



FAIRMODE:
Forecasting & exceedance indicators
Delta tool
INERIS feedback
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- Analyses of the features of the delta-tool dedicated to forecast evaluation
- Use of the MACC-III/CAMS Ensemble outputs for 2015
 - Median values of 7 models (CHIMERE,EMEP,EURAD,LOTOS-EUROS,MATCH,MOCAGE,SILAM)
 - Assessment of the performances only for D+0 so far
 - Focus on ozone (max daily-8h 120 $\mu\text{g}/\text{m}^3$) and PM10 performances
 - Daily performances (daily mean for PM10 and daily max for O3). No assessment of hourly values.
- Background observations over Europe for 2015 (Urb, Sub and Rur)

Target indicator comments

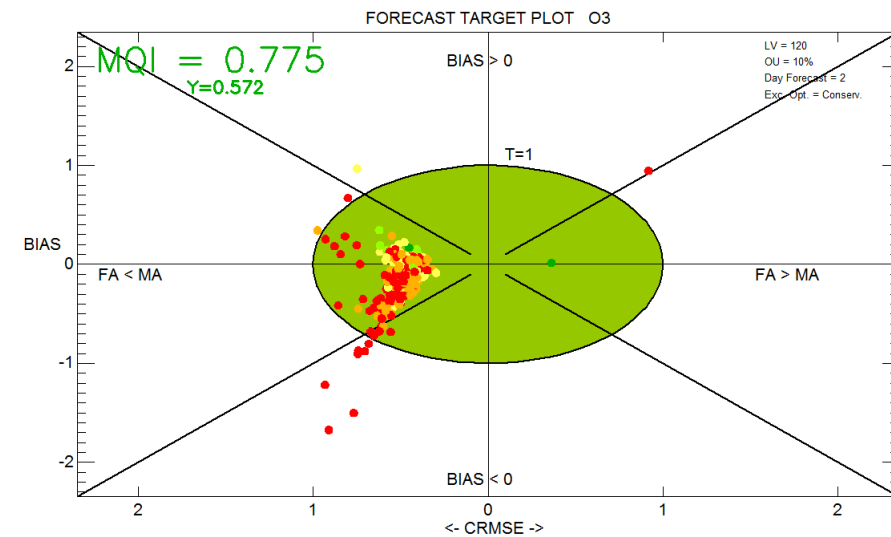
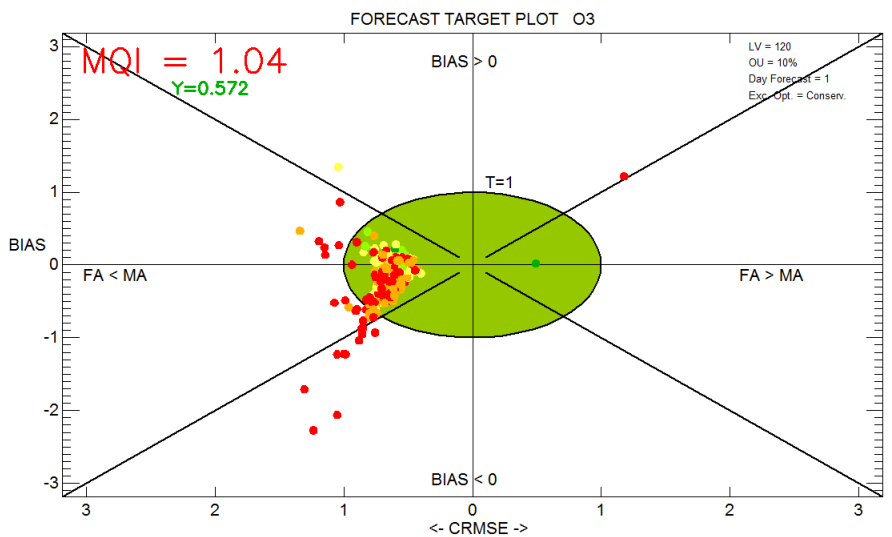
- Use of the persistence model as the worst acceptable performance :

$$\text{Target}_{\text{forecast}} = \frac{\sqrt{\frac{1}{N} \sum_{i=1}^N (M_i^* - O_i)^2}}{\sqrt{\frac{1}{N} \sum_{i=1}^N (O_{i-j} - O_i)^2}}$$

