

1 **Reviewer's comments on Buchanan et al. "*Optimisation of the World***  
2 ***Ocean Model of Biogeochemistry and Trophic-dynamics (WOMBAT)***  
3 ***using surrogate machine learning methods"***

4 *June 19, 2025*

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5 **Overview**

6 Thanks to the authors for their thorough response to my comments. The additional text in the revised manuscript  
7 addresses my concerns. In particular I find the additional figure S6 complementing very well the figure 7 to show  
8 the interest of using the surrogate model to run an extensive optimisation. One remaining question to me: how  
9 the optimisation affect the drift of the model? If it could be shown that the optimisation reduce the drift that  
10 would be an additional strength of the method. Maybe by comparing the drifts in the best of the sensitivity  
11 experiments and the best of the optimal experiments, both run on 100 years? In addition, I have a couple of  
12 minor and specific comments, some of which I did not catch during the previous review. Once these minor  
13 adjustments are made, the manuscript will be ready for publication.

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14 **Minor and specific comments**

15 **Abstract**

16 (1) 1. 27: I think "earth" in "...of earth system models..." is more commonly written with a capital E ("...of  
17 Earth system models...")

18 **Methods**

19 (2) 1. 318-333: Is it one surrogate model trained for each cost function J (so 8 surrogate models in total) or one  
20 for the global cost function (equation 2)? Can you clarify? I had a similar question for the sensitivity analysis  
21 during the first round of review. The authors clarified very well, notably by using plural forms or emphasizing  
22 singular terms when appropriate.

23 **Results**

24 (3) 1. 463-464: "The 512 experiments were used to calibrate the global cost function synthetically using the  
25 machine learning model." I do not think this sentence really state what was done. What I understood is that:  
26 the 512 experiment are used to trained the machine learning model to reproduce the global cost function. The  
27 trained model is then used to look for the optimal values of the parameters, i.e. the ones minimizing the global  
28 cost function. It do not think we can say that the global cost function is calibrated. Can the authors rephrase?

29 (4) 1. 478-479: "We also note that the model predicted optimal values that often aligned well with ecological  
30 theory." Is the initial range of the parameters' values much wider than the theory? Otherwise it seems expected

31 that the optimal values are aligned with the ecological theory and thus the argument is not very strong and could  
32 be removed.

33 (5) 1. 531: "unoptimised biogeochemical model". I assume the authors mean the former version of the model  
34 that even if not optimised was considered good enough to conduct analysis and numerical experiment. Correct?  
35 This model was still tuned. Can the author specify this? Otherwise, it sounds like the new optimised version is  
36 compared to a version that should even not be used for any study.

37 (6) Sec. 3.4.3: Is the bloom phenology better than with the unoptimised model version?

## 38 **Summary**

39 (7) 1. 666-668: The authors should mention here that the surrogate model can provide the large number of  
40 samples at a low computational cost.

41 (8) 1. 677: Shouldn't it be "statistically" instead of "statically"?

## 42 **Figures**

43 (9) Fig. 5: I do not think emphasizing "at most" and "at least" with bold font is necessary.