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Assessing the impact of sea ice initialization on the decadal predictability of CNRM-CM5.1 AOGCM

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The decadal predictability of the Arctic sea ice cover has been investigated using two sets of experiments. The first set was performed using the CNRM-CM5.1 AOGCM (Voldoire et al., 2012). It consists in 10 member ensembles of 10 year long hindcasts initialized every 5 years starting from 1st January 1961 till 1st January 2006 (10 start dates). Initial states are extracted from coupled experiments in which the ocean temperature and salinity are nudged towards the NEMOVAR-COMBINE reanalysis without any direct constraint on sea ice. Despite an initial shock, once bias-corrected (following the CLIVAR protocol), it appears that the model has some skill in predicting the sea-ice cover. However, a 10-member set of historical simulations (i.e. without any realistic initialization) performed with the same coupled model gives very similar skill, showing that the decadal predictability of sea ice is mostly due to external forcing. This is confirmed by the much lower skill of the hindcasts once the linear regression on the CO_2 time series has been removed. Despite this lack of improvement in skill, the decadal ensemble spread during the first 2-3 years appears to be much smaller than the spread of the uninitialized historical simulations. This reduction in spread can be seen as an improvement of the prognostic potential predictability as defined by Pohlmann et al. (2004). These results indicate that sea ice cover anomalies are potentially predictable up to several years, but the weak impact of the initialization suggests that an improved initialization of sea ice cover could increase the skill. In order to assess the impact of the initialization technique, several nudged experiments were performed using the same AOGCM as for the first set of decadal experiments. In these experiments, the ocean is constrained in the same way as previously. Additionally, a sea ice cover reconstruction over the period 1979-2010 is used to nudge either sea ice concentration or thickness. This reconstruction is produced by running the ocean-sea ice component of CNRM-CM5.1 in forced mode, driven by the ERA Interim Reanalysis (Dee et al., 2011). The second set of decadal experiments initial states were provided by those nudged simulations. Comparing both sets of decadal hindcasts allowed us to assess the impact of a better initialization of sea ice on the ability of CNRM-CM5.1 to predict the variability of the sea ice cover on interannual to decadal time-scales.