

Modelling some heavy metals air concentration in Europe

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In this presentation we pretend to

- Show some model results for As, Pb, Cd, Ni, Zn, Cu, Cr and Se in Europe using the **CHIMERE model**
- Expose the limitations on the modelling exercise
- Open a discussion on the evaluation of the model performance for this type of pollutant

Very recently we have included the description of some non-reactive metallic species in the **CHIMERE model**, as particles

chim2008c version

Directive 2004/107/EC

- Arsenic
- Lead
- Cadmium
- Nickel

Chromium

Copper

Selenium

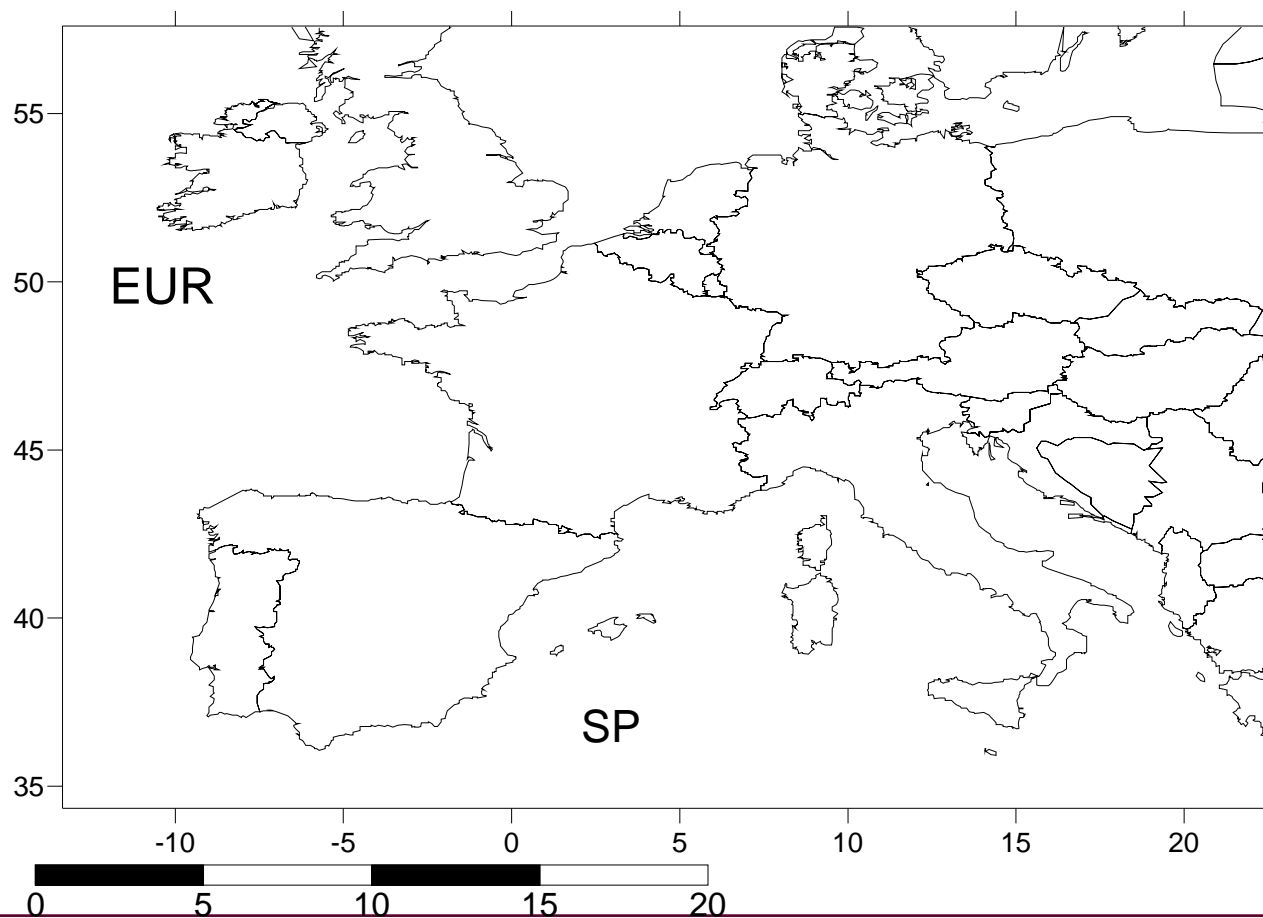
Zinc

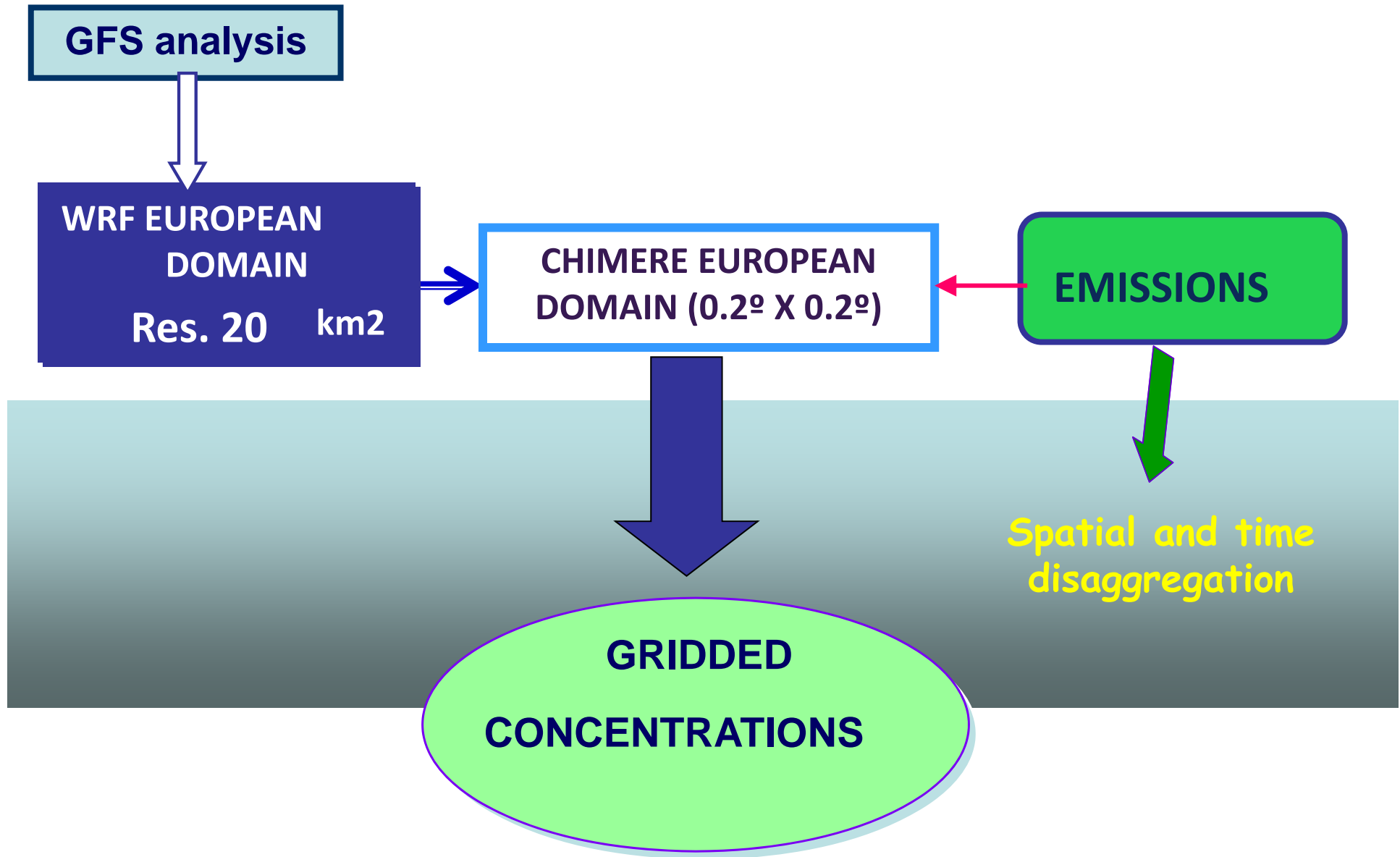
Set-up of the modelling exercise

- Simulations for 2008
- Domain over Europe, at a horizontal resolution of **0.2° x 0.2°** (aprox. 20 x 20 km)
- Meteorology: WRF meteorological model using GFS analysis
- No boundary conditions for heavy metals!

Modelling domain

0.2 x 0.2° (aprox. 20 x 20 km)





Emissions

Lead
Cadmium

- **2008 EMEP database (50 x 50 km²) (Vestreng et al. 2005)**

Arsenic
Nickel
Selenium
Chrome
Copper
Zinc

- **TNO 2000 Emissions for:**
Provided by Ilya
Ilin MSC- East
- Except for Spain: 2006 emissions from Spanish Ministry of Environment and Rural and Marine Affairs

- Model performance was evaluated considering the observations at the **EMEP monitoring sites** (daily, 366 and 183, weekly, only some periods)

EMEP monitoring sites

Station	Name	Long (°)	Lat (°)	Cd	Pb	As	Ni	Cu	Cr	Zn	Se
AT0002R	Illmitz	16.767	47.767	120	120	120	118				
AT0005R	Vorhegg	12.972	46.678	102	106	74	86				
AT0048R	Zoebelboden	14.441	47.839	114	116	84	116				
BE0014R	Koksijde	2.493	51.120	360	360	360	360	359	360	360	
CZ0001R	Svratouch	16.033	49.733	286	286	286	286	286			
CZ0003R	Kosetice	15.083	49.583		360	360	360	360			
DE0001R											
DE0002R											
DE0003R											
DE0007R											
DE0008R											
DE0009R											
DK0005R											
ES0007R											
ES0008R											
ES0009R											
ES0011R											
ES0012R											
ES0013R											
FR0009R											
FR0013R											
GB0013R											
GB0017R											
HU0002R											
LT0015R	Preila	21.067	55.350	353	353	353	353	353	353	353	
NL0008R	Bilthoven	5.200	52.117	182	182	182	182			182	
NL0009R	Kollumerwaard	6.277	53.334	182	182	182	182			182	
NL0010R	Vredepeel	5.854	51.541	57	57	57	57			57	
PL0005R	Diabla_Gora	22.067	54.150	352	352	352	352	366	352	352	
SI0008R	Iskrba	14.867	45.567	344	344	344	344				
SK0002R	Chopok	19.583	48.933	362	362	355	355	362	355	362	
SK0004R	Stará Lesná	20.283	49.150	364	364	364	364	364	364	364	
SK0007R	Topolnky	17.861	47.960	299	299	299	299	299	299	299	

• We used all the stations for the graphical evaluation of model performance

• To select the stations for the statistical evaluation we had to decide on:

a) Minimum number of observations (51 values, 14% 366)

b) Cut-off values

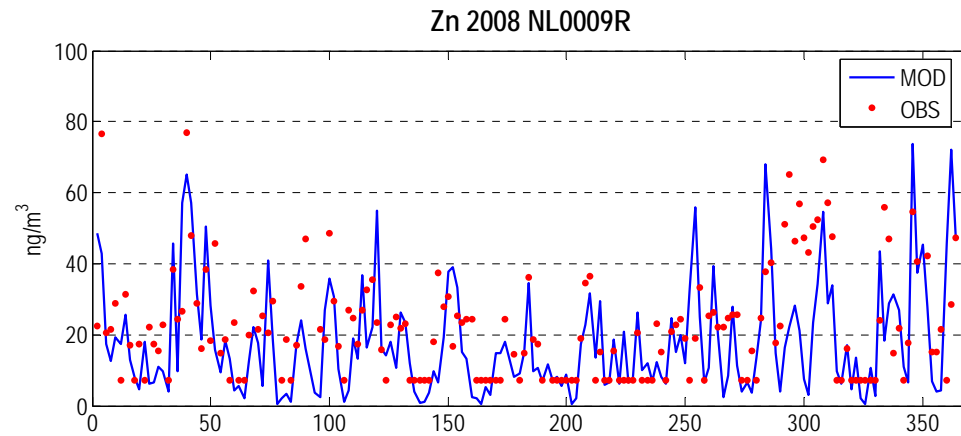
344



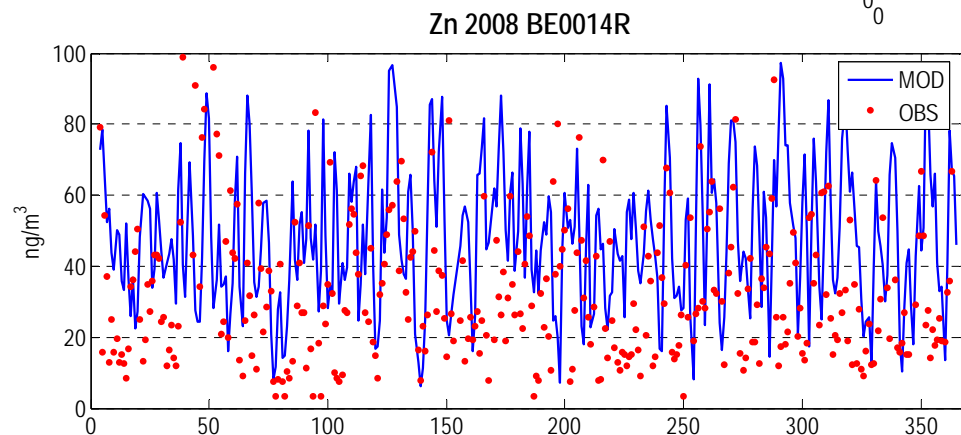
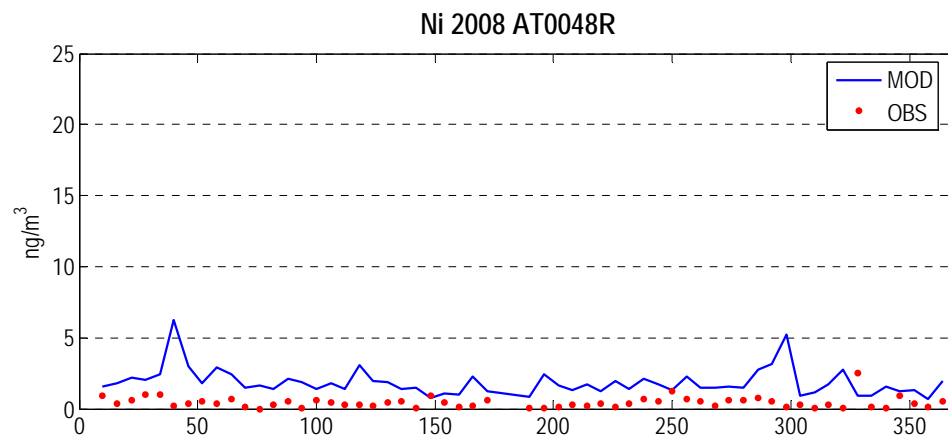
Kos Island, Greece, 26 October 2011
14th HARMO

