Environmental Physics Division
Fachverband Umweltphysik (UP)

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Übersicht der Hauptvorträge und Fachsitzungen
(HS 22)

Plenarvorträge an den Sitzungstagen des FV Umweltphysik

PV IV	Di	9:00– 9:45	Plenarsaal	**Testing General Relativity with Cosmological Observations** — •Ruth Durrer
PV V	Di	9:45–10:30	Plenarsaal	**On the tension between mathematics and physics** — •Miklos Redei
PV VII	Mi	8:30– 9:15	Plenarsaal	**Reconciling the past and the present: The shared history of physicists and museums** — •Marta C Lourenco
PV VIII	Mi	9:15–10:00	Plenarsaal	**Particle-hole symmetries in condensed matter** — •Martin Zirnbauer
PV IX	Mi	10:00–10:30	Plenarsaal	**Decoding the QCD phase structure with relativistic nuclear collisions** — •Peter Braun-Munzinger
PV X	Mi	10:30–11:00	Plenarsaal	**Charmonia as Probe of Deconfinement - Recent Results and Perspectives** — •Johanna Stachel
PV XIII	Do	9:00– 9:45	Plenarsaal	**Climate change and gravity waves in the middle atmosphere** — •Franz-Josef Lübken
PV XIV	Do	9:45–10:30	Plenarsaal	**Tailoring ultrafast light pulses in waveguides** — •Carsten Fallnich

Hauptvorträge

UP 2.1	Di	11:15–11:45	HS 22	**Unravelling causes and tackling impacts of air pollution using multidisciplinary methods** — •Mihalis Vrekoussis
UP 4.1	Mi	11:00–11:30	HS 22	**Volcanic Gases - Telegrams of the inner Earth and the secrets of bromine** — •Nicole Bobrowski
UP 6.1	Mi	14:00–14:30	HS 22	**Advanced Multi-Parametric Synthetic Aperture Radar Techniques for Environmental Applications** — •Irena Hajnsek, Kostas Papathanassiou
UP 6.2	Mi	14:30–15:00	HS 22	**Aeolus - the first wind lidar in space: Challenges and first results** — •Oliver Reitebuch, Christian Lemmerz, Oliver Lux, Uwe Marksteiner, Markus Meringer, Karsten Schmidt, Fabian Weiler, Benjamin Witschas, Dorit Huber, Ines Nikolaus, Thomas Kanitz
UP 9.1	Do	14:00–14:30	HS 22	**Hydrodynamic control of biogeochemical cycling in streams** — •Andreas Lorke, Christian Noss, Christine Anlanger, Ute Risse-Buhl, Markus Weitere
UP 9.2	Do	14:30–15:00	HS 22	**El Niño's little brother in the tropical Atlantic - mechanisms and impacts** — •Joke Lübbecke

Hauptvorträge des fachübergreifenden Symposiums SYSA (Remote sensing of planetary atmospheres)
Das vollständige Programm dieses Symposiums ist unter SYSA aufgeführt.

SYSA 1.1	Di	14:00–14:30	Plenarsaal	**Remote sensing of planetary atmospheres: questions and (some) answers.** — •Martine De Maziere, Sieglinde Callewaert, Bart Dils, Bavo Langerock, Charles Robert, Mahesh K. Sha, Sophie Vandenbussche, Corinne Vigouroux, Minqiang Zhou
SYSA 1.2	Di	14:30–15:00	Plenarsaal	**24 years of atmospheric trace gas observations from spectrally resolving UV/vis satellite observations: optimisation of the spatio-temporal resolution and coverage** — •Thomas Wagner
SYSA 1.3	Di	15:00–15:30	Plenarsaal	**Infrared Remote Sensing of the Atmosphere of Mars** — •Armin Kleinböhl
SYSA 1.4	Di	15:30–16:00	Plenarsaal	**Investigating planetary atmospheres in our own Solar System and beyond: Advances and Perspectives** — •Miriam Rengel

Programmübersicht

UP 1	Di	11:00–11:15	HS 22	**Begrüßung**
UP 2.1–2.6	Di	11:15–13:00	HS 22	**Air pollution and tropospheric chemistry**
UP 3.1–3.9	Di	16:30–18:45	HS 22	**Planetary atmospheres (joint session EP/UP)**
UP 4.1–4.6	Mi	11:00–12:45	HS 22	**Trace gases and greenhouse gases**
UP 5	Mi	13:00–14:00	HS 22	**Meeting of members of the DPG environmental physics division**
UP 6.1–6.6	Mi	14:00–16:00	HS 22	**Remote sensing and data analysis methods**
UP 7.1–7.5	Mi	16:30–18:10	HS 22	**Clouds and aerosols**
UP 8.1–8.5	Do	11:00–12:40	HS 22	**Physics of the middle atmosphere**
UP 9.1–9.4	Do	14:00–15:40	HS 22	**Hydrology, oceanography and miscellaneous**
UP 10.1–10.6	Do	16:30–18:30	HS 22	**Poster session**

Mitgliederversammlung des Fachverbands Umweltphysik

Mittwoch 13:00–14:00 HS 22
Mitglieder des Fachverbands sowie Gäste sind herzlich willkommen. Ein Imbiss wird bereitgestellt.

UP 1: Begrüßung

Zeit: Dienstag 11:00–11:15 Raum: HS 22

Begrüßung durch Christian von Savigny

UP 2: Air pollution and tropospheric chemistry

Zeit: Dienstag 11:15–13:00 Raum: HS 22

Hauptvortrag UP 2.1 Di 11:15 HS 22

Unravelling causes and tackling impacts of air pollution using multidisciplinary methods — •Mihalis Vrekoussis — Laboratory for Modeling and Observation of the Earth System (LAMOS), Institute of Environmental Physics (IUP), University of Bremen, Bremen, Germany — Center for Marine Environmental Sciences (MARUM), University of Bremen, Bremen, Germany — Energy, Environment and Water Research Centre, The Cyprus Institute (CyI), Nicosia, Cyprus

The nearly exponential increase of the world's population is associated with the over-exploitation of natural resources, unprecedented industrial growth, and land use change. These intensified human activities modify the number and amount of chemical species introduced into the Earth's atmosphere that, in turn, influence climate, air quality and human health. To assess these impacts, we need to improve our understanding of surface fluxes, transport, and transformation of atmospheric constituents linked to past, present and future anthropogenic activities, in addition to the natural environmental changes. An important step in addressing the latter emanates from a multi-disciplinary approach combining observations of trace species at various spatial scales, from local to global, with state-of-the-art numerical models. Herewith, selected synergistic studies will be presented, scrutinizing in situ, airborne, and space-based observations as well as numerical simulations. This approach is an imperative for development and optimization of the needed tools for robust control strategies to mitigate emissions of trace gases.

UP 2.2 Di 11:45 HS 22

Comparative measurements of two Long Path-DOAS for detection of ship emissions — •Kai Krause[1], Folkard Wittrock[1], Stefan Schmitt[2], Denis Pöhler[2], Andreas Weigelt[3], and Stefan Schmolke[3] — [1]Institut für Umweltphysik, Universität Bremen — [2]Institut für Umweltphysik, Universität Heidelberg — [3]Bundesamt für Seeschifffahrt und Hydrographie

Ships are an important source of particles and traces gases like CO, CO2, NOx (NO + NO2), SO2, VOCs, PM and black carbon. Most of the emissions are found in close proximity of the coast.

Some of the above mentioned trace gases can be measured using the differential optical absorption spectroscopy (DOAS). To detect the emissions of ships two Long Path-DOAS have been set up in the Yachtharbour of Hamburg, in Wedel, to measure NO2 and SO2. One of the systems is a newly developed prototype, specifically designed to measure ship emissions, and is currently tested in Wedel, while the other system serves as a reference. The light path of both systems cross the Elbe river and thus allows to detect the plumes of the passing ships. The prototype system has been set up in October 2018, while the reference system is already running since April 2018.

Within the time series of both systems the plume of a single passing ship appears as a sharp peak. However peaks in NO2 and SO2 do not necessarily occur at the same time, sometimes there is a slight shift in time between both, or no SO2 peak at all.

Time series of both systems will be compared and NO2/SO2-ratios for different ship types will be shown.

UP 2.3 Di 12:00 HS 22

Reale NOx-Emissionsmessungen von Lkw auf Autobahnen zum Aufdecken von Abgasmanipulationen — •Tobias Engel und Denis Pöhler — Institut für Umweltphysik - Ruprecht-Karls-Universität, Heidelberg, Deutschland

Die durch den Verkehr hervorgerufene Schadstoffbelastung der Luft und insbesondere die NOx-Emissionen von Fahrzeugen sind zurzeit in der Bevölkerung, Politik und Wissenschaft ein viel diskutiertes Thema. Für die NOx-Emissionen einzelner Fahrzeuge auf der Straße gibt es bisher jedoch nur wenige und zugleich aufwändige Messverfahren. Mit dem ICAD-Messinstrument und dem "PlumeChasing-Verfahren" ist es jedoch möglich, die NOx-Emissionen eines Fahrzeuges in realen Verkehrssituationen mit guter Genauigkeit und geringem Aufwand zu bestimmen, ohne dabei Messgeräte am zu untersuchenden Fahrzeug anbringen zu müssen. Somit ist es bestens geeignet, um illegale Abgasmanipulationen aufzudecken.

