irCELine

Informing you on ambient air quality in the Belgian Regions

Flanders

VLAAMSE MILIEUMAATSCHAPPIJ

www.vmm.be

Brussels

BRUXELLES ENVIRONNEMENT
LEEFMILIEU BRUSSEL
-IBGE - BIM-

www.ibgebim.be

Wallonia

Air Climat
agence wallonne de l'air & du climat

airclimat.wallonie.be

Delta-tool a MS-experience

FAIRMODE recommandations:

→ use of models:

- **population exposure**
- **spatial extent of exceedances**

→ combined use of models and monitoring data: (among others) spatial interpolation

1. Belgian Interpolation technique : RIO-corine
2. Delta-tool statistics RIO-model
3. Population Exposure
4. Model Uncertainty
5. Conclusions

1. Belgian Interpolation technique RIO-Corine

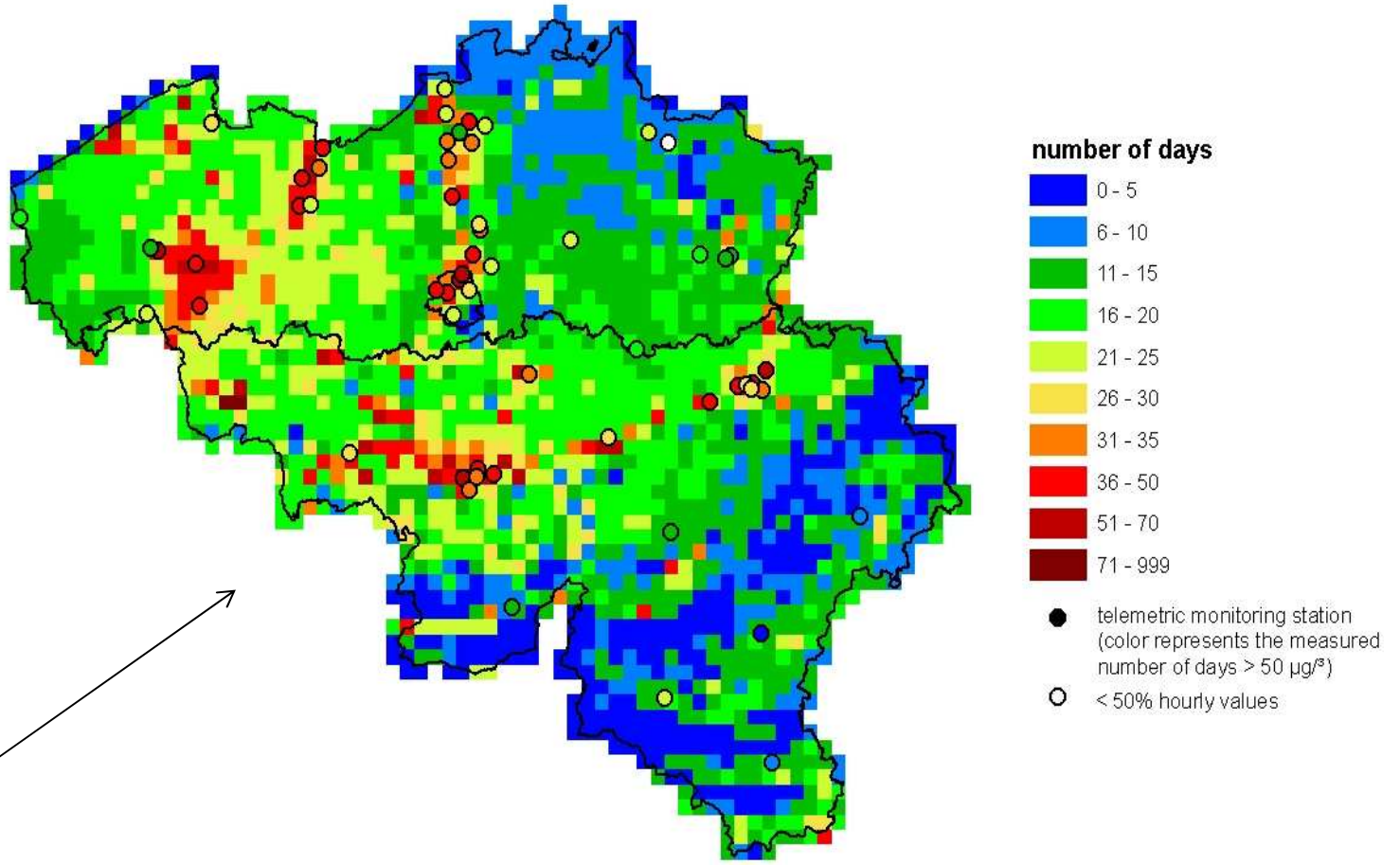
Belgium: RIO-Corine

→ O3, NO2, PM10, PM2.5

→ Operational interpolation technique using
- AQ measurements
- Landuse information
- Satellite data (AOD) PM2.5

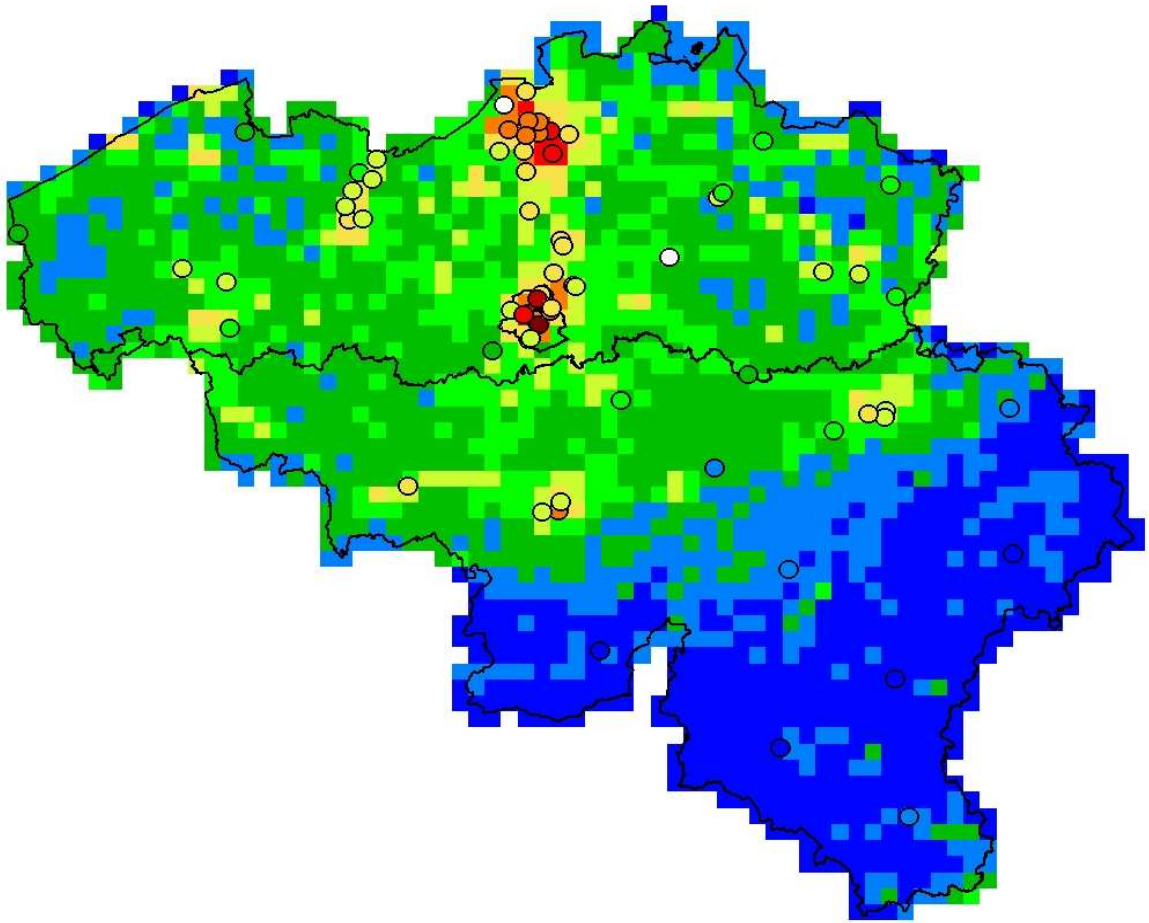
→ IRCEL:
- real-time (up-to-date) maps: website realtime
- **assessment (population exposure, compliance checking)**
- background concentrations as input for high resolution models

Number of days with daily mean PM10 > 50 µg/m³ (Belgium, 2009)



