



Informing you on ambient air quality
in the Belgian Regions

Flanders



VLAAMSE MILIEUMAATSCHAPPIJ

www.vmm.be

Brussels



www.ibgebim.be

Wallonia



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

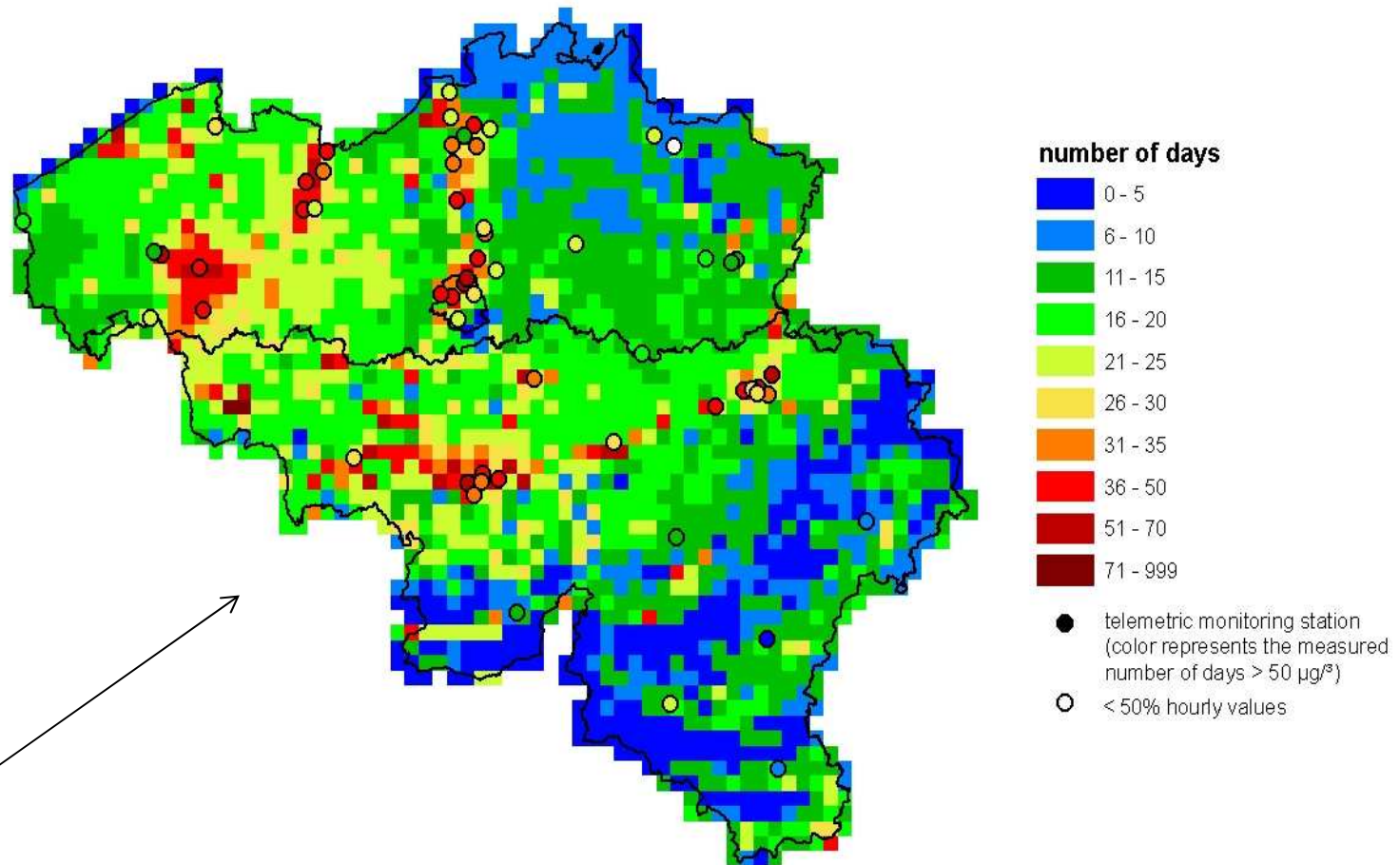
→ Operational interpolation technique using

- AQ measurements
- Landuse information
- Satellite data (AOD) PM2.5

→ IRCEL:

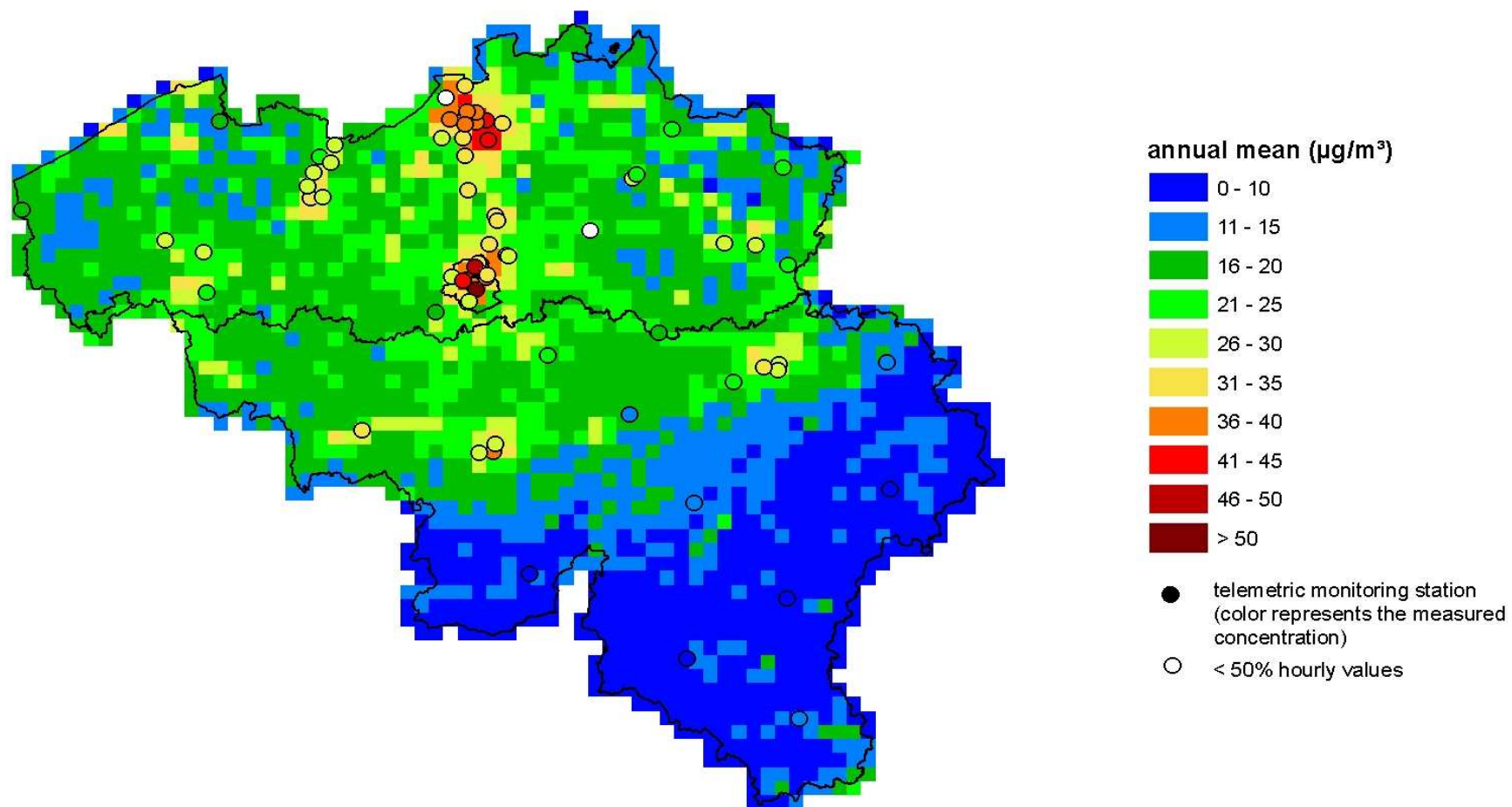
- real-time (up-to-date) maps: website realtime
- **assessment (population exposure, compliance checking)**
- background concentrations as input for high resolution models

