Feedback on the NO_2 MQO with 1-hr and 3-hr averages

Jenny Stocker,
David Carruthers
& Kate Johnson

7th Plenary Meeting of FAIRMODE

April 2014

Kjeller

Norway

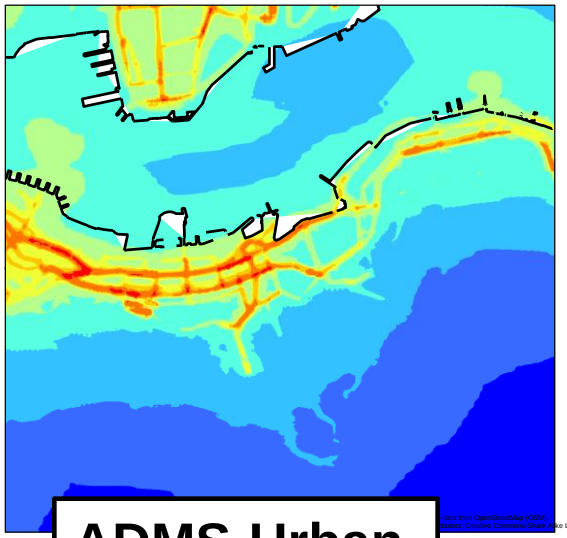
Contents

- Model descriptions
- DELTA tool developments (versions 1.2 to 3.6)
- New datasets for comparison
- Application of the 1-hr and 3-hr NO_2 averages
- Future development suggestions
- Summary

Model descriptions

- Models:
  - **ADMS-Urban** is a high resolution (10s of metres) Gaussian plume model
  - **CAMx** is an Eulerian grid photochemical dispersion model, usually run at resolutions up to 1 km
- Outputs:
  - For both models, hourly calculations are performed at background, roadside and kerbside locations

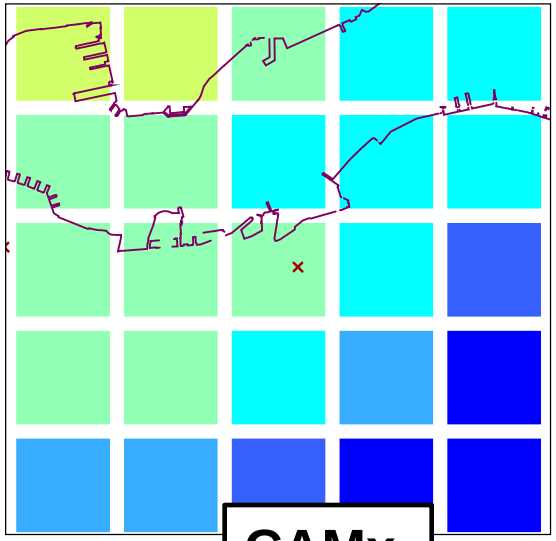
5 km



ADMS-Urban

NO_2 concentrations, Hong Kong

Note: plots are illustrative of spatial resolution only



CAMx

5 km

CERC

Environmental Protection Department
The Government of the Hong Kong Special Administrative Region

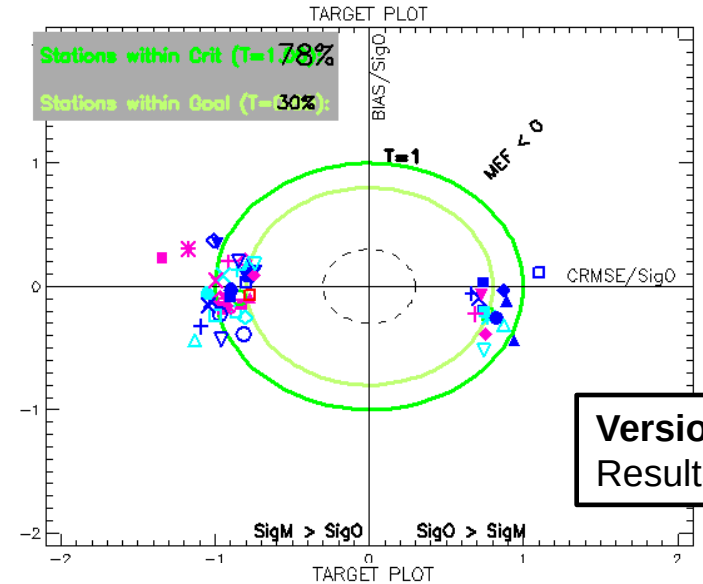
香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

DELTA tool developments (versions 1.2 to 3.6)

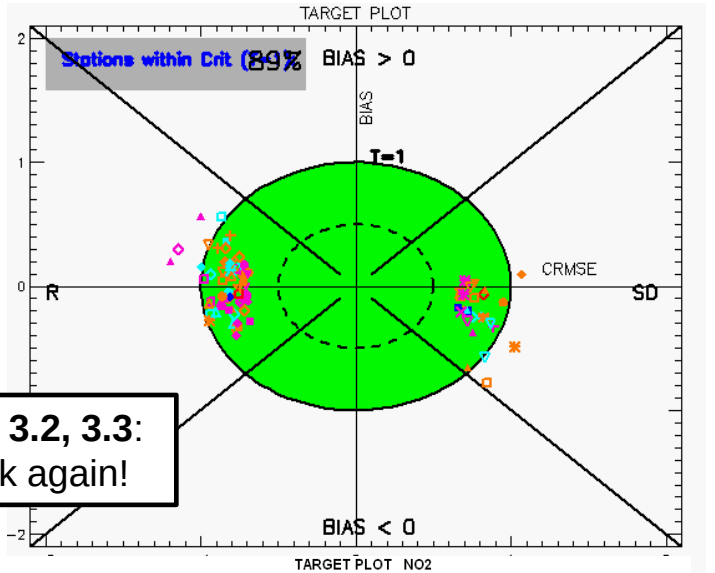
- Target plots showing ADMS-Urban London 2008 results:
  - NO_2 plots have changed significantly