Remark: color of the dots are the measured concentrations

Annual mean NO2 concentrations (Belgium, 2009)



annual mean (µg/m³)

- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50

telemetric monitoring station (color represents the measured concentration)

< 50% hourly values

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2. Delta-tool statistics
RIO-corine

Model evaluation: Deltatool

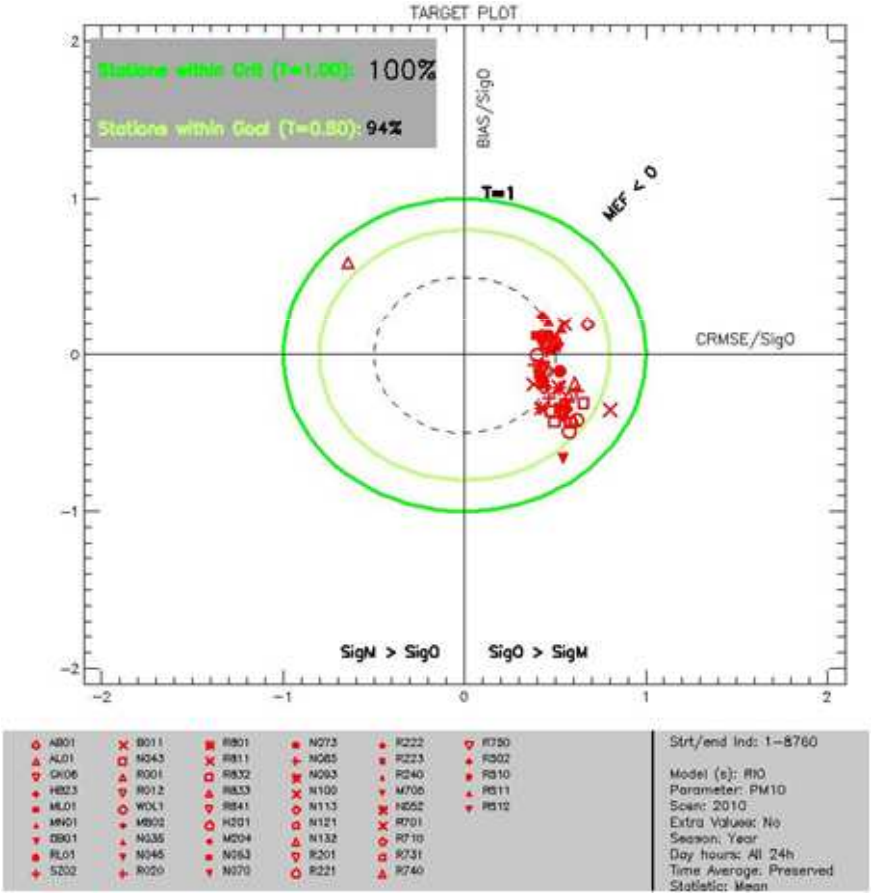
→ Comparison measurements – (interpolation) technique results (hourly values)

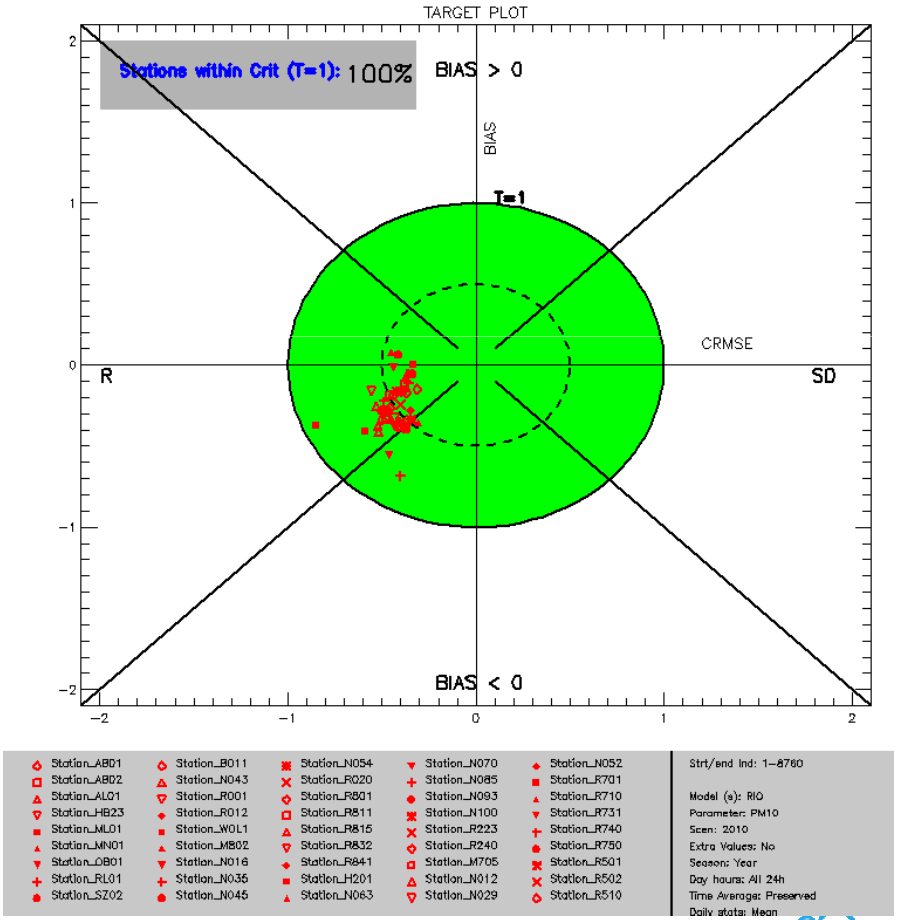
- “leaving-one-out” methodology : with n stations, interpolation with n-1, validation model results at the location of the left-out monitoring site

→ New version deltatool v3.2 :

- takes measurement uncertainty into account

Delta-tool 1.2 vs Delta-tool 3.2
PM10-hourly values





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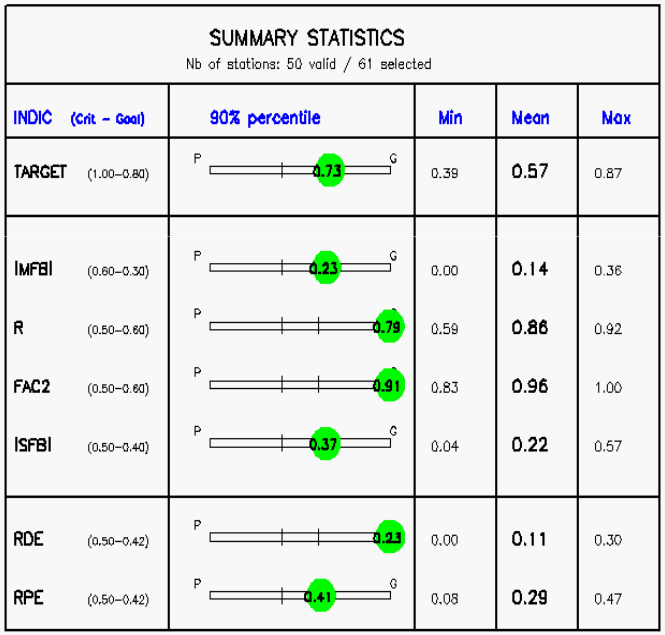
Summary statistics:
Delta-tool v.1.2 vs Delta-tool v.3.2
PM10-hourly values (2010)



