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COST 723 Data Exploitation and Modeling for the Upper Troposphere and Lower Stratosphere

Opening Workshop

Venue: ESTEC, Noordwijk, The Netherlands
Date : March 11-13, 2004
Time: March 11: 14:00-19:00
March 12: 09:00-18:00
March 13: 09:00-13:00

1 Program overview

For abstracts see Section 4.

Thursday, March 11, 2004

Joint opening session

Session chairman: Jörg Langen

14:00	Welcome, COST 723 overview	Stefan Buehler
14:15	WG3-T1: Working group 3 overview	Bernard Legras
14:30	WG2-T1: Working group 2 overview	Dominique Fonteyn
14:45	WG1-T1: Working group 1 overview	Herman Smit
15:00	WG1-T2: Upper tropospheric humidity: A comparison of satellite, radiosonde, Raman lidar, and aircraft measurements	Brian Soden
15:45	Coffee	
16:15	WG2-T2: Tropospheric trace gas assimilation and inverse modeling	Boris Khattatov
17:00	Posters	
19:00	Close	

Friday, March 12, 2004

Joint morning session

Session chairman: Richard Swinbank

09:00	WG3-T2: TBD	Peter Haynes
9:30	WG2-T3: Retrotransport, identification of the source of tracers, and adjoint equations	F. Hourdin, O. Talagrand and A. Idelkadi
10:00	WG2-T4: Stratospheric forecasts	Dominique Fonteyn
10:30	Coffee	
11:00	Separate sessions for the three working groups	
12:00	Lunch	

After Lunch: Separate sessions for the three working groups

13:00 Individual agendas see below. Mandatory tasks:

- Consolidate list of group members
- Consolidate work plan

15:30 Coffee

16:00 MC Meeting

18:00 Close

Saturday, March 13, 2004

Joint summary session

Session chairman: Stefan Buehler

09:00 Report from working group 1

09:30 Report from working group 2

10:00 Report from working group 3

10:30 Coffee

11:00 Joint discussion and plans

12:00 Close

2 Working group programs for Friday

For abstracts see Section 4.

Working group 1

	Session chairman: TBD	
11:00	WG1-T3: Upper Troposphere Lower Stratosphere Hygrometer Intercomparison Campaign at Sodankylä, LAUTLOS	Esko Kyro et al.
11:15	WG1-T4: The LAUTLOS campaign, first results	Ulrich Leiterer
11:30	WG1-T5: MARSCHALS: A new airborne millimetre-wave limb-sounder for the UTLS	Victoria Jay
11:45	WG1-T6: Systematic lidar measurements of water vapor at Jungfraujoch	Valentin Simeonov
12:00	Lunch	
13:00	Working group work. Possible topics:	
	UTLS data assessment	
	Intercomparison and validation activities	
	Data bases	
	Consolidate list of group members	
	Consolidate work plan	
15:30	Close (in time for coffee and MC meeting afterwards)	

Working group 2

11:00	WG2-T5: NWP	Richard Swinbank
11.20	WG2-T6: Assimilation of space and airborne measurements in a tropospheric chemistry transport model by 4D-var	Hendrik Elbern
11.40	WG2-T7: Assimilation of long lived species measured by Odin and Envisat into an isentropic model	Donal Murtagh
12:00	Lunch	

Session on ASSET themes:

13:00	WG2-T8: Assimilation of Envisat data at the University of Reading as part of the EU ASSET project	Alan Geer
13:15	WG2-T9: Assimilation of GOME ozone profiles	Arjo Segers
13:30	WG2-T10: Assimilation of GOMOS data	Slimane Bekki

Session on isentropic models & assimilation:

13:45	WG2-T11: Transport processes in the stratosphere, diagnosed from the ENVISAT/MIPAS observations	Yvan Orsolini
14:00	WG2-T12: Data assimilation in isentropic ccordinates	Federico Fierli

Session on retrievals & assimilation:

14:15	WG2-T13: French Organization in Atmospheric Chemistry Data Assimilation	Philippe Ricaud
14:30	WG2-T14: IMK-generated non-operational MIPAS data	Thomas von Clarmann
14:45	WG2-T15: GEO-MTR: A 2-Dimensional Multi-Target Retrieval system for MIPAS/ENVISAT observations	Bianca-Maria Dinelli
15:00	Short Break	
15:15	Consolidate list of group members & consolidate workplan	
15:45	Close	

Working group 3

11:00	WG3-T3: Ice supersaturated regions in the tropopause region	Klaus Gierens
11:20	WG3-T4: Climatology of the upper troposphere with lidar	Philippe Keckhut
11:40	WG3-T5: Global modelling of the upper-troposphere and lower stratosphere composition	Didier Hauglustaine

13:00 Joint session with working group 2

14:15 Working group meeting

To be discussed: Modelling needs for the UTLS, consolidate work plans.

15:30 Close

3 Poster session overview

For abstracts see Section 5.

