

FP7 PASODOBLE

Myair Information Services for Regional and Local
Air Quality Monitoring and Forecasting

Thilo Erbertseder and consortium

COST Action Meeting TD1105 EuNetAir

EEA, Copenhagen, Denmark, 3-4 October, 2013



PASODOBLE

- 35 air quality services to support local users
- Focus on regions and cities, complementary to MACC



PASODOBLE – Consortium (2010-2013)

DLR	Deutsches Zentrum für Luft- und Raumfahrt (coordinator), DE
ACRI	ACRI-ST, FR
R-AEA	Ricardo - AEA, UK
AUTH	Aristotle University of Thessaloniki, EL
IASB	Institut d'Aeronomie Spatiale de Belgique, BE
BAS	National Institute Bulgarian Academy of Sciences,, BG
CERC	Cambridge Environmental Research Consultants, UK
CGS	Compagnia Generale per lo Spazio, IT
CHU	Centre Hospitalier Universitaire Nice, FR
MUW	Medical Uni Vienna / European Aeroallergen Network, AT
EMA	European Medical Association, INT
FMI	Finish Meteorological Institut, FI
KNMI	Koninklijk Nederlands Meteorologisch Instituut, NL
NILU	Norsk Institutt for Luftforskning, NO
RIU	Rheinisches Institut für Umweltforschung, DE
TAS-F	Thales Alenia Space France, FR
TNO	Ned. Org. v. Toegepast Natuurwetenschappelijk Onderzoek, NL
VITO	Vlaamse instelling voor technologisch onderzoek, BE
RIVM	National Institute for Public Health and the Environment, NL
BMT ARGOSS, NL	
Nowcasting International, IE	
Outdoor Concepts, DE	

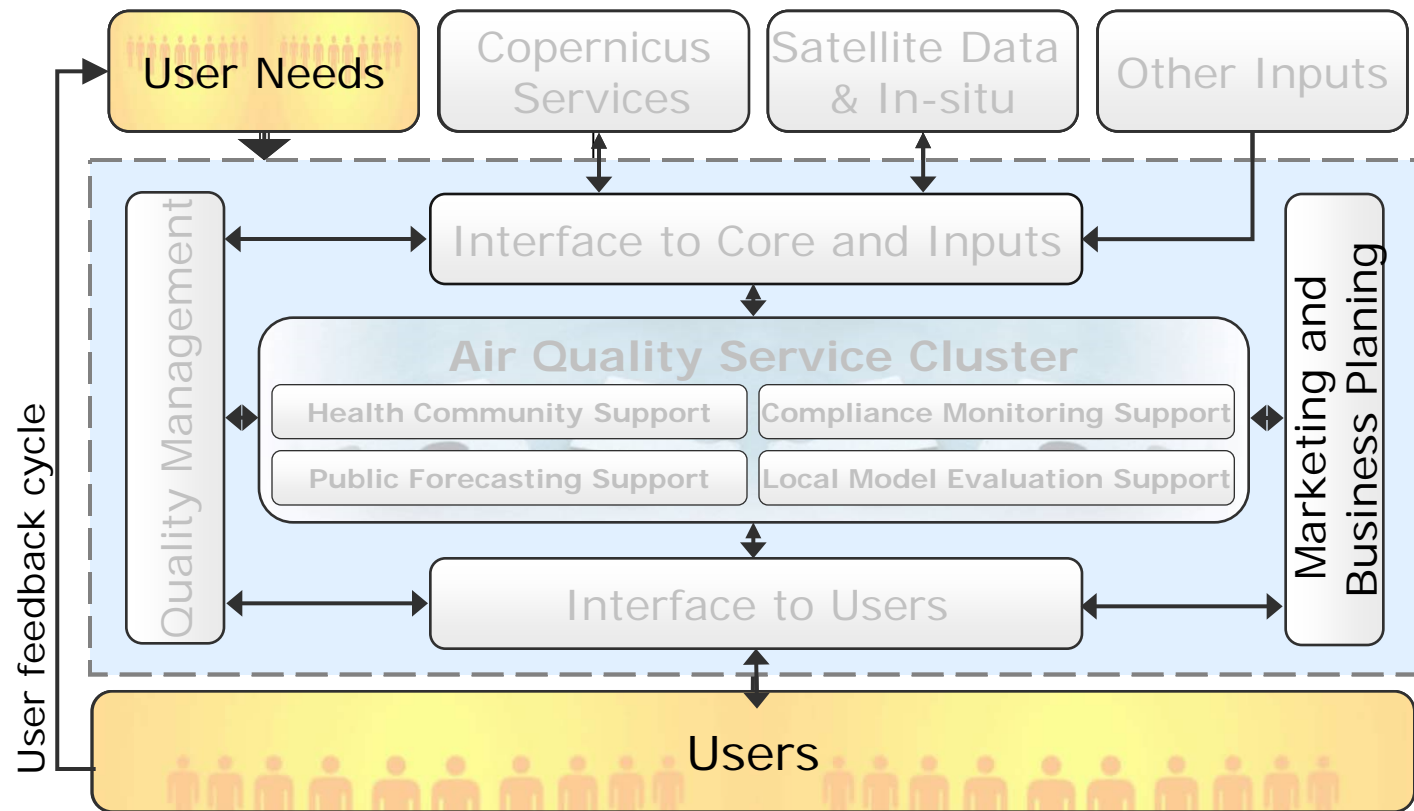
PASODOBLE - Goal

Develop and demonstrate user-driven services for the regional and local air quality sector by combining space-based data, in-situ data, numerical modelling and information technology in 4 areas:

- **Forecasting and assessment support**
for agencies, authorities, citizens
- **Health community support**
for people at risk, hospitals, pharmacies and doctors
- **Compliance monitoring support**
on particulate matter for regional environmental agencies
- **Model evaluation support**
for local authorities and city bodies

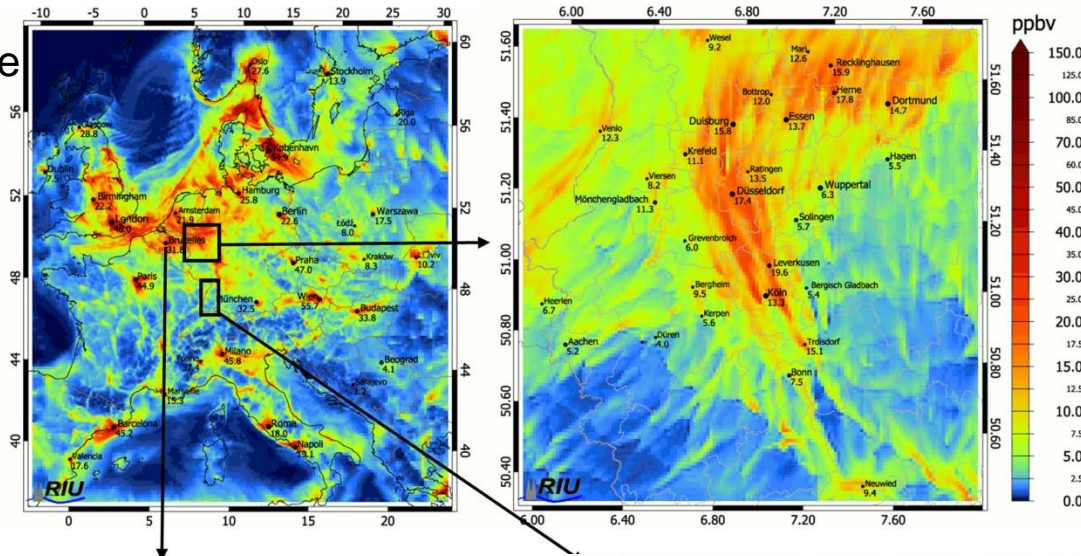
... embedded in a generic, harmonised infrastructure

PASODOBLE - Concept



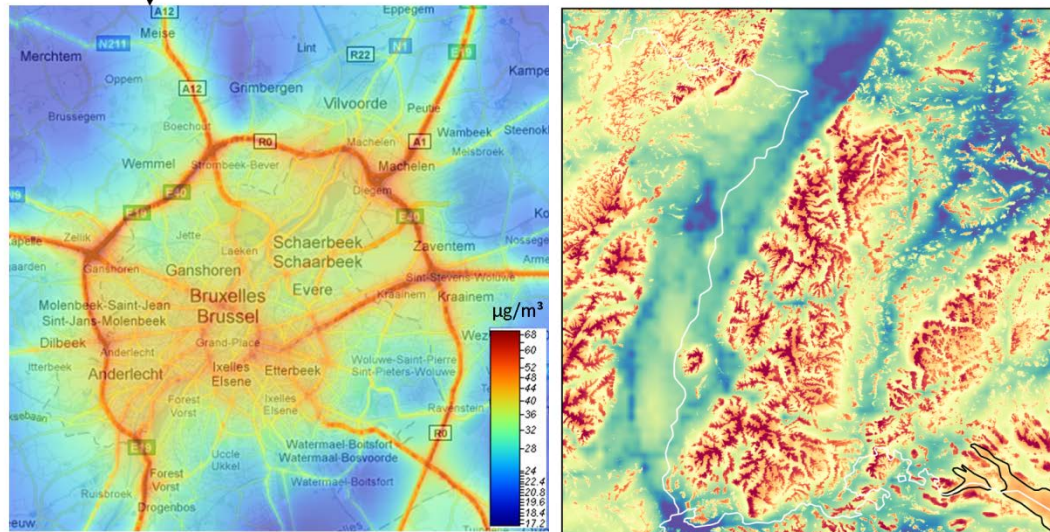
Air Quality Services at Regional and Local Scales

Central Europe
5km x 5km
NO₂



Industrialized Areas
Ruhr Area, DE
1km x 1km
NO₂

Cities
Brussels, BE
NO₂



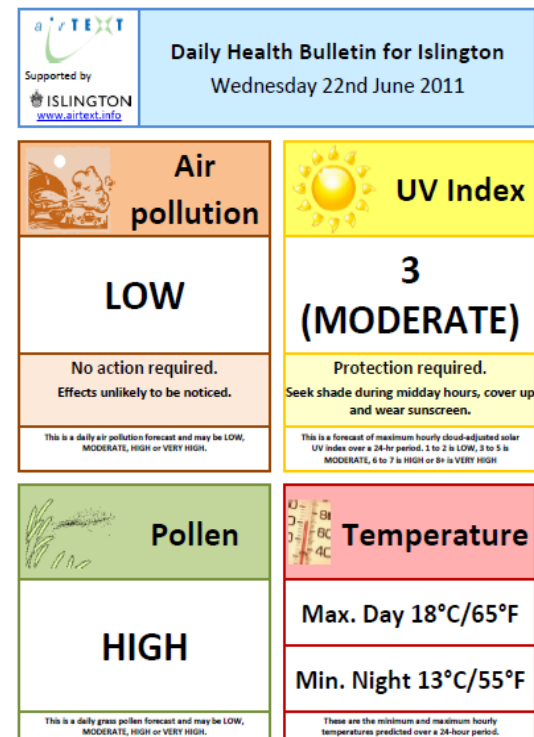
Mountain Areas
Black Forest, DE
1km x 1km
O₃

