AARHUS UNIVERSITY
DEPARTMENT OF ENVIRONMENTAL SCIENCE

May 6, 2013

Experiences using the Delta Tool for model quality assurance

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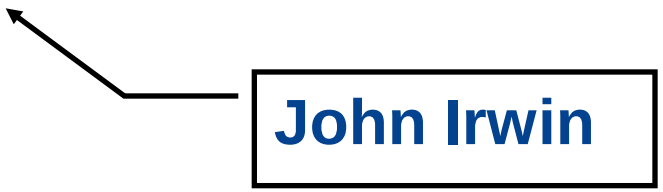
A broad perspective

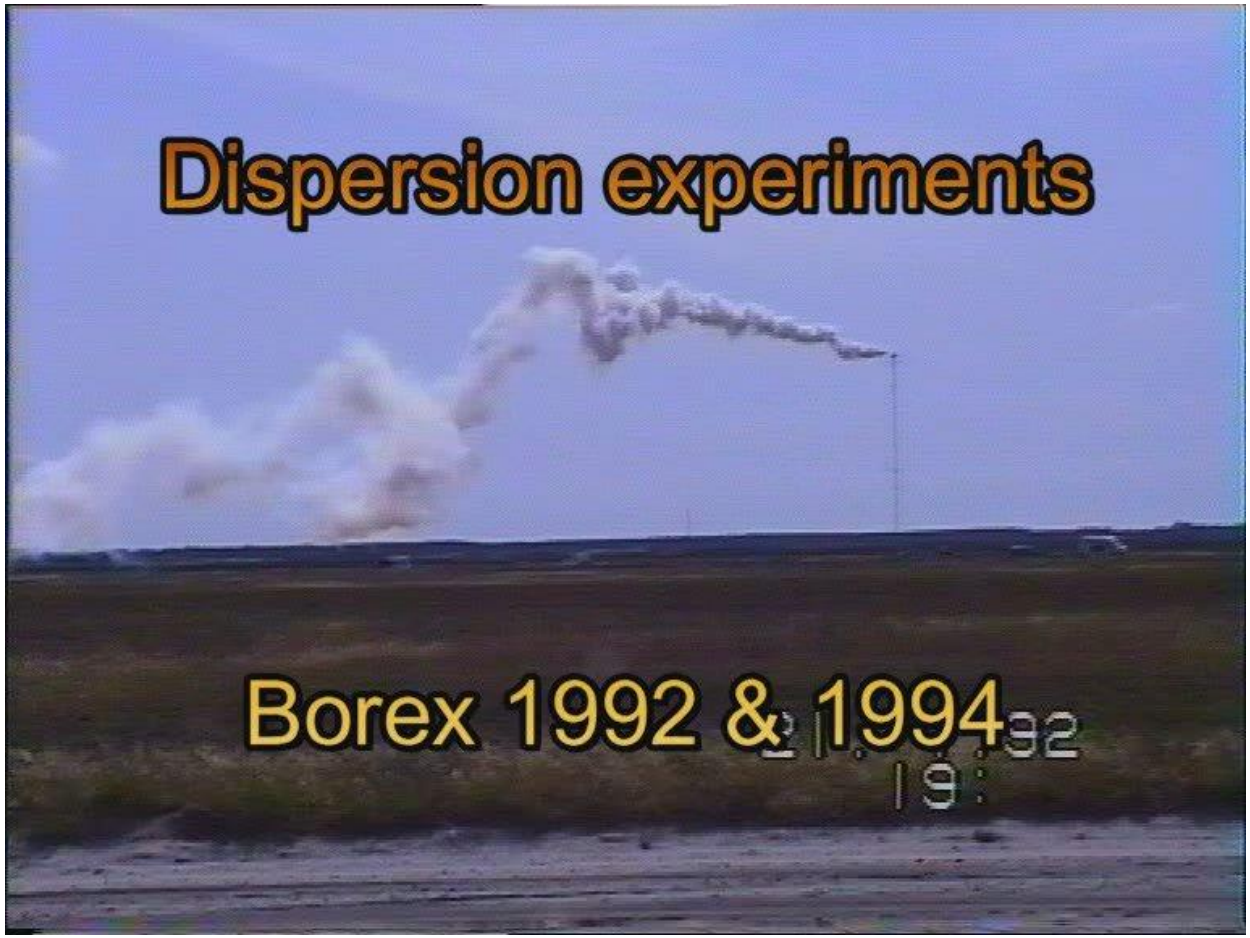
- The classic single stack problem.
- The ”EU Directive problem” where the Delta Tool comes in.