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)



2. Delta-tool statistics

RIO-corine

Model evaluation: Deltatool

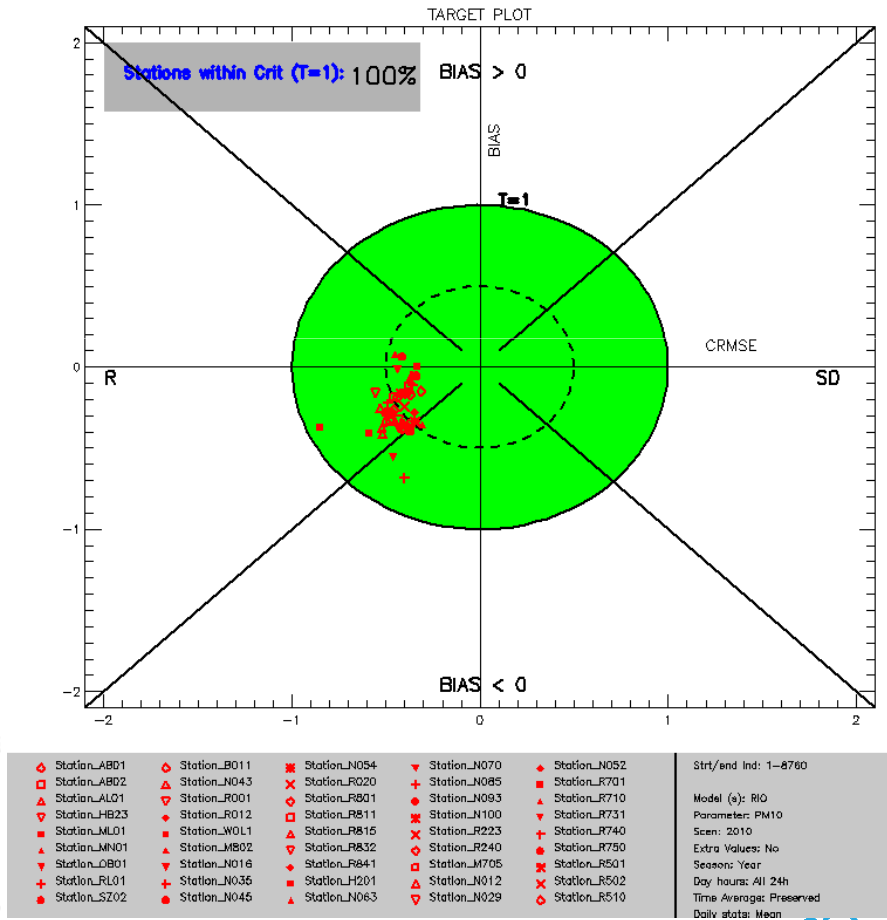
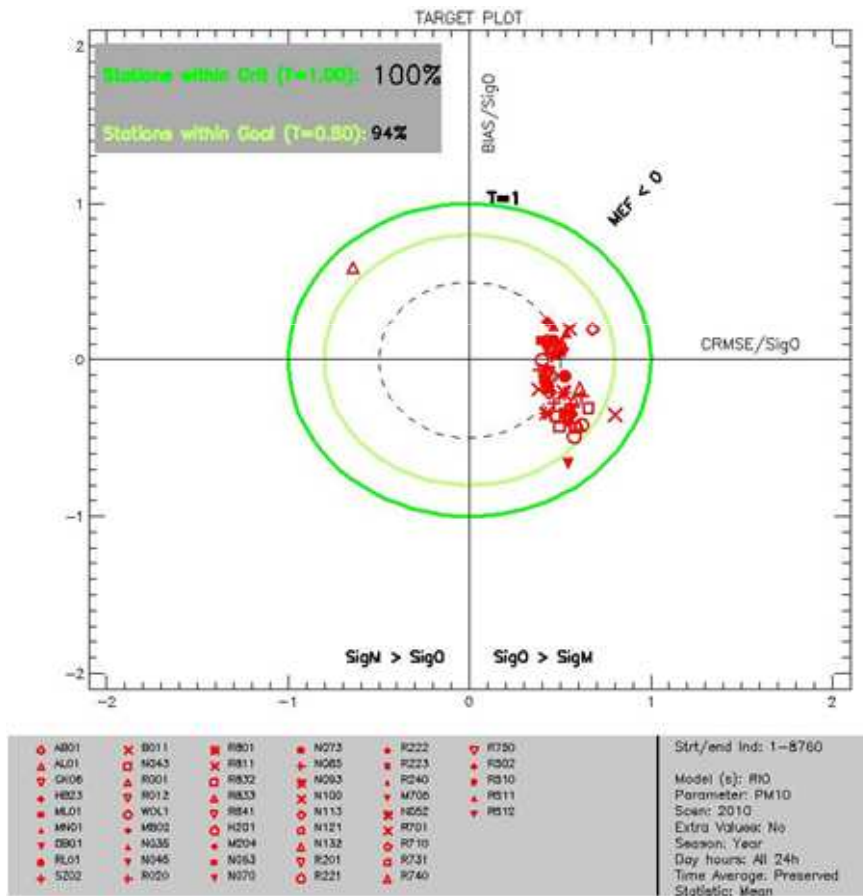
→ Comparison measurements – (interpolation) technique results (hourly values)

