Environmental Physics Division
Fachverband Umweltphysik (UP)

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Übersicht der Hauptvorträge und Fachsitungen

(Vorträge: MAG 100; Poster: MAG Poster, Plenarvortrag: Audimax, Symposium: Audimax)

Plenarvortrag von Interesse für UP

PV III	Tue	8:30– 9:15	Audimax	**Research Data Infrastructures – Challenges, Desires, Incentives** — •Maik Thomas

Hauptvorträge

UP 2.1	Tue	10:00–10:30	MAG 100	**Creating climate data records from operational meteorological microwave humidity sounders** — •Stefan Buehler, Viju John, Mathias Milz
UP 2.7	Tue	13:15–13:45	MAG 100	**Observing the Anthropocene from Space: from SCIAMACHY to GeoSCIA/Copernicus Sentinel 4, Sentinel 5, CarbonSat and SCIA-ISS** — •John P. Burrows
UP 5.1	Wed	9:30–10:00	MAG 100	**Fernerkundung der Atmosphäre mittels hochauflösender Infrarotspektroskopie** — •Johannes Orphal
UP 9.1	Wed	13:45–14:15	MAG 100	**New possibilities for UV research by simultaneous spectral radiance measurements** — •Gunther Seckmeyer, Stefan Riechelmann, Michael Schrempf, Ansgar Stührmann
UP 10.4	Wed	15:30–16:00	MAG 100	**Amplified Climate Changes in the Arctic: Role of Clouds and Atmospheric Radiation** — •Manfred Wendisch
UP 12.1	Thu	9:30–10:00	MAG 100	**Laser filament induced secondary ice multiplication under cirrus cloud conditions** — Thomas Leisner, Denis Duft, Harald Saathoff, Martin Schnaiter, Stefano Henin, Kamil Stelmaszczyk, Massimo Petrarca, Raphaëlle Delagrange, Zuoqiang Hao, Johannes Lüder, Yannick Petit, Philipp Rohwetter, Jérôme Kasparian, Jean-Pierre Wolf, •Ludger Wöste
UP 12.5	Thu	11:15–11:45	MAG 100	**Contact freezing induced by mineral dust particles** — •Nadine Hoffmann, Manfred Schäfer, Denis Duft, Alexei Kiselev, Thomas Leisner
UP 13.1	Thu	12:00–12:30	MAG 100	**The 5th IPCC report: climate change and the drivers** — •Monika Rhein
UP 13.2	Thu	13:30–14:00	MAG 100	**Wechselwirkung zwischen arktischem Meereis und der atmosphärischen Zirkulation** — •Klaus Dethloff, Dörthe Handorf, Ralf Jaiser, Annette Rinke
UP 13.5	Thu	14:30–15:00	MAG 100	**A simple physical explanation for the sensitivity of the hydrologic cycle to global climate change** — •Axel Kleidon, Maik Renner

Hauptvorträge des fachübergreifenden Symposiums SYKW

SYKW 1.1	Tue	16:30–17:00	Audimax	**Klimaänderungen in den Polarregionen** — •Peter Lemke
SYKW 1.2	Tue	17:00–17:30	Audimax	**The IPCC assessment of the recent hiatus in surface warming** — •Jochem Marotzke

SYKW 1.3	Tue	17:30–18:00	Audimax	**Die Rolle der oberen Troposphäre / unteren Stratosphäre bei dekadischer Klimavariabilität** — •Martin Riese
SYKW 1.4	Tue	18:00–18:30	Audimax	**Internal Southern Ocean Centennial Variability: Implications for Global Warming** — •Mojib Latif

Fachsitzungen

UP 1.1–1.1	Tue	8:30– 9:15	Audimax	**Plenary Talk by Maik Thomas**
UP 2.1–2.9	Tue	10:00–14:45	MAG 100	**Methoden - Fernerkundung**
UP 3.1–3.4	Tue	14:45–15:45	MAG 100	**Atmosphäre - Spurengase**
UP 4.1–4.4	Tue	16:30–18:30	Audimax	**Symposium - Klimawandel, gibt es eine Erwärmungspause ?**
UP 5.1–5.3	Wed	9:30–11:00	MAG 100	**Atmosphäre - Spurengase**
UP 6.1–6.2	Wed	11:00–11:30	MAG 100	**Kryosphäre und Ozeanographie**
UP 7.1–7.3	Wed	11:30–12:15	MAG 100	**Methoden - Messverfahren und Datenauswertung**
UP 8	Wed	12:15–13:45	MAG 100	**Fachverbandssitzung**
UP 9.1–9.1	Wed	13:45–14:15	MAG 100	**Methoden - Messverfahren und Datenauswertung**
UP 10.1–10.6	Wed	14:15–16:30	MAG 100	**Atmosphäre - Aerosole**
UP 11.1–11.13	Wed	17:00–18:30	MAG Poster	**Postersession**
UP 12.1–12.6	Thu	9:30–12:00	MAG 100	**Atmosphäre - Labor**
UP 13.1–13.5	Thu	12:00–15:00	MAG 100	**Klimamodellierung**

Mitgliederversammlung des Fachverbands Umweltphysik

Mittwoch 12:15 - 13:45 MAG 100
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: Plenary Talk by Maik Thomas

Time: Tuesday 8:30–9:15 Location: Audimax

Plenary Talk UP 1.1 Tue 8:30 Audimax

Research Data Infrastructures – Challenges, Desires, Incentives — •Maik Thomas — Helmholtz-Centre Potsdam, GFZ German Research Centre for Geosciences

New scientific instruments, such as sensor networks, satellites, telescopes and supercomputers, are generating vast amounts of data providing one of the most important pillars for scientific findings and supporting progressively decision-making processes. Although research data acquisition is generally associated with large technical, staff, and thus financial investments, the information content of resulting data products is often not fully exploited due to restricted access, deficiencies in documentation, or limited availability. After a long lasting fragmentation of science into more and more specialized research fields, present scientific challenges increasingly demand overcoming of frontiers separating scientific disciplines. In particular, substantial progress in modern information technologies supports this linking and, in principle, promotes the achievement of new synergetic effects. However, multi-disciplinary synergies and improvement in efficiency imply that research data are easily accessible and comprehensibly documented in order to be usable for a broad community outside of the specific subject area. This gains in importance considering that the spectrum of transdisciplinary benefit of research data is generally not obvious at the time of their generation. Although scientists are becoming more and more aware of the need for sustainable data handling and numerous data policies and strategies have been developed, the realization mainly depends on appropriate incentives for parties involved in data generation.

From the perspective of a scientist producing large amounts of data the talk outlines requirements concerning the development of future research data infrastructures and tries to identify prospects for the motivation of scientists to make their contribution to sustainable handling of research data.

UP 2: Methoden - Fernerkundung

Time: Tuesday 10:00–14:45 Location: MAG 100

Invited Talk UP 2.1 Tue 10:00 MAG 100

Creating climate data records from operational meteorological microwave humidity sounders — •Stefan Buehler[1], Viju John[2], and Mathias Milz[3] — [1]University of Hamburg — [2]Met Office (UK) — [3]Lulea University of Technology

We have now a more than 20 years data record from meteorological humidity sounders of the SSM/T2, AMSU-B, MHS family. These three instrument types are quite similar, but not identical in their characteristics. Furthermore, each of these instruments exists on different satellites. Copies of the same instrument type on different satellites are very similar, but also they are not completely identical. Having so many instances of broadly the same instrument opens unique possibilities, but also presents challenges.

When using all instruments together synergistically, it is important that they are properly inter-calibrated. The talk discusses methods to achieve this. With proper intercalibration, instruments that coexist in time can be used to reconstruct the diurnal cycle of atmospheric humidity. Also, the global time series can be reconstructed from the total data record. However, in that case orbit drift is an important issue in addition to instrument calibration. The talk discusses also options to address that issue.

UP 2.2 Tue 10:30 MAG 100

Atomic oxygen retrievals in the MLT region from SCIAMACHY nightglow observations — •Olexandr Lednyts'kyy and Christian von Savigny — Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Deutschland

Atomic oxygen in the mesosphere-lower thermosphere region (MLT) is one of the important reactive trace gases relevant for ozone and hydroxyl radical (OH) formation. The nightglow green line emission was measured near-globally by the sun-synchronous SCIAMACHY grating spectrometer aboard ENVISAT-1 satellite from August 2002 to April 2012 at approximately 22:00 LT. Atomic oxygen concentration [O] profiles were calculated with the SCIAMACHY volume emission rate profiles being retrieved from the limb emission rate profiles (upon solving of the inverse problem supported by the regularized total least squares minimization). The photochemical model based on the generally accepted 2-step Barth transfer scheme was applied in the calculation of [O] profiles on directly measured emissions of the excited atomic oxygen. Error analysis was done to estimate the maximum error uncertainty under assumption of independent contribution of errors for each considered parameter. The retrieved atomic oxygen profiles show the characteristic and expected seasonal variation in agreement with independent atmospheric models and satellite observations based on analysis of OH Meinel band emissions. Furthermore, a pronounced 11-year solar cycle variation can be identified in the atomic oxygen time series.

UP 2.3 Tue 10:45 MAG 100

A Fabry-Perot Interferometer - based Camera for two-dimensional mapping of SO_2 Distributions — •Jonas Kuhn[1], Nicole Bobrowski[1], Peter Lübcke[1], Leif Vogel[2], and Ulrich Platt[1] — [1]Institut for Environmental Physics, University of Heidelberg, Germany — [2]Earth Observation Science group, Space research Centre, University Leicester, GB

We present a new imaging method for the remote sensing of volcanic gases, which relies on the analysis of regularly spaced narrow-band absorption structures of many small molecules, like SO_2, BrO or OClO in the UV-visible spectral region. A Fabry-Perot interferometer (FPI) is used to compare the scattered solar radiance at wavelengths corresponding to absorption bands with the radiance at wavelengths in between the bands, thereby identifying and quantifying the gas. In this first theoretical study, we present sample calculations for the detection of SO_2. Optimum values for FPI parameters (finesse, free spectral range) are proposed and possible realisations of such instruments are sketched. Further, the performance of the FPI method is compared to "conventional" SO_2 cameras relying on interference filters. We show that camera systems using a FPI potentially achieve a higher sensitivity and are far less influenced by changes in atmospheric radiative transfer. Therefore FPI-based instruments have a great potential as future technique to examine emissions of SO_2 (and other gases) from volcanic sources or other point sources.

