The Cryosphere

Supplement of

Impact of boundary conditions on the modeled thermal regime of the Antarctic ice sheet

In-Woo Park et al.

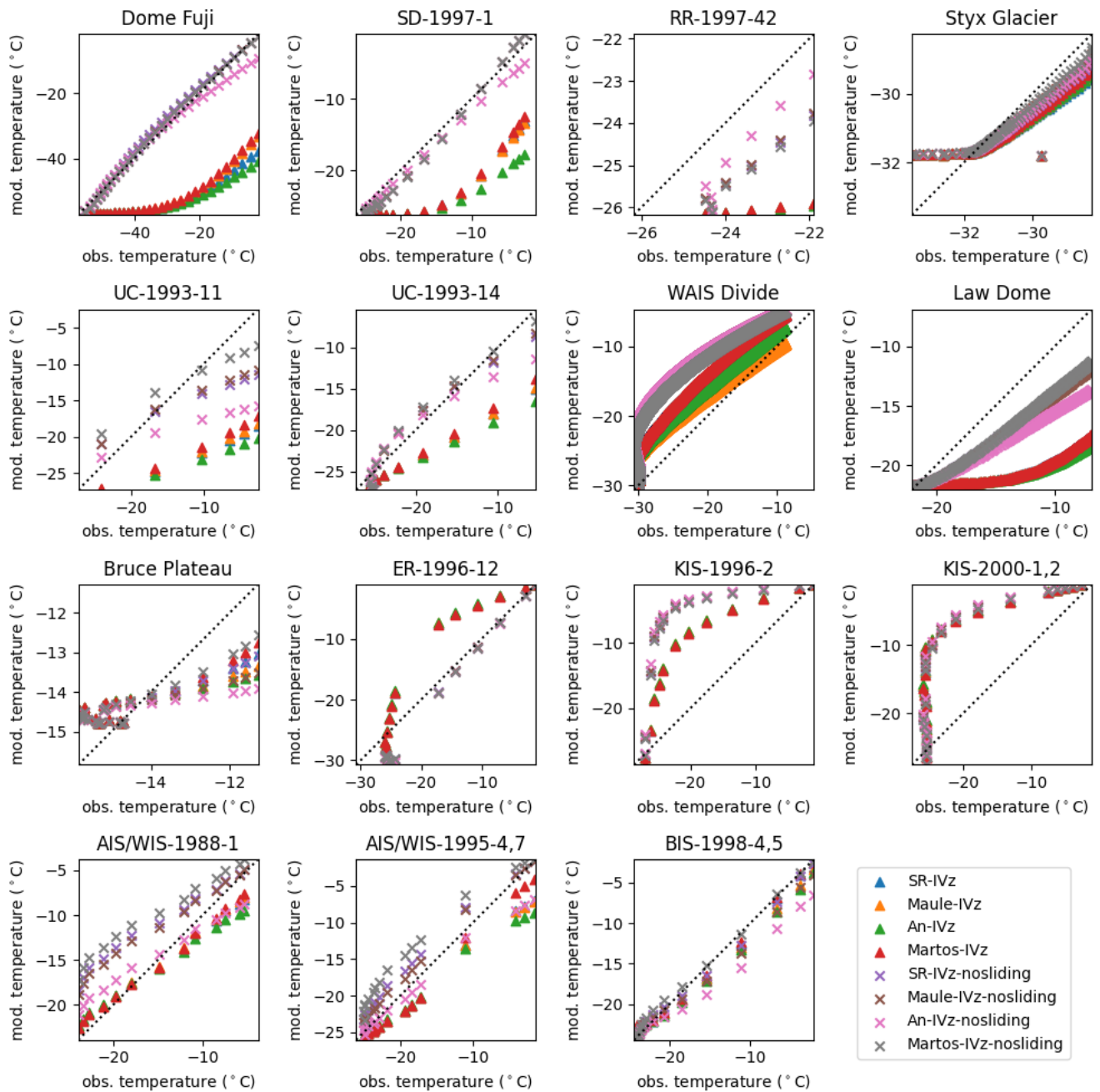*Correspondence to:* Emilia Kyung Jin (jin@kopri.re.kr)

Figure S1. Scatter plot showing the relationship between modeled and observed temperatures at each borehole depending on each experiment. Cross and triangle dot indicate IVz and IVz-nosliding group, respectively. A dashed solid line indicates modeled temperature equal to observed temperature.
