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Evolution of the Antarctic ice sheet throughout the last deglaciation: a study with a new coupled climate-north and south hemisphere ice sheet model

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The aim is to assess, through the understanding of deglaciation processes, the contribution of Antarctica to the sea-level rise during the last deglaciation. To achieve this goal, we used an Earth System model in which the interactions between the atmosphere, the ocean, the vegetation and the northern and Antarctic ice sheets are represented. This new tool allows the evolution of the Antarctic ice volume to be simulated, which starts to decrease at around 15 kyr BP. At the end of deglaciation, the melting of the Antarctic ice sheet contributes to an ice-equivalent sea-level rise of 9.5 m in the standard experiment and 17.5 m in a more realistic sensitivity experiment accounting for a different bathymetry in the Weddell Sea which succeeds in producing both major ice shelves (Ross and Ronne-Filchner). In both experiments, the melting of all ice sheets contributes to 121.5 m and 129.5 m respectively which is very consistent with data. The new coupled model provides a different timing and amplitude of Antarctic deglaciation than those previously obtained by prescribing the Vostok temperature record as a uniform temperature forcing. Sensitivity experiments have also been performed to analyse the impact of the parameters at the origin of the deglaciation process: insolation changes, atmospheric CO_2 variation, basal melting and sea-level rise. All those parameters have an influence on the timing of the deglaciation, but the sea-level rise, induced by northern hemisphere ice sheets melting, is shown to be crucial for the deglaciation evolution of the Antarctic ice sheet.