

Indian Ocean albacore Operating Model

Online session WPTmT - 16 April 2021

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Outline

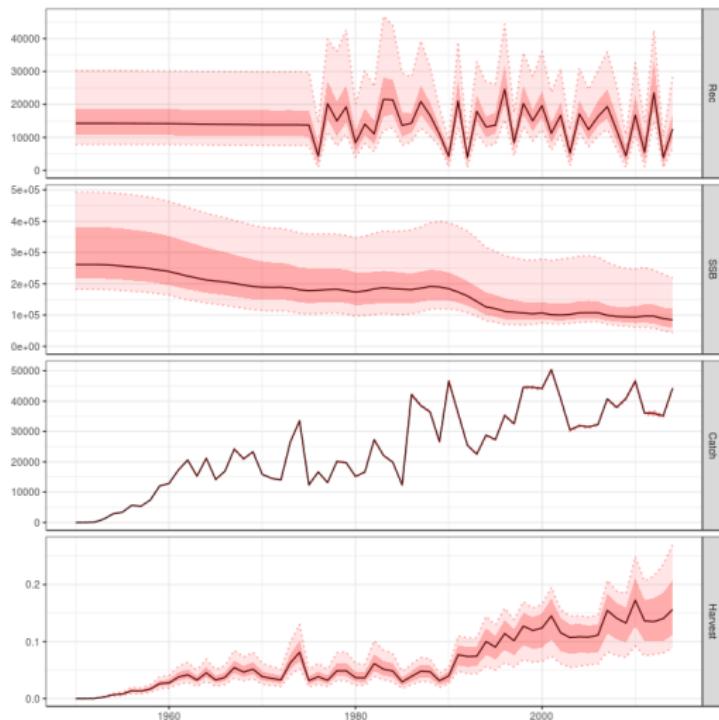
- 3rd iteration of albacore OM.
- Based on WPTmT 2019 SS3 model.
- Existing FLR platform and packages for SS 3.30.16.
 - `ioalbmse` to create model grid.
 - `ss3om` to load and assemble OM from SS3 models.
 - `mse` to run MP evaluations.
 - `mseviz` to visualize MSE output.
- Contract WMR - IOTC/FAO August 2020 - December 2021.
- <https://github.com/iotcwpml/alb>

WPTmT 2016 ALB OM grid

Factor	N	Prod	Values
Natural mortality	5	5	0202, 0303, 0404, 0403, 0402
Steepness SRR	3	15	0.7, 0.8, 0.9
sigma recruitment	2	30	0.4, 0.6
ESS length comps.	3	90	20, 50, 100
CV CPUE	4	360	0.2, 0.3, 0.4, 0.5
LL q increase	2	720	0%, 0.25% per quarter
Selectivity form	2	1440	logistic, double normal

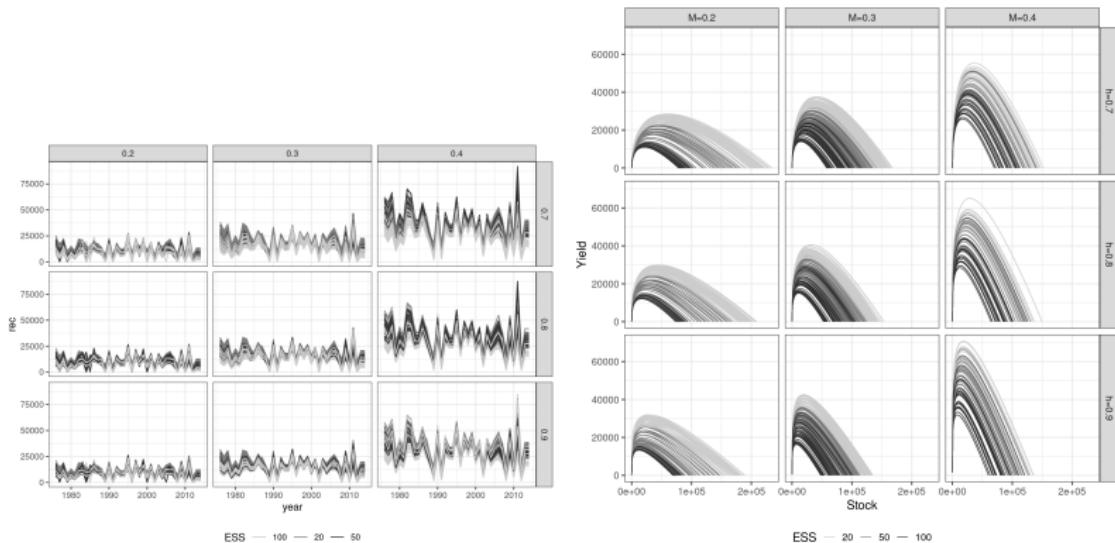
- 1,440 SS3 model runs (1.5 h each)
- Filtered by convergence.
- Equally weighted for subsampling.

WPTmT 2016 ALB OM

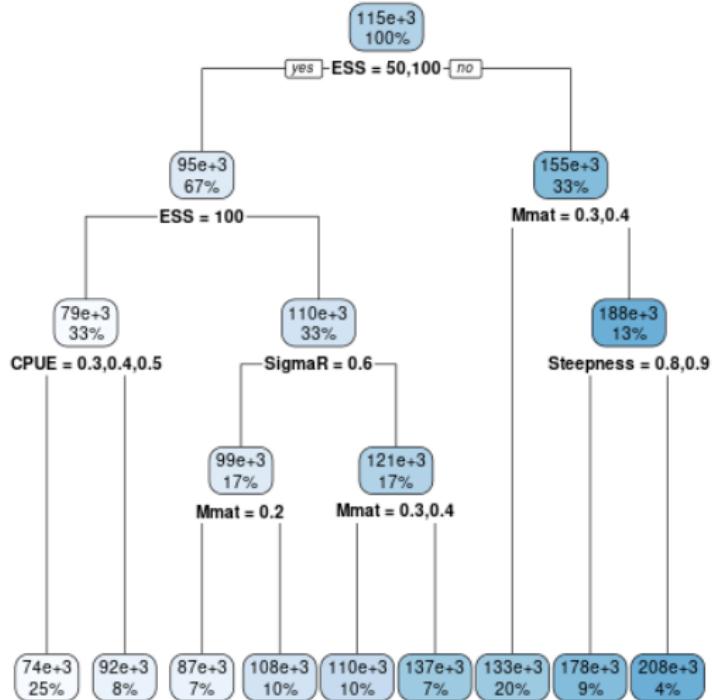


Analysis of 2016 grid

- What factors determine production, variability and status
- Adult M and ESS + CPUECV most important, then LLq

