

PROMOTE

Protocol Monitoring for the
GSE on Atmosphere

Project Management: KNMI

Speaker: Henk Eskes



GSE on Atmosphere

PROMOTE Mission

To deliver the Atmosphere GMES Service Element:

To construct and deliver a sustainable and reliable operational service to support informed decisions on the atmospheric policy issues of stratospheric ozone depletion, surface UV exposure, air quality and climate change.





GSE on Atmosphere

- **Anthropogenic activities have significantly altered natural chemical state of the atmosphere resulting in**
 - decrease its protective capacity
 - changes in levels of atmospheric constituents, affecting:
 - health, economy, ecosystems
 - weather and global climate
- **Policies & Initiatives**
 - International
 - Vienna Convention and Montreal Protocol
 - UN Framework Convention on Climate Change and Kyoto Protocol
 - Convention on Long-Range Transboundary Air Pollution (CLRTAP)
 - Integrated Global Atmospheric Chemistry Observation System (IGACO)
 - European
 - 6th Environmental Action Programme
 - Council Directives related to air pollutants (96/62/EC, 2002/69/EC, 1999/30/EC)



GSE: GMES Service Element

- **GMES - Global Monitoring for Environment and Security**
 - Joint ESA and EC endeavor to establish an independent capability for global monitoring in support of European environment & security goals
- **GSEs are the ESA contribution to GMES**
 - Foster use of Earth Observation, in combination with ground-based data and models, for GMES goals
 - Ensure that mature and near-mature processing systems become operational
 - Fully integrate users into processes
 - Identify requirements for future space sensor systems
- **10 GSE projects began in early 2003**
 - 0 dealing with atmosphere accepted
 - Mid-2003 ESA requested three atmosphere-related proposal teams form a single team – PROMOTE



PROMOTE

Providers

AirParif	
CERC	
DLR	
DWD	
FMI	
KNMI	
RIU	

Services

To deliver the Atmosphere GMES Service Element

To construct and deliver a sustainable and reliable operational service to support informed decisions on the atmospheric policy issues of stratospheric ozone depletion, surface UV exposure, air quality and climate change.

O3 Ozone layer:

past, present and forecast

UV Surface UV:

past, present and forecast

AQ Air Quality:

past, present and forecast

CC Greenhouse Gases:

emissions, concentrations

Users

ADEME	
INERIS	
ARPA	
BVDD	
ECMWF	
EMPA	
EPA	
JRC	
LUA	
NILU	
RIVM	
SYKE	
UBA-A	
WMO	



Consolidation Phase:
11/2005

Ozone Service

After
Consolidation
Phase

- The **Montreal Protocol** is the primary policy driver
- **Core Users: WMO, ECMWF, UV forecasters**
- **Precursor systems include existing TOMS, GOME, GOMOS, MIPAS and SCIAMACHY processing services**
- **PROMOTE aims**
 - A continuous global daily ozone record (1979-present) by means of data assimilation needed for ozone assessments
 - Daily forecast ozone values based on assimilated data (SCIAMACHY and OMI)

- **Expand Service Portfolio**
 - utilise data from upcoming missions (GOME-2)
 - move from total ozone fields to ozone profiles
 - increase the role of data assimilation
- **Service Sustainability**
 - Input of level2 data from EUMETSAT Ozone Monitoring Satellite Application Facility (O3MSAF)



Ozone Service

www.gse-promote.org



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Ozone

UV

Air Quality

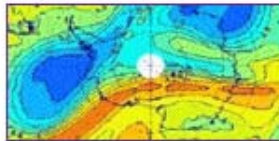
Climate



Ozone

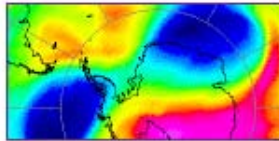
PROMOTE contains the ozone services listed here:

Ozone monitoring services



GOMOS ozone profile record

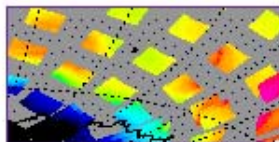
ACRI-ST.



GOME and SCIAMACHY assimilated total ozone record, 1995-2004

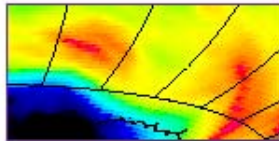
KNMI.

Ozone forecast services



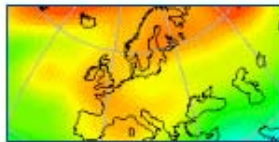
SCIAMACHY near-real-time total ozone

Operational scientific total ozone retrieval product, KNMI.



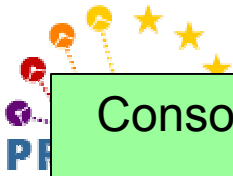
Total ozone forecasts based on SCIAMACHY

Ozone data assimilation analyses and forecasts, KNMI.



3D MIPAS ozone analysis

Assimilation with the 3D CTM DLR-ROSE, DLR.



