Programme AWI – IUP Blockseminar
"Methods, instruments and reference data"

16 February 2011, IUP Bremen, NW1 Room S1360

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IV. Remote sensing, laboratory and field measurements chair Annette Ladstätter-Weissenmayer			
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16:30 – 17:00	**Discussion/Closing**		

Abstracts:

Use of underwater platforms for scientific applications

Gerrit Meinecke

MARUM – Center for Marine Environmental Sciences

The talk will give a brief overview on existing underwater vehicles and carrier platforms, more and more in use for advanced scientific applications. The talk will cover the mayor types of vehicles, i.e. Remote Operated Vehicles, Autonomous Underwater Vehicles and Glider instruments, some also in use at MARUM and AWI. In addition to scientific tasks, technical and operational aspects/demands will be explained during presentation as well.

Obtaining high-precision solubilities of helium and neon in fresh water and seawater

Martin Vogt

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Institute of Environmental Physics (IUP), University of Bremen

The observed small excesses of helium and neon over solubility-equilibrium concentrations in the ocean mixed layer serve as a tool to study the physics of the atmosphere-ocean exchange of gases in general.

Currently this application is limited by the fact that published solubilities differ by 1% or more, compared to excesses of mostly about 4% and to measurement precisions of 0.4% or better. To resolve that discrepancy, we have developed a procedure capable of solubility measurement accurate to 0.2%.

Water and clean atmospheric air are equilibrated in a container under precise temperature control and at exact laboratory pressure. The solubility equilibrium is reached within about 1 hour. Samples of both the water and air phases are analyzed for helium and neon using the Bremen mass spectrometric facility. To minimize systematic errors, we rely on direct comparison for the samples of the two phases (alternate measurement). Sample treatment and transfer into the mass spectrometer is much the same for the two phases, and we made sure that remaining differences between the phases are small (< 0.1%). First results are presented, in comparison with literature data.

Confronting climate models with data

Thomas Jung

Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven

Climate models are widely used tools in environmental physics. Despite of substantial improvements in recent decades, present-day climate models are still subject to substantial short-comings. In this presentation a new seamless strategy is outlined for model assessment using observational data. It is argued

that climate models should be assessed during the first few time steps of the model (data assimilation and short-range weather forecasts) in order to prevent interactions between various processes from taking place. Examples will be given that highlight the potential of the seamless approach in guiding future model development.

Understanding archives: Large scale X-ray CT on polar firn and ice cores

Johannes Freitag

Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven

Enclosed air bubbles make polar ice to an unique gas archive for changes in atmospheric composition in the past. Accurate dating of air inclusions is an important requisite for the interpretation of ice core records. The overlying snow and firn column on top of the ice sheets is highly permeable for air causing a vertical exchange with the atmosphere down to firn layers in 50 to 100 m depth. Convective and diffusive mixing and a discontinuous close-off are a function of the complex pore structure of the firn during its densification path to bubbly ice.

In this talk I would like to present a new large scale X-ray microfocus-computer tomograph (ICE-CT) especially designed for the investigation of pore structures in ice cores. The ICE-CT is a milestone in the analysis of porous media. It bridges the gap between high resolution and large sampling volumes. High resolution of large volumes are needed to obtain representative data in the context of air enclosure and the layered structure of polar firn. It will be shown that by understanding the processes during air enclosure we are able to improve the accuracy of dating.

Combining satellite based radar interferometry with airborne and ground-based radar - examples from Antarctica

Reinhard Drews

Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven

The general inaccessibility of Antarctica necessitates the use of remote sensing techniques for the area-wide derivation of flow fields, surface elevation and bedrock topography. The ice sheet surface can be monitored with satellites. The stratified nature of the ice sheet is visualized with internal reflection horizons in the ice-penetrating radar data. The internal layering is commonly used to derive accumulation patterns, link ice-core drill sites and to investigate internal deformation. The use of polarimetric radar exploits the anisotropy of ice and its inclusions.

Once the scattering mechanism is fully understood, the polarization dependence may be used to infer different stress and strain regimes. The assemblage of the different glaciological parameters serves as input for mass balance studies, pre-site surveys of future drill sites, and ice sheet modeling.

Mars Remote Sensing, Geology & Landing Sites

Angelo P. Rossi

Jacobs University, Bremen

Mars has been observed with remote sensing, mainly from orbital platforms, for four decades. Especially in the last 10 years both the quality and quantity of remote sensing data, complemented with in-situ measurements by landers or rovers has greatly increased our knowledge of the planet.

Our understanding of the Geology of Mars has followed the remote sensing state of the art and there is now a reasonable picture of its large-scale evolution, although significant gaps are present and questions are arising at each new mission.

The choice of landing sites, from the relatively lucky strikes and educated guesses of Viking 1 & 2 landers in the '70s, is becoming a more and more complex exercise, involving large scientific and engineering teams, using a very large set of remotely sensed data.

An overview of the data used in Planetary Geology will be provided, hinting at the selection and characterization of landing sites for current and future missions.

Nitrogen dioxide detection with Optical Feedback Cavity Enhanced Absorption Spectroscopy

M. Horstjann, V. Nenakhov, M.D. Andrés Hernández, and J.P. Burrows

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Peroxy radicals (HO_2 and RO_2, R being an organic chain) are of major importance for tropospheric chemistry, and information about their concentration levels is therefore essential to improve our understanding of the mechanisms of chemical processing in the troposphere. One of the techniques to detect the total sum RO_2* of peroxy radicals ([RO_2*] = [HO_2] + [RO_2]) is to quickly convert them to Nitrogen Dioxide (NO_2) in a chain reaction. NO_2, despite being a radical itself, can be transported and measured without high losses, in stark contrast to the peroxy radicals themselves.