Classic single stack problem

- You have a single source surrounded by arcs of monitors.
- How do you evaluate model performance?
- "Model Validation Kit"
- ASTM standard guide D6589 on statistical evaluation of dispersion models

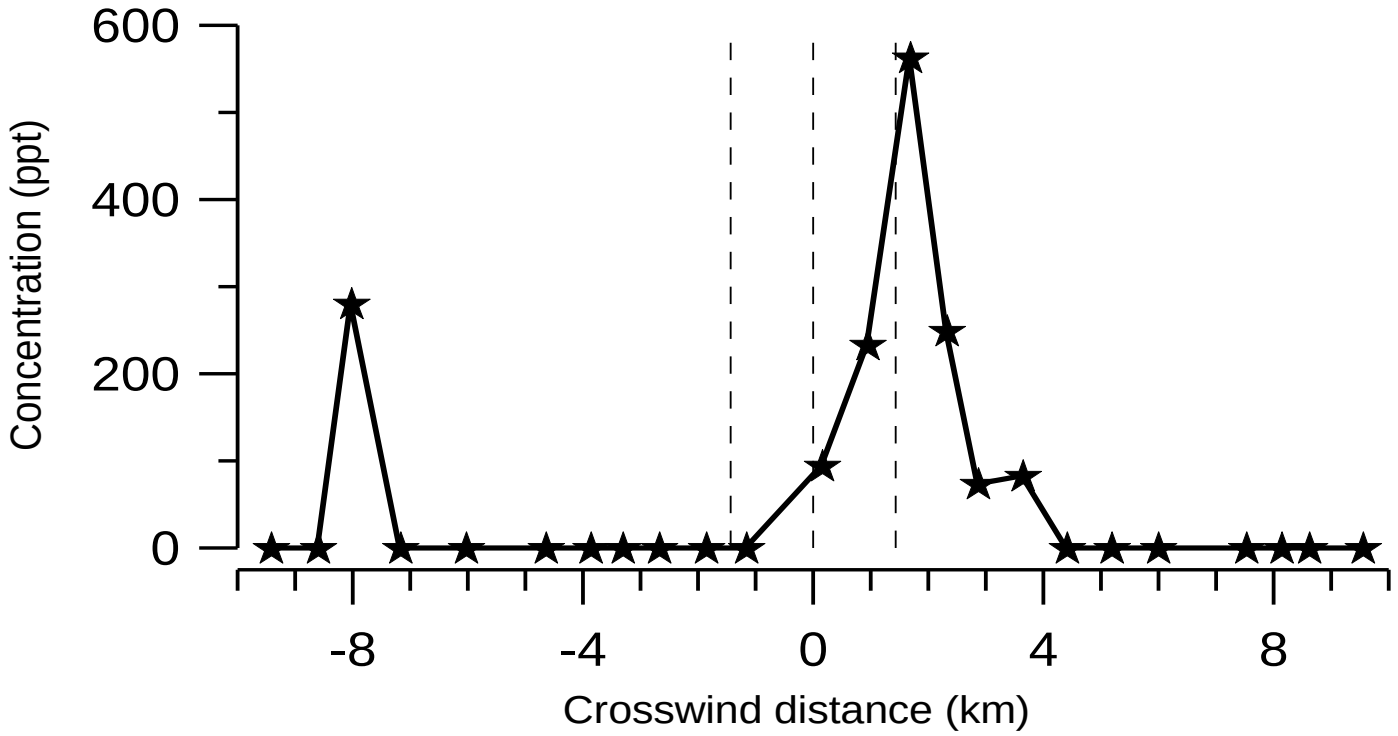


Video...



