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Arctic moisture source for Eurasian snow cover variations in autumn

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Global warming is enhanced at high northern latitudes where the Arctic surface air temperature has risen at twice the rate of the global average in recent decades - a feature called Arctic amplification. This recent Arctic warming signal likely results from several factors such as the albedo feedback due to a diminishing cryosphere, enhanced poleward atmospheric and oceanic transport, and change in humidity. The reduction in Arctic sea ice is without doubt substantial and a key factor. Arctic summer sea-ice extent has declined by more than 10% per decade since the start of the satellite era (e.g. Stroeve et al., 2012), culminating in a new record low in September 2012, with the long-term trend largely attributed to anthropogenic global warming.

Eurasian snow cover changes have been suggested as a driver for changes in the Arctic Oscillation and might provide a link between sea ice decline in the Arctic during summer and atmospheric circulation in the following winter. However, the mechanism connecting snow cover in Eurasia to sea ice decline in autumn is still under debate.

Our analysis focuses at sea ice decline in the Barents-Kara Sea region, which allows us to specify regions of interest for FLEXPART forward and backwards moisture trajectories. Based on Eularian and Lagrangian diagnostics from ERA-INTERIM, we can address the origin and cause of late autumn snow depth variations in a dense (snow observations from 820 land stations), unutilized observational datasets over the Commonwealth of Independent States.

Open waters in the Barents and Kara Sea have been shown to increase the diabatic heating of the atmosphere, which amplifies baroclinic cyclones and might induce a remote atmospheric response by triggering stationary Rossby waves (Honda et al. 2009).

In agreement with these studies, our results show enhanced storm activity originating at the Barents and Kara with disturbances entering the continent through a small sector from the Barents and Kara Seas, steered in October by a Scandinavia block and a low to the East, extending to Central Russia land areas. The disturbances transport moisture southward where their tracks merge with the eastward extension of the Mediterranean storm track. Maxima in storm activity trigger increasing uplift, often accompanied by positive snowfall and snow depth anomalies.

We show that declining sea ice in the Barents and Kara Seas acts as moisture source for enhanced Siberian snow cover as a result of changed tropospheric moisture transport. Transient disturbances enter the continent from the Barents and Kara Seas region related to anomalies in the planetary wave pattern and move southward along the Ural mountains.