# 1 Answer to reviewer 1

**Reviewer Comment**

Line 40: in vivo Hg speciation? or in vivo methylation/demethylation. Here, it appears that the authors are primarily focused on in vivo methylation. Although there is currently no conclusive evidence supporting in vivo methylation in marine organisms, in vivo demethylation has been widely documented. Therefore, the use of the term "in vivo Hg speciation" should be approached with caution or avoided.

**Author Response**

Thank you very much for reviewing the paper a second time. I fully agree with this comment. Based on some of the modern work, I find that there is evidence indicating more complex in vivo Hg chemistry. This is, however, very early stage research and distracts from the main aim of the paper, which is focused on understanding the more established pathway of bioaccumulation. I also realize that in the discussion, I do not evaluate this, as it is out of the main scope of the paper. As such, I have removed the section about in vivo Hg speciation and all of the references to this. I believe this would make an interesting topic for a dedicated modelling study but agree it should be discussed without being expanded upon in this manuscript.

**Reviewer Comment**

2. Conclusion section: no need to repeat the hypotheses here

**Author Response**

I removed the first part of the conclusion where I restated the hypothesis. Now the conclusion starts directly with the results.

# 2 Answer to reviewer 2

**Reviewer Comment**

Thanks for carefully addressing my comments, and the manuscript has been improved greatly. However, I have a very serious concern when I access to the nearly contemporaneous paper from the authors, which is also under review (https://doi.org/10.5194/egusphere-2025-1486). Why the authors separate the bioconcentration process from the model in that paper? If the bioconcentration process very important, the model performance from that paper should not achieve the best condition in my opinion. Considering the similar study regions and models, especially the nearly same titles, I have doubts about these two articles being online at the same time. What's the necessities, differences, and improvements?

**Author Response**

Thank you for revieuwing the work a second time and pointing this out, and I hope my suggestion below clarifies this concern. The difference is that the other paper is focused on analyzing the role of the ecosystem in Hg cycling and the feedback mechanisms

between bioaccumulation and Hg cycling. Examples are how bioaccumulation affects sedimentation, evaporation, the Hg budget, and Hg transport. This paper, on the other hand, is focused on analyzing the design choices that set this model apart from other Hg bioaccumulation models. Notably, the inclusion of bioconcentration of MMHg at every trophic level and the bioaccumulation of Hg2+. The honest reason why this is presented as a second paper rather than included in the other paper is two-fold. First, as mentioned before, the aim of the paper is different, and the paper is already 48 pages, not including the supplement. Initially, we wanted to make one combined paper but decided to make 1 paper for readers that were interested in how the ecosystem affects Hg cycling and another paper where we critically evaluate model design choices. We decided that presenting the messages that bioconcentration of Hg2+ might not be essential for Hg bioaccumulation modeling but that consumer level bioconcentration is, would be better in a more streamlined stand-alone paper mostly focused to help further Hg bioaccumulation model development. Because of this, I would suggest adding the following at the end of the introduction:

**Implementation**

Line 122
To clarify, the base case used in this study is identical to the base case of the 1D model presented in Amptmeijer et al., 2025, where the bioaccumulation of both $Hg^{2+}$ and $MMHg^{+}$ is represented through biomagnification and bioconcentration across all simulated trophic levels. The difference lies in the direction and scope of the analyses. In Amptmeijer et al., 2025, the model was evaluated for both carbon stocks and $Hg^{2+}$ and $MMHg^{+}$ to demonstrate that it reasonably reproduces the removal of Hg from the water column via bioaccumulation. This evaluation enabled an assessment of the feedback mechanism of bioaccumulation on Hg cycling and the overall Hg budget. In contrast, the present study focuses on a sensitivity analysis of two specific model design choices made in Amptmeijer et al., 2025: the incorporation of consumer-level bioconcentration of $MMHg^{+}$ and the bioaccumulation of $Hg^{2+}$.