Myair



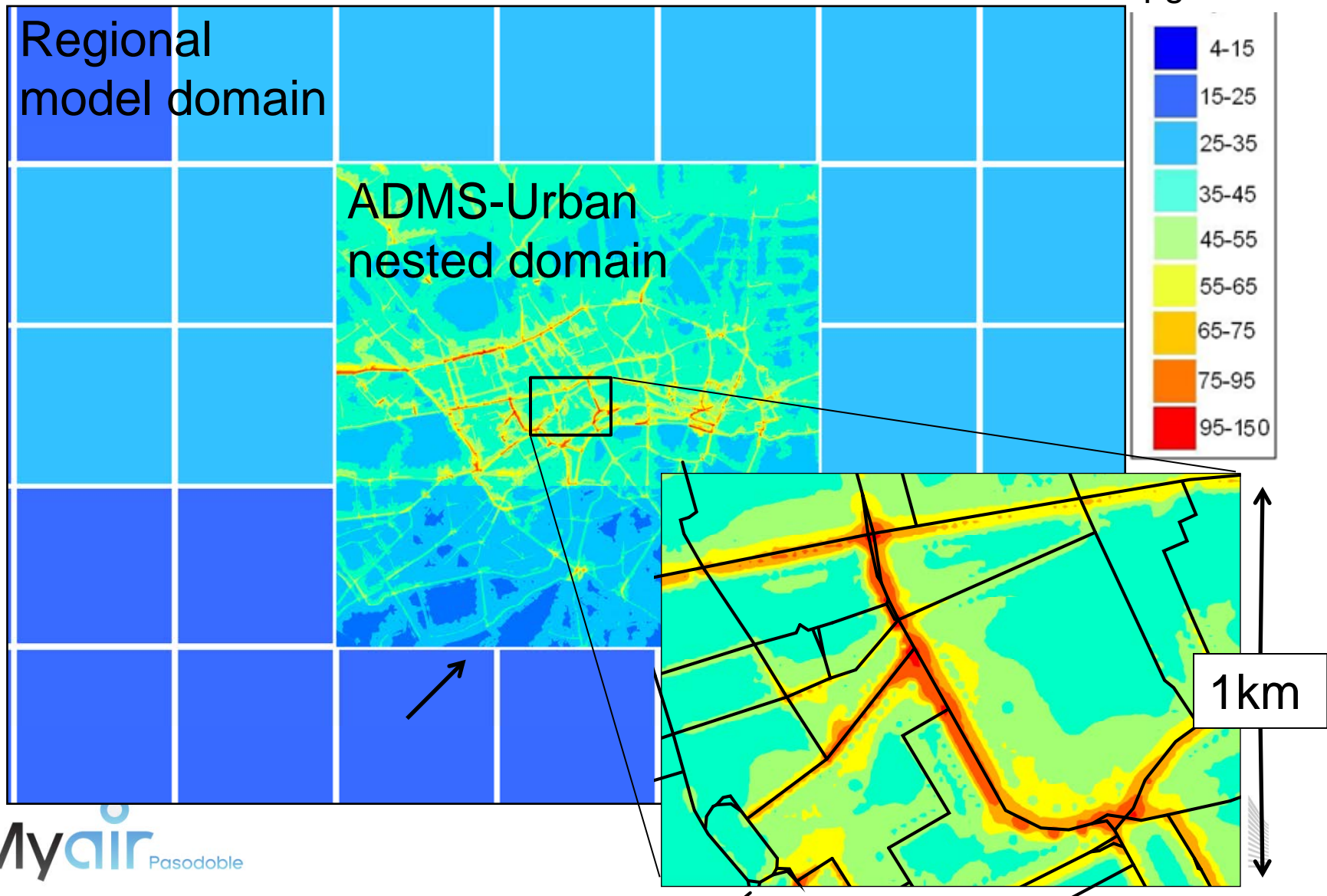
Forecasting and Assessment Services

- Improvement of existing AQ services (data assimilation ground and sat, model development)
- Regional harmonisation (Nesting in MACC, FAIRMODE, OGC, INSPIRE and ISO compliance)
- Thematic integration of physical, chemical, biological weather



