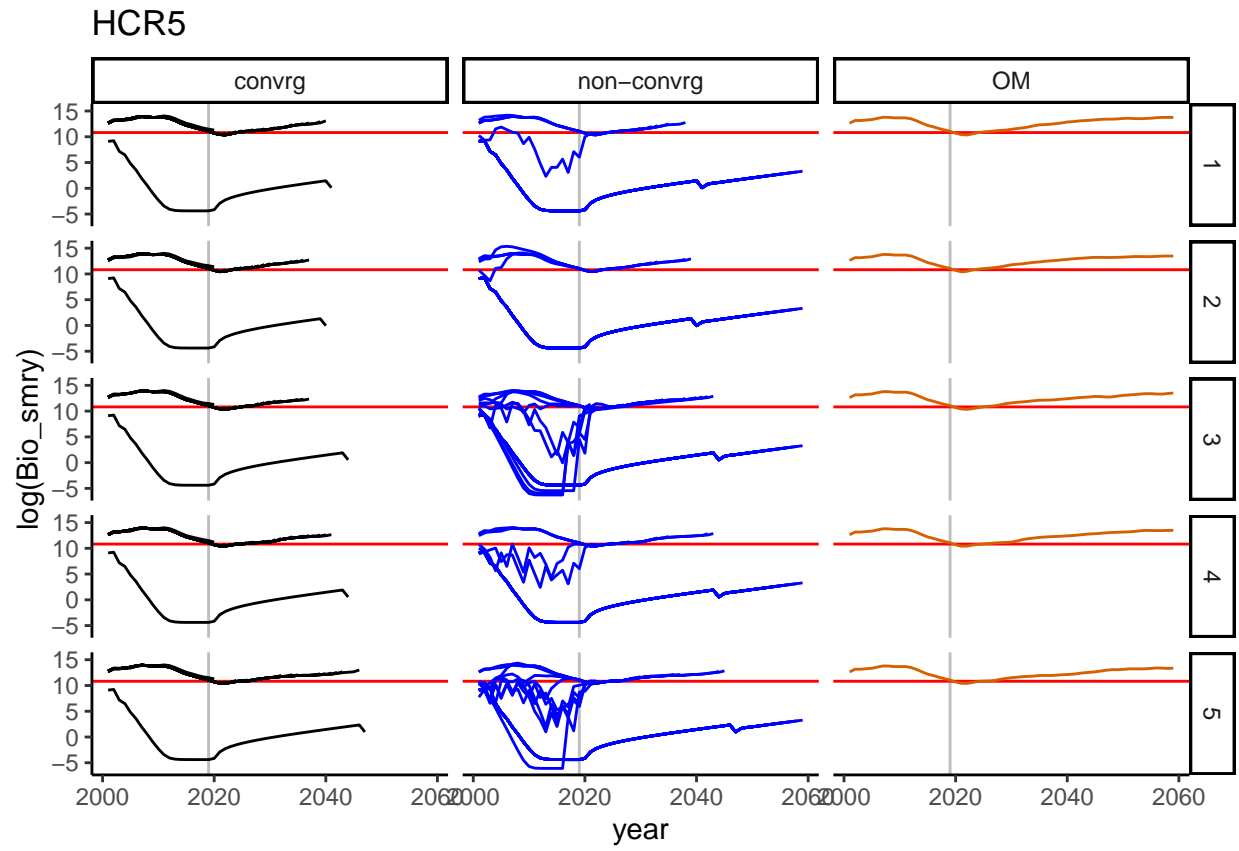
cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                           recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_","", recScen)) %>%
  left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
  mutate(plotGroup = case_when(model_run == omName ~ "OM",
                               max_grad > 0.01 ~ "non-cnvrng",
                               max_grad < 0.01 ~ "cnvrng"))

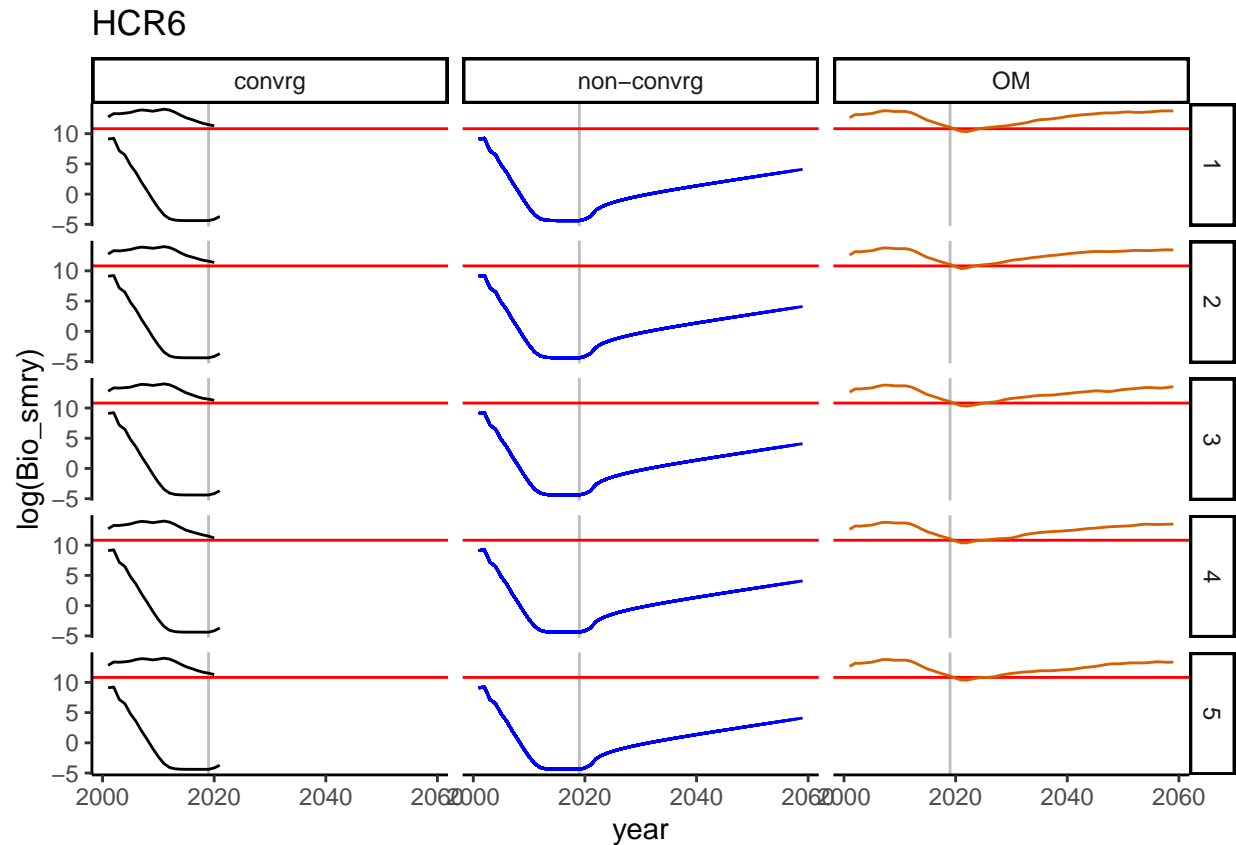
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```

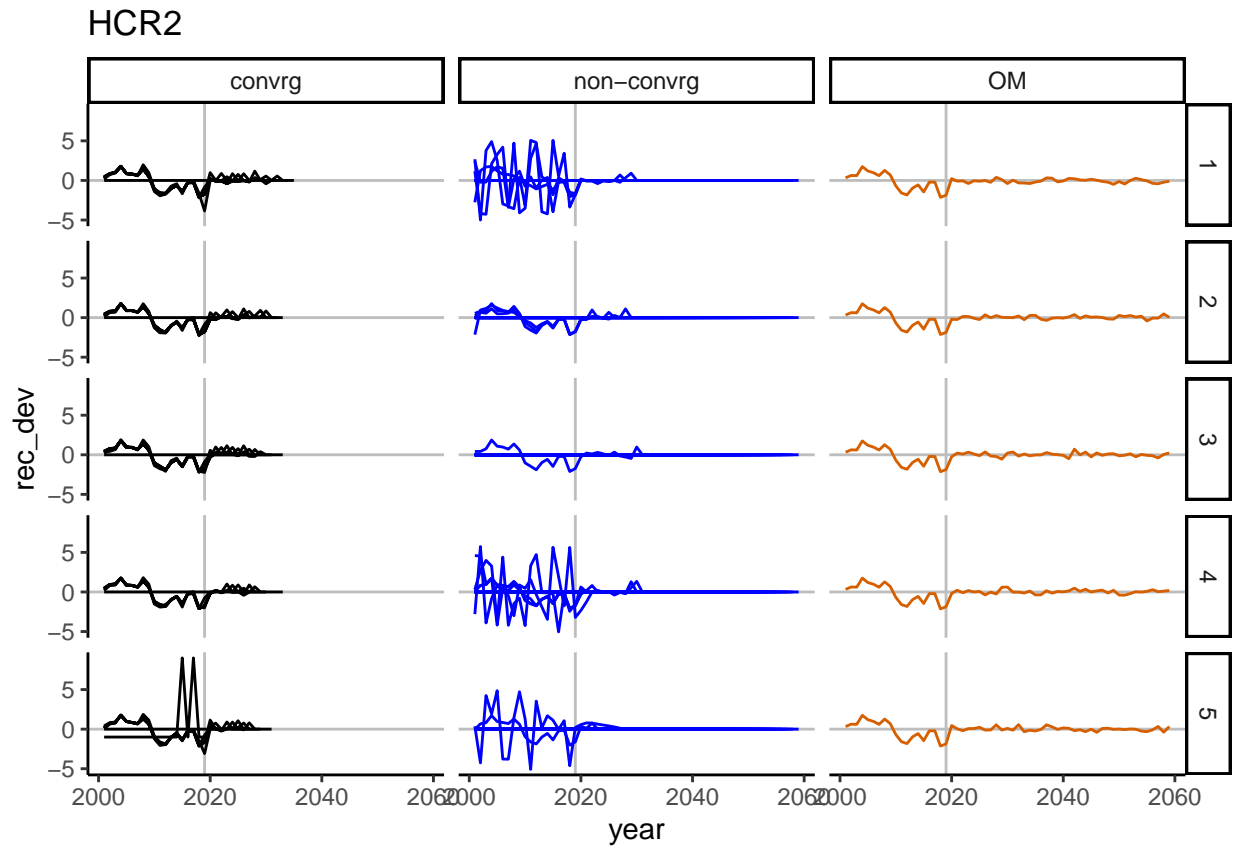


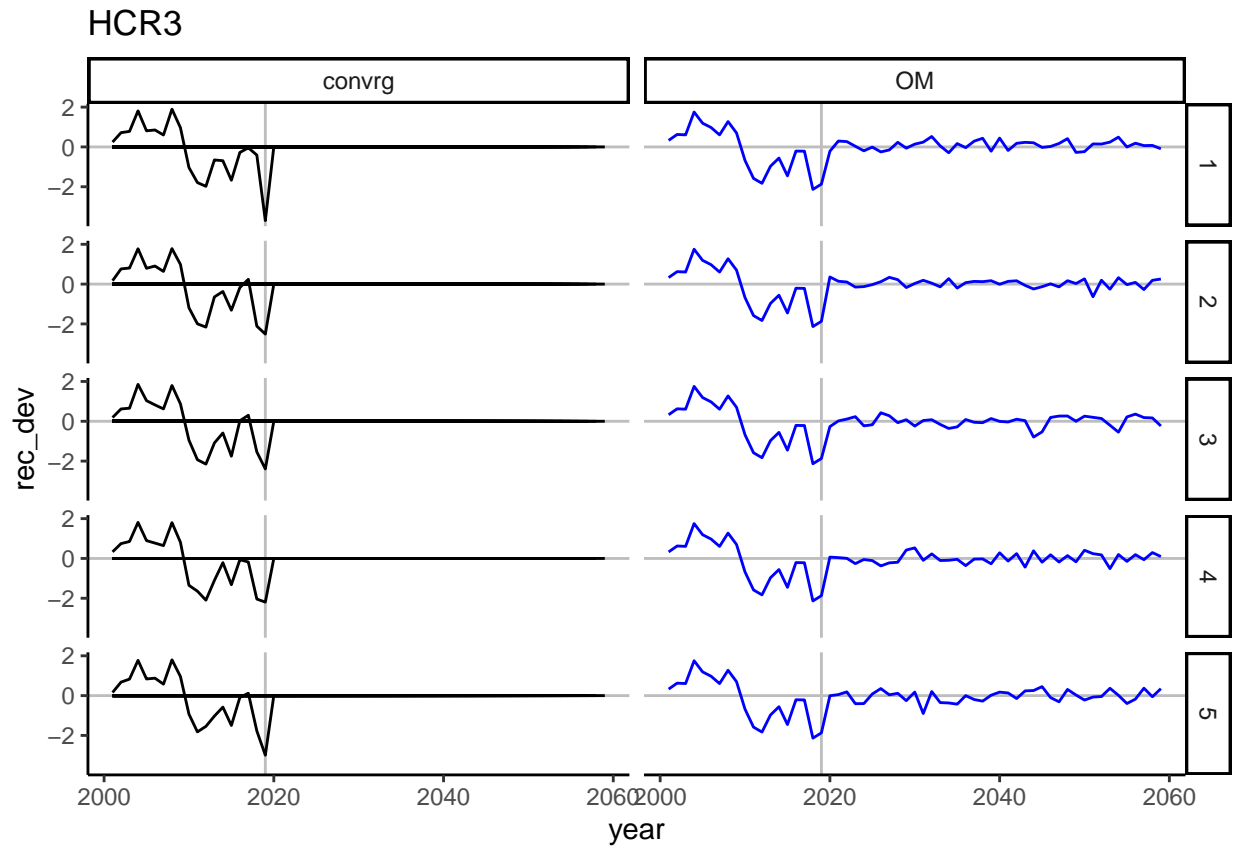




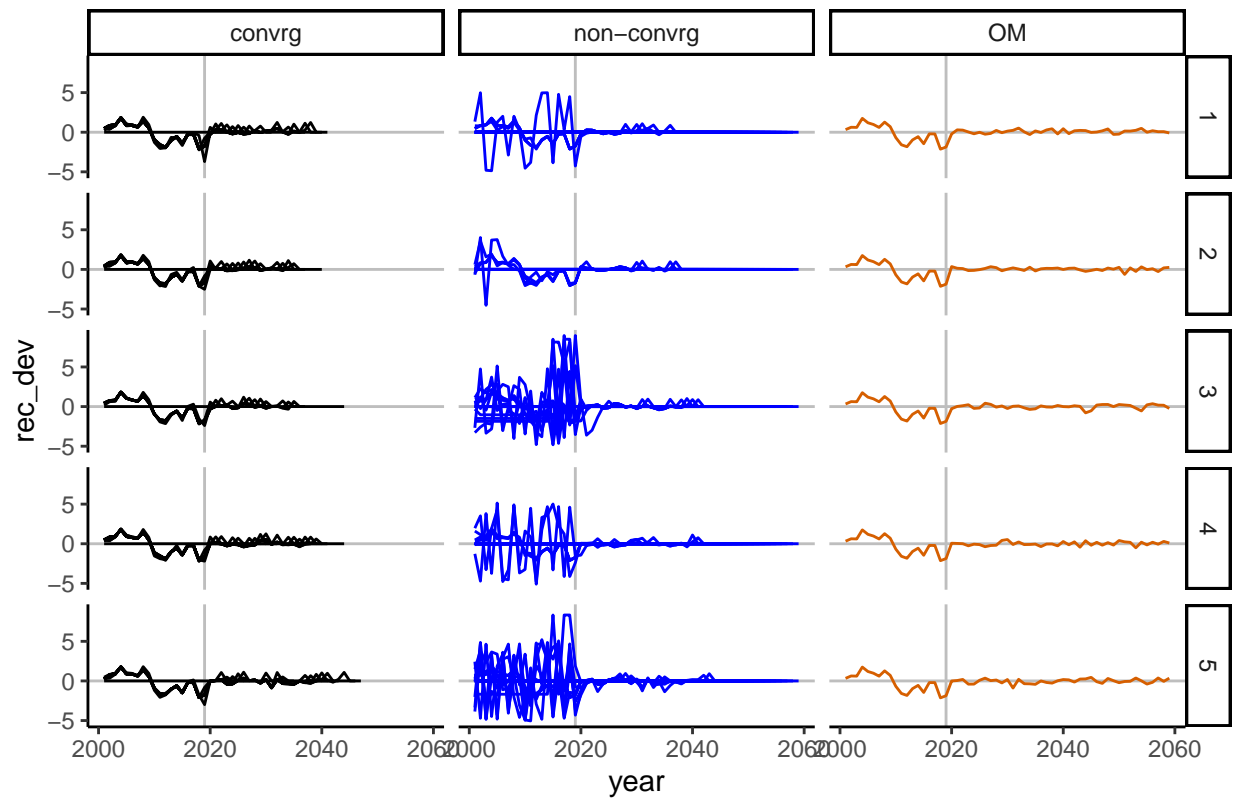


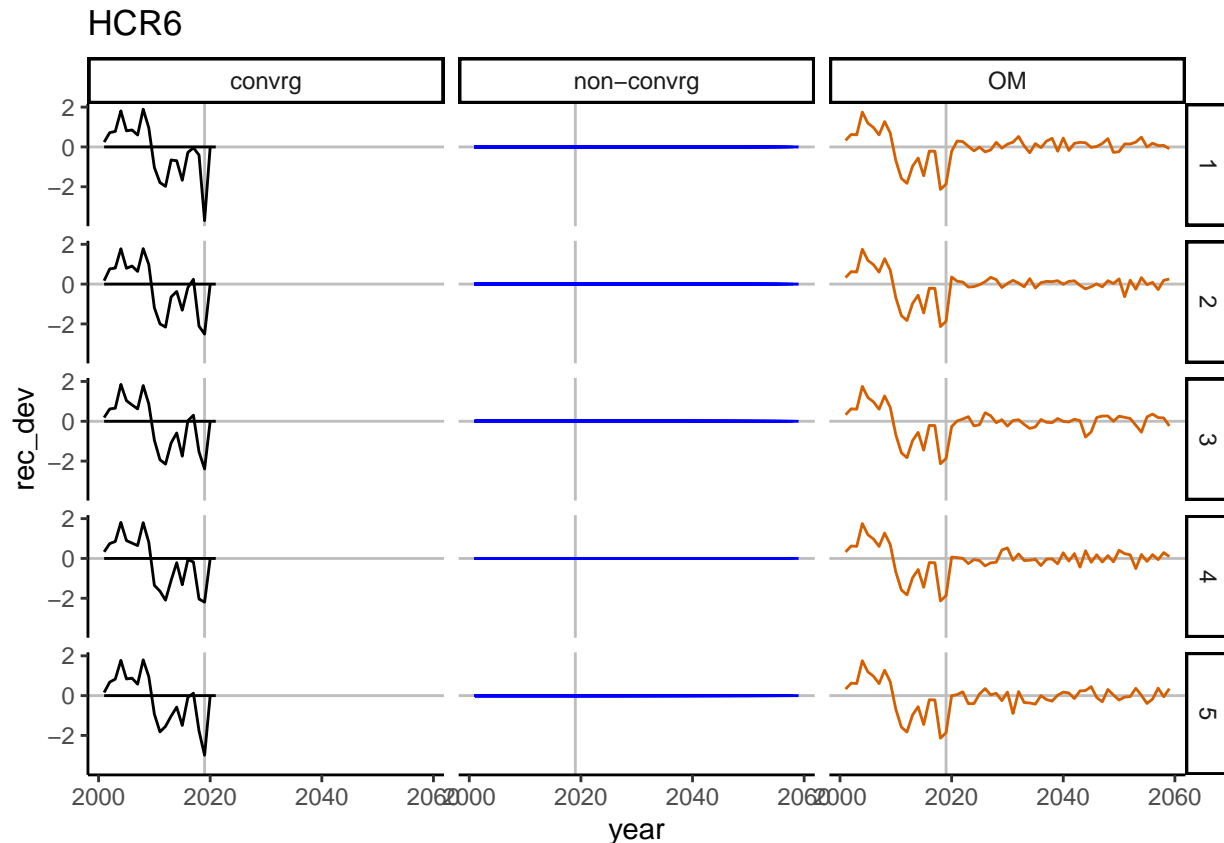
```
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```





HCR5





```
#termTS %>% filter(model_run == omName)
```

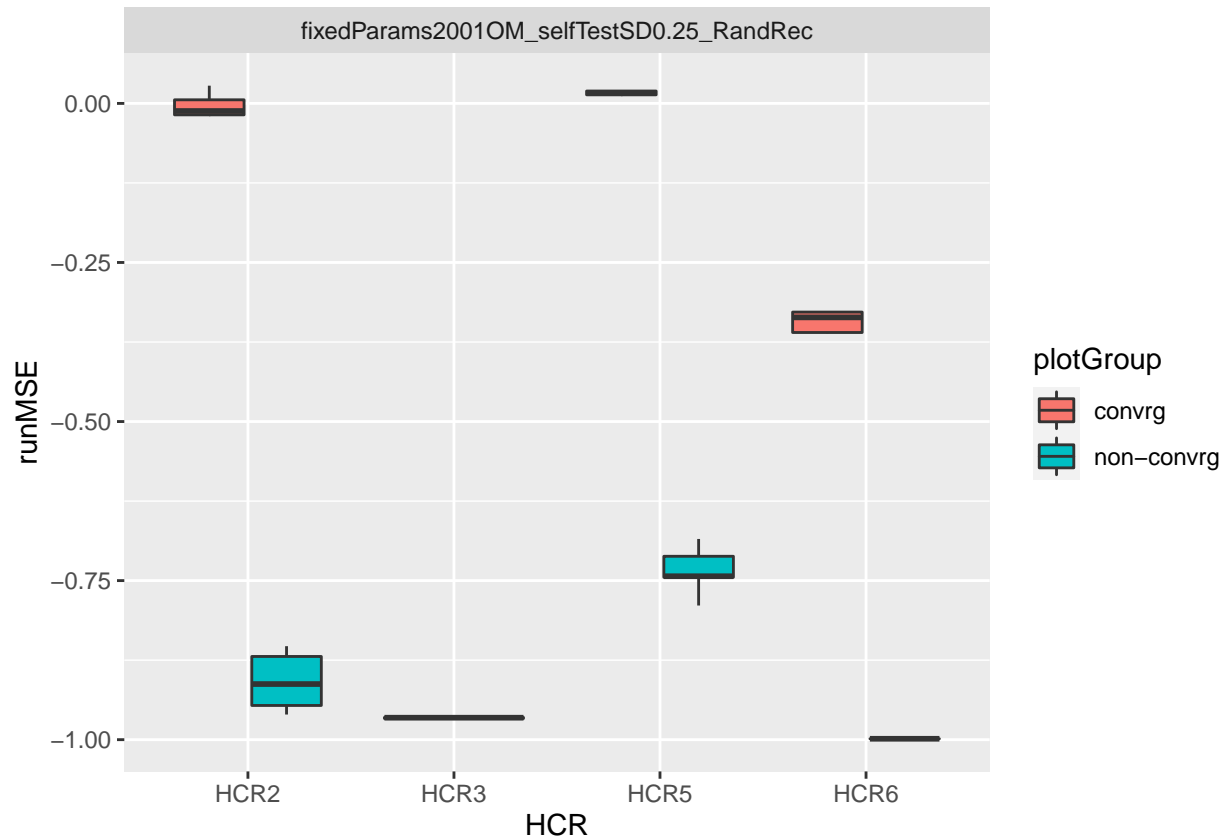
```
errCompare <- cnvrqTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
            by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
         age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
  # group_by(scenario, HCR, recScen, plotGroup) %>%
  # summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



Look at parameter estimate time series

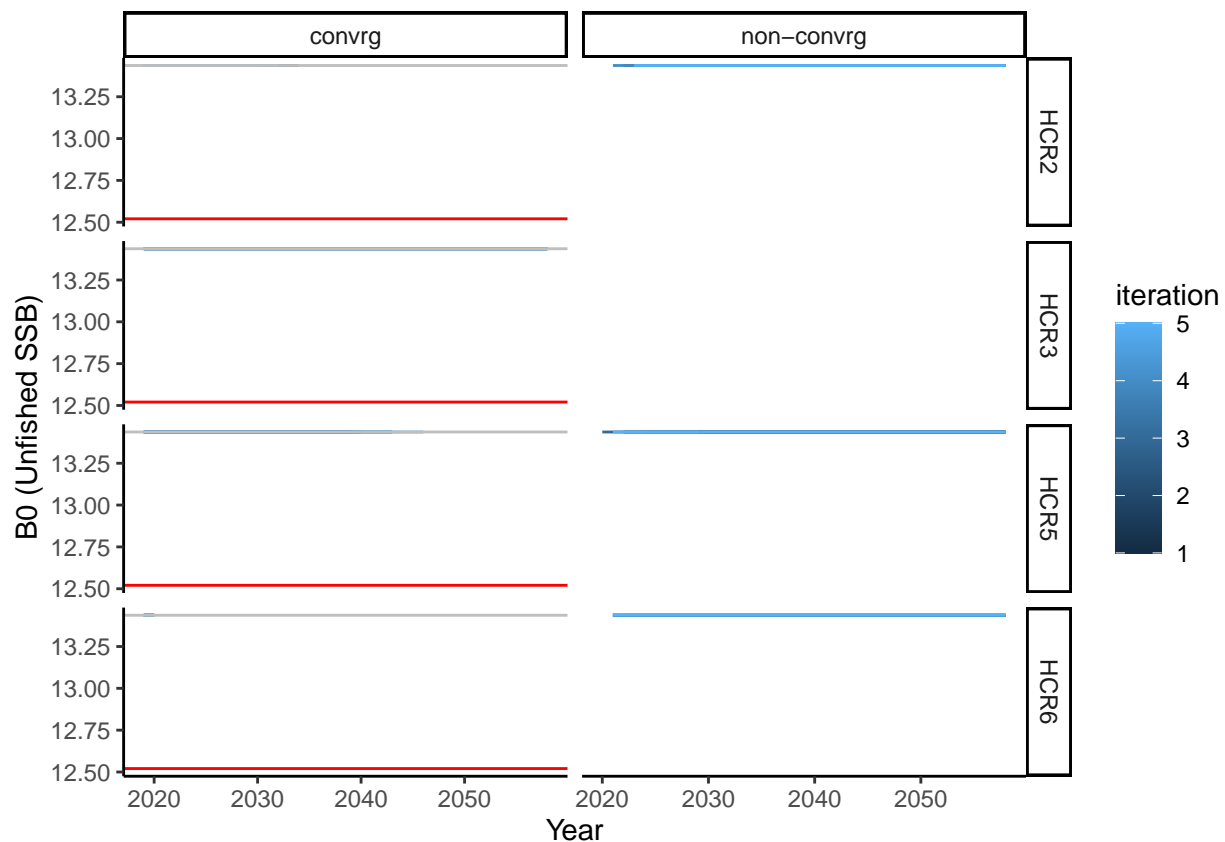
```
# Look at timeseries of B0 and account for non-convergence
B0s <- smryOutputList$sclSmry %>% mutate(emYear = as.numeric(regmatches(model_run,
  grexpr("[[:digit:]]+",
    model_run))),
  HCR = sub(pattern = ".*Rec", "", scenario),
  recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
    emYear = case_when(is.na(emYear) ~ 2019,
      TRUE ~ emYear),
    plotGroup = case_when(model_run == omName ~ "OM",
      max_grad > 0.01 ~ "non-convg",
      max_grad < 0.01 ~ "convg"))
meanB0s <- B0s %>% filter(max_grad < 0.01) %>%
  group_by(HCR, recScen, plotGroup) %>%
  summarize(meanB0est = mean(SSB_Unfished)) %>%
  mutate(pikitch0.4B0 = 0.4*meanB0est)
```

```
## 'summarise()' has grouped output by 'HCR', 'recScen'. You can override using
## the '.groups' argument.
```

```

B0s %>% filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = log(SSB_Unfished))) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "B0 (Unfished SSB)") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(meanB0est)), color = "grey") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(pikitch0.4B0)), color = "red")

```



```

# Want to look at the other parameters
sclSmryAll <- NULL

for(scn in 1:length(scenarios)){
  # read in SSMSE results summary scalars
  sclSumry <- read.csv(file.path(mseDir, scenarios[scn],
                                paste0("results_scalar_", scenarios[scn], ".csv")))
  # if(!"F_MSY" %in% names(sclSumry)){ # no catch scenarios don't have F_MSY
  #   sclSumry$F_MSY <- NA
  #   sclSumry$SSB_Unfished <- NA
  # }
}

```

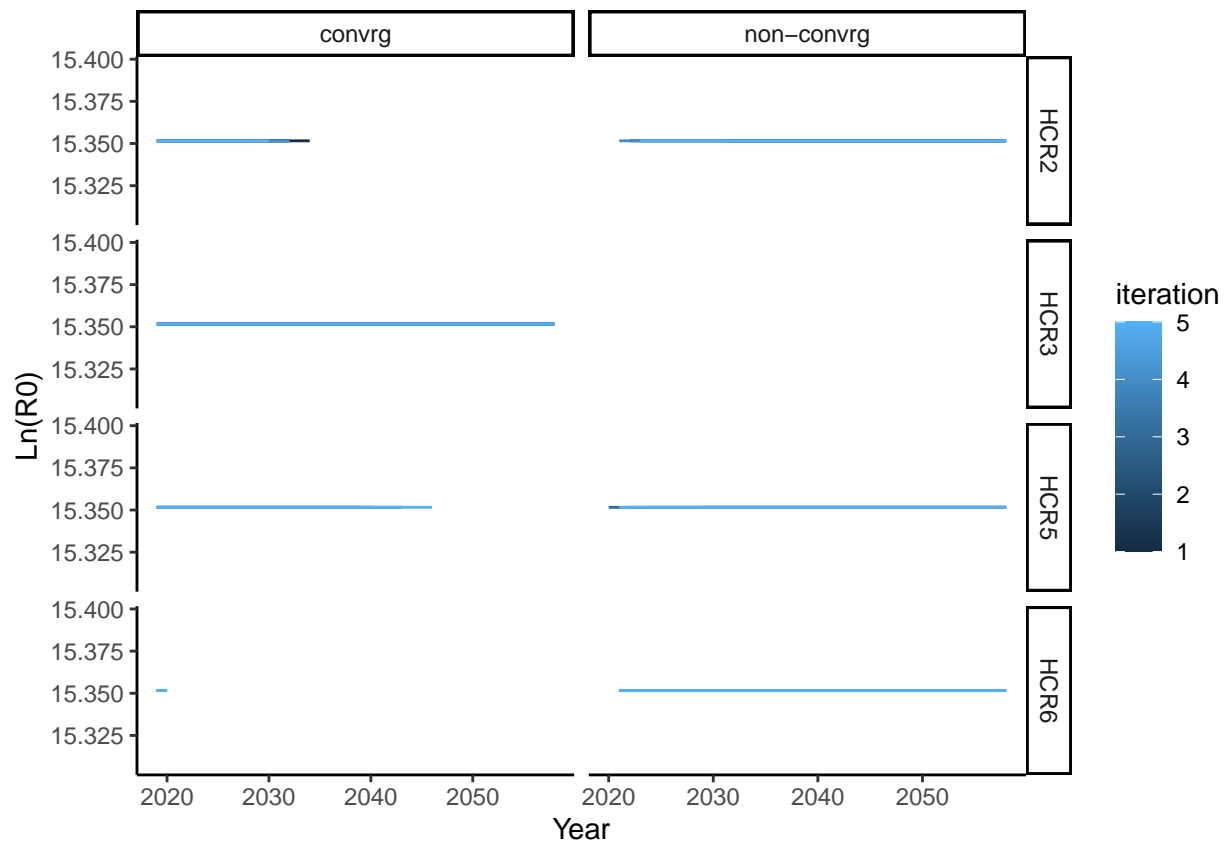
```

# sclSumry <- sclSumry[, c("F_MSY", "SmryBio_Unfished", "SSB_Unfished",
#                           "max_grad", "model_run", "iteration", "scenario")]

sclSmryAll <- bind_rows(sclSmryAll, sclSumry)
} # end 'scn' for-loop

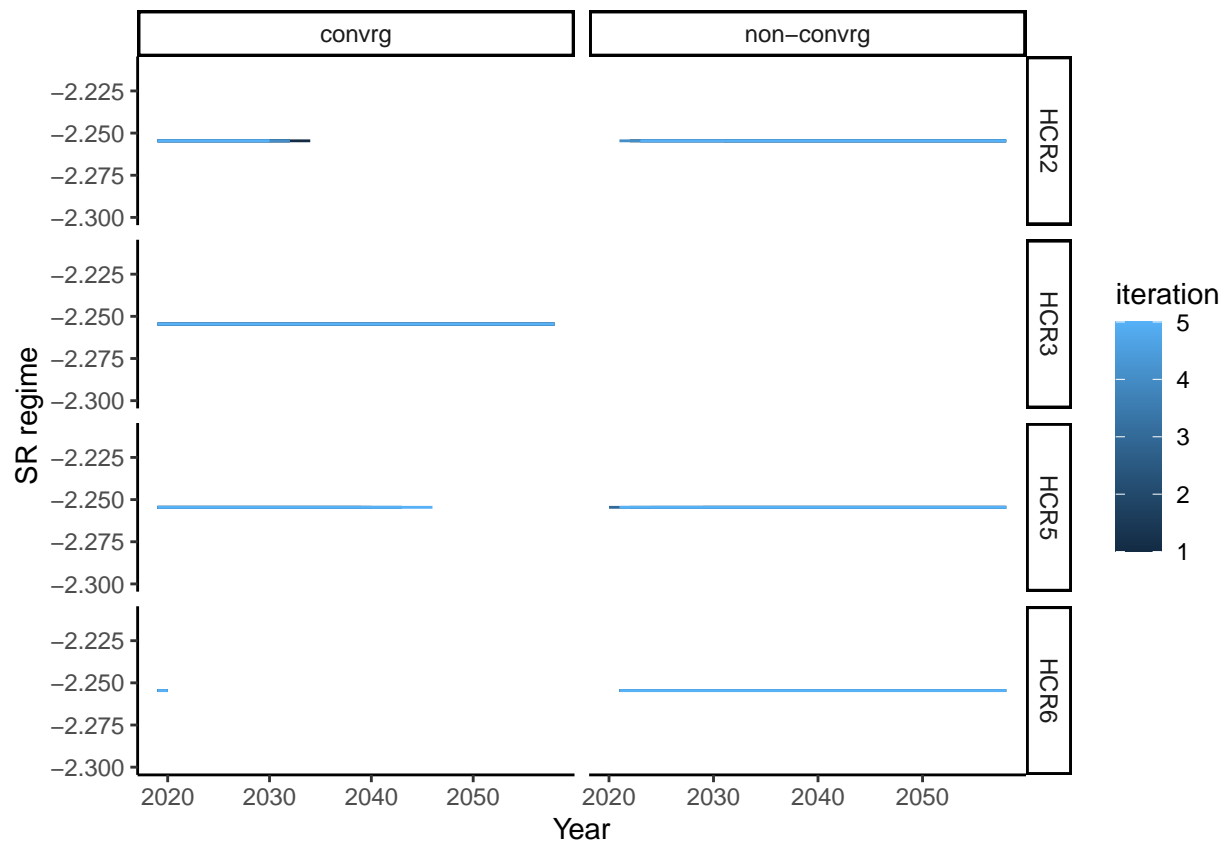
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                            model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
       emYear = case_when(is.na(emYear) ~ 2019,
                           TRUE ~ emYear),
       plotGroup = case_when(model_run == omName ~ "OM",
                              max_grad > 0.01 ~ "non-convrg",
                              max_grad < 0.01 ~ "convrg")) %>%
filter(model_run != omName, HCR != "HCR0") %>%
ggplot(aes(x = emYear, y = SR_LN_R0)) +
geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
#geom_rug(data = convrgCheck, mapping = aes(x = emYear),
#       sides = "b", inherit.aes = FALSE) +
labs(x = "Year", y = "Ln(R0)")

```

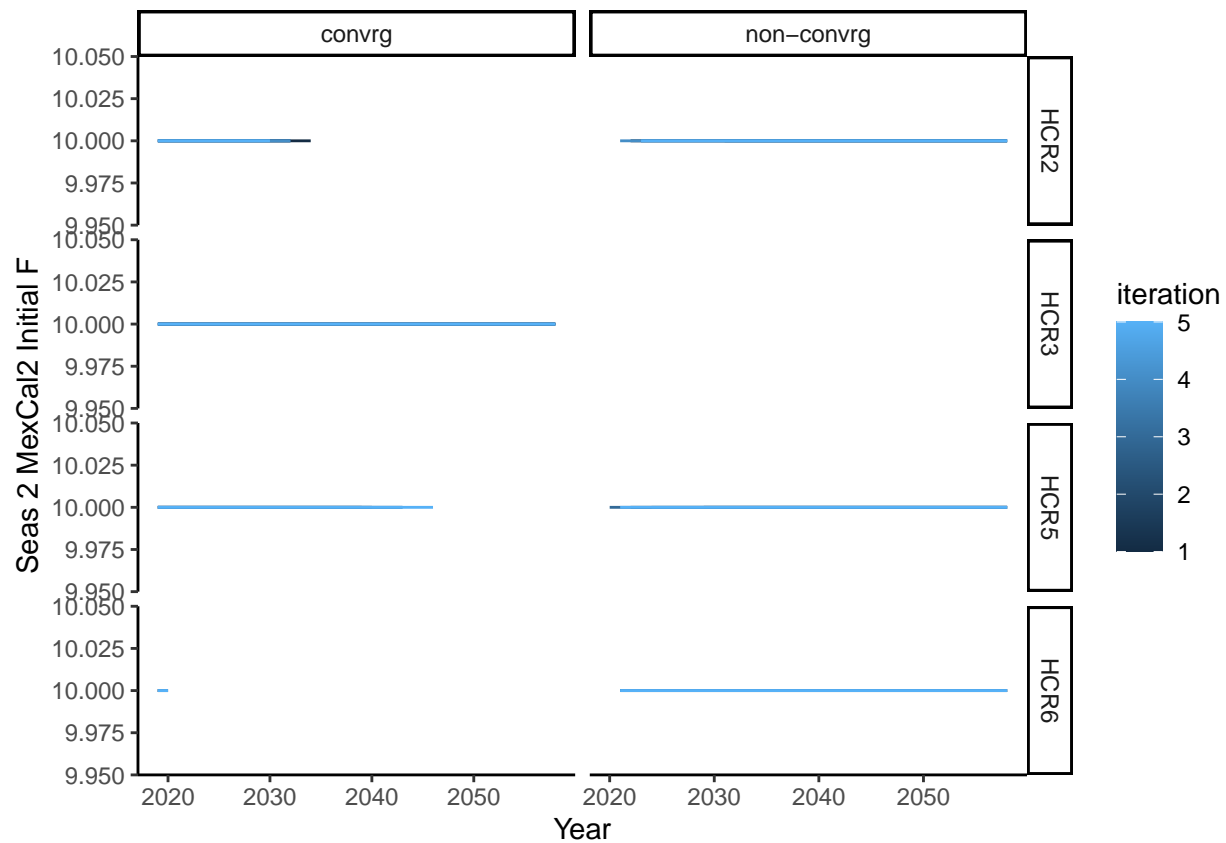



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[[:digit:]]+",
                                                    model_run))),

                    HCR = sub(pattern = ".*Rec","", scenario),
                    recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest","", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "QM",
                                max_grad > 0.01 ~ "non-convrgr",
                                max_grad < 0.01 ~ "convrgr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_regime_BLK1repl_2000)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #        sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "SR regime")
```



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "QM",
                                max_grad > 0.01 ~ "non-convrgr",
                                max_grad < 0.01 ~ "convrgr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = InitF_seas_2_flt_2MexCal_S2)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #        sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "Seas 2 MexCal2 Initial F")
```



```
sclSmryAll %>% select(max_grad, params_on_bound, params_stuck_low, params_stuck_high,
                      iteration, model_run, scenario) %>%
  filter(model_run != omName)
```

##	max_grad	params_on_bound	params_stuck_low	params_stuck_high	iteration
## 1	8.76182e-04	NA	NA	NA	1
## 2	1.21299e-04	NA	NA	NA	1
## 3	8.02716e+07	NA	NA	NA	1
## 4	1.97900e-03	NA	NA	NA	1
## 5	1.71476e-03	NA	NA	NA	1
## 6	2.12772e-04	NA	NA	NA	1
## 7	1.36608e-03	NA	NA	NA	1
## 8	1.75915e-03	NA	NA	NA	1
## 9	3.85590e+04	NA	NA	NA	1
## 10	5.74663e-03	NA	NA	NA	1
## 11	3.67575e+03	NA	NA	NA	1
## 12	4.88648e-04	NA	NA	NA	1
## 13	3.93470e+10	NA	NA	NA	1
## 14	1.52997e-03	NA	NA	NA	1
## 15	0.00000e+00	NA	NA	NA	1
## 16	2.42216e+06	NA	NA	NA	1
## 17	1.97720e+07	NA	NA	NA	1
## 18	4.68296e+07	NA	NA	NA	1
## 19	7.19001e+07	NA	NA	NA	1
## 20	9.55747e+07	NA	NA	NA	1

## 21	1.19044e+08	NA	NA	NA	1
## 22	1.42014e+08	NA	NA	NA	1
## 23	1.64412e+08	NA	NA	NA	1
## 24	1.86446e+08	NA	NA	NA	1
## 25	2.08226e+08	NA	NA	NA	1
## 26	2.29708e+08	NA	NA	NA	1
## 27	2.50870e+08	NA	NA	NA	1
## 28	2.71748e+08	NA	NA	NA	1
## 29	2.92359e+08	NA	NA	NA	1
## 30	3.12649e+08	NA	NA	NA	1
## 31	3.32561e+08	NA	NA	NA	1
## 32	3.52055e+08	NA	NA	NA	1
## 33	3.71144e+08	NA	NA	NA	1
## 34	3.89882e+08	NA	NA	NA	1
## 35	4.08324e+08	NA	NA	NA	1
## 36	4.26630e+08	NA	NA	NA	1
## 37	4.45762e+08	NA	NA	NA	1
## 38	4.66178e+08	NA	NA	NA	1
## 39	4.86229e+08	NA	NA	NA	1
## 40	3.15541e-05	NA	NA	NA	1
## 41	2.00234e-03	NA	NA	NA	2
## 42	6.55085e-05	NA	NA	NA	2
## 43	1.61950e-03	NA	NA	NA	2
## 44	2.45697e+02	NA	NA	NA	2
## 45	6.50064e-04	NA	NA	NA	2
## 46	5.78008e-04	NA	NA	NA	2
## 47	8.92850e+01	NA	NA	NA	2
## 48	1.48059e-04	NA	NA	NA	2
## 49	1.89356e-03	NA	NA	NA	2
## 50	2.77148e+03	NA	NA	NA	2
## 51	2.47208e-04	NA	NA	NA	2
## 52	5.24127e-03	NA	NA	NA	2
## 53	0.00000e+00	NA	NA	NA	2
## 54	2.59669e+06	NA	NA	NA	2
## 55	2.12038e+07	NA	NA	NA	2
## 56	5.00497e+07	NA	NA	NA	2
## 57	7.65325e+07	NA	NA	NA	2
## 58	1.01354e+08	NA	NA	NA	2
## 59	1.25617e+08	NA	NA	NA	2
## 60	1.49040e+08	NA	NA	NA	2
## 61	1.71704e+08	NA	NA	NA	2
## 62	1.93824e+08	NA	NA	NA	2
## 63	2.15475e+08	NA	NA	NA	2
## 64	2.36734e+08	NA	NA	NA	2
## 65	2.57730e+08	NA	NA	NA	2
## 66	2.78462e+08	NA	NA	NA	2
## 67	2.98884e+08	NA	NA	NA	2
## 68	3.19046e+08	NA	NA	NA	2
## 69	3.38928e+08	NA	NA	NA	2
## 70	3.58522e+08	NA	NA	NA	2
## 71	3.77787e+08	NA	NA	NA	2
## 72	3.96708e+08	NA	NA	NA	2
## 73	4.15386e+08	NA	NA	NA	2
## 74	4.33916e+08	NA	NA	NA	2

## 75	4.52275e+08	NA	NA	NA	2
## 76	4.72673e+08	NA	NA	NA	2
## 77	4.93126e+08	NA	NA	NA	2
## 78	5.13237e+08	NA	NA	NA	2
## 79	5.32933e+08	NA	NA	NA	2
## 80	1.08876e-05	NA	NA	NA	2
## 81	3.68869e-04	NA	NA	NA	3
## 82	4.28368e-04	NA	NA	NA	3
## 83	6.58983e-03	NA	NA	NA	3
## 84	3.01561e-03	NA	NA	NA	3
## 85	7.56014e-04	NA	NA	NA	3
## 86	1.95306e-05	NA	NA	NA	3
## 87	4.52258e-05	NA	NA	NA	3
## 88	9.19517e-04	NA	NA	NA	3
## 89	2.23151e-04	NA	NA	NA	3
## 90	3.07112e-04	NA	NA	NA	3
## 91	8.43399e-04	NA	NA	NA	3
## 92	2.21444e-02	NA	NA	NA	3
## 93	0.00000e+00	NA	NA	NA	3
## 94	2.59995e+06	NA	NA	NA	3
## 95	2.12661e+07	NA	NA	NA	3
## 96	5.01500e+07	NA	NA	NA	3
## 97	7.66227e+07	NA	NA	NA	3
## 98	1.01247e+08	NA	NA	NA	3
## 99	1.25311e+08	NA	NA	NA	3
## 100	1.48767e+08	NA	NA	NA	3
## 101	1.71670e+08	NA	NA	NA	3
## 102	1.94048e+08	NA	NA	NA	3
## 103	2.15904e+08	NA	NA	NA	3
## 104	2.37261e+08	NA	NA	NA	3
## 105	2.58358e+08	NA	NA	NA	3
## 106	2.79334e+08	NA	NA	NA	3
## 107	3.00025e+08	NA	NA	NA	3
## 108	3.20403e+08	NA	NA	NA	3
## 109	3.40449e+08	NA	NA	NA	3
## 110	3.60222e+08	NA	NA	NA	3
## 111	3.79704e+08	NA	NA	NA	3
## 112	3.98930e+08	NA	NA	NA	3
## 113	4.17872e+08	NA	NA	NA	3
## 114	4.36491e+08	NA	NA	NA	3
## 115	4.54833e+08	NA	NA	NA	3
## 116	4.75322e+08	NA	NA	NA	3
## 117	4.95568e+08	NA	NA	NA	3
## 118	5.15507e+08	NA	NA	NA	3
## 119	5.35106e+08	NA	NA	NA	3
## 120	5.71570e-05	NA	NA	NA	3
## 121	4.09663e-04	NA	NA	NA	4
## 122	6.11962e+01	NA	NA	NA	4
## 123	8.19173e+05	NA	NA	NA	4
## 124	3.67152e+04	NA	NA	NA	4
## 125	6.98118e-05	NA	NA	NA	4
## 126	3.25394e-03	NA	NA	NA	4
## 127	3.71472e-04	NA	NA	NA	4
## 128	1.29721e-03	NA	NA	NA	4

## 129	1.12438e-03	NA	NA	NA	4
## 130	4.28624e-04	NA	NA	NA	4
## 131	6.67775e+01	NA	NA	NA	4
## 132	6.21381e+06	NA	NA	NA	4
## 133	0.00000e+00	NA	NA	NA	4
## 134	2.62550e+06	NA	NA	NA	4
## 135	2.14008e+07	NA	NA	NA	4
## 136	5.04401e+07	NA	NA	NA	4
## 137	7.70388e+07	NA	NA	NA	4
## 138	1.01750e+08	NA	NA	NA	4
## 139	1.25723e+08	NA	NA	NA	4
## 140	1.48964e+08	NA	NA	NA	4
## 141	1.71600e+08	NA	NA	NA	4
## 142	1.93700e+08	NA	NA	NA	4
## 143	2.15359e+08	NA	NA	NA	4
## 144	2.36663e+08	NA	NA	NA	4
## 145	2.57743e+08	NA	NA	NA	4
## 146	2.78618e+08	NA	NA	NA	4
## 147	2.99234e+08	NA	NA	NA	4
## 148	3.19593e+08	NA	NA	NA	4
## 149	3.39661e+08	NA	NA	NA	4
## 150	3.59481e+08	NA	NA	NA	4
## 151	3.79030e+08	NA	NA	NA	4
## 152	3.98278e+08	NA	NA	NA	4
## 153	4.17203e+08	NA	NA	NA	4
## 154	4.35691e+08	NA	NA	NA	4
## 155	4.53772e+08	NA	NA	NA	4
## 156	4.73453e+08	NA	NA	NA	4
## 157	4.93480e+08	NA	NA	NA	4
## 158	5.13271e+08	NA	NA	NA	4
## 159	5.32883e+08	NA	NA	NA	4
## 160	1.66754e-06	NA	NA	NA	4
## 161	2.88492e-04	NA	NA	NA	5
## 162	1.29777e-03	NA	NA	NA	5
## 163	8.46440e-03	NA	NA	NA	5
## 164	1.69617e+01	NA	NA	NA	5
## 165	2.12899e-05	NA	NA	NA	5
## 166	3.61044e-04	NA	NA	NA	5
## 167	2.83872e-04	NA	NA	NA	5
## 168	4.49725e-03	NA	NA	NA	5
## 169	8.26370e-04	NA	NA	NA	5
## 170	4.21301e+08	NA	NA	NA	5
## 171	0.00000e+00	NA	NA	NA	5
## 172	2.80652e+06	NA	NA	NA	5
## 173	2.26430e+07	NA	NA	NA	5
## 174	5.28916e+07	NA	NA	NA	5
## 175	8.03516e+07	NA	NA	NA	5
## 176	1.05765e+08	NA	NA	NA	5
## 177	1.30243e+08	NA	NA	NA	5
## 178	1.53734e+08	NA	NA	NA	5
## 179	1.76411e+08	NA	NA	NA	5
## 180	1.98618e+08	NA	NA	NA	5
## 181	2.20475e+08	NA	NA	NA	5
## 182	2.41875e+08	NA	NA	NA	5

## 183	2.62823e+08	NA	NA	NA	5
## 184	2.83389e+08	NA	NA	NA	5
## 185	3.03545e+08	NA	NA	NA	5
## 186	3.23266e+08	NA	NA	NA	5
## 187	3.42570e+08	NA	NA	NA	5
## 188	3.61483e+08	NA	NA	NA	5
## 189	3.80043e+08	NA	NA	NA	5
## 190	3.98281e+08	NA	NA	NA	5
## 191	4.16305e+08	NA	NA	NA	5
## 192	4.34109e+08	NA	NA	NA	5
## 193	4.51662e+08	NA	NA	NA	5
## 194	4.69846e+08	NA	NA	NA	5
## 195	4.89393e+08	NA	NA	NA	5
## 196	5.08668e+08	NA	NA	NA	5
## 197	5.27619e+08	NA	NA	NA	5
## 198	5.46189e+08	NA	NA	NA	5
## 199	5.64433e+08	NA	NA	NA	5
## 200	9.03085e-06	NA	NA	NA	5
## 201	0.00000e+00	NA	NA	NA	1
## 202	0.00000e+00	NA	NA	NA	1
## 203	0.00000e+00	NA	NA	NA	1
## 204	0.00000e+00	NA	NA	NA	1
## 205	0.00000e+00	NA	NA	NA	1
## 206	0.00000e+00	NA	NA	NA	1
## 207	0.00000e+00	NA	NA	NA	1
## 208	0.00000e+00	NA	NA	NA	1
## 209	0.00000e+00	NA	NA	NA	1
## 210	0.00000e+00	NA	NA	NA	1
## 211	0.00000e+00	NA	NA	NA	1
## 212	0.00000e+00	NA	NA	NA	1
## 213	0.00000e+00	NA	NA	NA	1
## 214	0.00000e+00	NA	NA	NA	1
## 215	0.00000e+00	NA	NA	NA	1
## 216	0.00000e+00	NA	NA	NA	1
## 217	0.00000e+00	NA	NA	NA	1
## 218	0.00000e+00	NA	NA	NA	1
## 219	0.00000e+00	NA	NA	NA	1
## 220	0.00000e+00	NA	NA	NA	1
## 221	0.00000e+00	NA	NA	NA	1
## 222	0.00000e+00	NA	NA	NA	1
## 223	0.00000e+00	NA	NA	NA	1
## 224	0.00000e+00	NA	NA	NA	1
## 225	0.00000e+00	NA	NA	NA	1
## 226	0.00000e+00	NA	NA	NA	1
## 227	0.00000e+00	NA	NA	NA	1
## 228	0.00000e+00	NA	NA	NA	1
## 229	0.00000e+00	NA	NA	NA	1
## 230	0.00000e+00	NA	NA	NA	1
## 231	0.00000e+00	NA	NA	NA	1
## 232	0.00000e+00	NA	NA	NA	1
## 233	0.00000e+00	NA	NA	NA	1
## 234	0.00000e+00	NA	NA	NA	1
## 235	0.00000e+00	NA	NA	NA	1
## 236	0.00000e+00	NA	NA	NA	1

## 237	0.00000e+00	NA	NA	NA	1
## 238	0.00000e+00	NA	NA	NA	1
## 239	0.00000e+00	NA	NA	NA	1
## 240	1.42714e-05	NA	NA	NA	1
## 241	0.00000e+00	NA	NA	NA	2
## 242	0.00000e+00	NA	NA	NA	2
## 243	0.00000e+00	NA	NA	NA	2
## 244	0.00000e+00	NA	NA	NA	2
## 245	0.00000e+00	NA	NA	NA	2
## 246	0.00000e+00	NA	NA	NA	2
## 247	0.00000e+00	NA	NA	NA	2
## 248	0.00000e+00	NA	NA	NA	2
## 249	0.00000e+00	NA	NA	NA	2
## 250	0.00000e+00	NA	NA	NA	2
## 251	0.00000e+00	NA	NA	NA	2
## 252	0.00000e+00	NA	NA	NA	2
## 253	0.00000e+00	NA	NA	NA	2
## 254	0.00000e+00	NA	NA	NA	2
## 255	0.00000e+00	NA	NA	NA	2
## 256	0.00000e+00	NA	NA	NA	2
## 257	0.00000e+00	NA	NA	NA	2
## 258	0.00000e+00	NA	NA	NA	2
## 259	0.00000e+00	NA	NA	NA	2
## 260	0.00000e+00	NA	NA	NA	2
## 261	0.00000e+00	NA	NA	NA	2
## 262	0.00000e+00	NA	NA	NA	2
## 263	0.00000e+00	NA	NA	NA	2
## 264	0.00000e+00	NA	NA	NA	2
## 265	0.00000e+00	NA	NA	NA	2
## 266	0.00000e+00	NA	NA	NA	2
## 267	0.00000e+00	NA	NA	NA	2
## 268	0.00000e+00	NA	NA	NA	2
## 269	0.00000e+00	NA	NA	NA	2
## 270	0.00000e+00	NA	NA	NA	2
## 271	0.00000e+00	NA	NA	NA	2
## 272	0.00000e+00	NA	NA	NA	2
## 273	0.00000e+00	NA	NA	NA	2
## 274	0.00000e+00	NA	NA	NA	2
## 275	0.00000e+00	NA	NA	NA	2
## 276	0.00000e+00	NA	NA	NA	2
## 277	0.00000e+00	NA	NA	NA	2
## 278	0.00000e+00	NA	NA	NA	2
## 279	0.00000e+00	NA	NA	NA	2
## 280	2.63704e-05	NA	NA	NA	2
## 281	0.00000e+00	NA	NA	NA	3
## 282	0.00000e+00	NA	NA	NA	3
## 283	0.00000e+00	NA	NA	NA	3
## 284	0.00000e+00	NA	NA	NA	3
## 285	0.00000e+00	NA	NA	NA	3
## 286	0.00000e+00	NA	NA	NA	3
## 287	0.00000e+00	NA	NA	NA	3
## 288	0.00000e+00	NA	NA	NA	3
## 289	0.00000e+00	NA	NA	NA	3
## 290	0.00000e+00	NA	NA	NA	3

## 291	0.00000e+00	NA	NA	NA	3
## 292	0.00000e+00	NA	NA	NA	3
## 293	0.00000e+00	NA	NA	NA	3
## 294	0.00000e+00	NA	NA	NA	3
## 295	0.00000e+00	NA	NA	NA	3
## 296	0.00000e+00	NA	NA	NA	3
## 297	0.00000e+00	NA	NA	NA	3
## 298	0.00000e+00	NA	NA	NA	3
## 299	0.00000e+00	NA	NA	NA	3
## 300	0.00000e+00	NA	NA	NA	3
## 301	0.00000e+00	NA	NA	NA	3
## 302	0.00000e+00	NA	NA	NA	3
## 303	0.00000e+00	NA	NA	NA	3
## 304	0.00000e+00	NA	NA	NA	3
## 305	0.00000e+00	NA	NA	NA	3
## 306	0.00000e+00	NA	NA	NA	3
## 307	0.00000e+00	NA	NA	NA	3
## 308	0.00000e+00	NA	NA	NA	3
## 309	0.00000e+00	NA	NA	NA	3
## 310	0.00000e+00	NA	NA	NA	3
## 311	0.00000e+00	NA	NA	NA	3
## 312	0.00000e+00	NA	NA	NA	3
## 313	0.00000e+00	NA	NA	NA	3
## 314	0.00000e+00	NA	NA	NA	3
## 315	0.00000e+00	NA	NA	NA	3
## 316	0.00000e+00	NA	NA	NA	3
## 317	0.00000e+00	NA	NA	NA	3
## 318	0.00000e+00	NA	NA	NA	3
## 319	0.00000e+00	NA	NA	NA	3
## 320	1.74323e-05	NA	NA	NA	3
## 321	0.00000e+00	NA	NA	NA	4
## 322	0.00000e+00	NA	NA	NA	4
## 323	0.00000e+00	NA	NA	NA	4
## 324	0.00000e+00	NA	NA	NA	4
## 325	0.00000e+00	NA	NA	NA	4
## 326	0.00000e+00	NA	NA	NA	4
## 327	0.00000e+00	NA	NA	NA	4
## 328	0.00000e+00	NA	NA	NA	4
## 329	0.00000e+00	NA	NA	NA	4
## 330	0.00000e+00	NA	NA	NA	4
## 331	0.00000e+00	NA	NA	NA	4
## 332	0.00000e+00	NA	NA	NA	4
## 333	0.00000e+00	NA	NA	NA	4
## 334	0.00000e+00	NA	NA	NA	4
## 335	0.00000e+00	NA	NA	NA	4
## 336	0.00000e+00	NA	NA	NA	4
## 337	0.00000e+00	NA	NA	NA	4
## 338	0.00000e+00	NA	NA	NA	4
## 339	0.00000e+00	NA	NA	NA	4
## 340	0.00000e+00	NA	NA	NA	4
## 341	0.00000e+00	NA	NA	NA	4
## 342	0.00000e+00	NA	NA	NA	4
## 343	0.00000e+00	NA	NA	NA	4
## 344	0.00000e+00	NA	NA	NA	4

## 345	0.00000e+00	NA	NA	NA	4
## 346	0.00000e+00	NA	NA	NA	4
## 347	0.00000e+00	NA	NA	NA	4
## 348	0.00000e+00	NA	NA	NA	4
## 349	0.00000e+00	NA	NA	NA	4
## 350	0.00000e+00	NA	NA	NA	4
## 351	0.00000e+00	NA	NA	NA	4
## 352	0.00000e+00	NA	NA	NA	4
## 353	0.00000e+00	NA	NA	NA	4
## 354	0.00000e+00	NA	NA	NA	4
## 355	0.00000e+00	NA	NA	NA	4
## 356	0.00000e+00	NA	NA	NA	4
## 357	0.00000e+00	NA	NA	NA	4
## 358	0.00000e+00	NA	NA	NA	4
## 359	0.00000e+00	NA	NA	NA	4
## 360	1.24297e-05	NA	NA	NA	4
## 361	0.00000e+00	NA	NA	NA	5
## 362	0.00000e+00	NA	NA	NA	5
## 363	0.00000e+00	NA	NA	NA	5
## 364	0.00000e+00	NA	NA	NA	5
## 365	0.00000e+00	NA	NA	NA	5
## 366	0.00000e+00	NA	NA	NA	5
## 367	0.00000e+00	NA	NA	NA	5
## 368	0.00000e+00	NA	NA	NA	5
## 369	0.00000e+00	NA	NA	NA	5
## 370	0.00000e+00	NA	NA	NA	5
## 371	0.00000e+00	NA	NA	NA	5
## 372	0.00000e+00	NA	NA	NA	5
## 373	0.00000e+00	NA	NA	NA	5
## 374	0.00000e+00	NA	NA	NA	5
## 375	0.00000e+00	NA	NA	NA	5
## 376	0.00000e+00	NA	NA	NA	5
## 377	0.00000e+00	NA	NA	NA	5
## 378	0.00000e+00	NA	NA	NA	5
## 379	0.00000e+00	NA	NA	NA	5
## 380	0.00000e+00	NA	NA	NA	5
## 381	0.00000e+00	NA	NA	NA	5
## 382	0.00000e+00	NA	NA	NA	5
## 383	0.00000e+00	NA	NA	NA	5
## 384	0.00000e+00	NA	NA	NA	5
## 385	0.00000e+00	NA	NA	NA	5
## 386	0.00000e+00	NA	NA	NA	5
## 387	0.00000e+00	NA	NA	NA	5
## 388	0.00000e+00	NA	NA	NA	5
## 389	0.00000e+00	NA	NA	NA	5
## 390	0.00000e+00	NA	NA	NA	5
## 391	0.00000e+00	NA	NA	NA	5
## 392	0.00000e+00	NA	NA	NA	5
## 393	0.00000e+00	NA	NA	NA	5
## 394	0.00000e+00	NA	NA	NA	5
## 395	0.00000e+00	NA	NA	NA	5
## 396	0.00000e+00	NA	NA	NA	5
## 397	0.00000e+00	NA	NA	NA	5
## 398	0.00000e+00	NA	NA	NA	5

## 399	0.00000e+00	NA	NA	NA	5
## 400	4.41852e-06	NA	NA	NA	5
## 401	3.51875e-05	NA	NA	NA	1
## 402	7.32537e-04	NA	NA	NA	1
## 403	1.50067e-03	NA	NA	NA	1
## 404	2.48335e-04	NA	NA	NA	1
## 405	1.55770e-03	NA	NA	NA	1
## 406	2.33510e-03	NA	NA	NA	1
## 407	6.78029e-04	NA	NA	NA	1
## 408	2.33976e-03	NA	NA	NA	1
## 409	1.59426e-03	NA	NA	NA	1
## 410	1.04963e-02	NA	NA	NA	1
## 411	9.44115e-04	NA	NA	NA	1
## 412	3.03438e+08	NA	NA	NA	1
## 413	9.35844e+02	NA	NA	NA	1
## 414	8.40771e-04	NA	NA	NA	1
## 415	1.88906e-02	NA	NA	NA	1
## 416	1.55121e-04	NA	NA	NA	1
## 417	8.97511e-04	NA	NA	NA	1
## 418	1.12146e-02	NA	NA	NA	1
## 419	8.38483e-05	NA	NA	NA	1
## 420	1.99505e-03	NA	NA	NA	1
## 421	0.00000e+00	NA	NA	NA	1
## 422	2.30973e+06	NA	NA	NA	1
## 423	1.92153e+07	NA	NA	NA	1
## 424	4.62912e+07	NA	NA	NA	1
## 425	7.18175e+07	NA	NA	NA	1
## 426	9.61479e+07	NA	NA	NA	1
## 427	1.20376e+08	NA	NA	NA	1
## 428	1.44230e+08	NA	NA	NA	1
## 429	1.67619e+08	NA	NA	NA	1
## 430	1.90663e+08	NA	NA	NA	1
## 431	2.13459e+08	NA	NA	NA	1
## 432	2.35935e+08	NA	NA	NA	1
## 433	2.57935e+08	NA	NA	NA	1
## 434	2.79540e+08	NA	NA	NA	1
## 435	3.00886e+08	NA	NA	NA	1
## 436	3.22018e+08	NA	NA	NA	1
## 437	3.42994e+08	NA	NA	NA	1
## 438	3.63771e+08	NA	NA	NA	1
## 439	3.84238e+08	NA	NA	NA	1
## 440	1.42714e-05	NA	NA	NA	1
## 441	6.63803e-04	NA	NA	NA	2
## 442	2.65543e-04	NA	NA	NA	2
## 443	3.70739e+03	NA	NA	NA	2
## 444	2.42705e-04	NA	NA	NA	2
## 445	4.25484e-05	NA	NA	NA	2
## 446	1.62047e-03	NA	NA	NA	2
## 447	5.62336e-05	NA	NA	NA	2
## 448	3.91219e-04	NA	NA	NA	2
## 449	2.46668e-03	NA	NA	NA	2
## 450	2.04393e-03	NA	NA	NA	2
## 451	3.40428e-05	NA	NA	NA	2
## 452	1.05929e-02	NA	NA	NA	2

## 453	9.47640e+02	NA	NA	NA	2
## 454	6.25731e-04	NA	NA	NA	2
## 455	2.48333e-03	NA	NA	NA	2
## 456	9.27629e-04	NA	NA	NA	2
## 457	2.91766e-03	NA	NA	NA	2
## 458	9.28104e+00	NA	NA	NA	2
## 459	9.54443e+03	NA	NA	NA	2
## 460	0.00000e+00	NA	NA	NA	2
## 461	2.32805e+06	NA	NA	NA	2
## 462	1.93688e+07	NA	NA	NA	2
## 463	4.65594e+07	NA	NA	NA	2
## 464	7.21777e+07	NA	NA	NA	2
## 465	9.65399e+07	NA	NA	NA	2
## 466	1.20692e+08	NA	NA	NA	2
## 467	1.44338e+08	NA	NA	NA	2
## 468	1.67432e+08	NA	NA	NA	2
## 469	1.90105e+08	NA	NA	NA	2
## 470	2.12406e+08	NA	NA	NA	2
## 471	2.34377e+08	NA	NA	NA	2
## 472	2.56087e+08	NA	NA	NA	2
## 473	2.77533e+08	NA	NA	NA	2
## 474	2.98644e+08	NA	NA	NA	2
## 475	3.19364e+08	NA	NA	NA	2
## 476	3.39800e+08	NA	NA	NA	2
## 477	3.59982e+08	NA	NA	NA	2
## 478	3.79963e+08	NA	NA	NA	2
## 479	3.99666e+08	NA	NA	NA	2
## 480	2.63704e-05	NA	NA	NA	2
## 481	3.01663e+05	NA	NA	NA	3
## 482	1.70363e-04	NA	NA	NA	3
## 483	2.99736e-03	NA	NA	NA	3
## 484	5.49936e-03	NA	NA	NA	3
## 485	5.71475e-02	NA	NA	NA	3
## 486	2.15146e-04	NA	NA	NA	3
## 487	2.08557e+02	NA	NA	NA	3
## 488	2.58166e-04	NA	NA	NA	3
## 489	1.62908e-03	NA	NA	NA	3
## 490	2.61524e-03	NA	NA	NA	3
## 491	4.65438e-03	NA	NA	NA	3
## 492	2.99315e-03	NA	NA	NA	3
## 493	8.25899e+03	NA	NA	NA	3
## 494	1.24862e-01	NA	NA	NA	3
## 495	1.08702e-03	NA	NA	NA	3
## 496	7.20711e-04	NA	NA	NA	3
## 497	2.32572e-03	NA	NA	NA	3
## 498	5.45000e-02	NA	NA	NA	3
## 499	5.46252e+08	NA	NA	NA	3
## 500	6.22064e+07	NA	NA	NA	3
## 501	3.50027e+02	NA	NA	NA	3
## 502	5.21253e+04	NA	NA	NA	3
## 503	3.75368e+04	NA	NA	NA	3
## 504	0.00000e+00	NA	NA	NA	3
## 505	2.15522e+06	NA	NA	NA	3
## 506	1.79446e+07	NA	NA	NA	3

## 507	4.31151e+07	NA	NA	NA	3
## 508	6.66894e+07	NA	NA	NA	3
## 509	8.91290e+07	NA	NA	NA	3
## 510	1.11666e+08	NA	NA	NA	3
## 511	1.34083e+08	NA	NA	NA	3
## 512	1.56250e+08	NA	NA	NA	3
## 513	1.78194e+08	NA	NA	NA	3
## 514	1.99965e+08	NA	NA	NA	3
## 515	2.21513e+08	NA	NA	NA	3
## 516	2.42731e+08	NA	NA	NA	3
## 517	2.63506e+08	NA	NA	NA	3
## 518	2.83938e+08	NA	NA	NA	3
## 519	3.04261e+08	NA	NA	NA	3
## 520	1.74323e-05	NA	NA	NA	3
## 521	7.05961e-06	NA	NA	NA	4
## 522	3.44611e-04	NA	NA	NA	4
## 523	4.18824e-04	NA	NA	NA	4
## 524	1.07765e-04	NA	NA	NA	4
## 525	5.46045e+02	NA	NA	NA	4
## 526	4.15933e-04	NA	NA	NA	4
## 527	1.30794e-03	NA	NA	NA	4
## 528	4.77132e+03	NA	NA	NA	4
## 529	4.83328e-04	NA	NA	NA	4
## 530	9.86230e-04	NA	NA	NA	4
## 531	2.61167e-03	NA	NA	NA	4
## 532	1.26658e-03	NA	NA	NA	4
## 533	3.17360e+06	NA	NA	NA	4
## 534	6.74680e-03	NA	NA	NA	4
## 535	6.90679e+01	NA	NA	NA	4
## 536	2.03711e-03	NA	NA	NA	4
## 537	9.59565e-04	NA	NA	NA	4
## 538	8.51280e-03	NA	NA	NA	4
## 539	5.68040e-04	NA	NA	NA	4
## 540	4.73238e-03	NA	NA	NA	4
## 541	9.87378e-03	NA	NA	NA	4
## 542	2.49321e+02	NA	NA	NA	4
## 543	7.98767e+07	NA	NA	NA	4
## 544	0.00000e+00	NA	NA	NA	4
## 545	2.15367e+06	NA	NA	NA	4
## 546	1.79461e+07	NA	NA	NA	4
## 547	4.33122e+07	NA	NA	NA	4
## 548	6.74625e+07	NA	NA	NA	4
## 549	9.04962e+07	NA	NA	NA	4
## 550	1.13434e+08	NA	NA	NA	4
## 551	1.36052e+08	NA	NA	NA	4
## 552	1.58343e+08	NA	NA	NA	4
## 553	1.80415e+08	NA	NA	NA	4
## 554	2.02367e+08	NA	NA	NA	4
## 555	2.24094e+08	NA	NA	NA	4
## 556	2.45462e+08	NA	NA	NA	4
## 557	2.66444e+08	NA	NA	NA	4
## 558	2.87146e+08	NA	NA	NA	4
## 559	3.07566e+08	NA	NA	NA	4
## 560	1.24297e-05	NA	NA	NA	4

## 561	1.41786e-04	NA	NA	NA	5
## 562	3.90946e+05	NA	NA	NA	5
## 563	1.77005e-01	NA	NA	NA	5
## 564	7.63856e-04	NA	NA	NA	5
## 565	3.03886e-06	NA	NA	NA	5
## 566	3.71136e-04	NA	NA	NA	5
## 567	8.44806e-05	NA	NA	NA	5
## 568	2.28938e-04	NA	NA	NA	5
## 569	7.56060e+06	NA	NA	NA	5
## 570	1.10115e+03	NA	NA	NA	5
## 571	9.79950e+03	NA	NA	NA	5
## 572	9.14267e-04	NA	NA	NA	5
## 573	5.65138e+07	NA	NA	NA	5
## 574	6.14076e-03	NA	NA	NA	5
## 575	4.49883e-03	NA	NA	NA	5
## 576	4.40046e+06	NA	NA	NA	5
## 577	8.21108e+03	NA	NA	NA	5
## 578	5.24210e+07	NA	NA	NA	5
## 579	4.92918e-04	NA	NA	NA	5
## 580	6.01618e-04	NA	NA	NA	5
## 581	5.66825e-04	NA	NA	NA	5
## 582	6.23846e-04	NA	NA	NA	5
## 583	5.39538e-03	NA	NA	NA	5
## 584	9.18403e+02	NA	NA	NA	5
## 585	4.80711e+07	NA	NA	NA	5
## 586	2.62681e-03	NA	NA	NA	5
## 587	0.00000e+00	NA	NA	NA	5
## 588	2.08927e+06	NA	NA	NA	5
## 589	1.74680e+07	NA	NA	NA	5
## 590	4.21155e+07	NA	NA	NA	5
## 591	6.55381e+07	NA	NA	NA	5
## 592	8.80057e+07	NA	NA	NA	5
## 593	1.10357e+08	NA	NA	NA	5
## 594	1.32342e+08	NA	NA	NA	5
## 595	1.53985e+08	NA	NA	NA	5
## 596	1.75437e+08	NA	NA	NA	5
## 597	1.96707e+08	NA	NA	NA	5
## 598	2.17608e+08	NA	NA	NA	5
## 599	2.38096e+08	NA	NA	NA	5
## 600	4.41852e-06	NA	NA	NA	5
## 601	0.00000e+00	NA	NA	NA	1
## 602	6.93283e+06	NA	NA	NA	1
## 603	4.14124e+07	NA	NA	NA	1
## 604	8.06216e+07	NA	NA	NA	1
## 605	1.09136e+08	NA	NA	NA	1
## 606	1.32203e+08	NA	NA	NA	1
## 607	1.52505e+08	NA	NA	NA	1
## 608	1.70685e+08	NA	NA	NA	1
## 609	1.87292e+08	NA	NA	NA	1
## 610	2.02720e+08	NA	NA	NA	1
## 611	2.17301e+08	NA	NA	NA	1
## 612	2.31232e+08	NA	NA	NA	1
## 613	2.44620e+08	NA	NA	NA	1
## 614	2.57622e+08	NA	NA	NA	1

## 615	2.70355e+08	NA	NA	NA	1
## 616	2.82825e+08	NA	NA	NA	1
## 617	2.94967e+08	NA	NA	NA	1
## 618	3.06832e+08	NA	NA	NA	1
## 619	3.18503e+08	NA	NA	NA	1
## 620	3.30018e+08	NA	NA	NA	1
## 621	3.41438e+08	NA	NA	NA	1
## 622	3.52729e+08	NA	NA	NA	1
## 623	3.65017e+08	NA	NA	NA	1
## 624	3.79560e+08	NA	NA	NA	1
## 625	3.93901e+08	NA	NA	NA	1
## 626	4.08951e+08	NA	NA	NA	1
## 627	4.24391e+08	NA	NA	NA	1
## 628	4.39638e+08	NA	NA	NA	1
## 629	4.54658e+08	NA	NA	NA	1
## 630	4.70155e+08	NA	NA	NA	1
## 631	4.86000e+08	NA	NA	NA	1
## 632	5.01654e+08	NA	NA	NA	1
## 633	5.17701e+08	NA	NA	NA	1
## 634	5.33755e+08	NA	NA	NA	1
## 635	5.49632e+08	NA	NA	NA	1
## 636	5.65365e+08	NA	NA	NA	1
## 637	5.80995e+08	NA	NA	NA	1
## 638	5.96670e+08	NA	NA	NA	1
## 639	6.12729e+08	NA	NA	NA	1
## 640	1.42714e-05	NA	NA	NA	1
## 641	0.00000e+00	NA	NA	NA	2
## 642	6.93771e+06	NA	NA	NA	2
## 643	4.17762e+07	NA	NA	NA	2
## 644	8.16069e+07	NA	NA	NA	2
## 645	1.10411e+08	NA	NA	NA	2
## 646	1.33628e+08	NA	NA	NA	2
## 647	1.54049e+08	NA	NA	NA	2
## 648	1.72365e+08	NA	NA	NA	2
## 649	1.89180e+08	NA	NA	NA	2
## 650	2.04955e+08	NA	NA	NA	2
## 651	2.19924e+08	NA	NA	NA	2
## 652	2.34179e+08	NA	NA	NA	2
## 653	2.47834e+08	NA	NA	NA	2
## 654	2.61046e+08	NA	NA	NA	2
## 655	2.73889e+08	NA	NA	NA	2
## 656	2.86380e+08	NA	NA	NA	2
## 657	2.98590e+08	NA	NA	NA	2
## 658	3.10560e+08	NA	NA	NA	2
## 659	3.22285e+08	NA	NA	NA	2
## 660	3.33828e+08	NA	NA	NA	2
## 661	3.45219e+08	NA	NA	NA	2
## 662	3.56464e+08	NA	NA	NA	2
## 663	3.68475e+08	NA	NA	NA	2
## 664	3.82912e+08	NA	NA	NA	2
## 665	3.97186e+08	NA	NA	NA	2
## 666	4.12068e+08	NA	NA	NA	2
## 667	4.27261e+08	NA	NA	NA	2
## 668	4.42177e+08	NA	NA	NA	2

## 669	4.56865e+08	NA	NA	NA	2
## 670	4.71939e+08	NA	NA	NA	2
## 671	4.87343e+08	NA	NA	NA	2
## 672	5.02596e+08	NA	NA	NA	2
## 673	5.18235e+08	NA	NA	NA	2
## 674	5.34073e+08	NA	NA	NA	2
## 675	5.49626e+08	NA	NA	NA	2
## 676	5.64976e+08	NA	NA	NA	2
## 677	5.80142e+08	NA	NA	NA	2
## 678	5.95165e+08	NA	NA	NA	2
## 679	6.10633e+08	NA	NA	NA	2
## 680	2.63704e-05	NA	NA	NA	2
## 681	0.00000e+00	NA	NA	NA	3
## 682	6.93044e+06	NA	NA	NA	3
## 683	4.13496e+07	NA	NA	NA	3
## 684	8.03041e+07	NA	NA	NA	3
## 685	1.08513e+08	NA	NA	NA	3
## 686	1.31362e+08	NA	NA	NA	3
## 687	1.51515e+08	NA	NA	NA	3
## 688	1.69556e+08	NA	NA	NA	3
## 689	1.86167e+08	NA	NA	NA	3
## 690	2.01793e+08	NA	NA	NA	3
## 691	2.16564e+08	NA	NA	NA	3
## 692	2.30616e+08	NA	NA	NA	3
## 693	2.44078e+08	NA	NA	NA	3
## 694	2.57048e+08	NA	NA	NA	3
## 695	2.69643e+08	NA	NA	NA	3
## 696	2.81890e+08	NA	NA	NA	3
## 697	2.93777e+08	NA	NA	NA	3
## 698	3.05338e+08	NA	NA	NA	3
## 699	3.16666e+08	NA	NA	NA	3
## 700	3.27819e+08	NA	NA	NA	3
## 701	3.38793e+08	NA	NA	NA	3
## 702	3.49620e+08	NA	NA	NA	3
## 703	3.60845e+08	NA	NA	NA	3
## 704	3.74772e+08	NA	NA	NA	3
## 705	3.88540e+08	NA	NA	NA	3
## 706	4.02838e+08	NA	NA	NA	3
## 707	4.17501e+08	NA	NA	NA	3
## 708	4.31803e+08	NA	NA	NA	3
## 709	4.45909e+08	NA	NA	NA	3
## 710	4.60204e+08	NA	NA	NA	3
## 711	4.75306e+08	NA	NA	NA	3
## 712	4.90296e+08	NA	NA	NA	3
## 713	5.05362e+08	NA	NA	NA	3
## 714	5.21095e+08	NA	NA	NA	3
## 715	5.36687e+08	NA	NA	NA	3
## 716	5.52050e+08	NA	NA	NA	3
## 717	5.67088e+08	NA	NA	NA	3
## 718	5.81877e+08	NA	NA	NA	3
## 719	5.97023e+08	NA	NA	NA	3
## 720	1.74323e-05	NA	NA	NA	3
## 721	0.00000e+00	NA	NA	NA	4
## 722	6.94138e+06	NA	NA	NA	4

## 723	4.15900e+07	NA	NA	NA	4
## 724	8.09845e+07	NA	NA	NA	4
## 725	1.09431e+08	NA	NA	NA	4
## 726	1.32324e+08	NA	NA	NA	4
## 727	1.52449e+08	NA	NA	NA	4
## 728	1.70482e+08	NA	NA	NA	4
## 729	1.86913e+08	NA	NA	NA	4
## 730	2.02129e+08	NA	NA	NA	4
## 731	2.16448e+08	NA	NA	NA	4
## 732	2.30177e+08	NA	NA	NA	4
## 733	2.43518e+08	NA	NA	NA	4
## 734	2.56469e+08	NA	NA	NA	4
## 735	2.69041e+08	NA	NA	NA	4
## 736	2.81299e+08	NA	NA	NA	4
## 737	2.93244e+08	NA	NA	NA	4
## 738	3.04912e+08	NA	NA	NA	4
## 739	3.16318e+08	NA	NA	NA	4
## 740	3.27485e+08	NA	NA	NA	4
## 741	3.38470e+08	NA	NA	NA	4
## 742	3.49279e+08	NA	NA	NA	4
## 743	3.59953e+08	NA	NA	NA	4
## 744	3.73313e+08	NA	NA	NA	4
## 745	3.87099e+08	NA	NA	NA	4
## 746	4.00988e+08	NA	NA	NA	4
## 747	4.15780e+08	NA	NA	NA	4
## 748	4.30462e+08	NA	NA	NA	4
## 749	4.44972e+08	NA	NA	NA	4
## 750	4.59490e+08	NA	NA	NA	4
## 751	4.74740e+08	NA	NA	NA	4
## 752	4.89821e+08	NA	NA	NA	4
## 753	5.04952e+08	NA	NA	NA	4
## 754	5.20827e+08	NA	NA	NA	4
## 755	5.36559e+08	NA	NA	NA	4
## 756	5.52039e+08	NA	NA	NA	4
## 757	5.67240e+08	NA	NA	NA	4
## 758	5.82242e+08	NA	NA	NA	4
## 759	5.97528e+08	NA	NA	NA	4
## 760	1.24297e-05	NA	NA	NA	4
## 761	0.00000e+00	NA	NA	NA	5
## 762	6.93518e+06	NA	NA	NA	5
## 763	4.15144e+07	NA	NA	NA	5
## 764	8.08128e+07	NA	NA	NA	5
## 765	1.09250e+08	NA	NA	NA	5
## 766	1.32141e+08	NA	NA	NA	5
## 767	1.52172e+08	NA	NA	NA	5
## 768	1.70131e+08	NA	NA	NA	5
## 769	1.86690e+08	NA	NA	NA	5
## 770	2.02207e+08	NA	NA	NA	5
## 771	2.16857e+08	NA	NA	NA	5
## 772	2.30795e+08	NA	NA	NA	5
## 773	2.44146e+08	NA	NA	NA	5
## 774	2.56986e+08	NA	NA	NA	5
## 775	2.69378e+08	NA	NA	NA	5
## 776	2.81438e+08	NA	NA	NA	5

## 777	2.93127e+08	NA	NA	NA	5
## 778	3.04477e+08	NA	NA	NA	5
## 779	3.15572e+08	NA	NA	NA	5
## 780	3.26468e+08	NA	NA	NA	5
## 781	3.37154e+08	NA	NA	NA	5
## 782	3.47674e+08	NA	NA	NA	5
## 783	3.58102e+08	NA	NA	NA	5
## 784	3.70809e+08	NA	NA	NA	5
## 785	3.84306e+08	NA	NA	NA	5
## 786	3.97684e+08	NA	NA	NA	5
## 787	4.12279e+08	NA	NA	NA	5
## 788	4.26895e+08	NA	NA	NA	5
## 789	4.41408e+08	NA	NA	NA	5
## 790	4.55697e+08	NA	NA	NA	5
## 791	4.70845e+08	NA	NA	NA	5
## 792	4.85942e+08	NA	NA	NA	5
## 793	5.00935e+08	NA	NA	NA	5
## 794	5.16524e+08	NA	NA	NA	5
## 795	5.31906e+08	NA	NA	NA	5
## 796	5.47166e+08	NA	NA	NA	5
## 797	5.62308e+08	NA	NA	NA	5
## 798	5.77187e+08	NA	NA	NA	5
## 799	5.92029e+08	NA	NA	NA	5
## 800	4.41852e-06	NA	NA	NA	5
##	model_run			scenario	
## 1	constGrowSelfTest_EM_2020	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 2	constGrowSelfTest_EM_2021	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 3	constGrowSelfTest_EM_2022	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 4	constGrowSelfTest_EM_2023	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 5	constGrowSelfTest_EM_2024	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 6	constGrowSelfTest_EM_2025	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 7	constGrowSelfTest_EM_2026	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 8	constGrowSelfTest_EM_2027	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 9	constGrowSelfTest_EM_2028	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 10	constGrowSelfTest_EM_2029	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 11	constGrowSelfTest_EM_2030	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 12	constGrowSelfTest_EM_2031	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 13	constGrowSelfTest_EM_2032	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 14	constGrowSelfTest_EM_2033	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 15	constGrowSelfTest_EM_2034	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 16	constGrowSelfTest_EM_2035	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 17	constGrowSelfTest_EM_2036	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 18	constGrowSelfTest_EM_2037	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 19	constGrowSelfTest_EM_2038	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 20	constGrowSelfTest_EM_2039	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 21	constGrowSelfTest_EM_2040	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 22	constGrowSelfTest_EM_2041	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 23	constGrowSelfTest_EM_2042	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 24	constGrowSelfTest_EM_2043	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 25	constGrowSelfTest_EM_2044	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 26	constGrowSelfTest_EM_2045	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 27	constGrowSelfTest_EM_2046	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 28	constGrowSelfTest_EM_2047	fixedParams20010M_selfTestSD0.25_RandRecHCR2			
## 29	constGrowSelfTest_EM_2048	fixedParams20010M_selfTestSD0.25_RandRecHCR2			

[illegible]

[illegible]

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]


```
## 786 constGrowSelfTest_EM_2045 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 787 constGrowSelfTest_EM_2046 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 788 constGrowSelfTest_EM_2047 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 789 constGrowSelfTest_EM_2048 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 790 constGrowSelfTest_EM_2049 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 791 constGrowSelfTest_EM_2050 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 792 constGrowSelfTest_EM_2051 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 793 constGrowSelfTest_EM_2052 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 794 constGrowSelfTest_EM_2053 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 795 constGrowSelfTest_EM_2054 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 796 constGrowSelfTest_EM_2055 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 797 constGrowSelfTest_EM_2056 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 798 constGrowSelfTest_EM_2057 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 799 constGrowSelfTest_EM_2058 fixedParams20010M_selfTestSD0.25_RandRecHCR6
## 800 constGrowSelfTest_EM_init fixedParams20010M_selfTestSD0.25_RandRecHCR6
```

EM 2001 self test, recruitment at SD=0.25, perfect information, turning on params

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
```

```
scenarios <- c("fixedParams20010M_SD0.25_RandRecHCR0",
               "fixedParams20010M_SD0.25_RandRecHCR2")
```

```
smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)
```

```
## Rows: 560 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8820 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
smryOutputList$dqSmry$model_run <- sub("0.", "dot",
                                       smryOutputList$dqSmry$model_run, fixed = TRUE)
smryOutputList$sclSmry$model_run <- sub("0.", "dot",
                                       smryOutputList$sclSmry$model_run, fixed = TRUE)
smryOutputList$tsSmry$model_run <- sub("0.", "dot",
                                       smryOutputList$tsSmry$model_run, fixed = TRUE)
```

```
performanceList <- CalcPerformance(smryOutputList)
```

```
## 'summarise()' has grouped output by 'iteration'. You can override using the  
## '.groups' argument.  
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override  
## using the '.groups' argument.  
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You  
## can override using the '.groups' argument.  
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You  
## can override using the '.groups' argument.  
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can  
## override using the '.groups' argument.  
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override  
## using the '.groups' argument.
```

```
## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf
```

```
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override  
## using the '.groups' argument.
```

```
## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf
```

```
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override  
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics
```

```
# parse out HCR and recruitment scenario
```

```
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),  
                                   recScen = sub(pattern = "HCR.*", "", scenario)) %>%  
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))
```

```
hcrPal <- brewer.pal(10, "Set3")[-2]
```

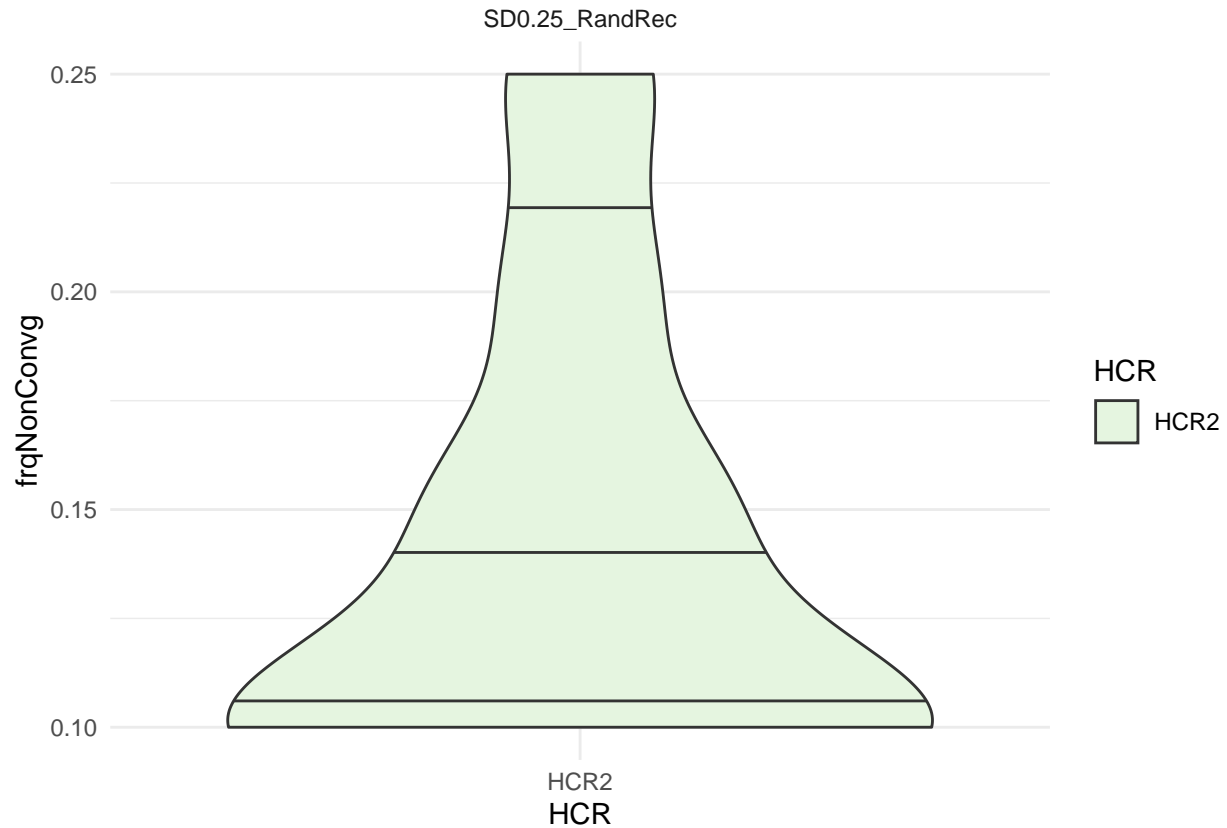
```
# plot convergence frequency
```

```
metricsTbl %>% filter(HCR != "HCRO") %>%  
  ggplot(aes(x = HCR, y = frqNonConv)) +  
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +  
  facet_wrap(~recScen) +  
  theme_minimal() +  
  scale_fill_brewer(palette = hcrPal)
```

```
## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and  
## only the first element will be used
```

```
## Warning in pal_name(palette, type): Unknown palette  
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```

```
## Warning: Removed 5 rows containing non-finite values (stat_ydensity).
```



```
# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

convrCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                    model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))

hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

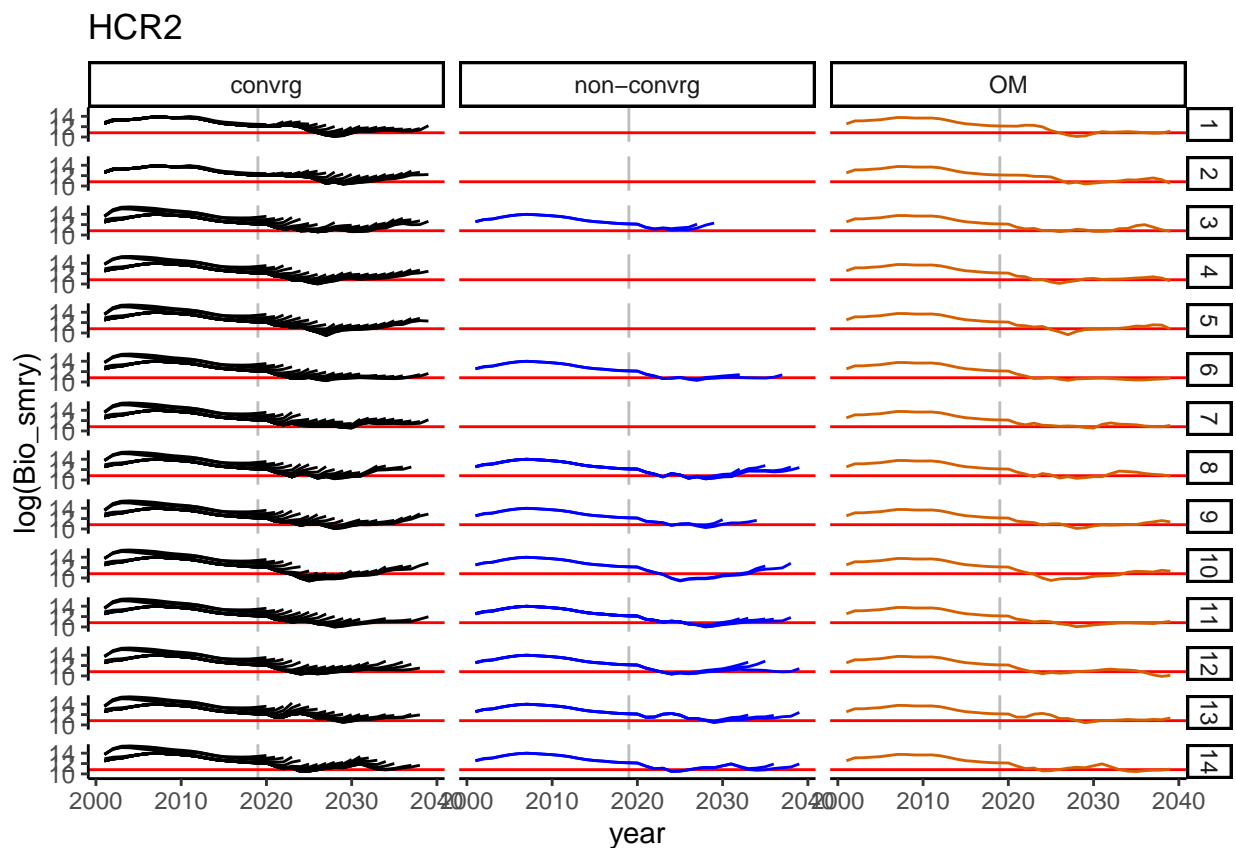
cnvrTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
```

```

                                recScen = sub(pattern = "HCR.*", "", scenario)) %>%
mutate(recScen = sub(pattern = ".*OM_", "", recScen)) %>%
left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
mutate(plotGroup = case_when(model_run == omName ~ "OM",
                              max_grad > 0.01 ~ "non-convrg",
                              max_grad < 0.01 ~ "convrg"))

for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```



```

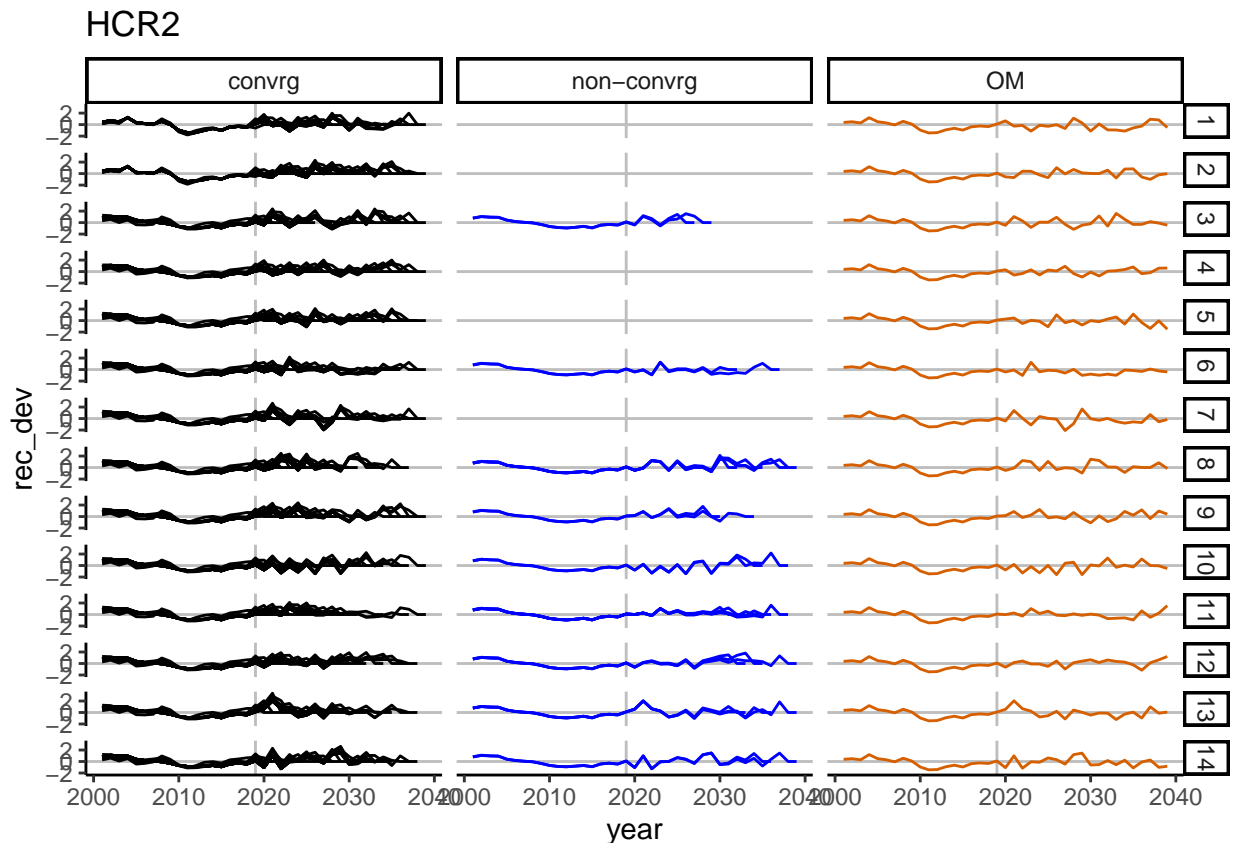
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +

```

```

ggplot2::geom_hline(yintercept = 0, color = "gray") +
ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
ggplot2::guides(linetype = "none") +
facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
ggplot2::theme_classic() + theme(legend.position="none") +
labs(title = hcrs[hcr]))
}

```



```

#termTS %>% filter(model_run == omName)

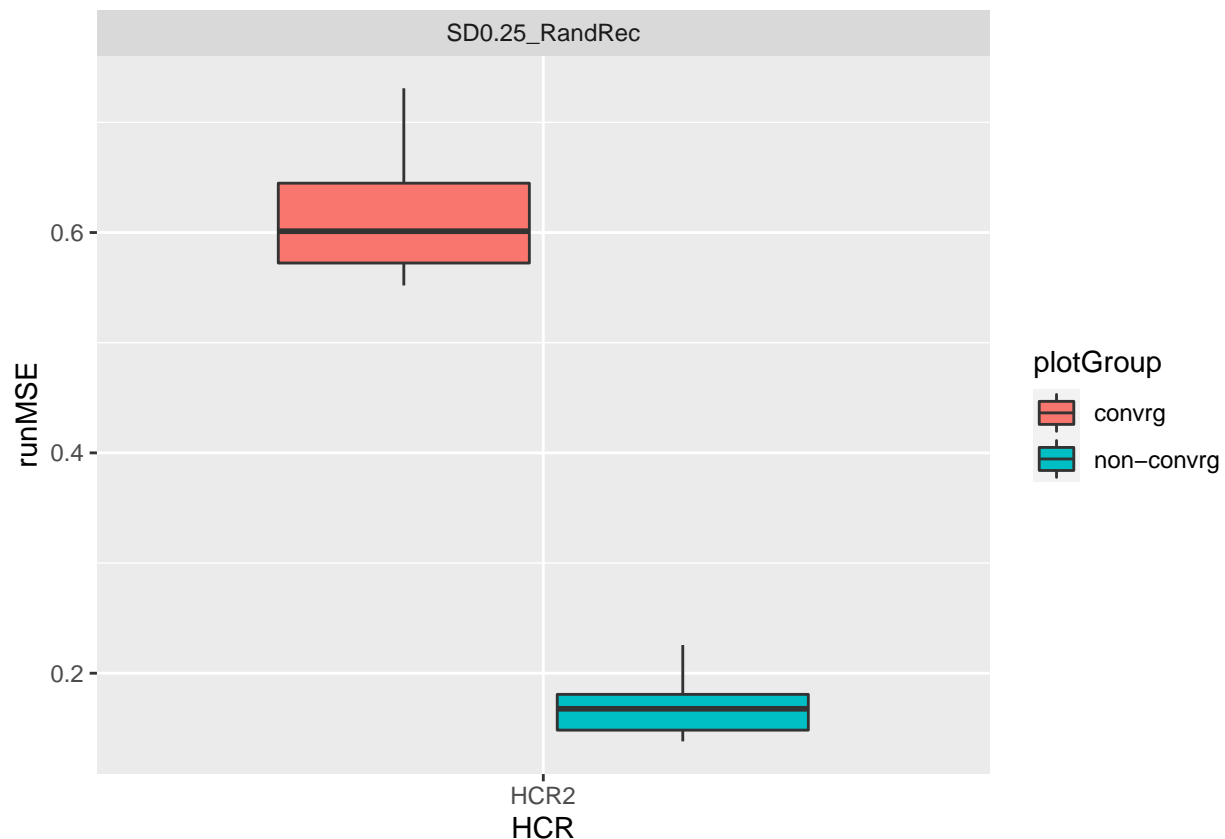
errCompare <- cnvrTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
inner_join(y = subset(termTS, model_run == omName),
           by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
         age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
         group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%

```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
      # group_by(scenario, HCR, recScen, plotGroup) %>%
      # summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
  ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



Look at parameter estimate time series

```
# Look at timeseries of B0 and account for non-convergence
B0s <- smryOutputList$sclSmry %>% mutate(emYear = as.numeric(regmatches(model_run,
  gregexpr("[:digit:]]+",
    model_run))),
  HCR = sub(pattern = ".*Rec", "", scenario),
  recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen),
    emYear = case_when(is.na(emYear) ~ 2019,
      TRUE ~ emYear),
    plotGroup = case_when(model_run == omName ~ "OM",
      max_grad > 0.01 ~ "non-convrg",
```

```

max_grad < 0.01 ~ "convrq")
meanB0s <- B0s %>% filter(max_grad < 0.01) %>%
  group_by(HCR, recScen, plotGroup) %>%
  summarize(meanB0est = mean(SSB_Unfished)) %>%
  mutate(pikitch0.4B0 = 0.4*meanB0est)

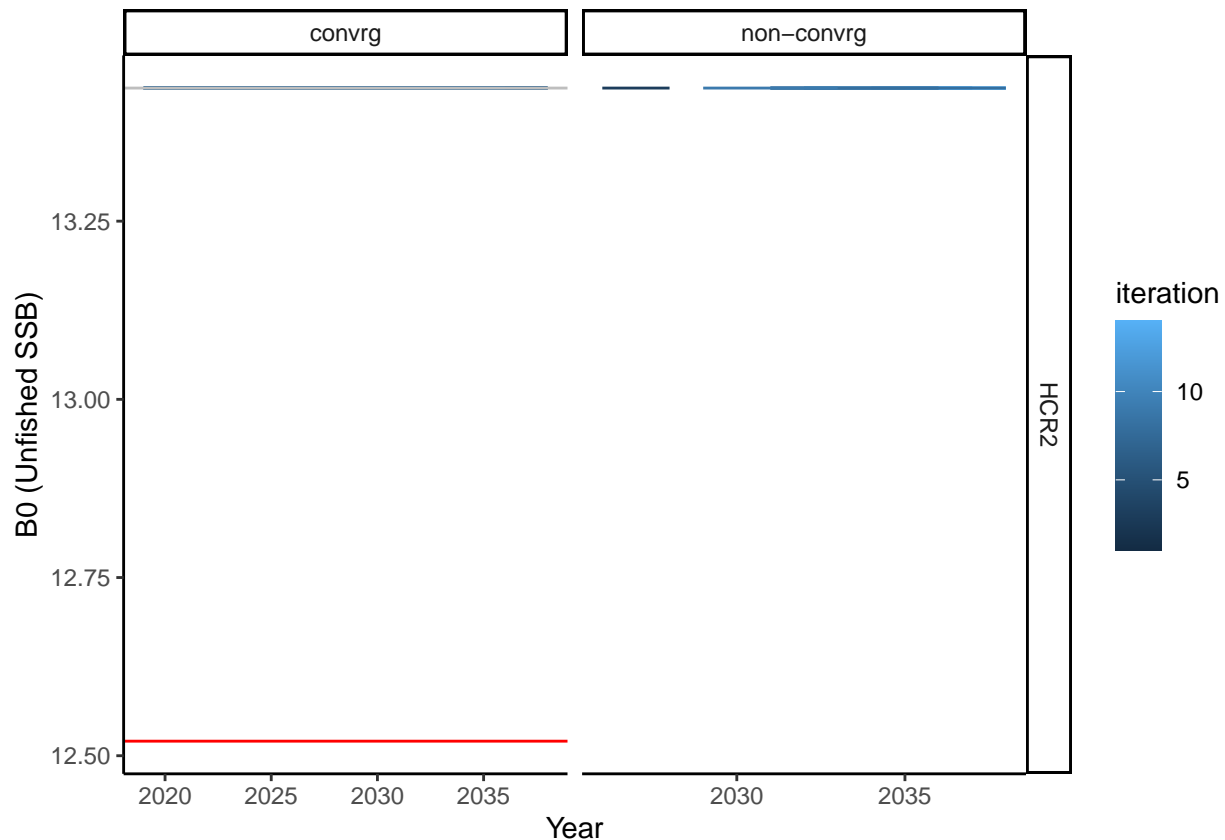
```

'summarise()' has grouped output by 'HCR', 'recScen'. You can override using
the '.groups' argument.

```

B0s %>% filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = log(SSB_Unfished))) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "B0 (Unfished SSB)") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(meanB0est)), color = "grey") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(pikitch0.4B0)), color = "red")

```



```

# Want to look at the other parameters
sclSmryAll <- NULL

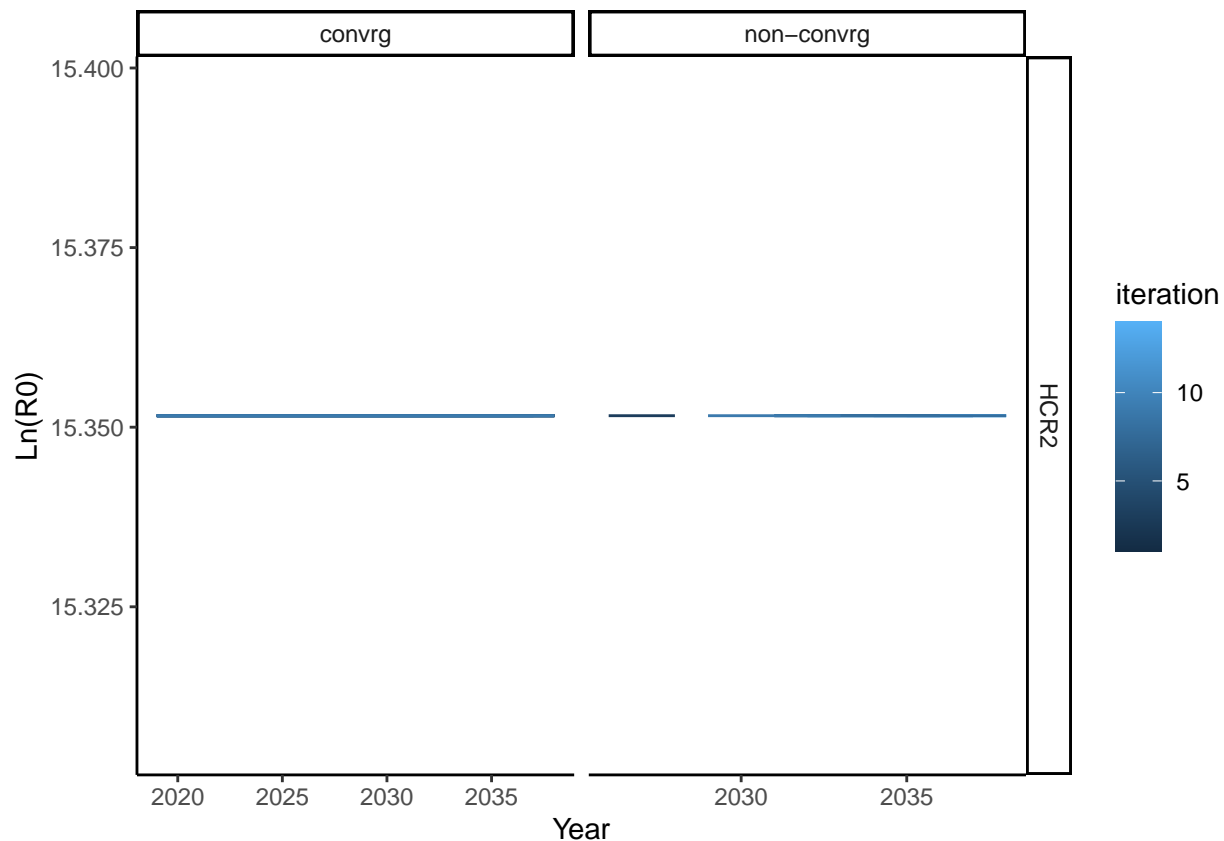
for(scn in 1:length(scenarios)){
  # read in SSMSE results summary scalars
  sclSumry <- read.csv(file.path(mseDir, scenarios[scn],
                                paste0("results_scalar_", scenarios[scn], ".csv")))
  # if(!"F_MSY" %in% names(sclSumry)){ # no catch scenarios don't have F_MSY
  #   sclSumry$F_MSY <- NA
  #   sclSumry$SSB_Unfished <- NA
  # }
  # sclSumry <- sclSumry[, c("F_MSY", "SmryBio_Unfished", "SSB_Unfished",
  #                          "max_grad", "model_run", "iteration", "scenario")]

  sclSmryAll <- bind_rows(sclSmryAll, sclSumry)
} # end 'scn' for-loop

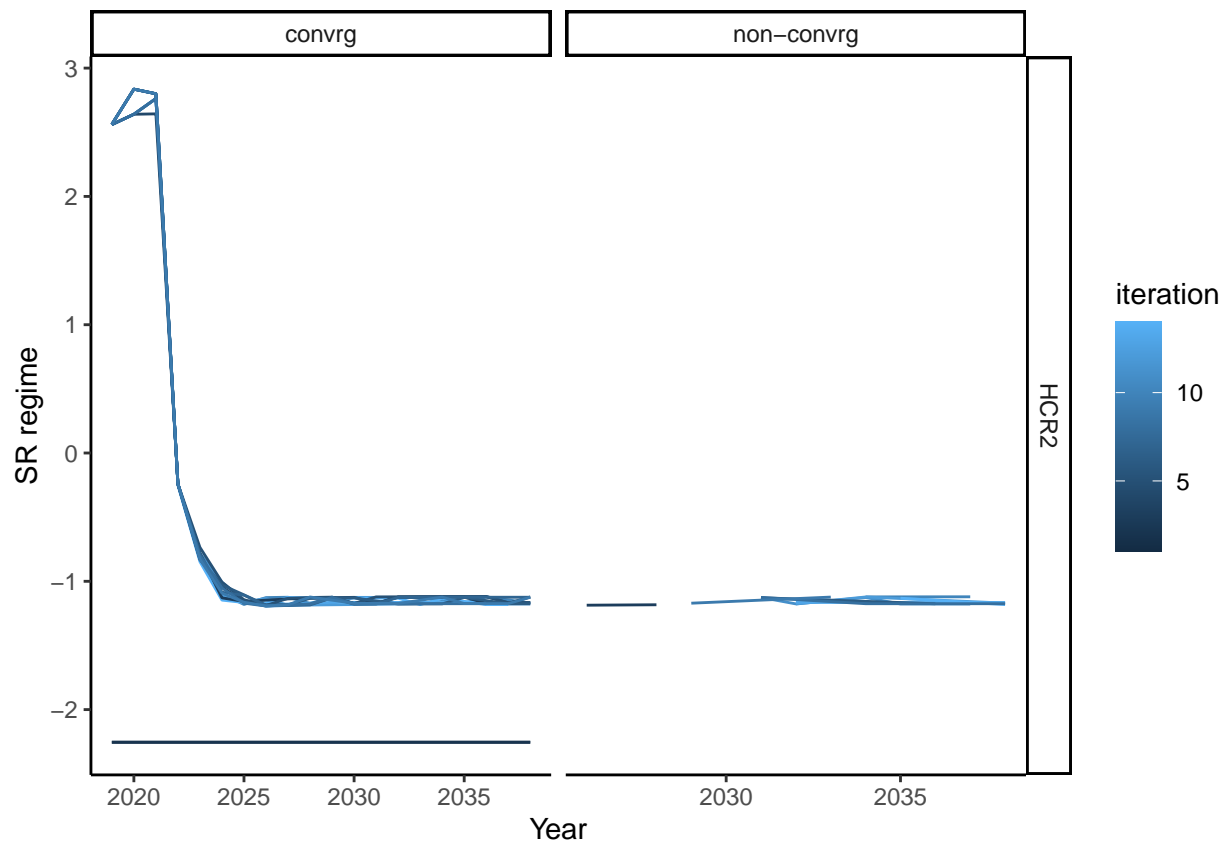
sclSmryAll$model_run <- sub("0.", "dot", sclSmryAll$model_run, fixed = TRUE)

sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                            model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "OM",
                                max_grad > 0.01 ~ "non-convrge",
                                max_grad < 0.01 ~ "convrge")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_LN_R0)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgeCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "Ln(R0)")

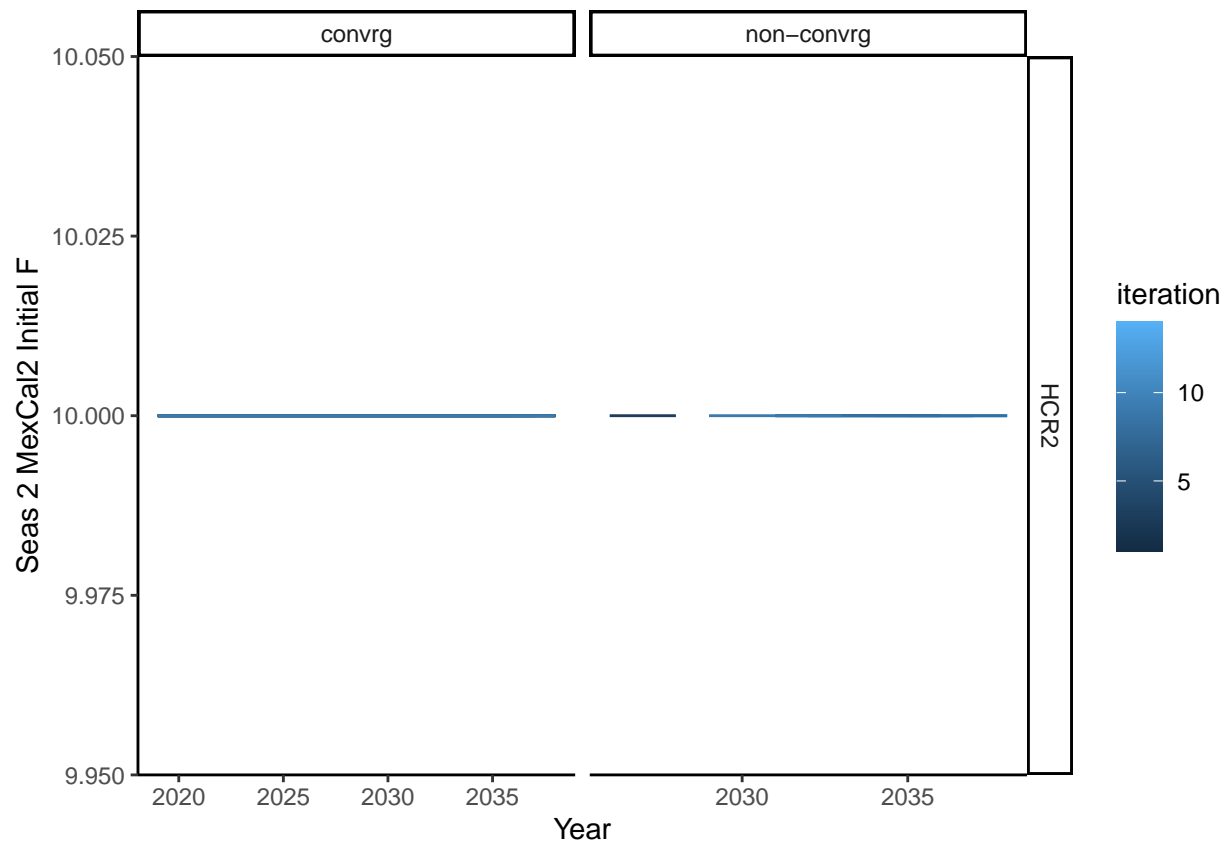
```

```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "OM",
                                max_grad > 0.01 ~ "non-convr",
                                max_grad < 0.01 ~ "convr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_regime_BLK1repl_2000)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrCheck, mapping = aes(x = emYear),
  #        sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "SR regime")
```



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[[:digit:]]+",
                                                    model_run))),
                    HCR = sub(pattern = ".*Rec","", scenario),
                    recScen = sub(pattern = "HCR.*","", scenario)) %>%
mutate(recScen = sub(pattern = ".*OM","", recScen),
       emYear = case_when(is.na(emYear) ~ 2019,
                           TRUE ~ emYear),
       plotGroup = case_when(model_run == omName ~ "OM",
                              max_grad > 0.01 ~ "non-convrg",
                              max_grad < 0.01 ~ "convrg")) %>%
filter(model_run != omName, HCR != "HCR0") %>%
ggplot(aes(x = emYear, y = InitF_seas_2_flt_2MexCal_S2)) +
geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
labs(x = "Year", y = "Seas 2 MexCal2 Initial F")
```



```
sclSmryAll %>% select(max_grad, params_on_bound, params_stuck_low, params_stuck_high,
                      iteration, model_run, scenario) %>%
  filter(model_run != omName)
```

##	max_grad	params_on_bound	params_stuck_low	params_stuck_high	iteration
## 1	9.56772e-07	NA	NA	NA	1
## 2	6.34989e-05	NA	NA	NA	1
## 3	1.05032e-04	NA	NA	NA	1
## 4	1.99223e-05	NA	NA	NA	1
## 5	5.01306e-04	NA	NA	NA	1
## 6	2.40559e-04	NA	NA	NA	1
## 7	3.41665e-04	NA	NA	NA	1
## 8	5.93691e-05	NA	NA	NA	1
## 9	3.66184e-04	NA	NA	NA	1
## 10	2.39465e-04	NA	NA	NA	1
## 11	1.10862e-03	NA	NA	NA	1
## 12	8.46268e-05	NA	NA	NA	1
## 13	2.99618e-03	NA	NA	NA	1
## 14	5.88330e-05	NA	NA	NA	1
## 15	5.78021e-04	NA	NA	NA	1
## 16	1.96925e-03	NA	NA	NA	1
## 17	3.46615e-04	NA	NA	NA	1
## 18	1.73869e-04	NA	NA	NA	1
## 19	1.87510e-03	NA	NA	NA	1
## 20	1.28745e-06	NA	NA	NA	1

## 21	1.60326e-06	NA	NA	NA	2
## 22	1.66983e-05	NA	NA	NA	2
## 23	5.86611e-06	NA	NA	NA	2
## 24	9.30307e-07	NA	NA	NA	2
## 25	4.61953e-05	NA	NA	NA	2
## 26	4.38391e-03	NA	NA	NA	2
## 27	2.69529e-04	NA	NA	NA	2
## 28	1.61117e-04	NA	NA	NA	2
## 29	7.15629e-04	NA	NA	NA	2
## 30	3.73344e-04	NA	NA	NA	2
## 31	2.10436e-04	NA	NA	NA	2
## 32	6.20982e-04	NA	NA	NA	2
## 33	9.76212e-03	NA	NA	NA	2
## 34	1.92640e-04	NA	NA	NA	2
## 35	5.11987e-05	NA	NA	NA	2
## 36	7.02226e-04	NA	NA	NA	2
## 37	1.71512e-03	NA	NA	NA	2
## 38	2.32314e-03	NA	NA	NA	2
## 39	3.01287e-03	NA	NA	NA	2
## 40	1.02154e-05	NA	NA	NA	2
## 41	6.72697e-06	NA	NA	NA	3
## 42	1.24906e-07	NA	NA	NA	3
## 43	1.65993e-04	NA	NA	NA	3
## 44	1.66512e-03	NA	NA	NA	3
## 45	8.38815e-05	NA	NA	NA	3
## 46	3.78575e-04	NA	NA	NA	3
## 47	1.02216e-02	NA	NA	NA	3
## 48	2.51010e-03	NA	NA	NA	3
## 49	1.11142e-02	NA	NA	NA	3
## 50	8.79135e-03	NA	NA	NA	3
## 51	3.45652e-03	NA	NA	NA	3
## 52	1.31016e-03	NA	NA	NA	3
## 53	1.58089e-03	NA	NA	NA	3
## 54	3.25393e-03	NA	NA	NA	3
## 55	1.33677e-03	NA	NA	NA	3
## 56	1.53883e-03	NA	NA	NA	3
## 57	1.75128e-03	NA	NA	NA	3
## 58	3.92109e-04	NA	NA	NA	3
## 59	5.99855e-04	NA	NA	NA	3
## 60	1.49450e-06	NA	NA	NA	3
## 61	5.23708e-05	NA	NA	NA	4
## 62	2.14713e-04	NA	NA	NA	4
## 63	3.77354e-05	NA	NA	NA	4
## 64	1.09780e-04	NA	NA	NA	4
## 65	3.11779e-05	NA	NA	NA	4
## 66	1.28563e-03	NA	NA	NA	4
## 67	3.44870e-04	NA	NA	NA	4
## 68	2.31162e-03	NA	NA	NA	4
## 69	4.47387e-05	NA	NA	NA	4
## 70	5.01810e-03	NA	NA	NA	4
## 71	1.44258e-03	NA	NA	NA	4
## 72	2.45524e-03	NA	NA	NA	4
## 73	5.96085e-04	NA	NA	NA	4
## 74	3.27848e-05	NA	NA	NA	4

## 75	9.90994e-03	NA	NA	NA	4
## 76	2.94916e-03	NA	NA	NA	4
## 77	5.30051e-03	NA	NA	NA	4
## 78	6.24474e-03	NA	NA	NA	4
## 79	1.74976e-04	NA	NA	NA	4
## 80	3.79175e-06	NA	NA	NA	4
## 81	4.92478e-06	NA	NA	NA	5
## 82	5.77956e-06	NA	NA	NA	5
## 83	3.40545e-04	NA	NA	NA	5
## 84	1.59818e-04	NA	NA	NA	5
## 85	4.27566e-04	NA	NA	NA	5
## 86	1.79070e-04	NA	NA	NA	5
## 87	8.13324e-04	NA	NA	NA	5
## 88	6.61612e-03	NA	NA	NA	5
## 89	5.25557e-04	NA	NA	NA	5
## 90	4.88097e-03	NA	NA	NA	5
## 91	3.00125e-04	NA	NA	NA	5
## 92	6.05458e-03	NA	NA	NA	5
## 93	1.70805e-04	NA	NA	NA	5
## 94	7.57376e-03	NA	NA	NA	5
## 95	6.83757e-03	NA	NA	NA	5
## 96	3.35351e-04	NA	NA	NA	5
## 97	3.12128e-03	NA	NA	NA	5
## 98	6.80346e-03	NA	NA	NA	5
## 99	3.85135e-03	NA	NA	NA	5
## 100	1.49450e-06	NA	NA	NA	5
## 101	3.14358e-05	NA	NA	NA	6
## 102	4.30454e-05	NA	NA	NA	6
## 103	5.20047e-05	NA	NA	NA	6
## 104	4.33202e-04	NA	NA	NA	6
## 105	8.26567e-04	NA	NA	NA	6
## 106	6.37190e-04	NA	NA	NA	6
## 107	2.59787e-03	NA	NA	NA	6
## 108	1.88408e-03	NA	NA	NA	6
## 109	5.86753e-03	NA	NA	NA	6
## 110	6.67661e-04	NA	NA	NA	6
## 111	9.55385e-03	NA	NA	NA	6
## 112	1.16093e-02	NA	NA	NA	6
## 113	2.51501e-03	NA	NA	NA	6
## 114	5.45155e-03	NA	NA	NA	6
## 115	1.87342e-04	NA	NA	NA	6
## 116	5.82593e-03	NA	NA	NA	6
## 117	1.97583e-02	NA	NA	NA	6
## 118	5.87572e-03	NA	NA	NA	6
## 119	7.14397e-04	NA	NA	NA	6
## 120	3.79175e-06	NA	NA	NA	6
## 121	3.90521e-05	NA	NA	NA	7
## 122	1.51426e-05	NA	NA	NA	7
## 123	2.10822e-04	NA	NA	NA	7
## 124	7.06477e-04	NA	NA	NA	7
## 125	9.68181e-05	NA	NA	NA	7
## 126	1.84609e-03	NA	NA	NA	7
## 127	2.00014e-04	NA	NA	NA	7
## 128	1.75651e-03	NA	NA	NA	7

