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CAN THE WIDE RANGE OF RESOURCE BEHAVIOURS EVIDENT ACROSS THE ABFT MSE INTERIM GRID OF OMs BE "TAMED" BY THE FEEDBACK CONTROL PROVIDED BY A CMP?

D. S. Butterworth, and R.A. Rademeyer[1]

SUMMARY

The interim grid of OMs is used to explore the 30-year projection behaviour for catches and the status of the eastern and western ABFT stocks (expressed in terms of their abundance relative to dynamic Bmsy by the Br30 statistic) for both constant future catches and some simple "Fixed Proportion" CMPs. If current TACs continue unchanged, both stocks are rendered extinct for about 20% of these 96 OMs. However, this undesirable feature can be "tamed" through CMPs' feedback control mechanisms, which can prevent occurrences of extinction. The trade-offs between catches and final abundance across the OMs, as CMP control parameters are varied from lower to higher harvesting intensities, are illustrated. CMP refinements need to reduce the spread of the Br30 distributions across the OMs. Priorities for future work are listed, including use of these results to indicate which of the uncertainty axes in the grid have the greater impacts on CMP performance. The interim grid provides a useful framework to continue this work, even though (together with advice on final management objectives and desired trade-offs) it still awaits finalisation.

RÉSUMÉ

La grille provisoire des OM est utilisée pour explorer le comportement des projections sur 30 ans des captures et l'état des stocks de thon rouge de l'Est et de l'Ouest (exprimé en termes d'abondance relative par rapport à BPME dynamique par la statistique Br30) pour les captures futures constantes et quelques CMP simples à « proportion fixe ». Si les TAC actuels ne sont pas modifiés, les deux stocks risquent de disparaître d'après environ 20 % de ces 96 OM. Toutefois, cette caractéristique indésirable peut être « maîtrisée » grâce aux mécanismes de contrôle de rétroaction des CMP, qui peuvent empêcher les situations d'extinction. Les compromis entre les captures et l'abondance finale dans les différents OM, tels que les paramètres de contrôle des CMP, allant d'une intensité de capture plus faible à une intensité plus élevée, sont illustrés. Les améliorations apportées aux CMP doivent réduire la dispersion des distributions de Br30 dans les OM. Les priorités pour les travaux futurs sont énumérées, y compris l'utilisation de ces résultats pour indiquer les axes d'incertitude de la grille qui ont les plus grands impacts sur la performance de la CMP. La grille provisoire fournit un cadre utile pour poursuivre ces travaux, même si (avec un avis sur les objectifs de gestion finaux et les compromis souhaités) elle n'est pas encore finalisée.

RESUMEN

La matriz provisional de OM se utiliza para explorar el comportamiento de la proyección de 30 años para las capturas y el estado de los stocks oriental y occidental de atún rojo del Atlántico (expresada en términos de su abundancia relativa respecto a la B_{RMS} dinámica mediante la estadística Br30) para las capturas futuras constantes y algunos CMP simples de «proporción fijada». Si los TAC actuales continúan sin cambios, ambos stocks corren el riesgo de extinguirse según aproximadamente el 20 % de estos 96 OM. Sin embargo, esta característica indeseable puede ser «dominada» mediante los mecanismos de control de la retroalimentación de los CMP, que pueden impedir situaciones de extinción. Se presentan los compromisos entre las capturas y la abundancia final en los diversos OM, como los parámetros de control de los CMP, que varían de intensidades de captura menores a mayores. Las mejoras aportadas a los CMP tienen que reducir la dispersión de las distribuciones Br30 entre los OM. Se enumeran las prioridades para

[1] Marine Resource Assessment and Management Group (MARAM), Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch 7701, South Africa

el trabajo futuro, incluido el uso de estos resultados para indicar cuáles de los ejes de incertidumbre de la matriz tienen mayor impacto en el desempeño de los OM. La matriz provisional proporciona un marco de trabajo útil para continuar este trabajo, aunque (junto con el asesoramiento sobre los objetivos de ordenación finales y los compromisos deseados) está pendiente su finalización.

KEYWORDS

Management Strategy Evaluation, Candidate Management Procedure, Operating Model grid, Atlantic bluefin tuna, performance trade-offs, feedback control

Introduction

This document uses the latest version of the ABFT MSE package (version 6.6.12) to illustrate two features of 96 Operating Models (OMs) that comprise the current version of the interim grid of OMs.

First, projections are conducted under constant future catches and under future catches to provide an initial indication of the relative impacts made by the different uncertainty axes in the interim grid on some key output performance statistics.

These projections show that for an appreciable proportion of these OMs (with their wide range of characteristics and behaviours), continuation of the current catches leads to resource extinction, raising concerns as to whether some of these OMs might be "unrealistically extreme" and need re-consideration. To check this, relatively simple CMPs are applied to these OMs to check whether their feedback control mechanisms have the capability of "taming" such behaviour by demonstrating performances that, in particular, avoid extinction.

Methods

Constant Catch Projections

As a first step in examining performance across the 96 OMs of the interim grid, both deterministic and stochastic (see explanations below) projections are conducted for future constant catches of zero and the current TACs for the East and the West areas. Note that running zero catch projections is fairly standard, as these provide bounds on the maximal "recovery" capability of stocks for the OMs concerned.

Candidate Management Procedures (CMPs)

The methods applied here are essentially an updated and simplified version of those detailed in Butterworth et al. (2018 and 2019).

Aggregate abundance indices

An aggregate abundance index is developed for each of the East and the West areas by first standardising each index available for that area to an average value of 1 over the past years for which the index appeared reasonably stable[2], and then taking a weighted average of the results for each index, where the weight is inversely proportional to the variance of the residuals used to generate future values of that index in the future modified to take into account the loss of information content as a result of autocorrelation. The mathematical details are as follows.

[2] These years are for the Eastern indices: 2014-2017 for FR_AER_SUV2, 2012-2016 for MED_LAR_SUV, 2015-2016 for GBYP_AER_SUV_BAR, 2012-2018 for MOR_POR_TRAP and 2012-2019 for JPN_LL_NEAtl2; and for the Western indices: 2006-2017 for GOM_LAR_SURV, 2006-2018 for all US_RR and US_GOM_PLL2 indices, 2010-2019 for JPN_LL_West2 and 2006-2017 for CAN_SWNS..

J_y is an average index over *n* series (*n*=5 for the East area and *n*=7 for the West area) [3]:

$$J_y \ = \frac{\sum_i^n w_i \times I_y^{i*}}{\sum_i^n w_i} \tag{1}$$

where

$$w_i = \frac{1}{(\sigma^i)^2}$$

and where the standardised index for each index series (*i*) is:

$$I_y^{i*} = {I_y^i}\Big/{Average\ of\ historical\ I_y^i}$$

σ^i is computed as $\sigma^i = \frac{SD^i}{1-AC^i}$

where SD^i is the standard deviation of the residuals in log space and AC^i is their autocorrelation, averaged over the OMs, as used for generating future pseudo-data. **Table 1** lists these values for σ^i.

The actual index used in the CMPs, J_{av}, is the average over the last three years for which data would be available at the time the MP would be applied, hence

$$J_{av,y} = \frac{1}{3}\left(J_y \ + J_{y-1} + J_{y-2}\right) \tag{2}$$

where the *J* applies either to the East or to the West area.

CMP specifications

The Fixed Proportion (FXP) CMPs tested set the TAC every second year simply as a multiple of the J_{av} value for the area at the time, but subject to the change in the TAC for each area being restricted to a maximum of 20% (up or down). The formulae are given below.

For the East area:

$$TAC_{E,y} = \left(\frac{TAC_{E,2018}}{J_{E,2016}}\right) \cdot \alpha \cdot J^E_{av,y-2} \tag{3a}$$

If $TAC_{E,y} \geq 1.2 * TAC_{E,y-1}$ then $TAC_{E,y} = 1.2 * TAC_{E,y-1}$

If $TAC_{E,y} \leq 0.8 * TAC_{E,y-1}$ then $TAC_{E,y} = 0.8 * TAC_{E,y-1}$

For the West area:

$$TAC_{W,y} = \left(\frac{TAC_{W,2018}}{J_{W,2016}}\right) \cdot \beta \cdot J^W_{av,y-2} \tag{3b}$$

If $TAC_{W,y} \geq 1.2 * TAC_{W,y-1}$ then $TAC_{W,y} = 1.2 * TAC_{W,y-1}$

If $TAC_{W,y} \leq 0.8 * TAC_{W,y-1}$ then $TAC_{W,y} = 0.8 * TAC_{W,y-1}$

Note that in equation (3a), setting $\alpha = 1$ will amount to keeping the TAC the same as for 2018 until the abundance indices change. If α or $\beta > 1$ harvesting will be more intensive than at present and for α or $\beta < 1$ it will be less intensive.

[3] For the aerial surveys, there is no value for 2013, 2018 and 2019 (French) and 2017-2019 (Mediterranean). For GBYP aerial survey there is no value for 2012, 2014, 2016 and 2019. For MOR_POR_TRAP survey, there is no value for 2019. These years were omitted from this averaging where relevant.

