

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2022-110

Anonymous Referee #1

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Referee comment on "Improved upper-ocean thermodynamical structure modeling with combined effects of surface waves and  $M_2$  internal tides on vertical mixing: a case study for the Indian Ocean" by Zhanpeng Zhuang et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-110-RC1>, 2022

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**Title:** "Improved ocean circulation modeling with combined effects of surface

waves and  $M_2$  internal tides on vertical mixing: a case study for the Indian Ocean"

### Summary

The main result of this study is to investigate the contribution of surface wave- and internal tides-induced vertical mixing in the upper ocean of the Indian Ocean. By adding three mixing schemes (vertical diffusive terms) into ocean circulation model, namely non-breaking surface-wave-generated turbulent mixing, the mixing induced by the wave transport flux residue, and the internal-tide-generated turbulent mixing schemes, the role of three vertical mixing schemes is quantified by switching off each diffusive term. Especially, the surface wave mainly improves the vertical mixing in the sea surface while the internal tide mainly contributes to the vertical mixing in the ocean interior. Improvement of upper ocean temperature structure is observed when all three schemes are combined.

**Recommendation:** Major revision.

The authors have presented a clear description of three mixing schemes, model experiments, and results that shows significant improvement of upper ocean thermal structure in the Indian Ocean. The study would be of importance to local oceanography, and it will also help improving the vertical mixing parameterization scheme that is used in the low-resolution models. However, a first impression of this paper is that the topic, i.e., what scientific object the authors are intended to improve, is not very clear, which could be related to the presentation of the introduction. The results also need more explanation. I would recommend major revision this time.

Detailed comments can be found in the Supplement file.

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2022-110/gmd-2022-110-RC1-supplement.pdf>