

Delta tool 5.5 – forecast mode Poland

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PAŃSTWOWY INSTYTUT BADAWCZY



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AQ modelling for policy in Poland – new approach starting 2018

- ❑ Proposed legislation to amend several status will go to the Parliament this year (2017)
- ❑ Starting in 2018/2019 the Institute of Environmental Protection – National Research Institute will be responsible for
 - caring out air quality assessments and forecast
 - maintaining the national bottom-up emission database



Model GEM-AQ

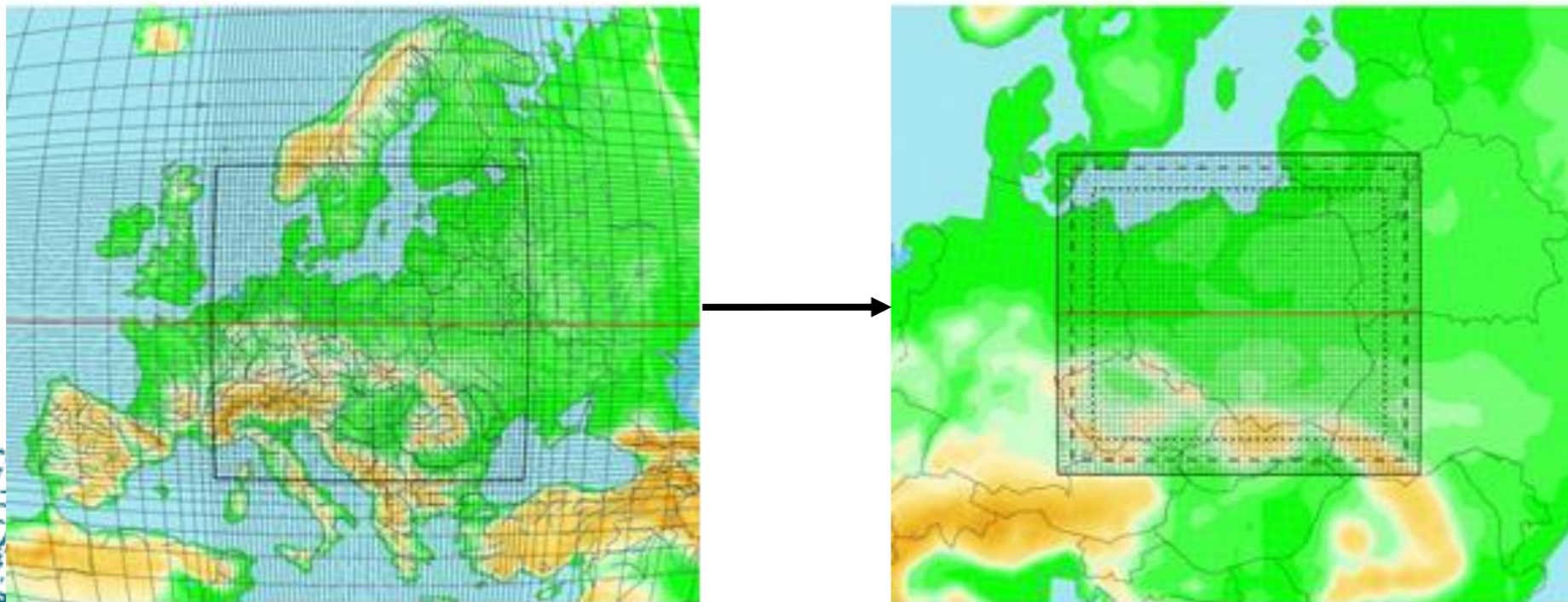
Global Environmental Multiscale – Air Quality model

- ❑ GEM – Operational weather prediction for Canadian Meteorological Centre
- ❑ Eulerian model on-line type
- ❑ Tropospheric chemistry (further development of ADOM IIb)
- ❑ Aerosol module – 5 aerosol types, 12 diameters of particulates
- ❑ Grid configuration allows calculations on different spatial scale – from global to local



Model configuration - 2016

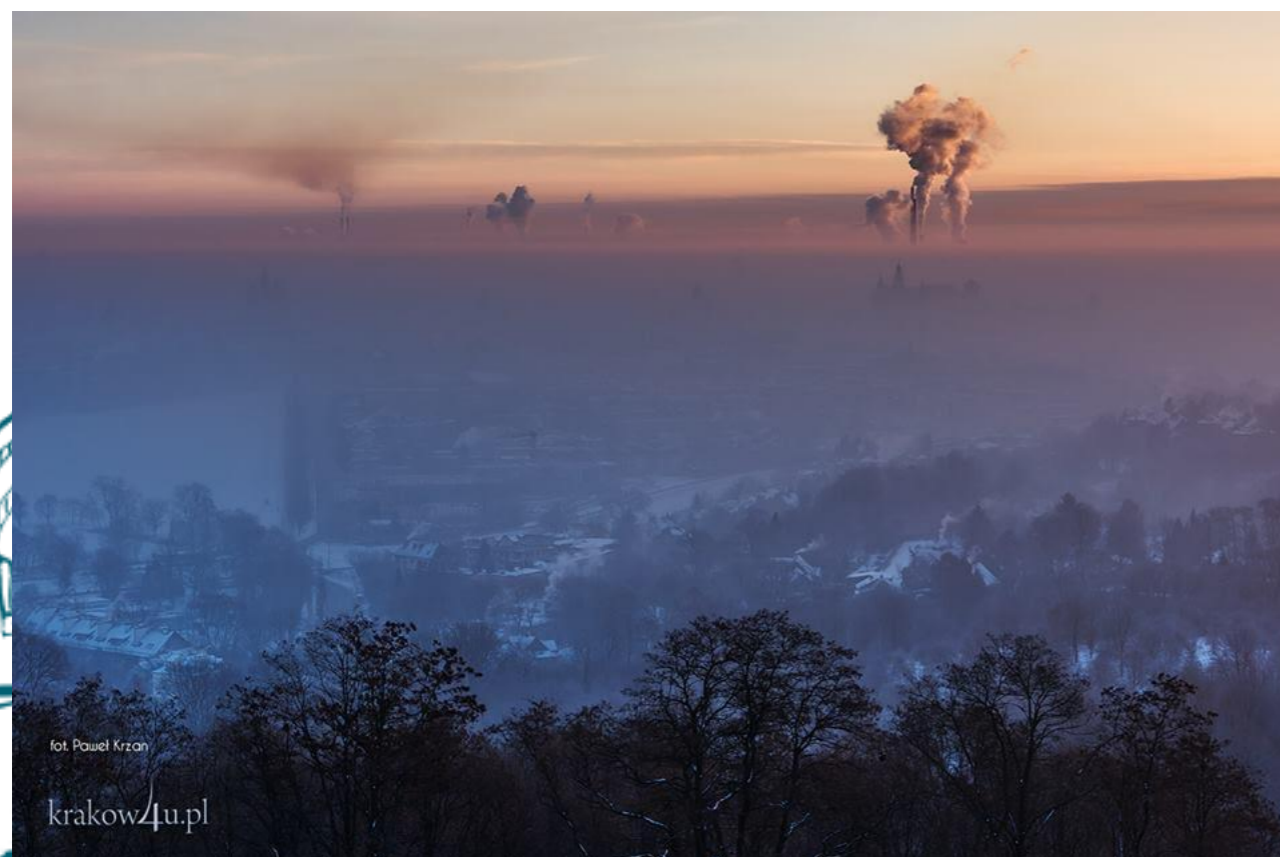
- ❑ Two domains: global variable with 15km resolution over Europe, and 5km uniform grid over Poland
- ❑ 28 hybrid levels, model top on 10 hPa
- ❑ EDGAR emissions used for global grid
- ❑ EMEP emissions used for Europe and Poland (relocated)
- ❑ Daily forecast for 72 hours
- ❑ Pollutants: PM10, PM2.5, O3, NO2, SO2 and CO
- ❑ No data assimilation



Measurement data used

- ❑ 253 stations from Poland with PM10 measurements
- ❑ Automatic and manual observations
- ❑ 102 stations from Poland with O3 measurements
- ❑ Only automatic observations
- ❑ No distinction between stations types

