

# Status of work at RIU at University of Cologne (FRIUUK)

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# EURAD features

## forecasts

- Multi-level, multi-area nesting:
  - N. hem.,
  - Europe,
  - central Europe, Irish-British Isles,
  - Northrhine Westfalia, (Mecklenburg-Vorpommern for DLR)
- optional chemistry (mainly RADM-2, RACM-MIM)
- aqueous phase chemistry
- primary and secondary organic aerosols (MADE, SORGAM)
- MM5 as meteorological driver

## data assimilation

- 2- ad 3-var in routine operation
- surface in situ data from state EPAs ingested
- measurements serve for skill scores: bias, RMS, figure of merit, NMSE, Hit rates 20% and 50%
- further non-operationally assimilated data include:
  - GOME, SCIAMACHY NO<sub>2</sub> columns
  - neural network derived O<sub>3</sub> profiles
  - MOZAIC data
  - EMEP
- 4d-var gas phase chemistry available in nesting mode

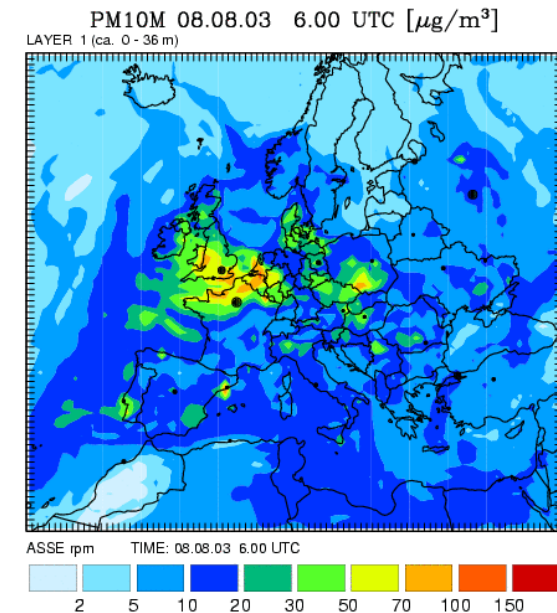
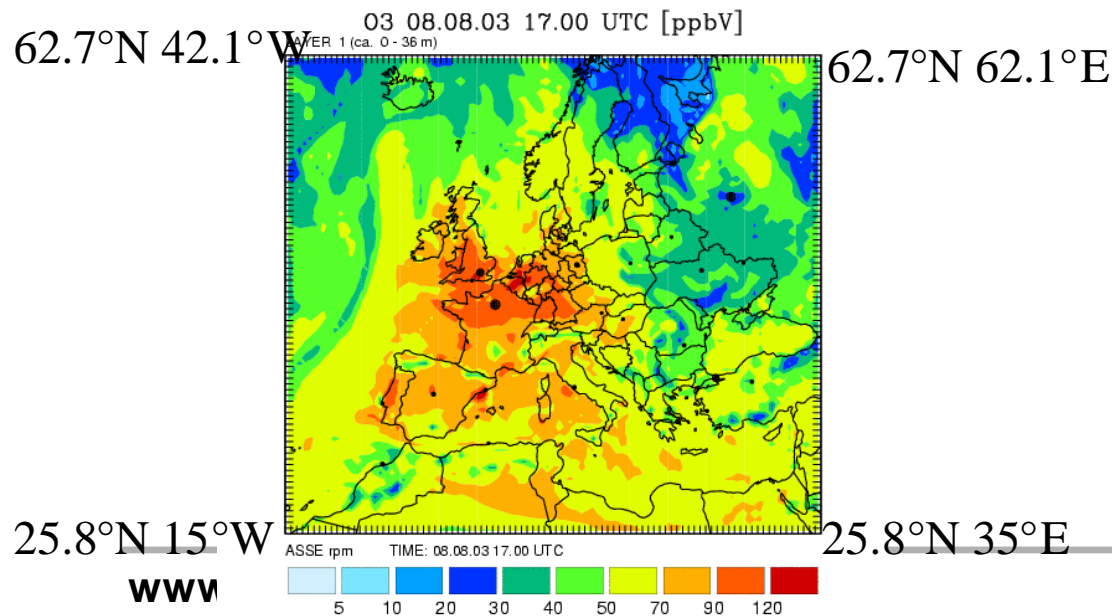
## WP\_RAQ\_1.1

- FRIUUK) contribution (0,75 man.month) couple the limited-area model EURAD running locally at University of Köln (Germany) with IFS outputs. RIU will perform the simulations requested for testing the RAQ models and will participate, together with others modelling groups, to the analysis of dispersion results.
- Status:
  - “Special Project” for ECMWF compute facility access approved,
  - account implementation in progress
  - IFS output file → regrid

# Integration domain and preliminary resolution

## Grid design

grid: 95 (W→E) x 85 (S→N) x 23 level  
 horizontal resolution 54 km (mother grid, presently, later →10 km)  
 vertical grid:  $\sigma$ , top 100 hPa, pronounced PBL refinements  
 projection: Lambert conformal, tangent point 50°N 10°E

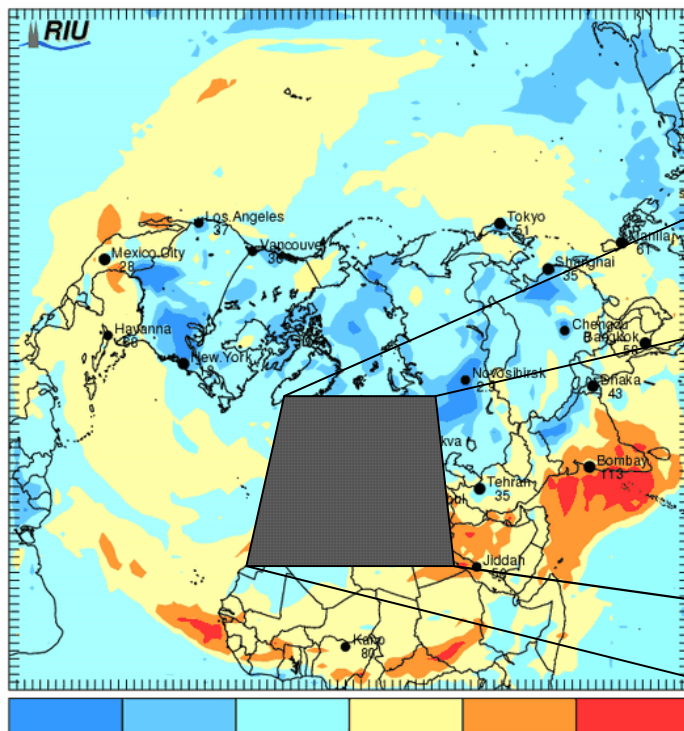


## WP\_RAQ\_2.1 : Chemical coupling between RAQ models and GRG, AER

Interpolation Global/hemispheric → European scale

- horizontal: presently linear, higher orders locally to be achieved via Wabha and Wendelberger (1989)
- vertical: (log p)-linear
- temporal: linear

