

UP 5: Postersession

Zeit: Dienstag 16:40–18:10

Raum: GW2 B3010

UP 5.1 Di 16:40 GW2 B3010

Evaluating the potential for improved vertical sensitivity of MAX-DOAS measurements — ●ANDREAS RICHTER, TIM BÖSCH, ENNO PETERS, FOLKARD WITTRÖCK, and JOHN P. BURROWS — Institut für Umweltphysik, Universität Bremen, Bremen, Germany

Ground-based Multi-Axis DOAS (MAX-DOAS) measurements can be used to derive vertical profiles of trace gases and aerosols in the lower troposphere. Together with the integrated tropospheric columns, these profiles are interesting information for comparison with in-situ measurements and atmospheric models.

One limitation of this technique is the rapid loss of sensitivity with altitude which results from the measurement principle providing the highest sensitivity close to the altitude of the instrument. Extending the profile sensitivity to higher altitudes would increase the applicability of MAX-DOAS measurements, in particular for observations of long-range transport events.

In this study, several possible approaches to extend the vertical profiles are investigated using the radiative transfer model SCIATRAN. Tests include the use of several wavelengths, combination of different azimuthal directions, application of a fixed background spectrum and exploitation of polarised measurements. First results indicate that there is some additional profile information in such measurements but that the effect for practical applications is limited.

UP 5.2 Di 16:40 GW2 B3010

Comparison of NO₂ vertical columns from satellite measurements with ground based measurements over Xianghe, China — ●LISA K. BEHRENS¹, ANDREAS HILBOLL², ANDREAS RICHTER¹, ENNO PETERS¹, FRANCOIS HENDRICK³, MICHEL VAN ROOZENDAEL³, and JOHN P. BURROWS¹ — ¹Institute of Environmental Physics, Bremen, Germany — ²MARUM, Bremen, Germany — ³Belgian Institute for Space Aeronomy, Belgium

NO₂ is an important indicator for air pollution from anthropogenic sources. Due to its relatively short atmospheric life time, polluted areas can clearly be identified in global maps of satellite-derived NO₂ abundances. For a better understanding of anthropogenic air pollution, there is constant need for validation of the satellite measurements using independent data sources. Here, we show a comparison of ground based and satellite measurements of NO₂ tropospheric vertical columns (VCs) over Xianghe in Eastern China for the time period 2010-2013. The ground based data are from measurements by a Multi-Axis Differential Absorption Spectrometer (MAX-DOAS), located at 39.75°N and 116.96°E. For this study, the data of different satellite instruments were used.

The ground based measurements are compared with two different NO₂ VCs retrievals from satellite measurements which are based on two different sets of a priori data. We investigate the influence of the satellite retrievals' a priori assumptions and other parameters on their agreement with the ground based observations, providing valuable information to further improve the satellite retrievals over China.

UP 5.3 Di 16:40 GW2 B3010

High Precision NO₂ and NO_x measurements with the ICAD instrument during s-b-s campaign Hohenpeißenberg 2016 — DENIS PÖHLER¹, ●ERIK LUTZ¹, MARTIN HORBANSKI¹, JOHANNES LAMPEL¹, and ACTRIS s-b-s TEAM² — ¹Institute of Environmental Physics, Uni Heidelberg — ²ACTRIS s-b-s intercomparison NO_x 2016 Team

Nitrogen Oxides (NO_x) play a major role in air pollution and atmospheric chemistry. Beside health effects they influence e.g. acid rain, ozone and oxidation capacity. But precise NO₂ and NO_x measurements are still difficult. During a ACTRIS side by side (s-b-s) inter-comparison campaign at the Meteorological Observatory Hohenpeißenberg (DWD) 2016 the performance of different instruments for NO₂, NO and NO_x were investigated under natural and artificial conditions. We present results of our ICAD Instruments for direct optical NO₂ and NO_x measurements. The inter-comparison demonstrates excellent performance of ICAD in terms of accuracy and drift. Also different conditions like different humidity's, temperatures and possible interfering gases do not influence the measurement result.

UP 5.4 Di 16:40 GW2 B3010

Tower DOAS off-axis measurements of NO₂ in Vienna, Austria — STEFAN F. SCHREIER¹ and ●ANDREAS RICHTER² — ¹Institut für Meteorologie, Universität für Bodenkultur, Wien, Österreich — ²Institut für Umweltphysik, Universität Bremen, Bremen, Deutschland

Off-axis DOAS measurements were carried out on the rotating platform of the Danube Tower in Vienna (about 160 m above ground) in spring 2016. More than thirty rounds, each lasting for about 26 minutes, were performed on five days. After the measurements taken in off-axis direction inside the tower through a glass window, a couple of zenith-sky measurements were recorded from the open terrace (about ten meters below). The DOAS analysis is applied for the retrieval of O₄ and NO₂ differential slant column densities (DSCDs) in the visible spectral range. First results show a clear spatial variability in the distribution of NO₂. Higher values are generally found above industrial areas and busy roads. O₄ DSCDs are larger towards the plain, smaller towards the hilly area, and smallest towards the DC Tower (tallest skyscraper in Austria). The recorded spectral measurements have the potential to provide averaged NO₂ mixing ratios in the horizontal path at about 160 m altitude for all directions.

