GRG WP1 progress report

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WP_GRG1 summary

Task 1.1:

Extension of EMCWF assimilation system to include new tracers (NOx, SO2, CO, and HCHO)

Task 1.2:

Evaluation of chemical formation and loss rates for ozone, NOx, SO2, CO, HCHO, O3 and CH4 from the three CTMs

Task 1.3:

Addition of chemical formation and loss rates to the ECMWF assimilation system

Task 1.4:

Assessment and delivery of satellite data for ozone, NO2, SO2, CO, CH4 and HCHO

Task 1.5:

Collection of satellite data for ozone, reformatting for use in the IFS, and monitoring of the data sets against IFS

WP_GRG1 summary

Task 1.6, 1.7:

Collection of satellite data for NO2, SO2, HCHO, CO, reformatting for use in the IFS, and monitoring of the data sets against IFS

Task 1.8, 1.9, 1.10:

Assimilation of ozone, NO2, SO2, HCHO, CO satellite data

Task 1.11:

Implementing a nudging capability for assimilated tracer fields into the CTMs of WP_GRG_2

WP_GRG1 summary

Task 1.12:

Critical assessment of assimilated ozone, NO2, SO2, HCHO, CO: implementation aspects

Task 1.13:

Critical assessment of assimilated ozone, NO2, SO2, HCHO, CO: comparison with independent models and assimilation

Task 1.14:

Critical assessment of assimilated ozone, NO2, SO2, HCHO, CO, based on independent data from WP_GRG_4

Task 1.15:

Review of inverse modelling techniques for non-CO2 gases

Partners:

ECMWF, Meteo-France, KNMI, IFE-Bremen, BIRA/IASB, SA-UPMC, NKUA

Status for partners involved in GRG-wp1

WP_GRG1 ECMWF status

ECMWF assimilation system has been extended to include GRG tracers

First version of GRG assimilation :

- simple total column observation operator
- Diagonal background error covaricance matrix
- constant initial fields
- no chemistry

Assimilation tests have begun to evaluate GRG assimilation system
(single obs experiments and experiments with MOPITT CO data)

WP_GRG1 ECMWF status

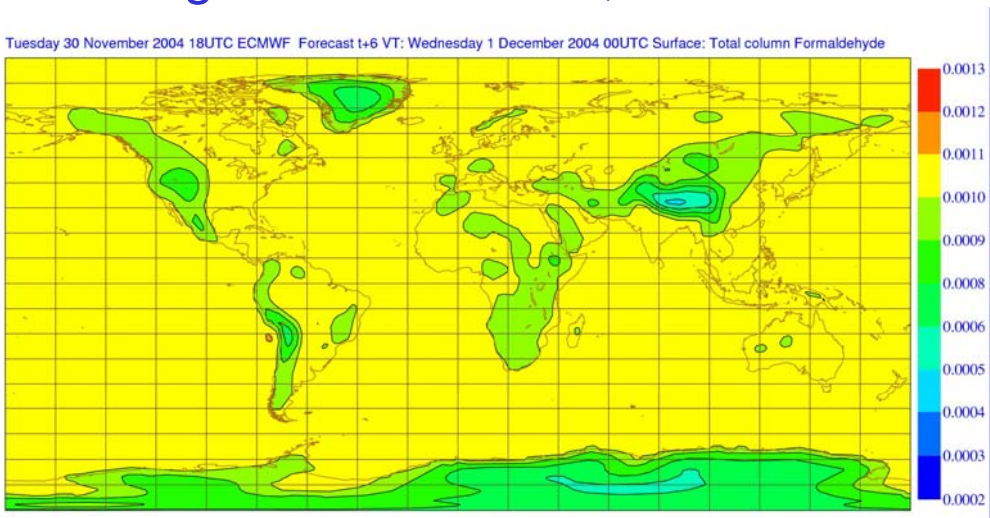
Satellite data for GRG are being collected and work on bufr tools is under way. Sample data are:

- KNMI SCIAMACHY NO2 for 2003 and 2004
- MOPITT CO for 2003 and 2004
- AURA TES CO for July 2005
- KNMI GOME HCHO for December 2001

Work is beginning on constructing background error covariance matrices for the GRG gases

Test assimilation of MOPITT total column CO

Background 20041201, 0z



Obs error 10%

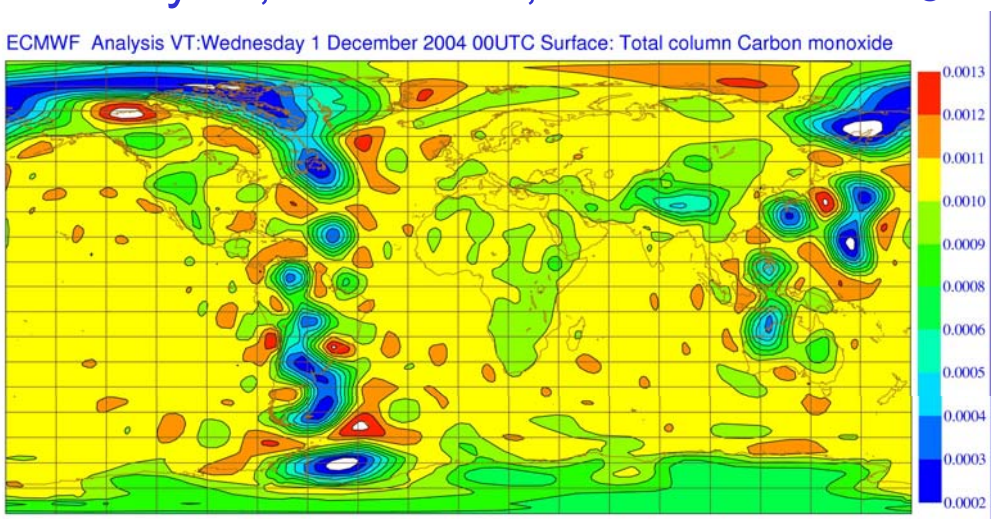
diagonal B,
σb=1.e-7 kg/kg,

Background field=1.e-7 kg/kg

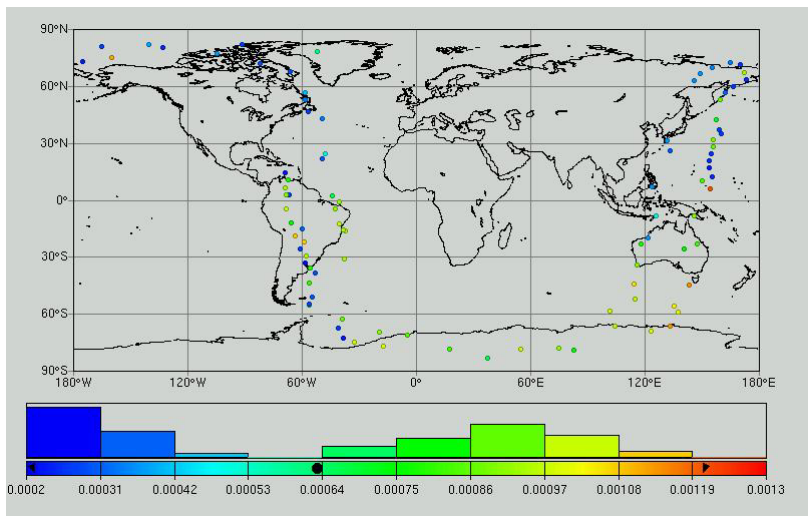
No chemistry

Analysis, 20041201, 0z

Kg/m2



CO observations



METEO FRANCE
Toujours un temps d'avance

GEMS

WP_GRG1 Meteo France summary of activities

Task 1.2: Evaluation of chemical formation and loss rates for ozone, NOx, SO2, CO, HCHO, O3 and CH4 from the three CTMs

METEO-FR has contributed to the selection of the OASIS4 software to manage the coupling between the IFS and the CTMs. The use of this coupling software will provide high flexibility and will allow to perform extensive comparisons of the use of the IFS model with the products of one or the other CTMs.