Kaffeepause, 30 min

UP 2.4 Tue 11:30 MAG 100

Evaluierung von Eiswolken-Parametrisierungen mittels höheren Radarmomenten — •Maximilian Maahn[1], Ulrich Löhnert[1] und Pavlos Kollias[2] — [1]Institut für Geophysik und Meteorologie, Universität zu Köln, Deutschland — [2]Dep. of Atmospheric and Oceanic Sciences, McGill University, Montreal, Kanada

Das Verständnis der mikrophysikalischen Prozesse und Eigenschaften von Eiswolken ist immer noch lückenhaft und langfristige Beobachtungen sind zur Verbesserung notwendig. Flugzeuggebundene In-situ Beobachtungen sind jedoch sehr aufwendig und können daher nur Momentaufnahmen liefern. Bodengebundene Fernerkundungsmethoden haben das Potential diese Lücke zu füllen, jedoch weisen Standardverfahren zur Messungen meteorologischer Parameter mittels z.B. Wolkenradar große Unsicherheiten auf, da sie nur einen Bruchteil der erforderlichen Freiheitsgrade erfassen können. Üblicherweise wird nur Reflektivität oder Dopplergeschwindigkeit eines Wolkenradars verwendet. Die hier vorgestellte Studie benutzt daher zusätzlich auch die höheren Momente des Dopplerspektrums wie spektrale Breite, Schiefe und Wölbung sowie die Steigungen der Spektren. Diese werden verwendet um verschiedene Parametrisierungen von Anzahl, Dichte, Form und Streueigenschaften von Eispartikeln zu testen. Hierzu werden die Radarbeobachtungen inklusive der höheren Radarmomente mit Hilfe von In-situ Messdaten der ISDAC Kampagne in Alaska simuliert und

mit Beobachtungen des MMCR Radars des ARM Observatoriums in Barrow, Alaska, verglichen.

UP 2.5 Tue 11:45 MAG 100

Estimation of anthropogenic greenhouse gas emission rates using Methane Airborne MAPper (MAMAP) spectroscopic measurments — •Sven Krautwurst, Thomas Krings, Konstantin Gerilowski, Michael Buchwitz, John Burrows, and Heinrich Bovensmann — University of Bremen, Institute of Environmental Physics. P.O. 330440, 28334 Bremen, Germany

Carbon dioxide (CO2) and methane (CH4) are the two most important anthropogenic greenhouse gases. The quantification of their sources and sinks is essential to predict their future abundance and their impact on climate. The Methane Airborne MAPper (MAMAP) instrument provides spectroscopic measurements which can be used to estimate emission rates of localized CO2 and CH4 sources. In this talk, new measurements of the coal-fired power plants (PP) Jaenschwalde and Schwarze Pumpe taken during a campaign in the year 2011 are presented. The obtained column-averaged dry air mole fractions of carbon dioxide (XCO2) were compared to previous data of the same PPs gathered during a campaign in the year 2007. It could be confirmed that a modification of the instrument, between 2007 and 2011, improved the precision of retrieved XCO2. Furthermore, an algorithm was developed utilizing vertically highly resolved potential temperature and wind profiles from model runs for a more realistic description of the lower atmosphere, in order to determine the plume propagation and its vertical distribution. From that, mean wind speeds of the plumes used for emission rate estimates of both PPs in 2007 and 2011 were estimated.

UP 2.6 Tue 12:00 MAG 100

Bestimmung vertikaler Spurengasprofile in der antarktischen Troposphäre mithilfe helikoptergestützer Differentieller Optischer Absorptionsspektroskopie (DOAS) — •Jan-Marcus Nasse, Johannes Zielcke, Udo Friess und Ulrich Platt — Institut für Umweltphysik, Ruprecht-Karls Universität Heidelberg

In Polarregionen wird das freie Radikal Brommonoxid (BrO) mit der Rückkehr des Sonnenlichts im Frühjahr durch eine autokatalytische Reaktion aus Meereis gelöst. Es verändert die Oxidationseigenschaften der Troposphäre und führt regelmäßig zu bodennahem Ozonabbau. Weiterhin beeinflusst es die Bildung von Wolkennukleationskeimen und führt zu vermehrtem Eintrag von Quecksilber in die Biosphäre.

Wir präsentieren hier am Beispiel von BrO helikoptergestütze Messungen mit der Fernerkundungsmethode MAX-DOAS (Multi-Axial DOAS), die schräge Säulendichten verschiedener Spurengase messen kann. Der Einsatz dieser Technik an einem Hubschrauber erlaubt die Messung von Aerosol- und Spurengasprofilen mit hoher vertikaler Auflösung. Hierfür wurde ein kompaktes MAX-DOAS Instrument auf den Bordhelikoptern des Forschungseisbrechers Polarstern von August bis Oktober 2013 in der nördlichen Weddellsee/Antarktis betrieben.

Mit MAX-DOAS können durch eine Kombination verschiedener Messwinkel und Strahlungstransportmodelle auch vom Boden aus vertikale Konzentrationsprofile von Aerosolen und Spurengasen berechnet werden. Die präsentierten helikoptergestützen Messungen dienen der Validierung dieser weniger aufwendigen, bodengestützen Messmethode.

Mittagspause

Invited Talk UP 2.7 Tue 13:15 MAG 100

Observing the Anthropocene from Space: from SCIAMACHY to GeoSCIA/Copernicus Sentinel 4, Sentinel 5, CarbonSat and SCIA-ISS — •John P. Burrows — Institute of Environmental Physics/Institute of Remote Sensing IUP/IFE University of Bremen - FB1 Postfach 330440 28334 Bremen Germany

From the beginning of the Neolithic revolution around 10000 BC and 1800 A.D., the earth*s human population is estimated to have risen from several million nomadic hunter gathers to 1 Billion rural settlement and city dwellers. This development is dwarfed by the impact of the industrial revolution over the past two centuries. There are no over 7 Billion people on earth with over half living in cities and urban areas, e.g. there are ˜ 3 billion more citizens than when the author was born and 2 million more than when the project SCIAMACHY (SCanning Imaging and Absorption spectroMeter for Atmospheric ChartographY) was proposed!

The remote sounding of the atmosphere from instrumentation on satellite platforms provides a unique opportunity to retrieve regional and global observations of key trace atmospheric constituents (gases, aerosol and clouds) and surface parameters (ocean colour, ice extent, flora etc.). This talk describes results from the SCIAMACHY project and its spin offs, GOME (originally SCIA-mini - Global Ozone Monitoring Experiment), GOME-2, and the planning for their successors ESA Sentinel 4 (originally GeoSCIA), Sentinel 5, CarbonSat and SCIA-ISS.

UP 2.8 Tue 13:45 MAG 100

Overview of the UHOH Water Vapor DIAL Measurements: Vertical profiles and fields of moisture and aerosols during HOPE — •Florian Späth, Shravan Kumar Muppa, Simon Metzendorf, Andrea Riede, Andreas Behrendt, and Volker Wulfmeyer — University of Hohenheim, Institute of Physics and Meteorology, Garbenstr. 30, 70599 Stuttgart, Gemany

The water vapor (WV) differential absorption lidar (DIAL) of the University of Hohenheim (UHOH) is able to measure 3-dimensional WV fields with very high resolution in space and time. To reach high resolution, a high power injection seeded Ti:Sapphire laser with 250 Hz and a 80-cm scanning telescope are used.

Embedded in the project HD(CP)2 (High Definition Clouds and Precipitation for advancing Climate Prediction), in spring 2013 the HD(CP)2 Observational Prototype Experiment (HOPE) took place near Jülich, Germany. Within HOPE, measurements of the WV fields were performed with the UHOH WV DIAL. For the first time, the new UHOH data retrieval was applied to these measurements. Results of vertical and scanning measurements will be presented at the conference.

UP 2.9 Tue 14:00 MAG 100

Entwicklung, Aufbau und Charakterisierung eines neuen sensorgesteuerten Mini MAX-DOAS Systems — •Lara Penth, Denis Pöhler, Johannes Lampel, Jens Tschritter und Ulrich Platt — Institut für Umweltphysik, Heidelberg

MAX-DOAS (multi-axiale differentielle optische Absorptionsspektroskopie) ist eine mittlerweile etablierte Fernerkundungsmethode der Atmosphäre. Durch die Messung von Streulicht der Sonne bei verschiedenen Elevationswinkeln lassen sich Höhenprofile von einer Vielzahl atmosphärischer Spurengase sowie Aerosol optische Eigenschaften in der Troposphäre und Stratosphäre ableiten. Zu diesem Zweck wurde ein neues Mini MAX-DOAS System entwickelt, welches durch die Integration verschiedenster neuartiger Lage-, Positions- und Bewegungssensoren möglichst selbstständig Messungen auch unter schwierigen Bedingungen durchführen soll. Dadurch entfällt die aufwändige manuelle Einstellung und Ausrichtung des Messgeräts im Feld. Die automatische Positionierung der Teleskopeinheit und die automatische Ansteuerung der Elevationswinkel erfolgt so beispielsweise durch den Einsatz von Beschleunigungs- und Gyroskopsensoren, die durch die Kombination mit Filteralgorithmen Messungen auch auf stark bewegten Plattformen wie auf Schiffen mit hoher Präzision ermöglichen. Ziel ist es den Messablauf unter verschiedensten Bedingungen vollständig zu automatisieren und einen stabilen Betrieb im Feld zu gewährleisten. Das neu entwickelte sensorgesteuerte MAX-DOAS System, welches alle für den Messbetrieb nötigen Komponenten in einem kompakten Messgerät enthält, wird vorgestellt.

Kaffepause, 30 min

UP 3: Atmosphäre - Spurengase

Time: Tuesday 14:45–15:45 Location: MAG 100

UP 3.1 Tue 14:45 MAG 100

Glyoxal columns retrieved from OMI data as an indicator of fire emissions — •Leonardo Alvarado[1], Andreas Richter[1], Mihalis Vrekoussis[2], Folkard Wittrock[1], Andreas Hilboll[1], Stefan Schreier[1], and John Burrows[1] — [1]Institute of Environmental Physics, University of Bremen, Bremen, Germany — [2]Energy, Environment and Water Research Center, The Cyprus Institute, Nicosia, Cyprus

Glyoxal (CHOCHO) is an intermediate product in the oxidation of most Volatile Organic Compounds (VOC) and an indicator of secondary aerosol formation in the atmosphere. It is the smallest of the alpha-dicarbonyls and the most predominant in the atmosphere. CHOCHO originates from natural and anthropogenic activities mainly as secondary production. Nevertheless, about 18% of global glyoxal is due to pyrogenic emissions, of which around 60% are emitted directly by fires, whereas the rest is by secondary production.

