Global Reactive Gases and Aerosols

Draft integrated service specifications and road map

Part 1: Technical service description

Service 2: Boundary conditions for regional air quality analyses and forecasts

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Objectives

- provide chemical tracer boundary conditions from MACC global reanalyses and forecasts for regional air quality models in Europe and elsewhere

Users

- MACC partners in R-ENS
- AQMEII (contact: Kenneth Scheere, US EPA)
- GURME (contact: Gregory Carmichael, Univ. Iowa)
- Indian Institute of Tropical Meteorology (contact: Gufran Beig, Pune)
- Shanghai Meteorological Bureau SMB (contact: Fuhai Geng)
- Operators of regional air quality models world-wide

Design criteria:

- provide regular data from daily forecasts with sufficient spatial and temporal resolution
- provide gridded fields with sufficient time resolution from reanalysis runs
- online data access in near-real time with the possibility of a dynamic enquiry
- daily data delivery before 6am UMT for regional forecasts
- data format netcdf
- long-term consistency
- provision of quality-controlled data

Service description

The MACC regional air quality boundary condition service provides chemical tracer boundary conditions for regional air quality models from MACC global reanalyses and forecasts. The service enables the operators of regional air quality models world-wide to select and retrieve the lateral and top boundary conditions for concentrations of up to 32 chemical tracers according to their needs. Presently, data must be retrieved from two different storage locations at ECMWF and access to ECMWF computers must be granted. The concentrations of the gas-phase species Ozone and CO as well as of the aerosol tracers dust,

sea salt, black carbon (BC) and organic carbon (OC) are retrieved from the IFS output on the ECMWF MARS archive. Additional 22 tracer concentrations are available from the MOZART global CTM tracer output fields which are stored as netcdf files on the ECMWF ECFS archive as part of the global MACC forecast and reanalysis system with the coupled model MOZART-IFS (table 1). Data is available for any region of the world with a temporal resolution of 3h and a horizontal resolution of approximately 1.875° (T63, GEMS) and 1.1° (T106, MACC) and about 125 km (T159) for the IFS output. The IFS resolution has been improved for the MACC reanalysis to about 78 km (T255). The vertical coordinates are 47 hybrid sigma-pressure model levels with centre values between the surface and 10 hPa. These levels refer to the 47 lowest levels of the IFS 60 level model version. Technical details on the IFS system as a whole as well as on vertical and horizontal resolution can be found at http://www.gmes-atmosphere.eu/about/product_portfolio/streams/primary_global/specification.
Software for horizontal interpolation and conversion to netcdf is provided with the MARS archive.
Historic reanalyses from the MACC predecessor project GEMS are available from 2003 to 2008. A new MACC reanalysis will cover the time period 2003-2009. The boundary condition files from the daily forecasts can be made available within minutes after posting of the global MACC forecast products.
Software will be developed which allows the automated and flexible selection of boundaries and of chemical tracers via a web-based interface. In a future version of this service, all data fields shall be retrieved from one location.

Currently, MACC tracer concentrations are provided as boundary conditions for the European regional air quality models employed in MACC R-ENS. This prototype service is based on static netcdf files stored in ECFS and accounts for the different needs of the R-ENS models. For other world regions, the model operators should contact the GRG team to discuss the optimal set-up.

Type of global simulations

- GEMS reanalysis (2003-2008)
- MACC reanalysis (2003-2009)
- Daily MACC forecasts up to 4 days

Output characteristics

- horizontal resolution: IFS: T159 (GEMS reanalysis and MACC forecasts)
- horizontal resolution: IFS: T255 (MACC reanalysis)
- horizontal resolution: MOZART / GEMS reanalysis: T63
- horizontal resolution: MOZART / MACC reanalysis and forecasts: T106
- vertical grid: 47 hybrid sigma-pressure model levels from the surface to 10 hPa
- volume mixing ratios for 28 chemical tracers: see Table 1; each concentration value should be interpreted as mean value over the 15 minute model time step
- temporal resolution: 3 hours beginning at 00 h GMT

