Conditioning the North Atlantic Albacore Operating Model on Multifan-CL

Validation

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OM conditioning

The Operating Model (OM) is a mathematical–statistical model used to describe the actual resource dynamics in simulation trials and to generate resource monitoring data when projecting forward. The OM simulates historical and future dynamics and psuedo data for use in the Management procedure (MP).

An OM is conditioned on available information by adjusting the parameter values to ensure that it is consistent with this information, and hence reflects assumptions that are plausible this process maybe, but does not have to be similar to an assessment; the conditioning provides the initial conditions for projecting resource dynamics forward.

The OEM is the component of the OM that generates fishery-dependent and/or fishery-independent resource monitoring data for input to an MP.

Multifan-CL

The OM was conditioned by fitting Multifan-Cl to a range of scenarios based on the 2013 ICCAT North Atlantic Albacore Stock Assessment i.e.

- **Base** Model specifications provided in SCRS/2013/058
- **Alt1** Includes Chinese Taipei LL SF data and allows dome-shaped selectivity for this fleet
- **Alt2** Model starts in 1950
- **Alt3** All SF data down-weighted
- **Alt4** Japanese LL CPUE data no longer down-weighted
- **Alt5** Includes the Chen and Watanabe age-specific natural mortality vector (Santiago 2004)
- **Alt6** Excludes final 4 years of data (2008 – 2011)
- **Alt7** Includes equal weights for Japan and Chinese Taipei LL SF and CPUE data (similar to 2009 continuity run)
- **Alt8** Includes total catch in weight but effort calculated from CPUE in numbers (incorrect effort data calculation)
- **Tag** Includes tagging data for release events that occurred between 1988 and 1991

Additional scenarios were considered corresponding to

- **Natural Mortality** three levels
- **Steepness** four levels
- **Trend in catchability** two levels

Validation Steps

Multifan-CL is a fully integrated model, where growth and catch-at-age structure are estimated simultaneously with recruitment, selectivity, catchability, natural mortality, and other parameters.

Stock Recruitment Relationship

In Multifan-CL a Beverton-Holt stock-recruitment relationship (SRR) is assumed and the deviations between the recruitment predicted by the SRR and the recruitment, used in the age structured dynamics when fitting, are estimated and included in the likelihood. This means that the dynamics are driven by the recruitment, i.e. the relationship is of recruit-stock form rather than stock-recruit.

Figure 4 shows the estimates of steepness derived from the S-R pairs estmated by Multifan-CL as used in the dynamics, while **Figure 5** shows the posteriors from Multifan-CL. **Figure 6** plots the crosscorrelations between the estimated recruitments (i.e. the deviates plus the expected recruits) and shows that as the lags are all positive that large stock sizes are driven by the incoming recruitment rather than the SRR.

Figure 8 shows little evidence for auto-correlation between deviates, while **Figure 9** shows the estmiated regimes using the STARS algorithm.

Figures 11 and 12 show simulated recruitments with and without regime shifts.

Observation Error Model

The Observation Error Model (OEM) simulates psuedo data from the OM for use in the MP. The objective of MSE is to ensure that advice is robust it must therefore model the characteristics of the actual data used to provide the advice.

A main concern expressed by stakeholders was that the CPUE time series simulated in the OEM did not correspond to the ones actually used in the assessment, i.e.

- In the 2016 MSE a single CPUE had been used which corresponded to the total biomass, whiile q had been fixed at 1 so that the index represented an unbiased estimate of absolute abundance.
- In the 2017 MSE, only four indices which started in 1980 and were available for the entire simulated period, although 5 were used in the assessment, only 1 started in 1980, the others were of shorter duration and the Japanese longline bycatch was no longer representative of albacore abundance and so was trunacted in 2012. In addition the assumed selection patterns for all OM scenarios were taken from the base case.

Figure 13 shows that the selection patterns actually vary by OM scenario

Biological parameters

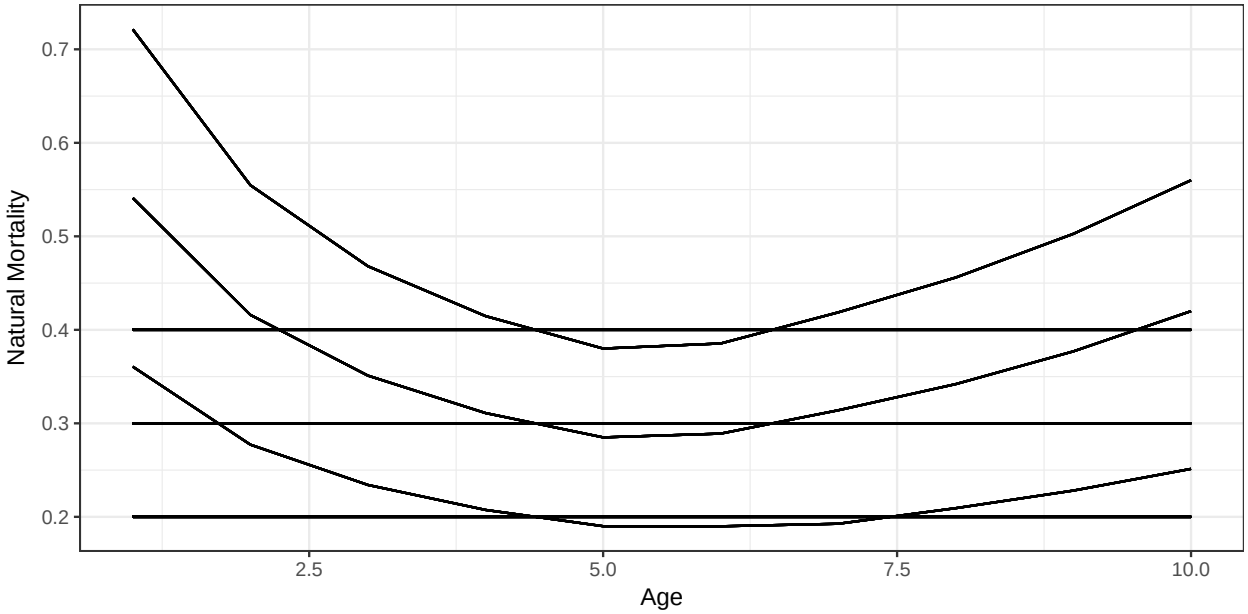

Figure 1. Natural Mortality vectors showing the three levels of M, and the Chen Watannabe vector that assumes scenescence.

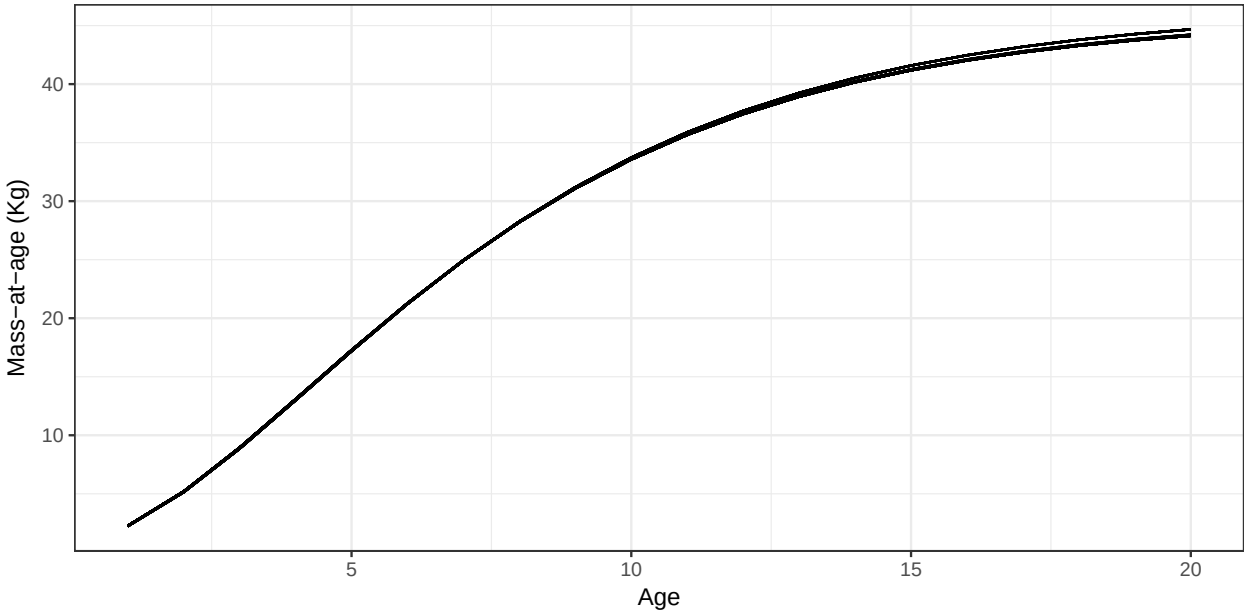

Figure 2. Mass-at-age.

