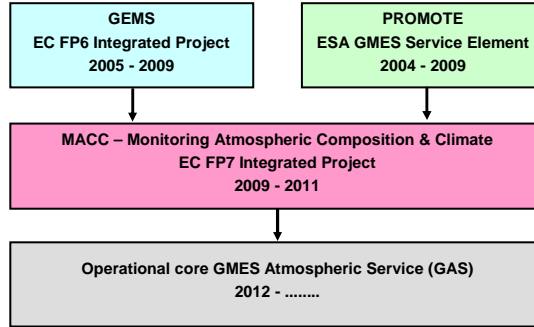


Global Reactive Gases emission inventories in GEMS and MACC

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EU Projects GEMS and MACC

Starting in 2005, the FP6 project GEMS (Global and regional Earth system Monitoring using Satellite and in-situ data) aimed at establishing a European monitoring and forecast facility with data assimilation for greenhouse gases, reactive gases, and aerosols at ECMWF both on a regional and global scale. The FP7 project MACC (Monitoring Atmospheric Composition & Climate) is designed to continue, improve, extend, integrate and validate the GEMS service lines, so that the overall MACC system is ready near the end of 2011 for qualification as the operational GMES Atmospheric Core Service. MACC will prepare this core service in terms of implementation, sustained operation and availability.



Project details and Web service products at <http://gems.ecmwf.int>

Global Reactive Gases

Three Chemical Transport Models (MOZART3, TM5, MOCAGE) are currently coupled to ECMWF's Integrated Forecast Model (IFS) to build a coupled system CTM-IFS which adds detailed atmospheric chemistry to the ECMWF forecast system. In MACC this system will be further developed into a chemistry module of a meteorological and chemical forecast model C-IFS. The integrated global reactive gases forecasting for stratospheric and tropospheric ozone, ozone precursors (NO_x, CO, HCHO, SO₂) developed in the GEMS project will be operated and improved, including the extended validation with independent data and through well-defined case studies

Global Surface Emission Inventories

Anthropogenic Emissions

Unfortunately, there was no funding for the development of updated emission inventories in the GEMS project. Thus we started with the anthropogenic emissions available from the RETRO project (see <http://retro.enes.org>) and assumed the RETRO 2000 emission inventory to be valid also for the GEMS reanalysis years 2003-2009. Monthly gridded emissions from 19 species have been compiled for 7 sectors. Over the Asian region the RETRO emissions have been replaced by emissions from the regional REAS inventory (Ohara et al. 2007) but keeping the RETRO seasonality. Ship emissions were originally taken from Endresen et al. (2003) and have been updated to source strengths according to Corbett et al. (2003).

Future plans:

The objectives of the D-EMIS sub-group within MACC are to evaluate anthropogenic and natural emissions inventories. Current surface emission inventories will be updated based on evaluation. A link with the GEIA and AEROCOM international projects is established for defining a methodology for inter-comparison and evaluation of emissions. As a first case SO₂ anthropogenic surface emissions are evaluated (GEMS inventory vs. AEROCOM, IPCC and literature) and updated with main focus on metal smelting industry.

For further details see poster P10 from Khokhar et al.

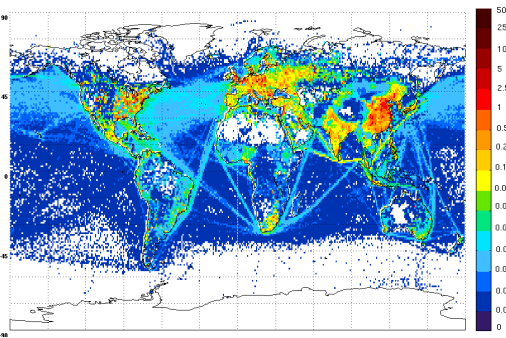


Figure 1: D-EMIS updated 2003 anthropogenic SO₂ inventory [10⁹ kg m⁻² s⁻¹]

Natural Emissions

Monthly biogenic emissions for 10 species were taken from Lathière et al. (2006). Emissions from Oceanic sources, NO soil emissions, and SO₂ emissions from continuously outgassing volcanoes are from GEIA. The DMS emissions are from the marine biogeochemistry model HAMOCC5 (Kloster et al. 2006).

Future plans:

In the C-IFS biogenic emission inventories will be replaced by online calculation of emissions from vegetation based on MEGAN (Guenther et al. 2006).

