Stock assessment work for Alaska pollock in the Eastern Bering Sea

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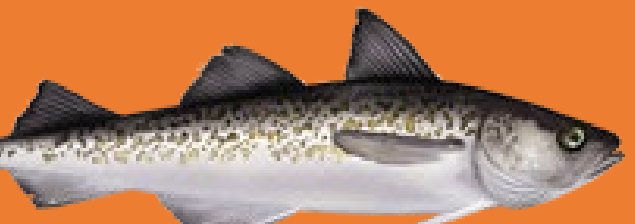

Eastern Bering Sea pollock stock assessment model evaluations

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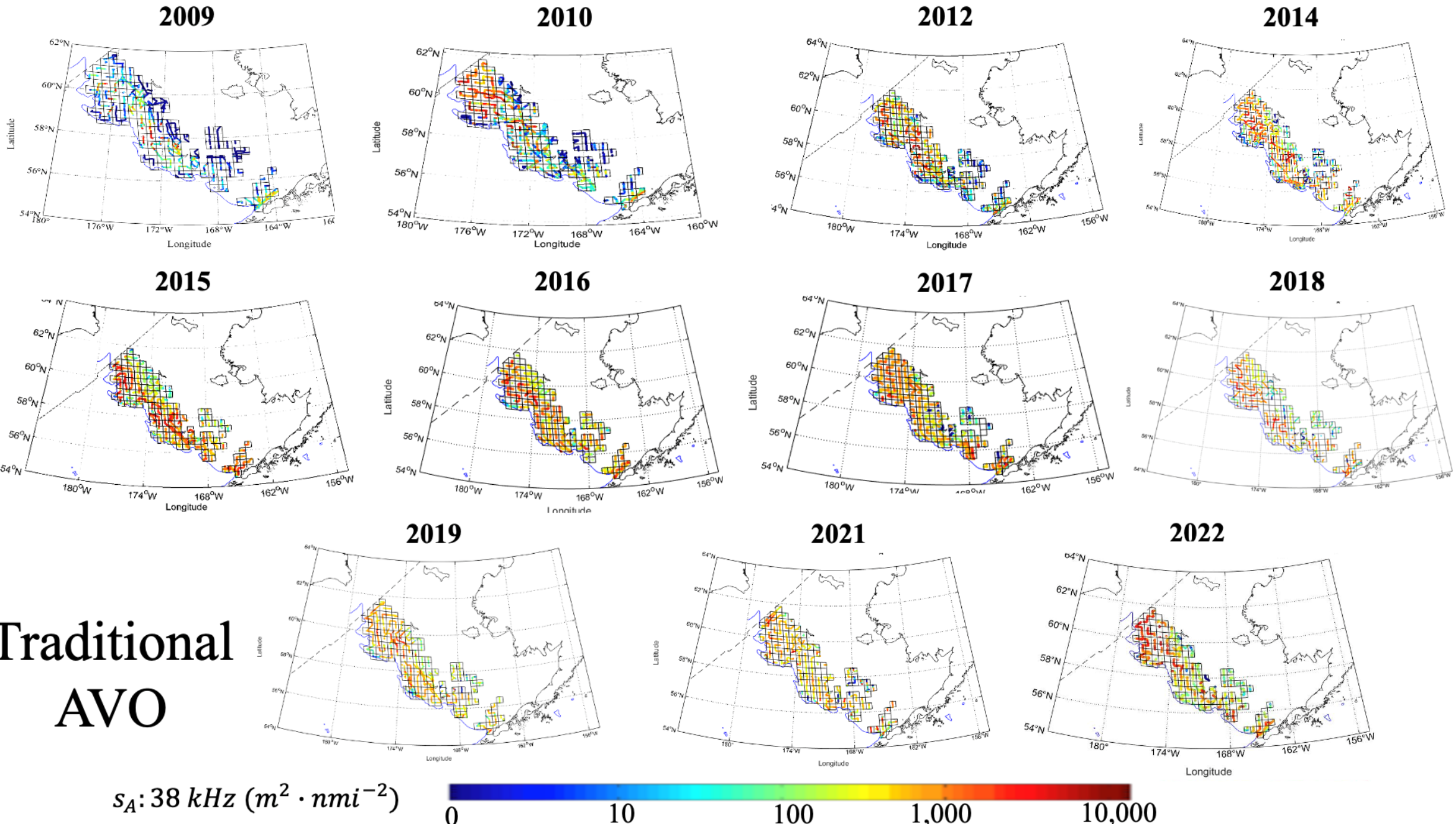
1 Background

