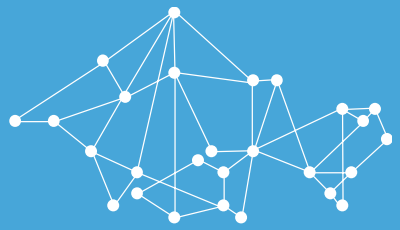
FAIRMODE
Forum for air quality modelling in Europe



CT3 FORECAST HACKATHON
MAY 26, 2021

AGENDA HACKATHON

FAIRMODE CT3 HACKATHON - 26/5/2021		
09:30	09:45	Stijn Janssen, Antonio Piersanti - Welcome and short introduction
09:45	09:55	Kees Cuvelier - Summary of indicators implemented in the Delta tool
09:55	10:15	Lina Vitali - ENEA's feedback on the Proposed New Forecast Plots
10:15	10:25	discussion
10:25	10:35	Alexandra Monteiro - Status of test phase on Portugal
10:35	10:45	discussion
10:45	11:00	coffee break
11:00	11:20	Michele Stortini - First results using the new version of Delta tool on Emilia-Romagna
11:20	11:30	discussion
11:30	12:00	overall discussion and summary

FORECAST EVALUATION

General concept for the evaluation metrics

- Forecast Modelling Quality Objective comes on top of FAIRMODE's assessment MQO

- The forecast MQO should test two different features of a forecast model:
  1. Detection of "episodes" (changes in the concentration)
  2. Threshold exceedances (as trigger for short term action plans)

- For 1. we use the "persistence model" as a benchmark
- For 2. we use standard threshold indicators

MQI FOR FORECAST

Target for the forecast model M is to do better than the "persistence" model P

» Definition: MQI

$$MQI_{forecast} = \sqrt{\frac{\frac{1}{N}\sum_{i=1}^{N}(M_i - O_i)^2}{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}} \quad \text{and}$$

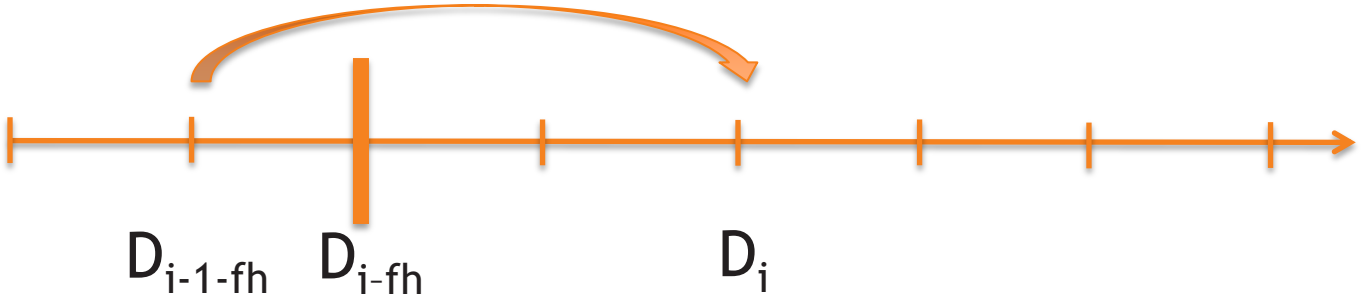
$MQO_{forecast}$ is fulfilled if $MQI_{forecast} \leq 1$,

NEW PROPOSAL!
SEE SLIDE 8

PERSISTENCE MODEL

- For day D_i forecast was made at day $D_{i\text{-forecast horizon}}$
- At day of the forecast, only observation from the previous day are available
- The persistence model uses these observation for all forecast horizons