Calculations have been carried out using version 6.6.12 of the Package that became available on 6th May, 2020. For the deterministic case, CMPs have been run under selections from the Package for deterministic OMs with *Perfect observation* and with no implementation error. For the stochastic case, CMPs are run under selections from the Package for normal OMs with *Good observation* and with no implementation error.

Results

Numerous performance statistics are available for report for projections for any CMP. This initial presentation focuses on two that encapsulate the fundamental trade-off between catch that can be taken and conservation of the resource, specifically:

1) Br30: This is the spawning stock depletion after 30 years of projection expressed relative to the dynamic Bmsy at the time, and is reported for each of the eastern-origin and western-origin biological stocks.

2) Av30: This is the average catch taken over the 30-year projection period, reported for the East area and for the West area for which the TACs are set.

Constant Catch Projections

Results for the constant catch projections are reported in various forms in **Appendix A**, which in particular orders these OMs in terms of their performance for the Br30 performance statistic (separately for the eastern origin and western origin stocks). Of particular note is that under continuation of the current TACs in the East and the West areas, about 20% of the OMs result in extinction of the stock.

The worst 30 OMs (in terms of their Br30 performances) are then examined in terms of which levels in each uncertainty axis are contributing most to this poor performance. For most of these axes, all levels contribute to virtually identical extents, with two exceptions. The minor exception is a somewhat smaller proportion for west origin stock for the "++" scale option. The major exception is that the R2 recruitment scenario (no historical regime shifts) dominates to the virtual exclusion of the other two scenarios considered.

Candidate Management Procedures

The values of the control parameters chosen for the example CMPs considered here are as follows:

« 0.5-0.5 »:	$\alpha = 0.5$; $\beta = 0.5$
« 0.75-0.75 »:	$\alpha = 0.75$; $\beta = 0.75$
« 1-1 »:	$\alpha = 1.0$; $\beta = 1.0$

These vary from lower to higher levels of harvesting intensity. To aid comparisons, the Tables and Figures also include results for two other "extreme CMPs": future catches of zero (C=0) and kept constant at their current levels (C=cur).

Detailed plots comparing both deterministic and stochastic applications for each OM are given for these CMPs in **Appendix B**. However, for simplicity in an overview intended to aid initial impressions and inferences, the main text focuses on distributions of the two chosen performance statistics (AvC30 by East and West area, and Br30 by eastern and western stock) across the 96 OMs.

Hence **Table 2** provides such summary statistics for the five CMPs (the three "examples" of genuine feedback control CMPs plus the two extremes) for their deterministic applications across all the OMs. **Tables 3a** and **3b** show the differences between deterministic and stochastic applications (showing both medians and lower 5%-iles for the latter) for the 0.75-0.75 CMP in a) and for the 0.5-0.5 CMP in b). **Figure 1** shows comparative histograms across the OM results for deterministic applications of each of the five CMPs, i.e. these correspond to the results summarised in **Table 2**. Similarly **Figure 2** shows a deterministic vs stochastic histogram comparison for the 0.75-0.75 CMP; this corresponds to the results summarised in **Table 3a**.

Discussion

The fact that the R2 recruitment scenario dominates the instances of poor performance under constant current catch projections limits the inferences that can be drawn about the relative impacts on performance of the other uncertainty axes. Further analyses will be necessary to provide more insight on this. These will likely need to be based on the results from some simple CMPs such as those considered here, so as to lessen the impact that the choice of the recruitment option has on differences in outcomes.

An important outcome from the C=cur "CMP" is that the wide range of behaviours of the OMs of the interim grid leads to resource extinction (for both eastern and western stocks) for a considerable proportion of these OMs (about 20%). Fortunately, the results for the examples CMPs with feedback control (based on their reactions to future values of the abundances indices) shows that these **can** nevertheless "tame" this adverse outcome. The results in **Table 2** for the minimum value of Br30 across all the OMs for both eastern and western stocks is above zero for the deterministic case (though perilously close to it for the 1-1 CMP for the western stock). However, when stochasticity is taken into account (**Table 3a** and **Figure 2**), the 0.75-0.75 CMP fails to meet this rather stringent criterion at the 5%-ile level; the 0.5-0.5 CMP does meet it (**Table 3b**), though at the expenses of lower catches in future.

Viewing these results more broadly, both the Tables and Figures show how feedback succeeds in narrowing the distribution of the Br30 results about their median compared to the C=cur results, particularly for the eastern stock. This is the desirable feature sought – ideally feedback would lead to achievement of the same final target abundance irrespective of the underlying dynamics (perfect robustness), so the more such distribution narrowing, the better. The Tables and Figures also show the behaviours expected as the intensity of harvesting is increased from the 0.5-0.5 to the 1-1 CMP: the median values of AvC30 increase, while those for Br30 drop – indicating how tuning to final agreed objectives can be achieved in due course through varying the values of the control parameters of a CMP. Though a final grid of OMs, together with plausibility weightings and trade-off targets, have yet to be agreed, these results show that the current interim grid nevertheless provides a useful framework to use to refine CMPs with the aim, in particular, of narrowing the spread of results for Br30 about their median value across the OMs. (Note that clearly Cav30 andBr30 are not the only output performance statistics of importance, but they provide a useful starting point to narrow down CMP options at a broad level, before examining the results for other performance statistics and their trade-offs in more detail.)

Priorities for further work based on these example CMPs would include the following:

1) Analysis of their results to provide further insights into the relative impact on CMP performance of the different uncertainty axes in the current interim grid.

2) Experimenting with options for which the values of the control parameters α and β differ so that both eastern and western stocks move closer to median (across OMs) values of 1 for Br30, for consistency with the Commission's general objective of MSY. (For the equal values chosen for the current examples, clearer a relatively higher harvesting intensity (as measured by these parameters) on the East compared to the West area is possible.

3) The basic control rules of equations (3a) and (3b) need refinement to reduce TACs further for lower values of the aggregate indices so as to narrow the Br30 distributions across the OMs in a way that their lower tails are further above zero.

4) Nevertheless, efforts must be made to achieve the aims above without unnecessary sacrifices of catch when stocks are in a healthy state.

References

Butterworth DS, Miyagawa M and Jacobs MRA. 2018. Further investigations of simple “Fixed proportion” candidate management procedures for North Atlantic Bluefin Tuna using operating model package version 3.3.0. SCRS/2018/181.

Butterworth DS, Jacobs MRA, Rademeyer RA and Miyagawa M. 2019. Application of “fixed proportion” candidate Management Procedures for North Atlantic bluefin tuna using operating model package version 5.2.3. SCRS/2019/130.

Table 1: σ^i values used in weighting when averaging over the indices to provide composite indices for the East and the West areas (see equation 1).

EAST		WEST	
Index name	σ^i	Index name	σ^i
MOR_POR_TRAP	0.56	GOM_LAR_SUV	0.58
JPN_LL_NEAtl2	0.45	JPN_LL_West2	0.62
FR_AER_SUV2	1.00	US_RR_66_114	1.47
GBYP_AER_SUV_B.	0.56	US_RR_115_144	0.71
MED_LAR_SUV	0.56	US_RR_177	1.29
		US_GOM_PLL2	0.89
		CAN SWNS	1.71

Table 2: Summary statistics (median, standard deviation and minimum (for Br30) of the distributions of key performance statistics across the 96 OMs of the initial grid for the five CMPs considered. Note that AvC30 refers to the catch from the East or West area, whereas Br30 refers to the eastern or western origin stock. **Deterministic** case.

	EAST					WEST				
	AvC30		Br30			AvC30		Br30		
	Median	SD	Median	SD	Br30min	Median	SD	Median	SD	Br30min
C=0	0.00	0.00	3.42	0.70	1.99	0.00	0.00	2.78	0.62	1.18
"05-05"	23.55	6.50	2.20	0.64	1.06	1.38	0.67	1.39	0.65	0.38
"075-075"	32.48	9.30	1.74	0.63	0.73	1.83	0.79	1.13	0.64	0.11
"1-1"	40.34	12.02	1.40	0.63	0.23	2.08	0.84	0.93	0.61	0.02
C=cur	36.00	6.00	1.61	1.07	0.00	2.35	0.31	1.05	0.71	0.00

Table 3a: Results as in Table 1, but here comparing the **Deterministic** and **Stochastic** cases for the **075-075** CMP. For the Stochastic case, statistics of the distribution across the 96 OMs are shown first for the median values of the OM outputs, and then for their lower 5%-iles.

"075-075"	EAST					WEST				
	AvC30		Br30			AvC30		Br30		
	Median	SD	Median	SD	Br30min	Median	SD	Median	SD	Br30min
Deterministic	32.48	9.30	1.74	0.63	0.73	1.83	0.79	1.13	0.64	0.11
Stoch. median	33.49	11.00	1.59	0.71	0.28	1.68	0.85	0.98	0.64	0.03
Stoch. lower 5%	30.02	10.40	1.31	0.72	0.00	1.44	0.76	0.70	0.60	0.00

Table 3b: Results as in Table 2a, but here for the **05-05** CMP.