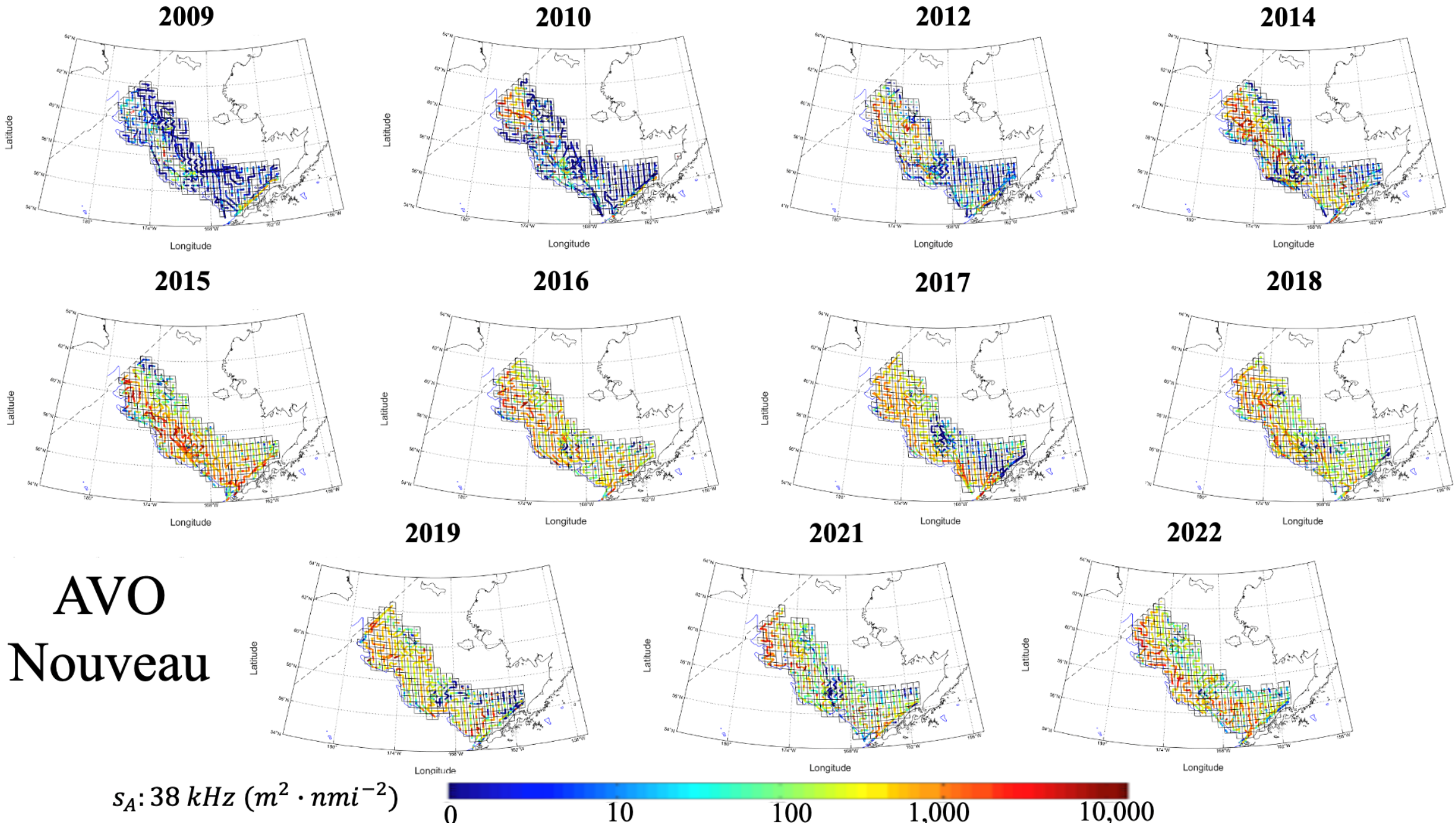
Each year we attempt to show how the Eastern Bering Sea walleye pollock assessment model is affected by data and assumptions. In most recent years, the evaluations have arisen from alternative methods for data processing (e.g., use of the VAST index, including NBS region, etc.). This year we evaluate new treatment of the acoustic data collected from the bottom-trawl survey data (the acoustic vessels of opportunity (AVO) series). In addition, we updated and re-evaluated some of the other input data specifications. This included reconsidering the relative weights among different data sets. We present alternative process-error specifications (e.g., the amount of allowed variability among processes related to time-varying selectivity) and compare that with an alternative where additional observation error variance was estimated. We also began to take the steps needed to be able to compare the current model across different assessment software platforms. Table 1 below shows the model evaluations examined, the naming convention used, relevant comparisons, and notes.