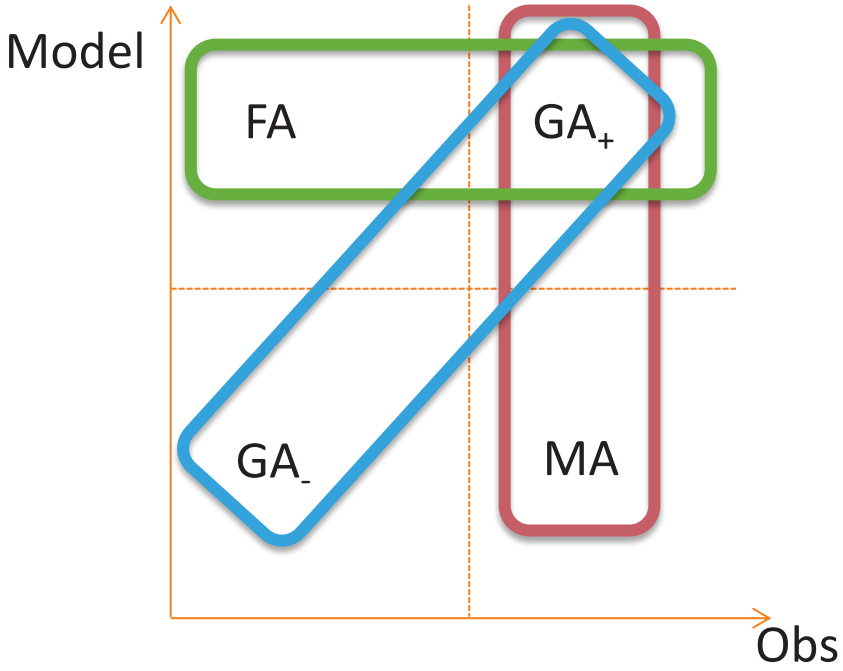
  → $P_i = O_{i\text{-}1\text{-forecast horizon}}$



Forecast horizon fh = 0, +1, +2,… +n

THRESHOLD EXCEEDANCES

Definition of threshold exceedance indicators



- False Alarms (FA)
- Missed Alarms (MA)
- Good values below thr (GA_-)
- Good values above thr (GA_+)

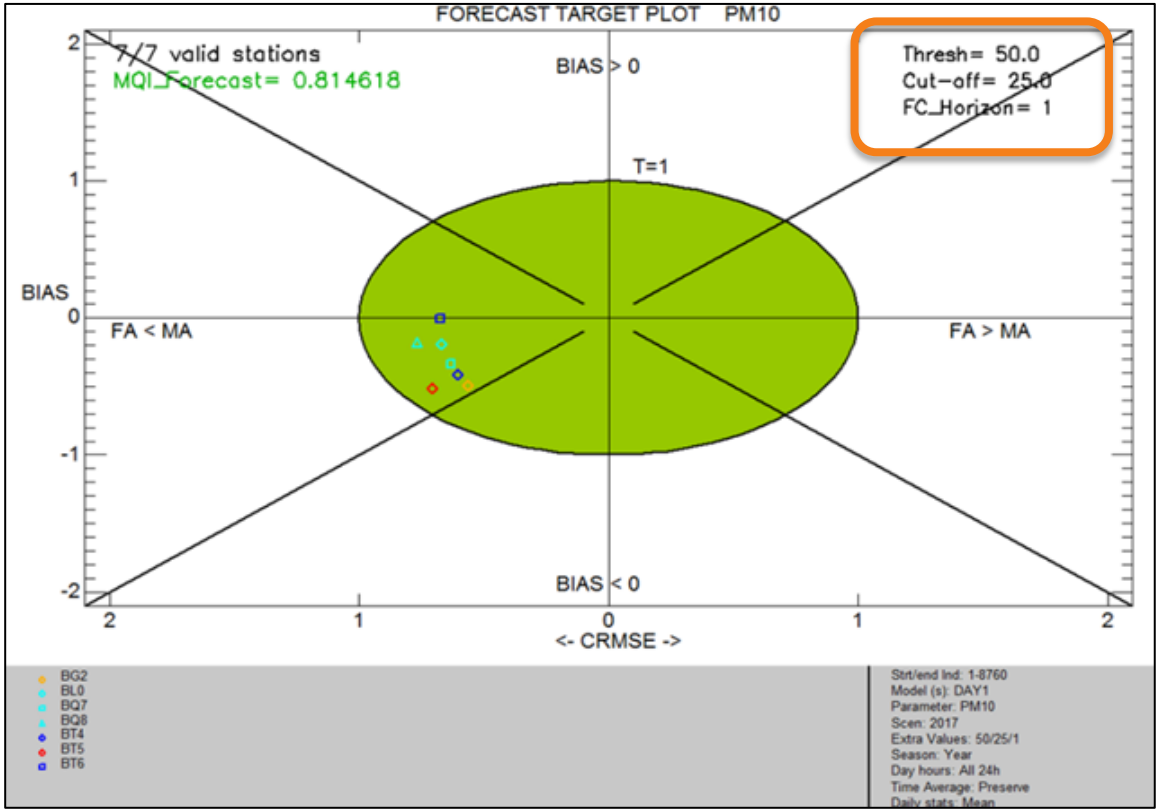
- **Probability of detection**: $PoD = GA_+ / (MA + GA_+)$
- **Success ratio**: $SR = 1 - FAR = 1 - FA/(FA + GA_+) = GA_+/(FA + GA_+)$
- **Accuracy**: $ACC = (GA_+ + GA_-)/(GA_+ + GA_- + MA + FA)$

