Geophysical Research Abstracts, Vol. 7, 11022, 2005
SRef-ID: 1607-7962/gra/EGU05-A-11022

Ozone interactions at the foliage surface

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The contribution of the non-stomatal sinks to the total removal of ozone to vegetative surfaces can be as much as 50% (e.g. Zeller & Nikolov 2000) to 70% (Fowler et al. 2001). The potential mechanisms of this removal are presently under scrutiny and are commonly considered to be related to the interaction of ozone with airborne compounds and with the vegetation and soil surfaces.

The nitrogen oxides emitted from the soil may result in a significant consumption of O_3(Pilegaard, 2001). Terpene quenching in the atmosphere may also play a role (Goldstein, 2003, Mikkelsen et al., 2004), including reactions leading to aerosol formation (Bonn & Moortgat, 2003). As to the role of foliage surfaces, correlation with temperature, solar radiation and the presence of wetness have been reported, and mechanisms such as photochemical reactions, thermal decomposition, and the modulation by the surface wetness have been proposed (see Massman (2004) for a summary).

Regional deposition models often follow Wesely (1989) and parameterise this surface deposition according to gas reactivity and solubility in the framework of various pathway resistances. Dew and rain are assumed to affect the stomatal resistance and the external resistance of the upper canopy, but this is parameterised in a simple way as a constant adjustment in the resistances for dry conditions. This approach underplays the variability of the sink strength and the fact that, at a particular time, there are different components involved. Zhang et al. (2002) proposed a parameterisation for the non-stomatal sink of ozone that introduced a moisture enhancement (as determined by ambient relative humidity, canopy leaf area index and friction velocity) although without being explicit in the mechanistic details.

Previous analysis of the measurements of ozone flux at the Finnish SMEAR field station in Hyytiälä (Altimir et al., 2004) have shown that moisture enhances the deposition of $O_3$to foliage by up to 50%. The strength of this moisture-related sink was found to be variable and could be predicted from the ambient relative humidity. We have thereafter tested the hypothesis that moisture modulates the non-stomatal O_3flux via formation of a water film on the foliage surface. We present results of this analysis and discuss various alternatives for the mechanisms behind these observations.

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