



## Shoot-level monitoring of O<sub>3</sub> and NO<sub>x</sub> fluxes of Scots pine (*Pinus sylvestris* L.)

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O<sub>3</sub> and nitrogen oxides (NO<sub>x</sub>=NO+NO<sub>2</sub>) are important atmospheric pollutants. Both are involved in atmospheric chemistry in various significant ways. O<sub>3</sub> is a greenhouse gas. Both gases have potentially harmful effects on plants, but NO<sub>x</sub> can have nutritional as well as toxic effects. One of the processes underlying the atmospheric balance of O<sub>3</sub> and NO<sub>x</sub> is their interaction with vegetation. Both are removed, absorbed, and NO<sub>rmx</sub> potentially also emitted by the foliage. The mechanisms driving these processes are not known in sufficient detail for accurate modeling of leaf-level O<sub>3</sub> and NO<sub>x</sub> fluxes for the needs of i.e. global atmosphere-biosphere models. For example, the role of biogenic volatile compounds (BVOCs) in ozone scavenging and the role of nitrate in the biological and chemical NO<sub>x</sub> emissions require further research.

The SMEAR II (Station of Measuring Forest Ecosystem-Atmosphere Relations) station in Hyttiälä, Finland, is well-known for its series of shoot-level O<sub>3</sub> and NO<sub>x</sub> fluxes measured on Scots pine (*Pinus sylvestris* L.) in the field. Measurements from shoot-scale gas exchange chambers have provided valuable insights into O<sub>3</sub> and NO<sub>x</sub> exchange (i.e. Raivonen & al. 2009, Altimir & al. 2006). The measuring system has since been upgraded with at least two major improvements:

- A new chamber type was designed in order to remove the enclosure effect. The chamber is built as a sliding box that encloses the shoot only for the short time needed to make a measurement and otherwise allows the shoot to experience all occurring ambient conditions, including wind and rain.

- In order to allow targeted flux measurement of NO<sub>x</sub>, not NO<sub>y</sub>, the molybdenum converter of the NO<sub>x</sub> analyser was replaced with a photolytic, NO<sub>2</sub>-specific one.

We present preliminary results of O<sub>3</sub> and NO<sub>x</sub> shoot-scale flux measurements after these improvements and discuss their value in increasing our understanding of the shoot-scale processes involving O<sub>3</sub> and NO<sub>x</sub>.

Altimir N., Kolari P., Tuovinen J.-P., Vesala T., Bäck J., Suni T., Kulmala M. & Hari P. 2006. Foliage surface ozone deposition: a role for surface moisture? *Biogeosciences* 3 : 209-228.

Raivonen M., Vesala T., Pirjola L., Altimir N., Keronen P., Kulmala M. & Hari P. 2009. Compensation point of NO<sub>x</sub> exchange: Net result of NO<sub>x</sub> consumption and production. *Agric for Meteorol* 149(6-7):1073-81.