



WG1 PROBABILITY ESTIMATE FOR FORECAST EXCEEDANCES FAIRMODE TECHNICAL MEETING ATHENS 2017

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Outline

- Some sensitivity tests w.r.t. the
- Using OVL forecast model for PM10
 - ANN
 - Day -1 & morning concentrations of day0
 - Meteo forecasts (BLH, wind speed, ...)

Current definition of forecast target indicator...

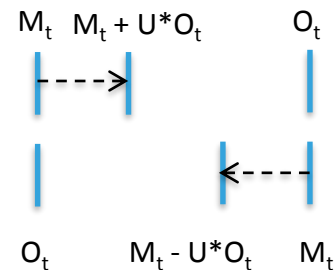
- Definition

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

- Measurement uncertainty (U) → should take same value as in three MQO for assessment

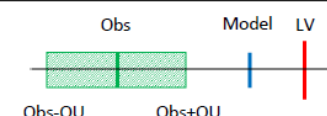
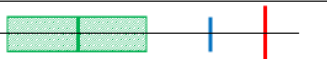
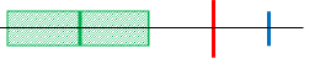
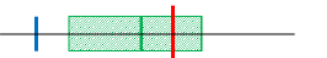


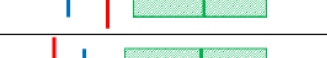
if $M_t < O_t$ then $M_t^* = \min(M_t + U * O_t, O_t)$

if $M_t \geq O_t$ then $M_t^* = \max(M_t - U * O_t, O_t)$



WG1 – FORECAST EXCEEDANCES

Effect of uncertainty on indicators & limit value ?

	Observations		Model (M*)		DELTA
	relation to LV	Alarm?	relation to LV	Alarm?	
	$O_+ < LV$	No	$M^* < LV$	No	GA-
	$O_+ < LV$	No	$M^* \geq LV$	Yes	FA
	$O_- < LV$ $O_+ \geq LV$	1: Yes, conservative 2: No, cautious 3: Same as model	$M^* < LV$	No	MA GA- GA-
	$O_- < LV$ $O_+ \geq LV$	1: Yes, conservative 2: No, cautious 3: Same as model	$M^* \geq LV$	Yes	GA+ FA GA+
	$O_- \geq LV$	Yes	$M^* < LV$	No	MA
	$O_- \geq LV$	Yes	$M^* \geq LV$	Yes	GA+

Options for uncertainty behaviour

→ Val3

Table 7: Possible cases with respect with model, observation and associated uncertainty. Please note that some "<" or ">" signs from the Note table have been changed to "≤" or "≥" to make sure all situations are included. The DELTA column indicates how DELTA considers the specific cases here described.

Problems

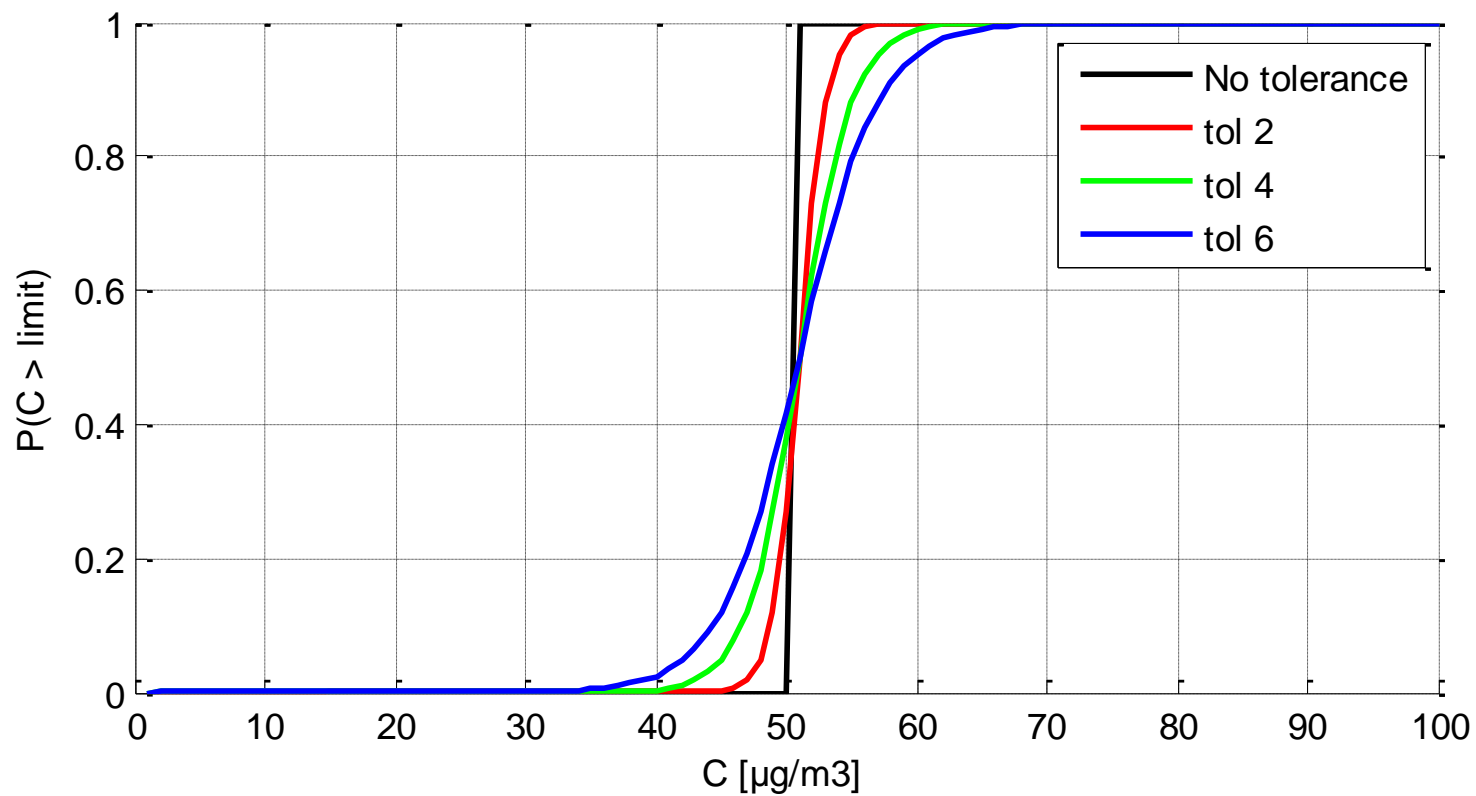
- Sometimes threshold behaviour can be very sensitive, especially around the LV... what do we learn then ?

