Research Goals of GEMS:
*Global **E**arth-system **M**onitoring using **S**pace and in-situ data*

Greenhouse Gases	P.Ciais, (IGCO, LSCE), P.Cox
Reactive Gases	G.Brasseur, M.Schultz (MPI_M),
	C.Granier (SA/UPMC)
Aerosol	O.Boucher (CNRS, LOA), J.Langen (IGACO, ESTEC),
Regional Air Quality	V-H.Peuch (Meteo.Fr),
Validation	H.Eskes (KNMI)
Production System	A.Hollingsworth, A.Simmons, J-N Thepaut,
`	R Engelen, A Dethof (ECMWF),
	+ many more....

GEMS Objectives

- By 2008 build an operational global integrated variational forecast / assimilation / monitoring capability for
  - greenhouse gases,
  - reactive gases
  - aerosols.
- Build sophisticated variational inversion methods to infer surface fluxes of CO_2 and other species on a routine monthly basis
- Global retrospective (EOS/ ENVISAT)analyses of atmospheric dynamics and composition for the troposphere & stratosphere
- The global forecasts will provide key information on long-range transport of air pollutants to regional forecast models, through the forecast boundary conditions used by the regional systems.
- The improved regional forecasts will be used by air-quality authorities at city level, in dozens of cities across Europe.

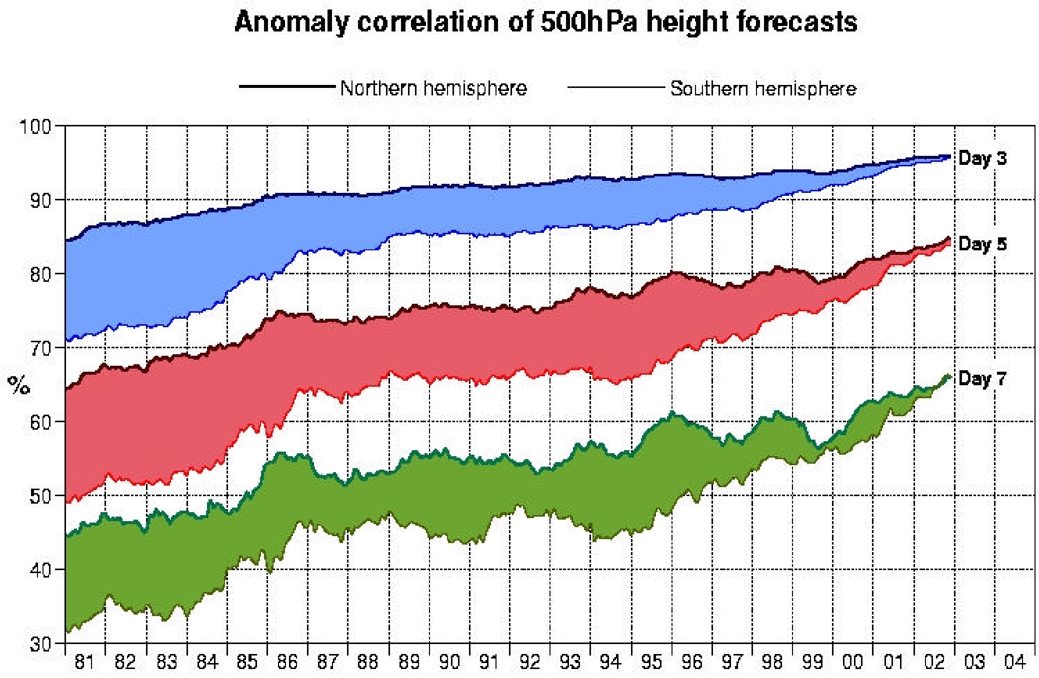
Demands for estimates of sources /sinks / transport of atmospheric constituents

- **Policy Needs: Assessment, Validation of treaties**
  - **Convention on Long-Range Transport of Air Pollutants**
  - **Montreal Protocol**
  - **UNFCCC- Kyoto Protocol / carbon trading ….**
- **Operational Needs**
  - **Air quality forecasts**
  - **Chemical Weather Forecasts**
- **Scientific Needs**
  - **IPCC**
  - **WMO / Global Atmospheric Watch**
  - **World Climate research programme**
  - **IGBP**

Environmental Concerns have triggered $25B for New satellite missions in 2001-2007

N.America	Europe / Collabs.	Asia / Collabs.
	JASON-1	
TERRA	ENVISAT	ADEOS-II
AQUA	MSG	GPM
SSMI/S	GOCE	COSMIC
AURA	CRYOSAT	
CALIPSO	METOP	
CLOUDSAT	ADM	
OCO		
HYDROS	SMOS	
GIFTS		

Evolution of forecast skill for northern and southern hemispheres 1981-2002



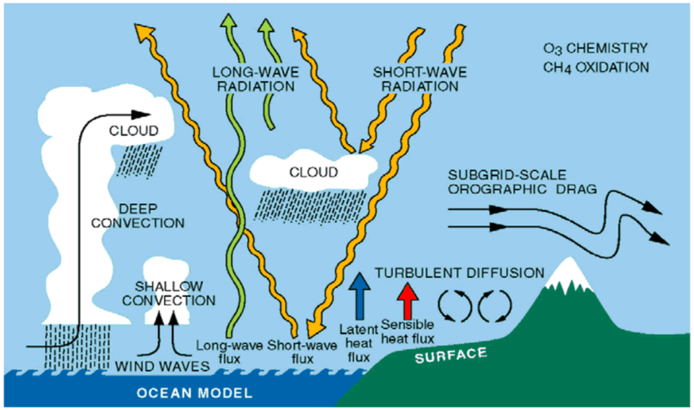
The ECMWF Earth-system model used for Numerical Weather Prediction

High-resolution model

- T_L511 spectral resolution
- N256 reduced Gaussian grid (40 km in the mid-latitudes)
- 60 hybrid vertical levels from the surface to about 65km
- Parametrized physical processes
- GEMS will develop and validate extensive new modelling capabilities

ECMWF MODEL / ASSIMILATION SYSTEM

ATMOSPHERE	STRATOSPHERE	DYNAMICS–RADIATION–SIMPLIFIED CHEMISTRY		
	TROPOSPHERE	DYNAMICS–RADIATION–CLOUDS–ENERGY & WATER CYCLE		
OCEAN / LAND		OCEAN	LAND HYDROSPHERE	LAND BIOSPHERE
		OCEAN SURFACE WAVES OCEAN CIRCULATION SIMPLIFIED SEA ICE	SNOW ON LAND SOIL MOISTURE FREEZING	LAND SURFACE PROCESSES SOIL MOISTURE PROCESSES SIMPLIFIED VEGETATION



Synergy of NWP & Environmental Monitoring

- New remotely-sensed data offers unprecedented levels of measurement accuracy.
-
- In the domain of atmospheric sounding, for example, we are moving from levels of accuracy of ~ 1K over thick layers in the last decade, to levels of ~0.1 - 0.5 K over much thinner layers in this decade.
- Full exploitation of instrumental accuracy requires accounting for a wide range of physical and surface biophysical processes that have hitherto been inaccessible to measurement, and thus neglected (aerosol, trace-gases, land…)
- It is increasingly necessary for NWP to model and assimilate satellite data on many of these aspects of the Earth-system.
- Such developments offer products of great scientific and societal interest for climate and other issues.

Elements of WMO's World Weather Watch,

Global Observing System takes observations (GOS)

Global Telecommunications system for observations & products (GTS)

Global Data Processing System makes products (GDPS)

- Global Observation System
  - makes space observations & in-situ observations
- Observation Dissemination via Global Telecommunications System (GTS)
- Global Data Assimilation & Forecasting
- Regional Data Assimilation & Forecasting
- Product Dissemination via Global Telecommunications System
- Users & Applications in Air Quality, Climate Monitoring....