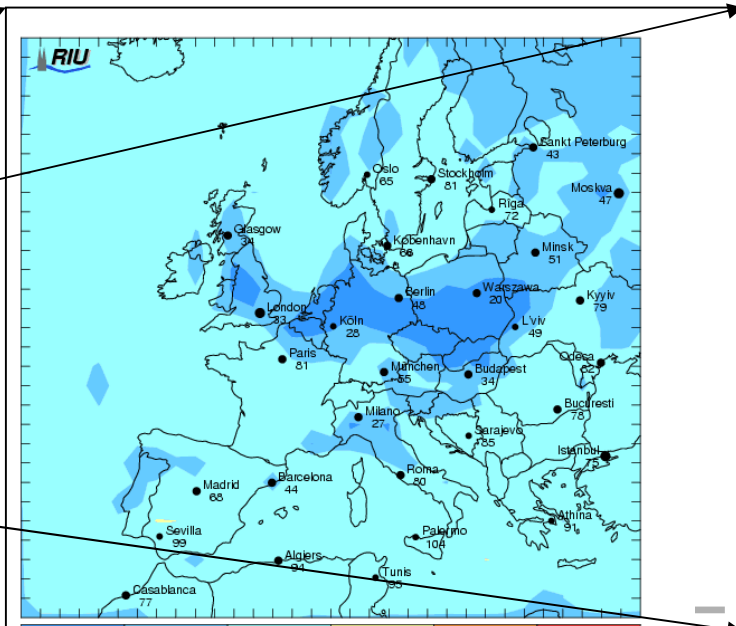
Ozone  $\mu\text{g}/\text{m}^3$  Level 1 08.12.2005 Daily Mean



VISAO

17 33 60 90 120

Ozone  $\mu\text{g}/\text{m}^3$  Level 1 08.12.2005 Daily Maximum



VISAO

33 65 120 180 240

## WP\_RAQ\_2.4

FRIUUK will contribute to the specification of the subcontract for the finalization of the reference GEMS emissions inventory, providing expertise gained with the EURAD modelling system.

- emissions
  - geographic grid based emissions
  - emission type classification
  - aerosol type classification
- boundary values:
  - geographic grid, pressure level based
  - full fields requested
  - 6 hours temporal resolution at least

# Objectives

- Objective:  
Assimilate ENVISAT tropospheric data into the Univ. Cologne EURAD-CTM (EUROpean Air pollution Dispersion model), and produce *quality controlled tropospheric analyses*.
- Methodology:  
*chemical 4D-var* algorithm to assimilate satellite retrievals over Europe for gas phase constituents and 2/3Dvar for aerosols

## 2003 – Episode

### 4Dvar – Settings:

- assimilation window: 8 -12 UTC
- timestep: 10 min
- max. no. of iterations: 12
- BECM: Diffusion paradigm  
[Weaver & Courtier,2001]
- spin-up: June 2003 (30 days)
- meteorology: MM5, nonhydrostatic

### Grid:

- size: 95 x 85 x 23 cells
- meshwidth: 54 km



## Observation Data

### satellite data:

- SCIAMACHY: NO<sub>2</sub>-tropospheric columns
- GOME: NO<sub>2</sub>-tropospheric columns (KNMI)  
O<sub>3</sub> NNorsy profiles
- MIPAS: IMK (O<sub>3</sub>, HNO<sub>3</sub>) profiles  
ESA(O<sub>3</sub>, HNO<sub>3</sub>) profiles

