Environmental Physics Division
Fachverband Umweltphysik (UP)

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Overview of invited talks and sessions

(Lecture hall HSZ 105; Poster P2/4OG)

Invited Talks

UP 2.1	Tue	9:50–10:20	HSZ 105	**Towards process-based narratives for seasonal climate predictions** — •Johanna Baehr
UP 2.4	Tue	11:30–12:00	HSZ 105	**Earth-system model simulations of the effect of the asteroid impact 66 million years ago** — •Georg Feulner, Julia Brugger, Matthias Hofmann, Stefan Petri
UP 2.5	Tue	12:00–12:30	HSZ 105	**Sonne oder Treibhaus? Globale Erwärmung einfach und physikalisch nachgerechnet** — •Axel Kleidon
UP 3.1	Tue	14:00–14:30	HSZ 105	**Flugzeuggetragene Messungen am globalen Hotspot der Schwerewellenaktivität für ein besseres Verständnis der Dynamik der mittleren Atmosphäre** — •Markus Rapp, das SOUTHTRAC Team
UP 4.1	Tue	14:50–15:20	HSZ 105	**Capturing Spatial and Temporal Patterns of NO2 in Cities using mobile and stationary DOAS measurements.** — •Mark Wenig, Sheng Ye, Ying Zhu, Jia Chen, Florian Dietrich, Xiao Bi, Ka Lok Chan

Invited talks of the joint symposium SYCE

See SYCE for the full program of the symposium.

SYCE 1.1	Wed	9:30–10:00	HSZ 02	**Towards a carbon-free energy system: Expectations from R&D in renewable energy technologies** — •Bernd Rech, Rutger Schlatmann
SYCE 1.2	Wed	10:00–10:30	HSZ 02	**Decarbonizing the Heating Sector - Challenges and Solutions** — •Florian Weiser
SYCE 1.3	Wed	10:30–11:00	HSZ 02	**The challenge of anthropogenic climate change - Earth system analysis can guide climate mitigation policy** — •Matthias Hofmann
SYCE 1.4	Wed	11:15–11:45	HSZ 02	**A carbon-free Energy System in 2050: Modelling the Energy Transition** — •Christoph Kost, Philip Sterchele, Hans-Martin Henning
SYCE 1.5	Wed	11:45–12:15	HSZ 02	**The transition of the electricity system to 100% renewable energy: agent-based modeling of investment decisions under climate policies** — •Kristian Lindgren

Sessions

UP 1.1–1.2	Sun	16:00–18:00	HSZ 04	**Tutorials (joint session UP/TUT)**
UP 2.1–2.7	Tue	9:45–13:10	HSZ 105	**Climate, Climate modelling & Energy**
UP 3.1–3.2	Tue	14:00–14:50	HSZ 105	**Atmospheric Dynamics**
UP 4.1–4.3	Tue	14:50–16:00	HSZ 105	**Atmospheric Chemistry 1**
UP 5.1–5.7	Wed	14:00–16:00	P2/4OG	**Poster Session**
UP 6.1–6.5	Wed	16:30–18:10	HSZ 105	**Atmospheric Chemistry 2**
UP 7.1–7.6	Thu	10:00–12:30	HSZ 105	**Measurement Techniques**
UP 8	Thu	12:45–13:45	HSZ 105	**Meeting of members of the DPG environmental physics division**
UP 9.1–9.6	Thu	14:00–16:00	HSZ 105	**Aerosols**

Mitgliederversammlung des Fachverbands Umweltphysik

Donnerstag 12:45–13:45 HSZ 105 Mitglieder des Fachverbands sowie Gäste sind herzlich willkommen. Ein Imbiss wird bereitgestellt.

UP 1: Tutorials (joint session UP/TUT)

Time: Sunday 16:00–18:00 Location: HSZ 04

Tutorial UP 1.1 Sun 16:00 HSZ 04

Spektroskopische Messungen atmosphärischer Spurenstoffe — •Christian von Savigny — Institute of Physics, University of Greifswald, Greifswald, Germany

Die Messung atmosphärischer Spurenstoffe ist eine wichtige Teildisziplin der physikalischen Umweltforschung. Mit spektroskopischen Verfahren im Optischen, Infrarot und im Mikrowellen-Bereich lassen sich eine Vielzahl atmosphärischer Spurenstoffe experimentell bestimmen. Dabei spielen beispielsweise die Messung von Treibhausgasen, Stickoxiden und anderen Luftschadstoffen, oder von Ozon in der Stratosphäre eine besondere Rolle. Die Messungen werden als in-situ oder Fernerkundungsmessungen durchgeführt und können vom Boden, von Flugzeugen, Forschungsballons oder auch an Bord von Satelliten durchgeführt werden. Dieses Tutorial gibt einen Überblick über die zugrundeliegenden physikalischen Messprinzipien, die erforderlichen numerischen Methoden zur Ableitung von Spurenstoffmengen und veranschaulicht anhand zahlreicher Beispiele die aktuellen technischen und experimentellen Möglichkeiten und den Beitrag dieser Messungen zur aktuellen Atmosphären- und Klimaforschung.

Tutorial UP 1.2 Sun 17:00 HSZ 04

Die "Dieselproblematik": Warum erst jetzt "saubere" PKW-Diesel und sind sie "sauber"? — •Ulrich Platt — Institut für Umweltphysik, Universität Heidelberg