Working group 1

WG1-P1: Upper tropospheric humidity observed from MOZAIC-Aircraft: Seasonal and inter-annual variations	Herman Smit
WG1-P2: Water vapor retrievals for MIPAS/Envisat in the UTLS: Improvements by using the UTLS-mode	Mathias Milz
WG1-P3: Water Vapor Measurements in Ny-Alesund, Spitsbergen	Marion Mueller
WG1-P4: Validation of pressure, temperature, water vapour and ozone profiles from Envisat with the profiles measured at three polish stations	Adam Jaczewski
WG1-P5: Homogenisation of water vapour data from RS-80 and RS-90 radiosondes	Barbara Brzoska
WG1-P6: Comparison of AMSU-B Brightness Temperature with Simulated Brightness Temperature using Global Radiosonde Data	Viju Oommen John, Stefan Buehler, Arash Houshangpour, Mashrab Kuvatov
WG1-P7: The UTH-MOS project in the German AFO2000 research program	Stefan Buehler et al
WG1-P8: Ground-based water vapour soundings by microwave radiometry and Raman lidar on Jungfraujoch	Dietrich Feist
WG1-P9: LAUTLOS: First results from the ground-based water vapour radiometer - MIAWARA	Beat Deuber
WG1-P10: Potential of Odin/SMR for the study of stratospheric water vapor and its isotopes	Joachim Urban
WG1-P11: GPS radio occultation with champ: global monitoring of climate change parameters	Torsten Schmidt
WG1-P12: Tomographic limb-sounding of the upper troposphere and lower stratosphere	Victoria Jay
WG1-P13: The correction of Lindenberg operational RS80-A-Humicap radiosonde humidity measurements	Horst Dier
WG1-P14: Tropospheric humidity measurements with a chilled-mirror hygrometer and comparison with an operational VIZ/Sippican resistive hygristo	Pierre Jeannet
WG1-P15: Balloon-borne measurements of water vapor at Sodankylä in the winter 2003/2004	Rigel Kivi
WG1-P16: A practical demonstration on attainable retrieval precision for upper tropospheric humidity by AMSU	Patrick Eriksson, Carlos Jiménez, Stefan Buehler, Viju Oommen John, Ulrich Leiterer, and Horst Dier

Working group 2

WG2-P1: TBD	Zdenek Zelinger
WG2-P2: Assimilation of ODIN/SMR Measurements of Stratospheric O3 and N2O	L. El Amraoui et al.

Working group 3

WG3-P1: Changes and climatology of the UTLS over Poland	Bogumil Kois
WG3-P2: Vertical diffusivity in the lower stratosphere from airborne chemical measurements and Lagrangian back-trajectories	Bernard Legras
WG3-P3: Ice supersaturated regions in the tropopause region	Peter Spichtinger
WG3-P4: Inertia-gravity waves observed over Aberystwyth	Geraint Vaughan
WG3-P5: One year analysis of combined measurements of 10Be	Prodromos Zanis

and 7Be at two high-altitude stations at the Alps	
WG3-P6: Natural and anthropogenic variations in cirrus cloudiness from regional to global scales	Kostas Eleftheratos, Christos Zerefos
WG3-P7: Development of the January 10-2004 mini-hole above Iberian Peninsula: Combined effect of tropical advection and fast uplifting	Manuel Gil
WG3-P8: Stratospheric intrusions layering in the free troposphere from lidar water vapour analysis	Federico Fierli

4 Talk abstracts

Working group 1

WG1-T1: Working group 1 overview

Herman Smit

No abstract available.

WG1-T2: An assessment of upper tropospheric water vapor measurements from the ARM program

Brian Soden

To improve our understanding of the distribution and radiative effects of water vapor, the U.S. Department of Energy Atmospheric Radiation Measurement (ARM) program has conducted a series of coordinated water vapor Intensive Observation Periods (IOPs). This talk intercompares satellite, radiosonde, lidar, and aircraft observations from five ARM IOPs to assess their ability to monitor variations in upper tropospheric water vapor.

WG1-T3: Upper Troposphere Lower Stratosphere Hygrometer Intercomparison Campaign at Sodankylä, LAUTLOS

Esko Kyrö, Rigel Kivi, Juha Karhu, Timo Turunen, Tuomo Suortti, Timo Sukuvaara, Ari Paukkunen, Paul Ruppert, Rolf Maag, Thomas Brossi, Ulrich Leiterer, Tatjana Naebert, Gisela Peters, Vladimir Yuskov, Alexander Lukyanov, Alexander Katz, Sergey Khaikin, Leonid Korshunov, Daria Vasilyeva, Holger Vömel, Roland Neuber, Marion Müller, Niklaus Kämpfer, Beat Dauber, Alexander Häfele, Dietrich Feist

An intercomparison of balloon borne hygrometers was performed at Arctic Centre of Finnish Meteorological Institute (FMIARC), Sodankylä, Finland. Participants included two commercial companies, Vaisala OYJ with its dual Humicap-H sensor in the new digital radiosonde RS-92 and Meteolabor AG with its Peltier cooled chilled mirror hygrometer Snow White. Furthermore, the following research institutes participated: Lindenberg observatory with its own FN-method, Central Aerological Observatory, Moscow with its Lyman alpha hygrometer, University of Colorado with two types of cryogen cooled chilled mirror hygrometers, namely, the classical NOAA hygrometer and the new CFH version, FMIARC as the main organizer and operator of RS-80, RS-90, RS-92 radiosondes and Cryogen cooled hygrometers, and Alfred Wegener Institute as an observer and also as an operator of Cryogen hygrometers. Altogether 35 payloads were sent during a month long period from Jan 26 to Feb 27, 2004. In addition to balloon borne instruments University of Bern operated its ground based 22 GHz microwave instrument at Sodankylä and a smaller airborne version from Lear Jet of Swiss air force. In this presentation we give an overview to the field campaign and refer to the companion presentations in this meeting for early results of LAUTLOS campaign.

WG1-T4: First results of February LAUTLOS Water Vapour Validation

Ulrich Leiterer

First results of February LAUTLOS Water Vapour Validation Campaign in Sodankyla will be presented. Mainly the comparision between FN-Radiosonde and Snow-White-Hygrometer humidity measurments will be shown.
Furthermore, a proposal for an one-year-radiosonde-reference-dataset within the COST723-community
The proposal for an one-year-radiosonde-reference-dataset will be presented and discussed. The COST-723 WG1-members should be ready to nominate some radiosonde stations of their countries which attend to create corrected reference datasets.

