Evaluation of Delta Forecasting MQO v5.4 for London

Jenny Stocker,
Amy Stidworthy
& Kate Johnson

FAIRMODE Technical Meeting

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Zagreb

Croatia

Contents

- Context
- Delta 5.4 evaluation using London forecasting system performance data
- Specific issues:
  - Colour of points
  - Flexibility option
  - Exceedence indicator bar plots
  - Limited statistics available
- Summary

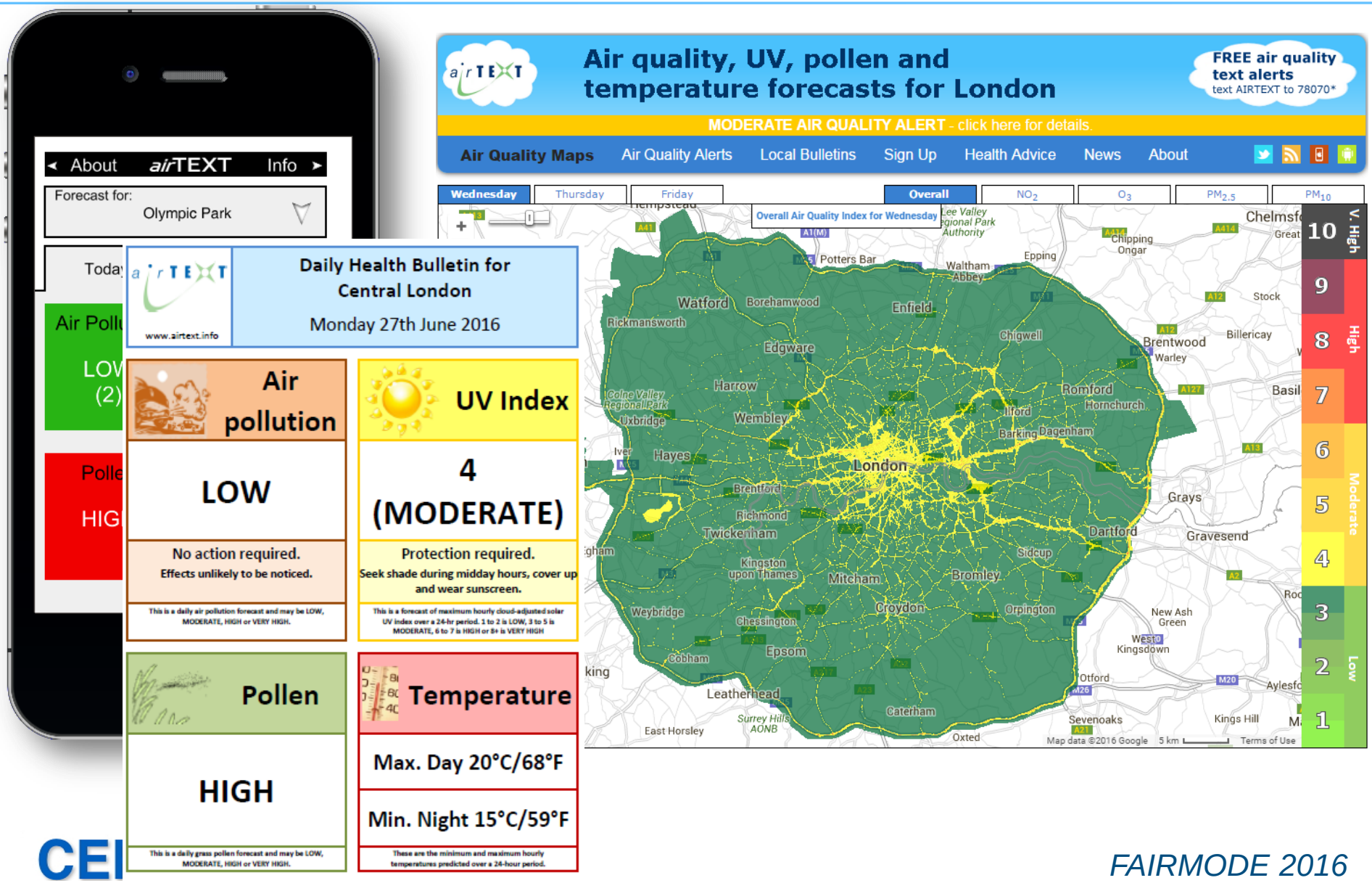
Context

