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in the Belgian Regions

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Wallonia



airclimat.wallonie.be

Belgium feedback Delta-tool

Outline

- 1. NO2 Deltatool statistics**
- 2. Deltatool JRC – ATMOSYS model evaluation tool**
- 3. PM10 Deltatool model comparison**
 **sensitivity exceedances EU daily LV**
- 3. Conclusions**

1. NO2 Deltatool statistics

Measurements : passive sampling campaign

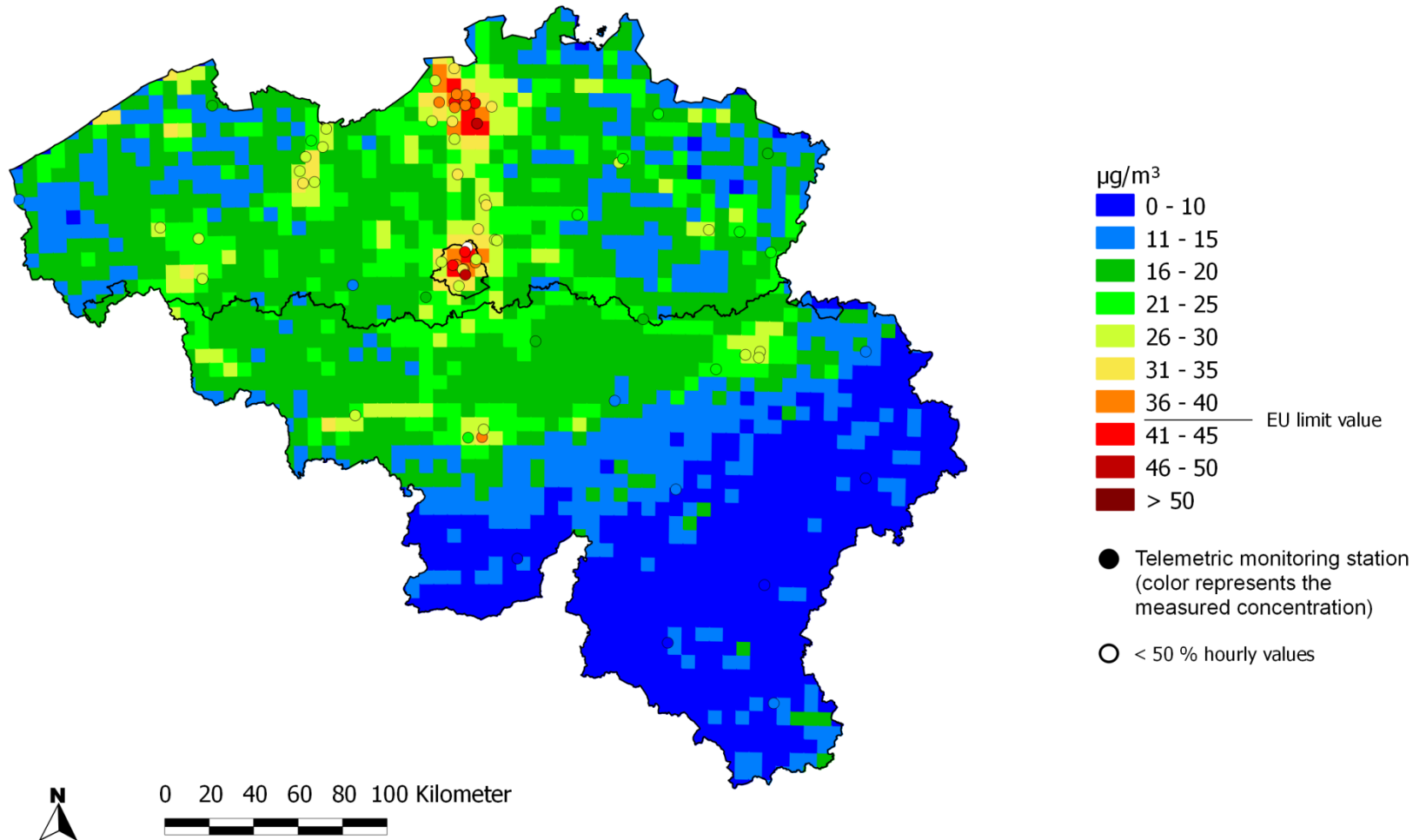
- open street (6 sites)
- urban background (6 sites)
- Street canyon (6 sites)

Modelling : 2 models

- RIO (*intelligent* interpolation) 4 x 4 km²
- RIO-IFDM (RIO background + on top gaussian dispersion model)

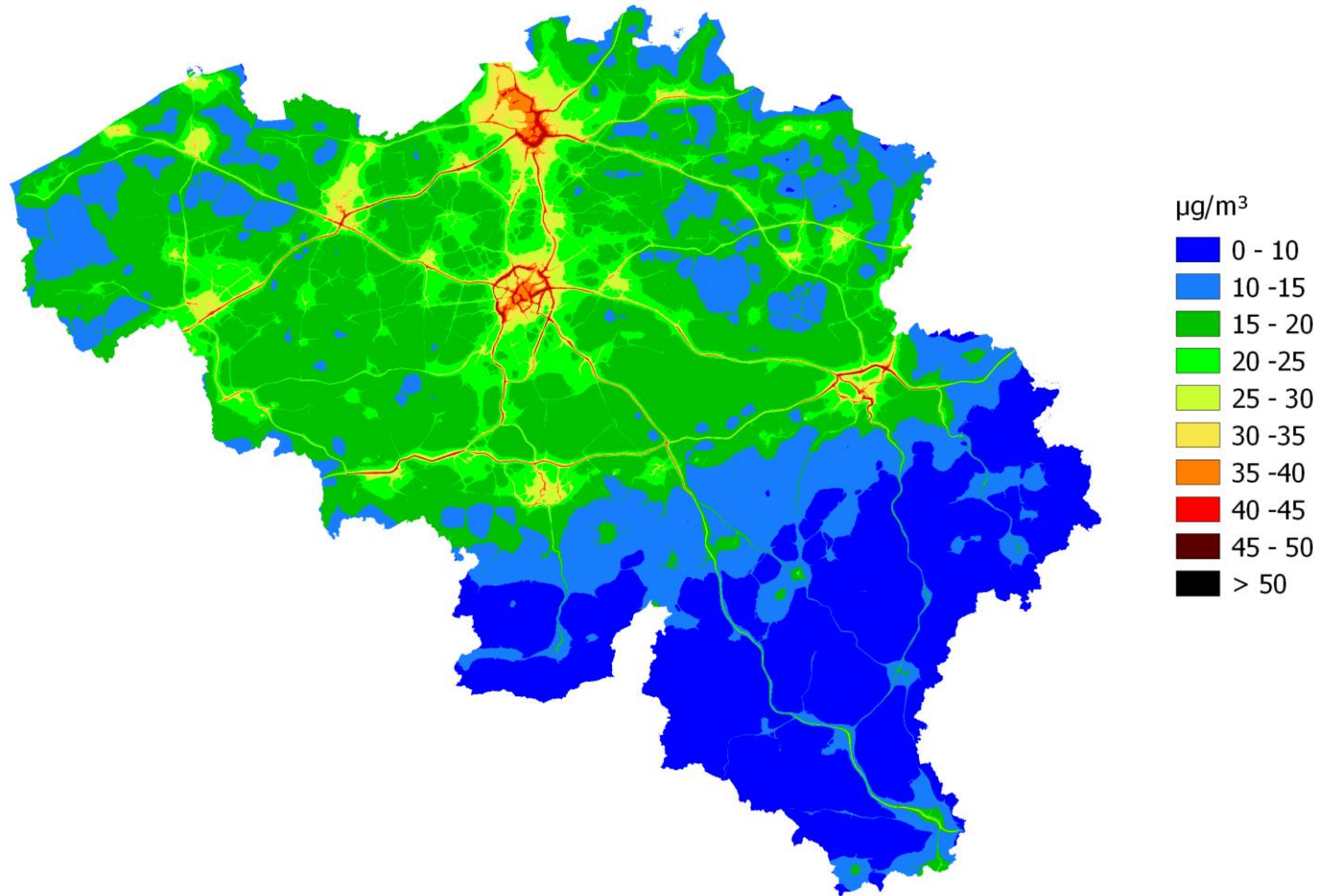
RIO 4x4 km²

Annual mean NO₂ concentrations (Belgium, 2011)