Using a newly developed Differential Optical Absorption Spectroscopy (DOAS) retrieval of CHOCHO from satellite measurements by the Ozone Monitoring Instrument (OMI), this study focuses on a comparison between CHOCHO and Fire Radiative Power (FRP) over the large fire event over European Russia in summer 2010. The results show good agreement between the two quantities. The highest values were observed over the same region (east of Moscow) for both products. Moreover, preliminary correlations between CHOCHO and FRP over other regions with large fire emissions are presented.

UP 3.2 Tue 15:00 MAG 100

Airborne measurements of NO_2 shipping emissions with an imaging DOAS instrument — •Andreas Meier[1], Anja Schönhardt[1], Andreas Richter[1], André Seyler[1], Thomas Ruhtz[2], Carsten Lindemann[2], and John P. Burrows[1] — [1]Institut für Umweltphysik, Universität Bremen, Bremen, Germany — [2]Institut für Weltraumwissenschaften, Freie Universität Berlin, Berlin, Germany

NO_x (NO and NO_2) play a key role in tropospheric chemistry and affect human health and the environment. Shipping emissions contribute substantially to the global emissions of anthropogenic NO_x. Due to globalization and increased trade volume, the relative importance emissions from ships gain even more importance. The Airborne imaging DOAS instrument for Measurements of Atmospheric Pollution (AirMAP), developed at IUP Bremen, has been used to perform measurements of NO_2 in the visible spectral range. The observations allow the determination of spatial distributions of column densities of NO_2 below the aircraft. Airborne measurements were performed over Northern Germany during the NOSE (NO_2 from Shipping Emissions) campaign in August 2013. The focus of the campaign activities was on shipping emissions, but NO_2 over cities and power plants has been measured as well. The measurements have a spatial resolution below the order of 100 × 30 m^2, and they reveal the large spatial variability of NO_2 and the evolution of NO_2 plumes behind point sources. Shipping lanes as well as plumes of individual ships are detected by the AirMAP instrument. In this study, first results from the NOSE campaign are presented for selected measurement areas.

UP 3.3 Tue 15:15 MAG 100

Präzise In-Situ-Gasmonitore mit massenproduzierten kommerziellen Sensoren — •Jan-Lukas Tirpitz, Lara Penth, Leoni Neubauer, Christiane Yeman, Denis Pöhler und Ulrich Platt — Institut für Umweltphysik, Universität Heidelberg

In-Situ-Messgeräte zur Konzentrationsmessung einzelner Spurengase in der Umgebungsluft spielen in der Umweltphysik eine zentrale Rolle. In den meisten Fällen finden hier Geräte Verwendung, die sich chemische Prozesse oder das Prinzip der Absorptionsspektroskopie zu nutze machen. Leider sind diese Geräte recht teuer und bei Verwendung unter extremen Bedingungen vergleichsweise kurzlebig.

Wir entwickeln Messgeräte, die Sensoren aus kommerziellen Industrieanwendungen und somit sehr kostengünstigen Komponenten enthalten und optimieren ihre Genauigkeit. Letzteres wird unter anderem durch Rekalibration und die Charakterisierung verschiedener Querempfindlichkeiten erreicht. Im Idealfall können diese Geräte in Punkto Präzision und Zuverlässigkeit mit herkömmlichen Messgeräten konkurrieren aber auch bei geringerer Genauigkeit sind sie gerade in extremeren Situationen wissenschaftlich einsetzbar und eine preisgünstige Alternative zu herkömmlichen Geräten. Ein Beispiel sind Messungen an Vulkanen, wo ohnehin größere Konzentrationen der relevanten Gase auftreten und so bereits mit einfachen Mitteln eine ausreichend hohe relative Genauigkeit erzielt werden kann.

Hier stellen wir Entwicklungen, Ergebnisse und Beispielmessungen eines CO2-Monitors dieser Art vor.

UP 3.4 Tue 15:30 MAG 100

Einfluss der linear-k Methode auf Genauigkeit und Rechenaufwand des GOSAT BESD XCO_2 Algorithmus — •Michael Hilker, Maximilian Reuter, Jens Heymann, Michael Buchwitz, Heinrich Bovensmann und John P. Burrows — Institut für Umweltphysik, Universität Bremen, Deutschland

CO_2 ist das wichtigste anthropogene Treibhausgas und trägt entscheidend zum globalen Klimawandel bei. Doch trotz der Bedeutung weist unser Wissen über die Quellen und Senken von CO_2 große Unsicherheiten auf. Messungen der CO_2-Konzentration durch Instrumente wie SCIAMACHY auf dem Satelliten ENVISAT bieten durch die globale Abdeckung der Messungen die Möglichkeit, die Unsicherheit der CO_2-Flüsse zu reduzieren. Der Bremen Optimal Estimation - DOAS (BESD) Retrieval Algorithmus wurde entwickelt, um Säulenmittel der CO_2-Konzentration aus den Messungen von SCIAMACHY zu bestimmen. Seit dem Ende der ENVISAT Mission ist TANSO, auf dem Satelliten Gosat, das einzige Satelliteninstrument mit hoher Sensitivität in Bodennähe. Um die Messungen von TANSO auswerten zu können, wurde BESD modifiziert. BESD benötigt rechenaufwendige Strahlungstransportrechnungen, die aufgrund der höheren spektralen Auflösung der TANSO Messungen nicht mit den gleichen Näherungen vereinfacht werden können, die für die Auswertung von SCIAMACHY Messungen verwendet wurden. Um TANSO Messungen mit vertretbarem Aufwand auswerten zu können, wird eine modifizierte linear-k Methode verwendet. Erste Erkenntnisse über den Einfluss dieser Methode auf die Genauigkeit des BESD Algorithmus werden präsentiert.

UP 4: Symposium - Klimawandel, gibt es eine Erwärmungspause ?

Time: Tuesday 16:30–18:30 Location: Audimax

Invited Talk UP 4.1 Tue 16:30 Audimax

Klimaänderungen in den Polarregionen — •Peter Lemke — Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung — Institut für Umweltphysik, Universität Bremen

Die größten Auswirkungen der globalen Erwärmung treten in hohen Breiten und in großen Höhen auf. Dadurch werden die Komponenten der Kryosphäre (Schnee, Gletscher, Permafrost, Meereis, Schelfeis und Eisschilde) am stärksten betroffen. In allen Bereichen ist ein fortschreitender Rückgang zu beobachten, der teilweise sogar beschleunigt auftritt. Ein entsprechend größerer Anteil der zusätzlichen Wärme durch den verstärkten Treibhauseffekt wird daher für das Schmelzen von Eis und Schnee verwendet. Einzig das winterliche antarktische Meereis zeigt keinen Rückgang. Einige Erklärungen dafür wurden vorgeschlagen, aber verstanden ist das Problem noch nicht. In dem Vortrag werden neue Ergebnisse, auch von einer Winterexpedition in das Südpolarmeer, vorgestellt und diskutiert.

Invited Talk UP 4.2 Tue 17:00 Audimax

The IPCC assessment of the recent hiatus in surface warming — •Jochem Marotzke — Max-Planck-Institut für Meteorologie, Hamburg, Deutschland

I will review what is known about the recent observed reduction in global-mean surface-warming trend and the ability of climate models to simulate this "hiatus". A comprehensive assessment of the published literature on this topic has recently been given in the fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate

Change (IPCC). A particular challenge lies in the evaluation of an ensemble of model simulations vis-à-vis internal variability in the observed record. Furthermore, trends in both observations-based and simulated radiative forcing need to be taken into account, as well as the models* responses to these trends.

The AR5 concludes that the observed hiatus in surface warming trend is due in roughly equal measure to a reduced trend in radiative forcing and a cooling contribution from internal variability, which includes a possible redistribution of heat within the ocean. During the surface-warming hiatus, the climate system has continued to increase its heat content, consistent with estimates of anthropogenic forcing. Surface temperature trends over periods as short as 15 years are thus of little relevance for long-term anthropogenic warming.

Invited Talk UP 4.3 Tue 17:30 Audimax

Die Rolle der oberen Troposphäre / unteren Stratosphäre bei dekadischer Klimavariabilität — •Martin Riese — Forschungszentrum Jülich, Institut für Energie- und Klimaforschung (IEK-7), 52425 Jülich

Beobachtete Trends der global gemittelten Oberflächentemperatur zwischen 1951 und 2012 werden von Klimasimulationen recht gut wiedergegeben. Eine zuverlässige Simulation dekadischer Variationen, z. B. der Erwärmungspause zwischen 1998 und 2012, gelingt dagegen noch nicht.

Für zuverlässigere Vorhersagen von dekadischer Klimavariabilität ist auch ein verbessertes Verständnis physikalischer und chemischer Prozesse in der Atmosphäre erforderlich. Dabei spielt der Höhenbereich der oberen Troposphäre und unteren Stratosphäre (engl. UTLS) eine wichtige Rolle. Änderungen der Zusammensetzung und dynamischen Struktur dieses Höhenbereichs wirken sich besonders stark auf das Bodenklima aus. Solomon et al. (2010) zeigen beispielsweise dass beobachtete, unzureichend verstandene, dekadische Variationen von Wasserdampf in der unteren Stratosphäre die Erwärmung des Bodenklimas zwischen 1980 und 2000 beschleunigt und zwischen 2000 und 2010 verlangsamt haben.

Im Vortrag wird die Rolle der oberen Troposphäre und unteren Startopshäre im Zusammenhang mit dekadischer Klimavariabilität diskutiert. Außerdem werden Unsicherheiten der zugrungeliegenden Prozesse beleuchtet, die die Genauigkeit von Klimavorhersagen zurzeit begrenzen.

Invited Talk UP 4.4 Tue 18:00 Audimax

Internal Southern Ocean Centennial Variability: Implications for Global Warming — •Mojib Latif — GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel

Some of the recent decadal trends observed in the Southern Hemisphere including the lack of a strong Southern Ocean surface warming may have originated from longer-term internal centennial variability. This is supported by the instrumental sea surface temperatures, a multi-millennial reconstruction of Tasmanian summer temperatures from tree rings, and a millennial control integration of the Kiel Climate Model (KCM). In the model, the centennial timescale originates from the slow accumulation of heat in the Weddell Sea at mid-depth. During phases of Weddell Sea deep convection, vast amounts of heat are released to the atmosphere, which drives global teleconnections. After the deep convection halts, the heat accumulation at mid-depth resumes, and this phase is accompanied by expanding Antarctic sea ice cover and Southern Ocean Sector surface cooling, similar to what was observed during the recent decades. This suggests that internal centennial variability should be considered in addition to external forcing when discussing the climate of the 20th century and that of the 21st century. In the KCM, the centennial variability is associated with global average surface air temperature changes of the order of a few tenths of a degree per century, suggesting a contribution to the current hiatus in global warming through an enhanced deep ocean heat uptake.