"05-05"	EAST					WEST				
	AvC30		Br30			AvC30		Br30		
	Median	SD	Median	SD	Br30min	Median	SD	Median	SD	Br30min
Deterministic	23.55	6.50	2.20	0.64	1.06	1.38	0.67	1.39	0.65	0.38
Stoch. median	24.26	7.38	2.06	0.73	0.75	1.31	0.65	1.34	0.65	0.28
Stoch. lower 5%	21.58	7.05	1.81	0.73	0.46	1.14	0.56	1.07	0.64	0.15

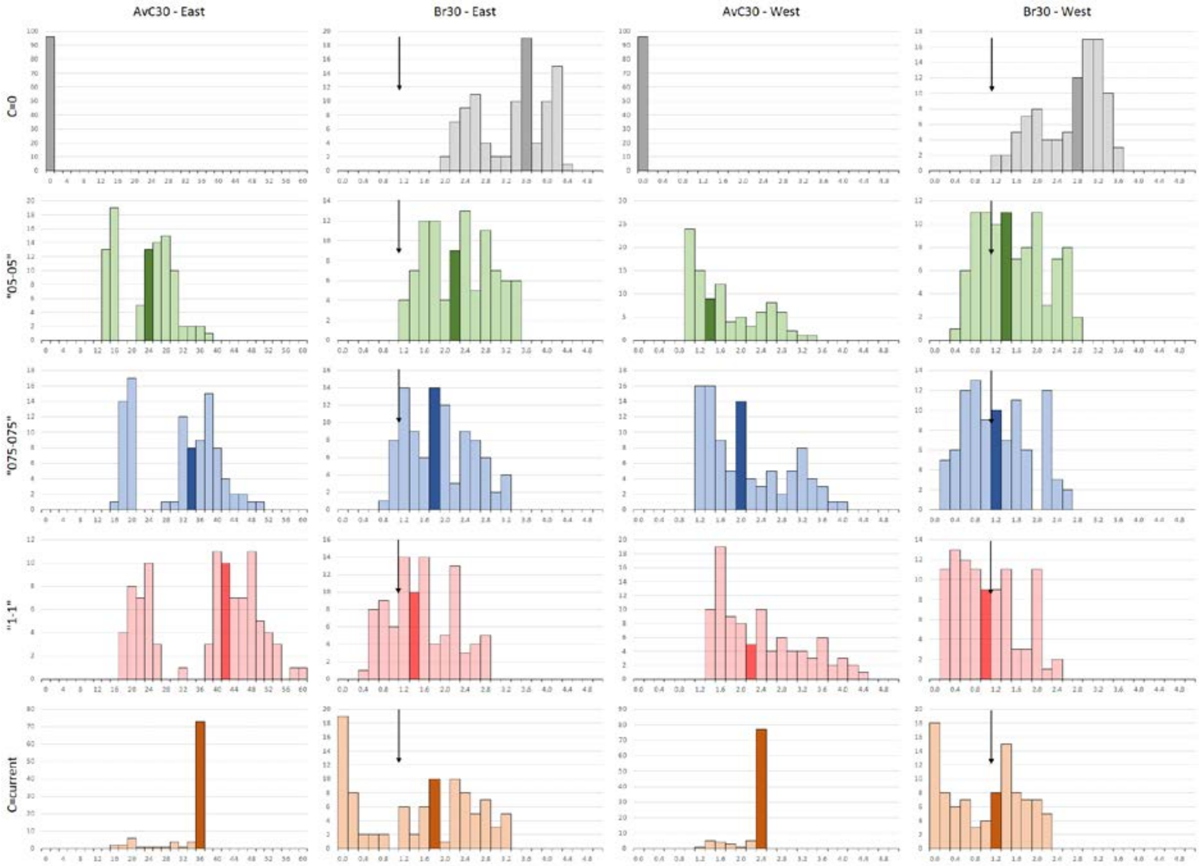

Figure 1: Histograms of AvC30 and Br30 results across the 96 interim grid OMs for the East and West areas (AvC30) and eastern and western origin stocks (Br30) for the five CMPs. **Deterministic** results. For the horizontal axis, the first block represents the frequency of 0, and thereafter, each block represents the frequency between the previous block value and its value. For example, block 2.0 for Br30 – East includes results >1.8 and ≤ 2.0. The darker bar in each plot reflect the bar in which the median is found. The vertical arrows in the Br30 plots show the value 1.

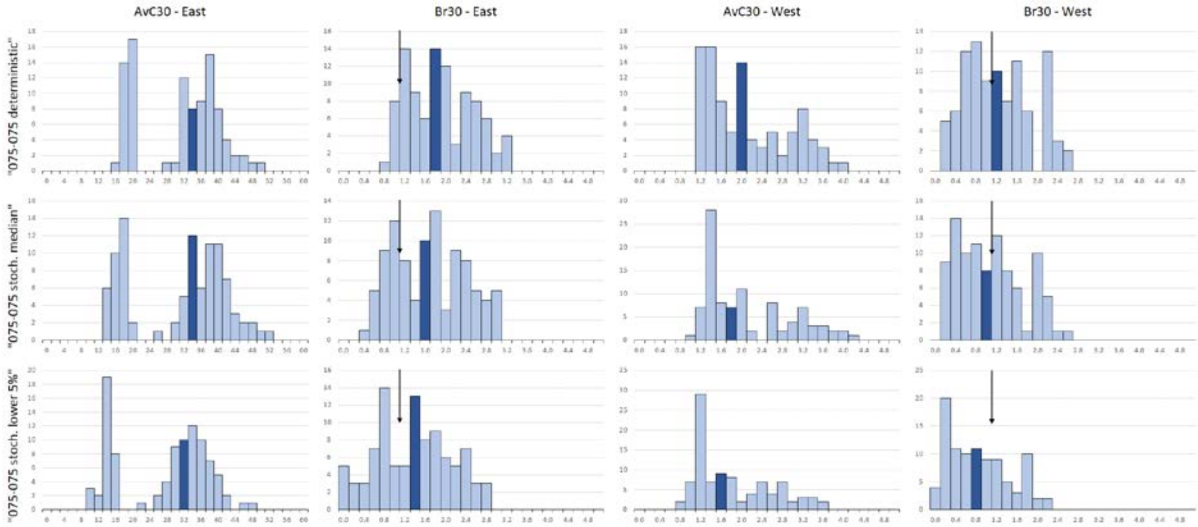

Figure 2: Histograms of AvC30 and Br30 results across the 96 interim grid OMs for the East and West areas (AvC30) and eastern and western origin stocks (Br30) for the **075-075** CMP. Results are shown for the **Deterministic** case and for the median and lower 5%-ile of the **Stochastic** case. The darker bar in each plot reflect the bar in which the median is found. The vertical arrows in the Br30 plots show the value 1.

APPENDIX A

Table A1: Proportions of each uncertainty axis level in the interim grid for the first 30 worst cases in terms of Br30 (different for the eastern origin and the western origin stocks) for the **deterministic** results under C=current.

East

Length Comp		Scale		Mixing		Spawn. Frac./M		Rec.	
L	0.53	"--"	0.27	I	0.53	A	0.47	R1	0.00
H	0.47	""-+"	0.23	II	0.47	B	0.53	R2	1.00
		"+-"	0.27					R3	0.00
		"++"	0.23						

West

Length Comp		Scale		Mixing		Spawn. Frac./M		Rec.	
L	0.57	"--"	0.30	I	0.47	A	0.47	R1	0.00
H	0.43	""-+"	0.27	II	0.53	B	0.53	R2	0.97
		"+-"	0.27					R3	0.03
		"++"	0.17						

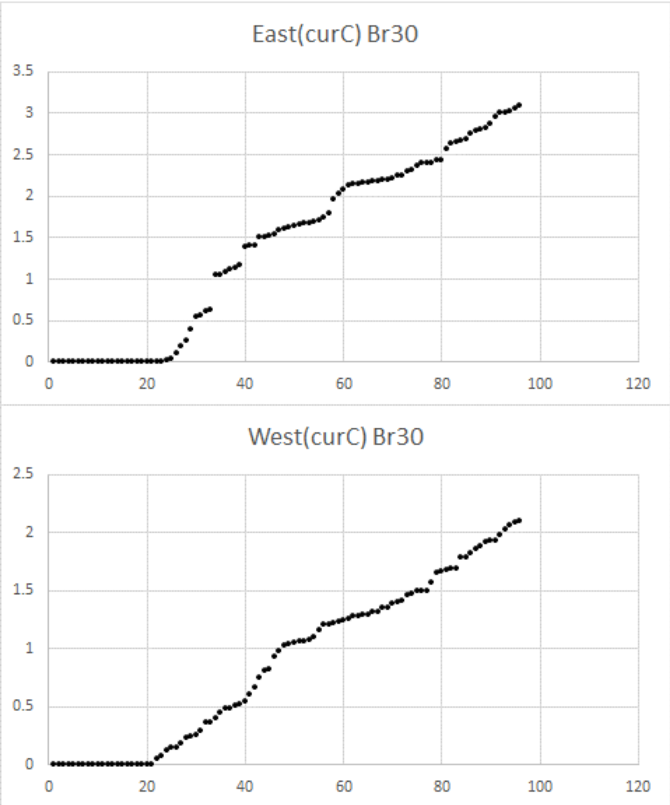

Figure A1: Br30 values for each of the 96 OMs, sorted in ascending order (different for the eastern origin and the western origin stocks) for the **deterministic** runs under C=current.