RIO-IFDM

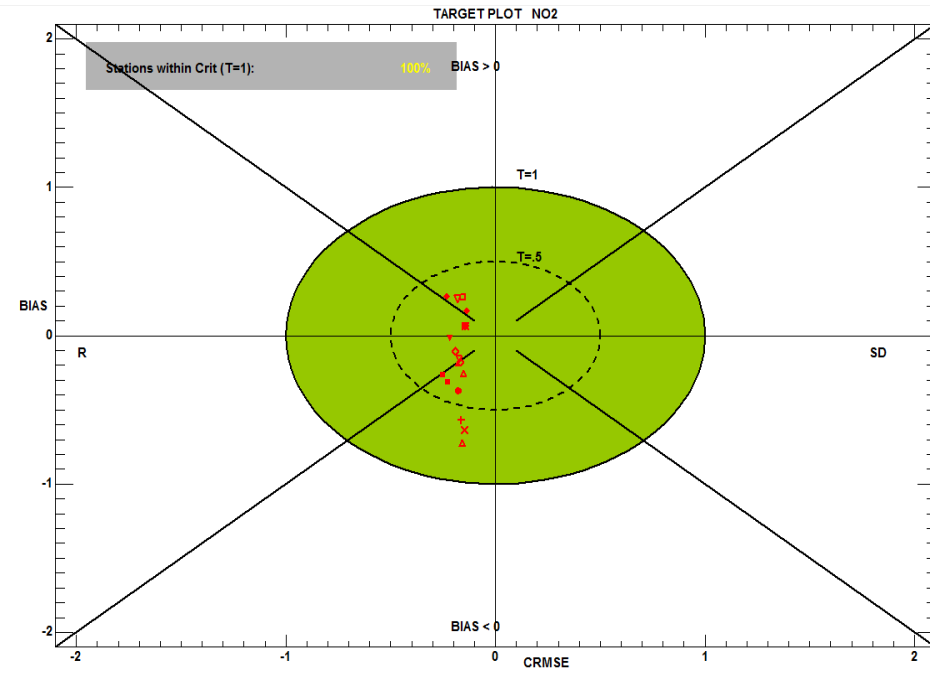
Annual mean NO2 concentration 2011



TARGET PLOTS NO2 HOURLY

RIO 4x4

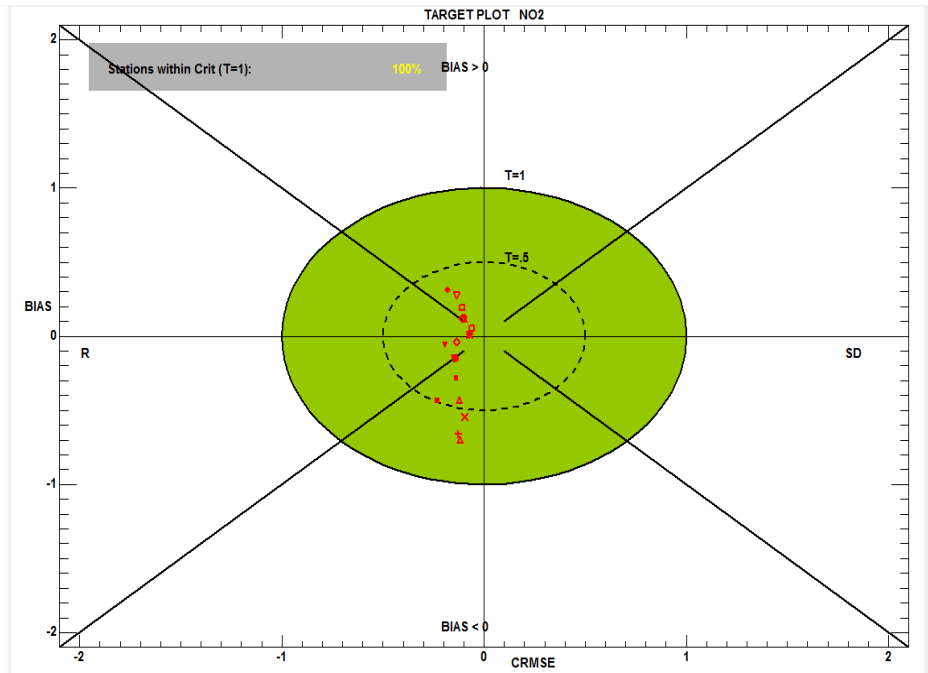
RIO-IFDM



---Info about plot data---

| | |
|--------|--------|
| ◇ AT29 | ◇ GN27 |
| ◇ AT30 | ◇ GN28 |
| ◇ AT31 | ◇ GN29 |
| ◇ AT32 | ◇ GN30 |
| ◇ AT33 | ◇ GN31 |
| ◇ AT34 | ◇ GN32 |
| ◇ BB25 | ◇ OS08 |
| ◇ BB26 | ◇ OS09 |
| ◇ BB27 | ◇ OS10 |

Site/nd Ind: 1-8760
 Model (s): RIO
 Parameter: NO2
 Scen: 2013
 Extra Values: No
 Season: Year
 Day hours: All 24h
 Time Average: Preserved
 Daily stats: preserved



---Info about plot data---

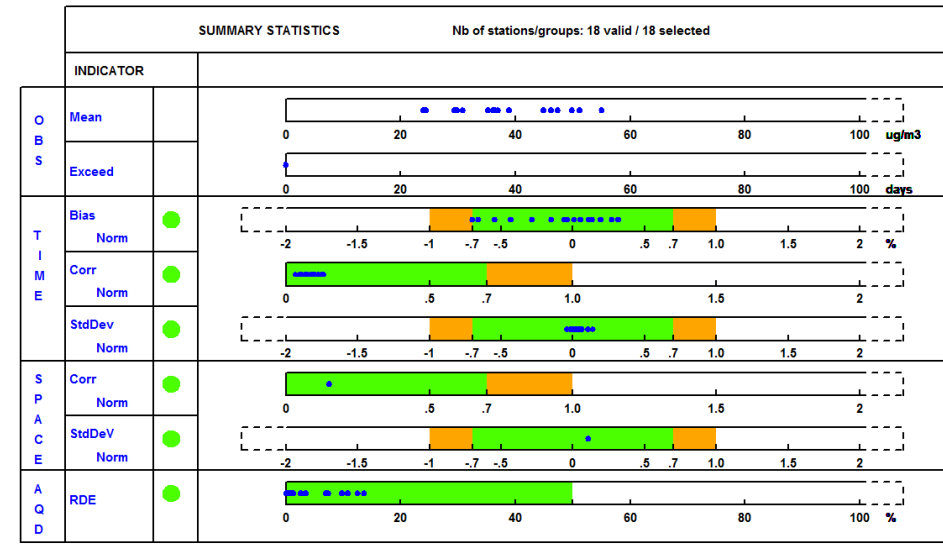
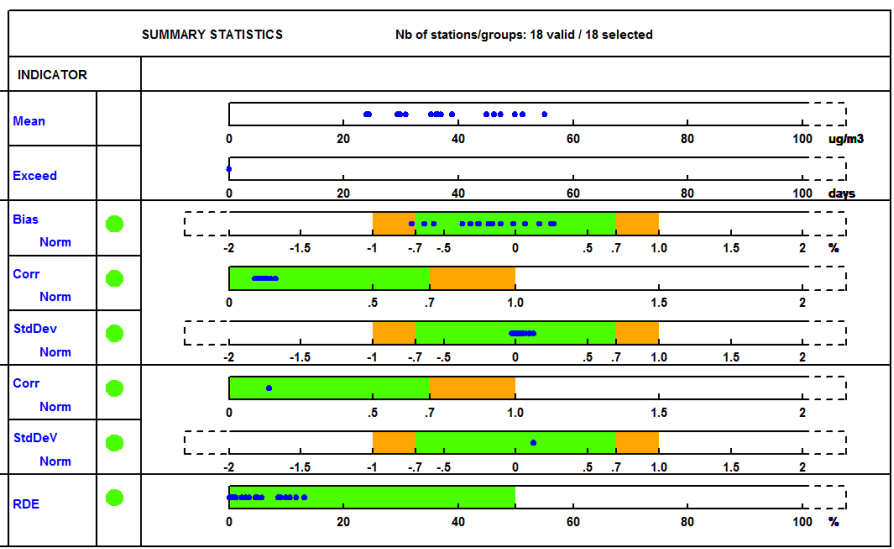
| | |
|--------|--------|
| ◇ AT29 | ◇ GN27 |
| ◇ AT30 | ◇ GN28 |
| ◇ AT31 | ◇ GN29 |
| ◇ AT32 | ◇ GN30 |
| ◇ AT33 | ◇ GN31 |
| ◇ AT34 | ◇ GN32 |
| ◇ BB25 | ◇ OS08 |
| ◇ BB26 | ◇ OS09 |
| ◇ BB27 | ◇ OS10 |

Site/nd Ind: 1-8760
 Model (s): RIOIFDM
 Parameter: NO2
 Scen: 2013
 Extra Values: No
 Season: Year
 Day hours: All 24h
 Time Average: Preserved
 Daily stats: preserved

SUMMARY STATISTICS NO2 HOURLY

RIO 4x4

RIO-IFDM



---Info about plot data---

- AT29
- AT30
- AT31
- AT32
- AT33
- AT34
- BE25
- BE26
- BE27
- GN27
- GN28
- GN29
- GN30
- GN31
- GN32
- OS08
- OS09
- OS10

---Info about plot data---

- AT29
- AT30
- AT31
- AT32
- AT33
- AT34
- BE25
- BE26
- BE27
- GN27
- GN28
- GN29
- GN30
- GN31
- GN32
- OS08
- OS09
- OS10

