

# Update of the Indian Ocean albacore Operating Model

## IOTC Working Party on Methods MSE Taskforce

01-05 March 2021, Iago MOSQUEIRA

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# Outline

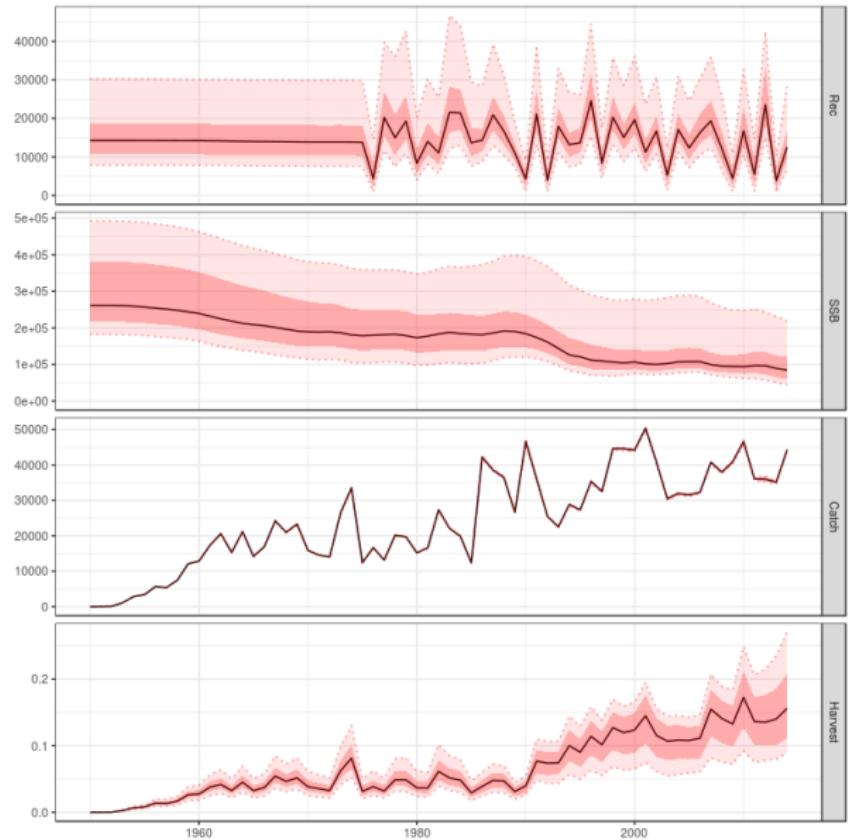
- 3rd iteration of albacore OM.
- Based on WPTmT 2019 SS3 model.
- Existing FLR platform (`ss3om + ioalbmse + mse`) for SS 3.30.16.
- Contract WMR - IOTC/FAO August 2020 - December 2021.
- <https://github.com/iotcwpmlab> (to be updated)

# 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

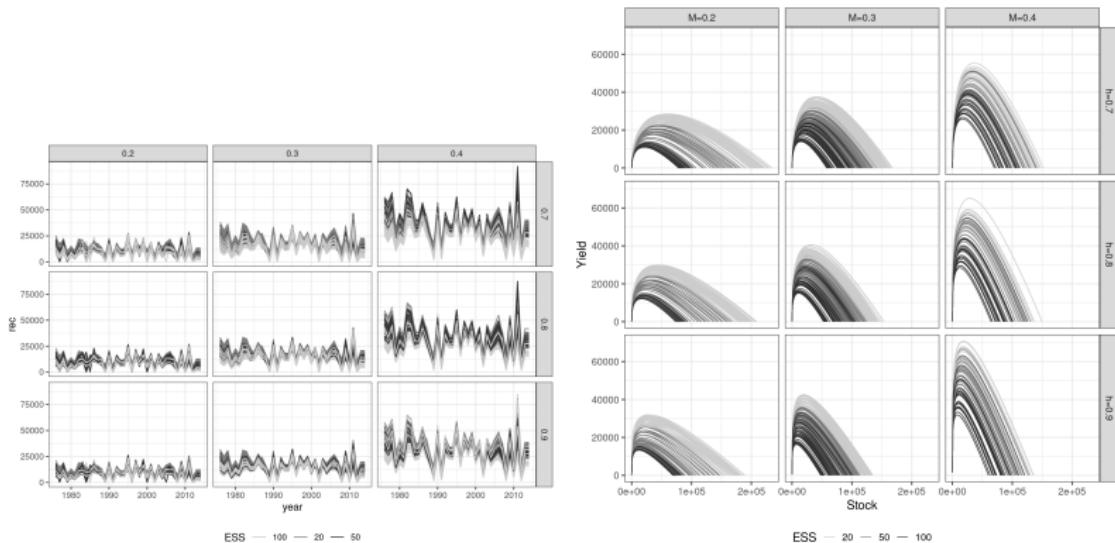
- 1,440 SS3 model runs (1.5 h each)