UP 5.5 Di 16:40 GW2 B3010

Long-term MAX-DOAS measurement of trace gases and aerosol in the Environmental Research Station Schneefenerhaus — ●ZHUORU WANG and NAN HAO — German Aerospace Centre, Remote Sensing Technology Institute (DLR-IMF), Oberpfaffenhofen, Germany

The Environmental Research Station Schneefenerhaus (UFS) is located under the summit of Zugspitze, Germany. It is an observation site with mostly clean and unpolluted air.

A MAX-DOAS instrument has been working in the UFS since February 2011. The telescope is located on the terrace of UFS. During the daytime, the telescope sequentially scans 8 different elevation angles. The instrument has two spectrometers, one for UV region, and the other for VIS region. The spectra measured by the two spectrometers are recorded synchronously.

The DSCDs of O₄, NO₂ and HCHO are calculated from the spectra with DOAS method. A retrieval algorithm, based on the radiative transfer model LIDORT and the optimal estimation technique, is used to provide information on the vertical profiles and VCDs of aerosol and trace gases.

This work presents the results of the MAX-DOAS measurement in the UFS from 2012 to 2015, including aerosol (derived from O₄ measurement), NO₂ and HCHO etc. The vertical profiles as well as the seasonal and diurnal variation patterns of tropospheric aerosol and trace gases will be shown.

UP 5.6 Di 16:40 GW2 B3010

Inter-comparison of glyoxal vertical columns retrieved from SCIAMACHY, OMI, GOME-2 (A and B) instruments — ●LEONARDO M. A. ALVARADO¹, ANDREAS RICHTER¹, ANDREAS HILBOLL^{1,2}, MIHALIS VREKOUSIS^{1,2}, JOHN P. BURROWS¹, STELIOS MYRIOKEFALITAKIS³, and MARIA KANAKIDOU³ — ¹Institute of Environmental Physics, University of Bremen, Bremen, Germany — ²Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany — ³Environmental Chemical Processes Laboratory, University of Crete, Heraklion, Greece

Glyoxal is an intermediate product in the oxidation process of most VOC and an indicator of secondary aerosol formation in the atmosphere. Similar to other VOC, glyoxal is mainly emitted from natural processes, however has also a significant contribution from fires and anthropogenic sources. Since many years the number of retrievals of glyoxal abundances from satellite instruments using the DOAS method has increased. Most recently, some studies focused on improving the retrieval of glyoxal from different satellite measurements in order to reduce the uncertainties in the glyoxal columns and in estimation of VOC emissions. This study focuses on a new homogenized glyoxal product using AMF computed based on profiles simulated with the TM4-ECPL chemistry transport model. This retrieval algorithm is applied to (a) SCIAMACHY, (b) OMI, and (c) the two GOME-2 (A and B). Overall, the retrieved glyoxal column amounts from the homogenized retrieval algorithm show similar seasonal behavior among the instruments over

selected regions.

UP 5.7 Di 16:40 GW2 B3010

Nachweis von nicht-identifiziertem Spurenstoff durch spektroskopische Fernerkundung im Hafengebiet von Hamburg. — ●STEFAN SCHMITT¹, ANDREAS WEIGELT³, BARBARA MATHIEU-ÜFFING², ANDRÉ SEYLER², FOLKARD WITTRÖCK², JOHANNES LAMPEL¹, DENIS PÖHLER¹ und ULRICH PLATT¹ — ¹Institut für Umweltphysik, Universität Heidelberg — ²Institut für Umweltphysik, Universität Bremen — ³Bundesamt für Seeschifffahrt und Hydrographie

Im August 2016 wurden über einen Zeitraum von 6 Wochen Langpfad-DOAS Messungen zur Überwachung von Schiffsemissionen im Hafengebiet von Hamburg durchgeführt. Dabei wurden Spurenstoffe innerhalb eines ca. 6 km langen Lichtweges über dem Fluss Elbe gemessen. Neben Absorptionen der bekannten Spezies NO₂, SO₂, O₃ und HCHO konnte auch eine bisher nicht identifizierbare Absorptionsstruktur nachgewiesen werden, welche im Wellenlängenbereich zwischen 280 nm bis 330 nm eine Progression von Absorptionsbanden besitzt und mit außerordentlich hohen optischen Dichten von bis zu 2% auftrat. Der Absorber hat einen ausgeprägten Tagesgang und wurde überwiegend tagsüber (bei solarer Einstrahlung) nachgewiesen, was ein Indiz für einen durch Photolyse gebildeten Spurenstoff ist. Die Absorptionsstruktur konnte noch keinem aus der Atmosphärenchemie bekannten Spurenstoff zugeordnet werden und auch nicht in bisherigen Datensätzen gefunden werden. Die spektrale Struktur ähnelt anderen bekannten UV-Absorbieren und ein instrumentelles Problem kann ausgeschlossen werden.

UP 5.8 Di 16:40 GW2 B3010

Measurements of shipping emissions and trends in air quality with different methods — ●BARBARA MATHIEU-ÜFFING^{1,2}, LISA KATTNER^{1,2}, ANDRÉ SEYLER¹, FOLKARD WITTRÖCK¹, ANDREAS WEIGELT², STEFAN SCHMOLKE², and JOHN BURROWS¹ — ¹University of Bremen, Institute of Environmental Physics (IUP), Bremen, Germany — ²Federal Maritime and Hydrographic Agency (BSH), Hamburg, Germany

During the project MeSmarT (Measurement of Shipping Emissions in the Marine Troposphere) the short and long term impact by emissions of nearby passing individual ships on air quality is monitored by in-situ measurements of NO, NO₂, O₃, SO₂ and CO₂, by DOAS (Differential Optical Absorption Spectroscopy) measurements and diffusive sampling of NO₂ and SO₂ at two stations, at river Elbe and at Neuwerk island. At times in parallel AQMesh[®] sensors were tested for suitability for measuring individual ship's emissions and air quality trends.

