The Referee's comments below are in italics, our answer in plain font in blue

The authors present the ability of CMIP5 GCMs to be used, together with ice core and d18O proxies, as a tool to reconstruct by data assimilation Antarctic temperature and SMB. They explore regionally the relation between these two variables by using different reconstruction techniques, and conclude that using both SMB and d18O proxies is most optimal. Doing this they can now better reconstruct SMB in the last two centuries. The paper is well written, with clear figures and a new, at least to me, approach in reconstructing temperature and SMB far back in time based on physical models. The results are robust, well presented, sufficiently new and original, and I do not feel that any information is missing. I therefore strongly recommend publication in The Cryosphere. However, I do have some comments on the clarity of the paper and would also recommend to make the data assimilation explanation more clear, as I will explain below.

We would like to thank the Referee for the positive evaluation and for the useful comments.

P1, Title: To me the title does not really catch the main conclusions and content of the manuscript. To me, the paper comes across as a new temperature and SMB reconstruction based on a new/better technique. Do the authors feel that the main content of the paper is the link of SMB and temperature? The current title seems to "state the obvious", and did not really attract me at first to review the manuscript.

We agree with the referee that the title does not totally correspond to the main content of the manuscript. We have decided to change it to: "How useful is snow accumulation in reconstructing surface temperature in Antarctica? A study combining ice core records and climate models."

P1, Abstract, l7: This sentence is confusing, as d18O and temperature could also be the same. You mean the SMB-temperature relationship is stronger than the relationship between d180 and temperature? Maybe write out this sentence and omit the -dash.

We have changed this sentence. "We find that, on the regional scale, the modeled relationship between surface temperature and SMB is generally stronger than between temperature and $\delta^{18}O$."

P1, Abstract, l13: This is not clear. Which reconstruction method is used for the SMB?

We agree that this sentence is ambiguous. We have changed it by:

Finally, we provide a spatial SMB reconstruction of the AIS over the last two centuries showing 1) large variability in SMB trends at regional scale; and 2) a large SMB increase (0.82 Gt year^{-2}) in West Antarctica over 1957–2000 while at the same time, East Antarctica has experienced a large SMB decrease (-3.3 Gt year^{-2}), which is consistent with a recent reconstruction.

by:

Finally, using the same data assimilation method as for the surface temperature reconstruction, we provide a spatial SMB reconstruction for the AIS over the last two centuries showing large variability in SMB trends at regional scale, with an increase (0.82 Gt

year^{-2}) in West Antarctica over 1957–2000 and a decrease in East Antarctica during the same period (-3.3 Gt year^{-2}). As expected, this is consistent with the recent reconstruction used as a constraint in the data assimilation.

P1, Abstract, general: The abstract (and title) should be reconsidered. The abstract is the first thing people read, and should be instantaneously clear. I had to re-read the abstract several times to understand it. Of course I understood it after reading the whole manuscript, but the abstract should be standalone in my opinion.

As suggested by the reviewer, we have rewritten the abstract to highlight our main conclusions.

P3, l17: what is meant here with "estimated by d18O"? This relation comes out of the blue.

We wanted to point out here that the $\delta^{18}O$ is used as a proxy of surface temperature in some studies analyzing the link between surface temperature and SMB. Therefore, those studies (e.g. Fudge et al., 2016; Altnau et al., 2015; Philippe et al., 2016; Goursaud et al., 2019) have analyzed the link between $\delta^{18}O$ and SMB rather than the link between surface temperature and SMB. In other words, they are not based on observed surface temperature but on estimated surface temperature derived from $\delta^{18}O$.

We have changed this sentence to illustrate this:

However, some studies (Fudge et al., 2016; Altnau et al., 2015; Philippe et al., 2016; Goursaud et al., 2019) indicate that this SMB-surface temperature relationship (estimated by $\delta^{18}O$) is not always positive, and varies spatially and temporally.

by:

However, some studies using surface temperature reconstructions based on $\delta^{18}O$ data (Fudge et al., 2016; Altnau et al., 2015; Philippe et al., 2016; Goursaud et al., 2019) suggest that this SMB-surface temperature relationship is not always positive and varies spatially and temporally.

P10, Figure 3: Where does the very low reconstructed value for West Antarctica in ∼1700 come from?

This very low value is likely related to the low number of ice cores used for the SMB composite of the West Antarctica region at this time. As shown by Thomas et al. (2017), the regional SMB composites before 1800 are based on very few records, which can lead to large uncertainties. We have decided to only display the 1800-2010 period for the reconstruction to avoid those uncertain values.

P11, Figure 4: Please change the y-axis and x-axis labels. Slope West/Slope East is unclear.

We agree that this plot is unclear. We have changed the plot to make it clearer (see the response to the second review).

P12, Figure5: why is this shown in a contour plot? To me this is confusing. Can't you make a scatter plot (such as Fig. 7) showing the correlations?

We think it is important to display the correlations between SMB and surface temperatures on a map instead of a scatter plot to keep the spatial dimension. For example, by analyzing the results for RACMO2, we observe that the coastal regions of East Antarctica display weak correlations between the two variables. Replacing this map by a scatter plot will remove this spatial information, which is important in our interpretation.

P17, Discussion and conclusions: Same comments for this section as for the abstract:
I miss a clear emphasis on the main conclusion of the manuscript. How can these datasets be used in future work? What's the relevance of the study? What's the most important take-home message? I expect that the authors can easily strengthen the relevance of the study by giving this some extra thoughts.

We will change our conclusion in order to strengthen our main findings as asked by the referee.