# WPTmT 2016 ALB OM

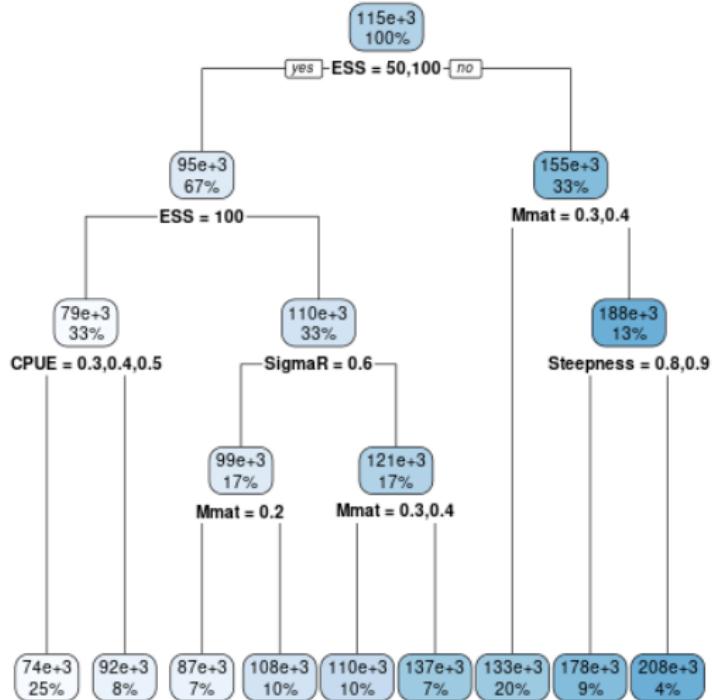


# Analysis of 2016 grid

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



# Regression tree SB0

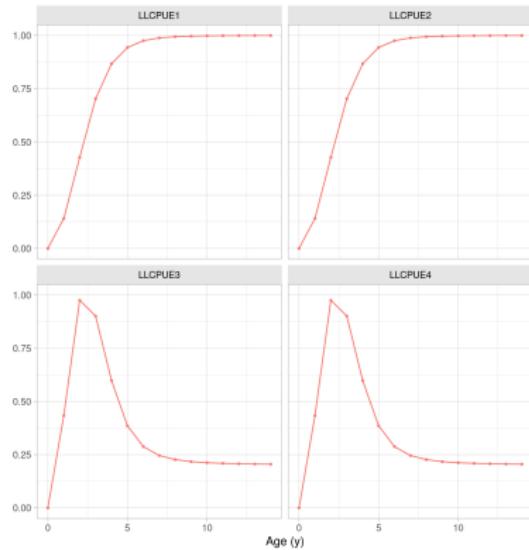
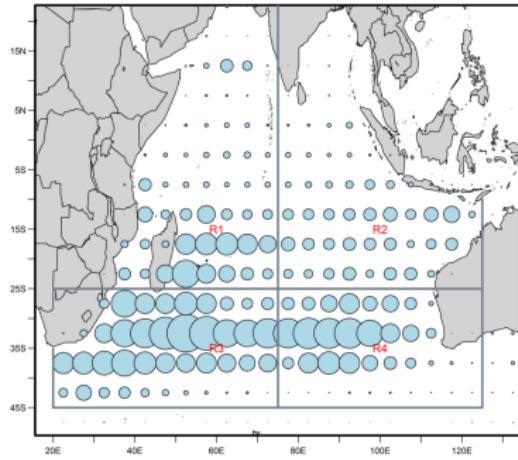


# The WPTmT 2019 SS3 albacore stock assessment

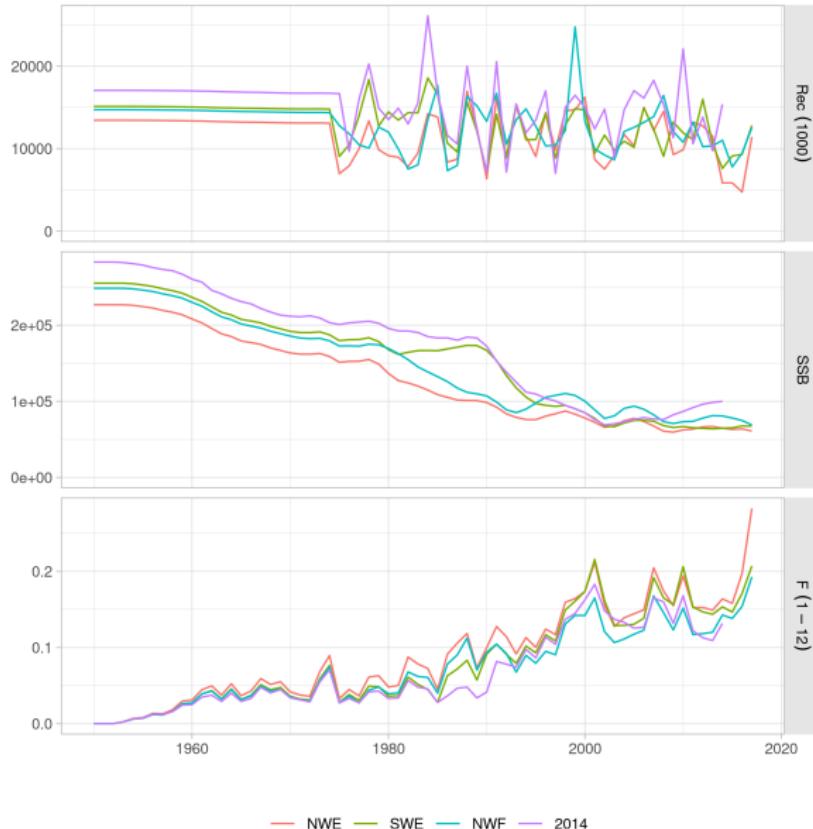
- 2 sex, one area
- 4 LL fleets, DN (1982-92), PS (NW), Other.
- 3 runs: NW CPUE + LF, SW CPUE + LF, NW CPUE down LF



