Environmental Physics Division
Fachverband Umweltphysik (UP)

Justus Notholt
Institut für Umweltphysik
Universität Bremen
Otto-Hahn-Allee
28359 Bremen
notholt@uni-bremen.de

Ulrich Platt
Institut für Umweltphysik
Universität Heidelberg
Im Neuenheimer Feld 229
69120 Heidelberg
Ulrich.Platt@iup.uni-heidelberg.de

Übersicht der Hauptvorträge und Fachsitzungen

(Vorträge: G/gHS und M/SR3; Poster: G/Poster; Plenarvorträge und Symposium: C/gHS)

Plenarvorträge von Interesse für die Umweltphysik

PV IV	Tue	20:00–21:00	Neue Aula	**Klimawandel: Zu spät für 2°C?** — •Thomas Stocker
PV IX	Thu	9:45–10:30	PV-Rooms	**Atom Trap, Krypton-81, and Global Groundwater** — •Zheng-Tian Lu
PV XI	Fri	9:00– 9:45	PV-Rooms	**The Oceans in a Warming World: How are the oceans changing and what role do they play in climate change?** — •John Marshall

Hauptvorträge

UP 2.1	Wed	9:00– 9:30	G/gHS	**Ozone trends and variability in a changing climate** — •Mark Weber
UP 3.1	Wed	16:45–17:15	G/gHS	**Einsatz kleiner unbemannter Forschungsflugzeuge (UAV) in der Atmosphärenphysik** — •Jens Bange
UP 5.1	Thu	8:45– 9:15	G/gHS	**Satellite remote sensing of atmospheric trace gases in the UV/vis spectral range: observing pollution in the atmospheric layer in which we live** — •Thomas Wagner
UP 10.4	Thu	17:45–18:15	M/SR3	**Können Einsteins Teeblätter das Wattenmeer vor dem Untergang retten?** — •Hans Burchard
UP 11.1	Thu	17:00–17:30	G/gHS	**Radar meteor echoes and their relation to atmospheric and plasma physics** — •Jorge L. Chau, Gunter Stober, Carsten Schult, Irina Strelnikova, Meers M. Oppenheim
UP 16.3	Fri	11:45–12:15	G/gHS	**Air-Sea Gas Exchange: from Empiric Wind Speed Relations to Regimes and Ranges** — •Bernd Jähne

Vorträge des fachübergreifenden Symposiums SYNG

SYNG 1.1	Thu	11:00–11:30	C/gHS	**Development of a new facility for measuring 81Kr and 85Kr at ultra-trace level in environmental samples.** — •Bernard Lavielle, Eric Gilabert, Bertrand Thomas, Romain Rebeix, Grégory Canchel, Christophe Moulin, Sylvain Topin, Fabien Pointurier
SYNG 1.2	Thu	11:30–12:00	C/gHS	**Atom counting system to measure trace krypton contamination in ultra-pure xenon** — •Andre Loose, Tanya Zelevinsky, Elena Aprile
SYNG 1.3	Thu	12:00–12:30	C/gHS	**Krypton-85 and Radioxenon: Environmental Tracers and Indicators for Nuclear Activities** — •Clemens Schlosser, Verena Heidmann, Martina Konrad, Sabine Schmid
SYNG 1.4	Thu	12:30–12:45	C/gHS	**Miniature High Sensitive Time-of-Flight Noble gas Mass spectrometer for very low gas measurements** — •Ramakrishna Ramisetty, Ingo Leya
SYNG 1.5	Thu	12:45–13:00	C/gHS	**Studying the constancy of galactic cosmic rays using cosmogenic noble gases and radionuclides in iron meteorites** — •Thomas Smith, Ingo Leya, Silke Merchel, Georg Rugel, Stefan Pavetich, Anton Wallner, Keith Fifield, Stephen Tims, Gunter Korschinek

SYNG 2.1	Thu	14:30–15:00	C/gHS	**Using Noble Gases to Understand the History of Terrestrial Volatiles** — •Don Porcelli
SYNG 2.2	Thu	15:00–15:30	C/gHS	**Noble gas analysis in water: from temperature reconstruction over excess formation to oxygen turnover on environmentally relevant time scales** — •Rolf Kipfer, Matthias Brennwald
SYNG 2.3	Thu	15:30–16:00	C/gHS	**Applications of Noble Gases in Oceanography** — •Peter Schlosser, Robert Newton, Gisela Winckler, Angelica Pasqualini
SYNG 2.4	Thu	16:00–16:15	C/gHS	**Basal ice-shelf melting in the Weddell Sea inferred from oceanic noble-gas observations** — •Oliver Huhn, Monika Rhein, Michael Schröder
SYNG 2.5	Thu	16:15–16:30	C/gHS	**Environmental Tracer and helium measurements in the context of Coal Seam Gas exploration.** — •Axel Suckow, Stanley D. Smith

Fachsitzungen

UP 1.1–1.1	Tue	20:00–21:00	Neue Aula	**PV Stocker (Abendvortrag)**
UP 2.1–2.22	Wed	8:50–16:45	G/gHS	**Atmosphäre**
UP 3.1–3.7	Wed	16:45–19:15	G/gHS	**Meßtechnik**
UP 4.1–4.25	Wed	10:45–19:45	G/Foyer	**Postersession Atmosphäre**
UP 5.1–5.2	Thu	8:45– 9:30	G/gHS	**Meßtechmik**
UP 6.1–6.1	Thu	9:45–10:30	PV-Rooms	**PV Lu**
UP 7.1–7.5	Thu	11:00–13:00	C/gHS	**Applied Noble Gas Physics Part 1**
UP 8	Thu	13:00–14:30	G/gHS	**Mitgliederversammlung**
UP 9.1–9.5	Thu	14:30–16:30	C/gHS	**Applied Noble Gas Physics Part 2**
UP 10.1–10.7	Thu	17:00–19:00	M/SR3	**Ozeanographie**
UP 11.1–11.1	Thu	17:00–17:30	G/gHS	**Atmosphäre**
UP 12.1–12.6	Thu	17:30–19:00	G/gHS	**Meßtechnik**
UP 13.1–13.27	Thu	10:45–19:45	G/Foyer	**Postersession Bodenkunde, Kryosphäre, Meßtechnik, Ozeanographie**
UP 14.1–14.1	Fri	9:00– 9:45	PV-Rooms	**PV Marschall**
UP 15.1–15.3	Fri	10:00–10:45	G/gHS	**Bodenkunde und Kryosphäre**
UP 16.1–16.6	Fri	10:45–13:00	G/gHS	**Meßtechnik**

Mitgliederversammlung des Fachverbands Umweltphysik

Donnerstag 13:00 - 14:30 G/gHS
Mitgliederversammlung mit Mittagsimbiss für alle Mitglieder des Fachverbandes, Gäste willkommen

- Bericht des Vorsitzenden und Vertreters
- Wahlen
- Verschiedenes, z.B. Kommentare und Anregungen der Teilnehmer

UP 1: PV Stocker (Abendvortrag)

Time: Tuesday 20:00–21:00 Location: Neue Aula

Evening Talk UP 1.1 Tue 20:00 Neue Aula

Klimawandel: Zu spät für 2°C? — •Thomas Stocker — Klima- und Umweltphysik, Physikalisches Institut, Universität Bern, Schweiz

Die CO_2 Konzentrationen in der Atmosphäre sind heute über 30% höher als je zuvor in den letzten 800'000 Jahren und steigen über 100 Mal schneller an als je in den letzten 20'000 Jahren. Die Ursache dafür ist die Verbrennung fossiler Energieträger und die Abholzung tropischer Regenwälder. Der Anstieg der Treibhausgase, allen voran CO2, hat zu einer Aufnahme von Energie im Erdsystem geführt: ca. $270{\cdot}10^{21}$ J seit 1970. Der neuste Sachstandsbericht *Climate Change 2013: The Physical Science Basis* des Weltklimarats IPCC dokumentiert ein sich rasch und tiefgreifend änderndes Erdsystem und liefert wissenschaftliche Informationen über künftige Änderungen. Eine Einschränkung des Klimawandels erfordert umfangreiche und langfristige Reduktionen der Treibhausgasemissionen. Trotz aller Komplexität des gekoppelten physikalisch-biogeochemischen Erdsystems gibt es einen überraschend einfachen, linearen Zusammenhang zwischen der Summe der CO_2 Emissionen seit der industriellen Revolution und der erwarteten Erwärmung im 21. Jahrhundert. Ein gesellschaftlich vereinbartes Klimaziel impliziert deshalb ein limitiertes CO_2 Budget. Für das 2°C Ziel wurden bereits 2/3 dieses Budgets konsumiert; bei gegenwärtigen Emissionen ist es in weniger als 25 Jahren aufgebraucht.

UP 2: Atmosphäre

Time: Wednesday 8:50–16:45 Location: G/gHS

Begrüßung und Eröffnung

Invited Talk UP 2.1 Wed 9:00 G/gHS

Ozone trends and variability in a changing climate — •Mark Weber — Universität Bremen FB1, Bremen,Germany

Three decades of global satellite observations of ozone show variability on various time scales related to atmospheric dynamics as well as to stratospheric halogen changes following the phasing out of ozone depleting substances (ODS) in response to the Montreal Protocol and its Amendments. Many climate models predict a strengthening in the Brewer-Dobson circulation in a changing climate, which is expected to increase ozone transport into high latitudes, thus accelerating the ongoing ozone recovery as a result from decreasing halogen levels. However, observed total ozone trends (representative of lower stratosphere ozone) do not show statistically significant positive trends since 2000. Nevertheless, the trend change from the long-term decrease observed before is robust, thus confirming the success of the Montreal protocol.

From limb satellite observations during the last decade positive ozone trends in the upper stratosphere are observed and are indicative of ODS related ozone recovery. From climate model studies it appears that both changes in greenhouse gases and ODS have about equal contribution to the observed ozone changes in this altitude region. In contrast a continuous negative ozone trend is observed between 30 and 40 km altitude (middle stratosphere) in the tropics. In the lowermost tropical stratosphere ozone has leveled off, which, however, is related to changes in the tropical upwelling. Highlights from the current WMO ozone assessment released in January 2015 will be presented.

UP 2.2 Wed 9:30 G/gHS

Optisch arbeitender In-Situ Schwefeldioxidmonitor als Alternative zu elektrochemischen Sensoren — •Jan-Lukas Tirpitz, Adrian Herkert, Henning Finkenzeller, Nicole Bobrowski, Denis Pöhler und Ullrich Platt — Institut für Umweltphysik, Universität Heidelberg

In der Vulkanologie spielen In-Situ-Gasmessungen in der Vulkanfahne eine maßgebliche Rolle für die Untersuchung von Entgasungsprozessen, welche häufig Rückschlüsse auf die Aktivität oder die innere Struktur eines Vulkans erlauben. Für die Konzentrationsbestimmung von SO2 finden hierbei gewöhnlich vergleichsweise träge elektrochemische Verfahren Verwendung. Wir haben einen Schwefeldioxid-Sensor entwickelt, der stattdessen auf dem optischen Prinzip der nicht-dispersiven UV-Absorption basiert. Er benötigt keine Kalibrierung und besitzt bei gleicher Nachweisgrenze eine deutlich verbesserte Zeitauflösung. Vorgestellt werden das Messprinzip, der grundlegende Aufbau, sowie Zeitreihen erster Kampagnen und Vergleichsmessungen mit elektrochemischen Sensoren.

UP 2.3 Wed 9:45 G/gHS

Spatio-Temporal Variability of Water Vapor Investigated by LIDAR and FTIR vertical soundings above Mt. Zugspitze — •Hannes Vogelmann, Ralf Sussmann, Thomas Trickl, and Andreas Reichert — IMK-IFU, Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

We quantitatively analyzed the spatio-temporal variability (minutes to hours, 500 m to 10 km) of integrated water vapor (IWV) and water vapor profiles in the free troposphere above Mt. Zugspitze (Germany). Our data have been measured with a differential absorption lidar (DIAL, Schneefernerhaus, 2675 m) and a solar FTIR (summit, 2962 m). This investigation benefits from the arrangement of one zenith-viewing and one sun-pointing instrument 680 m away from each other and the temporal resolution of the instruments. Within a time interval of 20 min, the spatial variability of IWV becomes significant for horizontal distances above 2 km, but only during the warm season (0.35 mm). The temporal variability of IWV increases from 0.05 mm within 5 min to more than 0.5 mm within a time interval of 15 h. The vertical profile variability has a minimum at about 4.5 km a.s.l. and peaks in the tropopause region. We found that the long-range transport of heterogeneous air masses may cause short-term variations of the water-vapor density which exceed the impact of local convection by one order of magnitude, even near the ground. Our results demonstrate the importance of closely co-locating H_2O instruments for investigations together with other atmospheric sensors or for quantitative validation. Our findings could also be useful for model parametrization.

UP 2.4 Wed 10:00 G/gHS

Remote sensing of greenhouse gases from space and ground — •Andre Butz, Arne Babenhauserheide, Ramiro Checa-Garcia, Constanze Fischerkeller, Philipp Hahne, Frank Hase, Friedrich Klappenbach, Julian Kostinek, and Rasmus Raecke — IMK-ASF, Karlsruhe Institute of Technology, Germany

Man-made emissions of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4) are major drivers of climate change. Once the gases are released to the atmosphere, CO_2 and CH_4 concentrations are controlled by the biogeochemical processes of the carbon and methane cycles. Over the recent years, advances in instrument design and data reduction techniques have facilitated remote sensing of the atmospheric CO_2 and CH_4 abundances with the accuracy required to deduce information on the emission and uptake processes at the Earth's surface. The overall methodological approach relies on solar absorption spectroscopy in the shortwave-infrared spectral range. Our group develops and operates a radiative transfer algorithm that enables analysis of space-based solar backscatter soundings from satellites such as the Greenhouse Gases Observing Satellite (GOSAT) and the Orbiting Carbon Observatory (OCO-2). To validate our satellite retrievals, we deploy spectrometers on ground-based platforms such as the research vessel Polarstern. Here, we report on recent developments of the employed methodologies and validation exercises and demonstrate the usefulness of remote sensing greenhouse gas records for infering source/sink information.

UP 2.5 Wed 10:15 G/gHS

Wie stratosphärisch sind stratosphärische Intrusionen in die Troposphäre? — •Thomas Trickl[1], Hannes Vogelmann[1], Hans-Eckhart Scheel[1], Michael Sprenger[2] und Andreas Stohl[3] — [1]Karlsruher Institut für Technologie, IMK-IFU, Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen — [2]ETH Zürich, Schweiz — [3]NILU, Kjeller, Norwegen

Der langanhaltende Anstieg des Ozons auf der Zugspitze (2962 mm)

konnte auf eine Verdopplung des Ozoneintrags aus der Stratosphäre seit den Siebzigerjahren zurückgeführt werden. Ein stratosphärischer Anteil von mittlerweile etwa 40 % widerlegt die oft behauptete klare Dominanz der anthropogenen Komponente des Ozons. Um den stratosphärischen Beitrag zu quantifizieren, ist allerdings die Modifikation der Intrusionsschichten durch Durchmischen mit Troposphärenluft zu klären. Lidarmessungen von Ozon und Wasserdampf über viele Jahre hinweg zeigen nun, daß zwar das Ozon in stark abgesunkenen Intrusionen meist nur im Bereich zwischen 60 und 80 ppb liegt, aber die Feuchte zu einem hohen Prozentsatz Werte aufweist, wie sie direkt über der dynamischen Tropopause vorliegen. Selbst bei Absinkzeiten von bis zu zwei Wochen kommen solch extrem trockene Fälle vor. Mischvorgänge in der freien Troposphäre in Atmosphärenmodellen werden offenbar um grob eine Größenordnung überschätzt. Auch die CO-Messungen auf der Zugspitze stellen klar, daß Intrusionen offenbar nur aus der untersten Schicht der Stratosphäre austreten, in Einklang mit dem moderaten Ozon. Das Zugspitze-CO hat abgenommen. ist aber in Stratosphärenluft angestiegen, ein Hinweis auf einen asiatischen Beitrag.

Kaffeepause

UP 2.6 Wed 11:00 G/gHS

Towards a better tropospheric ozone product from SCIAMACHY Limb-Nadir-Matching method — •Jia Jia, Alexei Rozanov, Annette Ladstätter-Weissenmayer, Felix Ebojie, Stefan Bötel, and John Burrows — Institute of Environmental Physics, Bremen, Germany

Tropospheric ozone is one of the most important green-house gases with an estimated RF of 0.40 +- 0.20 W/m2 (IPCC, 2013). It is the main component of photochemical smog. As a strongly oxidizer, it influences human health as well as vegetation. Tropospheric ozone is either transported from the stratosphere or photochemically produced during the pollution events in the troposphere. Satellite measurements are well suitable to investigate sources, transport mechanisms of tropospheric ozone in a global view and to studyb characteristics in regional scale. However, the usage of satellite data is associated with challenges as 90% ozone is located in the stratosphere and only about 10% can be observed in the troposphere.

The limb-nadir matching (LNM) technique is one of the methods used to retrieve tropospheric ozone distributions from space borne observations. It is an approach that involves the subtraction of the stratospheric ozone column from the total ozone column by using tropopause height information. In our study this approach is applied with SCIAMACHY instrument which alternates between limb and nadir geometry. Here we focus on reducing the uncertainty of the tropospheric ozone by refining both limb retrievals and the matching technique. The results are validated with ozone sonde measurements.

UP 2.7 Wed 11:15 G/gHS

Retrieval of BrO at Tungurahua volcano and the NOVAC network — •Simon Warnach[1], Peter Lübcke[1], Nicole Bobrowski[1], Santiago Arellano[2], Bo Galle[2], Silvana Hidalgo[3], Leif Vogel[4], Florian Dinger[1], and Ulrich Platt[1] — [1]Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany — [2]Department of Earth and Space Sciences, Chalmers University of Technology, Gothenburg, Sweden — [3]Instituto Geofisico, Escuela Politecnica Nacional, Quito, Ecuador — [4]Earth Observation Science, Space Research Centre, University of Leicester, Leicester, UK

The composition of volcanic gas emissions, in particular the ratio of BrO/SO_2, can yield information about magmatic processes.

The evaluation of the long-term data collected at the 30 volcanoes monitored in the Network for Volcanic and Atmospheric Change (NOVAC) can help to obtain a better understanding of the BrO/SO_2 ratio and its correlation to magmatic processes. However, the evaluation for BrO proves difficult for volcanoes with low gas emissions.

In this work we introduce an improved BrO retrieval, which is able to measure BrO and determine the BrO/SO_2 ratio at volcanoes with low gas emissions. Using a high resolution, SO_2 free solar spectrum to identify the spectra influenced by volcanic gas, the BrO retrieval can be improved to gain a better signal-to-noise and a more precise BrO value.

The effects of our new retrieval technique will be demonstrated on data collected by NOVAC instruments at Tungurahua volcano, Ecuador, which is part of the NOVAC network since 2007.

UP 2.8 Wed 11:30 G/gHS

Bromine Chemistry in the Tropical UTLS during the NASA ATTREX Experiments — •Bodo Werner et al. — Institut für Umweltphysik, University of Heidelberg, Heidelberg, Germany

Bromine plays an important role for the chemistry of ozone in the stratosphere and upper troposphere. An accurate quantitative understanding of the sources, sinks, and chemical transformation of bromine species is thus important to understand the bromine budget in the upper troposphere and lower stratosphere (UTLS), which also serves as a gate to the stratosphere. Vertical transport of very short-lived organic bromine precursors and inorganic product gases has been identified as the main source of bromine in the UTLS. However, the contribution of inorganic vs. organic compounds is not well quantified, particularly in the tropical UTLS.

A limb scanning Differential Optical Absorption Spectroscopy instrument was deployed onboard NASA's unmanned high-altitude Global Hawk aircraft during the NASA Airborne Tropical TRopopause EXperiment (ATTREX) during a series of flights into the eastern and western Pacific tropopause layer up to 18 km. Observations of BrO, NO_2 and O_3 and of other trace species, in particular of brominated hydrocarbons, are compared with simulations of the SLIMCAT chemical transport model and interpreted with respect to photochemistry and the budget of bromine within the tropical tropopause layer (TTL).

UP 2.9 Wed 11:45 G/gHS

Langpfad-DOAS Messungen mit einer Laserbetriebenen Lichtquelle und verbesserter Modenmischung — •Philipp Eger, Denis Pöhler und Ulrich Platt — Institut für Umweltphysik, Universität Heidelberg, Im Neuenheimer Feld 229, D-69120 Heidelberg, Deutschland

Differentielle Optische Absorptionsspektroskopie (DOAS) ist eine weit verbreitete Methode, um Spurenstoffe mit geringen atmosphärischen Mischungsverhältnissen nachzuweisen. Bei aktiven Langpfad (LP-DOAS) Messungen können die mittleren Konzentrationen verschiedener Spurengase entlang eines definierten Lichtwegs mit Hilfe des Lambert-Beerschen Gesetzes simultan bestimmt werden. Die Qualität von LP-DOAS Messungen hängt von der Wahl der Lichtquelle und einer passenden Faserkombination ab. In dieser Präsentation werden die Vorteile einer Laserbetriebenen Lichtquelle (LDLS) gegenüber konventionellen Xenon-Hochdrucklampen und LEDs vorgestellt und die Eignung für LP-DOAS anhand von atmosphärischen Messungen in Heidelberg diskutiert. Aufgrund des kleinen stabilen Brennflecks konnte eine neue Faserkombination gewählt werden, die die Lichttransmission des Gesamtsystems maximiert. Mittels einer neu entwickelten Methode zur Mischung der Lichtmoden gelang es, das Residuum im UV-Bereich auf unter $5 \cdot 10^{-5}$ rms zu reduzieren und damit die Nachweisgrenzen verschiedener Spurenstoffe im Vergleich zu früheren Messungen um einen Faktor 4 zu senken. Besonders die erwartete Verbesserung bei zukünftigen Feldmessungen von BrO, ClO und IO stellt neue Erkenntnisse im Bereich der Halogenchemie in Aussicht.