Table A2: Br30 and avC30 values for each of the 96 OMs of the interim grid, sorted in ascending order of the Br30 values (different for the eastern origin and the western origin stocks) for the **deterministic** runs under C=current.

EAST							Br30	AvC30
1	L	"--"	MixI	A	R2	OM2	0.00	15.91
2	L	"--"	MixI	B	R2	OM5	0.00	14.32
3	L	"--"	MixII	A	R2	OM8	0.00	18.73
4	L	"--"	MixII	B	R2	OM11	0.00	18.01
5	L	"-+"	MixI	A	R2	OM14	0.00	29.42
6	L	"-+"	MixI	B	R2	OM17	0.00	25.70
7	L	"-+"	MixII	B	R2	OM23	0.00	28.93
8	L	"+-"	MixI	A	R2	OM26	0.00	16.44
9	L	"+-"	MixI	B	R2	OM29	0.00	16.43
10	L	"+-"	MixII	A	R2	OM32	0.00	18.99
11	L	"+-"	MixII	B	R2	OM35	0.00	18.17
12	H	"--"	MixI	A	R2	OM50	0.00	28.45
13	H	"--"	MixI	B	R2	OM53	0.00	19.61
14	H	"--"	MixII	B	R2	OM59	0.00	22.78
15	H	"-+"	MixI	B	R2	OM65	0.00	29.44
16	H	"+-"	MixI	A	R2	OM74	0.00	26.82
17	H	"+-"	MixI	B	R2	OM77	0.00	19.95
18	H	"+-"	MixII	A	R2	OM80	0.00	32.41
19	H	"+-"	MixII	B	R2	OM83	0.00	21.51
20	L	"++"	MixI	A	R2	OM38	0.00	31.59
21	H	"--"	MixII	A	R2	OM56	0.00	33.27
22	L	"++"	MixI	B	R2	OM41	0.00	32.29
23	H	"++"	MixII	B	R2	OM95	0.01	34.42
24	L	"++"	MixII	B	R2	OM47	0.02	34.33
25	L	"-+"	MixII	A	R2	OM20	0.03	33.98
26	L	"++"	MixII	A	R2	OM44	0.11	35.53
27	H	"-+"	MixII	B	R2	OM71	0.19	35.83
28	H	"++"	MixI	B	R2	OM89	0.26	35.91
29	H	"++"	MixI	A	R2	OM86	0.40	36.00
30	H	"-+"	MixI	A	R2	OM62	0.54	36.00
31	L	"--"	MixII	B	R3	OM12	0.56	36.00
32	H	"++"	MixII	A	R2	OM92	0.61	36.00
33	H	"-+"	MixII	A	R2	OM68	0.63	36.00
34	L	"--"	MixI	A	R3	OM3	1.06	36.00
35	L	"+-"	MixI	A	R3	OM27	1.06	36.00
36	L	"--"	MixII	A	R3	OM9	1.08	36.00
37	L	"+-"	MixI	B	R3	OM30	1.12	36.00
38	L	"+-"	MixII	A	R3	OM33	1.14	36.00
39	L	"+-"	MixII	B	R3	OM36	1.16	36.00
40	L	"--"	MixI	B	R3	OM6	1.39	36.00
41	L	"-+"	MixI	A	R3	OM15	1.40	36.00
42	L	"-+"	MixII	A	R3	OM21	1.41	36.00
43	H	"+-"	MixI	B	R3	OM78	1.51	36.00
44	L	"++"	MixI	A	R3	OM39	1.52	36.00
45	L	"++"	MixII	A	R3	OM45	1.53	36.00
46	H	"+-"	MixI	A	R3	OM75	1.53	36.00
47	H	"--"	MixII	A	R3	OM57	1.60	36.00
48	H	"+-"	MixII	B	R3	OM84	1.61	36.00
49	H	"--"	MixI	A	R3	OM51	1.62	36.00
50	L	"--"	MixII	B	R1	OM10	1.64	36.00
51	H	"+-"	MixII	A	R3	OM81	1.66	36.00
52	L	"-+"	MixII	B	R3	OM24	1.67	36.00
53	L	"++"	MixI	B	R3	OM42	1.68	36.00
54	H	"--"	MixI	B	R3	OM54	1.70	36.00
55	L	"-+"	MixI	B	R3	OM18	1.71	36.00
56	L	"++"	MixII	B	R3	OM48	1.74	36.00
57	H	"--"	MixII	B	R3	OM60	1.79	36.00
58	H	"-+"	MixII	A	R3	OM69	1.97	36.00
59	H	"-+"	MixI	A	R3	OM63	2.02	36.00
60	H	"++"	MixI	B	R3	OM90	2.09	36.00
61	L	"+-"	MixI	B	R1	OM28	2.13	36.00
62	L	"+-"	MixII	B	R1	OM34	2.15	36.00
63	H	"++"	MixI	A	R3	OM87	2.15	36.00
64	L	"--"	MixI	A	R1	OM1	2.16	36.00
65	L	"--"	MixII	A	R1	OM7	2.16	36.00
66	H	"++"	MixII	B	R3	OM96	2.18	36.00
67	H	"++"	MixII	A	R3	OM93	2.18	36.00
68	L	"+-"	MixI	A	R1	OM25	2.19	36.00
69	H	"-+"	MixI	B	R3	OM66	2.20	36.00
70	L	"--"	MixI	B	R1	OM4	2.21	36.00
71	H	"-+"	MixII	B	R3	OM72	2.24	36.00
72	L	"+-"	MixII	A	R1	OM31	2.24	36.00
73	L	"-+"	MixI	A	R1	OM13	2.30	36.00
74	L	"-+"	MixII	A	R1	OM19	2.32	36.00
75	L	"-+"	MixII	B	R1	OM22	2.37	36.00
76	L	"-+"	MixI	B	R1	OM16	2.39	36.00
77	L	"++"	MixI	A	R1	OM37	2.41	36.00
78	L	"++"	MixI	B	R1	OM40	2.41	36.00
79	L	"++"	MixII	A	R1	OM43	2.43	36.00
80	L	"++"	MixII	B	R1	OM46	2.44	36.00
81	H	"+-"	MixI	B	R1	OM76	2.56	36.00
82	H	"+-"	MixII	B	R1	OM82	2.64	36.00
83	H	"--"	MixII	A	R1	OM55	2.65	36.00
84	H	"--"	MixI	B	R1	OM52	2.68	36.00
85	H	"--"	MixI	A	R1	OM49	2.68	36.00
86	H	"--"	MixII	B	R1	OM58	2.75	36.00
87	H	"-+"	MixI	A	R1	OM61	2.80	36.00
88	H	"+-"	MixI	A	R1	OM73	2.80	36.00
89	H	"-+"	MixII	A	R1	OM67	2.83	36.00
90	H	"+-"	MixII	A	R1	OM79	2.87	36.00
91	H	"++"	MixI	B	R1	OM88	2.95	36.00
92	H	"-+"	MixI	B	R1	OM64	3.01	36.00
93	H	"++"	MixII	B	R1	OM94	3.02	36.00
94	H	"-+"	MixII	B	R1	OM70	3.03	36.00
95	H	"++"	MixI	A	R1	OM85	3.06	36.00
96	H	"++"	MixII	A	R1	OM91	3.10	36.00