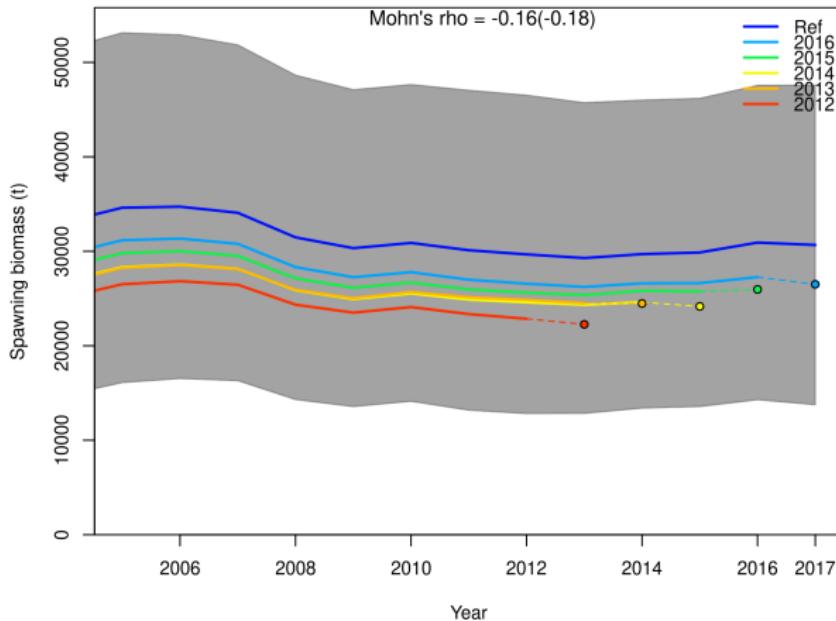
# Fleet spatial structure



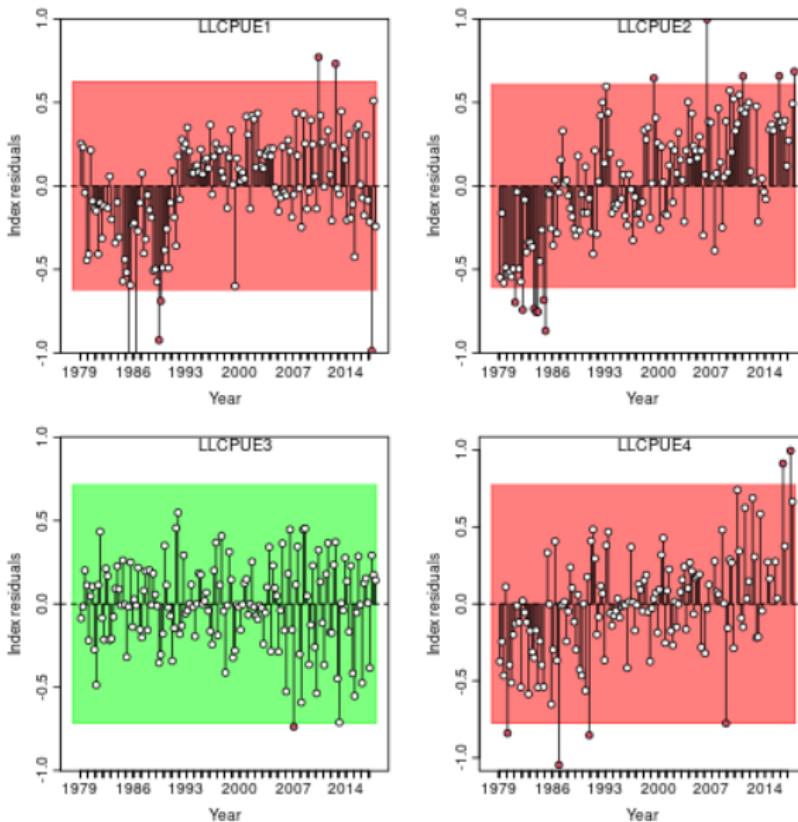
# The WPTmT 2019 SS3 albacore stock assessment



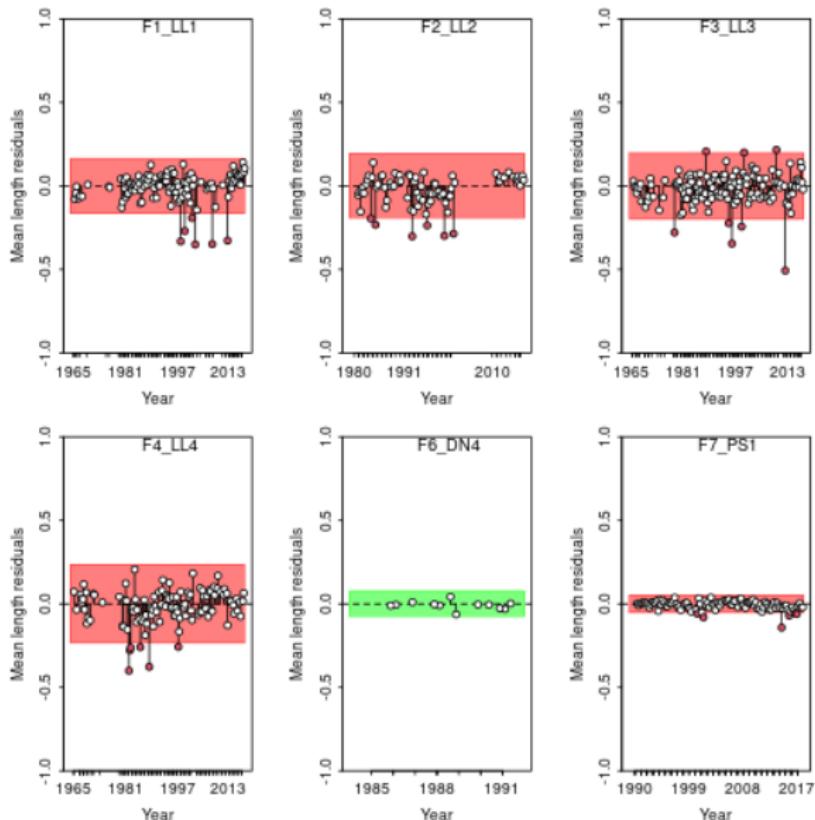
# Model diagnostics: Retrospective analysis