FORECAST TARGET DIAGRAM

Normalization by the intra-day variations

- Target forecast: RMSE
- Y-axis: Bias
- X-axis: CRMSE
- Left/right asymmetry:

- **Cut-off**: remove lower concentration values to put more emphasis on high episodes → good idea?



MQI FOR FORECAST: NEW PROPOSAL (PHILIPPE THUNIS)

Target for the forecast model M is to do better than the "persistence" model P, taking into account the uncertainty of observations (OU)

» Definition: MQI

$$MQI_{forecast} = \sqrt{\frac{\frac{1}{N}\sum_{i=1}^{N}(M_i - O_i)^2}{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}}$$

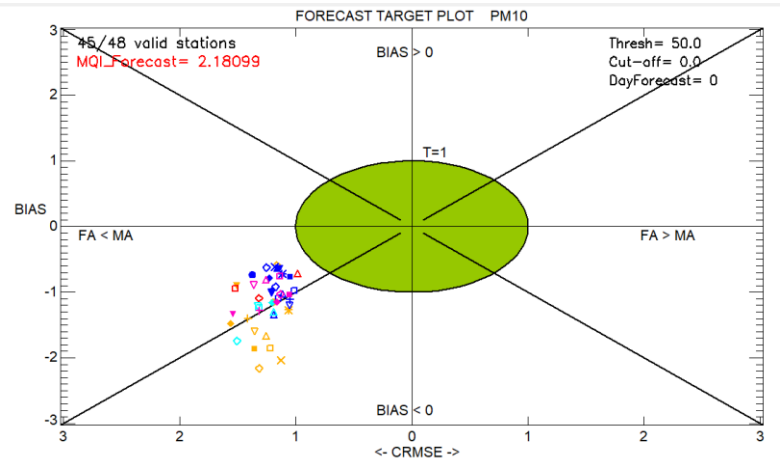
$$P_i = O_{i-1-forecast\ horizon} \pm OU\left(O_{i-1-forecast\ horizon}\right)$$

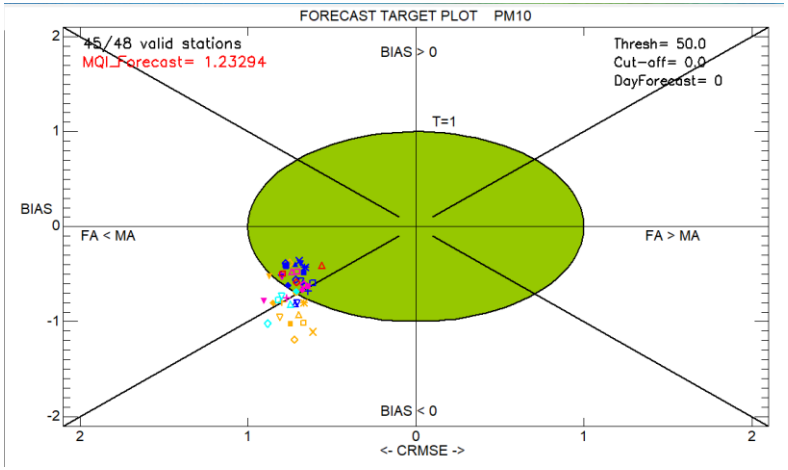
$MQO_{forecast}$ is fulfilled if $MQI_{forecast} \leq 1$,