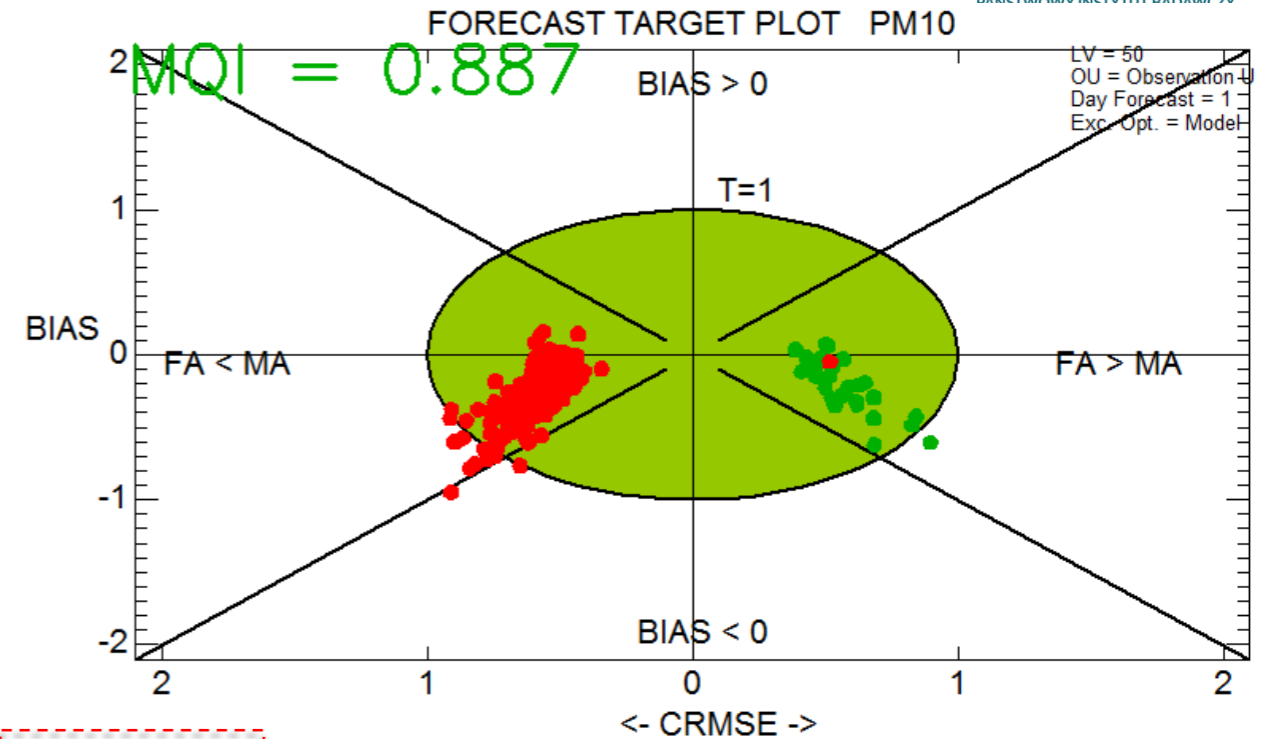
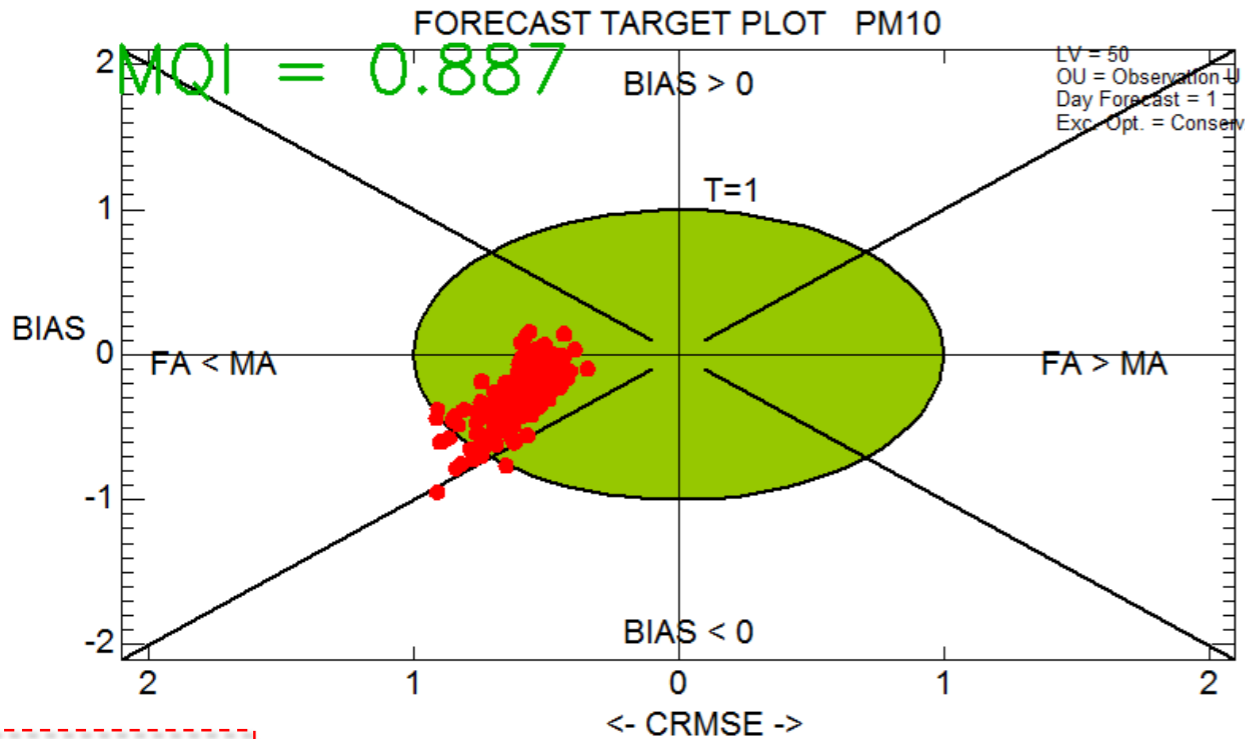
Krakow



Warsaw



Target plot – PM10



- FAR < 0.2
- 0.2 < FAR < 0.4
- 0.4 < FAR < 0.6
- 0.6 < FAR < 0.8
- 0.8 < FAR < 1.0

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/1.0/1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

- FAR < 0.2
- 0.2 < FAR < 0.4
- 0.4 < FAR < 0.6
- 0.6 < FAR < 0.8
- 0.8 < FAR < 1.0

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/3.0/1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

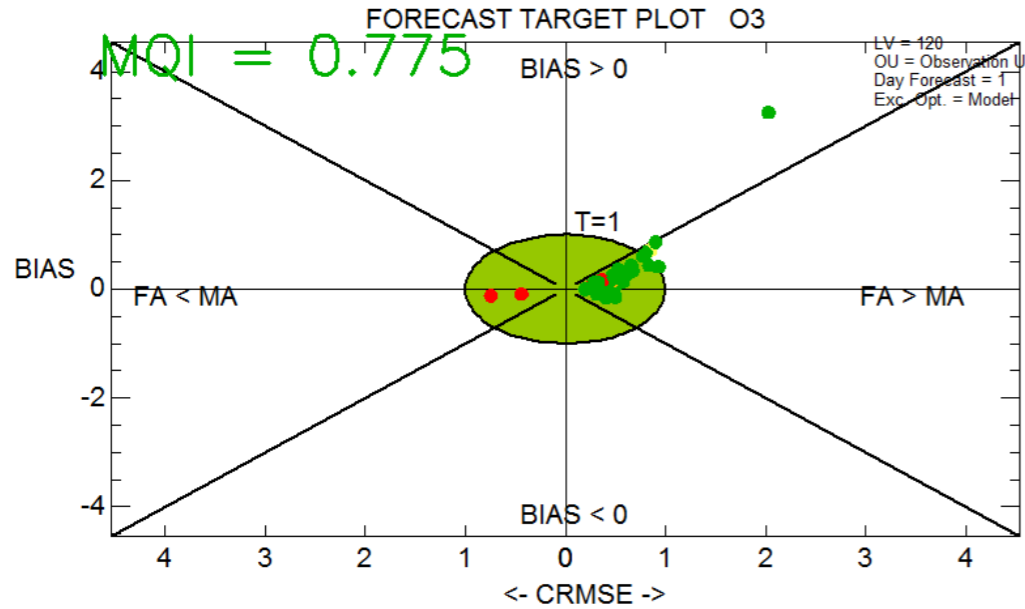
- $\frac{FA}{FA + GA_+} < 0.2 \Rightarrow$ Dark green
- $0.2 \leq \frac{FA}{FA + GA_+} < 0.4 \Rightarrow$ Light green
- $0.4 \leq \frac{FA}{FA + GA_+} < 0.6 \Rightarrow$ Yellow
- $0.6 \leq \frac{FA}{FA + GA_+} < 0.8 \Rightarrow$ Orange
- $0.8 \leq \frac{FA}{FA + GA_+} \Rightarrow$ Red

Confused !!!