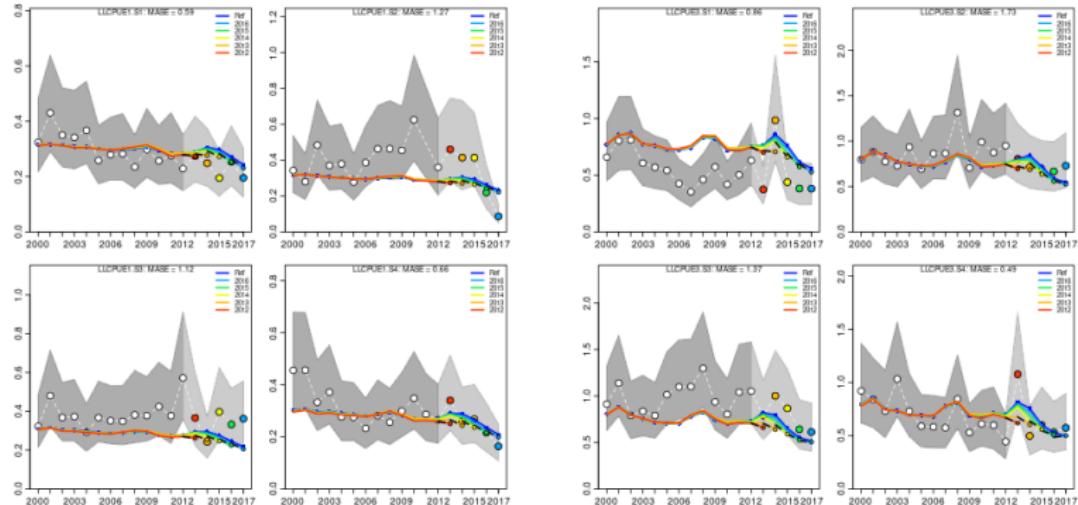
# Model diagnostics: CPUE runs tests



# Model diagnostics: LF runs tests

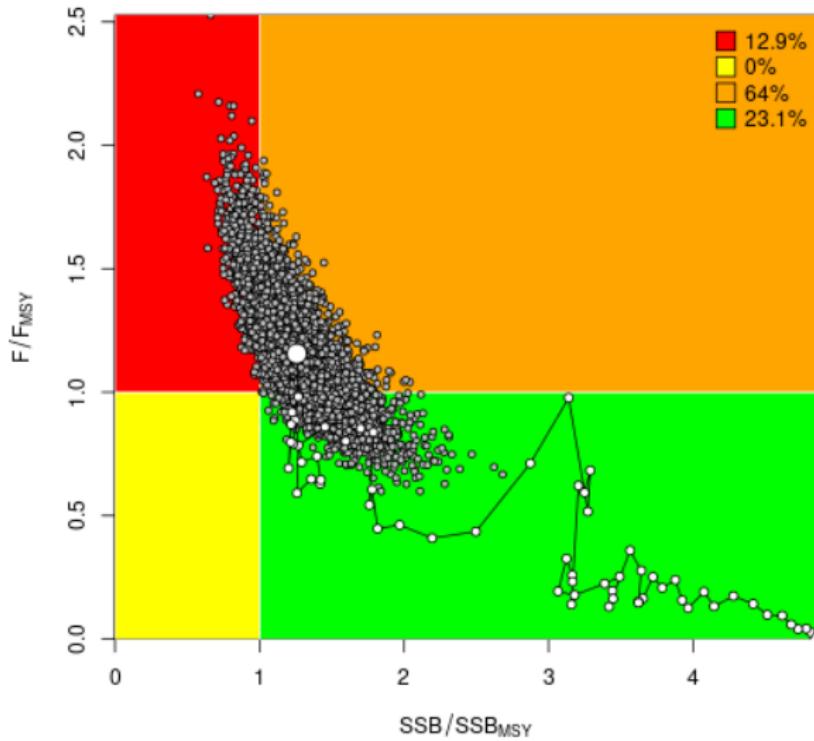


# Model diagnostics: Hindcasting cross validation (MASE)



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

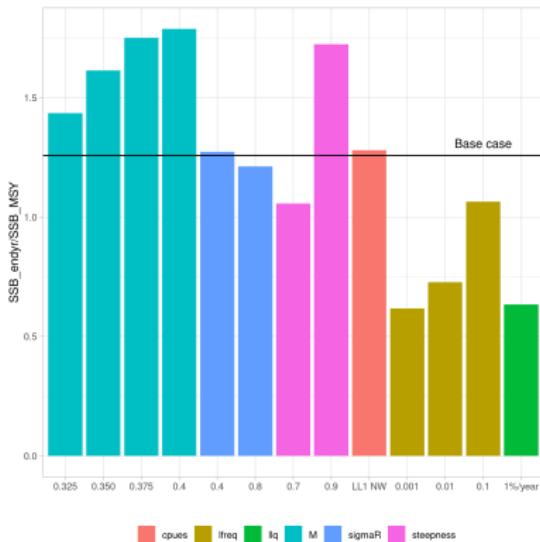
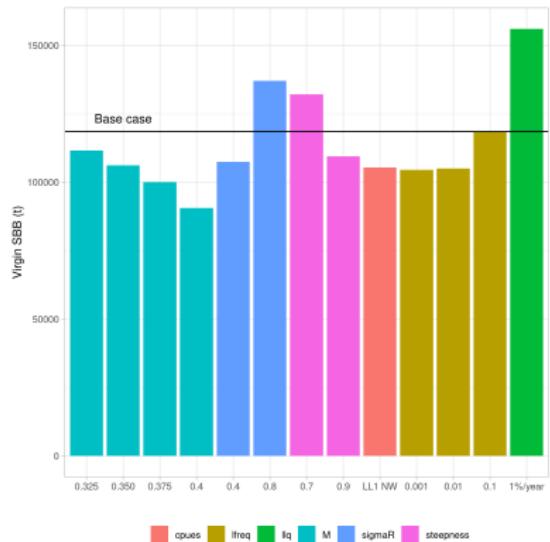
# Parameter uncertainty: MVLN



# Operating Model grid

- 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



# Grid corners

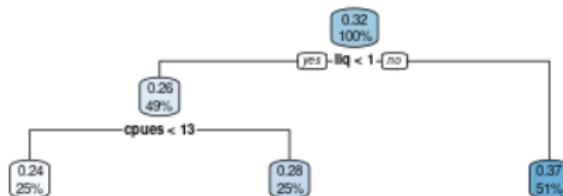
- 64 ( $2^6$ ) model runs:
  - 3 with  $B_0 > 1e7$ .
  - 1 with final gradient  $> 1e-4$ .
  - 8 with MASE(LLCPUE3S01)  $> 1$
- 53 model runs accepted

