Post Processing of the Air Quality Forecasting system: PREV'AIR

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This platform is proposed by the **PREV 'AIR consortium** - **http://www.prevair.org**

Questions about PREV 'AIR? Please send an e-mail to frederik.meleux@ineris.fr

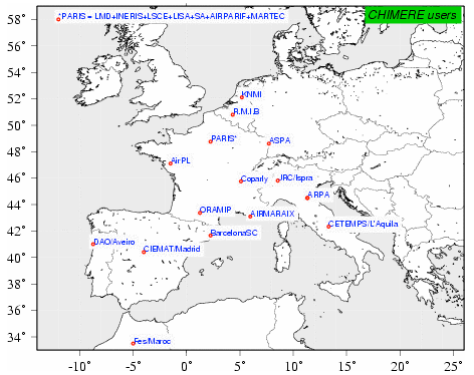
Principles of the PREV'AIR system : www.prevair.org (i)

- An operational system that has become a part of the French air quality monitoring strategy .
- A new approach, borne by numerical tools, to reinforce the air quality management network, with new products :
  - Forecasts: since 2003, public information procedures and emergency measures are based not only on measurements but also on forecasts. This is one of the decision of the "Air Plan" adopted by the national authorities after the August heat wave
    - Regulatory pollutants: O3, NO2 and PM
    - Global / European / French scales
    - 3 days ahead ➔ Prevention of exposure
  - Monitoring: not all regions are fully covered by fixed measurement stations
    - Measurements and model results are combined to provide « analyses » : the most relevant
    - Air pollution maps describing air pollution patterns on a hourly or daily basis

PREV'AIR

Principles of the PREV'AIR system : www.prevair.org (ii)

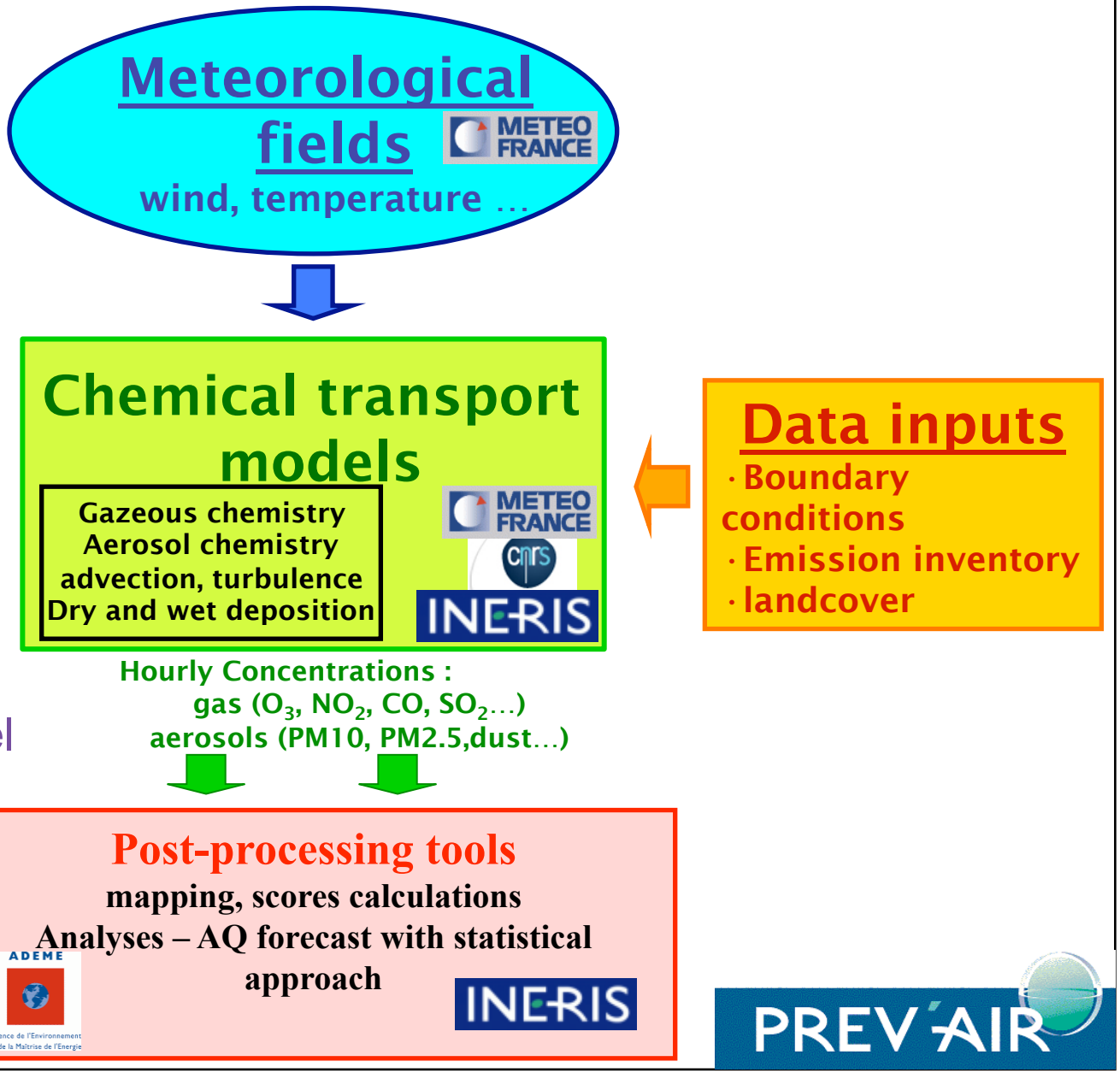
- Daily broadcast of information through Internet: ***http://www.prevair.org***
- A user- oriented system which to reach different kinds of products
  - Free access, open scope: forecast maps / observations / analyses
  - Restricted access, registered users: numerical model data
- More than 60 users among which local and regional air quality monitoring agencies, research laboratories, private companies