METEO-FR has also contributed to the discussion of the coupling method which aims at making initial choices concerning the fields to be exchanged between the IFS and the CTMs, the frequency of exchange and the way to combine the received fields with the model variables without creating an unbalance of the models. At least for a first go, we advocate the first option proposed by Johannes Flemming, i.e. the CTMs provide one total tendencies of the chemical tracers to the IFS with no distinction between loss and production. In this approach, the CTM is recognised as a comprehensive external parametrisation of the chemistry

GEMS

WP_GRG1 Meteo France summary of activities

Task 1.2: Evaluation of chemical formation and loss rates for ozone, NOx, SO2, CO, HCHO, O3 and CH4 from the three CTMs

In brief, we propose the following implementation for a first go at the coupling between CTM and IFS :

-IFS provides every hour 3D (T,u,v,w,q,P) to the CTM (via OASIS)

-CTM provides every hour one "total tendencies" 3D field to the IFS per tracer considered (via OASIS)

-IFS advects its chemical compounds and applies the total tendencies ; assimilation for the different species is done monovariate (from the point of view of chemistry)

-3D fields in IFS (analyses or forecasts) are sent to the CTM at a lower temporal frequency or with a nudging scheme, so that the differences in these 3D distributions between CTM and IFS stay in a reasonable range.

METEO FRANCE
Toujours un temps d'avance

GEMS

WP_GRG1 Meteo France summary of activities

Task 1.3: Addition of chemical formation and loss rates to the ECMWF assimilation system

The IFS/ MOCAGE interface via OASIS4 is under development. Instead of reading the meteo fields from files, the serial version of MOCAGE can now run at ECMWF with forcing fields provided by a coupled program. The implementation of the same interface but for the parallel version is in progress. The MOCAGE to IFS tracers tendencies sending is still to be implemented as well as the reception of the updated concentrations in MOCAGE.

WP_GRG1 MPI-Hamburg activities

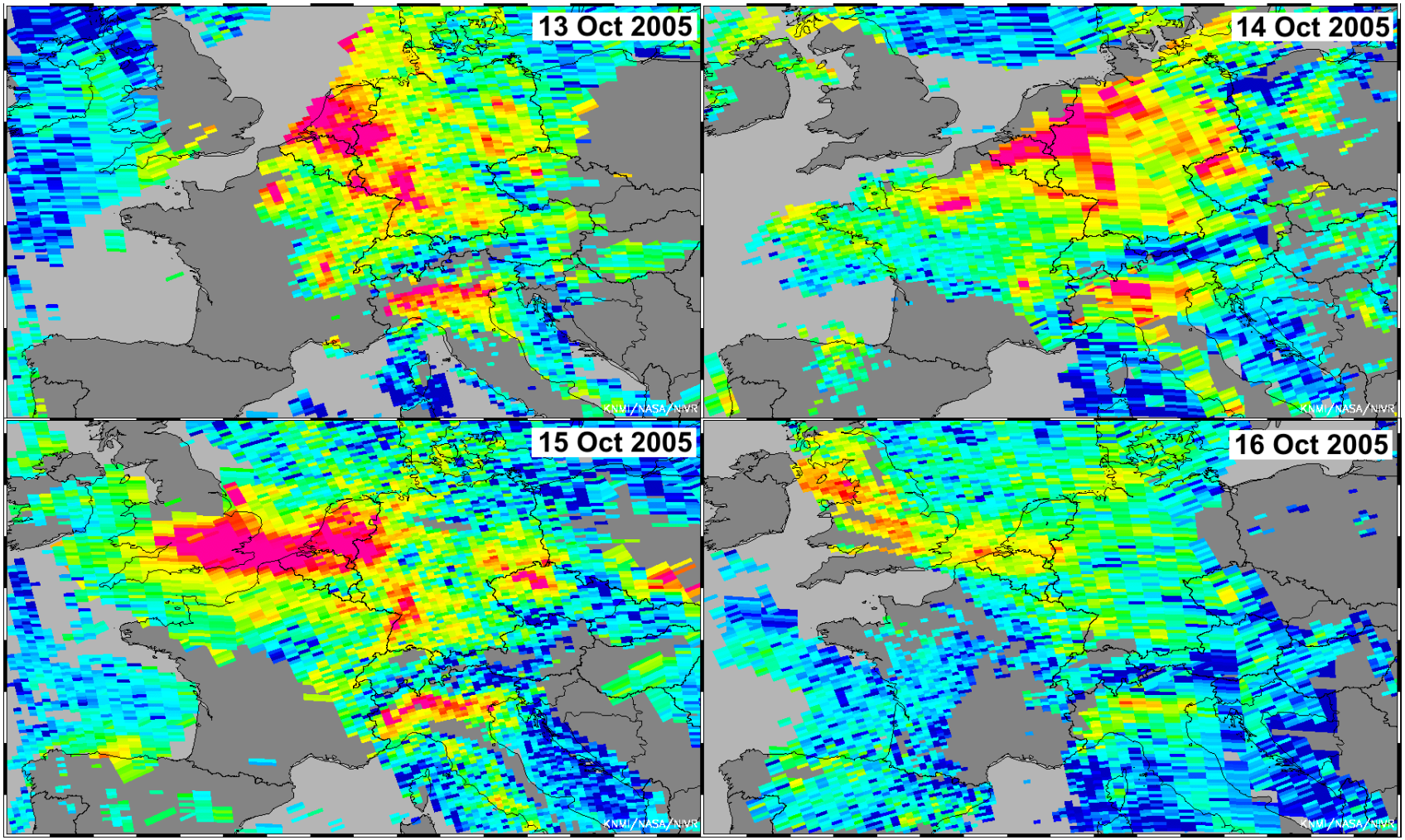
- Chemical production and loss rates implemented for MOZART-3 (1.3)
- P and L available for 1-week simulation with IFS meteo (1.2) and for a one-year simulation with WACCM meteorology.
- All MOZART-3 output available to GEMS / IFS

WP_GRG1 KNMI activities

GEMS

- Working document on production and loss rate: definition in CTM and use in IFS. Participation in designing the coupling. (1.2, 1.3)
- Data sets of ozone and NO2 from SCIAMACHY prepared and delivered to ECMWF. HCHO retrieved by BIRA/KNMI for GOME has become available end of 2005. SO2 will follow. (1.5, 1.6)
- A GEMS document on available tropospheric satellite data sets is in preparation (with Univ. Bremen, 1.5, 1.6)
- OMI near-real time data on ozone and NO2 available very soon
- Discussions with ECMWF on the formulation of the background covariance and observation operators
- OSSE study on emission estimates based on SCIAMACHY methane and a 4D-Var system has been completed (Meirink et al, ACP)

OMI near-real time NO2, 13-16 October 2005



IFE / IUP Bremen activities

Task 1.4: Assessment and delivery of satellite data for ozone, NO_2, SO_2, CO, CH_4 and HCHO

Task Lead: Partner 7 *Partners: Partner 7, Partner 12.*

All available (tropospheric) satellite data for O_3, NO_2, SO_2, CO, CH_4 and HCHO will be critically reviewed and recommendations for assimilation will be made depending on the quality and availability. Data sets produced by the GEMS partners will be made available.