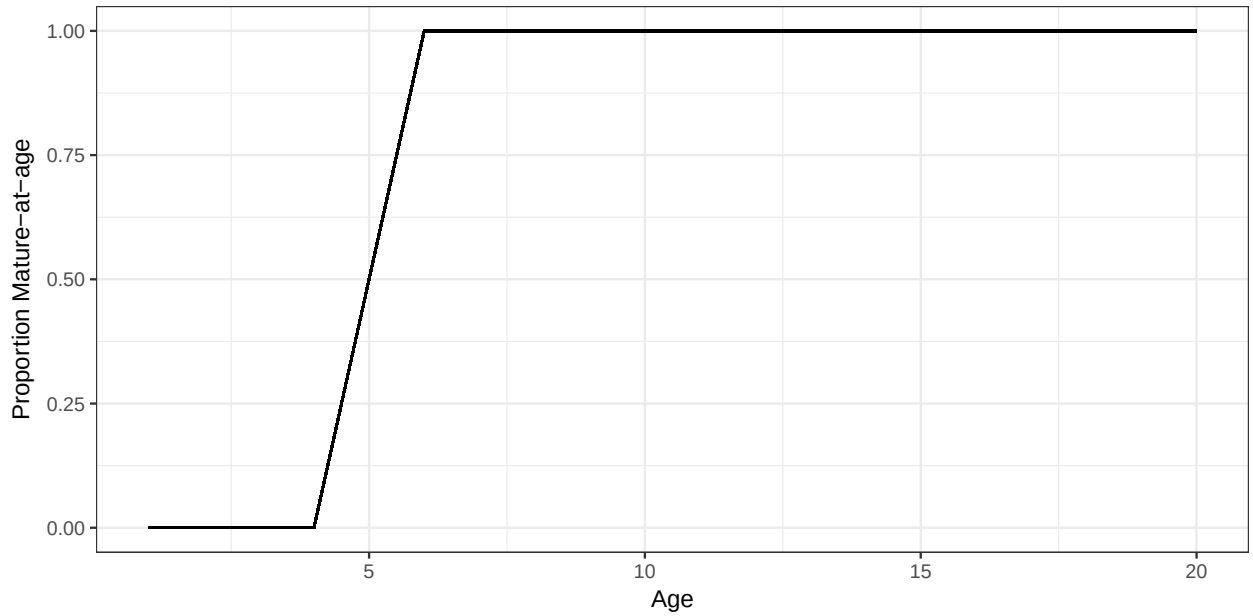

Figure 3. Proportion mature-at-age.

Recruitment dynamics

The stock recruitment relationship and the recruitment deviates are estimated as part of the Multifan-CL fitting procedure. A prior was used for steepness.

Base run configuration and base tests to assess it is doing what we think it should, i.e. the steepness formulation should not be driven by the prior for recruitment dynamics.

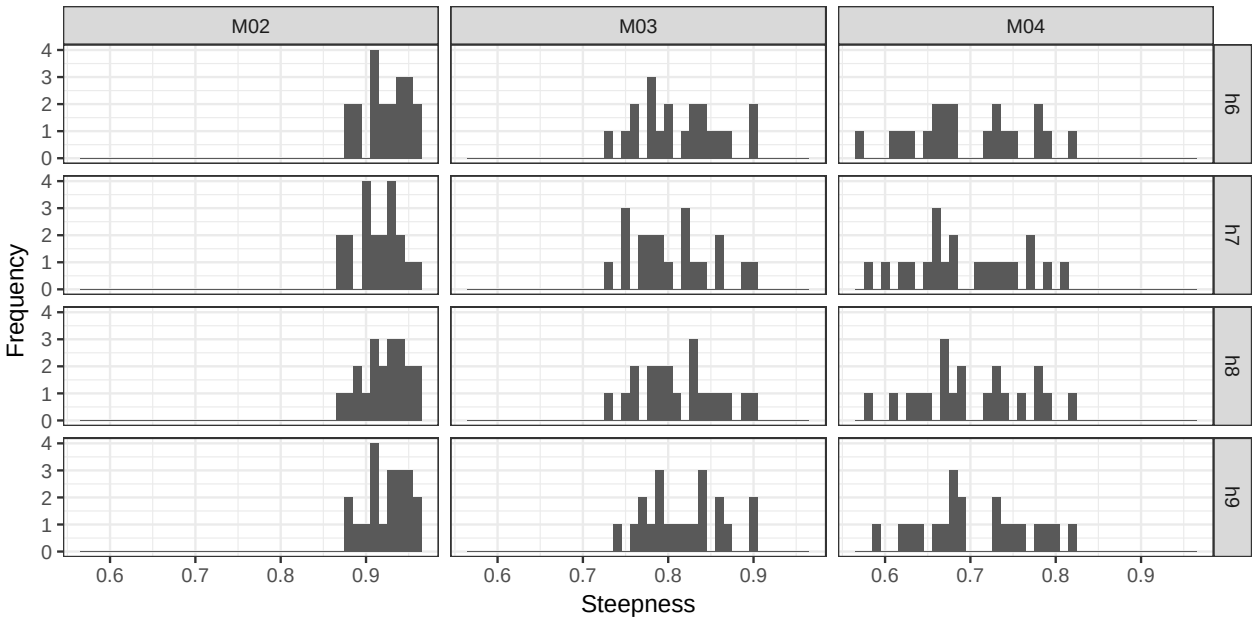

Figure 4. Steepness of the stock recruitment relationship estimated from on the stock recruitment parirs estimated by Multufan-CL.

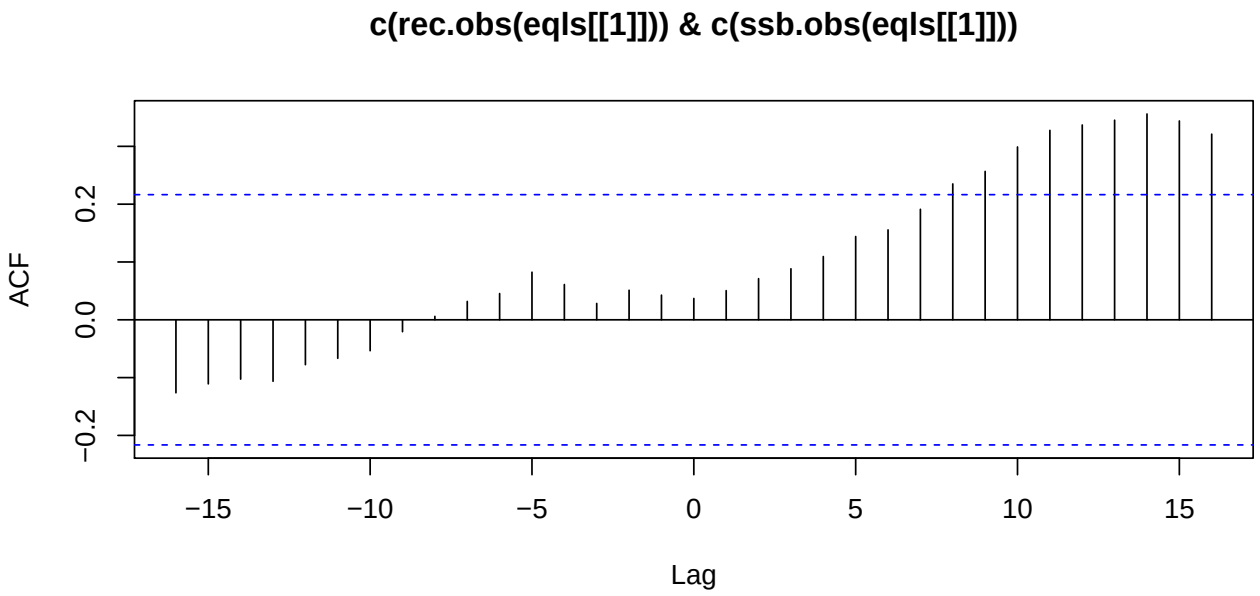

Figure 5. Crosscorrelations between recruitment and SSB, the correlations are dominated by positive lags showing that the dynamics are drive by incoming recruitments, i.e. they are of recruit-stock form.