WG1-T5: MARSCHALS: a new airborne millimetre-wave limb-sounder for the UTLS

B.Kerridge, W.J.Reburn, R.Siddans, V.L.Jay, B.Moyna, D.Matheson

MARSCHALS is a new airborne instrument designed to sound O3, H2O, CO and other trace gases in the upper troposphere and lower stratosphere by observing their limb emission at millimetre wavelengths, where extinction by aerosol and polar stratospheric clouds is negligible and extinction by cirrus clouds is low by comparison to infrared and shorter wavelengths. MARSCHALS measures (single side-band) emission spectra at 200MHz resolution in three 10GHz wide frequency bands centred near 300, 325 and 345 GHz, which enables the spectral features of target gases to be discriminated from continua. Comparatively high vertical resolution is achieved by scanning the atmospheric limb in 1km steps using a 220mm

antenna. To identify clouds, images of near-IR sunlight scattered into the limb direction are recorded concurrently by an 850nm wavelength camera. MARSCHALS has been built under ESA contract by a consortium led by Rutherford Appleton Laboratory in the UK, and is scheduled to have its first flight on the Geophysika (M55) aircraft in spring 2004 from Oberpfaffenhofen in Germany, funded by the EU's APE-INFRA programme. An overview will be presented of key features of the MARSCHALS design and observational capabilities, as quantified through retrieval simulations.

WG1-T6: Systematic lidar measurements of water vapor at Jungfraujoch

Valentin Simeonov

Lidar measurements of water vapor mixing ratio and relative humidity taken by the EPFL Raman lidar at Jungfraujoch (3600 m a.s.l.) will be presented. The measurements are taken within the framework of FP 5 EARLINET project. The data cover an altitude region from 4000 up to 10000 m above sea level. The lidar data are compared to radiosonde and GPS observations. Results from other EARLINET groups and their possible contribution to COST 723 action will also be discussed.

Working group 2

WG2-T1: Overview of WG2 activities

Dominique Fonteyn

An overview of WG2 activities in the COST action will be provided, including examples from action participants.

WG2-T2: Tropospheric Trace Gas Assimilation and Inverse Modeling

Boris Khattatov

In this talk we present two results pertinent to assimilation and inverse modeling of trace gases in the troposphere. Both are related to MOPITT CO measurements.

WG2-T3: Retrotransport, identification of the source of tracers, and adjoint equations

F. Hourdin, O. Talagrand and A. Idelkadi

The problem of identifying the source of a tracer is encountered in many applications. Because of the presence of diffusion and, more generally, because no numerical model can explicitly resolve all scales of motions, exact identification is impossible, and can be done, at best, in terms of a probability distribution for the source of the tracer.

The presence of diffusion (either molecular diffusion or sub-grid scale diffusion) has the effect that the spatial area of possible origin of a tracer increases as one proceeds backwards in time. This means that diffusion must remain diffusive in the equation describing the backward evolution of the probability distribution of the origin of the tracer. In the case diffusion is due to unresolved motions of transporting air which are statistically symmetric in time, the diffusion to be applied in the backward integration is identical with the forward diffusion.

In a similar way, the presence of, say, a sink in the forward evolution of the tracer has the effect that the probability that the tracer originated at a given time t decreases as t increases backward in time. Therefore, sources and sinks in the forward evolution must remain sources and sinks in the backward equation for the probability distribution.

Convection can be treated in a similar way. It basically suffices to invert the roles of entrainment or detrainment in order to obtain the equations for backward propagation of the probability distribution of the origin of the tracers.

Starting from the equation describing the forward advection and diffusion of the tracer, the above considerations lead to the equation describing the backward evolution of the probability distribution for the tracer origin. The transformation requires only changing the sign of a number of terms. The backward equation turns out to be identical with the adjoint of the forward equation, taken with respect to a scalar product weighted by the mass of transporting air.

Numerical examples, using data of the European Transport Experiment and the LMDZ GCM, are presented and discussed.

WG2-T4: Stratospheric forecasts

Dominique Fonteyn

No abstract available.

WG2-T5: Data assimilation at the Met Office

Richard Swinbank

This presentation will discuss current developments in data assimilation at the Met Office. The move from the "old dynamics" to the "new dynamics" and the use of novel datasets will be some of the topics discussed.

WG2-T6: Assimilation of space and air borne measurements in a tropospheric chemistry transport model by 4D-var

Hendrik Elbern

Tropospheric ozone profiles from GOME neuronal network retrievals are assimilated in a tropospheric chemitry transport model (top=100 hPa) by 4d-variational data assimilation. In addition from one or two aircraft campaigns further O3, NO, and CO data are assimilated. results are presented on a limited Eoropean domain.

WG2-T7: Assimilation of long lived species measured by Odin and Envisat into an isentropic model

Donal Murtagh

No abstract available.

WG2-T8: Assimilation of Envisat data at the University of Reading as part of the EU ASSET project

Dr. Alan Geer

The University of Reading is assimilating stratospheric observations from Envisat into the Met Office Unified Model with the aim of producing analyses of temperature, ozone and water vapour. MIPAS temperature and ozone observations have been assimilated for the period of the ozone hole split in September 2002. These experiments help validate the MIPAS data and evaluate the model, especially its parameterisations and dynamics. Work is also ongoing to assimilate water vapour, and in future, data from GOMOS and SCIAMACHY.

WG2-T9: Assimilation of GOME ozone profiles

Arjo Segers

Until recently, retrieval of concentrations of atmospheric trace gasses from satellite instruments has been limitted to higher altitudes only. With the growing spectral resolution of the instruments, it has became possible to retrieve vertical profiles however. In this study, ozone profiles retrieved from the GOME instrument (nadir viewing) have been assimilated in an atmospheric chemistry model. Although the sensitivity of GOME is limitted below the stratospheric ozone maximum, the instrument is able to provide additional information about ozone in the UTLS. A comparision with ozone sondes has been made to judge the quallity of GOME profiles and assimilation results in the UTLS.

WG2-T10: Assimilation of GOMOS data

Slimane BEKKI

No abstract available.

WG2-T11: Transport processes in the stratosphere, diagnosed from the ENVISAT/MIPAS observations

Yvan J. ORSOLINI

MIPAS is an infrared limb-sounding instrument launched aboard the ENVISAT satellite in March 2002. We analyse Near-Real-Time (NRT) MIPAS observations of stratospheric trace species produced by ESA, and diagnose transport processes in the middle atmosphere. The MIPAS data are of high quality, and two periods are chosen to illustrate the diagnosis of processes that can be obtained using MIPAS data : (i) the austral spring 2002 during the final breakdown of the Antarctic stratospheric vortex, and (ii) the summer 2003. Comparisons are drawn with other satellite observations, as well as with fields reconstructed using tracer-potential vorticity correlations and advected dynamical tracers.