Partner 7 contribution

Inventory of available satellite data sets, and assistence with collection of relevant data sets. Delivery of O_3, NO_2, SO_2 and HCHO satelite data sets produced by the KNMI to GEMS.

Partner 12 contribution

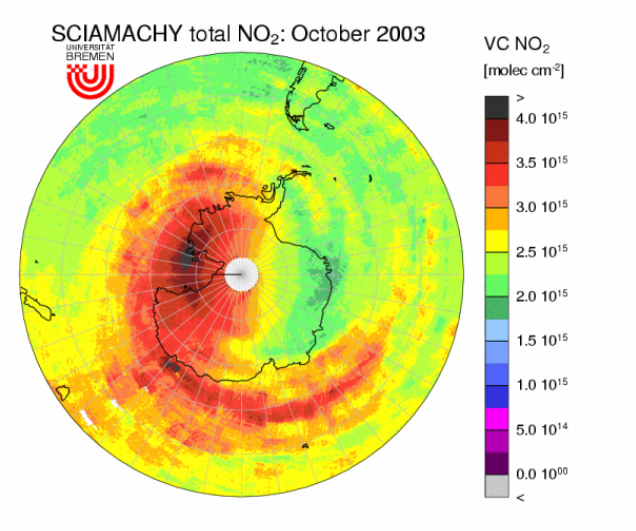
Recommend on the selection of relevant satellite data sets on O_3, NO_2, SO_2, CO, CH_4 and HCHO for the GRG. Advice on data quality and availability.

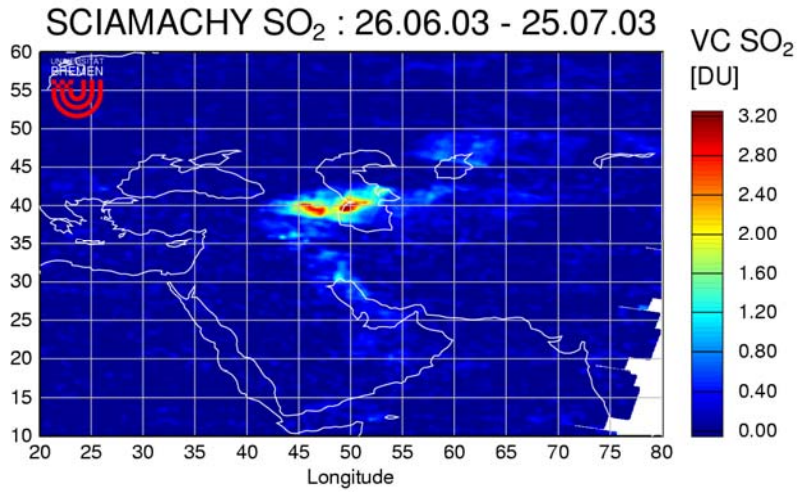
IFE / IUP Bremen activities

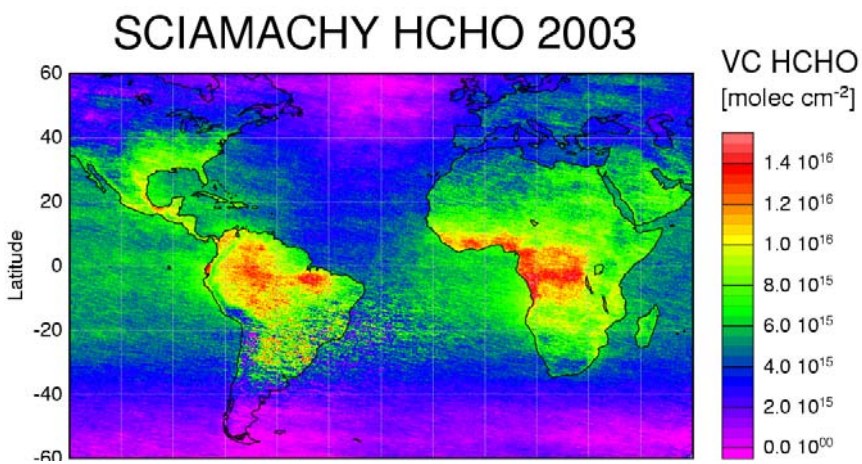
Proposed ToC of wp1.4 report (Draft ready end of February)

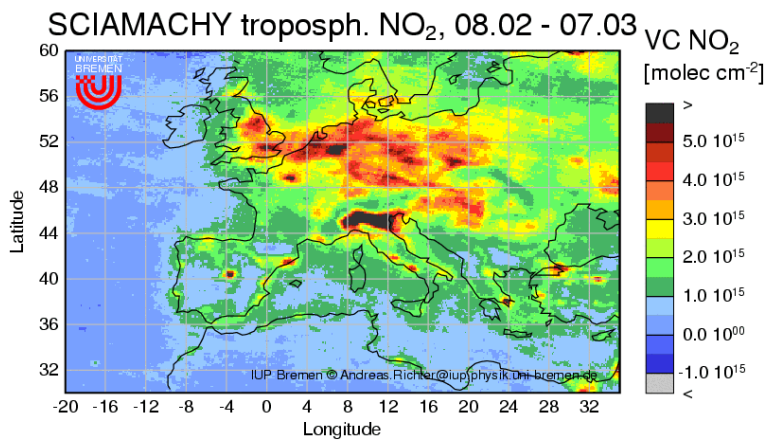
- 1. Requirements on data for assimilation (KNMI)
- 2. Requirements on data for model evaluation (MPI-HH/IFE)
- 3. Survey on existing satellite data sets (IFE)
- 4. Recommendations on the use of satellite data sets within GEMS for data assimilation (IFE/KNMI)
- 5. Recommendations on the use of satellite data sets within GEMS for model evaluation (IFE/KNMI)