*air*TEXT forecasting system for London

Free air pollution, UV and pollen forecasts for Greater London

Currently providing free air quality alerts to more than 10 000 subscribers

Context
*air*TEXT forecasting system for London

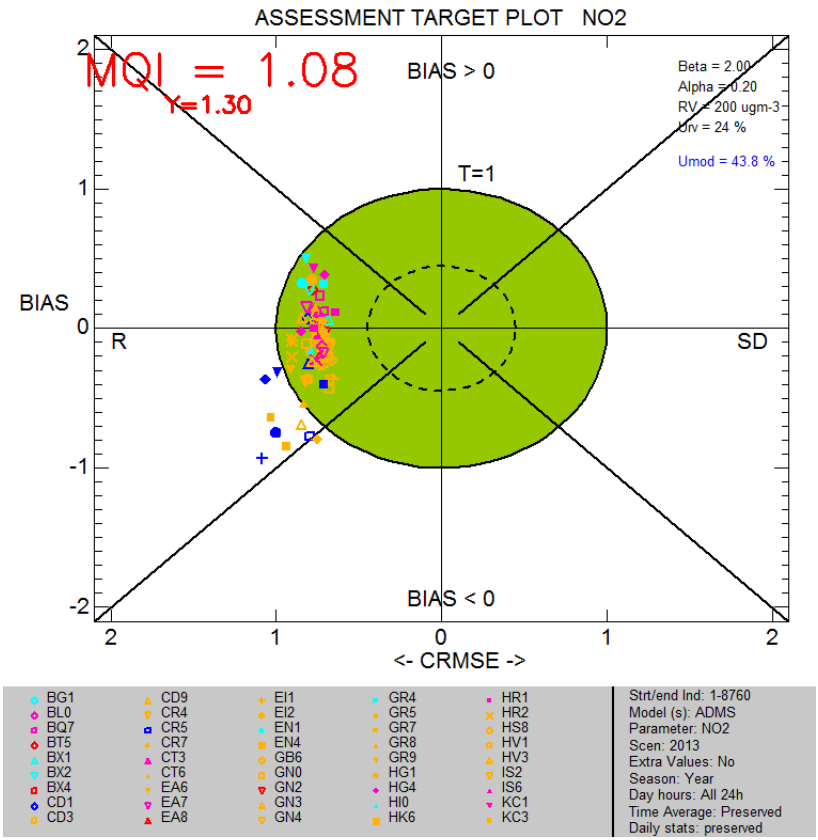


Forecasts supported by funding from defra (www.defra.gov.uk) and EU FP7 PASODOBLE (www.myair-eu.org)

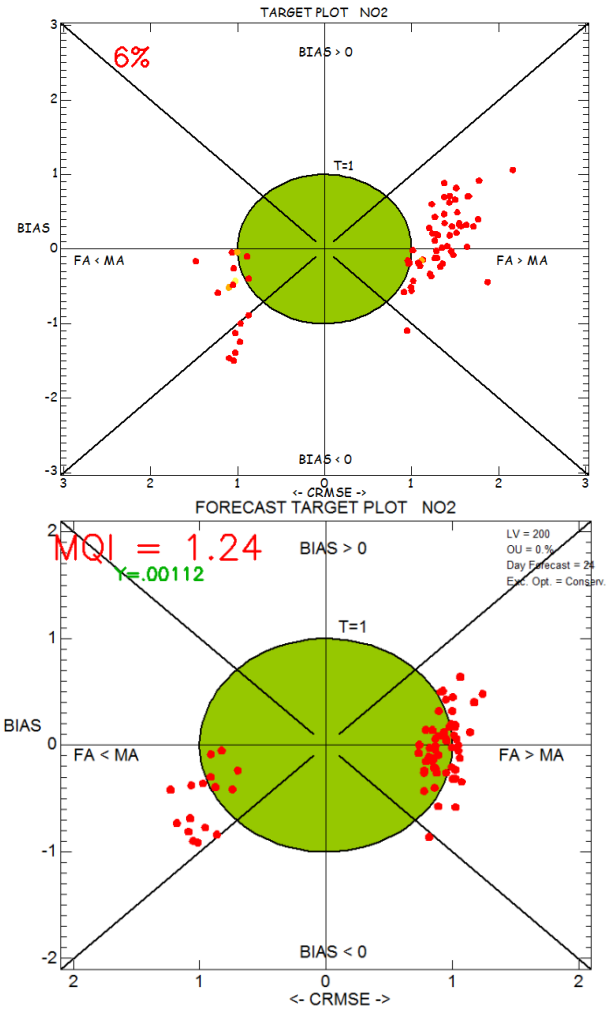
Delta 5.4 evaluation
Data from London's *air*TEXT forecasting system