Consolidation Phase:
11/2005

Surface UV Radiation

After
Consolidation
Phase

- **The Montreal Protocol and UNCED Agenda 21 are the primary policy drivers**
- **Core Users: RIVM, SYKE, BVDD**
- **Precursor systems to be utilised**
 - National UV estimation and forecasting systems
- **PROMOTE aims**
 - Accurate long-term time series of surface UV (1979-present)
 - Accurate daily surface UV index & dose estimates & forecasts based on new sensors

- **Expand Service Portfolio**
 - Improve current products
 - updates of Ozone Service
 - include characteristics affecting UV doses such as clouds, aerosols, snow and ice surfaces
 - Customised service to users
 - offer in native languages
 - regional characteristics
- **Increase user base**
 - more health users such as dermatologists and WHO
 - more commercial users
- **Service Sustainability**
 - O3SAF level 2 input data



Surface UV Radiation

www.gse-promote.org



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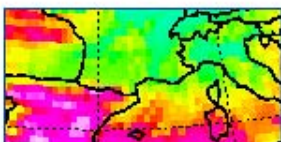
Climate



UV services

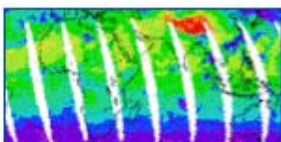
PROMOTE consists of the UV services listed here:

UV monitoring services



UV monitoring service

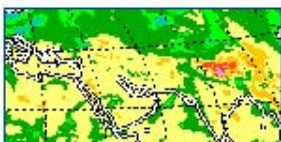
provided by KNMI, The Netherlands.



UV record

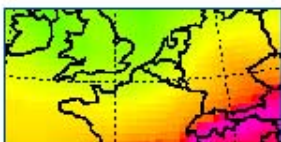
provided by FMI, Finland.

UV forecast services



Forecasts of UV Index and dose, cloudy and clear sky

provided by DWD, Germany.



Forecasts of UV index

from SCIAMACHY provided by KNMI, The Netherlands.



UV-Check service

provided by DLR, Germany.



Consolidation Phase:
11/2005

Air Quality (AQ)

After
Consolidation
Phase

- **Several EU directives & CLRTAP are primary policy drivers**
- **Core Users: JRC, NILU, EPA, ADEME, UBA-A, EMPA, ARPA, LUA, AirParif, RIVM, INERIS**
- **Precursor systems**
 - GOME, SCIAMACHY, AATSR, ATSR-2 processing systems developed under ESA DUE and EC RTD programmes
 - EURAD, CHIMERE/MOCAGE, ADMS-Urban AQ models
- **PROMOTE aims**
 - Tropospheric aerosol and chemical concentrations derived from satellite data for monitoring purposes
 - Near-surface estimates & forecasts of pollutant concentrations based on assimilated satellite & ground data

- **Service portfolio expansion**
 - Expand forecasts to Northern Hemisphere
 - High resolution forecast in more regions and in more European cities
 - Use improved assimilation schemes as they become available
 - Develop new products in response to epidemiological and health care community needs
- **User Base Expansion and service sustainability**
 - Direct involvement of EEA
 - More national, regional, and local environmental agencies
 - Begin to target urban planners, health organisations, and general public



Air Quality (AQ)

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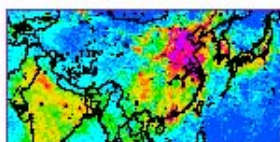
UV

Air Quality

Climate



Air quality monitoring services



Global NO₂ monitoring by GOME and SCIAMACHY

KNMI & BIRA-IASB.



Global SO₂ monitoring by GOME and SCIAMACHY

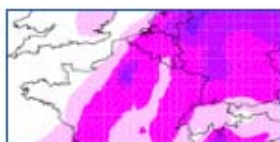
BIRA-IASB.



Air quality data base for Europe, Germany and Northrhine-Westfalia

RIU, University of Cologne, Germany.

Air quality forecast services



Air quality forecast for France and Europe

Prev'Air, France.



Air quality forecast for Europe, Germany and Northrhine-Westfalia

RIU, University of Cologne, Germany.



Air quality forecast of central London

CERC, UK.



AERES air-quality forecasts for South-East France



Consolidation Phase:
11/2005

Climate Change

After
Consolidation
Phase

- The **Kyoto Protocol** is the primary policy driver
- Core Users: JRC-IES, NILU, EPA, UBA-A
- Development work under EC RTD project **EVERGREEN**
- **PROMOTE aim**
 - In dialog with users define requirements for a **future operational service** to provide greenhouse gas concentrations and emissions

- **Future service expansion**
 - Provide assimilated CO₂, CH₄ and CO concentration distributions derived from satellite measurements
 - Derive emissions (CH₄) by inverse modelling
- **Sustainability issue**
 - Data products based on ENVISAT (SCIAMACHY) for which there are no long-term continuity plans



PROMOTE Summary

- **PROMOTE is the only GSE dealing with the Atmosphere**
 - Utilising multiple EO sensors, in conjunction with ground-based observations, in concert with models -----> **IGACO Strategy**
- **Extensive utilisation and contacts with EC RTD and ESA DUP/DUE projects**
- **PROMOTE runs from April 2004 - November 2005**
- **During this Consolidation Phase, PROMOTE will**
 - Define a Service related to Climate Change
 - Demonstrate Air Quality Service
 - Deliver Ozone and UV Services



www.gse-promote.org



GEMS

GEMS IP (EU - GMES)

Global and regional Earth-system Monitoring using Satellite and in-situ data

The GEMS project will create a new European system for operational global monitoring of atmospheric chemistry and dynamics and an operational system to produce improved medium-range & short-range air-chemistry forecasts, through much improved exploitation of satellite data.



