UP 9: Atmosphäre - Spurengase

Zeit: Mittwoch 16:00–18:30 Raum: GW2 B3009

Kaffeepause (30 min)

Hauptvortrag UP 9.1 Mi 16:30 GW2 B3009

Observing the impact of the Anthropocene on atmospheric composition using remote sensing from space based and aircraft instrumentation. — •John P. Burrows — Instiute of Environmental Physics, University of Bremen, Bremen

Since the industrial revolution, the earth's population has grown from 1 to ~7.5 Billion and at the same time its standard of living and longevity has increased dramatically. Pollution in the atmosphere now spans all scales from the local to the global. Air quality, stratospheric ozone and climate change are all being influenced by anthropogenic activity, and it is proposed that the earth has entered a new geological epoch the Anthropocene. The global measurement of many atmospheric trace constituents began with the SCIAMACHY (Scanning Imaging Absorption spectrometer for Atmospheric CHartographY) project in the 1980s. As a result of this initiative the following instruments have been developed and launched on satellite platforms into sun synchronous low earth orbit: GOME (Global Ozone Monitoring Experiment - ESA ERS-2 1995-2011), SCIAMACHY (ESA Envisat 2002 to 2012), GOME-2 (EUMTSAT Metop A 2006 to present, Metop B 2012 to present). In addition, the spin off OMI (Ozone Monitoring Instrument - NASA AURA 2004 to present) was developed by NSO. GOME GOME-2 and OMI make measurements of the back scattered electromagnetic up welling at the top of the atmosphere in nadir. SCIAMACHY makes alternate limb and nadir measurements. This presentation will provide an overview of the interpretation of the data provided by these instruments and related instruments developed for aircraft.

Hauptvortrag UP 9.2 Mi 17:00 GW2 B3009

NO_2 from space: What can we learn? — •Steffen Beirle — Max-Planck-Institut für Chemie, Mainz

Since two decades, satellite measurements of UV/Vis spectra allow for the global retrieval of tropospheric NO_2. This dataset has tremendously increased our understanding on the spatial (maps) and temporal patterns (trends, seasonal or weekly cycles) of NO_x sources. Nowadays, a main application is the quantification of NO_x emissions from NO_2 observations via inversion or assimilation techniques, involving CTMs. These approaches implicitly assume that the model describes processes such as transport and tropospheric chemistry accurately enough in order to relate differences in modeled and observed NO_2 columns to the a-priori emissions.

Here we investigate how far the satellite measurements of tropospheric NO_2 can be used to derive information beyond NO_x emissions, i.e. chemistry (NO_x lifetime) and transport, by analyzing and comparing the spatio-temporal patterns above and downwind from strong emission sources.

UP 9.3 Mi 17:30 GW2 B3009

Real Driving NOx Emissions of European trucks — •Tim Adler, Denis Pöhler, Christof Krufzik, Martin Horbanski, Johannes Lampel, and Ulrich Platt — Institute of Environmental Physics, Heidelberg, Germany

NO_x is one of the most problematic pollutants and thus emissions of e.g. trucks are strongly regulated. However, real emissions are typically not investigated. During a study the NO_x emission of more than 200 trucks under real driving conditions on the German highway was investigated. Therefore, a NO_x-ICAD-instrument (Iterative Cavity Enhanced DOAS) together with a CO_2 sensor were used to determine the pollutants in the emissions plume. We developed an algorithm to automatically evaluate the time series and compute the emission for each vehicle based on the plume chasing principle.

For most trucks of our data set the brand, the model name, the country of registration and its EURO class could be determined and used in a statistical analysis. Our data showed that that the emission of individual trucks are much higher than the allowed EURO Norm. The results and statistical analysis including different brands, EURO classes, country of registration etc. will be presented.

