UP 14: Atmosphere 2

Time: Thursday 14:00–17:15 Location: HFT-FT 131

UP 14.1 Thu 14:00 HFT-FT 131

Cyclone induced East-Asian SO2 transport to the lower stratosphere: First proof by airborne measurements of SO2 and Fukushima Xe-133 — Hans Schlager[1], •Frank Arnold[2,1], Robert Baumann[1], Heinfried Aufmhoff[1], Anja Reiter[1], Hardy Simgen[2], Ludwig Rauch[2], Sebastian Lindemann[2], Florian Käther[2], and Ulrich Schumann[1] — [1]DLR, IPA , Oberpfaffenhofen, Germany — [2]MPIK, Heidelberg, Germany

The stratospheric aerosol layer contributes to the planetary albedo and influences stratospheric chemistry, and therefore is of considerable interest. The layer is thought to be formed preferably via SO2 injection by volcanic eruptions. Here, we report on observations of anthropogenic SO2 injection into the lower stratosphere. We have conducted airborne measurements of elevated SO2 and Fukushima Xe-133 at altitudes up to 13 km. The Xe-133, which was released by the March 2011 Fukushima nuclear power plant complex accident, is chemically inert and served as an ideal transport tracer. It has a half-live (against radioactive decay) of 5.25 days, similar to the SO2 half-live (against OH-induced conversion to aerosol particles). Our measurements unambiguously proved that cyclone induced injection of East-Asian SO2 containing planetary boundary layer air into the upper troposphere and lower stratosphere is operative. Implications of the observed injected stratospheric SO2 are discussed, including the formation and effects of stratospheric aerosol particles.

UP 14.2 Thu 14:15 HFT-FT 131

Entwicklung und Anwendung eines kompakten Langpfad-DOAS-Instruments basierend auf Faseroptik und LEDs — •Stefan Schmitt[1], Denis Pöhler[1], Sebastian Landwehr[1], Jens Tschritter[1], Holger Sihler[1,2] und Ulrich Platt[1] — [1]Institut für Umweltphysik, Im Neuenheimer Feld 229, 69120 Heidelberg, Deutschland — [2]Max Planck Institut für Chemie, Joh.-Joachim-Becher-Weg 27, 55128 Mainz, Deutschland

Langpfad-Differentielle Optische Absorptionsspektroskopie (LP-DOAS) ist eine etablierte Methode zur genauen Bestimmung von Spurengaskonzentrationen, z.B von NO_2, O_3, SO_2, HCHO, IO und BrO. Aufgrund des Gewichts von bis zu 100 kg und der komplexen Bedienung ist das Anwendungsfeld heutiger Instrumente beschränkt auf stationäre Messungen in Regionen mit ausreichender Infrastruktur.

Wir präsentieren ein neu entwickeltes, kompaktes LP-DOAS Instrument basierend auf Faser-Optik und LEDs. Geringes Gewicht, kompakte Bauform und niedriger Stromverbrauch ermöglichen es dem neuen Gerät, das Anwendungsgebiet von LP-DOAS Messungen auf entlegene Regionen, wie Küsten und Vulkane, zu erweitern.

Im Sommer 2011 konnten räumliche Verteilungen von Jodmonoxid (bis zu 36 ppt) an der Westküste Irlands mit dem neuen System aufgelöst werden. Die gemessene Konzentrationen korrelieren stark mit Sonneneinstrahlung und Tidenhöhe und unterstützen die Theorie, das küstennahen Makroalgen die Quelle für Jodemissionen sind.

UP 14.3 Thu 14:30 HFT-FT 131

Luftpaket-Verfolgung mit der fliegenden Atmosphären-Forschungsstation CARIBIC — •Armin Rauthe-Schöch[1], Angela Baker[1], Tanja Schuck[1], Carl Brenninkmeijer[1], Greta Stratmann[2] und Peter van Velthoven[3] — [1]Max-Planck-Institut für Chemie, Mainz — [2]Deutsches Zentrum für Luft- und Raumfahrt, Institutfür Physik der Atmosphäre, Wessling — [3]Koninklijk Nederlands Meteorologisch Instituut (KNMI), De Bilt, Niederlande

Das Forschungsprogramm CARIBIC (Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrument Container) untersucht physikalische und chemische Prozesse in der Erdatmosphäre mit einem Mess-Container an Bord eines Lufthansa Langstrecken Airbus A340. Das dafür speziell konstruierte Einlass-System ist permanent am Flugzeug montiert und besitzt Einlässe für Luft, Wasserdampf und Aerosolpartikel. Neben in-situ Messungen werden Luftproben gesammelt zur späteren Untersuchung im Labor. Auch ein MAX-DOAS System und eine Videokamera zur Wolkenbeobachtung sind vorhanden. Seit 2005 wurden von Frankfurt aus auf mehr als 250 Passagierflügen in die ganze Welt Messungen durchgeführt. Nach den Flügen werden am KNMI Rückwärtstrajektorien berechnet, um die Quellen der gemessenen Luftpakete zu ermitteln. Auf den monatlich vier aufeinanderfolgenden Messflügen werden in einigen Fällen Luftpakete zweimal durchflogen. Der Vortrag diskutiert die Schwierigkeiten bei der Bestimmung von doppelt gemessenen Luftpaketen und präsentiert erste Ergebnisse der beobachteten Spurengas-Änderungen während des Transports der Luftpakete zwischen den beiden CARIBIC-Messungen.

