



## Goals of GEMS:

### *Global Earth-system Monitoring using Space and in-situ data*

Greenhouse Gases	P.Rayner, A.Chedin, P.Ciais, M.Heimann, M.Best
Reactive Gases	G.Brasseur, M.Schultz (MPI_M), C.Granier (SA/UPMC)
Aerosol	O.Boucher (LOA) H.Feichter (MPIM) JJ.Morcrette
Regional Air Quality	V-H.Peuch (Meteo.Fr),
Validation	H.Eskes (KNMI)
Production System	A.Simmons, H.Boettger, J-N Thepaut, R Engelen, A Dethof (ECMWF),
Coordinator	A.Hollingsworth



# GEMS- Overview

- GEMS is an Integrated Project co-funded by the European Commission, 6th Framework Programme - Aeronautics & Space (GMES)
- GEMS addresses 'Atmospheric Composition and Dynamics'
- Resources
  - 17 M€ budget, 12.5 M€ EC-contribution
- Partnership
  - 31 consortium members
- Duration: 4 years

# GMES 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



# GEMS Research and Operational Goals

Build an operational thoroughly-validated assimilation system for atmospheric composition and dynamics, by 2008.

- **Delivering**
  - Daily global monitoring of atmospheric dynamics & composition
  - Improvements in daily regional air quality forecasts
  - Monthly / seasonal estimates of surface fluxes for Co<sub>2</sub> and other species
  - Extended reanalyses of composition & dynamics for validation, and in support of GCOS
- **Using**
  - Best available models, assimilation systems
  - Best available in-situ data
  - Best available satellite data and algorithms
- Collaborating with MERSEA & GEOLAND to implement IGOS\_P Themes on
  - Carbon Cycle
  - Atmospheric Chemistry

## GEMS Member State Participation by Institute (31) and Project

Country	Greenhouse GHG	Reactive GRG	Aerosol AER	Production PRO	Regional RAQ	Validation VAL
B		BIRA	RMIB			
Cz					CHMI	
D	MPIBG	MPIM, DWD,UB	MPIM,DWD		MPIM, FRIUUK	MPIBG
DK		DMI			DMI	DMI
F	CNRS, LSCE	CNRS, SA,MET.FR	CNRS, LSCE, SA		CNRS, SA MET.FR, INERIS	
Fin		FMI	FMI		FMI	
Hellas		NKUA			NKUA	
INT	ECMWF. JRC	ECMWF	ECMWF	ECMWF		
Irl			NUIG		EPAI	NUIG
It					ARPA, ISAC	
NL		KNMI			KNMI	KNMI
Nor					MET.NO	
Pol					PIEP	
UK	UKMO				ICSTM, UKMO	

