

# Copernicus / GMES User forum - Atmosphere

Johanna Tamminen

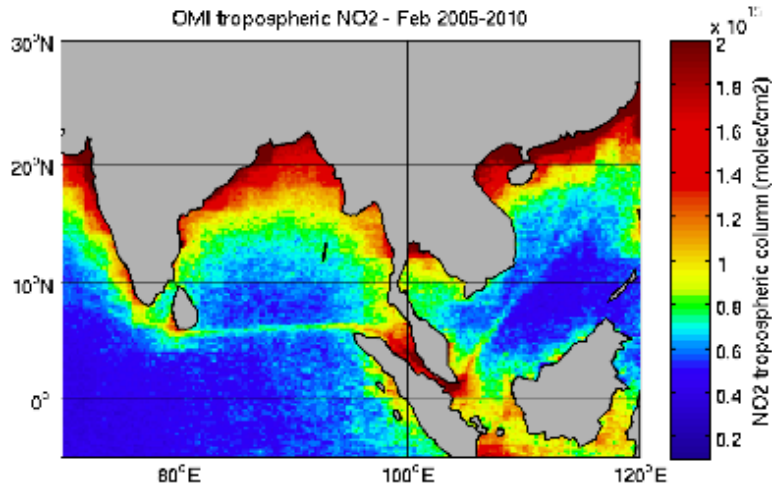
([johanna.tamminen@fmi.fi](mailto:johanna.tamminen@fmi.fi))

Finnish Meteorological Institute

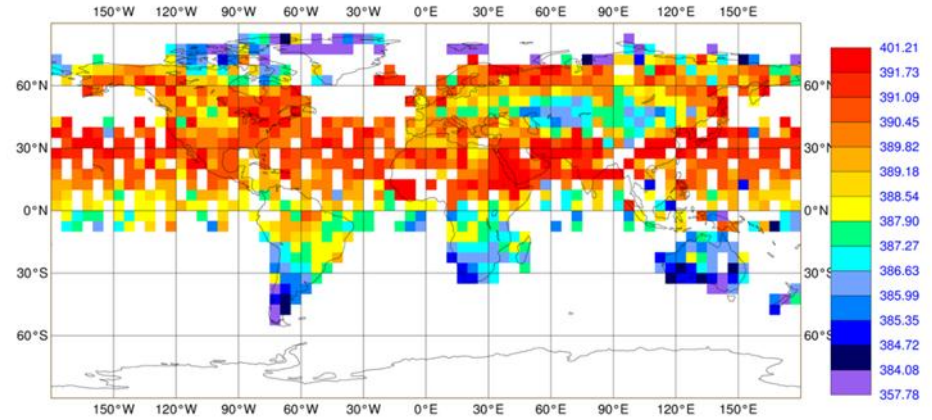
With input from FMI and  
V-H. Peuch, ECMWF, MACC-II

GMES User Forum Finland  
9.1. 2013

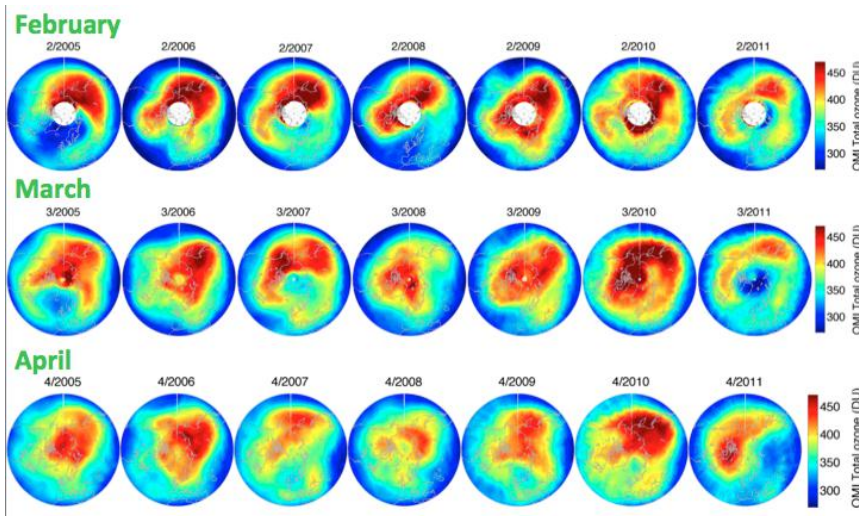
# Interesting satellite measurements



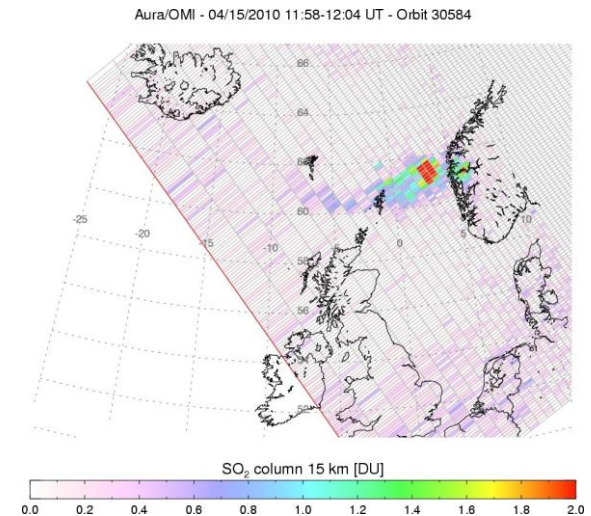
NO<sub>2</sub> from ship emissions, OMI, FMI