Forecasts produced under EU FP7 project PAS00008E: <http://www.myair-eu.org/>

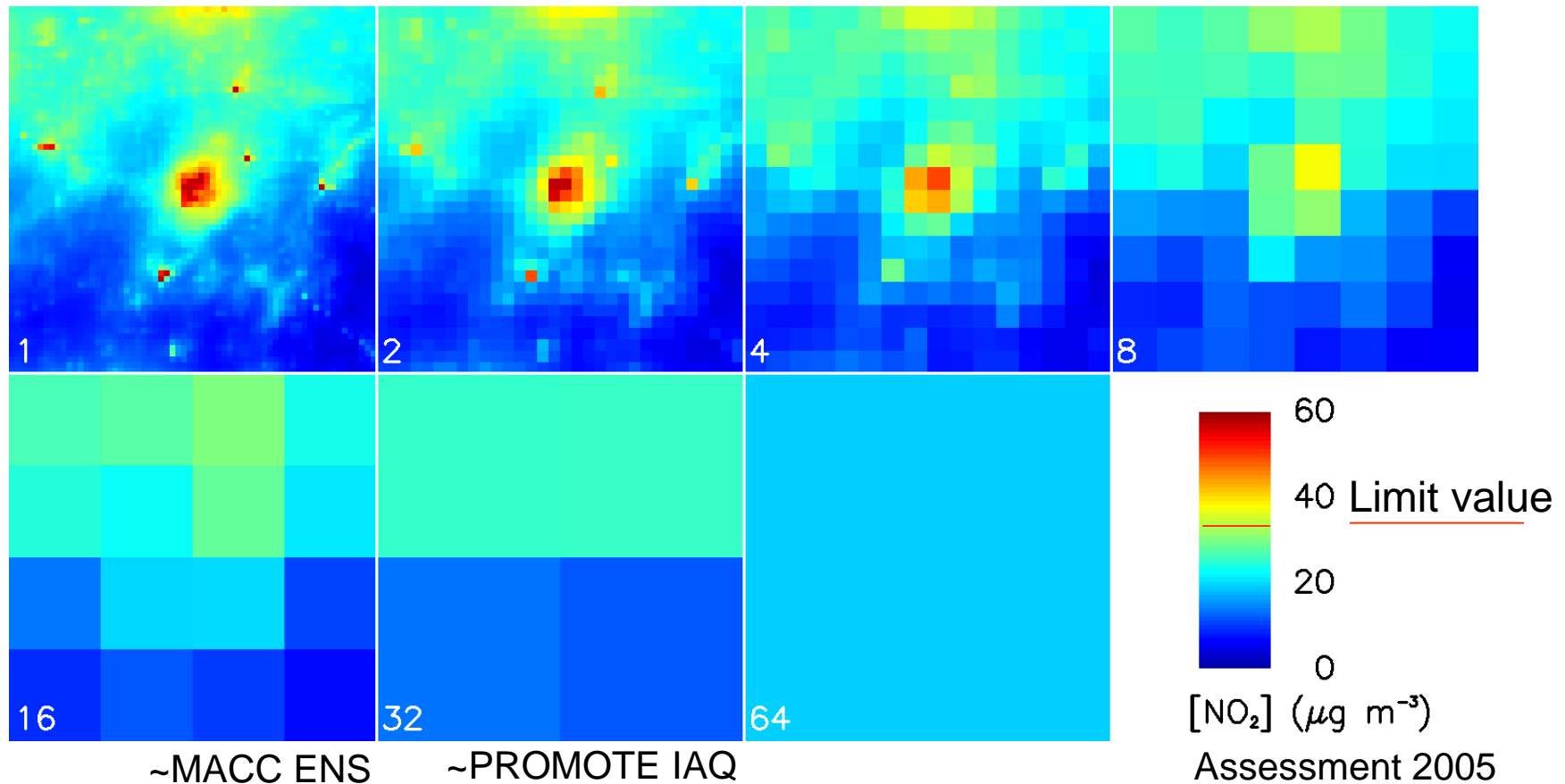
ADMS-Urban nested in regional model



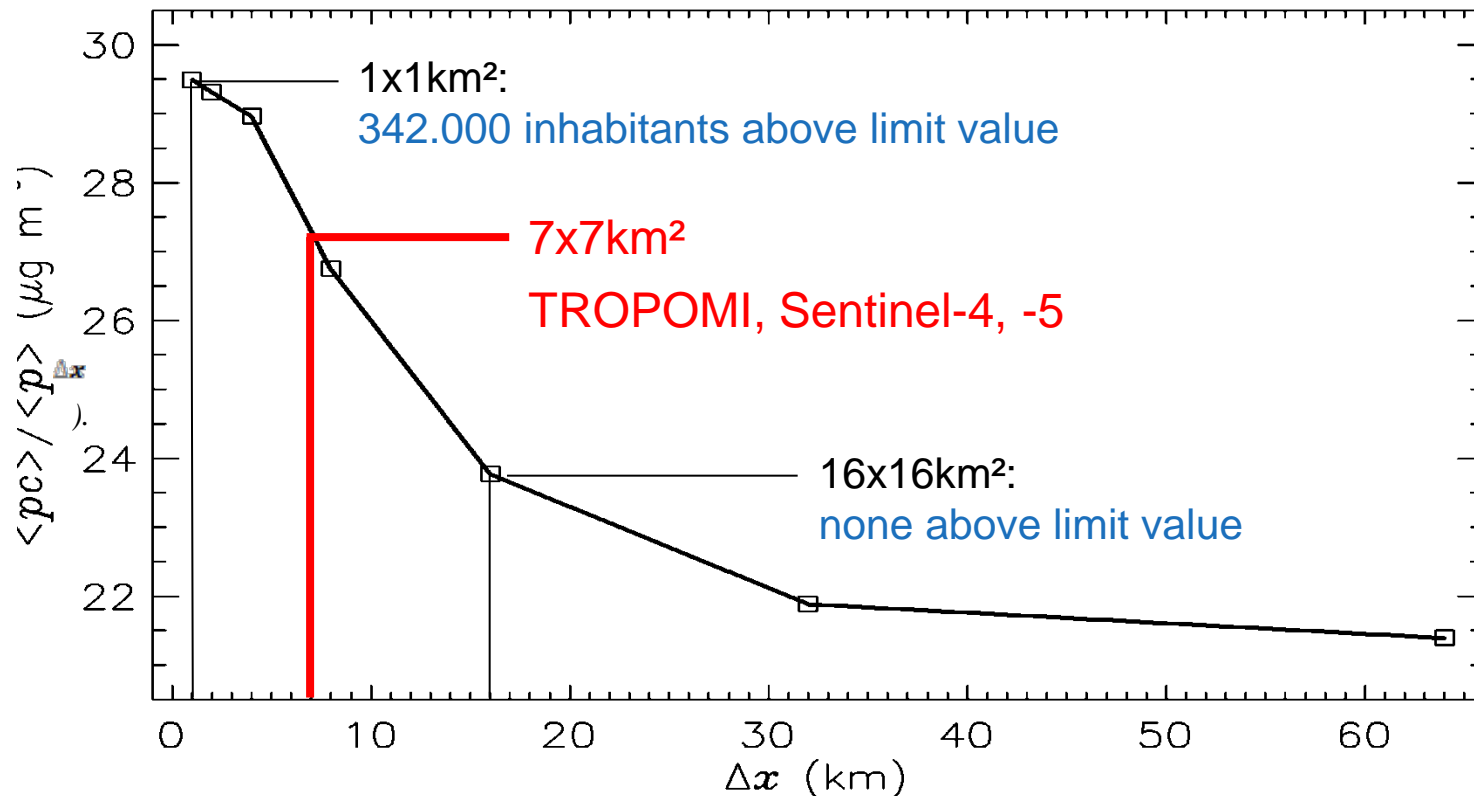
Mayor of London backed AQ service for Olympics



Need for considering local scales – Brussels NO2



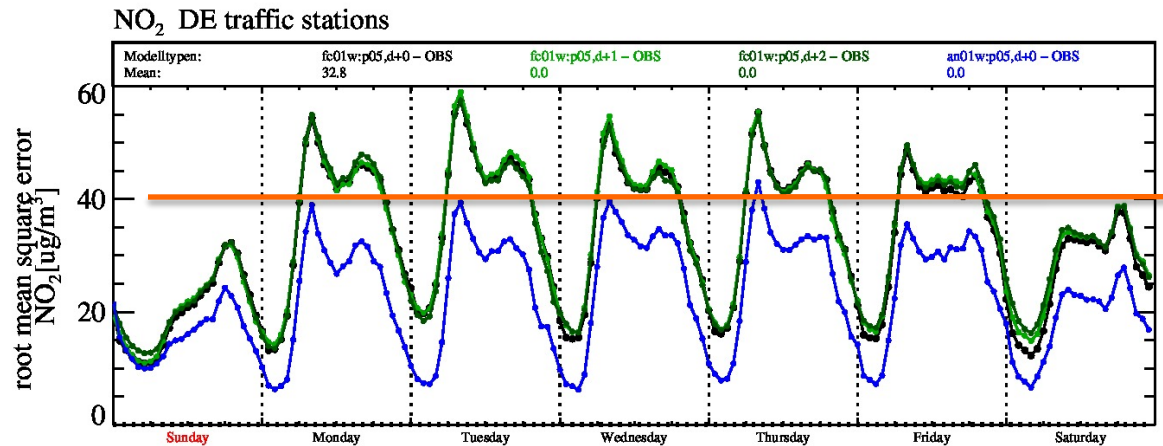
Need for considering local scales – Brussels NO2



Population density weighted concentration (i.e., exposure) for a 64×64 km² sub-domain, as a function of spatial resolution

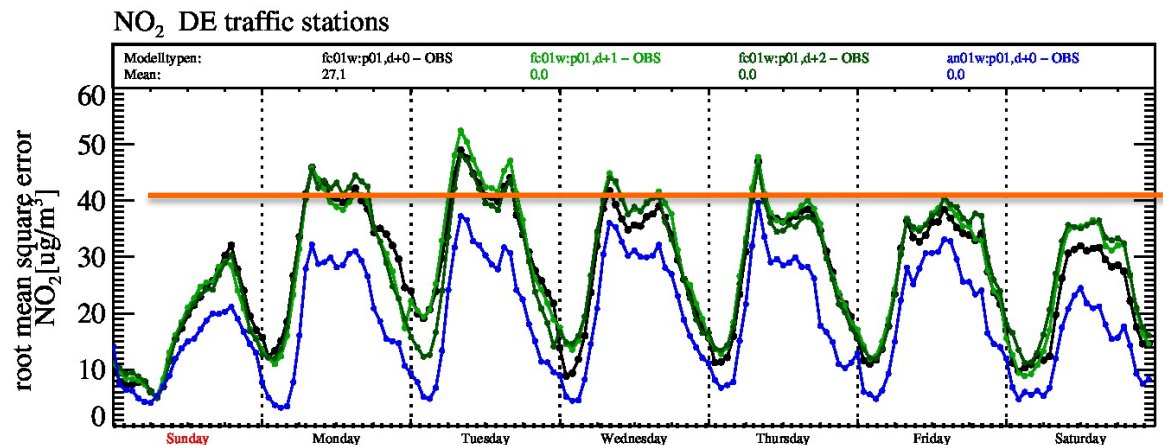
AQ Service for Northrhine-Westfalia (EURAD-IM)

Time-series of averaged NO₂ **RMSE** weekly cycle
Improvement with model resolution



traffic, 5 km resolution

- forecast d+0
- forecast d+1
- forecast d+2
- analysis

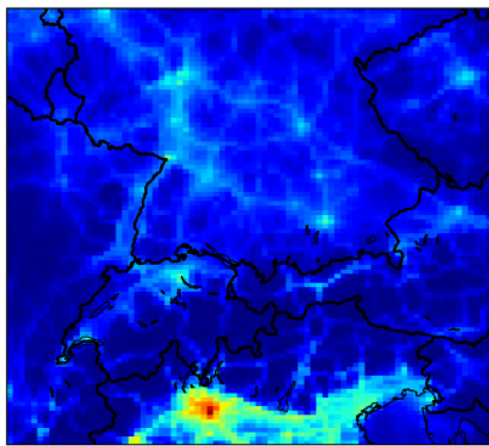


traffic, 1 km resolution

22. Jan., 0 UTC – 20. April 2012, 23 UTC

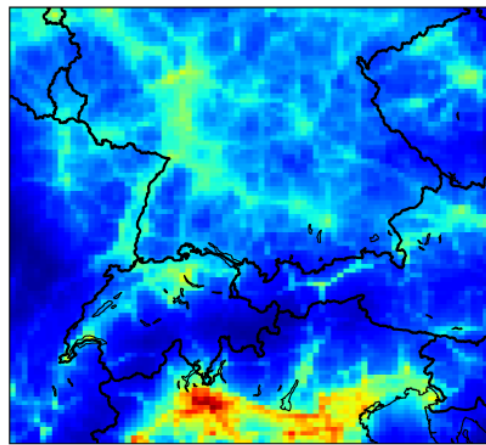
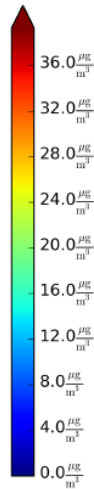
Ensemble Based Data Assimilation of In-situ Stations

Bayesian Filtering improves air pollution analysis

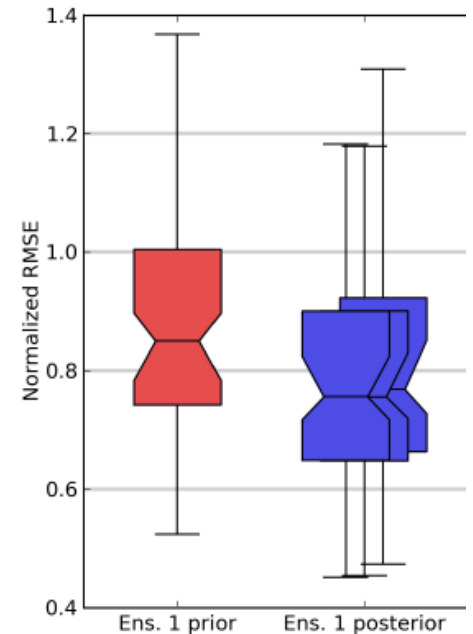
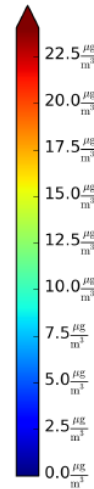


NO2

RMSE deviation between posterior and prior distributions



O3



NRMSE for O3 at verification stations

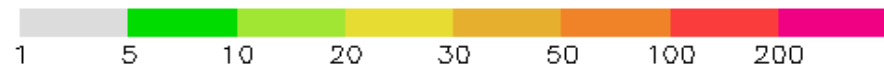
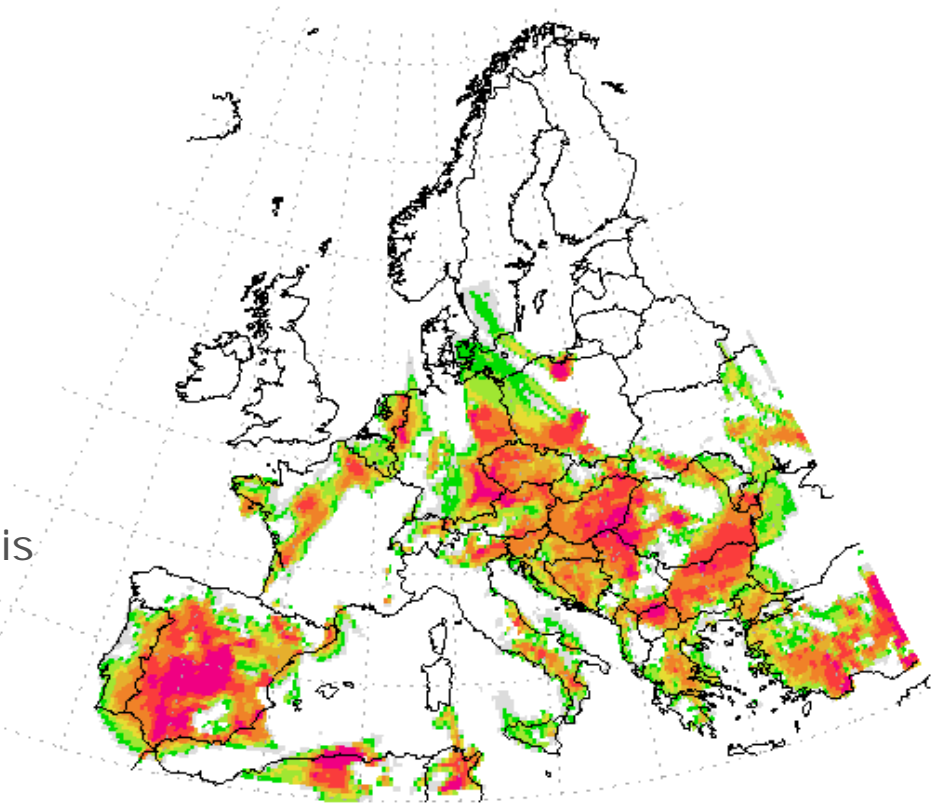
NRT Demonstration of Pollen In-situ Network

