

Explore resilience evi

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Prepare data

```
# Read data
raw_evires <- read.csv(file=paste(di, "/data/resilience/resiliences.csv", sep=""), header = TRUE, sep = ",")

# add data of pop
anomalias <- read.csv(file=paste(di, "/data/anomalies/anomalias_evimean.csv", sep=""), header = TRUE, sep = ",")

attr_iv_malla_modis_id <- anomalias %>% dplyr::select(iv_malla_modi_id,long,lat,pop) %>% unique()

raw_evires <- raw_evires %>% inner_join(attr_iv_malla_modis_id, by='iv_malla_modi_id')

# filter by pop and add new variable
evires <- raw_evires %>%
  mutate(
    clu_pop = as.factor(case_when(
      pop == 1 ~ "Camarate",
      pop %in% c(2,3,4,5) ~ 'Northern slope',
      pop %in% c(6,7,8) ~ 'Southern slope',
      pop == 9 ~ 'out')),
    clu_pop2 = as.factor(case_when(
      pop %in% c(1,2,3,4,5) ~ 'Northern slope',
      pop %in% c(6,7,8) ~ 'Southern slope',
      pop == 9 ~ 'out')))) %>%
  filter(clu_pop != 'out')

# Change name of clu_pop2 and disturb_year para los analisis anovas
evires <- evires %>% rename(site = clu_pop2) %>%
  mutate(disturb_year = as.factor(disturb_year))
```

ANOVAs

Recovery

Table 1: ANOVA table: rc

term	df	sumsq	meansq	statistic	p.value
disturb_year	1	1.951	1.951	420.3	0
site	1	0.6528	0.6528	140.6	0
disturb_year:site	1	1.969	1.969	424.1	0
Residuals	1820	8.45	0.00464		

	Statistic
R^2	0.35
$\text{adj}R^2$	0.35
σ_e	0.07
F	328.31
p	0.00
df_m	4.00
logLik	2313.52
AIC	-4617.05
BIC	-4589.50
dev	8.45
df_e	1820.00

```
# Post hoc Define model
```

```
mymodel <- aov_rc$mymodel
```

```
postH_rc <- phc(mymodel = mymodel, resp_var = resp_var)
```

```
##
```

```
## ### Event ###
```

```
## $lsmeans
```

```
##   disturb_year    lsmean      SE    df lower.CL upper.CL
##   2005          1.120312 0.002257496 1820 1.115885 1.124740
##   2012          1.057062 0.002257496 1820 1.052634 1.061489
```

```
##
```

```
## Results are averaged over the levels of: site
```

```
## Confidence level used: 0.95
```

```
##
```

```
## $contrasts
```

```
##   contrast      estimate      SE    df t.ratio p.value
##   2005 - 2012 0.06325071 0.003192582 1820  19.812  <.0001
```

```
##
```

```
## Results are averaged over the levels of: site
```

```
##
```

```
##   disturb_year    lsmean      SE    df lower.CL upper.CL .group
##   2012          1.057062 0.002257496 1820 1.051998 1.062126    a
##   2005          1.120312 0.002257496 1820 1.115248 1.125377    b
```

```
##
```

```
## Results are averaged over the levels of: site
```

```
## Confidence level used: 0.95
```

```
## Conf-level adjustment: bonferroni method for 2 estimates
```

```
## significance level used: alpha = 0.01
```

```
##
```

```
## ### Clu pop ###
```

```
## $lsmeans
```

```
##   site          lsmean      SE    df lower.CL upper.CL
##   Northern slope 1.107615 0.002220056 1820 1.103261 1.111969
##   Southern slope 1.069759 0.002294326 1820 1.065259 1.074259
```

```
##
```

```
## Results are averaged over the levels of: disturb_year
```

```
## Confidence level used: 0.95
```

```
##
```

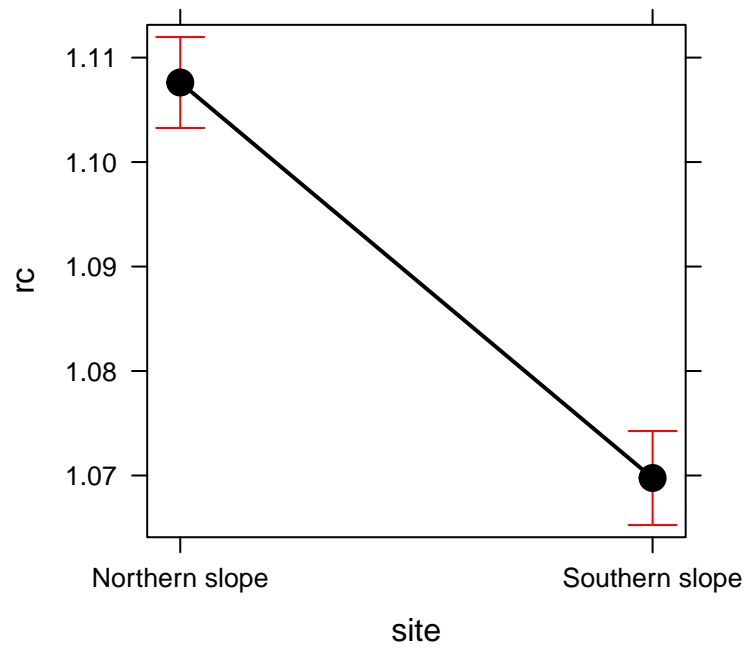
```
## $contrasts
```

```

## contrast estimate SE df t.ratio
## Northern slope - Southern slope 0.03785579 0.003192582 1820 11.857
## p.value
## <.0001
##
## Results are averaged over the levels of: disturb_year
##
## site lsmean SE df lower.CL upper.CL .group
## Southern slope 1.069759 0.002294326 1820 1.064612 1.074906 a
## Northern slope 1.107615 0.002220056 1820 1.102635 1.112595 b
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
## significance level used: alpha = 0.01
##
## ### Event:Clu pop ###
## $lsmeans
## disturb_year site lsmean SE df lower.CL upper.CL
## 2005 Northern slope 1.172113 0.003139633 1820 1.165955 1.178271
## 2012 Northern slope 1.043117 0.003139633 1820 1.036959 1.049275
## 2005 Southern slope 1.068512 0.003244666 1820 1.062148 1.074876
## 2012 Southern slope 1.071007 0.003244666 1820 1.064643 1.077370
##
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df
## 2005,Northern slope - 2012,Northern slope 0.128996090 0.004440112 1820
## 2005,Northern slope - 2005,Southern slope 0.103601172 0.004514992 1820
## 2005,Northern slope - 2012,Southern slope 0.101106495 0.004514992 1820
## 2012,Northern slope - 2005,Southern slope -0.025394918 0.004514992 1820
## 2012,Northern slope - 2012,Southern slope -0.027889595 0.004514992 1820
## 2005,Southern slope - 2012,Southern slope -0.002494677 0.004588651 1820
## t.ratio p.value
## 29.052 <.0001
## 22.946 <.0001
## 22.394 <.0001
## -5.625 <.0001
## -6.177 <.0001
## -0.544 1.0000
##
## P value adjustment: bonferroni method for 6 tests
ps

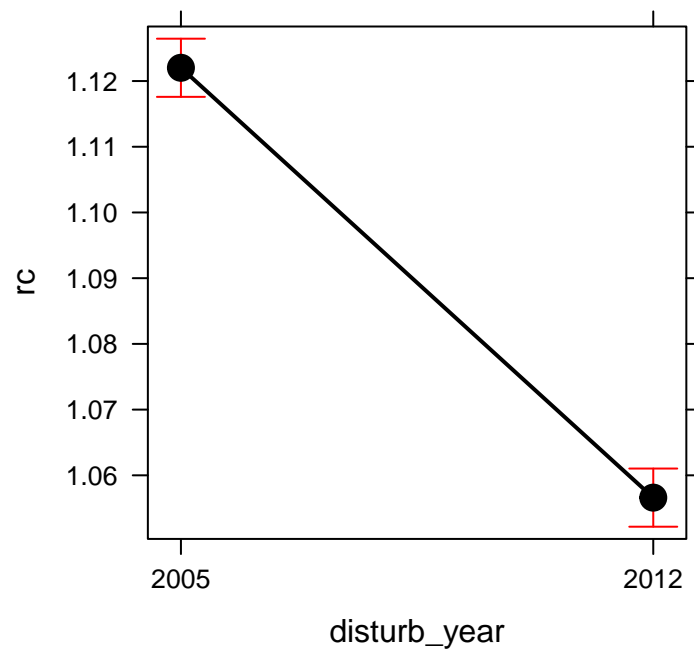
```