CO<sub>2</sub>, GOSAT, ACOS/JAXA/NIES



Arctic ozone, OMI, FMI

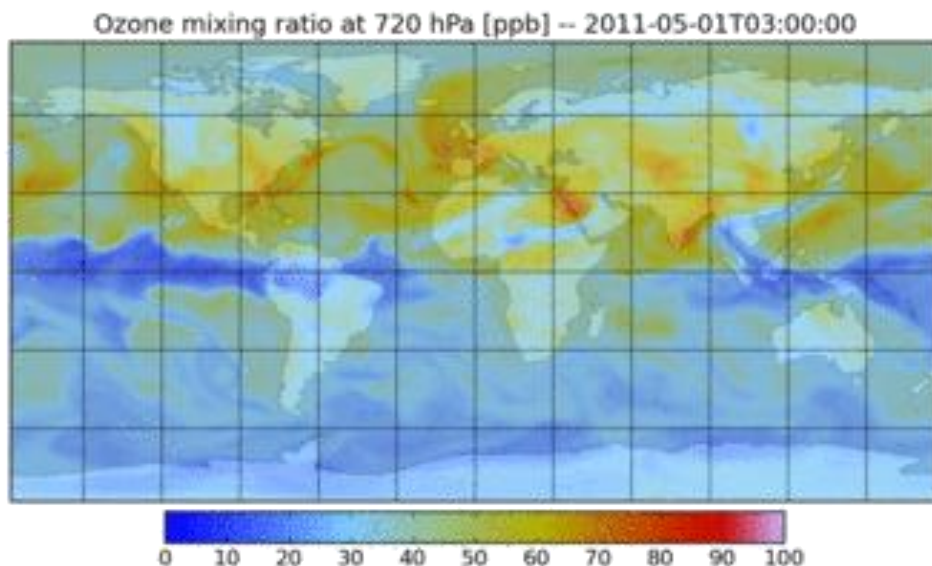


OMI Volcanic SO<sub>2</sub> 15.4. 2010  
(S. Carn)

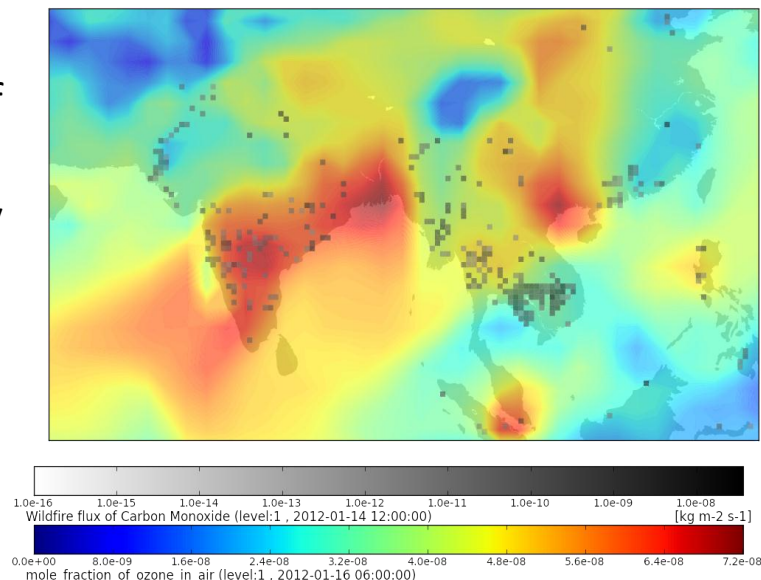
# Atmosphere composition is dynamic!

Air pollution is a result of emissions, transport and chemistry

*Ozone concentrations at 720 hPa, modeling.*



*Surface ozone concentrations with overlay of CO fire emissions of 14/01/2012*



Pollutants can be transported over long distances and affect air quality far away from the emission sources

