Chemistry of the Atmospheric Aqueous-Phase in the TROPOS LaserLab

Thomas Schaefer, the LaserLab Group and Hartmut Herrmann

Leibniz Institute for Tropospheric Research (TROPOS), Atmospheric Chemistry Department (ACD), Leipzig, Germany

The presence of aqueous aerosol particles and clouds in the troposphere emphasizes the importance of chemical processes occurring in the aqueous phase and indicates their significant contribution to atmospheric chemistry. Dissolved substances from the soluble aerosol fraction and soluble trace gases undergo conversion and degradation reactions in the aqueous phase, leading to the formation of highly oxidized organic species that can increase the aerosol mass through oligomerization and condensation processes (formation of secondary organic aerosols, SOA). During these reactions, fragmentation of the dissolved organic components can lead to the release of volatile organic compounds (VOCs) into the gas phase. The complexity of the multiphase chemistry has also been associated with the aging of aerosol within the particle, but the driving sources of these processes remain uncertain due to an incomplete understanding of the interacting reactive species.

Over the past three decades, kinetic studies on the oxidation capacity of the most important radicals such as $\cdot OH$, $NO_3\cdot$, $SO_4\cdot^-$, $Cl\cdot$, $Cl_2\cdot^-$, $Br\cdot$, $Br_2\cdot^-$ with respect to water-soluble organic substance classes such as aromatic compounds emitted from biomass burning have been performed in the TROPOS LaserLab. In addition, product studies of OH radical-induced reactions with important water-soluble organics such as isoprene oxidation products were also conducted. These studies were complemented by spectroscopic studies of short-lived peroxyl radicals ($RO_2\cdot$, $HO_2\cdot$ and $O_2\cdot^-$) and excited triplet photosensitizers as well as the photochemistry of iron complexes. Besides the photochemistry of iron complexes in the aqueous phase, the reactions of iron complexes with hydrogen peroxide (H_2O_2) and reactions of ozone and H_2O_2 with organic substances in the absence of light were also investigated.

This overview of the investigations carried out in the TROPOS LaserLab reveals that they address a large number of the fundamental reactions in the aqueous phase, which forms the basis for understanding the complex multiphase interactions within the troposphere.