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Diurnal cycles in middle atmospheric water vapor and ozone: Measurements and models

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Tidal perturbations of the wind and temperature field are expected to produce daily variations in middle atmospheric trace constituents through advection or by modulating temperature dependent reaction rates. In this respect we analyzed time series of middle atmospheric ozone and water vapor measured by two ground-based microwave radiometers of the NDACC network located at midlatitudes in the alpine region. The main focus is put on the time period of the first CAWSES campaign in September 2005. We compare the observed daily variations with simulations from three different chemistry climate models and find good qualitative agreement in the upper stratosphere while major discrepancies show up in lower stratospheric ozone and mesospheric water vapor. A seasonal investigation reveals good agreement in terms of the seasonal cycle of amplitude and phase.
Meridional advection could be identified to be the most important process for the generation of daily variations in stratospheric water vapor. The daily cycle in ozone is mainly governed by photochemistry except in the lower stratosphere where advection becomes important. Some consistency with temperature measurements from the SABER experiment becomes evident under the assumption of adiabatic vertical transport at lower stratospheric heights.