# Satellite-aided computational assessment of air quality and associated health effects

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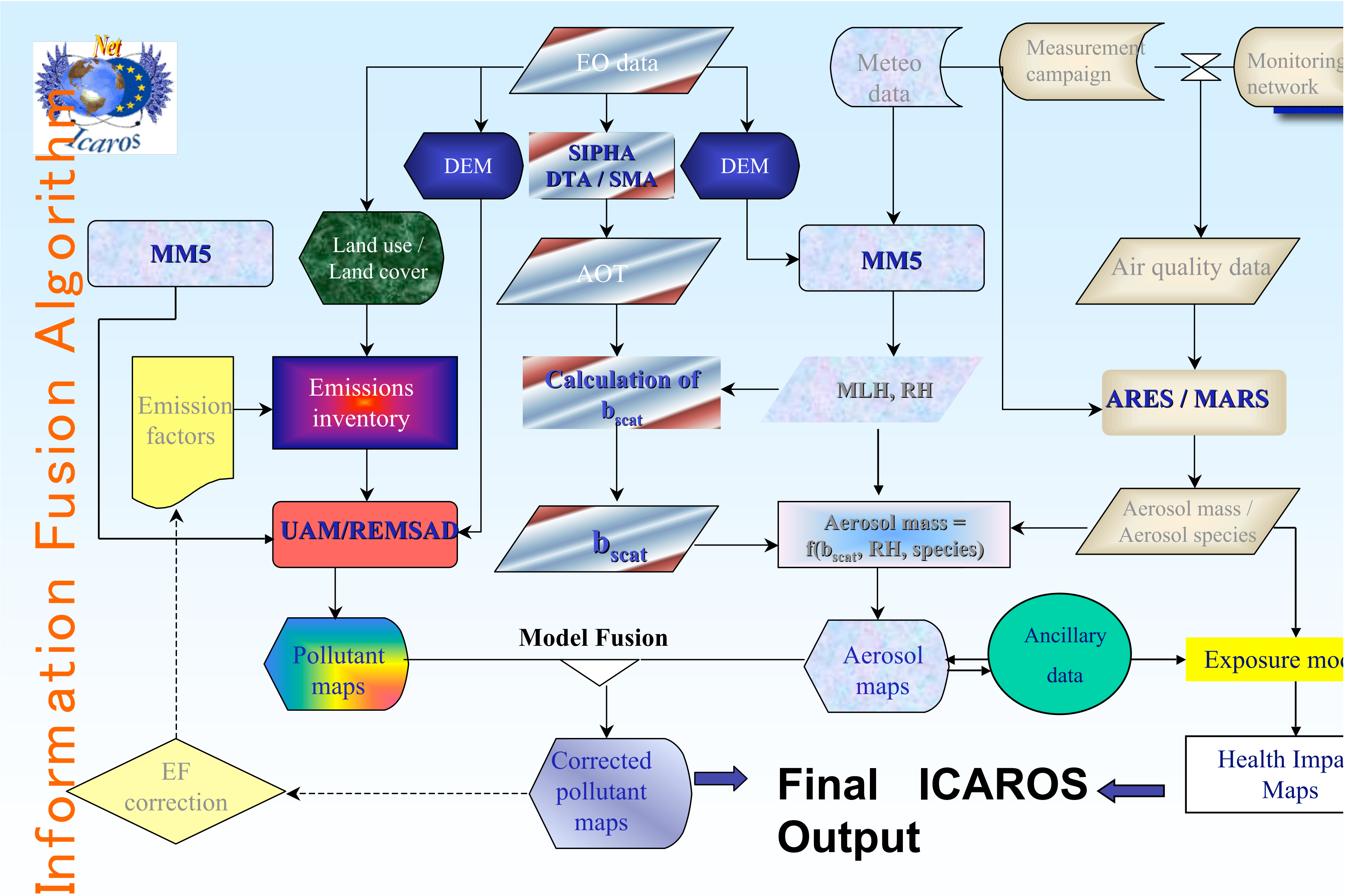
http://icaros-net.jrc.cec.eu.int



Information Fusion Algorithm
Net Icaros
EO data
Meteo data
Measurement campaign
Monitoring network
DEM
SIPHA DTA / SMA
DEM
MM5
Land use / Land cover
AOT
MM5
Air quality data
Emission factors
Emissions inventory
Calculation of $b_{scat}$
MLH, RH
ARES / MARS
UAM/REMSAD
$b_{scat}$
Aerosol mass = $f(b_{scat}$, RH, species)
Aerosol mass / Aerosol species
Pollutant maps
Model Fusion
Aerosol maps
Ancillary data
Exposure mo
EF correction
Corrected pollutant maps
Final ICAROS Output
Health Impa Maps

# Calculation of $\sigma_e$ from EO-derived AOD

In most cases, near surface concentration of fine aerosol can be represented by the concentration within the mixing layer