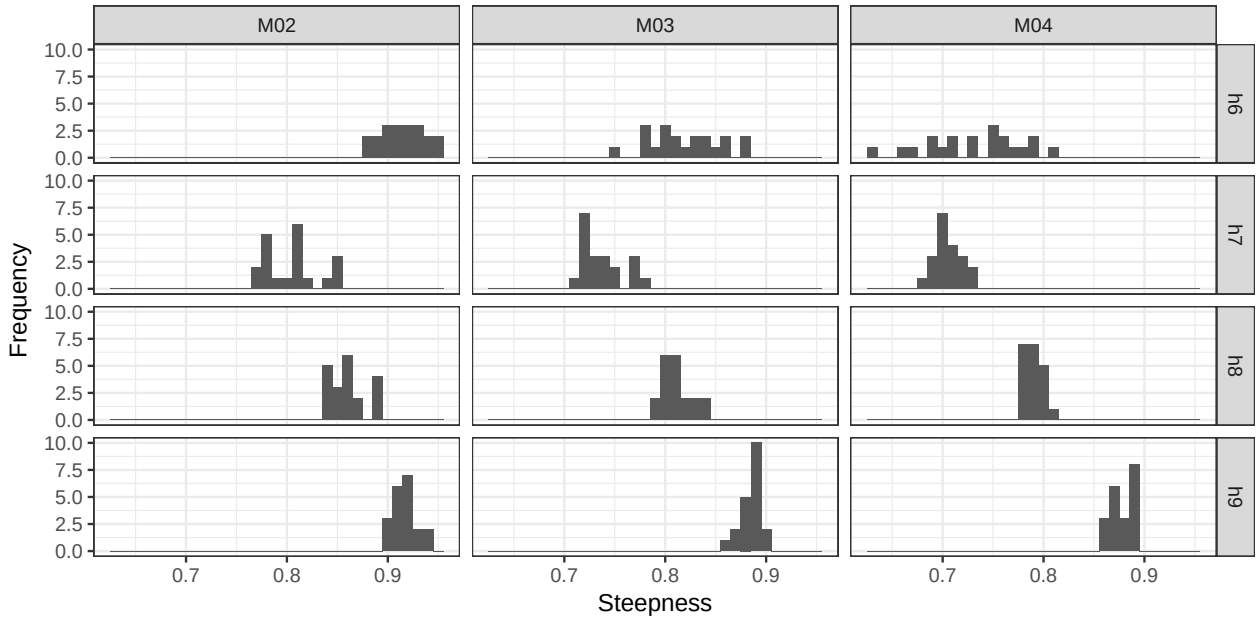

Figure 6. Steepness of the stock recruitment relationship, estimated by Multifan-CL.

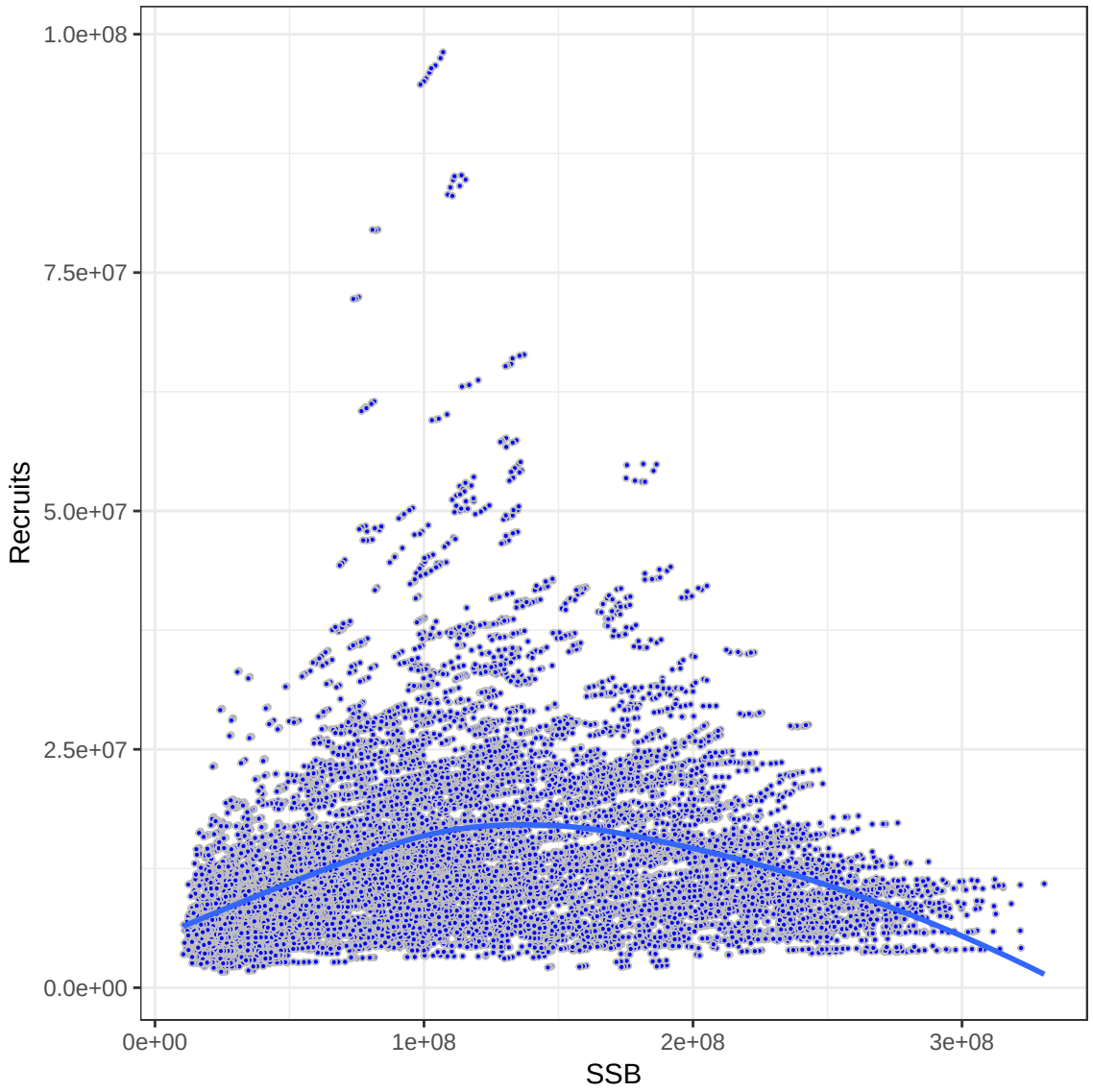

Figure 7. Stock recruitment pairs, with loess smoother.

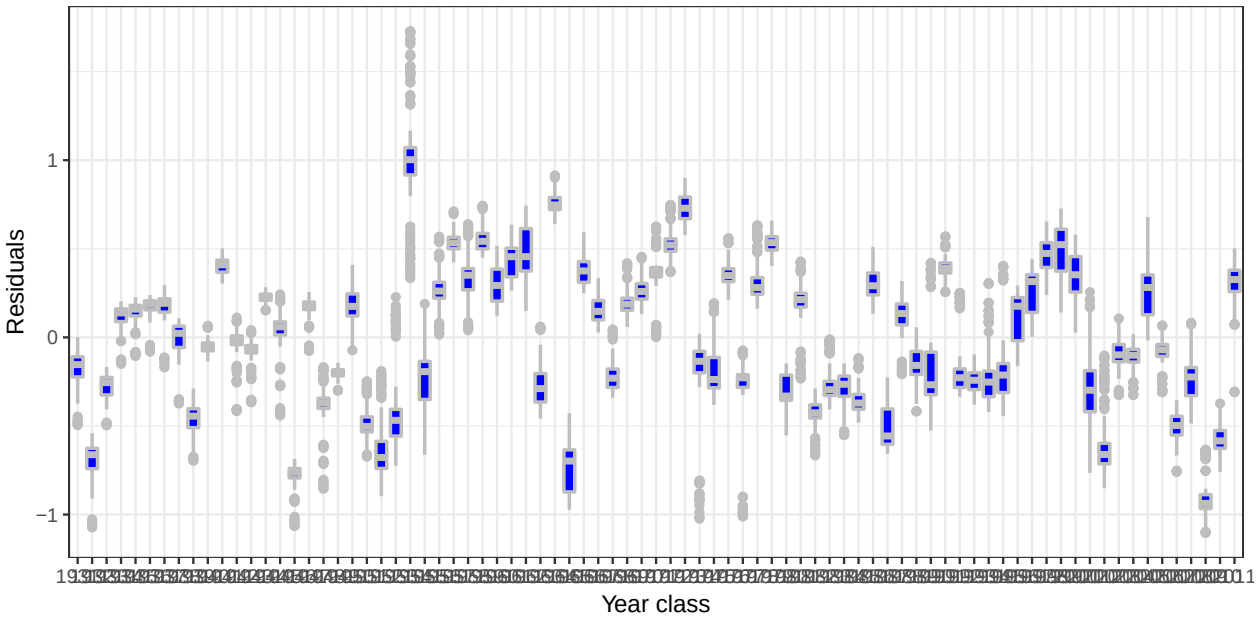

Figure 8. Recruitment residuals.