## 129	1.02353e-03	NA	NA	NA	7
## 130	9.47460e-04	NA	NA	NA	7
## 131	1.70879e-03	NA	NA	NA	7
## 132	7.64426e-03	NA	NA	NA	7
## 133	3.29010e-03	NA	NA	NA	7
## 134	7.67042e-04	NA	NA	NA	7
## 135	9.76499e-03	NA	NA	NA	7
## 136	5.99651e-04	NA	NA	NA	7
## 137	6.52814e-04	NA	NA	NA	7
## 138	2.88189e-03	NA	NA	NA	7
## 139	6.53792e-04	NA	NA	NA	7
## 140	1.49450e-06	NA	NA	NA	7
## 141	1.56842e-04	NA	NA	NA	8
## 142	3.50913e-05	NA	NA	NA	8
## 143	4.76979e-06	NA	NA	NA	8
## 144	1.39333e-03	NA	NA	NA	8
## 145	1.79969e-03	NA	NA	NA	8
## 146	1.22932e-03	NA	NA	NA	8
## 147	3.12680e-03	NA	NA	NA	8
## 148	8.61179e-04	NA	NA	NA	8
## 149	3.51396e-03	NA	NA	NA	8
## 150	4.46405e-04	NA	NA	NA	8
## 151	9.48071e-03	NA	NA	NA	8
## 152	1.37589e-02	NA	NA	NA	8
## 153	2.48043e-03	NA	NA	NA	8
## 154	4.45261e-03	NA	NA	NA	8
## 155	2.31876e-02	NA	NA	NA	8
## 156	1.07096e-03	NA	NA	NA	8
## 157	7.36674e-03	NA	NA	NA	8
## 158	1.14979e-02	NA	NA	NA	8
## 159	1.83725e-02	NA	NA	NA	8
## 160	3.79175e-06	NA	NA	NA	8
## 161	4.85809e-05	NA	NA	NA	9
## 162	3.09071e-06	NA	NA	NA	9
## 163	2.80887e-06	NA	NA	NA	9
## 164	1.47967e-03	NA	NA	NA	9
## 165	3.42987e-03	NA	NA	NA	9
## 166	1.03228e-04	NA	NA	NA	9
## 167	2.89807e-03	NA	NA	NA	9
## 168	1.18605e-03	NA	NA	NA	9
## 169	7.11226e-03	NA	NA	NA	9
## 170	1.05093e-02	NA	NA	NA	9
## 171	4.07319e-03	NA	NA	NA	9
## 172	7.06633e-03	NA	NA	NA	9
## 173	2.47969e-03	NA	NA	NA	9
## 174	3.44178e-02	NA	NA	NA	9
## 175	5.93829e-04	NA	NA	NA	9
## 176	2.55503e-03	NA	NA	NA	9
## 177	1.39148e-03	NA	NA	NA	9
## 178	9.10570e-04	NA	NA	NA	9
## 179	7.63541e-03	NA	NA	NA	9
## 180	1.49450e-06	NA	NA	NA	9
## 181	3.88089e-06	NA	NA	NA	10
## 182	2.08313e-04	NA	NA	NA	10

## 183	6.45311e-06	NA	NA	NA	10
## 184	1.49349e-03	NA	NA	NA	10
## 185	2.45887e-03	NA	NA	NA	10
## 186	2.66363e-03	NA	NA	NA	10
## 187	4.90046e-03	NA	NA	NA	10
## 188	5.14156e-04	NA	NA	NA	10
## 189	7.35420e-03	NA	NA	NA	10
## 190	2.98942e-03	NA	NA	NA	10
## 191	3.19425e-03	NA	NA	NA	10
## 192	9.06321e-03	NA	NA	NA	10
## 193	7.01177e-04	NA	NA	NA	10
## 194	1.12338e-03	NA	NA	NA	10
## 195	1.32924e-02	NA	NA	NA	10
## 196	2.78327e-03	NA	NA	NA	10
## 197	1.05516e-04	NA	NA	NA	10
## 198	1.02330e-02	NA	NA	NA	10
## 199	8.47520e-03	NA	NA	NA	10
## 200	3.79175e-06	NA	NA	NA	10
## 201	6.78545e-06	NA	NA	NA	11
## 202	6.95222e-05	NA	NA	NA	11
## 203	1.23601e-03	NA	NA	NA	11
## 204	8.05240e-06	NA	NA	NA	11
## 205	4.43733e-04	NA	NA	NA	11
## 206	2.50073e-05	NA	NA	NA	11
## 207	1.35125e-03	NA	NA	NA	11
## 208	3.57432e-04	NA	NA	NA	11
## 209	1.88048e-03	NA	NA	NA	11
## 210	7.99926e-04	NA	NA	NA	11
## 211	5.65931e-04	NA	NA	NA	11
## 212	1.34890e-02	NA	NA	NA	11
## 213	2.06161e-02	NA	NA	NA	11
## 214	4.01327e-03	NA	NA	NA	11
## 215	2.98917e-02	NA	NA	NA	11
## 216	1.78609e-02	NA	NA	NA	11
## 217	1.97779e-03	NA	NA	NA	11
## 218	1.07776e-02	NA	NA	NA	11
## 219	5.46895e-03	NA	NA	NA	11
## 220	1.49450e-06	NA	NA	NA	11
## 221	4.90967e-05	NA	NA	NA	12
## 222	1.08647e-06	NA	NA	NA	12
## 223	2.02630e-05	NA	NA	NA	12
## 224	2.45413e-04	NA	NA	NA	12
## 225	8.67476e-04	NA	NA	NA	12
## 226	2.52979e-03	NA	NA	NA	12
## 227	5.38513e-04	NA	NA	NA	12
## 228	2.77755e-04	NA	NA	NA	12
## 229	1.04813e-03	NA	NA	NA	12
## 230	1.49836e-03	NA	NA	NA	12
## 231	5.06986e-03	NA	NA	NA	12
## 232	1.72902e-03	NA	NA	NA	12
## 233	1.30131e-02	NA	NA	NA	12
## 234	1.83964e-03	NA	NA	NA	12
## 235	1.44057e-02	NA	NA	NA	12
## 236	7.18926e-04	NA	NA	NA	12

## 237	4.15006e-03	NA	NA	NA	12
## 238	6.56858e-03	NA	NA	NA	12
## 239	2.52328e-02	NA	NA	NA	12
## 240	3.79175e-06	NA	NA	NA	12
## 241	7.07245e-06	NA	NA	NA	13
## 242	1.29535e-04	NA	NA	NA	13
## 243	3.79574e-04	NA	NA	NA	13
## 244	7.12904e-04	NA	NA	NA	13
## 245	1.49414e-04	NA	NA	NA	13
## 246	1.66673e-03	NA	NA	NA	13
## 247	8.99758e-04	NA	NA	NA	13
## 248	9.31349e-05	NA	NA	NA	13
## 249	8.08293e-03	NA	NA	NA	13
## 250	1.49844e-03	NA	NA	NA	13
## 251	5.27288e-03	NA	NA	NA	13
## 252	5.63830e-03	NA	NA	NA	13
## 253	1.65810e-02	NA	NA	NA	13
## 254	5.23643e-03	NA	NA	NA	13
## 255	3.91333e-03	NA	NA	NA	13
## 256	1.86210e-02	NA	NA	NA	13
## 257	3.19330e-03	NA	NA	NA	13
## 258	8.67970e-03	NA	NA	NA	13
## 259	2.42794e-02	NA	NA	NA	13
## 260	1.49450e-06	NA	NA	NA	13
## 261	1.00231e-05	NA	NA	NA	14
## 262	4.45086e-04	NA	NA	NA	14
## 263	2.63329e-04	NA	NA	NA	14
## 264	6.81013e-05	NA	NA	NA	14
## 265	3.64562e-03	NA	NA	NA	14
## 266	1.80445e-03	NA	NA	NA	14
## 267	1.21250e-03	NA	NA	NA	14
## 268	2.03407e-03	NA	NA	NA	14
## 269	1.88903e-03	NA	NA	NA	14
## 270	5.95860e-03	NA	NA	NA	14
## 271	9.77595e-04	NA	NA	NA	14
## 272	3.94479e-03	NA	NA	NA	14
## 273	3.55476e-03	NA	NA	NA	14
## 274	9.48330e-03	NA	NA	NA	14
## 275	4.18160e-03	NA	NA	NA	14
## 276	1.72328e-02	NA	NA	NA	14
## 277	2.24808e-04	NA	NA	NA	14
## 278	1.29060e-03	NA	NA	NA	14
## 279	4.45262e-02	NA	NA	NA	14
## 280	3.79175e-06	NA	NA	NA	14
##	model_run			scenario	
## 1	constGrowSelfTest_EM_2020	fixedParams20010M_SD0.25_RandRechCR2			
## 2	constGrowSelfTest_EM_2021	fixedParams20010M_SD0.25_RandRechCR2			
## 3	constGrowSelfTest_EM_2022	fixedParams20010M_SD0.25_RandRechCR2			
## 4	constGrowSelfTest_EM_2023	fixedParams20010M_SD0.25_RandRechCR2			
## 5	constGrowSelfTest_EM_2024	fixedParams20010M_SD0.25_RandRechCR2			
## 6	constGrowSelfTest_EM_2025	fixedParams20010M_SD0.25_RandRechCR2			
## 7	constGrowSelfTest_EM_2026	fixedParams20010M_SD0.25_RandRechCR2			
## 8	constGrowSelfTest_EM_2027	fixedParams20010M_SD0.25_RandRechCR2			
## 9	constGrowSelfTest_EM_2028	fixedParams20010M_SD0.25_RandRechCR2			

[illegible]

[illegible]


```
## 280 constGrowSelfTest_EM_init fixedParams20010M_SD0.25_RandRecHCR2
```

EM 2001 self test, recruitment at $SD=0.5$, $h=0.6$, $N_{samp} = 100$

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"

scenarios <- c("constGrow20010M_MidSteepMidNsamp_RandRecHCR2",
              "constGrow20010M_MidSteepMidNsamp_RandRecHCREM")

smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)

## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

smryOutputList$dqSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                       smryOutputList$dqSmry$model_run, fixed = TRUE)
smryOutputList$sclSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                       smryOutputList$sclSmry$model_run, fixed = TRUE)
smryOutputList$tsSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                       smryOutputList$tsSmry$model_run, fixed = TRUE)

performanceList <- CalcPerformance(smryOutputList)

## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
```

```

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

metricsTbl <- performanceList$performanceMetrics

# parse out HCR and recruitment scenario
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                   recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen))

hcrPal <- brewer.pal(10, "Set3")[-2]

# plot convergence frequency
metricsTbl %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)

## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used

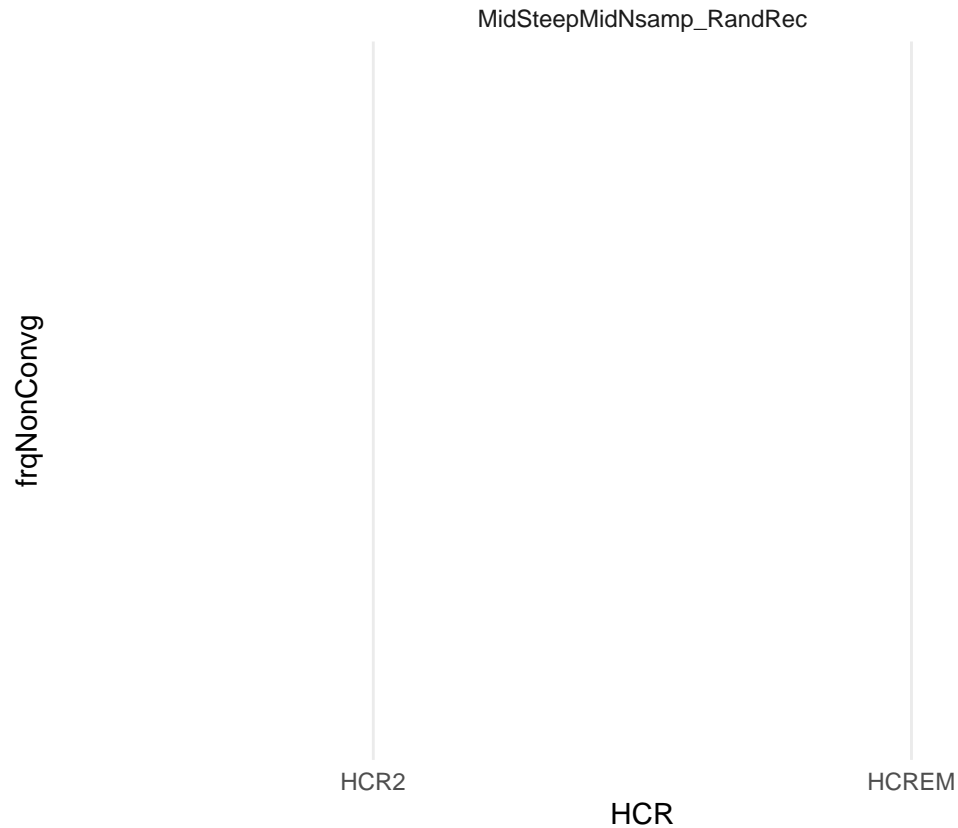
## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD

## Warning: Removed 6 rows containing non-finite values (stat_ydensity).

## Warning in max(data$density): no non-missing arguments to max; returning -Inf

## Warning: Computation failed in 'stat_ydensity()':
## replacement has 1 row, data has 0

```



```
# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM","", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

convrCheck <- smryOutputList$sc1Smry %>% #filter(!model_run %in% omName) %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                    model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM","", recScen))

hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

cnvrTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
```

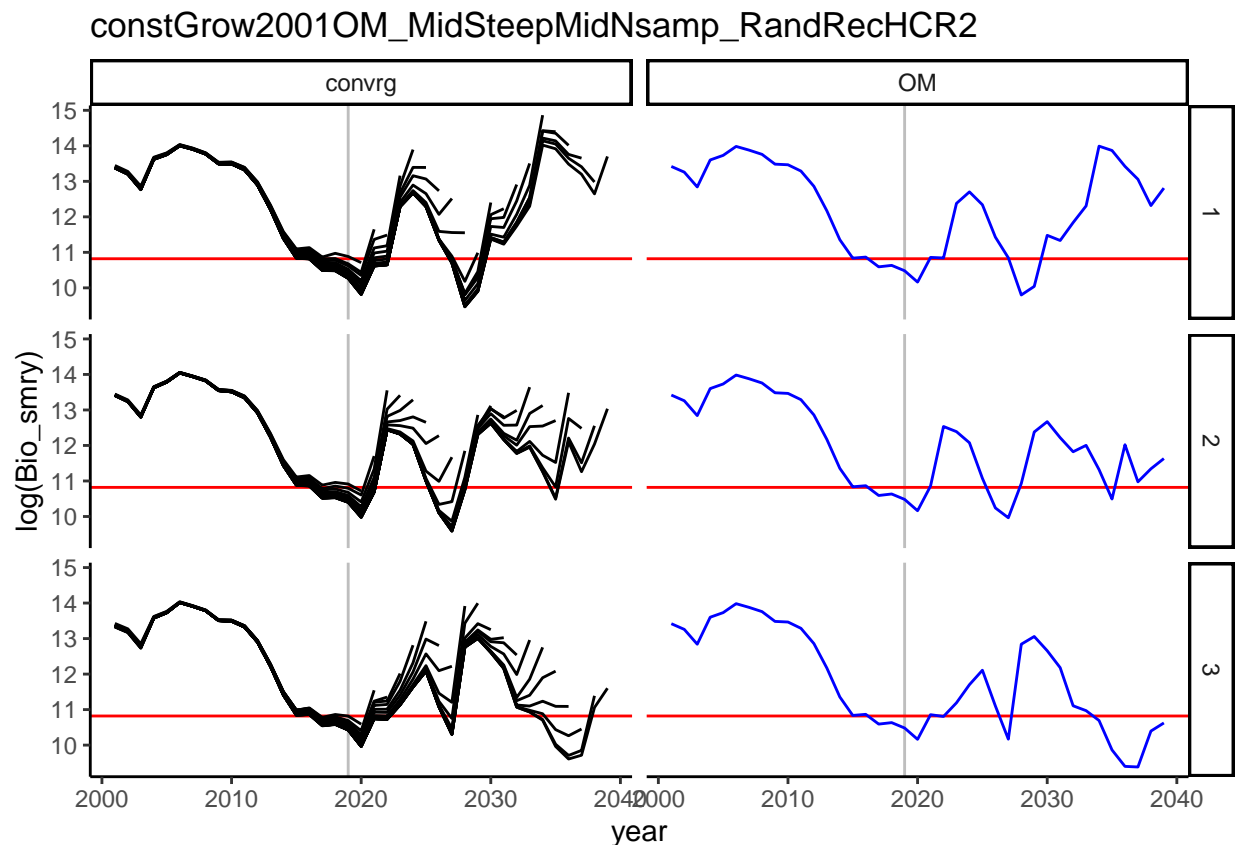


```

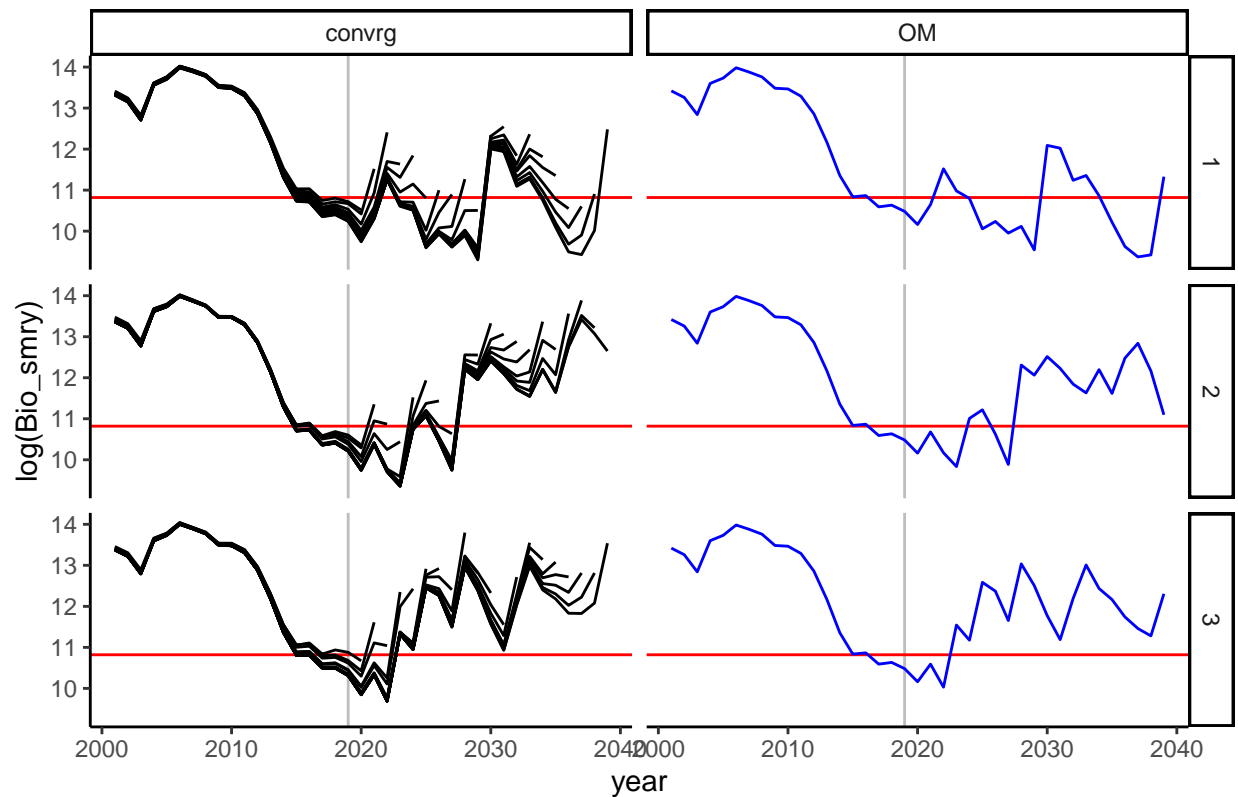
                                recScen = sub(pattern = "HCR.*", "", scenario)) %>%
mutate(recScen = sub(pattern = ".*OM_", "", recScen)) %>%
left_join(y = convrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
mutate(plotGroup = case_when(model_run == omName ~ "OM",
                              max_grad > 0.01 ~ "non-convrg",
                              max_grad < 0.01 ~ "convrg"))

for(mr in 1:length(scenarios)){
  print(cnvrgTS %>% filter(scenario == scenarios[mr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup)) +
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = scenarios[mr]))
}

```

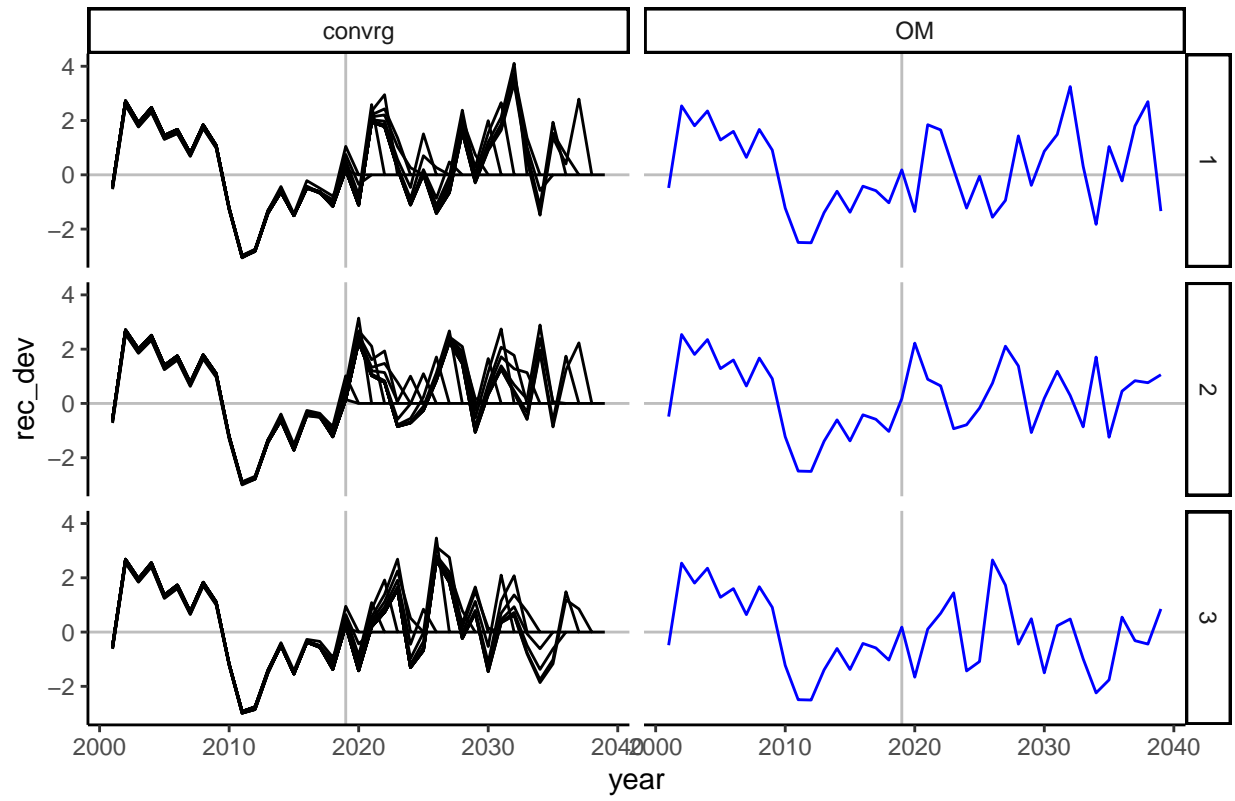


constGrow2001OM_MidSteepMidNsamp_RandRecHCREM

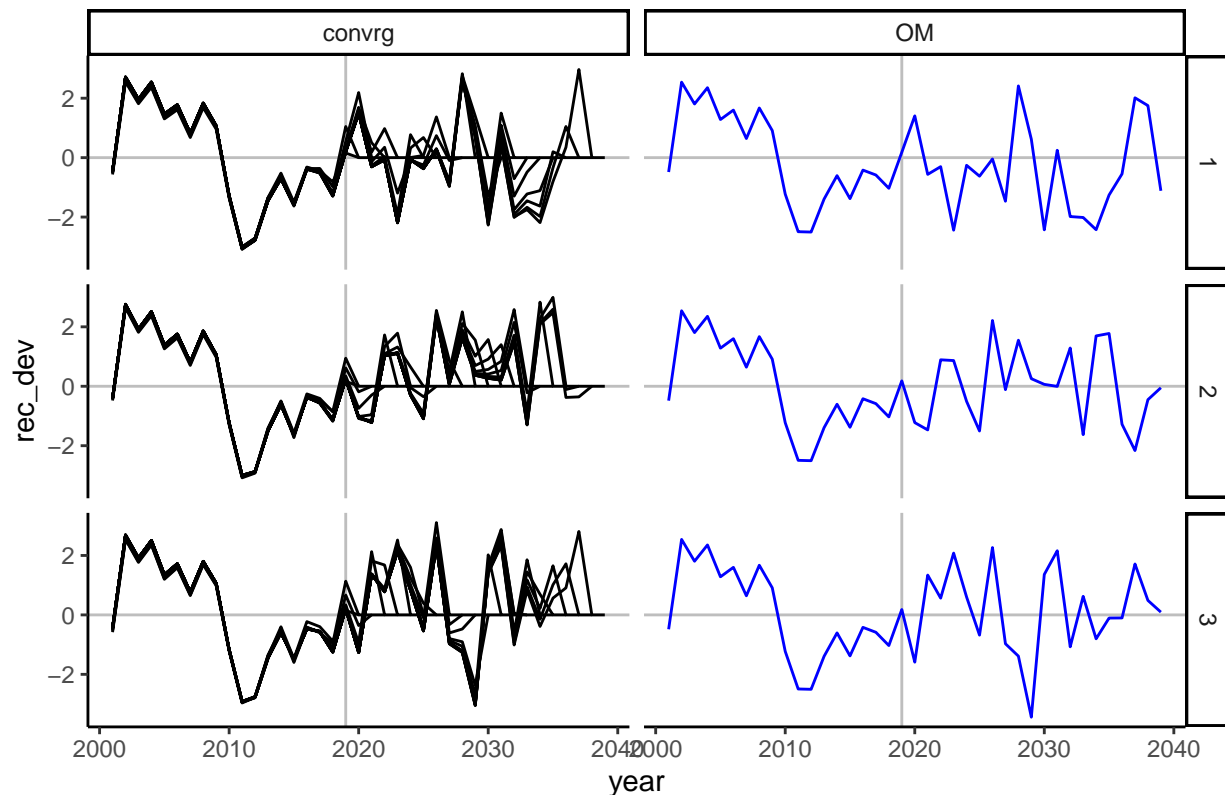


```
for(mr in 1:length(scenarios)){
  print(cnvrgTS %>% filter(scenario == scenarios[mr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = scenarios[mr]))
}
```

constGrow2001OM_MidSteepMidNsamp_RandRecHCR2



constGrow2001OM_MidSteepMidNsamp_RandRecHCREM



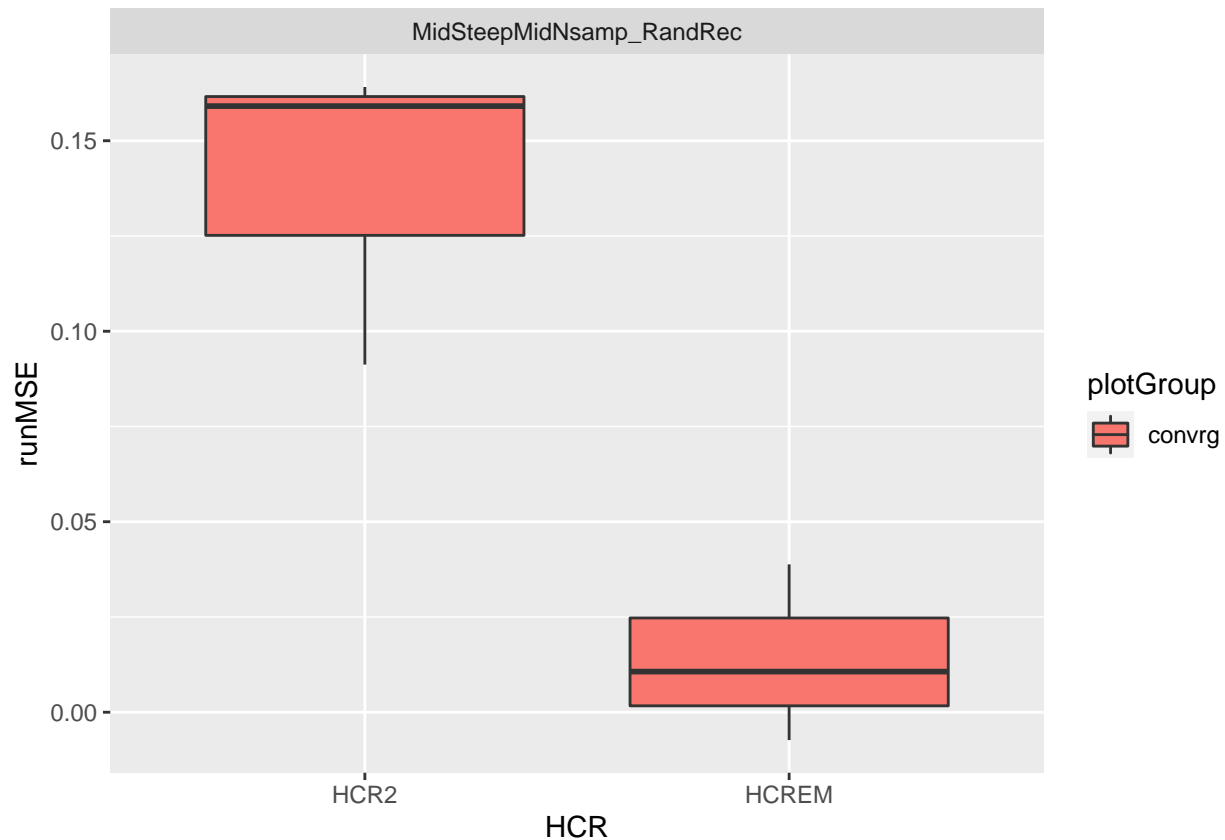
```
#termTS %>% filter(model_run == omName)

errCompare <- cnvrgTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR,
         recScen, emYear, plotGroup) %>%
  inner_join(y = subset(termTS, model_run == omName),
            by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
         age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x,
         iteration, scenario, HCR, recScen, plotGroup) %>%
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))
```

```
errCompare %>% #filter(HCR != "HCR3") %>%
  ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



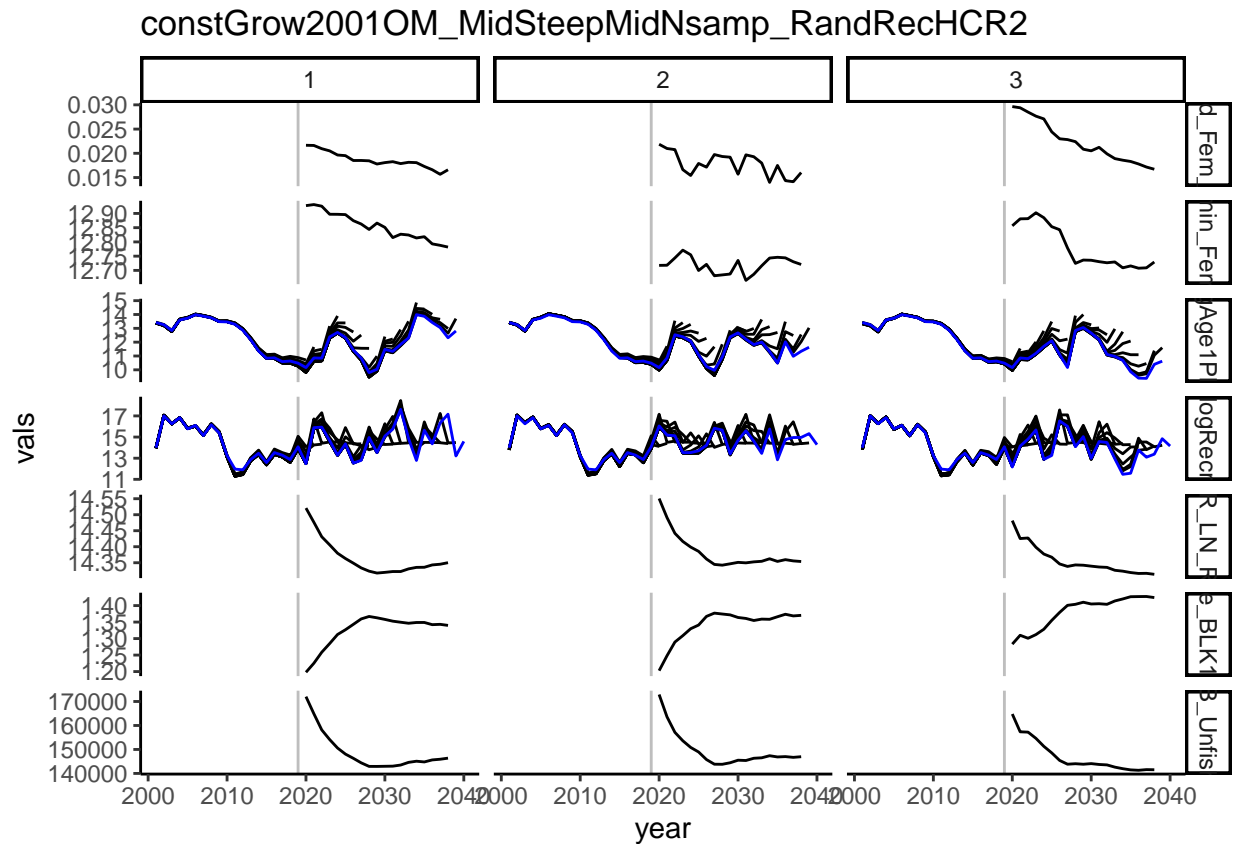
```
PlotEMAnnualEsts(dirSSMSE = mseDir, scenarios = scenarios,
  varCol = c("SSB_Unfished", #"NatM_uniform_Fem_GP_1",
    "L_at_Amin_Fem_GP_1", "SR_LN_R0",
    "SR_regime_BLK1repl_2000", "InitF_seas_2_flt_2MexCal_S2",
    "CV_old_Fem_GP_1"))
```

```
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
```

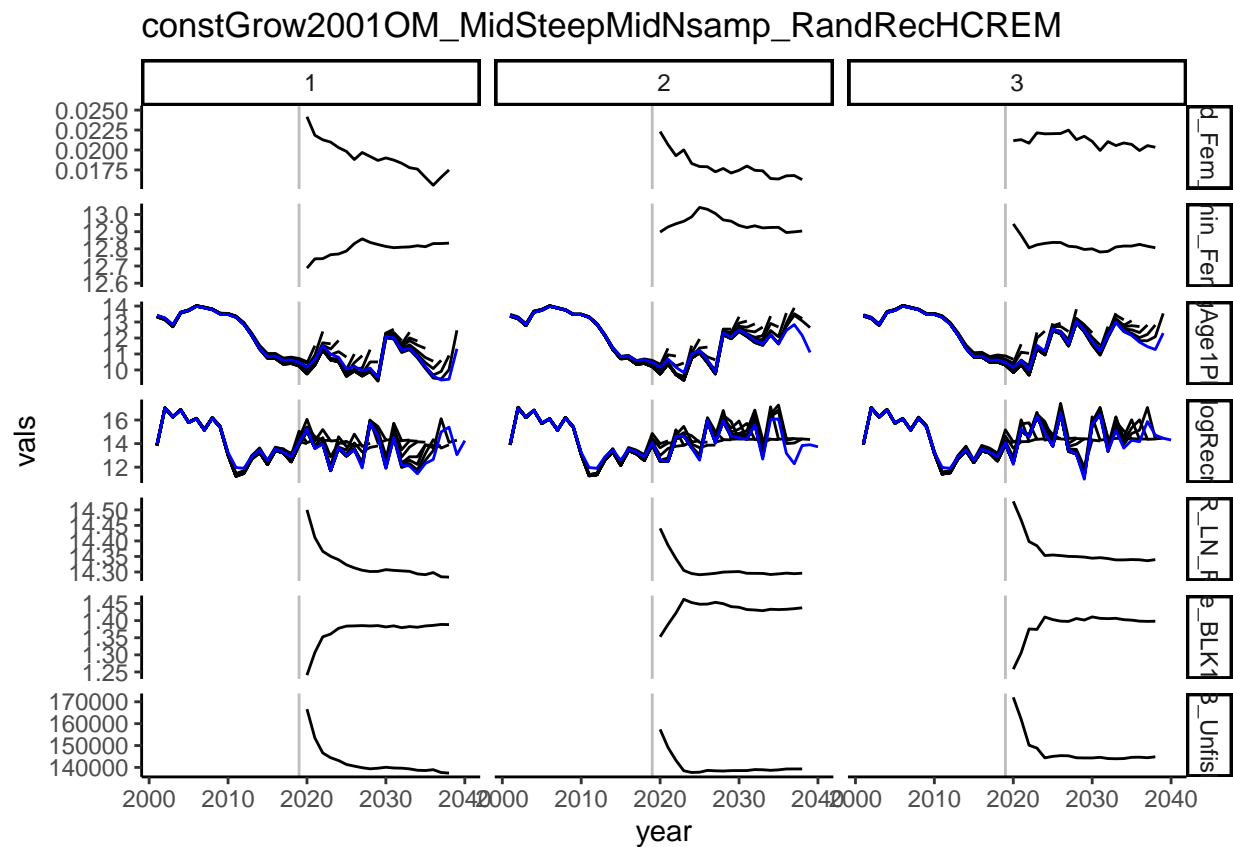
```
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

## Warning: Removed 30 row(s) containing missing values (geom_path).
```

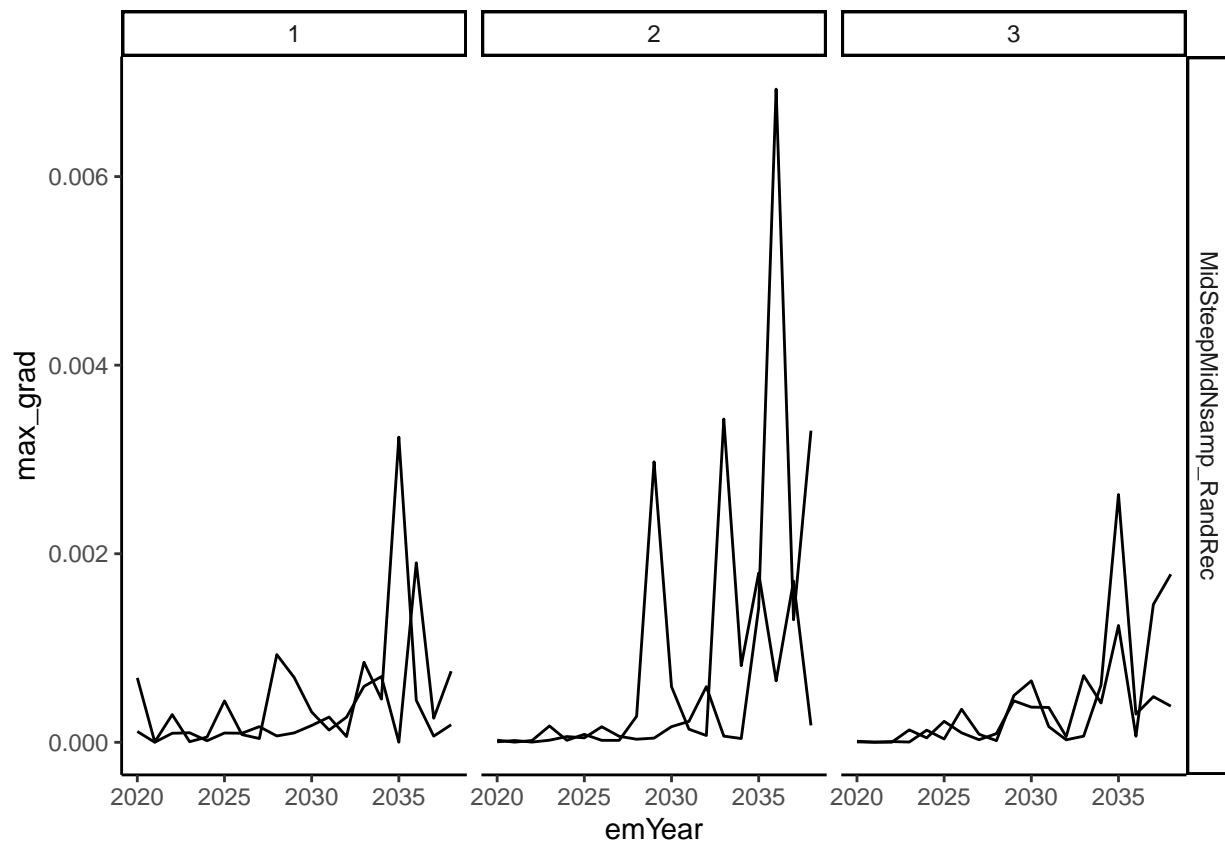


```
## Warning: Removed 30 row(s) containing missing values (geom_path).
```



```
convrgCheck %>%
  ggplot(aes(x = emYear, y = max_grad)) +
  geom_line(aes(linetype = scenario)) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(recScen), cols = vars(iteration), scales = "free") +
  theme_classic() + theme(legend.position="none")
```

Warning: Removed 4 row(s) containing missing values (geom_path).



```
# investigate non-converged models
# omOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfT
# fixedOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_se
# compFixed <- SSsummarize(list(OM = omOut, EM2032 = fixedOut))
# compFixed$pars$relErr <- round((compFixed$pars$EM2032 - compFixed$pars$OM)/compFixed$pars$OM, digits = 4)
# SSplotComparisons(compFixed)
# compFixed$pars
```

Take closer look at estimated derived and parameter values

```
# error of params
hcr2 <- read_csv(file = file.path(mseDir, scenarios[1], "results_scalar_constGrow20010M_MidSteepMidNsamp

## Rows: 63 Columns: 144
## -- Column specification -----
## Delimiter: ","
## chr   (3): version, model_run, scenario
## dbl (137): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (4): params_on_bound, params_stuck_low, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```



```
hcr2Fixed <- read_csv(file = file.path(mseDir, scenarios[2], "results_scalar_constGrow20010M_MidSteepMi~
```

```
## Rows: 63 Columns: 144
## -- Column specification -----
## Delimiter: ","
## chr   (3): version, model_run, scenario
## dbl (137): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (4): params_on_bound, params_stuck_low, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
sclHCR2 <- rbind(hcr2, hcr2Fixed)
unique(sclHCR2[, c("params_on_bound", "params_stuck_low", "params_stuck_high", "scenario")])
```

```
## # A tibble: 2 x 4
##   params_on_bound params_stuck_low params_stuck_high scenario
##   <lgl>           <lgl>           <lgl>           <chr>
## 1 NA             NA             NA             constGrow20010M_MidSteepMi~
## 2 NA             NA             NA             constGrow20010M_MidSteepMi~
```

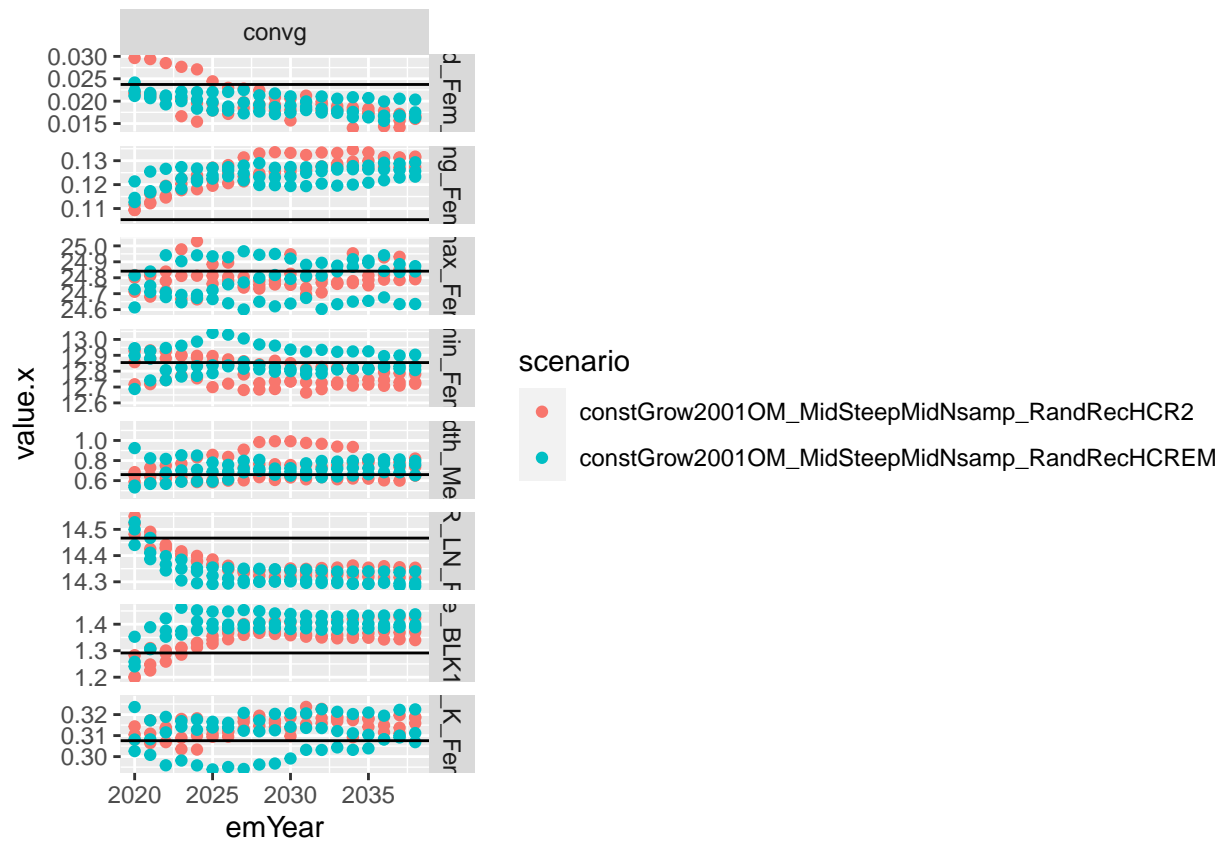
```
parCols <- c("CV_old_Fem_GP_1", "Size_95.width_MexCal_S1_1", "CV_young_Fem_GP_1",
             "VonBert_K_Fem_GP_1", "SR_regime_BLK1repl_2000", "L_at_Amax_Fem_GP_1",
             "L_at_Amin_Fem_GP_1", "SR_LN_R0")
focPars <- sclHCR2 %>% select(max_grad, parCols,
                             model_run, iteration, scenario) %>%
  pivot_longer(cols = parCols, names_to = "parameter", values_to = "value")
```

```
## Note: Using an external vector in selections is ambiguous.
## i Use 'all_of(parCols)' instead of 'parCols' to silence this message.
## i See <https://tidyselect.r-lib.org/reference/faq-external-vector.html>.
## This message is displayed once per session.
```

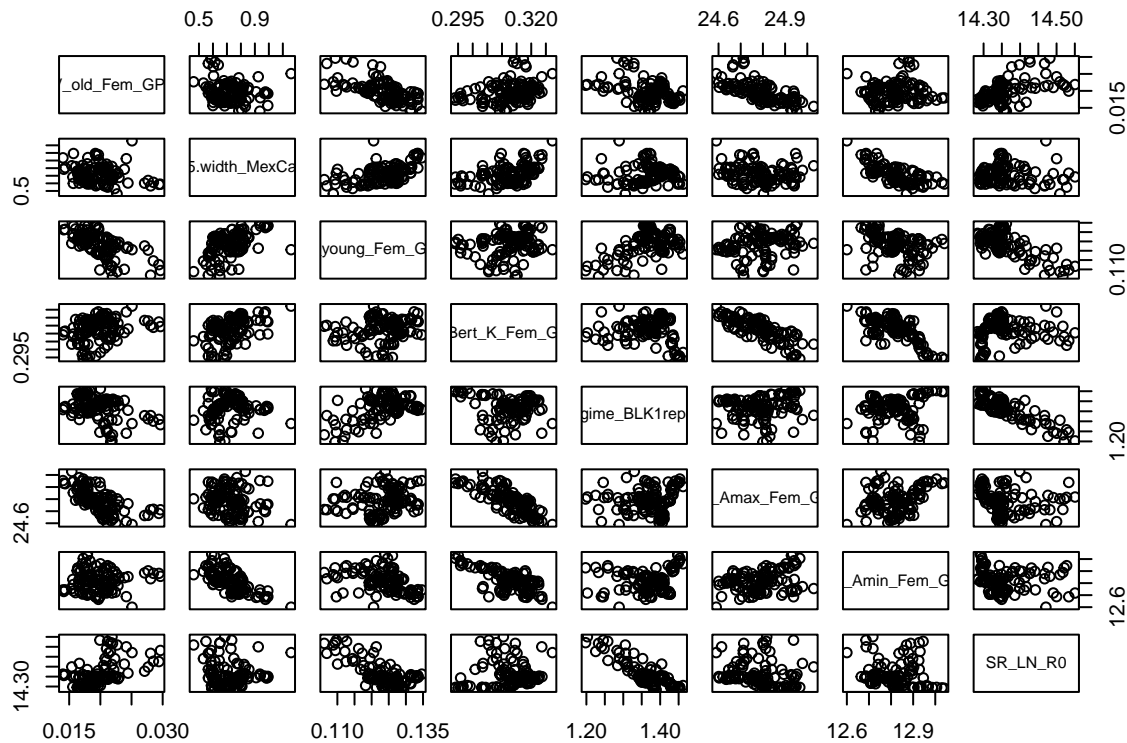
```
focParsOM <- focPars %>% filter(grepl("_OM", model_run, fixed = TRUE))
focPars <- focPars %>% filter(!grepl("_OM", model_run, fixed = TRUE)) %>%
  left_join(y = focParsOM, by = c("iteration", "scenario", "parameter")) %>%
  mutate(parRE = (value.x - value.y)/value.y * 100,
         emYear = as.numeric(regmatches(model_run.x,
                                         gregexpr("[:digit:]]+",
                                                    model_run.x))),
         convg = case_when(max_grad.x > 0.01 ~ "non-convg",
                           max_grad.x < 0.01 ~ "convg"))

focPars %>% ggplot(aes(x = emYear, y = value.x, color = scenario)) +
  #geom_line() +
  geom_point() +
  facet_grid(rows = vars(parameter), cols = vars(convg), scales = "free") +
  geom_hline(aes(yintercept = value.y))
```

```
## Warning: Removed 48 rows containing missing values (geom_point).
```



```
pairs(focPars %>% mutate(combo = paste(scenario, iteration, model_run.x, sep = "-")) %>%
  dcast(combo ~ parameter, value.var = "value.x") %>%
  select(unique(focPars$parameter)))
```



```
# error of summary biomass
simDat <- smryOutputList$obsCPUE %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                             model_run = sub(pattern = ".*[[:digit:]]+/", "", resDir),
                                             iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d")),
         plotGroup = "simData") %>%
  rename(Bio_smry = obs) %>%
  filter(!grepl("_OM", model_run, fixed = TRUE), index == 4, seas != 10) %>%
  select(year, Bio_smry, model_run, iteration, scenario, plotGroup)

age1PlusBio <- smryOutputList$tsSmry %>% filter(Seas == 1) %>%
  select(year, Bio_smry, model_run, iteration, scenario) %>%
  mutate(plotGroup = case_when(grepl("_OM", model_run, fixed = TRUE) ~ "OM",
                               TRUE ~ "EM"))

age1PlusRE <- age1PlusBio %>% filter(plotGroup != "OM")
age1PlusRE <- rbind(age1PlusRE, simDat)
age1PlusRE <- age1PlusRE %>% pivot_wider(names_from = "plotGroup", values_from = "Bio_smry") %>%
  left_join(y = convrgCheck,
            by = c("model_run", "iteration", "scenario")) %>%
  full_join(y = subset(age1PlusBio, subset = plotGroup == "OM",
                      by = c("iteration", "scenario", "year")) %>%
            mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                                       max_grad < 0.01 ~ "convrg",
                                       TRUE ~ "OM"),
```

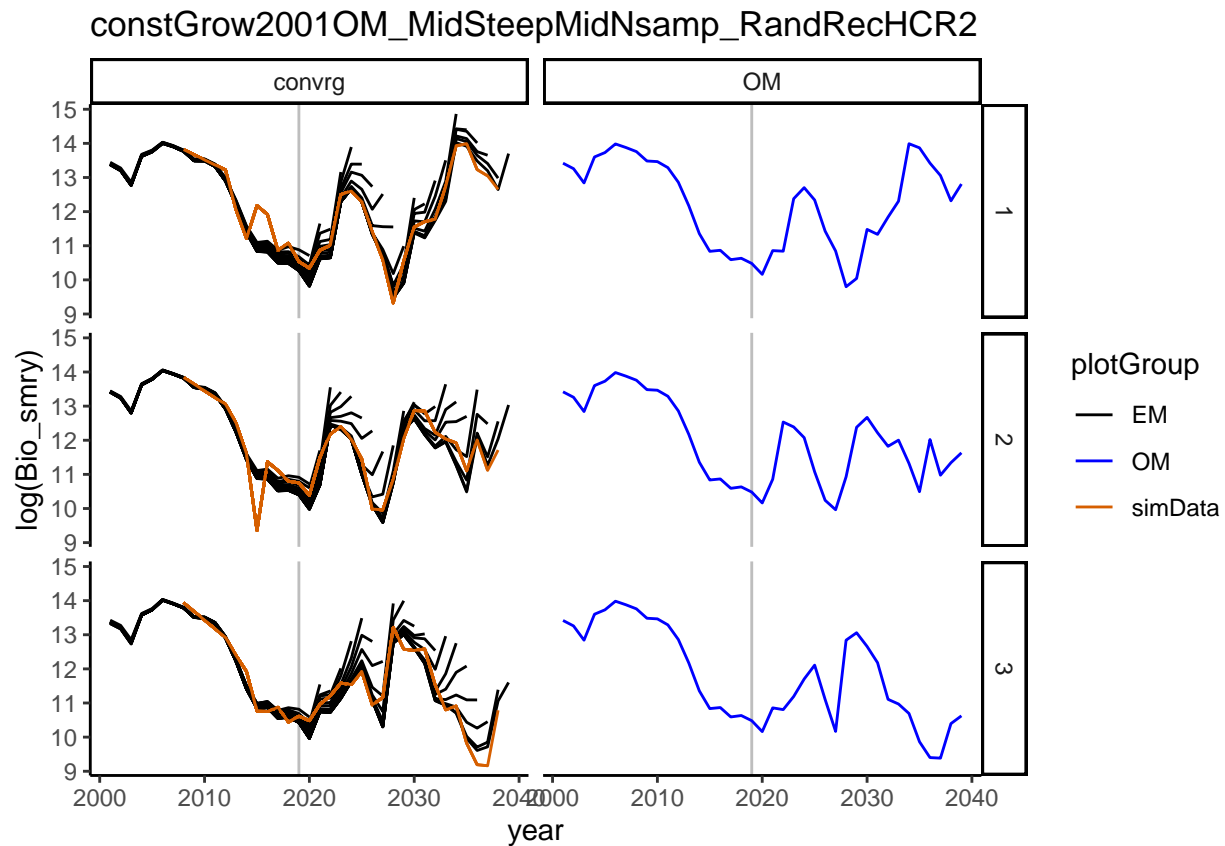
```

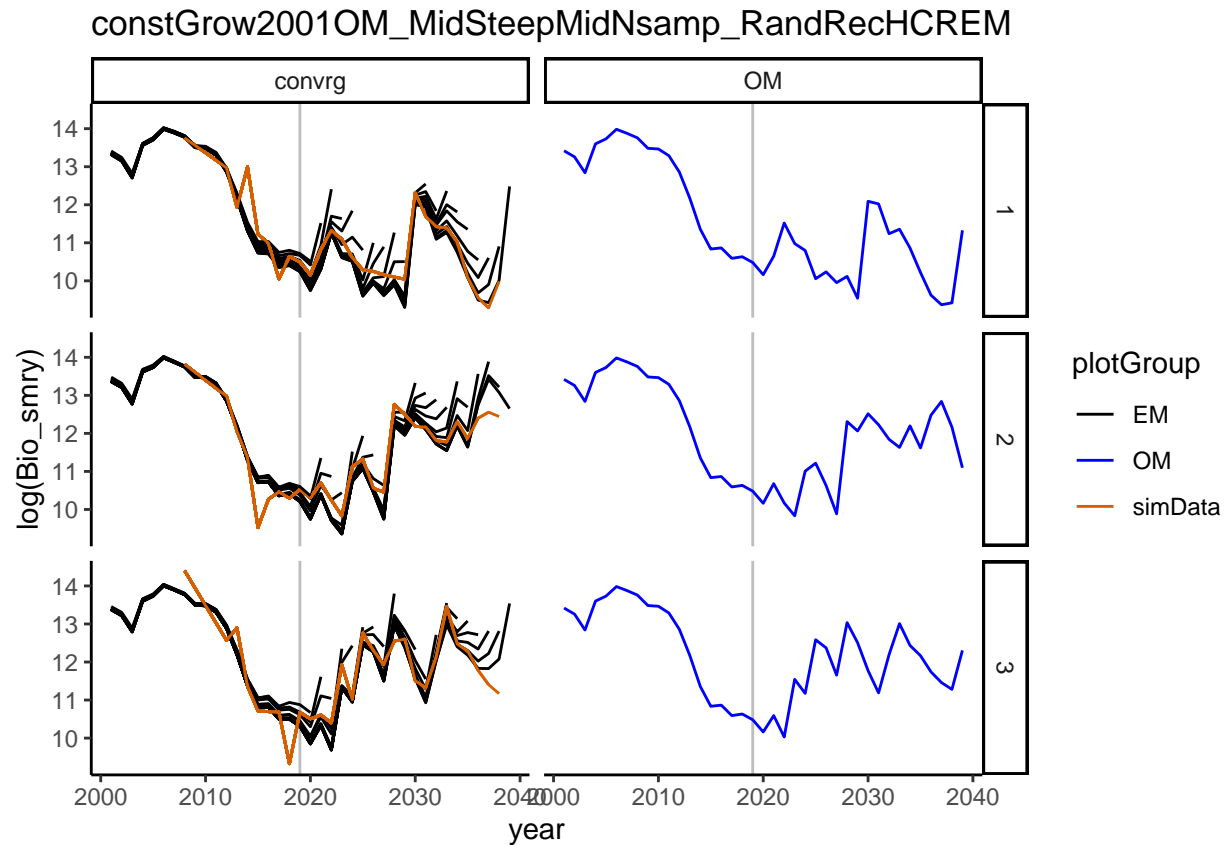
    datRE = (simData - Bio_smry)/Bio_smry * 100,
    emRE = (EM - Bio_smry)/Bio_smry * 100)

age1PlusBio <- rbind(age1PlusBio, simDat)
age1PlusBio <- age1PlusBio %>% left_join(y = convrgCheck,
                                         by = c("model_run", "iteration", "scenario")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"))

for(mr in 1:length(scenarios)){
  print(age1PlusBio %>% filter(scenario == scenarios[mr]) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_line(ggplot2::aes(linetype = as.character(model_run), color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    ggplot2::facet_grid(rows = vars(iteration), cols = vars(convrg)) +
    ggplot2::theme_classic() +
    labs(title = scenarios[mr]))
}

```

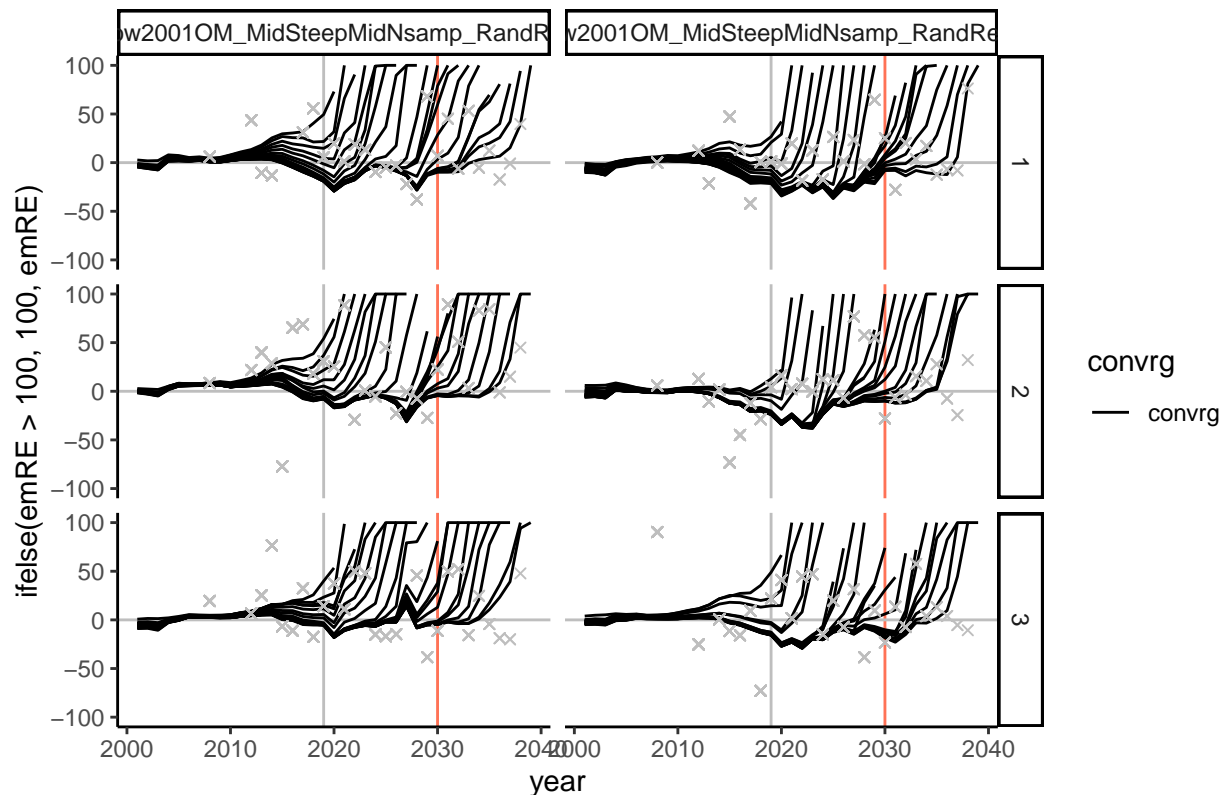




```
# Plot relative errors of biomass over time
age1PlusRE %>% filter(HCR != "HCRO") %>%
  ggplot(aes(x = year, y = ifelse(emRE > 100, 100, emRE))) + #y = emRE)) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_vline(xintercept = 2030, color = "coral1") +
  geom_hline(yintercept = 0, color = "gray") +
  geom_line(aes(linetype = as.character(model_run.x), color = convrg)) +
  geom_point(aes(y = datRE), shape = 4, color = "grey") +
  scale_color_manual(values = c("black", "blue", "#D65F00")) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(iteration), cols = vars(scenario)) +
  theme_classic() + labs(title = "Relative Error of Age 1+ Biomass (%)") +
  ylim(-100, 100)
```

```
## Warning: Removed 1412 rows containing missing values (geom_point).
```

Relative Error of Age 1+ Biomass (%)



```
# error of catch
simCat <- smryOutputList$obsCatch %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                             model_run = sub(pattern = ".*[[:digit:]]+", "", resDir),
                                             iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d")),
         plotGroup = "simCatch") %>%
  group_by(year, model_run, iteration, scenario, plotGroup) %>%
  # summarize total catch within year
  dplyr::summarize(totCatch = sum(catch)) %>%
  filter(!grepl("_OM", model_run, fixed = TRUE), year != -999) %>%
  select(year, totCatch, model_run, iteration, scenario, plotGroup)
```

'summarise()' has grouped output by 'year', 'model_run', 'iteration',
'scenario'. You can override using the '.groups' argument.

```
catchTS <- smryOutputList$tsSmry %>%
  mutate(totCatch = retainB_1 + retainB_2 + retainB_3) %>%
  group_by(year, model_run, iteration, scenario) %>%
  # summarize total catch within year
  dplyr::summarize(totCatch = sum(totCatch)) %>%
  select(year, totCatch, model_run, iteration, scenario) %>%
  mutate(plotGroup = case_when(grepl("_OM", model_run, fixed = TRUE) ~ "OM",
                               TRUE ~ "EM"))
```

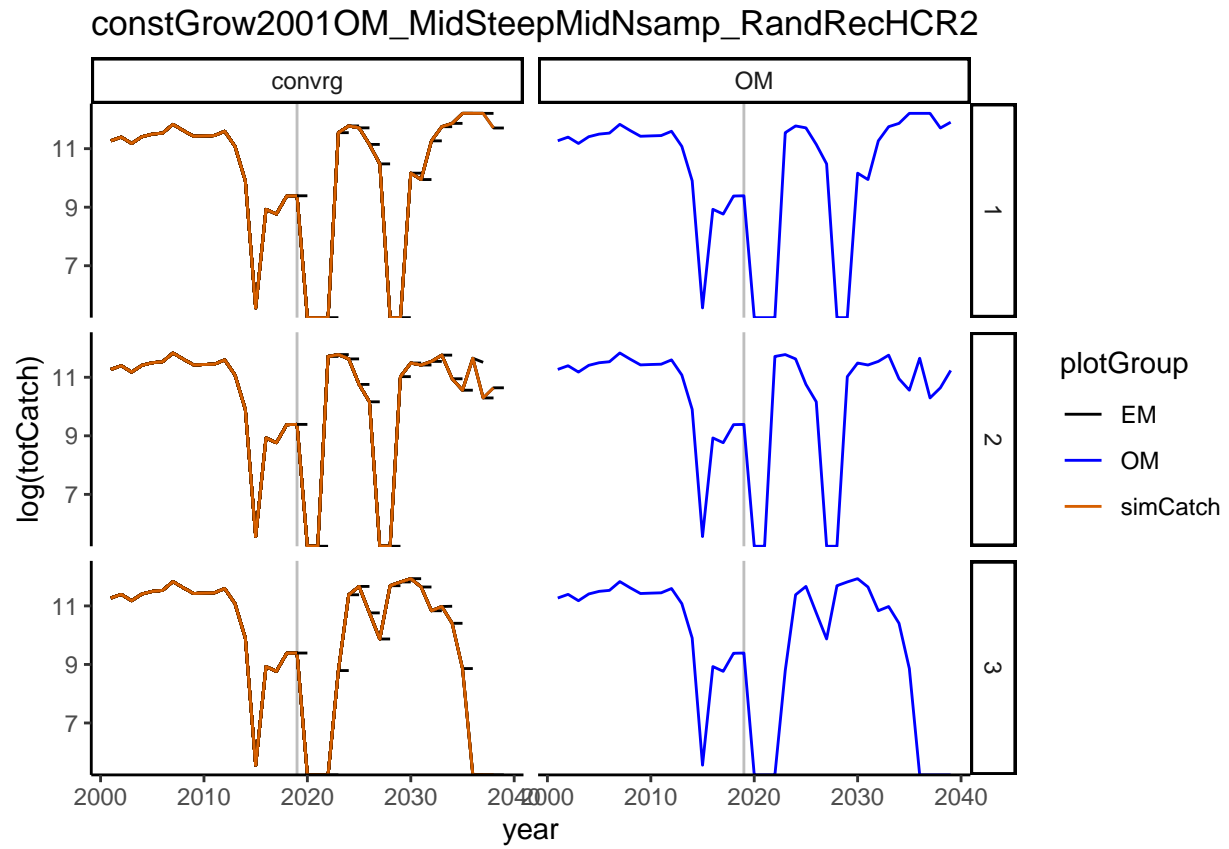
'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can

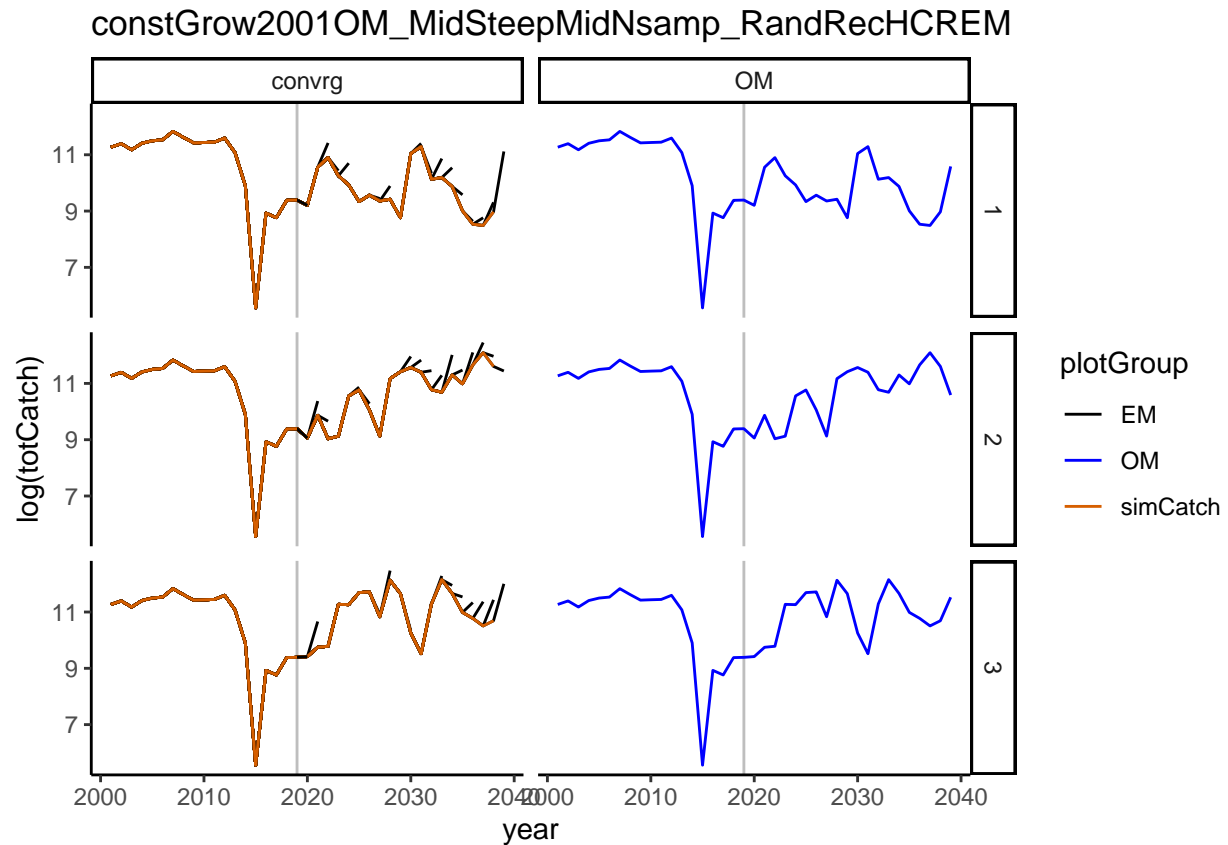
```
## override using the '.groups' argument.
```

```
catchRE <- catchTS %>% filter(plotGroup != "OM")
catchRE <- rbind(catchRE, simCat)
catchRE <- catchRE %>% pivot_wider(names_from = "plotGroup", values_from = "totCatch") %>%
  left_join(y = convrgCheck,
            by = c("model_run", "iteration", "scenario")) %>%
  full_join(y = subset(catchTS, subset = plotGroup == "OM"),
            by = c("iteration", "scenario", "year")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"),
         datRE = (simCatch - totCatch)/(totCatch + 0.0001) * 100, # add small amount so
         emRE = (EM - totCatch)/(totCatch + 0.0001) * 100)

catchTS <- rbind(catchTS, simCat)
catchTS <- catchTS %>% left_join(y = convrgCheck,
                                by = c("model_run", "iteration", "scenario")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"))

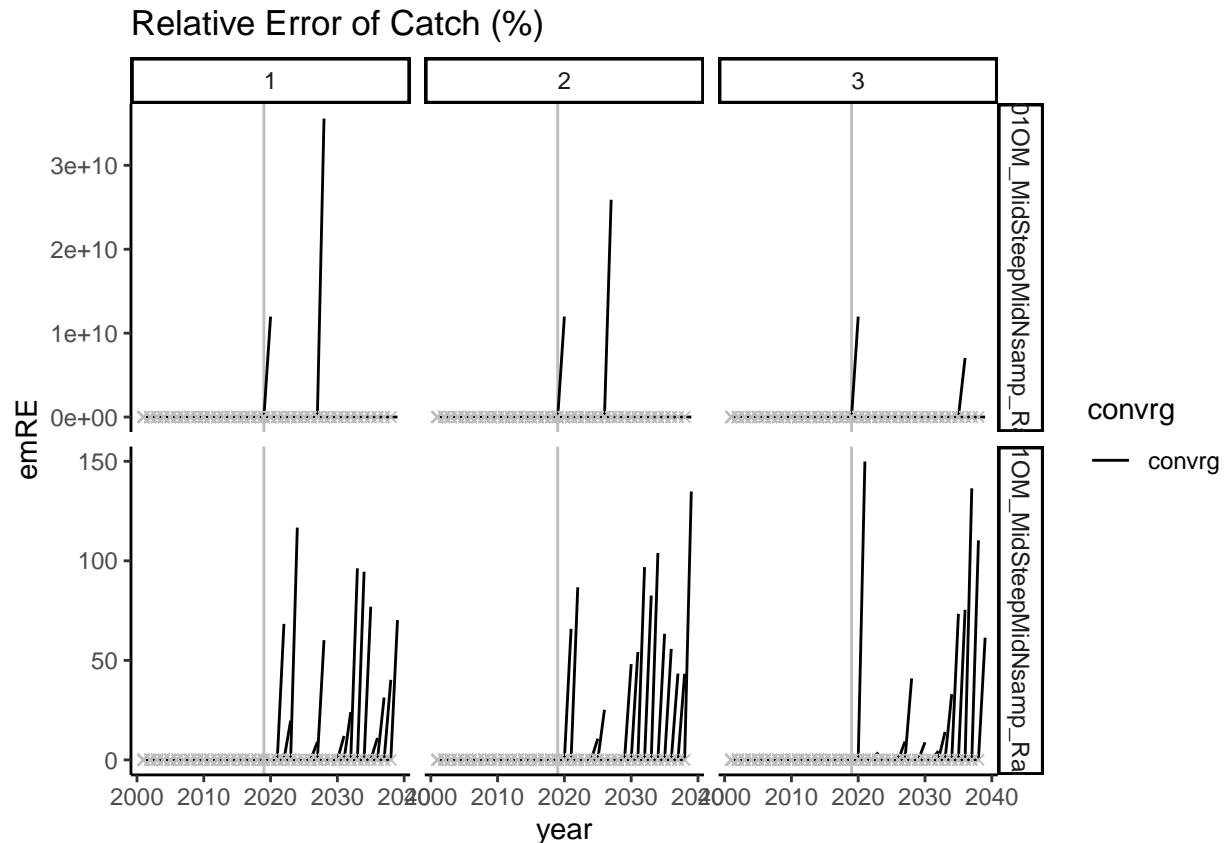
for(mr in 1:length(scenarios)){
  print(catchTS %>% filter(scenario == scenarios[mr]) %>%
    ggplot(aes(x = year, y = log(totCatch))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_line(ggplot2::aes(linetype = as.character(model_run), color = plotGroup)) +
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    ggplot2::facet_grid(rows = vars(iteration), cols = vars(convrg)) +
    ggplot2::theme_classic() +
    labs(title = scenarios[mr]))
}
```





```
# Plot relative errors of biomass over time
catchRE %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = year, y = emRE)) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_line(aes(linetype = as.character(model_run.x), color = convrg)) +
  geom_point(aes(y = datRE), shape = 4, color = "grey") +
  scale_color_manual(values = c("black", "blue", "#D65F00")) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(cols = vars(iteration), rows = vars(scenario), scales = "free") +
  theme_classic() + labs(title = "Relative Error of Catch (%)")
```

```
## Warning: Removed 120 rows containing missing values (geom_point).
```



Model expects high catches for 2020 in initial EM fit (emYear 2019)

Check harvest guideline from EMs

```
# Use parallelization to pull in composition and EM data -----
# Adapted from code from Peter Kuriyama

# set up the directories
# get the iterations
resultsDirs <- NULL
for(scn in 1:length(scenarios)){
  iters <- list.dirs(file.path(mseDir, scenarios[scn]), recursive = FALSE, full.names = FALSE)

  # get the model directory names
  runNames <- list.dirs(file.path(mseDir, scenarios[scn], iters[1]),
                        recursive = FALSE,
                        full.names = FALSE)

  # remove OM folder from list
  runNames <- runNames[!grep("_OM", runNames, fixed = TRUE)]

  #The results directories to read in
  scnResultsDirs <- expand_grid(scenarios[scn], iters, runNames) %>%
    mutate(scn = file.path(mseDir, `scenarios[scn]`, iters, runNames)) %>%
    pull(scn)

  resultsDirs <- c(resultsDirs, scnResultsDirs)
}
```

```

# extract wanted tables per directory and add data origin
start_time <- Sys.time()
ncores <- detectCores() - 2 #Leave some cores open for background stuff
cl <- makeCluster(ncores)
registerDoParallel(cl)

resultsList <- foreach::foreach(ii = 1:length(resultsDirs),

                                .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_output(resultsDirs[ii],
                        covar = FALSE, printstats = FALSE,
                        verbose = FALSE)
  outList %>% magrittr::extract("sprseries") %>%
    map2(.y = resultsDirs[ii],
         .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)
run_time <- Sys.time() - start_time; run_time #To see how long it takes

```

Time difference of 28.02133 secs

```

# summarize into single table for export
smryForeBio <- resultsList %>% map_dfr(magrittr::extract2, "sprseries") %>%
  filter(Era=="FORE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*[/[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[/[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  select(Yr, Bio_Smry.1, scenario, model_run, iteration)

# apply HCR as calculated in HCR_sar_hcr2.R

#upload the CalCOFI temperature timeseries
Ctemp=read.csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineMSE/dat/calcofi_sst_projected.csv")
# Ctemp=read.csv("J:/Desiree/Sardine/SardineMSE/dat/calcofi_sst_projected.csv")

#extract the average for the three years prior to the forecast
#Tyr=c((EMts$Yr[1]-1), (EMts$Yr[1]-2), (EMts$Yr[1]-3))
#Temsy = mean(Ctemp$gfdl_sst_all[Ctemp$year %in% Tyr])#here we might need to create a separte hcr 2 fu
smryForeBio$Temsy <- NA
for(i in 1:nrow(smryForeBio)){
  smryForeBio[i, "Temsy"] <- mean(Ctemp$gfdl_sst_all[Ctemp$year %in% (smryForeBio[i, "Yr"]-3):(smryFore
}]

#set input to hcr
#Emsy = -18.46452+3.25209*Temsy-0.19723*Temsy^2+0.0041863*Temsy^3
smryForeBio <- smryForeBio %>% mutate(Emsy = -18.46452+3.25209*Temsy-0.19723*Temsy^2+0.0041863*Temsy^3)
cutoff = 150000
distribution = 0.87

#if biomass is less than the cutoff, the harvest guideline is set to 0, if not the current hg rule is

```

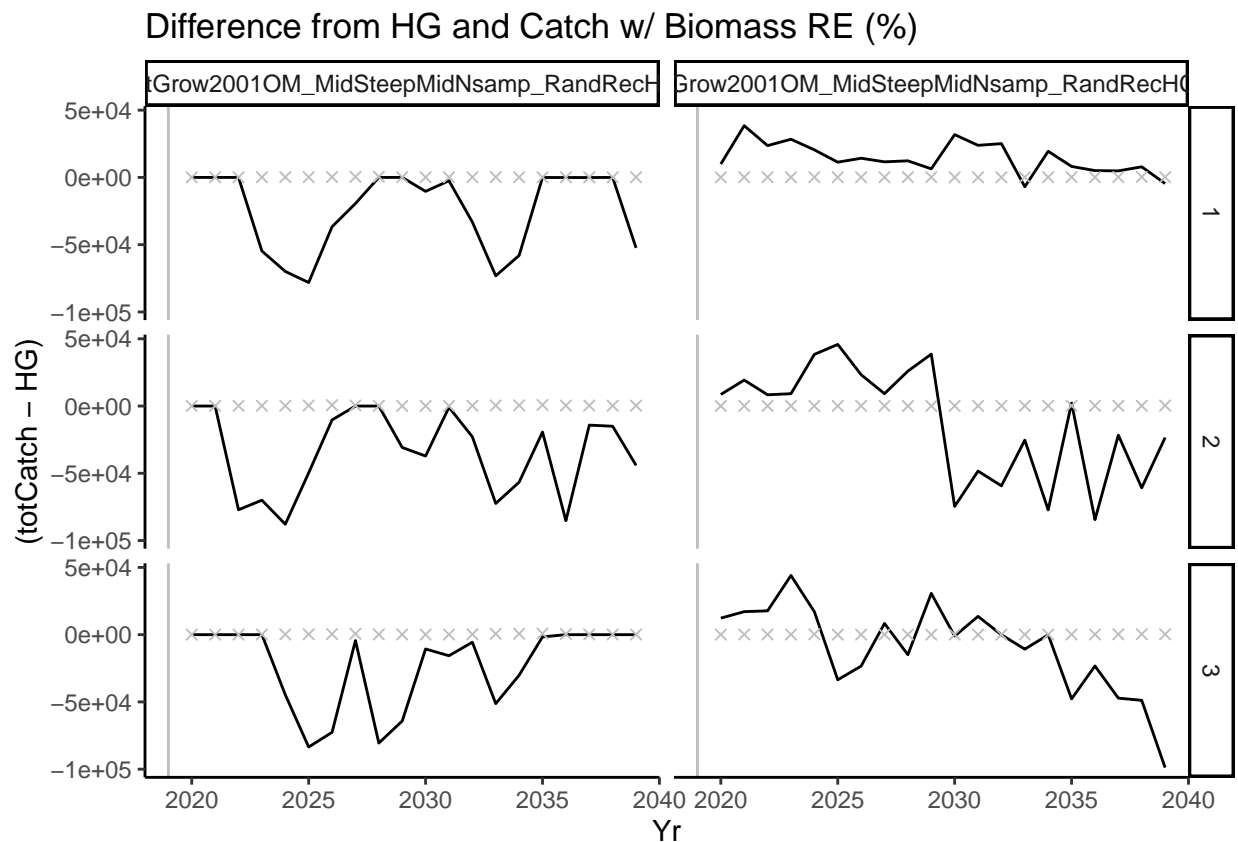
```

#HG=(BIOMASS-CUTOFF)*FRACTION*DISTRIBUTION
#Note that as there are still
# if (bio1 < cutoff) {HG = 0 } else {HG = (bio1-cutoff)*Emsy*distribution}
#
# #the hg is capped at a maximum catch of 200000 mt
# if (HG > 200000) {HG = 200000}

smryForeBio <- smryForeBio %>% mutate(HG = case_when(Bio_Smry.1 < cutoff ~ 0,
                                                    TRUE ~ (Bio_Smry.1-cutoff)*Emsy*distribution)) %>%
  mutate(HG = case_when(HG > 200000 ~ 200000,
                        TRUE ~ HG)) %>%
  left_join(y = subset(catchTS, subset = plotGroup == "OM"),
            by = c("Yr" = "year", "scenario", "iteration")) %>%
  left_join(y = subset(age1PlusBio, subset = plotGroup == "OM"),
            by = c("Yr" = "year", "scenario", "iteration")) %>%
  select(Yr, scenario, model_run.x, iteration, Bio_Smry.1, HG, Bio_smry, totCatch, HCR.)

smryForeBio %>% ggplot(aes(x = Yr, y = (totCatch - HG))) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_line(aes(linetype = as.character(scenario))) +
  geom_point(aes(y = (Bio_Smry.1 - Bio_smry)/Bio_smry*100), shape = 4, color = "grey") +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(iteration), cols = vars(scenario)) +
  theme_classic() + labs(title = "Difference from HG and Catch w/ Biomass RE (%)")

```



```

# compare OM, EM, and HG total catches

# look at catches listed in OM data files
# set up the directories
# get the iterations
omDirs <- NULL
for(scn in 1:length(scenarios)){
  iters <- list.dirs(file.path(mseDir, scenarios[scn]), recursive = FALSE, full.names = FALSE)

  # get the model directory names
  runNames <- list.dirs(file.path(mseDir, scenarios[scn], iters[1]),
                        recursive = FALSE,
                        full.names = FALSE)
  # keep only OM folder from list
  runNames <- runNames[grepl("_OM", runNames, fixed = TRUE)]

  #The results directories to read in
  scnResultsDirs <- expand_grid(scenarios[scn], iters, runNames) %>%
    mutate(scn = file.path(mseDir, `scenarios[scn]`, iters, runNames)) %>%
    pull(scn)

  omDirs <- c(omDirs, scnResultsDirs)
}

# extract wanted tables per directory and add data origin
start_time <- Sys.time()
ncores <- detectCores() - 2 #Leave some cores open for background stuff
cl <- makeCluster(ncores)
registerDoParallel(cl)

omDataList <- foreach::foreach(ii = 1:length(omDirs),

                              .packages = c("tidyverse", "r4ss")) %dopar% {
  outList <- SS_readat(file.path(omDirs[ii], "data.ss"),
                      version = "3.30", verbose = FALSE)
  outList %>% magrittr::extract(c("catch", "CPUE")) %>%
    map2(.y = omDirs[ii],
        .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)

# summarize into single table for export
omDataCatch <- omDataList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchDat = catch)

cl <- makeCluster(ncores)
registerDoParallel(cl)

```

```

omDataExpList <- foreach::foreach(ii = 1:length(omDirs),

                                .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_readdat(file.path(omDirs[ii], "data.ss_new"),
                        version = "3.30", verbose = FALSE,
                        section = 2)
  outList %>% magrittr::extract(c("catch", "CPUE")) %>%
    map2(.y = omDirs[ii],
         .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)

# summarize into single table for export
omDataExpCatch <- omDataExpList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchExp = catch)

cl <- makeCluster(ncores)
registerDoParallel(cl)
omDataBootList <- foreach::foreach(ii = 1:length(omDirs),

                                   .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_readdat(file.path(omDirs[ii], "data.ss_new"),
                        version = "3.30", verbose = FALSE,
                        section = 3)
  outList %>% magrittr::extract(c("catch", "CPUE")) %>%
    map2(.y = omDirs[ii],
         .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)
# summarize into single table for export
omDataBootCatch <- omDataBootList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchBoot = catch)

# need to look at conditioning data for EM runs
cl <- makeCluster(ncores)
registerDoParallel(cl)
emDataList <- foreach::foreach(ii = 1:length(resultsDirs),

                                .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_readdat(file.path(resultsDirs[ii], "init_dat.ss"),
                        version = "3.30", verbose = FALSE)
  outList %>% magrittr::extract(c("catch", "CPUE")) %>%
    map2(.y = resultsDirs[ii],

```

```

        .f = function(x, y){x['resDir'] <- y;x}
    }

stopCluster(cl)
# summarize into single table for export
emDataCatch <- emDataList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchEMInit = catch) %>%
  group_by(year, resDir, scenario, model_run, iteration) %>%
  summarize(totCatchInitDatEM = sum(catchEMInit)) %>%
  filter(year != -999)

```

'summarise()' has grouped output by 'year', 'resDir', 'scenario', 'model_run'.
 ## You can override using the '.groups' argument.

```
run_time <- Sys.time() - start_time; run_time #To see how long it takes
```

Time difference of 20.55837 secs

```

omDataCatch <- omDataCatch %>% left_join(y = omDataExpCatch,
                                         by = c("year", "seas", "fleet", "resDir",
                                                  "scenario", "model_run", "iteration")) %>%
  left_join(y = omDataBootCatch,
            by = c("year", "seas", "fleet", "resDir",
                   "scenario", "model_run", "iteration")) %>%
  group_by(year, resDir, scenario, model_run, iteration) %>%
  summarize(totCatchDat = sum(catchDat),
            totCatchExp = sum(catchExp),
            totCatchBoot = sum(catchBoot)) %>%
  filter(year != -999)

```

'summarise()' has grouped output by 'year', 'resDir', 'scenario', 'model_run'.
 ## You can override using the '.groups' argument.

```

# add OM catch from tsSmry
omDataCatch <- omDataCatch %>% left_join(y = subset(catchTS, subset = plotGroup == "OM"),
                                         by = c("year", "scenario", "iteration")) %>%
  rename(totCatchTSOM = totCatch)

# add OM catch from data.ss_new file
omDatNewCat <- smryOutputList$obsCatch %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                                  model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
                                                  iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d")),
         plotGroup = "OM") %>%
  group_by(year, model_run, iteration, scenario, plotGroup) %>%
  # summarize total catch within year

```

```

    dplyr::summarize(totCatchDatNewOM = sum(catch)) %>%
  filter(grepl("_OM", model_run, fixed = TRUE), year != -999) %>%
  select(year, totCatchDatNewOM, model_run, iteration, scenario, plotGroup)

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration',
## 'scenario'. You can override using the '.groups' argument.

omDataCatch <- omDataCatch %>% left_join(y = omDatNewCat,
                                         by = c("year", "scenario", "iteration",
                                                  "model_run.x" = "model_run"))

catchTS <- omDataCatch %>% left_join(y = subset(catchTS, subset = plotGroup == "EM"),
                                     by = c("year", "iteration", "scenario",
                                              "recScen", "HCR")) %>%
  rename(totCatchEstEM = totCatch) %>%
  left_join(y = subset(catchTS, subset = plotGroup == "simCatch"),
            by = c("year", "iteration", "scenario", "emYear.y" = "emYear",
                   "recScen", "HCR", "model_run")) %>%
  rename(totCatchSimDatEM = totCatch) %>%
  left_join(y = emDataCatch, by = c("year", "iteration", "scenario", "model_run")) %>%
  ungroup() %>%
  select(year, iteration, scenario, emYear.y, recScen, HCR, max_grad.x, convrg.x,
         totCatchDat, totCatchDatNewOM, totCatchExp, totCatchBoot,
         totCatchTSOM, totCatchInitDatEM, totCatchSimDatEM, totCatchEstEM)

# Note: the HG is the catch advice provided from the HCR from the previous emYear
#       to be applied in 'year'
catchTS <- catchTS %>% left_join(smryForeBio,
                                by = c("year" = "Yr", "iteration", "scenario",
                                         "recScen" = "recScen.y", "HCR" = "HCR.y")) %>%
  rename(emForeBioSmry = Bio_Smry.1,
         omBioSmry = Bio_smry) %>%
  select(year, iteration, scenario, emYear.y, recScen, HCR, max_grad.x,
         convrg.x, HG, totCatchDat, totCatchDatNewOM, totCatchExp, totCatchBoot,
         totCatchTSOM, totCatchInitDatEM, totCatchSimDatEM, totCatchEstEM, emForeBioSmry, omBioSmry)
catchTS %>% filter(year %in% 2028:2032, emYear.y %in% 2028:2032,
                  iteration == 1, scenario == scenarios[2]) %>% select(-scenario, -recScen, -HCR)

## # A tibble: 19 x 16
##   year iteration emYear.y max_grad.x convrg.x   HG totCatchDat
##   <int>      <dbl>   <dbl>    <dbl> <chr>    <dbl>    <dbl>
## 1  2028         1     2028      NA OM        0     19754.
## 2  2028         1     2029      NA OM        0     19754.
## 3  2028         1     2030      NA OM        0     19754.
## 4  2028         1     2031      NA OM        0     19754.
## 5  2028         1     2032      NA OM        0     19754.
## 6  2029         1     2028      NA OM        0      6381.
## 7  2029         1     2029      NA OM        0      6381.
## 8  2029         1     2030      NA OM        0      6381.
## 9  2029         1     2031      NA OM        0      6381.
## 10 2029         1     2032      NA OM        0      6381.
## 11 2030         1     2029      NA OM    30711.    62574.

```



```
## 12 2030      1      2030      NA OM      30711.      62574.
## 13 2030      1      2031      NA OM      30711.      62574.
## 14 2030      1      2032      NA OM      30711.      62574.
## 15 2031      1      2030      NA OM      56110.      89568.
## 16 2031      1      2031      NA OM      56110.      89568.
## 17 2031      1      2032      NA OM      56110.      89568.
## 18 2032      1      2031      NA OM           0      31129.
## 19 2032      1      2032      NA OM           0      31129.
## # ... with 9 more variables: totCatchDatNewOM <dbl>, totCatchExp <dbl>,
## #   totCatchBoot <dbl>, totCatchTSOM <dbl>, totCatchInitDatEM <dbl>,
## #   totCatchSimDatEM <dbl>, totCatchEstEM <dbl>, emForeBioSmry <dbl>,
## #   omBioSmry <dbl>
```

```
# omOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow2001OM_MidSt
# em2030Out <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow2001OM_M
# compFree <- SSsummarize(list(OM = omOut, EM2029 = em2029Out))

#SS_plots(em2030Out)
```

Check out the CPUE timeseries and EM implementation

```
datNewCPUE <- smryOutputList$obsCPUE %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                                model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
                                                iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  filter(seas == 1, index %in% c(4, -4))
cpueTS <- datNewCPUE %>% filter(grepl("_OM", model_run, fixed = TRUE)) %>%
  rename(cpueDatNewOM = obs) %>%
  full_join(y = subset(datNewCPUE, subset = !grepl("_OM", model_run, fixed = TRUE)),
            by = c("year", "seas", "index", "iteration", "scenario")) %>%
  rename(cpueDatNewEM = obs)

omDataCPUE <- omDataList %>% map_dfr(magrittr::extract2, "CPUE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(cpueDatOM = obs) %>%
  filter(seas == 1, index %in% c(4, -4))

omDataExpCPUE <- omDataExpList %>% map_dfr(magrittr::extract2, "CPUE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(cpueDatExpOM = obs) %>%
  filter(seas == 1, index %in% c(4, -4))

omDataBootCPUE <- omDataBootList %>% map_dfr(magrittr::extract2, "CPUE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
```

```

        model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
        iteration = str_extract(resDir, "\\d/")) %>%
mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
       iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
rename(cpueDatBootOM = obs) %>%
filter(seas == 1, index %in% c(4, -4))

emDataCPUE <- emDataList %>% map_dfr(magrittr::extract2, "CPUE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(cpueInitEM = obs) %>%
  filter(seas == 1, index %in% c(4, -4))

omDataCPUE <- omDataCPUE %>% left_join(y = omDataExpCPUE,
                                       by = c("year", "seas", "resDir",
                                              "scenario", "model_run", "iteration")) %>%
  left_join(y = omDataBootCPUE,
            by = c("year", "seas", "resDir",
                  "scenario", "model_run", "iteration")) %>%
  full_join(y = emDataCPUE,
            by = c("year", "seas", "scenario", "iteration"))

cpueTS <- cpueTS %>% left_join(y = omDataCPUE, by = c("year", "seas", "scenario",
                                                    "iteration", "model_run.y", "resDir.y")) %>%
  select(year, scenario, iteration, model_run.y, cpueDatOM, cpueDatNewOM,
         cpueDatExpOM, cpueDatBootOM, cpueInitEM, cpueDatNewEM) %>%
  mutate(emYear = as.numeric(regmatches(model_run.y,
                                         gregexpr("[[:digit:]]+",
                                                    model_run.y))))

cpueTS %>% filter(year %in% 2028:2032, emYear %in% 2028:2032,
                 iteration == 1, scenario == scenarios[1]) %>%
  arrange(year, emYear) %>% select(-scenario)

```

##	year	iteration	model_run.y	cpueDatOM	cpueDatNewOM	cpueDatExpOM
## 1	2028	1	constGrowSelfTest_EM_2028	1	NA	19121.4
## 2	2028	1	constGrowSelfTest_EM_2029	1	NA	19121.4
## 3	2028	1	constGrowSelfTest_EM_2030	1	NA	19121.4
## 4	2028	1	constGrowSelfTest_EM_2031	1	NA	19121.4
## 5	2028	1	constGrowSelfTest_EM_2032	1	NA	19121.4
## 6	2029	1	constGrowSelfTest_EM_2029	1	NA	32534.5
## 7	2029	1	constGrowSelfTest_EM_2030	1	NA	32534.5
## 8	2029	1	constGrowSelfTest_EM_2031	1	NA	32534.5
## 9	2029	1	constGrowSelfTest_EM_2032	1	NA	32534.5
## 10	2030	1	constGrowSelfTest_EM_2030	1	NA	99009.0
## 11	2030	1	constGrowSelfTest_EM_2031	1	NA	99009.0
## 12	2030	1	constGrowSelfTest_EM_2032	1	NA	99009.0
## 13	2031	1	constGrowSelfTest_EM_2031	1	NA	94490.9
## 14	2031	1	constGrowSelfTest_EM_2032	1	NA	94490.9
## 15	2032	1	constGrowSelfTest_EM_2032	1	NA	159773.0
##			cpueDatBootOM	cpueInitEM	cpueDatNewEM	emYear

## 1	18864.7	11182.1	11182.1	2028
## 2	18864.7	11182.1	11182.1	2029
## 3	18864.7	11182.1	11182.1	2030
## 4	18864.7	11182.1	11182.1	2031
## 5	18864.7	11182.1	11182.1	2032
## 6	41103.0	38589.9	38589.9	2029
## 7	41103.0	38589.9	38589.9	2030
## 8	41103.0	38589.9	38589.9	2031
## 9	41103.0	38589.9	38589.9	2032
## 10	112186.0	103502.0	103502.0	2030
## 11	112186.0	103502.0	103502.0	2031
## 12	112186.0	103502.0	103502.0	2032
## 13	62272.7	121239.0	121239.0	2031
## 14	62272.7	121239.0	121239.0	2032
## 15	319576.0	130051.0	130051.0	2032

EM 2001 self test, recruitment at SD=0.5, h=0.6, corrected sample size

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
```

```
scenarios <- c("constGrow20010M_selfTestMidSteep_RandRecHCR0",
               "constGrow20010M_selfTestMidSteep_RandRecHCR2",
               "constGrow20010M_selfTestMidSteepFixRec_RandRecHCR2")
```

```
smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)
```

```
## Rows: 120 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
```

```

## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

smryOutputList$ddqSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                         smryOutputList$ddqSmry$model_run, fixed = TRUE)
smryOutputList$sclSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                         smryOutputList$sclSmry$model_run, fixed = TRUE)
smryOutputList$tsSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                       smryOutputList$tsSmry$model_run, fixed = TRUE)

performanceList <- CalcPerformance(smryOutputList)

## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

metricsTbl <- performanceList$performanceMetrics

# parse out HCR and recruitment scenario
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                   recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen))

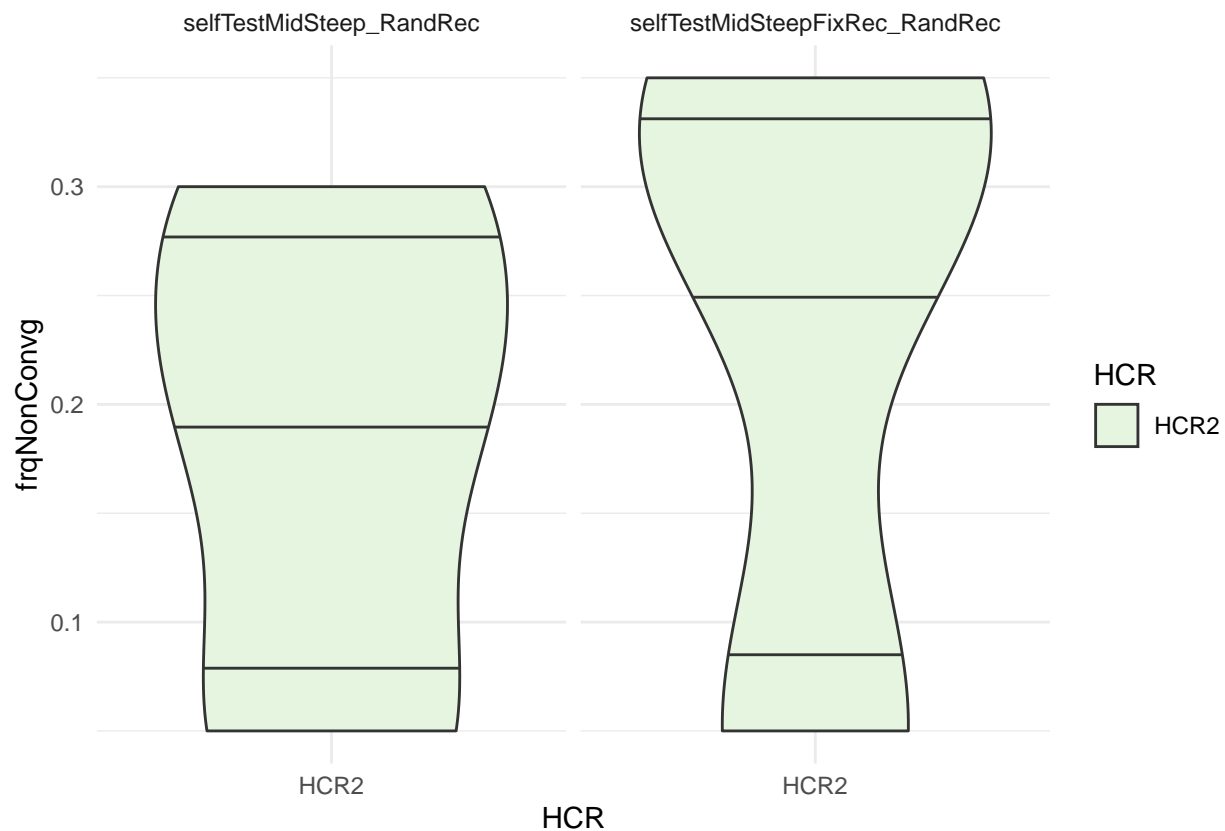
hcrPal <- brewer.pal(10, "Set3")[-2]

# plot convergence frequency
metricsTbl %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)

## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used

```

```
## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```



```
# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec", "", scenario),
         recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))
```

```
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
```

```
omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

convrCheck <- smryOutputList$sclSmry %>% #filter(!model_run %in% omName) %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                    model_run))),
         HCR = sub(pattern = ".*Rec", "", scenario),
         recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))

hcrs <- unique(termTS$HCR)
```

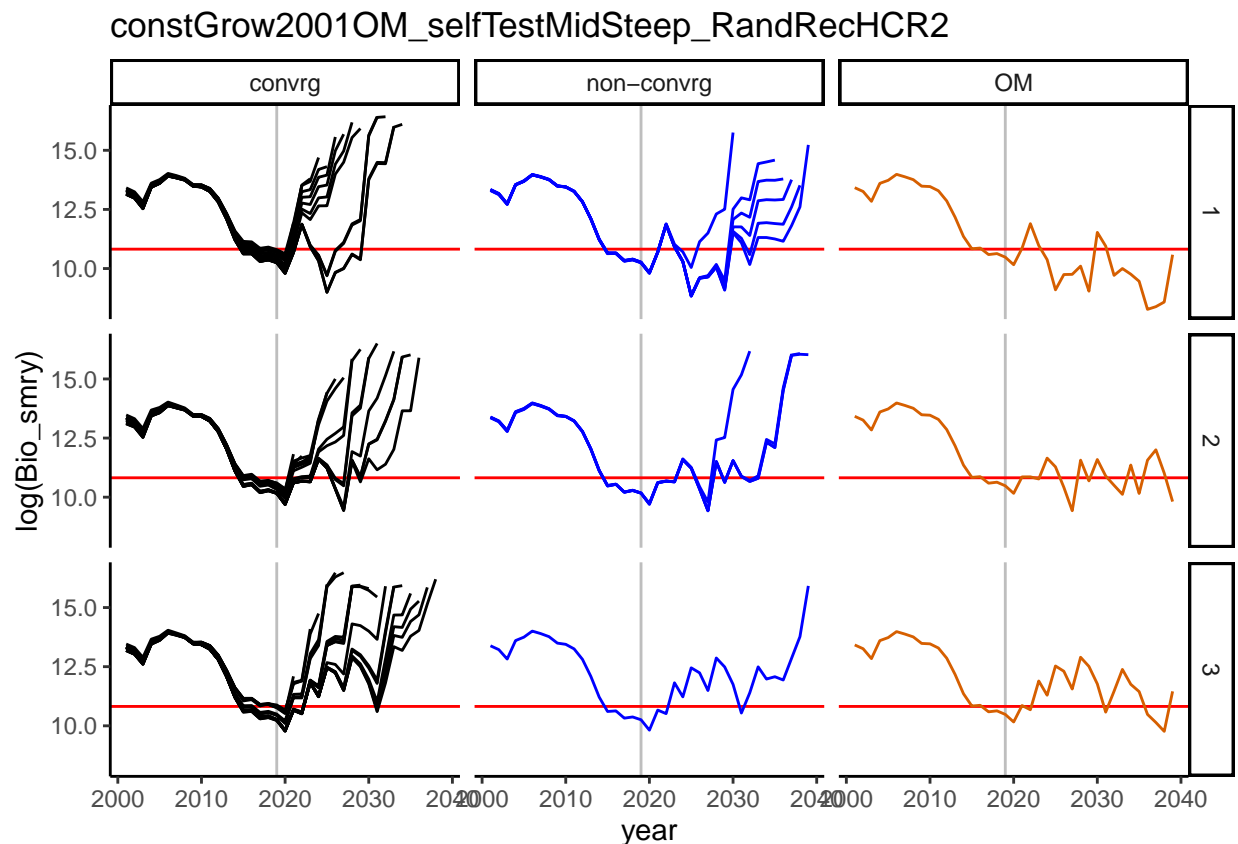
```

#exIters <- sample(termTS$iteration, size = 4)

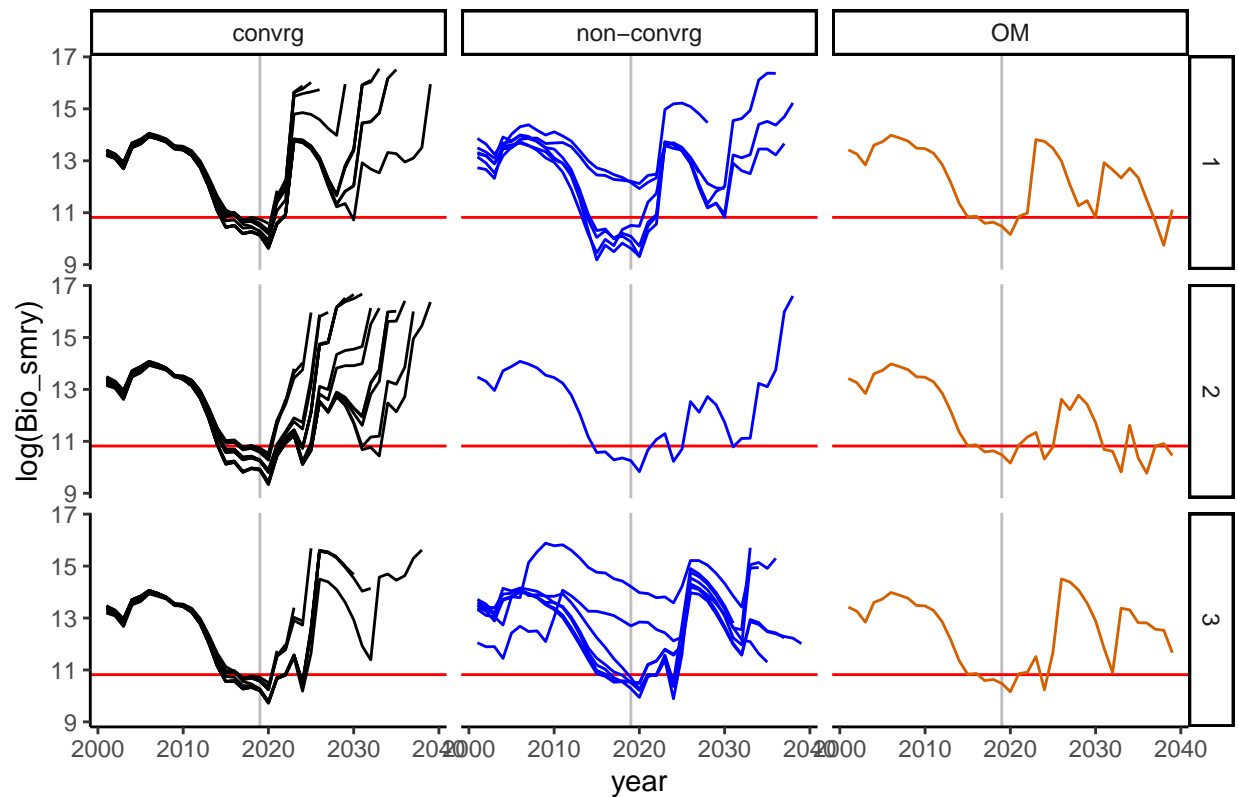
cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                             recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen)) %>%
  left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
  mutate(plotGroup = case_when(model_run == omName ~ "OM",
                                max_grad > 0.01 ~ "non-cnvrng",
                                max_grad < 0.01 ~ "cnvrng"))

for(mr in 2:3){
  print(cnvrgTS %>% filter(scenario == scenarios[mr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = scenarios[mr]))
}

```

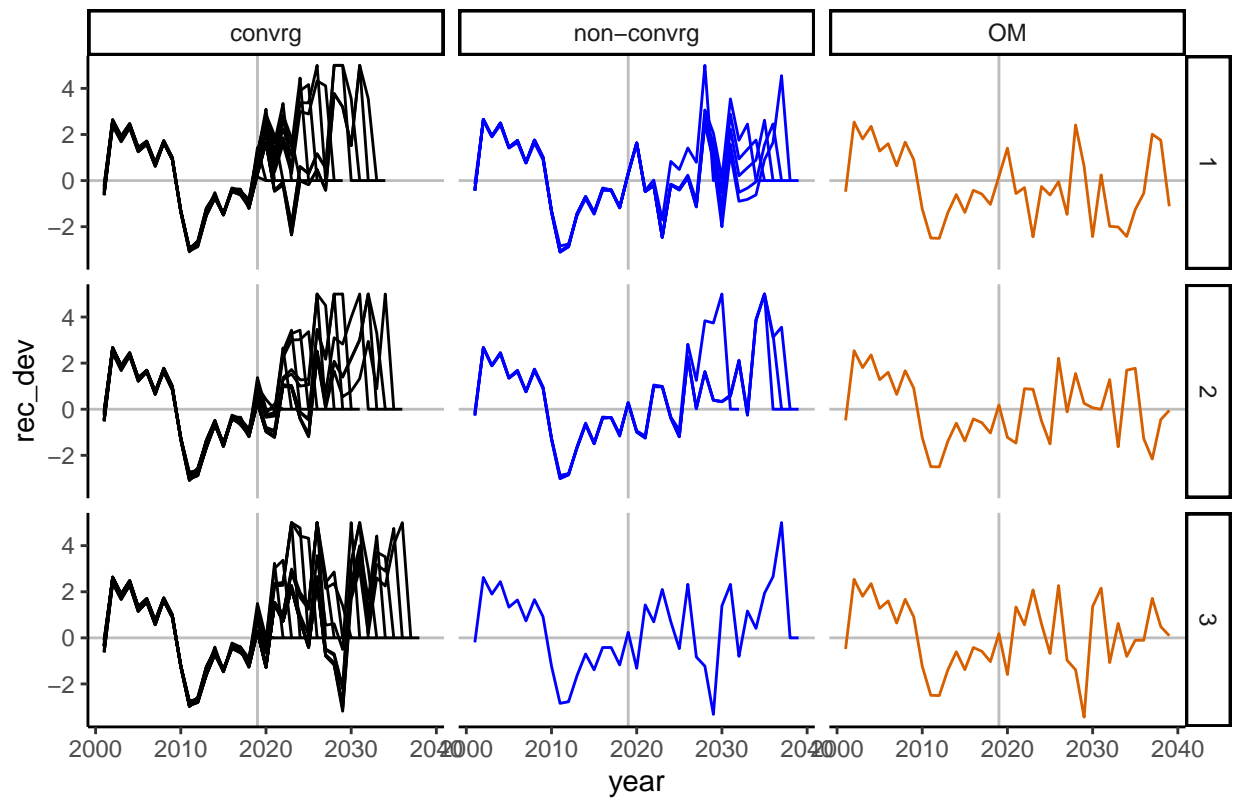


constGrow2001OM_selfTestMidSteepFixRec_RandRecHCR2

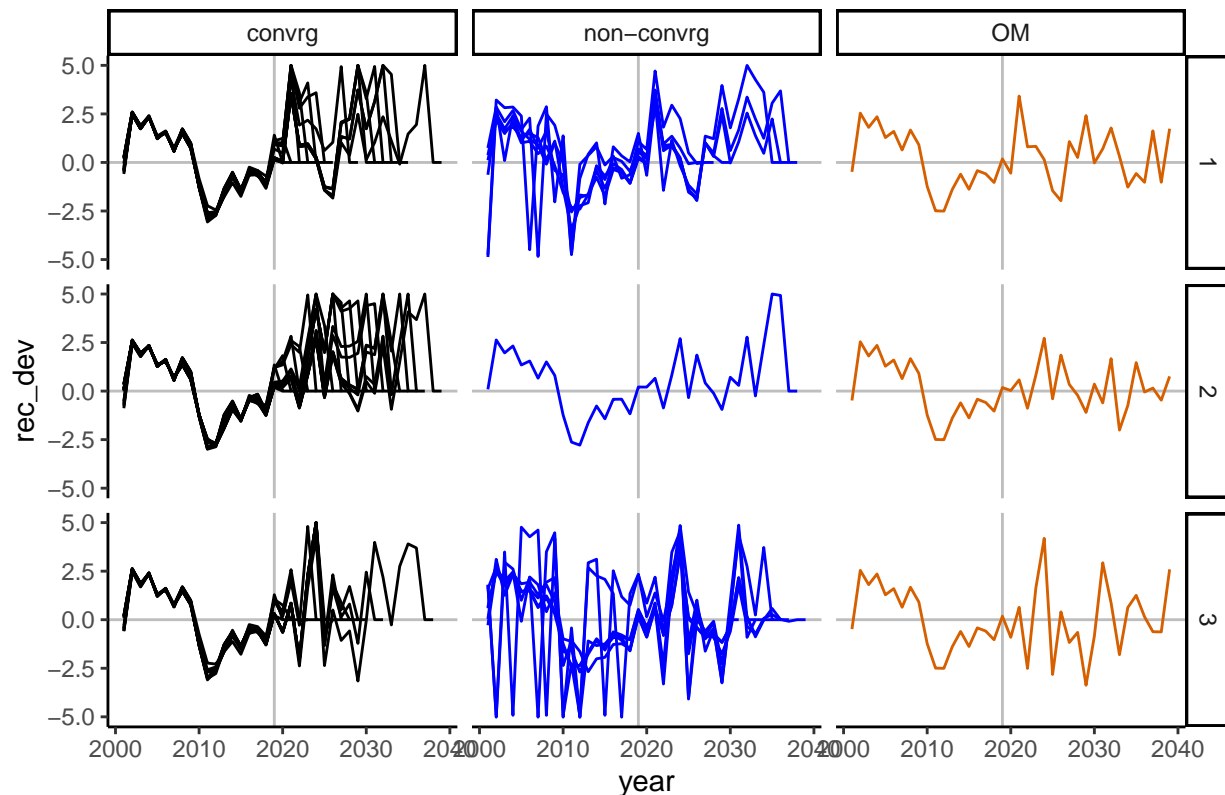


```
for(mr in 2:3){
  print(cnvrgTS %>% filter(scenario == scenarios[mr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = scenarios[mr]))
}
```

constGrow2001OM_selfTestMidSteep_RandRecHCR2



constGrow2001OM_selfTestMidSteepFixRec_RandRecHCR2



```
#termTS %>% filter(model_run == omName)
```

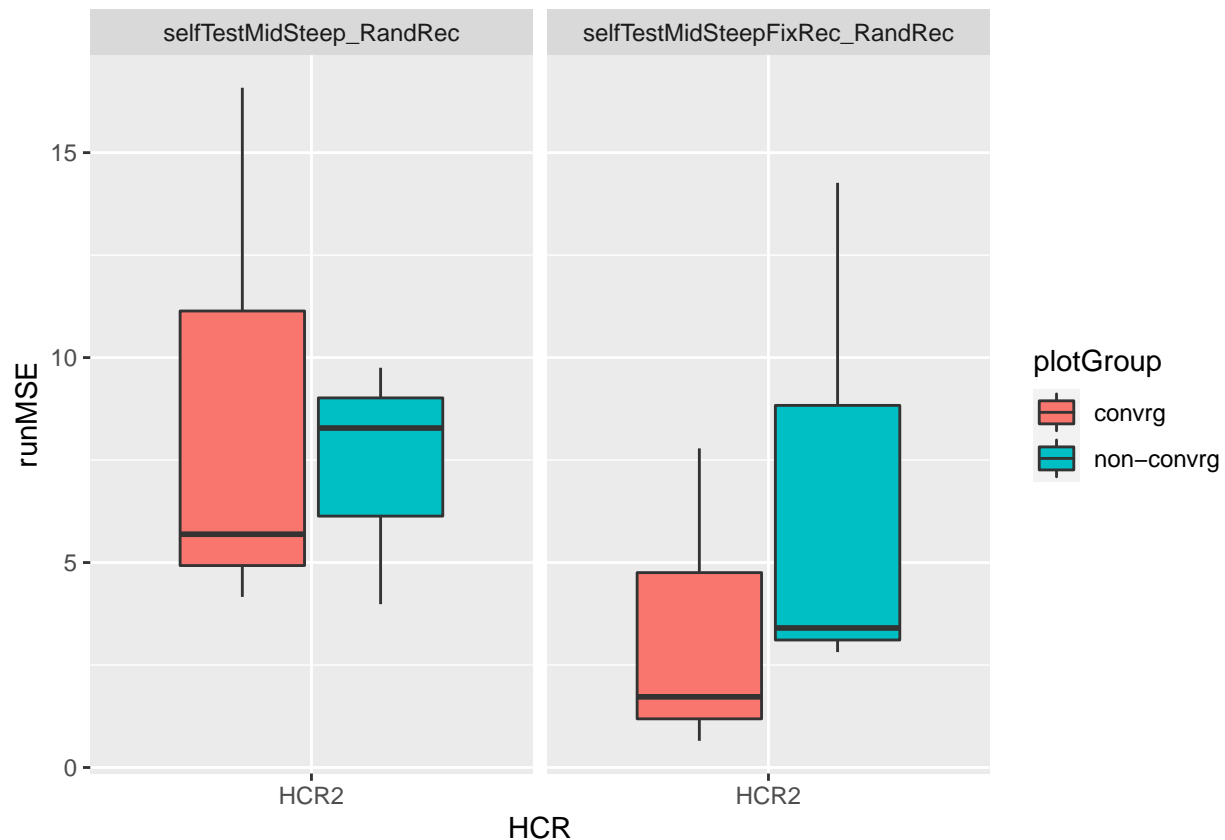
```
errCompare <- cnvrqTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
    by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
    age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))
```

```
errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



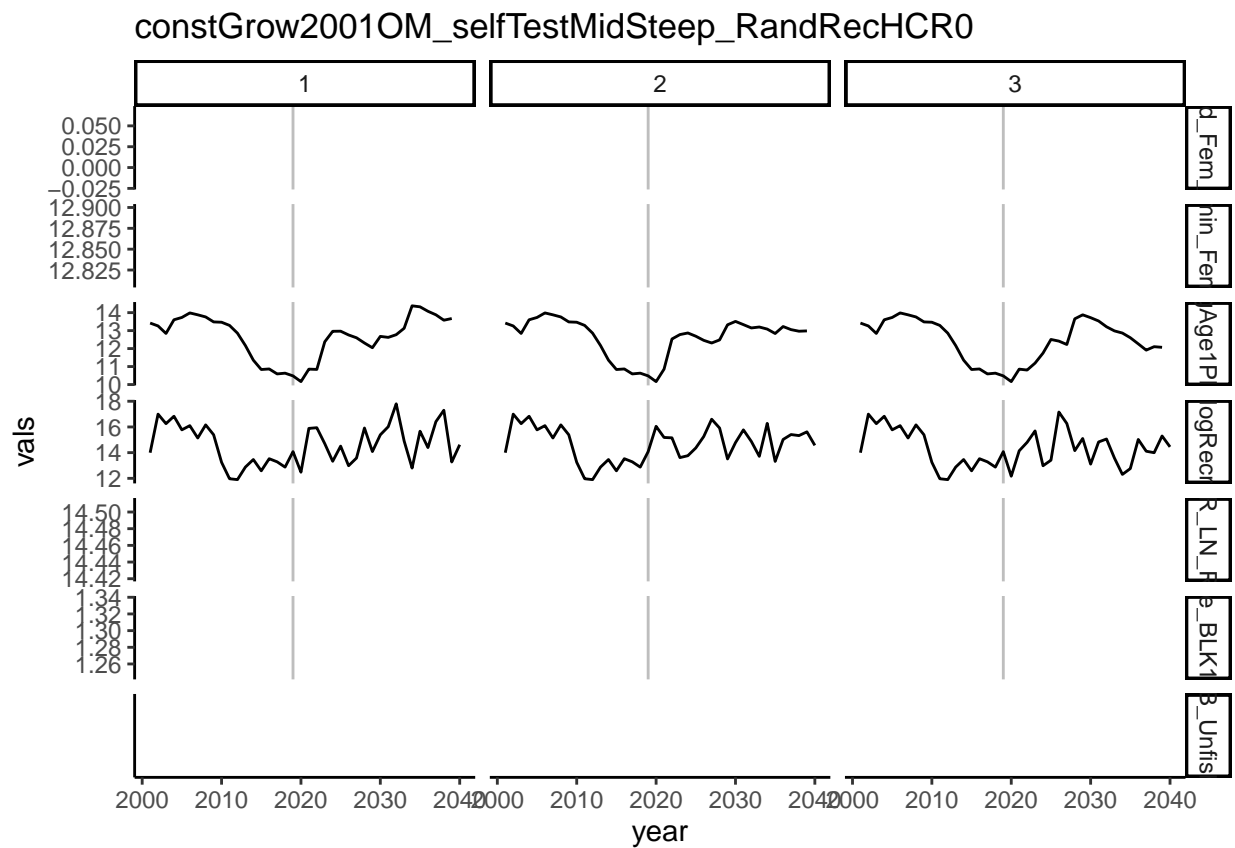
```
PlotEMAnnualEsts(dirSSMSE = mseDir, scenarios = scenarios,
  varCol = c("SSB_Unfished", #"NatM_uniform_Fem_GP_1",
    "L_at_Amin_Fem_GP_1", "SR_LN_R0",
    "SR_regime_BLKirepl_2000", "InitF_seas_2_flt_2MexCal_S2",
    "CV_old_Fem_GP_1"))
```

```
## Rows: 120 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
```

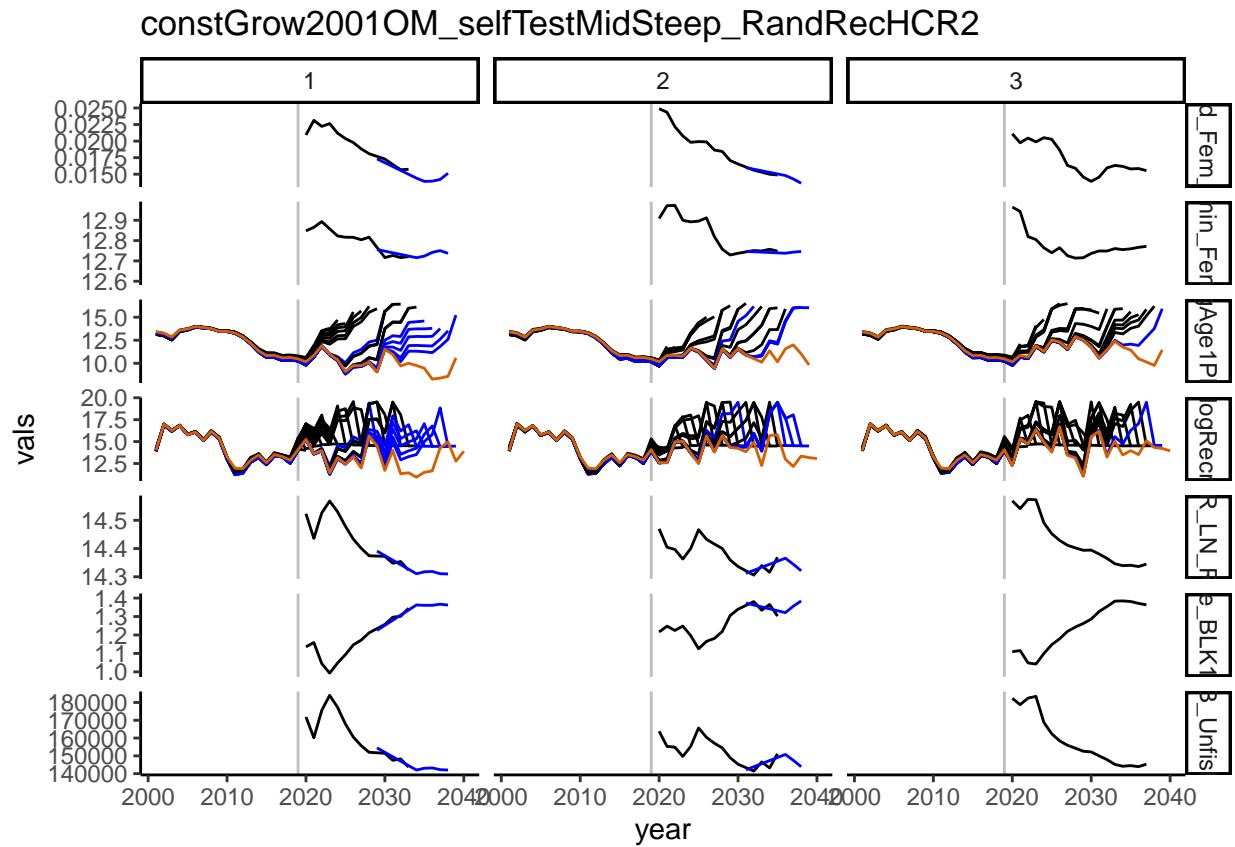
```
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

## Warning in mask$eval_all_mutate(quo): NAs introduced by coercion

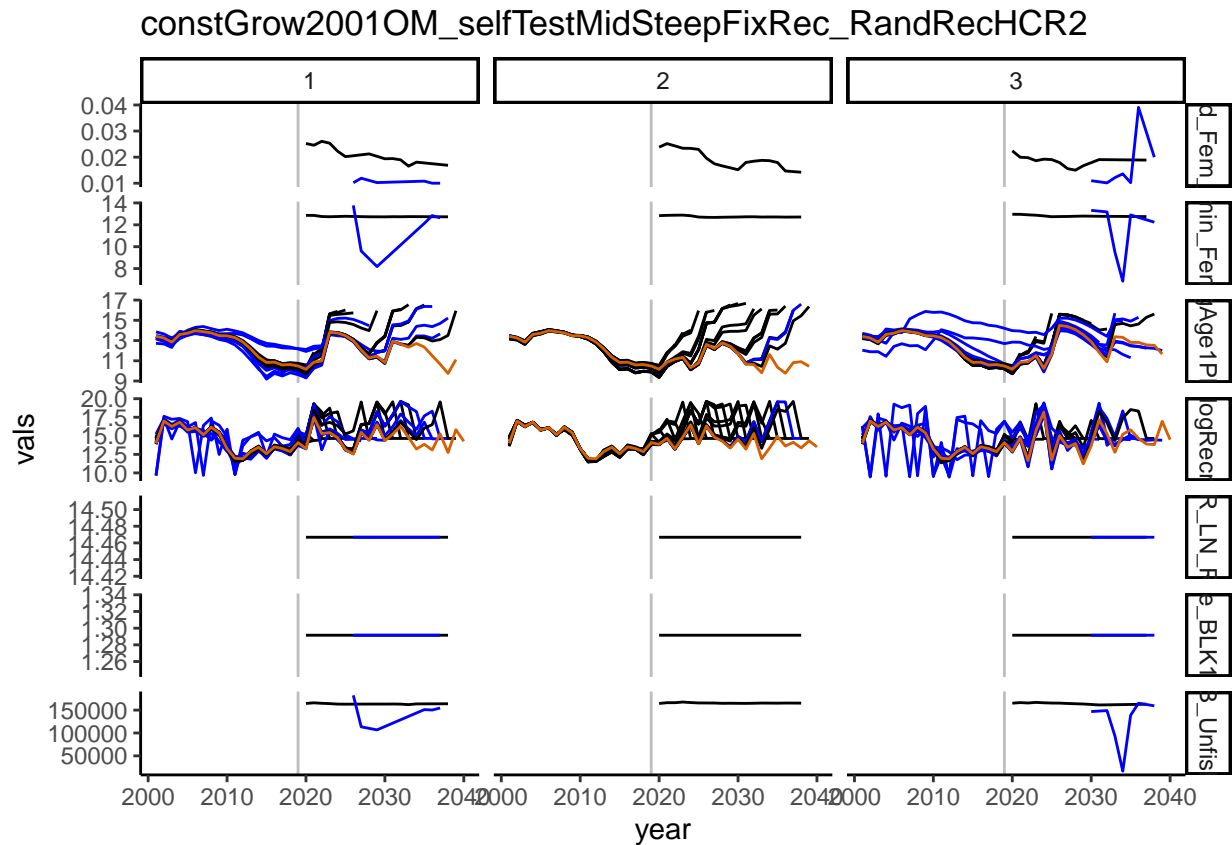
## Warning: Removed 15 row(s) containing missing values (geom_path).
```



```
## Warning: Removed 30 row(s) containing missing values (geom_path).
```

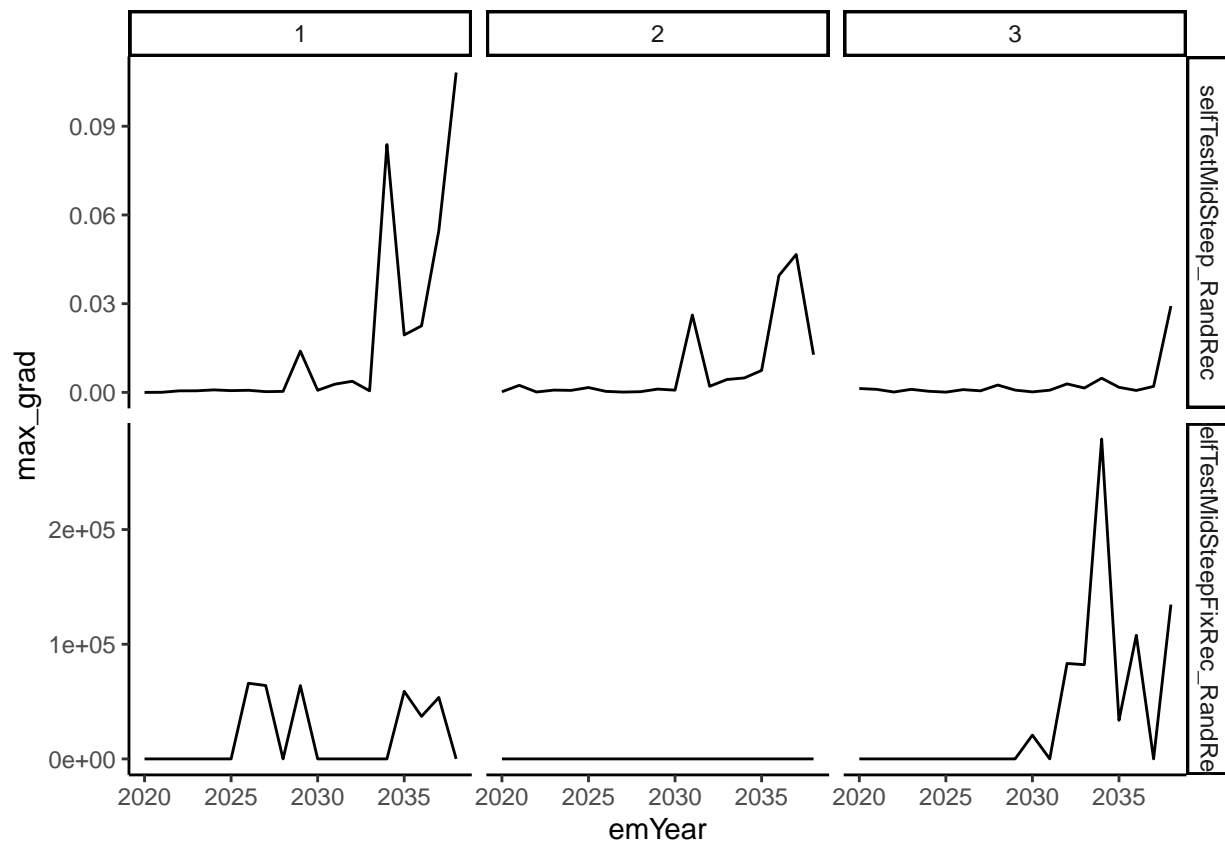


Warning: Removed 30 row(s) containing missing values (geom_path).



```
convrgCheck %>%
  ggplot(aes(x = emYear, y = max_grad)) +
  geom_line(aes(linetype = scenario)) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(recScen), cols = vars(iteration), scales = "free") +
  theme_classic() + theme(legend.position="none")
```

Warning: Removed 7 row(s) containing missing values (geom_path).



```
# investigate non-converged models
```

```
omOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec_RandRec")
```

```
## Getting header info from:
```

```
## C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec_RandRec
```

```
## This function tested on SS versions 3.24 and 3.30.
```

```
## You are using 3.30.18.00 which SHOULD work with this package.
```

```
## Report file time:Tue May 17 17:56:25 2022
```

```
## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec_RandRec"):
```

```
## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec_RandRec"):
```

```
## 'Variances are 0.0 for first two elements, so do not write '
```

```
## input 'covar' changed to FALSE.
```

```
## Reading full report file
```

```
## Got all columns using ncols = 62
```

```
## Got Report file
```

```
## !warning: temporary files were written in this run:
```

```
## TempFile Size
```

```
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
```

```
## <NA> <NA>
```

```
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"
```

```

## Got warning file. Therewere 4 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenario
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
##   2028 rows of length comp data,
##   0 rows of generalized size comp data,
##   459 rows of age comp data,
##   0 rows of conditional age-at-length data,
##   720 rows of ghost fleet age comp data,
##   0 rows of ghost fleet conditional age-at-length data,
##   3471 rows of ghost fleet length comp data,
##   0 rows of mean length at age data,
##   0 rows of mean weight at age data,
##   0 rows of 'TAG1' comp data, and
##   0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR"
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 17:56:25 2022"
##
## $RunTime
## [1] "0 hours, 0 minutes, 1 seconds."
##
## $Files_used
## [1] "Data_File: data.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 4
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR"
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_"
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE: Max data length bin: 28 < max pop len bins: 30; so will accumulate larger pop len bins"
## [11] "2 Forecast=0 or -1, so rest of forecast file will not be read and can be omitted;"
## [12] "2 A one year forecast using recent F will be done automatically"

```

```

## [13] "3 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for
## [14] "4 setting in starter does not request all priors, and 1 parameters have priors and are not est.
## [15] "N warnings: 4"
##
## $likelihoods_used
##
##              values lambdas
## TOTAL          63785.8000000      NA
## Catch           63576.4000000      NA
## Equil_catch      0.0000000      NA
## Survey          -28.0180000      NA
## Length_comp      41.9452000      NA
## Age_comp         37.4688000      NA
## Recruitment      78.3199000        1
## InitEQ_Regime    0.0000000        0
## Forecast_Recruitment 79.6215000        1
## Parm_priors      0.0000000        1
## Parm_softbounds  0.0019748      NA
## Parm_devs        0.0000000        1
## Crash_Pen        0.0000000        1
##
## $likelihoods_laplace
##
##              values lambdas
## NoBias_corr_Recruitment(info_only) 75.1513        1
## Laplace_obj_fun(info_only)        63782.6000      NA
##
## $likelihoods_by_fleet
##
##              Label      ALL      MexCal_S1      MexCal_S2      PNW AT_Survey
## 185      Catch_lambda      NA      1.00000      1.00000      1.00000      1.00000
## 186      Catch_like 63576.4000 26767.60000 26527.50000 10281.40000      0.00000
## 187 Init_equ_lambda      NA      0.00000      0.00000      0.00000      1.00000
## 188 Init_equ_like      0.0000      0.00000      0.00000      0.00000      0.00000
## 189      Surv_lambda      NA      0.00000      0.00000      0.00000      1.00000
## 190      Surv_like -28.0180      0.00000      0.00000      0.00000     -9.94359
## 191      Surv_N_use      NA      0.00000      0.00000      0.00000     18.00000
## 192      Surv_N_skip      NA      0.00000      0.00000      0.00000     20.00000
## 193 Length_lambda      NA      1.00000      1.00000      1.00000      1.00000
## 194 Length_like 41.9452      0.98456      2.63440      1.66827     36.65790
## 195 Length_N_use      NA     14.00000     14.00000     15.00000      9.00000
## 196 Length_N_skip      NA     20.00000     20.00000     29.00000     20.00000
## 197      Age_lambda      NA      1.00000      1.00000      1.00000      1.00000
## 198      Age_like 37.4688      1.16795      3.26694      3.16781     29.86610
## 199      Age_N_use      NA     14.00000     14.00000     14.00000      9.00000
## 200      Age_N_skip      NA     20.00000     20.00000     20.00000     20.00000
##
##      DEPM      TEP_all
## 185 1.00000      1.0000
## 186 0.00000      0.0000
## 187 1.00000      1.0000
## 188 0.00000      0.0000
## 189 1.00000      1.0000
## 190 -1.76351    -16.3109
## 191 10.00000     13.0000
## 192 0.00000      0.0000
## 193 0.00000      0.0000
## 194 0.00000      0.0000

```



```

## 195 0.00000 0.0000
## 196 0.00000 0.0000
## 197 0.00000 0.0000
## 198 0.00000 0.0000
## 199 0.00000 0.0000
## 200 0.00000 0.0000
##
## $N_estimated_parameters
## [1] 1
##
## $table_of_phases
##
## -99 -5 -4 -3 -2 -1
## 1 1 1 10 4 22
##
## $estimated_non_dev_parameters
## [1] Value Phase Min Max Init Status
## [7] Parm_StDev Gradient Pr_type Prior Pr_SD Pr_Like
## <0 rows> (or 0-length row.names)
##
## $maximum_gradient_component
## [1] 0
##
## $Length_Comp_Fit_Summary
## Factor Fleet Recommend_var_adj # N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1846 4 1 59.69170 # 34 14 6 86.00 32.5914
## 1847 4 2 36.47650 # 34 14 9 108.80 59.3200
## 1848 4 3 111.35100 # 44 15 1 174.48 86.7573
## 1849 4 4 0.43845 # 29 9 12 31.00 19.8889
## mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN Curr_Var_Adj
## 1846 32.5914 NA NA 74598.2000 1945.44000 1
## 1847 59.3200 NA NA 70693.4000 2163.79000 1
## 1848 86.7573 NA NA 22722.6000 9660.53000 1
## 1849 19.8889 NA NA 79.1256 8.72028 1
## Fleet_name
## 1846 MexCal_S1
## 1847 MexCal_S2
## 1848 PNW
## 1849 AT_Survey
##
## $Age_Comp_Fit_Summary
## Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1987 5 1 9.329390 # 34 14 5.92 86.00
## 1988 5 2 4.260200 # 34 14 8.92 105.16
## 1989 5 3 17.893600 # 34 14 26.88 138.12
## 1990 5 4 0.428988 # 29 9 12.00 31.00
## mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN
## 1987 31.0686 31.0686 NA NA 10076.4000
## 1988 58.3143 58.3143 NA NA 8139.9400
## 1989 76.2971 76.2971 NA NA 3175.6600
## 1990 19.8889 19.8889 NA NA 60.1969
## HarMean_effN Curr_Var_Adj Fleet_name
## 1987 289.85100 1 MexCal_S1
## 1988 248.43000 1 MexCal_S2

```

```

## 1989    1365.23000          1      PNW
## 1990      8.53209          1  AT_Survey
##
## $SBzero
## [1] 80588.5
##
## $current_depletion
## [1] 0.2633068
##
## $last_years_SPR
## [1] NaN
##
## $SPRratioLabel
## [1] "raw_SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info
##           period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1           Main    20   1.526787   2.331078      NA             NA
## 2      Early+Main    26   1.364724   1.862471      NA             NA
## 3 Early+Main+Late    46   1.374346   1.888828      NA             NA
##  sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1                      NA              3.053573              NA
## 2                      NA              2.729447              NA
## 3                      NA              2.748692              NA
##  alternative_sigma_R
## 1                      NA
## 2                      NA
## 3                      NA
##
## $rmse_table
##   ERA  N    RMSE RMSE_over_sigmaR mean_BiasAdj
## 1 main 20 1.488130      8.85811    0.841539
## 2 early 6 0.618608      1.53070    0.766330

## completed SS_output

fixedOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec

## Getting header info from:
##   C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec
## This function tested on SS versions 3.24 and 3.30.
##   You are using 3.30.18.00 which SHOULD work with this package.
## Report file time:Tue May 17 17:52:46 2022

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteepFixRec
##   'Variances are 0.0 for first two elements, so do not write '
##   input 'covar' changed to FALSE.