- In this target, the definition of persistence is not fixed with O_{i-j}
 - Even if we can choose the « j » value », there's no obligation to use a common basis for evaluation of all the forecasts (D+0, D+1 ...)
 - Ex: Forecast length for CAMS/PREV'AIR are 4 days: it means a persistent model of O_{i-5} for evaluating D+4 and O_{i-1} for D+0
 - How relevant it is ?
 - Is this information useable by policy makers ?
 - High preference for using $j=1$ for all forecasts
 - Because the same level of confidence for the evaluation of all forecast days is of high interest to set-up policy measures

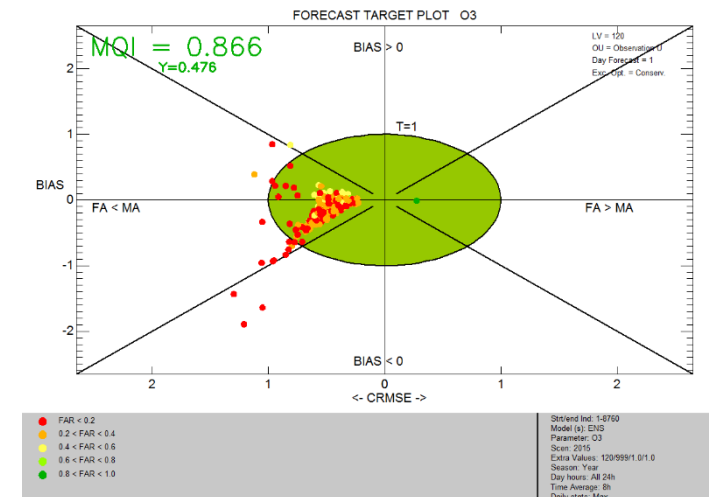
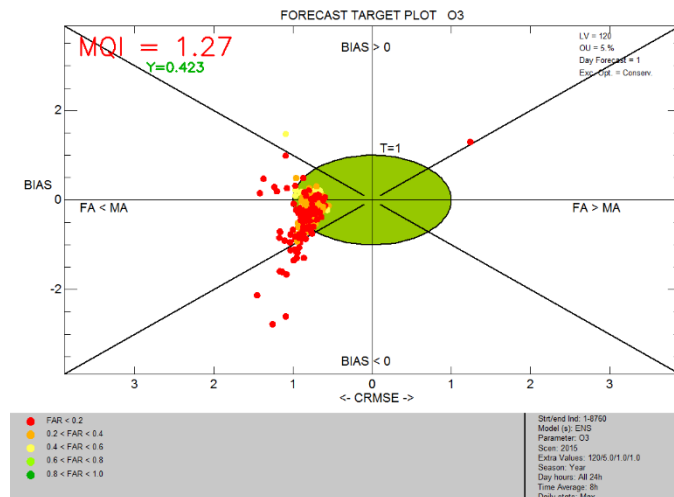
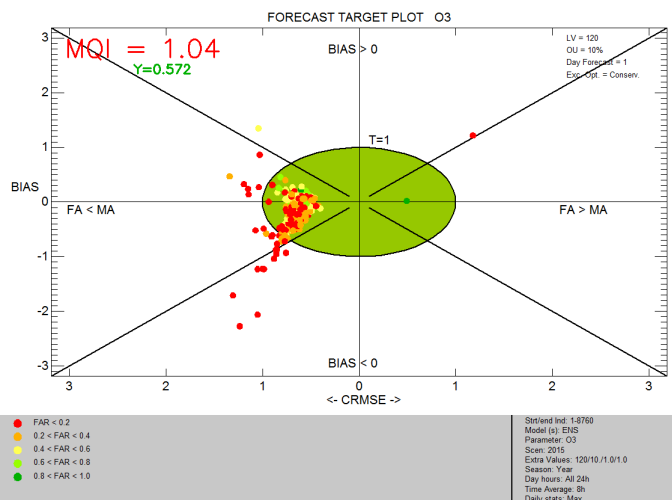
Target indicator

- O3 120 $\mu\text{g}/\text{m}^3$ limit value with $j=1$ (left) and $j=2$ (right)
 - Obviously in all cases tested, we have a significant improvement of the MQI (D+0) when j increases.