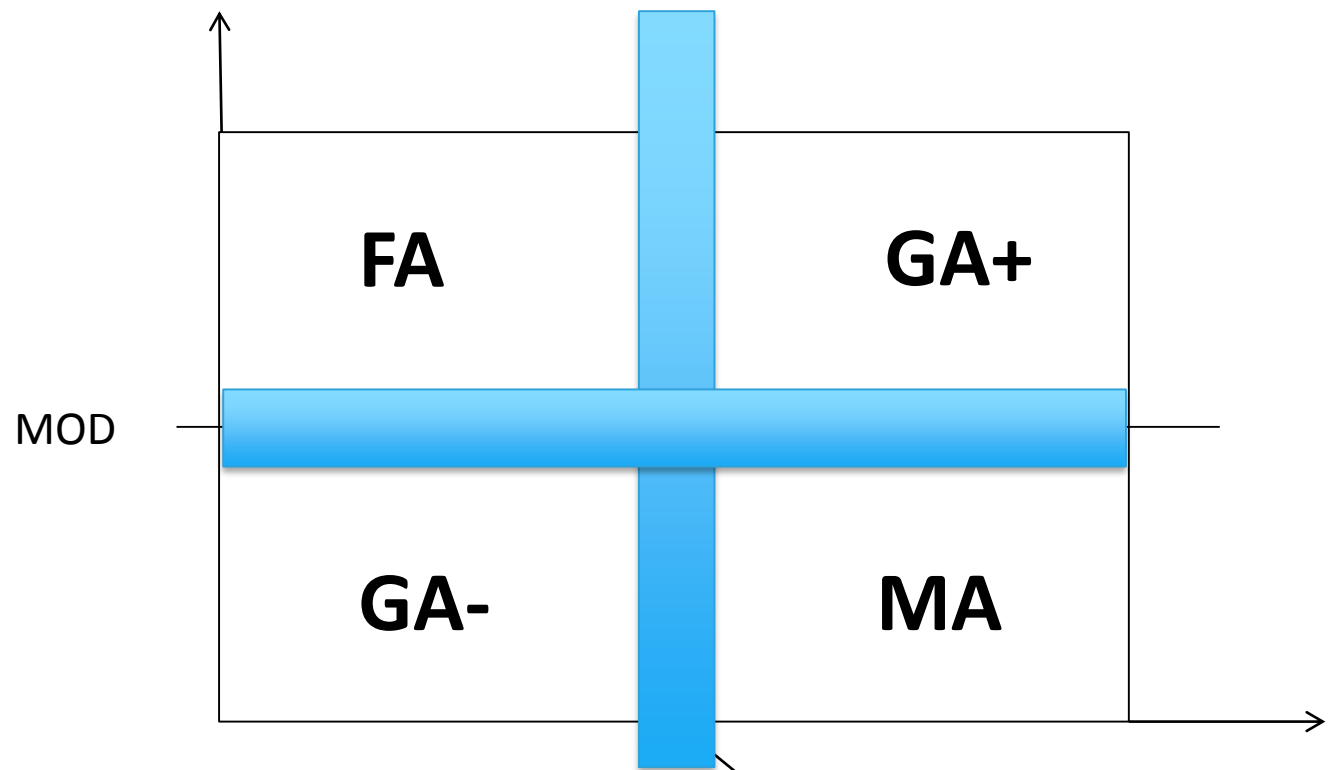
WG1 – FORECAST EXCEEDANCES

Introducing a “soft” threshold ?