Cutoff values:

- Because of instrumentation (detection limits, working OK?)
- Because of very low values increasing normalized errors



Cd

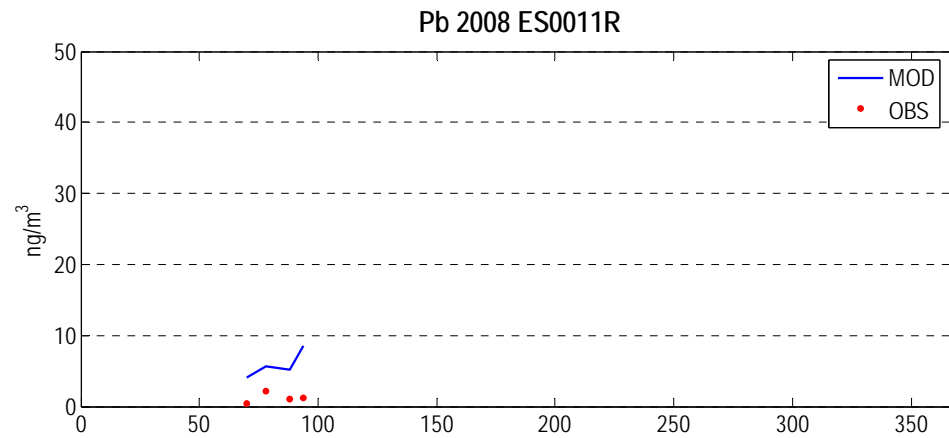
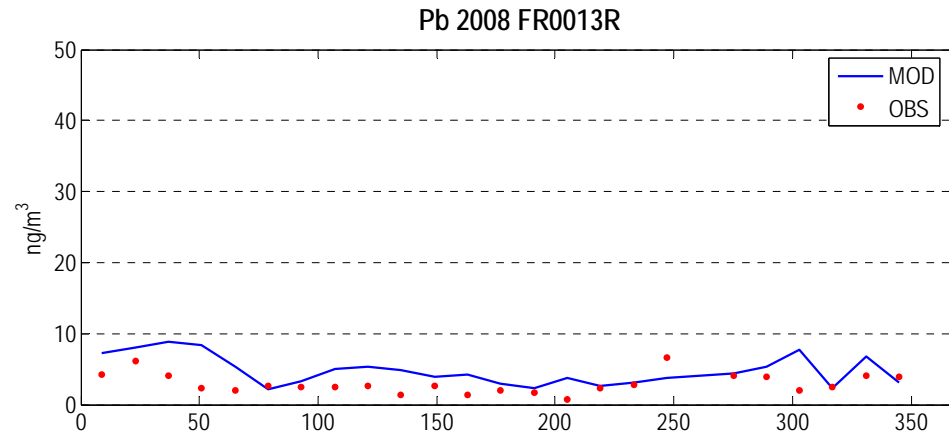


14th HARMO
Kos Island, Greece, 2-6 October 2011

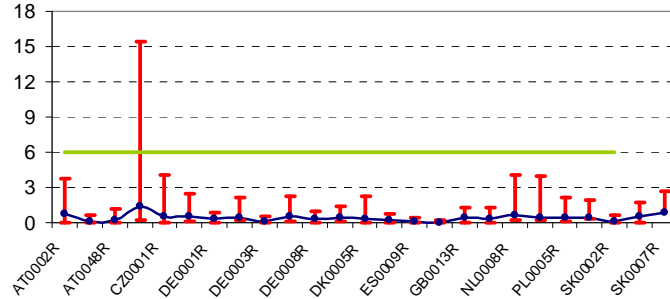
	Cut-off value 10% AL ng/m ³	Annual mean value	Annual limit (or target) value ng/m ³
Cd	0.5	0.1	5
Ni	2	1	20
As	0.6	0.4	6
Pb	50	5	500
Annual mean value (ng/m³)			
Cu	2		
Cr	0.7		
Zn	15		
Se	1		

Temporal coverage:

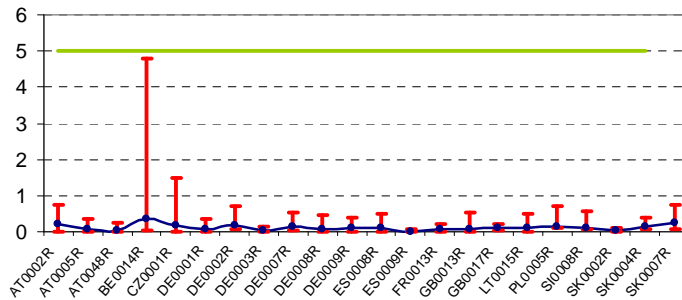
Minimum number of observations



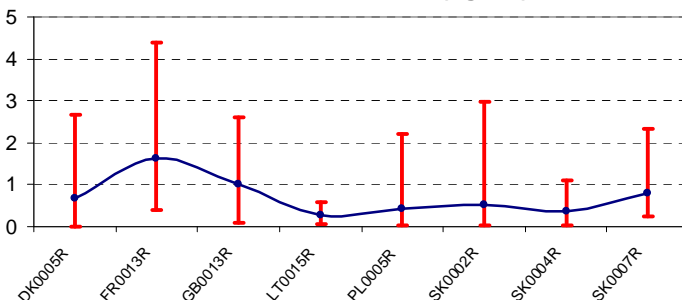
As annual mean values (ng/m3)



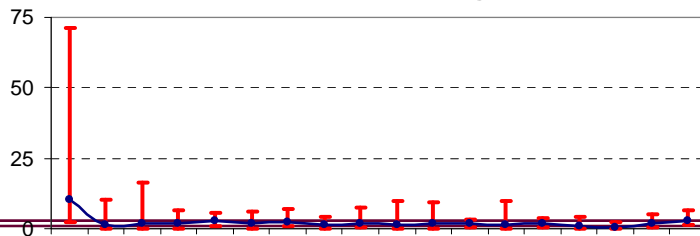
Cd annual mean values (ng/m3)



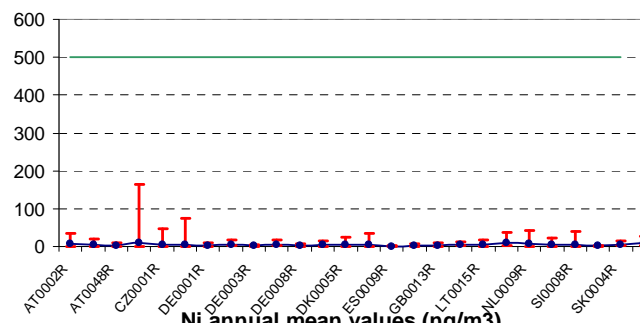
Cr annual mean values (ng/m3)



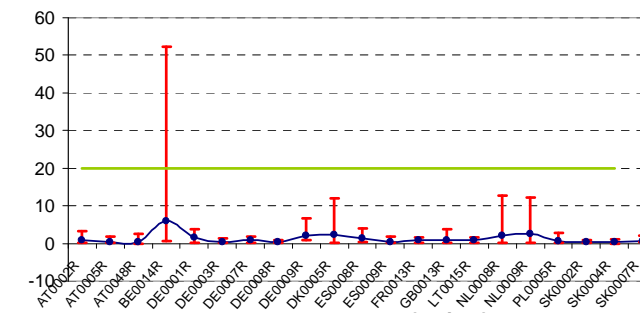
Cu annual mean values (ng/m3)



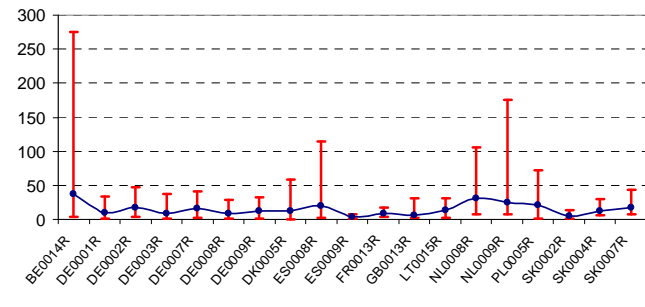
Pb annual mean values (ng/m3)



Ni annual mean values (ng/m3)



Zn annual mean values (ng/m3)



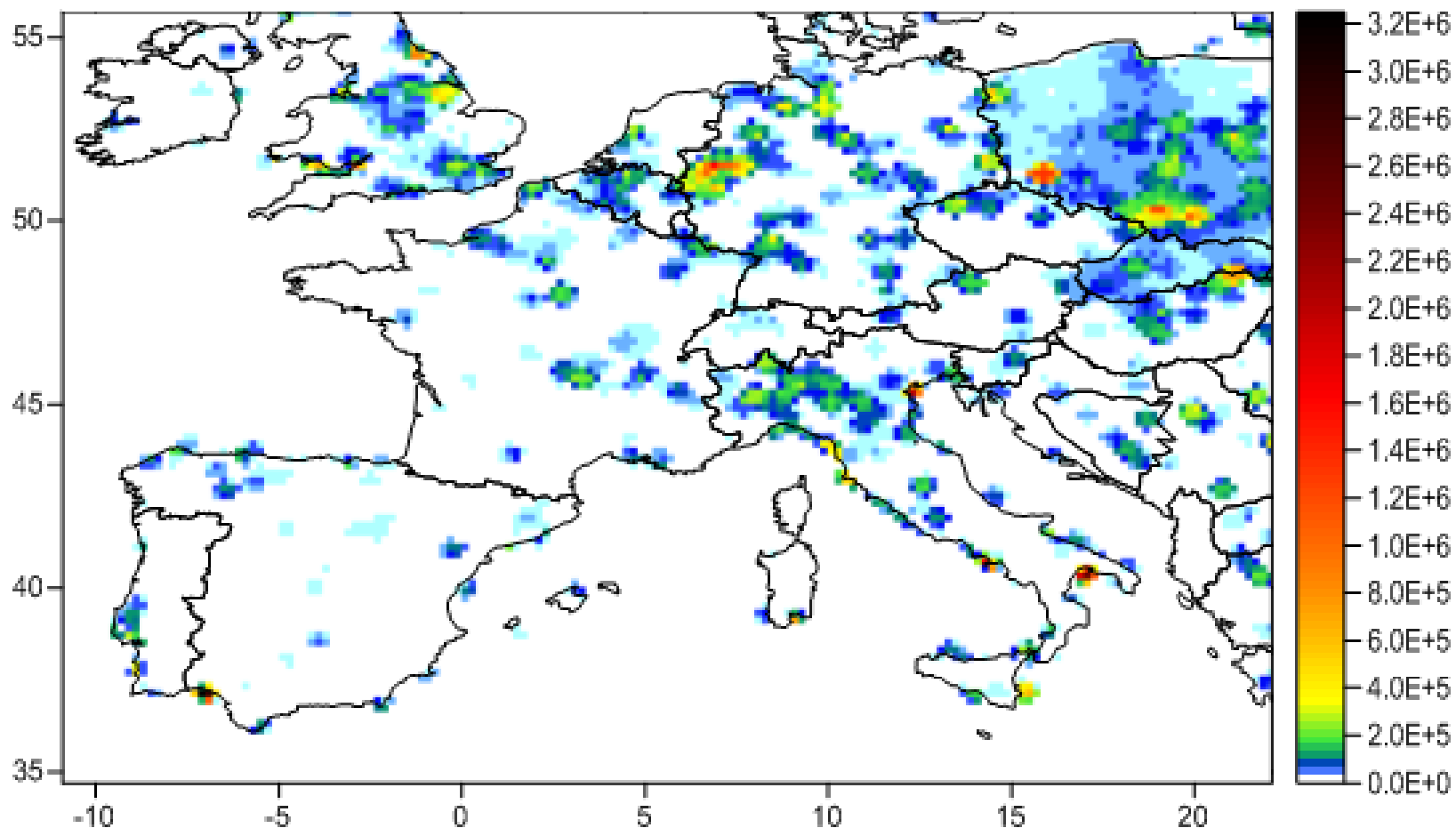
Se	MAX	MIN	MED
DK0005R	2.674	0.038	0.5101



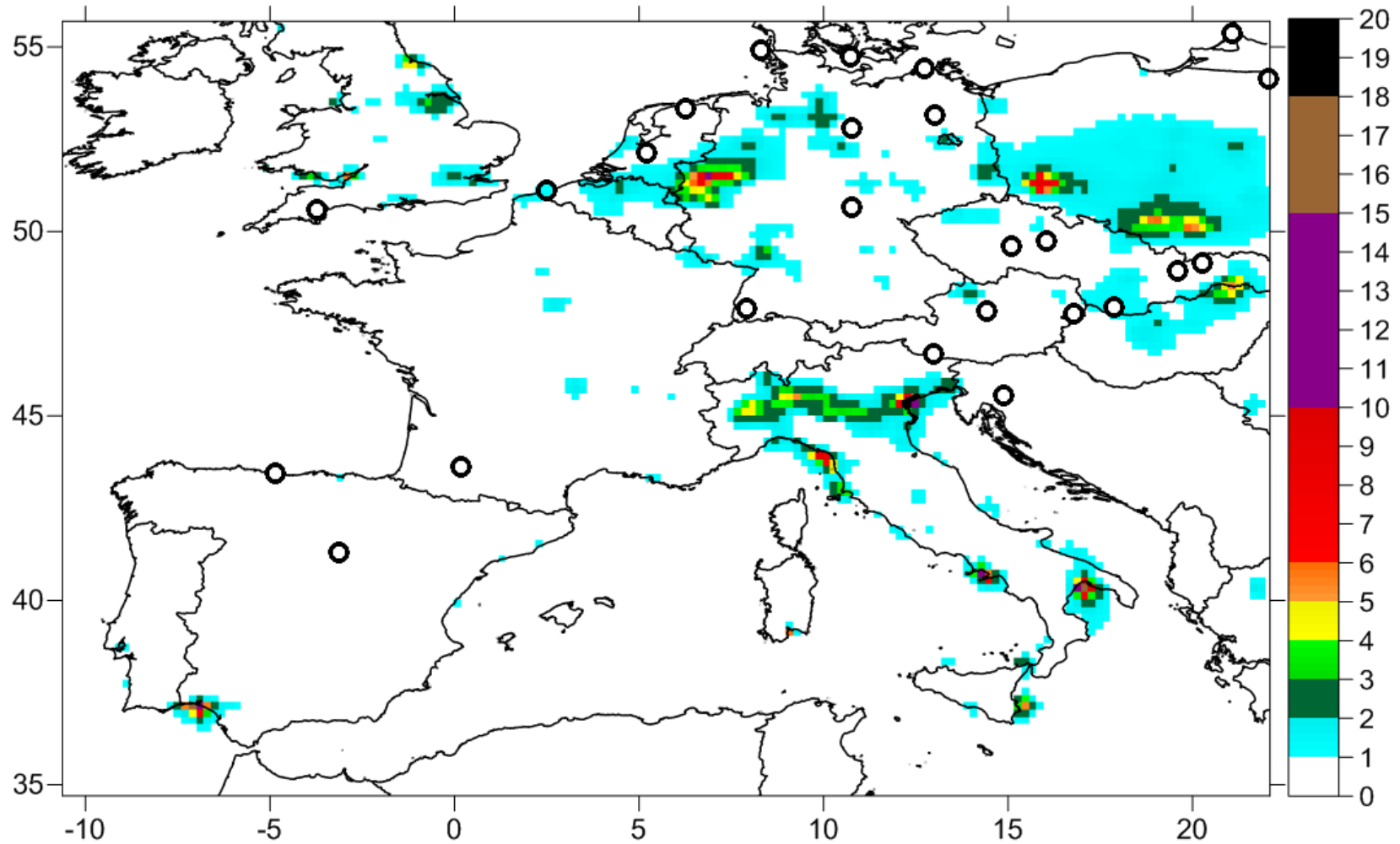
14th HARMO
Kos Island, Greece, 2-6 October 2011

Results of the evaluation of model performance...

