GRG WP2 PROGRESS

Johannes Flemming
Olaf Stein (MPI-Hamburg)
Martin Scultz (MPI-Hamburg)
Frans Alkemade (KNMI)
Arjo Seghers (KNMI/ECMWF)
Philippe Monait (meteo-france)
Vincent Henri Peuch (meteo-france)
Claire Cranier (SA UMPC)
Antje Dethof
Claes Larsson

Outline

- GRG WP_2 overview
- Dependencies with PRO_4 & PRO_3
- Current status of CTM implementation at HPCF
- Current status of P&L discussions / implementation
- Current status of OASIS4 implementation
- Emission data
- Meteorological analysis 2003
- Summary

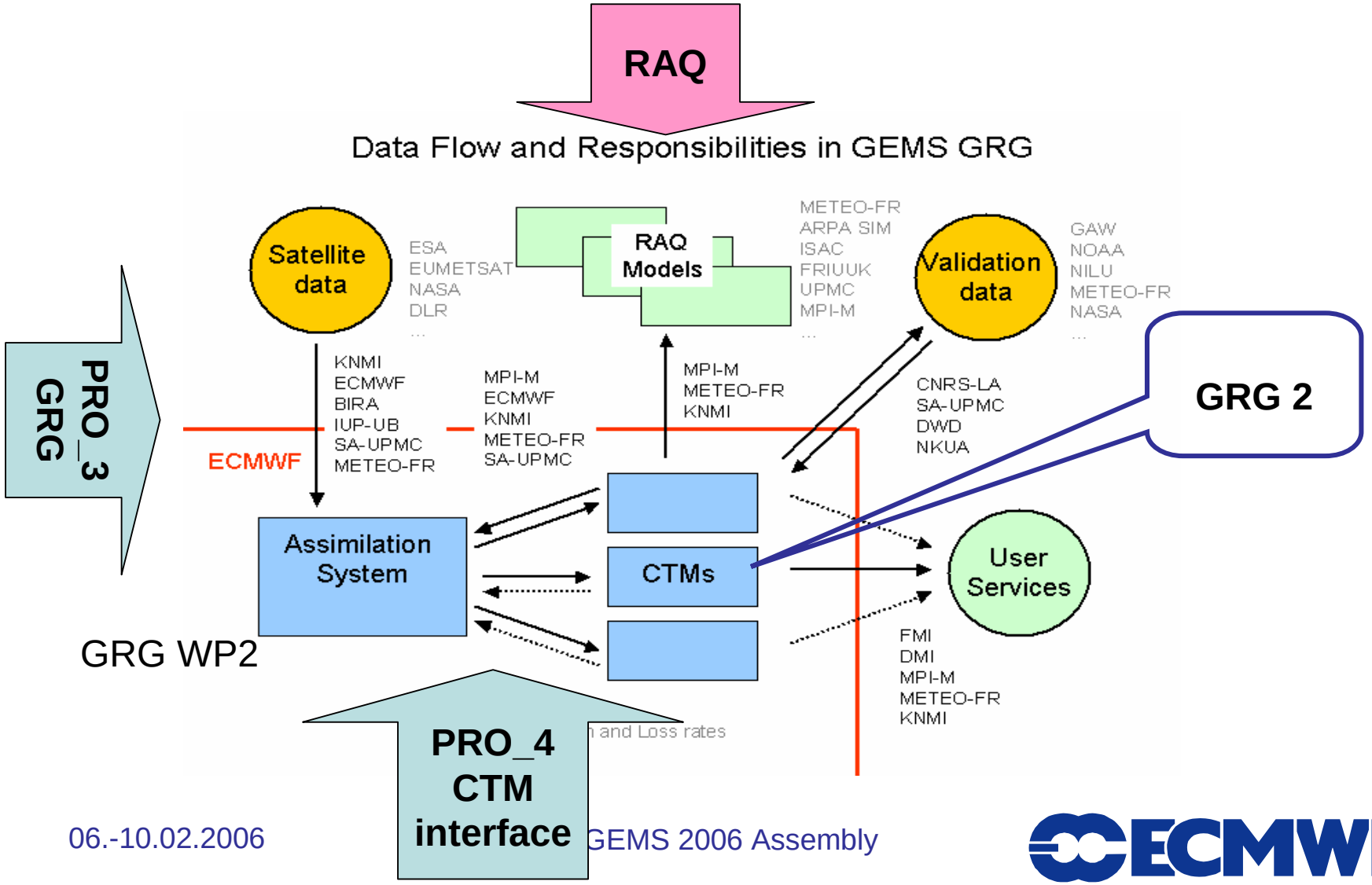
Objectives GRG 2

- *“ Implement existing three-dimensional chemistry-transport models at the ECMWF Center in order to evaluate the use of assimilated trace gas fields as tracer conditions…”*
- What means implemented?
  - Scientifically up-to-date
  - Run time performance
  - Coupler interface
  - Source and Sink information output

Why CTM at ECMWF

- Use ECMWF capabilities (operational, data assimilation system, computer resource ..) for GRG forecast and re-analysis runs
- Data assimilation of GRG species requires forward model but Chemical mechanism with 50 species can hardly be incorporated in IFS.
  - Include only O_3, CO, NO_2, SO_2 and HCHO in IFS (assimilation and transport)
  - Couple IFS with CTM (MOZART, TM5, MOCAGE)
- CTM stand-alone runs

GRG_2 Interaction



GRG WP2

GRG Production system (WP PRO_3)

- … *to bring to operations developments of GRG_1*
- IFS Interface development and general GRG support in WP PRO_4
- First analysis runs in coupled mode in autumn 2006 (PRO_3) !
- CTM have to be implemented technically by May 2006 (GRG 2.1-2.3)
- CTM-IFS interaction works scientifically acceptable (GRG 2.4-2.6, GRG 1, PRO 4)
  - This will need a lot of time
  - What can be investigated already ?