Bei Messungen auf deutschen und österreichischen Autobahnen wurden so die NOx-Emissionswerte von mehreren hundert Lkw bestimmt. Die ausgewerteten Messwerte liefern einen guten Überblick über die NOx-Emissionen der Lkw des europäischen Transitverkehrs. Dabei zeigt sich, dass voll funktionstüchtige EURO V und EURO VI Lkw im realen Fahrbetrieb auf der Autobahn die Emissionsgrenzwerte einhalten. Eine erhebliche Anzahl an Lkw (25%-35%) weist jedoch defekte oder illegal manipulierte Abgassysteme auf. Davon sind auch neue EURO VI Lkw betroffen. Die Fahrzeuge emittieren damit deutlich mehr NOx und verursachen so einen Großteil der gesamten Emissionen.

UP 2.4 Di 12:15 HS 22

Ozon und seine Auswirkungen auf die Vegetation in Nordskandinavien — •Stefanie Falk, Frode Stordal und Ane Victoria Vollsnes — Universitet i Oslo, Olso, Norwegen

Ozon ist eines der wichtigsten Spurengasen in der Atmosphäre. Während es uns in Form der Ozonschicht in der Stratosphäre vor schädlicher, kurzwelliger Strahlung schützt, zählt es in der planetaren Grenzschicht zu den überaus schädlichen Reizgasen. Eine Aufnahme einer Dosis von 50 ppm über die Dauer von 30 min gilt für den Menschen als tödlich. Pflanzen nehmen Ozon durch ihre Stoma auf, wo dieses zur Zerstörung von Zellen beiträgt, die der Photosynthese dienen, und letztlich Wachstum und Ertrag reduziert. Die empfindlichen Ökosysteme im Norden Skandinaviens erfahren bereits durch den Klimawandel einen erhöhten Stress. Sollte das Polarmeer dauerhaft eisfrei werden, so würde sich der Schiffsverkehr und damit die Menge der Ozonvorläufersubstanzen drastisch erhöhen. Insbesondere während des Polarsommers ist eine nächtliche Reparatur der entstandenen Ozonschäden gehindert. Wir präsentieren hier einen Überblick über die schädlichen Auswirkungen von Ozon auf Vegetation und erste Studien zu der Entwicklung von Ozonkonzentrationen in Nordskandinavien. Dabei greifen wir sowohl auf Langzeitmessungen als auch Modellsimulationen zurück.

UP 2.5 Di 12:30 HS 22

Evaluation of the ENFUSER air quality model — •Oliver Mehling[1,2], Leena Järvi[2], Lasse Johansson[3], and Pauli Paasonen[2] — [1]Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Germany — [2]Institute for Atmospheric and Earth System Research, University of Helsinki, Finland — [3]Finnish Meteorological Institute, Helsinki, Finland

The quantitative evaluation of air quality models dates back to the 1980s, but, until today, most commonly only basic metrics like the Pearson correlation coefficient r^2 are reported.

In our work, a broader approach is taken: through a multitude of evaluation metrics, model bias is pondered against actual meteorological variables such as temperature, relative humidity and atmospheric stability. Partial correlation of model bias and subsets of key meteorological variables, conditioned on the remaining variables, is used to identify probable "drivers" of bias. In addition, the use of hourly instead of daily averages allows to resolve how well a model predicts diurnal concentration patterns of air pollutants. A cluster analysis is used to group diurnal patterns of bias into different categories, for which interpretations of recurring over- and underestimations are given.

These methods are used to perform a comprehensive evaluation of FMI-ENFUSER, a novel air quality model applied to the Greater Helsinki Area, which combines dispersion modeling, information fusion and statistical approaches to forecast NO_2, O_3, PM_{10} and $PM_{2.5}$ concentrations. We discuss how a strictly statistical evaluation helps to draw real-world conclusions to foster future model improvements.

UP 2.6 Di 12:45 HS 22

KISP - an artificial intelligence approach to predict air pollution — •André Schella and Manfred Menze — enercast GmbH, Unversitätsplatz 12, 34127 Kassel

In its recent report, WHO stated air pollution to be a major global health risk worldwide [1]. Consequently, many German communities cope with the issue of polluted air in cities by means of possible driving bans. However, air pollution measuring stations are sparse and additional parameters like traffic volume and peculiar weather situations complicate the prediction of certain pollutants.

In this contribution, we investigate how weather parameters from local monitoring stations as well as numerical weather models influence the air pollutant nitrogen dioxide. Subsequently, we present our approach to predict the nitrogen dioxide level for the day ahead forecast horizon and beyond by means of artificial intelligence [2]. We thank DWD and UBA as our cooperation partners as well as the BMVI under grant no. VB18F1003A (mFund, project KISP) for financial support.

[1] World Health Organization "Ambient air pollution: A global assessment of exposure and burden of disease." (2016) [2] A. Russo, et al. "Neural network forecast of daily pollution concentration using optimal meteorological data at synoptic and local scales." Atmospheric Pollution Research 6.3 (2015): 540-549.

UP 3: Planetary atmospheres (joint session EP/UP)

Zeit: Dienstag 16:30–18:45 Raum: HS 22

UP 3.1 Di 16:30 HS 22

Lidar-Messungen von extremen Schwerewellen an der Südspitze Südamerikas — •Natalie Kaifler, Bernd Kaifler, Andreas Dörnbrack und Markus Rapp — Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Deutschland

Mit dem CORAL-Rayleigh-Lidar befindet sich seit November 2017 ein vollautomatisches Lidar-System für Temperaturmessungen bis in 90 km Höhe in Rio Grande, Argentinien, an der Südspitze Südamerikas. Aufgrund der starken Winde und der Topographie treten in dieser Region die weltweit stärksten atmosphärischen Schwerewellen auf. Wir zeigen die Aktivität von Schwerewellen im Jahresverlauf, auch im Vergleich zu entsprechenden Messungen während der DEEPWAVE-Kampagne 2014 in Neuseeland. Anhand eines mehrere Tage anhaltenden, extremen Schwerewellen-Ereignisses im Juni 2018 mit Spitzenamplituden von 80 K wird die Ausbreitung der Wellen in der Atmosphäre und deren Einfluß auf die Hintergrundströmung anhand von Lidar-Messungen und ECMWF-Analysen erläutert. Die Messungen in Rio Grande dienen auch der Vorbereitung und Begleitung der SouthTRAC-Kampagne mit dem Forschungsflugzeug HALO, die im September 2019 in der Region stattfinden wird. Während SouthTRAC werden die Rolle von Schwerewellen und stratosphärischer Zirkulation für das Klima der Südhemisphäre untersucht.

UP 3.2 Di 16:45 HS 22

Validation of the Multiple Airglow Chemistry model applied on the basis of data sets from various sources — •Olexandr Lednyts'kyy[1], Miriam Sinnhuber[2], and Christian von Savigny[1] — [1]University of Greifswald, Greifswald, Germany — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany

The Multiple Airglow Chemistry (MAC) model was proposed to couple electronically excited states of molecular (O_2, four states) and atomic (O, two states) oxygen with each other as well as with the O_2 and O ground states to represent the photochemistry in the upper Mesosphere and Lower Thermosphere region. Rate values of processes coupling seven O_2 and three O states considered in the extended MAC model were tuned on the basis of the in-situ measurements from the Energy Transfer in the Oxygen Nightglow campaign. Calculations with the MAC model are verified and validated on the basis of the in-situ measurements from the 2nd WAve propagation and DISsipation in the middle atmosphere campaign and the WAVes in airglow structures Experiment 2004 campaign. The MAC calculations are analyzed in various cases, in which some of these in-situ data sets are replaced with collocated remote measurements or data sets simulated with the NRLMSISE-00 (Naval Research Laboratory Mass Spectrometer Incoherent Scatter Extended, 2000) model. The level of self-consistency of the MAC input and output data sets varies from one case to another.

UP 3.3 Di 17:00 HS 22

Long-term evolution of MLT-temperatures above Europe as observed by the GRIPS spectrometers within the Network for the Detection of Mesospheric Change (NDMC) — •Carsten Schmidt[1], Lisa Küchelbacher[1], Sabine Wüst[1], and Michael Bittner[1,2] — [1]Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen — [2]Universität Augsburg

The German Aerospace Center (DLR) operates more than a dozen identical, so-called ground-based infrared p-branch spectrometers (GRIPS) in eight European countries to study excited hydroxyl-molecules in the upper mesosphere / lower thermosphere (MLT region). They contribute high quality observations to the Network for the Detection of Mesospheric Change (NDMC). Observations started at the Environmental Research Station Schneefernerhaus (UFS), Germany (47.42 N, 10.98 E) in October 2008.

