



## Detection of PM episodes using satellite retrievals

*<sup>1</sup>Bessagnet, B ; <sup>1</sup>Aymoz, G. ; <sup>2</sup>Chepfer, H. ; <sup>3</sup>Hodzic, A. ; <sup>4</sup>Leon, J.-F. ;  
<sup>5</sup>Mallet, M. ; <sup>1</sup>Meleux, F ; <sup>2</sup>Menut, L ; <sup>1-5</sup>Pere, J.-C. ; <sup>5</sup>Pont, V. ; <sup>1</sup>Rouil, L. ;  
<sup>1</sup>Ung, A.*

- 1) INERIS, France
- 2) IPSL/LMD, France
- 3) NCAR, USA
- 4) LOA, France
- 5) LA/OMP, France



# Outline

- 1- Model description (CHIMERE)**
- 2- Ukraine dust event in March 2007**
- 3- Ammonium nitrate events in spring 2007**
- 4- Impact of forest fires in Portugal in 2003**
- 5- Saharan dust outbreak impacts**
- 6- Conclusions**

# CHIMERE Model Setup

## Meteorological Data

ECMWF, GFS/MM5  
REGCM

## Boundary conditions

Average monthly  
climatologies GOCART,  
MOZART, LMDzINCA

## Emissions

- Anthropogenic (EMEP)
- Biogenic

## CHIMERE

### Gaseous chemistry

MELCHIOR [Lattuati, 1997]  
44 species, 116 reactions

### Aerosol module

[Bessagnet et al., 2004]

### Transport

- Horizontal (PPM)
- Vertical diffusion

### Deposition

- Dry [Seinfeld and Pandis, 1998]
- Wet [Guelle et al., 1998]

-Résolution  
horizontal : 2-50km  
vertical : 200 hPa

Air pollutant forecasting  
(D, D+1, D+2)  
PREVAIR

Simulation for emission  
reduction studies  
EURODELTA - CITYDELTA

Optical properties computation  
[Hodzic et al., 2004] + new PhD.

- Free download at <http://euler.lmd.polytechnique.fr/chimere>
- Development at IPSL/LMD (CNRS), LISA and INERIS



## Dust event in March 2007

### First analyses :

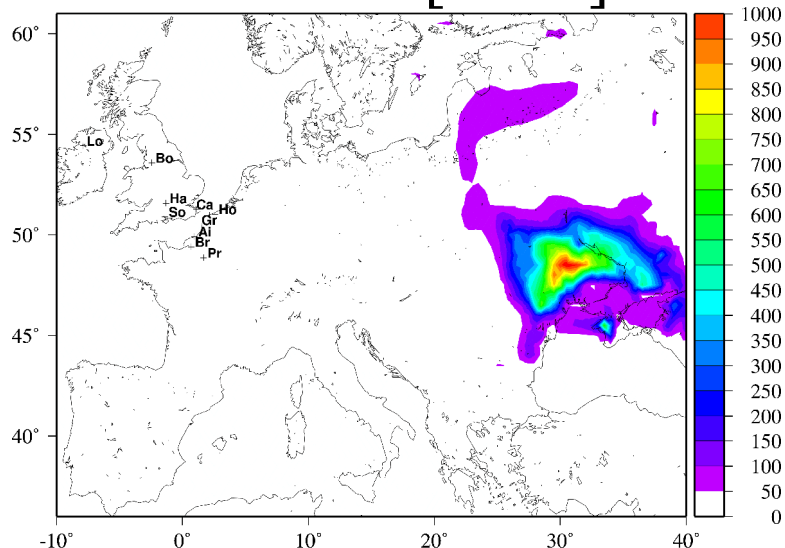
- Dust fall observed in Great Britain (March, 25)
- High PM concentrations observed in Belgium (March, 24-25)
- backtrajectories :
  - air mass potentially issued from Sahara (Lybia), and from Asia.

### More recently :

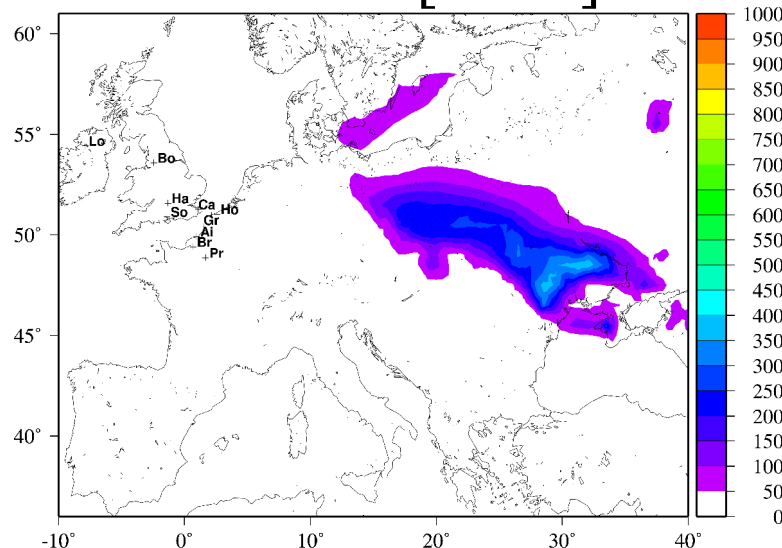
- Birmili et al., 2008 assume that this event originate from Ukraine (wind blown dust).