This coincides with satellite passes around noon

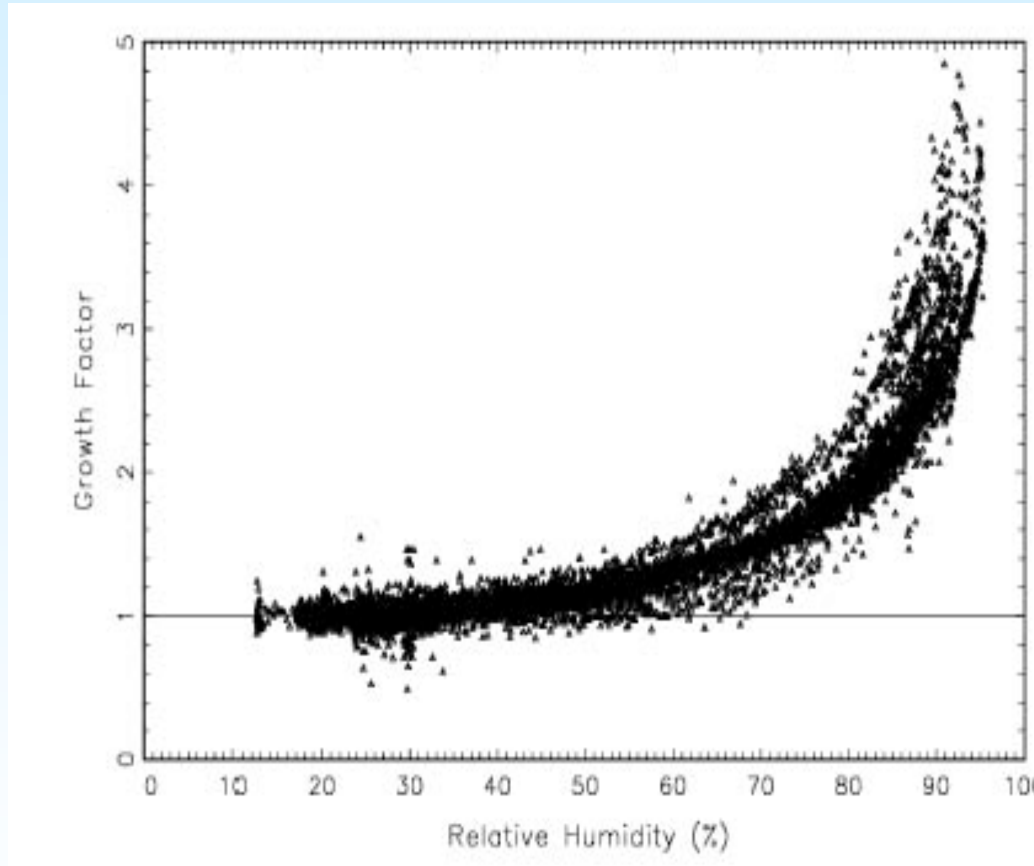
Hence, our first approximation was to consider that the correct scaling height for the scattering coefficient was Hmix

$$AOD = \int_{o}^{z_B} \sigma_e(0) \, dz = \sigma_e(0) * z_B$$

# Effect of humidity on aerosol size

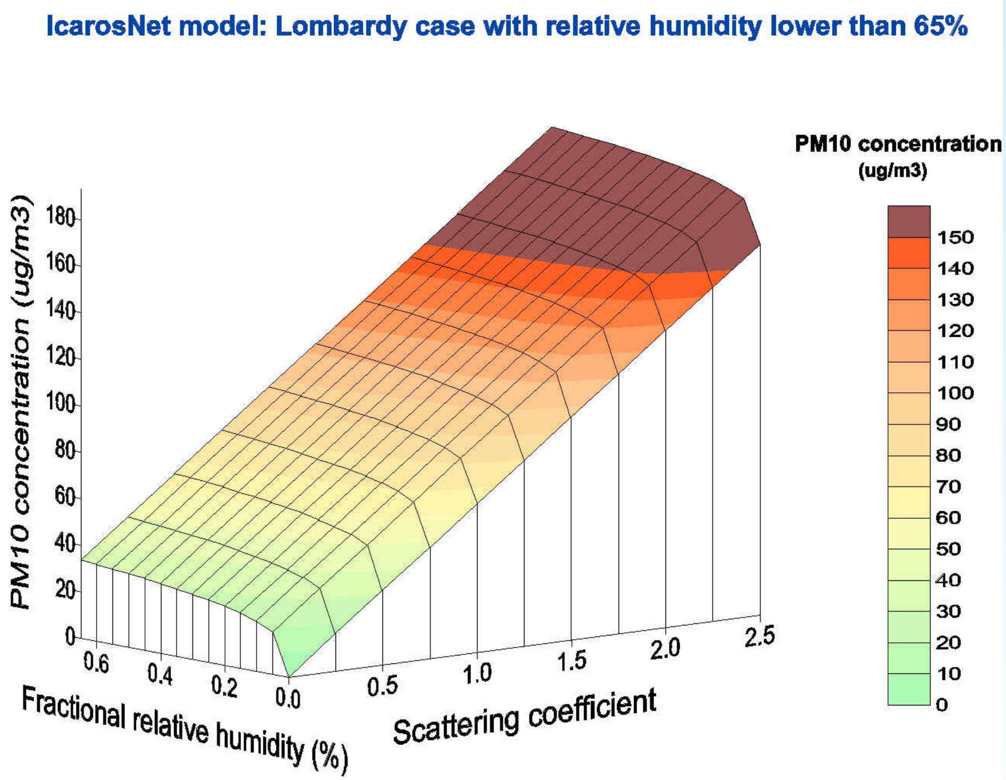
- According with Mie theory, highly scattering particles are those with diameters of the order of 0.5 to 2 times the wavelength observed by the sensors (550 nm → 0.2 −1.0 μm).