DELTA tool developments (versions 1.2 to 3.6)

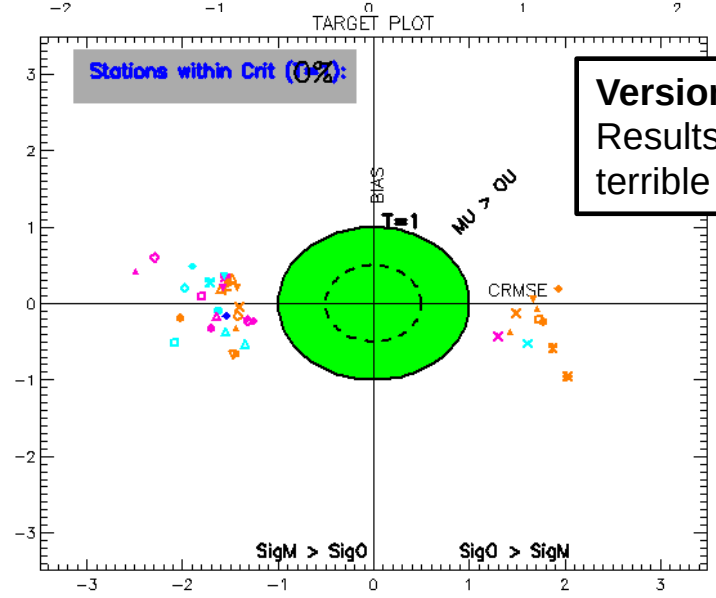
- Target plots showing ADMS-Urban London 2008 results: NO_2



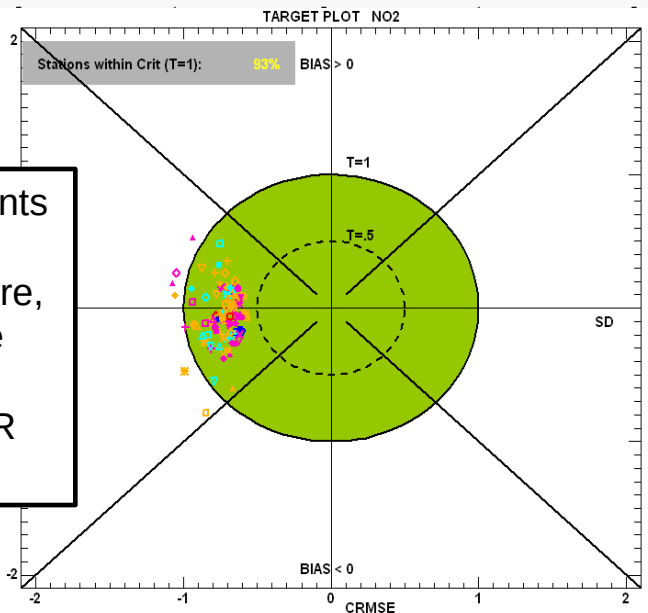
Version 1.2: Results look ok



Versions 3.2, 3.3: Results ok again!



Version 2.0: Results look terrible



Version 3.6: Points have moved towards the centre, and those on the SD side have swapped to the R side

DELTA tool developments (versions 1.2 to 3.6)

- Target plots showing ADMS-Urban London 2008 results:
  - NO_2 plots have changed significantly
- Between versions 3.3 and 3.6, it looks like the RMS_u has changed again, from:

$$RMS_U = ku_r^{RV}\sqrt{(1-\alpha)(\overline{O}^2+\sigma_o^2)+\alpha * RV^2}$$

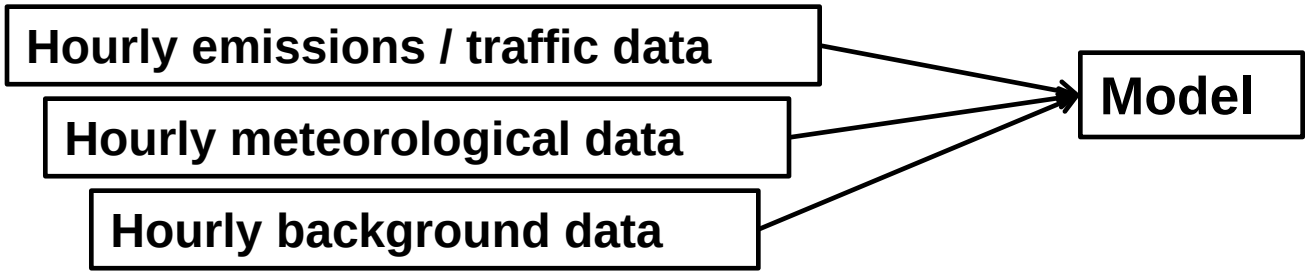
to

$$RMS_U = ku_r^{RV}\sqrt{(1-\alpha)(\overline{O}^2)+\alpha * RV^2}$$

- Is there an explanation of this change? Is it not important to keep a measure of the standard deviation of the observations in this parameter?