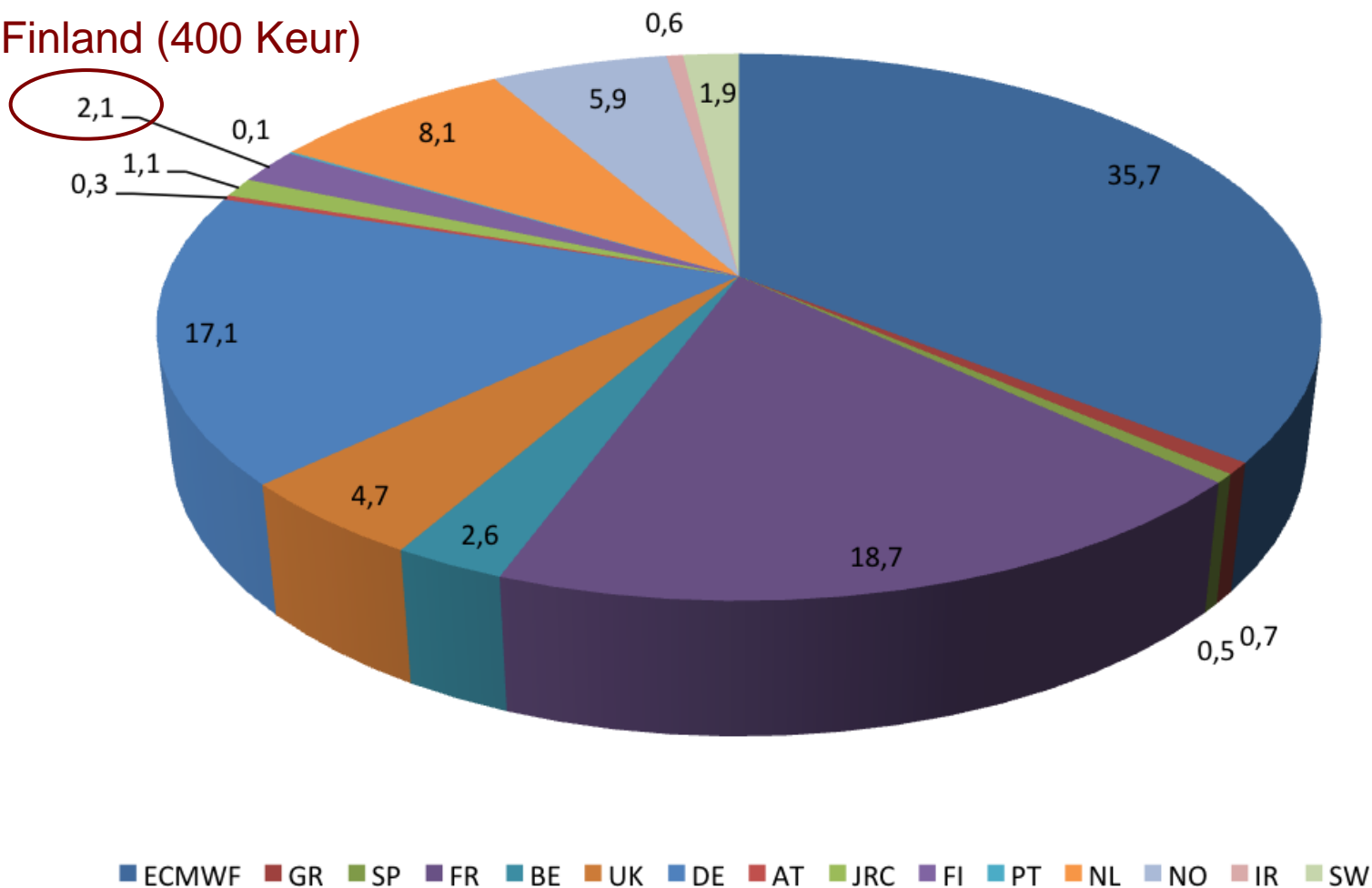
Courtesy V-H Peuch, ECMWF

- **GMES core service MACC-II is a Collaborative Project (2011-2014) funded by the EU under the FP7**
- **Coordinated by the European Centre for Medium-Range Weather Forecasts (ECMWF) and operated by a 36-member consortium from 13 countries**
- **Combine information from modeling and global measurements for monitoring atmospheric composition and climate**
  - European air quality
  - Global atmospheric composition
  - Climate forcing, greenhouse gases, aerosols
  - Ozone layer
  - UV radiation and solar energy
- **Pre-operational atmospheric service of the European GMES programme. Expected to enter fully operational phase in 2014.**



# MACC-II Budget distribution (tot 19 Meur)

Finland (400 Keur)





## Home

[News](#)  
[Press Room](#)  
[About the Project](#)  
[Operational Info](#)  
[Contact us](#)  
[Jobs](#)

## Today's Forecasts

[Reactive Gases](#)  
[Aerosols](#)  
[European Air Quality](#)  
[UV Index](#)  
[Ozone Layer](#)  
[CO2](#)

## Latest Analyses

[Fire Monitoring](#)  
[European Air Quality](#)  
[Reactive Gases](#)  
[Aerosols](#)

## **LATEST** MACC-II aerosol feature in French science magazine



**Air Quality and  
Atmospheric  
Composition**



**Climate Forcing**



**Ozone Layer & UV**



**Solar Radiation**



**Emissions and  
Surface Fluxes**

## Services

[Air Quality &  
Atmospheric  
Composition](#)  
[Climate Forcing](#)  
[Ozone Layer & Ultra-  
Violet Radiation](#)  
[Solar Radiation](#)  
[Emissions & Surface  
Fluxes](#)



## In Focus: MACC-II Summer School

### Modelling and Forecasting of Atmospheric Composition at Different Scales

June 9-16 2013  
South-West of France

Applications:  
<http://www.gmes-atmosphere.eu/events/summerschool/>  
Deadline for applications : January 31<sup>st</sup>, 2013

**December 2012** MACC-II organizes a Summer School on modelling and forecasting of atmospheric composition at different scales in Anglet, France, from 9 - 16 June 2013. The summer school is meant for MACC-II users and young scientists and will focus on the generation and use of the various MACC-II products. Application for the summer school is open until 31 January 2013.

Potential users of MACC-II are invited to complete the questionnaire at this [link](#)

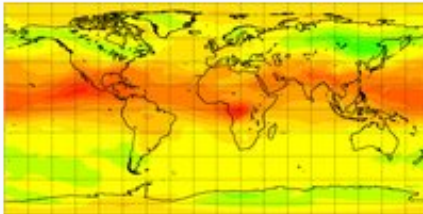
MACC-II is a Collaborative Project (2011-2014) funded by the European Union under the 7th Framework Programme. It is coordinated by the European Centre for Medium-Range Weather Forecasts and operated by a 36-member consortium.





