

# MACC-III

## Towards the Copernicus Atmosphere Services (CAMS)

Laurence Rouil (INERIS)

Leonor Tarrason (NILU)

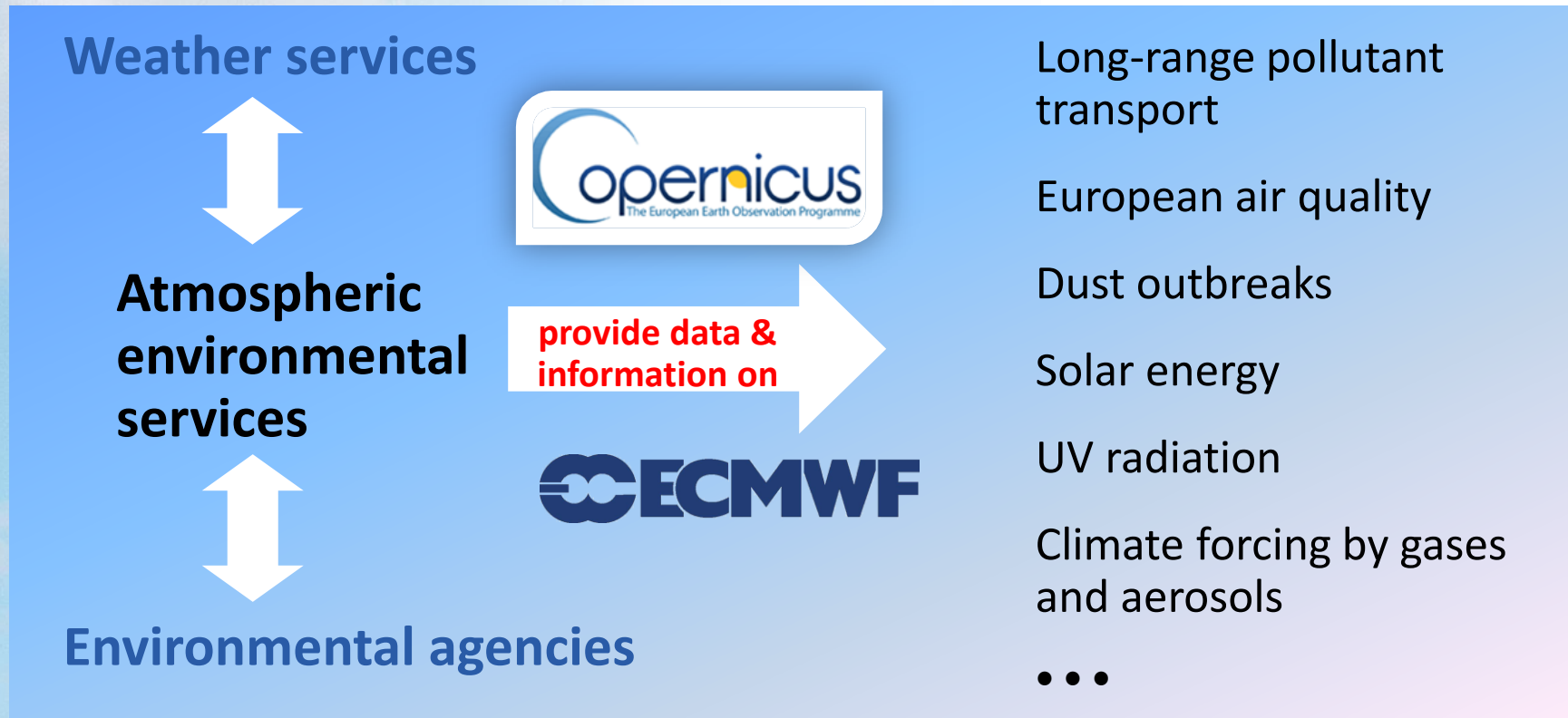
*On behalf of the MACC-III consortium*



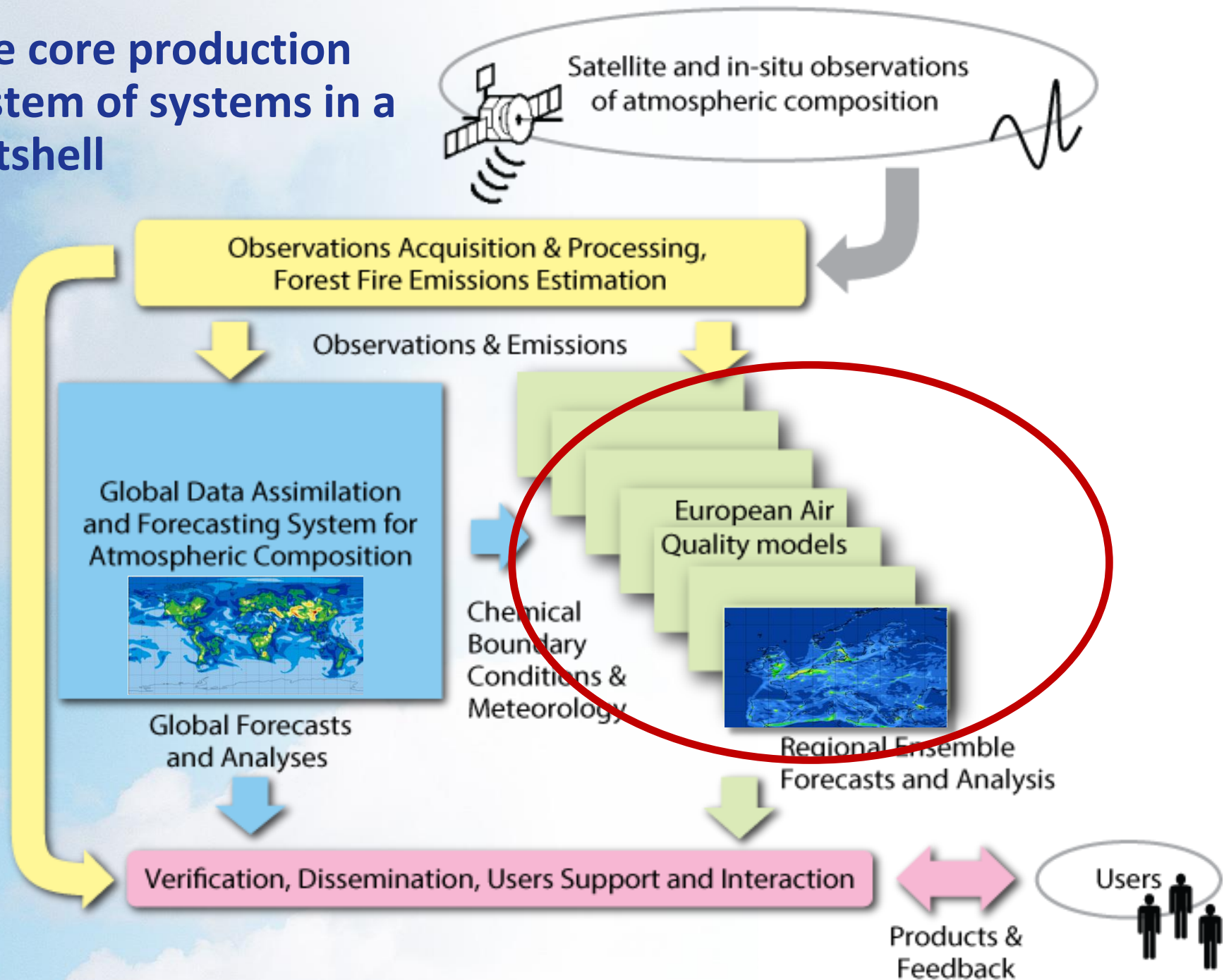
# Monitoring Atmospheric Composition and Climate – Interim Implementation achieved