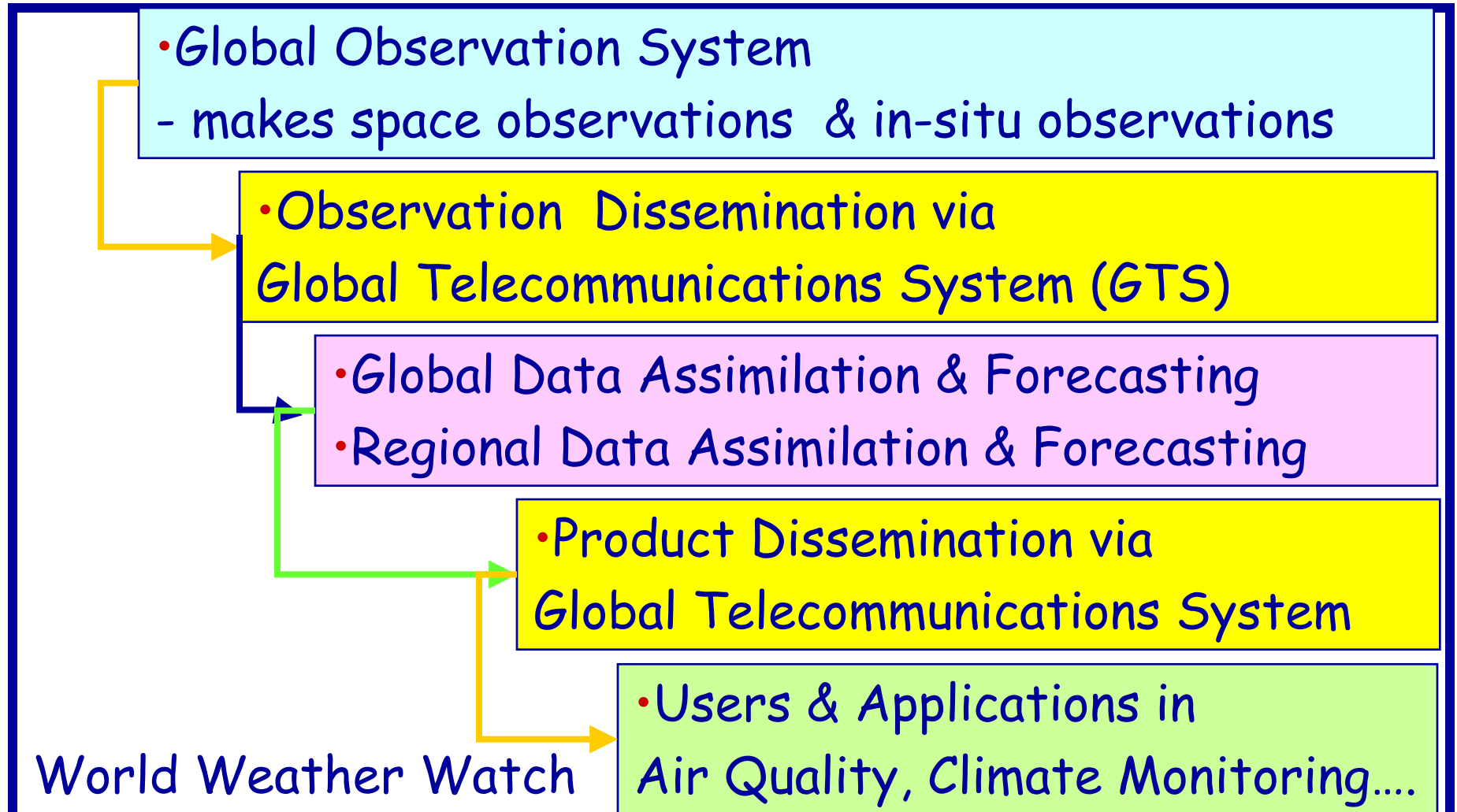


## Elements of WMO's World Weather Watch,

Global Observing System takes observations (GOS)

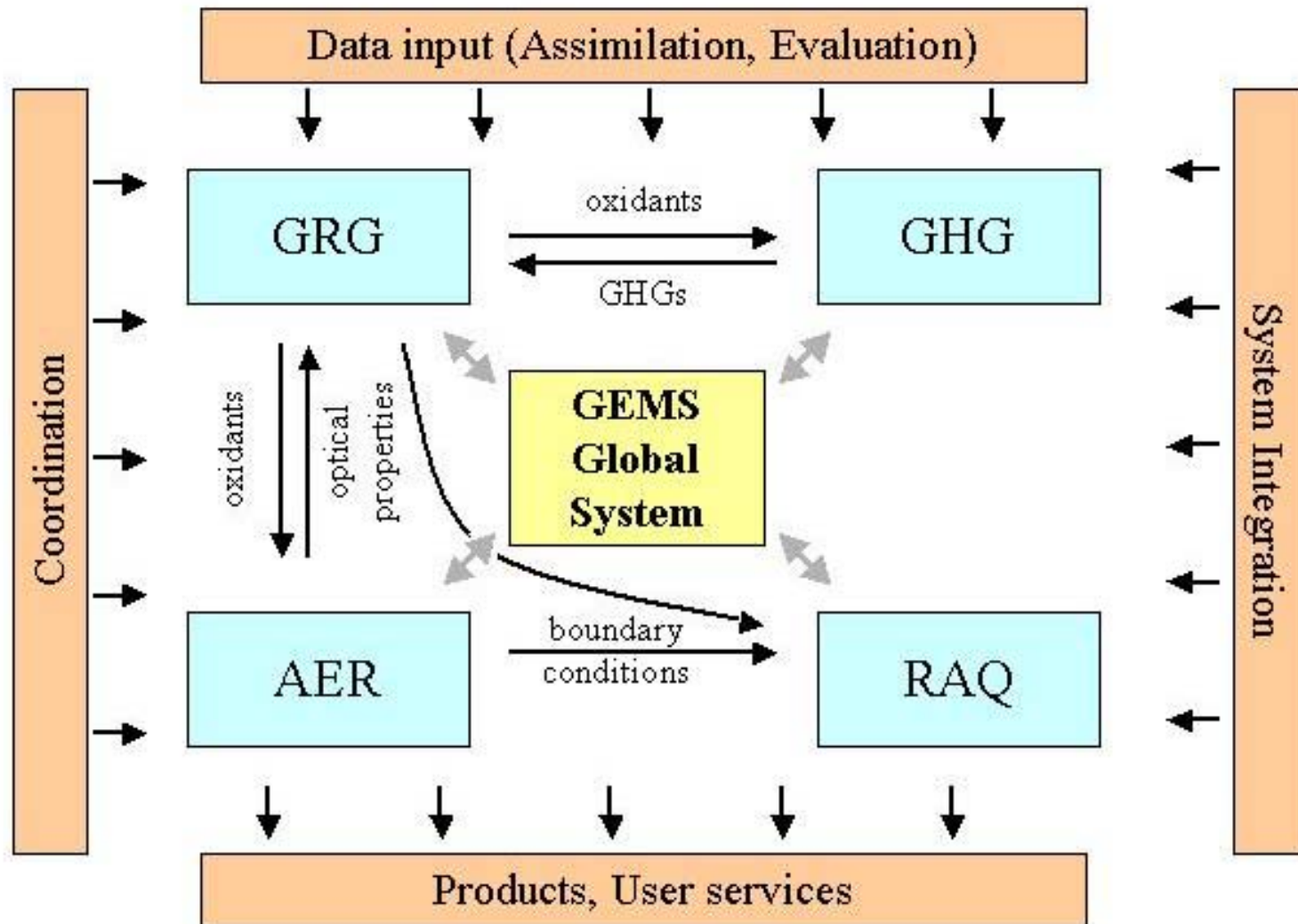
Global Telecommunications system for observations & products (GTS)

Global Data Processing System makes products (GDPS)



