Ozone fluxes over a spruce forest and a clear-cut: first results from the EGER II project

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As part of the EGER (ExchanGE processes in mountainous Regions) project the exchange of ozone between the atmosphere and a forest / clear-cut was investigated during summer 2011 in the Fichtelgebirge mountains (SE Germany). The winter storm "Kyrill" (2007) generated a road-like wind-throw in the spruce-forest ecosystem "Weidenbrunnen". The wind-throw was cleared from stems and trees and until 2010 secondary vegetation developed, which consists mainly of young Spruce, Calamagrostis, Deschampsia and Vaccinium and differs in its phenology and leaf physiology from the original Picea abies.

We seized the opportunity to investigate (a) differences of the ozone exchange between the spruce forest and the clear-cut vegetation, and (b) the influence of the disturbed ecosystem as a whole on the exchange. Several towers were installed within the forest, in the clear-cut, and along the forest/clear-cut edge.

The eddy-covariance technique was applied to measure vertical turbulent fluxes of ozone. Two fast (20 Hz) gas-phase chemiluminescence ozone analyzers (enviscope GmbH) were used to measure the turbulent fluctuations of ozone mixing ratio in arbitrary units, while the absolute ozone mixing ratio was monitored by slow-response (0.5 Hz), UV-absorption based ozone analyzers (2BTechnologies). Fast and slow-response measurements of ozone mixing ratio were performed at 32 m above the forest floor and 5.5 m above the soil surface in the clear-cut. In both cases, the fast ozone analyzers were combined with 3D sonic anemometers (METEK USA-1, Campbell CSAT3)

For the calculation of turbulent fluxes of ozone, momentum, and sensible heat from the observed time series a computer based algorithm was applied that was developed in the EGER program previously. Dry deposition velocities of ozone were also determined. In addition to our flux calculating procedure, fluxes were also calculated by the well-known TK3 algorithm (Department of Micrometeorology, University Bayreuth, Germany) to check for consistency and to provide TK3's quality assurance and quality control (QA/QC) measures.

The ozone flux differences between forest and clear cut are analyzed for mean daily cycles averaged over the whole measuring period as well as for three periods of four to five days with fairly good conditions. While the averaged flux above the forest show a clear diel variation with nighttime fluxes between -0.3 and -0.4 μg m^{-2} s^{-1} and daytime fluxes up to -0.6 μg m^{-2} s^{-1}, the flux in the clear-cut shows nearly no diel cycle and is about one order of magnitude smaller than above the forest.