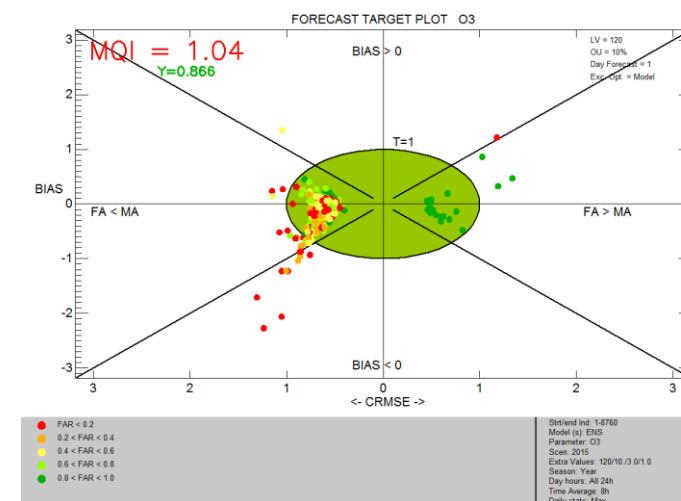
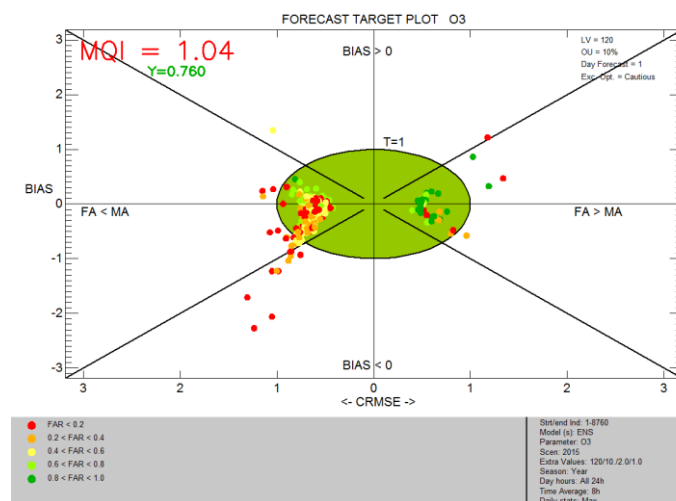
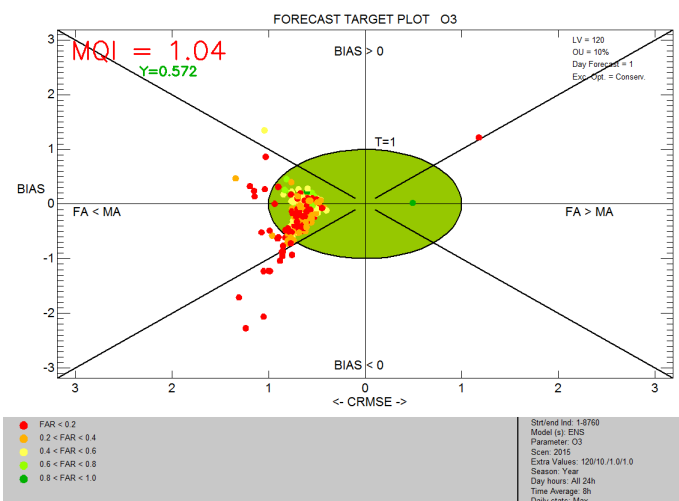
Observation uncertainty

- Model evaluation is very sensitive to the observation uncertainty
 - OU=10% (left) & OU=5% (center) & OU = 999 (variable)
 - OU=10% has MQI lower than OU=5% but higher than OU=variable
 - Only OU=variable has better performance than the persistent model.
 - OU has an impact on the model capability to detect threshold exceedances (it improves with increase OU).

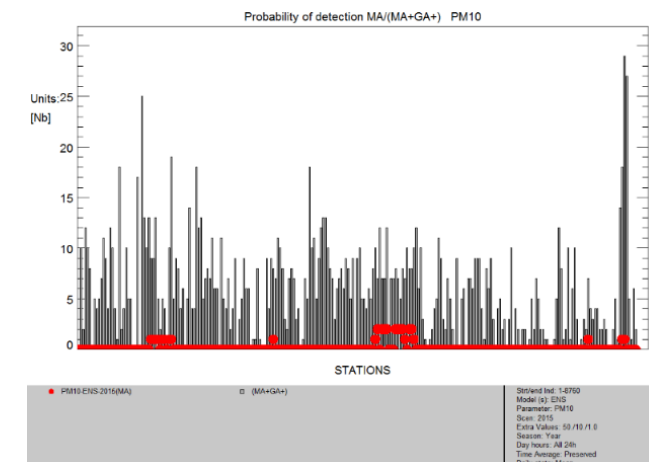


Observation uncertainty

- Test for 3 approaches: left=conservative (1), center=cautious (2), right=same as model(3)
 - Approach 3 provides the best performances but it seems to be rather close to cautious case in this ENS evaluation (should be dependent of the number of threshold exceedances).
 - Compared to the previous versions, no impact on the MQI as it only affects the way observation around the limit value is taken into account.
- This implementation of the uncertainty is very interesting and easy to interpret.
- Alternative proposed by VITO to include a probability of threshold exceedance should also be evaluated.