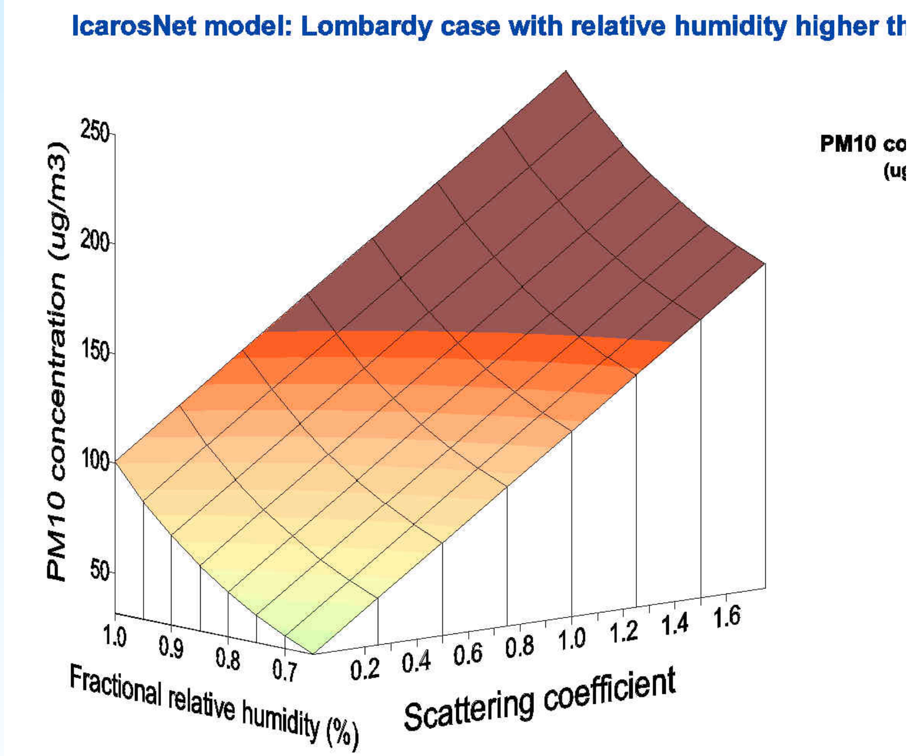
- Increase in relative humidity leads to an increase of particle radius. This is particularly true for the fine fraction of PM (PM1 and PM2.5)




Day D.E and Malm W. C. (2001)

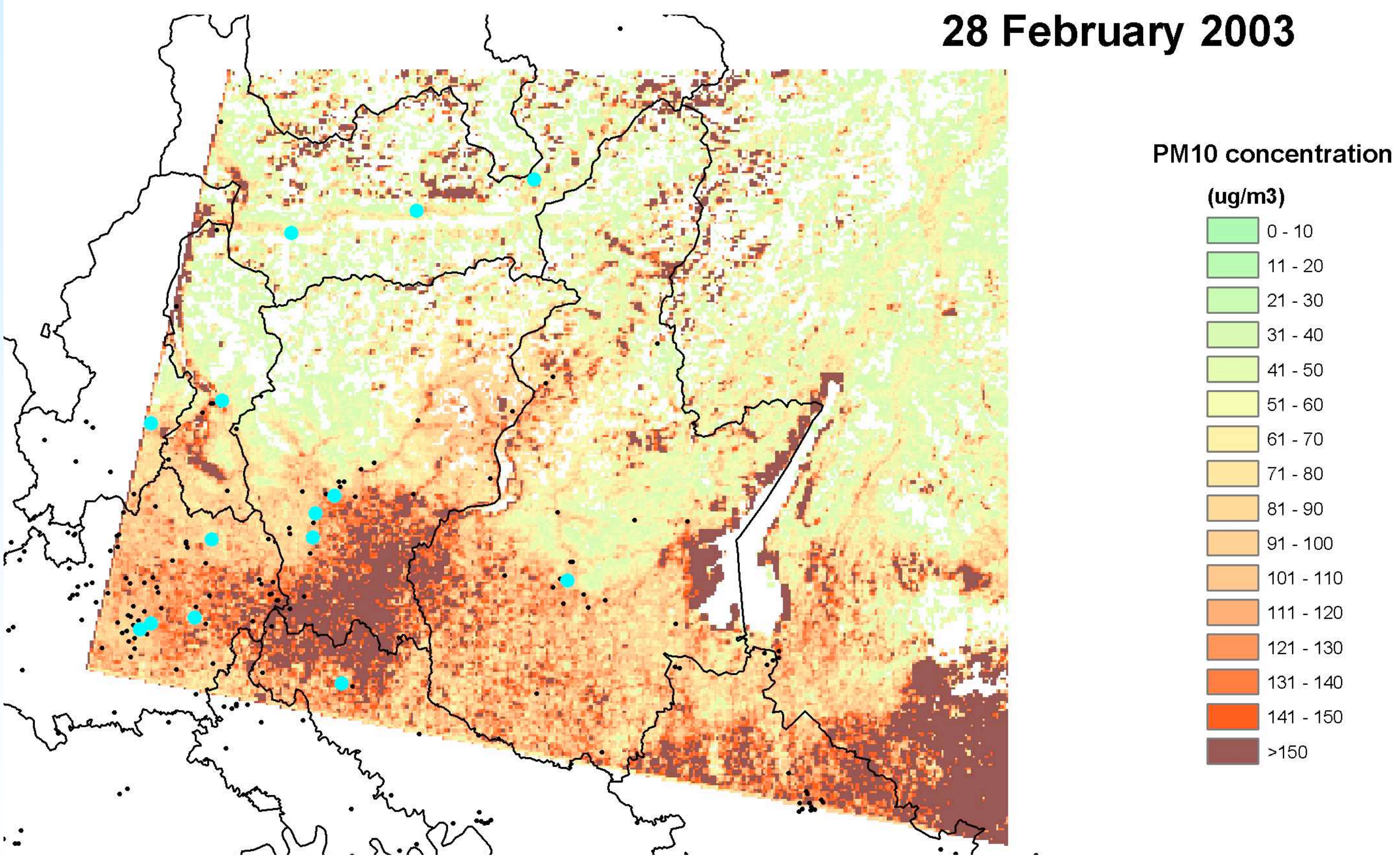
# ICAROS NET particle model $C_{PM10} = f(\sigma_e$, RH)