```

```

## Reading full report file
## Got all columns using ncols = 62
## Got Report file
## Setting minimum biomass threshold to 0.25 based on US west coast assumption associated with biomass
## !warning: temporary files were written in this run:

##                               TempFile                               Size
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
##                               <NA>                               <NA>
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"

## Got warning file. There were 8 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenario
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
## 4524 rows of length comp data,
## 0 rows of generalized size comp data,
## 1035 rows of age comp data,
## 0 rows of conditional age-at-length data,
## 0 rows of ghost fleet age comp data,
## 0 rows of ghost fleet conditional age-at-length data,
## 351 rows of ghost fleet length comp data,
## 0 rows of mean length at age data,
## 0 rows of mean weight at age data,
## 0 rows of 'TAG1' comp data, and
## 0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
## running SS_readstarter
## data, control files: init_dat.ss, control.ss
## converge_criterion = 1e-05
## SPR_basis = 4
## F_report_basis = 2
## Assuming version 3.30 based on number of numeric values.
## MCMC_output_detail = 0
## ALK_tolerance = 1e-04
## Reading a random seed value:11917336
## Read of starter file complete. Final value: 3.3
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADM
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 17:52:46 2022"
##

```

```

## $RunTime
## [1] "0 hours, 0 minutes, 37 seconds."
##
## $Files_used
## [1] "Data_File: init_dat.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 8
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE: Max data length bin: 28 < max pop len bins: 30; so will accumulate larger pop len bins
## [11] "2 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for
## [12] "3 setting in starter does not request all priors, and 1 parameters have priors and are not est
## [13] "4 1st iteration warning: ssb(endyr)/ssb(styr)= 1.035e-07; suggest start with larger R0 to get r
## [14] "5 Final gradient: 58924.5 is larger than final_conv: 1e-05"
## [15] "6 setting positive forecast relF for forecast only fleet: 1"
## [16] "7 setting positive forecast relF for forecast only fleet: 2"
## [17] "8 Number_of_active_parameters_on_or_near_bounds: 1"
## [18] "N warnings: 8"
##
## $likelihoods_used
##
##              values lambdas
## TOTAL          12914.700000000    NA
## Catch           1.097720000    NA
## Equil_catch      0.000000000    NA
## Survey          370.882000000    NA
## Length_comp     8651.920000000    NA
## Age_comp        3516.200000000    NA
## Recruitment     153.706000000     1
## InitEQ_Regime    0.000000000     0
## Forecast_Recruitment 220.848000000     1
## Parm_priors      0.000000000     1
## Parm_softbounds  0.000943409    NA
## Parm_devs        0.000000000     1
## Crash_Pen        0.000000000     1
##
## $likelihoods_laplace
##
##              values lambdas
## NoBias_corr_Recruitment(info_only) 150.537     1
## Laplace_obj_fun(info_only)         12911.500    NA
##
## $likelihoods_by_fleet
##
##              Label      ALL  MexCal_S1  MexCal_S2      PNW AT_Survey
## 180  Catch_lambda      NA 1.00000e+00  1.000000  1.00000  1.000
## 181  Catch_like    1.09772 1.50678e-03  0.086501  1.00971  0.000

```

```

## 182 Init_equ_lambda      NA 0.00000e+00    0.000000    0.00000    1.000
## 183   Init_equ_like      0.00000 0.00000e+00    0.000000    0.00000    0.000
## 184     Surv_lambda      NA 0.00000e+00    0.000000    0.00000    1.000
## 185     Surv_like    370.88200 0.00000e+00    0.000000    0.00000   377.481
## 186     Surv_N_use      NA 0.00000e+00    0.000000    0.00000   34.000
## 187     Surv_N_skip      NA 0.00000e+00    0.000000    0.00000    0.000
## 188   Length_lambda      NA 1.00000e+00    1.000000    1.00000    1.000
## 189   Length_like    8651.92000 2.68497e+03 1572.780000 1125.76000 3268.420
## 190   Length_N_use      NA 3.00000e+01   30.000000   31.00000   25.000
## 191   Length_N_skip      NA 0.00000e+00    0.000000    9.00000    0.000
## 192     Age_lambda      NA 1.00000e+00    1.000000    1.00000    1.000
## 193     Age_like    3516.20000 3.00783e+02  672.655000  569.04300 1973.720
## 194     Age_N_use      NA 3.00000e+01   30.000000   30.00000   25.000
## 195     Age_N_skip      NA 0.00000e+00    0.000000    0.00000    0.000
##      DEPM   TEP_all
## 180 1.000000 1.00000
## 181 0.000000 0.00000
## 182 1.000000 1.00000
## 183 0.000000 0.00000
## 184 1.000000 1.00000
## 185 -0.858206 -5.74158
## 186 10.000000 13.00000
## 187 0.000000 0.00000
## 188 0.000000 0.00000
## 189 0.000000 0.00000
## 190 0.000000 0.00000
## 191 0.000000 0.00000
## 192 0.000000 0.00000
## 193 0.000000 0.00000
## 194 0.000000 0.00000
## 195 0.000000 0.00000
##
## $N_estimated_parameters
## [1] 61
##
## $table_of_phases
##
## -99  -5  -4  -3  -2  -1   1   2   3   4   5
##   1   1   2  10   4   3  20   6  16   2  17
##
## $estimated_non_dev_parameters
##
##      Value Phase   Min   Max      Init Status
## L_at_Amin_Fem_GP_1    12.1358000    3   3.00 30.00 12.8541000    OK
## L_at_Amax_Fem_GP_1    25.7290000    3  15.00 40.00 24.8415000    OK
## VonBert_K_Fem_GP_1     0.2894620    3   0.05  0.99  0.3075730    OK
## CV_young_Fem_GP_1     0.1342370    3   0.05  0.50  0.1053490    OK
## CV_old_Fem_GP_1       0.0108055    3   0.01  0.10  0.0237245    LO
## Size_inflection_MexCal_S1(1) 13.1826000    3   0.00 30.00 10.9072000    OK
## Size_95%width_MexCal_S1(1)   2.1659400    3   0.00 10.00  0.6599090    OK
## AgeSel_P1_MexCal_S1(1)   0.5000130    3 -10.00 11.00  0.5000240    OK
## AgeSel_P2_MexCal_S1(1)  -1.2206900    3 -10.00 11.00  0.2048810    OK
## AgeSel_P3_MexCal_S1(1)   0.2638380    3 -10.00 15.00  0.3827920    OK
## AgeSel_P4_MexCal_S1(1)  -1.5115700    3 -10.00 11.00 -1.5494000    OK
## AgeSel_P5_MexCal_S1(1)  -0.1259250    3 -10.00 11.00 -0.2361890    OK

```

```

## AgeSel_P2_MexCal_S2(2)      -0.4749760      3 -10.00 15.00  0.4405260      OK
## AgeSel_P3_MexCal_S2(2)      -0.8140620      3 -10.00 11.00 -1.1690800      OK
## AgeSel_P4_MexCal_S2(2)      -0.5149490      3 -10.00 11.00 -0.1425740      OK
## AgeSel_P5_MexCal_S2(2)      -0.3653070      3 -10.00 11.00 -0.4707320      OK
## Age_inflection_PNW(3)        2.9051200      4   0.00 10.00  2.8525100      OK
## Age_95%width_PNW(3)         1.1841200      4  -5.00 15.00  1.2152300      OK
##                               Parm_StDev          Gradient  Pr_type Prior
## L_at_Amin_Fem_GP_1          0                      NaN No_prior  NA
## L_at_Amax_Fem_GP_1          0                      NaN No_prior  NA
## VonBert_K_Fem_GP_1          0                      NaN No_prior  NA
## CV_young_Fem_GP_1           0 -3757.34999999999991 No_prior  NA
## CV_old_Fem_GP_1             0                      NaN No_prior  NA
## Size_inflection_MexCal_S1(1) 0                      NaN No_prior  NA
## Size_95%width_MexCal_S1(1)   0                      NaN No_prior  NA
## AgeSel_P1_MexCal_S1(1)       0      0.00000000383115 No_prior  NA
## AgeSel_P2_MexCal_S1(1)       0 -3729.389999999999987 No_prior  NA
## AgeSel_P3_MexCal_S1(1)       0 -5080.130000000000011 No_prior  NA
## AgeSel_P4_MexCal_S1(1)       0  4123.869999999999989 No_prior  NA
## AgeSel_P5_MexCal_S1(1)       0  4203.180000000000029 No_prior  NA
## AgeSel_P2_MexCal_S2(2)       0 -41398.900000000000146 No_prior  NA
## AgeSel_P3_MexCal_S2(2)       0 -8265.120000000000080 No_prior  NA
## AgeSel_P4_MexCal_S2(2)       0 -3679.239999999999978 No_prior  NA
## AgeSel_P5_MexCal_S2(2)       0  -644.740000000000001 No_prior  NA
## Age_inflection_PNW(3)        0 -6607.960000000000004 No_prior  NA
## Age_95%width_PNW(3)         0  9133.920000000000007 No_prior  NA
##                               Pr_SD Pr_Like Afterbound
## L_at_Amin_Fem_GP_1          NA      NA      OK
## L_at_Amax_Fem_GP_1          NA      NA      OK
## VonBert_K_Fem_GP_1          NA      NA      OK
## CV_young_Fem_GP_1           NA      NA      OK
## CV_old_Fem_GP_1             NA      NA      CHECK
## Size_inflection_MexCal_S1(1) NA      NA      OK
## Size_95%width_MexCal_S1(1)   NA      NA      OK
## AgeSel_P1_MexCal_S1(1)       NA      NA      OK
## AgeSel_P2_MexCal_S1(1)       NA      NA      OK
## AgeSel_P3_MexCal_S1(1)       NA      NA      OK
## AgeSel_P4_MexCal_S1(1)       NA      NA      OK
## AgeSel_P5_MexCal_S1(1)       NA      NA      OK
## AgeSel_P2_MexCal_S2(2)       NA      NA      OK
## AgeSel_P3_MexCal_S2(2)       NA      NA      OK
## AgeSel_P4_MexCal_S2(2)       NA      NA      OK
## AgeSel_P5_MexCal_S2(2)       NA      NA      OK
## Age_inflection_PNW(3)        NA      NA      OK
## Age_95%width_PNW(3)         NA      NA      OK
##
## $maximum_gradient_component
## [1] 58924.5
##
## $parameters_with_highest_gradients
##                               Value Gradient
## AgeSel_P2_MexCal_S2(2) -0.474976 -41398.90
## Late_RecrDev_2021      3.729200  15581.20
## Main_RecrDev_2019       0.191979   9549.98
## Age_95%width_PNW(3)     1.184120   9133.92

```

```

## AgeSel_P3_MexCal_S2(2) -0.814062 -8265.12
##
## $Length_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1648      4      1      0.0254428 # 30 30      6      2000      1081.73
## 1649      4      2      0.0563949 # 30 30      9      2000      1094.20
## 1650      4      3      0.0223265 # 40 31      1      2000      1074.03
## 1651      4      4      0.0150114 # 25 25     12      2000      1287.16
##      mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN Curr_Var_Adj
## 1648      1081.73      NA      NA 315.7830      27.5223      1
## 1649      1094.20      NA      NA 178.1230      61.7073      1
## 1650      1074.03      NA      NA 364.1850      23.9794      1
## 1651      1287.16      NA      NA 44.6371      19.3221      1
##      Fleet_name
## 1648 MexCal_S1
## 1649 MexCal_S2
## 1650      PNW
## 1651 AT_Survey
##
## $Age_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1773      5      1      0.0257599 #      30 30      100      2000
## 1774      5      2      0.0203643 #      30 30      100      2000
## 1775      5      3      0.0668584 #      30 30      100      2000
## 1776      5      4      0.0167467 #      25 25      100      2000
##      mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN
## 1773      1113.33      1113.33      NA      NA 993.754      28.6794
## 1774      1113.33      1113.33      NA      NA 337.714      22.6723
## 1775      1113.33      1113.33      NA      NA 730.812      74.4357
## 1776      1316.00      1316.00      NA      NA 55.337      22.0387
##      Curr_Var_Adj Fleet_name
## 1773      1 MexCal_S1
## 1774      1 MexCal_S2
## 1775      1      PNW
## 1776      1 AT_Survey
##
## $SBzero
## [1] 75537.5
##
## $current_depletion
## [1] 67.02697
##
## $last_years_SPR
## [1] 0.969296
##
## $SPRratioLabel
## [1] "1-SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info
##      period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1      Main      20 1.467892 2.154708      0      0

```

```
## 2      Early+Main      26      1.822159      3.320264      0      0
## 3 Early+Main+Late      42      2.119524      4.492384      0      0
##      sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1              1.467892              2.935785              2.935785
## 2              1.822159              3.644318              3.644318
## 3              2.119524              4.239049              4.239049
##      alternative_sigma_R
## 1              1.467892
## 2              1.822159
## 3              2.119524
##
## $rmse_table
##      ERA N      RMSE RMSE_over_sigmaR mean_BiasAdj
## 1 main 20 1.43072      8.18789      0.841539
## 2 early 6 2.68763      28.89340      0.766330
```

```
## completed SS_output
```

```
compFixed <- SSsummarize(list(OM = omOut, EM2032 = fixedOut))
```

```
## Summarizing 2 models:
## imodel=1/2
##      N active pars = 0
## imodel=2/2
##      N active pars = 61
## Summary finished. To avoid printing details above, use 'verbose = FALSE'.
```

```
compFixed$pars$relErr <- round((compFixed$pars$EM2032 - compFixed$pars$OM)/compFixed$pars$OM, digits = 3)
SSplotComparisons(compFixed)
```

```
## Warning in SSplotComparisons(compFixed): setting btarg = -999 because models
## don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting minbthresh = -999 because
## models don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting sprtarg = -999 because models
## don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting label for SPR plot to 8th
## element of input 'labels' because the models don't have matching labels
```

```
## Warning in SSplotComparisons(compFixed): setting label for F plot to 13th
## element of input 'labels' because the models don't have matching labels
```

```
## showing uncertainty for all models
## No uncertainty available for model 1
## No uncertainty available for model 2
## skipping plots with uncertainty:2,4,6,8,10,12
## subplot 1: spawning biomass
## subplot 3: biomass ratio (hopefully equal to fraction of unfished)
```



```
## subplot 5: SPR ratio
## subplot 7: F value
## subplot 9: recruits
## subplot 11: recruit devs
## subplot 13: index fits
## subplot 14: index fits on a log scale
## subplot 15: phase plot
```

```
compFixed$pars
```

##	OM	EM2032	Label	Yr	recdev	relErr
## 1	5.85000e-01	5.85000e-01	NatM_uniform_Fem_GP_1	NA	FALSE	0.000
## 2	1.28541e+01	1.21358e+01	L_at_Amin_Fem_GP_1	NA	FALSE	-0.056
## 3	2.48415e+01	2.57290e+01	L_at_Amax_Fem_GP_1	NA	FALSE	0.036
## 4	3.07573e-01	2.89462e-01	VonBert_K_Fem_GP_1	NA	FALSE	-0.059
## 5	1.05349e-01	1.34237e-01	CV_young_Fem_GP_1	NA	FALSE	0.274
## 6	2.37245e-02	1.08055e-02	CV_old_Fem_GP_1	NA	FALSE	-0.545
## 7	7.52420e-06	7.52420e-06	Wtlen_1_Fem_GP_1	NA	FALSE	0.000
## 8	3.23320e+00	3.23320e+00	Wtlen_2_Fem_GP_1	NA	FALSE	0.000
## 9	1.54400e+01	1.54400e+01	Mat50%_Fem_GP_1	NA	FALSE	0.000
## 10	-8.92520e-01	-8.92520e-01	Mat_slope_Fem_GP_1	NA	FALSE	0.000
## 11	1.00000e+00	1.00000e+00	Eggs/kg_inter_Fem_GP_1	NA	FALSE	0.000
## 12	0.00000e+00	0.00000e+00	Eggs/kg_slope_wt_Fem_GP_1	NA	FALSE	NaN
## 13	1.00000e+00	1.00000e+00	CohortGrowDev	NA	FALSE	0.000
## 14	5.00000e-01	5.00000e-01	FracFemale_GP_1	NA	FALSE	0.000
## 15	1.44668e+01	1.44668e+01	SR_LN(R0)	NA	FALSE	0.000
## 16	6.00000e-01	6.00000e-01	SR_BH_steep	NA	FALSE	0.000
## 17	5.00000e-01	5.00000e-01	SR_sigmaR	NA	FALSE	0.000
## 18	0.00000e+00	0.00000e+00	SR_regime	NA	FALSE	NaN
## 19	0.00000e+00	0.00000e+00	SR_autocorr	NA	FALSE	NaN
## 20	1.29153e+00	1.29153e+00	SR_regime_BLK1repl_2000	2000	FALSE	0.000
## 21	-2.88697e-01	-3.07707e+00	Early_InitAge_7	1994	TRUE	9.658
## 22	3.72469e-01	1.99899e+00	Early_InitAge_6	1995	TRUE	4.367
## 23	4.78720e-01	-1.85034e+00	Early_InitAge_5	1996	TRUE	-4.865
## 24	9.02129e-01	1.14370e+00	Early_InitAge_4	1997	TRUE	0.268
## 25	3.05911e-01	9.54468e-01	Early_InitAge_3	1998	TRUE	2.120
## 26	-9.68186e-01	-4.92270e+00	Early_InitAge_2	1999	TRUE	4.084
## 27	-8.66061e-01	1.68919e-01	Main_InitAge_1	2000	TRUE	-1.195
## 28	-4.83997e-01	-6.35286e-01	Main_RecrDev_2001	2001	TRUE	0.313
## 29	2.54035e+00	2.49671e+00	Main_RecrDev_2002	2002	TRUE	-0.017
## 30	1.80610e+00	1.72999e+00	Main_RecrDev_2003	2003	TRUE	-0.042
## 31	2.35307e+00	2.38757e+00	Main_RecrDev_2004	2004	TRUE	0.015
## 32	1.28145e+00	1.11743e+00	Main_RecrDev_2005	2005	TRUE	-0.128
## 33	1.60077e+00	1.70789e+00	Main_RecrDev_2006	2006	TRUE	0.067
## 34	6.42868e-01	7.45676e-01	Main_RecrDev_2007	2007	TRUE	0.160
## 35	1.67048e+00	1.61034e+00	Main_RecrDev_2008	2008	TRUE	-0.036
## 36	9.11681e-01	-4.11908e-01	Main_RecrDev_2009	2009	TRUE	-1.452
## 37	-1.22678e+00	-6.46226e-01	Main_RecrDev_2010	2010	TRUE	-0.473
## 38	-2.49263e+00	-2.55205e+00	Main_RecrDev_2011	2011	TRUE	0.024
## 39	-2.50412e+00	-1.80898e+00	Main_RecrDev_2012	2012	TRUE	-0.278
## 40	-1.39346e+00	-1.65086e+00	Main_RecrDev_2013	2013	TRUE	0.185
## 41	-6.05812e-01	-7.61842e-01	Main_RecrDev_2014	2014	TRUE	0.258
## 42	-1.37941e+00	-1.72643e+00	Main_RecrDev_2015	2015	TRUE	0.252
## 43	-4.19554e-01	-3.60905e-01	Main_RecrDev_2016	2016	TRUE	-0.140

## 44	-5.84894e-01	-5.21453e-01	Main_RecrDev_2017	2017	TRUE	-0.108
## 45	-1.03107e+00	-1.08059e+00	Main_RecrDev_2018	2018	TRUE	0.048
## 46	1.81024e-01	1.91979e-01	Main_RecrDev_2019	2019	TRUE	0.061
## 47	-5.53022e-01	-5.36846e-02	Late_RecrDev_2020	2020	TRUE	-0.903
## 48	3.41754e+00	3.72920e+00	Late_RecrDev_2021	2021	TRUE	0.091
## 49	8.05897e-01	8.71901e-01	Late_RecrDev_2022	2022	TRUE	0.082
## 50	8.29097e-01	9.25592e-01	Late_RecrDev_2023	2023	TRUE	0.116
## 51	1.44066e-01	1.63539e-01	Late_RecrDev_2024	2024	TRUE	0.135
## 52	-1.45429e+00	-1.37218e+00	Late_RecrDev_2025	2025	TRUE	-0.056
## 53	-1.96859e+00	-1.96349e+00	Late_RecrDev_2026	2026	TRUE	-0.003
## 54	1.07576e+00	1.35716e+00	Late_RecrDev_2027	2027	TRUE	0.262
## 55	2.56016e-01	1.21952e+00	Late_RecrDev_2028	2028	TRUE	3.763
## 56	2.41263e+00	3.96429e+00	Late_RecrDev_2029	2029	TRUE	0.643
## 57	-2.13077e-02	1.78000e+00	Late_RecrDev_2030	2030	TRUE	-84.538
## 58	7.01607e-01	3.27149e+00	Late_RecrDev_2031	2031	TRUE	3.663
## 59	1.77653e+00	4.99788e+00	Late_RecrDev_2032	2032	TRUE	1.813
## 60	3.15854e-01	4.26346e+00	Late_RecrDev_2033	2033	TRUE	12.498
## 61	-1.27045e+00	3.61393e+00	Late_RecrDev_2034	2034	TRUE	-3.845
## 62	-5.69927e-01	0.00000e+00	Late_RecrDev_2035	2035	TRUE	-1.000
## 63	-1.02099e+00	NA	Late_RecrDev_2036	2036	TRUE	NA
## 64	1.62756e+00	NA	Late_RecrDev_2037	2037	TRUE	NA
## 65	-1.01834e+00	NA	Late_RecrDev_2038	2038	TRUE	NA
## 66	1.73727e+00	NA	Late_RecrDev_2039	2039	TRUE	NA
## 67	0.00000e+00	NA	ForeRecr_2040	2040	TRUE	NA
## 68	1.21292e-01	NA	F_fleet_1_YR_2001_s_1	2001	FALSE	NA
## 69	1.60017e-01	NA	F_fleet_1_YR_2002_s_1	2002	FALSE	NA
## 70	1.15293e-01	NA	F_fleet_1_YR_2003_s_1	2003	FALSE	NA
## 71	7.42379e-02	NA	F_fleet_1_YR_2004_s_1	2004	FALSE	NA
## 72	3.87888e-02	NA	F_fleet_1_YR_2005_s_1	2005	FALSE	NA
## 73	6.25647e-02	NA	F_fleet_1_YR_2006_s_1	2006	FALSE	NA
## 74	1.54007e-01	NA	F_fleet_1_YR_2007_s_1	2007	FALSE	NA
## 75	1.56914e-01	NA	F_fleet_1_YR_2008_s_1	2008	FALSE	NA
## 76	9.04702e-02	NA	F_fleet_1_YR_2009_s_1	2009	FALSE	NA
## 77	7.50834e-02	NA	F_fleet_1_YR_2010_s_1	2010	FALSE	NA
## 78	1.59744e-01	NA	F_fleet_1_YR_2011_s_1	2011	FALSE	NA
## 79	2.26301e-02	NA	F_fleet_1_YR_2012_s_1	2012	FALSE	NA
## 80	5.05764e-02	NA	F_fleet_1_YR_2013_s_1	2013	FALSE	NA
## 81	2.33744e-01	NA	F_fleet_1_YR_2014_s_1	2014	FALSE	NA
## 82	7.89600e-04	NA	F_fleet_1_YR_2015_s_1	2015	FALSE	NA
## 83	2.28433e-02	NA	F_fleet_1_YR_2016_s_1	2016	FALSE	NA
## 84	1.69121e-02	NA	F_fleet_1_YR_2017_s_1	2017	FALSE	NA
## 85	3.69568e-03	NA	F_fleet_1_YR_2018_s_1	2018	FALSE	NA
## 86	1.36791e-02	NA	F_fleet_1_YR_2019_s_1	2019	FALSE	NA
## 87	0.00000e+00	NA	F_fleet_1_YR_2020_s_1	2020	FALSE	NA
## 88	0.00000e+00	NA	F_fleet_1_YR_2020_s_2	2020	FALSE	NA
## 89	0.00000e+00	NA	F_fleet_1_YR_2021_s_1	2021	FALSE	NA
## 90	0.00000e+00	NA	F_fleet_1_YR_2021_s_2	2021	FALSE	NA
## 91	1.24856e-01	NA	F_fleet_1_YR_2022_s_1	2022	FALSE	NA
## 92	0.00000e+00	NA	F_fleet_1_YR_2022_s_2	2022	FALSE	NA
## 93	1.34846e-01	NA	F_fleet_1_YR_2023_s_1	2023	FALSE	NA
## 94	0.00000e+00	NA	F_fleet_1_YR_2023_s_2	2023	FALSE	NA
## 95	1.11726e-01	NA	F_fleet_1_YR_2024_s_1	2024	FALSE	NA
## 96	0.00000e+00	NA	F_fleet_1_YR_2024_s_2	2024	FALSE	NA
## 97	3.81286e-01	NA	F_fleet_1_YR_2025_s_1	2025	FALSE	NA

## 98	0.00000e+00	NA	F_fleet_1_YR_2025_s_2	2025	FALSE	NA
## 99	6.96600e-01	NA	F_fleet_1_YR_2026_s_1	2026	FALSE	NA
## 100	0.00000e+00	NA	F_fleet_1_YR_2026_s_2	2026	FALSE	NA
## 101	6.29423e-01	NA	F_fleet_1_YR_2027_s_1	2027	FALSE	NA
## 102	0.00000e+00	NA	F_fleet_1_YR_2027_s_2	2027	FALSE	NA
## 103	1.50000e+00	NA	F_fleet_1_YR_2028_s_1	2028	FALSE	NA
## 104	0.00000e+00	NA	F_fleet_1_YR_2028_s_2	2028	FALSE	NA
## 105	1.50000e+00	NA	F_fleet_1_YR_2029_s_1	2029	FALSE	NA
## 106	0.00000e+00	NA	F_fleet_1_YR_2029_s_2	2029	FALSE	NA
## 107	9.25707e-03	NA	F_fleet_1_YR_2030_s_1	2030	FALSE	NA
## 108	0.00000e+00	NA	F_fleet_1_YR_2030_s_2	2030	FALSE	NA
## 109	3.36738e-01	NA	F_fleet_1_YR_2031_s_1	2031	FALSE	NA
## 110	0.00000e+00	NA	F_fleet_1_YR_2031_s_2	2031	FALSE	NA
## 111	3.66230e-01	NA	F_fleet_1_YR_2032_s_1	2032	FALSE	NA
## 112	0.00000e+00	NA	F_fleet_1_YR_2032_s_2	2032	FALSE	NA
## 113	1.04331e+00	NA	F_fleet_1_YR_2033_s_1	2033	FALSE	NA
## 114	0.00000e+00	NA	F_fleet_1_YR_2033_s_2	2033	FALSE	NA
## 115	4.69391e-01	NA	F_fleet_1_YR_2034_s_1	2034	FALSE	NA
## 116	0.00000e+00	NA	F_fleet_1_YR_2034_s_2	2034	FALSE	NA
## 117	5.83577e-01	NA	F_fleet_1_YR_2035_s_1	2035	FALSE	NA
## 118	0.00000e+00	NA	F_fleet_1_YR_2035_s_2	2035	FALSE	NA
## 119	1.50000e+00	NA	F_fleet_1_YR_2036_s_1	2036	FALSE	NA
## 120	0.00000e+00	NA	F_fleet_1_YR_2036_s_2	2036	FALSE	NA
## 121	1.50000e+00	NA	F_fleet_1_YR_2037_s_1	2037	FALSE	NA
## 122	0.00000e+00	NA	F_fleet_1_YR_2037_s_2	2037	FALSE	NA
## 123	1.50000e+00	NA	F_fleet_1_YR_2038_s_1	2038	FALSE	NA
## 124	0.00000e+00	NA	F_fleet_1_YR_2038_s_2	2038	FALSE	NA
## 125	3.00000e-01	NA	F_fleet_1_YR_2039_s_1	2039	FALSE	NA
## 126	0.00000e+00	NA	F_fleet_1_YR_2039_s_2	2039	FALSE	NA
## 127	3.31839e-01	NA	F_fleet_2_YR_2001_s_2	2001	FALSE	NA
## 128	3.51054e-01	NA	F_fleet_2_YR_2002_s_2	2002	FALSE	NA
## 129	9.61885e-02	NA	F_fleet_2_YR_2003_s_2	2003	FALSE	NA
## 130	6.66212e-02	NA	F_fleet_2_YR_2004_s_2	2004	FALSE	NA
## 131	8.45597e-02	NA	F_fleet_2_YR_2005_s_2	2005	FALSE	NA
## 132	1.11160e-01	NA	F_fleet_2_YR_2006_s_2	2006	FALSE	NA
## 133	1.83117e-01	NA	F_fleet_2_YR_2007_s_2	2007	FALSE	NA
## 134	2.14921e-01	NA	F_fleet_2_YR_2008_s_2	2008	FALSE	NA
## 135	1.84649e-01	NA	F_fleet_2_YR_2009_s_2	2009	FALSE	NA
## 136	1.47652e-01	NA	F_fleet_2_YR_2010_s_2	2010	FALSE	NA
## 137	2.44080e-01	NA	F_fleet_2_YR_2011_s_2	2011	FALSE	NA
## 138	4.18170e-01	NA	F_fleet_2_YR_2012_s_2	2012	FALSE	NA
## 139	4.46688e-01	NA	F_fleet_2_YR_2013_s_2	2013	FALSE	NA
## 140	8.55593e-02	NA	F_fleet_2_YR_2014_s_2	2014	FALSE	NA
## 141	1.45442e-02	NA	F_fleet_2_YR_2015_s_2	2015	FALSE	NA
## 142	5.76442e-01	NA	F_fleet_2_YR_2016_s_2	2016	FALSE	NA
## 143	5.67745e-01	NA	F_fleet_2_YR_2017_s_2	2017	FALSE	NA
## 144	9.61627e-01	NA	F_fleet_2_YR_2018_s_2	2018	FALSE	NA
## 145	1.39729e+00	NA	F_fleet_2_YR_2019_s_2	2019	FALSE	NA
## 146	0.00000e+00	NA	F_fleet_2_YR_2020_s_1	2020	FALSE	NA
## 147	0.00000e+00	NA	F_fleet_2_YR_2020_s_2	2020	FALSE	NA
## 148	0.00000e+00	NA	F_fleet_2_YR_2021_s_1	2021	FALSE	NA
## 149	0.00000e+00	NA	F_fleet_2_YR_2021_s_2	2021	FALSE	NA
## 150	0.00000e+00	NA	F_fleet_2_YR_2022_s_1	2022	FALSE	NA
## 151	2.04668e-02	NA	F_fleet_2_YR_2022_s_2	2022	FALSE	NA

## 152	0.00000e+00	NA	F_fleet_2_YR_2023_s_1	2023	FALSE	NA
## 153	1.39717e-01	NA	F_fleet_2_YR_2023_s_2	2023	FALSE	NA
## 154	0.00000e+00	NA	F_fleet_2_YR_2024_s_1	2024	FALSE	NA
## 155	3.80791e-01	NA	F_fleet_2_YR_2024_s_2	2024	FALSE	NA
## 156	0.00000e+00	NA	F_fleet_2_YR_2025_s_1	2025	FALSE	NA
## 157	6.01903e-01	NA	F_fleet_2_YR_2025_s_2	2025	FALSE	NA
## 158	0.00000e+00	NA	F_fleet_2_YR_2026_s_1	2026	FALSE	NA
## 159	1.50000e+00	NA	F_fleet_2_YR_2026_s_2	2026	FALSE	NA
## 160	0.00000e+00	NA	F_fleet_2_YR_2027_s_1	2027	FALSE	NA
## 161	1.47956e+00	NA	F_fleet_2_YR_2027_s_2	2027	FALSE	NA
## 162	0.00000e+00	NA	F_fleet_2_YR_2028_s_1	2028	FALSE	NA
## 163	1.50000e+00	NA	F_fleet_2_YR_2028_s_2	2028	FALSE	NA
## 164	0.00000e+00	NA	F_fleet_2_YR_2029_s_1	2029	FALSE	NA
## 165	1.50000e+00	NA	F_fleet_2_YR_2029_s_2	2029	FALSE	NA
## 166	0.00000e+00	NA	F_fleet_2_YR_2030_s_1	2030	FALSE	NA
## 167	2.61445e-03	NA	F_fleet_2_YR_2030_s_2	2030	FALSE	NA
## 168	0.00000e+00	NA	F_fleet_2_YR_2031_s_1	2031	FALSE	NA
## 169	4.04868e-01	NA	F_fleet_2_YR_2031_s_2	2031	FALSE	NA
## 170	0.00000e+00	NA	F_fleet_2_YR_2032_s_1	2032	FALSE	NA
## 171	1.02303e+00	NA	F_fleet_2_YR_2032_s_2	2032	FALSE	NA
## 172	0.00000e+00	NA	F_fleet_2_YR_2033_s_1	2033	FALSE	NA
## 173	5.88645e-01	NA	F_fleet_2_YR_2033_s_2	2033	FALSE	NA
## 174	0.00000e+00	NA	F_fleet_2_YR_2034_s_1	2034	FALSE	NA
## 175	5.96913e-01	NA	F_fleet_2_YR_2034_s_2	2034	FALSE	NA
## 176	0.00000e+00	NA	F_fleet_2_YR_2035_s_1	2035	FALSE	NA
## 177	1.50000e+00	NA	F_fleet_2_YR_2035_s_2	2035	FALSE	NA
## 178	0.00000e+00	NA	F_fleet_2_YR_2036_s_1	2036	FALSE	NA
## 179	1.50000e+00	NA	F_fleet_2_YR_2036_s_2	2036	FALSE	NA
## 180	0.00000e+00	NA	F_fleet_2_YR_2037_s_1	2037	FALSE	NA
## 181	1.50000e+00	NA	F_fleet_2_YR_2037_s_2	2037	FALSE	NA
## 182	0.00000e+00	NA	F_fleet_2_YR_2038_s_1	2038	FALSE	NA
## 183	1.50000e+00	NA	F_fleet_2_YR_2038_s_2	2038	FALSE	NA
## 184	0.00000e+00	NA	F_fleet_2_YR_2039_s_1	2039	FALSE	NA
## 185	3.00000e-01	NA	F_fleet_2_YR_2039_s_2	2039	FALSE	NA
## 186	1.06782e-01	NA	F_fleet_3_YR_2001_s_1	2001	FALSE	NA
## 187	1.93908e-02	NA	F_fleet_3_YR_2001_s_2	2001	FALSE	NA
## 188	2.39520e-01	NA	F_fleet_3_YR_2002_s_1	2002	FALSE	NA
## 189	5.50046e-03	NA	F_fleet_3_YR_2002_s_2	2002	FALSE	NA
## 190	3.95077e-01	NA	F_fleet_3_YR_2003_s_1	2003	FALSE	NA
## 191	3.89999e-02	NA	F_fleet_3_YR_2003_s_2	2003	FALSE	NA
## 192	6.74988e-01	NA	F_fleet_3_YR_2004_s_1	2004	FALSE	NA
## 193	2.11495e-02	NA	F_fleet_3_YR_2004_s_2	2004	FALSE	NA
## 194	7.89422e-01	NA	F_fleet_3_YR_2005_s_1	2005	FALSE	NA
## 195	2.00356e-03	NA	F_fleet_3_YR_2005_s_2	2005	FALSE	NA
## 196	3.01902e-01	NA	F_fleet_3_YR_2006_s_1	2006	FALSE	NA
## 197	2.68273e-01	NA	F_fleet_3_YR_2007_s_1	2007	FALSE	NA
## 198	1.99320e-01	NA	F_fleet_3_YR_2008_s_1	2008	FALSE	NA
## 199	2.53893e-01	NA	F_fleet_3_YR_2009_s_1	2009	FALSE	NA
## 200	1.03103e-02	NA	F_fleet_3_YR_2009_s_2	2009	FALSE	NA
## 201	3.84672e-01	NA	F_fleet_3_YR_2010_s_1	2010	FALSE	NA
## 202	8.75292e-07	NA	F_fleet_3_YR_2010_s_2	2010	FALSE	NA
## 203	3.64402e-01	NA	F_fleet_3_YR_2011_s_1	2011	FALSE	NA
## 204	7.41851e-02	NA	F_fleet_3_YR_2011_s_2	2011	FALSE	NA
## 205	1.07231e+00	NA	F_fleet_3_YR_2012_s_1	2012	FALSE	NA

## 206	2.90892e-02	NA	F_fleet_3_YR_2012_s_2	2012	FALSE	NA
## 207	1.03031e+00	NA	F_fleet_3_YR_2013_s_1	2013	FALSE	NA
## 208	2.64028e-02	NA	F_fleet_3_YR_2013_s_2	2013	FALSE	NA
## 209	5.07457e-01	NA	F_fleet_3_YR_2014_s_1	2014	FALSE	NA
## 210	1.08626e-01	NA	F_fleet_3_YR_2014_s_2	2014	FALSE	NA
## 211	3.90412e-03	NA	F_fleet_3_YR_2015_s_1	2015	FALSE	NA
## 212	9.68231e-05	NA	F_fleet_3_YR_2015_s_2	2015	FALSE	NA
## 213	1.49269e-02	NA	F_fleet_3_YR_2016_s_1	2016	FALSE	NA
## 214	5.66757e-06	NA	F_fleet_3_YR_2016_s_2	2016	FALSE	NA
## 215	1.30617e-04	NA	F_fleet_3_YR_2017_s_1	2017	FALSE	NA
## 216	3.21184e-04	NA	F_fleet_3_YR_2017_s_2	2017	FALSE	NA
## 217	9.56200e-04	NA	F_fleet_3_YR_2018_s_1	2018	FALSE	NA
## 218	3.99623e-04	NA	F_fleet_3_YR_2018_s_2	2018	FALSE	NA
## 219	1.13294e-03	NA	F_fleet_3_YR_2019_s_1	2019	FALSE	NA
## 220	4.89963e-04	NA	F_fleet_3_YR_2019_s_2	2019	FALSE	NA
## 221	0.00000e+00	NA	F_fleet_3_YR_2020_s_1	2020	FALSE	NA
## 222	0.00000e+00	NA	F_fleet_3_YR_2020_s_2	2020	FALSE	NA
## 223	0.00000e+00	NA	F_fleet_3_YR_2021_s_1	2021	FALSE	NA
## 224	0.00000e+00	NA	F_fleet_3_YR_2021_s_2	2021	FALSE	NA
## 225	1.50000e+00	NA	F_fleet_3_YR_2022_s_1	2022	FALSE	NA
## 226	4.87566e-02	NA	F_fleet_3_YR_2022_s_2	2022	FALSE	NA
## 227	1.50000e+00	NA	F_fleet_3_YR_2023_s_1	2023	FALSE	NA
## 228	2.20301e-01	NA	F_fleet_3_YR_2023_s_2	2023	FALSE	NA
## 229	1.50000e+00	NA	F_fleet_3_YR_2024_s_1	2024	FALSE	NA
## 230	5.53770e-02	NA	F_fleet_3_YR_2024_s_2	2024	FALSE	NA
## 231	6.45538e-01	NA	F_fleet_3_YR_2025_s_1	2025	FALSE	NA
## 232	2.08425e-02	NA	F_fleet_3_YR_2025_s_2	2025	FALSE	NA
## 233	7.99680e-01	NA	F_fleet_3_YR_2026_s_1	2026	FALSE	NA
## 234	3.04381e-02	NA	F_fleet_3_YR_2026_s_2	2026	FALSE	NA
## 235	4.61565e-01	NA	F_fleet_3_YR_2027_s_1	2027	FALSE	NA
## 236	1.63907e-02	NA	F_fleet_3_YR_2027_s_2	2027	FALSE	NA
## 237	1.50000e+00	NA	F_fleet_3_YR_2028_s_1	2028	FALSE	NA
## 238	2.16444e-01	NA	F_fleet_3_YR_2028_s_2	2028	FALSE	NA
## 239	1.50000e+00	NA	F_fleet_3_YR_2029_s_1	2029	FALSE	NA
## 240	1.01565e+00	NA	F_fleet_3_YR_2029_s_2	2029	FALSE	NA
## 241	1.92616e-01	NA	F_fleet_3_YR_2030_s_1	2030	FALSE	NA
## 242	4.94484e-03	NA	F_fleet_3_YR_2030_s_2	2030	FALSE	NA
## 243	1.50000e+00	NA	F_fleet_3_YR_2031_s_1	2031	FALSE	NA
## 244	4.09589e-01	NA	F_fleet_3_YR_2031_s_2	2031	FALSE	NA
## 245	1.50000e+00	NA	F_fleet_3_YR_2032_s_1	2032	FALSE	NA
## 246	1.72356e-01	NA	F_fleet_3_YR_2032_s_2	2032	FALSE	NA
## 247	1.50000e+00	NA	F_fleet_3_YR_2033_s_1	2033	FALSE	NA
## 248	1.10737e-01	NA	F_fleet_3_YR_2033_s_2	2033	FALSE	NA
## 249	1.50000e+00	NA	F_fleet_3_YR_2034_s_1	2034	FALSE	NA
## 250	1.87708e-01	NA	F_fleet_3_YR_2034_s_2	2034	FALSE	NA
## 251	1.50000e+00	NA	F_fleet_3_YR_2035_s_1	2035	FALSE	NA
## 252	2.23508e-01	NA	F_fleet_3_YR_2035_s_2	2035	FALSE	NA
## 253	1.50000e+00	NA	F_fleet_3_YR_2036_s_1	2036	FALSE	NA
## 254	2.38429e-01	NA	F_fleet_3_YR_2036_s_2	2036	FALSE	NA
## 255	1.50000e+00	NA	F_fleet_3_YR_2037_s_1	2037	FALSE	NA
## 256	6.48519e-01	NA	F_fleet_3_YR_2037_s_2	2037	FALSE	NA
## 257	1.50000e+00	NA	F_fleet_3_YR_2038_s_1	2038	FALSE	NA
## 258	1.04488e+00	NA	F_fleet_3_YR_2038_s_2	2038	FALSE	NA
## 259	3.00000e-01	NA	F_fleet_3_YR_2039_s_1	2039	FALSE	NA

## 260	3.00000e-01	NA	F_fleet_3_YR_2039_s_2	2039	FALSE	NA
## 261	0.00000e+00	0.00000e+00	LnQ_base_AT_Survey(4)	NA	FALSE	NaN
## 262	-1.83000e+00	-1.83000e+00	LnQ_base_DEPM(5)	NA	FALSE	0.000
## 263	-5.90000e-01	-5.90000e-01	LnQ_base_TEP_all(6)	NA	FALSE	0.000
## 264	1.09072e+01	1.31826e+01	Size_inflection_MexCal_S1(1)	NA	FALSE	0.209
## 265	6.59909e-01	2.16594e+00	Size_95%width_MexCal_S1(1)	NA	FALSE	2.282
## 266	5.00024e-01	5.00013e-01	AgeSel_P1_MexCal_S1(1)	NA	FALSE	0.000
## 267	2.04881e-01	-1.22069e+00	AgeSel_P2_MexCal_S1(1)	NA	FALSE	-6.958
## 268	3.82792e-01	2.63838e-01	AgeSel_P3_MexCal_S1(1)	NA	FALSE	-0.311
## 269	-1.54940e+00	-1.51157e+00	AgeSel_P4_MexCal_S1(1)	NA	FALSE	-0.024
## 270	-2.36189e-01	-1.25925e-01	AgeSel_P5_MexCal_S1(1)	NA	FALSE	-0.467
## 271	1.99999e+00	1.99999e+00	AgeSel_P1_MexCal_S2(2)	NA	FALSE	0.000
## 272	4.40526e-01	-4.74976e-01	AgeSel_P2_MexCal_S2(2)	NA	FALSE	-2.078
## 273	-1.16908e+00	-8.14062e-01	AgeSel_P3_MexCal_S2(2)	NA	FALSE	-0.304
## 274	-1.42574e-01	-5.14949e-01	AgeSel_P4_MexCal_S2(2)	NA	FALSE	2.612
## 275	-4.70732e-01	-3.65307e-01	AgeSel_P5_MexCal_S2(2)	NA	FALSE	-0.224
## 276	2.85251e+00	2.90512e+00	Age_inflection_PNW(3)	NA	FALSE	0.018
## 277	1.21523e+00	1.18412e+00	Age_95%width_PNW(3)	NA	FALSE	-0.026
## 278	0.00000e+00	0.00000e+00	AgeSel_P1_AT_Survey(4)	NA	FALSE	NaN
## 279	0.00000e+00	0.00000e+00	AgeSel_P2_AT_Survey(4)	NA	FALSE	NaN
## 280	NA	0.00000e+00	ForeRecr_2036	2036	TRUE	NA

Take closer look at estimated derived and parameter values

```
# error of params
```

```
hcr2 <- read_csv(file = file.path(mseDir, scenarios[2], "results_scalar_constGrow20010M_selfTestMidSteepe"))
```

```
## Rows: 63 Columns: 144
## -- Column specification -----
## Delimiter: ","
## chr   (3): version, model_run, scenario
## dbl  (137): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (4): params_on_bound, params_stuck_low, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
hcr2Fixed <- read_csv(file = file.path(mseDir, scenarios[3], "results_scalar_constGrow20010M_selfTestMidSteepe"))
```

```
## Rows: 63 Columns: 144
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl  (137): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

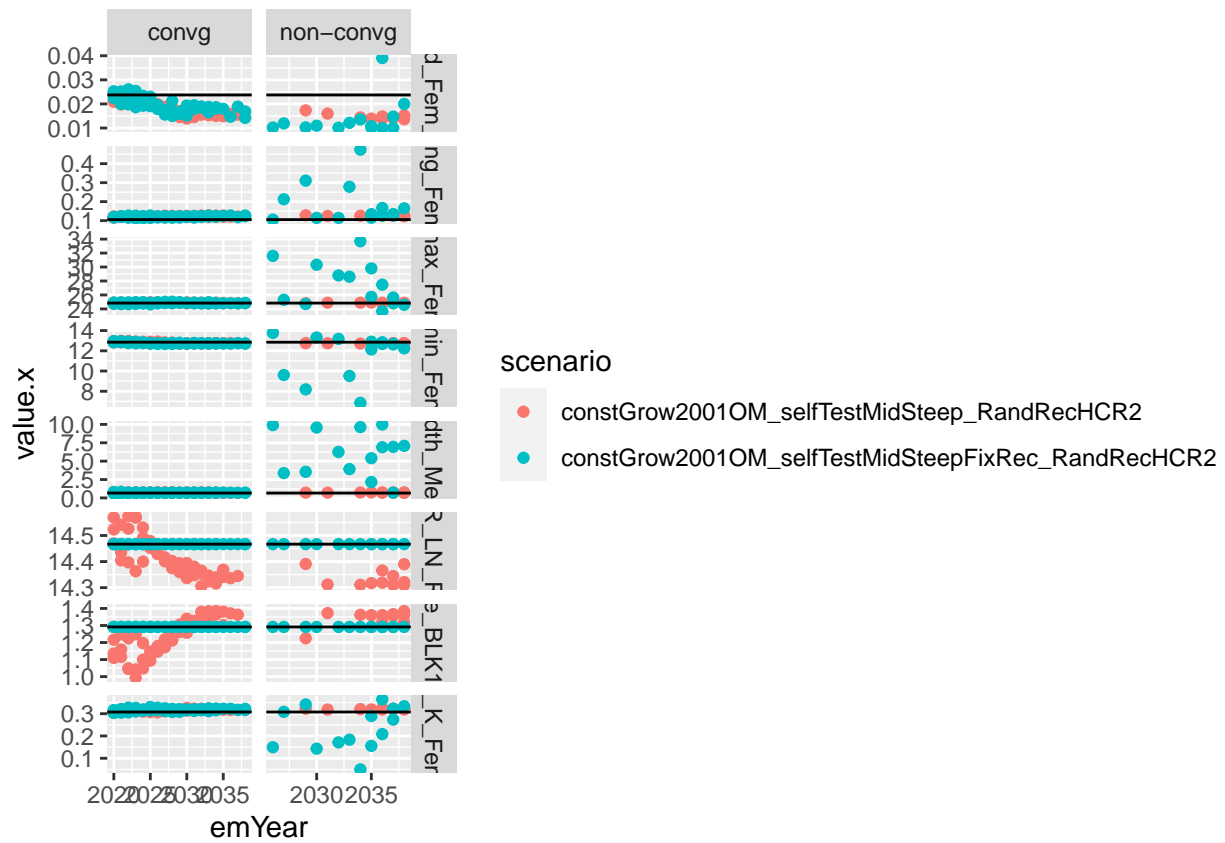
```
sclHCR2 <- rbind(hcr2, hcr2Fixed)
unique(sclHCR2[, c("params_on_bound", "params_stuck_low", "params_stuck_high", "scenario")])
```

```
## # A tibble: 7 x 4
##   params_on_bound params_stuck_low      params_stuck_high      scenario
##   <lgl>           <chr>           <chr>           <chr>
## 1 NA             <NA>           <NA>           constGrow20~
## 2 NA             <NA>           <NA>           constGrow20~
## 3 NA             CV_old_Fem_GP_1  Size_95%width_MexCal_S1(1) constGrow20~
## 4 NA             CV_old_Fem_GP_1  <NA>           constGrow20~
## 5 NA             VonBert_K_Fem_GP_1 <NA>           constGrow20~
## 6 NA             <NA>           Size_95%width_MexCal_S1(1) constGrow20~
## 7 NA             AgeSel_P3_MexCal_S2(2) <NA>           constGrow20~

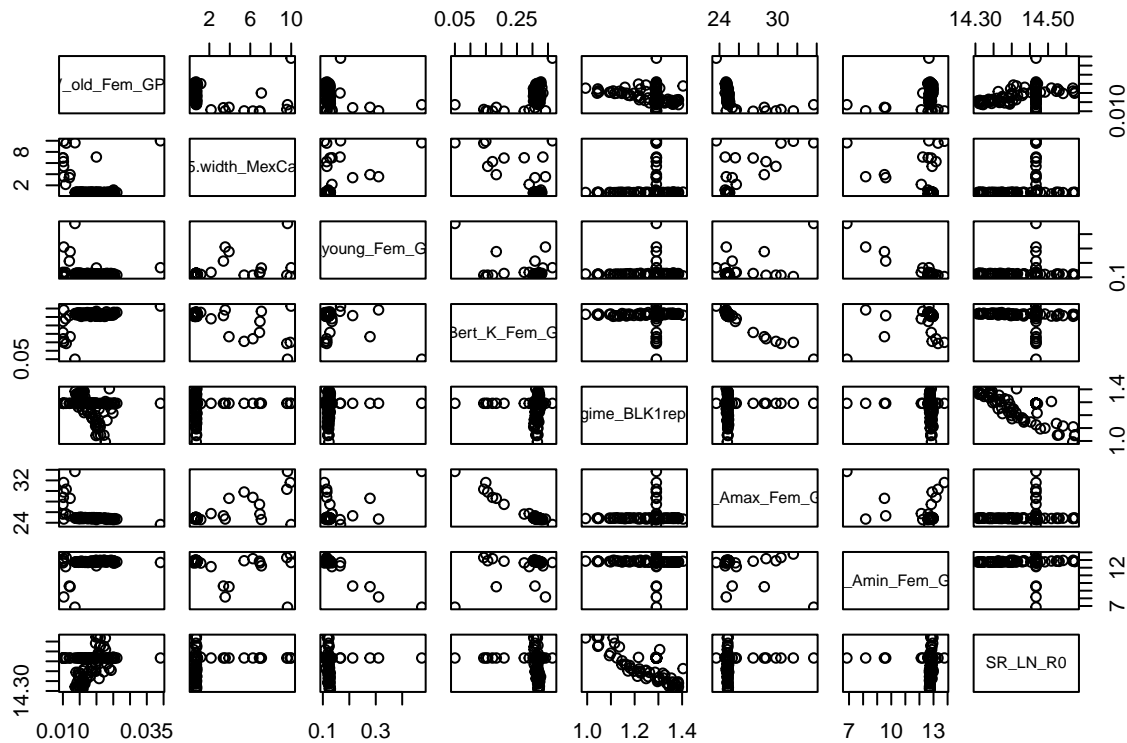
parCols <- c("CV_old_Fem_GP_1", "Size_95.width_MexCal_S1_1", "CV_young_Fem_GP_1",
             "VonBert_K_Fem_GP_1", "SR_regime_BLK1repl_2000", "L_at_Amax_Fem_GP_1",
             "L_at_Amin_Fem_GP_1", "SR_LN_R0")
focPars <- sclHCR2 %>% select(max_grad, parCols,
                             model_run, iteration, scenario) %>%
  pivot_longer(cols = parCols, names_to = "parameter", values_to = "value")
focParsOM <- focPars %>% filter(grepl("_OM", model_run, fixed = TRUE))
focPars <- focPars %>% filter(!grepl("_OM", model_run, fixed = TRUE)) %>%
  left_join(y = focParsOM, by = c("iteration", "scenario", "parameter")) %>%
  mutate(parRE = (value.x - value.y)/value.y * 100,
         emYear = as.numeric(regmatches(model_run.x,
                                         gregexpr("[:digit:]]+",
                                                  model_run.x))),
         convg = case_when(max_grad.x > 0.01 ~ "non-convg",
                           max_grad.x < 0.01 ~ "convg"))

focPars %>% ggplot(aes(x = emYear, y = value.x, color = scenario)) +
  #geom_line() +
  geom_point() +
  facet_grid(rows = vars(parameter), cols = vars(convg), scales = "free") +
  geom_hline(aes(yintercept = value.y))

## Warning: Removed 48 rows containing missing values (geom_point).
```



```
pairs(focPars %>% mutate(combo = paste(scenario, iteration, model_run.x, sep = "-")) %>%
  dcast(combo ~ parameter, value.var = "value.x") %>%
  select(unique(focPars$parameter)))
```

```
# error of summary biomass
simDat <- smryOutputList$obsCPUE %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                             model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
                                             iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d")),
         plotGroup = "simData") %>%
  rename(Bio_smry = obs) %>%
  filter(!grepl("_OM", model_run, fixed = TRUE), index == 4, seas != 10) %>%
  select(year, Bio_smry, model_run, iteration, scenario, plotGroup)

age1PlusBio <- smryOutputList$tsSmry %>% filter(Seas == 1) %>%
  select(year, Bio_smry, model_run, iteration, scenario) %>%
  mutate(plotGroup = case_when(grepl("_OM", model_run, fixed = TRUE) ~ "OM",
                              TRUE ~ "EM"))

age1PlusRE <- age1PlusBio %>% filter(plotGroup != "OM")
age1PlusRE <- rbind(age1PlusRE, simDat)
age1PlusRE <- age1PlusRE %>% pivot_wider(names_from = "plotGroup", values_from = "Bio_smry") %>%
  left_join(y = convrgCheck,
            by = c("model_run", "iteration", "scenario")) %>%
  full_join(y = subset(age1PlusBio, subset = plotGroup == "OM"),
            by = c("iteration", "scenario", "year")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                           max_grad < 0.01 ~ "convrg",
                           TRUE ~ "OM"),
```

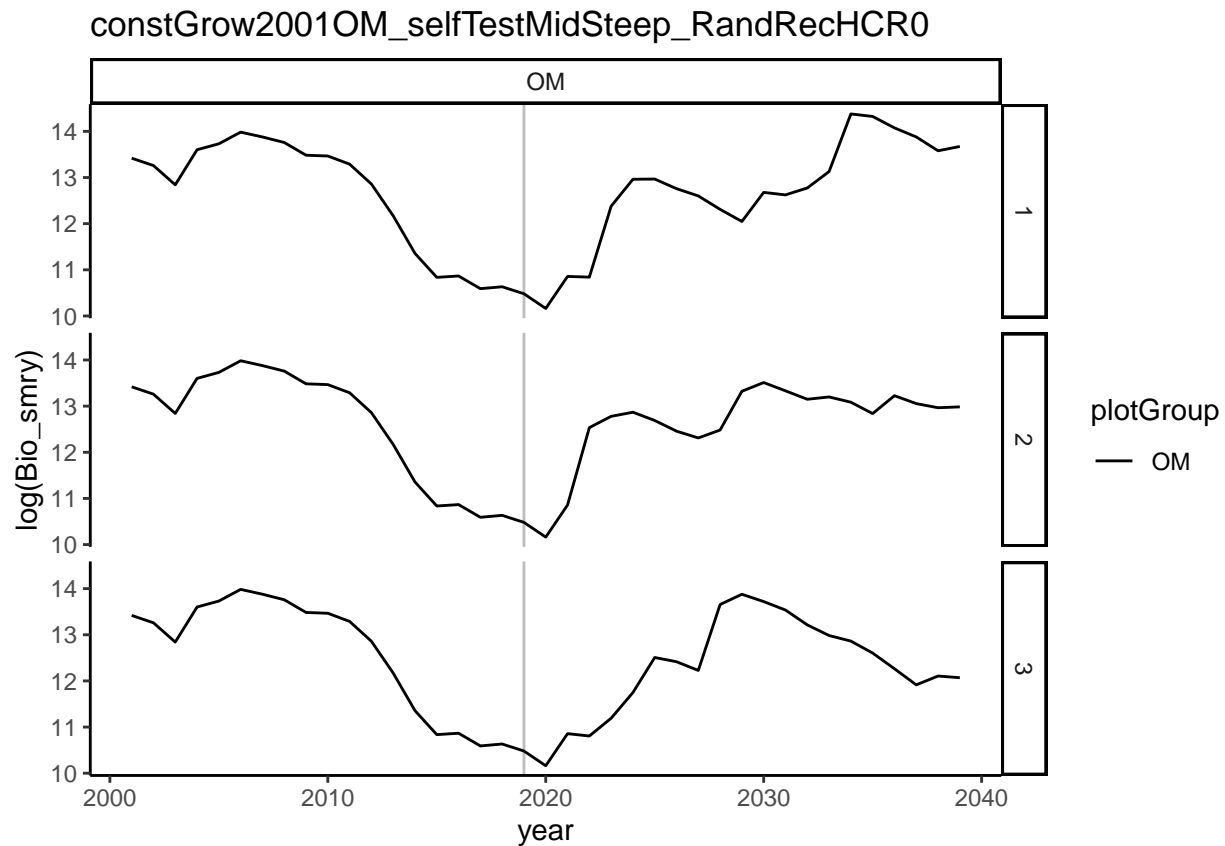
```

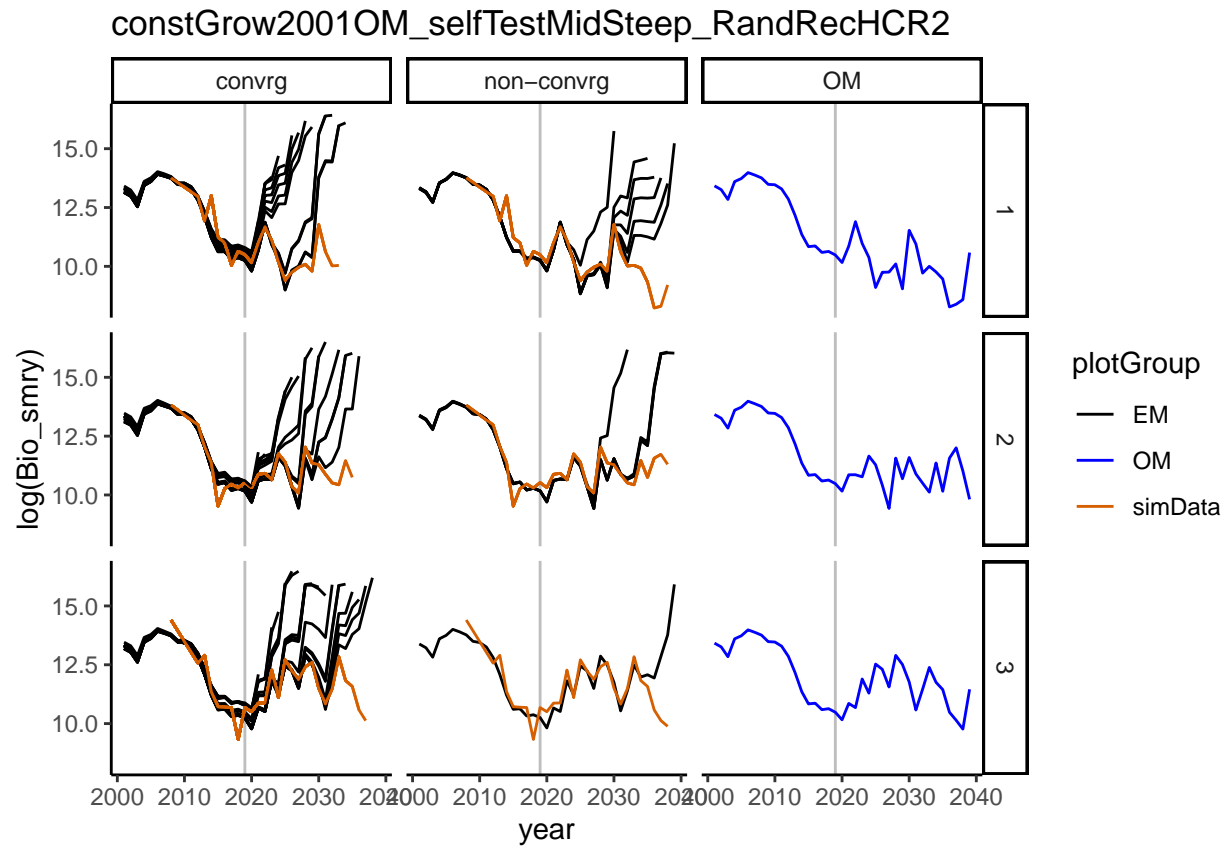
datRE = (simData - Bio_smry)/Bio_smry * 100,
emRE = (EM - Bio_smry)/Bio_smry * 100)

age1PlusBio <- rbind(age1PlusBio, simDat)
age1PlusBio <- age1PlusBio %>% left_join(y = convrgCheck,
                                         by = c("model_run", "iteration", "scenario")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"))

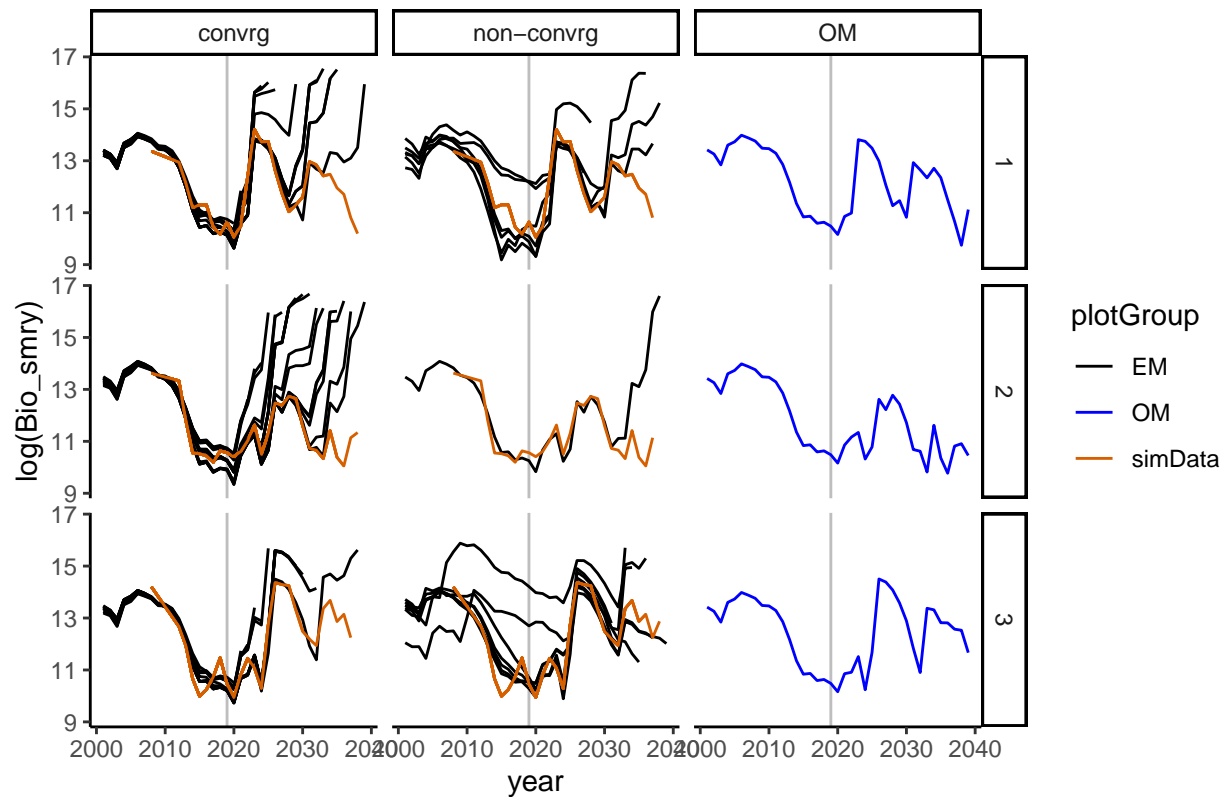
for(mr in 1:3){
  print(age1PlusBio %>% filter(scenario == scenarios[mr]) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_line(ggplot2::aes(linetype = as.character(model_run), color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    ggplot2::facet_grid(rows = vars(iteration), cols = vars(convrg)) +
    ggplot2::theme_classic() +
    labs(title = scenarios[mr]))
}

```





constGrow2001OM_selfTestMidSteepFixRec_RandRecHCR2

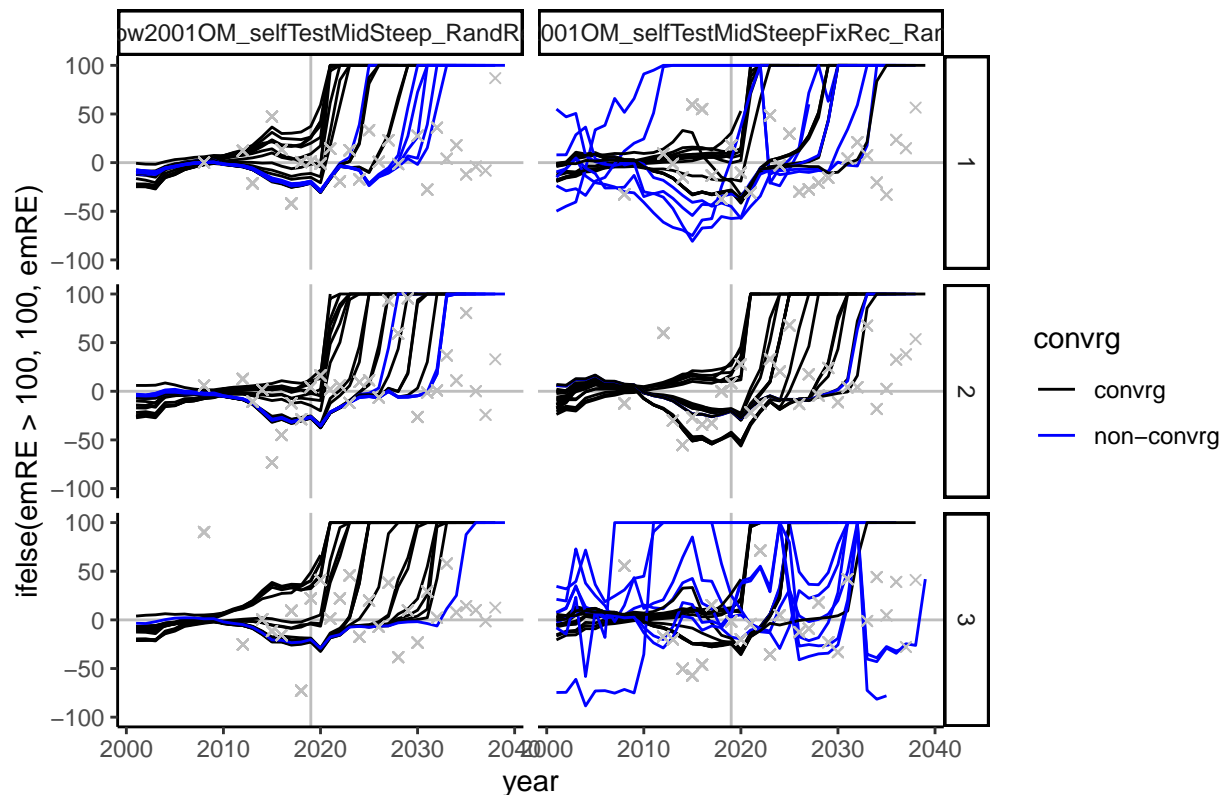


Plot relative errors of biomass over time

```
age1PlusRE %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = year, y = ifelse(emRE > 100, 100, emRE))) + #y = emRE)) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "gray") +
  geom_line(aes(linetype = as.character(model_run.x), color = convrg)) +
  geom_point(aes(y = datRE), shape = 4, color = "grey") +
  scale_color_manual(values = c("black", "blue", "#D65F00")) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(iteration), cols = vars(scenario)) +
  theme_classic() + labs(title = "Relative Error of Age 1+ Biomass (%)") +
  ylim(-100, 100)
```

Warning: Removed 1437 rows containing missing values (geom_point).

Relative Error of Age 1+ Biomass (%)



```
# error of catch
simCat <- smryOutputList$obsCatch %>% mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
                                             model_run = sub(pattern = ".*[[:digit:]]+/", "", resDir),
                                             iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.*/", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d")),
         plotGroup = "simCatch") %>%
  group_by(year, model_run, iteration, scenario, plotGroup) %>%
  # summarize total catch within year
  dplyr::summarize(totCatch = sum(catch)) %>%
  filter(!grepl("_OM", model_run, fixed = TRUE), year != -999) %>%
  select(year, totCatch, model_run, iteration, scenario, plotGroup)
```

'summarise()' has grouped output by 'year', 'model_run', 'iteration',
'scenario'. You can override using the '.groups' argument.

```
catchTS <- smryOutputList$tsSmry %>%
  mutate(totCatch = retainB_1 + retainB_2 + retainB_3) %>%
  group_by(year, model_run, iteration, scenario) %>%
  # summarize total catch within year
  dplyr::summarize(totCatch = sum(totCatch)) %>%
  select(year, totCatch, model_run, iteration, scenario) %>%
  mutate(plotGroup = case_when(grepl("_OM", model_run, fixed = TRUE) ~ "OM",
                               TRUE ~ "EM"))
```

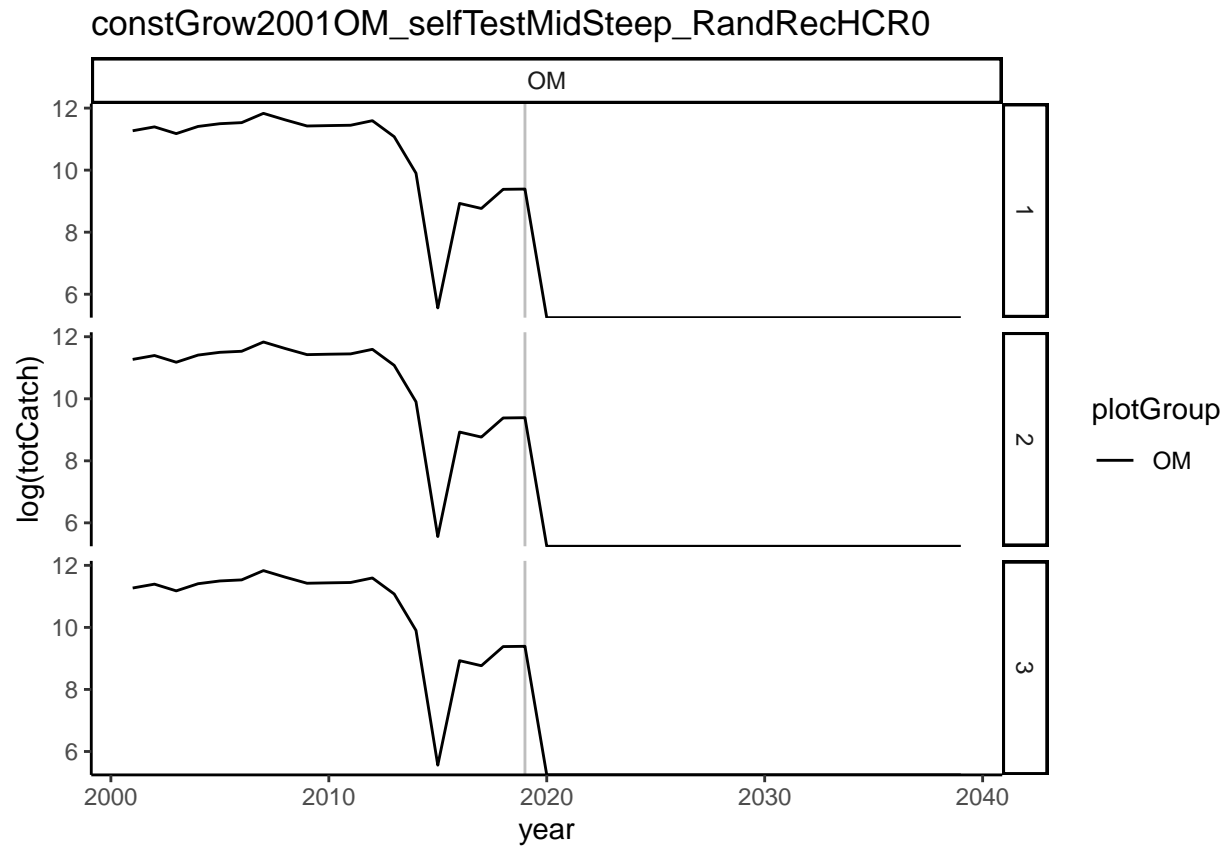
'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can

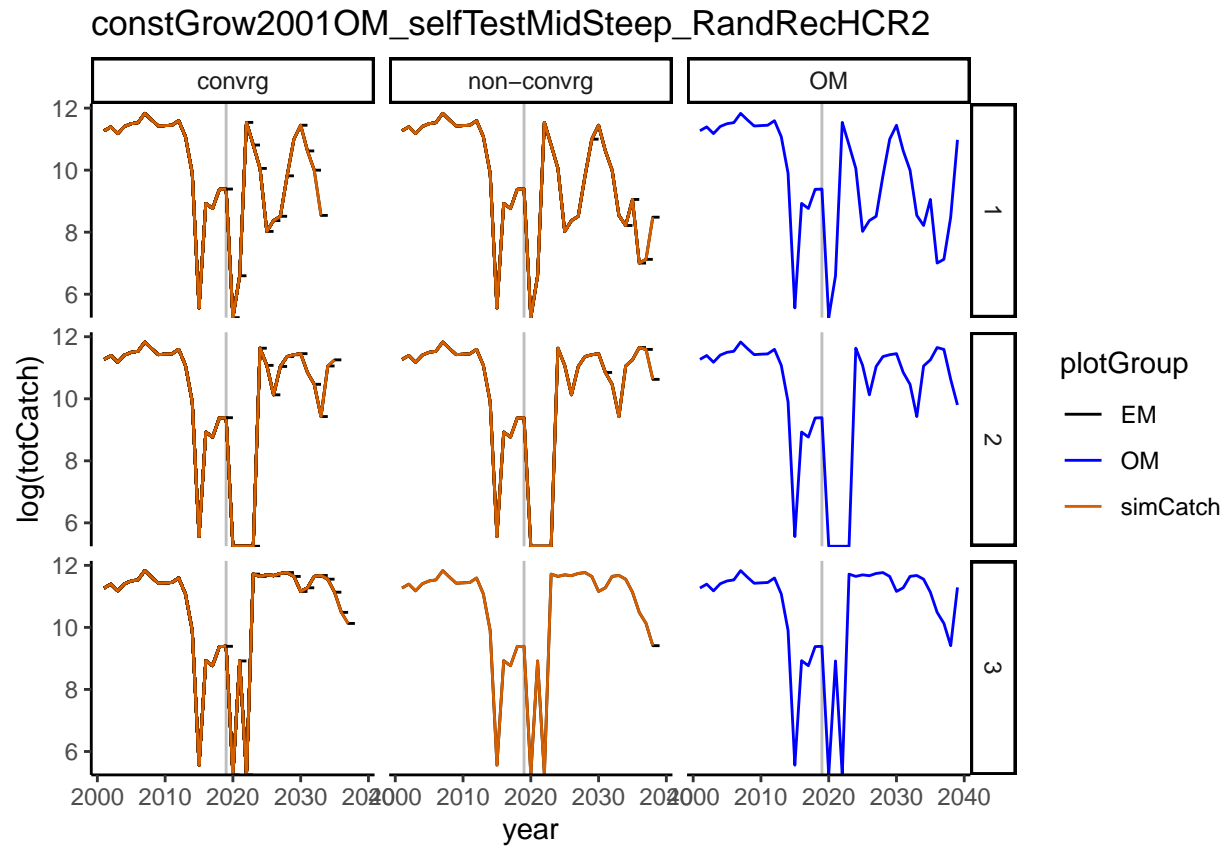
```
## override using the '.groups' argument.
```

```
catchRE <- catchTS %>% filter(plotGroup != "OM")
catchRE <- rbind(catchRE, simCat)
catchRE <- catchRE %>% pivot_wider(names_from = "plotGroup", values_from = "totCatch") %>%
  left_join(y = convrgCheck,
            by = c("model_run", "iteration", "scenario")) %>%
  full_join(y = subset(catchTS, subset = plotGroup == "OM"),
            by = c("iteration", "scenario", "year")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"),
         datRE = (simCatch - totCatch)/(totCatch + 0.0001) * 100, # add small amount so
         emRE = (EM - totCatch)/(totCatch + 0.0001) * 100)

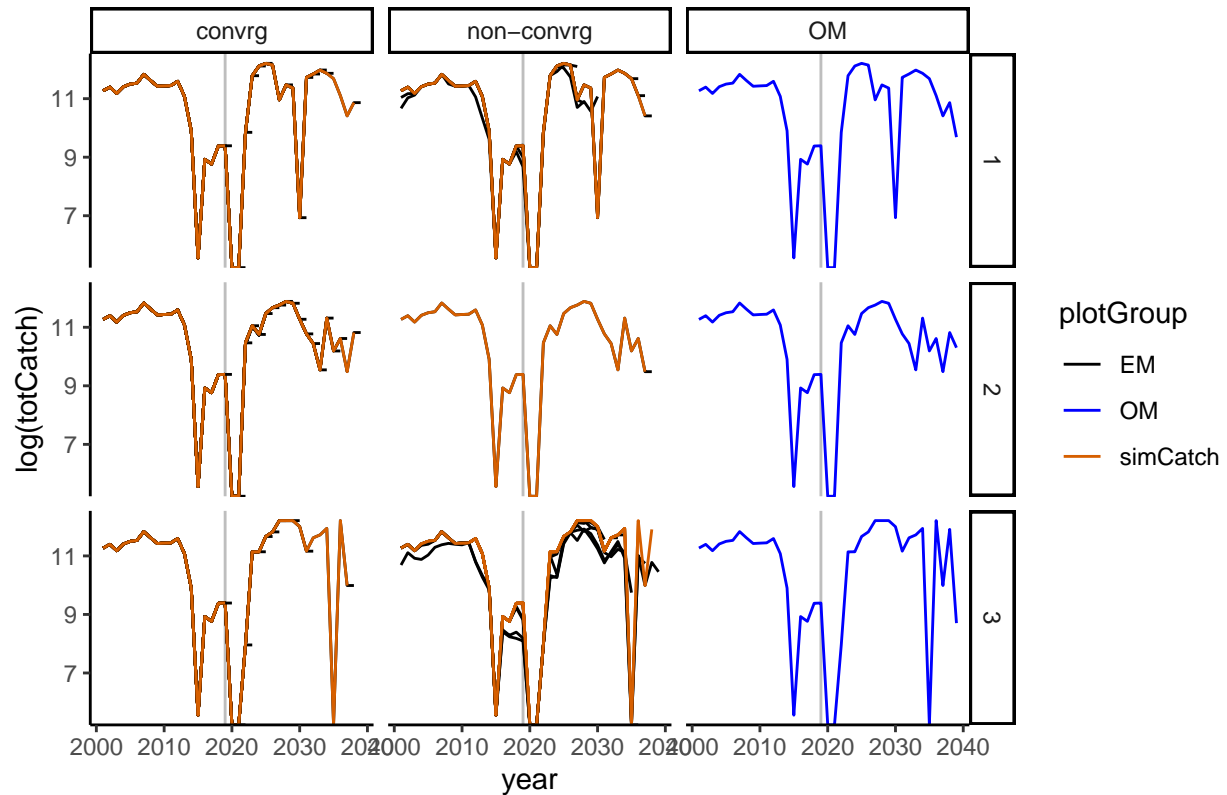
catchTS <- rbind(catchTS, simCat)
catchTS <- catchTS %>% left_join(y = convrgCheck,
                                by = c("model_run", "iteration", "scenario")) %>%
  mutate(convrg = case_when(max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg",
                             TRUE ~ "OM"))

for(mr in 1:3){
  print(catchTS %>% filter(scenario == scenarios[mr]) %>%
    ggplot(aes(x = year, y = log(totCatch))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_line(ggplot2::aes(linetype = as.character(model_run), color = plotGroup)) +
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    ggplot2::facet_grid(rows = vars(iteration), cols = vars(convrg)) +
    ggplot2::theme_classic() +
    labs(title = scenarios[mr]))
}
```



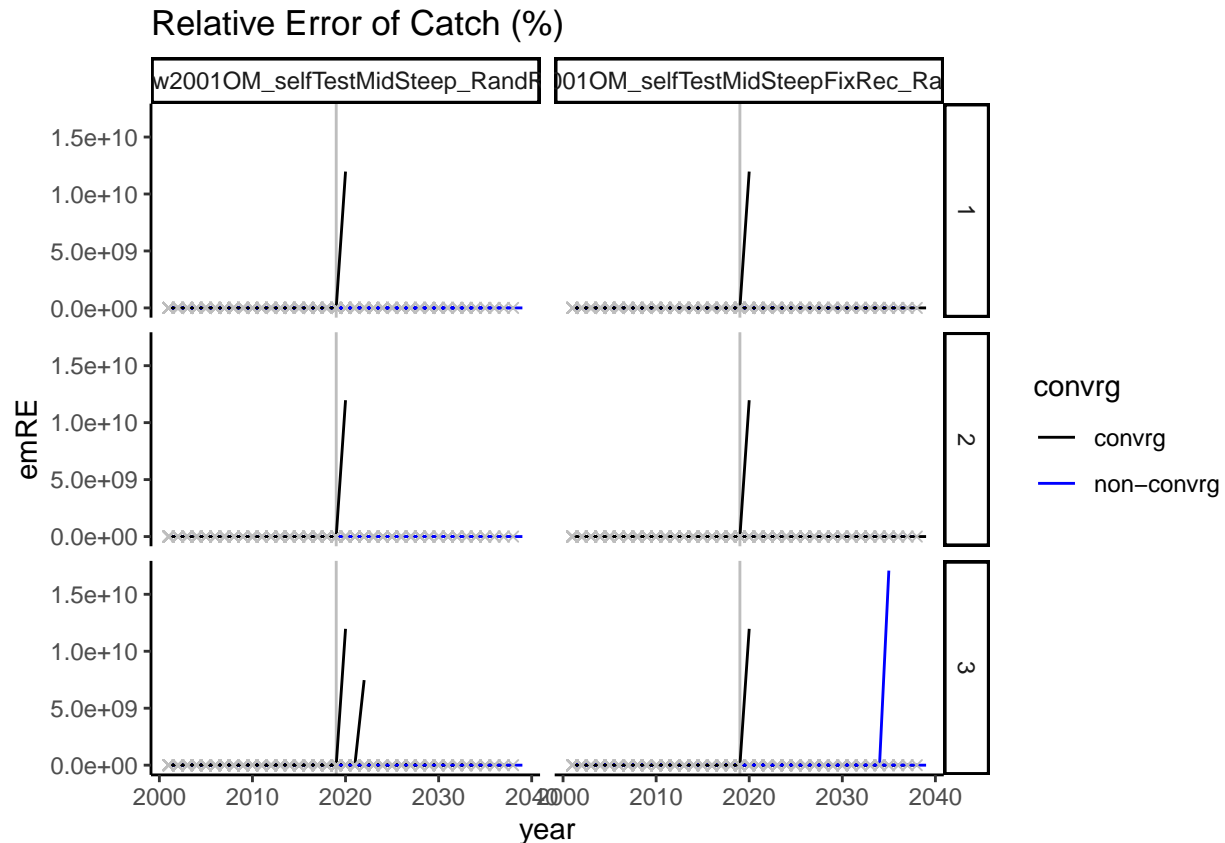


constGrow2001OM_selfTestMidSteepFixRec_RandRecHCR2



```
# Plot relative errors of biomass over time
catchRE %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = year, y = emRE)) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_line(aes(linetype = as.character(model_run.x), color = convrg)) +
  geom_point(aes(y = datRE), shape = 4, color = "grey") +
  scale_color_manual(values = c("black", "blue", "#D65F00")) +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(iteration), cols = vars(scenario)) +
  theme_classic() + labs(title = "Relative Error of Catch (%)")
```

```
## Warning: Removed 120 rows containing missing values (geom_point).
```



Model expects high catches for 2020 in initial EM fit (emYear 2019)

Check harvest guideline from EMs

```
# Use parallelization to pull in composition and EM data -----
# Adapted from code from Peter Kuriyama

# set up the directories
# get the iterations
resultsDirs <- NULL
for(scn in 1:length(scenarios)){
  iters <- list.dirs(file.path(mseDir, scenarios[scn]), recursive = FALSE, full.names = FALSE)

  # get the model directory names
  runNames <- list.dirs(file.path(mseDir, scenarios[scn], iters[1]),
                        recursive = FALSE,
                        full.names = FALSE)

  # remove OM folder from list
  runNames <- runNames[!grep("_OM", runNames, fixed = TRUE)]

  #The results directories to read in
  scnResultsDirs <- expand_grid(scenarios[scn], iters, runNames) %>%
    mutate(scn = file.path(mseDir, `scenarios[scn]`, iters, runNames)) %>%
    pull(scn)

  resultsDirs <- c(resultsDirs, scnResultsDirs)
}
```

```

# extract wanted tables per directory and add data origin
start_time <- Sys.time()
ncores <- detectCores() - 2 #Leave some cores open for background stuff
cl <- makeCluster(ncores)
registerDoParallel(cl)

resultsList <- foreach::foreach(ii = 1:length(resultsDirs),

                                .packages = c("tidyverse", "r4ss")) %dopar% {
  outList <- SS_output(resultsDirs[ii],
                        covar = FALSE, printstats = FALSE,
                        verbose = FALSE)
  outList %>% magrittr::extract("sprseries") %>%
    map2(.y = resultsDirs[ii],
         .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)
run_time <- Sys.time() - start_time; run_time #To see how long it takes

```

Time difference of 28.09952 secs

```

# summarize into single table for export
smryForeBio <- resultsList %>% map_dfr(magrittr::extract2, "sprseries") %>%
  filter(Era=="FORE") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*[/[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[/[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  select(Yr, Bio_Smry.1, scenario, model_run, iteration)

# apply HCR as calculated in HCR_sar_hcr2.R

#upload the CalCOFI temperature timeseries
Ctemp=read.csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineMSE/dat/calcofi_sst_projected.csv")
# Ctemp=read.csv("J:/Desiree/Sardine/SardineMSE/dat/calcofi_sst_projected.csv")

#extract the average for the three years prior to the forecast
#Tyr=c((EMts$Yr[1]-1), (EMts$Yr[1]-2), (EMts$Yr[1]-3))
#Temsy = mean(Ctemp$gfdl_sst_all[Ctemp$year %in% Tyr])#here we might need to create a separte hcr 2 fu
smryForeBio$Temsy <- NA
for(i in 1:nrow(smryForeBio)){
  smryForeBio[i, "Temsy"] <- mean(Ctemp$gfdl_sst_all[Ctemp$year %in% (smryForeBio[i, "Yr"]-3):(smryFore
}]

#set input to hcr
#Emsy = -18.46452+3.25209*Temsy-0.19723*Temsy^2+0.0041863*Temsy^3
smryForeBio <- smryForeBio %>% mutate(Emsy = -18.46452+3.25209*Temsy-0.19723*Temsy^2+0.0041863*Temsy^3)
cutoff = 150000
distribution = 0.87

#if biomass is less than the cutoff, the harvest guideline is set to 0, if not the current hg rule is

```

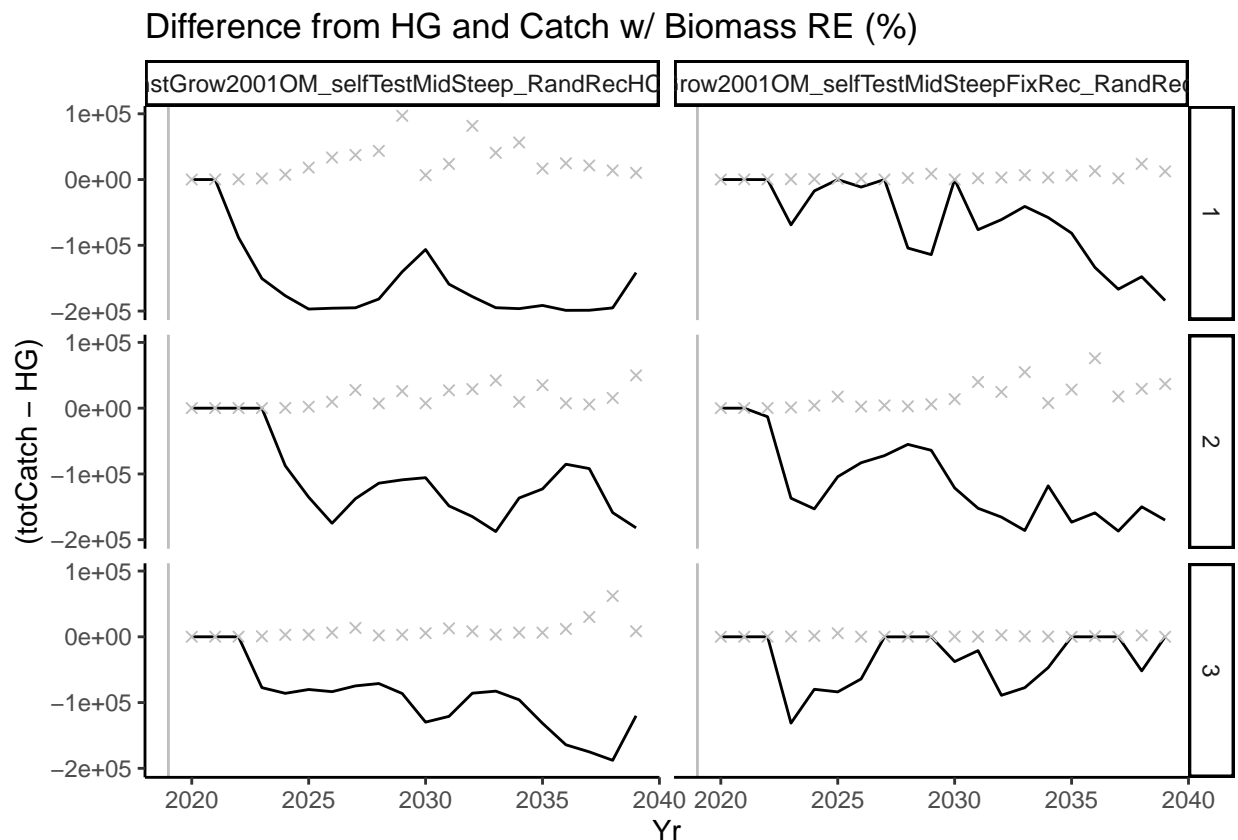
```

#HG=(BIOMASS-CUTOFF)*FRACTION*DISTRIBUTION
#Note that as there are still
# if (bio1 < cutoff) {HG = 0 } else {HG = (bio1-cutoff)*Emsy*distribution}
#
# #the hg is capped at a maximum catch of 200000 mt
# if (HG > 200000) {HG = 200000}

smryForeBio <- smryForeBio %>% mutate(HG = case_when(Bio_Smry.1 < cutoff ~ 0,
                                                    TRUE ~ (Bio_Smry.1-cutoff)*Emsy*distribution)) %>%
  mutate(HG = case_when(HG > 200000 ~ 200000,
                        TRUE ~ HG)) %>%
  left_join(y = subset(catchTS, subset = plotGroup == "OM"),
            by = c("Yr" = "year", "scenario", "iteration")) %>%
  left_join(y = subset(age1PlusBio, subset = plotGroup == "OM"),
            by = c("Yr" = "year", "scenario", "iteration")) %>%
  select(Yr, scenario, model_run.x, iteration, Bio_Smry.1, HG, Bio_smry, totCatch, HCR.)

smryForeBio %>% ggplot(aes(x = Yr, y = (totCatch - HG))) +
  geom_vline(xintercept = 2019, color = "gray") +
  geom_line(aes(linetype = as.character(scenario))) +
  geom_point(aes(y = (Bio_Smry.1 - Bio_smry)/Bio_smry*100), shape = 4, color = "grey") +
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(iteration), cols = vars(scenario)) +
  theme_classic() + labs(title = "Difference from HG and Catch w/ Biomass RE (%)")

```



```

# compare OM, EM, and HG total catches

# look at catches listed in OM data files
# set up the directories
# get the iterations
omDirs <- NULL
for(scn in 1:length(scenarios)){
  iters <- list.dirs(file.path(mseDir, scenarios[scn]), recursive = FALSE, full.names = FALSE)

  # get the model directory names
  runNames <- list.dirs(file.path(mseDir, scenarios[scn], iters[1]),
                        recursive = FALSE,
                        full.names = FALSE)
  # keep only OM folder from list
  runNames <- runNames[grepl("_OM", runNames, fixed = TRUE)]

  #The results directories to read in
  scnResultsDirs <- expand_grid(scenarios[scn], iters, runNames) %>%
    mutate(scn = file.path(mseDir, `scenarios[scn]`, iters, runNames)) %>%
    pull(scn)

  omDirs <- c(omDirs, scnResultsDirs)
}

# extract wanted tables per directory and add data origin
start_time <- Sys.time()
ncores <- detectCores() - 2 #Leave some cores open for background stuff
cl <- makeCluster(ncores)
registerDoParallel(cl)

omDataList <- foreach::foreach(ii = 1:length(omDirs),

                              .packages = c("tidyverse", "r4ss")) %dopar% {
  outList <- SS_readat(file.path(omDirs[ii], "data.ss"),
                      version = "3.30", verbose = FALSE)
  outList %>% magrittr::extract("catch") %>%
    map2(.y = omDirs[ii],
        .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)

# summarize into single table for export
omDataCatch <- omDataList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchDat = catch)

cl <- makeCluster(ncores)
registerDoParallel(cl)

```

```

omDataExpList <- foreach::foreach(ii = 1:length(omDirs),

                                .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_readdat(file.path(omDirs[ii], "data.ss_new"),
                        version = "3.30", verbose = FALSE,
                        section = 2)
  outList %>% magrittr::extract("catch") %>%
  map2(.y = omDirs[ii],
       .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)

# summarize into single table for export
omDataExpCatch <- omDataExpList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchExp = catch)

cl <- makeCluster(ncores)
registerDoParallel(cl)
omDataBootList <- foreach::foreach(ii = 1:length(omDirs),

                                   .packages = c("tidyverse", 'r4ss')) %dopar% {
  outList <- SS_readdat(file.path(omDirs[ii], "data.ss_new"),
                        version = "3.30", verbose = FALSE,
                        section = 3)
  outList %>% magrittr::extract("catch") %>%
  map2(.y = omDirs[ii],
       .f = function(x, y){x['resDir'] <- y;x})
}

stopCluster(cl)
# summarize into single table for export
omDataBootCatch <- omDataBootList %>% map_dfr(magrittr::extract2, "catch") %>%
  mutate(scenario = sub(pattern = ".*Scenarios/", "", resDir),
         model_run = sub(pattern = ".*/[[:digit:]]+/", "", resDir),
         iteration = str_extract(resDir, "\\d/")) %>%
  mutate(scenario = sub(pattern = "/[[:digit:]]+/.+", "", scenario),
         iteration = as.numeric(str_extract(iteration, "\\d"))) %>%
  rename(catchBoot = catch)

run_time <- Sys.time() - start_time; run_time #To see how long it takes

## Time difference of 13.98018 secs

omDataCatch <- omDataCatch %>% left_join(y = omDataExpCatch,
                                         by = c("year", "seas", "fleet", "resDir",
                                                  "scenario", "model_run", "iteration")) %>%
  left_join(y = omDataBootCatch,
           by = c("year", "seas", "fleet", "resDir",
                  "scenario", "model_run", "iteration")) %>%
  group_by(year, resDir, scenario, model_run, iteration) %>%

```

```

summarize(totCatchDat = sum(catchDat),
          totCatchExp = sum(catchExp),
          totCatchBoot = sum(catchBoot)) %>%
filter(year != -999)

```

'summarise()' has grouped output by 'year', 'resDir', 'scenario', 'model_run'.
You can override using the '.groups' argument.

```

catchTS <- omDataCatch %>% left_join(y = subset(catchTS, subset = plotGroup == "EM"),
                                   by = c("year", "iteration", "scenario")) %>%
rename(totCatchEstEM = totCatch) %>%
left_join(y = subset(catchTS, subset = plotGroup == "simCatch"),
          by = c("year", "iteration", "scenario", "emYear", "recScen",
                "HCR", "model_run.y" = "model_run")) %>%
rename(totCatchSimDatEM = totCatch) %>% ungroup() %>%
select(year, iteration, scenario, emYear, recScen, HCR, max_grad.x, convrg.x,
       totCatchDat, totCatchExp, totCatchBoot, totCatchSimDatEM, totCatchEstEM)

# Note: the HG is the catch advice provided from the HCR from the previous emYear
#       to be applied in 'year'
catchTS <- catchTS %>% left_join(smryForeBio,
                                by = c("year" = "Yr", "iteration", "scenario",
                                      "recScen" = "recScen.y", "HCR" = "HCR.y")) %>%
rename(emForeBioSmry = Bio_Smry.1,
       omBioSmry = Bio_smry) %>%
select(year, iteration, scenario, emYear, recScen, HCR, max_grad.x,
       convrg.x, HG, totCatchDat, totCatchExp, totCatchBoot,
       totCatchSimDatEM, totCatchEstEM, totCatch, emForeBioSmry, omBioSmry)
catchTS %>% filter(year == 2030)

```

```

## # A tibble: 63 x 17
##   year iteration scenario      emYear recScen HCR    max_grad.x convrg.x    HG
##   <int>      <dbl> <chr>          <dbl> <chr>   <chr>      <dbl> <chr>    <dbl>
## 1  2030          1 constGrow2001~    NA <NA>   <NA>      NA    <NA>    NA
## 2  2030          2 constGrow2001~    NA <NA>   <NA>      NA    <NA>    NA
## 3  2030          3 constGrow2001~    NA <NA>   <NA>      NA    <NA>    NA
## 4  2030          1 constGrow2001~  2029 selfTe~ HCR2    0.0140 non-con~  2e5
## 5  2030          1 constGrow2001~  2030 selfTe~ HCR2    0.000718 convrg    2e5
## 6  2030          1 constGrow2001~  2031 selfTe~ HCR2    0.00278 convrg    2e5
## 7  2030          1 constGrow2001~  2032 selfTe~ HCR2    0.00377 convrg    2e5
## 8  2030          1 constGrow2001~  2033 selfTe~ HCR2    0.000532 convrg    2e5
## 9  2030          1 constGrow2001~  2034 selfTe~ HCR2    0.0838 non-con~  2e5
## 10 2030          1 constGrow2001~  2035 selfTe~ HCR2    0.0194 non-con~  2e5
## # ... with 53 more rows, and 8 more variables: totCatchDat <dbl>,
## #   totCatchExp <dbl>, totCatchBoot <dbl>, totCatchSimDatEM <dbl>,
## #   totCatchEstEM <dbl>, totCatch <dbl>, emForeBioSmry <dbl>, omBioSmry <dbl>

```

```

omOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteep_RandR")

```

Getting header info from:

```

## C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteep_RandR

```

```

## This function tested on SS versions 3.24 and 3.30.
## You are using 3.30.18.00 which SHOULD work with this package.
## Report file time:Tue May 17 17:25:28 2022

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_se

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_se
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Reading full report file
## Got all columns using ncols = 62
## Got Report file
## !warning: temporary files were written in this run:

##                               TempFile                               Size
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
##                               <NA>                               <NA>
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"

## Got warning file. Therewere 6 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
## 2028 rows of length comp data,
## 0 rows of generalized size comp data,
## 459 rows of age comp data,
## 0 rows of conditional age-at-length data,
## 720 rows of ghost fleet age comp data,
## 0 rows of ghost fleet conditional age-at-length data,
## 3471 rows of ghost fleet length comp data,
## 0 rows of mean length at age data,
## 0 rows of mean weight at age data,
## 0 rows of 'TAG1' comp data, and
## 0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADM
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 17:25:28 2022"
##

```



```

## $RunTime
## [1] "0 hours, 0 minutes, 0 seconds."
##
## $Files_used
## [1] "Data_File: data.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 6
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_"
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_"
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE: Max data length bin: 28 < max pop len bins: 30; so will accumulate larger pop len bins"
## [11] "2 Forecast=0 or -1, so rest of forecast file will not be read and can be omitted;"
## [12] "2 A one year forecast using recent F will be done automatically"
## [13] "3 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for"
## [14] "4 setting in starter does not request all priors, and 1 parameters have priors and are not est."
## [15] "5 Forecast F capped by max possible F from control file: 4"
## [16] "6 Forecast F capped by max possible F from control file: 4"
## [17] "N warnings: 6"
##
## $likelihoods_used
##
##              values lambdas
## TOTAL          94763.8000000    NA
## Catch           94539.6000000    NA
## Equil_catch      0.0000000    NA
## Survey          -28.0180000    NA
## Length_comp      41.9452000    NA
## Age_comp         37.4688000    NA
## Recruitment      78.3199000     1
## InitEQ_Regime     0.0000000     0
## Forecast_Recruitment  94.4705000     1
## Parm_priors       0.0000000     1
## Parm_softbounds   0.0019748    NA
## Parm_devs         0.0000000     1
## Crash_Pen        0.0000000     1
##
## $likelihoods_laplace
##
##              values lambdas
## NoBias_corr_Recruitment(info_only)  75.1513     1
## Laplace_obj_fun(info_only)        94760.6000    NA
##
## $likelihoods_by_fleet
##
##              Label      ALL  MexCal_S1  MexCal_S2      PNW AT_Survey
## 185  Catch_lambda      NA    1.00000    1.00000    1.00000    1.00000
## 186  Catch_like 94539.6000 34314.90000 34781.80000 25442.80000    0.00000
## 187 Init_equ_lambda      NA    0.00000    0.00000    0.00000    1.00000

```

```

## 188 Init_equ_like      0.0000      0.00000      0.00000      0.00000      0.00000
## 189 Surv_lambda       NA      0.00000      0.00000      0.00000      1.00000
## 190 Surv_like        -28.0180      0.00000      0.00000      0.00000     -9.94359
## 191 Surv_N_use       NA      0.00000      0.00000      0.00000     18.00000
## 192 Surv_N_skip      NA      0.00000      0.00000      0.00000     20.00000
## 193 Length_lambda     NA      1.00000      1.00000      1.00000      1.00000
## 194 Length_like      41.9452      0.98456      2.63440      1.66827     36.65790
## 195 Length_N_use     NA     14.00000     14.00000     15.00000      9.00000
## 196 Length_N_skip    NA     20.00000     20.00000     29.00000     20.00000
## 197 Age_lambda       NA      1.00000      1.00000      1.00000      1.00000
## 198 Age_like        37.4688      1.16795      3.26694      3.16781     29.86610
## 199 Age_N_use       NA     14.00000     14.00000     14.00000      9.00000
## 200 Age_N_skip      NA     20.00000     20.00000     20.00000     20.00000
##      DEPM  TEP_all
## 185 1.00000  1.0000
## 186 0.00000  0.0000
## 187 1.00000  1.0000
## 188 0.00000  0.0000
## 189 1.00000  1.0000
## 190 -1.76351 -16.3109
## 191 10.00000  13.0000
## 192 0.00000  0.0000
## 193 0.00000  0.0000
## 194 0.00000  0.0000
## 195 0.00000  0.0000
## 196 0.00000  0.0000
## 197 0.00000  0.0000
## 198 0.00000  0.0000
## 199 0.00000  0.0000
## 200 0.00000  0.0000
##
## $N_estimated_parameters
## [1] 1
##
## $table_of_phases
##
## -99 -5 -4 -3 -2 -1
##  1  1  1 10  4 22
##
## $estimated_non_dev_parameters
## [1] Value      Phase      Min      Max      Init      Status
## [7] Parm_StDev Gradient  Pr_type  Prior      Pr_SD      Pr_Like
## <0 rows> (or 0-length row.names)
##
## $maximum_gradient_component
## [1] 0
##
## $Length_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj #  N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1846      4      1      59.69170 # 34  14      6      86.00      32.5914
## 1847      4      2      36.47650 # 34  14      9     108.80      59.3200
## 1848      4      3     111.35100 # 44  15      1     174.48      86.7573
## 1849      4      4      0.43845 # 29   9     12      31.00      19.8889
##      mean_Nsamp_adj mean_Nsamp_DM DM_theta  mean_effN HarMean_effN Curr_Var_Adj

```

```

## 1846      32.5914      NA      NA 74598.2000 1945.44000      1
## 1847      59.3200      NA      NA 70693.4000 2163.79000      1
## 1848      86.7573      NA      NA 22722.6000 9660.53000      1
## 1849      19.8889      NA      NA   79.1256   8.72028      1
##      Fleet_name
## 1846  MexCal_S1
## 1847  MexCal_S2
## 1848      PNW
## 1849  AT_Survey
##
## $Age_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1987      5      1      9.329390 #      34      14      5.92      86.00
## 1988      5      2      4.260200 #      34      14      8.92     105.16
## 1989      5      3     17.893600 #      34      14     26.88     138.12
## 1990      5      4      0.428988 #      29      9     12.00      31.00
##      mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN
## 1987      31.0686      31.0686      NA      NA 10076.4000
## 1988      58.3143      58.3143      NA      NA 8139.9400
## 1989      76.2971      76.2971      NA      NA 3175.6600
## 1990      19.8889      19.8889      NA      NA   60.1969
##      HarMean_effN Curr_Var_Adj Fleet_name
## 1987      289.85100      1  MexCal_S1
## 1988      248.43000      1  MexCal_S2
## 1989     1365.23000      1      PNW
## 1990       8.53209      1  AT_Survey
##
## $SBzero
## [1] 80588.5
##
## $current_depletion
## [1] 0.1729074
##
## $last_years_SPR
## [1] NaN
##
## $SPRratioLabel
## [1] "raw_SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info
##      period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1      Main      20   1.526787   2.331078      NA      NA
## 2  Early+Main      26   1.364724   1.862471      NA      NA
## 3 Early+Main+Late     46   1.432577   2.052278      NA      NA
##      sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1      NA      3.053573      NA
## 2      NA      2.729447      NA
## 3      NA      2.865155      NA
##      alternative_sigma_R
## 1      NA
## 2      NA

```

```

## 3          NA
##
## $rmse_table
##   ERA  N      RMSE RMSE_over_sigmaR mean_BiasAdj
## 1  main 20 1.488130      8.85811      0.841539
## 2  early 6 0.618608      1.53070      0.766330

## completed SS_output

em2029Out <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_sel

## Getting header info from:
##   C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestMidSteep_RandR
## This function tested on SS versions 3.24 and 3.30.
##   You are using 3.30.18.00 which SHOULD work with this package.
## Report file time:Tue May 17 17:14:13 2022

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_sel

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_sel
##   'Variances are 0.0 for first two elements, so do not write '
##   input 'covar' changed to FALSE.

