

Geosci. Model Dev. Discuss., author comment AC4
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Reply on RC1

Jiangbo Jin et al.

Author comment on "Formulation of a new explicit tidal scheme in revised LICOM2.0" by
Jiangbo Jin et al., Geosci. Model Dev. Discuss.,
<https://doi.org/10.5194/gmd-2021-441-AC4>, 2022

Thanks for the comments and suggestions that help to improve the quality of this paper.
We provide point-to-point responses to the reviewers' comments below with blue texts.

Reviewer #1: Recommendation.

Tides play an important role in the ocean, which plays crucial role in energy transfer and maintaining the thermohaline circulation. Thus, the introduction of tidal processes in global ocean models is necessary. This paper firstly presents a new method for inclusion of tides in a global model via the explicit calculation of the tide-generating force based on the positions of the Sun and Moon is proposed, rather than the traditional method of including about eight tidal constituents with empirical amplitudes and frequencies. Excellent results are demonstrated for the effect on improving simulations of the ocean circulation. This paper has a clear logic and concise structure, which can provide guidance for further improvement of ocean models related to tidal forcing. So, I recommend to accept the MS with the following minor editing.

Reply: We greatly appreciate your detailed summary and excellent comments which helped us clarify our logic and language expression.

L107-109: What is needed in the equation of barotropic modal motion is the horizontal tidal force, so why convert it to the tidal potential in equation (5) after getting the tidal force?

Reply: This is because the direction of the tidal force has not been decomposed into directions along longitude and latitude before being converted to tidal potential. Therefore, it is more convenient and affordable to express the tidal force in the form of the gradient of the tidal potential after converting it into a scalar of the tidal potential.

L132-135: Do the two wave drag terms take exactly the same coefficients as your references?

Reply: Yes, the parameterization of two wave drag terms are exactly following Simmons et al. (2004) as MOM and Schiller and Fiedler (2007).

L118-120: Both and are functions of universal time. What is this function?

Reply: Thanks. The projected position and distance of the sun and the moon on the earth are obtained by polynomial expansion, and the specific formula is given by Sun and moon, Satellite Orbits: Models, Methods and Applications (Montenbruck and Gill, 2000). However, because the formula is too large, it is not reflected in the text. We have modified this part of the paper and uploaded supplementary documents.

L187: What's does "large non-closed circular bands" mean?

Reply: This shows that the minimum value of Exp2 in Fig.2 is a circle around the earth without closing, rather than the existence of two closed minimums like Exp1 (Figure R1 in supplementary documents). Schwiderski (1980) pointed out that when the Earth is an ideal sphere, the equilibrium tide covering the earth's surface exhibits an ellipsoid shape, and distribution of Exp2 is consistent with the ellipsoid's planar expansion.

L211: total errors => total error

Reply: Thanks for your suggestion, we have revised it according to your suggestion.

L212: I don't think phrasing "phase error" is specific enough, especially when it first appears. Instead, "amplitude-weighted phase error (phase error)".

Reply: Thanks for your suggestion, we have revised it according to your suggestion. It is more standard to use "amplitude-weighted phase error" here.

L225: a similar distribution => similar distributions

Reply: Thanks for your suggestion, we have revised it according to your suggestion.

L311-312: "This is because Exp2, in applying the new formulation of the tidal scheme, can better represent the projection positions of both the Sun and Moon relative to Exp1.", Why?

Reply: This is because the projection positions of the sun and moon are always in low latitude in Exp2, and tidal potential signal of climatic state is lost caused by simplifying the tidal potential to the form of sine wave in Exp1.

L325-326: modes => constituents

Reply: Thanks for your suggestion, we have revised it according to your suggestion. It should be “constituents” here.

Fig.9: dynamic sea level => DSL

Reply: Thanks for your suggestion, we have revised it according to your suggestion.

References

Montenbruck, and Gill.: Sun and moon, Satellite Orbits: Models, Methods and Applications, 69–77, 2000.

Schiller, A., and Fiedler, R.: Explicit tidal forcing in an ocean general circulation model, *Geophys. Res. Lett.*, 34(3), L03611, <https://doi.org/10.1029/2006GL028363>, 2007.

Schwiderski, E.: On charting global ocean tides, *Rev. Geophys.*, 18(1), 243–268, <https://doi.org/10.1029/RG018i001p00243>, 1980.

Simmons, H. L., Jayne, S. R., Laurent, L. C. S., and Weaver, A. J.: Tidally driven mixing in a numerical model of the ocean general circulation, *Ocean Modell.*, 6, 245–263, [https://doi.org/10.1016/S1463-5003\(03\)00011-8](https://doi.org/10.1016/S1463-5003(03)00011-8), 2004.

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2021-441/gmd-2021-441-AC4-supplement.pdf>