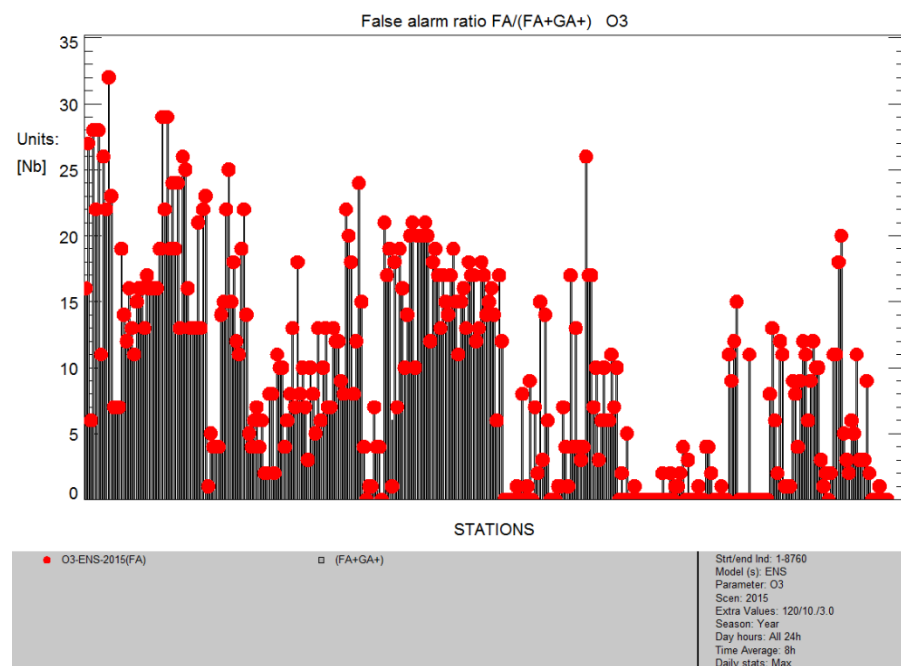
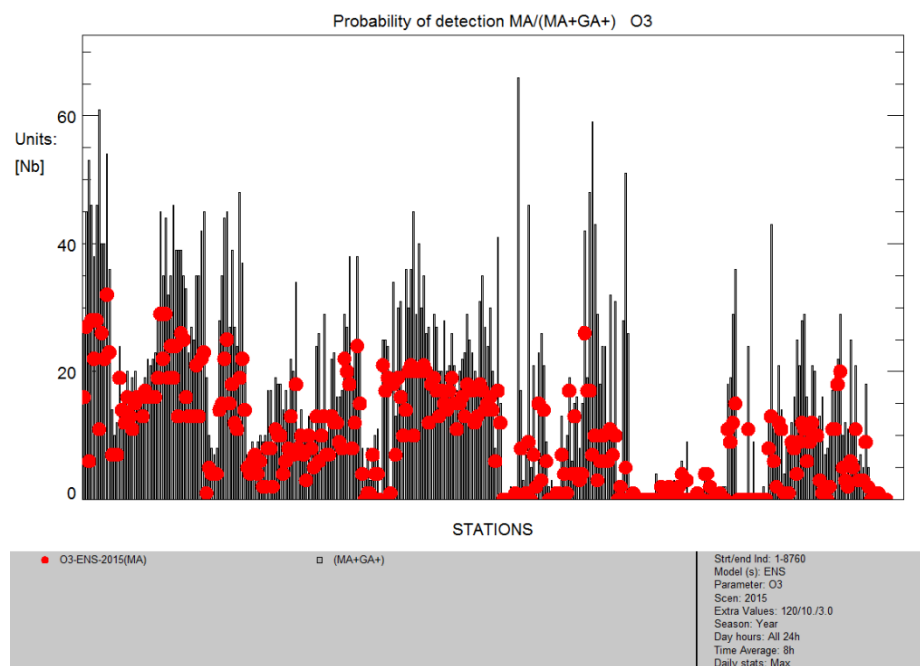
- Dot colors are according to the documentation related to the value of the ratio:
 - $FAR = FA / (FA + GA+)$
 - Low values means good skills and high values low skills to detect threshold exceedances => reverse the dot colors
 - Is documentation for this part consistent with the target plots ?
 - Is there any chance to move to a « positive » ratio ?
 - $GA+ / (FA + GA+)$ or DP ratio instead of showing a ratio related to bad performances
- Title of Probability of detection plot is wrong as well as statistics description
 - change to $GA+ / (MA + GA+)$
- False alarm ratio explanation in documentation inconsistent with legend of figure 4 – what is displayed ? FAR or $(1 - FAR)$