## Reading full report file
## Got all columns using ncols = 62
## Got Report file
## Setting minimum biomass threshold to 0.25 based on US west coast assumption associated with biomass
## !warning: temporary files were written in this run:

##           TempFile           Size
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
##           <NA>           <NA>
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"

## Got warning file. Therewere 7 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
##   3588 rows of length comp data,
##   0 rows of generalized size comp data,
##   819 rows of age comp data,
##   0 rows of conditional age-at-length data,
##   0 rows of ghost fleet age comp data,
##   0 rows of ghost fleet conditional age-at-length data,
##   351 rows of ghost fleet length comp data,
##   0 rows of mean length at age data,
##   0 rows of mean weight at age data,
##   0 rows of 'TAG1' comp data, and
##   0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
## running SS_readstarter

```

```

## data, control files: init_dat.ss, control.ss
## converge_criterion = 1e-05
## SPR_basis = 4
## F_report_basis = 2
## Assuming version 3.30 based on number of numeric values.
## MCMC_output_detail = 0
## ALK_tolerance = 1e-04
## Reading a random seed value:7545668
## Read of starter file complete. Final value: 3.3
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR"
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 17:14:13 2022"
##
## $RunTime
## [1] "0 hours, 0 minutes, 29 seconds."
##
## $Files_used
## [1] "Data_File: init_dat.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 7
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR"
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_"
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE: Max data length bin: 28 < max pop len bins: 30; so will accumulate larger pop len bins"
## [11] "2 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for"
## [12] "3 setting in starter does not request all priors, and 1 parameters have priors and are not est."
## [13] "4 1st iteration warning: ssb(endyr)/ssb(styr)= 1.03879e-07; suggest start with larger R0 to ge"
## [14] "5 Final gradient: 0.0139556 is larger than final_conv: 1e-05"
## [15] "6 setting positive forecast relF for forecast only fleet: 1"
## [16] "7 setting positive forecast relF for forecast only fleet: 2"
## [17] "N warnings: 7"
##
## $likelihoods_used
##
values lambdas

```

```

## TOTAL                6093.1899999999959982      NA
## Catch                0.00000000000594608      NA
## Equil_catch         0.00000000000000000      NA
## Survey              142.53299999999998704      NA
## Length_comp         3645.19000000000005457      NA
## Age_comp            2147.44000000000005457      NA
## Recruitment          89.43750000000000000      1
## InitEQ_Regime        0.00000000000000000      0
## Forecast_Recruitment 68.59619999999999607      1
## Parm_priors          0.00000000000000000      1
## Parm_softbounds      0.00190164000000000      NA
## Parm_devs            0.00000000000000000      1
## Crash_Pen           0.00000000000000000      1
##
## $likelihoods_laplace
##                               values lambdas
## NoBias_corr_Recruitment(info_only) 86.269      1
## Laplace_obj_fun(info_only)         6090.030     NA
##
## $likelihoods_by_fleet
##      Label      ALL  MexCal_S1  MexCal_S2      PNW AT_Survey
## 180  Catch_lambda      NA 1.00000e+00 1.00000e+00 1.00000e+00      1.000
## 181  Catch_like 5.94608e-12 2.80259e-13 2.14372e-13 5.45145e-12      0.000
## 182 Init_equ_lambda      NA 0.00000e+00 0.00000e+00 0.00000e+00      1.000
## 183 Init_equ_like 0.00000e+00 0.00000e+00 0.00000e+00 0.00000e+00      0.000
## 184  Surv_lambda      NA 0.00000e+00 0.00000e+00 0.00000e+00      1.000
## 185  Surv_like 1.42533e+02 0.00000e+00 0.00000e+00 0.00000e+00     156.441
## 186  Surv_N_use      NA 0.00000e+00 0.00000e+00 0.00000e+00      28.000
## 187  Surv_N_skip      NA 0.00000e+00 0.00000e+00 0.00000e+00      0.000
## 188 Length_lambda      NA 1.00000e+00 1.00000e+00 1.00000e+00      1.000
## 189 Length_like 3.64519e+03 5.86452e+02 5.19829e+02 3.88025e+02    2150.880
## 190 Length_N_use      NA 2.40000e+01 2.40000e+01 2.50000e+01      19.000
## 191 Length_N_skip      NA 0.00000e+00 0.00000e+00 9.00000e+00      0.000
## 192  Age_lambda      NA 1.00000e+00 1.00000e+00 1.00000e+00      1.000
## 193  Age_like 2.14744e+03 1.32687e+02 1.11915e+02 1.92612e+02    1710.220
## 194  Age_N_use      NA 2.40000e+01 2.40000e+01 2.40000e+01      19.000
## 195  Age_N_skip      NA 0.00000e+00 0.00000e+00 0.00000e+00      0.000
##      DEPM  TEP_all
## 180 1.00000 1.00000
## 181 0.00000 0.00000
## 182 1.00000 1.00000
## 183 0.00000 0.00000
## 184 1.00000 1.00000
## 185 -4.92958 -8.97901
## 186 10.00000 13.00000
## 187 0.00000 0.00000
## 188 0.00000 0.00000
## 189 0.00000 0.00000
## 190 0.00000 0.00000
## 191 0.00000 0.00000
## 192 0.00000 0.00000
## 193 0.00000 0.00000
## 194 0.00000 0.00000
## 195 0.00000 0.00000

```

```

##
## $N_estimated_parameters
## [1] 57
##
## $table_of_phases
##
## -99 -5 -4 -3 -2 -1 1 2 3 4 5
## 1 1 1 10 4 2 21 6 16 3 11
##
## $estimated_non_dev_parameters
##
## Value Phase Min Max Init Status
## L_at_Amin_Fem_GP_1 12.7560000 3 3.00 30.00 12.8541000 OK
## L_at_Amax_Fem_GP_1 24.8069000 3 15.00 40.00 24.8415000 OK
## VonBert_K_Fem_GP_1 0.3222160 3 0.05 0.99 0.3075730 OK
## CV_young_Fem_GP_1 0.1280350 3 0.05 0.50 0.1053490 OK
## CV_old_Fem_GP_1 0.0173211 3 0.01 0.10 0.0237245 OK
## SR_LN(R0) 14.3909000 1 3.00 25.00 14.4668000 OK
## SR_regime_BLK1repl_2000 1.2247800 4 -15.00 15.00 1.2915300 OK
## Size_inflection_MexCal_S1(1) 10.8172000 3 0.00 30.00 10.9072000 OK
## Size_95%width_MexCal_S1(1) 0.7145150 3 0.00 10.00 0.6599090 OK
## AgeSel_P1_MexCal_S1(1) 0.4999980 3 -10.00 11.00 0.5000240 OK
## AgeSel_P2_MexCal_S1(1) 0.8810790 3 -10.00 11.00 0.2048810 OK
## AgeSel_P3_MexCal_S1(1) 0.3458780 3 -10.00 15.00 0.3827920 OK
## AgeSel_P4_MexCal_S1(1) -1.6849700 3 -10.00 11.00 -1.5494000 OK
## AgeSel_P5_MexCal_S1(1) 0.0135282 3 -10.00 11.00 -0.2361890 OK
## AgeSel_P2_MexCal_S2(2) 0.5434880 3 -10.00 15.00 0.4405260 OK
## AgeSel_P3_MexCal_S2(2) -1.3161300 3 -10.00 11.00 -1.1690800 OK
## AgeSel_P4_MexCal_S2(2) -0.0870818 3 -10.00 11.00 -0.1425740 OK
## AgeSel_P5_MexCal_S2(2) -0.3694020 3 -10.00 11.00 -0.4707320 OK
## Age_inflection_PNW(3) 2.9168400 4 0.00 10.00 2.8525100 OK
## Age_95%width_PNW(3) 1.1460100 4 -5.00 15.00 1.2152300 OK
##
## Parm_StDev Gradient Pr_type Prior Pr_SD
## L_at_Amin_Fem_GP_1 0 -0.002163100000000 No_prior NA NA
## L_at_Amax_Fem_GP_1 0 -0.001293310000000 No_prior NA NA
## VonBert_K_Fem_GP_1 0 -0.000915555000000 No_prior NA NA
## CV_young_Fem_GP_1 0 -0.000206307000000 No_prior NA NA
## CV_old_Fem_GP_1 0 -0.000020638000000 No_prior NA NA
## SR_LN(R0) 0 -0.013955500000000 No_prior NA NA
## SR_regime_BLK1repl_2000 0 -0.000366477000000 No_prior NA NA
## Size_inflection_MexCal_S1(1) 0 -0.000300606000000 No_prior NA NA
## Size_95%width_MexCal_S1(1) 0 -0.000050926800000 No_prior NA NA
## AgeSel_P1_MexCal_S1(1) 0 -0.000000000743779 No_prior NA NA
## AgeSel_P2_MexCal_S1(1) 0 -0.000102136000000 No_prior NA NA
## AgeSel_P3_MexCal_S1(1) 0 -0.000405965000000 No_prior NA NA
## AgeSel_P4_MexCal_S1(1) 0 -0.000083824300000 No_prior NA NA
## AgeSel_P5_MexCal_S1(1) 0 -0.000069218200000 No_prior NA NA
## AgeSel_P2_MexCal_S2(2) 0 -0.001139580000000 No_prior NA NA
## AgeSel_P3_MexCal_S2(2) 0 -0.000409461000000 No_prior NA NA
## AgeSel_P4_MexCal_S2(2) 0 -0.000391958000000 No_prior NA NA
## AgeSel_P5_MexCal_S2(2) 0 -0.000238854000000 No_prior NA NA
## Age_inflection_PNW(3) 0 -0.000137020000000 No_prior NA NA
## Age_95%width_PNW(3) 0 0.000157750000000 No_prior NA NA
##
## Pr_Like Afterbound
## L_at_Amin_Fem_GP_1 NA OK

```

```

## L_at_Amax_Fem_GP_1          NA          OK
## VonBert_K_Fem_GP_1          NA          OK
## CV_young_Fem_GP_1           NA          OK
## CV_old_Fem_GP_1             NA          OK
## SR_LN(R0)                   NA          OK
## SR_regime_BLK1repl_2000      NA          OK
## Size_inflection_MexCal_S1(1) NA          OK
## Size_95%width_MexCal_S1(1)  NA          OK
## AgeSel_P1_MexCal_S1(1)       NA          OK
## AgeSel_P2_MexCal_S1(1)       NA          OK
## AgeSel_P3_MexCal_S1(1)       NA          OK
## AgeSel_P4_MexCal_S1(1)       NA          OK
## AgeSel_P5_MexCal_S1(1)       NA          OK
## AgeSel_P2_MexCal_S2(2)       NA          OK
## AgeSel_P3_MexCal_S2(2)       NA          OK
## AgeSel_P4_MexCal_S2(2)       NA          OK
## AgeSel_P5_MexCal_S2(2)       NA          OK
## Age_inflection_PNW(3)        NA          OK
## Age_95%width_PNW(3)         NA          OK
##
## $maximum_gradient_component
## [1] 0.0139556
##
## $parameters_with_highest_gradients
##              Value      Gradient
## SR_LN(R0)      14.390900 -0.01395550
## L_at_Amin_Fem_GP_1 12.756000 -0.00216310
## L_at_Amax_Fem_GP_1 24.806900 -0.00129331
## Late_RecrDev_2020  1.632340 -0.00127818
## AgeSel_P2_MexCal_S2(2) 0.543488 -0.00113958
##
## $Length_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1464      4      1      0.0392351 # 24 24      6      2000      852.167
## 1465      4      2      0.0625035 # 24 24      9      2000      867.750
## 1466      4      3      0.0265517 # 34 25      1      2000      851.800
## 1467      4      4      0.0109828 # 19 19     12      2000     1062.050
##      mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN Curr_Var_Adj
## 1464      852.167      NA      NA 307.9150      33.4348      1
## 1465      867.750      NA      NA 439.6570      54.2374      1
## 1466      851.800      NA      NA 932.2270      22.6167      1
## 1467     1062.050      NA      NA 28.5111      11.6643      1
##      Fleet_name
## 1464 MexCal_S1
## 1465 MexCal_S2
## 1466 PNW
## 1467 AT_Survey
##
## $Age_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1565      5      1      0.3222570 #      24 24      100      2000
## 1566      5      2      0.2677410 #      24 24      100      2000
## 1567      5      3      0.5023540 #      24 24      100      2000
## 1568      5      4      0.0172619 #      19 19      100      2000

```



```

##      mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN
## 1565      891.667      891.667      NA      NA 1171.710 287.3460
## 1566      891.667      891.667      NA      NA 2290.480 238.7360
## 1567      891.667      891.667      NA      NA 825.454 447.9320
## 1568     1100.000     1100.000      NA      NA 231.448 18.9881
##      Curr_Var_Adj Fleet_name
## 1565          1 MexCal_S1
## 1566          1 MexCal_S2
## 1567          1      PNW
## 1568          1 AT_Survey
##
## $SBzero
## [1] 77234
##
## $current_depletion
## [1] 9.435611
##
## $last_years_SPR
## [1] 0.733235
##
## $SPRratioLabel
## [1] "1-SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info
##      period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1      Main    20  1.617123  2.615088      0      0
## 2 Early+Main    26  1.444087  2.085387      0      0
## 3 Early+Main+Late 36  1.552902  2.411504      0      0
##      sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1      1.617123      3.234246      3.234246
## 2      1.444087      2.888174      2.888174
## 3      1.552902      3.105804      3.105804
##      alternative_sigma_R
## 1      1.617123
## 2      1.444087
## 3      1.552902
##
## $rmse_table
##      ERA N      RMSE RMSE_over_sigmaR mean_BiasAdj
## 1 main 20 1.576180      9.93733 0.841539
## 2 early 6 0.640152      1.63918 0.766330

```

```
## completed SS_output
```

```
compFree <- SSsummarize(list(OM = omOut, EM2029 = em2029Out))
```

```

## Summarizing 2 models:
## imodel=1/2
## N active pars = 0
## imodel=2/2

```

```
## N active pars = 57
## Summary finished. To avoid printing details above, use 'verbose = FALSE'.
```

```
#SS_plots(em2029Out)
```

EM tries to throw in really high rec_dev at end of time series, maybe to support high forecast catches?

EM 2001 self test, recruitment at SD=0.5, h=0.6, high sample size

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"

scenarios <- c("constGrow20010M_selfTestSteep0dot6_RandRecHCR0",
              "constGrow20010M_selfTestSteep0dot6_RandRecHCR2",
              "constGrow20010M_selfTestSteep0dot6FixRec_RandRecHCR2")

test1 <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTest
```

```
## Rows: 63 Columns: 144
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl (137): SSB_Unfished, Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, S...
## lgl   (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
#View(test1)
test1 %>% select(model_run, SR_LN_R0, SR_regime_BLK1repl_2000, iteration, scenario)
```

```
## # A tibble: 63 x 5
##   model_run          SR_LN_R0 SR_regime_BLK1repl_2000 iteration scenario
##   <chr>              <dbl>          <dbl>      <dbl> <chr>
## 1 constGrowFixRec_EM_2020    14.5          1.29        1 constGrow~
## 2 constGrowFixRec_EM_2021    14.5          1.29        1 constGrow~
## 3 constGrowFixRec_EM_2022    14.5          1.29        1 constGrow~
## 4 constGrowFixRec_EM_2023    14.5          1.29        1 constGrow~
## 5 constGrowFixRec_EM_2024    14.5          1.29        1 constGrow~
## 6 constGrowFixRec_EM_2025    14.5          1.29        1 constGrow~
## 7 constGrowFixRec_EM_2026    14.5          1.29        1 constGrow~
## 8 constGrowFixRec_EM_2027    14.5          1.29        1 constGrow~
## 9 constGrowFixRec_EM_2028    14.5          1.29        1 constGrow~
## 10 constGrowFixRec_EM_2029   14.5          1.29        1 constGrow~
## # ... with 53 more rows
```

```
smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)
```

```

## Rows: 120 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1890 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

smryOutputList$ddqSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                         smryOutputList$ddqSmry$model_run, fixed = TRUE)
smryOutputList$sclSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                         smryOutputList$sclSmry$model_run, fixed = TRUE)
smryOutputList$ttsSmry$model_run <- sub("Steepness0dot6", "MidSteep",
                                         smryOutputList$ttsSmry$model_run, fixed = TRUE)

performanceList <- CalcPerformance(smryOutputList)

## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.

## Warning in min(All_exp_mean): no non-missing arguments to min; returning Inf

```

```
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics

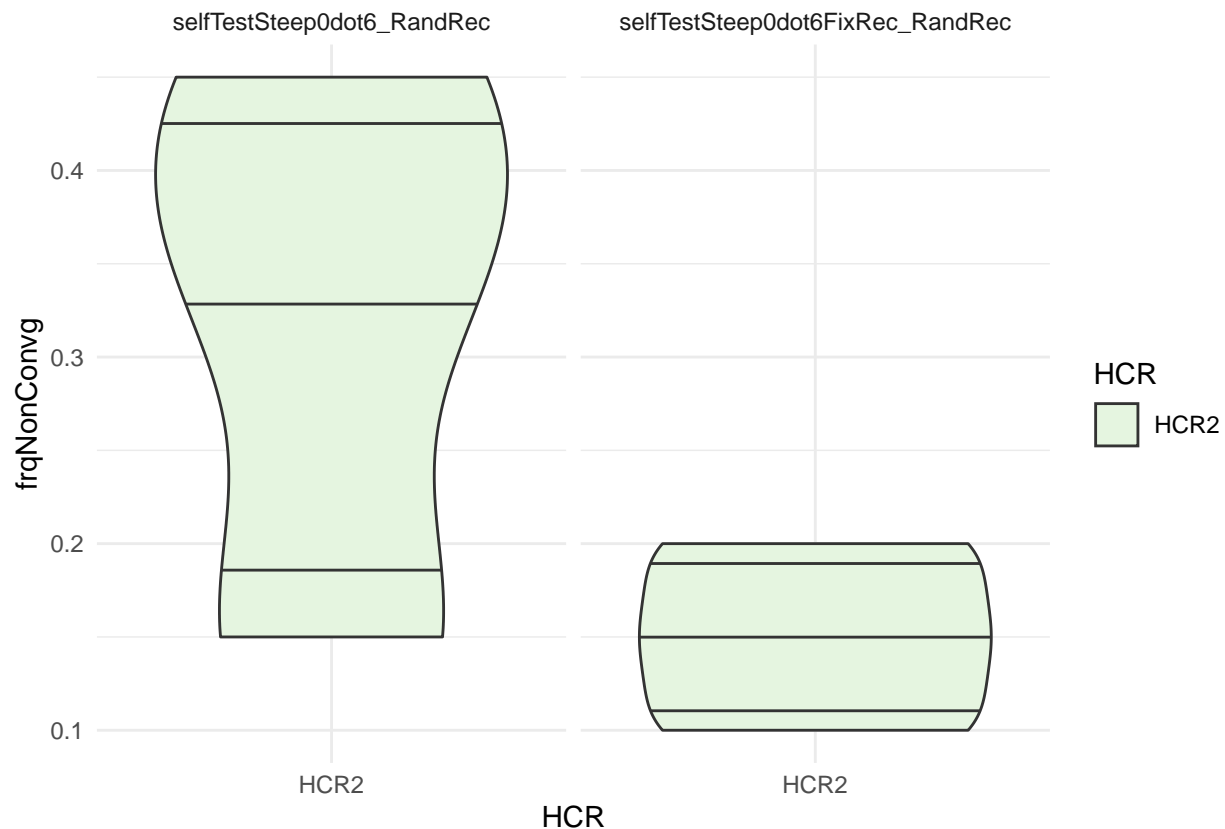
# parse out HCR and recruitment scenario
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),
                                   recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_", "", recScen))

hcrPal <- brewer.pal(10, "Set3")[-2]

# plot convergence frequency
metricsTbl %>% filter(HCR != "HCR0") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)
```

```
## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```



```

# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

cnvrgCheck <- smryOutputList$sclSmry %>% #filter(!model_run %in% omName) %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                    model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen))

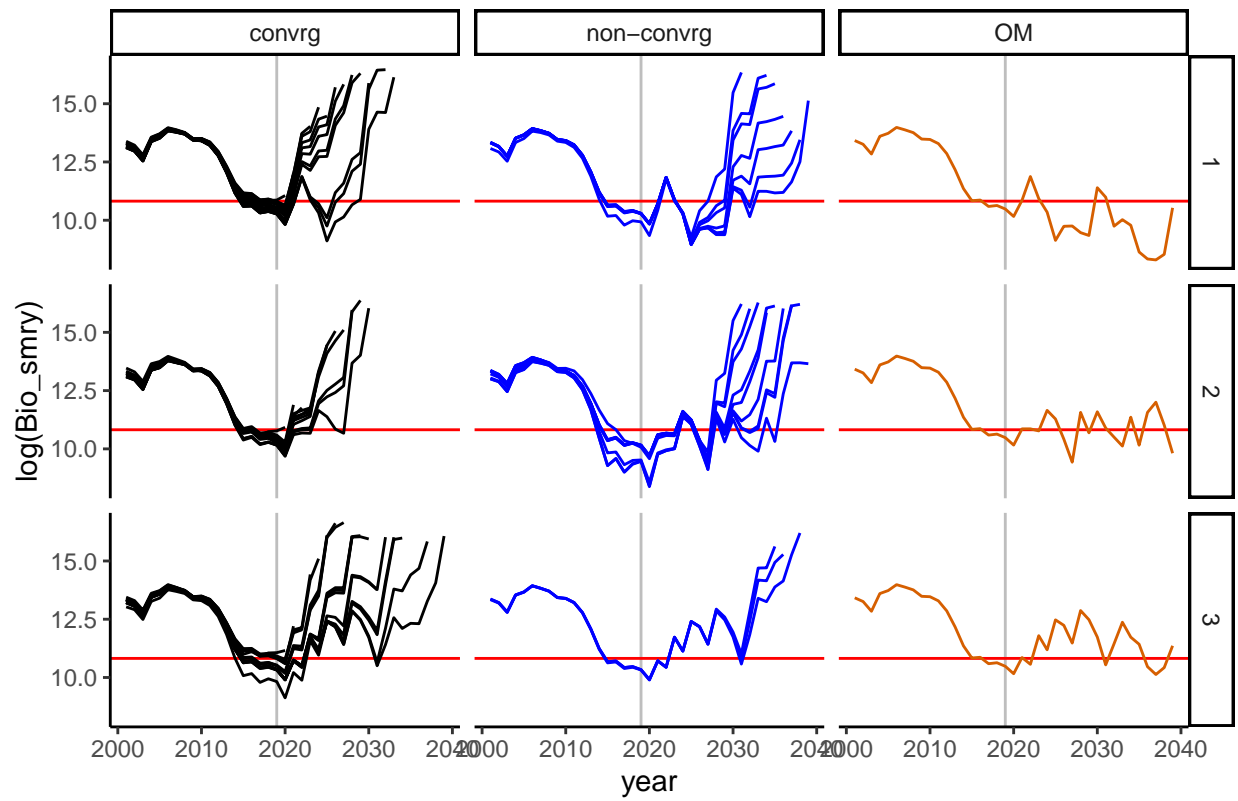
hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                           recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM_","", recScen)) %>%
  left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
  mutate(plotGroup = case_when(model_run == omName ~ "OM",
                               max_grad > 0.01 ~ "non-cnvrng",
                               max_grad < 0.01 ~ "cnvrng"))

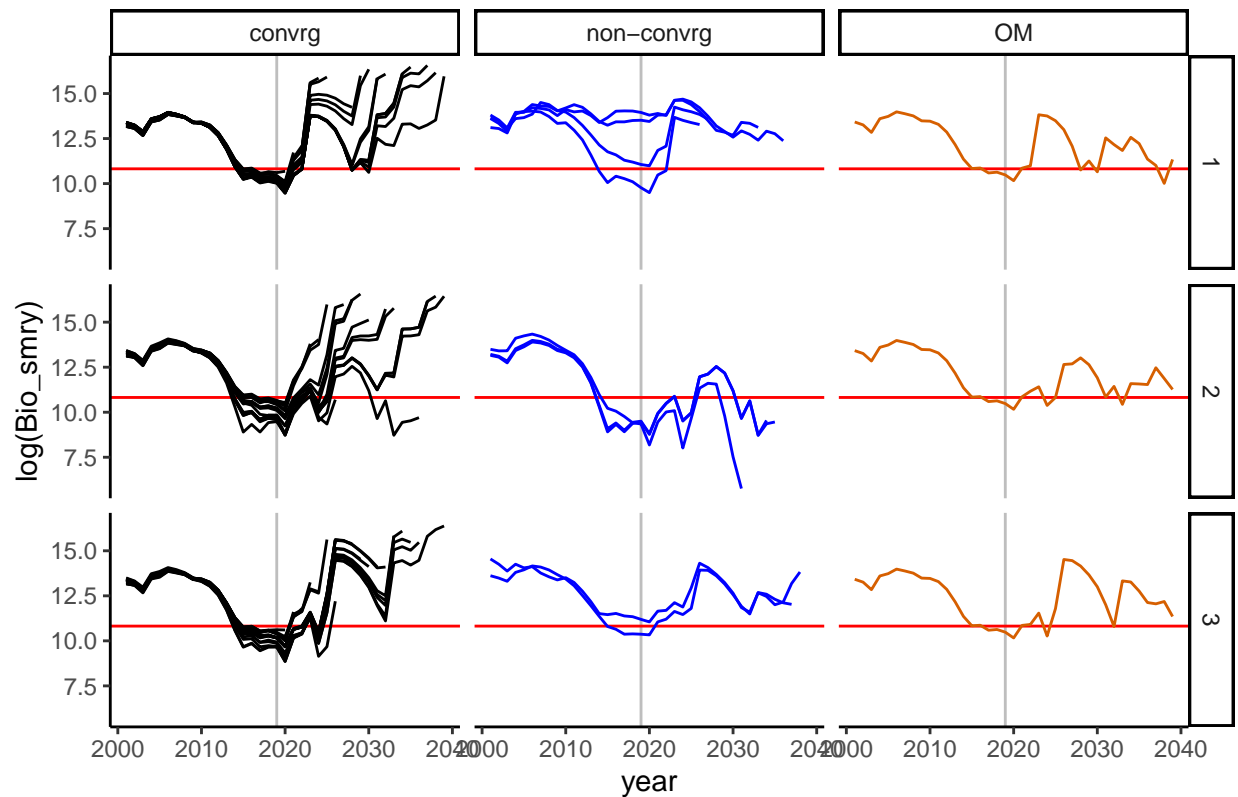
for(mr in 2:3){
  print(cnvrgTS %>% filter(scenario == scenarios[mr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = scenarios[mr]))
}

```

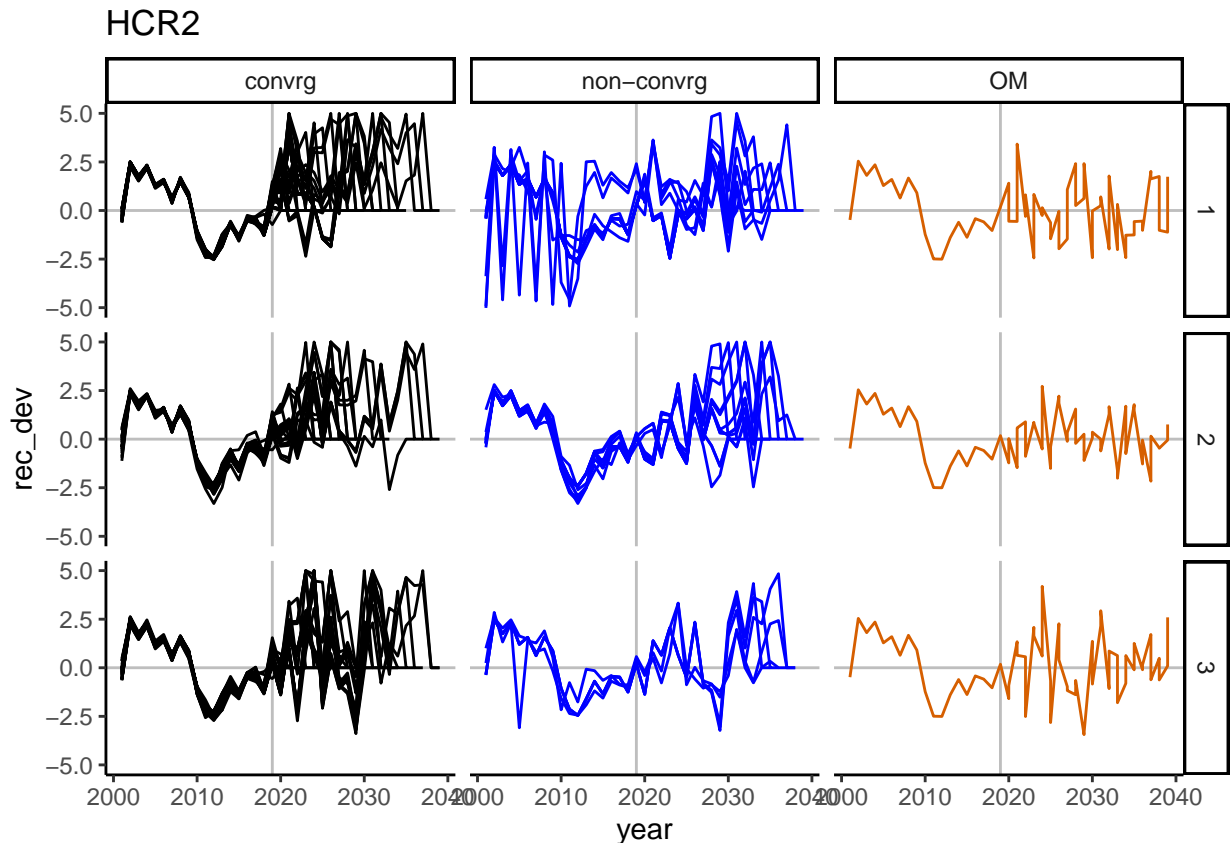
constGrow2001OM_selfTestSteep0dot6_RandRecHCR2



constGrow2001OM_selfTestSteep0dot6FixRec_RandRecHCR2



```
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```



```
#termTS %>% filter(model_run == omName)

errCompare <- cnvrTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
    by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
    age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

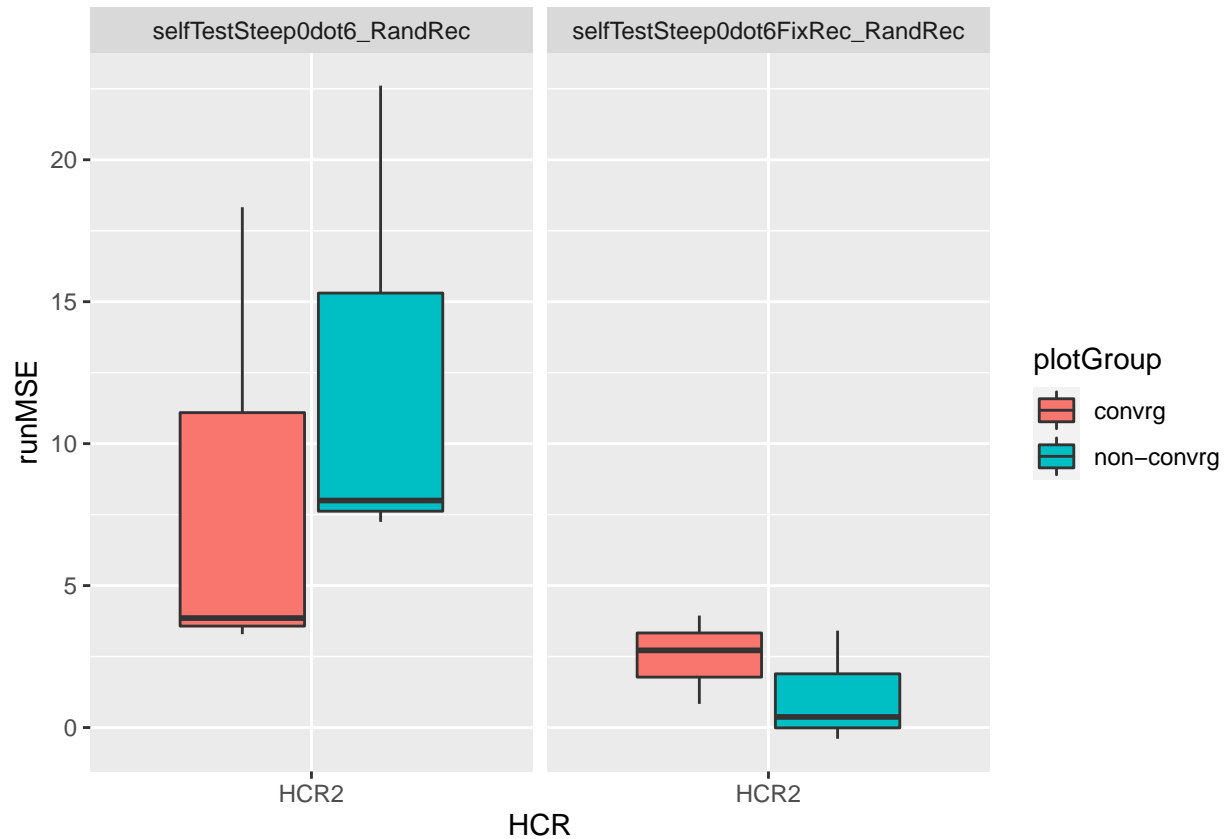
```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```



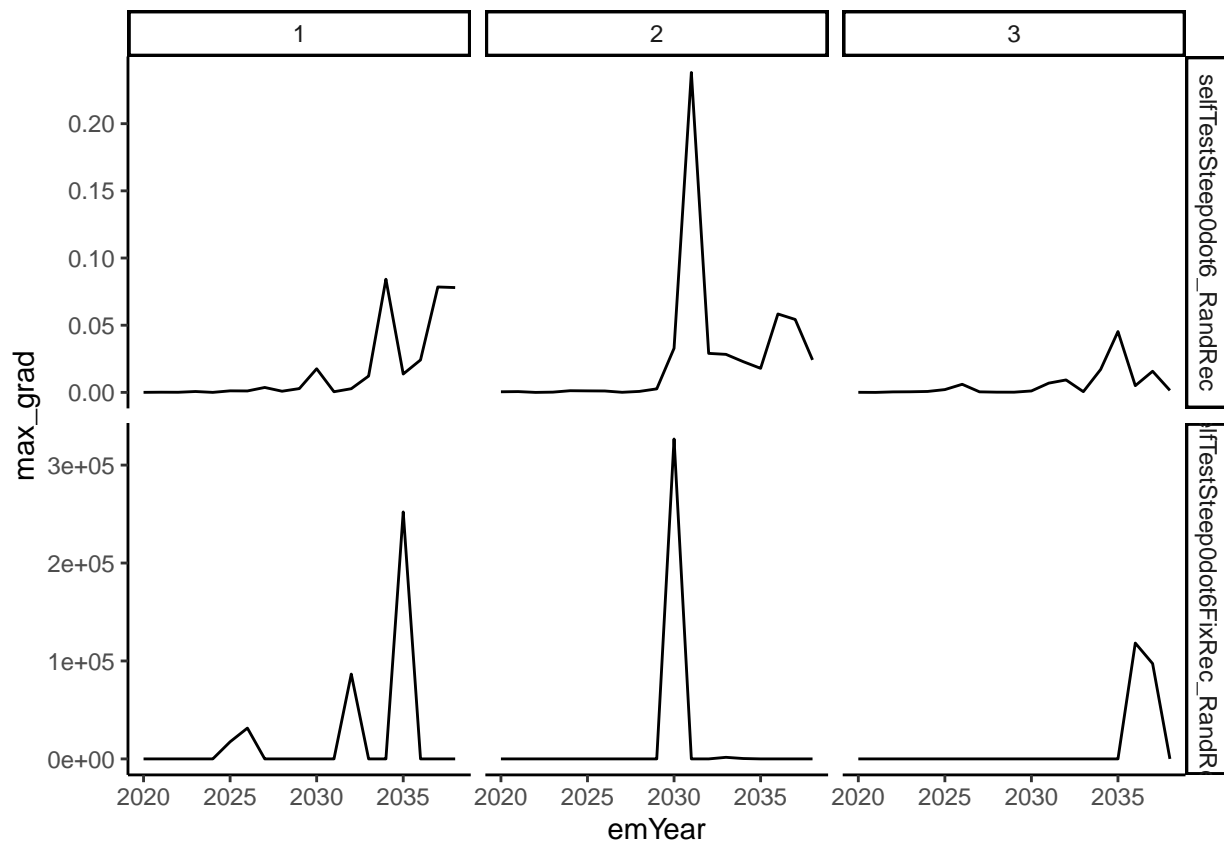
```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



```
# PlotEMAnnualEsts(dirSSMSE = mseDir, scenarios = scenarios,
#                   varCol = c("SSB_Unfished", "NatM_uniform_Fem_GP_1",
#                               "L_at_Amin_Fem_GP_1", "SR_LN_R0",
#                               "SR_regime_BLK1repl_2000", "InitF_seas_2_flt_2MexCal_S2",
#                               "CV_old_Fem_GP_1"))
```

```
convrCheck %>%
  ggplot(aes(x = emYear, y = max_grad)) +
  geom_line(aes(linetype = scenario))+
  scale_linetype_manual(values = rep("solid", 51)) +
  guides(linetype = "none") +
  facet_grid(rows = vars(recScen), cols = vars(iteration), scales = "free") +
  theme_classic() + theme(legend.position="none")
```

```
## Warning: Removed 7 row(s) containing missing values (geom_path).
```



```
omOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixRec_RandR")
```

```
## Getting header info from:
## C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixRec_RandR
## This function tested on SS versions 3.24 and 3.30.
## You are using 3.30.18.00 which SHOULD work with this package.
## Report file time:Tue May 17 12:40:17 2022
```

```
## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixRec_RandR"):
```

```
## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixRec_RandR"):
```

```
## 'Variances are 0.0 for first two elements, so do not write '
```

```
## input 'covar' changed to FALSE.
```

```
## Reading full report file
## Got all columns using ncols = 62
## Got Report file
## !warning: temporary files were written in this run:
```

```
## TempFile Size
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
## <NA> <NA>
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"
```

```

## Got warning file. Therewere 6 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenario
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
##   2028 rows of length comp data,
##   0 rows of generalized size comp data,
##   459 rows of age comp data,
##   0 rows of conditional age-at-length data,
##   720 rows of ghost fleet age comp data,
##   0 rows of ghost fleet conditional age-at-length data,
##   3471 rows of ghost fleet length comp data,
##   0 rows of mean length at age data,
##   0 rows of mean weight at age data,
##   0 rows of 'TAG1' comp data, and
##   0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 12:40:17 2022"
##
## $RunTime
## [1] "0 hours, 0 minutes, 0 seconds."
##
## $Files_used
## [1] "Data_File: data.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 6
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_A
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE:  Max data length bin: 28  < max pop len bins: 30; so will accumulate larger pop len bin
## [11] "2 Forecast=0 or -1, so rest of forecast file will not be read and can be omitted;"
## [12] "2 A one year forecast using recent F will be done automatically"

```

```

## [13] "3 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for
## [14] "4 setting in starter does not request all priors, and 1 parameters have priors and are not est.
## [15] "5 Forecast F capped by max possible F from control file: 4"
## [16] "6 Forecast F capped by max possible F from control file: 4"
## [17] "N warnings: 6"
##
## $likelihoods_used
##              values lambdas
## TOTAL          2774.2700000      NA
## Catch          2564.9300000      NA
## Equil_catch      0.0000000      NA
## Survey         -28.0180000      NA
## Length_comp     41.9452000      NA
## Age_comp        37.4688000      NA
## Recruitment      78.3199000        1
## InitEQ_Regime    0.0000000        0
## Forecast_Recruitment 79.6215000        1
## Parm_priors      0.0000000        1
## Parm_softbounds  0.0019748      NA
## Parm_devs        0.0000000        1
## Crash_Pen        0.0000000        1
##
## $likelihoods_laplace
##              values lambdas
## NoBias_corr_Recruitment(info_only) 75.1513        1
## Laplace_obj_fun(info_only)         2771.1100      NA
##
## $likelihoods_by_fleet
##              Label      ALL  MexCal_S1  MexCal_S2      PNW  AT_Survey
## 185  Catch_lambda      NA    1.00000    1.00000    1.00000    1.00000
## 186  Catch_like 2564.9300 1052.51000 1049.18000 463.23700    0.00000
## 187  Init_equ_lambda      NA    0.00000    0.00000    0.00000    1.00000
## 188  Init_equ_like    0.0000    0.00000    0.00000    0.00000    0.00000
## 189  Surv_lambda      NA    0.00000    0.00000    0.00000    1.00000
## 190  Surv_like  -28.0180    0.00000    0.00000    0.00000   -9.94359
## 191  Surv_N_use      NA    0.00000    0.00000    0.00000   18.00000
## 192  Surv_N_skip      NA    0.00000    0.00000    0.00000   20.00000
## 193  Length_lambda      NA    1.00000    1.00000    1.00000    1.00000
## 194  Length_like  41.9452    0.98456    2.63440    1.66827   36.65790
## 195  Length_N_use      NA   14.00000   14.00000   15.00000    9.00000
## 196  Length_N_skip      NA   20.00000   20.00000   29.00000   20.00000
## 197  Age_lambda      NA    1.00000    1.00000    1.00000    1.00000
## 198  Age_like  37.4688    1.16795    3.26694    3.16781   29.86610
## 199  Age_N_use      NA   14.00000   14.00000   14.00000    9.00000
## 200  Age_N_skip      NA   20.00000   20.00000   20.00000   20.00000
##
##      DEPM  TEP_all
## 185 1.00000  1.0000
## 186 0.00000  0.0000
## 187 1.00000  1.0000
## 188 0.00000  0.0000
## 189 1.00000  1.0000
## 190 -1.76351 -16.3109
## 191 10.00000 13.0000
## 192 0.00000  0.0000

```

```

## 193 0.00000 0.0000
## 194 0.00000 0.0000
## 195 0.00000 0.0000
## 196 0.00000 0.0000
## 197 0.00000 0.0000
## 198 0.00000 0.0000
## 199 0.00000 0.0000
## 200 0.00000 0.0000
##
## $N_estimated_parameters
## [1] 1
##
## $table_of_phases
##
## -99 -5 -4 -3 -2 -1
## 1 1 1 10 4 22
##
## $estimated_non_dev_parameters
## [1] Value Phase Min Max Init Status
## [7] Parm_StDev Gradient Pr_type Prior Pr_SD Pr_Like
## <0 rows> (or 0-length row.names)
##
## $maximum_gradient_component
## [1] 0
##
## $Length_Comp_Fit_Summary
## Factor Fleet Recommend_var_adj # N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1846 4 1 59.69170 # 34 14 6 86.00 32.5914
## 1847 4 2 36.47650 # 34 14 9 108.80 59.3200
## 1848 4 3 111.35100 # 44 15 1 174.48 86.7573
## 1849 4 4 0.43845 # 29 9 12 31.00 19.8889
## mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN Curr_Var_Adj
## 1846 32.5914 NA NA 74598.2000 1945.44000 1
## 1847 59.3200 NA NA 70693.4000 2163.79000 1
## 1848 86.7573 NA NA 22722.6000 9660.53000 1
## 1849 19.8889 NA NA 79.1256 8.72028 1
## Fleet_name
## 1846 MexCal_S1
## 1847 MexCal_S2
## 1848 PNW
## 1849 AT_Survey
##
## $Age_Comp_Fit_Summary
## Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1987 5 1 9.329390 # 34 14 5.92 86.00
## 1988 5 2 4.260200 # 34 14 8.92 105.16
## 1989 5 3 17.893600 # 34 14 26.88 138.12
## 1990 5 4 0.428988 # 29 9 12.00 31.00
## mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN
## 1987 31.0686 31.0686 NA NA 10076.4000
## 1988 58.3143 58.3143 NA NA 8139.9400
## 1989 76.2971 76.2971 NA NA 3175.6600
## 1990 19.8889 19.8889 NA NA 60.1969
## HarMean_effN Curr_Var_Adj Fleet_name

```

```

## 1987      289.85100           1 MexCal_S1
## 1988      248.43000           1 MexCal_S2
## 1989     1365.23000           1      PNW
## 1990         8.53209           1 AT_Survey
##
## $SBzero
## [1] 80588.5
##
## $current_depletion
## [1] 0.2233433
##
## $last_years_SPR
## [1] NaN
##
## $SPRratioLabel
## [1] "raw_SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info
##           period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1           Main    20   1.526787   2.331078      NA      NA
## 2      Early+Main    26   1.364724   1.862471      NA      NA
## 3 Early+Main+Late    46   1.374346   1.888828      NA      NA
##  sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1                      NA              3.053573      NA
## 2                      NA              2.729447      NA
## 3                      NA              2.748692      NA
##  alternative_sigma_R
## 1                      NA
## 2                      NA
## 3                      NA
##
## $rmse_table
##      ERA  N      RMSE RMSE_over_sigmaR mean_BiasAdj
## 1 main 20 1.488130      8.85811      0.841539
## 2 early 6 0.618608      1.53070      0.766330

## completed SS_output

fixedOut <- SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixR

## Getting header info from:
## C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixR
## This function tested on SS versions 3.24 and 3.30.
## You are using 3.30.18.00 which SHOULD work with this package.
## Report file time:Tue May 17 12:31:23 2022

## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixR
## Warning in SS_output("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTestSteep0dot6FixR
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

```

```

## Reading full report file
## Got all columns using ncols = 62
## Got Report file
## Setting minimum biomass threshold to 0.25 based on US west coast assumption associated with biomass
## !warning: temporary files were written in this run:

##                               TempFile                               Size
## "size of file gradfil1.tmp = 0" "size of file gradfil2.tmp = 0"
##                               <NA>                               <NA>
## "size of file varssave.tmp = 0" "size of file cmpdiff.tmp = 0"

## Got warning file. There were 10 warnings in C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenario
## Finished reading files
## CompReport file separated by this code as follows (rows = Ncomps*Nbins):
## 4056 rows of length comp data,
## 0 rows of generalized size comp data,
## 927 rows of age comp data,
## 0 rows of conditional age-at-length data,
## 0 rows of ghost fleet age comp data,
## 0 rows of ghost fleet conditional age-at-length data,
## 351 rows of ghost fleet length comp data,
## 0 rows of mean length at age data,
## 0 rows of mean weight at age data,
## 0 rows of 'TAG1' comp data, and
## 0 rows of 'TAG2' comp data.
## Finished dimensioning
## You skipped the covar file
## Finished primary run statistics list
## running SS_readstarter
## data, control files: init_dat.ss, control.ss
## converge_criterion = 1e-05
## SPR_basis = 4
## F_report_basis = 2
## Assuming version 3.30 based on number of numeric values.
## MCMC_output_detail = 0
## ALK_tolerance = 1e-04
## Reading a random seed value:11917333
## Read of starter file complete. Final value: 3.3
##
## Statistics shown below (to turn off, change input to printstats=FALSE)

## $SS_version
## [1] "3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_ADMR"
##
## $SS_versionshort
## [1] "3.30"
##
## $SS_versionNumeric
## [1] 3.3
##
## $StartTime
## [1] "StartTime: Tue May 17 12:31:23 2022"
##

```

```

## $RunTime
## [1] "0 hours, 0 minutes, 28 seconds."
##
## $Files_used
## [1] "Data_File: init_dat.ss Control_File: control.ss"
##
## $Nwarnings
## [1] 10
##
## $warnings
## [1] "#V3.30.18.00;_safe;_compile_date:_Sep 30 2021;_Stock_Synthesis_by_Richard_Methot_(NOAA)_using_"
## [2] "#_Stock_Synthesis_is_a_work_of_the_U.S._Government_and_is_not_subject_to_copyright_protection_"
## [3] "#_Foreign_copyrights_may_apply._See_copyright.txt_for_more_information."
## [4] "#_User_support_available_at:NMFS.Stock.Synthesis@noaa.gov"
## [5] "#_User_info_available_at:https://vlab.noaa.gov/group/stock-synthesis"
## [6] "#_Source_code_at:_https://github.com/nmfs-stock-synthesis/stock-synthesis"
## [7] ""
## [8] "This file contains warnings, suggestions and notes generated as files are read and processed"
## [9] ""
## [10] "1 NOTE: Max data length bin: 28 < max pop len bins: 30; so will accumulate larger pop len bins"
## [11] "2 settle_month is less than spawn_month, so logical age at settlement calculated to be: 1 for"
## [12] "3 setting in starter does not request all priors, and 1 parameters have priors and are not est."
## [13] "4 1st iteration warning: ssb(endyr)/ssb(styr)= 1.03665e-07; suggest start with larger R0 to get"
## [14] "5 Final gradient: 86629.7 is larger than final_conv: 1e-05"
## [15] "6 setting positive forecast relF for forecast only fleet: 1"
## [16] "7 setting positive forecast relF for forecast only fleet: 2"
## [17] "8 Forecast F capped by max possible F from control file: 4"
## [18] "9 Forecast F capped by max possible F from control file: 4"
## [19] "10 Number_of_active_parameters_on_or_near_bounds: 1"
## [20] "N warnings: 10"
##
## $likelihoods_used
##
##              values lambdas
## TOTAL          53471.30000000    NA
## Catch           640.81700000    NA
## Equil_catch      0.00000000    NA
## Survey          785.23900000    NA
## Length_comp     29234.40000000    NA
## Age_comp        22368.60000000    NA
## Recruitment      392.65500000     1
## InitEQ_Regime    0.00000000     0
## Forecast_Recruitment  49.60920000     1
## Parm_priors      0.00000000     1
## Parm_softbounds  0.00205837    NA
## Parm_devs        0.00000000     1
## Crash_Pen        0.00000000     1
##
## $likelihoods_laplace
##
##              values lambdas
## NoBias_corr_Recruitment(info_only)  389.487     1
## Laplace_obj_fun(info_only)         53468.200    NA
##
## $likelihoods_by_fleet
##
##              Label      ALL MexCal_S1 MexCal_S2      PNW AT_Survey      DEPM

```



```

## 180    Catch_lambda      NA      1.000      1.000      1.000000      1.000      1.0000
## 181    Catch_like    640.817    163.435    477.364      0.018243      0.000      0.0000
## 182 Init_equ_lambda      NA      0.000      0.000      0.000000      1.000      1.0000
## 183    Init_equ_like      0.000      0.000      0.000      0.000000      0.000      0.0000
## 184    Surv_lambda      NA      0.000      0.000      0.000000      1.000      1.0000
## 185    Surv_like    785.239      0.000      0.000      0.000000      750.636    17.2897
## 186    Surv_N_use      NA      0.000      0.000      0.000000      31.000    10.0000
## 187    Surv_N_skip      NA      0.000      0.000      0.000000      0.000      0.0000
## 188    Length_lambda      NA      1.000      1.000      1.000000      1.000      0.0000
## 189    Length_like  29234.400    6643.650    5627.670    7322.950000    9640.150      0.0000
## 190    Length_N_use      NA     27.000     27.000     28.000000     22.000      0.0000
## 191    Length_N_skip      NA      0.000      0.000      9.000000      0.000      0.0000
## 192    Age_lambda      NA      1.000      1.000      1.000000      1.000      0.0000
## 193    Age_like    22368.600    2770.440    7330.180    3626.270000    8641.700      0.0000
## 194    Age_N_use      NA     27.000     27.000     27.000000     22.000      0.0000
## 195    Age_N_skip      NA      0.000      0.000      0.000000      0.000      0.0000
##      TEP_all
## 180    1.0000
## 181    0.0000
## 182    1.0000
## 183    0.0000
## 184    1.0000
## 185   17.3125
## 186   13.0000
## 187    0.0000
## 188    0.0000
## 189    0.0000
## 190    0.0000
## 191    0.0000
## 192    0.0000
## 193    0.0000
## 194    0.0000
## 195    0.0000
##
## $N_estimated_parameters
## [1] 58
##
## $table_of_phases
##
##  -99  -5  -4  -3  -2  -1   1   2   3   4   5
##    1   1   2  10   4   3  20   6  16   2  14
##
## $estimated_non_dev_parameters
##
##           Value Phase    Min    Max      Init Status
## L_at_Amin_Fem_GP_1    10.1582000      3    3.00  30.00  12.8541000      OK
## L_at_Amax_Fem_GP_1    22.9142000      3   15.00  40.00  24.8415000      OK
## VonBert_K_Fem_GP_1     0.4616730      3    0.05   0.99   0.3075730      OK
## CV_young_Fem_GP_1     0.2416620      3    0.05   0.50   0.1053490      OK
## CV_old_Fem_GP_1       0.0100001      3    0.01   0.10   0.0237245      LO
## Size_inflection_MexCal_S1(1) 15.5152000      3    0.00  30.00  10.9072000      OK
## Size_95%width_MexCal_S1(1)   3.5942000      3    0.00  10.00   0.6599090      OK
## AgeSel_P1_MexCal_S1(1)   0.5000190      3  -10.00  11.00   0.5000240      OK
## AgeSel_P2_MexCal_S1(1)  -2.9313800      3  -10.00  11.00   0.2048810      OK
## AgeSel_P3_MexCal_S1(1)  -0.6326710      3  -10.00  15.00   0.3827920      OK

```

```

## AgeSel_P4_MexCal_S1(1)      -2.5375400      3 -10.00 11.00 -1.5494000      OK
## AgeSel_P5_MexCal_S1(1)      -1.6282100      3 -10.00 11.00 -0.2361890      OK
## AgeSel_P2_MexCal_S2(2)      -1.5887700      3 -10.00 15.00  0.4405260      OK
## AgeSel_P3_MexCal_S2(2)      -6.0024100      3 -10.00 11.00 -1.1690800      OK
## AgeSel_P4_MexCal_S2(2)       1.0881700      3 -10.00 11.00 -0.1425740      OK
## AgeSel_P5_MexCal_S2(2)      -3.8011500      3 -10.00 11.00 -0.4707320      OK
## Age_inflection_PNW(3)        1.1896600      4  0.00 10.00  2.8525100      OK
## Age_95%width_PNW(3)         3.7771700      4 -5.00 15.00  1.2152300      OK
##                               Parm_StDev      Gradient Pr_type Prior
## L_at_Amin_Fem_GP_1           0                NaN No_prior  NA
## L_at_Amax_Fem_GP_1           0                NaN No_prior  NA
## VonBert_K_Fem_GP_1           0                NaN No_prior  NA
## CV_young_Fem_GP_1            0      7663.170000000000007 No_prior  NA
## CV_old_Fem_GP_1              0                NaN No_prior  NA
## Size_inflection_MexCal_S1(1)  0                NaN No_prior  NA
## Size_95%width_MexCal_S1(1)   0                NaN No_prior  NA
## AgeSel_P1_MexCal_S1(1)       0      0.00000000558243 No_prior  NA
## AgeSel_P2_MexCal_S1(1)       0 -79538.899999999999418 No_prior  NA
## AgeSel_P3_MexCal_S1(1)       0 -49925.500000000000000 No_prior  NA
## AgeSel_P4_MexCal_S1(1)       0 -20253.099999999999854 No_prior  NA
## AgeSel_P5_MexCal_S1(1)       0 -15844.299999999999927 No_prior  NA
## AgeSel_P2_MexCal_S2(2)       0 -35872.300000000000291 No_prior  NA
## AgeSel_P3_MexCal_S2(2)       0 -31918.500000000000000 No_prior  NA
## AgeSel_P4_MexCal_S2(2)       0 -27048.599999999999854 No_prior  NA
## AgeSel_P5_MexCal_S2(2)       0 -8159.140000000000033 No_prior  NA
## Age_inflection_PNW(3)        0      771.865999999999999 No_prior  NA
## Age_95%width_PNW(3)         0      2472.869999999999989 No_prior  NA
##                               Pr_SD Pr_Like Afterbound
## L_at_Amin_Fem_GP_1           NA      NA      OK
## L_at_Amax_Fem_GP_1           NA      NA      OK
## VonBert_K_Fem_GP_1           NA      NA      OK
## CV_young_Fem_GP_1            NA      NA      OK
## CV_old_Fem_GP_1              NA      NA      CHECK
## Size_inflection_MexCal_S1(1)  NA      NA      OK
## Size_95%width_MexCal_S1(1)   NA      NA      OK
## AgeSel_P1_MexCal_S1(1)       NA      NA      OK
## AgeSel_P2_MexCal_S1(1)       NA      NA      OK
## AgeSel_P3_MexCal_S1(1)       NA      NA      OK
## AgeSel_P4_MexCal_S1(1)       NA      NA      OK
## AgeSel_P5_MexCal_S1(1)       NA      NA      OK
## AgeSel_P2_MexCal_S2(2)       NA      NA      OK
## AgeSel_P3_MexCal_S2(2)       NA      NA      OK
## AgeSel_P4_MexCal_S2(2)       NA      NA      OK
## AgeSel_P5_MexCal_S2(2)       NA      NA      OK
## Age_inflection_PNW(3)        NA      NA      OK
## Age_95%width_PNW(3)         NA      NA      OK
##
## $maximum_gradient_component
## [1] 86629.7
##
## $parameters_with_highest_gradients
##                               Value Gradient
## AgeSel_P2_MexCal_S1(1) -2.931380 -79538.9
## AgeSel_P3_MexCal_S1(1) -0.632671 -49925.5

```

```

## AgeSel_P2_MexCal_S2(2) -1.588770 -35872.3
## AgeSel_P3_MexCal_S2(2) -6.002410 -31918.5
## AgeSel_P4_MexCal_S2(2) 1.088170 -27048.6
##
## $Length_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # N Npos min_Nsamp max_Nsamp mean_Nsamp_in
## 1555      4      1      0.01514690 # 27 27      6      2000      979.704
## 1556      4      2      0.03954000 # 27 27      9      2000      993.556
## 1557      4      3      0.01778210 # 37 28      1      2000      974.821
## 1558      4      4      0.00737611 # 22 22     12      2000     1189.950
##      mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN Curr_Var_Adj
## 1555      979.704      NA      NA 68.5123      14.83950      1
## 1556      993.556      NA      NA 82.6470      39.28520      1
## 1557      974.821      NA      NA 86.4484      17.33440      1
## 1558     1189.950      NA      NA 14.8454      8.77723      1
##      Fleet_name
## 1555 MexCal_S1
## 1556 MexCal_S2
## 1557      PNW
## 1558 AT_Survey
##
## $Age_Comp_Fit_Summary
##      Factor Fleet Recommend_var_adj # Nsamp_adj Npos min_Nsamp max_Nsamp
## 1668      5      1      0.00161284 #      27 27      5.92      2000
## 1669      5      2      0.00094508 #      27 27      8.92      2000
## 1670      5      3      0.00822159 #      27 27     26.88      2000
## 1671      5      4      0.00516293 #      22 22     12.00      2000
##      mean_Nsamp_in mean_Nsamp_adj mean_Nsamp_DM DM_theta mean_effN HarMean_effN
## 1668      979.073      979.073      NA      NA 26.0883      1.579090
## 1669      993.200      993.200      NA      NA 131.0620      0.938653
## 1670     1002.520     1002.520      NA      NA 31.4682      8.242350
## 1671     1189.950     1189.950      NA      NA 26.7037      6.143660
##      Curr_Var_Adj Fleet_name
## 1668      1 MexCal_S1
## 1669      1 MexCal_S2
## 1670      1      PNW
## 1671      1 AT_Survey
##
## $SBzero
## [1] 67045
##
## $current_depletion
## [1] 3.337348
##
## $last_years_SPR
## [1] 0.583495
##
## $SPRratioLabel
## [1] "1-SPR"
##
## $sigma_R_in
## [1] 0.5
##
## $sigma_R_info

```

```
##           period N_devs SD_of_devs Var_of_devs mean_SE mean_SEsquared
## 1           Main     20   3.197848   10.226233      0          0
## 2      Early+Main     26   2.853787    8.144099      0          0
## 3 Early+Main+Late     39   2.440844    5.957718      0          0
##  sqrt_sum_of_components SD_of_devs_over_sigma_R sqrt_sum_over_sigma_R
## 1              3.197848              6.395696              6.395696
## 2              2.853787              5.707574              5.707574
## 3              2.440844              4.881687              4.881687
##  alternative_sigma_R
## 1              3.197848
## 2              2.853787
## 3              2.440844
##
## $rmse_table
##   ERA N    RMSE RMSE_over_sigmaR mean_BiasAdj
## 1 main 20 3.11688      38.85970    0.841539
## 2 early 6 1.25538      6.30396    0.766330
```

```
## completed SS_output
```

```
compFixed <- SSsummarize(list(OM = omOut, EM2032 = fixedOut))
```

```
## Summarizing 2 models:
## imodel=1/2
##   N active pars = 0
## imodel=2/2
##   N active pars = 58
## Summary finished. To avoid printing details above, use 'verbose = FALSE'.
```

```
compFixed$pars$relErr <- round((compFixed$pars$EM2032 - compFixed$pars$OM)/compFixed$pars$OM, digits = 3)
SSplotComparisons(compFixed)
```

```
## Warning in SSplotComparisons(compFixed): setting btarg = -999 because models
## don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting minbthresh = -999 because
## models don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting sprtarg = -999 because models
## don't have matching values
```

```
## Warning in SSplotComparisons(compFixed): setting label for SPR plot to 8th
## element of input 'labels' because the models don't have matching labels
```

```
## Warning in SSplotComparisons(compFixed): setting label for F plot to 13th
## element of input 'labels' because the models don't have matching labels
```

```
## showing uncertainty for all models
## No uncertainty available for model 1
## No uncertainty available for model 2
## skipping plots with uncertainty:2,4,6,8,10,12
```

```

## subplot 1: spawning biomass
## subplot 3: biomass ratio (hopefully equal to fraction of unfished)
## subplot 5: SPR ratio
## subplot 7: F value
## subplot 9: recruits
## subplot 11: recruit devs
## subplot 13: index fits
## subplot 14: index fits on a log scale
## subplot 15: phase plot

```

```
compFixed$pars
```

	OM	EM2032	Label	Yr	recdev	relErr
## 1	5.85000e-01	5.85000e-01	NatM_uniform_Fem_GP_1	NA	FALSE	0.000
## 2	1.28541e+01	1.01582e+01	L_at_Amin_Fem_GP_1	NA	FALSE	-0.210
## 3	2.48415e+01	2.29142e+01	L_at_Amax_Fem_GP_1	NA	FALSE	-0.078
## 4	3.07573e-01	4.61673e-01	VonBert_K_Fem_GP_1	NA	FALSE	0.501
## 5	1.05349e-01	2.41662e-01	CV_young_Fem_GP_1	NA	FALSE	1.294
## 6	2.37245e-02	1.00001e-02	CV_old_Fem_GP_1	NA	FALSE	-0.578
## 7	7.52420e-06	7.52420e-06	Wtlen_1_Fem_GP_1	NA	FALSE	0.000
## 8	3.23320e+00	3.23320e+00	Wtlen_2_Fem_GP_1	NA	FALSE	0.000
## 9	1.54400e+01	1.54400e+01	Mat50%_Fem_GP_1	NA	FALSE	0.000
## 10	-8.92520e-01	-8.92520e-01	Mat_slope_Fem_GP_1	NA	FALSE	0.000
## 11	1.00000e+00	1.00000e+00	Eggs/kg_inter_Fem_GP_1	NA	FALSE	0.000
## 12	0.00000e+00	0.00000e+00	Eggs/kg_slope_wt_Fem_GP_1	NA	FALSE	NaN
## 13	1.00000e+00	1.00000e+00	CohortGrowDev	NA	FALSE	0.000
## 14	5.00000e-01	5.00000e-01	FracFemale_GP_1	NA	FALSE	0.000
## 15	1.44668e+01	1.44668e+01	SR_LN(R0)	NA	FALSE	0.000
## 16	6.00000e-01	6.00000e-01	SR_BH_steep	NA	FALSE	0.000
## 17	5.00000e-01	5.00000e-01	SR_sigmaR	NA	FALSE	0.000
## 18	0.00000e+00	0.00000e+00	SR_regime	NA	FALSE	NaN
## 19	0.00000e+00	0.00000e+00	SR_autocorr	NA	FALSE	NaN
## 20	1.29153e+00	1.29153e+00	SR_regime_BLK1repl_2000	2000	FALSE	0.000
## 21	-2.88697e-01	-1.94334e+00	Early_InitAge_7	1994	TRUE	5.731
## 22	3.72469e-01	1.21041e+00	Early_InitAge_6	1995	TRUE	2.250
## 23	4.78720e-01	1.08420e+00	Early_InitAge_5	1996	TRUE	1.265
## 24	9.02129e-01	1.53691e+00	Early_InitAge_4	1997	TRUE	0.704
## 25	3.05911e-01	6.29130e-01	Early_InitAge_3	1998	TRUE	1.057
## 26	-9.68186e-01	-5.29999e-01	Early_InitAge_2	1999	TRUE	-0.453
## 27	-8.66061e-01	-7.94279e-01	Main_InitAge_1	2000	TRUE	-0.083
## 28	-4.83997e-01	-4.92708e+00	Main_RecrDev_2001	2001	TRUE	9.180
## 29	2.54035e+00	3.22748e+00	Main_RecrDev_2002	2002	TRUE	0.270
## 30	1.80610e+00	-4.59887e+00	Main_RecrDev_2003	2003	TRUE	-3.546
## 31	2.35307e+00	2.88415e+00	Main_RecrDev_2004	2004	TRUE	0.226
## 32	1.28145e+00	1.50990e+00	Main_RecrDev_2005	2005	TRUE	0.178
## 33	1.60077e+00	2.04768e+00	Main_RecrDev_2006	2006	TRUE	0.279
## 34	6.42868e-01	-4.65601e+00	Main_RecrDev_2007	2007	TRUE	-8.243
## 35	1.67048e+00	3.01916e+00	Main_RecrDev_2008	2008	TRUE	0.807
## 36	9.11681e-01	-4.83679e+00	Main_RecrDev_2009	2009	TRUE	-6.305
## 37	-1.22678e+00	2.43058e+00	Main_RecrDev_2010	2010	TRUE	-2.981
## 38	-2.49263e+00	-4.91545e+00	Main_RecrDev_2011	2011	TRUE	0.972
## 39	-2.50412e+00	-3.50868e+00	Main_RecrDev_2012	2012	TRUE	0.401
## 40	-1.39346e+00	2.50798e+00	Main_RecrDev_2013	2013	TRUE	-2.800
## 41	-6.05812e-01	2.53811e+00	Main_RecrDev_2014	2014	TRUE	-5.190

## 42	-1.37941e+00	1.30161e+00	Main_RecrDev_2015	2015	TRUE	-1.944
## 43	-4.19554e-01	1.95394e+00	Main_RecrDev_2016	2016	TRUE	-5.657
## 44	-5.84894e-01	1.50485e+00	Main_RecrDev_2017	2017	TRUE	-3.573
## 45	-1.03107e+00	1.16947e+00	Main_RecrDev_2018	2018	TRUE	-2.134
## 46	1.81024e-01	2.14227e+00	Main_RecrDev_2019	2019	TRUE	10.834
## 47	-5.53022e-01	5.03369e-01	Late_RecrDev_2020	2020	TRUE	-1.910
## 48	3.41754e+00	3.63026e+00	Late_RecrDev_2021	2021	TRUE	0.062
## 49	8.05897e-01	3.00436e-01	Late_RecrDev_2022	2022	TRUE	-0.627
## 50	8.29097e-01	8.87742e-01	Late_RecrDev_2023	2023	TRUE	0.071
## 51	1.44066e-01	1.20254e-02	Late_RecrDev_2024	2024	TRUE	-0.917
## 52	-1.45429e+00	-9.74968e-01	Late_RecrDev_2025	2025	TRUE	-0.330
## 53	-1.96859e+00	-8.89858e-01	Late_RecrDev_2026	2026	TRUE	-0.548
## 54	1.07576e+00	1.41075e+00	Late_RecrDev_2027	2027	TRUE	0.311
## 55	2.56016e-01	1.73238e-01	Late_RecrDev_2028	2028	TRUE	-0.323
## 56	2.41263e+00	2.52320e+00	Late_RecrDev_2029	2029	TRUE	0.046
## 57	-2.13077e-02	-5.70735e-01	Late_RecrDev_2030	2030	TRUE	25.785
## 58	7.01607e-01	1.97575e-01	Late_RecrDev_2031	2031	TRUE	-0.718
## 59	1.77653e+00	0.00000e+00	Late_RecrDev_2032	2032	TRUE	-1.000
## 60	3.15854e-01	NA	Late_RecrDev_2033	2033	TRUE	NA
## 61	-1.27045e+00	NA	Late_RecrDev_2034	2034	TRUE	NA
## 62	-5.69927e-01	NA	Late_RecrDev_2035	2035	TRUE	NA
## 63	-1.02099e+00	NA	Late_RecrDev_2036	2036	TRUE	NA
## 64	1.62756e+00	NA	Late_RecrDev_2037	2037	TRUE	NA
## 65	-1.01834e+00	NA	Late_RecrDev_2038	2038	TRUE	NA
## 66	1.73727e+00	NA	Late_RecrDev_2039	2039	TRUE	NA
## 67	0.00000e+00	NA	ForeRecr_2040	2040	TRUE	NA
## 68	1.21292e-01	NA	F_fleet_1_YR_2001_s_1	2001	FALSE	NA
## 69	1.60017e-01	NA	F_fleet_1_YR_2002_s_1	2002	FALSE	NA
## 70	1.15293e-01	NA	F_fleet_1_YR_2003_s_1	2003	FALSE	NA
## 71	7.42379e-02	NA	F_fleet_1_YR_2004_s_1	2004	FALSE	NA
## 72	3.87888e-02	NA	F_fleet_1_YR_2005_s_1	2005	FALSE	NA
## 73	6.25647e-02	NA	F_fleet_1_YR_2006_s_1	2006	FALSE	NA
## 74	1.54007e-01	NA	F_fleet_1_YR_2007_s_1	2007	FALSE	NA
## 75	1.56914e-01	NA	F_fleet_1_YR_2008_s_1	2008	FALSE	NA
## 76	9.04702e-02	NA	F_fleet_1_YR_2009_s_1	2009	FALSE	NA
## 77	7.50834e-02	NA	F_fleet_1_YR_2010_s_1	2010	FALSE	NA
## 78	1.59744e-01	NA	F_fleet_1_YR_2011_s_1	2011	FALSE	NA
## 79	2.26301e-02	NA	F_fleet_1_YR_2012_s_1	2012	FALSE	NA
## 80	5.05764e-02	NA	F_fleet_1_YR_2013_s_1	2013	FALSE	NA
## 81	2.33744e-01	NA	F_fleet_1_YR_2014_s_1	2014	FALSE	NA
## 82	7.89600e-04	NA	F_fleet_1_YR_2015_s_1	2015	FALSE	NA
## 83	2.28433e-02	NA	F_fleet_1_YR_2016_s_1	2016	FALSE	NA
## 84	1.69121e-02	NA	F_fleet_1_YR_2017_s_1	2017	FALSE	NA
## 85	3.69568e-03	NA	F_fleet_1_YR_2018_s_1	2018	FALSE	NA
## 86	1.36791e-02	NA	F_fleet_1_YR_2019_s_1	2019	FALSE	NA
## 87	0.00000e+00	NA	F_fleet_1_YR_2020_s_1	2020	FALSE	NA
## 88	0.00000e+00	NA	F_fleet_1_YR_2020_s_2	2020	FALSE	NA
## 89	0.00000e+00	NA	F_fleet_1_YR_2021_s_1	2021	FALSE	NA
## 90	0.00000e+00	NA	F_fleet_1_YR_2021_s_2	2021	FALSE	NA
## 91	5.85155e-02	NA	F_fleet_1_YR_2022_s_1	2022	FALSE	NA
## 92	0.00000e+00	NA	F_fleet_1_YR_2022_s_2	2022	FALSE	NA
## 93	1.33991e-01	NA	F_fleet_1_YR_2023_s_1	2023	FALSE	NA
## 94	0.00000e+00	NA	F_fleet_1_YR_2023_s_2	2023	FALSE	NA
## 95	1.11064e-01	NA	F_fleet_1_YR_2024_s_1	2024	FALSE	NA

## 96	0.00000e+00	NA	F_fleet_1_YR_2024_s_2	2024	FALSE	NA
## 97	3.79333e-01	NA	F_fleet_1_YR_2025_s_1	2025	FALSE	NA
## 98	0.00000e+00	NA	F_fleet_1_YR_2025_s_2	2025	FALSE	NA
## 99	6.92615e-01	NA	F_fleet_1_YR_2026_s_1	2026	FALSE	NA
## 100	0.00000e+00	NA	F_fleet_1_YR_2026_s_2	2026	FALSE	NA
## 101	1.50000e+00	NA	F_fleet_1_YR_2027_s_1	2027	FALSE	NA
## 102	0.00000e+00	NA	F_fleet_1_YR_2027_s_2	2027	FALSE	NA
## 103	1.50000e+00	NA	F_fleet_1_YR_2028_s_1	2028	FALSE	NA
## 104	0.00000e+00	NA	F_fleet_1_YR_2028_s_2	2028	FALSE	NA
## 105	1.50000e+00	NA	F_fleet_1_YR_2029_s_1	2029	FALSE	NA
## 106	0.00000e+00	NA	F_fleet_1_YR_2029_s_2	2029	FALSE	NA
## 107	1.50000e+00	NA	F_fleet_1_YR_2030_s_1	2030	FALSE	NA
## 108	0.00000e+00	NA	F_fleet_1_YR_2030_s_2	2030	FALSE	NA
## 109	5.04382e-01	NA	F_fleet_1_YR_2031_s_1	2031	FALSE	NA
## 110	0.00000e+00	NA	F_fleet_1_YR_2031_s_2	2031	FALSE	NA
## 111	6.10824e-01	NA	F_fleet_1_YR_2032_s_1	2032	FALSE	NA
## 112	0.00000e+00	NA	F_fleet_1_YR_2032_s_2	2032	FALSE	NA
## 113	1.00569e+00	NA	F_fleet_1_YR_2033_s_1	2033	FALSE	NA
## 114	0.00000e+00	NA	F_fleet_1_YR_2033_s_2	2033	FALSE	NA
## 115	5.11420e-01	NA	F_fleet_1_YR_2034_s_1	2034	FALSE	NA
## 116	0.00000e+00	NA	F_fleet_1_YR_2034_s_2	2034	FALSE	NA
## 117	6.53659e-01	NA	F_fleet_1_YR_2035_s_1	2035	FALSE	NA
## 118	0.00000e+00	NA	F_fleet_1_YR_2035_s_2	2035	FALSE	NA
## 119	4.97382e-01	NA	F_fleet_1_YR_2036_s_1	2036	FALSE	NA
## 120	0.00000e+00	NA	F_fleet_1_YR_2036_s_2	2036	FALSE	NA
## 121	1.50000e+00	NA	F_fleet_1_YR_2037_s_1	2037	FALSE	NA
## 122	0.00000e+00	NA	F_fleet_1_YR_2037_s_2	2037	FALSE	NA
## 123	1.50000e+00	NA	F_fleet_1_YR_2038_s_1	2038	FALSE	NA
## 124	0.00000e+00	NA	F_fleet_1_YR_2038_s_2	2038	FALSE	NA
## 125	1.39896e+00	NA	F_fleet_1_YR_2039_s_1	2039	FALSE	NA
## 126	0.00000e+00	NA	F_fleet_1_YR_2039_s_2	2039	FALSE	NA
## 127	3.31839e-01	NA	F_fleet_2_YR_2001_s_2	2001	FALSE	NA
## 128	3.51054e-01	NA	F_fleet_2_YR_2002_s_2	2002	FALSE	NA
## 129	9.61885e-02	NA	F_fleet_2_YR_2003_s_2	2003	FALSE	NA
## 130	6.66212e-02	NA	F_fleet_2_YR_2004_s_2	2004	FALSE	NA
## 131	8.45597e-02	NA	F_fleet_2_YR_2005_s_2	2005	FALSE	NA
## 132	1.11160e-01	NA	F_fleet_2_YR_2006_s_2	2006	FALSE	NA
## 133	1.83117e-01	NA	F_fleet_2_YR_2007_s_2	2007	FALSE	NA
## 134	2.14921e-01	NA	F_fleet_2_YR_2008_s_2	2008	FALSE	NA
## 135	1.84649e-01	NA	F_fleet_2_YR_2009_s_2	2009	FALSE	NA
## 136	1.47652e-01	NA	F_fleet_2_YR_2010_s_2	2010	FALSE	NA
## 137	2.44080e-01	NA	F_fleet_2_YR_2011_s_2	2011	FALSE	NA
## 138	4.18170e-01	NA	F_fleet_2_YR_2012_s_2	2012	FALSE	NA
## 139	4.46688e-01	NA	F_fleet_2_YR_2013_s_2	2013	FALSE	NA
## 140	8.55593e-02	NA	F_fleet_2_YR_2014_s_2	2014	FALSE	NA
## 141	1.45442e-02	NA	F_fleet_2_YR_2015_s_2	2015	FALSE	NA
## 142	5.76442e-01	NA	F_fleet_2_YR_2016_s_2	2016	FALSE	NA
## 143	5.67745e-01	NA	F_fleet_2_YR_2017_s_2	2017	FALSE	NA
## 144	9.61627e-01	NA	F_fleet_2_YR_2018_s_2	2018	FALSE	NA
## 145	1.39729e+00	NA	F_fleet_2_YR_2019_s_2	2019	FALSE	NA
## 146	0.00000e+00	NA	F_fleet_2_YR_2020_s_1	2020	FALSE	NA
## 147	0.00000e+00	NA	F_fleet_2_YR_2020_s_2	2020	FALSE	NA
## 148	0.00000e+00	NA	F_fleet_2_YR_2021_s_1	2021	FALSE	NA
## 149	0.00000e+00	NA	F_fleet_2_YR_2021_s_2	2021	FALSE	NA

## 150	0.00000e+00	NA	F_fleet_2_YR_2022_s_1	2022	FALSE	NA
## 151	9.74985e-03	NA	F_fleet_2_YR_2022_s_2	2022	FALSE	NA
## 152	0.00000e+00	NA	F_fleet_2_YR_2023_s_1	2023	FALSE	NA
## 153	1.38908e-01	NA	F_fleet_2_YR_2023_s_2	2023	FALSE	NA
## 154	0.00000e+00	NA	F_fleet_2_YR_2024_s_1	2024	FALSE	NA
## 155	3.78925e-01	NA	F_fleet_2_YR_2024_s_2	2024	FALSE	NA
## 156	0.00000e+00	NA	F_fleet_2_YR_2025_s_1	2025	FALSE	NA
## 157	5.98957e-01	NA	F_fleet_2_YR_2025_s_2	2025	FALSE	NA
## 158	0.00000e+00	NA	F_fleet_2_YR_2026_s_1	2026	FALSE	NA
## 159	1.50000e+00	NA	F_fleet_2_YR_2026_s_2	2026	FALSE	NA
## 160	0.00000e+00	NA	F_fleet_2_YR_2027_s_1	2027	FALSE	NA
## 161	1.50000e+00	NA	F_fleet_2_YR_2027_s_2	2027	FALSE	NA
## 162	0.00000e+00	NA	F_fleet_2_YR_2028_s_1	2028	FALSE	NA
## 163	1.50000e+00	NA	F_fleet_2_YR_2028_s_2	2028	FALSE	NA
## 164	0.00000e+00	NA	F_fleet_2_YR_2029_s_1	2029	FALSE	NA
## 165	1.50000e+00	NA	F_fleet_2_YR_2029_s_2	2029	FALSE	NA
## 166	0.00000e+00	NA	F_fleet_2_YR_2030_s_1	2030	FALSE	NA
## 167	6.73507e-01	NA	F_fleet_2_YR_2030_s_2	2030	FALSE	NA
## 168	0.00000e+00	NA	F_fleet_2_YR_2031_s_1	2031	FALSE	NA
## 169	6.18091e-01	NA	F_fleet_2_YR_2031_s_2	2031	FALSE	NA
## 170	0.00000e+00	NA	F_fleet_2_YR_2032_s_1	2032	FALSE	NA
## 171	1.45051e+00	NA	F_fleet_2_YR_2032_s_2	2032	FALSE	NA
## 172	0.00000e+00	NA	F_fleet_2_YR_2033_s_1	2033	FALSE	NA
## 173	4.64908e-01	NA	F_fleet_2_YR_2033_s_2	2033	FALSE	NA
## 174	0.00000e+00	NA	F_fleet_2_YR_2034_s_1	2034	FALSE	NA
## 175	6.52244e-01	NA	F_fleet_2_YR_2034_s_2	2034	FALSE	NA
## 176	0.00000e+00	NA	F_fleet_2_YR_2035_s_1	2035	FALSE	NA
## 177	1.50000e+00	NA	F_fleet_2_YR_2035_s_2	2035	FALSE	NA
## 178	0.00000e+00	NA	F_fleet_2_YR_2036_s_1	2036	FALSE	NA
## 179	7.17245e-01	NA	F_fleet_2_YR_2036_s_2	2036	FALSE	NA
## 180	0.00000e+00	NA	F_fleet_2_YR_2037_s_1	2037	FALSE	NA
## 181	1.50000e+00	NA	F_fleet_2_YR_2037_s_2	2037	FALSE	NA
## 182	0.00000e+00	NA	F_fleet_2_YR_2038_s_1	2038	FALSE	NA
## 183	1.42445e+00	NA	F_fleet_2_YR_2038_s_2	2038	FALSE	NA
## 184	0.00000e+00	NA	F_fleet_2_YR_2039_s_1	2039	FALSE	NA
## 185	1.50000e+00	NA	F_fleet_2_YR_2039_s_2	2039	FALSE	NA
## 186	1.06782e-01	NA	F_fleet_3_YR_2001_s_1	2001	FALSE	NA
## 187	1.93908e-02	NA	F_fleet_3_YR_2001_s_2	2001	FALSE	NA
## 188	2.39520e-01	NA	F_fleet_3_YR_2002_s_1	2002	FALSE	NA
## 189	5.50046e-03	NA	F_fleet_3_YR_2002_s_2	2002	FALSE	NA
## 190	3.95077e-01	NA	F_fleet_3_YR_2003_s_1	2003	FALSE	NA
## 191	3.89999e-02	NA	F_fleet_3_YR_2003_s_2	2003	FALSE	NA
## 192	6.74988e-01	NA	F_fleet_3_YR_2004_s_1	2004	FALSE	NA
## 193	2.11495e-02	NA	F_fleet_3_YR_2004_s_2	2004	FALSE	NA
## 194	7.89422e-01	NA	F_fleet_3_YR_2005_s_1	2005	FALSE	NA
## 195	2.00356e-03	NA	F_fleet_3_YR_2005_s_2	2005	FALSE	NA
## 196	3.01902e-01	NA	F_fleet_3_YR_2006_s_1	2006	FALSE	NA
## 197	2.68273e-01	NA	F_fleet_3_YR_2007_s_1	2007	FALSE	NA
## 198	1.99320e-01	NA	F_fleet_3_YR_2008_s_1	2008	FALSE	NA
## 199	2.53893e-01	NA	F_fleet_3_YR_2009_s_1	2009	FALSE	NA
## 200	1.03103e-02	NA	F_fleet_3_YR_2009_s_2	2009	FALSE	NA
## 201	3.84672e-01	NA	F_fleet_3_YR_2010_s_1	2010	FALSE	NA
## 202	8.75292e-07	NA	F_fleet_3_YR_2010_s_2	2010	FALSE	NA
## 203	3.64402e-01	NA	F_fleet_3_YR_2011_s_1	2011	FALSE	NA

## 204	7.41851e-02	NA	F_fleet_3_YR_2011_s_2	2011	FALSE	NA
## 205	1.07231e+00	NA	F_fleet_3_YR_2012_s_1	2012	FALSE	NA
## 206	2.90892e-02	NA	F_fleet_3_YR_2012_s_2	2012	FALSE	NA
## 207	1.03031e+00	NA	F_fleet_3_YR_2013_s_1	2013	FALSE	NA
## 208	2.64028e-02	NA	F_fleet_3_YR_2013_s_2	2013	FALSE	NA
## 209	5.07457e-01	NA	F_fleet_3_YR_2014_s_1	2014	FALSE	NA
## 210	1.08626e-01	NA	F_fleet_3_YR_2014_s_2	2014	FALSE	NA
## 211	3.90412e-03	NA	F_fleet_3_YR_2015_s_1	2015	FALSE	NA
## 212	9.68231e-05	NA	F_fleet_3_YR_2015_s_2	2015	FALSE	NA
## 213	1.49269e-02	NA	F_fleet_3_YR_2016_s_1	2016	FALSE	NA
## 214	5.66757e-06	NA	F_fleet_3_YR_2016_s_2	2016	FALSE	NA
## 215	1.30617e-04	NA	F_fleet_3_YR_2017_s_1	2017	FALSE	NA
## 216	3.21184e-04	NA	F_fleet_3_YR_2017_s_2	2017	FALSE	NA
## 217	9.56200e-04	NA	F_fleet_3_YR_2018_s_1	2018	FALSE	NA
## 218	3.99623e-04	NA	F_fleet_3_YR_2018_s_2	2018	FALSE	NA
## 219	1.13294e-03	NA	F_fleet_3_YR_2019_s_1	2019	FALSE	NA
## 220	4.89963e-04	NA	F_fleet_3_YR_2019_s_2	2019	FALSE	NA
## 221	0.00000e+00	NA	F_fleet_3_YR_2020_s_1	2020	FALSE	NA
## 222	0.00000e+00	NA	F_fleet_3_YR_2020_s_2	2020	FALSE	NA
## 223	0.00000e+00	NA	F_fleet_3_YR_2021_s_1	2021	FALSE	NA
## 224	0.00000e+00	NA	F_fleet_3_YR_2021_s_2	2021	FALSE	NA
## 225	6.40017e-01	NA	F_fleet_3_YR_2022_s_1	2022	FALSE	NA
## 226	1.82791e-02	NA	F_fleet_3_YR_2022_s_2	2022	FALSE	NA
## 227	1.50000e+00	NA	F_fleet_3_YR_2023_s_1	2023	FALSE	NA
## 228	2.06024e-01	NA	F_fleet_3_YR_2023_s_2	2023	FALSE	NA
## 229	1.50000e+00	NA	F_fleet_3_YR_2024_s_1	2024	FALSE	NA
## 230	5.46676e-02	NA	F_fleet_3_YR_2024_s_2	2024	FALSE	NA
## 231	6.40074e-01	NA	F_fleet_3_YR_2025_s_1	2025	FALSE	NA
## 232	2.06446e-02	NA	F_fleet_3_YR_2025_s_2	2025	FALSE	NA
## 233	7.91079e-01	NA	F_fleet_3_YR_2026_s_1	2026	FALSE	NA
## 234	3.00406e-02	NA	F_fleet_3_YR_2026_s_2	2026	FALSE	NA
## 235	1.50000e+00	NA	F_fleet_3_YR_2027_s_1	2027	FALSE	NA
## 236	1.00133e-01	NA	F_fleet_3_YR_2027_s_2	2027	FALSE	NA
## 237	1.50000e+00	NA	F_fleet_3_YR_2028_s_1	2028	FALSE	NA
## 238	3.91335e-01	NA	F_fleet_3_YR_2028_s_2	2028	FALSE	NA
## 239	1.50000e+00	NA	F_fleet_3_YR_2029_s_1	2029	FALSE	NA
## 240	1.40328e+00	NA	F_fleet_3_YR_2029_s_2	2029	FALSE	NA
## 241	1.50000e+00	NA	F_fleet_3_YR_2030_s_1	2030	FALSE	NA
## 242	1.50000e+00	NA	F_fleet_3_YR_2030_s_2	2030	FALSE	NA
## 243	1.50000e+00	NA	F_fleet_3_YR_2031_s_1	2031	FALSE	NA
## 244	1.00526e+00	NA	F_fleet_3_YR_2031_s_2	2031	FALSE	NA
## 245	1.50000e+00	NA	F_fleet_3_YR_2032_s_1	2032	FALSE	NA
## 246	3.73048e-01	NA	F_fleet_3_YR_2032_s_2	2032	FALSE	NA
## 247	1.50000e+00	NA	F_fleet_3_YR_2033_s_1	2033	FALSE	NA
## 248	1.54892e-01	NA	F_fleet_3_YR_2033_s_2	2033	FALSE	NA
## 249	1.50000e+00	NA	F_fleet_3_YR_2034_s_1	2034	FALSE	NA
## 250	3.26636e-01	NA	F_fleet_3_YR_2034_s_2	2034	FALSE	NA
## 251	1.50000e+00	NA	F_fleet_3_YR_2035_s_1	2035	FALSE	NA
## 252	2.92024e-01	NA	F_fleet_3_YR_2035_s_2	2035	FALSE	NA
## 253	9.37112e-01	NA	F_fleet_3_YR_2036_s_1	2036	FALSE	NA
## 254	3.26189e-02	NA	F_fleet_3_YR_2036_s_2	2036	FALSE	NA
## 255	1.50000e+00	NA	F_fleet_3_YR_2037_s_1	2037	FALSE	NA
## 256	4.39826e-01	NA	F_fleet_3_YR_2037_s_2	2037	FALSE	NA
## 257	1.50000e+00	NA	F_fleet_3_YR_2038_s_1	2038	FALSE	NA

## 258	6.38820e-01	NA	F_fleet_3_YR_2038_s_2	2038	FALSE	NA
## 259	1.50000e+00	NA	F_fleet_3_YR_2039_s_1	2039	FALSE	NA
## 260	1.35703e+00	NA	F_fleet_3_YR_2039_s_2	2039	FALSE	NA
## 261	0.00000e+00	0.00000e+00	LnQ_base_AT_Survey(4)	NA	FALSE	NaN
## 262	-1.83000e+00	-1.83000e+00	LnQ_base_DEPM(5)	NA	FALSE	0.000
## 263	-5.90000e-01	-5.90000e-01	LnQ_base_TEP_all(6)	NA	FALSE	0.000
## 264	1.09072e+01	1.55152e+01	Size_inflection_MexCal_S1(1)	NA	FALSE	0.422
## 265	6.59909e-01	3.59420e+00	Size_95%width_MexCal_S1(1)	NA	FALSE	4.447
## 266	5.00024e-01	5.00019e-01	AgeSel_P1_MexCal_S1(1)	NA	FALSE	0.000
## 267	2.04881e-01	-2.93138e+00	AgeSel_P2_MexCal_S1(1)	NA	FALSE	-15.308
## 268	3.82792e-01	-6.32671e-01	AgeSel_P3_MexCal_S1(1)	NA	FALSE	-2.653
## 269	-1.54940e+00	-2.53754e+00	AgeSel_P4_MexCal_S1(1)	NA	FALSE	0.638
## 270	-2.36189e-01	-1.62821e+00	AgeSel_P5_MexCal_S1(1)	NA	FALSE	5.894
## 271	1.99999e+00	1.99999e+00	AgeSel_P1_MexCal_S2(2)	NA	FALSE	0.000
## 272	4.40526e-01	-1.58877e+00	AgeSel_P2_MexCal_S2(2)	NA	FALSE	-4.607
## 273	-1.16908e+00	-6.00241e+00	AgeSel_P3_MexCal_S2(2)	NA	FALSE	4.134
## 274	-1.42574e-01	1.08817e+00	AgeSel_P4_MexCal_S2(2)	NA	FALSE	-8.632
## 275	-4.70732e-01	-3.80115e+00	AgeSel_P5_MexCal_S2(2)	NA	FALSE	7.075
## 276	2.85251e+00	1.18966e+00	Age_inflection_PNW(3)	NA	FALSE	-0.583
## 277	1.21523e+00	3.77717e+00	Age_95%width_PNW(3)	NA	FALSE	2.108
## 278	0.00000e+00	0.00000e+00	AgeSel_P1_AT_Survey(4)	NA	FALSE	NaN
## 279	0.00000e+00	0.00000e+00	AgeSel_P2_AT_Survey(4)	NA	FALSE	NaN
## 280	NA	0.00000e+00	ForeRecr_2033	2033	TRUE	NA

```
omDat <- SS_readdat("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTe
```

```
## assuming version 3.30 based on first five lines of data file
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
## SS_readdat_3.30 - read version = 3.30
## use_meanbodywt (0/1): 0
## N_lbinspop:
## use_lencomp (0/1): 1
## N_lbins: 39
## N_agebins: 9
## use_MeanSize_at_Age_obs (0/1): 0
## N_environ_variables: 0
## Read of section 2 of data file complete. Final value = 999
```

```
emDat <- SS_readdat("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrow20010M_selfTe
```

```
## assuming version 3.30 based on first five lines of data file
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
## The supplied data file has 2 sections. Using section = 1.
## SS_readdat_3.30 - read version = 3.30
## use_meanbodywt (0/1): 0
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
## N_lbins: 39
## N_agebins: 9
## use_MeanSize_at_Age_obs (0/1): 0
## N_envirom_variables: 0
## Read of section 1 of data file complete. Final value = 999

omDat$CPUE$index <- abs(omDat$CPUE$index)
compDat <- omDat$CPUE %>% left_join(y = emDat$CPUE, by = c("year", "seas", "index")) %>%
  filter(index == 4) %>% pivot_longer(cols = c(obs.x, obs.y), names_to = "model", values_to = "CPUE")
compDat %>% ggplot(aes(x = year, y = CPUE)) + geom_line(aes(group = model))

## Warning: Removed 7 row(s) containing missing values (geom_path).
```

EM 2001 self test, recruitment at SD=1.25, perfect information

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"

scenarios <- c("constGrow20010M_selfTestSD1.25_RandRecHCR0",
              "constGrow20010M_selfTestSD1.25_RandRecHCR2",
              "constGrow20010M_selfTestSD1.25_RandRecHCR3",
              "constGrow20010M_selfTestSD1.25_RandRecHCR5",
              "constGrow20010M_selfTestSD1.25_RandRecHCR6")

smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)

## Rows: 600 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
```

```
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 16400 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
performanceList <- CalcPerformance(smryOutputList)
```

```
## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics
```

```
# parse out HCR and recruitment scenario
```

```
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),
                                   recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_", "", recScen))
```

```
hcrPal <- brewer.pal(10, "Set3")[-2]
```

```
# plot convergence frequency
```

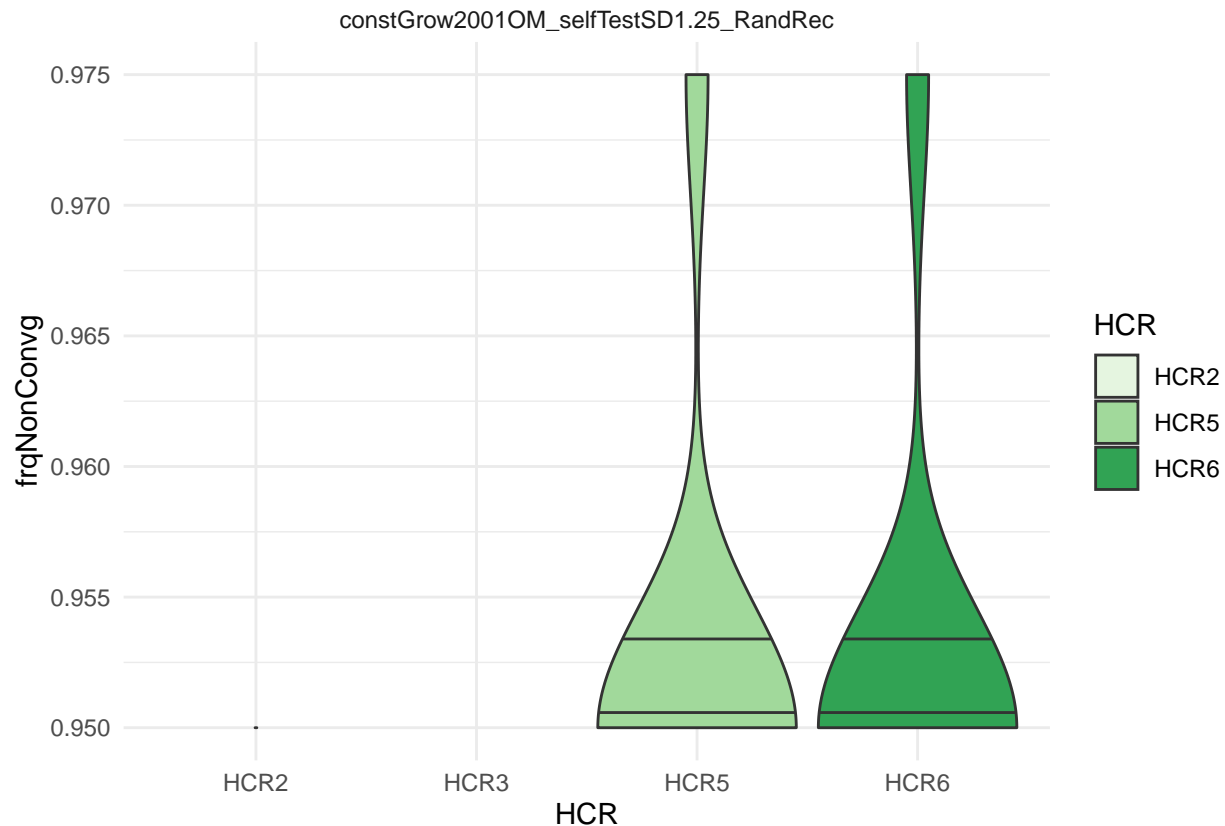
```
metricsTbl %>% filter(HCR != "HCRO") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)
```

```
## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```

```
## Warning: Removed 9 rows containing non-finite values (stat_ydensity).
```

```
## Warning: Groups with fewer than two data points have been dropped.
```



```
# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec", "", scenario),
         recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_", "", recScen))
```

```
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
```

```
omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

convrCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
```

```

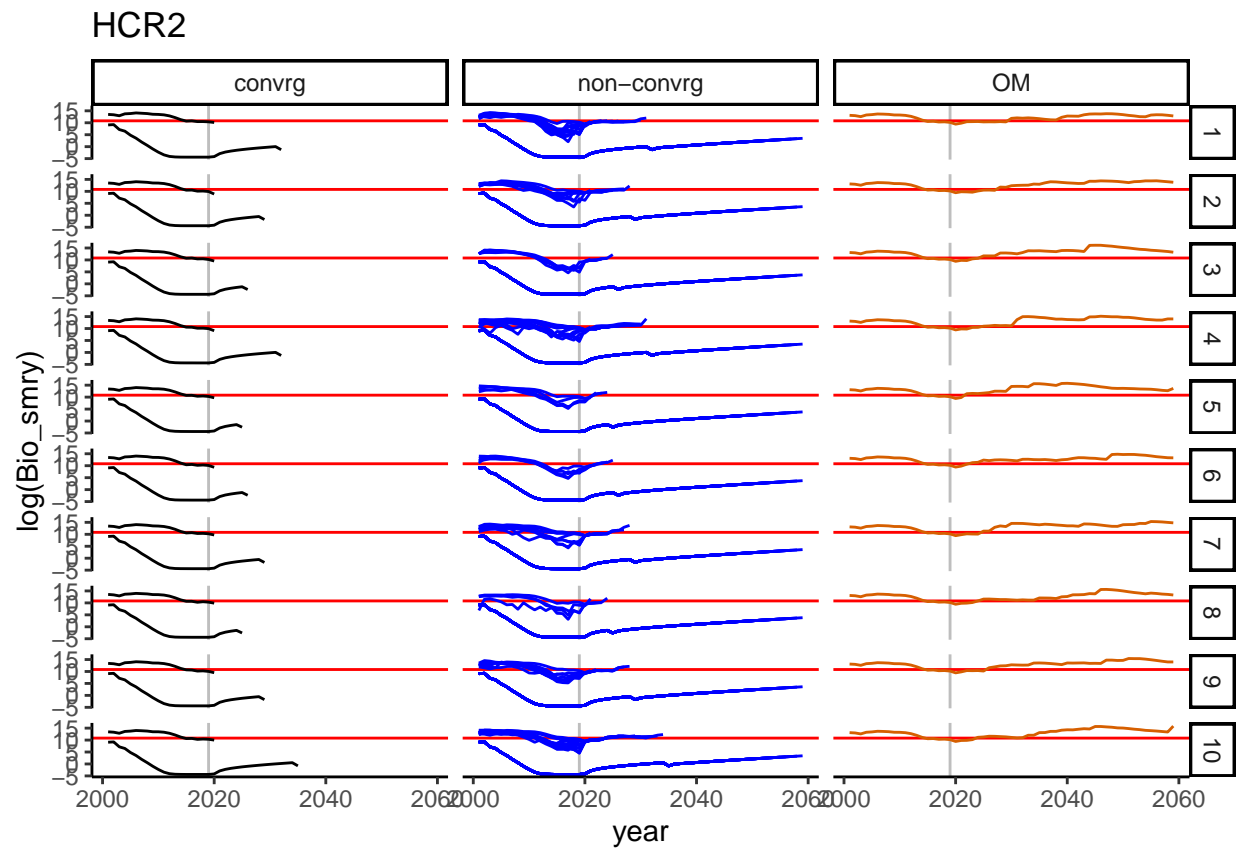
mutate(emYear = as.numeric(regmatches(model_run,
                                     gregexpr("[:digit:]]+",
                                               model_run))),
      HCR = sub(pattern = ".*Rec","", scenario),
      recScen = sub(pattern = "HCR.*","", scenario)) %>%
mutate(recScen = sub(pattern = ".*selfTest_","", recScen))

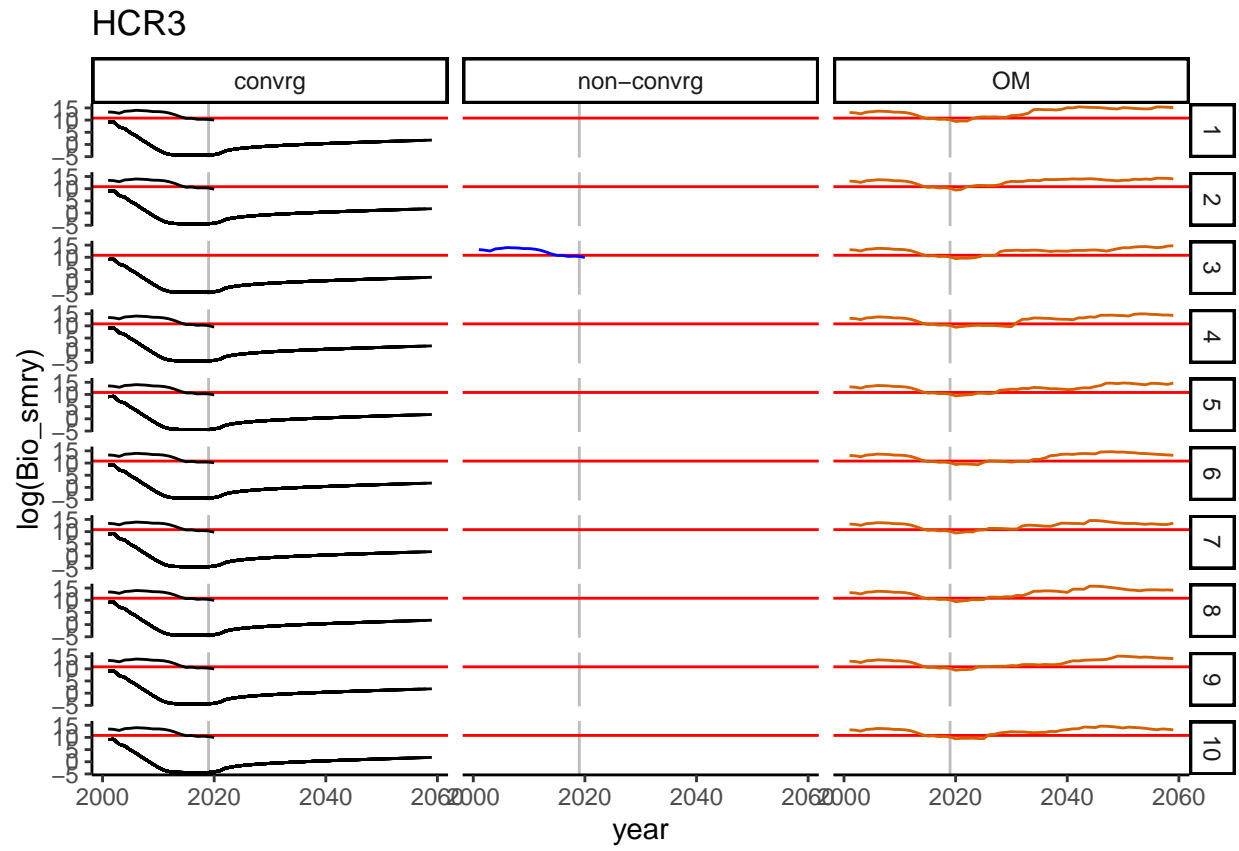
hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

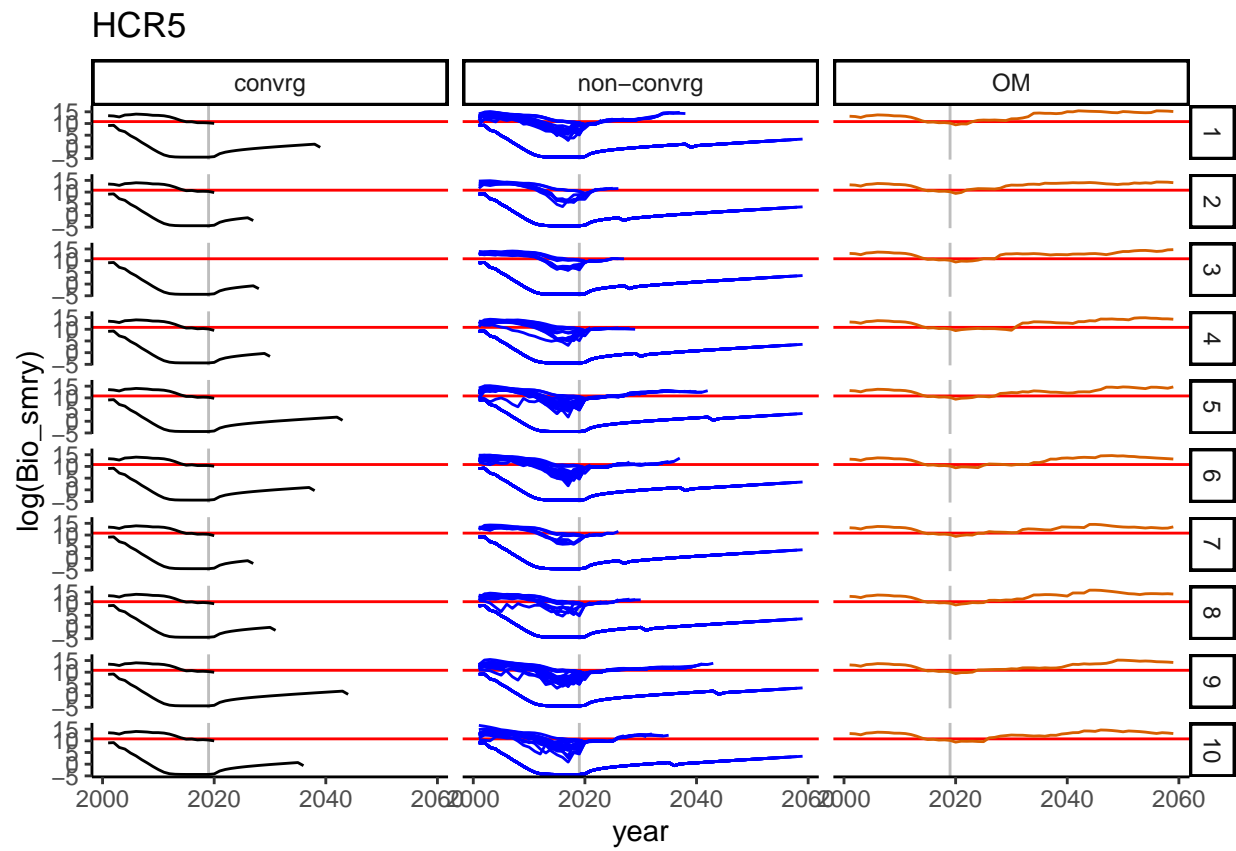
cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
      recScen = sub(pattern = "HCR.*","", scenario)) %>%
mutate(recScen = sub(pattern = ".*selfTest_","", recScen)) %>%
left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
mutate(plotGroup = case_when(model_run == omName ~ "OM",
                             max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg"))

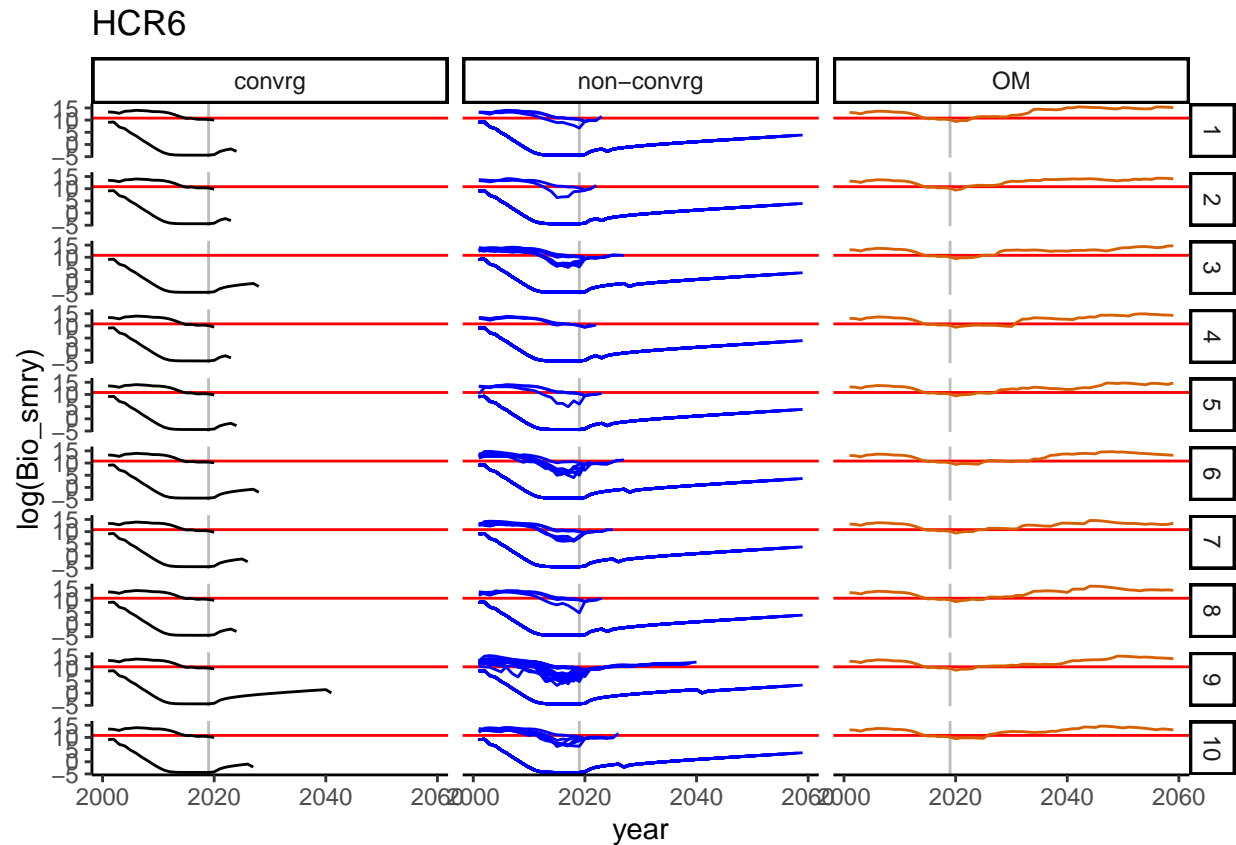
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```

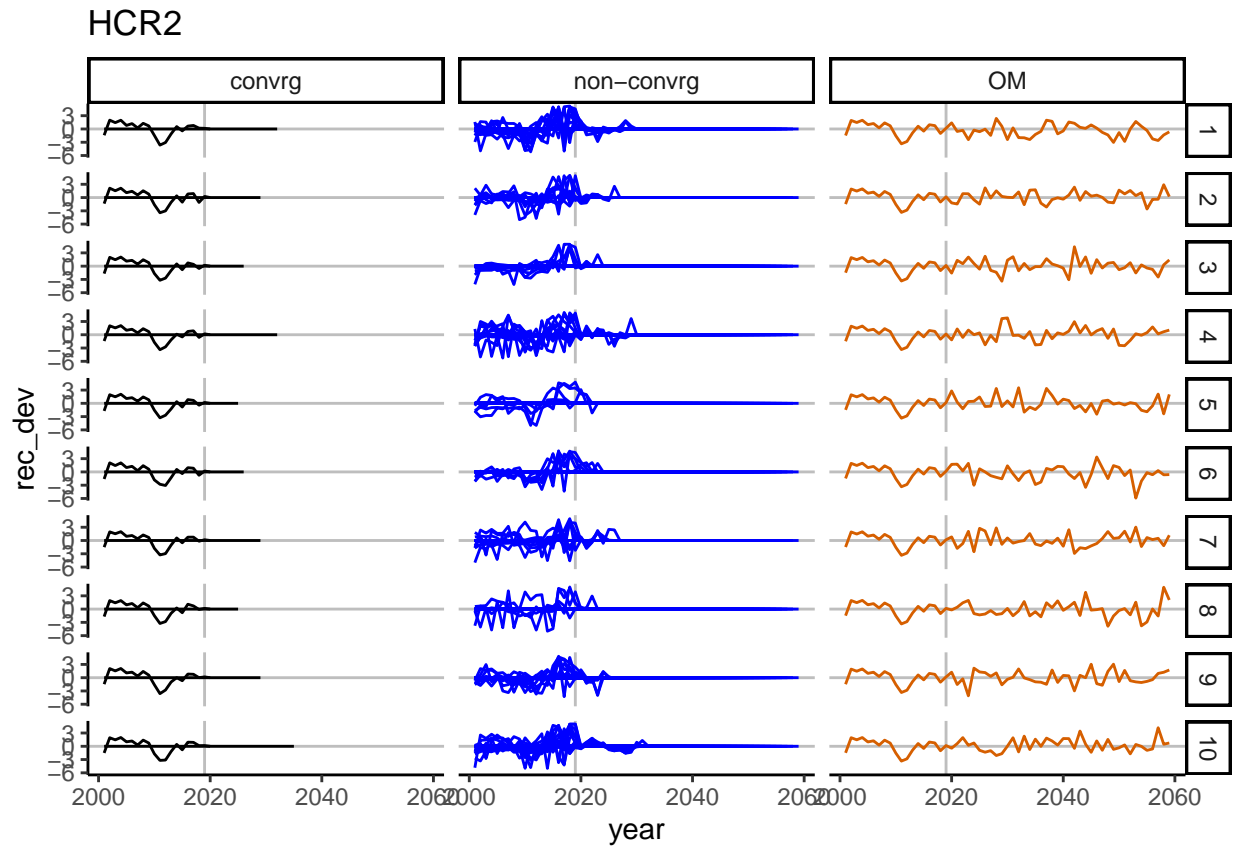


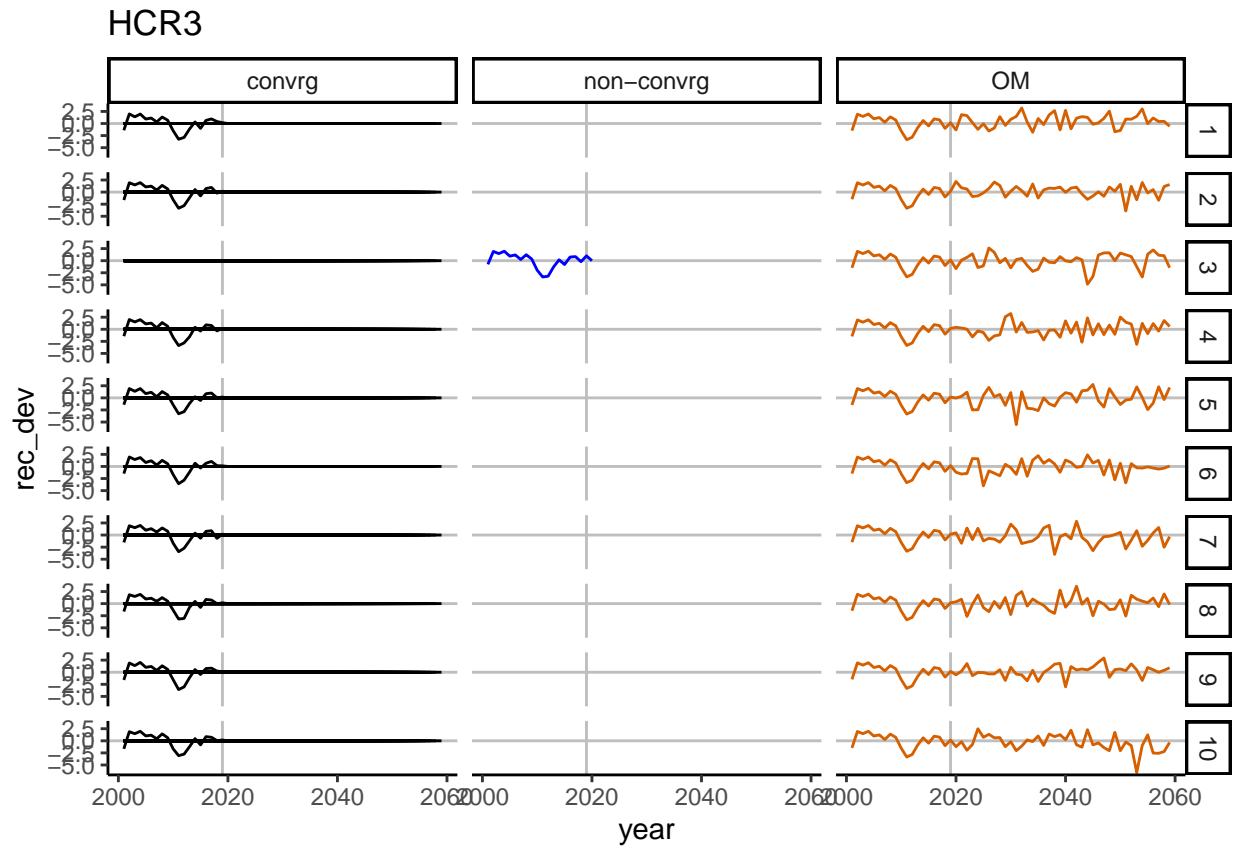


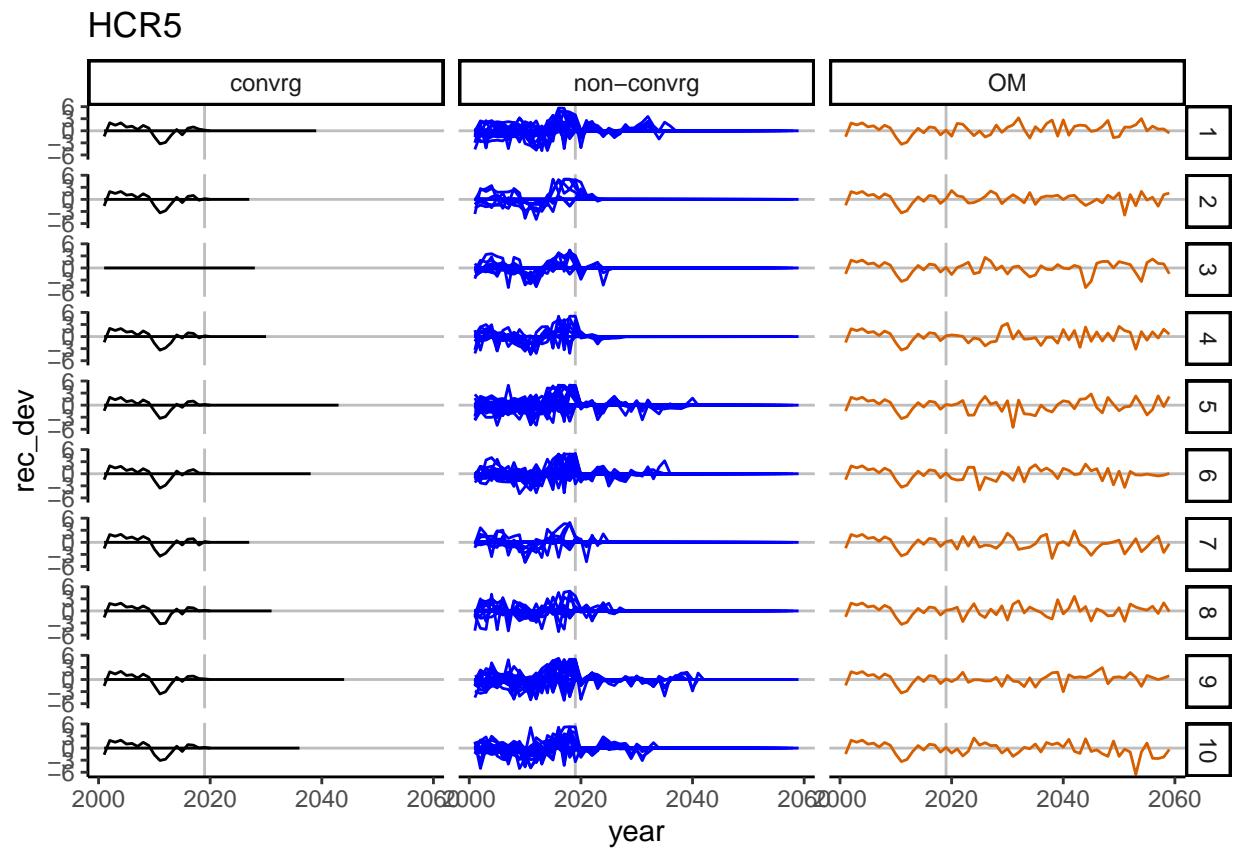


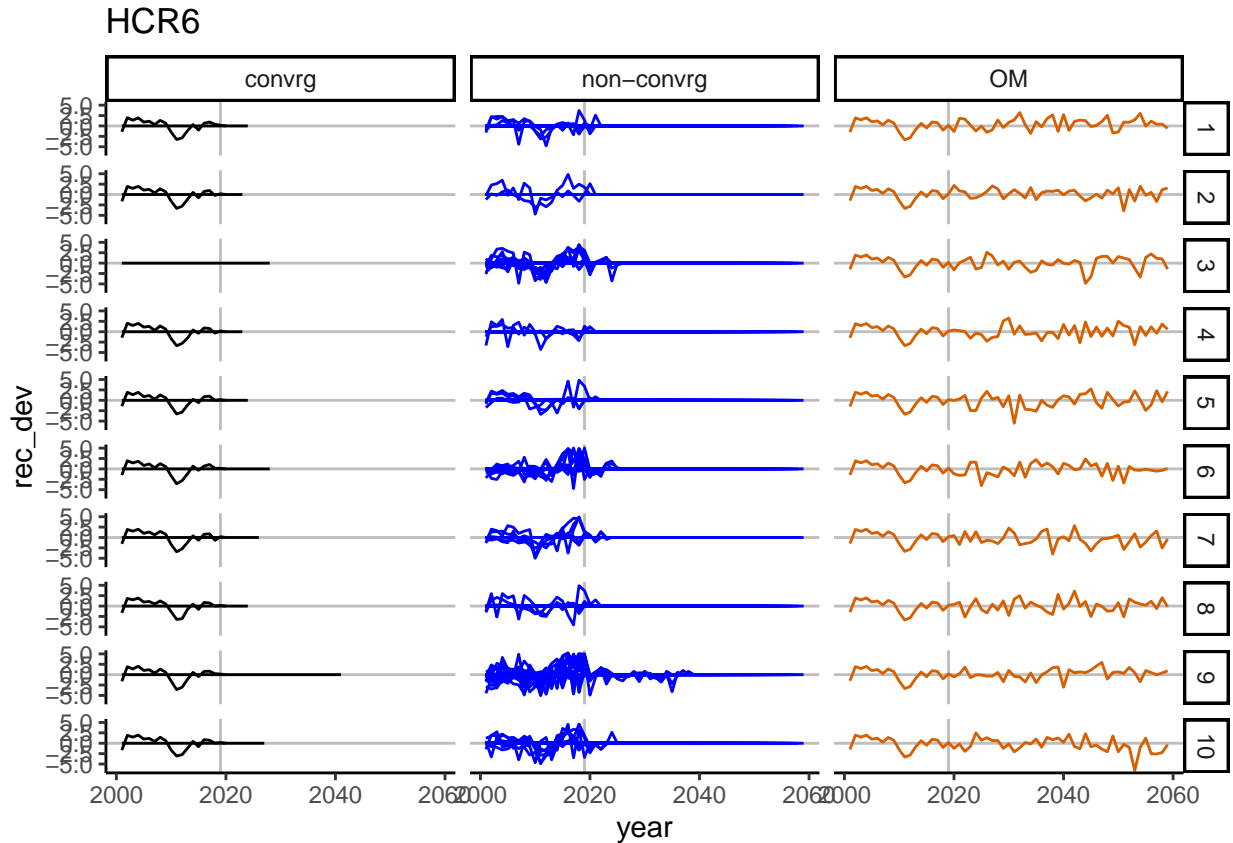


```
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```









```
#termTS %>% filter(model_run == omName)

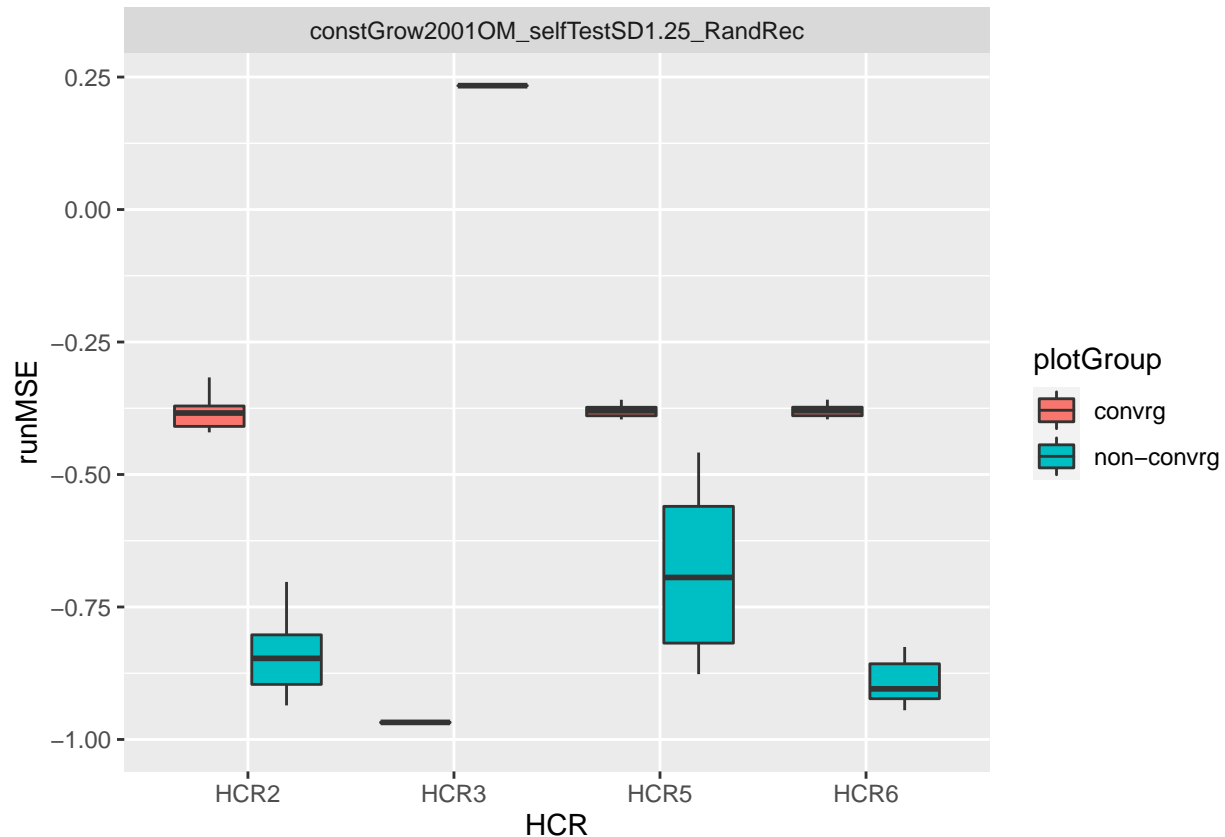
errCompare <- cnvrgTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
            by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
         age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



Look at parameter estimate time series

```
# Look at timeseries of B0 and account for non-convergence
B0s <- smryOutputList$sclSmry %>% mutate(emYear = as.numeric(regmatches(model_run,
  grexpr("[[:digit:]]+",
    model_run))),
  HCR = sub(pattern = ".*Rec", "", scenario),
  recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
    emYear = case_when(is.na(emYear) ~ 2019,
      TRUE ~ emYear),
    plotGroup = case_when(model_run == omName ~ "OM",
      max_grad > 0.01 ~ "non-convg",
      max_grad < 0.01 ~ "convg"))
meanB0s <- B0s %>% filter(max_grad < 0.01) %>%
  group_by(HCR, recScen, plotGroup) %>%
  summarize(meanB0est = mean(SSB_Unfished)) %>%
  mutate(pikitch0.4B0 = 0.4*meanB0est)
```

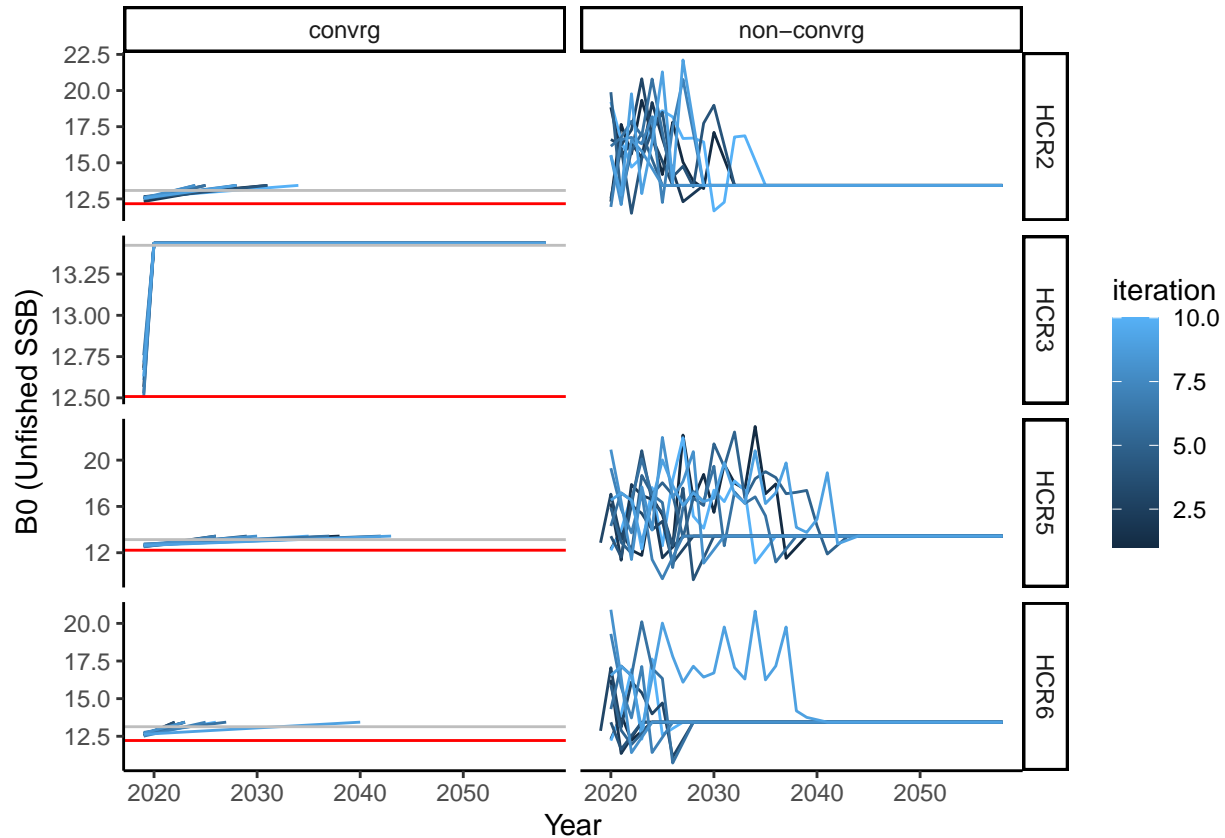
```
## 'summarise()' has grouped output by 'HCR', 'recScen'. You can override using
## the '.groups' argument.
```

```

B0s %>% filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = log(SSB_Unfished))) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "B0 (Unfished SSB)") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(meanB0est)), color = "grey") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(pikitch0.4B0)), color = "red")

```

geom_path: Each group consists of only one observation. Do you need to adjust
the group aesthetic?



```

# Want to look at the other parameters
sclSmryAll <- NULL

for(scn in 1:length(scenarios)){
  # read in SSMSE results summary scalars
  sclSmry <- read.csv(file.path(mseDir, scenarios[scn],
                                paste0("results_scalar_", scenarios[scn], ".csv")))
}

```



```

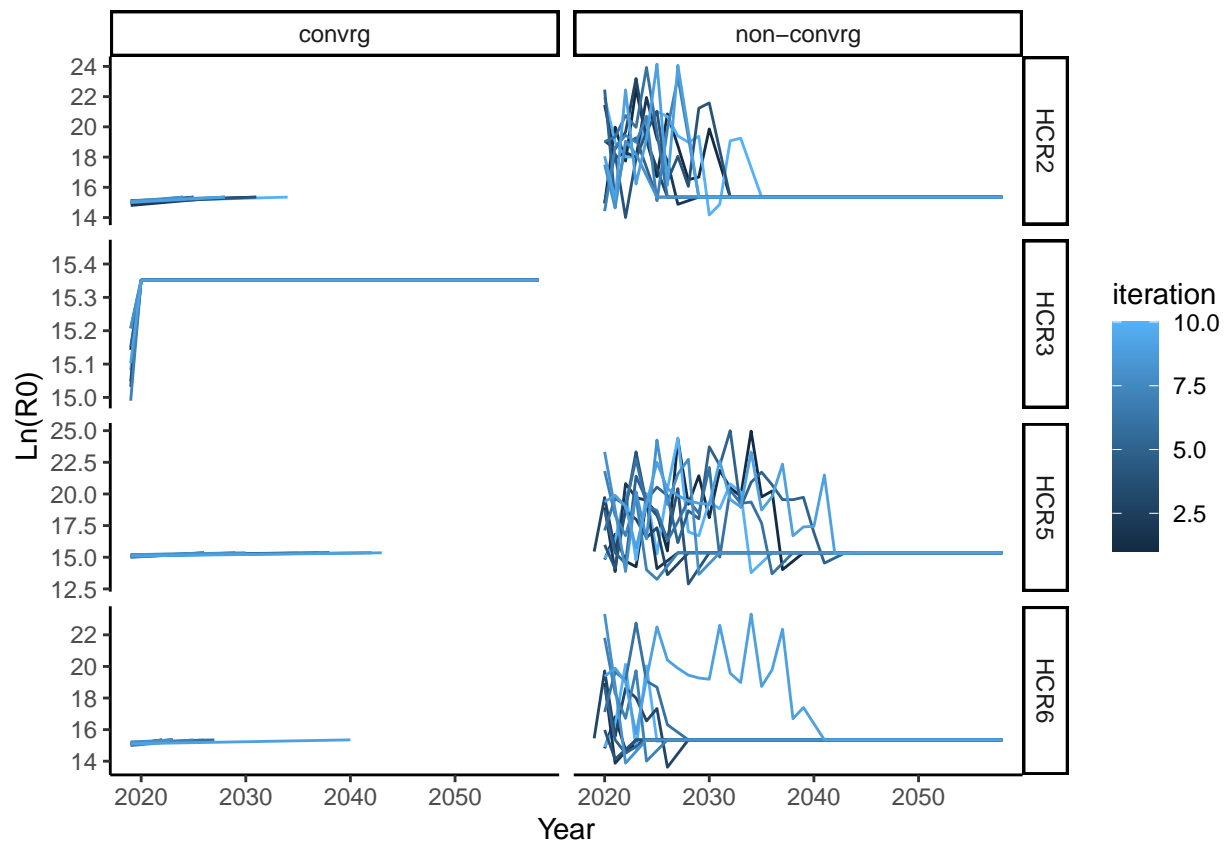
# if(!"F_MSY" %in% names(sclSumry)){ # no catch scenarios don't have F_MSY
#   sclSumry$F_MSY <- NA
#   sclSumry$SSB_Unfished <- NA
# }
# sclSumry <- sclSumry[, c("F_MSY", "SmryBio_Unfished", "SSB_Unfished",
#                           "max_grad", "model_run", "iteration", "scenario")]

sclSmryAll <- bind_rows(sclSmryAll, sclSumry)
} # end 'scn' for-loop

sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                       gregexpr("[:digit:]]+",
                                                       model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "OM",
                                max_grad > 0.01 ~ "non-convrg",
                                max_grad < 0.01 ~ "convrg")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_LN_R0)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "Ln(R0)")

```

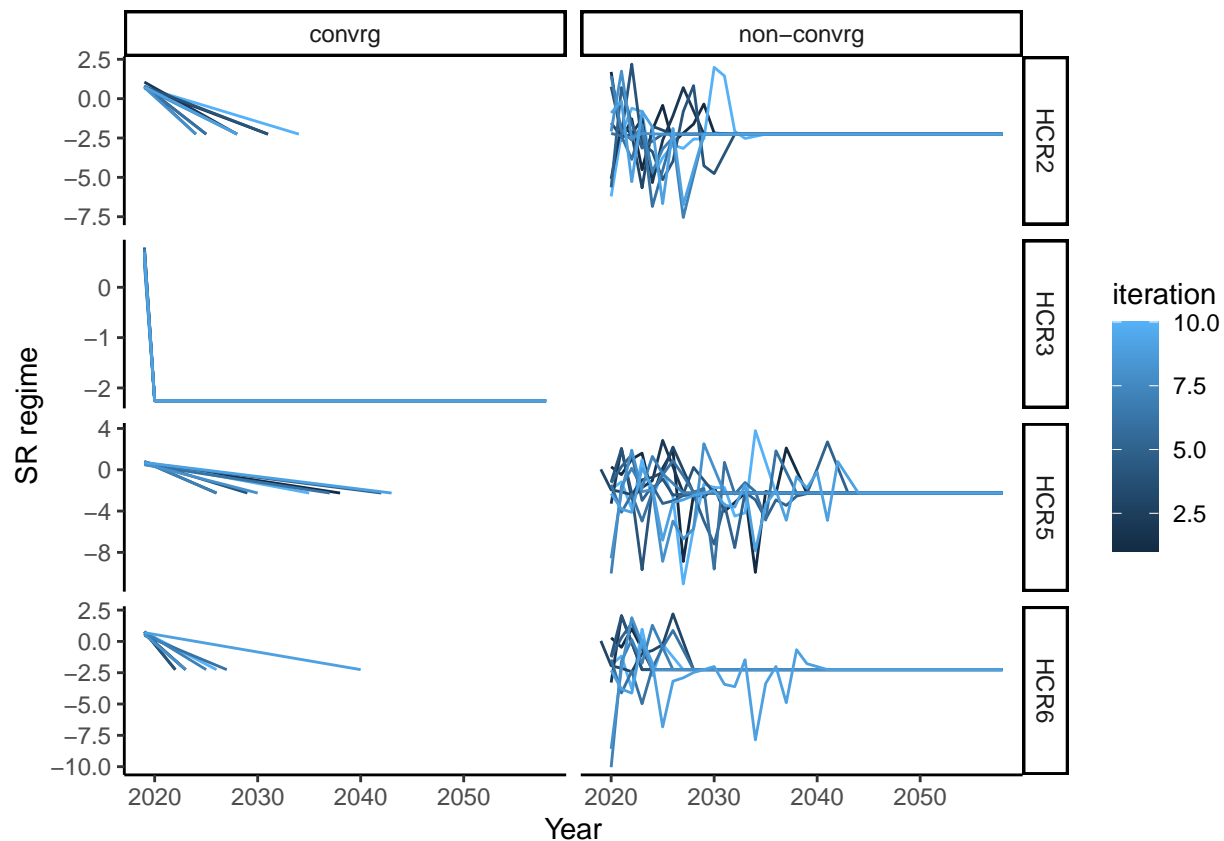
geom_path: Each group consists of only one observation. Do you need to adjust
 ## the group aesthetic?