- Daily information about the model performances is also available to build users' confidence
- Fully operational running conditions in summer with 24h/24h turns to guarantee the data availability on the user accounts each morning at 8:00 a.m.
- In case of persistent (more than 2 days) and large scale (more than 2 administrative regions) ozone episodes, PREV'AIR maps are sent to TV media for informing general public

Modelling plateform

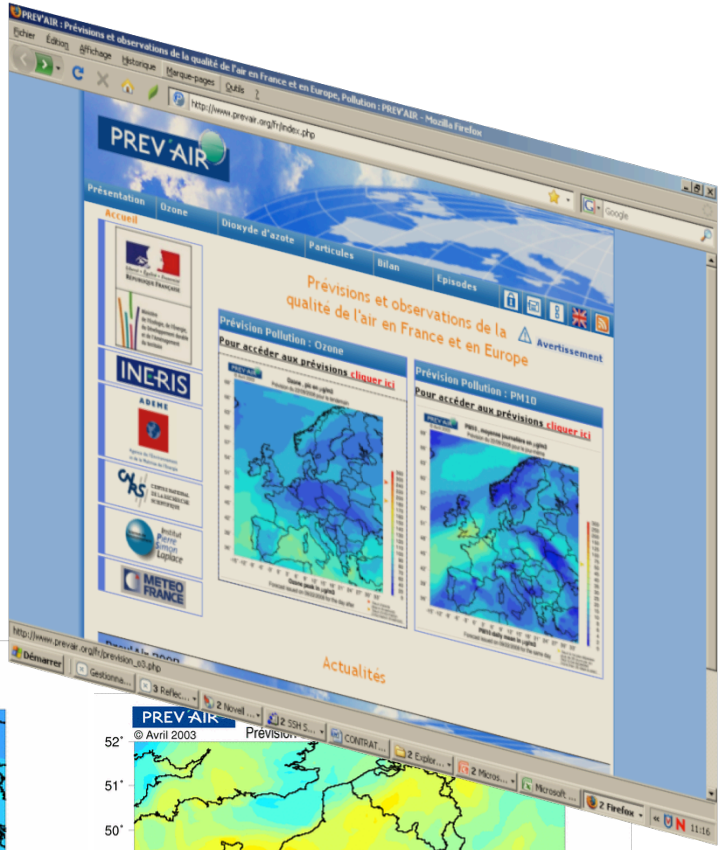
1. Processing meteorology
2. Processing data inputs
3. Air quality models:
   - Chimere **(CNRS/INERIS)**
   - Mocage **(METEOFRANCE)**
4. Post-processing:
   - combining obs and model