SCIAMACHY products at IUP Bremen

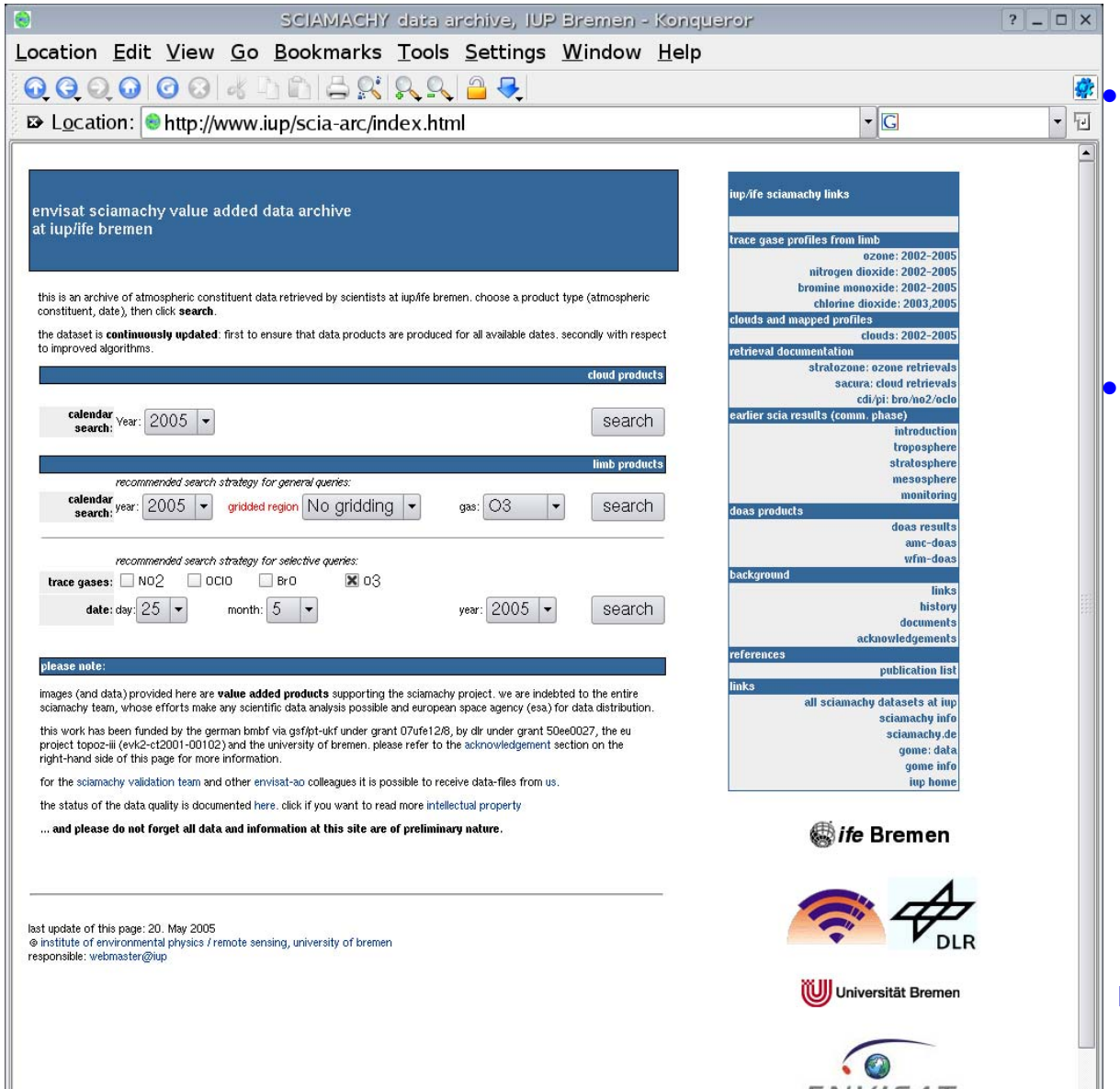








SCIAMACHY products at IFE / IUP Bremen



- products are organized in
  http://www/scia-arc
  Regulary processed
  - Sacura Cloud Parameters
  - Limb O3, NO2, BrO
- Also link to demonstration produ
  or products for
  selected set of data:
  - Nadir H2O
  - Nadir DOAS (incl. trop. Products)
  - Nadir CO, CO2, CH4
  - Cloud Parameters

WP_GRG1 IASB-BIRA and NKUA

These partners are mainly involved in the assessment of the outcome of the assimilation, work to be started in year 2

Satellite measurements of the tropospheric composition

Satellite data availability for 2003

Available for 2003

- O_3: SCIAMACHY (total column, stratospheric profile), AIRS (TBC)
- CO: MOPITT (free trop. column), SCIAMACHY (total column), AIRS (TBC)
- NO_2 SCIAMACHY (total column, tropospheric column, stratospheric profile)
- SO_2 SCIAMACHY (total column)
- HCHO SCIAMACHY (total column)
- CO_2 SCIAMACHY (total column), AIRS (TBC)
- CH_4 SCIAMACHY (total column), AIRS (TBC)

Carbon monoxide

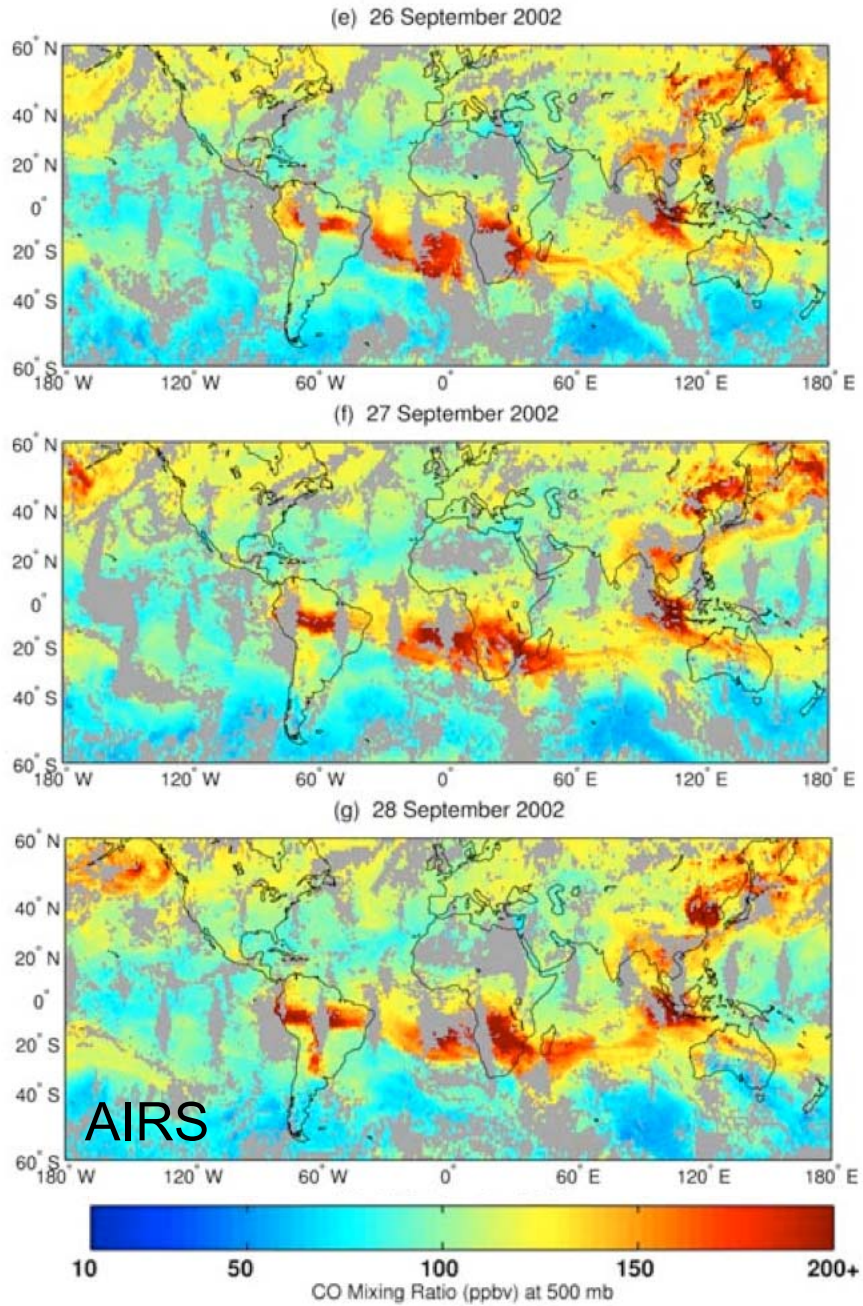
Satellite sensors:

- MOPITT
- AIRS
- IASI
- TES Aura
- SCIAMACHY
- IMG
- MIPAS
- SMR - Odin
- ACE-FTS
- MLS-Aura

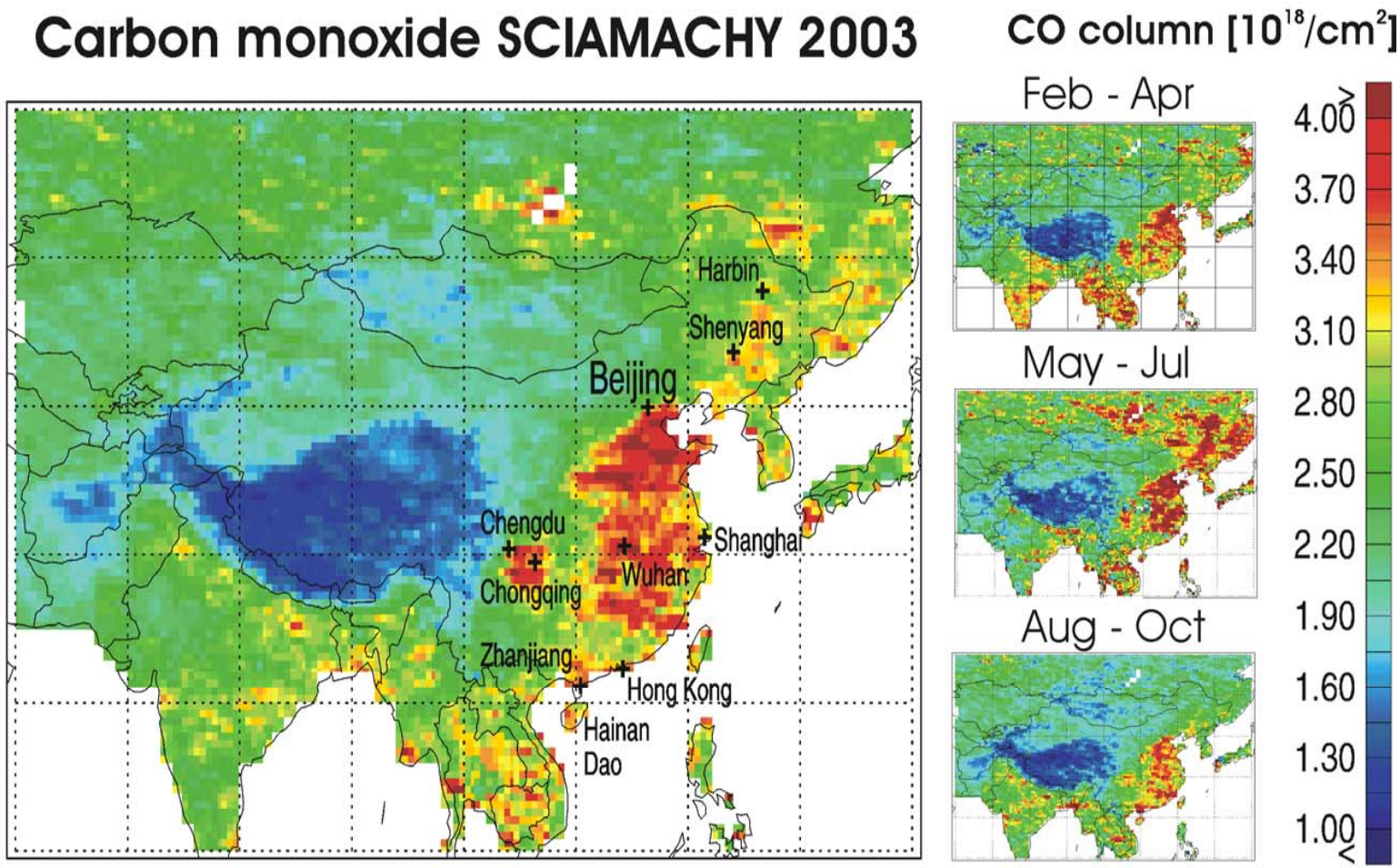
Note:

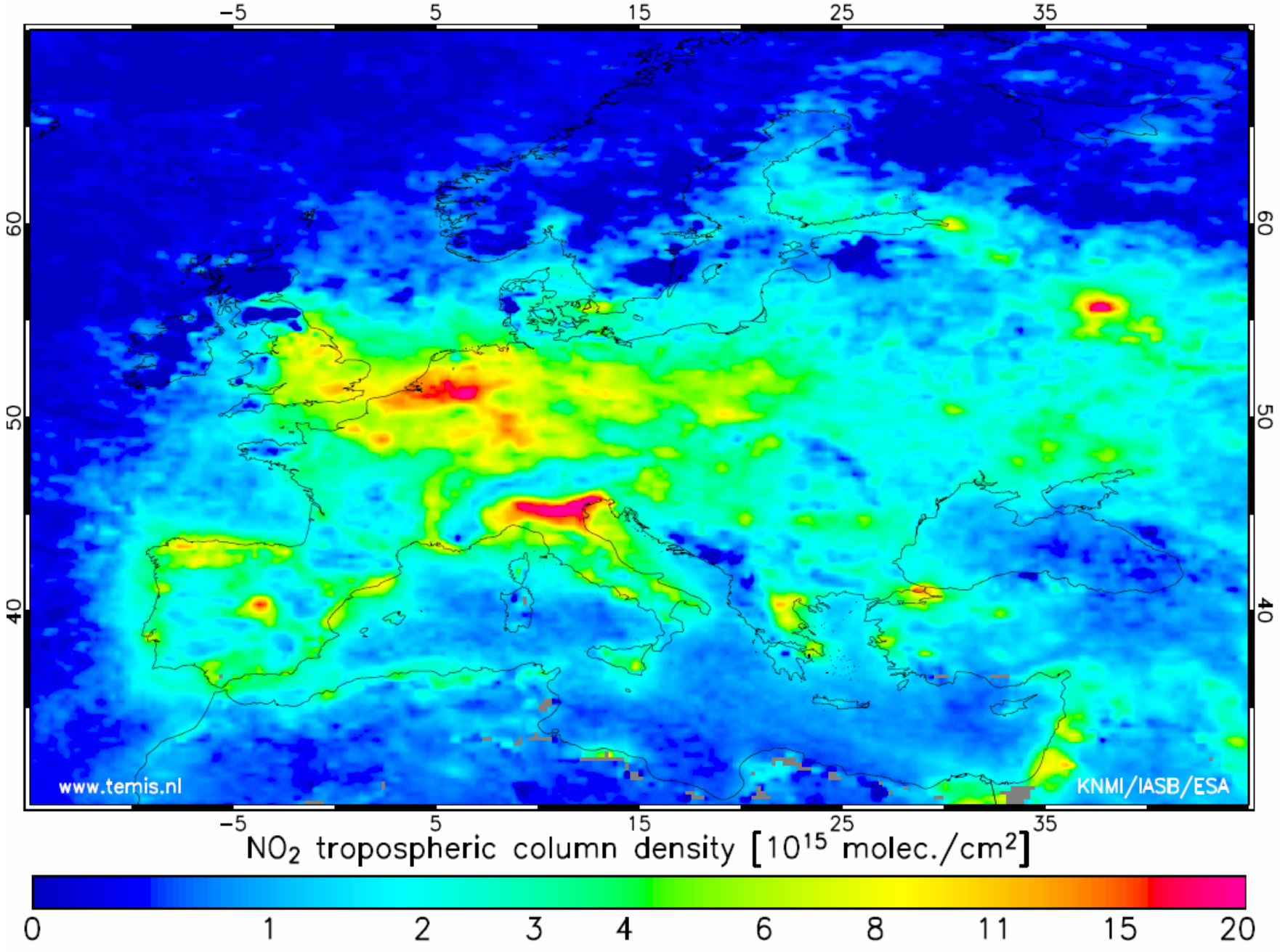
- Infrared instruments especialy sensitive to middle troposphere
- Near infrared sensitive to surface

