Comment on bg-2022-14

Yanxu Zhang (Referee)

Referee comment on "Assessing the spatial and temporal variability of methylmercury biogeochemistry and bioaccumulation in the Mediterranean Sea with a coupled 3D model" by Ginevra Rosati et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-14-RC1, 2022

A coupled transport-biogeochemical-metal bioaccumulation model is developed in this study and is applied to simulate the biogeochemical cycling of Hg in the Mediterranean Sea. The model results reveal the spatial and temporal variation of methylmercury concentrations in this region and its pattern in the plankton food webs. I find the model scheme and parameters are up to date and has several novel features that have not been considered in previous modeling efforts, which I think are important progress in this field:

- Online coupling with biogeochemical models facilitates the sensitivity analysis of biogeochemical parameters such as POC sinking velocity. The findings that this speed can influence the depth of maximum MeHg concentrations are interesting. This is a parameter that can be constrained by observations, pointing to important future research directions.
- The inclusion of DOC-bound Hg pools, and a 4-pool partitioning scheme: POC, DOC, HgCl, and dissolved phase. Different Kd values are also used for different pools.

In addition, the authors have a detailed analysis of the seasonal cycle of Hg cycling at different locations, well constrained by observed MeHg profiles. This highlights the importance of both hydrodynamic and biogeochemical parameters.

Here are my specific comments:

Line 75: I suggest including a subsection to describe the general biogeoprovinces of the Mediterranean Sea. A very brief introduction to bathymetry and circulation patterns is also helpful. This will lay a basis for the discussion of different sites of the Sea in the later text.

Line 105-115: need a better layout for these equations.

Line 114-115: This sentence is quite misleading. If the KD values reflect a balance between adsorption and remineralization, then why KD is a constant value through the whole water column, given that the remineralization rate varies drastically?

Line 160: It's a first-order reaction approach, where does the 0.118 parameter come from? Any literature or a tunable parameter?

Line 198: Seems that only riverine load in the dissolved phase is considered? How about riverine discharge in the particulate phase, which is the dominant form of riverine Hg discharge?

Section 2.7: It is a very meaningful practice to test the sensitivity of Hg cycling to the POC sinking velocity. Changing this parameter will not only influence Hg but also C. Are there any sediment trap observations that help to constrain the POC sinking flux itself?