CAWSES in Germany: status and first results from the DFG priority programme

Franz-Josef Lübken

Beijing, July 23, 2006.

Aktuelles

Schwerpunktprogramm 1176: "Klima und Wetter des solar-terrestrischen Systems"

Information für die Wissenschaft Nr. 16
16. Juli 2004

Der Senat der Deutschen Forschungsgemeinschaft (DFG) hat die Einrichtung des Schwerpunktprogramms "Klima und Wetter des solar-terrestrischen Systems / Climate and Weather of the Sun-Earth System, CAWSES" beschlossen. Als Laufzeit sind sechs Jahre vorgesehen.

Ziel des Programms ist ein besseres Verständnis des Einflusses der Sonne auf die Erdatmosphäre auf Zeitskalen von Stunden bis Jahrhunderten. Im Vordergrund stehen Fragestellungen zum solar-terrestrischen System als Ganzem. Die Sonne modifiziert die Atmosphäre durch die Absorption von Strahlung und Teilchen, durch die

Topics to be covered within priority programme:

- Characterize solar forcing variability

- Determine direct reaction in the atmosphere (temperature, composition, dynamics, etc.)
  - … from the ground to the thermosphere
  - … time scales: hours to centuries

- Study coupling mechanisms
  - transport of trace gases
  - waves (PW, GW, tides): generation, propagation, dissipation

- Detect and understand solar signal in indirectly influenced parameters

- Compare solar induced/ anthropogenic trends

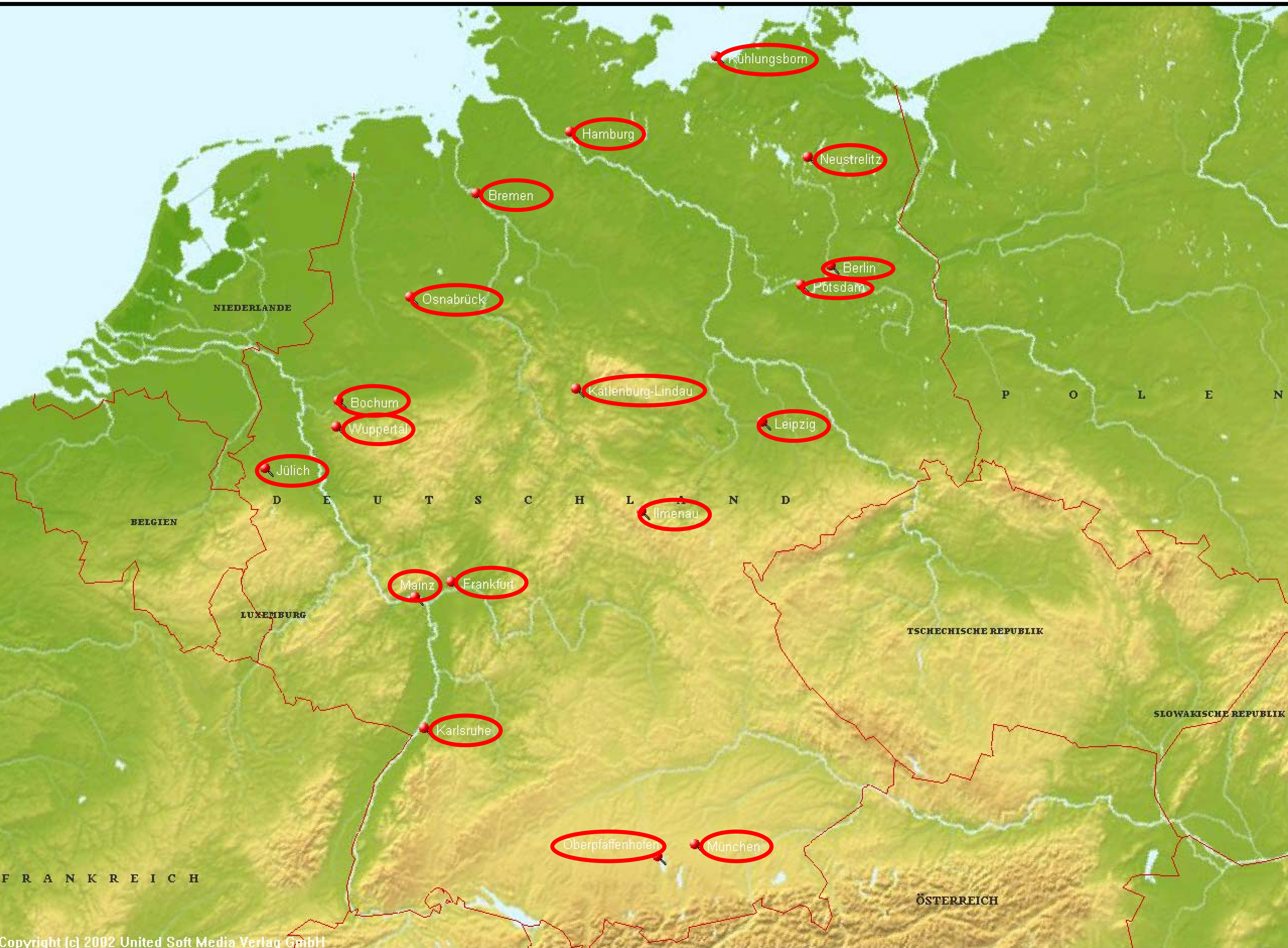
(not covered: technical aspects of space weather)

Priority Programme CAWSES of the German Science Fondation (DFG)

- Positive decision of DFG senat on May 6, 2004
  (12 out of 80 proposals)

- Review process within Germany: 26/27 Januar 2005:
  - 38 proposals submitted
  - 24 accepted (9 Postdocs, 30 PhD, travel, etc.)
  - appr. 3 Mio € per year for (2+2+2) years = 18 Mio €
  - 18 German institutions participate

- Next round of proposals: Nov. 2006 (review: Jan 2007) will select proposals for the next 2-year period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CAWSES - Projekte

Sprecher des Schwerpunktes: Franz-Josef Lübken (IAP, Kühlungsborn)

	PI	CoI	Postdoc Doktoranden etc.	Titel	Acronym
characterisation of solar radiation etc.:					
1.	Solanki		N. Krivova	Models of solar total and spectral irradiance variability for climate studies	SOLIVAR
2.	Weber	Bovensmann Burrows von Savigny Skupin	Rarasan	Solar irradiance variability on hourly to decadal scale from SCIAMACHY and its impact on middle atmospheric ozone and ozone-climate interaction	SOLOZON
3.	Fichtner	Heber	Sternal Scherer	Energetic particle transport in the atmosphere and environment of the Earth, cosmic rays, solar energetic particles, heliospheric and atmospheric transport	HELIOCAUSES
4.	Schiller	Günther Krämer Spang,Rohs	Gounou	Satellite and model studies of galactic cosmic rays and clouds, modulated by solar activity	SAGACITY
5.	Kallenrode		Bornebusch	Ionisation of the middle atmosphere by energetic particles	MAIONO
Influence on trace gases etc.:					
6.	Langematz	Cubasch Nevir Brühl	Spangehl Kubin	Project on Solar Effects on Chemistry and Climate Including Ocean Interactions	ProSECCO
7.	Sinnhuber	von Savigny	Kazeminejad	Solar variability impacts on the chemical composition of the middle atmosphere: measurements and model predictions	SICMA
8.	Engel	Schmidt Stiller	Glatthor Laube Möbius	Trace gas observations for the investigation of mean age and stratospheric transport under the influence of solar variability and long term change	
9.	Lübken	Berger	Herbort	Solar variability and trend effects in layers and trace gases in the upper atmosphere	SOLEIL
10.	Rapp		Strelnikova	Influence of charged aerosols on radar scattering (EISCAT)	
11.	Riese	Kaufmann	Lehmann	Response of Atomic Hydrogen and Oxygen to Solar Radiation Changes: Measurements and Simulations	HYDOX
12.	Reddmann	Stiller Konopka	Glatthor Vogel	Middle Atmosphere NOx variations and solar UV VAriability: Examples to study mesospheric/stratospheric coupling and the impact of solar variability on stratospheric ozone	MANOXUVA

13.	Schmidt	Kallenrode Brasseur Giorgetta	Wissing Kieser	The Atmospheric Response to Solar Variability: Simulations with a General Circulation and Chemistry Model for the Entire Atmosphere	ARTOS
Coupling by tides, gravity waves etc:					
14.	Oberheide			Seasonal and interannual variability of nonmigrating tides in the mesosphere and lower thermosphere	NMT-MLT
15.	Achatz	Grieger	Colson	Solar contribution to the variability of middle atmosphere solar tides in their interaction with zonal-mean-flow variations, planetary waves and gravity waves	SOTIVAR
16.	Jacobi	Jakowski Pogoreltsev	Borries Hoffmann	Climatology of planetary waves seen in ionospheric F-region pertubations using TEC of GPS	CPW-TEC
17.	Ern	Jacobi Preuße Wickert	Krebsbach Fröhlich Schmidt	Gravity wave coupling processes and their decadal variation	GW-CODE
18.	Pauldrach	Kutepov		Influence of irregular temperature variations caused by gravity waves on the infrared radiative cooling/ heating of the mesospere/lower thermosphere	
19.	Peters	Kirchner Graf	Gabriel	The Influence of Solar Radiation Perturbations on the Coupling of Atmospheric Layers	SORACAL
Monitoring of temperatures, winds, etc.:					
20.	Offermann	Jarisch Knieling		Temperature variations on extreme time scales	
21.	Notholt	Bremer H. Sinnhuber Hochschild	Palm Kopp	Sun driven Atmospheric Change Observed by ground based Stations in the Arctic and Tropics	SACOSAT
22.	Lühr		Rentz	Observation and modeling of the upper atmospheric density and winds and their dependence on the geomagnetic activity	
Charged aerosols					
23.	Leisner		Rzesanke	Laboratory experiments on the microphysics of electrified clouds droplets	MICHAELA
24.	Stelmaszczyk		Rohwetter	Detection of electrically charged clouds and aerosols by means of second harmonic generation (SHG)at the droplet-air interface	

- characterization of solar radiation etc.
- influence on trace gases, layers etc.
- coupling by gravity waves, tides, etc.
- monitoring of temperatures, winds etc.
- charged aerosols