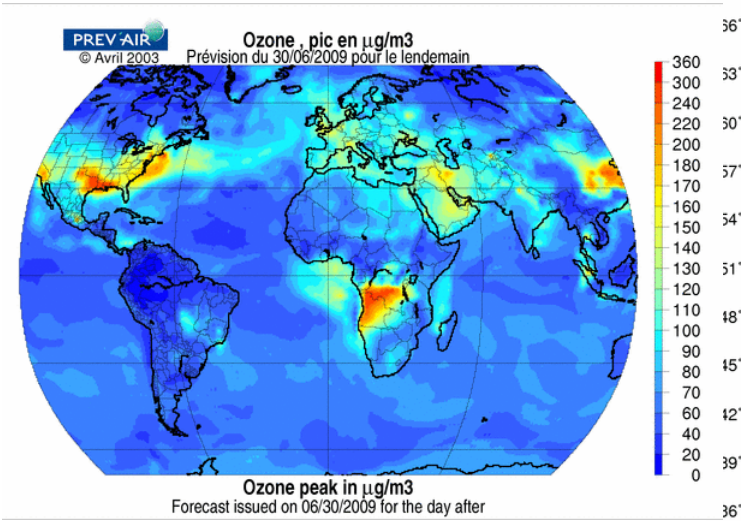


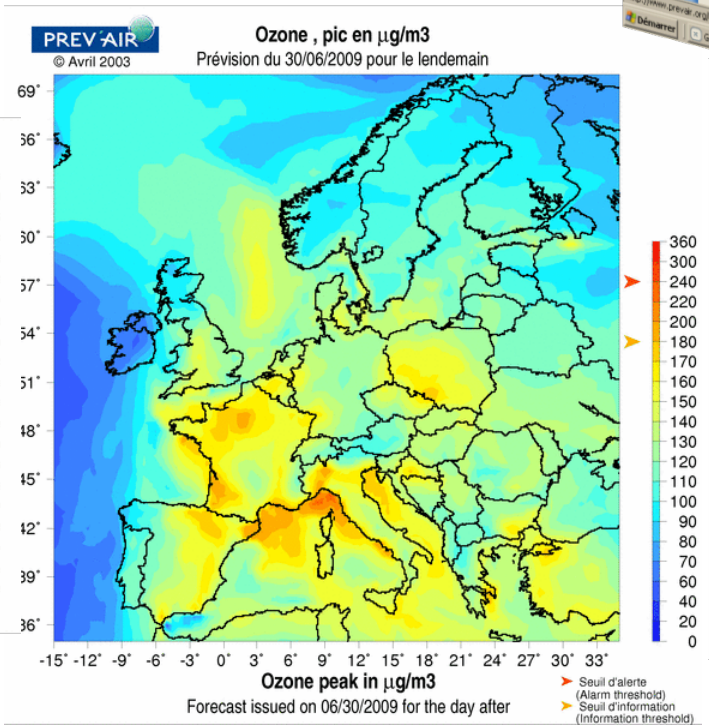
The website Prev'Air: www.prevair.org

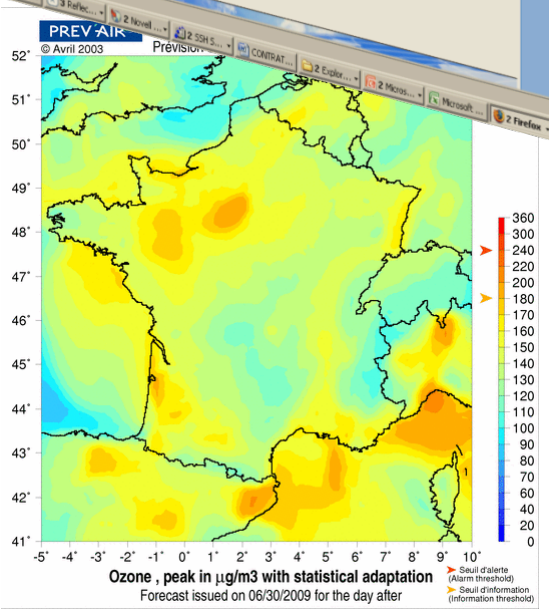
- Delivered on a daily basis before 8 am
- Daily peak and daily averaged values for:

  J+0, J+1, J+2
- Pollutants: O_3, NO_2, Particules (PM_{10}, $PM_{2.5}$ and DUST)