World Weather Watch

GEMS (i) Global Earth-system Monitoring using Space and in-situ data

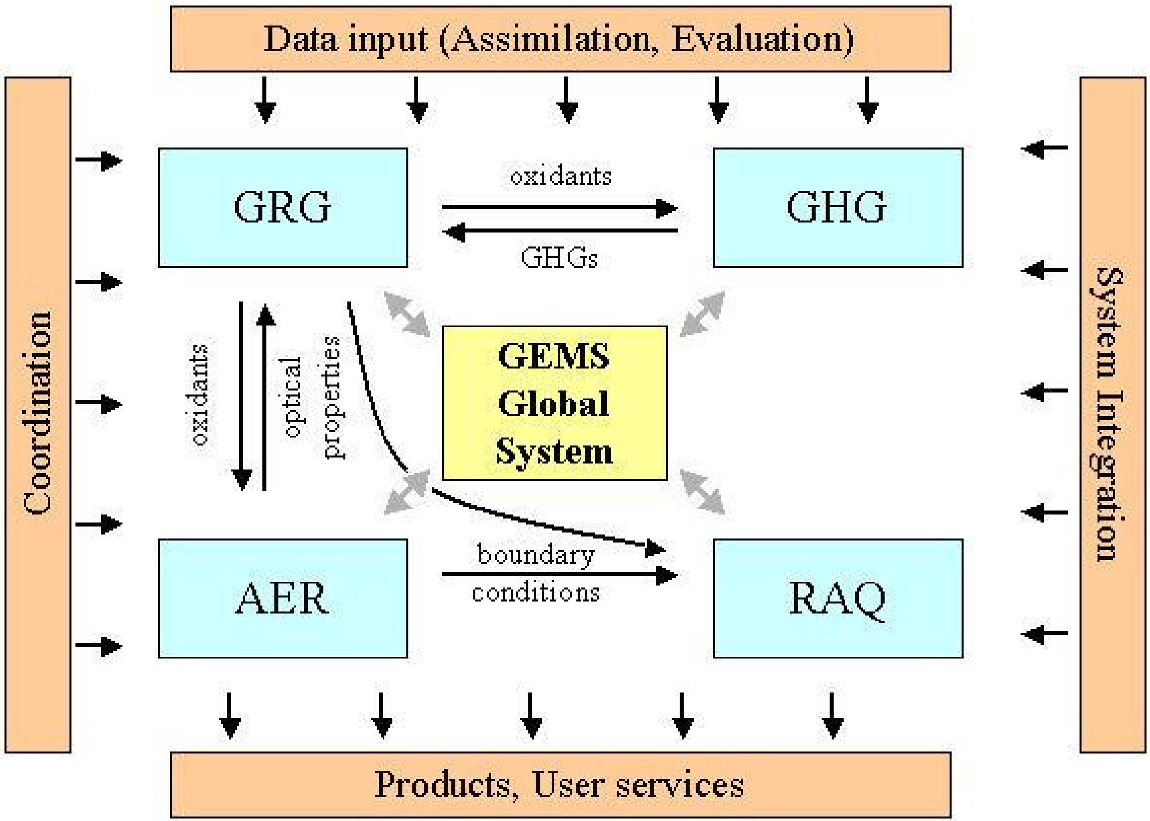
GEMS: Extend the Data Assimilation system at ECMWF to describe atmospheric dynamics, thermodynamics and composition:

- **GREEHOUSE GASES**
- **REACTIVE-GASES**
- **AEROSOL**
- **Drive REGIONAL AIR QUALITY MODELS**
- **VALIDATE THE SYSTEM**

- **Collaborate closely with 3 related EU Framework 6 funded projects**
  - **GEOLAND: Model and assimilate data on the Land Biosphere and global carbon cycle, using best available met input.**
  - **MERSEA: Model and assimilate upper-ocean, incl. Ocean-colour to estimate ocean carbon uptake, using best available met input.**
  - **HALO: Harmonisation of Atmosphere, Ocean, Land Projects**
- **By 2008**
  - **Operational GEMS system + 10-year reanalysis of EOS / ENVISAT era**

Links between the main elements of GEMS :

Greenhouse Gases (GHG), Global Reactive Gases (GRG), Global Aerosol (AER), Regional Air Quality (RAQ) & ECMWF global assimilation system.



Schedule of Activities at the Central Site

Outline Implementation plan for GEMS

Work by European Science Teams for Greenhouse Gases, Reactive Gases, Aerosol, Regional Air quality

First Year	Second Year	First half of third year	Mid-Year 3 to Mid-Year 4	Fourth Year, Second Half
Implement existing trace gas and aerosol formulations in NWPM	Assess test assimilations Refine and Improve the science	Implement Improved Science in NWPM	Assess Integrated Chemical Assimilation	Operational Chemical Assimilations Reporting Final assessments
Develop software for estimation of sources/ transport	Test the transport/source calculations on the reanalyses	Refine the methodology of the transport calculations and source estimates	Apply exploitation tools to the results of the chemical reanalyses	pre-Operational system for source-sink and transport estimates
Interface the regional models to the global system	Test impact in regional systems of the GRG and Aerosol results	Adapt regional systems for daily running	Begin running regional models on a daily basis	Operational regional air quality

Work at Global NWP Centre by the Production & Reanalysis System Team & Data / Technical Infrastructure team

Assimilation and Reanalysis Team

Build separate assimilations for • Greenhouse gases • Reactive gases • Aerosol	Trail Reanalysis 2000-2005 • Greenhouse gases • Reactive gases • Aerosol	Create Unified Assimilation System for • Composition • Dynamics	Unified Reanalysis 2000-2005 • Greenhouse gases • Reactive gases • Aerosol	Assessment Report writing Final preparations for Operations

Data / Technical Infrastructure Team

Couple the NWPM and CTM1	Extend coupling to CTM2/3, Provide access methods for Science partners Prepare web-site and validation capabilities	Create Validation Tools for the global and regional Science teams	Technical preparation of the operational global forecast system for dynamics and composition	Final preparations for Operations
Acquire, reformat, archive priority 1 global satellite data	Complete acquisition of historical data	Begin work on real-time data acquisition	Complete work on operational data acquisition, archiving and dissemination	Final preparations for Operations

Predominant direction of information flows between the Science and Implementation teams at a given time

GEMS-GREEHOUSE GASES:

- **Monitor seasonal variations of non-reactive Greenhouse Gases such as CO_2, CH_4, N_2O, CO**
- **Heritage:** COCO (FP5)
- **Instruments:** AIRS, SCIAMACHY, IASI, OCO
- **Data Mgt**
- **R/T** develop from COCO
- **Modelling** develop from COCO
- **Sources / Sinks** Current Methods
  + 3D-InVar; variational method
  using CTM very close to ECMWF
  model
- **Data Assim.** ECMWF & ….
- **Validation** build on COCO validation team

Global Greenhouse Gas Partners

SUB-PROJECT: GLOBAL GREENHOUSE GASES		
#	**Institute**	**Individual**
02	**METO.UK**	**Peter Cox** expert in modelling land surface processes in GCMs
01	**ECMWF**	**Richard Engelen** since 2002 has worked on an experimental data assimilation system for CO_2.
03	**CNRS-IPSL-LMD**	**Alain Chedin** Internationally recognised expert in radiative transfer, Director of Research at LMD
04	**CEA-LSCE**	**Philipe Ciais, Peter Rayner** Internationally recognised experts on the carbon cycle,
05	**MPI-BGC**	**Martin Heimann** Director the the carbon team at the Max Planck Institut for BioGeoChemistry at Jena
22	JRC	**Peter Bergamaschi** is an expert in inverse modelling for methane

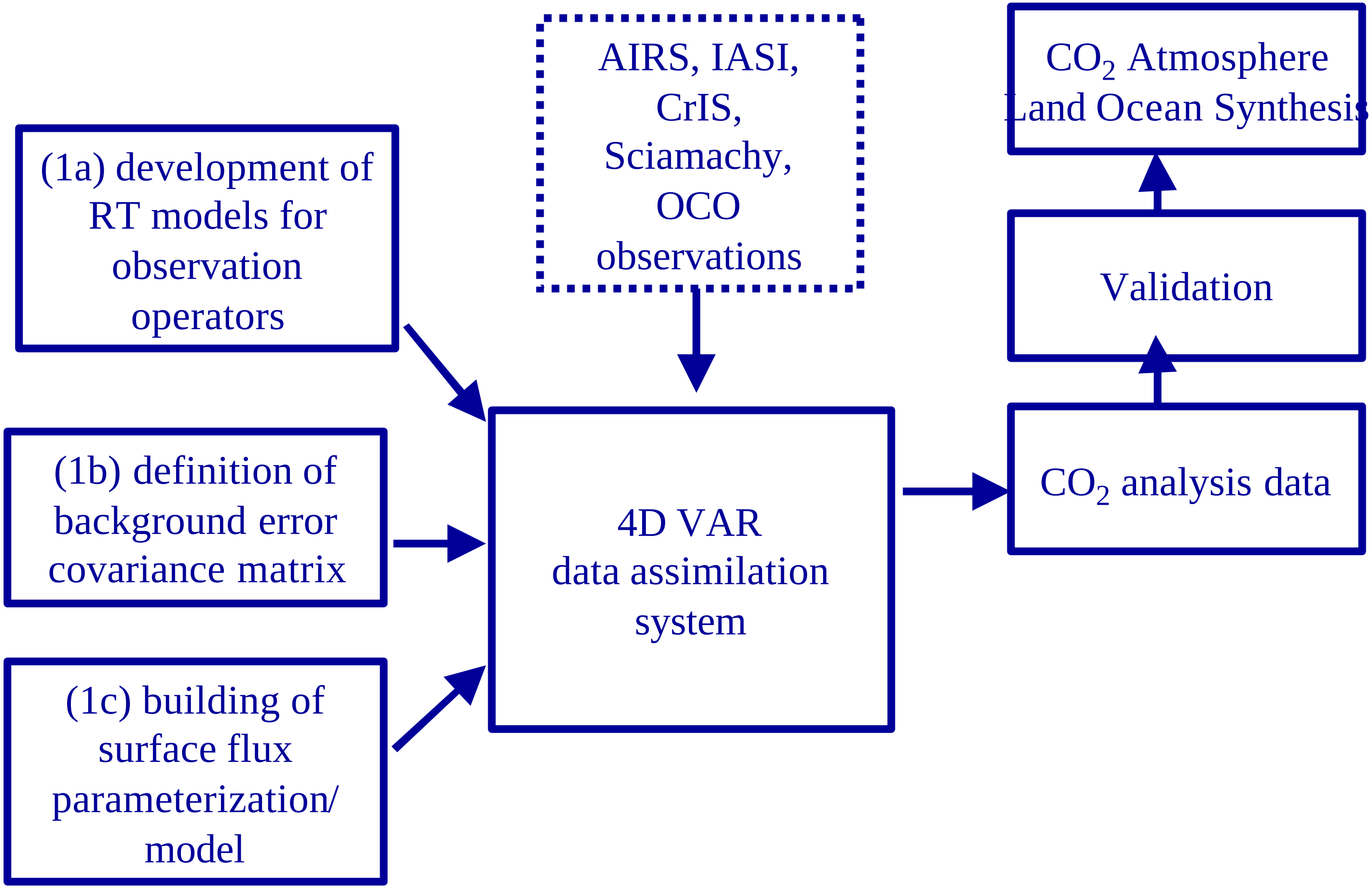
Table 2.7.1 Satellite Data on Greenhouse Gases to be used in GEMS