UP 5: Atmosphäre - Spurengase

Time: Wednesday 9:30–11:00 Location: MAG 100

Invited Talk UP 5.1 Wed 9:30 MAG 100

Fernerkundung der Atmosphäre mittels hochauflösender Infrarotspektroskopie — •Johannes Orphal — Institut für Meteorologie und Klimaforschung, Karlsruher Institut für Technologie

Für ein verbessertes Verständnis der dynamischen und chemischen Prozesse in der Erdatmosphäre sind hochgenaue Messungen von verschiedenen Spurengasen unentbehrlich. In diesem Vortrag werden neueste Entwicklungen auf dem Gebiet der Fernerkundung der Atmosphäre mittels hochauflösender Infrarotspektroskopie durch Anwendungen in den Bereichen von Stratosphären- und Klimaforschung sowie der Überwachung der troposphärischen Luftqualität illustriert.

UP 5.2 Wed 10:00 MAG 100

The seasonal cycle of total column CO_2 and CH_4 in the high Arctic — •Matthias Buschmann, Nicholas Deutscher, Mathias Palm, Thorsten Warneke, Tine Weinzierl, and Justus Notholt — Institut für Umweltphysik, Universität Bremen, Bremen, Deutschland

The measurement of long-lived greenhouse gases, like CO_2 and CH_4, and identification of their sources and sinks is very important in the context of climate change research. Networks like the TCCON (Total Carbon Column Observing Network) continuously monitor a variety of trace gases in the atmosphere by employing ground based Fourier Transform InfraRed (FTIR) spectroscopy on solar radiation in the near infrared (NIR). However, at high latitude sites (like Ny Ålesund, Spitzbergen at 79° N), there is no direct sunlight in winter due to the polar night and the moon is the next best source of NIR radiation. In this talk we will present the first record of the seasonal cycle of carbon dioxide and methane derived from solar absorption spectra in summer and lunar absorption spectra in the winter.

UP 5.3 Wed 10:15 MAG 100

Carbon monoxide retrieved from ground based FTIR remote sensing in the mid- and near infra-red spectral reagion — •Christof Petri[1], Thorsten Warneke[1], Bavo Langerock[2], Emmanuel Mahieu[3], Bruno Franco[3], Frank Hase[4], and Justus Notholt[1] — [1]Institute of Environmental Physics, University of Bremen, Bremen, Germany — [2]IASB-BIRA, Brussel, Belgium — [3]Université de Liège, Liège, Belgium — [4]KIT, University of Karlsruhe, Karlsruhe, Germany

The Network for the Detection of Atmospheric Composition Change (NDACC) and the Total Carbon Column Observing Network (TCCON) are the two leading networks for groundbased atmospheric FTIR measurements of tracegases.While NDACC is measuring in the middle infrared with a resolution of 0.005 wavenumbers, TCCON uses the near infrared spectral region and a resolution of 0.02 wavenumbers. The retrieval strategies in these different spectral regions are examined for interfering gases and compared in precision. Systematic deviations where found and refered to different sensitivity in the lower troposphere retrieval.

The contributing sites for this study are La Reunion, Jungfraujoch, Izana and Bremen. Bruker 125 HR interferometer have been used which are part of both, the TCCON and the NDACC network. At the Jungfraujoch site a Bruker 120 HR has been used.

Kaffeepause, 30 min

UP 6: Kryosphäre und Ozeanographie

Time: Wednesday 11:00–11:30 Location: MAG 100

UP 6.1 Wed 11:00 MAG 100

Snow grain size and snow depth retrieval over sea ice: investigating possible synergies — •Christian Melsheimer — Institut für Umweltphysik, Universität Bremen, Otto-Hahn-Allee 1, 28359 Bremen, Germany

A snow layer on sea ice has several significant effects: (1) The snow layer strongly reduces the heat flow between the ocean underneath the ice and the atmosphere above, which affects ice growth and melting; (2) the grain size of the snow layer determines the albedo and thus affects the radiative balance.

Both snow grain size and snow depth can be determined in principle from satellite remote sensing: The snow depth (SD) on level sea ice can be retrieved from microwave radiances near 19 and 37 GHz measured, e.g. by the sensor AMSR-E on the satellite Aqua (2001–2011) or its successor AMSR2 on the satellite GCOM-W1 (since 2012). The snow grain size (SGS) can be retrieved from visible/near infrared reflectances of three channels of MODIS on the satellites Terra and Aqua.

Here we want to study the synergy of these two remote sensing methods that use completely different parts of the electromagnetic spectrum to retrieve related parameters. Fresh snow has the smallest grains which then gradually grow when the snow ages, in particular after partial melting and refreezing. Thus, snowfall events should have an effect on the retrieved SGS (small) and on the SD (increase). Furthernore, the SD retrieval yields too large results in case of large SGS, so here the SGS retrieval might help to identify areas of bad SD retrieval.

UP 6.2 Wed 11:15 MAG 100

Sensitivity of phytoplankton growth to vertical mixing along a North Atlantic transect — •Lisa Hahn-Woernle[1], Henk Dijkstr[1], and Hans van der Woerd[2] — [1]Institute for Marine and Atmospheric research Utrecht, Utrecht University, The Netherlands — [2]Institute for Environmental Studies, VU University, Amsterdam, The Netherlands

During the "Stratiphyt" cruises in Summer 2009 and Spring 2011 in-situ plankton and nutrient concentrations as well as upper-ocean turbulence characteristics were measured from Las Palmas to Reykjavik [1]. The measurements agree with previous findings that the incoming light intensity and the stratification of the upper ocean set important conditions for the initiation of the phytoplankton bloom close to the surface and also for a possible shift to a deep chlorophyll maximum below the mixed layer. To understand the influence of the upper-ocean turbulence on the meridional depth (upper 200 m) variation of the phytoplankton distributions, a advection-reaction-diffusion phytoplankton model was calibrated to fit the measured optical and biological measurements and then forced by the in-situ vertical mixing profiles. The results show, that the vertical phytoplankton distribution depends strongly on the characteristics of the applied vertical turbulence profile. [1] E. Jurado, H. van der Woerd and H. A. Dijkstra, Microstructure measurements along a quasi-meridional transect in the North Atlantic, J. Geophysical Res. Oceans, 117,(2012).

UP 7: Methoden - Messverfahren und Datenauswertung

Time: Wednesday 11:30–12:15 Location: MAG 100

UP 7.1 Wed 11:30 MAG 100

Entwicklung eines Instruments zum Nachweis von Bromnitrat und Iodnitrat durch DOAS-Messungen von Stickstoffdioxid — •Christoph Kleinschmitt[1], Lennard Herlyn[1], Martin Horbanski[1], Stefan Schmitt[1], Julian Wittmer[2], Denis Pöhler[1], Cornelius Zetzsch[2] und Ulrich Platt[1] — [1]Institut für Umweltphysik (IUP), Ruprecht-Karls-Universität Heidelberg — [2]Bayreuth Center of Ecology and Environmental Research (BayCEER), Universität Bayreuth

Messungen von Halogenoxiden XO (X = Br, I) und Stickstoffdioxid (NO_2) in der atmosphärischen Grenzschicht am Toten Meer deuten auf Vorkommen von Bromnitrat ($BrONO_2$) und Iodnitrat ($IONO_2$) hin, die mit bisher verfügbaren, für Feldmessungen geeigneten Methoden nicht gemessen werden können. Zur genaueren Abschätzung der Quellstärke der reaktiven Halogenoxide BrO und IO müssen allerdings die Reservoirgase $XONO_2$ berücksichtigt werden. Daher wurde ein neuartiges Instrument entwickelt, welches $XONO_2$ thermisch (bei $T \approx 160\,^{\circ}\mathrm{C}$) in XO und NO_2 zersetzt und das entstandene NO_2 in der aufgeheizten Probe mithilfe der resonatorgestützten DOAS-Methode (CE-DOAS) misst. Durch den kompakten, geschlossenen Resonator wird dabei ein mobiler Einsatz im Feld ermöglicht.

Das Instrument wurde erstmals im Rahmen von Smogkammer-Experimenten in Zusammenarbeit mit der Universität Bayreuth eingesetzt, bei denen die Dunkelchemie von Iod und NO_2 unter Zugabe von Ozon untersucht wurde. Dabei konnten $IONO_2$-Konzentrationen von bis zu 550 ppt nachgewiesen werden.

UP 7.2 Wed 11:45 MAG 100

Deciphering transitions in climate time series using Bayesian inference — •Nadine Berner[1], Martin H. Trauth[2], and Matthias Holschneider[1] — [1]Focus Area for the Dynamics of Complex Systems (DYCOS), Universität Potsdam — [2]Institute of Earth and Environmental Science, Universität Potsdam

The estimation of transition events in environmental time series challenges analysis methods and modeling concepts. Commonly such changes are considered as isolated singularities in a more regular background indicating the transition between two regimes governed by different internal dynamics or external forcings.

Our aim is to derive a probabilistic expression quantifying multiple transition events in a data set on different temporal scales. Therefore we model a change in terms of the underlying regular dynamics and the evolution of the scedasticity of the data. We combine these two aspects in a linear mixed model which speeds up computations considerably. Furthermore we accomplish the estimation of the model's parameters via Bayesian inference and obtain associated uncertainty levels in a natural way. By applying a kernel based approach, we formally localize the resulting joint probability density of a transition. Thus we are able to investigate highly complex signals explicitly for trend changes in the statistical properties, without enlarging the dimensionality of the assumed underlying model.

We discuss our method's performance on well studied hydrological time series and present preliminary results of long scale, highly complex palaeo-signals from Northern Africa.

UP 7.3 Wed 12:00 MAG 100

Probing soil moisture by cosmic ray induced neutron showers — •Markus Köhli and Ulrich Schmidt — Physikalisches Institut, Universität Heidelberg, Heidelberg, Germany

The measurement of soil moisture at scales which average over local geological and biological structures is a major challenge in characterizing the land surface. It especially becomes important as refined numerical models in meteorology make use of mesh sizes of one kilometer or less. Fast cosmic ray induced neutrons are considered to be a probe for the determination of soil moisture on such medium scales. It is a the characteristic feature of hydrogen to slow down neutrons very efficiently during the scattering process. This leads to the spectrum of reflected neutrons being dependent on the water content.
In this talk Monte Carlo based simulations are presented to study the soil footprint measured by neutron detection systems. Therefore the influence of a number of features on neutron flux will be discussed and quantitatively described.