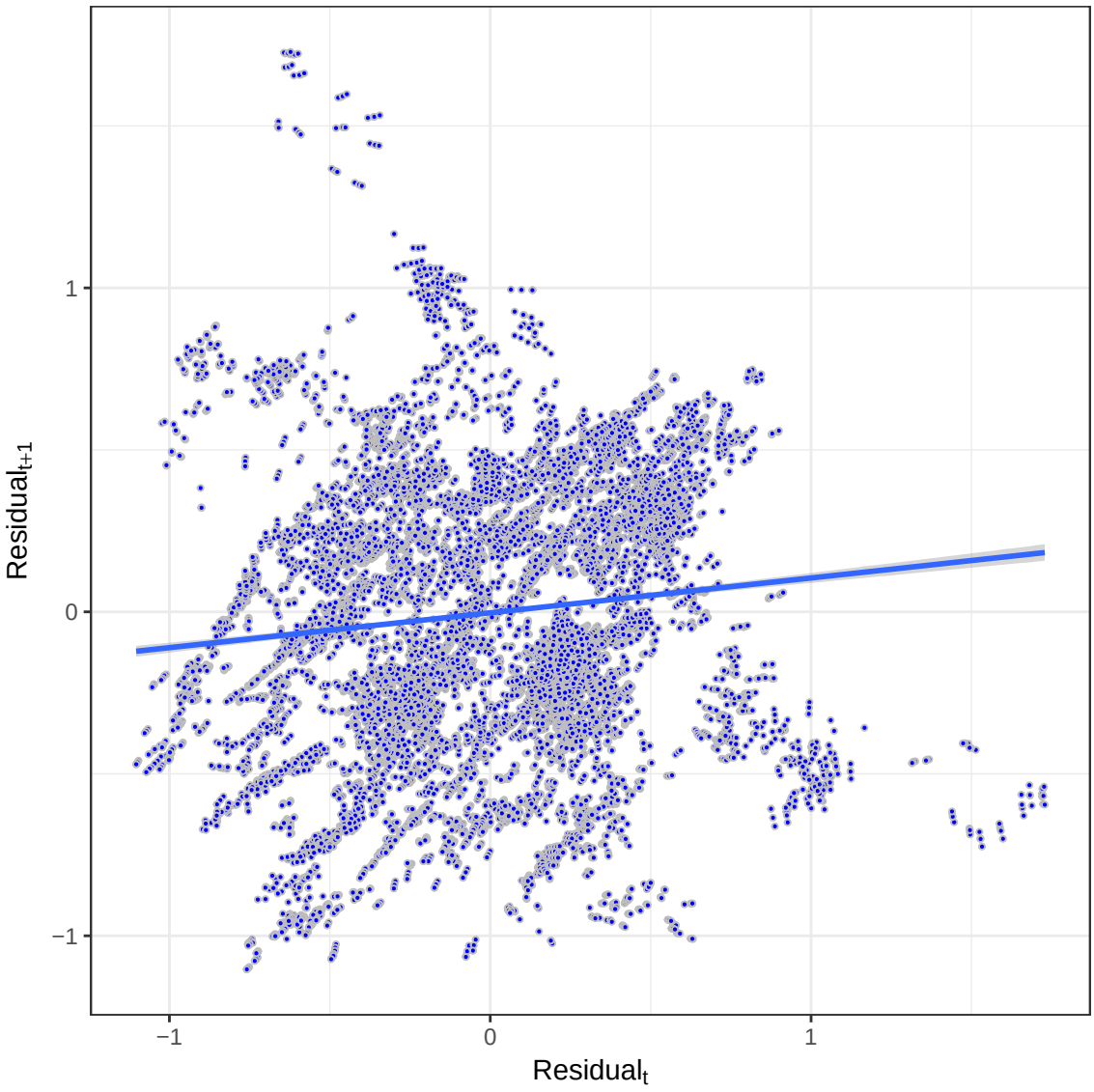

Figure 9. Autocorrelation in residuals

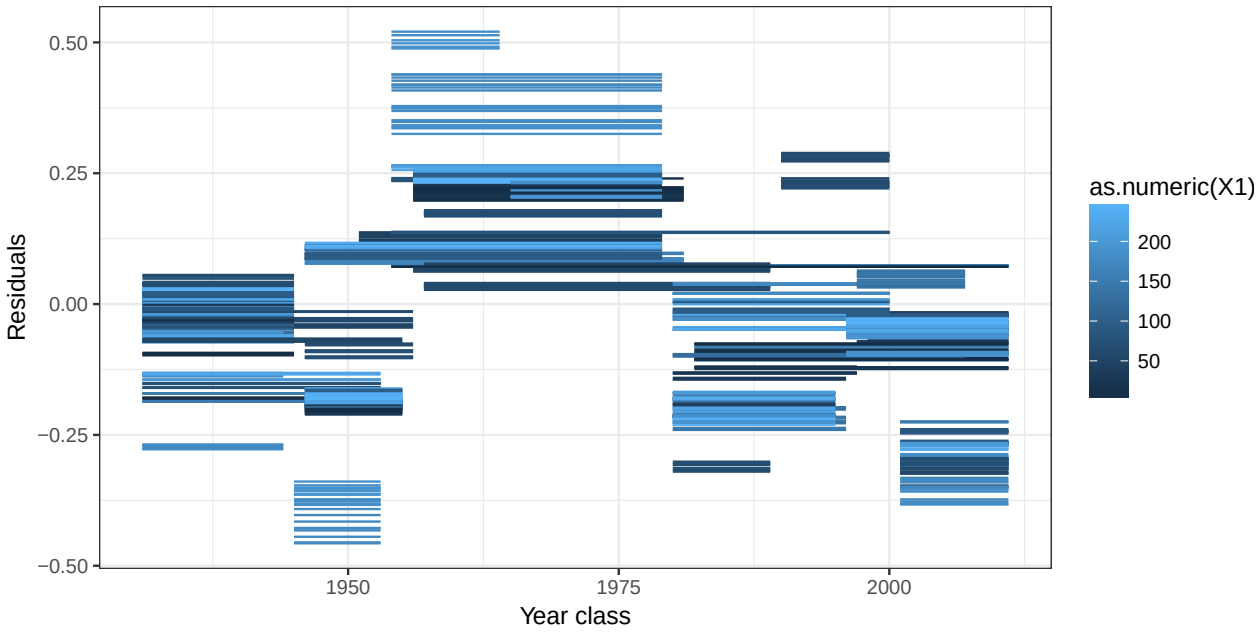

Figure 10. Regimes in recruitment residuals

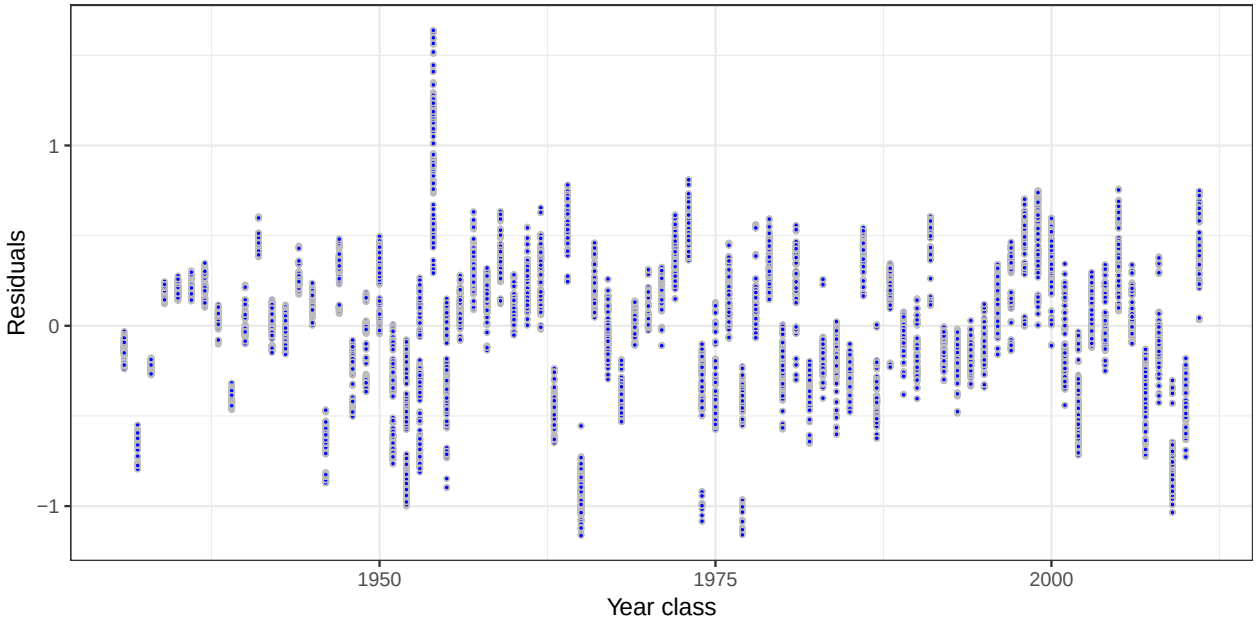

Figure 11. Recruitment residuals with regimes removed

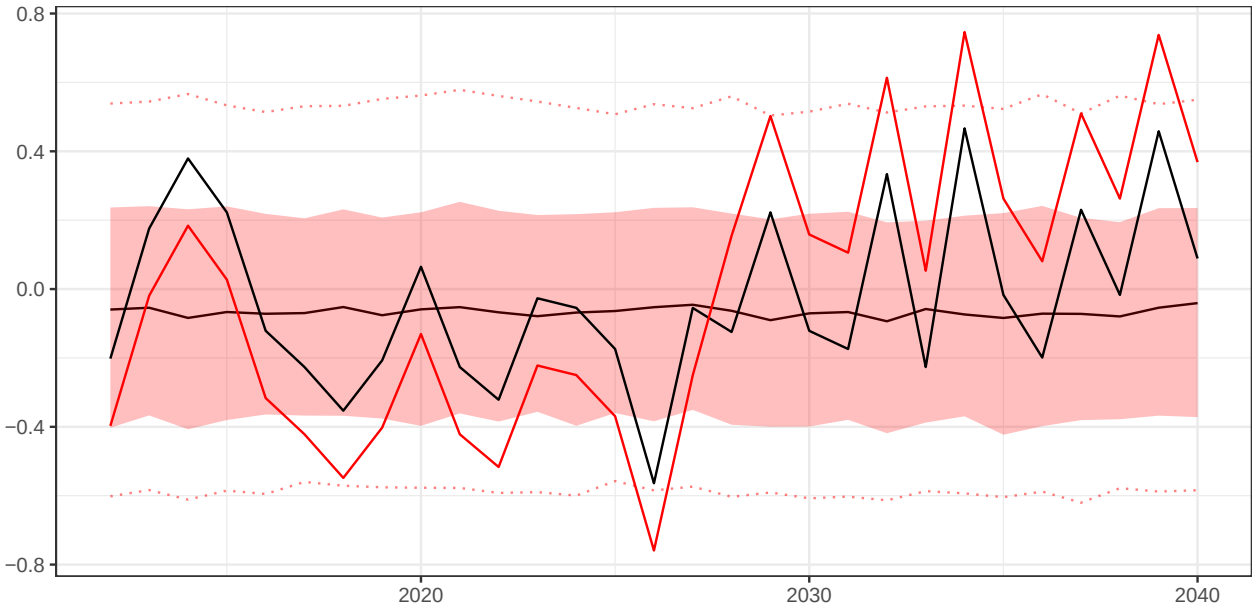

