

# AIR4EU Project Expert Workshop

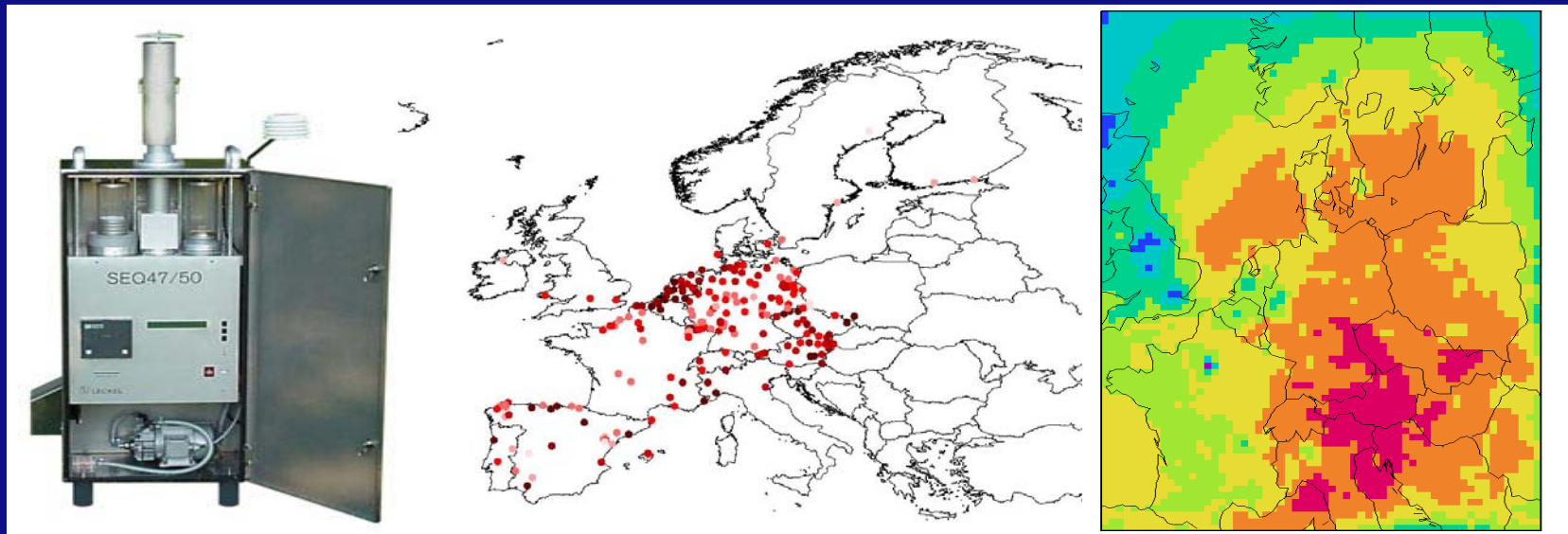
– Case Study Europe 1,  
Data assimilated concentration fields  
as regional background –

Brussels, June 30<sup>th</sup>, 2006

**TNO | Knowledge for business**



# Air quality assessment



Measurements

Modelling

To be combined using data assimilation

# Passive and active approaches

- **Passive** approach: Modelled fields are synthesized with measurements without a feedback to the model state
  - Synthesis is performed as a “finishing touch” using the model output

Examples: Kriging, Optimum interpolation

- **Active** approach: Modelled fields are synthesized with measurements with a feedback to the model state
  - The system uses and updates the causal relations within the modelling system
  - Assimilation is performed on the fly

Examples: Kalman filtering, 3D-VAR

# Examples of active data assimilation: EnKF

- The LOTOS-EUROS air quality model
- An Ensemble Kalman Filter

→ Goal of these experiments: To generate regional background concentrations for European cities

Ensembles created by putting noise to emissions and dry deposition speeds

Examples:

- Ozone: summer 2003
- PM: 2003

## Noise to emissions and dry deposition is 50 %, in a random mode

Use of hourly O<sub>3</sub> and daily averaged PM10 observations

Choice of “noise”, uncertainty of the observations:

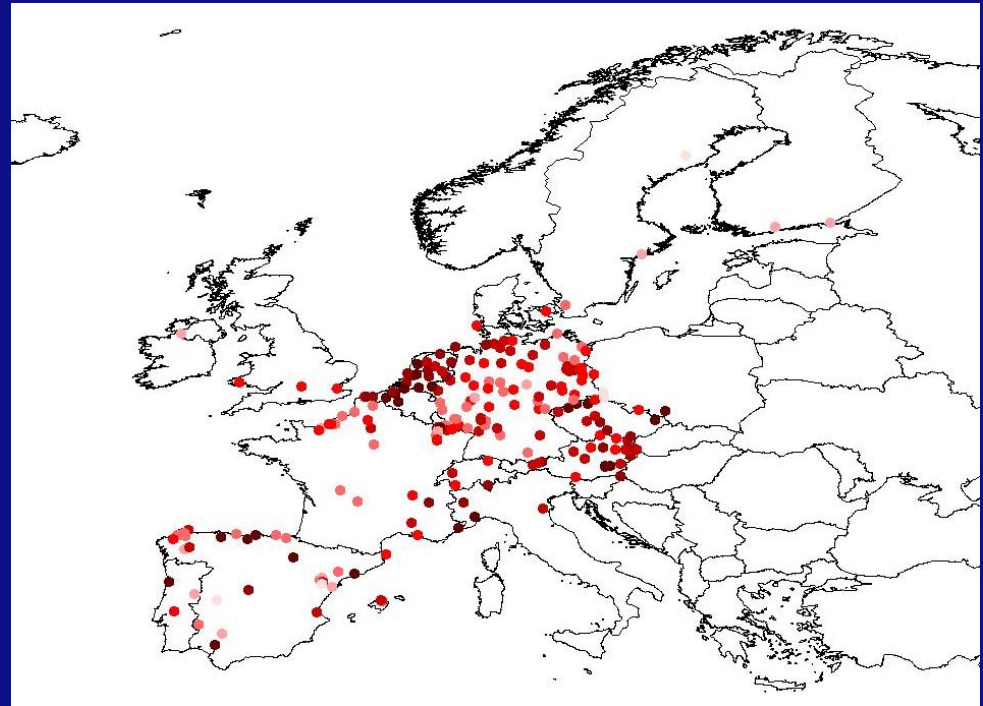
- O<sub>3</sub> : 10%, with max. of 5 µgr/m<sup>3</sup>
- PM10 : 12.5 %, without max. value

This is a choice made for spatial representativity,  
for the time being ....

(Results shown contained a small error in the O<sub>3</sub>-modelling,  
preliminary results)

# The Measurements

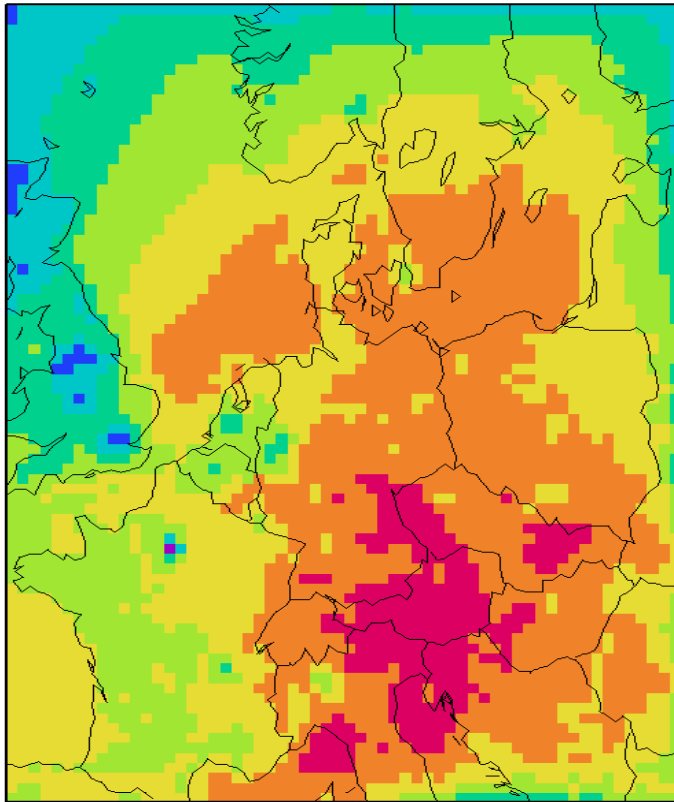
- $O_3$ 
  - EMEP data assimilated
  - AIRBASE as validation
  - Hourly data
  - Stdev = 10% with max. of  $5 \mu\text{g}/\text{m}^3$
- PM10:
  - AIRBASE data assimilated
  - Validation with city data and some EMEP stations
  - Daily data
  - Stdev = 12.5%