Probability of detection and False alarm ratio plots

These additional plots provide useful information to interpret forecast model capability to anticipate threshold exceedances

- Good performances related to the DP ratio around 60% in average
- Unexpected performances related to FA => no FA or only FA for all stations => inconsistent with color dots of the target plot

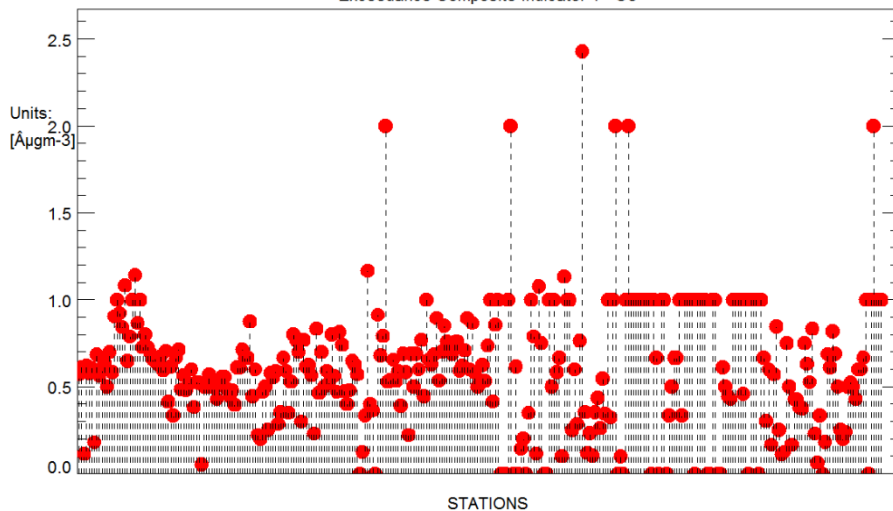


Composite exceedance Indicator (CEI)

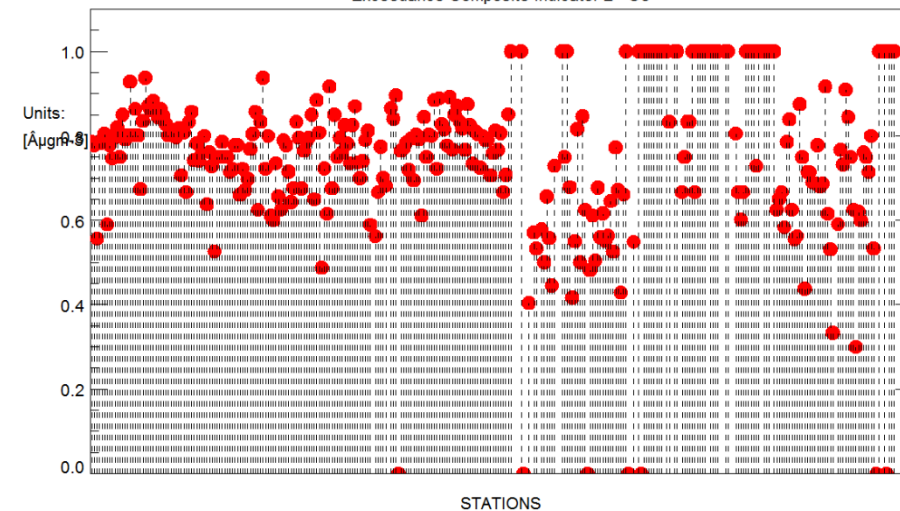
CEI1 is related to the ratio between model threshold exceedance detection and observed threshold exceedances => ~ 0.6