Step function (hard threshold) vs. sigmoid(x) : soft threshold

Tolerance \rightarrow uncertainty

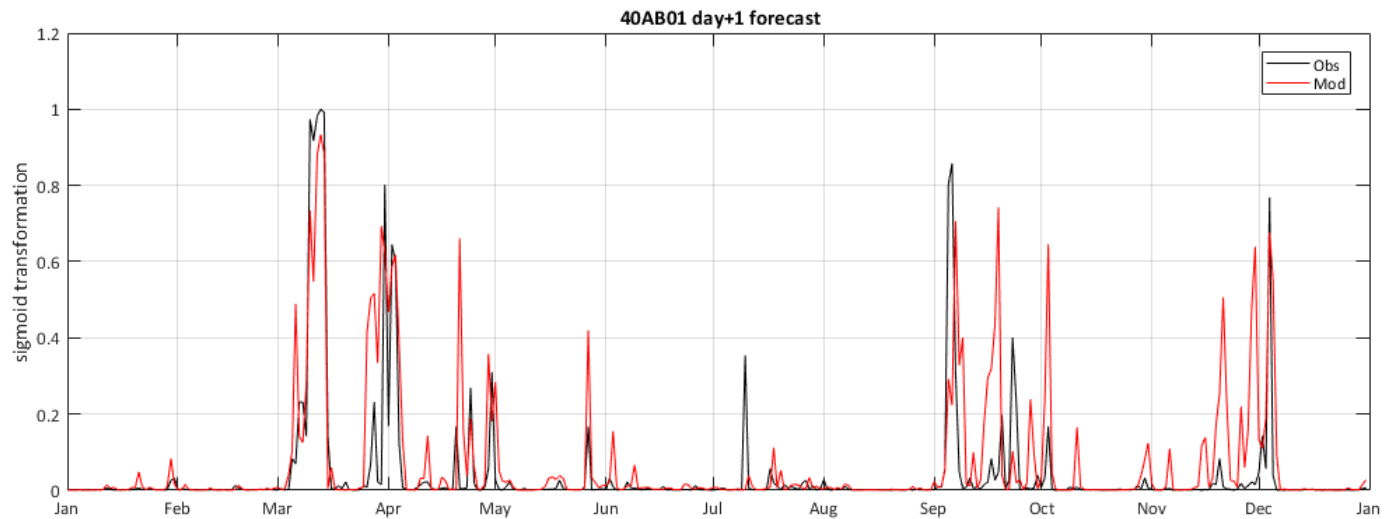
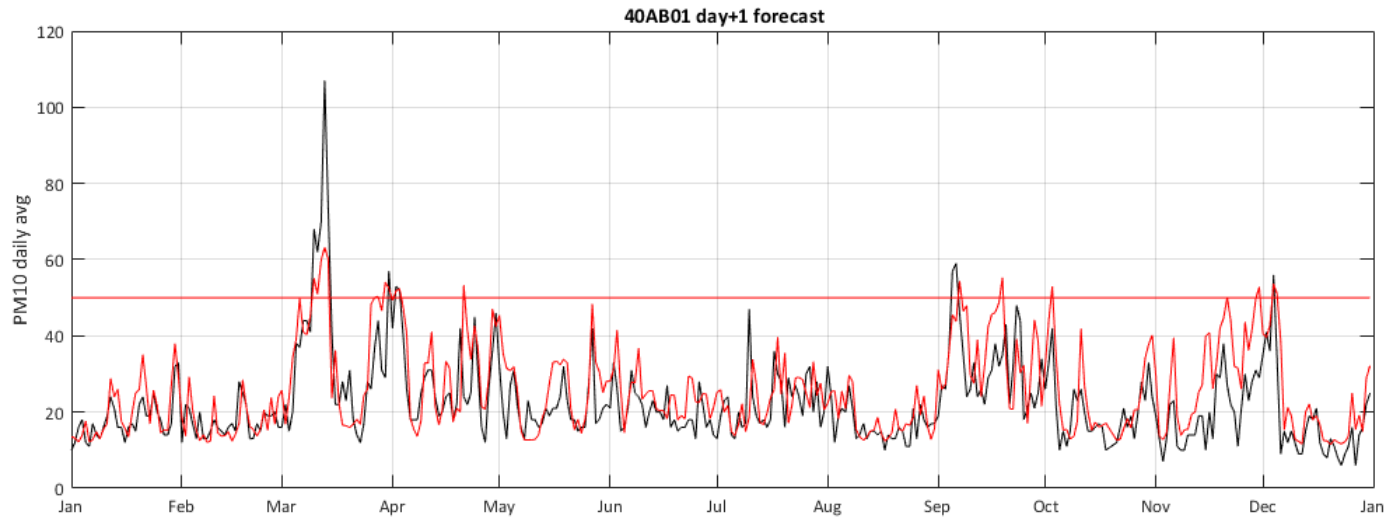




$$\begin{aligned} \text{GA+} &= \text{sigmoid}(0) * \text{sigmoid}(M) \\ \text{FA} &= (1 - \text{sigmoid}(0)) * \text{sigmoid}(M) \\ \text{MA} &= \text{sigmoid}(0) * (1 - \text{sigmoid}(M)) \\ \text{GA-} &= (1 - \text{sigmoid}(0)) * (1 - \text{sigmoid}(M)) \end{aligned}$$