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),

                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "QM",
                                max_grad > 0.01 ~ "non-convrgr",
                                max_grad < 0.01 ~ "convrgr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_regime_BLK1repl_2000)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "SR regime")
```

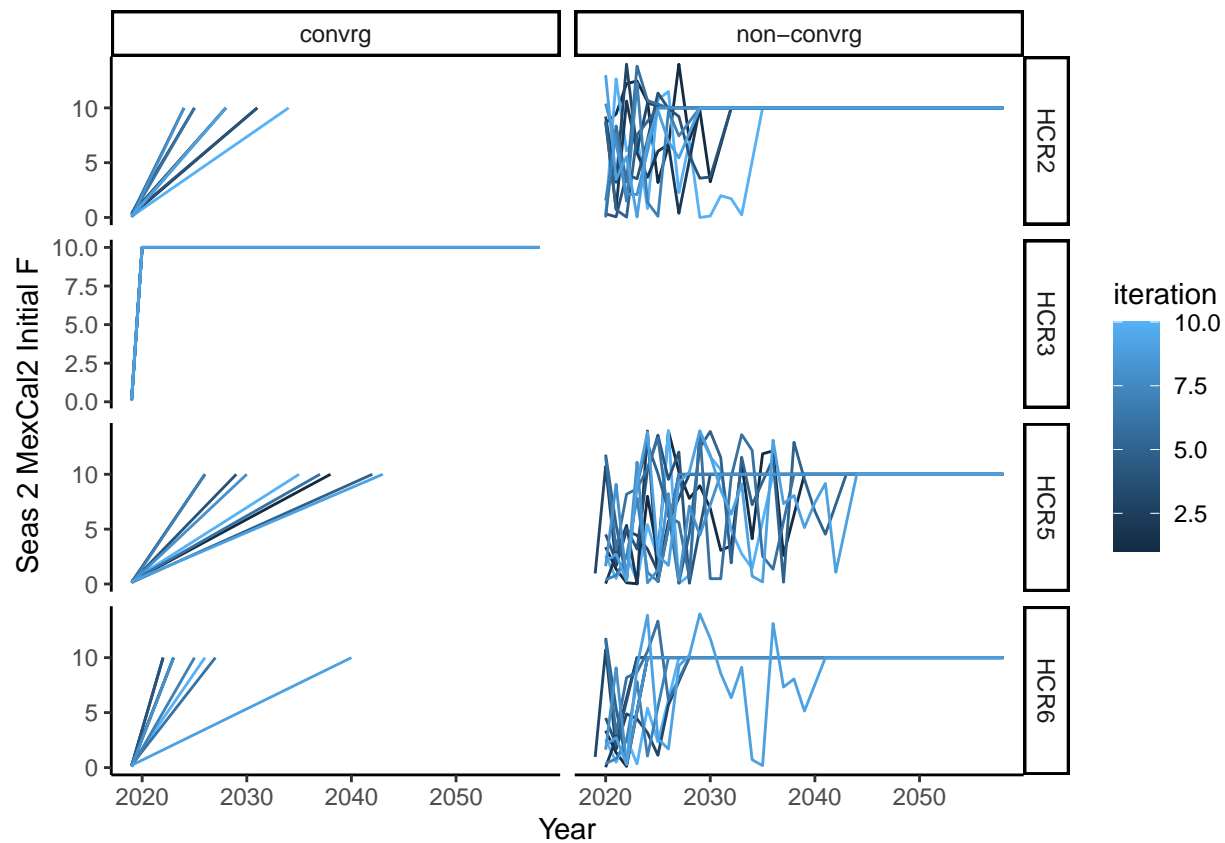
```
## geom_path: Each group consists of only one observation. Do you need to adjust
## the group aesthetic?
```



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),

                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "OM",
                                max_grad > 0.01 ~ "non-convr",
                                max_grad < 0.01 ~ "convr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = InitF_seas_2_flt_2MexCal_S2)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "Seas 2 MexCal2 Initial F")
```

```
## geom_path: Each group consists of only one observation. Do you need to adjust
## the group aesthetic?
```



```
sclSmryAll %>% select(max_grad, params_on_bound, params_stuck_low, params_stuck_high,
                      iteration, model_run, scenario) %>%
  filter(model_run != omName)
```

##	max_grad	params_on_bound
## 1	1.69204e+06	NA
## 2	1.29432e+08	NA
## 3	2.87075e+07	NA
## 4	8.50052e+06	NA
## 5	1.34249e+09	NA
## 6	4.51617e+06	NA
## 7	4.24065e+07	NA
## 8	2.57469e+07	NA
## 9	3.93093e+07	NA
## 10	7.55383e+05	NA
## 11	3.76163e+07	NA
## 12	1.49786e-04	NA
## 13	2.72089e+06	NA
## 14	2.19855e+07	NA
## 15	5.09870e+07	NA
## 16	7.67002e+07	NA
## 17	9.98122e+07	NA
## 18	1.21727e+08	NA
## 19	1.43012e+08	NA
## 20	1.65306e+08	NA

## 21	1.87711e+08	NA
## 22	2.09429e+08	NA
## 23	2.30641e+08	NA
## 24	2.52300e+08	NA
## 25	2.73961e+08	NA
## 26	2.95253e+08	NA
## 27	3.16111e+08	NA
## 28	3.36747e+08	NA
## 29	3.56949e+08	NA
## 30	3.76545e+08	NA
## 31	3.95432e+08	NA
## 32	4.13518e+08	NA
## 33	4.30903e+08	NA
## 34	4.47526e+08	NA
## 35	4.65393e+08	NA
## 36	4.85029e+08	NA
## 37	5.04602e+08	NA
## 38	5.23777e+08	NA
## 39	5.42282e+08	NA
## 40	3.13106e-06	NA
## 41	1.08109e+06	NA
## 42	4.87968e+07	NA
## 43	1.32440e+08	NA
## 44	3.30984e+07	NA
## 45	1.01100e+06	NA
## 46	1.61114e+08	NA
## 47	6.13834e+08	NA
## 48	3.75191e+04	NA
## 49	1.49786e-04	NA
## 50	3.10988e+06	NA
## 51	2.52955e+07	NA
## 52	5.83143e+07	NA
## 53	8.74057e+07	NA
## 54	1.13825e+08	NA
## 55	1.39675e+08	NA
## 56	1.64247e+08	NA
## 57	1.88673e+08	NA
## 58	2.12813e+08	NA
## 59	2.35986e+08	NA
## 60	2.58106e+08	NA
## 61	2.79293e+08	NA
## 62	2.99707e+08	NA
## 63	3.19423e+08	NA
## 64	3.38984e+08	NA
## 65	3.59276e+08	NA
## 66	3.79207e+08	NA
## 67	3.98979e+08	NA
## 68	4.18328e+08	NA
## 69	4.37250e+08	NA
## 70	4.55657e+08	NA
## 71	4.73433e+08	NA
## 72	4.91195e+08	NA
## 73	5.11341e+08	NA
## 74	5.31377e+08	NA

## 75	5.51499e+08	NA
## 76	5.71322e+08	NA
## 77	5.90901e+08	NA
## 78	6.09874e+08	NA
## 79	6.28227e+08	NA
## 80	4.91597e-05	NA
## 81	7.84711e+06	NA
## 82	3.16004e+07	NA
## 83	8.30207e+06	NA
## 84	3.02641e+08	NA
## 85	5.30177e+07	NA
## 86	1.49786e-04	NA
## 87	3.81292e+06	NA
## 88	2.91592e+07	NA
## 89	6.70040e+07	NA
## 90	9.87218e+07	NA
## 91	1.26222e+08	NA
## 92	1.51496e+08	NA
## 93	1.76030e+08	NA
## 94	2.00148e+08	NA
## 95	2.23039e+08	NA
## 96	2.44948e+08	NA
## 97	2.65784e+08	NA
## 98	2.85707e+08	NA
## 99	3.04938e+08	NA
## 100	3.24191e+08	NA
## 101	3.43001e+08	NA
## 102	3.61275e+08	NA
## 103	3.78930e+08	NA
## 104	3.97058e+08	NA
## 105	4.17214e+08	NA
## 106	4.37109e+08	NA
## 107	4.56657e+08	NA
## 108	4.75635e+08	NA
## 109	4.94078e+08	NA
## 110	5.11885e+08	NA
## 111	5.31928e+08	NA
## 112	5.51427e+08	NA
## 113	5.70211e+08	NA
## 114	5.88327e+08	NA
## 115	6.05952e+08	NA
## 116	6.22946e+08	NA
## 117	6.39459e+08	NA
## 118	6.55440e+08	NA
## 119	6.70846e+08	NA
## 120	6.13948e-05	NA
## 121	1.11476e-02	NA
## 122	3.27983e+07	NA
## 123	8.68388e+04	NA
## 124	7.15104e+07	NA
## 125	1.60988e+07	NA
## 126	4.77795e+06	NA
## 127	7.17749e+06	NA
## 128	3.15478e+08	NA

## 129	2.06912e+07	NA
## 130	1.22780e+08	NA
## 131	7.30977e+06	NA
## 132	1.49786e-04	NA
## 133	3.31043e+06	NA
## 134	2.70376e+07	NA
## 135	6.30755e+07	NA
## 136	9.52266e+07	NA
## 137	1.24553e+08	NA
## 138	1.52387e+08	NA
## 139	1.78634e+08	NA
## 140	2.03911e+08	NA
## 141	2.28112e+08	NA
## 142	2.51535e+08	NA
## 143	2.74233e+08	NA
## 144	2.96885e+08	NA
## 145	3.20670e+08	NA
## 146	3.44118e+08	NA
## 147	3.67455e+08	NA
## 148	3.90214e+08	NA
## 149	4.12430e+08	NA
## 150	4.34216e+08	NA
## 151	4.55360e+08	NA
## 152	4.76105e+08	NA
## 153	4.96157e+08	NA
## 154	5.15435e+08	NA
## 155	5.33934e+08	NA
## 156	5.51881e+08	NA
## 157	5.70385e+08	NA
## 158	5.90124e+08	NA
## 159	6.10334e+08	NA
## 160	9.85694e-06	NA
## 161	1.14700e+07	NA
## 162	1.38341e+05	NA
## 163	1.01796e+07	NA
## 164	5.18067e+07	NA
## 165	1.49786e-04	NA
## 166	4.22213e+06	NA
## 167	3.16148e+07	NA
## 168	7.00268e+07	NA
## 169	1.01475e+08	NA
## 170	1.29621e+08	NA
## 171	1.58319e+08	NA
## 172	1.84976e+08	NA
## 173	2.09850e+08	NA
## 174	2.33533e+08	NA
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## 187	4.92329e+08	NA
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## 234	5.38232e+08	NA
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## 747	1.49786e-04	NA
## 748	1.49786e-04	NA
## 749	1.49786e-04	NA
## 750	1.49786e-04	NA
## 751	1.49786e-04	NA
## 752	1.49786e-04	NA
## 753	1.49786e-04	NA
## 754	1.49786e-04	NA
## 755	1.49786e-04	NA
## 756	1.49786e-04	NA
## 757	1.49786e-04	NA
## 758	1.49786e-04	NA
## 759	1.49786e-04	NA
## 760	6.61650e-05	NA
## 761	1.49786e-04	NA
## 762	1.49786e-04	NA
## 763	1.49786e-04	NA
## 764	1.49786e-04	NA
## 765	1.49786e-04	NA
## 766	1.49786e-04	NA
## 767	1.49786e-04	NA
## 768	1.49786e-04	NA
## 769	1.49786e-04	NA
## 770	1.49786e-04	NA
## 771	1.49786e-04	NA
## 772	1.49786e-04	NA
## 773	1.49786e-04	NA
## 774	1.49786e-04	NA
## 775	1.49786e-04	NA
## 776	1.49786e-04	NA

## 777	1.49786e-04	NA
## 778	1.49786e-04	NA
## 779	1.49786e-04	NA
## 780	1.49786e-04	NA
## 781	1.49786e-04	NA
## 782	1.49786e-04	NA
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## 786	1.49786e-04	NA
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## 793	1.49786e-04	NA
## 794	1.49786e-04	NA
## 795	1.49786e-04	NA
## 796	1.49786e-04	NA
## 797	1.49786e-04	NA
## 798	1.49786e-04	NA
## 799	1.49786e-04	NA
## 800	9.72507e-06	NA
## 801	1.33686e+05	NA
## 802	9.28729e+06	NA
## 803	9.64820e+03	NA
## 804	2.74416e+04	NA
## 805	1.37813e+07	NA
## 806	1.50201e+08	NA
## 807	1.72623e+07	NA
## 808	3.60317e+07	NA
## 809	1.67430e+08	NA
## 810	1.67546e+07	NA
## 811	6.17739e+07	NA
## 812	8.36263e+07	NA
## 813	6.37799e+07	NA
## 814	1.17162e+08	NA
## 815	2.20617e+09	NA
## 816	2.22402e+07	NA
## 817	2.28063e+08	NA
## 818	3.35062e+05	NA
## 819	1.49786e-04	NA
## 820	2.69282e+06	NA
## 821	2.30024e+07	NA
## 822	5.51934e+07	NA
## 823	8.60723e+07	NA
## 824	1.15063e+08	NA
## 825	1.43511e+08	NA
## 826	1.71257e+08	NA
## 827	1.98259e+08	NA
## 828	2.24385e+08	NA
## 829	2.49666e+08	NA
## 830	2.74496e+08	NA

## 831	2.99703e+08	NA
## 832	3.24337e+08	NA
## 833	3.48235e+08	NA
## 834	3.71563e+08	NA
## 835	3.94416e+08	NA
## 836	4.17267e+08	NA
## 837	4.40953e+08	NA
## 838	4.64276e+08	NA
## 839	4.87149e+08	NA
## 840	7.44618e-06	NA
## 841	9.05531e+06	NA
## 842	7.55606e+04	NA
## 843	1.54775e+06	NA
## 844	1.83658e+08	NA
## 845	1.98195e+07	NA
## 846	3.96131e+04	NA
## 847	1.49786e-04	NA
## 848	3.44037e+06	NA
## 849	2.70583e+07	NA
## 850	6.28409e+07	NA
## 851	9.40713e+07	NA
## 852	1.21657e+08	NA
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## 854	1.72583e+08	NA
## 855	1.96214e+08	NA
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## 857	2.40968e+08	NA
## 858	2.62335e+08	NA
## 859	2.83018e+08	NA
## 860	3.03211e+08	NA
## 861	3.22970e+08	NA
## 862	3.42395e+08	NA
## 863	3.61298e+08	NA
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## 867	4.33118e+08	NA
## 868	4.49670e+08	NA
## 869	4.65761e+08	NA
## 870	4.81381e+08	NA
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## 872	5.14716e+08	NA
## 873	5.32998e+08	NA
## 874	5.50894e+08	NA
## 875	5.68751e+08	NA
## 876	5.86257e+08	NA
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## 878	6.21807e+08	NA
## 879	6.39090e+08	NA
## 880	1.26569e-04	NA
## 881	1.03714e+06	NA
## 882	5.98111e+05	NA
## 883	1.66687e+06	NA
## 884	1.26953e+06	NA

## 885	1.35512e+08	NA
## 886	3.02845e+07	NA
## 887	2.39987e+04	NA
## 888	1.49786e-04	NA
## 889	3.46012e+06	NA
## 890	2.76173e+07	NA
## 891	6.27889e+07	NA
## 892	9.34408e+07	NA
## 893	1.20617e+08	NA
## 894	1.46354e+08	NA
## 895	1.70789e+08	NA
## 896	1.93775e+08	NA
## 897	2.15388e+08	NA
## 898	2.35816e+08	NA
## 899	2.55736e+08	NA
## 900	2.74982e+08	NA
## 901	2.93644e+08	NA
## 902	3.12179e+08	NA
## 903	3.30305e+08	NA
## 904	3.48014e+08	NA
## 905	3.65566e+08	NA
## 906	3.82799e+08	NA
## 907	3.99413e+08	NA
## 908	4.15447e+08	NA
## 909	4.31830e+08	NA
## 910	4.48635e+08	NA
## 911	4.65679e+08	NA
## 912	4.82520e+08	NA
## 913	4.99507e+08	NA
## 914	5.17327e+08	NA
## 915	5.36669e+08	NA
## 916	5.55442e+08	NA
## 917	5.73574e+08	NA
## 918	5.91772e+08	NA
## 919	6.10477e+08	NA
## 920	2.96403e+03	NA
## 921	1.43603e+06	NA
## 922	1.22210e+05	NA
## 923	3.78801e+06	NA
## 924	1.41913e+06	NA
## 925	8.68435e+06	NA
## 926	3.82827e+07	NA
## 927	1.52491e+07	NA
## 928	1.47535e+07	NA
## 929	2.57758e+06	NA
## 930	1.49786e-04	NA
## 931	2.56840e+06	NA
## 932	2.25836e+07	NA
## 933	5.50047e+07	NA
## 934	8.40460e+07	NA
## 935	1.11261e+08	NA
## 936	1.37255e+08	NA
## 937	1.61877e+08	NA
## 938	1.85273e+08	NA

## 939	2.07435e+08	NA
## 940	2.28716e+08	NA
## 941	2.49253e+08	NA
## 942	2.69144e+08	NA
## 943	2.89582e+08	NA
## 944	3.09633e+08	NA
## 945	3.29812e+08	NA
## 946	3.49654e+08	NA
## 947	3.70206e+08	NA
## 948	3.90373e+08	NA
## 949	4.10273e+08	NA
## 950	4.29619e+08	NA
## 951	4.48593e+08	NA
## 952	4.67179e+08	NA
## 953	4.88538e+08	NA
## 954	5.10634e+08	NA
## 955	5.32410e+08	NA
## 956	5.53567e+08	NA
## 957	5.74323e+08	NA
## 958	5.94456e+08	NA
## 959	6.14254e+08	NA
## 960	2.94643e-04	NA
## 961	5.47832e+07	NA
## 962	4.39466e+03	NA
## 963	2.20214e+03	NA
## 964	1.40246e+06	NA
## 965	2.36509e+07	NA
## 966	5.45204e+07	NA
## 967	1.27969e+07	NA
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## 970	1.59844e+07	NA
## 971	5.95677e+08	NA
## 972	5.46009e+06	NA
## 973	6.43421e+07	NA
## 974	1.16958e+09	NA
## 975	1.19464e+07	NA
## 976	2.79052e+07	NA
## 977	2.11317e+09	NA
## 978	2.93875e+08	NA
## 979	9.80504e+08	NA
## 980	8.58355e+07	NA
## 981	1.27890e+08	NA
## 982	1.33350e+07	NA
## 983	1.49786e-04	NA
## 984	2.15285e+06	NA
## 985	1.79095e+07	NA
## 986	4.41998e+07	NA
## 987	7.01804e+07	NA
## 988	9.65004e+07	NA
## 989	1.22600e+08	NA
## 990	1.48054e+08	NA
## 991	1.73489e+08	NA
## 992	1.98362e+08	NA

## 993	2.22454e+08	NA
## 994	2.45736e+08	NA
## 995	2.68445e+08	NA
## 996	2.91802e+08	NA
## 997	3.14771e+08	NA
## 998	3.37054e+08	NA
## 999	3.58750e+08	NA
## 1000	1.33389e-04	NA
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## 1002	3.14739e+06	NA
## 1003	7.41482e+07	NA
## 1004	2.74149e+07	NA
## 1005	1.15908e+08	NA
## 1006	8.33351e+06	NA
## 1007	6.76148e+08	NA
## 1008	1.26814e+07	NA
## 1009	6.55100e+07	NA
## 1010	9.54932e+07	NA
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## 1017	6.01951e+06	NA
## 1018	1.49786e-04	NA
## 1019	2.50195e+06	NA
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## 1021	5.05140e+07	NA
## 1022	7.78101e+07	NA
## 1023	1.04036e+08	NA
## 1024	1.30042e+08	NA
## 1025	1.55313e+08	NA
## 1026	1.80068e+08	NA
## 1027	2.05587e+08	NA
## 1028	2.30763e+08	NA
## 1029	2.55578e+08	NA
## 1030	2.79688e+08	NA
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## 1033	3.48879e+08	NA
## 1034	3.70539e+08	NA
## 1035	3.91709e+08	NA
## 1036	4.12281e+08	NA
## 1037	4.32251e+08	NA
## 1038	4.51691e+08	NA
## 1039	4.70581e+08	NA
## 1040	6.59687e-06	NA
## 1041	2.15093e+05	NA
## 1042	2.56300e+07	NA
## 1043	2.54560e+06	NA
## 1044	1.97656e+07	NA
## 1045	3.19411e+04	NA
## 1046	4.34417e+05	NA

## 1047	1.49786e-04	NA
## 1048	3.40173e+06	NA
## 1049	2.59673e+07	NA
## 1050	5.78443e+07	NA
## 1051	8.46546e+07	NA
## 1052	1.08915e+08	NA
## 1053	1.33639e+08	NA
## 1054	1.57253e+08	NA
## 1055	1.79404e+08	NA
## 1056	2.00231e+08	NA
## 1057	2.19895e+08	NA
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## 1059	2.58179e+08	NA
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## 1061	2.96824e+08	NA
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## 1064	3.50965e+08	NA
## 1065	3.69913e+08	NA
## 1066	3.88536e+08	NA
## 1067	4.06617e+08	NA
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## 1069	4.40734e+08	NA
## 1070	4.57051e+08	NA
## 1071	4.75176e+08	NA
## 1072	4.92884e+08	NA
## 1073	5.10348e+08	NA
## 1074	5.27242e+08	NA
## 1075	5.43620e+08	NA
## 1076	5.60004e+08	NA
## 1077	5.75897e+08	NA
## 1078	5.91302e+08	NA
## 1079	6.06677e+08	NA
## 1080	1.07946e-05	NA
## 1081	1.14651e+05	NA
## 1082	3.28939e+07	NA
## 1083	1.77077e+04	NA
## 1084	4.13329e+07	NA
## 1085	4.97057e+05	NA
## 1086	1.30032e+07	NA
## 1087	4.87004e+08	NA
## 1088	3.02236e+06	NA
## 1089	1.07803e+08	NA
## 1090	3.94243e+05	NA
## 1091	1.49786e-04	NA
## 1092	2.82228e+06	NA
## 1093	2.27779e+07	NA
## 1094	5.48648e+07	NA
## 1095	8.54012e+07	NA
## 1096	1.13467e+08	NA
## 1097	1.40715e+08	NA
## 1098	1.66780e+08	NA
## 1099	1.91599e+08	NA
## 1100	2.15185e+08	NA

## 1101	2.38073e+08	NA
## 1102	2.62151e+08	NA
## 1103	2.85666e+08	NA
## 1104	3.09007e+08	NA
## 1105	3.33521e+08	NA
## 1106	3.57578e+08	NA
## 1107	3.81040e+08	NA
## 1108	4.03714e+08	NA
## 1109	4.25616e+08	NA
## 1110	4.46712e+08	NA
## 1111	4.66958e+08	NA
## 1112	4.86705e+08	NA
## 1113	5.08367e+08	NA
## 1114	5.29348e+08	NA
## 1115	5.50542e+08	NA
## 1116	5.71556e+08	NA
## 1117	5.92215e+08	NA
## 1118	6.12446e+08	NA
## 1119	6.32481e+08	NA
## 1120	6.48309e-05	NA
## 1121	4.52877e+06	NA
## 1122	9.87697e+06	NA
## 1123	6.81975e+05	NA
## 1124	2.46545e+06	NA
## 1125	1.88653e+08	NA
## 1126	9.25581e+05	NA
## 1127	2.84118e+07	NA
## 1128	5.10664e+07	NA
## 1129	1.87085e+07	NA
## 1130	1.90686e+08	NA
## 1131	9.92391e+08	NA
## 1132	6.21196e+06	NA
## 1133	7.03439e+05	NA
## 1134	7.93178e+07	NA
## 1135	1.53948e+05	NA
## 1136	3.15639e+06	NA
## 1137	6.90404e+07	NA
## 1138	6.21412e+07	NA
## 1139	8.03530e+06	NA
## 1140	9.13364e+07	NA
## 1141	3.34766e+07	NA
## 1142	1.05129e+07	NA
## 1143	5.55670e+03	NA
## 1144	1.49786e-04	NA
## 1145	2.28727e+06	NA
## 1146	1.90831e+07	NA
## 1147	4.60481e+07	NA
## 1148	7.20097e+07	NA
## 1149	9.78946e+07	NA
## 1150	1.24975e+08	NA
## 1151	1.51588e+08	NA
## 1152	1.77539e+08	NA
## 1153	2.02814e+08	NA
## 1154	2.27412e+08	NA

## 1155	2.51787e+08	NA
## 1156	2.75607e+08	NA
## 1157	2.98685e+08	NA
## 1158	3.21304e+08	NA
## 1159	3.43402e+08	NA
## 1160	6.61650e-05	NA
## 1161	3.47139e+06	NA
## 1162	5.73680e+06	NA
## 1163	7.55751e+06	NA
## 1164	1.66233e-02	NA
## 1165	1.62574e+08	NA
## 1166	1.49610e+06	NA
## 1167	3.35018e+07	NA
## 1168	1.19708e+06	NA
## 1169	7.91794e+06	NA
## 1170	8.45189e+05	NA
## 1171	8.88565e+07	NA
## 1172	6.17176e+07	NA
## 1173	8.24651e+07	NA
## 1174	1.02723e+07	NA
## 1175	5.70949e+06	NA
## 1176	1.49786e-04	NA
## 1177	2.40784e+06	NA
## 1178	2.00962e+07	NA
## 1179	4.78334e+07	NA
## 1180	7.45333e+07	NA
## 1181	1.00031e+08	NA
## 1182	1.25616e+08	NA
## 1183	1.50811e+08	NA
## 1184	1.76482e+08	NA
## 1185	2.01496e+08	NA
## 1186	2.25867e+08	NA
## 1187	2.50684e+08	NA
## 1188	2.74919e+08	NA
## 1189	2.98434e+08	NA
## 1190	3.21090e+08	NA
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## 1193	3.86394e+08	NA
## 1194	4.07232e+08	NA
## 1195	4.27347e+08	NA
## 1196	4.46614e+08	NA
## 1197	4.66666e+08	NA
## 1198	4.87940e+08	NA
## 1199	5.08612e+08	NA
## 1200	9.72507e-06	NA
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## 1203	9.64820e+03	NA
## 1204	1.49786e-04	NA
## 1205	4.67666e+06	NA
## 1206	3.35929e+07	NA
## 1207	7.11336e+07	NA
## 1208	1.01193e+08	NA

## 1209	1.26459e+08	NA
## 1210	1.49439e+08	NA
## 1211	1.71554e+08	NA
## 1212	1.92203e+08	NA
## 1213	2.12149e+08	NA
## 1214	2.32247e+08	NA
## 1215	2.53156e+08	NA
## 1216	2.73336e+08	NA
## 1217	2.92652e+08	NA
## 1218	3.11349e+08	NA
## 1219	3.29387e+08	NA
## 1220	3.47378e+08	NA
## 1221	3.65620e+08	NA
## 1222	3.83478e+08	NA
## 1223	4.01417e+08	NA
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## 1225	4.35954e+08	NA
## 1226	4.52636e+08	NA
## 1227	4.68945e+08	NA
## 1228	4.84759e+08	NA
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## 1238	6.55779e+08	NA
## 1239	6.75071e+08	NA
## 1240	7.44618e-06	NA
## 1241	9.05531e+06	NA
## 1242	7.55606e+04	NA
## 1243	1.49786e-04	NA
## 1244	5.49664e+06	NA
## 1245	3.75599e+07	NA
## 1246	7.72864e+07	NA
## 1247	1.07850e+08	NA
## 1248	1.33481e+08	NA
## 1249	1.57309e+08	NA
## 1250	1.80355e+08	NA
## 1251	2.02107e+08	NA
## 1252	2.22394e+08	NA
## 1253	2.41641e+08	NA
## 1254	2.60357e+08	NA
## 1255	2.78326e+08	NA
## 1256	2.95577e+08	NA
## 1257	3.12794e+08	NA
## 1258	3.29416e+08	NA
## 1259	3.45588e+08	NA
## 1260	3.61446e+08	NA
## 1261	3.77017e+08	NA
## 1262	3.92374e+08	NA

## 1263	4.07352e+08	NA
## 1264	4.22099e+08	NA
## 1265	4.36660e+08	NA
## 1266	4.50830e+08	NA
## 1267	4.64511e+08	NA
## 1268	4.77717e+08	NA
## 1269	4.90561e+08	NA
## 1270	5.03033e+08	NA
## 1271	5.15527e+08	NA
## 1272	5.29384e+08	NA
## 1273	5.45449e+08	NA
## 1274	5.61176e+08	NA
## 1275	5.76876e+08	NA
## 1276	5.92267e+08	NA
## 1277	6.08686e+08	NA
## 1278	6.25997e+08	NA
## 1279	6.42970e+08	NA
## 1280	1.26569e-04	NA
## 1281	1.03714e+06	NA
## 1282	5.98111e+05	NA
## 1283	1.66687e+06	NA
## 1284	1.26953e+06	NA
## 1285	1.35512e+08	NA
## 1286	3.02845e+07	NA
## 1287	2.39987e+04	NA
## 1288	1.49786e-04	NA
## 1289	3.45729e+06	NA
## 1290	2.75932e+07	NA
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## 1293	1.20518e+08	NA
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## 1303	3.30102e+08	NA
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## 1306	3.82582e+08	NA
## 1307	3.99192e+08	NA
## 1308	4.15222e+08	NA
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## 1313	4.99272e+08	NA
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## 1327 9.89828e+07	NA
## 1328 1.22191e+08	NA
## 1329 1.42628e+08	NA
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## 1335 2.51052e+08	NA
## 1336 2.68145e+08	NA
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## 1339 3.15314e+08	NA
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## 1341 3.43946e+08	NA
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## 1436	5.61078e+08	NA
## 1437	5.78553e+08	NA
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## 1439	6.12078e+08	NA
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## 1468	4.35155e+08	NA
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## 1470	4.66365e+08	NA
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## 1487 6.82395e+07	NA
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## 1495 2.46657e+08	NA
## 1496 2.65795e+08	NA
## 1497 2.84423e+08	NA
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## 1519 6.51496e+08	NA
## 1520 6.48309e-05	NA
## 1521 4.52877e+06	NA
## 1522 9.87697e+06	NA
## 1523 6.81975e+05	NA
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## 1526 9.25581e+05	NA
## 1527 2.84118e+07	NA
## 1528 5.10664e+07	NA
## 1529 1.87085e+07	NA
## 1530 1.90686e+08	NA
## 1531 9.92391e+08	NA
## 1532 6.21196e+06	NA

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## 1534 7.93178e+07	NA
## 1535 1.53948e+05	NA
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## 1563 7.55751e+06	NA
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## 1565 1.62574e+08	NA
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## 1593	5.19789e+08	NA
## 1594	5.37888e+08	NA
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## 1596	5.72079e+08	NA
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## 1598	6.04494e+08	NA
## 1599	6.20311e+08	NA
## 1600	9.72507e-06	NA
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## 201	InitF_seas_2_flt_2MexCal_S2

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## 245	AgeSel_P5_MexCal_S2(2)	
## 246	InitF_seas_2_flt_2MexCal_S2;AgeSel_P5_MexCal_S2(2)	
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## 280	InitF_seas_2_flt_2MexCal_S2
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## 320 InitF_seas_2_flt_2MexCal_S2
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## 324 InitF_seas_2_flt_2MexCal_S2
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## 326 AgeSel_P5_MexCal_S1(1)
## 327 VonBert_K_Fem_GP_1;AgeSel_P2_MexCal_S2(2)
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## 365                                     <NA>
## 366                                     <NA>
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## 368             AgeSel_P5_MexCal_S2(2)
## 369                                     <NA>
## 370             InitF_seas_2_flt_2MexCal_S2
## 371 InitF_seas_2_flt_2MexCal_S2;AgeSel_P1_MexCal_S1(1)
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## 1436	<NA>	6 constGrowSelfTest_EM_2055
## 1437	<NA>	6 constGrowSelfTest_EM_2056
## 1438	<NA>	6 constGrowSelfTest_EM_2057
## 1439	<NA>	6 constGrowSelfTest_EM_2058
## 1440	<NA>	6 constGrowSelfTest_EM_init
## 1441	<NA>	7 constGrowSelfTest_EM_2020
## 1442	<NA>	7 constGrowSelfTest_EM_2021
## 1443	<NA>	7 constGrowSelfTest_EM_2022
## 1444	<NA>	7 constGrowSelfTest_EM_2023
## 1445	<NA>	7 constGrowSelfTest_EM_2024
## 1446	<NA>	7 constGrowSelfTest_EM_2025
## 1447	<NA>	7 constGrowSelfTest_EM_2026
## 1448	<NA>	7 constGrowSelfTest_EM_2027
## 1449	<NA>	7 constGrowSelfTest_EM_2028
## 1450	<NA>	7 constGrowSelfTest_EM_2029
## 1451	<NA>	7 constGrowSelfTest_EM_2030
## 1452	<NA>	7 constGrowSelfTest_EM_2031
## 1453	<NA>	7 constGrowSelfTest_EM_2032
## 1454	<NA>	7 constGrowSelfTest_EM_2033
## 1455	<NA>	7 constGrowSelfTest_EM_2034
## 1456	<NA>	7 constGrowSelfTest_EM_2035
## 1457	<NA>	7 constGrowSelfTest_EM_2036
## 1458	<NA>	7 constGrowSelfTest_EM_2037
## 1459	<NA>	7 constGrowSelfTest_EM_2038
## 1460	<NA>	7 constGrowSelfTest_EM_2039
## 1461	<NA>	7 constGrowSelfTest_EM_2040
## 1462	<NA>	7 constGrowSelfTest_EM_2041

## 1463	<NA>	7 constGrowSelfTest_EM_2042
## 1464	<NA>	7 constGrowSelfTest_EM_2043
## 1465	<NA>	7 constGrowSelfTest_EM_2044
## 1466	<NA>	7 constGrowSelfTest_EM_2045
## 1467	<NA>	7 constGrowSelfTest_EM_2046
## 1468	<NA>	7 constGrowSelfTest_EM_2047
## 1469	<NA>	7 constGrowSelfTest_EM_2048
## 1470	<NA>	7 constGrowSelfTest_EM_2049
## 1471	<NA>	7 constGrowSelfTest_EM_2050
## 1472	<NA>	7 constGrowSelfTest_EM_2051
## 1473	<NA>	7 constGrowSelfTest_EM_2052
## 1474	<NA>	7 constGrowSelfTest_EM_2053
## 1475	<NA>	7 constGrowSelfTest_EM_2054
## 1476	<NA>	7 constGrowSelfTest_EM_2055
## 1477	<NA>	7 constGrowSelfTest_EM_2056
## 1478	<NA>	7 constGrowSelfTest_EM_2057
## 1479	<NA>	7 constGrowSelfTest_EM_2058
## 1480	<NA>	7 constGrowSelfTest_EM_init
## 1481	<NA>	8 constGrowSelfTest_EM_2020
## 1482	<NA>	8 constGrowSelfTest_EM_2021
## 1483	<NA>	8 constGrowSelfTest_EM_2022
## 1484	<NA>	8 constGrowSelfTest_EM_2023
## 1485	<NA>	8 constGrowSelfTest_EM_2024
## 1486	<NA>	8 constGrowSelfTest_EM_2025
## 1487	<NA>	8 constGrowSelfTest_EM_2026
## 1488	<NA>	8 constGrowSelfTest_EM_2027
## 1489	<NA>	8 constGrowSelfTest_EM_2028
## 1490	<NA>	8 constGrowSelfTest_EM_2029
## 1491	<NA>	8 constGrowSelfTest_EM_2030
## 1492	<NA>	8 constGrowSelfTest_EM_2031
## 1493	<NA>	8 constGrowSelfTest_EM_2032
## 1494	<NA>	8 constGrowSelfTest_EM_2033
## 1495	<NA>	8 constGrowSelfTest_EM_2034
## 1496	<NA>	8 constGrowSelfTest_EM_2035
## 1497	<NA>	8 constGrowSelfTest_EM_2036
## 1498	<NA>	8 constGrowSelfTest_EM_2037
## 1499	<NA>	8 constGrowSelfTest_EM_2038
## 1500	<NA>	8 constGrowSelfTest_EM_2039
## 1501	<NA>	8 constGrowSelfTest_EM_2040
## 1502	<NA>	8 constGrowSelfTest_EM_2041
## 1503	<NA>	8 constGrowSelfTest_EM_2042
## 1504	<NA>	8 constGrowSelfTest_EM_2043
## 1505	<NA>	8 constGrowSelfTest_EM_2044
## 1506	<NA>	8 constGrowSelfTest_EM_2045
## 1507	<NA>	8 constGrowSelfTest_EM_2046
## 1508	<NA>	8 constGrowSelfTest_EM_2047
## 1509	<NA>	8 constGrowSelfTest_EM_2048
## 1510	<NA>	8 constGrowSelfTest_EM_2049
## 1511	<NA>	8 constGrowSelfTest_EM_2050
## 1512	<NA>	8 constGrowSelfTest_EM_2051
## 1513	<NA>	8 constGrowSelfTest_EM_2052
## 1514	<NA>	8 constGrowSelfTest_EM_2053
## 1515	<NA>	8 constGrowSelfTest_EM_2054
## 1516	<NA>	8 constGrowSelfTest_EM_2055

## 1517	<NA>	8 constGrowSelfTest_EM_2056
## 1518	<NA>	8 constGrowSelfTest_EM_2057
## 1519	<NA>	8 constGrowSelfTest_EM_2058
## 1520	<NA>	8 constGrowSelfTest_EM_init
## 1521	<NA>	9 constGrowSelfTest_EM_2020
## 1522	<NA>	9 constGrowSelfTest_EM_2021
## 1523	<NA>	9 constGrowSelfTest_EM_2022
## 1524	<NA>	9 constGrowSelfTest_EM_2023
## 1525	<NA>	9 constGrowSelfTest_EM_2024
## 1526	<NA>	9 constGrowSelfTest_EM_2025
## 1527	<NA>	9 constGrowSelfTest_EM_2026
## 1528	<NA>	9 constGrowSelfTest_EM_2027
## 1529	<NA>	9 constGrowSelfTest_EM_2028
## 1530	InitF_seas_2_flt_2MexCal_S2	9 constGrowSelfTest_EM_2029
## 1531	CV_old_Fem_GP_1	9 constGrowSelfTest_EM_2030
## 1532	<NA>	9 constGrowSelfTest_EM_2031
## 1533	AgeSel_P1_MexCal_S1(1)	9 constGrowSelfTest_EM_2032
## 1534	<NA>	9 constGrowSelfTest_EM_2033
## 1535	<NA>	9 constGrowSelfTest_EM_2034
## 1536	<NA>	9 constGrowSelfTest_EM_2035
## 1537	<NA>	9 constGrowSelfTest_EM_2036
## 1538	<NA>	9 constGrowSelfTest_EM_2037
## 1539	<NA>	9 constGrowSelfTest_EM_2038
## 1540	<NA>	9 constGrowSelfTest_EM_2039
## 1541	<NA>	9 constGrowSelfTest_EM_2040
## 1542	<NA>	9 constGrowSelfTest_EM_2041
## 1543	<NA>	9 constGrowSelfTest_EM_2042
## 1544	<NA>	9 constGrowSelfTest_EM_2043
## 1545	<NA>	9 constGrowSelfTest_EM_2044
## 1546	<NA>	9 constGrowSelfTest_EM_2045
## 1547	<NA>	9 constGrowSelfTest_EM_2046
## 1548	<NA>	9 constGrowSelfTest_EM_2047
## 1549	<NA>	9 constGrowSelfTest_EM_2048
## 1550	<NA>	9 constGrowSelfTest_EM_2049
## 1551	<NA>	9 constGrowSelfTest_EM_2050
## 1552	<NA>	9 constGrowSelfTest_EM_2051
## 1553	<NA>	9 constGrowSelfTest_EM_2052
## 1554	<NA>	9 constGrowSelfTest_EM_2053
## 1555	<NA>	9 constGrowSelfTest_EM_2054
## 1556	<NA>	9 constGrowSelfTest_EM_2055
## 1557	<NA>	9 constGrowSelfTest_EM_2056
## 1558	<NA>	9 constGrowSelfTest_EM_2057
## 1559	<NA>	9 constGrowSelfTest_EM_2058
## 1560	<NA>	9 constGrowSelfTest_EM_init
## 1561	<NA>	10 constGrowSelfTest_EM_2020
## 1562	<NA>	10 constGrowSelfTest_EM_2021
## 1563	<NA>	10 constGrowSelfTest_EM_2022
## 1564	<NA>	10 constGrowSelfTest_EM_2023
## 1565	<NA>	10 constGrowSelfTest_EM_2024
## 1566	<NA>	10 constGrowSelfTest_EM_2025
## 1567	<NA>	10 constGrowSelfTest_EM_2026
## 1568	<NA>	10 constGrowSelfTest_EM_2027
## 1569	<NA>	10 constGrowSelfTest_EM_2028
## 1570	<NA>	10 constGrowSelfTest_EM_2029

```

## 1571          <NA>          10 constGrowSelfTest_EM_2030
## 1572          <NA>          10 constGrowSelfTest_EM_2031
## 1573          <NA>          10 constGrowSelfTest_EM_2032
## 1574          <NA>          10 constGrowSelfTest_EM_2033
## 1575          <NA>          10 constGrowSelfTest_EM_2034
## 1576          <NA>          10 constGrowSelfTest_EM_2035
## 1577          <NA>          10 constGrowSelfTest_EM_2036
## 1578          <NA>          10 constGrowSelfTest_EM_2037
## 1579          <NA>          10 constGrowSelfTest_EM_2038
## 1580          <NA>          10 constGrowSelfTest_EM_2039
## 1581          <NA>          10 constGrowSelfTest_EM_2040
## 1582          <NA>          10 constGrowSelfTest_EM_2041
## 1583          <NA>          10 constGrowSelfTest_EM_2042
## 1584          <NA>          10 constGrowSelfTest_EM_2043
## 1585          <NA>          10 constGrowSelfTest_EM_2044
## 1586          <NA>          10 constGrowSelfTest_EM_2045
## 1587          <NA>          10 constGrowSelfTest_EM_2046
## 1588          <NA>          10 constGrowSelfTest_EM_2047
## 1589          <NA>          10 constGrowSelfTest_EM_2048
## 1590          <NA>          10 constGrowSelfTest_EM_2049
## 1591          <NA>          10 constGrowSelfTest_EM_2050
## 1592          <NA>          10 constGrowSelfTest_EM_2051
## 1593          <NA>          10 constGrowSelfTest_EM_2052
## 1594          <NA>          10 constGrowSelfTest_EM_2053
## 1595          <NA>          10 constGrowSelfTest_EM_2054
## 1596          <NA>          10 constGrowSelfTest_EM_2055
## 1597          <NA>          10 constGrowSelfTest_EM_2056
## 1598          <NA>          10 constGrowSelfTest_EM_2057
## 1599          <NA>          10 constGrowSelfTest_EM_2058
## 1600          <NA>          10 constGrowSelfTest_EM_init
##                                     scenario
## 1  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 2  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 3  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 4  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 5  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 6  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 7  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 8  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 9  constGrow20010M_selfTestSD1.25_RandRechHCR2
## 10 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 11 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 12 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 13 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 14 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 15 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 16 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 17 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 18 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 19 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 20 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 21 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 22 constGrow20010M_selfTestSD1.25_RandRechHCR2
## 23 constGrow20010M_selfTestSD1.25_RandRechHCR2

```

[illegible]

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[illegible]

[illegible]

[illegible]

```
## 1590 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1591 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1592 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1593 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1594 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1595 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1596 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1597 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1598 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1599 constGrow20010M_selfTestSD1.25_RandRecHCR6
## 1600 constGrow20010M_selfTestSD1.25_RandRecHCR6
```

EM 2001 self test, recruitment at SD=1.25, perfect information & fixed params

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
```

```
scenarios <- c("fixedParams20010M_selfTestSD1.25_RandRecHCR0",
               "fixedParams20010M_selfTestSD1.25_RandRecHCR2",
               "fixedParams20010M_selfTestSD1.25_RandRecHCR3",
               "fixedParams20010M_selfTestSD1.25_RandRecHCR5",
               "fixedParams20010M_selfTestSD1.25_RandRecHCR6")
```

```
smryOutputList <- GetSumryOutput(dirSSMSE = mseDir,
                                scenarios = scenarios)
```

```
## Rows: 300 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
```

```
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 8200 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
performanceList <- CalcPerformance(smryOutputList)
```

```
## 'summarise()' has grouped output by 'iteration'. You can override using the
## '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration', 'scenario'. You
## can override using the '.groups' argument.
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
## 'summarise()' has grouped output by 'model_run', 'iteration'. You can override
## using the '.groups' argument.
```

```
metricsTbl <- performanceList$performanceMetrics
```

```
# parse out HCR and recruitment scenario
```

```
metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),
                                   recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_", "", recScen))
```

```
hcrPal <- brewer.pal(10, "Set3")[-2]
```

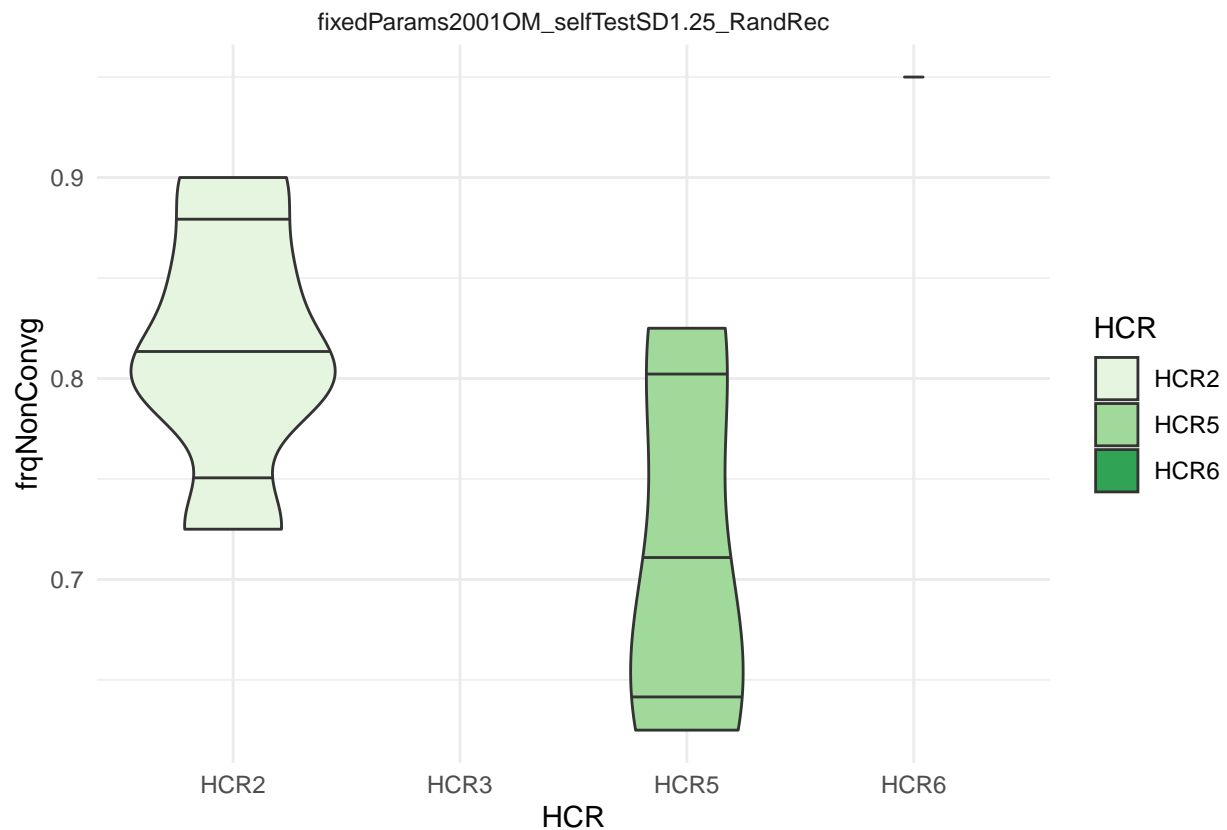
```
# plot convergence frequency
```

```
metricsTbl %>% filter(HCR != "HCRO") %>%
  ggplot(aes(x = HCR, y = frqNonConv)) +
  geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
  facet_wrap(~recScen) +
  theme_minimal() +
  scale_fill_brewer(palette = hcrPal)
```

```
## Warning in if (!palette %in% unlist(brewer)) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in pal_name(palette, type): Unknown palette
## #8DD3C7#BEBADA#FB8072#80B1D3#FDB462#B3DE69#FCCDE5#D9D9D9#BC80BD
```

```
## Warning: Removed 5 rows containing non-finite values (stat_ydensity).
```



```
# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec", "", scenario),
         recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest_", "", recScen))
```

```
## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.
```

```
omName <- grep("_OM", smryOutputList$tsSmry$model_run,
              fixed = TRUE, value = TRUE)[1]

convrgeCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                    model_run))),
         HCR = sub(pattern = ".*Rec", "", scenario),
         recScen = sub(pattern = "HCR.*", "", scenario)) %>%
```

```

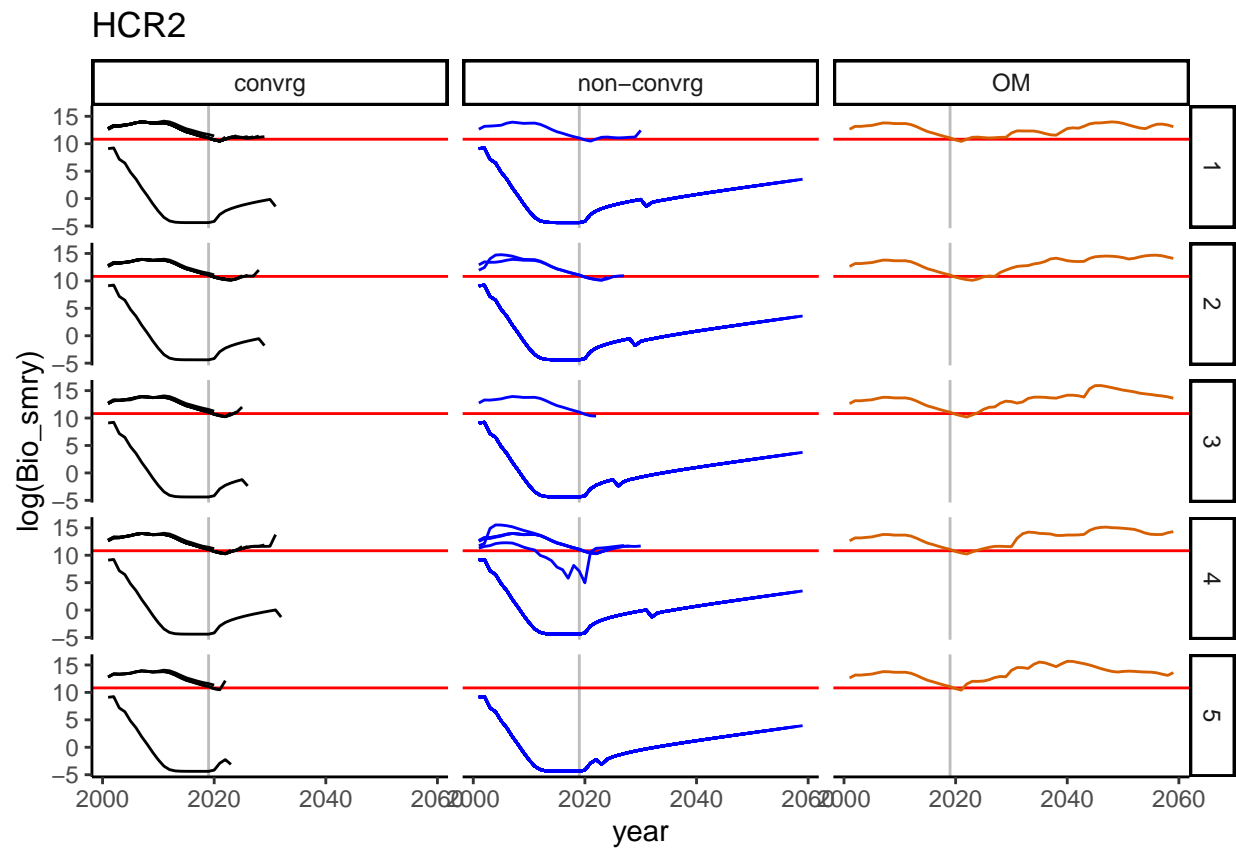
mutate(recScen = sub(pattern = ".*selfTest_", "", recScen))

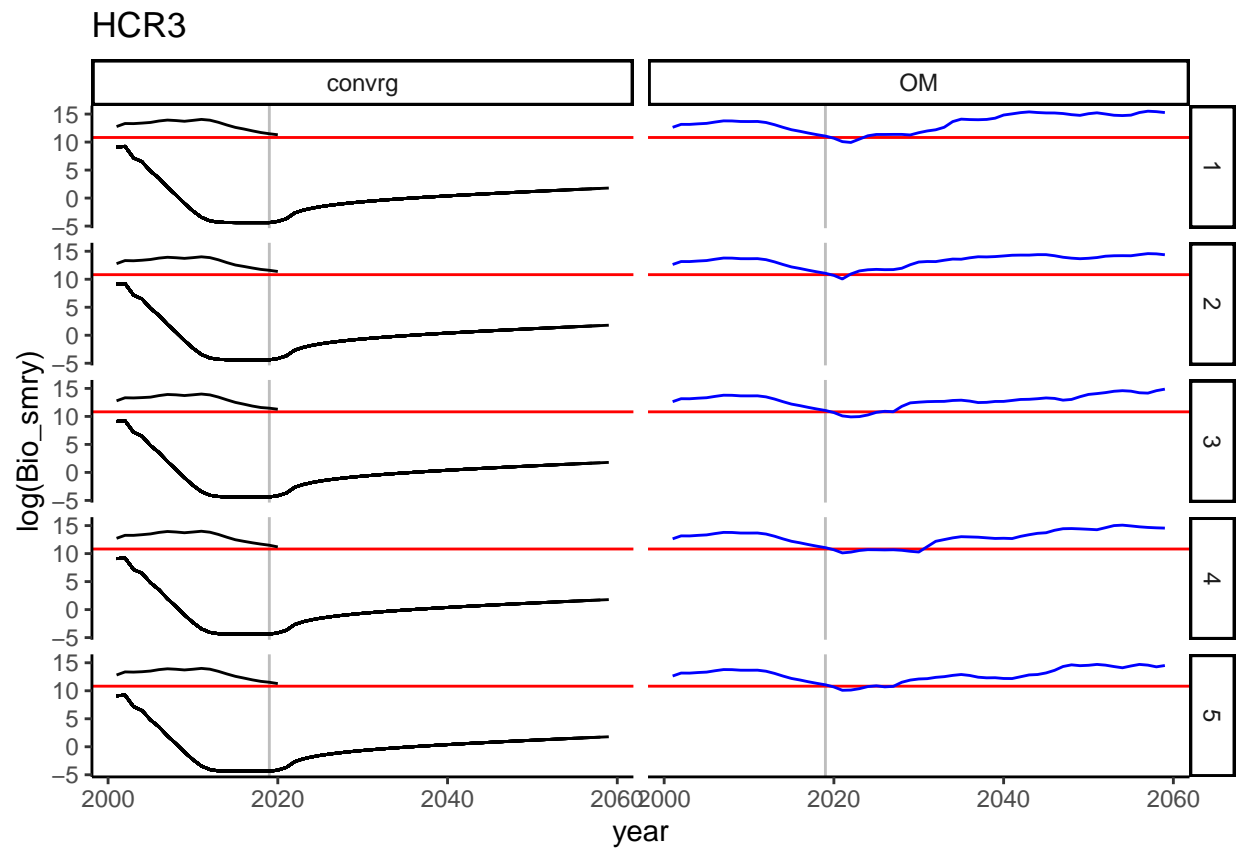
hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

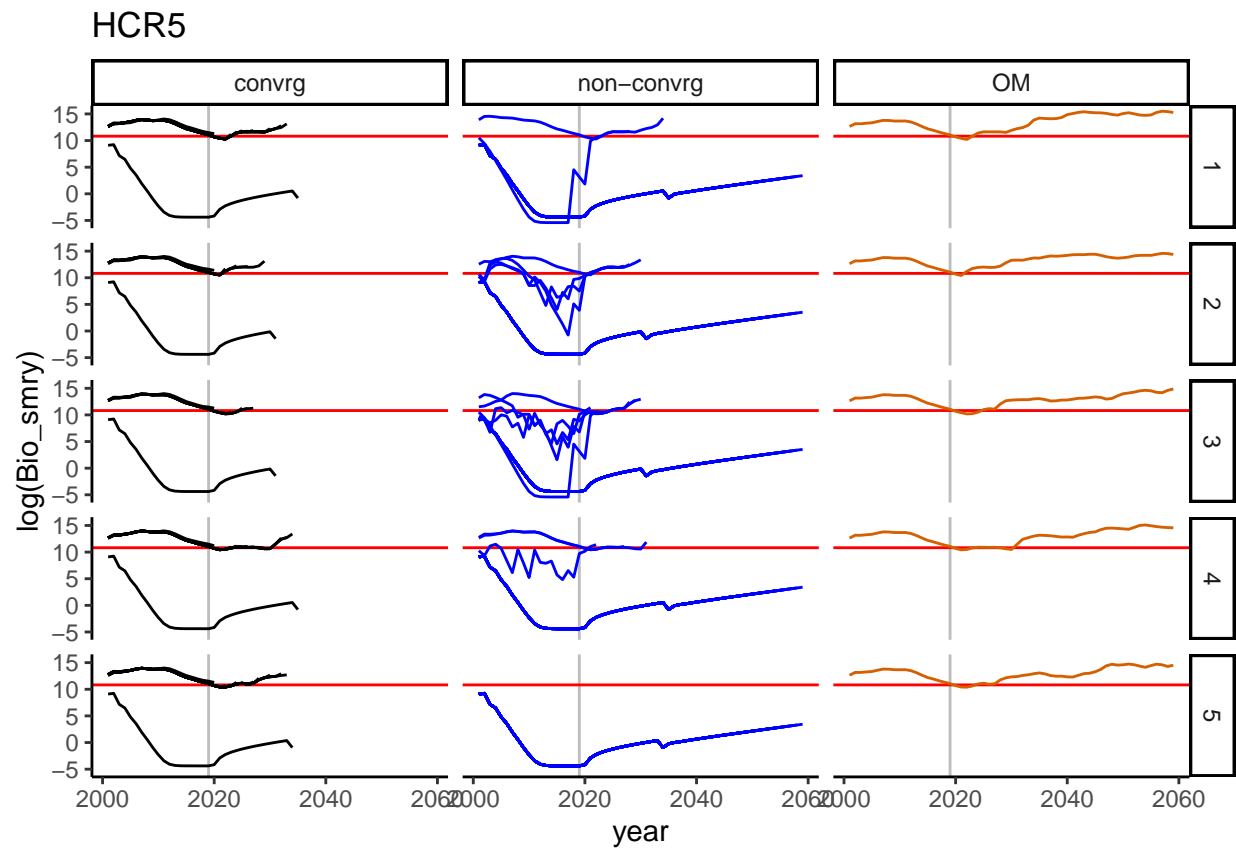
cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),
                                             recScen = sub(pattern = "HCR.*", "", scenario)) %>%
mutate(recScen = sub(pattern = ".*selfTest_", "", recScen)) %>%
left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
mutate(plotGroup = case_when(model_run == omName ~ "OM",
                             max_grad > 0.01 ~ "non-convrg",
                             max_grad < 0.01 ~ "convrg"))

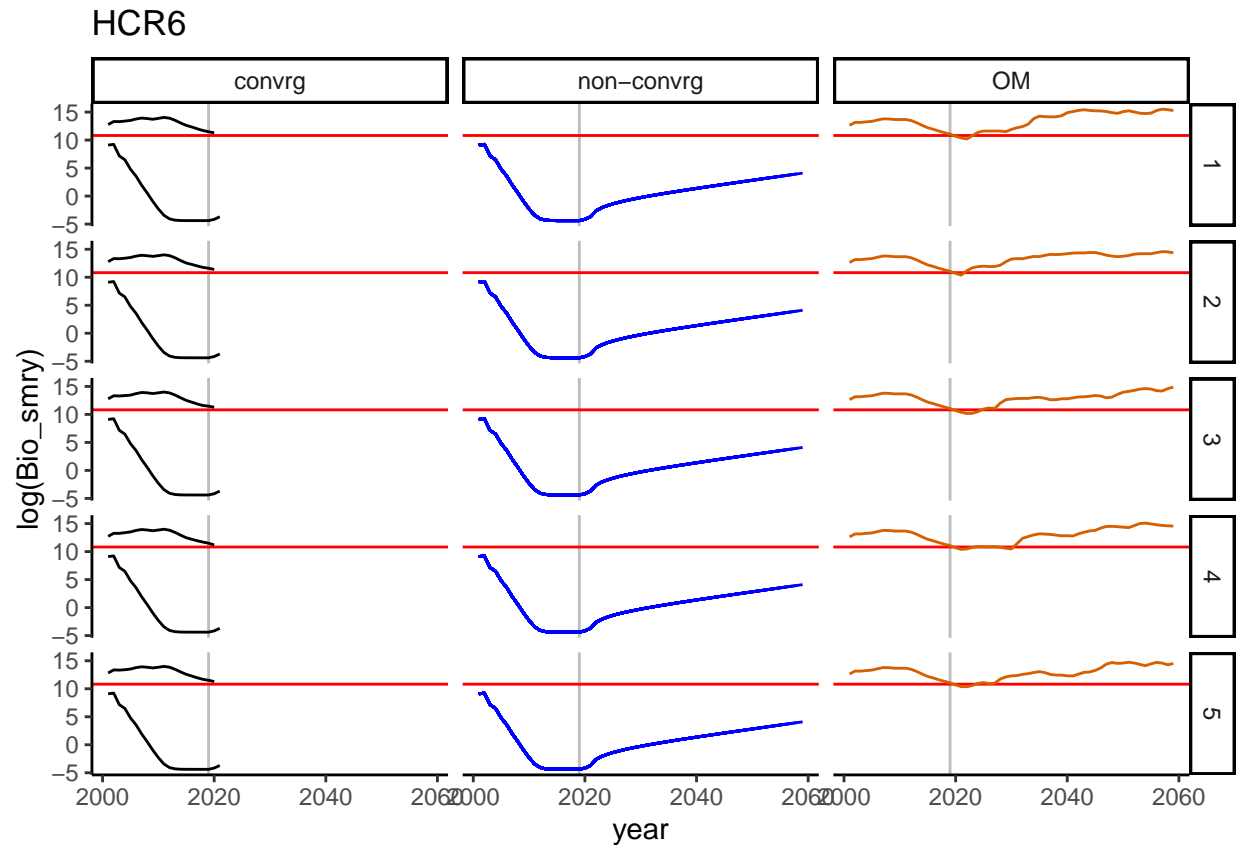
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```

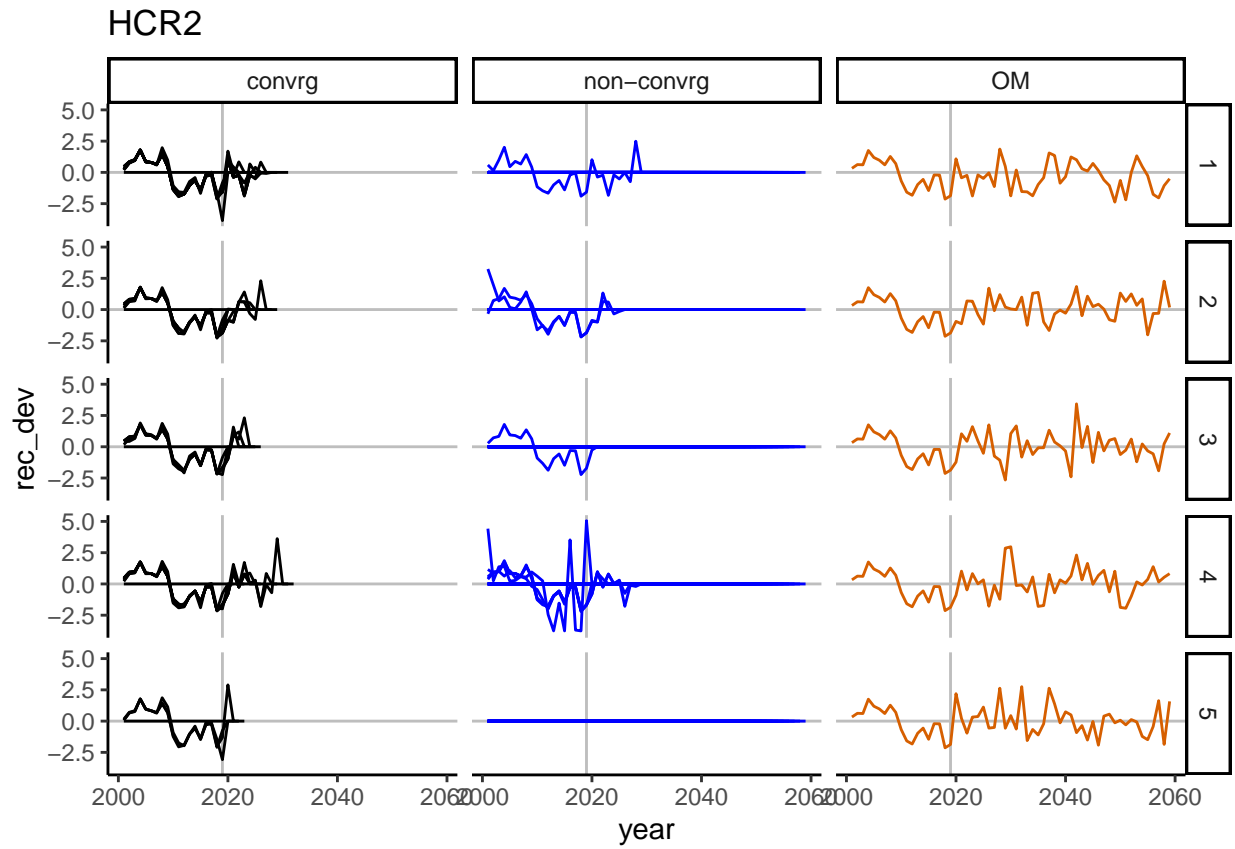


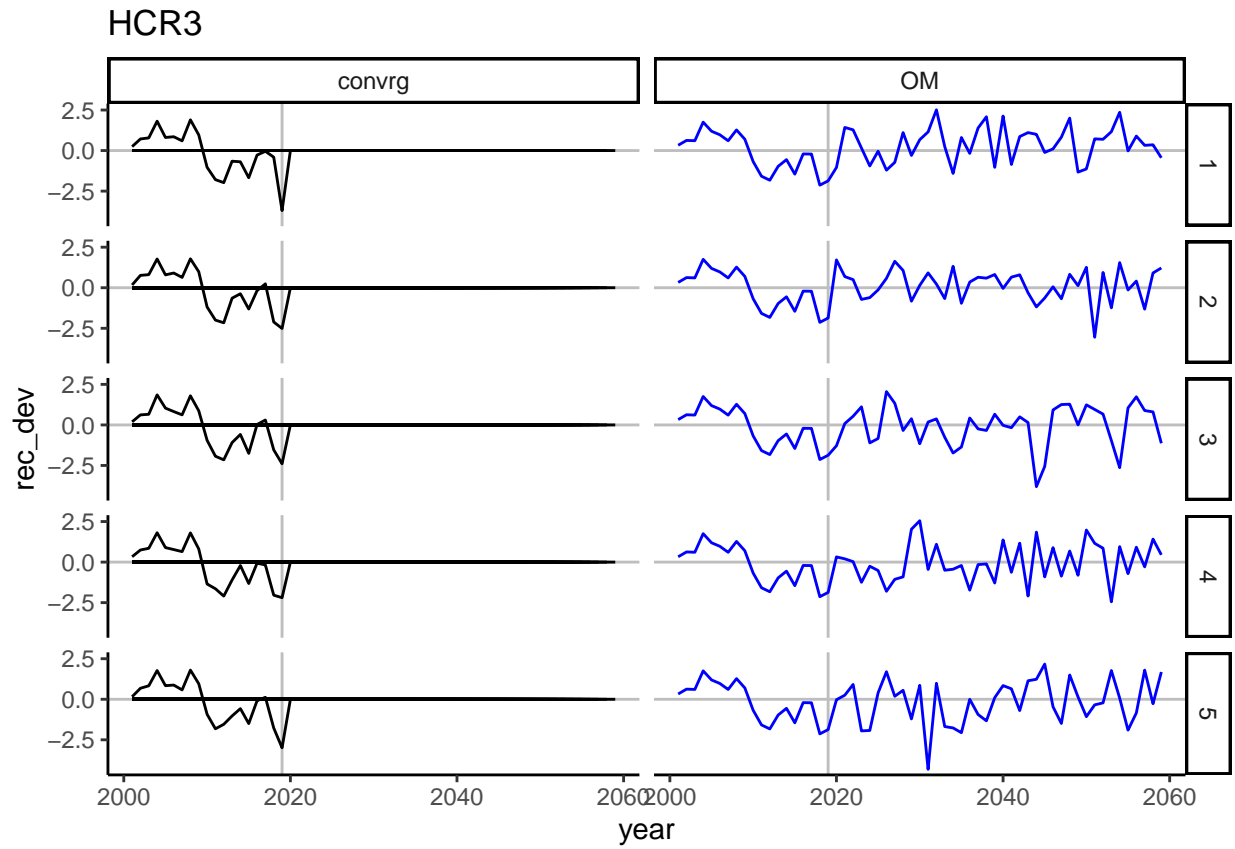




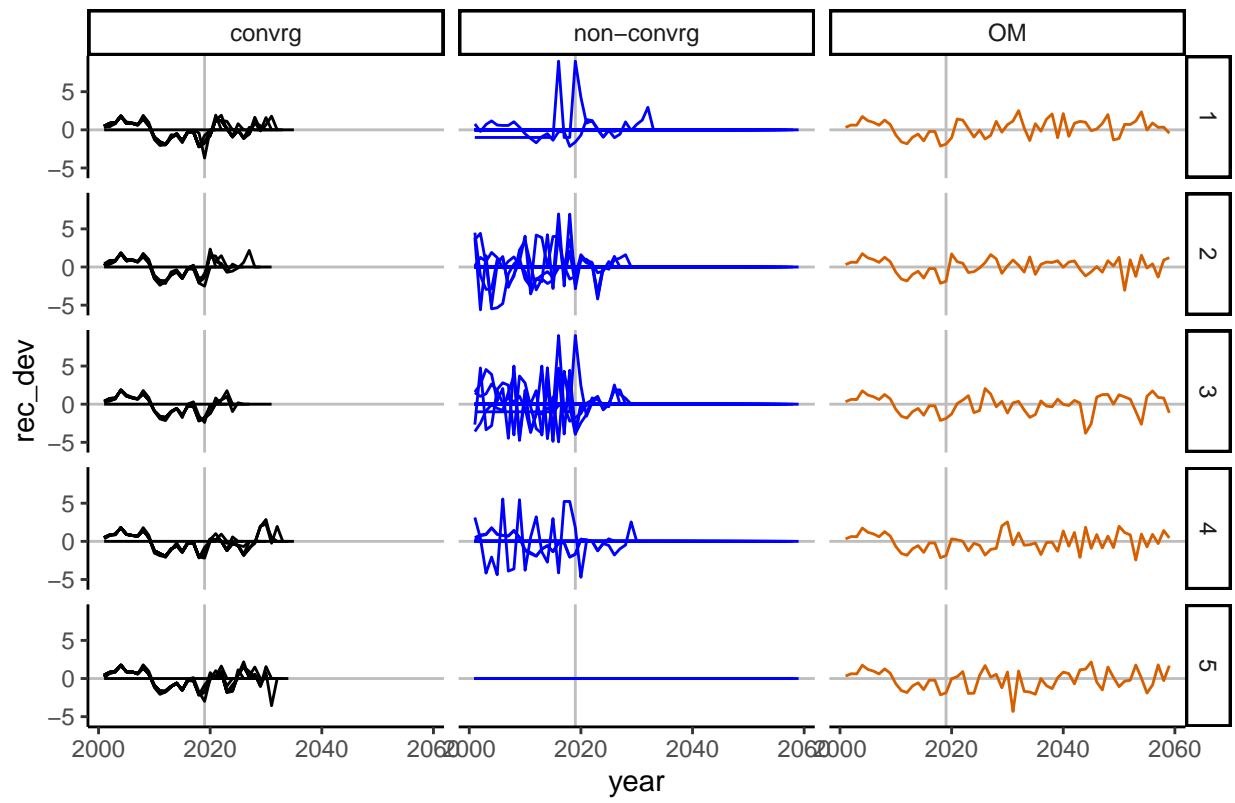


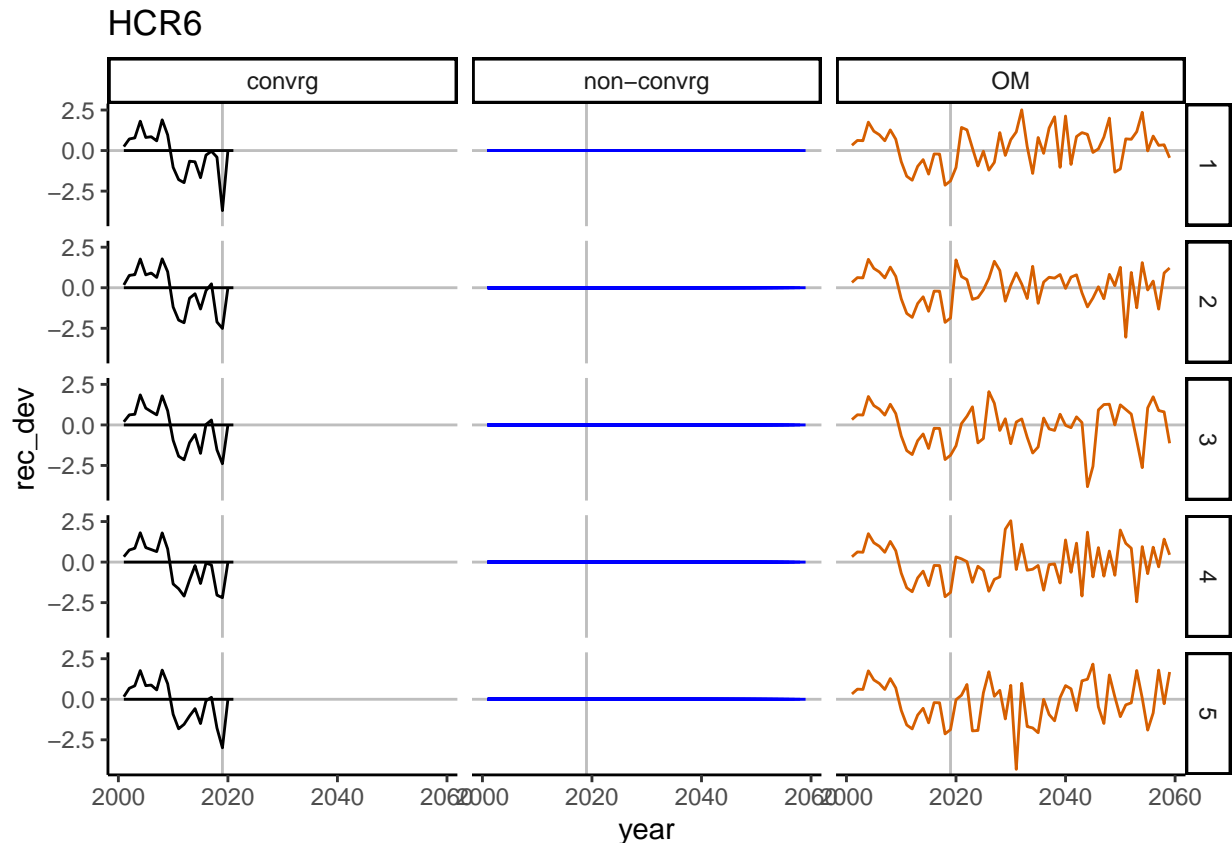
```
for(hcr in 2:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(iteration), cols = vars(plotGroup)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```





HCR5





```
#termTS %>% filter(model_run == omName)

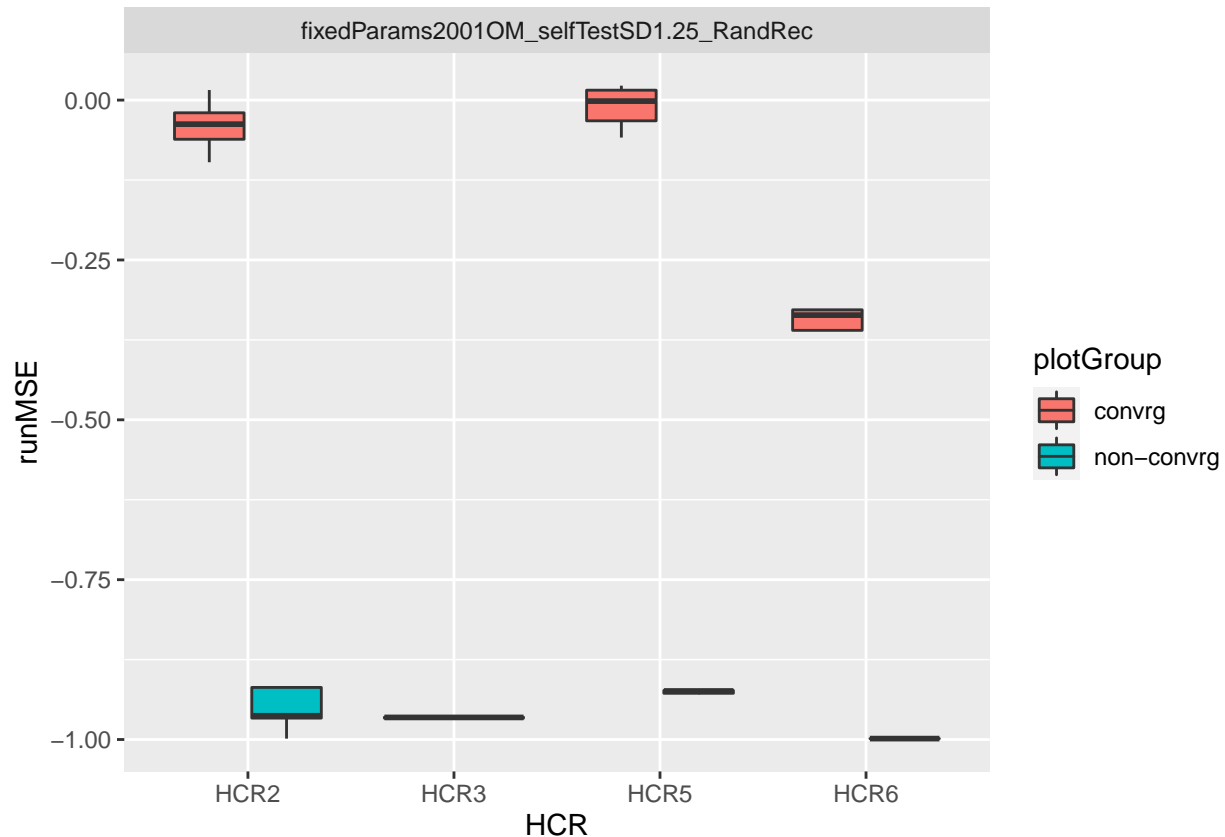
errCompare <- cnvrgTS %>% filter(Seas == 1, model_run != omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run == omName),
    by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
    age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%

## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen)
```



Look at parameter estimate time series

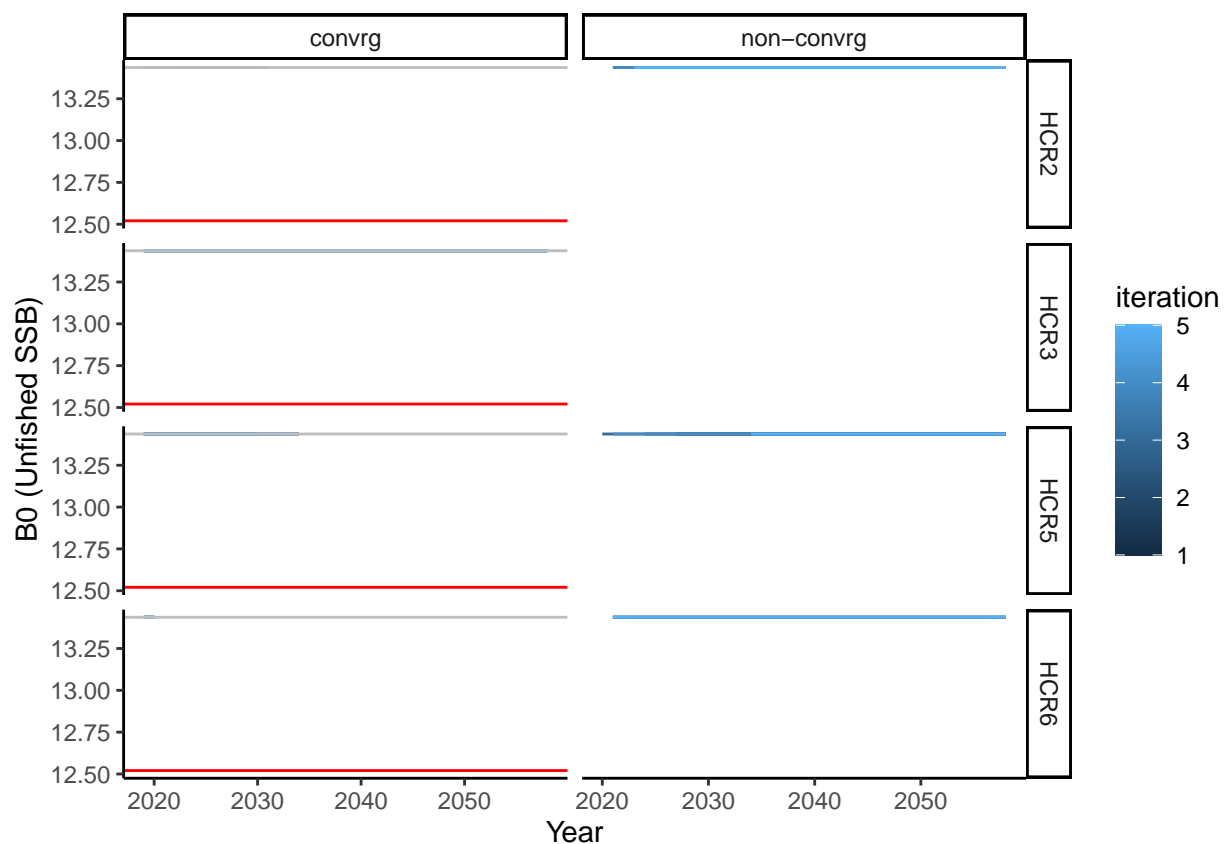
```
# Look at timeseries of B0 and account for non-convergence
B0s <- smryOutputList$sclSmry %>% mutate(emYear = as.numeric(regmatches(model_run,
  grexpr("[[:digit:]]+",
    model_run))),
  HCR = sub(pattern = ".*Rec", "", scenario),
  recScen = sub(pattern = "HCR.*", "", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
    emYear = case_when(is.na(emYear) ~ 2019,
      TRUE ~ emYear),
    plotGroup = case_when(model_run == omName ~ "OM",
      max_grad > 0.01 ~ "non-convg",
      max_grad < 0.01 ~ "convg"))
meanB0s <- B0s %>% filter(max_grad < 0.01) %>%
  group_by(HCR, recScen, plotGroup) %>%
  summarize(meanB0est = mean(SSB_Unfished)) %>%
  mutate(pikitch0.4B0 = 0.4*meanB0est)
```

```
## 'summarise()' has grouped output by 'HCR', 'recScen'. You can override using
## the '.groups' argument.
```

```

B0s %>% filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = log(SSB_Unfished))) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #      sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "B0 (Unfished SSB)") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(meanB0est)), color = "grey") +
  geom_hline(data = meanB0s, mapping = aes(yintercept = log(pikitch0.4B0)), color = "red")

```



```

# Want to look at the other parameters
sclSmryAll <- NULL

for(scn in 1:length(scenarios)){
  # read in SSMSE results summary scalars
  sclSumry <- read.csv(file.path(mseDir, scenarios[scn],
                                paste0("results_scalar_", scenarios[scn], ".csv")))
  # if(!"F_MSY" %in% names(sclSumry)){ # no catch scenarios don't have F_MSY
  #   sclSumry$F_MSY <- NA
  #   sclSumry$SSB_Unfished <- NA
  # }
}

```



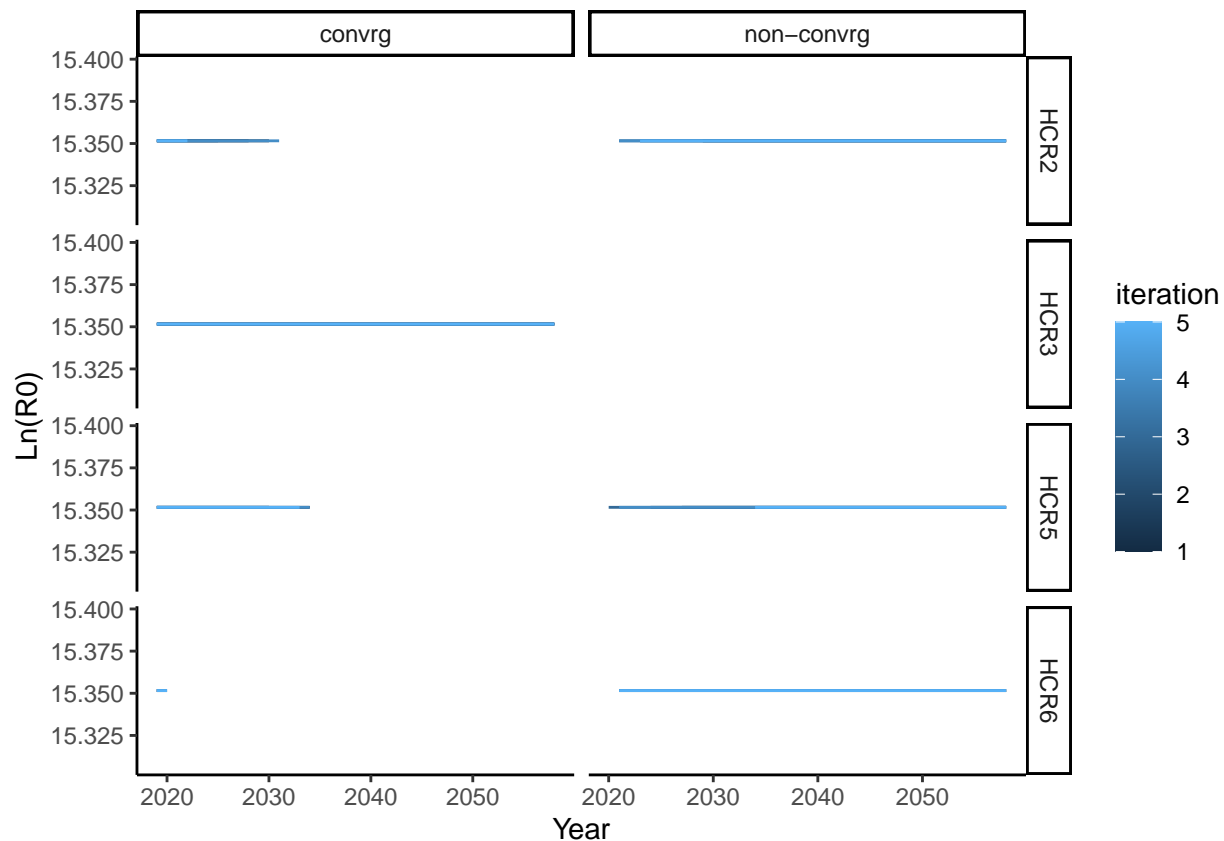
```

# sclSumry <- sclSumry[, c("F_MSY", "SmryBio_Unfished", "SSB_Unfished",
#                           "max_grad", "model_run", "iteration", "scenario")]

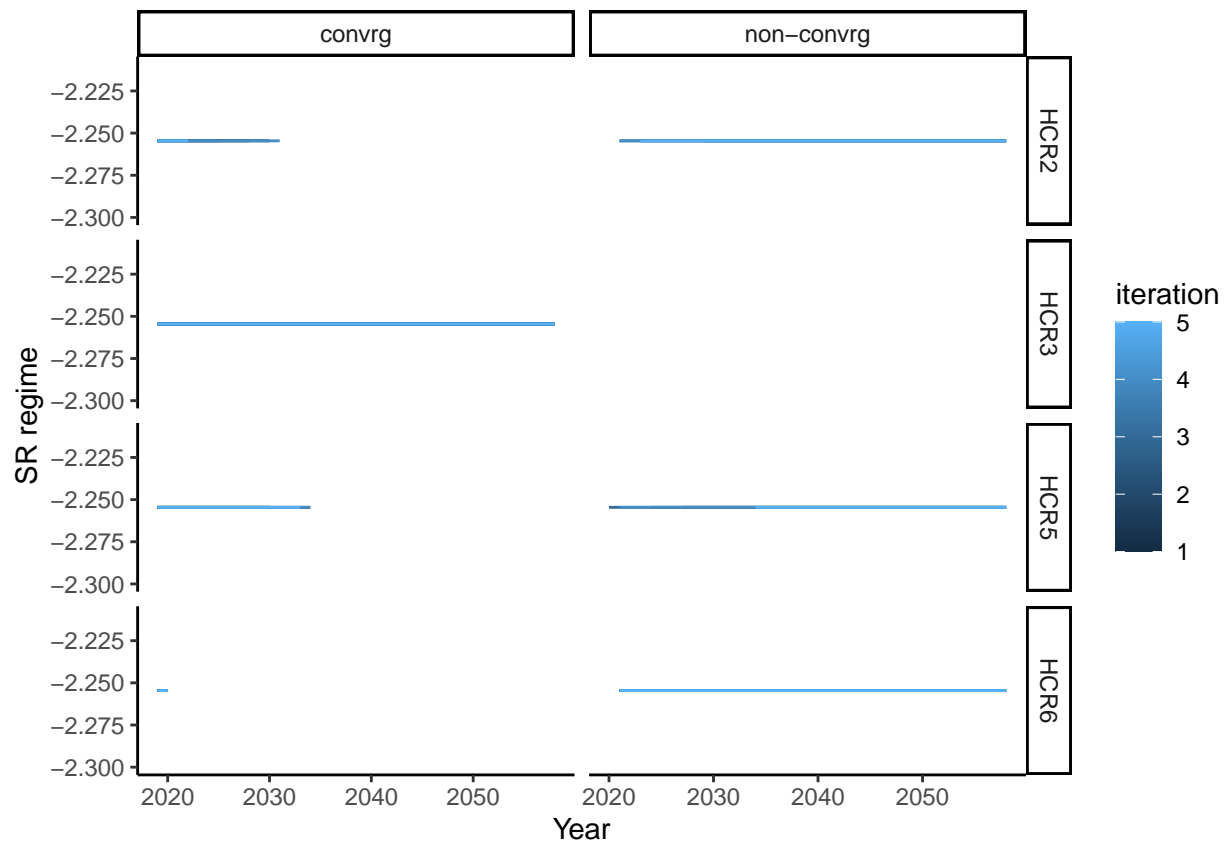
sclSmryAll <- bind_rows(sclSmryAll, sclSumry)
} # end 'scn' for-loop

sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                            model_run))),
                    HCR = sub(pattern = ".*Rec", "", scenario),
                    recScen = sub(pattern = "HCR.*", "", scenario)) %>%
mutate(recScen = sub(pattern = ".*selfTest", "", recScen),
       emYear = case_when(is.na(emYear) ~ 2019,
                           TRUE ~ emYear),
       plotGroup = case_when(model_run == omName ~ "OM",
                              max_grad > 0.01 ~ "non-convrg",
                              max_grad < 0.01 ~ "convrg")) %>%
filter(model_run != omName, HCR != "HCRO") %>%
ggplot(aes(x = emYear, y = SR_LN_R0)) +
geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration)) +
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
#geom_rug(data = convrgCheck, mapping = aes(x = emYear),
#       sides = "b", inherit.aes = FALSE) +
labs(x = "Year", y = "Ln(R0)")

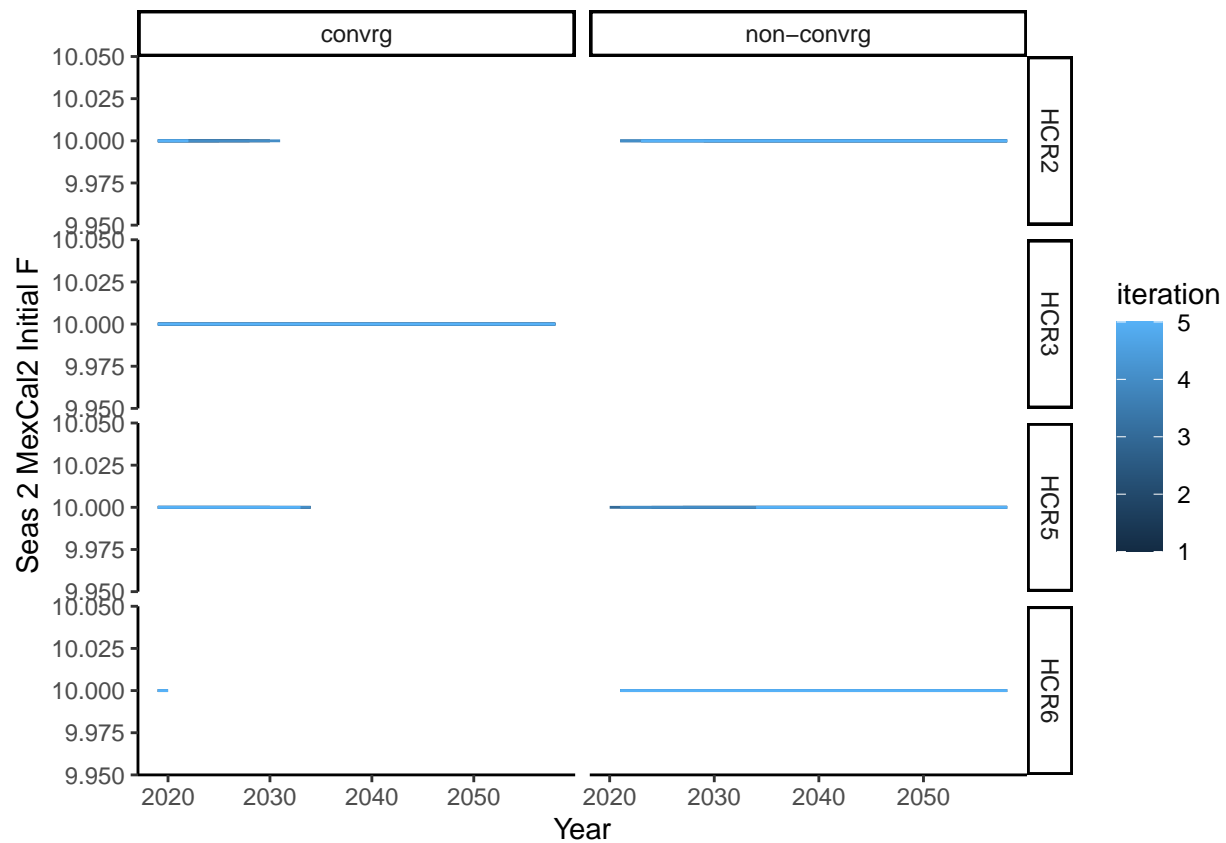
```



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),
                    HCR = sub(pattern = ".*Rec","", scenario),
                    recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest","", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "QM",
                                max_grad > 0.01 ~ "non-convrgr",
                                max_grad < 0.01 ~ "convrgr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = SR_regime_BLK1repl_2000)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #       sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "SR regime")
```



```
sclSmryAll %>% mutate(emYear = as.numeric(regmatches(model_run,
                                                    gregexpr("[:digit:]]+",
                                                    model_run))),
                    HCR = sub(pattern = ".*Rec","", scenario),
                    recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*selfTest","", recScen),
         emYear = case_when(is.na(emYear) ~ 2019,
                             TRUE ~ emYear),
         plotGroup = case_when(model_run == omName ~ "QM",
                                max_grad > 0.01 ~ "non-convrgr",
                                max_grad < 0.01 ~ "convrgr")) %>%
  filter(model_run != omName, HCR != "HCR0") %>%
  ggplot(aes(x = emYear, y = InitF_seas_2_flt_2MexCal_S2)) +
  geom_line(ggplot2::aes(linetype = as.character(iteration), color = iteration))+
  #ggplot2::scale_color_manual(values = c("#D65F00", "blue")) +
  ggplot2::scale_linetype_manual(values = rep("solid", 100)) +
  ggplot2::guides(linetype = "none") +
  ggplot2::facet_grid(rows = vars(HCR), cols = vars(plotGroup), scales = "free") +
  ggplot2::theme_classic() +
  #geom_rug(data = convrgCheck, mapping = aes(x = emYear),
  #        sides = "b", inherit.aes = FALSE) +
  labs(x = "Year", y = "Seas 2 MexCal2 Initial F")
```



```
sclSmryAll %>% select(max_grad, params_on_bound, params_stuck_low, params_stuck_high,
                      iteration, model_run, scenario) %>%
  filter(model_run != omName)
```

##	max_grad	params_on_bound	params_stuck_low	params_stuck_high	iteration
## 1	8.76182e-04	NA	NA	NA	1
## 2	1.87745e-04	NA	NA	NA	1
## 3	4.39490e-04	NA	NA	NA	1
## 4	3.75504e-04	NA	NA	NA	1
## 5	5.51073e-04	NA	NA	NA	1
## 6	5.15205e-04	NA	NA	NA	1
## 7	5.32622e-03	NA	NA	NA	1
## 8	5.72692e-04	NA	NA	NA	1
## 9	9.37143e-03	NA	NA	NA	1
## 10	8.83642e+02	NA	NA	NA	1
## 11	0.00000e+00	NA	NA	NA	1
## 12	2.89080e+06	NA	NA	NA	1
## 13	2.32542e+07	NA	NA	NA	1
## 14	5.39514e+07	NA	NA	NA	1
## 15	8.14531e+07	NA	NA	NA	1
## 16	1.06218e+08	NA	NA	NA	1
## 17	1.29485e+08	NA	NA	NA	1
## 18	1.51313e+08	NA	NA	NA	1
## 19	1.72341e+08	NA	NA	NA	1
## 20	1.93611e+08	NA	NA	NA	1

## 21	2.15149e+08	NA	NA	NA	1
## 22	2.36330e+08	NA	NA	NA	1
## 23	2.56957e+08	NA	NA	NA	1
## 24	2.77621e+08	NA	NA	NA	1
## 25	2.98507e+08	NA	NA	NA	1
## 26	3.19237e+08	NA	NA	NA	1
## 27	3.39628e+08	NA	NA	NA	1
## 28	3.59768e+08	NA	NA	NA	1
## 29	3.79684e+08	NA	NA	NA	1
## 30	3.99144e+08	NA	NA	NA	1
## 31	4.17948e+08	NA	NA	NA	1
## 32	4.35972e+08	NA	NA	NA	1
## 33	4.53218e+08	NA	NA	NA	1
## 34	4.69824e+08	NA	NA	NA	1
## 35	4.88114e+08	NA	NA	NA	1
## 36	5.07126e+08	NA	NA	NA	1
## 37	5.26460e+08	NA	NA	NA	1
## 38	5.45547e+08	NA	NA	NA	1
## 39	5.64042e+08	NA	NA	NA	1
## 40	3.15541e-05	NA	NA	NA	1
## 41	2.00234e-03	NA	NA	NA	2
## 42	1.06231e-04	NA	NA	NA	2
## 43	1.53752e-04	NA	NA	NA	2
## 44	3.21352e+03	NA	NA	NA	2
## 45	2.67613e-05	NA	NA	NA	2
## 46	9.60487e-04	NA	NA	NA	2
## 47	6.35123e+02	NA	NA	NA	2
## 48	2.74379e-03	NA	NA	NA	2
## 49	0.00000e+00	NA	NA	NA	2
## 50	3.15073e+06	NA	NA	NA	2
## 51	2.53018e+07	NA	NA	NA	2
## 52	5.86912e+07	NA	NA	NA	2
## 53	8.81790e+07	NA	NA	NA	2
## 54	1.14972e+08	NA	NA	NA	2
## 55	1.40901e+08	NA	NA	NA	2
## 56	1.65924e+08	NA	NA	NA	2
## 57	1.90292e+08	NA	NA	NA	2
## 58	2.14427e+08	NA	NA	NA	2
## 59	2.37933e+08	NA	NA	NA	2
## 60	2.60379e+08	NA	NA	NA	2
## 61	2.81771e+08	NA	NA	NA	2
## 62	3.02406e+08	NA	NA	NA	2
## 63	3.22486e+08	NA	NA	NA	2
## 64	3.42306e+08	NA	NA	NA	2
## 65	3.62400e+08	NA	NA	NA	2
## 66	3.82604e+08	NA	NA	NA	2
## 67	4.02530e+08	NA	NA	NA	2
## 68	4.22192e+08	NA	NA	NA	2
## 69	4.41464e+08	NA	NA	NA	2
## 70	4.60296e+08	NA	NA	NA	2
## 71	4.78573e+08	NA	NA	NA	2
## 72	4.97106e+08	NA	NA	NA	2
## 73	5.17360e+08	NA	NA	NA	2
## 74	5.37805e+08	NA	NA	NA	2

## 75	5.58248e+08	NA	NA	NA	2
## 76	5.78584e+08	NA	NA	NA	2
## 77	5.98623e+08	NA	NA	NA	2
## 78	6.18217e+08	NA	NA	NA	2
## 79	6.37116e+08	NA	NA	NA	2
## 80	1.08876e-05	NA	NA	NA	2
## 81	3.68869e-04	NA	NA	NA	3
## 82	1.26562e+02	NA	NA	NA	3
## 83	2.64939e-04	NA	NA	NA	3
## 84	3.79765e-04	NA	NA	NA	3
## 85	1.05659e-03	NA	NA	NA	3
## 86	0.00000e+00	NA	NA	NA	3
## 87	3.88742e+06	NA	NA	NA	3
## 88	2.97172e+07	NA	NA	NA	3
## 89	6.70500e+07	NA	NA	NA	3
## 90	9.91519e+07	NA	NA	NA	3
## 91	1.27045e+08	NA	NA	NA	3
## 92	1.52599e+08	NA	NA	NA	3
## 93	1.76809e+08	NA	NA	NA	3
## 94	2.00490e+08	NA	NA	NA	3
## 95	2.23378e+08	NA	NA	NA	3
## 96	2.45240e+08	NA	NA	NA	3
## 97	2.66197e+08	NA	NA	NA	3
## 98	2.86271e+08	NA	NA	NA	3
## 99	3.05705e+08	NA	NA	NA	3
## 100	3.24918e+08	NA	NA	NA	3
## 101	3.43986e+08	NA	NA	NA	3
## 102	3.62604e+08	NA	NA	NA	3
## 103	3.80643e+08	NA	NA	NA	3
## 104	3.98646e+08	NA	NA	NA	3
## 105	4.17740e+08	NA	NA	NA	3
## 106	4.37318e+08	NA	NA	NA	3
## 107	4.56573e+08	NA	NA	NA	3
## 108	4.75329e+08	NA	NA	NA	3
## 109	4.93481e+08	NA	NA	NA	3
## 110	5.11091e+08	NA	NA	NA	3
## 111	5.30598e+08	NA	NA	NA	3
## 112	5.49994e+08	NA	NA	NA	3
## 113	5.68862e+08	NA	NA	NA	3
## 114	5.87111e+08	NA	NA	NA	3
## 115	6.04867e+08	NA	NA	NA	3
## 116	6.22221e+08	NA	NA	NA	3
## 117	6.39084e+08	NA	NA	NA	3
## 118	6.55528e+08	NA	NA	NA	3
## 119	6.71479e+08	NA	NA	NA	3
## 120	5.71570e-05	NA	NA	NA	3
## 121	4.09663e-04	NA	NA	NA	4
## 122	3.86160e+01	NA	NA	NA	4
## 123	1.69004e-04	NA	NA	NA	4
## 124	2.86245e+03	NA	NA	NA	4
## 125	8.24846e-04	NA	NA	NA	4
## 126	3.31040e-04	NA	NA	NA	4
## 127	7.15223e+08	NA	NA	NA	4
## 128	1.93669e+03	NA	NA	NA	4

## 129	1.96232e-03	NA	NA	NA	4
## 130	1.42064e-02	NA	NA	NA	4
## 131	5.39936e-03	NA	NA	NA	4
## 132	0.00000e+00	NA	NA	NA	4
## 133	3.09945e+06	NA	NA	NA	4
## 134	2.56318e+07	NA	NA	NA	4
## 135	5.99478e+07	NA	NA	NA	4
## 136	9.06745e+07	NA	NA	NA	4
## 137	1.18815e+08	NA	NA	NA	4
## 138	1.45911e+08	NA	NA	NA	4
## 139	1.71576e+08	NA	NA	NA	4
## 140	1.96219e+08	NA	NA	NA	4
## 141	2.20290e+08	NA	NA	NA	4
## 142	2.43662e+08	NA	NA	NA	4
## 143	2.66492e+08	NA	NA	NA	4
## 144	2.89168e+08	NA	NA	NA	4
## 145	3.12358e+08	NA	NA	NA	4
## 146	3.35808e+08	NA	NA	NA	4
## 147	3.59035e+08	NA	NA	NA	4
## 148	3.81951e+08	NA	NA	NA	4
## 149	4.04325e+08	NA	NA	NA	4
## 150	4.26253e+08	NA	NA	NA	4
## 151	4.47743e+08	NA	NA	NA	4
## 152	4.68725e+08	NA	NA	NA	4
## 153	4.89209e+08	NA	NA	NA	4
## 154	5.08895e+08	NA	NA	NA	4
## 155	5.27697e+08	NA	NA	NA	4
## 156	5.47494e+08	NA	NA	NA	4
## 157	5.67869e+08	NA	NA	NA	4
## 158	5.88060e+08	NA	NA	NA	4
## 159	6.08436e+08	NA	NA	NA	4
## 160	1.66754e-06	NA	NA	NA	4
## 161	2.88492e-04	NA	NA	NA	5
## 162	5.38396e-04	NA	NA	NA	5
## 163	0.00000e+00	NA	NA	NA	5
## 164	5.80685e+06	NA	NA	NA	5
## 165	3.93434e+07	NA	NA	NA	5
## 166	8.12521e+07	NA	NA	NA	5
## 167	1.14310e+08	NA	NA	NA	5
## 168	1.42574e+08	NA	NA	NA	5
## 169	1.68341e+08	NA	NA	NA	5
## 170	1.92177e+08	NA	NA	NA	5
## 171	2.15510e+08	NA	NA	NA	5
## 172	2.38137e+08	NA	NA	NA	5
## 173	2.59487e+08	NA	NA	NA	5
## 174	2.79882e+08	NA	NA	NA	5
## 175	3.00176e+08	NA	NA	NA	5
## 176	3.20272e+08	NA	NA	NA	5
## 177	3.39533e+08	NA	NA	NA	5
## 178	3.57809e+08	NA	NA	NA	5
## 179	3.75315e+08	NA	NA	NA	5
## 180	3.92887e+08	NA	NA	NA	5
## 181	4.10594e+08	NA	NA	NA	5
## 182	4.27913e+08	NA	NA	NA	5

## 183	4.44658e+08	NA	NA	NA	5
## 184	4.60854e+08	NA	NA	NA	5
## 185	4.76483e+08	NA	NA	NA	5
## 186	4.91484e+08	NA	NA	NA	5
## 187	5.05863e+08	NA	NA	NA	5
## 188	5.19671e+08	NA	NA	NA	5
## 189	5.33019e+08	NA	NA	NA	5
## 190	5.46022e+08	NA	NA	NA	5
## 191	5.59987e+08	NA	NA	NA	5
## 192	5.76300e+08	NA	NA	NA	5
## 193	5.92305e+08	NA	NA	NA	5
## 194	6.07980e+08	NA	NA	NA	5
## 195	6.23340e+08	NA	NA	NA	5
## 196	6.38422e+08	NA	NA	NA	5
## 197	6.53172e+08	NA	NA	NA	5
## 198	6.68924e+08	NA	NA	NA	5
## 199	6.84258e+08	NA	NA	NA	5
## 200	9.03085e-06	NA	NA	NA	5
## 201	0.00000e+00	NA	NA	NA	1
## 202	0.00000e+00	NA	NA	NA	1
## 203	0.00000e+00	NA	NA	NA	1
## 204	0.00000e+00	NA	NA	NA	1
## 205	0.00000e+00	NA	NA	NA	1
## 206	0.00000e+00	NA	NA	NA	1
## 207	0.00000e+00	NA	NA	NA	1
## 208	0.00000e+00	NA	NA	NA	1
## 209	0.00000e+00	NA	NA	NA	1
## 210	0.00000e+00	NA	NA	NA	1
## 211	0.00000e+00	NA	NA	NA	1
## 212	0.00000e+00	NA	NA	NA	1
## 213	0.00000e+00	NA	NA	NA	1
## 214	0.00000e+00	NA	NA	NA	1
## 215	0.00000e+00	NA	NA	NA	1
## 216	0.00000e+00	NA	NA	NA	1
## 217	0.00000e+00	NA	NA	NA	1
## 218	0.00000e+00	NA	NA	NA	1
## 219	0.00000e+00	NA	NA	NA	1
## 220	0.00000e+00	NA	NA	NA	1
## 221	0.00000e+00	NA	NA	NA	1
## 222	0.00000e+00	NA	NA	NA	1
## 223	0.00000e+00	NA	NA	NA	1
## 224	0.00000e+00	NA	NA	NA	1
## 225	0.00000e+00	NA	NA	NA	1
## 226	0.00000e+00	NA	NA	NA	1
## 227	0.00000e+00	NA	NA	NA	1
## 228	0.00000e+00	NA	NA	NA	1
## 229	0.00000e+00	NA	NA	NA	1
## 230	0.00000e+00	NA	NA	NA	1
## 231	0.00000e+00	NA	NA	NA	1
## 232	0.00000e+00	NA	NA	NA	1
## 233	0.00000e+00	NA	NA	NA	1
## 234	0.00000e+00	NA	NA	NA	1
## 235	0.00000e+00	NA	NA	NA	1
## 236	0.00000e+00	NA	NA	NA	1

## 237	0.00000e+00	NA	NA	NA	1
## 238	0.00000e+00	NA	NA	NA	1
## 239	0.00000e+00	NA	NA	NA	1
## 240	1.42714e-05	NA	NA	NA	1
## 241	0.00000e+00	NA	NA	NA	2
## 242	0.00000e+00	NA	NA	NA	2
## 243	0.00000e+00	NA	NA	NA	2
## 244	0.00000e+00	NA	NA	NA	2
## 245	0.00000e+00	NA	NA	NA	2
## 246	0.00000e+00	NA	NA	NA	2
## 247	0.00000e+00	NA	NA	NA	2
## 248	0.00000e+00	NA	NA	NA	2
## 249	0.00000e+00	NA	NA	NA	2
## 250	0.00000e+00	NA	NA	NA	2
## 251	0.00000e+00	NA	NA	NA	2
## 252	0.00000e+00	NA	NA	NA	2
## 253	0.00000e+00	NA	NA	NA	2
## 254	0.00000e+00	NA	NA	NA	2
## 255	0.00000e+00	NA	NA	NA	2
## 256	0.00000e+00	NA	NA	NA	2
## 257	0.00000e+00	NA	NA	NA	2
## 258	0.00000e+00	NA	NA	NA	2
## 259	0.00000e+00	NA	NA	NA	2
## 260	0.00000e+00	NA	NA	NA	2
## 261	0.00000e+00	NA	NA	NA	2
## 262	0.00000e+00	NA	NA	NA	2
## 263	0.00000e+00	NA	NA	NA	2
## 264	0.00000e+00	NA	NA	NA	2
## 265	0.00000e+00	NA	NA	NA	2
## 266	0.00000e+00	NA	NA	NA	2
## 267	0.00000e+00	NA	NA	NA	2
## 268	0.00000e+00	NA	NA	NA	2
## 269	0.00000e+00	NA	NA	NA	2
## 270	0.00000e+00	NA	NA	NA	2
## 271	0.00000e+00	NA	NA	NA	2
## 272	0.00000e+00	NA	NA	NA	2
## 273	0.00000e+00	NA	NA	NA	2
## 274	0.00000e+00	NA	NA	NA	2
## 275	0.00000e+00	NA	NA	NA	2
## 276	0.00000e+00	NA	NA	NA	2
## 277	0.00000e+00	NA	NA	NA	2
## 278	0.00000e+00	NA	NA	NA	2
## 279	0.00000e+00	NA	NA	NA	2
## 280	2.63704e-05	NA	NA	NA	2
## 281	0.00000e+00	NA	NA	NA	3
## 282	0.00000e+00	NA	NA	NA	3
## 283	0.00000e+00	NA	NA	NA	3
## 284	0.00000e+00	NA	NA	NA	3
## 285	0.00000e+00	NA	NA	NA	3
## 286	0.00000e+00	NA	NA	NA	3
## 287	0.00000e+00	NA	NA	NA	3
## 288	0.00000e+00	NA	NA	NA	3
## 289	0.00000e+00	NA	NA	NA	3
## 290	0.00000e+00	NA	NA	NA	3

## 291	0.00000e+00	NA	NA	NA	3
## 292	0.00000e+00	NA	NA	NA	3
## 293	0.00000e+00	NA	NA	NA	3
## 294	0.00000e+00	NA	NA	NA	3
## 295	0.00000e+00	NA	NA	NA	3
## 296	0.00000e+00	NA	NA	NA	3
## 297	0.00000e+00	NA	NA	NA	3
## 298	0.00000e+00	NA	NA	NA	3
## 299	0.00000e+00	NA	NA	NA	3
## 300	0.00000e+00	NA	NA	NA	3
## 301	0.00000e+00	NA	NA	NA	3
## 302	0.00000e+00	NA	NA	NA	3
## 303	0.00000e+00	NA	NA	NA	3
## 304	0.00000e+00	NA	NA	NA	3
## 305	0.00000e+00	NA	NA	NA	3
## 306	0.00000e+00	NA	NA	NA	3
## 307	0.00000e+00	NA	NA	NA	3
## 308	0.00000e+00	NA	NA	NA	3
## 309	0.00000e+00	NA	NA	NA	3
## 310	0.00000e+00	NA	NA	NA	3
## 311	0.00000e+00	NA	NA	NA	3
## 312	0.00000e+00	NA	NA	NA	3
## 313	0.00000e+00	NA	NA	NA	3
## 314	0.00000e+00	NA	NA	NA	3
## 315	0.00000e+00	NA	NA	NA	3
## 316	0.00000e+00	NA	NA	NA	3
## 317	0.00000e+00	NA	NA	NA	3
## 318	0.00000e+00	NA	NA	NA	3
## 319	0.00000e+00	NA	NA	NA	3
## 320	1.74323e-05	NA	NA	NA	3
## 321	0.00000e+00	NA	NA	NA	4
## 322	0.00000e+00	NA	NA	NA	4
## 323	0.00000e+00	NA	NA	NA	4
## 324	0.00000e+00	NA	NA	NA	4
## 325	0.00000e+00	NA	NA	NA	4
## 326	0.00000e+00	NA	NA	NA	4
## 327	0.00000e+00	NA	NA	NA	4
## 328	0.00000e+00	NA	NA	NA	4
## 329	0.00000e+00	NA	NA	NA	4
## 330	0.00000e+00	NA	NA	NA	4
## 331	0.00000e+00	NA	NA	NA	4
## 332	0.00000e+00	NA	NA	NA	4
## 333	0.00000e+00	NA	NA	NA	4
## 334	0.00000e+00	NA	NA	NA	4
## 335	0.00000e+00	NA	NA	NA	4
## 336	0.00000e+00	NA	NA	NA	4
## 337	0.00000e+00	NA	NA	NA	4
## 338	0.00000e+00	NA	NA	NA	4
## 339	0.00000e+00	NA	NA	NA	4
## 340	0.00000e+00	NA	NA	NA	4
## 341	0.00000e+00	NA	NA	NA	4
## 342	0.00000e+00	NA	NA	NA	4
## 343	0.00000e+00	NA	NA	NA	4
## 344	0.00000e+00	NA	NA	NA	4