### airborne data:

- MOZAIC O<sub>3</sub>, CO

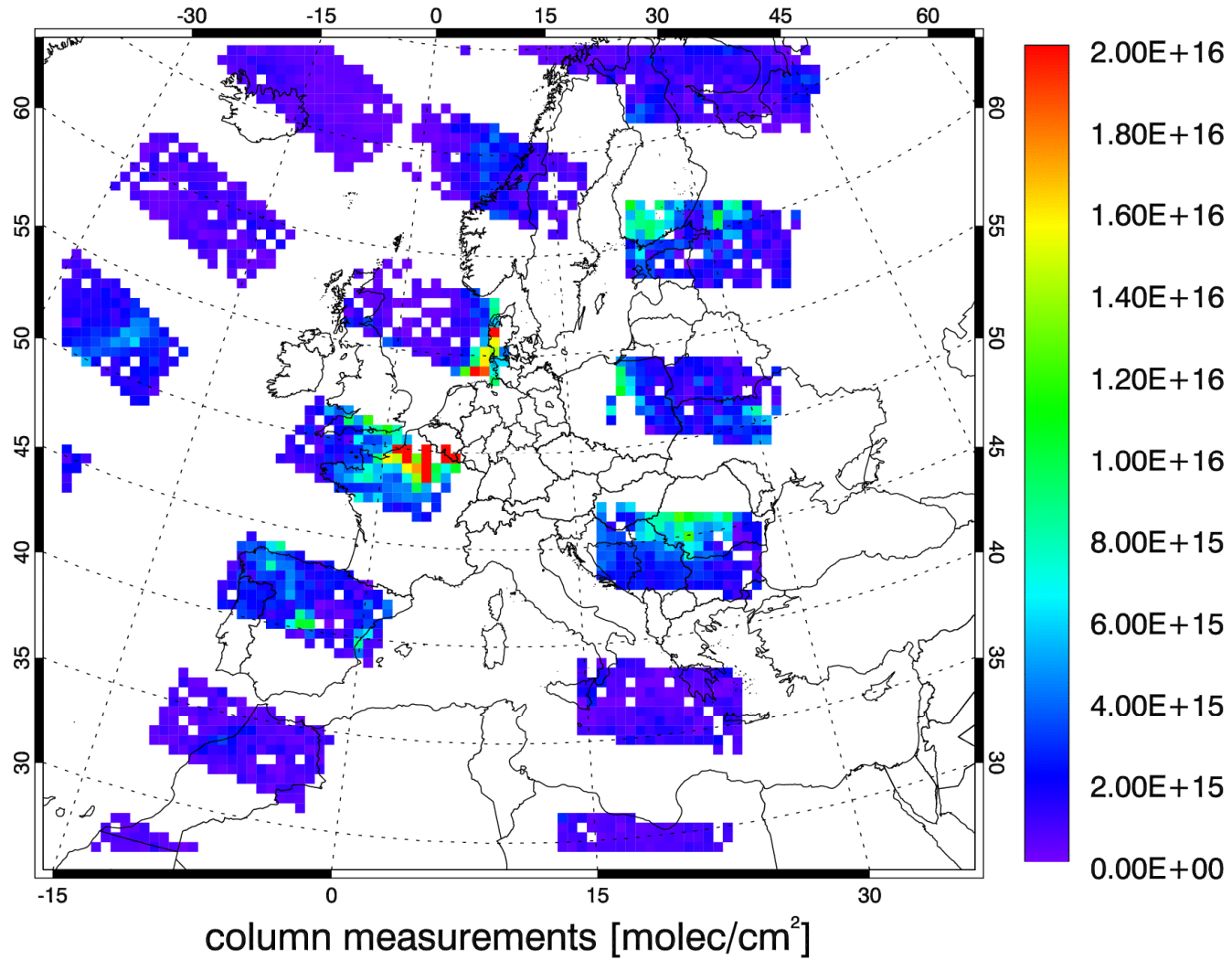
### surface in situ data:

- UK
- Germany
- (next cycle) EEA

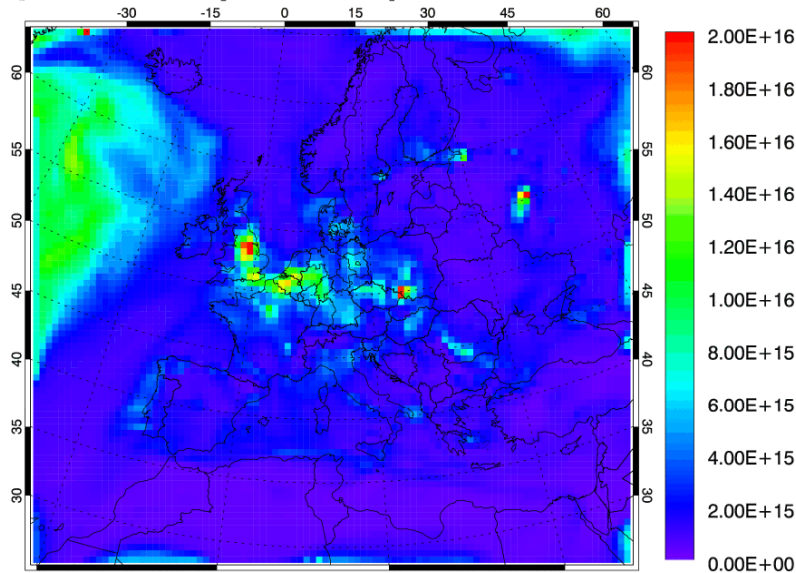
Species assimilated: SO<sub>2</sub>, NO, NO<sub>2</sub>, O<sub>3</sub>, HNO<sub>3</sub>, CO

# NO<sub>2</sub> Columns

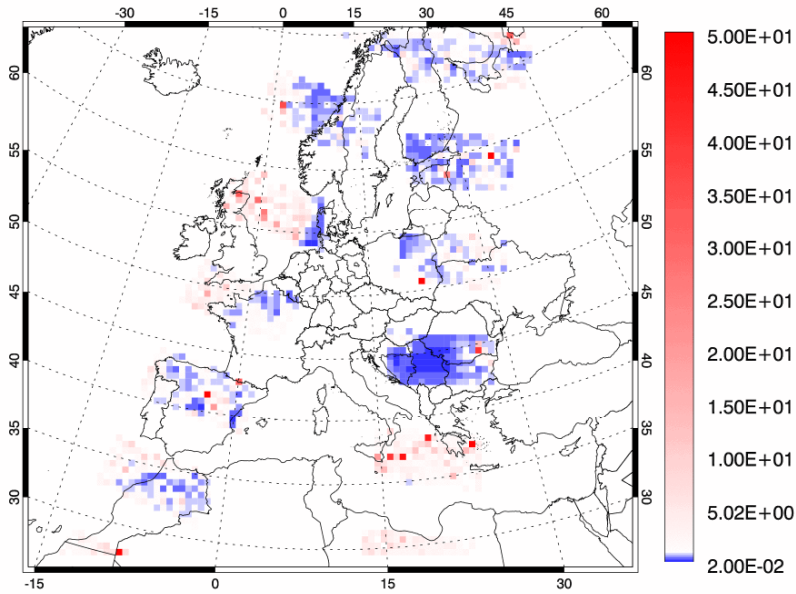
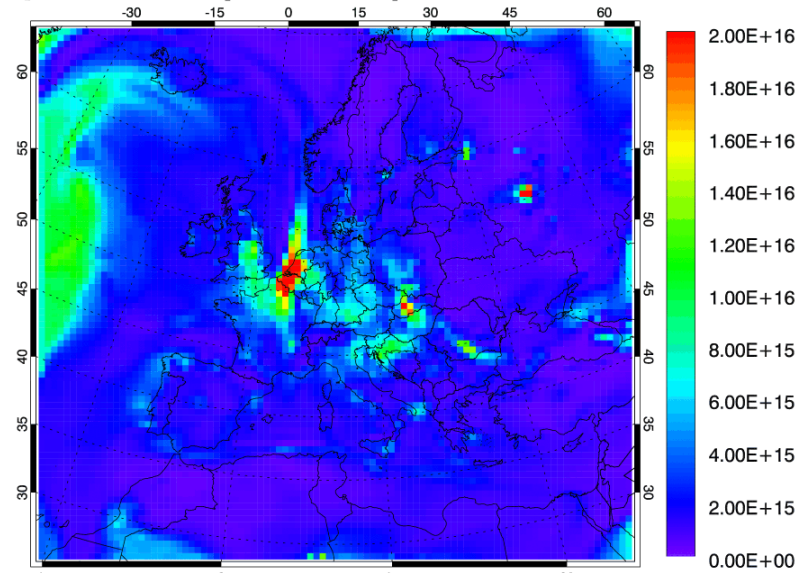
SCIAMACHY NO2-CLM TROPOSPHERIC ; NO2