# Dust event in March 2007

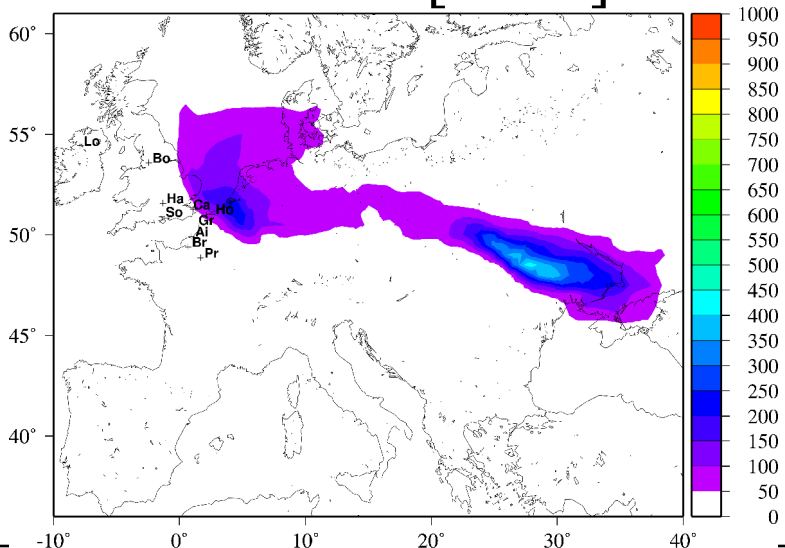
20070323 [12:00]



20070324 [12:00]



20070324 [18:00]



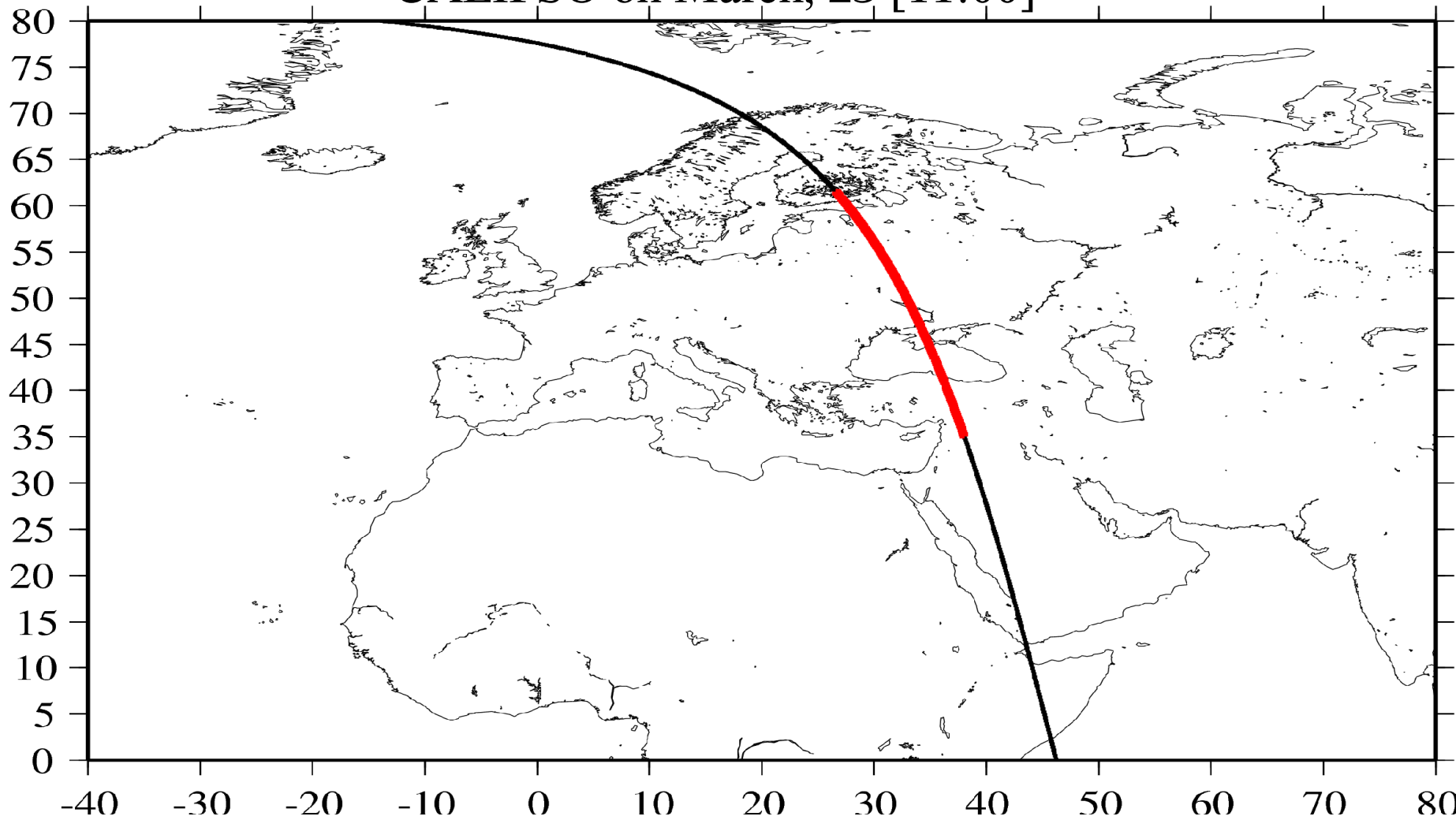
**Simulated PM10 concentrations in  $\mu\text{g}/\text{m}^3$**