Clearly, a long-term oscillation with a period of several years (ca. 8 years) modulates the OH temperatures. Maximum temperatures are reached during winters 2013 to 2015. This behavior implies a correlation with variations of solar activity (F10.7cm). However, the winter oscillation is not only more pronounced but it also precedes the variation in summer with a lead of 0.5 to 1.5 years. These variations can, at least in part, explain several remarkable seasonal patterns observed at all mid-latitude sites, e.g. between 2016 and 2018.

We attribute the different behavior to changes of northern middle atmospheric dynamics, having a larger impact on winter temperatures. Observations at the southern sites in Italy and Israel support this view.

UP 3.4 Di 17:15 HS 22

Solar heating rates derived from SCIAMACHY observations of the O_2 dayglow — •Miriam Sinnhuber[1], Stefan Bender[2], Thomas Reddmann[1], and Amirmahdi Zarboo[1] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]University of Trondheim, Trondheim, Norway

Solar heating by ozone absorption in the UV spectral range is an important contributor to radiative heating of the terrestrial stratosphere and mesosphere. At altitudes above about 60 km, the efficiency of the heating is reduced as part of the absorbed energy is transferred to excited species – $O_2(^1\Sigma)$, $O_2(^1\Delta)$ – and lost by emission.

We use observations of the $O_2(^1\Sigma)$ and $O_2(^1\Delta)$ dayglow in the mesosphere and lower thermosphere observed by SCIAMACHY on ENVISAT from 2008-2012 to derive ozone densities and the efficiency of the ozone solar heating. The heating efficiency decreases from 1 around 60 km to less than 0.6 at the mesopause depending on latitude and time of year. Resulting ozone heating rates vary from more than 10 K/day in the lower mesosphere to less than 1 K/day around 80 km, with a secondary maximum of up to 5 K/day around 90 km in the region of the second ozone maximum.

UP 3.5 Di 17:30 HS 22

The relativistic electron radiation belt response to CME- and CIR-driven geomagnetic storms — •Frederic Effenberger, Yuri Shprits, Nikita Aseev, Juan Sebastian Cervantes Villa, and Angelica Maria Castillo Tibocha — Helmholtz Zentrum Potsdam, Deutsches Geoforschungs Zentrum GFZ

The Earth's magnetosphere responds differently to storms driven by coronal mass ejections (CME) and co-rotating interaction regions (CIR). To understand the effects of geomagnetic activity on the inner and outer magnetosphere, CME- and CIR-driven storms should be considered separately. In this work, we investigate the impact of both types of storms on the radiation belt environment during the Van Allen Probe era, using the Versatile Electron Radiation Belt (VERB) code. We use the Kp index as a measure of geomagnetic activity to parameterize wave models, diffusion coefficients, and the plasmapause location. The electron population is considered to originate from the plasma sheet, and we set up the outer boundary conditions at geostationary orbit using GOES data. We model storm individually and with long-term simulations, and compare the simulation results with Van Allen Probes measurements to validate the model performance.

We use data assimilation methods to assist with initial and boundary conditions and the validation and we utilize different performance metrics. The work shows, how well we understand the response of the belts to CME and CIR drivers and helps to identify the applicability of present wave models to CME- or CIR-driven storms.

UP 3.6 Di 17:45 HS 22

Middle atmosphere ionization from particle precipitation as observed by the SSUSI satellite instruments — •Stefan Bender and Patrick Espy — Norwegian University of Science and Technology, Trondheim, Norway

Solar, auroral, and radiation belt electrons enter the atmosphere at polar regions leading to ionization and affecting its chemistry. Climate models usually parameterize this ionization and the related changes in chemistry based on satellite particle measurements. Precise measurements of the particle and energy influx into the upper atmosphere are difficult because they vary substantially in location and time. Widely used particle data are derived from the POES and GOES satellite measurements which provide electron and proton spectra.

We present electron energy and flux measurements from the Special Sensor Ultraviolet Spectrographic Imagers (SSUSI) satellite instruments. This formation of satellites observes the auroral zone in the UV from which electron energies and fluxes are inferred. We use these observed electron energies and fluxes to calculate ionization rates and electron densities in the mesosphere. We also present an initial comparison of these rates to other models and compare the electron densities to those measured by the EISCAT radar.

UP 3.7 Di 18:00 HS 22

Spectropolarimetric Simulations of Earthshine — •Mihail Manev[1], Claudia Emde[1], Michael Sterzik[2], and Stefano Bagnulo[3] — [1]Meteorological Institute, Ludwig-Maximilians-University, Theresienstr. 37, D-80333 Munich, Germany — [2]European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching, Germany — [3]Armagh Observatory and Planetarium, College Hill, Armagh BT61 9DG, UK

Understanding exoplanet atmospheres and ultimately the remote detection of signatures of life from other worlds belong to the most important goals of modern astrophysics. Earth serves as a benchmark object to infer biosignatures of life as we know it today. One way to study Earth as an exoplanet is to observe Earthshine: sun-light scattered by Earth and back-reflected from the lunar surface to Earth.

Here we interpret spectropolarimertic observations of Earthshine carried out at the VLT (Sterzik et al., Spectral and Temporal Variability of Earth Observed in Polarization, accepted at A&A on 28-Nov-2018, https://arxiv.org/abs/1811.12079) utilizing the Monte Carlo radiative transfer model MYSTIC and employing meteorological and satellite data as an input (Emde et al., Influence of aerosols, clouds, and sunglint on polarization spectra of Earthshine, A&A, Vol. 605, A2, 2017). The results reveal the contributions of the major components of the Earth system to the spectropolarimetric signal: water and land surfaces, vegetation, atmospheric gases, water and ice clouds.

We think that similar simulations will become an important tool for the interpretation of observations of exo-Earth type planets.

UP 3.8 Di 18:15 HS 22

Atmospheric Characterization via Broadband Color Filters on the PLAnetary Transits and Oscillations of stars Mission — •John Lee Grenfell[1], Mareike Godolt[2], Juan Cabrera[1], Ludmila Carone[3], Antonio Garcia Muñoz[2], Daniel Kitzmann[4], and Heike Rauer[1,2,5] — [1]Department of Extrasolar Planets and Atmospheres (EPA), German Aerospace Centre (DLR), Berlin, Germany — [2]Centre for Astronomy und Astrophysics (ZAA), Berlin Institute of Technology (TUB), Germany — [3]Max-Planck-Institute for Astronomy (MPIA), Heidelberg, Germany — [4]Centre for Space and Habitability (CSH), Bern, Switzerland — [5]Institute for Geological Sciences, Free University Berlin (FUB), Germany

We assess broadband color filters for the two fast cameras on the PLAnetary Transits and Oscillations of stars space mission with respect to the characterization of exoplanetary atmospheric composition, haze and geometric albedo. We focus on Ultra Hot Jupiters and Hot Jupiters placed 25pc and 100pc away from the Earth and low mass low density planets placed 10pc and 25pc away. Our analysis takes as input literature values for the difference in transit depth between the broadband lower (500-675nm) wavelength interval (hereafter referred to as blue) and the upper (675-1125nm) broadband wavelength interval (hereafter referred to as red) for transmission, reflection and occultation spectroscopy. Planets orbiting main sequence central stars with stellar classes F, G, K and M are investigated. We calculate the signal-to-noise ratio with respect to photon and instrument noise for detecting the difference in the blue and red spectral intervals.

UP 3.9 Di 18:30 HS 22

Modeling the Formation of super-Earth Atmospheres — Nicolas Cimerman[1], •Rolf Kuiper[1], and Chris Ormel[2] — [1]University of Tübingen — [2]University of Amsterdam

In the core accretion paradigm of planet formation, gas giants form a massive atmosphere via run-away gas accretion once their progenitors exceed a threshold mass: the critical core mass. On the one hand, the majority of observed exo-planets never crossed this line. On the other hand, these exo-planets have accreted substantial amounts of gas from the circumstellar disk during their embedded formation epoch.

We investigate the hydrodynamical and thermodynamical properties of proto-planetary atmospheres by direct numerical modeling of their formation phase. Our studies cover one-dimensional (1D) spherically symmetric, two-dimensional (2D) axially symmetric, and three-dimensional (3D) simulations with and without radiation transport.

In terms of hydrodynamic evolution, no clear boundary demarcates bound atmospheric gas from disk material in a 3D scenario in contrast to 1D and 2D computations. The atmospheres denote open systems where gas enters and leaves the Bondi sphere in both directions. In terms of thermodynamics, we compare the gravitational contraction of the forming atmospheres with its radiative cooling and advection of thermal energy, as well as the interplay of these processes. The coaction of radiative cooling of atmospheric gas and advection of atmospheric-disk gas prevents the proto-planets to undergo run-away gas accretion. Hence, this scenario provides a natural explanation for the preponderance of super-Earth like planets.