WG1 – FORECAST EXCEEDANCES

Effect on time series : tolerance 0 -> 5 -> 10

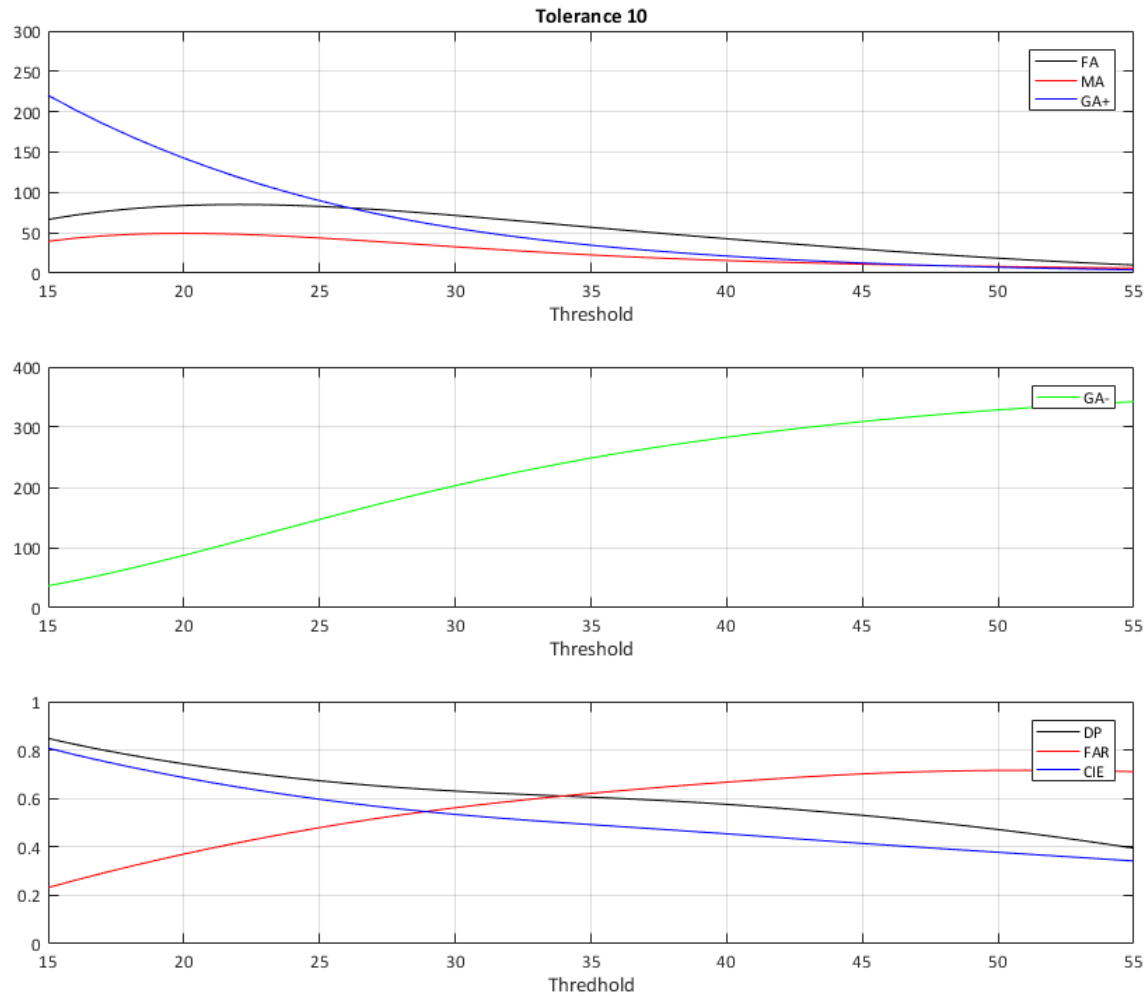


Effect on indicators ?

- Counting FA, MA, GA+ and GA-
- Evaluation of
 - Detection probability $DP = GA+ / (MA + GA+)$
 - False Alarm Ratio $FAR = FA / (FA + GA+)$
 - Composite Index of Exceedance $CIE = 0.5 (DP + 1 - FAR)$
- Impact on robustness w.r.t. the threshold level
- Impact of the tolerance

WG1 – FORECAST EXCEEDANCES

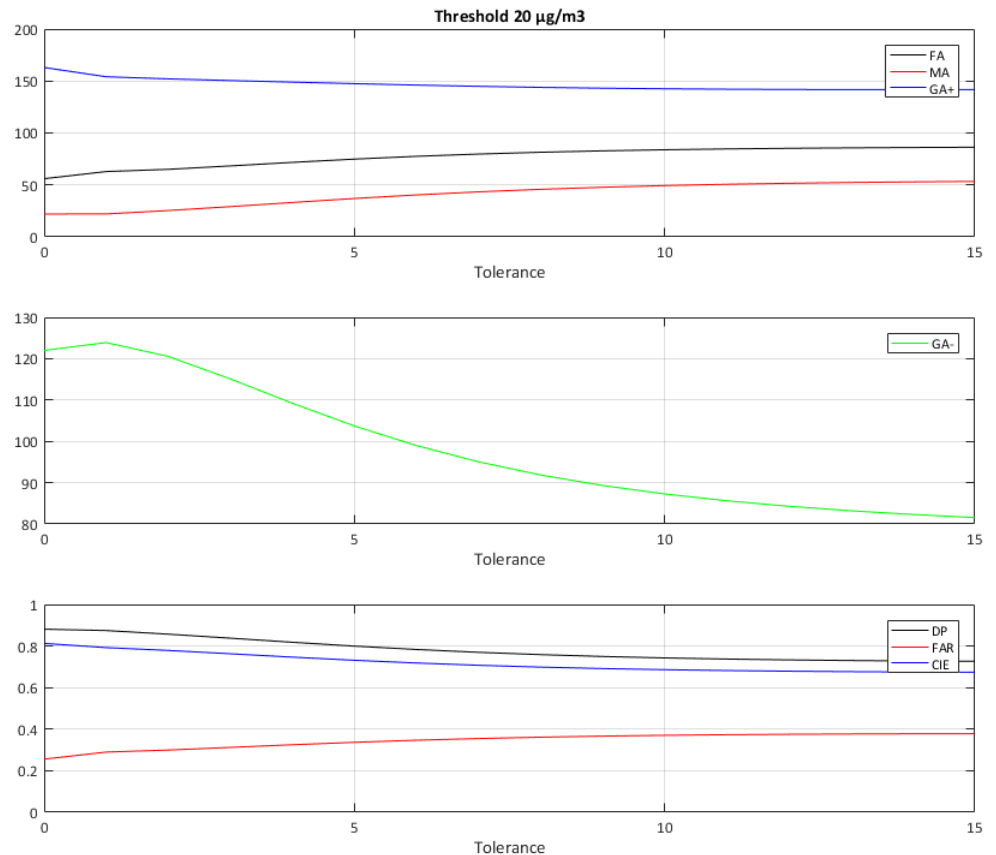
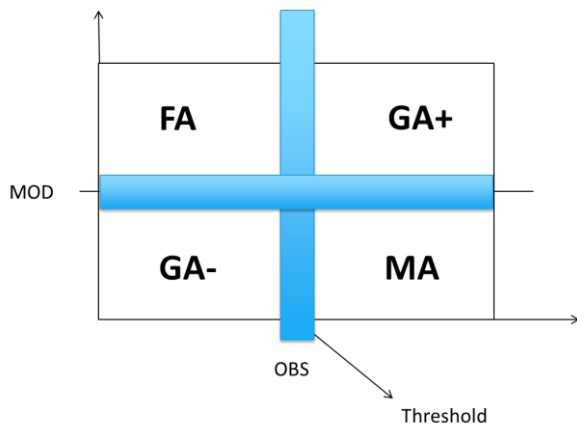
Robustness w.r.t. threshold value, using sigmoid for both OBS & MOD