Verharmlosend als "Dieselproblematik" bezeichnet wird der vermutlich größte Industrie-skandal der letzten Jahrzehnte. Worum geht es dabei? Bekanntlich stoßen Verbrennungs-motoren Schadstoffe aus die die menschliche Gesundheit bedrohen, im Zentrum des Inter-esses stehen Stickoxide (NO und NO2), Kohlenmonoxid (CO), Kohlenwasserstoffe und Feinstaub (Partikel mit Radien unter 1/100 mm). Zum Schutz der Bewohner, insbesondere von Ballungsgebieten, werden verbindliche Grenzwerte für die o.g. Spezies festgelegt, in der EU sind des aktuell nach der EU Richtlinie 2007/46/EG die Euro 6 Grenzwerte, die z.B. für Diesel PKW eine Emission von max. 80 mg NOX (Summe aus NO und NO2) vorschreibt. Problematisch ist bei Dieselabgasen (im Gegensatz zu Abgasen von Benzinmotoren) insbesondere die Entfernung von NOX aus dem Abgas, eine Lösung ist die selective kata-lytische Reduktion (SCR) bei der eine in den Abgas-Strom eingespritzte Harnstoff-Lösung NOX zu N2 reduziert. Seit etwa 10 Jahren zeigen Messungen auf der Straße jedoch bei Diesel PKW keine Abnahme der NOX-Emission im realen Verkehr, obwohl in diesem Zeitraum die Grenzwerte in 3 Stufen um nahezu eine Größenordnung abgesenkt wurden. Dies scheint auch die PKW aller Hersteller zu betreffen. Im Tutorial werden die Grundlagen der Schadstoffbildung im Abgas und die Verfahren zur Abgasreinigung vorgestellt und erklärt. Konsequenzen fehlender Luftreinhaltung werden diskutiert, Methoden zur Emissionsmessung, vor allem auch die Messungen im tatsächlichen Verkehr (Real Driving Emissions, RDE und Plume Chasing), werden beschrieben. Zum Schluss wird ein Ausblick auf die Zukunft der Luftreinhaltung gegeben.

UP 2: Climate, Climate modelling & Energy

Time: Tuesday 9:45–13:10 Location: HSZ 105

Introduction

Invited Talk UP 2.1 Tue 9:50 HSZ 105

Towards process-based narratives for seasonal climate predictions — •Johanna Baehr — Institute of Oceanography, Center for Earth System Research and Sustainability, Universität Hamburg

Skillful seasonal climate predictions for European climate remain a formidable challenge. I will present recent progress in predicting European climate variability using prediction systems based on the Max-Planck-Institute Earth System Model (MPI-ESM). In the presentation, I will challenge the current practice in seasonal climate predictions to focus on the analysis of the ensemble-mean forecast. In addition, I will suggest process-based narratives, which I will illustrate by analyzing seasonal re-forecasts for European summer and winter climate.

UP 2.2 Tue 10:20 HSZ 105

Variability of surface climate in model simulations of past and future climate — •Kira Rehfeld[1], Raphaël Hébert[2], Juan Lora[3], Marcus Lofverström[4], and Chris Brierley[5] — [1]Institut für Umweltphysik, Heidelberg University, Germany — [2]Alfred-Wegener Institute for Polar- and Marine Research, Potsdam, Germany — [3]Department of Geology and Geophysics, Yale University, US — [4]Department of Geosciences, University of Arizona, US — [5]Department of Geography, University College London, UK

Mean surface temperature of the Earth is projected to rise under all considered emission scenarios, yet little is known about future changes in climate variability. We assess changes in the variability of surface temperature, precipitation, and modes of variability over the entire model ensembles of the Paleoclimate Modeling Intercomparison Project, including the time slices of the Last Interglacial, Last Glacial Maximum, the Mid Holocene, idealized warming experiments and future projections. We examine changes at the local scale and relate them to global mean temperature and precipitation changes. We investigate systematic changes in modes of variability, such as the North Atlantic Oscillation, with global mean temperature change. Mean precipitation across the ensemble is correlated with mean temperature, but the correlation with precipitation variability is weak. We find decreases (increases) of precipitation variability for warm (cold) simulations in western continent regions. Compositing extreme precipitation events we show that, in these regions, they are dominated by the same climatic modes in palaeoclimate and future simulations.

UP 2.3 Tue 10:40 HSZ 105

Understanding and modeling the scaling spectrum of climate — •Beatrice Ellerhoff and Kira Rehfeld — Institute of Environmental Physics, INF 229, 69120 Heidelberg, Germany

Modeling climate dynamics in a comprehensive way and improving its predictability in a warming world requires a better understanding of climate variability across scales. However, fundamental mechanisms governing variability on long timescales are still poorly understood. The temporal evolution of climate can be inferred from paleoclimate records, such as ice cores or marine sediments. The reconstructed continuous spectrum of surface temperature shows a scaling break, following different power-laws on monthly to decadal versus millennial to longer periods. It is yet mostly unexplained, how these power-laws arise and whether a coupling between different timescales can be deduced from it. We study these questions by comparing and applying spectral analyses to paleoclimate records and climate model simulations for the Quaternary. The temperature spectrum is computed from both, climate forcings and responses on diurnal to astronomical timescales. Higher order spectra test for correlations between forcings and responses. In particular, the bispectrum and bicoherence is computed for statistical processes and evaluated for temperature records in order to study whether the scaling properties are related to energy transfers between different states in time. We elaborate the potential of these methods to reveal dynamical processes governing the continuous spectrum of surface temperature.

30 minute break

Invited Talk UP 2.4 Tue 11:30 HSZ 105

Earth-system model simulations of the effect of the asteroid impact 66 million years ago — •Georg Feulner[1], Julia Brugger[1,2], Matthias Hofmann[1], and Stefan Petri[1] — [1]Potsdam-Institut für Klimafolgenforschung (PIK), Potsdam, Germany — [2]Institut für Physik und Astronomie, Universität Potsdam, Potsdam, Germany

Numerical models of Earth's climate system have become essential tools in modern climate science. They provide a glimpse into our future in a warming world, but they also allow us to explore the past and

thus to investigate Earth-system dynamics and stability under a range of different boundary conditions. After an overview of palaeoclimate work in my group, I will present recent results on one of the most dramatic events, the asteroid impact 66 million years ago which has been linked to the end-Cretaceous mass extinction event, and particularly to the demise of the (non-avian) dinosaurs. Specifically, we study the climate effects of sulfate aerosols and carbon dioxide formed during the impact using a coupled ocean-atmosphere model and the biogeochemical effect of sulfur, carbon, iron and phosphate from the impact using a marine biogeochemistry model. We find a strong decrease of annual global surface air temperatures by at least 26°C, returning to pre-impact temperatures after about 100 years. The cooling induces vigorous ocean mixing that leads to changes in oxygen distributions and nutrient availability. Importantly, we find a significant increase in primary productivity once the light returns after the impact.