UP 4: Trace gases and greenhouse gases

Zeit: Mittwoch 11:00–12:45 Raum: HS 22

Hauptvortrag UP 4.1 Mi 11:00 HS 22

Volcanic Gases - Telegrams of the inner Earth and the secrets of bromine — •Nicole Bobrowski — IUP, Universität Heidelberg, Germany — MPI-C, Mainz, Germany

The presentation starts with a general introduction on current possibilities and difficulties to read and interpret geochemical data with view on volcanic activity focusing on open conduit volcanoes. Then I will focus on bromine as one trace element in volcanic volatiles. Bromine has a considerable environmental impact, in particular on atmospheric chemistry and composition. The discovery of the highest atmospheric BrO mixing ratio in volcanic plumes (up to ppb in 2002) was followed by a revival of interest on volcanic plume chemistry. Such a discovery and follow up investigation were possible due to advances in volcanic remote sensing techniques, in particular, miniaturized DOAS instruments. The possibility of continuous measurements by automated instruments located at safe distances from the volcano lead additionally to relatively easily gained long-term data sets. Therefore, an increased interest developed in the volcanic community to investigate the bromine-sulfur ratio as a potential tracer of volcanic activity.

This presentation attempts to provide a comprehensive summary on volcanic bromine data of the last 15 years achieved from established and cutting edge measurement techniques as well as their treatment and interpretation in recent model experiments (atmospheric chemistry and volcanology). It points out controversially discussed relation of bromine degassing to volcanic activity and puts a light on remaining uncertainties.

UP 4.2 Mi 11:30 HS 22

Neue Beobachtungen zur Chemie reaktiver Halogenverbindungen in der antarktischen Troposphäre — •Jan-Marcus Nasse[1], Udo Friess[1], Denis Pöhler[1], Stefan Schmitt[1], Holger

Sihler[1,4], Rolf Weller[2], Thomas Schaefer[2,3], Zsófia Jurányi[2], Helene Hoffmann[2] und Ulrich Platt[1] — [1]Institut für Umweltphysik, Univeristät Heidelberg — [2]Alfred Wegener Institute für Polar und Meeresforschung, Bremerhaven — [3]Leibniz Institut für Troposphärenforschung, Leipzig — [4]Max-Planck Institut für Chemie, Mainz

Reaktive Halogenverbindungen (IO, BrO, ClO) spielen in der polaren Grenzschicht bei in einer Reihe unterschiedlicher Prozesse wie dem episodenhaften Abbau troposphärischen Ozons oder der Oxidation von gasförigem Quecksilber eine zentrale Rolle. Trotz langjähriger Forschung sind zentrale Fragen zu Freisetzung und Transport, insbesondere von Chlor- und Jodverbindungen weiterhin offen.

Wir präsentieren Ergebnisse einer zweieinhalbjährigen Messkampagne auf der deutschen Antarktisstation Neumayer III. Von 2016 bis 2018 wurden mit einem Langpfad-DOAS Instument kontinuierlich Konzentrationen relevanter Spurengase gemessen und mehrere überraschende Beobachtungen gemacht. Für BrO konnten zusätzlich zu bekannten Frühjahrsepisoden nahzu durchgehend regelmäßige Erhöhungen des Mischungsverhältnisses auf über 15 ppt festgestellt werden. Höchstwerte waren in Polargebieten bislang unbeobachtete 110 ppt. Weiterhin konnte ClO in Mischungsverhältnissen bis zu 100 ppt detektiert werden - der Freisetzungsmechanismus ist bislang noch unklar.

UP 4.3 Mi 11:45 HS 22

An Investigation of Source Regions Contributing to the Deposition of Reactive Nitrogen in Arctic and Boreal Areas — •Hanne Eline Byre, Stefanie Falk, Frode Stordal, and Terje K. Berntsen — University of Oslo, Department of Geoscience

Long range atmospheric transport is an important source of reactive nitrogen (Nr) to Boreal and Artic ecosystems. The combined effect of climate change and deposition of reactive nitrogen which is an important nutriant for these systems, have the potential to change the carbon storage in high latitude reservoirs. Furthermore a change in vegetation, will lead to changes in the exchange of energy and humidity between the land surface and the atmosphere. We have conducted several model studies to investigate and quantify the importance and contribution of distinguished source regions to Nr deposition in polar and sub-polar regions in the northern hemisphere. Using a global chemistry transport model, we will assess the following questions: To what extent are emissions from agriculture in South-Asia affecting NOx deposition in the Arctic? What would happen if we shut down the automotive sector in Germany, do we see a reduction in the amount of NOx deposited in Norway?

UP 4.4 Mi 12:00 HS 22

Aircraft-based 2- and 3D Trace Gas Measurements with HAIDI (Heidelberg Airborne Imaging DOAS Instrument) - Results of EMeRGe Mission Asia — •Katja Bigge, Denis Pöhler, Udo Friess, and Ulrich Platt — Institute of Environmental Physics, Heidelberg University, Heidelberg, Germany

Due to their disproportionate impact, it is important to locate and quantify trace gases in the Earth's atmosphere. Aircraft-based measurements fill the gap between satellite instruments with good spatial coverage but poor spatial and temporal resolution and ground based measurements with good temporal resolution but poor spatial coverage. The HAIDI instrument can yield high temporal and spatial resulution in 2D and 3D during overflight and can thus resolve small-scale chemical and dynamical processes. Sources of trace gases can also be identified and quantified. Within the EMeRGe (Effect of Megacities on the transport and transformation of pollutants on the Regional to Global Scales) project HAIDI was installed in the research airplane HALO (High Altitude and LOng range research aircraft) of the DLR (German Aerospace Center). Two missions (July 2017 in Europe and March 2018 in Asia) were performed to investigate the chemical composition of the outflow of megacities and the atmospheric impact of urban pollution. Target areas included Paris, London and the Po area as well as Manila, Taiwan cities and China outflow. HAIDI derived a number of trace gases such as NO2, SO2, O3, BrO and HCHO. We will present results of the HAIDI measurements during the EMeRGe mission, including high-resolution data of megacity and ship plumes.

UP 4.5 Mi 12:15 HS 22

First resuls of total water vapour column from Sentinel-5P derived by the AMC-DOAS method — •Tobias Küchler, Stefan Noël, Heinrich Bovensmann, and John P. Burrows — University of Bremen, Bremen, Germany

Water vapour is the most abundant and also the most important natural greenhouse gas and plays a key role in tropospheric chemistry, as source of the hydroxyl radical, OH, and as a third body in key reactions of hydroperoxyl radical, HO2. Its amount is highly variable and is also affected by anthropogenic global warming. To investigate these effects, long time series of global water vapour amount and distribution are required.

The Air Mass Corrected Differential Optical Absorption Spectroscopy (AMC-DOAS) approach to derive global water vapour vertical columns was originally developed for Global Ozone Monitoring Experiment (GOME) on ERS-2, but has been applied also to measurements of the SCIAMACHY instrument on ENVISAT and the GOME-2 instruments on METOP-A and METOP-B. An application of the AMC-DOAS method to TROPOMI data on Sentinel-5P is currently under development.

In this presentation, we show promising results from our research. These include validations with independent data sets to assess the quality of the derived data will be shown. Since there is currently no operational water vapour product from Sentinel-5P, the new AMC-DOAS product will provide a valuable addition to the Sentinel 5P project.

UP 4.6 Mi 12:30 HS 22

Determination of the Emission Rates of CH4- and CO2-Point Sources with Airborne Lidar — •Sebastian Wolff, Christoph Kiemle, Axel Amediek, Gerhard Ehret, Martin Wirth, and Andreas Fix — Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR e.V.), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

Anthropogenic point sources produce a major share of global carbon dioxide (CO2) and methane (CH4) emissions. More observations of point sources are required to provide accurate inventories of atmospheric greenhouse gas (GHG) concentrations. Active remote sensing measurements by airborne lidar show much promise to this regard and demonstrate potential for future satellite implementations. Installed onboard the German research aircraft HALO the integrated-path differential-absorption (IPDA) lidar CHARM-F measures weighted vertical columns of CH4 and CO2 below the aircraft and along its flight track.

During the CoMet field campaign in spring 2018 such measurements were performed focusing on the major European hot spots of anthropogenic CO2- and CH4-emissions, i.e. large coal-fired power plants and coal mining areas. The measurement flights were designed to capture individual GHG plumes from which point-source emission rates can be derived. The observed plumes have been compared to mesoscale simulations generated with the Weather Research and Forecast Model. Detailed analysis of the observed data, which are in good agreement with reported point-source emissions rates, will be presented.

UP 5: Meeting of members of the DPG environmental physics division

Zeit: Mittwoch 13:00–14:00 Raum: HS 22

Lunch Break and UP Meeting of Members

UP 6: Remote sensing and data analysis methods

Zeit: Mittwoch 14:00–16:00 Raum: HS 22

Hauptvortrag UP 6.1 Mi 14:00 HS 22

Advanced Multi-Parametric Synthetic Aperture Radar Techniques for Environmental Applications — •Irena Hajnsek[1] and Kostas Papathanassiou[2] — [1]Institute of Environmental Engineering, ETH Zürich, Switzerland — [2]Microwaves and Radar Institute, German Aerospace Center, Germany

Recent advancement in the multi-parametric Synthetic Aperture Radar (SAR) techniques will be presented on the base of the German satellite mission TanDEM-X and airborne F-SAR campaigns acquiring unique data for the retrieval of environmental applications. The focus will be on the use of multiple techniques (polarimetric SAR, interferometric SAR, polarimetric SAR interferometry and tomography) in relation to their capability to derive specific information like for example 3D information content.