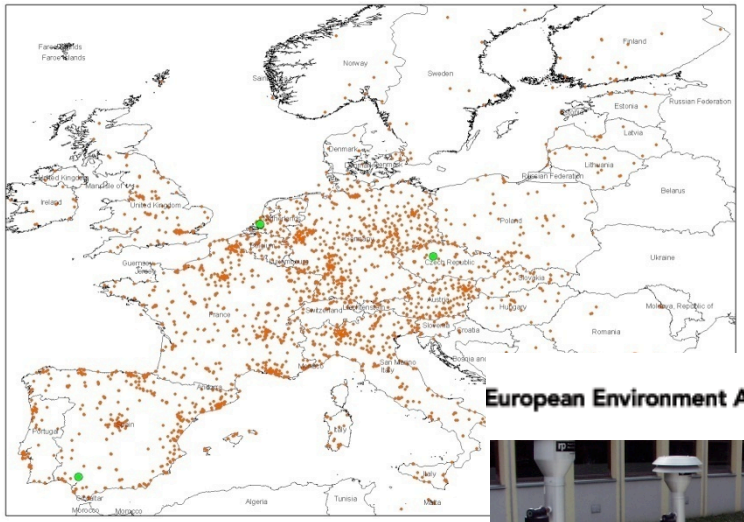








PREV'AIR and observations



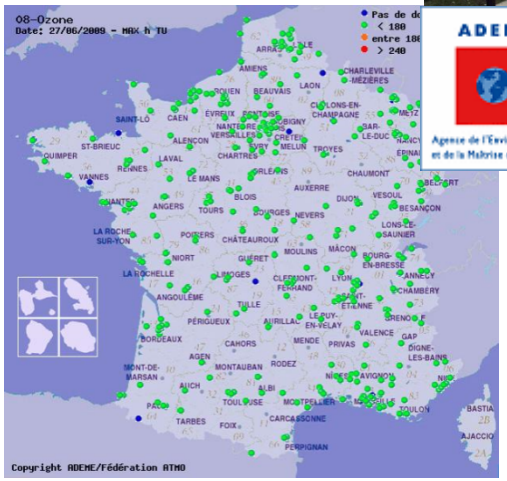
European databases:
- Ozoneweb (NRT)
- Airbase

