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Quasi 18-hour wave activity in ground-based observed mesospheric H_2O over Bern, Switzerland

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Observations of oscillations in the abundance of middle atmospheric trace gases can provide insight into the dynamics of the middle atmosphere. Long term, high temporal resolution and continuous measurements of dynamical tracers within the strato- and mesosphere are rare, but would be important to better understand the impact of planetary and gravity waves on the middle atmosphere. Here we report on water vapor measurements from the NDACC (Network for the Detection of Atmospheric Composition Change) affiliated ground-based microwave radiometer MIAWARA located close to Bern during two winter periods of 6 months from October to March. Oscillations with periods between 6 and 30 hours are analyzed in the pressure range 0.01–10 hPa. Seven out of twelve months have the highest wave amplitudes between 15 and 21 hour periods in the mesosphere above 0.1 hPa. The quasi 18-hour wave is studied in more detail. We examine the temporal behavior and use SD-WACCM simulations for comparison and to derive characteristic wave features considering low-frequency gravity-waves being involved in the observed water vapor oscillations. The 18-hour wave is also found in SD-WACCM horizontal wind data and in measured zonal wind from the microwave Doppler wind radiometer WIRA. For two cases in January 2016 we derive the propagation direction, intrinsic period, horizontal and vertical wavelength of the model resolved 18-hour wave. A south-westward to westward propagation with horizontal wavelengths of 1884 and 1385 km and intrinsic periods close to 14 h are found. Vertical wavelengths are typically below 6 km. We were not able to single out a distinct temporal correlation between 18-hour band-pass filtered water vapor and wind data time series, although H_2O should mostly be dynamically controlled in the mesosphere and sub-diurnal time range. More sophisticated numerical model studies are needed to uncover the manifold effects of gravity waves on the abundance of chemical species.