Integration of European
Aeroallergen Network (EAN)
to improve pollen forecasts

Demonstration of NRT
capabilities:

- Automated pollen monitors
(Hund Wetzlar)
- Speed-up of manual analysis
of pollen traps
- Assimilation of delayed
pollen observations
into SILAM

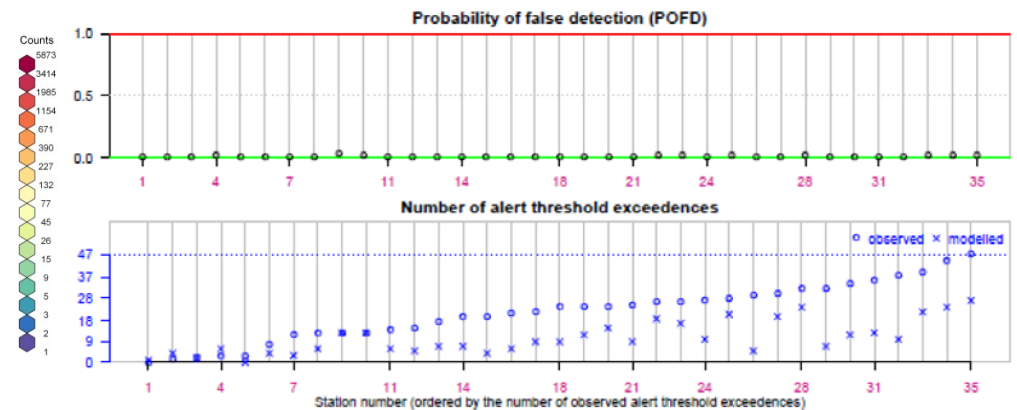
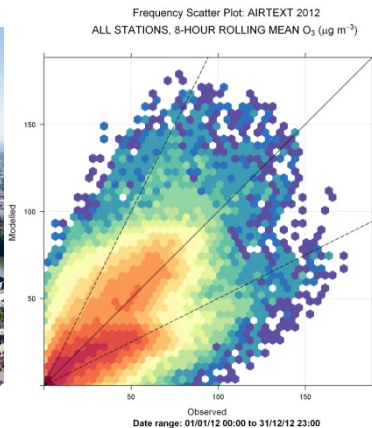
Birch, grass, olive, ragweed



Grass pollen (Poaceae) forecast in [grains/m³]
for 16.5.2013 (SILAM/FMI/MUW)

Model Evaluation Toolbox

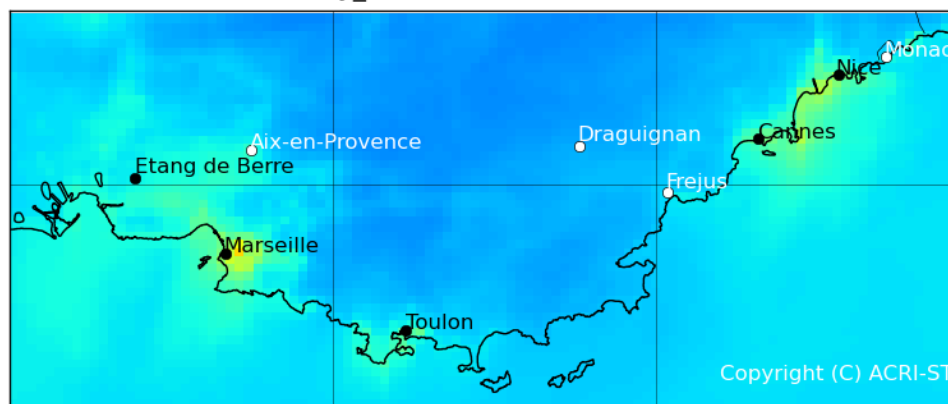
- A toolbox following FAIRMODE guidance has been developed
- Facilitates in depth validation of CTMs (air quality, forecasting)
- Defines protocols for performance evaluation using sat & in-situ
- Provides ~40 statistical parameters
- Freely available and widely used in community so far



Health Community Support Services

- Target: people at risk, hospitals, pharmacies, doctors
- Developed risk and discomfort indices accounting for multiple exposure impacts
- Allows communication of health risk for different pathologies
- Enables sensitive groups to take precautionary action
- Reduces health costs and increases quality of life

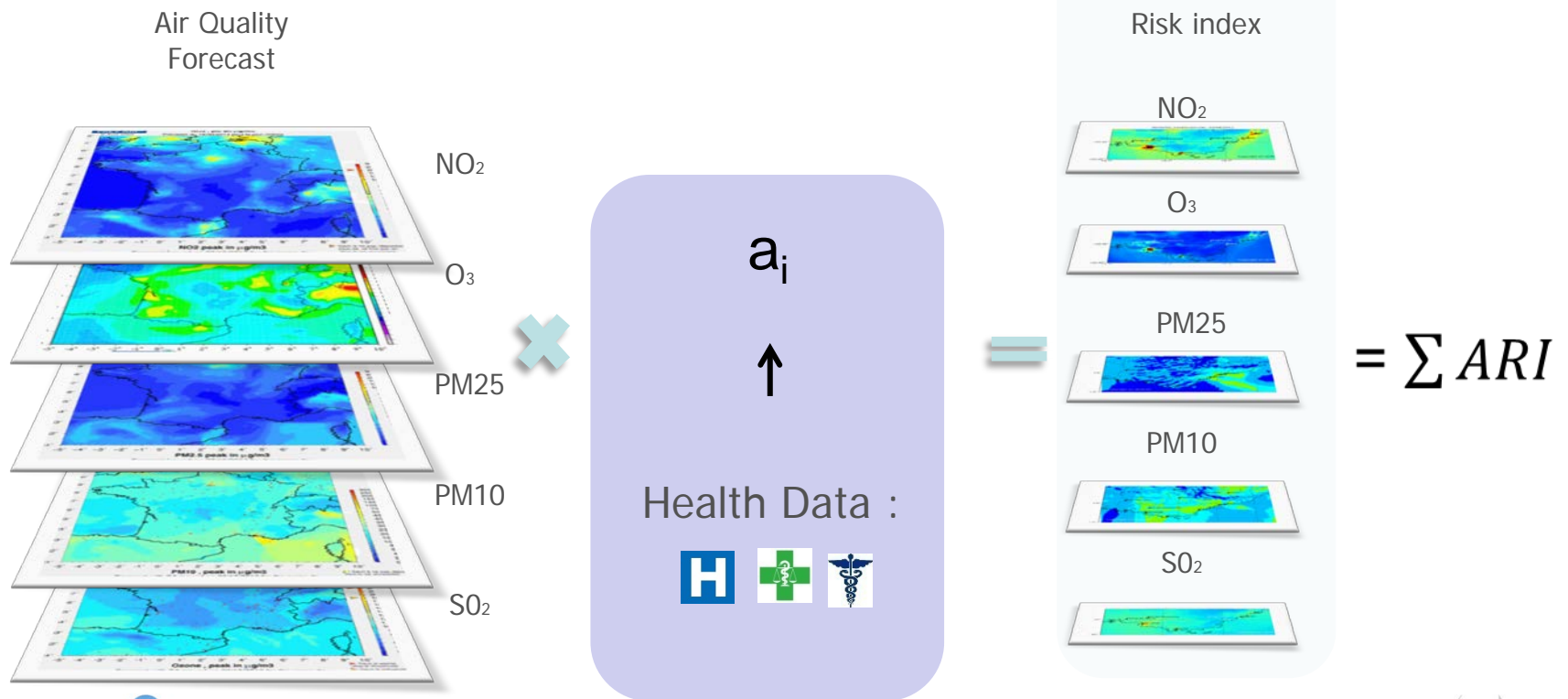
Mortality_Cardiovascular, 23/04/2013



Aggregate Risk Index Forecasts at Regional Level

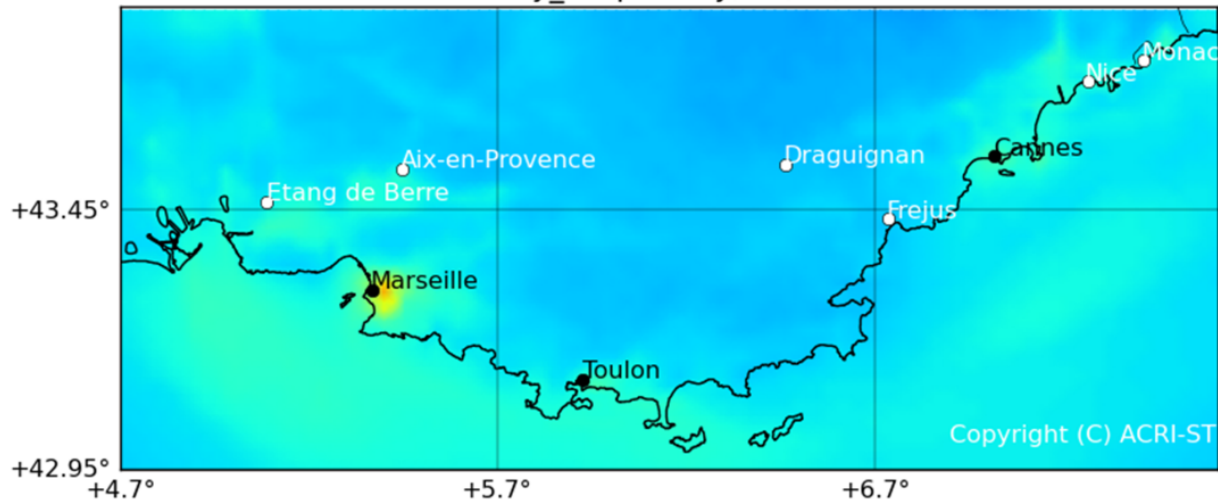
Assessment of additive effects of short-term exposure to mixture of air pollutants for different pathologies:

$$ARI = a_{O_3} * C_{O_3} + a_{NO_2} * C_{NO_2} + a_{SO_2} * C_{SO_2} + a_{PM_{2.5}} * C_{PM_{2.5}} + a_{PM_{10}} * C_{PM_{10}}$$

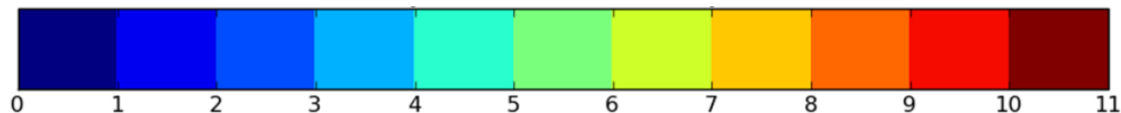


Health Community Support Services

Mortality_Respiratory, 29/03/2012



Aggregate Risk Index



0
1
2
3
4

Enjoy your usual outdoor activities.
Follow your doctor's advice for exercise.