Agency	Mission	Instruments	Species	Data Volume/day of satellite life (MB/day)
ESA	ENVISAT	SCIAMACHY	CO_2, N_2O, CO, CH_4	11
ESA	ENVISAT	MIPAS	CH4, N2O	2
EUMET	METOP-1	IASI	CO_2, N_2O, CO, CH_4	1500
NASA	AQUA	AIRS	CO_2, N_2O, CO, CH_4	280
NASA	TERRA	MOPITT	CO, CH_4	64
NASA	AURA	TES	CO, CH_4	16
NASA	AURA	HIRDLS & MLS	CO, N_2O, CH_4	4
NASA	OCO	OCO	CO2	80
NESDIS	NPP	CrIS	CO_2, N_2O,CO, CH_4	280

Table 2.8.1 Correlative in-situ data on Greenhouse Gases to be used by GEMS

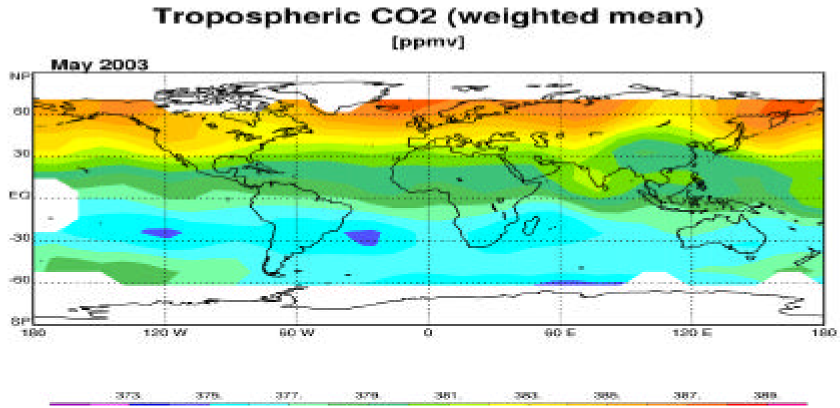
Agency / network / institute	**Species**	**Instruments**	**Partner responsible for accessing and using the data for validation of GEMS products**
Network of flask monitoring stations	CO_2	in-situ CO_2 monitoring stations	Ciais (through agreement with Carboeurope IP partners)
Network of tall towers (CarboEurope IP)	CO_2, CH_4, N_2O	in-situ measurements from tall towers	Ciais (through agreement with Carboeurope IP partners)
Aircraft measurement campaigns (CarboEurope IP)	CO_2, CH_4, CO	aircraft in-situ	Heimann
FLUXNET Network of eddy flux towers	CO_2 fluxes, surface energy balance	eddy flux towers	Ciais & Heimann

Greenhouse Gas Activities



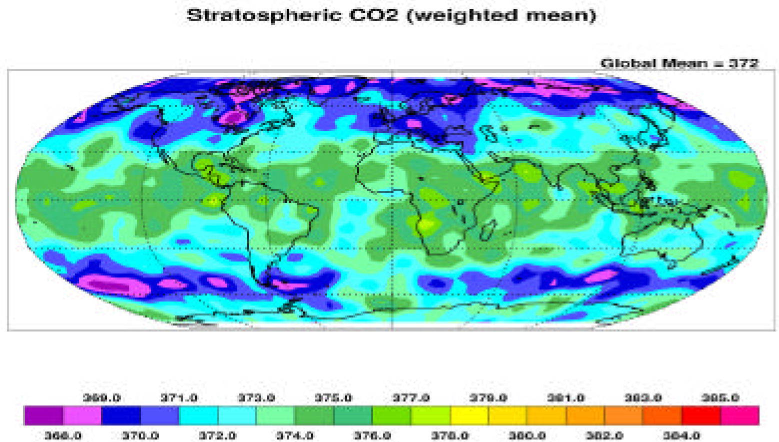
$COCO\ CO_2$ assimilation

- Troposphere



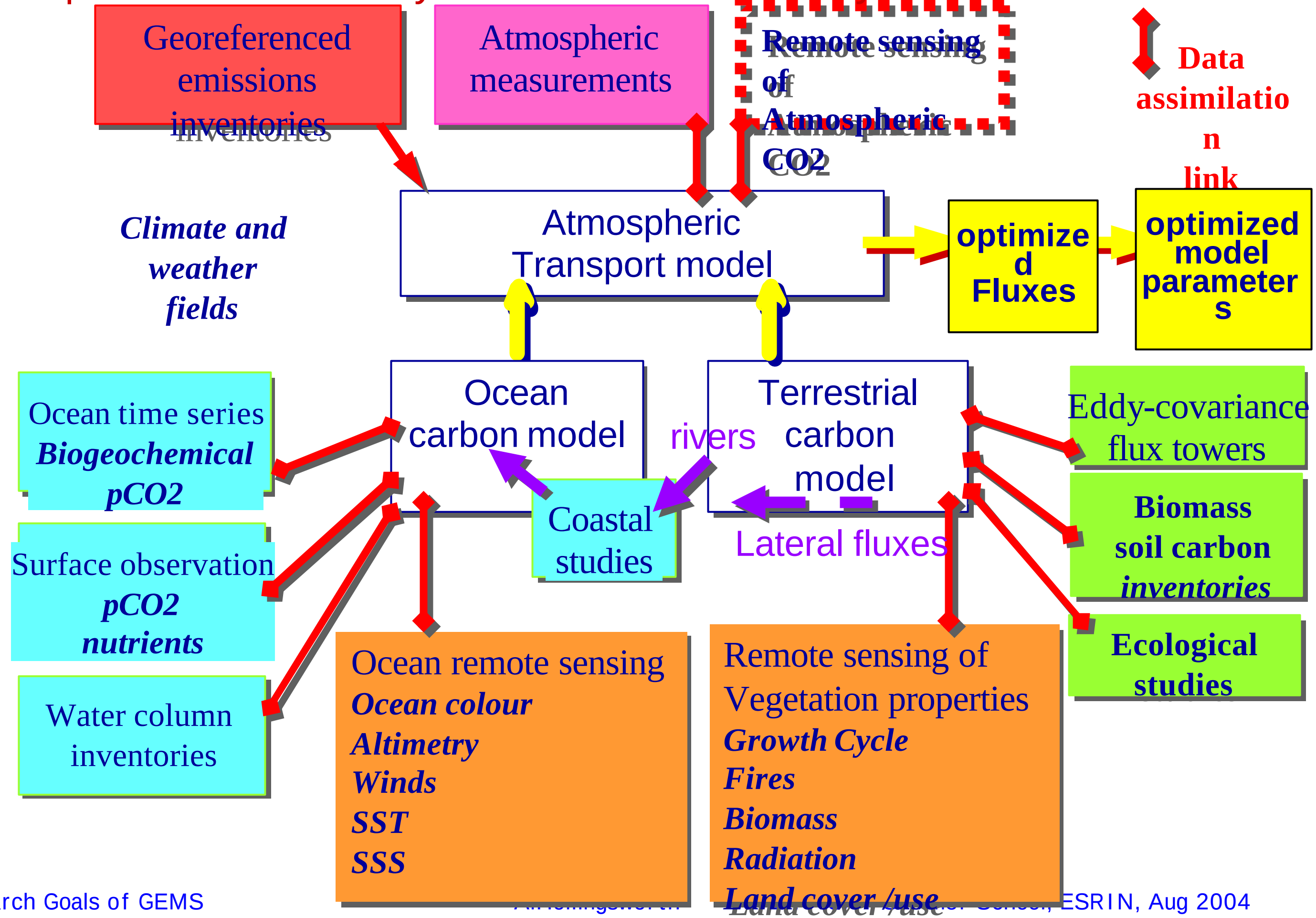
- Stratosphere

May 2003



IGOS_P / IGCO

Development of Carbon Cycle Data assimilation systems



Objectives: REACTIVE-GASES

- **Deliverables**
  - Determine the magnitude and location of stratospheric / tropospheric ozone exchanges
  - Determine the modes and magnitudes of intercontinental transport of ozone and other constituents.
  - Provide global Chemical Weather Forecasts including UV-B forecasts, plus initial and boundary conditions for regional Chemical Weather Forecasts.
- **Data Assimilation Approach**
  - Stream 1: 4d Var with simplified chemistry to retrieve Ozone (12hr window).
  - Stream 2: Chemical Transport Model uses Atmospheric transport from stream 1 to assimilate / transport up to 50 species. A priori surface flux fields specified from RIVM-EDGAR database
- **Instruments: UARS, AIRS, MIPAS, SCIAMACHY, GOMOS,**

