Comment on gmd-2021-427

Anonymous Referee #1

Referee comment on "The 3D biogeochemical marine mercury cycling model MERCY v2.0 – linking atmospheric Hg to methylmercury in fish" by Johannes Bieser et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-427-RC1, 2022

General comment:

The manuscript presents detailed description of formulation, development and evaluation of a new biogeochemical marine Hg cycling model MERCY v2.0 as a part of a multi-media modelling system. Developments of multi-media capabilities of Hg dispersion modelling is highly topical. The problem of Hg pollution on a global scale is well recognized and currently assessed under the effectiveness evaluation efforts of the Minamata Convention. Despite other pollutants Hg requires model evaluation in various environmental compartments. However, available developments of Hg modelling in the marine environment are still insufficient. The presented a model of Hg cycling in seawater including transport transformation and bioaccumulation processed. The model is applied as a part of a modelling complex in combination with atmospheric and oceanic transport models, and a seawater biogeochemical model to simulate Hg levels and dynamics in the North and Baltic seas. The results are thoroughly evaluated against observations to reveal the model uncertainties and propose ways for further improvement. For this purpose, a system of detailed statistical analysis is developed and applied based on methods used in atmospheric transport modelling. This statistical evaluation system could be useful for application by other marine chemistry modelers.

The subject of the manuscript is relevant to the scope of the journal and the work makes up a new and original contribution to the modelling science. The scientific approaches applied are adequate and explicitly stated. Description of the modelling methods is sufficiently complete and precise to allow reproduction. The manuscript will be suitable for publication after addressing comments mentioned below.

Specific comments:

Generally, the manuscript contains a large number of typos and misprints and requires

careful editing.

Page 3, lines 84: *"While there is a large number of emissions …"*

Probably, there should be mentioned a large number of emission inventories.

Page 7, lines 182: *"… change in concentration of Hg state variables over time δC/δt is estimated by the prognostic equation…"*

δC/δt is unnecessary here. The partial derivative describes the change rate. The change itself requires integration of the equation over time.

Page 9, lines 220-227: *"… Bioconcentration … remineralization rate (see Eq. 9 in Section 2.3.1). …"*

Notations of variables and parameters used in this paragraph differ from those in Eq. 5. It complicates understanding.

Page 10, Figure 1: The oxidation pathway via formation of the intermediate oxidation product (Hg*) is not included to the model (page 13, line 280) but shown in the model scheme.

Page 12, Table 3: Reactions R5, R13, R18 and R20 are not shown in the model scheme (Fig. 1).

Page 13, line 282: *"… oxidation (R5) …"*. Should be R4.
Page 13, line 283: *"… oxidation (R6) rates …"*. Should be R5.

Page 13, line 287: *"… of MeHg+ (R19), which …"*. Should be R20.

Page 15, lines 339-341: Species HgOHCl(aq), Hg2+-POC(s) and MeHg+-POC(s). are absent in Table 2. MeHg+-POC(s) is also absent in Fig. 1.

Page 15, line 282: "*… (Eqs. 10-13). …".* Should be (Eqs. 10-12).

Page 15, line 355 and hereafter: Units of non-dimensional parameters can be given as [1] or [n/d].

Page 16, line 369: "*… (Table 2) …".* Should be (Table 1).

Page 42, line 953: "*… Figure 14 …".* Should be Figure 15.

Figures 7, 9 and 17: The circles showing measured data in the figures are very small and not readable.

Figure 13: The upper and lower panels are not signed in the caption. The legend is not readable.

Figures 14, 15, 16, 19: The legends are not readable.

Figure 18: The panels are not signed in the caption.