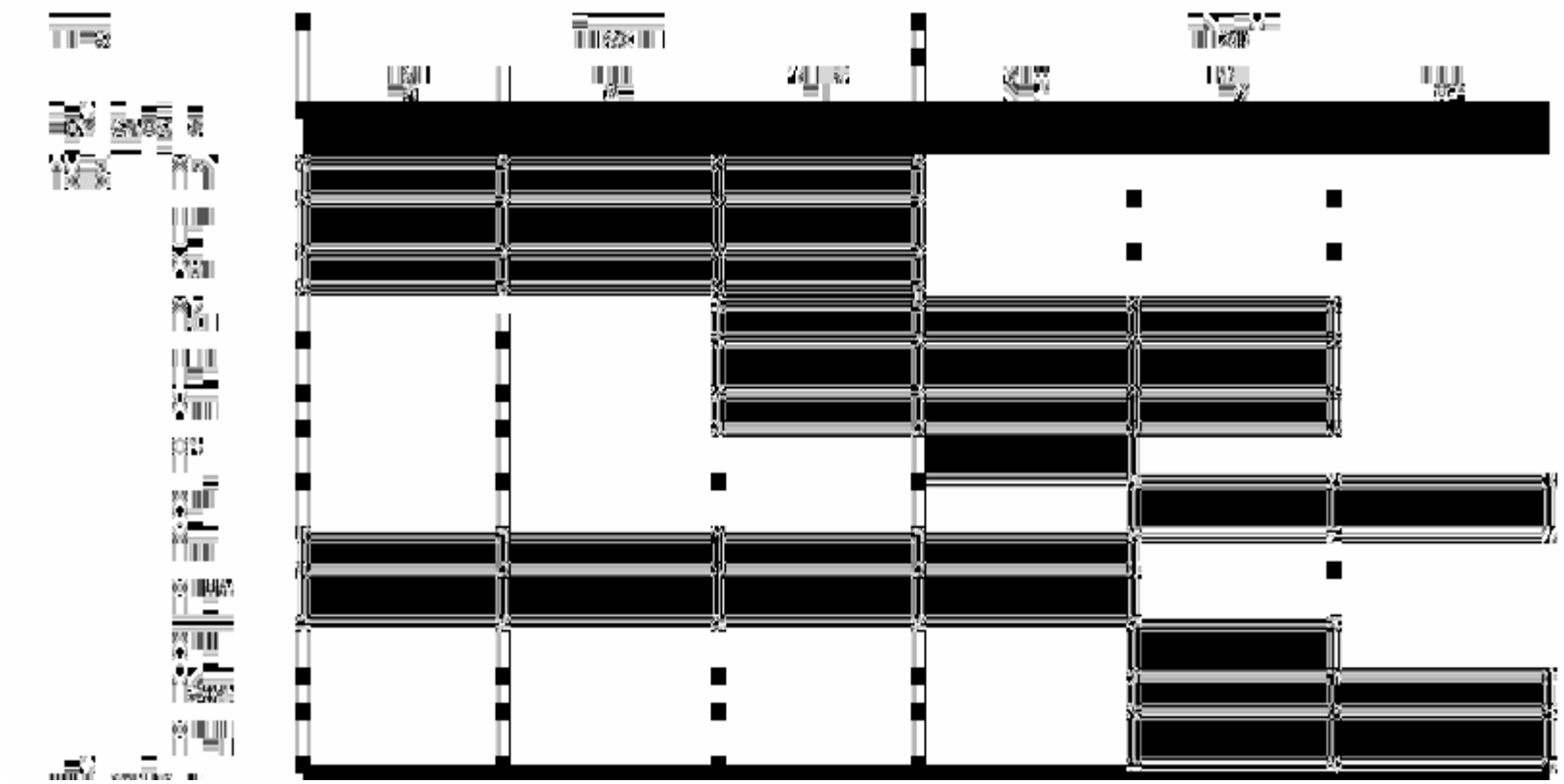
Tasks WP GRG 2

Tasks within the first 18 month

- 2.1 - 2.3 Implementation of MOZART (MPI) / TM5 (KNMI) / MOCAGE (meteo-france) & (ECMWF)
- 2.4 – 2.6 Test simulations with MOZART (MPI) / TM5 (KNMI) / MOCAGE (meteo-france) & (ECMWF)
- 2.7 Definitions of variables and quality criteria for inter –comparison (SA_UPMC)
- 2.8 Preliminary model inter-comparison (SA_UPMC)
- 2.9 Consistent estimates of anthropogenic emissions (SA_UPMC)
- 2.10 Consistent estimates of natural emissions (SA_UPMC)
- 2.11 Preparation of input data for re-analysis runs (MPI, KNMI, meteo-france)
- 2.12 Short-term variability of emission fluxes (MPI)
- 2.13 Implementation of GWEM (MPI)