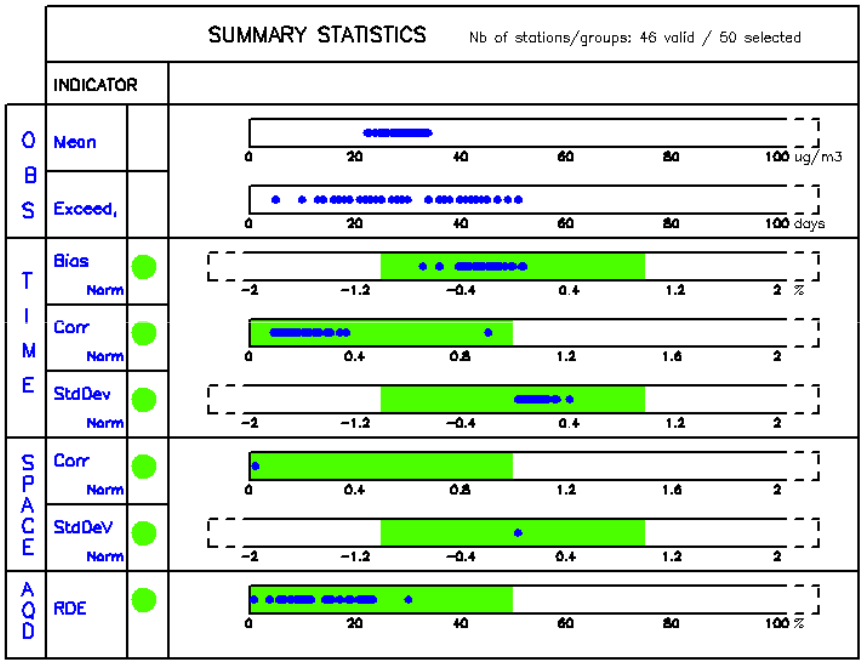
SUMMARY STATISTICS

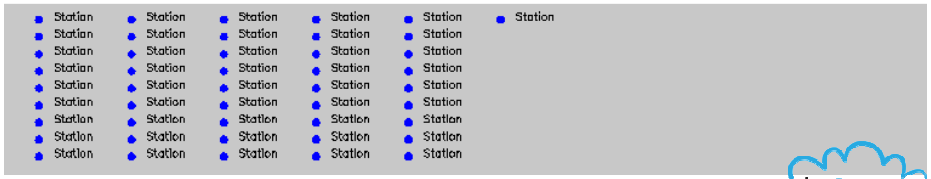
Nb of stations: 50 valid / 61 selected

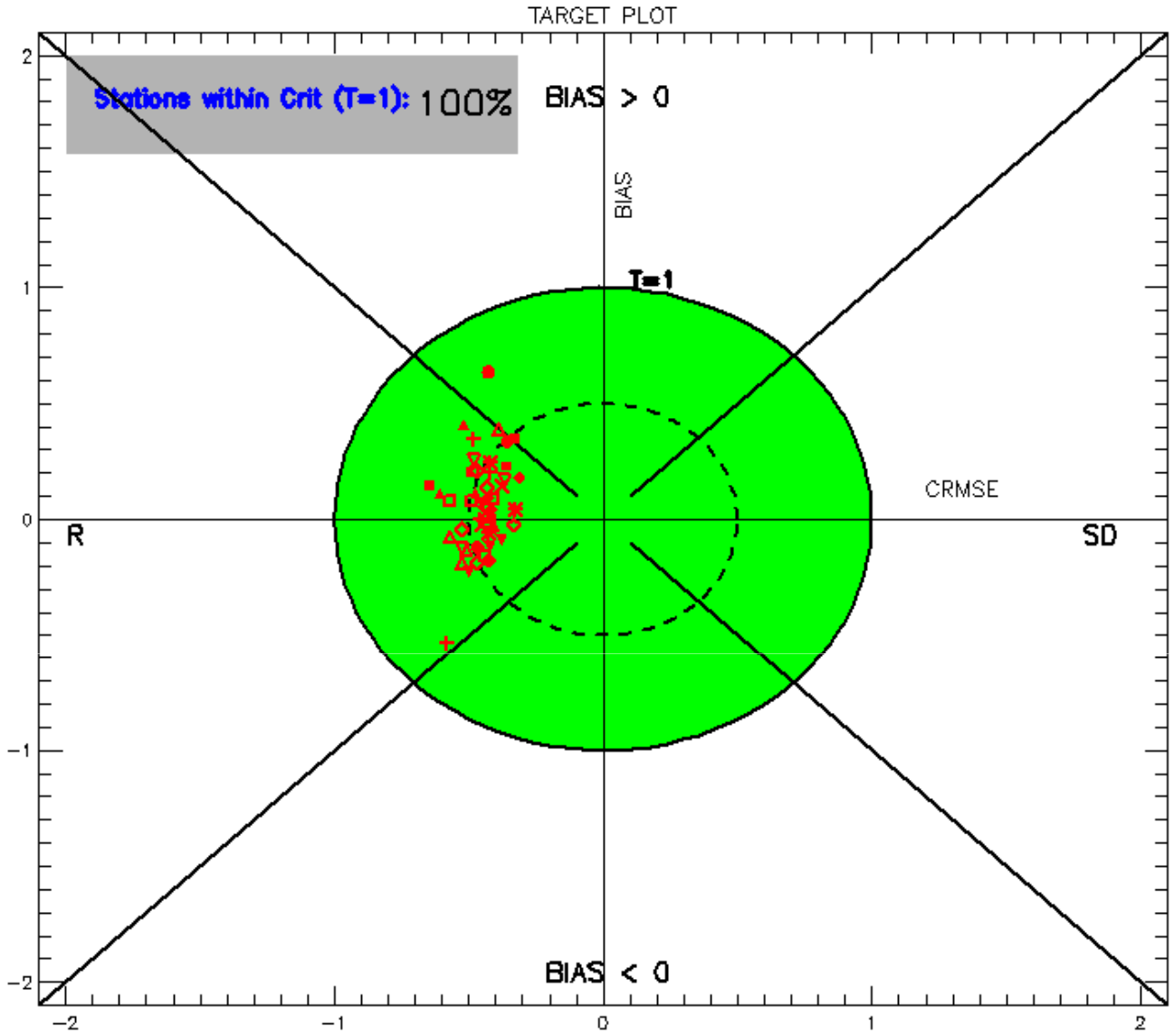
INDIC (Crit – Goal)	90% percentile	Min	Mean	Max
TARGET (1.00–0.80)	0.73	0.39	0.57	0.87
IMFBI (0.60–0.30)	0.23	0.00	0.14	0.36
R (0.50–0.80)	0.79	0.59	0.86	0.92
FAC2 (0.50–0.80)	0.91	0.83	0.96	1.00
ISFBI (0.50–0.40)	0.37	0.04	0.22	0.57
RDE (0.50–0.42)	0.23	0.00	0.11	0.30
RPE (0.50–0.42)	0.41	0.08	0.29	0.47