## 345	0.00000e+00	NA	NA	NA	4
## 346	0.00000e+00	NA	NA	NA	4
## 347	0.00000e+00	NA	NA	NA	4
## 348	0.00000e+00	NA	NA	NA	4
## 349	0.00000e+00	NA	NA	NA	4
## 350	0.00000e+00	NA	NA	NA	4
## 351	0.00000e+00	NA	NA	NA	4
## 352	0.00000e+00	NA	NA	NA	4
## 353	0.00000e+00	NA	NA	NA	4
## 354	0.00000e+00	NA	NA	NA	4
## 355	0.00000e+00	NA	NA	NA	4
## 356	0.00000e+00	NA	NA	NA	4
## 357	0.00000e+00	NA	NA	NA	4
## 358	0.00000e+00	NA	NA	NA	4
## 359	0.00000e+00	NA	NA	NA	4
## 360	1.24297e-05	NA	NA	NA	4
## 361	0.00000e+00	NA	NA	NA	5
## 362	0.00000e+00	NA	NA	NA	5
## 363	0.00000e+00	NA	NA	NA	5
## 364	0.00000e+00	NA	NA	NA	5
## 365	0.00000e+00	NA	NA	NA	5
## 366	0.00000e+00	NA	NA	NA	5
## 367	0.00000e+00	NA	NA	NA	5
## 368	0.00000e+00	NA	NA	NA	5
## 369	0.00000e+00	NA	NA	NA	5
## 370	0.00000e+00	NA	NA	NA	5
## 371	0.00000e+00	NA	NA	NA	5
## 372	0.00000e+00	NA	NA	NA	5
## 373	0.00000e+00	NA	NA	NA	5
## 374	0.00000e+00	NA	NA	NA	5
## 375	0.00000e+00	NA	NA	NA	5
## 376	0.00000e+00	NA	NA	NA	5
## 377	0.00000e+00	NA	NA	NA	5
## 378	0.00000e+00	NA	NA	NA	5
## 379	0.00000e+00	NA	NA	NA	5
## 380	0.00000e+00	NA	NA	NA	5
## 381	0.00000e+00	NA	NA	NA	5
## 382	0.00000e+00	NA	NA	NA	5
## 383	0.00000e+00	NA	NA	NA	5
## 384	0.00000e+00	NA	NA	NA	5
## 385	0.00000e+00	NA	NA	NA	5
## 386	0.00000e+00	NA	NA	NA	5
## 387	0.00000e+00	NA	NA	NA	5
## 388	0.00000e+00	NA	NA	NA	5
## 389	0.00000e+00	NA	NA	NA	5
## 390	0.00000e+00	NA	NA	NA	5
## 391	0.00000e+00	NA	NA	NA	5
## 392	0.00000e+00	NA	NA	NA	5
## 393	0.00000e+00	NA	NA	NA	5
## 394	0.00000e+00	NA	NA	NA	5
## 395	0.00000e+00	NA	NA	NA	5
## 396	0.00000e+00	NA	NA	NA	5
## 397	0.00000e+00	NA	NA	NA	5
## 398	0.00000e+00	NA	NA	NA	5

## 399	0.00000e+00	NA	NA	NA	5
## 400	4.41852e-06	NA	NA	NA	5
## 401	3.51875e-05	NA	NA	NA	1
## 402	1.85455e-05	NA	NA	NA	1
## 403	4.88876e-04	NA	NA	NA	1
## 404	3.18700e-04	NA	NA	NA	1
## 405	3.43278e-04	NA	NA	NA	1
## 406	6.11683e-03	NA	NA	NA	1
## 407	6.23627e-03	NA	NA	NA	1
## 408	1.07752e+03	NA	NA	NA	1
## 409	9.83993e-04	NA	NA	NA	1
## 410	8.66530e-03	NA	NA	NA	1
## 411	5.53797e-03	NA	NA	NA	1
## 412	3.35567e-03	NA	NA	NA	1
## 413	4.62421e-03	NA	NA	NA	1
## 414	7.93094e-02	NA	NA	NA	1
## 415	0.00000e+00	NA	NA	NA	1
## 416	2.86600e+06	NA	NA	NA	1
## 417	2.35407e+07	NA	NA	NA	1
## 418	5.56542e+07	NA	NA	NA	1
## 419	8.54230e+07	NA	NA	NA	1
## 420	1.13706e+08	NA	NA	NA	1
## 421	1.42271e+08	NA	NA	NA	1
## 422	1.70571e+08	NA	NA	NA	1
## 423	1.98382e+08	NA	NA	NA	1
## 424	2.25789e+08	NA	NA	NA	1
## 425	2.52392e+08	NA	NA	NA	1
## 426	2.78313e+08	NA	NA	NA	1
## 427	3.03688e+08	NA	NA	NA	1
## 428	3.28427e+08	NA	NA	NA	1
## 429	3.52391e+08	NA	NA	NA	1
## 430	3.75830e+08	NA	NA	NA	1
## 431	3.99296e+08	NA	NA	NA	1
## 432	4.22686e+08	NA	NA	NA	1
## 433	4.45393e+08	NA	NA	NA	1
## 434	4.67373e+08	NA	NA	NA	1
## 435	4.88955e+08	NA	NA	NA	1
## 436	5.10483e+08	NA	NA	NA	1
## 437	5.34012e+08	NA	NA	NA	1
## 438	5.59053e+08	NA	NA	NA	1
## 439	5.83595e+08	NA	NA	NA	1
## 440	1.42714e-05	NA	NA	NA	1
## 441	6.63803e-04	NA	NA	NA	2
## 442	2.74305e-04	NA	NA	NA	2
## 443	1.25052e-03	NA	NA	NA	2
## 444	2.43327e-03	NA	NA	NA	2
## 445	1.48852e+06	NA	NA	NA	2
## 446	3.66269e-04	NA	NA	NA	2
## 447	2.00714e+03	NA	NA	NA	2
## 448	1.06330e+06	NA	NA	NA	2
## 449	3.67540e-03	NA	NA	NA	2
## 450	1.09937e+07	NA	NA	NA	2
## 451	0.00000e+00	NA	NA	NA	2
## 452	3.11328e+06	NA	NA	NA	2

## 453	2.50423e+07	NA	NA	NA	2
## 454	5.86753e+07	NA	NA	NA	2
## 455	8.92276e+07	NA	NA	NA	2
## 456	1.17261e+08	NA	NA	NA	2
## 457	1.44569e+08	NA	NA	NA	2
## 458	1.71114e+08	NA	NA	NA	2
## 459	1.96580e+08	NA	NA	NA	2
## 460	2.21291e+08	NA	NA	NA	2
## 461	2.45458e+08	NA	NA	NA	2
## 462	2.69138e+08	NA	NA	NA	2
## 463	2.92294e+08	NA	NA	NA	2
## 464	3.14906e+08	NA	NA	NA	2
## 465	3.37138e+08	NA	NA	NA	2
## 466	3.58903e+08	NA	NA	NA	2
## 467	3.79940e+08	NA	NA	NA	2
## 468	4.00163e+08	NA	NA	NA	2
## 469	4.19745e+08	NA	NA	NA	2
## 470	4.38881e+08	NA	NA	NA	2
## 471	4.57781e+08	NA	NA	NA	2
## 472	4.76660e+08	NA	NA	NA	2
## 473	4.95535e+08	NA	NA	NA	2
## 474	5.14328e+08	NA	NA	NA	2
## 475	5.35495e+08	NA	NA	NA	2
## 476	5.56452e+08	NA	NA	NA	2
## 477	5.77368e+08	NA	NA	NA	2
## 478	5.98338e+08	NA	NA	NA	2
## 479	6.18911e+08	NA	NA	NA	2
## 480	2.63704e-05	NA	NA	NA	2
## 481	3.01663e+05	NA	NA	NA	3
## 482	3.39110e-04	NA	NA	NA	3
## 483	3.42145e-05	NA	NA	NA	3
## 484	4.63216e+05	NA	NA	NA	3
## 485	1.89943e-03	NA	NA	NA	3
## 486	8.60644e-05	NA	NA	NA	3
## 487	3.03995e-04	NA	NA	NA	3
## 488	4.38506e+06	NA	NA	NA	3
## 489	1.75467e+04	NA	NA	NA	3
## 490	6.27977e-02	NA	NA	NA	3
## 491	0.00000e+00	NA	NA	NA	3
## 492	2.99916e+06	NA	NA	NA	3
## 493	2.42041e+07	NA	NA	NA	3
## 494	5.63033e+07	NA	NA	NA	3
## 495	8.53337e+07	NA	NA	NA	3
## 496	1.11969e+08	NA	NA	NA	3
## 497	1.37256e+08	NA	NA	NA	3
## 498	1.61041e+08	NA	NA	NA	3
## 499	1.83869e+08	NA	NA	NA	3
## 500	2.06179e+08	NA	NA	NA	3
## 501	2.27858e+08	NA	NA	NA	3
## 502	2.49146e+08	NA	NA	NA	3
## 503	2.70167e+08	NA	NA	NA	3
## 504	2.90751e+08	NA	NA	NA	3
## 505	3.11018e+08	NA	NA	NA	3
## 506	3.31037e+08	NA	NA	NA	3

## 507	3.50510e+08	NA	NA	NA	3
## 508	3.69207e+08	NA	NA	NA	3
## 509	3.87749e+08	NA	NA	NA	3
## 510	4.06743e+08	NA	NA	NA	3
## 511	4.26002e+08	NA	NA	NA	3
## 512	4.45254e+08	NA	NA	NA	3
## 513	4.64460e+08	NA	NA	NA	3
## 514	4.83734e+08	NA	NA	NA	3
## 515	5.04379e+08	NA	NA	NA	3
## 516	5.25821e+08	NA	NA	NA	3
## 517	5.46507e+08	NA	NA	NA	3
## 518	5.66847e+08	NA	NA	NA	3
## 519	5.87585e+08	NA	NA	NA	3
## 520	1.74323e-05	NA	NA	NA	3
## 521	7.05961e-06	NA	NA	NA	4
## 522	5.67936e+07	NA	NA	NA	4
## 523	1.14437e-03	NA	NA	NA	4
## 524	1.13974e-03	NA	NA	NA	4
## 525	2.40638e-03	NA	NA	NA	4
## 526	4.34044e-03	NA	NA	NA	4
## 527	6.38911e+01	NA	NA	NA	4
## 528	2.92393e-03	NA	NA	NA	4
## 529	2.01230e-04	NA	NA	NA	4
## 530	5.81089e-03	NA	NA	NA	4
## 531	1.60332e-02	NA	NA	NA	4
## 532	1.39316e-03	NA	NA	NA	4
## 533	8.46694e-04	NA	NA	NA	4
## 534	3.16935e-03	NA	NA	NA	4
## 535	0.00000e+00	NA	NA	NA	4
## 536	2.67561e+06	NA	NA	NA	4
## 537	2.18727e+07	NA	NA	NA	4
## 538	5.16023e+07	NA	NA	NA	4
## 539	7.87518e+07	NA	NA	NA	4
## 540	1.03839e+08	NA	NA	NA	4
## 541	1.28345e+08	NA	NA	NA	4
## 542	1.52200e+08	NA	NA	NA	4
## 543	1.75910e+08	NA	NA	NA	4
## 544	1.99671e+08	NA	NA	NA	4
## 545	2.23210e+08	NA	NA	NA	4
## 546	2.46627e+08	NA	NA	NA	4
## 547	2.70152e+08	NA	NA	NA	4
## 548	2.93786e+08	NA	NA	NA	4
## 549	3.17004e+08	NA	NA	NA	4
## 550	3.39751e+08	NA	NA	NA	4
## 551	3.61950e+08	NA	NA	NA	4
## 552	3.83820e+08	NA	NA	NA	4
## 553	4.05865e+08	NA	NA	NA	4
## 554	4.28236e+08	NA	NA	NA	4
## 555	4.50401e+08	NA	NA	NA	4
## 556	4.72043e+08	NA	NA	NA	4
## 557	4.94527e+08	NA	NA	NA	4
## 558	5.17903e+08	NA	NA	NA	4
## 559	5.40775e+08	NA	NA	NA	4
## 560	1.24297e-05	NA	NA	NA	4

## 561	1.41786e-04	NA	NA	NA	5
## 562	2.11211e-04	NA	NA	NA	5
## 563	7.19344e-04	NA	NA	NA	5
## 564	1.66572e-03	NA	NA	NA	5
## 565	2.18043e-03	NA	NA	NA	5
## 566	1.63184e-04	NA	NA	NA	5
## 567	2.80911e-03	NA	NA	NA	5
## 568	3.00156e-03	NA	NA	NA	5
## 569	9.13435e-04	NA	NA	NA	5
## 570	1.30625e-03	NA	NA	NA	5
## 571	4.83376e-04	NA	NA	NA	5
## 572	3.79273e-05	NA	NA	NA	5
## 573	3.87830e-03	NA	NA	NA	5
## 574	0.00000e+00	NA	NA	NA	5
## 575	2.69629e+06	NA	NA	NA	5
## 576	2.22680e+07	NA	NA	NA	5
## 577	5.22009e+07	NA	NA	NA	5
## 578	7.89973e+07	NA	NA	NA	5
## 579	1.03587e+08	NA	NA	NA	5
## 580	1.27523e+08	NA	NA	NA	5
## 581	1.50463e+08	NA	NA	NA	5
## 582	1.72681e+08	NA	NA	NA	5
## 583	1.94836e+08	NA	NA	NA	5
## 584	2.16960e+08	NA	NA	NA	5
## 585	2.38805e+08	NA	NA	NA	5
## 586	2.60644e+08	NA	NA	NA	5
## 587	2.82973e+08	NA	NA	NA	5
## 588	3.05872e+08	NA	NA	NA	5
## 589	3.28879e+08	NA	NA	NA	5
## 590	3.51329e+08	NA	NA	NA	5
## 591	3.73437e+08	NA	NA	NA	5
## 592	3.95438e+08	NA	NA	NA	5
## 593	4.16890e+08	NA	NA	NA	5
## 594	4.37583e+08	NA	NA	NA	5
## 595	4.57720e+08	NA	NA	NA	5
## 596	4.77976e+08	NA	NA	NA	5
## 597	5.00893e+08	NA	NA	NA	5
## 598	5.23567e+08	NA	NA	NA	5
## 599	5.45486e+08	NA	NA	NA	5
## 600	4.41852e-06	NA	NA	NA	5
## 601	0.00000e+00	NA	NA	NA	1
## 602	6.91798e+06	NA	NA	NA	1
## 603	4.13007e+07	NA	NA	NA	1
## 604	8.13633e+07	NA	NA	NA	1
## 605	1.11275e+08	NA	NA	NA	1
## 606	1.35606e+08	NA	NA	NA	1
## 607	1.56896e+08	NA	NA	NA	1
## 608	1.75810e+08	NA	NA	NA	1
## 609	1.92965e+08	NA	NA	NA	1
## 610	2.08781e+08	NA	NA	NA	1
## 611	2.23941e+08	NA	NA	NA	1
## 612	2.38648e+08	NA	NA	NA	1
## 613	2.52892e+08	NA	NA	NA	1
## 614	2.67163e+08	NA	NA	NA	1

## 615	2.81749e+08	NA	NA	NA	1
## 616	2.96301e+08	NA	NA	NA	1
## 617	3.10365e+08	NA	NA	NA	1
## 618	3.23967e+08	NA	NA	NA	1
## 619	3.37304e+08	NA	NA	NA	1
## 620	3.50567e+08	NA	NA	NA	1
## 621	3.63992e+08	NA	NA	NA	1
## 622	3.81461e+08	NA	NA	NA	1
## 623	3.99024e+08	NA	NA	NA	1
## 624	4.16451e+08	NA	NA	NA	1
## 625	4.34828e+08	NA	NA	NA	1
## 626	4.53097e+08	NA	NA	NA	1
## 627	4.71051e+08	NA	NA	NA	1
## 628	4.88822e+08	NA	NA	NA	1
## 629	5.07168e+08	NA	NA	NA	1
## 630	5.25146e+08	NA	NA	NA	1
## 631	5.44114e+08	NA	NA	NA	1
## 632	5.63317e+08	NA	NA	NA	1
## 633	5.81966e+08	NA	NA	NA	1
## 634	6.00017e+08	NA	NA	NA	1
## 635	6.17785e+08	NA	NA	NA	1
## 636	6.36424e+08	NA	NA	NA	1
## 637	6.55429e+08	NA	NA	NA	1
## 638	6.74585e+08	NA	NA	NA	1
## 639	6.93355e+08	NA	NA	NA	1
## 640	1.42714e-05	NA	NA	NA	1
## 641	0.00000e+00	NA	NA	NA	2
## 642	7.02203e+06	NA	NA	NA	2
## 643	4.36953e+07	NA	NA	NA	2
## 644	8.65365e+07	NA	NA	NA	2
## 645	1.17614e+08	NA	NA	NA	2
## 646	1.42627e+08	NA	NA	NA	2
## 647	1.64427e+08	NA	NA	NA	2
## 648	1.83873e+08	NA	NA	NA	2
## 649	2.01933e+08	NA	NA	NA	2
## 650	2.19344e+08	NA	NA	NA	2
## 651	2.36169e+08	NA	NA	NA	2
## 652	2.52188e+08	NA	NA	NA	2
## 653	2.67436e+08	NA	NA	NA	2
## 654	2.82248e+08	NA	NA	NA	2
## 655	2.96704e+08	NA	NA	NA	2
## 656	3.10708e+08	NA	NA	NA	2
## 657	3.24459e+08	NA	NA	NA	2
## 658	3.38028e+08	NA	NA	NA	2
## 659	3.51229e+08	NA	NA	NA	2
## 660	3.64173e+08	NA	NA	NA	2
## 661	3.76948e+08	NA	NA	NA	2
## 662	3.90306e+08	NA	NA	NA	2
## 663	4.06669e+08	NA	NA	NA	2
## 664	4.22731e+08	NA	NA	NA	2
## 665	4.38907e+08	NA	NA	NA	2
## 666	4.56021e+08	NA	NA	NA	2
## 667	4.72600e+08	NA	NA	NA	2
## 668	4.88562e+08	NA	NA	NA	2

## 669	5.04488e+08	NA	NA	NA	2
## 670	5.20793e+08	NA	NA	NA	2
## 671	5.36922e+08	NA	NA	NA	2
## 672	5.53774e+08	NA	NA	NA	2
## 673	5.70989e+08	NA	NA	NA	2
## 674	5.88136e+08	NA	NA	NA	2
## 675	6.05008e+08	NA	NA	NA	2
## 676	6.21721e+08	NA	NA	NA	2
## 677	6.38575e+08	NA	NA	NA	2
## 678	6.56206e+08	NA	NA	NA	2
## 679	6.73499e+08	NA	NA	NA	2
## 680	2.63704e-05	NA	NA	NA	2
## 681	0.00000e+00	NA	NA	NA	3
## 682	6.91375e+06	NA	NA	NA	3
## 683	4.09408e+07	NA	NA	NA	3
## 684	7.91591e+07	NA	NA	NA	3
## 685	1.07178e+08	NA	NA	NA	3
## 686	1.30277e+08	NA	NA	NA	3
## 687	1.50768e+08	NA	NA	NA	3
## 688	1.69210e+08	NA	NA	NA	3
## 689	1.86976e+08	NA	NA	NA	3
## 690	2.04164e+08	NA	NA	NA	3
## 691	2.20417e+08	NA	NA	NA	3
## 692	2.35827e+08	NA	NA	NA	3
## 693	2.50540e+08	NA	NA	NA	3
## 694	2.64628e+08	NA	NA	NA	3
## 695	2.78313e+08	NA	NA	NA	3
## 696	2.91571e+08	NA	NA	NA	3
## 697	3.04246e+08	NA	NA	NA	3
## 698	3.16327e+08	NA	NA	NA	3
## 699	3.28086e+08	NA	NA	NA	3
## 700	3.39706e+08	NA	NA	NA	3
## 701	3.51096e+08	NA	NA	NA	3
## 702	3.65156e+08	NA	NA	NA	3
## 703	3.79934e+08	NA	NA	NA	3
## 704	3.94532e+08	NA	NA	NA	3
## 705	4.10332e+08	NA	NA	NA	3
## 706	4.26003e+08	NA	NA	NA	3
## 707	4.41286e+08	NA	NA	NA	3
## 708	4.55979e+08	NA	NA	NA	3
## 709	4.71149e+08	NA	NA	NA	3
## 710	4.87325e+08	NA	NA	NA	3
## 711	5.03775e+08	NA	NA	NA	3
## 712	5.20967e+08	NA	NA	NA	3
## 713	5.38497e+08	NA	NA	NA	3
## 714	5.56119e+08	NA	NA	NA	3
## 715	5.73625e+08	NA	NA	NA	3
## 716	5.90745e+08	NA	NA	NA	3
## 717	6.07245e+08	NA	NA	NA	3
## 718	6.24286e+08	NA	NA	NA	3
## 719	6.41725e+08	NA	NA	NA	3
## 720	1.74323e-05	NA	NA	NA	3
## 721	0.00000e+00	NA	NA	NA	4
## 722	6.94932e+06	NA	NA	NA	4

## 723 4.18148e+07	NA	NA	NA	4
## 724 8.16670e+07	NA	NA	NA	4
## 725 1.10444e+08	NA	NA	NA	4
## 726 1.33449e+08	NA	NA	NA	4
## 727 1.53461e+08	NA	NA	NA	4
## 728 1.71260e+08	NA	NA	NA	4
## 729 1.87261e+08	NA	NA	NA	4
## 730 2.01778e+08	NA	NA	NA	4
## 731 2.15447e+08	NA	NA	NA	4
## 732 2.29340e+08	NA	NA	NA	4
## 733 2.43475e+08	NA	NA	NA	4
## 734 2.57413e+08	NA	NA	NA	4
## 735 2.71069e+08	NA	NA	NA	4
## 736 2.84471e+08	NA	NA	NA	4
## 737 2.97415e+08	NA	NA	NA	4
## 738 3.09915e+08	NA	NA	NA	4
## 739 3.21985e+08	NA	NA	NA	4
## 740 3.33647e+08	NA	NA	NA	4
## 741 3.45045e+08	NA	NA	NA	4
## 742 3.56238e+08	NA	NA	NA	4
## 743 3.68284e+08	NA	NA	NA	4
## 744 3.83262e+08	NA	NA	NA	4
## 745 3.98195e+08	NA	NA	NA	4
## 746 4.14173e+08	NA	NA	NA	4
## 747 4.30744e+08	NA	NA	NA	4
## 748 4.47468e+08	NA	NA	NA	4
## 749 4.64439e+08	NA	NA	NA	4
## 750 4.81855e+08	NA	NA	NA	4
## 751 4.98875e+08	NA	NA	NA	4
## 752 5.16743e+08	NA	NA	NA	4
## 753 5.34817e+08	NA	NA	NA	4
## 754 5.53208e+08	NA	NA	NA	4
## 755 5.71448e+08	NA	NA	NA	4
## 756 5.89762e+08	NA	NA	NA	4
## 757 6.07965e+08	NA	NA	NA	4
## 758 6.25772e+08	NA	NA	NA	4
## 759 6.43187e+08	NA	NA	NA	4
## 760 1.24297e-05	NA	NA	NA	4
## 761 0.00000e+00	NA	NA	NA	5
## 762 6.93456e+06	NA	NA	NA	5
## 763 4.15157e+07	NA	NA	NA	5
## 764 8.10051e+07	NA	NA	NA	5
## 765 1.09923e+08	NA	NA	NA	5
## 766 1.33292e+08	NA	NA	NA	5
## 767 1.53477e+08	NA	NA	NA	5
## 768 1.71666e+08	NA	NA	NA	5
## 769 1.89001e+08	NA	NA	NA	5
## 770 2.05546e+08	NA	NA	NA	5
## 771 2.21203e+08	NA	NA	NA	5
## 772 2.36112e+08	NA	NA	NA	5
## 773 2.50462e+08	NA	NA	NA	5
## 774 2.64404e+08	NA	NA	NA	5
## 775 2.77975e+08	NA	NA	NA	5
## 776 2.91239e+08	NA	NA	NA	5

## 777	3.03906e+08	NA	NA	NA	5
## 778	3.15921e+08	NA	NA	NA	5
## 779	3.27470e+08	NA	NA	NA	5
## 780	3.38738e+08	NA	NA	NA	5
## 781	3.49636e+08	NA	NA	NA	5
## 782	3.60302e+08	NA	NA	NA	5
## 783	3.73862e+08	NA	NA	NA	5
## 784	3.88099e+08	NA	NA	NA	5
## 785	4.02243e+08	NA	NA	NA	5
## 786	4.17437e+08	NA	NA	NA	5
## 787	4.33505e+08	NA	NA	NA	5
## 788	4.50080e+08	NA	NA	NA	5
## 789	4.67039e+08	NA	NA	NA	5
## 790	4.84634e+08	NA	NA	NA	5
## 791	5.01995e+08	NA	NA	NA	5
## 792	5.20432e+08	NA	NA	NA	5
## 793	5.38419e+08	NA	NA	NA	5
## 794	5.55763e+08	NA	NA	NA	5
## 795	5.72639e+08	NA	NA	NA	5
## 796	5.89644e+08	NA	NA	NA	5
## 797	6.07215e+08	NA	NA	NA	5
## 798	6.24842e+08	NA	NA	NA	5
## 799	6.41860e+08	NA	NA	NA	5
## 800	4.41852e-06	NA	NA	NA	5
##	model_run			scenario	
## 1	constGrowSelfTest_EM_2020	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 2	constGrowSelfTest_EM_2021	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 3	constGrowSelfTest_EM_2022	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 4	constGrowSelfTest_EM_2023	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 5	constGrowSelfTest_EM_2024	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 6	constGrowSelfTest_EM_2025	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 7	constGrowSelfTest_EM_2026	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 8	constGrowSelfTest_EM_2027	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 9	constGrowSelfTest_EM_2028	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 10	constGrowSelfTest_EM_2029	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 11	constGrowSelfTest_EM_2030	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 12	constGrowSelfTest_EM_2031	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 13	constGrowSelfTest_EM_2032	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 14	constGrowSelfTest_EM_2033	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 15	constGrowSelfTest_EM_2034	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 16	constGrowSelfTest_EM_2035	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 17	constGrowSelfTest_EM_2036	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 18	constGrowSelfTest_EM_2037	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 19	constGrowSelfTest_EM_2038	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 20	constGrowSelfTest_EM_2039	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 21	constGrowSelfTest_EM_2040	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 22	constGrowSelfTest_EM_2041	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 23	constGrowSelfTest_EM_2042	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 24	constGrowSelfTest_EM_2043	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 25	constGrowSelfTest_EM_2044	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 26	constGrowSelfTest_EM_2045	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 27	constGrowSelfTest_EM_2046	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 28	constGrowSelfTest_EM_2047	fixedParams20010M_selfTestSD1.25_RandRecHCR2			
## 29	constGrowSelfTest_EM_2048	fixedParams20010M_selfTestSD1.25_RandRecHCR2			

[illegible]

[illegible]

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

```
## 786 constGrowSelfTest_EM_2045 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 787 constGrowSelfTest_EM_2046 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 788 constGrowSelfTest_EM_2047 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 789 constGrowSelfTest_EM_2048 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 790 constGrowSelfTest_EM_2049 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 791 constGrowSelfTest_EM_2050 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 792 constGrowSelfTest_EM_2051 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 793 constGrowSelfTest_EM_2052 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 794 constGrowSelfTest_EM_2053 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 795 constGrowSelfTest_EM_2054 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 796 constGrowSelfTest_EM_2055 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 797 constGrowSelfTest_EM_2056 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 798 constGrowSelfTest_EM_2057 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 799 constGrowSelfTest_EM_2058 fixedParams2001OM_selfTestSD1.25_RandRecHCR6
## 800 constGrowSelfTest_EM_init fixedParams2001OM_selfTestSD1.25_RandRecHCR6
```

EM 2001 self test, recruitment at SD=1.25, perfect information, turning on params

```
mseDir <- "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"

scenarios <- c("fixedParams2001OM_selfTest_RandRecHCR2",
              "fixedParams2001OM_selfTestRegime_RandRecHCR2",
              "fixedParams2001OM_selfTestR0_RandRecHCR2",
              "fixedParams2001OM_selfTestInitF_RandRecHCR2",
              "fixedParams2001OM_selfTestGrowth_RandRecHCR2")

# have to restructure output list to deal with multiple OMs
smryOutputList <- list()
for(i in 1:length(scenarios)){
  smryOutputList[[i]] <- GetSumryOutput(dirSSMSE = mseDir, scenarios = scenarios[i])
}
```

```
## Rows: 1260 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1260 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1260 Columns: 12
## -- Column specification -----
```

```

## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1260 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
## Rows: 1260 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

lenComp <- smryOutputList %>% map_dfr(magrittr::extract2, "lenComp")
ageComp <- smryOutputList %>% map_dfr(magrittr::extract2, "ageComp")
obsCPUE <- smryOutputList %>% map_dfr(magrittr::extract2, "obsCPUE")
obsCatch <- smryOutputList %>% map_dfr(magrittr::extract2, "obsCatch")
dqSmry <- smryOutputList %>% map_dfr(magrittr::extract2, "dqSmry")
sclSmry <- smryOutputList %>% map_dfr(magrittr::extract2, "sclSmry")
tsSmry <- smryOutputList %>% map_dfr(magrittr::extract2, "tsSmry")

smryOutputList <- list("lenComp" = lenComp, "ageComp" = ageComp,
  "obsCPUE" = obsCPUE, "obsCatch" = obsCatch,
  "dqSmry" = dqSmry, "sclSmry" = sclSmry, "tsSmry" = tsSmry)

#
# performanceList <- CalcPerformance(smryOutputList) # also going to have OM issues
#
# metricsTbl <- performanceList$performanceMetrics
#
# # parse out HCR and recruitment scenario
# metricsTbl <- metricsTbl %>% mutate(HCR = sub(pattern = ".*Rec", "", scenario),
#                                     recScen = sub(pattern = "HCR.*", "", scenario)) %>%
#   mutate(recScen = sub(pattern = ".*OM_", "", recScen))
#
# hcrPal <- brewer.pal(10, "Set3")[-2]
#
# # plot convergence frequency
# metricsTbl %>% filter(HCR != "HCRO") %>%
#   ggplot(aes(x = HCR, y = frqNonConv)) +
#   geom_violin(aes(fill = HCR), draw_quantiles = c(0.1, 0.5, 0.9)) +
#   facet_wrap(~recScen) +
#   theme_minimal() +
#   scale_fill_brewer(palette = hcrPal)

```

```

# get terminal estimates of these values for timeseries plots
termTS <- CalcTermTS(smryOutputList) %>%
  mutate(HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM","", recScen))

## 'summarise()' has grouped output by 'year', 'model_run', 'iteration'. You can
## override using the '.groups' argument.

omName <- unique(grep("_OM", smryOutputList$tsSmry$model_run,
                    fixed = TRUE, value = TRUE))

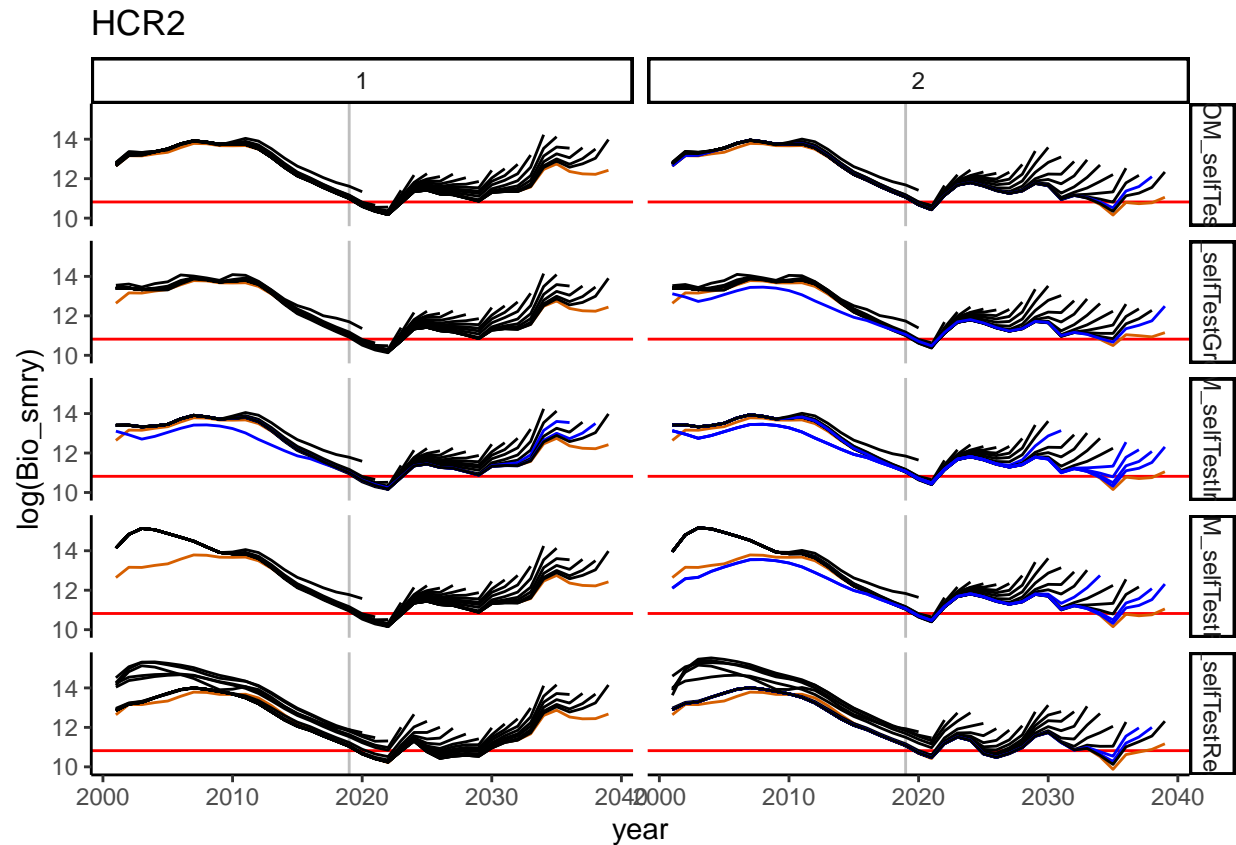
cnvrgCheck <- smryOutputList$sclSmry %>%
  select(max_grad, model_run, iteration, scenario) %>%
  mutate(emYear = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+",
                                                  model_run))),
         HCR = sub(pattern = ".*Rec","", scenario),
         recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM","", recScen))

hcrs <- unique(termTS$HCR)
#exIters <- sample(termTS$iteration, size = 4)

cnvrgTS <- smryOutputList$tsSmry %>% mutate(HCR = sub(pattern = ".*Rec","", scenario),
                                           recScen = sub(pattern = "HCR.*","", scenario)) %>%
  mutate(recScen = sub(pattern = ".*OM","", recScen)) %>%
  left_join(y = cnvrgCheck, by = c("iteration", "model_run", "scenario", "HCR", "recScen")) %>%
  mutate(plotGroup = case_when(model_run %in% omName ~ "OM",
                               max_grad > 0.01 ~ "non-cnvrng",
                               max_grad < 0.01 ~ "cnvrng"))

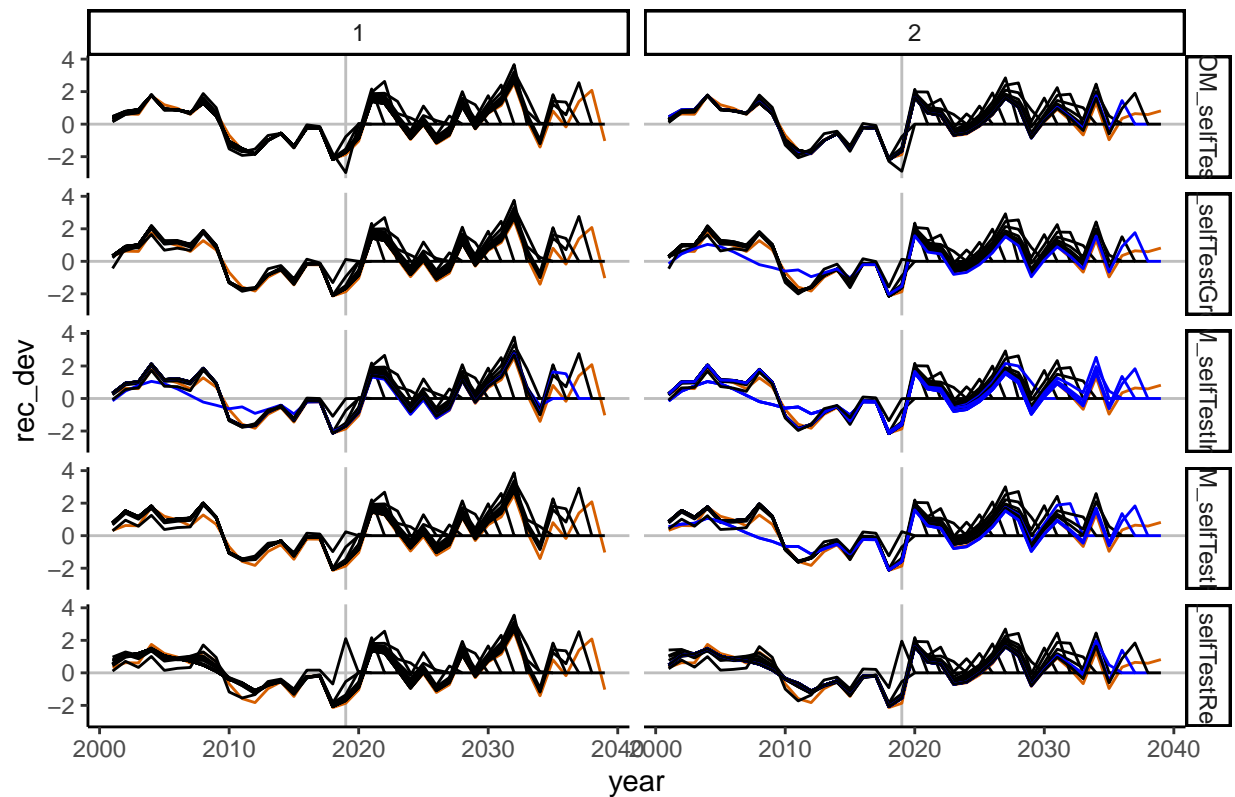
for(hcr in 1:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = log(Bio_smry))) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = log(50000), color = "red") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(scenario), cols = vars(iteration)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}

```



```
for(hcr in 1:length(hcrs)){
  print(cnvrgTS %>% filter(HCR == hcrs[hcr], Seas == 1) %>%
    ggplot(aes(x = year, y = rec_dev)) +
    ggplot2::geom_vline(xintercept = 2019, color = "gray") +
    ggplot2::geom_hline(yintercept = 0, color = "gray") +
    ggplot2::geom_line(aes(linetype = model_run, color = plotGroup))+
    ggplot2::scale_color_manual(values = c("black", "blue", "#D65F00")) +
    ggplot2::scale_linetype_manual(values = rep("solid", 51)) +
    ggplot2::guides(linetype = "none") +
    facet_grid(rows = vars(scenario), cols = vars(iteration)) +
    ggplot2::theme_classic() + theme(legend.position="none") +
    labs(title = hcrs[hcr]))
}
```

HCR2



```
#termTS %>% filter(model_run == omName)

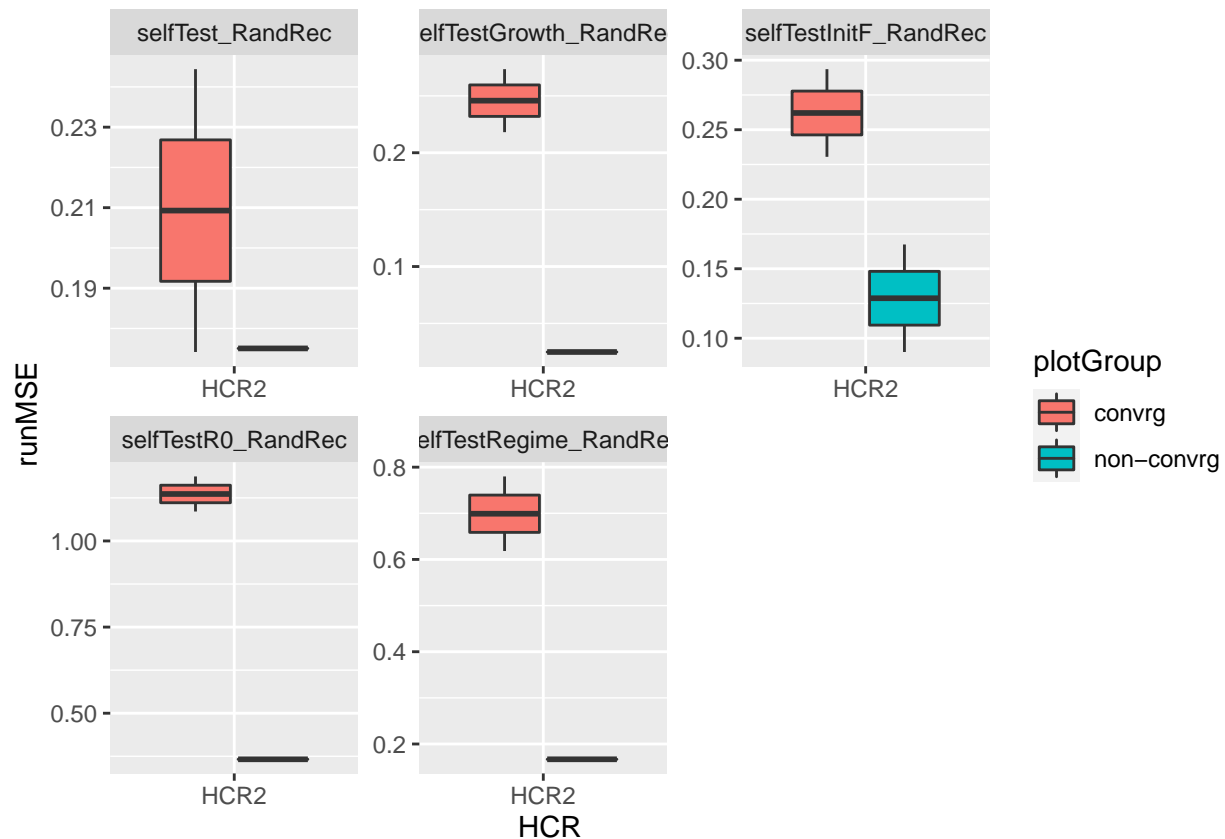
errCompare <- cnvrgTS %>% filter(Seas == 1, !model_run %in% omName) %>%
  select(Bio_smry, year, model_run, iteration, scenario, HCR, recScen, emYear, plotGroup)
  inner_join(y = subset(termTS, model_run %in% omName),
    by = c("year", "iteration", "scenario", "HCR", "recScen")) %>%
  #filter(iteration == 1) %>%
  rename(age1plusOM = Bio_smry.y,
    age1plusEM = Bio_smry.x) %>%
  mutate(errSmryBio = (age1plusEM - age1plusOM)/age1plusOM) %>%
  select(age1plusEM, age1plusOM, errSmryBio, year, model_run.x, iteration, scenario, HCR,
  group_by(model_run.x, iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(errSmryBio)) %>%
  group_by(iteration, scenario, HCR, recScen, plotGroup) %>%
  summarize(runMSE = mean(runMSE)) #>%
```

```
## 'summarise()' has grouped output by 'model_run.x', 'iteration', 'scenario',
## 'HCR', 'recScen'. You can override using the '.groups' argument.
## 'summarise()' has grouped output by 'iteration', 'scenario', 'HCR', 'recScen'.
## You can override using the '.groups' argument.
```

```
# group_by(scenario, HCR, recScen, plotGroup) %>%
# summarize(runMSE = mean(runMSE))

errCompare %>% #filter(HCR != "HCR3") %>%
```

```
ggplot(aes(x = HCR, y = runMSE, fill = plotGroup)) +
  geom_boxplot(outlier.shape = NA) +
  facet_wrap(~recScen, scales = "free")
```



EM 2001 self test, random recruitment

Look at years of no convergence and parameter bounds

```
selfTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvgEM2001fixed")
```

```
## Rows: 123 Columns: 185
## -- Column specification -----
## Delimiter: ","
## chr (4): params_stuck_low, version, model_run, scenario
## dbl (178): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl (3): params_on_bound, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convgCheckSelfTest <- selfTest %>% select(max_grad, params_on_bound,
                                           params_stuck_low, params_stuck_high,
```

```

                                model_run, iteration) %>%
mutate(year = as.numeric(regmatches(model_run,
                                gregexpr("[[:digit:]]+", model_run)))) %>%

filter(max_grad > 0.01)

convrgCheckSelfTest

```

```

## # A tibble: 11 x 7
##   max_grad params_on_bound params_stuck_low      params_stuck_hi~ model_run
##   <dbl> <lgl>          <chr>          <lgl>          <chr>
## 1    276. NA          Size_95%width_MexCal_S1(~ NA          testConv~
## 2   78062. NA          InitF_seas_2_flt_2MexCal~ NA          testConv~
## 3    9980. NA          CV_old_Fem_GP_1;Size_95%~ NA          testConv~
## 4  189971. NA          <NA>          NA          testConv~
## 5   97451. NA          <NA>          NA          testConv~
## 6   39964. NA          CV_old_Fem_GP_1      NA          testConv~
## 7  168650. NA          <NA>          NA          testConv~
## 8   26137. NA          <NA>          NA          testConv~
## 9   11038. NA          CV_old_Fem_GP_1      NA          testConv~
## 10    373. NA          Size_95%width_MexCal_S1(~ NA          testConv~
## 11  281653. NA          <NA>          NA          testConv~
## # ... with 2 more variables: iteration <dbl>, year <dbl>

```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```

selfBio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                      scenario = "testConvrgEM2001fixedParms_RandRec_HCR1",
                      termYr = 2058, surveyInx = 4)

```

```

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```



```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

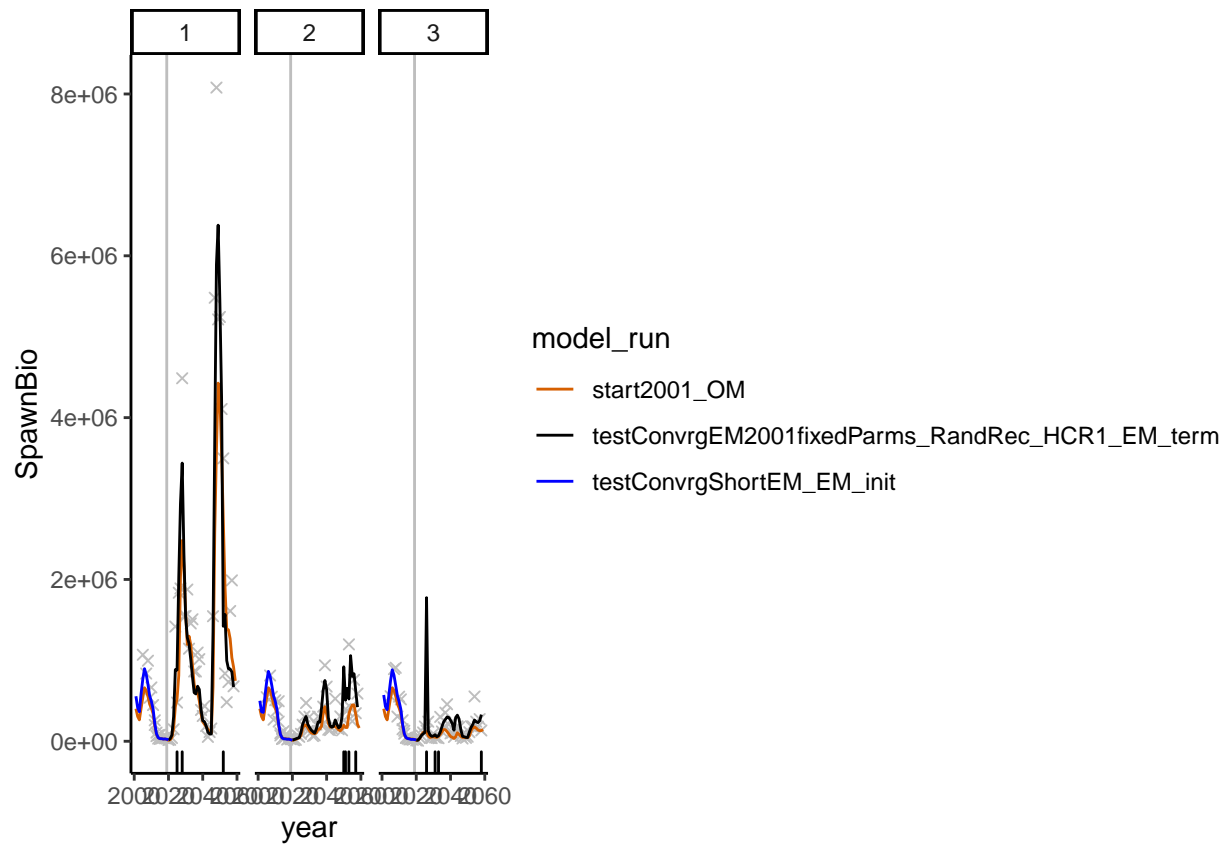
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

```

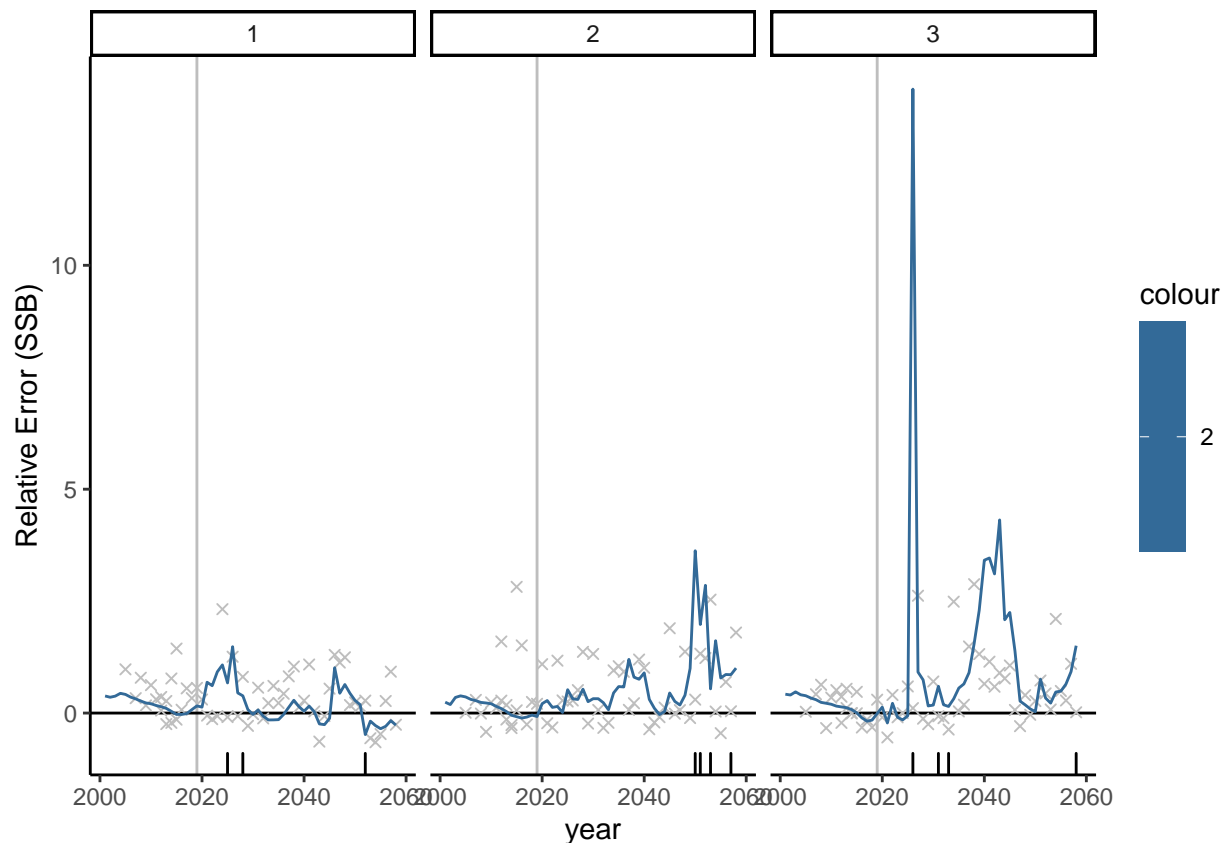
```
selfBio[[1]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)
```



```
selfBio[[2]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrgEM2001fixedParms_RandRec_HCR1",
              termYr = 2058, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

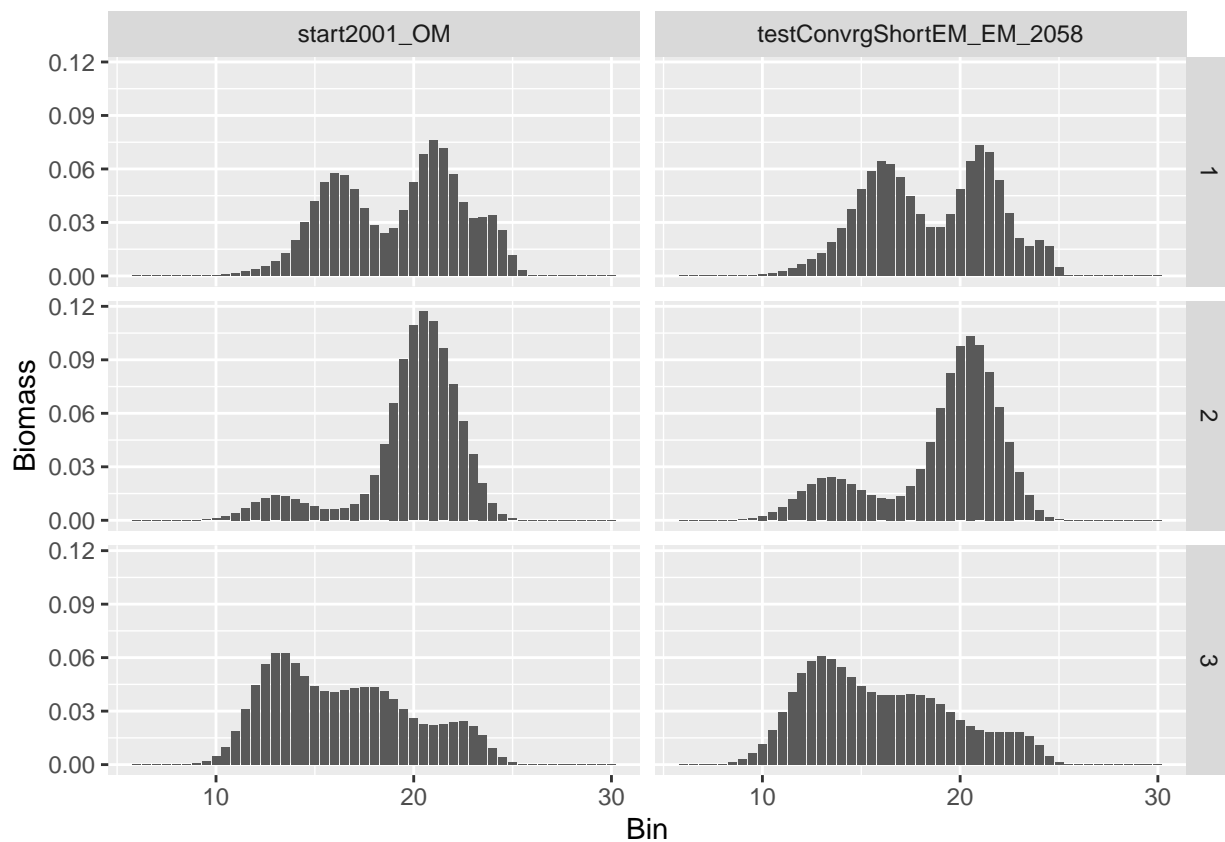
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

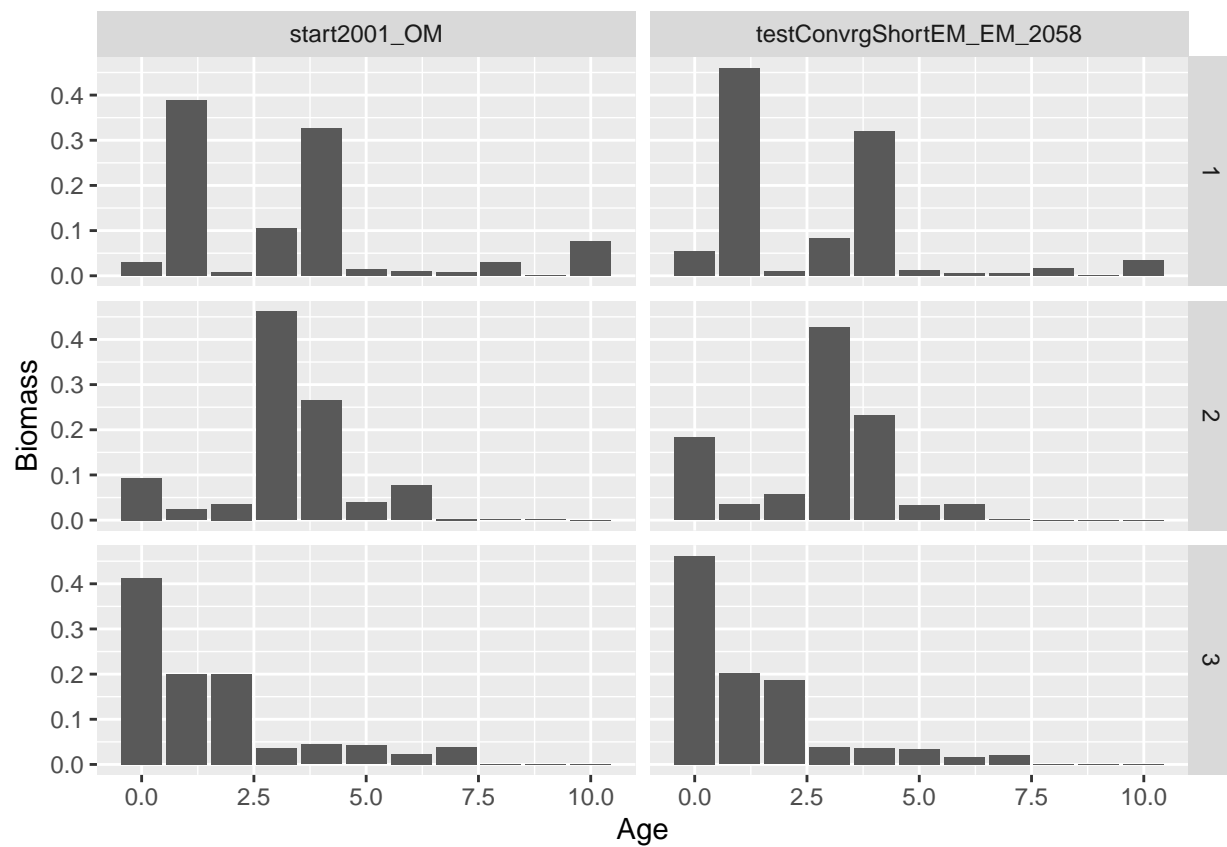
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

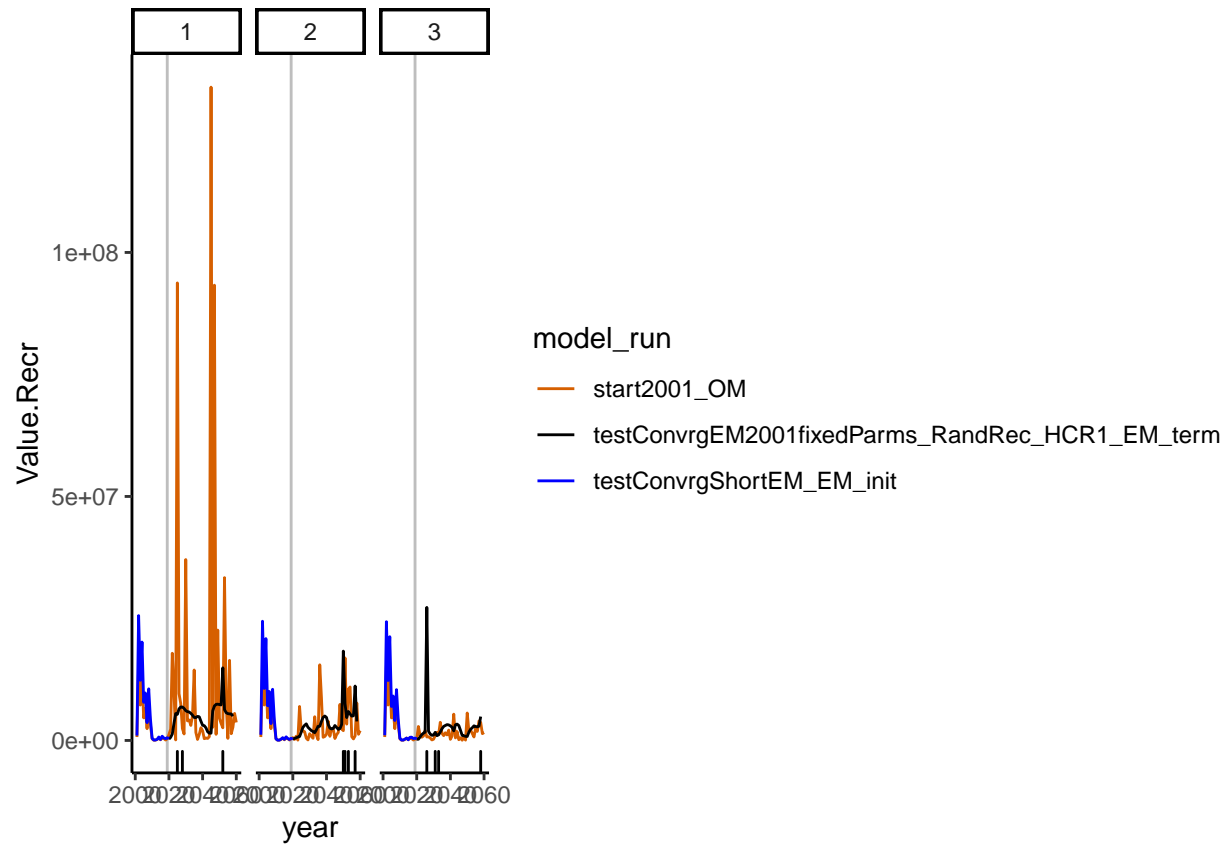
## [[1]]
```



```
##
## [[2]]
```

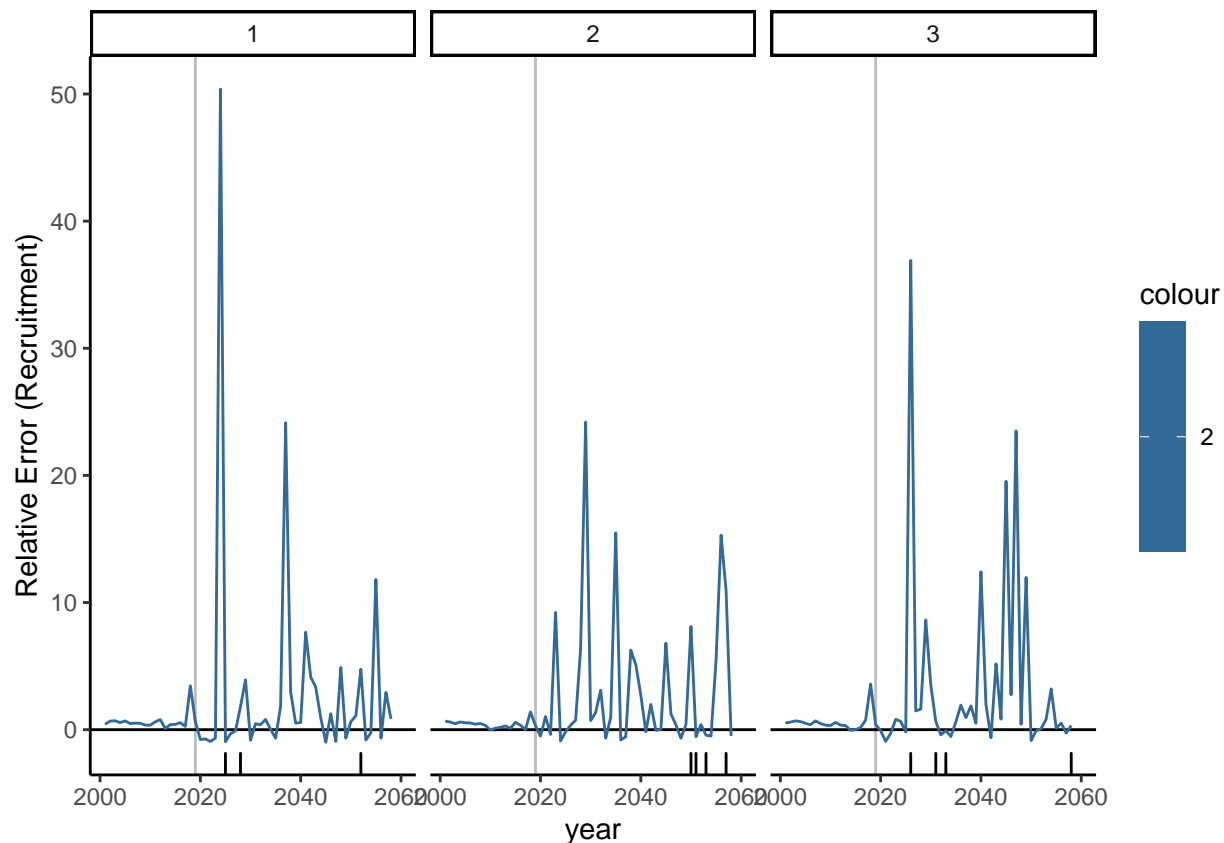


```
selfRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_RandRec_HCR1", termYr = 2058)
selfRec[[1]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
selfRec[[2]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
selfCat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                          scenario = "testConvrgEM2001fixedParms_RandRec_HCR1", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```



```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

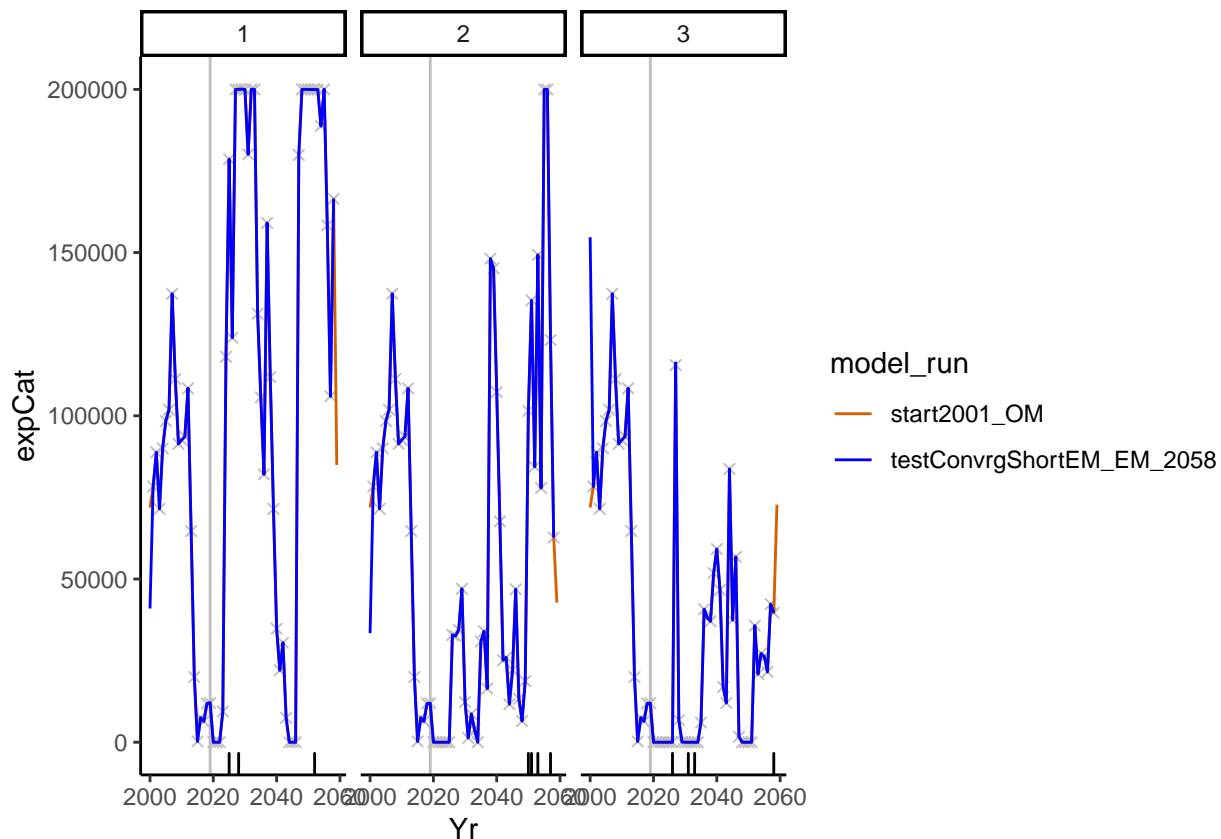
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

selfCat[[1]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)

```



```
selfAge1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_RandRec_HCR1", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
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##      'Variances are 0.0 for first two elements, so do not write '
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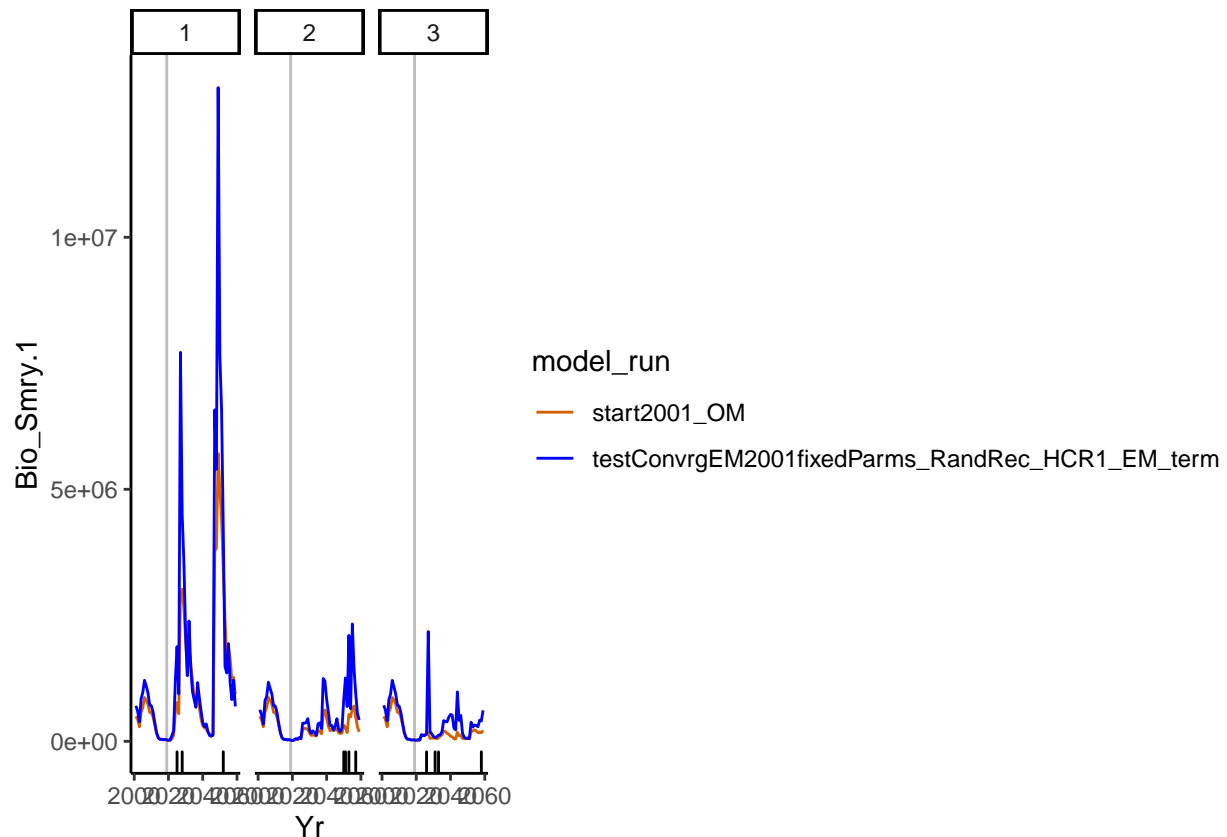
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

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```



```
selfAge1Plus[[1]] + geom_rug(data = convrgCheckSelfTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckSelfTest <- selfTest %>% select(max_grad, SR_LN_R0, SR_regime, SR_BH_steep,
                                          SR_regime_BLK1repl_2000,
                                          model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheckSelfTest
```

```
## # A tibble: 11 x 8
##   max_grad SR_LN_R0 SR_regime SR_BH_steep SR_regime_BLK1re~ model_run iteration
##   <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <chr>      <dbl>
## 1    276.     15.0      0      0.3      0.805 testConv~      1
## 2   78062.    15.0      0      0.3      0.804 testConv~      1
## 3    9980.    16.5      0      0.3     -0.658 testConv~      1
## 4  189971    18.9      0      0.3     -3.53  testConv~      2
## 5   97451.    16.2      0      0.3     -0.573 testConv~      2
## 6   39964.    15.6      0      0.3     -0.0412 testConv~      2
## 7  168650    17.5      0      0.3     -2.02  testConv~      2
## 8   26137.    18.1      0      0.3     -1.67  testConv~      3
## 9   11038    20.4      0      0.3     -4.96  testConv~      3
```

```
## 10      373.      14.9      0      0.3      0.917 testConv~      3
## 11 281653      15.9      0      0.3      -0.238 testConv~      3
## # ... with 1 more variable: year <dbl>
```

```
# compare to OM
```

```
selfTest %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                    model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>                <dbl> <chr>          <dbl> <dbl>
## 1     14.8        0                0.546 start2001_OM      1  2001
## 2     14.8        0                0.546 start2001_OM      2  2001
## 3     14.8        0                0.546 start2001_OM      3  2001
```

```
selfTestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeM2001")
```

```
## Rows: 9834 Columns: 26
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
selfTestFrates <- selfTestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(selfTestFrates)
```

```
##      F_1      F_2      F_3      Seas
## Min.   :0.00000 Min.   :0.0000 Min.   :0.000000 Min.   :1.0
## 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.:0.000115 1st Qu.:1.0
## Median :0.00000 Median :0.0000 Median :0.018148 Median :1.5
## Mean   :0.05097 Mean   :0.1605 Mean   :0.204662 Mean   :1.5
## 3rd Qu.:0.07210 3rd Qu.:0.1365 3rd Qu.:0.250440 3rd Qu.:2.0
## Max.   :3.99663 Max.   :3.9999 Max.   :3.610320 Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :2001 Length:9834 Min.   :1 Length:9834
## 1st Qu.:2010 Class :character 1st Qu.:1 Class :character
## Median :2020 Mode  :character Median :2 Mode  :character
## Mean   :2022 Mean   :2
## 3rd Qu.:2032 3rd Qu.:3
## Max.   :2059 Max.   :3
```

```
selfTestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckSelfTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 899 x 13
##       F_1    F_2    F_3  Seas  year model_run  iteration scenario yearEM max_grad
##       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>         <dbl> <chr>         <dbl>    <dbl>
##  1 0.135      0  1.79     1  2004 testConvr~         2 testCon~    2050  189971
##  2 0.268      0  1.16     1  2004 testConvr~         2 testCon~    2051   97451.
##  3 0.103      0  1.81     1  2004 testConvr~         2 testCon~    2057  168650
##  4 0.148      0  1.18     1  2004 testConvr~         3 testCon~    2031   11038
##  5 0.0368     0  1.29     1  2005 testConvr~         1 testCon~    2052    9980.
##  6 0.0430     0  1.09     1  2005 testConvr~         2 testCon~    2023      NA
##  7 0.0414     0  1.02     1  2005 testConvr~         2 testCon~    2024      NA
##  8 0.0416     0  1.02     1  2005 testConvr~         2 testCon~    2027      NA
##  9 0.0417     0  1.02     1  2005 testConvr~         2 testCon~    2028      NA
## 10 0.0413     0  1.02     1  2005 testConvr~         2 testCon~    2029      NA
## # ... with 889 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <lgl>
```

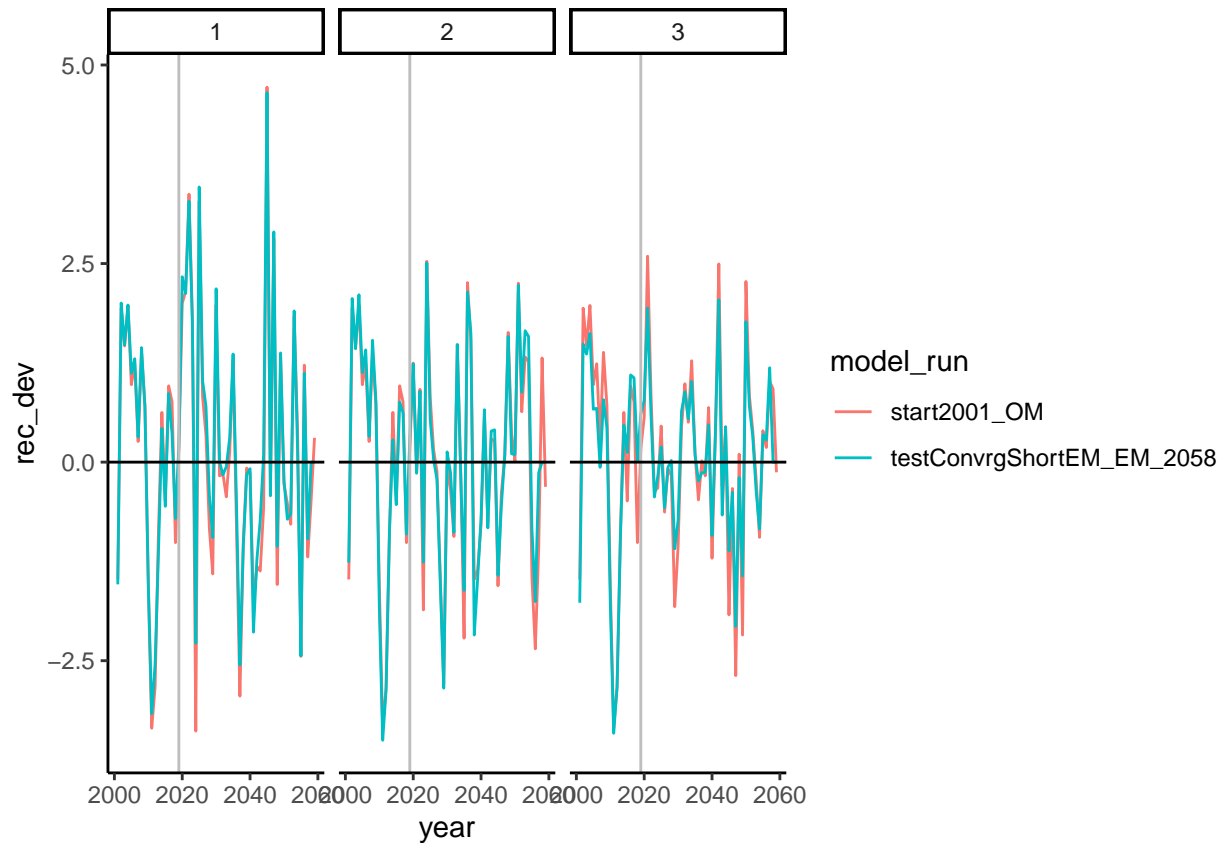
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvr~EM2001fixed")
```

```
## Rows: 9834 Columns: 26
## -- Column specification -----
## Delimiter: ","
## chr  (2): model_run, scenario
## dbl  (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

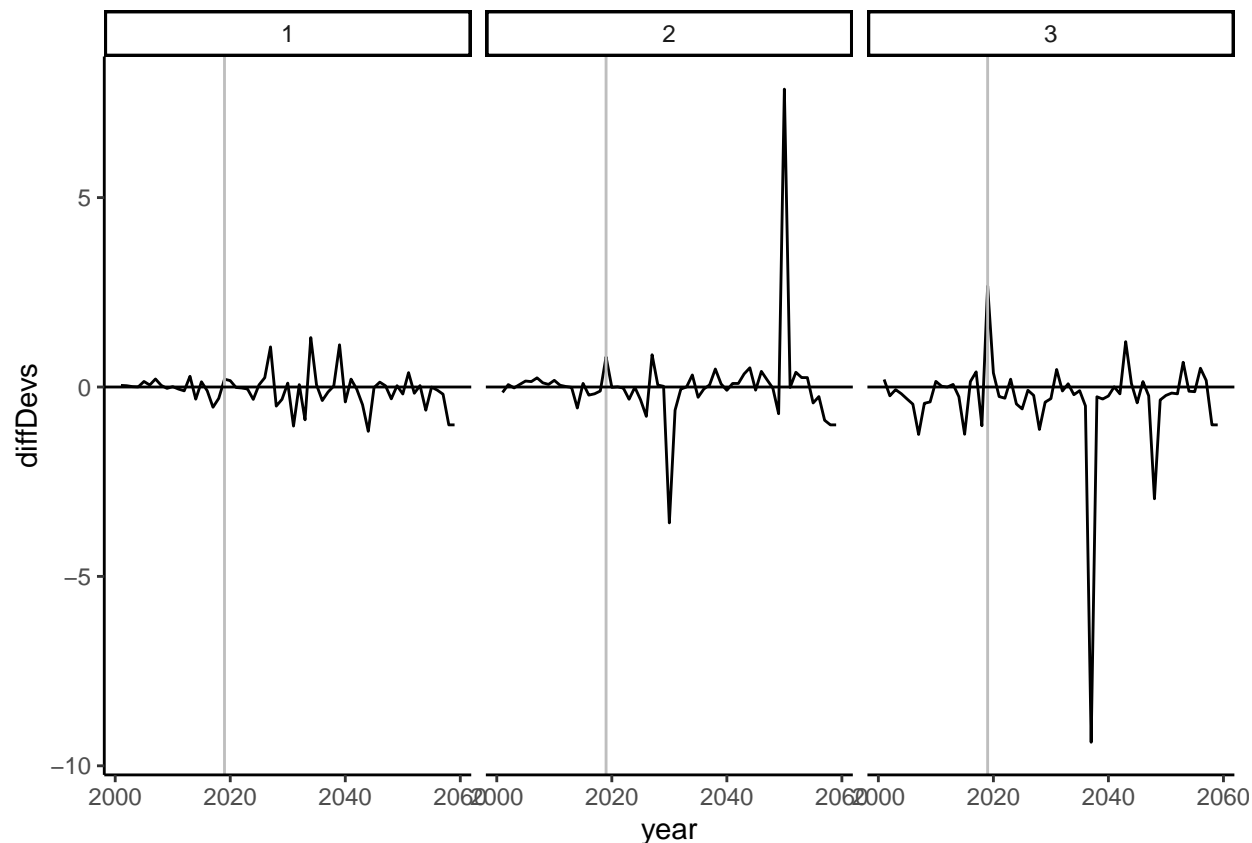
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2058", model_run)) %>%
  filter(complete.cases())

recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrgShortEM_EM_2058 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
# EM 2001 self test, random recruitment HCR3 (constant catch)
```

```
Look at years of no convergence and parameter bounds
```

```
selfHCR3Test <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeM2001f
```

```
## Rows: 123 Columns: 185
## -- Column specification -----
## Delimiter: ","
## chr (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl (178): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgeCheckHCR3SelfTest <- selfHCR3Test %>% select(max_grad, params_on_bound,
                                                    params_stuck_low, params_stuck_high,
                                                    model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)
```

```
convrgeCheckHCR3SelfTest
```

```
## # A tibble: 48 x 7
```

```
##      max_grad params_on_bound params_stuck_low      params_stuck_hi~ model_run
##      <dbl> <lgl>          <chr>          <chr>          <chr>
## 1 3067350      NA          CV_old_Fem_GP_1;Size~ <NA>          testConv~
## 2   952.      NA          CV_old_Fem_GP_1;Size~ <NA>          testConv~
## 3  92375.      NA          <NA>          <NA>          testConv~
## 4   2713.      NA          CV_old_Fem_GP_1      <NA>          testConv~
## 5    0.0369 NA          <NA>          <NA>          testConv~
## 6   9015.      NA          CV_old_Fem_GP_1      <NA>          testConv~
## 7    0.0102 NA          CV_old_Fem_GP_1      <NA>          testConv~
## 8    0.0595 NA          <NA>          <NA>          testConv~
## 9  16153.      NA          CV_old_Fem_GP_1      <NA>          testConv~
## 10  3520.      NA          <NA>          <NA>          testConv~
## # ... with 38 more rows, and 2 more variables: iteration <dbl>, year <dbl>
```

Look at dynamics of to see if population crashes

```
selfHCR3BioTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001fixedParms_RandRec_HCR3")
```

```
## Rows: 4920 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
selfHCR3BioTest %>% filter(Value.SSB < 1000) %>%
  filter(model_run == "start2001_OM") %>%
  select(year, Value.SSB, Value.Recr, iteration)
```

```
## # A tibble: 31 x 4
##   year Value.SSB Value.Recr iteration
##   <dbl>   <dbl>   <dbl>     <dbl>
## 1  2048     882.   64304.         2
## 2  2049     954.   19448.         2
## 3  2059     952.    9930.         2
## 4  2033   1000.   23521.         3
## 5  2034     751.   38326.         3
## 6  2035     557.    8804.         3
## 7  2036     663.   5874.         3
## 8  2037     485.   7023.         3
## 9  2038     246.   2959.         3
## 10 2039     118.   3362.         3
## # ... with 21 more rows
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR3)

```
selfHCR3Bio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_RandRec_HCR3",
  termYr = 2058, surveyInx = 4)
```

```

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

```

```
## Read of section 1 of data file complete. Final value = 999
```

```
## Char version is 3.30
```

```
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

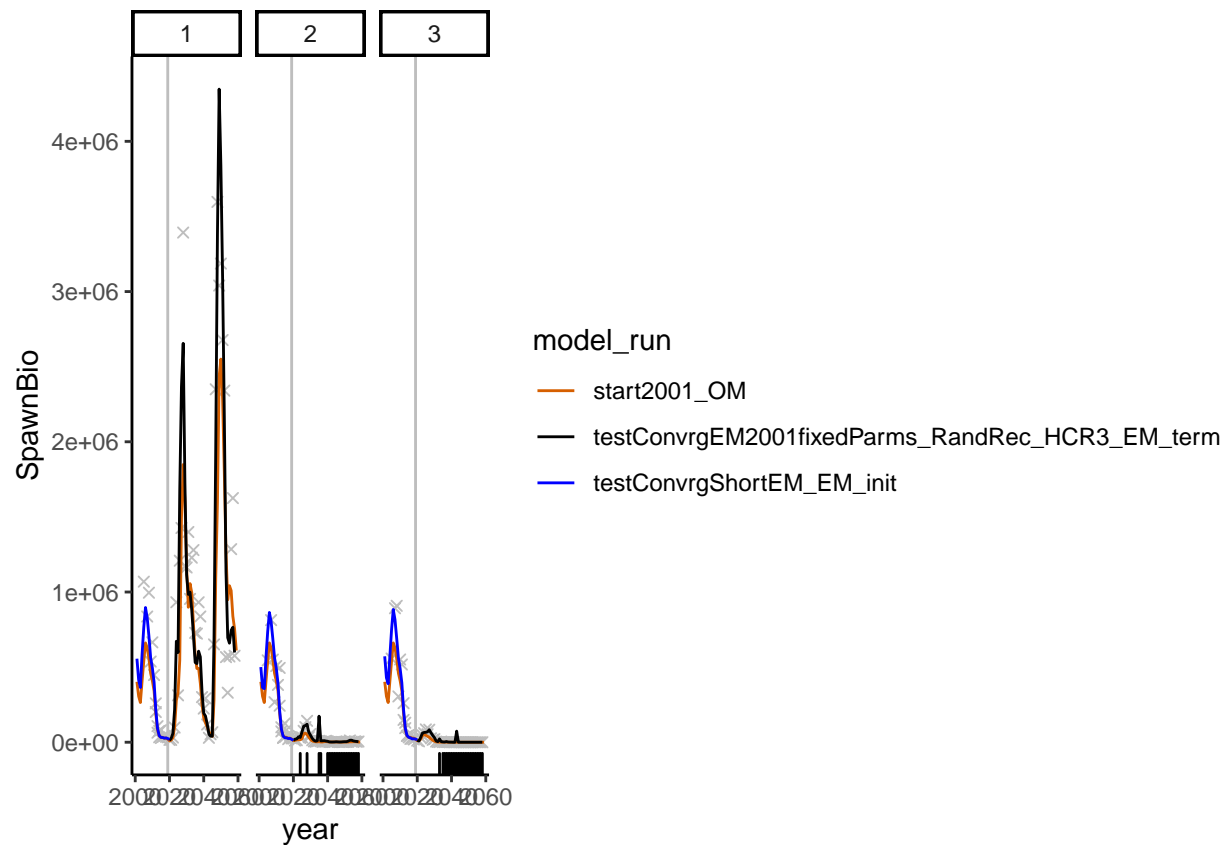
```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0
```

```
## N_environ_variables: 0
```

```
## Read of section 1 of data file complete. Final value = 999
```

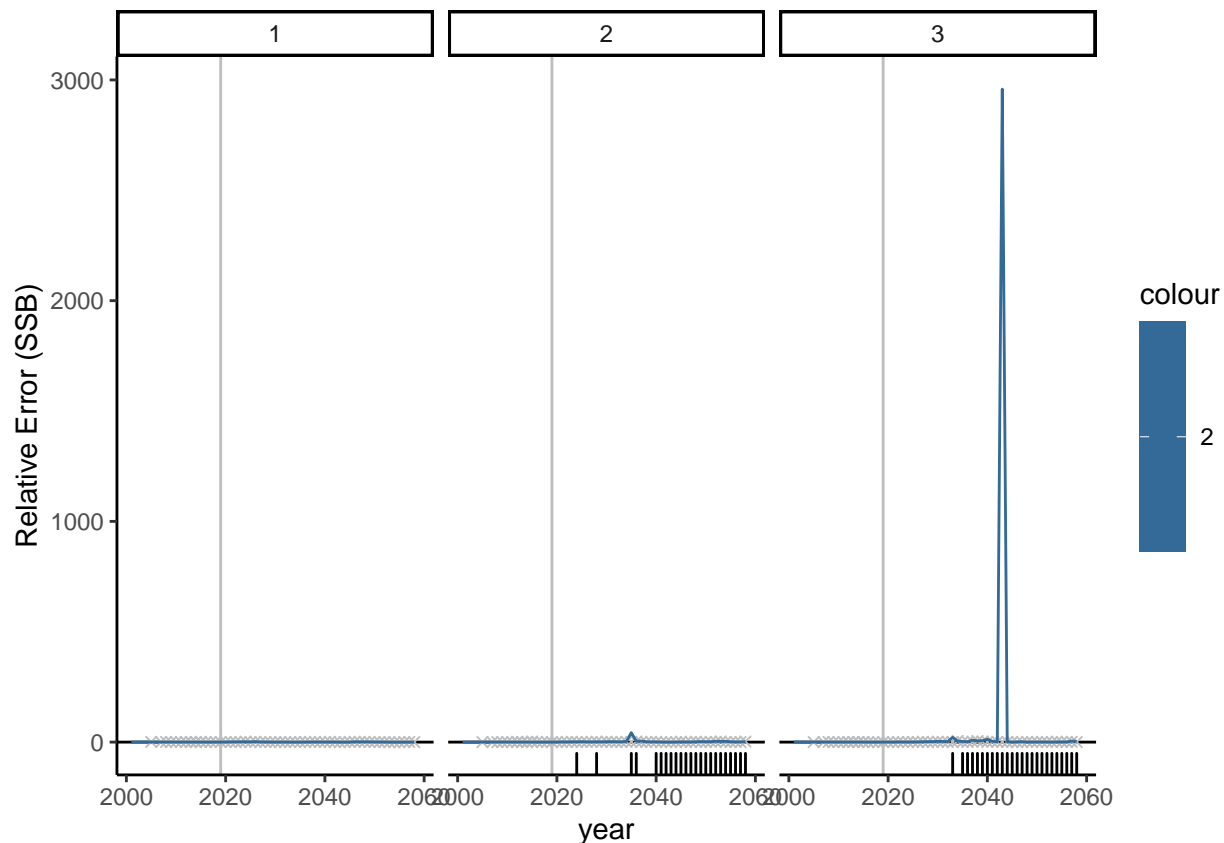
```
selfHCR3Bio[[1]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),  
                             sides = "b", inherit.aes = FALSE)
```

```
selfHCR3Bio[[2]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrgEM2001fixedParms_RandRec_HCR3",
              termYr = 2058, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

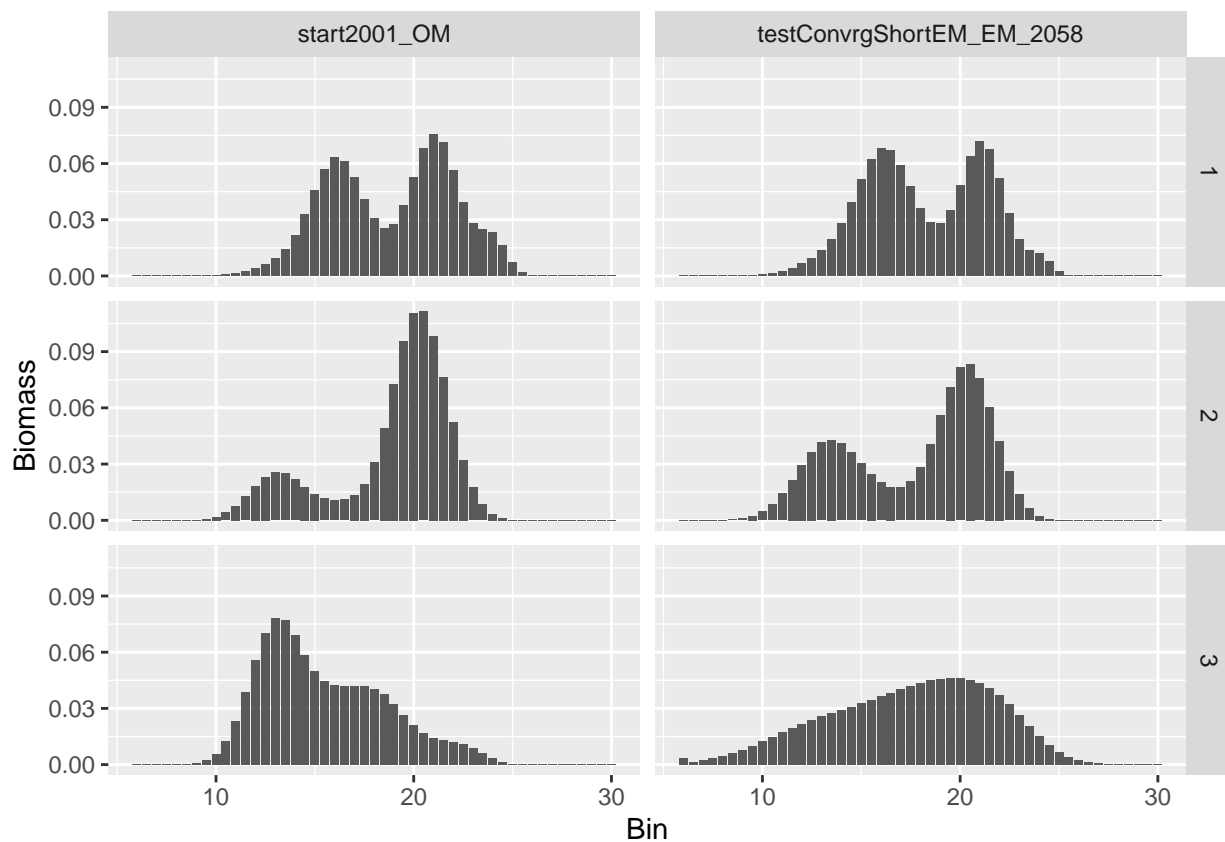
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

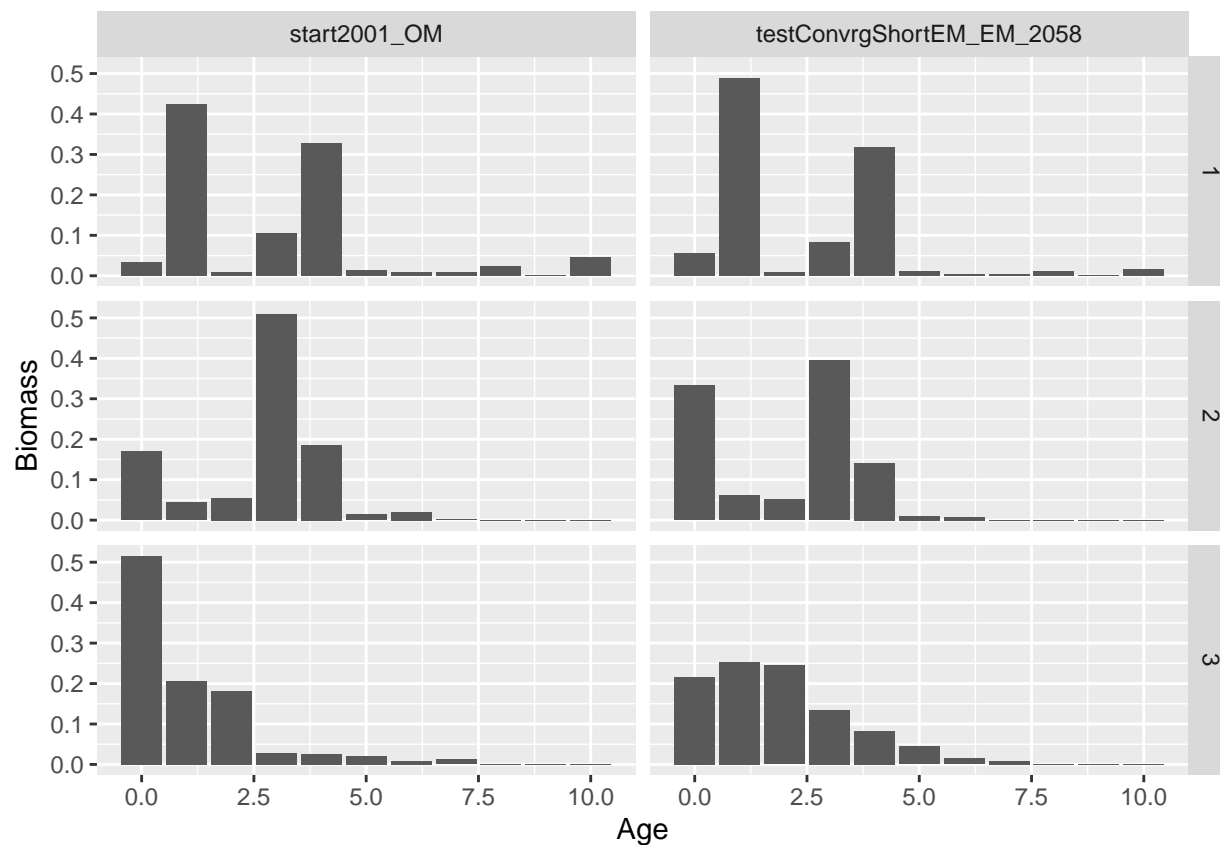
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

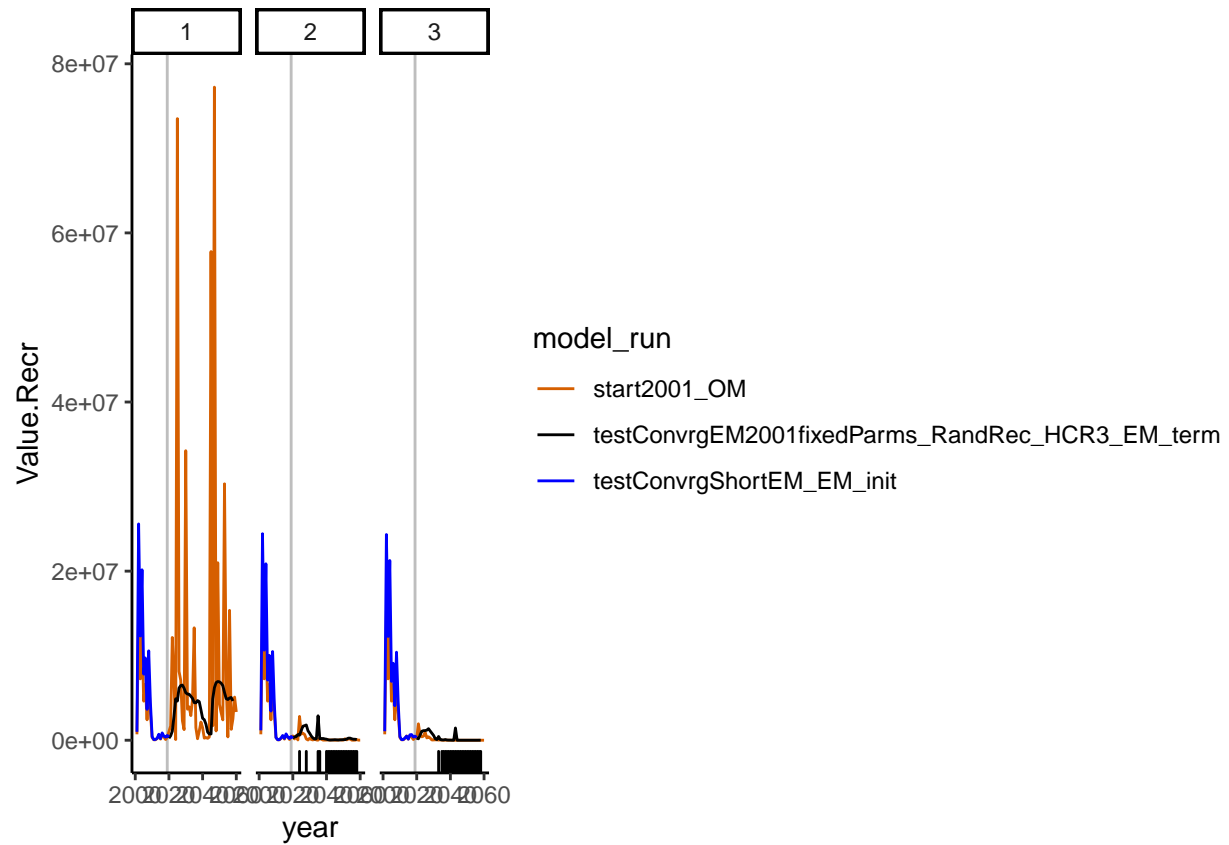
## [[1]]
```



```
##
## [[2]]
```

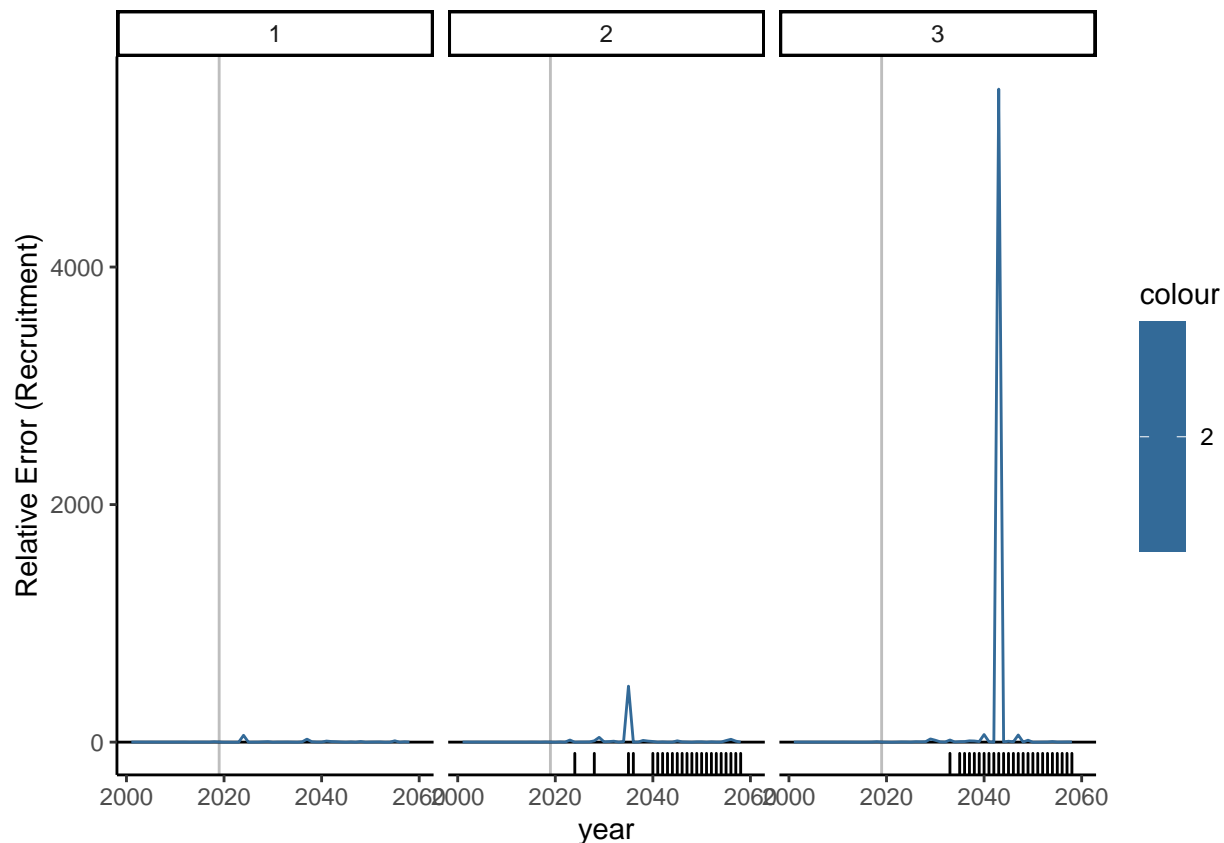


```
selfHCR3Rec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_RandRec_HCR3", termYr = 2058)
selfHCR3Rec[[1]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
selfHCR3Rec[[2]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
selfHCR3Cat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                             scenario = "testConvrgEM2001fixedParms_RandRec_HCR3", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

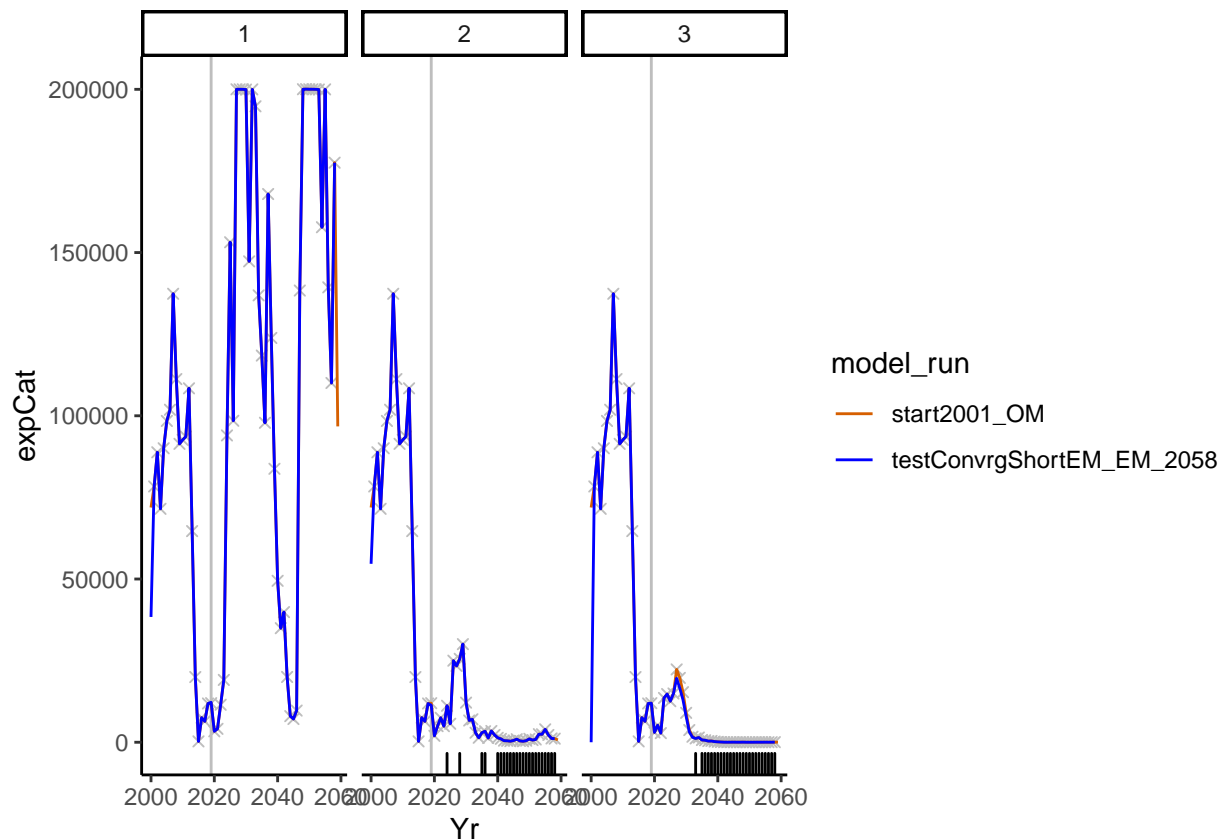
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

selfHCR3Cat[[1]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)

```

```
selfHCR3Age1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenario",
  scenario = "testConvrgEM2001fixedParms_RandRec_HCR3", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
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##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

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```

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```



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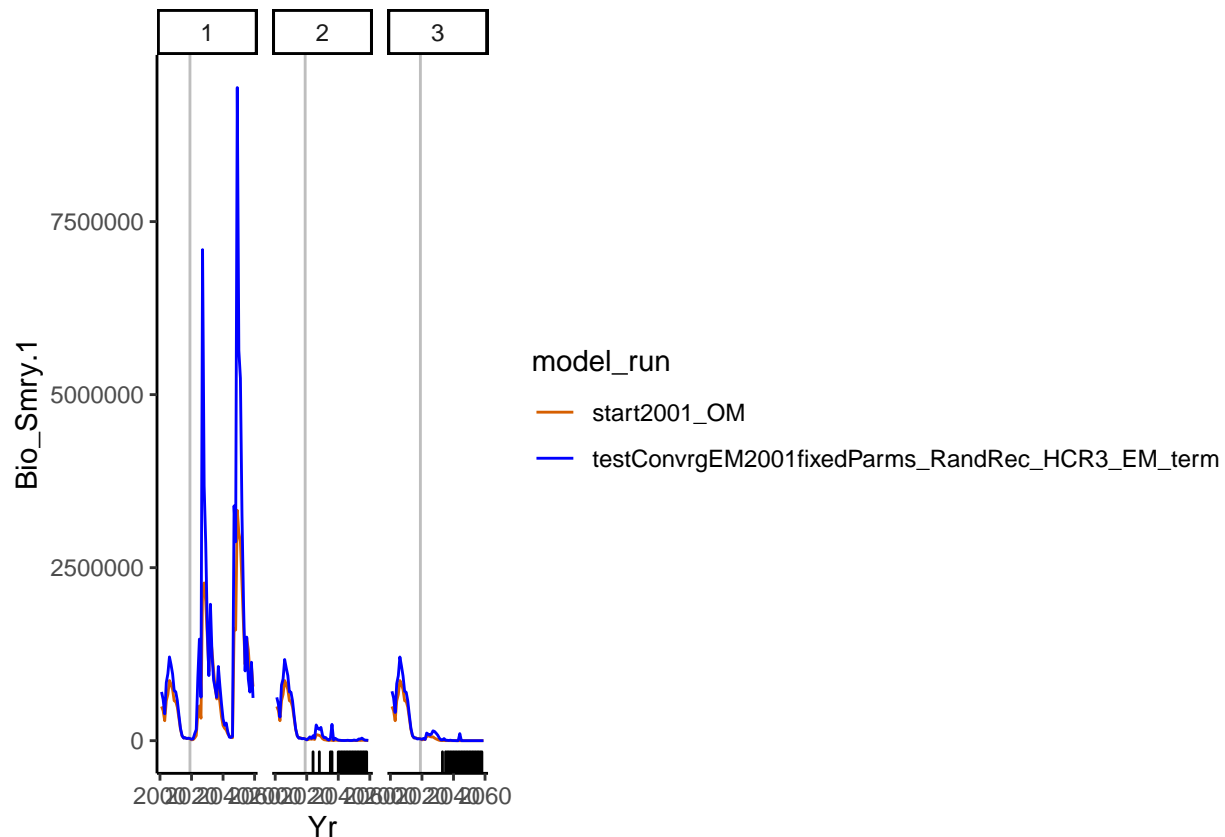
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
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##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

```

```
selfHCR3Age1Plus[[1]] + geom_rug(data = convrgCheckHCR3SelfTest, mapping = aes(x = year),
                                sides = "b", inherit.aes = FALSE)
```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckHCR3SelfTest <- selfHCR3Test %>% select(max_grad, SR_LN_R0, SR_regime, SR_BH_steep,
                                                SR_regime_BLK1repl_2000,
                                                model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)
paramCheckHCR3SelfTest
```

```
## # A tibble: 48 x 8
##   max_grad SR_LN_R0 SR_regime SR_BH_steep SR_regime_BLK1r~ model_run iteration
##   <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <chr>      <dbl>
## 1  3.07e+6    15.0      0        0.3      0.673 testConv~      2
## 2  9.52e+2    14.9      0        0.3      0.712 testConv~      2
## 3  9.24e+4    15.9      0        0.3     -0.205 testConv~      2
## 4  2.71e+3    20.7      0        0.3     -5.39  testConv~      2
## 5  3.69e-2    14.9      0        0.3      0.724 testConv~      2
## 6  9.01e+3    15.1      0        0.3      0.454 testConv~      2
## 7  1.02e-2    14.9      0        0.3      0.725 testConv~      2
## 8  5.95e-2    14.9      0        0.3      0.724 testConv~      2
## 9  1.62e+4    15.3      0        0.3      0.341 testConv~      2
```



```
## 10 3.52e+3 14.7 0 0.3 0.950 testConv~ 2
## # ... with 38 more rows, and 1 more variable: year <dbl>
```

```
# compare to OM
```

```
selfHCR3Test %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                        model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
```

```
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    14.8      0          0.546 start2001_OM      1  2001
## 2    14.8      0          0.546 start2001_OM      2  2001
## 3    14.8      0          0.546 start2001_OM      3  2001
```

```
selfHCR3TestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEL
```

```
## Rows: 9834 Columns: 26
```

```
## -- Column specification -----
```

```
## Delimiter: ","
```

```
## chr (2): model_run, scenario
```

```
## dbl (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
```

```
##
```

```
## i Use 'spec()' to retrieve the full column specification for this data.
```

```
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
selfHCR3TestFrates <- selfHCR3TestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, sc
summary(selfHCR3TestFrates)
```

```
##      F_1      F_2      F_3      Seas
## Min.   :0.000000 Min.   :0.000000 Min.   :0.00000 Min.   :1.0
## 1st Qu.:0.000000 1st Qu.:0.000000 1st Qu.:0.01243 1st Qu.:1.0
## Median :0.000052 Median :0.000059 Median :0.12713 Median :1.5
## Mean   :0.143137 Mean   :0.254295 Mean   :0.48017 Mean   :1.5
## 3rd Qu.:0.155390 3rd Qu.:0.259373 3rd Qu.:0.58769 3rd Qu.:2.0
## Max.   :4.000030 Max.   :4.000030 Max.   :4.00003 Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :2001 Length:9834 Min.   :1 Length:9834
## 1st Qu.:2010 Class :character 1st Qu.:1 Class :character
## Median :2020 Mode  :character Median :2 Mode  :character
## Mean   :2022 Mean   :2
## 3rd Qu.:2032 3rd Qu.:3
## Max.   :2059 Max.   :3
```

```
selfHCR3TestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckHCR3SelfTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 2,330 x 13
##       F_1    F_2    F_3  Seas  year model_run  iteration scenario yearEM max_grad
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>          <dbl> <chr>    <dbl>    <dbl>
## 1 0      1.25 0.0650    2  2001 testConvr~      2 testCon~  2057   507591
## 2 0      2.66 0.0314    2  2001 testConvr~      3 testCon~  2057 11885400
## 3 0      1.17 0.118    2  2001 testConvr~      3 testCon~  2058  4469440
## 4 1.22    0    0.666    1  2002 testConvr~      2 testCon~  2057   507591
## 5 0.504    0    1.05    1  2002 testConvr~      3 testCon~  2037   222957
## 6 0      1.60 0.0170    2  2002 testConvr~      2 testCon~  2057   507591
## 7 0      1.13 0.0100    2  2002 testConvr~      3 testCon~  2050  8879370
## 8 0      1.24 0.00993    2  2002 testConvr~      3 testCon~  2053   223010
## 9 0      1.07 0.0230    2  2002 testConvr~      3 testCon~  2058  4469440
## 10 1.20    0    1.24    1  2003 testConvr~      2 testCon~  2057   507591
## # ... with 2,320 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <chr>
```

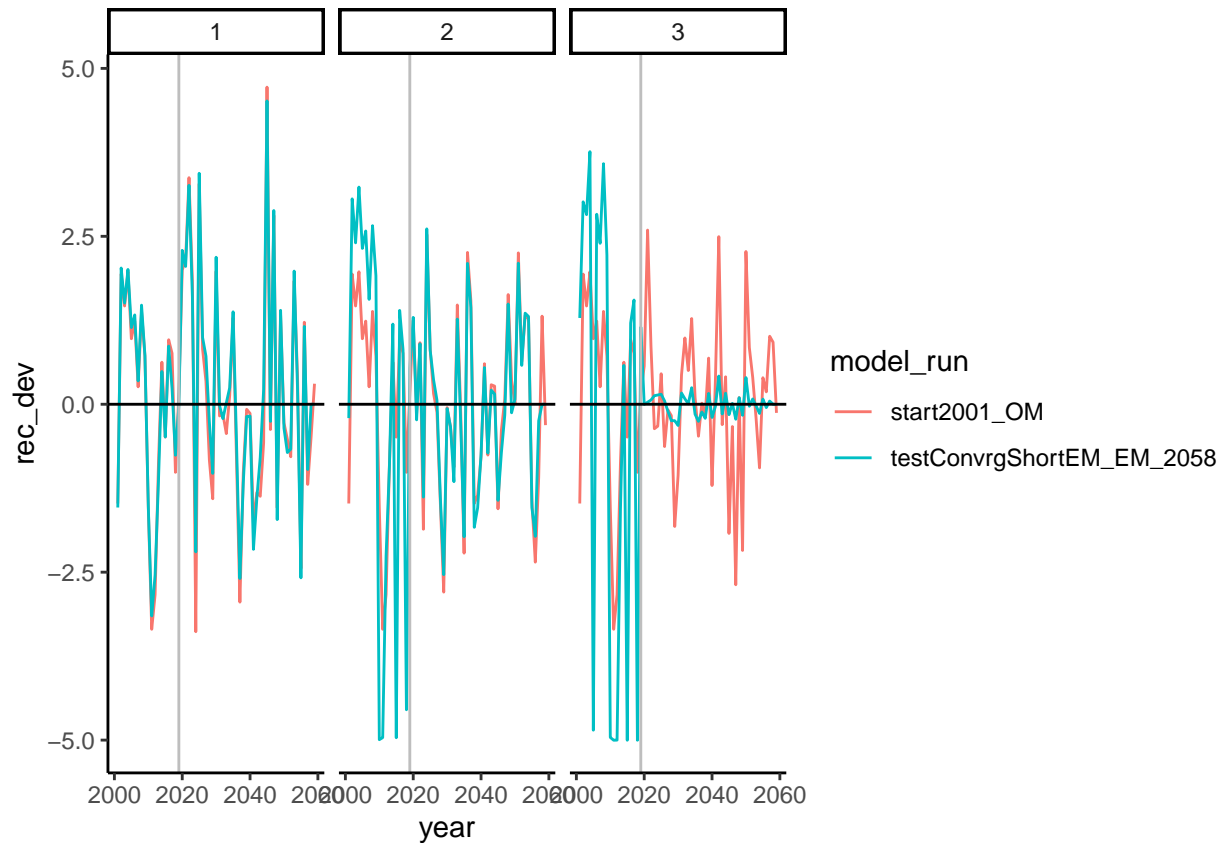
Plot error for estimates of rec devs from 2058 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrEM2001fixed")
```

```
## Rows: 9834 Columns: 26
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

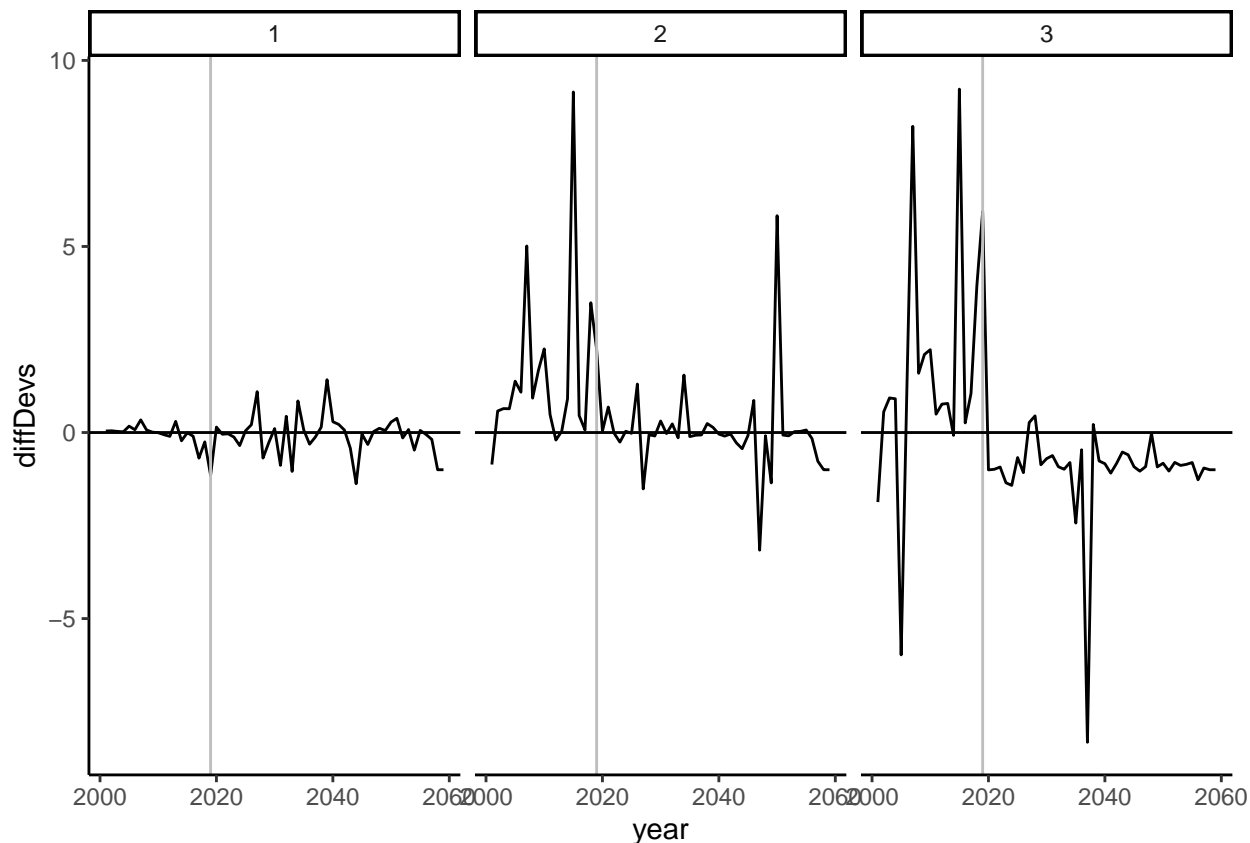
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2058", model_run)) %>%
  filter(complete.cases(.))

recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrgShortEM_EM_2058 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