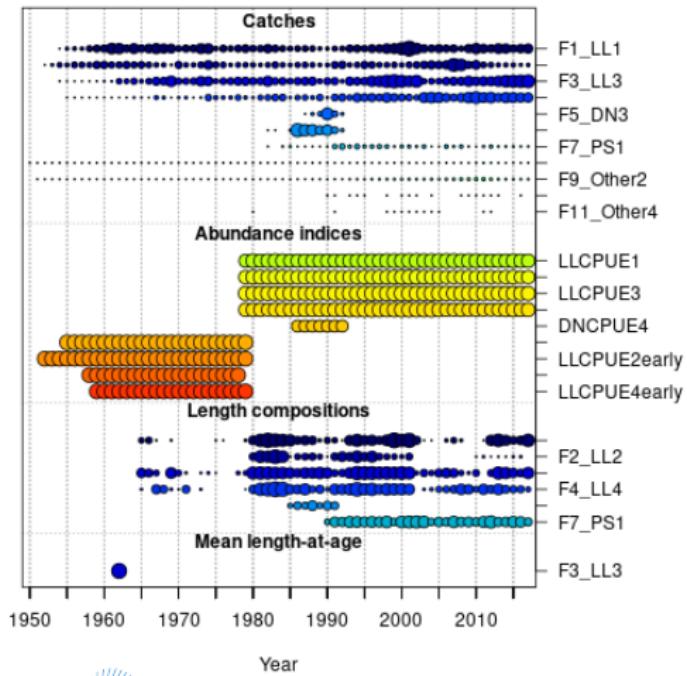


Regression tree SB0



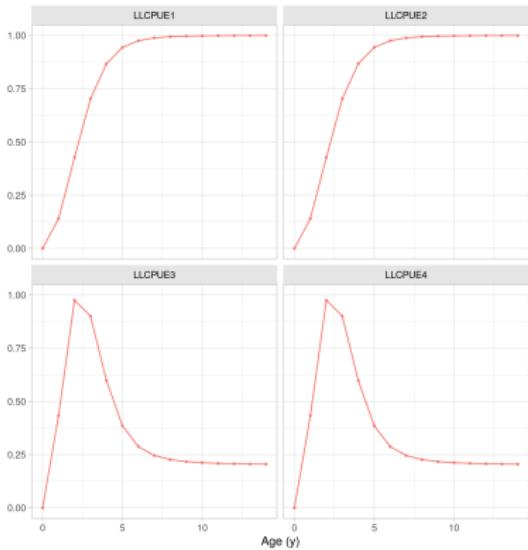
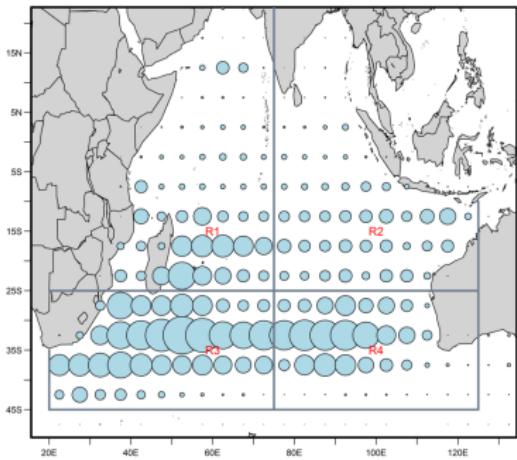
WPTmT 2019 SS3 albacore SA

- 2 sex, one area
- 4 LL fleets, DN (1982-92), PS (NW), Other.

