The Cryosphere

Supplement of

Net effect of ice-sheet–atmosphere interactions reduces simulated transient Miocene Antarctic ice-sheet variability

Lennert B. Stap et al.

Correspondence to: Lennert B. Stap (l.b.stap@uu.nl)

Table S1. Resulting amplitude of ice volume variability in the equilibrium cycle of the 40-kyr transient simulation, for the experiments testing the index method compared to the matrix interpolation method to obtain the climate forcing for the ice-sheet model.

	Precipitation via index method	Precipitation via matrix method
Temperature via index method	*Case NOFEEDB* 34.1 m.s.l.e.	*Case NOFEEDB-T* 36.1 m.s.l.e.
Temperature via matrix method	*Case NOFEEDB-P* 19.3 m.s.l.e.	*Case REF* 27.1 m.s.l.e.
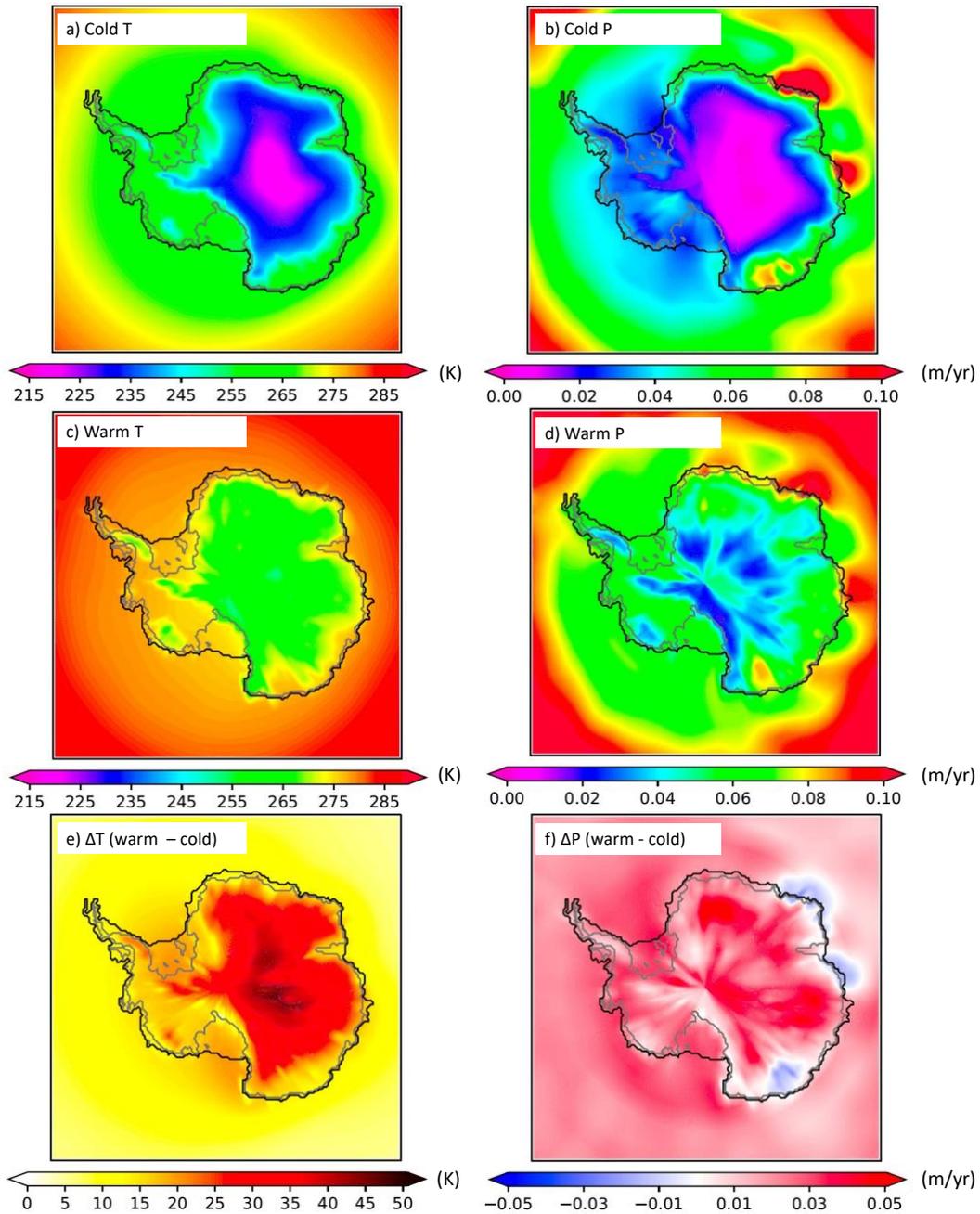
Figure S1. (**a**) Annual average GENESIS 2-m air temperature and (**b**) precipitation, remapped to the 40x40-km ice-sheet-model grid, from the cold (1fumebi) simulation. (**c**) and (**d**) Same for the warm (3nomebi) simulation. (**e**) Difference between the warm and cold temperatures and (**f**) precipitation (warm - cold).