PM10 > 1400  $\mu\text{g}/\text{m}^3$  in Slovakia and 150  $\mu\text{g}/\text{m}^3$  in France (Birmili et al., 2008)

Bessagnet et al., 2008 in JGR

# Dust event in March 2007

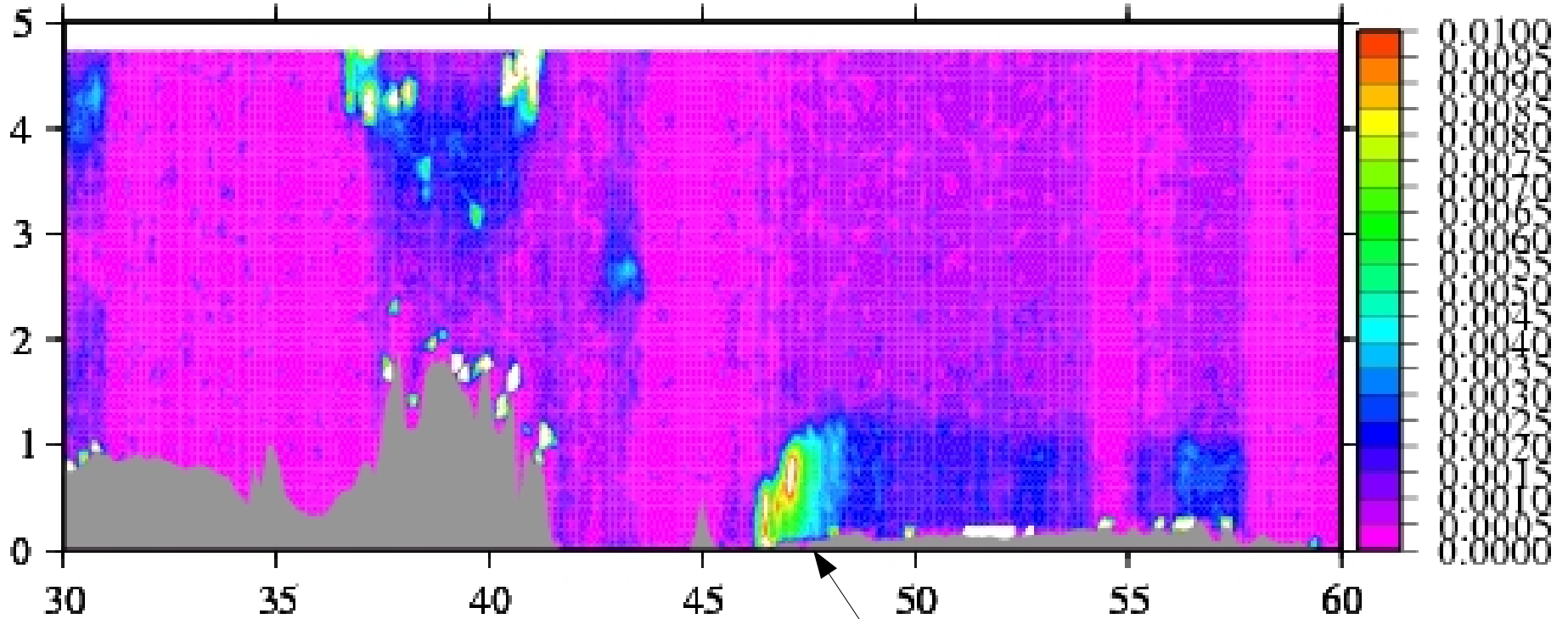
CALIPSO on March, 23 [11:00]



# Ukraine dust event

CALIOP lidar : Backscatter signal – 20070323 [11:00]