GEMS

GEMS subprojects:

- 1 Greenhouse gases
- 2 Reactive gases
- 3 Aerosols
- 4 Regional air quality
- 5 Overall validation

Status:

GEMS description of work and CPF sent to EU

Anticipated starting date: early 2005; 4-year project



GEMS and relation with PROMOTE

From GEMS Description of Work:

The GEMS project is establishing a close collaboration and **working relationship** with the ESA-funded GMES Service Element (GSE) project PROMOTE (PROtocol MOniToring for the GMES Service Element on Atmospheric Composition). **GEMS will build the infrastructure to generate atmospheric composition analysis** based on all available observational data sets. PROMOTE will provide services on ozone monitoring and forecasts, UV monitoring and forecast, air pollution monitoring and forecast, and Climate Change monitoring and emissions. **PROMOTE will build strong links with users** of such data sets and will provide a service for access to these data sets. The PROMOTE service will be based on research and development work funded by e.g. the EC Research and Technology Development programme, and will benefit directly from the atmospheric analyses provided by GEMS. The collaboration with the ESA GSE through PROMOTE will extend the use of the analyses produced by GEMS and will provide additional contacts with the user community consisting of public authorities, governmental agencies, scientists and the general public. The partnership between GEMS and PROMOTE will be formalised in a common memorandum of understanding, to be written in the first months of the GEMS project.



GEMS and relation with PROMOTE

From GEMS Description of Work:

The partnership between GEMS and PROMOTE will be formalised in a common **memorandum of understanding**, to be written in the first months of the GEMS project. This memorandum will specify the co-operation, taking account of the tasks of the two projects and the phasing of activities. Regular meetings will be held between the GEMS and PROMOTE management teams during the course of both projects.



GEMS and relation with PROMOTE

From GEMS Description of Work:

During phase 1 of GEMS, the partnership with PROMOTE will probably include activities such:

- Definition of user requirements and user segment for GEMS based on the PROMOTE user services.**
- Coordination of activities to avoid duplication (several partners of GEMS are also involved in PROMOTE).**
- Delivery of PROMOTE (scientific) level-2 products for GEMS use; joint intercomparisons of assimilated GEMS and PROMOTE products .**
- Definition of follow-on activities (post-2005) for GSE-PROMOTE on the basis of development work in GEMS. Such a PROMOTE follow-on project will use the GEMS analyses to provide added-value products to satisfy the user needs.**



EVERGREEN

EnVisat for Environmental Regulation of GREENhouse gases

- **EC 5th framework programme**
- **Feb. 2003 – Feb. 2006**
- **Objective:** use ENVISAT (SCIAMACHY and MIPAS) measurements for inverse modelling of GHG emissions
- **Partners:**
KNMI (NL, co-ordinator), Univ. Bremen (DE), Univ. Leicester (GB), Univ. Heidelberg (DE), NILU (NO), SRON (NL), MPI-BGC (DE), BIRA-IASB (BE), UPMC-SA (FR), RWE-Rheinbraun (DE), Univ. Liège (BE), EC-JRC-IES (IT)
- **Website:** <http://www.knmi.nl/evergreen>

(presentation by Jan Fokke Meirink, KNMI)



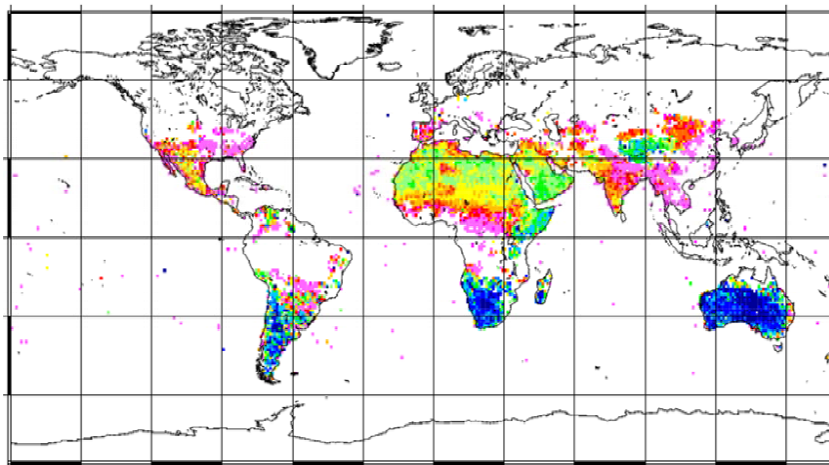
EVERGREEN: tasks

- **Retrieval and validation:**
CH₄, CO, (CO₂), O₂ columns, clouds
- **Radiation budget modelling:**
use of measured trace gas distributions in radiative forcing calculations
- **(Inverse) modelling:**
CH₄, CO, CO₂
 - emission inventory
 - model intercomparison (²²²Rn, SF₆, ...)
 - inverse modelling