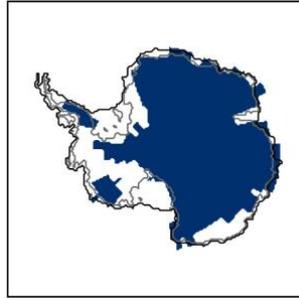
Figure S2. Ice mask used in the cold GENESIS simulation (1fumebi), remapped to the 40x40-km ice-sheet-model grid. Grey and black lines indicate the Bedmachine present-day grounding line and continental edge respectively. N.B. In the warm GENESIS simulation (3nomebi), the ice mask is zero everywhere.
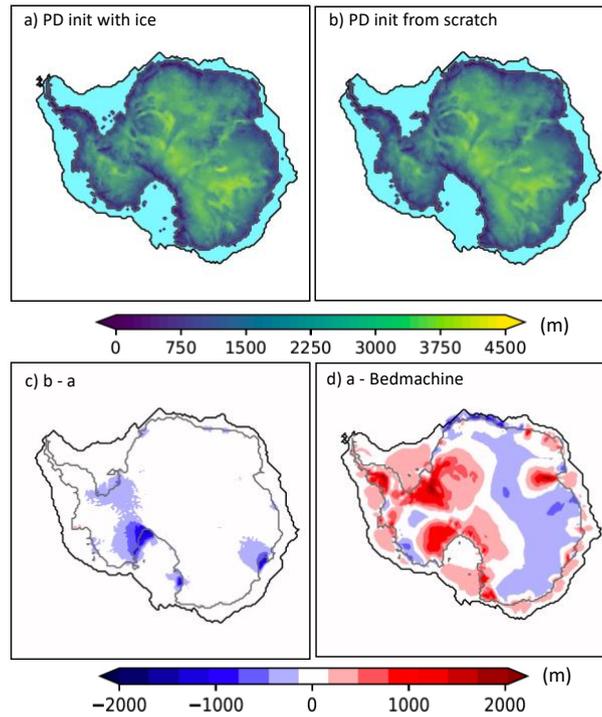
Figure S3. (**a**) Simulated equilibrated grounded ice thickness using present-day (PD) forcing starting from Bedmachine PD ice and topography and (**b**) without ice and an isostatically rebounded topography. Cyan areas indicate ice shelf extent. (**c**) Difference in ice thickness between (**b**) and (**a**) (grounding line and continental edge as in (**b**)), and (**d**) difference between (**a**) and Bedmachine data remapped to our 40x40-km model grid (grounding line and continental edge as in (**a**)).