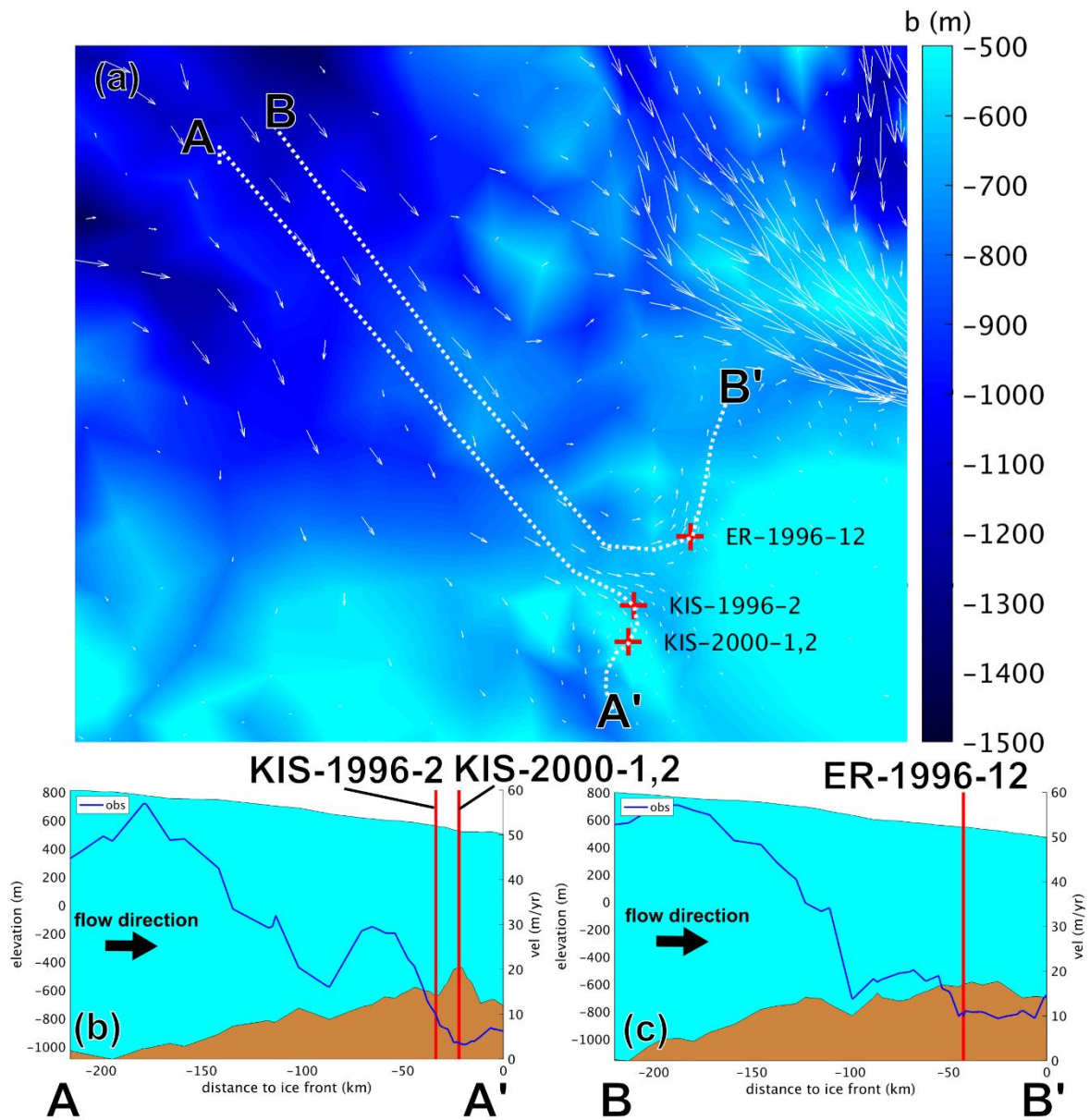
Figure S2. (a) Bed geometry and ice velocity map at ER and KIS boreholes. (b, c) Cross sectional geometry and ice velocity along the $\overline{AA`}$ and $\overline{BB`}$ section lines in (a). Red vertical lines in (b,c) indicate the location of KIS and ER boreholes.