Altitude



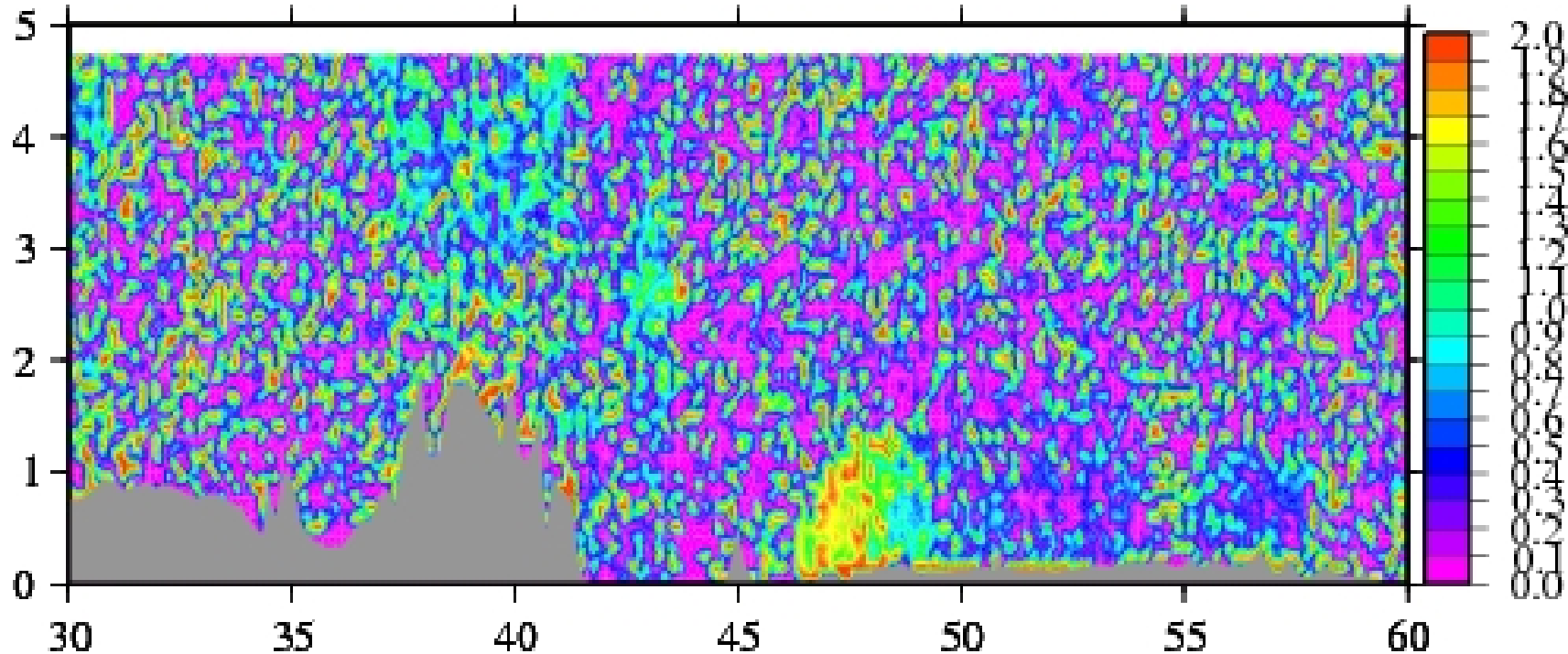
Latitude

Ukraine

H. Chepfer (LMD)

# Ukraine dust event

Color ratio



The high value of color ratio ( $CR > 1.3$ ) underlines that the particles are large compared to usual aerosols : CR is about 0.5 for urban and maritime aerosols, and 1.2 for Saharan dust