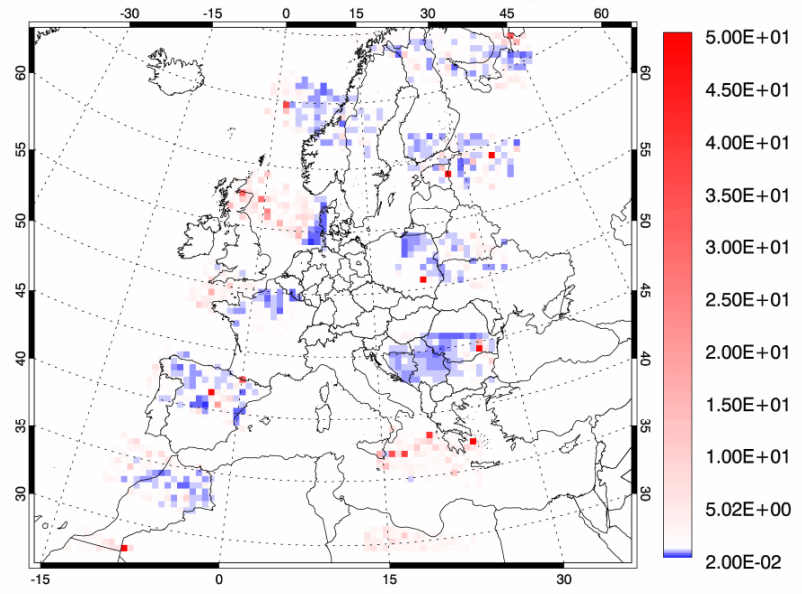
NO<sub>2</sub> ; model column [10<sup>15</sup> molec/cm<sup>2</sup>] ; it=01 ; hr=10 ; level=0



NO<sub>2</sub> ; model column [10<sup>15</sup> molec/cm<sup>2</sup>] ; it=13 ; hr=10 ; level=0

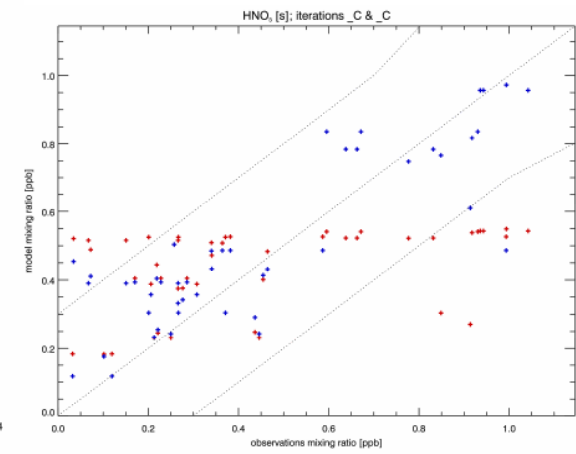
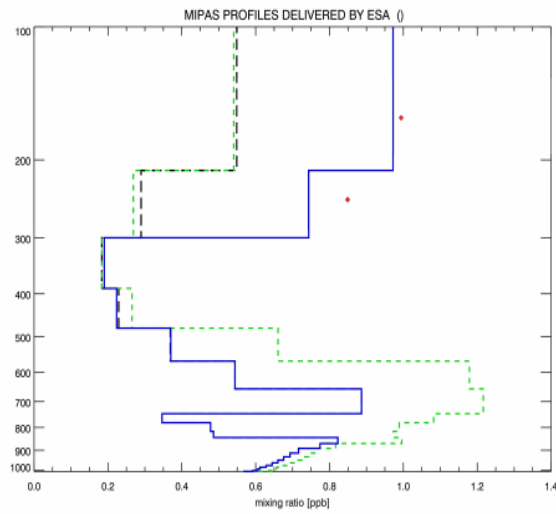
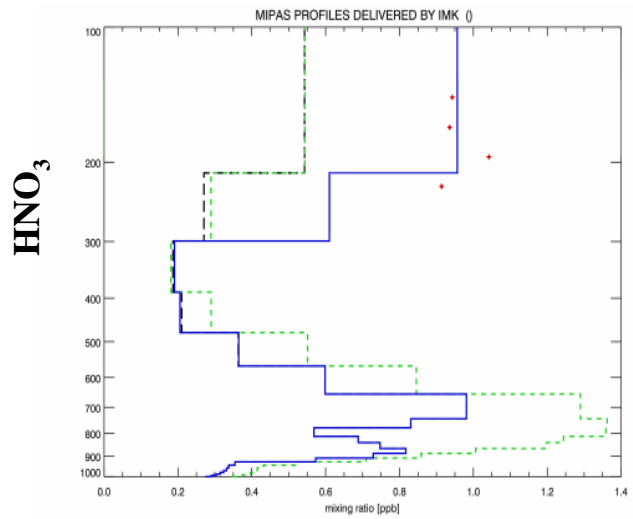
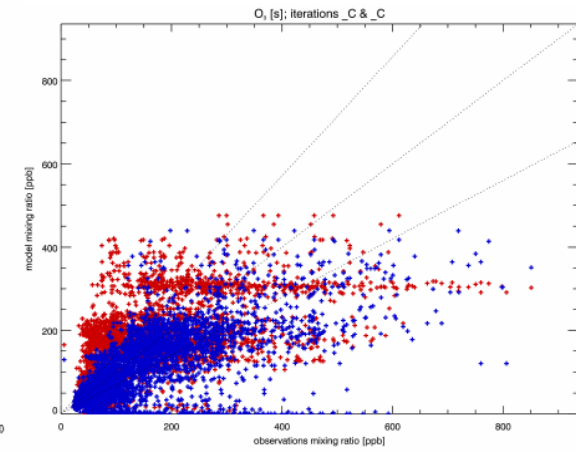
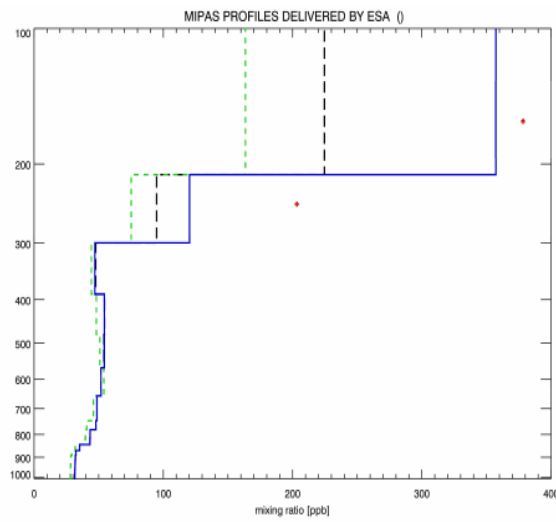
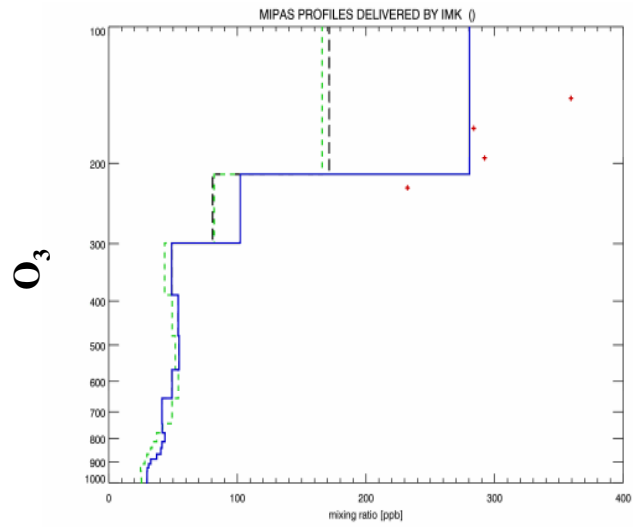


