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The Eocene-Oligocene boundary and the Antarctic Circumpolar Current

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Development of the Antarctic Circumpolar Current (ACC) during the Cenozoic is controversial both in terms of timing and regarding the role of the current in driving major climate transitions. It has been proposed that the development of the ACC, after the opening of the Drake Passage at the Eocene/Oligocene boundary, was instrumental in initiating glaciation on Antarctica. Palaeoclimate modelling has highlighted a decline in atmospheric CO2 concentration as the most likely cause of Antarctic glaciation with changes in the ACC and Antarctic topography of secondary importance. Using the Hadley Centre Coupled Climate Model version 3 to perform a suite of Oligocene experiments we demonstrate that whilst an ACC does initiate following the opening of Drake Passage its volume transport is weak compared to modern. The volume transport can be increased by prescribing an East Antarctic ice sheet in the model, but still it does not increase to modern. Only when the palaeogeography in the model is altered so that Australia is further north and the depth of Drake Passage exceeds 500 m does the model simulate a strong modern-type ACC. We conclude that the direct causal relationship between initial opening of Drake Passage, initiation of the ACC, thermal isolation of the continent and Antarctic glaciation is not demonstrated by our initial model results. Instead of acting as a trigger the role of the ACC may have been to reinforce Antarctic cooling which was initially caused by another mechanism.