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Interactive comment on "A Framework for Ice Sheet – Ocean Coupling (FISOC) V1.1" *by* Rupert Gladstone et al.

Anonymous Referee #1

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Gladstone et al. present a new coupling infrastructure (FISOC) that is designed to accommodate various types of ocean and ice-sheet models. The manuscript is well written, and FISOC, the verification protocol as well as the results are clearly presented. By implementing two ocean models (with distinct regridding methods) within the FISOC framework, the authors demonstrate the flexibility of their approach. The two simple verification experiments proposed here are convincing and could be used for the verification of other coupled models. Given the several references to synchronous vs asynchronous approaches in the paper, I would have found it useful to see a set of sensitivity experiments to estimate the influence of the coupling interval (e.g., from 1 day to a few months), which would also further demonstrate the flexibility of FISOC, but this is probably beyond the scope of the present paper. Therefore, besides a few

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elements that require clarifications (see below), I recommend the manuscript for publication in GMD.

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Minor comments:

- L.7: “thesemechanisms”

- L.29: other anterior references for the ice geometry feedback onto melt rates include De Rydt et al. (2014), Timmermann and Goeller (2017) and Donat-Magnin et al. (2017).

- L. 43-45: “offline coupling” and “partial restart” should be defined. I am not sure that “offline coupling” is very relevant as deciding what is “online” and “offline” can be somewhat subjective and the synchronous/asynchronous distinction is probably enough.

- L.102: there is a subsection 2.1.1 but no subsection 2.1.2. I suggest putting everything under 2.1 with no 2.1.1 subsection.

- L.113: indicate that the user manual is provided on github or as supplementary file.

- L.135-138: in which circumstances is it necessary to extrapolate? Is the ocean grid extends beyond the ice grid, I would expect the ice geometry (seen by the ocean) to be taken from observational data, not extrapolated from the ice model.

- L.151: “. Cavity geometry. . .” add “seen by the ocean”.

- L.161: It is unclear what is meant by “partial restart” here. In Favier et al. (2019), the ocean is restarted every coupling interval by conserving its velocity field (and all information on the current and previous time steps that is usually used to restart the ocean model), not only temperature and salinity as in De Rydt et al. (2016), so shouldn’t it be called a full ocean restart. The main difference between Favier et al. (2019) and ROMS/FVCOM here is that the ice geometry seen by the ocean evolves by step, i.e. every coupling interval rather than every ocean time step, and that there is an associ-

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ated correction on barotropic velocities to cope with that.

- L.311-312 (or in section 2.6): please specify whether the 3-equation formulation is used with a constant exchange velocity. It could be worth mentioning that “rotation is disabled” to avoid asymmetric melt rates and seek a perfectly flat solution for the ice draft.

- L.320-323: if these details are given for FVCOM, I guess they should be provided for ROMS as well. Having said that, I am not sure these are useful in this paper, unless there are reasons to think that some schemes are less conservative than others.

- L. 311 and 353-354: are these in-situ or potential temperatures?

- section 4.1: it would be worth mentioning whether the ocean models make the Boussinesq approximation (which would probably mean that they are expected to conserve volume rather than mass). Is the ocean mass in Fig. 4 derived from the uniform sea water densities shown in Tab. 2 based on its volume?

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Additional references

De Rydt, J., Holland, P. R., Dutrieux, P. and Jenkins, A. (2014). Geometric and oceanographic controls on melting beneath Pine Island Glacier. Journal of Geophysical Research: Oceans, 119(4), 2420-2438.

Donat–Magnin, M., Jourdain, N. C., Spence, P., Le Sommer, J., Gallée, H. and Durand, G. (2017). Ice–Shelf Melt Response to Changing Winds and Glacier Dynamics in the Amundsen Sea Sector, Antarctica. Journal of Geophysical Research: Oceans, 122(12), 10206-10224.

Timmermann, R. and Goeller, S. (2017). Response to Filchner–Ronne Ice Shelf cavity warming in a coupled ocean–ice sheet model–Part 1: The ocean perspective. Ocean Science, 13, 765-776.

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