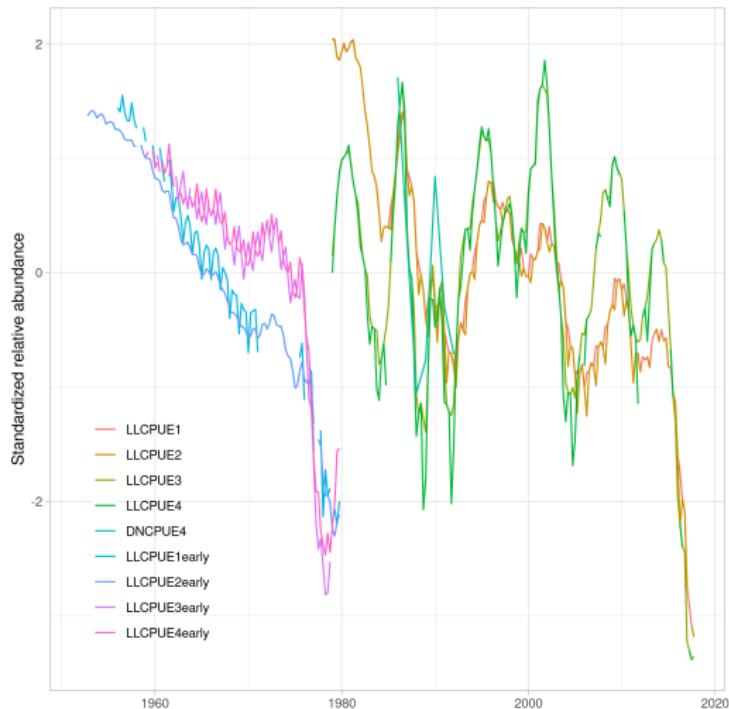


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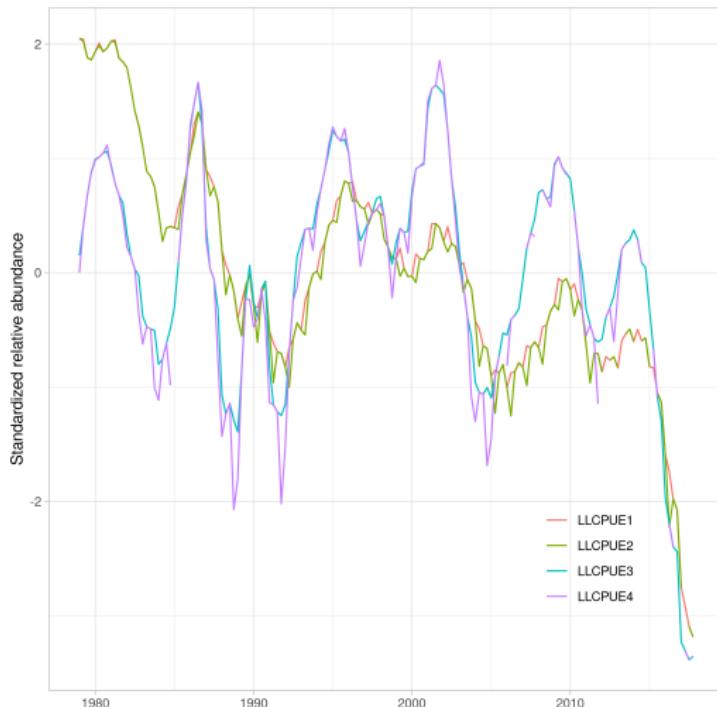
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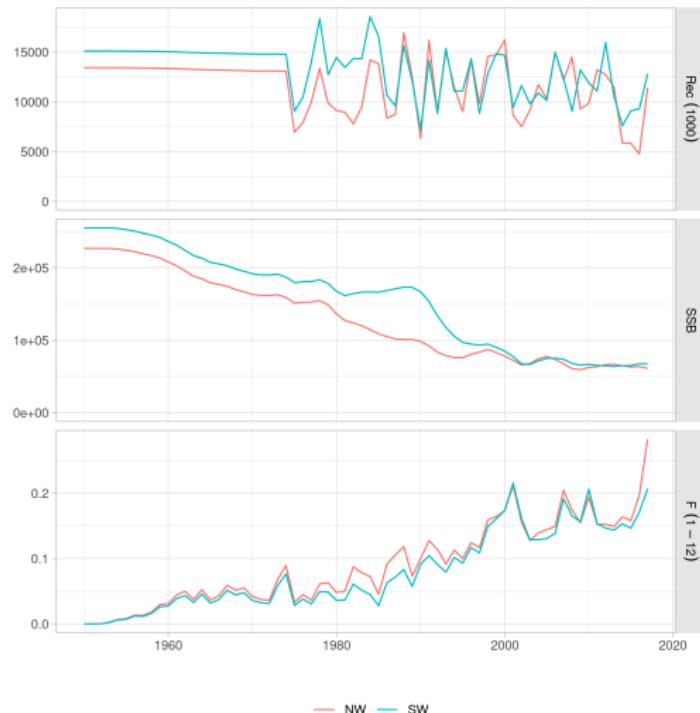
WPTmT 2019 SS3 albacore SA: indices



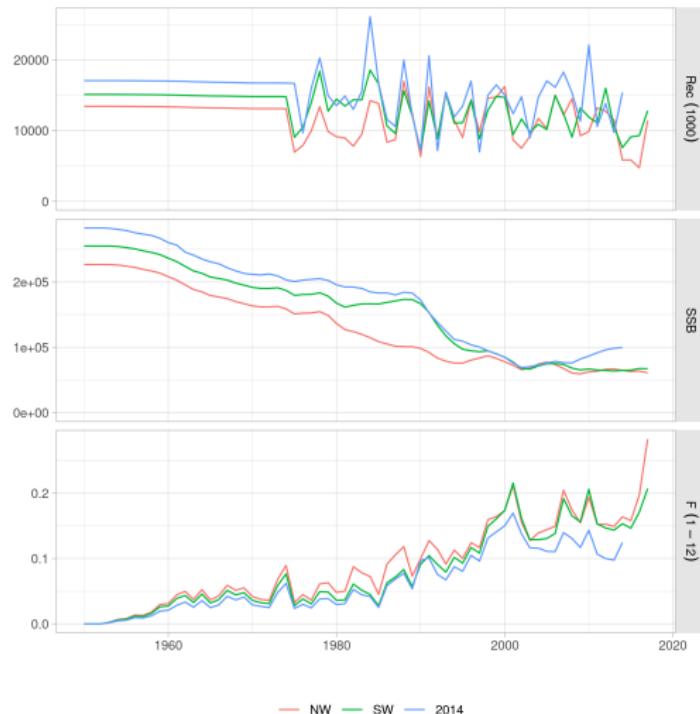
WPTmT 2019 SS3 albacore SA: recent indices