Inherent incertainty

- The atmosphere is turbulent with stochastic variations
- Nature provides us with individual realisations.
- With our models we can only hope to predict ensemble averages.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Concentration (ppt)
-8
-4
0
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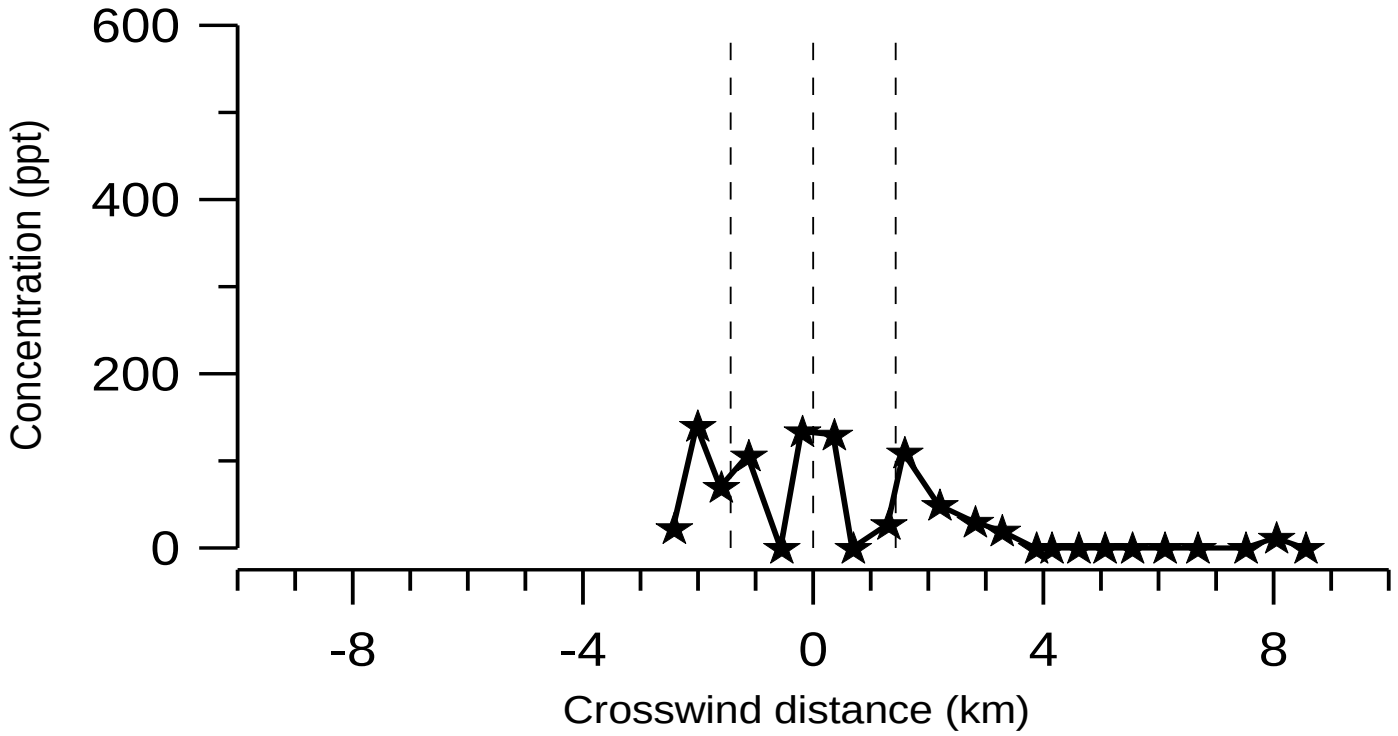
Crosswind distance (km)


600
400
200
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Concentration (ppt)
-8
-4
0
4
8
Crosswind distance (km)

Classic stack problem

Conclusion already established in the eighties:

- Pairing model results and observations with respect to time and space is not useful when dealing with a single stack.
  It yields a correlation close to zero.

Parameters we may consider

- Arc-wise maxima (Model Validation Kit)
- Near centerline concentrations (ASTM Standard Guide)
- Crosswind integrated concentrations (Cy) and sigma's (Sy) (John Irwin's most recent recommendations)

John Irwins latest recommendations

- Compare group geometric mean values of observed Cy and Sy values.
  John states: ”We place too much emphasis on the importance of Cmax in our model evaluations; Cmax is dependent upon Cy and Sy (not the other way around).”
- More on John’s work at his website

  www.jsirwin.com
- (you may also go though the URL mentioned in my abstract)

The ”EU Directive problem”

- Models are used to assess compliance with limit values at numerous locations in Europe.
- How should requirements for model performance be defined? In other words: What ”Model Quality Objectives” will it make sense to put into a legal framework?
- The Delta Tool is work in progress to address this problem. JRC Ispra leads the work.
- Philippe Thunis has a presentation tomorrow on the Delta Tool.

Differences between the two problems

- **The classic single stack problem:** We try to model a highly fluctuating signal.
  If we compare observations and model results in space and time correlation will be close to zero.
- **The ”EU Directive problem”:** For the majority of monitoring sites multiple sources interact.
  Background pollution is important.
  For the majority of sites we deal with a relatively smooth signal.

Further differences between problems

- **The classic single stack problem**: The emission source strength is known.
- **The ”EU Directive problem”:** The emission inventory is part of the problem. The quality of the *total system* is an issue: *emission modelling* plus *atmospheric transport and chemistry modelling*.

