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Marine ice sheet collapse and terrestrial climate stability in Pliocene East Antarctica

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New marine evidence is emerging of ice sheet collapses in vulnerable marine basins of the East Antarctica during warm periods of the Pliocene. This contrasts the long-standing terrestrial evidence from the Dry Valleys and wider Transantarctic Mountains, showing landscape and climatic stability since the middle Miocene. This terrestrial evidence has been used to infer that the East Antarctic Ice Sheet has been large and in a similar state to today for at least 10 million years.

Here we present a series of sensitivity experiments using the HadCM3 General Circulation Model, simulating the impact of ice sheet retreats on Pliocene climate. Major collapses in the marine basins cause changes in the atmospheric circulation around East Antarctica and propagate warmer and wetter air masses into the interior of the ice sheet. However, remaining areas of upland ice sheet act to protect areas of the interior from increases in temperature and precipitation. Only when ice retreats from the upland areas between the subglacial basins and the Transantarctic Mountains of Northern Victoria Land are the Dry Valleys exposed to mean summer temperatures significantly above freezing and the full increases in modelled precipitation. This suggests that collapses of the marine portions of the Wilkes Subglacial Basin and Aurora Subglacial Basin would not have significantly altered the palaeoenvironmental record of the Dry Valleys. These results provide a reconciliation of the records of East Antarctic ice sheet retreat and climate stability and further corroborate the findings from marine cores.

We also present the results of an iceberg modelling study that shows that observed losses of Wilkes Land IRD in the Prydz Bay region cannot be explained by climate induced changes in melting or iceberg trajectory, but probably requires the loss of the marine margin of the Wilkes Land sector of the East Antarctic Ice Sheet.