WG2-T12: Data assimilation in isentropic ccordinates

Federico Fierli

We describe a method for assimilating sequentially tracer measurements in isentropic chemistry-transport models (CTMs) of the stratosphere. The model used here is a high resolution isentropic advection model which is driven by ECMWF (European Center for Medium range Weather Forcast) meteorological

analyses. The assimilation on isentropic surfaces allow us to exploit the well-established correlation between tracer mixing ratio and potential vorticity in the formulation of the forecast error covariance. statistics are used to optimise the assimilation system by adjusting parameters of the error covariance. The quality of the analysis is found to be significantly improved when the strong correlation between ozone and potential vorticity is taken into account. Studies of tracer analyses in presence of dynamical barriers will be also presented.

WG2-T13: French Organization in Atmospheric Chemistry Data Assimilation

Philippe Ricaud

French laboratories and organizations have decided to gather their expertises in different themes (satellites, assimilation techniques, modelling, real-time processing) in order to optimally develop a tool able to answer different scientific questions relative to the evolution of the Earth atmosphere in terms of chemistry and dynamics. Based on the PALM tool able to interconnect different codes, it will be able to process different satellite data using two atmospheric models and assimilation schemes within the French ETHER data base.

WG2-T14: IMK-generated non-operational MIPAS data

Thomas von Clarmann

IMK in co-operation with IAA maintains a non-operational level-2 MIPAS data processor which is used to infer atmospheric state parameters beyond the ESA near real-time level-2 data. These additional data include, among others: vertical profiles of mixing ratios of ClONO2, N2O5, ClO, CFCs, NO, CO. Episodes under investigation are the Austral spring 2002 split vortex event, the autumn 2003 solar storm event, and many others, in particular such where independent validation measurements exist. Current activities cover the improvement of retrievals in the UT-LS region.

WG2-T15: GEO-MTR: A 2-Dimensional Multi-Target Retrieval system for MIPAS/ENVISAT observations

Bianca Maria Dinelli

In this paper we present a new retrieval system for MIPAS/ENVISAT measurements, developed in the frame of the ESA study ‘Development of algorithms for the exploitation of MIPAS special modes measurements’. The new code performs 2-Dimensional (2-D) retrievals of the altitude distributions of pressure, temperature and Volume Mixing Ratio of selected molecules. With the new system the retrieval of 4 target quantities from a full orbit can be performed in near–real time, making it a good candidate for a new Level 2 processor for MIPAS measurements.The new system has been tested on real MIPAS observations, using micro windows especially selected for 2-D, MTR analyses. The 2-D retrievals of pressure, temperature and of the VMR of Ozone and Water Vapour from selected orbits have been performed. These results, along with the comparison of the new results with the data retrieved by the ESA Level 2 near-real time processor will be presented.

Working group 3

WG3-T1: Working group 3 overview

Bernard Legras

No abstract available.

WG3-T2: TBD

Peter Haynes

No abstract available.

WG3-T3: On relative humidity and supersaturation within cirrus clouds

Klaus Gierens

We have analysed relative humidity statistics from measurements in cirrus clouds taken accidentally during the Measurement of OZone by Airbus In--service aircraft project (MOZAIC). The shapes of the in-cloud humidity distributions change from nearly symmetric in relatively warm cirrus (warmer than -40 degrees Celsius) to considerably positively skew (i.e. towards high humidities) in colder clouds. These results are in agreement to findings obtained recently from the interhemispheric differences in Cirrus properties from Anthropogenic emissions (INCA) campaign. We interprete the temperature dependence of the shapes of the humidity distributions as an effect of the length of time a cirrus cloud needs from

formation to a mature equilibrium stage, where the humidity is close to saturation. The duration of this transitional period increases with decreasing temperature. Hence cold cirrus clouds are more often met in the transitional stage than warm clouds.

WG3-T4: Climatology of the upper troposphere with lidar

Philippe Keckhut

The upper troposphere should play an important role on the climate. Several greenhouse gazes as well as cirrus clouds present in this region a large variability in both temporal and spatial scales. This variability is strongly connected with processes and air mass exchanges with the lower altitude as well as the stratosphere. The upper troposphere is not easy to probe nor from space nor from the ground. Lidar appears to be a good candidate for probing the upper troposphere. Ozone, water vapor, cirrus clouds, and temperature can be measure with lidar. All those measurements have been deployed in two sites. One is located in south of France at mid-latitude of the Northern Hemisphere and the other at the tropical site of the Southern Hemisphere: La Réunion. The technology has been improved to make such reliable measurements on a routine basis and to implement those measurements on a single instrument. Statistical analysis need to take into account the episodic nature of the variability. First climatologies of each parameter independently have been already obtained. Future strategy will be discussed.

WG3-T5: Global modelling of the upper-troposphere and lower stratosphere composition

Didier Hauglustaine

The upper-troposphere and lower-stratosphere (UTLS) is considered as a key region of the atmosphere as far as composition and climate interactions are concerned. Radiative forcing by greenhouse gases such as water vapor and ozone remains especially sensitive to concentration change in the UTLS. The UTLS is also the layer in which stratospheric and tropospheric air are mixed. The exchange between these atmospheric domains controls the influx of tracers into the stratosphere and the O3 and NOx flux from the stratospheric reservoir down into the troposphere. Due to the influence of rapid convection and the large-scale vertical transport associated with convergence, the imprints of lower tropospheric events such as biomass burning and forest fires and several regional air pollution episodes are also imposed on the upper troposphere. Furthermore, in this relatively dry region, species like peroxides and oxygenated hydrocarbons play a major role in controlling the budget of HOx radicals. In this presentation, we will review these features and illustrate how current global models can reproduce the composition of this region of the atmosphere compared to aircraft and satellite data. After evaluation, these models can be used to estimate the future evolution of the atmosphere under anthropogenic activites, including the impact of aircraft emissions.