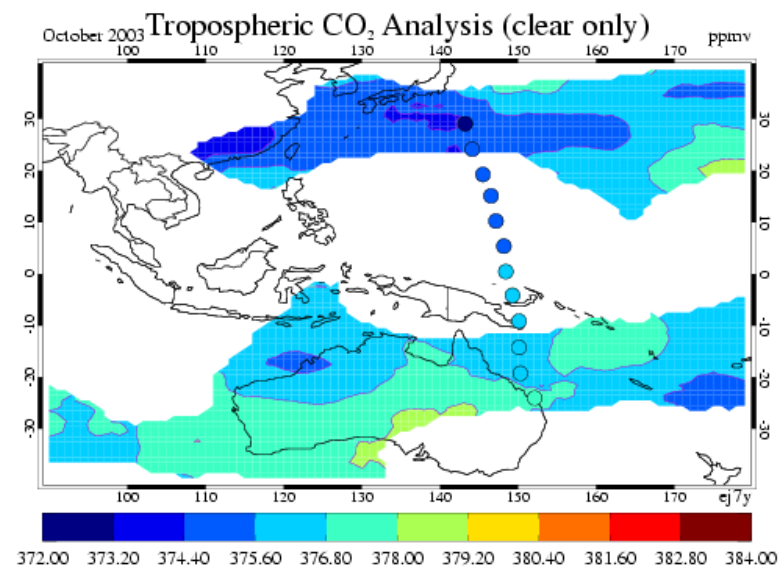
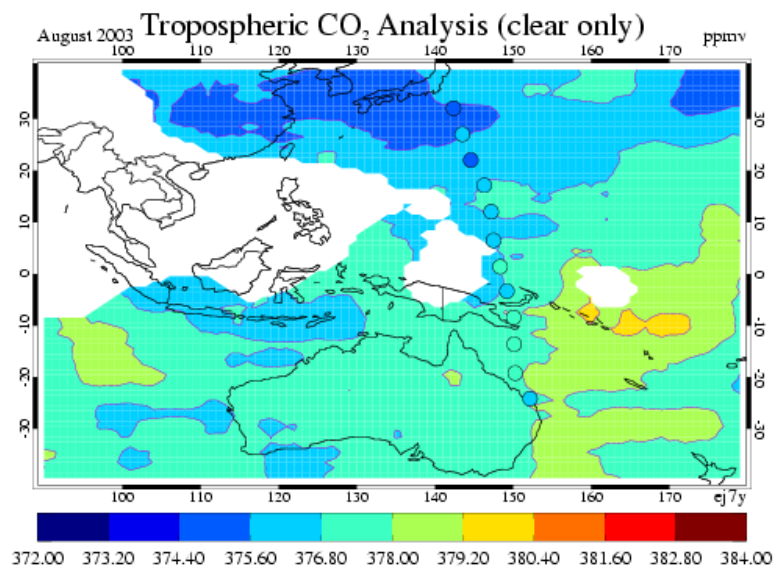
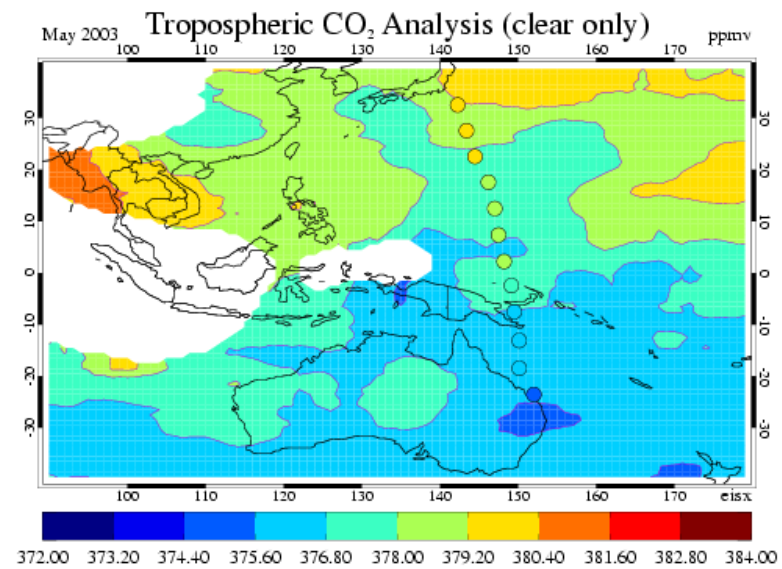
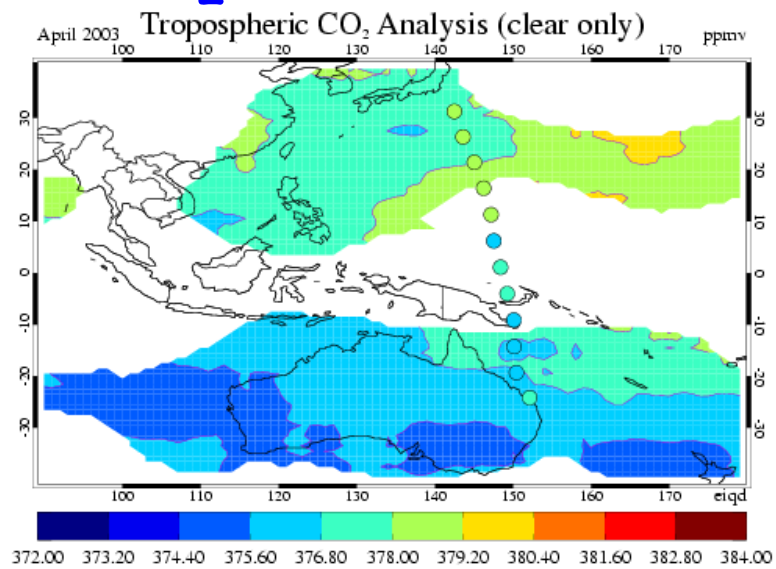
## Links between the main elements of GEMS :

