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Role of plant-generated water vapor and VOC fluxes in shoot chamber measurements of O_3 and NO_x

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One of the processes underlying the atmospheric balance of O_3 and NO_x is their interaction with vegetation. Both are removed, absorbed, and NO_x potentially also emitted by foliage. Uncertainties remain on relevant factors controlling O_3 and NO_x interactions with foliage as well as on including them in large-scale models.
One reason for the uncertainty is that chamber measurements of O_3 and NO_x fluxes are complicated. These reactive gases are adsorbed and desorbed on the chamber walls, depending on the conditions (i.e. humidity). These artefact gas fluxes (chamber blank) must also be quantified and taken into account in the data analysis. Their importance increases when measuring in clean air, where the fluxes are generally small. At near-zero concentrations, the fluxes may not pass the detection limit of the instrumentation, which usually means it is not possible to separate the plant-related fluxes from the chamber blank.
The long-term field measurements at the SMEAR II station in Hyytiälä, Southern Finland, have provided valuable insights into O_3 and NO_x exchange (i.e. Raivonen & al. 2009, Altimir & al. 2006). This project builds up on the expertise and conclusions from these works.
The aim of this study was to improve the reliability of the measuring system by checking the role of potential measuring artefact(s). A live shoot, enclosed in a chamber, creates a water vapor in the chamber flux by transpiring. There are also biogenic VOC emissions from the shoot. In principle, these may affect the reactions of O_3 and possibly NO_x in the chamber. The potential interference of these fluxes created naturally during chamber closure is a main concern. Their effect on the O_3 and NO_x flux measurements has been tested with field calibrations in 2010–2011.
In these calibrations, a controlled water vapor /VOC flux was fed into an empty shoot measurement chamber, and the H_2O, CO_2, O_3 and NO_x fluxes created in the chamber were measured. The created water vapor flux pattern was modified to either simulate shoot transpiration or to break the close connection of natural daily variation in transpiration, radiation and temperature. We will present results of this experiment.

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