5 Poster abstracts

Working group 1

WG1-P1: Upper Tropospheric Humidity Observed from MOZAIC-Aircraft: Seasonal and Inter-annual Variations

Herman G.J. Smit

Although upper tropospheric humidity (UTH) plays a crucial role in our Earth's climate, very little is known about the spatial and temporal distribution of UTH content and the processes controlling it. A comprehensive climatology of the UTH distribution over the Atlantic obtained from MOZAIC (Measurement of Ozone and Water Vapor by Airbus In Service Aircraft) measurements will be presented and discussed. UTH reveals a strong spatial and temporal variability on different scales whereby a significant portion of the observations show ice supersaturation. Very pronounced are the seasonal cycle and inter-annual variability of UTH in the mid-latitudes related to large scale transport. In the tropics and sub-tropics UTH show a clearly bi-modal distribution with a wet (ice supersaturated) and a dry branch which are strongly linked to the tropical dynamics of deep convection and subsidence.

WG1-P2: Water vapor retrievals for MIPAS/Envisat in the UTLS: improvements by using the UTLS-mode

Mathias Milz

The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) onboard Envisat provides global coverage with measurements covering the stratosphere down to the upper troposphere. At IMK a scientific MIPAS level 2 data processor is used to derive among other parameters water vapor profiles. Here we present results of water vapor retrievals in the UTLS-Region using the MIPAS standard measurement mode and a special mode dedicated to improved UTLS observations. Measurements taken with both modes are compared and differences, advantages and disadvantages of the modes with respect to observations in the UTLS region are discussed.

WG1-P3: Water Vapor Measurements in Ny-Alesund, Spitsbergen

Marion Müller

At the German Arctic station in Ny-Alesund, Spitsbergen (79º N, 12ºE), water vapor measurements are performed by different instruments. Although the Arctic troposphere is very dry, the humidity distribution in the lower troposphere reveals strong variability that is monitored applying the Raman lidar technique. The water vapor concentration in the upper troposphere and stratosphere is measured by balloon-borne frostpoint hygrometers. These H2O soundings provide high resolution profiles that e.g. allow the identification of dynamical processes at the polar vortex edge or the distinction of dehydration events due to sedimentation of polar stratospheric ice cloud particles. Besides these case studies, future plans for climatological studies will be presented.

WG1-P4: Validation of pressure, temperature, water vapour and ozone profiles from Envisat with the profiles measured at three polish stations

Adam Jaczewski

The Envisat was launched in the beginning of 2002. Three of its instruments (MIPAS, GOMOS and SCIAMACHY) offer the scientific community unique opportunities for atmospheric research. The radiosoundings, as part of the daily worldwide routine measurements are reliable source of data for the validation of atmospheric profiles. Three polish stations (Legionowo, Wroclaw, Leba) has been used for validation of temperature, pressure and water vapour profiles (twice daily routine) and one station (Legionowo) for validation of ozone profiles (weekly routine). To improve the effectiveness of validation, additional ozone soundings are performed in close collocation with relevant satellite observations. Preliminary validation results of SCIAMACHY, MIPAS, and GOMOS profiles will be presented. Comparison of ozone profiles to the SMOBA profiles (gridded global daily data) will be also shown.

WG1-P5: HOMOGENISATION OF WATER VAPOUR DATA FROM RS-80 AND RS-90 RADIOSONDES

Barbara Brzoska

In Poland, humidity has been measured with Vaisala Humicap since 1992. In 1999 the radiosonde type has been changed from RS-80 to RS-90 one. The change made data series inhomogeneous, because of different RS-80's behaviour at low temperatures, in comparison to RS-90, which is much more sensible.

Previously five methods have been used, available in literature. Colorado correction (Wang et al., 2002), seemed to be quite good, but still was not reliable. Lately we use the correction processed in Lindenberg (Leiterer, 2002), which takes into account climatological data.
To check if that correction 'works' well, we have looked at the time series (12 UT and 00 UT) at given heights (25 levels from ground to 12 km, every 500 m), the humidity tendencies, and have compared them with temperature tendencies. At first approximation the tendencies should be negatively correlated. This is observed at more levels for the corrected humidity series than for the uncorrected humidity series.
The results of the comparisons show that the Leiterer's method is the best one for our series correction purposes.
Preliminary results of temperature and humidity trends at pressure levels (up to 200 hPa), using wavelet analysis will be presented.

WG1-P6: Comparison of AMSU-B Brightness Temperature with Simulated Brightness Temperature using Global Radiosonde Data

Viju Oommen, Stefan Buehler, Arash Houshangpour, Mashrab Kuvatov

We present a comparison of brightness temperature measured by AMSU to radiative transfer model calculations based on radiosonde data. The forward model used is the stable version of the Atmospheric Radiative Transfer Simulator(ARTS), a general purpose radiative transfer model which can handle many different remote sensing instruments in the millimeter to infrared spectral region. The atmospheric profiles used are the Met Office - Global Radiosonde Data taken from the British Atmospheric Data Center (BADC). As a first step, the comparison is done for Lingenberg, Germany which uses Vaisala RS80 radiosondes and Kem, Russia which uses Goldbeater's skin radiosondes.

As the forward model ARTS has already been validated against AMSU brightness temperatures using high resolution radiosonde data from Lindenberg which is a reference station for German Weather service(DWD), the main aim of this comparison is to check the quality of the radiosonde data from the different stations.

WG1-P7: The UTH-MOS project in the German AFO2000 research program

Stefan Buehler, Emmanuel Brocard, Nathalie Courcoux, Claudia Emde, Axel von Engeln, Arash Houshangpour, Thomas Kuhn, Mashrab Kuvatov, Oliver Lemke, Viju Oommen John, Claas Teichmann, and Sreerekha T.R.