Variations and trends in background concentrations and pollution rate of some trace gases and differences between the two stations can be seen. The comparison of results shows chances and limitations of these methods with aspect to its application in environmental monitoring in atmospheric science and control of regulatory limits, i.e. to the MARPOL regulation of marine fuel sulphur content and its effect on air quality.

UP 5.9 Di 16:40 GW2 B3010

Monitoring shipping emissions in the German Bight using MAX-DOAS measurements — ●ANDRÉ SEYLER¹, FOLKARD WITTRÖCK¹, LISA KATTNER^{1,2}, BARBARA MATHIEU-ÜFFING^{1,2}, ENNO PETERS¹, ANDREAS RICHTER¹, STEFAN SCHMOLKE², and JOHN P. BURROWS¹ — ¹Institute of Environmental Physics (IUP), University of Bremen — ²German Federal Maritime and Hydrographic Agency (BSH), Hamburg

Shipping emissions contribute substantially to air pollution in coastal areas and harbor towns. The North Sea has one of the highest ship densities in the world.

A three-year time series of ground-based MAX-DOAS measurements of NO₂ and SO₂ on the island Neuwerk in the German Bight has been analyzed for contributions from shipping emissions. Measurements of individual ship plumes as well as of background pollution are possible from this location, a few kilometers away from the shipping lane towards the port of Hamburg. More than 2000 individual ship emission plumes have been identified in the data and analyzed for the emission ratio of SO₂ to NO₂. Contributions of ships and land-based sources to coastal air pollution levels have been estimated. Since January 2015, much lower fuel sulfur content limits of 0.1% (before: 1.0%) apply in the North Sea Emission Control Area (ECA). The impact of this change in regulations on the coastal SO₂ levels has been investigated.

This study is part of the project MeSmarT (www.mesmart.de), a co-

operation between the University of Bremen and the German Federal Maritime and Hydrographic Agency (BSH).

UP 5.10 Di 16:40 GW2 B3010

Measurement of atmospheric trace gases using solar absorption spectroscopy in the Inner Tropics — ●MATHIAS PALM¹, CORNELIUS BECKER², THORSTEN WARNEKE¹, CHRISTOF PETRI¹, and JUSTUS NOTHOLT¹ — ¹Universität Bremen — ²Meteorologische Dienst Suriname

Measurements of atmospheric trace gas distributions in the inner tropics are sparse. The AG Notholt of the Universität Bremen has been active since 2004 in Paramaribo, Suriname, 6N. Until 2012 measurements were only conducted on campaigns during the dry periods in spring and autumn.

Since 2012 measurements could be extended to cover the whole year. We show the first results of whole year measurements above Paramaribo and compare them to independent measurements from satellite and some first model results. This is of interest because the inner tropical convergence zone (ITCZ) sweeps over Paramaribo and allows measurements of the southern and northern atmosphere and the transition thereof.

One trace gas, HCl, which is linked to Ozone depletion, shows since a few years a very distinct seasonal cycle. First attempts of the interpretation of those measurements will be shown and discussed.

UP 5.11 Di 16:40 GW2 B3010

LED Based Quarz Enhanced Photoacoustic Spectroscopy: A cost effective solution for in-situ detection of volcanic Sulfur Dioxide? — ●LUKAS TIRPITZ, SIMONE WALD, NICOLE BOBROWSKI, ULRICH PLATT und JONAS KUHN — Institut für Umweltphysik Heidelberg

Volcanic gas measurements, particularly of sulfur dioxide (SO₂) play an essential role for the examination of volcanic degassing processes. In the field application, in-situ instruments are frequently affected by harsh environmental conditions and the high corrosivity of volcanic gas species, making such measurements laborious, expensive, and frequently unreliable. Sensors for volcanic SO₂ based on quartz enhanced photoacoustic spectroscopy (QEPAS) use the fact, that SO₂ is the dominant absorber of UV-radiation around 300 nm wavelength. Thus the amount of radiation absorbed by the sample gas depends only on its SO₂ content. Since the absorbed radiation is converted to heat, illumination by a pulsed light source causes the temperature and thus pressure of the sample gas to oscillate and to emit an acoustic wave. A small resonant 32.8 kHz quartz tuning fork (as it is used in any quartz clock) serves as a microphone to detect the signal intensity and to determine the SO₂ concentration. Typically, large and expensive laser systems are used as light sources. We are developing a cost effective, mobile, and potentially ultra-compact QEPAS instrument using commercially available UV light emitting diodes, which we expect to be sufficient to reliably detect typical volcanic plume SO₂ abundances at useful detection limits (<1 ppm).