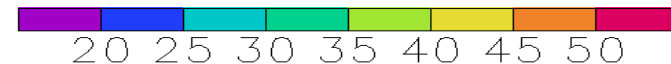
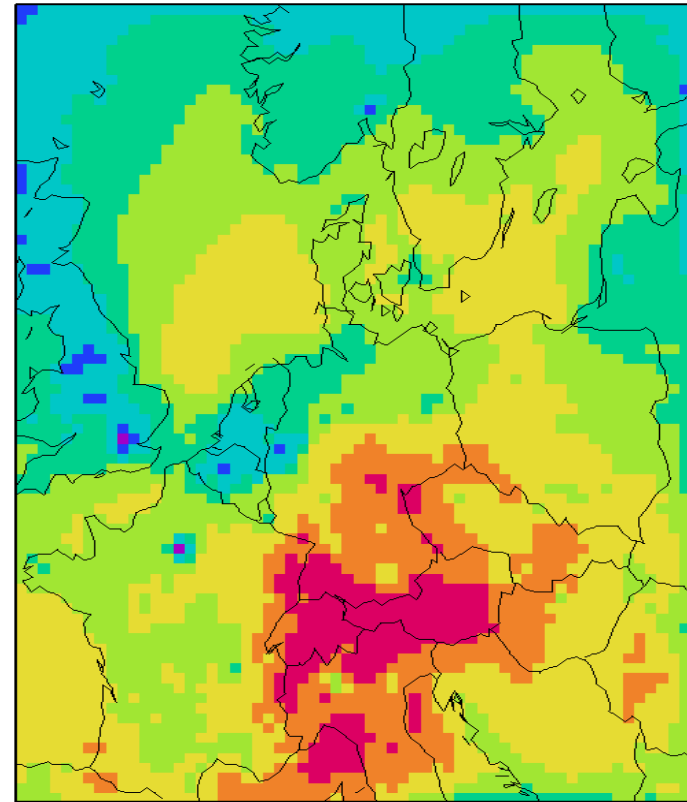
*PM10 stations in AIRBASE*