MQI FOR FORECAST: NEW PROPOSAL

Target for the forecast model M is to do better than the "persistence" model P, taking into account the uncertainty of observations (OU)

» the main impact of adding uncertainty in the formulation is to improve both the bias and correlation





MQI FOR FORECAST: NEW PROPOSAL

Target for the forecast model M is to do better than the "persistence" model P, taking into account the uncertainty of observations (OU)

- the main impact of adding uncertainty in the formulation is to improve both the bias and correlation
- including the observation uncertainty, we prevent the denominator to tend to zero (issue highlighted by ENEA) and therefore the overall indicator cannot tend to infinity
- since larger relative uncertainties are expected in the low concentration range, a good forecast at low concentration values is now less important than it was in the original formulation

→ First version implemented in DELTA (thanks to Kees!)
→ Available for further testing and evaluation

MQI&MFE PLOT PROPOSAL (LINA VITALI, ENEA)

Main topics:

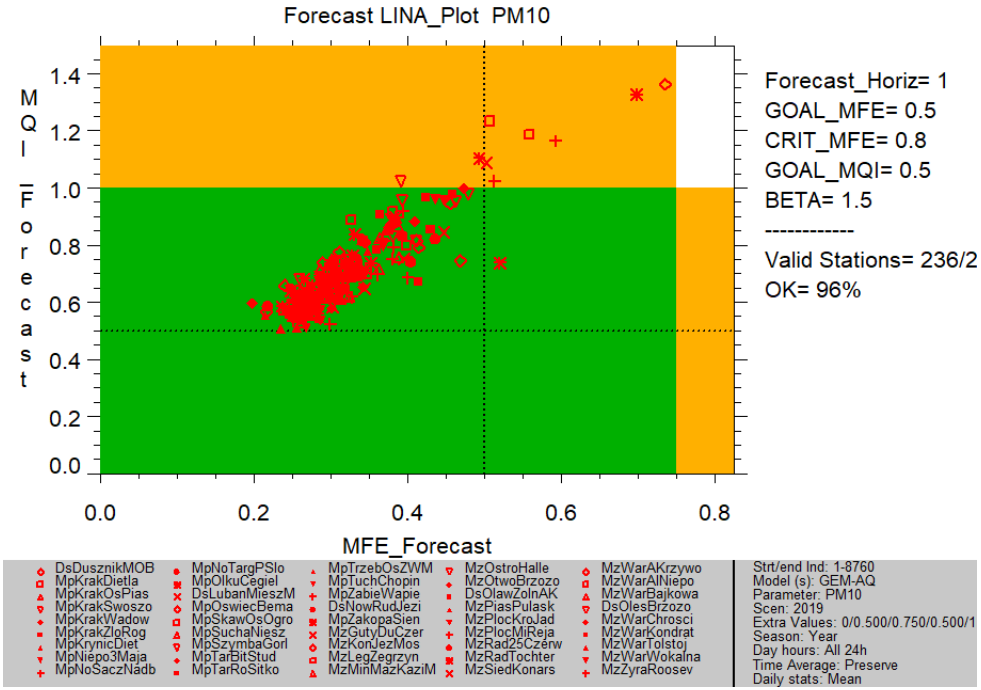
» Introduction of MFE (mean fractional error) as additional statistical indicator