5
6
7

Consider reducing strenuous physical outdoor activities, or reschedule to times when index is lower.
Follow your doctor's advice for exercise.

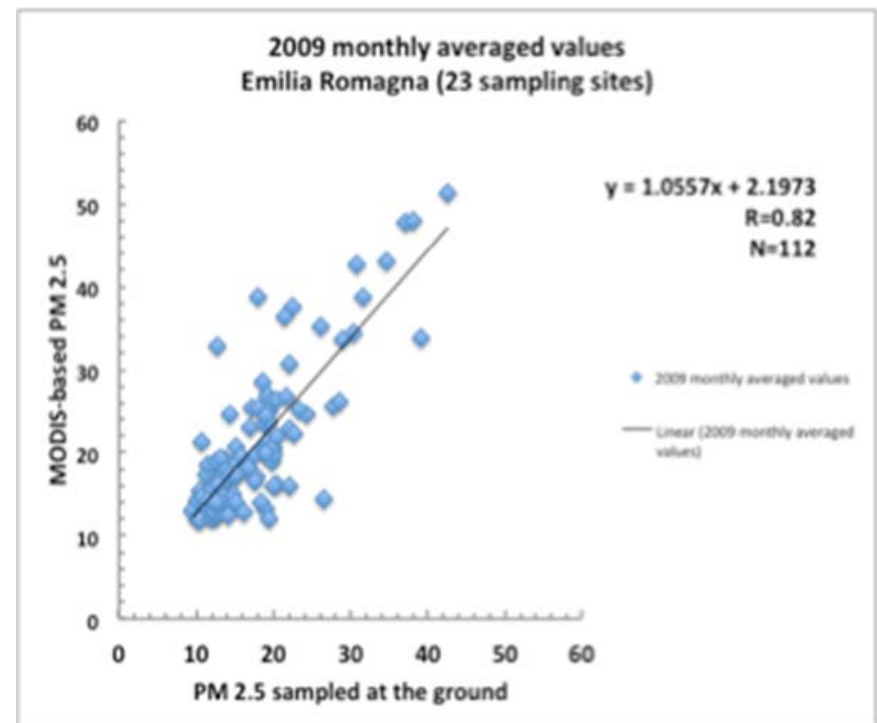
8
9
10
11

Reduce physical exertion outdoors and particularly if you experience symptoms.
Follow your doctor's usual advice. People with asthma may need their reliever inhaler more often. If symptoms persist seek medical advice.

Health Warning of emergency conditions. Avoid physical activities.
Follow your doctor's usual advice. People with asthma may need their reliever inhaler more often.

Compliance Monitoring Support Services

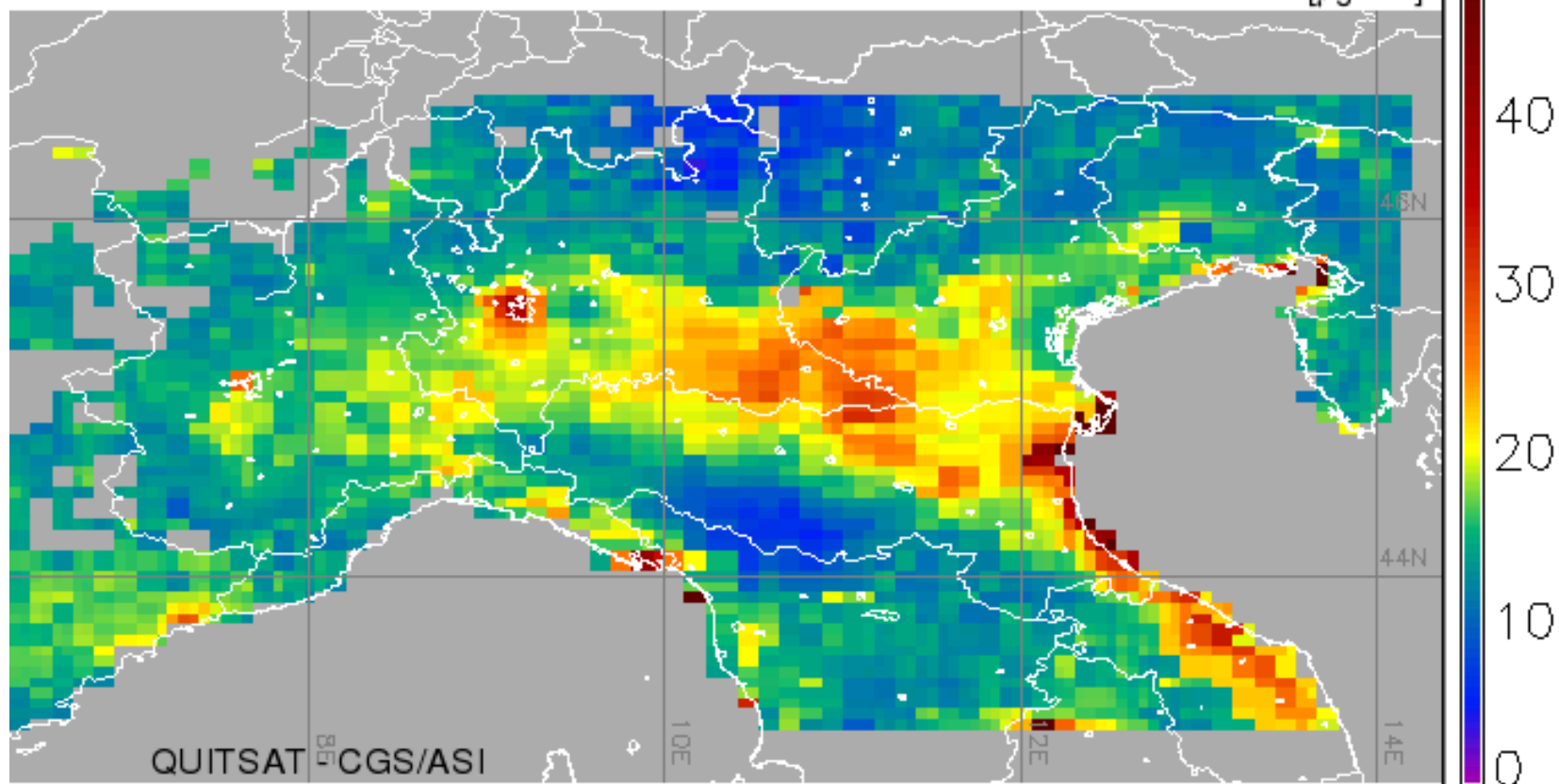
- Facilitate compliance reporting duties of environmental agencies
- Help explain exceedances
- Service has introduced satellite data complementary to in-situ data to
 - better cover the spatial extent
 - quantify PM and mineral dust
 - distinguish natural from anthropogenic contributions
- Successful services in Italy, Spain, Germany and the Netherlands



Compliance Monitoring Support Services

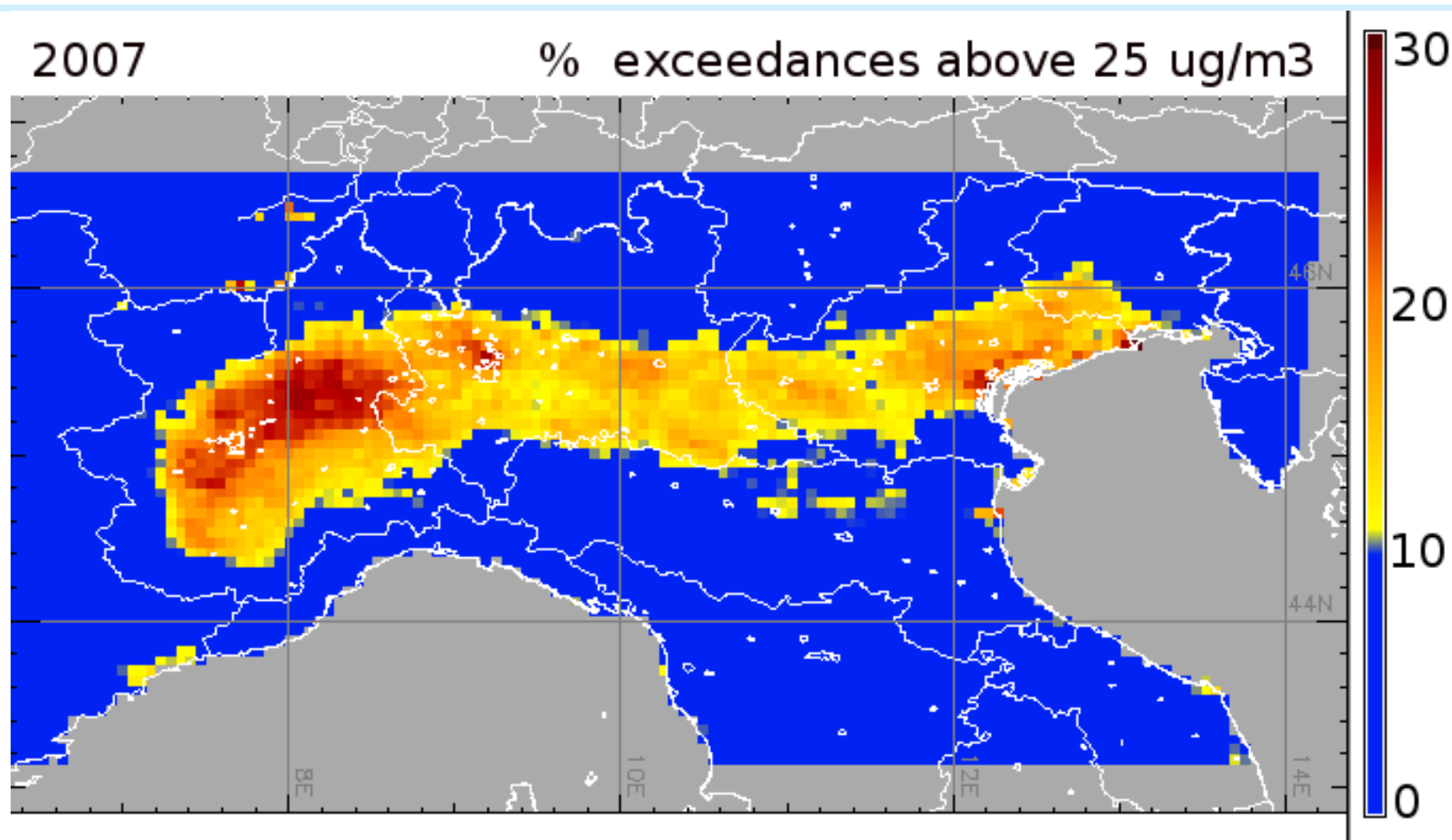
MOD 2007 07 17 Tue 10:20UTC

PM2.5 [$\mu\text{g}/\text{m}^3$]