# Results Ozone (ppb)

modelled ozone july 2003



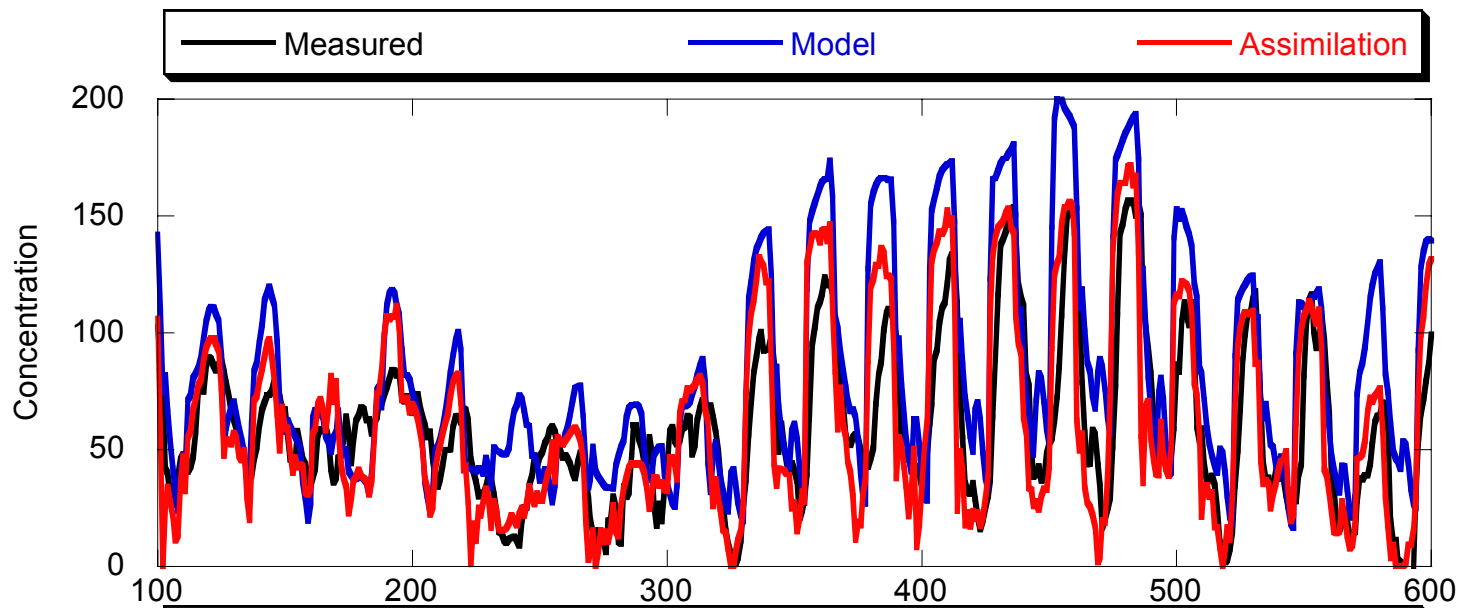
assimilated ozone july 2003



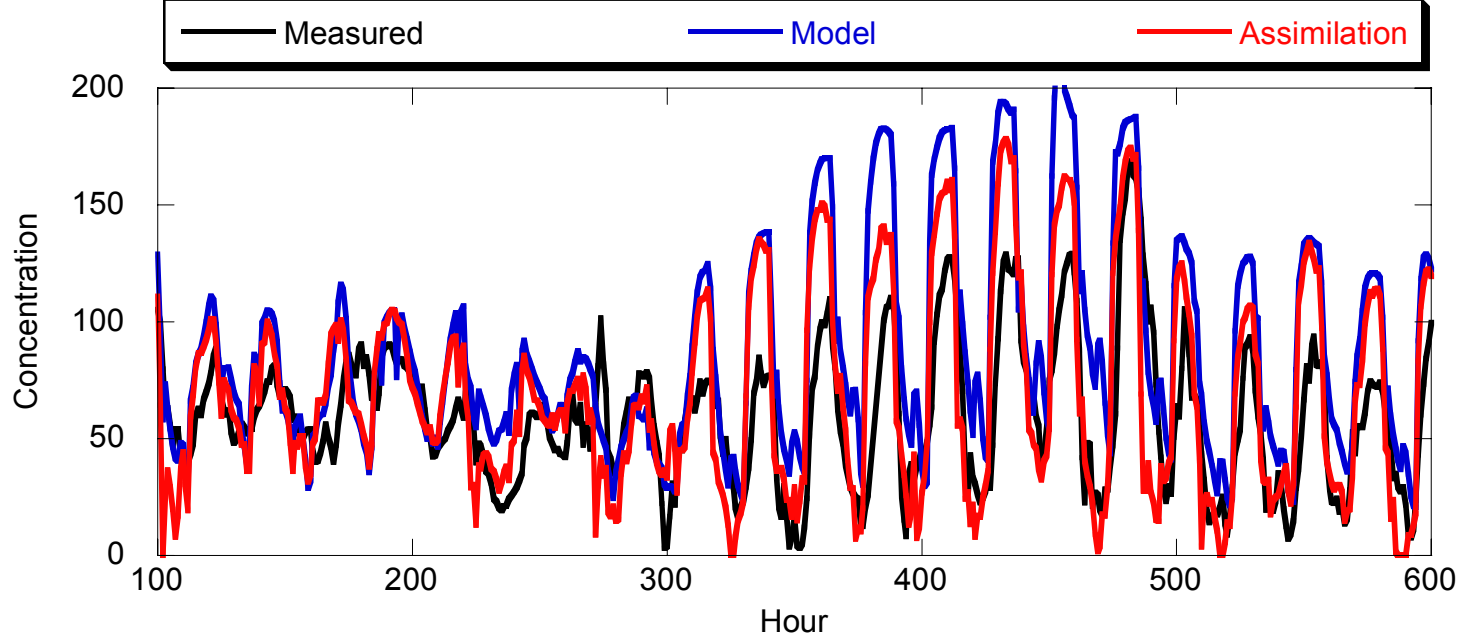
*Ozone measurements from the EMEP network assimilated*