site effect plot

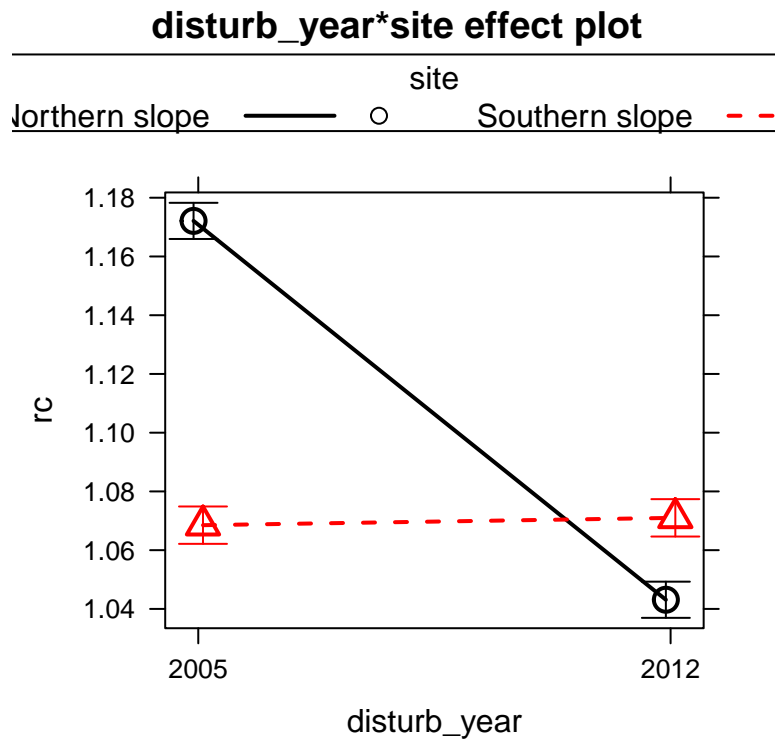


pd

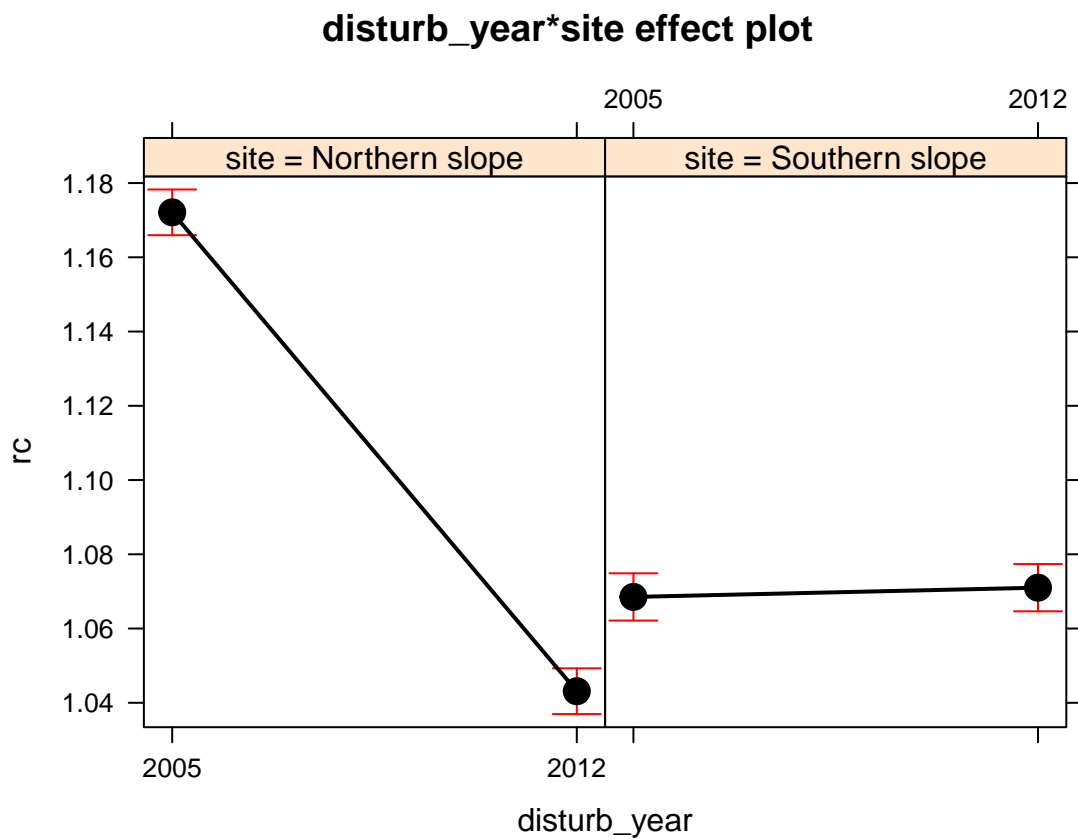
disturb_year effect plot



picollapse



pi



Resistance

Table 3: ANOVA table: rt

term	df	sumsq	meansq	statistic	p.value
disturb_year	1	3.266	3.266	1079	0
site	1	0.6366	0.6366	210.2	0
disturb_year:site	1	0.9736	0.9736	321.5	0
Residuals	1820	5.511	0.00303		