Tasks WP GRG 2

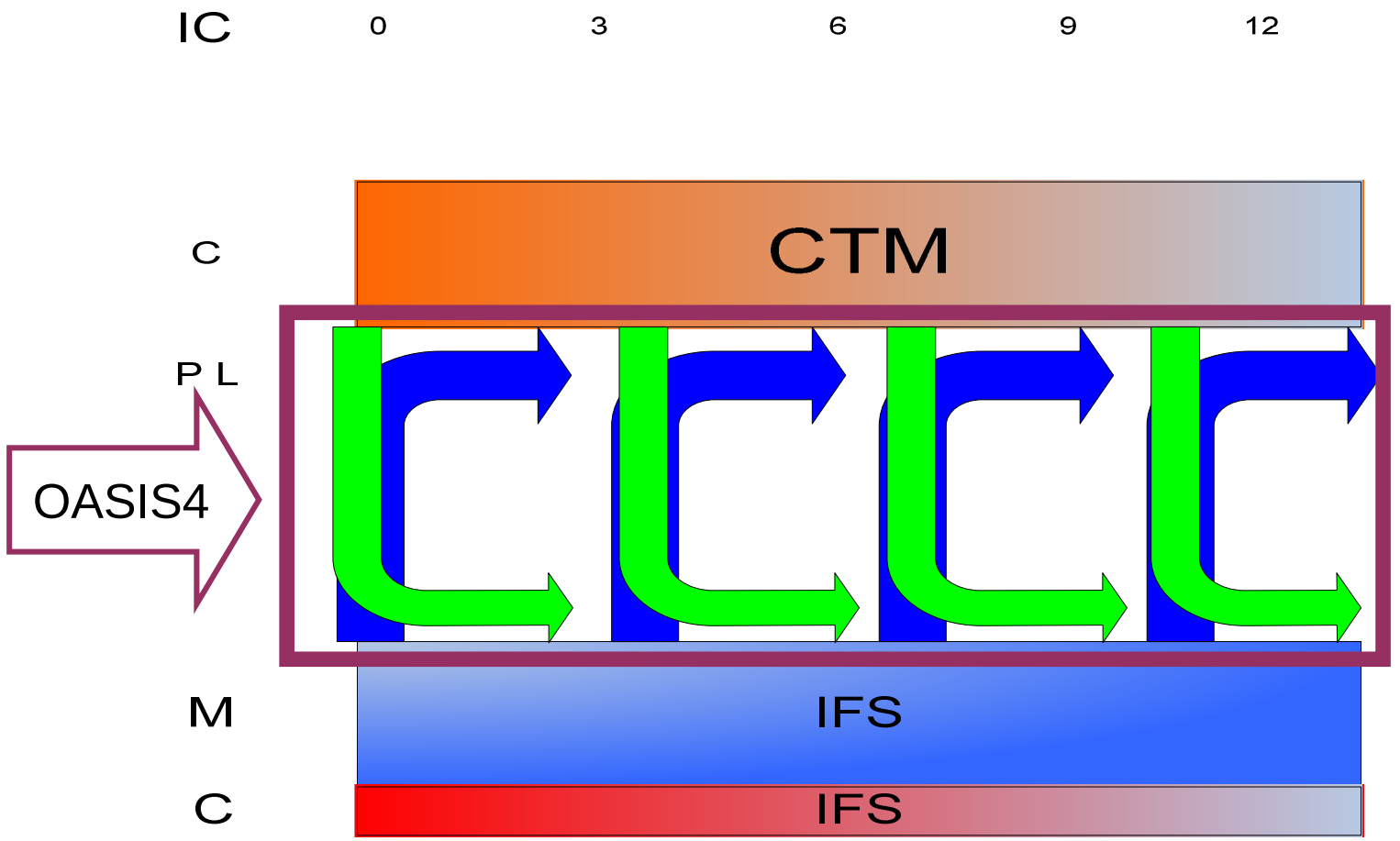
Tasks within the first 18 month



GRG technical meeting
17-18 October 2005 in Reading

- Coupling IFS and CTMs by means of OASIS4
  - High performance coupling based on MPI communication
  - Is still being developed and has to be tested
- Start discussions on implementations
  - Fields to be exchanged
  - Formulation and of missing sink and source terms
  - Loss rates vs. tendencies, totals vs. process specific
  - Vertical interpolation
  - Compilation and Scheduling setup for coupled runs
- Storage and archiving