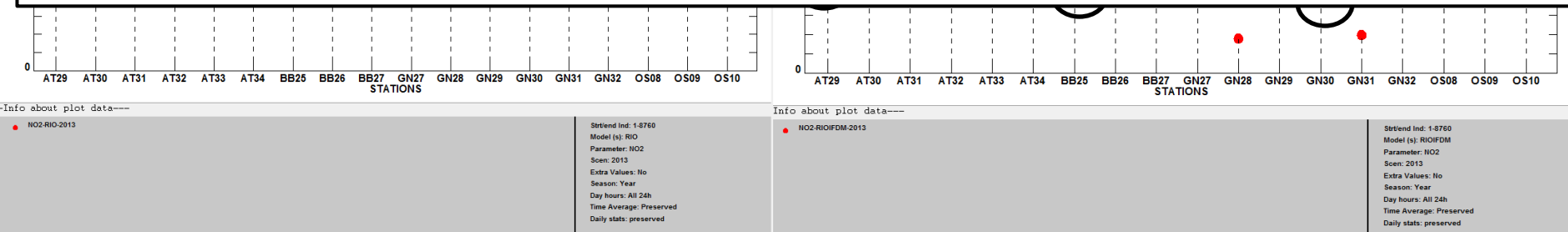


RMSE NO2

RIO 4x4

RIO-IFDM

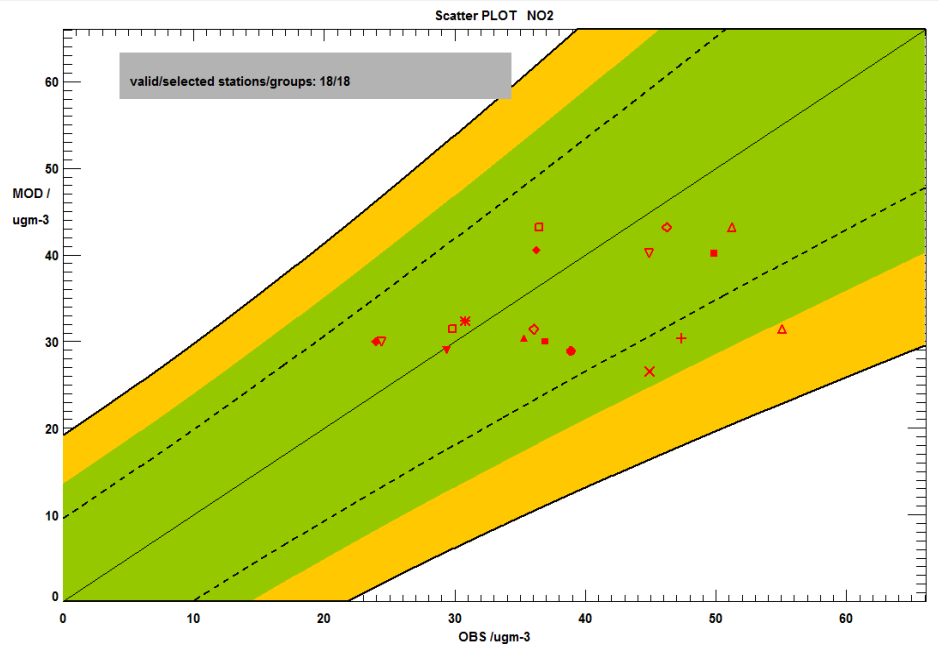
Target plot and sum stats \approx equal for both models :
other parameters need to be analysed to compare
model performances



○ =RMSE open street sites

SCATTER PLOTS HOURLY NO2

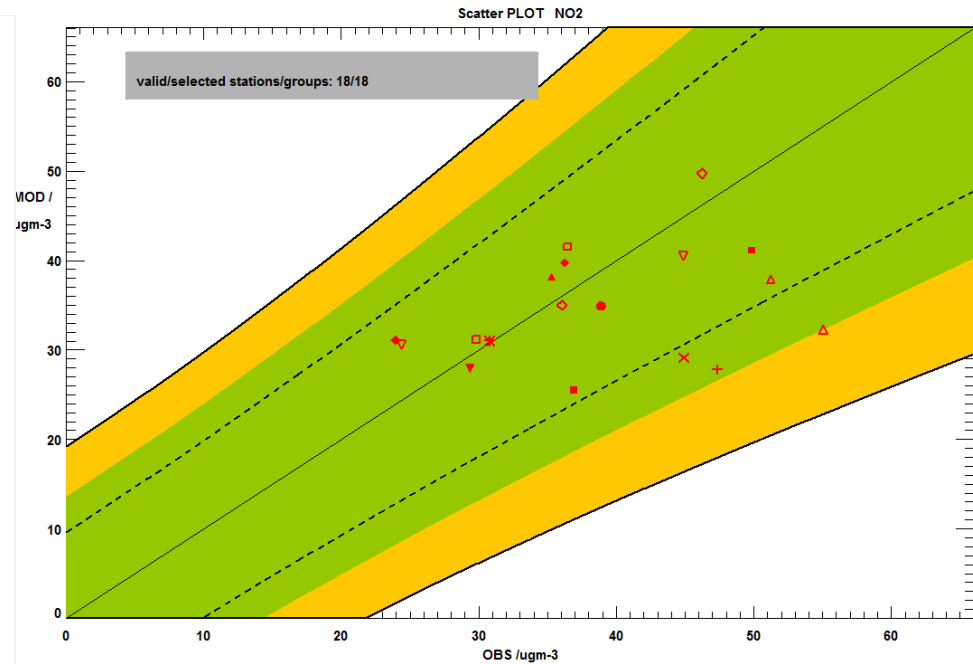
RIO 4x4



info about plot data---

| | | |
|--------|--------|-------------------------|
| ◇ AT29 | ◇ GH27 | StrIend Ind: 1-8760 |
| ◇ AT30 | ◇ GH28 | Model (s): RIO |
| ◇ AT31 | ◇ GH29 | Parameter: NO2 |
| ◇ AT32 | ◇ GH30 | Scen: 2013 |
| ◇ AT33 | ◇ GH31 | Extra Values: No |
| ◇ AT34 | ◇ GH32 | Season: Year |
| ◇ BB25 | ◇ OS08 | Day hours: All 24h |
| ◇ BB26 | ◇ OS09 | Time Average: Preserved |
| ◇ BB27 | ◇ OS10 | Daily stats: preserved |