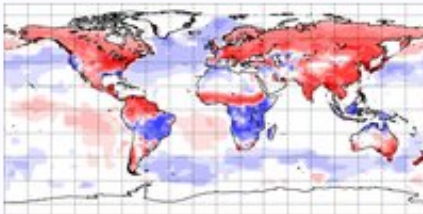
ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# MACC – Climate Forcing



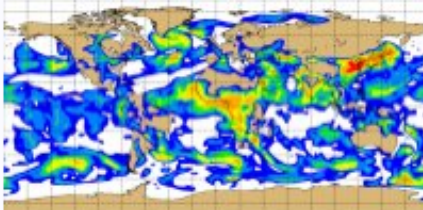
## Monitoring of Greenhouse Gases and Fluxes

Analyses of atmospheric CO<sub>2</sub> and CH<sub>4</sub> and their surface fluxes running 6 months behind real time.



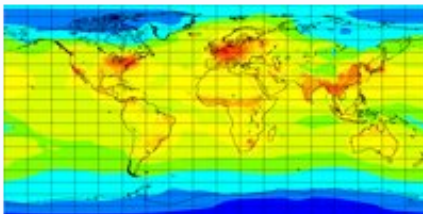
## Reanalysis of Greenhouse Gases and Fluxes

Renalysis of atmospheric CO<sub>2</sub> and CH<sub>4</sub> and their surface fluxes for the period 2003 - 2010.



## Monitoring of Global Aerosols

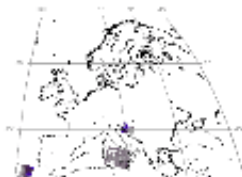
Daily analyses and 4-day forecasts of global aerosol.



## Reanalysis of Global Atmospheric Composition

Reanalysis of atmospheric composition for the period 2003 - 2010

MACC  
Aerosol Optical Depth and Aerosol Speciation Record



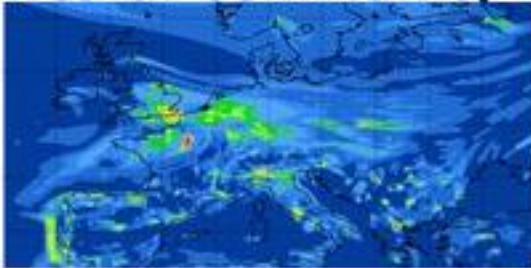
## Observed Aerosol Optical Depth and Aerosol Speciation Record

Aerosol parameters are retrieved from a combination of simultaneous AATSR and SCIAMACHY measurements.



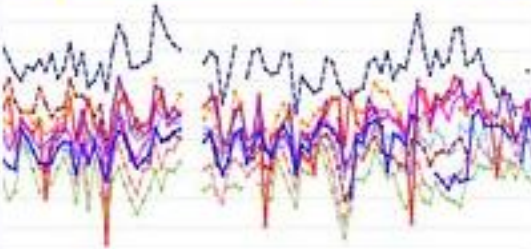
# MACC – Health community

## Health Community



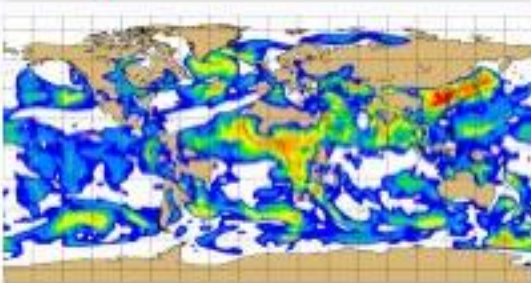
### European Air Quality Monitoring and Forecasting

Daily 3-day air quality forecasts for Europe from an ensemble of models.



### Reanalysis of European Air Quality

Validated assessments of air quality in Europe



### Near-real-time Forecasts of Atmospheric Composition

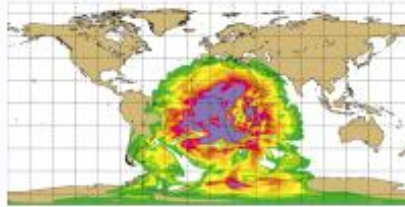
Daily analysis and 4-day forecast of global 3-dimensional ozone, carbon monoxide, and aerosol.





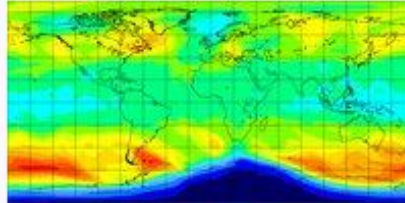
ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# UV radiation, solar energy, stratospheric ozone



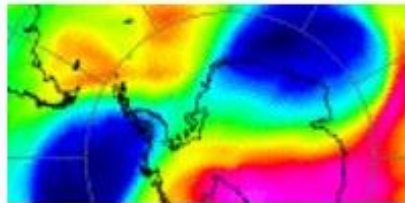
## Monitoring and Forecasting of Ultraviolet Radiation

Daily analyses and forecasts of the biologically effective dose of UV radiation.



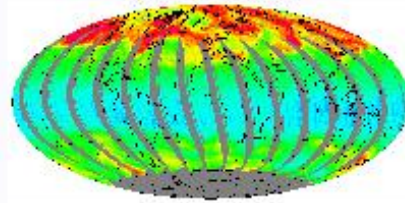
## Monitoring and Forecasting of Total ozone

Daily analyses and forecasts of total ozone.