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

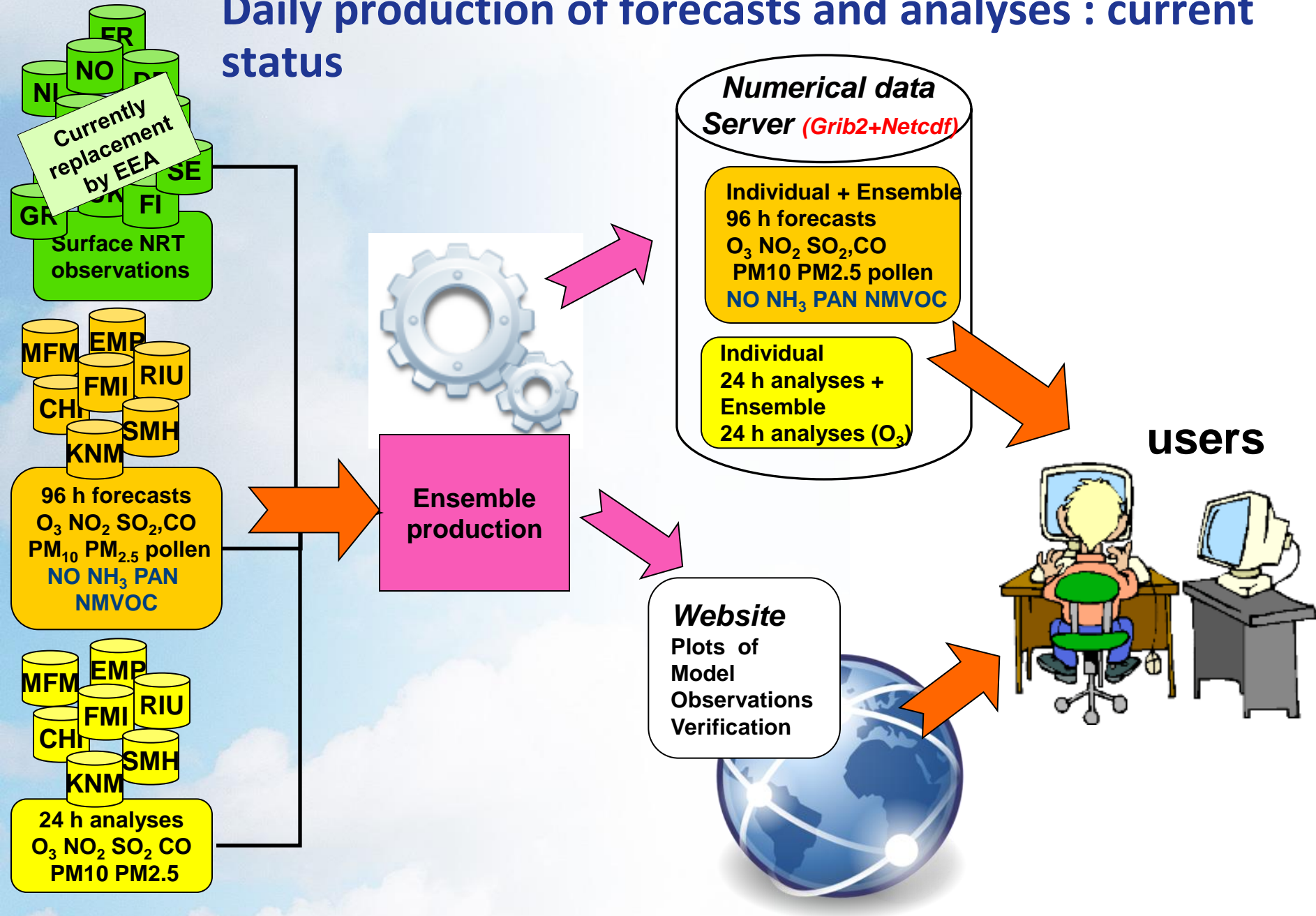
Final stage before the implementation of operational services coordinated by ECMWF (fall 2015)



# The core production system of systems in a nutshell



# Daily production of forecasts and analyses : current status





# European Air quality forecasts and analyses

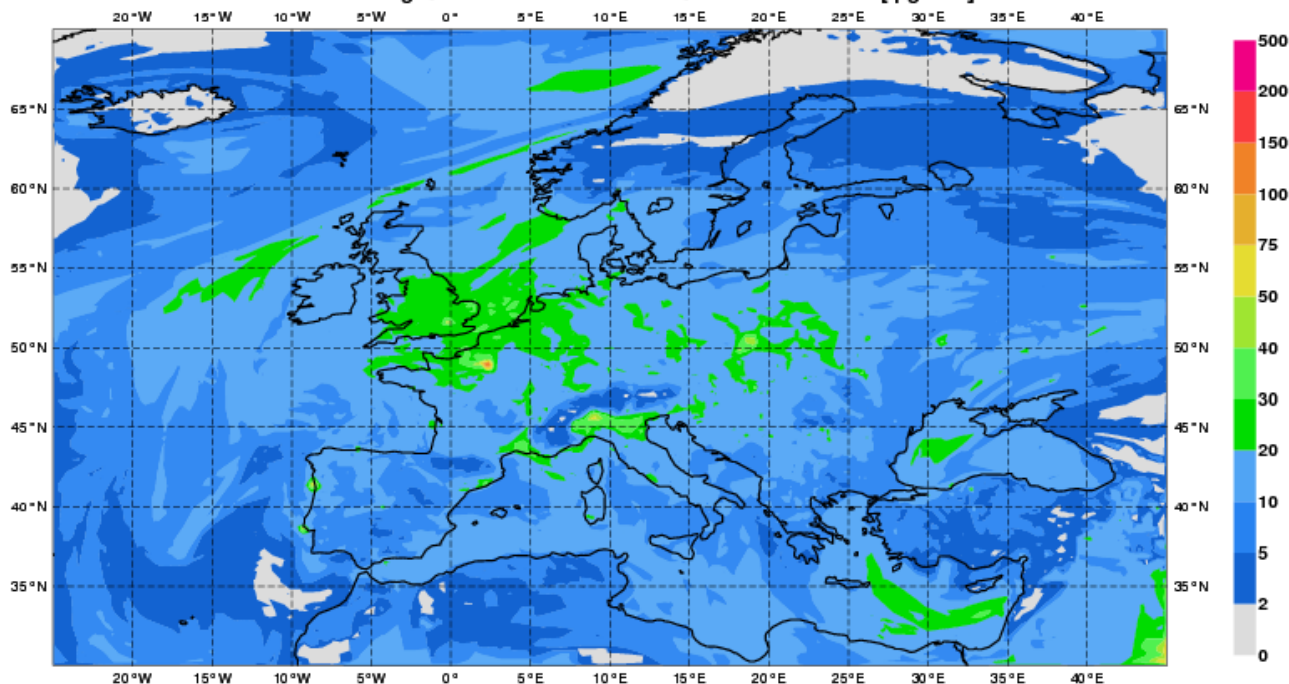
Monitoring atmospheric composition & climate

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Thursday 12 February 2015 00UTC MACC-RAQ Forecast t+000 VT: Thursday 12 February 2015 00UTC  
Model: ENSEMBLE MEDIAN Height level: Surface Parameter: PM10 Aerosol [ $\mu\text{g}/\text{m}^3$ ]