RIO-IFDM

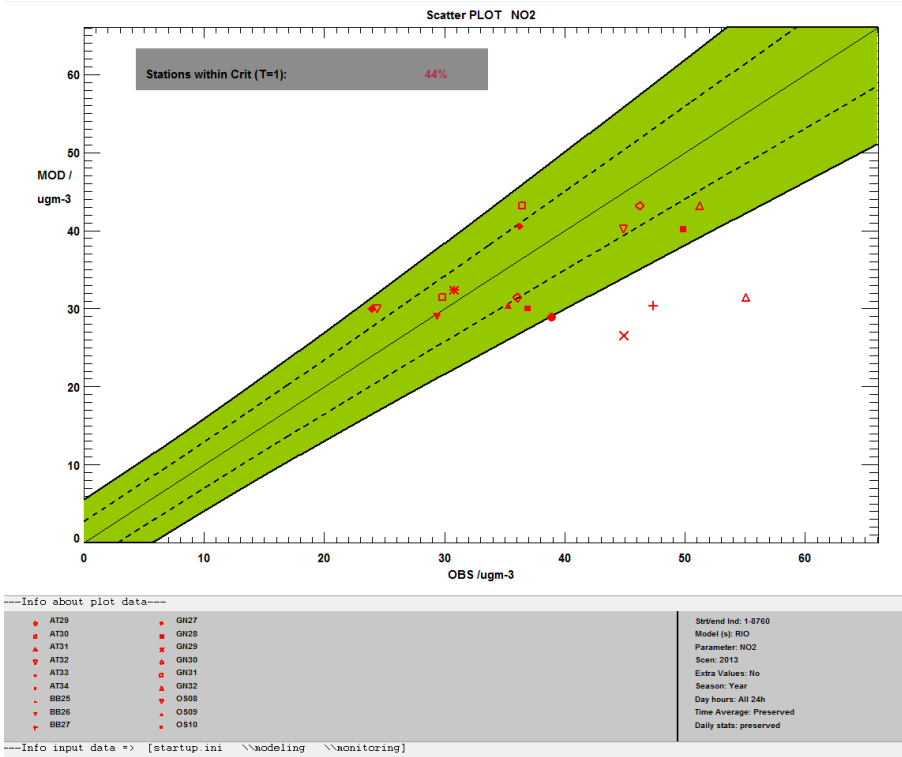


info about plot data---

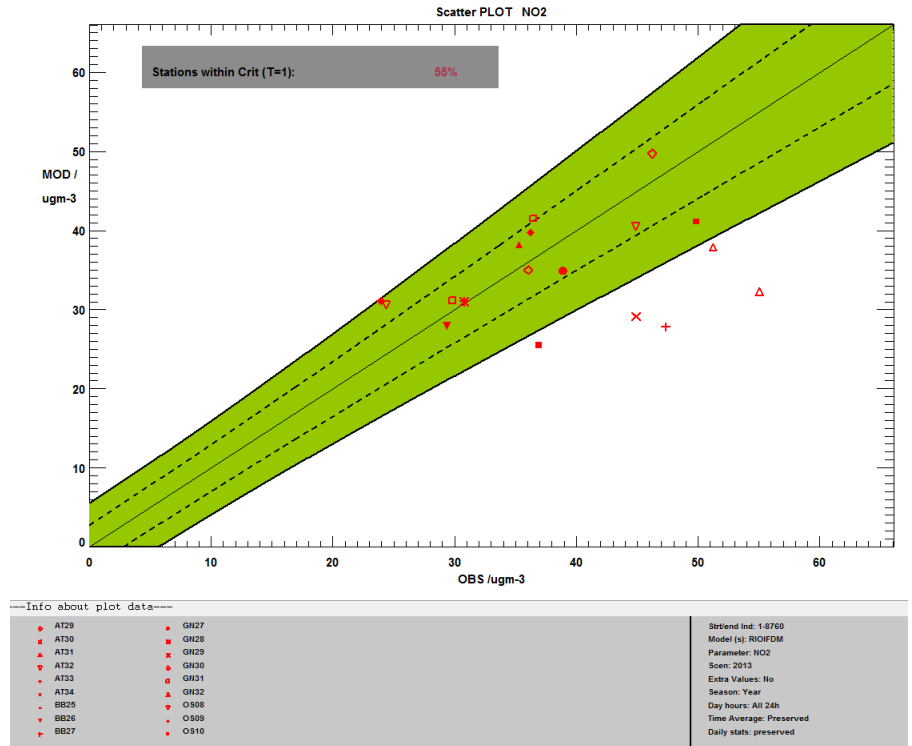
| | | |
|--------|--------|-------------------------|
| ◇ AT29 | ◇ GH27 | StrIend Ind: 1-8760 |
| ◇ AT30 | ◇ GH28 | Model (s): RIOIFDM |
| ◇ AT31 | ◇ GH29 | Parameter: NO2 |
| ◇ AT32 | ◇ GH30 | Scen: 2013 |
| ◇ AT33 | ◇ GH31 | Extra Values: No |
| ◇ AT34 | ◇ GH32 | Season: Year |
| ◇ BB25 | ◇ OS08 | Day hours: All 24h |
| ◇ BB26 | ◇ OS09 | Time Average: Preserved |
| ◇ BB27 | ◇ OS10 | Daily stats: preserved |

SCATTER PLOTS NO2 ANNUAL MEAN

RIO 4x4



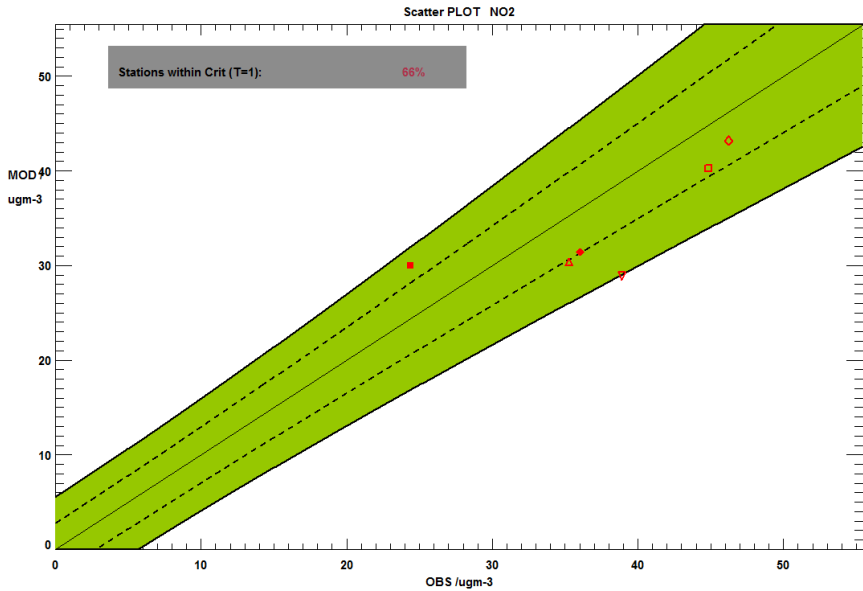
RIO-IFDM



RIO-IFDM is performing better

SCATTER PLOTS NO2 ANNUAL MEAN

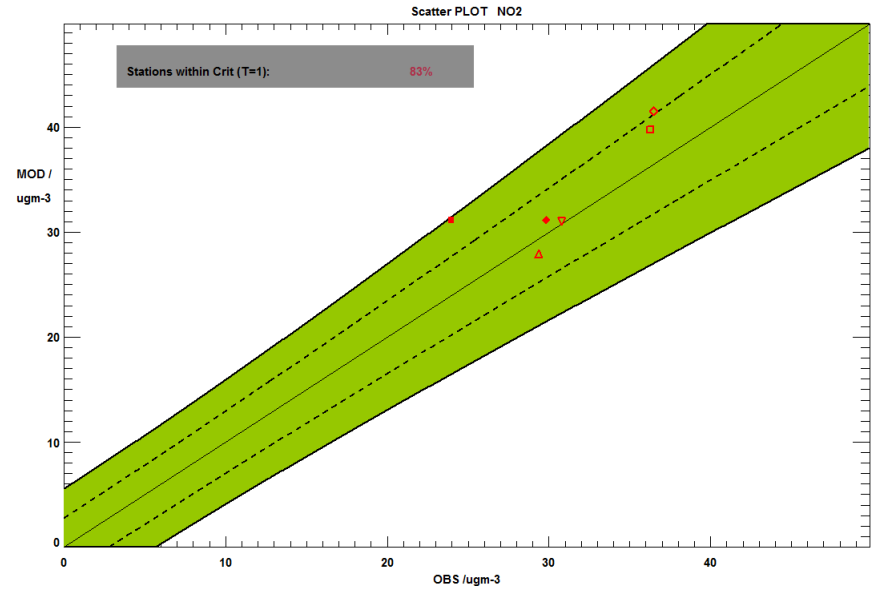
RIO-IFDM open street



---Info about plot data---

| | |
|--|---|
| <ul style="list-style-type: none"> ◇ AT29 ◇ AT32 ◇ BB25 ◇ GH27 ◇ GH30 ◇ OS08 | Sirtrend Ind: 1-8760 Model (s): RIO Parameter: NO2 Scen: 2013 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserved Daily stats: preserved |
|--|---|

RIO-IFDM urban background

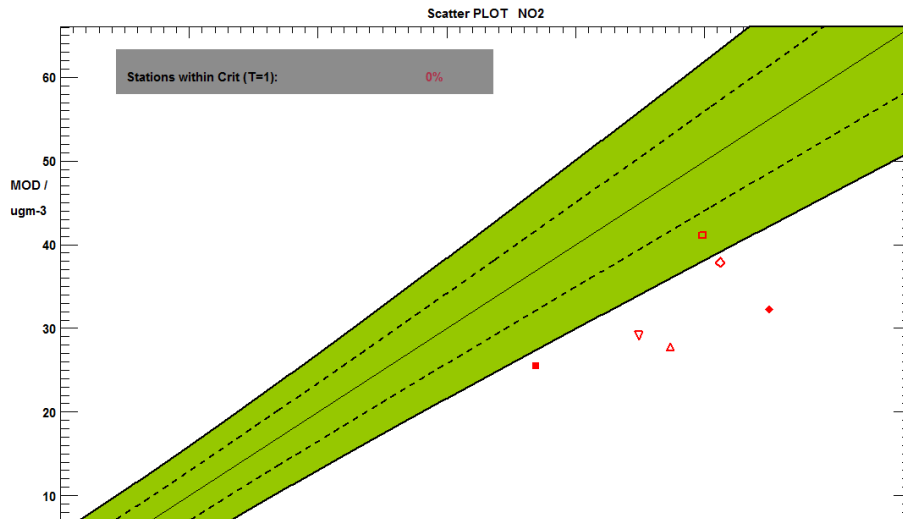


---Info about plot data---

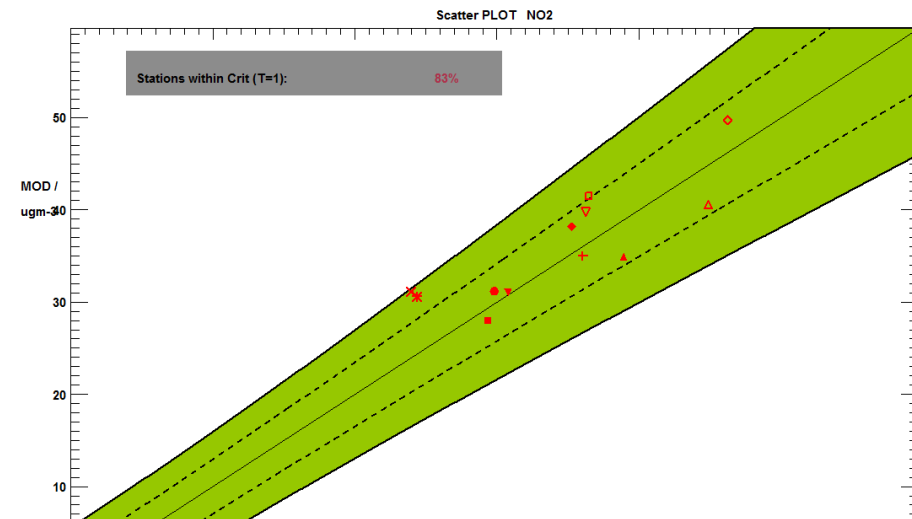
| | |
|--|---|
| <ul style="list-style-type: none"> ◇ AT30 ◇ AT33 ◇ BG26 ◇ GH28 ◇ GH31 ◇ OS09 | Sirtrend Ind: 1-8760 Model (s): RIOIFDM Parameter: NO2 Scen: 2013 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserved Daily stats: preserved |
|--|---|