UP 8: Fachverbandssitzung

Time: Wednesday 12:15–13:45 Location: MAG 100

Mittagspause mit Fachverbandssitzung, 90 min

UP 9: Methoden - Messverfahren und Datenauswertung

Time: Wednesday 13:45–14:15 Location: MAG 100

Invited Talk UP 9.1 Wed 13:45 MAG 100

New possibilities for UV research by simultaneous spectral radiance measurements — •Gunther Seckmeyer, Stefan Riechelmann, Michael Schrempf, and Ansgar Stührmann — Institut für Meteorologie und Klimatologie, Herrenhäuserstr. 2, 30419 Hannover

The knowledge of the angular distribution of solar radiance and its spectral characteristics is required for many applications including solar energy and the impact of UV radiation on humans. Sky radiance has been found to be the dominant factor for the solar UV exposure of humans, both with respect to positive and negative effects of UV radiation. We recently developed a novel method to calculate vitamin D3 weighted exposure by integrating the incident solar spectral radiance over all relevant parts of the human body. Our calculations show that the UV index is not a good indicator for the exposure which depends on the orientation of the body (e.g. vertical (standing) or horizontal (lying down) posture). At the winter solstice vitamin D3 cannot be obtained with realistic clothing even if the exposure were extended to all daylight hours. Since clouds play a crucial role in determining the actual exposure of humans and the yield of solar cells, new instruments that measure sky radiance in dependence of zenith and azimuth angle in more than 100 directions simultanuously have been developed in recent years.

UP 10: Atmosphäre - Aerosole

Time: Wednesday 14:15–16:30 Location: MAG 100

UP 10.1 Wed 14:15 MAG 100

Stratospheric aerosol profile retrievals from SCIAMACHY limb-scatter observations: current results — •Christian von Savigny[1], Lena Brinkhoff[2], Florian Ernst[2], Alexei Rozanov[2], Rene Hommel[2], and John Burrows[2] — [1]Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, Greifswald — [2]Institut für Umweltphysik, Universität Bremen, Bremen

Stratospheric aerosol extinction profiles in the visible spectral range are retrieved from limb-scatter observations with the SCIAMACHY instrument on Envisat from fall 2002 until spring 2012. The retrievals are performed with a colour-index approach in combination with an iterative scheme and the SCIATRAN radiative transfer model. The aerosol extinction profiles agree globally to within about 15% with co-located SAGE II (vs. 7.0) solar occultation measurements. This contribution presents current results on decadal trends and spatial/temporal variability in stratospheric aerosol extinction caused by different processes. A main feature is the more of less continuous increase in stratospheric aerosol optical depth from 2003 to 2012, which appears to be a consequence of a series of small volcanic eruptions.

UP 10.2 Wed 14:30 MAG 100

Raman spectroscopy of levitated glassy aerosols — •Andreas Peckhaus, Alexei Kiselev, and Thomas Leisner — Karlsruher Institut für Technologie (KIT), Karlsruhe, Baden-Württemberg

Recent field measurements showed that ice clouds in the upper troposphere exhibit low ice particle number concentrations and high in-cloud relative humidities with respect to ice, which is explained by the suppression of crystallization by glassy aerosols. Aqueous sucrose solution droplets levitated in an electrodynamic balance (EDB) are used as a proxy for highly oxygenated organic compounds showing a glass transition or homogeneous freezing behavior depending on the temperature and relative humidity. We present trajectories of the phase diagram which clearly reveal the formation of a glassy amorphous state and ice nucleation. The deliquescence of a crystalline and an amorphous aerosol at different temperatures is reported. By means of angle-resolved Mie scattering pattern of levitated aerosol droplets the onset of the phase transition can be detected. In addition, the Raman spectroscopy is used to study phase transitions at characteristic points of the trajectory. Both methods used make it possible to experimentally derive a phase diagram of the binary mixture of sucrose and water and compare it with theoretical expectations.

UP 10.3 Wed 14:45 MAG 100

Untersuchungen zum Kontaktgefrieren unterkühlter Wassertröpfchen an biologischen Partikeln — •Manfred Schäfer[1], Nadine Hoffmann[1], Alexei Kiselev[1] und Thomas Leisner[1,2] — [1]Institut für Meteorologie und Klimaforschung-atmosphärische Aerosolforschung, KIT — [2]Institut für Umweltphysik, Universität Heidelberg

Das Gefrieren unterkühlter Wolkentropfen ist für atmosphärische, wetterbildende Prozesse von Bedeutung. Dieses kann, unter anderen, durch Kontakt mit INA (Ice-Nucleation Active) Aerosolpartikeln biologisches Ursprungs initiiert werden. In dieser Arbeit haben wir die Kontaktgefrierwahrscheinlichkeit von Bakterienfragmenten (SNOMAX) und Pollenbestandteilen (Betula Pendula) an unterkühlten Mikrotröpfchen untersucht. Dafür wurden elektrisch geladene Wassertröpfchen in einer elektrodynamischen Falle (Paulfalle) levitiert und einem Strom monodisperser INA-Aerosolpartikel ausgesetzt. Die Gefrierwahrscheinlichkeiten wurden in einem Temperaturbereich von -16°C bis -32°C (Pollen) bzw. -9°C bis -23°C (SNOMAX) ermittelt. Außerdem haben wir die Gefrierwahrscheinlichkeit von Pollenbestandteilen für verschiedene Partikelgrößen bei zwei Temperaturen (-24°C und -29°C) bestimmt. In diesem Beitrag werden die gewonnene Daten analysiert und deren Relevanz für das Vereisen der troposphärischen Mischphasenwolken diskutiert.

Kaffeepause, 30 min

Invited Talk UP 10.4 Wed 15:30 MAG 100

Amplified Climate Changes in the Arctic: Role of Clouds and Atmospheric Radiation — •Manfred Wendisch — Universität Leipzig, Institute for Meteorology, Leipzig, Germany

The characteristic conditions and processes leading to the so-called Arctic amplification are outlined. The phenomenon of Arctic amplification comprises an enhanced variability and amplified increase of the near-surface air temperature in the Arctic in comparison to the average near-surface warming at lower latitudes. Observations and simulations show the magnitude of the observed Arctic near-surface air temperature increase is more than double the air temperature increase at lower latitudes. To illustrate the phenomenon of Arctic amplification, several examples of observed Arctic near-surface air temperature increases are presented. In general, Arctic amplification also implies serious Arctic climate changes other than near-surface air temperature, such as the dramatic summer melting of Arctic Sea ice and the Greenland ice sheet, and the decrease of snow cover and surface albedo of the Greenland ice sheet. Numerous reasons for the Arctic climate changes are discussed; the direct and indirect surface albedo feedback and the related increase of near-surface water vapor and cloudiness, meridional heat and water vapor transports in the atmosphere and ocean, and increased soot amounts in both the atmosphere and snow/ice surfaces. The special role of low-level clouds under Arctic conditions (low Sun, polar day and night, high surface albedo) for the self-enforcing amplification processes is described. In particular, the impact of ice in Arctic mixed-phase clouds on the cloud radiative forcing is investigated.

UP 10.5 Wed 16:00 MAG 100

Nucleation and growth of ice on the substrates of K-feldspar observed in ESEM — •Alexei Kiselev, Andreas Peckhaus, and Thomas Leisner — Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research

Atmospheric mineral dust particles, originating from arid regions such as the Sahara, are known to have a strongly variable mineralogical composition. The main components they are composed of are(in order of diminishing average weight content): clay minerals (e.g. kaolinite), micas (e.g. illite), quarts, feldspars, and calcite. These minerals are characterized by different ice nucleating efficiency, which describes the freezing probability of supercooled cloud droplet due to the presence of mineral dust particle serving as a heterogeneous ice nucleus (IN). Potassium (K) feldspar, although not the main component of atmospheric mineral dust, was shown recently to be one of the most effective ice nuclei among airborne mineral dust particles, potentially being responsible for the overall IN efficiency of feldspar-containing mineral dusts (Atkinson et al., 2013). In this contribution we describe the deposition ice nucleation experiments carried out on the freshly cleaved substrates of K-feldspar in an Environmental Scanning Electron Microscope (ESEM). We also compare this approach to the immersion freezing results obtained with similar substrates and droplets of aqueous suspensions of feldspar particles on a cold stage. Comparison to literature data and atmospheric implications will be discussed as well.

Atkinson et al., The importance of feldspar for ice nucleation by mineral dust in mixed-phase clouds, in Nature 498, 355-358 (2013);

UP 10.6 Wed 16:15 MAG 100

Polarization-resolved exact light backscattering by an ensemble of particles in the atmosphere — •Elodie Coillet, Gregory David, Alain Miffre, and Patrick Rairoux — Institut Lumière Matière (ILM), Université Lyon 1, CNRS, Lyon, France

Exact backscattering of light by an ensemble of particles in ambient air has been observed in the laboratory. The experimental set-up operates in the far-field single scattering approximation, covers the exact backscattering direction with accuracy ($\theta = \pi$ +/- ϵ with $\epsilon = 3.5$ x 10-3 rad) and efficiently collects the particles backscattering radiation, while minimizing any stray light. By using scattering matrix formalism, the observation of the particles UV-backscattering signal allowed to measure the particles diagonal scattering coefficient (depolarization) of water droplets and salt particles in air, for the first time, in the exact backscattering direction [1]. These results may be useful for comparison with the existing numerical models, for remote sensing field applications [2], in radiative transfer and climatology and for further laboratory experiments on chemical and physical properties of aerosols. References [1] G. David, B. Thomas, E. Coillet, A. Miffre, P. Rairoux, Polarization-resolved exact light backscattering by an ensemble of particles in air, Opt. Ex., 21,18624-18639, (2013). [2] G. David, B. Thomas, T. Nousiainen, A. Miffre, and P. Rairoux, Retrieving volcanic, desert dust, and sea-salt particle properties from two/three-component particle mixtures after long-range transport using UV-VIS polarization Lidar and T-matrix, Atmos. Chem. Phys. (2013).

UP 11: Postersession

Time: Wednesday 17:00–18:30 Location: MAG Poster

UP 11.1 Wed 17:00 MAG Poster

Transmissionsprofile aus SCIAMACHY Sonnenokultationsmessungen — •Jacob Zalach und Christian von Savigny — Ernst-Moritz-Arndt-Universität, Greifswald

Vertikale Transmissionsprofile 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, wofür zunächst die zugehörigen Transmissionsprofile vorliegen müssen.