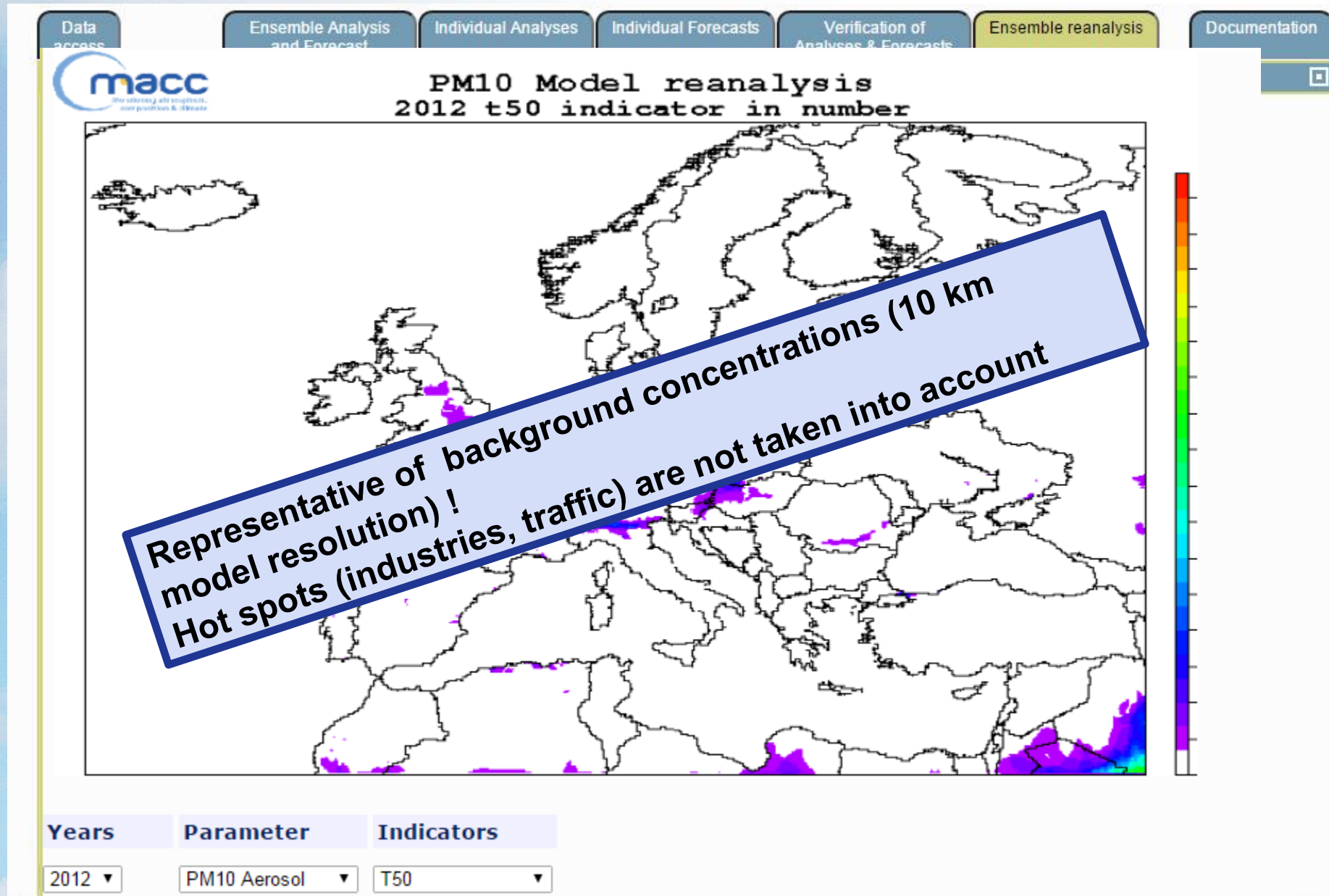


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014 013 012 011 010 009 008 007 006 005 004 003 002 001 000 001 002 003 004 005 006 007 008 009 010 011 012 013 014 015

Forecast base time	Model	Level	Parameter
Thu 12 Feb 2015 00 UTC	ENSEMBLE	Surface	PM10 Aerosol

# European air quality re-analyses (assessment)



# Yearly assessment and validation reports

MACC-II Report n°D113.4

Assessment Report:  
Air quality in Europe  
in 2012

Date: 07/2014  
Authors: Laurence ROUIL (INERIS), and the  
MACC/EVA teams



Grant agreement n°283576




MACC-II Report n°D113.5

Validation report for 2012


MACC-II Deliverables  
D102.16 (new) & D106.19 (new)

ENSEMBLE regional  
forecasting system and  
performances

Date: 01/2013  
Lead Beneficiary: MF-CNRM (#23)  
Nature: R  
Dissemination level: PU



Grant agreement n°283576






Grant agreement n°283576



# Evaluation/verification : a key issue ....

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 Monitoring atmospheric composition & climate
 


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[FORECAST VS OBSERVATIONS](#)
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Forecast base time: **Times Series 2012 10 31**

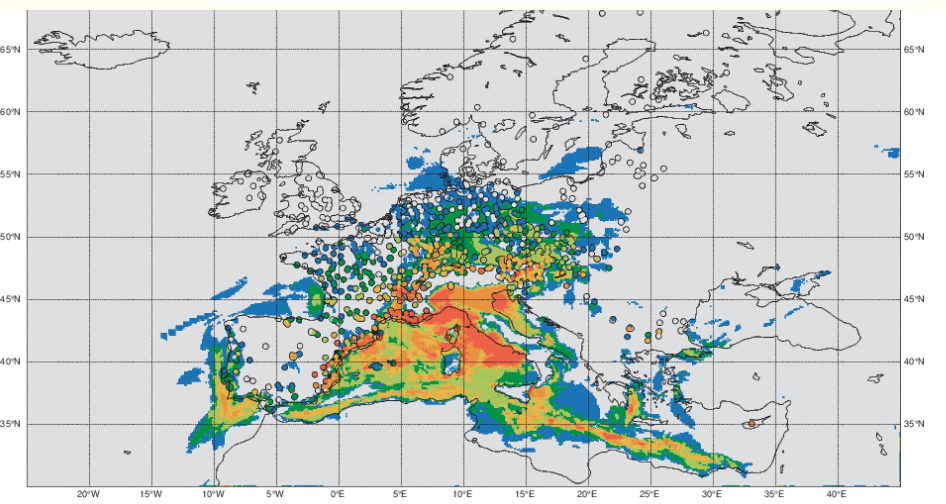
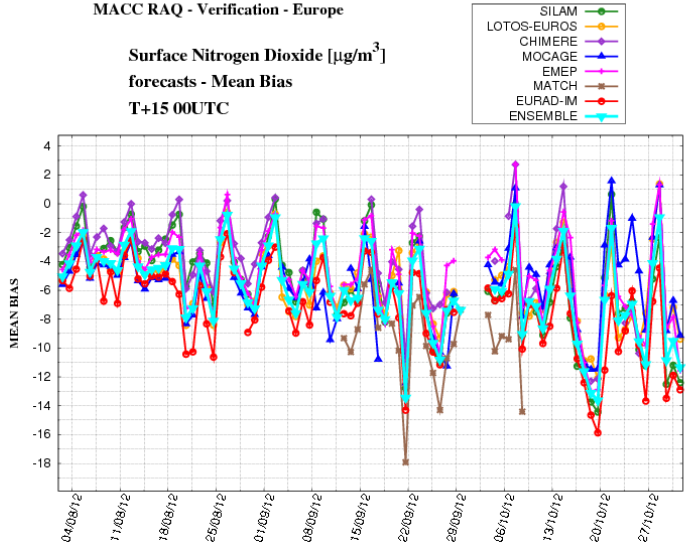
Wed 31 Oct 2012 00UTC

Step 3 Step 15

MACC RAQ - Verification - Europe

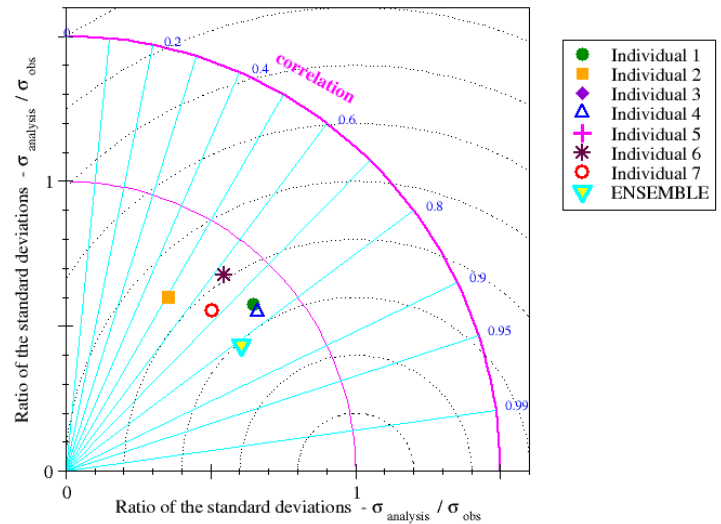
Surface Nitrogen Dioxide [ $\mu\text{g}/\text{m}^3$ ]  
forecasts - Mean Bias  
T+15 00UTC

Legend:  
 SILAM (green circle)  
 LOTOS-EUROS (orange circle)  
 CHIMERE (purple circle)  
 MOCAGE (blue triangle)  
 EMEP (magenta triangle)  
 MATCH (brown square)  
 EURAD-IM (red circle)  
 ENSEMBLE (cyan triangle)