UP 2.10 Wed 12:00 G/gHS

Space-based observations of CO_2: From SCIAMACHY to CarbonSat — •M. Reuter, M. Buchwitz, M. Hilker, J. Heymann, O. Schneising, D. Pillai, H. Bovensmann, and J.P. Burrows — Institute of Environmental Physics, University of Bremen, Germany

CO_2 and CH_4 are the most important anthropogenic greenhouse gases. Their global increasing concentrations in the Earth's atmosphere are the main driver for global warming. However, there are still large uncertainties on their sources and sinks. SCIAMACHY (2002-2012) was the first near infrared satellite instrument which allowed measurements of the dry-air column-average mole fraction of both gases (XCO_2, XCH_4). GOSAT was launched in 2009 and provides measurements of XCO_2 and XCH_4 since then. With their relatively large pixel size and sampling distance, these instruments primarily focus on natural fluxes. In this context, we will present recent findings on the European carbon sink. Analyzing five SCIAMACHY and GOSAT XCO_2 data sets, we find that the satellite-derived European sink is considerably larger (1.0 ± 0.3GtC/a) than previously estimated (0.4 ± 0.4GtC/a). Additionally, we will present results of a study related to anthropogenic emission trends derived from SCIAMACHY XCO_2 and NO_2 data. We find a positive trend of the CO_2-to-NO_x emission ratio in East Asia which confirms that the newly installed and renewed technology is cleaner in terms of NO_x emissions. In the future, CarbonSat (an ESA EE8 candidate mission) will allow flux estimates at higher spatial resolution because its imaging capabilities are optimized for hot spot monitoring.

UP 2.11 Wed 12:15 G/gHS

Charakterisierung und Vergleich von photoakustischer und Cavity-Ring-Down Spektroskopie zur Überwachung von Ammoniakkonzentrationen im Spurengasbereich — •Nils Lüttschwager[1], Andrea Pogány[1], Anne Rausch[1], Olav Werhahn[1] und Volker Ebert[1,2] — [1]Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig — [2]TU Darmstadt, Center of Smart Interfaces, Petersenstraße 17, 64287 Darmstadt

Zwei Verfahren zur Messung der atmosphärischen Ammoniakkonzentration basierend auf der Cavity-Ring-Down-Spektroskopie (CRDS) und der photoakustischen Spektroskopie (PAS) wurden vor dem Hintergrund möglicher umweltwissenschaftlicher oder industrieller Feldanwendungen hinsichtlich ihrer metrologischen Eigenschaften untersucht und verglichen. Die eingesetzten Spektrometer detektieren Ammoniak-Absorptionslinien im Nahinfrarotbereich, bei dem die Überlagerung mit Kohlendioxid- und Wasserlinien berücksichtigt werden muss. Zusätzlich ist die ausgeprägte Adsorption von Ammoniak an Oberflächen beim Samplingprozess, insbesondere bei geringen Konzentrationen, eine besondere Herausforderung und verlangsamt die Systemreaktionszeit. In diesem Beitrag analysieren und vergleichen wir Selektivität, Nachweisgrenzen und Reaktionszeiten der beiden Instrumente, deren Reproduzierbarkeit als auch die Unsicherheiten der jeweiligen Messergebnisse.

Diese Arbeit wurde im Rahmen des Forschungsprogramms EMRP durchgeführt. Das EMRP wird finanziert durch die teilnehmenden Staaten innerhalb EURAMET e.V. und der EU.

UP 2.12 Wed 12:30 G/gHS

Retrieval of atmospheric methane from mid-infrared FTIR spectrometry optimized for profile information content and minimal cross-sensitivity to water vapor — •Petra Hausmann and Ralf Sussmann — Karlsruhe Institute of Technology, IMK-IFU, Garmisch-Partenkirchen, Germany

Mid-infrared ground-based solar FTIR measurements performed within the Network for the Detection of Atmospheric Composition Change (NDACC) contain information on total columns which can be used for source-sink inversions or satellite validation. Additionally, mid-infrared FTIR is one of the few ground-based techniques containing information on the CH_4 vertical profile. Previous retrievals were optimized for high-accuracy columns and eliminating water vapor interference (Sussmann et al., 2011), or for separating the tropospheric partial column (Sepulveda et al., 2014). The goal of our present study is to combine the benefits of these approaches in order to attain maximum profile information and simultaneously minimize cross-sensitivity to water vapor. We apply a 3-block first-order Tikhonov regularization to make best possible use of the profile information contained in the spectra and separate a tropospheric and stratospheric column. We analyze almost 20 years of FTIR measurements at Zugspitze (47° N, 2964 m a.s.l.) with our new retrieval and provide time series of CH_4 partial columns, profiles, and multi-annual seasonal cycles. Our results may be used to quantify trends of stratospheric methane oxidation and corresponding production of water vapor in the highly climate-sensitive region of the lower stratosphere.

Mittagspause

UP 2.13 Wed 13:45 G/gHS

A model study of the plasma chemistry of stratospheric Blue Jets — •Holger Winkler and Justus Notholt — Institut für Umweltphysik, Universität Bremen

Stratospheric Blue Jets (BJs) are upward propagating discharges in the altitude range 15–40 km above thunderstorms. They appear as conical bodies of blue light originating at the top of thunderclouds and proceed upward with velocities of the order of 100 km/s. BJs consist of an upward propagating leader which emits a fan of streamers.

Electric discharges in the atmosphere are known to have chemical effects. Reactive nitrogen and oxygen species are produced which initiate rapid ion-neutral reactions. Of particular interest from the atmospheric chemistry point of view is the formation of ozone, and the production of ozone depleting nitrogen radicals.

We have used a numerical plasma chemistry model in order to simulate the chemical processes in stratospheric BJs. It was applied to BJ streamers in the altitude range 18-38 km. Additionally, the chemical processes in the leader part of a BJ have been simulated for the first time. The model results indicate that there is considerable impact on nitrogen species and ozone. The chemical effects of the streamers predicted by our model are by orders of magnitude larger than in previous model studies. In the leader channel, driven by high-temperature reactions, the concentration of N_2O and NO increases by several orders of magnitude, and there is a significant depletion of ozone.

UP 2.14 Wed 14:00 G/gHS

Retrieval of metal atom and ion number densities in the mesosphere and lower thermosphere from SCIAMACHY/Envisat limb MLT measurements — •Martin Langowski[1,4], Christian von Savigny[1], Miriam Sinnhuber[2], Art C. Aikin[3], and John P. Burrows[4] — [1]EMAU Greifswald — [2]KIT-IMK-ASF, Karlsruhe — [3]CUA Washington D.C. — [4]IUP Uni Bremen

Most meteoroids entering the earth atmosphere ablate in between 80 and 120 km altitude. This leads to an injection of metals into this altitude region and finally to a formation of metal atom and ion layers.

The metal atoms and ions show very strong resonance fluorescence signals, which, e.g., can be detected with the SCIAMACHY grating spectrometer on Envisat. This emission is used to retrieve the densities of these species, and global densities retrieved on an altitude and latitude grid for Mg,Mg^+ and Na are obtained so far.

We will present these result and will discuss the vertical, seasonal and latitudinal variations as well as the involved physical and chemical processes.

UP 2.15 Wed 14:15 G/gHS

Lunar semi-diurnal tidal signatures in noctilucent clouds — •Christian von Savigny[1] and Matthew DeLand[2] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Germany — [2]Science Systems and Applications, Inc., Lanham, MD, U.S.A.

Noctilucent clouds (NLCs) are optically thin water ice clouds occurring near the polar summer mesopause in the summer hemisphere. NLCs are a highly variable phenomenon subject to different sources of variability including planetary and gravity waves, solar variability and long-term changes of the middle atmosphere climate. In this contribution we report on another process affecting NLCs, i.e. the lunar semi-diurnal gravitational tide. While lunar ocean tides are a well known phenomenon, many aspects of lunar tidal signatures in the atmosphere are uncertain. To our best knowledge our results are the first robust identification of the lunar semi-diurnal tide in NLCs. Earlier studies on lunar semi-diurnal tidal signatures in NLCs reported unrealistically large amplitudes in NLC parameters or showed periods inconsistent with the lunar tide. In our study the lunar tidal signature is extracted from satellite observations of NLCs with the SBUV instruments using the superposed epoch analysis technique.

UP 2.16 Wed 14:30 G/gHS

A semi-empirical approach to derive parameters of charged aerosols from EISCAT dual frequency PMSE observations — •Irina Strelnikova[1], Martin Friedrich[2], Markus Rapp[3], Jorge L. Chau[1], and Boris Strelnikov[1] — [1]Leibniz-Institute of Atmospheric Physics, 18225 Kühlungsborn, Germany — [2]Graz University of Technology, Graz, Austria — [3]German Aerospace Center Institute of Atmospheric Physics, Oberpfaffenhofen, Germany

The existence of ice crystals in the high latitude summer mesopause region is today well established. From optical observations the mean ice mass and the variability of the clouds of these ice crystals can be obtained. Unfortunately "subvisible" ice crystals fractions cannot be observed by optical means. Since these ice crystals are embedded in a plasma, they are involved in the charge balance of the D-region, i.e., they can attach ions and electrons and/or they can lose electrons due to photo detachment and photoemission. Until recently only in-situ observations by rockets have been used for observing the charged components of the plasma. Some attempts have been made to derive size or number density of charged ice crystals from radar observations of polar mesosphere summer echoes (PMSE). In this work we apply recent theories to simultaneously obtain dust size, and number the number densities of dust and electrons from PMSE. These theories are applied to EISCAT VHF and UHF radar observations and are complemented by electron densities from the empirical IMAZ model. The analysis demonstrates that the obtained results are in reasonable quantitative agreement with other observations and theoretical expectations.

UP 2.17 Wed 14:45 G/gHS

Sources of ultrafine particles over Germany, an airborne survey — •Wolfgang Junkermann — KIT, IMK-IFU, Garmisch-Partenkirchen, Germany

Ultrafine particles in the planetary boundary layer were considered to be climate and health relevant. The climate effect is based on their ability to act as cloud condensation nuclei with an impact on cloud microphysics and rainfall distribution, their health effect is due to the high mobility and deep penetration into the lungs where chemical components bound to the aerosols can be deposited. Although a network for monitoring of ultrafine particles (GUAN) now exists for several years in Germany the knowledge about sources and distribution in the planetary boundary layer is still limited. Airborne measurements were performed using small aircraft flying low and slow to characterize ultrafine particle number concentrations all over Germany from the Bavarian Alps towards the Northern Sea, to identify the major sources and to estimate their source strength and contribution to the overall ultrafine particle budget. Dominating single sources identified were all related to burning and processing of sulphur containing fossil fuel, highlighting the role of sulphur compounds for the generation of ultrafine particulate matter.

UP 2.18 Wed 15:00 G/gHS

Airborne differential absorption and high spectral resolution lidar measurements for aerosol and cirrus cloud studies — •Silke Gross, Martin Wirth, Andreas Schäfler, and Andreas Fix — Deutsches Zentrum für Luft- und Raumfahrt, Insitut für Physik der Atmosphäre, Oberpfaffenhofen

Airborne lidar measurements were performed with the WALES system of the German Aerospace Center (DLR), Oberpfaffenhofen, which comprises high spectral resolution lidar (HSRL) and water vapour differential absorption lidar (DIAL) capability to measure the 2-dimensional distribution of aerosols and humidity along the flight track. The system was operated onboard the German long range and high altitude research aircraft HALO. During three flight campaigns, the Technomission in October/November 2010, the NARVAL mission in December 2013 and January 2014, and the ML-Cirrus campaign in March/April 2014, more than 200 flight hours were performed over Central Europe, the Tropical North Atlantic and the Extra-tropical North Atlantic region.

In our presentation we will give a general overview of the campaigns and the WALES measurements, and we will show first results of the lidar measurements with focus on cirrus cloud structure and humidity distribution within and outside the cirrus cloud.

Kaffeepause

UP 2.19 Wed 15:45 G/gHS

In situ characterization of small cloud ice particles in mixed phase clouds — •Paul Vochezer, Martin Schnaiter, and Thomas Leisner — IMK, Karlsruhe Institute of Technology, Karlsruhe, Germany

Mixed phase clouds contain liquid droplets as well as ice particles and are a common cloud type in mid-latitudes. The occurrence of ice particles in mixed phase clouds is of importance for their dynamics, lifetime and radiative properties. In order to characterize mixed phase clouds we use the small ice detector (SID) cloud probe in which a light scattering experiment with individual cloud particles is carried out. A careful analysis of the light scattered in 5° - 26° relative to the forward direction allows for a detailed characterization of liquid water droplets and ice particles. In case of a liquid droplet a Mie solution is fitted to the measured profile which allows for a precise size determination and calibration of the instrument. In case of an ice particle a shape factor and a roughness parameter are determined for each individual particle. We present results of measurements on artificial and natural mixed phase clouds. Artificial clouds were generated under well-defined laboratory conditions at the AIDA cloud chamber facility of the Karlsruhe Institute of Technology. The measurements on natural mixed phase clouds were conducted at the High Alpine Research Station Jungfraujoch as well as on board of research aircrafts in the Canadian arctic over the Beaufort Sea.

UP 2.20 Wed 16:00 G/gHS

Deposition nucleation and growth of polar and non-polar gases on small nanoparticles in a linear ion trap — •Denis Duft[1], Mario Nachbar[1,2], and Thomas Leisner[1,2] — [1]Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Germany — [2]University of Heidelberg, Institute of Environmental Physics, Germany

In the higher atmospheres of planets re-condensed particles formed from evaporated meteoric material can act as heterogeneous nuclei for the condensation of gaseous species. These sub-2nm meteoric smoke particles (MSP) are believed to be the precursors for polar mesospheric water ice clouds on Earth as well as for mesospheric carbon dioxide clouds on Mars. However, microphysical understanding of nucleation and growth processes on such nanoscale systems is scarce. To improve our understanding we devised an experiment where meteor smoke analogue particles are stored in a linear ion trap under well-defined supersaturated mesospheric conditions. Nucleation and growth on the nanoparticles are measured as a change in mass with a time-of-flight mass spectrometer. In this contribution we present results of deposition nucleation and growth of polar water vapor on nanoparticles in comparison to measurements of nonpolar carbon dioxide. We show how molecular dipole-moment and different thermal conditions for both gases influence the nucleation and growth behavior. Furthermore the versatility of the experiment allows us to derive sticking coefficients, desorption energies, contact parameters as well as critical supersaturations for nucleation.

UP 2.21 Wed 16:15 G/gHS

FTIR based measurements of the self-broadening and shift coefficients of the first overtone band of HCl — •Gang Li[1], Anton Serdyukov[1], Olav Werhahn[1], and Volker Ebert[1,2] — [1]Physikalisch-Technische Bundesanstalt, Bundesallee 100, 38116 Braunschweig, Germany — [2]Center of Smart Interfaces, TU Darmstadt,Petersenstrsße 32, Darmstadt 64287, Germany

FTIR spectra of the 2-0 band of HCl molecule have been measured in the 5300-5900 cm-1 spectral region at 15 different pressures (0.05 - 2.5 bar) and a spectral resolution of 0.07 cm-1. For the first time, reliable self-induced broadening and shift coefficients for the complete HCl 2-0 band have been reported. Line intensities determined from a robust regression analysis with improved uncertainties are also presented. Compared to our previous laser-based measurement for the R3 line {Ortwein et al., Applied Physics B: Lasers & Optics, 100:341-7 (2010)}, our newly measured $\gamma_$self coefficient and line intensity are 1.35% and 0.24% larger, respectively. Furthermore, a test on the Hartmann & Boulet theory {Hartmann & Boulet, JCP 133, 9000 (2000)} on the self-induced shifts suggest a breakdown of the theory in the HCl-HCl collisional system.

UP 2.22 Wed 16:30 G/gHS

Competition between contact and immersion freezing of supercooled water droplets induced by biological particles — •Nadine Hoffmann, Michael Koch, Denis Duft, Alexei Kiselev, and Thomas Leisner — IMK-AAF, Karlsruhe Institute of Technology

The contact freezing of supercooled cloud droplets is one of the potentially important and the least investigated heterogeneous mechanism of ice formation in tropospheric clouds [1]. To investigate this freezing mode we use an Electrodynamic Balance to levitate single water droplets in a laminar flow containing aerosol particles [2].

The particles can act as contact or immersion heterogeneous ice nuclei. By repeating the freezing experiment for a sufficient number of times we were able to reproduce the statistical freezing behavior of large ensembles of supercooled droplets. The resulting freezing curves have a special shape depending on the rates of contact and immersion freezing events. To demonstrate the relative importance of contact and immersion freezing modes on the shape of the resulting freezing curve, the results obtained with Birch Pollen Washing Water (BPWW) particles will be discussed in detail.

[1] - Ladino Moreno, L. A., Stetzer, O., and Lohmann, U.: Contact freezing: a review of experimental studies, Atmos. Chem. Phys., 13, 9745-9769, doi:10.5194/acp-13-9745-2013, 2013. [2] - Hoffmann, N., Kiselev, A., Rzesanke, D., Duft, D., and Leisner, T.: Experimental quantification of contact freezing in an electrodynamic balance, Atmos. Meas. Tech., 6, 2373-2382, doi:10.5194/amt-6-2373-2013, 2013.

UP 3: Meßtechnik

Time: Wednesday 16:45–19:15 Location: G/gHS

Invited Talk UP 3.1 Wed 16:45 G/gHS

Einsatz kleiner unbemannter Forschungsflugzeuge (UAV) in der Atmosphärenphysik — •Jens Bange — Universität Tübingen, Zentrum für Angewandte Geowissenschaften

Unbemannte und automatisch operierende Kleinflugzeuge (UAV) sind vergleichsweise neue Instrumente der Atmosphärenforschung. Entsprechend ausgelegt, mit schneller und genauer Sensorik ausgestattet ermöglichen sie die Messung der turbulenten Strukturen und Flüsse in der atmosphärischen Grenzschicht. Übliche Messgeräte sind meist zu groß, schwer und verbrauchsintensiv. Daher muss die wissenschaftliche Nutzlast aus erwerblichen Systemen angepasst oder neu entwickelt werden. Da UAV aber eine interessante und kostenreduzierte Alternative zu bemannten Flugzeugen darstellen, wird auf diesem Gebiet seit etwa 10 Jahren intensiv entwickelt.

Kleine Forschungs-UAV werden mittlerweile in vielen meteorologischen Feldexperimenten eingesetzt. Diese Instrumente bieten ähnliche Anwendungsprofile und Datenqualität wie kleine bemannte Forschungsflugzeuge - insbesondere hinsichtlich den thermodynamischen Grundgrößen und der Turbulenzmessung - bei sehr geringen Einsatzkosten.

Der Vortrag gibt einen Überblick über die wissenschaftlichen Anforderungen und technischen Spezifikationen solcher UAV. Verschiedene Messtechnik wird vorgestellt und Ergebnisse einiger Messkampagnen werden erläutert. Im Ausblick werden Projekte der nahen Zukunft skizziert. Insbesondere die Anwendung von UAV in der Windenergieforschung wird erörtert.

Kaffeepause

UP 3.2 Wed 17:45 G/gHS

BrO/SO_2 emission ratios from four "NOVAC" volcanoes — •F. Dinger[1], P. Lübcke[1], S. Warnach[1], N. Bobrowski[1], L. Vogel[1,7], U. Platt[1], T. Wagner[2], S. Arellano[3], B. Galle[3], G. Garzon[4], S. Hildago[5], and M. Yalire[6] — [1]IUP, University of Heidelberg, Germany — [2]MPIC, Mainz, Germany — [3]Chalmers University of Technology, Gothenburg, Sweden — [4]SGC, Cali, Colombia — [5]IGEPN, Quito, Ecuador — [6]OVG, D.R. Congo — [7]now at University of Leicester, UK

Volcanic gas emissions often correlate with changes in the volcanic system. The total amount and the chemical composition of gas emissions help to understand the volcanic system and thus allow to improve forecasts of volcanic activity. BrO/SO_2 ratios can be obtained by remote-sensing Differential Optical Absorption Spectroscopy (DOAS). The Network for Observation of Volcanic and Atmospheric Change (NOVAC) has installed 80 scanning DOAS instruments at 30 volcanoes world wide. The instruments monitor volcanic emissions by measuring scattered solar radiation. SO_2 emissions are continuously monitored and transmitted to the observatories. While the retrieval of volcanic SO_2 emissions from NOVAC data is well developed, the retrieval of volcanic halogen emissions is more challenging due to the lower amount and therefore lower optical densities. This work will focus on an overview of the currently evaluated data, discuss the results, and investigate the BrO/SO_2 ratio in volcanic emissions as a potential proxy for the magma depth. We will show examples from Nyiragongo (Congo), Tungurahua (Ecuador), Nevado del Ruiz and Galeras (Colombia).