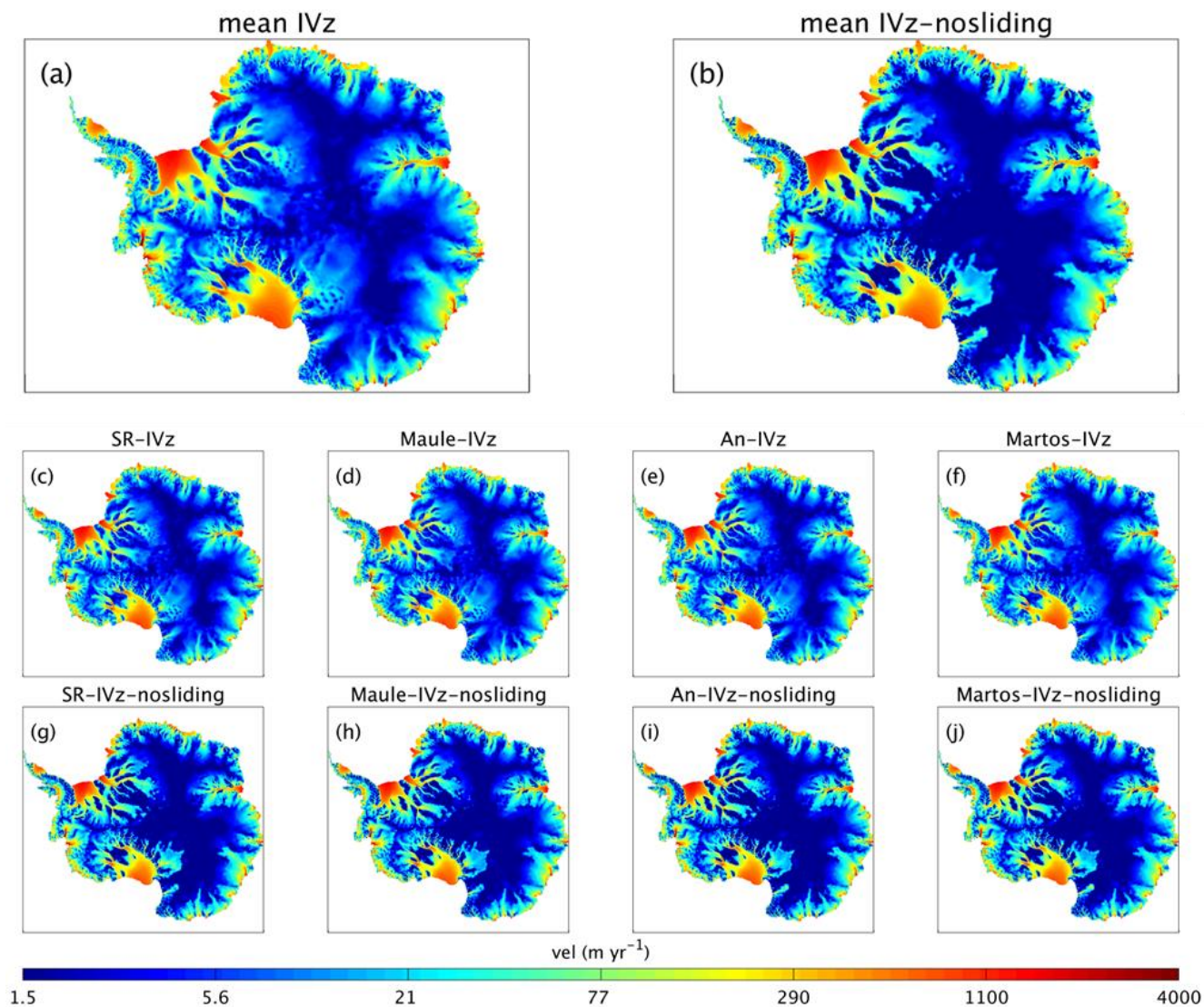
Figure S3. Upper panels (a,b) indicate the mean modeled velocity for (a) IVz group and (b) IVz-nosliding group. Lower panels (c-h) indicate the modeled ice velocity for each initialization.