European Environment Agency

Request

Data transfer

Request



ADEME

Agence de l'Environnement et de la Maîtrise de l'Energie

French databases:
- BASTER (NRT)
- BDQA

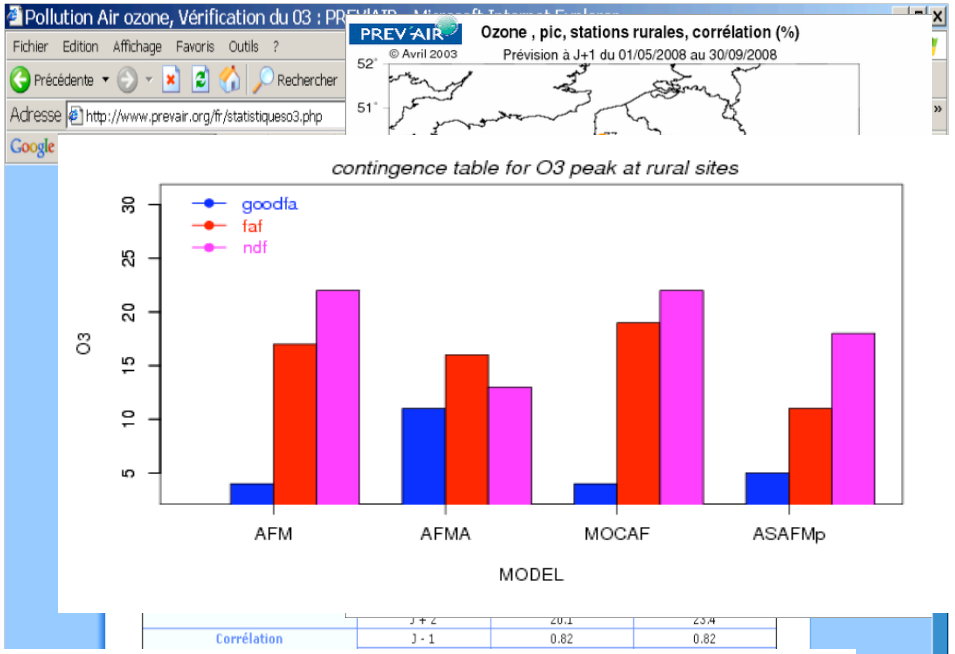
PREVAIR database

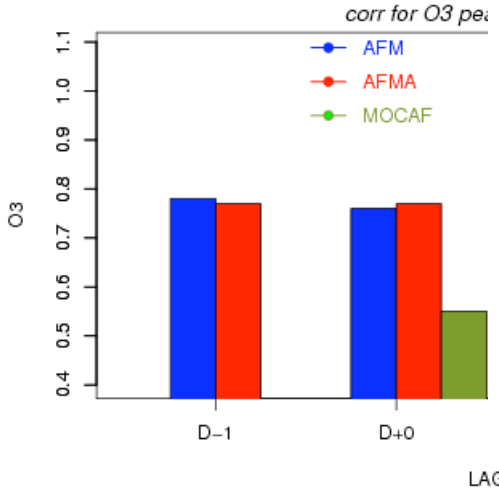
PREV'AIR

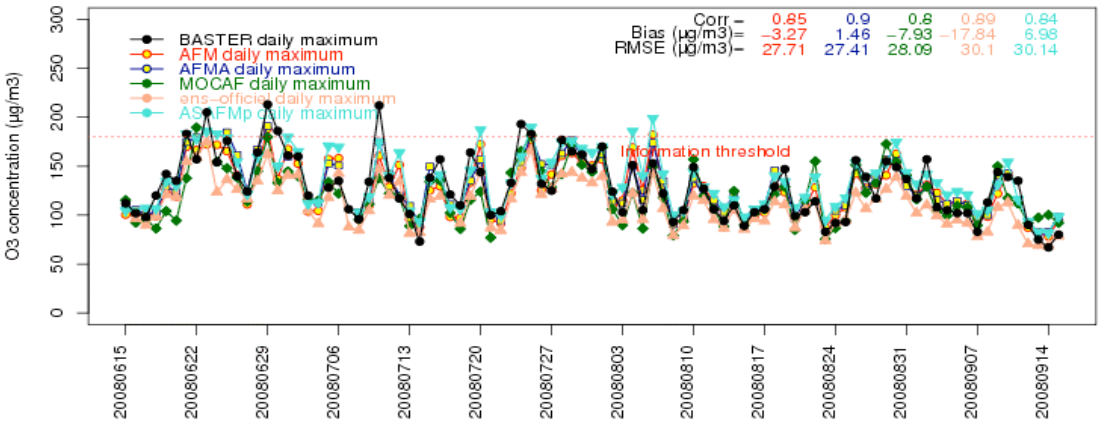
PREV'AIR and observations:

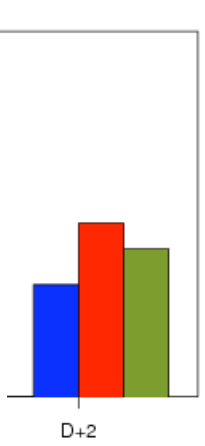
forecast evaluations

1. Statistical indicators
   - **Bias, RMSE, correlation ...**
2. Time series
   - **Comparison with in-situ measurements in near real time (BASTER, Ozoneweb) : Rural, suburban, urban**
3. Contingency tables
   - **European standards (180 µg/m^3 and 240 µg/m^3 for O_3)**
4. …









PREV'AIR and observations: AQ forecast upgraded

❑ Analyses: data assimilation:

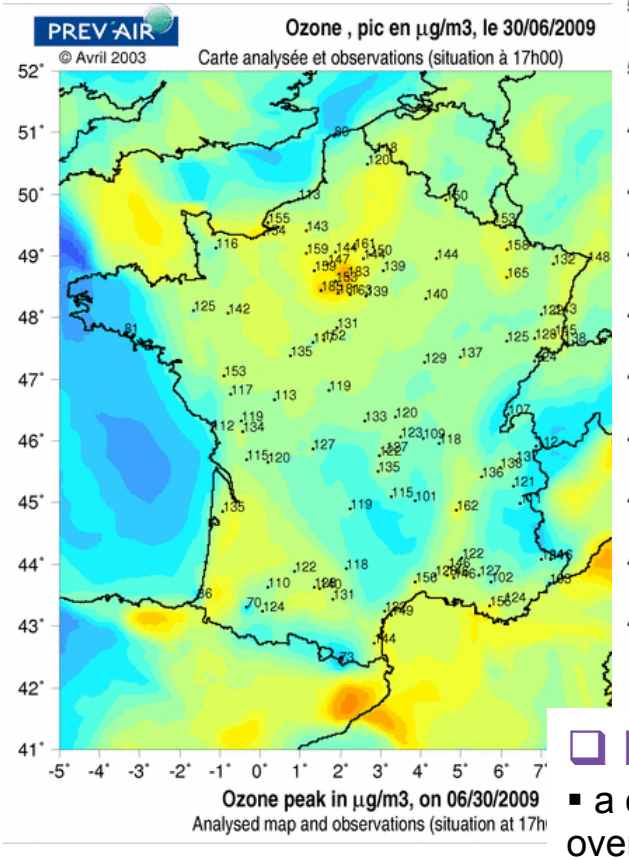
•Goal: have the best possible picture of air quality over France

