FAIRMODE – Cross-cutting activities: Forecasting evaluations

F. Meleux

and VITO,BSC,CERC,JRC

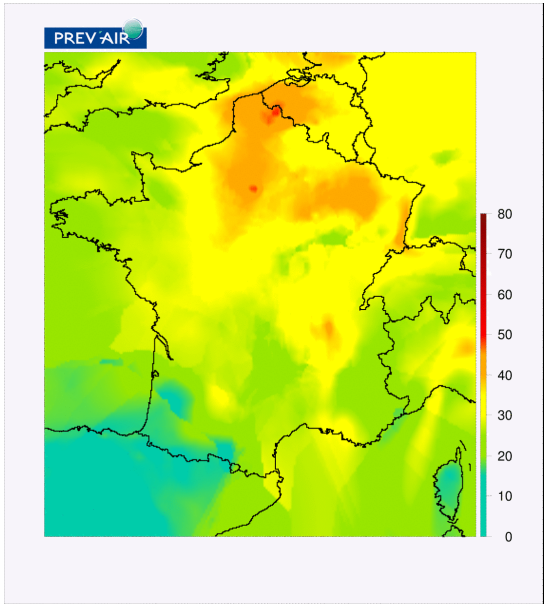
INERIS

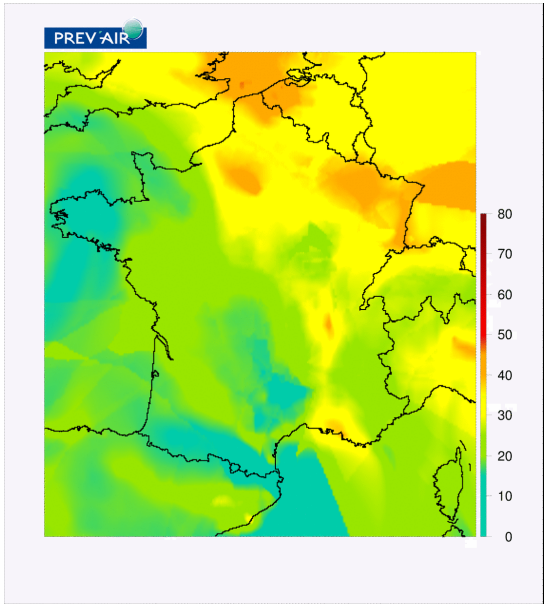
FAIRMODE

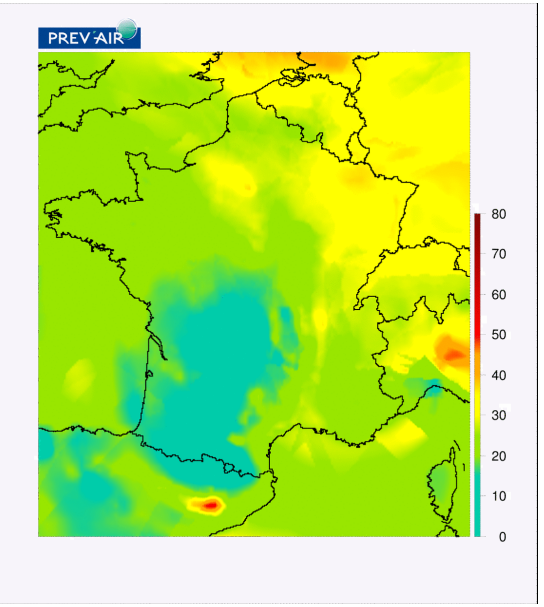
Forum for air quality modelling in Europe

INTRODUCTION

- Air quality platforms produce daily forecasts for the D+0, D+1 and D+...).
  - provide every day information related to the air quality levels
  - targetted pollutants: O3,NO2,PM10,PM2.5







OBJECTIVES

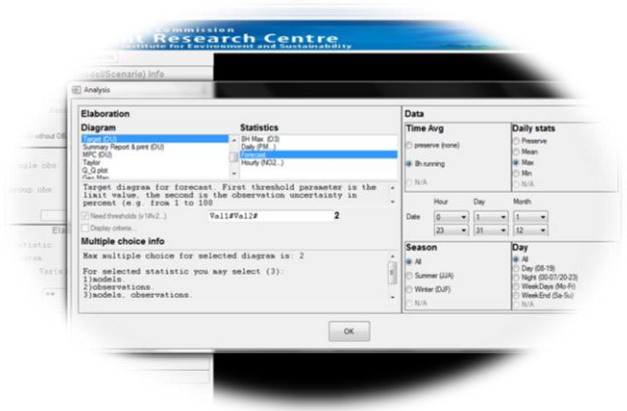
- What are the policy objectives for using AQ forecasts:
  - Predict & anticipate the development of a pollution episode
    - Inform and provide recommendations to the public
    - the episode caracteristics
    - to identify the likely causes
    - to set-up efficient measures (short term action plans)