2 way - Coupling in Forecast mode



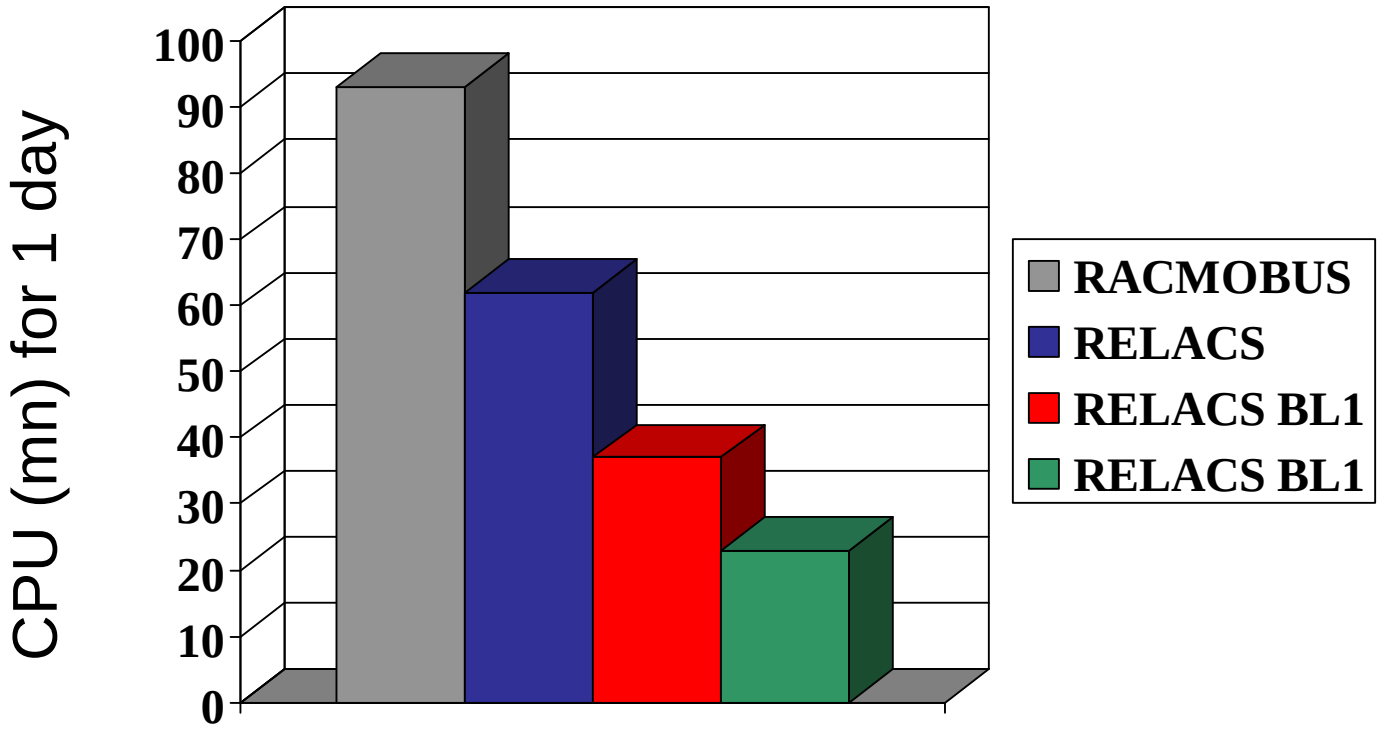
Proposed implementation

- IFS to CTM: Basic meteorological fields
  - high update frequency
- CTM to IFS: One total 3D tendency field accounting for emission, deposition, chemistry, deposition, convection ("IFS with CTM physics")
  - high update frequency
- IFS advects its five chemical compounds
- IFS applies the total tendencies with diffusion and convection switched off
- Monovariate chemistry assimilation
- IFS to CTM: 3D concentration fields (analyses or forecasts)
  - at lower frequency or
  - applied with a nudging scheme.

CTM Implementation Status
(GRG_WP 2)

- All CTM are implemented at ECMWFs HPCF
- MOZART:
  - MPI and openMP with horizontal domain decomposition
  - **1 day** in T63/L60/106s on 96 CPUs ~ **5.25 min**
- TM5:
  - MPI parallel over layers and species
  - **1 day** in 3º*2º/25L/50s on 8 CPUs = **30 min**
- MOCAGE:
  - openMP or MPI parallel over chemistry, newly developed
  - 1 day in 2º*2º/60L/118s on 16 CPUs = **160 min** (reduced model version 40 min)
- First test runs started to start soon with new 2003 re-analysis

Available options for reducing the CPU: results with the “climate” version of MOCAGE



Standard version
2°x2° 47 niv.

Climate version
T42 60 niv.