UP 5.12 Di 16:40 GW2 B3010

Development of the Scanning Mobile ATMONSYS Lidar for water Vapor, Aerosol and Temperature — ●HANNES VOGELMANN, THOMAS TRICKL, MATTHIAS PERFAHL, and STEFAN BIGGEL — KIT IMK-IFU, Garmisch-Partenkirchen, Germany

Water vapor is the most important greenhouse gas and dominates weather patterns, the atmospheric energy budget and atmospheric dynamics. For analysing dynamic processes of the planetary boundary layer we developed a scanning lidar for measuring water vapor, aerosols and temperature. In order to obtain 3-dimensional information it is equipped with a scanner covering the entire hemisphere above the system. Water vapor is measured with the differential absorption method (DIAL), aerosol with simple backscatter from different wavelengths and temperature with the rotational Raman-backscatter of air-molecules. We present the design of the three-stage laser-system including a diode-pumped Nd:YAG-Laser, a single mode two-wavelengths Ti:Sapphire oscillator and a regenerative Ti:Sapphire amplifier. We also give insight into the design of the lidar receiver with separate telescopes for near and far field, the scanning optics, the structure of the polychromators and the data acquisition. Additionally we report from our first field campaign (ScaleX) with the new system in summer 2016 in Peißenberg.

UP 5.13 Di 16:40 GW2 B3010

Results of the imaging DOAS instrument IMPACT at

CINDI-2 and comparison to MAX-DOAS-observations — ●MAREIKE OSTENDORF¹, ENNO PETERS¹, ANJA SCHÖNHARDT¹, ANDREAS RICHTER¹, ANDRÉ SEYLER¹, FOLKARD WITTRÖCK¹, STEFAN SCHREIER², MIHALIS VREKOUSIS^{1,3}, and JOHN P. BURROWS¹ — ¹Institut für Umweltphysik (IUP), Universität Bremen, Bremen, Deutschland — ²Institut für Meteorologie, Universität für Bodenkultur Wien (BOKU), Wien, Österreich — ³Zentrum für Marine Umweltwissenschaften (MARUM), Bremen, Deutschland

This contribution presents and discusses the new ground-based instrument IMPACT (Novel Imaging MaPper for Atmospheric observations) developed at the IUP Bremen. The instrument uses Differential Optical Absorption Spectroscopy (DOAS) to measure trace gas column amounts, e.g. of NO₂. The special characteristic of the imaging DOAS instrument is the capability to measure in 50 vertical viewing directions (elevation angles) simultaneously. By combination with a pantilt head for azimuthal movements, complete hemispheric scans are achieved within a short time. See also accompanying talk by E. Peters.

The measurement and retrieval procedure results in images of distributions of NO₂ and O₄, which yield information about local sources, transport and diurnal variations.

The poster focuses on results and comparisons to MAX-DOAS measurements, which were obtained during the CINDI-2 campaign in summer 2016 in Cabauw, Netherlands.

UP 5.14 Di 16:40 GW2 B3010

20 years of tropical tropospheric ozone columns from nadir retrievals of GOME, SCIAMACHY and GOME-2 using the Convective Clouds Differential technique Elpida — ●ELPIDA LEVENTIDOU¹, MARK WEBER¹, KAI-UWE EICHMANN¹, JOHN P. BURROWS¹, and ANDREA POZZER² — ¹Inst. of Environmental Physics, University of Bremen, Bremen, Germany — ²Max-Planck-Institut für Chemie, Mainz, Germany

Tropical tropospheric ozone columns can be retrieved with the Convective Cloud Differential (CCD) technique using retrieved total ozone columns and cloud parameters from space-borne observations. A CCD-IUP algorithm has been developed and applied to GOME, SCIAMACHY, and GOME-2 weighting function DOAS total ozone data. A 20 years record of monthly averaged tropical tropospheric ozone columns (20S - 20N) was created starting in 1996 and was extensively validated by comparisons with SHADOZ ozonesonde data. The comparison shows good agreement. Biases were found to be within 5 DU and the RMS errors less than 10 DU. The dataset has been harmonized into one consistent time series and was later used to determine tropical tropospheric ozone trends. The mean tropical tropospheric ozone trends range between +/-5 DU/Decade, with a mean value of 1.15 +/- 1.1 DU/Decade. The influence of 2015 el Niño event has been investigated in a case study using simulations from the ECHAM/Messy Atmospheric Chemistry model. Enhanced tropospheric ozone columns have been found over the Indonesian region (~ 8DU) and reduced over the eastern Pacific (~10 DU).

UP 5.15 Di 16:40 GW2 B3010

Retrieval of stratospheric ozone profiles from OMPS measurements in limb viewing geometry — ●CARLO AROSIO¹, ALEXEI ROZANOV¹, KAI-UWE EICHMANN¹, ELIZAVETA MALININA¹, JOHN P. BURROWS¹, GLENN JAROSS², and PAWAN K. BHARTIA² — ¹Institute of Environmental Physics, University of Bremen, Germany — ²NASA, Goddard Space Flight Center, USA

Due to its crucial role in the radiative budget of the stratosphere as well as its importance as an absorber of UV radiation, a continuous monitoring of the stratospheric ozone has been a priority for the scientific community. After the European ENVISAT satellite ceased its operations in 2012, only a few older satellite missions have been still contributing to this task. At the end of 2011, SUOMI-NPP mission carrying OMPS instrument was launched, enabling the study of the vertical distribution of stratospheric ozone by analyzing the intensity of the scattered solar light in limb viewing geometry.

The focus of our study is to adapt the algorithm developed at IUP for the retrieval of stratospheric ozone profiles from SCIAMACHY limb measurements to OMPS observations, with the final aim to obtain a continuous data set from both instruments. The retrieval settings account for the instrumental design by exploiting different spectral ranges at UV and VIS wavelengths. A cloud filter based on the Color Index Ratio is applied and surface albedo is retrieved simultaneously, accounting for stratospheric aerosol. The retrieval results over 6 months are compared in this poster with the NASA retrieval product and validated using MLS and ozonesondes collocated observations.

