UP 10: Atmosphäre - Aerosole

Time: Wednesday 14:15–16:30 Location: MAG 100

UP 10.1 Wed 14:15 MAG 100

Stratospheric aerosol profile retrievals from SCIAMACHY limb-scatter observations: current results — •Christian von Savigny[1], Lena Brinkhoff[2], Florian Ernst[2], Alexei Rozanov[2], Rene Hommel[2], and John Burrows[2] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald — [2]Institut für Umweltphysik, Universität Bremen, Bremen

Stratospheric aerosol extinction profiles in the visible spectral range are retrieved from limb-scatter observations with the SCIAMACHY instrument on Envisat from fall 2002 until spring 2012. The retrievals are performed with a colour-index approach in combination with an iterative scheme and the SCIATRAN radiative transfer model. The aerosol extinction profiles agree globally to within about 15% with co-located SAGE II (vs. 7.0) solar occultation measurements. This contribution presents current results on decadal trends and spatial/temporal variability in stratospheric aerosol extinction caused by different processes. A main feature is the more of less continuous increase in stratospheric aerosol optical depth from 2003 to 2012, which appears to be a consequence of a series of small volcanic eruptions.

UP 10.2 Wed 14:30 MAG 100

Raman spectroscopy of levitated glassy aerosols — •Andreas Peckhaus, Alexei Kiselev, and Thomas Leisner — Karlsruher Institut für Technologie (KIT), Karlsruhe, Baden-Württemberg

Recent field measurements showed that ice clouds in the upper troposphere exhibit low ice particle number concentrations and high in-cloud relative humidities with respect to ice, which is explained by the suppression of crystallization by glassy aerosols. Aqueous sucrose solution droplets levitated in an electrodynamic balance (EDB) are used as a proxy for highly oxygenated organic compounds showing a glass transition or homogeneous freezing behavior depending on the temperature and relative humidity. We present trajectories of the phase diagram which clearly reveal the formation of a glassy amorphous state and ice nucleation. The deliquescence of a crystalline and an amorphous aerosol at different temperatures is reported. By means of angle-resolved Mie scattering pattern of levitated aerosol droplets the onset of the phase transition can be detected. In addition, the Raman spectroscopy is used to study phase transitions at characteristic points of the trajectory. Both methods used make it possible to experimentally derive a phase diagram of the binary mixture of sucrose and water and compare it with theoretical expectations.

UP 10.3 Wed 14:45 MAG 100

Untersuchungen zum Kontaktgefrieren unterkühlter Wassertröpfchen an biologischen Partikeln — •Manfred Schäfer[1], Nadine Hoffmann[1], Alexei Kiselev[1] und Thomas Leisner[1,2] — [1]Institut für Meteorologie und Klimaforschung-atmosphärische Aerosolforschung, KIT — [2]Institut für Umweltphysik, Universität Heidelberg

Das Gefrieren unterkühlter Wolkentropfen ist für atmosphärische, wetterbildende Prozesse von Bedeutung. Dieses kann, unter anderen, durch Kontakt mit INA (Ice-Nucleation Active) Aerosolpartikeln biologisches Ursprungs initiiert werden. In dieser Arbeit haben wir die Kontaktgefrierwahrscheinlichkeit von Bakterienfragmenten (SNOMAX) und Pollenbestandteilen (Betula Pendula) an unterkühlten Mikrotröpfchen untersucht. Dafür wurden elektrisch geladene Wassertröpfchen in einer elektrodynamischen Falle (Paulfalle) levitiert und einem Strom monodisperser INA-Aerosolpartikel ausgesetzt. Die Gefrierwahrscheinlichkeiten wurden in einem Temperaturbereich von -16°C bis -32°C (Pollen) bzw. -9°C bis -23°C (SNOMAX) ermittelt. Außerdem haben wir die Gefrierwahrscheinlichkeit von Pollenbestandteilen für verschiedene Partikelgrößen bei zwei Temperaturen (-24°C und -29°C) bestimmt. In diesem Beitrag werden die gewonnene Daten analysiert und deren Relevanz für das Vereisen der troposphärischen Mischphasenwolken diskutiert.

