GEOmon Abstracts

(as available)

|Arctic methane - will the warming feed the warming?”

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Emissions of methane from Arctic sources such as wetland and clathrate may increase sharply with global warming. As the Arctic heats the warming may feed the warming. In 2007-2008 global levels of atmospheric methane rose significantly. New Arctic emissions may have been an important part of this rise.
There are several possible contributors: geological clathrates (methane hydrates), wetlands, fires and the gas industry. Stable isotopic analysis of atmospheric methane (δ13C), coupled with back trajectory analysis of the sampled air masses, can be used to identify the major Arctic emissions and help track sources as they change or switch on.
The release of methane from geological sources along the West Spitsbergen continental slope was investigated during a cruise on the Royal Research Ship James Clark Ross between 23 August and 24 September 2008 as part of a UK NERC funded International Polar Year Project, ëDynamics of Gas hydrates in polar marine environmentsí. Over 250 plumes of gas bubbles were identified using a 38-kHz sonar, emanating from the seabed at and above the upper limit of the gas hydrate stability zone, at depths of 150-400 m. At the plume sites concentrations of dissolved methane were up to 20 times greater at the bottom of the water column than in surface water.
If source signatures are known, then back trajectory analysis can be applied to methane in ambient air, to characterise inputs. Methane emissions from wetland areas in Northern Finland and Spitsbergen were studied during the summer of 2008. A diurnal sampling study carried out at Lompoloj‰nkk‰ fen between 5th and 6th August 2008 showed a high build up of methane overnight (maximum mixing ratio reached 2440 ± 5 ppb) with a methane source signature -69 ± 1 per mil.
Continued monitoring of δ13C of Arctic methane is important to monitor changes in emissions from sources within this highly sensitive region. Royal Holloway has initiated a programme of regular air sample collection. In the summer of 2008 methane mixing ratio and δ13C were measured at several Arctic sites: shipboard, Zeppelin in Spitsbergen, and Pallas in Northern Finland. The highest atmospheric methane mixing ratios in ambient air samples had 5-day back trajectories that passed over Siberia. Methane in these samples was relatively depleted in 13C. For example air masses that had passed over the Ob River gas field area had a methane δ13C source signature of -58 ± 2 per mil. This is likely to originate from mixing between methane emitted by both gas industry (around -49 per mil) and wetland (around -67 per mil). Source signatures of methane sources in Siberia were measured in collaboration with the Russian centre for atmospheric

research, St. Petersburg, as part of an INTAS project (1999-2000) and in the EU Meth-MonitEUr consortium.

"Effects of relative humidity on aerosol light scattering
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In the field, continuous measurements of aerosol light scattering is often performed under dry conditions (relative humidity RH < 30-40%) which differ from ambient, climate relevant ones. Since ambient aerosol particles experience a hygroscopic growth at enhanced RH, their microphysical (particle size, refractive index) and optical properties are strongly dependent on RH, i.e., scattering coefficients can experience RH enhancement factors of 2-6 at 90% RH compared to dry conditions. The knowledge of this RH dependence is of eminent importance for the comparison of ground based observations with satellite retrievals and aerosol parameters retrieved from LIDAR and sun photometers.
To model the optical properties, we have developed a model, which is based on Mie theory. Here we show first results on modelled aerosol optical properties at ambient relative humidity and comparisons with field measurements (for Jungfraujoch, Switzerland and Ny-Alesund, Spitzbergen)"

" Ground-based CO observations at the Jungfraujoch from 1997 till 2007: Comparison between FTIR and NDIR measurements"
Bart Dils (1), Philippe Demoulin (2), Emmanuel Mahieu (2), Martin Steinbacher (3), Brigitte Buchmann (3) and Martine De MaziËre (1)

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Here we will discuss CO measurements taken at the Swiss Alpine Jungfraujoch station (46.5∫ N, 8.0∞ E, 3580m a.s.l.) over the 1997-2007 time period. Results from two distinct techniques, namely Fourier Transform Infrared solar absorption spectrometry (FTIR), and the in situ Nondispersive Infrared technique (NDIR) have been compared. While the in situ NDIR measurements detect local CO concentrations at the site, the FTIR technique provides integrated measurements along the line-of-sight. Nevertheless, the pressure broadening of the spectral absorption lines recorded at high resolution enables retrieving information on the vertical distribution of CO, mainly in the troposphere, including its concentration near the surface. To provide enough information content the averaged vmr between 3.58 and 7 km is derived from the FTIR profile data.