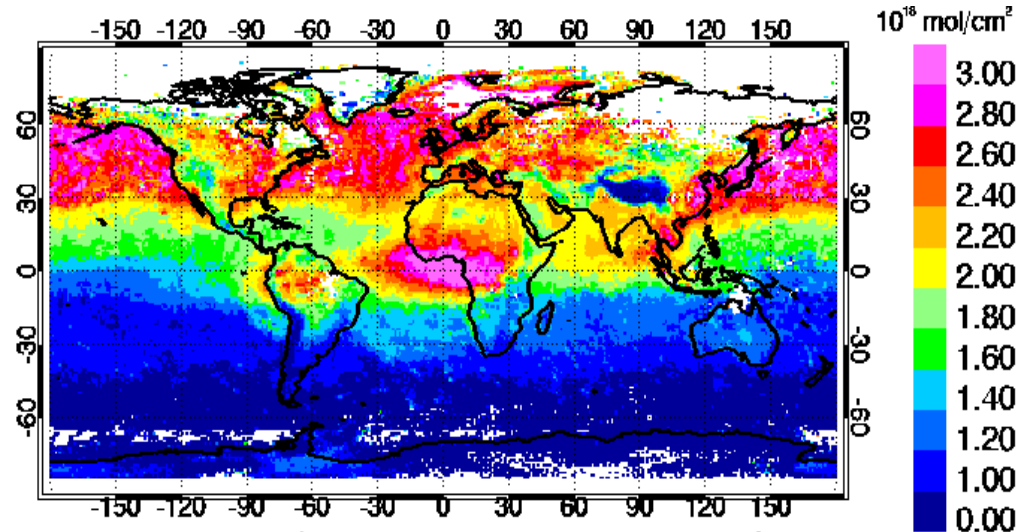


EVERGREEN

CO: SCIAMACHY vs. MOPITT



SRON IMLM algorithm, H. Schrijver 2004



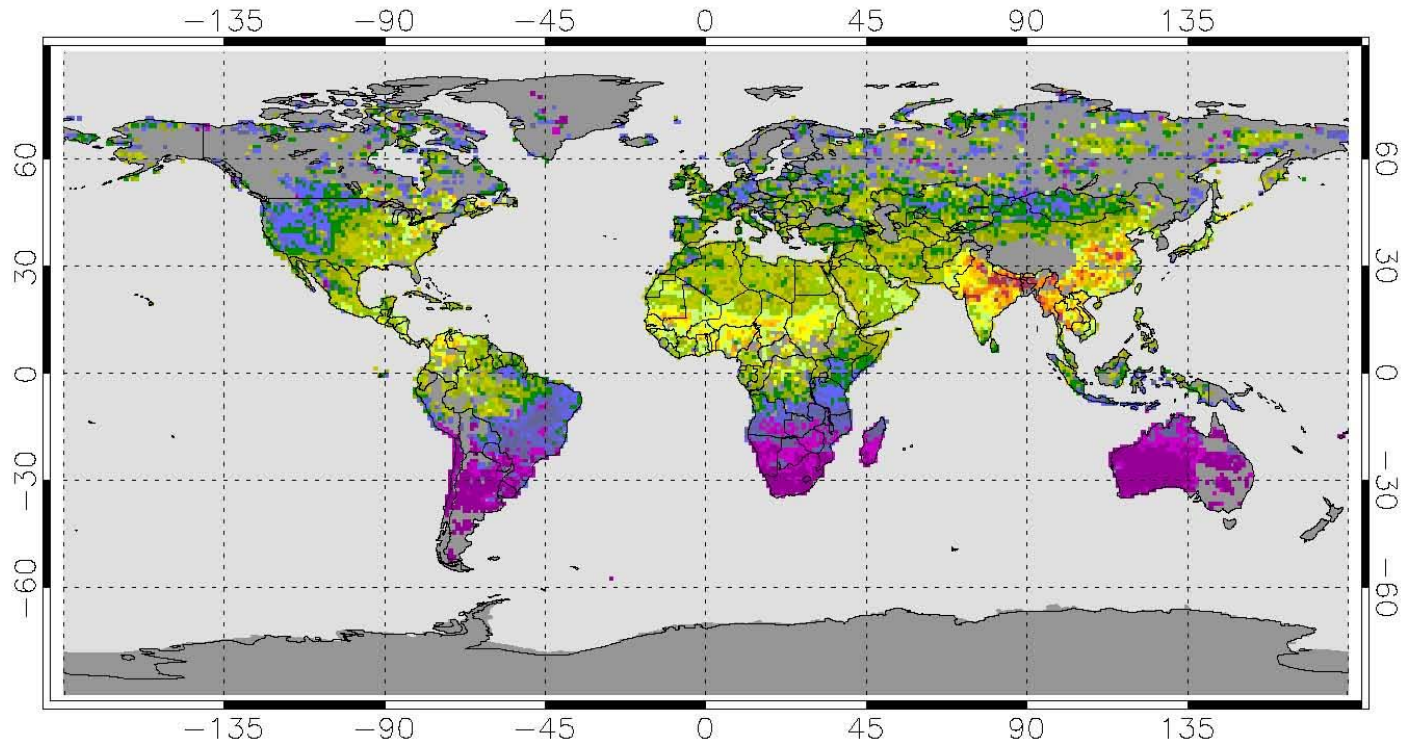
Downloaded from: www.eos.ucar.edu/mopitt/

February 2004

- **Large-scale features in good agreement**
- **Differences**
 - cloud masking
 - sensitivity to the lower troposphere



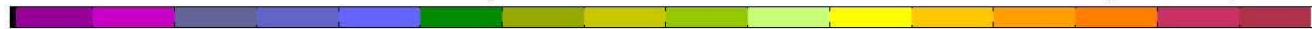
EVERGREEN CH₄ from SCIAMACHY



C. Frankenberg, Univ. Heidelberg

Aug-Oct 2003

CH₄ vertical column density 08–10 2003 scaled with CO₂ [molec/cm²]

