UP 9: Aerosols

Time: Thursday 14:00–16:00 Location: HSZ 105

UP 9.1 Thu 14:00 HSZ 105

Ice nucleation efficiency of K-rich feldspar can be enhanced by K-Na cation exchange — •Tilia Gädeke[1], Corina Wieber[1], Alice Keinert[1], Reiner Abart[2], Thomas Leisner[1,3], and Alexei Kiselev[1] — [1]Karlsruhe Institute of Technology, KIT — [2]University of Wien — [3]University of Heidelberg

The efficiency of ice nucleation (IN) varies over orders of magnitude between different mineral aerosols in the atmosphere. Among all types of mineral dust, alkali feldspars have been found to be the most efficient ice nucleating particles. One of the major unanswered questions is how the spatial distribution of Na-rich and K-rich regions of alkali feldspar is related to its IN efficiency and what is the mechanism behind it. In this contribution, we report the results of a droplet freezing experiment conducted on the thin sections of feldspar which is artificially modified with respect to its chemical composition. Gem-quality K-feldspar crystals were chemically shifted towards a more Na-rich composition where K-rich and Na-rich regions split up into lamellae. Between those emerge highly anisotropic contraction of the crystal lattice, inducing a tensile stress which results in microscopic cracks, observable by optical and electron microscopy. We observe that ice nucleation is often associated with the crack appearance. We report a significant enhancement of the overall IN efficiency of the modified feldspar as compared to the initial natural sample. Finally, using the data of electron scanning microscopy, X-Ray microanalysis and the simulated crystalline structure of feldspar and ice, we discuss the possible mechanisms responsible for the observed behavior.

UP 9.2 Thu 14:20 HSZ 105

Heterogeneous ice nucleation on positively and negatively charged nanoparticles at mesospheric conditions - laboratory experiments — •Demetrius Ramette[1], Denis Duft[1], Thomas Dresch[2], and Thomas Leisner[1,2] — [1]IMK-AAF, Karlsruhe Institute of Technology, Germany — [2]IUP, University of Heidelberg, Germany

Polar Mesospheric Clouds (PMCs) form at the polar summer mesopause in a cold and supersaturated environment and could serve as tracers for mesospheric processes and variability. PMC ice particles are presumed to grow on nanometre-size Meteoric Smoke Particles (MSPs). Rocket-borne measurements have shown that during polar summer, a significant fraction of mesospheric MSPs is positively charged. Therefore, studying heterogeneous ice nucleation on charged MSPs is of particular interest. We have developed an experimental setup for generating and trapping charged nanometre-size particles at mesospheric temperatures and adjustable water vapour supersaturation. These nanoparticles are composed e.g. of iron oxide Fe2O3 or silica SiO2 and serve as MSP analogues. Ice growth rates and ice nucleation onset conditions can be determined by measuring the particle mass as a function of residence time. Previous experiments performed on positively charged particles showed that the particle charge leads to an enhancement of particle growth for particles with a radius less than 3 nm. This contribution will show new experimental results, comparing the growth behaviour and critical saturation of positively and negatively charged nanoparticles.

UP 9.3 Thu 14:40 HSZ 105

Stratospheric aerosol particle size retrievals based on SAGE III/ISS — •Felix Wrana, Christian von Savigny, and Jacob Zalach — Universität Greifswald

Because of its role in the radiative balance of the atmosphere and in atmospheric chemistry interest in the particle size distribution (PSD) of stratospheric aerosol is growing in recent years. Here, the use of remote sensing using satellite measurements yields the benefit of a much greater spatial coverage in aerosol data, than ground based or in-situ measurements can provide. In this work the solar occultation data set of the SAGE III instrument mounted on the ISS, which is active since summer 2017, was used to derive the PSD parameters for stratospheric aerosol. For this, color ratios of extinction measurements at three different wavelengths were used to retrieve median radii and mode widths. While in the past it was often necessary to assume one parameter to determine the other, the broad wavelength spectrum of SAGE III allows the simultaneous retrieval of both parameters, which was done here. Number densities and effective radii were also calculated. While the median radii and mode widths interestingly show reverse trends with increasing height, the results seem to be in general agreement with other comparable works.