  SEVIRI, OMI, TES
- **R/T & Retrievals**
- **Modelling**
- **Sources / Sinks**
- **Data Assim.**
- **Validation**

Global Reactive Gas Partners

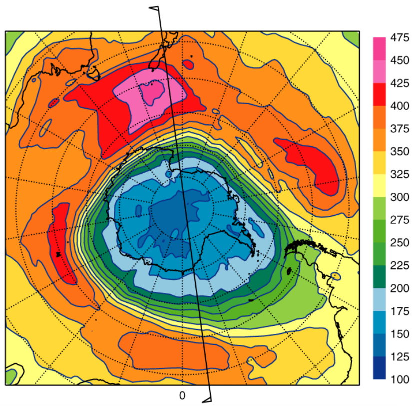
#	Institute	
06	**MPI-M**	**Guy Brasseur** Director, MPI for Meteorology, **Martin Schultz**
07	KNMI	**Henk Eskes**
08	BIRA	**D. Fonteyn, Jean-Christophe Lambert, J-F.Muller**,
09	FMI	**Antti Arola, Jussi Kaurola**
10	DMI	**Allan Gross**
11	DWD	**Harald Berresheim**
12	IUP_UB	**Heinrich Bovensmann**
13	SA-UPMC	**Claire Granier** Deputy project leader of GEMS, **Kathy Law,**
16	NUIG	**Colin O'Dowd**
03	CNRS- LA	**Jean-Pierre Cammas** Co-ordinator of MOZAIC
01	ECMWF	**Jean-Noel Thepaut Antje Dethof**
14	NUAK	**Christos Zerefos**
15	METEO-FR	**Vincent-Henri Peuch**

Table 2.7.2 Satellite Data on Reactive Gases to be used in GEMS					
Agency	**Missi on**	**Instrum ents**	**Species**	**Data Volume per day of satellite life (MB/day)**	
ESA	ENVIS AT	SCIAMAC HY	O_3, NO_2, SO_2, CH_2O	53	
ESA	ENVIS AT	GOMOS	O_3, NO_2	2	
ESA	ENVIS AT	MIPAS	O_3, NO_2	2	
ESA	ERS-2	GOME	O_3, NO_2, SO_2, CH_2O	19	
EUMET	METOP -1	GOME-2	O_3, NO_2	152	
EUMET	MSG	SEVIRI	O_3	10	
EUMET	METOP -1	IASI	O_3	1500	
NASA	AQUA	AIRS	O_3	280	
	Earthprobe ADEOS				

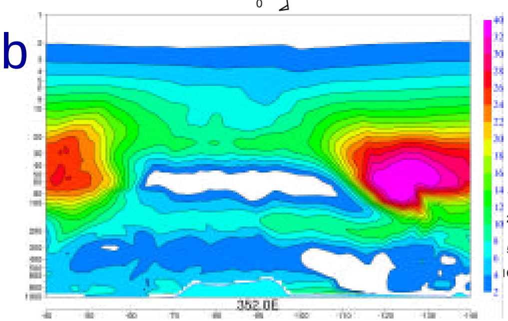
Table 2.8.2 Correlative in-situ data on Reactive Gases to be used by GEMS

Agency / network / institute	Species	Instruments	Partner using the data for validation of GEMS products
WMO/GAW global stations (WOUDC)	total ozone, ozone profile	Brewer, Dobson, filter ozonometers (M-124), ozone sonde	NHRF
WMO/GAW global stations	UV, solar radiation		FMI
WMO/GAW global stations	reactive gases (carbon monoxide, sulphur dioxide, nitrogen oxides, volatile organic compounds), chemical composition of rain	various	DWD
CMDL stations	ozone, CO, NO_x …	various	SA
selected "super sites", e.g. Hohenpeissenberg	O_3, NO_x, PAN, CO, peroxides, VOC, OH, etc.	various	DWD
SHADOZ	O_3 profiles, H_2O profiles	ozone sonde	LA
MOZAIC	ozone profiles, water vapor, carbon monoxide and nitrogen oxides	aircraft	LA

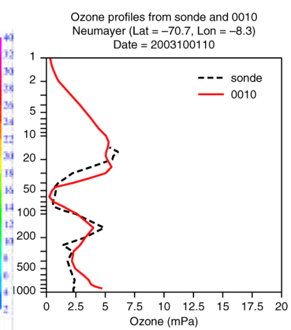
Ozone Hole 1 Oct 2003



a



b



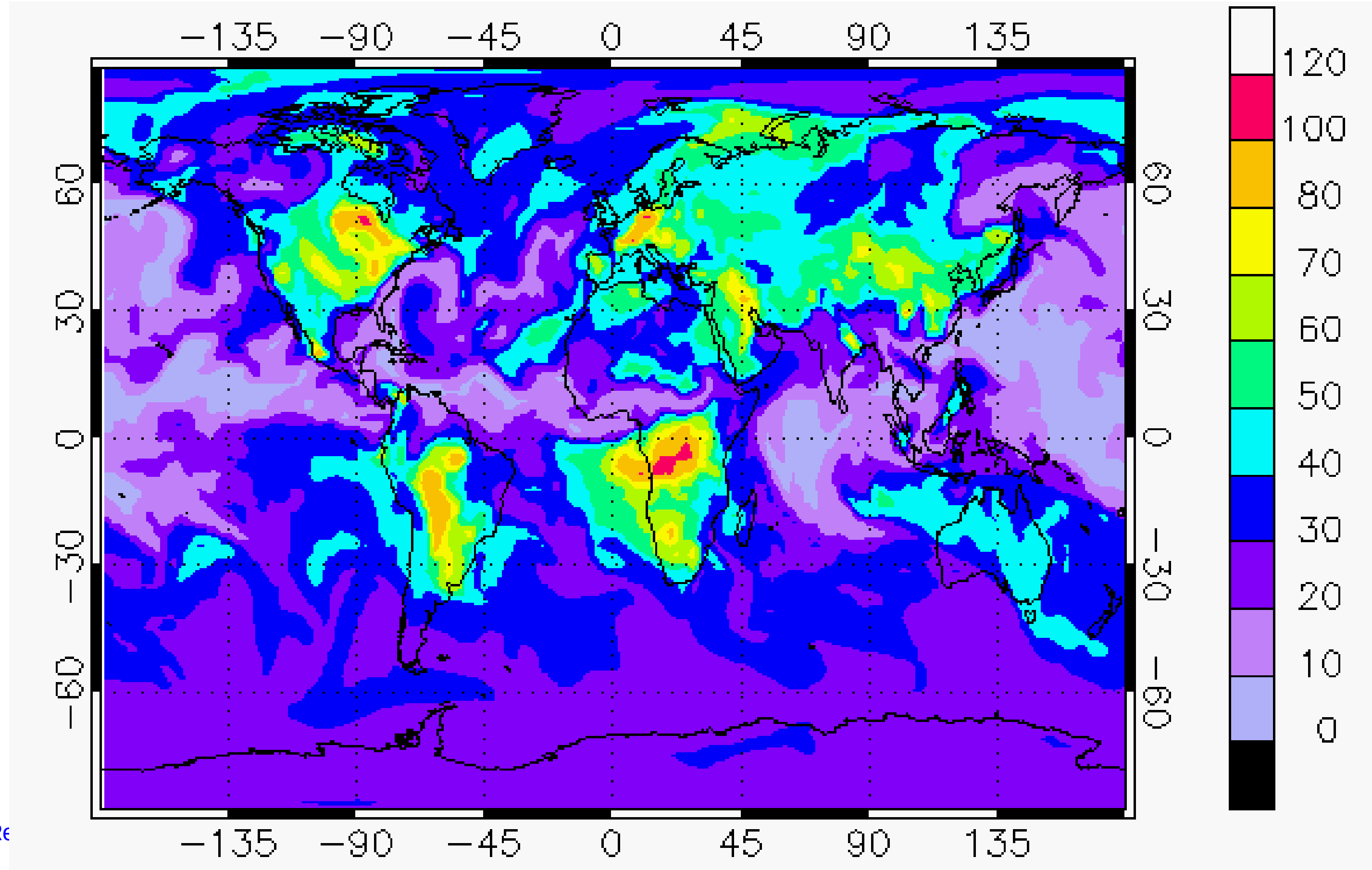
c

a) Ozone hole in Southern Hemisphere assimilation on 1 October 2003;