EM 2001 self test, mean recruitment

Look at years of no convergence and parameter bounds

```
meanTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeM2001fixed")
```

```
## Rows: 123 Columns: 185
## -- Column specification -----
## Delimiter: ","
## chr  (4): params_stuck_low, version, model_run, scenario
## dbl (178): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl  (3): params_on_bound, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgeCheckMeanTest <- meanTest %>% select(max_grad, params_on_bound,
                                           params_stuck_low, params_stuck_high,
                                           model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]+", model_run)))) %>%
  filter(max_grad > 0.01)

convrgeCheckMeanTest
```

```
## # A tibble: 5 x 7
##   max_grad params_on_bound params_stuck_low params_stuck_hi~ model_run iteration
##   <dbl> <lgl>           <chr>           <lgl>           <chr>           <dbl>
## 1  1.29e 7 NA           Size_95%width_M~ NA           testConv~         1
## 2  2.36e 4 NA           CV_old_Fem_GP_1 NA           testConv~         1
## 3  1.42e 3 NA           CV_old_Fem_GP_1~ NA           testConv~         2
## 4  4.05e 2 NA           Size_95%width_M~ NA           testConv~         2
## 5  2.56e15 NA           CV_old_Fem_GP_1~ NA           testConv~         3
## # ... with 1 more variable: year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
meanBio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_MeanRec_HCR1",
  termYr = 2058, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0
```

```
## N_envIRON_variables: 0
```

```
## Read of section 1 of data file complete. Final value = 999
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

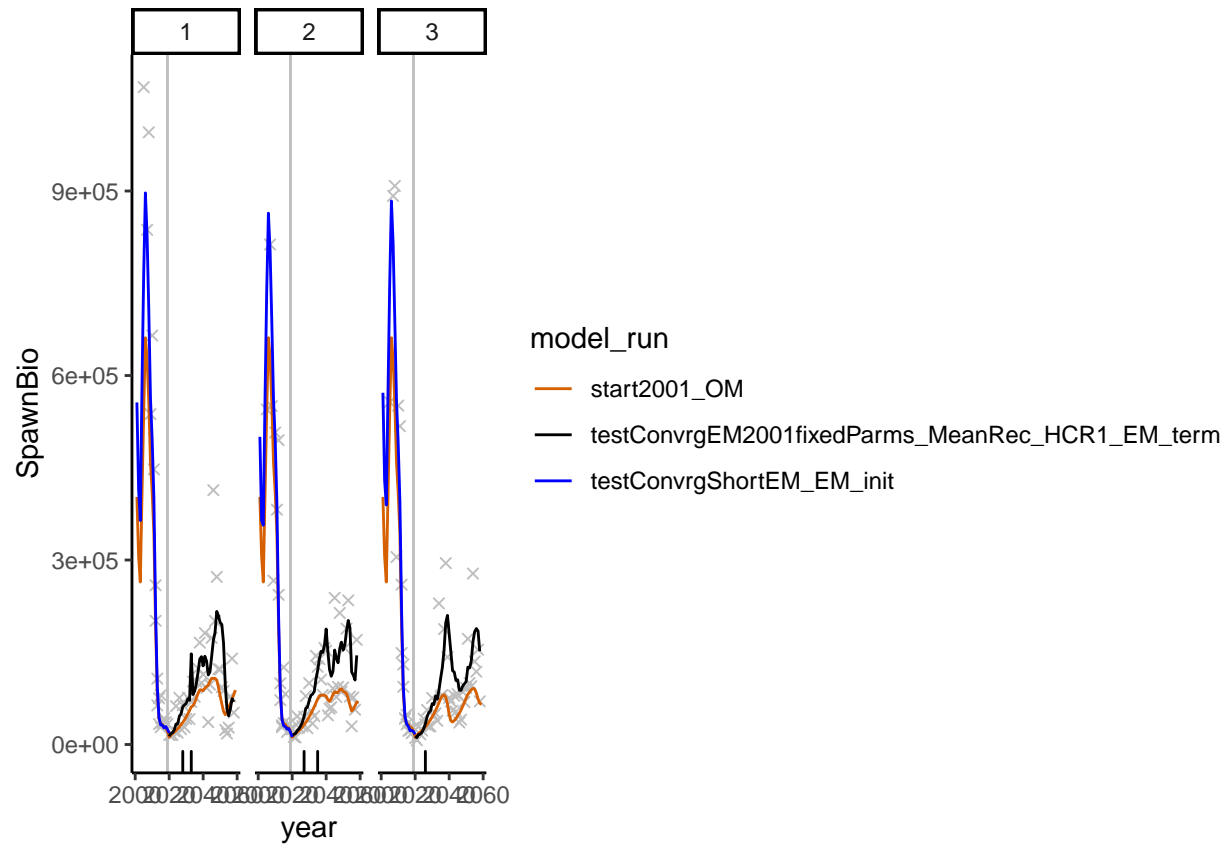
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

meanBio[[1]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)

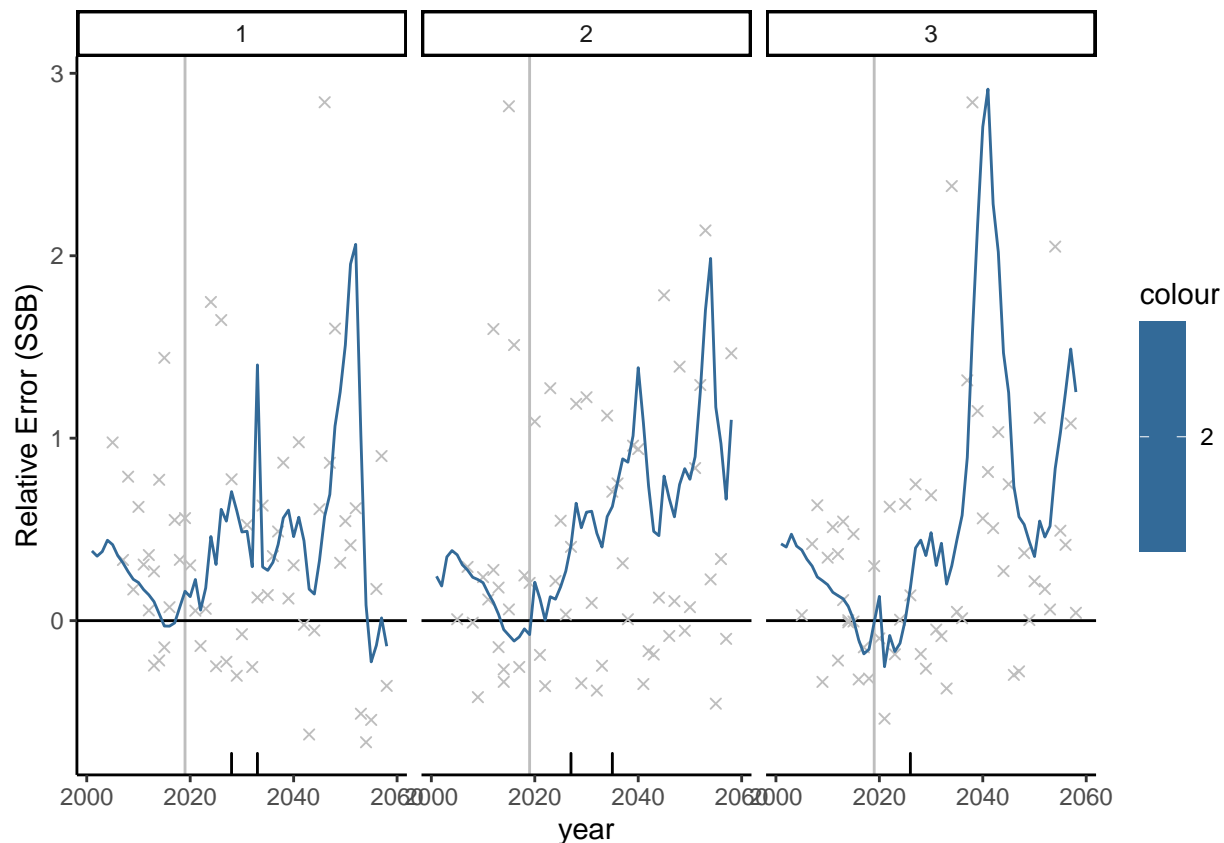
```



```
meanBio[[2]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrgEM2001fixedParms_MeanRec_HCR1",
              termYr = 2058, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```



```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

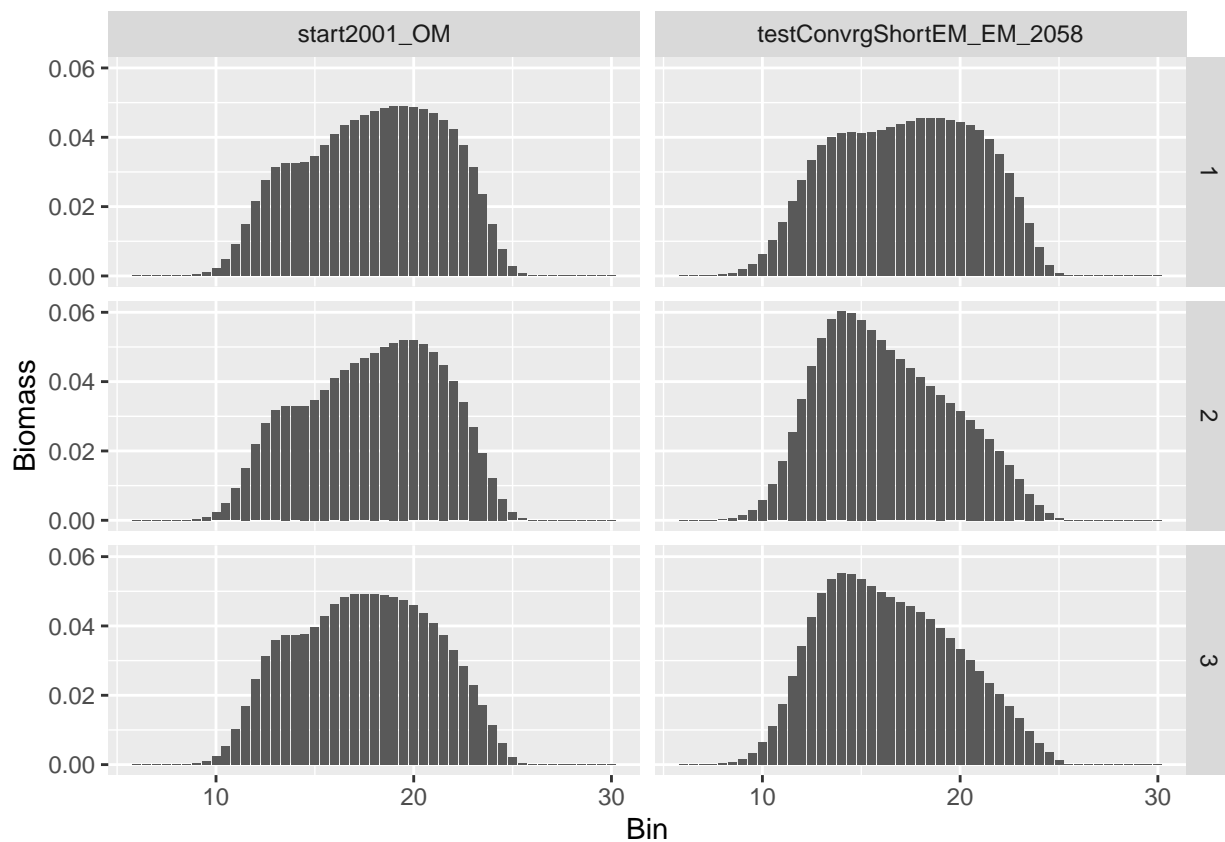
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

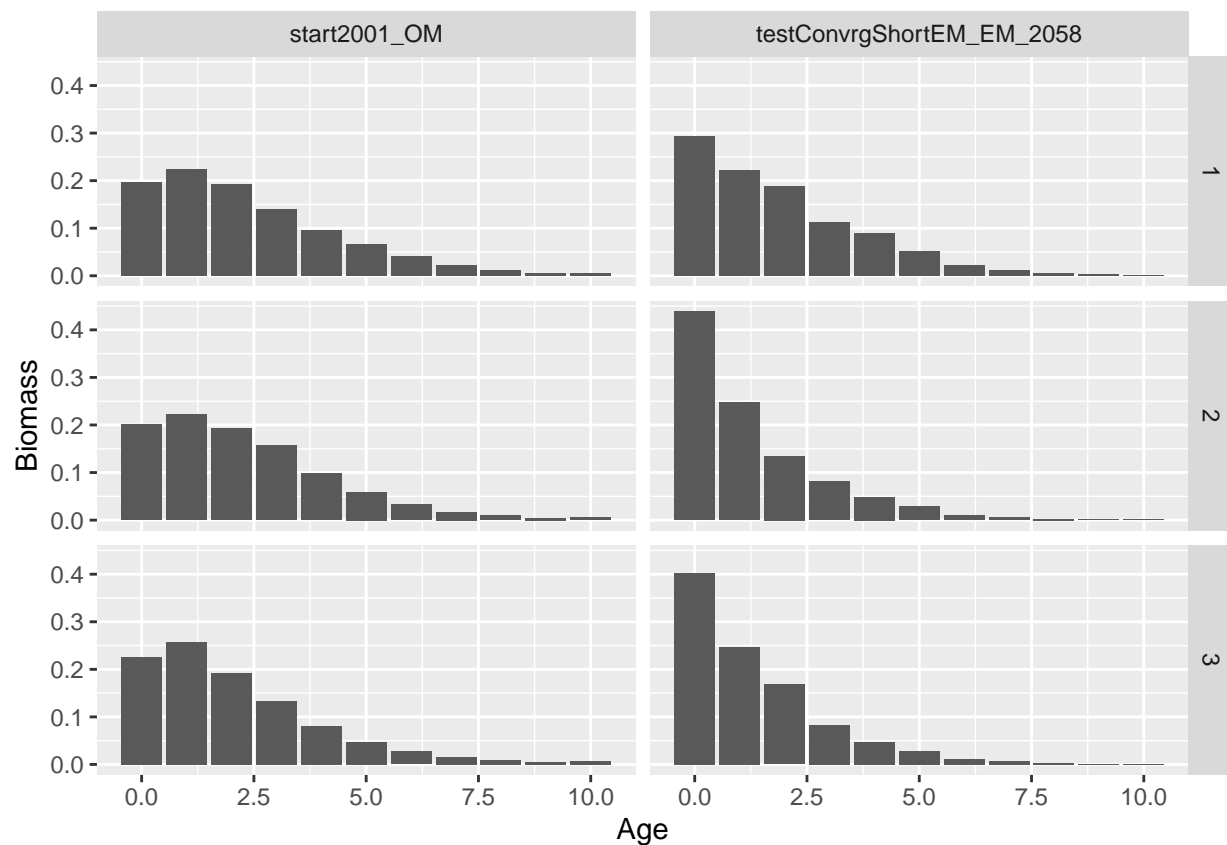
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

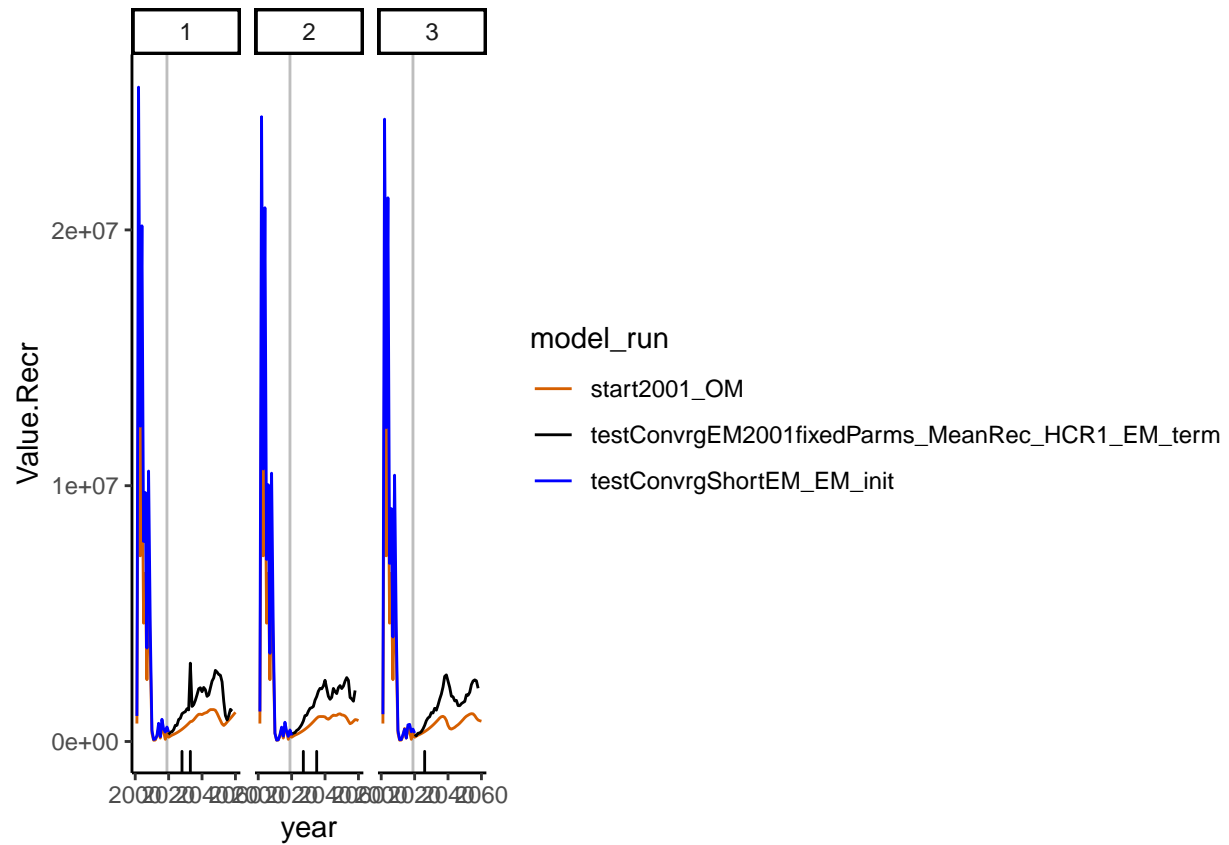
## [[1]]
```



```
##
## [[2]]
```

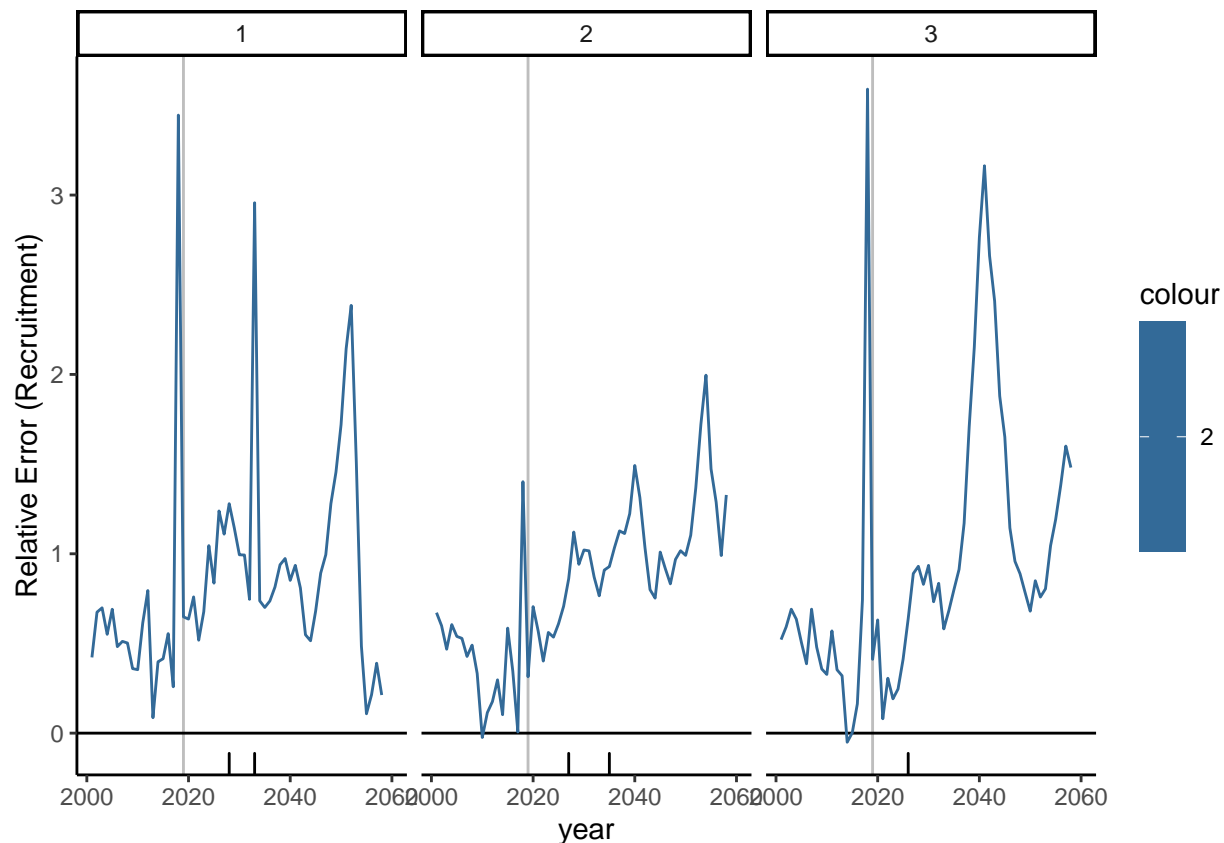


```
meanRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_MeanRec_HCR1", termYr = 2058)
meanRec[[1]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
meanRec[[2]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
meanCat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                          scenario = "testConvrgEM2001fixedParms_MeanRec_HCR1", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

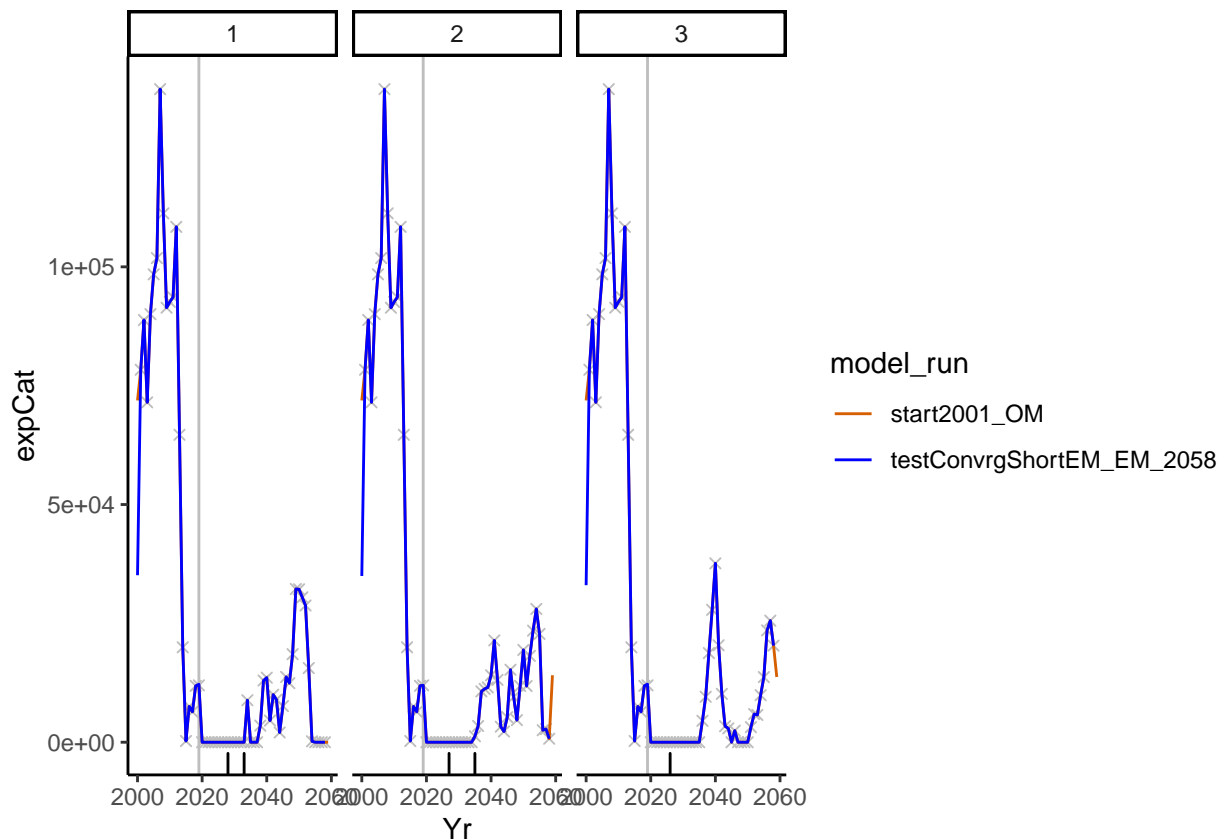
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

meanCat[[1]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)

```



```
meanAge1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001fixedParms_MeanRec_HCR1", termYr = 2058)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of zero variances
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the word 'variance'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of zero variances
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the word 'variance'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of zero variances
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the word 'variance'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of zero variances
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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##      'Variances are 0.0 for first two elements, so do not write '
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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

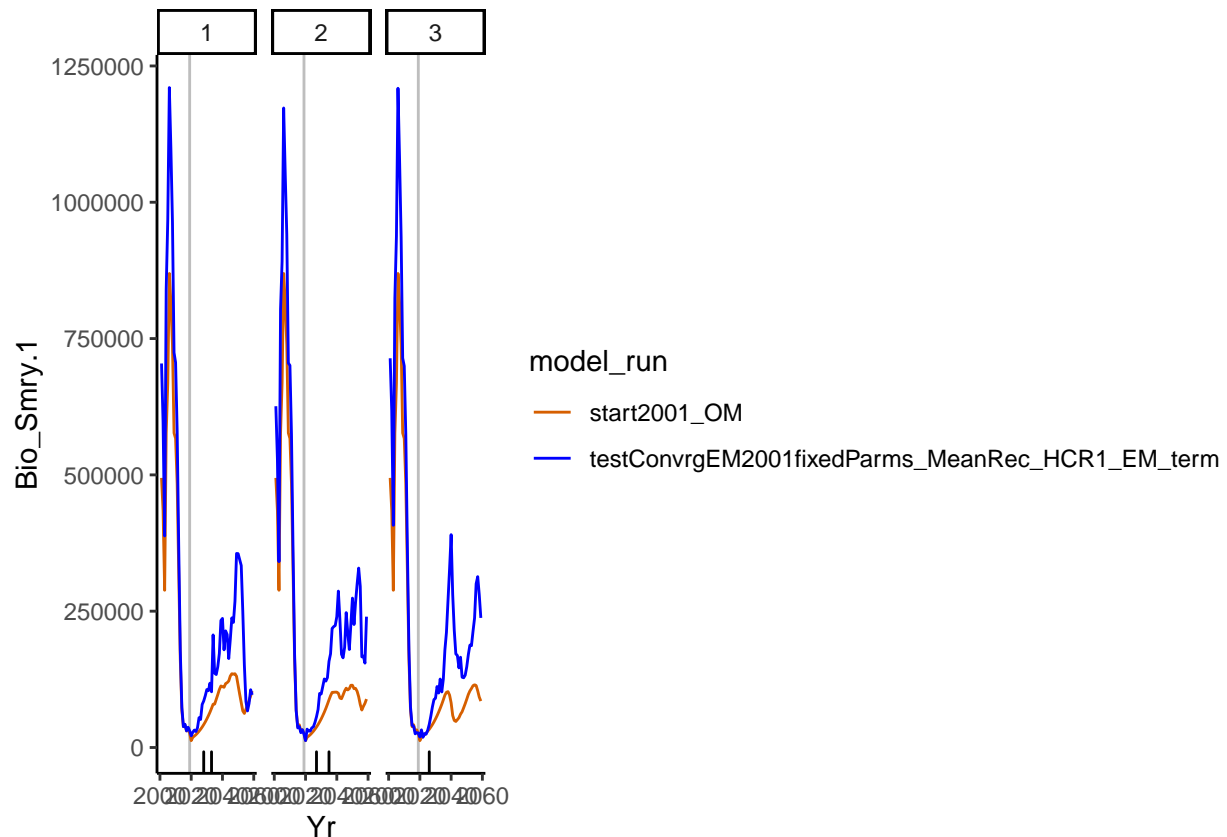
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

```

```
meanAge1Plus[[1]] + geom_rug(data = convrgCheckMeanTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```



Look at dynamics of to see if population crashes

```
meanBioTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001fi
```

```
## Rows: 4920 Columns: 12
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (10): Value.SSB, Value.Recr, Value.SPRratio, Value.F, Value.Bratio, Valu...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
meanBioTest %>% filter(Value.SSB < 1000) %>%
  filter(model_run == "start2001_OM") %>%
  select(year, Value.SSB, Value.Recr, iteration)
```

```
## # A tibble: 0 x 4
## # ... with 4 variables: year <dbl>, Value.SSB <dbl>, Value.Recr <dbl>,
## #   iteration <dbl>
```

Look at recruitment and fishing mortality parameter estimates

```
paramCheckMeanTest <- meanTest %>% select(max_grad, SR_LN_R0, SR_regime, SR_BH_steep,
                                          SR_regime_BLK1repl_2000,
                                          model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheckMeanTest
```

```
## # A tibble: 5 x 8
##   max_grad SR_LN_R0 SR_regime SR_BH_steep SR_regime_BLK1repl_~ model_run iteration
##   <dbl>    <dbl>    <dbl>    <dbl>          <dbl> <chr>          <dbl>
## 1  1.29e 7    15.0        0        0.3          0.788 testConv~      1
## 2  2.36e 4    19.7        0        0.3         -4.05 testConv~      1
## 3  1.42e 3    14.9        0        0.3          0.741 testConv~      2
## 4  4.05e 2    14.9        0        0.3          0.774 testConv~      2
## 5  2.56e15    15.0        0        0.3          0.841 testConv~      3
## # ... with 1 more variable: year <dbl>
```

```
# compare to OM
meanTest %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    14.8        0          0.546 start2001_OM      1  2001
## 2    14.8        0          0.546 start2001_OM      2  2001
## 3    14.8        0          0.546 start2001_OM      3  2001
```

```
meanTestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001")
```

```
## Rows: 9834 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
meanTestFrates <- meanTestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(meanTestFrates)
```

```
##           F_1           F_2           F_3           Seas
## Min.      :0.00000   Min.      :0.00000   Min.      :0.000000   Min.      :1.0
## 1st Qu.:0.00000   1st Qu.:0.00000   1st Qu.:0.000000   1st Qu.:1.0
```

```
## Median :0.00000 Median :0.00000 Median :0.001945 Median :1.5
## Mean :0.03028 Mean :0.13877 Mean :0.123536 Mean :1.5
## 3rd Qu.:0.02960 3rd Qu.:0.08926 3rd Qu.:0.107946 3rd Qu.:2.0
## Max. :0.45619 Max. :4.00002 Max. :2.541820 Max. :2.0
## year model_run iteration scenario
## Min. :2001 Length:9834 Min. :1 Length:9834
## 1st Qu.:2010 Class :character 1st Qu.:1 Class :character
## Median :2020 Mode :character Median :2 Mode :character
## Mean :2022 Mean :2
## 3rd Qu.:2032 3rd Qu.:3
## Max. :2059 Max. :3
```

```
meanTestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
    gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckMeanTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 559 x 13
## F_1 F_2 F_3 Seas year model_run iteration scenario yearEM max_grad
## <dbl> <dbl> <dbl> <dbl> <dbl> <chr> <dbl> <chr> <dbl> <dbl>
## 1 0.121 0 1.55 1 2004 testConvrg~ 1 testCon~ 2033 23562.
## 2 0.0600 0 2.25 1 2005 testConvrg~ 1 testCon~ 2033 23562.
## 3 0.0406 0 1.02 1 2005 testConvrg~ 2 testCon~ 2023 NA
## 4 0.0409 0 1.04 1 2005 testConvrg~ 2 testCon~ 2024 NA
## 5 0.0405 0 1.02 1 2005 testConvrg~ 2 testCon~ 2025 NA
## 6 0.0412 0 1.05 1 2005 testConvrg~ 2 testCon~ 2026 NA
## 7 0.0413 0 1.05 1 2005 testConvrg~ 2 testCon~ 2027 1416.
## 8 0.0422 0 1.07 1 2005 testConvrg~ 2 testCon~ 2028 NA
## 9 0.0411 0 1.07 1 2005 testConvrg~ 2 testCon~ 2029 NA
## 10 0.0418 0 1.09 1 2005 testConvrg~ 2 testCon~ 2030 NA
## # ... with 549 more rows, and 3 more variables: params_on_bound <lgl>,
## # params_stuck_low <chr>, params_stuck_high <lgl>
```

Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001fixedd")
```

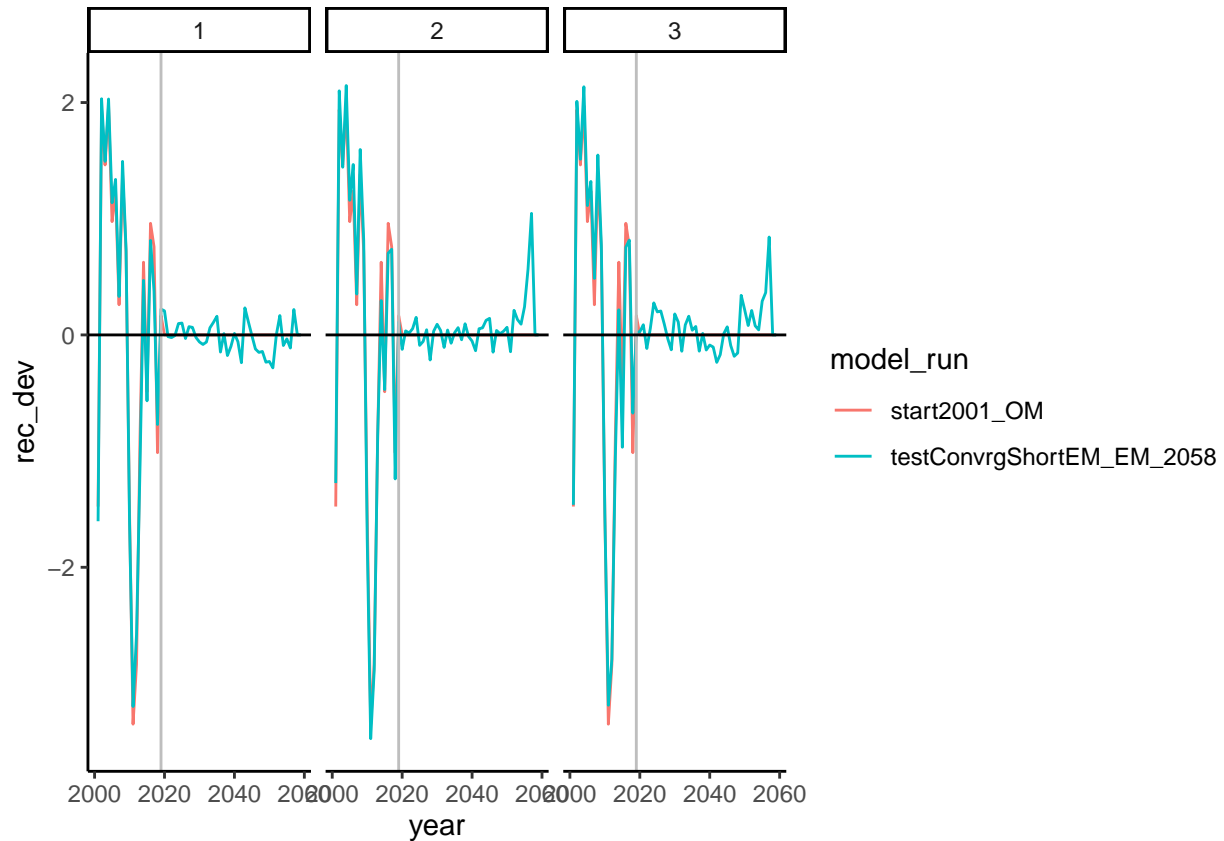
```
## Rows: 9834 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2058", model_run)) %>%
  filter(complete.cases())
```

```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
```



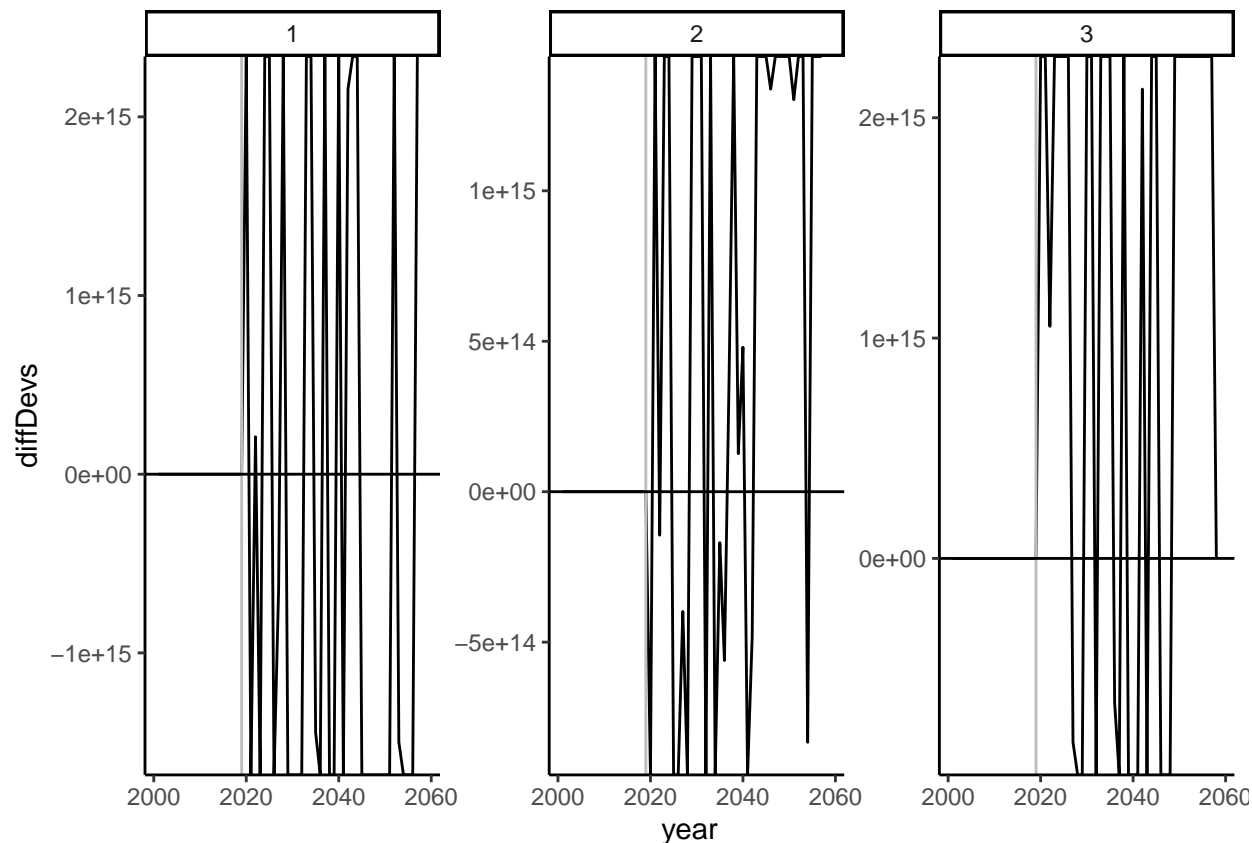
```
ggplot2::facet_wrap(. ~ iteration) +
ggplot2::geom_vline(xintercept = 2019, color = "gray") +
geom_hline(yintercept = 0, color = "black") +
ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrShortEM_EM_2058 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
ggplot2::facet_wrap(. ~ iteration, scales = "free") +
ggplot2::geom_vline(xintercept = 2019, color = "gray") +
geom_hline(yintercept = 0, color = "black") +
ggplot2::theme_classic()
```

```
## Warning: Removed 1 row(s) containing missing values (geom_path).
```



EM 2001 self test, recruitment at $SD = 1$

Look at years of no convergence and parameter bounds

```
sd1Test <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeM2001_1SDRa
```

```
## Rows: 153 Columns: 205
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl (198): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl   (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgeCheck1SDTest <- sd1Test %>% select(max_grad, params_on_bound,
                                         params_stuck_low, params_stuck_high,
                                         model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       grexpr("[[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

convrgeCheck1SDTest
```

```
## # A tibble: 90 x 7
##       max_grad params_on_bound params_stuck_low params_stuck_high model_run
##       <dbl> <lgl>           <chr>           <chr>           <chr>
## 1    4391.    NA              <NA>           <NA>           testConvrgSh~
## 2   284075    NA              <NA>           <NA>           testConvrgSh~
## 3    90471    NA             CV_old_Fem_GP_1 <NA>           testConvrgSh~
## 4    2918.    NA              <NA>           <NA>           testConvrgSh~
## 5   719031    NA              <NA>           <NA>           testConvrgSh~
## 6   303074    NA              <NA>           <NA>           testConvrgSh~
## 7    18630.    NA              <NA>           <NA>           testConvrgSh~
## 8  1221050    NA              <NA>           <NA>           testConvrgSh~
## 9      0.0395 NA              <NA>           <NA>           testConvrgSh~
## 10  121312    NA              <NA>           <NA>           testConvrgSh~
## # ... with 80 more rows, and 2 more variables: iteration <dbl>, year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
sd1Bio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001_1SDRandRec_HCR1",
  termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0
```

```
## N_environ_variables: 0
```

```
## Read of section 1 of data file complete. Final value = 999
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections.  Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections.  Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

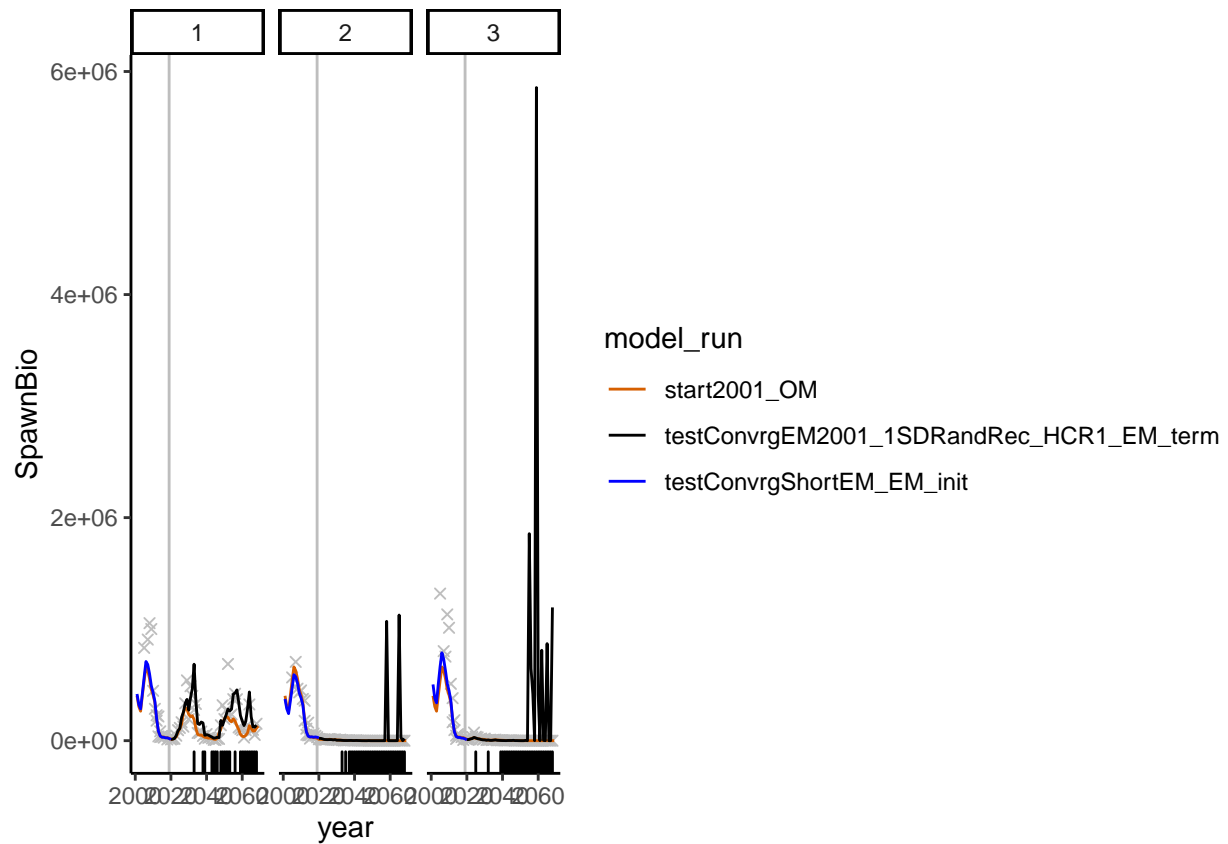
## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999
```

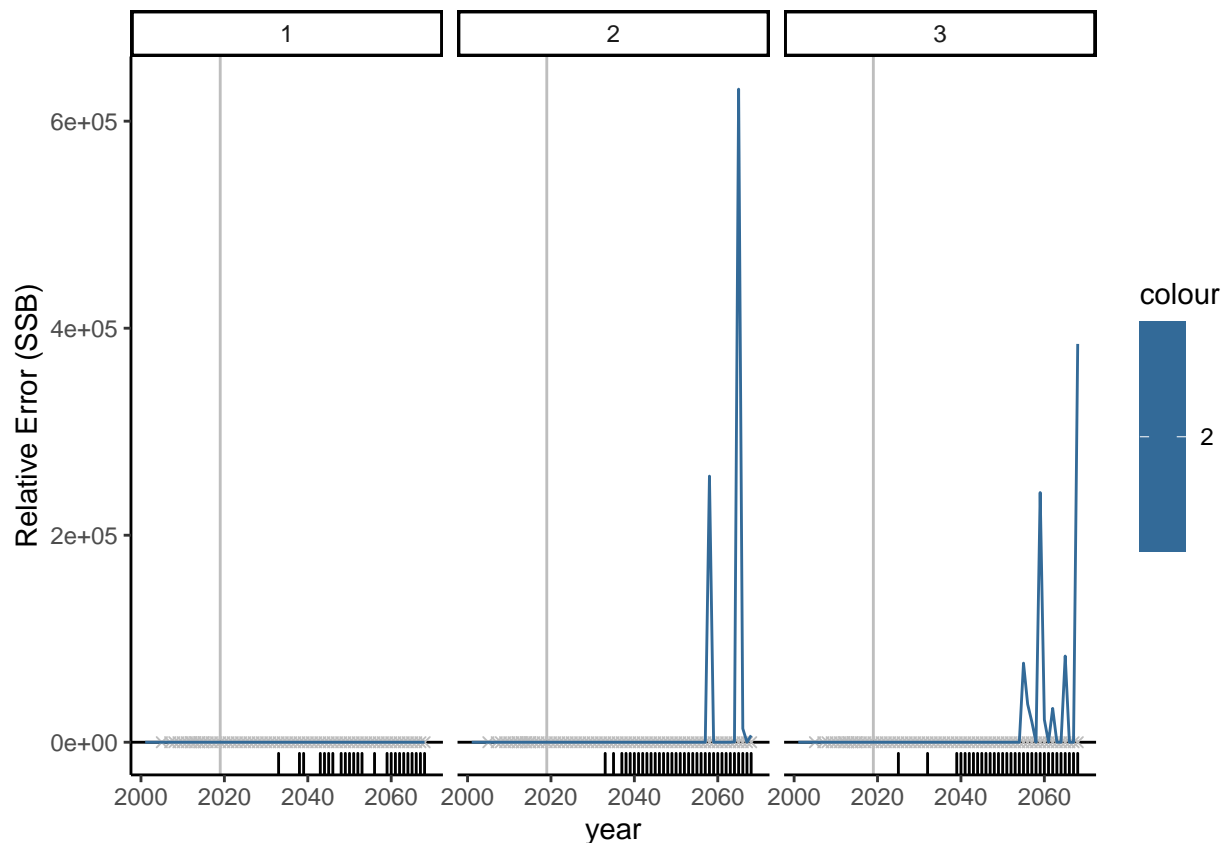
```
sd1Bio[[1]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
                      sides = "b", inherit.aes = FALSE)
```



```
sd1Bio[[2]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
                      sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrgeM2001_1SDRandRec_HCR1",
              termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

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##      'Variances are 0.0 for first two elements, so do not write '
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##      input 'covar' changed to FALSE.
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```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
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## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
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##      'Variances are 0.0 for first two elements, so do not write '
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```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
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```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

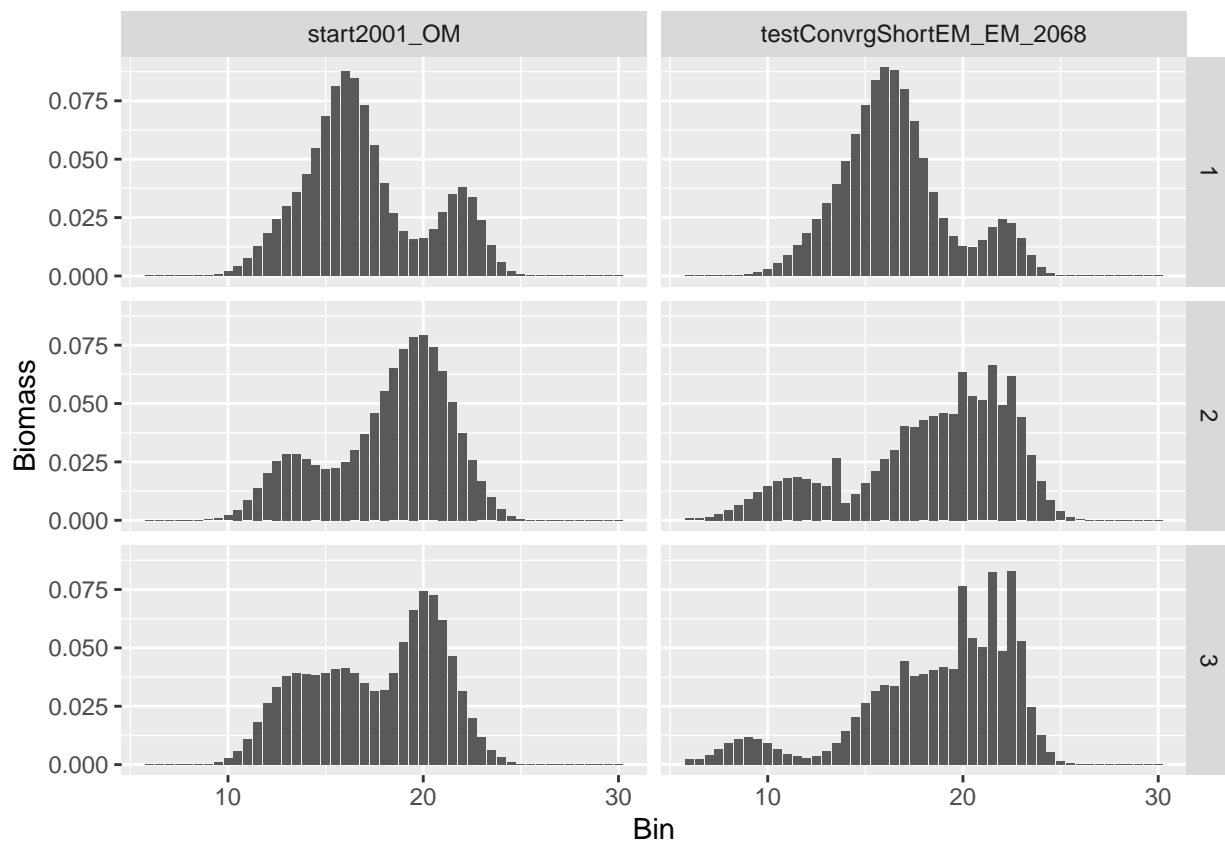
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

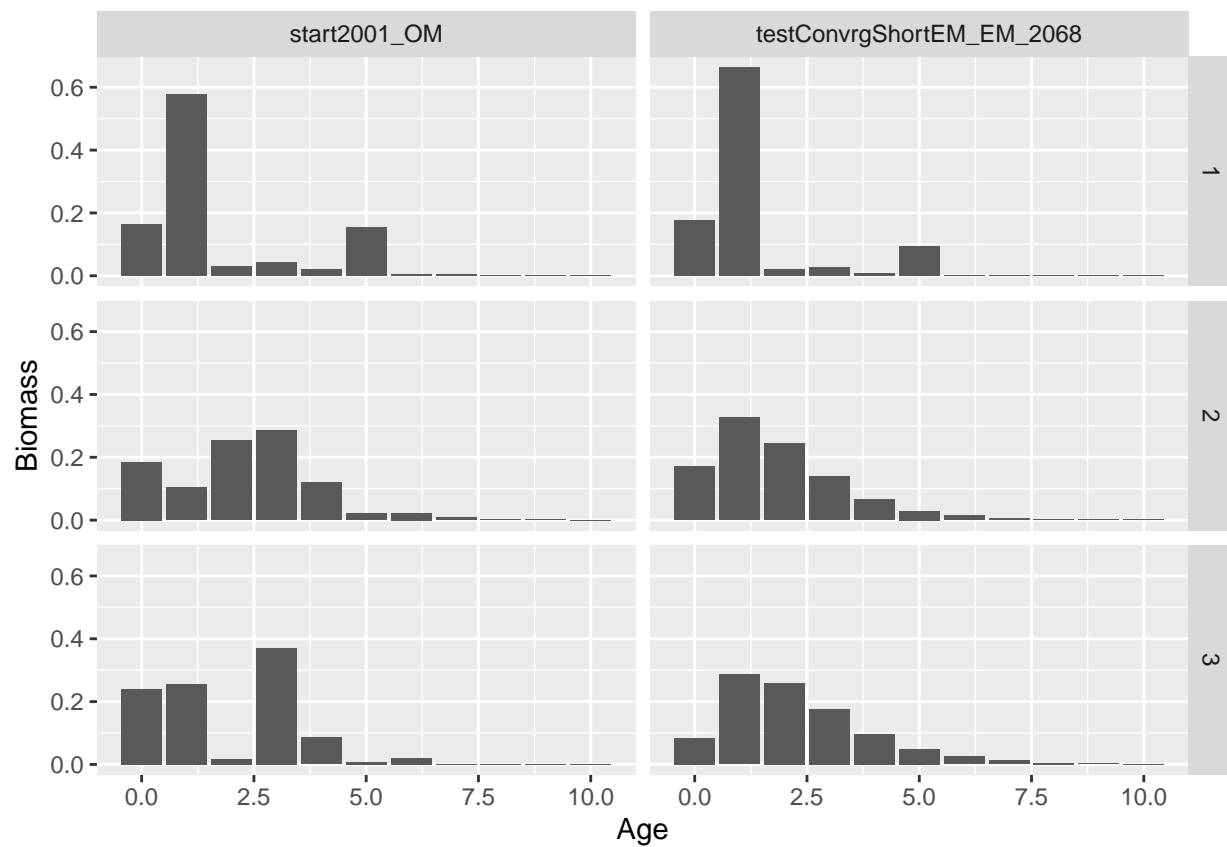
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

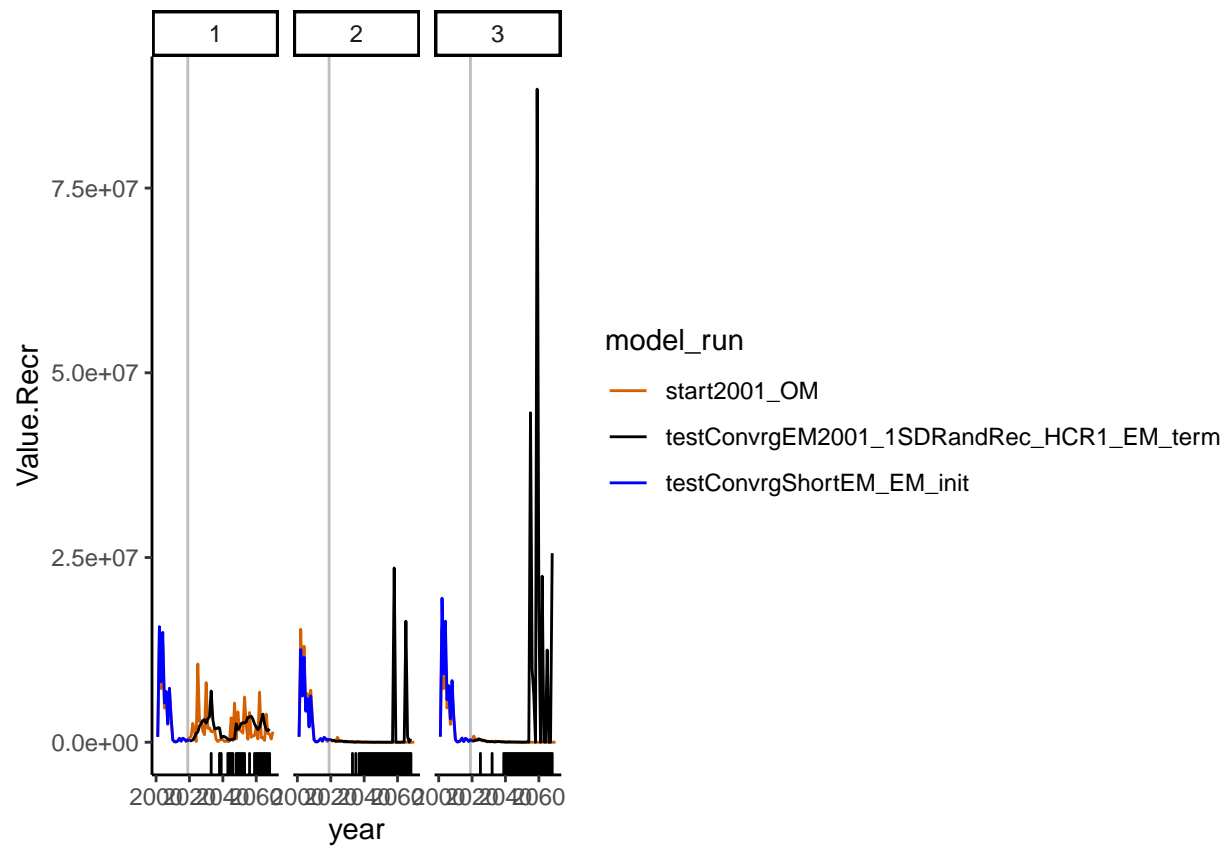
## [[1]]
```



```
##
## [[2]]
```

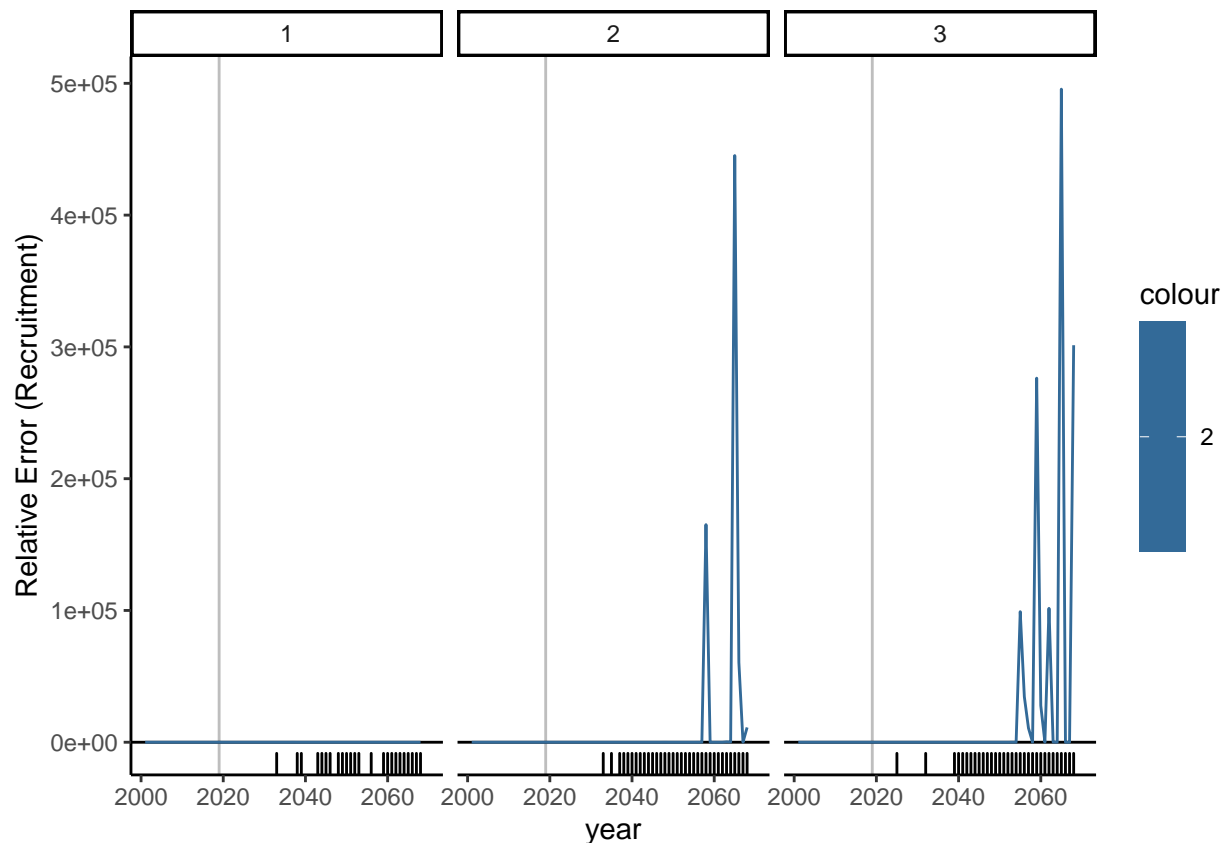


```
sdlRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001_1SDRandRec_HCR1", termYr = 2068)
sdlRec[[1]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
sd1Rec[[2]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
                        sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
sd1Cat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2001_1SDRandRec_HCR1", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
```

```
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

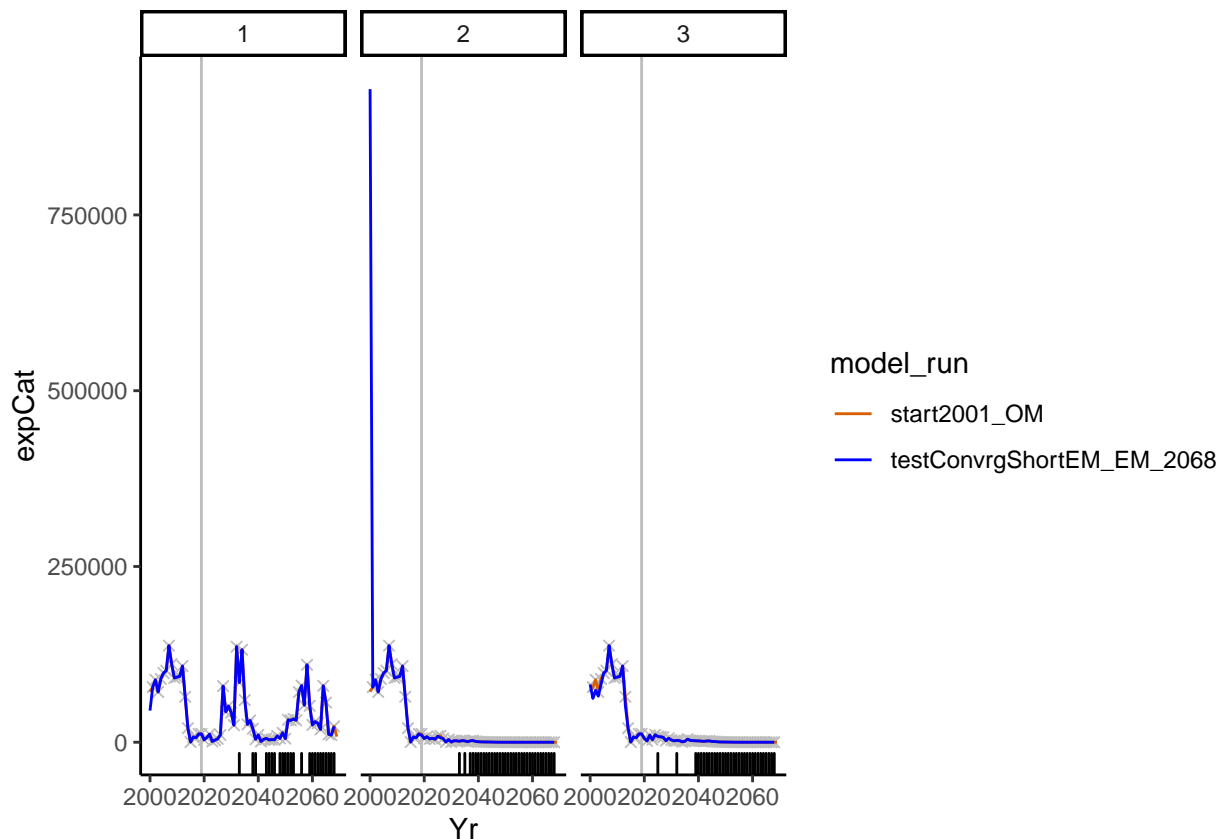
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

sd1Cat[[1]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
                      sides = "b", inherit.aes = FALSE)

```



```
sd1Age1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                                scenario = "testConvrgEM2001_1SDRandRec_HCR1", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
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```
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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

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##      input 'covar' changed to FALSE.

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## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because
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```

```

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
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##      input 'covar' changed to FALSE.
```

```

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```

```
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```

```

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##      'Variances are 0.0 for first two elements, so do not write '
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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

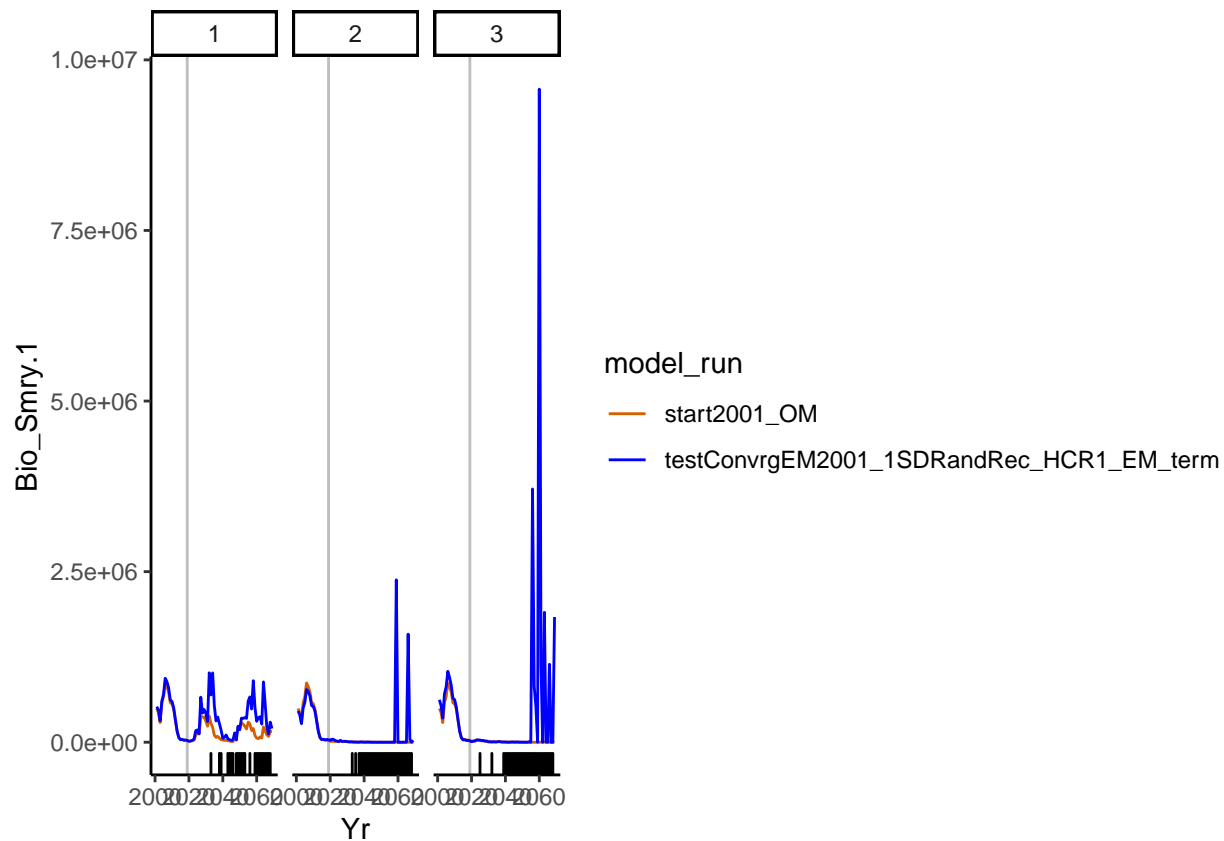
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

sd1Age1Plus[[1]] + geom_rug(data = convrgCheck1SDTest, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)

```



Look at recruitment and fishing mortality parameter estimates

```
paramCheck1SDTest <- sd1Test %>% select(max_grad, SR_LN_R0, SR_regime,
                                         SR_regime_BLK1repl_2000,
                                         model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheck1SDTest
```

```
## # A tibble: 90 x 7
##       max_grad SR_LN_R0 SR_regime SR_regime_BLK1repl~ model_run iteration year
##       <dbl>   <dbl>   <dbl>         <dbl> <chr>         <dbl> <dbl>
## 1    4391.    19.4     0          -4.29 testConv~      1 2033
## 2   284075    21.4     0          -6.29 testConv~      1 2038
## 3    90471    15.8     0         -0.588 testConv~      1 2039
## 4    2918.    15.4     0         -0.146 testConv~      1 2043
## 5   719031    16.2     0         -0.665 testConv~      1 2044
## 6   303074    17.5     0         -2.00 testConv~      1 2045
## 7    18630.    15.8     0         -0.452 testConv~      1 2046
## 8  1221050    17.6     0         -2.21 testConv~      1 2048
## 9      0.0395    14.8     0          0.894 testConv~      1 2049
## 10  121312    15.2     0          0.154 testConv~      1 2050
## # ... with 80 more rows
```



```
# compare to OM
sd1Test %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                      gregexpr("[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    14.8        0            0.546 start2001_OM         1  2001
## 2    14.8        0            0.546 start2001_OM         2  2001
## 3    14.8        0            0.546 start2001_OM         3  2001
```

```
sd1TestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001.
```

```
## Rows: 13764 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
sd1TestFrates <- sd1TestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(sd1TestFrates)
```

```
##      F_1          F_2          F_3          Seas
## Min.   :0.00000   Min.   :0.0000   Min.   :-2.620090   Min.   :1.0
## 1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.: 0.001077   1st Qu.:1.0
## Median :0.00000   Median :0.0000   Median : 0.021151   Median :1.5
## Mean   :0.10903   Mean   :0.4030   Mean   : 0.329244   Mean   :1.5
## 3rd Qu.:0.08061   3rd Qu.:0.3875   3rd Qu.: 0.291724   3rd Qu.:2.0
## Max.   :4.00003   Max.   :4.0000   Max.   : 4.000030   Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :2001   Length:13764   Min.   :1   Length:13764
## 1st Qu.:2012   Class :character   1st Qu.:1   Class :character
## Median :2023   Mode  :character   Median :2   Mode  :character
## Mean   :2025                      Mean   :2
## 3rd Qu.:2037                      3rd Qu.:3
## Max.   :2069                      Max.   :3
```

```
sd1TestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                      gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheck1SDTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 3,642 x 13
##      F_1  F_2  F_3 Seas year model_run iteration scenario yearEM max_grad
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>          <dbl> <chr>          <dbl>    <dbl>
```

```
## 1 0.659    0 1.62      1 2001 testConvrgS~      2 testCon~ 2052 1.95e6
## 2 0.644    0 1.00      1 2001 testConvrgS~      2 testCon~ 2055 2.37e6
## 3 0.129    0 4        1 2001 testConvrgS~      2 testCon~ 2058 2.81e6
## 4 0.163    0 4        1 2001 testConvrgS~      2 testCon~ 2063 7.20e4
## 5 0.625    0 4        1 2001 testConvrgS~      2 testCon~ 2064 1.15e8
## 6 0.194    0 4        1 2001 testConvrgS~      2 testCon~ 2065 1.39e6
## 7 0.206    0 4        1 2001 testConvrgS~      2 testCon~ 2066 3.28e5
## 8 1.08     0 4.00     1 2001 testConvrgS~      2 testCon~ 2067 6.71e7
## 9 0.228    0 1.57     1 2001 testConvrgS~      2 testCon~ 2068 3.33e4
## 10 1.00     0 0.698   1 2001 testConvrgS~      3 testCon~ 2046 1.56e7
## # ... with 3,632 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <chr>
```

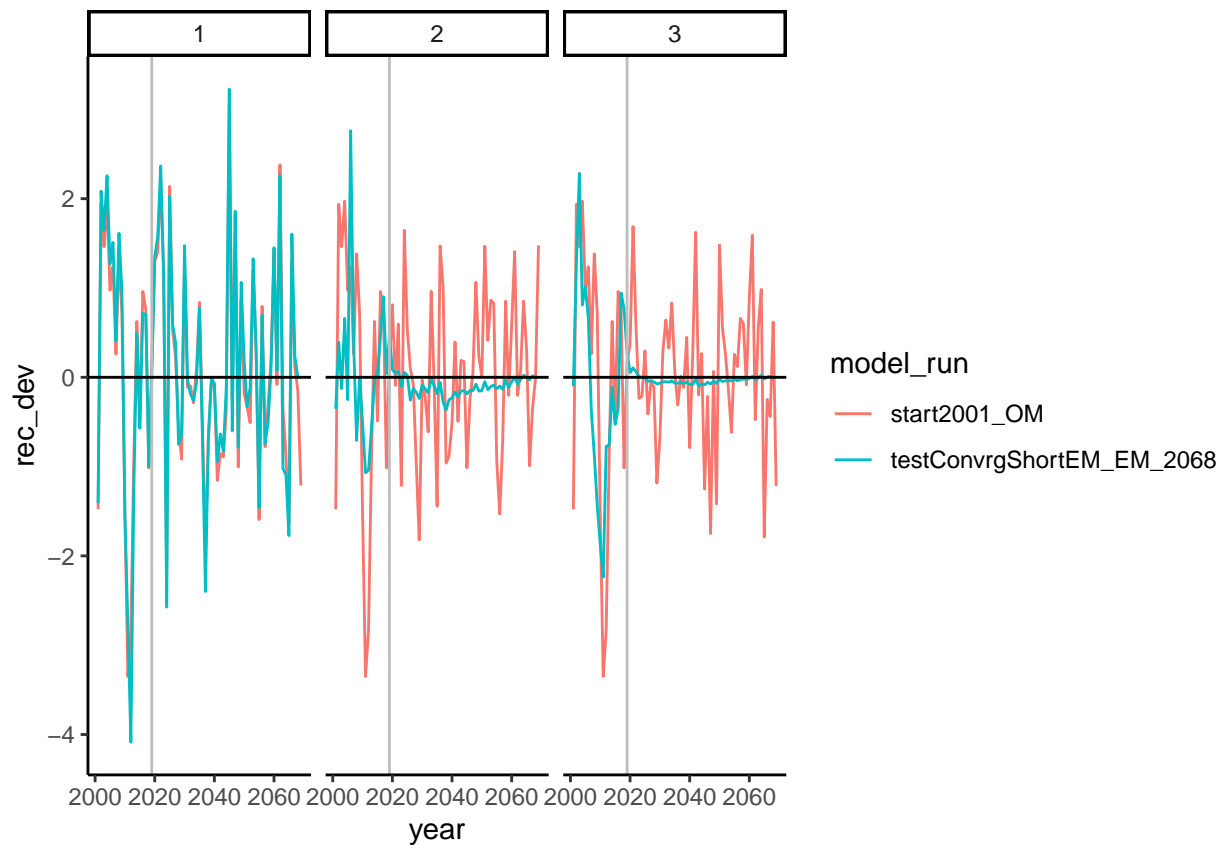
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2001_1SDR")
```

```
## Rows: 13764 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

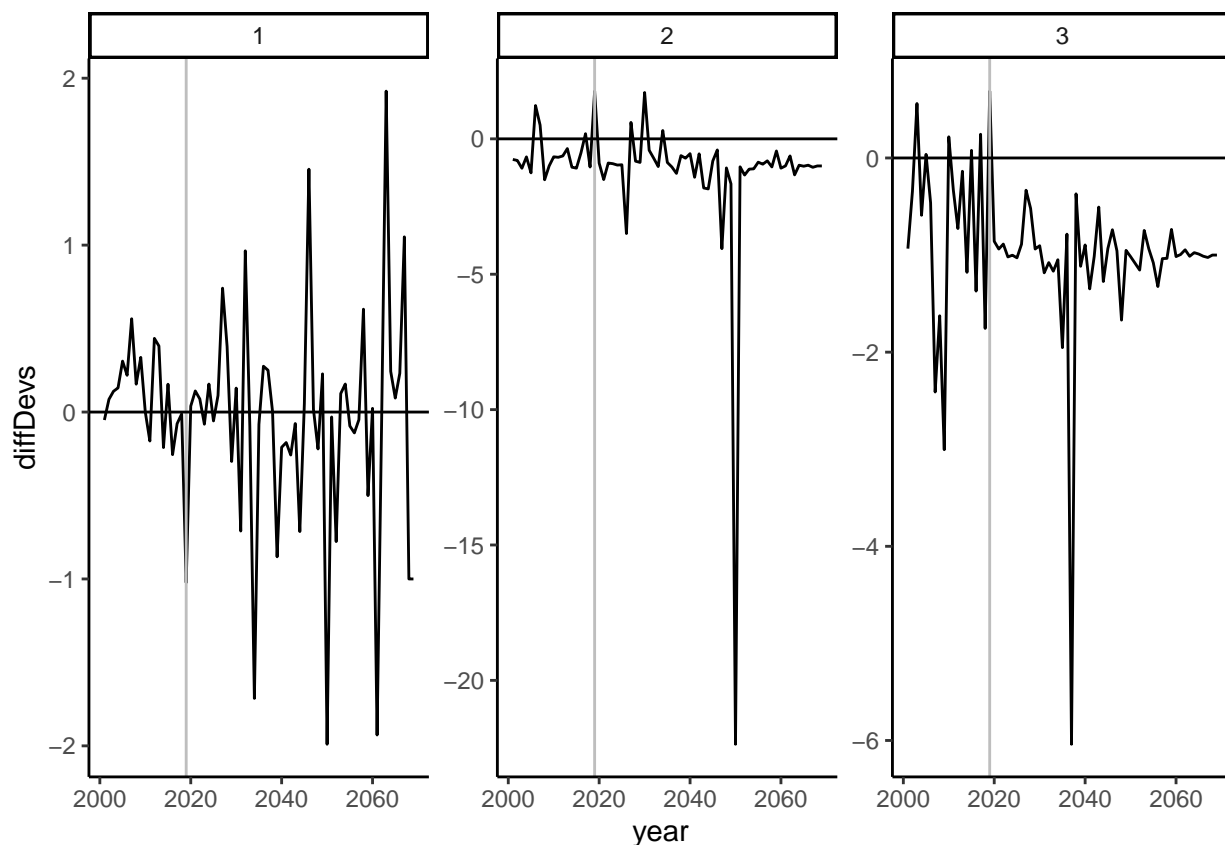
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2068", model_run)) %>%
  filter(complete.cases(.))
```

```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrShortEM_EM_2068 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration, scales = "free") +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



OM_K 1981 self test, EM management strategy

Look at years of no convergence and parameter bounds

```
omkselfTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgOM_KselfTest.csv")
```

```
## Rows: 153 Columns: 352
## -- Column specification -----
## Delimiter: ","
## chr   (3): version, model_run, scenario
## dbl (344): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl   (5): alt_sigma_r, params_on_bound, params_stuck_low, params_stuck_high...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgCheckOMKselfTest <- omkselfTest %>% select(max_grad, params_on_bound,
                                                params_stuck_low, params_stuck_high,
                                                model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]+", model_run)))) %>%
  filter(max_grad > 0.01)

convrgCheckOMKselfTest
```

```
## # A tibble: 0 x 7
## # ... with 7 variables: max_grad <dbl>, params_on_bound <lgl>,
## #   params_stuck_low <lgl>, params_stuck_high <lgl>, model_run <chr>,
## #   iteration <dbl>, year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
omkselfBio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgOM_Kself_RandRec_EM",
  termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 3 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0
```

```
## N_environ_variables: 2
```

```
## Read of section 1 of data file complete. Final value = 999
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 3 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 2

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 3 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

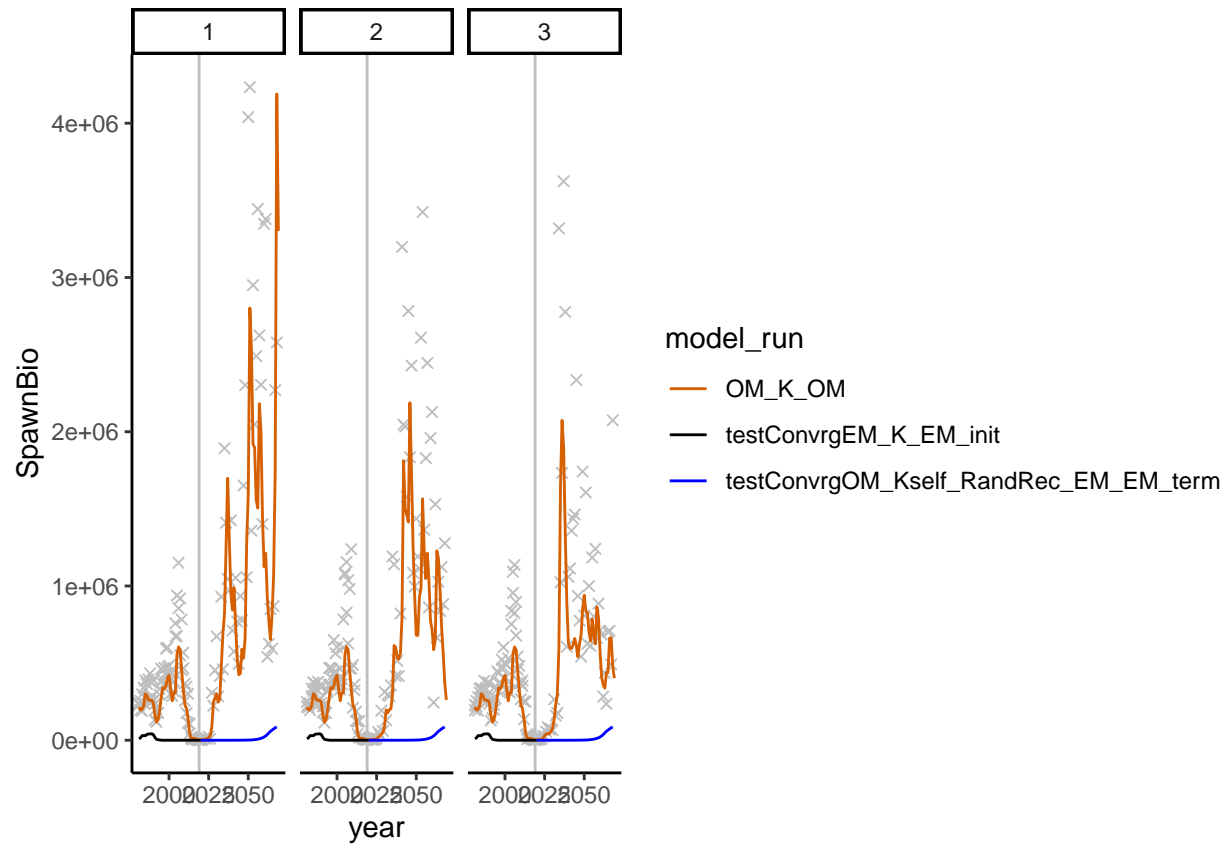
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 2

## Read of section 1 of data file complete. Final value = 999

omkselfBio[[1]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
                           sides = "b", inherit.aes = FALSE)

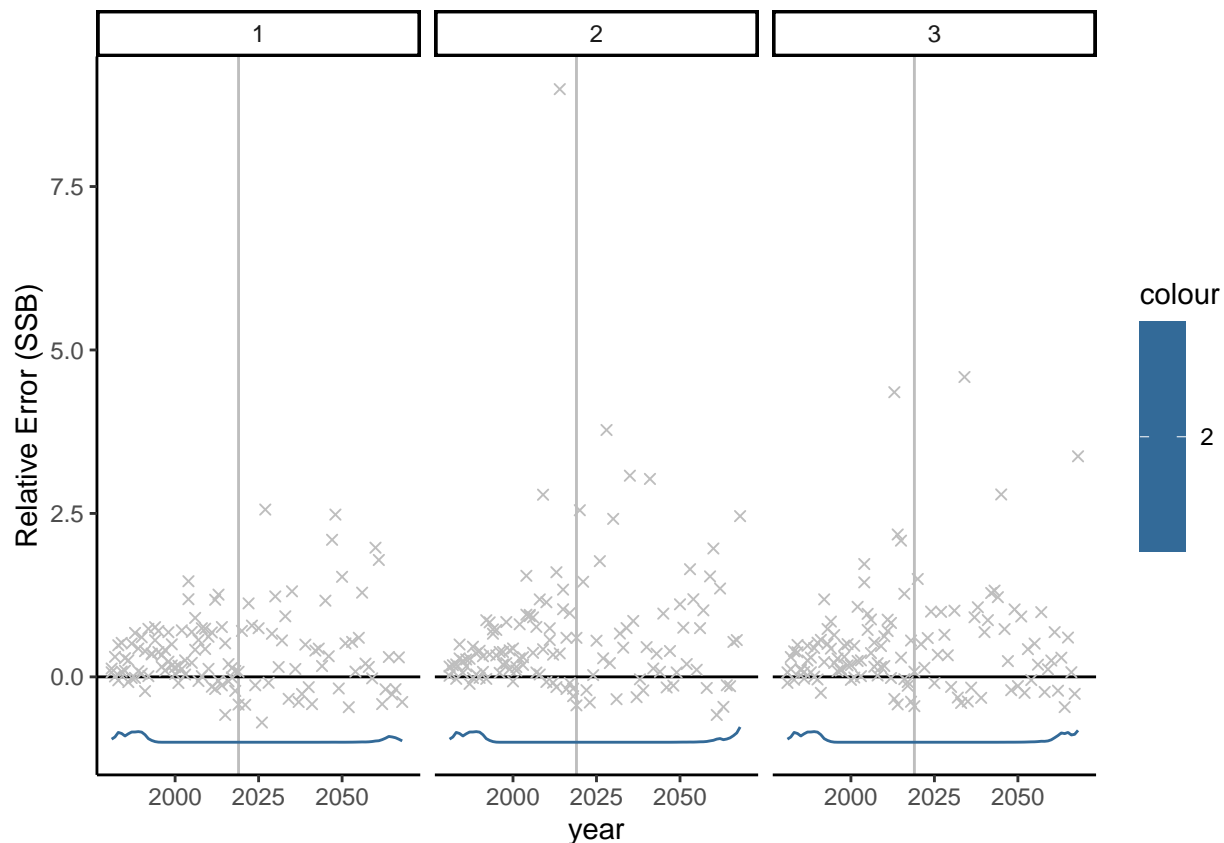
```



```
omkselfBio[[2]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrOM_Kself_RandRec_EM",
              termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```



```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

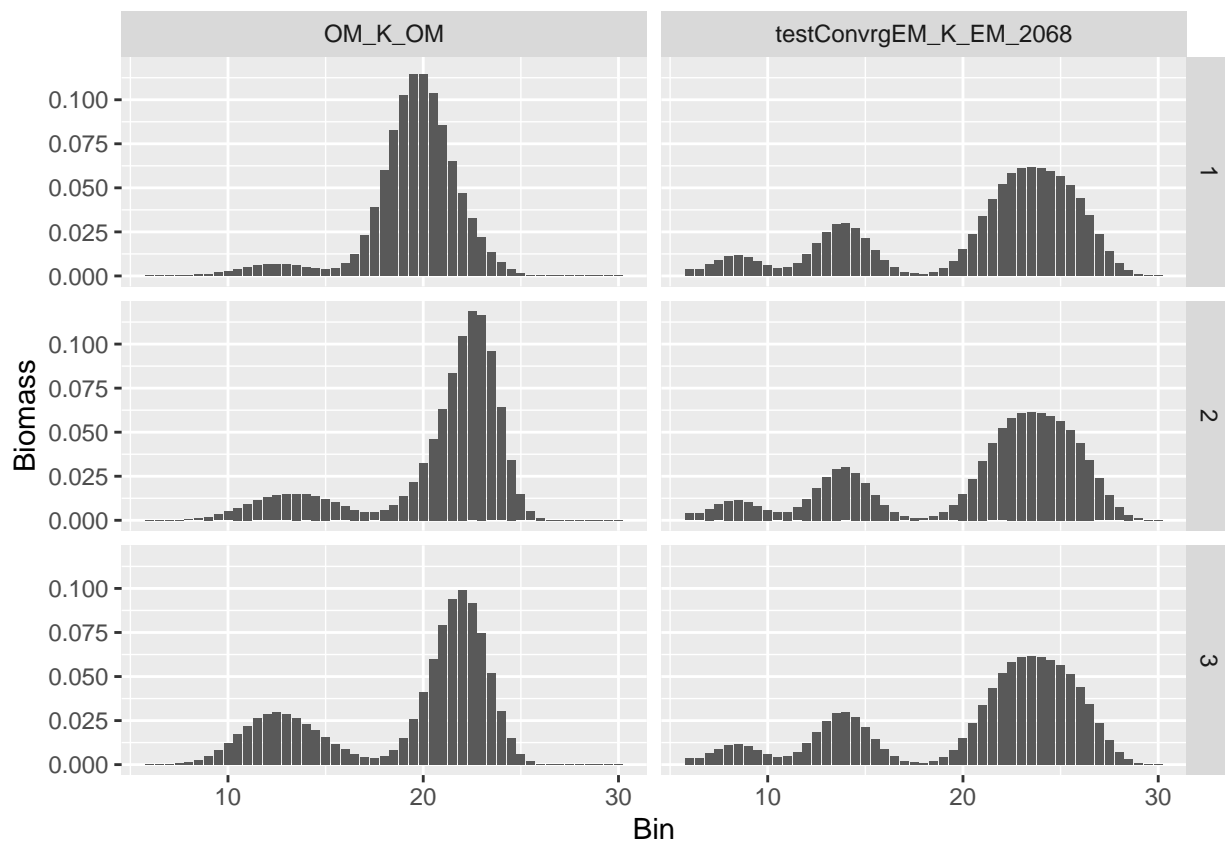
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

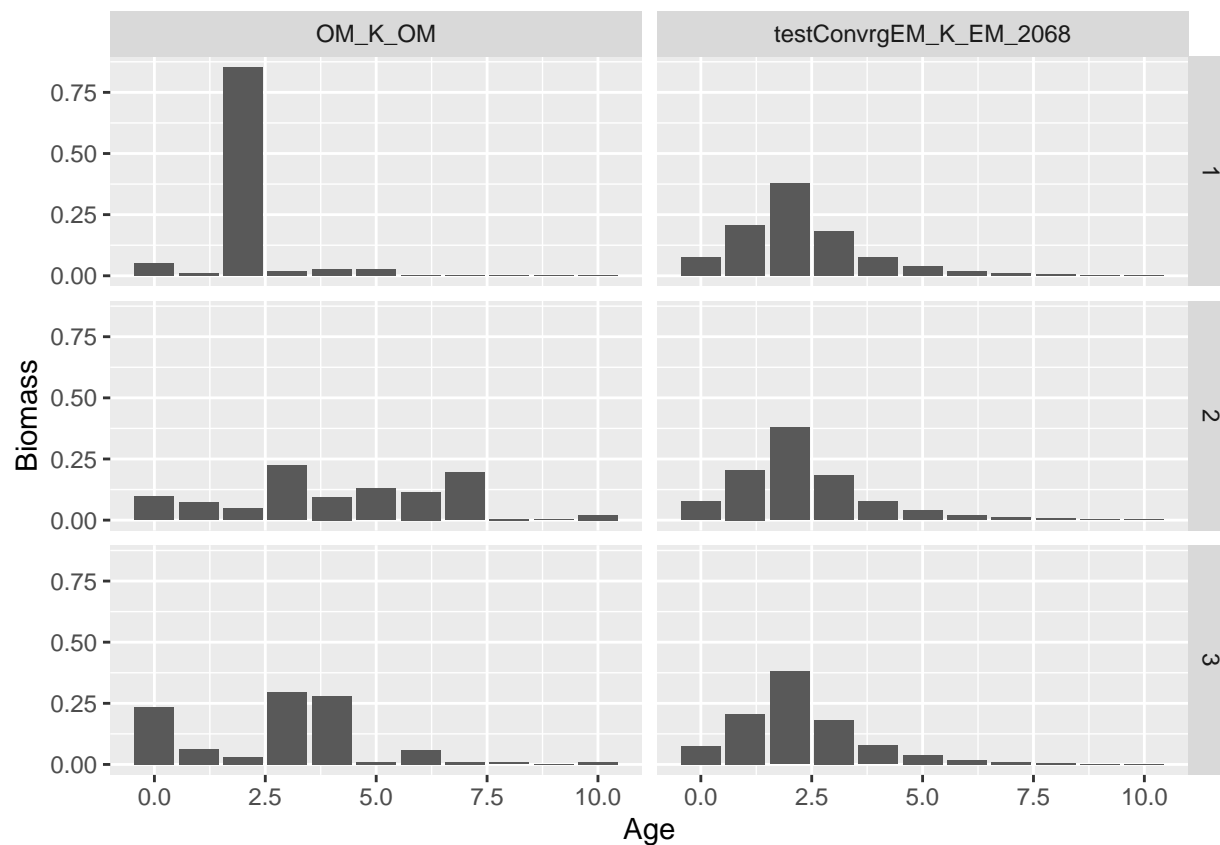
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

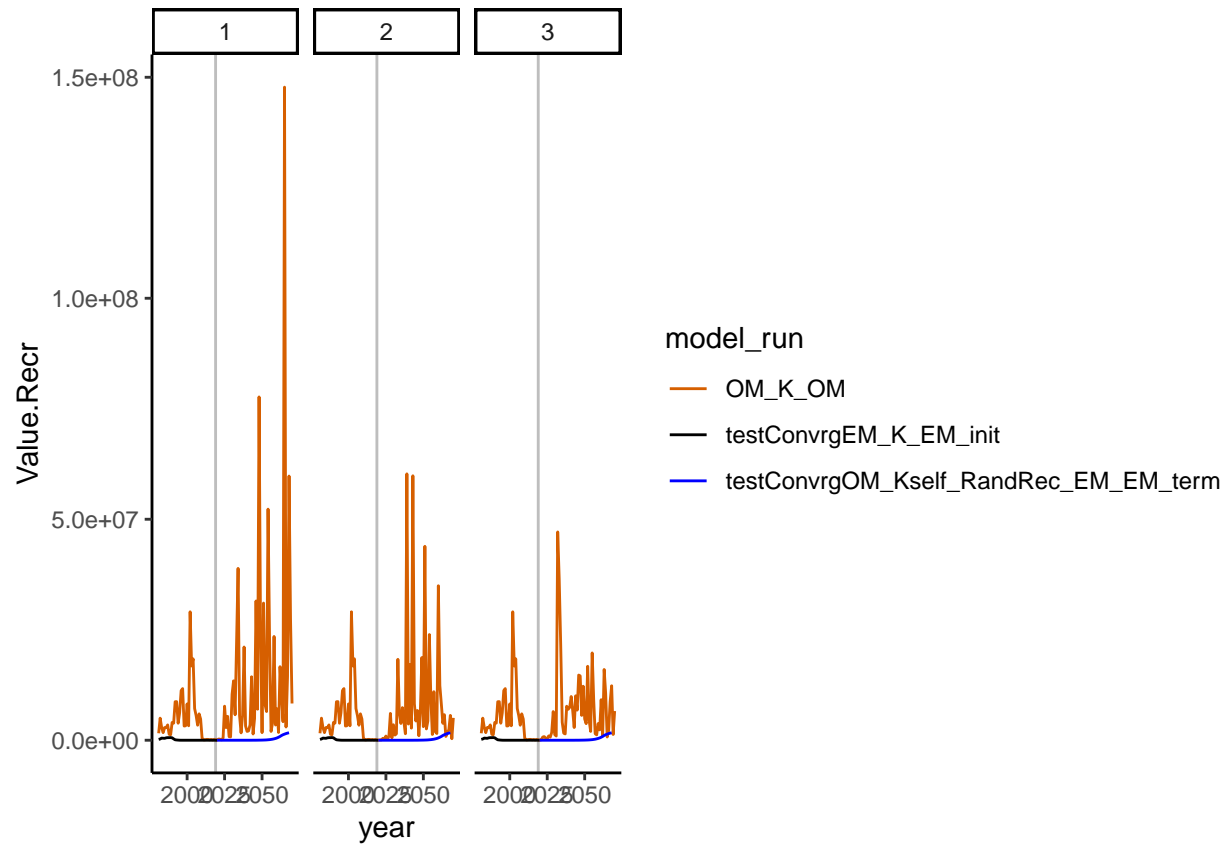
## [[1]]
```



```
##
## [[2]]
```

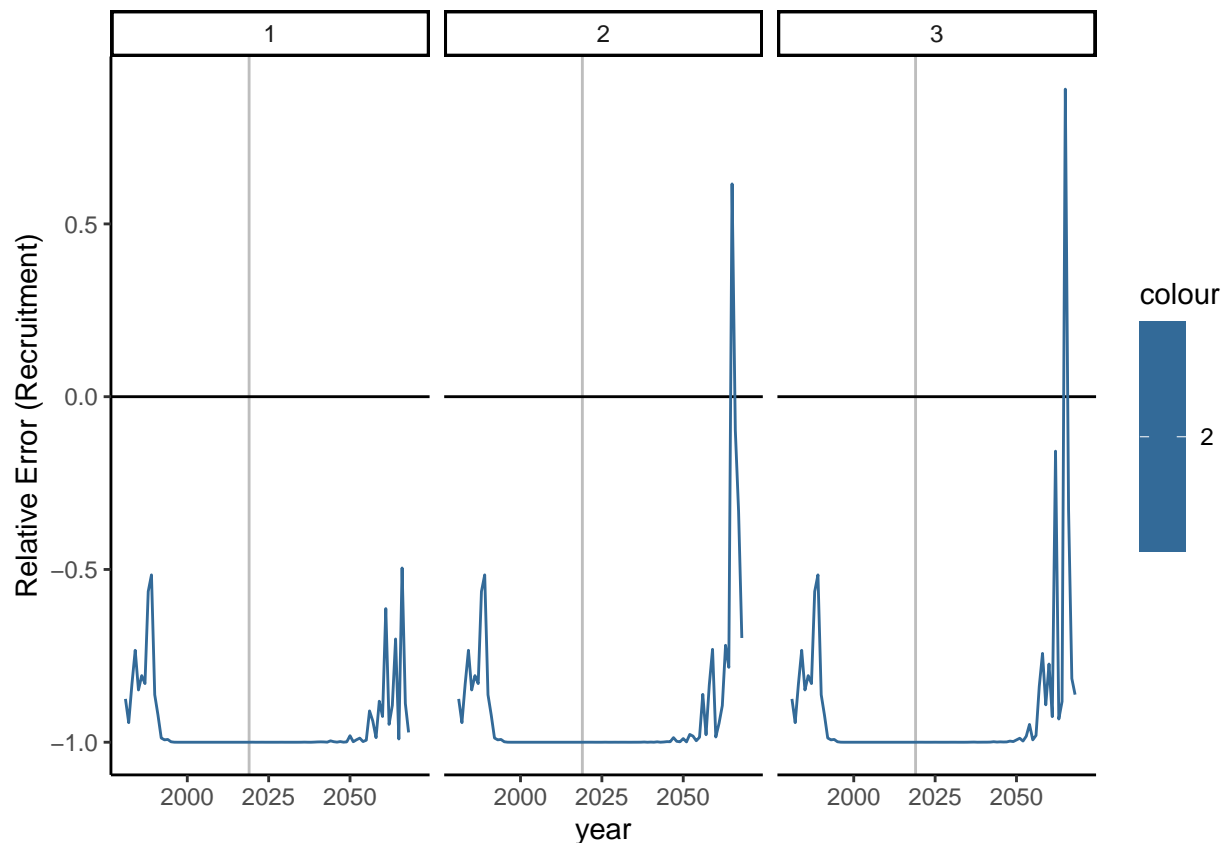


```
omkselfRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgOM_Kself_RandRec_EM", termYr = 2068)
omkselfRec[[1]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
omkselfRec[[2]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
omkselfCat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                             scenario = "testConvrgOM_Kself_RandRec_EM", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 3 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 2

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 3 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 2

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 3 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

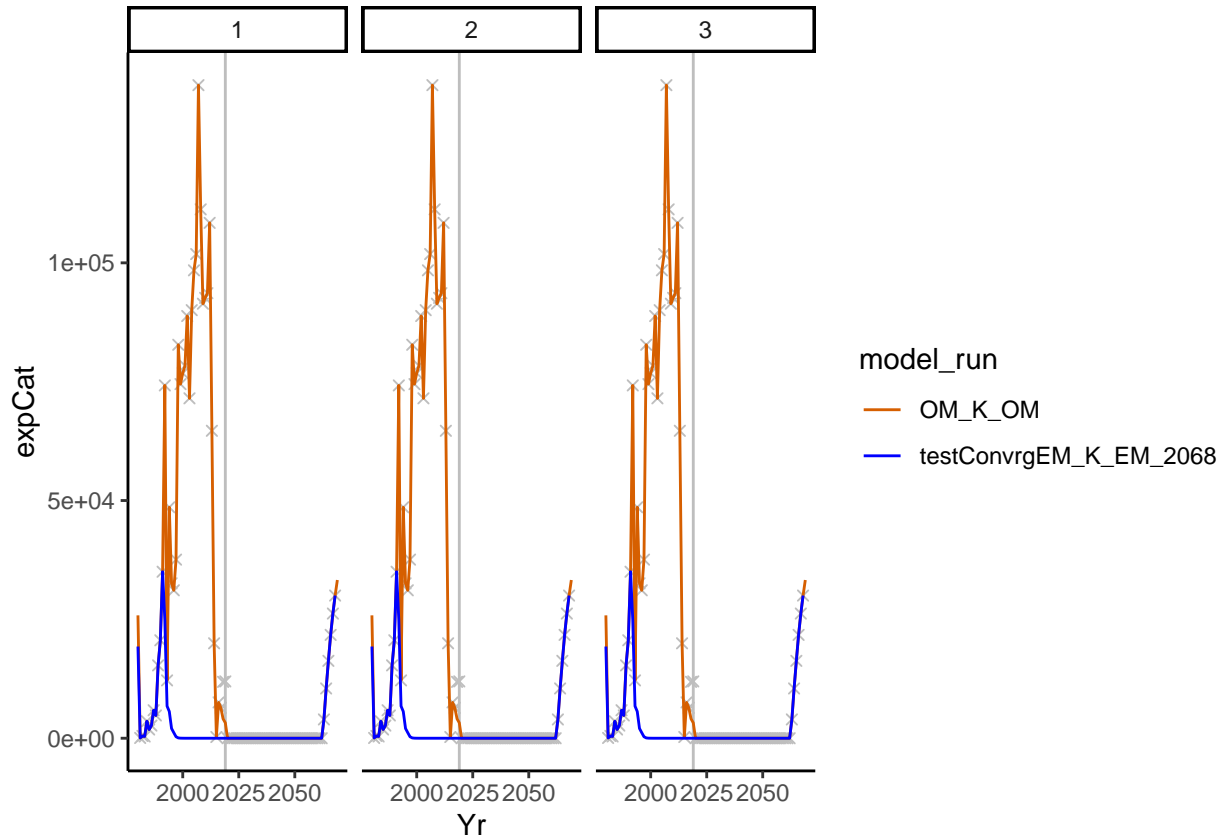
## N_environ_variables: 2

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

omkselfCat[[1]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
                           sides = "b", inherit.aes = FALSE)

```



```
omkselfAge1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgOM_Kself_RandRec_EM", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of singular covariance matrix
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the word 'Variances'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of singular covariance matrix
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the word 'Variances'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of singular covariance matrix
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the word 'Variances'
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of singular covariance matrix
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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##      'Variances are 0.0 for first two elements, so do not write '
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##      'Variances are 0.0 for first two elements, so do not write '
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## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

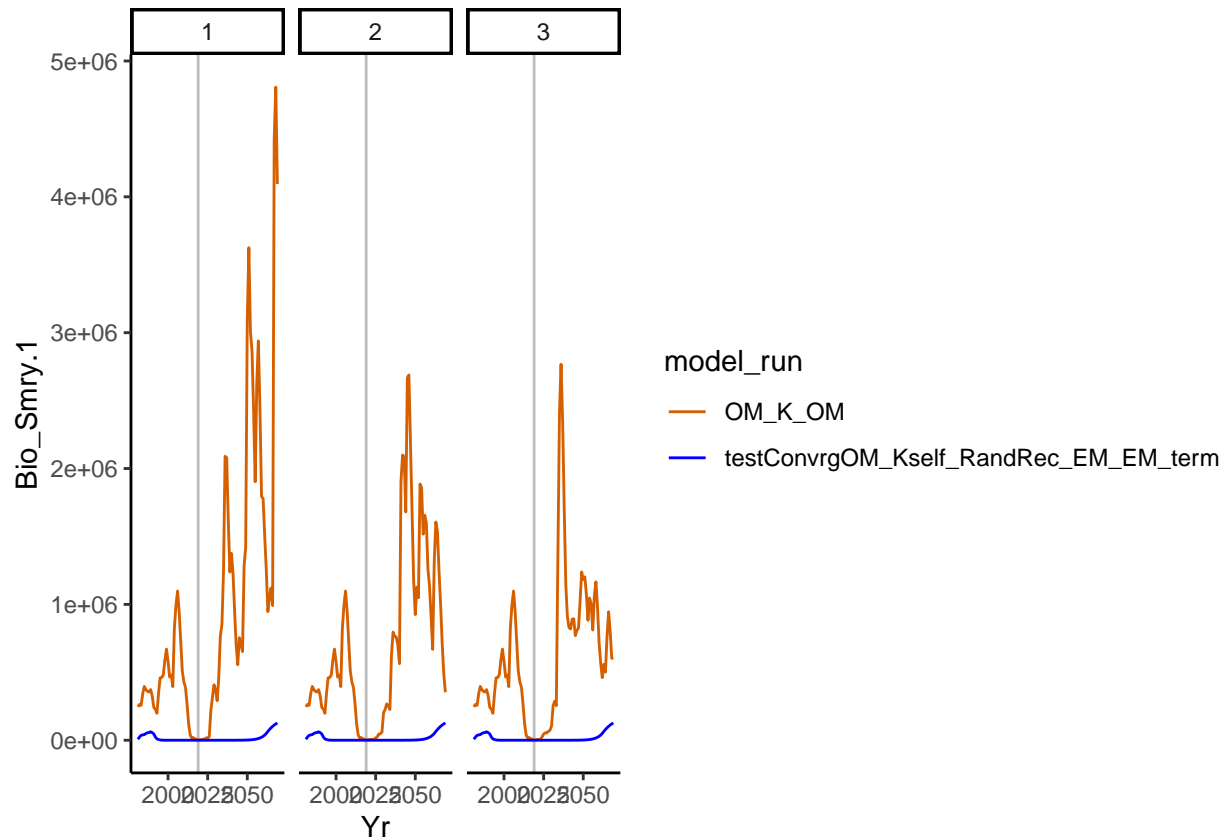
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

omkselfAge1Plus[[1]] + geom_rug(data = convrgCheckOMKselfTest, mapping = aes(x = year),
                                sides = "b", inherit.aes = FALSE)

```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckOMKselfTest <- omkselfTest %>% select(max_grad, SR_LN_R0, SR_regime,
  SR_regime_BLK1repl_1980,
  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
    gregexpr("[:digit:]", model_run)))) %>%
  filter(max_grad > 0.01)
paramCheckOMKselfTest
```

```
## # A tibble: 0 x 7
## #   ... with 7 variables: max_grad <dbl>, SR_LN_R0 <dbl>, SR_regime <dbl>,
## #   SR_regime_BLK1repl_1980 <dbl>, model_run <chr>, iteration <dbl>, year <dbl>
```

```
# compare to OM
omkselfTest %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_1980,
  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
    gregexpr("[:digit:]", model_run)))) %>%
  filter(model_run == "OM_K_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_1980 model_run iteration year
##   <dbl>     <dbl>                <dbl> <chr>          <dbl> <dbl>
## 1    15.7         0                -1.04 OM_K_OM          1    NA
```

```
## 2      15.7      0      -1.04 OM_K_OM      2      NA
## 3      15.7      0      -1.04 OM_K_OM      3      NA
```

```
omkselfTestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeOMKselfTestFrates.csv")
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
omkselfTestFrates <- omkselfTestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(omkselfTestFrates)
```

```
##      F_1      F_2      F_3      Seas
## Min.   :0.0000 Min.   :0.0000 Min.   :0.0000 Min.   :1.0
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:1.0
## Median :0.0000 Median :0.0000 Median :0.0000 Median :1.5
## Mean   :0.8482 Mean   :0.8822 Mean   :0.7278 Mean   :1.5
## 3rd Qu.:0.1530 3rd Qu.:0.2145 3rd Qu.:0.0000 3rd Qu.:2.0
## Max.   :4.0000 Max.   :4.0000 Max.   :4.0000 Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :1981 Length:19884 Min.   :1 Length:19884
## 1st Qu.:1997 Class :character 1st Qu.:1 Class :character
## Median :2013 Mode  :character Median :2 Mode  :character
## Mean   :2015
## 3rd Qu.:2030
## Max.   :2069
##      iteration      scenario
## Min.   :1 Length:19884
## 1st Qu.:1 Class :character
## Median :2 Mode  :character
## Mean   :2
## 3rd Qu.:3
## Max.   :3
```

```
omkselfTestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                         gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckOMKselfTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 8,730 x 13
##      F_1 F_2 F_3 Seas year model_run iteration scenario yearEM max_grad
##      <dbl> <dbl> <dbl> <dbl> <dbl> <chr>      <dbl> <chr>      <dbl> <dbl>
## 1      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2020 NA
## 2      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2021 NA
## 3      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2022 NA
## 4      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2023 NA
## 5      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2024 NA
## 6      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2025 NA
## 7      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2026 NA
## 8      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2027 NA
## 9      0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2028 NA
## 10     0 1.06 0      2 1990 testConvrge~ 1 testCon~ 2029 NA
## # ... with 8,720 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <lgl>, params_stuck_high <lgl>
```

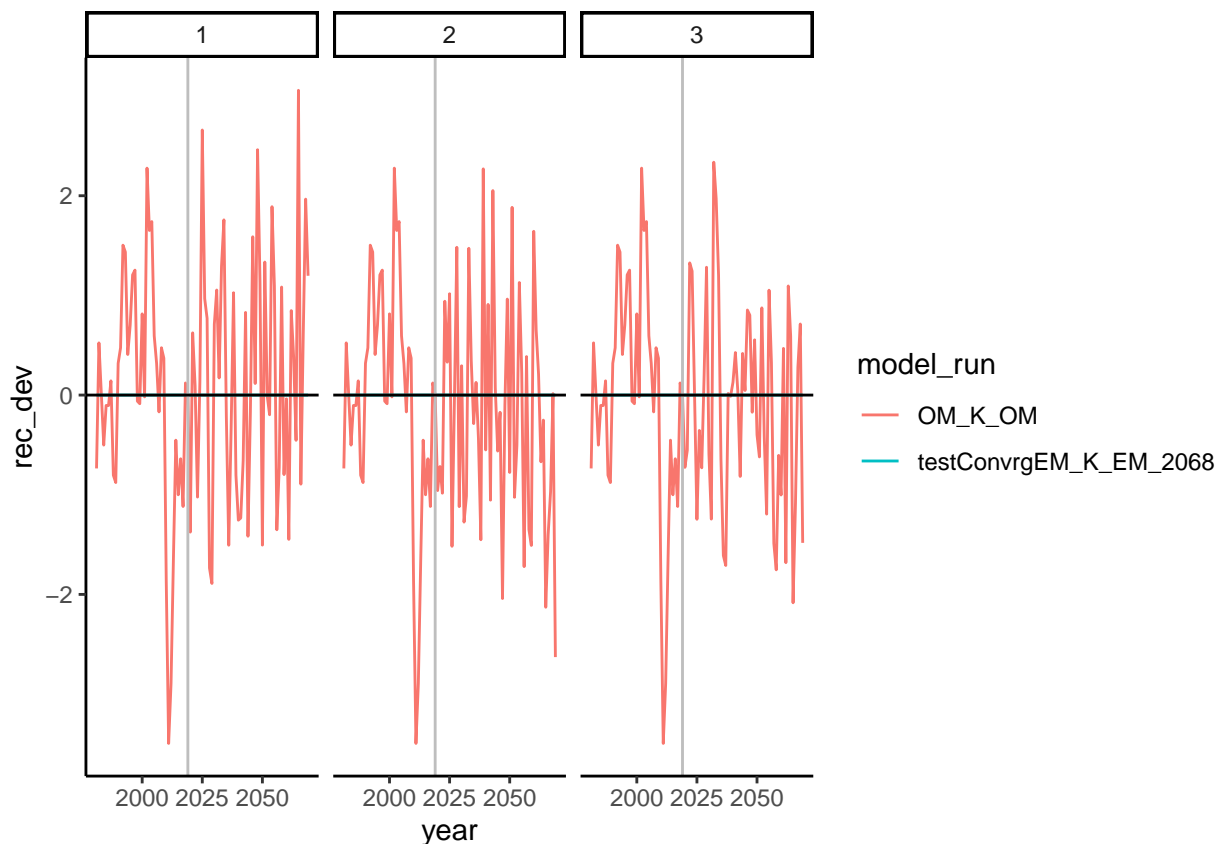
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeOM_Kself_Ra
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

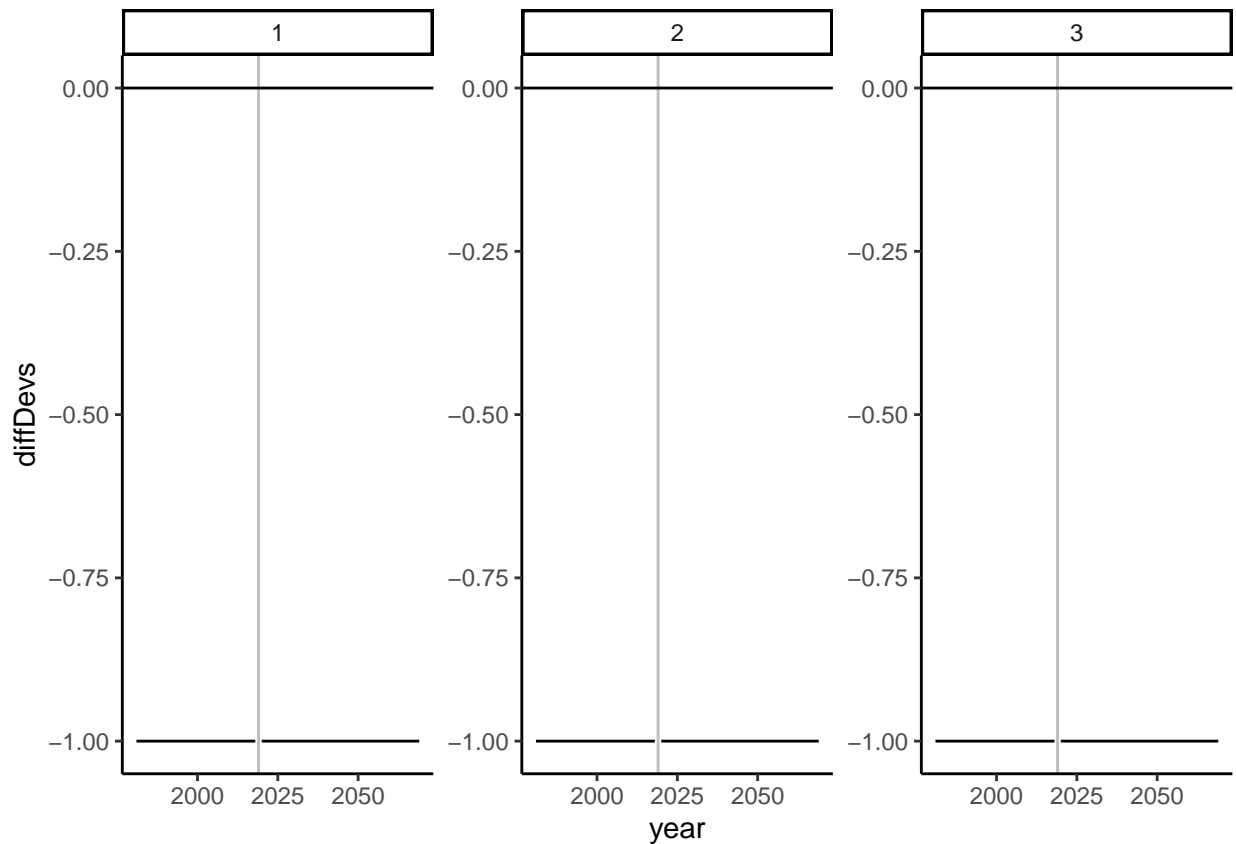
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "OM_K_OM" | grepl("2068", model_run)) %>%
  filter(complete.cases())
```

```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrgeM_K_EM_2068 - OM_K_OM)/OM_K_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration, scales = "free") +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



OM_K 1981 with EM_K test, EM management strategy

Look at years of no convergence and parameter bounds

```
omkemkTest <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeOM_KandEM")

## Rows: 153 Columns: 302
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl (295): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl   (2): params_on_bound, hessian
```

```
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgCheckOMKEMKTest <- omkemkTest %>% select(max_grad, params_on_bound,
                                              params_stuck_low, params_stuck_high,
                                              model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

convrgCheckOMKEMKTest
```

```
## # A tibble: 57 x 7
##       max_grad params_on_bound params_stuck_low      params_stuck_hi~ model_run
##       <dbl> <lgl>          <chr>          <chr>          <chr>
## 1 36939.    NA              <NA>          <NA>          testConv~
## 2   0.0819 NA              <NA>          <NA>          testConv~
## 3 218832    NA              L_at_Amax_Fem_GP_1_DE~ <NA>          testConv~
## 4   0.0220 NA              <NA>          <NA>          testConv~
## 5 213169    NA              InitF_seas_2_flt_2Mex~ <NA>          testConv~
## 6 296600    NA              InitF_seas_2_flt_2Mex~ <NA>          testConv~
## 7  35654.    NA              <NA>          <NA>          testConv~
## 8  11773.    NA              AgeSel_P8_MexCal_S1(1) <NA>          testConv~
## 9 386688    NA              <NA>          <NA>          testConv~
## 10   0.0454 NA              <NA>          <NA>          testConv~
## # ... with 47 more rows, and 2 more variables: iteration <dbl>, year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
omkemkBio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                       scenario = "testConvrgOM_KandEM_K_RandRec_EM",
                       termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

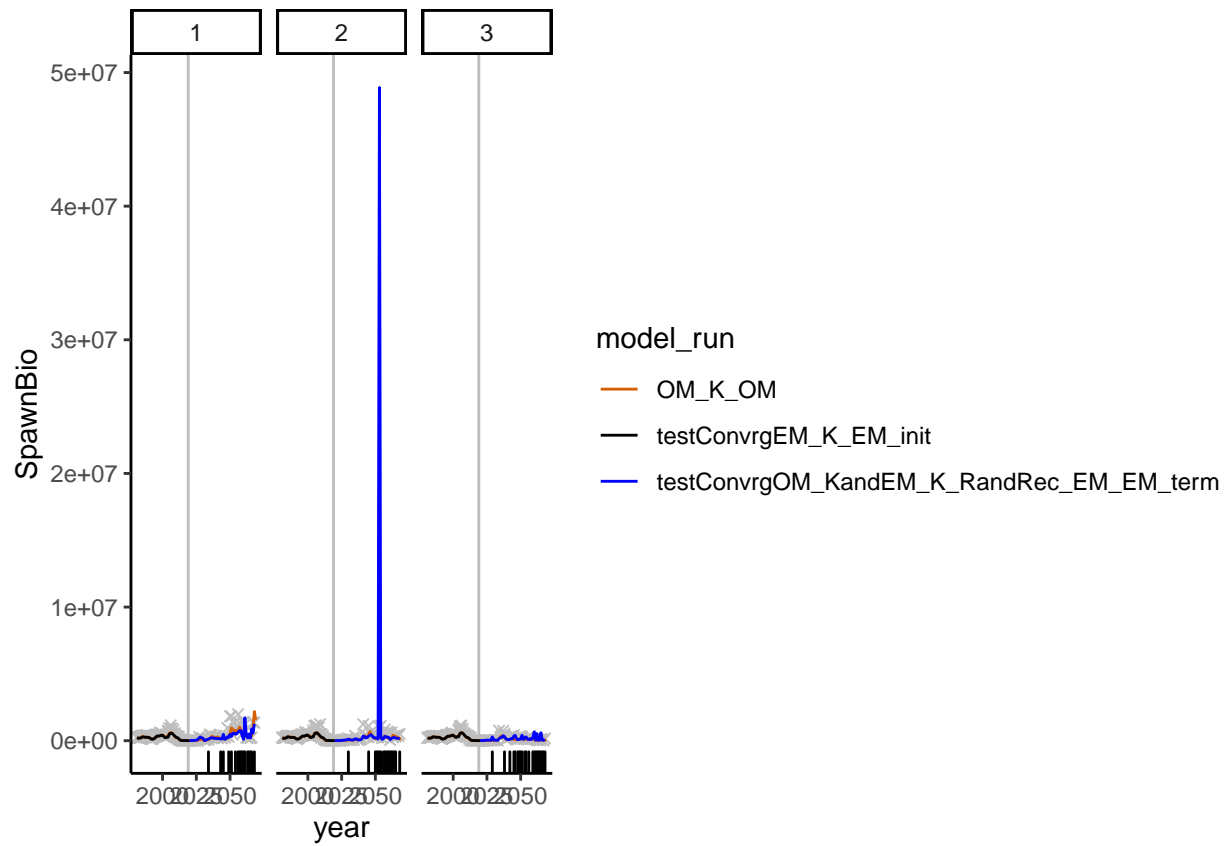
## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999
```

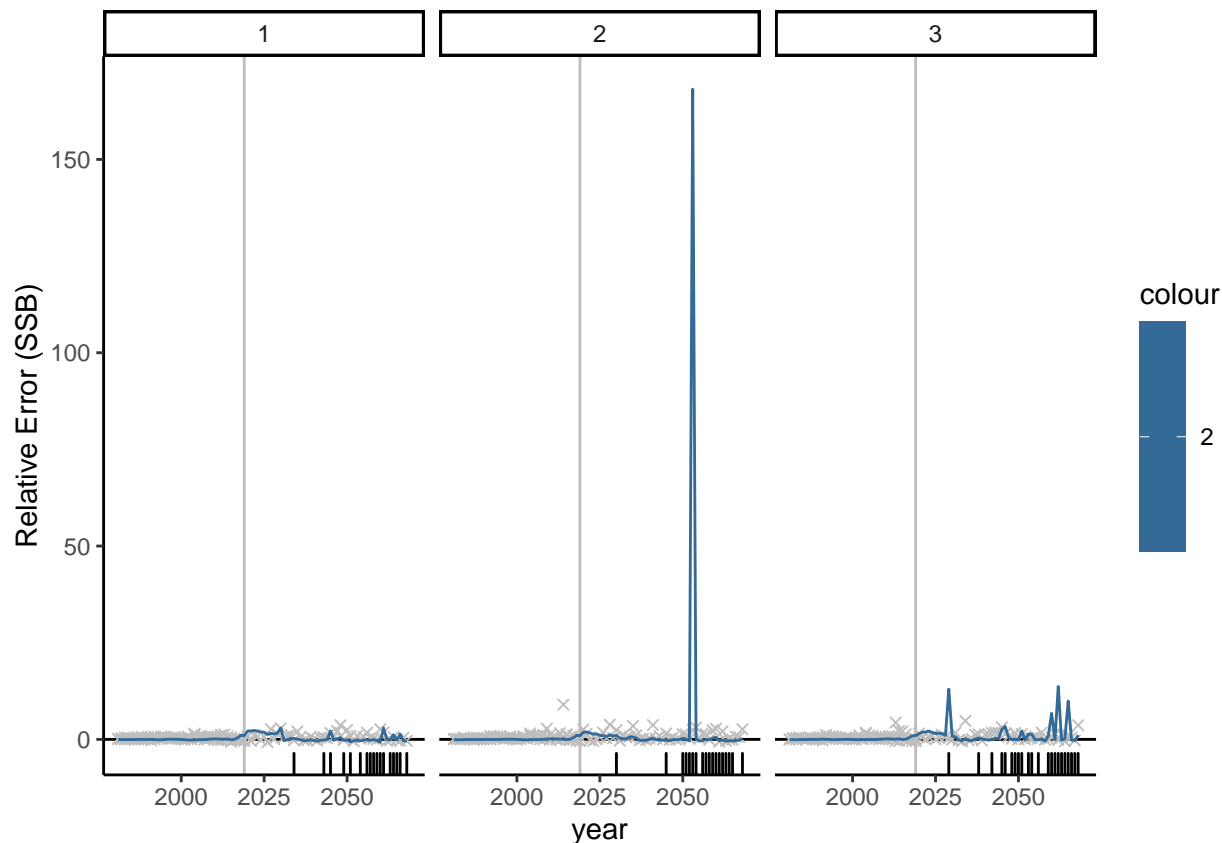
```
omkemkBio[[1]] + geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
omkemkBio[[2]] + geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

```
## Warning: Removed 3 row(s) containing missing values (geom_path).
```

```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrGOM_KandEM_K_RandRec_EM",
              termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

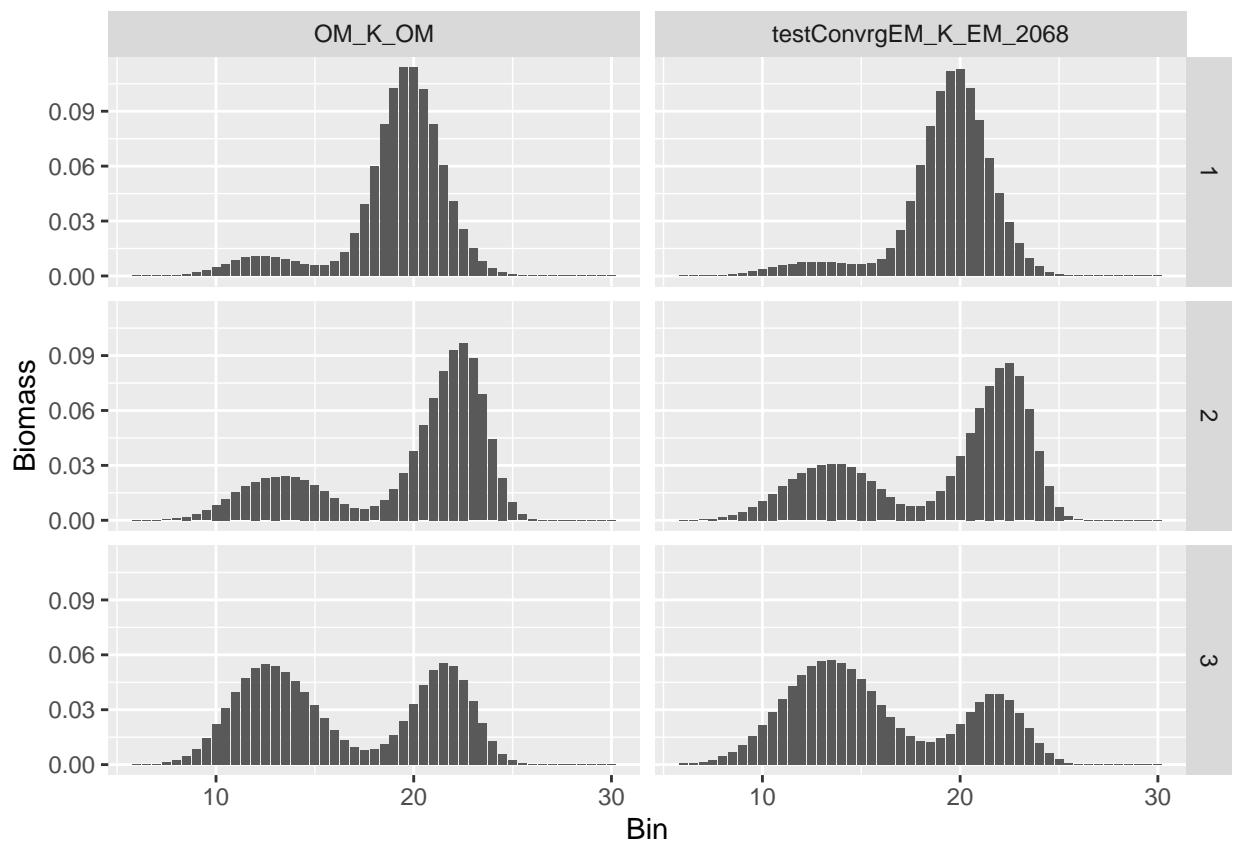
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

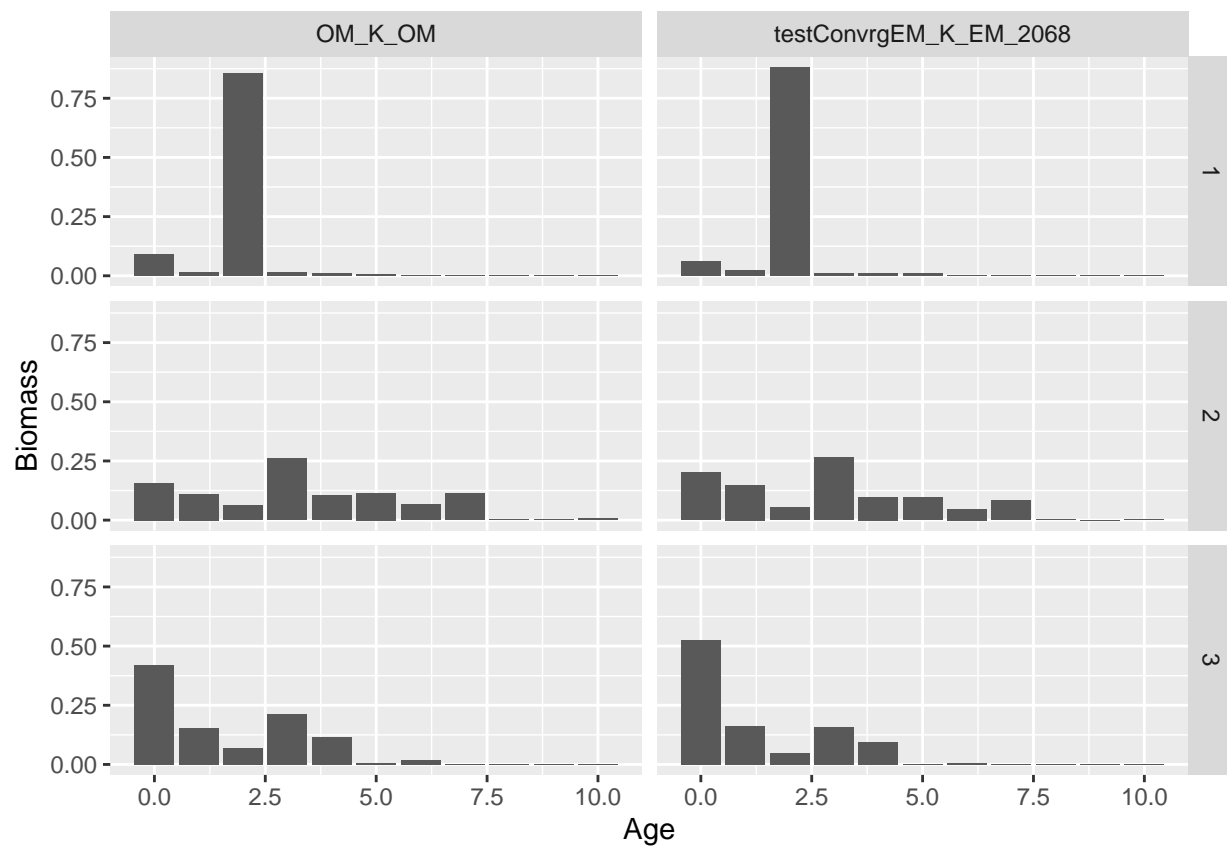
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

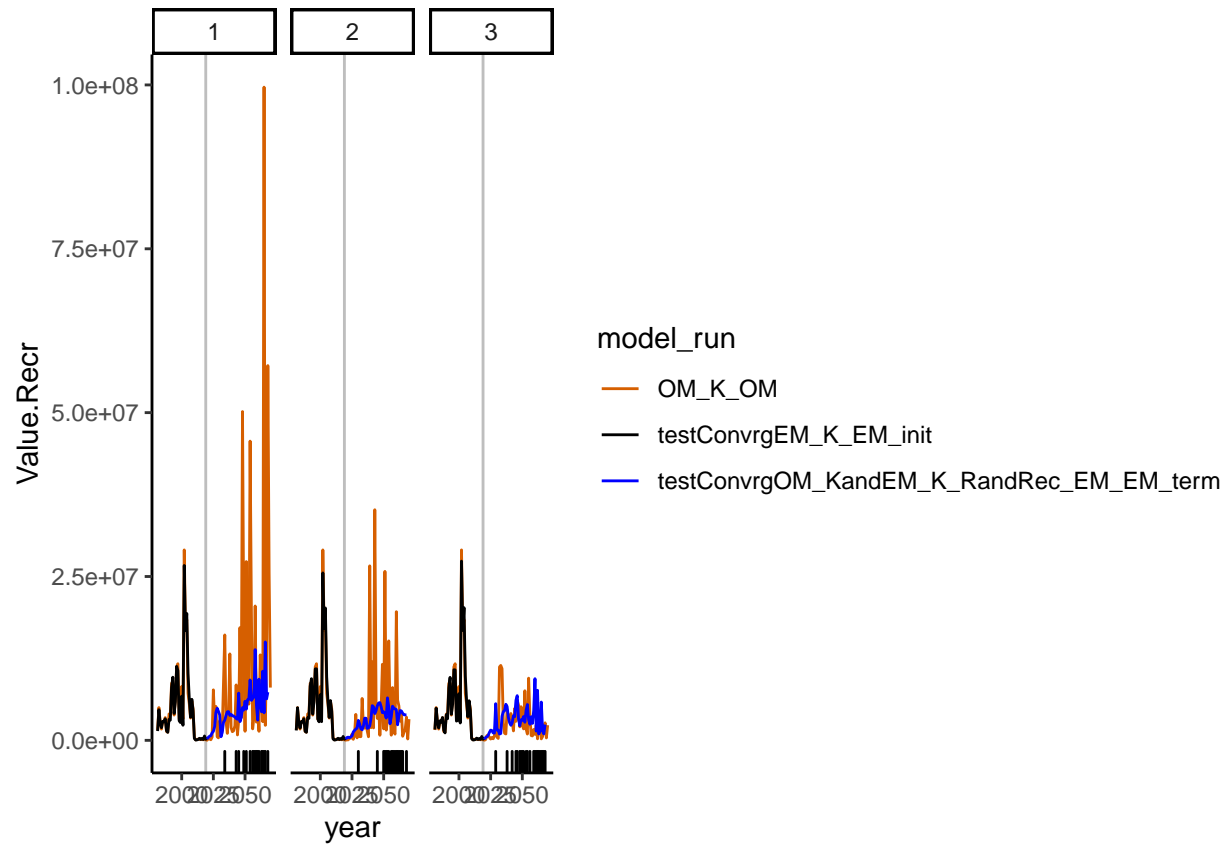
## [[1]]
```



```
##
## [[2]]
```

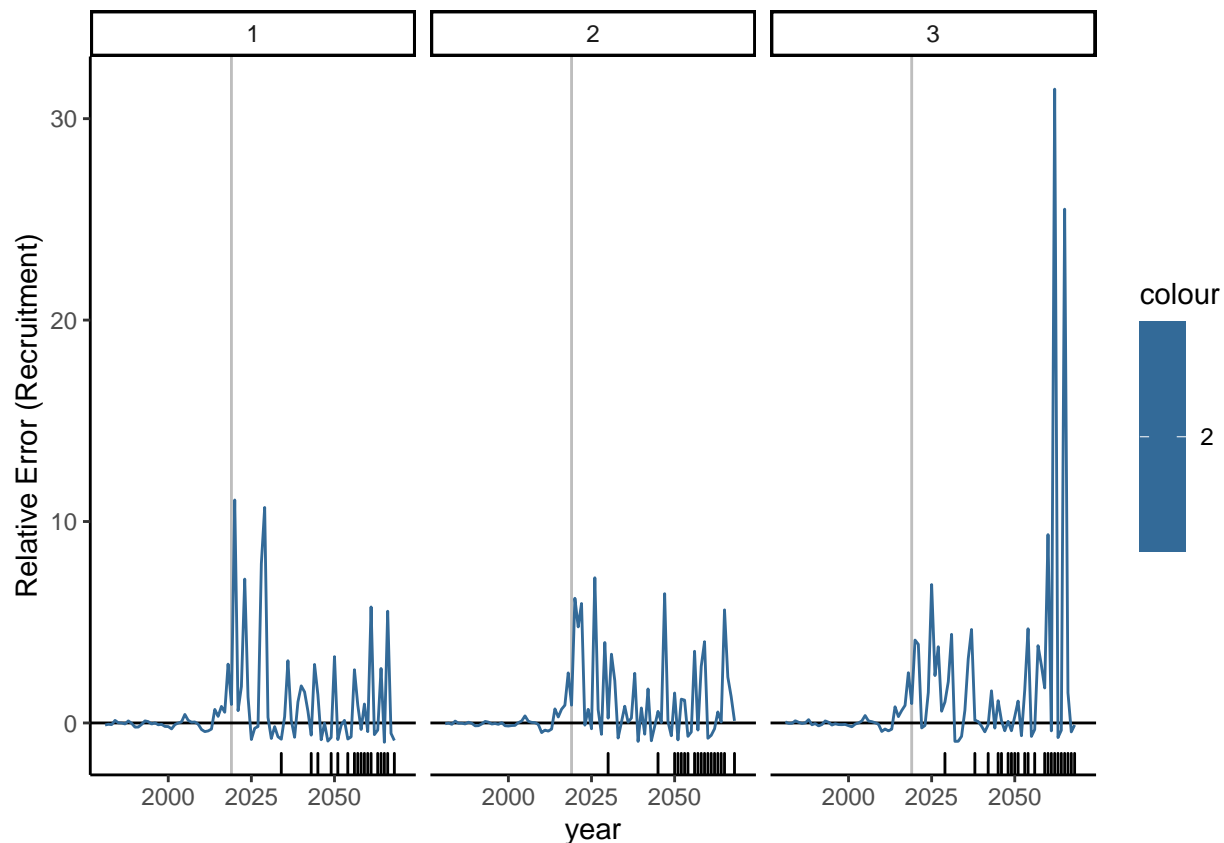


```
omkemkRec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgOM_KandEM_K_RandRec_EM", termYr = 2068)
omkemkRec[[1]] + geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
omkemkRec[[2]] + geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 6 row(s) containing missing values (geom_path).
```



```
omkemkCat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                             scenario = "testConvrgOM_KandEM_K_RandRec_EM", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
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## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of data file complete. Final value = 999

```

```

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

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## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

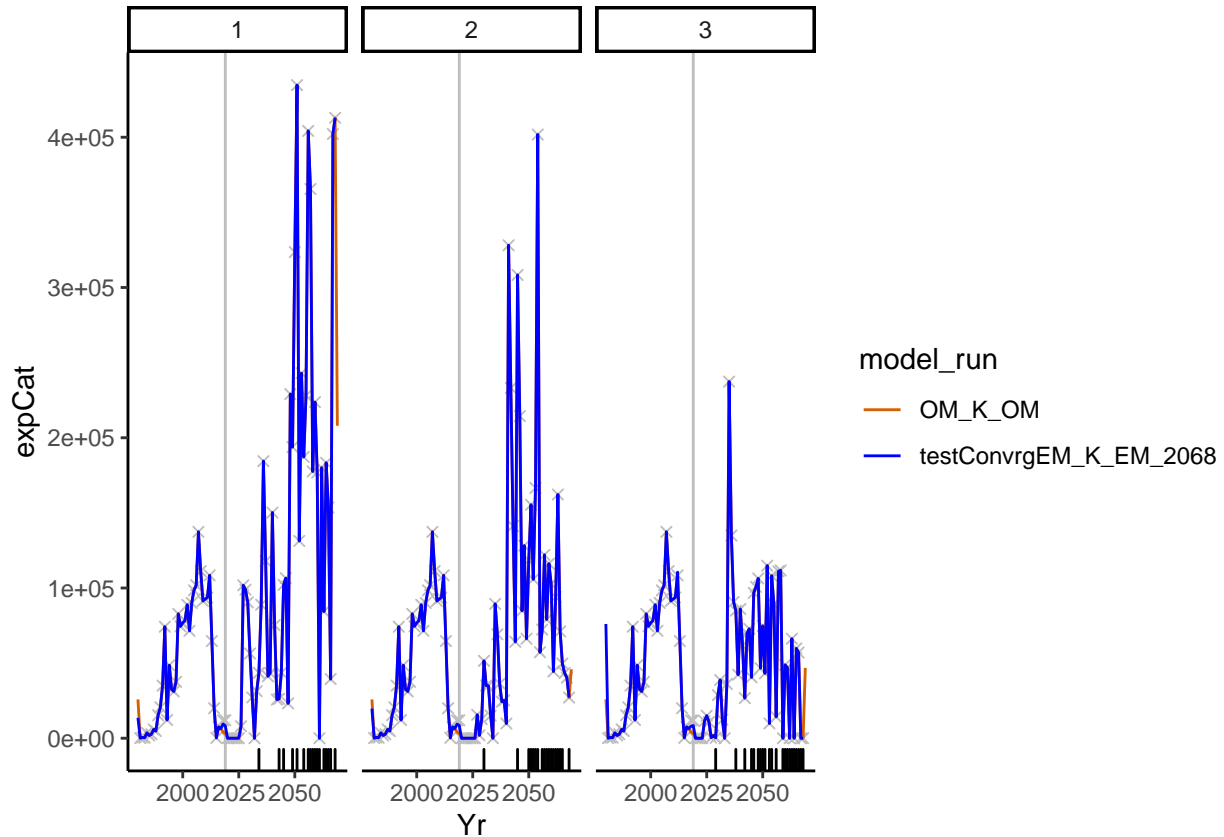
## N_environ_variables: 0

## Read of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

omkemkCat[[1]] + geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
                          sides = "b", inherit.aes = FALSE)

```



```
omkemkAge1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
  scenario = "testConvrgOM_KandEM_K_RandRec_EM", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

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##      input 'covar' changed to FALSE.

