Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
https://doi.org/10.5194/gmd-2022-21-RC1, 2022

Comment on gmd-2022-21

Nicolas Jourdain (Referee)

Referee comment on "Evaluation of an emergent feature of sub-shelf melt oscillations from an idealized coupled ice sheet–ocean model using FISOC (v1.1) – ROMSIceShelf (v1.0) – Elmer/Ice (v9.0)" by Chen Zhao et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-21-RC1, 2022

Review of "Evaluation of an emergent feature of sub-shelf melt oscillations from an idealised coupled ice-sheet/ocean model using FISOC(v1.1)-ROMSIceShelf(v1.0)-Elmer/Ice(v9.0)" by Chen Zhao, Rupert Gladstone, Ben Galton-Fenzi, David Gwyther and Tore Hattermann.

Recommendation: minor revision

Sub-shelf melt oscillations emerge from coupled ocean–ice-sheet simulations of the Marine Ice Sheet Intercomparision Project (MISOMIP), and this paper investigates the causes of these oscillations. This is a useful study for the ocean–ice-sheet modelling community. The paper is well written and the sensitivity tests make sense and are clearly analysed. I only have minor comments and I suggest to accept the manuscript once they have been considered.

Specific comments:

- Abstract: it should be reminded that there is no external (atmosphere or sea ice) forcing in the MISOMIP experiments. This would help understand that it is somewhat surprising that an ocean oscillation emerges.
- L. 53, 152 and at other places: I am not a native speaker, but "couple" should probably be "coupled" (or "coupling" for some occurrences).
- L. 97: Weddell and Ross cavities are usually classified as cold, not warm.
- L. 128: "This parameterization" is a bit unclear.
- L. 145-146 (and caption of Tab. 1): It is not clear to me what is the difference between "conserving the volume integrals of tracer values (temperature and salt)" and

"preserve the absolute values, (e.g. heat or freshwater)" as, for example, the volume integral of temperature directly gives the heat content when multiplied by ρc_p. Furthermore, how exactly is imposed the conservation: additional flux at the surface? uniform T,S correction? Without this information, it is difficult to understand section 3.5.

- Please provide more details on the CTRL and Ocean3 experiments somewhere in section 2 or 3.1 (initial state, temperature and salinity restoring near the northern boundary, coupled models or ocean model with ice draft evolution, etc).
- Fig. 2: is the maximum of the barotropic stream function calculated under the ice shelf or all over the MISOMIP domain?
- Fig. 4: it would be easier to see the signal if the plots were showing anomalies with respect to the mean between year 63 and year 70.
- L. 185-186: what gyre are the authors referring to? Are these the gyres near the northern boundary or the gyre circulation within the ice shelf cavity?
- L. 193-195: I do not understand what the authors want to show with the barotropic circulation: any melt variation is associated with a change in barotropic circulation due to the modified horizontal density gradient and its role in the geostrophic balance (see Jourdain et al., *JGR,* 2017).
- L. 199-204: it is not so much the melt rate that is insensitive to the coupling period (it is actually smoothed for 6-month and 12-month coupling periods in Favier et al. 2019), it is the ice-sheet dynamics. Fig. 5 should therefore include another panel to show the ice sheet response (e.g. volume above floatation).
- L. 201-202: While I appreciate that FISOC is flexible, this sentence comes out of the blue and I would remove it.
- Fig. 6: The vertical resolution seems to have an effect on the melt oscillation period (e.g. compare orange to black curves).
- L. 238: fu_* should be u_*
- L. 239: if melt is independent from u_*, what equivalent constant u_* value is applied?
- Section 4.1: more information is needed: do all these models have the same ocean and/or ice-sheet resolution?
- Fig. 11: anomalies with respect to the entire period would be better.
- L. 307 and 349-342 and 401: I do not see why the grid direction would matter, the issue of having discrete grounding line retreat will remain whatever the grid direction. I don't pretend that it won't make any difference, but I do not see why it would make oscillations disappear (for example, the ice slopes will still be affected by the grounding line motions). Instead of rotating the grid, I would suggest increasing the ocean resolution.
- L. 323: buoyant plume speed…. and speed associated with the horizontal density gradient.
- L. 399: "not sensitive" -> "not very sensitive".