UP 9.4 Mi 17:45 GW2 B3009

Comprehensive study of NO_x and SO_2 from shipping emissions measured with on-shore in-situ instruments — •Lisa Kattner[1,2], Barbara Mathieu-Üffing[1,2], André Seyler[1], Folkard Wittrock[1], Andreas Weigelt[2], Stefan Schmolke[2], and John P. Burrows[1] — [1]Institute of Environmental Physics, University of Bremen — [2]Bundesamt für Seeschifffahrt und Hydrographie, Hamburg

Shipping emissions are a significant source of air pollution, especially for coastal areas and harbor towns. The establishment of a Sulfur Emission Control Area (SECA) for North Sea and Baltic Sea by the International Maritime Organization has been a first step to control and reduce SO_2 emissions by consecutively regulating the sulfur content of fuels.

Within the project MeSmarT, a collaboration between the University of Bremen and the Bundesamt für Seeschifffahrt und Hydrographie, a monitoring system for the sulfur content of ship fuels has been developed. The method is based on in-situ measurements of plumes of ships passing a fixed station at the river Elbe. In addition to SO_2 and CO_2, which are necessary for the sulfur content analysis, nitrogen oxides (NO_x) and O_3 are measured as well. After two and a half years of measurements a large dataset of more than 12000 plumes of ships has been acquired. Based on this dataset, the relations between the exhaust gas components as well as emission factors of different ship types and for various conditions will be presented.

UP 9.5 Mi 18:00 GW2 B3009

Airborne remote sensing of NO_2 air pollution over the city of Zurich — •Gerrit Kuhlmann and Dominik Brunner — Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland

Nitrogen dioxide (NO_2) is an important air pollutant and plays a key role in the formation of photochemical smog. We used the airborne imaging spectrometer APEX to retrieved a high-resolution NO_2 map ($50x50m^2$) over the city of Zurich during a flight campaign on 30th August 2013 (11:24-12:05 UTC).

The retrieval is based on a modified differential optical absorption spectroscopy (DOAS) algorithm, which retrieves NO_2 vertical column densities (VCD) from a wide spectral window (410-510 nm) making full use of APEX's spectral range. To allow for a wide spectral window, we replaced the low-order polynomial traditionally used in DOAS with a cubic spline and applied wavelength-dependent air mass factors pre-calculated with the SCIATRAN radiative transfer model.

The new algorithm improves the quality of the fit and reduces the retrieval noise. NO_2 VCD errors are estimated to about 20% for polluted areas. The retrieved map shows enhanced NO_2 values in populated areas. Furthermore, we find increased NO_2 values near the exit of highway tunnels and along the trajectory of airplanes departing from Zurich airport.

In conclusions, airborne observations allow mapping of the NO_2 distribution in urban areas providing a different perspective on urban air quality which cannot be acquired by ground-based observations.

UP 9.6 Mi 18:15 GW2 B3009

An improved total and tropospheric NO2 column retrieval for GOME-2 — •Song Liu[1], Pieter Valks[1], Gaia Pinardi[2], Isabelle De Smedt[2], Huan Yu[2], and Steffen Beirle[3] — [1]Institut für Methodik der Fernerkundung (IMF), Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Germany — [2]Belgian Institute for Space Aeronomy (BIRA/IASB), Brussels, Belgium — [3]Max Planck Institute for Chemistry (MPI-C), Mainz, Germany

This work focuses on an improved algorithm for the retrieval of total and tropospheric NO2 columns from the Global Ozone Monitoring Experiment-2 (GOME-2). A larger 425-497 nm wavelength fitting window with correction for GOME-2 slit function variations is used to determine the NO2 slant column density. The STRatospheric Estimation Algorithm from Mainz (STREAM) is applied to determine the stratospheric column density of NO2. For the calculation of the air mass factor (AMF), a new surface Lambertian equivalent reflectance (LER) climatology based on GOME-2 observations and the IMAGES a priori NO2 profile are used. Examples of the retrieved GOME-2 total and tropospheric NO2 columns are shown for Europe and Asia.