The objective of the UTH-MOS project is to develop and interpret an upper tropospheric humidity climatology product from microwave data collected by the polar orbiting operational meteorological sensors AMSU-B and SSM-T2. This data record goes back to 1995 and will extend into the future for at least the next decade. For the correct interpretation of these data, the impact of cirrus clouds on the measurement in the microwave channels has to be well understood and taken into account in the retrieval. An auxiliary objective is to explore the potential of these data for deriving information on cloud ice particles. The research work in UTH-MOS is split between the modeling of the radiative transfer in the presence of cirrus clouds on one hand, and the actual data analysis and atmospheric research applications on the other hand.

The poster gives an overview of UTH-MOS project activities and results in 2003.

WG1-P8: Ground-based water vapour soundings by microwave radiometry and Raman lidar on Jungfraujoch

Dietrich Feist

Water vapour has been measured from the International Scientific Station Jungfraujoch in the Swiss Alps during the winters of 1999/2000 and 2000/2001 by microwave radiometry and Raman lidar. Most measurement techniques are only suitable for either tropospheric or stratospheric water vapor abundances and none can produce a vertical distribution profile from ground level to the top of the stratosphere. We present such a water vapour profile where simultaneous measurements from a Raman lidar and a microwave radiometer were combined to cover both the troposphere and the stratosphere.

WG1-P9: First Results from the Ground-based Water Vapour Radiometer - MIAWARA

Beat Deuber

We present first results of stratospheric H2O profiles retrieved from the ground based radiometer MIAWARA which was operated in Sodankylä during LAUTLOS/WAVVAOP.

WG1-P10: Potential of Odin/SMR for the study of stratospheric water vapor and its isotopes

Joachim URBAN

The Sub-Millimetre Radiometer (SMR) on board the Odin satellite, launched on February 21, 2001 observes stratospheric H2O, H2O-18, and HDO using two bands centred at 488.9 and 490.4 GHz. The so far achieved observation capabilities of the SMR radiometer with respect to these target species are presented and the potential and limitations of the global data set for scientific studies are discussed.

WG1-P11: GPS RADIO OCCULTATION WITH CHAMP: GLOBAL MONITORING OF CLIMATE CHANGE PARAMETERS

Torsten Schmidt

The availability of GPS radio signals has introduced a new promising remote sensing technique for the Earth's atmosphere. The GPS-based radio occultation (RO) exploits these signals received onboard a Low Earth Orbiting (LEO) satellite for atmospheric limb sounding. The GPS signals are influenced by the atmospheric refractivity field resulting in a time delay and bending of the signal. The atmospheric excess phase path is the basic observable that is measured with millimetric accuracy. This is the basis for high vertical resolution and precise refractivity and temperature profiles. The GPS RO technique requires no calibration, is not affected by clouds, aerosols or precipitation, and the occultations are almost uniformly distributed over the globe. CHAMP RO data are available since 2001 with up to 200 high resolution temperature and tropospheric water vapor profiles per day. The temperature bias between CHAMP temperature profiles and radiosonde data as well as ECMWF analyzes is less than 0.5 K between 300-30 hPa. As an example for global monitoring the structure and temporal and spatial variability of the tropical tropopause are discussed. In the CHAMP RO temperature data clear evidence of the stratospheric quasi-biennial oscillation (QBO) was found. In addition results of a 1DVAR retrieval scheme to derive tropospheric water vapor profiles using ECMWF data as background will be shown and discussed. Because of the accuracy, high vertical resolution, and globally distributed temperature data in the tropopause region the relatively new RO technique is suitable for global monitoring of the UTLS as an important part of the atmosphere. The CHAMP RO experiment generates the first long-term RO data set. Other satellite missions will follow (GRACE, TerraSAR-X, COSMIC, METOP) generating some thousand profiles of refractivity and temperature daily.

WG1-P12: Tomographic limb-sounding of the Upper Troposphere and Lower Stratosphere

W.J.Reburn, R.Siddans, V.L.Jay, B.Latter, C.Emde, A.Baran, B.J.Kerridge

The MASTER instrument concept is being developed by ESA to sound the global distributions of trace gases in the upper troposphere and lower stratosphere (UTLS) at high fidelity by measuring limb-emission spectra in three millimetre-wave frequency bands (300, 325 and 345 GHz). By limb-scanning in the orbit plane with comparatively small vertical and horizontal spacings between adjacent tangent-points, a given airmass can be viewed from several different directions, enabling a tomographic (2-D) approach to retrieve horizontal and vertical structure simulataneously. Conventional limb-sounding assumes the atmosphere to be spherically symmetric even though the UTLS is characterised by horizontal structure in trace gases such as O3 and H2O. By dispensing with the assumption of spherical symmetry, modelling radiative transfer in 2-D and using multiple limb-scans simultaneously in a 2-D retrieval, the tomographic approach can achieve a horizontal resolution ~100km together with ~2 km vertical resolution for water vapour, ozone and other trace gases in the UTLS. In this paper, simulation experiments performed for MASTER in an ESA study will be presented for realistic atmospheric scenarios, with and without cloud, and appropriate errors.

As part of the same study, the impact of cirrus clouds on the frequency with which limb-sounders at different wavelengths (mm-wave, IR and 1micron) can penetrate into the troposphere has been estimated using new calculations of cirrus single scattering properties together with ECMWF cloud data. Statistics will be presented from an initial analysis of one year's data sampled one day in ten.

WG1-P13: The correction of Lindenberg operational RS80-A-Humicap radiosonde humidity measurements

Horst Dier

All steps of correction and quality control for RS80-A-Humicap radiosonde humidity measurements are

shown: groundcheck-correction, time-lag correction, temperature dependent correction and the recognition of sensor-icing during the ascent.

The effect of the Lindenberg correction procedures will be shown by examples.

Finally the 40 years old Lindenberg upper air humidity time series will be presented. This time series includes measurements with different radiosonde types (Freiberg with hair-hygrometer, MRZ with Goldbeater skin and RS80 with A-Humicap).

