

Geosci. Model Dev. Discuss., author comment AC4
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Reply on CC1

Nairita Pal et al.

Author comment on "Barotropic tides in MPAS-Ocean (E3SM V2): impact of ice shelf cavities" by Nairita Pal et al., Geosci. Model Dev. Discuss.,
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Hi Dr. Wang,

Thank you so much for the comments, and for pointing to the very interesting papers. We have now modified our manuscript and have included the suggested citations (second paragraph of the Introduction Section).

You have pointed out very accurately that the ice shelf considerations include two aspects : (1) open ice shelf cavities in the model domain (2) add an extra pressure (p^s) term in the momentum equation to represent the weight of the ice-floating shelves. The two points amount to the following critical factors in representing the effect of ice-shelf cavities on tides: (1) including the cavity area in the horizontal ocean domain (as has been done before), and (2) ensuring that the correct vertical column height is simulated in the cavities. By including the extra pressure (p^s) term, the sea-surface height is depressed (by more than 1000m in some places!) by the weight of the ice-shelves. Considering that tidal dynamics are modulated by the $\sqrt{g \cdot H}$ shallow-water phase speed, the addition of p^s thus ensures the ice-shelf cavities generate the correct dynamic response in our model, confirmed by the various figures and improvements in the paper.

This paper is thus a preliminary effort to directly measure the improvements in global tidal prediction once the extra pressure (p^s) term is added to the momentum equation. In particular, figures 4, 5, 6, 8 show our tidal predictions in the global ocean domain with and without the extra pressure term. In addition, we focus on tidal predictions in the Southern Ocean (Figure 7), and also the predictions between 66°N and 66°S (bar chart in Figure 8). All these results indicate that including the extra pressure (p^s) term leads to substantial improvement in global tidal predictions.

Thank you so much once again for the comments and the very useful articles. The articles have indeed improved our understanding of the subject.

Best regards,

Nairita Pal (on behalf of all coauthors)