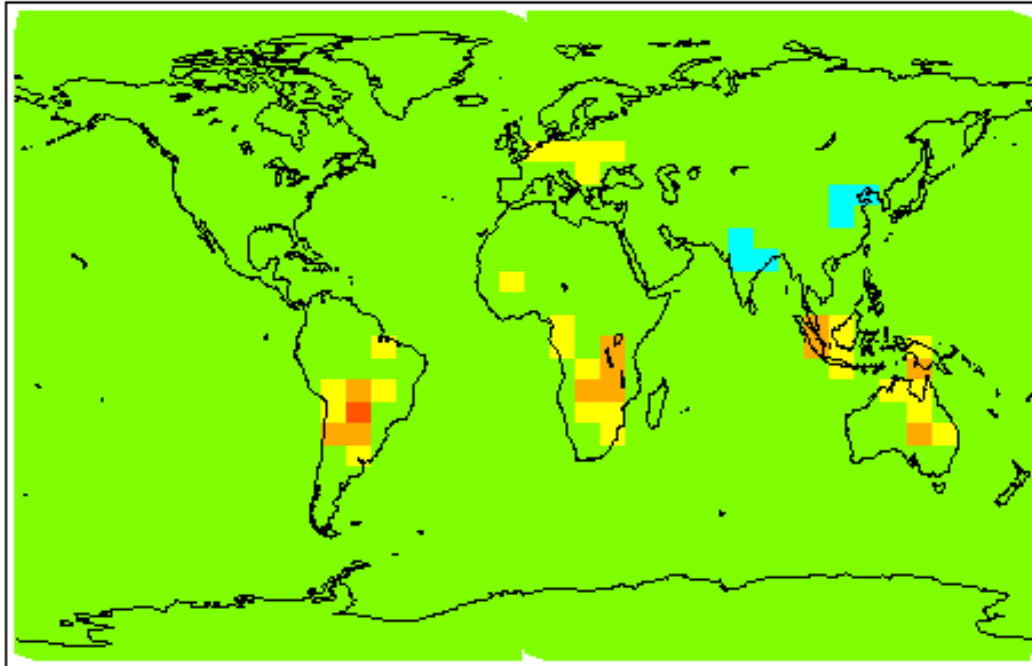


3.70e+19 3.75e+19 3.80e+19 3.85e+19 3.90e+19 3.95e+19 4.00e+19 4.05e+19 4.10e+19



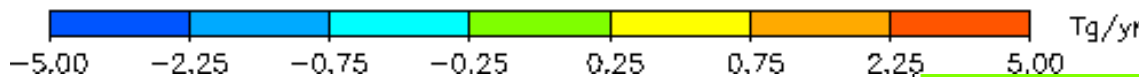
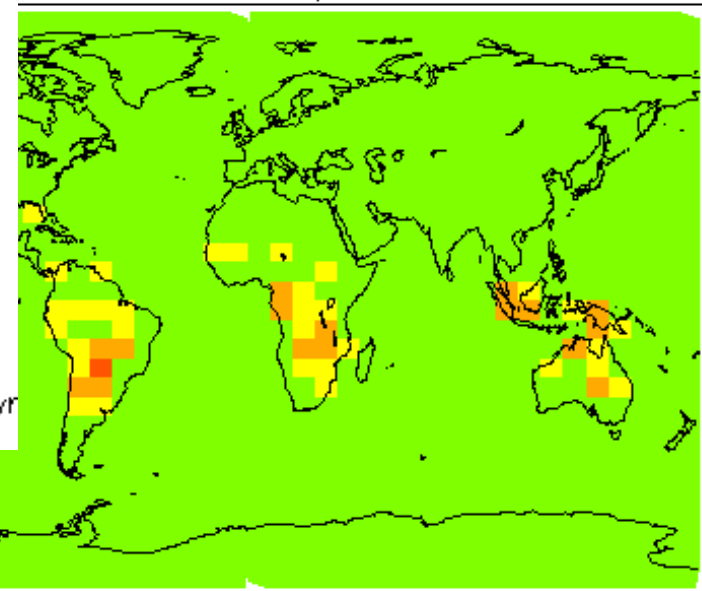
EVERGREEN - Inverse modelling CH₄ OSSE