DELTA tool developments (versions 1.2 to 3.6)

- Target plots showing ADMS-Urban London 2008 results:
  - NO_2 plots have changed significantly
- **Questions to answer:**
  - Is the hourly NO_2 target achievable? The models require accurate hourly input data, including significant variation, to produce good results.



  - For this ADMS-Urban DELTA version 3.6 NO_2 dataset all the points are on the left hand side of the target. Is this the case for all datasets?

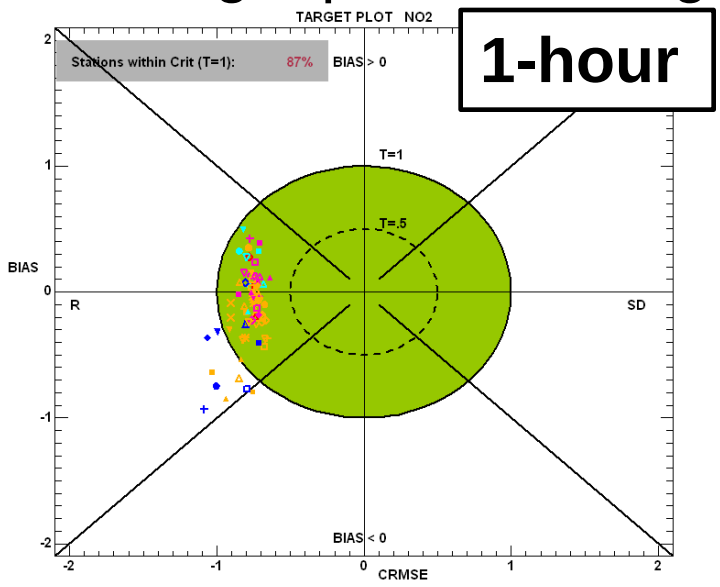
New datasets for comparison

Datasets summary

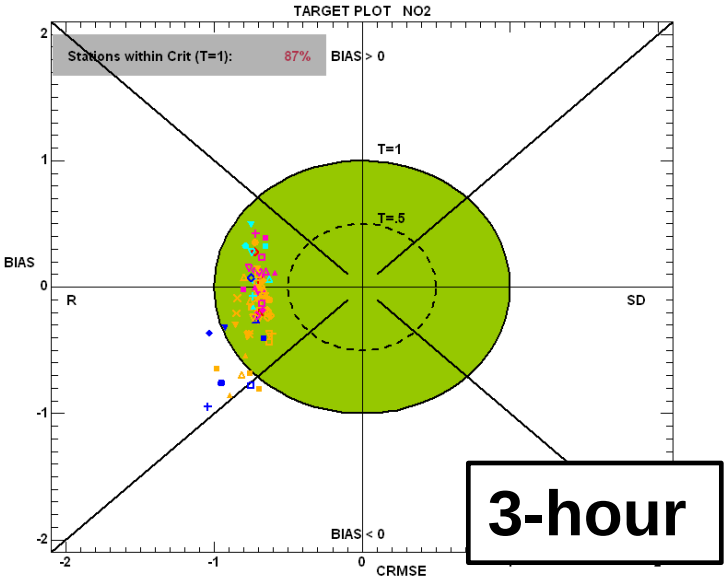
Location	London	London	Hong Kong	Hong Kong
Year	2008	2013	2010	2010
Model	ADMS-Urban	ADMS-Urban	ADMS-Urban	CAMx
Model type	Gaussian	Gaussian	Gaussian	Eulerian
Set up mode	Hindcast	Forecast	Hindcast	Hindcast
Number of monitors	~100	~100	14	14
Monitor type	Roadside, urban background	Roadside, urban background	Roadside, urban background, rural	Roadside, urban background, rural

Application of the 1-hr and 3-hr NO_2 averages
ADMS-Urban, London 2013

- Target plots showing ADMS-Urban London 2013 results:



1-hour

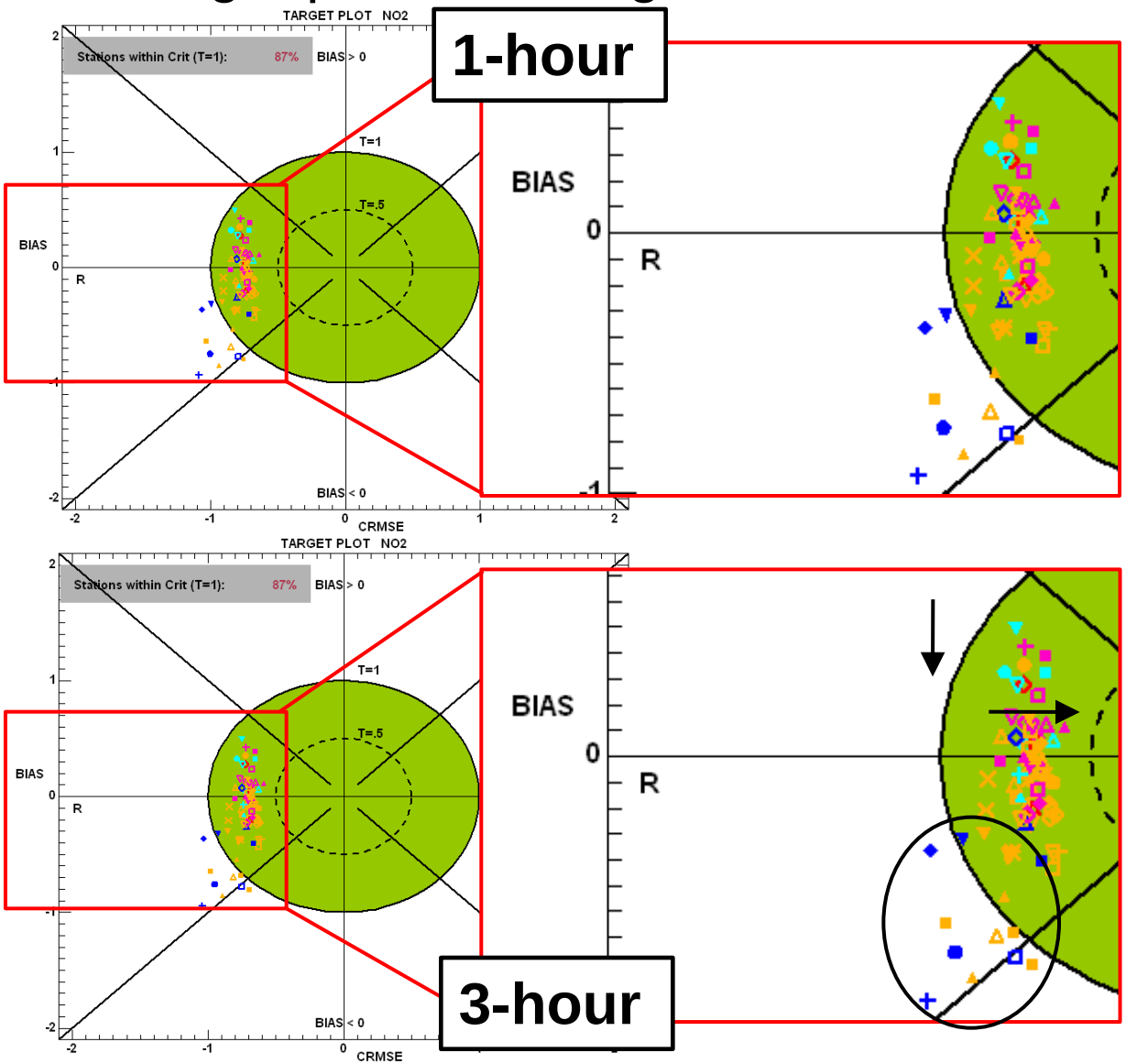


3-hour

- Results for 1-hr and 3-hr averaging times not significantly different

Application of the 1-hr and 3-hr NO_2 averages
ADMS-Urban, London 2013

- Target plots showing ADMS-Urban London 2013 results:



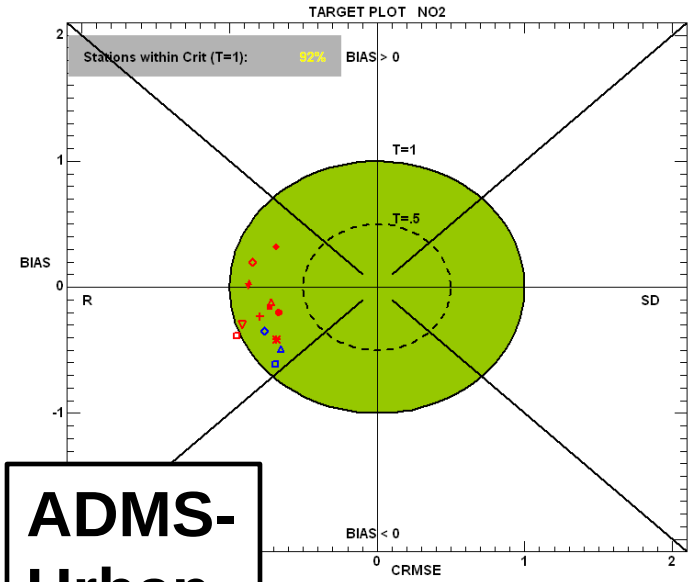
- Results for 1-hr and 3-hr averaging times not significantly different
- ‘Centre’ of group of points marginally closer to the target
- Outliers have improved slightly

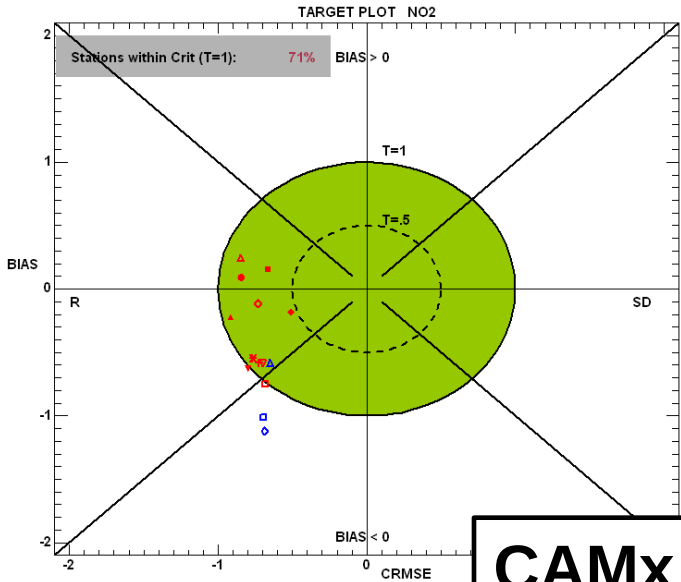
Application of the 1-hr and 3-hr NO_2 averages ADMS-Urban and CAMx, Hong Kong 2010