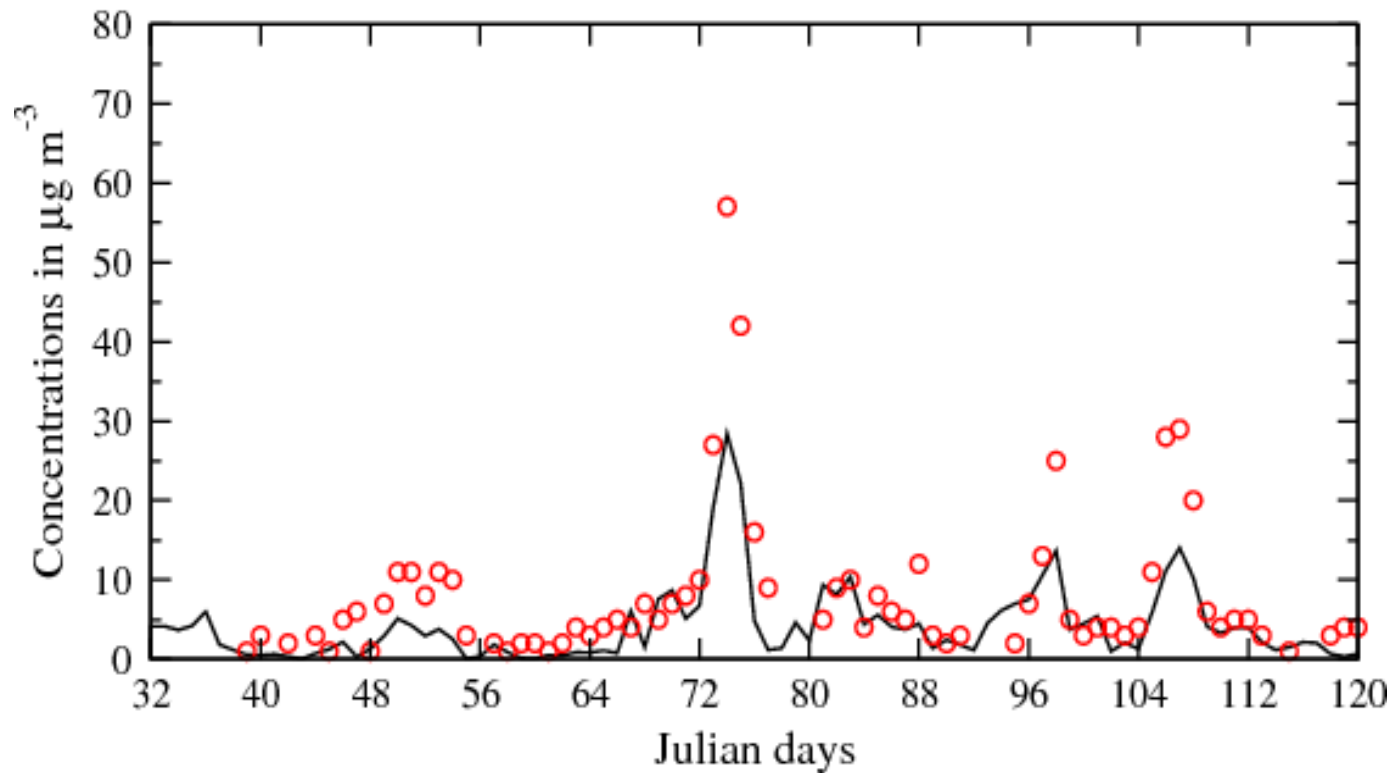


# PM episodes in Spring 2007

Ammonium nitrate concentrations

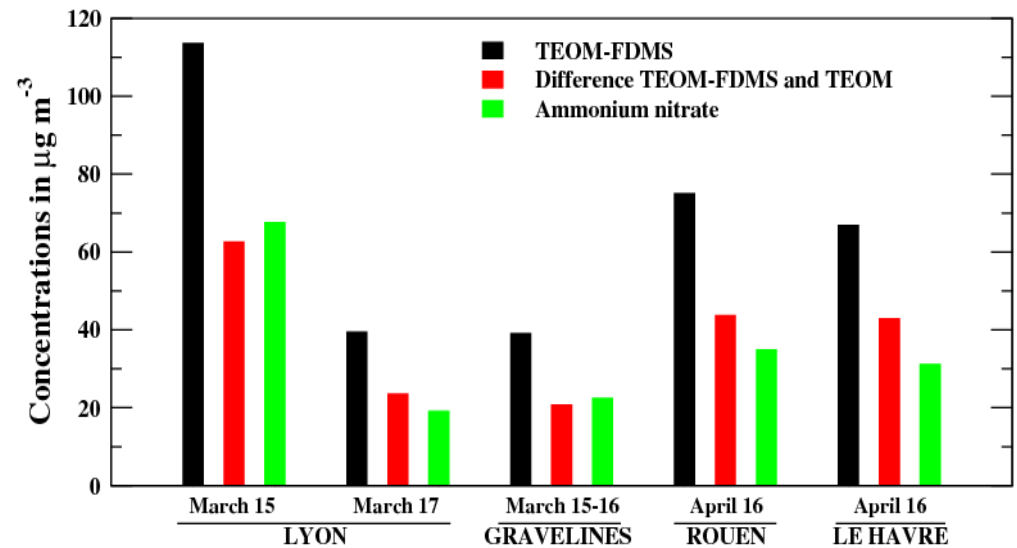
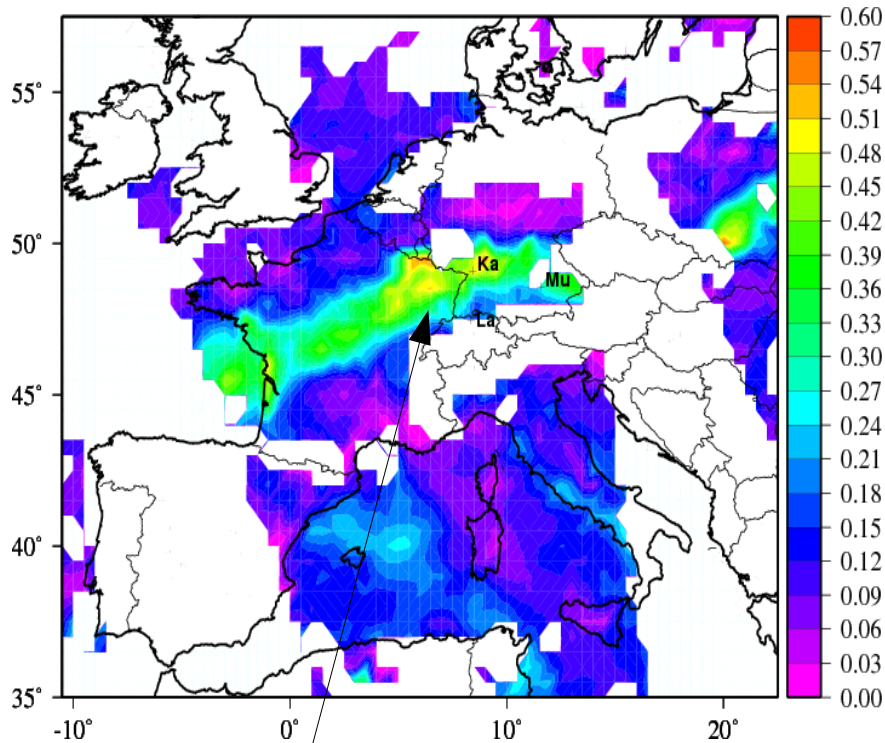
**LIMOGES**