A posteriori minus a priori, run: 14347



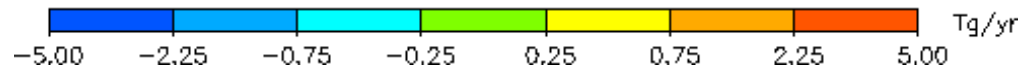
- Cloud free and cloudy pixels

Truth minus a priori



March 2004

Δx : +30% wetland emissions





Backup slides

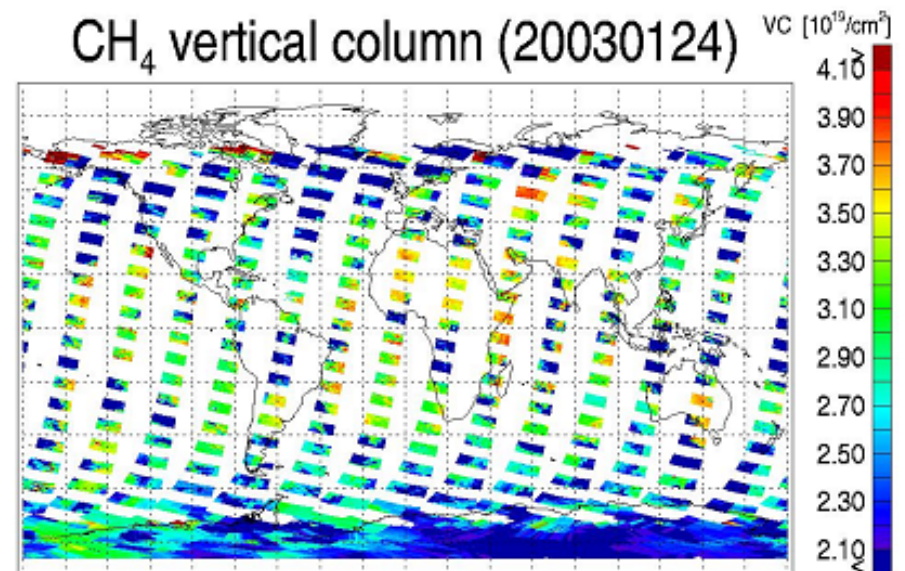


Initial PROMOTE Approach

- **4 themes selected**
based on identifiable user requirements *and* maturity or promise of satellite and ground-based observations
 - Stratospheric Ozone
 - Surface UV Radiation
 - Air Quality
 - Climate Change
- **Based extensively on precursor systems and several past, current, and future EC RTD and GMES projects**
- **Consortium**
 - 34 partners from 11 European countries
 - 15 Core users

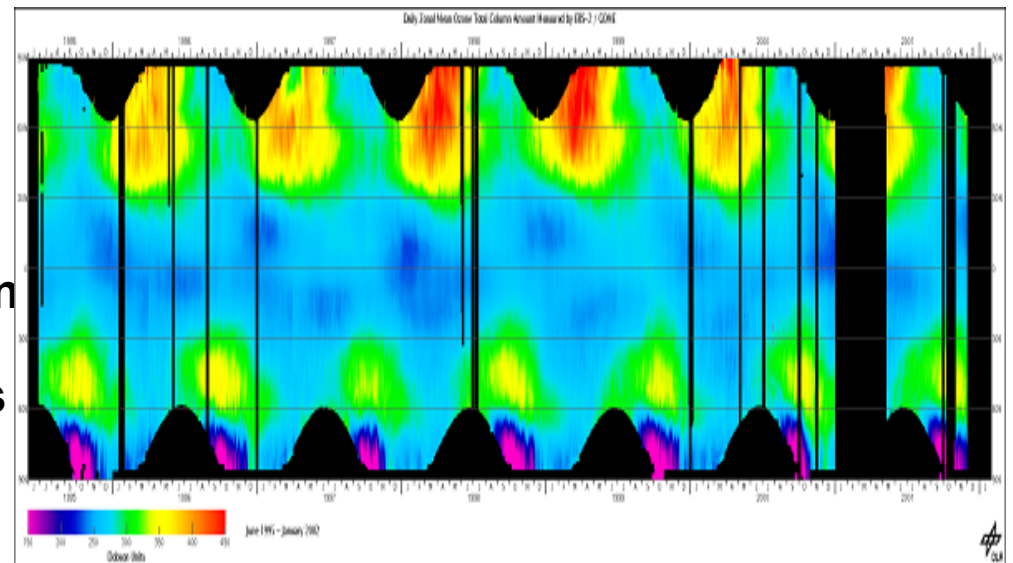
Climate Change

- The **Kyoto Protocol** is the primary policy driver
- Core Users: JRC-IES, NILU, EPA, UBA-A
- Development work under EC RTD project EVERGREEN
- PROMOTE aim
 - In dialog with Users define requirements for a future operational service to provide greenhouse gas concentrations and emissions



Ozone Service

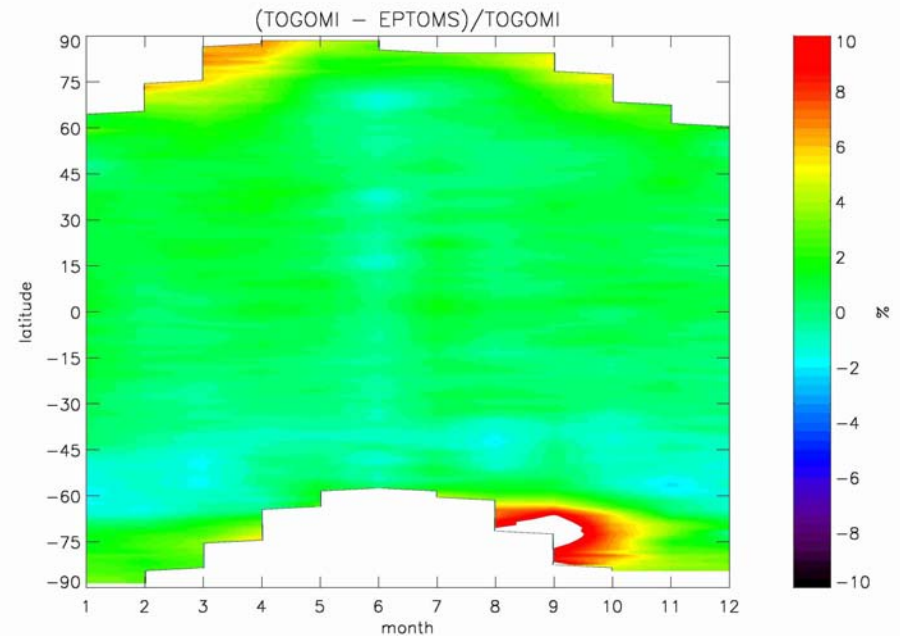
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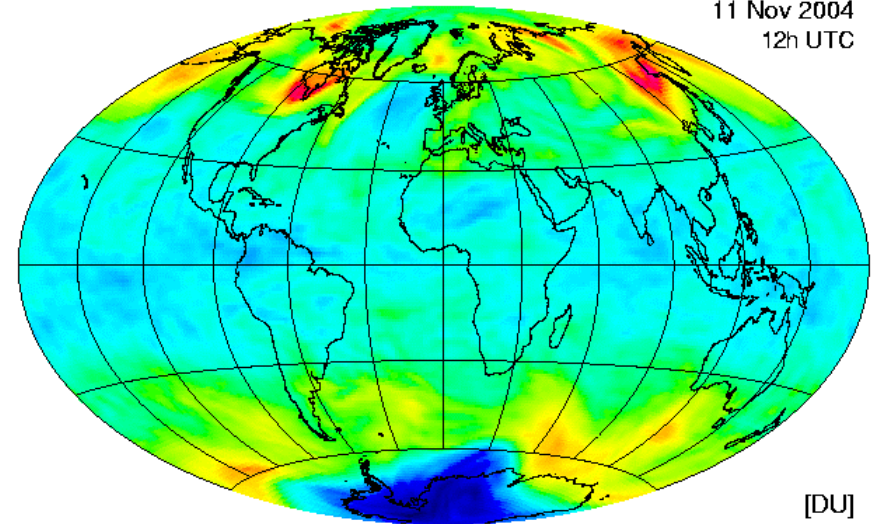
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KNMI / ESA