column diff (model/measurement) ; it=01



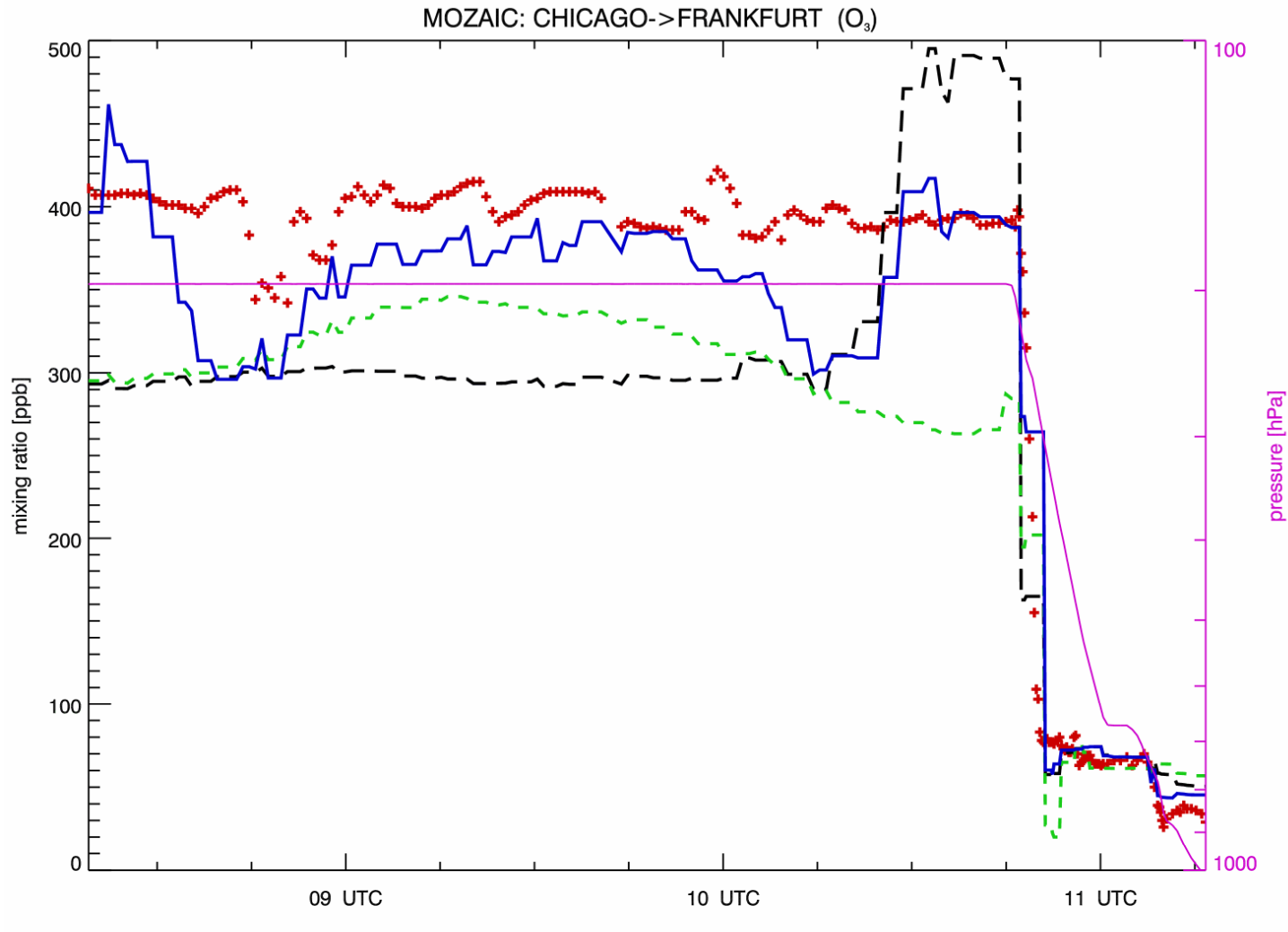
column diff (model/measurement) ; it=13

# Satellite Profiles - MIPAS



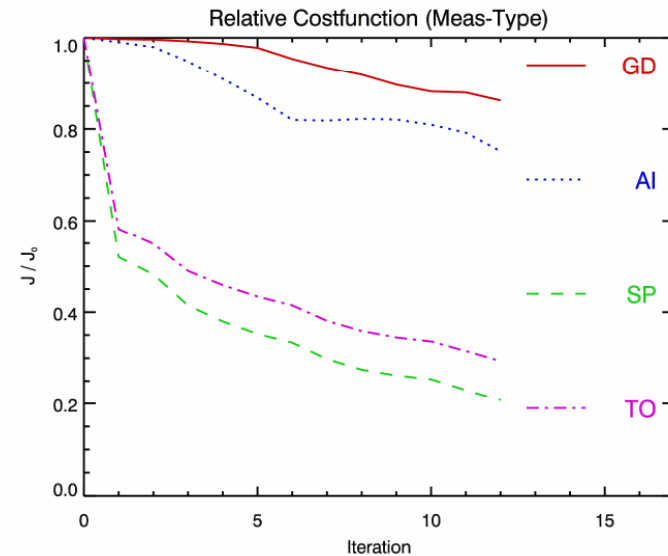