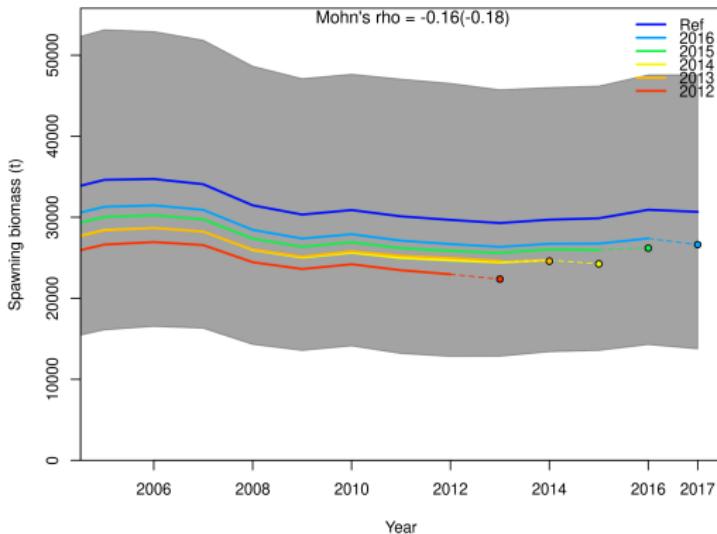
WPTmT 2019 SS3 albacore SA: runs



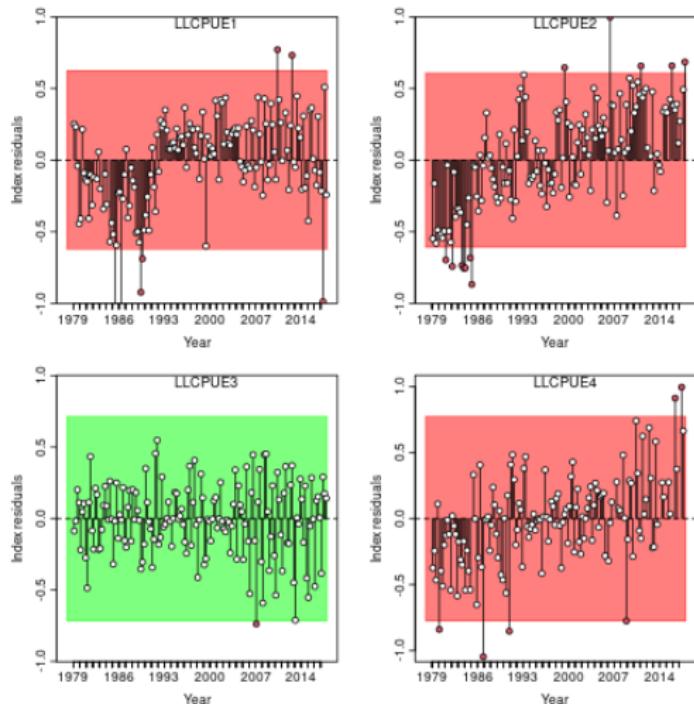
WPTmT 2016 and 2019 SS3 albacore SA: runs



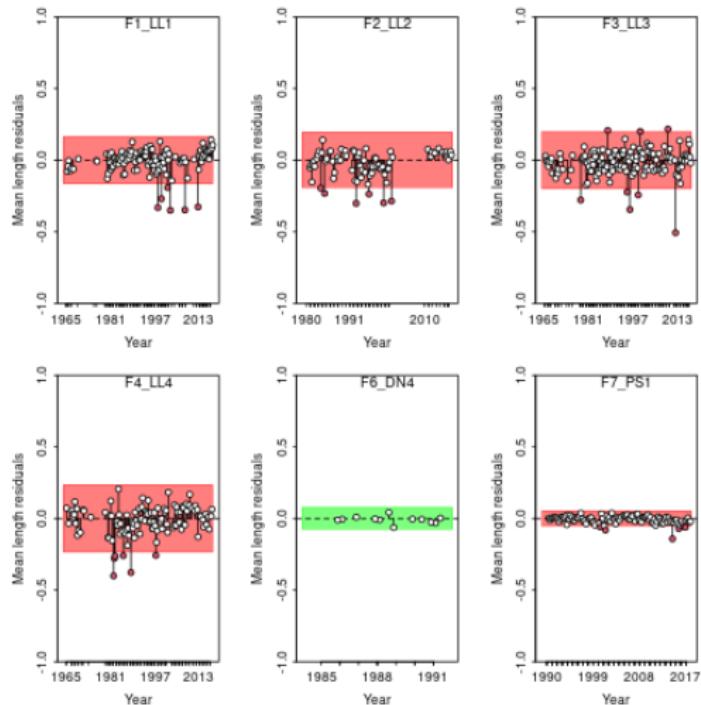
Model diagnostics: Retrospective analysis