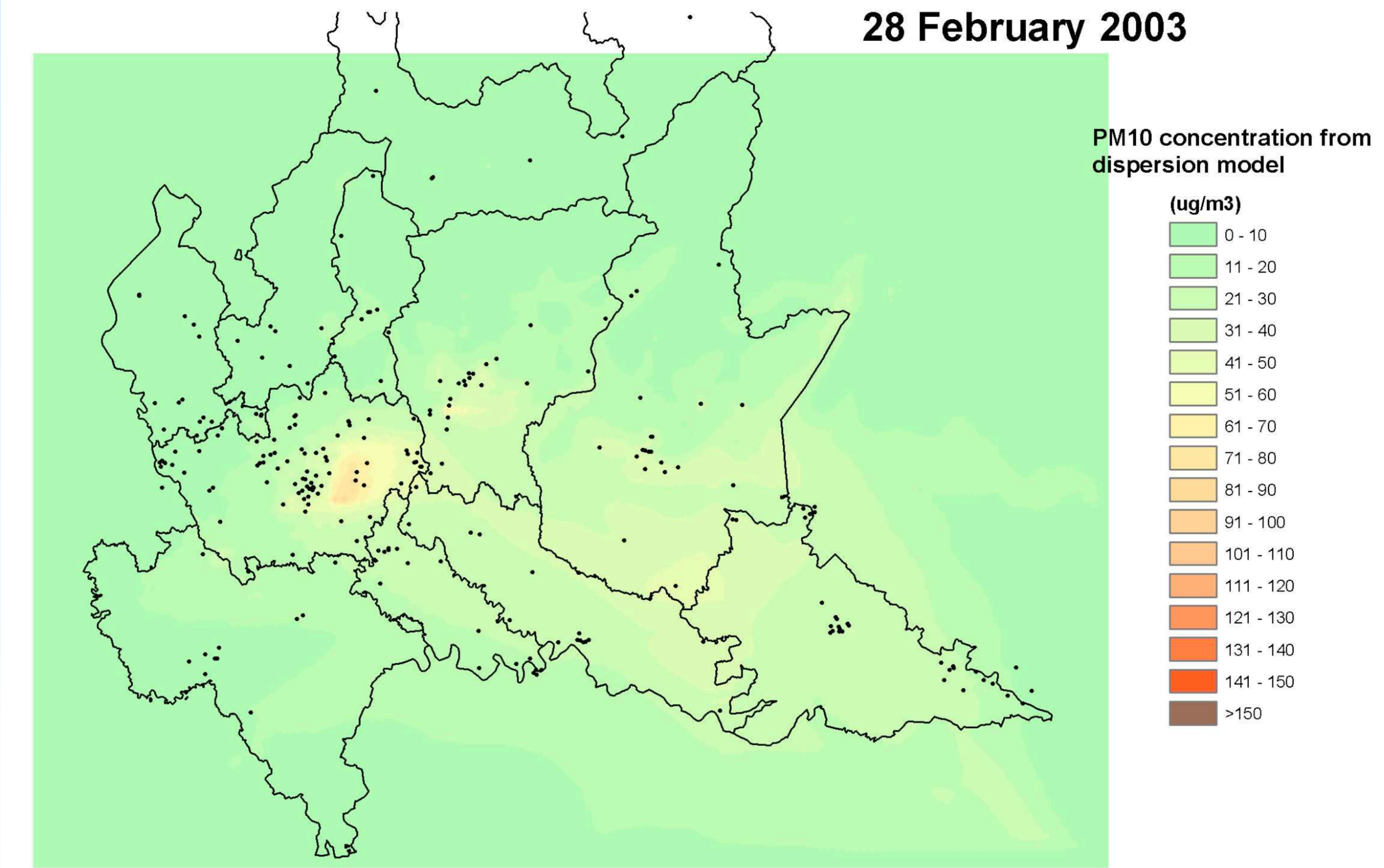




- $C_{PM10} = a \cdot \sigma_e + b \cdot RH$ for $RH < RH_o$
- $C_{PM10} = a' \cdot \sigma_e + b' \cdot \exp(K \cdot RH)$ for $RH > RH_o$ $K = 3.32$