Target plot – O3

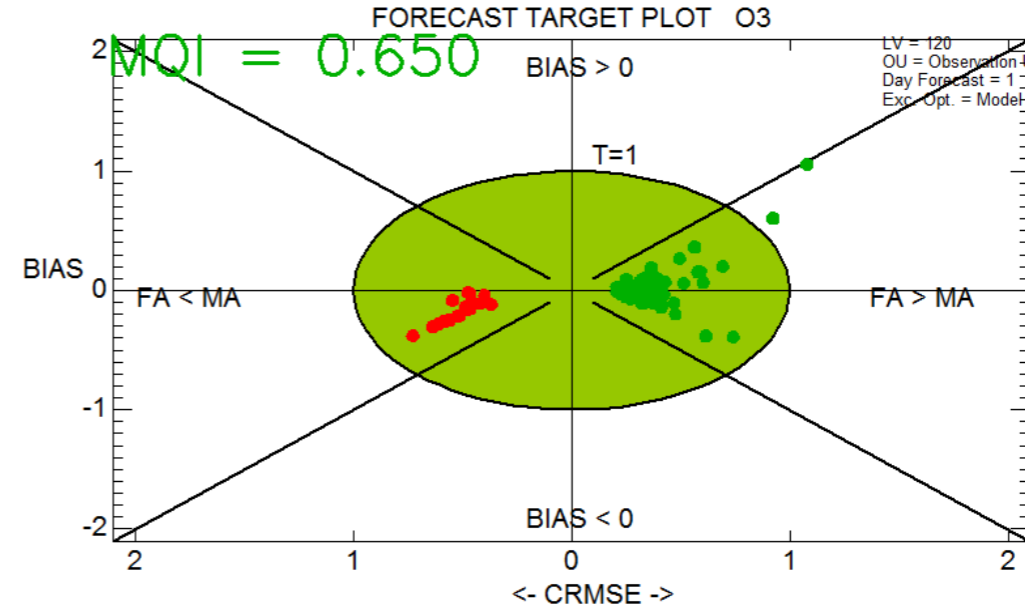
2014



- FAR < 0.2
- 0.2 < FAR < 0.4
- 0.4 < FAR < 0.6
- 0.6 < FAR < 0.8
- 0.8 < FAR < 1.0

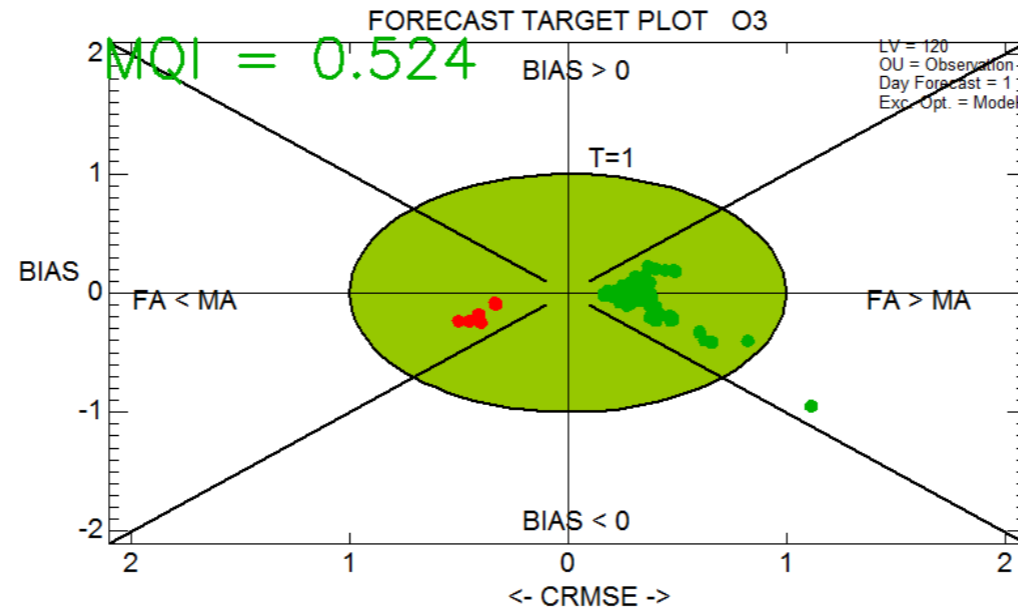
Strt/end Ind: 2161-6552
Model (s): GEM
Parameter: O3
Scen: 2014
Extra Values: 120/999/3.0/1.0
Season: Year
Day hours: All 24h
Time Average: 8h
Daily stats: Max

2015



- FAR < 0.2
- 0.2 < FAR < 0.4
- 0.4 < FAR < 0.6
- 0.6 < FAR < 0.8
- 0.8 < FAR < 1.0

Strt/end Ind: 2161-6552
Model (s): GEM
Parameter: O3
Scen: 2015
Extra Values: 120/999/3.0/1.0
Season: Year
Day hours: All 24h
Time Average: 8h
Daily stats: Max



- FAR < 0.2
- 0.2 < FAR < 0.4
- 0.4 < FAR < 0.6
- 0.6 < FAR < 0.8
- 0.8 < FAR < 1.0

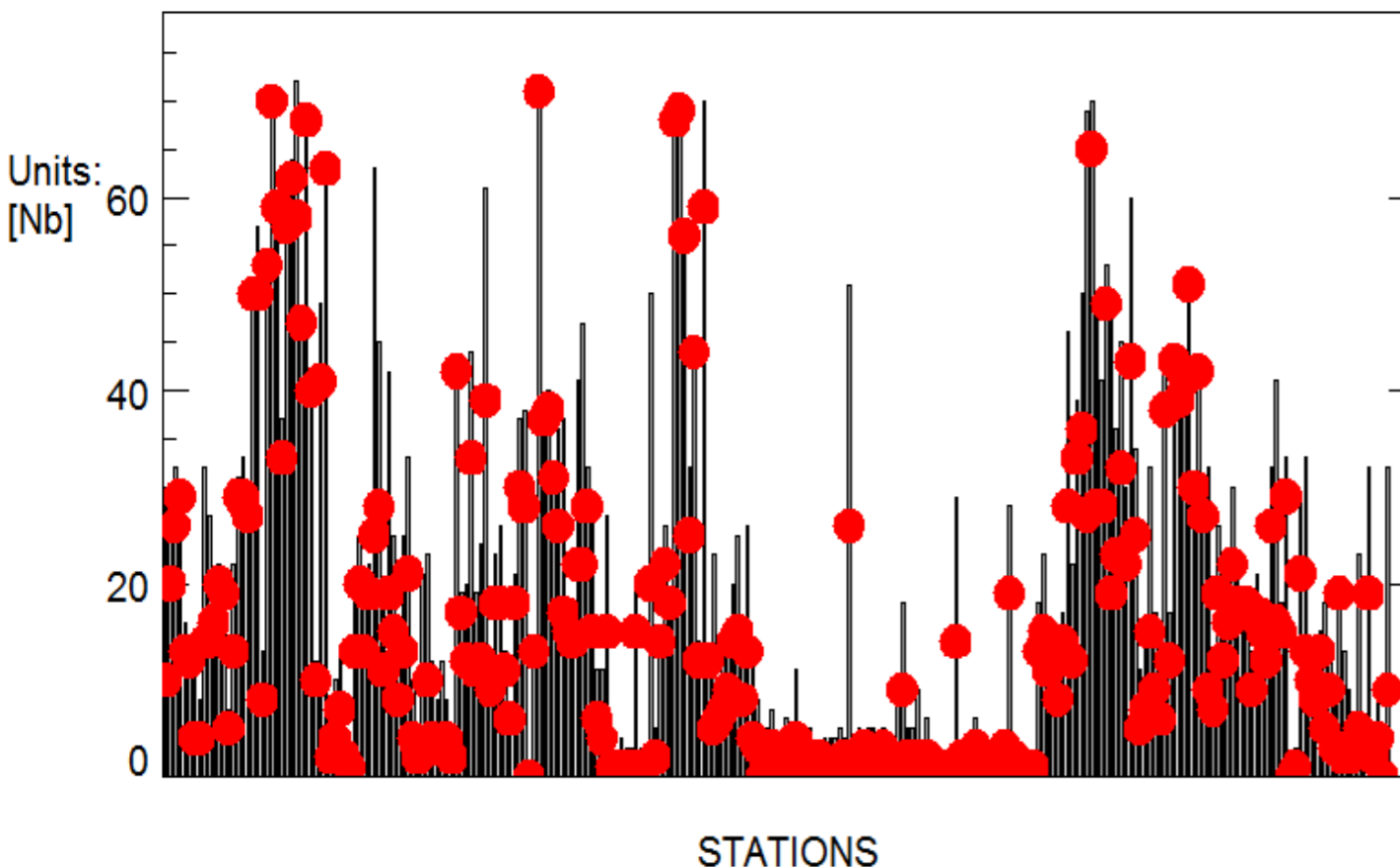
Strt/end Ind: 2185-6576
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: 120/999/3.0/1.0
Season: Year
Day hours: All 24h
Time Average: 8h
Daily stats: Max

2016

Probability of detection – PM10 – flexibility issues 1

Flexibility 2 and 3

Probability of detection $MA/(MA+GA+)$ PM10



● PM10-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/3.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

10.4.2. “Probability of detection” and “False alarm ratio” plots

Based on the following definitions:

- Probability of detection: $DP=GA+/(MA+GA+)$ and
- False alarm ratio: $FAR=FA/(FA+GA+)$,