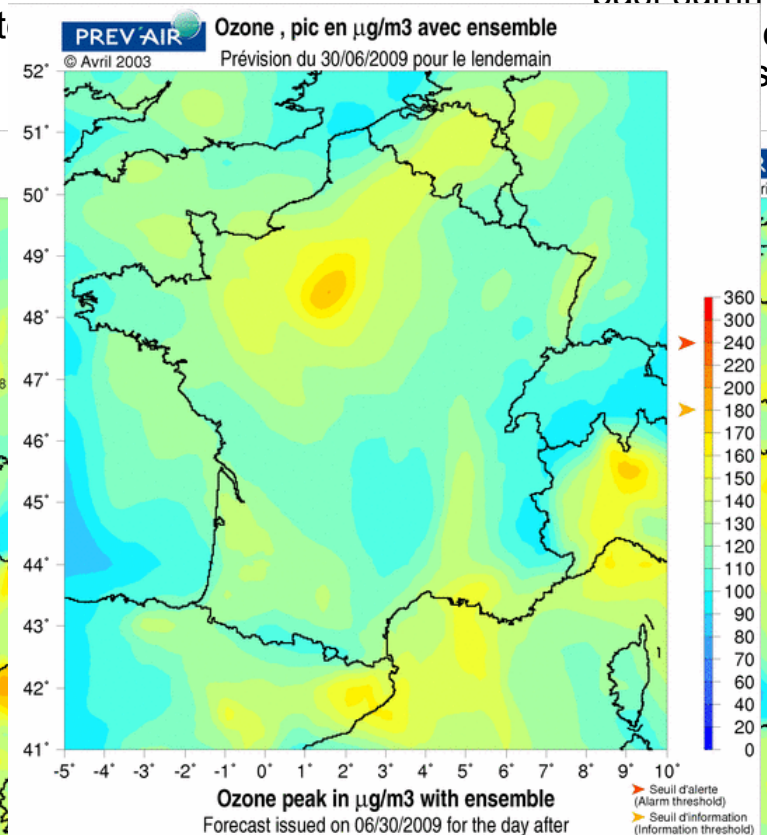
• Idea: inject information in the syst based on current observations

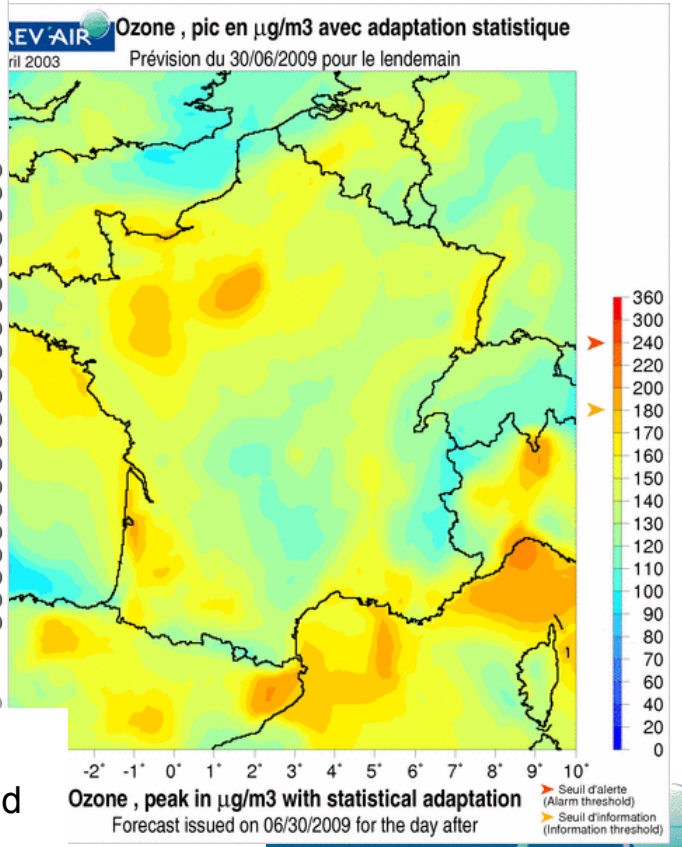
❑ Maps with statistical correction :

•Requires a chemical climatological database from past summers:

on past error fields, a linear regression is sess the ozone error in forecast mode







❑ Ensemble forecast:

▪ a combination of all prev'air models established over a training period (30 days spin-up)

A new challenge for future: downscaling

In the framework of the CITEAIR2 European project, the objectives is to design a processing to compute relevant information over urban area from regional model output

Baseline: Prev'Air forecast at 50 kmx50km over Europe

Target: Urban air quality forecast over background sites

1. Build a multi linear AQ model: Statistical Adaptation (SA)
   - Formulation of the downscaling process using multilinear regressions

2. Choice of quantitative and qualitative variables as explanatory data
   - Meteorological forecast data
   - European model output
   - Observation data → Model error for the previous day
   - Type of days and hours