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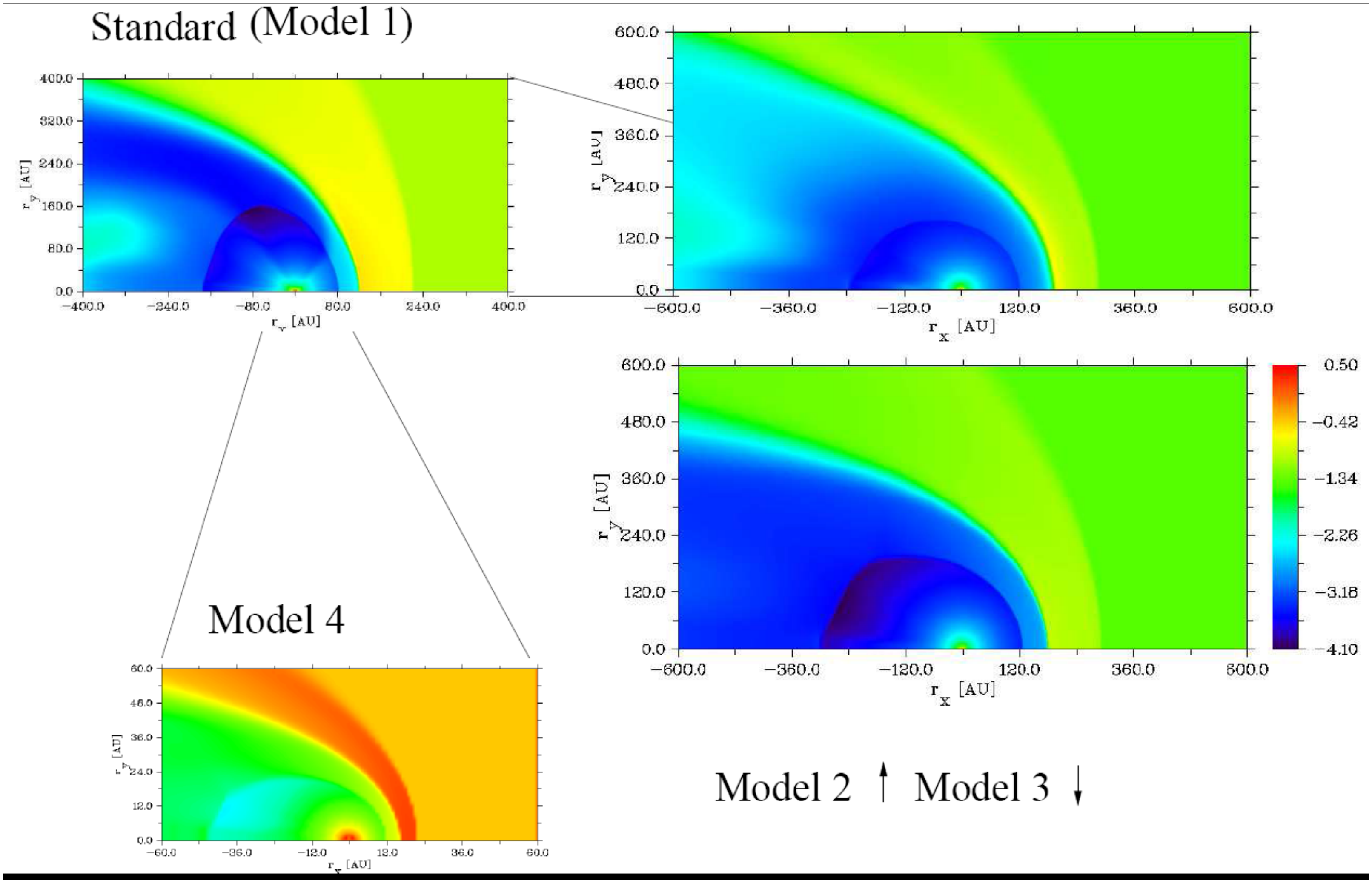
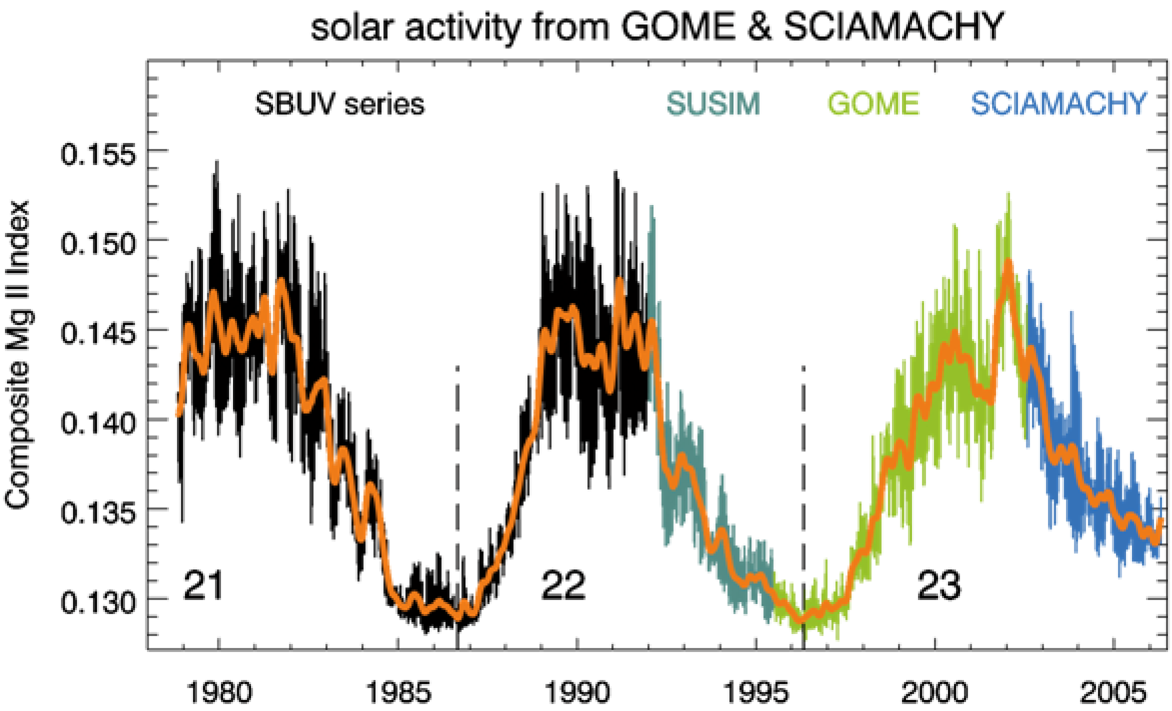
Fichtner, Scherer et al.

The composition of interstellar medium changes when the sun moves around the galactic center ; this changes the composition inside the shock and its heliocentric distance , this intern influences fluxes and spectra of cosmic rays ; will influence cosmic rays (influence on climate?)



Solar irradiance variability

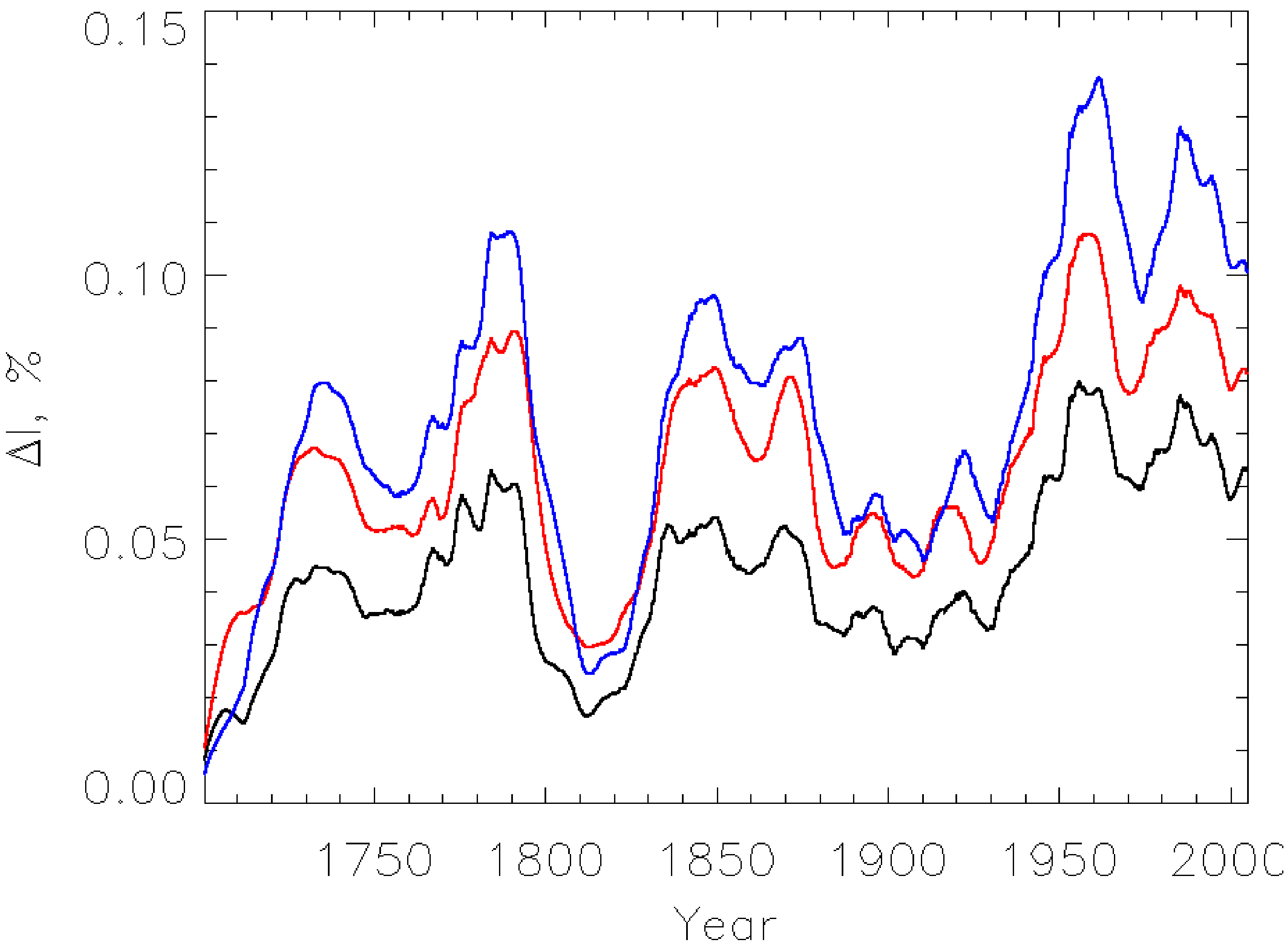


DFG project SOLOZON
University of Bremen

- GOME and SCIAMACHY first space instruments to regularly observe the sun in the UV, visible and NIR spectral range
- Mg II index is a suitable proxy for modelling solar UV and EUV variability
- Solar variability influences atmosphere via dynamical coupling from the upper atmosphere down to troposphere