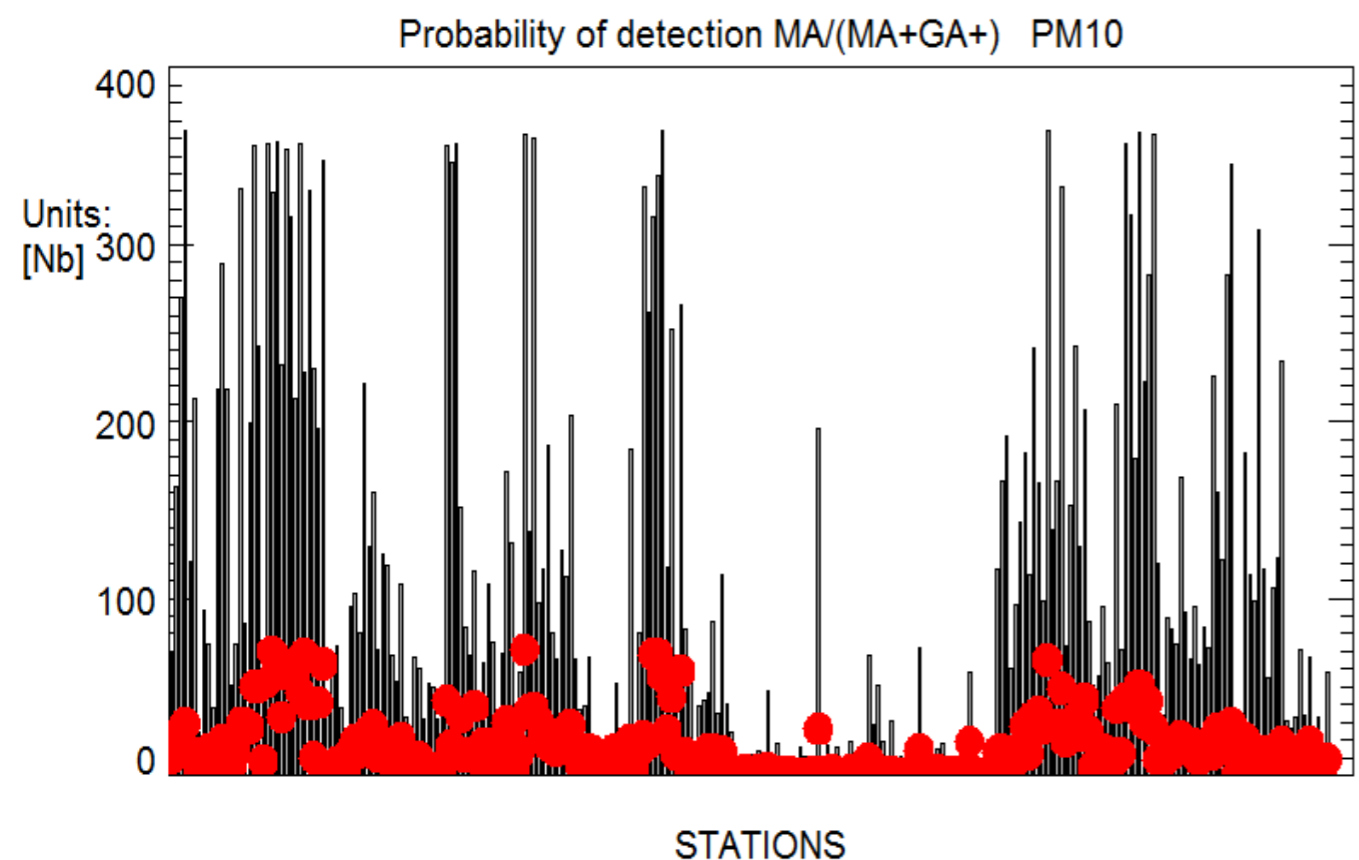
two bar plots are created:

- The first (Figure 3) for the probability of detection plots GA+ as red dots and (MA+GA+) as grey column for each station. A good model capability would see all red dots on top of the column.
- The second (Figure 4) for false alarms is based on $1-FAR=GA+/(FA+GA+)$ in which again the red dots are for GA+ and the grey column for (FA+GA+). A good model again would see red dots close to the column tops.



Probability of detection – PM10 – flexibility issues 2

Flexibility 1 – conservative



Sources of MA

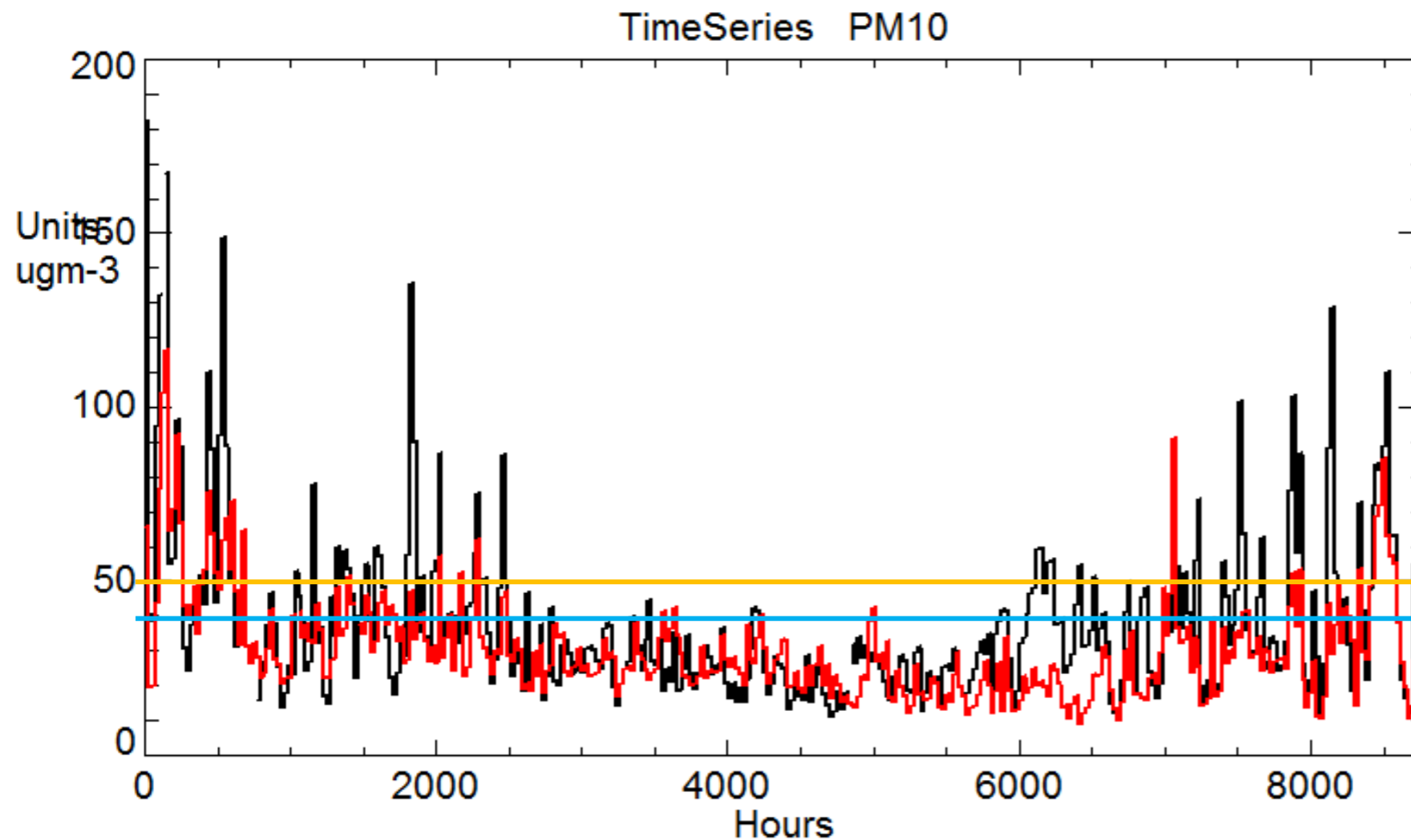
Obs	Model	LV	Observations		Model (M*)		DELTA
			relation to LV	Alarm?	relation to LV	Alarm?	
			O.<LV	No	M*<LV	No	GA-
			O.<LV	No	M*≥LV	Yes	FA
			O.<LV O.≥LV	1: Yes, conservative 2: No, cautious 3: Same as model	M*<LV	No	MA GA- GA-
			O.<LV O.≥LV	1: Yes, conservative 2: No, cautious 3: Same as model	M*≥LV	Yes	GA+ FA GA+
			O.≥LV	Yes	M*<LV	No	MA
			O.≥LV	Yes	M*≥LV	Yes	GA+