— Model  
○ Observations



# PM episodes in Spring 2007

POLDER AOD (550 nm)  
20070314 [13:00]



Ammonium nitrate

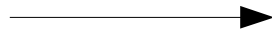
Ammonia evaporated from soil  
due to high temperatures

Coll. LOA/LA-OMP

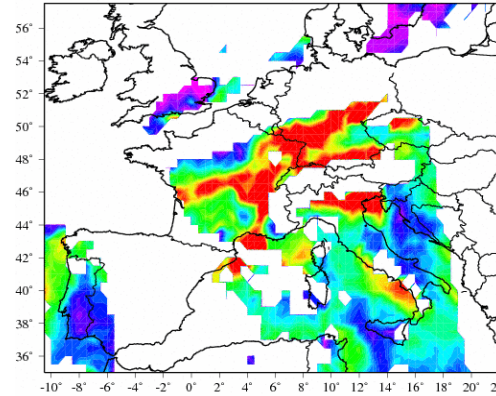
# POLDER

# MODIS

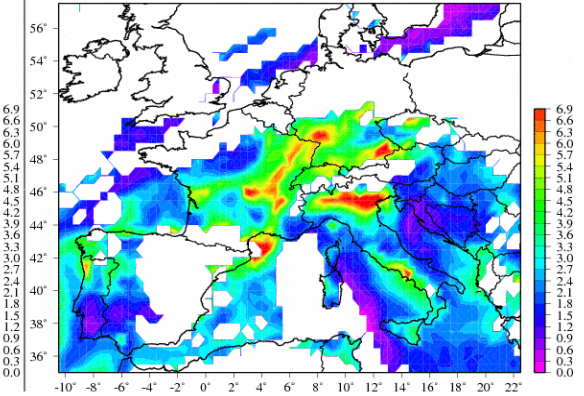
Satellite retrievals



POLDER AOT 550nm (unit\*20) date : 20070316



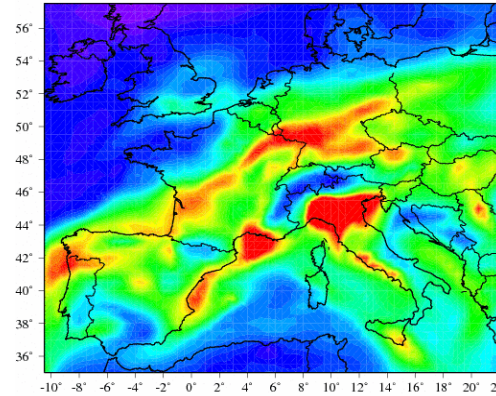
MODIS AOT 550nm (unit\*10) date : 20070316



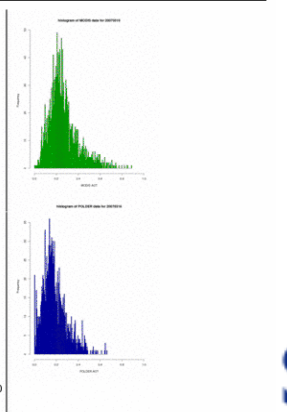
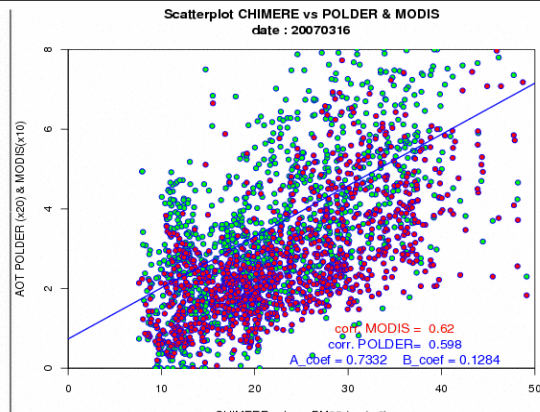
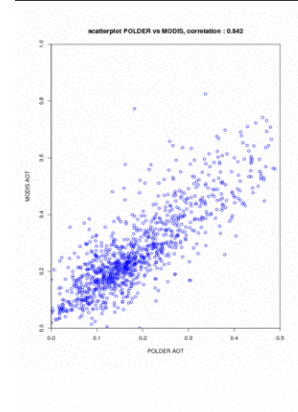
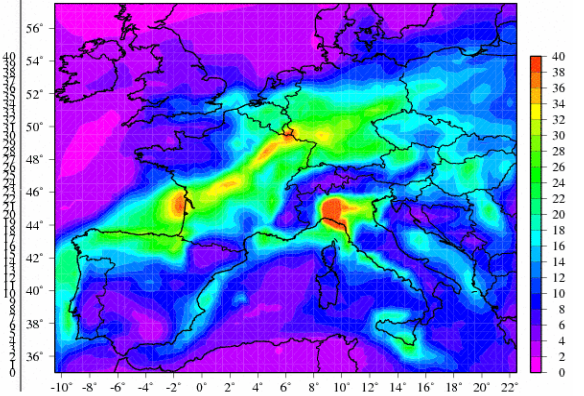
Model