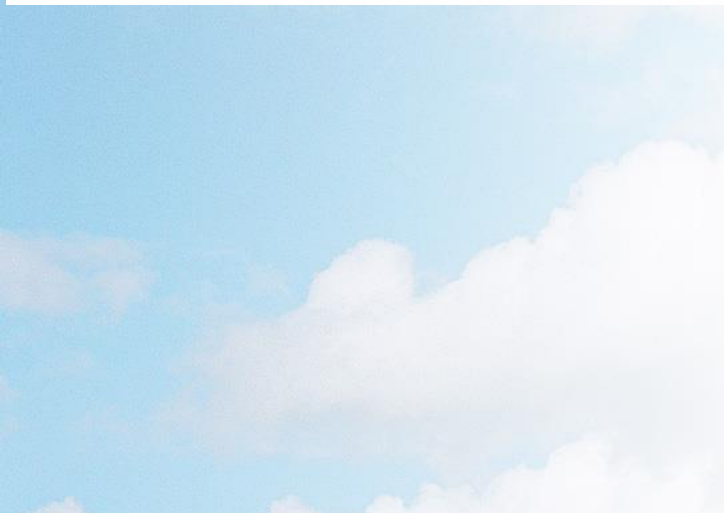
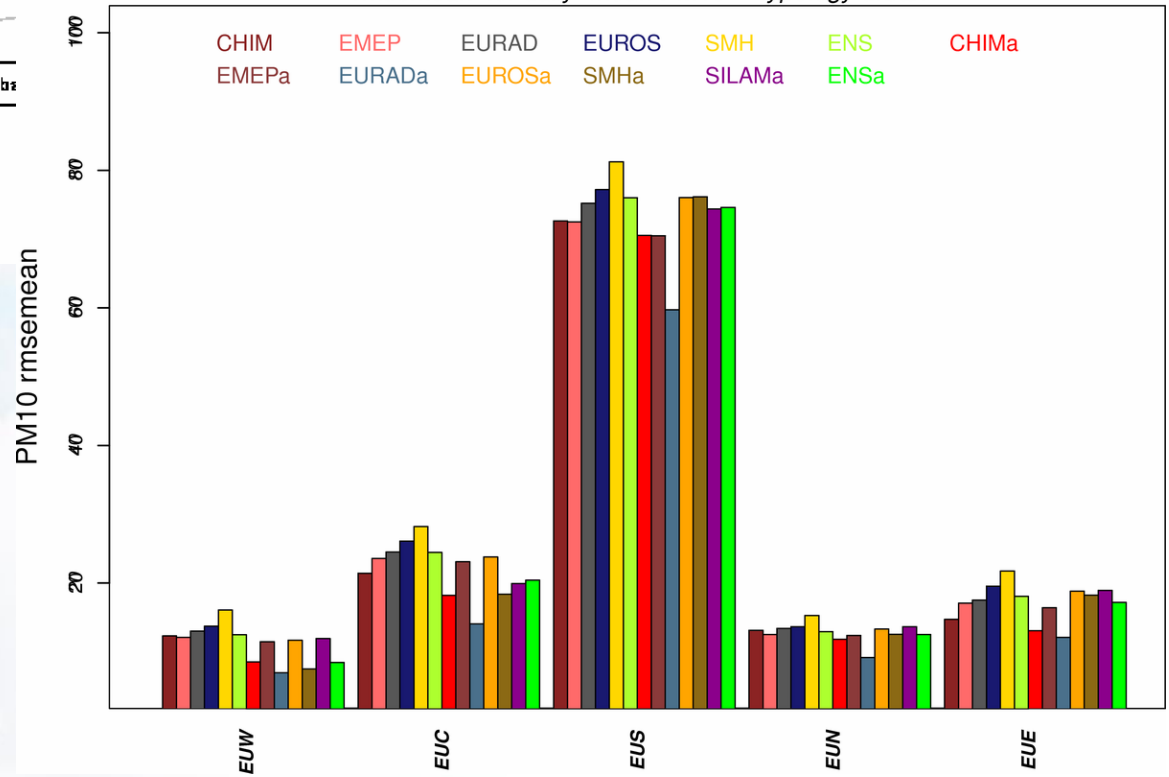
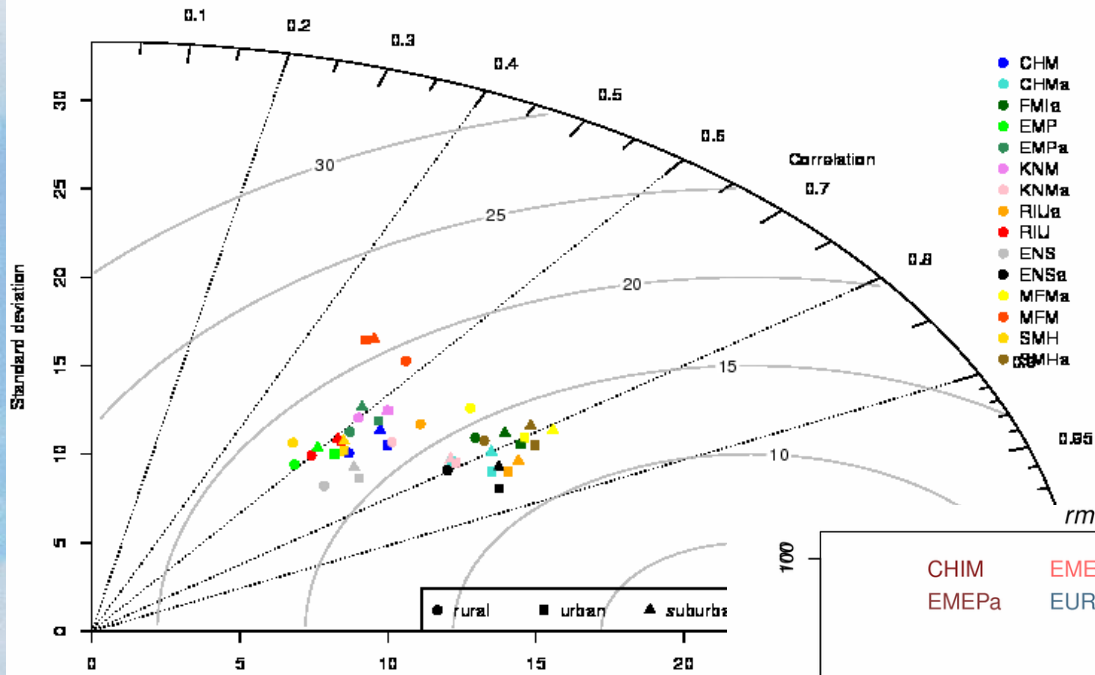
or both daily and yearly production !

Taylor Plot - Europe - 3 months  
Ozone - 20141012 00UTC to 20150111 00UTC





Taylor Diagram with all models with summer daily mean of pollutant O3



## Links with FAIRMODE

- **Experience in air quality forecasting + ensemble**
  - **Air quality assessments based on data assimilated fields**
  - **Verification**
- 
- Evaluation of the MACC/CAMS model results against the FAIRMODE quality criteria
  - Evaluation of forecasts and re-analyses (cross-cutting in Fairmode)
  - Work on modeled « composite » air quality maps should take into account European-wide approaches : EEA maps, EMEP maps and Copernicus maps
  - Use of the TNO/MACC emission inventory for comparison of top/down and bottom-up approaches

# Other policy-oriented services : short term scenarios and source receptor analyses

- To help policy users in the design of policy responses to prevent severe air pollution episodes.
  - Using the Copernicus forecasting capacities to provide daily regular information on the expected effect that short term measures
  - Assessing the relevance of implantation of short term action plans **in advance** to manage the predicted episodes
- 
- **S1 - Combustion in energy and transformation industries – 10 %**
  - **S2 - Non-industrial combustion plants – 30 %**
  - **S3 - Combustion in manufacturing industry -10%**
  - **S4 - Production processes -10%**
  - **S7 - Road transport – 30 %**
  - **S10 – Agriculture – 30%**

[http://www.copernicus-atmosphere.eu/services/aqac/policy\\_interface/green\\_scenarios/control\\_scenarios/](http://www.copernicus-atmosphere.eu/services/aqac/policy_interface/green_scenarios/control_scenarios/)