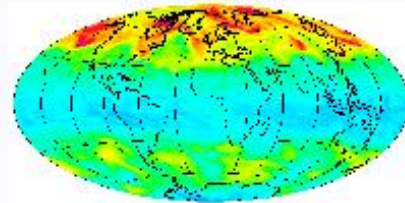
## Total Ozone Record

Assimilated total ozone column based on TOMS, GOME, SCIAMACHY, OMI and GOME-2



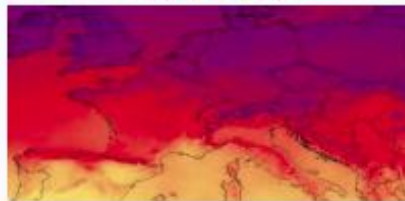
## Near-real-time Ozone Monitoring

Near real time total ozone columns based on SCIAMACHY, GOME or OMI measurements.



## Near-real-time Ozone Forecasts

The near-real time total ozone columns, derived from observations by SCIAMACHY, are input to a data assimilation program which provides near-real time ozone fields for today and a forecast for the coming days.

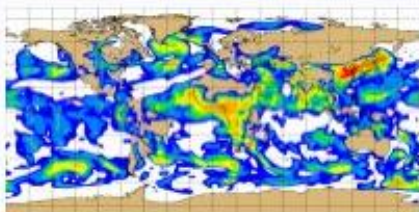


## Monitoring of surface solar irradiance

Historical and daily updated services for solar energy users

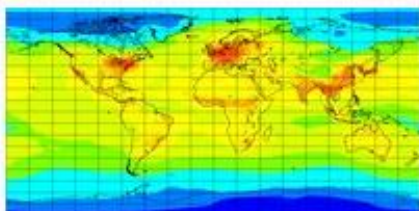


# MACC: Global atmospheric Composition



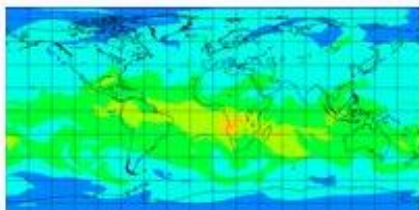
## **Monitoring and Forecasting of Global Atmospheric Composition**

Daily analysis and 4-day forecast of global 3-dimensional ozone, carbon monoxide, and aerosol.



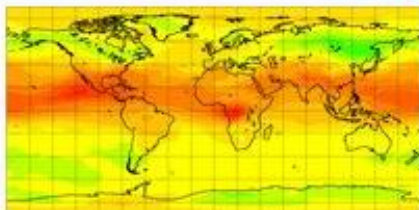
## **Reanalysis of Global Atmospheric Composition**

Reanalysis of atmospheric composition for the period 2003 - 2010



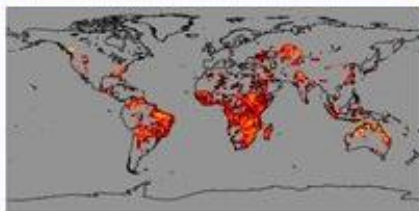
## **Support for Scientific Observational Campaigns**

Specific plots and special tracers to support scientific observational campaigns



## **Monitoring of Greenhouse Gases and Fluxes**

Analyses of atmospheric CO<sub>2</sub> and CH<sub>4</sub> and their surface fluxes running 6 months behind real time.



## **Global Fire Emissions**

Observations of Fire Radiative Power are used to estimate global fire emissions of carbon dioxide, methane, carbon monoxide, and aerosol.

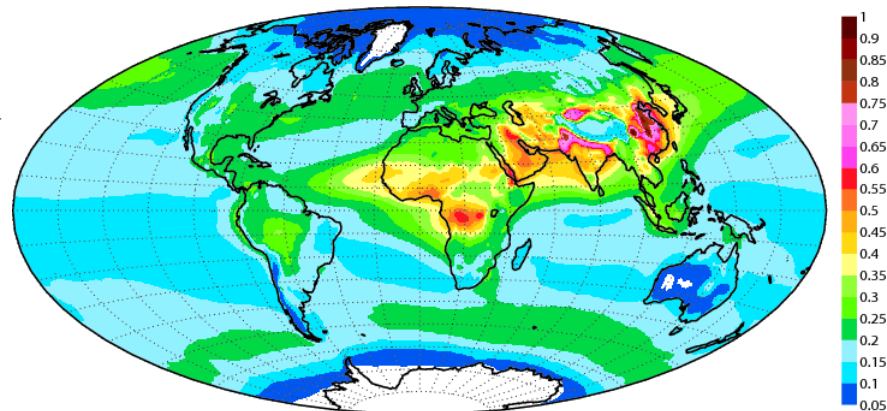


<http://www.gmes-atmosphere.eu>

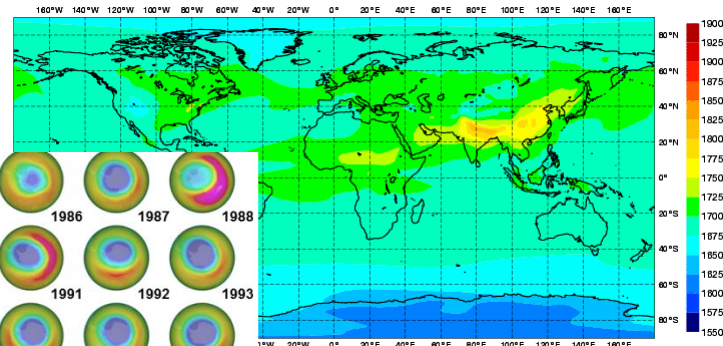
## Retrospective Service Provision

Reanalysis of Atmospheric  
Composition (2003-2011)