Model diagnostics: CPUE runs tests

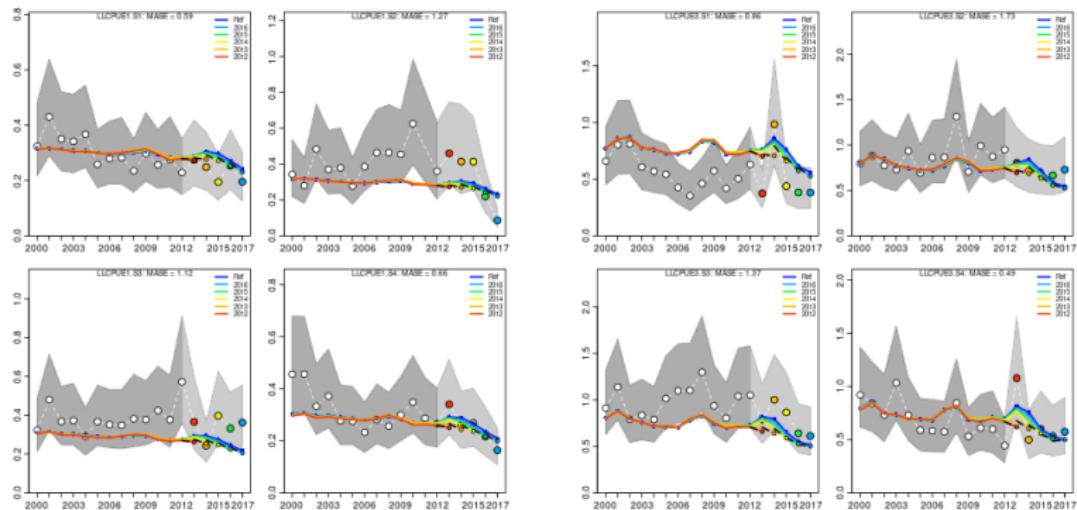


Model diagnostics: LF runs tests



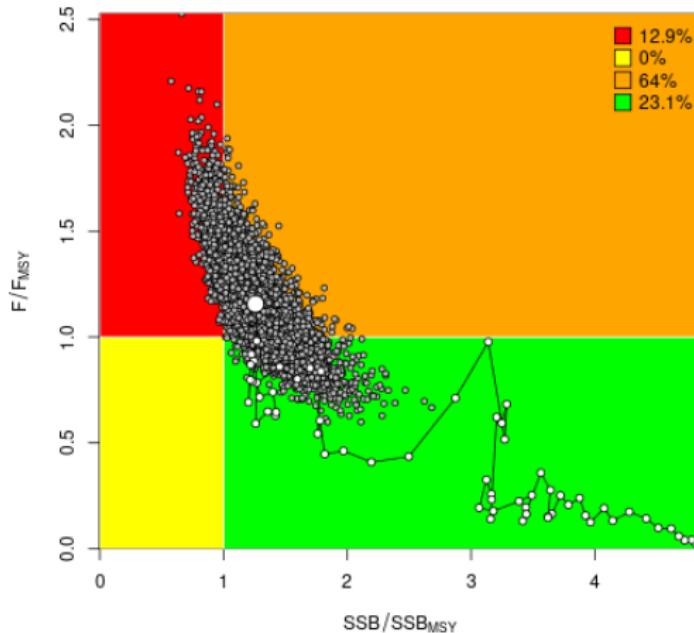
Model diagnostics: Hindcasting cross validation (MASE)

- 5 retrospective runs (one year less each time).
- Project CPUE 1 year ahead based on catch
- Compare observation and prediction.



MASE < 1: LLCPUE3 S1, S4, LLCPUE1 S1, S4

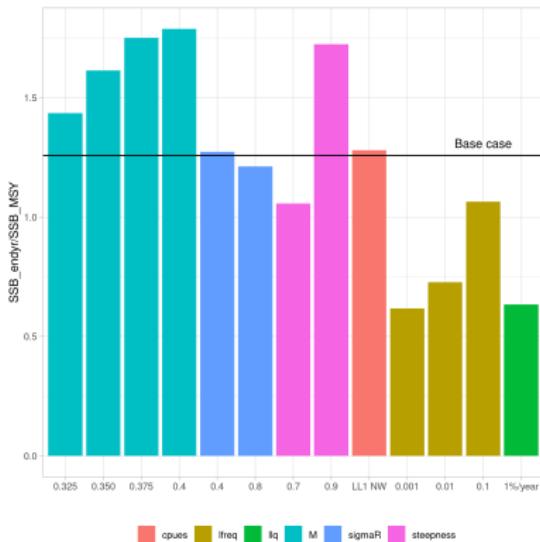
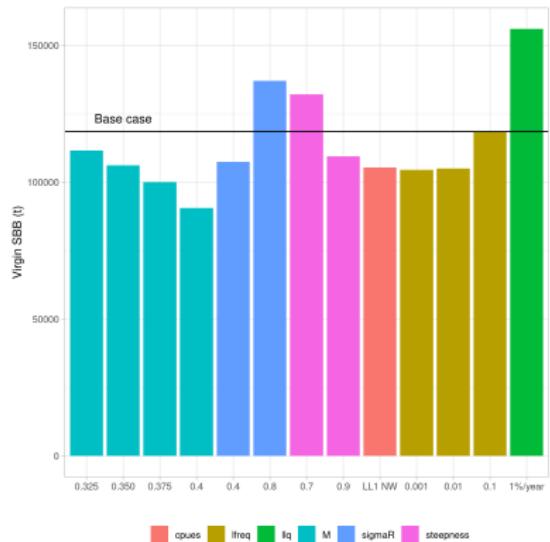
Parameter uncertainty: MVLN



Operating Model grid (WPM 2020)

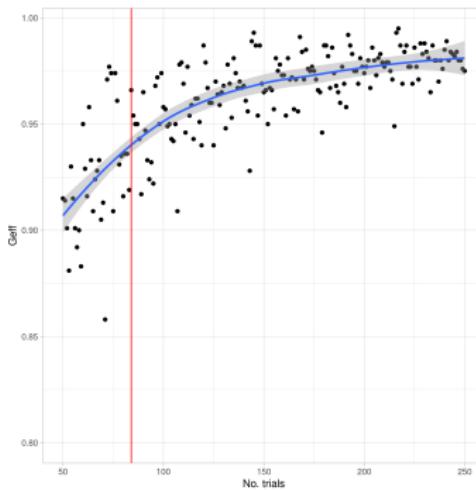
- 6 factors, 2-4 levels each.
- Natural mortality (M):
 - 0.20, 0.25, 0.30 or 0.35, for all ages.
- SD recruitment deviates (sigmaR):
 - 0.4, 0.6, or 0.8.
- SRR steepness (h):
 - 0.7, 0.8 or 0.9.
- LL CPUE series (cpues):
 - Northwest (LLCPUE1, 12) or Southwest (LLCPUE3, 14).
- LF data lkhd weighting (lfreq):
 - 0.01, 0.1 or 1.
- Catchability increase LL CPUE (llq):
 - 0% or 1% per year.
- $4 \times 3 \times 3 \times 2 \times 3 \times 2 = 432$ runs

