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Anomalous moisture transport and associated precipitation patterns: a case study during the ACLOUD campaign near Svalbard

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The Arctic is a region of major interest due to its high sensitivity to global warming with significant implications for both regional climate and global climate system. Significant increase in the atmospheric moisture content has been documented over the Arctic in the recent years. This is partially explained by the reduction of sea-ice cover, which enhances local evaporation. However, others argue that the predominant reason is the enhanced poleward moisture flux during the recent decades, which is expected to continuously increase in the future. This might be due to several factors or a combination of them, such as changes in the atmospheric circulation patterns, increased moisture transport intensity, and/or higher evaporation rates in the lower-latitude moisture source regions. Our study focuses on the anomalous moisture transport events confined to long, narrow and transient corridors, known as atmospheric rivers (ARs) which are expected to have a strong influence on Arctic mass and energy budget.

Here we present a case study on 29-30 May 2017 with anomalous moisture transport identified as an AR reaching Ny-Ålesund, during the ACLOUD campaign (Arctic Cloud Observations Using airborne measurements during polar Day) that took place in Svalbard during May 22 to June 28, 2017. We explore the temporal and spatial evolution of the AR by means of two tracking algorithms (Gorodetskaya et al., 2014; Guan and Waliser, 2015) and several reanalysis products (ECMWF's ERA-Interim and ERA5, NASA's MERRA-2, JMA's JRA-55, and NCEP's CFSR). The intensity and pathways of the AR are analysed in synergy with the measurements from the AWIPEV research station in Ny-Ålesund. We analyse ground-based remote sensing measurements from Humidity and Temperature Profiler (HATPRO) and the vertical profiles of the atmosphere by radiosondes. Further, we analyse satellite-based remote sensing measurements from GPS.

Preliminary results show the AR that reached Ny-Ålesund extended from Western Siberia and was characterized by integrated water vapour transport greater than 200 kg m^{-1} s^{-1} intensifying significantly over the coastal regions, Kara Sea and the Arctic Ocean before reaching Svalbard. Integrated water vapour (IWV) showed large values over the Siberian Plain indicating that it could be a potential source region for anomalous moisture transport. At the same time, large IWV values over the Arctic Ocean together with anomalous sea-ice retreat south of Svalbard during the campaign period indicate local evaporation as an additional moisture source. The IWV showed a peak up to 1.5 cm at Ny-Ålesund on 29-30 May 2017 with radiosonde measurements showing intense and short-lived warm and moist advection below 600 hPa. This event was accompanied by intense precipitation along the AR track, with rainfall dominating in the lower latitudes, while snowfall and mixed-phase precipitation occurred in the higher latitudes. This AR event was accompanied not only by significant precipitation, but also a strong retreat of the sea ice edge further north, indicating an important role of ARs in the Arctic climate system.