Forecast SCIA assimilated total ozone
11 Nov 2004
12h UTC



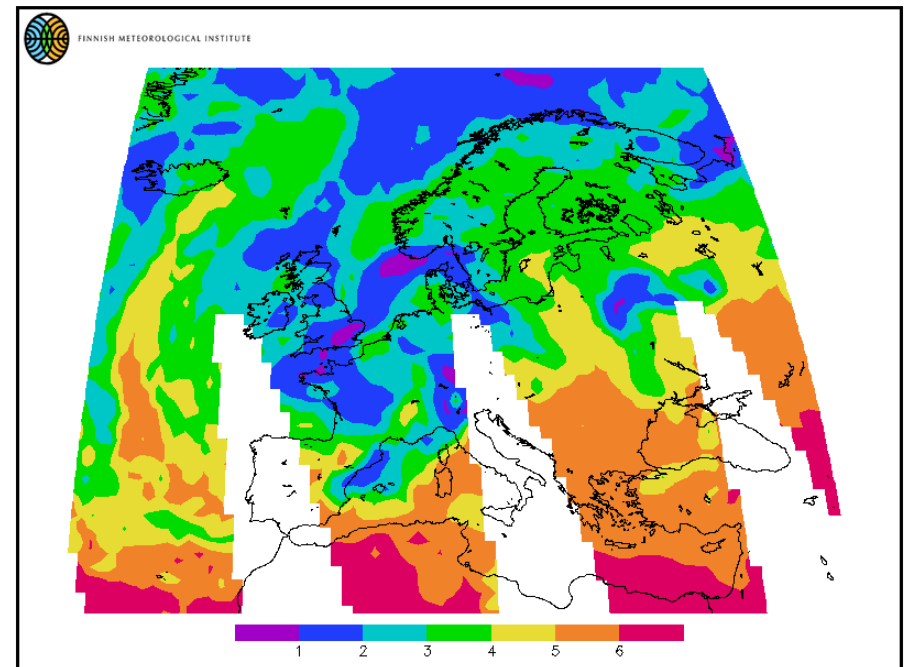
150 175 200 225 250 275 300 325 350 375 400 425 450 475 500

Surface UV Radiation

- The **Montreal Protocol** and **UNCED Agenda 21** are the primary policy drivers
- Core Users: RIVM, SYKE, MétéoFrance, BVDD
- Precursor systems to be utilised
 - National UV estimation and forecasting systems
- PROMOTE aims
 - Accurate long-term time series of surface UV (1979-present)

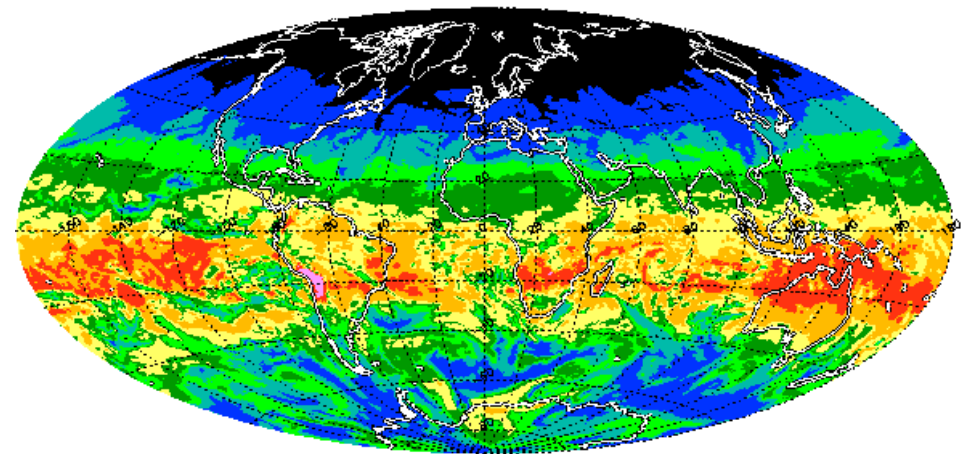
Cloud Corrected Daily Erythemal Dose (kJ/m²) on 1997-6-27

PROMOTE UV Record / Production date 2004-08-12
TOMS V8 Total Ozone data / TOMSUVFMI-0.94 Algorithm