● PM10-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean



Missed alarms – PM10 – near LV relation 1

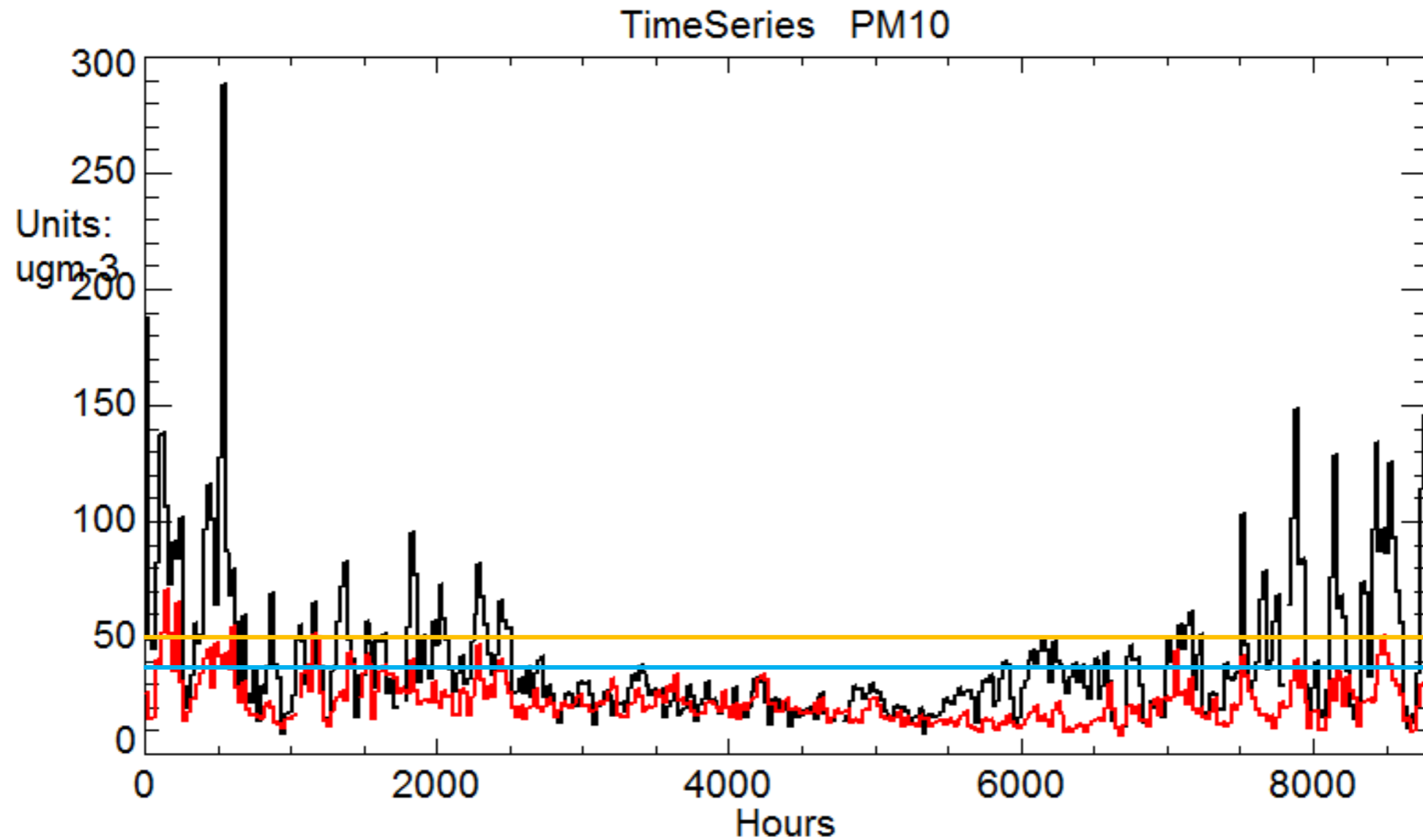


● OBS
● GEMAQ

Strt/end Ind: 1-8784
Station: SIDabro1000L
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: Preserved

UO = 28%
 $39,1 * 1,28 = 50,05$
 $39.1 > LV$

Missed alarms – PM10 – near LV relation 2



● OBS
● GEMAQ

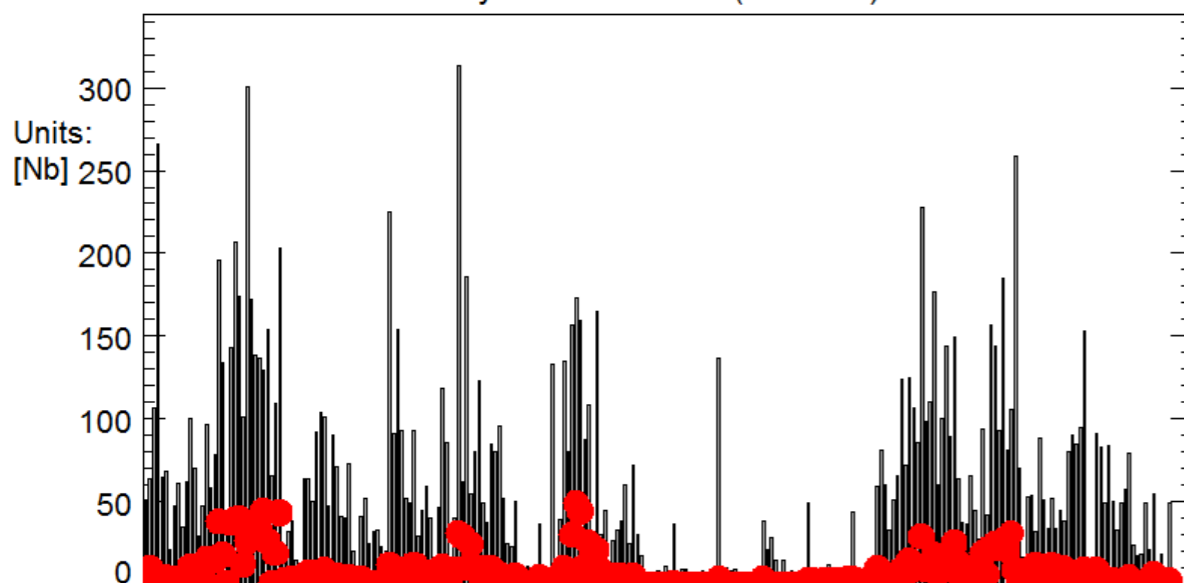
Strt/end Ind: 1-8784
Station: MpKrakBujaka
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: Preserved

Probability of detection – PM10 – OU problems

Still not enough MA !!!

Flexibility 1 – OU 12 %

Probability of detection MA/(MA+GA+) PM10



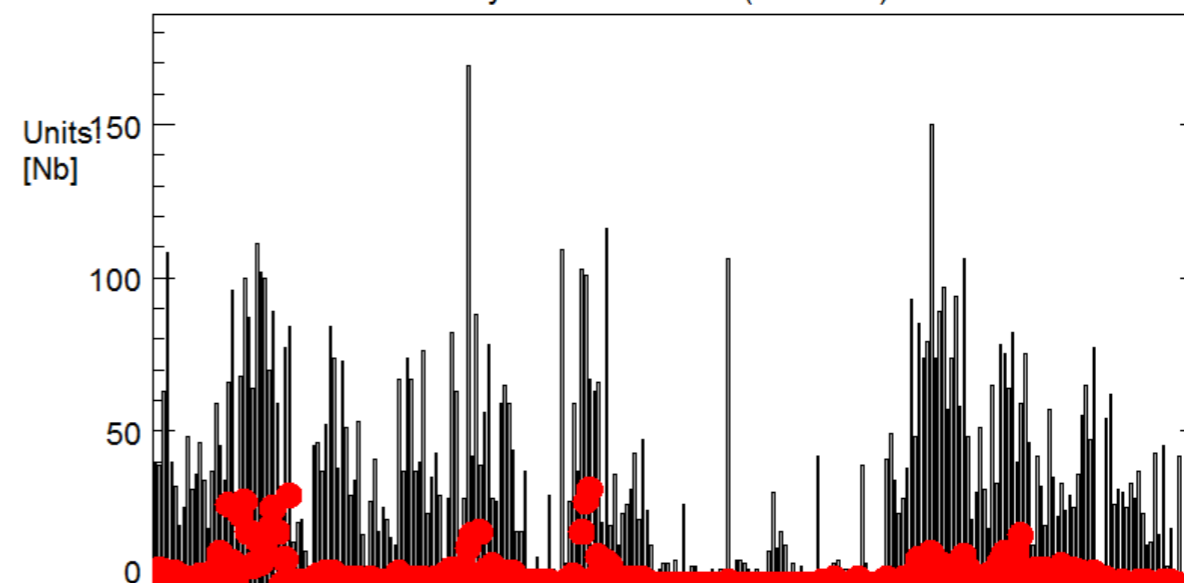
STATIONS

● PM10-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./12./1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

Flexibility 1 – OU 0 %

Probability of detection MA/(MA+GA+) PM10



STATIONS

● PM10-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./0.0/1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