Eine etablierte Methode zur Messung dieser Profile sind satellitengestützte Okkultationsmessungen. 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 nicht möglich, vor allem wegen der unterschiedlichen räumlichen Auflösung der Sonnenprofile. Um Transmissionswerte für vorgegebene Tangentenhöhen direkt aus den Messungen entnehmen zu können, müssen bestehende Verfahren an die vorliegenden Datensätze angepasst werden.

Dieser Beitrag stellt die bisher angewandte Datenaufbereitung zur Diskussion und zeigt die so gewonnenen Transmissionsprofile.

UP 11.2 Wed 17:00 MAG Poster

Remote sensing of methane with optical correlation spectroscopy on the Q-branch of the 2ν3 band — •Katja Rieth[1,3], Christophe Anselmo[1], Benjamin Thomas[2], Jean-Pierre Cariou[4], Alain Miffre[1], Johannes Orphal[3], and Patrick Rairoux[1] — [1]Institut Lumière Matière (ILM), Université Lyon 1, CNRS, Lyon, France — [2]Center for Advanced Technology (CAT), City University New York, USA — [3]Institute for Meteorology and Climate Research Research (IMK), Karlsruhe Institute of Technology (KIT) , Germany — [4]Leosphere, Orsay, France

We propose a study on the ability to realize accurate remote sensing of greenhouse gases concentration in the Earth's atmosphere by applying broadband optical correlation spectroscopy (OCS) with Acoustic Optical Programmable Dispersive Filter (AOPDF) [1]. Our study focuses on the 2ν3 methane absorption band, centered at the 1665 nm wavelength. Studies have been achieved to assess the accuracy on the retrieved methane-mixing ratio when applying the OCS-AOPDF methodology. We will show that atmospheric temperature gradient induces a systematic error on the retrieved methane-mixing ratio and that methane-mixing ratios are weakly sensitive to the pressure broadening of the absorption line and to the statistical variation of the absorption line strength [2]. References [1] B. Thomas, A. Miffre, G. David, C. Anselmo, J.P. Cariou and P. Rairoux, App. Phys. B, 113, 265-275, (2013). [2] B. Thomas, A. Miffre, G. David, C. Anselmo, E. Coillet, J.P. Cariou and P. Rairoux, , J. Mol. Spec., 293, 3-8,(2013).

UP 11.3 Wed 17:00 MAG Poster

A multi-wavelength retrieval of tropospheric NO_2 from GOME-2 observations — Andreas Richter, •Andreas Hilboll, and John P. Burrows — Institut für Umweltphysik, Universität Bremen, Bremen, Deutschland

Satellite observations of tropospheric NO_2 columns are frequently used when applying satellite measurements in atmospheric pollution research. They have been used for the identification and evaluation of natural and anthropogenic NO_x emissions and their changes over time, for process studies, and for the investigation of atmospheric transport events.

One limitation of the commonly used DOAS retrieval of NO_2 columns from satellite observed radiances is the lack of vertical resolution. Together with the altitude-dependence of retrieval sensitivity, this necessitates the use of a priori information on the NO_2 vertical profile. This is one of the major sources of uncertainties in the retrieval, which could be reduced if information on the vertical location of the NO_2 could be retrieved from the measurements themselves.

In this study, the vertical information content of nadir NO_2 observations in the wavelength range 400–500 nm is investigated using both synthetic spectra and real GOME-2 measurements over polluted regions. We show that at least for cloud free scenes, some information on the vertical location of tropospheric NO_2 plumes can be retrieved. Limitations of the method as well as possible applications for future sensors such as S-5P are discussed.

UP 11.4 Wed 17:00 MAG Poster

Comparing RD94 dropsonde and aircraft temperature and humidity measurements based on data from arctic field studies — •Lukas Schmidt[1], Marion Maturilli[1], Roland Neuber[1], Klaus Dethloff[1], and Andreas Herber[2] — [1]Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Potsdam, Germany — [2]Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany

Dropsondes are launched from research aircraft to measure vertical pro-

files of temperature, humidity, pressure and wind in the atmosphere while falling to the ground. Onboard the aircraft Polar 5 of the Alfred Wegener Institute for Polar and Marine Research (AWI), they are deployed on arctic and antarctic campaigns.

Here we compare temperature and humidity data from Vaisala RD94 dropsondes with data from the permanently installed sensors of the aircraft. Dropsonde profiles are combined with profiles measured during ascent or descent by the aircraft nearby. The aerosol lidar AMALi is used to identify the presence and altitude of clouds. Furthermore the time constants of the dropsonde temperature and humidity sensors are deduced from atmospheric data.

The overall agreement between aircraft and dropsonde data is good, but for high humidities as in clouds the dropsonde shows a systematic dry bias of almost 10%. Data suggest a temperature dependency of this bias. The combination of dry bias and time lag of the sensors can make cloud detection from dropsondes alone difficult in cold environments.

UP 11.5 Wed 17:00 MAG Poster

Long-Term Changes in Temperature and Radiation at the Arctic Station Ny-Ålesund (79°N, 12°E) — •Marion Maturilli[1], Andreas Herber[2], and Gert König-Langlo[2] — [1]Alfred-Wegener-Institut, Helmholtz Zentrum für Polar- und Meeresforschung, Potsdam — [2]Alfred-Wegener-Institut, Helmholtz Zentrum für Polar- und Meeresforschung, Bremerhaven

At the Franco-German AWIPEV Arctic research base in Ny-Ålesund (79°N, 12°E), Svalbard, surface radiation measurements have been operated since 1992 in the frame of the Baseline Surface Radiation Network (BSRN). The data are complemented with surface meteorology measurements since 1993, contributing to the study of climate change in the Arctic with focus on alpine/marine landscape. Over the last 20 years, changes both in surface radiation and temperature have been observed in Ny-Ålesund. An increase of the annual mean temperature of +1.4 +/-0.8 K per decade indicates a substantial warming of the Ny-Ålesund environment, accompanied by an increase of the annual mean radiation budget of +4.9 +/-2.9 Wm-2 per decade. Separating the annual radiation budget to its different contributions it turns out that by far the largest changes are observed in the increasing longwave radiation during the winter season. In fact, also the temperature increase is largest during the winter season, with +3.3 +/-2.6 K per decade. In the recent warmer winters, precipitation has often occurred in the form of rain rather than snow. Furthermore, changes in reflective solar radiation indicate an earlier onset of the snow melt by 1 week compared to 20 years ago.

UP 11.6 Wed 17:00 MAG Poster

Long-term changes of tropospheric NO_2 over megacities derived from multiple satellite instruments — •Andreas Hilboll, Andreas Richter, and John P. Burrows — Institut für Umweltphysik, Universität Bremen, Bremen, Deutschland

Nitrogen oxides (NO_x = NO+NO_2) in the troposphere have been retrieved from satellite-based measurements by the GOME, SCIAMACHY, OMI, and GOME-2 instruments since the mid 1990s, using the DOAS technique. These instruments differ in spatial resolution, local time of measurement, viewing geometry, and other details.

In this study, we present two ways to account for instrumental differences in trend analyses of the tropospheric NO_2 columns derived from these measurements, while preserving the individual instruments' spatial resolutions. The first method explicitly accounts for the instruments' difference in ground pixel size (40×320 km^2 vs. 30×60 km^2 for GOME and SCIAMACHY), based on spatial averaging of the measured earthshine spectra and extraction of a spatial pattern of the resolution effect. The second method is an empirical correction, which summarizes all instrumental differences by including instrument-dependent offsets in a fitted trend function.

Both approaches show consistent trends of tropospheric NO_2 for a selection of areas on both regional and city scales. Measured tropospheric NO_2 columns have been increasing by a factor 3 over east-central China. On a megacity level, individual trends can be as large as +27.2±3.9% yr^{-1} and +20.7±1.9% yr^{-1} in Dhaka and Baghdad, while Los Angeles shows a strong decrease of -6.00±0.72% yr^{-1}.

UP 11.7 Wed 17:00 MAG Poster

Spatial distributions of NO_2 in emission plumes observed by imaging DOAS from aircraft — •Anja Schönhardt[1], Andreas Meier[1], Andreas Richter[1], Thomas Ruhtz[2], Carsten Lindemann[2], and John P. Burrows[1] — [1]Institut für Umweltphysik, Universität Bremen — [2]Institut fuer Weltraumwissenschaften, Freie Universität Berlin

Nitrogen dioxide, NO_2, is an important reactive trace gas in the troposphere leading to ozone formation as well as acidification and eutrophication of ecosystems. NO_2 is produced from nitric oxide, NO, mainly emitted by combustion processes. The IUP Bremen AirMAP (Airborne imaging DOAS instrument for Measurements of Atmospheric Pollution) has been used for NO_2 observations over point sources and polluted areas during aircraft campaigns in 2011 and 2013. The instrument yields NO_2 column densities at fine horizontal resolution (below 100m, down to 30m), and at good spatial coverage. Within only a few minutes, NO_2 maps covering areas of several km^2 are obtained. Aircraft observations of spatial NO_2 distributions are presented, and the obtained maps reveal large spatial variability of NO_2, which is made possible by the AirMAP imaging capabilities. In particular, strongly non-uniform distributions of NO_2 within emission plumes downwind of point sources are discovered. The observations have implications for experimental emission estimates, the deduced relevance of emission sources and downwind chemistry. In this study, the NO_2 amounts and their particularly non-uniform distributions, resulting from chemical transformation and atmospheric dynamics, are investigated.

UP 11.8 Wed 17:00 MAG Poster

A Central Facility for Greenhouse Gas Analyses within the ICOS Network (Integrated Carbon Observation System) — Maria Büttner, Michael Hielscher, Stephan Baum, Bert Steinberg, Adam Janoschka, Christian Lütz, Rico Hengst, Markus Eritt, •Daniel Rzesanke, and Armin Jordan — Max Planck Institute for 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. We are currently building up the Flask and Calibration Laboratory (FCL) in Jena, a central facility of the ICOS research infrastructure. It will be responsible for measurements of CO_2, CH_4, N_2O, CO, H_2, SF_6 and O_2/N_2 ratios as well as stable isotope analyses (CO_2 and CH_4) of flask air samples collected at atmospheric and oceanic observing platforms of the ICOS monitoring network.

The second major task of the FCL is the provision of real air reference standards calibrated relative to the respective WMO calibration scales for the calibration and quality control of continuous measurement systems at the monitoring stations. Furthermore, a relational database management an QC/QA system is being developed in collaboration with colleagues of the ICOS Central Radiocarbon Laboratory at Heidelberg and the Atmospheric Thematic Centre near Paris.

In our contribution we will give an overview of the new institution, its instrumentation and the mode of operation.