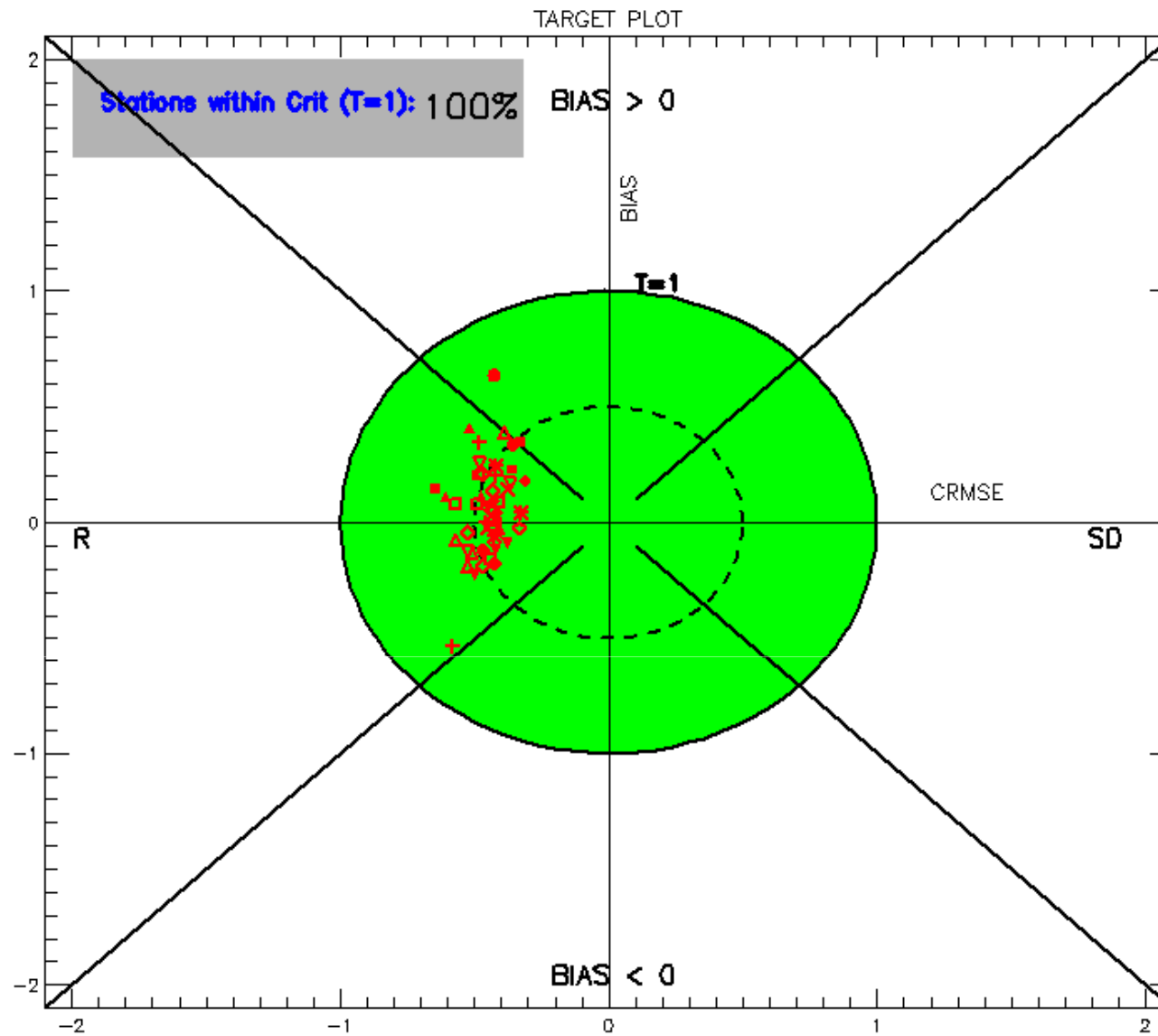
- “leaving-one-out” methodology : with n stations, interpolation with n-1, validation model results at the location of the left-out monitoring site

→ New version deltatool v3.2 :