FAIRMODE Meeting – draft agenda first day

Wednesday, 10th of April 2013

Elzenveld Conference Center in Antwerp, Belgium

09:00-09:45	*Registration and welcome coffee*	
09:45-10:15	*Welcome by the host*	**Elke Trimpeneers (IRCELINE) & Stijn Janssen (VITO)**
10:15-10:45	*The Air Policy Review process – status quo and future developments*	**DG Environment** ***(tbc)***
10:15-11:00	*FAIRMODE – where we are within working group 2*	**Stefano Galmarini (JRC)**
11:00 -11:20	*Coffee Break*	
11:20-12.30	WG2 – Quality assurance and benchmarking	**Stefano Galmarini (JRC)**

SG4: Benchmarking and Model Quality Objectives

- *Experiences/comments from participants regarding Model quality objectives and discussion*
- *Discussion*
- *DELTA tool: Overview of updates*
- *DELTA tool: MS experiences & feedback*

The Delta Tool

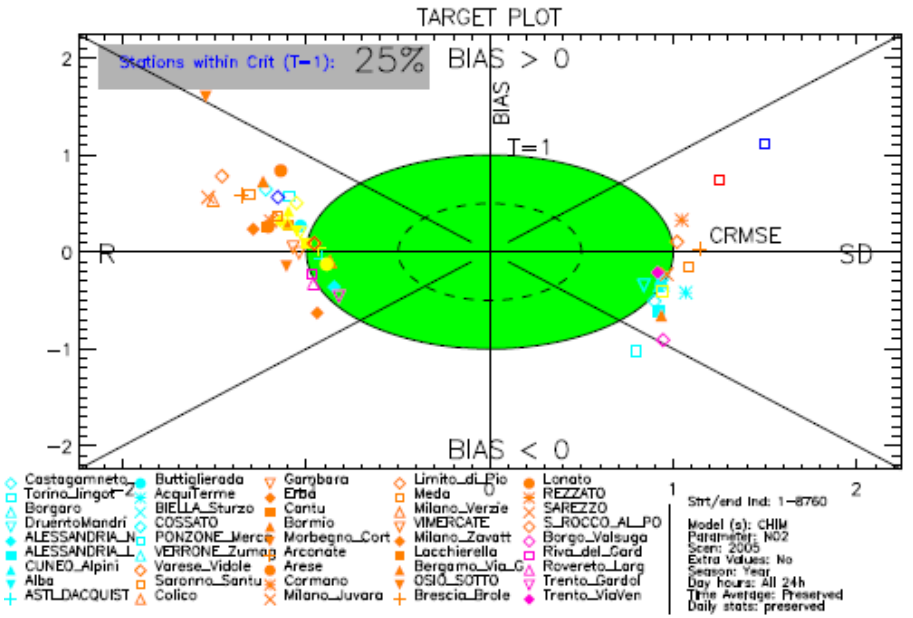
- A set of software. The user prepares
  1. Data for one year of observations for a number of stations.
  2. Model results at the corresponding locations.
- The system provides a common frame of reference for evaluating model performance.
- It is possible to make some exploratory analyses within the system.
  However, the core is a Benchmarking report

Notes on the Benchmarking tool

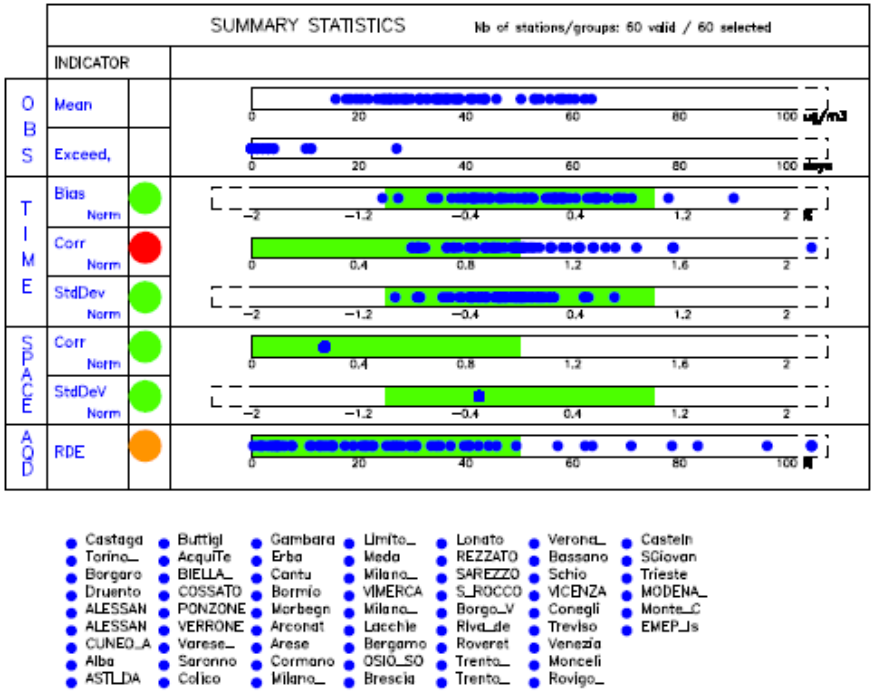
- It is in a testing fase.
- The tool operates with performance criteria, but these are provisional and subject to discussion within the Fairmode community.
- There have been several versions of the tool with some major changes.
- For normalisation the plots now use **measurement uncertainty** (Delta Tool version 3.x).