Main effects: Change in SB0, SBMSY by factor

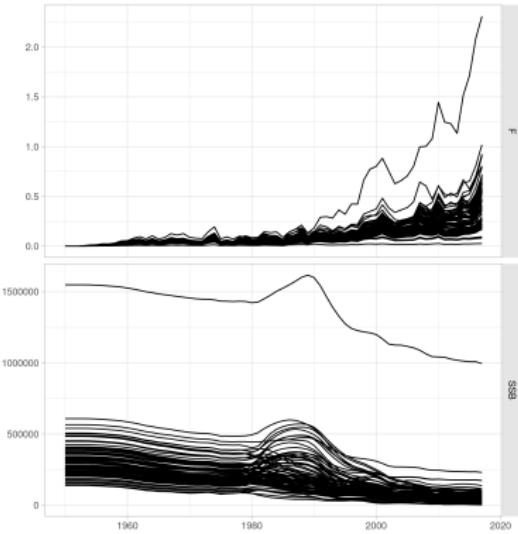
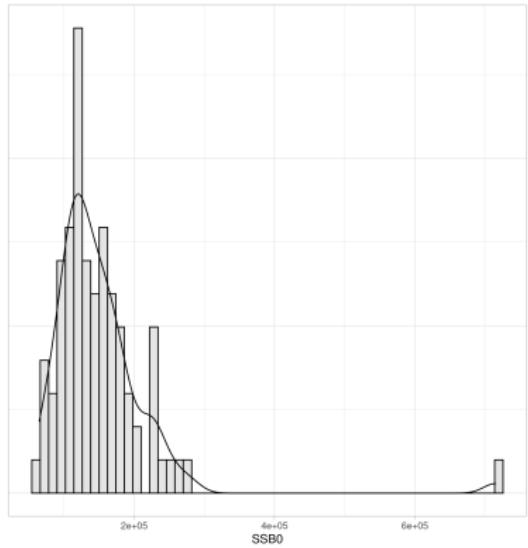


Partial factorial grid

- Federov's exchange algorithm (`AlgDesign::optFederov`)
- 84 runs
- Normalized variance = 0.95
- Equal numbers by level on all factors



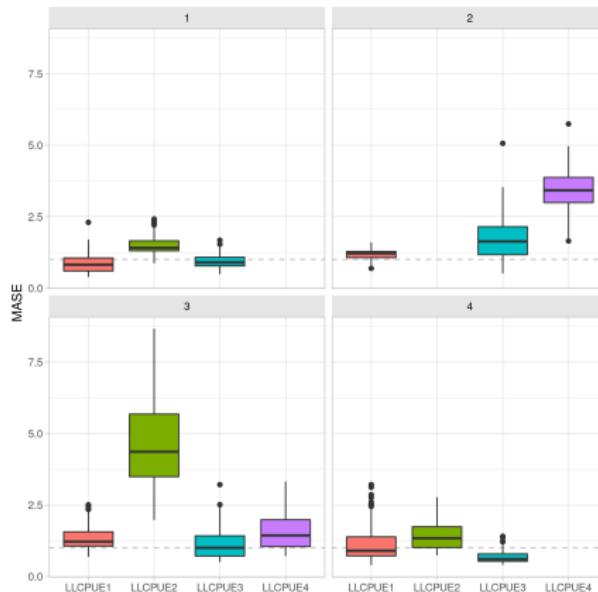
Model grid results: SSB0 & stock trajectories



- Run 6
 - $M=0.25$, $\sigma R=0.6$, $h=0.9$, CPUE SW, Ifreq=0.01, Ilq=1

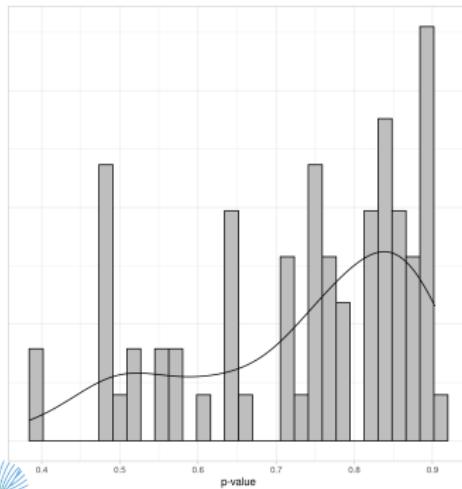
Diagnostics: CPUE xval MASE

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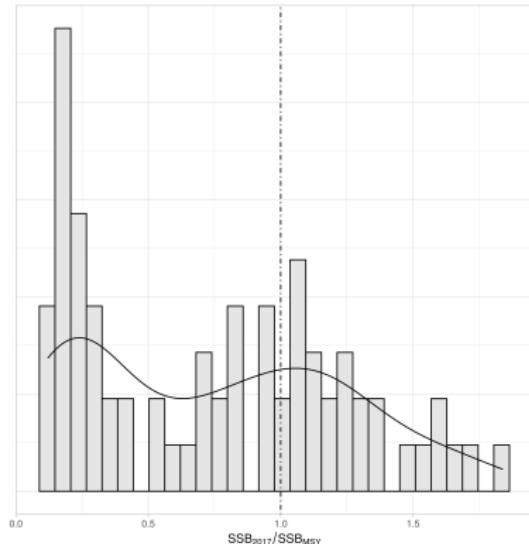
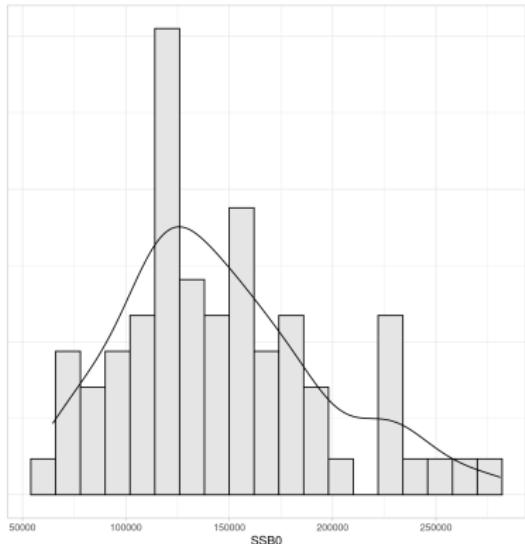
Model selection & weighting