Invited Talk UP 2.5 Tue 12:00 HSZ 105

Sonne oder Treibhaus? Globale Erwärmung einfach und physikalisch nachgerechnet — •Axel Kleidon — Max-Planck-Institut für Biogeochemie, Jena

Die globale Klimaerwärmung zeigt sich zunehmend stärker. Aber woher wissen wir, dass die beobachtete Erwärmung durch den Treibhauseffekt und nicht durch die Sonne verursacht wird? Was ich hier zeige ist, dass man die Erwärmungsmuster durch den Treibhauseffekt klar von denen durch Solarstrahlung unterscheiden kann, weil sie unterschiedliche Terme in der Energiebilanz beeinflussen. Ein stärkerer Treibhauseffekt führt zu den beobachteten, stärkeren Erwärmungen während der Nacht, des Winters, und in den Polargebieten, also zu Zeiten, in dem die Erwärmung durch Solarstrahlung gering ist oder fehlt. Diese Muster können somit nicht durch eine erhöhte Absorption von Solarstrahlung erklärt werden. Ich nutze eine einfache Formulierung der Energiebilanz, um diese unterschiedlichen Wirkungsweisen von Treibhauseffekt und Solarstrahlung zu quantifizieren. Die grundlegenden Muster des Klimawandels lassen sich somit auch einfach und physikalisch verstehen und berechnen, und man ist dafür nicht auf komplexe Klimamodelle angewiesen.

UP 2.6 Tue 12:30 HSZ 105

Energy Storage in Concentration Gradients — •Ulrich Platt and Florian Dinger — Institut für Umweltphysik, Universität Heidelberg

Reliable systems for energy storage are a central component of energy supply systems with a high fraction of renewable energy. Here we propose energy storage using two reservoirs of water with different salt concentrations. Storage of excess energy takes place by reverse osmosis increasing the salt concentration in one reservoir. The produced fresh water will be stored in a second reservoir or discarded, e.g. in a river. Release of the stored energy by an osmosis power station (OPS), exploiting the osmotic pressure of the high concentration reservoir. Energy storage density can reach 8 kWh/m3, up to one order of magnitude higher than in typical pumped-storage hydroelectricity (PSH) at comparable efficiency. Besides the described onshore application using fresh water, an OPS can also be installed at the coast or offshore utilizing the still large concentration gradient between ocean water and saturated salt solution. The technology of such a system is readily available: Reverse osmosis for production of fresh water from ocean water is in widespread use and the technical components (large area membranes, pressure exchangers) are commercially available. Also, the principle of OPS was realized in a demonstration plant in 2009. Compared to PSH our new approach requires no altitude difference of reservoirs, therefore large storage capacities can be realized very economically. A series of different realization schemes and sample calculations of power and energy densities are provided.

UP 2.7 Tue 12:50 HSZ 105

Energy harvesting Technologies for IIoT Applications in Electricity Grid Management — •Joana R. C. Faria and Francisco J. A. Cardoso — LIBPhys - University of Coimbra, Portugal

Being based on the significant advances in different technological areas - sensors, Microsystems, wireless networks, and web service programming -, the Internet of Things (IoT) represents a concept that enables data produced at a number of different locations to be aggregated in a central database. A single IoT device can be useful on its own, but it is the combination of information from numerous devices that tends to increase their intrinsic value, thus underlying the concepts of smart buildings, factories and cities.

The Industrial Internet of Things (IIoT), which is a major tool for the upcoming Industry 4.0, has grown at a faster pace because it can help businesses operate more efficiently, make better informed decisions and unlock new revenue sources. Numerous connected devices demand innovative ways to supply their power demands in a permanent and sustainable way. Energy harvesting technologies reuse ambient energy which is otherwise wasted, creating a practical and self-sufficient solution for IoT power supply.

Here, it is shown that opportunities for energy harvesting technologies exist even in electricity grids. Energy harvesting from two energy sources in the surrounding environment (solar and thermoelectric) are presented in different application contexts of electricity grid management, including the respective experimental results.

UP 3: Atmospheric Dynamics

Time: Tuesday 14:00–14:50 Location: HSZ 105

Invited Talk UP 3.1 Tue 14:00 HSZ 105

Flugzeuggetragene Messungen am globalen Hotspot der Schwerewellenaktivität für ein besseres Verständnis der Dynamik der mittleren Atmosphäre — •Markus Rapp[1,2] und das SOUTHTRAC Team[3] — [1]Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany — [2]LMU München — [3]FZJ, KIT, U. Mainz, U. Frankfurt

Die Region um die Südspitze Südamerikas und die Antarktische Halbinsel ist als globaler Hotspot der Schwerewellenaktivität in der mittleren Atmosphäre bekannt. In dieser Region treffen starke troposphärische Winde auf die Anden und die Berge der antarktischen Halbinsel. Dort wurde im September und November 2019 die SOUTHTRAC (Transport, Dynamics and Composition of the Southern Hemisphere) Messkampagne mit dem deutschen Forschungsflugzeug HALO durchgeführt. Vom Basisflughafen in Rio Grande wurden insgesamt 6 Messflüge mit einer durchschnittlichen Länge von 7000 km realisiert, die sich speziell mit der Dynamik von Schwerewellen beschäftigten. An Bord befanden sich in-situ und Fernerkundungsinstrumente, die die Charakterisierung von Schwerewellen vom Boden bis in 90 km Höhe ermöglichten. In diesem Vortrag werden wissenschaftliche Motivation, Messstrategie und erste Ergebnisse der Messungen vorgestellt.

UP 3.2 Tue 14:30 HSZ 105

Could there be a synchronization between the phases of the Madden-Julian oscillation and the solar 27-day cycle? — •Christoph Hoffmann and Christian von Savigny — Universität Greifswald, Institut für Physik, Felix-Hausdorff-Str. 6, 17487 Greifswald

The solar irradiance is subject to variations on different time scales including the 27-day cycle. These variations are known to introduce variability in the upper and middle atmosphere. Implications for the troposphere are currently under discussion.

The Madden-Julian oscillation (MJO) is a major source of intraseasonal variability in the troposphere. Recently, studies have indicated that the occurrence of strong MJO events could be modulated by the solar 27-day cycle.

We analyze whether also the temporal evolution of the MJO phases could be linked to the solar 27-day cycle and find indications for such a synchronization, which are most notable under particular atmospheric background conditions, like, e.g., boreal winter conditions. We do not claim to unambiguously prove this relationship; neither in a statistical, nor in a causal sense. Instead, we challenge these initial findings ourselves in detail by varying underlying datasets and methods. Note that the question discussed here, is not connected to the questions concerning the influence of the sun on the Earth's climate but addresses much shorter time scales.