Hauptvortrag UP 6.2 Mi 14:30 HS 22

Aeolus - the first wind lidar in space: Challenges and first results — •Oliver Reitebuch[1], Christian Lemmerz[1], Oliver Lux[1], Uwe Marksteiner[1], Markus Meringer[1], Karsten Schmidt[1], Fabian Weiler[1], Benjamin Witschas[1], Dorit Huber[2], Ines Nikolaus[3], and Thomas Kanitz[4] — [1]DLR, Oberpfaffenhofen, Germany — [2]DoRIT, Fürstenfeldbruck, Germany — [3]University of Applied Sciences, Munich, Germany — [4]ESA, Noordwijk, The Netherlands

Soon after its successful launch in August 2018, the spaceborne wind lidar ALADIN (Atmospheric LAser Doppler INstrument) on-board ESA's Earth Explorer satellite Aeolus has demonstrated to provide atmospheric wind profiles on a global scale. Being the first ever Doppler wind lidar instrument in space, ALADIN contributes to the improvement in numerical weather prediction by measuring one component of the wind vector along the instrument's line-of-sight from ground throughout the troposphere up to the lower stratosphere.

The measurements are performed with the single payload ALADIN, which is a direct-detection Doppler wind lidar operating at an ultraviolet wavelength of 354.8 nm. ALADIN uses a frequency-tripled Nd:YAG laser, a large 1.5 m Cassegrain telescope, and 2 interferometers for detection of the Doppler frequency shift from molecules and particles.

Challenges during the development of the ALADIN instrument are highlighted and first results are discussed including validation with an airborne instrument demonstrator.

UP 6.3 Mi 15:00 HS 22

Impact of three-dimensional cloud-structures on atmospheric trace gas retrievals — •Claudia Emde[1], Arve Kylling[2], Huan Yu[3], Michel van Roozendael[3], Bernhard Mayer[1], and Kerstin Stebel[2] — [1]Meteorological Institute, LMU, Munich — [2]Norwegian Institute for Air Research (NILU), Oslo, Norway — [3]Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium

Operational retrievals of tropospheric trase gases from space-borne spectrometers are based on one-dimensional radiative transfer models in combination with simplified cloud correction schemes, which do not consider effects like cloud scattering into neighboring pixels or cloud shadowing.

To study the impact of three-dimensional (3D) cloud structures, we have developed the Absorption Lines Importance Sampling (ALIS) method and implemented it into the Monte Carlo radiative transfer model MYSTIC. ALIS allows efficient simulations of radiances in high spectral resolution for 3D model atmospheres including realistic clouds. Furthermore we implemented 3D box-airmass-factor calculations.

Based on 3D cloud fields as model input we simulate spectral radiances for regions relevant for NO2 retrievals: The spectrum between 400 and 500nm includes characteristic NO2 absorption features, and the O2A absorption band between about 755 and 775nm is used for cloud correction. We apply a DOAS retrieval algorithm including a simple cloud correction scheme on the simulated data and by comparing the retrieved NO2 column with the model input, we estimate the error due to cloud scattering.

UP 6.4 Mi 15:15 HS 22

Uncertainties in the retrieval of shortwave broadband albedo from satellite, airborne and ground-based radiative measurements — •Christine Pohl, Larysa Istomina, Vladimir Rozanov, Gunnar Spreen, and Georg Heygster — Institut für Umweltphysik, Universität Bremen

Arctic surface shortwave broadband albedo, hereafter called as albedo, is a key quantity determining the Arctic surface radiation energy budget and is closely related to the Arctic climate. Consequently, climate models require an albedo accuracy of 0.02 - 0.05 to simulate the Arctic climate correctly.

Albedo is derived from reflectance measurements by various satellite (e.g. MODIS, AVHRR/3), airborne (e.g. SMART-Albedometer), or field instruments (eg. FIGIFIGO, ASD-spectroradiometer). However, these instruments have various fields of views (FOVs) and different spectral and spatial resolution, which introduces uncertainties in the derived albedo product.

We quantify these uncertainties for typical Arctic surface types under variable solar zenith angles (55°- 80°) using the radiative transfer model SCIATRAN. Spectrally and angularly sparse resolved satellite observations introduces the highest uncertainties in the albedo retrieval, which tend to increase with the solar zenith angle. Uncertainties due to different FOVs can be neglected.

UP 6.5 Mi 15:30 HS 22

Cosmic Ray Neutron Sensing with novel neutron detectors — •Markus Köhli[1,2], Jannis Weimar[1], Fabian Allmendinger[1], Fabian Schmidt[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg, Heidelberg, Deutschland — [2]Physikalisches Institut, Universität Bonn, Bonn, Deutschland

The method of cosmic ray neutron sensing - measuring soil moisture non-invasively at the hectometer scale has turned out to be feasible by detecting the environmental albedo neutron density. The key feature of the method is that neutrons generated by cosmic rays show an exceptionally different behavior interacting with hydrogen. It slows down fast neutrons whereas any other heavier element, independent of the chemical composition, 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 targeted meanwhile by a manifold of experiments. We are now developing boron-lined neutron detectors using spin-off technologies from the upcoming European Spallation Source and instrument design experience from past experiments. These detectors shall also offer an alternative platform to current Helium-3 based systems. In order to reduce costs we recently have developed readout electronics and data acquistion systems based on Arduino microcontrollers.

UP 6.6 Mi 15:45 HS 22

digital filter design based on FPGA system for nuclear detection — •yuzhen ma — Institute of Semiconductor and Microsystems Technology, Technische Universität Dresden, Dresden 01069, Germany

Amplitude is an important parameter in the measurement system for the nuclear radiation, which is very critical for a nuclear instrumentation for it is proportional to the amount of charge. By using the traditional Fourier transform appears to be powerless for nuclear radiation signal. As a new signal measurement method, wavelet analysis decomposes various frequency components in the signal into non-overlapping frequency bands, which provides an effective way for signal filtering, The use of wavelet analysis for measuring signal is an important application in nuclear instrumentation, which provides a useful tool for the analysis for non-stationary signals. This work performs a comparison between different digital filters and presents a filter based on FPGA system to obtain precise amplitude value. A filter based on wavelet transform is designed to improve the performance of measuring system for radioactive detection. With specific scintillation detector, the energy resolution is improved by the designed measurement technique comparing to other filters.

UP 7: Clouds and aerosols

Zeit: Mittwoch 16:30–18:10 Raum: HS 22

UP 7.1 Mi 16:30 HS 22

Ableitung von mikrophysikalischen Wolkenparametern auf IR-Spektren gemessen während der Polarsternkampagnen PS106 und PS107 — •Philipp Richter, Mathias Palm, Christine Weinzierl und Justus Notholt — Institut für Umweltphysik, Universität Bremen

Wolken spielen eine große Rolle im Strahlungshaushalt der Erde. Im langwelligen (terrestrischen) Frequenzbereich bewirken sie in Abhängigkeit ihres Wassergehalts einen Nettostrahlungsfluss zur Erde, wohingegen sie im kurzwelligen (solaren) Bereich die Einstrahlung auf den Erdboden verringern. Eine akkurate Beschreibung der Wolken ist damit unerlässlich zur Verständnis des Klimas und des Wetters. In der Arktis enthält ein großer Teil der Wolken nur eine geringe Menge an Wasser. Weiterhin sind häufig Mischphasenwolken (enthalten Eis- und Flüssigwasser) anzutreffen. Die sonst zur bodengestützten Bestimmung des Wassergehalts in Wolken benutzen Mikrowellenradiometer können aufgrund des geringen Wassergehalts der Wolken nur eingeschränkt verwendet werden. Deswegen wurde für die vorliegende Messkampagne ein FT-IR Spektrometer zur Wolkenbeobachtung verwendet. Die Messungen fanden zwischen dem 24.5.2017 und 19.8.2017 auf der Überfahrt von Bremerhaven nach Spitzbergen und daran anschließend im Arktischen Ozean im Rahmen der Polarsternkampagnen PS106 und PS107 statt. In diesem Vortrag wird das Retrieval beschrieben und die damit bestimmten Wolkenparameter der beiden Schiffskampagnen.