Figure 12. Recruitment deviates for the same scenario and random number seed, with (red) and without (black) regime shift.

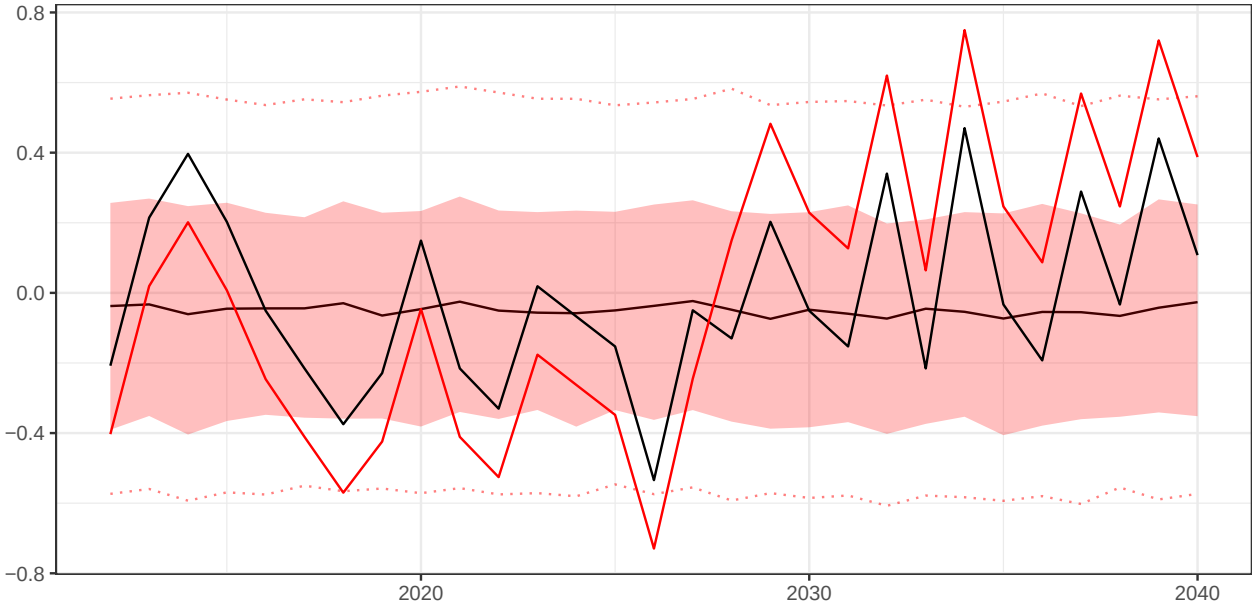

Figure 13. Recruitment deviates for two different scenario for the same random number seed with regime shift.

OEM

How is the OE component being implemented.