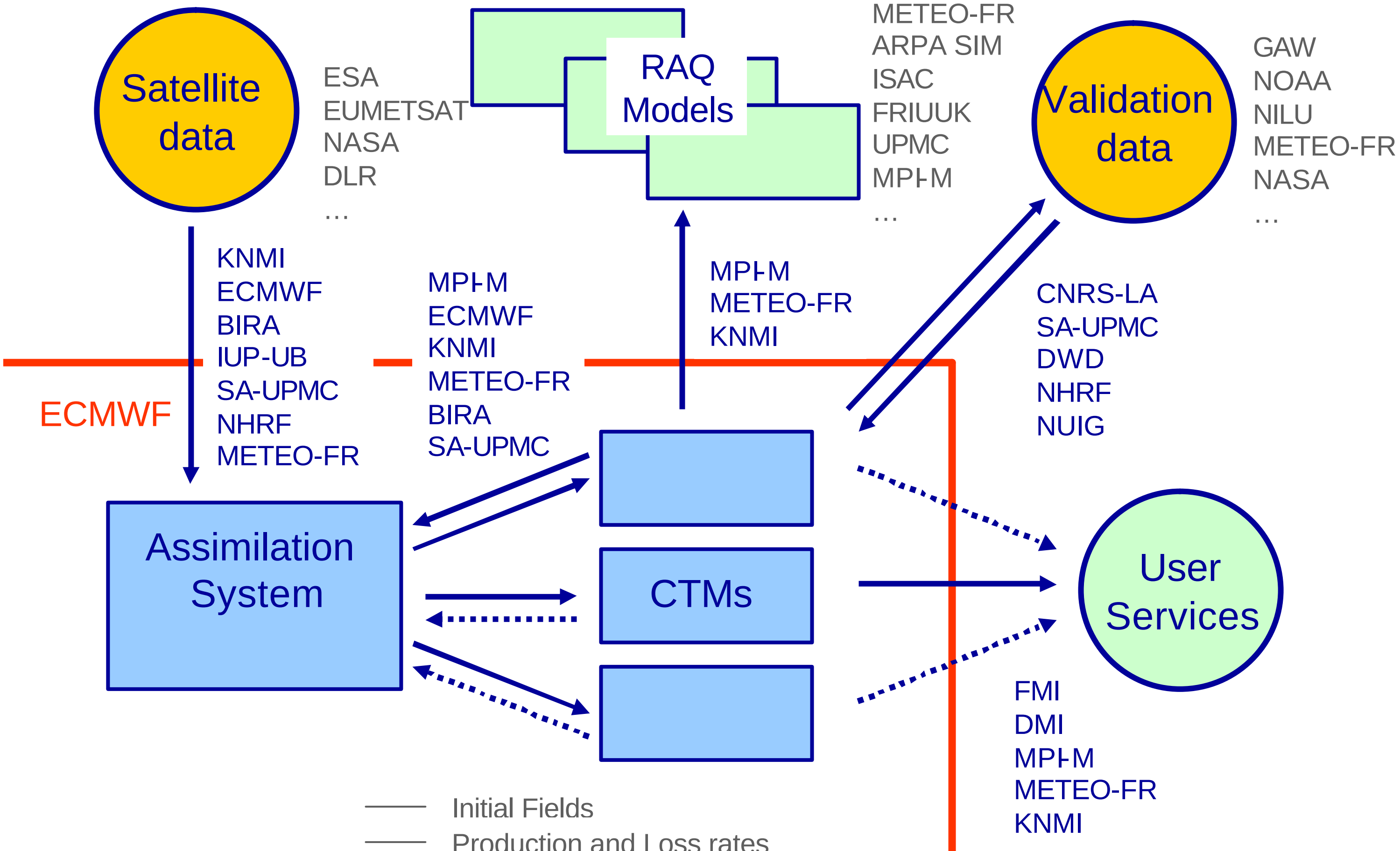
b) Vertical cross section of ozone partial pressure along 8W in a); the partial pressure of ozone is almost zero at 15km, over a wide area.

c) Comparison of (independent) ozonesonde profile data at Neumayer (70.7S 8.3W) with the assimilated field; the agreement is remarkable.

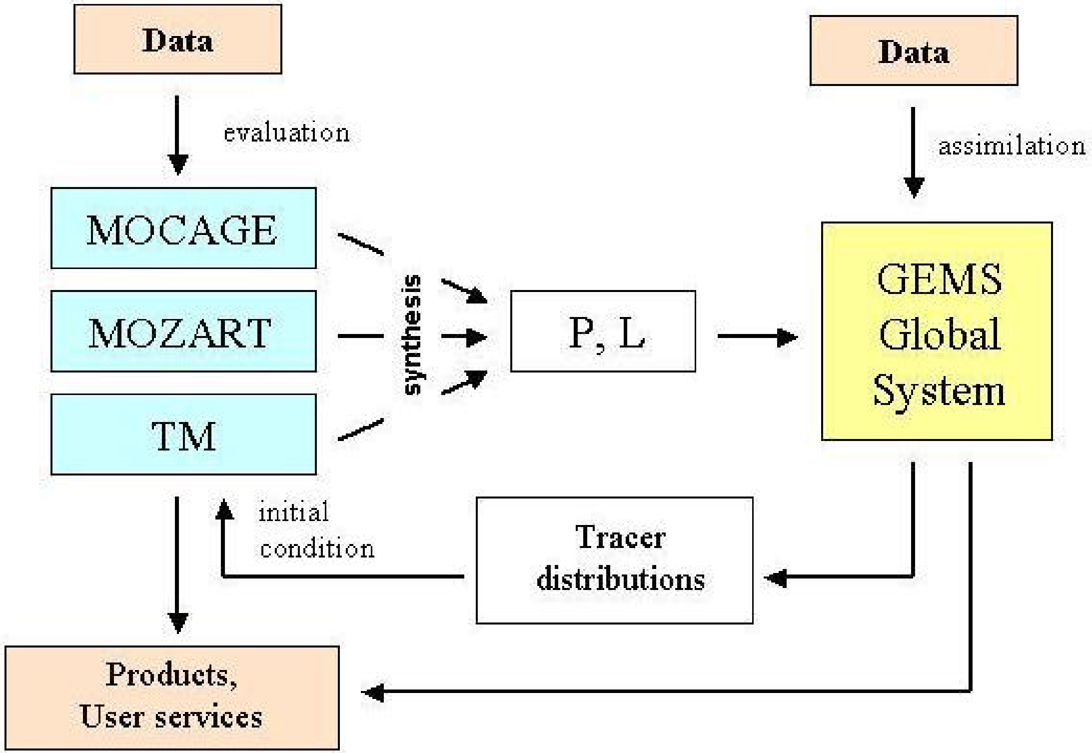
<u>Figure 4.2.1:</u> Ozone mixing ratio (nmol/mol) at 850 hPa for August 3, 2003, 1500 UTC as simulated with the MOZART-2 chemistry transport model. This figure illustrates the large variability and wide-spread influence of pollution over hemispheric scales



Data Flow and Responsibilities in GEMS GRG



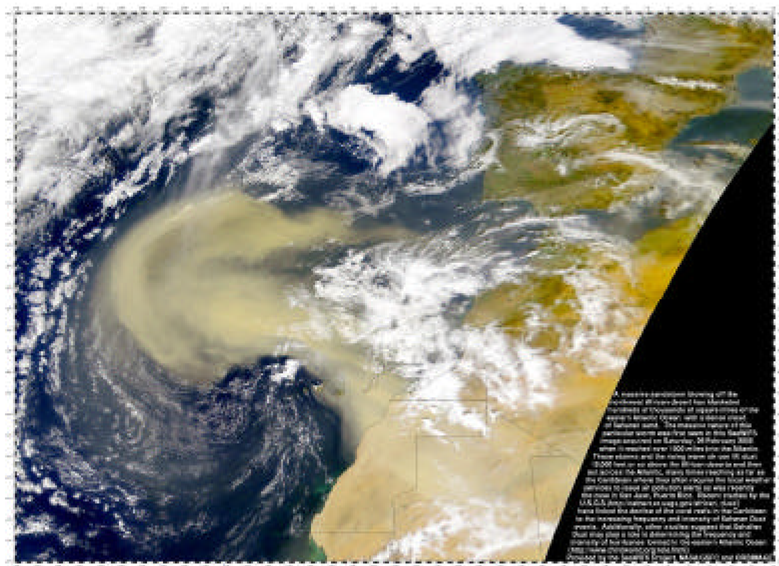
The CTMs produce the P &L rates of the species to be assimilated by the IFS system. After assimilation by IFS, the distributions are fed back into the 3 CTMs, to calculate the distributions of all chemical species, and updates values of the P & L rates of assimilated species.