WG1-P14: Tropospheric humidity measurements with a chilled-mirror hygrometer and comparison with an operational VIZ/Sippican resistive hygristor

Pierre Jeannet

Fifty dual soundings with the chilled-mirror hygrometer "Snow White" and the operational VIZ/Sippican resistive hygristor have been launched at Payerne (Switzerland). The chilled-mirror humidity profiles often show cirrus clouds characterized by humidity values close to (or larger than) saturation over ice. This dataset allows deriving tentative correction factors for the VIZ/Sippican hygristor.

WG1-P15: Balloon-borne measurements of water vapor at Sodankylä in the winter 2003/2004

Rigel Kivi

In the winter 2003/2004 Arctic Research Centre of the Finnish Meteorological Institute in Sodankylä hosted an intercomparison campaign of balloon-borne water vapor sensors. This campaign was motivated by the need to improve the quality of water vapor measurements in the lower stratosphere and upper troposhere by balloon-borne instruments. In Sodankylä (67.4 N, 26.6 E) altogether thirty five balloon flights of several water vapor sensors took place during the period January 29 - February 26, 2004. 21 payloads included RS80-A, RS-90 and RS-92 radiosondes manufactured by Vaisala Oy, FN- sonde (a modified version of RS-90 radiosonde by Lindenberg Observatory, Germany) and a chilled mirror hygrometer by Meteolabor, Switzerland (SW-sonde). 12 larger payloads included RS80-A, RS80-H, RS-92, FN-sonde, SW-sonde, NOAA or CFH frost-point hygrometer and FLASH-B Lyman alpha hygrometer. In this study we focus on the performance of two relatively new instruments: RS-92 and FLASH-B hygrometer. Data from both instruments are compared with the measurements by NOAA frost-point hygrometer flown in the same payload. RS-92 is the newest radiosonde type by Vaisala Oy, the manufacturer of the majority of operational radiosondes. Wider use of this instrument is expected to improve the UT humidity measurements by radiosonde network in the future. FLASH-B is a Lyman- alpha fluorescence hygrometer that has been developed by the Central Aerological Observatory in Moscow, Russia. In Sodankylä 14 flights of the instrument were performed and the results indicate that the instrument is capable of good measurements in the stratosphere.

WG1-P16: A practical demonstration on attainable retrieval precision for upper tropospheric humidity by AMSU

Patrick Eriksson, Carlos Jiménez, Stefan Buehler, Viju Oommen John, UlrichLeiterer, and Horst Dier

Large uncertainties exist regarding the global distribution and variability of upper tropospheric humidity (UTH), due to a lack of relevant data. Instruments of AMSU-B type have some sensitivity to UTH but this data source has so far only been explored marginally. High quality radiosonde data from the Lindenberg station have been used to train a neural net for retrieval of UTH, here defined as the mean relative humidity between 500 and 200 hPa. The retrieval precision was then estimated by comparison of AMSU-B and radiosonde data not included in the training, where a precision of 7 %RH was obtained. This means that the attainable retrieval precision is better than 7 %RH, as spatial and temporal mismatch between the two data sources deteriorates somewhat the precision. No cloud screening was applied, which shows the advantage of mm-wave observations compared to IR. The generalization of the technique to perform global inversions is discussed.

Working group 2

WG2-P1: TBD

Zdenek Zelinger

No abstract available.

WG2-P2: Assimilation of ODIN/SMR Measurements of Stratospheric O3 and N2O

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The Swedish-led mini-satellite Odin, launched in February 2001 on a polar orbit, performs measurements in 4 observations modes: the stratospheric, the odd-hydrogen, the odd-nitrogen and the water isotope mode. The stratospheric mode provides measurements of major stratospheric constituents such as O3, ClO, N2O and HNO3. The vertical profiles of these species are retrieved using the MOLIERE/5 code which is installed within the French level-2 processor. The retrieval technique used is the Optimal Estimation Method.

The vertical profiles of ozone and nitrous oxide are assimilated using the MSDOL system. This later includes a three-dimensional Chemical-Transport Model (3D-CTM) combined with an assimilation module. The model is driven by the ECMWF analysis and has an horizontal resolution of 2.5º both in latitude and longitude and 36 pressure levels between 250 and 0.1 hPa. The assimilation module is based on the sequential statistical interpolation method.

The aim of this contribution is to present the optimal parameters of the assimilation system and to present the results of the assimilation of stratospheric measurements of ozone and nitrous oxide from the Odin/SMR instrument.

Working group 3

WG3-P1: Changes and climatology of the UTLS region over Poland

Bogdan Kois

Valuable data for climatology of the UTLS region and its changes at mid latitudes provide measurements of radiosondes launched at upper-air stations from Leba, Legionowo, and Wroclaw (since 1961), ozonesondes from Legionowo (since 1979), and total ozone from Belsk (since 1963). The results indicate that the thermal structure of the UTLS region over Poland has considerably changed over the years. During winter, a significant cooling of the LS correlated with total ozone decrease, the frequency of the multiple tropopause increase, and a significant warming in the troposphere took place. During summer, a significant warming of the troposphere was larger in the centre than in the north of Poland. The cross-tropopause transport is one of the key factors controlling the budget of ozone, water vapor and other constituents in the UTLS region. Despite of its importance, the precise mechanisms of the exchange of mass between the stratosphere and troposphere are still controversial. Valuable information for tackling the problems can be obtained by visual inspection of ozonesoundings. The mutual relationship between the ozonopause and tropopause has been determined statistically on series of ozonesoundings performed at Legionowo for the period 1979-2002. The ozonopause is defined here as the bottom of the layer where ozone starts to increase in the UTLS region. The transition from air having composition typical of the troposphere (low ozone) to air typical of the stratosphere (high ozone) for the bulk cases was easy to recognise, whilst for a few cases it was hardly possible; an interesting example is presented. Results show that the ozonopause at the NH mid latitude (52N), on the average, is located 600m below the tropopause. The fitted curves indicate descending of the ozonopause during winter and early spring, its rising during summer to a peak in the autumn. For some extreme cases, the ozonopause descended to 4-6km, and such cases are fairly uniformly dispersed throughout the year. Stratospheric intrusions of ozone into the troposphere can be recognised by extremely low humidity values.