CEI2 = 0.5 x (DP + 1 - FAR) => ~ 0.8

Exceedance Composite Indicator 1 O3



Exceedance Composite Indicator 2 O3

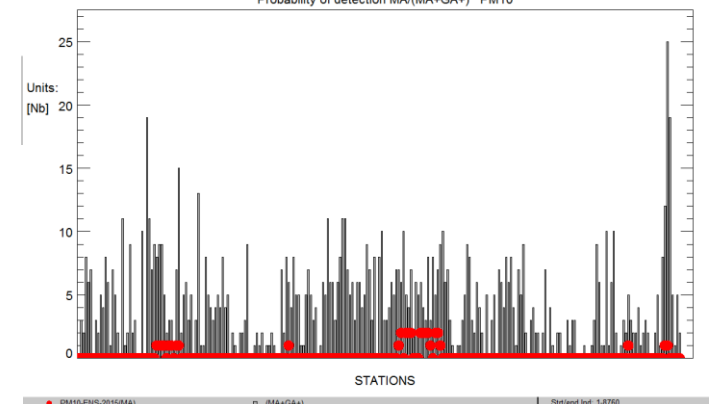
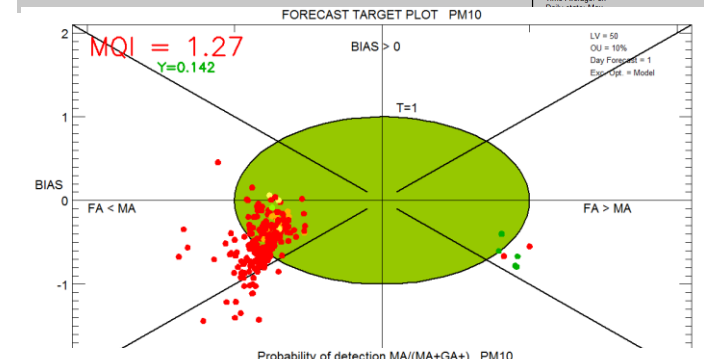
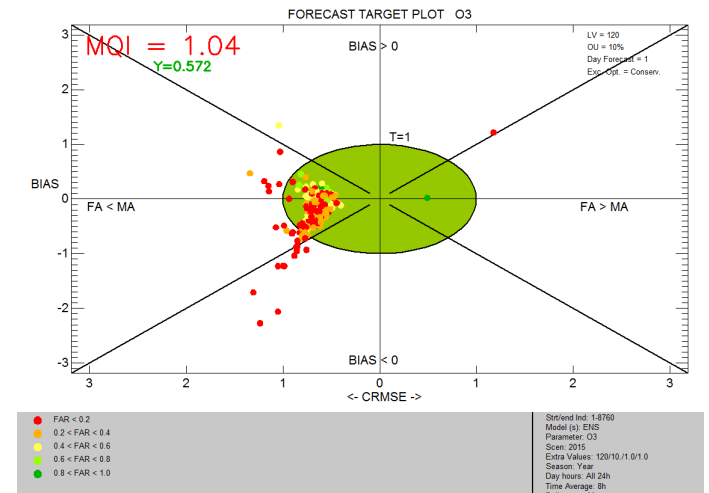


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What do we learn about the MACC/CAMS regional Ensemble evaluation

Focus on the ozone limit value of $120 \mu\text{g}/\text{m}^3$ daily-8h max

- with $\text{OU}=10\%$, it behaves like the persistent model
- Negative bias \Rightarrow more MA than FA (left-side)
- DP and FAR or $(1-\text{FAR})$ show good performances but not fully consistent with the dot color
- Composite indicators are in favor of good performances
- Focus on PM10
 - Perfectible performance
 - Common underestimation of the Ensemble
 - difficult to detect daily threshold exceedance of $50 \mu\text{g}/\text{m}^3$



- The features of this new version is very interesting and promising
 - Few options certainly need to be further analysed
 - Interest to use the same persistence length (same j equal to 1) in the target plot for all forecast dates
 - Interest to implement probability of exceedance
 - Ratio to use to determine the color of the dot in the target plot (suggestion to have GA+ at the numerator ?)
 - Unconsistency seems to remain between what is displayed in the delta-tool and the documentation which makes the interpretation not always easy
- The use of the delta-tool-forecast provides very interesting insights in the CAMS Ensemble capability to anticipate threshold exceedances
 - Performance seems to be quite good for O3 but less satisfying for PM10
- Comments : the handling of big datasets as the one generated in Copernicus service is very complex – is there any plan to make the delta-tool more user friendly or such dataset evaluation ?