	Statistic
R^2	0.47
$\text{adj}R^2$	0.47
σ_e	0.06
F	536.85
p	0.00
df_m	4.00
logLik	2703.33
AIC	-5396.66
BIC	-5369.12
dev	5.51
df_e	1820.00

```
# Post hoc Define model
mymodel <- aov_rt$mymodel
postH_rt <- phc(mymodel = mymodel, resp_var = resp_var)

##
## ### Event ###
## $lsmeans
##   disturb_year    lsmean      SE    df  lower.CL  upper.CL
##   2005          0.8607403 0.001823114 1820 0.8571647 0.8643159
##   2012          0.9438559 0.001823114 1820 0.9402803 0.9474315
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   2005 - 2012 -0.08311557 0.002578272 1820 -32.237  <.0001
##
## Results are averaged over the levels of: site
##
##   disturb_year    lsmean      SE    df  lower.CL  upper.CL .group
##   2005          0.8607403 0.001823114 1820 0.8566506 0.8648300    a
##   2012          0.9438559 0.001823114 1820 0.9397662 0.9479456    b
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
```

```

## significance level used: alpha = 0.01
##
## ### Clu pop ###
## $lsmeans
##   site          lsmean          SE    df  lower.CL  upper.CL
## Northern slope 0.8836057 0.001792878 1820 0.8800894 0.8871220
## Southern slope 0.9209905 0.001852856 1820 0.9173566 0.9246245
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
##
## $contrasts
##   contrast          estimate          SE    df t.ratio
## Northern slope - Southern slope -0.03738486 0.002578272 1820   -14.5
## p.value
##   <.0001
##
## Results are averaged over the levels of: disturb_year
##
##   site          lsmean          SE    df  lower.CL  upper.CL .group
## Northern slope 0.8836057 0.001792878 1820 0.8795838 0.8876276   a
## Southern slope 0.9209905 0.001852856 1820 0.9168341 0.9251470   b
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
## significance level used: alpha = 0.01
##
## ### Event:Clu pop ###
## $lsmeans
##   disturb_year site          lsmean          SE    df  lower.CL
## 2005           Northern slope 0.8189321 0.002535512 1820 0.8139593
## 2012           Northern slope 0.9482792 0.002535512 1820 0.9433064
## 2005           Southern slope 0.9025485 0.002620335 1820 0.8974093
## 2012           Southern slope 0.9394325 0.002620335 1820 0.9342934
##   upper.CL
## 0.8239049
## 0.9532521
## 0.9076877
## 0.9445717
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast          estimate          SE    df
## 2005,Northern slope - 2012,Northern slope -0.12934712 0.003585755 1820
## 2005,Northern slope - 2005,Southern slope -0.08361641 0.003646227 1820
## 2005,Northern slope - 2012,Southern slope -0.12050043 0.003646227 1820
## 2012,Northern slope - 2005,Southern slope  0.04573071 0.003646227 1820
## 2012,Northern slope - 2012,Southern slope  0.00884669 0.003646227 1820
## 2005,Southern slope - 2012,Southern slope -0.03688402 0.003705713 1820
## t.ratio p.value
## -36.072 <.0001
## -22.932 <.0001

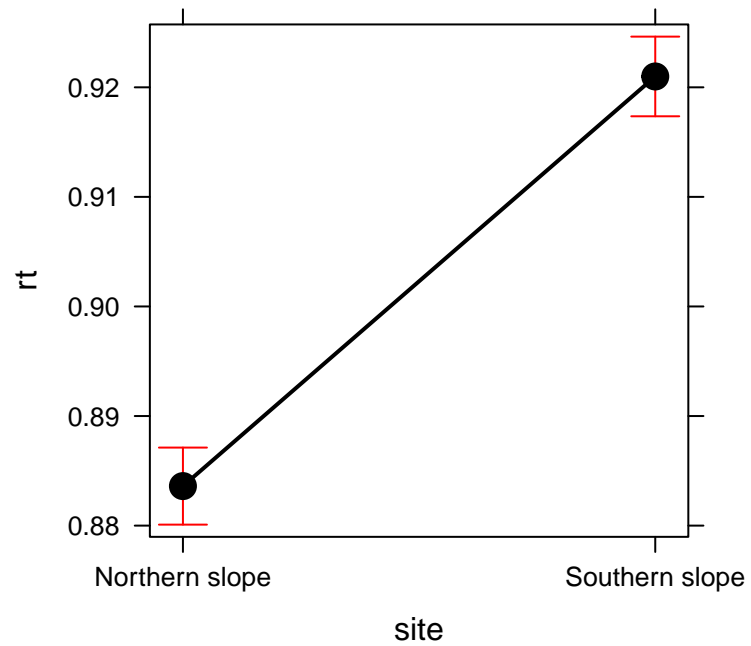
```

```
## -33.048 <.0001
## 12.542 <.0001
## 2.426 0.0921
## -9.953 <.0001
##
```

```
## P value adjustment: bonferroni method for 6 tests
```

