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Interactive comment on "Promising Oldest Ice sites in East Antarctica based on thermodynamical modelling" *by* Brice Van Liefferinge et al.

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This study deals with the hot topic of detecting a suitable site for an "Oldest Ice" core in Antarctica. It is essentially an update of an earlier study by Van Liefferinge and Pattyn (2013). The authors use a transient 1D model, forced by time-dependent atmospheric conditions and ice thickness over the last 2 Ma, and compute the basal temperature as a function of the geothermal heat flux (GHF). By comparing with existing GHF data, the authors compute probability maps for the basal temperature having reached the pressure melting point. Combination with other criteria (flow speed, basal roughness etc.) allows identifying several candidates for Oldest Ice sites in the vicinity of Dome C

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and Dome F.

The findings are certainly not the final word on the matter, but the paper constitutes a significant progress, and I am generally in favour of publication. However, I would like to raise some points the authors should consider:

Throughout MS: "Puruker" -> "Purucker"

P2, L3: Add a semicolon after "ice sheet".

P2, L24: "of the crustal" -> "of the crust"

P2, L25/26, "it is crucial to know basal temperature gradients at the ice-bedrock interface and not GHF within the crust": This is not necessarily true and depends on the type of the modelling study. For longer-term (e.g., glacial-interglacial cycle) modelling studies, it is more physical to use the GHF within the crust and apply it as a boundary condition some kilometres below the ice-bedrock interface.

P4, Fig. 1: If I'm not misled, this figure is not referenced anywhere in the text.

P5, L17/18, "horizontal advection may safely be neglected": What about horizontal conduction?

P5, Eq. (2): This boundary condition only holds for a cold base.

P5, Eq. (3): This equation should be given a reference.

P5, Eq. (3) and L26 vs. P6, L3 and Eq. (5): The surface accumulation rate should consistently be denoted by either "a" or "\dot{a}".

P6, Table 1: Why not using the more realistic, temperature-dependent representations of the thermal conductivity and the heat capacity? For the large range of temperatures relevant for Antarctica, the dependence is significant (e.g., Greve and Blatter 2009, "Dynamics of Ice Sheets and Glaciers").

P6, L10: I think it is problematic to keep the bed elevation constant in time and then ap-

ply a time-varying ice thickness produced by a model that includes isostatic adjustment (Pollard and DeConto 2009). This procedure overestimates surface elevation variability and thus surface temperature variability over time. Why not including a simple local-lithosphere-relaxing-asthenosphere model? This should be easy to implement, not consume much extra computing time, and it is quite realistic for the interior of Antarctica due to the enormous horizontal extent.

P7, L2: "500 m by 500" -> "500 by 500 m"

P10, L3/4, "Although, the regions highlighted...": I don't understand this sentence.

P10, L7: "our analyse is more contrasted" -> "our analysis is more contrasted"

P11, L4/5: I'm not sure whether the Shapiro and Ritzwoller (2004) GHF values are the best reference. If I interpret Figs. 7b and 8b correctly, this produces probabilities of Dome F and Dome C having reached the PMP of $\sim$0.3 and 0.5, respectively. However, if I remember well, direct observations have shown that both ice cores are warm-based today. This challenges the credibility of the presented results. Further, I have found that the Martos et al. (2017) data generally produce better results for ice flow and basal temperature in 3D, large-scale simulations of Antarctica (recent work, unpublished).

P12, L4: "on Fig. 7" -> "in Fig. 7"

P14, L22: "the values lies" -> "the values lie"

P14, L26: I think the reference to Fig. 9 is wrong.

P14, L29, "Spatial and temporal forcing variations with respect to surface temperature and accumulation rate are relatively limited (Fig. 9)": Looking at Fig. 9, these variations don't seem to be so small.

P15, L15, "high probablity of being below or close to the pmp": What is meant by "below or close"?

P16, L8, "maximum radial distance of 4 km and 2 km from Dome Fuji and Dome C":

Are these numbers correct? If so, I don't understand it. Earlier in the paper (Figs. 7 and 8), much larger windows around these two sites were discussed. How does this go together?

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