# Validation

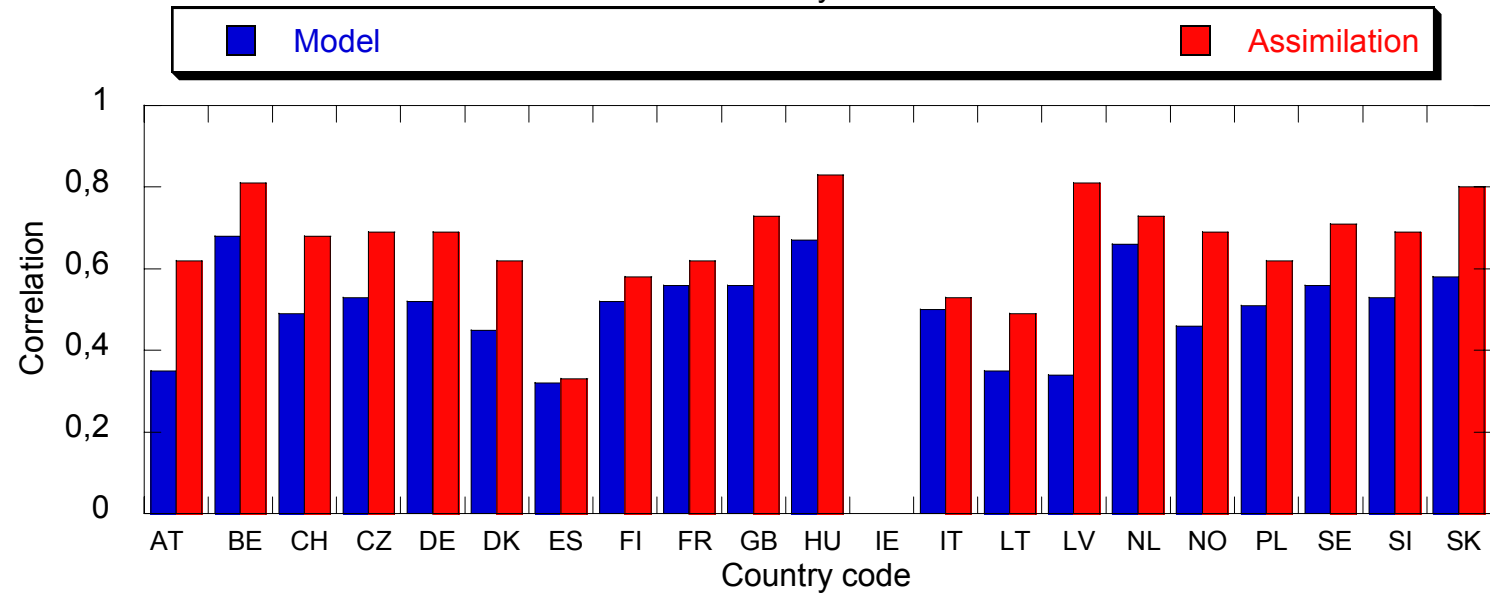
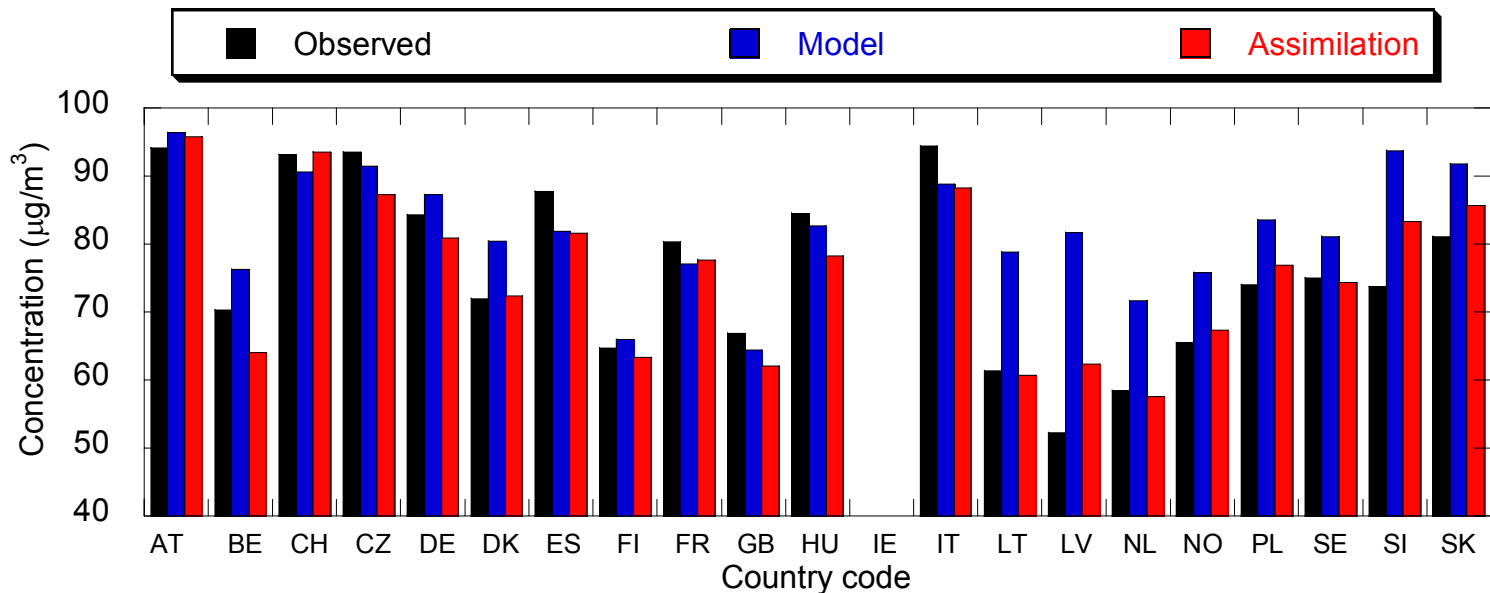
Vredepeel  
Assimilation  
station



