Geophysical Research Abstracts
Vol. 15, EGU2013-3863, 2013
EGU General Assembly 2013

Effect of SOA Coatings on the Ice Nucleation Behavior of Desert Dust Particles

Monika Niemand (1), Zamin A. Kanji (2), Ottmar Möhler (1), Paul J. DeMott (3), and Harald Saathoff (1)

(1) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology , Karlsruhe, Germany (monika.niemand@kit.edu), (2) Process Research Section, Air Quality Research Division, Atmospheric Science & Technology Directorate, Environment Canada, Toronto, Canada (zamin.kanji@ec.gc.ca), (3) Atmospheric Science, Colorado State University, Fort Collins, USA (pdemott@lamar.colostate.edu)

The atmospheric aerosol is composed of a complex mixture of insoluble and soluble substances. This leads to the internal mixing of atmospheric dust aerosols that undergo long-range transport which can get coated with various in(organic) substances. Large amounts of particulate matter are organics, either directly emitted at the ground or, to a large extend, formed in the atmosphere as so-called secondary organic aerosol (SOA) by the chemical conversion of volatile organic precursor gases. The effect of SOA coating on the ice nucleation efficiency of desert dust particles was studied at the Aerosol Interaction and Dynamics in the Atmosphere (AIDA) simulation chamber of Karlsruhe Institute of Technology (KIT) at mixed-phase and cirrus cloud temperatures.

In the temperature range between -22 °C and -29 °C droplet formation occurred in each experiment with coated desert dust particles. Freezing was initiated as soon as water saturated conditions were reached. A suppression of the ice nucleation efficiency by the organic coating of more than a factor of two was observed in the experiments. A variability of more than a factor of ten in the freezing behavior was found among certain uncoated desert dusts. However it can be shown that the parameterization for immersion freezing of natural untreated desert dust particles suggested by Niemand et al. 2012 is also suitable to describe the average freezing behavior of SOA coated desert dust particles in the immersion mode.

In the temperature range -39 °C to -45 °C, coated particles exhibited two distinct ice nucleation modes. A suppression of about a factor of two in the deposition mode ice nucleation by the SOA coating occurred in the range 110 % to about 135 % relative humidity with respect to ice. Close to water saturation the ice nucleation ability was enhanced due to water uptake of the water soluble SOA coating and the dust particles froze presumably via immersion freezing.