Benchmarking report

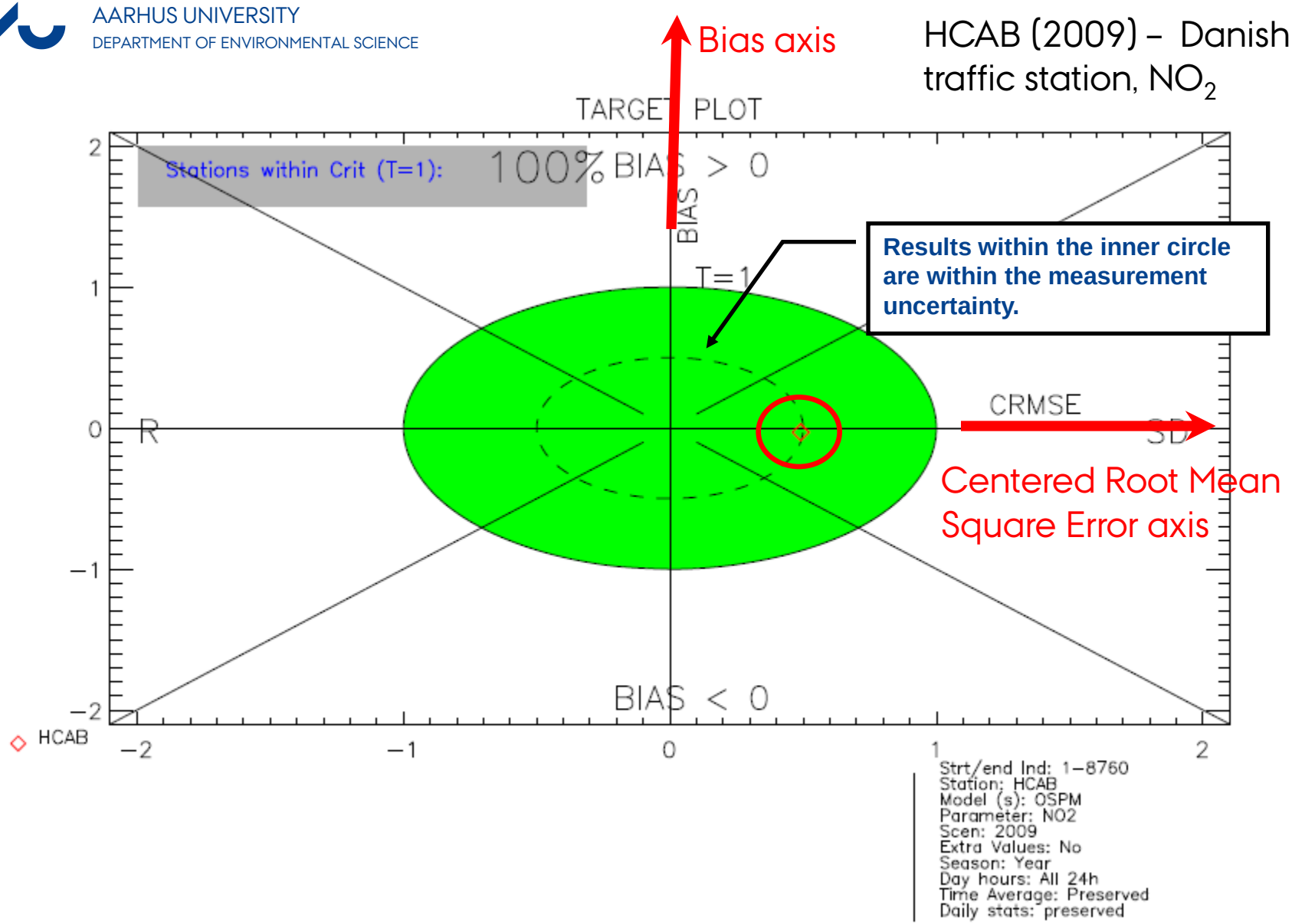
Target plot



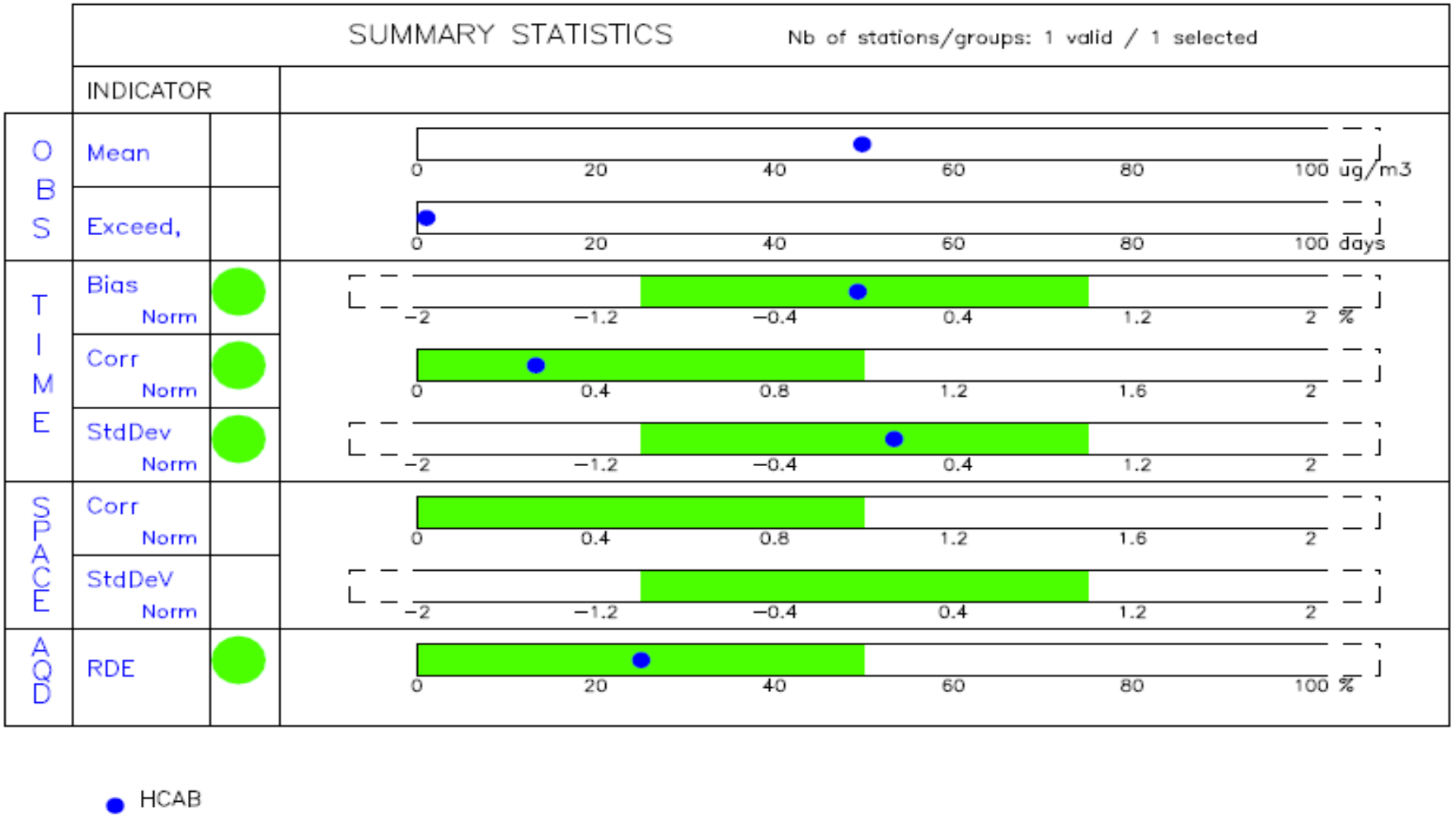
Summary of statistics: Do results comply with performance criteria?



HCAB (2009) – Danish traffic station, NO_2



Summary of statistics: Do results comply with performance criteria?