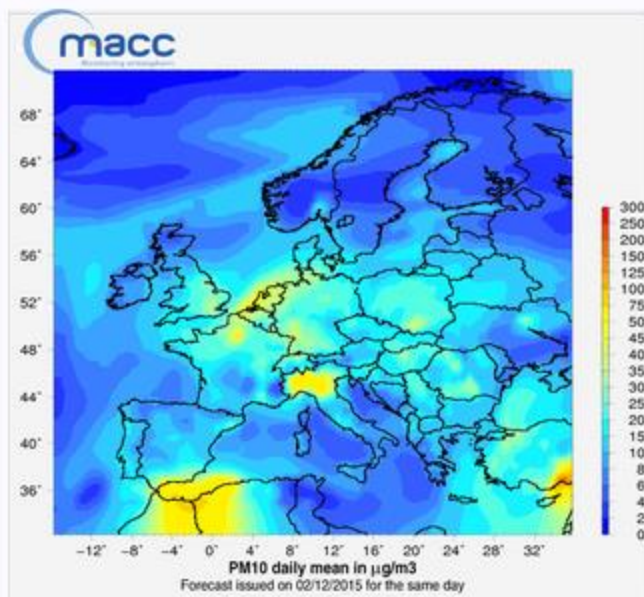
## Control scenarios

Forecasts

Emission scenario impacts

Pollutant  Day

Particles PM 10 daily mean  
(reference)

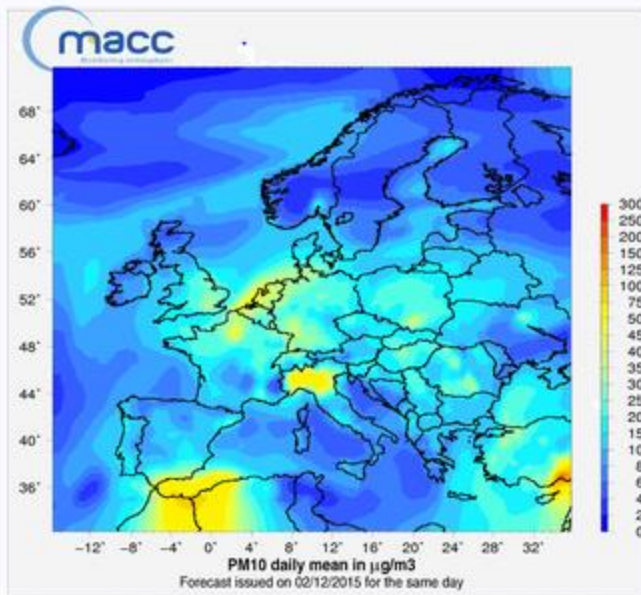


Reference is the baseline scenario with the complete set of emissions for 7 pollutants: nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), ammonia (NH<sub>3</sub>), volatile organic compounds (VOCs), sulphur dioxide (SO<sub>2</sub>), PM (PM<sub>coarse</sub> and PM<sub>2.5</sub>). It will enable us to assess the impact of the emission reduction scenarios presented below.

Based on the CHIMERE model (INERIS) run with coarse resolution (0.5° ) to reduce computing times

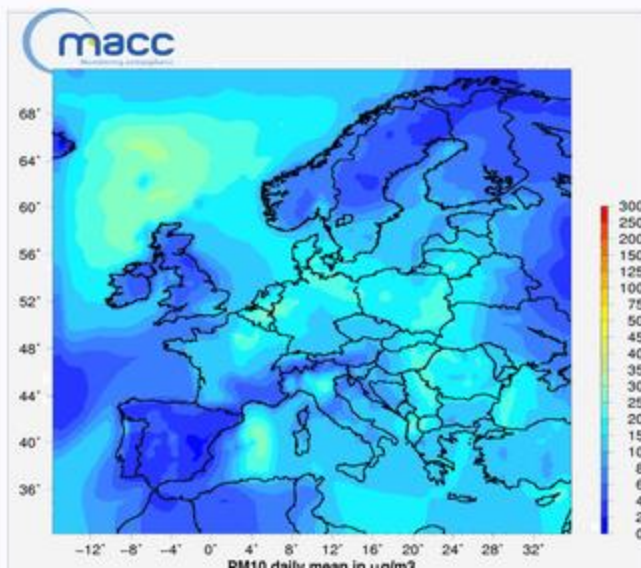


## Particles PM 10 daily mean (stra)



The traffic oriented scenario is based on an hypothetical reduction of road traffic emissions throughout Europe by 30%. This reduction targets the following pollutants: nitrogen oxides ( $\text{NO}_x$ ), carbon monoxide ( $\text{CO}$ ), ammonia ( $\text{NH}_3$ ), volatile organic compounds (VOCs), sulphur dioxide ( $\text{SO}_2$ ), PM. The 30% reduction assumption is fully theoretical but can be seen as representative of reducing by a half the number of vehicles used in Europe. The objective is to assess the impact of this "extreme" scenario. It should be noted that because of non linearities in atmospheric chemistry and complex ozone formation processes, increasing ozone levels can occur.

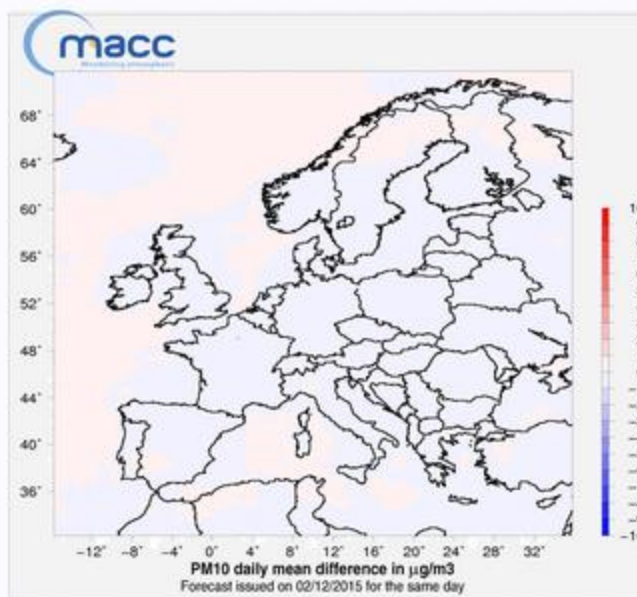
## Particles PM 10 daily mean (sres)



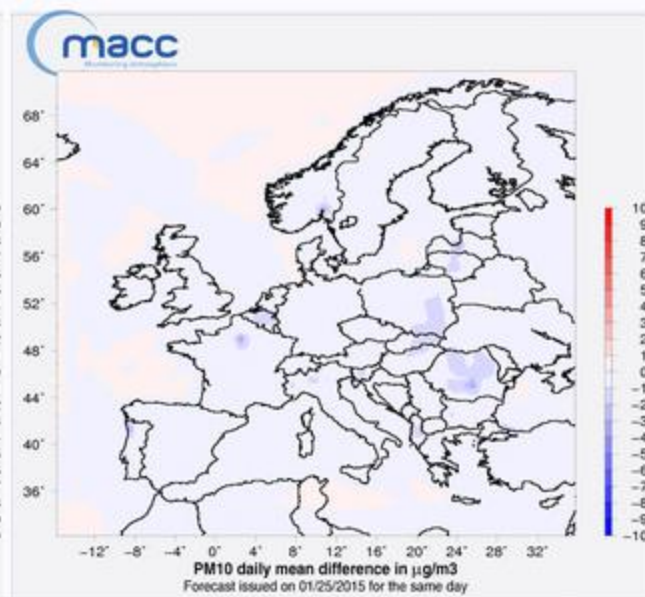
The residential oriented scenario is based on an hypothetical reduction of residential heating emissions throughout Europe by 30%. Clearly it concerns rather winter periods and PM episodes likely to occur. This reduction targets the following pollutants: nitrogen oxides ( $\text{NO}_x$ ), carbon monoxide ( $\text{CO}$ ), ammonia ( $\text{NH}_3$ ), volatile organic compounds (VOCs), sulphur dioxide ( $\text{SO}_2$ ), PM. The 30% reduction assumption is fully theoretical the objective is to assess the maximum feasible ambient concentration reductions under this "extreme" scenario.