CHIMERE column PM25(mg/m2) date : 2007031613

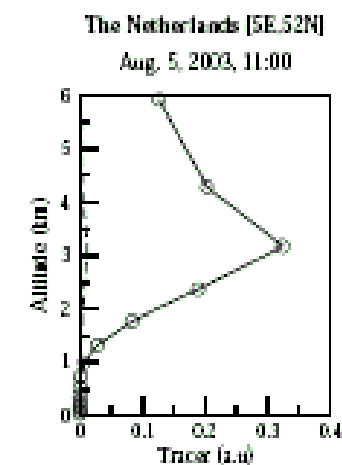
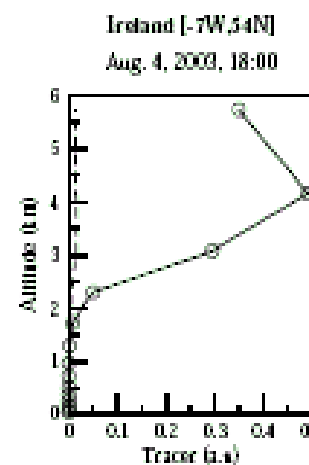
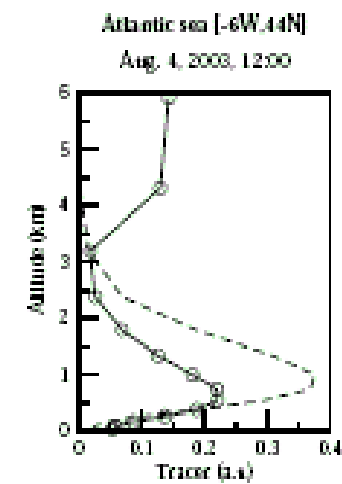
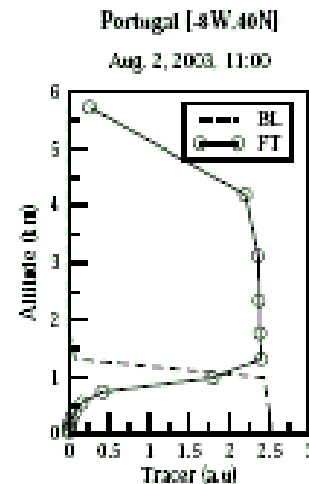
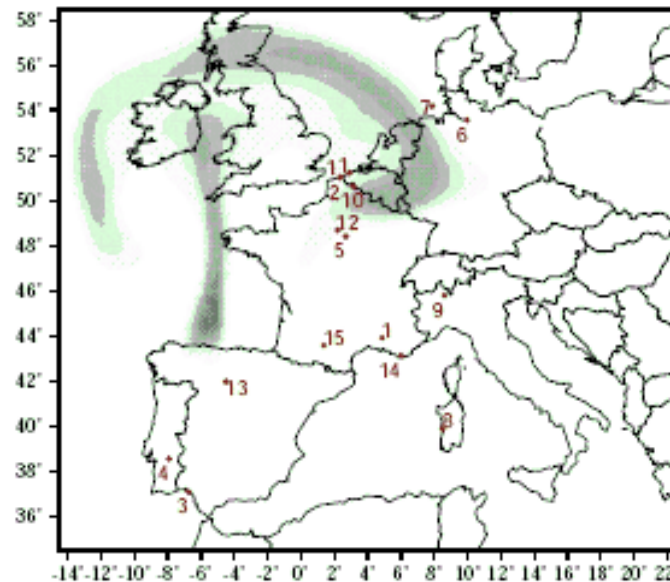