UP 9.4 Thu 15:00 HSZ 105

Untersuchung der stratosphärischen Aerosolschicht über Nordnorwegen mit dem ALOMAR RMR Lidar — •Arvid Langenbach[1], Gerd Baumgarten[1], Franz-Josef Lübken[1], Christian von Savigny[2] und Jacob Zalach[2] — [1]Leibniz-Institut für Atmosphärenphysik e.V. an der Universität Rostock, Schlossstraße 6,18225 Kühlungsborn — [2]Ernst-Moritz-Arndt Universität, Institut für Physik, Felix-Hausdorff-Str. 6, 17489 Greifswald

Die stratosphärische Aerosolschicht hat eine fundamentale Bedeutung für die Strahlungsbilanz der Atmosphäre und die Ozonchemie. Umfangreiche Daten über ihre Ausprägung und Beschaffenheit in den nördlichen polaren Breiten existieren kaum. Die Auswertemethodik auf Basis von Daten des ALOMAR RMR Lidars für stratosphärische Aerosole beruht auf der Messung der Rückstreuung bei unterschiedlichen Wellenlängen und der Nutzung verschiedener Streuprozesse. Für Nachtmessungen werden Rückstreuverhältnisse der Aerosole aus dem elastisch rückgestreuten Signal bei 1064, 532 oder 355 nm und dem inelastisch rückgestreuten Signal bei 387 oder 608 nm bestimmt. Für Tagmessungen wird ein Farbverhältnis aus elastisch rückgestreuten Signalen mit Hilfe einer Korrekturfunktion zu einem Profil des Rückstreuverhältnisses approximiert. So erhält man erstmals einen Datensatz in hohen Breiten, der das komplette Jahr abdeckt. Die Daten liegen in einer bisher unerreichten Auflösung von fünf Minuten und 150 Metern vor. Insgesamt umfasst der Datensatz 7490 Stunden.

UP 9.5 Thu 15:20 HSZ 105

Estimating the impact of volcanic eruptions on the thermal structure of the mesosphere and lower thermosphere by analyzing HALOE temperature data — •Sandra Peglow, Anne Krüger, Christoph Hoffmann, and Christian von Savigny — University Greifswald, Felix-Hausdorff-Str. 6, 17489 Greifswald

A paper published in 1998 by She et al. [1] analyzed lidar temperature profiles and reported an episodic warming of the mesopause region that peaked in 1993 and was attributed by the authors to a delayed response from the Pinatubo eruption in 1991. A considerable temperature increase with a magnitude up to 12.9 K in 100 km altitude was observed. The hypothesized correlation between the tropical volcanic eruption of the Mount Pinatubo and the temperature in the mesopause region needs further investigation. Therefore, temperature data from the Halogen Occultation Experiment (HALOE) on the Upper Atmosphere Research Satellite is currently used to extract temperature variations in the middle atmosphere considering seasonal, solar and volcanic contributions. This study provides a critical comparison with the magnitude and position of the perturbation reported by She et al. [1] C. Y. She, Steven W. Thiel, and David A. Krueger. Observed episodic warming at 86 and 100 km between 1990 and 1997: Effects of mount pinatubo eruption. Geophysical Research Letters, 25(4):497*500, 1998.

UP 9.6 Thu 15:40 HSZ 105

Volcanic impact on atmosphere and climate - overview of the DFG research unit VolImpact — •C. von Savigny[1], C. Timmreck[2], S. Bühler[3], J. Burrows[4], M. Giorgetta[2], G. Hegerl[5], C. Hoose[6], A. Hoshyaripour[6], E. Malinina[4], J. Quaas[7], A. Rozanov[4], H. Schmidt[2], L. Thomason[8], M. Toohey[9] und B. Vogel[6] — [1]University of Greifswald — [2]MPI Meteorology — [3]University of Hamburg — [4]University of Bremen — [5]University of Edinburgh — [6]Karlsruhe Institute of Technology — [7]University of Leipzig — [8]NASA Langley — [9]University of Saskatchewan

Explosive volcanic eruptions are natural experiments that can provide unique insights into many of atmospheric processes. Understanding how the climate system responds to volcanic forcing does not only allow testing our understanding of processes relevant to climate change, it can also advance our ability to interpret past records. Although volcanic effects on atmosphere and climate have been a topic of intensive research for several decades, many important processes are still only poorly understood. This contribution will provide an overview of research activities within the recently funded cooperative research project

"VolImpact" (DFG Research Unit FOR 2820), which will address several of these insufficiently understood processes. These include the initial development of explosive volcanic plumes, the radiative and chemical effects associated with volcanic stratospheric aerosols, aerosol-cloud interactions, dynamical effects of volcanic eruptions in the troposphere, stratosphere and mesosphere as well as effects on the hydrological cycle.