UP 3.3 Wed 18:00 G/gHS

A Fabry-Perot interferometer-based Camera for SO_2 detection — •Jonas Kuhn[1], Nicole Bobrowski[1], Peter Lübcke[1], Denis Pöhler[1], Jan-Lukas Tirpitz[1], Leif Vogel[2], and Ulrich Platt[1] — [1]Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany — [2]Earth Observation Science, Space Research Centre, University of Leicester, Leicester, UK

The SO_2 camera is becoming an established tool for measuring two-dimensional SO_2 column density distributions at volcanoes with a high temporal resolution. Transport and dilution processes are visualized and SO_2 emission fluxes can be determined on a very short timescale. However, these major advantages go together with a simplified identification principle that is far less accurate than conventional remote sensing trace gas measurements with only one viewing direction. By using a Fabry-Perot interferometer in a new camera design, the SO_2 selectivity and sensitivity can be improved substantially. We present first laboratory measurements of a one pixel prototype of a Fabry-Perot interferometer-based SO_2 camera. In addition, different possible implementations of an imaging device are proposed.

UP 3.4 Wed 18:15 G/gHS

Scanning lidar measurements of water vapor and temperature in the atmospheric boundary layer — •Florian Späth, Eva Hammann, Shravan Kumar Muppa, Simon Metzendorf, Andrea Riede, Andreas Behrendt, and Volker Wulfmeyer — University of Hohenheim, Institute of Physics and Meteorology, Garbenstr. 30, 70599 Stuttgart, Germany

The University of Hohenheim has developed and operates two unique high-resolution scanning lidar systems. One system uses the differential absorption lidar (DIAL) technique to determine atmospheric water vapor content. The other system is a rotational Raman lidar (RRL) with the focus of measuring temperature. These two systems were employed within the surface-atmosphere-boundary-layer exchange (SABLE) field campaign near Pforzheim (southwest Germany) in summer 2014. The goal of the campaign was to collect a new data set on the exchange processes of the surface and the vegetation with the boundary layer. For this, synchronized scanning measurements of the water vapor DIAL and the temperature RRL were performed for the first time. Additional vertical measurements were performed to analyze the entrainment processes between boundary layer and free troposphere.

The new set-ups of the two Hohenheim lidars and first results of lidar measurements during the SABLE campaign will be presented at the conference.

UP 3.5 Wed 18:30 G/gHS

D/H Isotope Ratio Measurements of Atmospheric Volatile Organic Compounds — •Thomas Meisehen, Fred Bühler, Ralf Koppmann, and Marc Krebsbach — Institute for Atmospheric and Environmental Research, University of Wuppertal

Analysis of isotope ratios in volatile organic compounds (VOC) is a reliable method to allocate their sources, to estimate atmospheric residence times and investigate physical and chemical processes on various temporal and spatial scales. Most investigations yet focus on carbon isotope ratios. However, more detailed information can be gained by the ratio of deuterium (D) to hydrogen (H) in VOC, especially due to the high mass ratio.

We thoroughly set up and characterized a gas chromatograph pyrolysis isotope ratio mass spectrometer to measure the D/H ratios in atmospheric VOC. From about 200 L of air VOC were absorbed on Tenax®TA to remove atmospheric CO_2. Our results show that the pyrolysis method has a significant impact on the D/H ratios. A pyrolysis temperature of at least 1723 K and conditioning of the ceramic tube on a regular basis is essential to obtain reproducible D/H isotope ratios. D/H ratios of the pure VOC used for a custom made gas standard mixture were determined independently by elemental analysis. Comparison of the results shows a good agreement. We further demonstrate the stability of our system and show that the sample preparation does not affect the isotope ratios. Combining measurements of carbon and hydrogen isotopes could lead to considerable improvement in our understanding of atmospheric processes in the future.

UP 3.6 Wed 18:45 G/gHS

A Compact Longpath DOAS — •Nikolai Riedel, Denis Poehler, Stefan Schmitt, and Ulrich Platt — Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany

Longpath DOAS systems are well established and used in high sensitive measurements of trace gases in the atmosphere. Using active light sources trace gases can be measured independent of the sun. In the past these systems were dependent on electrical infrastructure and regular adjustment by experienced operators and thus had only a limited application. Based on an earlier prototype we developed a mobile *Longpath DOAS* instrument, which can perform autonomous measurements. The instrument is a low power system using different LED's (315, 340 and 450 nm central wavelength) as light sources. Trace gases such as pollutants like NO_2, O_3, SO_2, $HCHO$ and $HONO$ can be measured as well as the halogen compounds ClO, BrO and IO. We

present the developed system and first example measurements.

UP 3.7 Wed 19:00 G/gHS

Ground based in-situ measurements of snow fall with a 2D-Video Disdrometer on Mt. Zugspitze, Germany — •Felix Bernauer[1], Martin Schwinzerl[2], Kerstin Hürkamp[1], Werner Rühm[1] und Jochen Tschiersch[1] — [1]Institute of Radiation Protection, Helmholtz Zentrum Muenchen, 85764 Neuherberg, Germany — [2]Joanneum Research, 8010 Graz Austria

The measurement of micro physical properties of snow fall is a challenging task that is essential in many areas of research e. g. wet deposition of atmospheric pollution. In this contribution we analyze the suitability of a 2D-video-disdrometer (2DVD by Joanneum Research) to measure shape parameters of solid precipitation and present a simple and reproducible method for precipitation event classification with a focus on solid type precipitation. For our study we installed the 2DVD at a high alpine site in southern Germany (the Environmental Research Station Schneefernerhaus (UFS) on Mt. Zugspitze, 2650m a.s.l.). A very important prerequisite for our results is to introduce a new matching algorithm suitable for solid and mixed phase hydrometeors which allows classification without artifacts. An experiment with steel spheres in a size range from 0.5mm to 10.0mm showed that simple geometries can be represented very well with shape parameters measured with the 2DVD. Analysis of 40 snow fall events and comparison with man made observations showed that solid type precipitation can be reliably differentiated in three classes of dominating hydrometeor types and three classes of riming. Addidionaly liquid and mixed phase precipitation can be classified.

UP 4: Postersession Atmosphäre

Time: Wednesday 10:45–19:45 Location: G/Foyer

UP 4.1 Wed 10:45 G/Foyer

Tropical tropospheric ozone from satellite observations with the Convective Clouds Differential technique — •Elpida Leventidou, Kai-Uwe Eichmann, Mark Weber, and John Burrows — Institute of Environmental Physics, Bremen, Germany

Ozone influences most of the chemical reactions in the Troposphere. Its tropospheric abundance can be retrieved using space-borne observations of vertically integrated ozone and cloud heights. The Convective Clouds Differential (CCD) technique takes advantage of the frequent occurrence of convective clouds in the western Pacific region by subtracting above-cloud ozone of this region from clear-sky ozone elsewhere to derive global monthly mean tropospheric amount. An important assumption is that the above-cloud ozone in the western Pacific simulates the stratospheric ozone and that the stratospheric ozone field is invariant with longitude; which is approximately true in the tropics. A CCD algorithm has been developed and is applied to optical remote sensing observations from three satellite instruments, so that a unique long-term record of monthly averaged tropical (20S, 20N) tropospheric vertically integrated ozone (1995-2012) is created. First results of the CCD technique, including validation by comparisons with ozone data from ozonesondes, will be presented.

UP 4.2 Wed 10:45 G/Foyer

Reactive chlorine chemistry in the boundary layer of coastal Antarctica — •Johannes Zielcke[1], Denis Pöhler[1], Tim Hay[2], Udo Friess[1], Philipp Eger[1], Karin Kreher[2,3], and Ulrich Platt[1] — [1]Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany — [2]formerly: National Institute for Water and Atmospheric Research, Lauder, New Zealand — [3]Bodeker Scientific, Alexandra, New Zealand

A unique feature of the polar troposphere is the strong impact of halogen photochemistry, in which reactive halogen species are responsible for ozone depletion as well as the oxidation of elemental mercury and dimethyl sulphide. The source, however, as well as release and recycling mechanisms of these halogen species - for some species even abundances - are far from being completely known, especially of chlorine and iodine compounds. Here we present active long-path differential optical absorption spectroscopy (LP-DOAS) measurements conducted during austral spring 2012 at Ross Island, Antarctica, observing several species (BrO, O3, NO2, IO, ClO, OBrO, OClO, OIO, I2, CHOCHO, HCHO, HONO). For the first time, ClO was detected and quantified in the marine boundary layer of coastal Antarctica, with typical mixing ratios around 20 pptv and maxima around 50 pptv. Meteorological controls on the mixing ratio of ClO as well as the interplay with other halogen compounds will be discussed, such as the lack of observed OClO ($<$ 1 pptv). The results seem to reflect previously in chamber studies observed dependences on ozone levels and solar irradiance.

UP 4.3 Wed 10:45 G/Foyer

Characterizing variability in OH * emission altitudes during the last solar cycle retrieved from SCIAMACHY nightglow observations — •Georg Teiser[1], Christian von Savigny[1], and Holger Winkler[2] — [1]Institute of Physics, Ernst-Moritz-Arndt-Universität Greifswald, Felix-Hausdorff-Str. 6, 17489 Greifswald — [2]Institute of Environmental Physics, University of Bremen, Otto-Hahn-Allee 1, 28359 Bremen

Hydroxyl nightglow observations are a fundamental tool to study the mesosphere. In particular the knowledge of the spatial and temporal variability of the OH* nightglow emission altitude is of importance for the interpretation of ground-based OH temperature measurements. In this context the OH* nightglow data set from SCIAMACHY (Scanning Imaging Absorption spectrometer for Atmospheric CHartographY) on Envisat (from August 2002 to December 2012) is analyzed for 11-year solar cycle signatures and short-term variability, e.g. solar-driven 27-day cycle and QBO (Quasi-Biennial Oscillation) signatures in vertical volume emission rate profiles and mean emission altitude of the OH(3*1) Meinel emission near the mesopause. Additionally, first results of investigation of the effect of SPEs (solar proton events) on the OH Meinel emission altitude and the comparison with simulations using the UBIC (University of Bremen Ion Chemistry) model are presented.

UP 4.4 Wed 10:45 G/Foyer

Aircraft-borne DOAS limb observations of UV/visible absorbing trace gas species over Borneo — •Katja Grossmann[1], Marcel Dorf[2], Bodo Werner[1], and Klaus Pfeilsticker[1] — [1]Institute of Environmental Physics, Heidelberg, Germany — [2]Max Planck Institute for Chemistry, Mainz, Germany

Airborne spectroscopic measurements were carried out aboard the research aircraft DLR-Falcon during the SHIVA campaign at Malaysian Borneo in November and December 2011 to study the abundance and transport of trace gases in the lower atmosphere. The measurements were evaluated using the DOAS technique in limb geometry, which supports observations of UV/visible absorbing trace gases. Vertical profiles of IO were inferred with maximum mixing ratios of 0.5-1.5 ppt close to its source region in the marine boundary layer. Enhanced IO concentrations occasionally occurred in the mid-troposphere, suggesting rapid vertical transport by shallow to medium strong convection. BrO did not exceed the detection limit since in the terrestrial tropical atmosphere around Borneo the chemistry of volatile organic compounds (VOCs) acts as a large sink for reactive bromine species. Frequently enhanced concentrations of HCHO and CHOCHO indicate efficient VOC photochemistry around Borneo since they are mainly produced through the oxidation of VOCs emitted from the tropical rain forest and from distinct anthropogenic sources. Signatures of HONO, HCHO, and NO_2 in the outflow of convective clouds suggest a rapid transport of HCHO and NO_2 from polluted near surface air into the upper troposphere as well as lightning-induced production of HONO and NO_x.

UP 4.5 Wed 10:45 G/Foyer

Spectroscopic measurements in the tropical tropopause layer from aboard the NASA Global Hawk — J. Stutz[1], M. Spolaor[1], J. Festa[1], F. Colosimo[1], B. Werner[2], R. Raecke[1,2], •L. Scalone[2], K. Pfeilsticker[2], M. Chipperfield[3], and R. Hossaini[3] — [1]Department of Atmospheric and Oceanic Science, UCLA, Los Angeles, USA — [2]IUP, University of Heidelberg, Heidelberg, Germany — [3]Institute for Climate and Atmospheric Science, SEE, University of Leeds, Leeds, UK

The Nasa initiated ATTREX (Airborne Tropical TRopopause EXper-

iment) project aims to answer relevant scientific questions such as the photochemistry, the micro-physics of aerosols and cloud particles, and air mass transport into and within the tropical tropopause layer (TTL). Within the ATTREX project, DOAS measurements were performed, using a 3 channel (UV/vis/near-IR) optical spectrometer. The DOAS measurements aim to measure the vertical profiles of Ozone relevant species in the TTL, such as O3, NO2, O4, BrO, IO and H2O, the liquid and ice water paths as well as some micro-physical properties of aerosols and clouds. Here an overview of the data is presented which were collected during the two field campaigns led from Edwards Air Force Base (EAFB) and Guam into the Eastern and Western Pacific. In particular we focus on the BrO and IO spectral retrieval which are interpreted using the radiative transfer model McArtim and predictions based on the photochemical fields simulated by SLIMCAT model. From the data new insights will be obtained into the photochemistry of halogen oxides in the TTL.

UP 4.6 Wed 10:45 G/Foyer

MAX-DOAS observation of CHOCHO, HCHO and NO2 over Nairobi and Athens — •Leonardo Alvarado[1], Andreas Richter[1], Enno Peters[1], Folkard Wittrock[1], John P. Burrows[1], Mihalis Vrekoussis[2], Myrto Gratsea[3], and Evangelos Gerasopoulos[3] — [1]Institute of Environmental Physics, University of Bremen, Bremen, Germany — [2]Energy, Environment and Water Research Center, The Cyprus Institute, Nicosia, Cyprus — [3]Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Athens, Greece

Glyoxal (CHOCHO) and formaldehyde (HCHO) are intermediate products in the oxidation of most volatile organic compounds (VOCs) in the atmosphere. They therefore can be used as tracers of VOC concentrations in the atmosphere.

Nitrogen dioxide (NO2) plays an important role in tropospheric ozone formation in combination with VOCs, and is mainly emitted by anthropogenic activities. While sources and chemistry of CHOCHO and HCHO are similar in many respects, the variation in production efficiency for different sources can be used to better constrain source attribution of VOCs.

In this study, we report time series of CHOCHO, HCHO, and NO2 vertical columns from MAX-DOAS measurements taken in Nairobi (2011-2013) and Athens (2013-2014), which are part of the BREDON network. The results show maxima for Jun-Jul-Aug and minima for Dec-Jan-Feb. Moreover, a significant increase of CHOCHO levels in Nairobi is observed for 2013 in comparison of the other two years.

UP 4.7 Wed 10:45 G/Foyer

Simultaneous balloon-borne measurements of the key inorganic bromine species BrO and $BrONO_2$ in the stratosphere: (DOAS evaluation) — •S. Kazarski[1,3], G. Maucher[1], A. Ebersoldt[2], A. Butz[1], H. Oelhaf[1], F. Friedl-Vallon[1], H. Nordmeyer[1], M. Hoepfner[1], S. Schmitt[3], L. Scalone[3], K. Grossmann[3], T. Hueneke[3], K. Pfeilsticker[3], and J. Orphal[1] — [1]IMK, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]IPE, Karlsruhe Institute of Technology, Karlsruhe, Germany — [3]IUP, University of Heidelberg, Heidelberg, Germany

Inorganic bromine contributes to a loss of stratospheric ozone of about 25 - 30%. Past studies have demonstrated several uncertainties in the photochemistry of stratospheric bromine, especially by considering the three body reaction (k_{BrONO_2}) $BrO + NO_2 + M \rightarrow BrONO_2 + M$, and the photolysis frequencies of $BrONO_2$ (j_{BrONO_2}). Hence, an improved knowledge of the ratio j_{BrONO_2}/k_{BrONO_2} is crucial to better assess the bromine-related loss of ozone as well as the total amount of bromine in the stratosphere. Here, we report on the first simultaneous balloon-borne measurements of NO_2, BrO, and $BrONO_2$ in the stratosphere, performed over Timmins (Ontario)/Northern Canada on Sept., 7^{th} and 8^{th}, 2014. During the flight the targeted species NO_2 and BrO were monitored by remote sensing in the UV and visible spectral ranges by Differential Optical Absorption Spectroscopy (DOAS). The analysis and interpretation of the measurements involves radiative transfer as well as photochemical modelling. Major features of the applied techniques are reported and first results are discussed.

UP 4.8 Wed 10:45 G/Foyer

Simultaneous balloon-borne measurements of the key inorganic bromine species BrO and BrONO2 in the stratosphere: MIPAS evaluation — •Gerald Wetzel[1], Hermann Oelhaf[1], Felix Friedl-Vallon[1], Andreas Ebersoldt[2], Thomas Gulde[1], Michael Höpfner[1], Anne Kleinert[1], Guido Maucher[1], Hans Nordmeyer[1], and Johannes Orphal[1] — [1]Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Karlsruhe, Germany — [2]Karlsruhe Institute of Technology, Institute for Data Processing and Electronics, Karlsruhe, Germany

Despite being much less abundant, the contribution of bromine to stratospheric ozone depletion is similar to that of chlorine. The two major inorganic bromine species in the lower stratosphere are bromine oxide (BrO) and bromine nitrate (BrONO2). While BrO has first been observed around 20 years ago, BrONO2 has been detected by satellite limb observations in the mid-infrared spectral region only recently (in 2008). Dedicated to the simultaneous observation of BrO and BrONO2 including their diurnal variability, a balloon campaign took place from Timmins, Canada in September 2014. The remote sounding instrumentation consisted of three spectrometers covering the UV-VIS, the mid-infrared and the microwave spectral region. In this contribution we present the first results from the Michelson Interferometer for Passive Atmospheric Sounding Balloon-borne version 2 (MIPAS-B2): time- and height-dependent distributions of BrONO2 and NO2 volume mixing ratios together with a comprehensive error estimation and further diagnostic parameters of the inversion procedure.

UP 4.9 Wed 10:45 G/Foyer

Monitoring shipping emissions with MAX-DOAS measurements of reactive trace gases — •André Seyler[1], Folkard Wittrock[1], Lisa Kattner[1,2], Barbara Mathieu-Üffing[1,2], Enno Peters[1], Andreas Richter[1], Stefan Schmolke[2], Norbert Theobald[2], and John P. Burrows[1] — [1]Institute of Environmental Physics (IUP), University of Bremen — [2]Federal Maritime and Hydrographic Agency (BSH), Hamburg

The project MeSMarT (Measurements of shipping emissions in the marine troposphere, www.mesmart.de) has been established as a cooperation between the University of Bremen and the German Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency) with support of the Helmholtz Research Centre Geesthacht to estimate the influence of ship emissions on the atmospheric boundary layer and to establish a monitoring system for main shipping routes.

On the 1st of January 2015, the allowed sulfur content of marine fuels inside Sulfur Emission Control Areas (SECA) established by the International Maritime Organisation (IMO) has been significantly decreased from 1.0% to 0.1%.

Here we present MAX-DOAS observations of NO_2 and SO_2 carried out from two permanent sites close to the Elbe river (Wedel, Germany) and on the island Neuwerk close to the mouths of Elbe and Weser since the year 2013. Mixing ratios of both trace gases have been retrieved using different approaches (pure geometric and taking into account the radiative transfer) and compared to in situ observations. Furthermore, emission factors of NO_x and SO_2 have been calculated for single ships.

UP 4.10 Wed 10:45 G/Foyer

Airborne imaging DOAS during AROMAT — •Andreas C. Meier[1], Anja Schönhardt[1], André Seyler[1], Andreas Richter[1], Thomas Ruthz[2], and John P. Burrows[1] — [1]Uni Bremen, Institute of Environmental Physics — [2]FU Berlin, Institute for Space Sciences

The AROMAT campaign (Airborne Romanian Measurements of Aerosols and Trace Gases) was carried out in September 2014 as part of the preparations for the space-borne Sentinel-5 Precursor air-quality monitoring mission.

The IUP-Bremen contributed to this campaign with its imaging DOAS instrument, AirMAP. This instruments allows the detection of column densities of trace gases under the aircraft at a high spatial resolution (30×80 m^2). Mapping patterns were flown over Bucharest, that provided coverage the whole city in approx. 2.5h. These measurements show the spatial distribution of NO_2 column densities below the aircraft and show huge amounts of NO_2 inside the city centre and a strong gradient towards more rural areas.

UP 4.11 Wed 10:45 G/Foyer

Information content of tropospheric NO_2 measurements from space — •Andreas Hilboll, Andreas Richter, and John P. Burrows — Institut für Umweltphysik, Universität Bremen, Deutschland

In atmospheric pollution research, nitrogen dioxide (NO_2) is a commonly investigated trace gas. NO_2 vertical columns are routinely measured by several of today's satellite-based spectrometers. They can be useful for the identification and evaluation of natural and anthropogenic NO_x emissions and their changes over time.