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





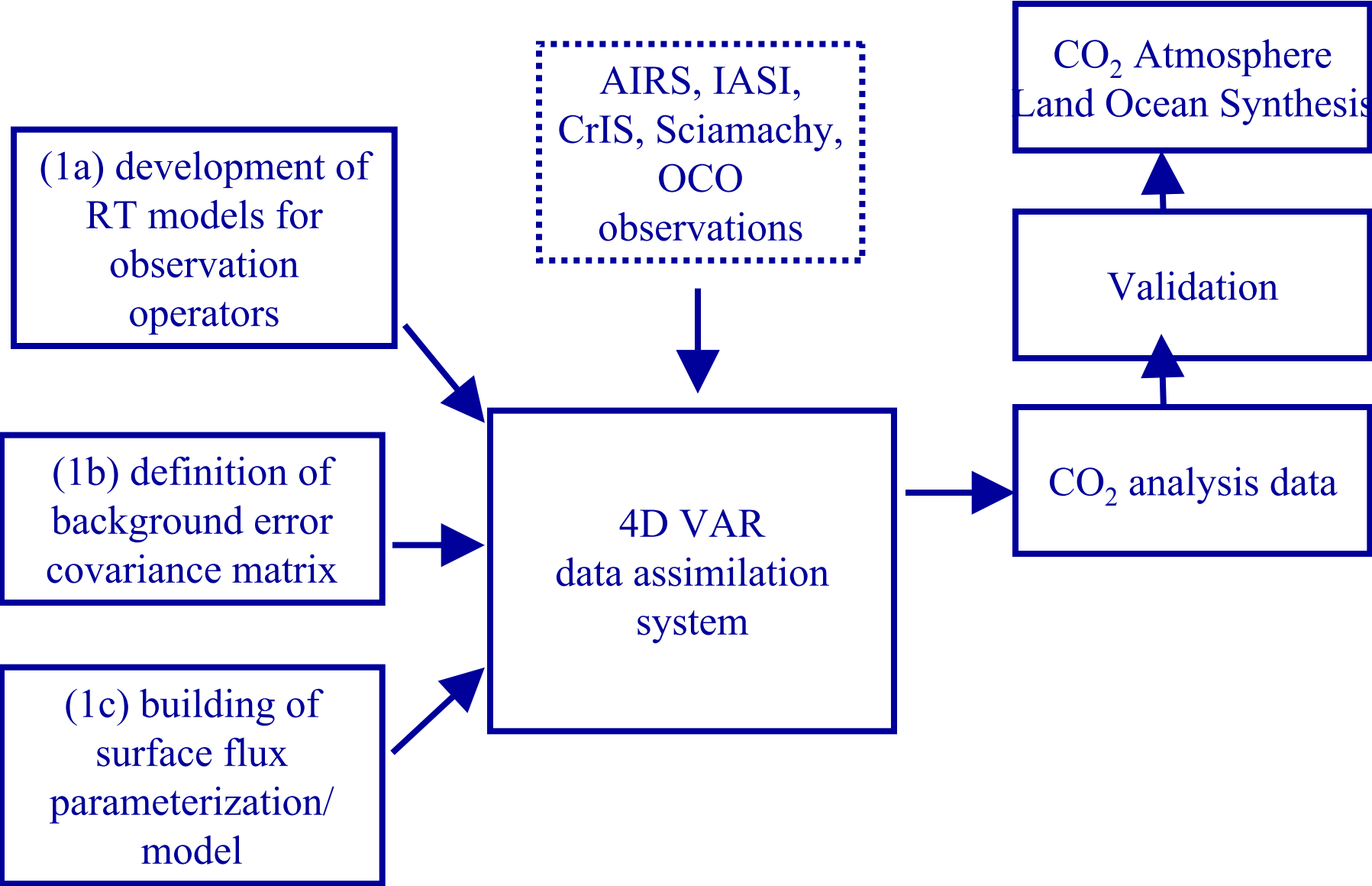
# CO<sub>2</sub> Assimilation - Validation







# Greenhouse Gas Activities





Objectives:

REACTIVE-GASES

- **Deliverables**

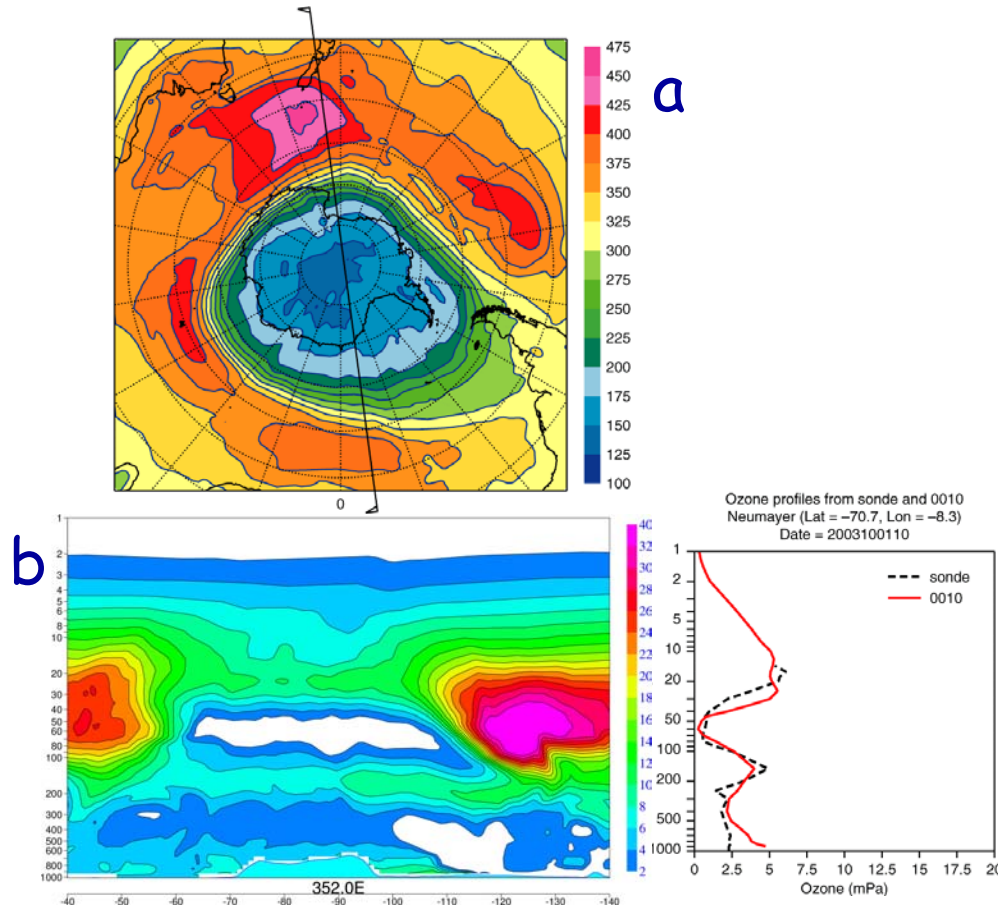
- Determine the magnitude and location of stratospheric / tropospheric ozone exchanges
- Determine the modes and magnitudes of intercontinental transport of ozone and other constituents.
- Provide global Chemical Weather Forecasts including UV-B forecasts, plus initial and boundary conditions for regional Chemical Weather Forecasts.