- Forecasting mode in version 5.4 is greatly improved compared to version 5.1

NO_2 – Standard target



NO_2 – Forecasting target



Version 5.1

Version 5.4

OU = 0.0

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Data from London's *air*TEXT forecasting system

- Why is the forecast model performance now more consistent with the assessment model performance?
- For a 24-hour forecast of NO_2 the persistence model result for hours 1 to 24 uses the observations from:
  - Version 5.1: hours 0 to 23 (an hour before) ✗
  - Version 5.4: hours -23 to 0 (a day before) ✓

Version 5.1

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

Version 5.4

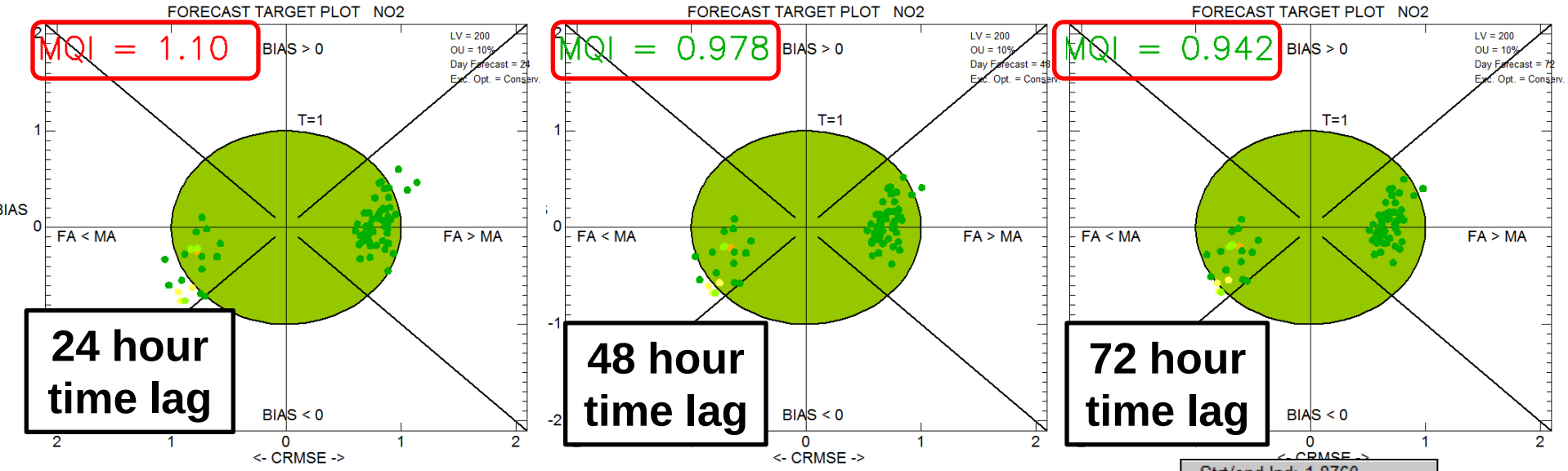
$$\text{Target}_{\text{forecast}} = \frac{\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(M_i^* - O_i\right)^2}}{\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(O_{i-j} - O_i\right)^2}}$$