UP 5.16 Di 16:40 GW2 B3010

Vergleich der Aerosol-Extinktionsprofile aus SCIAMACHY Okkultations- und Limbmessungen — ●JACOB ZALACH und CHRISTIAN VON SAVIGNY — Universität Greifswald

Im Rahmen des ROMIC-ROSA Projekts wurden stratosphärische Aerosol-Extinktionsprofile mitsamt der Teilchengrößenverteilung aus Sonnenokkultationsmessungen gewonnen. Die Messungen wurden mit dem Spektrometer SCIAMACHY auf EnviSat, dem ersten europäischen Okkultationsatelliten, gewonnen. Sie erstrecken sich über den Zeitraum 2002-2012 und überdecken den Wellenlängenbereich von 240 bis 2340 nm. Neben der Darstellung der Datenverarbeitung werden die errechneten Extinktionsprofile mit denen aus unabhängigen Limb-Referenzmessungen verglichen.

UP 5.17 Di 16:40 GW2 B3010

Merged Total Water Vapour product from AMSU-B and AMSR-E data in the Arctic region — ●ARANTXA TRIANA GÓMEZ, GEORG HEYGSTER, and CHRISTIAN MELSHEIMER — Institute of Environmental Physics, University of Bremen, Bremen, Germany

Water vapour plays a key role in the global climate system, and its global continuous knowledge is required for numerical weather prediction and climate models. Microwave imagers like SSM/I or AMSR-E have routinely provided daily vertically integrated water vapour content (total water vapour, TWV) over open ocean for more than 30 years, but not over the vast areas of the polar sea and land ice. Over those surfaces, a newer method based on data of the microwave humidity sounders AMSU-B and MHS, on the NOAA and METOP satellites respectively, gives the TWV. However, at the edges of the coverage of both methods some discrepancies have been observed. The first steps towards merging these two complementary datasets will be presented. This will eventually provide an Arctic-wide daily dataset of 50 km resolution with seamless coverage from the high Arctic to mid-latitudes from 2002 until now. With that, an assessment of water vapour distribution and temporal variations is possible.

UP 5.18 Di 16:40 GW2 B3010

Vergleich von Methoden zur Bestimmung der Nichtlinearität von Spektrometern — ●ERIK LUTZ, DENIS PÖHLER, MARTIN HORBANSKI und ULRICH PLATT — IUP, Heidelberg, Germany

Ist das elektrische Auslesesignal von Spektrometern nicht linear proportional zur einfallenden Lichtintensität, so spricht man von auftretender Nichtlinearität. Gerade bei DOAS Anwendungen mit kompakten Spektrometern, können diese Abweichung bis zu 5% des detektierten Signals ausmachen. Deshalb ist es dort unabdingbar, diese Effekte zu korrigieren um auftretende Absorptionsstrukturen korrekt zu erfassen.

Dieser Beitrag präsentiert zwei Methoden zur Bestimmung der Nichtlinearität von kompakten Spektrometern; die Methode der Belichtungszeitvariation sowie die Methode der differentiellen Intensität. Im Fokus steht jedoch letztere von beiden, bei welcher zwei LEDs per Faserkopplung superponiert werden, um die Sensitivität des Detektors über den kompletten Sättigungsbereich zu erfassen. Eine LED dient hierfür als variable Lichtquelle um das jeweilige Sättigungslevel einzustellen, die andere, temperaturstabilisiert und von geringer Intensität, als "differentiellen" Offset der während der Messung in alternierender Weise hinzugeschaltet wird.

Es werden Labormessungen mit beiden Methoden gezeigt und deren Vor- und Nachteile diskutiert.

UP 5.19 Di 16:40 GW2 B3010

Development of a measuring device to detect the angular distribution of solar irradiance — ●JÖRG BENDFELD, STEFAN BAL-LUFF, TOBIAS HARST, STEFAN WÜBBECKE, and JOHANNES BECKER — Universität Paderborn, Paderborn, Deutschland

The precise knowledge of solar resources is important for the most efficient conversion of irradiation into solar energy. Global Horizontal Irradiance (GHI) is the total amount of solar radiation received from the sun by a horizontal surface. This value is a base information for photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI). Direct Normal Irradiance (DNI) is the solar irradiation received by a surface that is normal to direction of the sun. The DNI is of importance for concentrating solar thermal installations and tracking Units. Diffuse Horizontal Irradiance (DHI) is the irradiation without the direct DNI. This diffuse irradiation is caused by scattering of molecules and particles in the atmosphere. The new device will be able to detect all of this parameters

and will be able to differentiate between the direction of all irradiation components. In contrast to classical pyranometers, the new device responds to the solar irradiation with an angular range sensor instead of a single horizontally oriented receptor surface. These tubular optical system is mounted on a gear to reach every azimuth and elevation angle over a hemispherical surface with a configuration which minimises overlap and missed regions of the sky. The internal surfaces of the tubular optical systems are designed to suppress reflections. This ensures sharply defined delimitation of the individual sky regions.