Strt/end Ind: 1–8760

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



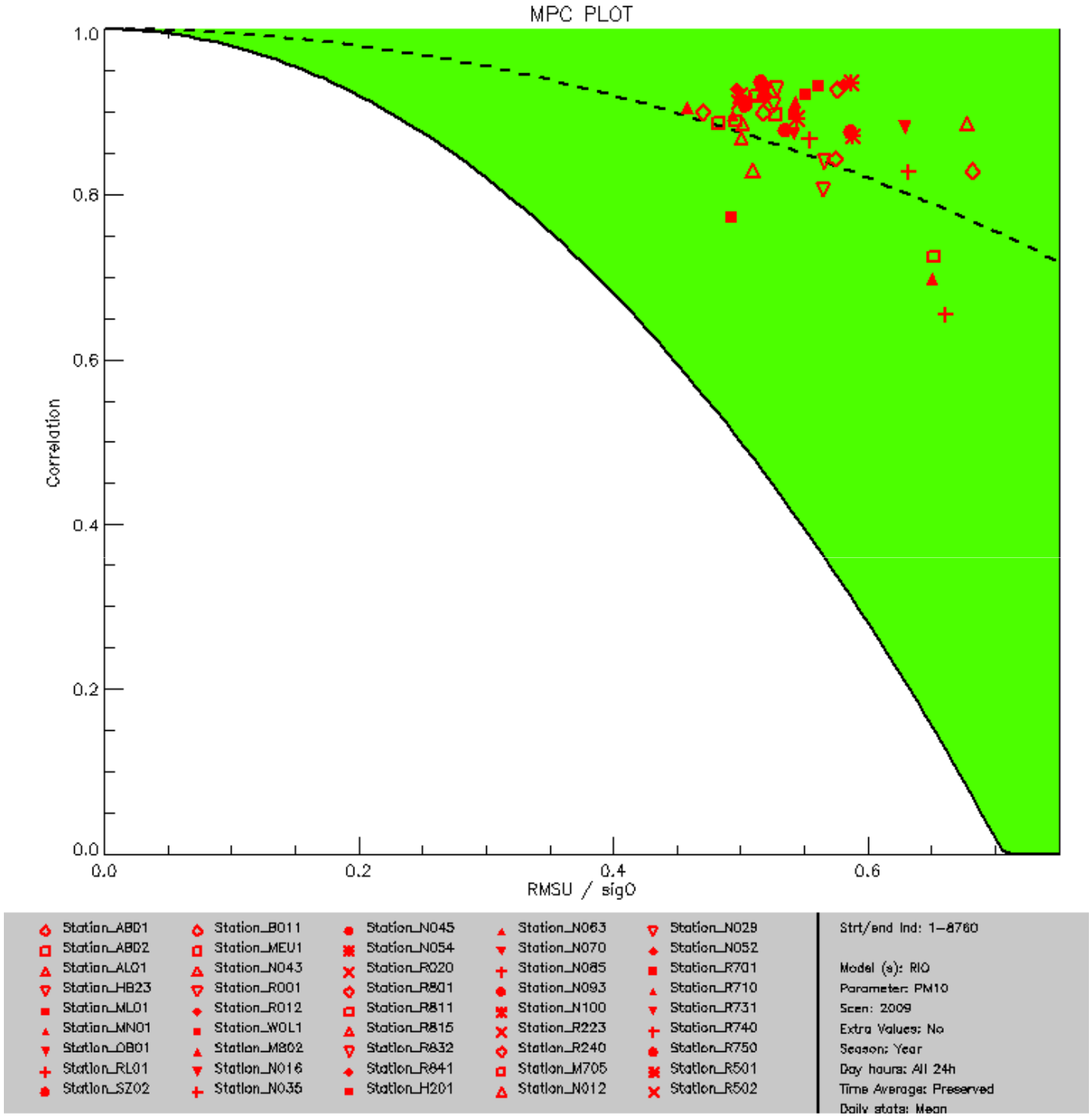




Station_AB01
Station_AB02
Station_AL01
Station_HB23
Station_ML01
Station_MN01
Station_OB01
Station_RL01
Station_SZ02
Station_B011
Station_MEU1
Station_N043
Station_R001
Station_R012
Station_WOL1
Station_M802
Station_N016
Station_N035
Station_N045
Station_N054
Station_R020
Station_R801
Station_R811
Station_R815
Station_R832
Station_R841
Station_H201
Station_N063
Station_N070
Station_N085
Station_N093
Station_N100
Station_R223
Station_R240
Station_M705
Station_N012
Station_N029
Station_N052
Station_R701
Station_R710
Station_R731
Station_R740
Station_R750
Station_R501
Station_R502

Strt/end Ind: 1–8760

Model (s): RIO
Parameter: PM10
Scen: 2009
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean


MPC PLOT
1.0
0.8
0.6
0.4
0.2
0.0
Correlation
0.0
0.2
0.4
0.6
RMSU / sig0
Station_AB01
Station_AB02
Station_AL01
Station_HB23
Station_ML01
Station_MN01
Station_OB01
Station_RL01
Station_SZ02
Station_B011
Station_MEU1
Station_N043
Station_R001
Station_R012
Station_WOL1
Station_M802
Station_N016
Station_N035
Station_N045
Station_N054
Station_R020
Station_R801
Station_R811
Station_R815
Station_R832
Station_R841
Station_H201
Station_N063
Station_N070
Station_N085
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Station_N100
Station_R223
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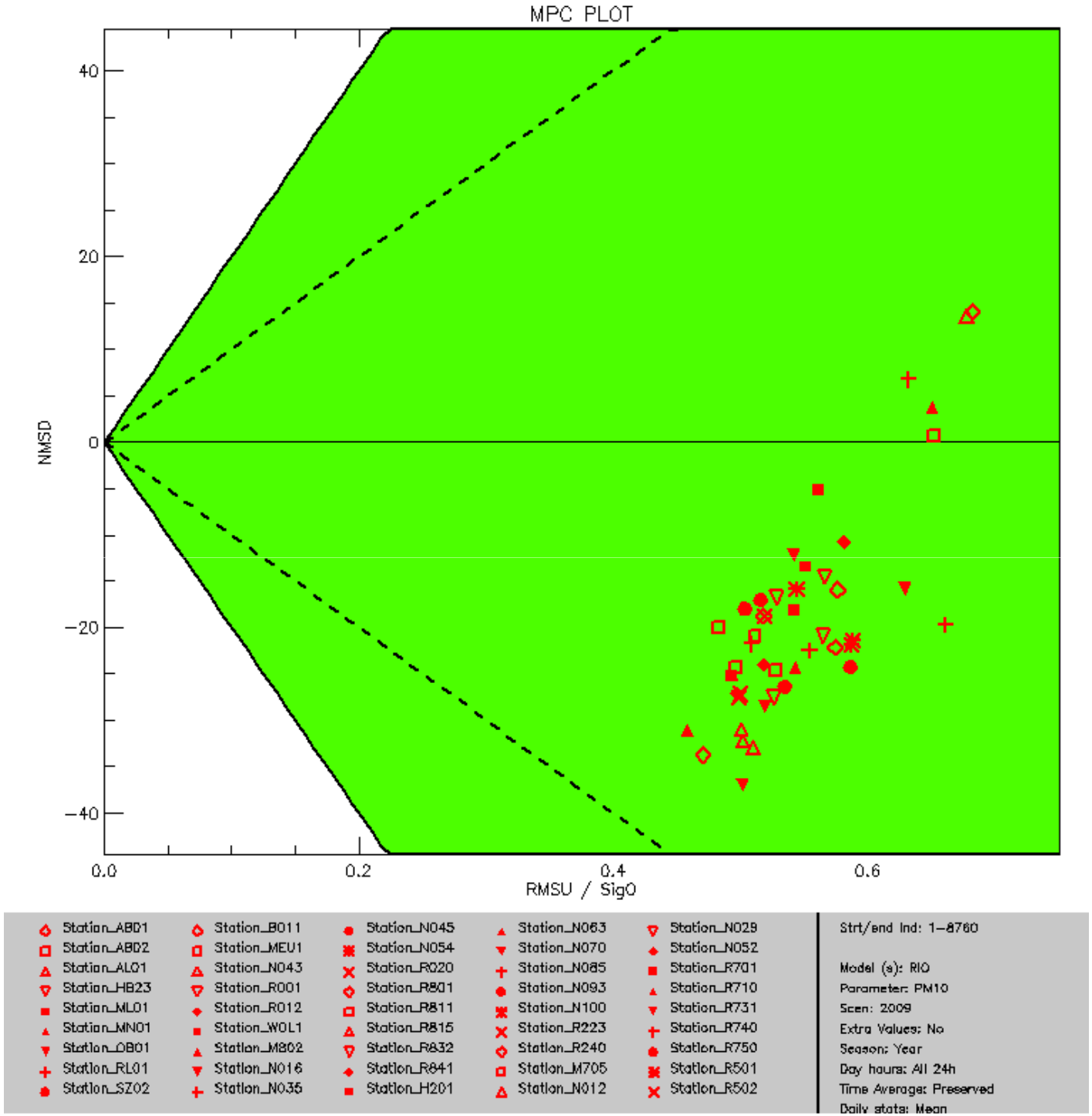
Time Average: Preserved
Daily stats: Mean


MPC PLOT
NMSD
RMSU / SigO
40
20
0
−20
−40
0.0
0.2
0.4
0.6
Station_AB01
Station_AB02
Station_AL01
Station_HB23
Station_ML01
Station_MN01
Station_OB01
Station_RL01
Station_SZ02
Station_B011
Station_MEU1
Station_N043
Station_R001
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Station_R502
Strt/end Ind: 1–8760
Model (s): RIO
Parameter: PM10
Scen: 2009
Extra Values: No
Season: Year
Day hours: All 24h
Time Average: Preserved
Daily stats: Mean

Conclusion:

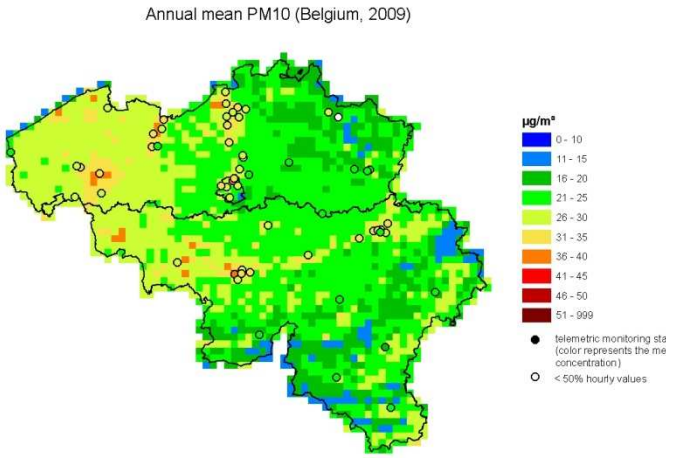
- **RIO-Corine** interpolation (PM10, NO2, 2009-2010) **complies** with **model quality objectives** DELTA-tool