Both datasets show a significant negative trend over the time period. However, the NDIR dataset's negative trend is much stronger. Pettitt change point tests reveal that the NDIR-FTIR bias changes substantially from 1997 till 2004 after which the bias stabilizes. Possible causes for these observations will be critically discussed. "

" Homogenization of UV-Vis reprocessing for ozone”

A. Griesfeller (1), F. Goutail (1), A. Pazmino (1), J.-P. Pommereau (1), D. Ionov (1,2)

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In the frame of the NDACC (Network for the Detection of Atmospheric Composition Change) UV-Visible working group a tentative homogenization of all UV-Vis zenith sky spectrometers processing has been initiated.
The first recommendation is concerning the total ozone retrieval. A significant change for the SAOZ (SystËme díAnalyse par Observation ZÈnithale) network is the use of different cross-sections (O3, H2O, O4, and ring calculations) and a different spectral window fitting which leads to a recalculation of the slant columns. The main change is the use of a climatological O3 AMF instead of an AMF calculated with a single summer profile.
Here we present the first comparison with various satellites (TOMS, GOME, OMI-TOMS, and OMI-DOAS) which highlights the impact of the recommendations on the differences between ground-based and UV-Visible measurements from space.

" ICARE: Data And Services In Support Of Cloud And Aerosol Research”

Jacques Descloitres, Jean-Marc Nicolas, and the ICARE Team

The ICARE Thematic Center was created in 2003 at the University of Lille to provide data and services to the science community in research fields such as aerosols, clouds, water cycle, radiation, and their interactions. ICARE is sponsored by CNES, CNRS/INSU, the University of Lille, and the Nord-Pas-De-Calais Regional Council. One primary objective is to help the science community access and exploit the huge data volumes derived from the A-train satellites, combine them with products derived from other satellite missions, including meteorological satellites, or compare them to ground-based measurements to support validation activities. ICARE is in charge of the production and distribution of PARASOL science products. In addition, many data sets such as Calipso, CloudSat, Aqua, and Aura products are routinely acquired by ICARE from other data providers, then made available to the ICARE community through the ICARE website or ftp server. ICARE develops expertise with satellite data and operational processing, and offers various support services to the users community, such as development of operational processing codes using algorithms provided by scientists, development of specific tools based on users requests, and development of web interfaces to help users browse, select and analyze data from the ICARE archive. In particular, ICARE favors multisensor approaches and aims at developing and implementing combined products (e.g., PARASOL-MODIS, CALIPSO-PARASOL, CALIPSO-Cloudsat...). Examples of ICARE achievements will be shown, with emphasis on the A-train related activities.
URL: http://www.icare.univ-lille1.fr

Stephan Henne

Empa

" Monitoring of air quality and atmospheric composition is often performed at surface sites using in-situ air samples. The atmospheric layer closest to the ground is, however, strongly influenced by geographically varying surface fluxes (emissions,

surface deposition) and can therefore be very heterogeneous. Thus, in order to perform measurements that are representative of a larger domain, observatories are often placed away from population centres or on mountain tops. These sites are often termed rural or remote background sites. However, their classification is usually based on subjective criteria that are not uniformly applied to the "European" network. Here we present an assessment of parameters reflecting site representativeness taking into account emission proxies, deposition velocities and topography in the vicinity of 34 selected sites covering most of Europe. Furthermore, the specific advection patterns towards these sites are considered by backward Lagrangian Particle Dispersion Modelling and the definition of the sites' catchment areas. The derived parameters are compared between the stations and individual station report cards are presented. Finally, a new classification of the selected sites is suggested that is based on clustering of LPDM derived parameters and results in 6 groups of European background sites.

NRT CO2: (1) General overview of the near real time processing of CO2 and CH4 concentrations

Jerome Tarniewicz

CEA

The poster will present the data management of the NRT greenhouse gases measurements. Each step of the processing, from the measurement station uploading to the web will be described: data collecting, cleaning, analysis, holding, processing and visualization. We will also present the available products derived from this dataset.