Westmaas  
Validation  
station



# Validation



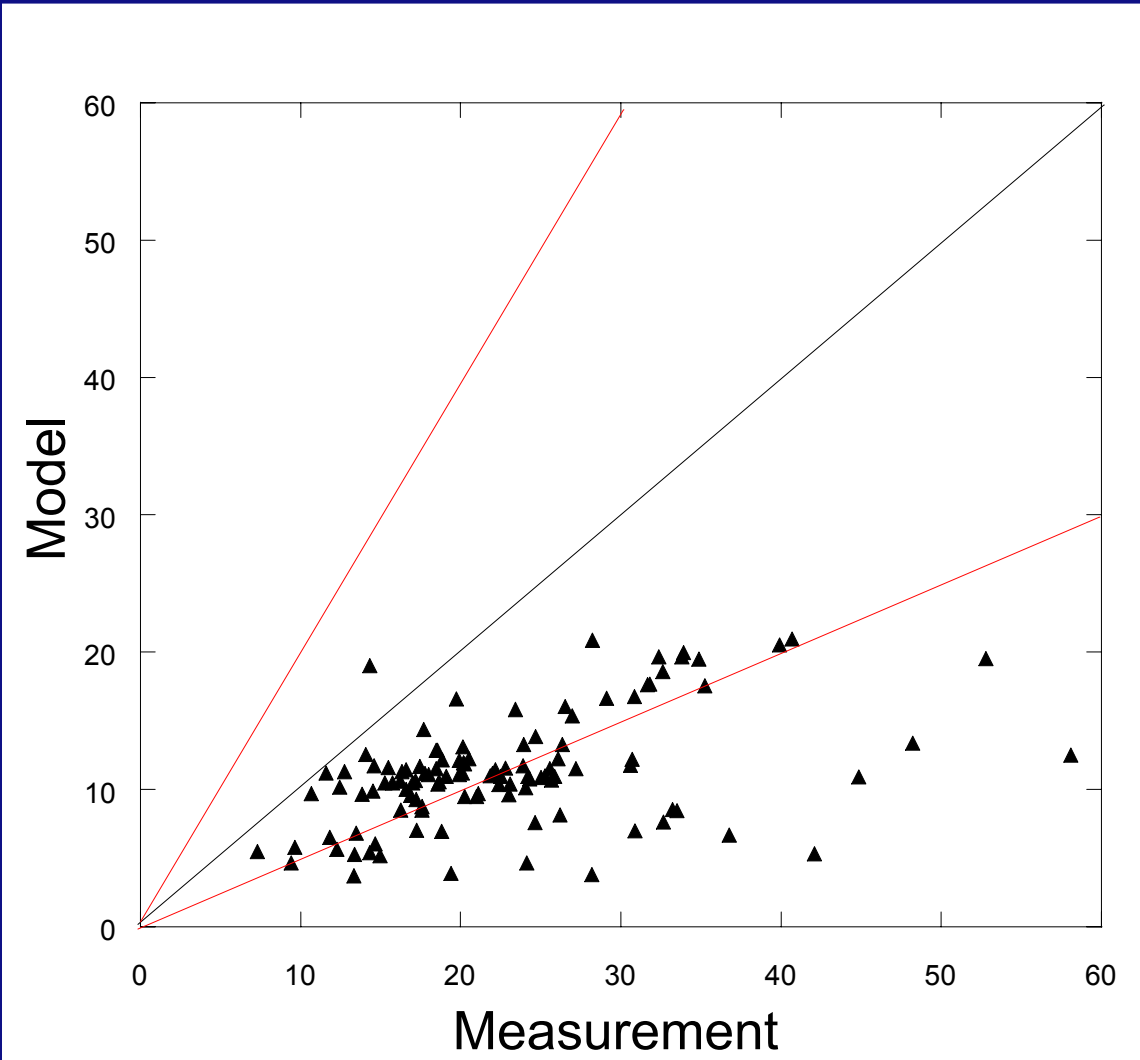
# Validation

335 AIRBASE stations within the domain

Large improvement in performance

	<b>Measured</b>	<b>Modelled</b>	<b>RMSE</b>	<b>Correlation</b>
Model	82.1	83.7	33.3	0.51
Assimilation	82.1	79.8	22.5	0.65