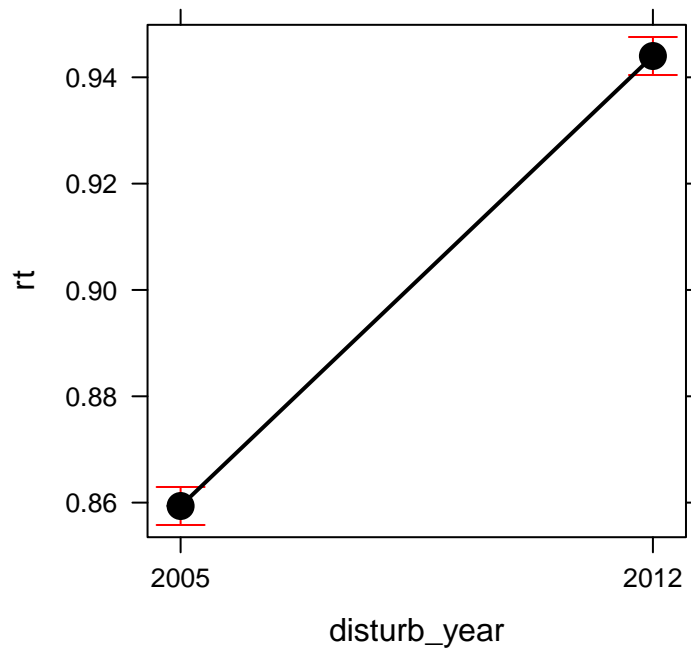
ps

site effect plot



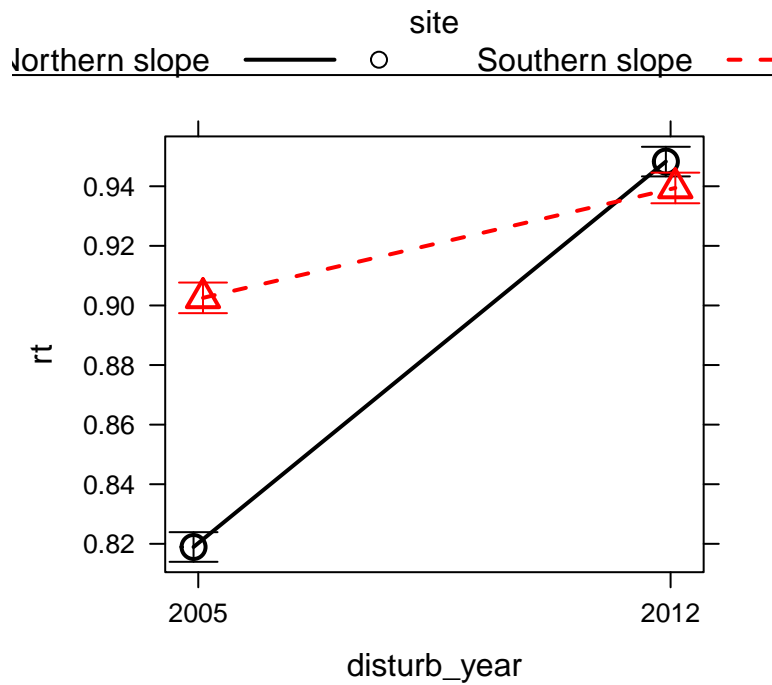
pd

disturb_year effect plot



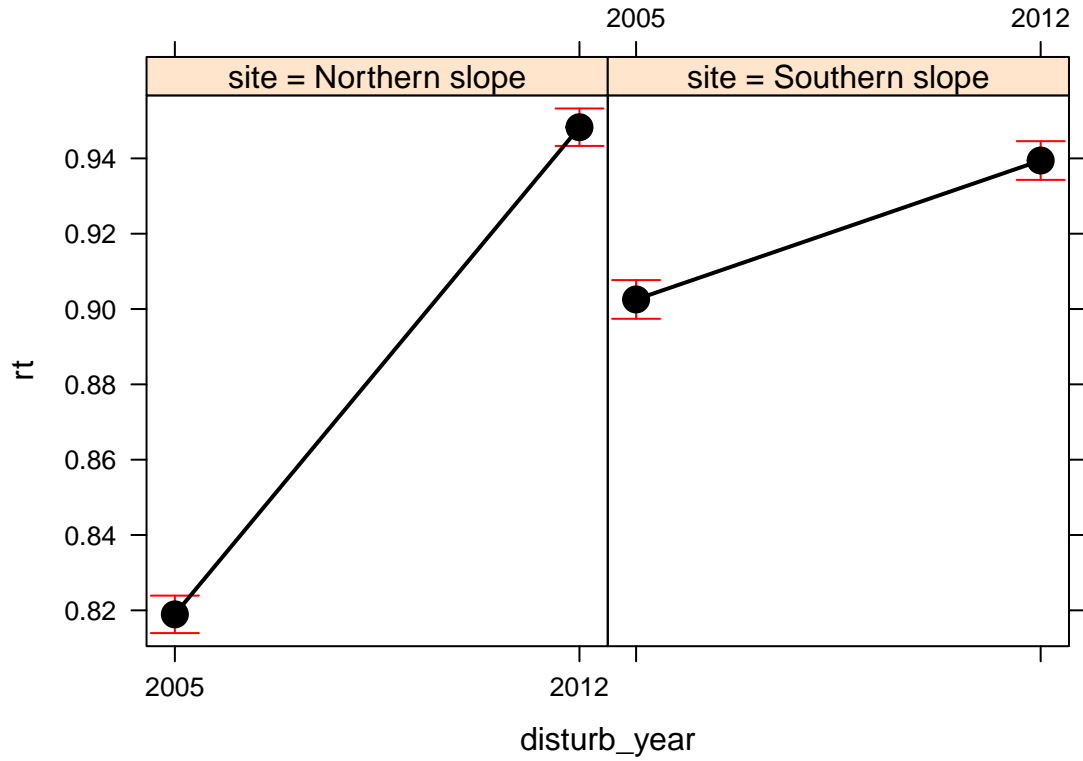
picollapse

disturb_year*site effect plot



pi

disturb_year*site effect plot



Resilience

Table 5: ANOVA table: rs

term	df	sumsq	meansq	statistic	p.value
disturb_year	1	0.6334	0.6334	258.4	0
site	1	0.0533	0.0533	21.74	0
disturb_year:site	1	0.01931	0.01931	7.875	0.00507
Residuals	1820	4.462	0.00245		

	Statistic
R^2	0.14
$\text{adj}R^2$	0.14
σ_e	0.05
F	96.00
p	0.00
df_m	4.00
logLik	2895.92
AIC	-5781.83
BIC	-5754.29
dev	4.46
df_e	1820.00

```

# Post hoc Define model
mymodel <- aov_rs$mymodel
postH_rs <- phc(mymodel = mymodel, resp_var = resp_var)

##
## ### Event ###
## $lsmeans
##   disturb_year    lsmean          SE    df  lower.CL  upper.CL
##   2005          0.9587200 0.001640436 1820 0.9555027 0.9619373
##   2012          0.9962045 0.001640436 1820 0.9929872 0.9994219
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate          SE    df t.ratio p.value
##   2005 - 2012 -0.03748452 0.002319926 1820 -16.158  <.0001
##
## Results are averaged over the levels of: site
##
##   disturb_year    lsmean          SE    df  lower.CL  upper.CL  .group
##   2005          0.9587200 0.001640436 1820 0.9550401 0.9623999    a
##   2012          0.9962045 0.001640436 1820 0.9925246 0.9998844    b
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
## significance level used: alpha = 0.01
##
## ### Clu pop ###
## $lsmeans
##   site          lsmean          SE    df  lower.CL  upper.CL
##   Northern slope 0.9720535 0.001613229 1820 0.9688896 0.9752175
##   Southern slope 0.9828710 0.001667198 1820 0.9796012 0.9861408
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate          SE    df t.ratio
##   Northern slope - Southern slope -0.01081743 0.002319926 1820  -4.663
##   p.value
##   <.0001
##
## Results are averaged over the levels of: disturb_year
##
##   site          lsmean          SE    df  lower.CL  upper.CL  .group
##   Northern slope 0.9720535 0.001613229 1820 0.9684347 0.9756724    a
##   Southern slope 0.9828710 0.001667198 1820 0.9791310 0.9866109    b
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates

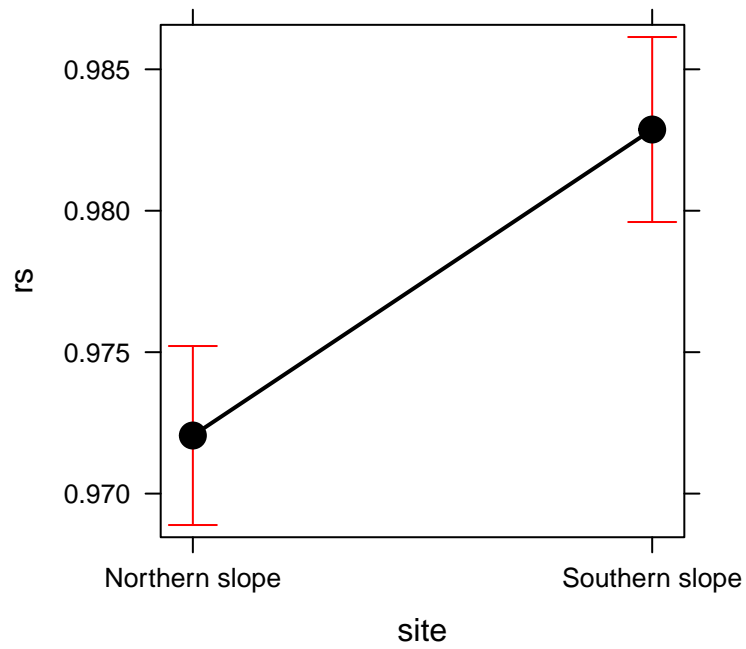
```

```

## significance level used: alpha = 0.01
##
## ### Event:Clu pop ###
## $lsmeans
##   disturb_year site          lsmean          SE    df  lower.CL
##   2005          Northern slope 0.9565664 0.002281451 1820 0.9520919
##   2012          Northern slope 0.9875407 0.002281451 1820 0.9830661
##   2005          Southern slope 0.9608736 0.002357774 1820 0.9562493
##   2012          Southern slope 1.0048684 0.002357774 1820 1.0002442
##   upper.CL
##   0.9610410
##   0.9920152
##   0.9654978
##   1.0094926
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast          estimate          SE    df
##   2005,Northern slope - 2012,Northern slope -0.030974221 0.003226458 1820
##   2005,Northern slope - 2005,Southern slope -0.004307134 0.003280871 1820
##   2005,Northern slope - 2012,Southern slope -0.048301950 0.003280871 1820
##   2012,Northern slope - 2005,Southern slope  0.026667087 0.003280871 1820
##   2012,Northern slope - 2012,Southern slope -0.017327728 0.003280871 1820
##   2005,Southern slope - 2012,Southern slope -0.043994816 0.003334396 1820
##   t.ratio p.value
##   -9.600  <.0001
##   -1.313  1.0000
##   -14.722 <.0001
##   8.128   <.0001
##   -5.281  <.0001
##   -13.194 <.0001
##
## P value adjustment: bonferroni method for 6 tests
ps

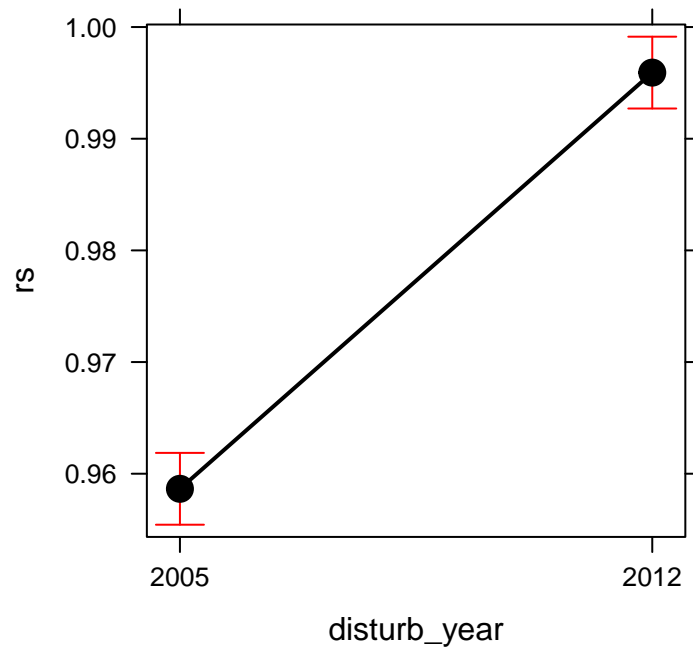
```