NRT CO2: (2) Preliminary data mining/selection and others added-value CO2 products

Jerome Tarniewicz

CEA

Following the general overview given in the NRT CO2 poster (1), a special interest is given here to some added value products. A preliminary "on-the-fly" automatic data selection technique based on the use of external parameter (wind direction and speed) is presented. An automatic detection of anomalies is also presented.

"The State of Greenhouse Gases in the Atmosphere in the using Global Observations through 2006"

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The latest analysis of data from the WMO-GAW Global Greenhouse Gas Monitoring Network, a comprehensive network of the Global Climate Observing System (GCOS), shows that the globally averaged mixing ratios of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) have reached new highs in 2007 with CO2 at 383.1 ppm, CH4 at 1789 ppb and N2O at 320.9 ppb. These values are higher than those in pre-industrial times (before 1750) by 37%, 156% and 19%, respectively. Atmospheric growth rates in 2007 of CO2 and N2O are consistent with recent years. The mixing ratio of CH4 shows the largest increase since 1998. The NOAA Annual Greenhouse Gas Index (AGGI) shows that from 1990 to 2007 the atmospheric radiative forcing by all long-lived greenhouse gases has increased by 24.2%. The combined radiative forcing by the most abundant ozone depleting substances, CFC-11 and CFC-12, exceeds that of N2O. They are decreasing very slowly as a result of emission reductions under the Montreal Protocol on Substances That Deplete the Ozone Layer.

“CARIBIC”
Irène Xueref-Remy

CEA

CARIBIC is a unique flying observatory for atmospheric species monitoring. Measurements are done monthly onboard regular aircrafts from LUFTHANSA, on different roads (Asia, South America and North America). Since november 2005, LSCE is leading the CO2 in-situ observation. Data have been recorded for about 25 flights. A first assessment of atmospheric CO2 variability and data precision will be given, as well as a comparison between CO2 data from CARIBIC recorded in the UTLS region and ground observations.

"Long Term Trends in Stratospheric NOy and Halogen Species
Martyn Chipperfield

University of Leeds

As part of GEOMON Activities 4 and 5 we are using three-dimensional models to interpret observed long-term trends in column amounts of stratospheric NOy and halogen species such as NO2, HCl and ClONO2. We will use data from the Network for the Detection of Atmospheric Composition Change (NDACC). For NO2 the main expected influences on the column abundance since the 1980s are an increase due to increasing N2O and modulation by the varying aerosol loading. Over the same time period column chlorine species should largely follow the increase, levelling off and recent decrease in atmospheric chlorine. We will discuss the success of the 3D model in interpreting these changes. We will also discuss dynamical trends - how these may contribute to observed changes and how spurious trends in the model (e.g. from analysed winds) can degrade the model-data comparison. Chemical data assimilation can be used to correct for these model transport errors.

"Long-term ground-based UV-visible observations of stratospheric BrO at 60°N, 28°N, and 45°S reveal a decline

F. Hendrick (1), P. V. Johnston (2), O. Puentedura (3), M. De MaziËre (1), M. Gil (3), K. Kreher (2), and M. Van Roozendael (1)

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A trend analysis has been performed of stratospheric bromine monoxide (BrO) columns derived from ground-based zenith-sky UV-visible observations at the NDACC (Network for the Detection of Atmospheric Composition Change) stations of Harestua (60∞N, 11∞E), Izana (28∞N, 16∞W), and Lauder (45∞S, 170∞E). The period covered by the observations is 1995 to 2005 for Harestua and Lauder and 2004-2008 for Izana. The stratospheric BrO vertical column densities have been retrieved by applying a profiling technique to the ground-based UV-visible observations. The thus obtained time series have been fitted using a statistical model including a linear trend and seasonal components represented by polyharmonic functions. The inclusion of such functions in the model enables to fit the strong seasonality of BrO in the stratosphere. At the Harestua and Lauder stations, the polyharmonic fit gives a positive trend for the 1995-2001 period, while a negative trend is found after 2001. At Izana, stratospheric BrO continuously decreases in the 2004-2008 period. The significance of these trends is discussed. Given the mean age of air over Harestua and Lauder, the decline of BrO in the stratosphere after 2001 is consistent with the reported decline of long-lived bromine source gases (mainly methyl bromide) observed since the second half of 1998. This study provides the first clear evidence for a decline of the stratospheric bromine loading in response to the Montreal Protocol limiting the production of brominated and chlorinated source gases.