UP 4: Atmospheric Chemistry 1

Time: Tuesday 14:50–16:00 Location: HSZ 105

Invited Talk UP 4.1 Tue 14:50 HSZ 105

Capturing Spatial and Temporal Patterns of NO2 in Cities using mobile and stationary DOAS measurements. — •Mark Wenig[1], Sheng Ye[1], Ying Zhu[1], Jia Chen[2], Florian Dietrich[2], Xiao Bi[2], and Ka Lok Chan[3] — [1]Meteorologisches Institut, Ludwig-Maximilinas-Universität München — [2]Fakultät für Elektrotechnik und Informationstechnik, Technische Universität München — [3]Institut für Methodik der Fernerkundung, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)

The problem of elevated NO2 levels in cities has gained some attention in the public and science in recent years. Urban air quality is typically monitored using a relatively small number or monitoring stations. Those in-situ measurements follow certain guidelines in terms of inlet height and location relative to streets, but the question remains how a limited number of point measurements can capture the spatial variability in cities. In this talk we present two measurement campaigns in Hong Kong and Munich where we utilized a combination of mobile in-situ and stationary remote sensing differential optical absorption spectroscopy (DOAS) instruments. We developed an algorithm to separate spatial and temporal patterns in order to generate pollution maps that represent average NO2 exposure. We use those maps to identify pollution hot spots and capture the weekly cycles of on-road NO2 levels and spatial dependency of long-term changes.

UP 4.2 Tue 15:20 HSZ 105

Individual air pollution exposure assessment using a newly developed smart handheld monitoring device — •Sheng Ye and Mark Wenig — Meteorologisches Institut, Ludwig Maximilians University, Theresienstr. 37, 80333 Munich, Germany

NO2 pollutant in the atmosphere is attracting more and more public attention. People are interested in not only the ambient NO2 levels but also the individual exposure. We developed a sensor-based handheld Air Quality Inspection Box (Airquix) for individual exposure measurements for different pollutants. The Airquix is a portable air monitoring instrument, which is equipped with electrical chemical NO2, O3, NO sensors, NDIR CO2 sensor, OPC PM sensor, environment parameters (T, RH, P), GPS, and a raspberry pi for data logging and display. We use stationary instruments to calibrate the Airquix before and after mobile measurements and achieve a relatively high accuracy, e.g. +/- 5 ppb 5 seconds time resolution for the NO2 measurements. We use several Airquixes to capture different daily activities of different people simultaneously. We distinguish different commutes, in- and outdoor activities and compare the influence of different habits on the personal pollution exposure. The resulting data set can be used for the assessment of health impacts.

UP 4.3 Tue 15:40 HSZ 105

Ozone impact on plant physiology and nitrogen partitioning — •Stefanie Falk[1], Ane Victoria Vollsnes[2], Frode Stordal[1], and Terje Koren Berntsen[1] — [1]University of Oslo, Department of Geosciences — [2]University of Oslo, Department of Biosciences

Ozone is an important trace gas in the Earth's atmosphere. Stratospheric ozone protects all lifeforms on its surface from harmful UV radiation. In the boundary layer, ozone is regarded as a toxic pollutant and cause to an average global loss of yield in the four major crops of about $3-15\,\%$. Future projections indicate that high ozone concentrations may affect food security in the future especially in Asia. Ozone alters the plants photosynthesis through, e.g. reduction of CO_2 uptake (decrease in stomatal/ mesophyll conductance), processing of CO_2 (decrease in enzymes/proteins important for light capture, electron transport, and carboxylation), and enhancement in defense and repair reactions. A key determinant for photosynthesis is the concentration of leaf nitrogen. Each CO_2 processing step has a nitrogen cost associated.

In the absence of ozone, such a nitrogen cost model (LUNA in CLM5.0) has been shown to capture $55-65\,\%$ of the observed variation in the maximum electron transport rate $J_{\max}$ and maximum carboxylation rate V_{cmax}, respectively.

Based on data of deciduous trees from recent peer-reviewed articles, we establish a relationship between accumulative ozone dose (CUO) and the change in nitrogen cost for photosynthesis and show first results.

UP 5: Poster Session

Time: Wednesday 14:00–16:00 Location: P2/4OG

UP 5.1 Wed 14:00 P2/4OG

Temperature and precipitation relationship during the last Glacial from pollen records and climate simulations — •Anna Sommani, Nils Weitzel, and Kira Rehfeld — Institute of Environmental Physics, Heidelberg, Germany

The hydrological response to radiative forcing is much less understood than the thermal one: many climate models have difficulties in simulating seasonal rainfall and its variability. Confident projections of precipitation are of crucial importance particularly for regions where agriculture is highly dependent on seasonal rainfall, such as South and Central Asia. It was shown that, while temperature and precipitation are negatively correlated on short timescales (10^{-3} to 10^{0} years), on longer timescales (10^{1} to 10^{3} years), proxy and instrumental data observations have a positive correlation between temperature and precipitation. Climate models in contrast simulate a negative correlation on all timescales for Asia. Here, temperature and precipitation from four high resolution pollen records at mid-latitudes in the Northern Hemisphere are reconstructed, investigated and compared with climate model simulations. We focus on the last Glacial period, characterized by pronounced millennial-scale climate fluctuations. The differences between reconstructed and simulated temperature–precipitation relationship as well as orbital- and millennial-scale variability are examined. In particular, we explore whether thermodynamic laws can explain the observed relationship between temperature and precipitation.

UP 5.2 Wed 14:00 P2/4OG

Assessing variability and possible decline of Atlantic Overturning in the past two millennia through temperature fingerprints — •Shirin Ermis[1], Paola Moffa-Sánchez[2], Alexandra Jahn[3], and Kira Rehfeld[1] — [1]Institute of Environmental Physics, INF 229, 69120 Heidelberg, Germany — [2]Department of Geography, Lower Mount Joy, South Road, Durham, DH1 3LE, UK — [3]Department of Atmospheric and Oceanic Sciences and Institute of Arctic and Alpine Research, University of Colorado Boulder, Campus Box 450, Boulder, CO 80309-0450, USA

The Atlantic Meridional Overturning Circulation (AMOC) is essential to maintain the temperate climates of Europe and North America. It redistributes heat from the tropics, and stores carbon in the deep ocean. Yet, its variability and evolution are largely unknown due to a lack of direct circulation measurements. Previous studies suggest a connection between the variabilities of the AMOC strength and a temperature dipole in the North Atlantic. These results suggest a substantial decline in the strength of the overturning at around 1850.