M* is the modelled forecast values after accounting for uncertainty

indice "j" represents the forecast time length

Delta 5.4 evaluation
Data from London's *air*TEXT forecasting system

- Does the target plot correctly assess forecasts for Day 1 (24 hour time lag), Day 2 (48 hour time lag), Day 3...
- Test using the same dataset for each of the Day 1, Day 2 and Day 3 forecasts
- *Model* forecast remains the same but *persistence* forecast gets worse
- Target MQI parameter reduces for the longer term forecasts ✓
- Further assessment – use real 3-day forecasts



NO_2 limit value 200 µg/m^3,
10% observation uncertainty

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: 1-8760
Model (s): ADMS
Parameter: NO2
Scen: 2013
Extra Values: 200/10./1.0/24.
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: preserved

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2016

Specific issues
Colour of points

Guidance doc v6 (March 2016)

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

$$0.2 \le \frac{GA_+}{FA+MA+GA_+} < 0.4 \Rightarrow \text{Orange}$$

$$0.4 \le \frac{GA_+}{FA+MA+GA_+} < 0.6 \Rightarrow \text{Yellow}$$

$$0.6 \le \frac{GA_+}{FA+MA+GA_+} < 0.8 \Rightarrow \text{Light green}$$

$$0.8 \le \frac{GA_+}{FA+MA+GA_+} \Rightarrow \text{Dark green}$$

Guidance doc v8 (June 2016)

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

$$0.2 \le \frac{FA}{FA+GA_+} < 0.4 \Rightarrow \text{Orange}$$

$$0.4 \le \frac{FA}{FA+GA_+} < 0.6 \Rightarrow \text{Yellow}$$

$$0.6 \le \frac{FA}{FA+GA_+} < 0.8 \Rightarrow \text{Light green}$$

$$0.8 \le \frac{FA}{FA+GA_+} \Rightarrow \text{Dark green}$$

- Both versions state

'Points should ideally be located within the right hand side of the circle (FA>MA) with symbols in green'

- V6 document
  - FA, MA large => metric close to 0 i.e. red
  - FA, MA small => metric close to 1 i.e. green ✓
- V8 document
  - Why has MA been removed from the metric?
  - FA large => metric close to 1 i.e. green ✗
  - FA small => metric close to 0 i.e. red
- Both versions
  - Why do we want FA > MA?
  - Do we prefer a forecast that overpredicts? No.

Specific issues
Flexibility options

- Flexibility level option is welcome
  - ‘Conservative’ & ‘cautious’ options are useful
  - ‘Model’ option is the fairest of the three – may exaggerate the skill of a model because of observation uncertainty?
  - Introduce a ‘certain’ option where data points are removed from the assessment if the observed data may or may not indicate an alert threshold?

‘Certain’ would restrict the assessment to those data points where it is certain that an alert was or was not exceeded.

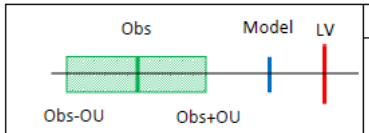
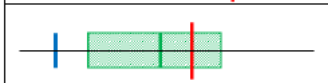
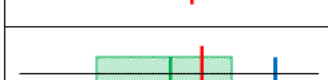
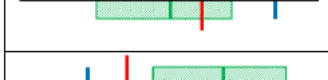
	Observations		Model		DELTA
	relation to LV	Alarm?	relation to LV	Alarm?	
	O_+<LV	No	M<LV	No	GA-
	O_+<LV	No	M≥LV	Yes	FA
	O_-<LV O_+≥LV	1: Yes, conservative 2: No, cautious 3: Same as model	M<LV	No	MA GA- GA-
	O_-<LV O_+≥LV	1: Yes, conservative 2: No, cautious 3: Same as model	M≥LV	Yes	GA+ FA GA+
	O_-≥LV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

Table 1: 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 (please check). The DELTA column indicates how DELTA considers the specific cases here described.