# Regression tree

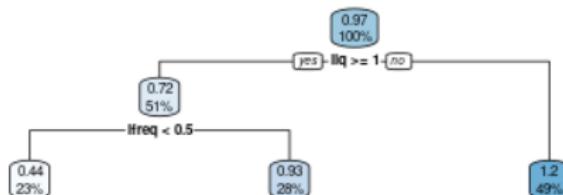
Virgin SSB



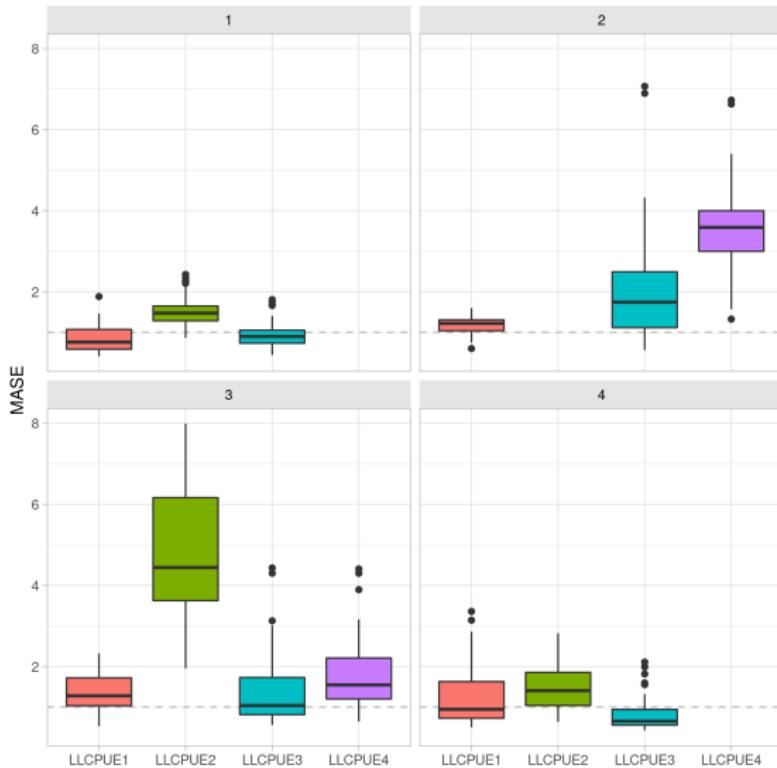
$\sigma$  Rec



SSB / SSBMSY

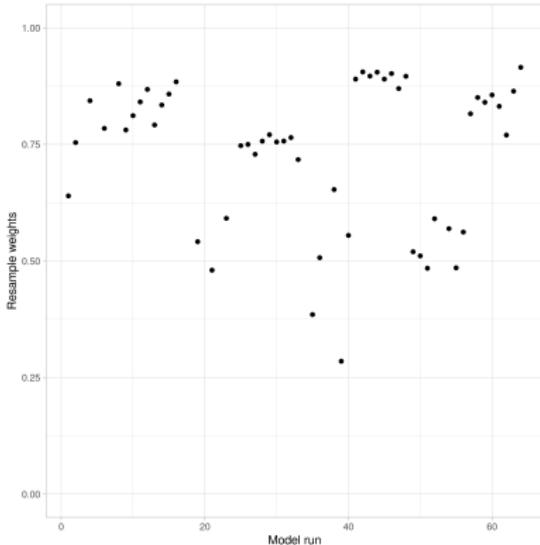


# MASE by LLCPUE and season

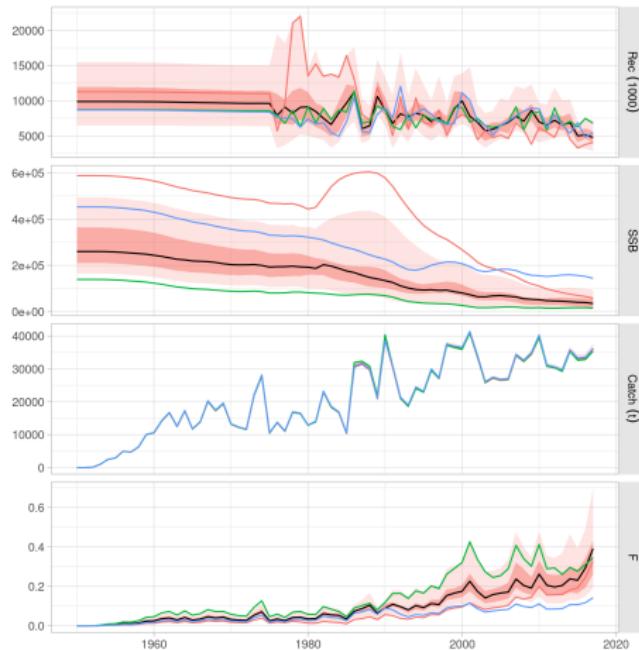


# Weighting of OM runs

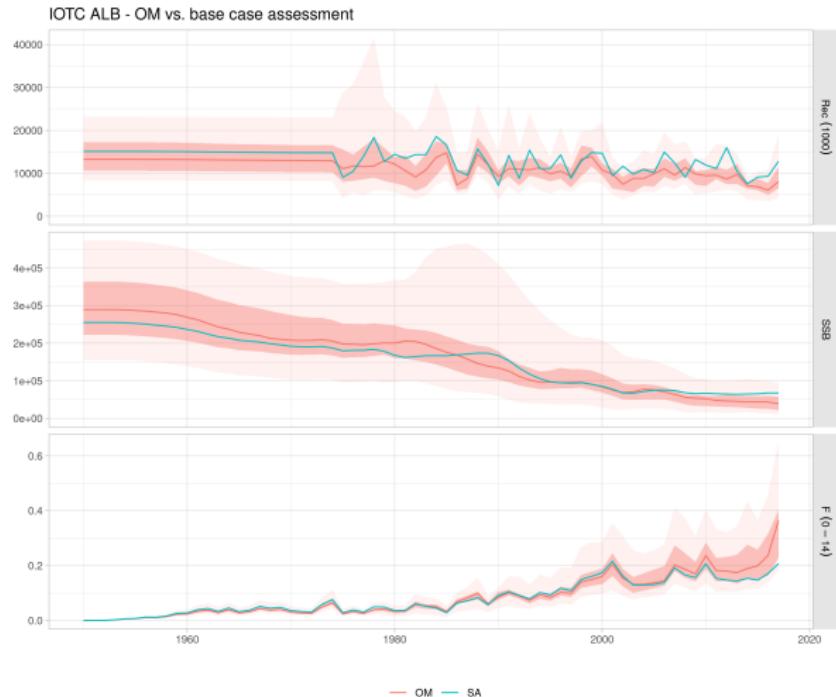
- Diebold-Mariano test (Harvey, Leybourne and Newbold, 1997).
- Compares naive and model 1-step-ahead predictions of CPUE.
  - prediction skill model > naive.
- DM p-value used as weight.



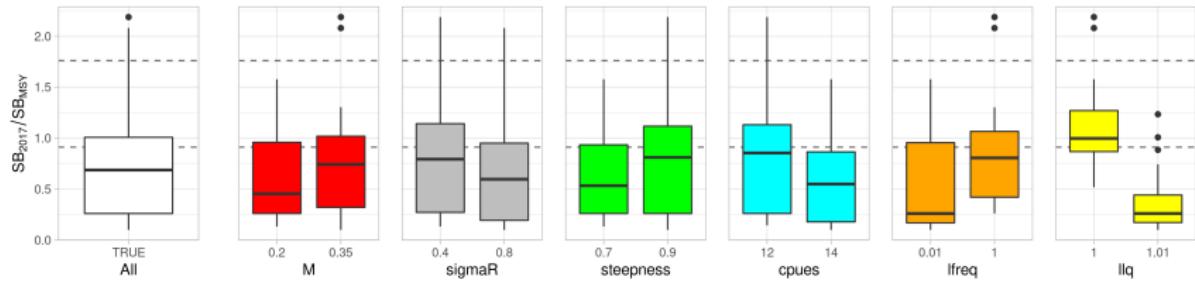
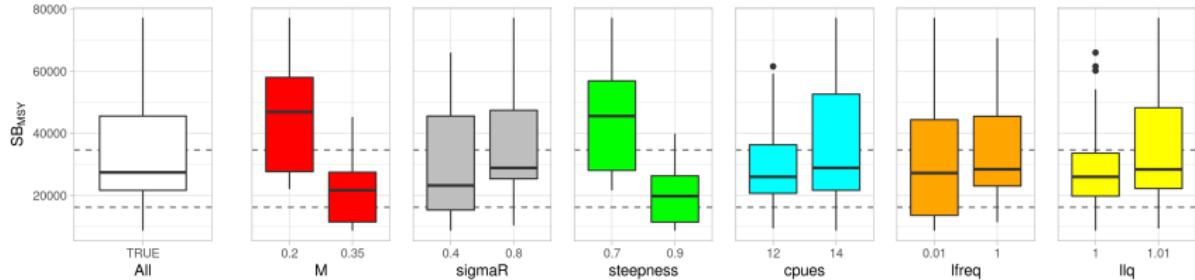
# OM 500 resamples