Suggestion - problem with OU or MA calculations



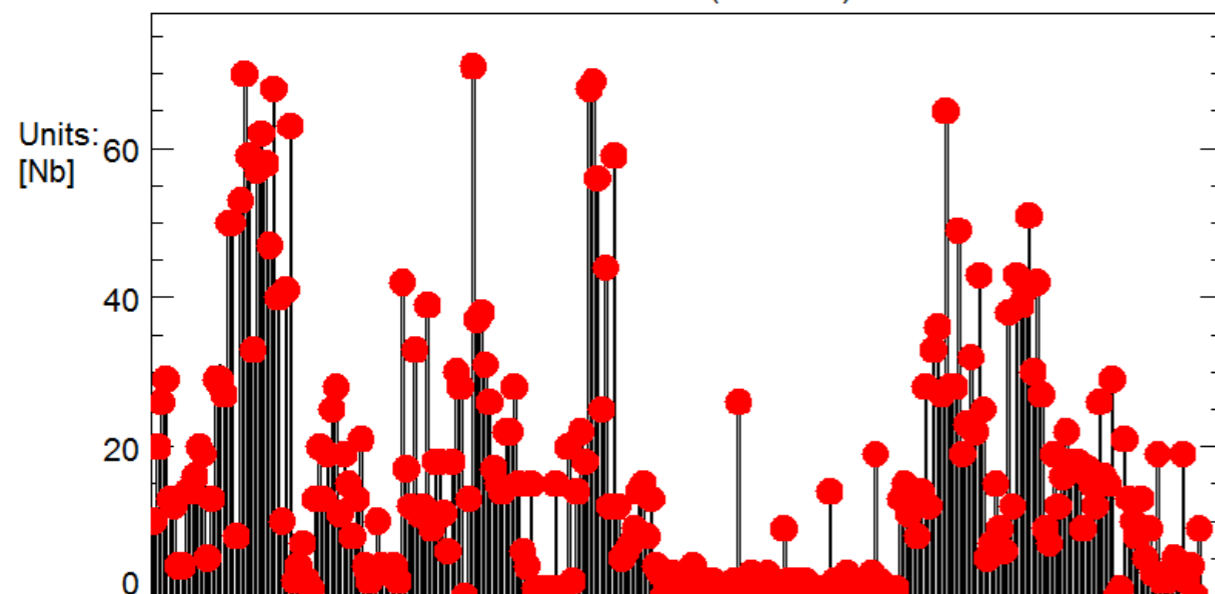
False alarm ratio– PM10



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Flexibility 1

False alarm ratio FA/(FA+GA+) PM10



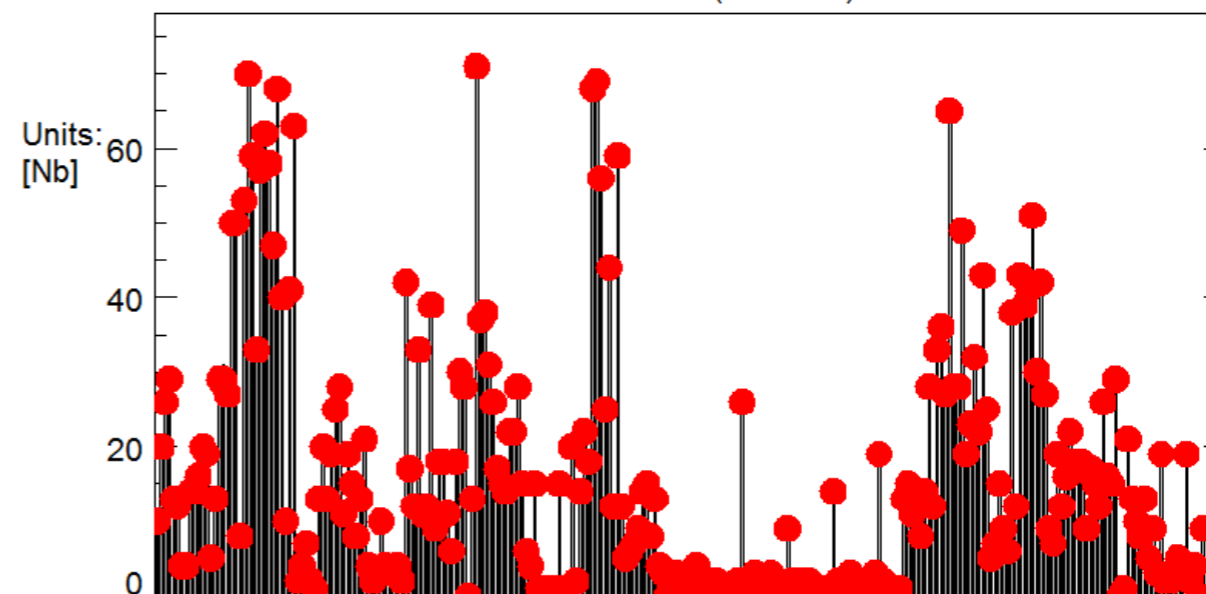
STATIONS

● PM10-GEMAQ-2016(FA) □ (FA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/3.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

Flexibility 2-3

False alarm ratio FA/(FA+GA+) PM10



STATIONS

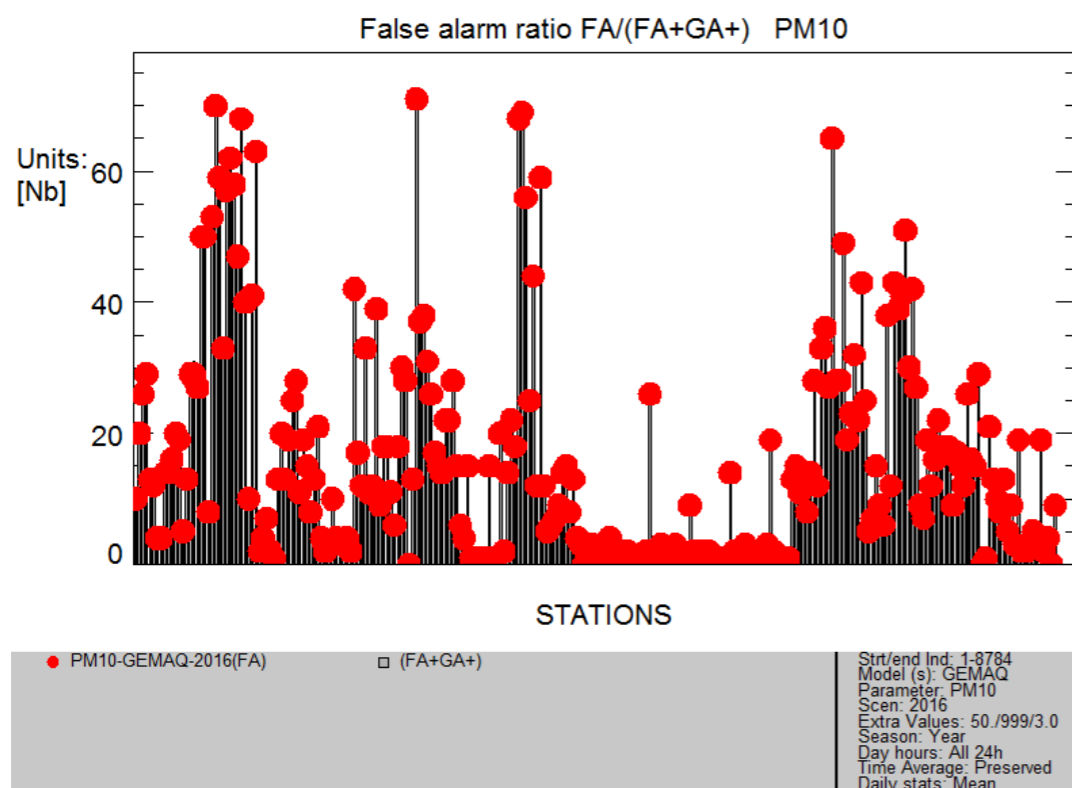
● PM10-GEMAQ-2016(FA) □ (FA+GA+)

Strt/end Ind: 1-8784
Model (s): GEMAQ
Parameter: PM10
Scen: 2016
Extra Values: 50./999/1.0
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

Identical – no MA no problem 😊



False alarm ratio– PM10 – issue in guidance doc.



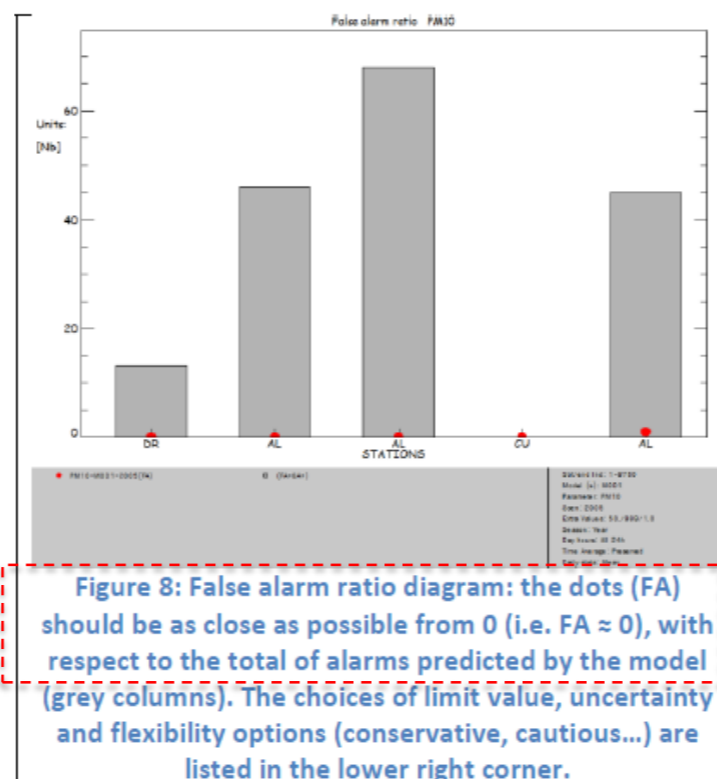
10.4.2. "Probability of detection" and "False alarm ratio" plots

Based on the following definitions:

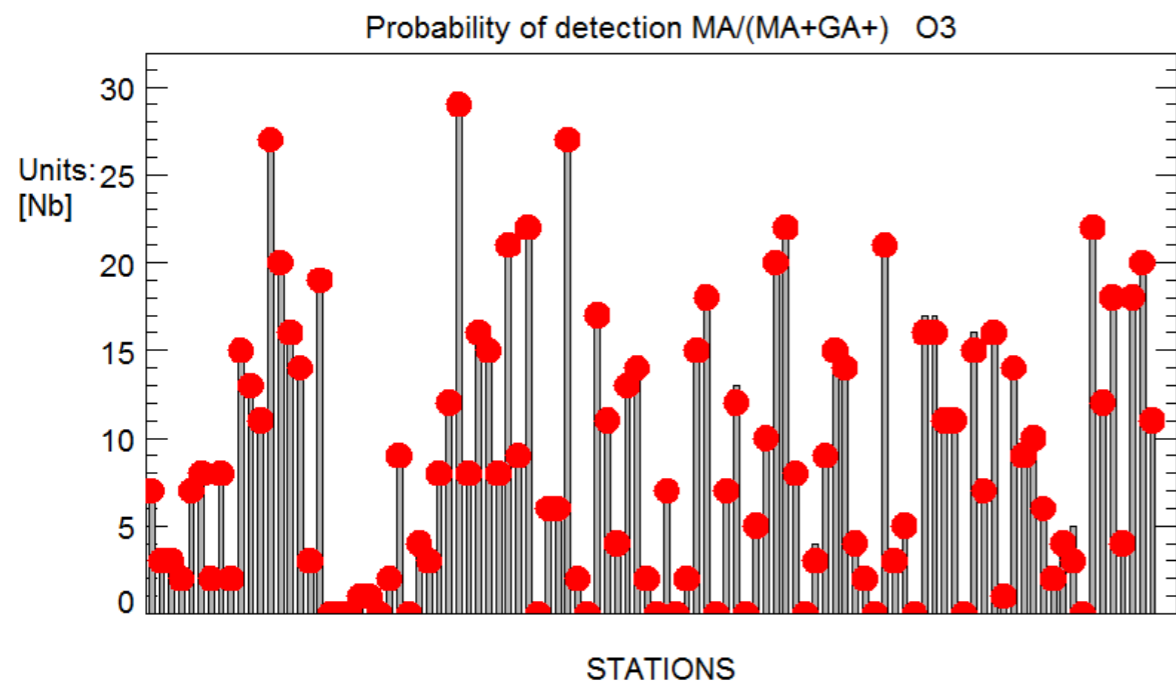
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- False alarm ratio: $FAR=FA/(FA+GA+)$,

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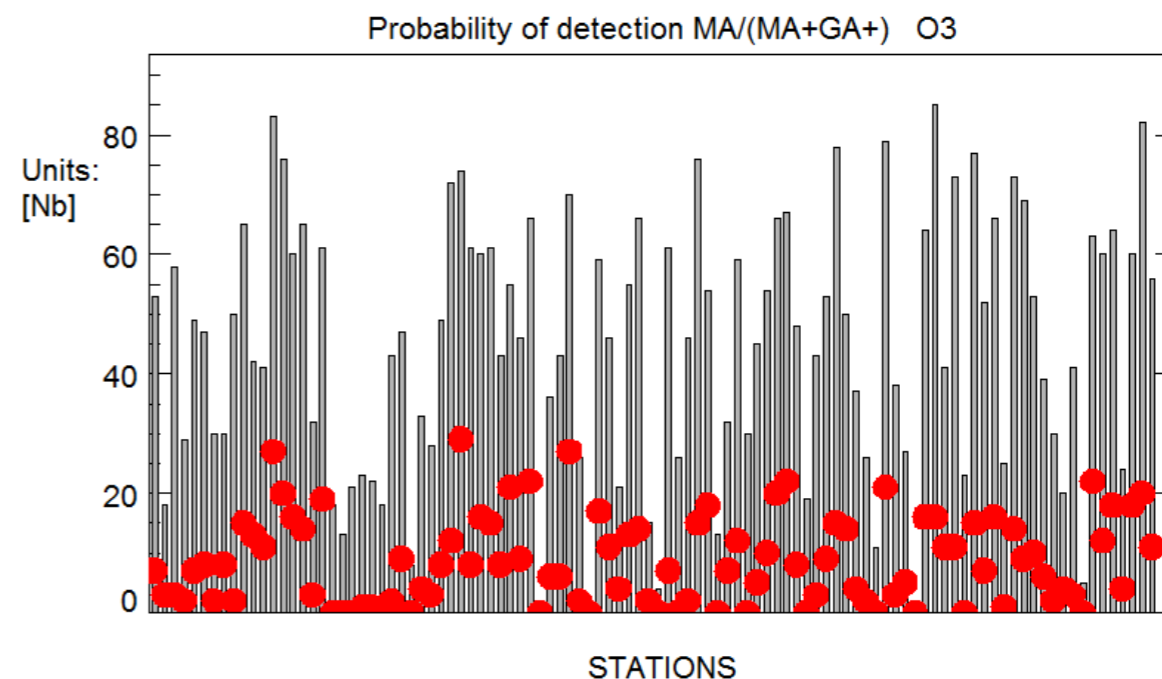


DP and FAR – O3 – similar results



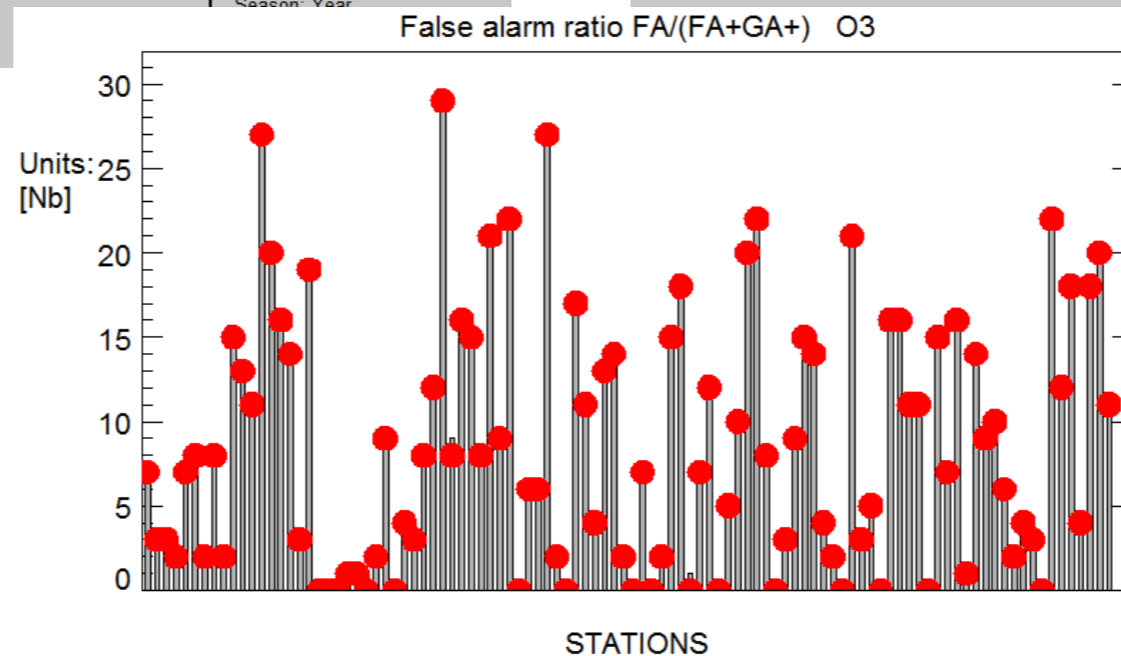
● O3-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 2185-6576
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: 120/999/3.0
Season: Year



● O3-GEMAQ-2016(MA) □ (MA+GA+)

Strt/end Ind: 2185-6576
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: 120/999/1.0
Season: Year
Day hours: All 24h
Time Average: 8h
Daily stats: Max

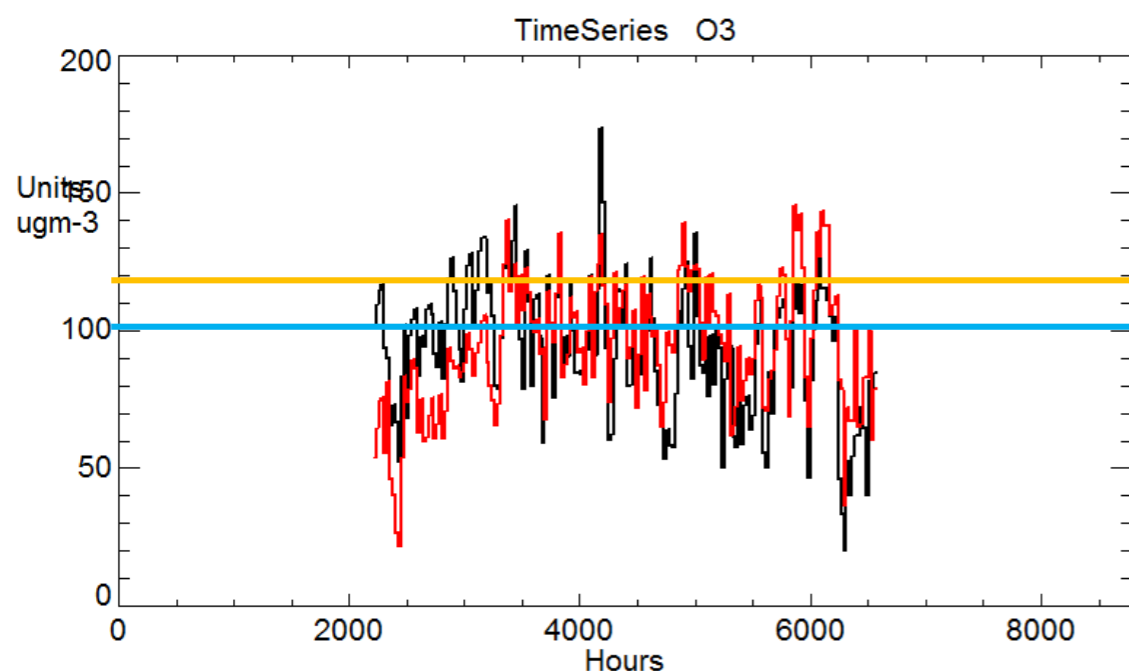


● O3-GEMAQ-2016(FA) □ (FA+GA+)