Solanki, Krivova et al.

solar irradiance reconstruction based on a physical model constrained by all information available (and extremes)



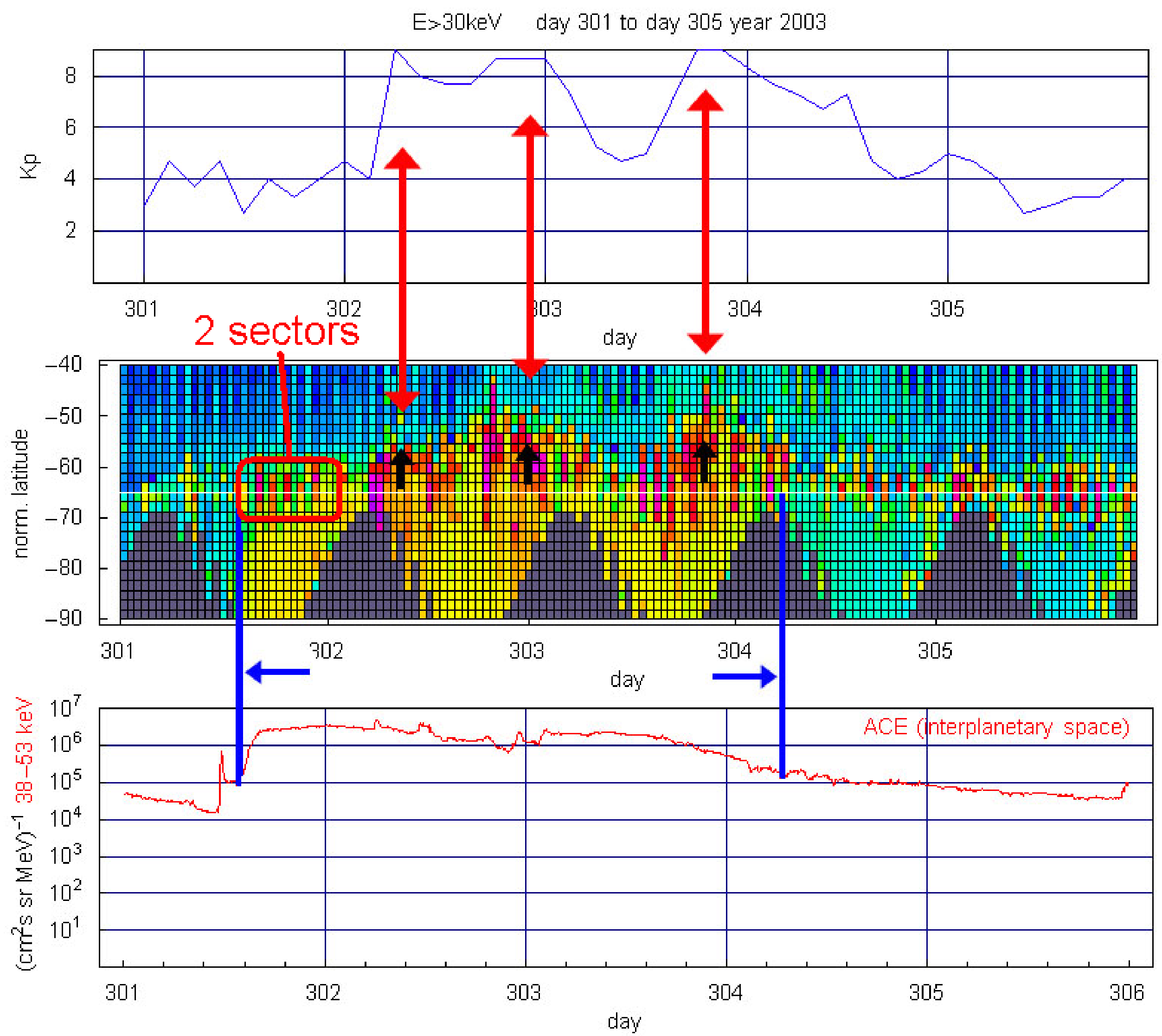
1.3 W/qm increase since Maunder minimum

Kallenrode

‚normalized magnetic field coordinates‘ for the first time allows to separate solar/magnetospheric energetic paticles‘

geomagn.

solar



- characterization of solar radiation etc.
- influence on trace gases, layers etc.
- coupling by gravity waves, tides, etc.
- monitoring of temperatures, winds etc.
- charged aerosols

Solar irradiance variability on hourly to decadal scale from SCIAMACHY and its impact on middle atmospheric ozone and ozone-climate interaction

SOLOZON

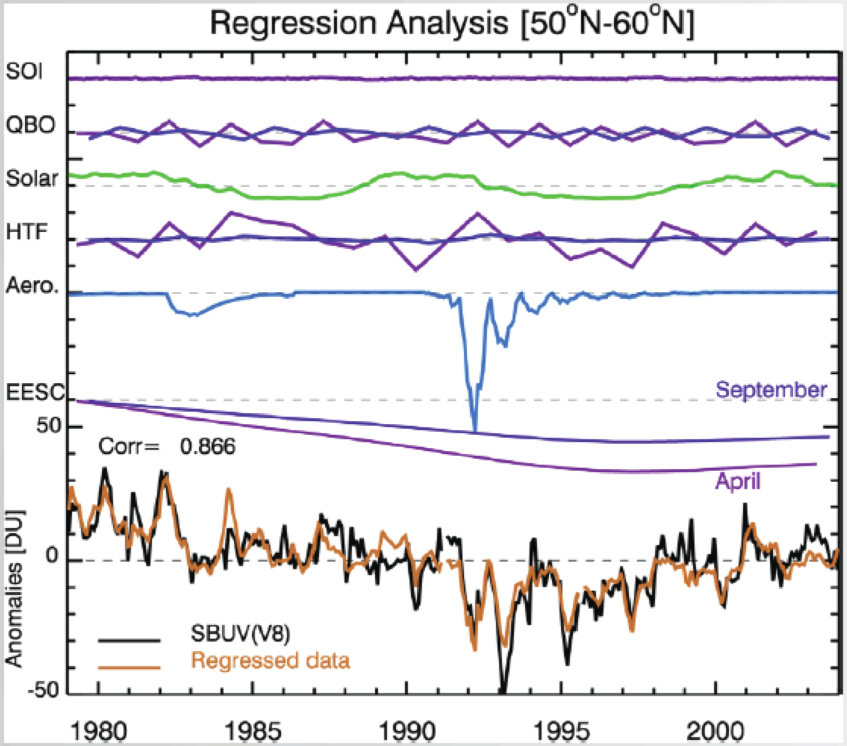
M. Weber, S. Dhomse, J. Skupin*, J. Pagaran,
and J.P. Burrows

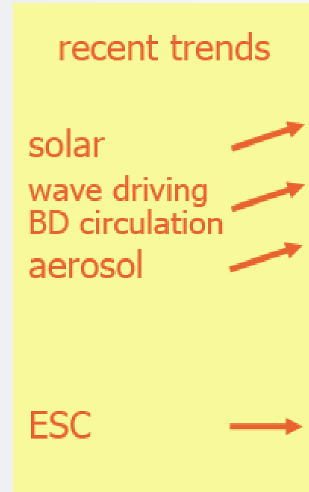
Universität Bremen FB1, Institut für Umweltphysik (iup)
**DESY, Hamburg*

weber@uni-bremen.de http://www.iup.uni-bremen.de/UVSAT

COSPAR, Beijing, July 2006

Total ozone trends: mid- to high NH latitudes





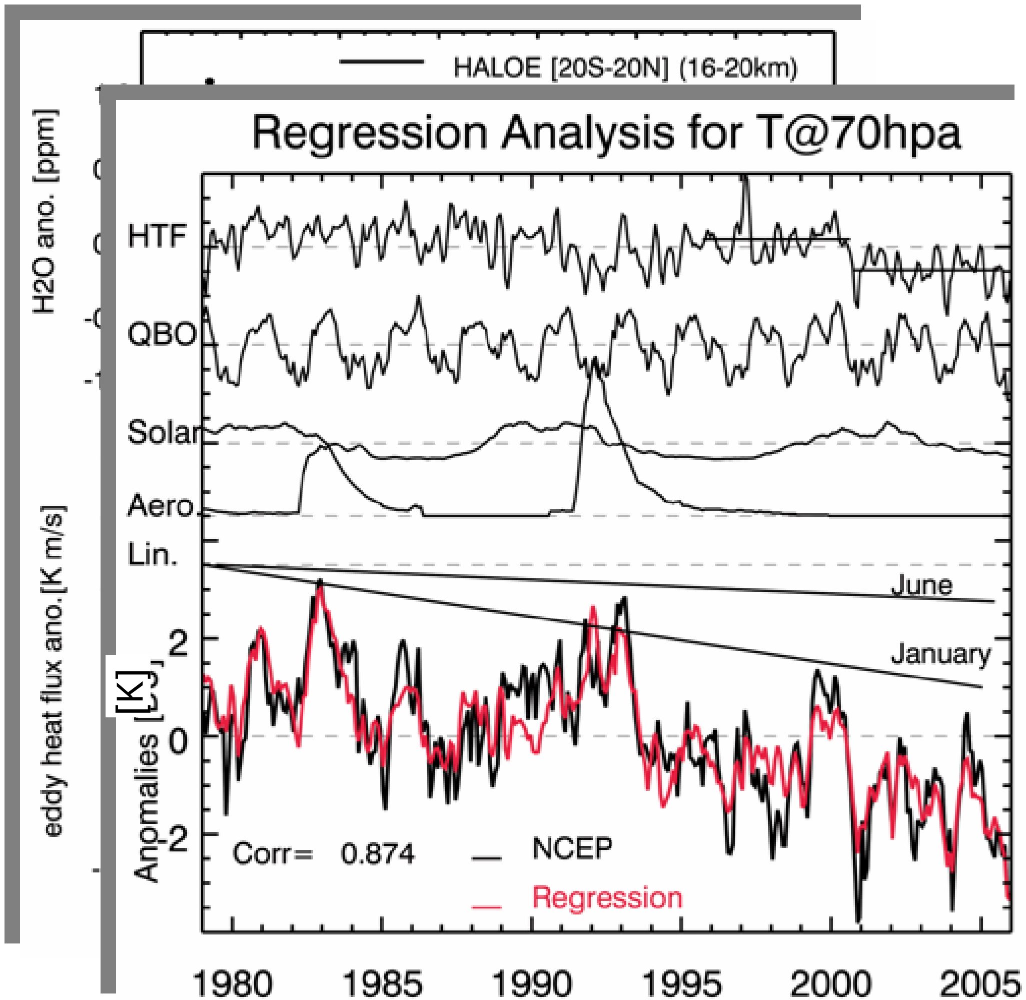
Dhomse et al. (2006)