W.W. McMillan et al, JGR 2005



Carbon monoxide, IFE Bremen

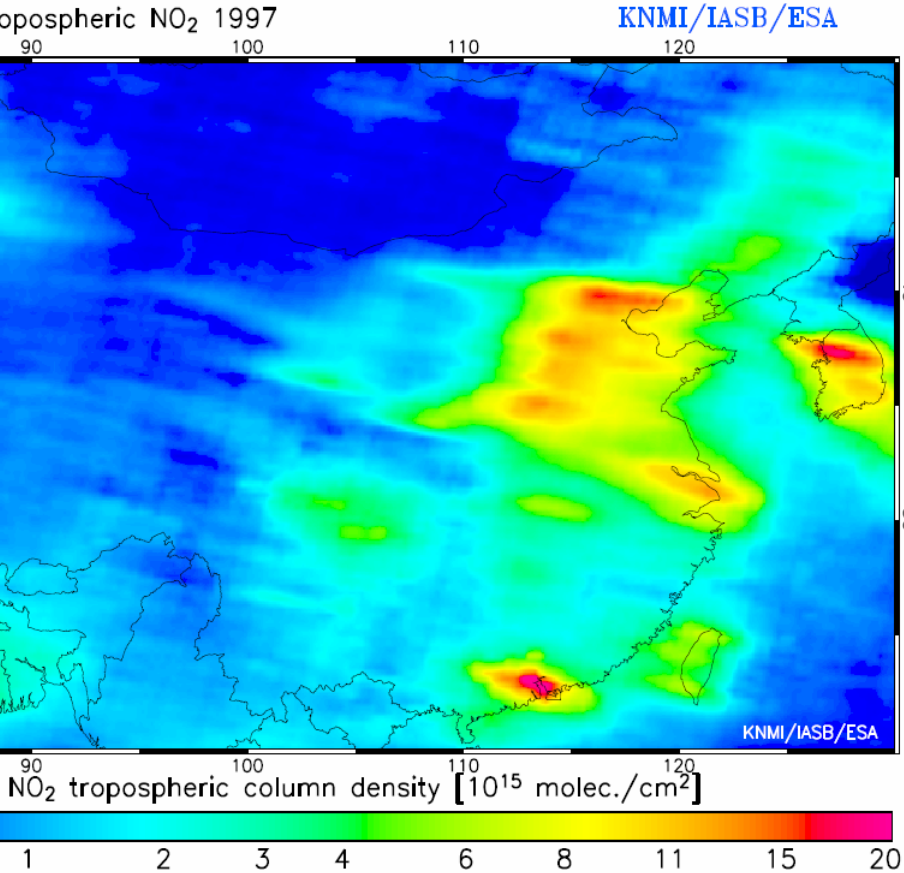



SCIAMACHY mean tropospheric NO2 2004
KNMI/IASB/ESA
−5
5
15
25
35
60
50
40
www.temis.nl
KNMI/IASB/ESA
NO2 tropospheric column density [10^15 molec./cm^2]
0
1
2
3
4
6
8
11
15
20

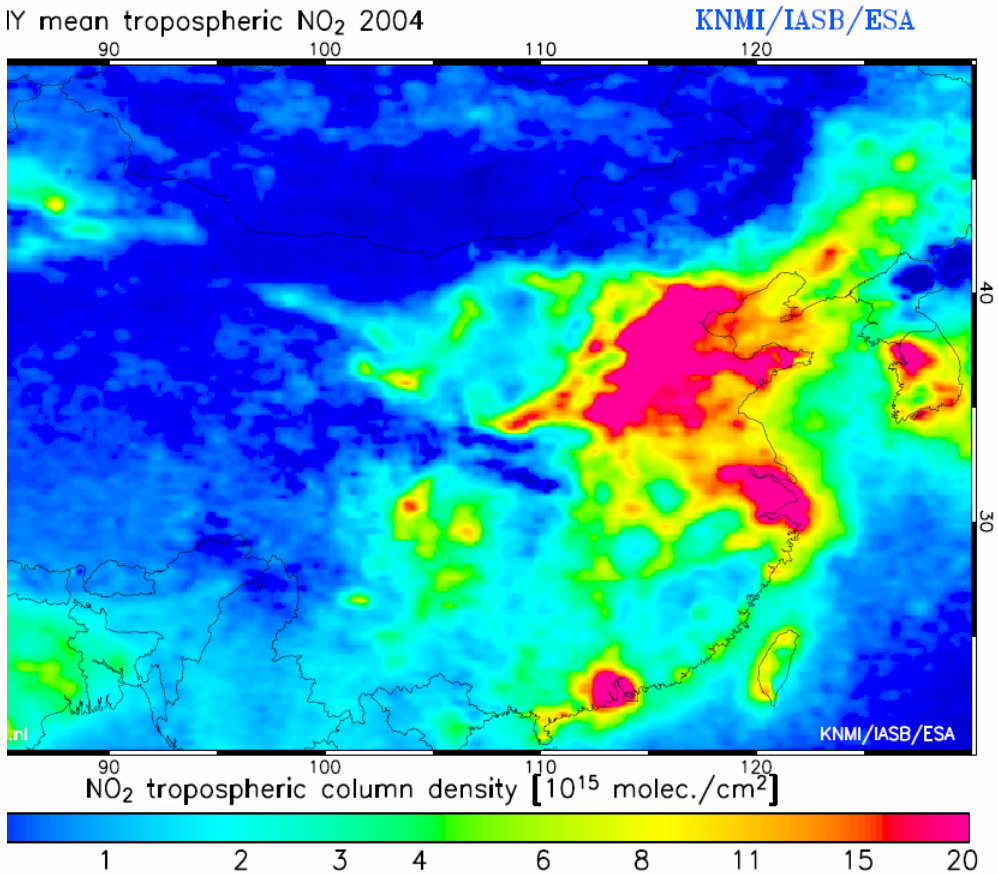
NO_2 trend over China

(A. Richter et al, Nature 437, Sep 2005)