GAW Network of world Stations

Monitor - AEROSOL:

- Model and assimilate global aerosol information
- Heritage: -
- Instruments: MERIS, MODIS x 2, MISR, SEAWIFS, POLDER
- Data Mgt tbd
- R/T
- Modelling “
- Sources/ Sinks “
- Data Assim. “
- Validation “



GLOBAL AEROSOL Partners

#	Acronym	Individual Skills and Experience
03	**CNRS/LOA**	**Olivier Boucher.Isabelle Chiapello, Jean-Francois Léon, Didier Tanre**,
06	MPI-M	**Johann Feichter** Irene Fischer-Bruns
04	CEA-LSCE	**Yves Balkanski** Michael Schulz
16	NUIG	**Colin O'Dowd**
09	**FMI**	**Mikhail Sofiev, Jaakko Kukkonen**
13	SA-UPMC	**Slimane Bekki**
17	RMIB	**Hugo De Backer Steven Dewitte**
11	**DWD**	**Harald Berresheim ,Wolfgang Fricke**
01	ECMWF	**Jean-Jaques Morcrette**

GEMS AEROSOL Global Monitoring System

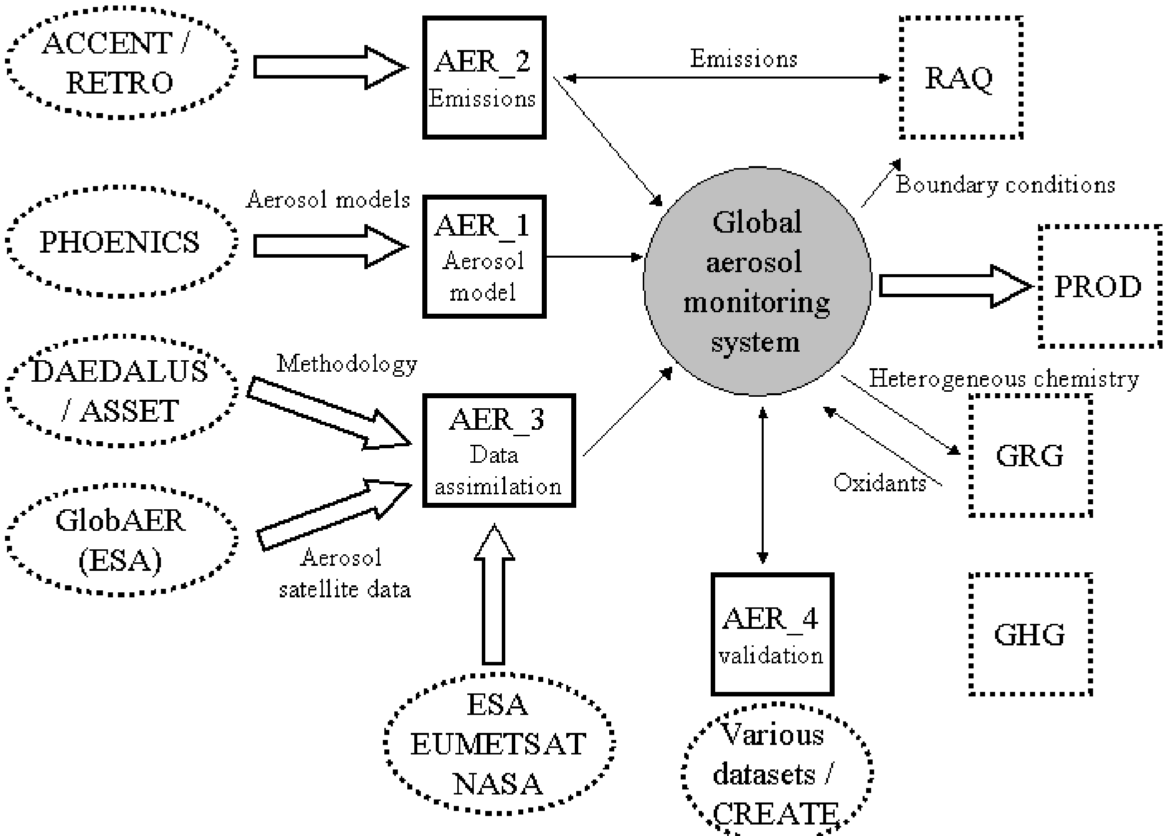


Table 2.7.3 Satellite Data on Aerosols to be used in GEMS

Agency	Mission	Instruments	Species	Data Volume per day of satellite life (MB/day)
ESA	ENVISAT	MERIS	Aerosol Optical Depth at 865 nm Aerosol Epsilon Factor Radiances	TBD (target ~250MB/day maximum)
ESA	ATSR AATSR	ERS-2 ENVISAT	Radiances used in GLOBAER project	TBD
EUMET	MSG	SEVIRI	Radiation budget Radiances for inversion	TBD low-moderate volume
	MSG	GERB	Radiation budget Radiances for inversion	TBD low-moderate volume
NASA	TERRA	MODIS	Aerosol optical depth / Type / Size Distribution Radiances	600

Table 2.8.3 Correlative in-situ data on Aerosol to be used by GEMS

Agency / network / institute	Species	Instruments	Partner using the data for validation of GEMS products
EMEP	aerosol mass concentrations aerosol size distributions	PM samplers	NUIG (CEA-IPSL-LSCE, MPI-M)
IMPROVE	aerosol mass concentrations	PM samplers	NUIG (CEA-IPSL-LSCE, MPI-M)
AERONET/PHOTONS	AOD, SSA, aerosol size distribution	sunphotometer	CNRS-LOA
GAW/WMO (WDCA)	AOD	precision filter radiometer	DWD
Brewer network	AOD (UV)	UV-B spectrophotometer	RMIB
	profile of aerosol extinction coefficient	lidars	various
Mace Head	aerosol mass concentrations aerosol size distribution	various	NUIG
Hohenpeissenberg	aerosol mass concentrations	various	DWD

Aerosol modelling and assimilation is an emerging issue for NWP

- ‘HIRS channels sensitive to the surface temperature, lower tropospheric temperature, and moisture are subject to a 0.5 K or more reduction in the brightness temperature during heavy dust loading conditions. (Weaver, Joiner, Ginoux JGR April 2003)

- Aerosol is the biggest source of error in ECMWF clear-sky radiation computations (JJ Morcrette, pers.comm.)

GEMS - Regional Air Quality Sub-project

Objectives

- Evaluate the added value of satellite information on long-range transport of pollutants in regional and city air-quality forecasts across Europe.
- Assess the health implications of the long-range transport of pollutants documented by the project.
- Provide science support for environmental policy evaluation and evolution by using air-quality hindcasts of typical & extreme cases to assess the effects of global variability and changes on regional air-quality
- Improve existing air quality models through systematic inter-comparison & verification, and explore multi-model ensemble approaches
- Develop routine cooperation between national air quality forecasts centers for data access and verification

Regional Air Quality Partners

Institute	Individual Skills and Experience
CNRS	**J-M. Flaud, G.Bergametti, R.Vautard J-P.Cammas**
MPI-M	**Daniela Jacob**
KNMI	**Henk Eskes**
FMI	**Mikhail Sofiev:**
DMI	**Allan Gross**
SA-UPMC	**Matthias Beekmann**
NKUA	**Christos Zerefos**
METEO-FR	**Vincent-Henri Peuch**
ARPA-SIM	**Marco Deserti**
ISAC	**Francesco Tampieri**
met.no	**Leonor Tarrason**
FRIUUK	**Hendrik Elbern**

And

INERIS: F

CHMI: Czech Hydromet

EPA I: Irish EPA

PIEP: Poland Institute of Environmental Protection

ICLON: Imperial College School of , Medicine

Table 2.8.4 Correlative in-situ data on Air Quality to be used by GEMS

MOZAIC	O_3, CO, NO_y, H_2O, profiles and cruise-level transects	aircraft	CNRS, Laboratoire d'Aérologie
'New' EMEP, incorporating historical data from EMEP, HELCOM, OSPAR and GAW data	Air-quality data: ozone, NO, NO_2, CO, PM, SO_2, HNO_3, NH_3... Deposition: rainfall analyses	various	met.no
CREATE	Air-quality data	various	
DAEDALUS	Air-quality data	various	CNRS-LOA
GMES-GATO	Air-quality data	various	Meteo-France
Met-Moniteur	Air-quality data	various	Meteo-France
AIRBASE air quality data	Air-quality data	various	met.no
Near-real-time data from regional and national agencies	Air-quality data	various	National partners responsible on a country by country basis (note that NRT data will necessarily be

Context

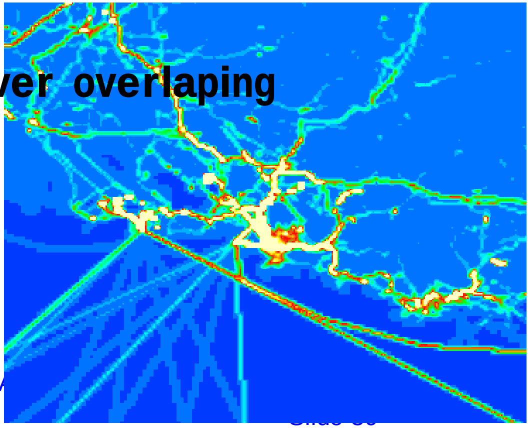
- **Over recent years, there has been extensive coordination efforts, with useful results (EU and national projects, EUMETNET WG-env, COST, CAFE-citydelta,…)**
- **However, limited existing experience on cooperative approach (other than web links) ; difficult to have data in real-time, as well as model numerical outputs.**
- **Given the political background and potential impacts (health, economics,..), it seems important to work for the development of common experience/expertise across Europe.**
- **Test the possibilities of ensemble / statistical forecasts**

The strengths of GEMS Regional Air Quality

- Coordinated efforts relying on large scale chemical data assimilation ;
- Make things work in an operational context.
- 5 sub-tasks:
  - boundaries (emissions, chemical fluxes, meteorology) ;
  - observations (real-time and archived) ;
  - operational forecasts ;
  - a posteriori simulations.
  - assessment of health implications of long-range transport
- Common forcings and observations between the partners
- Joint website as a working tool and interface to the users.