- Moreover: **meets** also the **model performance criteria** DELTA-tool v3.2

3. Population Exposure

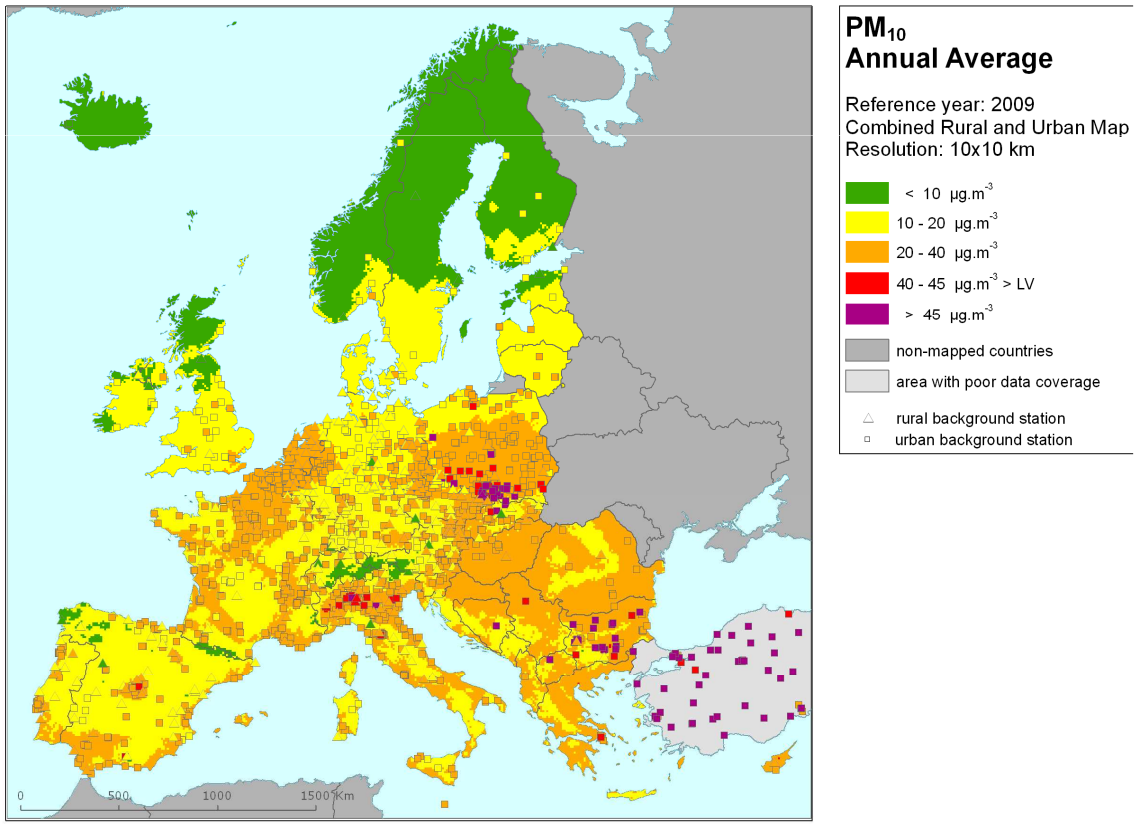
PM10 annual mean 2009: 2 model results :

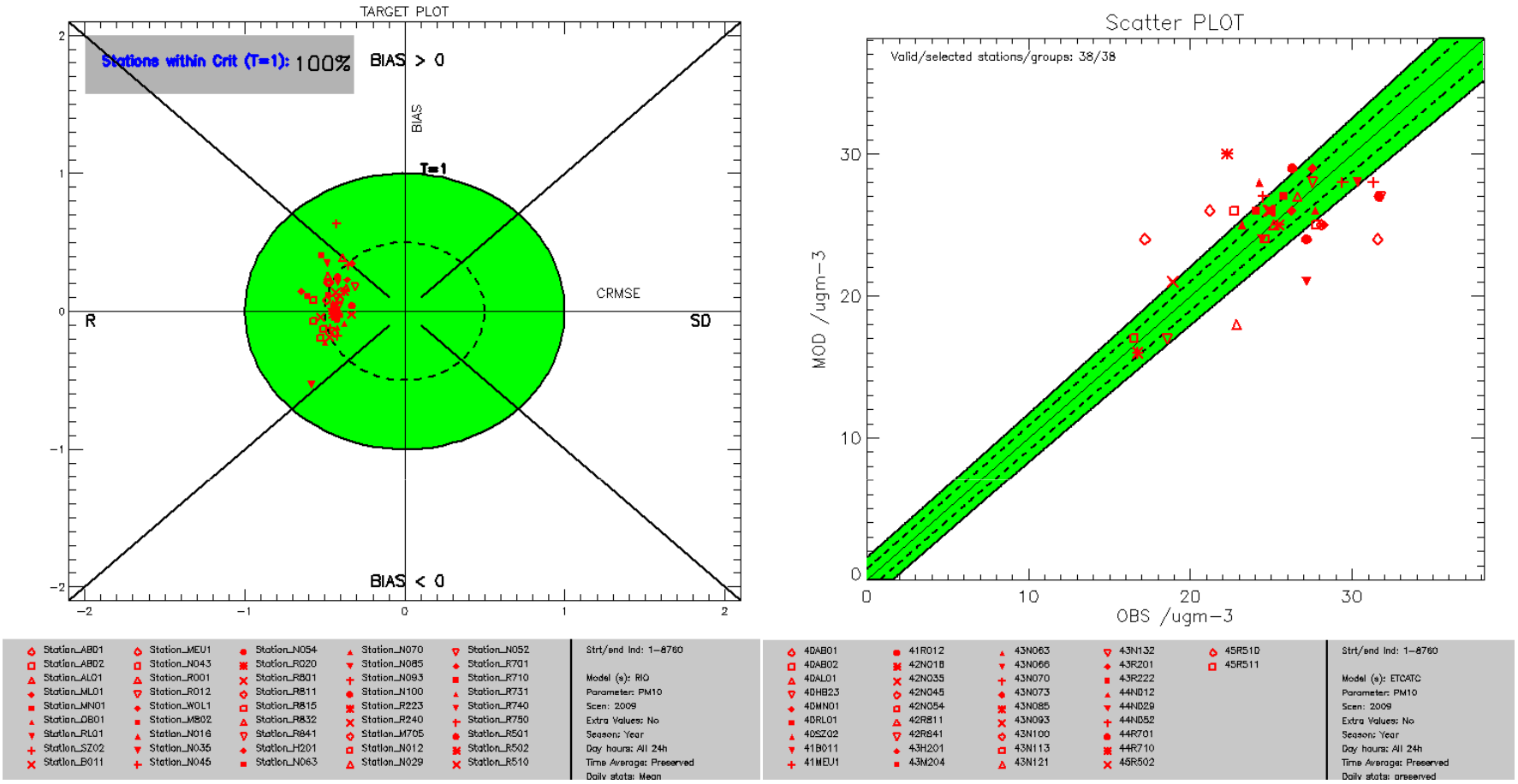
RIO-CORINE interpolation



ETC/ACM EU air quality maps BE

De Smet P,Horálek J,Kurfürst P,Schreiberová M, De Leeuw F,(2012) European air quality maps of ozone and PM10 for 2009 and their Uncertainty Analysis. ETC/ACM Technical Paper 2011/11