WG3-P2: VERTICAL DIFFUSIVITY IN THE UTLS FROM LAGRANGIAN RECONSTRUCTIONS OF N2O AND O3 TRANSECTS

Bernard Legras

Ozone, methane and nitrous oxyde are measured at high spatial and temporal resolution by instruments flying on ER2 NASA research aircraft. We estimate the Lagrangian turbulent diffusionexperienced by the air parcels by comparing the airborne transects to reconstructions using large ensemble of random trajectories. proceThe method has been applied to the SOLVE campaign in the Arctic. The resulting estimates for the diffusivity are usually of the order of 0.01 $m^2 s^{-1}$ or less except in the shear zone of the vortex edge. It is also observed from the evolution of filaments that large variations of Lagrangian diffusion occur at the mesoscale that cannot be accounted by variations of the Lagrangian strain, and are perhaps associated with breaking gravity waves.

WG3-P3: Ice supersaturated regions in the tropopause region

Peter Spichtinger

Cirrus clouds, including sub--species as condensation trails and subvisible cirrus, constitute now a well established research topic within the atmospheric sciences. But their formation regions, i.e. ice-supersaturated air masses, are still not very well characterised. There is now direct evidence,that ice supersaturation is frequent in upper tropospheric clear air and that it does even occur in the lowermost stratosphere. Such regions have been termed ice-supersaturated regions (ISSRs, Gierens et al., Ann. Geophys. 17, 1218-1226, 1999). In the last three years we have evaluated various data sets (aircraft - MOZAIC, satellite - MLS, radiosondes) and could answer some questions concerning the global distribution of ISSRs, their attributes and some aspects of formation and development of ISSRs. Some of these results are presented in this contribution.

WG3-P4: Inertia-gravity waves observed over Aberystwyth

Geraint Vaughan

The MST radar at Aberystwyth has operated more or less continuously since 1996, building up a unique archive of atmospheric profiles of winds and refractivity gradients. Prominent in this archive are inertia-gravity waves. These are long-period gravity waves with vertical wavelength ~ 1-2 km. It is clear that these waves are most frequently observed during the passages of jet streams, although there are examples of long-lasting wave events peristing long after the jet stream has passed. Work is under way at Aberystwyth to determine the climatology of these waves and their exact relation to the jet stream. Preliminary results will be shown on the poster.

WG3-P5: One year analysis of combined measurements of 10Be and 7Be at two high-altitude stations at the Alps

Prodromos Zanis

The cosmogenic radionuclides 7Be and 10Be are produced with spallation reactions mainly in the stratosphere and hence they can be considered as stratospheric tracers. However, no single cosmogenic radionuclide is an ideal stratospheric tracer because they attach to aerosols and hence their tropospheric lifetime is significantly controlled by wet scavenging processes. Combined measurements of 10Be and 7Be, which were carried out regularly throughout the course of a full year from March 2000 to February 2001 at the high altitude stations, Jungfraujoch (3580 m asl), Switzerland and Zugspitze (2962 m asl), Germany in the frame of the European Project STACCATO, are analysed with regard to relative humidity, specific humidity, ozone, weather types, synoptic patterns at 500 hPa and back trajectories. The use of the concentration ratio of the two radionuclides as an index of Stratosphere-to- Troposphere Transport (STT), which is not affected by wet deposition, is discussed.

WG3-P6: Natural and anthropogenic variations in cirrus cloudiness from regional to global scales

Kostas Eleftheratos, Christos Zerefos

This study examines the climatology of cirrus cloud cover (CCC) on regional and global scales based on observations by satellites from space. The analysis is based on the ISCCP D2 cloud dataset and covers the period 1984-1998. The natural variability of CCC is examined in relation to known large-scale natural phenomena such as ENSO, QBO and the NAO as well as in combination with dynamical proxies. As an index of dynamics in the UT/LS we use the vertical velocities at 300 mb from the NCEP/NCAR reanalysis dataset. While QBO was found to have a negligible effect on cirrus clouds, the effect of ENSO and NAO is more significant and can be very important regionally. Cirrus clouds and ENSO are significantly correlated mainly in the tropics while the correlation between CCC and NAO was found to be statistical significant over certain regions in the greater area of Europe. Changes in CCC in possible association with aviation activities at congested air corridors are also presented.

WG3-P7: Development of the January 10-2004 mini-hole above Iberian Peninsula: Combined effect of tropical advection and fast uplifting

Manuel Gil

During the first days of January 2004, an unusual persistent situation of tropical transport from the Caribian area to the Iberian Peninsula yielded very low ozone values for the season. This situation peaked on January 10 when 189 DU was recorded in Madrid. The ozone mini-hole developed fast through a combined effect of tropical transport and very fast uplifting in the hours previous arriving to Spain. Radiosounding profile shows very cold temperatures of –76ºC at 70 hPa associated to a high tropical tropopause, web above the mid-latitude tropopause. Ozone remained

below 2 mPa up to this level. Total observed amount represent the historical minimum above Spain by 25 DU below the previous record.

WG3-P8: Stratospheric intrusions layering in the free troposphere from lidar water vapour analysis

Federico Fierli

The observed water vapor evolution during the MAP campaign shows the presence of multiple mesoscale dry layers. Trajectories analyses allowed to identify the observed dry layers to the intrusion of stratospheric air consequent to occurrence of a tropopause folding. LIDAR observations highlighted the presence of different sub-structures at finer-scale in respect to principal intrusions. Similar sub-structures are not evident in the humidity field of ECMWF, have been reproduced by RDF (Reverse Domain Filling) simulations based on the FLEXTRA model and by mesoscale simulations. Trajectory indicates also that the mesoscale water vapour structures measured by lidar can be explained with the different air parcels origin, related to the streamer synoptic analysis.