Table 1: chemical tracers available as boundary conditions for regional air quality models

	Tracer	long name	units	source	quality
1	O3	ozone	mole mole-1	IFS	assimilated and validated
2	CO	carbon monoxide	mole mole-1	IFS	assimilated and validated
3	N2O	nitrous oxide	mole mole-1	MOZART	no validation
4	NO	nitric oxide	mole mole-1	MOZART	no validation
5	NO2	nitrogen dioxide	mole mole-1	MOZART	validated
6	NO3	nitrate radical	mole mole-1	MOZART	no validation
7	HNO3	nitric acid	mole mole-1	MOZART	no validation
8	HO2NO2	peroxynitric acid	mole mole-1	MOZART	no validation
9	CH4	methane	mole mole-1	MOZART	no validation
10	CH2O	formaldehyde	mole mole-1	MOZART	no validation
11	C2H6	ethane	mole mole-1	MOZART	no validation
12	CH3CHO	acetaldehyde	mole mole-1	MOZART	no validation
13	GLYOXAL		mole mole-1	MOZART	no validation
14	PAN	peroxyacetylnitrate	mole mole-1	MOZART	no validation
15	BIGENE	higher alkenes (C≥4)	mole mole-1	MOZART	no validation
16	BIGALK	higher alkanes (C≥4)	mole mole-1	MOZART	no validation
17	ISOP	isoprene	mole mole-1	MOZART	no validation
18	TOLUENE	(C7H8, benzene/toluene/xylene)	mole mole-1	MOZART	no validation
19	C10H16	terpenes	mole mole-1	MOZART	no validation
20	SO2	sulfur dioxide	mole mole-1	MOZART	no validation
21	SO4	sulfate	mole mole-1	MOZART	no validation
22	DMS	dimethyl sulfide C2H4S	mole mole-1	MOZART	no validation
23	NH3	ammonia	mole mole-1	MOZART	no validation
24	NH4NO3	ammonium nitrate	mole mole-1	MOZART	no validation
25	DUST 1	dust (0.03-0.55 microns)	µg m-3	IFS	assimilated as total AOD and validated
26	DUST 2	dust (0.55-0.9 microns)	µg m-3	IFS	assimilated as total AOD and validated
27	DUST 3	dust (0.9-20 microns)	µg m-3	IFS	assimilated as total AOD and validated
28	SEASALT 1	sea salt (0.03-0.5 microns)	µg m-3	IFS	assimilated as total AOD and validated
29	SEASALT 2	sea salt (0.5-5 microns)	µg m-3	IFS	assimilated as total AOD and validated
30	SEASALT 3	sea salt (5-20 microns)	µg m-3	IFS	assimilated as total AOD and validated
31	BC	black carbon	µg m-3	IFS	assimilated as total AOD and validated
32	OC	organic matter	µg m-3	IFS	assimilated as total AOD and validated

Assimilated species are constrained by satellite data.
Additional information on the lumping of chemical species found in the GEMS dataset can be found in the following MOZART model references:

http://gems.ecmwf.int/do/get/PublicDocuments/1531/1172?showfile=true
http://www.geosci-model-dev.net/3/43/2010/gmd-3-43-2010.pdf

Input data for global simulations

- anthropogenic and natural emissions from D-EMIS (monthly fields)
- daily fire emissions from D-FIRE (Gfedv3/FRP product)
- offline dry deposition (climatological values)

Note that input data sets from the GEMS reanalysis differ from those of the MACC reanalysis and the MACC daily forecasts.

Validation

Ozone and CO are regularly validated by comparing model output with observations from GAW surface stations, MOZAIC/IAGOS aircraft and independent satellite retrievals. Additional validation, also for some other compounds, is performed on a case by case basis.

Road map

- Jan 2010: Prototype service for R-ENS partners in MACC (only Europe)
- May 2010: Prototype service for selected users (AQMEII / Indian Met Service), GEMS reanalysis
- Autumn 2010: Further service development to enhance user-friendliness