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Millimeter-wave measurements of stratospheric and mesospheric trace gases from the high-altitude station of Testa Grigia (Italy; 45.9°N, 7.7°E, 3500 m a.s.l.)

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We present new ground-based measurements of stratospheric and mesospheric trace gases carried out from Testa Grigia (45.9° N, 7.7° E, elev. 3500 m above sea level), Cervinia, Italy, during the winters of 2004 and 2005. Testa Grigia is a mountain site where the Italian National Council for Research (CNR) set up a laboratory in 1948 to study cosmic rays. The chemical species that can be observed from Testa Grigia with the Ground-Based Millimeter-wave Spectrometer (GBMS) are: O_3, CO, HDO, HNO_3, N_2O and HCN, and this work focuses on measurements of O_3, N_2O, and CO. The GBMS allows the retrieval of vertical profiles of stratospheric and mesospheric trace gases by measuring their rotational spectra between 230 and 280 GHz. In order to obtain vertical profiles from rotational spectra the technique takes advantage of the dependence of the line broadening on atmospheric pressure, and hence on altitude. Considering that collisional line broadening is about 3 MHz/mb, that the GBMS bandwidth is 600 MHz, and that its spectral resolution is about 65 KHz, the GBMS allows the retrieval of vertical profiles from 20 to 70 km with an uncertainty of approximately $\pm$10%, increasing to $\pm$ 20% from 15 to 20 km and from 70 to 80 km. Deconvolution (or inversion) techniques adopted to retrieve vertical profiles from the emission spectra measured by the GBMS limit the vertical resolution of profiles to one scale height ($\sim$ 6-8 km).

In this contribution, we first show that Testa Grigia is an excellent location for carrying out observations in the spectral range of the water vapor continuum, given their need

for very low water vapor column contents. At Testa Grigia we measured less than 1 mm of total integrated water vapor column, which is comparable to values observed at the South Pole. We then move on illustrating the variability of stratospheric ozone at midlatitudes, influenced by the advection of polar air masses which can be identified using our measurements of stratospheric N_2O mixing ratio as a tracer. Similarly, we use the CO mixing ratio as a tracer for studying upper stratospheric and mesospheric winter transport, investigating the relative importance of transport on observed mesospheric ozone concentrations, mostly dominated by the ozone photochemical lifetime.