Introduction and Model Outline

Particles and dissolved solutes in the atmosphere can influence the physico-chemical cloud processing by affecting the phase state of aerosol species. The influence of particles on cloud processing is of particular importance under polluted conditions, the gas phase concentrations are notably reduced due to their direct aqueous phase oxidation products which affect the overall degradation of organic compounds contributing to the particulate organic mass (e.g., the formation of C2-C4 aldehydes).

Model Results

Figure 1: Schematic of the multiphase kinetics of the degradation of methylglyoxal, glyceraldehyde, and pyruvic acid.

Radical Oxidant Processing

As can be seen from Figure 2, both radicals and dissolved particles can significantly influence the tropospheric radical oxidant processing. In the urban scenario, the radical oxidation products are mainly produced due to the direct aqueous phase oxidation, whereas in the remote scenario, the radical oxidation mainly occurs in the gas phase.

Figure 2: Modelled gas phase concentrations of the radicals OH and HO2 for the urban and remote scenario with and without aqueous phase chemistry, respectively.

Organic Multiple Phase Processing

The simulation results plotted in Figure 3 show the modifications of the total organic and total inorganic aerosol mass spectra according to the physico-chemical aerosol cloud processing. The model results show that inorganic aerosol mass production is dominated by the in-cloud oxidation of carbonaceous aerosol particles due to the oxidation of NO3 radicals in the aqueous phase.

Figure 3: Modelled aerosol mass concentrations of the most important ions C (aq) (as calculated) and C (aq) (as measured) for the urban (left) and remote (right) conditions.

Summary and Outlook

Simulations with the coupled model CAPRAM have been carried out for different atmospheric conditions considering microphysics and multiphase chemistry. The results show that both the cloud droplet and deliquescent aerosol particle processes contribute to the tropospheric aerosol budget and influence the cloud microphysical and chemical properties. The inclusion of physico-chemical cloud processing is required as a crucial parameter for understanding the formation of new and existing aerosol particles and the associated chemical transformations leading to new phases and properties of the aerosol particles.

References