GOME, 1997

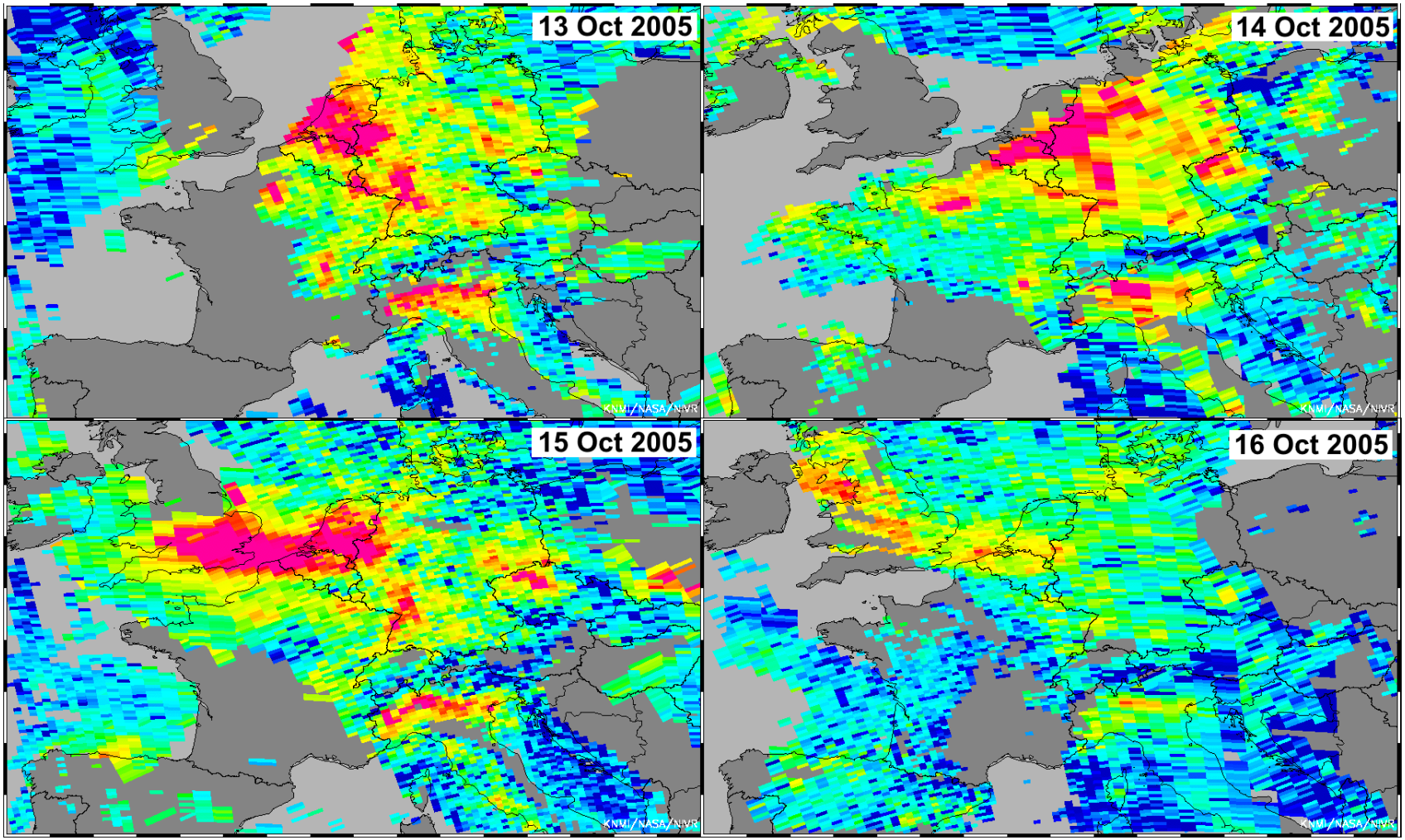


SCIA, 2004

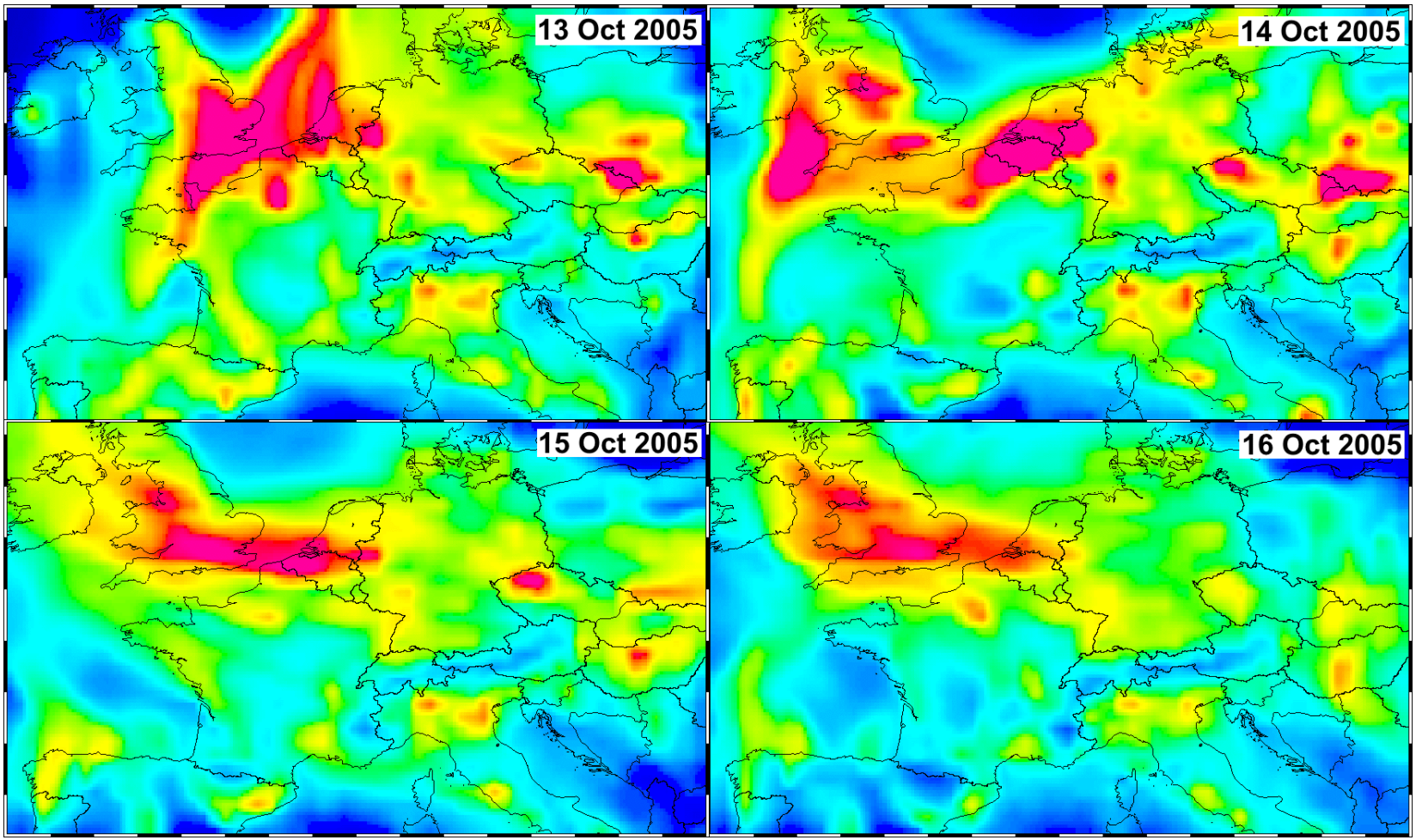


Henk Eskes, GEMS Assembly Feb 2006

OMI near-real time NO2, 13-16 October 2005



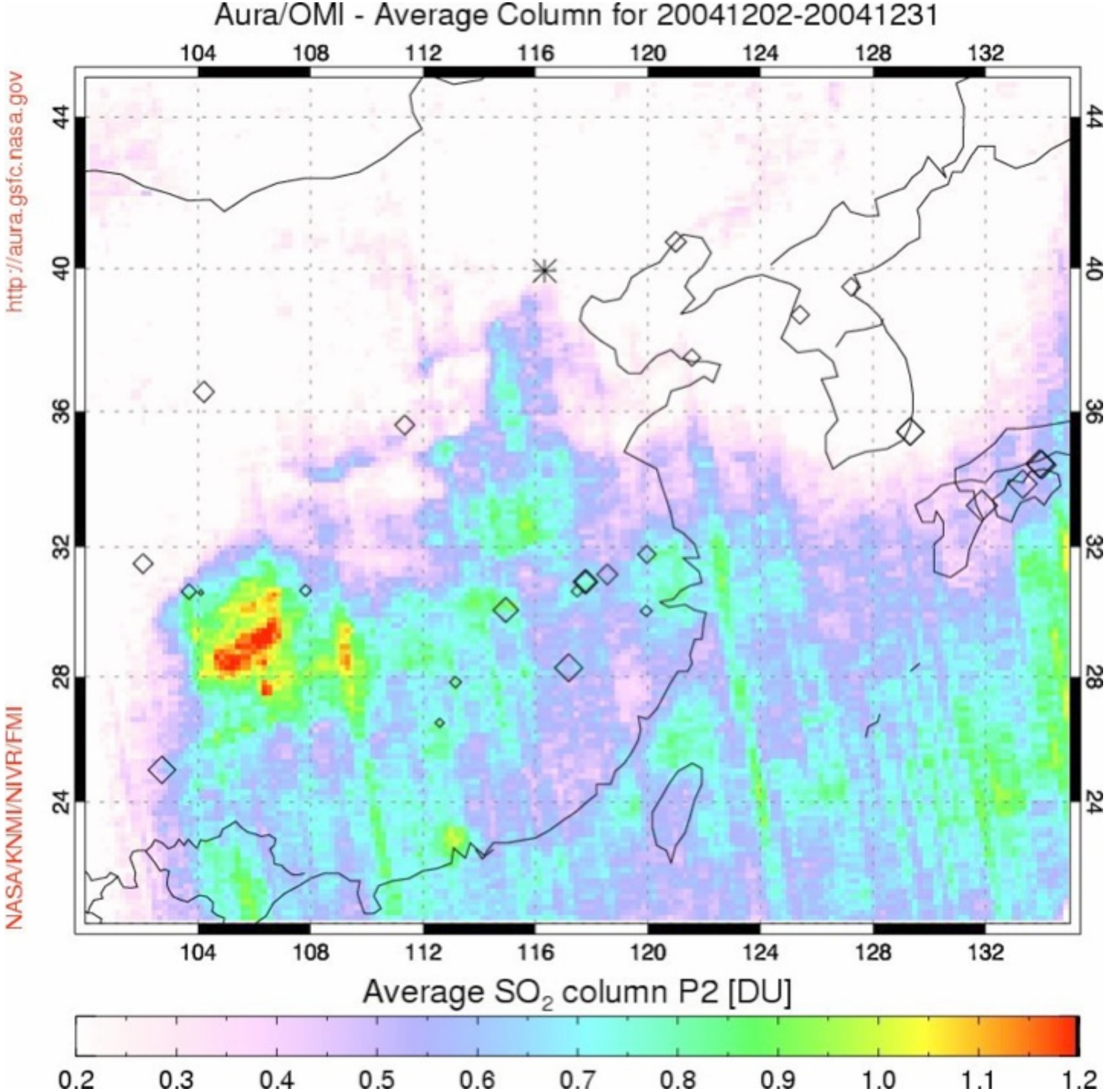
Chimere @ OMI overpass time, 13-16 Oct 2005



OMI SO_2

Source:
A. Krueger
S. Carn
(UMBC)

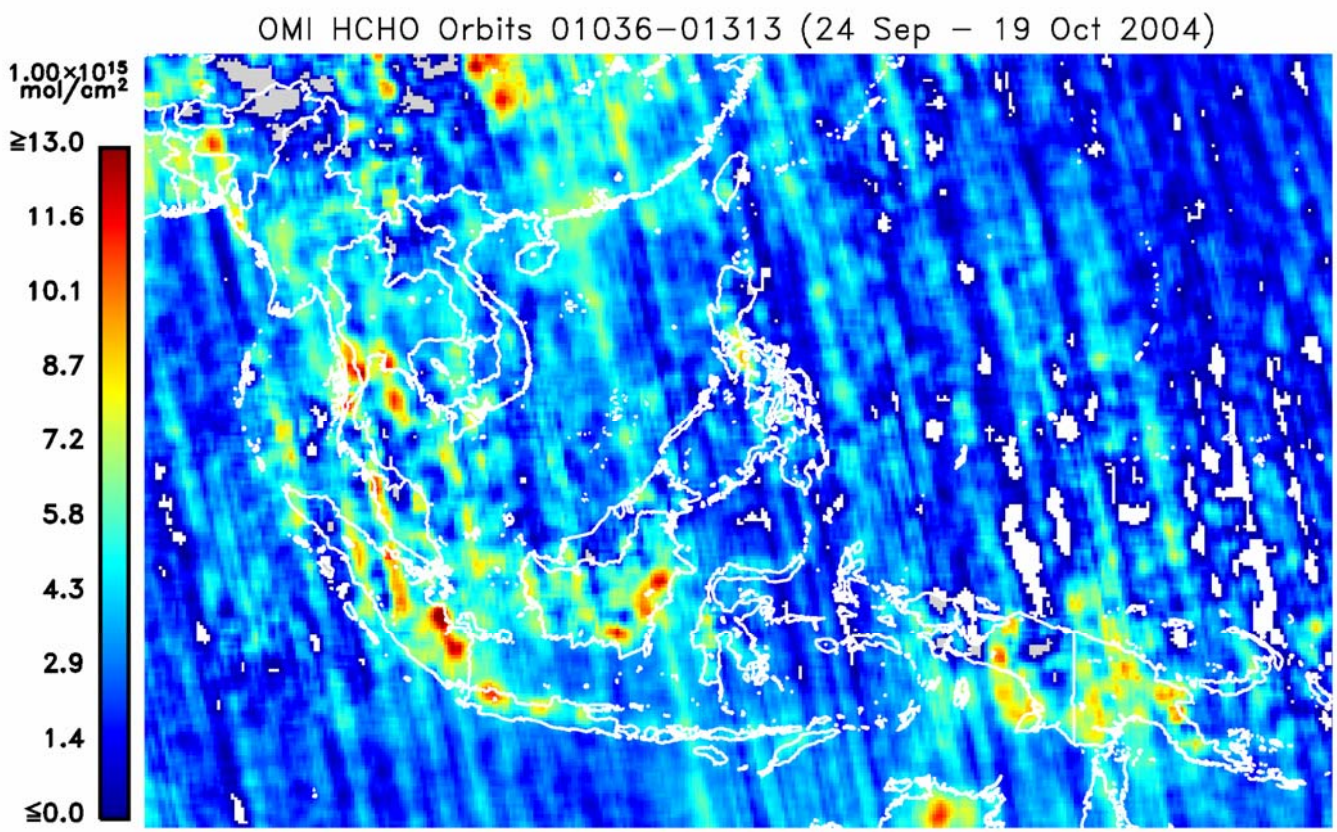
Presented at
OMI Science
Team meeting,
KNMI,
June 2005



OMI CH_2O

Source:
K. Chance
T. Koruso

Presented at
OMI Science
Team meeting,
KNMI,
June 2005



SCIAMACHY methane

SCIAMACHY

vs

TM model

C. Frankenberg
Science 308,
May 2005