Kaffeepause, 30 min

Invited Talk UP 10.4 Wed 15:30 MAG 100

Amplified Climate Changes in the Arctic: Role of Clouds and Atmospheric Radiation — •Manfred Wendisch — Universität Leipzig, Institute for Meteorology, Leipzig, Germany

The characteristic conditions and processes leading to the so-called Arctic amplification are outlined. The phenomenon of Arctic amplification comprises an enhanced variability and amplified increase of the near-surface air temperature in the Arctic in comparison to the average near-surface warming at lower latitudes. Observations and simulations show the magnitude of the observed Arctic near-surface air temperature increase is more than double the air temperature increase at lower latitudes. To illustrate the phenomenon of Arctic amplification, several examples of observed Arctic near-surface air temperature increases are presented. In general, Arctic amplification also implies serious Arctic climate changes other than near-surface air temperature, such as the dramatic summer melting of Arctic Sea ice and the Greenland ice sheet, and the decrease of snow cover and surface albedo of the Greenland ice sheet. Numerous reasons for the Arctic climate changes are discussed; the direct and indirect surface albedo feedback and the related increase of near-surface water vapor and cloudiness, meridional heat and water vapor transports in the atmosphere and ocean, and increased soot amounts in both the atmosphere and snow/ice surfaces. The special role of low-level clouds under Arctic conditions (low Sun, polar day and night, high surface albedo) for the self-enforcing amplification processes is described. In particular, the impact of ice in Arctic mixed-phase clouds on the cloud radiative forcing is investigated.

UP 10.5 Wed 16:00 MAG 100

Nucleation and growth of ice on the substrates of K-feldspar observed in ESEM — •Alexei Kiselev, Andreas Peckhaus, and Thomas Leisner — Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research

Atmospheric mineral dust particles, originating from arid regions such as the Sahara, are known to have a strongly variable mineralogical composition. The main components they are composed of are(in order of diminishing average weight content): clay minerals (e.g. kaolinite), micas (e.g. illite), quarts, feldspars, and calcite. These minerals are characterized by different ice nucleating efficiency, which describes the freezing probability of supercooled cloud droplet due to the presence of mineral dust particle serving as a heterogeneous ice nucleus (IN). Potassium (K) feldspar, although not the main component of atmospheric mineral dust, was shown recently to be one of the most effective ice nuclei among airborne mineral dust particles, potentially being responsible for the overall IN efficiency of feldspar-containing mineral dusts (Atkinson et al., 2013). In this contribution we describe the deposition ice nucleation experiments carried out on the freshly cleaved substrates of K-feldspar in an Environmental Scanning Electron Microscope (ESEM). We also compare this approach to the immersion freezing results obtained with similar substrates and droplets of aqueous suspensions of feldspar particles on a cold stage. Comparison to literature data and atmospheric implications will be discussed as well.

Atkinson et al., The importance of feldspar for ice nucleation by mineral dust in mixed-phase clouds, in Nature 498, 355-358 (2013);

UP 10.6 Wed 16:15 MAG 100

Polarization-resolved exact light backscattering by an ensemble of particles in the atmosphere — •Elodie Coillet, Gregory David, Alain Miffre, and Patrick Rairoux — Institut Lumière Matière (ILM), Université Lyon 1, CNRS, Lyon, France

Exact backscattering of light by an ensemble of particles in ambient air has been observed in the laboratory. The experimental set-up operates in the far-field single scattering approximation, covers the exact backscattering direction with accuracy ($\theta = \pi$ +/- ϵ with $\epsilon = 3.5$ x 10-3 rad) and efficiently collects the particles backscattering radiation, while minimizing any stray light. By using scattering matrix formalism, the observation of the particles UV-backscattering signal allowed to measure the particles diagonal scattering coefficient (depolarization) of water droplets and salt particles in air, for the first time, in the exact backscattering direction [1]. These results may be useful for comparison with the existing numerical models, for remote sensing field applications [2], in radiative transfer and climatology and for further laboratory experiments on chemical and physical properties of aerosols. References [1] G. David, B. Thomas, E. Coillet, A. Miffre, P. Rairoux, Polarization-resolved exact light backscattering by an ensemble of particles in air, Opt. Ex., 21,18624-18639, (2013). [2] G. David, B. Thomas, T. Nousiainen, A. Miffre, and P. Rairoux, Retrieving volcanic, desert dust, and sea-salt particle properties from

two/three-component particle mixtures after long-range transport using UV-VIS polarization Lidar and T-matrix, Atmos. Chem. Phys. (2013).