2008 As ANNUAL EMISSIONS (g/cell)

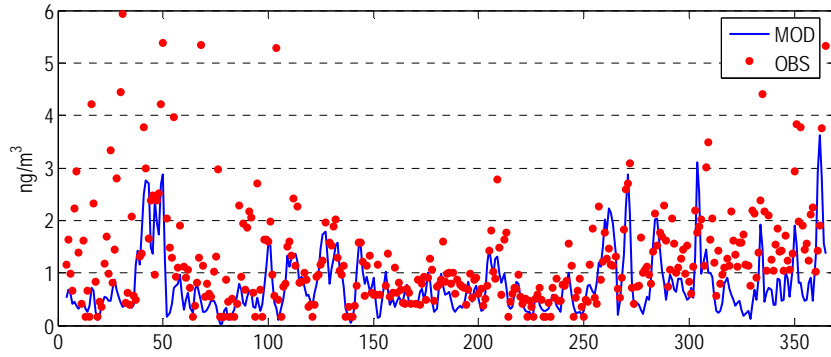


2008 - ARSENIC (ng/m³)

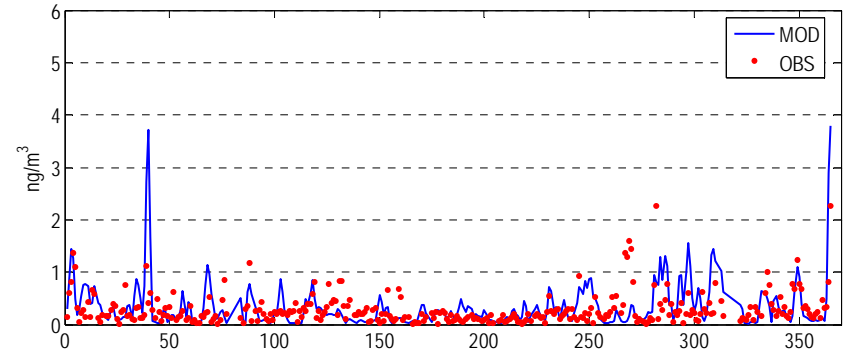


Annual mean concentration

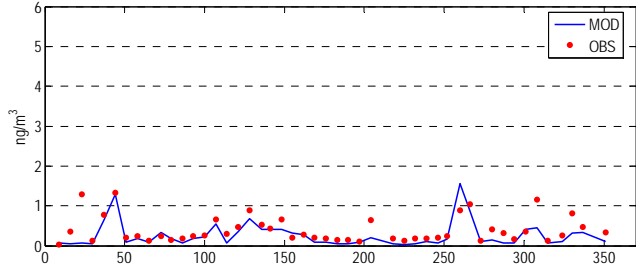
As 2008 BE0014R



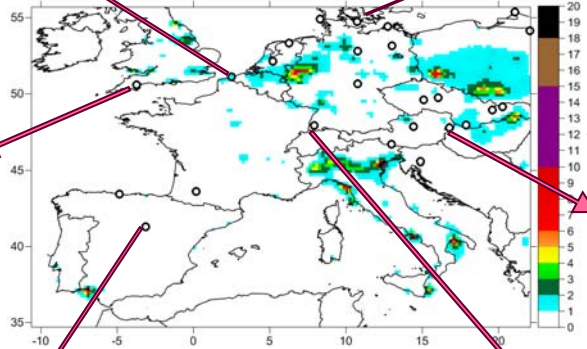
As 2008 DK0005R



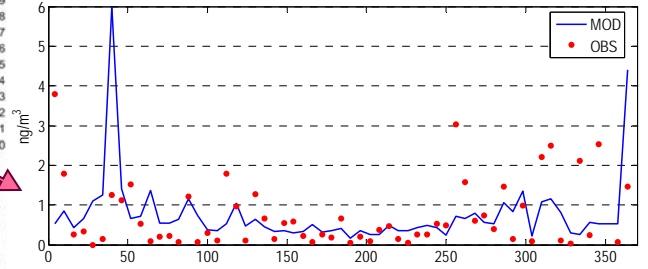
As 2008 GB0013R



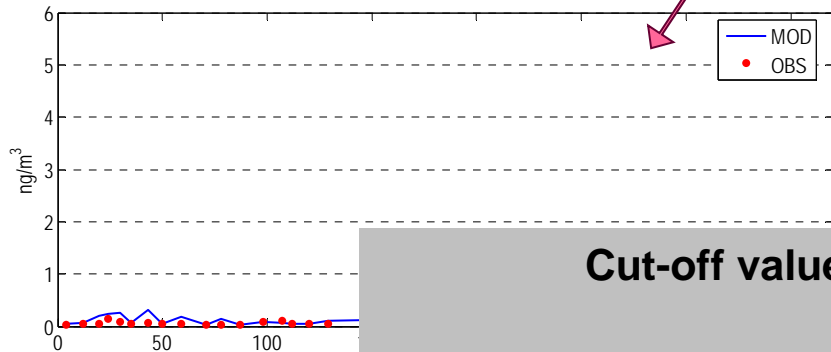
2008 - ARSENIC (ng/m3)



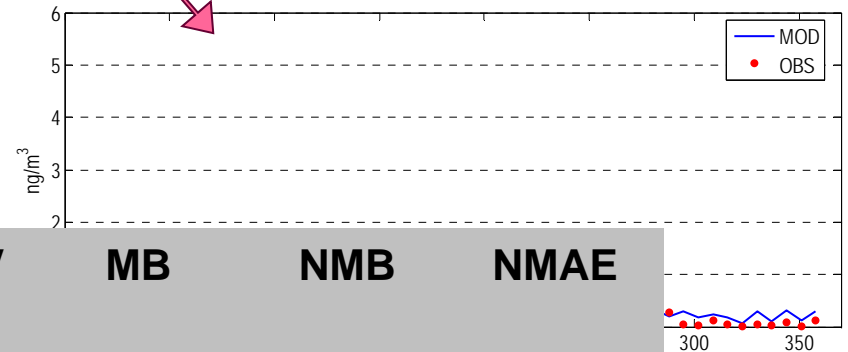
As 2008 AT0002R



As 2008 ES0009R



As 2008 DE0003R



Cut-off value:

ALV
ng/
m

MB

NMB

NMAE

10% ALV

ng/m³

%

%



As

0.6

6

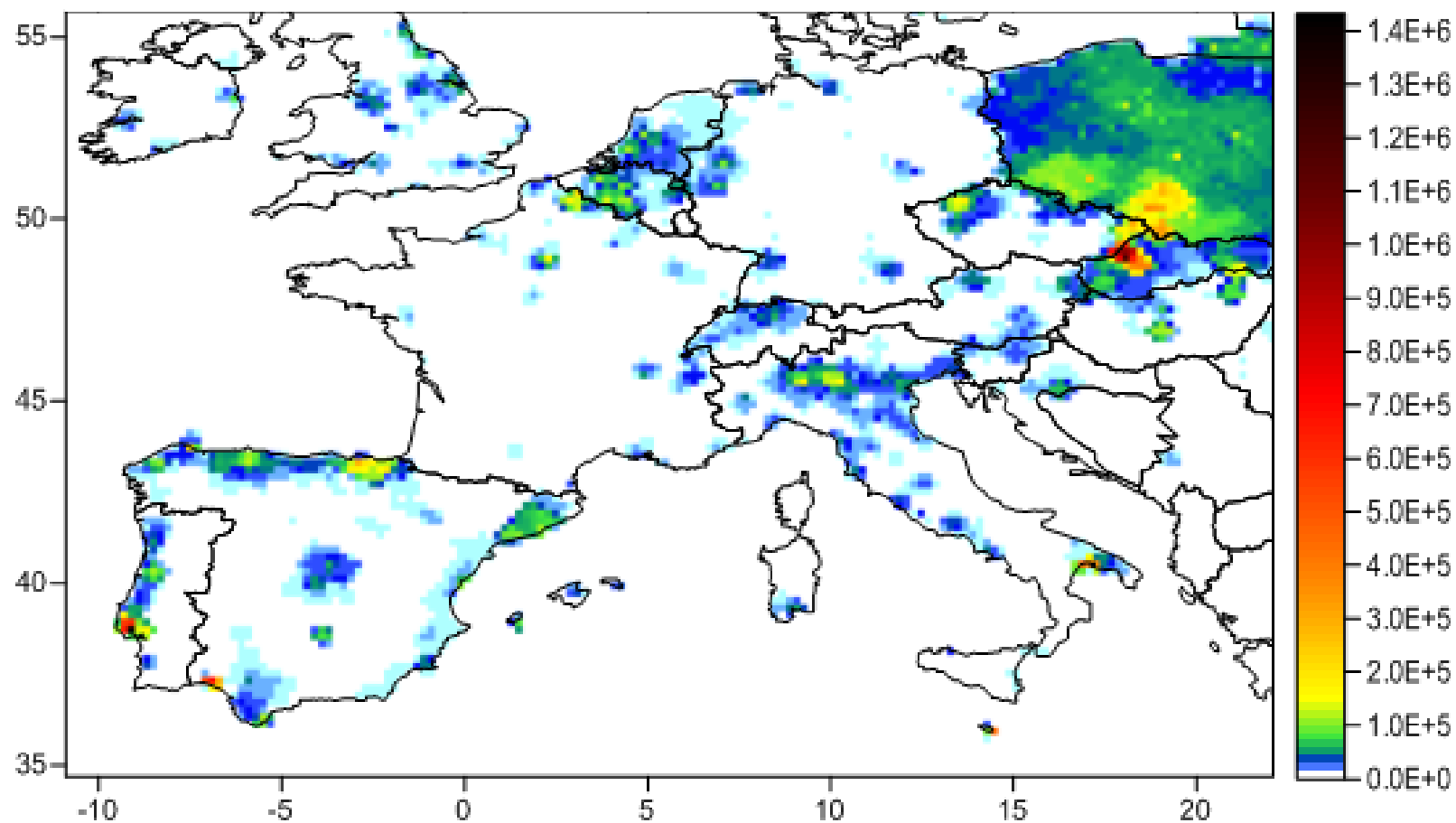
0.181

23.03

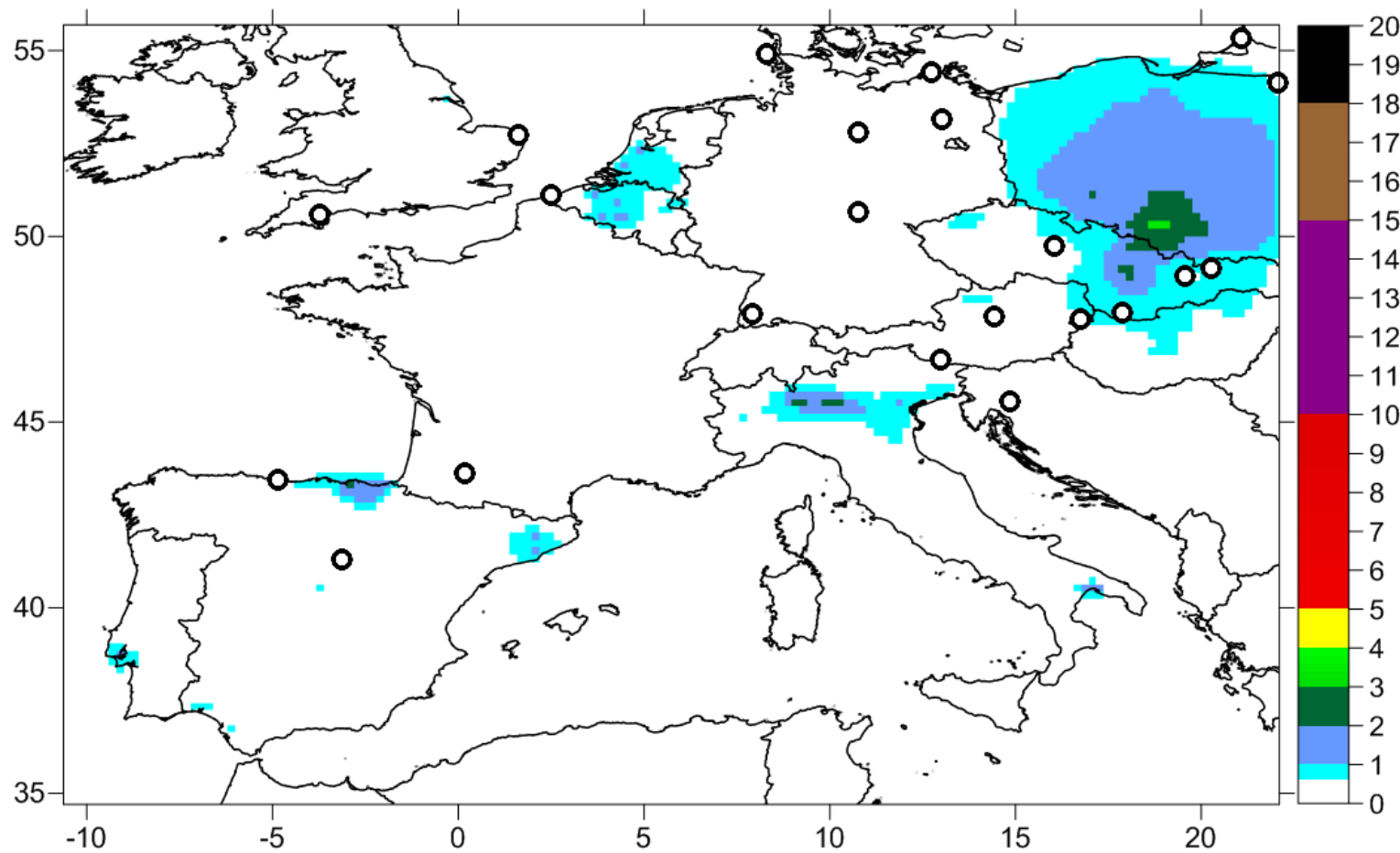
53.81

MO
011

2008 Cd ANNUAL EMISSIONS (g/cell)

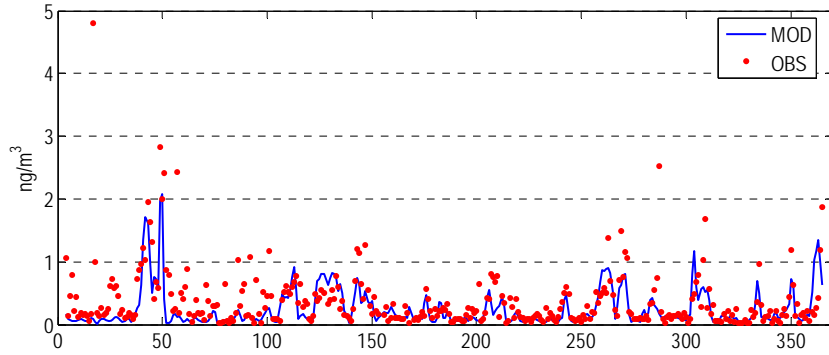


2008 - CADMIUM (ng/m³)