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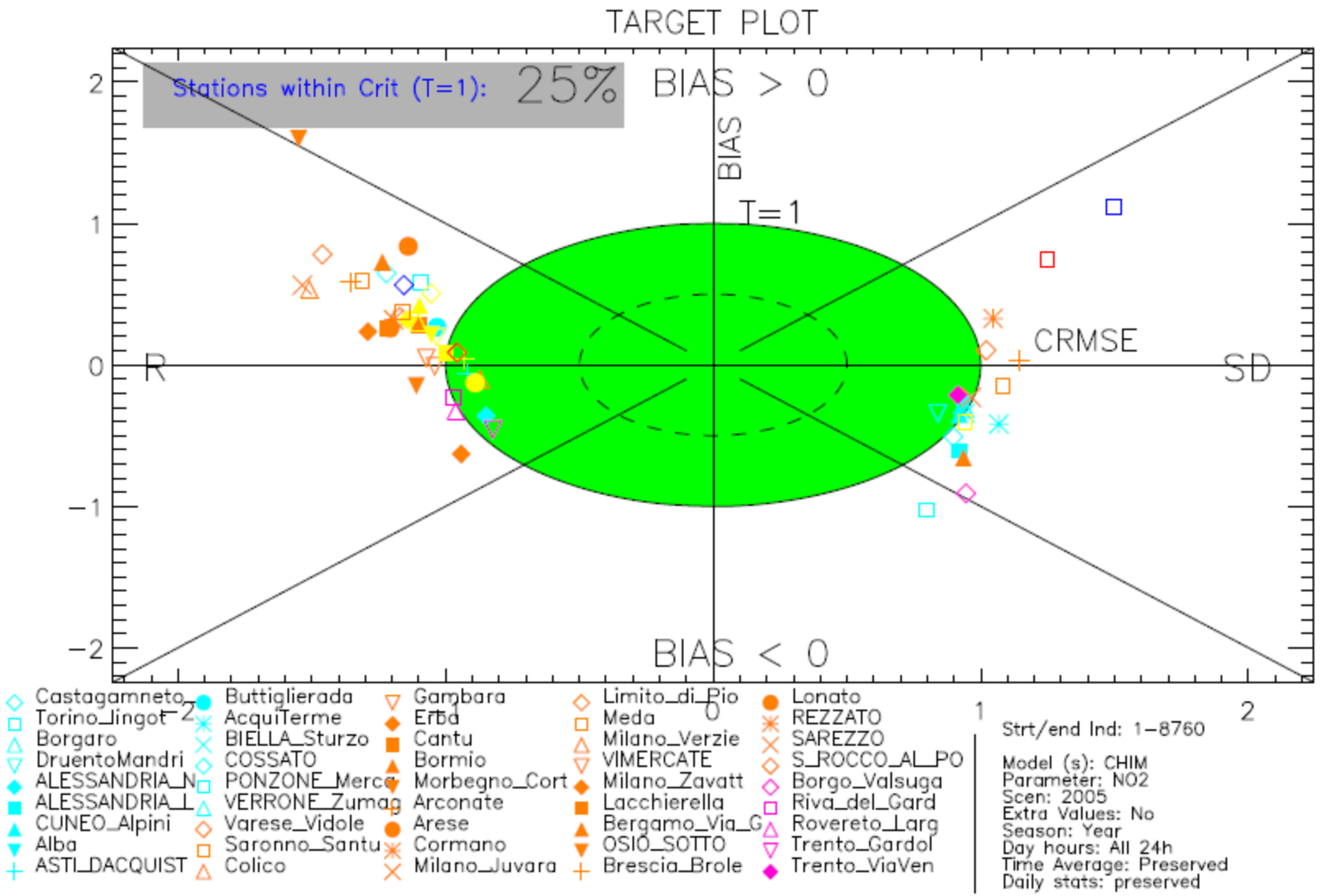
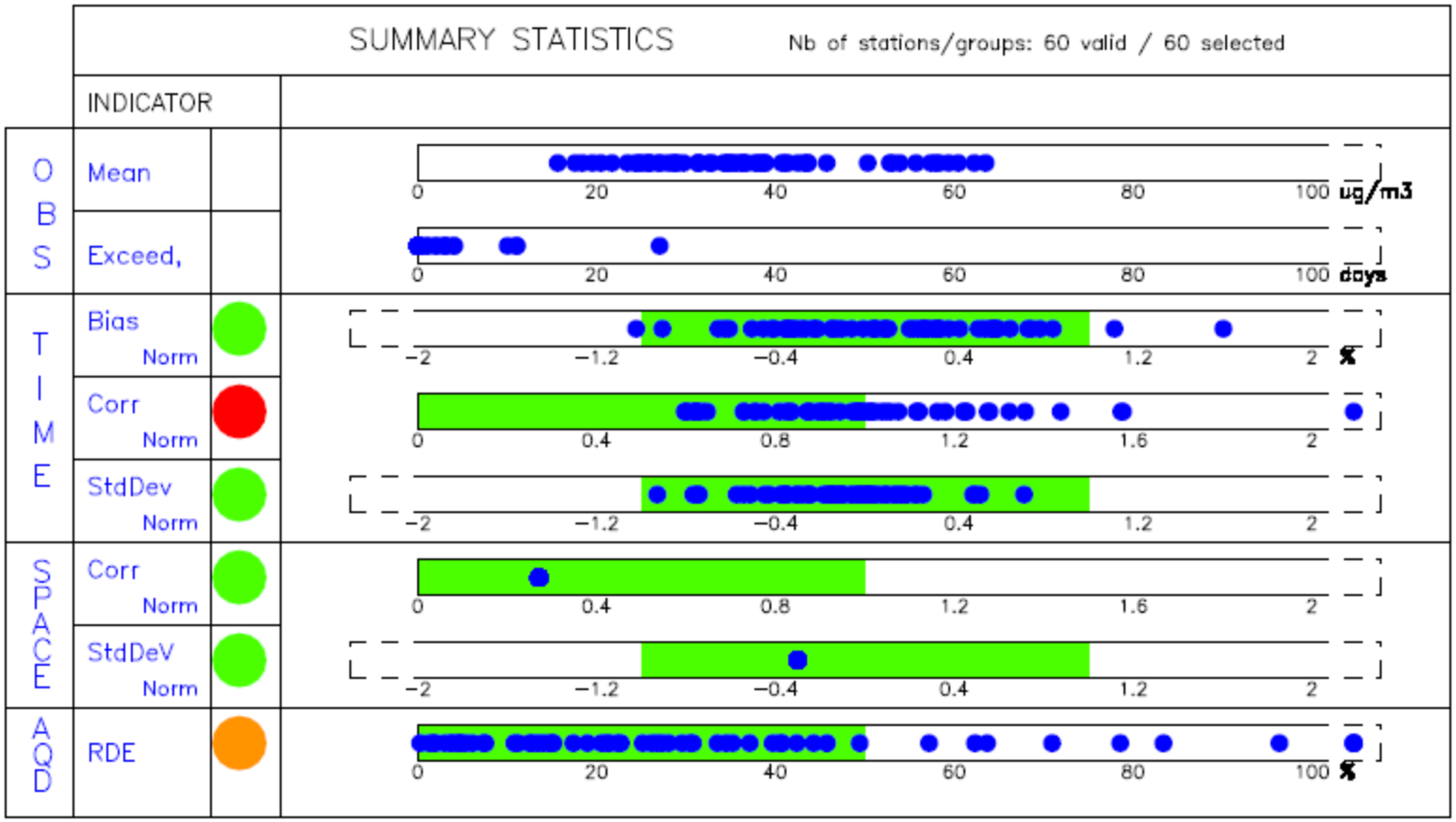
Delta Tool test data set: POMI (2005), Chimere – challenging Italian data set. NO_2