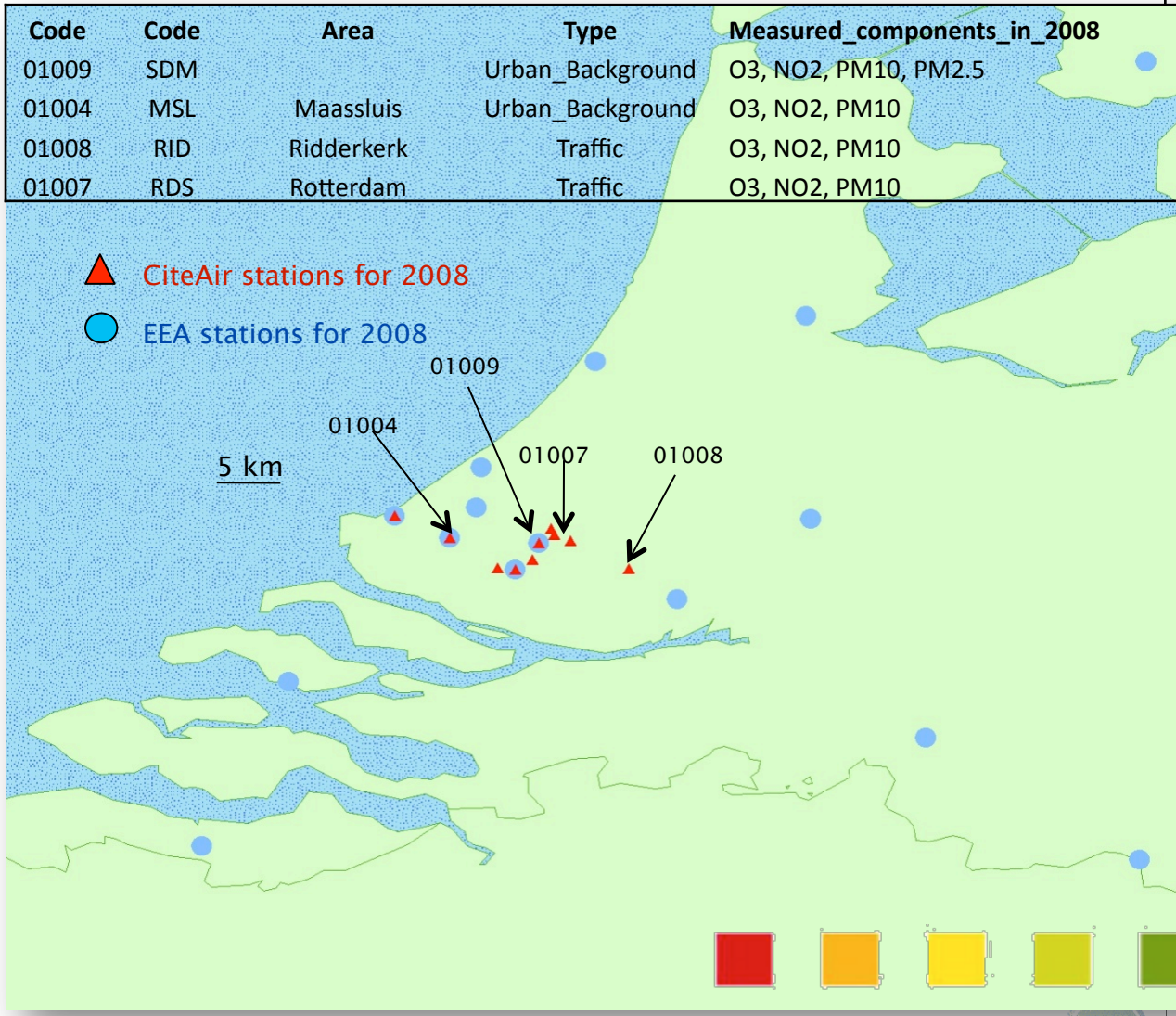
Test case: Rotterdam city (Nederland)

Available data for level 1

- 2008 meas. data from DCMR
- 2009 meas. data from airqualitynow.eu

- 2008, 2009 forecast from Prev'Air
- 2008, 2009 meas. from EEA database

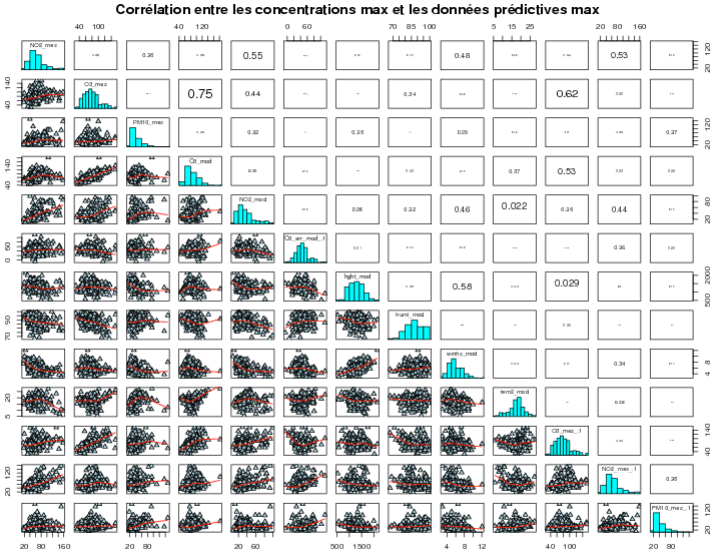
Code	Code	Area	Type	Measured_components_in_2008
01009	SDM		Urban_Background	O3, NO2, PM10, PM2.5
01004	MSL	Maassluis	Urban_Background	O3, NO2, PM10
01008	RID	Ridderkerk	Traffic	O3, NO2, PM10
01007	RDS	Rotterdam	Traffic	O3, NO2, PM10



