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Comparison of spaceborne retrievals of tropospheric water vapor profiles in the Arctic to ground-based Raman lidar measurements

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The tropospheric water vapor over the Arctic shows a predominant positive trend, mainly in the lower troposphere below 850 hPa (i.e. ∼2 km above the mean sea level) above 60°N latitude. This anomaly is mainly due to the anthropic activity that will intensify in the future with the possible exploitation of the Arctic subsoil and the opening of navigable trade routes. Water vapor anomalies in turn have a direct effect on the melt onset over sea ice, via the increase of low cloud formation and thus longwave radiation to the surface. This fundamental meteorological and climatic variable remains nevertheless difficult to measure in the lower troposphere in the Arctic area. Radiosondes show some inaccurate humidity measurements and are very sparse. Spaceborne observations appear as the more suited for a relevant spatiotemporal sampling. Nevertheless, they suffer from a lack of precision below 3 km due to the averaging kernels of the spectral channels used for the retrieval of the water vapor mixing ratio (WVMR). Lidar measurements are therefore strong assets in order to measure the WVMR in the first kilometers of atmosphere. During May 2016, the field campaign of the Pollution in the ARCtic System (PARCS) project, brought the ground-based H_2O/N2-Raman system WALI (Water Vapor & Aerosol LIdar) to Hammerfest, near the North Cape of Norway. Thanks to a narrow field of view and a powerful laser, WALI measured daytime profiles of WVMR between 0.15 and 4 km amsl during the entire campaign. We compare this unique dataset to satellite retrievals by AIRS, MODIS and IASI. As expected, discrepancies larger than ∼0.5 g/kg (15%) are highlighted in the lower troposphere, which are shown to persist in ECMWF reanalysis, which assimilate the IASI radiances. These results will be presented and discussed.