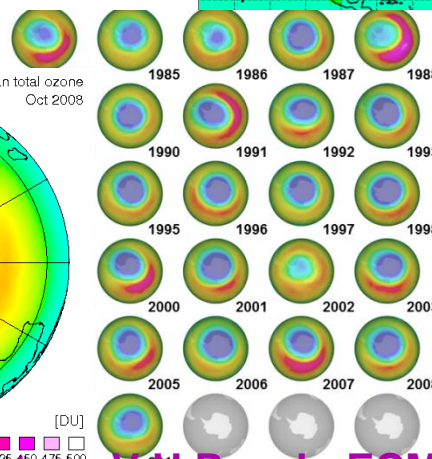
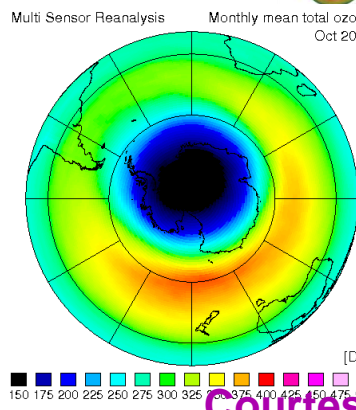
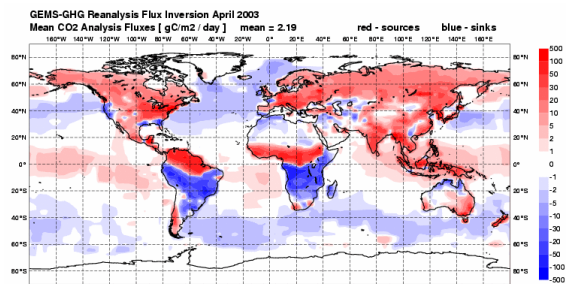
Aerosol Optical Depth



30 years ozone  
layer records



CO<sub>2</sub> and CH<sub>4</sub>  
surface flux  
inversions



Courtesy V-H Peuch, ECMWF

Methane

700+ users

<http://www.gmes-atmosphere.eu>  
**Near-Real-Time Service Provision**

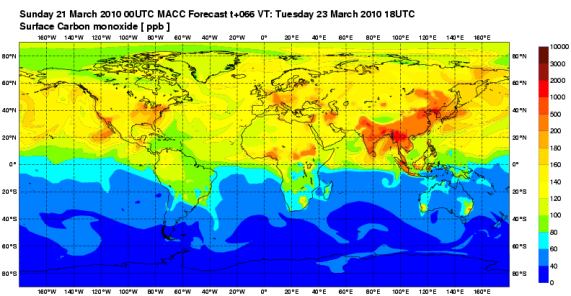
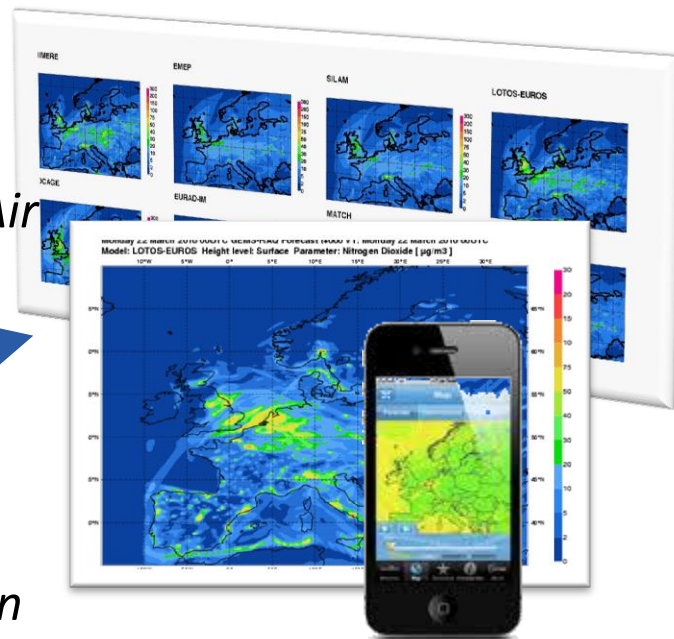
## 90+ users and obsAIRve



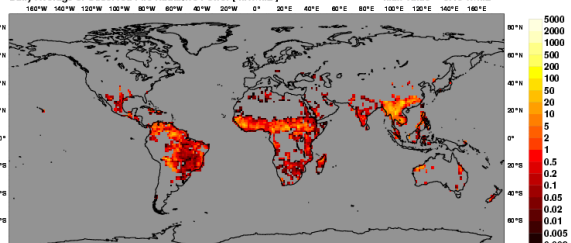
## European Air Quality

# Global Pollution

*Biomass  
burning  
emissions*

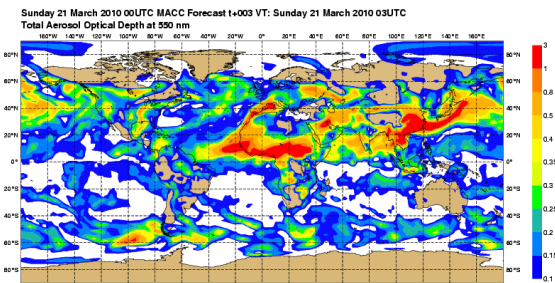


MACC Fire Intensity Products Wednesday 24 February 2010  
Daily Average of Observed Fire Radiative Power [ mW/m2 ] max value = 0.10 W/m2

