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Vertical distribution of reactive and non-reactive trace gases in and above a spruce canopy

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In the period from 13 Aug to 13 Oct 2007, the first Intensive Observation Period (IOP-1) of the EGER project (ExchanGE processes in mountainous Regions) was conducted at the spruce forest site "Weidenbrunnen" (Fichtelgebirge / Germany). The Project is focused on the role of process interactions among the different scales of soil, in-canopy and atmospheric exchange processes of mass and energy. Within that framework, tower-based vertical profiles of both reactive (NO, NO_2, O_3) and non-reactive (CO_2, H_2O) trace gas mixing ratios were measured in and above the spruce forest canopy (mean canopy height: 23 m). Vertical mixing ratio profiles are a useful tool for (a) characterizing the trace gas exchange between soil, plants and the atmosphere, (b) the investigation of in-canopy chemical processes and (c) net surface-atmosphere exchange fluxes above the canopy.

Measurements were performed continuously by two identical but independently operating analyzing units, whereas one was used for in-canopy (at 0.05, 0.3, 1, 2, 5, 10, 16 and 23 m a.g.l.) and the other for above-canopy (at 23 and 31 m a.g.l.) intake levels. During IOP-1, we observed NO mixing ratios of 0.7 ppb (day) and 0.2 ppb (night) at the forest floor and 1.2 ppb (day) and 0.01 (night) above the canopy (31 m a.g.l.). At forest floor and above canopy, the diel variation of NO_2 was from 5.0 ppb (day)

to 1.4 ppb (night) and from 6.5 ppb (day) to 1.3 (night), respectively. O_3 mixing ratios varied at the forest floor between 31 ppb (day) and 15 ppb (night) and above the canopy 43 ppb (day) and 23 ppb (night).

In our presentation we will focus on detailed quality assessment of the trace gas data (including evaluation of side-by-side measurements with other systems, response tests, measurement accuracy, detection limits). In particular, the vertical mixing ratio gradients above the canopy (prone to very low quantities) are evaluated with respect to their potential use for flux-gradient-relationships in the roughness sublayer. Time scales of turbulent mixing and chemical reactions will be discussed with respect to the turbulent exchange of reactive trace gases, i.e. whether chemical transformations in the NO-O_3–NO_2 triad have a noticeable effect on the vertical flux divergence.