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The effect of bedrock topography on East Antarctic ice sheet stability during the Cenozoic

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There has been a long standing disagreement regarding the stability of the East Antarctic ice sheet during the Oligocene, Miocene and Pliocene, the period after a continental sized ice sheet formed at the Eocene-Oligocene transition (EOT). Indirect evidence from benthic oxygen isotope records and from sequence stratigraphy has been used to suggest that there were large fluctuations in the volume of the Antarctic ice sheets during this interval. Provenance studies based on sediments recovered offshore of the east Antarctic continent suggest that there was significant ice retreat into the Wilkes Subglacial Basin during the Pliocene and possibly the Miocene. This is coupled with relatively low (typically $<$750 ppmv) atmospheric CO_2 during this interval as suggested by proxy records.

Until recently, ice sheet models have struggled to achieve significant ice loss from the East Antarctic ice sheet due to a strong hysteresis effect. Recent improvements in ice shelf physics and the addition of an ice cliff failure mechanism have helped to reconcile some of this disagreement, with significant ice loss simulated from the marine basins of the East Antarctic under Pliocene boundary conditions.

Here we present a number of coupled climate – ice sheet model simulations of the Antarctic ice sheet under EOT and Miocene boundary conditions, which include the recently developed ice sheet physics. Reconstructions of the bedrock topography of East Antarctica at the EOT and the Miocene suggest that the marine basins were less pronounced than modern (after accounting for isostatic loading). Although there is some retreat of the ice sheet into the marine basins, this would have a limited impact on sea level change ($\sim$5 m). Interestingly there is retreat into the Wilkes Subglacial Basin under Miocene boundary conditions, which is consistent with a recent sediment provenance study.