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Simultaneous measurements of HONO below and above a spruce forest canopy

M. Sörgel (1), I. Trebs (2), A. Moravek (2), K. Hens (2), C. Zetzsch (1,3)

(1) University Bayreuth, Atmospheric Chemistry Research Laboratory, Bayreuth, Germany (matthias.soergel@uni-bayreuth.de), (2) Max Planck Institute for Chemistry, Biogeochemistry Department, Mainz, Germany, (3) Fraunhofer Institute for Toxicology and Experimental Medicine, Hannover, Germany

Nitrous Acid (HONO) plays an important role in atmospheric chemistry because it is easily photolyzed and contributes to OH, the most important oxidizing agent in the atmosphere. Understanding sources and sinks of HONO (especially during daytime) leads to a better estimation of OH-budget.

We have performed simultaneous HONO measurements in and above a tall spruce forest canopy using two long path absorption photometers (LOPAPs) at a field site located in the Fichtelgebirge mountains in northeastern Bavaria, Germany (50°09'N, 11°52'E, 775m above sea level). The LOPAP is a wet chemical instrument actively correcting for interferences (Kleffmann et al., 2002). Measurements were made simultaneously with the devices from 13-25 Sep 2007 on a tower (z = 24.25m, above canopy) and in the trunk space (z = 0.48m close to the forest floor). To determine the instrument precisions, both instruments were operated side-by-side in the trunk space at z = 1m, enabling the validation of observed mixing ratio differences in and above the canopy. At HONO levels ranging from 30 ppt to 220 ppt, the two LOPAP instruments agreed within 10% under dry conditions. Both instruments were operating without temperature control under field conditions including rainy, foggy and dry clear sky periods with large temperature variations (5 – 20 °C). Several other micrometeorological and chemical quantities were measured aiming to investigate the coupling between soil, canopy and atmospheric boundary layer.

The measured HONO mixing ratios showed typical diel cycles with higher values during nighttime, especially during dry periods. During wet conditions, mixing ratios were significantly lower. Average mixing ratios measured with the LOPAP instruments ranged from 40 ppt to 80 ppt during the day and from 80 ppt to 150 ppt during the night with a higher variability during nighttime, but were found to be independent of NO2 mixing ratios. The average HONO/NO2 ratios are 0.03 both in and above canopy, which is comparable to other studies. Maximum HONO mixing ratios occasionally reached 500 ppt during nighttime. Although the HONO photolysis rate is 10 times lower in the trunk space than above the forest, daytime mixing ratios in and above the canopy were often comparable. Thus, the higher photolysis rate above the forest must be balanced by other processes delivering HONO (e.g., vertical mixing or photochemical formation).

[1] J. Kleffmann, J. Heland, R. Kurtenbach, J. Lörzer and P. Wiesen; ESPR-Environ Sci & Pollut Res; 2002; Special Issue 4; 48-54