- What the policy user needs to use AQ forecasts :
  - Get an assessment/knowledge about the capabilities of the forecasting system
    - How able are forecasts to reproduce the transition between low polluted situations to high polluted situations?
    - How able are forecasts to detect / anticipate threshold exceedances ?
      - The triggering of measures is based on threshold values
    - How stable are the forecast scores from D+0 to D+n (usually n = 2 or 3)?
      - Policy measures are more efficient when they are taken earliest – so the goal is really to provide confident forecasts at least at D+1 (D+2 would be even better)

FAIRMODE FORECAST TARGET

- To address these objectives, a specific diagram has been recently strengthening in the delta-tool to focus on evaluation of forecasting system capabilities:

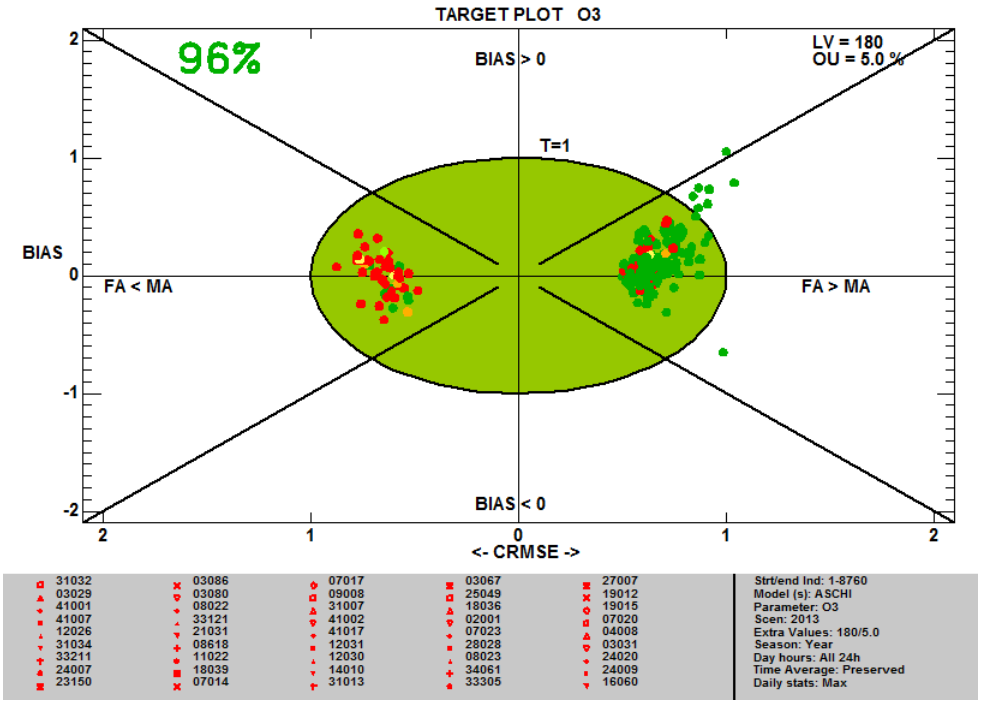
$$\text{target} = \frac{\sqrt{\frac{1}{N}\sum_{1}^{N}(M_i - O_i)^2}}{\sqrt{\frac{1}{N}\sum_{1}^{N}(O_{i-1} - O_i)^2}}$$



- Stating that the worst acceptable model is the persistent model, so at a given station the forecast (D+0) provides the observation of the eve (D-1).
- Assess the skill of the forecast to have a better intra-day variations than the persistent model