$$MQI_{forecast} = \frac{MFE_{forecast}}{\beta\, MFE_{persistence}}$$

$$MFE = \frac{2}{N}\sum_{i=1}^{N}\frac{|M_i - O_i|}{(M_i + O_i)}$$

» Extra dimension in the Target diagram

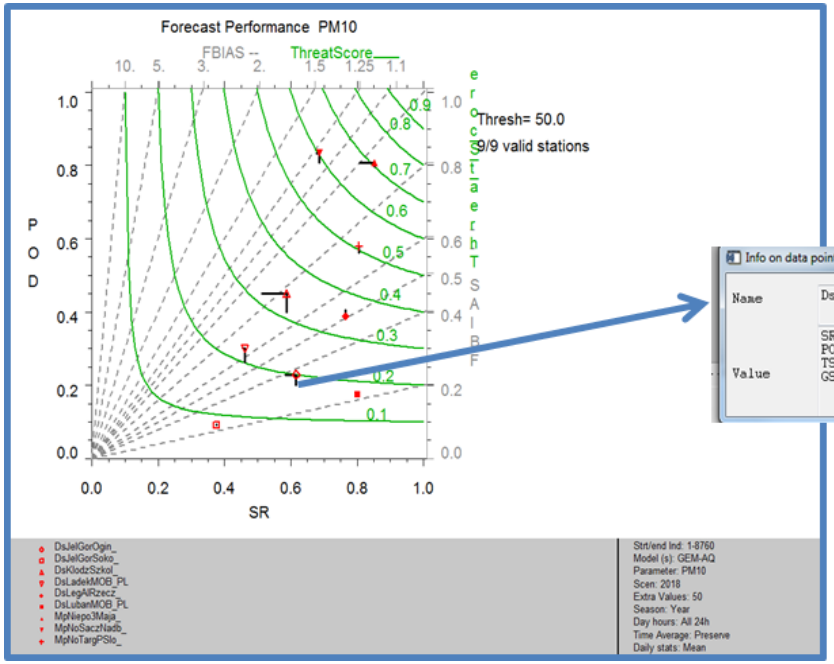
» Introduction of a relaxation parameter w.r.t. Persistence model

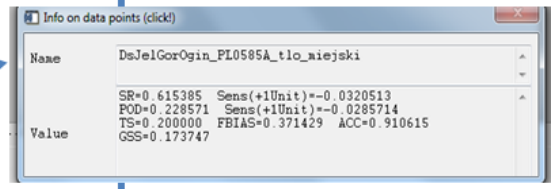


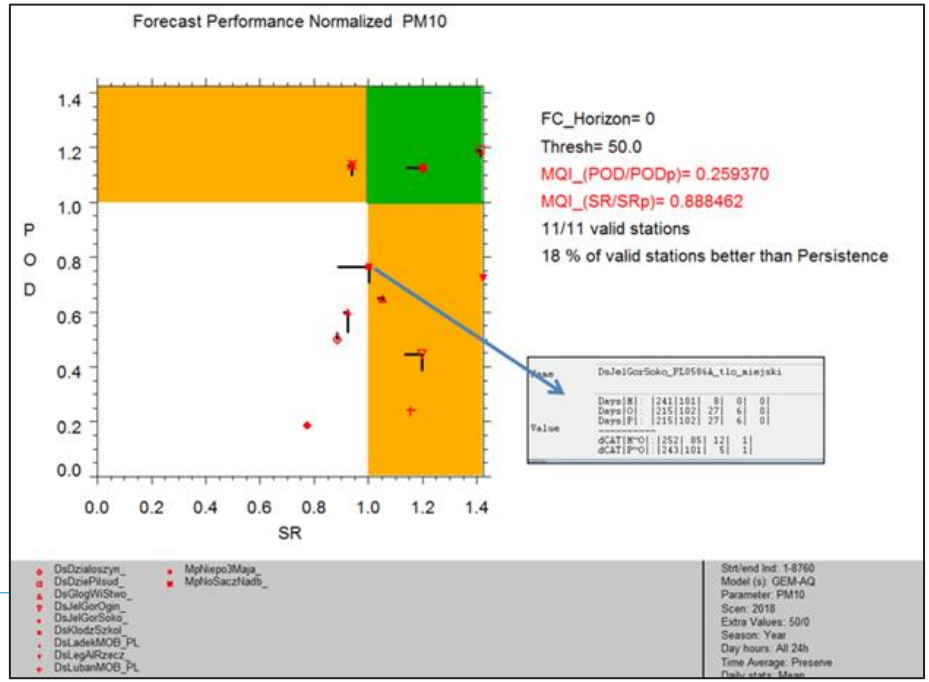
→ First version implemented in DELTA (thanks to Kees!)

