

Interactive comment on “Future ice-sheet surface mass balance and melting in the Amundsen region, West Antarctica” by Marion Donat-Magnin et al.

Anonymous Referee #1

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Review of "Future ice-sheet surface mass balance and melting in the Amundsen region, West Antarctica", submitted for publication in The Cryosphere by M. Donat-Magnin et al.

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SUMMARY ===

The manuscript by Donat-Magnin describes a model experiment in which the future surface mass balance (SMB) and surface melt in the Amundsen Sea Sector of the Antarctic Ice Sheet is investigated. This is done so by using anomalies of a CMIP5 multi-model mean anomaly added to a present-day forcing to the regional climate

C1

model MAR.

This paper is interesting both for its results and for its methodology. The Cryosphere would be a logical venue for publication, and the subject is relevant for the journal. I am enthusiastic about the methodology (including the discussion of its shortcomings) and by the results.

I would recommend publication of this paper after care has been taken to improve the manuscript on the following points.

GENERAL ===

Throughout the manuscript, the terms melt and runoff should be used with more care. It starts at P2 L18: This entire section makes sense but the use of "melt" and "runoff" needs to be more careful here. Runoff is produced only when water runs off into the ocean, and is lost from the ice sheet. In situations with ponding or hydrofracturing, leading to ice-shelf collapse, there is no runoff according to the definition, but only surface melt. If there were no ice-shelf collapse, the surface meltwater would refreeze. While runoff is currently probably about 1000 x smaller than SMB, surface melt is about 5% of SMB. It is not runoff but surface melt that triggers hydrofracturing. All over the manuscript, meltwater ponding and hydrofracturing is described as runoff, but it should be considered surface melt and not runoff, unless the water is really lost from the ice-sheet system. There are many instances with this confusion, like P10 L16 or P21 L14 and further.

SPECIFIC ===

Title: I would suggest to replace "Amundsen region" by "Amundsen sector"; remove or move the words "ice-sheet", and replace "melting" by "surface melt". So:

Future surface mass balance and surface melt in the Amundsen sector of the West Antarctic Ice Sheet.

Page 1 line 10: along -> during (or: in) P1 L11: melting -> melt P2 L2: hypothetically

C2

stable climate -> hypothetical, stable climate P2 L8: ice cores -> firn cores P2 L15: a -> an (<https://blog.apastyle.org/apastyle/2012/04/using-a-or-an-with-acronyms-and-abbreviations.html>)

P2 L31: surface melting -> surface melt (everywhere in the manuscript) P2 L31: the exponential relation between temperature and surface melt is valid

P3 L13: perhaps replace the reference to Lenaerts et al. (2018) to Van Wessem et al., Modelling the climate and surface mass balance of polar ice sheets using RACMO2, part 2: Antarctica (1979–2016). *The Cryosphere*, 1–35 (2018). The latter is more of a benchmark publication for RACMO2.

P3 L14: slightly expand the text here to discriminate between forcing with reanalyses (Donat-Magnin, 2020, Fettweis 2013, Datta 2019) and GCMs (Trusel 2015, this paper).

P4 L16: are these sensitivities based on climatological means or instantaneous values for temperature and wind speed?

P5 L8: move this listing of models to a table or appendix.

P7 L4: remove "potential" (doubles with possible)

P10 L16: referring to the above comment, lateral transport of meltwater (into ponds for example) is not runoff in an SMB definition. If it refreezes or remains in the ice sheet it is not runoff.

P10 L22: actually it would be very interesting to show the T-M relation for your model, along with the expression from Trusel et al. It gives insight to the sensitivity of your model melt to temperature compared to previous work. Please include a figure and brief discussion here.

P10 L29: remove "also"

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