UP 11.9 Wed 17:00 MAG Poster

Custom-designed optical measurement cell for temperature-dependent FTIR measurements of spectral line data — •Anton Serdyukov, Anne Rausch, Viktor Werwein, Jens Brunzendorf, Olav Werhahn, and Volker Ebert — Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, 38116 Braunschweig, Germany

Accurately determined spectral line parameters are an important input to each atmospheric monitoring activity. It is also important to know the temperature dependency of these parameters because of the broad temperature distribution in the atmosphere.

In the framework of the EMRP project EUMETRISPEC, a measurement cell was developed to allow for infrared measurements of gas samples at well defined environmental parameters – i.e. temperature, pressure and optical path-length. The massive copper body with the custom temperature stabilization design in combination with a refrigerated-heating circulator allows an accurate and stable temperature regulation of the gas sample in the range from -60 to +90°C. A special design of the cell windows ensures a reproducible optical path length, independent of varying gas pressures inside the cell.

We report on the cell design and present our first temperature-dependent measurements of carbon monoxide in the 2-0 band in the temperature range from -60 to +23°C at 300 mbar.

Acknowledgement: The European Metrology Research Programme (EMRP) is jointly funded by the EMRP participating countries within EURAMET and the European Union.

UP 11.10 Wed 17:00 MAG Poster

CO_2 self broadening and line strength measurements in the 2 μm region — •Jens Brunzendorf, Anton Serdyukov, Anne Rausch, Viktor Werwein, Olav Werhahn, and Volker Ebert — Physikalisch-Technische Bundesanstalt (PTB), Bundesallee 100, 38116 Braunschweig, Germany

CO_2 is one of the most important greenhouse gases. It is frequently monitored via satellites and ground-based stations using e.g. Fourier Transform Infrared (FTIR) spectrometers, often in the 2 μm region. Absolute CO_2 concentration retrievals can be improved with enhanced CO_2 spectral line parameters, which are preferably traceable to national standards.
Based on an FTIR instrumentation which has been setup in the framework of the European Metrology Programme (EMRP) we present measurements of CO_2 line parameters in the 2 μm wavelength region. We address the standardization of line data measurements and their uncertainty assessments facilitating measurements of spectral line data under well controlled conditions with traceable instruments. In particular, we present the FTIR spectrometer, the data reduction as well as the CO_2 spectra of the three bands around 2 μm. Retrieved self broadening coefficients and line strength data will be presented.
Acknowledgement: This work was performed within the European joint research project EUMETRISPEC (www.eumetrispec.org) funded by the EMRP. The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union.

UP 11.11 Wed 17:00 MAG Poster

Morphogenesis of short-time frozen microstructures in sea ice — •Bernd Kutschan[1], Silke Thoms[2], Klaus Morawetz[1,3,4], and Sibylle Gemming[5] — [1]Münster University of Applied Sciences, Stegerwaldstrasse 39, 48565 Steinfurt, Germany — [2]Alfred Wegener Institut, Am Handelshafen 12, D-27570 Bremerhaven, Germany — [3]International Institute of Physics (IIP), Avenida Odilon Gomes de Lima 1722, 59078-400 Natal, Brazil — [4]Max-Planck- Institute for the Physics of Complex Systems, 01187 Dresden, Germany — [5]Institute of Ion Beam Physics and Materials Research, Helmholtz- Zentrum Dresden-Rossendorf, P.O. Box 51 01 19, 01314 Dresden, Germany

Microstructures of salty water in sea ice are a unique habitat for microorganisms with a remarkable adaptibility to extreme environmental conditions. We model the early phase of brine entrapment in sea ice without salinity conservation by a Turing model and with salinity conservation by a phase field theory. The theory includes both macroscopic salt diffusion and microscopic order parameter dynamics describing the different symmetries, hexagonal ice and liquid water. The first structures emerging during sea-ice formation are determined by the phase instability of the ice-water system in the presence of salt. Realistic parameters allow to calculate a phase diagram and two-dimensional microstructures found in agreement with the measured samples. From a methodical perspective our approach could also be used to describe the morphology of ice and snow crystals. The research is supported by DFG-Priority Program 1158.

UP 11.12 Wed 17:00 MAG Poster

Freezing mechanisms of antifreeze proteins — •Bernd Kutschan[1], Silke Thoms[2], Klaus Morawetz[1,3,4], and Sibylle Gemming[5] — [1]Münster University of Applied Sciences, Stegerwaldstrasse 39, 48565 Steinfurt, Germany — [2]Alfred Wegener Institut, Am Handelshafen 12, D-27570 Bremerhaven, Germany — [3]International Institute of Physics (IIP), Avenida Odilon Gomes de Lima 1722, 59078-400 Natal, Brazil — [4]Max-Planck- Institute for the Physics of Complex Systems, 01187 Dresden, Germany — [5]Institute of Ion Beam Physics and Materials Research, Helmholtz- Zentrum Dresden-Rossendorf, P.O. Box 51 01 19, 01314 Dresden, Germany

The fascinating ability of algae, insects and fishes to survive at temperatures below normal freezing is realized by antifreeze proteins (AFPs). The mechanism of these proteins and how they inhibit the freezing of water is still an open question. We extend our earlier phase-field models for salt channel formation in sea ice to simulate and explain the mechanism of AFPs. We suggest a new thermodynamic hysteresis process stabilizing the supercooled liquid state by a non-equilibrium effect which explains the non-colligative behaviour of antifreeze proteins. The research is supported by DFG-Priority Program 1158.

UP 11.13 Wed 17:00 MAG Poster

Determination of sea ice concentration during summer using 1.4 GHz brightness temperatures — •Valentin Ludwig[1] and Lars Kaleschke[2] — [1]Raum 020, Institut für Meereskunde, Universität Hamburg, Bundesstraße 53, ZMAW-Gebäude, 20146 Hamburg — [2]Raum 016, Institut für Meereskunde, Universität Hamburg, Bundesstraße 53, ZMAW-Gebäude, 20146 Hamburg

An algorithm for the sea ice concentration retrieval from passive microwave data acquired in the protected frequency band of 1400-1427 MHz (L-band) was developed. It had been hypothesised that the wide range between the emissivities of open water and sea ice in L-band causes a high sensitivity towards low and intermediate ice concentrations. Previously used sensors had shown large uncertainties in low ice concentrations or were not even able to measure them at all. Additionally, the atmospheric influence can mostly be neglected in L-band. The results of this study indeed indicate the potential of the Soil Moisture and Ocean Salinity (SMOS) satellite in showing lower, physically consistent, sea ice concentrations than the Special Sensor Microwave/Imager (SSM/I) during the melting period 2012. Sea ice concentration uncertainties were found to be low for low and intermediate sea ice concentrations. A validation with Moderate Resolution Imaging Spectrometer (MODIS) infrared images shows good agreement with SMOS in low and intermediate ice concentrations. SMOS tends to underestimate high sea ice concentrations which exceed 80%. Additionally, clear 100% - 0% sea ice concentration jumps are smeared out due to the coarse spatial resolution.

UP 12: Atmosphäre - Labor

Time: Thursday 9:30–12:00 Location: MAG 100

Invited Talk UP 12.1 Thu 9:30 MAG 100

Laser filament induced secondary ice multiplication under cirrus cloud conditions — Thomas Leisner[1], Denis Duft[1], Harald Saathoff[1], Martin Schnaiter[1], Stefano Henin[2], Kamil Stelmaszczyk[3], Massimo Petrarca[2], Raphaëlle Delagrange[2], Zuoqiang Hao[3], Johannes Lüder[1], Yannick Petit[2], Philipp Rohwetter[3], Jérôme Kasparian[2], Jean-Pierre Wolf[2], and •Ludger Wöste[3] — [1]Institute for Meteorology and Climate Research, KI, 76131 Karlsruhe, Germany — [2]GAP, Université de Genève, CH 1211 Genève 4, Switzerland — [3]Institut für Experimentalphysik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany

The interaction of artificial plasma channels with water and ice clouds was investigated in the large cloud simulation chamber AIDA. Under the conditions of a typical storm cloud, where ice and supercooled water coexist, no influence of the plasma channels on the ice formation could be detected. Under conditions typical for thin cirrus ice clouds however, the plasma filaments induced a surprisingly strong effect of ice multiplication. Here, the laser action led to a strong enhancement of the total ice particle number density in the chamber by up to a factor of 100, even though only a 10-9 fraction of the chamber volume was exposed to the laser filaments. The newly formed ice particles quickly reduced the water vapor pressure to ice saturation thereby increasing the cloud optical thickness by up to three orders of magnitude. A model relying on the complete vaporization of ice particles in the laser filament and the condensation of the resulting water vapor on plasma ions reproduces our experimental findings [1].

UP 12.2 Thu 10:00 MAG 100

Growth amplification of small ice particles in saturated sucrose and sodium silicate solutions — •Patricia Handmann[1] and Thomas Leisner[2] — [1]Karlsruher Institut für Technologie, Karlsruhe, Baden-Württemberg — [2]Karlsruher Institut für Technologie, Karlsruhe, Baden-Württemberg

Reliable detection of particle phase state in clouds, containing water droplets and ice crystals, is a very challenging task. Furthermore the ability to discriminate between liquid and frozen cloud compounds is essential for understanding cloud glaciation and providing reliable parameterization for climate models. A vast number of optical instruments have been developed over the last decades to solve this task in field and laboratory experiments. In this presentation we revisit

the old method of ice crystal growth amplification (Bigg 1956) and demonstrate its advantages and drawbacks in a more modern setup.

Within this approach we exploit the property of ice crystals to grow to easily detectable sizes in the supercooled aqueous solutions of sucrose and sodium silicate solutions. In contrast to this, liquid droplets dissipate upon contact with the surface of such solution. We will show video records of the laboratory experiments and will discuss the applicability of the method for phase detection of secondary particles emitted by droplets during freezing.

Cited References:

BIGG, E. K. A new Technique for Counting Ice-Forming Nuclei in Aerosols Tellus, Blackwell Publishing Ltd, 1957, 9, 394-400

UP 12.3 Thu 10:15 MAG 100

Laboratory measurements on ice multiplication processes observed in individual cloud droplets — •Thomas Pander[1,2], Patricia Handmann[2], Alexei Kiselev[2], and Thomas Leisner[1,2] — [1]Ruprecht-Karls-Universität Heidelberg — [2]Karlsruher Institut für Technologie

Phase transitions in clouds have a profound influence on their radiative properties and lifetime. While it is common knowledge that water freezes at 0°C, cloud droplets can easily remain in a supercooled liquid state above -36°C. Heterogeneous freezing at warmer temperatures may be initiated by a suitable ice nucleus, ice itself being the ideal nucleus. As under typical conditions only a 10^{-5} fraction of the atmospheric aerosol particles are good ice nuclei, any multiplication processes of atmospheric ice particles are potentially relevant to the physics of the atmosphere. We present high-speed video evidence of such processes: a droplet may burst and emit several ice particles while freezing. The growing pressure in a liquid core surrounded by a growing ice shell can also be released by the pressing of water and dissolved gases through cracks in the shell, leading to bubbles on the outside of the droplet. If those bubbles burst, ice particles might be produced. The key influence of solid aerosol inclusions on these processes is explored and quantified.