WG1 – FORECAST EXCEEDANCES

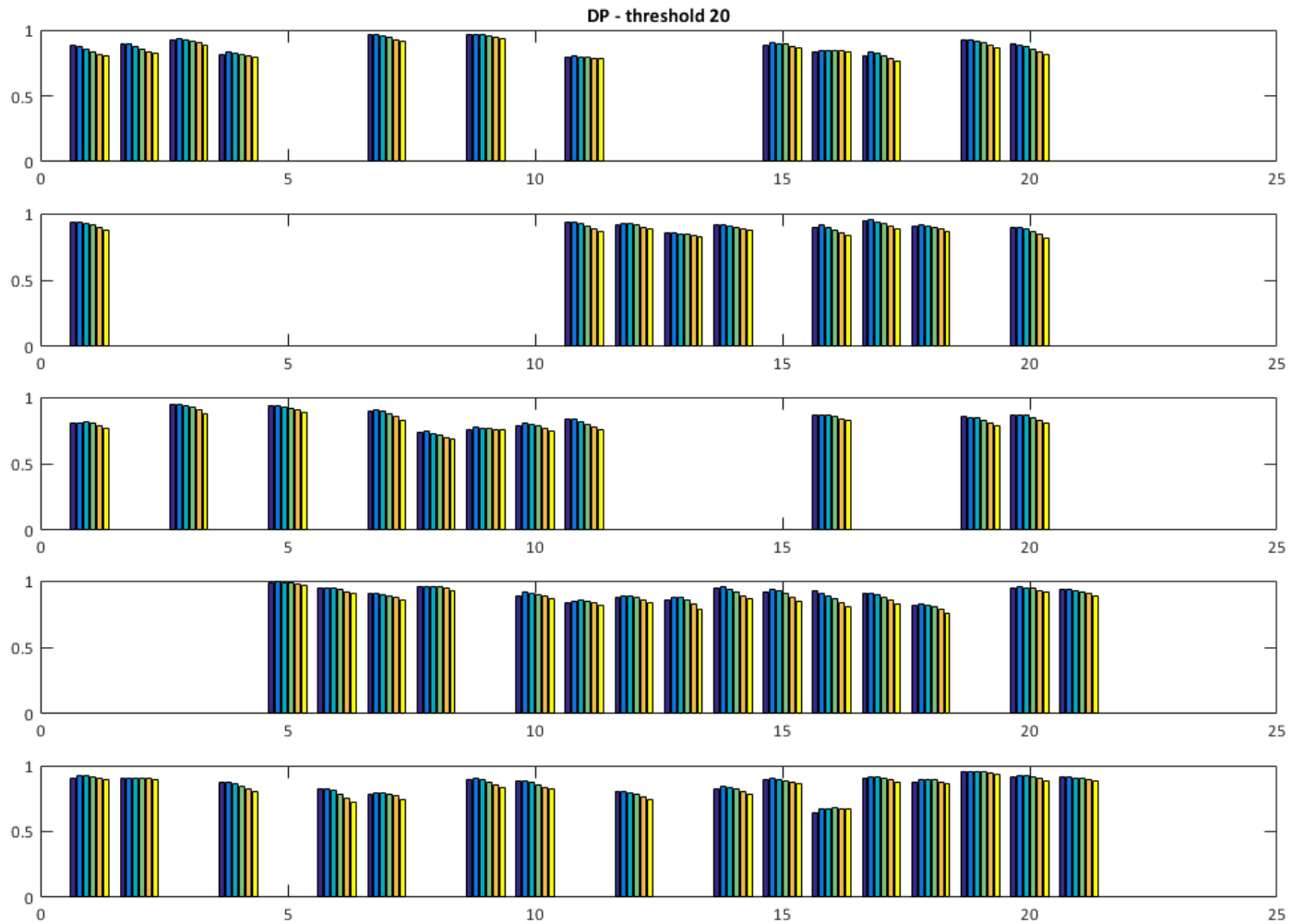
Sigmoid only on measurement exceedances

- Mainly MA going up and GA+ going down.
- DP, CIE goes down
- Not really the behaviour we would expect/desire ?
- Irrespective of whether to apply sigmoid at model/obs. or both



