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 γ_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.