DFG project SOLOZON
University of Bremen

- Increase in NH total ozone since mid nineties
  - → increase in BD circulation strength
  - → rise of solar cycle 23
  - → return to stratospheric aerosol background conditions after Pinatubo eruption

Stratospheric water vapor, BD circulation, and solar variability

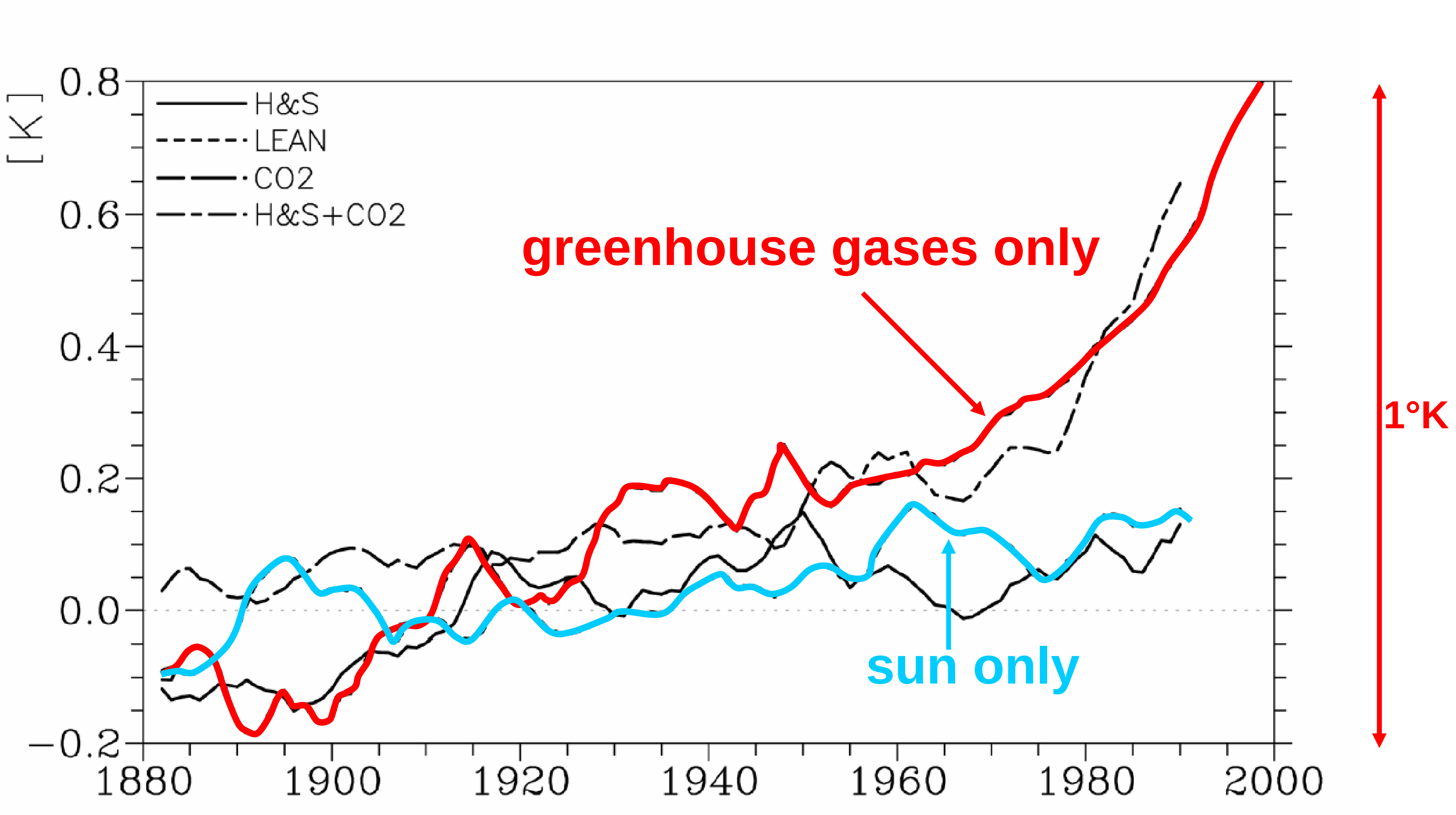
Dhomse et al. submitted



- Water vapor above tropical tropopause
  - Persistent low H2O since 2001
  - BD circulation strength increase in both hemispheres (increased freeze-drying)
- BD circulation changes since 2001 contributed to a ~0.5 K cooling near tropical tropopause
- Estimated solar cycle influence on T near tropical tropopause of about ±0.5K

DFG project SOLOZON
University of Bremen

GCM modeling of solar induced temperature changes



Cubasch & Voss, Space Sci. Rev., 2000.

Project on **S**olar **E**ffects on **C**hemistry and **C**limate Including **O**cean Interactions (ProSECCO)

WP2

Solar signal in the Troposphere

Freie Universität Berlin, Max-Planck-Institut für Chemie

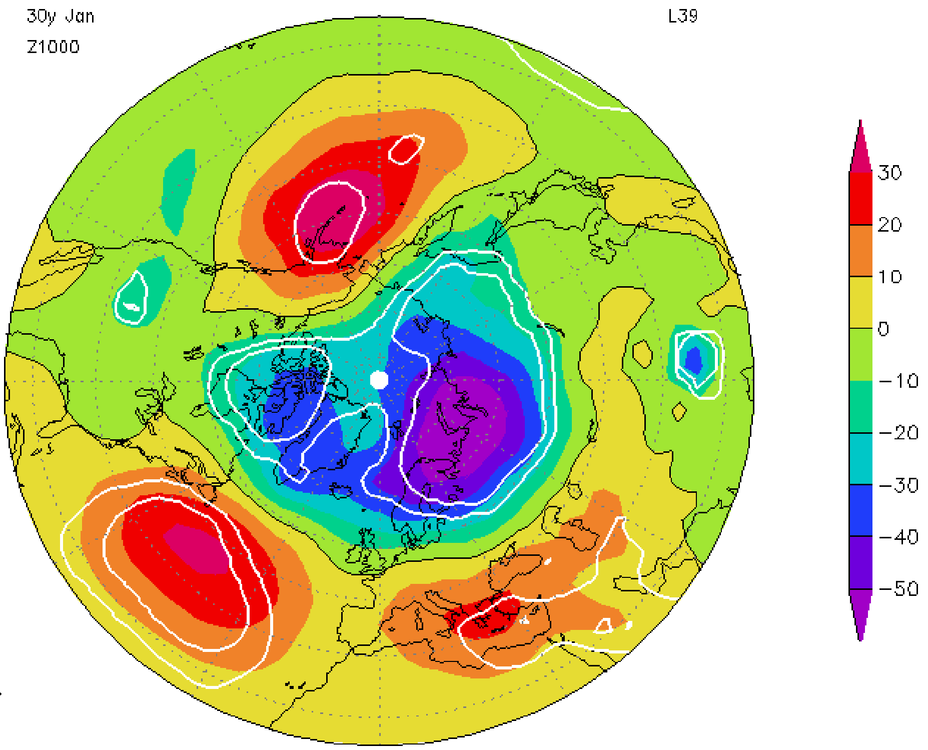
Ulrike Langematz, Christoph Brühl, Anne Kubin

Reproduction of the dynamical solar signal by inclusion of a momentum force in the stratosphere.

ECHAM5/MESSy Middle Atmosphere Climate Model, T42L39 and L90, model top at 0.01 hPa, perpetual January runs.

Significant solar signals in the stratosphere and in the tropo-sphere.