CHIMERE level1 PM25(mu/m2) date : 2007031613



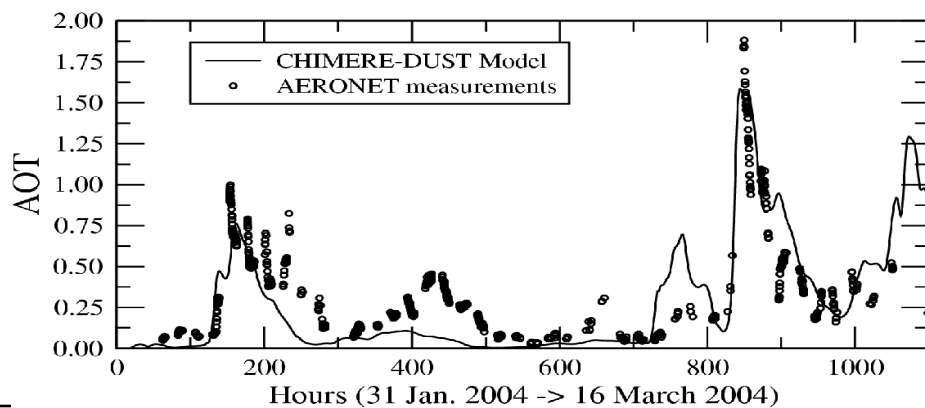
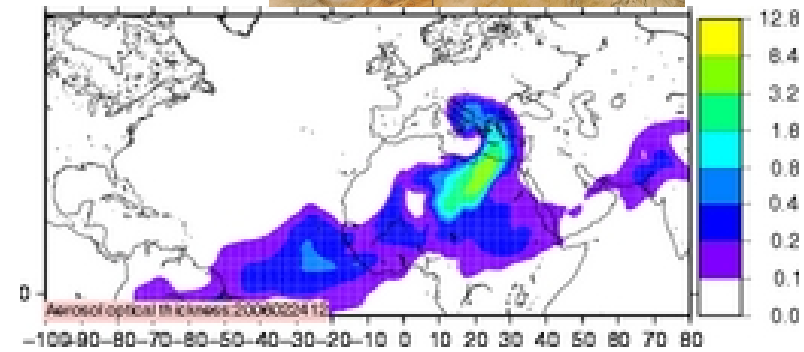
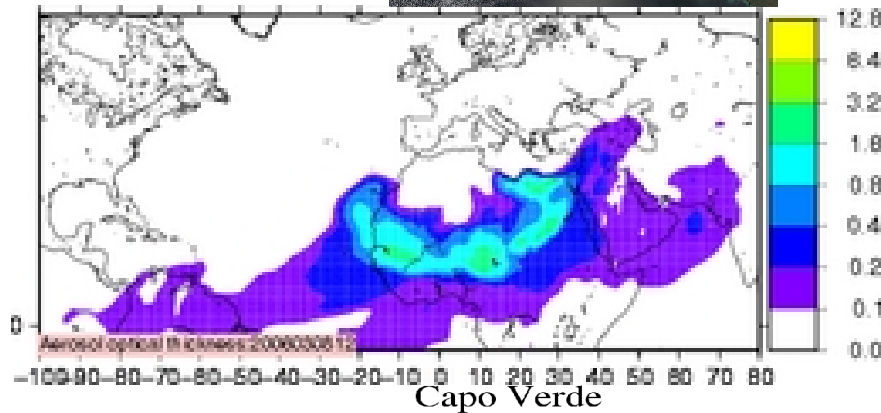
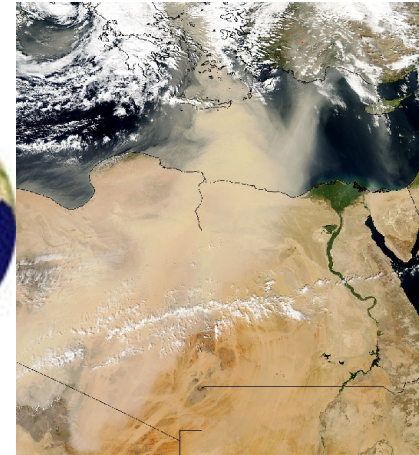
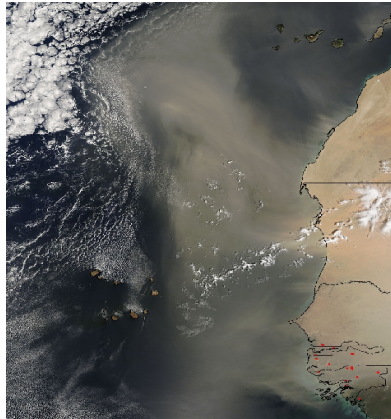
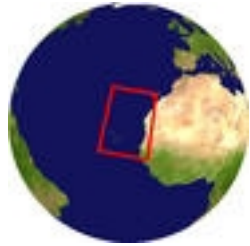
# A need to improve understanding of transport of aerosols in Europe [Hodzic et al., 2005; 2006]

In Portugal (summer 2003), gas and particles emitted by forest fires are directly injected in the free troposphere: change in the photolysis rates several hundred kilometers away.



*Good for spatial patterns,  
Only vertically integrated informations*

# Large scale transport of dust: development and use of the CHIMERE-DUST model for analysis and forecast



Direct comparison to satellite shows a good agreement of 'large plumes'. *Need more informations on the 'nature' of the aerosols.*



## Conclusions

- *Satellite data very useful to retrieve the origin of large scale PM events*
- *Instantaneous measurement over a large are with the same representativeness*
- *Quantitative validation : observed AOT vs. simulated AOT*
- *Most of sensors on board satellites provide integrated results*
  - *over the whole PM composition*
  - *on the column*
- *Lidar on board satellites : crucial to get a vertical profile*