One major drawback of the commonly used DOAS retrievals of NO_2 columns from satellite is the lack of vertical resolution. Combined with the altitude-dependence of retrieval sensitivity, this entails the use of a priori information on the NO_2 vertical profile, significantly contributing to the retrieval uncertainties. If information on the vertical location of the NO_2 could be retrieved from the measurements themselves, one could deduce surface mixing ratios, and the column uncertainties could be significantly reduced.

In this study, we investigate the vertical information content of nadir NO_2 observations in the UV/visible wavelength range. For this purpose, we investigate the information content of the radiances, to show how many independent pieces of information can be extracted from the masurements. We present the so-called information spectrum for the NO_2 profile inversion, showing the amount of information contained in the measured spectra at each wavelength, which will aid in an optimal selection of wavelengths for the profile retrieval.

UP 4.12 Wed 10:45 G/Foyer

Sensitivity of equatorial atomic oxygen in the MLT to the 11-year and 27-day cycles of solar activity — •Olexandr Lednyts'kyy and Christian von Savigny — Ernst-Moritz-Arndt-University of Greifswald, Greifswald, Germany

Atomic oxygen concentration ([O]) profiles are retrieved from O(^{1}S-^{1}D) nightglow emission rates provided by SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) on Envisat from August 2002 to April 2012 daily at approximately 22:00 local solar time. These O retrievals are used to assess the sensitivity of O in the mesosphere-lower thermosphere (MLT) region to the 11-year and 27-day solar activity cycles. The 11-year and 27-day solar cycle responses in SCIAMACHY O are statistically significant and of the same order. Our results correspond well to the 11-year solar cycle response in O volume mixing ratios found in simulations with the NCAR Whole Atmosphere Community Climate Model, version 3 (WACCM3), and the three-dimensional Hamburg Model of the Neutral and Ionized Atmosphere (HAMMONIA) model. Solar forcing causes increased photodissociation of O_2 and raises the O abundance consequently.

UP 4.13 Wed 10:45 G/Foyer

Activities and Trace Gas Analyses at the central Flask and Calibration Laboratory for the ICOS network — Maria Büttner, Bert Steinberg, Michael Hielscher, Adam Janoschka, Markus Eritt, Christian Luetz, Rico Hengst, Michael Kuenast, •Daniel Rzesanke, and Armin Jordan — MPI f. Biogeochemistry, ICOS-Central Flask and Calibration Laboratory, Kahlaische Str. 4, 07745 Jena/Germany

The Integrated Carbon Observation System (ICOS) is an European-wide research infrastructure that aims at providing high quality observational data for the long-term monitoring of the European greenhouse gases balance. In the last two years a central facility of this network has been established. In summer 2014, the (central) Flask and Calibration Laboratory (FCL) in Jena started operation. Major tasks of this facility are the high accuracy measurements of ICOS relevant trace gases, namely CO2, CH4, CO, N2O, as well as SF6 and H2, the analysis of stable isotopes of CO2, CH4 and the O2/N2 ratio from flask air samples and the provision of calibrated reference gases for the networks in-situ stations. This last function assures network conformance to primary scale. Therefore, the FCL holds a large set of WMO reference standards to link to the respective scale. The laboratory has different internal and external quality assurance activities like i.e. round robin intercomparisons to help maintaining the desired precision.

In our contribution we will give an overview of the achieved performances as far as the facility's activities in providing and supporting high accuracy trace gas measurements.

UP 4.14 Wed 10:45 G/Foyer

Observations of RHS concentrations and processes at the Dead Sea Valley — •Stefan Schmitt[1], Robert Holla[1,2], Denis Pöhler[1], Udo Friess[1], Ulrich Platt[1], Andreas Held[3], Katharina Kamilli[3], Ulrich Corsmeier[5], and Jutta Zingler[4] — [1]IUP, Heidelberg — [2]Deutscher Wetterdienst — [3]BayCEER, Bayreuth — [4]FTU, Karlsruher Institut für Technologie — [5]IMK, Karlsruher Institut für Technologie

The Dead Sea Valley (DSV), located at the border of Israel and Jordan, is a unique place with high activity of reactive halogen species (RHS). Former DOAS measurements revealed high abundances of bromine monoxide (BrO) as well as iodine monoxide (IO) but the processes and sources are still not understood. Therefore we performed intensive LP-DOAS measurements in May 2012. We observed mixing ratios of up to 90 ppt, 5ppt and 60 ppt for BrO, IO and I_2 respectively. NO_2 mixing ratios dropped from about 6 ppb to below the detection limit of 0,5 ppb during sunrise on every day while significant BrO and IO concentrations were only detected at low NO_2 mixing ratios. This supports the assumption that NO_2 is consumed by the formation of $BrONO_2$ and $IONO_2$ from released RHS. The data shows several interesting chemical features which are presented.

Further, condensation particle counter (CPC) measurements of particles with sizes of 9-800 nm indicate that significant mixing ratios of IO were observed only at low particle loads while BrO seems to prefer high particle concentrations. This indicates a possible influence of aerosols on the halogen chemistry at the DSV.

UP 4.15 Wed 10:45 G/Foyer

Detection of noctilucent clouds in SCIAMACHY/Envisat nadir UV-measurements — •Martin Langowski and Christian von Savigny — EMAU Greifswald

The polar summer mesopause is the coldest region in the Earth's atmosphere and yields favorable conditions for cloud formation during three summer months and >50 deg. latitude. These clouds are called noctilucent clouds NLC, as through their high altitude of 82-88 km they are still illuminated several hours after/before sunset/sunrise.

Long term studies from SBUV satellite nadir measurements, e.g. DeLand et. al. (2007) and Shettle et. al. (2009), show an 11 years cycle for the occurence frequency of NLC as well as an long-term increase. The long term increase is not seen in other studies of the same dataset (e.g. Stevens et. al. 2007), in which the data is filtered for only certain local times.

Currently a new algorithm for the GOME, SCIAMACHY and GOME-2 instruments is being developed to extend the NLC data from nadir measurements. We will present this algorithm and show first results.

UP 4.16 Wed 10:45 G/Foyer

Mie resonance spectroscopy of levitated ternary organic/ammonium sulfate (AS)/water aerosol particles — •Andreas Peckhaus[1] and Ulrich Krieger[2] — [1]Karlsruher Institut für Technologie (KIT), Karlsruhe, Deutschland — [2]Institut für Atmosphäre und Klima (IAC), ETH Zürich, Schweiz

The occurrence of liquid-liquid phase separation (LLPS) in internally mixed ternary C6/AS/H2O aerosol droplets levitated in an electrodynamic balance (EDB) is presented. The analysis of high resolution elastic Mie resonance spectra allowed the detection of LLPS and further changes in morphology within the aerosol particle. The influence of temperature and size on LLPS are discussed and compared with available literature. Bulk measurements of the refractive index, density and water activity of binary systems (C6/H2O and AS/H2O) and the ternary system (C6/AS/H2O, OIR = 0.5) are reported. From the Mie resonance spectra of these systems, refractive index, density and volume ratio can be retrieved. The obtained thermodynamic data expand the bulk measurements over a wider concentration range and can be used to calculate Mie resonance spectra for different morphologies (core-shell or partially engulfed configurations) and relative humidities. By comparison with the experimental spectra, conclusions can be drawn regarding the morphology of the phase separated aerosol.

UP 4.17 Wed 10:45 G/Foyer

Messung von Iodoxid in der Grenzschicht des indischen Ozeans mit CE-DOAS — •Henning Finkenzeller, Johannes Lampel, Denis Pöhler und Ulrich Platt — Institut für Umweltphysik, Universität Heidelberg

Auf der Schiffskampagne SO235 im tropischen indischen Ozean wurde Open-Path-Cavity-Enhanced-Differential-Optical-Absorption-Spectroscopy (Open Path CE-DOAS) zur berührungslosen in-situ Messung von Spurengasen in der marinen Grenzschicht betrieben. Im optischen Resonator wurden Lichtwege von ∼5 km im Spektralbereich von 420 - 450 nm realisiert; zur Senkung der Nachweisgrenzen wurden neue Ansätze im Messalgorithmus verfolgt um die Konzentrationsbestimmung von Iodoxid (IO), Glyoxal (CHOCHO), Stickstoffdioxid (NO_2), und Wasserdampf weiter zu verbessern.

Die vorläufige Auswertung bestimmt IO- und Glyoxal-Mischungsverhältnisse mit einer Nachweisgrenze von etwa 0,4 pptv und 60 pptv (parts per trillion volume). Innerhalb dieses Unsicherheitsbereichs wurde kein signifikanter Tagesgang von IO und Glyoxal beobachtet; deren Konzentrationen waren während SO235 niedriger

als erwartet.

Typische NO_2-Mischungsverhältnisse lagen im Bereich von 0-200 pptv. Erhöhte NO_2-Konzentrationen (15 min Nachweisgrenze 40 pptv) können als Indikator für die Kontamination durch Abgase des eigenen Schiffes oder naher Schiffe interpretiert werden und stellen wichtige Zusatzinformationen bei der Interpretation anderer auf dem Schiff gewonnenener Luftmesswerte dar.

UP 4.18 Wed 10:45 G/Foyer

Aerosoldaten aus SCIAMACHY Sonnenokultationsmessungen — •Jacob Zalach und Christian von Savigny — Institut für Physik, Ernst-Moritz-Arndt-Universität, Greifswald

Transmissionsmessungen der Atmosphäre liefern Informationen über ihre Beschaffenheit und erlauben die Bestimmung der Verteilung ihrer Bestandteile. Im Rahmen des ROMIC-ROSA Projektes sollen stratosphärische Aerosolextinktionsprofile und ihre Teilchengrößenverteilung ermittelt werden.

Eine etablierte Methode stellten dabei satellitengestützte Okkultationsmessungen dar. Die Sonnenokkultationsmessungen des SCIAMACHY-Spektrometers (EnviSat) erstrecken sich über einen Zeitraum von zehn Jahren und decken den Wellenlängenbereich von 240 bis 2380 nm ab. Sie wurden bisher noch nicht vollständig ausgewertet. Eine direkte Übernahme existierender Auswerteverfahren ist zum großen Teil nicht möglich, vor allem wegen der geringeren Abtastrate der Messungen.

Der Beitrag zeigt die mit neu entwickelten bzw. angepassten Algorithmen gewonnenen Dichteverteilungen von O3, NO2 und insbesondere der Aerosole, die mit SAGE II Messungen als Referenz verglichen werden.

UP 4.19 Wed 10:45 G/Foyer

Different dusts in AIDA cloud chamber immersion freezing and deposition ice nucleation experiments — •Romy Ullrich, Naruki Hiranuma, Corinna Hoose, Ottmar Möhler, Monika Niemand, Isabelle Steinke, and Robert Wagner — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Aerosols are defined as liquid or solid suspended particles in air. Their diverse composition and different sources impede a uniform handling regarding their ice nucleating ability and efficiency. Model studies, in-situ measurements as well as laboratory studies point out the importance of natural dust for heterogeneous ice nucleation. The variety of dust species shows the importance of the source and chemical features for forming ice by heterogeneous nucleation. The AIDA (Aerosol Interactions and Dynamics in the Atmosphere) cloud chamber was used for a series of ice nucleation experiments with among others different natural dust species to investigate the different ice nucleating behavior. These studies result in a comprehensive overview of the ice nucleation efficiency as a function of aerosol, temperature and humidity.

This conference contribution will show recent findings from the AIDA cloud chamber for different dust species including desert dust, soil dust, different clay minerals and volcanic ash particles (Steinke et al. (2011)). Additionally, a comparison of the different dust species regarding ice activity and possible reasons for deviations will be presented.

Steinke, I. (2011) Atmos. Chem. Phys., 11, 12945-12958

UP 4.20 Wed 10:45 G/Foyer

Aerosol measurements during the SOPRAN experiment in the Heidelberg Aeolotron — •Manuela van Pinxteren[1], Juan Najera[2], Badr R'Mili[3], Kerstin Krall[4], Gordon McFiggans[2], Barbara D'Anna[3], Bernd Jähne[4], and Hartmurt Herrmann[1] — [1]TROPOS Leipzig — [2]University of Manchester — [3]IRCELYON-CNRS-Univ. Lyon — [4]IUP University of Heidelberg

During the SOPRAN laboratory experiment in Heidelberg in November 2014, the annular wind-wave tank Aeolotron was filled with seawater from the Atlantic Ocean to study exchange processes between ocean and atmosphere. Besides gas exchange measurements, aerosol particles were sampled with different techniques in order to investigate to what extent organic material from the sea surface micro layer is transported into the aerosol particles. Aerosol particles were sampled on different filter materials and investigated for the total organic content and for different groups of organic compounds. Additionally the physical nature of the marine aerosols generated from seawater was characterize using continuously online sampling with an Scanning Mobility Particle Sizer coupled to a Condensation Particle Counter, and a Droplet Measurement Technologies-Cloud Condensation Nucleus counter. Finally, a MPS (mini-particle sampler) was applied which is a particle collection technique based on filtration on TEM porous grids. Further Transmission Electron Microscopy analysis will give information on size, morphology and elemental composition of the deposited particles. Here, the set up of the experiments and first preliminary results are presented.

UP 4.21 Wed 10:45 G/Foyer

A novel experimental setup to study heterogeneous nucleation and growth rates on meteor smoke particle analogues — •Mario Nachbar[1], Denis Duft[2], and Thomas Leisner[1,2] — [1]University of Heidelberg, IUP, Germany — [2]Karlsruhe Institute of Technology - IMK-AAF, Germany

Noctilucent clouds (NLC) have been detected in the polar summer mesopause region of Earth at heights of 80-90 km. These clouds are believed to be caused by heterogeneous nucleation of H2O on meteoric smoke particles (MSP). Surprisingly, similar clouds have been detected in the mesosphere of Mars as well. In contrast to NLCs on Earth, they consist of CO2 particles and occur at subtropical latitudes mostly during post aphelion season. Scientist dealing with the formation of NLCs struggle with large uncertainties in describing the nucleation processes taking place due to a lack of experimental data at the extreme mesospheric conditions which states the need of laboratory measurements. We recently designed a new linear ion trap which allows us to trap nanoscale particles under controlled temperature as well as H2O and CO2 concentration. We produce charged nanometer sized MSP analogues in a microwave resonator and transfer them to the ion trap held under typical mesospheric conditions. Heterogeneous ice nucleation and growth processes then can be examined by analyzing the mass distribution of the particles with a time-of-flight mass spectrometer as function of the residence time under supersaturated conditions. In this paper, the experimental setup and data analysis is exemplified with experiments on CO2 nucleation in the Martian mesosphere.

UP 4.22 Wed 10:45 G/Foyer

Preliminary results of the SOPRAN seawater gas exchange experiment in the Heidelberg Aeolotron — •Kerstin E. Krall[1], Jakob Kunz[1], Maximilian Bopp[1], Daniel Kiefhaber[1], Mariana Ribas Ribas[2], Janina Rahlff[2], Cuici Sun[3], Martin Sperling[3], Anke C. Nölscher[4], Bettina Derstroff[4], Christof Stönner[4], Bernd Schneider[5], Oliver Wurl[2], Anja Engel[3], Jonathan Williams[4], and Bernd Jähne[1,6] — [1]IUP, Universität Heidelberg — [2]ICBM, Universität Oldenburg — [3]GEOMAR, Kiel — [4]MPIC, Mainz — [5]IOW, Warnemünde — [6]HCI am IWR, Universität Heidelberg

In November of 2014, air-sea gas exchange measurements using natural seawater were performed at the large annular wind-wave tank, the Aeolotron, within the BMBF SOPRAN project. Gas exchange velocities of a large number of trace gases (e.g. He, Xe, Kr, SF_6, CO_2, N_2O), volatile chemical species (e.g. DMS, acetone, acetonitrile, methanol) and heat, covering the whole range of solubility and diffusivity, were measured. Measuring techniques were LI-COR, FT-IR spectroscopy, MIMS, PTR-MS, and active thermography. Temperatures, water and wind velocities and wind waves were monitored as well. Eleven wind speeds ranging from 1.4 to over 10 m/s were used. An aerator was used to simulate strong breaking waves with bubble entrainment and spray formation. One goal of the experiment was to study the effects of natural surfactants present in the sea surface micro layer, which dampen waves and reduce gas transfer. This poster presents the setup of the experiment and discusses first preliminary results.

UP 4.23 Wed 10:45 G/Foyer

Ice crystal growing on mineral surfaces in ESEM — •Felix Bachmann[1], Alexei Kiselev[1], Philipp Pedevilla[2], Stephen Cox[2], and Angelos Michaelisdes[2] — [1]Atmospheric Aerosol Research Department, Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]London Centre for Nanotechnology, University College London, London, UK

Observing deposition growth of ice crystals in an Environmental Scanning Electron Microscope (ESEM, FEI Quanta 650 FEG), we noticed that the ice crystals often have identical orientation of both basal and prism faces, and are tilted at a universal angle of 116° to the surface of the mineral substrate. To determine the range of conditions favoring such alignment, we have tested temperatures from -25°C to -50°C with freshly cleaved and weathered mineral surfaces. These experiments have been realized with our self-build humidity control system which allowed us to control partial water vapor pressure in the ESEM

chamber. Alignment of crystals requires that the c-axis of both ice and microcline crystal lattice have to be parallel but also means that the basal (001) planes of ice and microcline are mismatched. We report a gradual reduction of crystal alignment with decreasing temperature. We discuss a possible mechanism of crystal lattice alignment by considering a layer of ordered water on the surface of microcline forming prior to ice nucleation. Using DFT we show how the mineral surface interacts with water, particularly addressing the role of surface cations and hydroxyl groups in the arrangement of adsorbed water molecules.

UP 4.24 Wed 10:45 G/Foyer

Forward scattering by levitated ice crystals — •Mohamed Abdelrasoul[1,2], Alexei Kiselev[2], and Thomas Leisner[2,3] — [1]Karlsruhe School of Optics and Photonics KSOP (KIT), Karlsruhe — [2]Institute for Meteorology and Climate Research (KIT), Karlsruhe — [3]Institute of Environmental Physics, University of Heidelberg

Ice clouds have a significant impact on the energy budget of the earth-atmosphere system, as solar and terrestrial radiation interacts with earth's atmosphere. Cirrus clouds are made of non-spherical ice crystals which can take on a variety of shapes, from regular habits such as plates, columns and bullet- rosettes, to irregular habits, the shape of ice crystals being determined by the temperature and pressure of water vapor in the vicinity of a growing or evaporating ice crystal. The radiative properties of ice clouds depend on the optical properties of ice crystals, which can be best studied under laboratory conditions. With this goal in mind, we have built an optical system allowing for measurements of the two dimensional forward scattering patterns of the ice crystals that are freely levitated in an electrodynamic balance (EDB) of a quadrupole type. The temperature and relative humidity inside the balance are controlled. High dynamic range CMOS camera is used to record the forward scattering by a single ice crystal illuminated with circularly polarized 532 nm laser beam. The recorded scattering patterns are analyzed for characteristic features of different crystal habits and surface morphology (smooth or rough).

UP 4.25 Wed 10:45 G/Foyer

Studying Ice-crystallization on the Molecular Level using Nonlinear Optical Spectroscopy — •Ahmed Abdelmonem, Johannes Lützenkirchen, and Thomas Leisner — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Heterogeneous ice formation on mineral surfaces is important for precipitation formation in mixed phase clouds and for the formation of cirrus clouds. It is not well understood which structural and chemical characteristics of ice nucleation surfaces and dissolved ions account for the variability in ice crystallization efficiency.

We apply Second Harmonic Generation (SHG) spectroscopy to monitor the evolution of water structuring at solid surfaces upon cooling down to the temperature of heterogeneous freezing. This method enables a direct discrimination between good and poor ice nucleating surfaces. In this presentation, we compare the evolutions of the freezing process of water on two different surfaces (sapphire and mica). In addition, a direct comparison between ice crystallization on sapphire surface in the presence and absence of dissolved salts is presented. While sapphire which is known as poor ice nucleator shows no influence on the structure of water molecules in contact with its surface upon cooling until the freezing point, mica which is one of the common ice nucleation atmospheric substances shows an increase in the local ordering of the first water layer in contact with the surface which is expected to facilitate and control the crystallization of ice at the surface.

UP 5: Meßtechmik

Time: Thursday 8:45–9:30 Location: G/gHS

Invited Talk UP 5.1 Thu 8:45 G/gHS

Satellite remote sensing of atmospheric trace gases in the UV/vis spectral range: observing pollution in the atmospheric layer in which we live — •Thomas Wagner — MPI for Chemistry, Hahn-Meitner-Weg 1, 55131 Mainz

In 1995 the Global Ozone Monitoring Experiment (GOME) was launched. It was the first space-borne instrument recording continuous spectra of the backscattered solar radiation with moderate spectral resolution. Originally designed for the measurement of stratospheric ozone it soon turned out that also absorptions of several important tropospheric trace gases like NO2, SO2 or HCHO could be detected in GOME spectra. Because of the earth*s transparency in the UV / vis spectral range, even trace gases located close to the surface can be measured. Global maps of tropospheric trace gases measured by GOME and its successors (SCIAMACHY, OMI, and GOME-2) have revolutionised our understanding of the distribution of tropospheric pollutants. The presentation provides an overview on the measurement technique and highlights important results obtained during the last two decades. An outlook is given on planned near-future missions with largely improved spatial resolution.

