



Contribution of Atmospheric Advection to the Amplified Winter Warming in the Arctic North Atlantic Region

Sandro Dahlke (1,2) and Marion Maturilli (1)

(1) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany, (2) Institute of Physics and Astronomy, University of Potsdam, Potsdam, Germany

Arctic amplification of climate warming is caused by various feedback processes in the atmosphere-ocean-ice system, and yields the strongest temperature increase during winter in the Arctic North Atlantic region. Located in this key region, Svalbard is affected by increasing winter cyclone activity associated with warm and moist air advection from lower latitudes. In our study, we attempt to quantify the advective contribution to the recent observed atmospheric winter warming in the Svalbard area (1996 - 2016). Based on Ny-Ålesund radiosonde measurements during winter, a strong dependence of the tropospheric temperature on the synoptic flow direction is identified. Using FLEXTRA air backward trajectories, an increase in occurrence frequency of air with origin in the lower latitude Atlantic region is found, that is attributed to a change in atmospheric circulation patterns involving an intensified Icelandic low and a pronounced Ural blocking high. Both the Scandinavian blocking and the Ural blocking high seem to play an important role in the context of advecting air from lower latitudes towards the Svalbard region, therefore our study is of particular relevance for aerosol and trace gas transport, and according measurements on Svalbard. Beyond that, the enhanced occurrence of the Ural blocking in the recent decade has been linked to sea ice retreat in the Barents/Kara Seas. Given that this link is robust, it would directly feed back on additional sea ice retreat in the region due both to anomalous advection of warm air masses from the south and mechanically pushing pack ice more northward, leaving more open water surfaces along the Svalbard coast. Regarding the circulation changes, we find that about one quarter (0.45 K per decade) of the observed tropospheric winter warming trend in the North Atlantic region of the Arctic (2 K per decade) is due to increased advection of warm and moist air from the lower latitude Atlantic region. Furthermore, the Ny-Ålesund radiosonde data evidence that the corresponding warming footprint extends significantly from the surface throughout the entire troposphere, with a vertically constant relative contribution to the overall warming. Essentially, the climate of the Svalbard region as center of the strongest recent winter warming is found to be particularly sensitive to changes in the atmospheric circulation compared to other regions of the Arctic.