Table 1: Preliminary model configuration comparisons for the EBS pollock stock assessment, September 2023.

Description	Notes
Base	Original from folder 07, now in folder base22 with new code that accommodates arbitrary number of age-error matrices by gear and year, and the generalized Gamma distribution for index data
AVO new series	Newly integrated acoustic backscatter from "Acoustic vessels of opportunity"–namely the bottom-trawl survey vessels. Includes data from 2009 (data from early and in 2011 and 2013 omitted).
AVO full	As in "AVO new" series but with data from 2006-2008, 2011, and 2013 used from previous series (rescaled to have the same mean)
Tuned TV selectivity for ATS	As in "AVO full" but with time-varying (TV) acoustic-trawl survey (ATS) selectivity variability "tuned" to achieve model consistency with input variance terms
Tuned observation errors for indices	As in "AVO full" but with input index variability estimated for consistencey with model fit
Ageing error	Include age-determination error matrix
Diagonal	As in base but uses only the diagonal of the covariance matrix for the bottom-trawl survey (BTS) biomass estimates
Generalized Gamma distribution applied to BTS data	This is based on the MCMC posterior samples generated from the process of accounting for density-dependence within tows; the goal is to evaluate annually varying distribution assumptions compared to the standard lognormal distribution.
Alternative wt-age for SSB	Show how stock changes assuming a constant weight-at-age for SSB calculations
	Use empirical mean values from A-season fishery as a proxy
	Use predicted mean values from the year and cohort random-effects model
Base Proposed	Full AVO series and with the smoothed mean-wt-age (random effect model)

Traditional AVO




2009
2010
2012
2014
2015
2016
2017
2018
2019
2021
2022
Latitude
Longitude
AVO
Nouveau
s_A: 38 kHz $(m^2 \cdot nmi^{-2})$
0
10
100
1,000
10,000

