Authors' Response to Reviews of

The tidal effects in the Finite-volumE Sea ice–Ocean Model (FESOM2.1): a comparison between parameterised tidal mixing and explicit tidal forcing

Pengyang Song et al.
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RC: ***Reviewers' Comment***, AR: Authors' Response, □ Manuscript Text

1. Reviewer #2

1.1. General comments

RC: ***This manuscript deals with a comparison of a coarse resolution ocean model with a very simplistic parameterisation of tidal mixing and a model version without that scheme but explicit tidal potential included.***

There is a major physical flaw in this model setup. The authors seem to believe that having the long internal tidal waves in their model they have implemented "tidal mixing". This is not the case. The long tidal waves do not break, except maybe close to continental shelves. In contrast, it is the energy transfer by non-linear interaction from the long internal tides to the shorter background internal wave field, the "GM wave field", and the breaking of the shortest wave lengths in that GM wave field, which leads to the bulk of the "tidal mixing" in the interior ocean. This process is certainly not resolved in the current model. One would need very high resolution and non-hydrostatic dynamics to simulate that process. In the present manuscript, it is unclear how the long tidal waves would induce mixing, and the issue is not touched at all. However, it is clear that it would not correspond in any way to what happens in the ocean.

It is therefore of no use to compare the model experiments as done here, and this manuscript should be rejected.

AR: Thanks for reviewing this paper. We admit that our work does not fully consider the energy chain of tides. However, this is always a big challenge to simulate all-scale processes at a global range. The KPP scheme (Large et al., 1994) is applied in this model, where the mixing is shear-dependent. Thus, the baroclinic tides can lead to mixing in the model. In addition, our results show strong mixing caused by the trapped internal tides in the Kuril–Aleutian Ridge. That strong mixing causes stronger PMOC cell and shows better model performance in the Pacific Ocean. This is an important contribution of our work.

Large, W. G., McWilliams, J. C., & Doney, S. C. (1994). Oceanic vertical mixing: A review and a model with a nonlocal boundary layer parameterization. Reviews of geophysics, 32(4), 363-403.