UP 4: Trace gases and greenhouse gases

Zeit: Mittwoch 11:00–12:45 Raum: HS 22

Hauptvortrag UP 4.1 Mi 11:00 HS 22

Volcanic Gases - Telegrams of the inner Earth and the secrets of bromine — •Nicole Bobrowski — IUP, Universität Heidelberg, Germany — MPI-C, Mainz, Germany

The presentation starts with a general introduction on current possibilities and difficulties to read and interpret geochemical data with view on volcanic activity focusing on open conduit volcanoes. Then I will focus on bromine as one trace element in volcanic volatiles. Bromine has a considerable environmental impact, in particular on atmospheric chemistry and composition. The discovery of the highest atmospheric BrO mixing ratio in volcanic plumes (up to ppb in 2002) was followed by a revival of interest on volcanic plume chemistry. Such a discovery and follow up investigation were possible due to advances in volcanic remote sensing techniques, in particular, miniaturized DOAS instruments. The possibility of continuous measurements by automated instruments located at safe distances from the volcano lead additionally to relatively easily gained long-term data sets. Therefore, an increased interest developed in the volcanic community to investigate the bromine-sulfur ratio as a potential tracer of volcanic activity.

This presentation attempts to provide a comprehensive summary on volcanic bromine data of the last 15 years achieved from established and cutting edge measurement techniques as well as their treatment and interpretation in recent model experiments (atmospheric chemistry and volcanology). It points out controversially discussed relation of bromine degassing to volcanic activity and puts a light on remaining uncertainties.

UP 4.2 Mi 11:30 HS 22

Neue Beobachtungen zur Chemie reaktiver Halogenverbindungen in der antarktischen Troposphäre — •Jan-Marcus Nasse[1], Udo Friess[1], Denis Pöhler[1], Stefan Schmitt[1], Holger Sihler[1,4], Rolf Weller[2], Thomas Schaefer[2,3], Zsófia Jurányi[2], Helene Hoffmann[2] und Ulrich Platt[1] — [1]Institut für Umweltphysik, Univeristät Heidelberg — [2]Alfred Wegener Institute für Polar und Meeresforschung, Bremerhaven — [3]Leibniz Institut für Troposphärenforschung, Leipzig — [4]Max-Planck Institut für Chemie, Mainz

Reaktive Halogenverbindungen (IO, BrO, ClO) spielen in der polaren Grenzschicht bei in einer Reihe unterschiedlicher Prozesse wie dem episodenhaften Abbau troposphärischen Ozons oder der Oxidation von gasförigem Quecksilber eine zentrale Rolle. Trotz langjähriger Forschung sind zentrale Fragen zu Freisetzung und Transport, insbesondere von Chlor- und Jodverbindungen weiterhin offen.

Wir präsentieren Ergebnisse einer zweieinhalbjährigen Messkampagne auf der deutschen Antarktisstation Neumayer III. Von 2016 bis 2018 wurden mit einem Langpfad-DOAS Instument kontinuierlich Konzentrationen relevanter Spurengase gemessen und mehrere überraschende Beobachtungen gemacht. Für BrO konnten zusätzlich zu bekannten Frühjahrsepisoden nahzu durchgehend regelmäßige Erhöhungen des Mischungsverhältnisses auf über 15 ppt festgestellt werden. Höchstwerte waren in Polargebieten bislang unbeobachtete 110 ppt. Weiterhin konnte ClO in Mischungsverhältnissen bis zu 100 ppt detektiert werden - der Freisetzungsmechanismus ist bislang noch unklar.

UP 4.3 Mi 11:45 HS 22

An Investigation of Source Regions Contributing to the Deposition of Reactive Nitrogen in Arctic and Boreal Areas — •Hanne Eline Byre, Stefanie Falk, Frode Stordal, and Terje K. Berntsen — University of Oslo, Department of Geoscience

Long range atmospheric transport is an important source of reactive nitrogen (Nr) to Boreal and Artic ecosystems. The combined effect of climate change and deposition of reactive nitrogen which is an important nutriant for these systems, have the potential to change the carbon storage in high latitude reservoirs. Furthermore a change in vegetation, will lead to changes in the exchange of energy and humidity between the land surface and the atmosphere. We have conducted several model studies to investigate and quantify the importance and contribution of distinguished source regions to Nr deposition in polar and sub-polar regions in the northern hemisphere. Using a global chemistry transport model, we will assess the following questions: To what extent are emissions from agriculture in South-Asia affecting NOx deposition in the Arctic? What would happen if we shut down the automotive sector in Germany, do we see a reduction in the amount of NOx deposited in Norway?