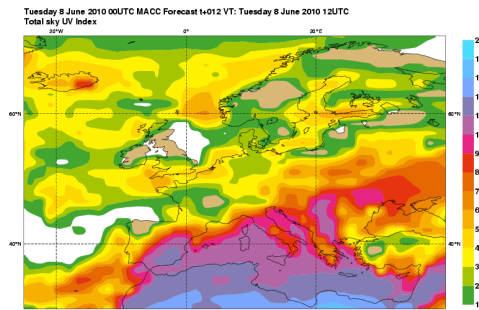


Courtesy V-H Peuch, ECMWF

# Aerosol










*UV index*





# MACC european regional AQ ensemble

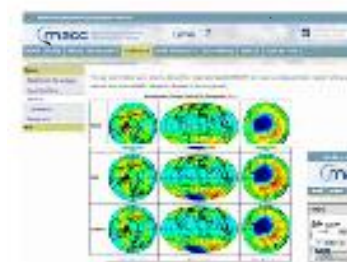
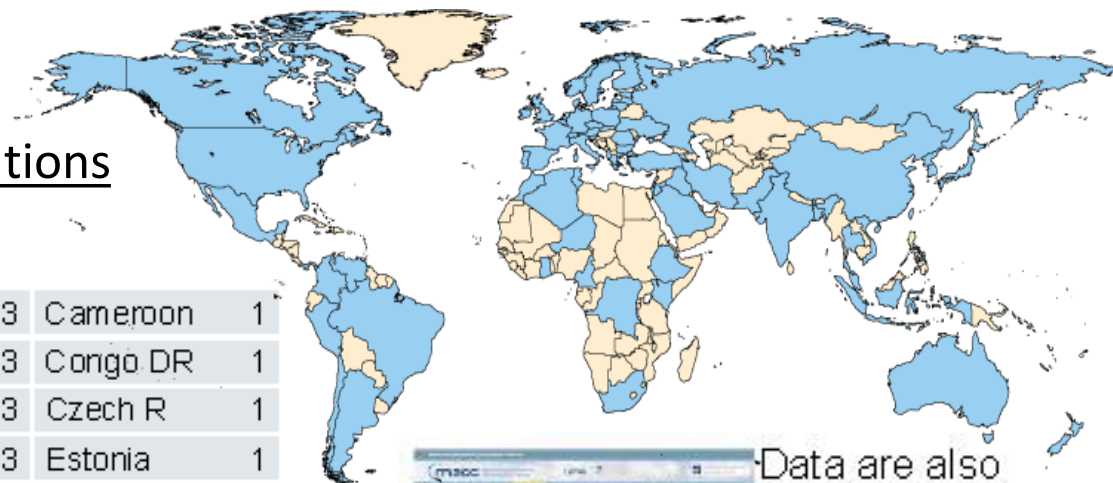
		<i>Current geometry</i>	<i>Assimilation method</i>	<i>Operations</i>
<b>CHIMERE</b> INERIS, CNRS		25km, L8, top : 500hpa	Optimal Interpolation	run @ INERIS
<b>EMEP</b> met.no		0.2°, L20, top : 100hpa	3d-var in development	run @ met.no
<b>EURAD</b> FRIUUK		15km, L23, top : 100hpa	Variational, 3d-var	run @ ECMWF
<b>L-EUROS</b> TNO, KNMI		15km, L4, top : 3.5km	Ensemble Kalman Filter	run @ KNMI
<b>MATCH</b> SMHI		0.2°, L40, top : 100hpa	Variational, 3d-var	run @ SMHI
<b>MOCAGE</b> MF, CERFACS		0.2°, L47, top : 5hpa	Variational, 3d-var	run @ MF
<b>SILAM</b> FMI		0.2°, L46/5, top : 100hpa	Variational, 4d-var	run @ FMI

+ same emissions, same met forecasts (IFS), same chemical boundary conditions (MACC global) : spread comes from differences in CTM formulation

# Worldwide users

ECMWF servers access by institutions  
(Jan. 2012)

China	103	Portugal	10	Austria	3	Cameroon	1
Germany	67	Australia	9	Chile	3	Congo DR	1
UK	64	Norway	9	Colombia	3	Czech R	1
France	57	Turkey	9	Ghana	3	Estonia	1
USA	52	Belgium	8	Malta	3	Hong Kong	1
Italy	24	Canada	7	Morocco	3	Iraq	1
Spain	24	Lithuania	7	New Zealand	3	Jordan	1
India	23	Taiwan	7	Slovakia	3	Kenya	1
Japan	18	Ukraine	7	South Africa	3	Latvia	1
Netherlands	18	Poland	6	Bangladesh	2	Malaysia	1
Brazil	16	South Korea	6	Ethiopia	2	Mexico	1
Russia	13	Denmark	5	Israel	2	Niger	1
Romania	12	Viet Nam	5	Pakistan	2	North Korea	1
Greece	11	Bulgaria	4	Slovenia	2	Panama	1
Indonesia	11	<b>Finland</b>	<b>4</b>	Thailand	2	Peru	1
Sweden	11	Ireland	4	Albania	1	Singapore	1
Switzerland	11	Saudi Arabia	4	Algeria	1	Tunisia	1
Iran	10	Argentina	3	Armenia	1	Venezuela	1