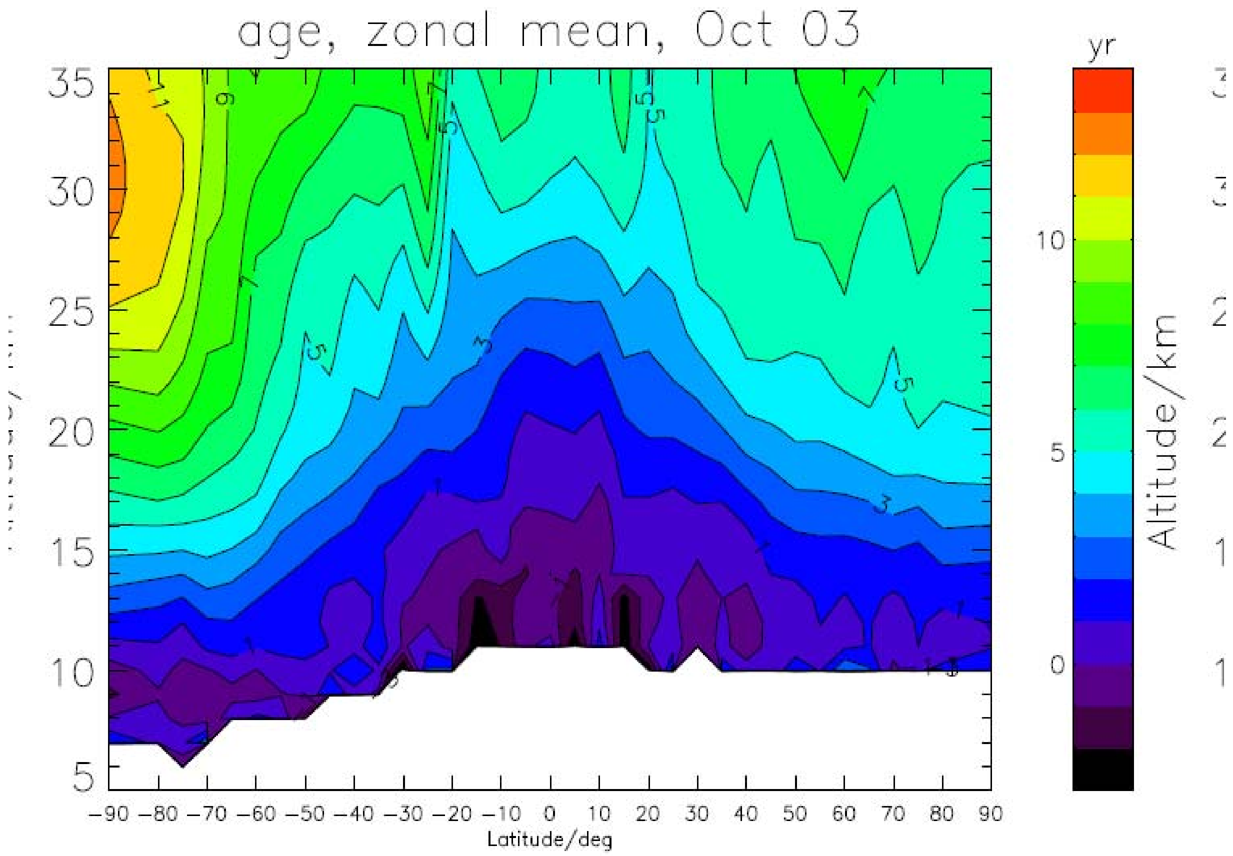
Example: AO-like anomaly of the 1000 hPa geopotential height in the L39-30y-January experiment. ⇨



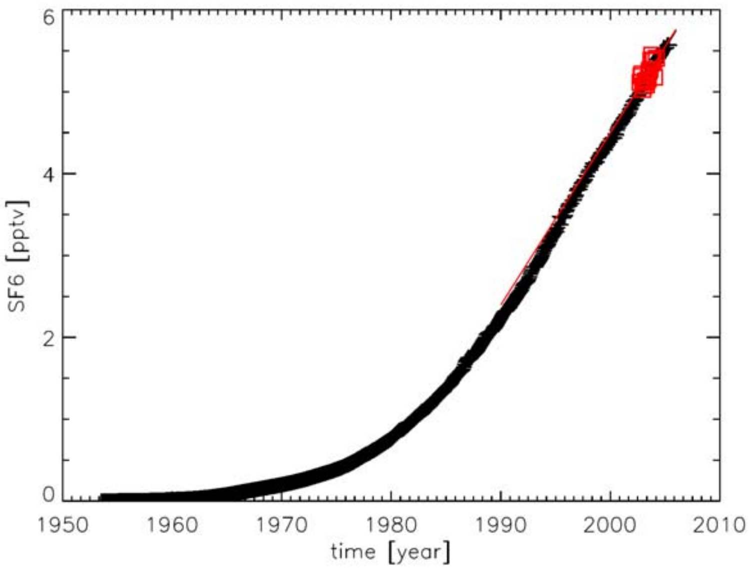
Stiller,Engler

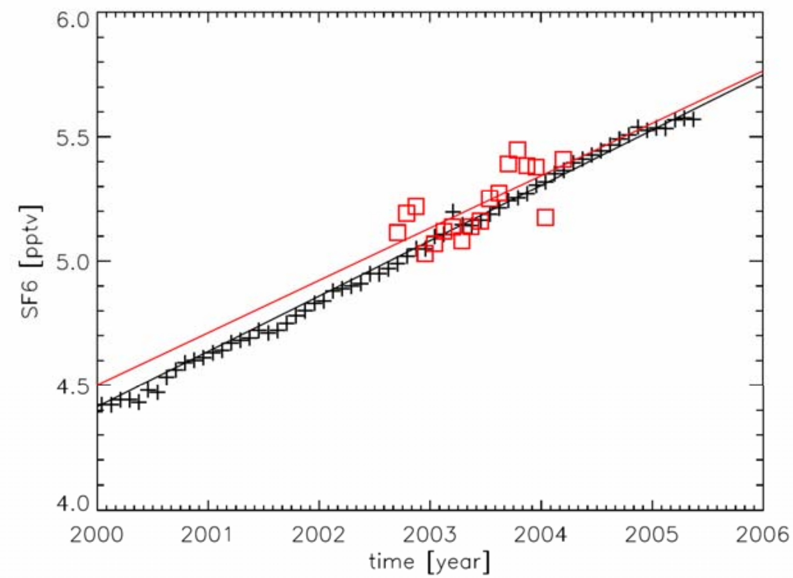
- determine mean age of air, compare with ground based and balloon measurements
- important indicator for circulation (and solar variation) in the UTLS

Mean age of air derived from MIPAS



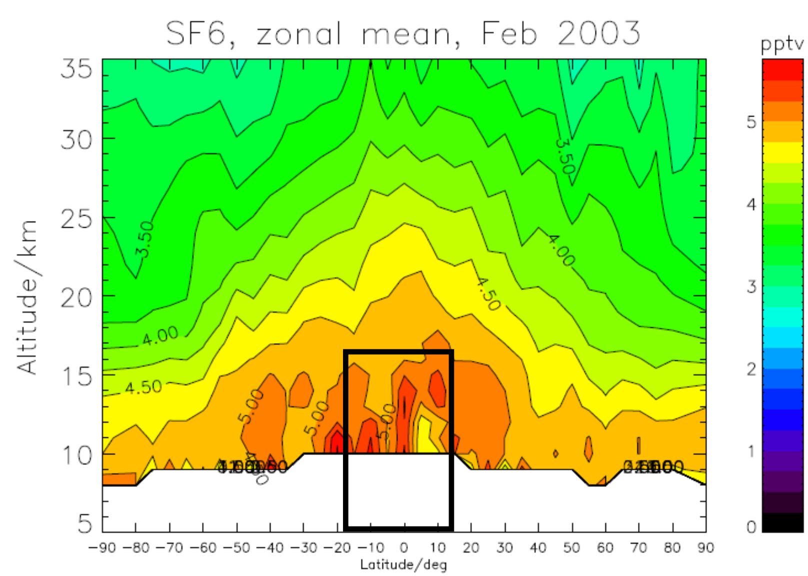
SF_6 as tracer for vertical transport



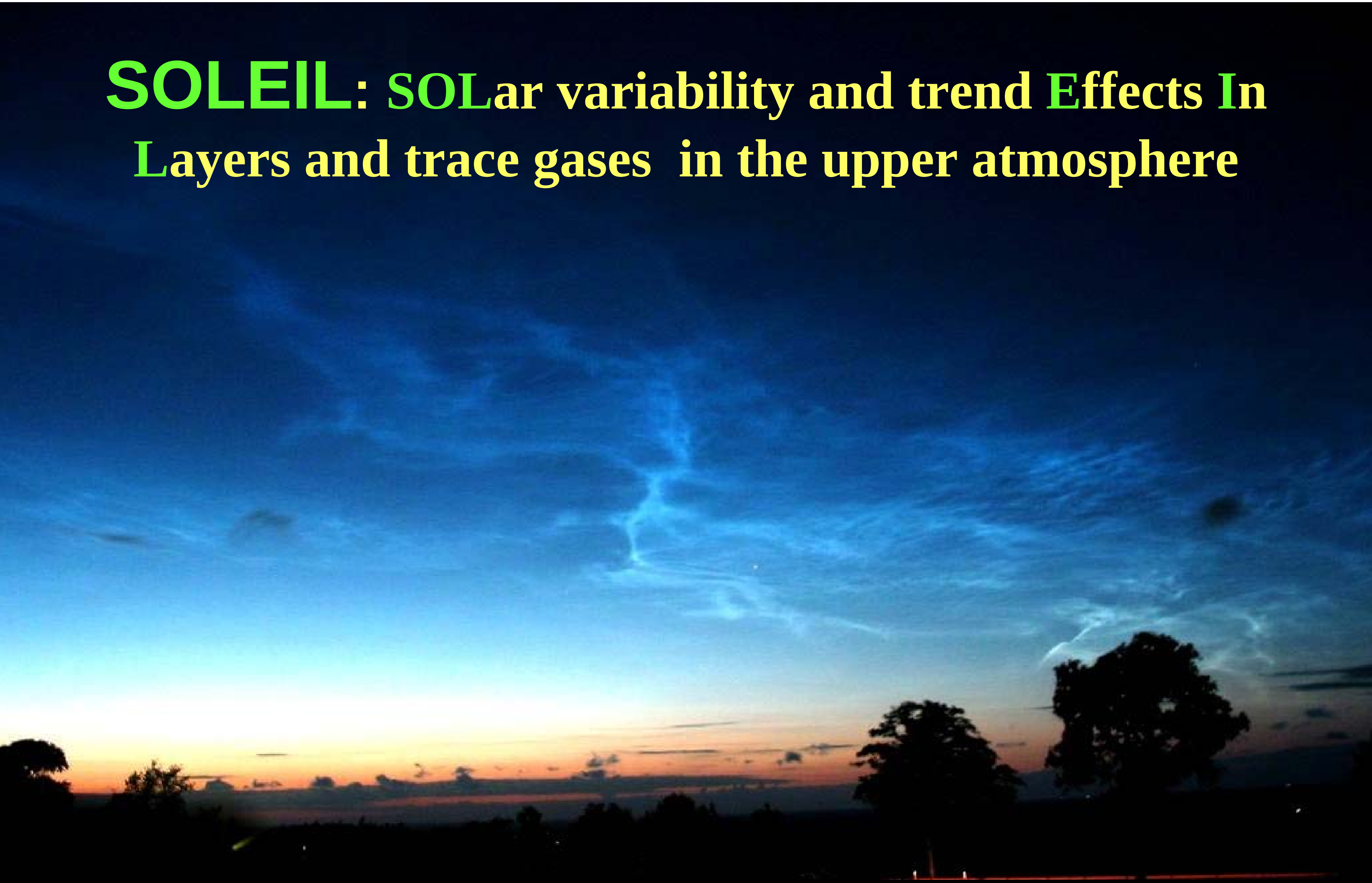


Regression line through Engel&Bönisch data set since 1990:
SF_6 [pptv] = 0.222 pptv/yr (t - 1990) + 2.190 pptv

