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Intercomparison of HONO SCDs and profiles from MAX-DOAS observations during the MAD-CAT campaign and comparison to chemical model simulations

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In order to promote the development of the passive DOAS technique and to improve the retrieval algorithms of trace gases and aerosols the Multi Axis DOAS – Comparison campaign for Aerosols and Trace gases (MAD-CAT) was held at the Max Planck Institute for Chemistry in Mainz, Germany from June to October 2013. MAX-DOAS (Multi-Axis Differential Optical Absorption Spectroscopy) instruments of various designs recorded UV-visible spectra of scattered sunlight at different elevation and azimuth angles. We present intercomparison results for slant column densities (SCDs) of nitrous acid (HONO) retrieved during this campaign by several research groups. Data analysis was performed in two steps, starting with the preferred settings of the individual groups, followed by an analysis using common retrieval settings. In general good agreement of the resulting HONO SCD sets was found. Furthermore, we performed various sensitivity analyses to improve and evaluate the uncertainties in the HONO SCD retrieval, such as the influence of the wavelength dependence of the NO_2 air mass factor, the selection of the wavelength interval of the retrieval, the choice of the Fraunhofer reference spectrum, or the offset correction. Finally we compared the results from different kinds of inversion algorithms for the vertical profiles of trace gases and aerosols. The derived HONO profiles, VMR near surface and tropospheric vertical column densities are compared with each other and with the results of regional chemical model simulations. We found a high HONO VMR near surface of about 200 ppt, which is much higher than the typical daytime VMR of lower than 10 ppt at the early noon (around 9:30 local time), probably indicating a strong source of HONO. The strong vertical gradient in the profile of HONO VMR probably indicates the HONO source is close to the surface.