Data are also served by other project partners

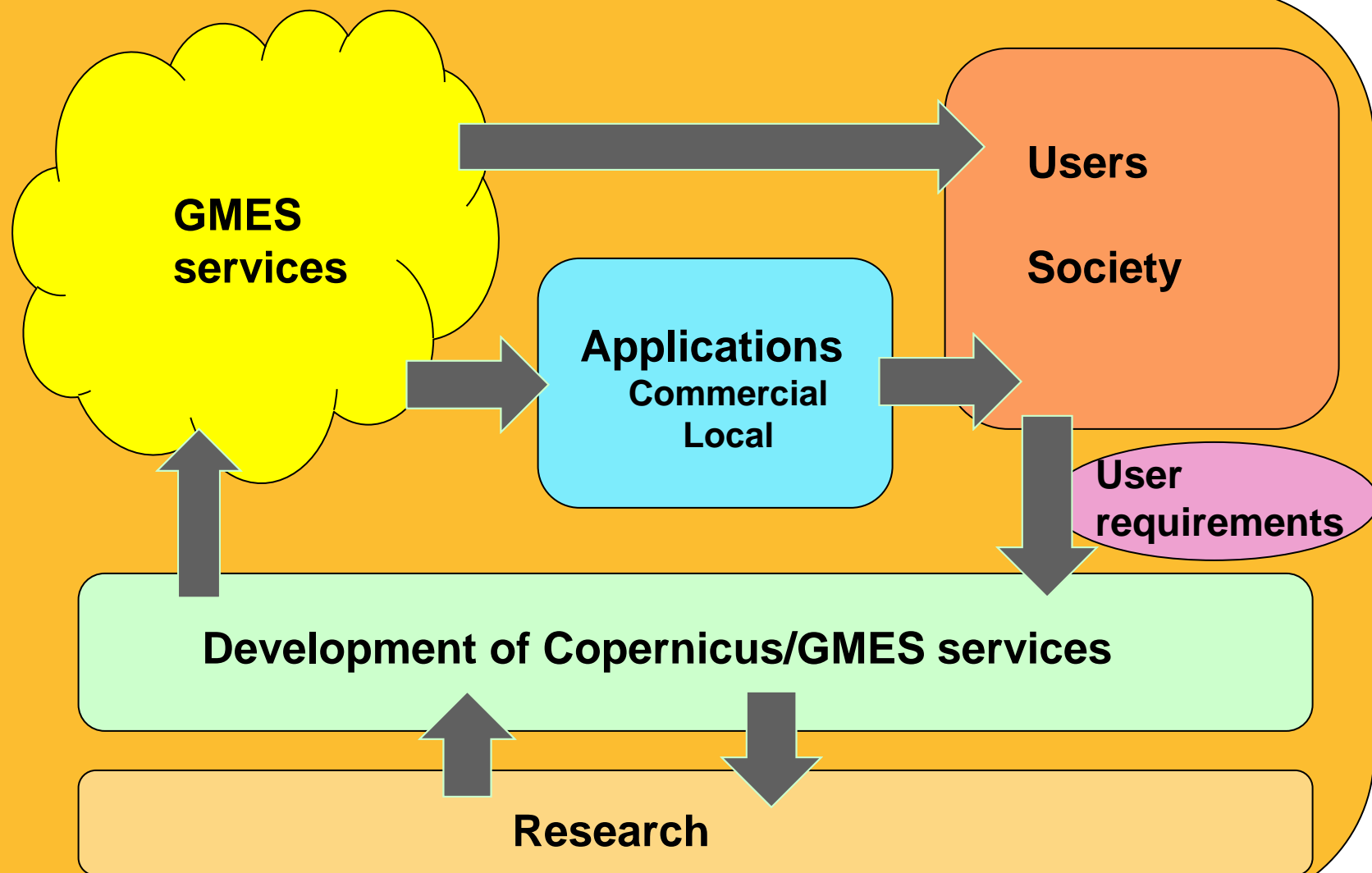


Courtesy V-H Peuch, ECMWF



ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# Copernicus/ GMES User forum





# GMES-PURE 2013 - 2014 (24 months)

- **GMES-PURE FP7 support action**
- **Led by EUMETSAT, other participants:**
  - RAL (UK), FMI (Finland), SMHI/EuroGOOS (Sweden)
- **Gathering user needs and translating to requirements/service specification in the Copernicus/GMES **marine** and **atmosphere** domain**

**Interested? - let us know**





S4



# Space Component

## GMES Space Component Long-Term Scenario

2011-2013

2014-2020

2021 ==>

### Access to Contributing Missions

Sentinel-1 A/B/C

Sentinel-1 A/B/C 2nd Gen

Sentinel-2 A/B/C

Sentinel-2 A/B/C 2nd Gen

Sentinel-3 A/B/C

Sentinel-3 A/B/C 2nd Gen

Sentinel-4 A/B (MTG-S1/2)

Sentinel 5 Precursor

Sentinel 5 A/B (MetOp-SG)

Jason-CS A/B

Jason -CS Follow-on A/B

GSC Evolution