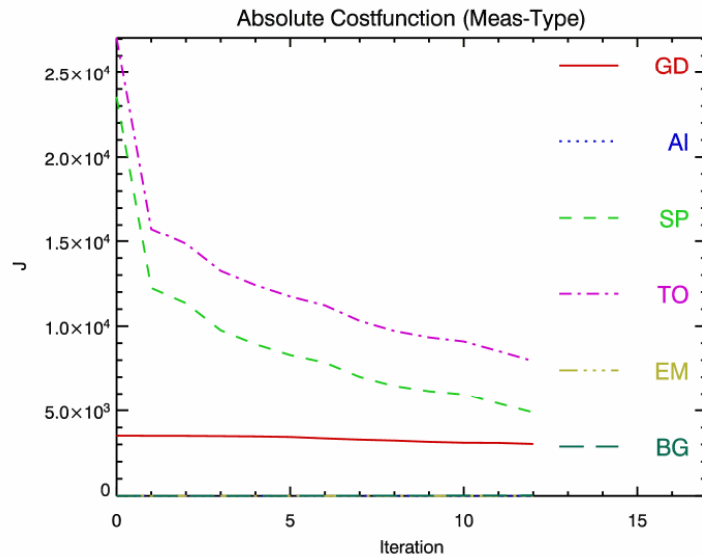
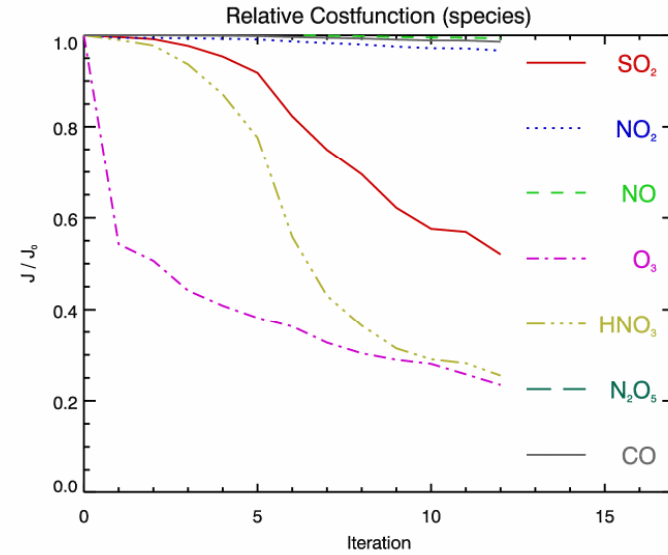
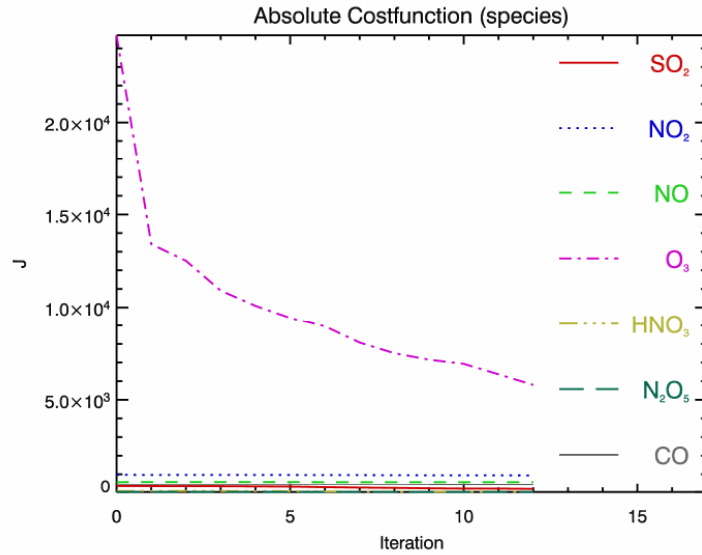
## Airborne Measurements (MOZAIC)