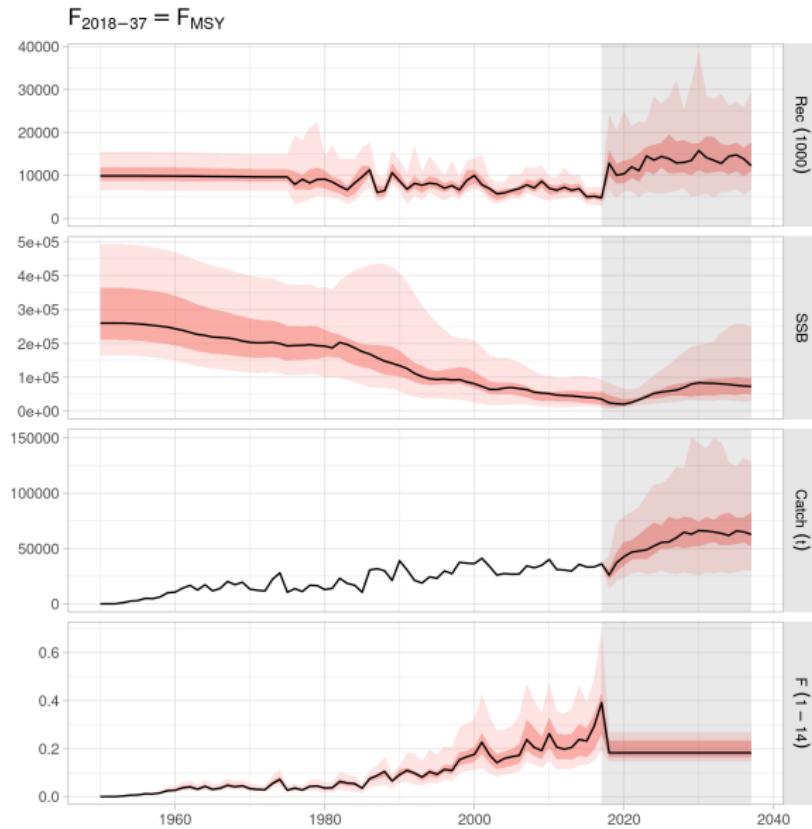
# Corners OM vs. base case SA



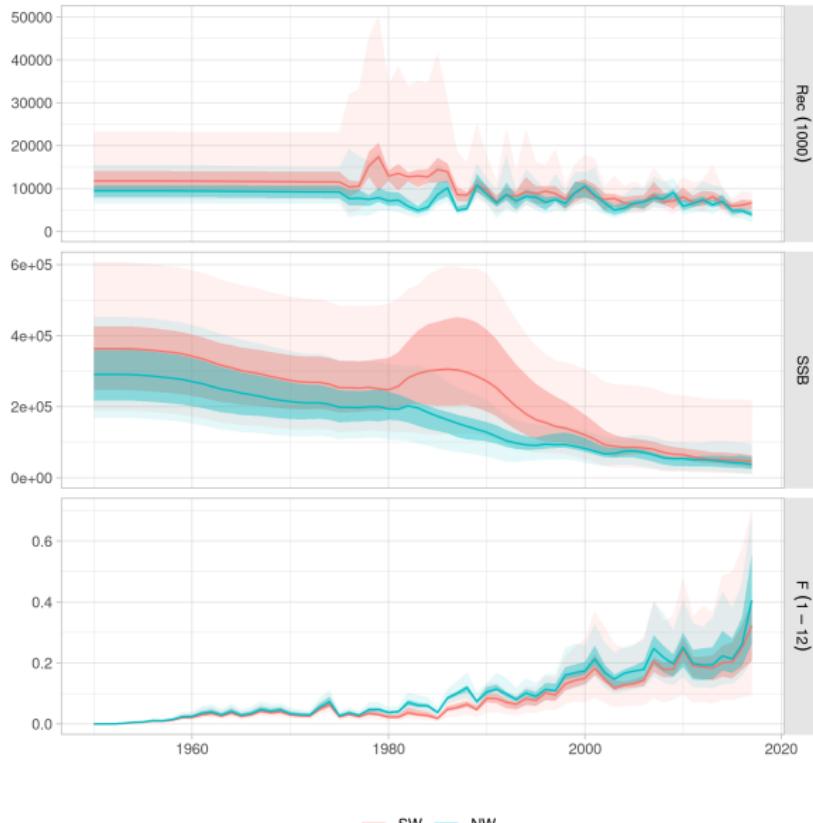
# OM factors variability vs. SA



# Projection F=FMSY

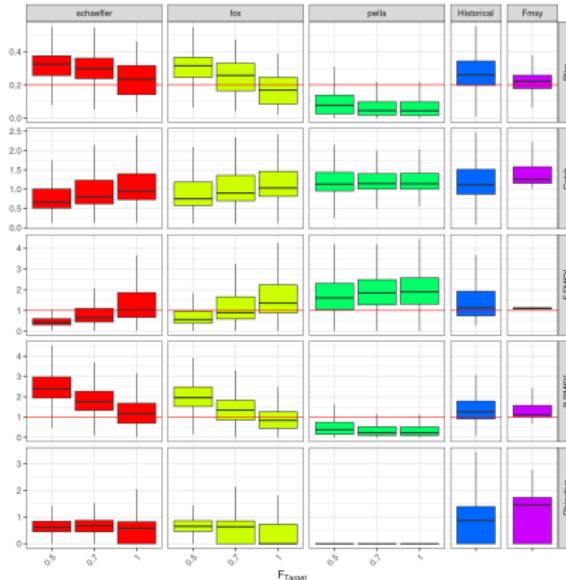


# OM difference by CPUE

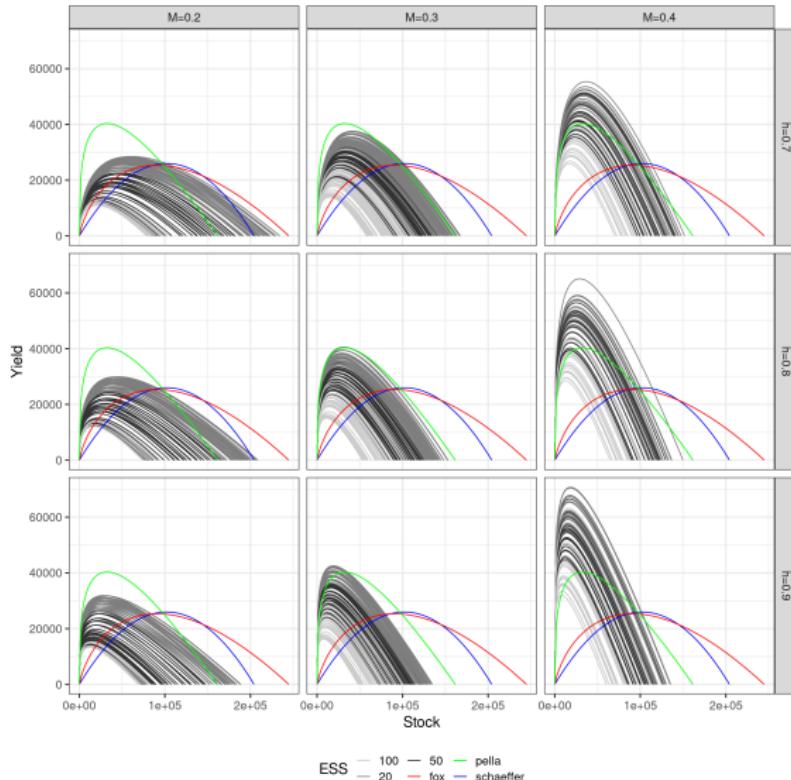


# Hindcast MPs on 2016 grid (2000-2014)

- Schaefer, Fox & Pella ( $B_{MSY}/K = 0.20$ )
- $F_{target} = F_{MSY}$  multiplier



# Production function (OM & MPs) by M, ESS and h



# Open questions on OM

- Maintain the two CPUES given only one will run MP?
  - Run MPs on LLCPUS (SW) start of year (S04-S01).
  - Separate as 2 OMs?
- Likelihood lambda enough contrast CPUE ~ LF?
- Do corners suffice to cover uncertainty space?
- Weighting based on prediction skill.