Species	Anthropogenic	Natural	Wildfire
CO	RETRO / REAS + Ships	GEIA	GFEDv2
NO _x	RETRO / REAS + Ships	GEIA + Lathière04	GFEDv2
CH ₃ OH	RETRO / REAS	Lathière04	GFEDv2
C ₂ H ₅ OH	RETRO / REAS	Lathière04	GFEDv2
C ₃ H ₈	RETRO / REAS + Ships	Lathière04	GFEDv2
C ₄ H ₁₀	RETRO / REAS + Ships	GEIA	GFEDv2
C ₅ H ₁₂	RETRO / REAS		
C ₆ H ₁₄	RETRO / REAS + Ships		
C ₇ H ₁₆	RETRO / REAS + Ships	GEIA + Lathière04	GFEDv2
C ₈ H ₁₈	RETRO / REAS + Ships	GEIA	GFEDv2
C ₉ H ₂₀	RETRO / REAS + Ships	Lathière04	GFEDv2
C ₁₀ H ₂₂	RETRO / REAS	Lathière04	GFEDv2
C ₁₁ H ₂₄	RETRO / REAS		
C ₁₂ H ₂₆	RETRO / REAS		
C ₁₃ H ₂₈	RETRO / REAS + Ships	GEIA + Lathière04	GFEDv2
C ₁₄ H ₃₀	RETRO / REAS + Ships	GEIA	GFEDv2
C ₁₅ H ₃₂	RETRO / REAS + Ships	Lathière04	GFEDv2
C ₁₆ H ₃₄	RETRO / REAS	Lathière04	GFEDv2
C ₁₇ H ₃₆	RETRO / REAS		
C ₁₈ H ₃₈	RETRO / REAS + Ships		
C ₁₉ H ₄₀	RETRO / REAS + Ships		
C ₂₀ H ₄₂	RETRO / REAS + Ships		
C ₂₁ H ₄₄	RETRO / REAS + Ships		
C ₂₂ H ₄₆	RETRO / REAS + Ships		
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C ₂₉ H ₆₀	RETRO / REAS + Ships		
C ₃₀ H ₆₂	RETRO / REAS + Ships		
C ₃₁ H ₆₄	RETRO / REAS + Ships		
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C ₇₂ H ₁₄₆	RETRO / REAS + Ships		
C ₇₃ H ₁₄₈	RETRO / REAS + Ships		
C ₇₄ H ₁₅₀	RETRO / REAS + Ships		
C ₇₅ H ₁₅₂	RETRO / REAS + Ships		
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C ₇₇ H ₁₅₆	RETRO / REAS + Ships		
C ₇₈ H ₁₅₈	RETRO / REAS + Ships		
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C ₉₂ H ₁₈₆	RETRO / REAS + Ships		
C ₉₃ H ₁₈₈	RETRO / REAS + Ships		
C ₉₄ H ₁₉₀	RETRO / REAS + Ships		
C ₉₅ H ₁₉₂	RETRO / REAS + Ships		
C ₉₆ H ₁₉₄	RETRO / REAS + Ships		
C ₉₇ H ₁₉₆	RETRO / REAS + Ships		
C ₉₈ H ₁₉₈	RETRO / REAS + Ships		
C ₉₉ H ₂₀₀	RETRO / REAS + Ships		
C ₁₀₀ H ₂₀₂	RETRO / REAS + Ships		
HCHO	RETRO / REAS	Lathière04	GFEDv2
CH ₃ CHO	RETRO / REAS	Lathière04	GFEDv2
CH ₃ COCH ₃	RETRO / REAS	Lathière04	GFEDv2
H ₂	RETRO / REAS + Ships	GEIA	GFEDv2
SO ₂	EDGAR2 / REAS + Ships	GEIA	GFEDv2
NH ₃	EDGAR2	GEIA	GFEDv2
DMS		Kloster06	

Table 1: Surface emissions CTM-IFS in GEMS and MACC

Wildfire Emissions

Currently the emissions from open wildfires are from the GFEDv2 inventory (van der Werf et al. 2006). Files with monthly resolution are available for the years 1997-2008 and with 8-day resolution from 2001-2007. Emissions are determined by scaling the GFED carbon emissions by the emission factors of Andreae & Merlet (2001) plus personal updates, using the vegetation classification provided with GFED. The vertical distribution of these emissions are treated differently by the CTMs. In MOZART all wildfire emissions are currently emitted in the surface layer.

Future plans:

During MACC the Global Fire Assimilation System (GFAS) will be further developed at ECMWF. It currently delivers global daily fields of observed Fire Radiative Power (FRP) based on SEVIRI and MODIS observations (Kaiser et al. 2009). As a first step global fire emission fields are derived from the FRP fields in real time. It is hoped that this product is more suitable for real time forecasting purposes than retrospective inventories.

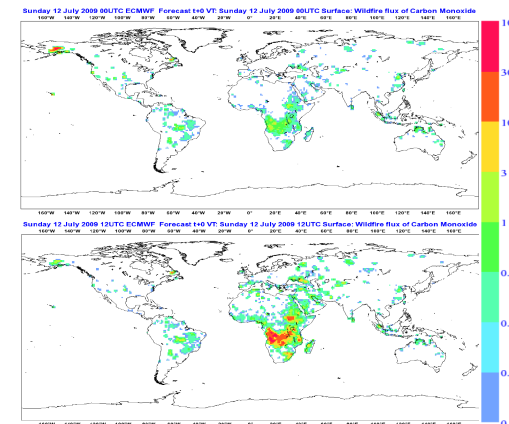


Figure 2: GFASv0 diurnally resolved fire emission density of CO [kg h⁻¹ km²] on 12 July 2009: 00-01 UTC (top), 12-13 UTC (bottom)

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