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Arctic sea ice conditions in seasonal re-forecasts with the CNRM-CM6-1 model

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During the last decades the Arctic sea ice area has declined and the ice has become thinner, younger and faster moving. The removal of sea ice has tendency to lower the albedo and increase turbulent energy fluxes and roughness between the surface and the atmosphere. Ice free conditions increase light transfer into the water and affect the ecological conditions in the polar ocean. Infrastructures, shipping, fishing and local livelihoods depend on the sea ice conditions. Furthermore, Arctic sea ice loss is likely to impact mid-latitude weather. For these reasons, there is a growing interest in understanding how the sea ice conditions will develop in seasonal and climate time-scales. The study of Arctic sea ice is hindered by the small number of observations, therefore modelling approaches are especially useful.

In this study, we assess the sea ice conditions in the CNRM-CM6-1 model. We address the seasonal re-forecasts for the time period of 1993-2014. The seasonal re-forecasts are initialized in May and November each year and run for forecast times of six months. The same model version is applied for the CMIP6 climate simulations, allowing us to study the model behaviour also in longer time-scales. While the seasonal forecasts provide tools to understand the role of initialization, the longer runs will allow to identify systematic errors independent of the initialization.

We focus on the essential sea ice processes: growth, melt, and the transport of ice. We will show the average seasonal cycle, inter-annual variability and evolution of the sea ice mass balance components during our study period. We will exploit also the ensemble mean and spread of the seasonal simulations in order to assess their uncertainties and predictive skill. The impact of initialization month and lead time on the ensemble spread will be evaluated. The sea ice area and concentration, for which monitoring data is available, will be compared against observations. In order to address the regional differences in the sea ice conditions and in the model performance, we will select different study areas in the marginal ice zone and central Arctic. Years of exceptionally low or high sea ice coverage will be selected for case studies.

Our analyses aim in understanding the processes related to modelling sea ice in seasonal time scales. We will try to pinpoint reasons behind successful and erroneous forecasts, as well as possible error compensations behind apparent skill. The results of these in-depth analyses will guide model developments in the future. Possible improvements related to developments in the sea ice model (e.g. land fast ice, melt ponds) will be discussed in the light of these results.