Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
https://doi.org/10.5194/gmd-2020-431-RC1, 2021

Comment on gmd-2020-431

Anonymous Referee #1

Referee comment on "Sensitivity of asymmetric oxygen minimum zones to mixing intensity and stoichiometry in the tropical Pacific using a basin-scale model (OGCM-DMEC V1.4)" by Kai Wang et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-431-RC1, 2021

General comments:

Wang and co-workers address in their paper "Sensitivity of asymmetric Oxygen Minimum Zones to remineralization rate and mixing intensity in the tropical Pacific using a basin-scale model (OGCM-DMEC V1.2)" one of the still open issues on understanding the interplay between the physical ocean and the marine biogeochemistry in shaping OMZs. Based on a basin-scale model with a high horizontal resolution they perform sensitivity studies with a set of vertical mixing parameters and a reduced DON remineralisation rate. With the final parameter set they state that the model successfully reproduces the observed asymmetric OMZ.

Unfortunately, there is no new scientific finding in this paper. The results are very descriptive without any critical assessment. Furthermore, the "improved model" setup is only evaluated wrt. oxygen distributions. Potential effects on other biological components and/or processes due to the new parametrisation are not analysed, even so, changes in the OMZ might feedback onto the net community production. The authors state in their conclusion that a "reduced remineralization rate leads to remarkable decrease of biological consumption over 200- 400 m". This is a rather trivial finding.

The physical and biological component of the applied OGCM are not sufficiently introduced. Only after reading previous papers of the authors I could gain a rudimentary understanding of the physical model setup. It would be useful to describe at least the major characteristics of the physical model. I also find that it is not a sufficient introduction of the biogeochemical component to only provide its equations in an Appendix. A more detailed description might be "boring" to the authors but it is very useful for the readers to get the basic concept of their model assumptions.

Moreover the oxygen cycle, the core topic of this paper, seems to be newly implemented into the biogeochemical module. However, a comprehensive introduction is missing. It would be interesting to know: 1) how is guaranteed that oxygen consumption does not exceed available oxygen? 2) are there any restrictions to remineralization depending on oxygen levels? Oxygen consumption from NH4 oxidation seems to be missing or is neglected. Oxygen production/consumption is calculated with a fixed ratio from NCP. However, photosynthesis based on nitrate produces a higher amount of oxygen than on NH4. Similarily, remineralization to NH4 needs less O2.

Furthermore, there is no sentence on nitrogen reduction processes such as denitrification, whose activity is highly correlated with export production in the ETSP (Kalvelage etal, 2013). As no values are given for NCP, export production, and also the distributions of nutrients or detritus are not provided it is impossible for the reader to judge the quality of the model performance. As far as I know, there has been previously no assessment of their biological component for the depth range below 200m.

In view of the extensive degree of revision, I refrain from specific and technical comments.