Impact of the initialisation on the predictability of the Southern Ocean sea ice at interannual to multi-decadal timescales

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In this study, we assess systematically the impact of different initialisation procedures on the predictability of the sea ice in the Southern Ocean. These initialisation strategies are based on three data assimilation methods: the nudging, the particle filter with sequential resampling and the nudging proposal particle filter. An Earth-system model of intermediate complexity has been used to perform hindcast simulations in a perfect model approach. The predictability of the Southern Ocean sea ice is estimated through two aspects: the spread of the hindcast ensemble, indicating the uncertainty on the ensemble, and the correlation between the ensemble mean and the pseudo-observations, used to assess the accuracy of the prediction. Our results show that, at decadal timescales, more sophisticated data assimilation methods as well as denser pseudo-observations used to initialise the hindcasts decrease the spread of the ensemble but improve only slightly the accuracy of the prediction of the sea ice in the Southern Ocean. Overall, the predictability at interannual timescales is limited, at most, to three years ahead. At multi-decadal timescales, there is a clear improvement of the correlation of the trend in sea ice extent between the hindcasts and the pseudo-observations if the initialisation takes into account the pseudo-observations. The correlation reaches values larger than 0.5 and is due to the inertia of the ocean, showing the importance of the quality of the initialisation below the sea ice.