# Impact of reductions for D+0

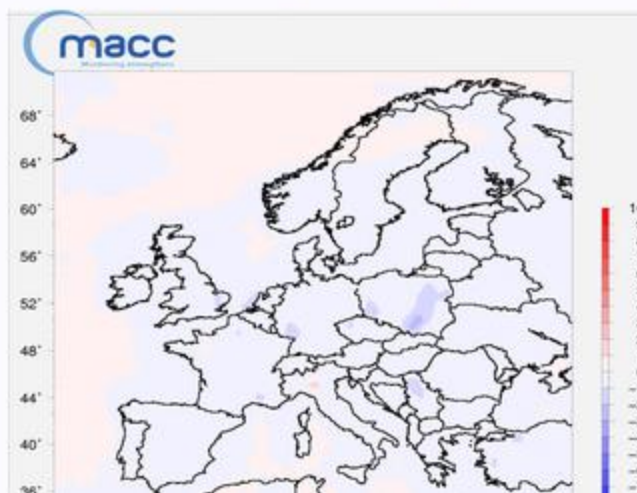
### Particles PM 10 daily mean difference (stra-ref)



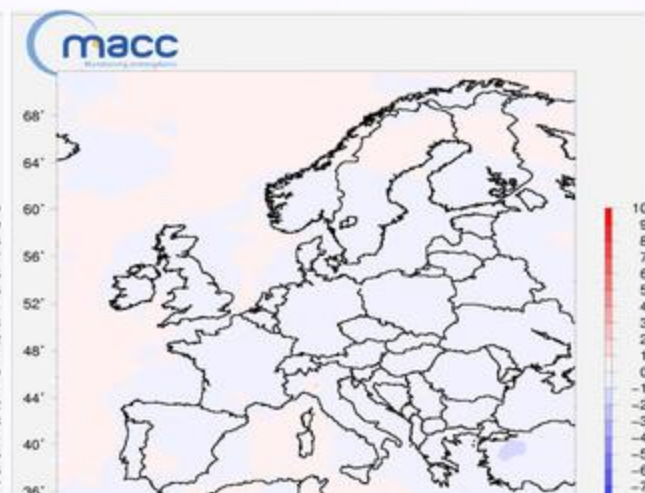
### Particles PM 10 daily mean difference (sres-ref)



### Particles PM 10 daily mean difference (sagr-ref)



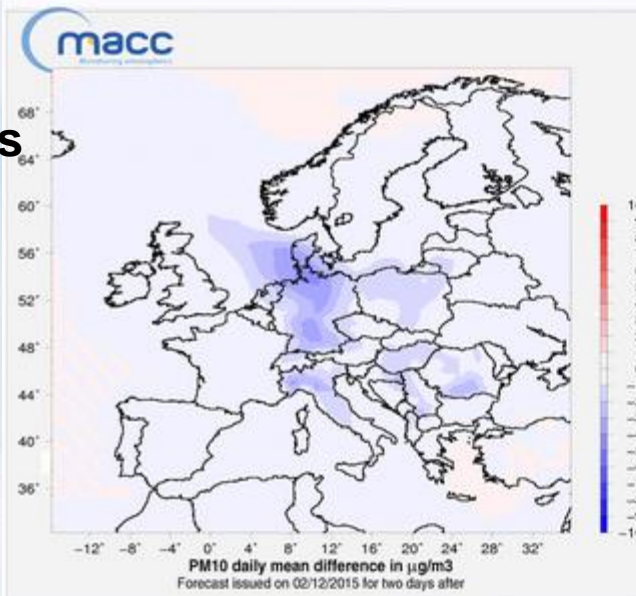
### Particles PM 10 daily mean difference (sind-ref)



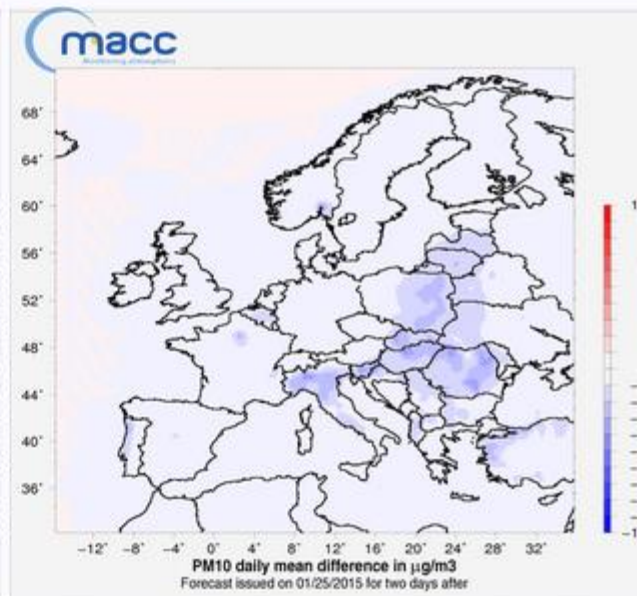


# Impact of reductions for D+2

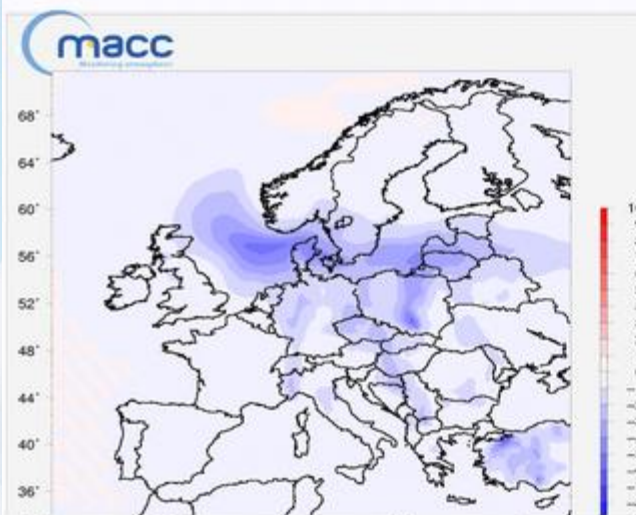
### Particles PM 10 daily mean difference (stra-ref)



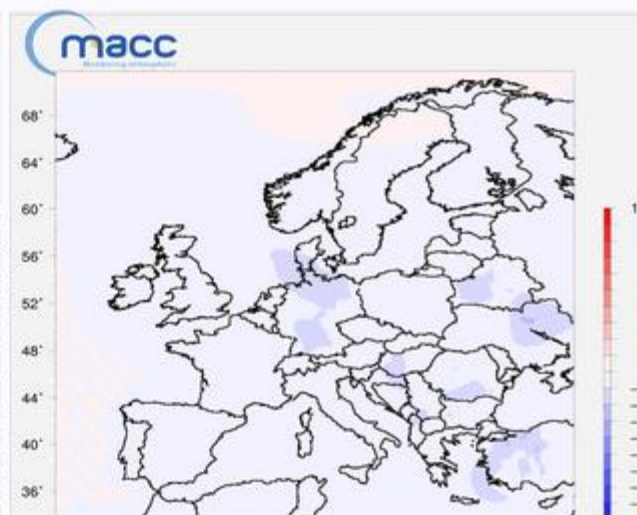
### Particles PM 10 daily mean difference (sres-ref)