UP 14.4 Thu 14:45 HFT-FT 131

Retrieval of atmospheric CO2 from satellite near-infrared nadir spectra — •M. Reuter, M. Buchwitz, O. Schneising, J. Heymann, H. Bovensmann, and J.P. Burrows — Institute of Environmental Physics, University of Bremen, Germany

Carbon dioxide is the most important anthropogenic greenhouse gas. Its global increasing concentration in the Earth*s atmosphere is the main driver for global warming. However, in spite of its importance, there are still large uncertainties on its global sources and sinks. Satellite measurements, if accurate and precise enough, have the potential to reduce these surface flux uncertainties. At present, there are only two satellite instruments orbiting the Earth which are able to measure the CO2 mixing ratio (XCO2) with large sensitivity also in the boundary layer. In 2002 SCIAMACHY aboard ENVISAT started the time series of XCO2 observation from space followed by GOSAT which was launched in 2009. Recent XCO2 retrieval results of global SCIAMACHY nadir observations will be the focus of the presentation.

UP 14.5 Thu 15:00 HFT-FT 131

Automated identification and verification of long-range transport events of NO_2 in GOME-2 observations — •Achim Zien, Andreas Hilboll, Andreas Richter, and John P. Burrows — Institute of Environmental Physics, University of Bremen, Germany

Atmospheric long-range transport (LRT) events relocate trace gases from emission to downwind regions on an intercontinental scale, drastically altering the atmospheric chemistry in remote regions. Tropospheric NO_2 is a very short-lived, mainly anthropogenic trace gas with strong impact on the ozone chemistry. Emissions are very localized and allow identification of individual LRT events.

This phenomenon is investigated by remote sensing satellite observations which provide the spatial and temporal coverage needed to identify large-scale, multi-day events. The long, continuous time-series of such measurements allows the estimation of regional, seasonal and global statistics of such events.

Based on a non-cloud-filtered GOME-2 dataset of NO_2 slant columns, we use a special algorithm to identify LRT candidates and verify them using Lagrangian transport models. We further discuss the problems in the assessment of spatial extent and NO_2 content of LRTs, which are often associated with cloud formation.

As results of this study, we present statistics of NO_2 LRT events based on a 4-year dataset, showing that NO_2 LRT is not a rare phenomenon. We find strong seasonality in frequency and typical routes of such events. Based on simple estimations, we also provide statistics on the transported NO_2 mass.

30 min coffee break

Invited Talk UP 14.6 Thu 15:45 HFT-FT 131

Detection of gaseous sulphur and halogen species in the outgassing plume from volcano Mt. Etna — •Christiane Voigt[1,2], Philipp Jessberger[1,2], Domink Schäuble[1], Tina Jurkat[1], Robert Baumann[1], Guiseppe Salerno[3], and Nicole Brobowski[4] — [1]DLR, Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany — [2]Johannes Gutenberg-Universität, Institut für Physik der Atmosphäre, Mainz, Germany — [3]Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Italy — [4]Ruprecht-Karls-Universität, Institut für Umweltphysik, Heidelberg, Germany

Volcanoes affect climate in multiple ways. Degassing volcanoes represent a strong local source of sulphur and halogen species into the troposphere, and the formation and deposition of acids may cause major environmental hazards.

Here we present new in-situ observations in the outgassing plume from the Sicilian volcano Mt. Etna. The volcanic plume was detected with two Atmospheric chemical Ionization Mass Spectrometers (AIMS) onboard the DLR research aircraft Falcon on 29 and 30 September 2011 during the CONCERT2011 campaign. High mixing ratios of SO2, HNO3 as well as chlorine and bromine species were measured in the

ageing volcanic plume. In addition, SO2 and BrO fluxes were detected at the crater rim with different DOAS instruments. We link those observations using HYSPLIT trajectory calculations and investigate the complex chemical evolution of the Etna plume from its origin to about 12 hours plume age.

UP 14.7 Thu 16:15 HFT-FT 131

Stratospheric trends of ozone and bromine oxide from SCIAMACHY limb measurements — •Claus Gebhardt, Alexei Rozanov, Mark Weber, and John P. Burrows — University of Bremen, Institute of Environmental Physics

Anthropogenic sources of bromine pose a considerable risk to the stratospheric ozone layer. The exact contribution of bromine in the overall halogen related ozone loss is still uncertain. More than two decades after signing Montreal Protocol there are meanwhile indications for decreases in stratospheric bromine. The SCIAMACHY satellite instrument aboard ENVISAT now provides amongst others a decade of ozone and BrO profile measurements from the limb retrieval (2002-2011).