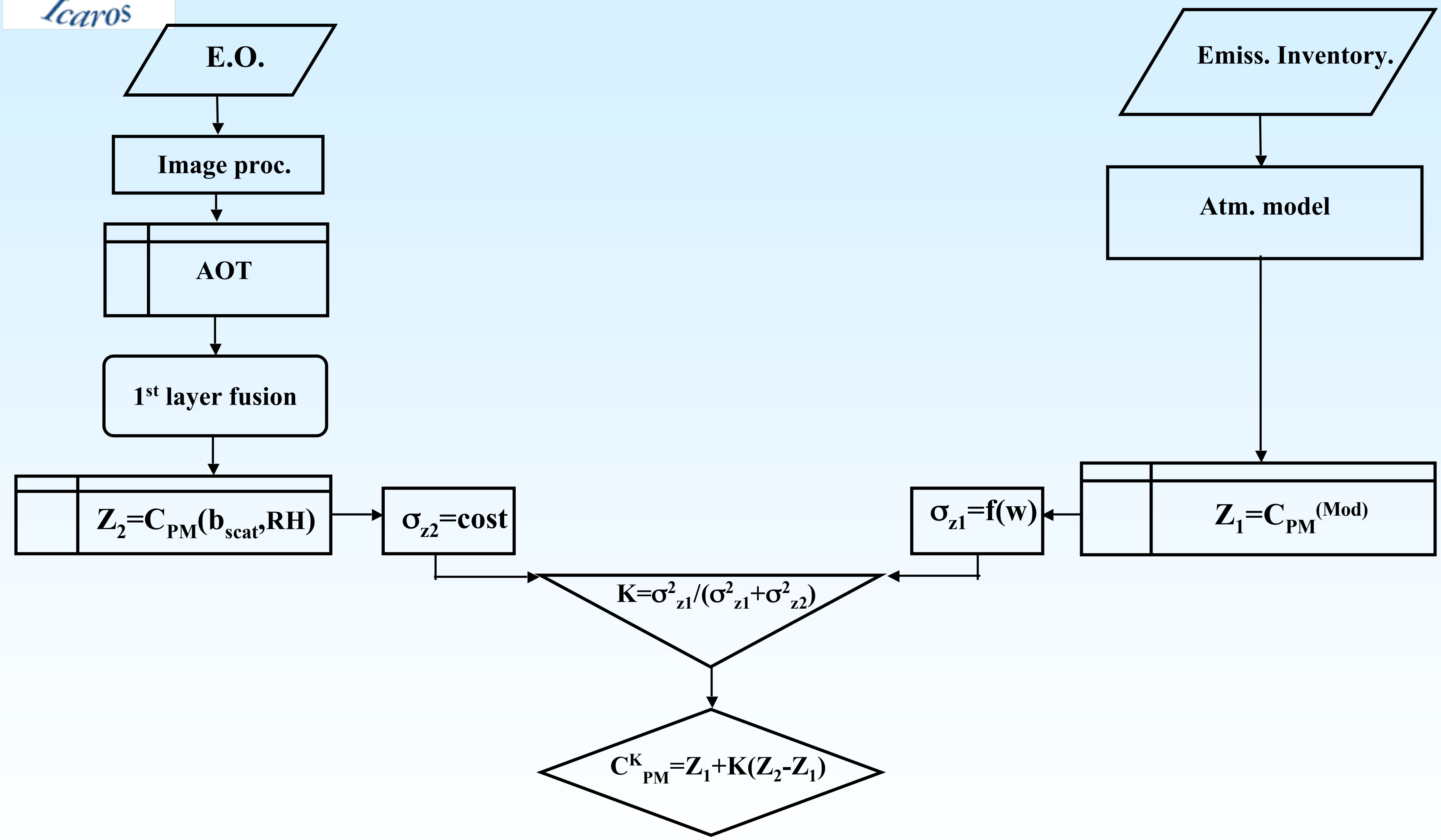
# EO-reckoned PM concentration in Lombardy