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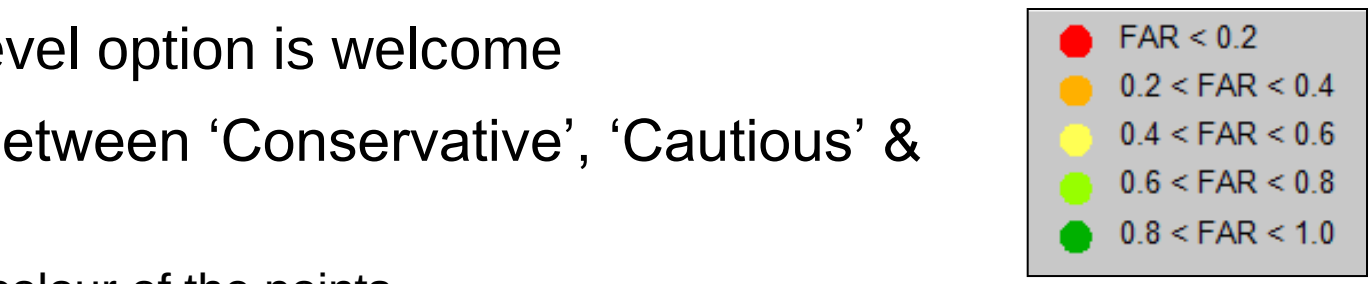
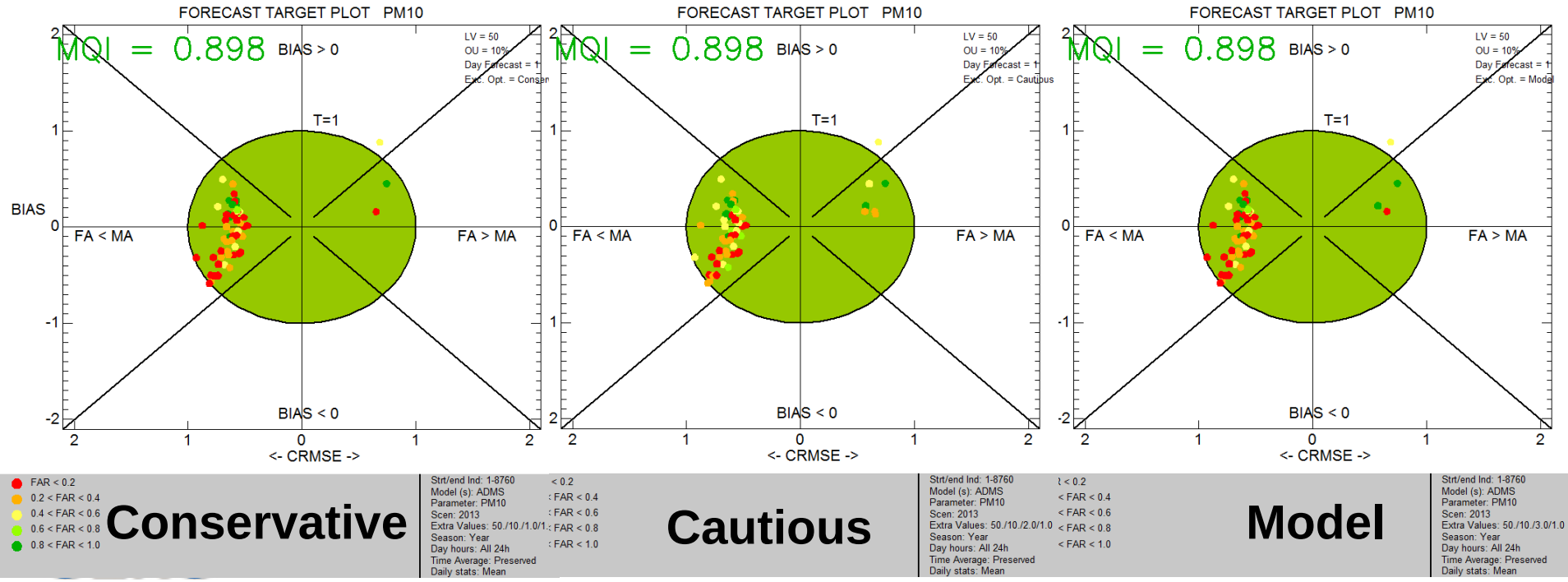
Specific issues
Flexibility options

- Flexibility level option is welcome
- Switching between ‘Conservative’, ‘Cautious’ & ‘Model’:
  - alters the colour of the points,
  - ‘flips’ points between left and right hand side of the plot
  - changes values? not in this case