UP 7.2 Mi 16:50 HS 22

Secondary Ice Production by drizzle droplets freezing in free fall — •Alice Keinert[1], Alexei Kiselev[1], Nadine Tüllmann[1], and Thomas Leisner[1,2] — [1]Institute of Meteorology and Climate Research - Atmospheric Aerosol Research Department, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany

The excess concentration of ice crystals as compared to the concentration of ice nuclei in cumuli has been one of the longest debated issues in cloud physics. Several ice multiplication mechanisms have been proposed to explain this discrepancy, with the Hallett-Mossop mechanism being the most well-known. Recent in-cloud observations have underlined the importance of secondary ice production upon shattering of freezing drizzle droplets. In this presentation, we report the recent results of the experimental study aimed to clarify the physics of this mechanism and to investigate its dependence on the environmental parameters. As in the recent study (Lauber et al., 2018), we levitate supercooled water droplets in an electrodynamic balance and observe the freezing process with a high-speed video camera. However, in the new setup the droplets are exposed to the gas flow mimicking the free fall at terminal velocity. We observe a very strong enhancement of shattering probability compared to the previous studies conducted under stagnant flow conditions.

Lauber, A., A. Kiselev, T. Pander, P. Handmann, and T Leisner (2018). "Secondary Ice Formation during Freezing of Levitated Droplets", Journal of the Atmospheric Sciences 75, pp. 2815-2826.

UP 7.3 Mi 17:10 HS 22

Detection of desert dust aerosol using S5P DOAS observations — •Andreas Richter, Kezia Lange, and John P. Burrows — Institute of Environmental Physics, University of Bremen, Bremen, Germany

In many arid parts of the world, dust from deserts and other dry surfaces can be uplifted into the air and become the largest fraction of atmospheric aerosols. Dust aerosol outbreaks can affect large areas, and have important effects on air quality, visibility, human health, and also on the transport of trace elements towards remote ocean regions.

Desert dust outbreaks can be observed from space in visible satellite images and quantified by aerosol retrieval methods which separate the contributions from surface reflection, scattering on air molecules and scattering by particles on the observed top of atmosphere reflectance based on the analysis of discrete wavelength bands.

A few years ago, a spectral interference of the surface spectral reflectance of deserts was found in GOME-2 satellite retrievals of atmospheric nitrogen dioxide (NO2) from space borne observations in the wavelength region 450 - 497 nm. This spectral signature which appears to be unique to certain desert soils was subsequently also identified in measurements of other satellites and in airborne data.

Here, we use measurements of the TROPOMI instrument on the recently launched S5P satellite to investigate the global distribution of the spectral sand signal and show that it is not only found over deserts, but can also be used to detect large desert dust aerosol events, mainly over the ocean but also over land.

UP 7.4 Mi 17:30 HS 22

Ultrafine particles in the lower troposphere: major sources, invisible plumes and meteorological transport processes — •Wolfgang Junkermann[1] and Jorg Hacker[2] — [1]KIT, IMK-IFU, Garmisch-P, Germany — [2]Airborne Research Australia, Salisbury South, SA

Ultrafine particles in the atmosphere are key factors for aerosol cloud interaction as they affect cloud droplet size distributions, latent heat transport into elevated layers via droplet evaporation and precipitation properties via delayed raindrop generation and possibly invigoration of torrential rains. They are spatially and temporarily highly uneven distributed, suggesting the presence of strong sources either for primary particle emissions or for particle precursor materials. Airborne investigations allow to identify major anthropogenic primary particle emitters, their source strength and contribution to the ultrafine particle budget. Emissions in mid elevations of the planetary boundary layer are transported over hundreds of km and vertically mixed by thermal convection on different time scales. Meteorological processes explain the spatial and temporal patterns of number and size distributions of ultrafine nucleation mode particles observations. Results from airborne experiments in clean and polluted Environments, their dependence on meteorology and the impact on rainfall distribution and the regional to continental scale hydrological cycle will be discussed.

UP 7.5 Mi 17:50 HS 22

Evaluation und Vergleich von kostengünstigen Sensoren für Feinstaub — •Konradin Weber, Tim Kramer, Tobias Pohl und Christian Fischer — Hochschule Düsseldorf, Labor für Umweltmesstechnik, Münsterstr. 156, 40476 Düsseldorf

Feinstaub ist nach wie vor ein Problem in vielen deutschen Städten und stark in der öffentlichen Diskussion. In diesem Zusammenhang wird auch diskutiert, ob ggf. mit zahlreichen kostengünstigen Feinstaubsensoren valide Informationen über die flächenhafte Feinstaubverteilung in der Stadt, z.B. für die Verkehrslenkung, gewonnen werden könnten. Eine Voraussetzung ist hierfür allerdings, dass genügend Informationen über die Datenqualität der Feinstaubsensoren vorhanden sind.

Aus diesem Grund hat die HSD verschiedene kostengünstige Feinstaubsensoren evaluiert und sie mit einem zertifizierten Messgerät für Feinstaub als Referenz verglichen. Die Untersuchungen beziehen sich zum einen auf den Low-Cost Sensor SDS011 (Nova Fitness) für PM10 und PM2.5, der auch in verschiedenen Citizen Science Projekten eingesetzt wird. Zum anderen wurden Mid-Cost Sensoreinheiten der Typen Alphasense N2 bzw. N3 evaluiert. Diese bieten gegenüber den SDS011 Sensoren den Vorteil, dass sie neben PM10, PM2.5 und PM1 auch prinzipiell die Partikelgrößenverteilung ermitteln können. Um repräsentative Ergebnisse zu erlangen, wurden die Untersuchungen in realer urbaner Atmosphäre unter verschiedenen meteorologischen Bedingungen durchgeführt.

UP 8: Physics of the middle atmosphere

Zeit: Donnerstag 11:00–12:40 Raum: HS 22

UP 8.1 Do 11:00 HS 22

Chemiluminescent potassium emission in the Earth's atmosphere — •Stefan Noll[1,2], John M. C. Plane[3], Wuhu Feng[3], Bastian Proxauf[4], Stefan Kimeswenger[5,6], and Wolfgang Kausch[5] — [1]Universität Augsburg, Germany — [2]DLR, Weßling-Oberpfaffenhofen, Germany — [3]University of Leeds, UK — [4]MPI für Sonnensystemforschung, Göttingen, Germany — [5]Universität Innsbruck, Austria — [6]UCN, Antofagasta, Chile

The evaporation of cosmic dust particles entering the Earth's atmosphere at high speeds leads to the formation of metal layers in the mesopause region at around 90 km. The alkali metal potassium (K) can be observed via the $K(D_1)$ line at 769.9 nm, which can be stimulated by sunlight, lasers, and chemical reactions. The latter mechanism is particularly useful for studying the underlying chemistry. However, as the related weak nighttime emission is difficult to observe, only a rough mean intensity has been measured, so far. With about 2,300 high-resolution spectra from the astronomical echelle spectrograph UVES at Cerro Paranal in Chile taken between 2000 and 2015, we have been able to study K nightglow in much more detail. Nighttime, seasonal, and long-term variations have been investigated for the first time. Moreover, we have simulated the K emission with the Whole Atmosphere Climate Community Model (WACCM) in order to estimate the efficiency of the chemiluminescent emission process. Overall, the variability and quantum yield are surprisingly different from the corresponding results for the better studied nightglow emission of sodium, another light alkali metal.

UP 8.2 Do 11:20 HS 22

Upper mesospheric Sodium profiles from OSIRIS nightglow measurements — •Julia Koch[1], Landon Rieger[2], Adam Bourassa[2], Doug Degenstein[2], and Christian von Savigny[1] — [1]University of Greifswald, Greifswald, Germany — [2]University of Saskatchewan, Saskatoon, Canada

The purpose of this research is to gain a better understanding of the mechanism of the Na-D-line excitation in the terrestrial nightglow. To do so a good approach is to find out more about the Na-density profile around the globe. OSIRIS (the Optical Spectrograph and InfraRed Imager System) on the satellite Odin provides limb measurements from February 2001 and is still operational today. Sodium emits radiation at 589,0 and 589,6 nm which is covered by the OSIRIS spectral range. Although its resolution is not good enough to separate the two lines OSIRIS has a better signal-to-noise ratio than other instruments. We implemented an inversion method to retrieve upper mesospheric Na profiles from OSIRIS nightglow measurements based on an effective Chapman excitation scheme. To validate the obtained results they were also compared to sodium profiles that were previously retrieved from SCHIAMACHY data. And it can be shown that both instruments provided results that are in good agreement with each other.