- Target plots showing Hong Kong 2010 results:

1-hour

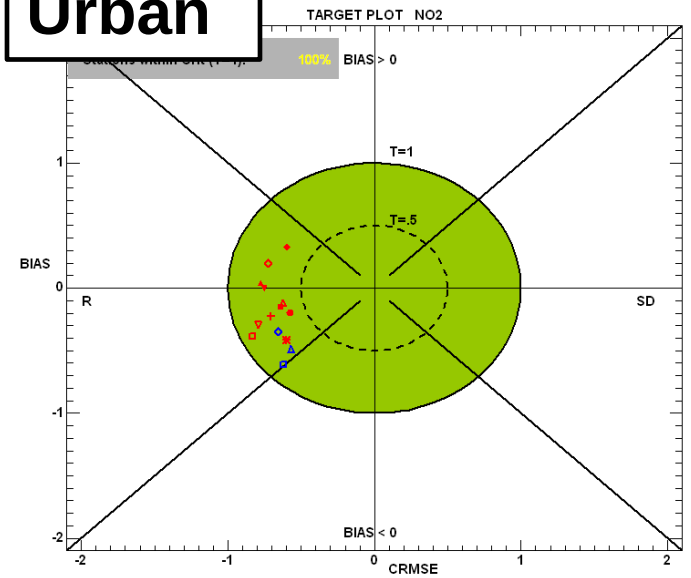
ADMS-Urban

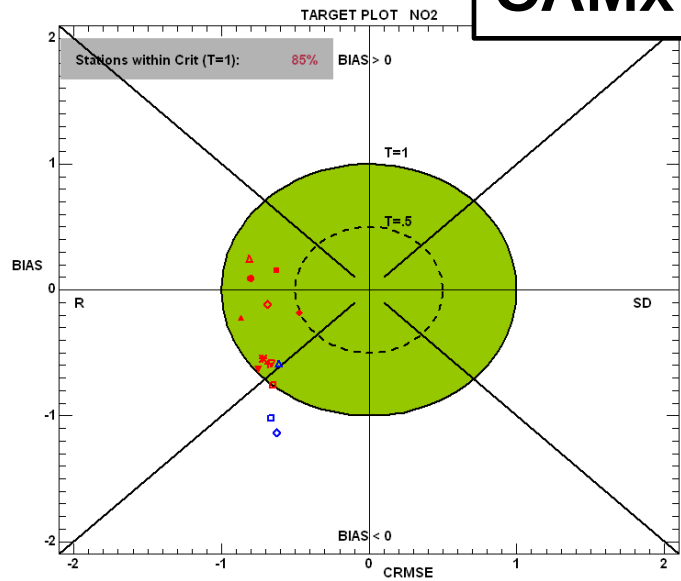




CAMx

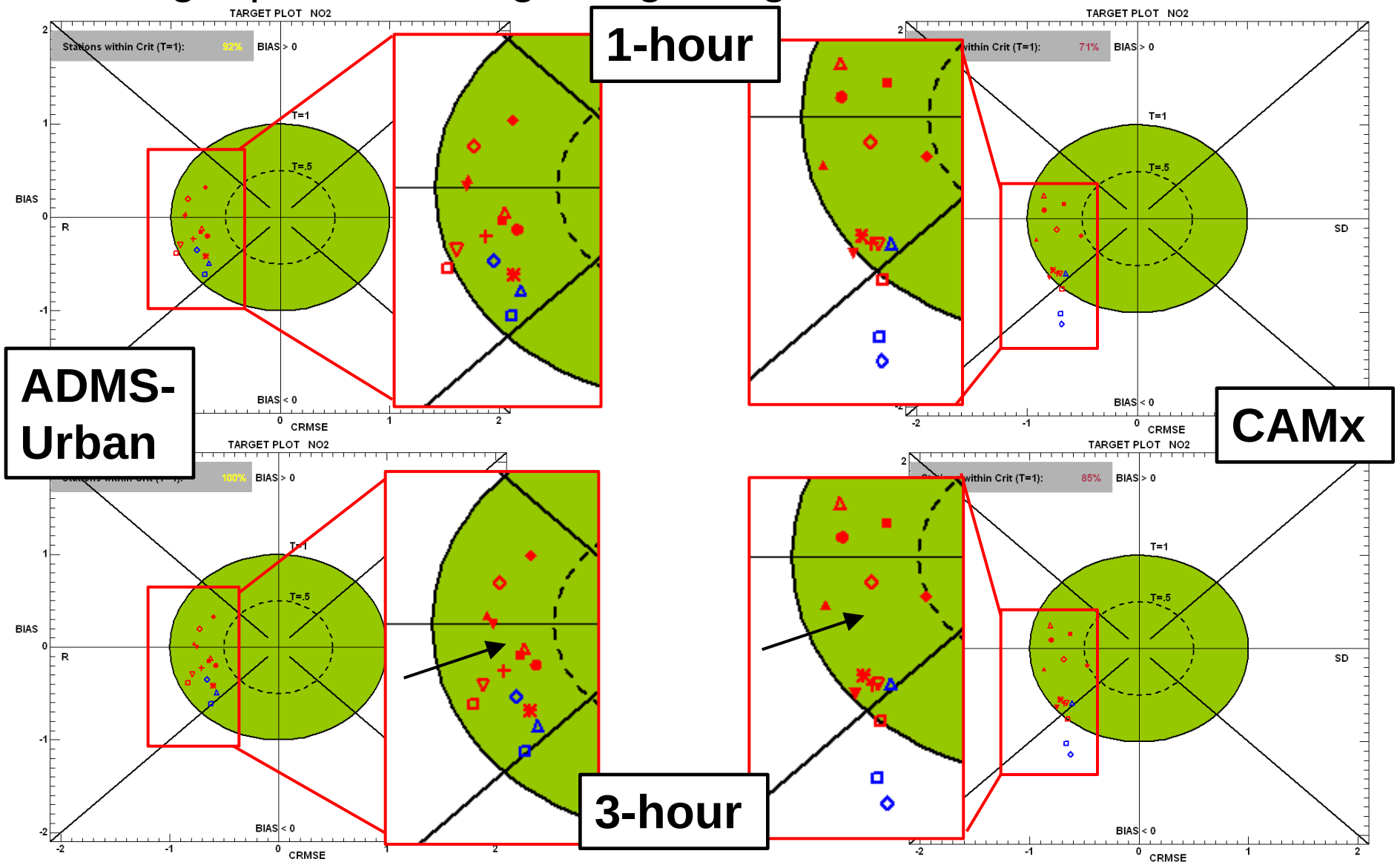
3-hour





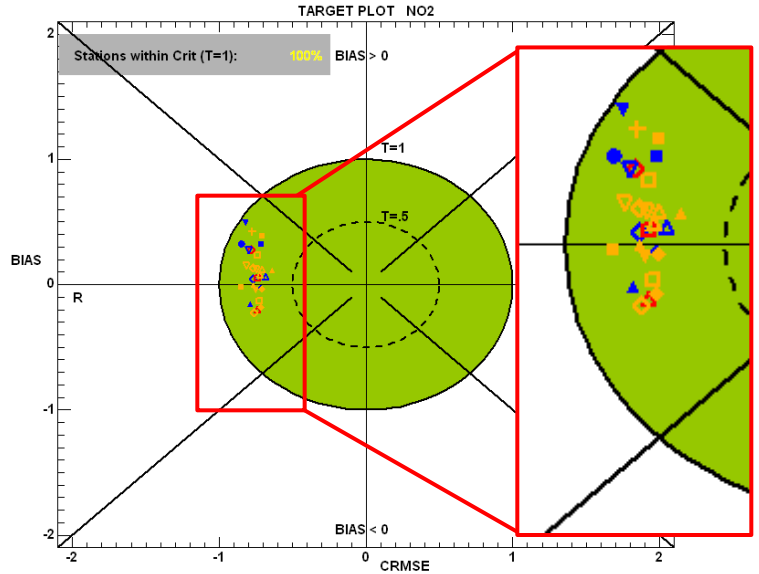