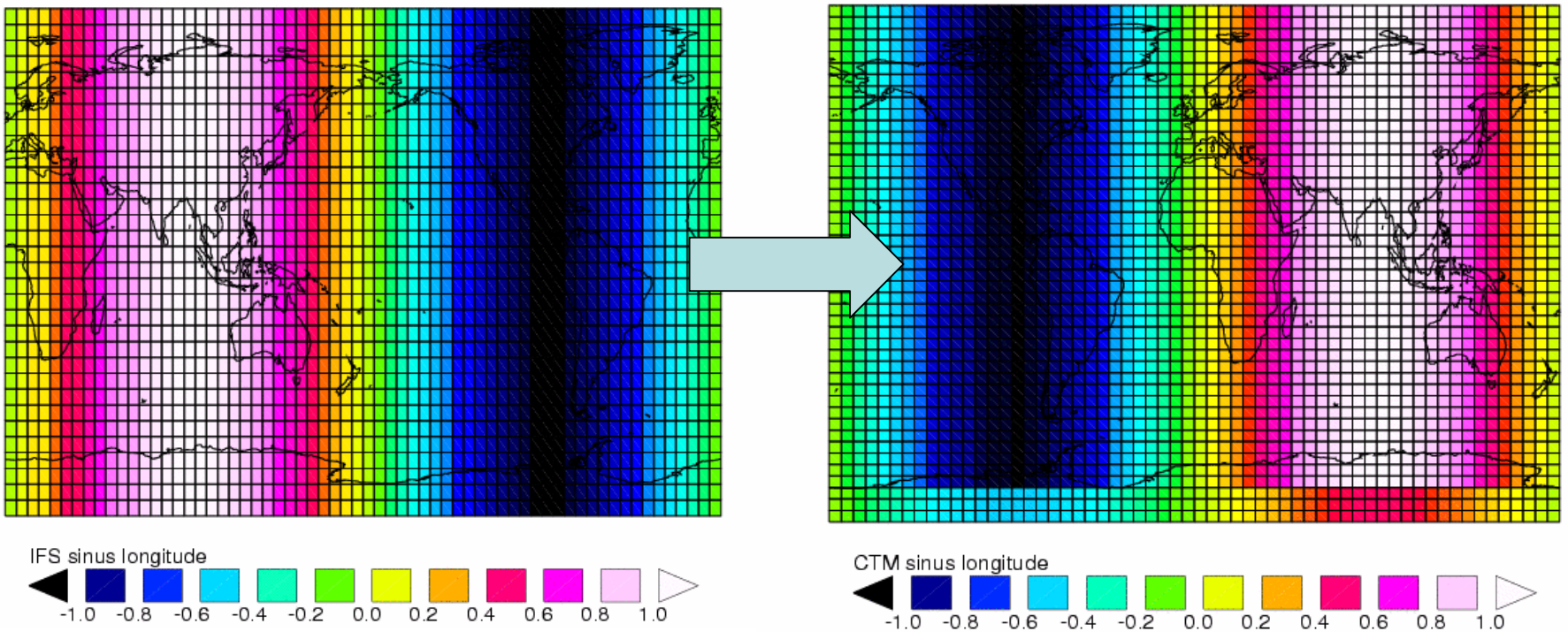
CTM Implementation Status
(GRG_WP 2)

- Implementation of OASIS4 interface
  - **TM5: OASIS4-coupled with IFS (T21/L19) in simple configuration in test environment**
  - MOCAGE: OASIS4 interface for input ready in serial model version
  - MOZART: previous OASIS3 interface
  - *Special session*
- Implementation of source & sink tendency terms for output
  - TM5: implementation in progress
  - MOZART: chemistry only
  - MOCAGE: not started (?)

Interpolation tests with latest version (Arjo)

