



## **Assessing the decadal predictability of Arctic sea ice in CNRM-CM5.1 : A regional study**

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The decadal predictability of the Arctic sea ice cover has been investigated using a set of experiments performed with the CNRM-CM5.1 AOGCM in the framework of CMIP5. It consists of 10-member ensembles of 10-year long hindcasts initialized on January 1st of 20 different years during the 1960-2006 period (20 start dates). Initial states are extracted from coupled experiments in which the ocean temperature and salinity are constrained towards the ocean reanalysis NEMOVAR-COMBINE. No constraint is directly applied on the sea ice cover. As a result, January 1st initial sea ice covers in the decadal hindcasts are very close to observations in terms of Sea Ice Extent (SIE), but exhibit a strong negative bias in Sea Ice Volume (SIV). Assessing the ensemble spread of those experiments leads to an estimation of the limit of Arctic SIE (SIV) prognostic potential predictability (PPP) from initial conditions of 2 (8) years. A regional investigation among peripheral seas highlights some discrepancies in this PPP, especially in winter, with higher predictability in the Atlantic than in the Pacific sector. The time evolution of the PPP has also been investigated, which highlighted the decrease of the PPP over recent decades. This decrease is attributed to the thinning of the sea ice cover, as well as the disappearance of sea ice in areas exhibiting strong variability such as the convection zone in the Greenland Sea.

Once bias-corrected, the hindcasts exhibit significant skills in predicting Arctic sea ice cover. However, a 10-member set of historical simulations (i.e. without any realistic initialization) performed with the same AOGCM has similar skills, suggesting that these skills are mostly due to external forcing. This is confirmed by the much lower skill of the hindcasts once the linear regression on the CO<sub>2</sub> time series has been removed. As for the potential predictability, these results differ when considering the ice cover of different peripheral seas, with higher predictive skills in the Atlantic sector, although not significant.