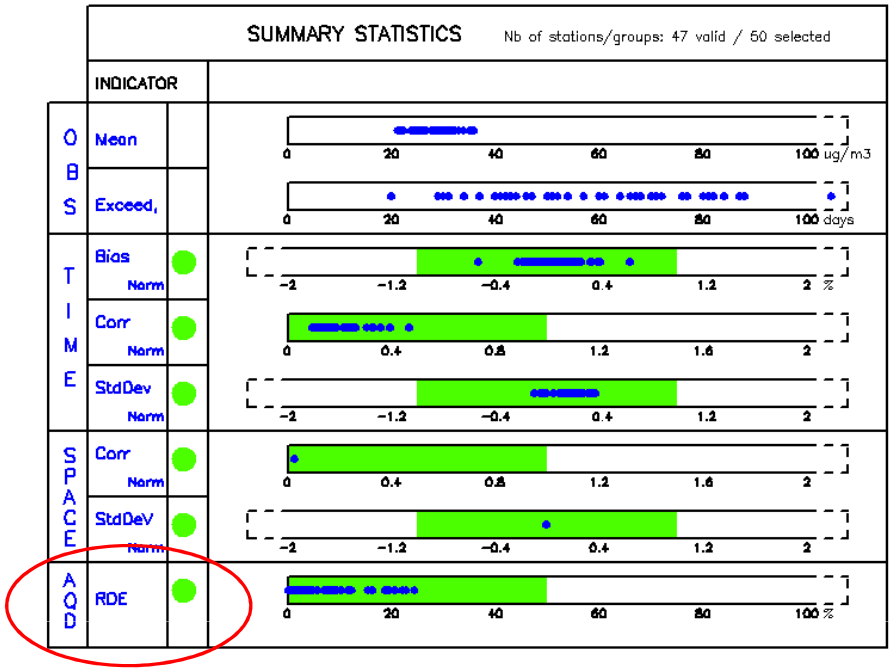


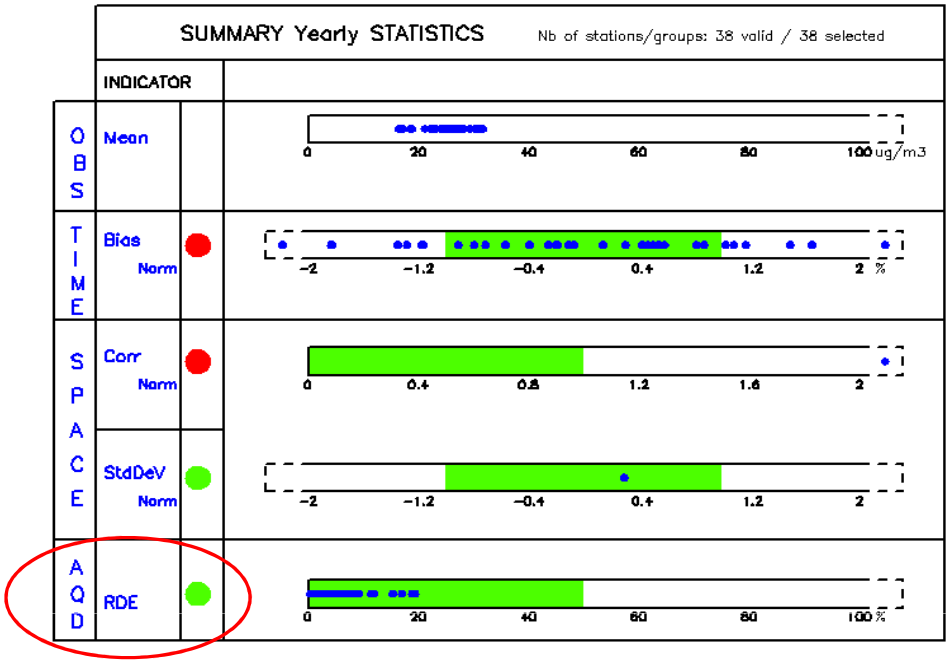
Targetplot RIO-Corine (hourly values)

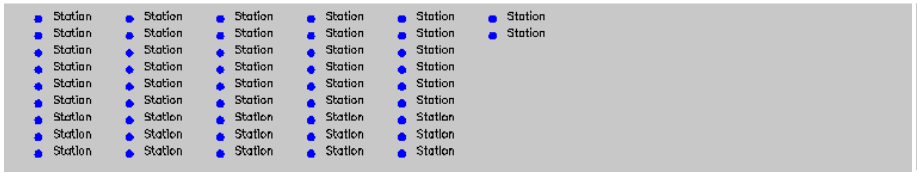
PM 10 annual mean 2009

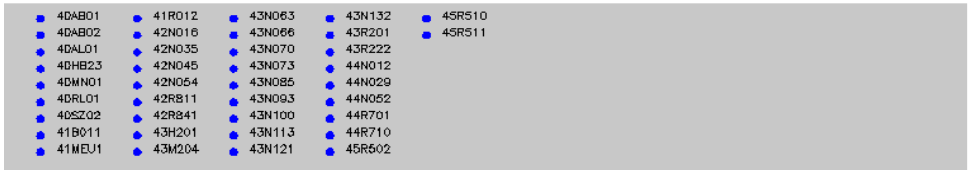
scatterplot ETC/ACM (yearly values)

PM 10 annual mean 2009









Summary RIO-Corine (hourly values)

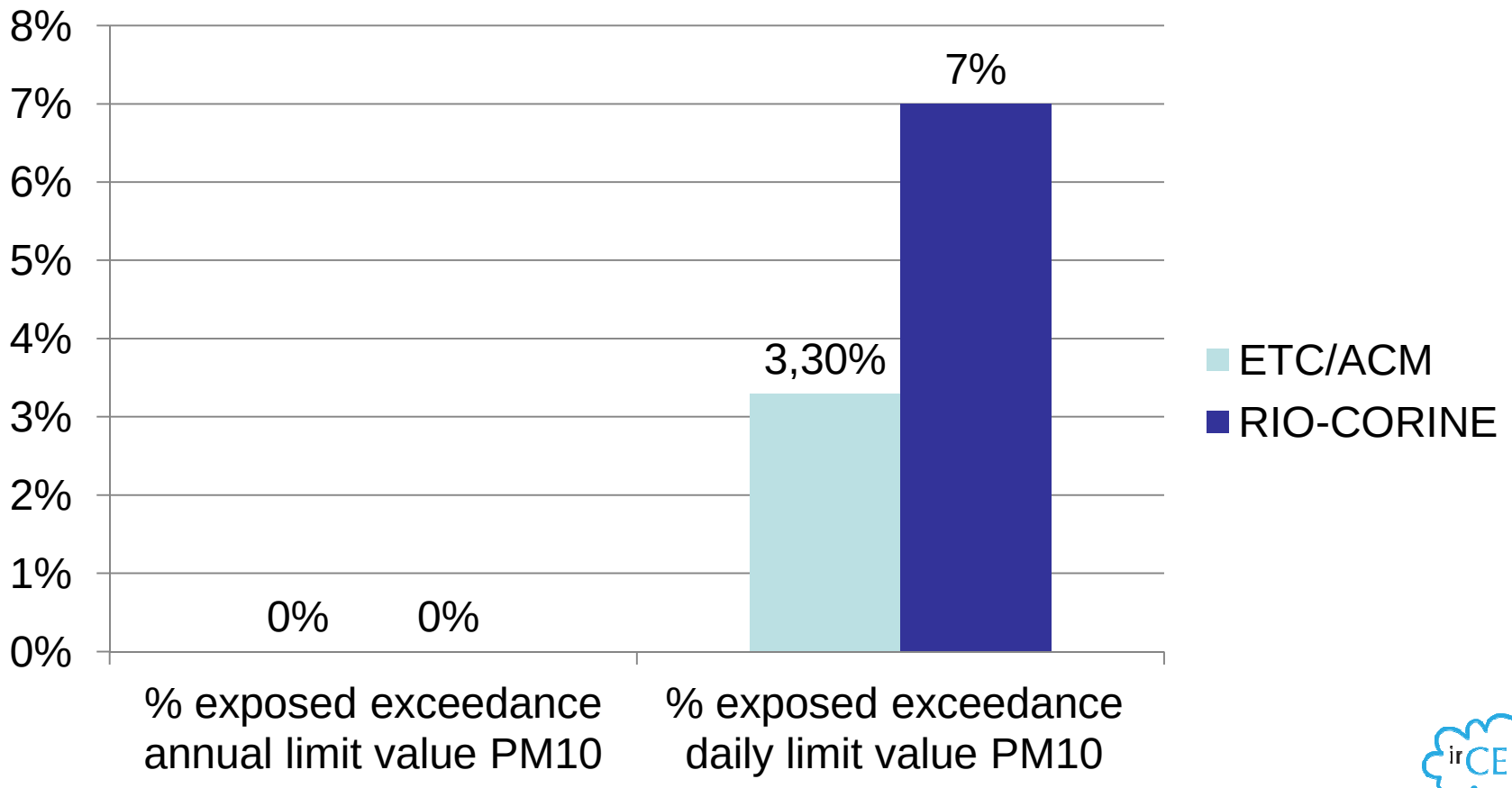
PM 10 annual mean 2009

Summary ETC/ACM (yearly values)

