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Investigation of the influence of liquid water films on O_3 and PAN deposition on plant leaf surfaces treated with organic / inorganic compounds

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Liquid water films on environmental surfaces play an important role in various fields of interest (Burkhardt and Eiden, 1994). For example, the deposition of water soluble trace gases could be increased by surface moisture. Chameides and Stelson (1992) found out that the dissolution of trace gases in airborne particulate matter increases with rising water/solid ratio of the particles. Further, Flechard et al. (1999) concluded that deliquescent salt particles represent a potential sink for trace gases, depending on their chemical property.
The formation of surface water films and its influence on the gas deposition was proposed by many previous studies (Fuentes and Gillespie, 1992, Burkhardt and Eiden, 1994, van Hove et al., 1989, Burkhardt et al., 1999, Flechard et al., 1999). In this study we investigate the influence of leaf surface water films on the deposition of O_3 and PAN under controlled laboratory conditions. A twin cuvette system described in Sun et al. (2015) was used to control the environmental parameters such as light, temperature, trace gas mixing ratio and humidity. Furthermore, the leaf surface was treated with various organic and inorganic solutions to investigate the influence of deposited compounds on the electrical surface conductance of the leaves and the surface deposition of O_3 and PAN at various relative humidities.

The result shows that RHcrit, where the electrical surface conductance (G) increases exponentially, was 40 % during the light period and 50 % during the dark period. Furthermore, we observed that the formation of the leaf surface liquid film was depended on the deposited compounds on the leaf cuticles. For the O_3 deposition on plants (Quercus ilex) a clear enhancement at rising environmental air humidity under light and dark condition was found. The increase during light conditions can be related partly to increasing stomatal conductance with higher RH. From the non-stomatal deposition measured in dark experiments, we could calculate the non-stomatal contribution for all experiments. In the case of PAN, the non-stomatal contribution ($\sim$20 %) was constant. For the ambient air exposed leaves the O_3 surface deposition has a lower contribution to the total O_3 deposition below 40 % RH. Above 40 % RH the contributions rises up to 40 % at 80 % RH. The enhancement was influenced by the deposited compounds and was largest for solutions containing halogen compounds (Cl-, Br-).

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