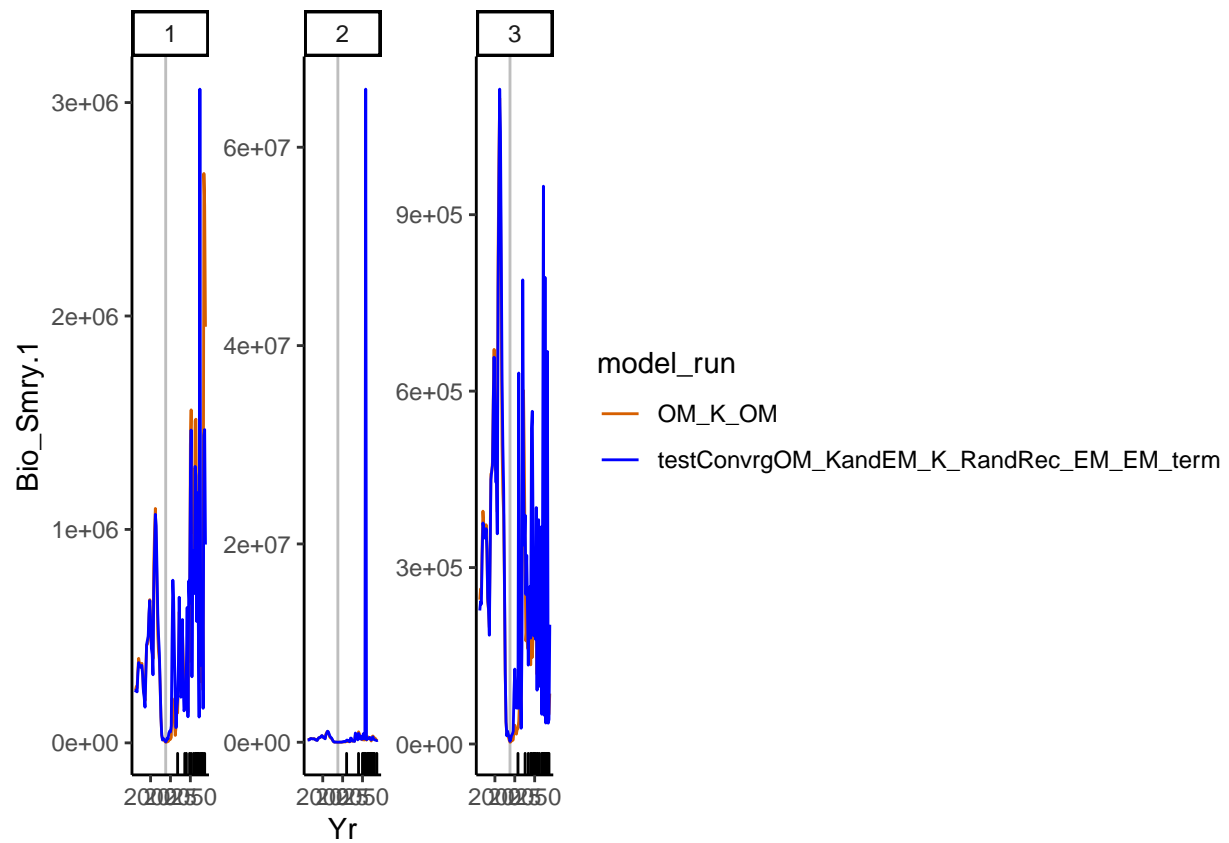
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped because of
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

```

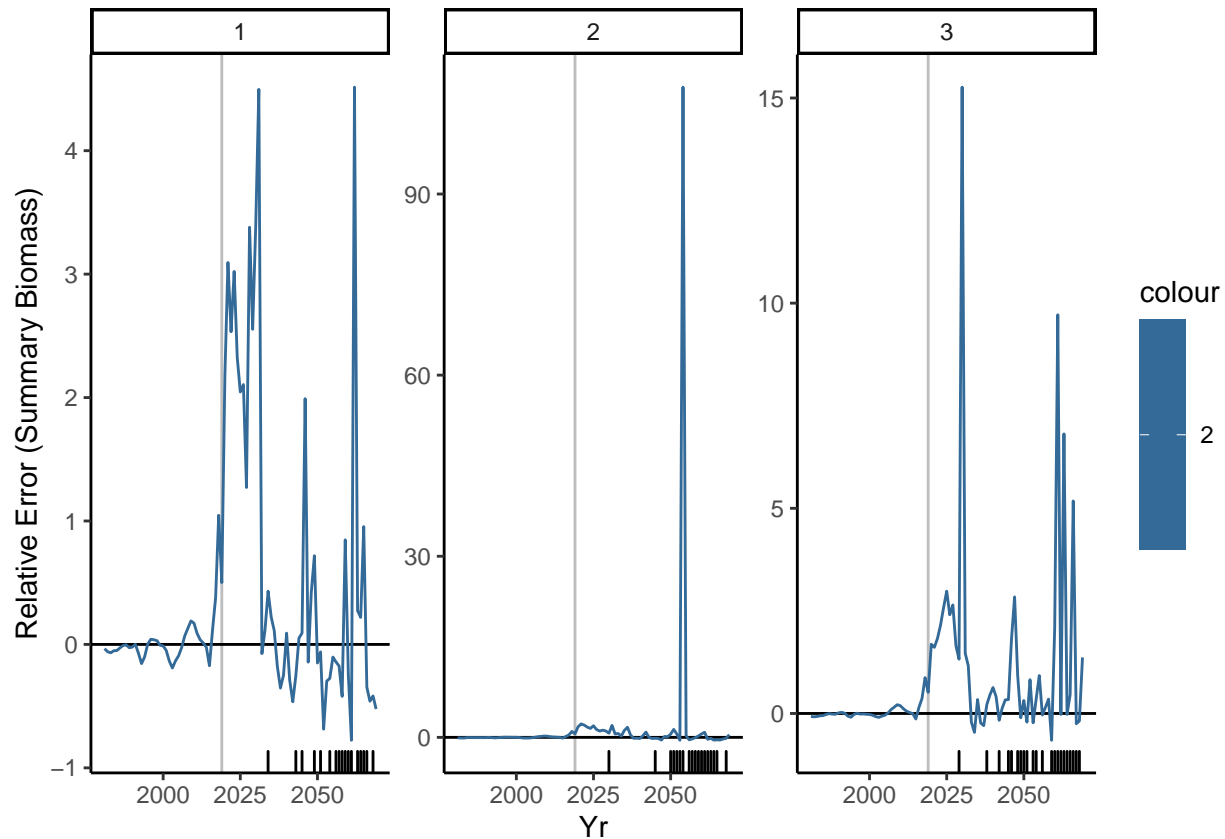
```

omkemkAge1Plus[[1]] + facet_wrap(. ~ iteration, scales = "free") +
  geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
           sides = "b", inherit.aes = FALSE)

```



```
omkenkAge1Plus[[2]] + facet_wrap(. ~ iteration, scales = "free") +
  geom_rug(data = convrgCheckOMKEMKTest, mapping = aes(x = year),
    sides = "b", inherit.aes = FALSE)
```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckOMKselfTest <- omkemkTest %>% select(max_grad, SR_LN_R0, SR_regime,
                                                SR_regime_BLK1repl_1980,
                                                model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheckOMKselfTest
```

```
## # A tibble: 57 x 7
##       max_grad SR_LN_R0 SR_regime SR_regime_BLK1repl_~ model_run iteration year
##       <dbl>   <dbl>   <dbl>   <dbl> <chr>          <dbl> <dbl>
## 1 36939.    15.6      0      -1.15 testConv~      1 2034
## 2  0.0819   15.7      0      -1.21 testConv~      1 2043
## 3 218832    16.0      0      -2.28 testConv~      1 2045
## 4  0.0220   15.7      0      -1.21 testConv~      1 2049
## 5 213169    15.8      0      -2.11 testConv~      1 2051
## 6 296600    16.5      0      -2.55 testConv~      1 2054
## 7 35654.    15.7      0      -1.15 testConv~      1 2056
## 8 11773.    15.7      0      -1.22 testConv~      1 2057
## 9 386688    16.9      0      -2.42 testConv~      1 2058
## 10 0.0454   15.7      0      -1.21 testConv~      1 2059
## # ... with 47 more rows
```

```
# compare to OM
omkemkTest %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_1980,
                     model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                      gregexpr("[:digit:]]+", model_run)))) %>%
  filter(model_run == "OM_K_OM")
```

```
## # A tibble: 3 x 6
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_1980 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    15.7        0          -1.04 OM_K_OM            1    NA
## 2    15.7        0          -1.04 OM_K_OM            2    NA
## 3    15.7        0          -1.04 OM_K_OM            3    NA
```

```
omkemkTestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeOM_
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
omkemkTestFrates <- omkemkTestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(omkemkTestFrates)
```

```
##      F_1          F_2          F_3          Seas
## Min.   :0.0000   Min.   :0.0000   Min.   :0.000000   Min.   :1.0
## 1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.000000   1st Qu.:1.0
## Median :0.0000   Median :0.0000   Median :0.001112   Median :1.5
## Mean   :0.1024   Mean   :0.2553   Mean   :0.106776   Mean   :1.5
## 3rd Qu.:0.0858   3rd Qu.:0.2372   3rd Qu.:0.020208   3rd Qu.:2.0
## Max.   :4.0000   Max.   :4.0000   Max.   :4.000000   Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :1981   Length:19884   Min.   :1   Length:19884
## 1st Qu.:1997   Class :character 1st Qu.:1   Class :character
## Median :2013   Mode  :character Median :2   Mode  :character
## Mean   :2015
## 3rd Qu.:2030
## Max.   :2069
##      iteration      scenario
## Mean   :2
## 3rd Qu.:3
## Max.   :3
```

```
omkemkTestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                      gregexpr("[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckOMKEMKTest, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 2,545 x 13
##   F_1 F_2 F_3 Seas year model_run iteration scenario yearEM max_grad
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>          <dbl> <chr>          <dbl> <dbl>
```

```
## 1 0 1.13 0 2 1990 testConvrgE~ 2 testCon~ 2053 20474.
## 2 1.17 0 0 1 1991 testConvrgE~ 1 testCon~ 2045 218832
## 3 1.38 0 0 1 1991 testConvrgE~ 1 testCon~ 2051 213169
## 4 4 0 0 1 1991 testConvrgE~ 1 testCon~ 2054 296600
## 5 1.46 0 0 1 1991 testConvrgE~ 1 testCon~ 2064 3686970
## 6 1.32 0 0 1 1991 testConvrgE~ 1 testCon~ 2066 577349
## 7 3.43 0 0 1 1991 testConvrgE~ 2 testCon~ 2053 20474.
## 8 1.62 0 0 1 1991 testConvrgE~ 3 testCon~ 2046 463854
## 9 1.65 0 0 1 1991 testConvrgE~ 3 testCon~ 2051 394741
## 10 1.38 0 0 1 1991 testConvrgE~ 3 testCon~ 2060 227291
## # ... with 2,535 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <chr>
```

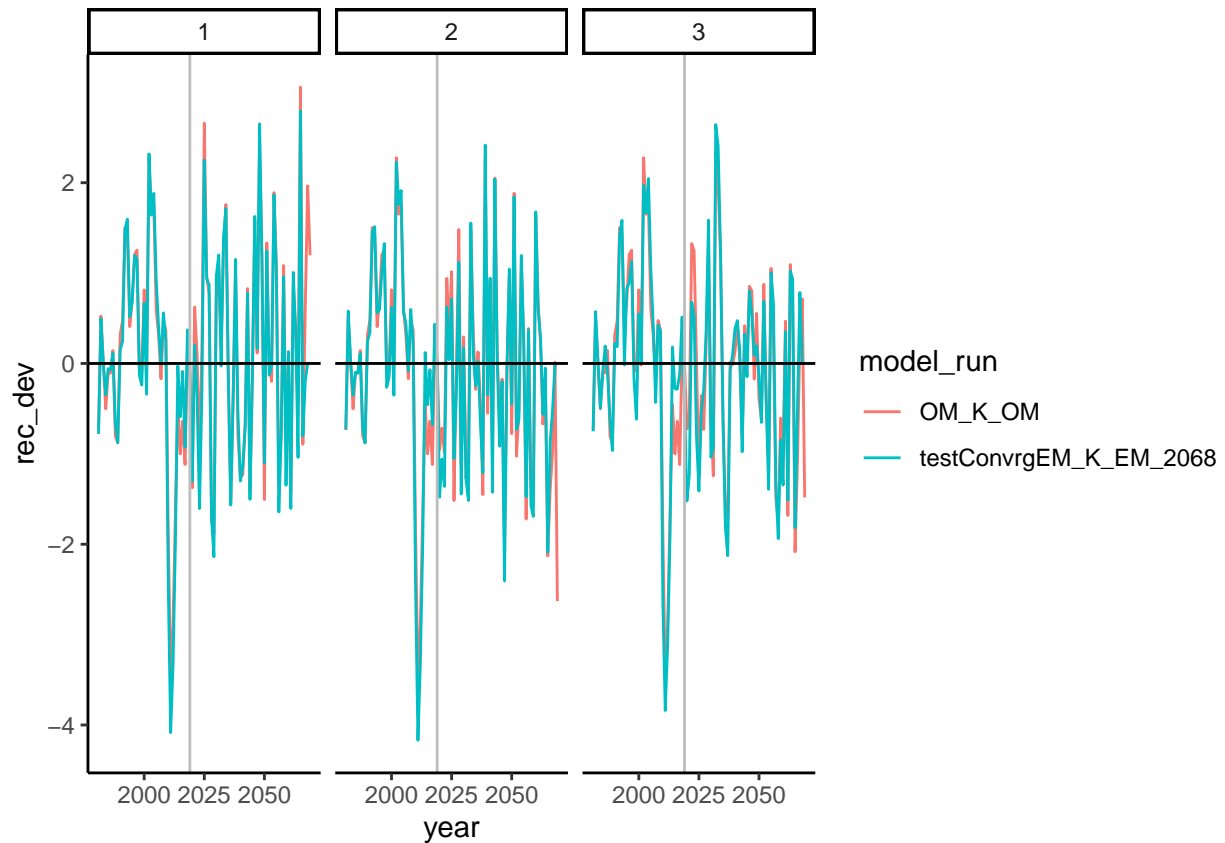
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgOM_KandEM_K
```

```
## Rows: 19884 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

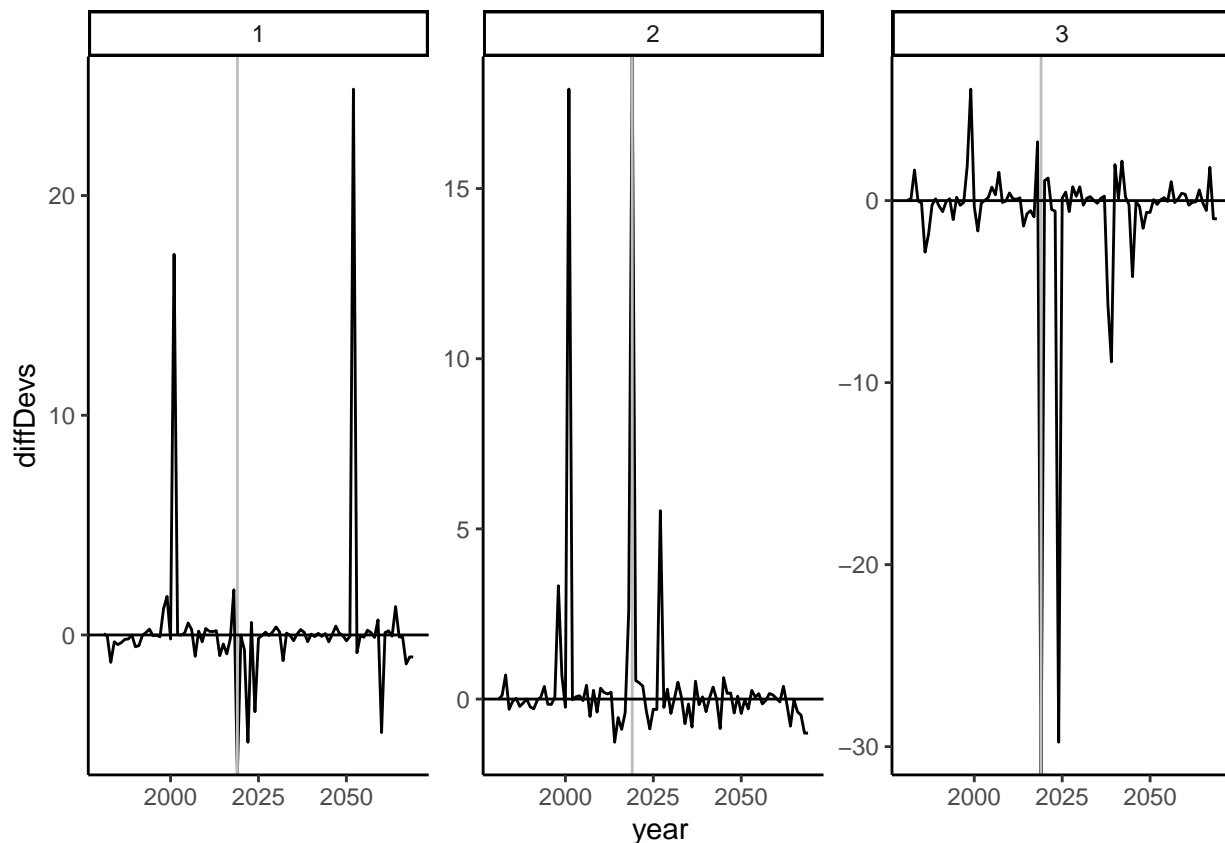
```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "OM_K_OM" | grepl("2068", model_run)) %>%
  filter(complete.cases(.))
```

```
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrgeM_K_EM_2068 - OM_K_OM)/OM_K_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration, scales = "free") +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



EM 2005 test, random recruitment

Look at years of no convergence and parameter bounds

```
em2005Test <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgEM2005fix")
```

```
## Rows: 153 Columns: 207
## -- Column specification -----
## Delimiter: ","
## chr  (4): params_stuck_low, version, model_run, scenario
## dbl (200): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl  (3): params_on_bound, params_stuck_high, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgCheck2005Test <- em2005Test %>% select(max_grad, params_on_bound,
                                             params_stuck_low, params_stuck_high,
                                             model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       grexpr("[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)
```

```
convrgCheck2005Test
```



```
## # A tibble: 13 x 7
##   max_grad params_on_bound params_stuck_low      params_stuck_high model_run
##   <dbl> <lgl>           <chr>           <lgl>           <chr>
## 1  14422. NA             <NA>            NA             testConvr~
## 2   74007. NA             AgeSel_P4_MexCal_S2(2) NA             testConvr~
## 3   736695 NA             <NA>            NA             testConvr~
## 4   135366 NA             <NA>            NA             testConvr~
## 5  2696080 NA             <NA>            NA             testConvr~
## 6  1189410 NA             <NA>            NA             testConvr~
## 7   53870. NA             <NA>            NA             testConvr~
## 8   75633. NA             <NA>            NA             testConvr~
## 9   63412. NA             <NA>            NA             testConvr~
## 10   8966. NA             <NA>            NA             testConvr~
## 11   4745. NA             <NA>            NA             testConvr~
## 12   38773. NA             CV_old_Fem_GP_1    NA             testConvr~
## 13  123337 NA             <NA>            NA             testConvr~
## # ... with 2 more variables: iteration <dbl>, year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
em2005Bio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvr~EM2005fixedParms_RandRec_HCR1",
  termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30

## The supplied data file has 2 sections.  Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections.  Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

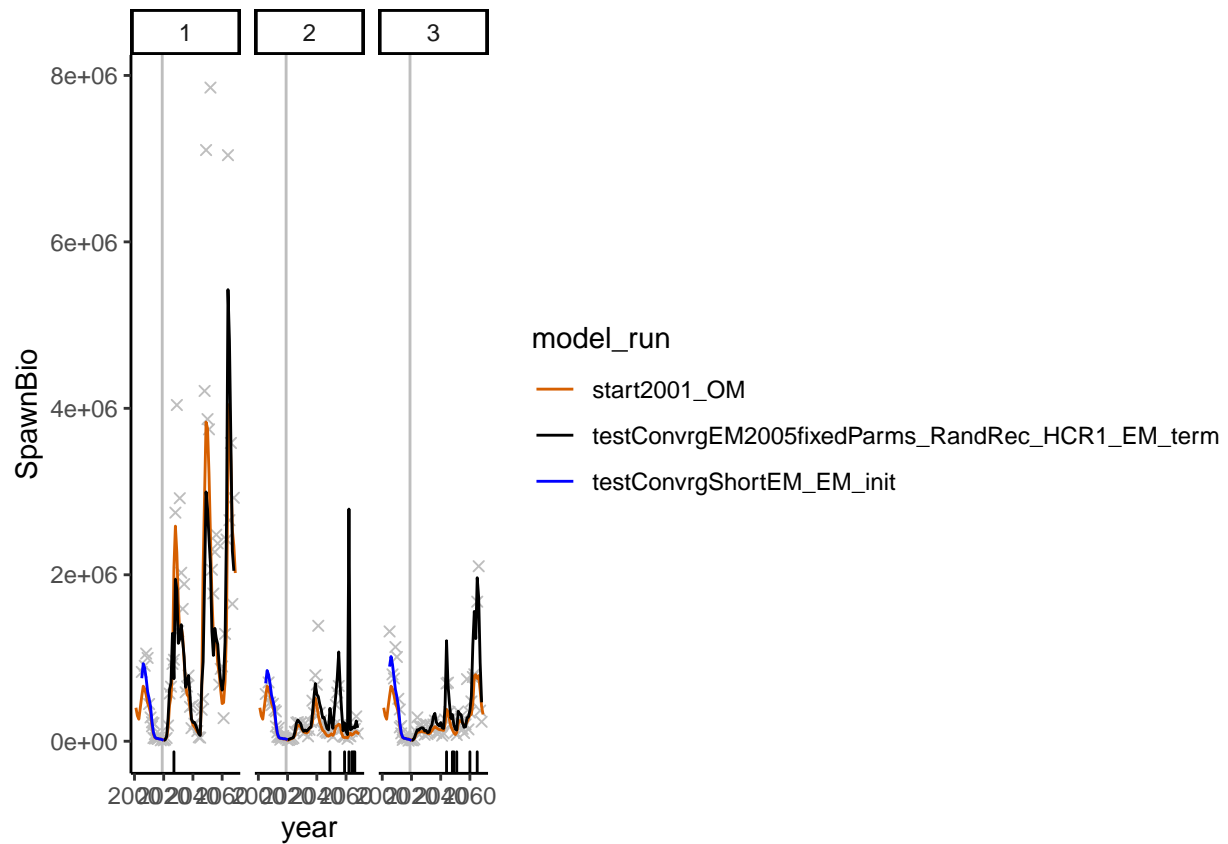
## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999
```

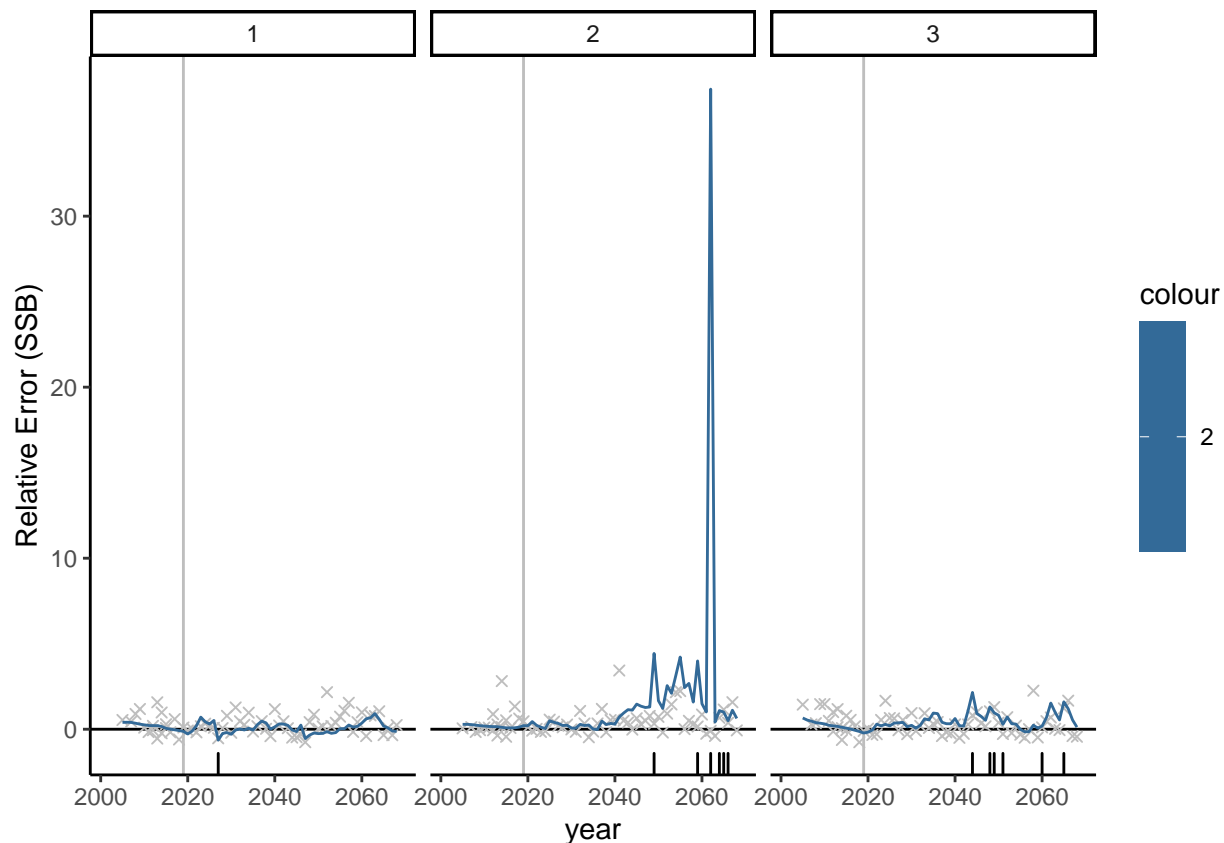
```
em2005Bio[[1]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
                           sides = "b", inherit.aes = FALSE)
```



```
em2005Bio[[2]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
                           sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 15 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "testConvrgeM2005fixedParms_RandRec_HCR1",
              termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

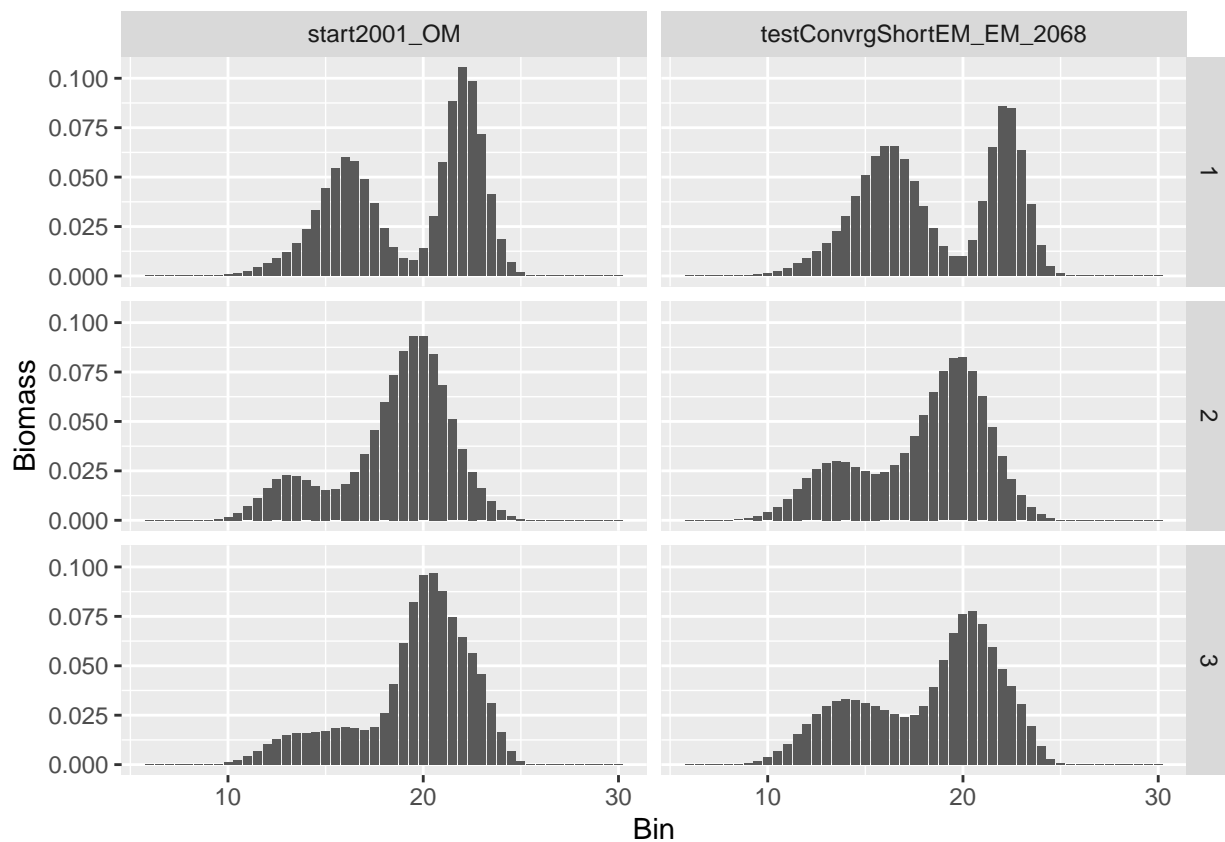
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

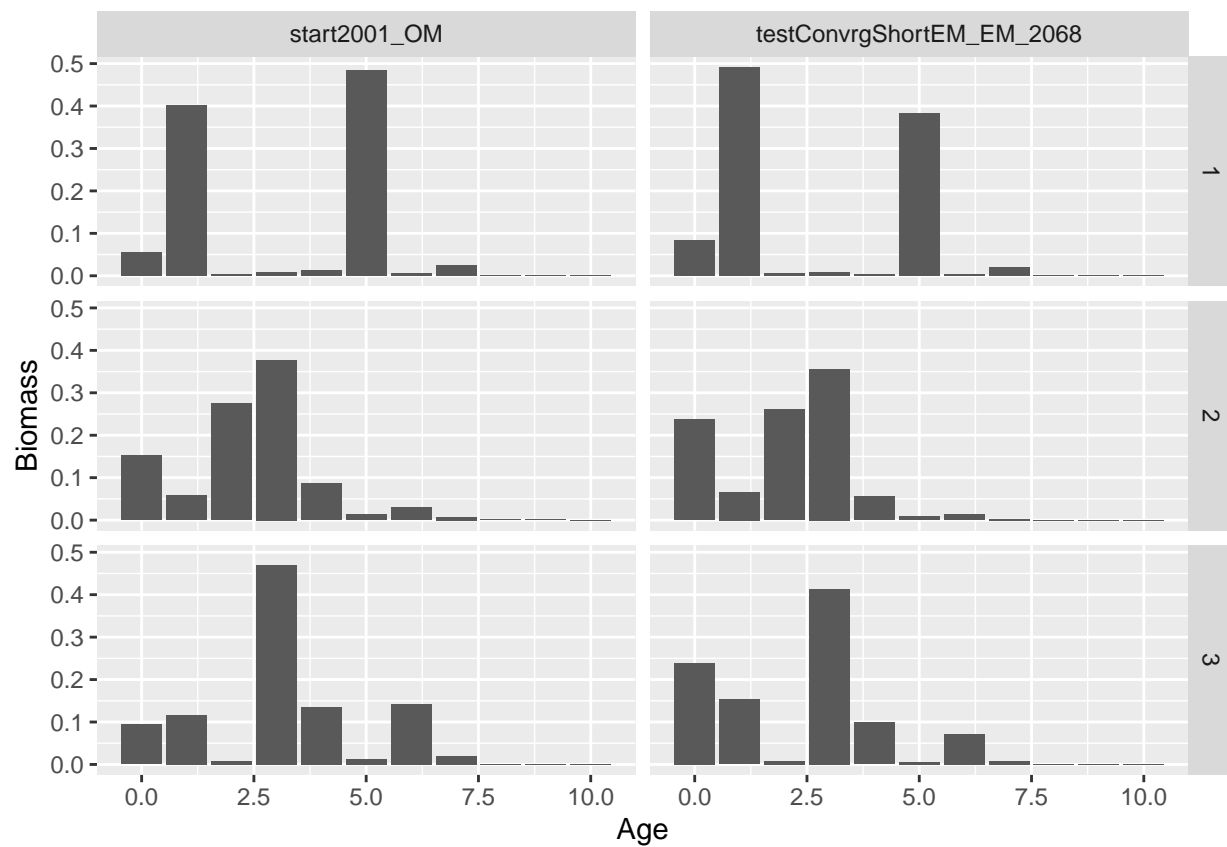
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

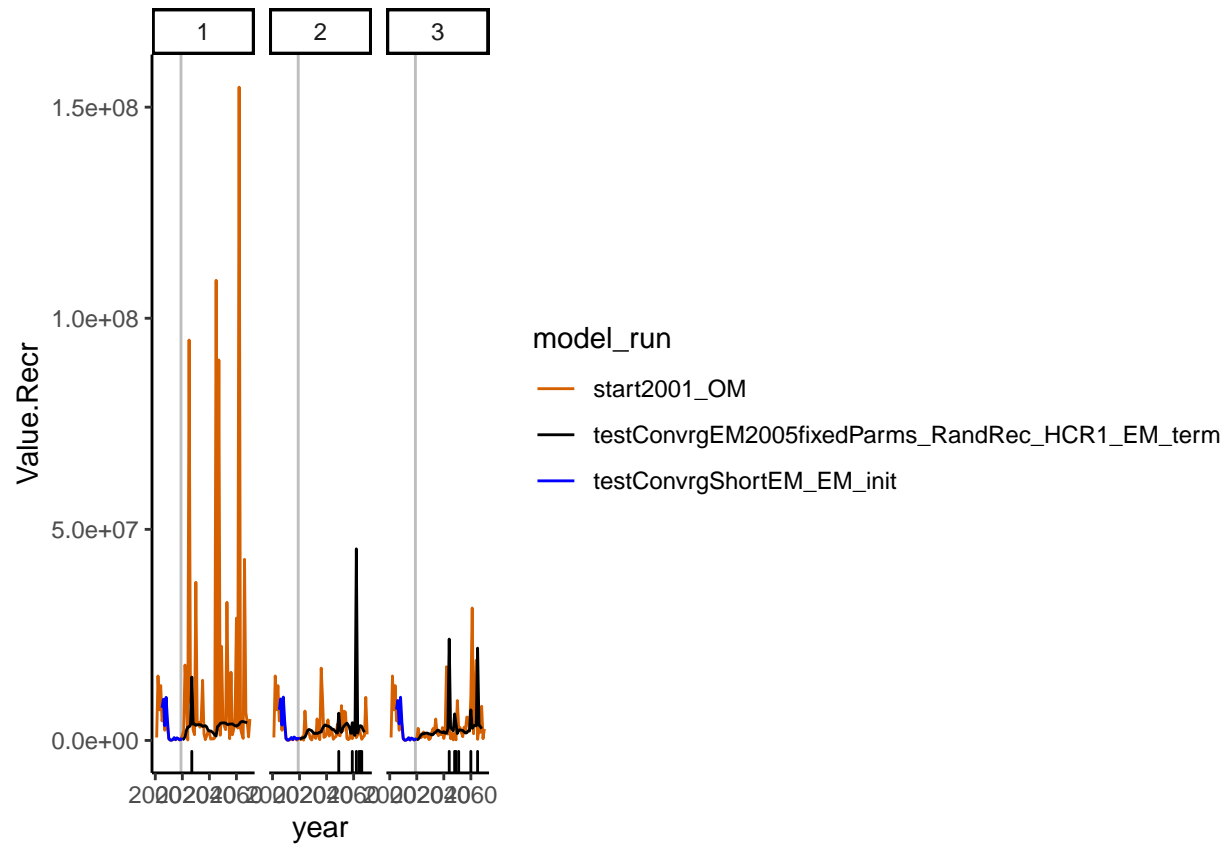
## [[1]]
```



```
##
## [[2]]
```

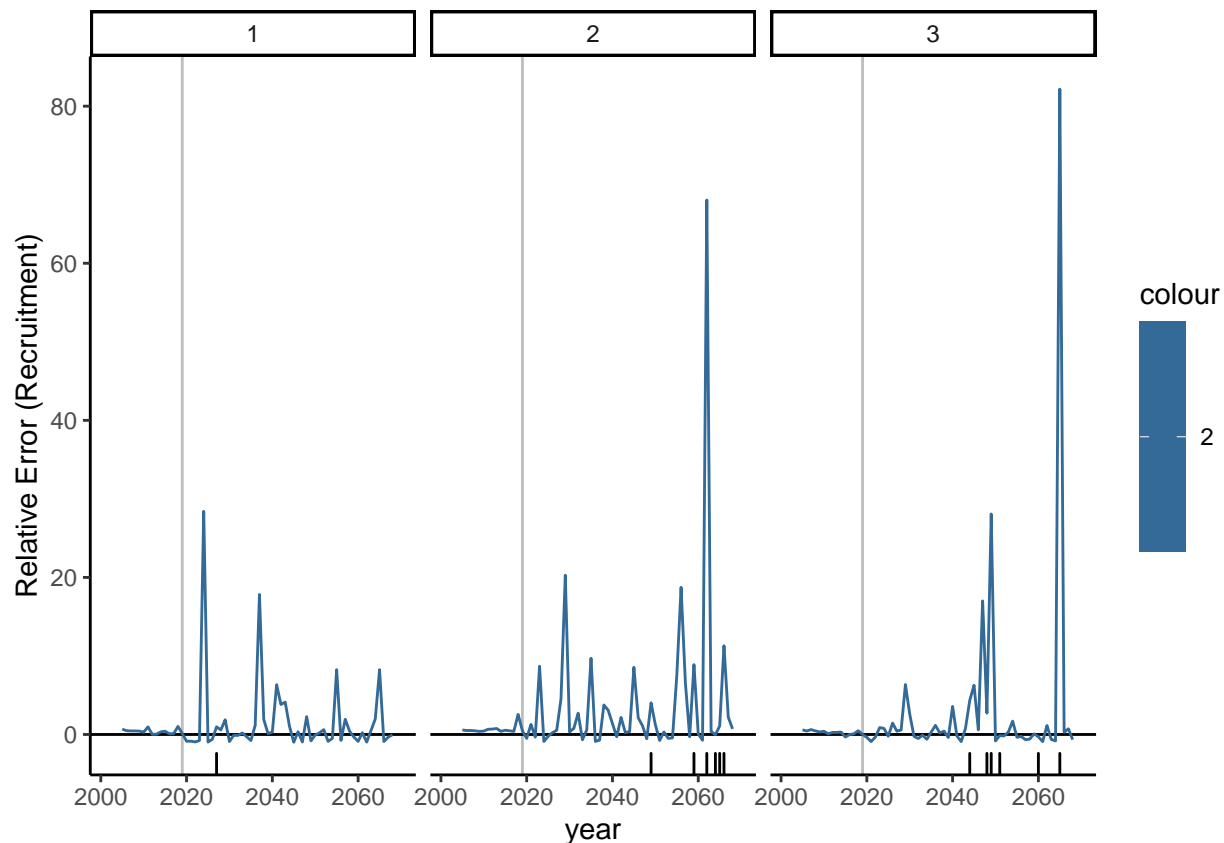


```
em2005Rec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "testConvrgEM2005fixedParms_RandRec_HCR1", termYr = 2068)
em2005Rec[[1]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
em2005Rec[[2]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 row(s) containing missing values (geom_path).
```



```
em2005Cat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                             scenario = "testConvrgEM2005fixedParms_RandRec_HCR1", termYr = 2068)

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30
```



```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains 0
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains 0
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

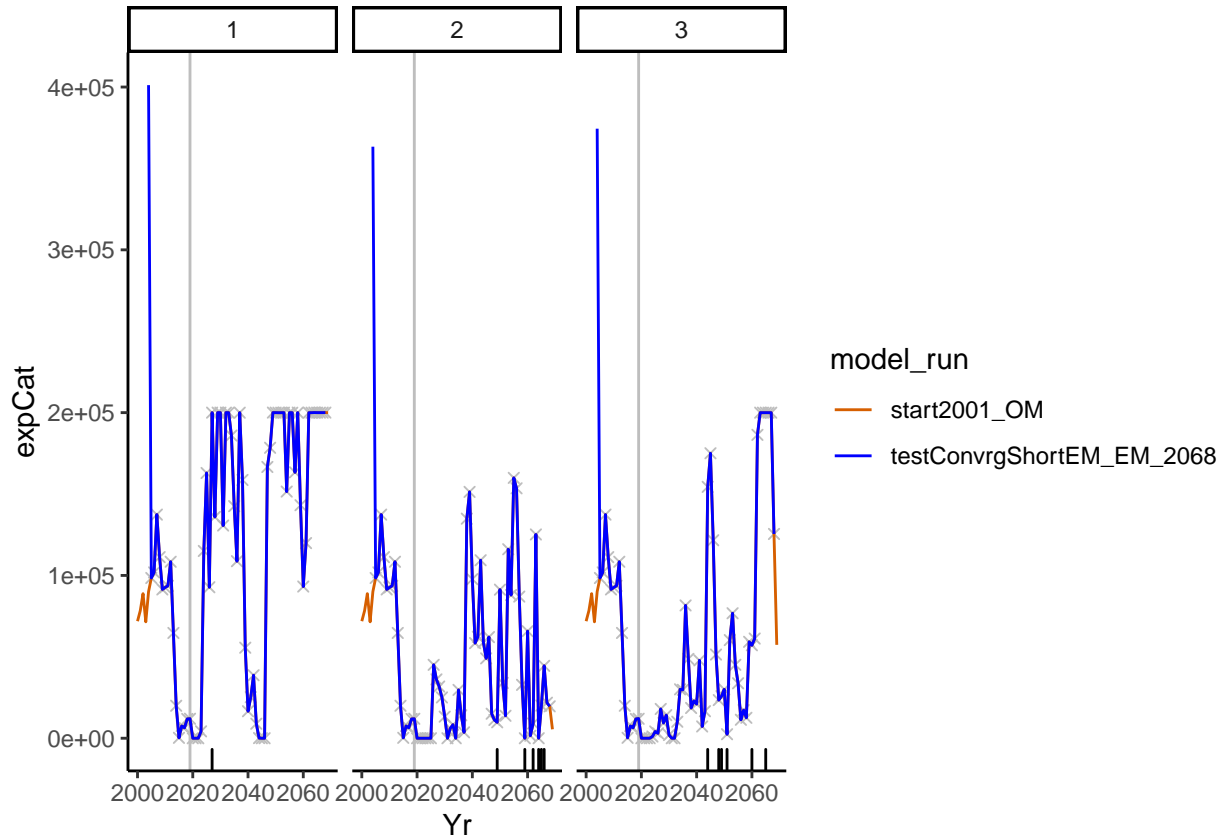
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

em2005Cat[[1]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
                          sides = "b", inherit.aes = FALSE)

```



```
em2005Age1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios"
  scenario = "testConvrgEM2005fixedParms_RandRec_HCR1", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

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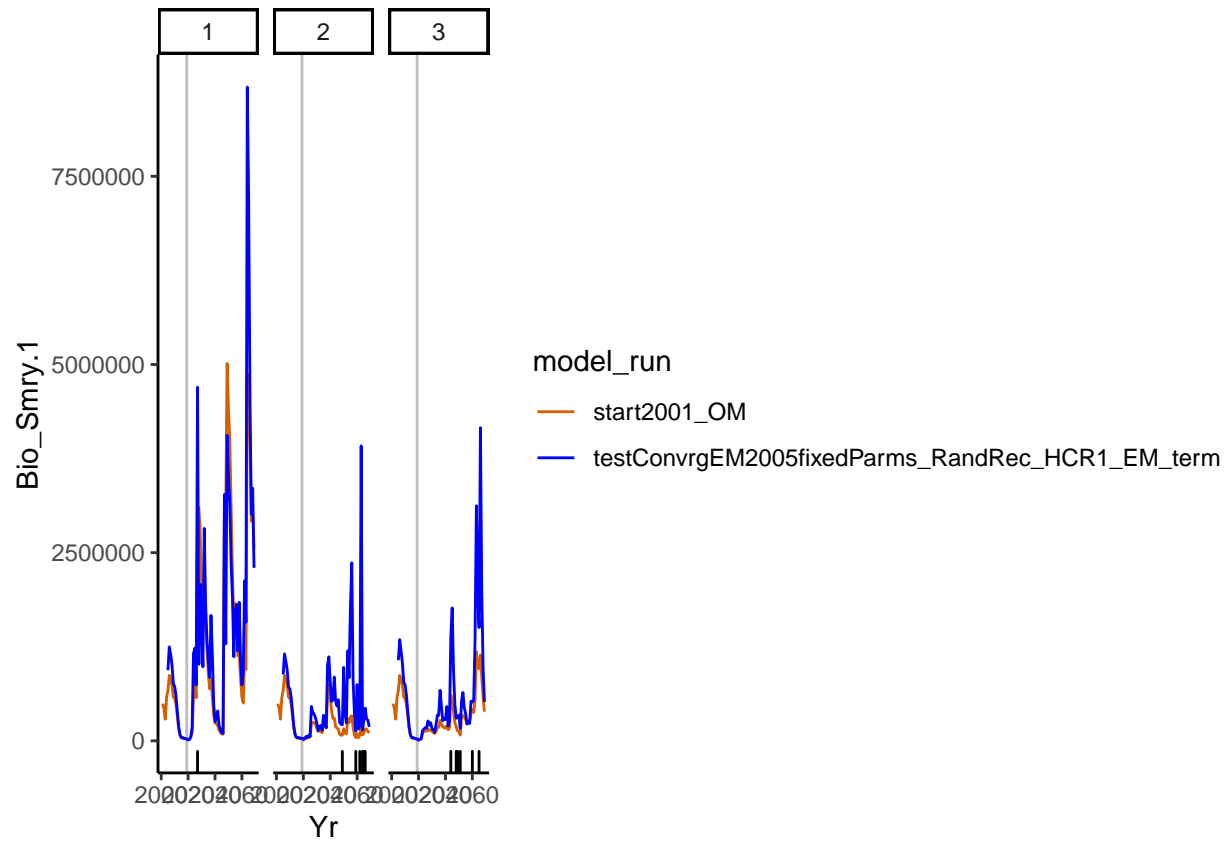
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

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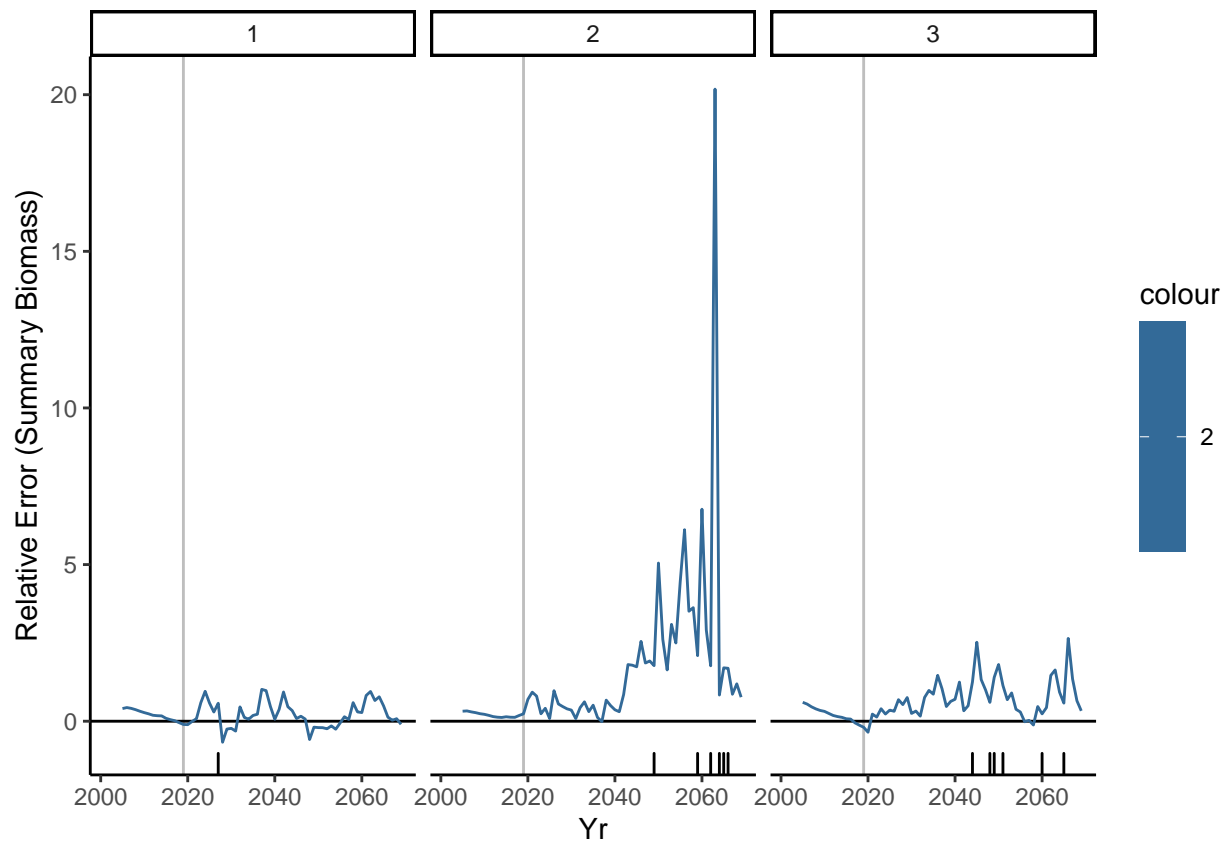
em2005Age1Plus[[1]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
                               sides = "b", inherit.aes = FALSE)

```



```
em2005Age1Plus[[2]] + geom_rug(data = convrgCheck2005Test, mapping = aes(x = year),
                               sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 12 row(s) containing missing values (geom_path).
```



Look at recruitment and fishing mortality parameter estimates

```
paramCheck2005Test <- em2005Test %>% select(max_grad, SR_LN_R0, SR_regime, SR_BH_steep,
      SR_regime_BLK1repl_2000,
      model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
      gregexpr("[:digit:]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheck2005Test
```

```
## # A tibble: 13 x 8
##   max_grad SR_LN_R0 SR_regime SR_BH_steep SR_regime_BLK1re~ model_run iteration
##   <dbl>   <dbl>   <dbl>   <dbl>   <dbl> <chr>      <dbl>
## 1  14422.    19.1     0       0.3     NA testConv~      1
## 2   74007.    16.6     0       0.3     NA testConv~      2
## 3  736695    17.3     0       0.3     NA testConv~      2
## 4  135366    17.6     0       0.3     NA testConv~      2
## 5 2696080    21.6     0       0.3     NA testConv~      2
## 6 1189410    22.4     0       0.3     NA testConv~      2
## 7   53870.    17.1     0       0.3     NA testConv~      2
## 8   75633.    20.6     0       0.3     NA testConv~      3
## 9   63412.    18.9     0       0.3     NA testConv~      3
## 10   8966.    20.7     0       0.3     NA testConv~      3
## 11   4745.    15.9     0       0.3     NA testConv~      3
## 12  38773.    24.0     0       0.3     NA testConv~      3
## 13 123337    16.8     0       0.3     NA testConv~      3
```

```
## # ... with 1 more variable: year <dbl>
```

```
# compare to OM
```

```
em2005Test %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                      model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
```

```
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>          <dbl> <chr>          <dbl> <dbl>
## 1    14.8      0            0.546 start2001_OM      1    2001
## 2    14.8      0            0.546 start2001_OM      2    2001
## 3    14.8      0            0.546 start2001_OM      3    2001
```

```
em2005TestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvrgeM2")
```

```
## Rows: 12564 Columns: 26
```

```
## -- Column specification -----
```

```
## Delimiter: ","
```

```
## chr (2): model_run, scenario
```

```
## dbl (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
```

```
##
```

```
## i Use 'spec()' to retrieve the full column specification for this data.
```

```
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
em2005TestFrates <- em2005TestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scenario)
summary(em2005TestFrates)
```

```
##           F_1           F_2           F_3           Seas
##  Min.   :0.00000   Min.   :0.0000   Min.   :0.000000   Min.   :1.0
## 1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.000713   1st Qu.:1.0
## Median :0.00000   Median :0.0000   Median :0.018131   Median :1.5
## Mean   :0.05508   Mean   :0.1590   Mean   :0.227111   Mean   :1.5
## 3rd Qu.:0.07612   3rd Qu.:0.1437   3rd Qu.:0.252624   3rd Qu.:2.0
## Max.   :4.00003   Max.   :4.0000   Max.   :4.000000   Max.   :2.0
##           year           model_run           iteration           scenario
##  Min.   :2001   Length:12564   Min.   :1   Length:12564
## 1st Qu.:2015   Class :character   1st Qu.:1   Class :character
## Median :2025   Mode  :character   Median :2   Mode  :character
## Mean   :2028
## 3rd Qu.:2039
## Max.   :2069
##           Max.   :3
```

```
em2005TestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheck2005Test, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 1,280 x 13
```



```
##      F_1    F_2    F_3  Seas  year model_run  iteration scenario yearEM max_grad
##      <dbl> <dbl> <dbl> <dbl> <dbl> <chr>         <dbl> <chr>         <dbl>    <dbl>
##  1 0.0936     0  2.90     1  2005 testConvr~         1 testCon~    2027  14422.
##  2 0.0440     0  1.05     1  2005 testConvr~         1 testCon~    2034     NA
##  3 0.0444     0  1.07     1  2005 testConvr~         1 testCon~    2036     NA
##  4 0.0443     0  1.06     1  2005 testConvr~         1 testCon~    2037     NA
##  5 0.0432     0  1.04     1  2005 testConvr~         1 testCon~    2039     NA
##  6 0.0429     0  1.00     1  2005 testConvr~         1 testCon~    2052     NA
##  7 0.0447     0  1.02     1  2005 testConvr~         2 testCon~    2027     NA
##  8 0.0446     0  1.01     1  2005 testConvr~         2 testCon~    2028     NA
##  9 0.0438     0  1.00     1  2005 testConvr~         2 testCon~    2029     NA
## 10 0.0445     0  1.01     1  2005 testConvr~         2 testCon~    2030     NA
## # ... with 1,270 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <lgl>
```

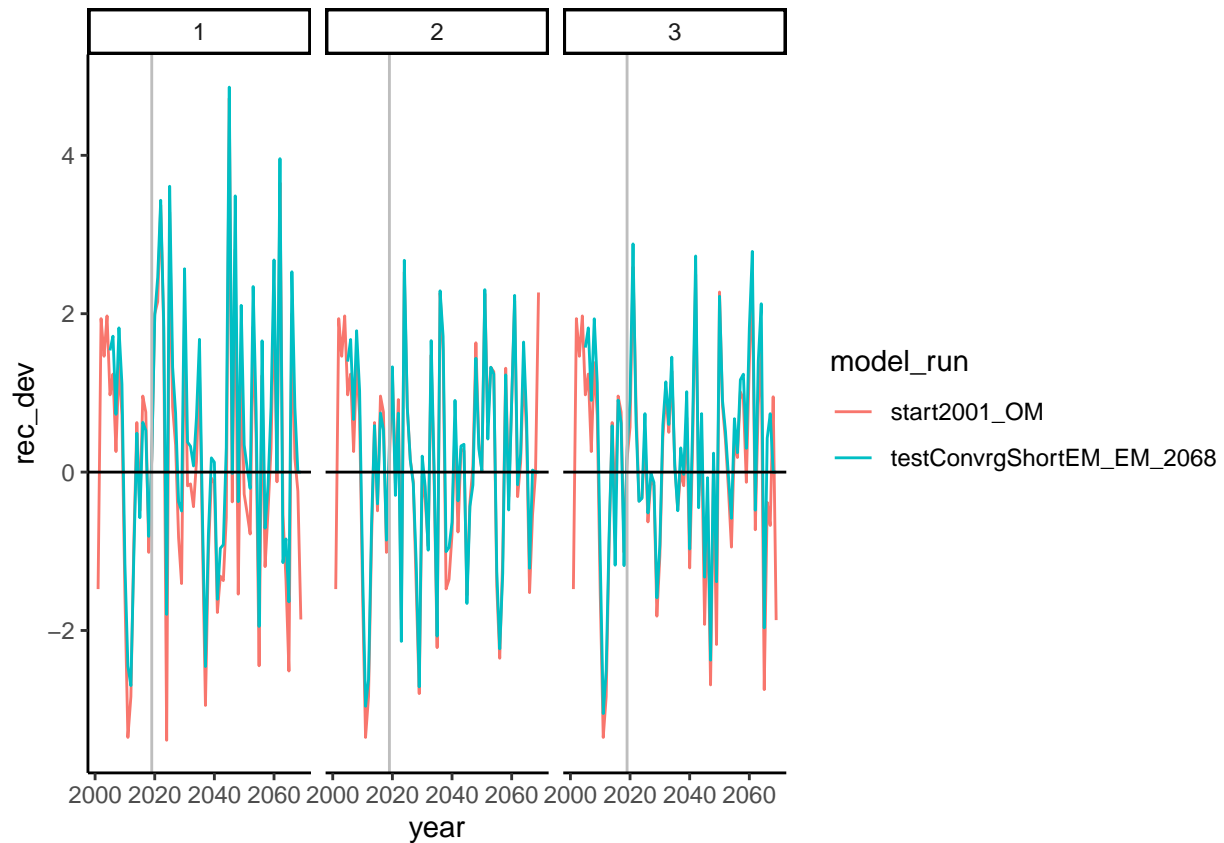
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/testConvr~EM2005fixed")
```

```
## Rows: 12564 Columns: 26
## -- Column specification -----
## Delimiter: ","
## chr  (2): model_run, scenario
## dbl  (24): Seas, Bio_smry, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2068", model_run)) %>%
  filter(complete.cases())

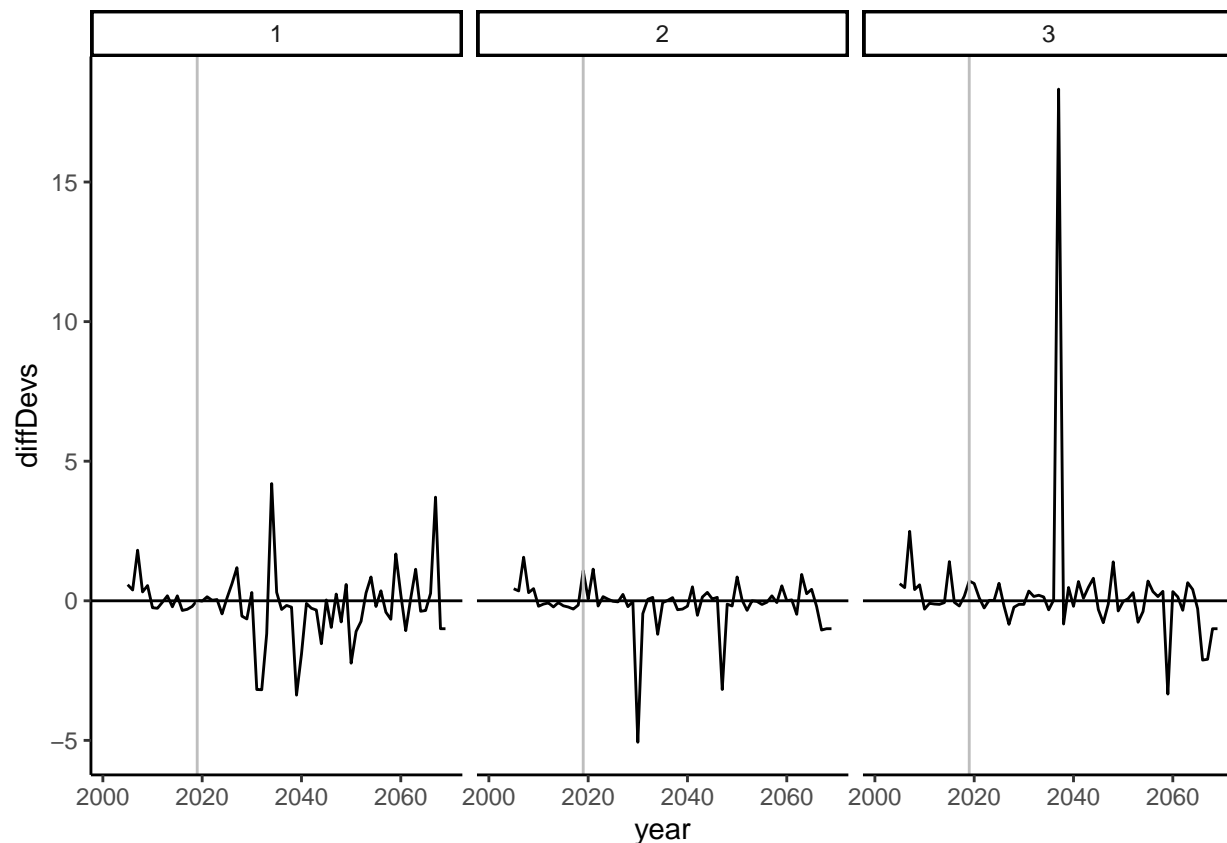
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrShortEM_EM_2068 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```

```
## Warning: Removed 4 row(s) containing missing values (geom_path).
```



EM 2005 test, SST recruitment

Look at years of no convergence and parameter bounds

```
sst2005Test <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrowthShortOM
```

```
## Rows: 153 Columns: 207
## -- Column specification -----
## Delimiter: ","
## chr   (5): params_stuck_low, params_stuck_high, version, model_run, scenario
## dbl  (200): Totbio_Unfished, SmryBio_Unfished, Recr_Unfished, max_grad, deple...
## lgl   (2): params_on_bound, hessian
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
convrgeCheckSST2005Test <- sst2005Test %>% select(max_grad, params_on_bound,
                                                  params_stuck_low, params_stuck_high,
                                                  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)
```

```
convrgeCheckSST2005Test
```

```
## # A tibble: 14 x 7
##       max_grad params_on_bound params_stuck_low      params_stuck_hi~ model_run
##       <dbl> <lgl>           <chr>           <chr>           <chr>
## 1      823.    NA             CV_old_Fem_GP_1    <NA>           testConv~
## 2    35816.    NA             <NA>             <NA>           testConv~
## 3     1781.    NA             CV_old_Fem_GP_1    <NA>           testConv~
## 4    21344.    NA             <NA>             <NA>           testConv~
## 5    31938.    NA             <NA>             <NA>           testConv~
## 6    42939.    NA             Size_95%width_MexCal_S~ <NA>           testConv~
## 7     9268.    NA             CV_old_Fem_GP_1    <NA>           testConv~
## 8      840.    NA             Size_95%width_MexCal_S~ <NA>           testConv~
## 9     9264.    NA             CV_old_Fem_GP_1    <NA>           testConv~
## 10   27152.    NA             <NA>             <NA>           testConv~
## 11  159613     NA             <NA>             <NA>           testConv~
## 12   88302.    NA             <NA>             <NA>           testConv~
## 13      0.183 NA             CV_old_Fem_GP_1    SR_LN(R0)       testConv~
## 14  106105     NA             <NA>             <NA>           testConv~
## # ... with 2 more variables: iteration <dbl>, year <dbl>
```

Plot diagnostics from self test of the 2001 model (random recruitment, HCR1)

```
sst2005Bio <- bDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "constGrowthShortOMandEM_SSTRec_HCR1",
  termYr = 2068, surveyInx = 4)
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```
## use_meanbodywt (0/1): 0
```

```
## N_lbinspop:
```

```
## use_lencomp (0/1): 1
```

```
## N_lbins: 39
```

```
## N_agebins: 9
```

```
## use_MeanSize_at_Age_obs (0/1): 0
```

```
## N_environ_variables: 0
```

```
## Read of section 1 of data file complete. Final value = 999
```

```

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

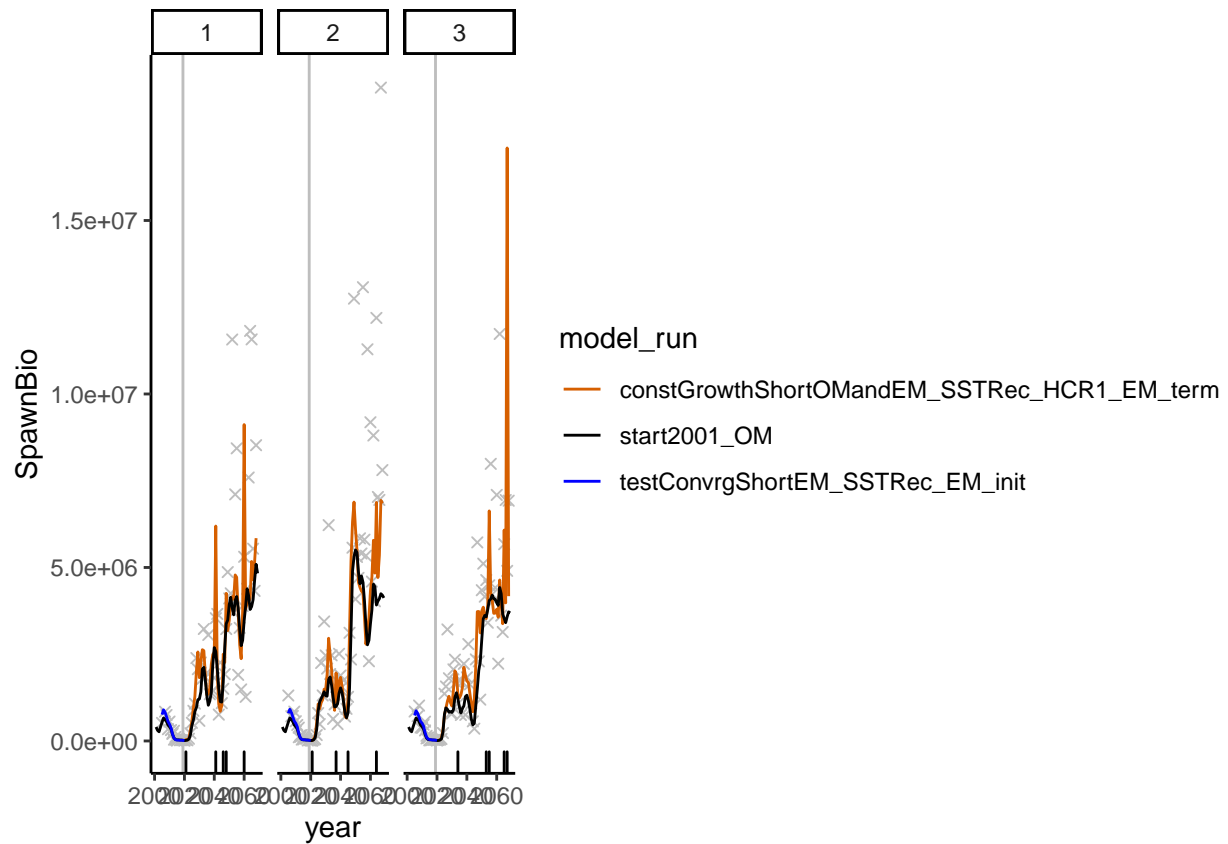
## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

```

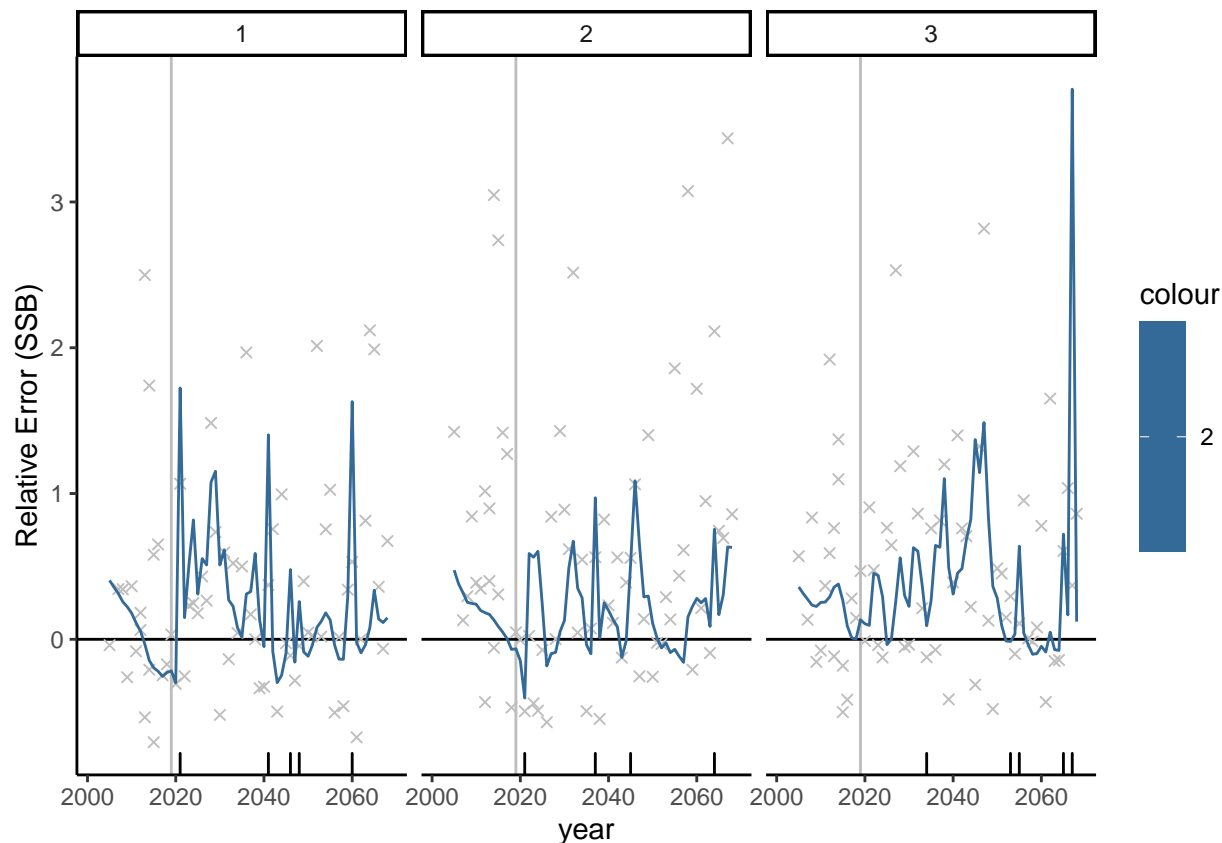
```
sst2005Bio[[1]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```



```
sst2005Bio[[2]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
                             sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 rows containing missing values (geom_point).
```

```
## Warning: Removed 15 row(s) containing missing values (geom_path).
```



```
compDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
              scenario = "constGrowthShortOMandEM_SSTRec_HCR1",
              termYr = 2068, surveyInx = 4)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
```

```
##      'Variances are 0.0 for first two elements, so do not write '
```

```
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

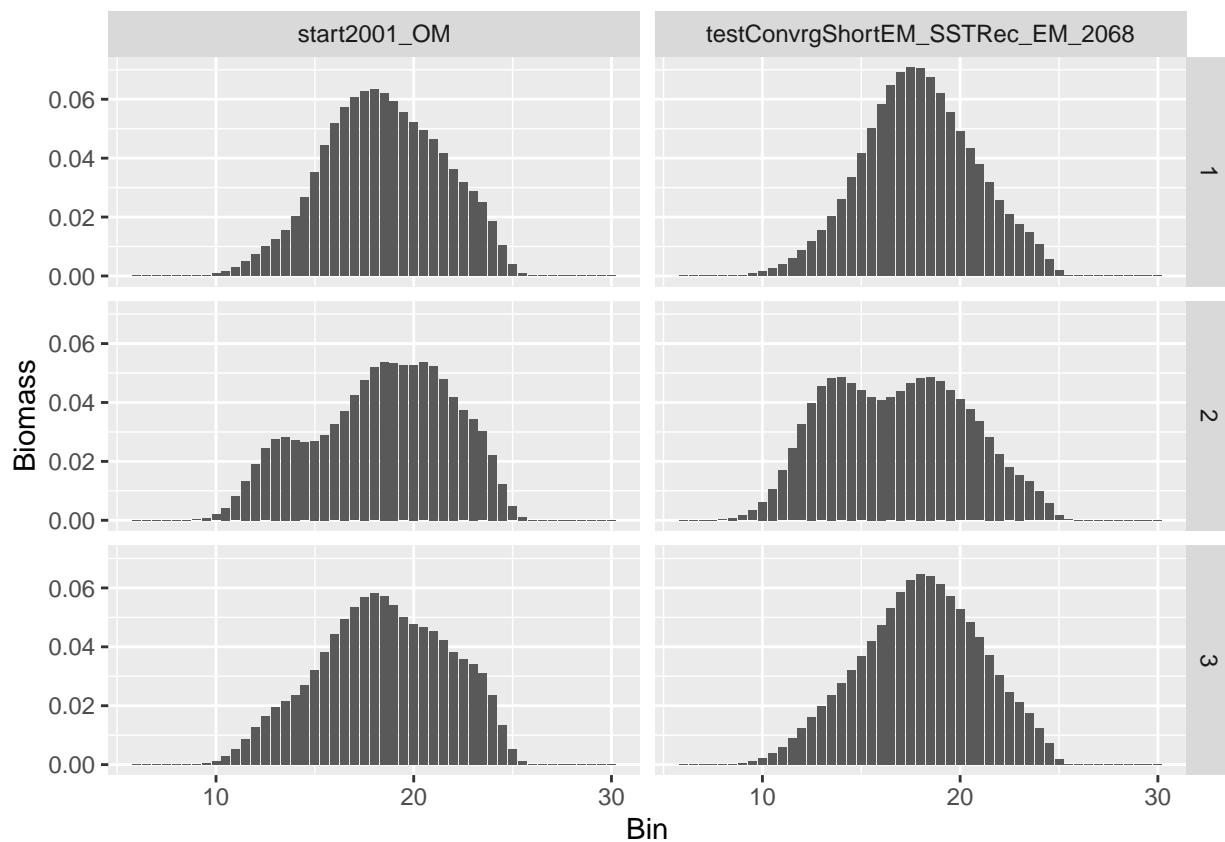
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

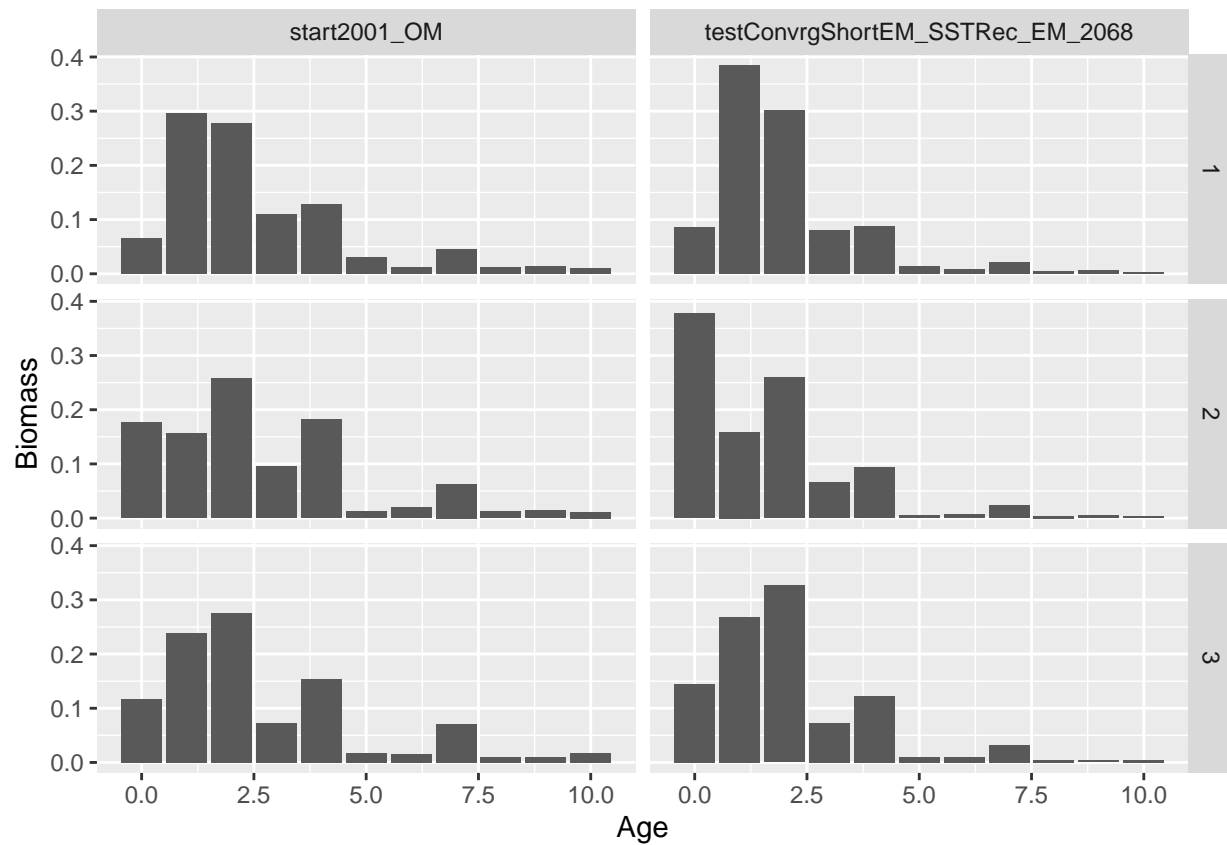
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skippe

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contain
##      'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.

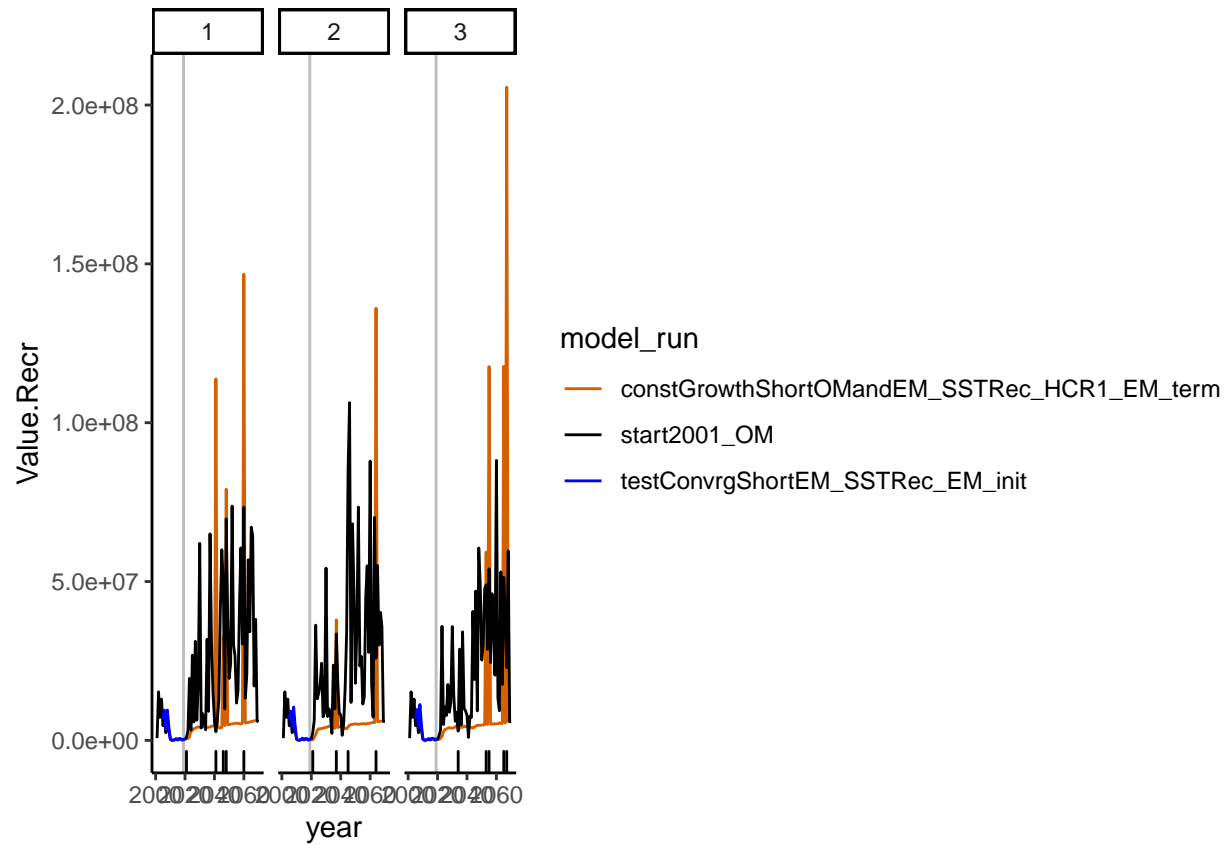
## [[1]]
```



```
##
## [[2]]
```

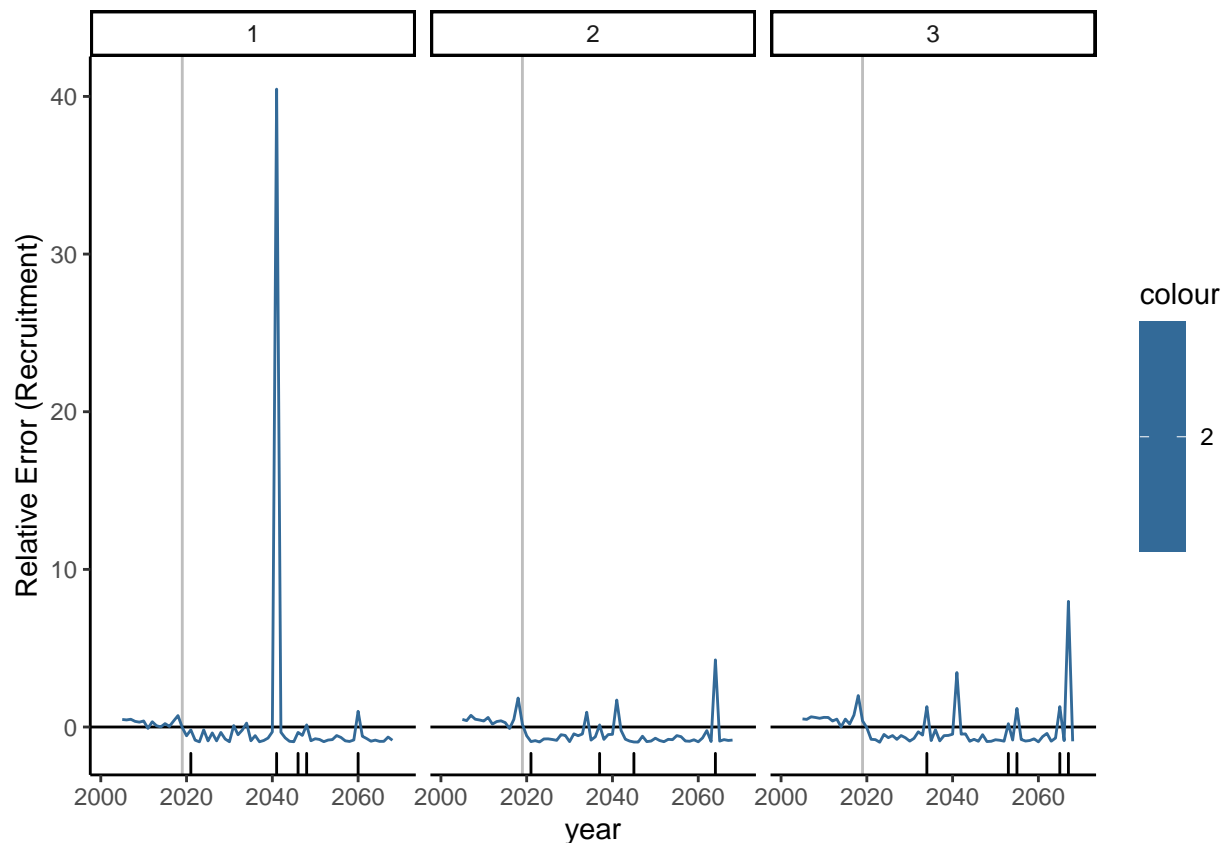



```
sst2005Rec <- recrDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "constGrowthShortOMandEM_SSTRec_HCR1", termYr = 2068)
sst2005Rec[[1]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```



```
sst2005Rec[[2]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
  sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 18 row(s) containing missing values (geom_path).
```



```
sst2005Cat <- catchDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
                             scenario = "constGrowthShortOMandEM_SSTRec_HCR1", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.
```

```
## Char version is 3.30
## Numeric version is 3.3
```

```
## Running SS_readdat_3.30
```

```
## The supplied data file has 2 sections. Using section = 1.
```

```
## SS_readdat_3.30 - read version = 3.30
```

```

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

```

```

## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, termName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : Some stats skipped

## Warning in SS_output(dir = file.path(dir, scenario, i, omName), dir.mcmc = NULL, : covar file contains
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Char version is 3.30
## Numeric version is 3.3

## Running SS_readdat_3.30

## The supplied data file has 2 sections. Using section = 1.

## SS_readdat_3.30 - read version = 3.30

## use_meanbodywt (0/1): 0

## N_lbinspop:

## use_lencomp (0/1): 1

## N_lbins: 39

## N_agebins: 9

## use_MeanSize_at_Age_obs (0/1): 0

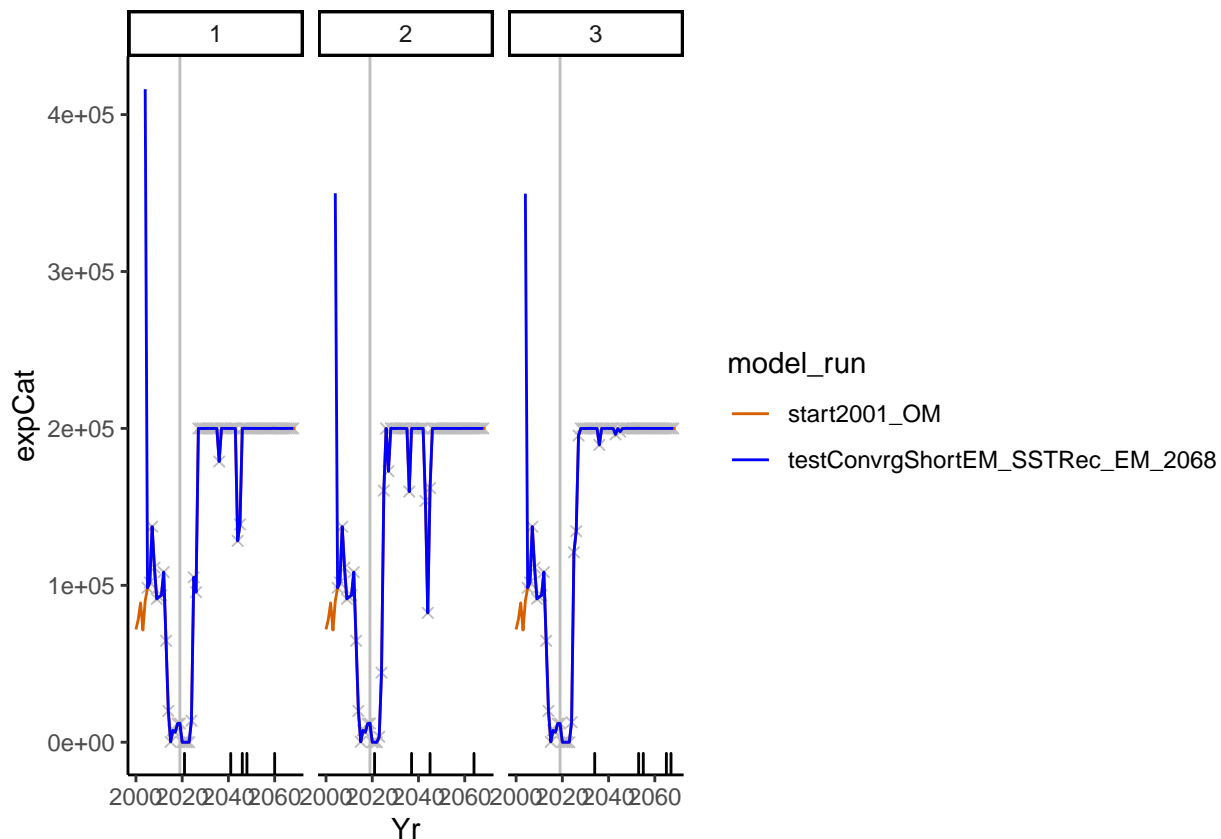
## N_environ_variables: 0

## Read of section 1 of data file complete. Final value = 999

## Warning: 'guides(<scale> = FALSE)' is deprecated. Please use 'guides(<scale> =
## "none")' instead.

sst2005Cat[[1]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
                           sides = "b", inherit.aes = FALSE)

```



```
sst2005Age1Plus <- age1plusDiagPlots(dir = "C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios",
  scenario = "constGrowthShortOMandEM_SSTRec_HCR1", termYr = 2068)
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, initName), dir.mcmc = NULL, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
## 'Variances are 0.0 for first two elements, so do not write '
## input 'covar' changed to FALSE.
```

```
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of
```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because of

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
##      'Variances are 0.0 for first two elements, so do not write '
##      input 'covar' changed to FALSE.

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

```



```

## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : Some stats skipped because

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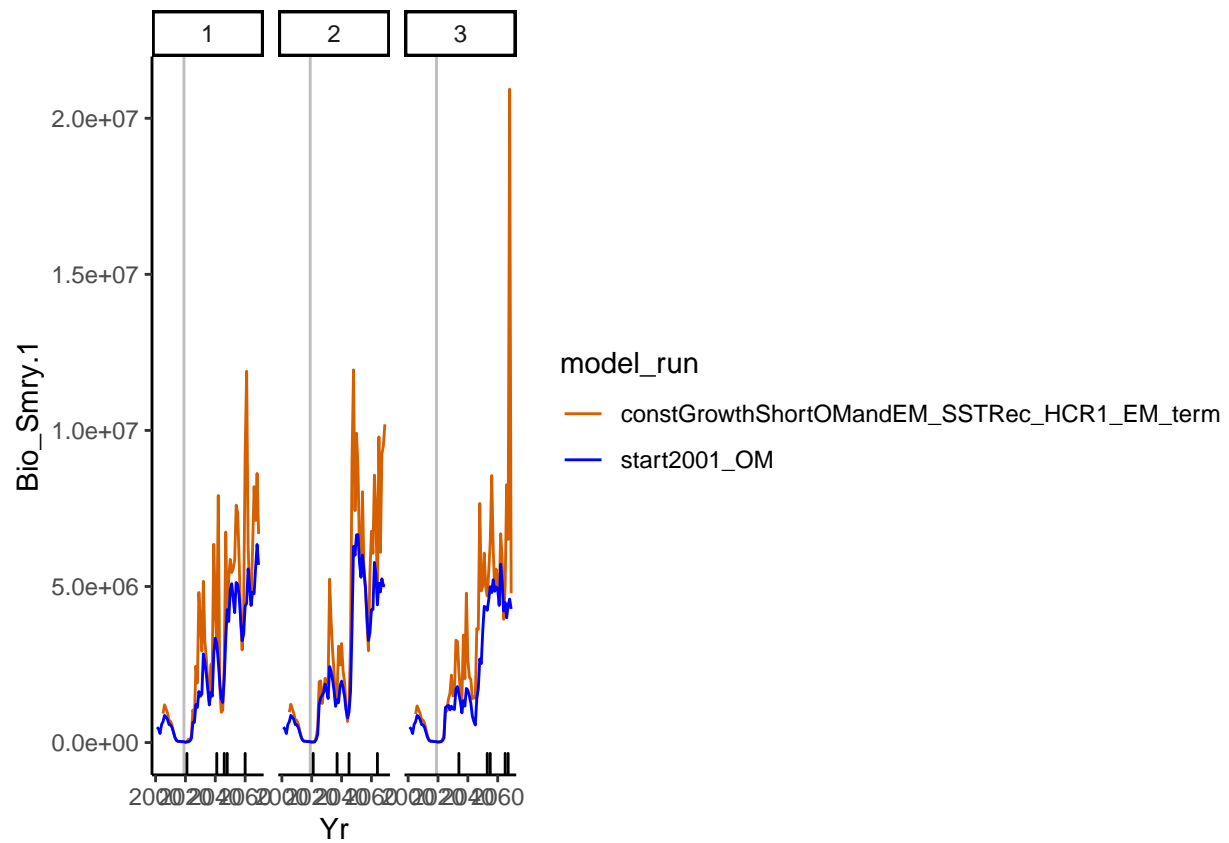
## Warning in SS_output(dir = file.path(dir, scenario, i, grep(y, termNames, : covar file contains the v
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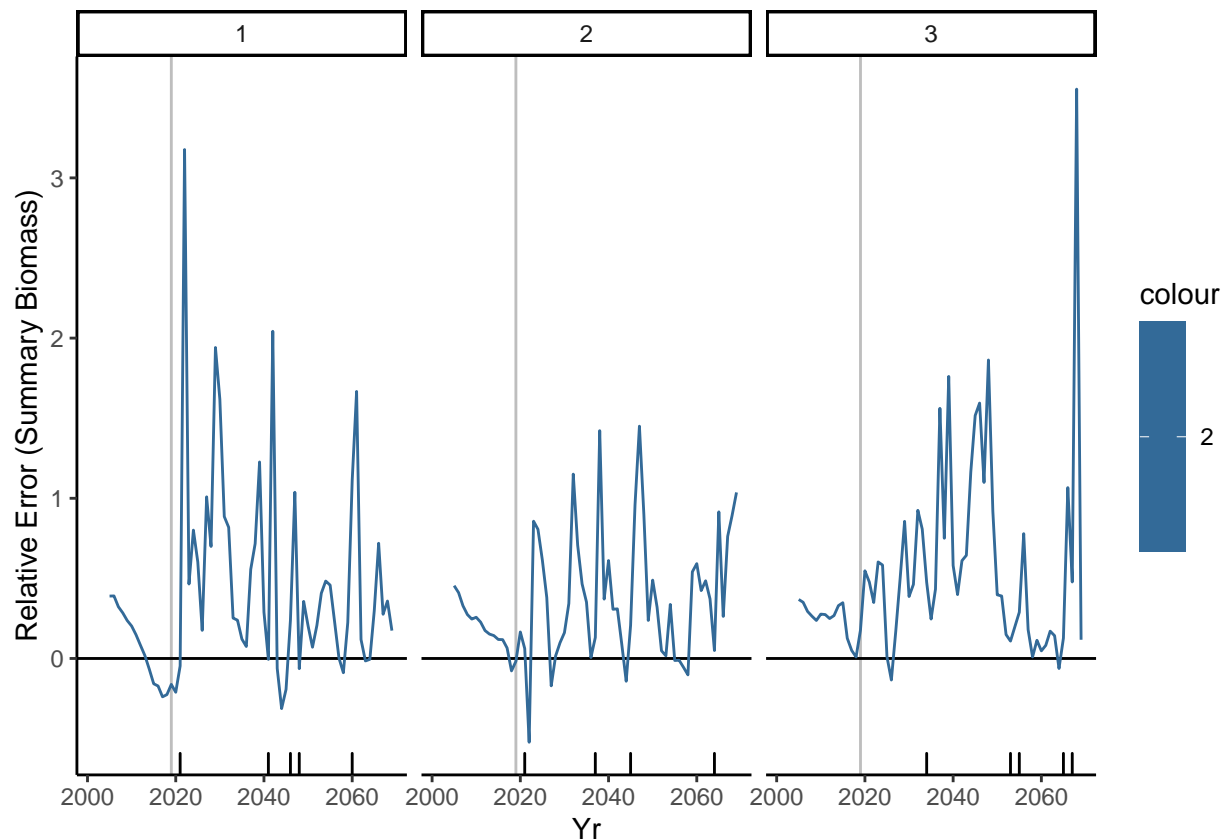
sst2005Age1Plus[[1]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
                                sides = "b", inherit.aes = FALSE)

```

```
sst2005Age1Plus[[2]] + geom_rug(data = convrgCheckSST2005Test, mapping = aes(x = year),
                                sides = "b", inherit.aes = FALSE)
```

```
## Warning: Removed 12 row(s) containing missing values (geom_path).
```



Look at recruitment and fishing mortality parameter estimates

```
paramCheckSST2005Test <- sst2005Test %>% select(max_grad, SR_LN_R0, SR_regime, SR_BH_steep,
  SR_regime_BLK1repl_2000,
  model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
    gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(max_grad > 0.01)

paramCheckSST2005Test
```

```
## # A tibble: 14 x 8
##   max_grad SR_LN_R0 SR_regime SR_BH_steep SR_regime_BLK1r~ model_run iteration
##   <dbl>    <dbl>    <dbl>    <dbl>    <dbl> <chr>      <dbl>
## 1  8.23e+2    14.7      0      0.3      NA testConv~      1
## 2  3.58e+4    21.5      0      0.3      NA testConv~      1
## 3  1.78e+3    17.5      0      0.3      NA testConv~      1
## 4  2.13e+4    20.1      0      0.3      NA testConv~      1
## 5  3.19e+4    19.8      0      0.3      NA testConv~      1
## 6  4.29e+4    14.3      0      0.3      NA testConv~      2
## 7  9.27e+3    21.8      0      0.3      NA testConv~      2
## 8  8.40e+2    14.6      0      0.3      NA testConv~      2
## 9  9.26e+3    21.7      0      0.3      NA testConv~      2
## 10 2.72e+4    15.2      0      0.3      NA testConv~      3
## 11 1.60e+5    19.5      0      0.3      NA testConv~      3
## 12 8.83e+4    19.8      0      0.3      NA testConv~      3
## 13 1.83e-1    25.0      0      0.3      NA testConv~      3
```

```
## 14 1.06e+5 19.2 0 0.3 NA testConv~ 3
## # ... with 1 more variable: year <dbl>
```

```
# compare to OM
```

```
sst2005Test %>% select(SR_LN_R0, SR_regime, SR_regime_BLK1repl_2000,
                      model_run, iteration) %>%
  mutate(year = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  filter(model_run == "start2001_OM")
```

```
## # A tibble: 3 x 6
```

```
##   SR_LN_R0 SR_regime SR_regime_BLK1repl_2000 model_run iteration year
##   <dbl>    <dbl>                <dbl> <chr>          <dbl> <dbl>
## 1    14.8      0                0.546 start2001_OM      1  2001
## 2    14.8      0                0.546 start2001_OM      2  2001
## 3    14.8      0                0.546 start2001_OM      3  2001
```

```
sst2005TestFrates <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrowthS
```

```
## Rows: 12564 Columns: 25
```

```
## -- Column specification -----
```

```
## Delimiter: ","
```

```
## chr (2): model_run, scenario
```

```
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
```

```
##
```

```
## i Use 'spec()' to retrieve the full column specification for this data.
```

```
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
sst2005TestFrates <- sst2005TestFrates %>% select(F_1, F_2, F_3, Seas, year, model_run, iteration, scen
summary(sst2005TestFrates)
```

```
##      F_1      F_2      F_3      Seas
## Min.   :0.00000 Min.   :0.0000 Min.   :0.000000 Min.   :1.0
## 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.:0.002367 1st Qu.:1.0
## Median :0.00000 Median :0.0000 Median :0.021441 Median :1.5
## Mean   :0.04362 Mean   :0.1439 Mean   :0.216098 Mean   :1.5
## 3rd Qu.:0.06615 3rd Qu.:0.1252 3rd Qu.:0.293929 3rd Qu.:2.0
## Max.   :0.72575 Max.   :4.0000 Max.   :2.950350 Max.   :2.0
##      year      model_run      iteration      scenario
## Min.   :2001 Length:12564 Min.   :1 Length:12564
## 1st Qu.:2015 Class :character 1st Qu.:1 Class :character
## Median :2025 Mode  :character Median :2 Mode  :character
## Mean   :2028 Mean   :2
## 3rd Qu.:2039 3rd Qu.:3
## Max.   :2069 Max.   :3
```

```
sst2005TestFrates %>% filter(F_1 > 1 | F_2 > 1 | F_3 > 1) %>% arrange(year, Seas) %>%
  mutate(yearEM = as.numeric(regmatches(model_run,
                                       gregexpr("[[:digit:]]+", model_run)))) %>%
  left_join(y = convrgCheckSST2005Test, by = c("yearEM" = "year", "iteration", "model_run"))
```

```
## # A tibble: 1,094 x 13
##       F_1    F_2    F_3  Seas  year model_run  iteration scenario yearEM max_grad
##   <dbl> <dbl> <dbl> <dbl> <dbl> <chr>      <dbl> <chr>    <dbl>    <dbl>
## 1 0.0871    0  1.37    1  2005 testConvr~      1 constGr~  2021    823.
## 2 0.0410    0  1.01    1  2005 testConvr~      1 constGr~  2022     NA
## 3 0.0415    0  1.06    1  2005 testConvr~      1 constGr~  2023     NA
## 4 0.0423    0  1.12    1  2005 testConvr~      1 constGr~  2024     NA
## 5 0.0420    0  1.16    1  2005 testConvr~      1 constGr~  2025     NA
## 6 0.0411    0  1.14    1  2005 testConvr~      1 constGr~  2026     NA
## 7 0.0408    0  1.13    1  2005 testConvr~      1 constGr~  2027     NA
## 8 0.0420    0  1.22    1  2005 testConvr~      1 constGr~  2028     NA
## 9 0.0427    0  1.21    1  2005 testConvr~      1 constGr~  2029     NA
##10 0.0415    0  1.17    1  2005 testConvr~      1 constGr~  2030     NA
## # ... with 1,084 more rows, and 3 more variables: params_on_bound <lgl>,
## #   params_stuck_low <chr>, params_stuck_high <chr>
```

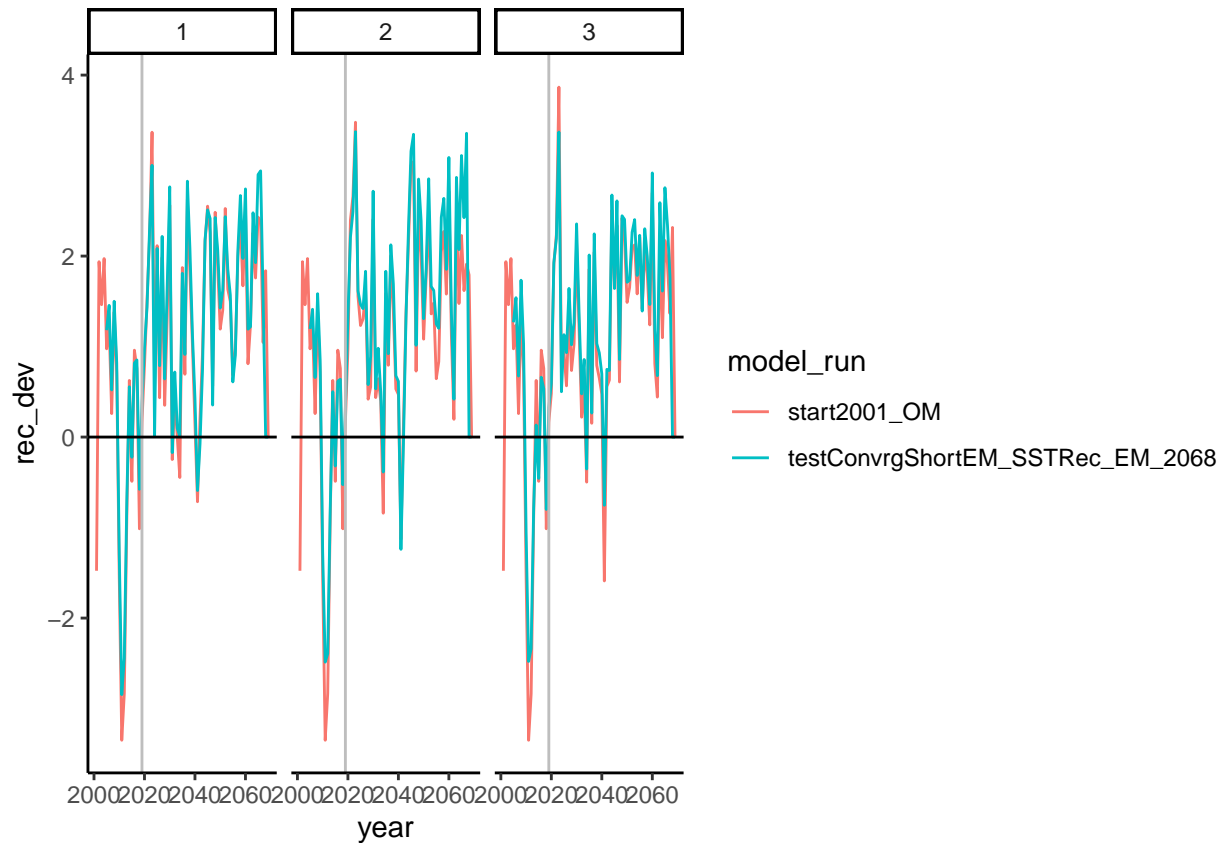
Plot error for estimates of rec devs from 2068 compared to OM (these aren't terminal year estimates like plots above)

```
recDevTS <- read_csv("C:/Users/r.wildermuth/Documents/FutureSeas/SardineScenarios/constGrowthShortOMandl")
```

```
## Rows: 12564 Columns: 25
## -- Column specification -----
## Delimiter: ","
## chr  (2): model_run, scenario
## dbl (23): Seas, SpawnBio, Recruit_0, retainB_1, retainN_1, retainB_2, retain...
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
recDevTS <- recDevTS %>% select(rec_dev, Seas, year, model_run, iteration, scenario) %>%
  filter(model_run == "start2001_OM" | grepl("2068", model_run)) %>%
  filter(complete.cases(.))

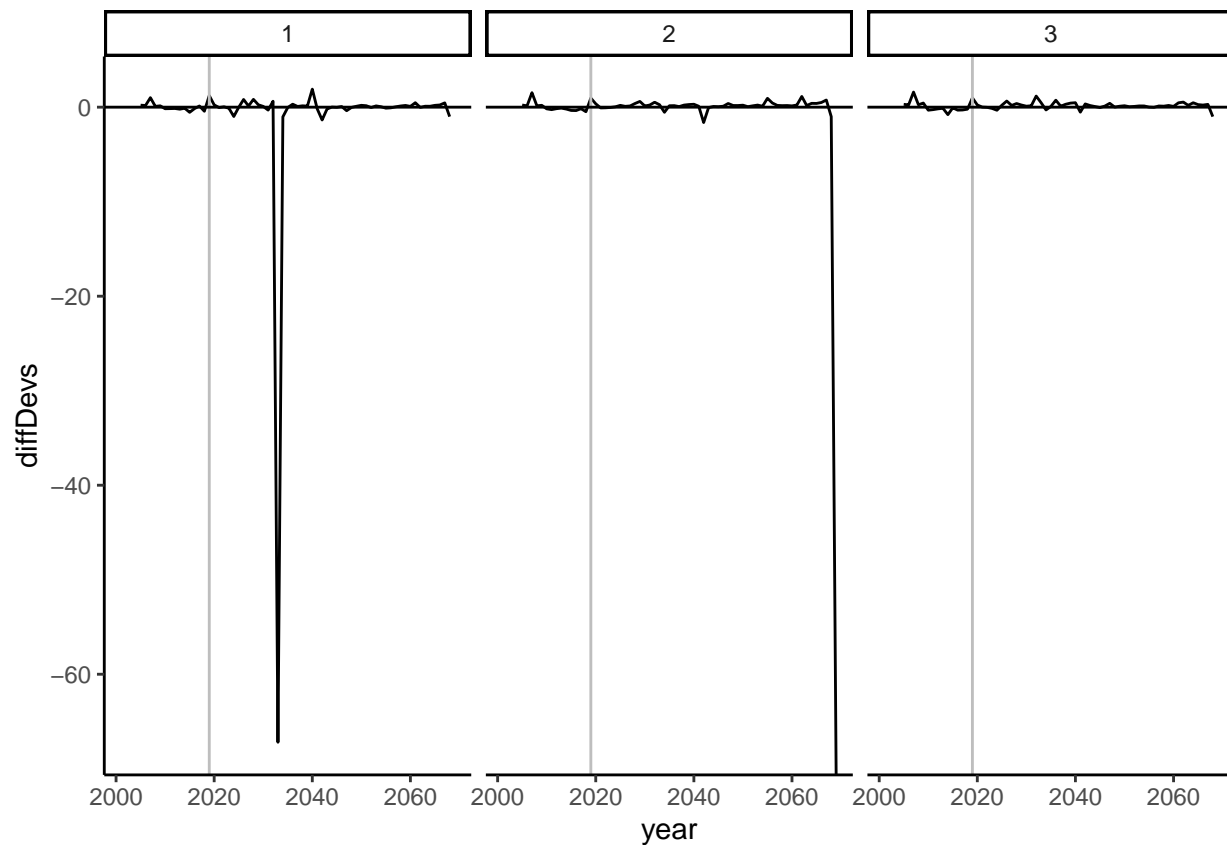
recDevTS %>% ggplot(aes(x=year, y=rec_dev)) + geom_line(aes(color = model_run)) +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```



```
relRecDevTS <- recDevTS %>% pivot_wider(id_cols = c(year, iteration),
                                         names_from = model_run,
                                         values_from = rec_dev) %>%
  mutate(diffDevs = (testConvrgShortEM_SSTRec_EM_2068 - start2001_OM)/start2001_OM)

relRecDevTS %>% ggplot(aes(x=year, y=diffDevs)) + geom_line() +
  ggplot2::facet_wrap(. ~ iteration) +
  ggplot2::geom_vline(xintercept = 2019, color = "gray") +
  geom_hline(yintercept = 0, color = "black") +
  ggplot2::theme_classic()
```

```
## Warning: Removed 5 row(s) containing missing values (geom_path).
```



Convergence summaries

Summary of non-convergence frequency per model run

```

rbind(
  convrgCheckServerTest %>% group_by(iteration) %>%
    summarize(nonconvg = length(max_grad)) %>%
    mutate(nYrs = max(serverTestFrates$year) - 2019,
           frqNonConvrg = nonconvg/nYrs,
           modRun = "old server OM2001 EM2005"),

  # convrgCheck1981ServerTest %>% group_by(iteration) %>%
  #   summarize(nonconvg = length(max_grad)) %>%
  #   mutate(nYrs = max(serv1981TestFrates$year) - 2019,
  #          frqNonConvrg = nonconvg/nYrs,
  #          modRun = "old server OM_K EM_K"),

  convrgCheckSelfTest %>% group_by(iteration) %>%
    summarize(nonconvg = length(max_grad)) %>%
    mutate(nYrs = max(selfTestFrates$year) - 2019,
           frqNonConvrg = nonconvg/nYrs,
           modRun = "OM2001 self test"),

  convrgCheckMeanTest %>% group_by(iteration) %>%

```

```

summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(meanTestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM2001 mean test"),

convrgeCheck1SDTest %>% group_by(iteration) %>%
summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(sd1TestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM2001 SD=1, free est of Q and M"),

convrgeCheckOMKselfTest %>% group_by(iteration) %>%
summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(omkselfTestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM_K self test"),

convrgeCheckOMKEMKTest %>% group_by(iteration) %>%
summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(omkemkTestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM_K EM_K"),

convrgeCheck2005Test %>% group_by(iteration) %>%
summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(em2005TestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM2001 EM2005"),

convrgeCheckSST2005Test %>% group_by(iteration) %>%
summarize(nonconvg = length(max_grad)) %>%
mutate(nYrs = max(sst2005TestFrates$year) - 2019,
      frqNonConvg = nonconvg/nYrs,
      modRun = "OM2001 EM2005 SSTRec")
)

```

```

## # A tibble: 20 x 5
##   iteration nonconvg  nYrs frqNonConvg modRun
##   <dbl>      <int> <dbl>      <dbl> <chr>
## 1         3        38    50         0.76 old server OM2001 EM2005
## 2         4        27    50         0.54 old server OM2001 EM2005
## 3         1         3    40         0.075 OM2001 self test
## 4         2         4    40         0.1  OM2001 self test
## 5         3         4    40         0.1  OM2001 self test
## 6         1         2    40         0.05 OM2001 mean test
## 7         2         2    40         0.05 OM2001 mean test
## 8         3         1    40         0.025 OM2001 mean test
## 9         1        24    50         0.48 OM2001 SD=1, free est of Q and M
## 10        2        34    50         0.68 OM2001 SD=1, free est of Q and M
## 11        3        32    50         0.64 OM2001 SD=1, free est of Q and M
## 12        1        17    50         0.34 OM_K EM_K
## 13        2        18    50         0.36 OM_K EM_K
## 14        3        22    50         0.44 OM_K EM_K

```

```
## 15      1      1    50      0.02 OM2001 EM2005
## 16      2      6    50      0.12 OM2001 EM2005
## 17      3      6    50      0.12 OM2001 EM2005
## 18      1      5    50      0.1  OM2001 EM2005 SSTRec
## 19      2      4    50      0.08 OM2001 EM2005 SSTRec
## 20      3      5    50      0.1  OM2001 EM2005 SSTRec
```

```
unique(convrgCheck2005Test$params_on_bound)
```

```
## [1] NA
```

```
unique(convrgCheck2005Test$params_stuck_low)
```

```
## [1] NA                                "AgeSel_P4_MexCal_S2(2)" "CV_old_Fem_GP_1"
```

```
unique(convrgCheck2005Test$params_stuck_high)
```

```
## [1] NA
```

```
unique(c(convrgCheckSelfTest$params_on_bound, convrgCheckMeanTest$params_on_bound))
```

```
## [1] NA
```

```
unique(c(convrgCheckSelfTest$params_stuck_low, convrgCheckMeanTest$params_stuck_low))
```

```
## [1] "Size_95%width_MexCal_S1(1)"
## [2] "InitF_seas_2_flt_2MexCal_S2;Size_95%width_MexCal_S1(1)"
## [3] "CV_old_Fem_GP_1;Size_95%width_MexCal_S1(1)"
## [4] NA
## [5] "CV_old_Fem_GP_1"
```

```
unique(c(convrgCheckSelfTest$params_stuck_high, convrgCheckMeanTest$params_stuck_high))
```

```
## [1] NA
```