WEST							Br30	AvC30
1	L	"--"	MixI	A	R2	OM2	0.00	1.25
2	L	"--"	MixI	B	R2	OM5	0.00	1.15
3	L	"--"	MixII	A	R2	OM8	0.00	1.33
4	L	"--"	MixII	B	R2	OM11	0.00	1.30
5	L	"-+"	MixI	A	R2	OM14	0.00	2.12
6	L	"-+"	MixI	B	R2	OM17	0.00	1.80
7	L	"-+"	MixII	B	R2	OM23	0.00	1.96
8	L	"+-"	MixI	A	R2	OM26	0.00	1.49
9	L	"+-"	MixI	B	R2	OM29	0.00	1.54
10	L	"+-"	MixII	A	R2	OM32	0.00	1.39
11	L	"+-"	MixII	B	R2	OM35	0.00	1.37
12	H	"--"	MixI	A	R2	OM50	0.00	2.11
13	H	"--"	MixI	B	R2	OM53	0.00	1.50
14	H	"--"	MixII	B	R2	OM59	0.00	1.47
15	H	"-+"	MixI	B	R2	OM65	0.00	1.74
16	H	"-+"	MixII	B	R2	OM71	0.00	2.15
17	H	"+-"	MixI	B	R2	OM77	0.00	2.20
18	H	"+-"	MixII	B	R2	OM83	0.00	1.65
19	H	"--"	MixII	A	R2	OM56	0.00	2.15
20	L	"-+"	MixII	A	R2	OM20	0.01	2.29
21	L	"++"	MixII	B	R2	OM47	0.06	2.35
22	H	"+-"	MixII	A	R2	OM80	0.08	2.35
23	L	"--"	MixII	B	R3	OM12	0.13	2.35
24	L	"++"	MixII	A	R2	OM44	0.15	2.35
25	H	"++"	MixII	B	R2	OM95	0.15	2.35
26	L	"++"	MixI	B	R2	OM41	0.18	2.35
27	H	"-+"	MixII	A	R2	OM68	0.23	2.35
28	L	"++"	MixI	A	R2	OM38	0.25	2.35
29	H	"-+"	MixI	A	R2	OM62	0.25	2.35
30	H	"+-"	MixI	A	R2	OM74	0.29	2.35
31	L	"-+"	MixII	B	R3	OM24	0.36	2.35
32	H	"--"	MixII	A	R3	OM57	0.37	2.35
33	H	"-+"	MixII	A	R3	OM69	0.41	2.35
34	L	"-+"	MixII	A	R3	OM21	0.45	2.35
35	L	"--"	MixII	A	R3	OM9	0.48	2.35
36	H	"++"	MixI	B	R2	OM89	0.49	2.35
37	H	"-+"	MixI	A	R3	OM63	0.51	2.35
38	H	"-+"	MixII	B	R3	OM72	0.52	2.35
39	H	"--"	MixI	A	R3	OM51	0.55	2.35
40	H	"--"	MixII	B	R3	OM60	0.61	2.35
41	L	"-+"	MixI	B	R3	OM18	0.66	2.35
42	L	"--"	MixI	B	R3	OM6	0.75	2.35
43	H	"++"	MixII	A	R2	OM92	0.81	2.35
44	L	"-+"	MixI	A	R3	OM15	0.83	2.35
45	L	"--"	MixI	A	R3	OM3	0.93	2.35
46	H	"++"	MixI	A	R2	OM86	0.98	2.35
47	H	"+-"	MixI	B	R3	OM78	1.02	2.35
48	L	"--"	MixII	B	R1	OM10	1.04	2.35
49	H	"++"	MixI	B	R3	OM90	1.06	2.35
50	H	"+-"	MixII	B	R3	OM84	1.06	2.35
51	H	"++"	MixII	B	R3	OM96	1.06	2.35
52	L	"++"	MixII	B	R3	OM48	1.08	2.35
53	H	"++"	MixI	A	R3	OM87	1.10	2.35
54	L	"-+"	MixII	B	R1	OM22	1.17	2.35
55	H	"+-"	MixII	A	R3	OM81	1.21	2.35
56	L	"++"	MixII	A	R3	OM45	1.21	2.35
57	H	"-+"	MixI	A	R1	OM61	1.22	2.35
58	L	"+-"	MixII	A	R3	OM33	1.23	2.35
59	H	"-+"	MixI	B	R3	OM66	1.24	2.35
60	H	"+-"	MixI	A	R3	OM75	1.26	2.35
61	H	"-+"	MixII	A	R1	OM67	1.28	2.35
62	H	"++"	MixII	A	R3	OM93	1.29	2.35
63	H	"--"	MixI	B	R3	OM54	1.29	2.35
64	H	"--"	MixII	A	R1	OM55	1.30	2.35
65	L	"-+"	MixII	A	R1	OM19	1.32	2.35
66	H	"-+"	MixII	B	R1	OM70	1.32	2.35
67	L	"+-"	MixII	B	R3	OM36	1.36	2.35
68	H	"--"	MixI	A	R1	OM49	1.36	2.35
69	L	"-+"	MixI	B	R1	OM16	1.39	2.35
70	L	"++"	MixI	A	R3	OM39	1.41	2.35
71	H	"--"	MixII	B	R1	OM58	1.41	2.35
72	L	"+-"	MixI	B	R3	OM30	1.46	2.35
73	L	"--"	MixII	A	R1	OM7	1.48	2.35
74	L	"-+"	MixI	A	R1	OM13	1.49	2.35
75	L	"+-"	MixI	A	R3	OM27	1.50	2.35
76	L	"--"	MixI	B	R1	OM4	1.50	2.35
77	L	"++"	MixI	B	R3	OM42	1.58	2.35
78	H	"++"	MixII	B	R1	OM94	1.65	2.35
79	L	"--"	MixI	A	R1	OM1	1.67	2.35
80	H	"++"	MixI	B	R1	OM88	1.68	2.35
81	H	"+-"	MixI	B	R1	OM76	1.69	2.35
82	H	"+-"	MixII	B	R1	OM82	1.69	2.35
83	H	"++"	MixI	A	R1	OM85	1.79	2.35
84	H	"-+"	MixI	B	R1	OM64	1.79	2.35
85	L	"++"	MixII	B	R1	OM46	1.82	2.35
86	H	"--"	MixI	B	R1	OM52	1.86	2.35
87	H	"++"	MixII	A	R1	OM91	1.89	2.35
88	H	"+-"	MixI	A	R1	OM73	1.92	2.35
89	H	"+-"	MixII	A	R1	OM79	1.93	2.35
90	L	"++"	MixI	A	R1	OM37	1.93	2.35
91	L	"++"	MixII	A	R1	OM43	1.98	2.35
92	L	"+-"	MixI	B	R1	OM28	2.03	2.35
93	L	"+-"	MixII	B	R1	OM34	2.06	2.35
94	L	"+-"	MixI	A	R1	OM25	2.09	2.35
95	L	"++"	MixI	B	R1	OM40	2.10	2.35
96	L	"+-"	MixII	A	R1	OM31	2.11	2.35

Table A3: Proportions of each uncertainty axis level in the interim grid for the first 30 worst cases in terms of median Br30 (different for the eastern origin and the western origin stocks) for the **stochastic** results, under C=current.

East

Length Comp		Scale		Mixing		Spawn. Frac./M		Rec.	
L	0.53	"--"	0.27	I	0.53	A	0.47	R1	0.00
H	0.47	""-+"	0.23	II	0.47	B	0.53	R2	1.00
		"+-"	0.27					R3	0.00
		"++"	0.23						

West

Length Comp		Scale		Mixing		Spawn. Frac./M		Rec.	
L	0.57	"--"	0.30	I	0.47	A	0.47	R1	0.00
H	0.43	""-+"	0.27	II	0.53	B	0.53	R2	0.97
		"+-"	0.27					R3	0.03
		"++"	0.17						

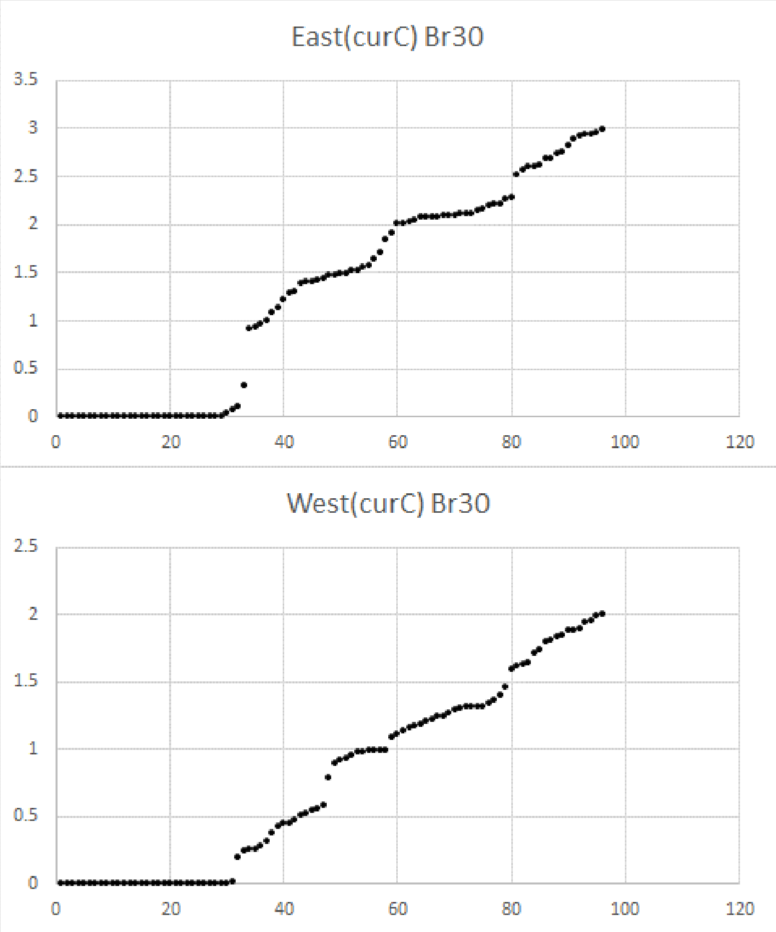

Figure A2: Br30 values for each of the 96 OM, sorted in ascending order (different for the eastern origin and the western origin stocks) for the **stochastic** runs under C=current.