- takes measurement uncertainty into account

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

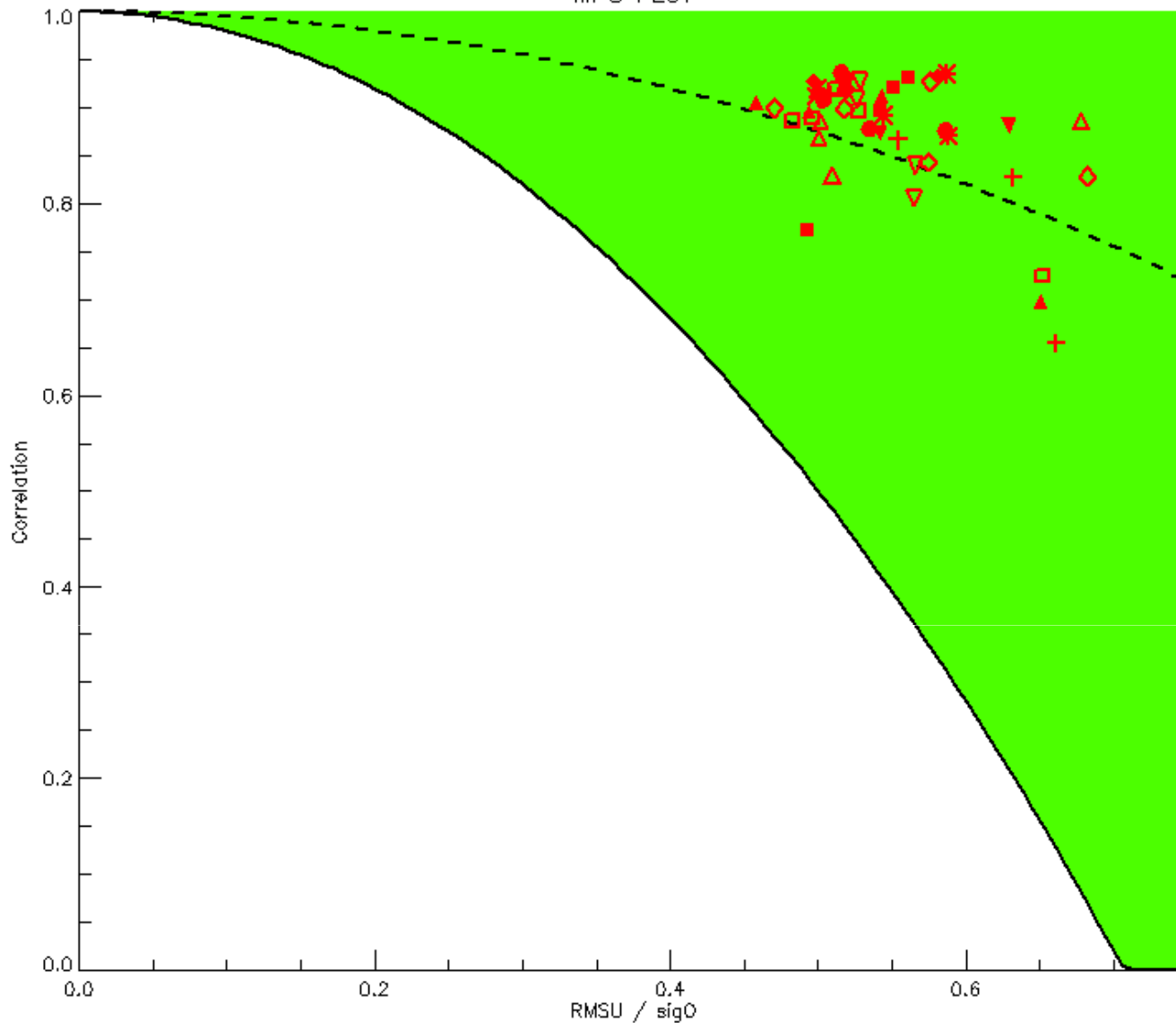




◇ Station_ABD1	◇ Station_B011	● Station_N045	▲ Station_N063	▽ Station_N029	Strt/end Ind: 1-8760 Model (s): RIO Parameter: PM10 Scen: 2009 Extra Values: No Season: Year Day hours: All 24h Time Averag: Preserved Daily stats: Mean
□ Station_ABD2	□ Station_MEU1	✖ Station_N054	▼ Station_N070	◆ Station_N052	
▲ Station_ALQ1	▲ Station_N043	✖ Station_R020	+	Station_N085	
▽ Station_HB23	▽ Station_R001	◇ Station_R801	● Station_N093	▲ Station_R710	
■ Station_MLD1	◆ Station_R012	□ Station_R811	✖ Station_N100	▼ Station_R731	
▲ Station_MND1	■ Station_W0L1	▲ Station_R815	✖ Station_R223	+	
▽ Station_OB01	▲ Station_M802	▽ Station_R832	◇ Station_R240	● Station_R750	
+ Station_RL01	▲ Station_N016	◆ Station_R841	Station_M705	□ Station_R501	
● Station_SZ02	+ Station_N035	■ Station_H201	▲ Station_N012	✖ Station_R502	



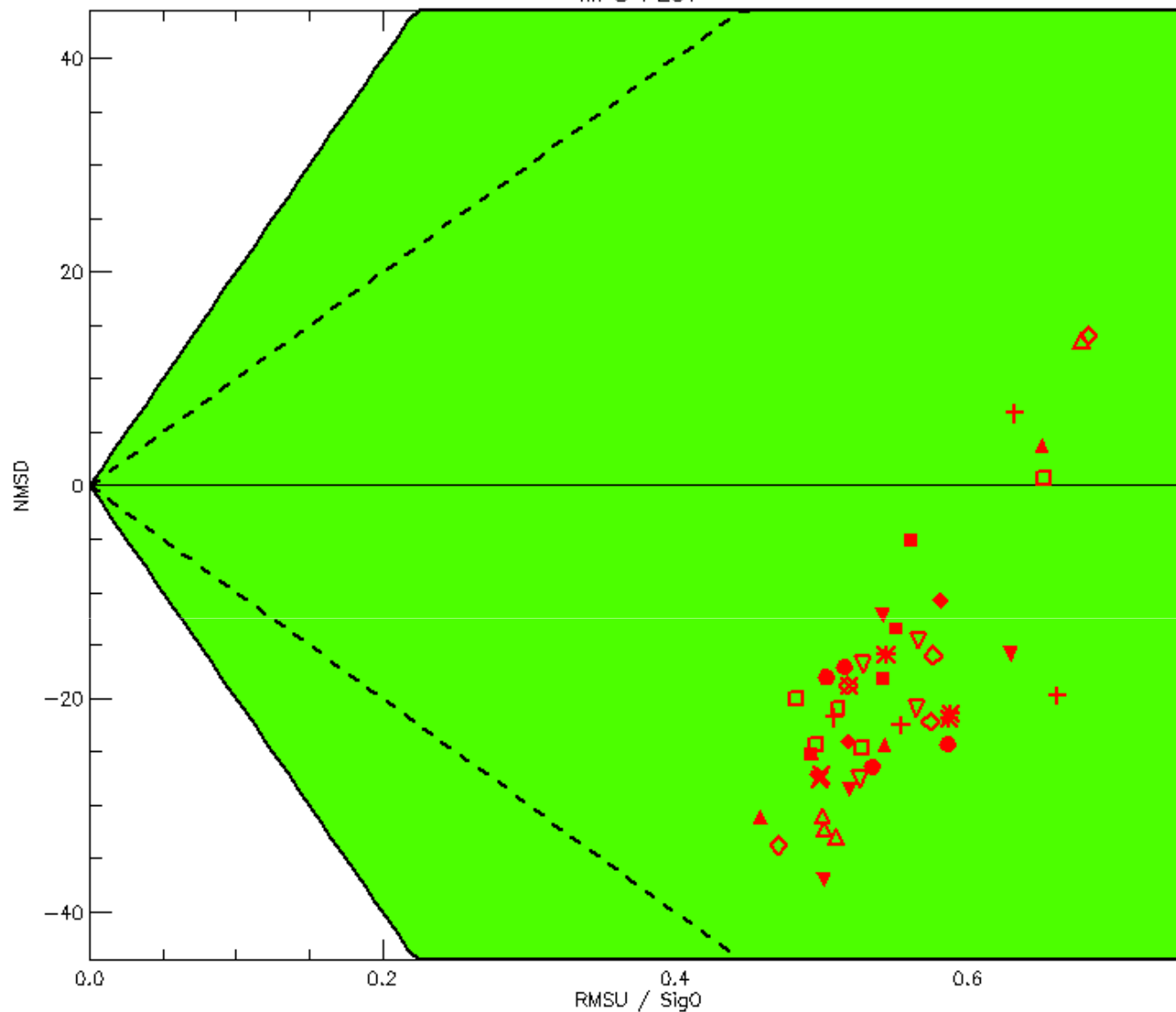
MPC PLOT



◇ Station_ABD1	◇ Station_B011	● Station_N045	▲ Station_N063	▽ Station_N029	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
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■ Station_MLD1	◆ Station_R012	□ Station_R811	✖ Station_N100	▲ Station_R710	
▲ Station_MND1	■ Station_W0L1	△ Station_R815	✕ Station_R223	▼ Station_R731	
▼ Station_OB01	▲ Station_M802	▽ Station_R832	◇ Station_R240	+	
Station_RL01	△ Station_N016	◆ Station_R841	● Station_M705	● Station_R750	
● Station_SZ02	+ Station_N035	■ Station_H201	□ Station_N012	✖ Station_R501	
				✕ Station_R502	



