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Atmospheric circulation response to eastern Arctic sea ice loss in initialized ensemble forecasts

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Sea ice loss in the Barents and Kara Seas (BKS) during late autumn has been suggested as a potential driver of winter atmospheric circulation anomalies in the Euro-Atlantic sector.
While some dynamical pathways that connect BKS sea ice anomalies to large-scale atmospheric circulation anomalies have been proposed, model studies show partly contrasting results with respect to the timing and character of the response. Here, this question is tackled using a state-of-the-art seasonal prediction system (CMCC-SPS3) by performing ensemble hindcasts of winter seasons for the historical period 1993–2016. In particular, the November sea ice cover in the BKS in the fully-coupled model set-up is perturbed using a conditional heat supply to the ocean mixed layer. The experimental set-up allows for sampling natural variability associated to other forcings (realistic initialization with different climate states) so as to isolate the effect of reduced sea ice in the BKS.
Results indicate a fast, local thermodynamic response over the BKS sector, consistent with outcomes from previous studies, expressed through a pronounced warming and a local low pressure anomaly. There is an indication of a warm Arctic - cold Siberian pattern in near-surface temperatures in December, however this pattern is replaced by a pronounced surface warming over northern Eurasia in January. Consistent with this surface warming are sea level pressure and geopotential height anomalies which imply a deep, equivalent barotropic circulation response that resembles the positive phase of the North Atlantic Oscillation (NAO), accompanied by a northward-shift of the eddy-driven jet stream in the Euro-Atlantic sector from its climatological mean position. The model exhibits biases in the North Atlantic eddy-driven jet stream (zonally elongated, less variable downstream and more intense compared to observations), and these biases likely influence the atmospheric response to the sea-ice forcing in the BKS. This supports the previously suggested notion that the response is to some extent model-dependent. The ensemble spread (20 members) is found to be at least twice as large as the interannual variability, pointing to a moderate impact of sea-ice loss compared to other sources of natural variability. The results invite for a deeper analysis of the response to pin down the respective underlying dynamics.