Here, we compare temperature reconstructions from four sediment cores in the North Atlantic and model simulations of CESM1 as well as the HadCM3 for the past two millennia. We test the robustness of previously used temperature fingerprints and assess drivers of variability in the ocean circulation and a possible decline in strength. Due to the particularly high resolution of available temperature reconstructions this study could provide new insights into the variability of Atlantic Overturning on decadal time scales and beyond.

UP 5.3 Wed 14:00 P2/4OG

Identification and Characterization of Cirrus Clouds at Higher Latitudes from Lidar Data — •Jennifer Hartisch[1], Jörg Gumbel[2], and Christian v. Savigny[3] — [1]Greifswald University, Physics Institute, Germany — [2]Stockholm University, MISU, Sweden — [3]Greifswald University, Physics Institute, Germany

Cirrus clouds are thin ice clouds that occur in the cold upper troposphere. Clouds have both a warming and a cooling effect on the Earth's system. Which of these processes dominates depends on surrounding conditions and properties of the cloud, especially on their optical thickness. The cirrus' net warming effect is strongest in the tropics, where they occur at very high and cold altitudes. The effect of cirrus clouds at higher latitudes, where they occur at 8-10 km altitude is much less known. From 1987 to 2017 observations of cirrus clouds in Northern Sweden with a Rayleigh/Mie/Raman lidar at Esrange Space Center have been performed. To identify and characterize cirrus clouds in these lidar data, appropriate analysis methods are needed that start out from the particle backscattering at the primary lidar wavelength of 532 nm. A particular challenge is to distinguish the cirrus scattering from molecular Rayleigh scattering by the background atmosphere. This is achieved by invoking measurements of molecular Raman scattering. This research describes analysis algorithms that let us derive important cirrus parameters like occurrence, height, optical thickness, as well as extinction and scattering coefficients. A central goal is to establish a climatology of the clouds' occurrence and optical properties as a function of meteorological conditions at these high latitudes.

UP 5.4 Wed 14:00 P2/4OG

Methode zur Fehlerabschätzung der Bestimmung der fraktalen Dimension von leuchtenden Nachtwolken — •Lukas Depenthal und Christian von Savigny — Universität Greifswald, Institut für Physik, Greifswald

Bei der Vermessung von leuchtenden Nachtwolken wurde bereits in früheren Studien eine Abhängigkeit der Fläche und des Umfangs festgestellt und die fraktale Dimension der Wolken bestimmt. Um die Größe des Fehlers bei der Bestimmung der beiden Parameter besser abschätzen zu können, wird nun eine Methode verwendet, bei der fraktale Objekte, die der Form und fraktalen Dimension einer leuchtenden Nachtwolke ähnlich sind, erzeugt werden. Diese können dann in sehr hoher Auflösung analysiert werden. Anschließend wird dasselbe Objekt in künstlich verschlechterter Auflösung erneut vermessen und dabei die Abweichung des fraktalen Dimensionsparameters ermittelt. Dabei wird ein besonderes Augenmerk auf die Wahl der Gitterbreite und des Schwellenwertes als Parameter der Auflösungsveränderung geworfen. Des Weiteren wird diese Methode auf leuchtende Nachtwolken mittels Fotoaufnahmen des Stratosphärenballons des „EBEX Balloon Borne Experiment“ angewendet.

UP 5.5 Wed 14:00 P2/4OG

Pilotstudie zur Untersuchung von Schwerewellensignaturen in der Mesopausenregion mittels ortsaufgelöster OH-Nightglow Messungen über Greifswald (Deutschland) — •Max Vincent Uzulis, Lukas Depenthal, Martin Rödiger, Christoph Hoffmann und Christian von Savigny — Institut für Physik Universität Greifswald, Greifswald, Deutschland

Die Schwerewellenpropagation in der Mesopause ist immer noch Gegenstand aktueller Forschung. Da in-situ-Messungen in diesen Höhen schwer umsetzbar sind, können bodengestützte Messungen unter den richtigen Wetterbedingungen eine Alternative darstellen. Um Schwerewellen in der Mesopause sichtbar zu machen, können Infrarotemissionen von OH Molekülen, sogenannter Airglow, genutzt werden. Hierzu wurden 2017 Fallstudien über Greifswald durchgeführt, die Schwerewellensignaturen in der Mesopause nachweisen konnten. Die dazu erforderliche Messmethodik erlaubt eine bodengestützte, zeitlich-örtlich aufgelöste Beobachtung des Airglows und der darin auftretenden Wellenereignissen und wird durch ein Infrarotkamerasystem bewerkstelligt. Im Gegensatz zu spektrografischen Messungen, erlaubt die Aufnahme von ganzen Bildern, eine Untersuchung eines weiten Ausschnittes am Nachthimmel, was einen Einblick in die Wellendynamik möglich macht. Durch Fourier-Analyse konnte die Größenordnung der Wellenlängen dieser Schwerewellensignaturen ermittelt werden.

UP 5.6 Wed 14:00 P2/4OG

Validation of the Multiple Airglow Chemistry model applied using zonally averaged data sets — •Olexandr Lednyts'kyy[1], Amirmahdi Zarboo[2], Christian von Savigny[1], and Miriam Sinnhuber[2] — [1]University of Greifswald, Greifswald, Germany — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany

The Multiple Airglow Chemistry (MAC) model proposed to represent the photochemistry in the upper Mesosphere and Lower Thermosphere (MLT) region is applied to retrieve profiles of atomic oxygen (O) concentration ([O]). O is an important tracer for the energy budget of the MLT region. SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) and SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) aboard two satellites measured multiple nightglow emission rate profiles remotely in the time range 4/2010...3/2011 at ∼22:00 local time; these profiles are employed in the [O] retrievals. Reference [O] profiles, extracted using SABER as well as simulated using the empirical NRLMSISE-00 model and the composition-climate models, are compared with [O] profiles retrieved using the MAC model. Previously, calculations using the MAC model were tuned on the basis of the individual *in situ* profiles measured during the ETON rocket campaign and validated using three other rocket campaigns. The results presented in this contribution demonstrate that the MAC model can be used to retrieve [O] profiles on the basis of individual and zonally averaged emission profiles obtained using satellite observations. These observations provide an important basis for evaluation of the O content in models.

