

Reply to Reviewer 2's comments

Reviewer 2: The paper estimates annual precipitation rates over the coastal area of Dronning Maud Land. Using a downscaling from general circulation models of the atmosphere, a regional model and reanalysis data, the paper attempts to identify key atmospheric processes predicted back in time and which can be used to infer surface precipitation rates. The idea is intriguing and worthy of study. It is consistent with the theme of this journal.

Authors:

The authors thank the reviewer for the careful reading of the manuscript and the comments.

Reviewer 2: The paper requires editorial revision and further analysis. Specifically, the paper repeatedly states that the results are an estimate of surface mass balance. In fact and as is also stated, the estimate is surface precipitation rates. Further reference to Lenaerts et al 2019 and the magnitude of other contributions to SMB would be useful.

Authors:

Over Antarctica, SMB variability has been shown to be mostly driven by snowfall, with a contribution often one to two orders of magnitude larger than the other components (sublimation, melting, runoff, snow ablation by wind). Lenaerts et al (2019) will be cited in the introduction, with estimates of the order of magnitude of the different components. This very strong link between precipitation and SMB has to be noted, because ice cores provide measurements of the SMB, and precipitation is a good proxy for the comparison with those measurements. However, we will carefully revise the manuscript to make a clear distinction when SMB can be mentioned, and when precipitation should be used instead.

Reviewer 2: Section 3.1 on the dataset should go at the end of the paper once a convincing argument about the utility of the data set has been made. To that point, the variation between model and ice core data seems to be about 25 % (Figure 8) and it needs to be made clear this is a meaningful result. Moreover and perhaps more importantly, there does not seem to be a strong correlation between the variations in the model data and the ice core data. If there is a correlation it should be quantified. I expected to read a conclusion about long term trends in precip rates as hinted at in the introduction. I did not find that nor do I think such a conclusion is possible based on inspection of Figure 13. More discussion on that point would be useful and would strengthen the paper whether a trend is discernible or not.

Authors:

We propose to maintain the information provided in Section 3.1 at the beginning of section 3, as in the submitted manuscript. It describes what information is accessible. We believe that this journal is precisely oriented toward the description of such a dataset and is thus at the core of the paper. The rest of the section illustrates the different parts of the accessible dataset that can be of interest for further analyses. The motivations (and utility) of the dataset will be clearly re-stated at the end of the introduction. Variations and correlations compared to ice core data have been computed for each member of the downscaling, and will be summarized in the text. However, the comparison should be taken cautiously, as there is still a mismatch between the spatial resolution and representativity of the dataset and the ice cores. Multi-decadal trends have also been computed for each time series, and will be discussed in the revision.

Reviewer 2: I made editorial comments in the text. My recommendation is to return the paper to the authors and to strongly encourage them to make major revisions before resubmitting. I believe they are on the right track to an interesting result but it needs a bit more work

Authors:

Thank you for the comments on the manuscript.

- *As said, reference to SMB and precipitation will be carefully checked in the text.*
- *Inconsistencies in the introduction will be checked, eg ice shelf/ice sheet.*
- *Snowfall is derived from CloudSat: SMB will be replaced by snowfall*
- *We will rephrase l.108-115, so as to better express the first trials and why they failed, to justify the method used.*
- *Zenodo will be explained: “Zenodo, an open-access repository operated by CERN”.*
- *We will ensure that there is no confusion in the text between CESM member and downscaled member.*