site effect plot

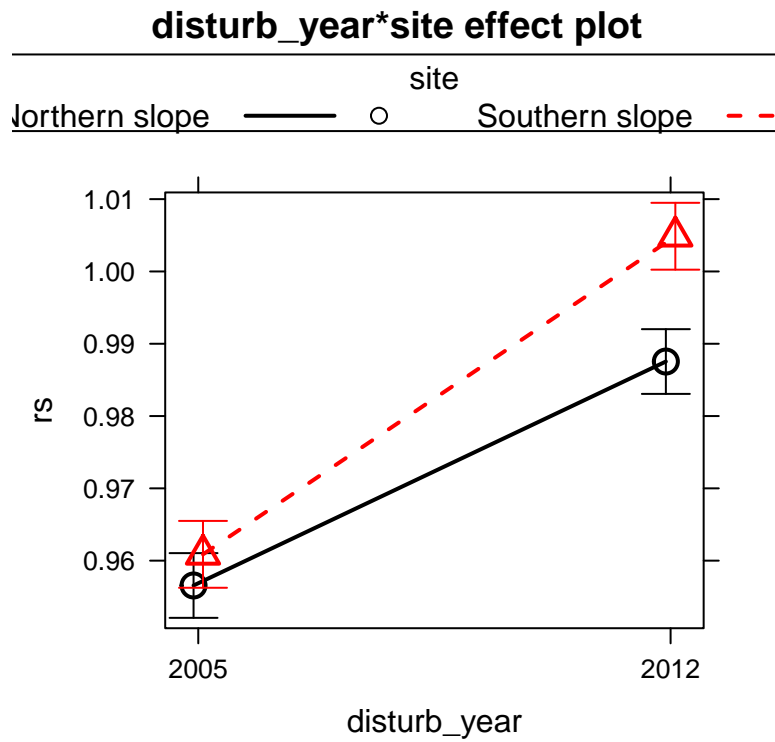


pd

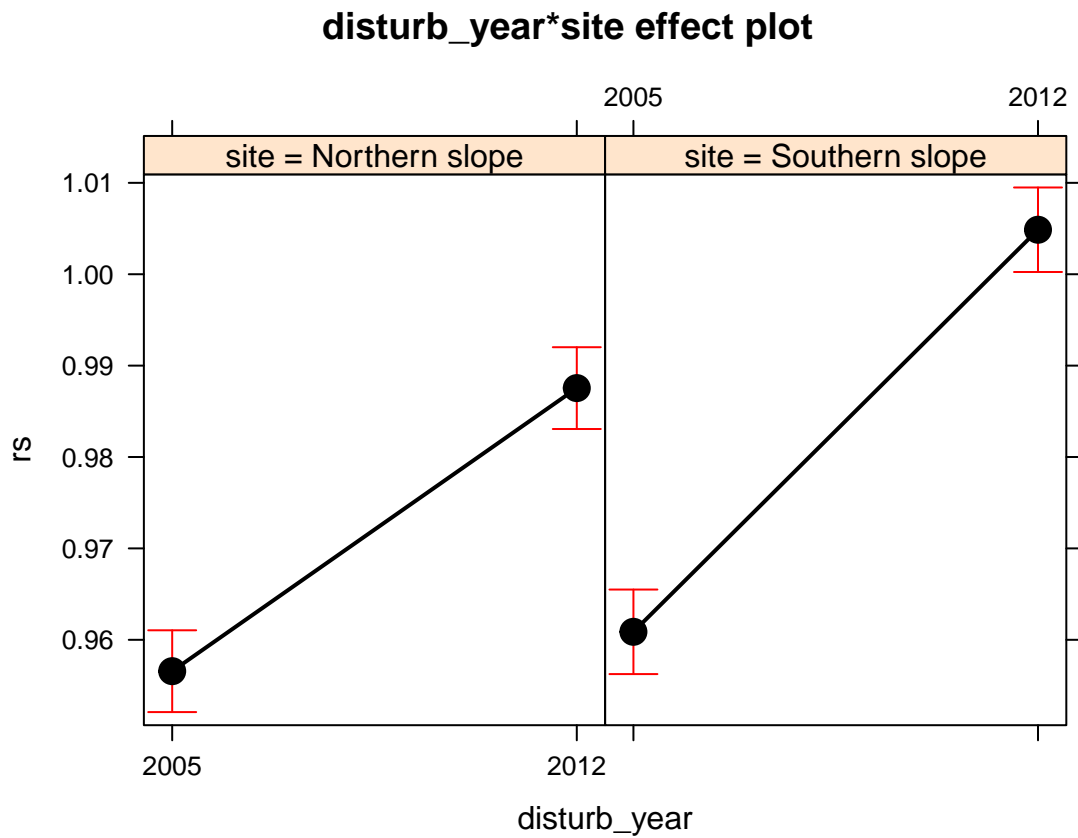
disturb_year effect plot



picollapse



pi



Relative Resilience

Table 7: ANOVA table: rrs

term	df	sumsq	meansq	statistic	p.value
disturb_year	1	1.023	1.023	321.9	0
site	1	0.3215	0.3215	101.2	0
disturb_year:site	1	1.267	1.267	398.7	0
Residuals	1820	5.783	0.00318		