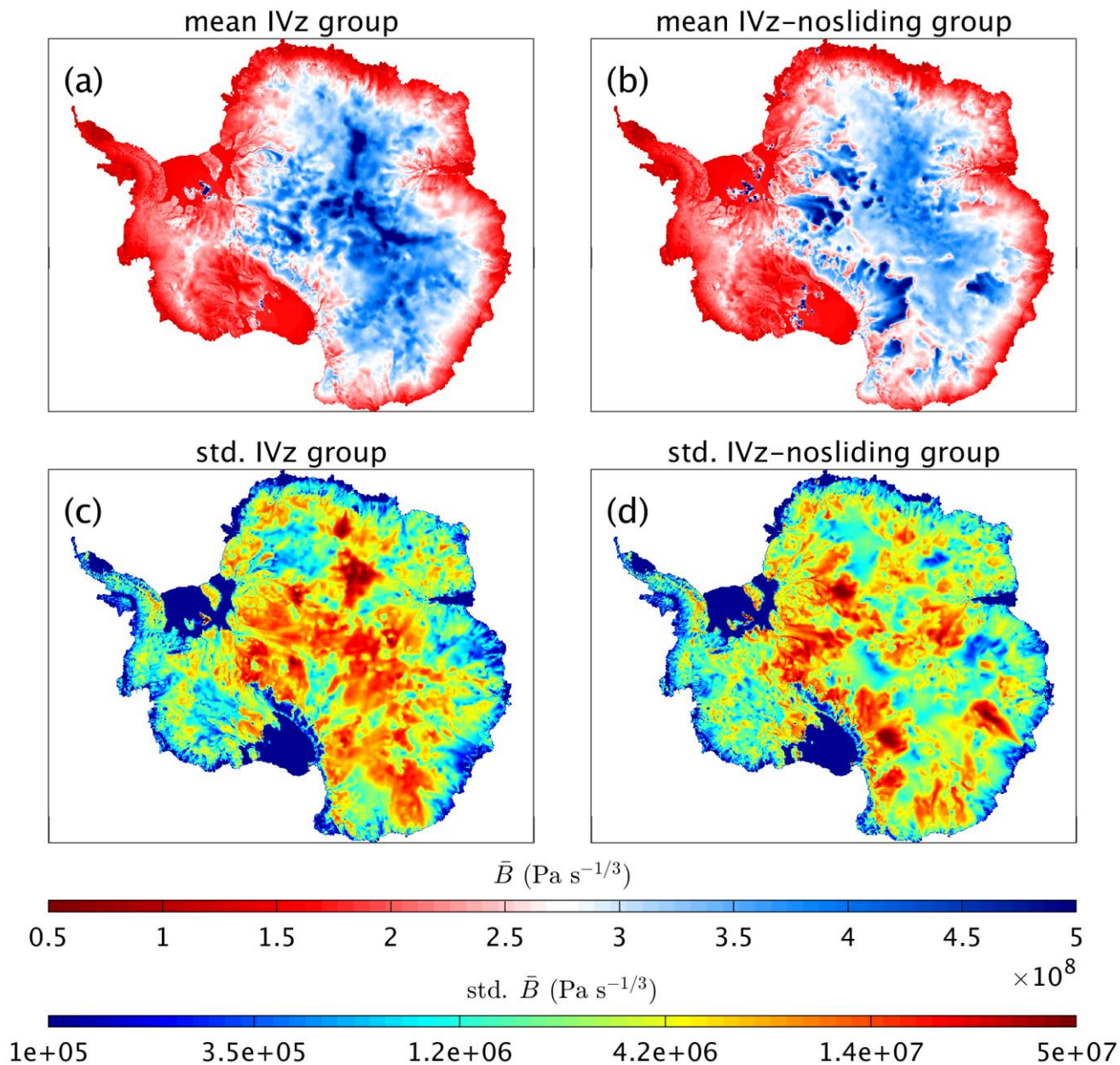
Figure S4. Mean (a,b) and standard deviation (c,d) of depth averaged rigidity for IVz and IVz-nosliding groups.