UP 5.7 Wed 14:00 P2/4OG

Influence of electrode materials on the dissociation of NO2, NO and CO2 via cold dielectric barrier discharge plasmas — •Maik Szafarska[1,2], Georgia Sourkouni-Argirusi[1], and Wolfgang Maus-Friedrichs[1,2] — [1]Clausthaler Zentrum für Materialtechnik — [2]Institut für Energieforschung und Physikalische Technologien

The purification of exhaust gas via cold dielectric barrier discharge plasmas aims to reduce the amount of emitted carbon dioxide or nitrogen oxides because it is an important aspect concerning air quality and greenhouse gas emissions. To find application in automotives, ships or other devices with polluting properties, dissociation rates have to be high and a cheap, robust and preferentially light reactor has to be developed. Gas mixtures were varied as well as the electrode materials, reactor materials and plasma parameters. Plasma induced changes to the gas mixture were analyzed via quadrupole mass spectrometry. The experimental results show that electrode material selection can have an impact on dissociation efficiency. In some cases, surface reactions between the electrodes and gases can be observed aswell. The tested electrodes consisted of copper, stainless steel and nickel.

UP 6: Atmospheric Chemistry 2

Time: Wednesday 16:30–18:10 Location: HSZ 105

UP 6.1 Wed 16:30 HSZ 105

Retrieval und Validierung von Ozonprofilen aus Nadir-Satellitenmessungen im hochaufgelösten UV Spektralbereich am Beispiel von OMI (Ozone Monitoring Instrument) — •Nora Mettig, Mark Weber, Alexeij Rozanov, Klaus Bramstedt und John P. Burrows — IUP, Bremen, Deutschland

Das IUP Ozonprofilretrieval beruht auf einem Optimal Estimation Ansatz mit einer Tikhonov-Regularisierung und dem Levenberg-Marquardt Algorithmus. Die vertikale Profilinformation wird dabei aus der unterschiedlichen Eindringtiefe der gemessenen UV Strahlung gewonnen. Es können Ozonprofile (0-50 km) mit einer mittleren vertikalen Auflösung von 10 km abgeleitet werden. Durch die Auswertung synthetischer Datensätze konnte eine Genauigkeit von 5% in der Stratosphäre und 40% in der Troposphäre nachgewiesen werden.

Für die Auswertung von OMI Daten wurde ein spektraler Bereich von 270 - 335 nm gewählt. Als Vorbereitung für das Retrieval ist eine sog. Softcalibration nötig (Liu, 2010). Hierfür wurden Strahlungstransferrechnungen mit MLS Ozonprofilen (microwave limb sounder) für einen Tag in den Tropen durchgeführt. Die mittleren Abweichungen der Spektren von OMI werden als räumlich und zeitlich unabhängige Korrektur verwendet. Die abgeleiteten Ozonprofile wurden mit dem offiziellen MLS Ozonprodukt validiert. Es konnte eine räumlich und zeitlich unabhängige Übereinstimmung mit MLS im Bereich 20 - 40 km Höhe gefunden werden. Die mittlere Abweichung der Profile liegt hier unter 10%. Im Bereich der Troposphäre werden die OMI Ozon-

profile mit Ozonsonden verglichen und erste Ergebnisse präsentiert.

UP 6.2 Wed 16:50 HSZ 105

Southeast Asian river CO2 emissions regulated by water pH — •Alexandra Klemme[1], Denise Müller-Dum[1], Moritz Müller[2], Justus Notholt[1], Tim Rixen[3], and Thorsten Warneke[1] — [1]Institute of Environmental Physics (IUP), Bremen, Germany — [2]Swinburne University of Technology, Faculty of Engineering, Computing Science, Kuching, Sarawak, Malaysia — [3]Leibniz Center for Tropical Marine Research (ZMT), Bremen, Germany

Southeast Asian rivers have been recognized as a hotspot for carbon dioxide (CO2) outgassing. This is due to extensive peatlands in Southeast Asia, which represent a globally important carbon store that is destabilized by deforestation, drainage and conversion into plantations. Peatland degradation is assumed to have increased carbon leaching from peat soils by about 200%. Despite the enhanced mobilization of carbon, recent data based estimates suggest only moderate CO2 emissions from Southeast Asian rivers. We find that the cause for these limited CO2 emissions is the water pH, which decreases along with increasing dissolved organic carbon (DOC) concentrations and hampers DOC respiration. Inputs of carbonate derived from rock weathering and soil erosion upstream of the coastal peatlands can suspend these natural limits by rising the pH. This implies that deforestation in the hinterland but also liming, which is a common practice in e.g. palm oil plantations, could increase CO2 outgassing from peat draining rivers. Furthermore, the pH dependency needs to be considered with regard to enhanced weathering, which is discussed as a possible measure to bind atmospheric CO2 and would increase soil and water pH.

UP 6.3 Wed 17:10 HSZ 105

Analyse von Sentinel-5 Precursor Satellitendaten bezüglich Emissionen lokalisierter Methanquellen — •Steffen Vanselow, Oliver Schneising und Michael Buchwitz — Institut für Umweltphysik (IUP), Universität Bremen FB1, Bremen

Methan ist nach CO_2 das wichtigste Treibhausgas und dessen steigende Konzentrationen in der Atmosphäre - verursacht durch zunehmende Methanemissionen - tragen signifikant zum Klimawandel bei. Messungen der atmosphärischen Methankonzentration ermöglichen die Detektion und Quantifizierung der zugrundeliegenden Emissionsquellen. Globale Satellitendaten spielen hierbei eine wichtige Rolle.

Der im Oktober 2017 gestartete Sentinel-5 Precursor (S5P) Satellit gestattet die Messung von u.a. Methan mit einer räumlichen Auflösung von 7x7 km^2 und einer täglichen globalen Abdeckung.

Das S5P Methanprodukt ist das vertikal gemittelte Mischungsverhältnis („XCH_4“ in parts per billion, ppb). Dieses XCH_4 Produkt wird operationell (EU/ESA) erzeugt, als auch mittels des wissenschaftlichen WFM-DOAS Auswerteverfahrens der Universität Bremen. Die entsprechenden Datensätze werden bzgl. lokal erhöhter Methankonzentrationen analysiert.