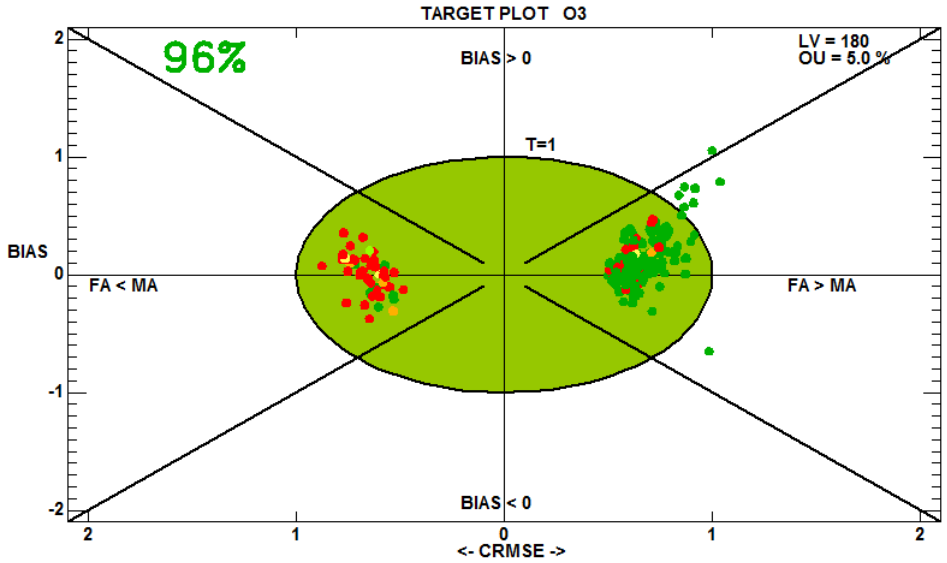
Forecast target diagram

- Keep part of indicators in the assessment diagram:
  - RMSE, BIAS, CRMSE



Forecast target diagram

- And to add new indicators more dedicated to the threshold exceedances:
  - FA (False alarm), MA (Missed alarm), GA+ and GA- (Good forecasts respectivily with and without threshold exceedances)



If $\frac{FA}{MA} \leq 1 \Rightarrow$ Left If $\frac{FA}{MA} > 1 \Rightarrow$ Right

$$\frac{GA+}{FA+MA} < 0.2 \Rightarrow \text{Red}$$

$$0.2 \leq \frac{GA+}{FA+MA} < 0.4 \Rightarrow \text{Orange}$$

$$0.4 \leq \frac{GA+}{FA+MA} < 0.6 \Rightarrow \text{Yellow}$$

$$0.6 \leq \frac{GA+}{FA+MA} < 0.8 \Rightarrow \text{Light green}$$

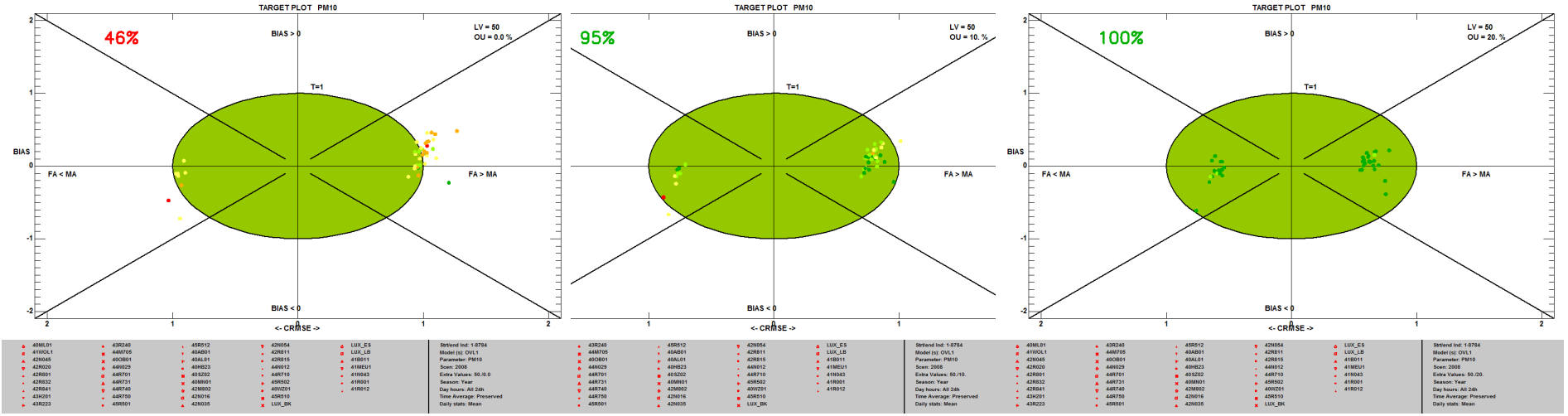
$$0.8 \leq \frac{GA+}{FA+MA} \Rightarrow \text{Dark green}$$

Forecast target diagram

- Introduction of an observation uncertainty (OU) attributed to the modelling outputs to take into account a margin of tolerance in the threshold exceedances:

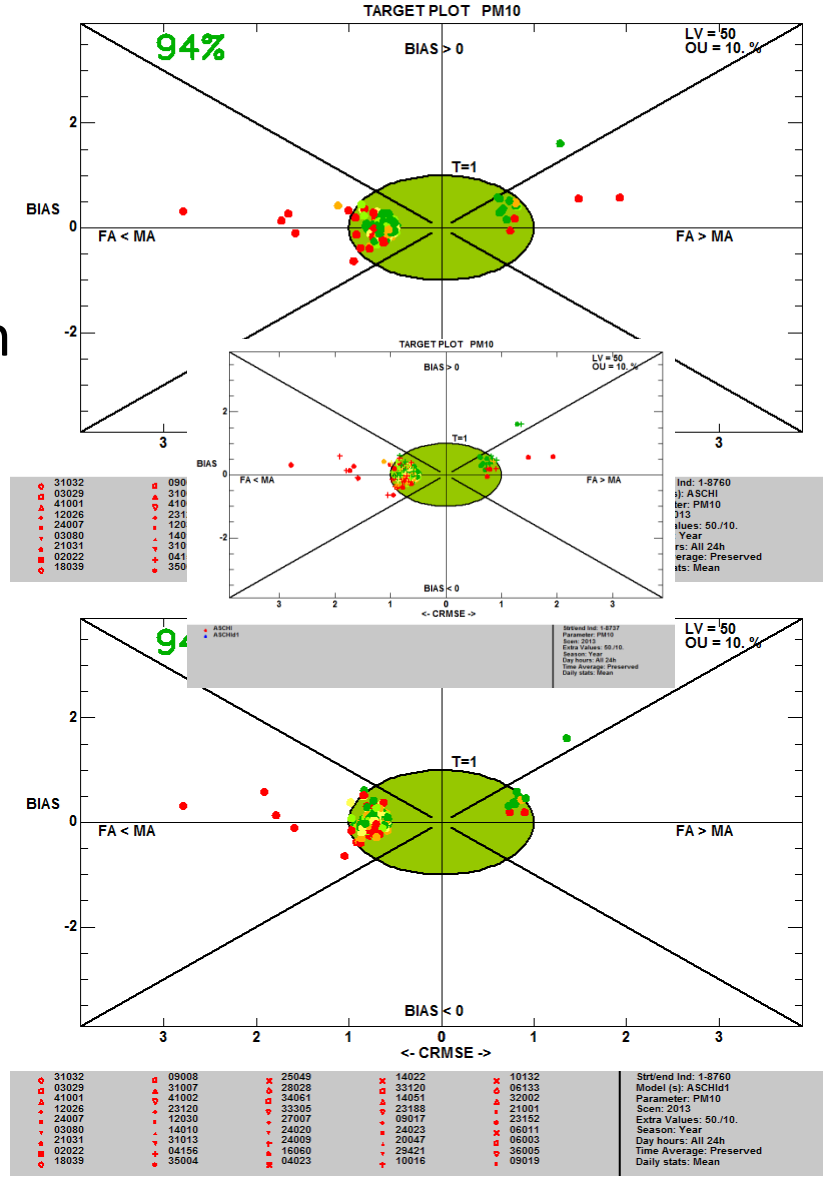
$$\text{if } M_t < O_t \text{ then } M_t^* = \min(M_t * (1+OU), O_t)$$

