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Drake Passage, pCO2 and Antarctica Cenozoic glaciation

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The Cenozoic glaciation of Antarctica marks the onset of a phase of the Earth's history characterized by the existence of large continental ice sheets. The long term trend of decreasing atmospheric CO_2 on the one hand, and tectonic activity leading to the opening and deepening of the Drake Passage (DP) on the other, have been invoked as potential main triggering mechanisms. Here we adopt an original approach based on a fully coupled climate-cryosphere model to investigate the role of both forcing factors on Antarctica glaciation and on global climate. Our results reveal that, although the rapid pCO_2 decrease plays a major role, the non-linear response of Antarctica hydrology to the DP opening is fundamental to explain the large ice sheet build up for CO_2concentration around three times the pre-industrial atmospheric level (PAL), as recorded in δ^{18}O data. Furthermore, it is only in case of open DP that the AIS volume evolution vs pCO_2 is characterized by an abrupt transition. Indeed, for open DP simulations, the inception of the AIS follows a threshold behaviour, consistent with the rapid shift recorded in δ^{18}O data at the Eocene-Oligocene boundary.

Keywords: Cenozoic Antarctic glaciation, climate system models, ice sheet models, climate-cryosphere coupling, Drake Passage