MPC PLOT



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▲ Station_MND1	■ Station_W0L1	▲ Station_R815	✕ Station_R223	▼ Station_R731	
▼ Station_OB01	▲ Station_M802	▼ Station_R832	◊ Station_R240	+	
+	▼ Station_N016	▲ Station_R841	● Station_M705	● Station_R750	
● Station_SZ02	+	■ Station_H201	◻ Station_M705	✱ Station_R501	
			▲ Station_N012	✕ Station_R502	



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

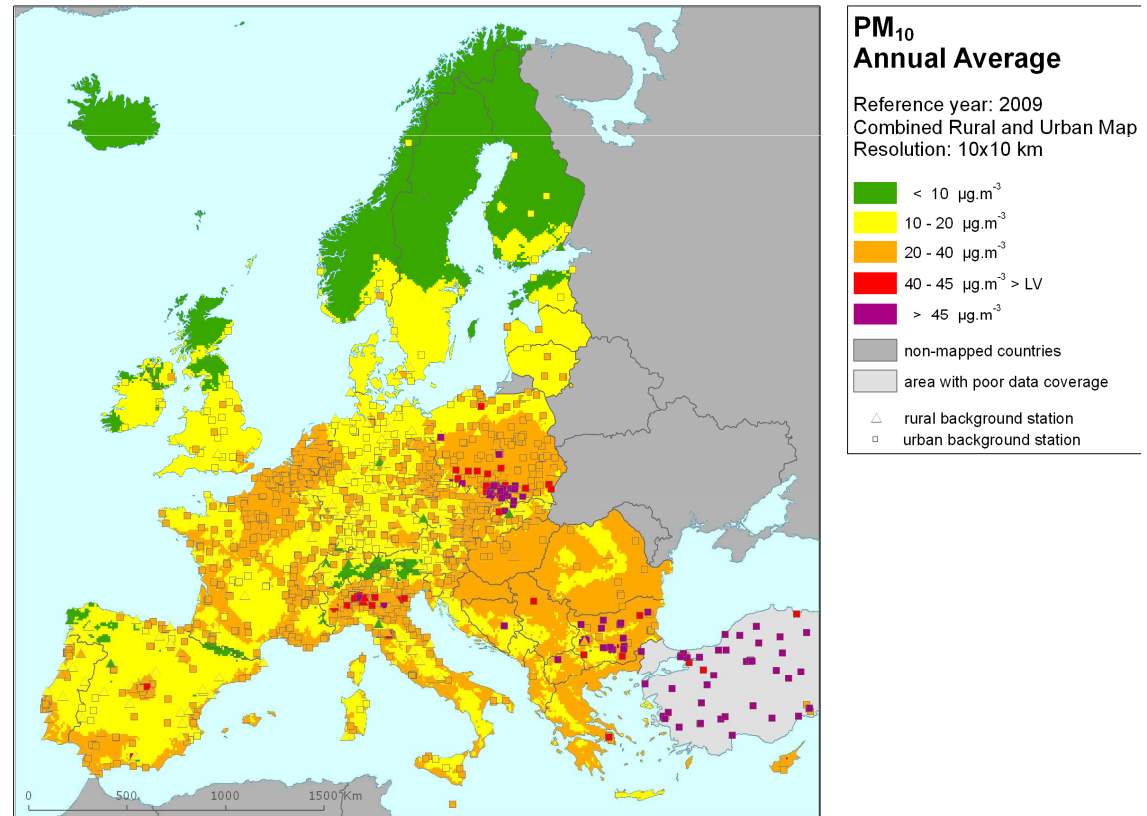
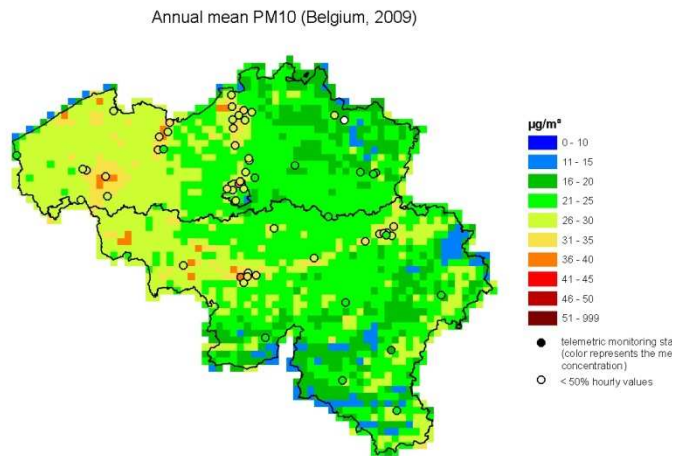
3. Population Exposure

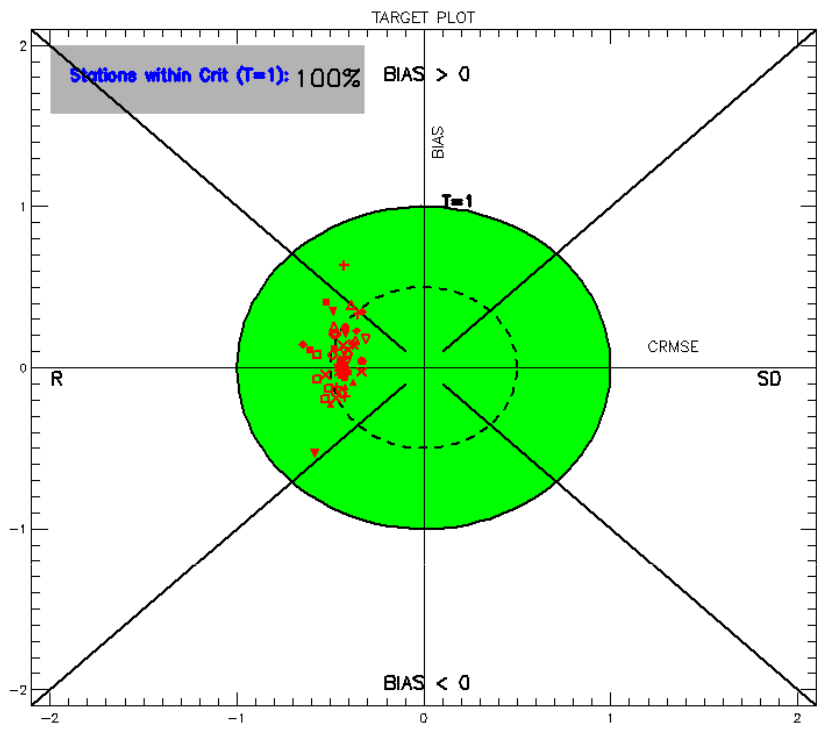
PM10 annual mean 2009: 2 model results :

