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Discussions

Interactive comment on "PISM-LakeCC: Implementing an adaptive proglacial lake boundary into an ice sheet model" *by* Sebastian Hinck et al.

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I think there's some confusion about the different uses of the phrase "self-gravitating". If I have read the description of the Lingle-Clark GIA model given by Bueler et al. (2007, which is what you refer to in your manuscript) correctly, their use of the phrase "self-gravitating" mean they include a self-gravitation term in the derivation of the Green's functions, which describes the diminishing local gravity as asthenosphere mass is displaced by a surface load.

What I meant in my review is the perturbation of the geoid by the mass of the surface load itself: the changing shape of the ocean surface caused by the gravitational

attraction of an evolving ice sheet. As an ice sheet retreats, relative sea level at the margin drops due to [1] instantaneous elastic rebound of the crust, [2] delayed viscous rebound of the mantle, and [3] instantaneous lowering of the geoid, due to the diminishing gravitational attraction of the ice sheet, which causes the ocean water to "relax" back to the opposite side of the Earth. The version of the Lingle-Clark model described by Bueler et al., 2007 includes [1] and [2] (with a self-gravitation term included in the calculation), but not [3].

The work by Natalya Gomez which I referred to earlier (Gomez, N., Mitrovica, J. X., Huybers, P., and Clark, P. U.: Sea level as a stabilizing factor for marine-ice-sheet grounding lines, Nature Geoscience 3, 850-853, 2010, doi: 10.1038/ngeo1012) shows that the magnitude of [3] is similar to that of [2], but since it is instantaneous rather than delayed, the effect on ice dynamics is much stronger, such that it can significantly reduce retreat rates, or even lead to stable grounding lines on (mildly) retrograde slopes. This is what I meant with the "geoid-MISI feedback" (though indeed Gomez et al. don't use that specific phrase). I think this is very relevant for the phenomena you're investigating here, and I'm not convinced that the strongly accelerated retreat in your results would still occur if this effect would be included.

Lastly, a minor point: the phrase "dynamical topography" is typically used to describe tectonic movement, changes in elevation due to mantle convection, and other processes that act on the Myr timescale.

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