SCATTER PLOTS NO2 ANNUAL MEAN

RIO-IFDM street canyons



RIO-IFDM without street canyons



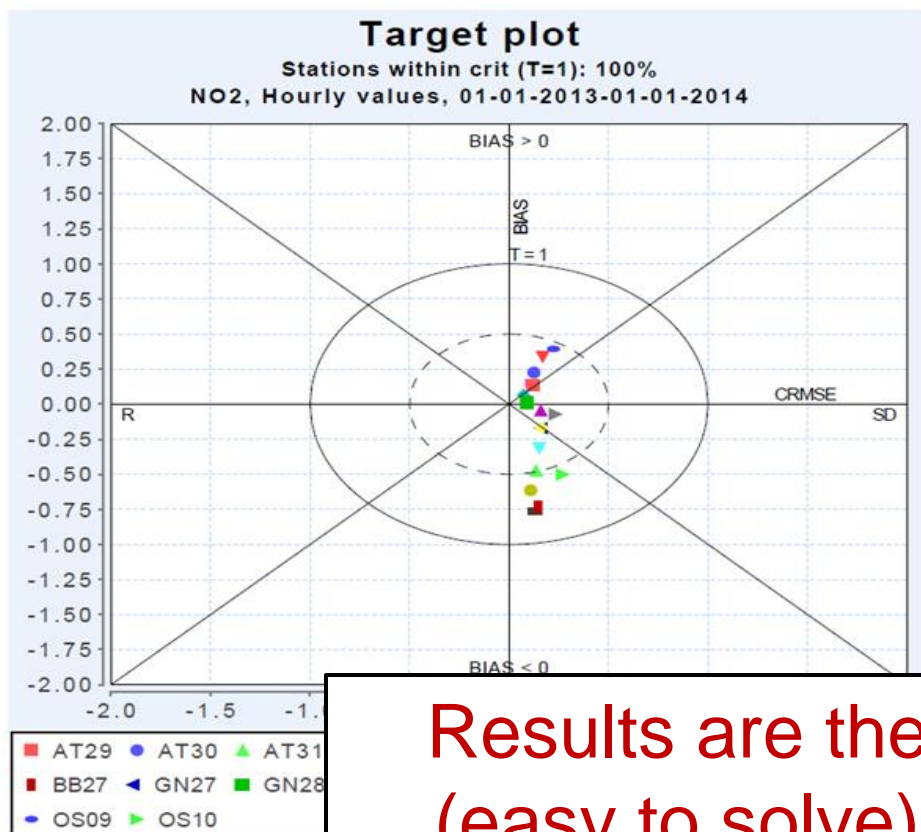
Station representativeness is important to evaluate model results. RIO-IFDM not designed for modelling street canyons
without these street canyon stations
T=85 % for RIO-IFDM

2. Comparison target plot deltatool JRC – ATMOSYS model evaluation tool

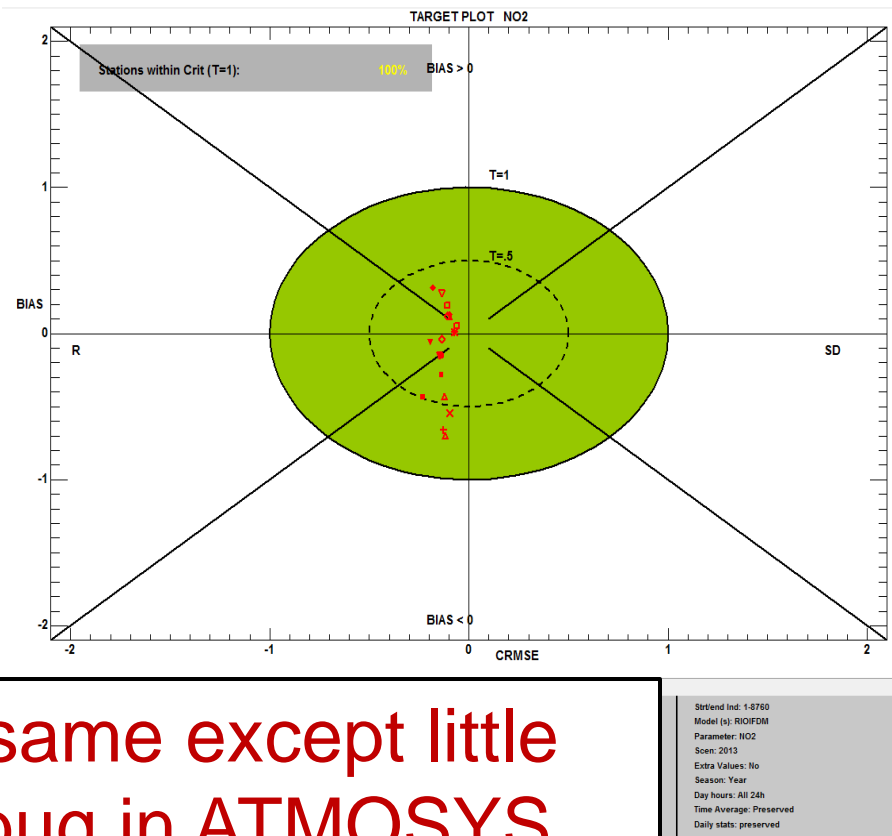
www.atmosys.eu

COMPARISON JRC DELTATOOL

ATMOSYS TOOL



JRC DELTA TOOL



Results are the same except little (easy to solve) bug in ATMOSYS switch R and SD

3. PM10 Deltatool model comparison

 **sensitivity exceedance
calculations**

PM10 daily mean 2009 model comparison 3 models:

- Aurora (Eulerian model)
- Aurora data assimilated
(-> + optimal interpolation)
- RIO (*intelligent* interpolation)

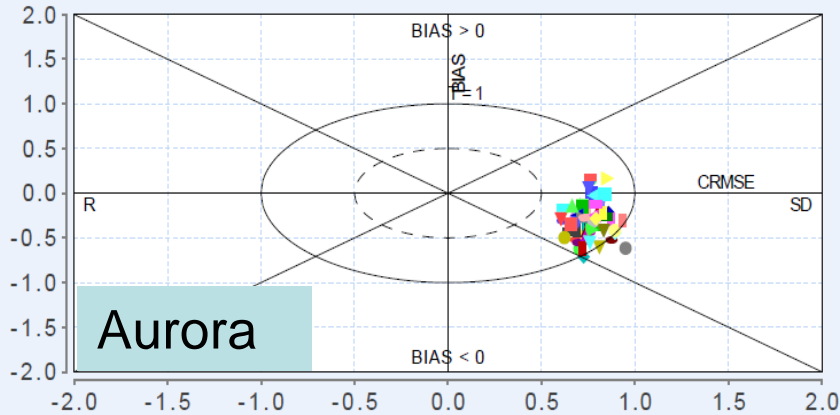
ATMOSYS model evaluation tool

TARGET PLOTS PM10 daily mean

Target plot

Stations within crit ($T=1$): 93.22%

PM10, Daily average, 01-01-2009-01-01-2010

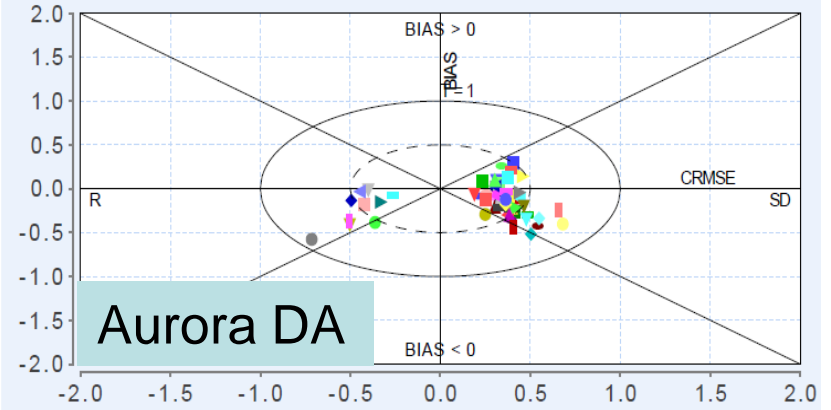


- | | | | | | |
|----------|----------|----------|----------|----------|----------|
| ■ 40AB01 | ● 40AB02 | ▲ 40AL01 | ◆ 40GK06 | ■ 40GK09 | ▼ 40HB23 |
| ○ 40ML01 | ▶ 40MN01 | ■ 40OB01 | ◀ 40RL01 | ■ 40SZ02 | ● 41B011 |
| ▲ 41MEU1 | ◆ 41N043 | ■ 41R001 | ▼ 41R012 | ■ 42M802 | ▼ 42N016 |
| ■ 42N035 | ■ 42N045 | ● 42R811 | ▼ 42R815 | ● 42R832 | ▶ 42R832 |
| ■ 42R811 | ▼ 42R815 | ● 42R832 | ▶ 42R832 | ■ 43N063 | ● 43N066 |
| ▲ 43N070 | ◆ 43N100 | ▶ 43N113 | ■ 43N121 | ◀ 43R222 | ◆ 43R223 |
| ■ 43R240 | ▼ 44N052 | ◀ 44R701 | ■ 44R710 | ● 44R731 | ▲ 44R740 |
| ◆ 44R750 | ▼ 45R501 | ▼ 45R502 | ● 45R510 | ▶ 45R510 | |