RIO-CORINE interpolation

ETC/ACM EU air quality maps BE

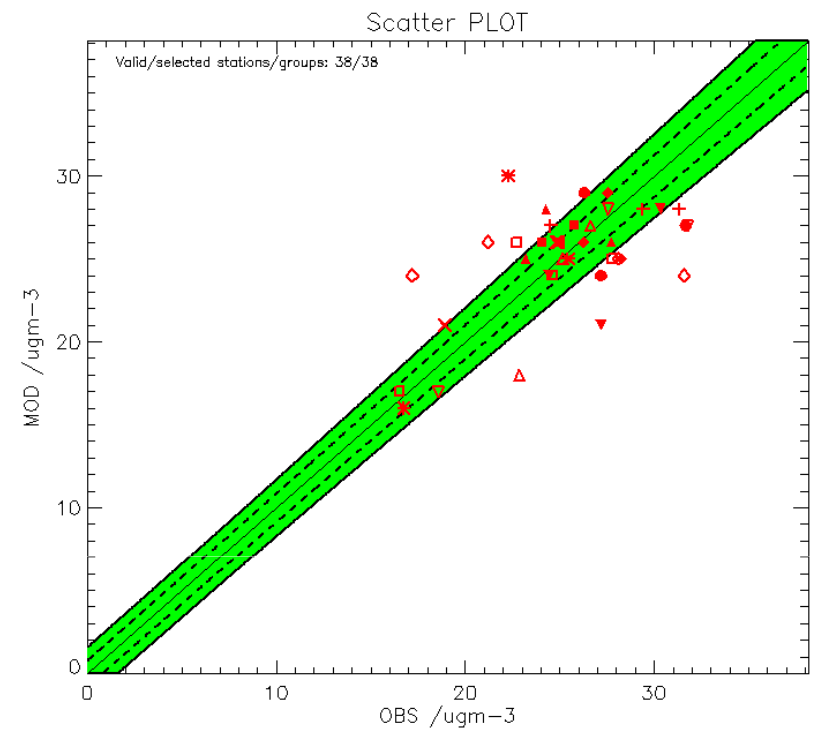
De Smet P, Horálek J, Kurfürst P, Schreiberová M, De Leeuw F, (2012)
European air quality maps of ozone and PM10 for 2009 and their
Uncertainty Analysis. ETC/ACM Technical Paper 2011/11





◇ Station_ABD1	◇ Station_MEU1	● Station_N054	▲ Station_N070	▽ Station_N052	Strt/end lnd: 1-8760
□ Station_ABD2	□ Station_N043	● Station_R020	▼ Station_N085	▲ Station_R701	Model (s): RIO
▲ Station_ALG1	▽ Station_R001	● Station_R801	● Station_N093	■ Station_R731	Parameter: PM10
◇ Station_MLQ1	▽ Station_R012	● Station_R811	● Station_N100	▲ Station_R750	Scen: 2009
◇ Station_MND1	◇ Station_WOL1	□ Station_R815	● Station_R223	▲ Station_R740	Extra Values: No
▲ Station_OBD1	■ Station_MB02	□ Station_R832	● Station_R240	▲ Station_R750	Season: Year
▲ Station_RLQ1	▲ Station_N016	▽ Station_R841	□ Station_M705	▲ Station_R501	Day hours: All 24h
▼ Station_SZ02	▼ Station_N036	▼ Station_H201	□ Station_N012	■ Station_R502	Time Averag: Preserved
× Station_B011	+ Station_N045	■ Station_N063	▲ Station_N029	× Station_R510	Daily stati: Mean

Targetplot RIO-Corine
(hourly values)
PM 10 annual mean 2009



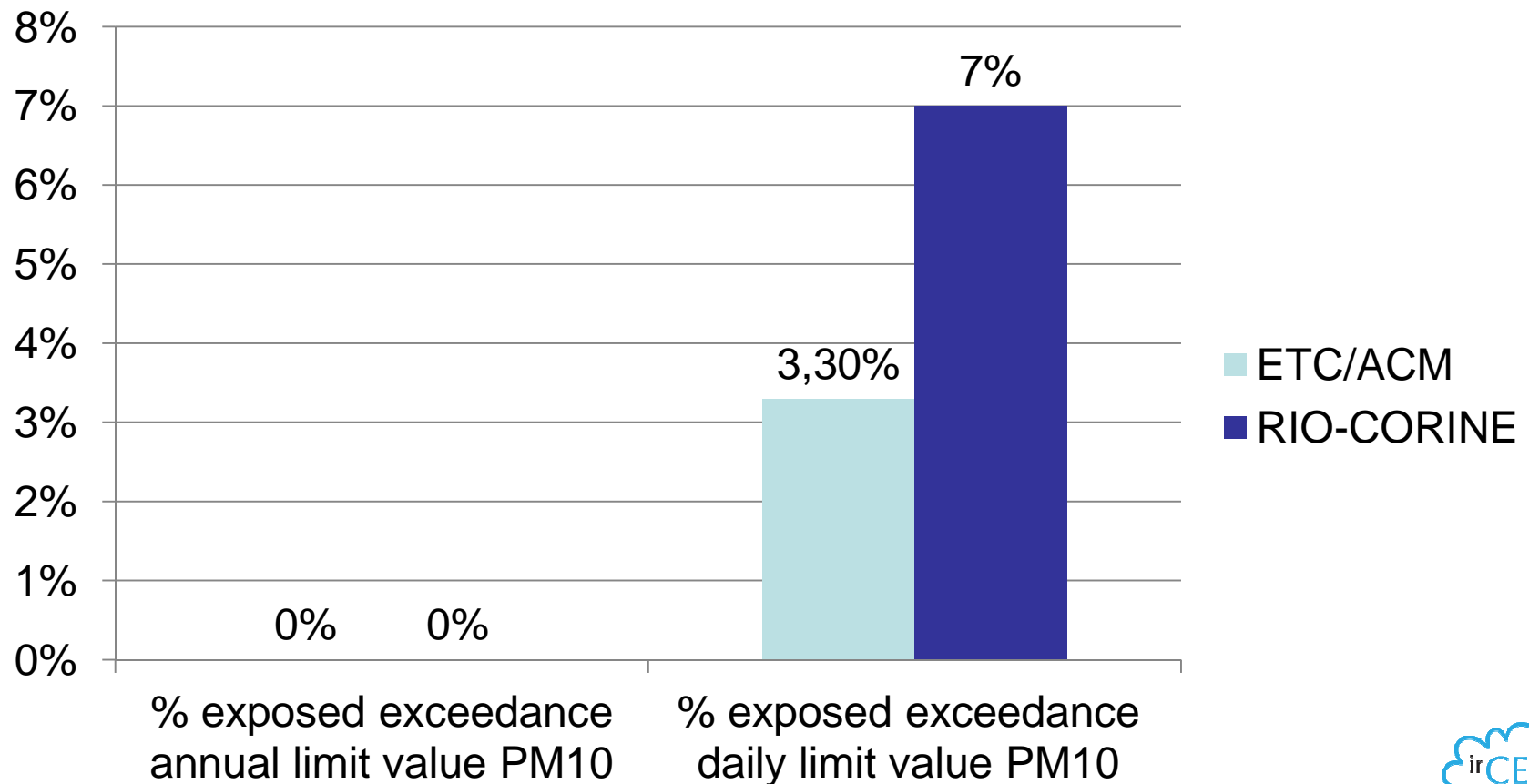
◇ 4DAB01	● 41R012	▲ 43N063	▽ 43N132	◇ 45R51D	Strt/end lnd: 1-8760
□ 4DAB02	□ 42N018	▼ 43N066	◆ 43R201	□ 45R511	Model (s): ETC/ACM
▲ 4DAL01	× 42N035	+ 43N070	■ 43R222		Parameter: PM10
▽ 4DHB23	× 42N045	+ 43N073	▲ 44N012		Scen: 2009
■ 4DMN01	▲ 42N054	× 43N085	▲ 44N029		Extra Values: No
▲ 4DRLO1	▲ 42R811	× 43N093	+ 44N052		Season: Year
▲ 4DSZ02	▼ 42R841	× 43N100	▲ 44R701		Day hours: All 24h
▼ 41B011	▼ 43H201	□ 43N113	■ 44R710		Time Averag: Preserved
+ 41MEU1	■ 43M204	▲ 43N121	× 45R502		Daily stati: preserved