→ Available for further testing and evaluation

FORECAST PERFORMANCE DIAGRAM & CUVELIER PLOT



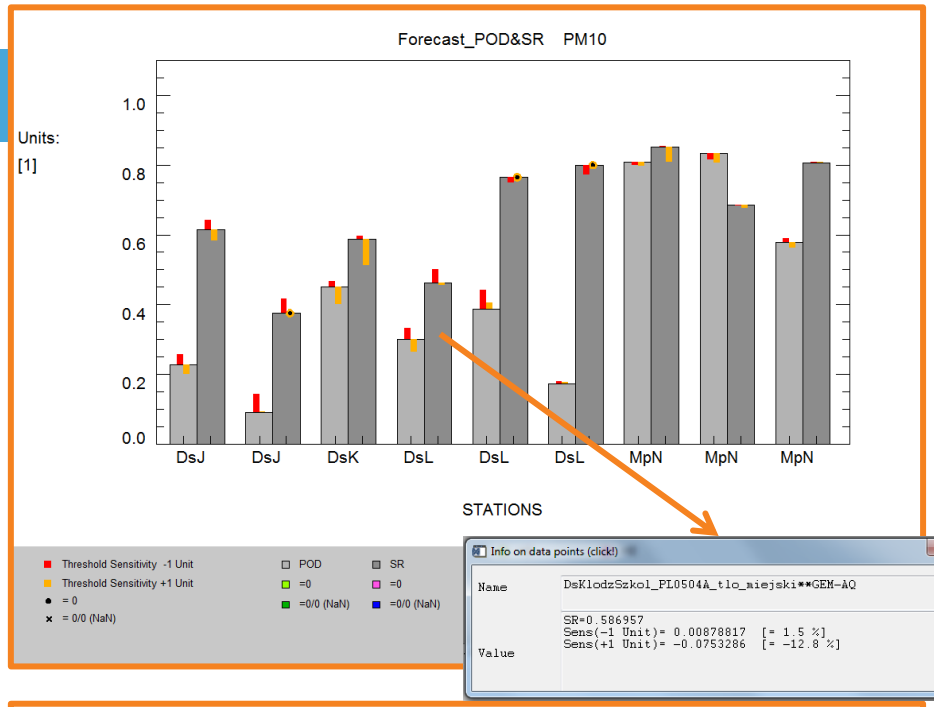


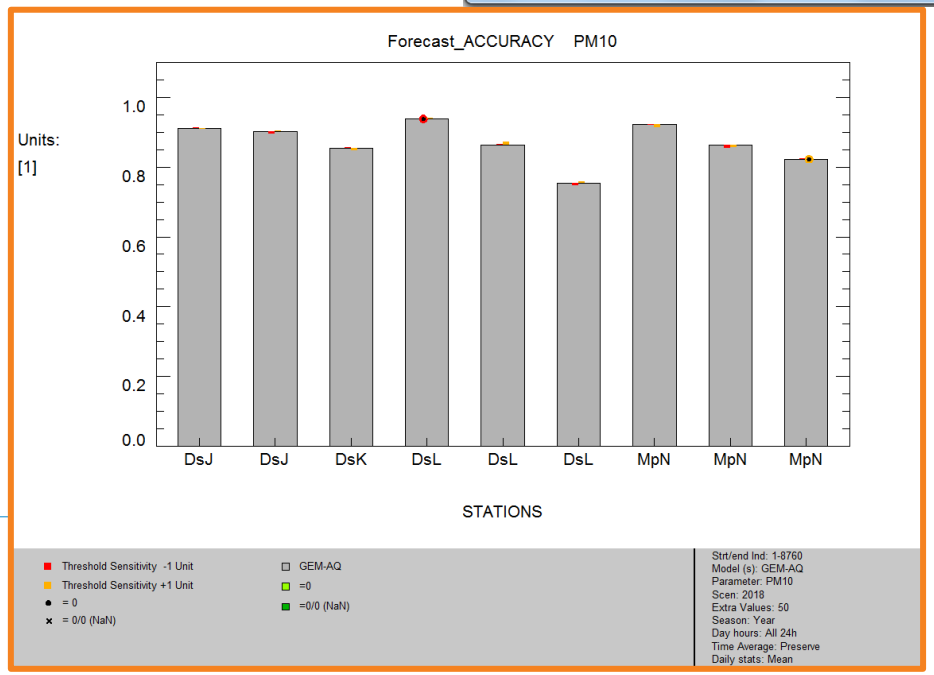


EXCEEDANCE INDICATORS

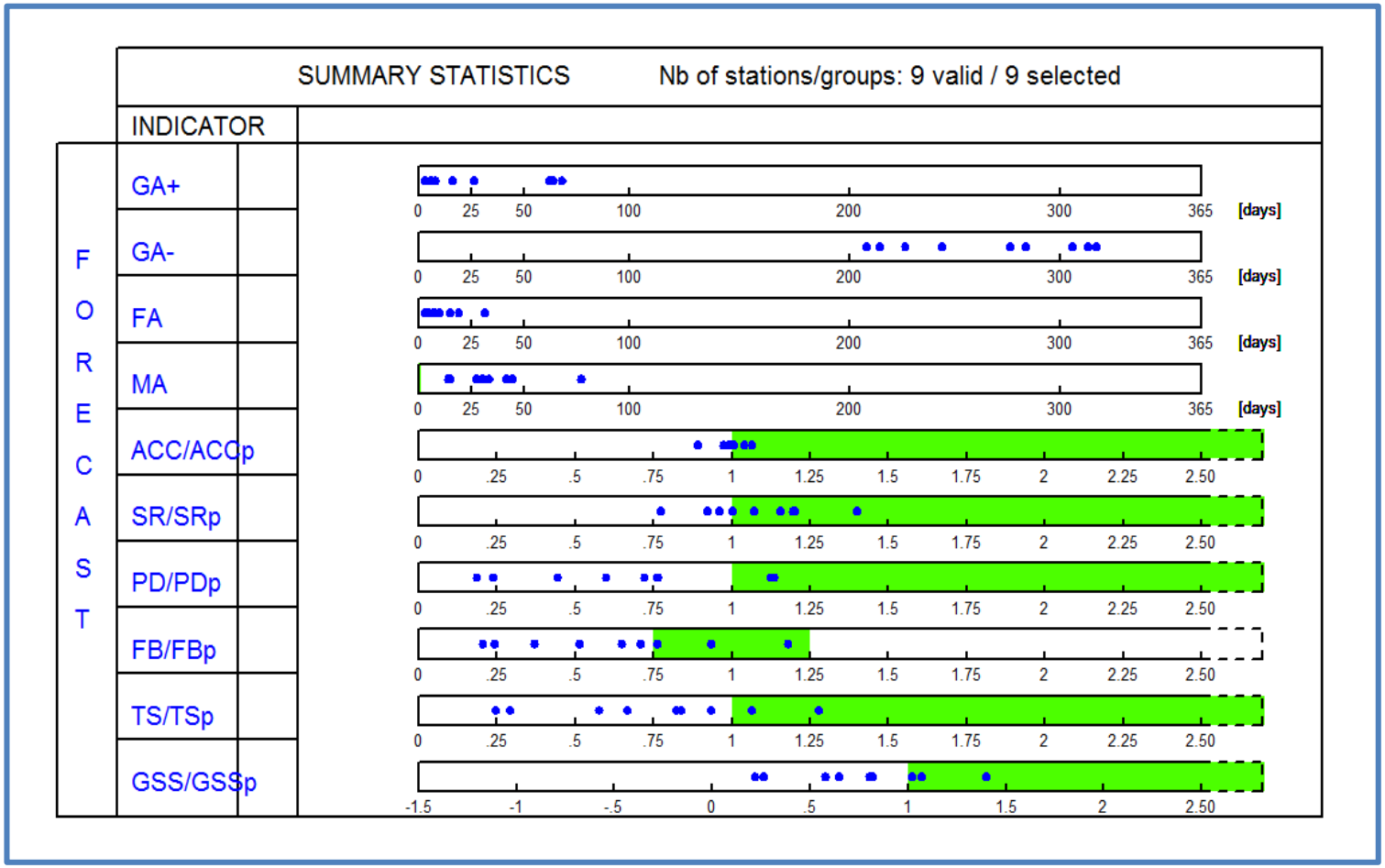