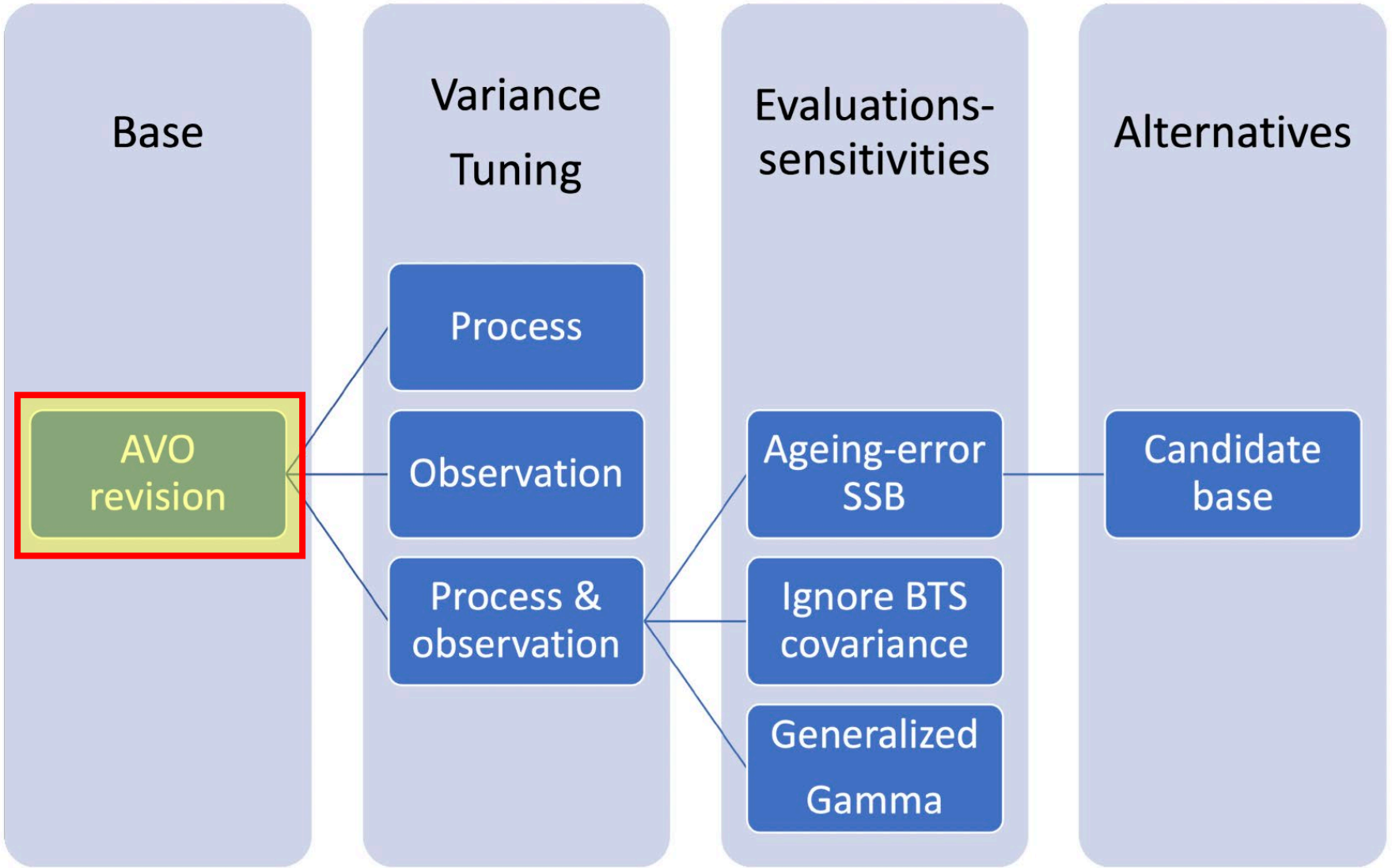


Figure 1: Schematic of approach for evaluating some planned changes in the EBS pollock assessment. See text for details.

