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The regional-scale surface mass balance of Pine Island Glacier, West Antarctica, over the period 2005–2014, derived from airborne radar soundings and neutron probe measurements

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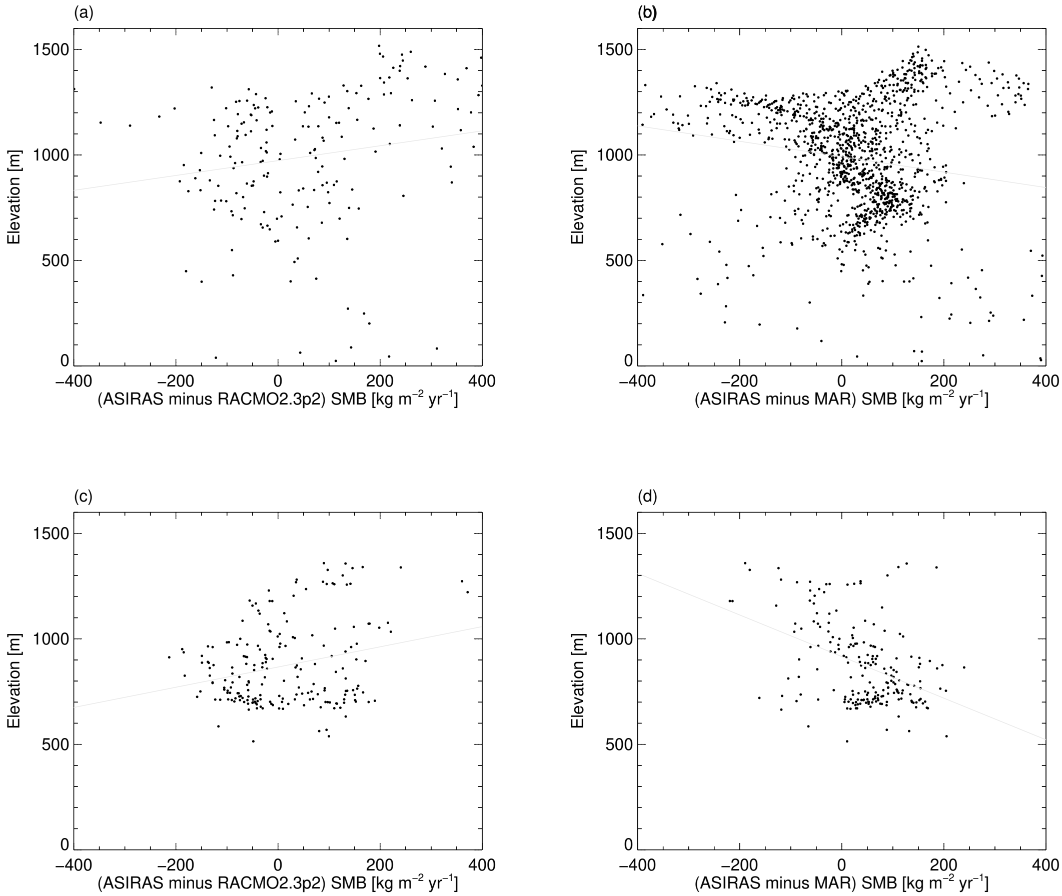

Figure S1. (a,b) ASIRAS OLK SMB "minus" simulated SMB against elevation based on Helm et al. (2014) with linear regression line. (c,d) Smoothed ASIRAS SMB according to Fig.5 (b) main text "minus" simulated nearest neighbour SMB.

Elevation dependent model drift

To evaluate a potential elevation dependent drift between Surface Mass Balance (SMB) estimates from ASIRAS and simulated SMB from the RACMO and MAR regional climate models, we first calculated the average SMB from overlapping ASIRAS estimates for each areal model pixel. Then, we subtracted the simulated SMB from the average ASIRAS SMB estimate for each pixel and assign its elevation to the digital elevation model provided by Helm et al. (2014). Due to the limited practical range of the ASIRAS ordinary logarithmic kriging (OLK) estimates, we only consider points inside the PIG outlines that do not exceed a maximum range limit of $100\ \mathrm{km}$ to the ASIRAS observations.

Figure S1 (a,b) shows the corresponding scatter plots with respect to the RACMO and MAR simulations respectively. The slope of the indicated linear regression line in Panel (a) is in agreement with the finding by Medley et al. (2014) that RACMO tends to underestimate SMB values at higher elevation and, vice versa, overestimate SMB values at lower elevation. The large scattering indicates a weak correlation in terms of an elevation dependent SMB bias. However, a Kendall's rank correlation test with $\alpha = 0.05$ significance level suggests that both variables are significantly correlated with each other, which corroborates the finding of Medley et al. (2014). With respect to the simulated SMB by MAR (Panel b), the slope of the linear regression line is negative in contrast to Panel (a). The large scattering persists and it seems that some clusters of scattering points exist, which may be constrained to local areas. Despite the weak correlation between scattering points, a Kendall's rank test with $\alpha = 0.05$

suggests that it is still significant. According to Agosta et al. (2019) MAR tends to simulate significantly lower snowfall rates near ice sheets margins than RACMO, which the authors explain by the effect of sublimation of precipitating particles in low-level atmospheric layers. Hence, this finding would support a negative slope similar to that of Panel (b). However, the scattering of the SMB bias is rather strong at low elevation levels in Panel (b), hence, it is difficult to judge if this finding is supported by our results.

We repeated the elevation dependent comparison between observed and simulated SMB estimates in Panels (c,d) but limit it to the smoothed ASIRAS SMB estimates according to Fig.5 (b) in the main text and nearest neighbour estimates from the RACMO and MAR models respectively to rule out a potential impact of the OLK procedure on the elevation dependent drift between simulated and observed SMB. The signs of slopes persist for both models, but the elevation range is limited to the ASIRAS flight track. The scattering remains strong and we have to increase α to 0.1 to reject the Null hypothesis based on a Kendall's rank test for Panel (c) while the correlation remains significant for $\alpha = 0.5$ in Panel (d).

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