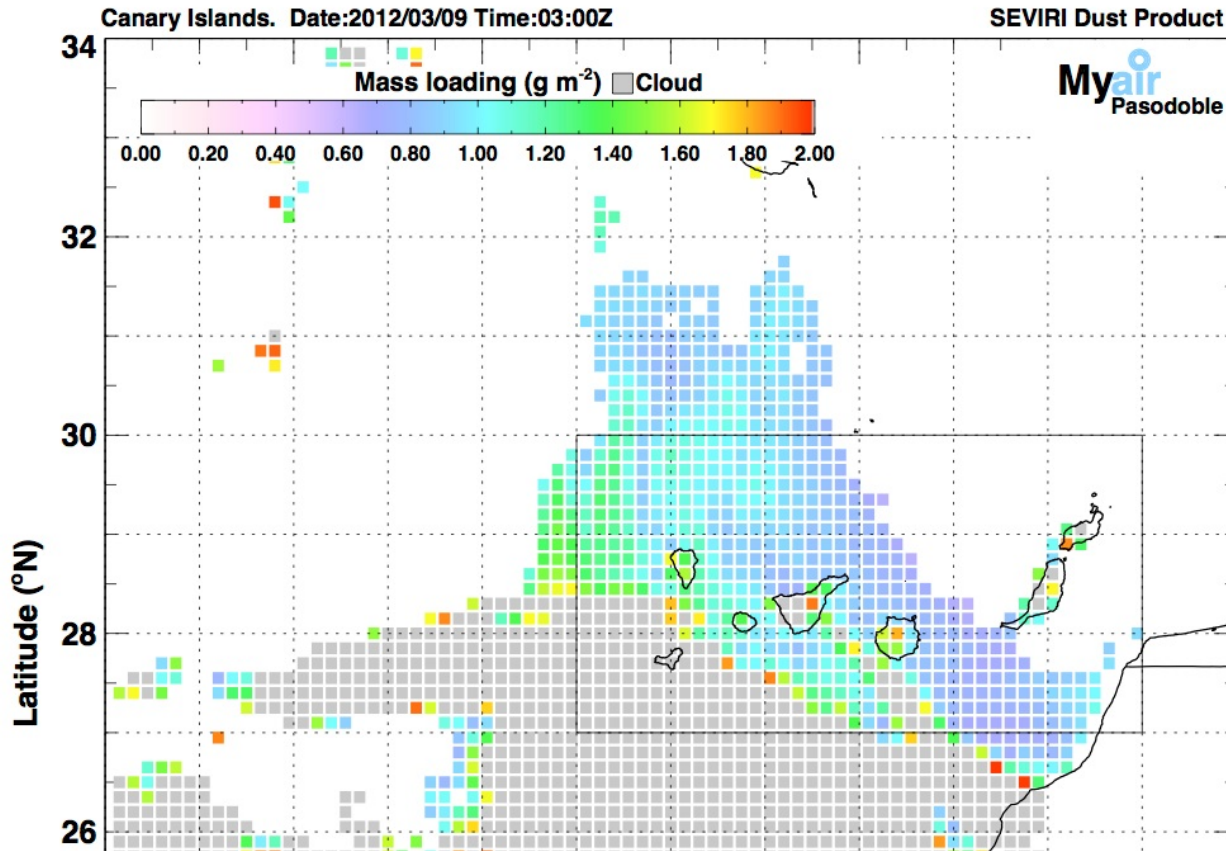
DiNicolantonio, 2011

Compliance Monitoring Support Services



Bias Yearly Mean: PM10: $4\mu\text{g}/\text{m}^3$, PM2.5: $2.5\mu\text{g}/\text{m}^3$

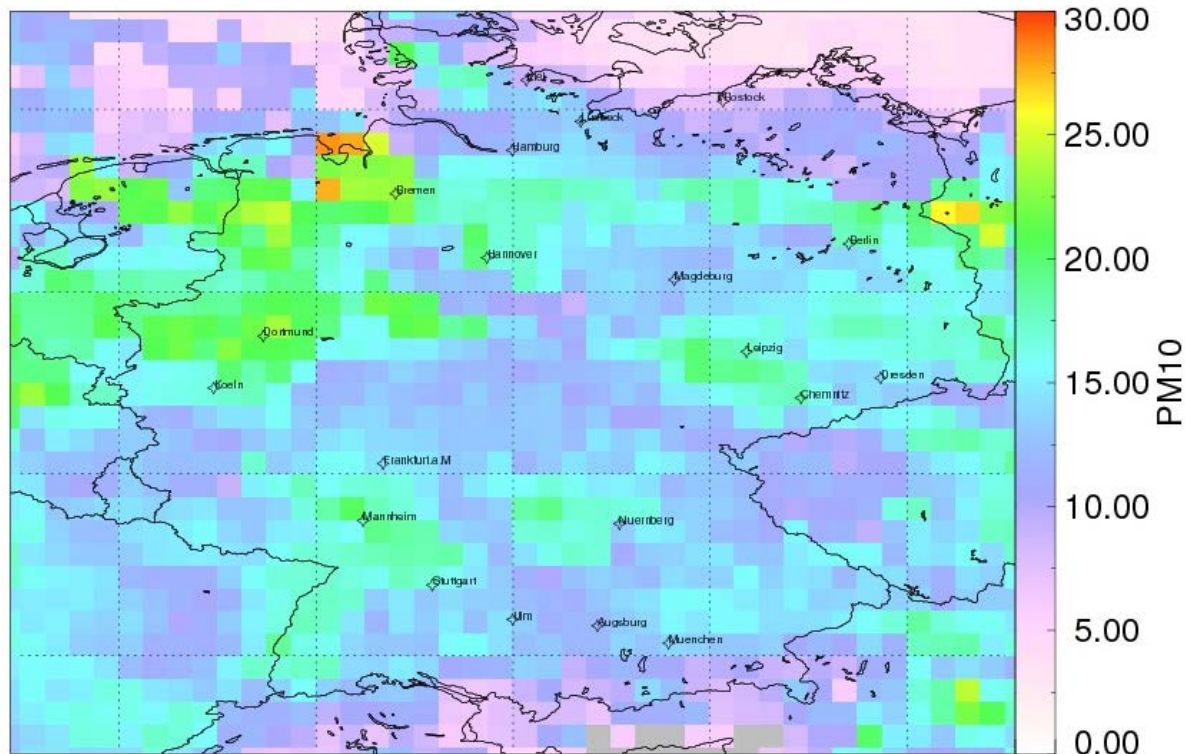
Quantification of Natural PM Contributions



3x3km, MSG, TIR

Prata et al.

Separating Natural and Anthropogenic PM



Sea salt, mineral dust (Coarse / Fine Mode)

R=0.5

RMSE versus EMEP PM_{2.5} (PM₁₀) ~4 (6) $\mu\text{g}/\text{m}^3$

Holzer Popp et al. , 2011

Interfaces to Data and Users

Objectives

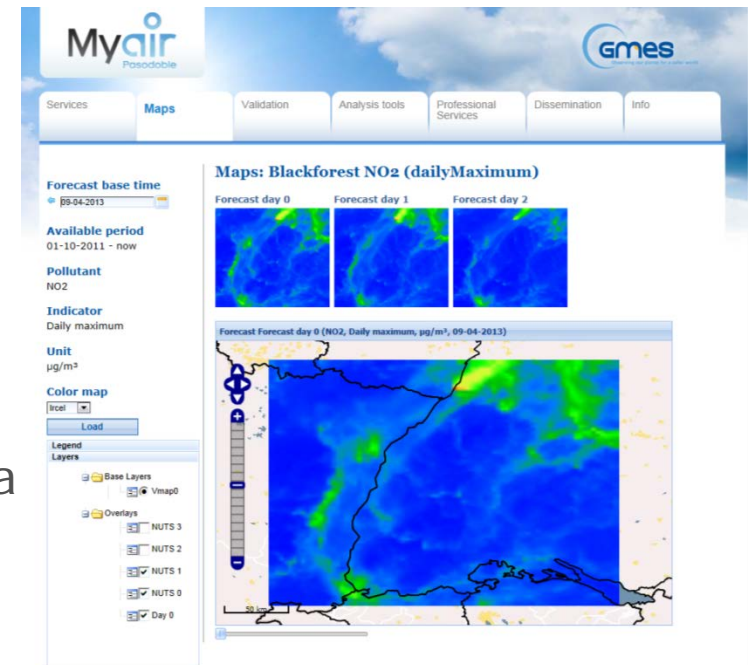
- Interoperable access to products in a simple harmonized way
- Development of a metadata scheme
- Common interface and catalogue

Access

- In-situ and model data
- concentration maps/time series

Functionalities (WMS, WFS, WCS, CSW)

- Visualize, analyse and validate data
- Retrieve data
- OGC and ISO compliance



Web Feature Service for EEA in-situ data

- Most users want fast and comfortable access to nrt in-situ data
- Web service information technology
- Simple requests can be sent by one URL
- Filter options:
 - By date
 - By country
 - By species
 - By bounding box
 - By station
- Available formats CSV and XML
- Can directly be integrated into GIS
- Used for online validation tools based on FAIRMODE guidance