In dieser Präsentation werden Resultate bzgl. der Detektion lokaler Methanerhöhungen räumlich lokalisierter Methanquellen (z.B. Fördergebiete für Kohle) vorgestellt. Dabei werden u.a. folgende Fragen beantwortet: Welche lokalisierten Methanquellen lassen sich mit S5P detektieren? Sind die Methanerhöhungen im Rahmen der Messgenauigkeit zeitlich stabil?

UP 6.4 Wed 17:30 HSZ 105

Evaluation of natural wetland CH4 emission datasets — •Alexandra Klemme[1], Thorsten Warneke[1], Nikos Daskalakis[1], Marielle Saunois[2], Mihalis Vrekoussis[1], Justus Notholt[1], and GCP-wetland modelers[3] — [1]Institute of Environmental Physics (IUP), Bremen, Germany — [2]Laboratoire des Sciences du Climat et de l'Environnement (LSCE-IPSL), Gif-sur-Yvette, France — [3]Several Institutions from Canada, China, France, Germany, Japan, UK & USA

Emissions from natural wetlands are the biggest source to atmospheric methane (CH4). At the same time, estimates of these emissions contain high uncertainties. The Global Carbon Project compiled emission data from 13 different land surface models. Global emissions in these datasets differ by approximately 75%. Emissions from indivitual wetlands however show significantly higher differences. Emissions from the Congo catchment for instance differ by more than 600%. In this study, we aim to evaluate these datasets in the following way: We model atmospheric CH4 concentrations for each emission dataset, using the TM5 chemistry and transport model and compare the results to satellite data (GOSAT). We look into the absolute atmospheric concentrations as well as the annual CH4 variations which are mainly caused by wetland emissions. Additionally, model runs excluding local wetland emissions are performed to estimate the impact of local wetland emissions on measured CH4 variations. The results show that satellite CH4 data are able to constrain wetland CH4 emissions.

UP 6.5 Wed 17:50 HSZ 105

Investigating the excitation mechansm of the sodium D-line emissions — •Julia Koch[1], Landon Rieger[2], Chris Roth[2], Adam Bourassa[2], Doug Degenstein[2], and Christian von Savigny[1] — [1]Universität Greifswald, Greifswald, Germany — [2]University of Saskatchewan, Saskatoon, Canada

The understanding of the excitation mechanism of the sodium D-line emission is important for all further investigations of atomic sodium in the upper mesosphere. In 1939 Chapman proposed a first scheme of the chemical reactions between sodium and ozone that were thought to lead to the yellow sodium line doublet. But after that it became clear that this mechanism could not explain the observed varability in the Na D-line ratio. That lead to a modified mechanism, known as the "modfied Chapman mechanism". However, it is well accepted that there is still a parameter that is not fully understood: the branching ratio f, that defines how many sodium atoms are produced (via the reaction Na + O3) in the excited Na(2P) state. Here we show sodium profiles retrieved from data measured with the OSIRIS instrument on the Odin satellite. And in combination with Lidar data from Logan, Utah we want to contribute to find a better value for the branching ratio.

UP 7: Measurement Techniques

Time: Thursday 10:00–12:30 Location: HSZ 105

UP 7.1 Thu 10:00 HSZ 105

Miniaturized widely tunable MID-Infrared Quantum-Cascade-Laser for Spectroscopic Applications — •André Merten[1], Stefan Hugger[2], Marcel Rattunde[2], Marko Härtelt[2], André Dreyhaupt[1], Markus Schwarzenberg[1], Robert Barth[1], Ralf Ostendorf[2], and Jan Grahmann[1] — [1]Fraunhofer IPMS, Maria-Reiche-Straße 2, 01309 Dresden — [2]Fraunhofer IAF, Tullastraße 72, 79108 Freiburg

Broadband tuning of MIR-infrared laser radiation from 3 to 10 micron (1000 to 3200 wavenumbers) is a very promising way for spectroscopic study of various gaseous, liquid, or solid species or intermixtures, due to the highly characteristic rotational-vibrational spectral structures. We present a miniaturized widely tunable IR-light source based on an External Cavity Quantum-Cascade-Laser (EC-QCL) in combination with a micro-optical-electrical-mechanics (MOEMS) grating as wavelength selective element. With this concept spectral tuning range in respect to the central wavelength of up to 25% for pulse operation and up to 10% for cw operation, respectively was realized. The bright monochromatic but tunable emission of 100mW and more allows new application for IR-spectroscopy e.g. real-time detection of hazardous liquid or solid species e.g. explosive in up to 3 m distance with a handheld device collecting the backscattered light. For spectral detection of most gaseous species, however, high spectral resolution is required, which demands also for controlling the cavity length to avoid mode hopping. Were present a concept for mode-hope free tuning and first results of high resolution gas-phase spectroscopy.

UP 7.2 Thu 10:20 HSZ 105

Fabry-Perot interferometer correlation spectroscopy - A novel technique for the imaging of atmospheric trace gases — •Christopher Fuchs[1], Jonas Kuhn[1,2], Nicole Bobrowski[1,2], and Ulrich Platt[1,2] — [1]Institute of Environmental Physics, Heidelberg University, Germany — [2]Max Planck Institute for Chemistry, Mainz, Germany

Imaging of trace gases by optical remote sensing can provide insights

in the dynamics of physical and chemical processes within the atmosphere. However, dispersive techniques are not able to resolve many processes on their intrinsic spatial and temporal scale, e.g. Imaging DOAS. Non-dispersive imaging techniques, e.g. SO_2 cameras, reach high spatial and temporal resolution, but due to their strongly restricted spectral information are limited to SO_2 only.
We introduce a novel imaging technique for atmospheric trace gases, based on the application of a Fabry-Perot interferometer (FPI). The increase of spectral information for the detection of trace gases is reducing cross sensitivities and allowing for the application to other species e.g., HCHO, BrO.
We present the first measurement for SO_2 with an imaging Fabry-Perot correlation spectroscopy (IFPICS) instrument with a sensitivity of $7.9 \times 10^{-20}\,\mathrm{cm^2\,molec^{-1}}$. Additionally, we will present sensitivity studies of further trace gases, which have been already performed in our laboratory, and resulted in prospected detection limits of $< 5 \times 10^{15}\,\mathrm{molec\,cm^{-2}\,s^{-1/2}}$ for HCHO and $< 10^{14}\,\mathrm{molec\,cm^{-2}\,s^{-1/2}}$ for BrO.