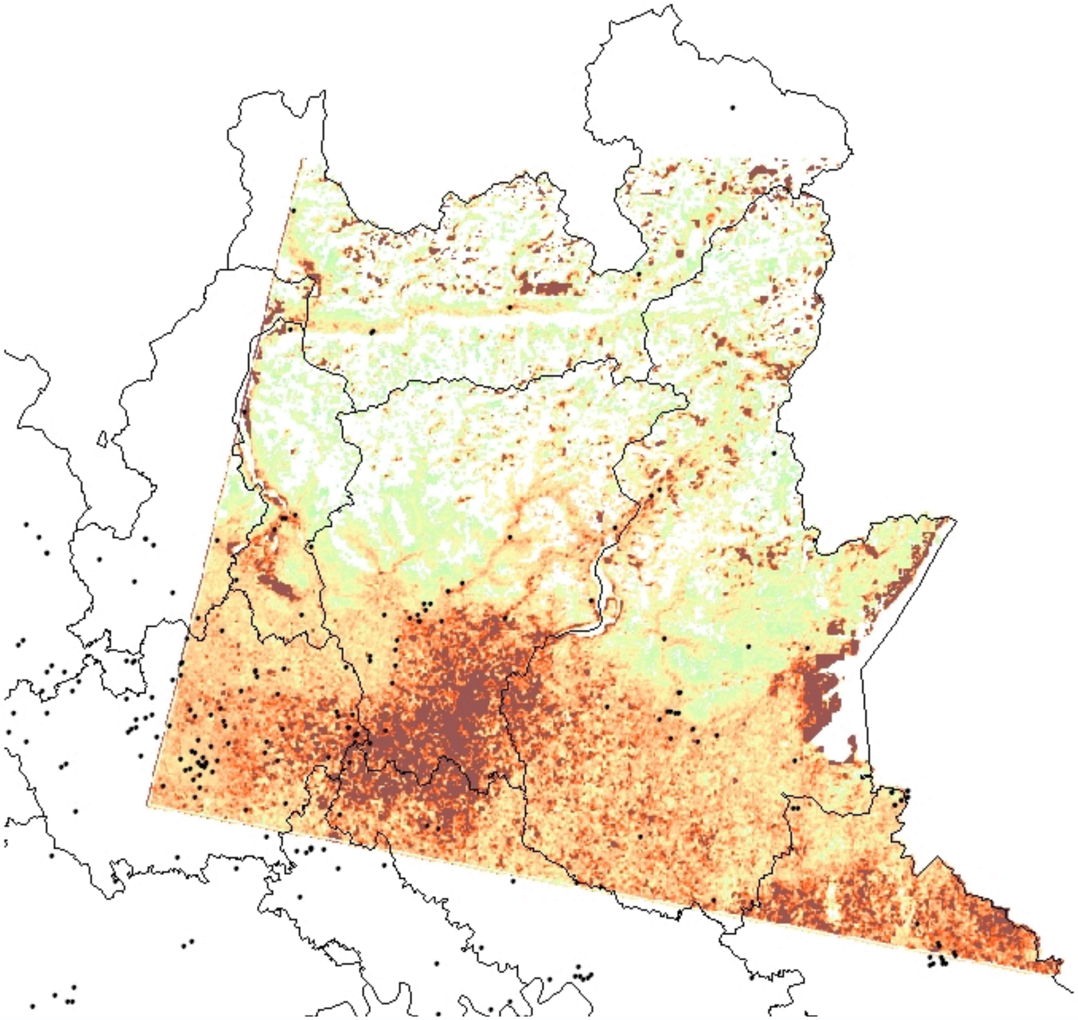


# PM concentration in Lombardy from REMSAD



# Model fusion - Kalman filter



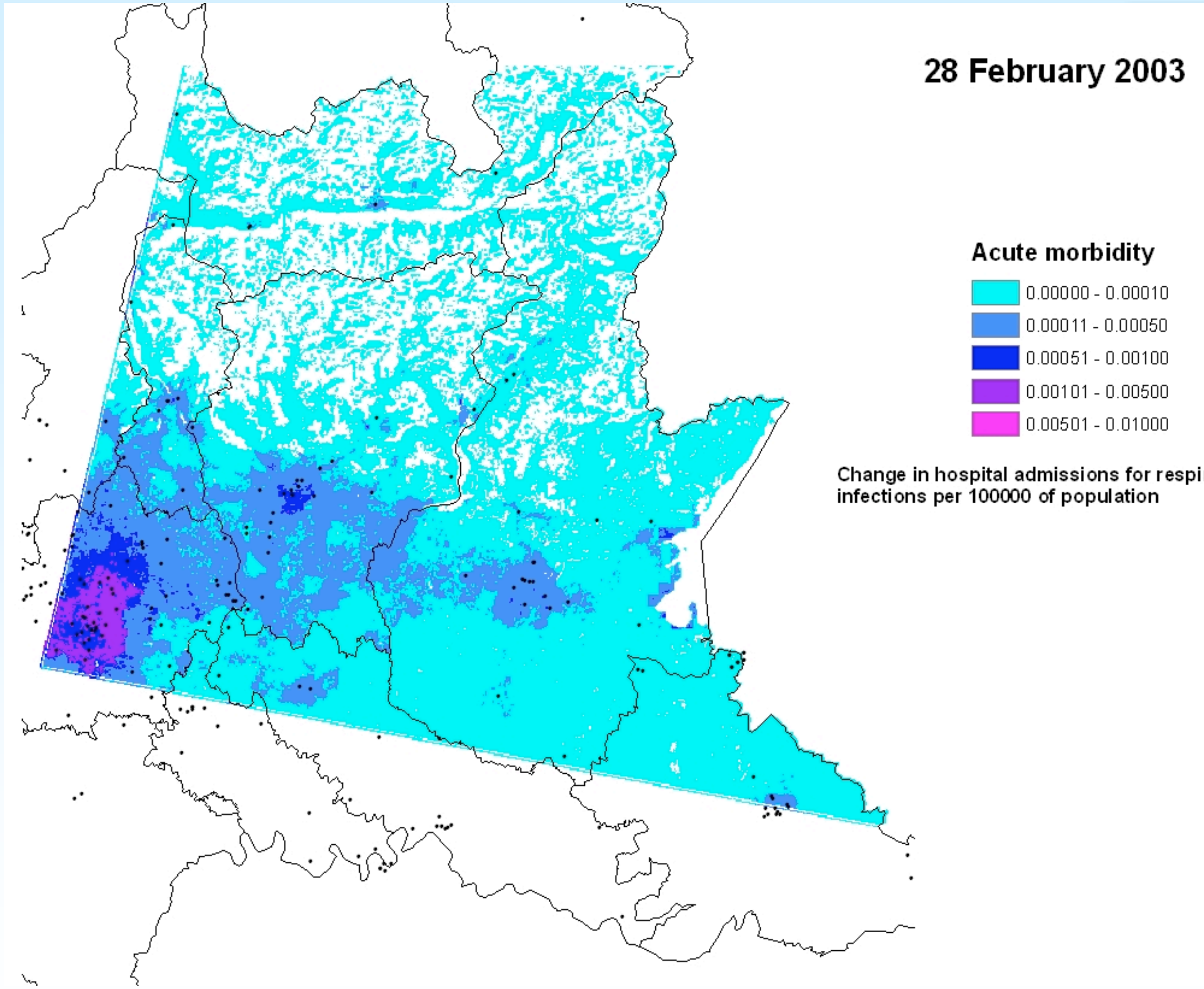