Trend MIPAS: 0.211 pptv/yr
Mean value 1Jul 2003 MIPAS: 5.24 pptv
Mean value 1Jul 2003 E&B: 5.19 pptv

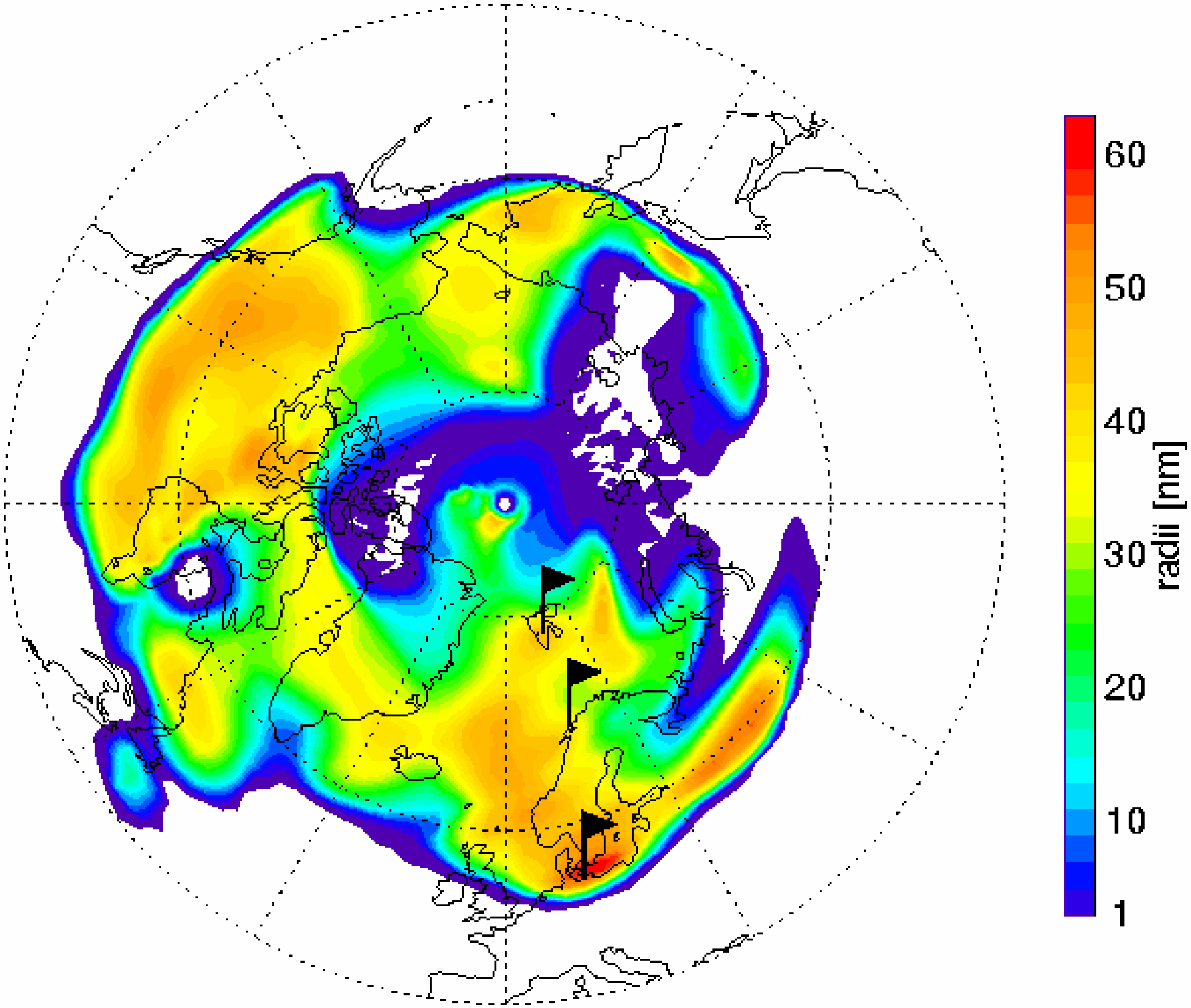


SOLEIL: SOLar variability and trend Effects In Layers and trace gases in the upper atmosphere

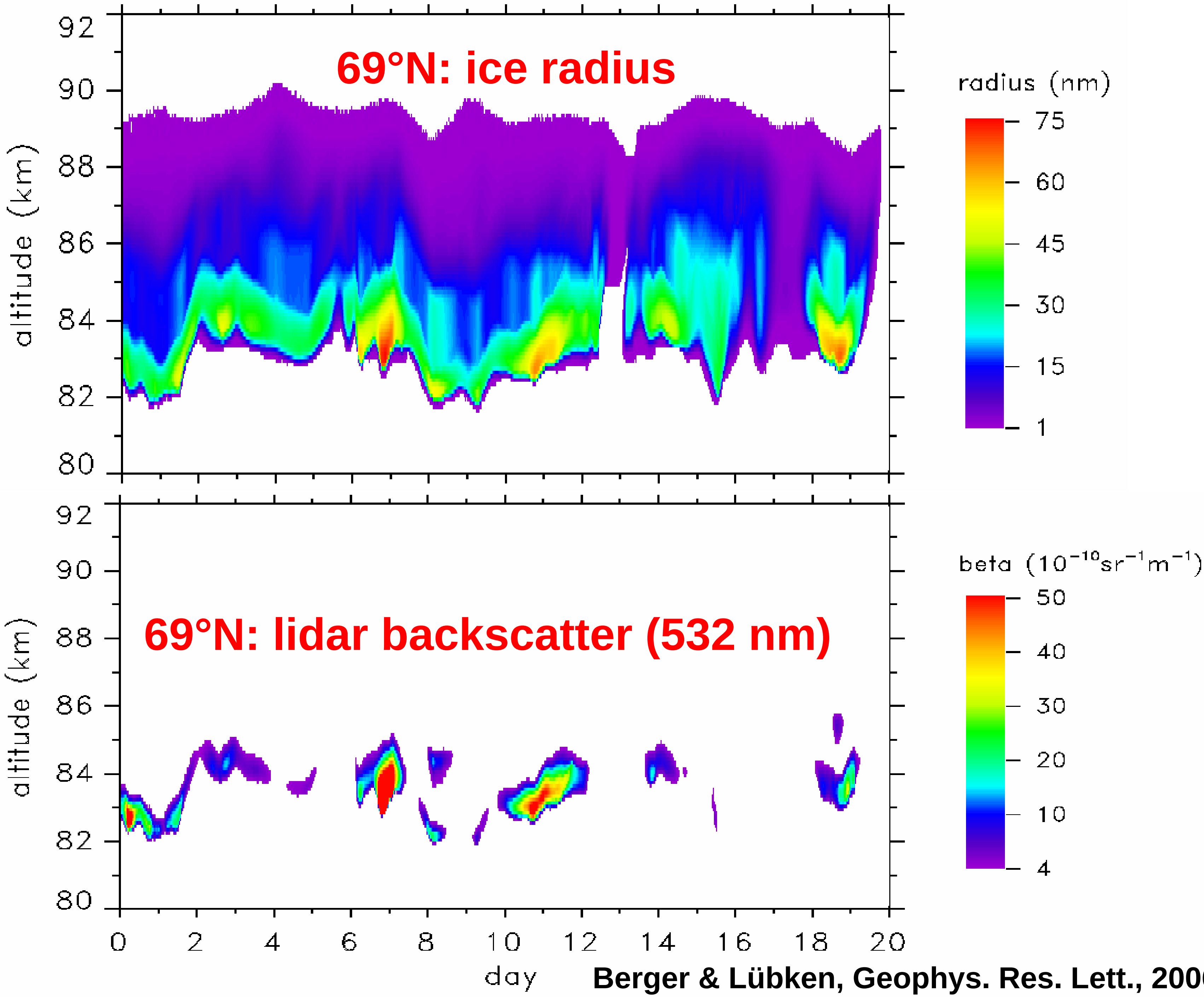


Franz-Josef Lübken and Uwe Berger
Leibniz Institute of Atmospheric Physics, Kühlungsborn, Germany

Maximum ice radius on July 1, 2001



Berger & Lübken, Geophys. Res. Lett., 2006



Berger & Lübken, Geophys. Res. Lett., 2006

MANOXUVA

Middle Atmosphere NOx variations and solar UV VAriability:

Examples to study mesospheric/stratospheric coupling and the impact of solar variability on stratospheric ozone

Thomas Reddmann, Gabriele Stiller, Thomas von Clarmann, Sven Gabriel, Wolfgang Kouker, Roland Ruhnke, Gabriele Stiller and Roland Uhl

Institut für Meteorologie und Klimaforschung
Universität Karlsruhe

Paul Konopka and Bärbel Vogel, ICG-I
Forschungszentrum Jülich in der Helmholtzgemeinschaft

Bernd Funke and Manuel Lopez-Puertas,
Instituto de Astrofisica de Andalucia, Granada