WG1 – FORECAST EXCEEDANCES

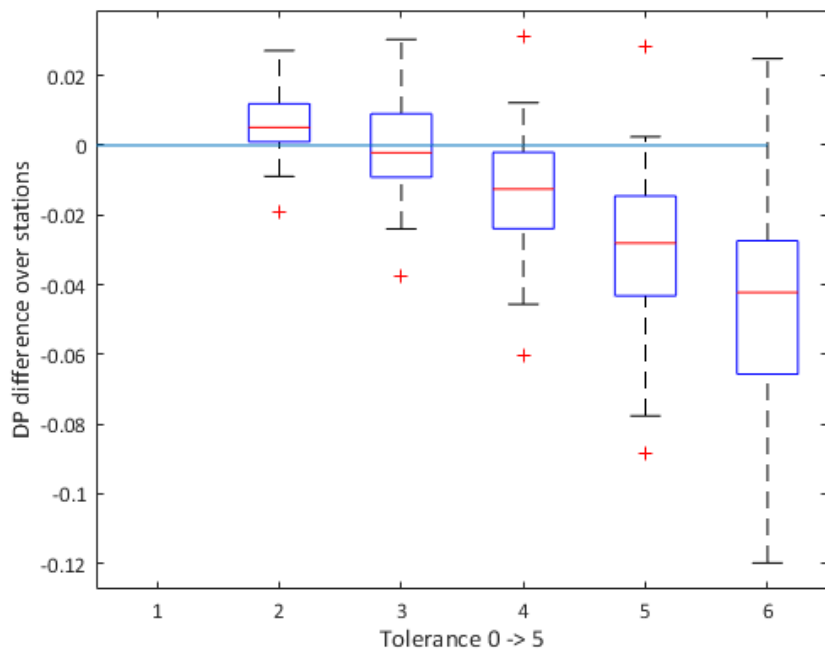
Other stations : DP



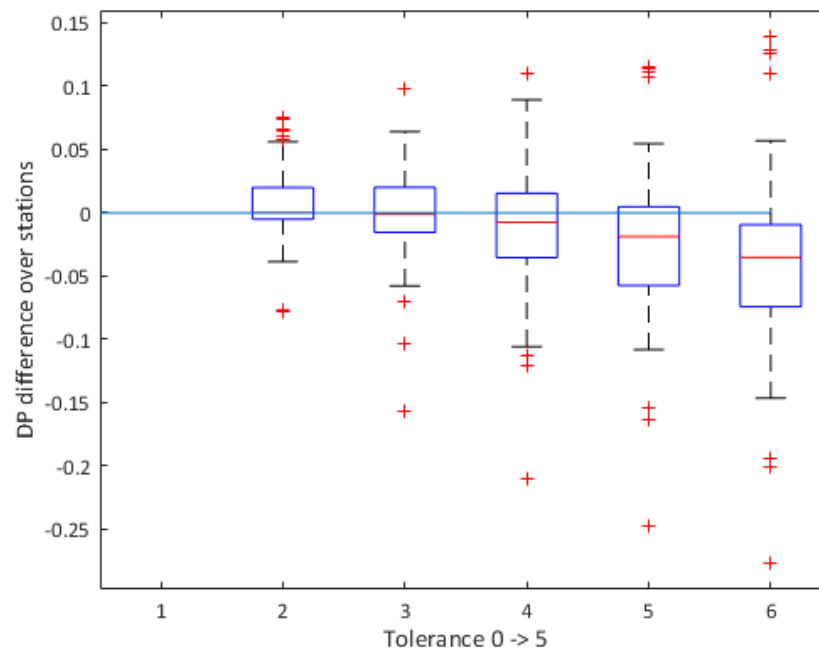
WG1 – FORECAST EXCEEDANCES

Other stations : DP

Threshold 20 µg/m³

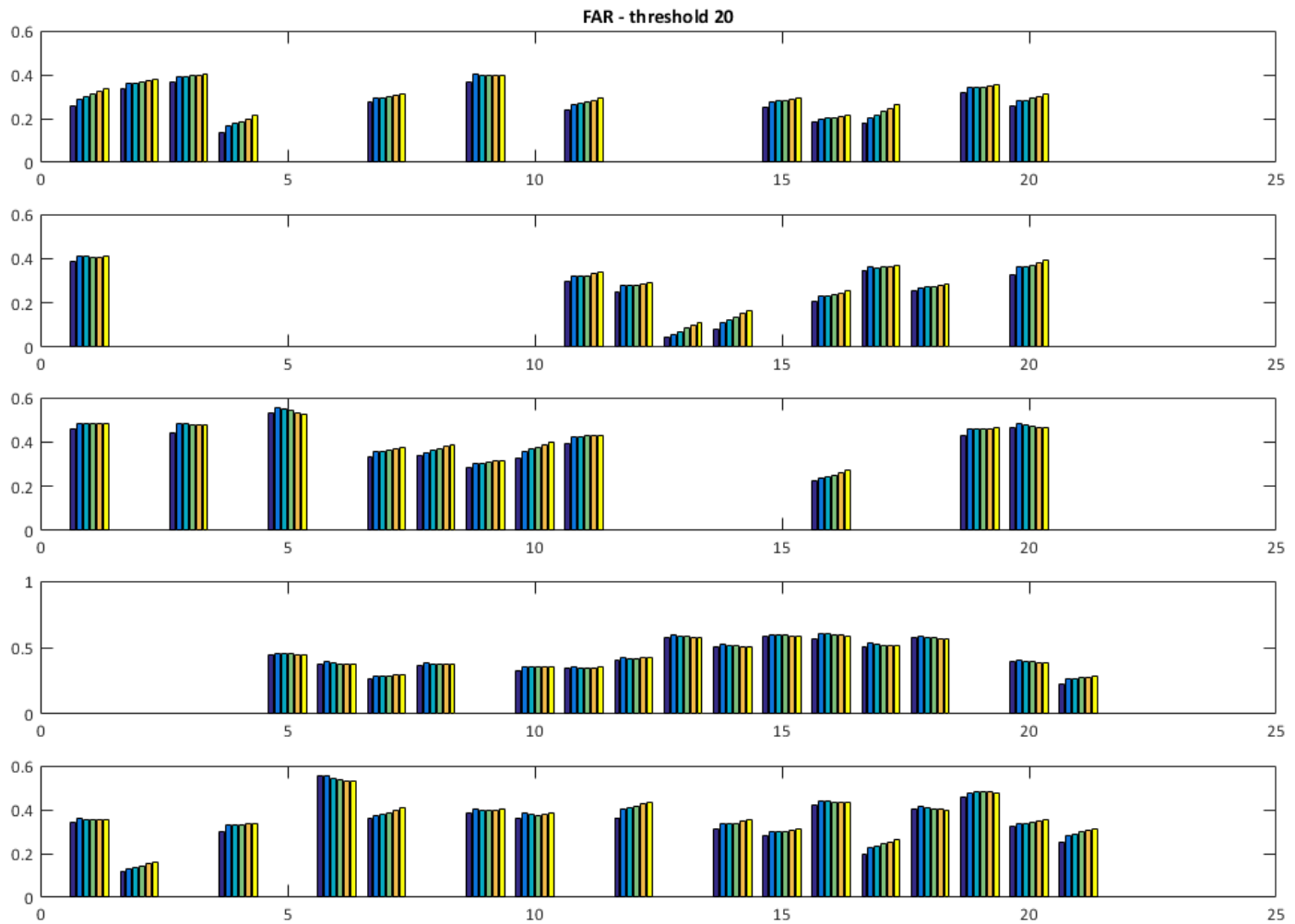


Threshold 50 µg/m³



WG1 – FORECAST EXCEEDANCES

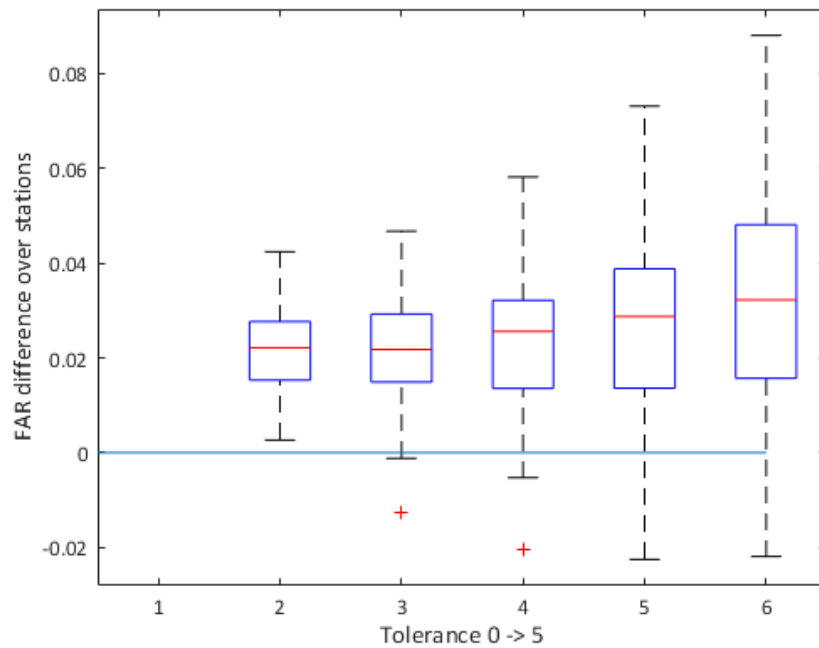
All stations : FAR



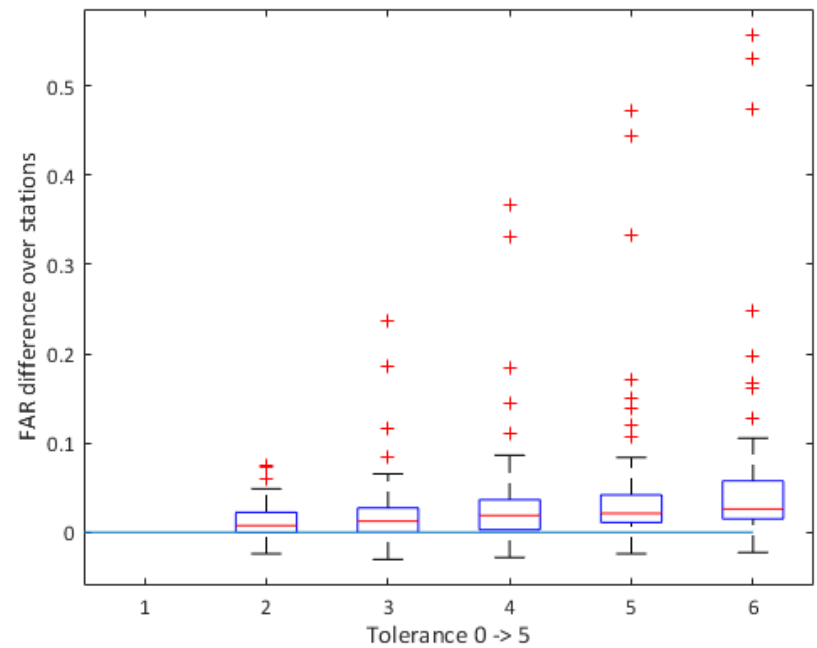
WG1 – FORECAST EXCEEDANCES

All stations : FAR

