UP 18 Atmosphärische Spurengase und Aerosole: Instrumentelles

Zeit: Dienstag 16:30–18:30 Raum: E

Fachvortrag UP 18.1 Di 16:30 E

Flugzeugmessungen von atmosphärischem SO_2 während SCOUT — •Verena Fiedler[1,2], Heinfried Aufmhoff[1], Rainer Nau[1], Anna Kuhlmann[1], Frank Arnold[1] und Hans Schlager[2] — [1]Max-Planck-Institut für Kernphysik, Atmosphärenphysik, Heidelberg — [2]DLR, Institut für Physik der Atmosphäre, Oberpfaffenhofen

Während der SCOUT-Kampagne wurden die bisher umfangreichsten modernen Messungen des atmosphärischen Spurengases SO_2 mit einem neuen flugzeuggetragenen Ionen-Molekül-Reaktions-Massenspektrometer durchgeführt. Während der Transferflüge (Deutschland-Australien-Deutschland) wurde permanent SO_2 gemessen. In Nordaustralien wurden mehrere lokale Messflüge durchgeführt. Alle Messungen wurden von einer permanenten SO_2-Eichung mit isotopisch markiertem SO_2 begleitet.

Fachvortrag UP 18.2 Di 16:45 E

Development of a measurement system for peroxy radicals using laser-induced fluorescence technique — •Hendrik Fuchs, Andreas Hofzumahaus, and Frank Holland — Institute for chemistry and dynamics of the geosphere, Forschungszentrum Jülich, Jülich, Germany

A new instrument for measuring the sum of atmospheric hydroperoxy and organic peroxy-radicals (HO_2+RO_2) was developed using a two-step chemical conversion and laser-induced fluorescence (LIF) technique. The detection is done by successive conversion of RO_2 to hydroxyl radicals (OH). The system consists of two differentially pumped chambers. About 7L/min of ambient air is sampled through a nozzle into the first chamber, in which pressure is reduced to 25hPa. An excess of NO and CO is added behind the nozzle leading to a conversion of RO_2 to HO_2. The pressure is further reduced in the second chamber. In this chamber HO_2 is converted to OH by adding an excess of NO. The detection of OH-radicals is done by time delayed gated photon counting after resonant excitation of OH-fluorescence at 308nm ($A^2\Sigma^+$ - $X^2\Pi$). The sensitivity of the system is calibrated using a radical source. OH-radicals are produced by water photolysis. They react with methane resulting in methylperoxy-radicals. The typical detection limit is $2 \cdot 10^6 cm^{-3}$ (0.08pptv) for 2-min averages and signal to noise ratio of 1. The estimated accuracy is 10%. Unlike chemical amplifying systems also used for measuring HO_2+RO_2-radicals, only a weak dependence of the sensitivity on water is found which can be explained by quenching of the fluorescence. Ambient air measurements were performed showing distinctive diurnal profiles.

Fachvortrag UP 18.3 Di 17:00 E

Nitrogen oxide measurements in urban environments using a novel LED-powered Long-Path DOAS instrument — •Christoph Kern[1], Sebastian Trick[2], Jutta Zingler[1], Bernhard Rippel[1], Daniel Pedersen[3], and Ulrich Platt[1] — [1]Institut für Umweltphysik, Universität Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg, Germany — [2]now at: ABB Automation GmbH, DEATG / F - Analytical, Stierstädter Str. 5, 60488 Frankfurt, Germany — [3]Institute of Earth Sciences, Hebrew University of Jerusalem, Edmond Safra Campus, Givat Ram, IL-91904 Jerusalem, Israel

Nitrogen oxides such as NO2 and the nitrate radical NO3 play an important role in the chemical processes of the urban boundary layer. The Long-Path Differential Optical Absorption Spectroscopy (DOAS) measurement technique is a well established method for measuring atmospheric trace gases such as these. Steady advances in light-emitting diode (LED) technology have led to the applicability of LEDs as light sources for active DOAS measurements, where they represent a potentially very advantageous alternative to common thermal emitters for a variety of reasons including low cost, high durability and reduced power consumption. The assets and drawbacks of these modern light sources will be discussed, and the design of a first LED-powered instrument shown. The novel instrumentation was used to conduct nitrogen oxide measurements over the cites of Heidelberg, Germany and Jerusalem, Israel. The results of these measurements will be presented as an example of how LED-powered Long-Path DOAS instruments can facilitate highly sensitive pollution monitoring in urban environments.