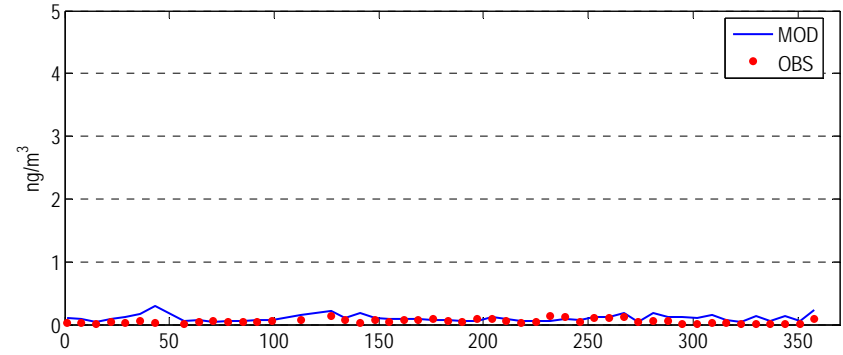


Annual mean concentration

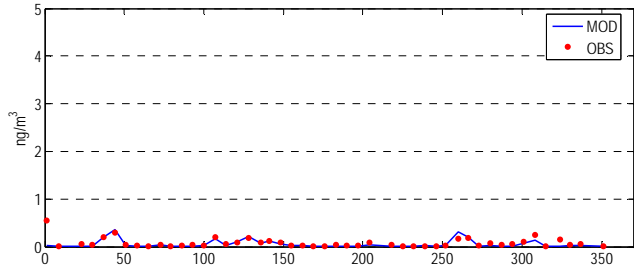
Cd 2008 BE0014R



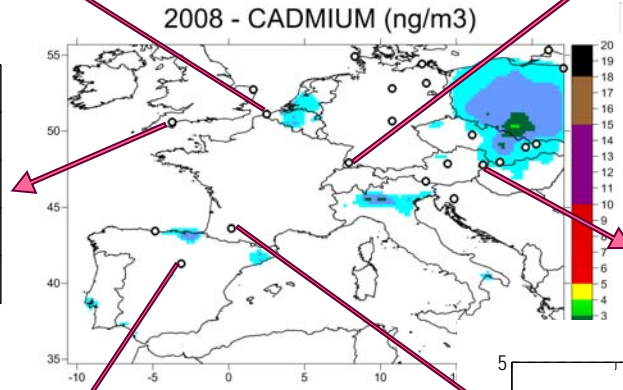
Cd 2008 DE0003R



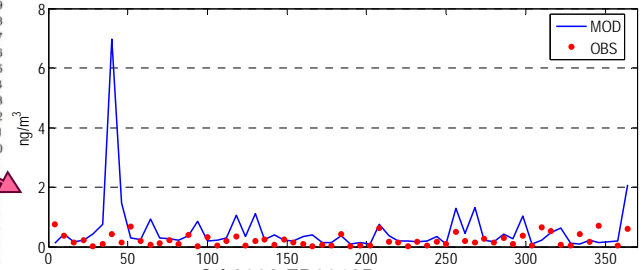
Cd 2008 GB0013R



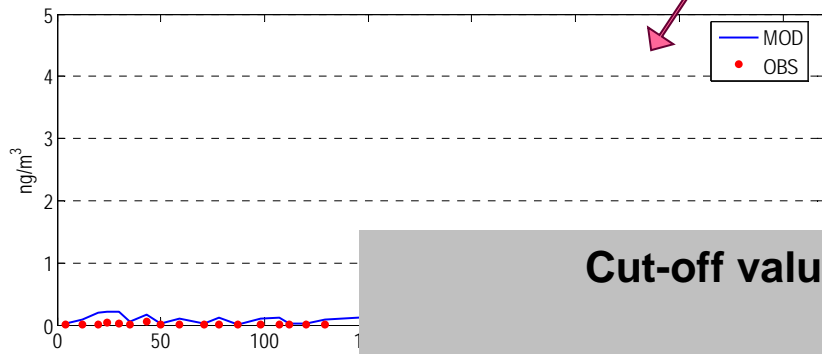
2008 - CADMIUM (ng/m3)



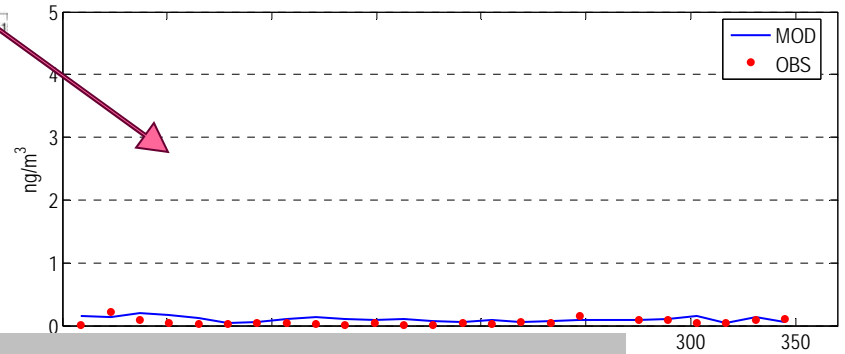
Cd 2008 AT0002R



Cd 2008 ES0009R



Cd 2008 FR0013R



Cut-off value:

ALV
ng/
m

MB

NMB

NMAE

10% ALV

ng/m³

%

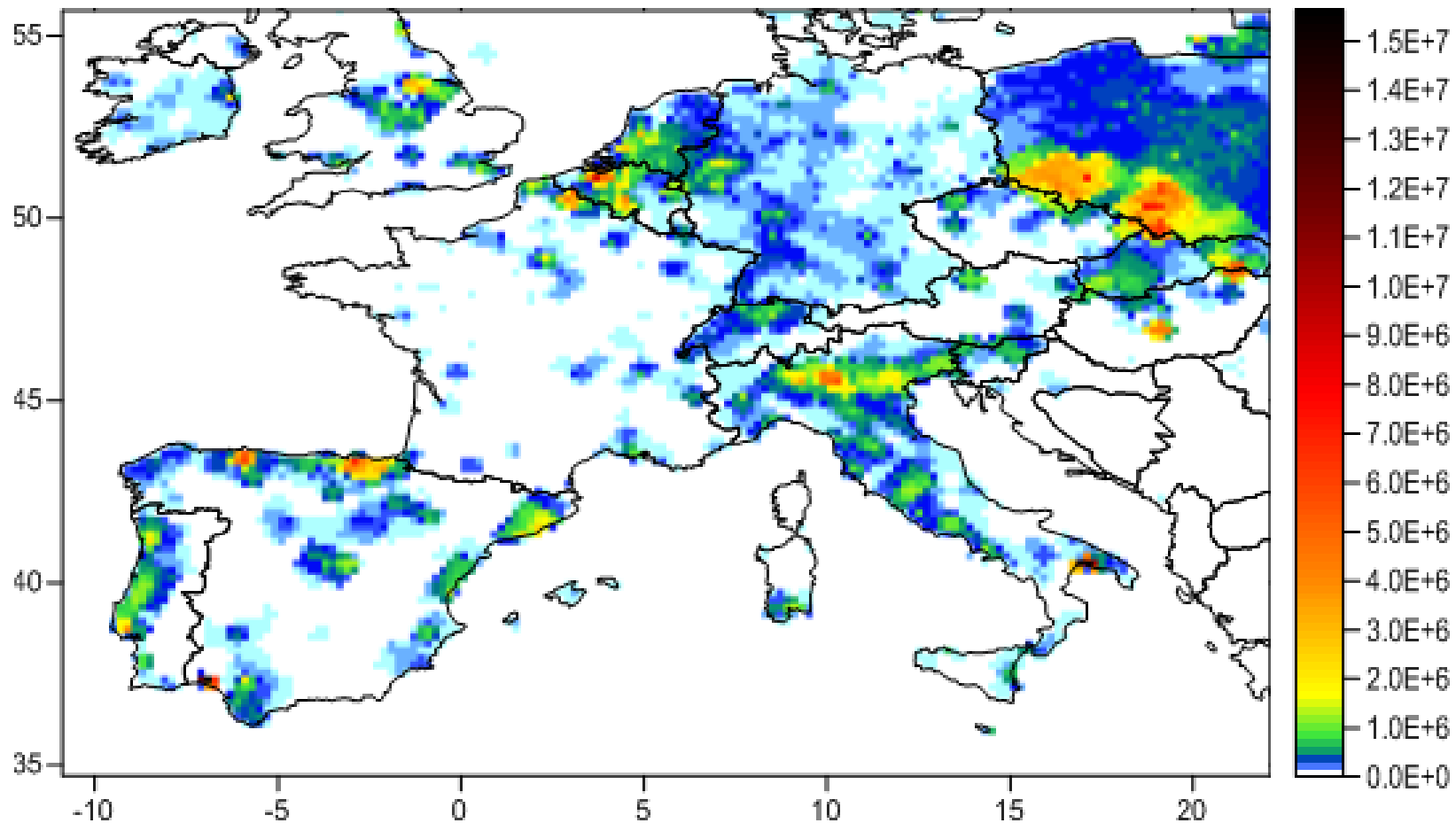
%



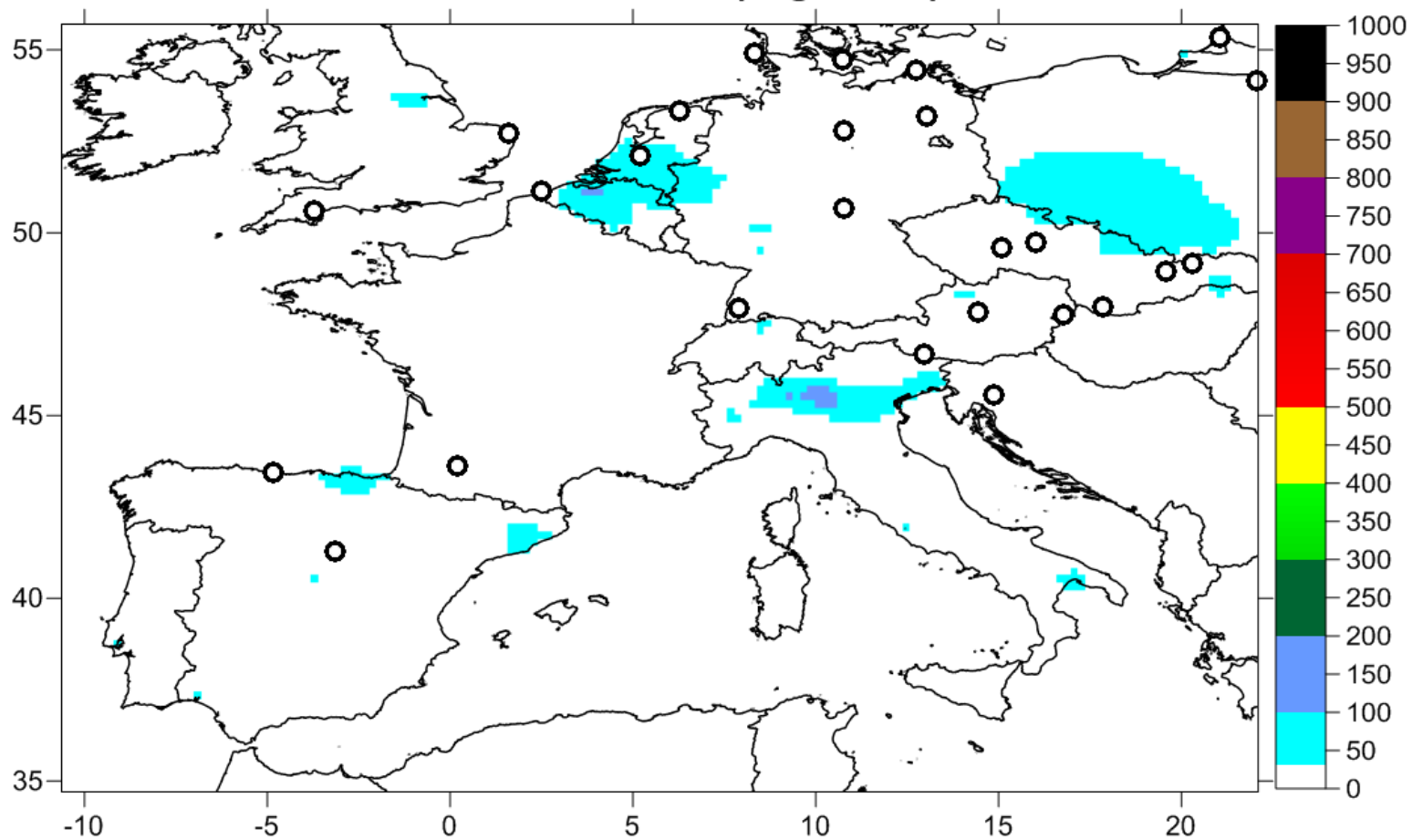
Cd	0.5	5	0.308	30.10	65.53
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MO
011

