UP 13: Postersession Bodenkunde, Kryosphäre, Meßtechnik, Ozeanographie

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

UP 13.1 Thu 10:45 G/Foyer

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

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

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

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

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

UP 13.2 Thu 10:45 G/Foyer

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

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

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

The ability of MAX-DOAS to retrieve cloud layer height and optical properties will be demonstrated with a comparison to co-located measurements of a commercial Ceilometer during several cruises of the German research vessel Polarstern. Advantages, limitations and possible applications of the technique will be discussed.

UP 13.3 Thu 10:45 G/Foyer

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

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

UP 13.4 Thu 10:45 G/Foyer

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

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

UP 13.5 Thu 10:45 G/Foyer

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

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

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

UP 13.6 Thu 10:45 G/Foyer

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

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

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

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

UP 13.7 Thu 10:45 G/Foyer

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

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

UP 13.8 Thu 10:45 G/Foyer

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

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

UP 13.9 Thu 10:45 G/Foyer

T-matrix calculation with the Green's dyadic technique for electromagnetic scattering: a numerical approach using the Dyson equation — •ugo tricoli and klaus pfeilsticker — Institute of Environmental Physics, University of Heidelberg, INF 229 Heidelberg, 69120, Germany

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

UP 13.10 Thu 10:45 G/Foyer

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

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

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

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

UP 13.11 Thu 10:45 G/Foyer

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

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

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

UP 13.12 Thu 10:45 G/Foyer

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

Soil hydraulic material properties are needed for a large range of applications, such as the optimization of irrigation and fertilization for food production in semi arid regions. However, these material properties are (i) unknown *a priori*, (ii) nearly impossible to measure directly, (iii) varying in space and in time, and (iv) highly non-linear. Hence, the development of efficient methods allowing for cheap and reliable identification of these properties is crucial.

In this study, we observed the dynamic deformation of the capillary fringe with time-lapse Ground Penetrating Radar (GPR) while forcing the hydraulic system with a fluctuating water table.

We then estimated effective material properties of the subsurface material distribution comparing the time-lapse GPR measurements to numerical simulations using the Levenberg-Marquardt optimization algorithm.

The corresponding numerical simulation of the GPR response is based on three coupled models comprising (i) a hydraulic model (Richards equation) which is based on conservation of water volume and an em-

pirical flux law, (ii) a electrodynamic model (Maxwell's equations), and (iii) a petrophysical relationship relating the previous two via the dependency of the composite relative permittivity of the soil on the water content.

UP 13.13 Thu 10:45 G/Foyer

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

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

UP 13.14 Thu 10:45 G/Foyer

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

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

UP 13.15 Thu 10:45 G/Foyer

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

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

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

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

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

UP 13.16 Thu 10:45 G/Foyer

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

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

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

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

UP 13.17 Thu 10:45 G/Foyer

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

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

UP 13.18 Thu 10:45 G/Foyer

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

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

UP 13.19 Thu 10:45 G/Foyer

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

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

UP 13.20 Thu 10:45 G/Foyer

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

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

UP 13.21 Thu 10:45 G/Foyer

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

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

UP 13.22 Thu 10:45 G/Foyer

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

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

UP 13.23 Thu 10:45 G/Foyer

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

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

UP 13.24 Thu 10:45 G/Foyer

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

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

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

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

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

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

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

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

UP 13.27 Thu 10:45 G/Foyer

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

Common parametrizations for bubble mediated gas transfer are compared on a basis of systematic measurements of gas transfer rates at a dedicated bubble tank. Trace gas concentrations were measured using a quadrupole mass spectrometer with a silicone membrane inlet in the water phase of the tank. Fourteen trace gases with a wide range of solubilities and diffusivities – SF_6, Neon, N_2, HD, D_2, O_2, Krypton, Pentafluoroethane, Xenon, N_2O, C_2H_2, CH_3Cl, Benzene and DMS – were used to investigate the dependency on these two physico-chemical parameters. Bubbles were generated by a water jet with adjustable kinetic energy, which entrained a controllable gas volume flux into the water tank. Invasion and evasion experiments with a variety of conditions were conducted including salt water (1.75% NaCl), the addition of the soluble surfactant Triton X-100, n-butanol and glycerol.

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