Target plot

Stations within crit ($T=1$): 100%

PM10, Daily average, 01-01-2009-01-01-2010

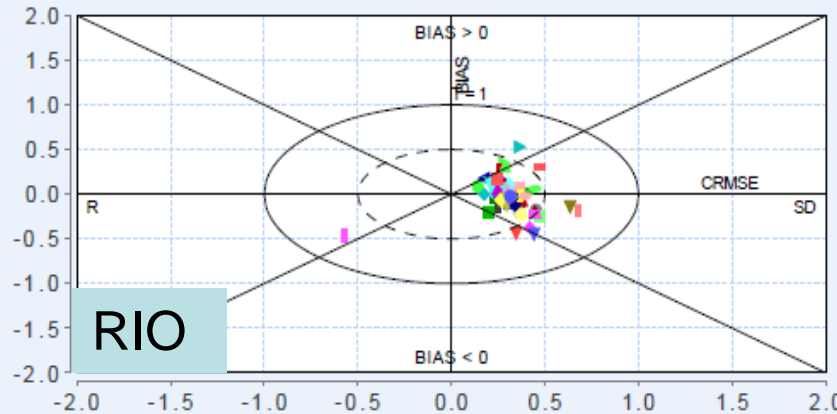


- | | | | | | |
|----------|----------|----------|----------|----------|----------|
| ■ 40AB01 | ● 40AB02 | ▲ 40AL01 | ◆ 40GK06 | ■ 40GK09 | ▼ 40HB23 |
| ○ 40ML01 | ▶ 40MN01 | ■ 40OB01 | ◀ 40RL01 | ■ 40SZ02 | ● 41B011 |
| ▲ 41R012 | ◆ 41W0L1 | ▶ 42M802 | ■ 42N054 | ▲ 42R020 | ◆ 42R801 |
| ■ 2R841 | ■ 43H201 | ◀ 43M204 | ■ 43N073 | ■ 43N085 | ▼ 43N093 |
| ■ 43N132 | ■ 43R201 | ● 43R221 | ■ 4M705 | ● 44N012 | ▶ 44N029 |
| ■ 4R731 | ▲ 44R740 | ◆ 44R750 | ■ 5R511 | ■ 45R512 | |

Target plot

Stations within crit ($T=1$): 100%

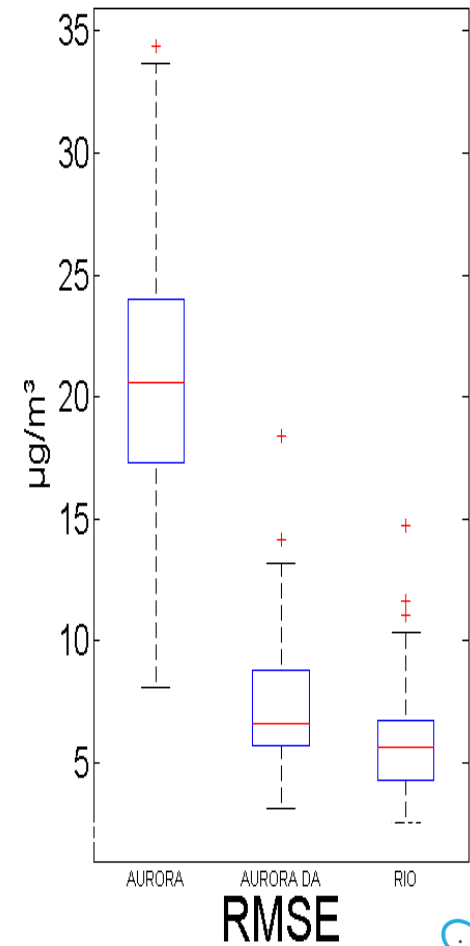
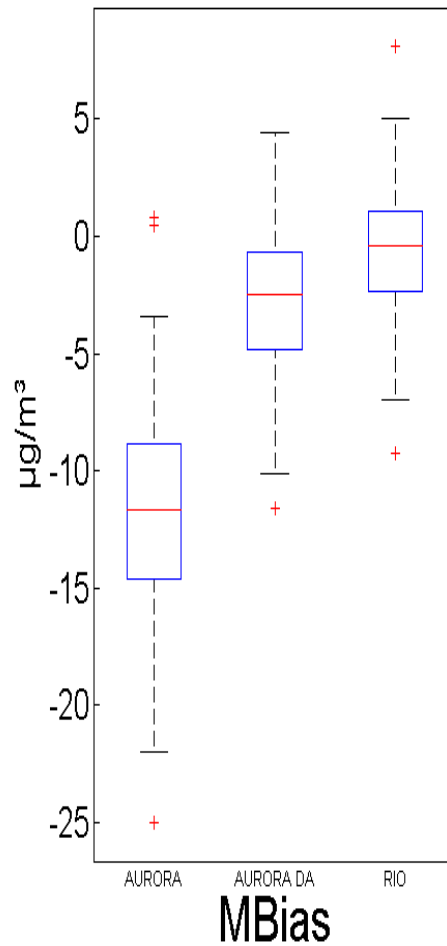
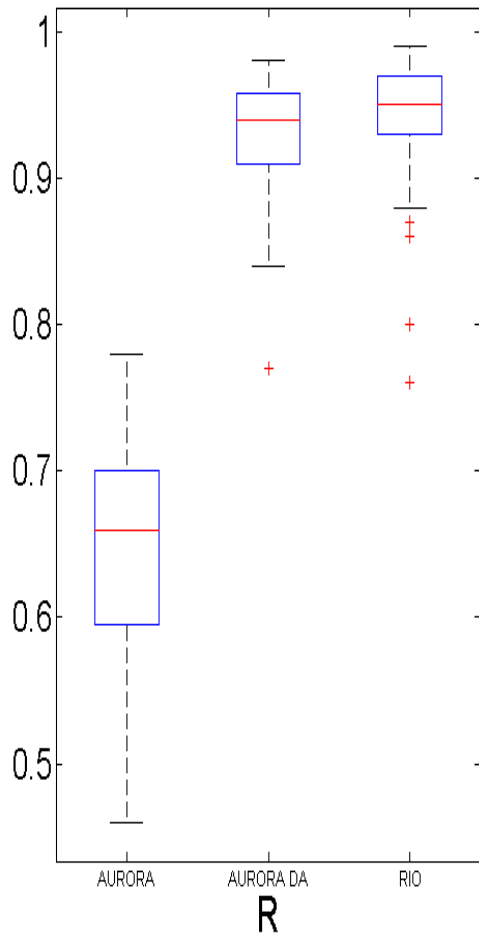
PM10, Daily average, 01-01-2009-01-01-2010



- | | | | | | |
|----------|----------|----------|----------|----------|----------|
| ■ 40AB01 | ● 40AB02 | ▲ 40AL01 | ◆ 40GK06 | ■ 40HB23 | ▼ 40ML01 |
| ○ 40MN01 | ▶ 40OB01 | ■ 40RL01 | ◀ 40SZ02 | ■ 41B011 | ● 41MEU1 |
| ▲ 41R001 | ◆ 41R012 | ■ 42M802 | ▼ 42N016 | ■ 42N035 | ▶ 42N045 |
| ■ 42N054 | ■ 42R020 | ■ 42R801 | ● 42R811 | ▲ 42R815 | ◆ 42R832 |

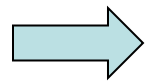
STATISTICS PM10 daily mean:

Boxplots of (R, Mbias, RMSE) for each station
temporal validation statistics

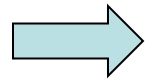


**assessment modelled/measured
exceedances:
PM10 daily mean > 50 µg/m³**

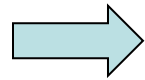
considering all stations 2009



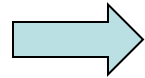
measured



modelled AURORA

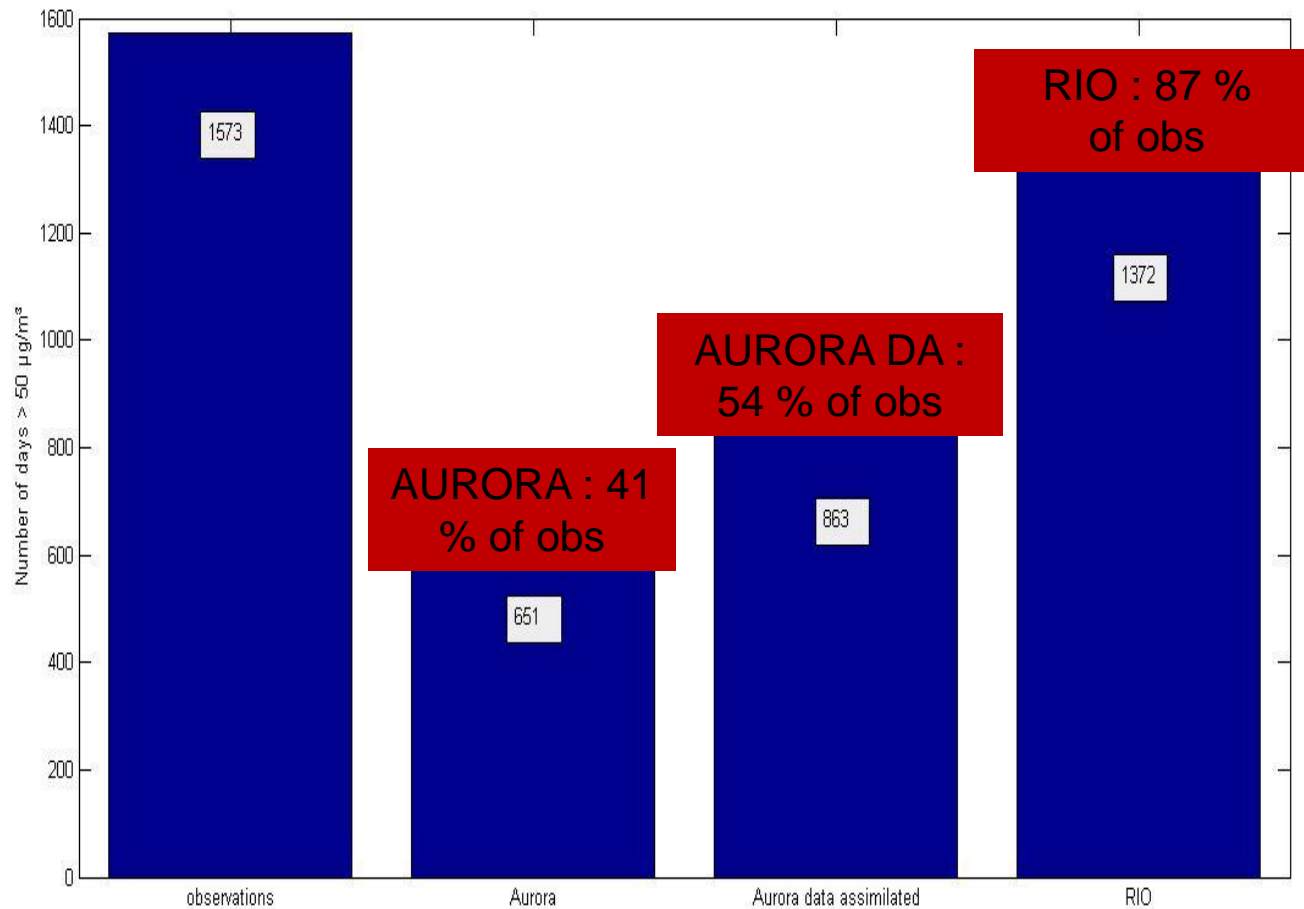


modelled AURORA DA



modelled RIO

assessment: PM10 daily mean exceedances for all monitoring stations



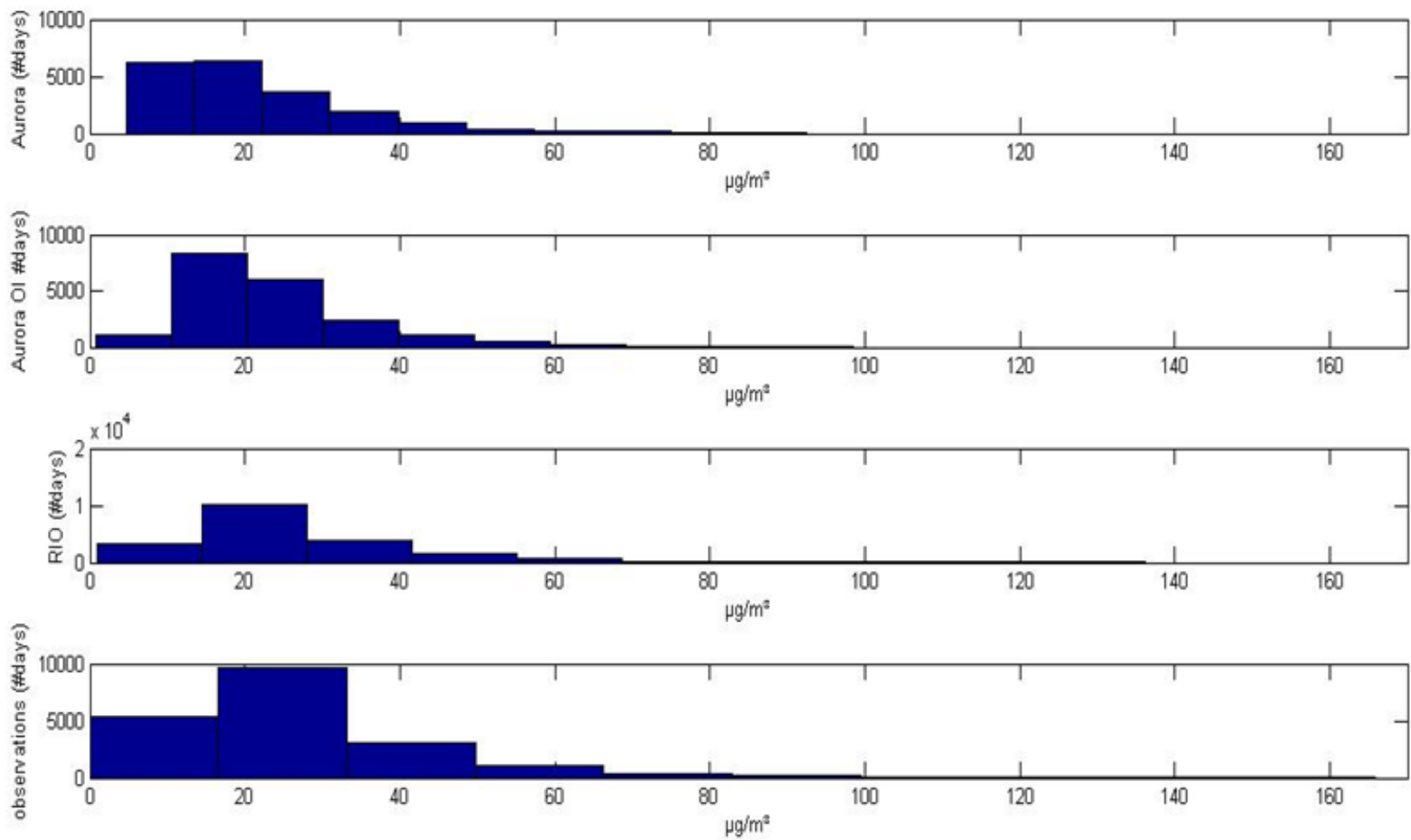
5. Conclusions

- **not only target plots but a broader range of other statistical indicators have to be analysed to compare the performance of different models**
- **ATMOSYS tool results are in line with DELTA tool JRC**
- **For PM10 daily mean different models comply to the MQO set, significant differences when comparing modelled and measured exceedances of the EU daily mean PM10 LV**

Thank you for your attention !

trimpeneers@irceline.be
fierens@irceline.be

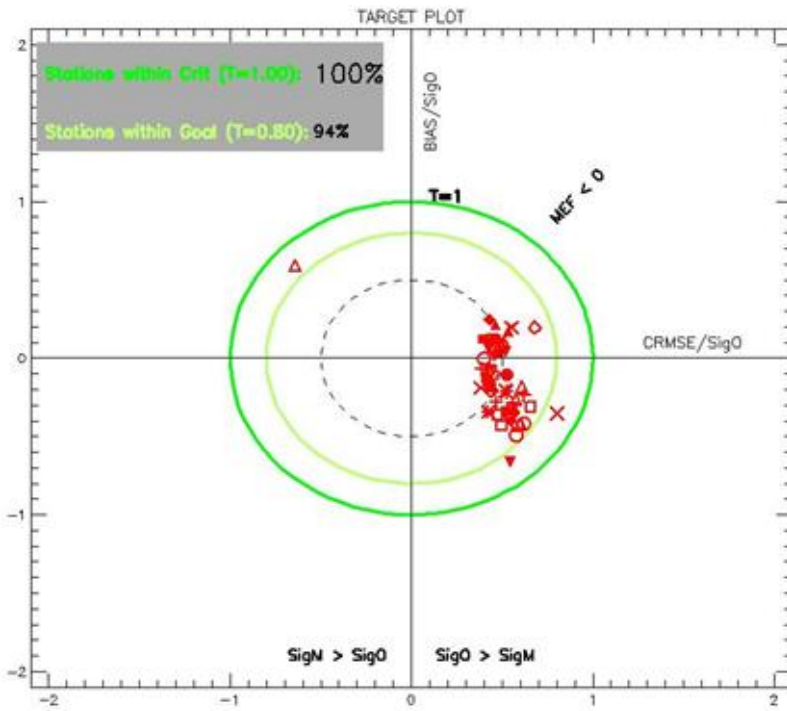
<http://www.ircel.be>
<http://www.vmm.be>