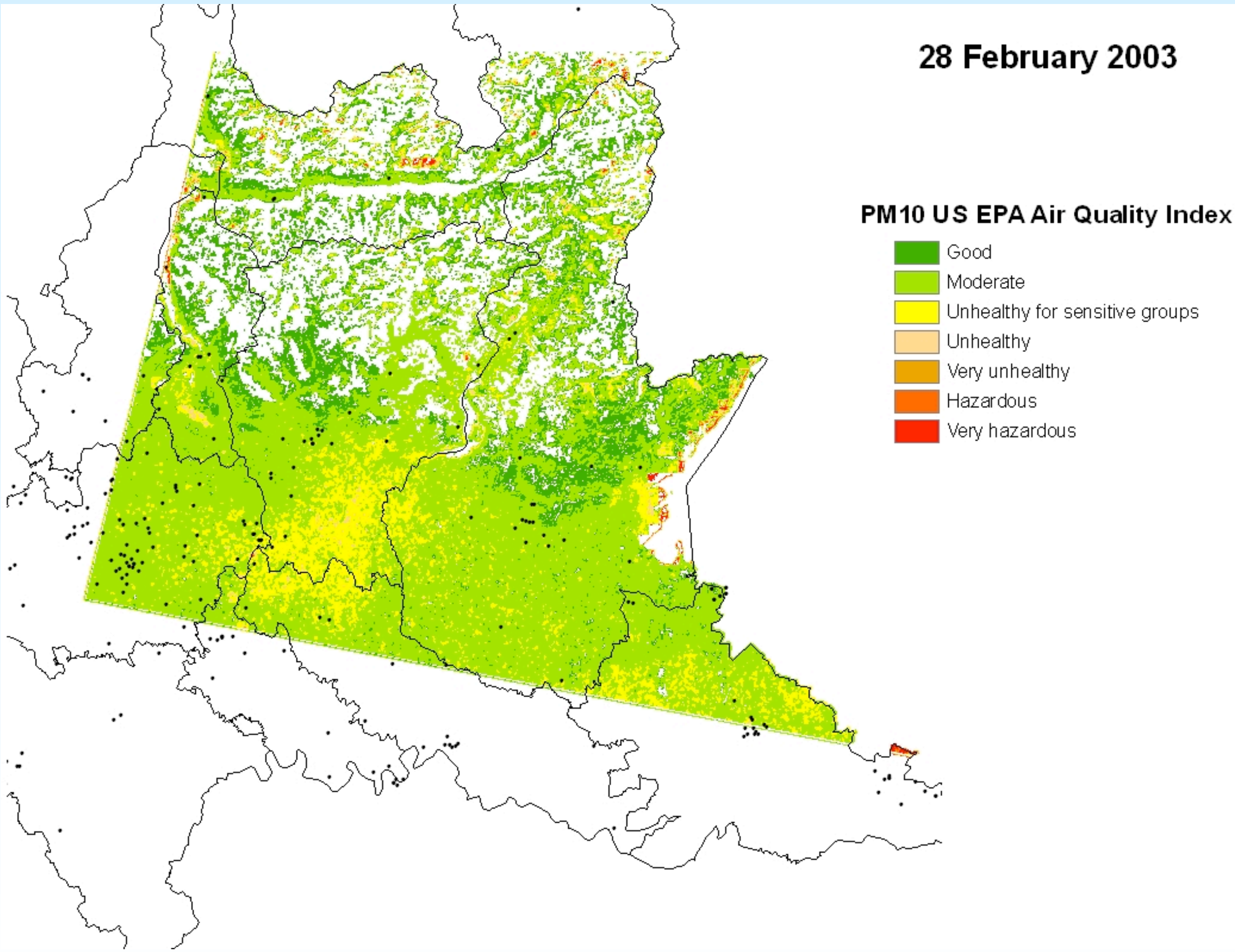
## 28 February 2003

**PM10 concentration from 2-nd layer of data fusion (Kalman filter)**

(ug/m3)