- **Data Assimilation Approach**

- Stream 4d Var with simplified chemistry to retrieve Ozone, NO<sub>2</sub>, SO<sub>2</sub>, Formaldehyde
- Assimilating Model coupled to CTM(s) to get sensible tropospheric profiles
- Surface sources and sinks, due to biomass burning.....

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# Ozone Hole 1 Oct 2003 in ECMWF operational assimilation, with very simple Chemistry



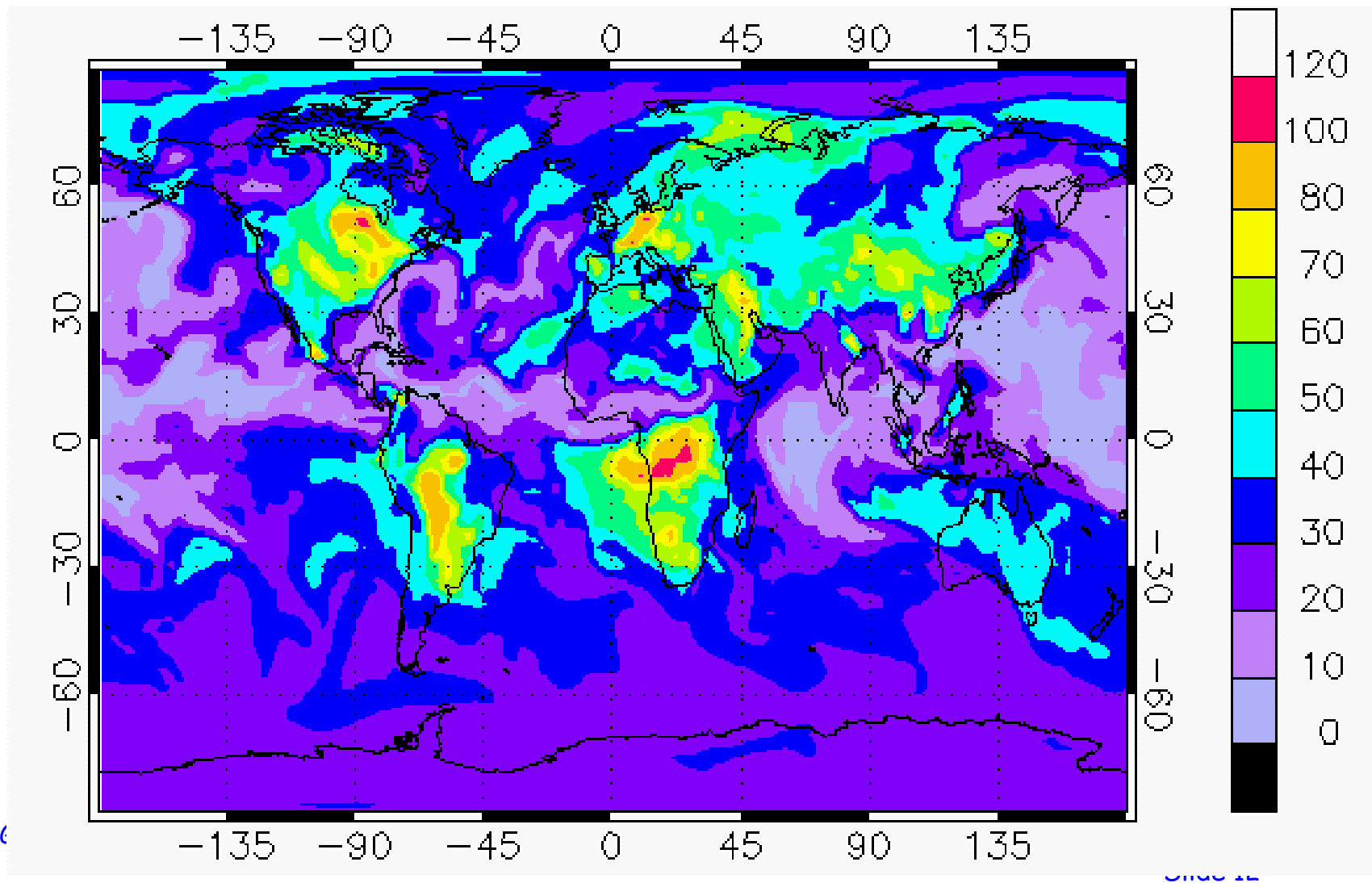
a) Ozone hole in Southern Hemisphere assimilation on 1 October 2003;