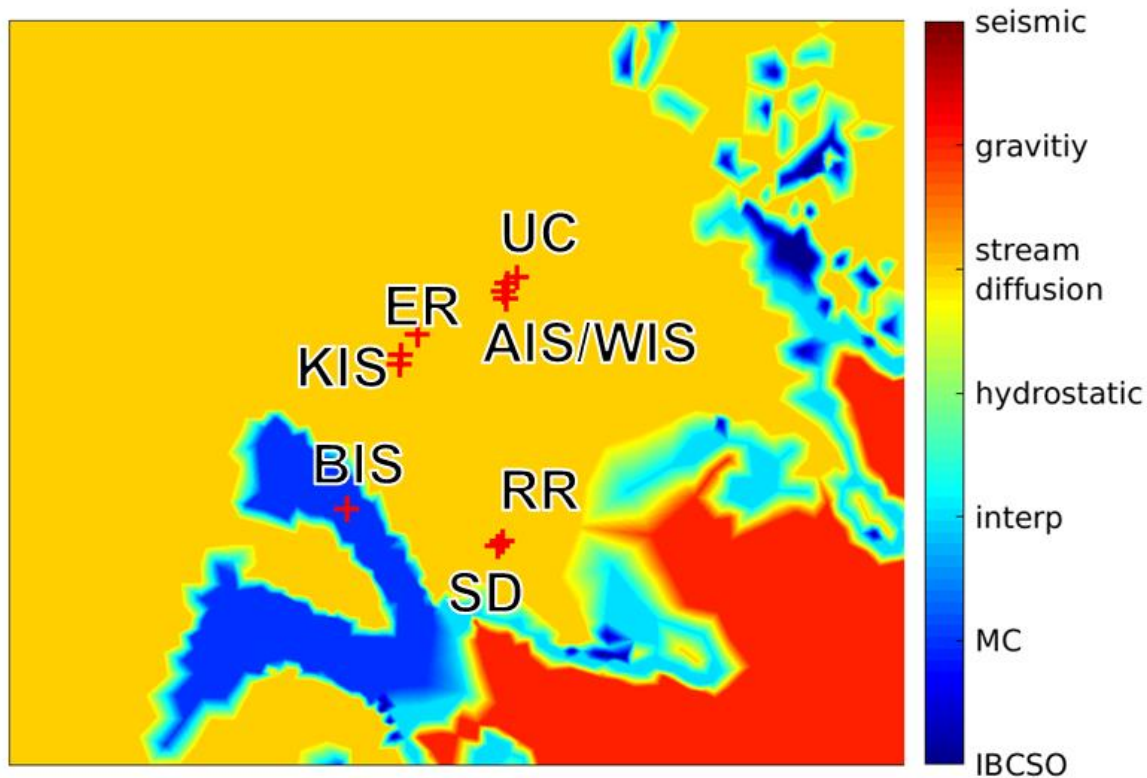
Figure S5. Methods for generating bed geometry of BedMachine at the West Antarctic Ice Sheet (WAIS) discharged to Ross Ice Shelf (Morlighem et al., 2020). Except for the geometry near Bindschadler Ice Stream (BIS) borehole, the geometry of other boreholes is generated using stream diffusion method, whereas, BIS region is generated using mass conservation method.
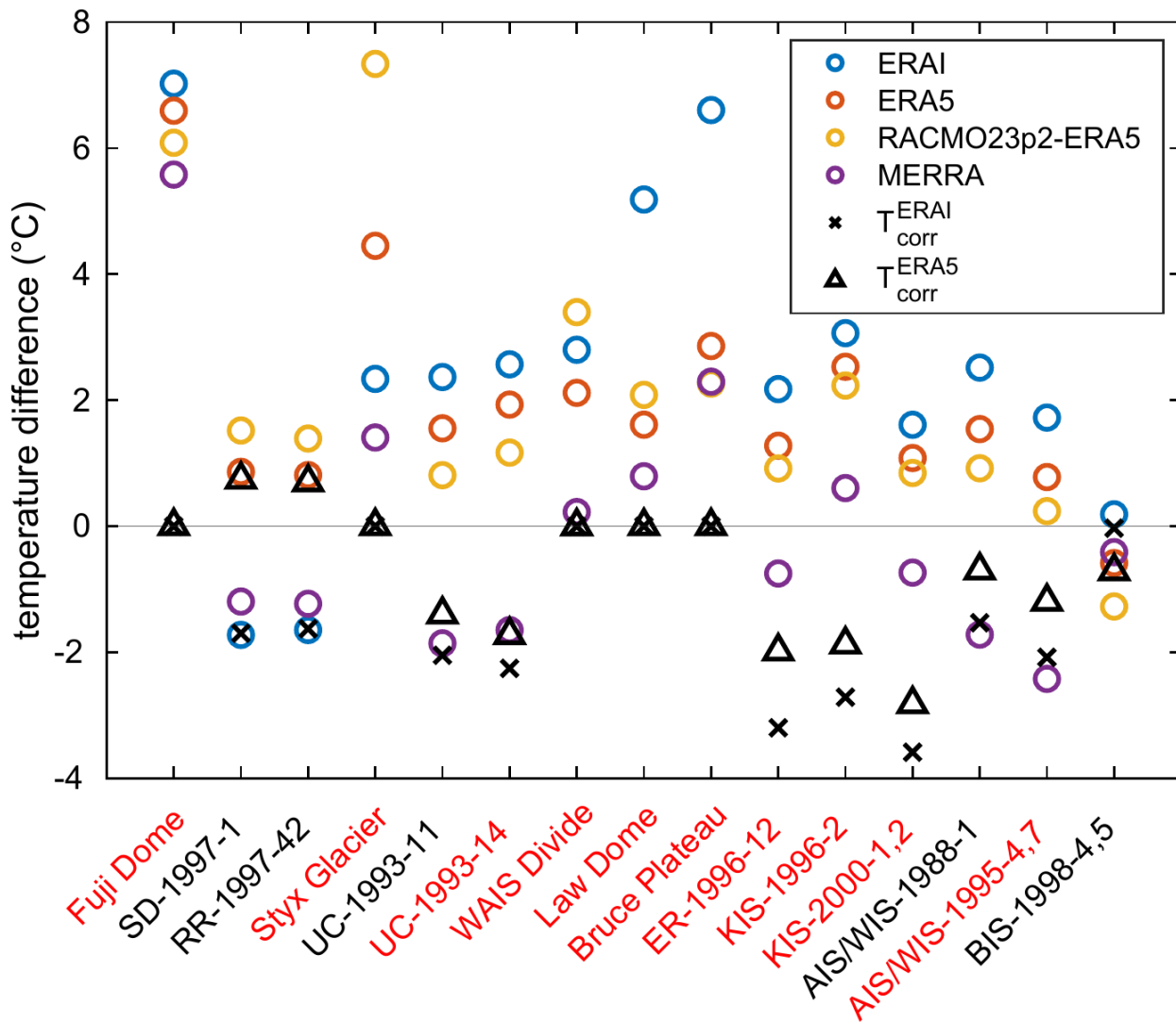
Figure S6. Difference between the climatological mean 2-m air temperature and observed surface temperature at each borehole. The climatological means for ERA-Interim (hereafter ERAI), ERA5 (Hersbach et al., 2023), RACMO23p2-ERA5 (van Wessem et al., 2023), and MERRA2 (Global Modeling and Assimilation Office (GMAO), 2015) are from the period 1979-2018. Borehole names highlighted in red indicate where surface ice temperature is corrected using exponential decay. T_{corr} indicates the difference between the corrected and observed temperatures for ERAI and ERA5.