Measurements of Ozone and water vapor by Airbus in-service airCrafft

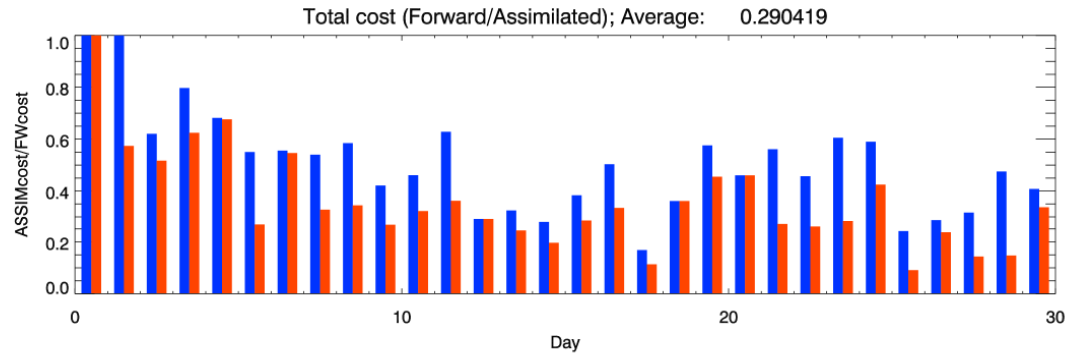


Jul 28 2003

# Iteration Statistics

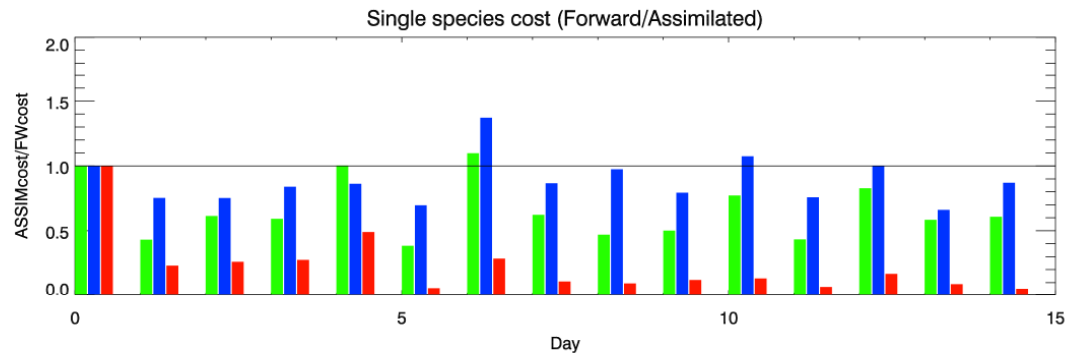


## Evolution of costs (starting month July 2003)



Blue: 1st it/fw 0.39

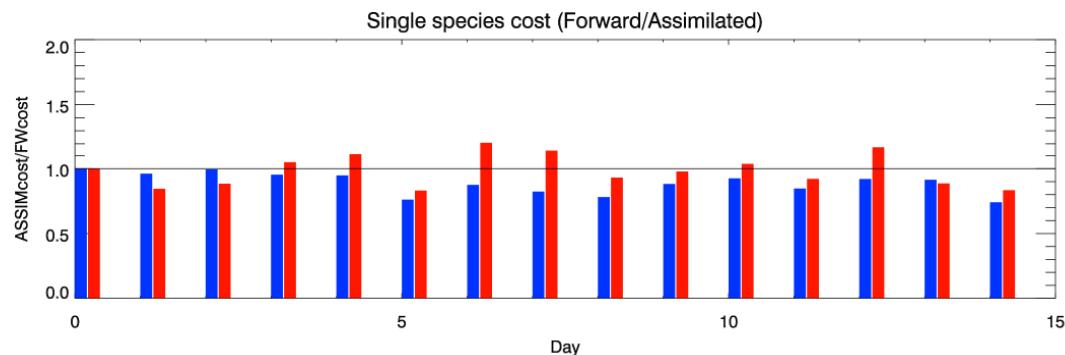
Orange: ass/fw: 0.29



Green:SO2 0.87

Blue: NO2 0.89

Red: O3 0.20



BLUE: NO 0.91

Red:CO 0.93

# Aerosol phase 2Dvar



## Why SYNAER data?

- SYNAER (...) provides a first step from aerosol optical properties to chemical properties
- Information breakdown in terms of:
  - water soluble
  - water insoluble
  - sea salt (accumulation mode)
  - sea salt (coarse mode)
  - soot
  - minerals transported

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## Assimilation of $PM_x$ using the SYNAER – Envisat Retrieval

SYNAER (SYNergetic Aerosol Retrieval) has been developed by DLR-DFD [Holzer-Popp et al., 2002]

- uses SCIAMACHY/AATSR (Envisat) & GOME-2/AVHRR (METOP) data
- selects dark fields and calculates BLAOT (boundary layer aerosol optical thickness) from radiometers and
- assigns aerosol type concentrations (40 mixtures)
- calculate SCIAMACHY/GOME-2 spectra and select best fit spectrum -> chosen mixture
- $PM_x$  calculated

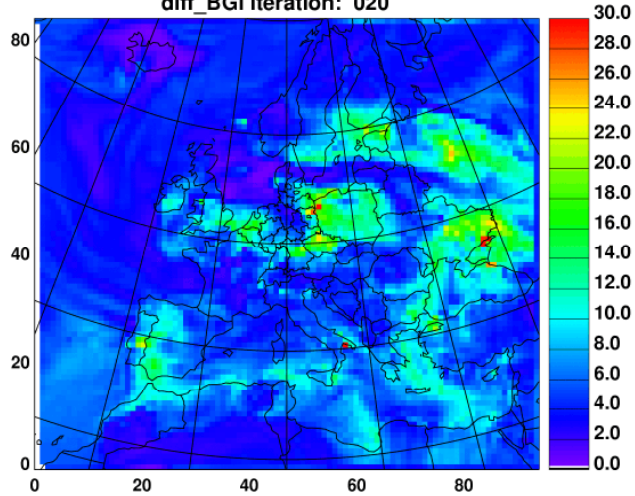
## aerosol measurements data

- in situ surface observations:
  - sources: EEA Airbase
  - available parameter:  $PM_{10}$
  
- satellite observations:
  - sources: SYNAER SCIAMACHY/AATSR synergistic retrievals
  - available:  $PM_{10}$ ,  $PM_{2.5}$ ,  $PM_{0.5}$ 
    - 40 aerosol composition scenarios
    - spatial resolution: ???
    - near realtime in operational mode

