The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2019-202-AC1, 2020


The Cryosphere Discussions

# *Interactive comment on* "Ocean forced evolution of the Amundsen Sea catchment, West Antarctica, by 2100" *by* Alanna V. Alevropoulos-Borrill et al.

**Alanna V. Alevropoulos-Borrill et al.**

alanna.alevropoulosborrill@vuw.ac.nz

Received and published: 14 January 2020

Section 3.3 To clarify line 290.....would that be an extra 1m/a of melt for each 0.1 deg of temperature rise? And also that it is assumed that a warming in the ocean outside an (unmodelled) cavity will reach the grounding line unchanged? The authors use a single, averaged mean temperature value for each model simulation to force melting on all ice shelves within the ASE. Is this a valid assumption? What is the spatial variability in oceanic conditions of the models like? Would we expect to see water with different properties entering different ice shelf cavities? Some further discussion of these points would be appreciated. »» We have added the following sentences to section 3.3 to address these questions: "...where an additional 0.1°C temperature increase results in an increase of 1 m/a to the basal melt rate. The CMIP5 AOGCM forcing data that we



use are relatively coarse in their spatial resolution and also do not capture sub-ice shelf oceanographic conditions. Consequently, we are unable to accurately incorporate the spatial complexity of ocean temperature variability that exists in the ASE (c.f. Turner et al., 2017). Given that our input data better reflect regional rather than local-scale oceanic changes, we force our simulations with spatially-averaged CMIP5 temperature anomalies."

The length scale, lambda, used in the melt rate forcing has a length scale of 1000m. Is there any physical based justification of this? Is there also any reason to assume that this will be constant for all ice shelves within the domain? »» There was a mistake in the text and the length scale is 10,000m which has now been amended (line 305). This length scale follows the practice of Cornford et al. (2015) and we are not aware of the physical basis for this.

The authors have used a relatively simple parameterization of melt rate that varies only with distance from the grounding line. Is there a reason they haven't used a more advanced method that would take into account changes in ice shelf basal slope? (for example a plume model such as Lazeroms et al 2018, or a box model like Reese et al 2018) »» To address this we have added the following paragraph to section 3.3: "The simplified distance dependent melt parameterisation employed in this investigation was chosen in order to maintain continuity with the Nias et al., (2016; 2019) studies. Our parameterisation neglects the effect of overturning circulation within an ice shelf cavity in addition to the ice shelf cavity geometry and presence of meltwater plumes which influence the pattern of sub-ice shelf basal melting (Dinniman et al., 2016). Whilst more complex parameterisations attempt to incorporate these mechanisms (e.g. Lazeroms et al., 2018; Reese et al., 2018), no parameterisation is yet able to replicate known patterns of sub-ice shelf melting (Favier et al., 2019). Furthermore, the uncertainty associated with the magnitude of the future forcing exceeds that associated with the parameterisation of sub-shelf melting (Holland et al., 2019), justifying the use of the simplified parameterisation employed in this investigation."

Smaller points and technical corrections 102-Is it a valid assumption that models are temporally consistent? »» Yes, it is a valid assumption that model performance is temporally consistent.

146 - Would it not make more sense to select models for the subset based upon their performance in the ASE rather than the Southern Ocean as a whole, given that this work is focused on the ASE. »» Already explained in lines 117-120.

212 How does the model deal with an advancing/retreating calving front? I assume it is held constant at the initilised position? »» Yes- fixed calving front. This has been added to 286.

276 results of the »» Done- changed to 'an' as suggested by Reviewer 2

400 Pope,Smith and Kohler »» Done (401)

500 Perhaps the discussion could also include mention of more advanced parameterization schemes? »» See lines 550-556.

Fig 2. The potential temperature axis seem to be labeled wrongly »» Thank you for identifying this, it has been corrected.

---

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2019-202, 2019.



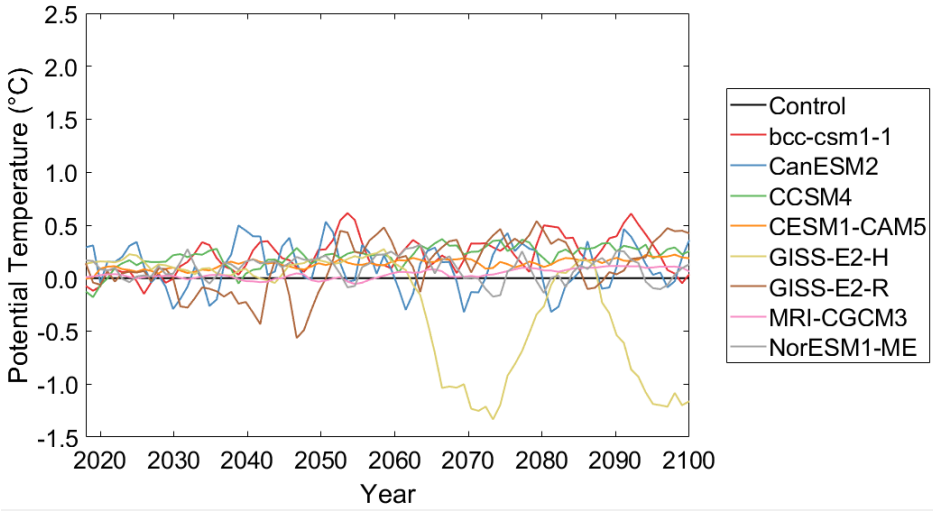


**Fig. 1.** Updated figure 2a (see revised manuscript for full caption).