To overcome the limitations of a NO_2 chemiluminescent detection scheme using luminol which prevents measurements below ambient pressures of less than 250 mbar, a novel optical detector based on cavity enhanced absorption spectroscopy (CEAS) and using optical feedback (OF) has been developed. Resonator calibration with ring-down time acquisition permits direct absorption coefficient measurements. A high finesse V-cavity with 40 cm mirror distance is employed; the mirror reflectivity of 99,996% results in an optical path length of more than 10 km. A NO_2 1σ-detection limit of 0.23 ppbv / (Hz)^0,5 (data rate of the detector: 9 Hz) is achieved.

Construction and installation of two observatories for ground-based solar absorption measurements of greenhouse gases in Orleans (France) and Bialystok (Poland)

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Column remote sensing measurements of greenhouse gases, both from the ground and from space, are becoming important constraints on carbon cycle processes. Ground-based column measurements are provided by the Total Carbon Column Observing Network (TCCON). TCCON has become a vital component in the global observing system for greenhouse gases and was included in the Global Atmosphere Watch (GAW) of the WMO in 2009.

For carbon cycle studies a co-location of the TCCON measurements with vertically resolved in situ measurements is highly important. For this reason the FTIR-group at the University of Bremen has upgraded two of the existing European sites for atmospheric greenhouse gas observations at Bialystok (Poland) and Orleans (France) with TCCON observations. The extensive co-located carbon cycle measurements make these sites two of the most important sites in Europe. The construction, installation of the TCCON observatories at the sites as well as first measurements will be presented.

Remote Sensing of the Atmosphere using airglow as a light source

Christian von Savigny

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Apart from the emissions in the IR and microwave spectral regions, the Earth's atmosphere exhibits various emission features in the UV, visible and NIR spectral ranges that are summarized by the term airglow. Airglow is a classical non-LTE (local thermodynamic equilibrium) phenomenon, because the excited states cannot be excited thermally, but are excited by solar radiation or exothermic chemical reactions. Airglow is not only a phenomenon of the Earth's upper atmosphere, but occurs in most planetary atmospheres.

Radiometric of spectroscopic observations of airglow emission features are routinely employed for retrieving a wide variety of atmospheric parameters: vertical profiles of atmospheric constituents (e.g., O, O+, OH, O3, NO), background parameters such as temperature profiles and upper atmospheric winds or chemical heating rates. This presentation will provide an overview of the range of applications of airglow remote sensing, discuss the most relevant emission features as well as their excitation mechanisms, and introduce the methods employed to use airglow for remote sensing.

Retrieval of trace gas profiles from ground-based MAX-DOAS measurements

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Satellite measurements of tropospheric constituents have advanced significantly over the last decade, now providing near global measurements of a number of species relevant in tropospheric chemistry (e.g. CO, NO_2, HCHO, SO_2, CHO.CHO). With improving spatial resolution, these data sets move towards air pollution monitoring and even air quality assessment. However, the integrating nature of this type of remote sensing measurements makes the link to in-situ data as they are usually provided by monitoring networks difficult. This is a problem for both validation and interpretation of the satellite data.

Multi-axis differential absorption spectroscopy (MAX-DOAS) measurements can improve on this situation in several ways. Firstly, they can be used to provide directly the integrated tropospheric columns which are the quantity needed for validation. Secondly, they offer some vertical resolution, information which is needed in the retrieval of satellite data. However, a good estimate on the accuracy of tropospheric columns and profiles for different atmospheric conditions (clouds/aerosols) and viewing geometries using the MAX-DOAS technique is still missing.

Here the CINDI campaign held in June to July 2009 in Cabauw has provided the unique opportunity to compare and validate MAX-DOAS NO_2-profiles with in-situ, NO_2-lidar and NO_2-sonde measurements. Furthermore it is possible to intercompare the different MAX-DOAS results and finally come to recommendations for harmonization / standardization of instruments settings and retrieval algorithms. In addition to the real data a MAXDOAS model study has been initiated to identify more clearly the pros and cons for each method and to elaborate more clearly the general limitations of this technique. Results from both studies will be shown and discussed.

Absorption cross-sections measurements in the laboratory

Anna Serdyuchenko, Victor Gorshelev

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We report on the current progress on the HARMONICS project. The goal of the project is to produce a consolidated and consistent set of ozone absorption cross-sections.

Newly measured ozone spectra are expected to exhibit quality on the level of reliable reference to improve absolute scaling of the cross-sections and wavelength scaling as well: wavelength coverage of 220–1000 nm at about 0.02 nm spectral resolution or better, absolute intensities accuracy of at least 2%, and wavelength accuracy better than 0.001 nm. A lot of attention is paid to the accuracy of the temperature, at which spectra are recorded. To fulfill the demands we take advantage of combination of Fourier transform spectrometer (FTS) with echelle spectrophotometer capabilities. We intend to extend the dynamic range of each system and thereby decrease the number of the concatenated spectra, since concatenation significantly influences the accuracy of measurements.

This work is in progress. New dataset is planned to be completed by the summer 2011.