Table A4: Br30 and avC30 values for each of the 96 OM, sorted in ascending order of the Br30 values (different for (different for the eastern origin and the western origin stocks) for the **stochastic** runs under C=current.

							Br30	AvC30								Br30	AvC30
1	L	"--"	MixI	A	R2	OM2	0.00	10.06	1	L	"--"	MixI	A	R2	OM2	0.00	0.82
2	L	"--"	MixI	B	R2	OM5	0.00	10.26	2	L	"--"	MixI	B	R2	OM5	0.00	0.81
3	L	"--"	MixII	A	R2	OM8	0.00	12.21	3	L	"--"	MixII	A	R2	OM8	0.00	0.88
4	L	"--"	MixII	B	R2	OM11	0.00	12.85	4	L	"--"	MixII	B	R2	OM11	0.00	0.94
5	L	"-+"	MixI	A	R2	OM14	0.00	19.48	5	L	"-+"	MixI	A	R2	OM14	0.00	1.40
6	L	"-+"	MixI	B	R2	OM17	0.00	19.75	6	L	"-+"	MixI	B	R2	OM17	0.00	1.31
7	L	"-+"	MixII	A	R2	OM20	0.00	23.14	7	L	"-+"	MixII	A	R2	OM20	0.00	1.58
8	L	"-+"	MixII	B	R2	OM23	0.00	21.84	8	L	"-+"	MixII	B	R2	OM23	0.00	1.47
9	L	"+-"	MixI	A	R2	OM26	0.00	10.17	9	L	"+-"	MixI	A	R2	OM26	0.00	1.09
10	L	"+-"	MixI	B	R2	OM29	0.00	11.53	10	L	"+-"	MixI	B	R2	OM29	0.00	1.17
11	L	"+-"	MixII	A	R2	OM32	0.00	11.67	11	L	"+-"	MixII	A	R2	OM32	0.00	0.92
12	L	"+-"	MixII	B	R2	OM35	0.00	12.58	12	L	"+-"	MixII	B	R2	OM35	0.00	0.99
13	L	"++"	MixI	A	R2	OM38	0.00	21.26	13	L	"++"	MixI	A	R2	OM38	0.00	1.79
14	L	"++"	MixI	B	R2	OM41	0.00	21.22	14	L	"++"	MixI	B	R2	OM41	0.00	1.68
15	L	"++"	MixII	A	R2	OM44	0.00	21.99	15	L	"++"	MixII	A	R2	OM44	0.00	1.57
16	L	"++"	MixII	B	R2	OM47	0.00	23.39	16	L	"++"	MixII	B	R2	OM47	0.00	1.65
17	H	"--"	MixI	A	R2	OM50	0.00	17.65	17	H	"--"	MixI	A	R2	OM50	0.00	1.46
18	H	"--"	MixI	B	R2	OM53	0.00	15.47	18	H	"--"	MixI	B	R2	OM53	0.00	1.20
19	H	"--"	MixII	A	R2	OM56	0.00	21.81	19	H	"--"	MixII	A	R2	OM56	0.00	1.45
20	H	"--"	MixII	B	R2	OM59	0.00	18.44	20	H	"--"	MixII	B	R2	OM59	0.00	1.14
21	H	"-+"	MixI	B	R2	OM65	0.00	23.53	21	H	"-+"	MixI	B	R2	OM65	0.00	1.34
22	H	"-+"	MixII	B	R2	OM71	0.00	30.75	22	H	"-+"	MixII	B	R2	OM71	0.00	1.69
23	H	"+-"	MixI	A	R2	OM74	0.00	17.50	23	H	"+-"	MixI	A	R2	OM74	0.00	2.09
24	H	"+-"	MixI	B	R2	OM77	0.00	15.74	24	H	"+-"	MixI	B	R2	OM77	0.00	1.88
25	H	"+-"	MixII	A	R2	OM80	0.00	22.11	25	H	"+-"	MixII	A	R2	OM80	0.00	1.72
26	H	"+-"	MixII	B	R2	OM83	0.00	16.46	26	H	"+-"	MixII	B	R2	OM83	0.00	1.32
27	H	"++"	MixI	A	R2	OM86	0.00	32.67	27	H	"++"	MixII	B	R2	OM95	0.00	1.84
28	H	"++"	MixII	B	R2	OM95	0.00	25.97	28	H	"-+"	MixI	A	R2	OM62	0.00	2.26
29	H	"++"	MixI	B	R2	OM89	0.00	33.51	29	H	"-+"	MixII	A	R2	OM68	0.00	2.26
30	H	"-+"	MixI	A	R2	OM62	0.04	35.02	30	L	"--"	MixII	B	R3	OM12	0.01	2.35
31	H	"++"	MixII	A	R2	OM92	0.08	35.86	31	H	"++"	MixI	B	R2	OM89	0.19	2.35
32	H	"-+"	MixII	A	R2	OM68	0.10	35.88	32	L	"-+"	MixII	B	R3	OM24	0.24	2.35
33	L	"--"	MixII	B	R3	OM12	0.32	35.95	33	L	"-+"	MixII	A	R3	OM21	0.25	2.35
34	L	"+-"	MixI	A	R3	OM27	0.91	36.00	34	L	"--"	MixII	A	R3	OM9	0.26	2.35
35	L	"--"	MixI	A	R3	OM3	0.94	36.00	35	H	"--"	MixII	A	R3	OM57	0.29	2.35
36	L	"--"	MixII	A	R3	OM9	0.97	36.00	36	H	"-+"	MixII	A	R3	OM69	0.31	2.35
37	L	"+-"	MixII	A	R3	OM33	0.99	36.00	37	H	"++"	MixII	A	R2	OM92	0.38	2.35
38	L	"+-"	MixI	B	R3	OM30	1.09	36.00	38	H	"-+"	MixI	A	R3	OM63	0.43	2.35
39	L	"+-"	MixII	B	R3	OM36	1.13	36.00	39	H	"--"	MixI	A	R3	OM51	0.45	2.35
40	L	"--"	MixI	B	R3	OM6	1.22	36.00	40	H	"-+"	MixII	B	R3	OM72	0.45	2.35
41	L	"-+"	MixII	A	R3	OM21	1.29	36.00	41	L	"-+"	MixI	B	R3	OM18	0.48	2.35
42	L	"-+"	MixI	A	R3	OM15	1.31	36.00	42	L	"-+"	MixI	A	R3	OM15	0.51	2.35
43	L	"++"	MixII	A	R3	OM45	1.39	36.00	43	H	"++"	MixI	A	R2	OM86	0.52	2.35
44	L	"++"	MixI	A	R3	OM39	1.40	36.00	44	H	"--"	MixII	B	R3	OM60	0.54	2.35
45	L	"++"	MixI	B	R3	OM42	1.41	36.00	45	L	"--"	MixI	B	R3	OM6	0.56	2.35
46	L	"--"	MixII	B	R1	OM10	1.42	36.00	46	L	"--"	MixI	A	R3	OM3	0.58	2.35
47	H	"+-"	MixI	A	R3	OM75	1.44	36.00	47	L	"--"	MixII	B	R1	OM10	0.78	2.35
48	H	"+-"	MixI	B	R3	OM78	1.47	36.00	48	L	"++"	MixII	B	R3	OM48	0.90	2.35
49	L	"++"	MixII	B	R3	OM48	1.48	36.00	49	L	"+-"	MixII	A	R3	OM33	0.92	2.35
50	L	"-+"	MixII	B	R3	OM24	1.49	36.00	50	L	"++"	MixII	A	R3	OM45	0.93	2.35
51	H	"--"	MixII	A	R3	OM57	1.50	36.00	51	H	"+-"	MixI	B	R3	OM78	0.95	2.35
52	L	"-+"	MixI	B	R3	OM18	1.52	36.00	52	H	"++"	MixII	B	R3	OM96	0.98	2.35
53	H	"--"	MixI	A	R3	OM51	1.52	36.00	53	H	"++"	MixI	B	R3	OM90	0.99	2.35
54	H	"+-"	MixII	B	R3	OM84	1.56	36.00	54	H	"++"	MixI	A	R3	OM87	0.99	2.35
55	H	"+-"	MixII	A	R3	OM81	1.57	36.00	55	H	"+-"	MixII	B	R3	OM84	0.99	2.35
56	H	"--"	MixI	B	R3	OM54	1.64	36.00	56	L	"+-"	MixI	A	R3	OM27	1.00	2.35
57	H	"--"	MixII	B	R3	OM60	1.71	36.00	57	L	"++"	MixI	A	R3	OM39	1.00	2.35
58	H	"-+"	MixII	A	R3	OM69	1.84	36.00	58	L	"-+"	MixII	B	R1	OM22	1.08	2.35
59	H	"-+"	MixI	A	R3	OM63	1.91	36.00	59	H	"+-"	MixII	A	R3	OM81	1.11	2.35
60	H	"++"	MixI	B	R3	OM90	2.01	36.00	60	L	"-+"	MixII	A	R1	OM19	1.14	2.35
61	H	"++"	MixI	A	R3	OM87	2.02	36.00	61	H	"-+"	MixI	A	R1	OM61	1.16	2.35
62	L	"--"	MixI	B	R1	OM4	2.03	36.00	62	H	"++"	MixII	A	R3	OM93	1.18	2.35
63	H	"++"	MixII	A	R3	OM93	2.04	36.00	63	H	"+-"	MixI	A	R3	OM75	1.19	2.35
64	L	"--"	MixI	A	R1	OM1	2.07	36.00	64	H	"-+"	MixII	A	R1	OM67	1.21	2.35
65	L	"+-"	MixI	A	R1	OM25	2.07	36.00	65	H	"--"	MixII	A	R1	OM55	1.22	2.35
66	L	"--"	MixII	A	R1	OM7	2.08	36.00	66	H	"-+"	MixII	B	R1	OM70	1.24	2.35
67	H	"-+"	MixI	B	R3	OM66	2.08	36.00	67	L	"+-"	MixII	B	R3	OM36	1.25	2.35
68	H	"++"	MixII	B	R3	OM96	2.09	36.00	68	L	"--"	MixII	A	R1	OM7	1.27	2.35
69	L	"+-"	MixI	B	R1	OM28	2.10	36.00	69	H	"--"	MixI	A	R1	OM49	1.30	2.35
70	L	"+-"	MixII	A	R1	OM31	2.10	36.00	70	L	"-+"	MixI	B	R1	OM16	1.30	2.35
71	H	"-+"	MixII	B	R3	OM72	2.12	36.00	71	H	"-+"	MixI	B	R3	OM66	1.31	2.35
72	L	"+-"	MixII	B	R1	OM34	2.12	36.00	72	L	"-+"	MixI	A	R1	OM13	1.32	2.35
73	L	"++"	MixI	B	R1	OM40	2.12	36.00	73	H	"--"	MixII	B	R1	OM58	1.32	2.35
74	L	"-+"	MixII	B	R1	OM22	2.15	36.00	74	L	"++"	MixI	B	R3	OM42	1.32	2.35
75	L	"++"	MixII	B	R1	OM46	2.17	36.00	75	L	"+-"	MixI	B	R3	OM30	1.34	2.35
76	L	"-+"	MixI	B	R1	OM16	2.20	36.00	76	H	"--"	MixI	B	R3	OM54	1.37	2.35
77	L	"-+"	MixI	A	R1	OM13	2.21	36.00	77	L	"--"	MixI	B	R1	OM4	1.40	2.35
78	L	"-+"	MixII	A	R1	OM19	2.21	36.00	78	L	"--"	MixI	A	R1	OM1	1.46	2.35
79	L	"++"	MixII	A	R1	OM43	2.27	36.00	79	H	"++"	MixII	B	R1	OM94	1.60	2.35
80	L	"++"	MixI	A	R1	OM37	2.28	36.00	80	H	"+-"	MixII	B	R1	OM82	1.62	2.35
81	H	"+-"	MixI	B	R1	OM76	2.52	36.00	81	H	"+-"	MixI	B	R1	OM76	1.63	2.35
82	H	"--"	MixII	A	R1	OM55	2.57	36.00	82	H	"++"	MixI	B	R1	OM88	1.64	2.35
83	H	"+-"	MixII	B	R1	OM82	2.60	36.00	83	L	"++"	MixII	B	R1	OM46	1.72	2.35
84	H	"--"	MixI	A	R1	OM49	2.61	36.00	84	H	"++"	MixI	A	R1	OM85	1.74	2.35
85	H	"--"	MixI	B	R1	OM52	2.62	36.00	85	L	"++"	MixI	A	R1	OM37	1.80	2.35
86	H	"--"	MixII	B	R1	OM58	2.68	36.00	86	H	"-+"	MixI	B	R1	OM64	1.82	2.35
87	H	"-+"	MixI	A	R1	OM61	2.69	36.00	87	H	"++"	MixII	A	R1	OM91	1.83	2.35
88	H	"-+"	MixII	A	R1	OM67	2.74	36.00	88	L	"++"	MixII	A	R1	OM43	1.84	2.35
89	H	"+-"	MixI	A	R1	OM73	2.75	36.00	89	H	"+-"	MixII	A	R1	OM79	1.88	2.35
90	H	"+-"	MixII	A	R1	OM79	2.82	36.00	90	H	"--"	MixI	B	R1	OM52	1.88	2.35
91	H	"++"	MixI	B	R1	OM88	2.89	36.00	91	H	"+-"	MixI	A	R1	OM73	1.89	2.35
92	H	"-+"	MixI	B	R1	OM64	2.92	36.00	92	L	"+-"	MixI	A	R1	OM25	1.94	2.35
93	H	"-+"	MixII	B	R1	OM70	2.94	36.00	93	L	"+-"	MixII	A	R1	OM31	1.95	2.35
94	H	"++"	MixII	B	R1	OM94	2.94	36.00	94	L	"++"	MixI	B	R1	OM40	2.00	2.35
95	H	"++"	MixI	A	R1	OM85	2.96	36.00	95	L	"+-"	MixI	B	R1	OM28	2.00	2.35
96	H	"++"	MixII	A	R1	OM91	3.00	36.00	96	L	"+-"	MixII	B	R1	OM34	2.02	2.35