Web Coverage Services for MACC ENS Data

Joined airshed available at 10:00 am for T-1, T+0, T+1, T+2, T+3

http://wdc.dlr.de/cgi-bin/airsheds_new

MACC_ENS available at 07:00 pm for T+0, T+1, T+2, T+3

http://wdc.dlr.de/cgi-bin/macc_ens

HTTP-requests can easily be integrated in operational scripts (wget)

These URLs will return all available options (get capabilities)

Summary

FP7 PASODOBLE

- ... developed 35 AQ services throughout Europe to support local actors
- ... developed a modular, generic and harmonized service infrastructure for air quality data services and data access
- ... combined modelling, in-situ data, remote sensing and information technology

- ... builds upon the Copernicus Atmosphere Service (MACC)
- ... bridged gaps between existing data, methods and user requirements

Conclusion

Comprehensive in-situ monitoring of chemical and biological composition of ambient air and availability in near-real time crucial to improve analyses and forecasts by data assimilation and to validate model results and satellite-based observations

Combined application of complementary measurement techniques and modelling important for a better understanding of processes and variability of pollutants

www.myair.eu

pasodoble@dlr.de

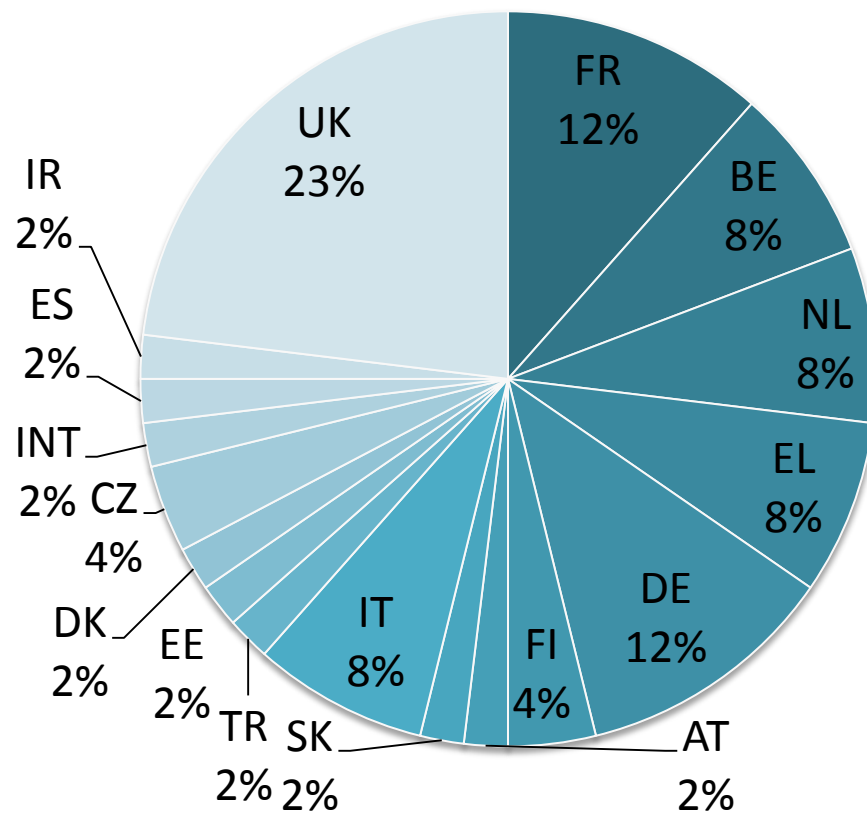


Reaching out to Users

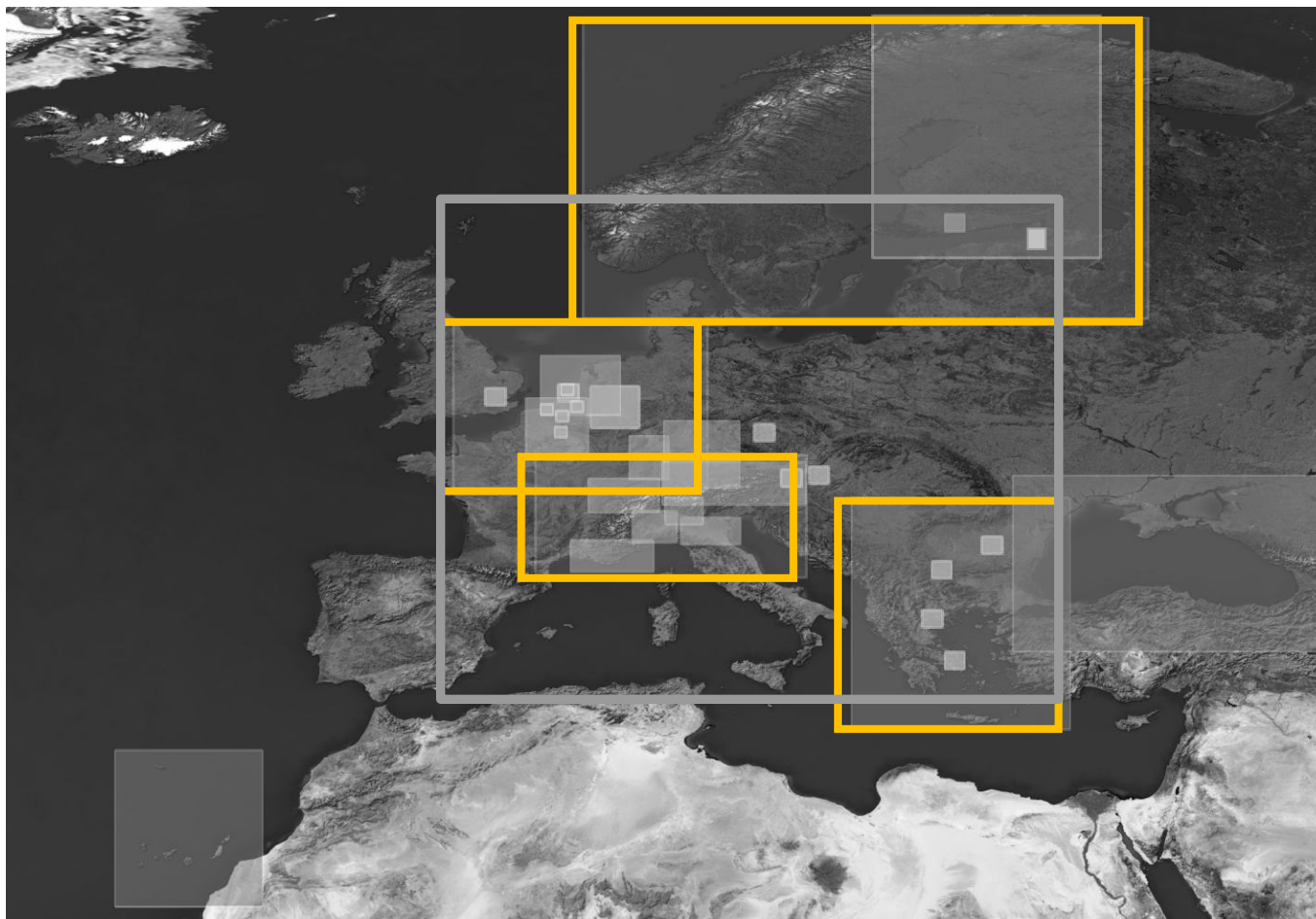
- Website with registration, portfolio and twitter
- 3 user workshops (52 representatives)
- User Requirement Documents
- User Evaluation Reports (over 50 contributions)
- Market Intelligence Assessment
- Interviews and surveys with potential clients
- Marketing material and webinars (60+)
- Marketing campaign (3700 potential clients)
- Service Level Agreements
(currently 20 signed)
- Detailed Business Planning and Strategy
to prepare sustainability



52 Users from 17 Countries



Harmonised Nesting via MACC ENS and Airsheds



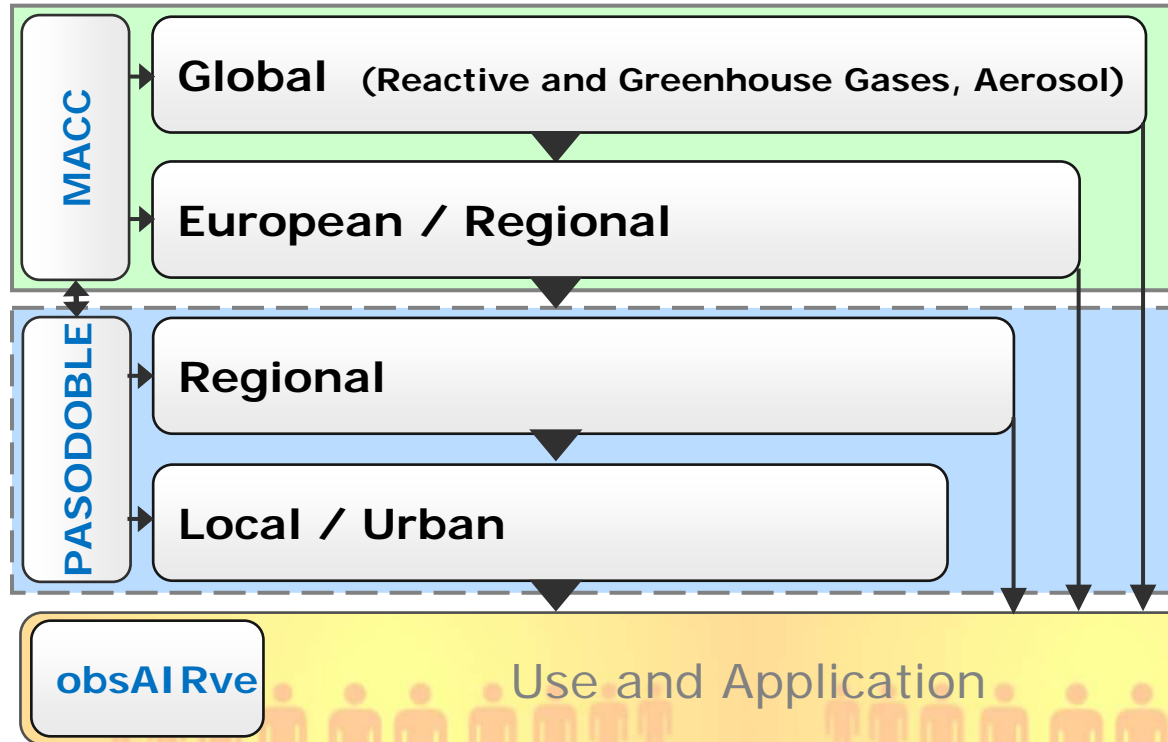
Intermediate
airsheds at
~ 7x7km
resolution