UP 4.4 Mi 12:00 HS 22

Aircraft-based 2- and 3D Trace Gas Measurements with HAIDI (Heidelberg Airborne Imaging DOAS Instrument) - Results of EMeRGe Mission Asia — •Katja Bigge, Denis Pöhler, Udo Friess, and Ulrich Platt — Institute of Environmental Physics, Heidelberg University, Heidelberg, Germany

Due to their disproportionate impact, it is important to locate and quantify trace gases in the Earth's atmosphere. Aircraft-based measurements fill the gap between satellite instruments with good spatial coverage but poor spatial and temporal resolution and ground based measurements with good temporal resolution but poor spatial coverage. The HAIDI instrument can yield high temporal and spatial resulution in 2D and 3D during overflight and can thus resolve small-scale chemical and dynamical processes. Sources of trace gases can also be identified and quantified. Within the EMeRGe (Effect of Megacities on the transport and transformation of pollutants on the Regional to Global Scales) project HAIDI was installed in the research airplane HALO (High Altitude and LOng range research aircraft) of the DLR (German Aerospace Center). Two missions (July 2017 in Europe and March 2018 in Asia) were performed to investigate the chemical composition of the outflow of megacities and the atmospheric impact of urban pollution. Target areas included Paris, London and the Po area as well as Manila, Taiwan cities and China outflow. HAIDI derived a number of trace gases such as NO2, SO2, O3, BrO and HCHO. We will present results of the HAIDI measurements during the EMeRGe mission, including high-resolution data of megacity and ship plumes.

UP 4.5 Mi 12:15 HS 22

First resuls of total water vapour column from Sentinel-5P derived by the AMC-DOAS method — •Tobias Küchler, Stefan Noël, Heinrich Bovensmann, and John P. Burrows — University of Bremen, Bremen, Germany

Water vapour is the most abundant and also the most important natural greenhouse gas and plays a key role in tropospheric chemistry, as source of the hydroxyl radical, OH, and as a third body in key reactions of hydroperoxyl radical, HO2. Its amount is highly variable and is also affected by anthropogenic global warming. To investigate these effects, long time series of global water vapour amount and distribution are required.

The Air Mass Corrected Differential Optical Absorption Spectroscopy (AMC-DOAS) approach to derive global water vapour vertical columns was originally developed for Global Ozone Monitoring Experiment (GOME) on ERS-2, but has been applied also to measurements of the SCIAMACHY instrument on ENVISAT and the GOME-2 instruments on METOP-A and METOP-B. An application of the AMC-DOAS method to TROPOMI data on Sentinel-5P is currently under development.

In this presentation, we show promising results from our research. These include validations with independent data sets to assess the quality of the derived data will be shown. Since there is currently no operational water vapour product from Sentinel-5P, the new AMC-DOAS product will provide a valuable addition to the Sentinel 5P project.

UP 4.6 Mi 12:30 HS 22

Determination of the Emission Rates of CH4- and CO2-Point Sources with Airborne Lidar — •Sebastian Wolff, Christoph Kiemle, Axel Amediek, Gerhard Ehret, Martin Wirth, and Andreas Fix — Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR e.V.), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

Anthropogenic point sources produce a major share of global carbon dioxide (CO2) and methane (CH4) emissions. More observations of point sources are required to provide accurate inventories of atmospheric greenhouse gas (GHG) concentrations. Active remote sensing measurements by airborne lidar show much promise to this regard and demonstrate potential for future satellite implementations. Installed onboard the German research aircraft HALO the integrated-path differential-absorption (IPDA) lidar CHARM-F measures weighted vertical columns of CH4 and CO2 below the aircraft and along its flight track.

During the CoMet field campaign in spring 2018 such measurements were performed focusing on the major European hot spots of anthropogenic CO2- and CH4-emissions, i.e. large coal-fired power plants and coal mining areas. The measurement flights were designed to capture individual GHG plumes from which point-source emission rates can be derived. The observed plumes have been compared to mesoscale simulations generated with the Weather Research and Forecast Model. Detailed analysis of the observed data, which are in good agreement with reported point-source emissions rates, will be presented.