Application of the 1-hr and 3-hr NO_2 averages ADMS-Urban and CAMx, Hong Kong 2010

- Target plots showing Hong Kong 2010 results:

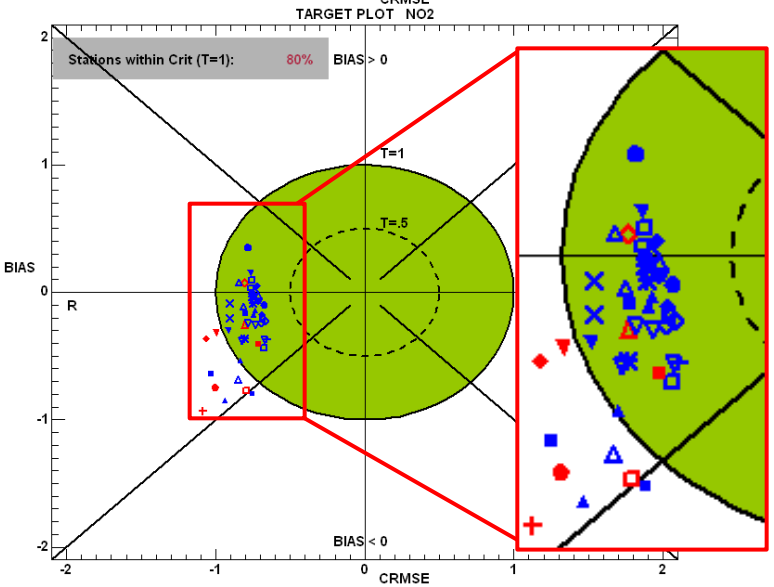


Application of the 1-hr and 3-hr NO_2 averages
Distinguish between roadside and urban background

- Target plots showing 1-hr ADMS-Urban London 2013 results:



Urban background

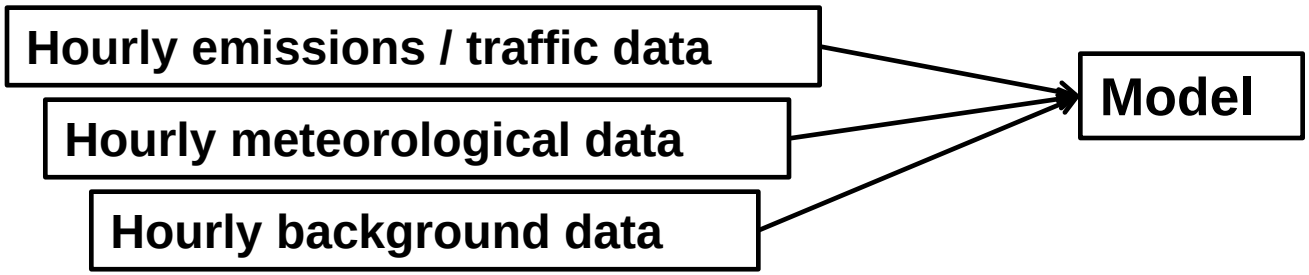


Roadside

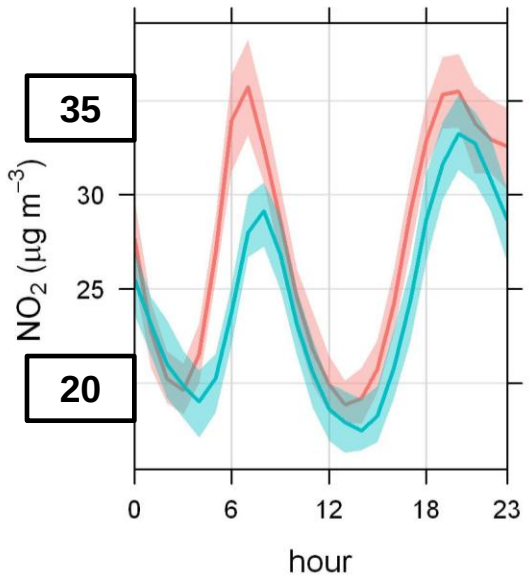
- NO_2 1-hourly statistic is achievable for urban background sites
- NO_2 is more challenging for roadside sites

Future development suggestions

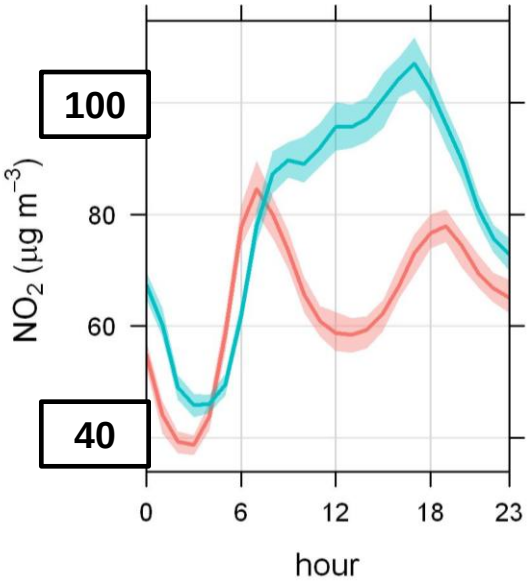
- **Questions to answer:**
  - Is the hourly NO_2 target achievable? The models require accurate hourly input data, including significant variation, to produce good results.



Urban background site HR1 (within MPC for R)



Roadside site MY1 (outside MPC for R)