UP 8.3 Do 11:40 HS 22

Stereoskopie der Airglowschicht zur Charakterisierung von Schwerewellen — •Patrick Hannawald[1], Sabine Wüst[2] und Michael Bittner[1,2] — [1]Universität Augsburg — [2]DLR, Deutsches Fernerkundungsdatenzentrum, Oberpfaffenhofen

Das sogenannte OH-Airglow in ungefähr 87km Höhe ist hervorragend für die Untersuchung der atmosphärischen Dynamik in der Mesosphäre geeignet. Aufgrund chemischer Vorgänge wird nachts Licht im nahen Infrarotbereich abgestrahlt. Atmosphärische Schwerewellen, welche die Dynamik in dieser Höhe zu einem großen Teil bestimmen, modulieren die Helligkeit dieser Schicht. Sie kann deshalb für die Beobachtung von Schwerewellen verwendet werden und erlaubt das Studium dieser, mit in-situ Messungen nur schwer zugänglichen, Schicht. Mit bodengebundenen Kameras können kontinuierliche Beobachtungen des Airglows über das gesamte Jahr hinweg durchgeführt und so z.B. die statistische Ausbreitungsrichtung von Schwerewellen bestimmt werden. Diese Informationen können zur Validation von Atmosphärenmodellen verwendet werden. Ein einzelnes Kamerasystem erlaubt nur die Ableitung der horizontalen Wellenparameter. Durch Kombination von zwei Kameras, welche von verschiedenen Standorten aus dasselbe Gebiet der Airglow-Schicht betrachten, ist es mittels Stereoskopie jedoch möglich zusätzliche Informationen über die Wellen zu erhalten und so die Dynamik in der mittleren Atmosphäre noch besser zu verstehen. Das DLR in Zusammenarbeit mit der Universität Augsburg betreibt ein solches Stereokamerasystem seit Anfang 2018. Im Vortrag werden die vorläufigen Ergebnisse anhand von Fallstudien gezeigt.

UP 8.4 Do 12:00 HS 22

Model studies on chemical effects of sprites in relation with satellite measurements — •Holger Winkler[1], Takayoshi Yamada[2,3], Yasuko Kasai[2,3], and Justus Notholt[1] — [1]Institut für Umweltphysik, Universität Bremen — [2]Terahertz Technology Research Center, National Institute of Information and Communications Technology, Japan — [3]Department of Environmental Chemistry and Engineering, Tokyo Institute of Technology, Japan.

Sprites are large scale electrical discharges in the mesosphere occurring above active thunderstorm clouds. The strong electric fields in sprites cause electron impact ionization, dissociation and excitation of air molecules and atoms as well as electron attachment to electronegative species. Mainly during the last decade, results of a number of model simulations of chemical sprite effects have been presented. However, until recently, there were no direct measurements of the chemical impact of sprites. Data from the Superconducting Submillimeter-Wave Limb Emission Sounder (SMILES) at the Japanese experiment module of the International Space Station indicate an increase of mesospheric HO_2 after three sprite events. These are the first direct observations of chemical sprite effects, and provide a unique opportunity to test our understanding of the chemical processes in sprites. We present results of plasma chemistry model simulations of sprites in relation with SMILES observations, and analyze the chemical reactions which lead to an increase of mesospheric HO_2 on time-scales of many minutes to a few hours after sprite events.

UP 8.5 Do 12:20 HS 22

Response of the middle atmospheric temperature to the solar 27-day cycle — •Piao Rong[1,2] and Christian von Savigny[1] — [1]Institute of Physics, University of Greifswald, Greifswald, Germany — [2]School of Science, Xi'an Jiaotong University, Xi'an, China

This contribution discusses the presence and characteristics of solar 27-day signatures in middle atmospheric temperature observed by the Microwave Limb Sounder (MLS) on NASA's Aura spacecraft. We use the superposed epoch analysis (SEA), the time-lagged linear regression method (sensitivity analysis), and a Monte-Carlo test method (significance test) to explore the dependence of the results on different parameters (e.g., smoothing filter, window width and epoch centers), on solar activity and season, as well as on latitude. Using different parameters does impact the results to a certain degree, but it does not affect the overall characteristics. The 27-day signature in temperature is stronger during winter than during summer. The sensitivity of temperature to solar 27-day forcing is larger at high latitudes than at low latitudes in strong solar activity years. However, in weak solar activity years, the sensitivity maximum appears at the equatorial mesopause. In addition, the sensitivity values of the strong solar activity years are smaller than the values in the weak solar activity years. That means, in weak solar activity years, the temperature may be affected by some factors other than the 27-day solar cycle to induce so high sensitivity.

UP 9: Hydrology, oceanography and miscellaneous

Zeit: Donnerstag 14:00–15:40 Raum: HS 22

Hauptvortrag UP 9.1 Do 14:00 HS 22

Hydrodynamic control of biogeochemical cycling in streams — •Andreas Lorke[1], Christian Noss[1], Christine Anlanger[1], Ute Risse-Buhl[2], and Markus Weitere[2] — [1]Institute for Enviromental Sciences, University of Koblenz-Landau, Forststr. 7, 76829 Landau — [2]Department River Ecology, Helmholtz Centre for Environmental Research UFZ, Brückstraße 3a, 39114 Magdeburg

Low-order streams form the most abundant and the largest component of fluvial networks. They transport and process particulate and dissolved substances of terrestrial or anthropogenic origin. For example, they can be strong sources of the atmospheric greenhouse gases CO2, CH4 and N2O, and they convert anthropogenic nitrate loads into N2. Biodiversity and biogeochemical cycling in streams, as well their spatial and temporal variability are ubiquitously linked to flow velocity and turbulence. Although stream flow has been modified globally by human activities, the processes by which flow and turbulence regulate biogeochemical cycling and biodiversity are poorly understood. Here we analyze the interactions between streambed and water surface roughness and their influence on stream flow turbulence and atmospheric aeration rates. By combining existing ecological and physical frameworks, we present a novel concept for quantifying physical heterogeneity in streams. The concept is applied to study the effects of physical heterogeneity on biodiversity and ecological functioning of epilithic biofilms.

Hauptvortrag UP 9.2 Do 14:30 HS 22

El Niño's little brother in the tropical Atlantic - mechanisms and impacts — •Joke Lübbecke — GEOMAR Helmholtz Centre for Ocean Research Kiel

A climate mode similar to the Pacific El Niño - Southern Oscillation (ENSO) exists in the tropical Atlantic Ocean. Sea surface temperature (SST) anomalies associated with this Atlantic Niño mode can have substantial impacts on rainfall over western Africa and northeastern South America as well as the marine ecosystem along the African coast.

Various processes have been suggested to contribute to the generation of Atlantic Niño events. In addition to the dominant Bjerknes feedback - which links the SST anomalies in the eastern equatorial basin to western basin wind stress anomalies and equatorial thermocline tilt - meridional advection of temperature anomalies, Rossby waves reflecting into equatorial Kelvin waves, and net surface heat flux can play an important role for individual events.

The strength and symmetry of the Atlantic Bjerknes feedback elements vary between decades. Consequently the characteristics of the Atlantic Niño, such as its spatial pattern and amplitude, and its impacts are not stationarity in time. The multi-decadal modulations might be related to the phase of the Atlantic multidecadal oscillation (AMO).

UP 9.3 Do 15:00 HS 22

Distinguishing Sea Ice Types in the Antarctic using Microwave Satellite Observations — •Christian Melsheimer[1], Gunnar Spreen[1], Mohammed Shokr[2], Yufang Ye[3], and Stefanie Arndt[4] — [1]University of Bremen, Bremen, Germany — [2]Environment and Climate Change Canada, Toronto, Canada — [3]Chalmers University of Technology, Göteborg, Sweden — [4]Alfred Wegener Institute, Bremerhaven, Germany

Sea ice can be classified into several types, such as young ice (YI, thin/smooth new ice), first-year ice (FYI, formed during one cold season), and multiyear ice (MYI, which has survived at least one melt season). As the physical properties of sea ice differ significantly for the different ice types, knowledge of the sea ice type is essential for properly modelling the ice-ocean-atmosphere system. Here we apply a new satellite-based retrieval of sea ice type in the Antarctic. This retrieval has originally been developed for the Arctic, where it can distinguish YI, FYI and MYI. Applying it in the Antarctic is useful because although there is MYI in the Antarctic, its distribution has not yet been investigated much, and there are sea ice types which do not occur in the Arctic. The retrieval uses input data from radar scatterometer and microwave radiometers and in addition corrects for, e.g., the effect of melt-refreeze or sea ice drift. The needed satellite data have been available since 1999 with daily coverage (but: retrieval impossible during summer melt), spatial resolution is about 25 km. We present and discuss results of this new retrieval applied to Antarctic sea ice.

UP 9.4 Do 15:20 HS 22

Testing the variability of speleothem growth in Glacial versus Interglacial climate — •Carla Roesch and Kira Rehfeld — Institute of Environmental Physics, Ruprecht-Karls-University Heidelberg, Germany

Major changes in global mean climate occurred since the Last Glacial Maximum (21 kyr ago), with a 3-8°C warming of global mean temperature, an about 120m rise in sea level and an increase of about 100ppm in CO_2. On long timescales, new evidence shows that surface temperature variability decreased globally. However, signs and magnitudes are still poorly constrained for precipitation.

Variations in growth rates of speleothems (cave deposits) have been suggested as an indicator of such global environmental changes. To further investigate the dynamics and variability of paleoclimate we investigate changes in speleothem growth rates. These are derived by modeling the accumulation process based on Uranium/Thorium radiometric point estimates of the age at different depths within the archive. The Bayesian models we apply draw accumulation rates from a Gamma-distribution.

We compare our results to reconstructions from other age-depth models to test the possibility of changing growth rates from the last Glacial to our current Interglacial.