UP 5.20 Di 16:40 GW2 B3010

Box-Modell der Spriteentzündung in der Mesosphäre — ●PHILIPP RICHTER, HOLGER WINKLER und JUSTUS NOTHOLT — Universität Bremen, Institut für Umweltphysik

Ein Sprite (dt. Kobold) ist eine Entladung, welche in der Mesosphäre in Höhen von ungefähr 80 km über Gewitterwolken auftreten kann. Mithilfe eines für diese Arbeit entwickelten Modells der Elektrostatik in der Mesosphäre wird das notwendige Strommoment bestimmt, welches für die Entstehung eines Sprites notwendig ist. Das Modell löst gewöhnliche Differentialgleichungen, welche sich aus der Kontinuitätsgleichung und der Poisson-Gleichung sowie Reaktionsgleichungen ergeben, zur Berechnung der (reduzierten) elektrischen Feldstärke, sowie Teilchendichten von e-, N2+, O2+, O-, O+, N+, N2 und O2. Dazu werden Ratenkoeffizienten von BOLSIG+, Borisov et al./Sentman et al. und Pasko et al. verwendet. Abhängig von den verwendeten Ratenkoeffizienten liegt die kritische reduzierte elektrische Feldstärke zwischen 93 Td und 138 Td, sowie das für einen Sprite notwendige Strommoment bei ungefähr 200 kA km. Ein Streamer kann bei denselben reduzierten elektrischen Feldstärken entstehen.

UP 5.21 Di 16:40 GW2 B3010

Atmospheric gravity waves activity in the polar mesopause region based on PMSE observations — ●NIKOLAZ GUDADZE, JORGE L. CHAU, and GUNTER STÖBER — Leibniz Institute of atmospheric physics at Rostock university, 18225 Kühlungsborn, Germany

Atmospheric gravity waves (AGW) has important influence on mesosphere-lower thermosphere dynamics. It assumed that the part of the Atmospheric gravity waves breaks and/or dissipates in the mesopause region. Continuous Observations of the polar summer mesosphere with the Middle Atmosphere Alomar Radar System (MAARSY) have been used to investigate dynamical structures of well-known phenomenon - Polar esosphere Summer Echoes (PMSE), an important tracer in the summer polar mesopause region. We use Signal to Noise Ratio (SNR) and Doppler radial velocity from the PMSEs to investigate the wave-like motions with periods larger than 5 minutes. Such oscillations are studied in terms of atmospheric gravity waves (AGWs). Analysis shows dominance of wave-like oscillations with periods close to 15 minute in the range of short-period wave activity. PMSE layering, which could also connected with AGWs, is studied in connection with the background conditions of the neutral atmosphere. Background winds are obtained from collocated meteor radar (MR) and also based on PMSE radial velocities observed during multi-beam experiments. Local enhancement method is used for the processing of altitude-time SNR images to detect and characterized layers in the PMSEs.

UP 5.22 Di 16:40 GW2 B3010

Combining L-band sensor data for thin sea ice thickness retrieval — ●CATALIN PATILEA, GEORG HEYGSTER, MARCUS HUNTEMANN, and JUSTUS NOTHOLT — University of Bremen, Institute of Environmental Physics, Bremen, Germany

Thin sea ice thickness retrieval has been developed for the L-band radiometer Soil Moisture Ocean Salinity (SMOS) using daily means of high incidence angle (40-50°) data. The algorithm uses the correlation between brightness temperature intensity and polarization difference for retrieving sea ice thickness up to 0.5 m.

Fit functions for the dependence of the horizontal and vertical polarized brightness temperatures (Tbs) on incidence angle have been used for each SMOS grid point and day so that Tbs for any incidence angle can be extracted. This avoids daily introduction of a bias by the averaging process and it replaces the Radio Frequency Interference (RFI) filter used formerly which removed the whole snapshot if it contained one data point over 300 K which resulted in large areas with no data.

The L-band conically scanning radiometer Soil Moisture Active Passive (SMAP) has satellite level RFI filtering yielding a more complete coverage. A combined product is developed regressing SMAP Tbs to those of SMOS at 40° incidence angle. The combined sea ice thickness data has a better daily coverage and less noise.

UP 5.23 Di 16:40 GW2 B3010

Observations and Models of Low Mode Internal Waves in the Ocean — ●MAREN WALTER¹, CHRISTIAN MERTENS¹, JANNA KÖHLER¹, JONAS LÖB¹, JIN-SONG VON STORCH², and MONIKA RHEIN¹ — ¹MARUM/IUP, Otto-Hahn Allee, 28359 Bremen — ²MPI für Meteorologie, Bundesstrasse 53, 20146 Hamburg

Internal gravity waves in the ocean are generated by tides, wind, and interaction of currents with the seafloor. Models predict a global energy supply for the internal waves of 0.7-1.3 TW by the conversion of barotropic tides at mid-ocean ridges and abrupt topographic features. Winds acting on the oceanic mixed layer contribute 0.3-1.5 TW and mesoscale flow over topography adds 0.2 TW. Globally, 1-2 TW are needed to maintain the stratification of the deep ocean by diapycnal mixing that results from breaking internal waves. Ocean circulation models show significant impact of the spatial distribution of internal wave dissipation and mixing on the ocean state, e.g. stratification and meridional overturning. Observations indicate that the local ratio of generation and dissipation of internal waves is often below unity and thus the energy available for mixing must be redistributed by internal tides and near-inertial waves at low vertical wavenumber that can propagate thousands of kilometers from their source. Eddy-permitting global ocean circulation models are able to quantify the sources of energy input and to simulate the propagation of the lowest wave modes. However, the variation of the internal wave energy flux along its paths and its ultimate fate by dissipation remains to be parameterized.