- Model runs dropped if:
 - $SSB0 > 0.5M$ t (1)
 - Convergence level $> 1e-4$ (5)
 - MASE (LLCPUE SW) > 1 (7)
- Model weight
 - P-value of Diebold-Mariano test LLCPUE SW cross-validation
 - Compares CPUE prediction and *naive* prediction ($I_y = I_{y-1}$)



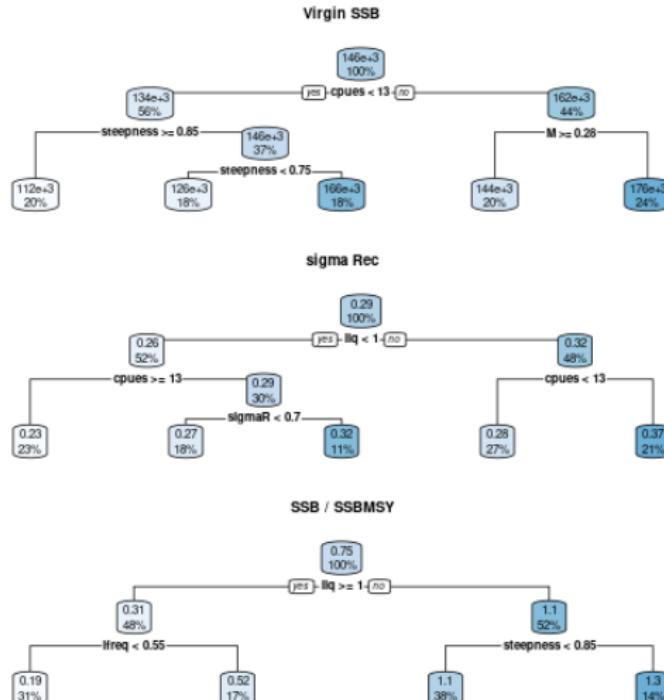
Selected model runs

- 71 model runs left.
- Dropped runs: Lower sigmaR, high h, NW CPUE.



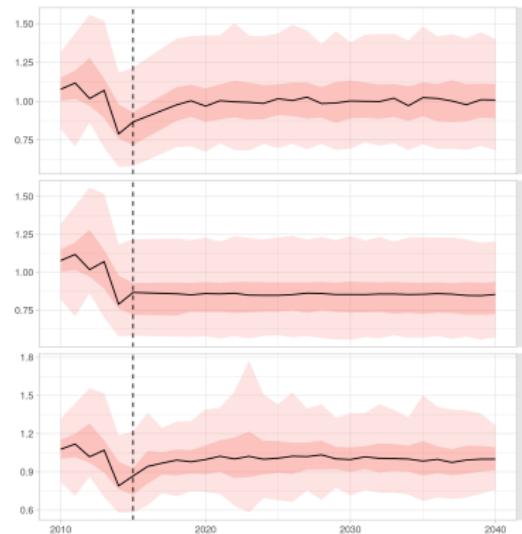
Main factors for results: regression trees

- Scale (SB0), variability (sigmaR), status (SB/SB_{MSY})