UP 10: Poster session

Zeit: Donnerstag 16:30–18:30 Raum: HS 22

UP 10.1 Do 16:30 HS 22

Estimating global warming from anthropogenic heat emissions — •Peter Steiglechner, Maria Martin, and Georg Feulner — Potsdam-Institut für Klimafolgenforschung (PIK)

The consumption of primary energy from sources such as fossil or nuclear fuels and the consequent dissipation to heat induces a direct climate warming, the so called anthropogenic heat flux (AHF) forcing.

The current global AHF is negligibly small compared to the indirect forcing from greenhouse gas emissions. However, by continuing the historically observed exponential growth of primary energy consumption, e.g. fueled by fusion power, the impacts of the AHF can become a relevant factor for anthropogenic post-greenhouse gas climate change even on the global scale.

We estimated the global warming from different scenarios of growing AHF forcing in climate models ranging from conceptual Energy Balance Models to a climate model of intermediate complexity. The associated feedbacks, in particular the ice-albedo feedback and the ocean heat uptake, as well as the influence of the heterogeneity of the forcing were examined. The global mean temperature response from the AHF today is of the order of $0.010 - 0.016\,\mathrm{K}$. A transient tenfold increase of this forcing heats up the Earth System additionally by roughly $0.1 - 0.2\,\mathrm{K}$ in the models used in this work.

The transition to a renewable energy mix, explicitly without nuclear power, however, largely eliminates the increasing AHF forcing and its climate impacts, independent of the growth of energy production.

UP 10.2 Do 16:30 HS 22

Cloud microphysical properties from airborne camera observations of the backscatter glory — •Veronika Pörtge, Lucas Höppler, Tobias Kölling, Tobias Zinner, and Bernhard Mayer — Ludwig-Maximilians-Universität, Meteorologisches Institut, München, Germany

Cloud microphysical properties such as the effective radius of the droplets or the shape of their size distribution determine the effect of clouds on the global radiation budget and hence on Earth's climate. In this study we present a remote sensing method for detecting those optical properties by using the backscatter glory which is a well-known optical phenomenon for water clouds.

The glory is caused by backscattering of sunlight by spherical droplets in clouds. This backscattering results in colorful concentric rings surrounding the observer's shadow which can be quantitatively described by Mie theory. The angular radius of the rings is a very accurate and direct measure of the droplet size, while the "sharpness" of the image contains information about the width of the size distribution.

We analyse systematic camera observations which were taken during the NARVAL-II campaign in 2016 from the HALO aircraft by comparing them with radiative transfer simulations. Results of this method will be presented and compared to "traditional" remote sensing methods.

UP 10.3 Do 16:30 HS 22

Untersuchung der raum-zeitlichen Variabilität verschiedener Luftschadstoffe in der Innenstadt Düsseldorfs mit mobilen Messungen — •Konradin Weber[1], Georg Heweling[2], Tobias Pohl[1], Christian Fischer[1] und Christoph Böhlke[1] — [1]Hochschule Düsseldorf HSD, Labor für Umweltmesstechnik UMT, Münsterstr. 156, 40476 Düsseldorf — [2]Qiagen GmbH, Qiagen Straße 1, 40724 Hilden

Die Corneliusstraße in der Düsseldorfer Innenstadt ist als eine besonders stark mit Luftschadstoff-Immissionen belastete Straße in NRW bekannt. Verschiedene Luftschadstoffe werden dort vom Landesumweltamt LANUV NRW überwacht. Um jedoch die Belastung eines ausgedehnten Innenstadtbereiches beurteilen zu können, sind zusätzlich auch Informationen über die räumliche und zeitliche Variabilität der Luftschadstoffe in diesem Stadtgebiet notwendig.

Aus diesem Grund wurden in 2017 zahlreiche Messfahrten mit einem umfangreich instrumentierten Mess-Pedelec der HSD in Düsseldorfs Innenstadt durchgeführt. Als Messsysteme wurden dabei eingesetzt: Cavity-DOAS (für NO2), Optical Particel Counter OPC (für Feinstaub), UV-Absorption (für Ozon), elektrische Aufladung (für Ultrafeinpartikel UFP), Aethalometer-Verfahren (für Ruß).

Die Messfahrten wurden mittags, in der Rush-Hour sowie um Mitternacht durchgeführt. Eine Besonderheit bei diesen Untersuchungen stellten die Messungen von UFP sowie Ruß dar. Bei den Untersuchungen konnten weitere Belastungsschwerpunkte in der Innenstadt identifiziert und einzelnen Schadstoffkomponenten zugeordnet werden.

UP 10.4 Do 16:30 HS 22

Potential Arctic Cirrus Cloud Feedbacks on the Composition of the UTLS — •Florian Haenel[1], Wolfgang Woiwode[1], Michael Höpfner[1], Roland Ruhnke[1], Farahnaz Khosrawi[1], Oliver Kirner[2], Felix Friedl-Vallon[1], Sören Johansson[1], Anne Kleinert[1], Jennifer Schröter[1], and Björn-Martin Sinnhuber[1] — [1]Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Karlsruhe, Germany — [2]Karlsruhe Institute of Technology, Steinbuch Centre for Computing, Karlsruhe, Germany

The composition of the UTLS (upper troposphere/lower stratosphere) plays a key role in climate change, as radiative forcing of the atmosphere is sensitive to abundances of greenhouse gases in this region. Therefore, a correct representation of processes and feedbacks in the UTLS in atmospheric models is crucial. Cirrus clouds in the UTLS are directly capable of redistributing water vapour (H2O) and nitric acid (HNO3). This may furthermore lead to changes in the vertical distributions of the greenhouse gases methane and ozone. The role of high latitude and particularly Arctic cirrus clouds is not well understood. We retrieve vertical profiles of these trace gases measured by the airborne infrared limb sounder GLORIA during the POLSTRACC campaign in the vicinity of cirrus clouds. Comparison to the measurements and sensitivity studies with simulations by the high-resolution forecast model ICON-ART and the climate-chemistry model EMAC will gain insight into the performance of the models and the significance of these processes on the composition of the UTLS.

UP 10.5 Do 16:30 HS 22

Bestimmung der zeitlichen Entwicklung stratosphärischer Aerosolparameter über Nordnorwegen aus LIDAR-Messungen — •Jacob Zalach und Christian von Savigny — Universität Greifswald

Stratosphärische Aerosole sind von großer Bedeutung für die Ozonchemie und die atmosphärische Strahlungsbilanz. Die Aerosolbefrachtung zeigte innerhalb der letzten 15 Jahre eine deutliche Variabilität, wobei sich bisherige LIDAR-Langzeitbeobachtungen auf mittlere geografische Breiten konzentrieren.

Im Rahmen des LESAP Projektes wurden Daten des RMR-LIDAR Systems der Alomar Station bei 69°N im Zeitraum von 1995 bis 2018 ausgewertet. Die Messungen der Rückstreuverhältnisse bei verschiedenen Wellenlängen erlauben es Partikelradien, Extinktionskoeffizienten und Dichten zu bestimmen.

Der Beitrag skizziert das Auswertekonzept und zeigt die im Messzeitraum beobachtete Aerosolentwicklung. Ein Vergleich der errechneten Extinktionskoeffizienten mit Werten, die mittels Satellitenmessungen gewonnen wurden, zeigt zwar eine relativ gute Übereinstimmung aber auch charakteristische Abweichungen. Die Gründe dafür werden diskutiert.

UP 10.6 Do 16:30 HS 22

Aerosols from remote Central West Antarctica - Characterization and Chemical Imaging — •Johannes Weis[1,2,6], Ricardo H. M. Godoi[1,3], Ana F. L. Godoi[1,3], Simon Mueller[1,2], Sérgio J. Goncalves Jr.[3], Heitor Evangelista[4], Swarup China[5], Bingbing Wang[5], Alexander Laskin[5], Tristan H. Harder[6], and Mary K. Gilles[1] — [1]Chemical Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA — [2]Department of Chemistry, University of California, Berkeley, CA 94720, USA — [3]Department of Environmental Engineering, Federal University of Paran UFPR, Curitiba, PR, Brazil — [4]LARAMG, State University of Rio de Janeiro Uerj, Rio de Janeiro, RJ, Brazil — [5]William R. Wiley Environmental and Molecular Science Laboratory, Pacific Northwest National Laboratory, Richland, Washington 99352, USA — [6]Department of Physics, University of Wuerzburg, Germany

Changes in Antactica's ice sheets and shelves are of primary concern to the regional and global climate. We hypothesize that the West Anarctic warming can be related to the aerosols transported and formed in this region. Internal composition and characteristics of single aerosol particles were studied by means of chemical mapping via synchrotron-based scanning transmission X-ray microscopy with near edge X-ray absorption fine structure spectroscopy (STXM/NEXAFS) and consequent rule-based cluster classification. Complementary data from computer-controlled scanning electron microscopy with energy-dispersive X-ray spectroscopy (CC-SEM/EDX) offers a deeper understanding of aerosol particles formed in Antarctica's pristine environment.