"On the Use of Air Quality Monitoring Networks for the Evaluation of Nitrogen Oxide Emission Inventories”

I.B. Konovalov, M. Beekmann

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We examined the usefulness of ground based air quality monitoring data for diagnostics of uncertainties in gridded emission inventories. A general probabilistic procedure for comparison of levels of uncertainties in different emission datasets was developed. It implies the evaluation of the agreement between modeling results obtained with these emission datasets and corresponding measurements. This procedure was applied to the evaluation of different datasets for European gridded nitrogen oxide (NOx) emissions by using the AirBase monitoring data and the CHIMERE chemistry-transport model. Numerical experiments were performed for two different types of spatial distributions of emission uncertainties and five different types of monitors. The results were also generalized for various levels of uncertainties in simulated and measured data. It is found, in particular, that most informative, from the point of view of diagnostics of NOx emission uncertainties, are the measurements of NO2 at rural background sites and measurements of ozone at suburban sites situated in the vicinity of intensive sources of emissions. A more precise conclusion regarding the relative accuracy of two emission datasets can be drawn with a larger number of monitors in a network and a higher accuracy of the model and measurements. For example, with a network of 50 rural background NO2 monitors,

the probability of choosing the more certain emission data set is more than 90 percent, if differences in uncertainty of two sets are more than 50 percent. Practical recommendations for designing or evolving surface measurement networks, in light of the study results, are given. The study was performed in the framework of the GeoMON WP 5.4."

The vertical distribution of biomass burning aerosols from Southern Africa
C. Textor, M. Schulz, F.-M.BrÈon, M. Labonne, A. Cozic, J. Griesfeller, S. Kinne & AeroCom modellers

Comparison of the vertical aerosol distribution simulated by global models from the the AeroCom initiative and observed from the ground and from satellite.

"Retrieving the Aerosol Asymmetry Parameter from EUSAAR Near-Real-Time Data
C. Textor, M. Schulz, F.-M.BrÈon, M. Labonne, A. Cozic, J. Griesfeller, S. Kinne & AeroCom modellers

Comparisons of aerosol parameters in climate models relevant to the direct aerosol climate effect have so far focussed on the total aerosol load in the column (aerosol optical depth) or on the ground (aerosol extinction coefficient). Simultaneously, it has been stated that significant uncertainty is induced in direct aerosol effect assessments by lack of data on single scattering albedo and asymmetry parameter. Within GEOMON, an inverse retrieval based algorithm has been developed that deduces the aerosol asymmetry parameter from the dataset reported by the selected EUSAAR stations in near-real-time. The algorithm's systematic uncertainty is quantified to no more than 5% even for extreme, rather unrealistic test cases. A test of the algorithm on operational data is planned for this year."

"The new JRC Ispra GHG monitoring site: first results and outlook
Bert Scheeren, Peter Bergamaschi, G¸nther Seufert, Niels Jensen, Ignacio Goded, and Frank Raes

European Commission, Joint Research Centre Ispra, Institute for Environment and Sustainability

We present first results of a new continuous greenhouse gas (GHG) monitoring station for CO2, CH4, N2O, and SF6, located at the EU Joint Research Centre in Ispra, Italy (JRC-Ispra). The rational behind this project is to contribute to the sparse continuous GHG monitoring network in Southern Europe, to support inverse modeling emission estimates for Northern Italy (Po Valley), and verification of GHG emissions reported to UNFCCC. To complement the GHG measurements, an ANSTO Radon monitor has been operational since October 2008, which will help us to improve our understanding boundary layer dynamics and will allow model independent estimates of regional GHG emissions. In addition, we use a Proton Transfer Reaction Mass Spectrometer (PTRMS) instrument to monitor specific organic trace gas species during dedicated periods to verify the air mass origin and role of local and regional GHG emission sources like traffic and residential heating. Here, we show PTRMS results from a continuous measurement period during the winter of 2007/08 focusing on VOCs and acetonitrile to infer information on the source strength of fossil fuel and biofuel emissions in the area. We show some first

estimates of the role of residential biofuel use in the pre-Alpine region using acetonitrile as biofuel emission tracer. A first TM5 model forward simulation for CH4 showed good agreement for synoptic scale variations, but is underestimating CH4 mixing ratios under stagnant high pressure conditions. Complementary to the Ispra site, the set-up of a second mountain based GHG monitoring station starting with the installation of a PICARRO CH4/CO2 analyzer is foreseen for 2009."