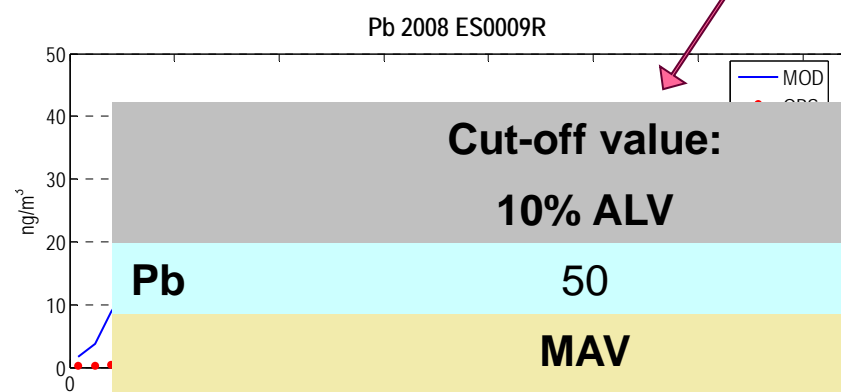
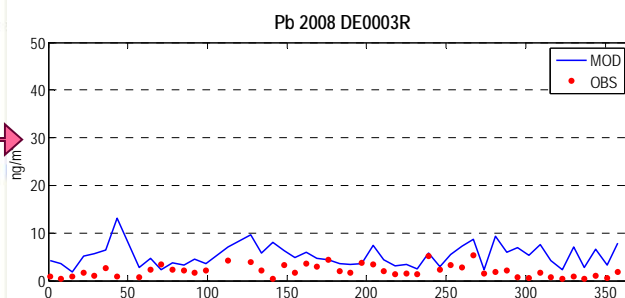
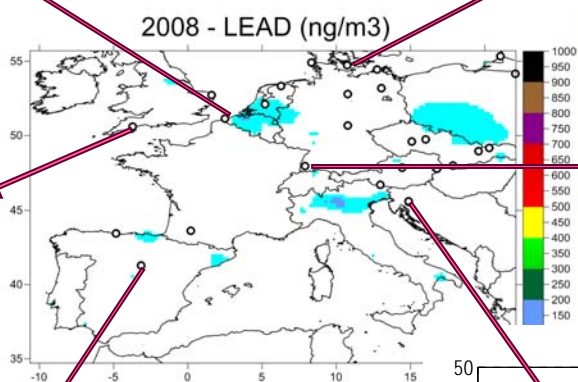
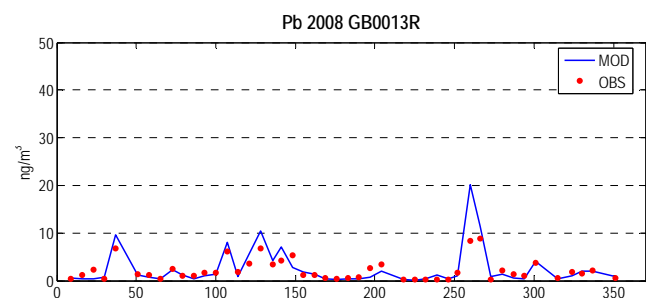
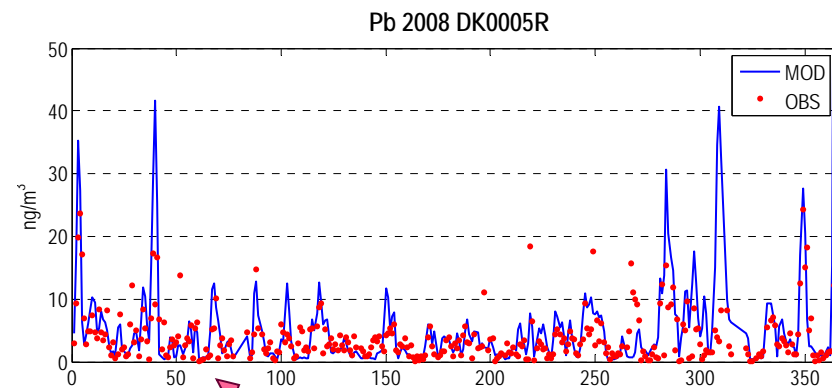
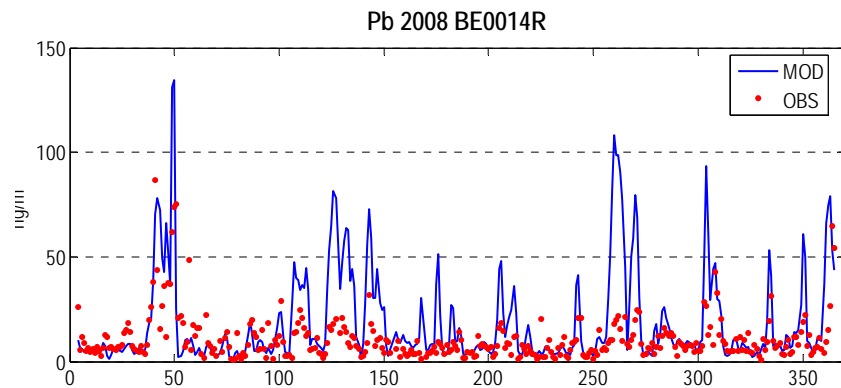
2008 Pb ANNUAL EMISSIONS (g/cell)



2008 - LEAD (ng/m³)