	Statistic
R^2	0.31
$\text{adj}R^2$	0.31
σ_e	0.06
F	273.95
p	0.00
df_m	4.00
logLik	2659.30
AIC	-5308.61
BIC	-5281.06
dev	5.78
df_e	1820.00

```
# Post hoc Define model
mymodel <- aov_rrs$mymodel
postH_rrs <- phc(mymodel = mymodel, resp_var = resp_var)

##
## ### Event ###
## $lsmeans
##   disturb_year    lsmean      SE    df  lower.CL  upper.CL
##   2005          0.09797968 0.001867656 1820 0.09431670 0.1016427
##   2012          0.05234863 0.001867656 1820 0.04868565 0.0560116
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   2005 - 2012 0.04563105 0.002641264 1820 17.276  <.0001
##
## Results are averaged over the levels of: site
##
##   disturb_year    lsmean      SE    df  lower.CL  upper.CL .group
##   2012          0.05234863 0.001867656 1820 0.04815899 0.05653826  a
##   2005          0.09797968 0.001867656 1820 0.09379004 0.10216931  b
##
## Results are averaged over the levels of: site
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
```

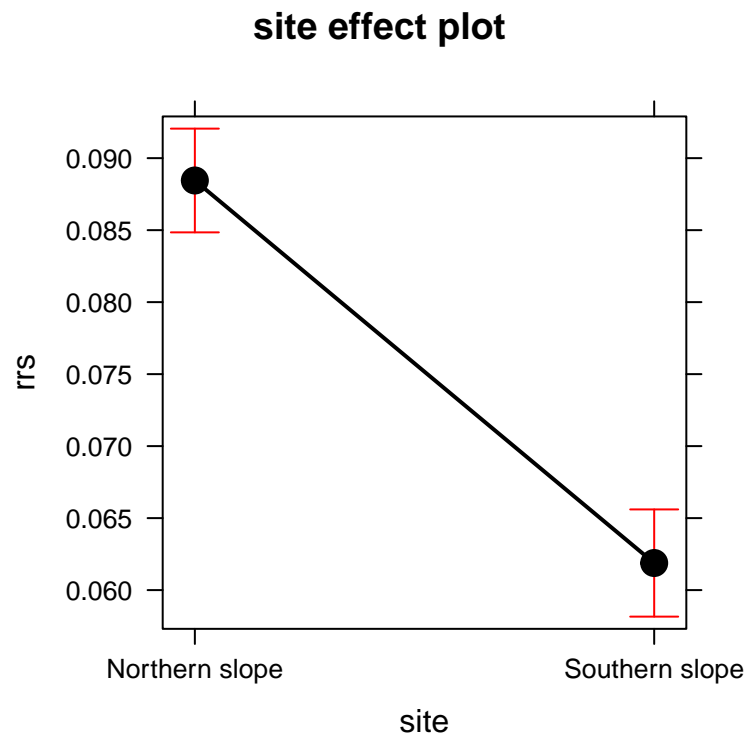
```

## significance level used: alpha = 0.01
##
## ### Clu pop ###
## $lsmeans
##   site          lsmean          SE    df   lower.CL   upper.CL
## Northern slope 0.08844787 0.001836681 1820 0.08484564 0.09205009
## Southern slope 0.06188044 0.001898125 1820 0.05815770 0.06560317
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
##
## $contrasts
##   contrast          estimate          SE    df t.ratio
## Northern slope - Southern slope 0.02656743 0.002641264 1820 10.059
## p.value
## <.0001
##
## Results are averaged over the levels of: disturb_year
##
##   site          lsmean          SE    df   lower.CL   upper.CL .group
## Southern slope 0.06188044 0.001898125 1820 0.05762245 0.06613842 a
## Northern slope 0.08844787 0.001836681 1820 0.08432772 0.09256802 b
##
## Results are averaged over the levels of: disturb_year
## Confidence level used: 0.95
## Conf-level adjustment: bonferroni method for 2 estimates
## significance level used: alpha = 0.01
##
## ### Event:Clu pop ###
## $lsmeans
##   disturb_year site          lsmean          SE    df   lower.CL
## 2005           Northern slope 0.13763432 0.002597459 1820 0.1325400
## 2012           Northern slope 0.03926142 0.002597459 1820 0.0341671
## 2005           Southern slope 0.05832504 0.002684355 1820 0.0530603
## 2012           Southern slope 0.06543584 0.002684355 1820 0.0601711
##   upper.CL
## 0.14272863
## 0.04435573
## 0.06358978
## 0.07070057
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast          estimate          SE    df
## 2005,Northern slope - 2012,Northern slope 0.098372900 0.003673362 1820
## 2005,Northern slope - 2005,Southern slope 0.079309278 0.003735312 1820
## 2005,Northern slope - 2012,Southern slope 0.072198481 0.003735312 1820
## 2012,Northern slope - 2005,Southern slope -0.019063621 0.003735312 1820
## 2012,Northern slope - 2012,Southern slope -0.026174419 0.003735312 1820
## 2005,Southern slope - 2012,Southern slope -0.007110797 0.003796251 1820
## t.ratio p.value
## 26.780 <.0001
## 21.232 <.0001

```

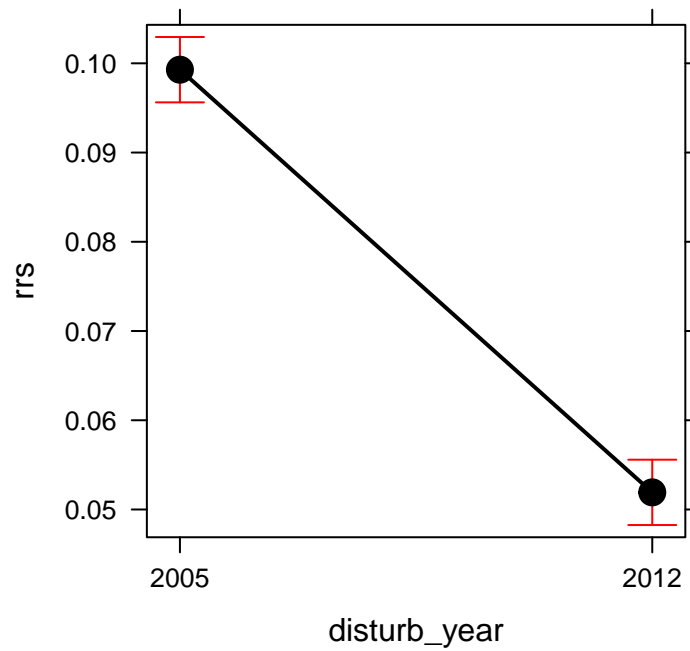


```
## 19.329 <.0001
## -5.104 <.0001
## -7.007 <.0001
## -1.873 0.3673
##
## P value adjustment: bonferroni method for 6 tests
ps
```