In this study we present vertically resolved trends for stratospheric ozone and BrO with a particular focus at their altitude and latitude variation. This is followed by comparisons of ozone trends with contemporary space borne instruments. An overview of the current bromine trends as derived from SCIAMACHY will be given.

UP 14.8 Thu 16:30 HFT-FT 131

Advances in CO_2 total column retrieval by mid-IR Fourier-Transform Spectroscopy — •Matthias Buschmann[1], Susanne Dohe[2], Emmanuel Mahieu[3], Nicholas Deutscher[1], Thorsten Warneke[1], and Justus Notholt[1] — [1]Institut für Umweltphysik, Universität Bremen — [2]Karlsruhe Institute of Technology (KIT) — [3]Université de Liège

Over the last decade ground-based remote sensing measurements of CO_2 have been established as an important component in the global observing system for greenhouse gases. Since 2004 the Total Carbon Column Observing Network (TCCON) sites have provided CO_2 retrievals in the near-IR region, which has several advantages. For example O_2 can be retrieved in the same spectral region and because the O_2 mole fraction is known, the CO_2 signal can be normalized by ratioing, thus systematic errors partly cancel. Additionally there is only one significant interference in the considered spectral window, namely water vapor, allowing analyzing broad spectral windows. CO_2 can also be retrieved in the mid-IR spectral region, but here many gases interfere and no O_2 absorptions are available. However there are 20 years of additional observations obtained in the mid-IR at a suite of FT-IR sites of the Network Detection of Atmospheric Composition Change (NDACC). It would be of great benefit to produce CO_2-data of sufficient precision from the mid-IR spectral region. In this study we have advanced the retrieval of CO_2 from the mid-IR spectral region. Limitations of the approach are outlined and the feasibility of a future CO_2-product of sufficient precision is discussed.

UP 14.9 Thu 16:45 HFT-FT 131

Ground based remote sensing of CO_2 and CH_4 using a mobile Bruker 120M FTIR spectrometer — •Christof Petri, Thorsten Warneke, Christine Weinzierl, and Justus Notholt — Institute of Environmental Physics, University of Bremen, Bremen, Germany

Throughout the last years the solar absorption spectrometry has been further developed to measure CO_2 and CH_4 with sufficient precision to contribute to the understanding of the cycle of these greenhouse gases. Such measurements are performed within the global "Total Carbon Column Observing Network" (TCCON), which was established in 2004. The observations within TCCON are performed in the near infrared spectral region using the high resolution Bruker 120 HR or 125 HR laboratory type interferometers. These instruments are quite large and expensive. For many applications mobile instruments would be required. However, up to now the required precision has not been demonstrated for mobile instruments. We performed observations using a mobile Bruker 120 M interferometer which is able to derive spectra with a resolution of 0.02 cm^{-1} as typically used in the TCCON network. The measurements have been performed in Bremen and compared to our observations using a Bruker 125 HR interferometer, which is part of the TCCON network. The observations have been performed for several months under different meteorological conditions. The retrieved results show that the instrument agrees within 0.2 % to the TCCON observations and that a precision of 0.3 % can be reached.

UP 14.10 Thu 17:00 HFT-FT 131

Rayleigh-Brillouin scattering of laser light in air - Results from laboratory and atmospheric measurements — •Benjamin Witschas[1], Oliver Reitebuch[1], Christian Lemmerz[1], Vieitez Maria Ofelia[2], Ubachs Wim[2], and van de Water Willem[3] — [1]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany — [2]Laser Centre, Vrije Universiteit (VU), The Netherlands — [3]Physics Department Eindhoven, University of Technology, The Netherlands

The global observation of atmospheric wind profiles remains to be the highest priority need for weather forecast. Therefore, the European Space Agency ESA decided to implement the Atmospheric Dynamics Mission ADM-Aeolus to demonstrate the potential of the Doppler lidar technology for global wind profiling. Thereby, the laser of the Doppler lidar sends short pulses into the atmosphere where they are partly scattered by aerosols and molecules. The backscattered light is collected by a telescope and analyzed concerning its frequency. The frequency shift between emitted and received light, caused by the Doppler-effect, is directly proportional to the atmospheric wind speed. The accuracy of this measurement technique is significantly depending on the knowledge of the spectral distribution of the backscattered light. For the validation and the improvement of spectral line shape models of Rayleigh-Brillouin scattered light, laboratory measurements as well as atmospheric measurements were performed. In my talk, the results of these measurements and the resulting influence on remote sensing techniques are extensively discussed.