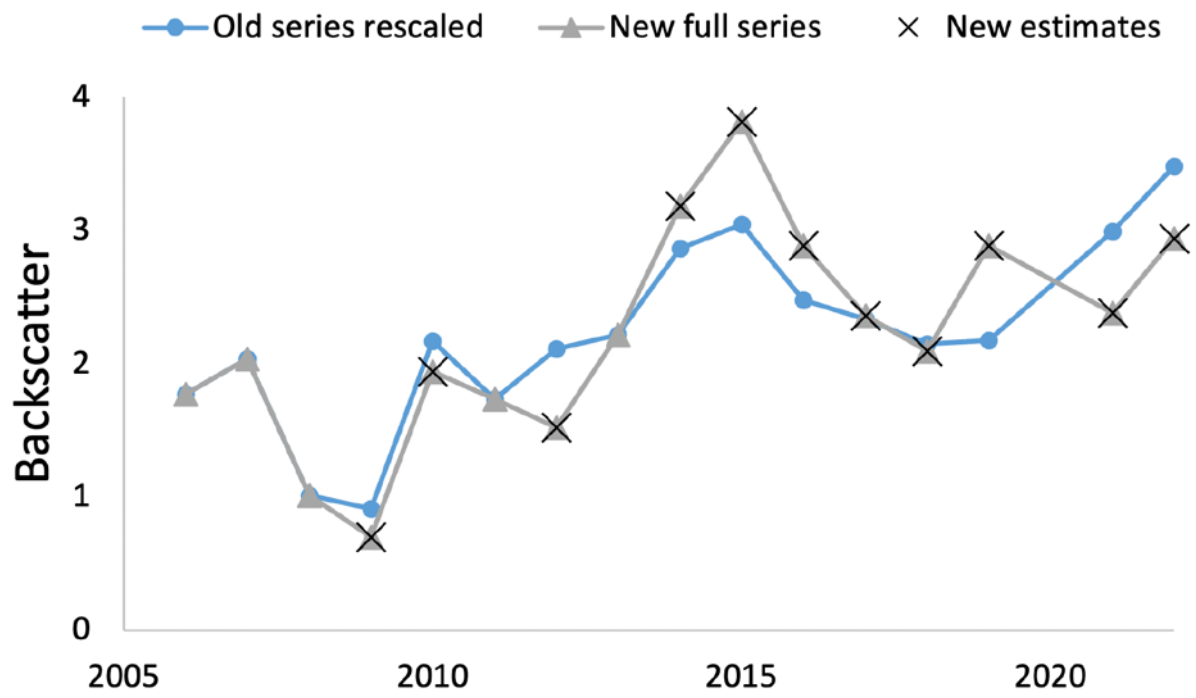
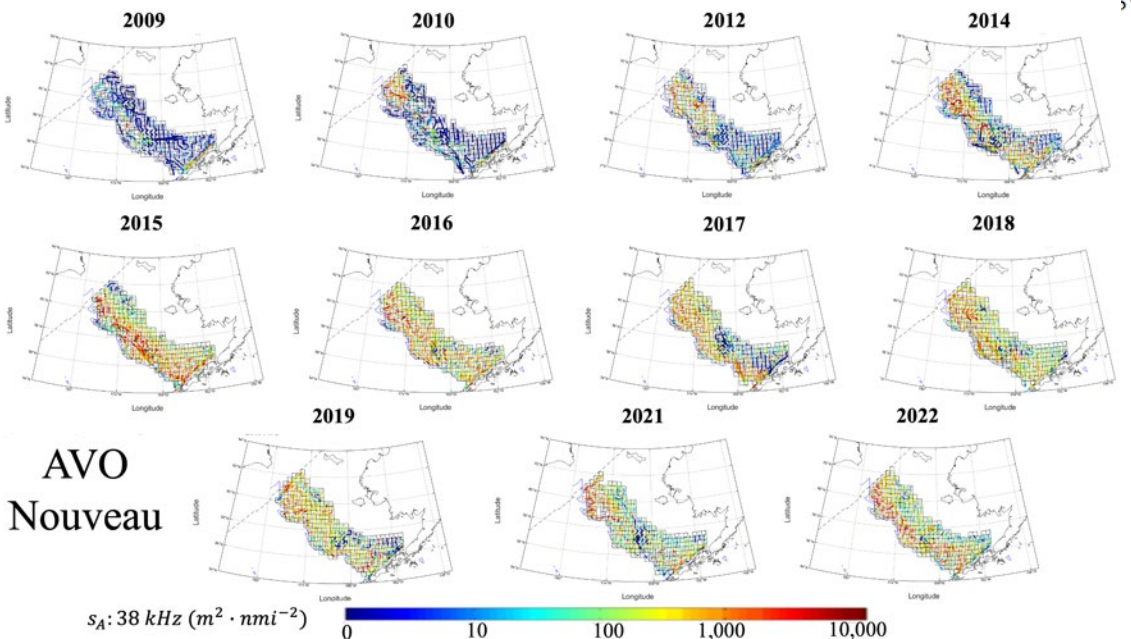


Figure 2: Time series of EBS pollock data from the acoustic vessels of opportunity (AVO) showing the years of new data compared to previous series and the full series.