UP 7.3 Thu 10:40 HSZ 105

Vollautomatisierte online Messungen der chemischen Zusammensetzung von Aerosolpartikeln auf einem Passagierflugzeug — •Christiane Schulz[1,2], Johannes Schneider[2], Markus Hermann[1], Florian Rubach[2], Christian Gurk[2], Anna Ludwig[2], Alfred Wiedensohler[1], Andreas Zahn[3] und Stephan Borrmann[2,4] — [1]Leibniz-Institut für Troposphärenforschung, Leipzig — [2]Max-Planck-Institut für Chemie, Mainz — [3]Karlsruher Institut für Technologie, Karlsruhe — [4]Institut für Physik der Atmosphäre, Johannes Gutenberg-Universität, Mainz

Im Rahmen des Projektes IAGOS-CARIBIC werden regelmäßig atmosphärische Messungen von Spurengasen und Aerosolpartikeln durchgeführt. Die Messgeräte befinden sich dabei in einem Frachtcontainer an Bord eines Passagierflugzeuges. Dadurch werden sowohl die obere Troposphäre als auch die untere Stratosphäre vermessen.

Seit Oktober 2018 wird auch die chemische Zusammensetzung von nicht-refraktären Aerosolpartikeln mittels eines online Aerosolmassenspektrometers gemessen. Dabei kann quantitativ und größenaufgelöst zwischen Organik, Nitrat, Sulfat, Ammonium und Chlorid unterschieden werden bei einem Größenbereich zwischen 80 und 800 nm.

Diese Messungen ermöglichen bspw. die Untersuchung, welche Art von Aerosolpartikeln durch Vulkane, hochreichende Konvektion oder Waldbrände in die obere Troposphäre und untere Stratosphäre eingetragen werden.

Neben der Erklärung des Gerätes werden technische Herausforderungen der Vollautomatisierung und erste Ergebnisse vorgestellt.

30 minute break

UP 7.4 Thu 11:30 HSZ 105

A novel compact Doppler lidar for Doppler Mie measurements and beyond — •Jan Froh, Alsu Mauer, Josef Höffner, Ronald Eixmann, and Franz-Josef Lübken — Leibniz-Institute of Atmospheric Physics

Doppler lidar with daylight capability are challenging and expensive systems because of the required small FOV and spectral filtering. The Institute of Atmospheric physics has developed a new approach. Beside very compact ($1\ m^3$) and less complex, the novel technology is applicable to a large variety of lasers as Doppler Mie, Doppler Rayleigh and/or Doppler Resonance lidar.

We demonstrate first Doppler Mie observations with a diode pumped pulsed alexandrite ring laser with unmatched properties. An optimized receiver allows efficient optical splitting of Rayleigh and Mie scattering. Optical splitting is achieved by combining narrow band spectral filtering with a pulsed laser of exceptional low line width and direct frequency control. By tuning the laser in frequency Aerosols and Doppler wind is measured simultaneously with a new method in the stratosphere. Because Rayleigh scattering is suppressed by approx. 2 orders of magnitude weak Mie signals can be observed which are not visible with established methods because of the strong Rayleigh background.

UP 7.5 Thu 11:50 HSZ 105

Scaling up CRNS - non-invasive soil moisture measurement at the hectometer scale — •Markus Köhli[1,2], Jannis Weimar[1], Martin Schrön[3], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Heidelberg University, Germany — [2]Physikalisches Institut, University of Bonn, Germany — [3]Helmholtz Zentrum für Umweltforschung, UFZ, Leipzig, Germany

A novel method called Cosmic-ray neutron sensing (CRNS) is challenging soil moisture measurements by its non-invasive application at a hectometer scaled footprint. Using this technique one can relate the flux density of albedo neutrons generated in cosmic-ray induced air showers to the amount of water in a radius of several hundred meters. The key principle here is that neutrons show an exceptionally different behavior interacting with hydrogen. It slows down fast neutrons, whereas any other heavier element rather reflects them. In the recent years the understanding of neutron transport by Monte Carlo simulations led to major advancements in precision, which have been successfully been tested in a manifold of experiments. A recent successfull application is the determination of the snow water equivalent in the Alps. In order to scale up the method and to reduce costs we recently have developed large-scale neutron detectors including readout electronics and data acquistion systems based on Arduino microcontrollers. These boron-lined detectors shall offer an alternative platform to current Helium-3 based systems. The final implementation of our design allowed also to build the largest up to now existing CRNS detector for the UFZ Leipzig.

UP 7.6 Thu 12:10 HSZ 105

Umweltphysikalische Detektion von natürlichen Neutronen zur Bestimmung von Wassermasseänderungen an der Landoberfläche — •Sascha Oswald — Universität Potsdam

An der Landoberfläche wird Wasser als Teil des Wasserkreislaufs und im Austausch mit der Atmosphäre in verschiedenen Formen wie Bodenwasser, Schnee, Gewässer und Biomasse zwischengespeichert. Die derzeit etablierten Methoden zur Messung der Wassergehalte an der Landoberfläche erlauben jedoch nur entweder eine kontinuierliche Erfassung an ausgewählten Messpunkten oder großräumige Momentaufnahmen mittels Fernerkundung. Typischerweise geht eine Vergrößerung der erfassten Flächen mit einer Verringerung der zeitlichen Auflösung einher, sodass auf einer regionalen Skala die zeitliche Dynamik von räumlichen Mustern nur unzureichend erfasst werden kann. Die nicht-invasive, passive CRNS-Methode (Cosmic-Ray Neutron Sensing) ermittelt Fluktuationen der natürlichen Neutronenflüsse an der Landoberfläche und hat das Potenzial diese kritische Lücke zwischen Punktskala und regionaler Skala zu schließen und kann auf einer Größenskala von etwa einem Quadratkilometer eingesetzt werden. Sie nutzt dabei den inversen Zusammenhang zwischen den Wassergehalten im Umfeld eines Neutronendetektors und der bodennahen Neutronenintensität. Zur Interpretation müssen hydrologische, bodenphysikalische und teilchenphysikalischer Aspekte berücksichtigt und verbunden werden. Es wird der aktuelle Stand in Anwendung und Potential dieser Methode dargestellt.

UP 8: Meeting of members of the DPG environmental physics division

Time: Thursday 12:45–13:45 Location: HSZ 105

Member meeting (Snacks & beverages will be provided).

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.