A perspective on global carbon cycle from trends in atmospheric CO2 and O2
"Trend analysis of tropical stratospheric NO2 columns
Pastel(1) M., Goutail(1) F., Pommereau(1) J.P., PazmiÒo(1) A., Held(2) G., Portafaix(3) T.

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The tropical region is the main entry point of stratospheric chemical species lifted by convection and transported into the stratosphere across the tropopause. It is therefore the most sensitive region to dynamical and chemical change. Long series of NO2 columns have become available from SAOZ (uv-visible spectrometer) at Bauru (Brazil, 22∞S) since 1995 and at Reunion Island (21∞S) since 1993. The seasonal variation of NO2 (in the order of 4±1*10e15 molecule/cm2) present a large inter annual variability, which have been analysed using a multi linear regression model. The influence of dynamical parameters such as quasi-biennal oscillation (QBO), El NiÒo-Southern Oscillation (ENSO), and Eliassen Palm fluxes (EP) have been studied. The solar spectrum changes, due to the 11 year solar cycle, are also included as well as stratospheric aerosols from volcanoís eruption. The impact on NO2 are not the same in these two stations due to the surrounding area, indeed, NO2 columns at Bauru are mostly controlled by the QBO (≈13%) while at Reunion Island the solar flux (≈8%) is the most influent parameter. After removing the signal from all the statistically significant parameters, the residual is less than ±0.2*10e15 molecule/cm2 at both stations. In addition, an increase of NO2 columns is observed at both stations since 2001. Same analysis applied to GOME and SCIAMACHY NO2 satellites columns above the stations present similar behaviour. Trends of NO2 columns from SLIMCAT 3D CTM will also be presented.

"Trends in European trace gases: background and peak values”
Zoï Fleming (1a), Giten Patel (1a), Paul Monks (1a), Chris Brunsden (1b), Stephan Henne (2), Brigitte Buchmann (2), Igor Konovalov (3), Mathhias Beekmann (3)

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The Network of networks of surface reactive gases measurements GEOMON project has produced a harmonised data set from ground-based measurement stations from a variety of regional, national and European air quality networks (e.g. EMEP, GAW). Investigations into instrumental calibration standards and data quality have been carried out in order to make comparison between the sites as accurate as possible for a long time-scale trend analysis.

Ozone seasonal cycles at the various sites have been compared, showing characteristic cycles according to latitude, elevation, vicinity to coastal areas and pollution sources and population nearby. A de-trending of this seasonal cycle revealed long-term variations in ozone and a considerable difference between background and peak ozone trends between sites. National, European and international legislation has aimed at reducing CO and NO2 and correspondingly, reduce O3 levels over the last 20 years but the trends are not as clear cut and reveal that there is not a homogeneous reduction in these species across Europe.
Splitting the data into seasonal periods and also into lower and upper percentiles shows us more clearly how variations in these species occurs at different locations. There is a tendency for peak ozone levels to decrease, whilst the background levels have mostly increased. Averages, lower and upper percentiles of these species at the GEOMON stations are shown on European maps and the distribution of average ozone trends is evaluated. Comparisons with models that estimate the lower and upper percentiles of ozone during summer are shown to overestimate ozone levels but not uniformly across Europe.

Evaluation of available data sets of stratospheric and mesospheric water vapour from ground based microwave radiometers.

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Ground based microwave radiometers are able to retrieve middle atmospheric water vapour from as low as 25 km to as high as 80 km. Nowadays there are only a few instruments in operation, but the number is increasing as there is a big need for such instruments. Especially the aspect of long-term measurements under stable conditions and also the good time resolution makes these measurements essential to study trends and the variability of middle atmospheric water vapour at all time scales.