UP 5.2 Thu 9:15 G/gHS

Diurnal dynamics of land surface-atmosphere exchange inferred from thermodynamic constraints — •Axel Kleidon and Maik Renner — Max-Planck-Institut für Biogeochemie, Jena, Germany

The convective boundary layer strongly shapes the exchange of energy and mass between the land surface and the atmosphere. Here, we approach this tightly coupled system by deriving the thermodynamic limit by which convective motion can be generated from the diurnal radiative forcing. An important part of the derivation is the inclusion of heat storage changes that are caused by the diurnal imbalance of absorbed solar radiation. Using 6-hourly radiosoundings of the Meteorological Observatory Lindenberg - Richard-Assmann-Observatory (MOL-RAO) of the German Meteorological Service (DWD) in Brandenburg we find that most of diurnal heat storage changes take place in the lower atmosphere. Using surface observations of absorbed solar radiation and the ground heat flux, our approach predicts the diurnal course of turbulent heat fluxes at the surface and heat content changes in the lower atmosphere surprisingly well. What this implies is that the diurnal dynamics of the atmospheric boundary layer are strongly constrained by the diurnal imbalance in the local radiative forcing. The resulting dynamics of the atmospheric boundary layer then reflect the tight interaction between turbulent heat fluxes, atmospheric heat storage changes, and thermodynamic limits to generate turbulent exchange.

UP 6: PV Lu

Time: Thursday 9:45–10:30 Location: PV-Rooms

Plenary Talk UP 6.1 Thu 9:45 PV-Rooms

Atom Trap, Krypton-81, and Global Groundwater — •Zheng-Tian Lu — Argonne National Laboratory, Lemont, USA — The University of Chicago, Chicago, USA

The long-lived noble-gas isotope ^{81}Kr is the ideal tracer for water and ice with ages of 10^5 - 10^6 years, a range beyond the reach of ^{14}C. ^{81}Kr-dating, a concept pursued over the past five decades by numerous laboratories employing a variety of techniques, is finally available to the earth science community at large. This is made possible by the development of the Atom Trap Trace Analysis (ATTA) method, in which individual atoms of the desired isotope are captured and detected. ATTA possesses superior selectivity, and is thus far used to analyze the environmental radioactive isotopes ^{81}Kr, ^{85}Kr, and ^{39}Ar. These three isotopes have extremely low isotopic abundances in the range of 10^{-16} to 10^{-11}, and cover a wide range of ages and applications. In collaboration with earth scientists, we are dating groundwater and mapping its flow in major aquifers around the world. We have also demonstrated for the first time ^{81}Kr-dating of old ice.

This work is supported by U.S. DOE, Office of Nuclear Physics, under contract DE-AC02-06CH11357.

UP 7: Applied Noble Gas Physics Part 1

Time: Thursday 11:00–13:00 Location: C/gHS

Invited Talk UP 7.1 Thu 11:00 C/gHS

Development of a new facility for measuring 81Kr and 85Kr at ultratrace level in environmental samples. — •Bernard Lavielle[1], Eric Gilabert[1], Bertrand Thomas[1], Romain Rebeix[1], Grégory Canchel[1], Christophe Moulin[2], Sylvain Topin[2], and Fabien Pointurier[2] — [1]CENBG, University of Bordeaux, BP 120, F-33175 Gradignan Cedex, France — [2]CEA-DASE, F-91297 Arpajon, France

Mainly produced on Earth by nuclear reactions induced by cosmic rays in the atmosphere, the radionuclide 81Kr (t1/2=229,000yr) is considered as the best tracer for absolute dating of old groundwaters or ice cores in the range of 50,000 yr to 1,000,000 yr. Kryton-85 (t1/2=10.76yr) is mainly released into the atmosphere by the reprocessing facilities for nuclear fuel. This isotope is of great interest as a tracer for nuclear activities but also for dating young groundwater (<50 yr). Several instruments and lines are being developed at CENBG in order to measure both 81Kr and 85Kr in groundwater using small volume of water (20 l). It includes: 1) a line for gas extraction from water, Kr separation and purification; 2) A double-focusing mass spectrometer operating a 81Kr and 85Kr enrichment process based on implantation of separated Kr isotope in Al foils; 3) An instrument based on RIS-TOF technique capable to perform Kr isotopic abundance measurements from samples containing only a few thousands of atoms. The extremely high sensitivity of this instrument also allows measurements of cosmogenic Kr at very low concentration to determine cosmic ray exposure of small meteorite samples.

Invited Talk UP 7.2 Thu 11:30 C/gHS

Atom counting system to measure trace krypton contamination in ultra-pure xenon — •Andre Loose, Tanya Zelevinsky, and Elena Aprile — Columbia University, 550 W 120th Street, New York, NY 10027, USA

The Atom Trap Trace Analysis (ATTA) Project at Columbia University is an experiment designed to measure the abundance of Kr in a Xe sample to the parts per trillion (ppt) level. Setting an upper limit on the amount of Kr-85 present in natural Xe is critical for knowing the sensitivity of dark matter searches based on LXe as target and detector medium. In particular, the ATTA will be an essential assaying tool for the XENON program. We completed the full ATTA setup and it's characterization for metastable Ar-40* in Ar and Kr-84* in Xe. The abundance of Kr-85 will then be inferred using previously measured relative isotopic abundances. We designed and tested custom pipettes to avoid air contamination of samples during the transport from the XENON1T detector to our ATTA setup. We verified the system calibration by comparing ATTA and rare gas spectrometer measurements for the same sample, and conducted first ATTA measurements of ultrapure Xe.

Invited Talk UP 7.3 Thu 12:00 C/gHS

Krypton-85 and Radioxenon: Environmental Tracers and Indicators for Nuclear Activities — •Clemens Schlosser, Verena Heidmann, Martina Konrad, and Sabine Schmid — Bundesamt für Strahlenschutz, Rosastraße 9, 79098 Freiburg

Already in the 1940s scientists recognized the usefulness of radioactive noble gases as for monitoring nuclear activities. Krypton-85 is a very good indicator for the reprocessing of nuclear fuel and Xe-133 can be used for the detection of clandestine nuclear weapon tests and nuclear reactor operation. Additionally, Kr-85 can be used as tracer in environmental sciences. The German Federal Office for Radiation Protection (BfS) operates a noble gas laboratory and a global network which continuously monitors the Kr-85 and Xe-133 activity concentrations in ground level air since the 1970s. The laboratory of the BfS and the techniques used will be presented. Currently, the mean activity concentrations at German sampling sites are approx. 1.5 Bq/m3 for Kr-85 and in the order of 1 mBq/m3 for Xe-133. Based on the long time series of the BfS the global atmospheric distribution and the influence of different sources on the atmospheric activity concentrations over the last decades are discussed. Since 2004, radioactive Xenonisotopes are continuously measured at Schauinsland by an automated system *SPALAX* as part of the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The network capacity of this global monitoring network is demonstrated on the basis of particular events, like the Fukushima nuclear power plant accident and the Nuclear Weapon Tests in North Korea.

UP 7.4 Thu 12:30 C/gHS

Miniature High Sensitive Time-of-Flight Noble gas Mass spectrometer for very low gas measurements — •Ramakrishna Ramisetty and Ingo Leya — University of Bern, Space Research and Planetary Sciences,Bern, Switzerland

Noble gas analysis in early solar system materials, which can provide valuable information about early solar system processes and timescales, are very challenging because of extremely low noble gas concentrations (ppt). We therefore developed a new, high sensitive, compact sized (33 cm length, 7.2cm diameter, 1.3 L internal volume) Time-of-Flight (TOF) noble gas mass spectrometer. The instrument uses electron impact ionization coupled to an ion trap, which allows us to ionize and measure all noble gas isotopes with high efficiency. Using a reflectron set-up we reach a mass resolution of >1000amu. In addition, the reflectron set-up also enables some extra focusing. The detection is via MCPs and the signals are processed either via ADC or TDC systems. The instrument can be tuned automatically and under normal operational conditions the electronics and valves are fully computer controlled Noble gas calibrations showed a detection limit in the range 10-14 cm3STP and about 7 orders of dynamic range.

UP 7.5 Thu 12:45 C/gHS

Studying the constancy of galactic cosmic rays using cosmogenic noble gases and radionuclides in iron meteorites — •Thomas Smith[1], Ingo Leya[1], Silke Merchel[2], Georg Rugel[2], Stefan Pavetich[2], Anton Wallner[3], Keith Fifield[3], Stephen Tims[3], and Gunter Korschinek[4] — [1]University of Bern, Switzerland — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]The Australian National University, Canberra, Australia. — [4]TU Munich, Germany.

Cosmogenic noble gases and radionuclides in meteorites are the only tools that provide information about the cosmic ray exposure (CRE) history of meteorites. In space, meteoroids are irradiated by galactic cosmic ray (GCR), which produces, among others, stable and radioactive cosmogenic nuclides. It has been demonstrated that periodic variations in the GCR intensity induce periodic peaks in the CRE age histograms. Therefore, searching for periodic peaks in CRE histograms enables one to obtain information about GCR fluency variations. Since expected GCR fluency variations have periodicities of a few hundred million years, one needs meteorites irradiated for at least that long. Iron meteorites, which have CRE ages ranging from a few million to a few billion years, are the best candidates. So far we measured noble gases and radionuclides in 28 iron meteorites by noble gas mass spectrometry and accelerator mass spectrometry. First CRE age histograms have been established and will be presented. Further analyses are ongoing and will improve the statistical interpretation, providing new information on the temporal variability of the GCR fluency.

UP 8: Mitgliederversammlung

Time: Thursday 13:00–14:30 Location: G/gHS

Mittagspause und Mitgliederversammlung

UP 9: Applied Noble Gas Physics Part 2

Time: Thursday 14:30–16:30 Location: C/gHS

Invited Talk UP 9.1 Thu 14:30 C/gHS

Using Noble Gases to Understand the History of Terrestrial Volatiles — •Don Porcelli — Oxford University, Dept Earth Sciences, Oxford, UK

Noble gas isotopes provide essential information on the origin and distribution of terrestrial volatiles. The 3He/4He ratios measured in mantle-derived volcanics indicate that the noble gases initially incorporated into the Earth remains heterogeneously distributed, although it is not yet clear how this relates to mantle structure. Xe isotopes indicate that separate noble gas reservoirs were established during Earth formation, with variations that must have been created before complete decay of short-lived 129I and 244Pu. Further, Ne isotopes suggest that there have been several different solar system sources of noble gases. Also, Xe isotopes indicate that substantial quantities of noble gases were incorporated into the Earth and lost soon after. A number of key questions remain, as data are limited due to the subtle variations and low concentrations involved, and the presence of atmospheric contamination. More precise measurements of all noble gases, and with greater sensitivity, are essential to better identify how many sources of noble gases there have been; the extent of isotope variability within the Earth and so the history of early losses and subsequent reservoir isolation; the role of the core in storing noble gases; and the relationship between variations of the different noble gases and so the history of each separate reservoir. With such data, the history of terrestrial volatiles can be understood within the context of evolving theories of planetary accretion.

Invited Talk UP 9.2 Thu 15:00 C/gHS

Noble gas analysis in water: from temperature reconstruction over excess formation to oxygen turnover on environmentally relevant time scales — •Rolf Kipfer and Matthias Brennwald — Eawag, Swiss Federal Institute of Aquatic Science and Technology, 8600 Dübendorf, Switzerland

Noble gases (and other quasi-conservative transient trace gases) in aquatic systems have commonly been used to determine water residence times and to reconstruct past environmental and climatic conditions.

However, these analyses were hampered by the occurrence of a surplus of atmospheric gases in natural ground water, e.g. the presence of excess air (EA) which in former days was only considered as contamination.

Recent developments in understanding the physics of air (gas) / water partitioning in porous media as well as revisiting noble gas diffusion in water now allows EA formation to be understood in mechanistic terms and facilitates the robust interpretation of EA as a proxy for the hydraulic conditions during groundwater recharge.

Furthermore, portable membrane-inlet mass spectrometers enable continuous and real-time analysis of dissolved (noble) gases directly in the field, allowing, for instance, quantification of O2 turnover rates on time scales as small as minutes.

This presentation will touch some of these recent achievements with the intention of stimulating a broader discussion on the future applications of gases in conventional and unconventional aquatic systems.

Invited Talk UP 9.3 Thu 15:30 C/gHS

Applications of Noble Gases in Oceanography — •Peter Schlosser[1,2,3], Robert Newton[3], Gisela Winckler[3], and Angelica Pasqualini[2,3] — [1]Dept of Earth and environmental Sciences, Columbia Universiy — [2]Dept of Earth and Environmental Engineering, Columbia University — [3]Lamont-Doherty Earth Observatory, Columbia University

Over the past decades, methods for detection and routine measurement of noble gases and their isotopes at ultra-low levels have been developed. They enabled application of these trace substances to many problems of ocean circulation, dynamics, and air/sea exchange. In principle, noble gases are used in studies such as (1) radioactive clocks (Tritium/He-3; Ar-39), (2) natural or anthropogenic injections into specific water masses (He isotopes), and (3) global dyes (Kr-85 or the quasi noble gas sulfurhexafluoride). To illustrate these applications three oceanographic noble gas studies are presented and discussed. Determination of the major circulation pathways and man residence times of the waters in the Arctic Ocean (tritium/He-3; Ar-39): knowledge of the Arctic Ocean circulation pattern is needed to understand the implications of rapid Arctic Environmental Change. Large-scale mixing at mid-depth in the Pacific Ocean: the turbulent mixing coefficients derived from these studies are used to quantify redistribution of water and dissolved substances (He-3). Air/sea exchange, especially in the high-wind regimes of the Southern Ocean: air/sea gas exchange rates, together with measurements of the partial pressure of carbon dioxide, are applied to calculate the uptake of carbon by the oceans.

UP 9.4 Thu 16:00 C/gHS

Basal ice-shelf melting in the Weddell Sea inferred from oceanic noble-gas observations — •Oliver Huhn[1], Monika Rhein[1], and Michael Schröder[2] — [1]Institute of Environmental Physics, University of Bremen, Germany — [2]Alfred-Wegener-Institute, Bremerhaven, Germany

We use oceanic noble-gas observations from the Weddell Sea from the period 1990 to 2013 to infer basal ice-shelf melting and the spatial distribution and temporal variability of the melt water input into the ocean. Helium and neon data were used to compute the glacial melt water contributing to the formation of Antarctic Bottom Water, a substantial water mass in the global ocean and important driver of the Meridional Overturning Circulation.

Oceanic measurement of low-solubility and stable noble-gases helium and neon provide a useful tool to quantify glacial melt water. Atmospheric air with a constant composition of these noble gases is trapped in the ice matrix during formation of the meteoric ice. Due to the enhanced hydrostatic pressure at the base of the floating ice, these gases are completely dissolved, when the ice is melting from below. This leads to an substantial excess of helium and neon in pure glacial melt water.

We find an increasing trend in helium, neon, and, hence, in the glacial melt water content in the deep Weddell Sea. Melt water fractions along a repeated section in the north-western Weddell Sea are almost doubling from 1990 to 2013, indicating increasing melting in the Weddell Sea.

UP 9.5 Thu 16:15 C/gHS

Environmental Tracer and helium measurements in the context of Coal Seam Gas exploration. — •Axel Suckow and Stanley D. Smith — CSIRO Land and Water Flagship, Gate 5, Waite Road, Urrbrae, SA 5064, Australia

The Surat Basin in Northeast Queensland, Australia is subject to massive exploration and development for coal-seam gas extraction. To extract the gases, reduction of hydrostatic pressure in the Walloon Coal Measures by up to 70bar is necessary. The impact of this groundwater de-pressurization on adjacent aquifers is unknown. Also the flow regime of the underlying Hutton Sandstone and Precipice Sandstone aquifers is not well understood. Environmental tracers (SF_6, CFCs, tritium, helium, $^{87}Sr/^{86}Sr$, ^{14}C, ^{36}Cl) were measured along two north-south transects in the Hutton Sandstone aquifer. Also helium pore water profiles were obtained in vertical profiles through two aquitards isolating the Walloon Coal measures from the underlying Hutton Sandstone and this from the underlying Precipice Sandstone. Results indicate that groundwater in the Hutton has very low flow velocities and ^{36}Cl decreases to background values along a flow distance of less than 150km. Vertical profiles of terrigenic helium through the aquitard formations indicate very low vertical flow in these formations and the aquifer system seems to be dominated by diffusion processes. However, it remains an open question to what extent the $^{36}Cl/Cl$ decrease can be attributed to aging or is dominated by diffusive inflow of dead Cl from adjacent aquitards. To further elucidate this flow system, samples for ^{81}Kr are planned along these transects.

UP 10: Ozeanographie

Time: Thursday 17:00–19:00 Location: M/SR3

UP 10.1 Thu 17:00 M/SR3

The role of shallow ground water ^{3}He/^{4}He ratios in geothermal energy potential and fault zone characterisation — •Florian Freundt[1], Sami Al Najem[2], Gerhard Schmidt[2], Werner Aeschbach-Hertig[1], Margot Isenbeck-Schröter[2], and Michael Kraml[3] — [1]Institute of Environmental Physics, Heidelberg University — [2]Institute of Earth Sciences, Heidelberg University — [3]GeoThermal Engineering GmbH

Large-scale geothermal energy production relies on extensive characterization of the target fault system: its spatial location as well as its hydraulic permeability. Current geophysical methods (e.g. 3D reflection seismics) offer only a limited insight in hydraulic permeability, which the TRACE project aims to expand by applying a multi tracer analysis on shallow ground water above the target zone. ^{3}He/^{4}He ratios are one important part of this approach, offering a tool to identify mantle and crustal influences in the meteorically dominated shallow ground water. Data from a sampling campaign in the northern Upper Rhine Graben, close to Groß-Gerau, Germany, shows promising results, where elevated isotope ratios coincide with characteristic geochemical data, the fault location, and a previously known saltwater anomaly spatially defined by new geochemical data. Higher saline NaCl-dominated waters show an impact of mantle fluids revealed by ^{3}He/^{4}He isotope analysis. The ratio is highest where the main fault of the northern Upper Rhine Graben crosses the Rhine river. This suggests that the fault is hydraulically active and connects ascending deep fluids with the shallow aquifer.

UP 10.2 Thu 17:15 M/SR3

Coastal upwelling velocities inferred from helium isozope disequilibrium — Reiner Steinfeldt[1], Jürgen Sültenfuss[1], •Marcus Dengler[2], Tim Fischer[2], and Monika Rhein[1] — [1]Universität Bremen, Institut für Umweltphysik — [2]Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR)

Oceanic upwelling velocities are too small (in the order of 10-5 m/s) to be measured directly. Here we use oceanic measurements of the helium-3/helium-4 isotopic ratio as an indirect means to infer these velocities. The water that upwells into the oceanic mixed layer from below is typically enriched in the lighter isotope helium-3. This excess of helium-3 originates from venting of primordial helium through hydrothermal activity. Helium data have been collected on four cruises within the coastal upwelling regions off Mauritania and Peru.

Near the coast, the helium derived upwelling velocities are in good agreement with the wind driven flow calculated from Ekman theory. At some locations in the open ocean, however, the helium method results in much higher vertical velocities compared to the wind derived Ekman divergence. This enhanced upwelling might be attributed to eddy activity. Both advective and turbulent (derived from microstructure measurements) fluxes of heat and nutrients into the mixed layer are determined. In coastal upwelling regions, these fluxes play a key role in fostering ocean primary productivity and cooling of sea surface temperature.

UP 10.3 Thu 17:30 M/SR3

Entgasung eines Sees, um limnische Eruptionen zu vermeiden — •Bertram Boehrer[1], Javier Sanchez-Espana[2] und Inaki Yusta[3] — [1]Helmholtz Centre for Environmental Research - UFZ, Magdeburg, Germany — [2]Geological Survey of Spain (IGME), Madrid, Spain — [3]University of the Basque Country (UPV/EHU),Bilbao, Biscay, Spain

Der Guadiana See im Erztagebau Herrerias (Andalusien, Spanien) füllte sich nach Aufgabe der Abbautätigkeit durch aufgehendes Grundwasser. Die Oxidation der anstehenden Metallerze führte zu einer extremen Versauerung der zufließenden Wässer, die dann Karbonat aus dem anstehenden Gestein lösen konnten. Es bildete sich Kohlensäure (gelöstes CO2) das sich in großen Mengen im Tiefenwasser ansammelte (2.5 Liter pro Liter Wasser). Um einem explosiven Austritt und der Gefahr des Erstickens von Menschen und Tieren in der Umgebung zuvorzukommen, sollte man das Gas kontrolliert entfernen. Zur Demonstration der Gefahr wurde - ähnlich wie in den Seen Nyos und Monoun in Kamerun - eine Röhre in den See gestellt, die Wasser nach oben führt und in einer Fontäne einen Großteil des Gases entlässt. Der Antrieb wird allein durch den Auftrieb der entstehenden Gasblasen in der Röhre bewerkstelligt. - Sánchez-España, J., Boehrer, B., Yusta, I. Environ. Sci. Technol. 48 (8), 4273 - 4281 (2014) doi: 10.1021/es5006797

Invited Talk UP 10.4 Thu 17:45 M/SR3

Können Einsteins Teeblätter das Wattenmeer vor dem Untergang retten? — •Hans Burchard — Leibniz-Institut für Ostseeforschung Warnemünde

Einstein nutzte im Jahr 1926 ein Alltagsexperiment, um die asymmetrische Erosion des Bodens eines gekrümmten Flussläufes und damit die Mäanderbildung von Flüssen anschaulich zu erläutern. Es ist die durch die Asymmetrie hervorgerufene laterale Sekundarströmung, die einen Netto-Sedimenttransport und damit morphodynamische Veränderungen bewirkt. Ähnliche Prozesse entscheiden das Schicksal des Wattenmeeres, das sich zwischen vorgelagerten Inseln und dem Festland in der Deutschen Bucht erstreckt und durch bei Niedrigwasser trockenfallenden Flächen (den Watten) chrakterisiert ist. Einem bisherigen Meeresspiegelanstieg von etwa 0.2 m / Jahrhundert konnte das Wattenmeer trotzen, indem ein Netto-Sedimentimport aus der Nordsee die Wattenflächen mit der selben Rate wie der Meeresspiegelanstieg anwachsen ließ. Im Wattenmeer wird die Querzirkulation hauptsächlich durch Dichteunterschiede zwischen den Watten und der offenen Nordsee verursacht. Im humiden Klima der mittleren Breiten sorgt ein Überschuss von Niederschlag gegenüber der Verdunstung dafür, dass das flache Wattenmeer sich stark versüßt. Nun wird allerdings für die Zukunft aufgrund des globalen Klimawandels eine Beschleunigung des Meeresspiegelantieges postuliert mit Raten von bis zu 1 m / Jahrhundert. Es stellt sich die Frage, ob die hier beschriebenen Prozesse des Netto-Sedimentimportes auch noch bei diesem erheblich erhöhten Sedimentbedarf ausreichen.

