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.
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
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
Ozone Service

Consolidation Phase: 11/2005

- 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)

After Consolidation Phase

- **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

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.
Surface UV Radiation

- The Montreal Protocol and UNCED Agenda 21 are the primary policy drivers

- Core Users: RIVM, SYKE, BVDD
  - 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

Consolidation Phase: 11/2005

After Consolidation Phase

- 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

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.

[www.gse-promote.org](http://www.gse-promote.org)
Air Quality (AQ)

Consolidation Phase: 11/2005

• 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

After Consolidation Phase

• 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)

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

www.gse-promote.org
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 CO\textsubscript{2}, CH\textsubscript{4} and CO concentration distributions derived from satellite measurements
- Derive emissions (CH\textsubscript{4}) by inverse modelling

Sustainability issue
- Data products based on ENVISAT (SCIAMACHY) for which there are no long-term continuity plans

Consolidation Phase: 11/2005
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 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
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.
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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**
- **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](http://www.knmi.nl/evergreen)

(presentation by Jan Fokke Meirink, KNMI)
EVERGREEN: tasks

• Retrieval and validation:
  \( \text{CH}_4, \text{CO}, \text{(CO}_2\text{)}, \text{O}_2 \text{ columns, clouds} \)

• Radiation budget modelling:
  use of measured trace gas distributions in radiative forcing calculations

• (Inverse) modelling:
  \( \text{CH}_4, \text{CO}, \text{CO}_2 \)
  • emission inventory
  • model intercomparison (\(^{222}\text{Rn}, \text{SF}_6, \ldots\))
  • inverse modelling
EVERGREEN
CO: SCIAMACHY vs. MOPITT

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

SRON IMLM algorithm, H. Schrijver 2004

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

February 2004
EVERGREEN
CH$_4$ from SCIAMACHY

C. Frankenberg, Univ. Heidelberg

Aug-Oct 2003

CH$_4$ vertical column density 08-10 2003 scaled with CO$_2$ [molec/cm$^2$]

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
CH$_4$ OSSE

A posteriori minus a priori, run: 14347

March 2004

$\Delta x$: +30% wetland emissions

• Cloud free and coudy pixels

Truth minus a priori
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
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- PROMOTE aims
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Cloud Corrected Daily Erythema Radiation (kJ/m2) on 1997–6–27
PROMOTE UV Record / Production date 2004–08–12
TOMS V8 Total Ozone data / TOMS/UVFM1~0.94 Algorithm
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