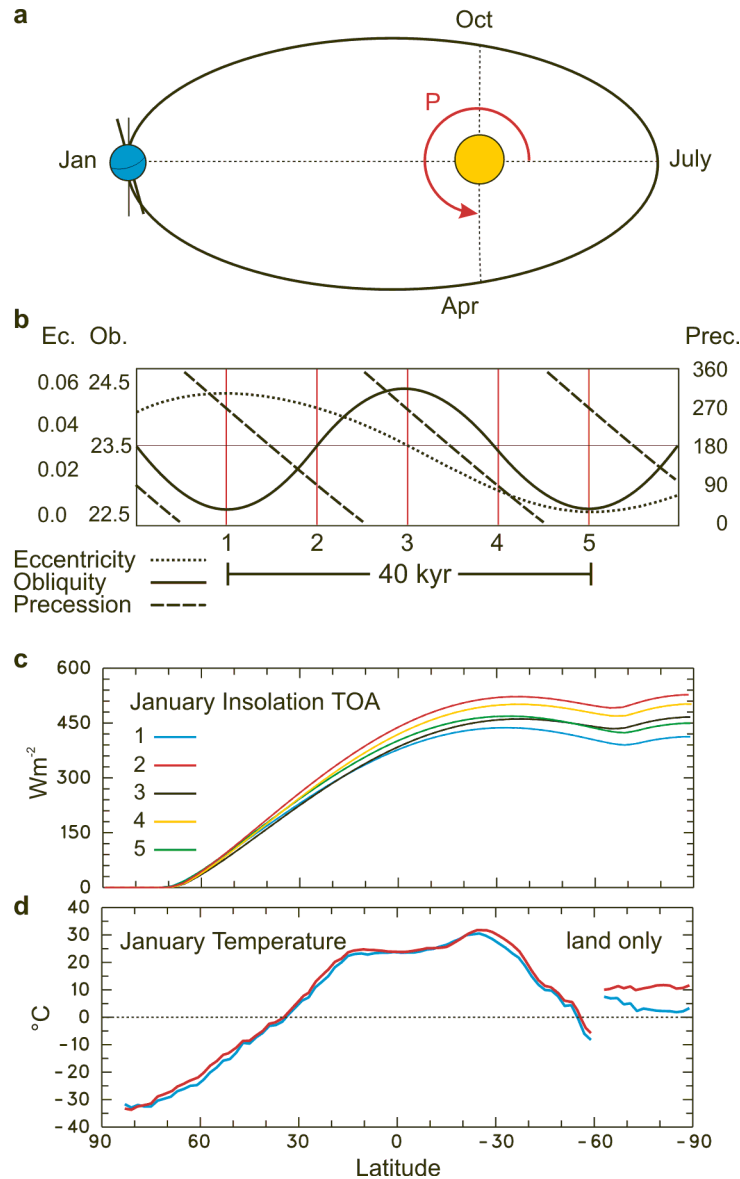




Supplementary Information Synthetic orbital parameters used in our GCM-ice sheet integrations and their potential effect on snow accumulation on an initially ice free Antarctica at $2\times\text{CO}_2$. All coupled GCM-ice sheet integrations used an idealized orbital cycle, with values of eccentricity and obliquity within the range of those calculated over the last 5 my^1 . **a**, A schematic representation of the orbital configuration used at the start of each 40-ky integration described in the Methods. P, the prograde angle between perihelion and the Northern Hemisphere vernal equinox, describes the precession cycle and determines the month when the Earth is at aphelion. **b**, The 40-ky synthetic orbital cycle used in our GCM-ice sheet simulations. Numbers 1-5 correspond to the timing of the GCM snapshot solutions every 10,000 years (first step). Orbital time-step 1 corresponds to the diagram in **a**, with maximum eccentricity (0.05), minimum obliquity (22.5°), and $P = 270^{\circ}$. **c**, Austral summer (January) insolation at the top

of the model atmosphere, shown at each orbital time-step (1-5). **d**, The effect of orbital parameters at time-step 1 (blue) and 2 (red) on warmest month (January) zonal mean temperatures at $2\times\text{CO}_2$ on an ice-free Antarctica. The orbital configuration at time-step 1 maintains warmest monthly mean temperatures near 0°C , whereas the orbital configuration 10 ky later (blue) places Antarctica into a strongly negative snow mass balance, illustrating increased sensitivity to Milankovitch orbital variations during geologic periods with higher than present atmospheric CO_2 and small Antarctic ice sheets. Precession, usually considered secondary to obliquity forcing in high latitudes during the last 60 ka when eccentricities have been relatively low, has a large high latitude effect on Antarctic snow budgets during periods of high eccentricity.

1. Berger, A. & Loutre, M. F. Insolation values for the climate of the last 10,000,000 years. *Quaternary Science Reviews* **10**, 297-317 (1991).