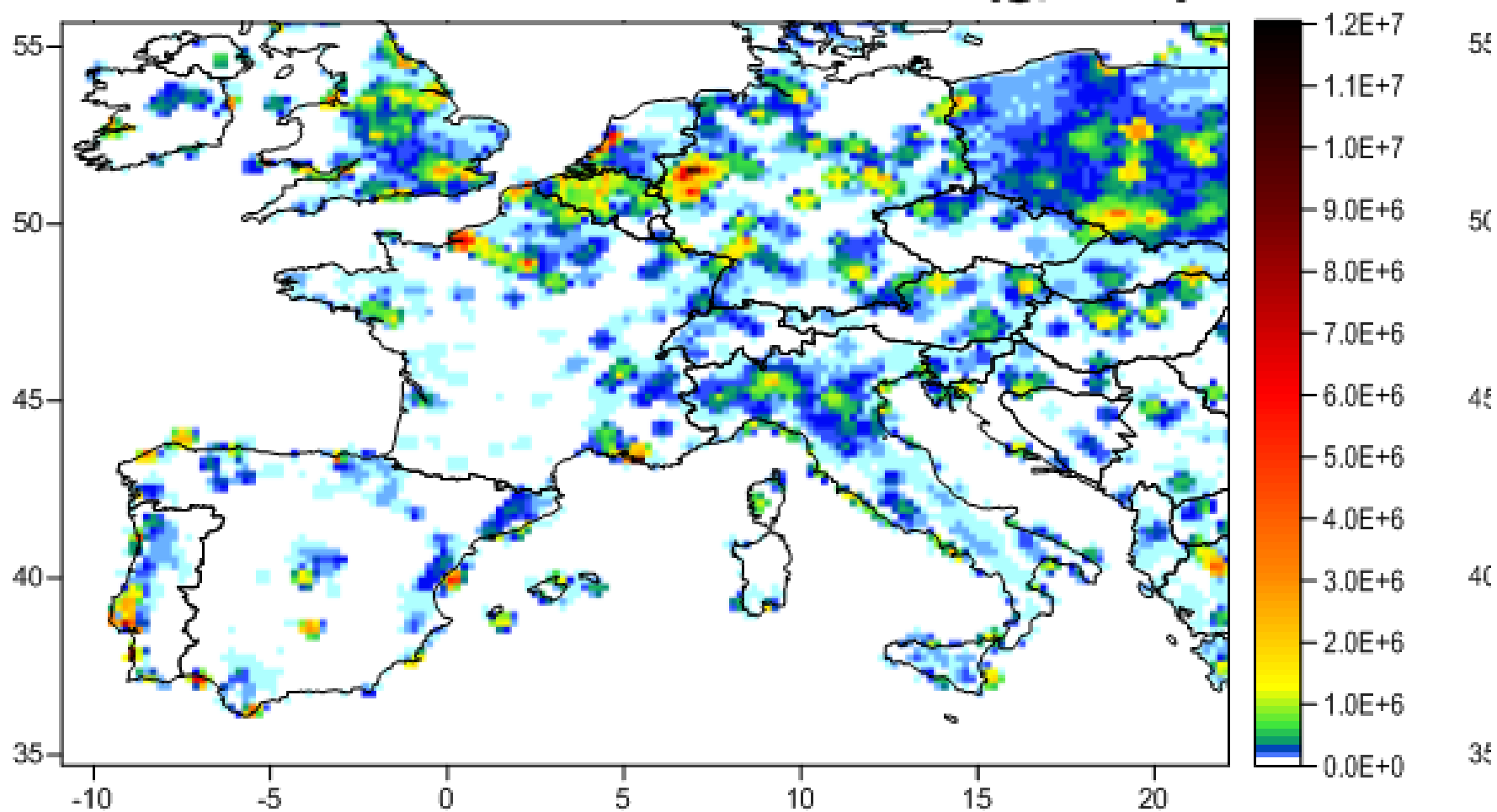


Annual mean concentration

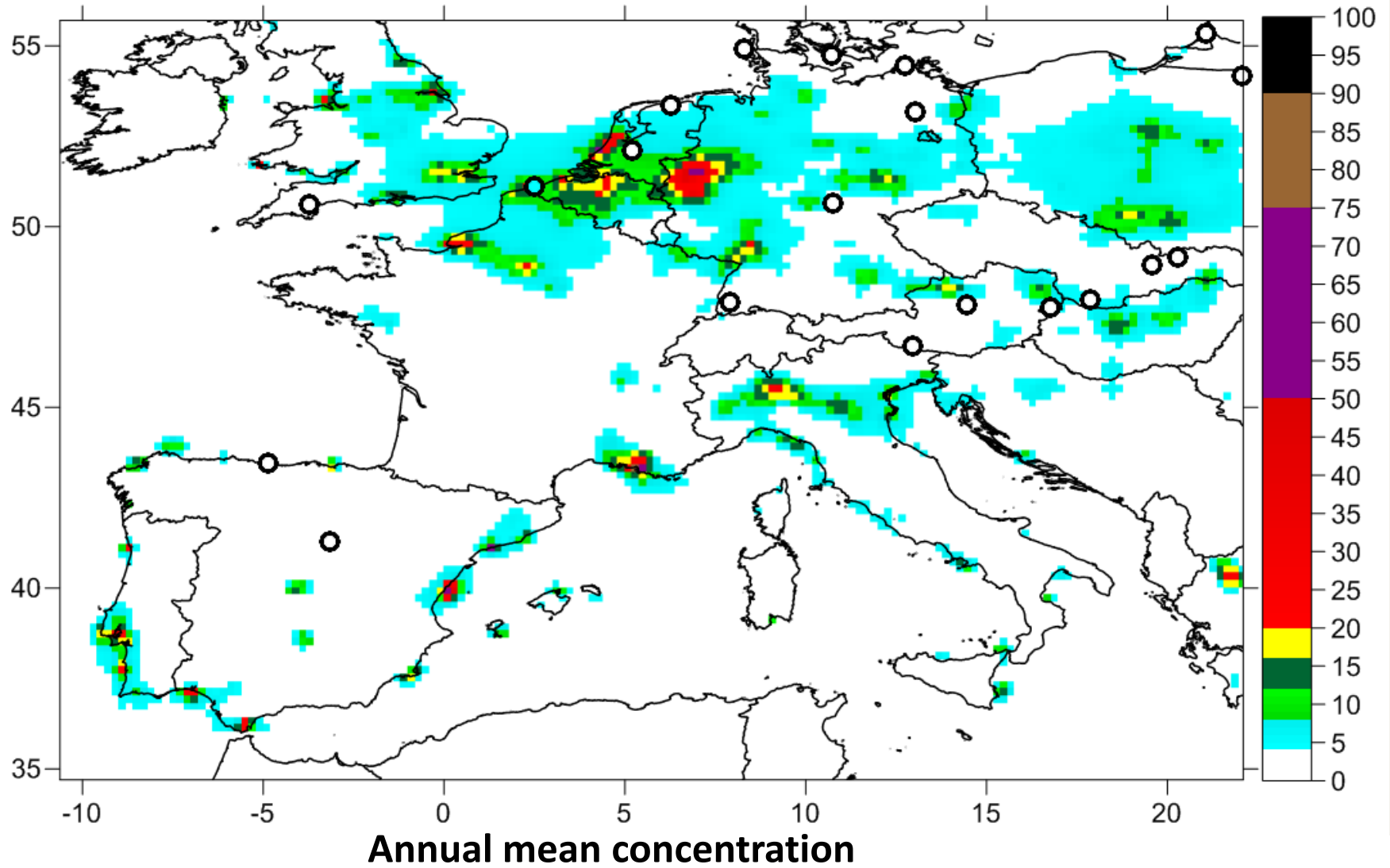


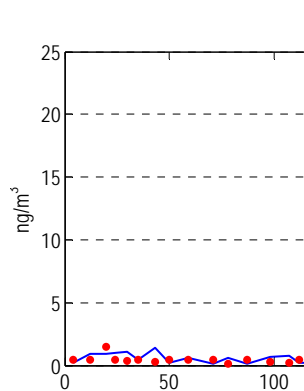
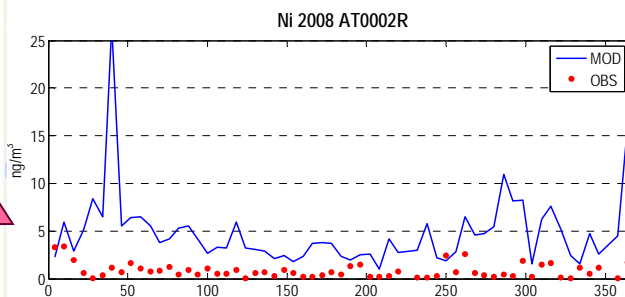
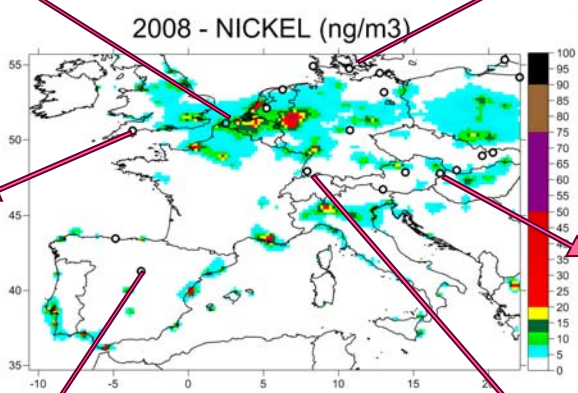
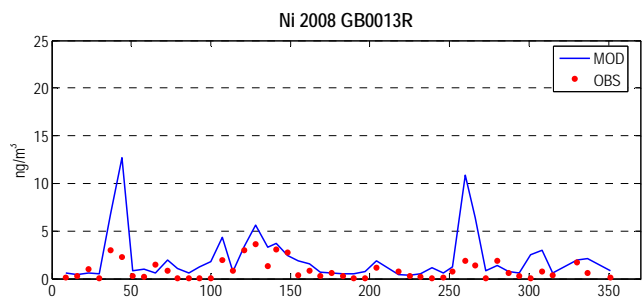
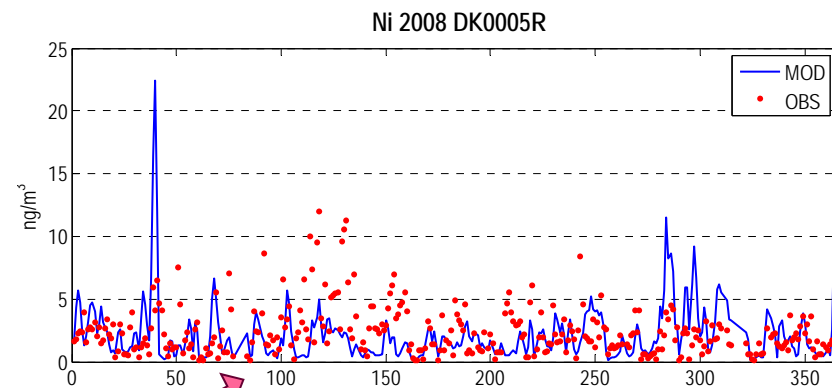
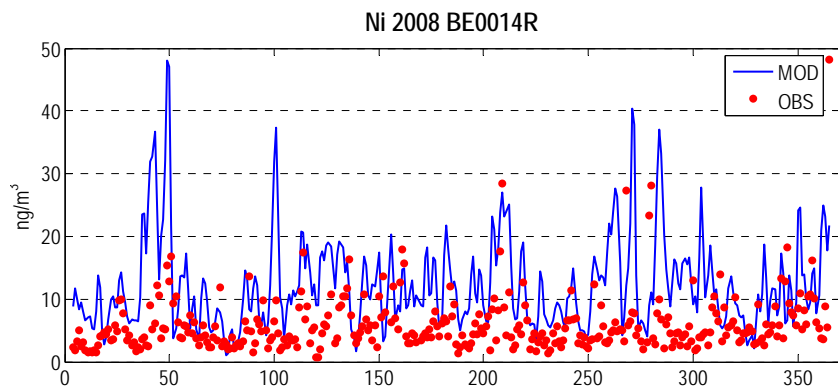
	Cut-off value:	ALV	MB	NMB	NMAE
	10% ALV	ng/m	ng/m ³	%	%
Pb	50	500	-16.882	-3.67	59.29
	MAV				
	5		11.5	122.2	145.9

2008 Ni ANNUAL EMISSIONS (g/cell)

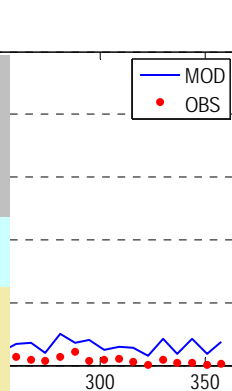


2008 - NICKEL (ng/m³)

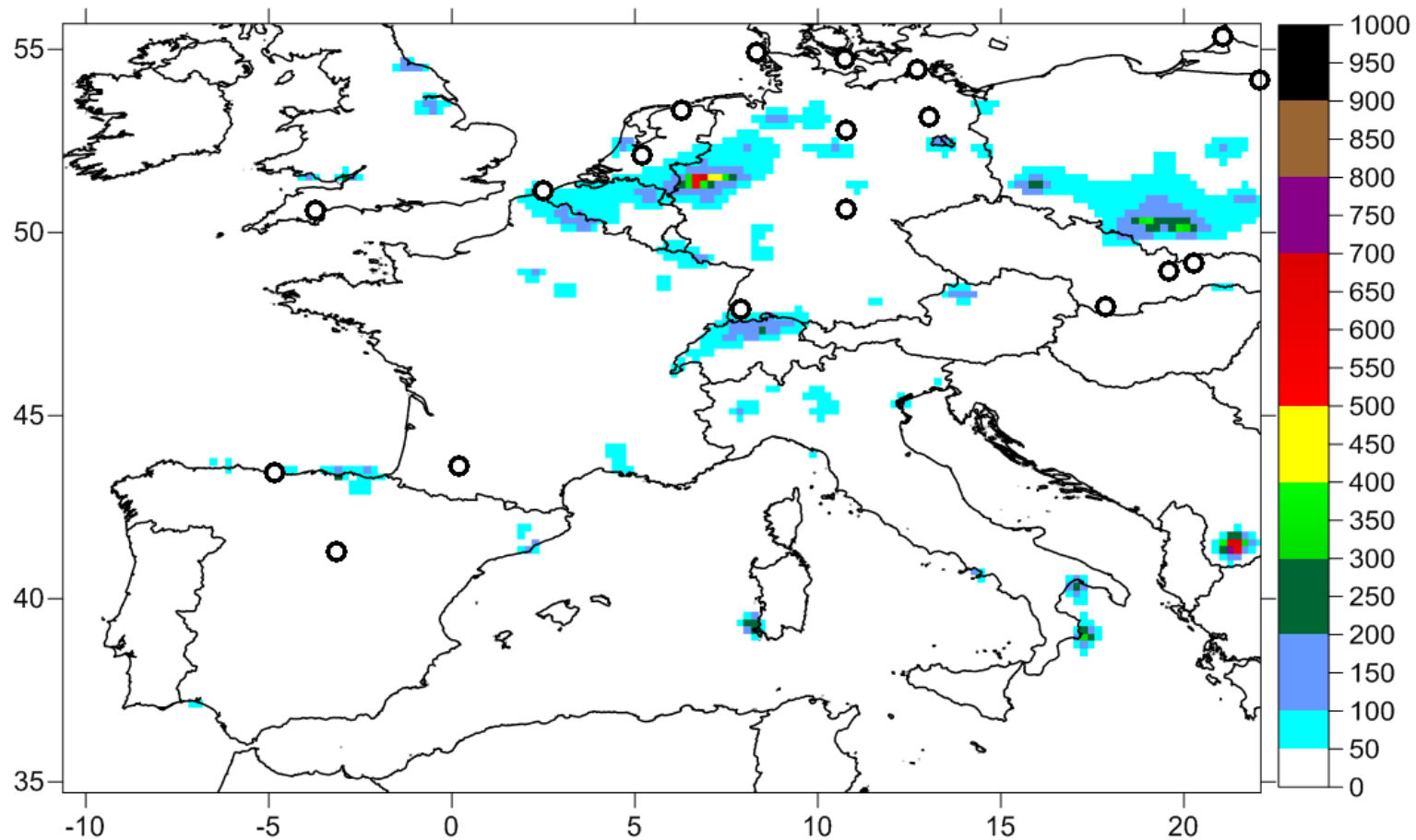


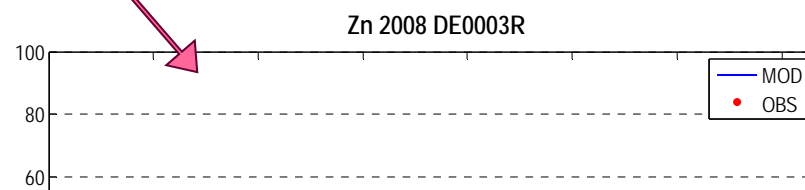
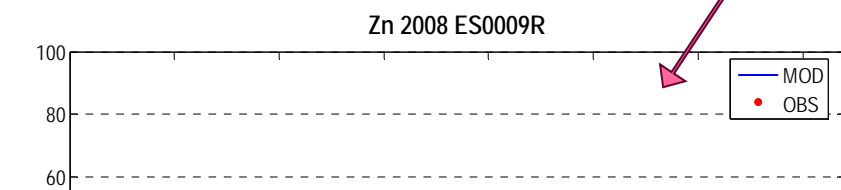
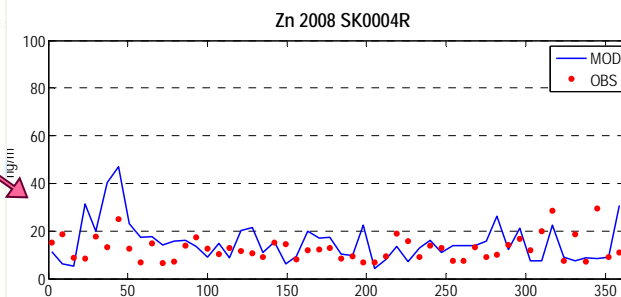
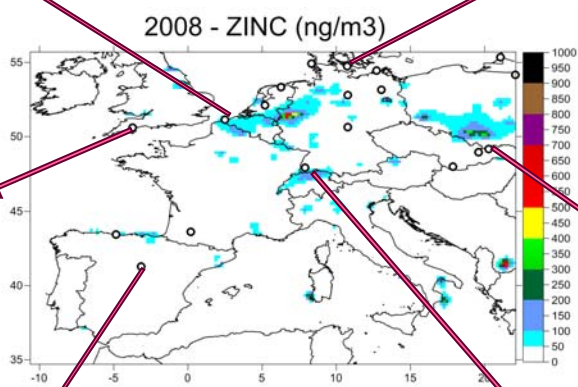
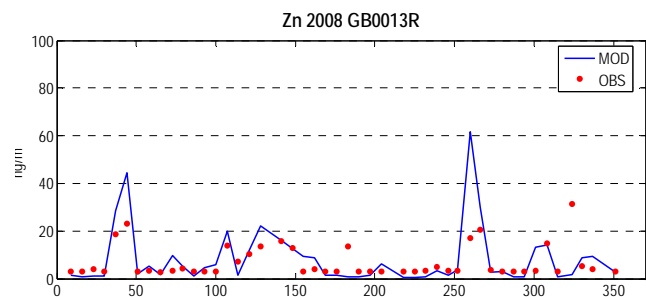
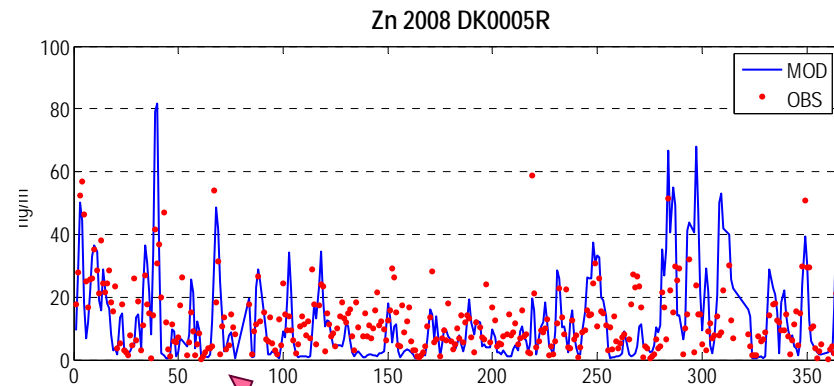
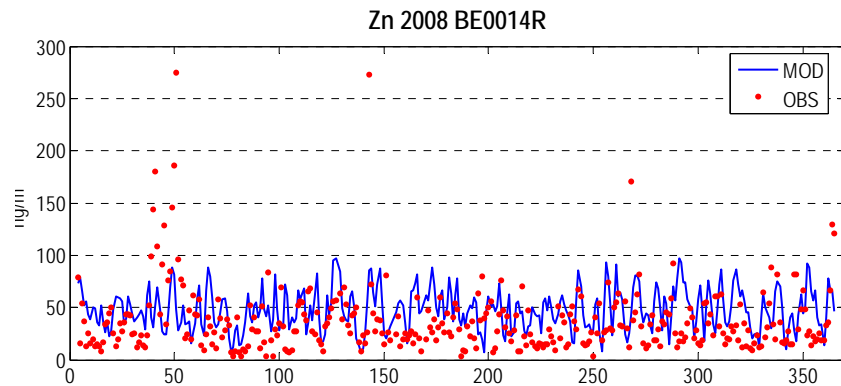


Cut-off value:		ALV	MB	NMB	NMAE
10% ALV		ng/m	ng/m ³	%	%
Ni	2	20	3.643	99.61	131.32
MAV	1		3.221	115.72	145.86



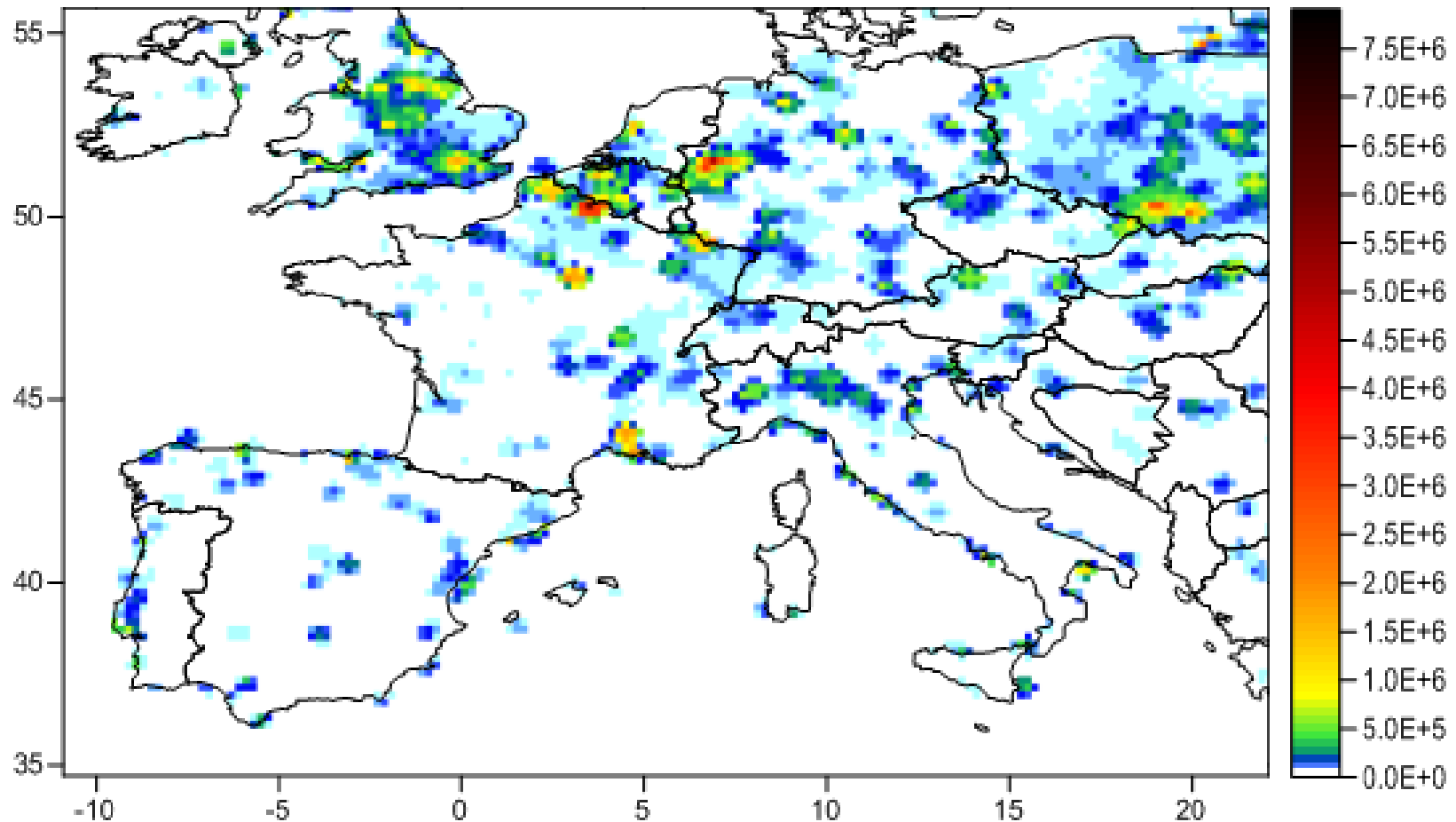
2008 - ZINC (ng/m³)



