This paper presents sensitivity studies with the atmosphere-only, stretched-grid GCM ARPEGE, forced by two present-day and strongly diverging end of 21st century sea ice and SST conditions from (bias-corrected) CMIP5 models. The results show that the Antarctic SMB is sensitive to Southern Ocean conditions, resulting from temperature and general-circulation changes. Although the paper contains some interesting results, it is very poorly written, contains factual errors, is and does not seem to come up with any clear answer to the problem posed in the title. I think it would require a very considerable effort from the authors to rewrite and strengthen the paper. I have decided not to focus on the language, but that doesn't mean that the paper needs a thorough check – it contains a lot of textual and grammatical errors! Instead, I will focus on (what I think are) the major issues with this paper, and hope the authors are able to improve the paper considerably. The only reason I decided not to reject is that I think the paper contains some interesting (but preliminary) results, but it will need to be thoroughly revised.

Major issues (in order of appearance)

Title: I think the title is a bit too general, and the paper does not really address it (see below for details). Something like: “Impact of two diverging scenarios of 21st century Southern Ocean surface changes on Antarctic surface climate and precipitation”.

Abstract: the abstract needs a few introductory and concluding sentences, introducing the problem and motivation, and giving some concluding remarks ('what did this study find, in relation to the title?')

Surface mass balance: is only one term of the mass balance; importantly, not the SMB causes a decrease in sea level, but the change (increase) in SMB, assuming solid ice discharge doesn't change. Since SMB and discharge are intimately linked, it is incorrect to describe SMB as a negative term contributor to sea level rise.

P2, L28: …allowing the use of cloud-resolving atmospheric model configuration. I think you mean ‘preventing’ instead of ‘allowing’?

P2, L33: *higher horizontal resolution leads to higher estimates of snow accumulation*. This is factually incorrect – actually, Genthon et al. (2009) suggest the opposite (see their Fig. 1). In addition, Lenaerts et al., 2017 do not find any significant impact of resolution on (integrated) SMB in the Amundsen region.

P3, L7: *RCM*. These random acronyms lead me to believe that the authors have been sloppy and have not sufficiently rechecked their manuscript prior to submission. Make sure these are defined when used for the first time.

P3, L18-29: This type of information does not fit in the introduction, it is far too detailed and should be moved to the methods.

Table 2: What are the units? What is the significance of these results, based on how much it varies in ERA-Interim over 1981-2010?

P7, L20*: 9.5 Kelvin/km*. Where does this lapse rate come from? It would require a reference to back up this number.

P9, L8 and around: This temperature bias is highly concerning, and instead of simply removing these areas, I would advise the authors to try to explain (and remedy) this bias. My intuition is that ARPEGE is not well able to represent strong surface-based temperature inversions (which not be surprising as many climate models struggle with this). Also, these simulations will likely need to be redone with ice shelves (mind the spelling) considered in the land model – that will allow the authors to analyze the effect of changing ocean conditions on ice shelves (which are a super-important component of the Antarctic glacial system – and located closest to the ocean, so should be most sensitive!). In any case, the authors will need to come up with an explanation why the ice shelves are so warm in the model, will need to remedy that bias, and apply that to new simulations. The current bias is alarming, because there is no reason why this bias wouldn't apply to other regions on Antarctica – where this bias is potentially compensated for by other model biases (radiation, clouds, albedo,…)?

Table 3 is very poorly readable, enlarge and perhaps move to supplementary material. Again, don't forget to mention units. Same for Table 4.

P12, L12: this contradicts what was (falsely) mentioned in the introduction, as ARPEGE (the lower-resolution model) gives higher precipitation than MAR (the higher-resolution model)

P12, L18 and around: Runoff is the result of a complex interaction between atmosphere and snow conditions, and requires a sophisticated albedo and snow model, the latter which allows for percolation and refreezing of surface meltwater. The authors do not present any compelling evidence why the surface melt and runoff rates in ARPEGE are any realistic, which casts doubt on the reliability of simulated future melt and runoff rates. For example, Table 5 suggests that, on the grounded AIS, about one-third of the liquid water production (rain + melt) runs off in ARPEGE, which suggests that its snow model is not capable to retain and refreeze sufficient meltwater (for comparison: both MAR and RACMO2 produce almost no runoff with comparable liquid water production). I would therefore advise the authors to focus solely on precipitation and temperature, possibly surface melting (provided that the authors can show evidence of realistic surface melt patterns in the present-day simulation, compared to MAR for example), but refrain from analyzing future runoff changes.

Table 6: Are these changes significant at all? What is the present-day variability? What is the relative change instead of / next to the absolute changes?

Conclusions: a concluding paragraph/section is missing on the actual conclusion of this work. What is the uncertainty of Southern Ocean conditions on Antarctic SMB? What is driving it? What is the impact of changing SIC vs. SST? What are the driving forces of the change in Antarctic SMB – the thermodynamic (i.e. increase in surface temperatures) or

the dynamic (large-scale atmospheric circulation)? What is the impact of the radiative and turbulent fluxes? There are many open questions that the authors do not discuss, but that can be answered if the model simulations are analyzed in more detail.

References

Genthon, C., Krinner, G., Castebrunet, H., 2009. Antarctic precipitation and climate change predictions: horizontal resolution and margin vs plateau issues. Ann. Glaciol. 50, 55–60(6).

Lenaerts, J.T.M., Ligtenberg, S.R.M., Medley, B., Van de Berg, W.J., Konrad, H., Nicolas, J.P., Van Wessem, J.M., Trusel, L.D., Mulvaney, R., Tuckwell, R.J., Hogg, A.E., Thomas, E.R., 2017. Climate and surface mass balance of coastal West Antarctica resolved by regional climate modelling. Ann. Glaciol. 1–13.