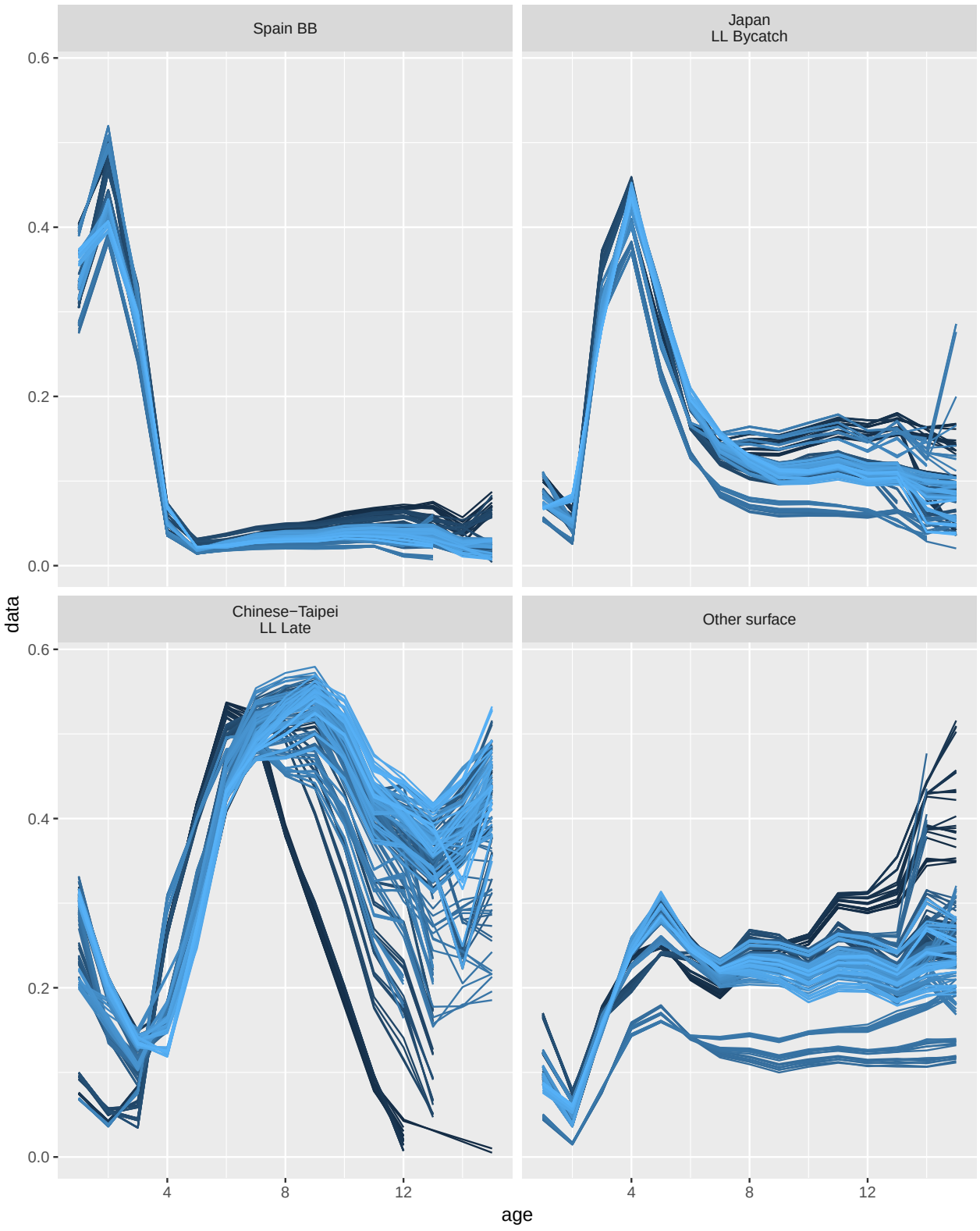

Figure 14. Selection Patterns from the 240 Multigan-CL runs.

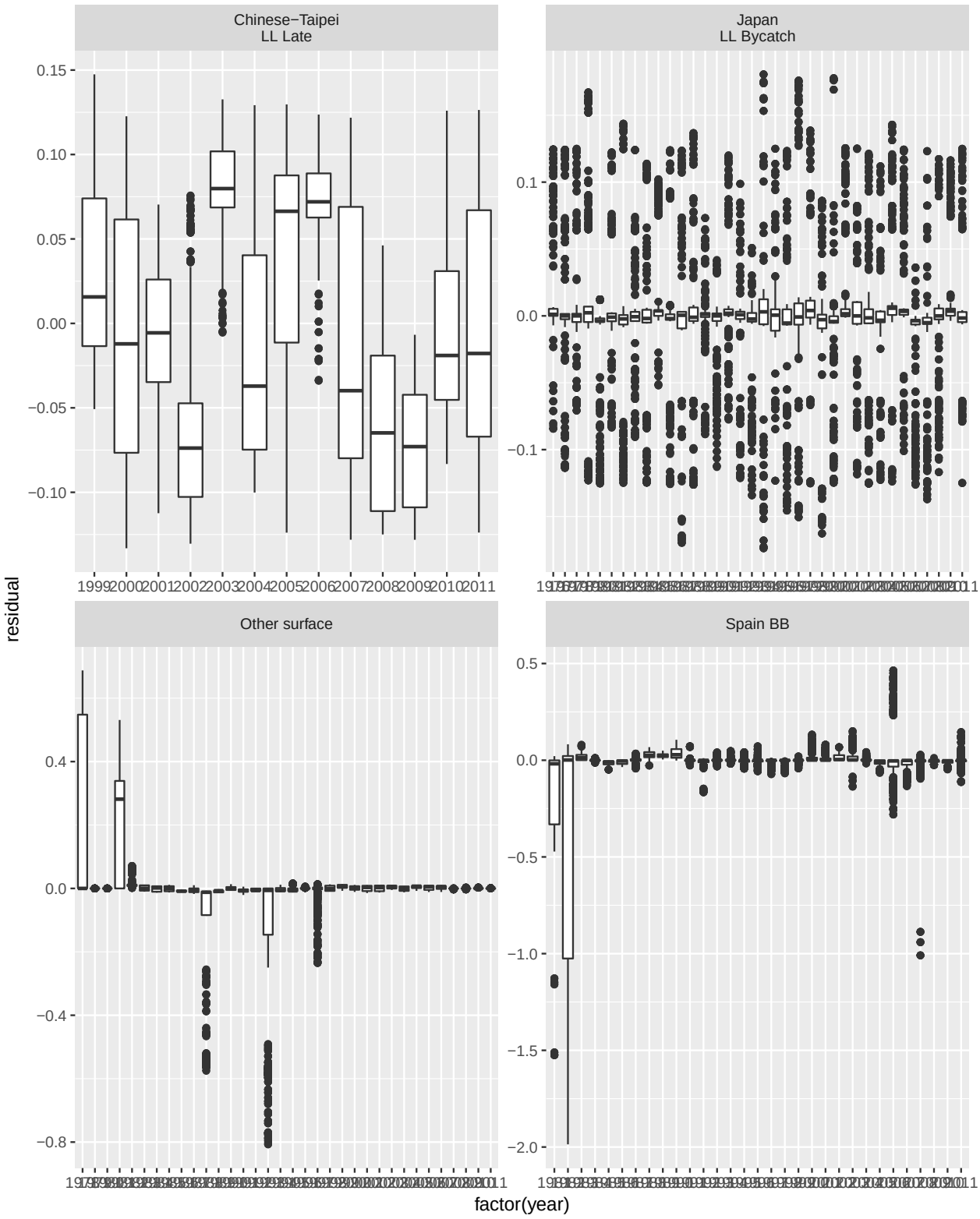

Figure 15. CPUE residuals by year from the 240 Multigan-CL runs.

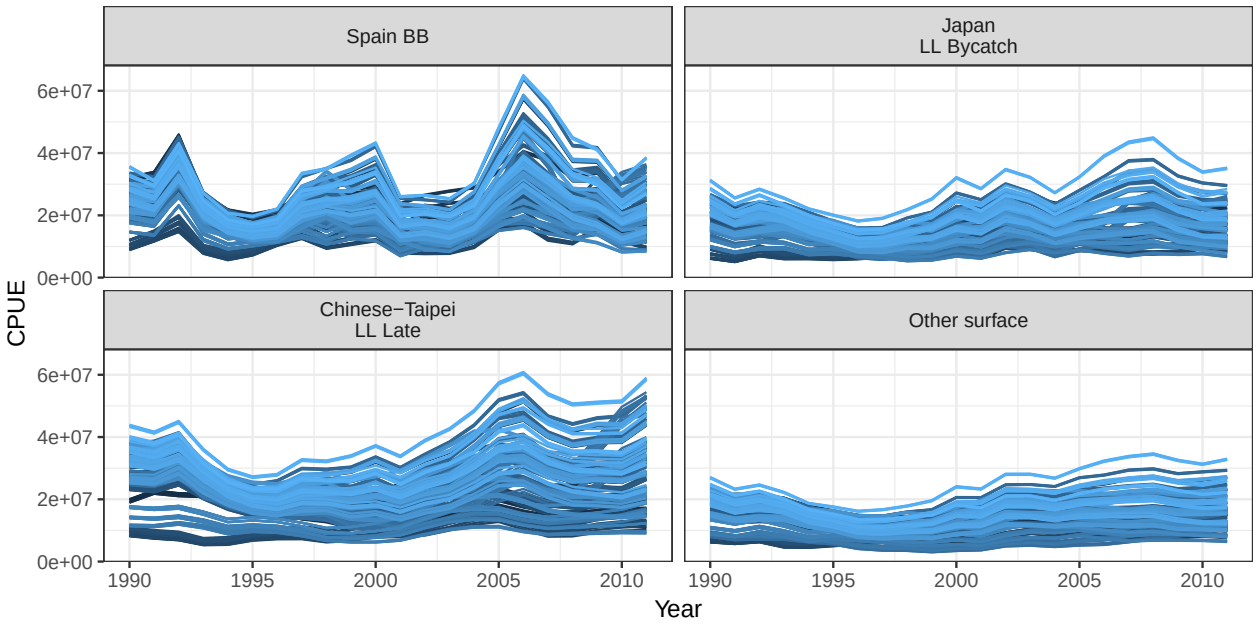

Figure 16. CPUE series by OM scenario.