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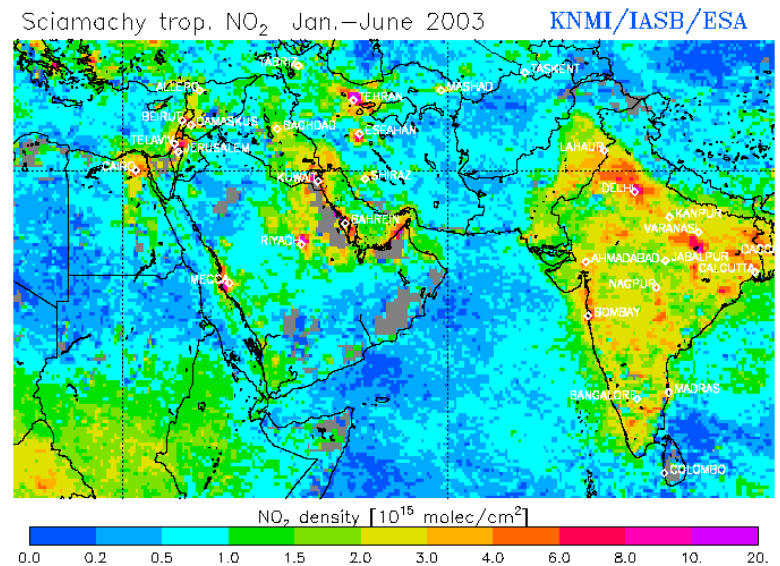
0 0.25 1.25 2.50 3.75 5.00 6.25 7.50 8.75 kJ/m²

Erythemal effective UV dose cloudy, 11.11.04 00:00 UTC period= +36 h



Air Quality (AQ)

- Several **EU directives** & **CLRTAP** are primary policy drivers
- **Core Users: JRC, NILU, EPA, ADEME, UBA-A, EMPA, ARPA, LUA**
- **Precursor systems**
 - GOME, SCIAMACHY, AATSR, ATSR-2 processing systems developed under ESA DUE and EC RTD programmes
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- **PROMOTE aims**
 - Tropospheric aerosol and chemical concentrations derived from satellite data for monitoring purposes





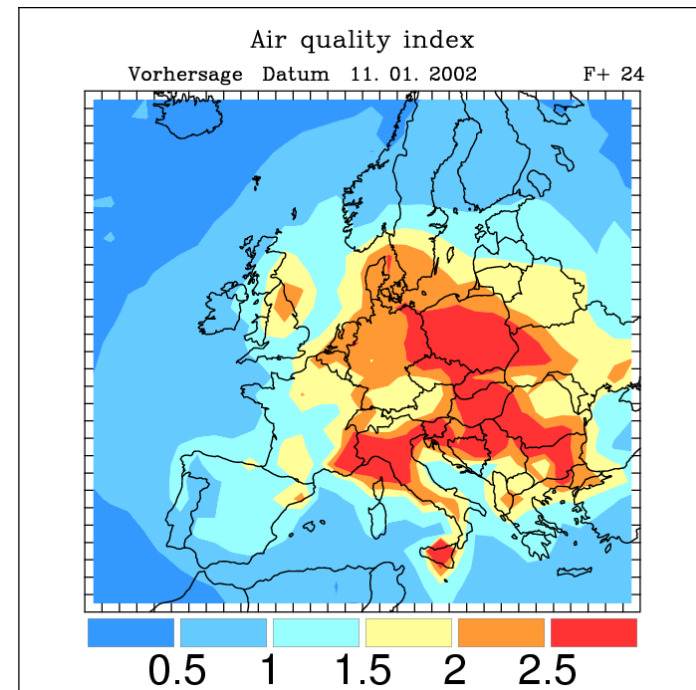
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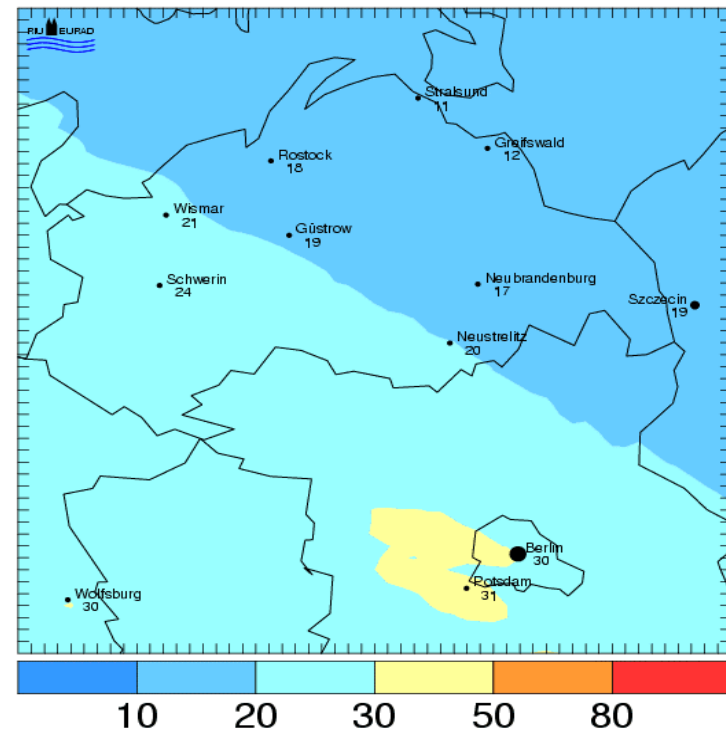
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Luft Qualitäts Index

Level 1

01.04.2004 24 UTC 24h Mittelw.



VISAO



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