Strt/end Ind: 2185-6576
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: 120/999/3.0
Season: Year
Day hours: All 24h
Time Average: 8h
Daily stats: Max

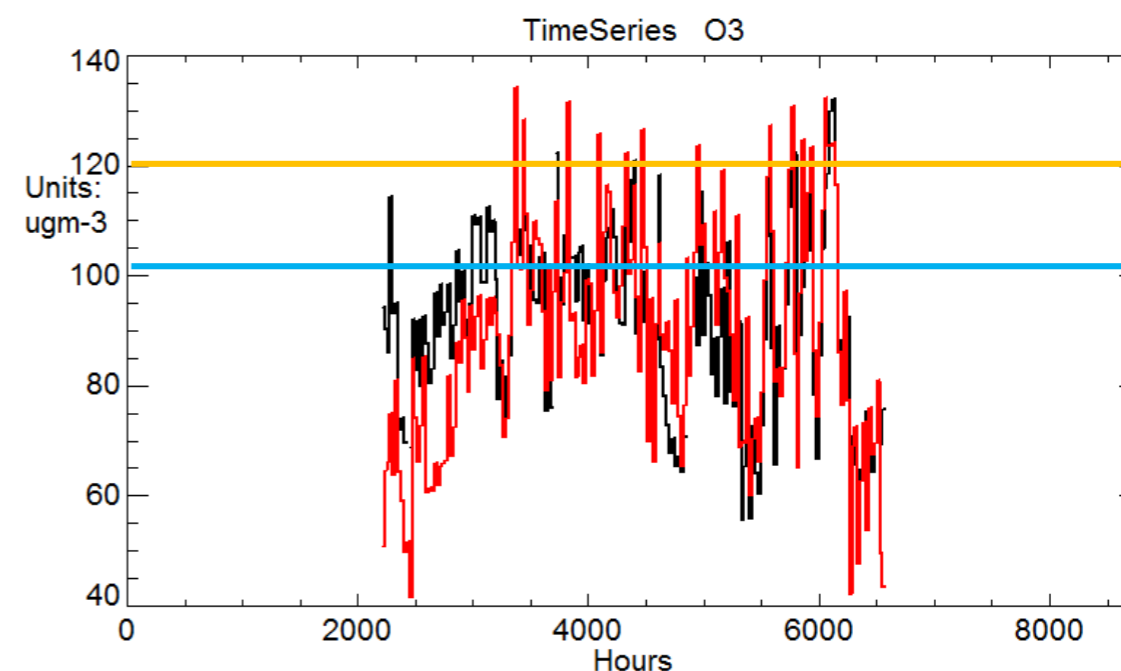


Missed alarms – O3 – near LV relation



● OBS
● GEMAQ

Strt/end Ind: 1-8784
Station: rybnik
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: 8h



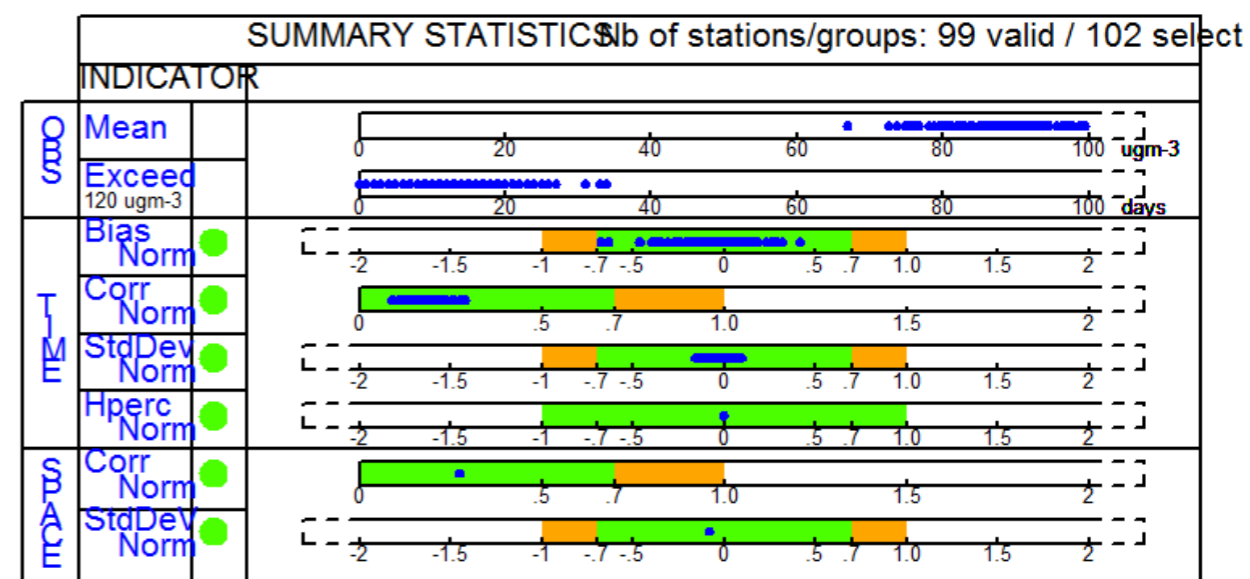
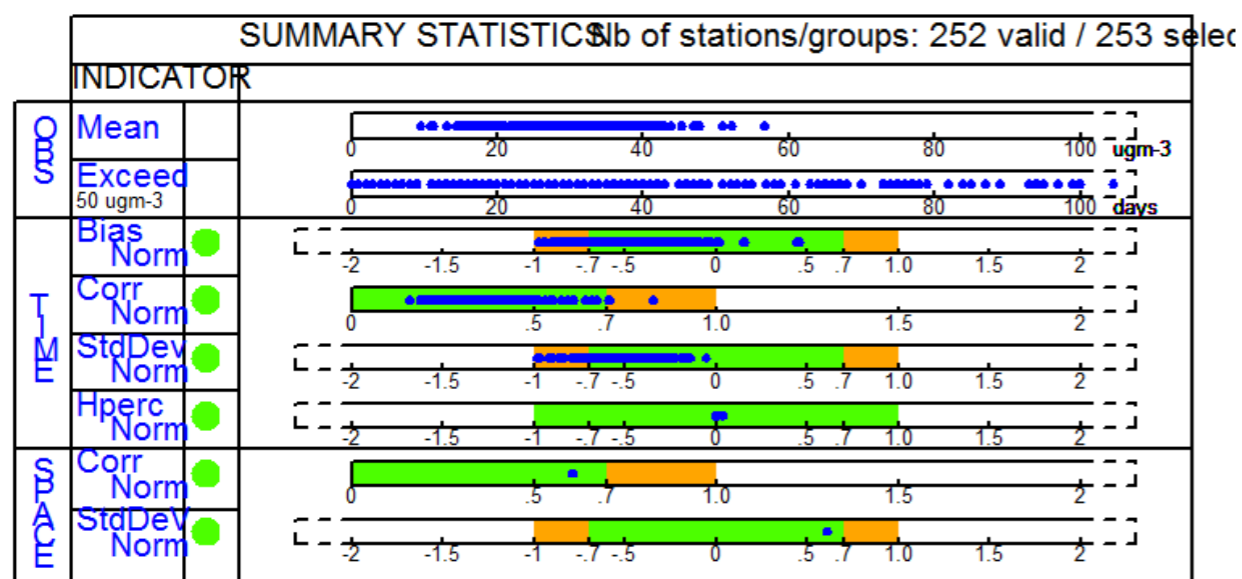
● OBS
● GEMAQ

Strt/end Ind: 1-8784
Station: belsk-igpan
Model (s): GEMAQ
Parameter: O3
Scen: 2016
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: 8h



$$UO = 18\%$$
$$102 * 1,18 = 120,3$$
$$102 > LV$$

Summary report 2016 – O3 and PM10



- Performance Criteria satisfied
- Performance Criteria satisfied; Error dominated by corresponding Indicator
- TIME: >90% of stations fulfills the Performance Criteria
- SPACE: Dot fulfills the Performance Criteria
- TIME: <90% of stations fulfills the Performance Criteria
- SPACE: Dot does not fulfill the Performance Criteria

- Performance Criteria satisfied
- Performance Criteria satisfied; Error dominated by corresponding Indicator
- TIME: >90% of stations fulfills the Performance Criteria
- SPACE: Dot fulfills the Performance Criteria
- TIME: <90% of stations fulfills the Performance Criteria
- SPACE: Dot does not fulfill the Performance Criteria

Participant	Index agreement	Threshold agreement	GA+	FA	FCF	FFA
MP		✓				
JS	✓	✓			✓	✓
AM	✓	✓		✓		
BM					✓	✓

$$FCF = GA+ / (GA++ MA)$$

$$DP = GA+ / (MA+GA+)$$

More details about those indicators needed !!!



Conclusions

- ❑ Flexibility – huge difference of model performance when working with near LV data
- ❑ Missed alarms counts – needs a check or different approach
- ❑ Minor changes in guidance document needed
- ❑ Summary report in forecast mode - more detailed description please 😊

- ❑ Some minor improvements in tool would be great:
 - Mouse click hit detection in barplots!!!
 - Button for „add all stations” would be great
 - Stations in some order – alphabetical for example