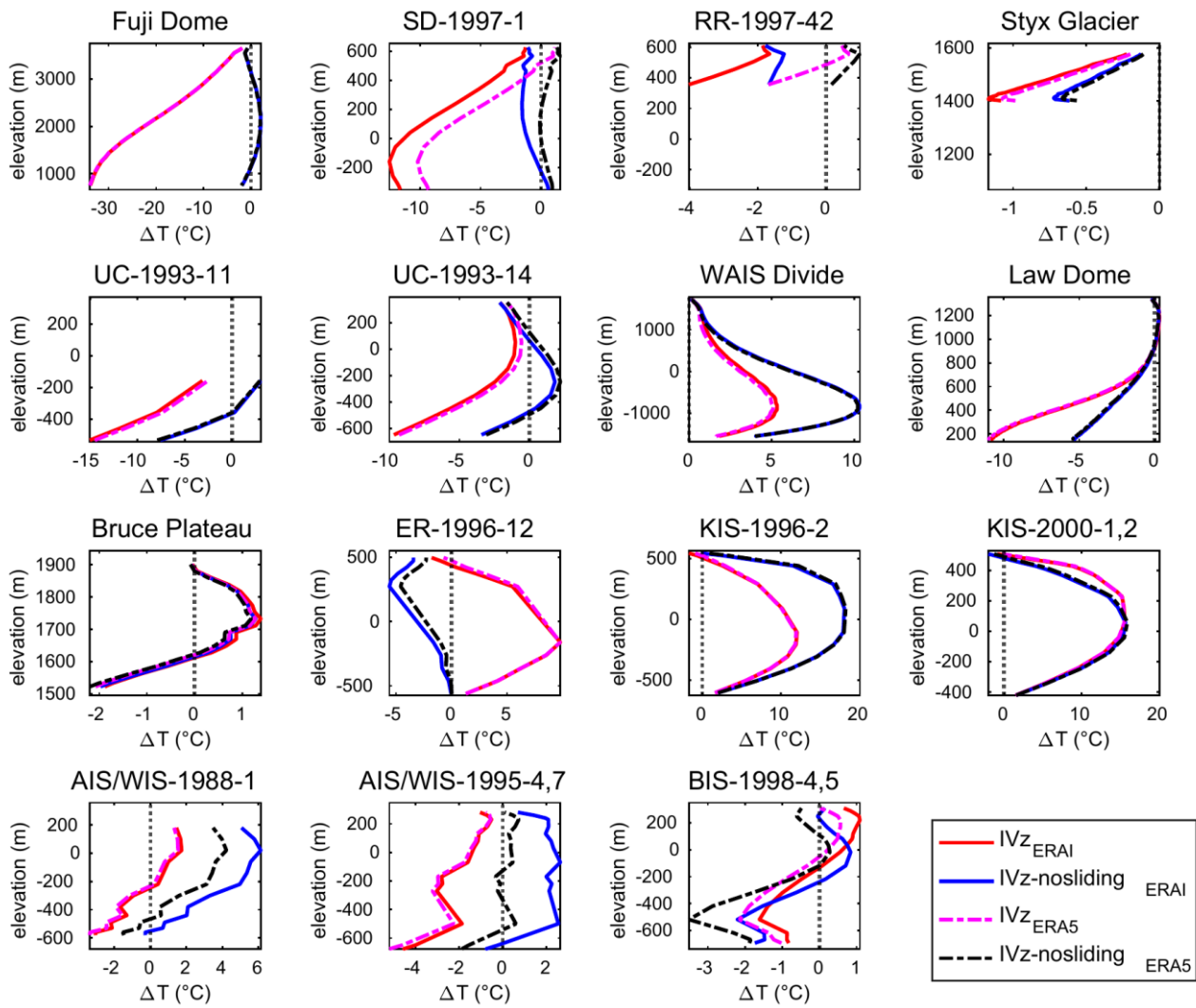
Figure S7. Differences between observed and the mean modeled vertical temperature profiles depend on each experiment group. A black vertical dashed line indicates where the misfit is zero.

References

Global Modeling and Assimilation Office (GMAO): MERRA-2 instM_2d_asm_Nx: 2d,Monthly mean, single-level, assimilation, Single-Level diagnostics V5.12.4, Greenbelt, MD, USA: Goddard Space Flight Center Distributed Active Archive Center (GSFC DAAC), https://doi.org/10.5067/5ESKGQTZG7FO, 2015.

Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., and Thépaut, J.-N.: ERA5 monthly averaged data on single levels from 1940 to present, Copernicus Climate Change Service (C3S) Climate Data Store (CDS), https://doi.org/DOI: 10.24381/cds.f17050d7, 2023.

Morlighem, M., Rignot, E., Binder, T., Blankenship, D., Drews, R., Eagles, G., Eisen, O., Ferraccioli, F., Forsberg, R., Fretwell, P., Goel, V., Greenbaum, J. S., Gudmundsson, H., Guo, J., Helm, V., Hofstede, C., Howat, I., Humbert, A., Jokat, W., Karlsson, N. B., Lee, W. S., Matsuoka, K., Millan, R., Mouginot, J., Paden, J., Pattyn, F., Roberts, J., Rosier, S., Ruppel, A., Seroussi, H., Smith, E. C., Steinhage, D., Sun, B., Broeke, M. R. van den, Ommen, T. D. van, Wessem, M. van, and Young, D. A.: Deep glacial troughs and stabilizing ridges unveiled beneath the margins of the Antarctic ice sheet, Nat. Geosci., 13, 132–137, https://doi.org/10.1038/s41561-019-0510-8, 2020.

van Wessem, J. M., van de Berg, W. J., and van den Broeke, M. R.: Data set: Monthly averaged RACMO2.3p2 variables (1979-2022); Antarctica, , https://doi.org/10.5281/zenodo.7845736, 2023.