$$\text{if } M_t \geq O_t \text{ then } M_t^* = \max(M_t * (1-OU), O_t)$$



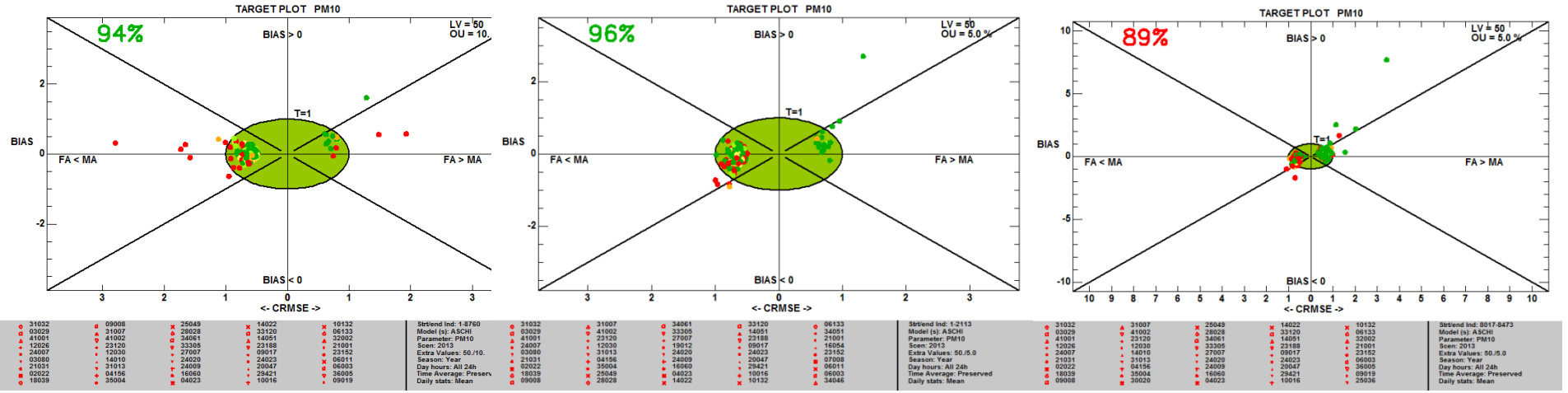
forecast diagram prospects

- Performances have to be considered independantly to the time lags (D+0, D+1 …)
  - to develop a general evaluation for the forecasting system
- Extent the summary statistics report :
  - to include statistics about threshold exceedance detection
  - to have a representation of the scores for multiple time-lags



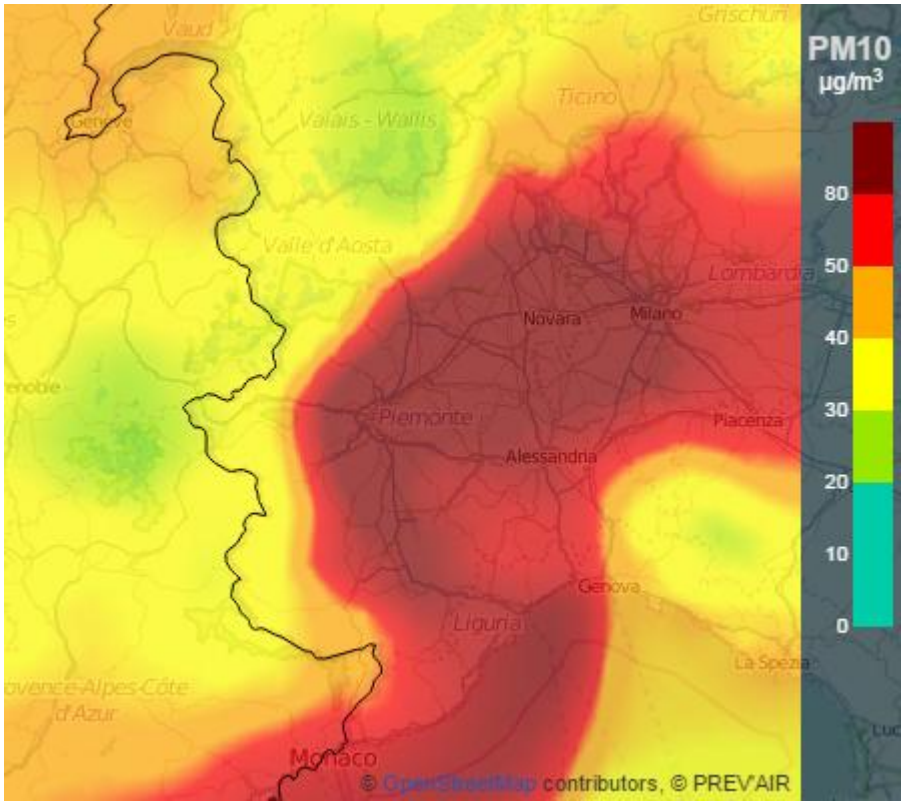
forecast diagram prospects

- Define a framework to carry out specific focus on threshold exceedance periods using subset of data
  - Seasonal (winter for PM10)
  - Episodes
  - Selection of high values (PM10 > 40 µg/m3)



Conclusions

- First version of the target forecast diagram
  - Iterative loop with users to improve the tool
  - Implementation of additional indicators
- Assessment of the consistency/accuracy of the whole forecasting system (global assessment for D+0,D+1, D+... and all thresholds)
- Introduce statistics about the threshold detection capabilities in the summary statistics report.
- Continue the test stage
  - Additional tests are foreseen with the large European database from MACC projects
  - Other contributions are welcome


PM10
µg/m3
80
50
40
30
20
10
0
Vaud
Graubünden
Ticino
Valais - Wallis
Valle d'Aosta
Lombardia
Novara
Milano
Piemonte
Piacenza
Alessandria
Genova
Liguria
La Spezia
Monaco
© OpenStreetMap contributors, © PREV'AIR

Thank you …