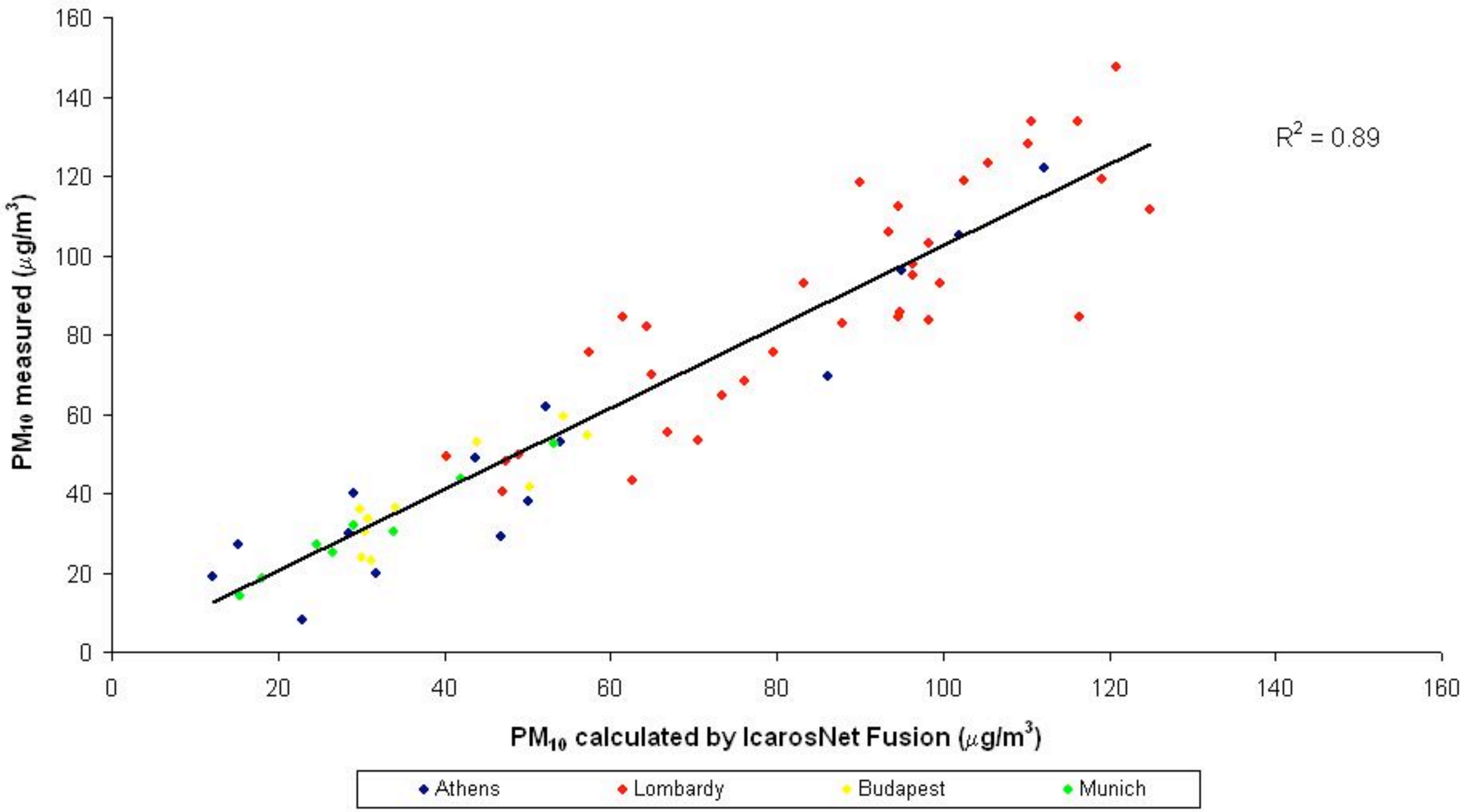
| |
|---|
| 0 - 10 |
| 11 - 20 |
| 21 - 30 |
| 31 - 40 |
| 41 - 50 |
| 51 - 60 |
| 61 - 70 |
| 71 - 80 |
| 81 - 90 |
| 91 - 100 |
| 101 - 110 |
| 111 - 120 |
| 121 - 130 |
| 131 - 140 |
| 141 - 150 |
| >150 |


28 February 2003
Acute morbidity
0.00000 - 0.00010
0.00011 - 0.00050
0.00051 - 0.00100
0.00101 - 0.00500
0.00501 - 0.01000
Change in hospital admissions for respira
infections per 100000 of population



28 February 2003
PM10 US EPA Air Quality Index
Good
Moderate
Unhealthy for sensitive groups
Unhealthy
Very unhealthy
Hazardous
Very hazardous

## Overall comparison on all the application sites between $PM_{10}$ measured - calculated by IcarosNet Fusion



# Conclusions

- Use of satellite information for air quality monitoring: a breakthrough technology
- Two levels of data/model fusion employed in the ICAROS NET algorithm to address weaknesses of EO remote sensing and atmospheric modelling
- Occasional limitations of the ICAROS NET application:
  - Reference image
  - Cloud coverage
  - Representativeness of mixing layer concentrations vs. near surface concentrations
- Overall error of the method in $PM_{10}$ calculation : less than 10%

THANK YOU

FOR YOUR ATTENTION