- Recruitment deviates to follow recent trends?
- Base case on extreme of OM: status.

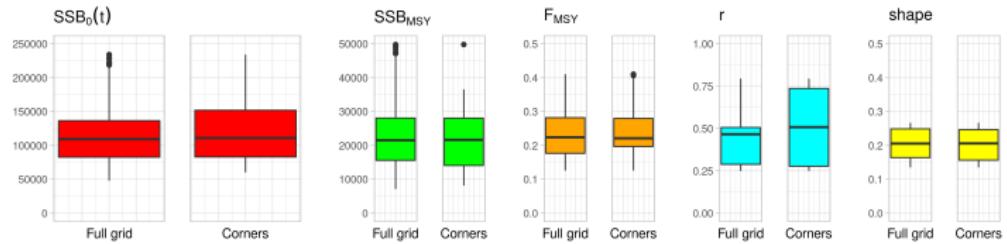
# Next steps

- Biomass dynamics MP implemented.
  1. TMB Jabba-like (observation error, fixed process error).
  2. Jabba slim down, 30s running time.
- Capture the spatial component in CPUE in one area OM?

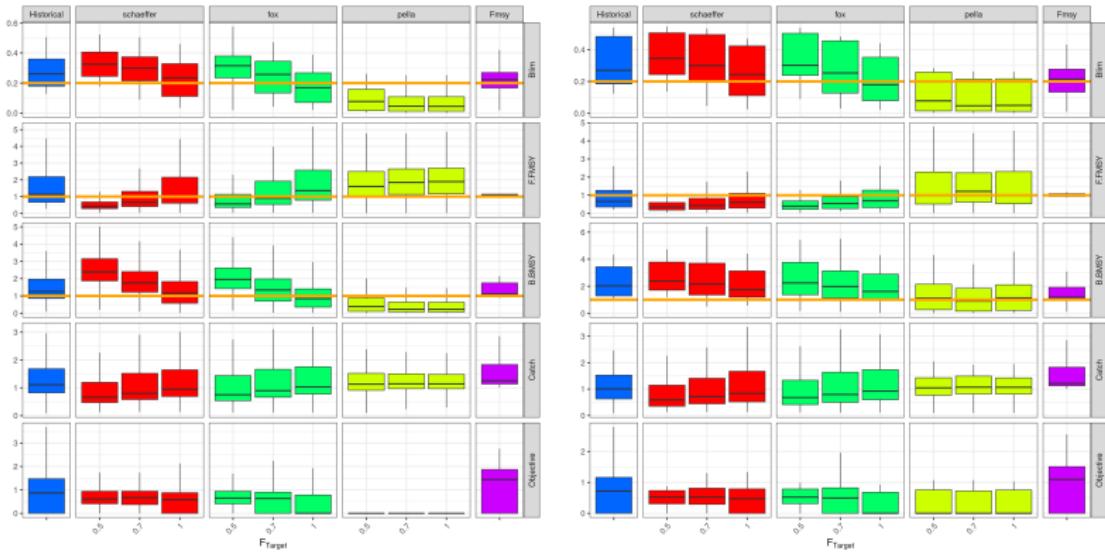
# Simulations workplan

- Tune MPs for
  1.  $P(\text{Kobe} == \text{green } 2030-2034) = 50\%$
  2.  $P(\text{Kobe} == \text{green } 2030-2034) = 60\%$
  3.  $P(\text{Kobe} == \text{green } 2030-2034) = 70\%$
- Robustness tests
  - Continuing recruitment decline
  - LLCPUE overcompensation bias
  - 10% overcatch, reported
  - 10% overcatch, not reported

