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A systematic assessment of integrated water vapor products from satellite and reanalysis in the Arctic during ACLOUD

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The role of atmospheric moisture within the Arctic climate system is raising increasing interest. However, with sparse surface and radiosonde measurements mainly limited to land areas, satellite observations provide the main information on moisture distribution across the Arctic. While a wealth of satellite measurements from different instruments exist, in particular for integrated water vapor (IWV), the special conditions in the Arctic hamper accurate observations. For example, methods based on solar radiation cannot be applied during polar night and the highly variable emissivity of snow and ice hinders microwave retrievals. With few measurements available, reanalysis is less constrained by observations increasing the influence of the underlying numerical model. Therefore, it is no surprise that the Arctic belongs to those regions that show strongest relative discrepancies between different long-term, global IWV data sets, i.e. satellite and reanalysis products (GEWEX water vapor assessment (G-VAP); WCRP Report 16/2017).

In this contribution, we provide a systematic assessment of different reanalysis, i.e. ERA-Interim, ERA5, MERRA2, CFSR, JRA55, and satellite products in the Arctic. Satellite products include operational retrievals using among others Microwave Integrated Retrieval System (MIRS), Infrared Atmospheric Sounding Interferometer (IASI), Moderate-resolution Imaging Spectroradiometer (MODIS), and Global Ozone Monitoring Experiment (GOME-2). As reference, we make use of the comprehensive set of measurements from the Arctic CLoud Observations Using airborne measurements during polar Day (ACLOUD) and the Physical feedbacks of Arctic planetary boundary level Sea ice, Cloud and AerosoL (PASCAL) campaigns which took place near Svalbard from May 23 to June 26, 2017. Thus, we focus on the Nordic Seas including the marginal sea ice zone and the neighboring land areas for the two months May and June in 2017. In addition to campaign observations by ground-based remote sensing, aircraft and radiosondes, all operational radiosonde soundings and surface-based IWV from the GNSS network are used. We investigate the specific advantages and disadvantages of the different data sources in order to finally answer the question to which degree we can reliably describe Arctic IWV patterns on the monthly scale.