UP 10.5 Thu 18:15 M/SR3

Fingerprinting North Atlantic water masses near Iceland using Nd-isotopes — •Norbert Frank[1], Astrid Waldner[2], Paolo Montagna[3], Christophe Colin[4], and Qiong Wu[5] — [1]Institut für Umweltphysik, INF229, Heidelberg — [2]Paul Scherrer Institute, Villigen, Switzerland — [3]CNR - ISMAR, Bologna, Italy — [4]IDES, Université de Paris-Sud, Orsay, France — [5]State Key Laboratory, Tongji University, Shanghai, China

The radiogenic ^{143}Nd/^{144}Nd ratio of seawater is a valuable tracer of north Atlantic circulation pathways, driven by continental runoff (freshwater and Aeolian dust), boundary exchange and advection and thus mixing patterns. A region of particular interest in the North Atlantic is the overflow across the Iceland-Scotland Ridge injecting water from the Arctic Ocean into the Iceland basin (Iceland Scotland Overflow Water). However, Iceland itself constitutes a local source for Nd due to possible leaching of young volcanic basalts adding radiogenic ^{143}Nd/^{144}Nd to seawater. We have conducted an intense survey of physical properties and Nd-isotope composition between Iceland and the Azores that allows to fingerprint different water masses of the North Atlantic through the ^{143}Nd/^{144}Nd ratio and that demonstrates the very local influence of volcanic material to the seawater Nd cycle. A first local transect is achieved from the open ocean to the outflow of the Vatnajökull glacier. Runoff influences seawater Nd in close vicinity (<40km near the outflow). A along shelf transect provide a similar observation. From Iceland to the Azores, however, water masses of the sub-tropical and sub-polar gyre are clearly distinguishable.

UP 10.6 Thu 18:30 M/SR3

Radiocarbon reservoir variations in a stalagmite from Northern Oman during the early Holocene — •Jens Fohlmeister[1], Andrea Schröder-Ritzrau[1], Bernd Kromer[2], and Norbert Frank[1] — [1]Institute for Environmental Physics, University of Heidelberg, Heidelberg, Germany — [2]Klaus-Tschira Laboratory for Archeometry, Mannheim, Germany

Observations of the precipitation pattern in Oman during the Holocene are sparse and limited to a few lacustrine sediment records and speleothem studies. Proxies from cave carbonates from Hoti cave in Northern Oman highlight a long lasting, more humid period between ~9000 to 6000 years before present (BP). Variations in the amount of rainfall during the humid period are responsible for changes in vegetation cover. In this study we use radiocarbon measurements, performed on the carbonate of speleothem H5, to analyse the variations in the

reservoir effect. Those changes can be interpreted in terms of a modifying vegetation cover and soil organic matter dynamics above the cave. The data indicate, that prior to 8200 years BP today the region was only barely covered with living vegetation. Only dead organic matter was decomposed by microbes and was the single source for soil gas CO2. This condition changed at about 8200 years BP, where the soil became covered by plants, favoured by more humid conditions. About 100 years later, climate deteriorations led to a renewed adaption of the ecosystem with a retreat of vegetation.

UP 10.7 Thu 18:45 M/SR3

Evolution of nuclear weapon-produced tritium and its decay product He-3 in the Mediterranean Sea, 1952-2011 — •Wolfgang Roether — IUP Univ. Bremen

After 1952, tritium in the Mediterranean Sea (Med) rose 100-fold up to a 30 TU peak in 1965 (1 TU = [H-3/H] · 10^{18}) and thereafter declined to about 1 TU in 2011. This resulted in a strong supply of its stable daughter He-3, concentrated in the 1960s. Terrigenic He being low in He-3 due to a predominantly crustal origin allowed precise determination of the tritiugenic He-3 (± 0.7% in delta He-3). The highest He-3 was found off the Tyrrhenian Sea in 1983 (delta He-3 ∼ 16%). The principle input into the subsurface waters occurs in the Eastern Med by way of the Levantine Intermediate Water (LIW), which moves as a high-salinity core westward toward the Strait of Gibraltar. The observations demonstrate strong longitudinal flow dispersion. As tritium-He-3 ages are biased toward times of strong input, one finds an age increase with calendar year of observation, attributed to fast flow contributions showing up first. A realistic estimate for transfer from the LIW source up to the Western Med is 22 years. Especially in the East, He-3 lately decreased distinctly, in response to the reduced He-3 generation.

UP 11: Atmosphäre

Time: Thursday 17:00–17:30 Location: G/gHS

Invited Talk UP 11.1 Thu 17:00 G/gHS

Radar meteor echoes and their relation to atmospheric and plasma physics — •Jorge L. Chau[1], Gunter Stober[1], Carsten Schult[1], Irina Strelnikova[1], and Meers M. Oppenheim[2] — [1]1.*Leibniz Institute of Atmospheric Physics at Rostock University, Germany — [2]2.*Center for Space Physics at Boston University, USA

For over 60 years radars have detected echoes coming from meteors. These echoes have been classified in three types: (a) head echoes coming from plasma as it forms in front of the meteoroid, (b) specular trail echoes that are due to Fresnel scattering, and (c) nonspecular trail echoes also known as range-spread echoes. These three classes of echoes occur at a rate of a few meteors per second to a few meteors per minute, depending on the location, size of the radar, pointing direction, etc. Radar meteor echoes have been used and studied in a variety of fields, like, Astronomy, Telecommunications, Aeronomy, Plasma Physics, etc. In this work, we present an overview of how these echoes are currently being exploited to diagnose the upper atmosphere. For example obtaining: (1) neutral winds, temperatures, and neutral densities from specular echoes, (2) neutral winds from non-specular echoes, and (3) meteor mass deposited in the atmosphere from meteor-head echoes. A special focus is devoted to the non-specular echoes, from both an observational as well as theoretical point of view. Our observations include those echoes associated to field-aligned irregularities and those that cannot come from field-aligned irregularities. Finally, we present preliminary results from a novel approach to get horizontally resolved wind fields from specular meteor echoes.

UP 12: Meßtechnik

Time: Thursday 17:30–19:00 Location: G/gHS

UP 12.1 Thu 17:30 G/gHS

Retrieval of Vertical Profiles of Trace Gases, Aerosols and Clouds from Multi-Axis DOAS measurements — •Udo Friess and Ulrich Platt — Institut für Umweltphysik, Universität Heidelberg

During recent years, Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) has found a growing number of applications for the retrieval of vertical profile information of atmospheric constituents. MAX-DOAS instruments measure the differential slant column density of trace gases along several lines of sight between the zenith and the horizon using spectroscopic techniques. From these measurements, vertical profiles of trace gases, but also aerosols and clouds in the planetary boundary layer can be retrieved. The conversion of dSCDs to vertical profiles of aerosols and trace gases is a complex problem, which can be solved using appropriate retrieval algorithms in conjunction with radiative transfer models.

Here we present results obtained by the Heidelberg profile retrieval algorithm (HEIPRO) for the retrieval of trace gas and aerosol vertical profiles from MAX-DOAS measurements. The versatility of the algorithm will be demonstrated on the basis of ground-based and airborne data from several campaigns reaching from mid-latitudes to Polar Regions, and the vertical sensitivity and information content will be discussed. The vertical profiles retrieved from MAX-DOAS will be compared to co-located aerosol and trace gas instrumentation, such as LIDAR, sun photometer, nephelometer and in situ trace gas measurements.

UP 12.2 Thu 17:45 G/gHS

Lidar-Messungen von Schwerewellen in der mittleren Atmosphäre während der DEEPWAVE-Kampagne in Neuseeland — •Natalie Kaifler, Bernd Kaifler, Benedikt Ehard und Markus Rapp — Institut für Physik der Atmosphäre, DLR

Im Rahmen des DEEP propagating WAVE experiment over New Zealand wurden zwischen Juni und November 2014 umfangreiche Lidar-Messungen mit einem bodengebundenen Rayleigh-Lidar über Lauder (45S, 170E) durchgeführt. Der Ort zeichnet sich durch seine Lage außerhalb des Polarwirbels sowie östlich der neuseeländischen Alpen aus. Letztere stellen eine Quelle für orographische Schwerewellen dar. Schwerewellen, die sich horizontal und vertikal über große Distanzen ausbreiten, sind durch die Impulsdeposition in der mittleren Atmosphäre von großer Bedeutung für die globale Zirkulation. In Modellen sind sie jedoch bisher nur unzureichend parametrisiert. Die Untersuchung von Schwerewellen mit einer Vielzahl von Instrumenten war das Ziel der DEEPWAVE-Kampagne. Wir haben ein leistungsfähiges Rayleigh-Lidar entwickelt, das Messungen in einem Höhenbereich zwischen 20 und 90 km mit hoher vertikaler und zeitlicher Auflösung erlaubt. Mit einer geeigneten Filterung werden Signaturen von Schwerewellen aus den Temperaturprofilen extrahiert. Die vertikale Wellenlänge und die Periode einzelner Wellen werden mit Hilfe von spektralen Analysemethoden bestimmt. Wir präsentieren eine Auswahl von Einzelfällen und geben einen Überblick der thermischen Struktur und der Schwerewellenaktivität während des gesamten Messzeitraums, der sowohl den Winter- als auch den Übergang zum Sommerzustand umfasst.

UP 12.3 Thu 18:00 G/gHS

Erste Messungen mit dem Hochleistungs-Raman-Lidar am Schneefernerhaus — •Katharina Höveler, Lisa Klanner, Thomas Trickl und Hannes Vogelmann — Karlsruher Institut für Technologie, IMK-IFU, Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen

Langfristig angelegte, vertikal und zeitlich hochaufgelöste Messungen des primären Treibhausgases Wasserdampf bis in die Stratosphäre stellen derzeit immer noch eine Herausforderung dar. Eine mögliche Lösung ist die Methode der Raman-Streuung und wird im globalen "Network for the Detection of Atmospheric Composition Change" (NDACC) propagiert. Allerdings müssen solche Lidar-Systeme wegen

des stratosphärischen Wasserdampfmischungsverhältnisses von nur 5 ppm um Größenordnungen leistungsstärker als bisher sein. Daher wurde am Schneefernerhaus (Zugspitze, 2675 m) in Ergänzung des vorhandenen differentiellen Absorptions-Lidars (DIAL) ein Raman-Lidar entwickelt, welches auf einem XeCl-Industrielasersystem und Empfangsteleskopen mit 1.5 m und 0.4 m Durchmesser beruht. Das Lasersystem wurde für den benötigten polarisierten Einlinienbetrieb umgebaut und liefert danach immer noch 170 W Leistung. Die Kalibrierung erfolgt mit dem DIAL, wodurch die Probleme mit der hohen Variabilität der Feuchte entfallen. Erste, noch kurze Messungen zeigten bereits eine Reichweite bis in 14 km Höhe. Die Tests werden nun unter Einbeziehung von Photonenzählen bis in über 20 km Höhe ausgedehnt. Das Lidar soll gleichzeitig Temperaturprofile bis in die Mesosphäre liefern. Systemaufbau und Testergebnisse werden auf der Tagung vorgestellt.

UP 12.4 Thu 18:15 G/gHS

Improved determination of volcanic SO_2 emission rates from SO_2 camera images — •Angelika Klein, Nicole Bobrowski, Peter Lübcke, and Ulrich Platt — Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany

SO_2 cameras determine the SO_2 emissions of volcanoes with a high temporal and spatial resolution. The first step to obtain emission rates is to integrate the column amount of SO_2 in two different plume cross sections; combined with wind speed information this allows the determination of SO_2 fluxes. A popular method to determine the mean wind speed relies on estimating the time lag of the SO_2 signal derived for two cross sections of the plume at different distances downwind of the source by maximizing the cross correlation coefficient of the two signals.

Another method to obtain the wind speed is to use the optical flow technique to obtain a more detailed wind field in the plume from a series of SO_2 camera images. While the cross correlation method only gives the mean wind speed between the two cross sections of the plume, the optical flow technique determines the wind speed and direction for each pixel individually.

The two methods were applied to a data set taken at Etna, Italy in July, 2014 and will illustrate the differences between cross-correlation and the optical flow method. The influence of the wind direction on the flux determination will be discussed using this data set as an example. In addition we have a closer look into the possibility of wind direction determination from SO_2 camera images.

UP 12.5 Thu 18:30 G/gHS

Pollution transport and processing in the upper tropospheric Indian summer monsoon from CARIBIC observations — •Armin Rauthe-Schöch[1], Angela Baker[1], Carl Brenninkmeijer[1], Andreas Zahn[2], Helmut Ziereis[3], Markus Hermann[4], and Peter van Velthoven[5] — [1]Max Planck Institut for Chemistry, Mainz, Germany — [2]Karlsruhe Institut of Technology, Karlsruhe, Germany — [3]German Aerospace Center, Oberpfaffenhofen, Germany — [4]Institute for Tropospheric Research, Leipzig, Germany — [5]Royal Netherlands Meteorological Institute, De Bilt, the Netherlands

The CARIBIC aircraft observatory was deployed to survey the Indian summer monsoon in the subtropical upper troposphere in 2008. Being a fully automated analytical laboratory including air sample and aerosol particle sample collection systems, over 100 trace gases as well as aerosol particle concentrations were assayed. The monthly CARIBIC flights between Frankfurt/Germany and Chennai/India, crossing the western edge of the huge upper tropospheric monsoon anticyclone (UTAC), demonstrated a remarkably consistent chemical evolution of the UTAC over a distance of more than 3000 km. Studies of greenhouse gas emissions, sources of methane as well as a methyl chloride emissions estimate from South Asia have been published. Here we combine chemical tracers observed with CARIBIC and meteorological analyses to obtain a more complete picture of the mixture of trace gases inside the UTAC, the chemical age of the air masses, photochemical tendencies, as well as source regions and export pathways of the air.

UP 12.6 Thu 18:45 G/gHS

Bestimmung von Emissionsquellstärken aus OMI SO2 Daten mittels eines Inversionsverfahrens basierend auf Chemischen Transportmodelsimulationen — •Mark Wenig — Meteorologisches Institut, Ludwig-Maximilians-Universität München

In diesem Beitrag wird ein neues Verfahren vorgestellt, dass SO2 Emissionskataster aus OMI Satellitendaten berechnet. Dieses Verfahren beruht auf Transportsimulationen mittels des Goddard Chemistry Aerosol Radiation and Transport (GOCART) Modells. Zunächst werden die Ausbreitungen einzelner Quellen simuliert, wobei jede Quelle auf eine einzelne Gitterzelle beschränkt ist. Dann wird die optimale Superposition dieser Emissionsfahnen bestimmt, die den von dem Ozone Monitoring Instrument (OMI) an Bord des NASA Aura Satelliten gemessenen SO2 Verteilungen am nächsten kommt. Die Fitparameter lassen sich in Quellstärken umrechnen, so dass ein Top-Down-Emissionskataster erstellt werden kann. Es wird ebenfalls beschrieben, wie Nichtlinearitäten in der Atmosphärenchemie für diese lineare Inversion behandelt werden, sowie Regularisierungsansätze um die relativ hohen Fehler des SO2 Säulendichten zu berücksichtigen.

UP 13: Postersession Bodenkunde, Kryosphäre, Meßtechnik, Ozeanographie

Time: Thursday 10:45–19:45 Location: G/Foyer

UP 13.1 Thu 10:45 G/Foyer

Evaluation of GOME2 tandem observations of NO_2 — •Andreas Richter, Andreas Hilboll, Lisa K. Behrens, and John P. Burrows — Institute of Environmental Physics, University of Bremen, Bremen, Germany

Observations of atmospheric NO_2 columns from satellite have proven to provide useful information for both tropospheric and stratospheric atmospheric chemistry studies.

Since the launch of the second GOME2 instrument on MetOp-B in September 2012, two nearly identical instruments observe atmospheric NO_2 with just half an orbit (45 min) separation. After an initial phase of operation with the same swath width (1920 km) and some test configurations, the GOME2 instrument on MetOp-A was switched to a narrower swath in July 2013. This resulted in smaller ground pixels (40× 40 km^2 instead of 80 × 40 km^2) while still conserving some spatial overlap with the measurements of GOME2 on MetOp-B.

This unique data set of parallel measurements provides an opportunity to investigate different aspects of the NO_2 retrieval from satellite data: The consistency between observations from two instruments, the impact of viewing geometry, the importance of spatial resolution, and the influence of clouds and their retrieval from the two data sets.

The overall result of the comparisons shows very good consistency between the two data sets with higher local values at better spatial resolution as expected, an important result for combined use of the two data sets. However, the analysis also reveals systematic differences which will be discussed in detail.

UP 13.2 Thu 10:45 G/Foyer

Cloud detection by inversion of MAX-DOAS measurements — •Jan-Marcus Nasse[1], Johannes Zielcke[1], Udo Friess[1], Johannes Lampel[2], Gert König-Langlo[3], and Ulrich Platt[1] — [1]Institut für Umweltphysik, Heidelberg — [2]Max-Planck-Institut für Chemie, Mainz — [3]Alfred-Wegener Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven

Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) is a widely used technique for the detection of atmospheric trace gases, e.g. NO_2, SO_2, but also for the oxygen collision complex O_4, whose atmospheric distribution is well known. By comparing measured O_4 differential slant column densities (dSCDs) with modelled ones, information on aerosol distributions and optical properties can be obtained. In combination with a radiative transfer model, an inversion of measured dSCDs allows the retrieval of vertical aerosol extinction profiles and properties.

Here the ability of MAX-DOAS observations to detect cloud altitude and cloud optical properties of different cloud covers will be discussed. An accurate retrieval of these parameters is crucial for an interpretation of trace gas dSCDs and a subsequent retrieval of vertical concentration profiles from measurements under cloudy conditions.

The ability of MAX-DOAS to retrieve cloud layer height and optical properties will be demonstrated with a comparison to co-located

measurements of a commercial Ceilometer during several cruises of the German research vessel Polarstern. Advantages, limitations and possible applications of the technique will be discussed.

UP 13.3 Thu 10:45 G/Foyer

Development of the Inertial Sensor-based Attitude compensating MAX-DOAS instrument — •Lara Penth, Denis Pöhler, Johannes Lampel, and Ulrich Platt — Institute of Environmental Physics, University of Heidelberg, Germany

Multi-AXis DOAS (MAX-DOAS) is a well established remote sensing technique for atmospheric trace gas observations. The spectral analysis of scattered solar radiation measured at different elevation angles allows to derive the vertical distribution of atmospheric trace gases as well as aerosol properties. Measurements of tropospheric constituents require a high precision of the elevation angle, which is especially challenging on moving platforms. The new Inertial Sensor-based Attitude compensating (ISA) MAX-DOAS instrument contains an automatic attitude and motion compensation of the elevation angle in real-time using latest MEMS sensors. Thus no manual adjustment on the measurement site is required and it could be demonstrated that the applied Kalman algorithms for moving platforms can maintain a precise attitude estimation of the instrument of about $\sigma = 0.12°$, even under highly dynamic operation conditions. The ISA MAX-DOAS instrument and measurement applications will be presented.

UP 13.4 Thu 10:45 G/Foyer

Validation of the IUP Nadir Ozone Profile Retrieval — •Stefan Bötel, Mark Weber, Alexei Rozanov, and John P. Burrows — Institute of Environmental Physics at the University of Bremen

Stratospheric profile retrieval of ozone in the Hartley-Huggins band in nadir viewing geometry is one of very few options of obtaining a far-reaching timeseries of ozone profiles. The IUP optimal estimation type retrieval including a spectral soft calibration based on the FUll Retrieval Method (FURM) by Hoogen et al. (1999) has been successfully applied to a number of sensonrs. SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric ChartographY) launched on ENVISAT in March 2002 measures sunlight, transmitted, reflected and scattered by the earth atmosphere or surface (240 nm - 2380 nm) in both nadir and limb viewing geometry. GOME (the Global Ozone Monitoring Instrument) and GOME-2 (the Global Ozone Monitoring Instrument-2) both measure in the nadir geometry from 1995 to 2003 and 2006 to today respectively in the wavelength region between 240 and 790 nm. Validation and intercomparison results for these sensors will be shown. The validation will be based on independant measurements such as WOUDC (World Ozone and Ultraviolet Radiation Data Centre) ozonesondes and NDACC (Network for the Detection of Atmospheric Composition Change) lidars. Intercomparison results will be shown based on zonal means between the three sensors used and ozone profiles retrived independantly from additional satellite based instruments.