Fachvortrag UP 18.4 Di 17:15 E

Search algorithm for optimized line selection in laser absorption spectrometers — •Karl Wunderle, Thomas Fernholz und Volker Ebert — Physikalisch - Chemisches Institut, Universität Heidelberg, INF 253, 69120 Heidelberg, Deutschland

Precise modelling of the atmospheric H_2O/CO_2 budget requires a detailed understanding of the transport processes between atmosphere and phytosphere. To quantify the gas transport of a plant leave we currently develop a tomografic tunable diode laser absorption spectrometer, TDLAS, to realize a non-intrusive spatially and temporally resolved determination of H_2O concentration profiles. To optimize the TDLAS performance, 10^4 H_2O-lines between $\lambda = 1.3 - 2.9\,\mu m$ must be compared with regard to optimal strength, minimized spectral interference and lowest dependence on pressure or temperature variations. Based on the HITRAN04 database and a detailed spectral simulation we developed an automated search algorithm to select the optimal absorption line depending on the experimental configuration and reject all lines with inappropriate absorbance, temperature dependence or spectral interference. Spectral interference by nearby lines is quantified in a pre-selected laser current tuning range by evaluating the standard deviation of the normalized difference between the total spectrum of the modelled setup and the isolated single line spectrum. To optimize the spectrometer performance we additionally calculate the expected Signal/Noise-Ratio, based on the spectrometer configurations as well as published detector data for responsivity, quantum efficiency and D* parameters.

Fachvortrag UP 18.5 Di 17:30 E

Auto-MAX DOAS : A New Measurements Platform — •Ossama Ibrahim, Torsten Stein, Thomas Wagner, and Ulrich Platt — Institut Für Umweltphysik, Universität Heidelberg, Heidelberg

Measurements of tropospheric and stratospheric trace gases using the well established Multi Axes Differential Optical Spectroscopy (MAX-DOAS) technique are widely used nowadays.The MAX-DOAS instruments are mounted on different types of mobile platforms (satellites, airplanes and ships) besides the stationary ground-based measurements. Here we present the description and the first results of atmospheric trace gas measurements of the ground-based mobile MAX-DOAS (Auto-MAX DOAS). A small size MAX-DOAS instrument was mounted on a car and measurement of NO2 from different types of pollution sources were carried out(industrial area, heating facility and a powerplant). Results showed elevated Slant Column Densities(SCDs)of NO2 downwind from the source areas as expected.The measurements from this new platform provides the possibility of encircling certain and well-defined targeted polluting areas(e.g.industrial,heavy traffic)to estimate the in-flux and out-flux of tropospheric pollutants from them (such as NO2)or from urban areas affected by them as well. The Auto-MAX measurements provide a spatial resolution better than that of Satellites and airplanes for city pollution scale and also gives more possibilities for measurement strategies than those of stationary ground-based measurements.In the near future,improving the spectrometer integration time will improve the spatial resolution and make it more suitable for city pollution and single plume measurements.

Fachvortrag UP 18.6 Di 17:45 E

Design and construction of a compact and mobile LIDAR system for atmospheric aerosol research — •Franz Immler[1], Otto Schrems[1], Özden Terli[1], Wilfried Ruhe[2], and Ingo Beninga[2] — [1]Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven — [2]Impres GmbH, Bremen

We have designed and constructed a new **C**ompact **C**loud and **A**erosol **L**idar (ComCAL) for the deployment in field campaigns including participation in ship cruises with our research vessel Polarstern. The backscattered light of a Nd:YAG Laser at 1064 nm, 532 nm, and 355 nm is collected by a telescope in a Newtonian configuration and 40 cm aperture. At 532 nm and 355 nm the polarisation is selected by a rotating Glan-Taylor prism which is synchronized with the laser. This configuration allows the measurement of the depolarization without the need for calibration. Biomass burning aerosol has recently been shown to fluoresce when irradiated by a UV laser beam. A 32-channel spectrometer measures Raman scattering and aerosol fluorescence simultaneously. The

measurement of wavelength dependent backscatter, extinction, depolarization, and fluorescence allows a detailed study of atmospheric aerosol. The systems determines aerosol optical properties and their vertical distribution in the range from 700 m up to 20 km. The aerosol types, their origins and abundance can be deduced from that data. These are important parameters for the study of the effect of natural and anthropogenic aerosols on climate.