EBS pollock new opportunistic acoustics from NMFS bottom-trawl survey

EBS pollock new opportunistic acoustics from NMFS bottom-trawl survey

Table 2: Goodness-of-fit measures to primary data for different assessment model configurations. RMSE=root-mean square log errors, NLL=negative log-likelihood (may not be comparable across model configurations), SDNR=standard deviation of normalized residuals, Eff. N=effective sample size for composition data)

	Component	Base 22	AVO new	AVO full
Lower better	RMSE BTS	0.166	0.166	0.166
	RMSE ATS	0.233	0.232	0.231
	RMSE AVO	0.221	0.341	0.292
	RMSE CPUE	0.093	0.093	0.093
Consistent ~1.0	SDNR BTS	0.990	0.980	0.980
	SDNR ATS	1.270	1.240	1.240
	SDNR AVO	0.650	1.710	1.460
Higher better	Eff. N Fishery	1,238	1,230	1,233
	Eff. N BTS	224	223	224
	Eff. N ATS	204	202	203
Lower better	Catch NLL	3	3	4
	BTS NLL	32	31	31
	ATS NLL	14	13	13
	AVO NLL	3	16	17
	Fish Age NLL	145	146	145
	BTS Age NLL	159	159	159
	ATS Age NLL	35	36	36
	NLL selectivity	158	158	158
	NLL Priors	20	20	20
	Data NLL	410	424	425
	Total NLL	623	637	638

Table 3: Summary of model results and the stock condition for EBS pollock. Biomass units are thousands of t.

Component	Base 22	AVO new	AVO full
B_{2023}	4,000	3,800	4,000
$CV_{B_{2023}}$	0.13	0.11	0.11
B_{MSY}	2,667	2,653	2,660
$CV_{B_{MSY}}$	0.2	0.2	0.2
B_{2023}/B_{MSY}	150%	144%	149%
B_0	6,640	6,608	6,624
$B_{35\%}$	2,114	2,101	2,111
SPR rate at F_{MSY}	33%	33%	33%
Steepness	0.61	0.61	0.61
Est. $B_{2022}/B_{2022,nofishing}$	0.61	0.6	0.61
B_{2022}/B_{MSY}	143%	137%	141%