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. Sharpness due to MIPAS

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

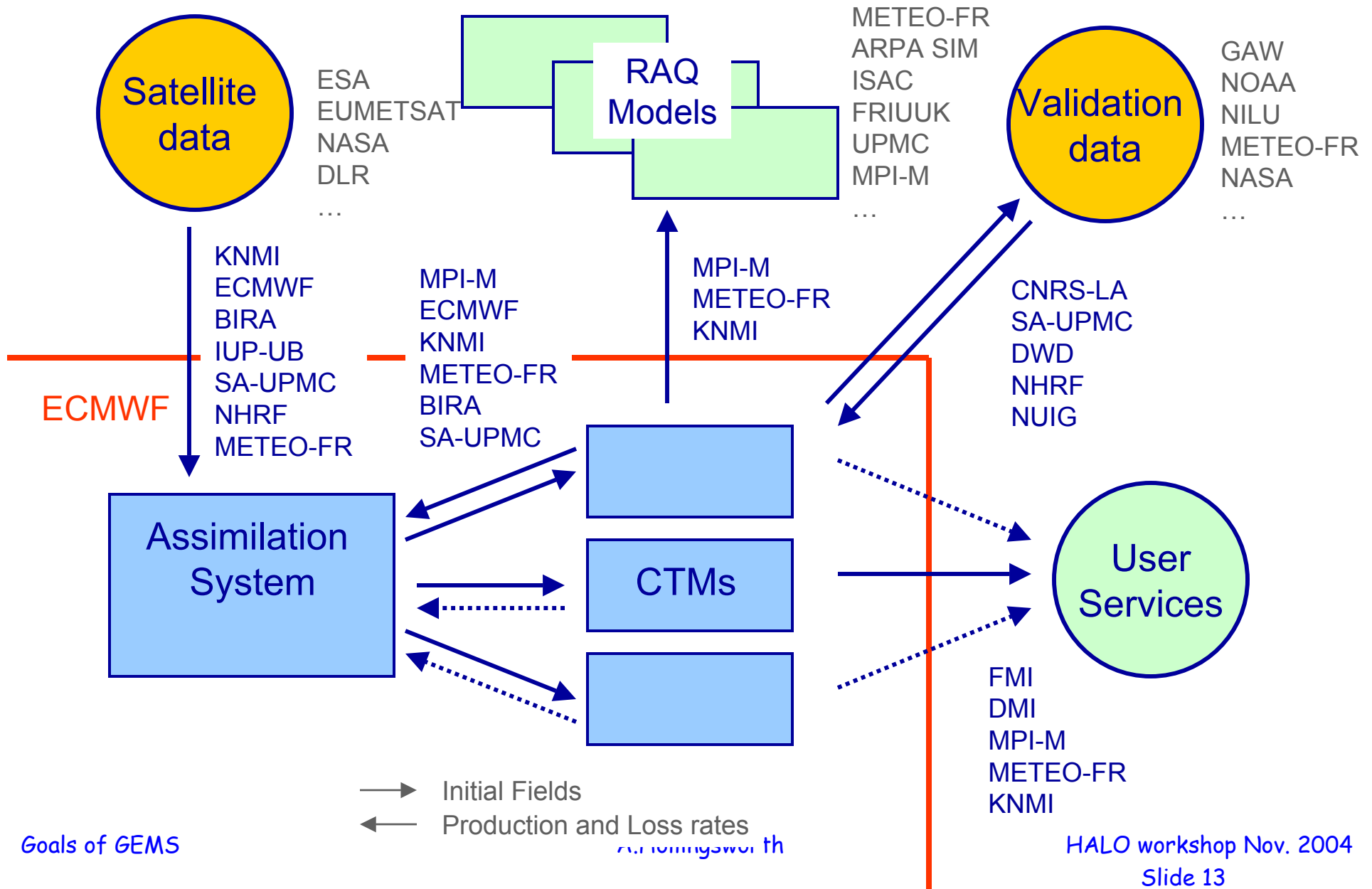
Simulation of Ozone mixing ratio (nmol/mol) at 850 hPa for August 3, 2003, 1500 UTC as simulated with MOZART-2 CTM. Modelling of Tropospheric Chemistry needs a full chemistry package and good surface emissions!

Initially we shall bootstrap by coupling GCM & CTM





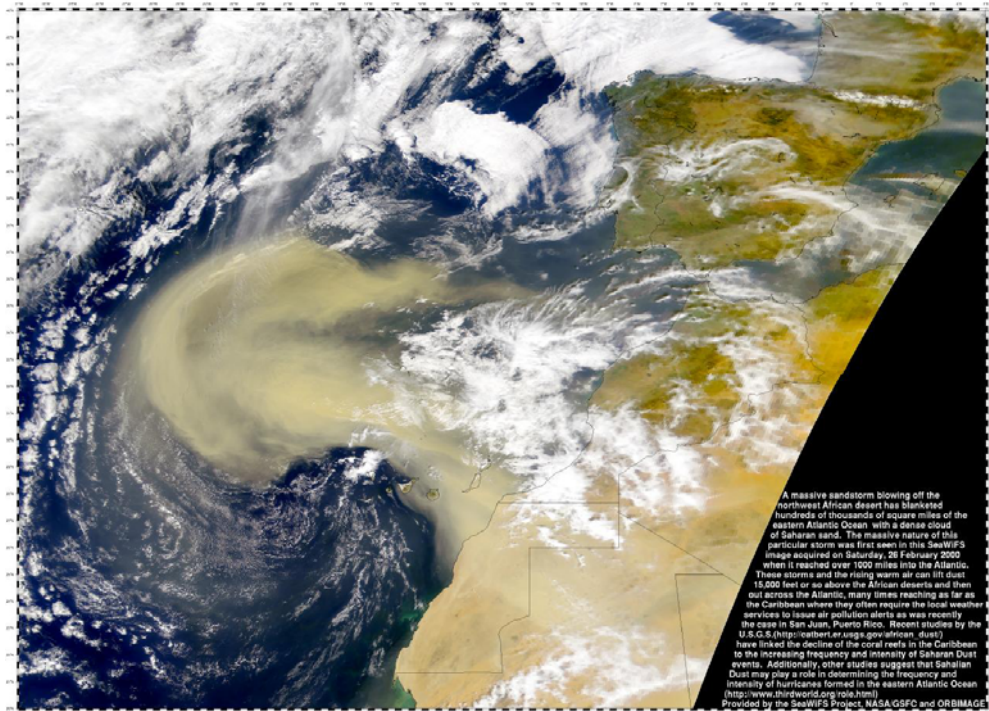
# Data Flow and Responsibilities in GEMS GRG