Figure B1 compares the deterministic results (AvC30 and Br30) for C=0, “075-075” and C=cur for each of the 96 OM, while Figure B2 compares similar results for “05-05”, “075-075” and “1-1”. Figure B3 compares stochastic results for the 075-075 CMP (medians, 5 and 95% iles) and the deterministic results.

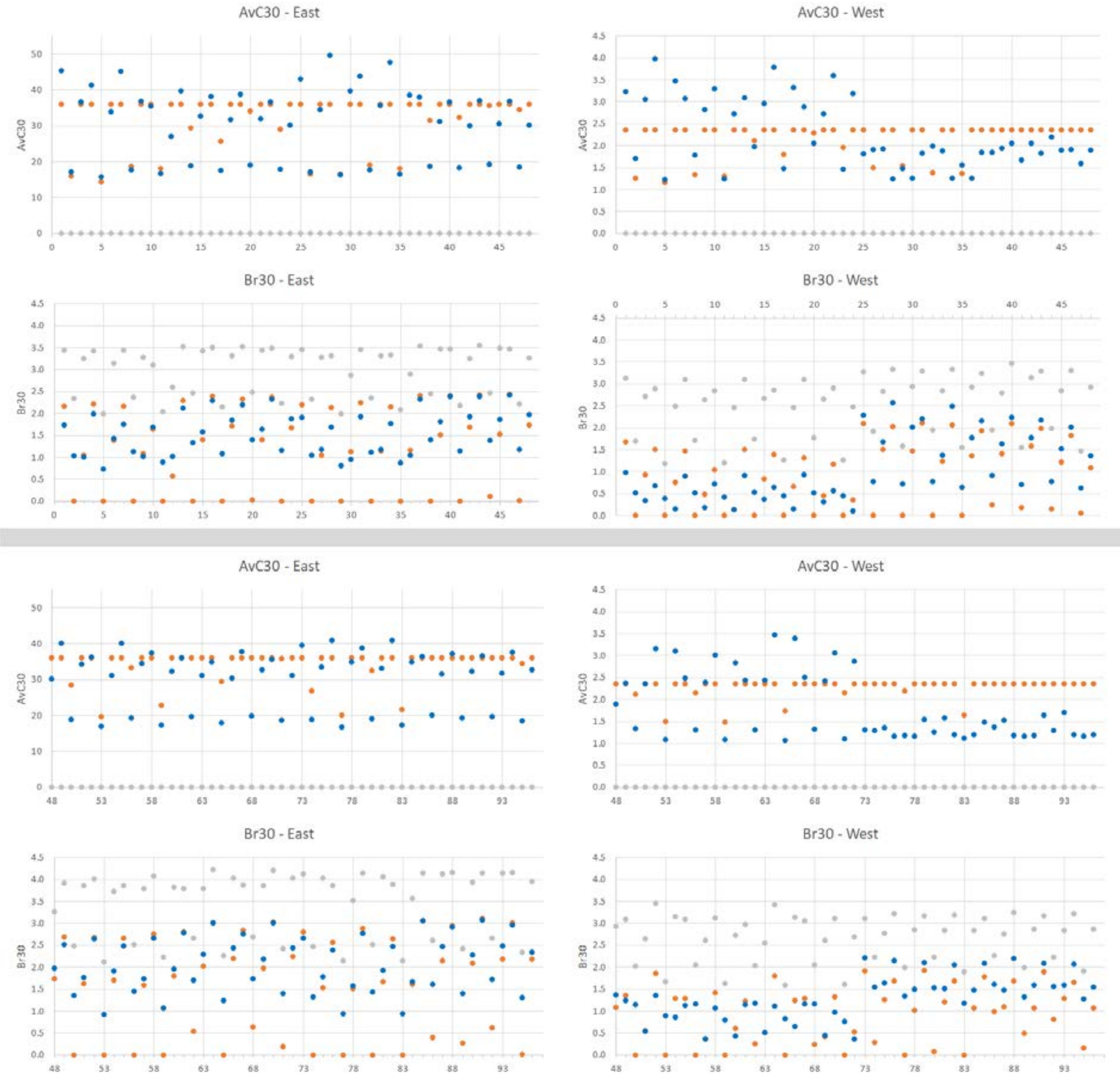

Figure B1: **Deterministic** results for the C=0 (grey), **075-075** (blue) and C=cur (orange) CMPs for each of the 96 OMs.

