



An integrated forecasting system for global reactive gases in the troposphere and stratosphere The GRG sub-project of MACC

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Objectives of the project:

- Develop an operational modelling system with data assimilation to forecast and analyze trace gas concentrations in the troposphere and stratosphere
- Perform multi-year reanalysis of the atmospheric chemical composition
- Begin the development of a fully coupled chemistry transport model based on the ECMWF integrated forecasting system in order to eliminate inconsistencies arising from the coupled set-up developed previously within the GEMS project.

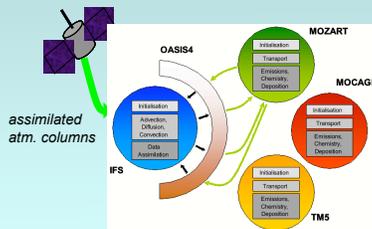
Forecasts and Reanalysis

The prototype once-daily system run in the preparatory GEMS project will be evolved in MACC so it produces global analyses and forecasts twice-daily within a few hours of observation time. The cut-off times for observational data receipt and the production schedule will be chosen to optimise real-time product quality for users.

MACC will provide a reanalysis of global atmospheric composition for the period 2003 - 2011. It will use satellite observations from different platforms. The simulated distributions will be compared with in-situ observations and surface data: for example, measurements from the GAW and NOAA/GMD networks will be used, together with aircraft data from the IAGOS (In-service aircraft for a global observing system).

The reanalysis is expected to start early 2010 and as soon as plots and data products are available, they will be published on the web pages of the MACC project. In the mean time MACC provides results from the 2003 - 2007 reanalysis of the preceding GEMS project.

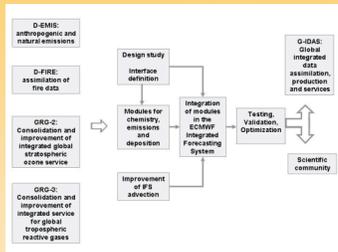
The GEMS GRG modeling system



Three global chemistry transport models have been coupled to the ECMWF Integrated Forecasting System (IFS) using the OASIS4 coupling software. Meteorological fields and chemical tendencies are exchanged at hourly intervals.

The GEMS-GRG system uses the data assimilation capabilities of the IFS system, which have been extended to accommodate column data of ozone, NO₂, CO, HCHO and SO₂. The MOZART, TM5 and MOCAGE models are used for forecasting/analysis, and the MOZART model is used for the reanalysis.

The integrated system to be developed within MACC

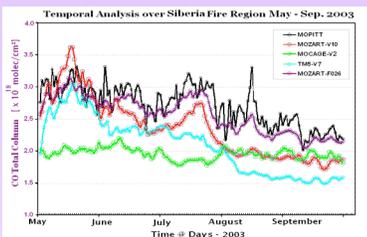


Within MACC, a demonstration version of a new model will be developed in which tropospheric and stratospheric chemistry will no longer run as separate models with a coupling interface to the ECMWF IFS, but will become part of the IFS code. The new model will consist of a flexible modular system which will allow for the exchange of specific parts of the chemistry code (reaction system, solver, emissions, deposition, etc.). Some preparatory work will be performed in order to create a portable model code, train the project partners in ECMWF coding rules and test the components of the system, and more specifically the tracer transport scheme.

Evaluation of the products

The MACC project includes a detailed evaluation of the simulations products. The reanalysis simulations and the quality of the predictions are assessed using routine chemical observations and event-based case studies.

Reports on the detailed evaluation work previously performed within GEMS and on the different metrics used for assessing the results are available from the GEMS project web site. Two examples are included in this poster, which emphasize the role of data assimilation



2003 Siberian fires case studies

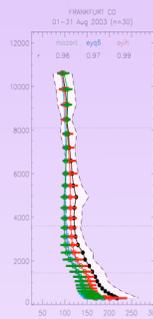
Simulations represented in the figure:

MOZART V10 = December 2008 stand-alone reference run for the year 2003. GRG anthropogenic emission and 8-day GFEDv2 fire emissions.

F206 = 2nd reanalysis run with assimilation (SCIAMACHY, MIPAS, GOME, SBU).

MOCAGE v2: stand-alone reference run. Uses vertical profiles of 8-day GFEDv2 for CO fire emissions inventories.

TM5 V7: Uses GRG anthropogenic emission inventories and monthly GFEDv2 for fire emissions inventories, injected in different amount to certain height levels.



Evaluation of the GEMS reanalysis:

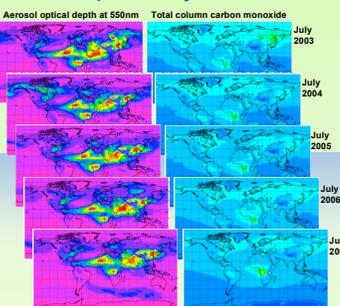
Comparison with observations from the MOZAIAC aircraft during ascent/descent at the Frankfurt airport. CO vertical profiles for August 2003.

Examples of products:

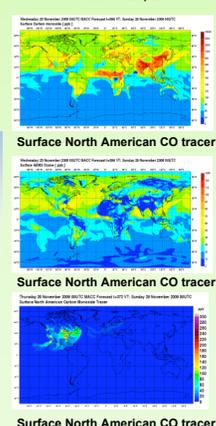
- Monitoring and forecasting of global atmospheric composition :daily analysis and 4-day forecast of global 3-dimensional ozone, carbon monoxide and aerosol
- Reanalysis of global atmospheric composition for the period 2003-2011 (this reanalysis will start at the beginning of 2010)
- Support for scientific observations campaigns: specific plots and special tracers to support campaign, such as the HIPPO campaign (Pole to Pole observations)
- Global fire emissions: observations of fire radiative power to estimate global fire emissions of CO₂, CH₄, CO, NO_x, etc. and aerosols

Link : <http://www.gmes-atmosphere.eu/data/>

From retrospective analysis for 2003 - 2009



Forecasting of the global composition of the atmosphere for November 29, 2009.



Results of the reanalysis for aerosol optical depth and total column carbon monoxide for the months of July from 2003 to 2007 from the GEMS reanalysis.