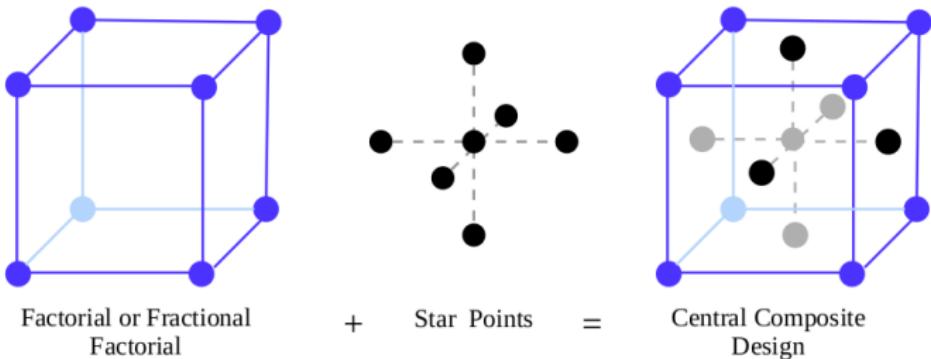
# Full grid vs. corners in 2016 OM



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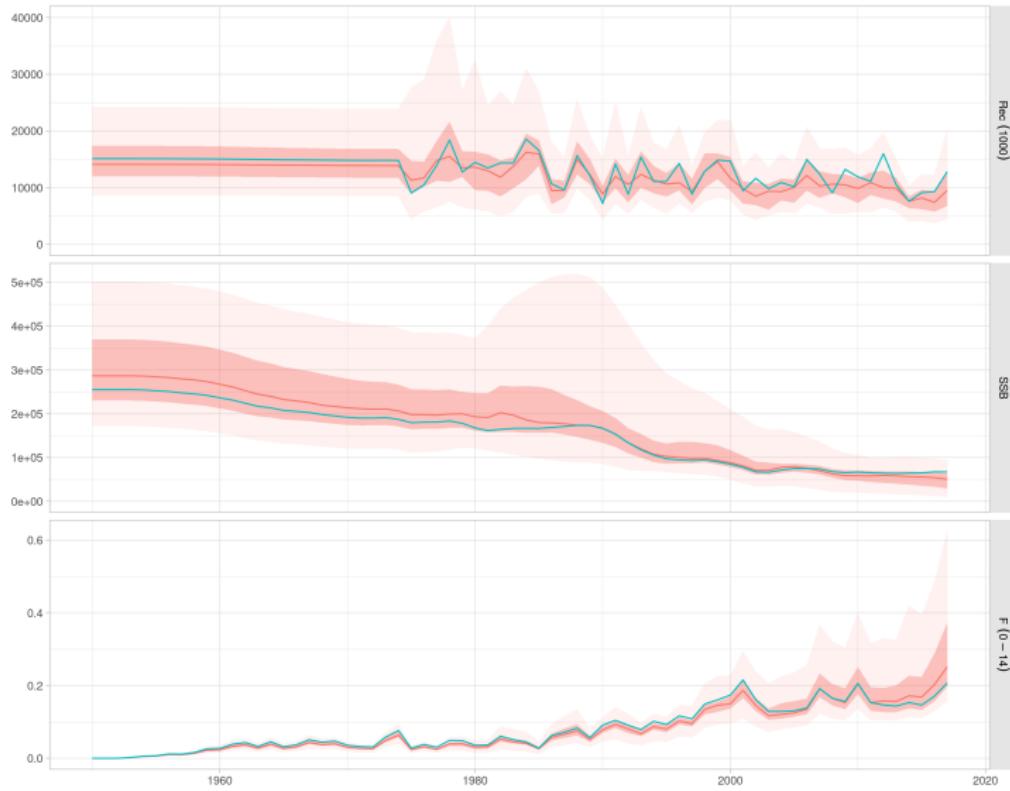


# Central Composite Design

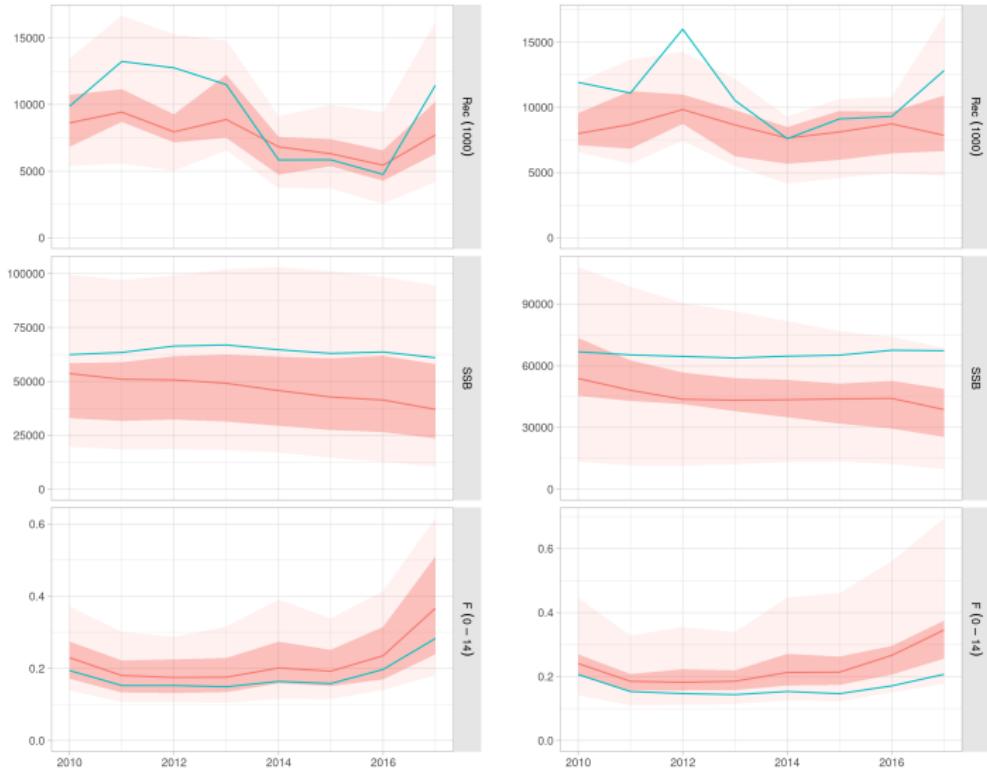


- $2^6 + 1 + 2 * 6 = 77$
- Compares well to  $3^6$  (Sanchez, 2005)

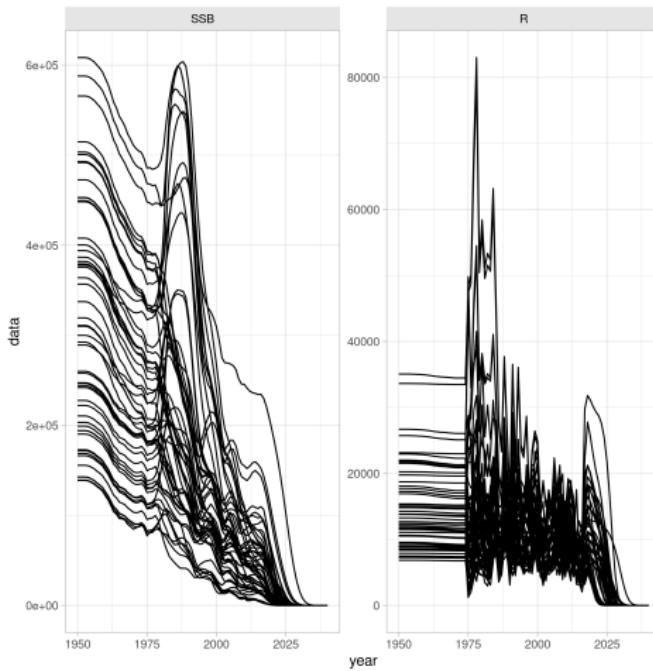
# Corners + main effects



# Corners by CPUE vs. bases



# Recruitment residuals in projections



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