Middle atmospheric O_3 and H_2O measurements by ground-based microwave radiometry in the Arctic

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The two ground-based microwave radiometers GROMOS-C for ozone and MIAWARA-C for water vapour have been located at the Arctic research station AWIPEV at Ny-Ålesund, Svalbard (79° N, 12° E) since September 2015. Both radiometers were built at the University of Bern, Switzerland and are specially designed for campaigns. The instruments measure the vertical distribution of ozone and water vapour in the middle atmosphere with a high time resolution and under most weather conditions. GROMOS-C provides hourly ozone profiles where for MIAWARA-C a resolution of 2–4 hours is realistic, depending on the atmospheric opacity. GROMOS-C additionally provides daily mean zonal and meridional wind profiles and can switch to carbon monoxide measurements. The unique datasets from these instruments are used to study dynamical events and the chemistry of ozone and water vapour in the middle atmosphere. We present an overview of the data from three years of continuous measurement and show characteristic events in the summer and winter atmosphere. During winter the polar vortex dominates the dynamics in the Arctic middle atmosphere. At the latitude of Ny-Ålesund one is mostly inside of the vortex system and we are able to estimate the descent rate of water vapour during its formation. Two sudden stratospheric warmings took place and we measured the reversals of the zonal wind and changes in ozone. During summer we study the effects of energetic particle precipitation on ozone and water vapour. We spectrally analysed the water vapour and ozone time series by means of a Fast Fourier Transformation in order to find periodicities. Both timeseries show signatures of atmospheric waves with periodicities of 2, 5 and 10 days. Ozone has addidionally a strong daily cycle. Special emphasis is given to the investigation of the link between ozone and water vapour concentrations in the upper stratosphere and lower mesosphere. The specified dynamics version of the Whole Atmosphere Community Climate Model (SD-WACCM) is used to support this investigation.