scatterplot ETC/ACM
(yearly values)
PM 10 annual mean 2009

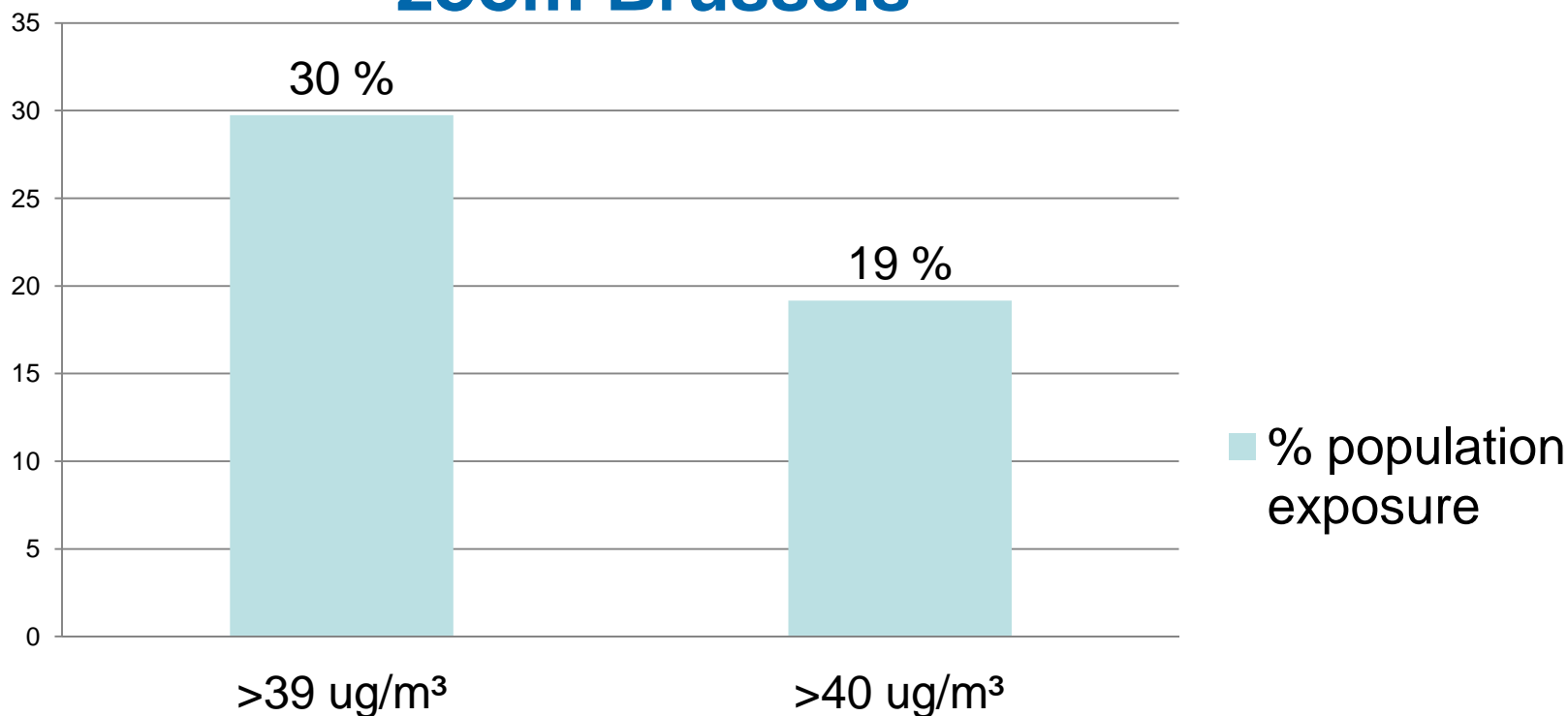


PM10 2009: % population exposure BE

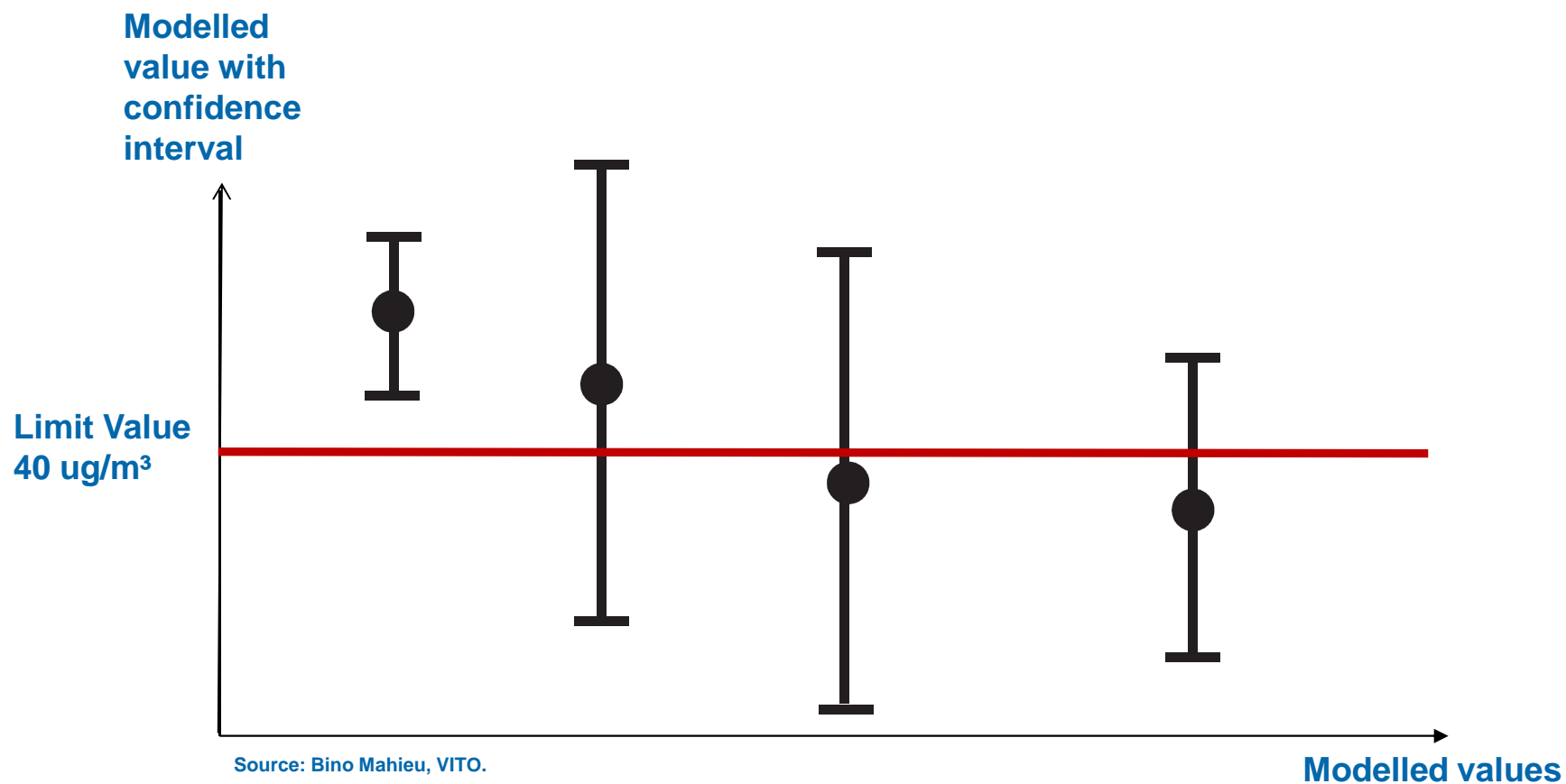
ETC/ACM EU air quality maps BE vs. RIO-CORINE interpolation



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



Difference of 11 % in population exposure when changing 1 ug/m^3 distribution around limit value is important



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



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

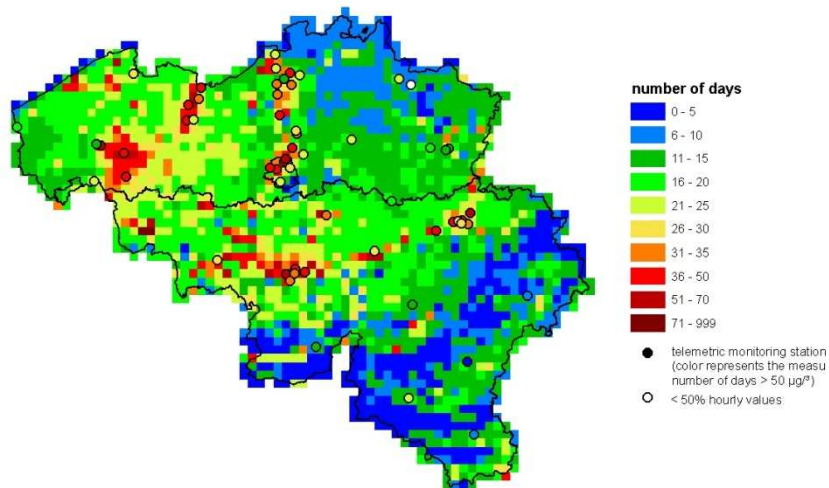
de-and
retrending

- uncertainty introduced by de-and retrending