- POD, SR & ACC = 1
  - → perfect model

- Sensitivity:
  - Red: threshold - 1unit
  - Yellow: threshold + 1unit

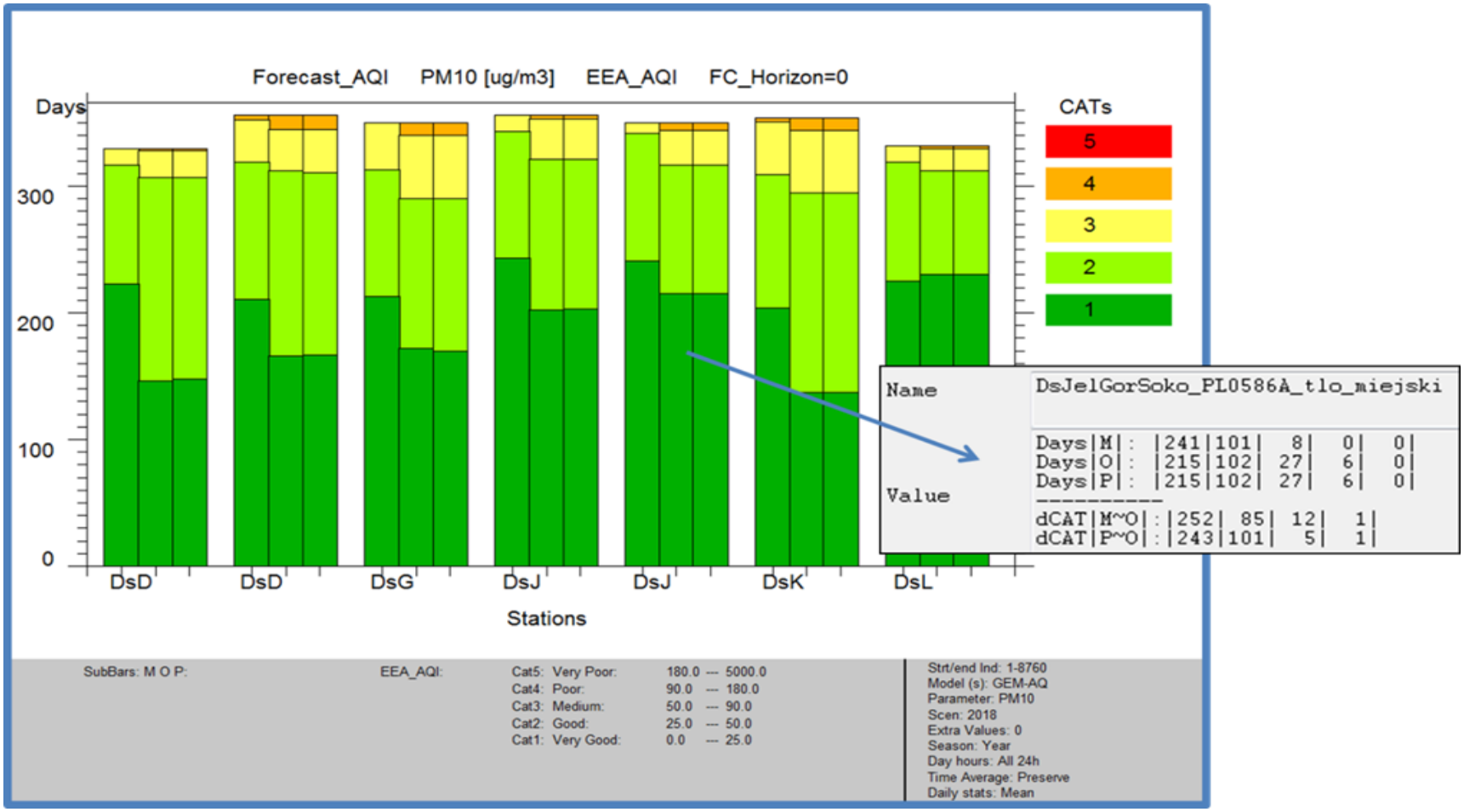




SUMMARY REPORT



AIR QUALITY INDICES



POINTS FOR DISCUSSION

- Is the Target diagram useful as MQO instrument?
- Is the Persistence model useful as MQO?
- Are the MQI&MFE, Performance & Cuvelier plots useful?

- What about the lower cutoff?
- Do we fix the threshold values for the exceedances?

- Publication: way forward?