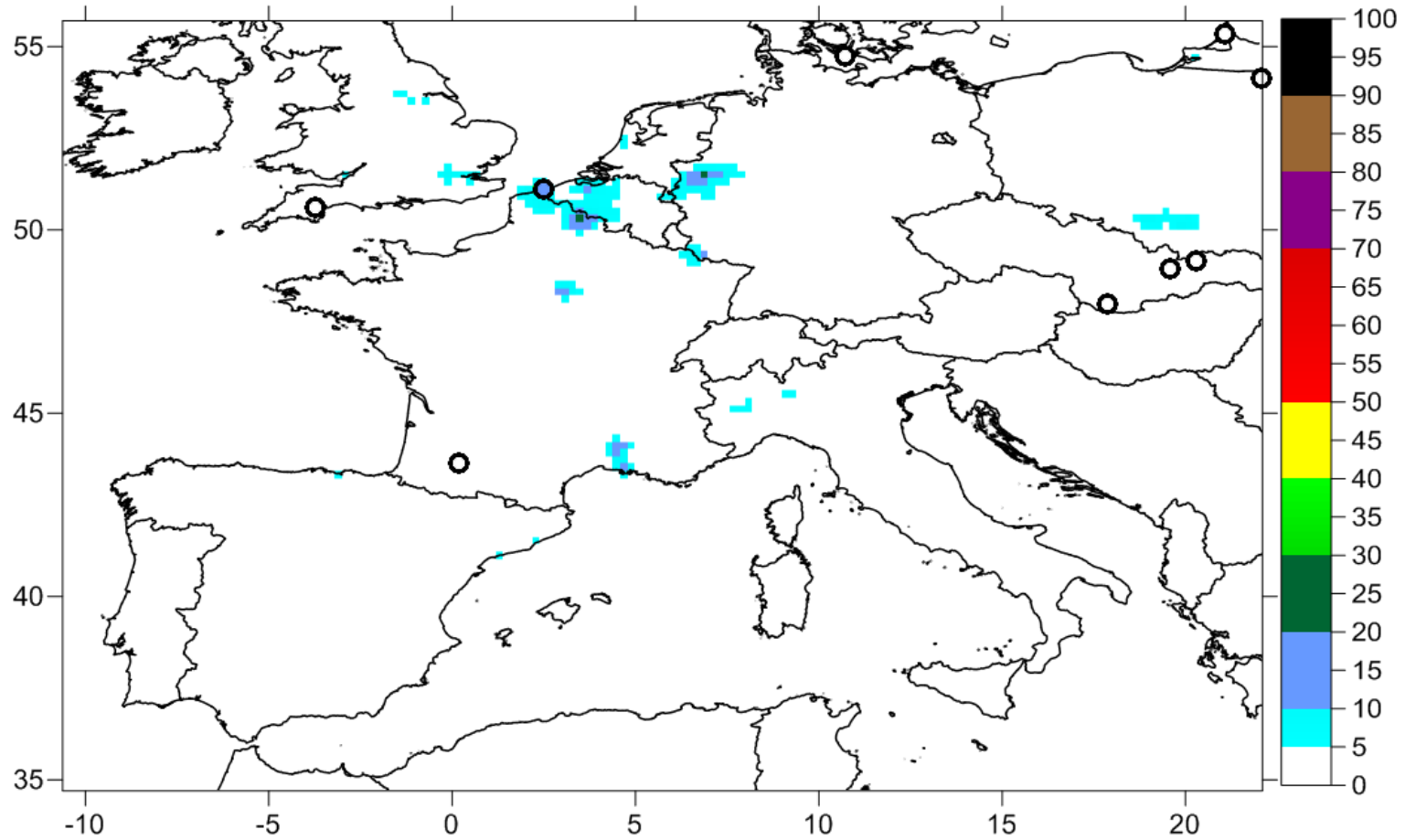


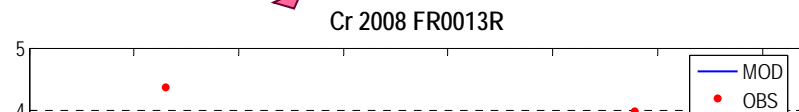
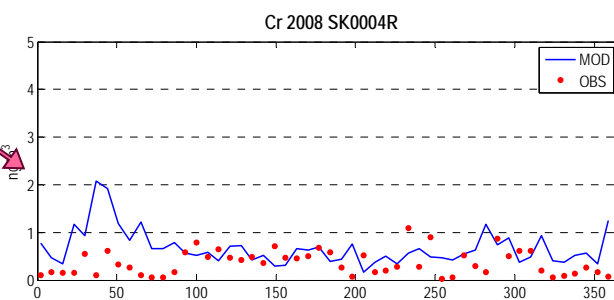
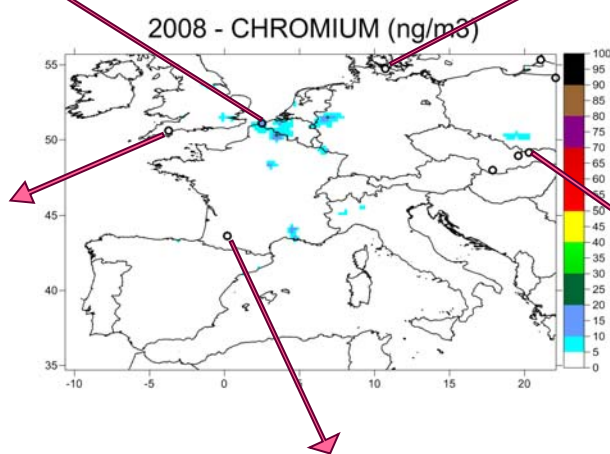
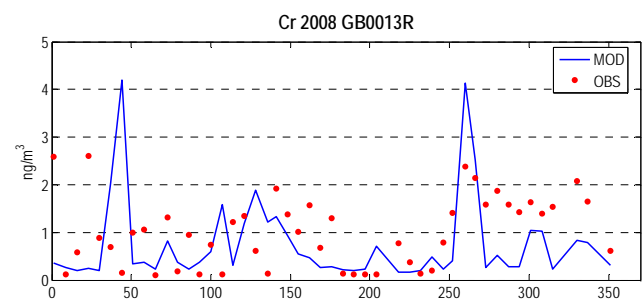
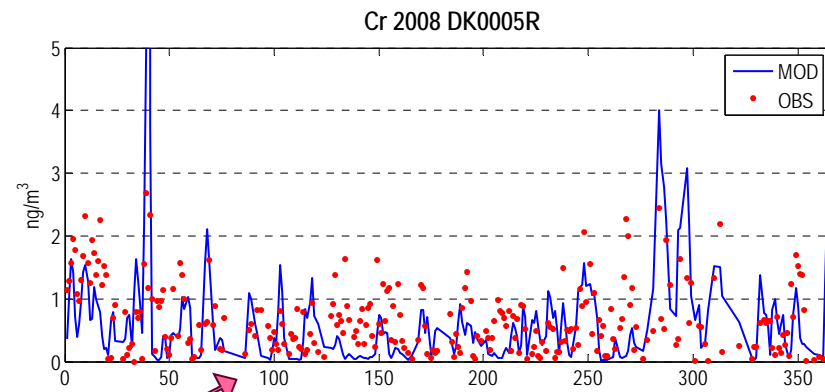
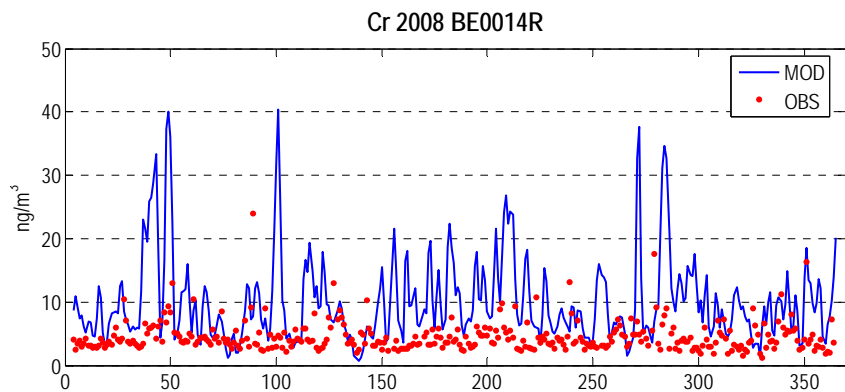
	Cut-off value:	MB	NMB	NMAE
	Annual mean value	ng/m3	%	%
Zn	15	1.463	22.11	60.77

2008 Cr ANNUAL EMISSIONS (g/cell)



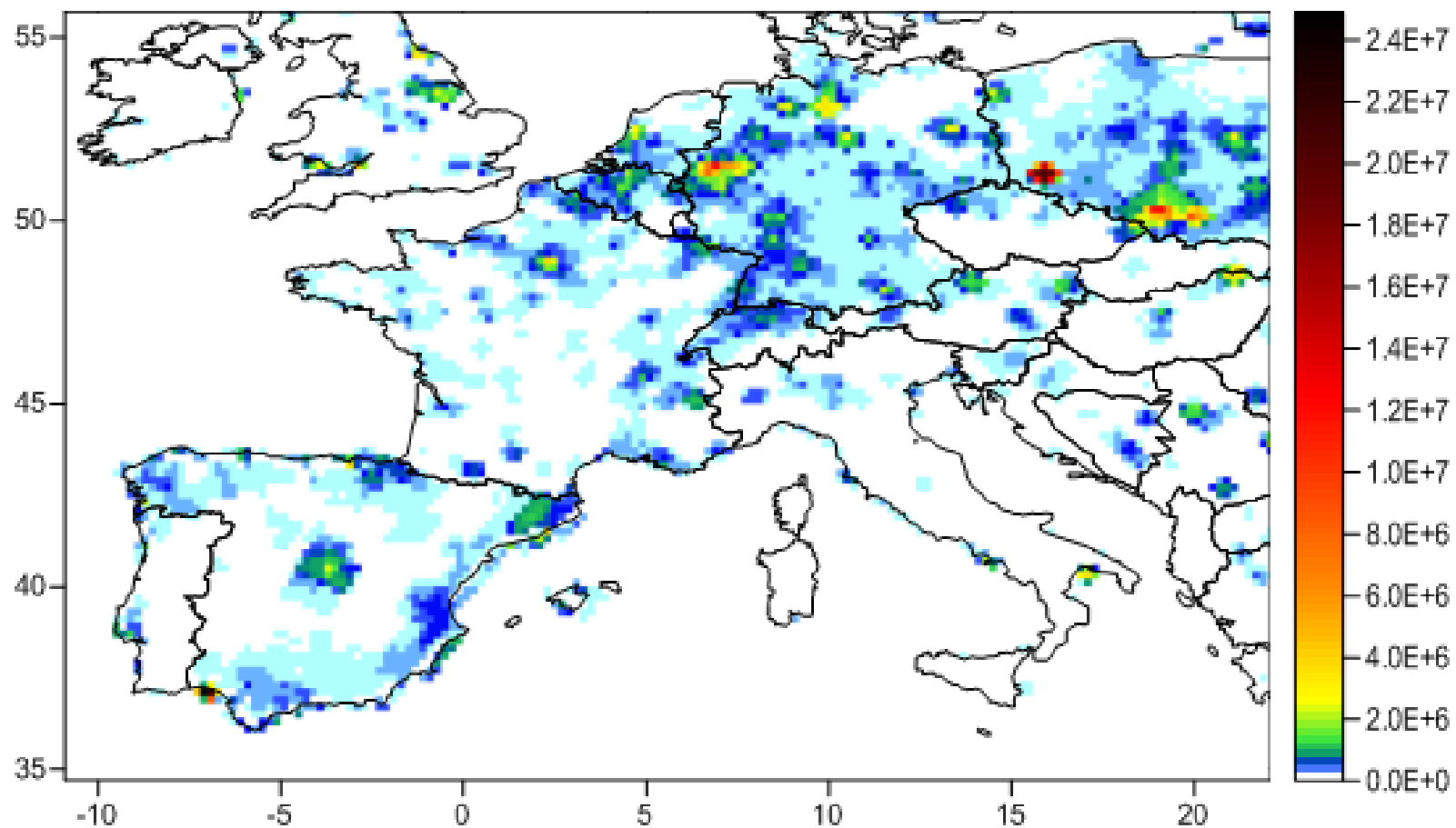
2008 - CHROMIUM (ng/m3)



