Influence of freshwater input on the skill of decadal forecast of sea ice in the Southern Ocean

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Recent studies have investigated the potential link between the freshwater input derived from the melting of the Antarctic ice sheet and the observed recent increase in sea ice extent in the Southern Ocean. In this study, we assess the impact of an additional freshwater flux on the trend in sea ice extent and concentration in simulations with data assimilation, spanning the period 1850–2009, as well as in retrospective forecasts (hindcasts) initialised in 1980. In the simulations with data assimilation, including an additional freshwater flux that follows an autoregressive process improves the reconstruction of the trend in ice extent and concentration between 1980 and 2009. This is linked to a better efficiency of the data assimilation procedure but can also be due to a better representation of the freshwater cycle in the Southern Ocean or to some compensations for model deficiencies. The results of the hindcast simulations show that an adequate initial state can lead to an increase in the sea ice extent spanning several decades that is in satisfying agreement with satellite observations, even in the absence of any major change in the freshwater input. Therefore, while the additional freshwater flux appears to play a key role in the reconstruction of the evolution of the sea ice in the simulation with data assimilation, it does not seem absolutely required in the hindcast simulations. The present work thus constitutes encouraging results for sea ice predictions in the Southern Ocean as in our simulation, the positive trend in ice extent over the last 30 years is largely determined by the state of the system in the late 1970's.