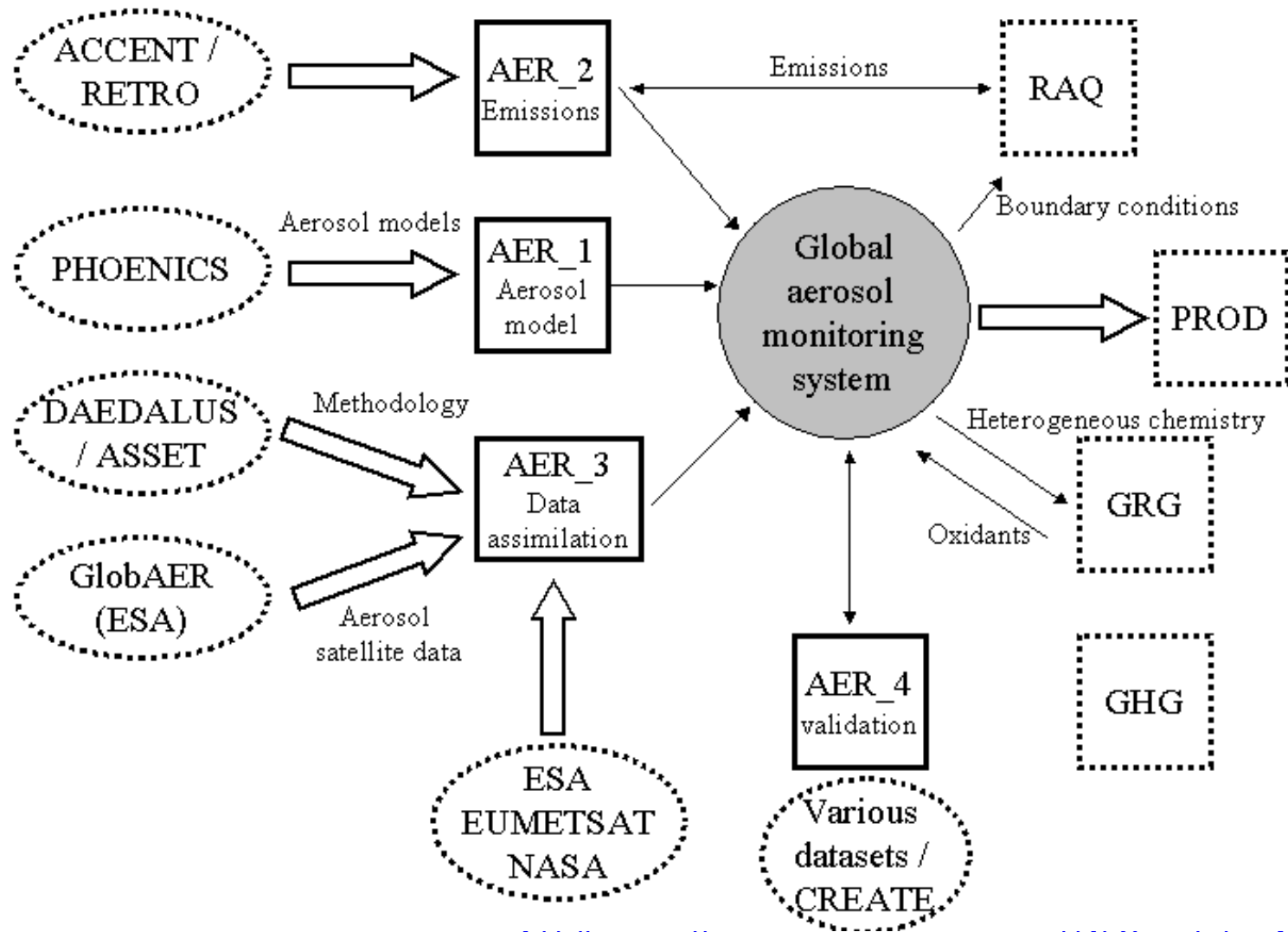
# Monitor-AEROSOL:

- 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 "