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Milano_

Limito_
Meda
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VIMERCA
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Lacchie
Bergamo
OSIO_SO
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VICENZA
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Some remarks on the Delta Tool

- Keep in mind: What do the underlying data represent?
- Establishing a common frame of reference is a good thing. It allows us to make a proper comparison of comparable results.
- However, care should be taken, especially when it comes to policy aspects.
- The data underlying two different benchmarking reports may represent two different challenges.

Remarks - continued

- As an extreme, imagine the classic single stack problem put into the Delta Tool framework.
- Poor performance in respect to the target plot is not necessarily an indicator of *unacceptable* model performance – it depends on the challenge you pose to a model. Further, you should consider fitness for purpose.

Examples where high correlation is hard to achieve

- A site under influence from a major point source is difficult to model correctly.
- A traffic site where traffic data are inaccurate, possibly just slightly shifted in time.

Delta Tool: Practical aspects

- Not everything runs smoothly when you are a first time user. However, feedback to the developers can improve this.
- A number of minor issues were brought up at the Fairmode plenary in April, regarding such things as better explanations of graphics.
- There is so far not a set of explanatory notes, which could ease interpretation of the Benchmarking reports.

Conclusion

- Those of you working with modelling in the context of the European Air Quality Directive should sooner or later acquaint yourself with the Delta Tool.
- Report any issues you may find to the developers.
- We should step carefully as to how the Delta Tool eventually should be used in conjunction with the Air Quality Directive. We should not impose unreasonable requirements on ourselves.