IFS

TM5

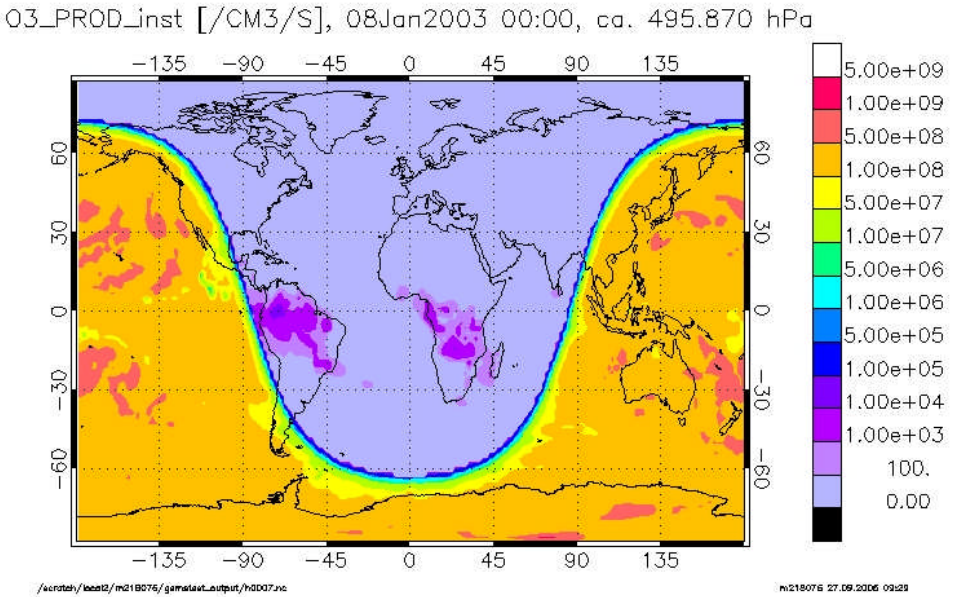


GRG – coupled system (modelling)
(PRO_4, GRG_WP1&2, PRO_3)

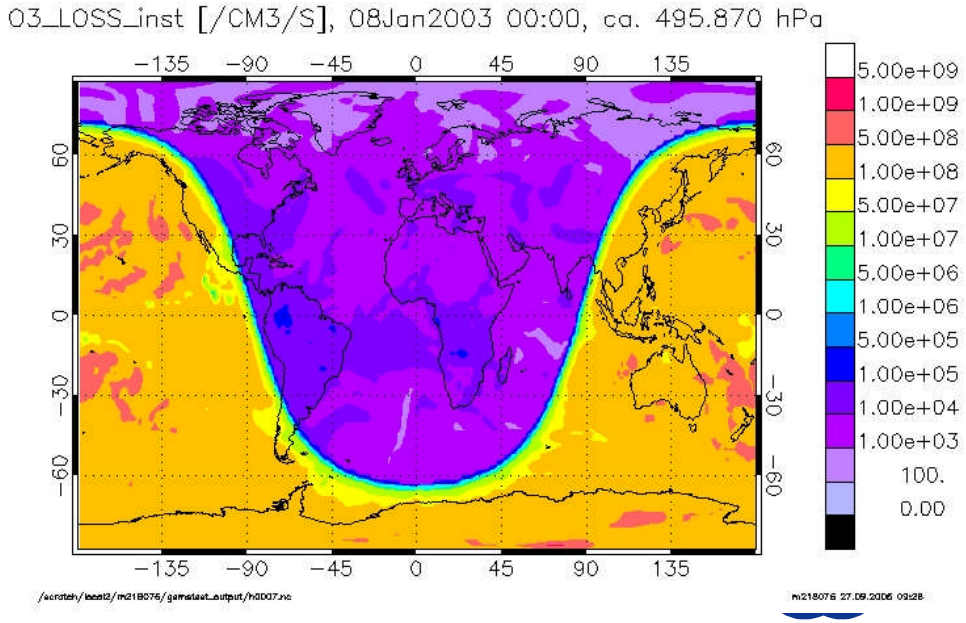
- OASIS4 (PRO_4.1)
  - OASIS4 supports reduced Gaussian grid (…*after lots of test*)
  - OASIS4 functionality limited but something to work with
  - OASIS4 code management (libraries for linux and HPC)
- IFS (PRO_4.1, GRG_1.3, GRG_2)
  - IFS output (15 fields) and input interface (5 fields) ready
  - Coupled System IFS – toy_ctm running on HPCD and linux
  - Start of coupled runs (forecasts and later analysis) with prepIFS
  - Name list based control of coupled mode (PRO_4.1 & 3.1)
  - Toy-ctm reads-in concentration and chemical tendency fields from MOZART run and passes them to IFS
  - …. w*aiting for a CTM ready to be coupled* …

500 hPa

$P(O_3)$
MOZART



$L(O_3)$
MOZART



06.-10.02.2006

Emission Task 2.9-2.11

- SA UMPC compared MOZART concentration data with GOME measurements to investigate temporal & spatial variability
- MPI Hamburg compiled new 2003 GEMS GRG data using RETRO & GFEDv2 data
- MOCAGE emission input adapted to new data (RETRO, POET biogenic)
- What are the differences between MPI and meteo-france data ?

Summary

- Task 2.1.-2.3. (CTM Implementation) finished according to plan
- Extra efforts due to OASIS4 interface implementation and testing
- CTM testing started (2.4-2.6)
- Emission task started (2.9.-2.10)
- Some pressure due to tight PRO schedule
  - Coupled system should be technically ready in May 2006