Fire in the GMES Atmosphere Component Service (GACS)

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GMES Atmosphere Component Service

- Part of Europe’s Global Monitoring for Environment and Security initiative
  - development of operational space-based observation
  - strengthening of complementary in-situ observing systems
  - development and operation of associated data and information services, based on core integrated assimilation and forecasting
    - Three environmental services for Land, Ocean and Atmosphere

- A 48-partner EC-funded project called MACC:
  - provides pilot GMES Atmosphere Component Service
  - succeeds earlier projects GEMS and PROMOTE
  - coordinated by ECMWF
MACC data use & modelling

data assimilation

meteo data, CO₂, CH₄, CO, O₃, NO₂, SO₂, aerosol

analysis & forecast

validation

global and regional data and web products

CO
3-day Global Forecast: Aerosol Optical Depth

Sunday 6 September 2009 00UTC ECMWF/GEMS Forecast t+003 VT: Sunday 6 September 2009 03UTC

Organic Matter, Black Carbon and Sulphate Aerosols Optical Depth at 550 nm

Sea-salt and Dust Aerosols Optical Depth at 550 nm
Reanalysis for 2003-8

Aerosol optical depth at 550nm

Total column carbon monoxide

July 2003
July 2004
July 2005
July 2006
July 2007
Comparison of GEMS simulated and analysed aerosol optical depth with MODIS and MISR for July 2003

Aerosol Optical Depth at 550 nm from Unconstrained Model Run
July 2003

MISR Terra Aerosol Optical Depth at 557.5 nm [unitless]
July 2003

Independent observations

Aerosol Optical Depth at 550 nm for Reanalysis using MODIS AOD
July 2003

MODIS Terra MOD08-M3.005 Aerosol Optical Depth at 550 nm [unitless]
July 2003

Assimilated observations

Morcrette et al., 2009; Benedetti et al., 2009
Fire emissions prescribed in model simulation

Extent of CO2 plume from model simulation

Cross-section of CO2 plume from model simulation

Cross-section of AIRS data assimilated fire plume

Cross-section of plume from AIRS assimilation

preliminary data
3-day European Air Quality Forecast: NO2 (single member of the ensemble shown)
Modelled AOD of Greek Fire Plumes, August 2007

Emissions calculated from Fire Radiative Power observed by SEVIRI on Meteosat.


Run at 25km global resolution, which is typical for regional models.
NRT Fire Emissions

- FRP-based (MODIS & SEVIRI)
- real time with 5 hours lag
- global

- 125 km spatial resolution
  - to be changed to 10 km
- 1 day temporal resolution
  - to be changed to 1 hour

- cloud cover affected
  - needs assimilation
    - measure of observation density
    - FRP=0 observations included
- emission factors calibrated with historic GFEDv2 emissions
Pyrogenic CO Tracer 3-Day Forecast

Monday 07 September 2009 00UTC ECMWF/GEMS Forecast t+006 VT: Monday 07 September 2009 06UTC
700 hPa NRT Biomass-Burning Carbon Monoxide Tracer
Observation Return Periods (hours)

7 February 2007, 00-24 UTC
Plans for the Future

- Global Fire Assimilation System
  - 10 km
  - 1 hour
  - real time
- add FRP from GOESs & MTSAT
- FRP forecast depending on meteorology
  - representation of diurnal cycle
  - up to about day 3
- real-time operation of GFEDv3
- injection height estimates
- improved emission factors
Conclusions

• MACC is merging FRP observations from several satellites to monitor global fire emissions.
  ▪ Accurate global fire emission model/parameterisation needed, but emission estimates have large uncertainties.

• The emissions are used to forecast global and regional atmospheric composition.

• Observations of aerosols, CO, CO2, CH4, O3 are assimilated into the ECMWF model to produce
  ▪ reanalyses
  ▪ real time analyses & forecasts (aerosols & reactive gases)
  ▪ of all the major C fluxes from fires

• Inversion techniques could determine fire parameters from merged fire and assimilated plume observations.
  ▪ Which parameters can be derived?
  ▪ Which inversion technique can use?
  ▪ Which parameters are most suitable
    ○ for emission estimation?
    ○ for other applications?
More Information

- [http://gems.ecmwf.int/](http://gems.ecmwf.int/)

GFASv0 Oct2008-Jun2009 vs. GFEDv2 Average 2000-2007
Modelled PM2.5 at Surface [$\mu$g/m$^3$]

25 Aug 2007, 12 UTC