MANOXUVA

IMK

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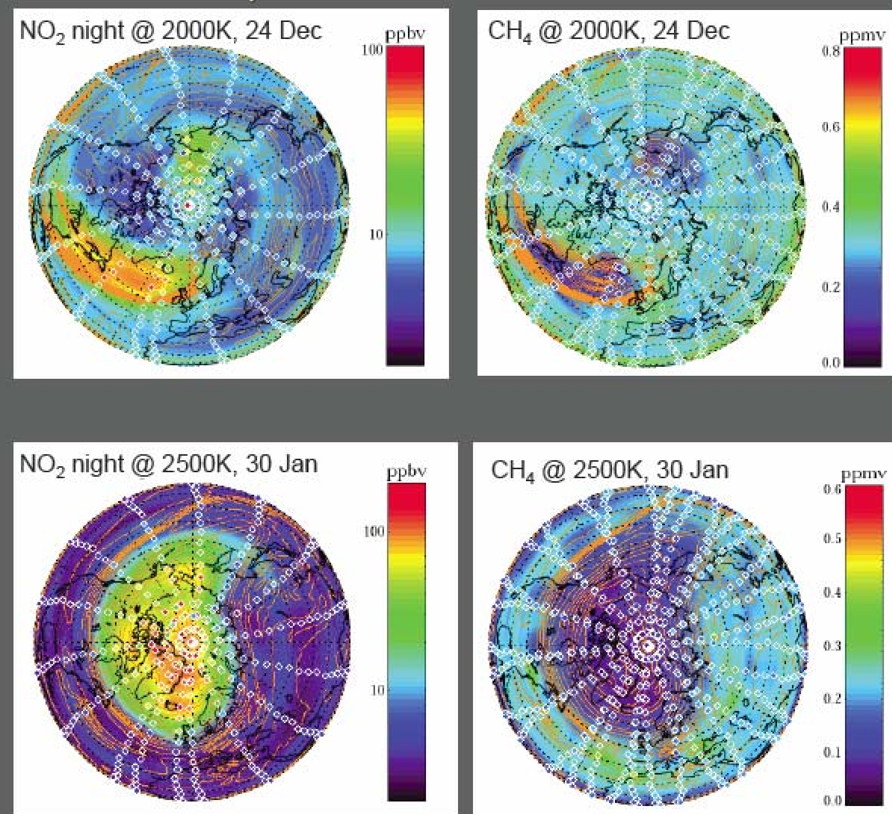
Downward transport and mixing of NOx in winter 2003/2004 observed by MIPAS/ENVISAT

Anti correlated NO_2/CH_4 indicates particle induced NOx rich air masses of mesospheric origin

After the stratospheric warming mid of December 2003 mesospheric NOx is lost after transport in sunlit mid latitudes

MIPAS observations clearly show that enhanced NOx concentrations in January 2004 are connected with downward transport and not with in-situ production



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FIMK

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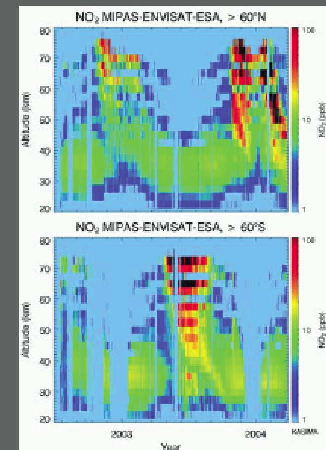
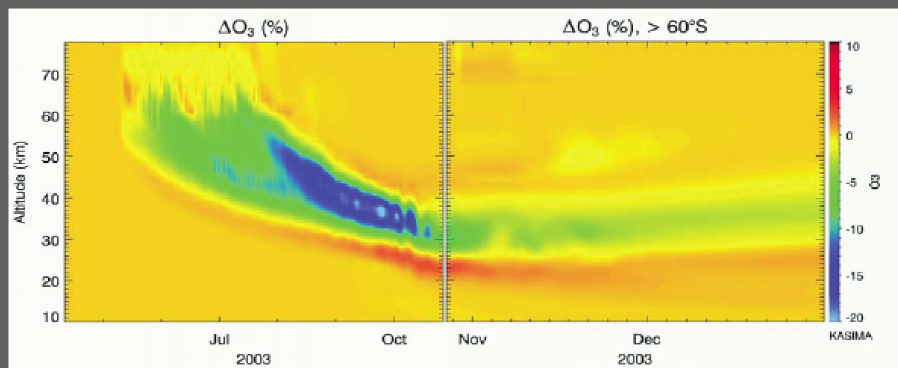
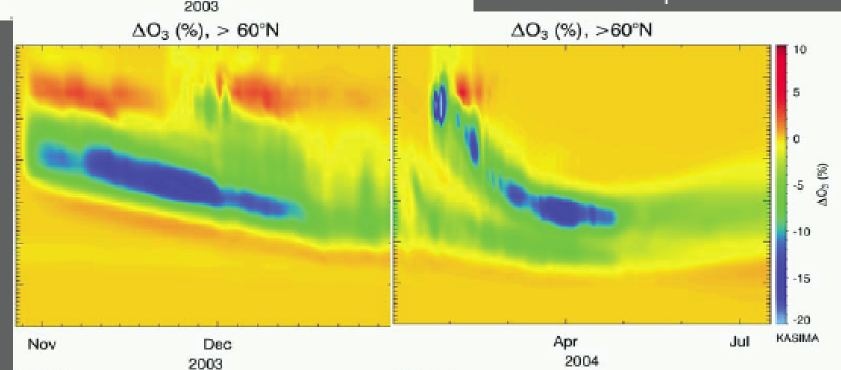
Modelling disturbed chemistry after energetic particle induced NOx enhancements based on MIPAS/ENVISAT observations



MIPAS observations give a complete picture of NOx intrusion into the polar night mesosphere





Using MIPAS observations at the upper boundary the KASIMA model is used to estimate ozone reduction caused by particle induced NOx. Effects are restricted to high latitudes and are important for ozone trend analyses.

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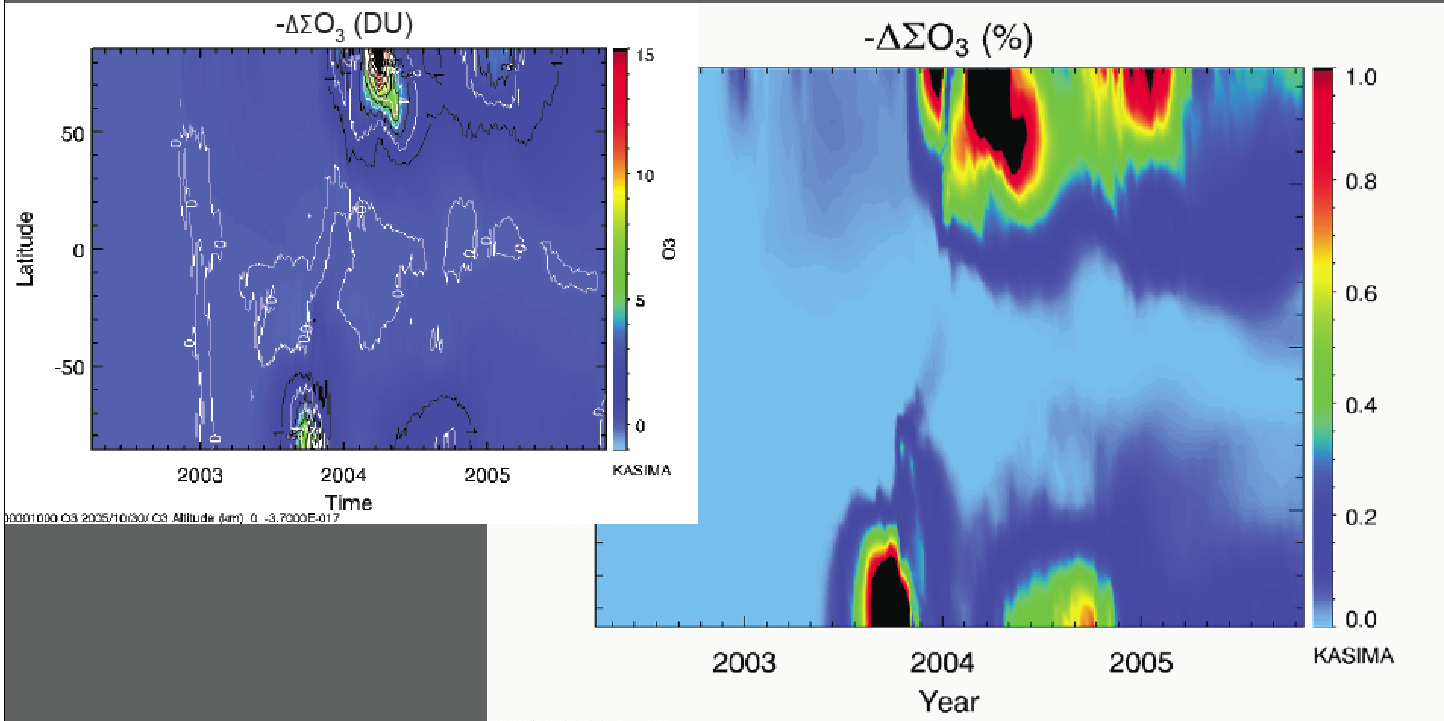
Effect on total ozone



