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Sensitivity of the CNRM-CM6-1 ocean-climate model to freshwater inputs from Antarctica

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Meltwater fluxes from Antarctica are in general poorly represented in ocean models in terms of quantity and spatio-temporal variability. These meltwater fluxes impact the stratification and the circulation of the Southern Ocean, which is a key component of the climate system. In particular, the opening of deep water polynyas depends, amongst other, on ocean stratification. In turn, these polynyas then, for instance, impact the ventilation of the Southern Ocean and the ocean-atmosphere exchanges of heat.

In this study, we explore how the ocean and sea-ice components of the CNRM-CM6-1 climate model are affected by the spatial distribution and magnitude of meltwater fluxes through three sensitivity experiments. In a first experiment, only a constant basal melting (restricted at the coast) is used as forcing. In a second experiment, only melting from monthly drifting icebergs is used. Finally, in a third experiment, both melting fluxes are used to force the model.

In our experiments, several deep water polynyas are diagnosed in the Weddell Sea and offshore of Pridz Bay. We find that these polynyas are places of deep-water formation impacting water masses properties over the entire column. In this study we analyze how the magnitude, occurrences and frequencies of occurrences of these polynyas are affected by the representation of the meltwater fluxes from Antarctica. We also diagnosed a deep water polynya around Maud Rise with features similar to the giant polynya observed every winter between 1974 and 1976.

Understanding the opening of these polynyas is challenging, since this requires an analysis on the stability of the water column and disentangling the role of external forcing (i.e. the role of the meltwater fluxes) from the model's internal variability.