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

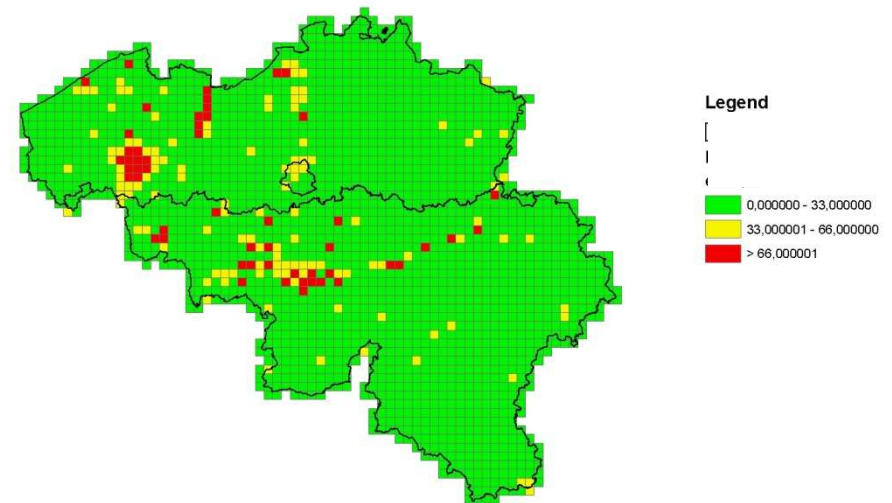
Example of probability exceedance

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



Exceedances daily mean
PM10 limit value 2009

Exceedance probability 2009 (number of days >50 µg/m³)



Probability exceedance 2009

3. Conclusions

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



spatial interpolation should also be **considered** in the **guidances**
(*cfr. remarks BE made concerning 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 occurred 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)**