Bridge gap
between MACC
and local nests

covering most of
the local/urban
services within
PASODOBLE

NO₂, O₃, PM₁₀

Contributing to the European Air Quality Service Chain



Web services for data extraction and nesting

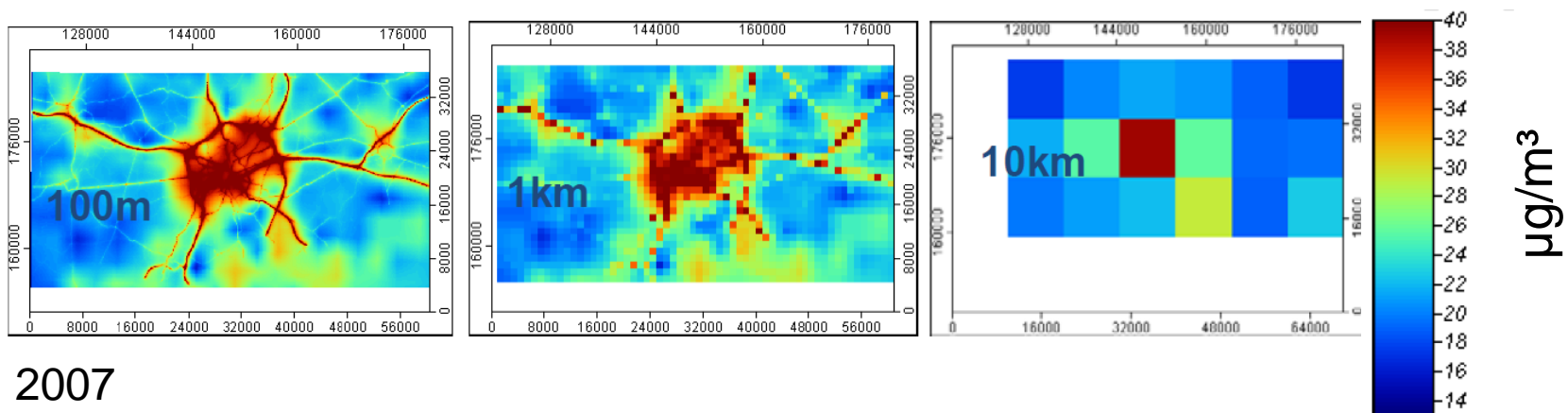
Sensitivity studies and recommendations on harmonized nesting

MACC service evaluation

Intermediate airsheds at ~7x7 to 5x5km resolution

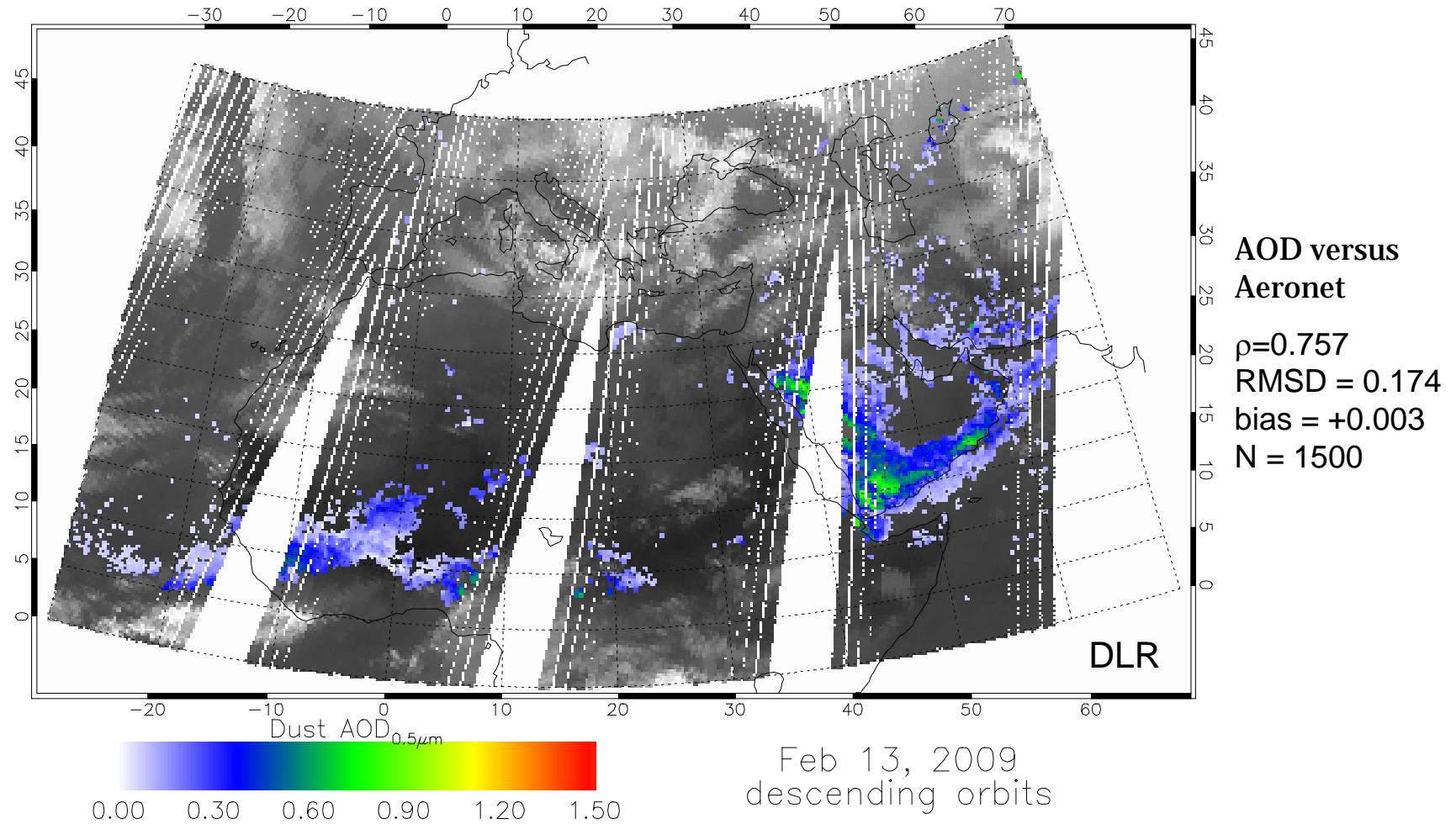
Need for considering local scales – Brussels NO2

Simulation for Brussels – NO2 yearly mean

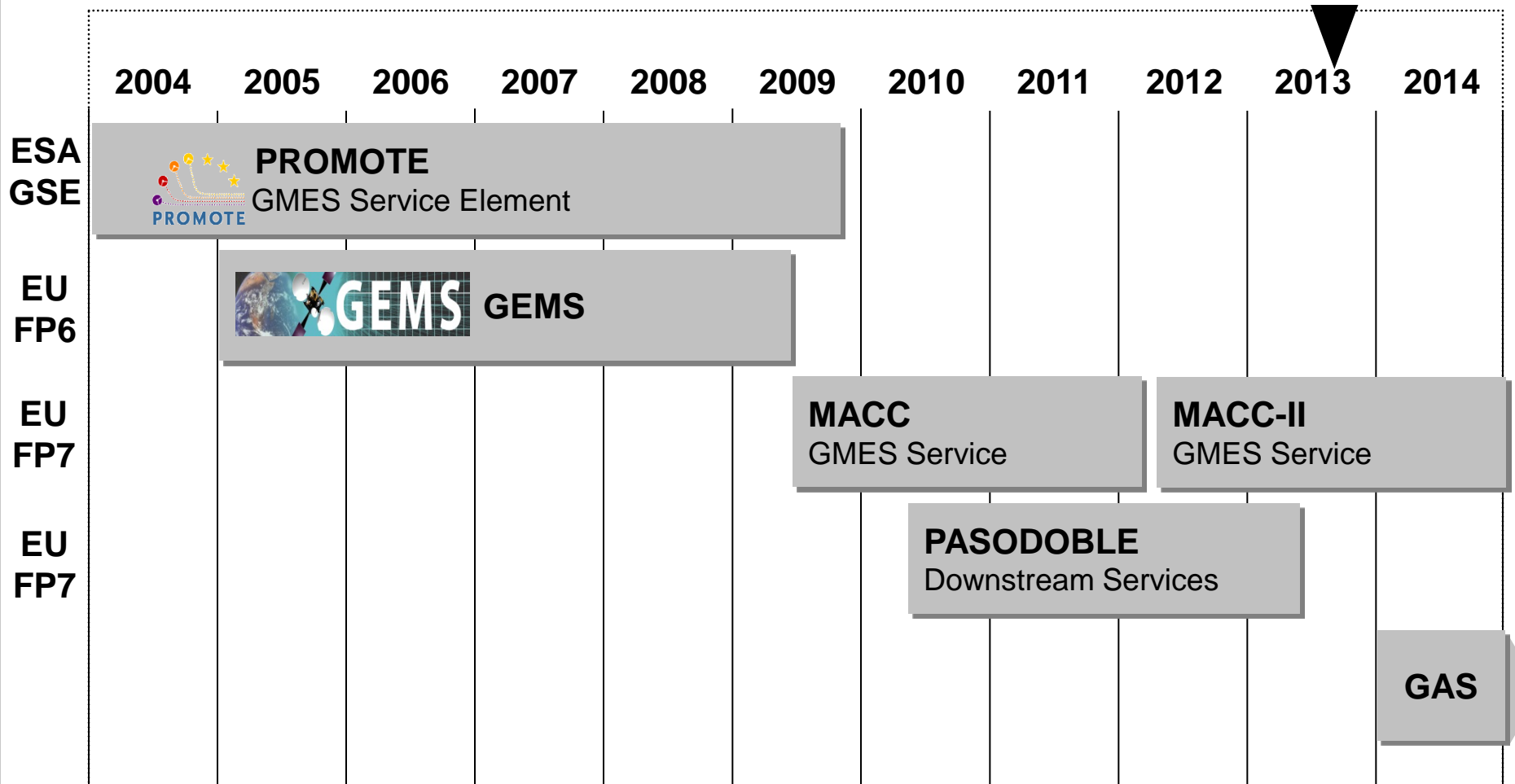


2007

IASI Retrieval of dust storms



Roadmap of Copernicus Services– Air Quality



-----pre-operational services-----