Statistical adapted models for ozone

Model formulation : $C_{AS} = ß_0 + ß_1.X_{meas} + ß_2.X_{forecast} + ß_3.X_{meteo\ 1} + ... + ß_n.X_{meteo\ n-2}$

- Measurements at D-1 ; Forecast at D+0, Error forecast at D-1
- 1model for each season: winter or summer
- 1 model for each station: four stations for Rotterdam

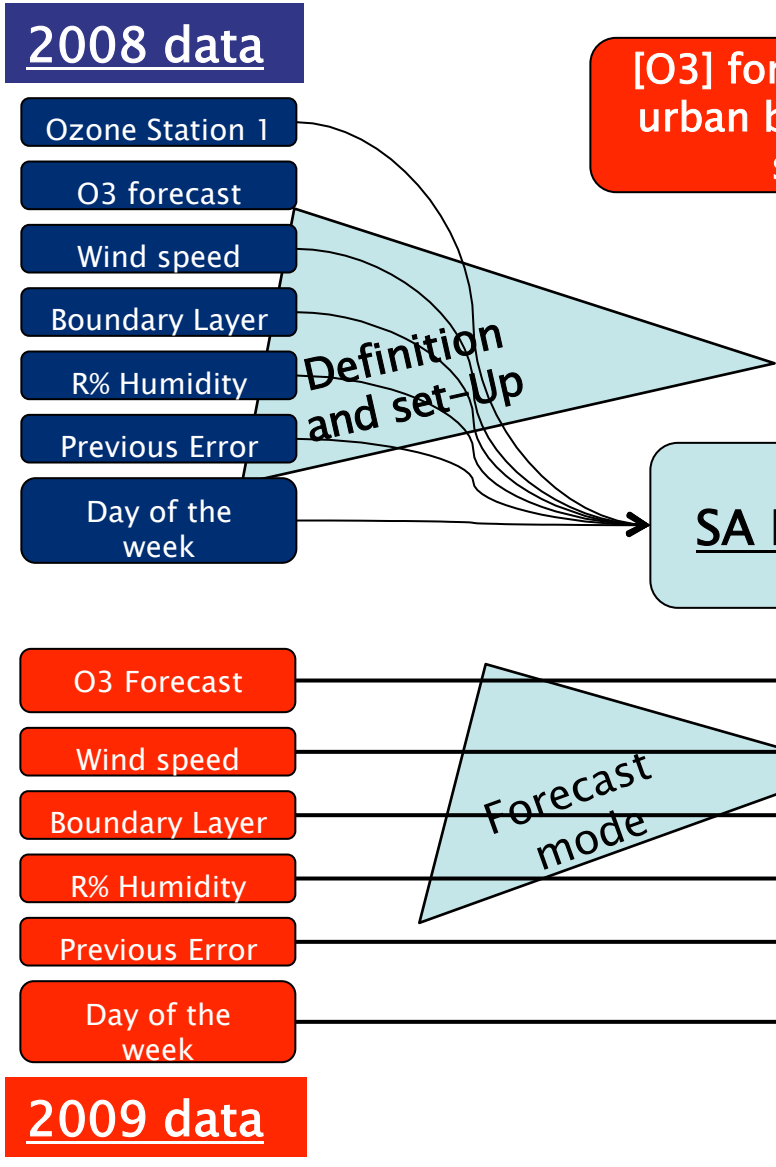


- **Predefine set of predictors**
  - NO_2, O_3, PM10 concentrations
  - Temperature at 2 m (daily min, max and mean)
  - Wind speed (daily min, max and mean)
  - Relative humidity at surface
  - Boundary layer altitude (daily min, max and mean)
  - Qualitative variables (day of the week, week-end or not)

- **Define best model with a maximum of explained variability R^2**
  - Selection of a set of explanatory variables

PREV'AIR

Statistical adapted models for ozone



ROTTERDAM CASE

O3 max concentration (MSL station)						
	SA_model			PREV'AIR EUROPE (50km)		
Concentrations in ug/m3	>0	>80	>100	>0	>80	>100
Number of data	84	57	17	84	57	17
RMSE	12.83	12.88	18.66	15.07	15.21	22.37
Correlation	0.65	0.61	0.54	0.61	0.54	0.47
E20%	0.83	0.88	0.71	0.71	0.79	0.53