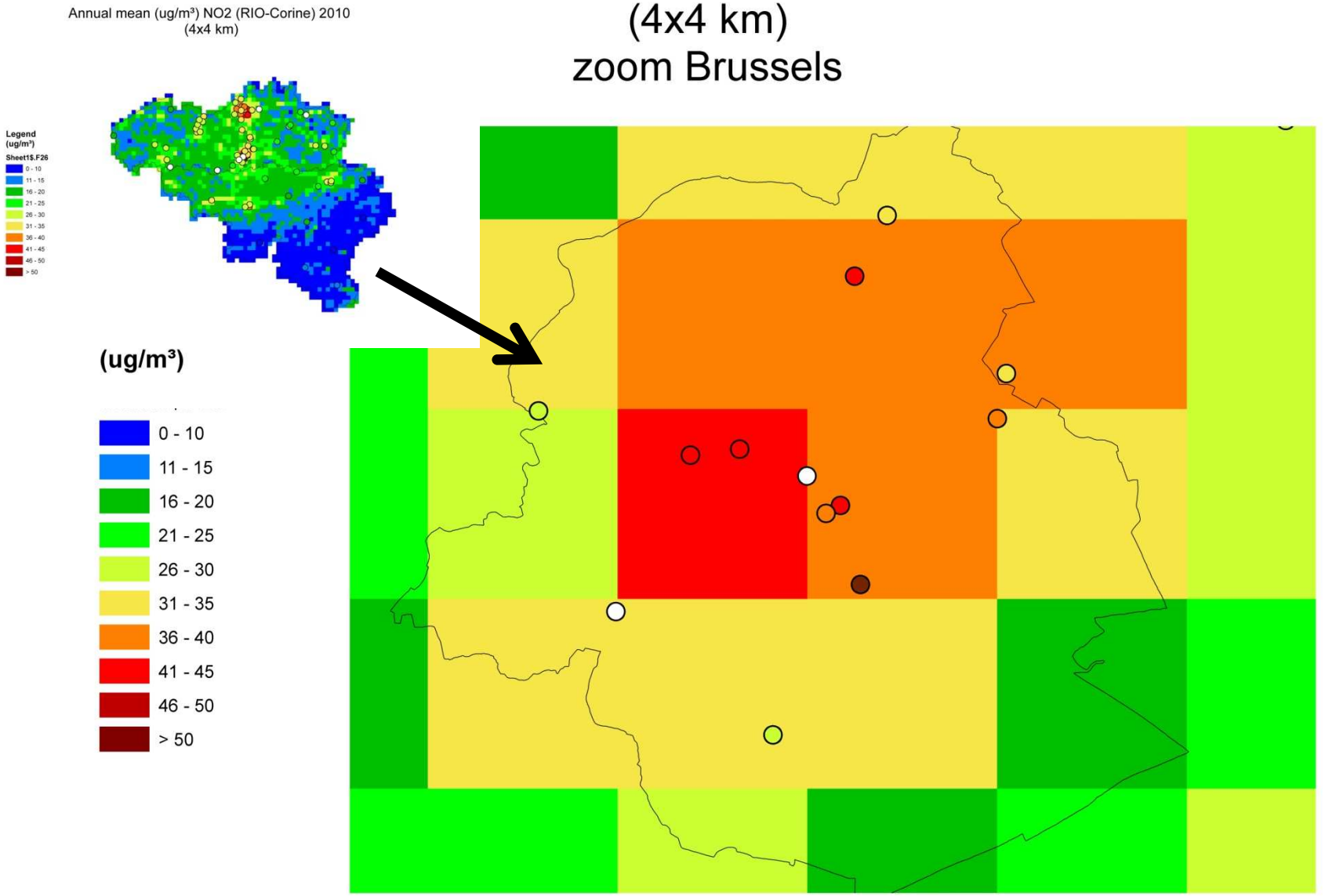
PM10 annual mean 2009

PM10 2009: % population exposure BE

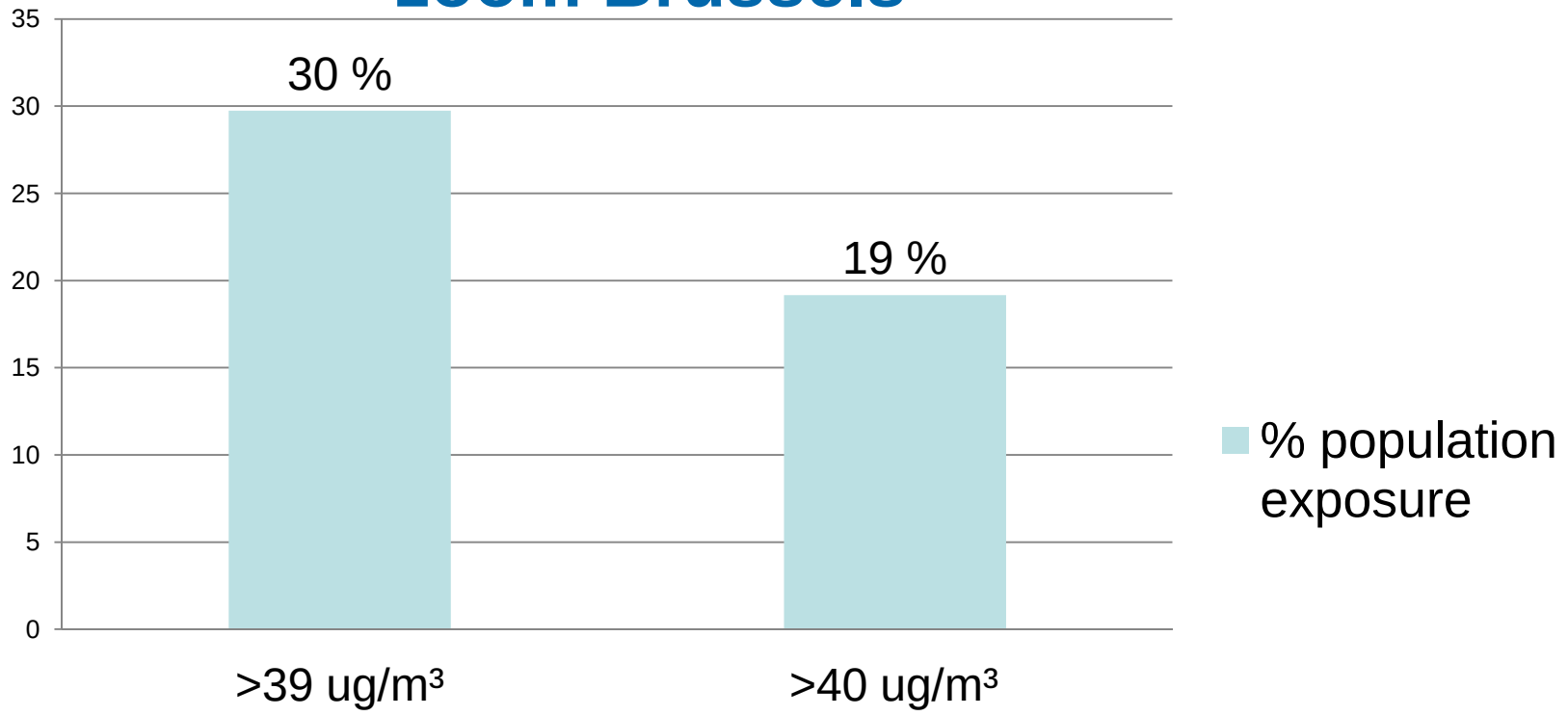
ETC/ACM EU air quality maps BE vs. RIO-CORINE interpolation