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Variability of transport and pathways of the North Atlantic Current: a comparison of satellite altimetry data and observational data from pressure inverted echo sounders — ●HANNAH NOWITZKI^{1,2}, MONIKA RHEIN^{1,2}, ACHIM ROESSLER^{1,2}, and DAGMAR KIEKE^{1,2} — ¹MARUM - Center for Marine Environmental Sciences, Bremen, Germany — ²Institute of Environmental Physics, University of Bremen, Germany

The North Atlantic with its major currents being part of the Atlantic Meridional Overturning Circulation (AMOC) is one of the major climate relevant regions and of special interest in the context of climate change. The North Atlantic Current (NAC) forms the upper branch of the AMOC and transports warm and saline water from the subtropics into the subpolar North Atlantic. This provides the energy for basal melt of the Greenland Ice Sheets and also leads, for instance through the exchange of heat between the sea surface and the atmosphere, to relatively mild winter temperatures in northern Europe. The strength of the NAC and its pathways, both examined in this work, are thus closely linked to the global climate.

To study the circulation in the subpolar North Atlantic with a focus on the NAC, satellite altimetry data is combined with NAC transports measured with pressure inverted echo sounders. This data is then related to the North Atlantic Oscillation in order to study the link between the NAC circulation and atmospheric fluctuations.

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detection and variability of frontal structures in the North-West Atlantic from satellite observations — ●ALEKSEI BUINYI¹, DAGMAR KIEKE¹, and PAUL MYERS² — ¹MARUM/IUP, University of Bremen, Bremen, Germany — ²Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada

The Subpolar North Atlantic (SPNA) is known as one of the climate relevant regions of the world's oceans. This region receives both warm and salty water masses of tropical/subtropical origin that are being transported to higher latitudes as well as cold and fresh waters from polar latitudes being transported southward. As a consequence, front formation takes place at the "meeting point" of these water masses. The present study deals with the analysis of Sea Surface Temperature (SST) and AVISO altimetry datasets in the western part of SPNA with the aim of detecting oceanic fronts and eddies and determining their shape, strength and location. Both datasets have a spatial resolution of 0.25°x0.25°, temporal resolution of one day, cover the time interval from 1993 to 2015. We examine the region bounded by longitudes 65°W-35°W and latitudes 35°N-65°N. For the detection of the fronts an algorithm based on the so-called gradient method was applied. Identifying the position of the highest SST gradients allows us to allocate thermal fronts. Dynamic topography fields from AVISO are used to detect dynamic fronts as places of divergence or convergence of velocity fields. As a result, usage of different data sources allows us to detect fronts with higher rate of evidence and get information about

their genesis and variability.

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Variability of Labrador Sea Water transport through Flemish Pass in 2015-2016 — ●FANNY WISCHNEWSKI¹, DAGMAR KIEKE^{1,2}, LINN SCHNEIDER¹, and MONIKA RHEIN^{1,2} — ¹IUP, University of Bremen, Bremen, Germany — ²MARUM, University of Bremen, Bremen, Germany

Labrador Sea Water (LSW), the lightest component of North Atlantic Deep Water, originates in the Labrador Sea and is transported southward by the Deep Western Boundary Current (DWBC). At the western margin of the subpolar North Atlantic at about 46°N up to 48°N, Flemish Pass represents an alternative pathway to the major DWBC pathway bypassing the underwater plateau Flemish Cap further offshore. Constrained by the Grand Banks and by Flemish Cap, Flemish Pass is a shallow underwater passage with a sill depth of 1200m that avoids zones of potential stirring and potential deflection of water masses into the interior North Atlantic. The passage allows about 20% of upper LSW to pass southward, and combined with the volume flowing within the DWBC around Flemish Cap, this makes an important contribution to the cold return branch of the Atlantic Meridional Overturning Circulation (AMOC). On the basis of sustained mooring data and ship-based measurements, recorded in 2015 and 2016, estimations of the recent volume transport of LSW through Flemish Pass are undertaken, and the variability of the resulting transport time series and possible variability-generating processes are analyzed. The findings of this study will contribute to a better understanding of this shallow cold return branch of the AMOC.

UP 5.27 Di 16:40 GW2 B3010

Wollingster See: Dating of lake sediment core using natural and artificial radionuclides — ●MANUEL PEREZ-MAYO¹, HAREEM IKRAM¹, DANIELA PITTAUER², DIRK ENTERS³, and HELMUT W. FISCHER¹ — ¹Institute of Environmental Physics, University of Bremen, Germany — ²MARUM, University of Bremen, Germany — ³Geopolar, University of Bremen, Germany

Lake sediment cores are valuable archives of the changing environment. They contain information on local and regional atmospheric deposition, including material from surroundings brought through erosion and specially metal pollutants. A very well know method to dating the last 100 years is based on the signal of ²¹⁰Pb_{ex} often supported by the peaks of ¹³⁷Cs as absolute time markers (e.g. atmospheric bomb test fallout and Chernobyl).

Natural and artificial radioisotopes as ²¹⁰Pb, ²¹⁴Bi, ²¹⁴Pb, ⁴⁰K, ¹³⁷Cs, ²⁴¹Am and plutonium isotopes were analysed in a sediment core taken in a deep part of the lake Wollingster See (NW Germany) in order to provide a reliable chronology enabling to reconstruct the environmental changes.

Actual results show very high and apparently also quite variable sediment accumulation rates. ¹³⁷Cs cannot be used as precise marker, as the bomb test and Chernobyl maxima can not be clearly indentified. In that case, we need to seek for information from additional radioisotopes like ²⁴¹Am using techniques of spectra summing in gamma spectrometry and measuring Pu isotopes by alpha spectroscopy to distinguish better between nuclear weapons testing and Chernobyl deposition.