### Particles PM 10 daily mean difference (sagr-ref)

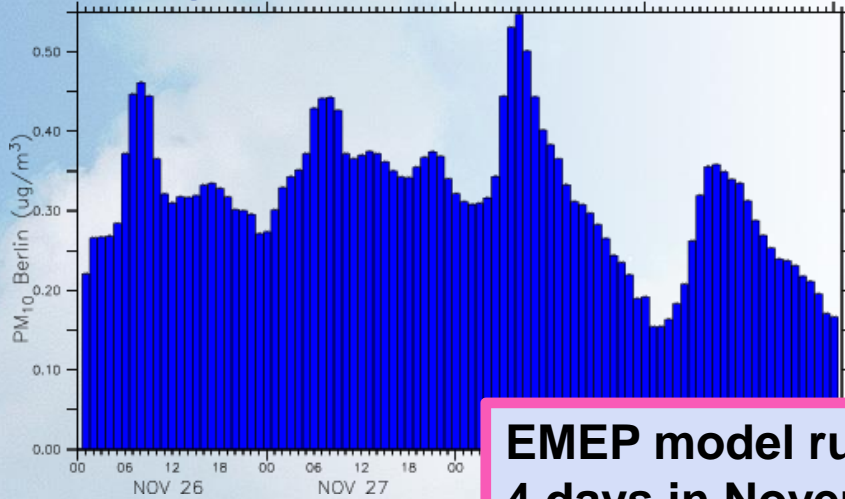


### Particles PM 10 daily mean difference (sind-ref)

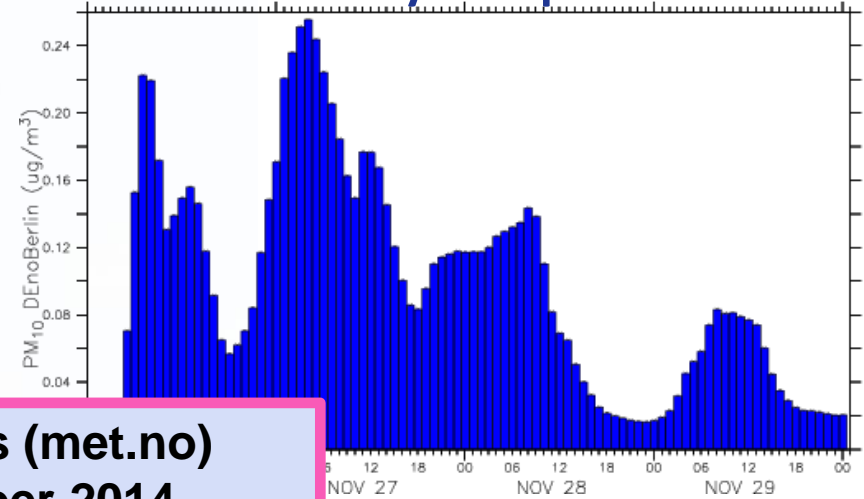


# PM<sub>10</sub> reductions in Berlin that can be achieved by a 15% reduction of all anthropogenic emissions in ...

## ... Berlin

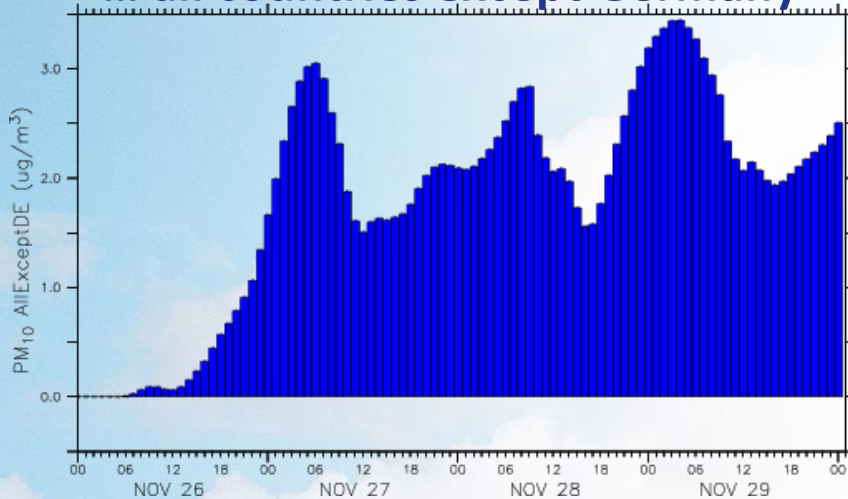


## ... all Germany except Berlin

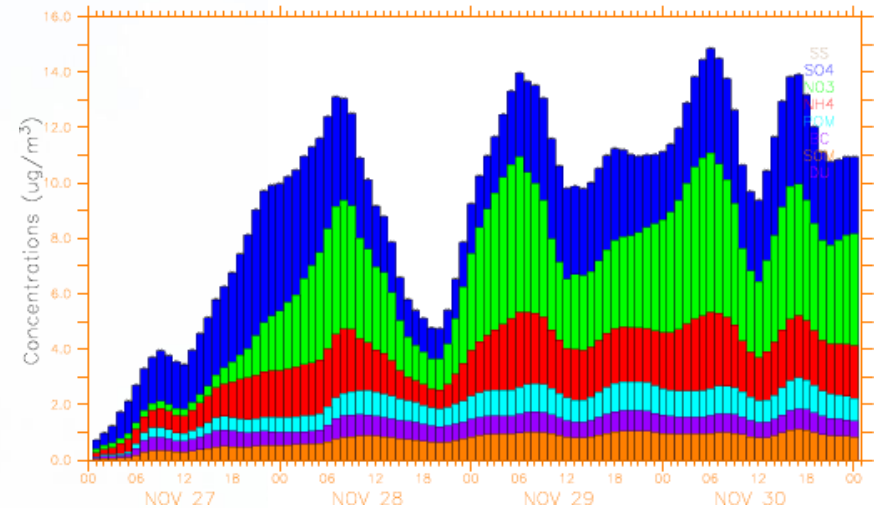


**EMEP model runs (met.no)  
4 days in November 2014**

## ... all countries except Germany



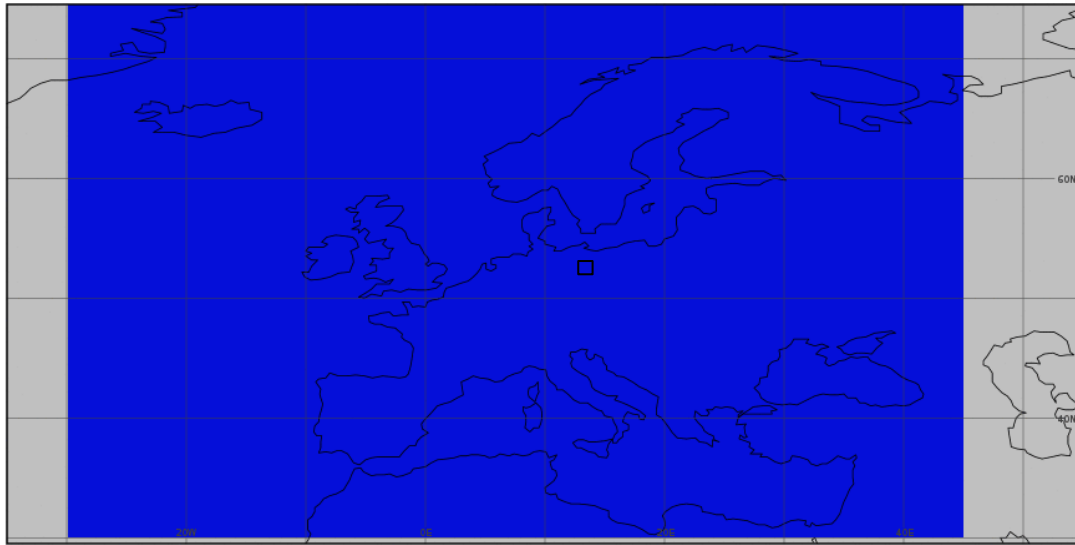
## Concentration of Pollutants over Berlin (µg/m³)