# GEMS AEROSOL Global Monitoring System





Participant Number	Institute	Individual	Institute
02	METO-UK	A. Manning	The Met Office, Exeter, Great-Britain
03	CNRS-LMD CNRS-LA CNRS-LISA	R. Vautard J.-P. Cammas V. Thouret J.-M. Flaud	Laboratoire de Météorologie Dynamique Institut Pierre-Simon Laplace Laboratoire d'Aérodynamique Observatoire Midi-Pyrénées
06	MPI-M	G. Bergametti D. Jacob B. Langmann	Laboratoire Inter-Universitaire des Systèmes Atmosphériques Max-Planck Institut für Meteorologie
07	KNMI	H. Eskes	Koninklijk Nederlands Meteorologisch Instituut
09	FMI	J. Kukkonen M. Sofiev	Finnish Meteorological Institute
10	DMI	A. Gross J.H Sorensen	Danmarks Meteorologiske Institut
13	SA-UPMC	M. Beekmann	Université Pierre et Marie Curie Service d'Aéronomie
14	NKUA	C. Zerefos D. Melas	Laboratory of Climatology and Atmospheric Environment University of Athens
<b>15</b>	<b>METEO-FR</b>	<b>V.-H. Peuch</b> A. Dufour	<b>Météo-France</b> <b>Centre National de Recherches Météorologiques</b>
18	ARPA-SIM	M. Deserti E. Minguzzi	ARPA Emilia Romagna, Servizio IdroMeteorologico
19	ISAC	F. Tampieri A. Buzzi	Institute of Atmospheric Sciences and Climate Consiglio Nazionale delle Ricerche
20	met.no	L. Tarrason L.-A. Breivik	Meteorologisk Institutt
21	FRIUUK	H. Elbern H. Jakobs	Rheinisches Institut für Umweltforschung Universität Köln
23	INERIS	L. Rouil	Institut National de l'Environnement Industriel et des Risques
24	CHMI	J.Keder, J.Santroch	Czech Hydrometeorological Institute
25	EPAI	F.McGovern B.Kelly	Irish Environmental Protection Agency
26	PIEP	W.Mill	Polish Institute of Environmental Protection
27	ICSTM	D.Briggs	A.Hollingsworth Imperial College of Science, Technology and Medicine, London

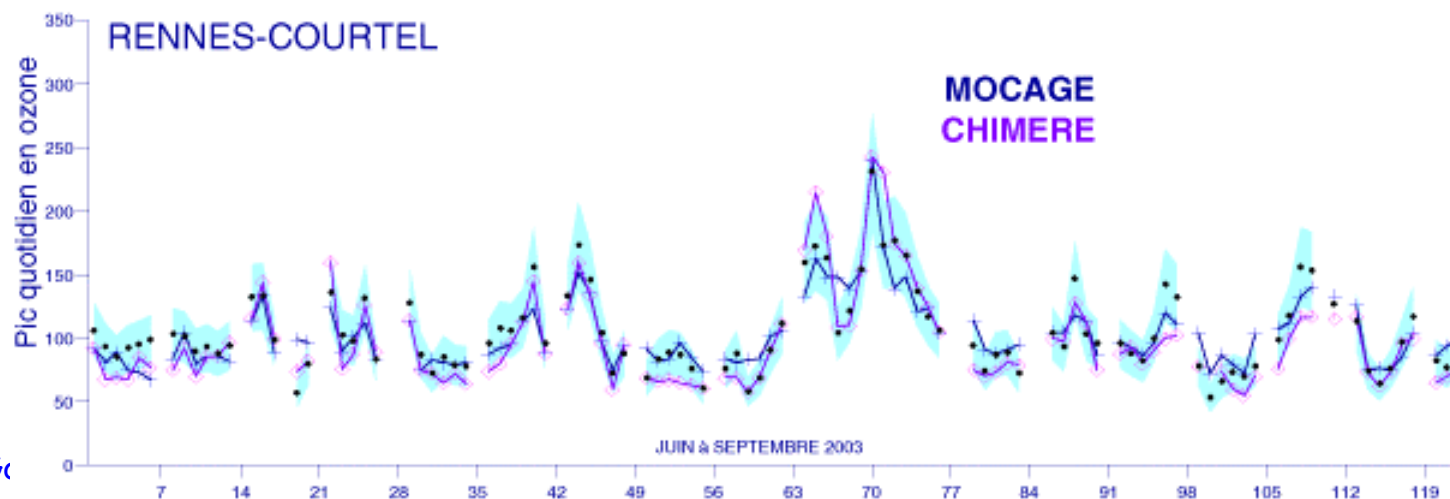
**GEMS**  
 Regional  
 Air Quality  
 Participants





## 2.2 Observations / NRT

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





## Main phases of work at ECMWF

<b>Month 1-12</b>	<b>Build and validate 3 separate assimilation systems for Greenhouse gases, Reactive gases, Aerosol; acquire data; build web-site</b>
<b>Month 13-24</b>	<b>Produce 3 different reanalyses for Greenhouse gases, Reactive gases, Aerosol; make them available for validation by all partners; feedback to data providers</b>
<b>Month 25-30</b>	<b>Merge the 3 assimilation systems into a unified system; upgrade the models and algorithms based on experiences of trial reanalyses</b>
<b>Month 31-42</b>	<b>Produce unified reanalyses for Greenhouse gases, Reactive gases, Aerosol; build operational system, with operational interfaces to partners</b>
<b>Month 43-48</b>	<b>Final pre-operational trials; documentation; scientific papers</b>



# GEMS Outreach and Operational Follow-on

GEMS outreach to the non-GEMS research community (including NMSs and Environment Agencies) will

- make all validated reanalysis and forecast material available on the web for research as soon as possible,
- welcome interested parties to the science sessions of the GEMS annual assembly
- entrain involvement of interested operational agencies in the GEMS near-real time experimentation in years three and four.

GEMDS will help prepare an operational GEMS follow-on, through discussion with interested parties (EU/GMES, ENMSs, EUMETNET, ECMWF, National Environment Agencies)

**END**

*thank you for your attention!*