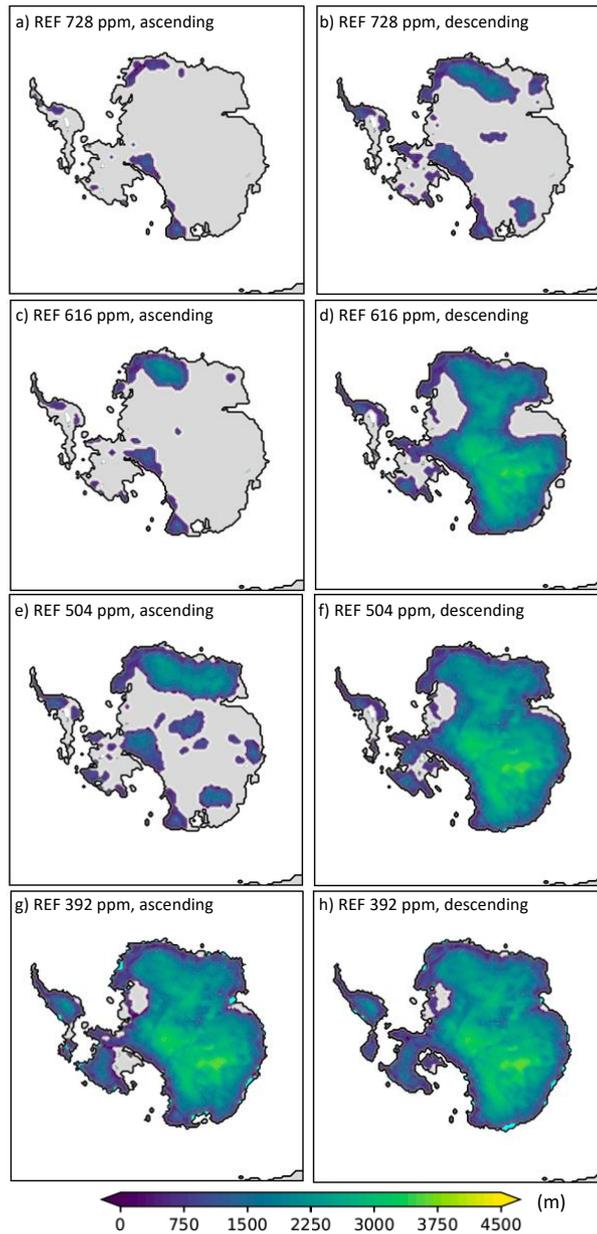
Figure S4. (a) Simulated equilibrated grounded ice thickness from experiment REF with 728-ppm CO2 forcing, starting without ice (ascending branch) and **(b)** continuing from the 280-ppm simulation (descending branch). Cyan areas indicate ice shelf extent, grey areas ice-free land.
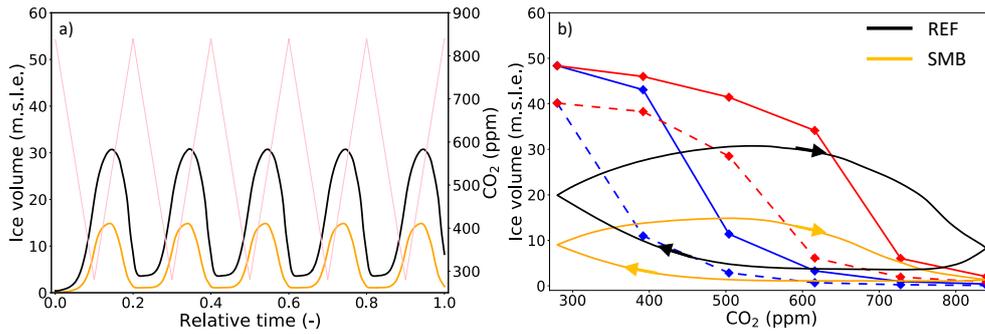
Figure S5. (a) Evolution of forcing CO_2 levels (pink) and ice volume above flotation (in meters sea level equivalent) over time (relative to the length of the simulation), for the transient REF (black) and SMB (orange) simulations. **(b)** Relation between CO_2 and equilibrium ice volume (REF, solid red and blue; SMB, dashed red and blue), and transient ice volume (as in **(a)**). Arrows in **(b)** indicate the progression direction of ice volume.