Threshold 20 $\mu\text{g}/\text{m}^3$



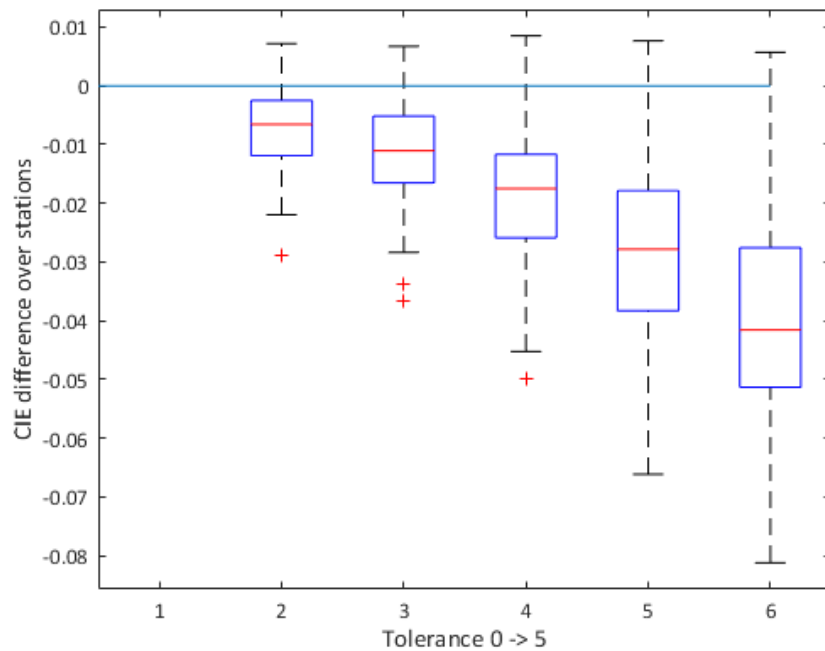
Threshold 50 $\mu\text{g}/\text{m}^3$



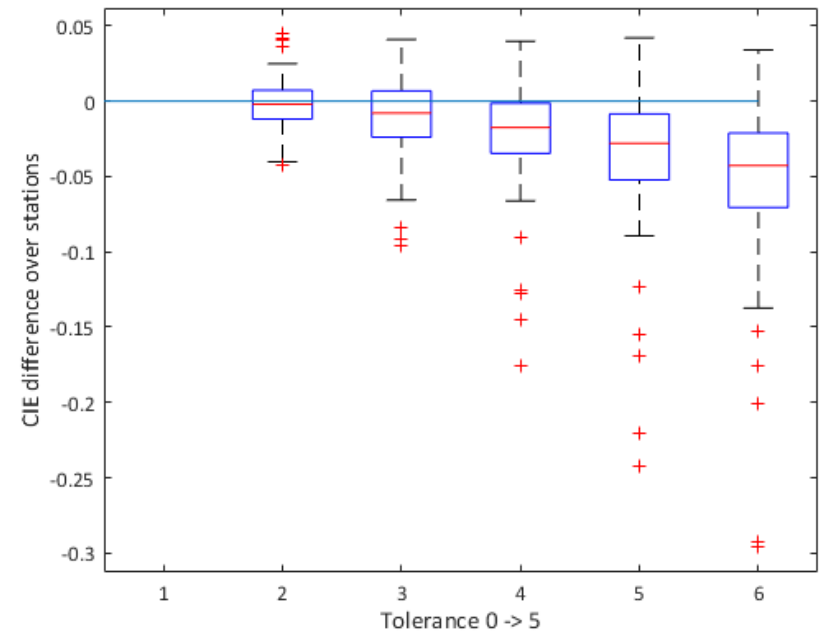
WG1 – FORECAST EXCEEDANCES

All stations : CIE

Threshold 20 $\mu\text{g}/\text{m}^3$



Threshold 50 $\mu\text{g}/\text{m}^3$



Conclusions

- We get smoother behaviour as a function of the threshold value, indicators become less sensitive
- The effects on FAR & DP are not intuitive...
 - Something wrong ?
 - Not sure why they should get better though ?
- Not clear how to integrate this with the OU
 - OU is assigned to the observation values, here prob.

- To properly take into account exceedance uncertainty
 - Work with probability distribution for observation uncertainty (assume Gaussian on log-transformed concentrations) ?
 - Same for model ?
 - Repeat this exercise, think how to derive the indicators...

- Need to think about this a bit further...