

Responses to Reviewers' Comments for Manuscript egusphere-2025-6078

**Solving calibration and reanalysis challenges
of ocean biogeochemical dynamics with
neural schemes: a 1D vertical model
case-study.**

Addressed Comments for Publication to

Biogeosciences

by

Jean Littaye, Laurent Memery and Ronan Fablet

Dear editorial support team,

Please find enclosed the revised version of our previous submission entitled “Solving calibration and reanalysis challenges of ocean biogeochemical dynamics with neural schemes: a 1D vertical model case-study.” with manuscript number egusphere-2025-6078. We thank you and the reviewers for the valuable comments to improve the quality of our manuscript. In this revision, we have meticulously addressed the comments made by the associate editor. The following section provides a concise overview of the primary modifications made, in addition to a meticulous, point-by-point response to the observations you raised.

Sincerely,

Jean Littaye, Laurent Memery and Ronan Fablet

Note: To enhance the legibility of this response letter, all the editor’s and reviewers’ comments are typeset in boxes. The respective corrections and modifications appear in the annotated version of the manuscript: deleted sentences are in red and crossed out, added sentences are in blue.

Authors' response to Dr. Yu

General Comments. Dear Authors,

Thank you for your diligent efforts in addressing the reviewers' comments and revising your manuscript. The revised manuscript has been re-evaluated by the reviewer, who provided a positive assessment. I have attached one minor comment and several technical corrections for your further consideration. Please address these points and proof-read the manuscript carefully.

After these corrections, we will be happy to accept your manuscript for publication in Biogeosciences. We appreciate your valuable contribution to the journal and look forward to your future submissions.

Response:

Dear Dr. Yu,

Thank you for your valuable remarks. We have carefully considered those and addressed them in a revised version of the manuscript. Please, find below the point-by-point responses with respect to the corrections we made.

Comment 1

There are several appendices in the manuscript. However, these appendices are not cited in the main text. Please add explicit references to the relevant appendices at the appropriate points in the text to help readers navigate what these appendices are for and how they support the experimental design, analysis, or discussion presented in the main manuscript.

In particular, Appendix D presents an important experiment that helps explain the core advantage of the UNet approach, namely, its robustness to forcing uncertainties. Currently, the rationale for this experiment (i.e., to provide a fairer comparison under perfect physics, as raised by Reviewer 1) is not introduced in the main text, and the results are not linked back to the discussion of UNet’s performance. I recommend adding a brief explanation of why the perfect-physics experiment was conducted, as well as a short discussion of its findings, so that readers can fully appreciate the broader implications of the comparison.

Response:

Explicit references to the appendices have been added to the revised version. Regarding Appendix D, we better justify the experiment and place it within the context of the manuscript.

The references have been added in Tab. 1, L.124, 144, 239, 324, 458, 479, 504, and few lines have been added in the discussion, L.502-506.

Comment 2

L18: ‘this approach’ is vague; please specify which method it refers to.

Response:

The method being referenced is the learning-based approach that we investigate in this study. This has been clarified in the revised version.

Comment 3

L18-19: 'BGC dynamics' - same comment as above. Please specify whether this refers to the state variables, the processes, or the parameters.

Response:

This term refers to the state variables, since in this approach we do not alter either the BGC model equations or the BGC parameters.

The term 'BGC dynamics' has been modified accordingly, L.19.

Comment 4

L29-30: This sentence is awkward; please revise for clarity and flow.

The sentence has been modified in the revised version, L.30-31.

Comment 5

- **L14-15:** 'model parameters' should be specified as 'BGC model parameters'. 'BGC dynamics' is vague; it could refer to state variables, processes, or parameters. Suggest replacing it with 'BGC state variables' to be more precise. Or to be more accurately, it can be 'the reconstruction of 1D biogeochemical state variables from sparse observations.'
- **L16:** Define 'DA' at first use in the abstract.
- **L27, 33:** 'key-role' —> 'key role'
- **L28:** 1 GtC = 10^9 tons C, not 10^{12} . Please correct the parenthetical.
- **L30, 41:** 'enable to quantify' -> 'enable us to quantify'.
- **L33:** 'plays' —> 'play'.
- **L37:** remove 'at'.
- **L41:** 'estimated between 6 to 13' —> 'estimated at 6 to 13'.
- **L73:** —> 'according to'.
- **L74:** remove extra 'of' before OSSEs.
- **L84:** -> 'ocean BGC model parameters'.
- **L135:** ', NO3 curve' —> 'and the NO3 profile'.
- **L137-138:** 'a main phytoplankton bloom during spring followed by a lower detritus one and a soon enough zooplankton peak. ' —> 'a spring phytoplankton bloom, followed by a detritus peak and a subsequent zooplankton peak. '
- **L162:** 'complement' —> 'augment'
- **L668:** 'observation' —> 'observational'

Response:

The various terms and sentences have been corrected point-by-point in the quoted lines.