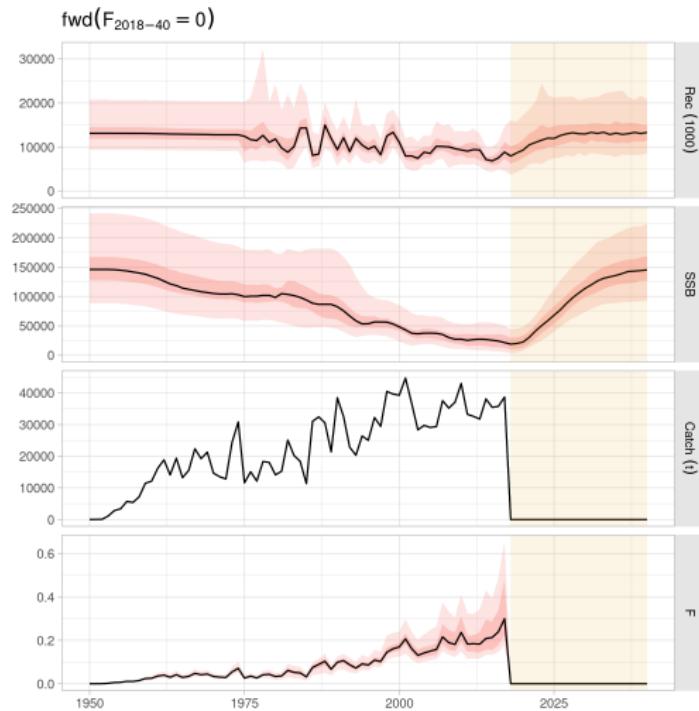


Resampling

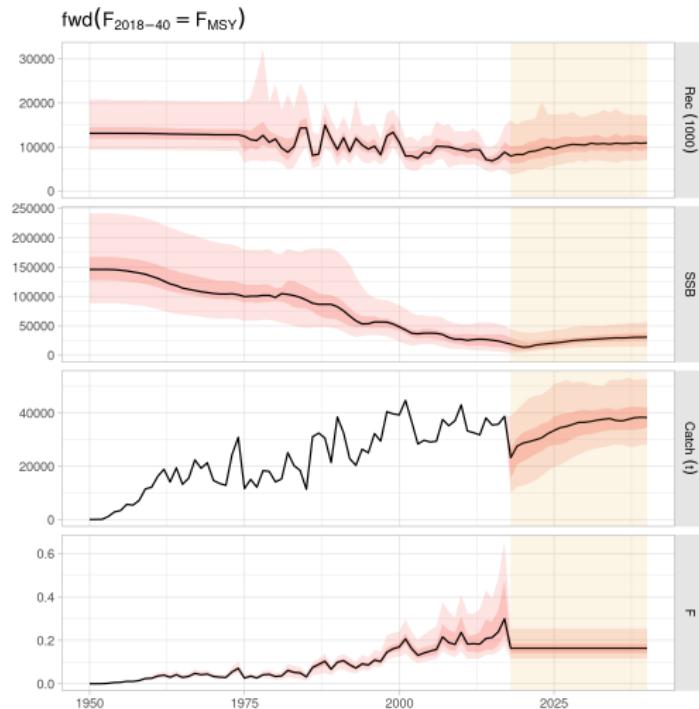
- 500 resamples from 71 runs, weighted by DM p-value.
- Future SRR deviates: $\rho=0.45$, sigma by run.
 - N: AC Lognormal
 - RHO: AC Lognormal at 2010-2015 level.
 - MOV: Lognormal with random walk.



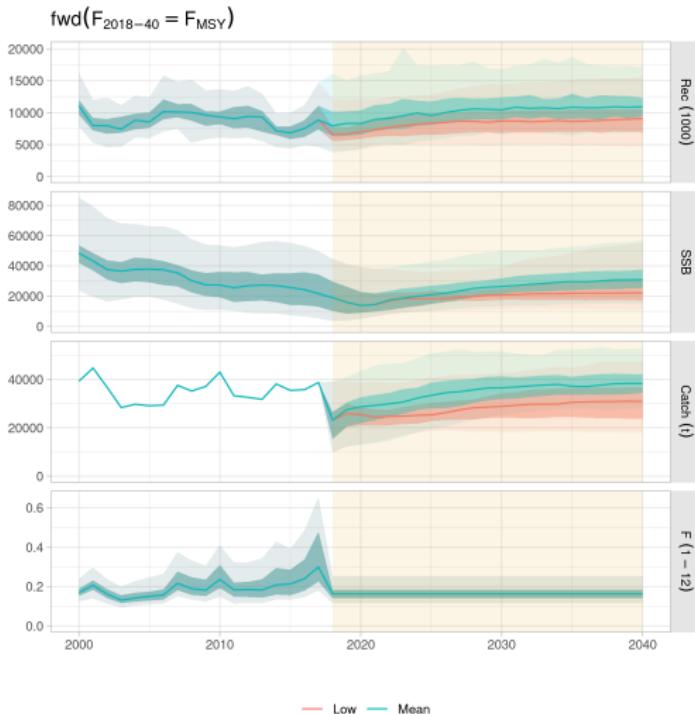
OM runs: F=0



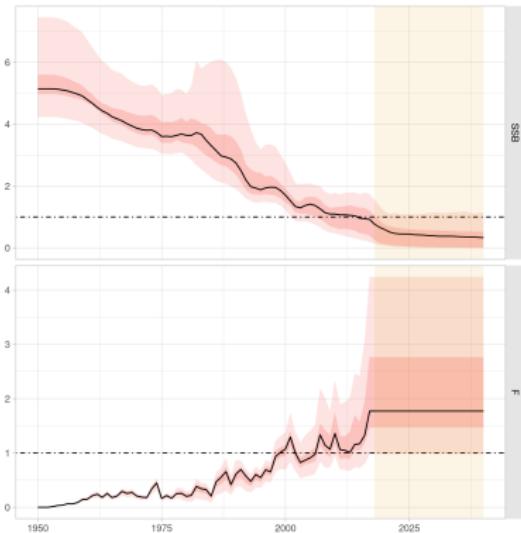
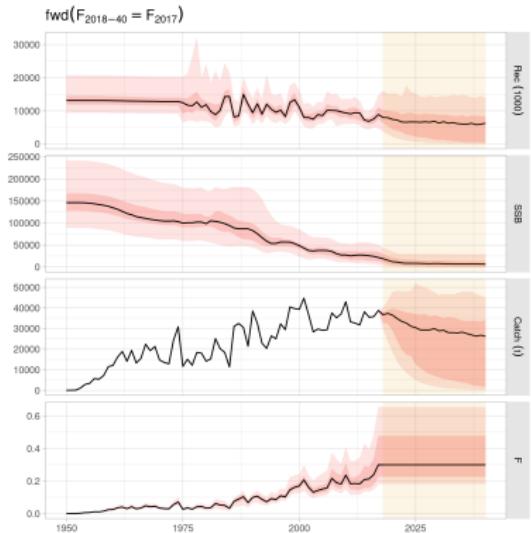
OM runs: F=FMSY



OM runs: $F=F_{MSY}$, recruitment deviances



OM runs: F=F2017



Next steps

- Test tuning with perfect MP (perfect.oem, perfect.sa) (ongoing).
- Tuning with model-based MP (JABBA + 4010 HCR)
- Tuning with model-free MP (CPUE slope and distance to mean)
- TCMP tuning criteria (TCMP03):
 - 50% P(Kobe=green), over 2018-2039.
 - 60% P(Kobe=green), over 2018-2039.
 - 70% P(Kobe=green), over 2018-2039.
- Informative presentation to TCMP.
- Present final runs and platform to WPM / SC 2021.

Elements under discussion

- Increase partial grid size to account for invalid runs.
- Updating OM to 2019 fwd(catch), 24 runs cannot sustain catches.

Some questions

- SW LLCPUE model run, why the (larger) bump in SSB?
- Is selection and weighting scheme reasonable?
- Any other recruitment scenario? (normal, low, low to normal)
- Possible ideas for robustness tests.