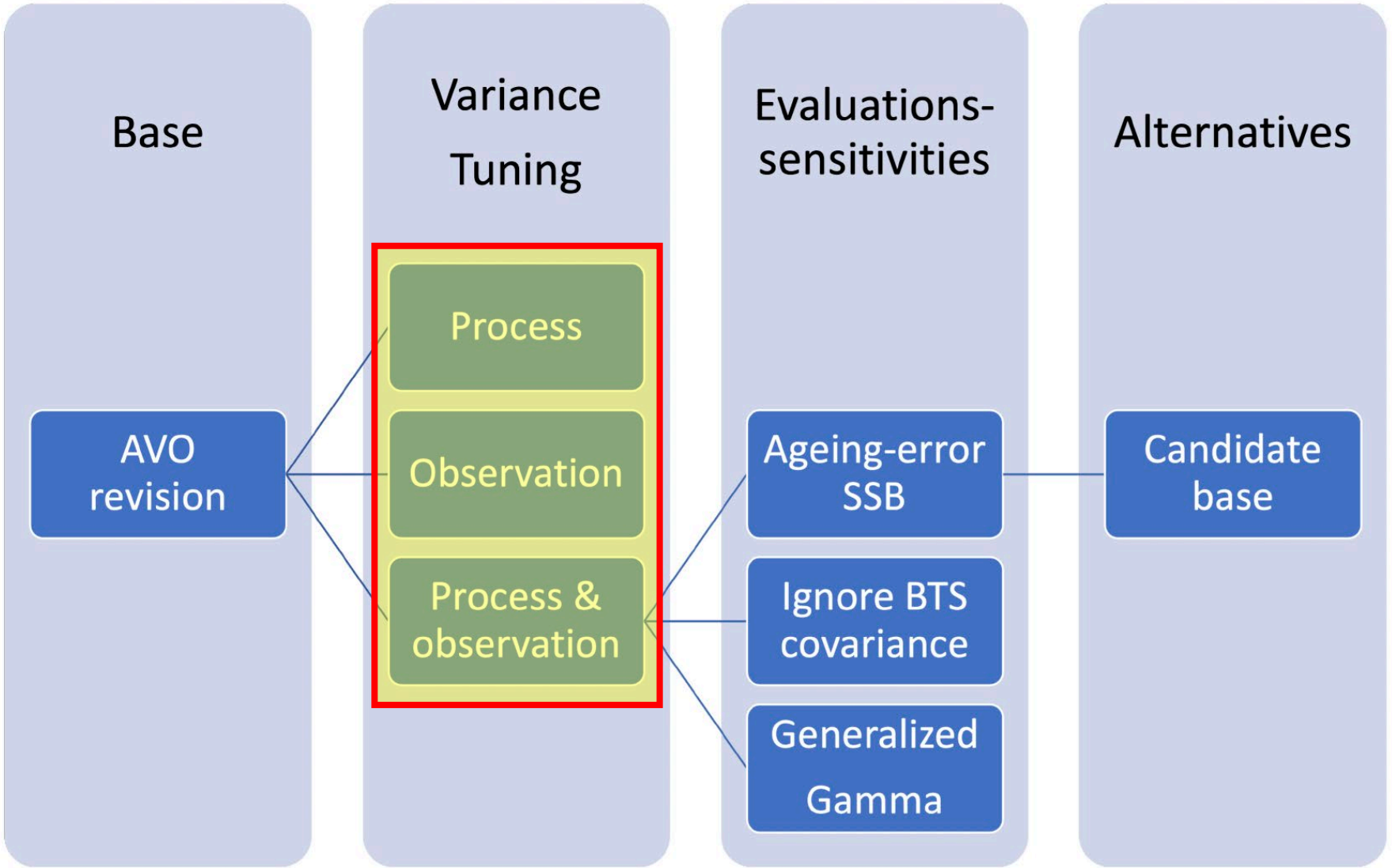


Figure 1: Schematic of approach for evaluating some planned changes in the EBS pollock assessment. See text for details.

EBS pollock model configuration summary

4 Summary

For the models we explored there was generally improvements to the model specifications that could be made. These were relatively minor impacts on the stock status and trends. For discussions, we therefore recommend:

- Adopting the use of the full revised AVO time series. *The data have been re-calibrated to the acoustic trawl survey and cover a larger area than previous AVO series. This may improve the ability to track expansion and contraction of the pollock stock in mid-water.*
- Allowing modest process error terms consistent with the observation-error specifications. *We prefer to follow allow slight deviations in process errors (here selectivity/availability in the ATS) to achieve consistency with specified survey-based observation-errors*
- Adopting the use of the RE model for A-season fishery mean body weight-at-age. *These smoothed values are based on uncertainty-weighted observations and reflect the pattern most available to the spawning season of pollock.*
- Pursuing model configurations that can best be used to bridge between other software platforms (e.g., WHAM, stock synthesis, and AMAK2). *This practice should help confirm that the model used for this assessment concurs with other software (e.g., as found in* Li et al. (2021)) *and also provide flexibility and transparency in transferring this assessment to future analysts.*

For future work we plan to adopt a new method for estimating cohort and year random effects for processes such as selectivity (e.g. Cheng et al. (2023)).

Other aspects

Acknowledgements

Carey McGilliard, Melissa Haltuch

Package and development

One-step ahead residual presentation