UP 13.5 Thu 10:45 G/Foyer

Performance of the HALO mini-DOAS instrument and detection of trace gases and cloud properties — •Tilman Hüneke[1], Matthias Knecht[1], Marcel Reichert[1], Jannis Weimar[1,2], and Klaus Pfeilsticker[1] — [1]Institut für Umweltphysik, University of Heidelberg, Heidelberg, Germany — [2]Helmholtz-Zentrum für Umweltforschung (UFZ), Leipzig, Germany

The HALO mini-DOAS instrument records scattered sunlight in the UV, visible and near-IR spectral ranges in nadir and limb viewing geometries. It was deployed on the German research aircraft DLR HALO during the recent campaigns Narval (December 2013 / January 2014), ML-Cirrus (March / April 2014) and ACRIDICON-CHUVA (August / September 2014).

Here, we report on the performance of the instrument during the deployments and show validation studies. For the detection of UV/visible absorbing radicals, such as O3, NO2, HONO, CH2O, C2H2O2, BrO and IO the DOAS (Differential Optical Absorption Spectroscopy) technique is used, which together with radiative transfer modelling (McArtim) and mathematical inversion will result in concentration profiles of the targeted gases. Due to the nonlinearity of the absorption features of gaseous, liquid and solid water, the DOAS technique can however not be employed in the traditional way for the interpretation of spectra in the near-IR wavelength range. Therefore a new retrieval scheme has been developed and tested against liquid water path (LWP) and ice water path (IWP) of other instrumentation, for example from the HAMP (HALO Microwave Package).

UP 13.6 Thu 10:45 G/Foyer

Discrete field of view sampling of satellite and ground-based DOAS-type instruments using high-resolution imager data — •Holger Sihler[1], Steffen Beirle[1], Peter Lübcke[2], Julia Remmers[1], and Thomas Wagner[1] — [1]Max Planck Institute for Chemistry, Mainz, Germany — [2]Institute of Environmental Physics, Heidelberg, Germany

The field of view (FOV) describes the spatial sensitivity distribution of optical instruments. In particular, its knowledge is essential for the interpretation of spectroscopic measurements of the earths atmosphere and surface. Spectroscopic instruments, like those designed for Differential Optical Absorption Spectroscopy (DOAS), typically feature a much lower spatial resolution than instruments with moderate to low spectral resolution in order to provide a sufficient signal-to-noise ratio physically limited by photon statistics.

In principle, the instrument's FOV can be either characterised under controlled conditions (i.e. in the lab) or simulated using ray tracing. In reality, however, the FOV may change during launch of a satellite-borne instrument or when a ground-based instrument is transported into the field.

We present a method to assess the FOV of spectroscopic DOAS-type instruments during operation using simultaneously recorded imager data. As a proof of concept, the method is applied to investigate the FOV of the GOME-2 (Global Ozone Monitoring Experiment 2) satellite instrument using simultaneous Advanced Very High Resolution Radiometer (AVHRR) measurements.

UP 13.7 Thu 10:45 G/Foyer

Simulation of radiative field modification in the UV/visible/nearIR spectral range due to tropical clouds (Cirrus and convective Clouds) — •Matthias Knecht, Katja Grossmann, Tim Deutschmann, Tilman Hüneke, and Klaus Pfeilsticker — Institut für Umweltphysik, Universität Heidelberg, Heidelberg, Germany

The interpretation of atmospheric trace gas measurements (O_3, NO_2, CH_2O, HONO, $C_2H_2O_2$, H_2O, O_4) and the detection of water phases (vapor, liquid, ice) by UV/vis/nearIR spectroscopy of scattered sunlight in Limb and Nadir geometry is largely hindered when clouds are present in the troposphere. This paper addresses sensitivity studies on the various microscopic and macroscopic parameters, i.e. the microphysical properties of the clouds and their geometric arrangement. For this purpose, the relevant parameters were varied in 3D Monte Carlo simulations using the radiative transfer model McArtim. Further, the simulations were evaluated in a statistical sense for the photon path lengths as a function of cloud and observation parameters, such as solar position, elevation angle and altitude of the observation. Results for test and proxy gases (O_2 and O_4) are compared with the data retrieved from measurements with our instrumentation. The paper reports on the set-up of the model and discusses major findings of the sensitivity studies.

UP 13.8 Thu 10:45 G/Foyer

The Brewer-Dobson circulation and polar ozone depletion — •Martin Budde — IUP Uni Bremen

The Brewer-Dobson Circulation (BDC) plays a major role in ozone transport from the tropics to the poles and by that it governs the global distribution of total column ozone. Climate models predict a strengthening of the BDC in times of climate change. This would lead to an accelerated recovery of ozone abundance in higher latitudes. However so far there is no clear evidence of this strengthening. Another major driver of the global ozone distribution is the photochemical destruction of ozone, due to ozone depleting substances (ODS) such as chlorofluorocarbons (CFCs). A special case of this is the rapid depletion of ozone in the presence of polar stratospheric clouds. These clouds build up inside the polar vortices, are highly temperature dependent and strengthen the efficiency of ODS. In order to analyse the evolution of the higher latitude ozone abundance as a function of dynamical changes and the change in the abundance of ODS it is necessary to quantify both effects separately. In this work this is done by analysing the influence of the mid-latitude 100hpa eddy heat flux on the total ozone column in higher latitudes.

UP 13.9 Thu 10:45 G/Foyer

T-matrix calculation with the Green's dyadic technique for electromagnetic scattering: a numerical approach using the

Dyson equation — •Ugo Tricoli and Klaus Pfeilsticker — Institute of Environmental Physics, University of Heidelberg, INF 229 Heidelberg, 69120, Germany

A new technique to compute the T-matrix for a single arbitrary shaped particle is presented, called the Green's dyadic technique for T-matrix (GDT-matrix). It is based on the use of the volume integral equation (VIE) for electromagnetic scattering. Interpreting the T-matrix as a generalized potential in combination with the Coupled Dipole Approximation (CDA) method, it is possible to make a parallel use of the Lippmann-Schwinger and the Dyson equations to iteratively solve for the T-matrix and the Green's function dyadic, respectively. Hence, there is no need to explicitly specify the boundary conditions and only an accurate spatial discretization of the particle is required, which is here done by a sparse-octree volume discretization. Further no assumptions regarding the particle symmetry, homogeneity and isotropy needs to be made. For the validation of the code, examples in 1D and 2D are investigated. Then, 3D results are compared with Mie theory for spherical particles. For more complex shaped particles, comparison against experimental results is provided for forward-scattering, in particular for rough ice particles.

UP 13.10 Thu 10:45 G/Foyer

Conceptual model: possible changes of the seawater uranium isotopic composition through time — •Hannah Nowitzki, Norbert Frank, and Jens Fohlmeister — Universität Heidelberg, Germany

U behaves in seawater like a conservative element. More than 99% of the oceanic U content is ^{238}U, whereas ^{234}U is only present in trace amounts. As the residence time of U is significantly longer than the mixing time of the ocean, the ocean is well mixed with respect to U and its isotopic composition (Dunk 2002). Moreover, living corals incorporate U without isotopic fractionation. Therefore, the past seawater isotopic evolution of (^{234}U/^{238}U) can be accessed via U/Th age-dating of corals and the subsequent calculation of the initial (^{234}U/^{238}U) value.

The isotopic (^{234}U/^{238}U) composition of seawater during the last 360ka scatters around the modern seawater value (δ^{234}U $\approx$ (145 $\pm$ 15)%, Henderson 2002). As these variations in the δ^{234}U value are rather small, a 'constant seawater isotopic composition hypothesis' is often used to validate U/Th ages of fossil corals. However, some authors find that the variability of the isotopic composition exceeds the expected range and suggest that it provides valuable information on variations in continental weathering and global run-off fluctuations or sea-level changes.

This work will attempt to compare literature data of the seawater U isotopic composition to the results of a conceptual box-model of the oceanic U budget.

UP 13.11 Thu 10:45 G/Foyer

Radiative Transfer in Volcanic Plumes — •Katja Bigge, Nicole Bobrowski, Peter Lübcke, and Ulrich Platt — Institute of Environmental Physics, University of Heidelberg, Heidelberg, Germany

Passive trace gas measurements such as Differential Optical Absorption Spectroscopy (DOAS) have been used to measure the gas contents of volcanic plumes for some time. SO2 is the most commonly measured gas and it plays an important role in volcanic processes and eruptions and in climate. Radiative transfer effects complicate these measurements and although this problem has been discussed already 30 years ago there is usually still no correction applied. However, the radiative transfer effects can cause over- and underestimation of retrieved gas fluxes in the order of tens of percent, or under certain conditions even lead to errors in the order of a magnitude, making current flux results inaccurate.

During a campaign at Etna, Italy, in July 2014, we measured SO2 fluxes simultaneously using two scanning DOAS instruments located at different distances from the plume, with the goal of determining the quantity of light dilution (underestimations of the flux) due to light not traversing the plume but entering the instruments. Additionally, we investigate some model estimations of the influence of the light dilution and multiple scattering inside the plume on our measurements using the Monte Carlo Radiative Transfer Model McArtim.

UP 13.12 Thu 10:45 G/Foyer

Estimation of soil hydraulic material properties based on time-lapse Ground Penetrating Radar measurements — •Stefan Jaumann, Klenk Patrick, and Kurt Roth — Institute of Environmental Physics, Heidelberg University

Soil hydraulic material properties are needed for a large range of applications, such as the optimization of irrigation and fertilization for food production in semi arid regions. However, these material properties are (i) unknown *a priori*, (ii) nearly impossible to measure directly, (iii) varying in space and in time, and (iv) highly non-linear. Hence, the development of efficient methods allowing for cheap and reliable identification of these properties is crucial.
In this study, we observed the dynamic deformation of the capillary fringe with time-lapse Ground Penetrating Radar (GPR) while forcing the hydraulic system with a fluctuating water table.
We then estimated effective material properties of the subsurface material distribution comparing the time-lapse GPR measurements to numerical simulations using the Levenberg-Marquardt optimization algorithm.
The corresponding numerical simulation of the GPR response is based on three coupled models comprising (i) a hydraulic model (Richards equation) which is based on conservation of water volume and an empirical flux law, (ii) a electrodynamic model (Maxwell's equations), and (iii) a petrophysical relationship relating the previous two via the dependency of the composite relative permittivity of the soil on the water content.

UP 13.13 Thu 10:45 G/Foyer

Development of a sample preparation procedure for the simultaneous determination of Np and Pu in clay samples — •Tobias Renz[1], Francesca Quinto[1], Markus Lagos[1], Markus Plaschke[1], Andreas Bauer[1], Horst Geckeis[1], and Heinrich Taubald[2] — [1]INE, KIT, Eggenstein-Leopoldshafen, Germany — [2]Eberhard Karls Universität, Tübingen, Germany

Neptunium (Np) and plutonium (Pu) are two key radionuclides for the long-term disposal of nuclear waste. Within this context Opalinus Clay formations are considered as a potential location for disposal of high-level radioactive waste. In the framework of experiments studying the diffusion behavior and retention of actinides under repository conditions, the present work focuses on the development of an analytical-chemical procedure for the determination of Np and Pu in clay (or clay-rich soil) samples. The procedure aims at the simultaneous determination of Np and Pu at femto- to attogram levels with AMS. Fields of application are the investigation of global fallout actinides in environmental clay-rich samples or the diffusion behavior of actinides in compacted clay liners used as technical barriers in nuclear waste repositories. Clay samples are spiked with certified standards of Pu-242 and Np-237. The analytical method, including a) leaching of the spiked clay samples, b) redox adjustments of Np and Pu, c) chromatographic separation of Np and Pu from the sample matrix and d) measurement of the actinides with Sector Field (SF)-ICP-MS will be presented. The suitability of a Pu isotope as non-isotopic tracer for determination of Np-237 is evaluated by determing the chemical yield using SF-ICP-MS.

UP 13.14 Thu 10:45 G/Foyer

Messtechnisches Prinzip eines neuen Einstrahlungsmessgerätes — •Jörg Bendfeld, Wolfgang Bermpohl und Stefan Balluff — Universität Paderborn, Paderborn, Deutschland

Das Messprinzip des Solarstrahlungssensors basiert auf der partiellen örtlichen Erfassung der Einstrahlung in festen Himmelsbereichen. Auf einem Halbkreis sind dazu radial 7 Bereichssensoren positioniert. Dieser Halbkreis dreht sich und ermöglicht so die Erfassung einer Halbkugeloberfläche Die scharfe Abgrenzung des Erfassungsbereiches des einzelnen Bereichssensors wird durch eine rotationssymmetrische Tubusoptik erreicht. Etwaige Reflexionen innerhalb der Tubusotik werden durch eine spezielle Beschichtung und die Geometrie der Innenoberfläche unterdrückt. Am Fußende der Tubusoptik befindet sich jeweils ein Messwandler auf Halbleiterbasis. Dieser wandelt die durch den Bereichssensor unter seinem festen Raumwinkel erfasste Bestrahlungsstärke in ein proportionales elektrisches Signal um.

UP 13.15 Thu 10:45 G/Foyer

High precision U-series dating of stalagmites — •Jennifer Arps[1], René Eichstädter[1], François Thil[2], and Edwige Pons-Branchu[2] — [1]Institut für Umweltphysik, Heidelberg, Germany — [2]Laboratoire des Sciences du Climat et de l'Environnement (LSCE), Gif-sur-Yvette, France

U/Th dating has become a major tool in geochronology to determine the age of secondary carbonates such as corals and stalagmites. The method is based on the radioactive disequilibrium between ^{238}U and its decay products ^{234}U and ^{230}Th in natural sedimentary deposits.

With the advent of new mass spectrometer generations the precision of age determinations as well as the sample throughput can be strongly improved, which is crucial for climate studies, and provides new tracers such as the U isotopic composition of drip water.

Here, we explore the possibility to achieve ϵ precision on stalagmites with high uranium contents using multi-collector inductively coupled plasma source mass spectrometry, whereas the challenge is to overcome the important abundance difference between uranium and thorium isotopes (in the order of 10^{-4} to 10^{-6}). First results obtained at the MC-ICPMS facility of the Laboratoire des Sciences du Climate et de L'Environnement (Gif-sur-Yvette, France) will be presented.

Ultimately we seek sub-decadal time resolution for archives as young as 2000 years, to test hypothesis on the trace of 'winter' climate change in speleothems during the Roman Migration Period (300-500 AD).

UP 13.16 Thu 10:45 G/Foyer

Towards 3D-space visualization of concentration fields of air-water gas transfer — •Darya Trofimova, Christine Kräuter, and Bernd Jähne — Institute of Environmental Physics, Heidelberg, Germany

Laser-Induced Fluorescence techniques are widely used for flow visualization, but are hard to apply for visualization of air-water gas transfer across the mass boundary layer. Due to necessity of high spatial and temporal resolution to resolve the mass boundary layer and fast turbulent processes, visualization of concentration fields are mostly possible in 2 dimensional space only.

Therefore, it is of importance to modify the technique that simplifies the fluorescence scene which will make it possible to use multi camera set up for capturing in 3 dimensional space, to measure the thickness of the mass boundary layer and to detect boundary layer detachments (surface renewal events). As the technique is based on reaction of an alkaline gas (in current studies - ammonia) with acid water died with fluorescent pH indicator (Pyranine), it is possible to gain constant fluorescence intensity with a combination of certain reagents concentrations.

In this work we present the verification of developed technique by conducting the experiments at liner-wave tank facility with measuring one dimensional concentration profiles. The results show the range of ammonia and Pyranine concentrations as well as initial conditions to maintain in order to gain binary concentration fields.

UP 13.17 Thu 10:45 G/Foyer

projection of high temperature and heat waves over China under 2°C target — •Xiaojun Guo, Yong Luo, Zongci Zhao, and Jianbin Huang — Center for Earth System Science, Tsinghua University, Beijing 100084, China

Evaluation and projection of high temperature and heat waves were carried out five CMIP5 global climate models with a 0.5°×0.5° horizontal resolution. The four indexes (heat waves frequency, heat waves duration, heat waves days and high temperature days) were adopted. Based on the five GCMs data, the timing and climate change with the global 2°C target reaching were calculated and analyzed. When global mean surface temperature rise 2°C relative to the pre-industrial, the warming rate over China region is stronger. The increase of heat waves is significant in the central of Xinjiang, northeast of Inner Mongoli, Guangdong province, northern Jiangxi and Zhejiang. And relative with the base climate(1971-2000), the increasing percentage of the heat waves days is highest with about 640%, while the increasing percentage of the high temperature days is lowest with about 165%. The percentage of area with annual heat waves number more than 1.5 times, annual heat waves duration longer than 3 days and the annual heat waves days more than 6 days increase from 0% in the base climate to more than 50%. Furthermore, the heat waves duration increase more significantly in South China and the middle and lower reaches of yangtze river, while in the Huanghuai region the heat waves number increases more remarkably.

UP 13.18 Thu 10:45 G/Foyer

The impact of energetic particle precipitation to middle atmosphere dynamic — •Khalil Karami, Miriam Sinnhuber, Stefan Versick, and Peter Braesicke — Karlsruhe Institute of Technology

Energetic particles including protons, electrons and heavier ions, enter the Earth*s atmosphere over polar region of both hemispheres, where the geomagnetic lines are considered to be open and connected to the interplanetary medium. Such particle precipitations can greatly disturb the chemical composition of the upper and middle atmosphere.The most important are changes to the budget of atmospheric nitric oxides, NOy, and to atmospheric reactive hydrogen oxides, HOx, which both contribute to ozone loss in the stratosphere and mesosphere. The chemistry-climate general circulation model ECHAM5/MESSy is used to investigate the impact of changed ozone concentration due to energetic particles precipitation on temperatures and wind fields. The simulated anomalies of both zonal mean temperature and zonal wind suggest that these changes are very unlikely to be caused in situ by ozone depletion and indirect dynamical condition is important. Different dynamical analysis (e.g., frequency of sudden stratospheric warming, dates of stratospheric final warming, divergence of Eliassen-Palm flux and refractive index of planetary waves) are performed to investigate the impact of ozone anomaly originated from high energetic particle precipitation on middle atmospheric temperature and circulation.

UP 13.19 Thu 10:45 G/Foyer

reconstruction of Arctic surface temperature in past 100 years using DINEOF — •Qiyi Zhang — Center for Earth System Science, Tsinghua University, Beijing, China

Global annual mean surface temperature has not risen apparently since 1998, which was described as global warming hiatus in recent years. However, measuring of temperature variability in Arctic is difficult because of large gaps in coverage of Arctic region in most observed gridded datasets. Since temperature risen in Arctic is faster than global mean, the unobserved temperature in central Arctic will result in cold bias in both global and Arctic temperature measurement compared with model simulations and reanalysis datasets. Data Interpolating Empirical Orthogonal Function (DINEOF) were applied to fill the coverage gap in Arctic of NASA's Goddard Institute for Space Studies Surface Temperature Analysis (GISTEMP 250km smooth) product and reconstruct Arctic temperature in past 100 years. This method provided temperature reconstruction in central Arctic and precise estimation of global and Arctic temperature variability with a long temporal scale. Results have been verified by extra observed records of stations in Arctic.The amplification in polar region is more significant in reconstruction in recent 30 years, as the trend in Arctic since 1997 is 0.76°C per decade, compared with 0.48°C and 0.67°C per decade from 250km smooth and 1200km smooth of original GISTEMP. And global temperature trend is two times greater after using DINEOF. The result indicates that global warming in these years is not as slow as thought.

UP 13.20 Thu 10:45 G/Foyer

Merging the climate model results with proxy records over land-only Arctic area in recent 600 years — •Xin Chen, Yong Luo, and Pei Xing — Center for Earth System Science(CESS), Tsinghua University, Beijing, China

Surface air temperature variation over Arctic area in past centuries is not well depicted due to the sparse of the proxy data. Another effective approach to study such a problem is high resolution climate system model simulation, which can provide a comprehensive picture of temperature evolvement. This research present a new approach to combine the proxy records and model simulation, in order to obtain a dataset over Arctic area, to be more completed and indicate more real signals recorded in proxy series. Optimal interpolation algorithm has been performed to merge the climate system model (BCC-CSM-1.1) simulations with the proxy records. Results indicate warming rate in arctic lands is 0.07°C per decade in modern years (1885-1985AD), while in north hemisphere lands is 0.05°C per decade, which is so called Arctic Amplification (AA). In our constructed dataset, AA can be identified in recent 350 years, the surface air temperature rise by 0.03°C per decade, a little higher than north hemisphere temperature trend over lands (0.02°C per decade). By comparing our merged dataset to the simulated results, model simulation tend to overestimate the temperature coldness in little ice age (1400-1850AD) by 0.2°C colder averagely, and a smaller warming rate in recent 350 years. However, they both indicate an agreeable warming trend in recent a hundred of years.

