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Potential linkage between the atmospheric summer circulation over Eurasia and preceding sea ice anomalies southwest of Greenland

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Sea ice alters the surface albedo and modulates the heat, moisture and momentum exchange between the ocean and the atmosphere. Various studies suggest an influence of the sea ice on the atmospheric circulation, whereby the focus is often on simultaneous connections and Arctic-wide sea ice conditions. Sea ice has a strong memory and we thus hypothesize a potential feedback on the atmosphere also at higher lags. Using ERA5 reanalysis data between 1983 and 2017, the present work investigates a potential connection of the summer atmospheric circulation over Eurasia to winter sea ice anomalies southwest of Greenland. Composites of the June-July geopotential height pattern show a wave-train structure throughout the troposphere and the resulting circulation anomalies are found to influence the two metre temperatures over northeastern Europe and northern Russia. These anomalies are significantly correlated with December-January sea ice anomalies. Persistent sea surface temperature (SST) anomalies associated with the strong ice memory indicates that the winter signal is partly stored in the Labrador Sea. The observations indicate a response in the June-July 500 hPa vertical velocity in proximity of the strongest SST anomalies that is dynamically consistent with the lower-level and upper-level divergence pattern. The result suggests that the vertical velocity potentially connects a vorticity forcing in the upper troposphere to near-surface conditions over the Labrador Sea that originate from the preceeding winter.
A further analysis shows a particularly pronounced wave-train signal when the December-January ice anomalies appear in phase with a strong North Atlantic Oscillation (NAO) index. Those years are characterized by extensive and persistent SST anomalies in the North Atlantic bearing similarities with the tripole pattern that is known to be associated with the NAO. The SST signal is accompanied by widespread heat flux anomalies hinting at a further influence coming from the central North Atlantic. The study provides a first analysis of two possible factors that potentially contribute to the linkage between winter sea ice and the summer atmospheric circulation.