UP 1: Atmospheric Trace Gases and Aerosols

Time: Monday 11:00–12:30 Location: ELP 6: HS 4

Invited Talk UP 1.1 Mon 11:00 ELP 6: HS 4

Atmospheric impact of energetic particle precipitation from the lower thermosphere to the surface — •Miriam Sinnhuber — Karlsruher Institut für Technologie

Energetic charged particles - protons, electrons and heavier ions with energies from tens of keV to hundreds of MeV - precipitate into the atmosphere at high latitudes, guided by the Earth's magnetic field. They originate from the sun, accelerated in the solar corona during flares or coronal mass ejection events, or from the terrestrial magnetosphere, accelerated during geomagnetic storms or auroral substorms by variations in the high-speed solar wind. In the atmosphere, they interact with the most abundant species by collision reactions, starting a chain of chemical-dynamical coupling mechanism. The first step is atmospheric ionization and the formation of radicals of the NOx and HOx families mainly in the mesosphere and lower thermosphere, and subsequent ozone loss. NOx can be transported into the stratosphere during polar winter, and contribute significantly to ozone loss at the top of the ozone layer. Radiative feedbacks in turn affect atmospheric dynamics possibly even down to tropospheric weather systems. This so-called geomagnetic forcing of the climate system is modulated by the quasi-continuous solar wind and sporadic solar eruptions and varies over the 11-year solar cycle; since CMIP6, it is also recommended as part of the solar forcing of the climate system. In this presentation, an overview of the state of the art will be provided, focusing on the 11-year variability as well as on the impact of extreme solar events.

UP 1.2 Mon 11:30 ELP 6: HS 4

Improvements of the HAGAR-V instrument and its performance during the HALO mission PHILEAS — •Ronja van Luijt, Valentin Lauther, Johannes Strobel, Andrea Rau, Lars Zlotos, and Claus Michael Volk — Institute for Atmospheric and Environmental Research, University of Wuppertal, Germany

Precise airborne in situ measurements of VOCs are useful to understand atmospheric processes and can be achieved by GC/MS. The need for high spatial resolution conflicts with typical time resolutions of 3 to 10 minutes for mobile GC/MS. We present the recently improved HAGAR-V (High Altitude Gas AnalyzeR-5 channel version), developed at the University of Wuppertal for use on the HALO aircraft, with a time resolution of 2 minutes while measuring about 30 VOC species in the ppt range by employing two identical GC channels with a single MS. Additionally, it includes a NDIR CO2 analyzer and a 2-channel GC/ECD. For the GC/MS, innovative multitasking of various processes and strong sample refocusing result in detection limits of a few ppq and precisions of 1-5% and a shorter sampling time of 40 s, yielding a significant improvement in resolving fine-scale atmospheric structure. We show the performance of the HAGAR-V instrument during the HALO mission PHILEAS investigating the impact of the Asian summer monsoon on the extratropical UTLS. HAGAR-V GC/MS measured with high resolution species with anthropogenic Asian sources, species with biomass burning sources and very short-lived NMHCs, providing key information for understanding the evolution of convectively uplifted pollutants in the UTLS.

UP 1.3 Mon 11:45 ELP 6: HS 4

A novel method of measuring the viscosity and surface tension of supercooled levitated droplets — Mohit Singh[1], Stephanie Helen Jones[1], Alexei Kiselev[1], Denis Duft[1], and •Thomas Leisner[1,2] — [1]Institut of Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Institut für Umweltphysik, Universität Heidelberg, Germany

Viscosity and surface tension of aerosol particles influence e.g. the rate of heterogeneous and photochemical reactions, the evaporation and growth processes leading to CCN formation, and the ability to act as ice nuclei. Both quantities can vary significantly during the atmospheric processing of aerosol particles. Following these changes requires a fast and reliable measurement technique, which can be applied to airborne particles under realistic atmospheric conditions where noneequilibrium conditions like supersaturation and superooling are widespread. We report a novel method to simultaneously measure the time-dependent viscosity and surface tension of charged droplets levitated in an environmental electrodynamic balance. In addition to the alternating electric field required for levitation, a secondary electric field of variable frequency is applied to induce shape oscillations in the levitated droplet. The shape oscillations are analysed by light scattering and the phase shift in the induced shape oscillations with respect to the driving field is used to determine droplet viscosity and surface tension.

UP 1.4 Mon 12:00 ELP 6: HS 4

New results from the joint research project VolImpact — •Christian von Savigny[1], Claudia Timmreck[2], Ali Hoshyaripour[3], Akos Horvath[4], Alexei Rozanov[5], John Burrows[5], Ulrike Niemeier[2], Felix Wrana[1], Anna Lange[1], Corinna Hoose[3], Johannes Quaas[6], Sandra Wallis[1], Hauke Schmidt[2], and Christopher Kadow[7] — [1]Institut für Physik, Universität Greifswald — [2]MPI für Meteorologie, Hamburg — [3]Institut für Meteorologie und Klimaforschung, KIT — [4]Institut für Meteorologie, Universität Hamburg — [5]Institut für Umweltphysik, Universität Bremen — [6]Institut für Meteorologie, Universität Leipzig — [7]DKRZ, Hamburg

Volcanic eruptions are one of the most important natural drivers of climate change on time scales from a few years up to a decade. In the DFG funded Research Unit VolImpact we investigate relevant aspects of volcanic eruptions on the atmosphere and climate in five projects, i.e. the initial development of volcanic plumes on time scales from hours to a few days, the evolution of volcanic aerosol layers in the stratosphere, interactions of volcanic aerosols and tropospheric clouds, dynamic and thermal effects of volcanic eruptions on the middle atmosphere as well as volcanic effects on the hydrological cycle. After a short overview of the VolImpact project, this talk will focus on recent results from the second phase of the VolImpact project, including results on the unusual eruption of Hunga-Tonga Hunga Ha'apai in January 2022, satellite remote sensing of microphysical parameters of stratospheric aerosols, as well as unusual optical phenomena in the atmosphere.

UP 1.5 Mon 12:15 ELP 6: HS 4

Tracing the Hunga Tonga - Hunga Ha'apai H_2O anomaly through the mesosphere — •Sandra Wallis and Christian von Savigny — University of Greifswald, Germany

The 2022 Hunga Tonga - Hunga Ha'apai eruption emitted an exceptionally large amount of approximately 150 Tg H_2O into the middle atmosphere (10 - 100 km). After an immediate subsidence, the volcanic H_2O anomaly began to rise in the tropics and crossed the stratopause (1 hPa) by the end of March 2023. We use MLS H_2O mixing ratios to trace its subsequent transport through the mesosphere (50 - 100 km altitude). This research is especially relevant to the noctilucent cloud community, because upon reaching the summer mesopause region (approximately 90 km) the H_2O anomaly could potentially have an impact on the properties of noctilucent clouds such as occurrence frequency or brightness.