The referees' comments are reproduced in black hereafter, and our responses are shown in blue.

Hartmut Hellmer (Referee #3)

The authors present a new methodology for calculating melt rates at the base of Antarctic ice shelves to serve ISMIP6 (Ice Sheet Model Intercomparison Project for CMIP6). Based on existing observational data sets (WOA18p, EN4, and MEOP) a present-day climatology has been constructed. The evolution of ocean temperature and salinity is derived from climate models by calculating anomalies as differences between the annual means and the 1995-2014 average, then added to the present-day climatology. The proposed parameterization of basal melting depends quadratically on, due to the architecture of the ISMIP6-ice sheet models, either non-local or local thermal forcing, both constrained by the observed temperature climatology. Two calibration methods are proposed based on (1) the mean Antarctic melt rate and (2) melt rates near the deep grounding line of Pine Island Ice Shelf, the latter to cover a high melting regime expected to become widespread in a warming climate. The still existing deficiencies of this approach ask for the consideration of more physics related to the cavity processes and more and long-term observations of hydrographic characteristics and basal melt rates.

General comments: Once having proposed a 'simple' box model to provide melt rates beneath Antarctic ice shelves and watched recent efforts with the same purpose, I highly appreciate this kind of approach based on data from ocean and ice shelf observations – though, it is just a step in the right direction and does not mark the end of the effort! My comments/questions are mostly marginal and, hopefully, will not hamper a rapid publication in TC.

> We thank Harmut Hellmer for his positive feedback.

Hartmut H. Hellmer

Specific comments (according to page and line numbers):

- P05L14: It took me a while to realize that ice shelf draft is not an issue and the open ocean profiles are extrapolated horizontally even into the ice. If I am right, please add a sub-clause for clarification.

> This is correct. We have added "and into locations currently occupied by ice".

- P08L07: I still puzzle about the procedure of extrapolating shelf water characteristics into the cavities, especially after having seen the thin lines in Figure 2. Looking at the southern Weddell Sea, one gets the impression that only a narrow band along the Filchner-Ronne Ice Shelf front has been considered, which does not even cover the most western part where High Salinity Shelf Water (HSSW), the fuel for basal melting, exists. Similar for the Ross Ice Shelf, where the most saline HSSW of McMurdo Sound is extrapolated into the cavities fringing the western Ross Sea. In addition, it is still a big unknown and its implementation technically not easy, but one should mention somewhere because of that the extrapolation into the cavities does not follow possible routes of cavity inflows.

> For the purposes of extrapolation, the basin boundaries are only used for regions of present-day grounded or floating ice, not for the open ocean. The reason we define the region in the open ocean is only because ice-sheet models will have different extent than present-day (including sometimes having calving fronts extended into present-day open ocean). In order to perform basin averages, these models need all grid points on the ISMIP6 grid to belong to one basin or another. Beyond the present-day calving front, this assignment is fairly arbitrary and probably not particularly important. Again, the extrapolation method does not use these basins.

To clarify, we have added the following text to section 3.2:

> "Note that, because we perform extrapolation first in the open ocean and then in each basin, we do not use the portions of each basin in Fig. 2 that has been extended into the open ocean. The basins have only been extended for use by ISMIP6 ice-sheet modelers, who may need the basins as part of the parameterizations described in section 4".

- P12L06: With regard to the non-local melting parameterization and the thermal forcing averaged over all ice shelves of a particular sector, one wonders how sensitive this approach is to the distribution of ice shelf drafts. I assume thermal forcing to be shifted to higher values for a sector with predominantly deep bases but this overestimates melting at lower (than average) bases.

> This is the idea behind this parameterization: in sectors with predominantly deep bases, the overall circulation induced by melting in the deepest parts of the cavities will strengthen turbulence everywhere, even along the lowest parts of ice shelf bases, as the cavity circulation is assumed to be driven by non-local processes.

- P13L06: Refreezing – obviously cannot happen for the local parameterization. Reese et al. (2018b) point to the impact of basal melting on ice flux across grounding lines, but I assume that refreezing has the same impact, at least for the big ice shelves where refreezing is widespread.

> Reese et al. (2018b) only applied mass loss, but it seems reasonable to assume that mass gain will have the opposite effect. Hence, we agree that not representing refreezing is a caveat.

- P13L17: What is the reason for using 10ˆ5 random samples. Why not more or less?

> With 10^5 samples, the median value of γ_0 is estimated with 3 significant digits (see below), and calculations start to be extremely long for more than 10^5 samples.

1,000 samples:	γ_0 = 0.1470e5
5,000 samples:	γ_0 = 0.1418e5
10,000 samples:	γ_0 = 0.1451e5
50,000 samples:	γ_0 = 0.1445e5
100,000 samples:	γ_0 = 0.1448e5

To clarify, we have added "Using 10^5 samples gives γ_0 values that converge with 3 significant digits".

- P13L19: The uncertainty of 0.17K comes out of the blue.

> It is explained in the following sentence: "The 0.17 K uncertainty was calculated as the average temperature standard deviation at 500 m depth, between 80°S and 60°S, only considering locations with more than three valid points in the original dataset (section 3), and neglecting the uncertainty in salinity in the calculation of freezing temperature."

- P15Tab2: Some 'first-glance-surprising' results are presented without the slight attempt for an explanation. Here is an example: what is the reason for the big difference (~3 times) in the median for non-local and local PIGL?

> We have added more explanations about the PIGL γ_0 values in Tab. 2:

> "The PIGL median and 5th-percentile γ_0 values are three times higher for the non-local than for the local parameterization, which can be explained by the presence of refreezing in the first case, requiring a large γ_0 to compensate small sector-averaged thermal forcing. For PIGL local, the 95th percentile γ_0 takes values as large as the non-local case because δT corrections become strongly negative and make the *max* function in eq. 2 produce zero melt at numerous grid points."

- P16Fig4: It took me a while to realize that the whole gray pattern (upper left) is the PIG with area of highest melt rates in red.

> We have expanded the figure caption, and this should be clearer now.

- P18L05: First, it is impossible to distinguish the different lines in Fig. 6 on a print. I had to go back to the online pdf-file to follow the writing. Second, 'good agreement' tends to be a self-serving statement, since the good agreement only holds for the depth range 400 – 1000 m, which, for FRIS, is above the depth of most grounding lines of the major ice streams.

> To improve the figure, we have thickened the lines for the future values. And we agree that "good agreement" was not appropriate. The sentence has been rewritten as "the MeanAnt method produces melt rates in good agreement with observations between 400 and 1000 m in the Ronne-Filchner sector (dashed light blue line in Fig. 6b), but underestimates melt rates at all depths in the warm cavities of the Amundsen sector by one order of magnitude (dashed red line in Fig. 6b), and in the deepest parts of Ronne-Filchner".

- P18L10. Since I cannot find any deltaT < 0 in Fig. 5c (non-local PIGL), why 'almost' everywhere?

> "almost everywhere" is for the single positive value in the PIGL-local (Fig. 5d).