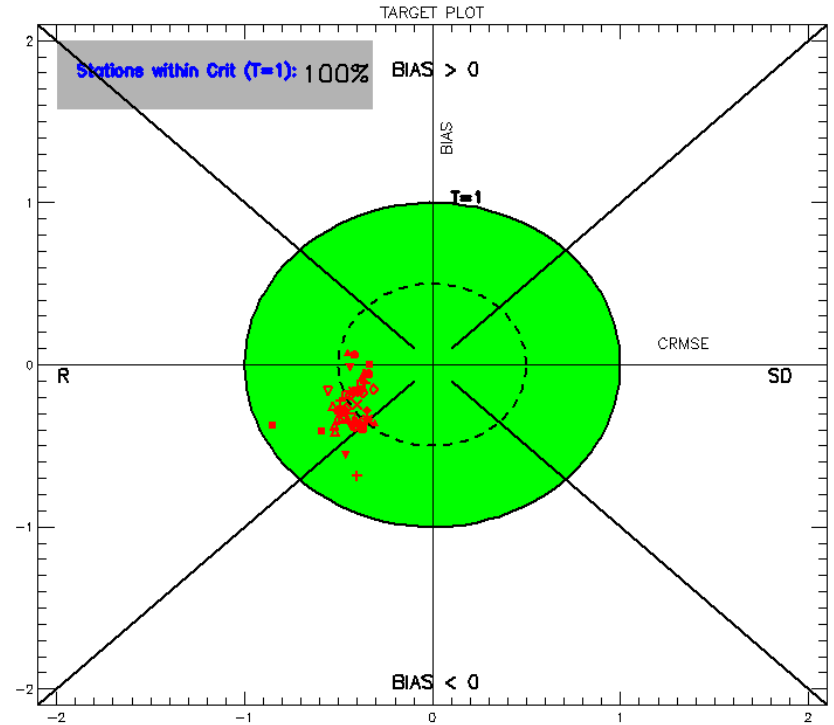
Histograms of PM10 daily mean values of Aurora, Aurora with data assimilation, RIO09 and observations for the year 2009 for all stations

Delta-tool 1.2 vs Delta-tool 3.2

PM10-hourly values



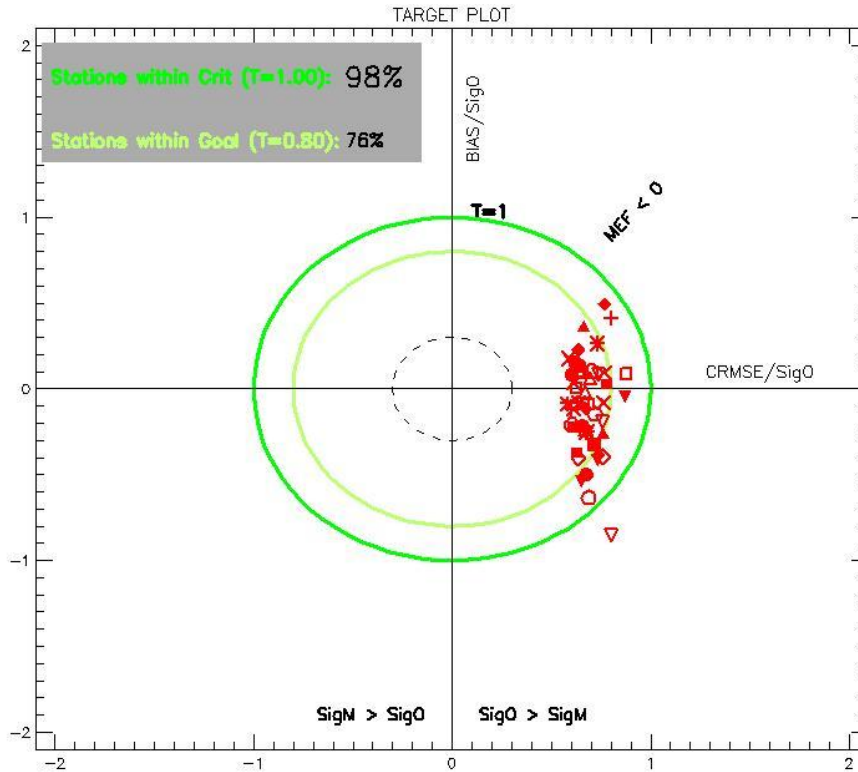
| | | | | | | |
|--------|--------|--------|--------|--------|--------|-------------------------|
| ○ AB01 | × B011 | ■ B801 | ● N073 | ◆ R222 | ▽ R750 | Strt/end Ind: 1-8760 |
| △ AL01 | □ N243 | × B811 | ● N085 | ◆ R223 | ▽ R802 | Model (s): RIO |
| ▽ GK06 | △ R001 | □ B832 | × N093 | ◆ R240 | ▽ R810 | Parameter: PM10 |
| ■ HB23 | ▽ R012 | □ B833 | × N100 | ▽ M706 | △ B511 | Scen: 2010 |
| ● ML01 | ○ W011 | ▽ B841 | × N113 | ▽ N652 | △ B512 | Extra Values: No |
| △ MW01 | ● M802 | ○ H201 | × N121 | × R701 | | Season: Year |
| ▽ OB01 | △ N436 | ● M204 | △ N132 | ▽ R710 | | Day hours: All 24h |
| ● RL01 | ▽ N546 | ● N063 | ▽ R201 | △ R731 | | Time Average: Preserved |
| △ SZ02 | △ R020 | ▽ N070 | ○ R221 | △ R740 | | Statistic: Mean |



| | | | | | |
|----------------|----------------|----------------|----------------|----------------|-------------------------|
| ○ Station_AB01 | ○ Station_B011 | × Station_N054 | ▽ Station_N070 | ◆ Station_N052 | Strt/end Ind: 1-8760 |
| □ Station_ABD2 | △ Station_N043 | × Station_R020 | ● Station_N085 | ■ Station_R701 | Model (s): RIO |
| △ Station_AL01 | ▽ Station_R001 | ○ Station_R801 | ● Station_N093 | △ Station_R710 | Parameter: PM10 |
| ▽ Station_HB23 | ◆ Station_R012 | □ Station_R811 | ● Station_N100 | ▽ Station_R731 | Scen: 2010 |
| ○ Station_ML01 | ■ Station_R012 | △ Station_R815 | × Station_R223 | ● Station_R740 | Extra Values: No |
| △ Station_MN01 | ▽ Station_MB02 | ▽ Station_R832 | ○ Station_R240 | ● Station_R750 | Season: Year |
| ▽ Station_OB01 | △ Station_N016 | △ Station_R841 | ○ Station_M706 | × Station_R501 | Day hours: All 24h |
| ○ Station_RL01 | ● Station_N036 | ■ Station_H201 | △ Station_N012 | × Station_R502 | Time Average: Preserved |
| ● Station_SZ02 | ● Station_N046 | △ Station_N063 | ▽ Station_N029 | ○ Station_R510 | Daily stats: Mean |

Statistics: Delta-tool 1.2

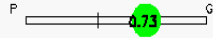
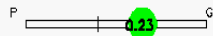
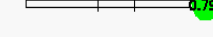

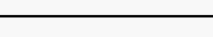

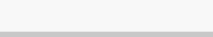
NO2-hourly values



Remark: for the validation all stations were used, although we know that the spatial resolution of the RIO-model (4x4km) is too low to validate the modelled concentrations at e.g. urban traffic monitoring stations.

| | | | | | | |
|--------|--------|--------|--------|--------|--------|---|
| ◇ HB23 | △ R001 | □ R010 | ○ N083 | ◇ R201 | ✖ R710 | Strt/end Ind: 1-8760 Model (s): RIO Parameter: NO2 Scen: 2010 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserved Statistic: preserved |
| □ LD01 | ◇ R002 | □ R821 | ◇ N086 | △ R222 | ✖ R721 | |
| △ LD02 | ◇ R012 | □ R822 | △ N070 | △ R223 | ◇ R740 | |
| ○ OB01 | ◇ W0L1 | ▽ R830 | △ N073 | ▽ R240 | ◇ R801 | |
| ◇ SZ01 | ◇ M802 | ◇ R841 | ▽ N085 | ◇ M702 | ◇ R802 | |
| ◇ B004 | ◇ N018 | ✖ R891 | ◇ N083 | ◇ M705 | ◇ R512 | |
| ◇ B006 | ◇ N035 | ✖ R892 | △ N100 | ◇ N012 | | |
| ✖ B011 | △ N040 | □ R893 | ✖ N121 | △ N029 | | |
| □ N043 | ✖ N046 | ▽ R897 | ✖ N132 | ◇ N052 | | |

Summary statistics: Delta-tool v.1.2 vs Delta-tool v.3.2 PM10-hourly values (2010)

| SUMMARY STATISTICS | | | | |
|--|--|------|------|------|
| Nb of stations: 50 valid / 61 selected | | | | |
| INDIC (Crit - Goal) | 90% percentile | Min | Mean | Max |
| TARGET (1.00-0.80) | P  G 0.73 | 0.39 | 0.57 | 0.87 |
| IMFBI (0.60-0.30) | P  G 0.23 | 0.00 | 0.14 | 0.36 |
| R (0.50-0.60) | P  G 0.79 | 0.59 | 0.86 | 0.92 |
| FAC2 (0.50-0.60) | P  G 0.91 | 0.83 | 0.96 | 1.00 |
| ISFBI (0.50-0.40) | P  G 0.37 | 0.04 | 0.22 | 0.57 |
| RDE (0.50-0.42) | P  G 0.23 | 0.00 | 0.11 | 0.30 |
| RPE (0.50-0.42) | P  G 0.41 | 0.08 | 0.29 | 0.47 |

St1/end Ind: 1-8760

Model (s): RIO
 Parameter: PM10
 Scan: 2010
 Extra Values: No
 Season: Year
 Day hours: All 24h
 Time Average: Preserved
 Statistic: Mean