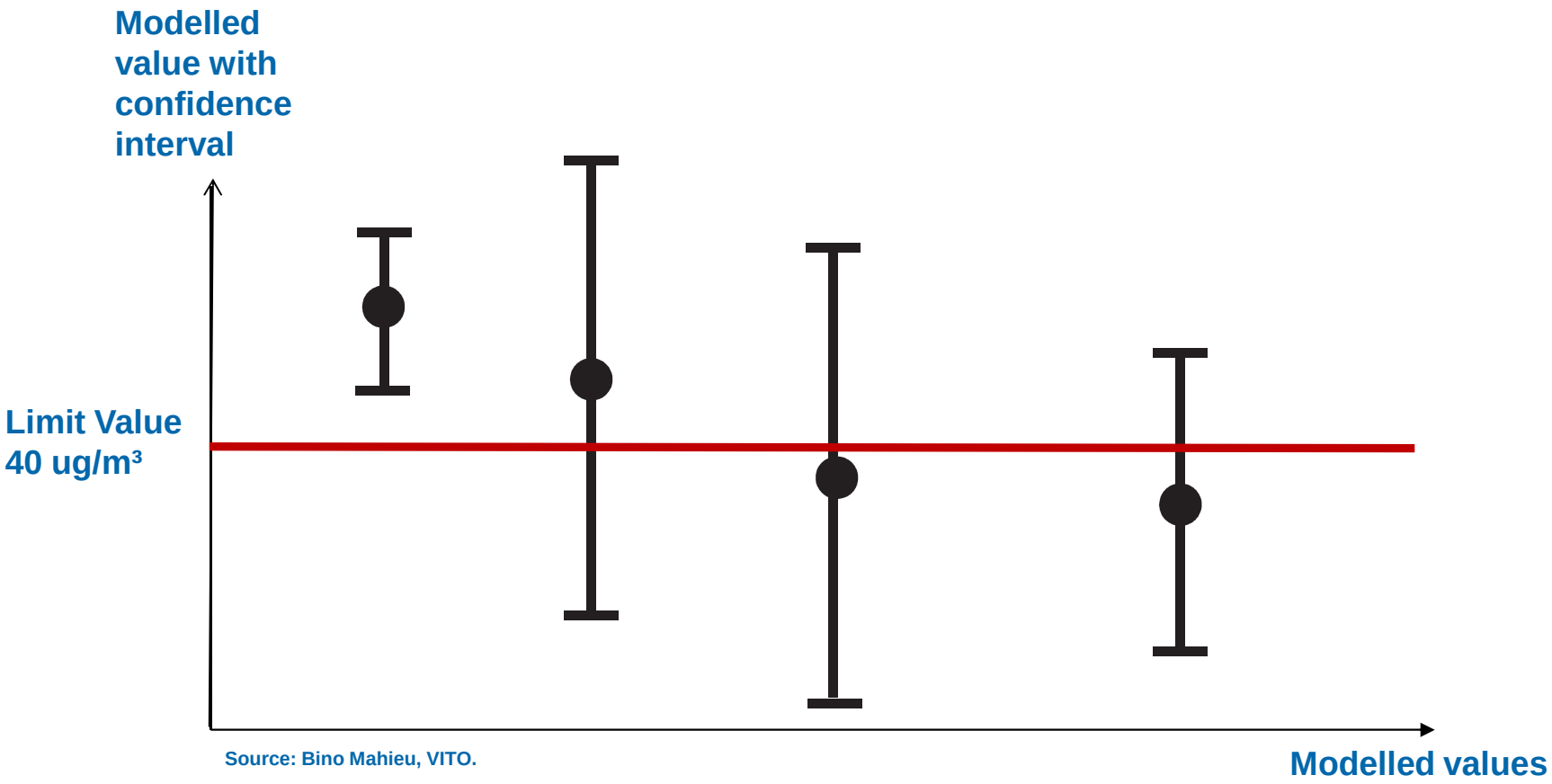
Annual mean (ug/m³) NO2 (RIO-Corine) 2010 (4x4 km) zoom Brussels



RIO-Corine (4x4 km) NO2 annual mean concentration 2010 : zoom Brussels



Difference of 11 % in population exposure when changing 1 ug/m³ distribution around limit value is important



Source: Bino Mahieu, VITO.

How many exceedances ?
Or is the question: What is the probability of an exeedance ?

Model uncertainty

4. Model uncertainty

- **Delta tool = validation statistics**
  - comparison between measurements and model results
  - for interpolation tools (via “leaving-one-out”)

- **Model Uncertainty**
  - covers the whole domain
  - takes into account uncertainty of input data (for Eulerian models : uncertainty emissions, meteo, ...)

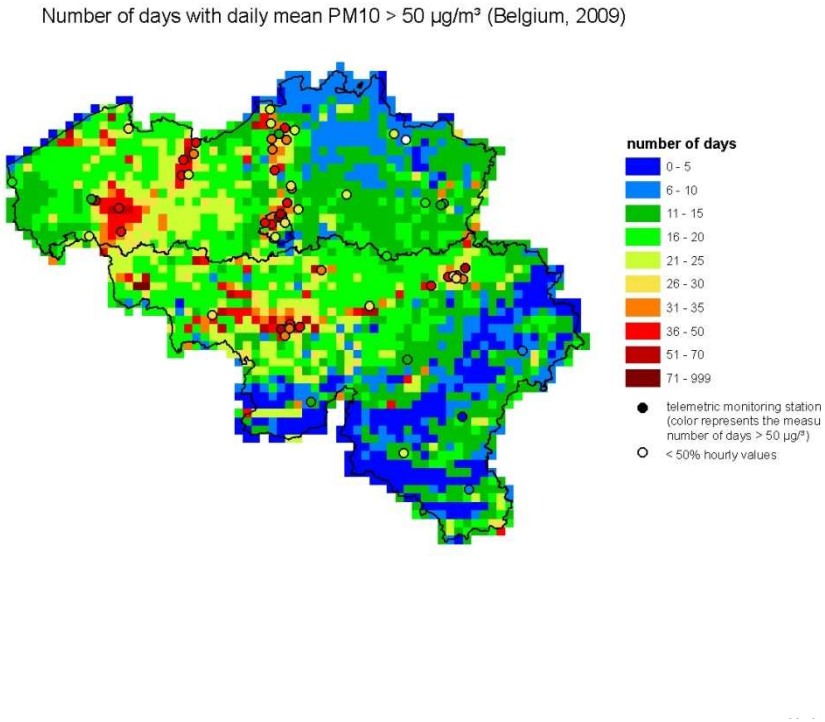
How to calculate uncertainty of the RIO-model?

- **Contributions to the RIO-model uncertainty:**

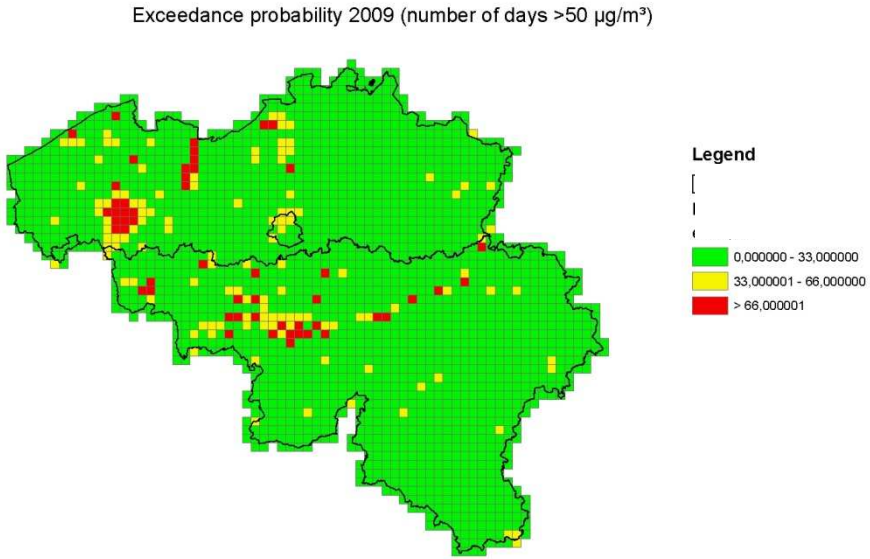
Kriging	• clustering of measurements stations • measurement uncertainty • distance to the measurements stations • variance of measurements
de-and retrending	• uncertainty introduced by de-and retrending

- **Aggregation to annual averages: temporal autocorrelation is taking into account**

Example of probability exceedance



Exceedances daily mean PM10 limit value 2009



Probability exceedance 2009

3. Conclusions

- Delta-tool statistics: **RIO-interpolation** tool is **performing well** (PM10, NO2, 2009-2010)

→ **spatial interpolation** should also be **consindered** in the **guidances**
(cfr. remarks BE made concering the NO2-guidance)

•Results **of exposure assessment** : strongly depend on the models used : difficult for a MS to explain these differences to the public

•Model Uncertainty or '**probability exceedance**' should be **taken into account**

•Some technical difficulties occured with the Delta-tool

Thank you for your attention !

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http://www.vmm.be

twitter.com/SMOG_BE

Technical information on RIO-model:

Publications

•Jef Hooyberghs, Clemens Mensink, Gerwin Dumont and Frans Fierens, *Spatial interpolation of ambient ozone concentrations from sparse monitoring points in Belgium*, **J. Environ. Monit., 2006, 8, 1129-1135** (doi: 10.1039/B612607N)

•Stijn Janssen, Gerwin Dumont, Frans Fierens and Clemens Mensink, Spatial interpolation of air pollution measurements using CORINE land cover data, **Atmospheric Environment 42, Issue 20, June 2008,** Pages 4884-4903 (doi:10.1016/j.atmosenv.2008.02.043)

•Stijn Janssen, Gerwin Dumont, Frans Fierens, Felix Deutsch, Bino Maiheu, David Celis, Elke Trimpeneers and Clemens Mensink, Land use to characterize spatial representativeness of air quality monitoring stations and its relevance for model validation. **Accepted to Atmospheric Environment (2012)**

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