# Validation for PM10

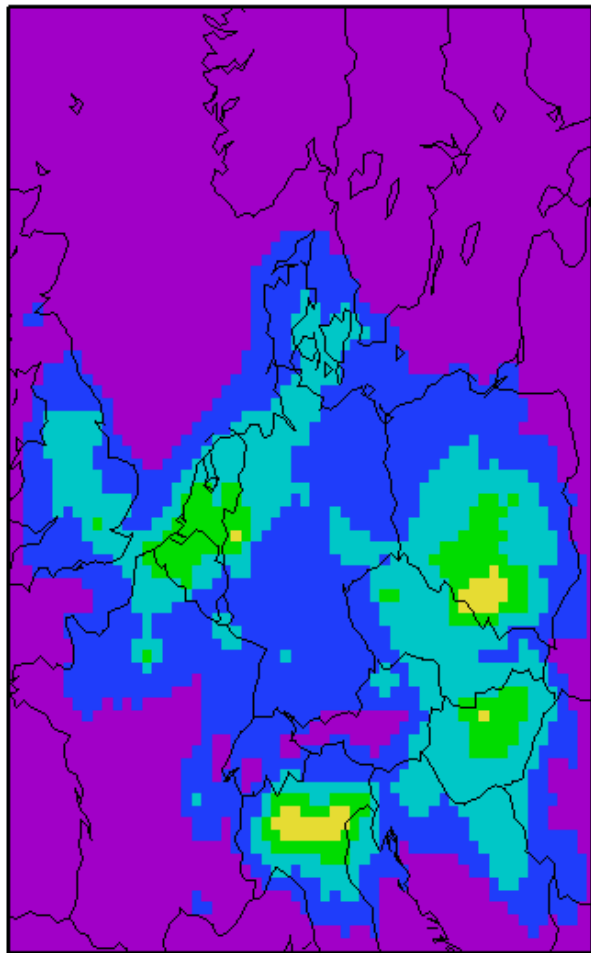


Underestimation : 40-60%

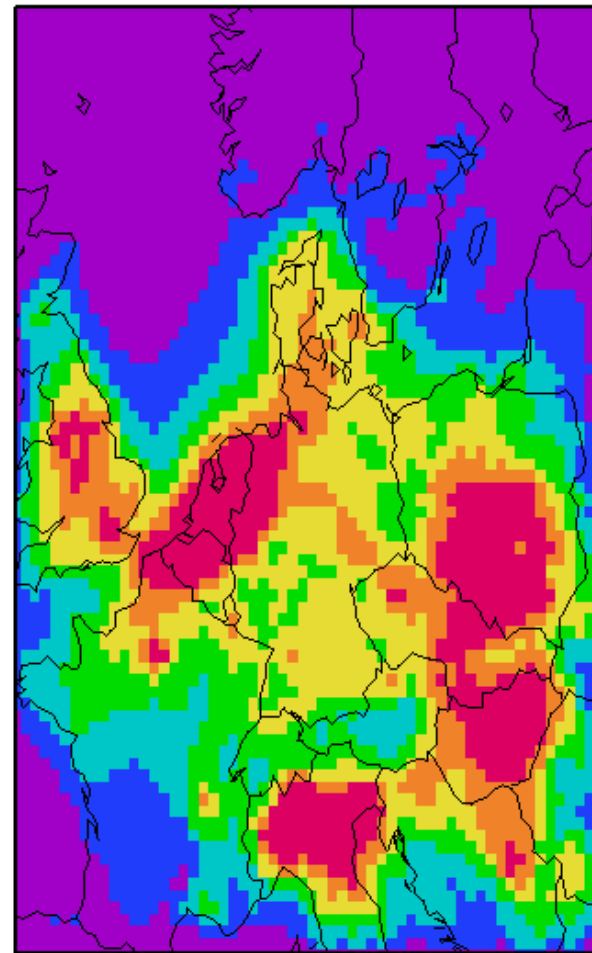
Bias correction : 50%

# PM10 fields for March-April, 2003

*modelled*

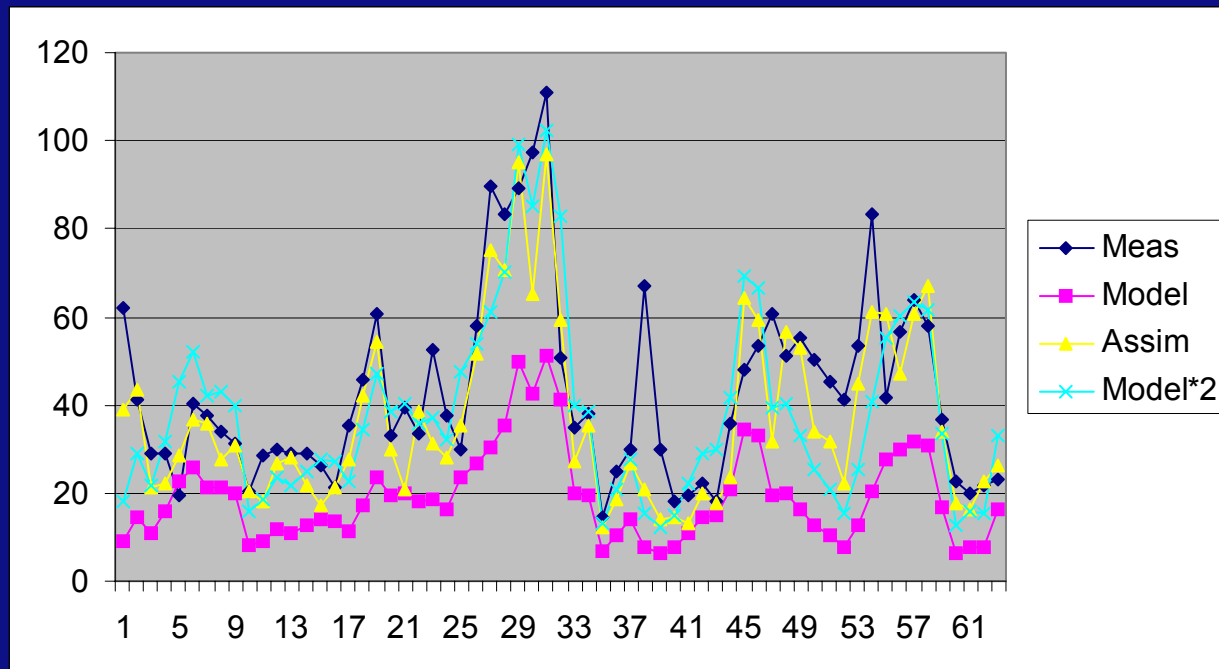


*assimilated*



# Validation plot

- First results give a mixed picture
- Small innovations point at too low model uncertainty in combination with high measurement uncertainty, in this case noise on rainout is needed
- PM is complex, due to large measurement uncertainties



# Conclusions

- It is possible to create in an operational mode, regional concentration fields over Europe combining monitoring and modelling
- More stable results for O<sub>3</sub> than for PM10
- These regional background fields can be used as BC for city areas (attention for double counting, required is consistent meteorology)
- Uncertainty analysis is very important and determines the end result. Further model development, especially for PM is needed, as well as improved measurement methods and spatial coverage
- These assimilated regional BC will/can be used in a number of case studies