### PM10 Surface (ug/m3)

Time at end of period: 2014-06-22 00:00:00

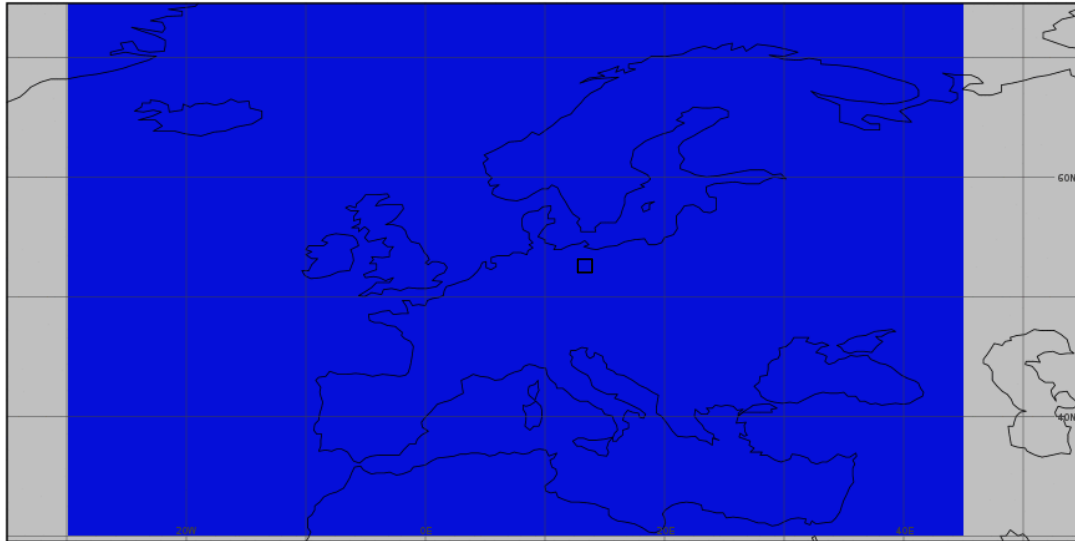


Norwegian  
Meteorological  
Institute

## June 2014

### PM10 Surface (ug/m3)

Time at end of period: 2014-11-26 00:00:00

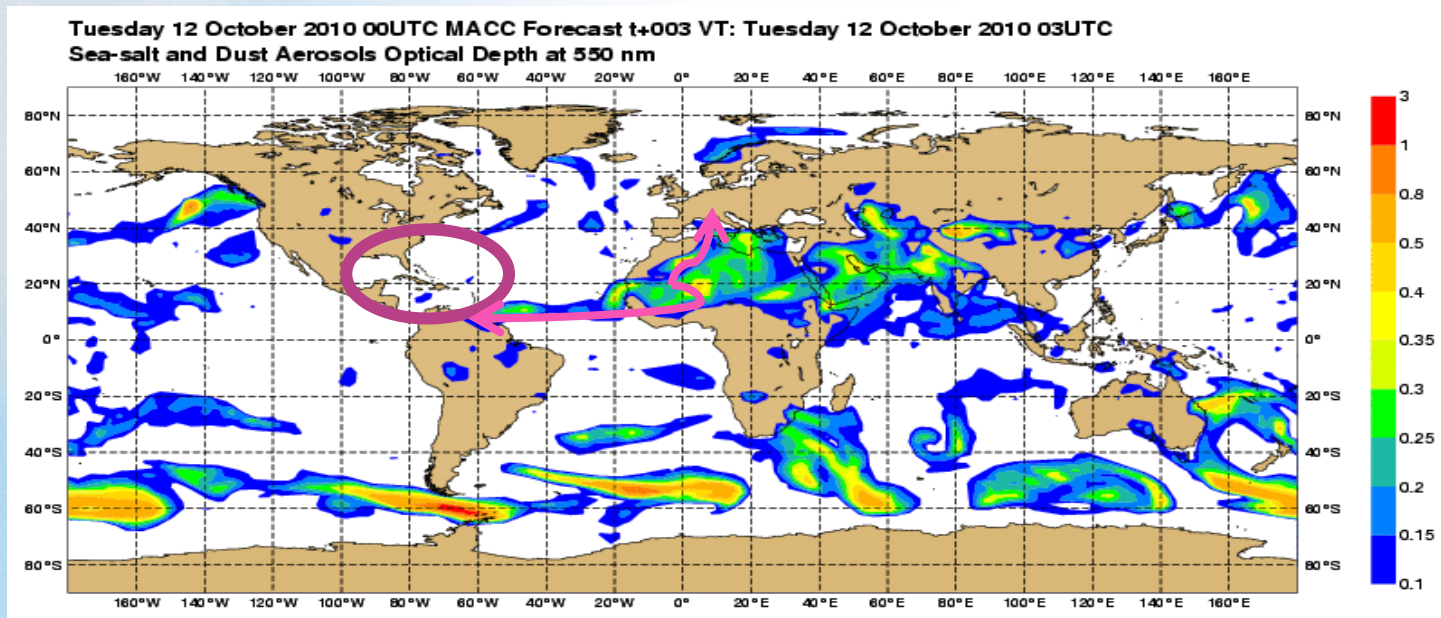


Norwegian  
Meteorological  
Institute

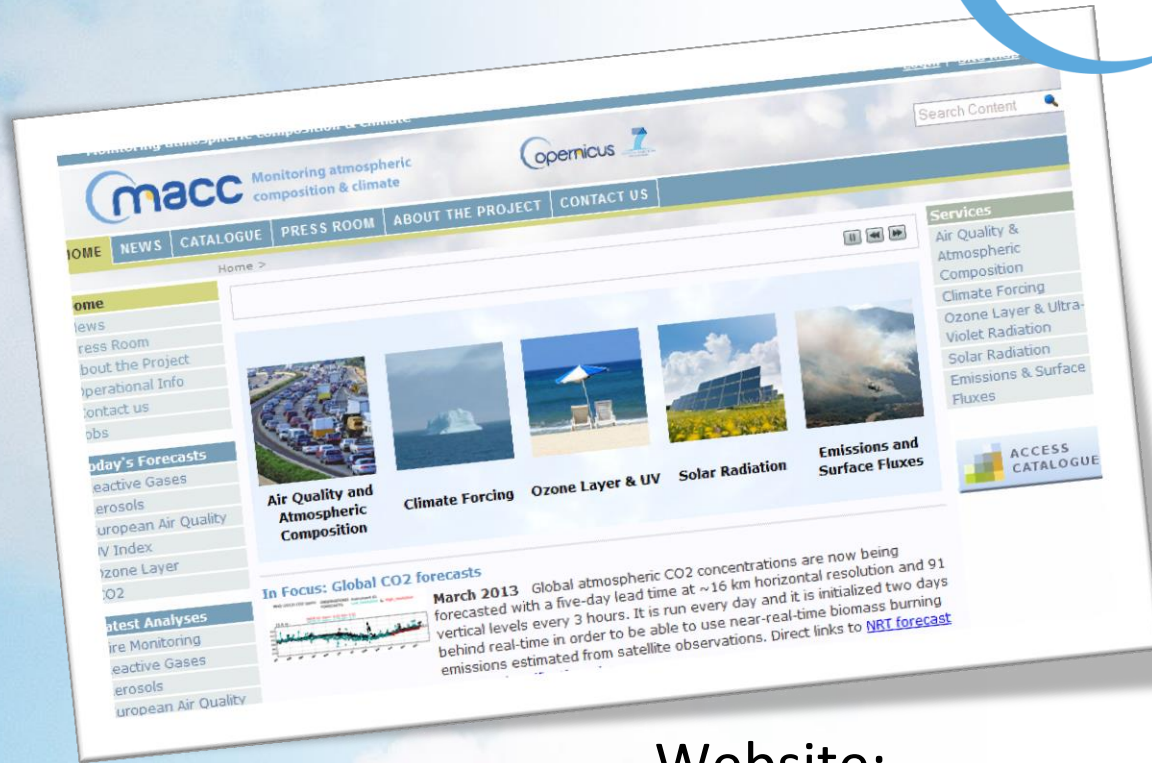
## November 2014

## Links with FAIRMODE

- Source-receptor analysis performed at various scale (city, country) could contribute to work on SA (Fairmode WG3)
- As forecasts and maps of natural PM (dust, sea salt)



- Daily forecasts of scenarios results could be valuable inputs for planning evaluation (Fairmode WG4)



Website:  
<http://atmosphere.copernicus.eu>  
 Contact:  
[info@atmosphere.copernicus.eu](mailto:info@atmosphere.copernicus.eu)  
 YouTube Copernicus Atmosphere

# MACC-III Policy support user Worksho



**Where?** Wien, Austria

**When?** 3 March 12:00 -  
4 March 14:00

**Why?** The workshop is  
addressed to the FAIRMODE  
community

Learn more on how to use MACC  
products for policy support applications  
– Experience Sharing

**Workshop webpage:**

**[http://copernicus-](http://copernicus-atmosphere.eu/services/agac/policy_interface/second)**

**[atmosphere.eu/services/agac/policy\\_interface/second](http://copernicus-atmosphere.eu/services/agac/policy_interface/second)**