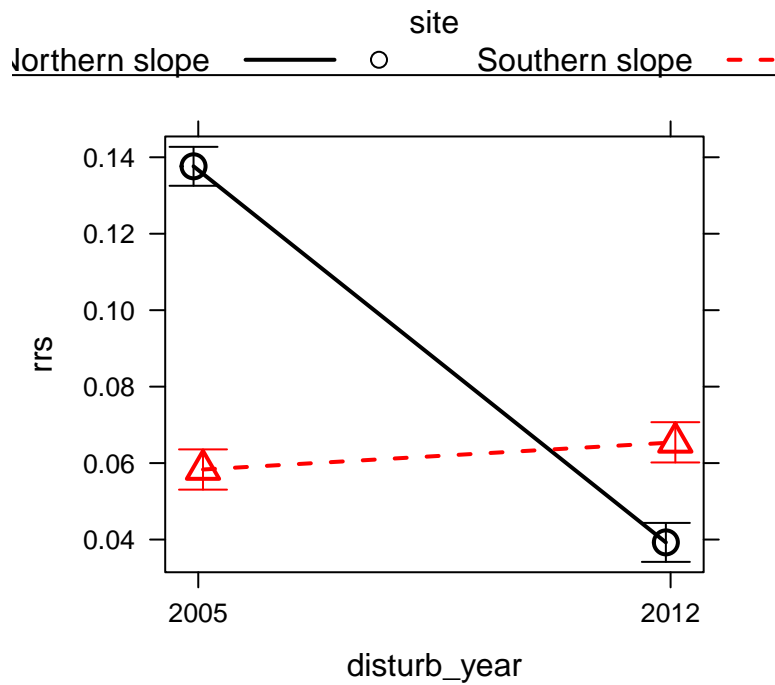
```
pd
```

disturb_year effect plot



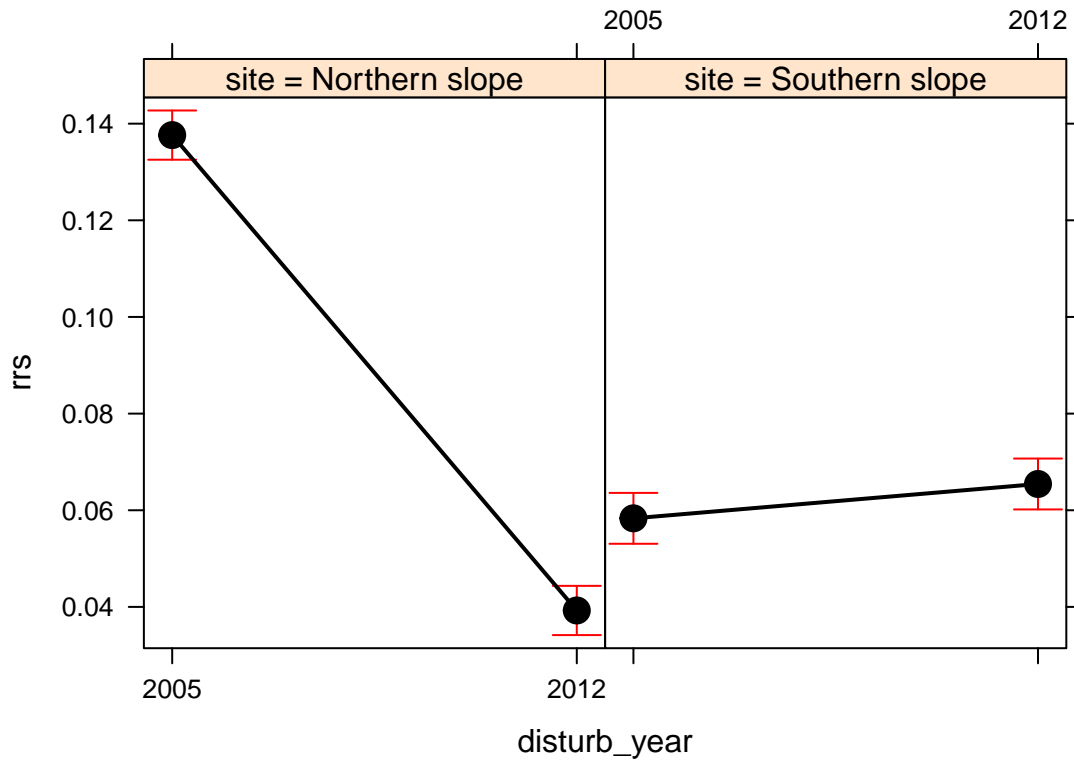
picollapse

disturb_year*site effect plot



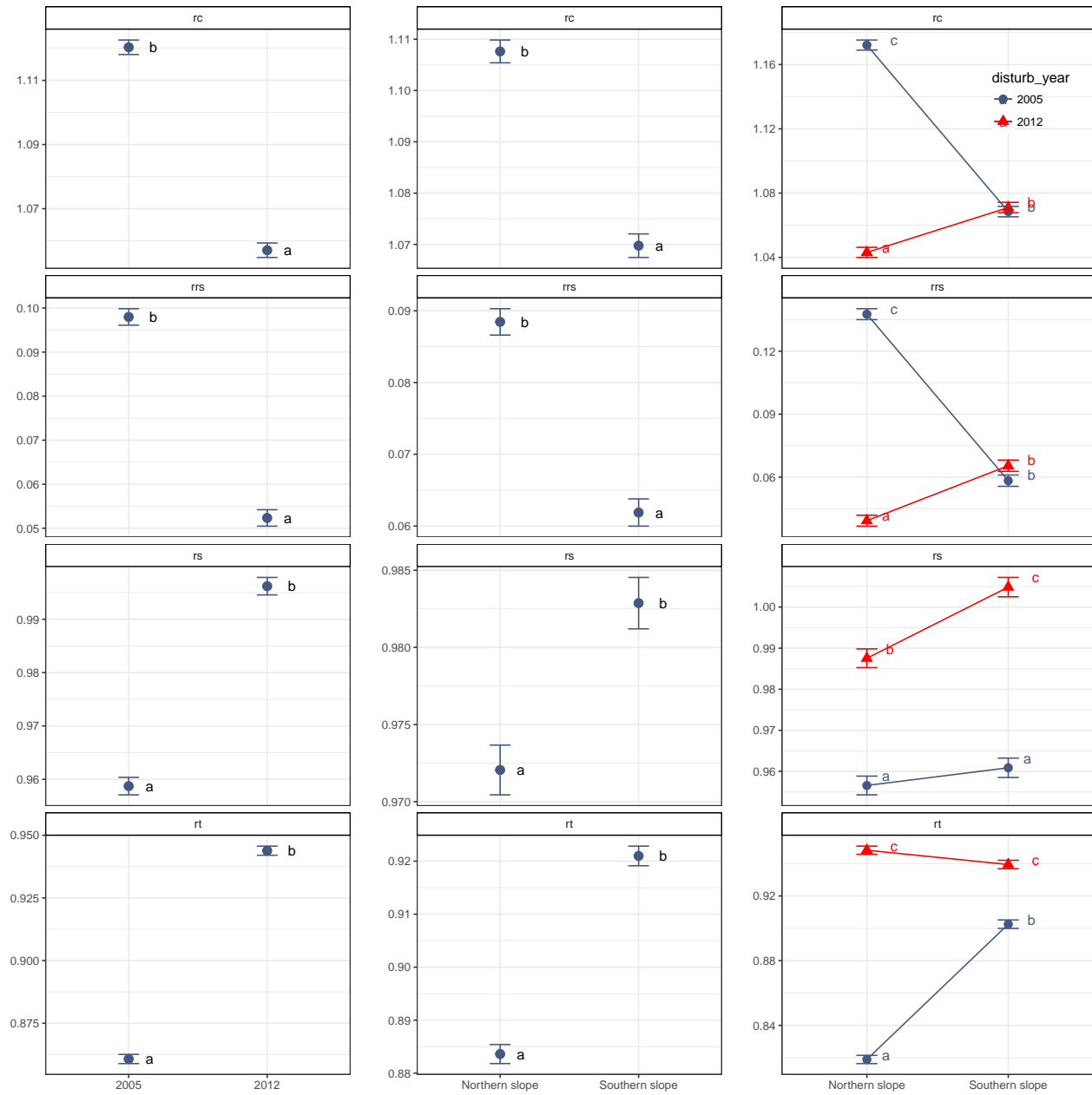
pi

disturb_year*site effect plot



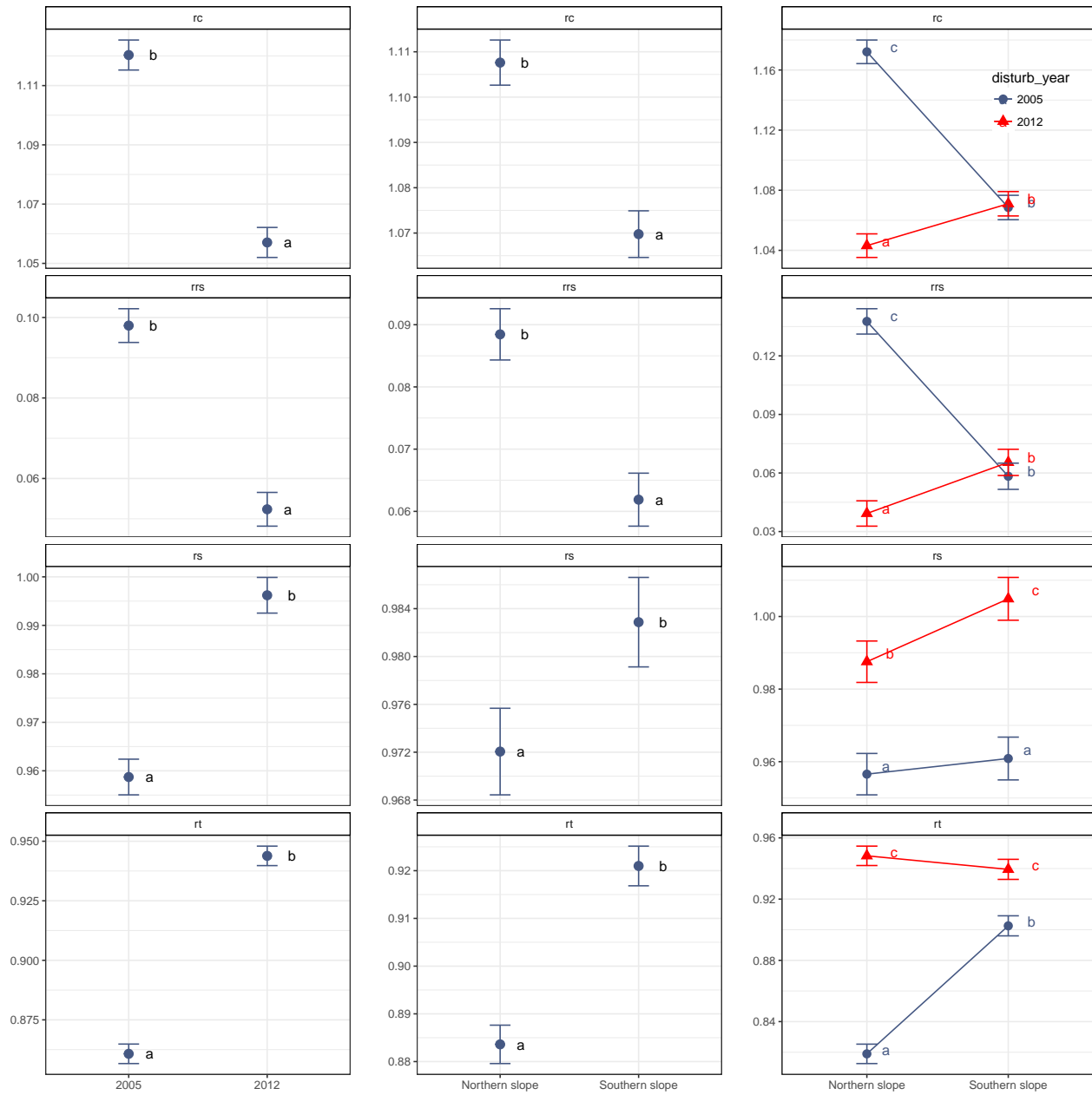
mean + sd

```
grid.arrange(plot_mdSE, plot_msSE, plot_mdsSE, ncol=3)
```



mean + ci

```
grid.arrange(plot_mdCI, plot_msCI, plot_mdsCI, ncol=3)
```



```
## pdf
## 2
## pdf
## 2
```

term	df	sumsq	meansq	statistic	p.value	var
disturb_year	1	1.951	1.951	420.3	3.368e-84	rc
site	1	0.6528	0.6528	140.6	2.706e-31	rc
disturb_year:site	1	1.969	1.969	424.1	7.127e-85	rc
Residuals	1820	8.45	0.004643	NA	NA	rc
disturb_year	1	3.266	3.266	1079	3.446e-186	rt
site	1	0.6366	0.6366	210.2	3.608e-45	rt
disturb_year:site	1	0.9736	0.9736	321.5	2.446e-66	rt

term	df	sumsq	meansq	statistic	p.value	var