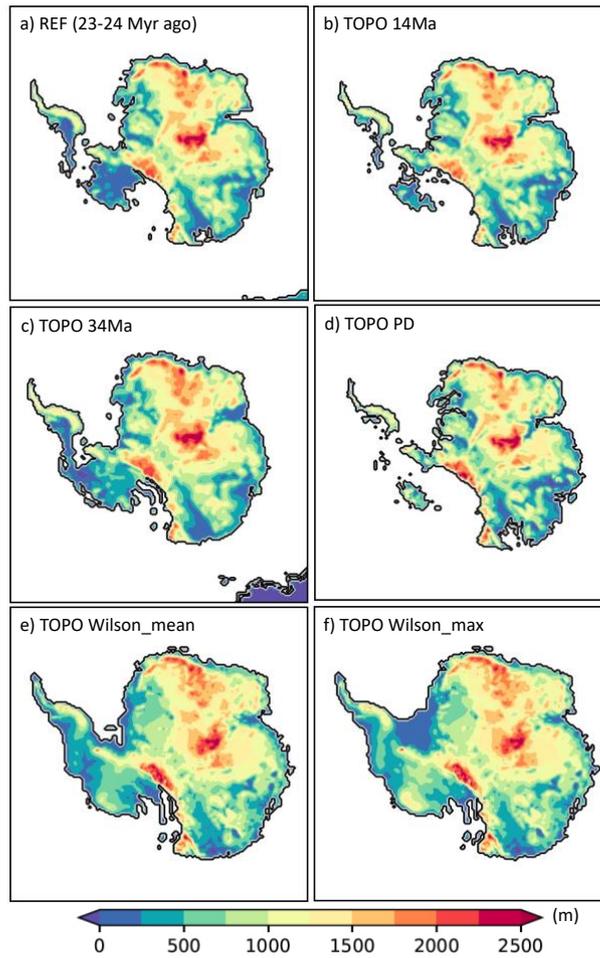
Figure S6. Input initial bedrock topography for experiments **(a)** REF, **(b)** TOPO 14Ma, **(c)** TOPO 34Ma, taken from Paxman et al. (2019), for experiment **(d)** TOPO PD, taken from Morlighem et al. (2020), and for experiments **(e)** TOPO Wilson_mean, and **(f)** TOPO Wilson_max, taken from Wilson et al. (2012). White areas indicate ocean.
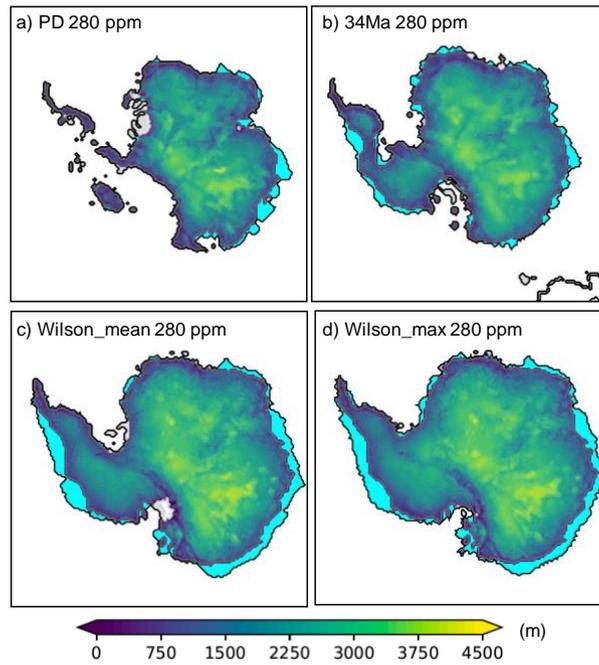
Figure S7. (**a**) Simulated equilibrated grounded ice thickness from experiment TOPO PD, (**b**) TOPO 34Ma, (**c**) TOPO Wilson_mean, and (**d**) TOPO Wilson_max, with 280-ppm CO_2 forcing. Cyan areas indicate ice shelf extent, grey areas ice-free land.