1.1 Boundaries / emissions

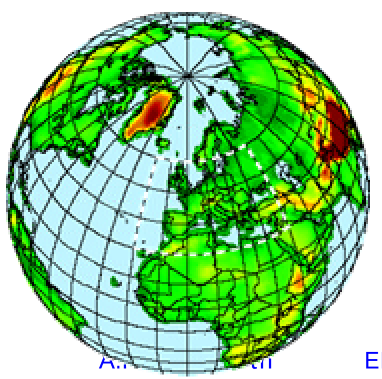
- **Joint effort on the basis of EMEP 50x50 (GENEMIS temporal profiles).**
- **? Sub-contracting with GENEMIS (~5km) ; ? Merging existing national inventories.**
- **Aerosol emissions across Europe.**
- **Biogenic emissions modelling (all based upon ECMWF surface parameters?).**
- **Consistency with the global emissions over overlaping domains.**

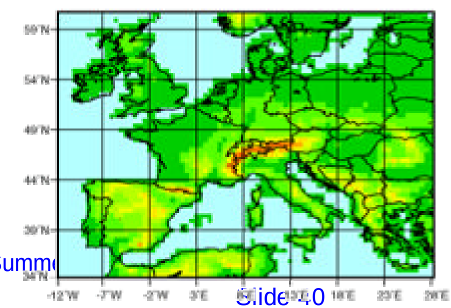


NOx emissions around Marseille 21/06/01

1.2 Boundaries / chemistry

- **Forcings by fluxes (lateral, vertical, total columns) coming from the global assimilation systems (MOZART, MOCAGE, ECMWF-aerosols) ; hemispheric models with data assimilation**
- **Define standards for chemical forcings : what species, groups of species, chemical scheme? How consistent should the sub-systems be relative to global systems?**



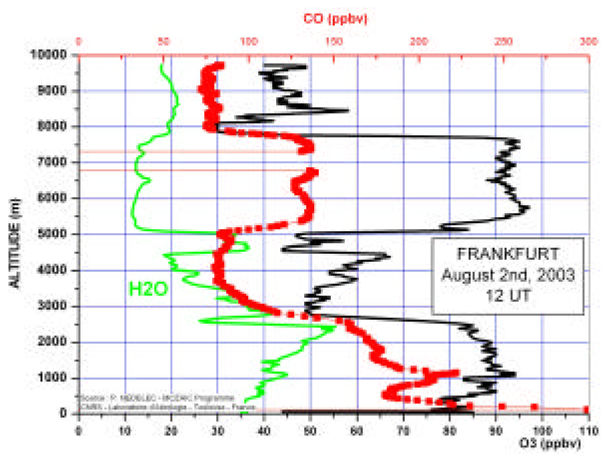


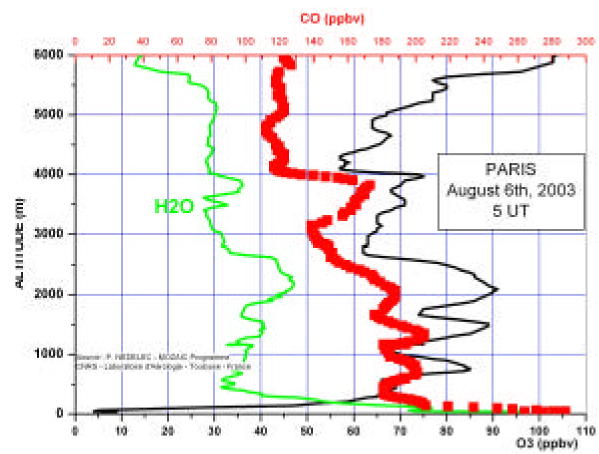
1.3 Boundaries / meteo

- Rely on GEMS specific operations (a ; T159 then T319) or on ECMWF operations (b ; T511)? Probably (a) for a posteriori and (b) for chemical weather.
- Some limited-area meteorological models will run : HIRLAM, MM5,… Where will the different models run?
- Document the impact of meso-scale meteorology for AQ (ozone, but also primary pollutants gaz/aerosols) : urban, breezes, orography effects.
- Export of chemical compounds from the polluted PBL

2.1 Observations / archive

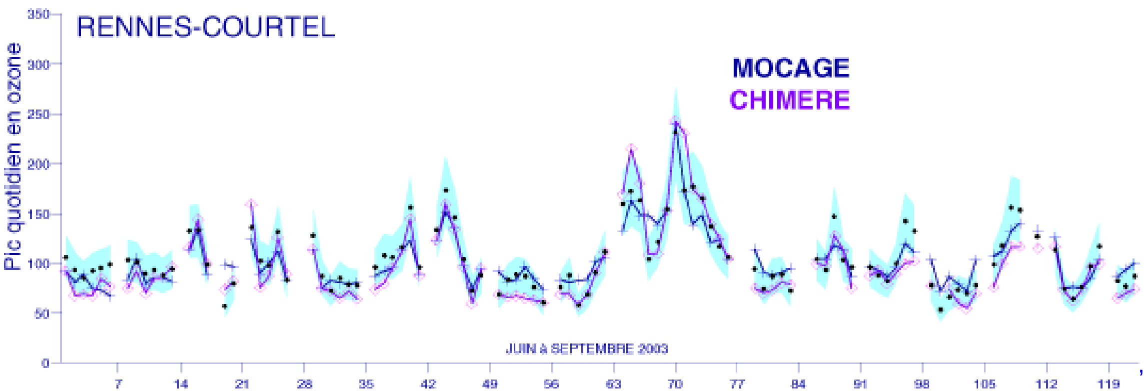
- **EMEP background AQ surface database**
- **Research networks (surface and teledetection)**
- **WOUDC / NILU ozonesondes ; MOZAIC profiles**
- **Spaceborn data not assimilated : MOPITT?,…**





2.2 Observations / NRT

- **Provide national contacts with AQ monitoring agencies : NRT data exchange with « expert-user » access to forecast / evaluation products**
- **Extension of MOZAIC and research networks capable of NRT data transfer**
- **Effort on data concentration / formating / dispatching (with the GEMS consortium)**



3. Operations

- **Run several models over Europe and some countries, daily and up to J+3 (or more ?). Where?**
- **As much as possible numerical data on a single website with different levels of access.**
- **List of models (provisional) : MOCAGE-europe (MF), EURAD (Ger., U. Koeln), EMEP (Met. No.), REMO (Ger., MPI), CHIMERE (Fr., LISA, IPSL), SILAM (FMI), BOLAM (It., CNR), Greece, DMI, Belgium.**
- **Common NRT model skill score assessment.**
- **Ensemble / statistical post-treatment approaches**
- **Build-up a network of « active » users ; link with GSE Atmos ESA project (A. Goede, KNMI).**
- **? Link with BACC-TO-BACC 1 year operations, including NRT supersites ; ? campaigns (ITOP,…)**