Residuals	1820	5.511	0.003028	NA	NA	rt
disturb_year	1	0.6334	0.6334	258.4	1.817e-54	rs
site	1	0.0533	0.0533	21.74	3.346e-06	rs
disturb_year:site	1	0.01931	0.01931	7.875	0.005066	rs
Residuals	1820	4.462	0.002452	NA	NA	rs
disturb_year	1	1.023	1.023	321.9	2.05e-66	rrs
site	1	0.3215	0.3215	101.2	3.356e-23	rrs
disturb_year:site	1	1.267	1.267	398.7	2.249e-80	rrs
Residuals	1820	5.783	0.003178	NA	NA	rrs

	rc	rt	rs	rrs
R^2	0.3511444	0.4694715	0.1366188	0.3110905
adj R^2	0.3500749	0.4685970	0.1351956	0.3099549
σ_e	0.06813799	0.05502703	0.04951326	0.05637145
F	328.31282	536.84720	95.99708	273.95212
p	2.291209e-170	7.130860e-250	1.111125e-57	1.015581e-146
df_m	4	4	4	4
logLik	2313.524	2703.332	2895.917	2659.304
AIC	-4617.048	-5396.664	-5781.835	-5308.608
BIC	-4589.504	-5369.120	-5754.291	-5281.064
dev	8.449871	5.510913	4.461844	5.783487
df_e	1820	1820	1820	1820
<i>variable</i>	rc	rt	rs	rrs