UP 13.21 Thu 10:45 G/Foyer

Extraction of neodymium isotopes from different phases of deep sea sediments by selective leaching — •Patrick Blaser[1], Jörg Lippold[2], Norbert Frank[1], Marcus Gutjahr[3], and Evelyn Böhm[1] — [1]Ruprecht-Karls-Universität Heidelberg, Germany — [2]Universität Bern, Switzerland — [3]GEOMAR, Helmholtz Centre for Ocean Research, Kiel, Germany

The analysis of seawater-derived neodymium (Nd) isotopes in marine

sediments provides a unique proxy for deep water provenance, and thus ocean circulation, in particular in the Atlantic. Bottom water Nd is archived in different authigenic phases in the sediment. Extracting this Nd from mineral accretions bound to foraminiferal tests has lately become the preferred since most reliable method. Attempts have also been made to extract the Nd-rich authigenic fraction by leaching it off the bulk sediment and thereby use this proxy with less effort, in the highest possible resolution and in sediments where foraminifera are not sufficiently present. However, often other sedimentary components are also leached in the process and contaminate the extracted Nd. In this project several sediments across the Atlantic were leached in ten consecutive steps with two commonly used acidic solutions. The leachates were analysed on their elemental and Nd isotope compositions, as well as rare earth element (REE) distributions. By graduating the total leaching procedure into smaller stages the results display which processes take place in the course of sediment leaching in the laboratory and thus help to better evaluate the quality of sediment leaches for Nd isotope analysis.

UP 13.22 Thu 10:45 G/Foyer

Deep Atlantic Circulation changes around Heinrich events: A 231Pa/230Th compilation — •Benny Antz[1], Jörg Lippold[2], Norbert Frank[1], and Hartmut Schulz[3] — [1]Institute of Environmental Physics, University of Heidelberg, Germany — [2]Institute of Geological Sciences, University of Bern, Switzerland — [3]Department of Geosciences, University of Tübingen, Germany

Freshwater input through abrupt melting of continental ice sheets can affect the Atlantic Meridional Overturning Circulation's (AMOC) overturning vigour. Such forcing can be tested by investigating its behaviour during extreme iceberg discharge events into the open North Atlantic, so called Heinrich-Events [Heinrich 1988]. In this project we have measured 231Pa/230Th ratios in numerous sediment cores and present a compilation across Heinrich Events 1 (˜17 ka BP) and 2 (˜24 ka BP). The comparison of those demonstrates that interpretations of a single profile is not sufficient for reaching conclusions related to AMOC in its entirety. We observe large variations of opal contents and with a few data points showing correlation with 231Pa/230Th. Furthermore we find a clear disparity in the influence of melting icebergs on (North-) Atlantic Circulation during Heinrich Event 1 and 2. By the observation of self-measured and published 231Pa/230Th over Heinrich-Stadials 1 & 2 and their comparison we see, that a supposed weakening of AMOC strength due to freshwater-input was fiercer during Heinrich Stadial 1. With an inverse model approach [Luo et al. 2010] strength of the AMOC before, during and after the Heinrich-Stadials 1 & 2 will be derived from this database.

UP 13.23 Thu 10:45 G/Foyer

Growth rates of ferromanganese crusts - O2 concentration in the deep Pacific during the LGM — •Freya Hemsing[1], Augusto Mangini[1], Christian Wirsig[2], and Norbert Frank[1] — [1]Institute of Environmental Physics, Heidelberg, Germany — [2]Laboratory of Ion Beam Physics, ETH Zurich, Switzerland

In the last years several studies and hypotheses suggest climate driven variations of the O_2 concentration leading to potentially anoxic conditions in the Deep Water of the Pacific during glacial times like the Last Glacial Maximum (LGM). The growth of ferromanganese crusts is closely linked to the dissolved O_2 content in bottom waters. The crust VA13-2 from the Equatorial Pacific (146° W, 9° 25' S, 4830 m) is analysed for a period covering the LGM. Due to the extremely slow growth rate of 10.30 ± 0.88 mm/Ma this only corresponds to about the upper 300 ± 10 μm. Four profiles were taken with a spatial resolution of 12.6 mm^2 and a depth resolution of 10 - 20 μm. The ^{230}Th concentration of each layer was measured by thermal ionisation mass spectrometry. Applying ^{230}Th excess dating and a constant flux model for ^{230}Th, the temporal growth rate development was derived with a resolution of 500 a. The obtained temporal variations of the growth rate show a significant slowdown of the growth during the LGM. This implies a noticeable O_2 depletion of the Pacific Deep Water during the LGM. However, no growth stops and thus no anoxic conditions can be inferred with respect to the achieved resolution.

UP 13.24 Thu 10:45 G/Foyer

Noble Gases of Glacial Origin in Palaeogroundwater in the Northern Part of the Baltic Artesian Basin, Estonia. — •Therese Weissbach[1], Werner Aeschabch-Hertig[1], Valle Raidla[2], and Rein Vaikmäe[2] — [1]Institute of Environmental Physics, Heidelberg University, Heidelberg, Germany — [2]Institute of Geology, Tallinn University of Technology, Tallinn, Estonia

The Cambrian-Vendian (Cm-V) and Ordovician-Cambrian (O-Cm) aquifer systems are part of the Baltic Artesian Basin (BAB). The groundwater of these aquifer systems is characterized by a strong depletion of the stable isotope composition (δ^{18}O in the range of -18.5‰to -22‰) and low radiocarbon concentration. Considering both facts, an origin of this groundwater from glacial meltwater during the last glaciation is indicated. An extensive noble gas study was conducted in these aquifer systems to investigate the noble gas signature of this water, which is known to be unusually gas rich. Indeed, the BAB groundwaters exhibit enormous excess air amounts, which could be due to trapped air in glacial ice that was forced into solution during recharge beneath an ice sheet. Furthermore, the noble gas composition of the Estonian wells clearly shows a depletion of neon compared to atmospheric air, possibly due to a loss of neon by diffusion through the ice. However, no conclusive scenario for the formation of the highly unusual noble gas signature is currently available.

UP 13.25 Thu 10:45 G/Foyer

Dynamics of reactive and inert gases in soil air and groundwater in the context of noble gases as environmental tracers — •Simon Mayer, Florian Jenner, and Werner Aeschbach-Hertig — Institut für Umweltphysik, Heidelberg, Deutschland

A detailed understanding of the dynamics of reactive and inert gases in the subsurface is important for reliable gas tracer studies such as noble gas (NG) temperature determination and groundwater dating. Our study provides a long-term record of NG, SF_6 and CFCs in both soil air and groundwater at different sites near Heidelberg (Germany) as well as a NG analysis in a tropical region (Santarém, Brazil). The influence of soil respiration is investigated by O_2, CO_2, soil temperature and moisture measurements.

Measured NG partial pressures in soil air show an increase with respect to atmospheric air by up to 12%. In Heidelberg, this enhancement occurs as a seasonal effect. Here, a mass-dependent fractionation is caused by varying diffusivities of different isotopes. In Santarém, such fractionation effects were not observed, indicating a NG enhancement with respect to the atmosphere during the entire year.

SF_6 concentrations in soil air correspond to the mean local atmospheric mixing ratio which is enhanced in the study area near Heidelberg due to industrial sources by more than 12% with respect to the mean concentration in the Northern hemisphere. Thus a reliable correction of the local atmospheric input curve is possible for groundwater dating.

UP 13.26 Thu 10:45 G/Foyer

Dating with Atom Trap Trace Analysis of ^{39}Ar: Methods of sample preparation — •Arne Kersting[1], Thomas Reichel[1], Sven Ebser[2], Florian Ritterbusch[1,2], Werner Aeschbach-Hertig[1], and Markus K. Oberthaler[2] — [1]Institute of Environmental Physics, Heidelberg, Germany — [2]Kirchhoff-Institute for Physics, Heidelberg, Germany

We have developed an Atom Trap Trace Analysis setup of ^{39}Ar as well as an extraction and separation system for water and ice samples. For the explicit demonstration of application, we took large groundwater samples, degassed them in the field and separated argon by a gas chromatographic technique. The argon purification of ice samples is realized with a setup based on a titanium getter. With argon purities of about 98% and recoveries above 90%, the setup fulfills the sample requirements of the ATTA apparatus for ^{39}Ar dating. Only small modifications of the ice purification setup are required to adapt the sample preparation method to ocean samples.

UP 13.27 Thu 10:45 G/Foyer

Comparison of Parametrizations for Bubble-induced Gas Exchange — •Wolfgang Mischler and Bernd Jähne — Institut für Umweltphysik, Heidelberg, Deutschland

Common parametrizations for bubble mediated gas transfer are compared on a basis of systematic measurements of gas transfer rates at a dedicated bubble tank. Trace gas concentrations were measured using a quadrupole mass spectrometer with a silicone membrane inlet in the water phase of the tank. Fourteen trace gases with a wide range of solubilities and diffusivities – SF_6, Neon, N_2, HD, D_2, O_2, Krypton, Pentafluoroethane, Xenon, N_2O, C_2H_2, CH_3Cl, Benzene and DMS – were used to investigate the dependency on these two physico-chemical parameters. Bubbles were generated by a water jet with adjustable kinetic energy, which entrained a controllable gas volume flux into the

water tank. Invasion and evasion experiments with a variety of conditions were conducted including salt water (1.75% NaCl), the addition of the soluble surfactant Triton X-100, n-butanol and glycerol.

Existing models for bubble mediated gas transfer are tested. Simple power law dependencies turn out to be incapable to describe the transfer for the whole range of solubilities and diffusivities. An extension of the parametrization proposed by Woolf fits the data best. A simple model using only 2 parameters is proposed. Its performance is almost as good as the extended Woolf model.

UP 14: PV Marschall

Time: Friday 9:00–9:45 Location: PV-Rooms

Plenary Talk UP 14.1 Fri 9:00 PV-Rooms

The Oceans in a Warming World: How are the oceans changing and what role do they play in climate change? — •John Marshall — Massachusetts Institute of Technology, Cambridge, MA, USA

Due to its enormous heat capacity and ability to move heat around the globe, the ocean plays an out-sized role in climate and climate change. The ocean is at the center of contemporary questions such as:
- Why have global-mean surface temperatures not warmed in the last decade, despite CO_2 continuing to rise in the atmosphere?
- Why is the Arctic losing sea-ice but not the Antarctic?
- Will ocean currents such as the Gulf Stream change?
- How much might sea-level rise this century?
- How might life respond to the ocean becoming ever more acidic as CO_2 dissolves into it?

In this discussion we will touch on some of the above questions and review how scientists observe patterns of warming propagating down in to the ocean's interior, how the ocean is responding to that warming, what we think the future holds and why.

UP 15: Bodenkunde und Kryosphäre

Time: Friday 10:00–10:45 Location: G/gHS

UP 15.1 Fri 10:00 G/gHS

Soil Hydrology - Simultaneous Estimation of States, Parameters and Boundary Condition with Ensemble Kalman Filter — •Hannes Helmut Bauser, Stefan Jaumann, and Kurt Roth — Institute of Environmental Physics, Heidelberg University, Heidelberg

The Ensemble Kalman Filter (EnKF) is widely used in hydrologic modeling to estimate states and parameters incorporating uncertainties in measurements and all model components. In soil hydrologic modeling, especially the experimental determination of evaporation faces large uncertainties which are relayed to the formulation of the upper boundary condition of the model.

Thus, we expand the EnKF to additionally estimate the upper boundary condition by augmenting the state vector. Lacking a formulation of the forward model of the boundary condition, highly uncertain measurements are implemented as the forward model.

Additionally, the EnKF is applied iteratively allowing the update of the boundary condition to be dampened in case of a strongly non linear relationship of the boundary condition to the measurements.

The proposed new method is successfully tested on a synthetic 1D data set of subsurface water content measurements, imitating a Time Domain Reflectometry (TDR) measurement time-series. The results indicate that this modified EnKF is capable of estimating the upper boundary condition well, as long as a low temporal resolution is sufficient.

UP 15.2 Fri 10:15 G/gHS

Solute transport in heterogeneous layered porous media with stationary water flow — •Lisa Feustel and Kurt Roth — Institut für Umweltpysik, Heidelberg University, Germany

We present the results of tracer experiments in heterogeneous layered porous media realized in a quasi-two-dimensional Hele-Shaw cell. A flux depending pathway of the tracer pulse around structures of low conductivity is observed. Different possibilities to analyze experiments based on optical images are evaluated. It is shown, that the behavior of a tracer pulse and especially its pathway can generally be reproduced by a simulation, based on a numerical solution of the Richards equation and the convection-dispersion- equation. Material parameters are chosen on the basis of some simple geometric estimations and experimental observations. On the basis of a number of simulations solute transport in heterogeneous media is further analyzed. The heterogeneous structure of the porous medium is found to dominantly influence the shape and pathway during transport of a tracer pulse.

UP 15.3 Fri 10:30 G/gHS

Glacial-interglacial variability change: a view beyond ice cores — •Kira Rehfeld[1], Sze Ling Ho[1], Thomas Münch[1,2], and Thomas Laepple[1] — [1]Helmholtz Junior Research Group ECUS, Alfred-Wegener-Institut für Polar und Meeresforschung, Potsdam, Germany — [2]Department of Physics, Universität Potsdam, Germany

The last glacial period was characterized by a highly variable climate, including abrupt changes such as Heinrich- and Dansgaard-Oeschger events. By contrast, the warm Holocene time period was relatively stable. This variability change is often discussed based on data from polar ice cores, particularly from Greenland. Here, we contrast the polar ice core based variability change with the variability change as recorded by a global compilation of marine and terrestrial proxy records.
Accounting for uneven sampling in time and space, we develop an understanding of proxy signal-to-noise ratios which allows insight into proxy-specific biases concerning the recording of climate variability. Our results suggest that the oxygen isotopic composition of Greenland ice cores may not have reliably recorded Holocene temperature variability.
Globally, we find climate at the glacial maximum five times more variable than during the Holocene. This variability is expressed in particular by the polar ice cores: We find a stronger polar amplification of climate variability during the Glacial than during the warm Holocene. Our results indicate that the view of an extremely variable Glacial contrasting with a quiet Holocene may underestimate the actual variability of the present warm Interglacial.

UP 16: Meßtechnik

Time: Friday 10:45–13:00 Location: G/gHS

UP 16.1 Fri 10:45 G/gHS

High-precision surface-based Ground-Penetrating Radar monitoring of near-surface hydrological processes — •Patrick Klenk, Stefan Jaumann, and Kurt Roth — Inst. f. Umweltphysik, Universität Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg

Throughout the last decade, Ground-Penetrating Radar (GPR) has been developed as a versatile tool for imaging the sub-surface. Especially its application for observing soil water content, a crucial state variable in soil hydrology, has been investigated, since traditional methods have often proven to be insufficient at the field-scale. For developing high-precision GPR methods for monitoring soil water dy-

namics, the ASSESS experimental site was constructed close to Heidelberg. This test-site has been designed with a complicated but known subsurface structure to advance the quantification of GPR methods under a wide range of different conditions. Highly dynamic conditions can be induced by either varying the water table position through pumping water into and out of an observation well or by infiltration with a sprinkler system.
We here present a series of *time-lapse GPR observations* of deliberately induced *infiltration*, *imbibition* and *drainage processes*, which we compare with numerical simulations of both subsurface water flow and the expected GPR response. In particular, we discuss the attainable precision in this well-controlled setup with respect to high-resolution observation of infiltration processes, which is currently about one order of magnitude better than so far demonstrated in the field.

UP 16.2 Fri 11:00 G/gHS

Soil moisture sensing by cosmic ray induced neutron showers — •Markus Köhli[1], Martin Schrön[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg, Heidelberg, Germany — [2]Helmholtz Zentrum Für Umweltforschung, UFZ, Leipzig

Techniques for probing soil moisture at intermediate scales inbetween those of satellite based systems and local on site measurements have become a highly demanded field of research. Passive sensing of neutrons originating from cosmic particle air showers offers the possibility of detecting water by averaging over a large area. It is a characteristic feature of hydrogen to slow down neutrons very efficiently whereas heavier elements more likely reflect them. This leads to the spectrum of reflected neutrons being dependent on the water content in the environment. We present Monte Carlo based simulations to study the footprint of this method for various conditions. Intensity and range dependencies can furthermore now be described by analytical functions.

Kaffeepause

Invited Talk UP 16.3 Fri 11:45 G/gHS

Air-Sea Gas Exchange: from Empiric Wind Speed Relations to Regimes and Ranges — •Bernd Jähne — Institut für Umweltphysik, Universität Heidelberg — HCI, Universität Heidelberg

Even after more than thirty years of intensive research on air-water gas transfer (the 1st symposium on Gas Transfer at Water Surfaces took place in 1983), no satisfactory physically-based model of gas transfer is available. Consequently, semi-empirical relationships between the gas transfer velocity k and wind speed at 10 m height, U_{10}, are still state-of-the-art — and (too) many of them are available.

However, measured transfer velocities show significant deviations from a such a simple relationship. This variability is obviously caused by different conditions at the water surface at the same wind speed such as atmospheric stability, water temperature, different degrees of contamination by surface active material, and the sea state — but a comprehensive model will need further years of research.

Given this unsatisfactory situation, a better alternative to empirical wind speed relations is proposed: the definition of upper and lower limits in different wind speed regimes both for the gas transfer velocity and its dependency on the Schmidt number. This approach is possible by a combined analysis including theoretical considerations and available laboratory and field data. In this way, modelers get clear evidence about the range of possible gas transfer velocities in different wind speed ranges.

UP 16.4 Fri 12:15 G/gHS

Sensing Environmental Water Content with Cosmic-Ray Neutrons — •Martin Schrön[1], Markus Köhli[2], Steffen Zacharias[1], Peter Dietrich[1], and Sascha Oswald[3] — [1]Helmholtz-Zentrum für Umweltforschung - UFZ Leipzig — [2]Physikalisches Institut, Universität Heidelberg — [3]Institut für Erd- und Umweltwissenschaften, Universität Potsdam

Cosmic-ray neutron sensing has become an increasingly accepted and unique method to monitor the effective soil water content at the field scale. The technology is famous for its low maintenance, non-invasiveness, continuous measurement, and most importantly, for its large footprint.

The method takes advantage of neutrons induced by cosmic radiation which are extraordinarily sensitive to hydrogen and behave like a hot gas in air. Information about nearby water sources quickly mixes in a domain of tens of hectares.

We investigate different contributions to the neutron signal and the influence of spatial structures and environmental conditions. Stationary detectors as well as mobile surveys with the Cosmic-Ray Rover reveal pros and cons of this state-of-the-art technology.

UP 16.5 Fri 12:30 G/gHS

Active Thermography as a Tool to Investigate Heat and Gas Transfer — •Jakob Kunz[1] and Bernd Jähne[1,2] — [1]Institute of Environmental Physics, University of Heidelberg, INF 229, D-69120 Heidelberg, Germany — [2]Heidelberg Collaboratory for Image Processing, University of Heidelberg, Speyerer Straße 6, D-69115 Heidelberg, Germany

Gas exchange between the ocean and the atmosphere plays a key role for climate modelling. While direct measurements of the gas exchange are mainly suitable for laboratory measurements with well-defined air and water volumes, local measurements of heat transfer are also possible in field experiments.

The active thermography measuring technique provides a tool to estimate heat transfer velocities both in lab and field experiments on spatial scales of less than a m^2 and time scales in the order of minutes. It is based on heating a well-defined area of the water surface with a laser and measuring the temperature response of the water surface with an infrared camera in the 3-5 μm range.

To compare gas and heat exchange under the most natural conditions possible in a laboratory, measurements with sea water from the north Atlantic have been performed in November 2014 in the annular Heidelberg wind-wave facility (Aeolotron) within the framework of the BMBF SOPRAN project.

The talk will explain the measuring technique and will present first results.

UP 16.6 Fri 12:45 G/gHS

High-resolution 2-D fluorescence imaging of gas transfer at a free water surface — •Christine Kräuter[1,2], Darya Trofimova[1,2], Daniel Kiefhaber[1,2], and Bernd Jähne[1,2] — [1]Institut für Umweltphysik, Heidelberg University, Germany — [2]Interdisciplinary Center for Scientific Computing, Heidelberg University, Germany

Results from a first study with a novel 2-D fluorescence imaging technique to visualize gas exchange between air and water are presented. The invasion of ammonia into water leads to an increase in pH (starting from a value of 4), which is visualized by a fluorescent dye. Fluorescence is stimulated with high power LED arrays and observed with a low noise scientific CMOS camera. Thus, it is possible to visualize ammonia concentration differences in a thin layer ($<$ 1 mm) at the water surface. By controlling the flux of ammonia, a fraction of the mass boundary layer at the water surface is controlled. In this way, processes from different depths are observed. In addition to the fluorescence measurements, collocated infrared imagery as well as wave slope measurements are available from an experiment at the large annular Aeolotron wind-wave facility at the Institute of Environmental Physics in Heidelberg. The measurements give a direct insight into the mechanisms of air-sea gas transfer. Langmuir circulations enhance gas transfer but do not change the Schmidt number exponent. With increasing frequency of microscale wave breaking, the Schmidt number exponent gradually changes from 2/3 to 1/2. Surface films significantly suppress the frequency of mircoscale wave breaking.