EGU2020-5433
https://doi.org/10.5194/egusphere-egu2020-5433
EGU General Assembly 2020

Photochemical aging of organic aerosols at temperatures between 213 K and 293 K

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The chemical composition of aerosols, in both gas and particle phase, is an important factor regarding their properties influencing weather, climate and human health. Organic compounds are a major fraction of atmospheric aerosols and their composition depends on chemical processing by atmospheric oxidants and photochemical reactions. These processes are complex due to the abundance of possible reactions and reaction partners and rarely studied over a wider range of atmospheric temperatures. To get a better understanding of photochemical processes in the atmosphere we studied different organic test aerosols from simple to more complex systems between 213 K and 293 K in the AIDA simulation chamber at the Karlsruhe Institute of Technology. Photochemical reactions were studied using a new LED light-source simulating solar radiation in the UV and visible. The organic aerosols were either generated in situ by oxidation of VOC with ozone, OH radicals and NO_3 radicals or by nebulizing aqueous solutions containing the aerosol components. The aerosols were analysed by a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) and a high–resolution time-of-flight chemical ionization mass spectrometer (FIGAERO-HR-ToF-CIMS). The latter one offers the possibility to study the composition of gas phase and particle phase separately. First results suggest that secondary organic aerosols from single precursors like toluene or α-pinene show no or only very small changes related to photochemistry even when formed in presence of high NOx concentrations. In contrast, aerosol particles containing molecules with larger mesomeric systems or atmospherically relevant photosensitizers show significant changes upon irradiation.

In this presentation, we will discuss the changes that organic aerosols undergo in gas and particle phase, during photochemical aging at temperatures between 213 and 293 K.