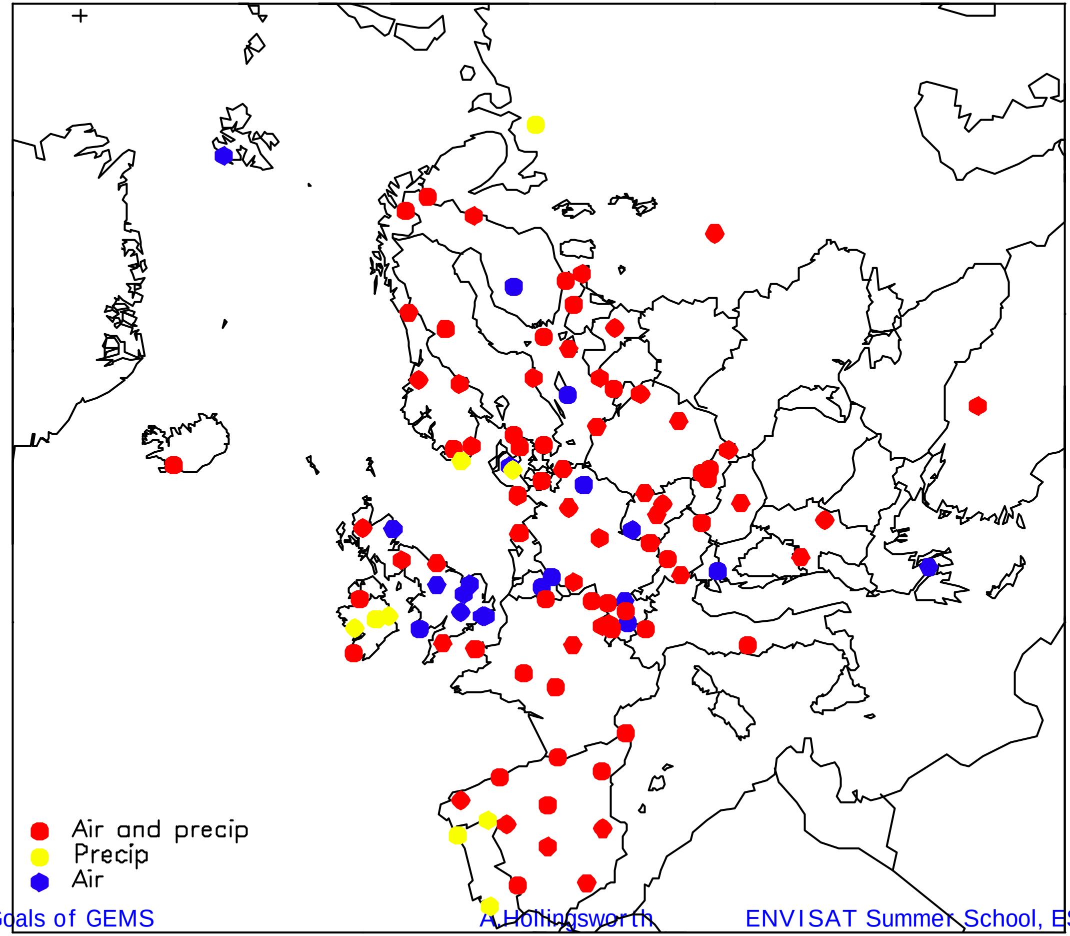
4. A posteriori

- Run several models over Europe and some countries over past periods, inclunding chemical forcings by global or hemispheric assimilated fields.
- Climatologies of AQ across Europe. Are « chemical weather » day types a valid approach? Is it possible to « reconstruct » climatologies with a limited number of high-resolution simulations.
- Contribution to trans-boundary pollution studies.
- Define standards for model versions evaluation : which set of data, what period of time,…
- How to evolve from the existing monitoting capacity of AQ : profiles, new satellite missions, which frequency & coverage

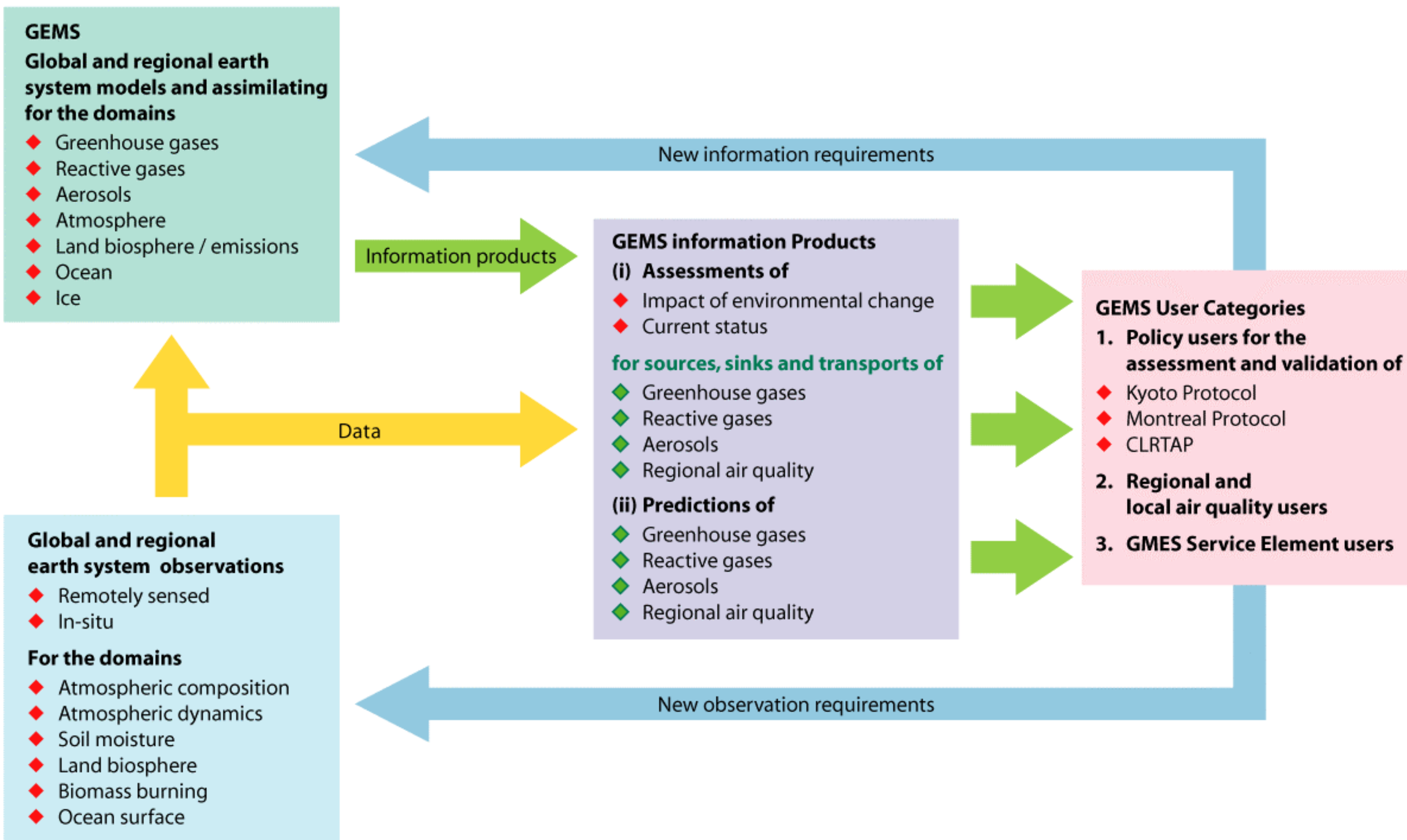
Key issues for Regional Air Quality Success

- The outcome must be larger than sum of all contributions. We must clearly answer the possible point on models/systems redundancy.
- Evaluate the impact of Global Monitoring on AQ applications and give insight on the impact of possible additional NRT observation systems .
- An important technical effort : a central website is certainly crucial for the AQ sub-project, with efficient data transfer (both for forecasts and simulations).
- Number of scientific questions will be adressed.

Figure 8.3.1: the EMEP network

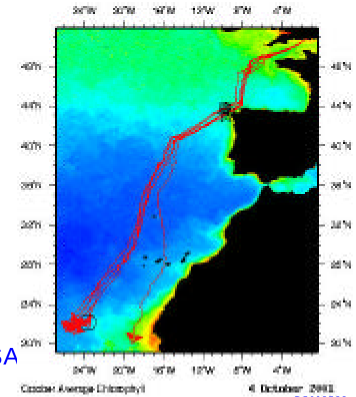


Global Environmental Monitoring using Satellite and In-situ Data
Flows of data, information products and requirements



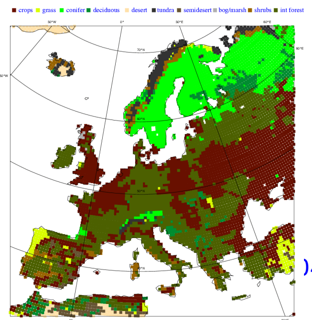
MERSEA collaboration

- **Deliverables**
  - **Monthly estimates of ocean carbon uptake through assimilation of data on the dynamics and biology of the upper-ocean.**
- **Instruments:**
  - **QSCAT, ASCAT, RA2, JASON, MERIS, MODIS, MISR, SeaWifs,**
- **R/T & Retrievals**
  - **Satellite agencies' baseline meteo retrievals;**
- **Modelling**
- **Sources/ Sinks**
- **Data Assim.**
- **Validation**



GEOLAND collaboration

- **Deliverables**
  - **2006 Stage I: Prototype offline assimilation system of remote sensing products and land surface model(s) to provide boundary conditions for the GHG and AEROSOL sub-projects. Data assimilation products: Soil moisture, LAI, biomass, snow, fluxes of carbon, water and energy.**
  - **2008 Stage II: As above but with refined assimilation scheme and land surface model(s) and below- and above-ground carbon storage as deliverables.**
- **Data Assimilation Approach**
  - **Build on existing FP5 projects (ELDAS, CAMELS, Land-SAF); model and product benchmarking; off-line assimilation with several models (ISBA-A-gs, MOSES, C-TESSEL). Transition from assimilation of derived geophysical products (Stage I) to top of the atmosphere radiances (Stage II).**
- **Instruments:**
  - **AVHRR, ATSR, GRACE, POLDER, VEGETATION, SEVIRI, MERIS, MISR, MODIS, SMOS**
- **R/T & Retrievals**
  -
- **Modelling**
- **Data Assim.**
- **Validation**



The Research and Technical Goal

A operational thoroughly-validated 'system of systems' by 2008!

- **Delivering**
  - **Daily global monitoring of atmospheric dynamics & composition**
  - **Improvements in daily regional air quality forecasts**
  - **Monthly / seasonal estimates of surface fluxes for Co2 and other species**
  - **Extended reanalyses of dynamics in support of GCOS**

- **Using**
  - **All available in-situ data**
  - **All available satellite data**

- **Implementing IGOS_P Themes on**
  - **Carbon Cycle**
  - **Atmospheric Chemistry**
  - **(Water Cycle as part of NWP operational developments)**

END

thank you for your attention!