2Dvar Assimilation of SYNAER wildfire aerosol data  
background simulation

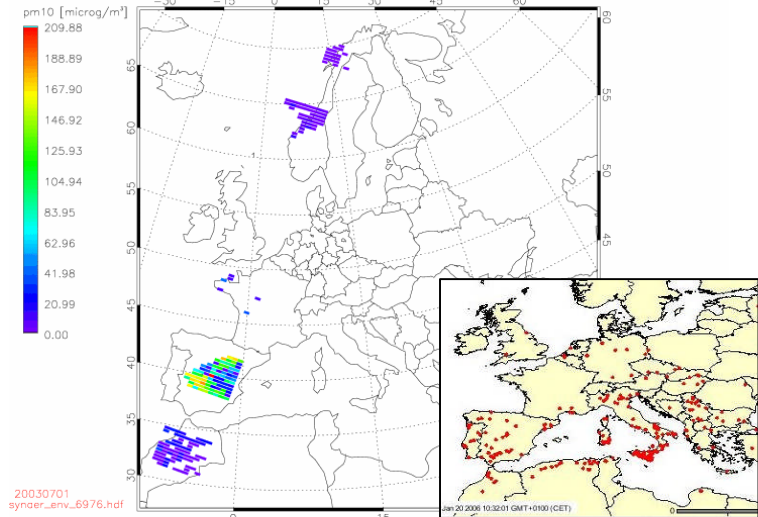
EURAD/MADE

diff\_BGI iteration: 020



1.7.2003

SYNAER PM10 retrieval

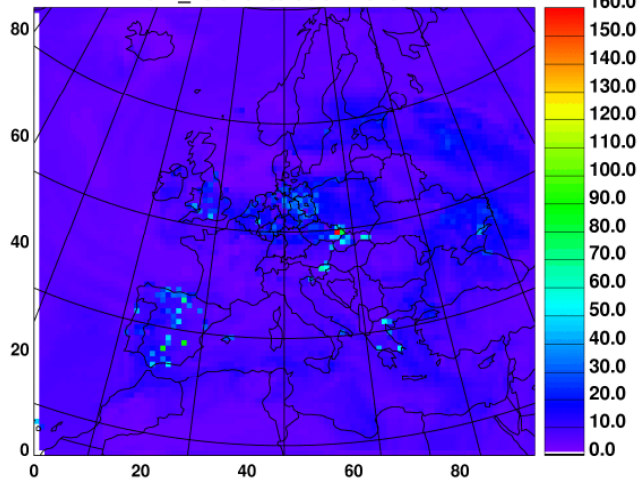


2D-var analysis

MODIS fire count

without

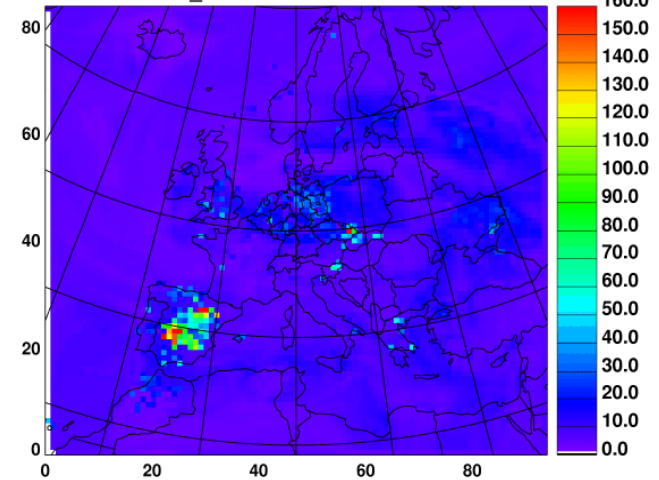
diff\_vciana iteration: 020



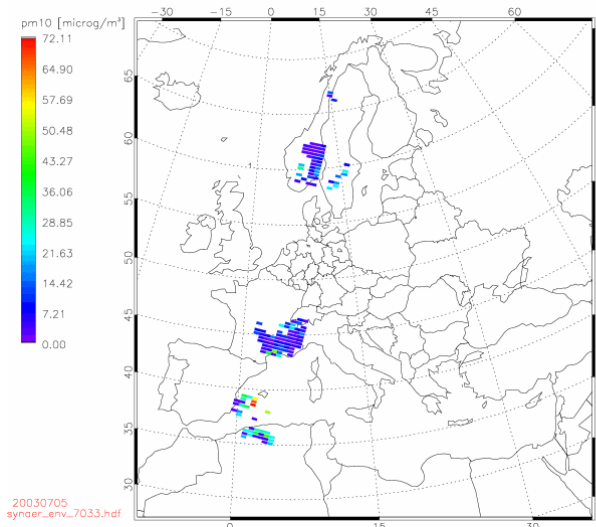
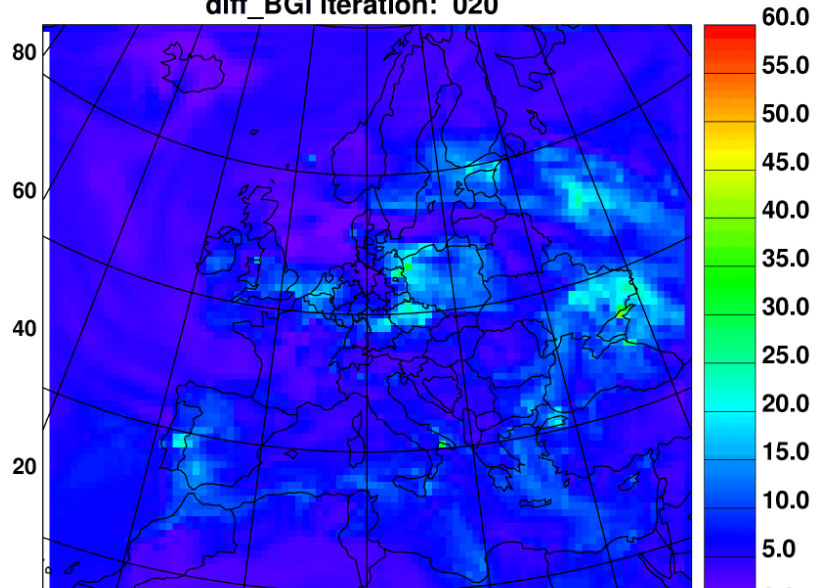
particulate biomass  
burning emissions

with

diff\_vciana iteration: 020



diff\_BGi iteration: 020



diff\_vciana iteration: 020