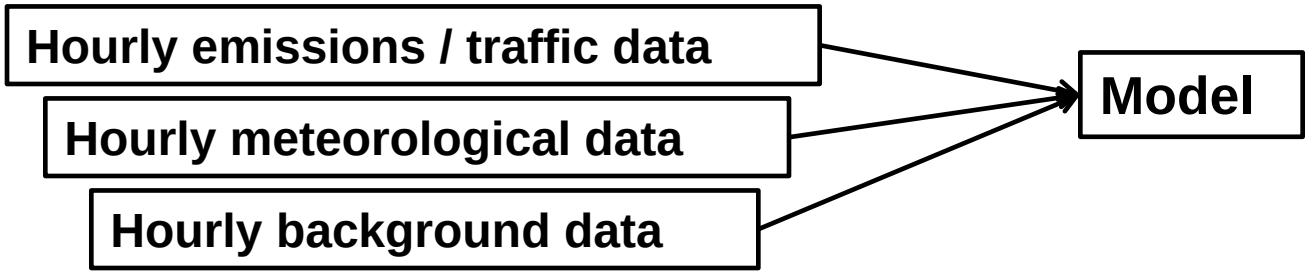
Diurnal annual averages

Modelled

Observed

Future development suggestions

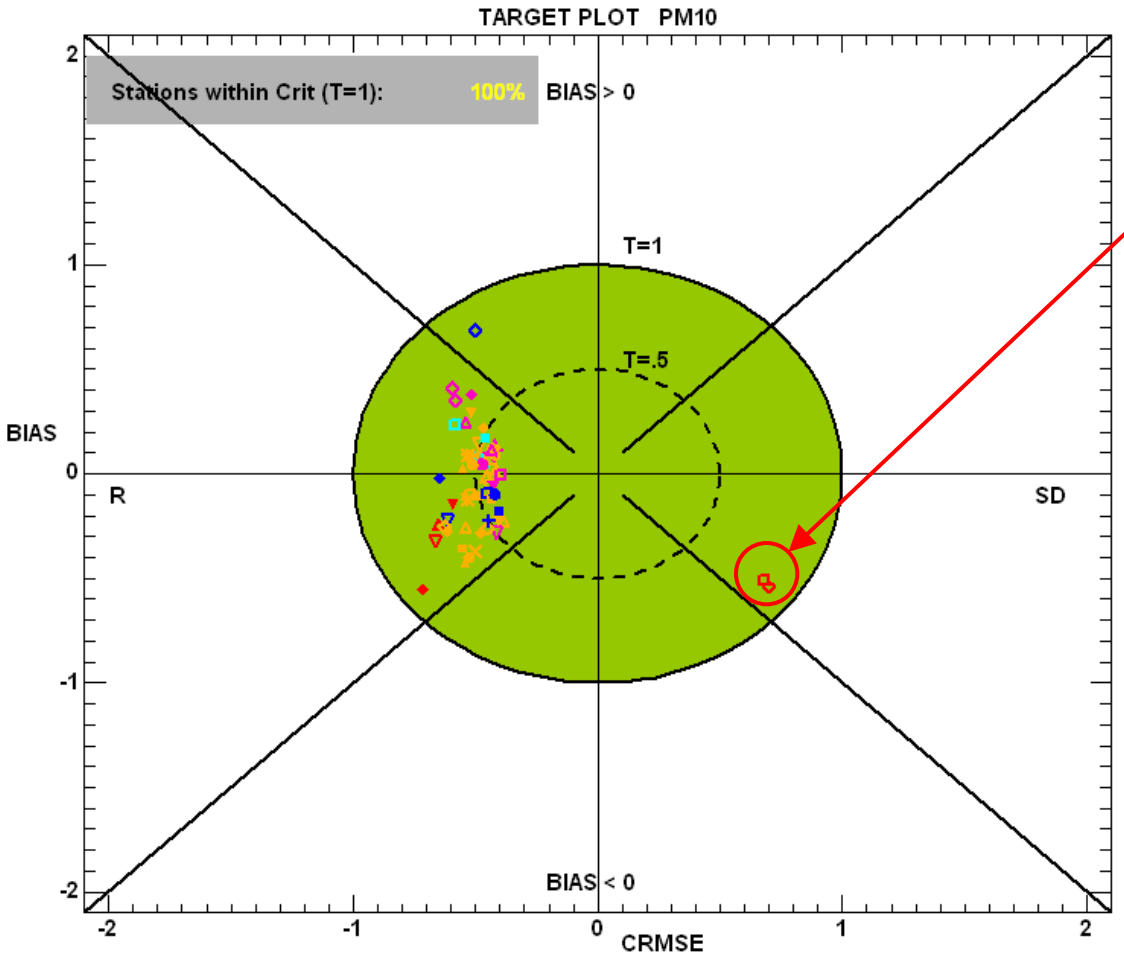
- **Questions to answer:**
  - Is the hourly NO_2 target achievable? The models require accurate hourly input data, including significant variation, to produce good results.



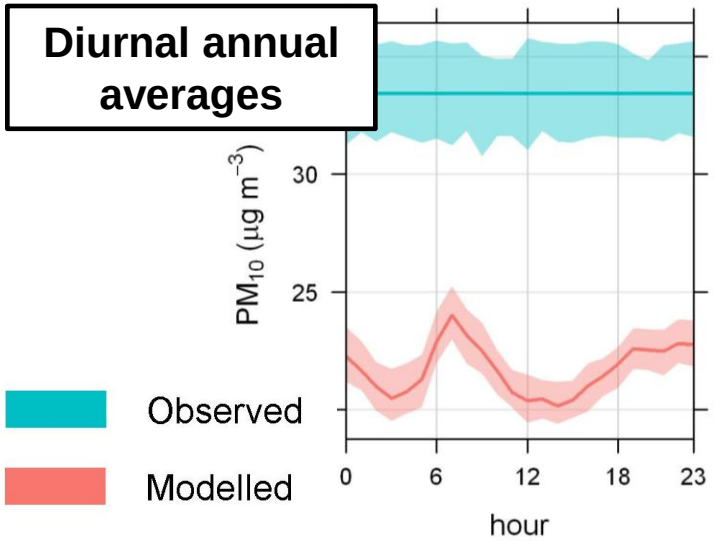
Could have a different MPC for roadside sites to allow for additional uncertainty in ***local model inputs***?

Future development suggestions

- **Questions to answer:**
  - For this NO_2 ADMS-Urban dataset the points are on the LHS of the target. Is this the case for all datasets?



- No!
- For the PM_{10} 2013, there are two points on the RHS
- But there is something wrong with the monitoring data for these two points



Summary

- The 3-hourly NO_2 averaging time has been implemented in the DELTA Tool, but it does not result in a significant improvement in results.
- Introduce a different MPC for roadside sites to allow for additional uncertainty in local model inputs.
- Re-evaluate the need for the right hand side of the target plot.

Possible developments:

- Inclusion of NO_x
  - In order to investigate issues with NO_2 modelling, it is helpful to look at NO_x performance.
- Release of an associated 'What's New?' document with new versions of the DELTA tool, to explain updates to formulations as well as new file formats and other features.
- Displaying more monitors in the key (>45) and more unique symbols (more colours?)