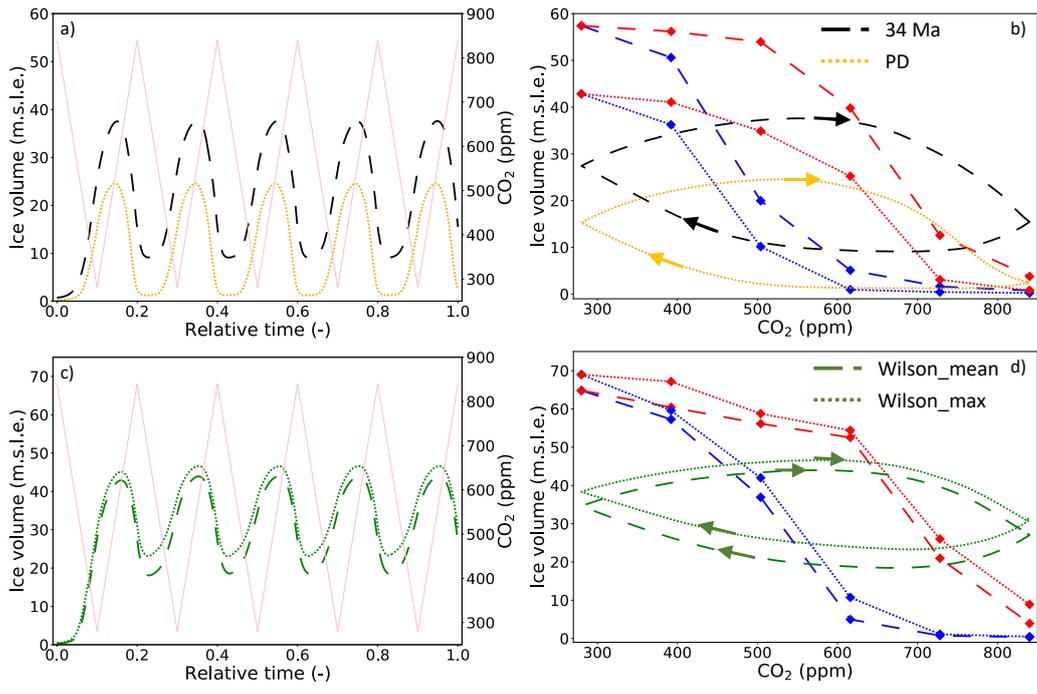
Figure S8. (a) Evolution of forcing CO_2 levels (pink) and ice volume above flotation (in meters sea level equivalent) over time (relative to the length of the simulation), for the transient TOPO 34 Ma (black, long-dashed) and TOPO PD (orange, dotted) simulations. **(b)** Relation between CO_2 and equilibrium ice volume (TOPO 34Ma, long-dashed red and blue; TOPO PD, dotted red and blue), and transient ice volume (as in **(a)**). **(c)** and **(d)** Same for the TOPO Wilson_mean (long-dashed red, blue and green) and TOPO Wilson_max (dotted red, blue and orange) equilibrium and transient 40-kyr simulations. Mind the differing y-axis scales.
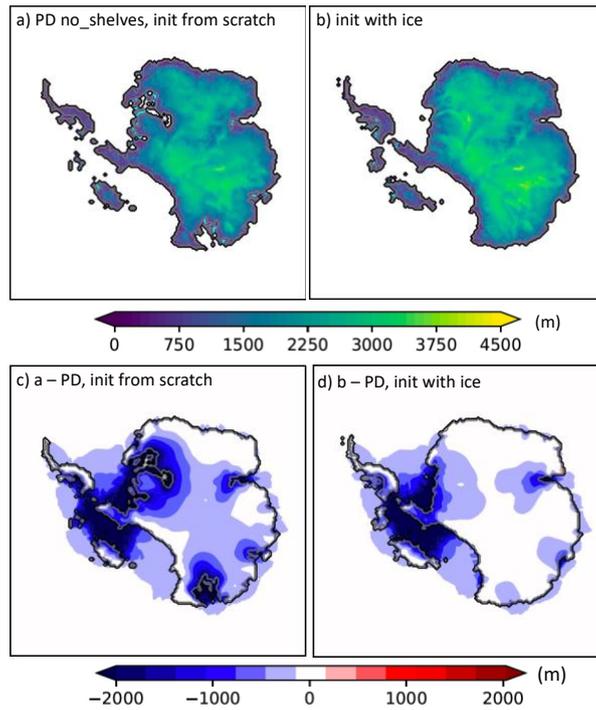
Figure S9. (**a**) Simulated equilibrated grounded ice thickness using present-day (PD) forcing starting without ice and an isostatically rebounded topography and (**b**) from Bedmachine PD ice and topography, applying a constant basal melt rate of 400 m/yr. The small cyan areas indicate the ice shelf extent that exists despite the high basal melt rates. (**c**) Difference in ice thickness between (**a**) and the reference PD simulation started without ice and an isostatically rebounded topography (grounding line and continental edge as in (**a**)), and (**d**) between (**b**) and the reference PD simulation (grounding line and continental edge as in (**b**).