Biomass Dynamic

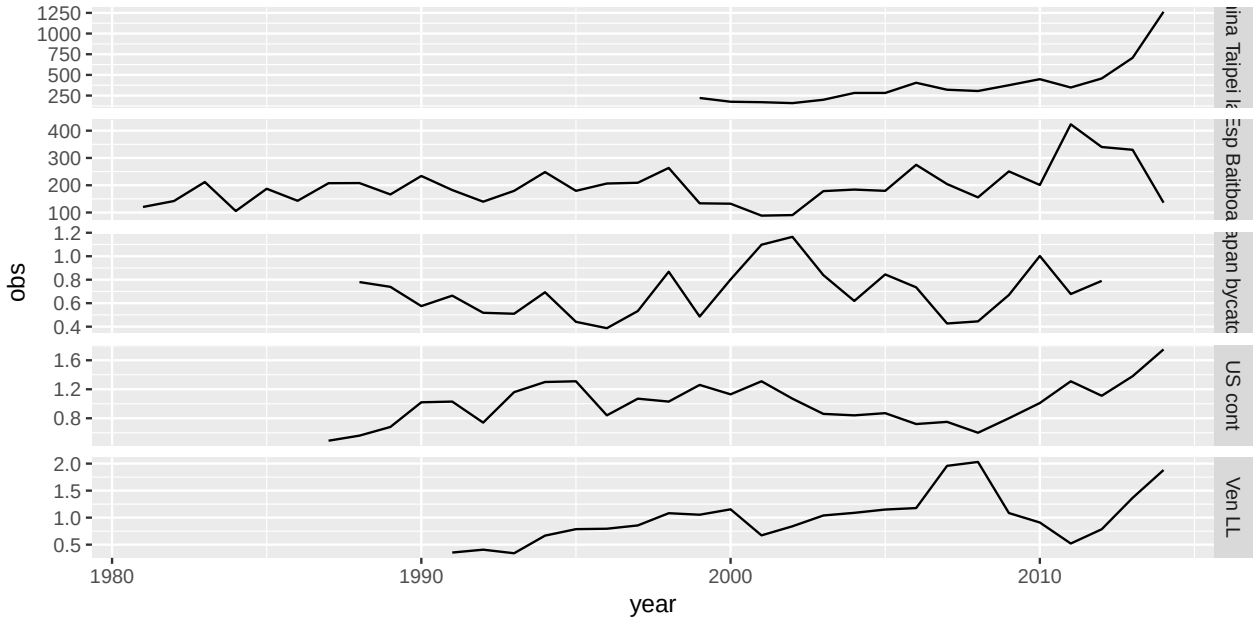

Figure 17. CPUE series used in biomass dynamic assessment model.

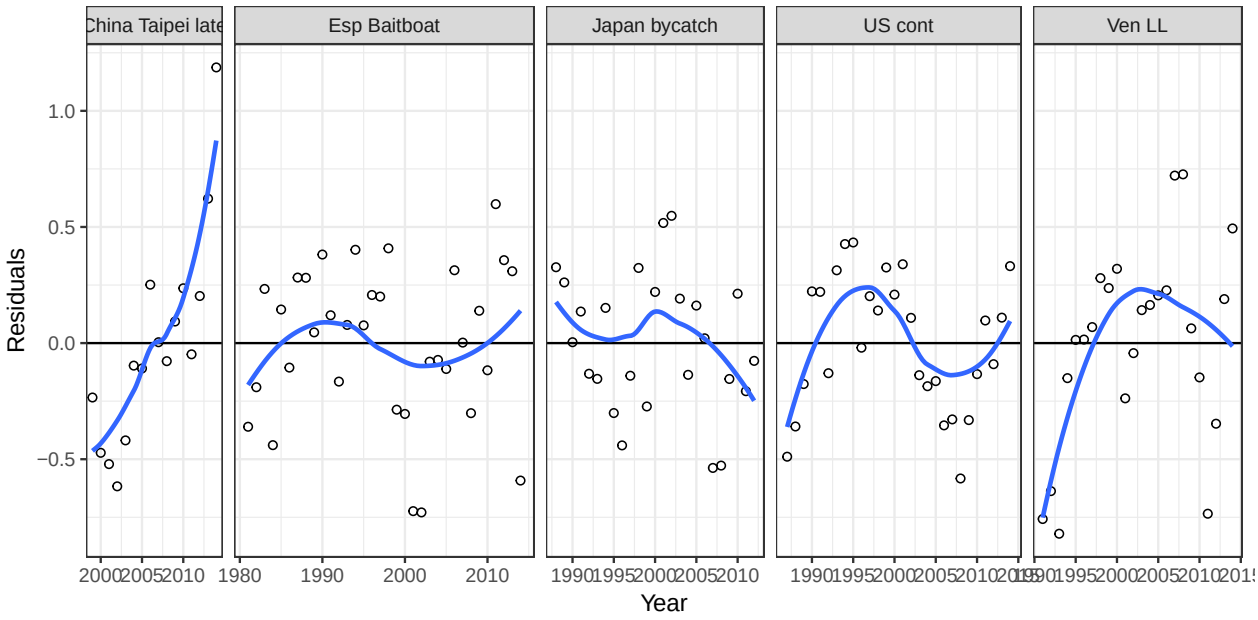

Figure 18. Residuals from fit to CPUE by biomass dynamic assessment model.