Fachvortrag

UP 18.7 Di 18:00 E

Two dimensional concentration distributions of a NO_2 Emission plume from a point source derived by Airborne DOAS Tomography — •Klaus-Peter Heue[1], Bing Chao Song[1], Ping Wang[2], Marco Bruns[3], John P. Burrows[3], Andreas Richter[3], Thomas Wagner[1], Ulrich Platt[1], and Irene Pundt[1] — [1]Institut für Umweltphysik, Universität Heidelberg, INF 229, 69120 Heidelberg — [2]Royal Netherlands Meteorological Institute (KNMI), P.O. Box 201, 3730 AE De Bilt, The Netherlands — [3]Institut für Umweltphysik, Universität Bremen, Otto-Hahn-Allee 1, 28359 Bremen

We present airborne DOAS tomography measurements of two-dimensional concentration cross-sections of a plume from a point source. The measurements were performed with the AMAXDOAS (Airborne Multi-AXis Differential Optical Absorption Spectroscopy) instrument. The NO_2 slant column densities form ten different viewing direction are observed simultaneously.

As part of the second campaign of the European FORMAT project (FORMAldehyde as a tracer of photo oxidation in the Troposphere) in August / September 2003, the instrument was installed on board a small aeroplane. Three over flights were performed across the emission plume of the power plant in Sermide on the bank of the Po river.

We present a novel technique to use two dimensional weighting matrices from atmospheric radiative transfer simulations for 2D tomographic reconstructions. The NO_x emissions of $4-5\cdot10^{24}$ molec/s derived by the reconstruction are compared to the information provided by the power plant company.

Fachvortrag

UP 18.8 Di 18:15 E

Hochempfindlicher CO-Nachweis mit $2.3\,\mu m$-Diodenlaser — •Steven Wagner, Jürgen Wolfrum und Volker Ebert — Physikalisch - Chemisches Institut, Universität Heidelberg, INF 253, 69120 Heidelberg, Deutschland

Empfindliche CO-Messungen (bspw. für die Bilanzierung anthropogener CO_2-Emissionen) werden bisher meistens aufwändig und mit geringer Zeitauflösung mittels Gaschromatografen bestimmt. Absorptionsspektrometer auf Basis neuer $2.3\,\mu m$-Diodenlaser bieten hingegen die Möglichkeit zum selektiven, schnellen, kalibrationsfreien und empfindlichen CO-Nachweis. Vorraussetzung ist die präzise, allerdings aufwändige spektrale Charakterisierung. Mithilfe eines neuen automatisierten Messstandes und aufwändiger Auswerteverfahren wurde die Charakterisierungsdauer auf 1/60 reduziert und deren Genauigkeit deutlich erhöht. Mithilfe von CO-Liniendaten und einer genauen Bestimmung des Brechungsindex eines hoch auflösenden Germanium-Etalons gelang die präzise Bestimmung der statischen und frequenzabhängigen, dynamischen Abstimmkoeffizienten mit einer Genauigkeit besser als 1%. Das mit dem so charakterisierten Laser aufgebaute CO-Spektrometer zeigte bei der maximalen zeitlichen Auflösung ($0.05\,s$) eine Nachweisgrenze von $5.5\,ppm\cdot m$, die sich im Optimum, bei $100\,s$ Messzeit, auf $175\,ppb\cdot m$ bzw. $2\cdot10^{-6}$ OD steigern ließ. Mit $100\,m$ Messtrecke sollten sich somit Nachweisgrenzen von $1.75\,ppb$ realisieren lassen.