EGU2020-346, updated on 29 Jun 2022
https://doi.org/10.5194/egusphere-egu2020-346
EGU General Assembly 2020

The effect of the photomineralization mechanism on ambient organic aerosols' cloud condensation nuclei and ice nucleation abilities

Silvan Müller and Nadine Borduas-Dedekind
ETH Zurich, Institute of Biogeochemistry and Pollutant Dynamics (IBP), Department of Environmental Systems Science, Zürich, Switzerland (muesilva@student.ethz.ch)

Organic aerosol (OA) is an important component of the atmospheric submicron particulate mass, consisting of a complex mixture of organic compounds from natural and anthropogenic sources. During its lifetime of approximately one week in the atmosphere, OA is exposed to sunlight and thus undergoes atmospheric processing through photochemistry. This photochemical aging mechanism is thought to have a substantial effect on the propensity of OA to participate in cloud-forming processes by increasing its cloud condensation nuclei (CCN) activity. However, this effect is not well-constrained, and the influence of photochemistry on the ice nucleation (IN) activity of OA is uncertain. In this study, we aim to better understand how the photomineralization mechanism changes the cloud-forming properties of OA by measuring the CCN and IN abilities of photochemically aged OA of different sources: (1) Laboratory-generated ammonium sulfate-methylglyoxal (a proxy for secondary OA), and ambient OA bulk solutions collected from (2) wood smoke and (3) urban particulate matter in Padua (Italy). The solutions are exposed to UV-B radiation in a photoreactor for up to 25 hour and subsequently analyzed for their IN ability and, following aerosolization, for their CCN ability. To correlate changes in cloud-forming properties with changes in chemical composition due to photomineralization, we measure total organic carbon, UV-Vis absorbance, and CO, CO_2, acetic acid, formic acid, pyruvic acid and oxalic acid production. Indeed, preliminary data of wood smoke OA highlights photomineralization as an important atmospheric aging process that modifies the CCN ability of OA. By characterizing both the CCN and IN abilities of photochemically aged OA, our study may thus provide important insights into the atmospheric evolution and cloud-forming properties of OA, potentially establishing photomineralization of OA as an important mechanism to consider in regional and global climate model predictions.