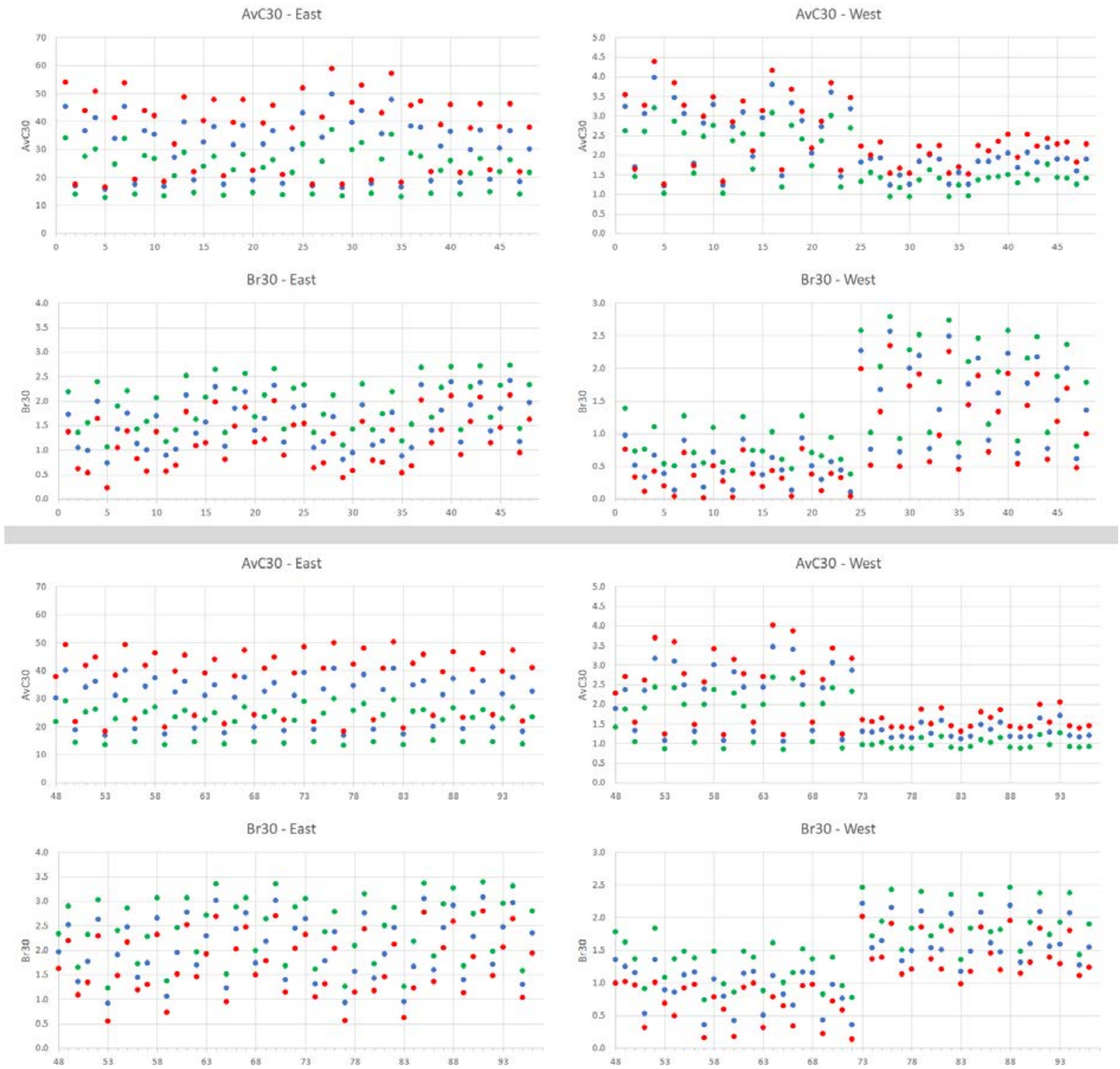

Figure B2: **Deterministic** results for the 05-05 (green), **075-075** (blue) and 1-1 (red) CMPs for each of the 96 OMs.

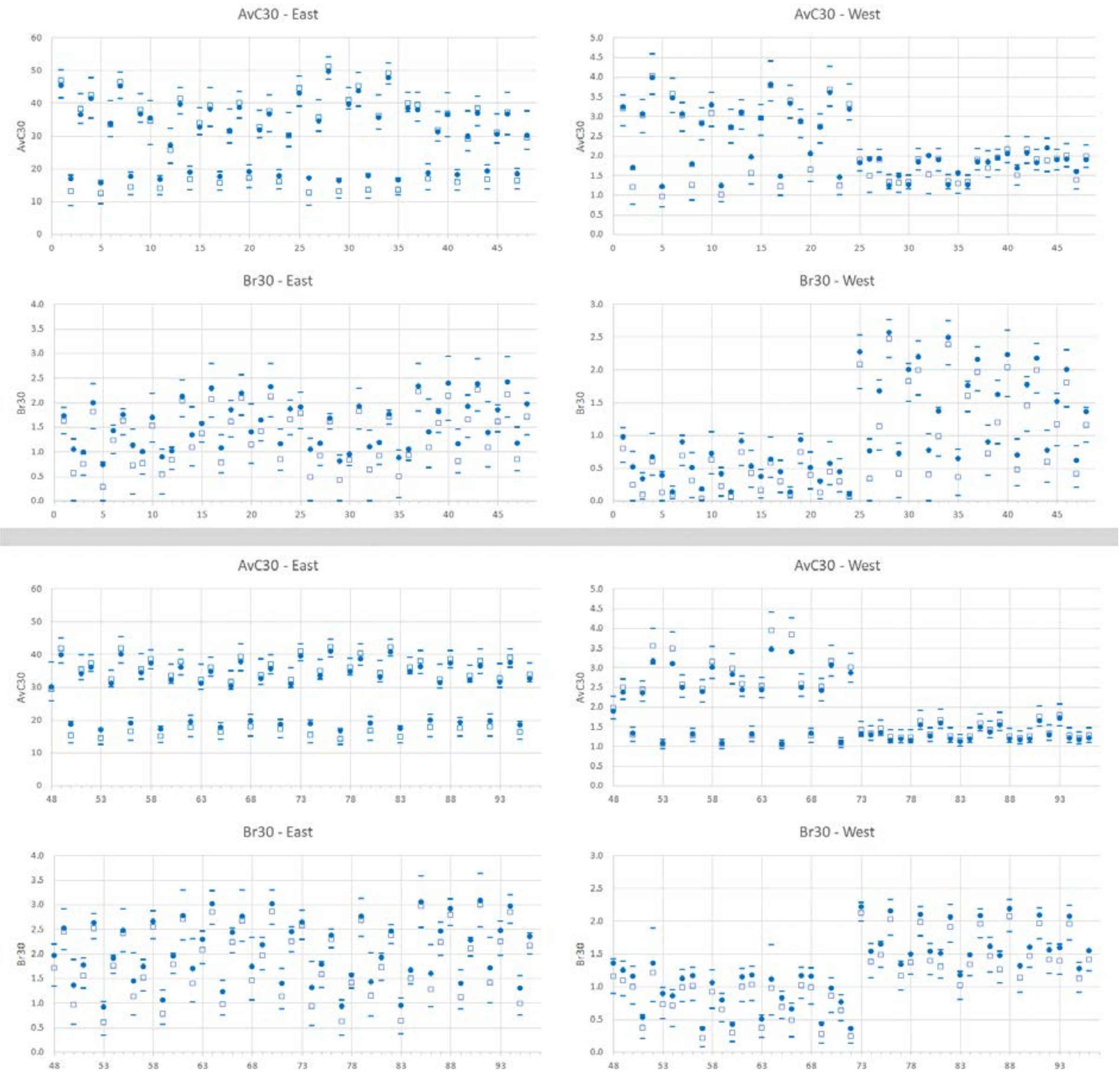

Figure B3: **Stochastic** results for the **075-075** (blue) CMP for each of the 96 OMs. Medians (open squares) and 5- and 95%-iles (dashes) are shown. The full circles show the deterministic results for the 075-075 CMP.