Ozone change of ozone column in the aftermath of NOx intrusions in 2003/2004

MANOXUVA

CAWSES

- characterization of solar radiation etc.
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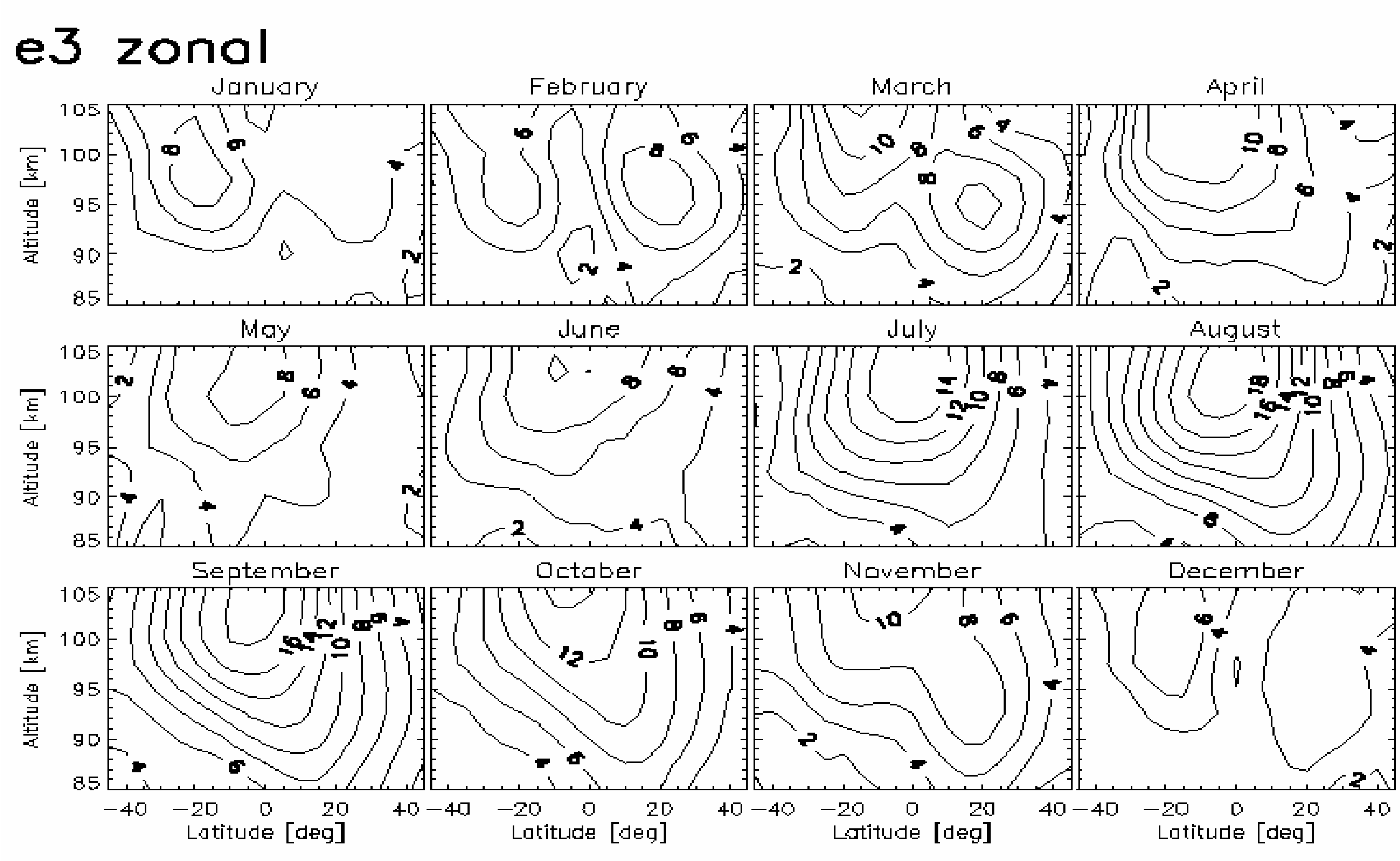
- charged aerosols

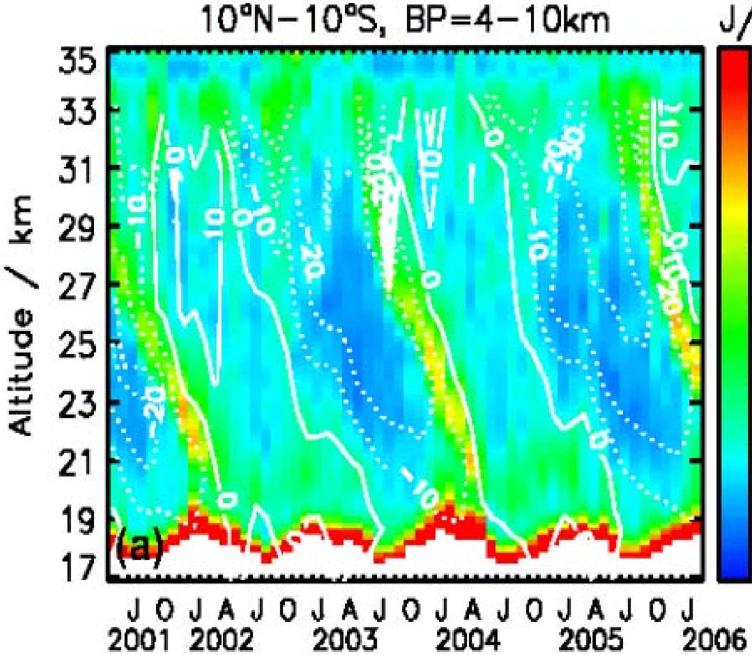
Oberheide et al.

tides from TIDI; first observation of vertical structure ; climatologies ;
nonmigrating often exceed normal tide ; sources: latent heat, wave-wave interaction

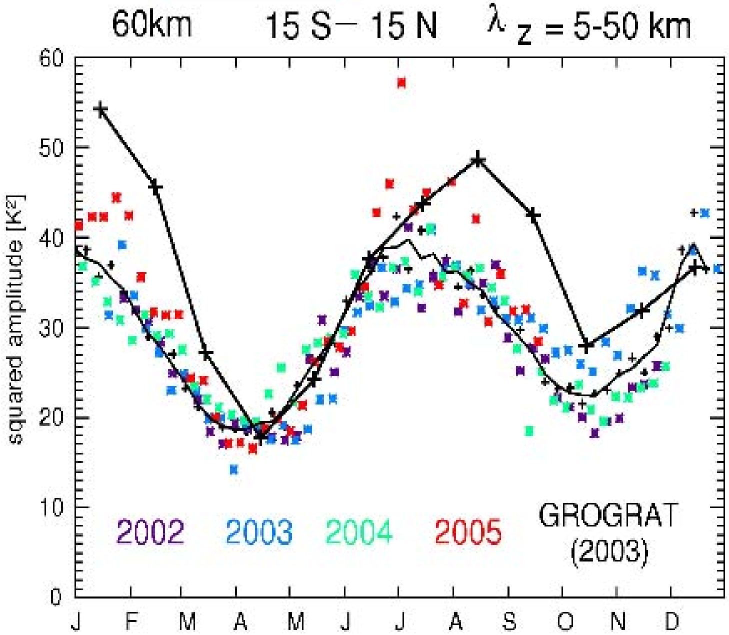


QBO and SAO signals found in gravity wave activity from GPS radio occultation and SABER

CHAMP & SAC-C



SABER



The CAWSES project GW-CODE:

M. Ern (1), M. Krebsbach (1), P. Preusse (1), K. Fröhlich (2), G. Stober (2), C. Jacobi (2), T. Schmidt (3), and J. Wickert (3)

Forschungszentrum Jülich

in der Helmholtz-Gemeinschaft

GFZ

POTSDAM

- characterization of solar radiation etc.
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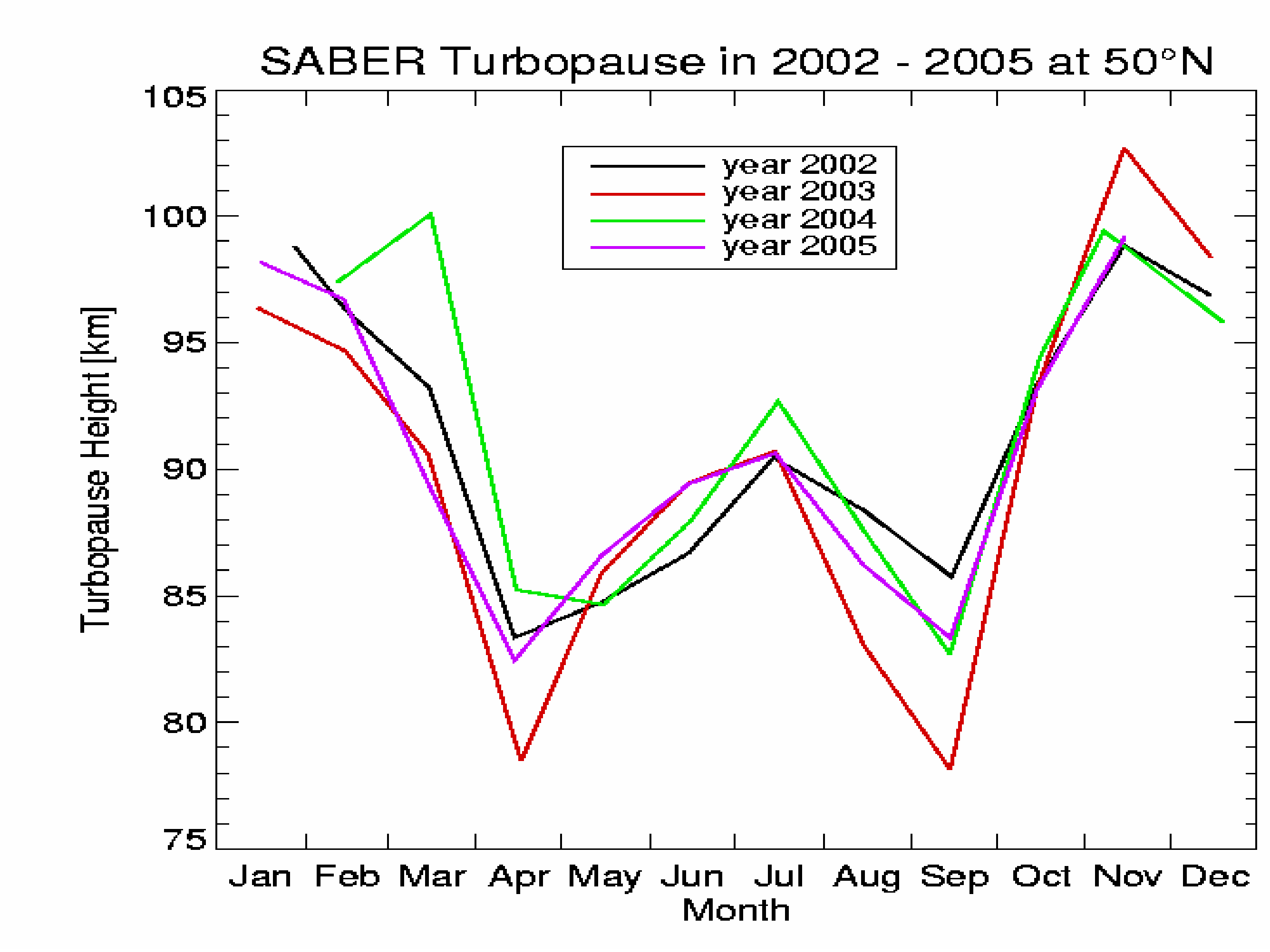
Offermann

temperature fluctuations –> ‚wave turbopause‘ ; shows seasonal variation occur close to mesospheric zero wind lines



see German CAWSES
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www.iap-kborn.de

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