UP 12.4 Thu 10:30 MAG 100

Laboratory experiments on ice nucleation and growth rates on meteoric smoke particles at mesospheric conditions — •Mario Nachbar[1], Denis Duft[2], Markus Eritt[2], and Thomas Leisner[1,2] — [1]Institute for Environmental Physics, Ruprecht-Karls-University Heidelberg, Germany — [2]Institute for Meteorology and Climate Research, Karlsruher Institute of Technology (KIT)

Ice particles have been detected at the polar mesopause region (height of 80-90 km) during summer term by radar measurements as polar mesospheric summer echoes (PMS). If large enough, they can be observed by eye as noctilucent clouds (NLC). Heterogeneous nucleation on nanometer sized (< 2nm) meteoric smoke particles (MSP) is believed to be one of the major nucleation processes taking place. PMSE and NLC could be used as a probe for the extreme physical and thermodynamical conditions of the mesopause region. In addition, long term trends due to the influence of anthropogenic greenhouse gas emissions could be validated. Therefore, the microphysical processes need to be understood in detail. We produce charged nanometer sized particles in a microwave resonator at 60 mb and transfer them into the TRAPS apparatus in order to examine ice nucleation as well as growth rates. Our new quadrupol ion trap allows us to store these particles under controlled mesospheric temperature and water vapor saturation conditions. Ice nucleation and growth processes are examined by analysing the mass distribution of the particles with a time of flight spectrometer as a function of the trapping time. In this talk, first measurements using the new setup will be presented.

Kaffeepause, 30 min

Invited Talk UP 12.5 Thu 11:15 MAG 100

Contact freezing induced by mineral dust particles — •Nadine Hoffmann, Manfred Schäfer, Denis Duft, Alexei Kiselev, and Thomas Leisner — IMK-AAF, KIT, Karlsruhe, Germany

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]. On the time scales of cloud lifetime the freezing of supercooled water droplets via contact mechanism may occur at higher temperature compared to the same IN immersed in the droplet. In our experiment we study single water droplets freely levitated in an Electrodynamic Balance [2]. We have shown previously that the rate of freezing at given temperature is governed only by the rate of droplet-particle collision and by the properties of the contact ice nuclei [2, 3]. Recently, we have extended our experiments to potassium reach feldspar (Microcline), being one of the most abundant components of the atmospheric mineral dust particles [4]. We have dispersed feldspar particles from the water suspension and as dry powder and compared their freezing properties. In this presentation we will present these results and discuss their possible implication for elucidation of contact freezing mechanism.

[1] Ladino et al., Atmos. Chem. Phys., 13, doi:10.5194/acpd-13-7811-2013, 2013. [2] Hoffmann et al., Atmos. Meas. Tech., doi:10.5194/amtd-6-3407-2013, 2013. [3] Hoffmann et al., Faraday Discuss., doi: 10.1039/C3FD00033H, 2013. [4] Atkinson et al., Nature, 498, doi:10.1038/nature12278, 2013.

UP 12.6 Thu 11:45 MAG 100

Characterization of ice crystals in the AIDA cloud chamber — •Paul Vochezer, Ahmed Abdelmonem, and Martin Schnaiter — KIT IMK-AAF, Karlsruhe, Germany

Clouds remain a major source of uncertainty for both weather forecasts and climate models. These uncertainties are strongly linked to the occurrence and development of ice particles in clouds. Our group is currently involved in field and laboratory measurements to quantify and qualify ice particles in clouds.

In our contribution we present measurements obtained by two cloud particle probes during a series of laboratory based AIDA cloud chamber experiments with ice containing clouds in a temperature range from -20°C to -60°C. The PHIPS-HALO instrument includes a stereo microscope which takes real images of individual cloud particles at a resolution of 3μm/pixel. The PPD2-K instrument acquires high resolution 2D scattering patterns of individual cloud particles in forward direction 5°-25°. Asphericity of the particles leads to deviations from the Airy pattern and allows the discrimination between droplets and ice particles. Symmetric ice particles like columns or plates generate symmetric scattering pattern which are filtered and analyzed habit by habit.

The data sets of PHIPS-HALO and PPD2-K are analyzed to determine the fraction of cloud ice particles and the occurrence of certain ice particle habits. Furthermore the transverse and longitudinal growth rates of airborne columnar ice particles are derived.

UP 13: Klimamodellierung

Time: Thursday 12:00–15:00 Location: MAG 100

Invited Talk UP 13.1 Thu 12:00 MAG 100

The 5th IPCC report: climate change and the drivers — •Monika Rhein — IUP, Universität Bremen, Germany

The talk summarizes the results of the 5th IPCC report, WG1 (the physical basis). After presenting the main changes in the climate system in the last 100 years, the drivers of that climate change are identified. The projected changes in the climate system till 2100 are discussed as well as the related scenarios.

Mittagspause, 60 min

Invited Talk UP 13.2 Thu 13:30 MAG 100

Wechselwirkung zwischen arktischem Meereis und der atmosphärischen Zirkulation — •Klaus Dethloff, Dörthe Handorf, Ralf Jaiser und Annette Rinke — Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, AWI Forschungsstelle Potsdam

Die beobachtete arktische Meereisabnahme fördert durch barokline Instabilität die Entstehung von synoptischen Wettersystemen über dem arktischen Ozean. Diese barokline Verstärkung im Sommer beeinflusst die planetaren Wellen und die grosskalige Zirkulation der Tropo- und Stratosphäre im Winter.

Die mit der globalen Erwärmung einhergehende Meereisabnahme verursacht dabei ein Klimaparadoxon, weil sie negative Phasen der Arktischen Oszillation mit stärker ausgeprägten meridionalen Strömungsmustern anfachen kann. Dadurch treten stabile Hochdruckgebiete und Blockierungslagen über Nordeuropa und Eurasien häufiger auf.

Die Dynamik der atmosphärischen Telekonnektionsmuster wird neben externen Antriebsfaktoren auch durch nichtlineare Wechselwirkungen zwischen planetaren Wellen und synoptischen Zyklonen mit subgridskaligen Prozessen bestimmt.

Klimamodellsimulationen könnnen die beobachteten atmosphärischen Reaktionen auf niedrige und hohe Meereiskonzentrationen nur teilweise reproduzieren, weil das komplexe Zusammenwirken von externen Antriebsmechanismen mit intern erzeugten atmosphärischen Musteränderungen bisher nicht verstanden ist.

UP 13.3 Thu 14:00 MAG 100

A Scale Invariance Criterion for LES Parametrizations — •Urs Schaefer-Rolffs — Institut für Atmosphärenphysik Kühlungsborn

The role of scale invariance (SI) is mandatory to explain a turbulent kinetic energy cascade in different fluid dynamical systems, including rotating and stratified flows. However, the representation of subgrid-scales in large eddy simulations do not necessarily fulfill this constraint. So far, SI has been considered in the context of isotropic, incompressible, and three-dimensional turbulence. In this presentation, the theory is extended to compressible flows that obey the hydrostatic approximation, as well as to corresponding subgrid-scale parametrizations. A criterion is presented to check if the symmetries of the governing equations are correctly translated into the equations used in numerical models. By applying scaling transformations to the model equations, relations between the scaling factors involved are obtained by demanding that the mathematical structure of the equations does not change.

The method is validated by the breakdown of SI occurring in the conventional Smagorinsky model, but not in the Dynamic Smagorinsky Model. Further, the criterion proves that the compressible continuity equation is intrinsically scale invariant, while for the hydrostatic approximation horizontal and vertical scales exhibit different scaling behaviour. The criterion also shows that a simplified kinetic energy equation can be scale invariant. Finally, in models of turbulent transport of a tracer, a constant mixing length must be avoided to allow for SI.

UP 13.4 Thu 14:15 MAG 100

The role of different modes of ice initiation for rain formation — •Thibault Hiron[1,2], Andrea Flossmann[1], and Marie Monier[1] — [1]LaMP, Université Blaise Pascal/CNRS, Clermont-Ferrand, France — [2]IMK-AAF, Karlsruhe Institut für Technologie, Karlsruhe, Germany

In mid-latitudes most clouds develop rain while passing through the ice phase.

In order to initiate the ice phase at temperatures above -35°C, particular aerosol particles are necessary, called IN (ice nuclei). Only little is known regarding the required properties of an aerosol particle to act as IN at a certain temperature region. Furthermore, it is uncertain whether they will act through condensation freezing, immersion freezing or contact freezing.

The detailed bin-resolved microphysics model DESCAM has been used to study the role of the different modes of ice initiation on rain formation using data from the literature, coupled with the sensitivity tests.

Invited Talk UP 13.5 Thu 14:30 MAG 100

A simple physical explanation for the sensitivity of the hydrologic cycle to global climate change — •Axel Kleidon and Maik Renner — Max-Planck-Institut für Biogeochemie, Jena, Germany

The global hydrologic cycle is likely to increase in strength with global warming, although some studies indicate that warming due to solar absorption may result in a different sensitivity than warming due to an elevated greenhouse effect. Here we show that these sensitivities of the hydrologic cycle can be derived analytically from an extremely simple surface energy balance model that is constrained by the assumption that vertical convective exchange within the atmosphere operates at the thermodynamic limit of maximum power. Using current climatic mean conditions, this model predicts a sensitivity of the hydrologic cycle of 2.2 % K^{-1} to greenhouse-induced surface warming which is the sensitivity reported from climate models. The sensitivity to solar-induced warming includes an additional term, which increases the total sensitivity to 3.2 % K^{-1}. These sensitivities are explained by shifts in the turbulent fluxes in the case of greenhouse-induced warming, which is proportional to the change in slope of the saturation vapor pressure, and in terms of an additional increase in turbulent fluxes in the case of solar radiation-induced warming. We illustrate an implication of this explanation for geoengineering, and show that our simple model can explain the result of much more complex climate models very well. We conclude that the sensitivity of the hydrologic cycle to surface temperature can be understood and predicted with very simple physical considerations.