In this work we evaluate the ability and the consistency of a selection of ground-based instruments, most of which are part of the Network for the Detection of Atmospheric Composition Change (NDACC). One of the instruments, MIAWARA, which is located nearby Bern [47∞N, 7∞E], Switzerland, provides data for GEOMON. For this evaluation we make use of the global measurements of stratospheric and mesospheric temperatures of the Aura/MLS instrument, which is used in the water vapour retrievals for all of the ground-based radiometers. The cross validation reveals an agreement between the radiometers better than 10% in the mesosphere, e.g. for pressures between 0.3 and 0.03 hPa.

Middle atmospheric water vapour profiles over Seoul, S-Korea.

Evelyn De Wachter (1), Alexander Haefele (1), Soohyun Ka (2), Jung Jin Oh (2), Niklaus Kämpfer (1).

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We would like to present a little more than 2 year time-set of middle atmospheric water vapour profiles over Seoul [37∞N, 132∞ E], S-Korea. This dataset is provided by SWARA, the Stratospheric WAter vapour RAdiometer, which is a microwave radiometer designed to measure the water vapour content in the middle atmosphere (from about 25 to 80 km). The instrument was developed as a joint project between the University of Bern, Switzerland, and the Sookmyung Women's University of Seoul, S-Korea. SWARA has been operational in Seoul since November 2006. Long-term measurements of middle atmospheric water vapour by ground-based microwave instruments are sparse. These instruments provide long-term stability and high time resolution, so are in this sense ideal for short time-scale variability studies, monitoring long-term trends and validation of satellites.
We would like to present here the basic concept of the instrument and a timeseries of middle atmospheric water vapour over the mid-latitudinal Asiatic continent. SWARA can be of importance for the GEOMON project, providing water vapour profiles over Seoul, S-Korea."

"What is the horizontal resolution of a limb sounder?

Thomas von Clarmann(1), Coralie De Clercq(2), Marco Ridolfi(3), Michael Hoepfner(1), Jean-Christopher Lambert(2), Swarup Chauhan(1), Norbert Glatthor(1)

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Remote sensing with limb sounders provides estimates of the atmospheric state at good altitude resolution but each measurement integrates information along a ray-path through the atmosphere which is about two thousand kilometers long. The usual data analysis schemes invert a series of limb measurements of varying tangent altitudes to obtain vertical profiles of temperature or abundances of trace species under the assumption that the atmosphere is horizontally homogeneous within the range covered by the lines of sight of one limb sequence. In order to properly characterize the horizontal smoothing characteristics, we have developed an analysis tool which is based on the two-dimensional (horizontally along line-of-sight vs. altitude) averaging kernel matrix of the retrieval. While this methodical approach is universal for limb sounding applications, we have used it to gain better insight into the horizontal smoothing characteristics of the MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) instrument on Envisat. Application of our method to MIPAS taught us the following lessons: The point where most information comes from is not identical to the point where most radiance comes from. The range where the bulk of the information originates from is surprisingly small. It is typically around 100 to 400 km, depending on the measurement mode, gas and regularization scheme. This should be considered when coincidence criteria are defined for validation purposes. In many cases the horizontal distance over which the information is smeared is smaller than the horizontal distance between two adjacent limb scans. This means that the atmosphere often is undersampled, which may lead to aliasing effects in the analysis of small-scale periodic structures. The horizontal averaging kernel varies dramatically when limb measurements at lowermost tangent altitudes are rejected, e.g. because of cloud filtering. This implies that it will hardly be possible to provide data assimilation scientists with a “once-and-for-all” observation operator. Any regularization in the vertical domain also maps into the horizontal domain. The

displacement of information with respect to the nominal geolocation of the limb scan is systematically different for temperature and for trace gas abundance information. This adds complication to the use of retrieved temperatures for subsequent trace gas retrievals in sequential data analysis schemes.

N.Kämpfer, Th. Flury, K.Hocke and A.Haefele

The ground based microwave radiometers for ozone and water vapour of the University of Bern operated in the frame of NDACC observed in February 2008 a significant O3 depletion and an increase of upper stratospheric H2O. These phenomena are linked with a major sudden stratospheric warming that was accompanied by a lower stratospheric cooling. The talk will discuss this extraordinary event and attempt to give explanations.