

**Comments of Stefanini et al. “Snow accumulation rates at Concordia Station,
Antarctica, observed by stake farms”**

The Antarctic surface mass balance is a key factor and an important source of uncertainty in understanding the current total Antarctic mass balance and its contribution to global sea level rise, and thus deserves to be studied fully. However, Antarctic SMB measurements remain challenging due to its isolated location and harsh environment, which is even more evident in the Antarctic interior, although some continuous measurements have been maintained at South Pole, Vostok, and Dome F, etc. This study utilized stake farms installed around Concordia Station by Italy and France, combined with reanalysis and regional climate models to assess the SMB in the vicinity of Dome C, providing important information about the interior Antarctic SMB. Overall, this study is well done, but there are still some places that need to be enhanced to make the study completer and more meaningful. Therefore, I would recommend the authors to make a major revision of the manuscript before it can be published.

Specific comments:

1. L27-28: In the Abstract, the authors should specifically point out what kind of effects of buildings on SMB, e.g. whether it increases or decreases the snow accumulation rate? Do the buildings primarily influence the snow blowing or snow falling process? If possible, explain in detail the dynamical mechanisms by which buildings located upwind may have an impact on snowfall.
2. Introduction: The authors have described the significance and some advances on Antarctic SMB measurements, to which I suggest some additions. On the one hand, please add more articles on the factors and mechanisms affecting snow accumulation variations in Antarctic interior, which can include the Dome C, South Pole, Vostok, Dome A and Dome F. On the other hand, there are a number of findings based on deep ice cores and stake farms available at these stations (e.g., Fujita et al., 2011; Lazzara et al., 2012), suggesting that the authors include them in the introduction. Moreover, I recommended the authors to cite two papers (Wang et al., 2021; 2023), they integrated the Antarctic SMB observations and Automatic Weather Stations, which can provide more details for the Introduction and make it completer. In the quality-controlled SMB

dataset, in addition to stakes and stake farms, SMB measurements based on other means, such as snow pits, ice cores, ultrasonic sounders, and ground-penetrating radar were collected. They also introduce some AWS instrument installation, sensor and data quality control standards, which includes the Dome C and may be useful for introducing AWS accuracy in this study. A few are listed here, and I suggest that authors actively search for more literature and summarize them.

Fujita, S., Holmlund, P., Andersson, I., et al. (2011). Spatial and temporal variability of snow accumulation rate on the East Antarctic ice divide between Dome Fuji and EPICA DML, The Cryosphere, 5, 1057–1081, <https://doi.org/10.5194/tc-5-1057-2011>.

Lazzara, M. A., Keller, L. M., Markle, T., & Gallagher, J. (2012). Fifty-year Amundsen–Scott South Pole station surface climatology. Atmospheric Research, 118, 240-259.

Wang, Y., Ding, M., Reijmer, C. H., et al. (2021). The AntSMB dataset: a comprehensive compilation of surface mass balance field observations over the Antarctic Ice Sheet, Earth Syst. Sci. Data, 13, 3057–3074, <https://doi.org/10.5194/essd-13-3057-2021>.

Wang, Y., Zhang, X., Ning, W., et al. (2023). The AntAWS dataset: a compilation of Antarctic automatic weather station observations, Earth Syst. Sci. Data, 15, 411–429, <https://doi.org/10.5194/essd-15-411-2023>.

3. Data and methods: 2.2 Reanalysis and regional climate models: Please detail how SMB or snow accumulation rates from reanalysis (or regional climate models) are calculated. Is it precipitation minus evaporation? I see a similar description in the Results, but they should have been made clear in the second section.

4. I would strongly encourage the authors to go into more detail about the sites and sensors, their measurement metrics and possible errors in section 2.4. Perhaps a table could be created.

5. Results: I would suggest that the authors place sections 4.1 and 4.2 in the Results rather than in the Discussion. In terms of content, they are more of a description of the Results.

6. L222: This algorithm may artificially create some differences between reanalyzes, regional climate models and stake farms. Considering the temporal and spatial continuity of the simulation results, it is recommended that the authors divide the

accumulation period based on measurements (possibly based on French stake farms). Although not all the datasets are available with daily resolution, the authors should have added at least some results from products capable of providing daily resolution data as a validation, such as ERA5 and MERRA-2.

7. L370-376: I don't think the description here is adequate, please explain in conjunction with simulations or other studies how buildings have affected the snow accumulation rate, especially when the atmospheric aquifer is not primarily concentrated in the lower atmosphere. Also, is the main effect of buildings reducing or increasing snowfall, or changing the wind scouring of deposited snow? This is similar to the 1st comment.

--L378: ablation-->wind ablation.

8. L381-383: "Besides, black carbon produced by the Station can also affect the albedo causing differences in surface temperature, sublimation, and surface hoar frost formation, impacting the final snow accumulation". It's an interesting thing, so is it possible to provide more descriptions about how to influence them (Just cite more papers to explain it). In particular, I would like to know what is the source of these black carbon? Also, if they have a large effect on the surface temperature, sublimation, and surface hoar frost formation, even the surface mass balance, does this mean that expedition activities will obviously affect the ice, and what should be done to minimize this effect?

9. Discussion: I don't think the sections 4.3 and 4.4 are well delineated. A more sensible approach would be to first describe the effects of wind on snow accumulation rates, and then discuss their interaction with station buildings in more detail in the second section.

10. Current analyses of the effect of wind on snow accumulation rates have focused on resolving the differences between the two stake farms, and whether it is possible to provide more information on whether wind direction, wind speed, or other surface processes influence the overall accumulation rate results than spatial variability.

11. The authors discussed the effects of a number of localized factors on Dome C snow accumulation rates, and as the authors cited a few studies, these have actually been mentioned before. Therefore, to add an innovative point, I suggest that the authors add some results to discuss the factors controlling the variability or interannual fluctuations

in snow accumulation rates (since the authors claim that there is not a significant trend), and that studies could be carried out in terms of factors such as local temperatures and clear-sky precipitation, then to discuss the impacts of large-scale forcing such as SAM and ENSO on the snow accumulation rate.

12. Figure 12: Explain any reference for the selection of the threshold.

13. L439-L441: Such events have been widely watched and studied, and I encourage authors to analyze the accumulation values during several extreme events and judge their contribution to the annual accumulation values, based on observational data available at monthly resolution.

14. A small question: the anomalies calculated in this manuscript are relative anomalies (%), could absolute anomalies (cm or mm) be provided for comparison? These can be placed in the supplementary file.

15. Improvement of the figure: Figure 1: This figure could be improved. First, the font of **a), b) and c)** is too big compared to the rest of the information on this figure and I would suggest that the authors adjust the font size. Also, it is recommended that the three subfigures be placed on one page after stitching them together instead of splitting them on two pages.

--Figure 1 and Figure 2: I suggest that the author remove the white area from the figure that doesn't present any information.

--Figures 4 and 5 can be stitched together as sub-figures, which can be easily compared by readers.