Exceedance indicator bar plots

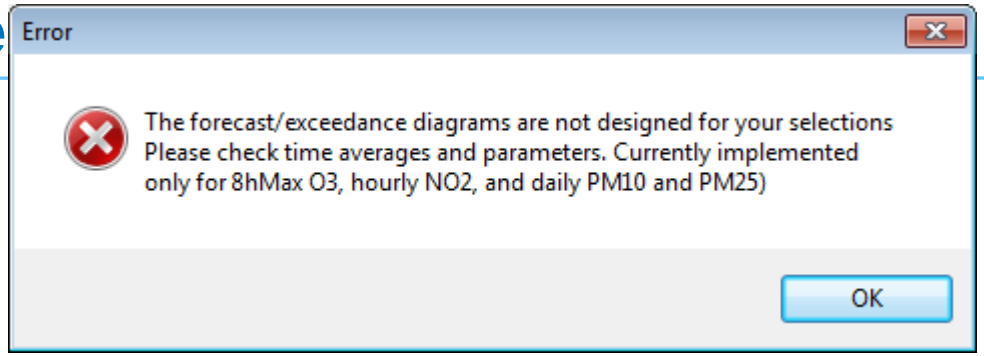
- Two versions of the "composite exceedances ratio"

$$\mathrm{CEI}_1 = \frac{DP}{1-FAR} = \frac{FA+GA_+}{MA+GA_+} = \frac{\text{Modelled exceedances}}{\text{Observed exceedances}}$$

$$\mathrm{CEI}_2 = 0.5\left(DP+1-FAR\right) = 0.5\left[\frac{GA_+}{MA+GA_+} + \frac{GA_+}{FA+GA_+}\right]$$

- **CEI_1 is not useful:**
  - A poor forecast, with FA and MA high but GA_+ low gives CEI_1~1
  - A good forecast, with FA=0 and MA=0, gives CEI_1=1
- **CEI_2** is more helpful:
  - Only a good forecast could give CEI_2=1
  - A very poor forecast (GA_+=0) would give CEI_2=0.

Specific issues
Limited statistics available



- For PM_{10} & $PM_{2.5}$:
  - Delta forecast tool assesses the
  - Consistent with CAQI & DAQI
- For NO_2:
  - Delta forecast tool assesses hourly values
  - Consistent with CAQI but not with DAQI (maximum over the day)
- For O_3:
  - Delta forecast tool assesses the maximum daily 8 hour average
  - Consistent with DAQI but not CAQI

Common Air Quality Index (CAQI)

THE HOURLY AND DAILY COMMON INDICES

- NO2, O3, SO2: hourly value / maximum hourly value in µg/m3
- PM10, PM2.5: hourly value / maximum hourly value or adjusted daily average in µg/m3
- CO: 8 hours moving average / maximum 8 hours moving average in µg/m3

UK Daily Air Quality Index (DAQI)

PM_{10} Particles

Based on the daily mean concentration for historical data, latest 24 hour running mean for the current day.

Index	1	2	3	4	5	6	7	8	9	10
Band	Low	Low	Low	Moderate	Moderate	Moderate	High	High	High	Very High
µg/m³	0-16	17-33	34-50	51-58	59-66	67-75	76-83	84-91	92-100	101 or more

Common air quality index calcu

		ROADSIDE INDEX								
		Mandatory pollutant			Auxiliary pollutant				Ma po	
			PM10		PM2.5		CO	NO2		
			hour	24 hours	1 hour	24 hours			1 hou	
Very High	>100	>400	>180	>100	>110	>60	>20000	>400	>18	
High	100	400	180	100	110	60	20000	400	180	
	75	200	90	50	55	30	10000	200	90	
Medium	75	200	90	50	55	30	10000	200	90	
	50	100	50	30	30	20	7500	100	50	
Low	50	100	50	30	30	20	7500	100	50	

Summary

- Forecasting mode in version 5.4 is greatly improved compared to version 5.1
- Only a few minor issues to resolve:
  - Colour of points – resolve definition
  - Flexibility option – include ‘certain’?
  - Exceedence indicator bar plots – remove CE_1?
  - Limited statistics available – can we make the statistics user defined?

- If time during the meeting, it would be good to resolve the ‘Remaining issues’ (Section 5 of document) as some of these are out of date & we should possibly add new ones?