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Assessing the contribution of ocean and sea ice initialization for seasonal prediction in the Arctic

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Predictive skill in the Arctic resides in the ocean, the sea ice and the atmosphere. While the influence of the atmosphere is short-lived, ocean and sea ice play a crucial role on seasonal time scale. We aim to identify the role of the initial state of the upper ocean and the sea ice for seasonal prediction, analyzing seasonal and regional differences. We use the Norwegian Climate Prediction Model, which combines the fully coupled Earth system model NorESM and the Ensemble Kalman Filter data assimilation method. The performances of two versions of the system are compared: one assimilating only ocean data and one assimilating in addition sea ice concentration (SIC) for the period 1980 to 2010.
In the reanalysis, initializing the ocean (V1) enhances the ocean state in the Barents Sea and the Beaufort Gyre strength, resulting in improved sea ice thicknesses (SIT) in wide areas of the Central Arctic and enhanced summer sea ice extents along the rim of the gyre. Additional assimilation of SIC (V2) shows only very moderate improvements for the ocean but reduces the overall SIT bias in the Central Arctic and noticeably enhances SIC during the summer seasons.
The prediction skill is tested for sea ice extent (SIE) with 4 seasonal hindcasts per year from 1985 to 2010. We find a pronounced seasonality in the prediction skill. In the Barents, Okhotsk, Bering and Labrador Seas during winter, V1 can achieve skilful predictions when and where sea ice variability relates to the ocean heat content. The improved ocean and sea ice initial conditions in V2 further enhance and prolong this skill. The improved initial Beaufort Gyre and relatedly enhanced thickness in V1 show to be beneficial for the variability in SIE along the Siberian coast up to the Beaufort Gyre. The additional improvements in SIT in first year ice regions found in V2 greatly enhance the skill of SIE - in particular for the autumn ice extent forecast initialized in July.