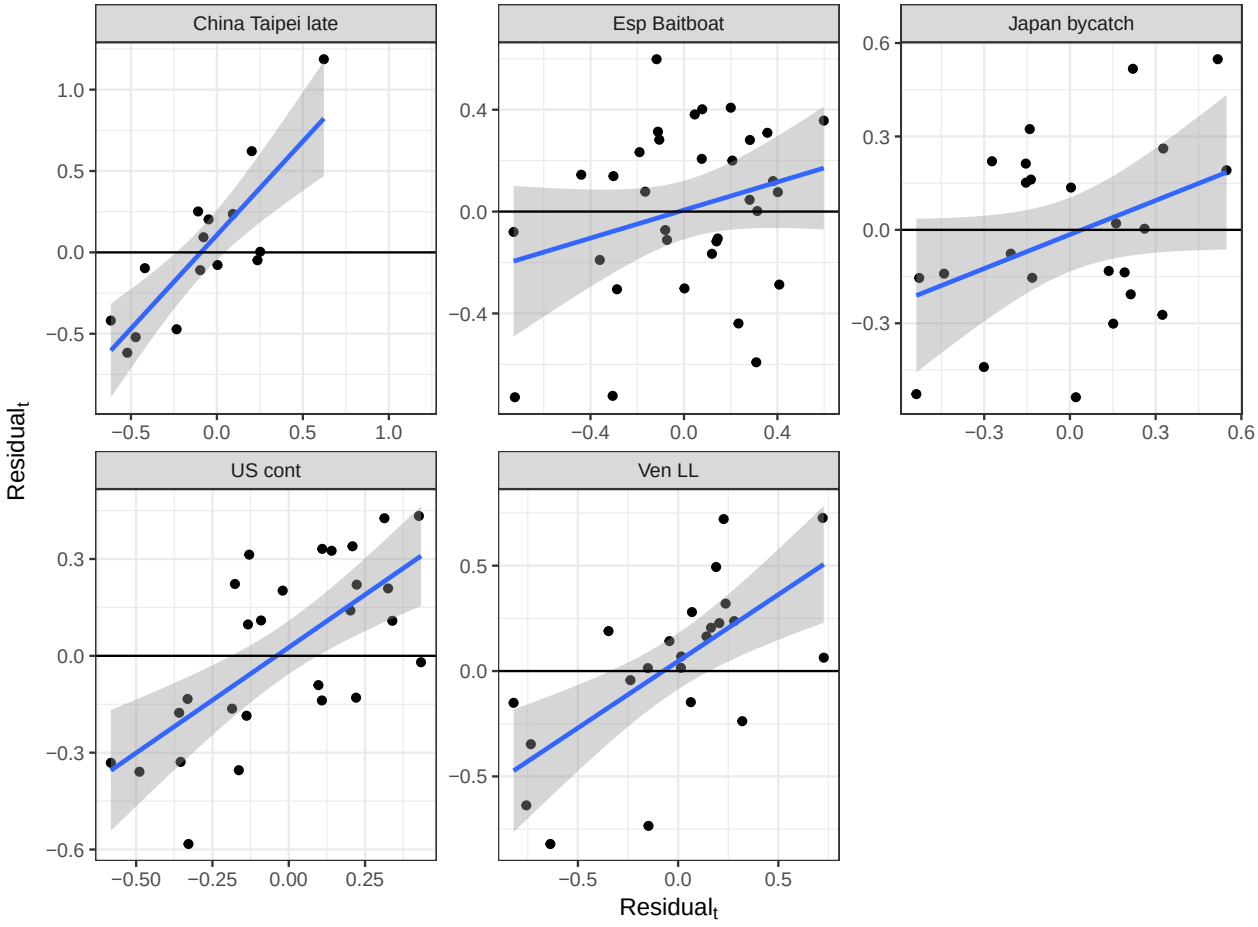

Figure 19. Autocorrelation of residuals (lag 1) from fit to CPUE by biomass dynamic assessment model.

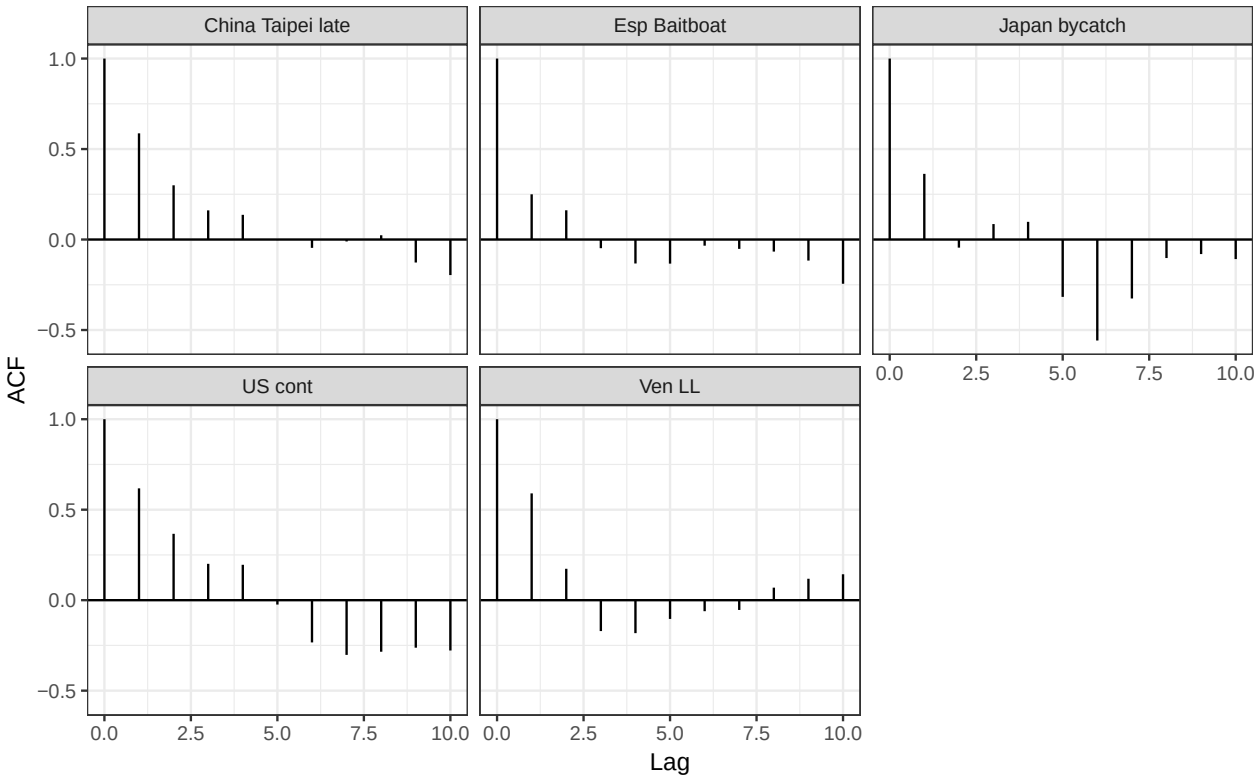

Figure 20. Autocorrelation of residuals from fit to CPUE by biomass dynamic assessment model.

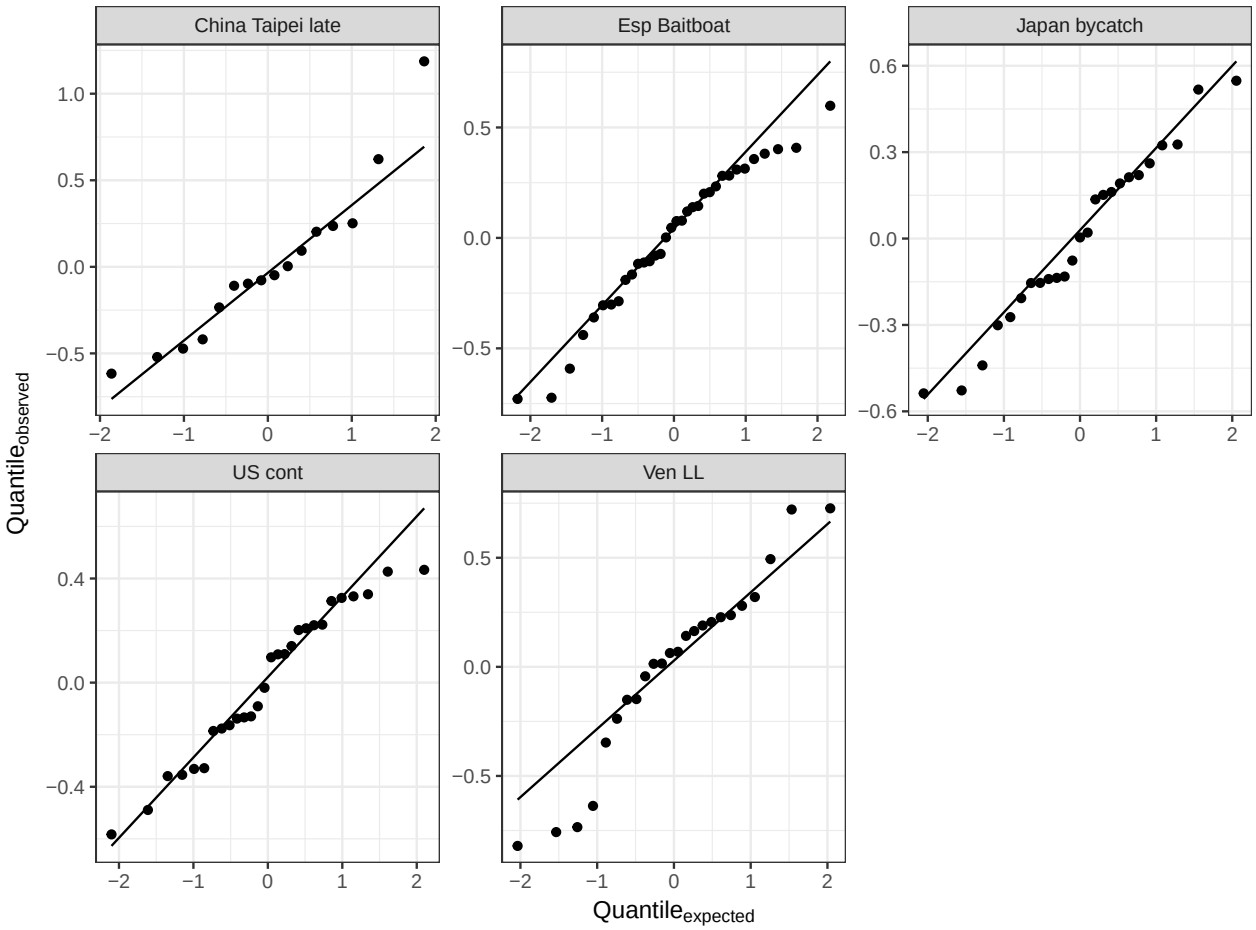

Figure 21. Quantile Quantile plot of residuals from fit to CPUE by biomass dynamic assessment model