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Re-examination of Cs-137 depth profiles in undisturbed soils in Northern Germany — ●AIKATERINI ANESIADOU¹, MARIA EVANGELIA SOUTI¹, HELMUT FISCHER¹, and GERALD KIRCHNER² — ¹Institute of Environmental Physics, University of Bremen, Germany, email: aanesiad@uni-bremen.de — ²Hamburg University, Germany

Knowledge of the evolution of Cs-137 vertical profile in soils after a surface contamination is crucial for predicting the transfer to human food chains and/or groundwater contamination. The objective of this study is the re-examination the vertical distribution of Cs-137 originating from the Chernobyl accident and nuclear weapons fallout at undisturbed soil profiles in northern Germany sampled in 1992 and 1994 and recently in 2014 at two identical locations. The goals are to measure and compare the depth distributions between the two sampling dates and also between the two regions. Moreover, a mathematical model based on the convection-dispersion equation will be fitted

to the data of each soil core. The comparison between profiles taken at different times is expected to provide more reliable modelling results.

For both locations, the first one characterised as Orthic Podsol and the second one as Umbric Gleysol, Cs-137 could be detected until 72 cm respectively 48 cm depth. Results, in general, demonstrate decreasing activity concentrations with depth with values ranging from about 29.5 to 0.1 Bq/kg and from about 11.5 to 0.1 Bq/kg respectively. Additionally, the expected downward migration of Cs-137 between the past and recent soil core is observed.

UP 5.29 Di 16:40 GW2 B3010

Mathematische Neubetrachtungen der katalytischen Wasserstoff- Sauerstoffverbrennung — ●MATHIAS SCHMITZ — confiducia GmbH, 69118 Heidelberg

Die regenerativen Energiequellen haben bei allen Vorzügen ein Problem, das darin besteht, dass in der Regel die Energieerzeugung diskontinuierlich abläuft. Das Sonnenergie- und Windangebot unterliegt täglichen und jahreszeitlichen Schwankungen, die nicht der Energienachfrage entsprechen. Damit stellt sich die Aufgabe, die Energie zwischenzeitlich zu speichern. Leider sind die technisch eingesetzten Speichersysteme für thermische und elektrische Energie sehr teuer und daher sind in den meisten Anwendungen Speicher unwirtschaftlich. Besonders dann, wenn die Speicherzeiten aus dem Stundenbereich in den Tagebereich verlängert werden, ist die Wirtschaftlichkeitsgrenze schnell überschritten. Insbesondere ist die eMobilität von leistungsfähigen Speichern abhängig. Eine Lösung dieser Problematik bietet das Konzept der Wasserstoffwirtschaft. Im Rahmen der Wasserstoffwirtschaft wurde auch die katalytische Verbrennung untersucht. In meiner Diplomarbeit mit dem Thema: *Untersuchungen zum Mechanismus und zur Kinetik der Reaktion explosiver Wasserstoff-Sauerstoff-Gemische an selbstbegrenzenden Palladium-Katalysatoren* führte ich Messungen zu einem katalytischen Rechenmodell durch. Nun, über 30 Jahre später stelle ich dieses Rechenmodell in Frage, wie bereits in der Diplomarbeit dargestellt ist.

UP 5.30 Di 16:40 GW2 B3010

Parameter for forecasting of offshore wind farms — ●JÖRG BENDFELD and STEFAN BALLUFF — Universität Paderborn, Paderborn, Deutschland

Data from operational offshore wind farms is only available over a short time period. Consequently, it is difficult to extrapolate current data to future deployments. The alternative approach is to estimate wind climate using wind speed data from met masts like FINO I, II and III or the met masts Amrumbank West, Arkona Becken Südost and climate model data like MERRA. There are very few stations that record offshore wind speed and climate. Offshore wind speed, especially in areas that are not close to land, is not subject to many of the spatial factors that influence changes in wind speed onshore; as a result is likely to be more homogeneous over larger areas. The Fetch is important to keep in mind. Predicting the short term wind speed and the resulting energy is of high importance. The chosen meteorological and geographical parameters are very important to improve the forecast/nearcast. Among several parameters the trend of wind speed, wind direction, thermal layering and pressure are important.

UP 5.31 Di 16:40 GW2 B3010

Evidenz und Kausalität der schädlichen Wirkung von Infraschall — ●JOACHIM SCHLÜTER. — Badenweiler

Die Richtigkeit der in vielen Fallstudien erhobenen Behauptung, Infraschall (IS) mache auch unterhalb der Hörschwelle krank, ist von Wanka und Cooper experimentell bewiesen worden. Der Einwand der Befürworter der Windkraft, windradgenerierter IS reiche ohnehin nur 700 m weit, beruht auf der fehlerhaften Auswertung einer Messung: Glättung eines harmonischen IS-Spektrums durch geringe Auflösung. Solche Spektren jedoch können Mensch und Tier wahrnehmen und als Zeichen der Annäherung eines Predators interpretieren. Mit dieser Hypothese wird die krankmachende Wirkung des IS erklärt. Sie wird zusätzlich durch Alltagsbeobachtungen gestützt. Die Umweltbelastung durch IS beruht auf dem Informationsgehalt diskreter Spektren und kann daher nur mit Hilfe des Signal-Rausch-Verhältnisses, nicht aber des Schallpegels bewertet werden.