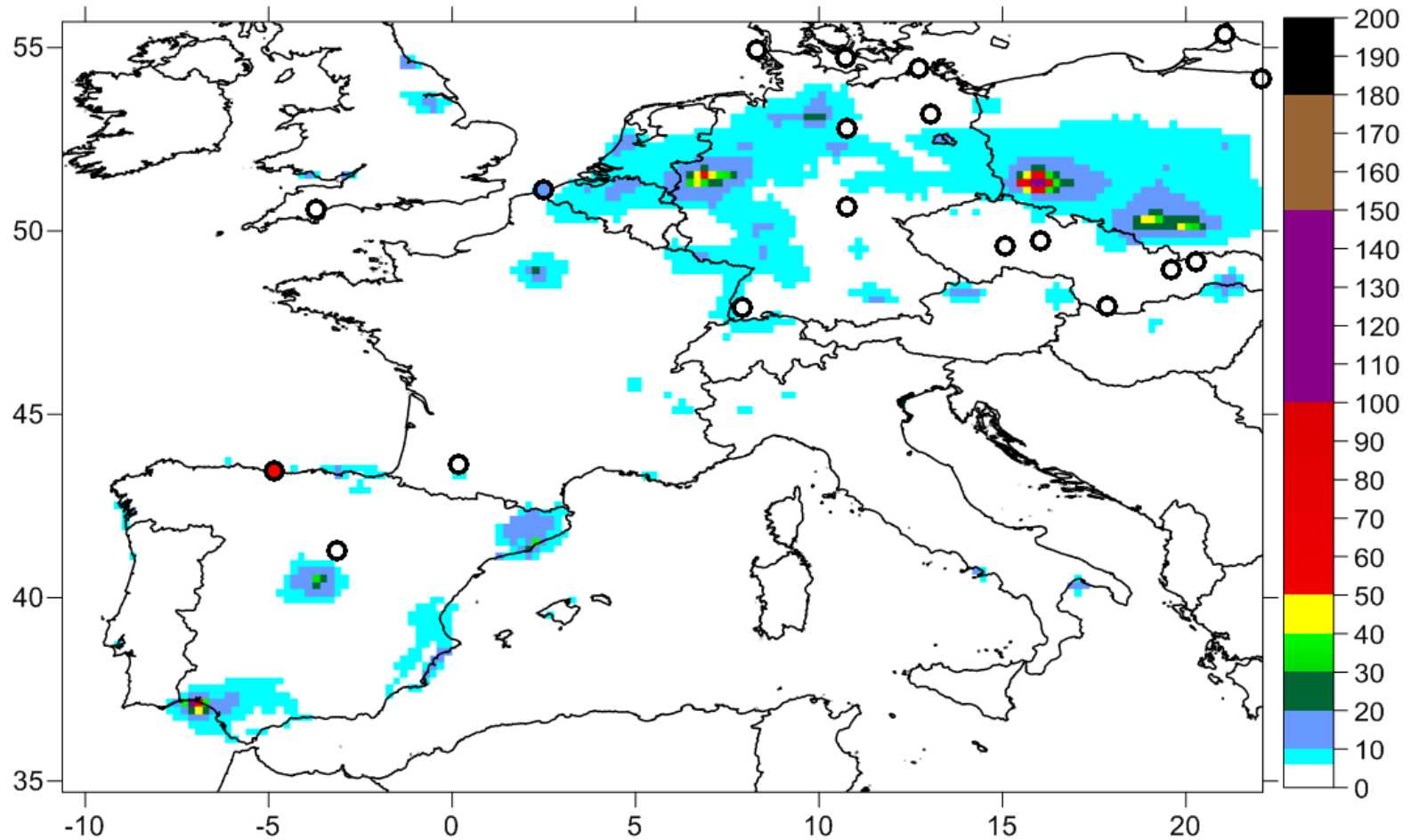


	Cut-off value:	MB	NMB	NMAE
	Annual mean value	ng/m3	%	%
Cr	0.7	-0.432	-37.7	61.07

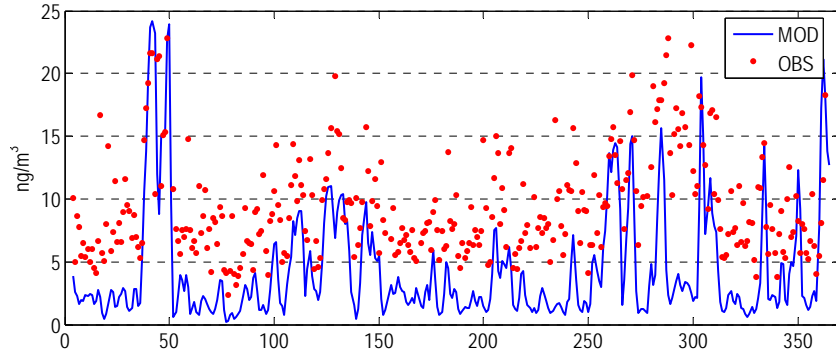
2008 Cu ANNUAL EMISSIONS (g/cell)



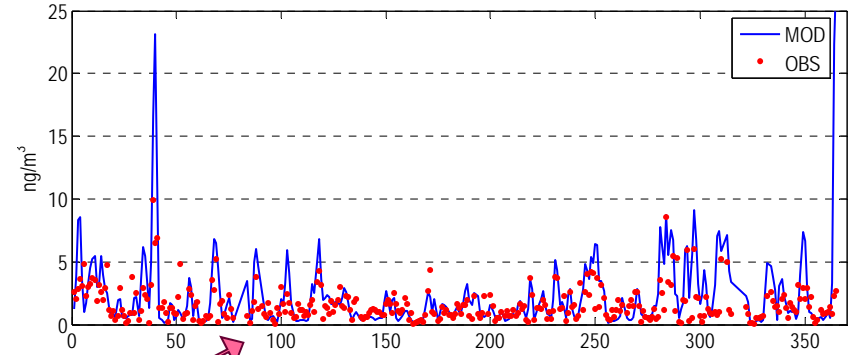
2008 - COPPER (ng/m³)



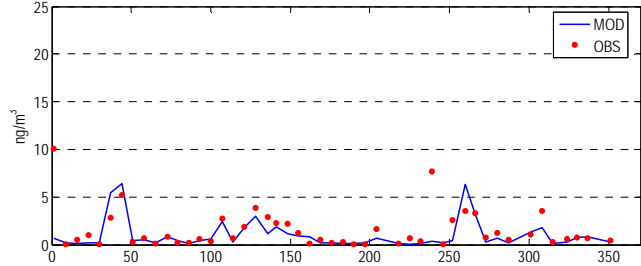
Cu 2008 BE0014R



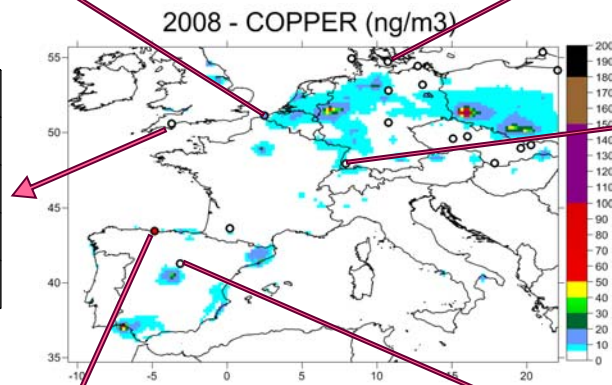
Cu 2008 DK0005R



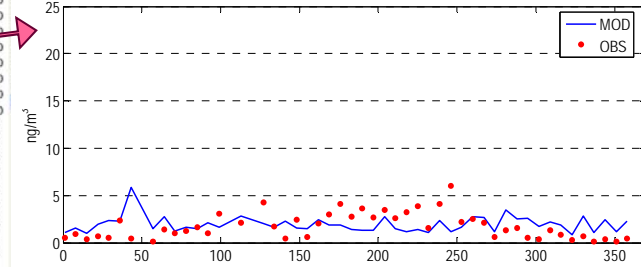
Cu 2008 GB0013R



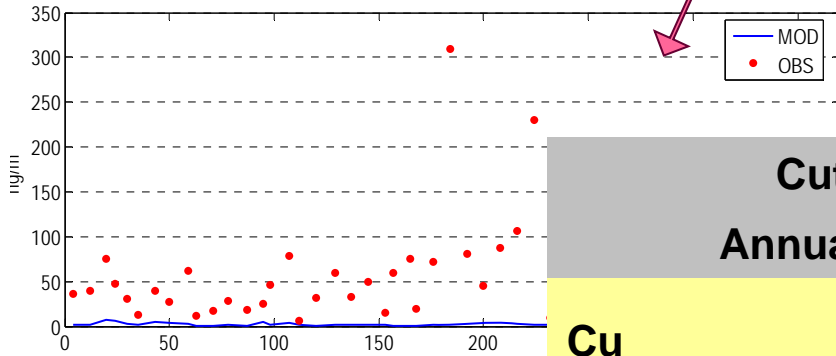
2008 - COPPER (ng/m3)



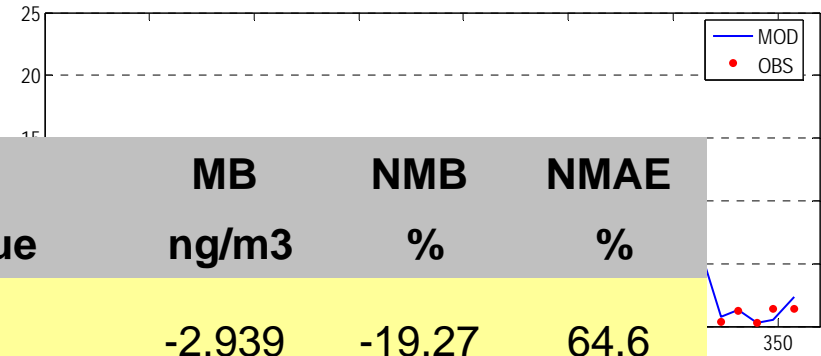
Cu 2008 DE0003R



Cu 2008 ES0008R

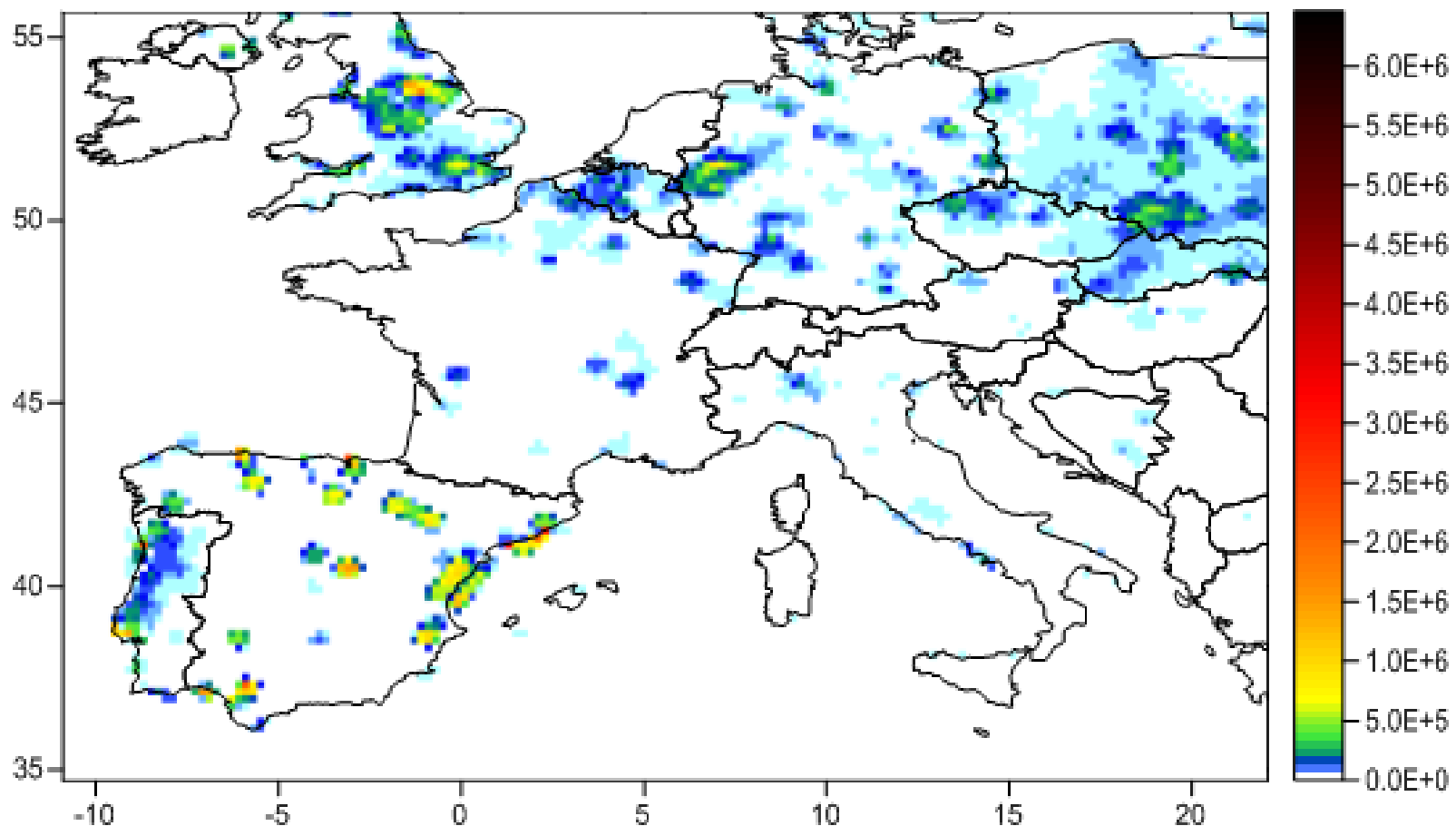


Cu 2008 ES0009R

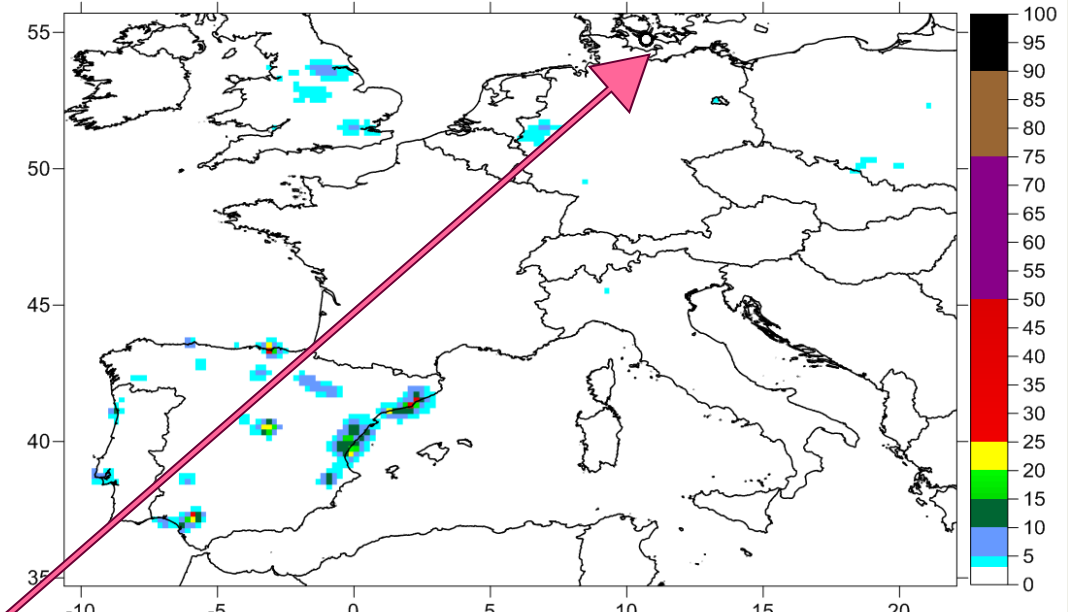


	Cut-off value:	MB	NMB	NMAE
	Annual mean value	ng/m3	%	%
Cu	2	-2.939	-19.27	64.6

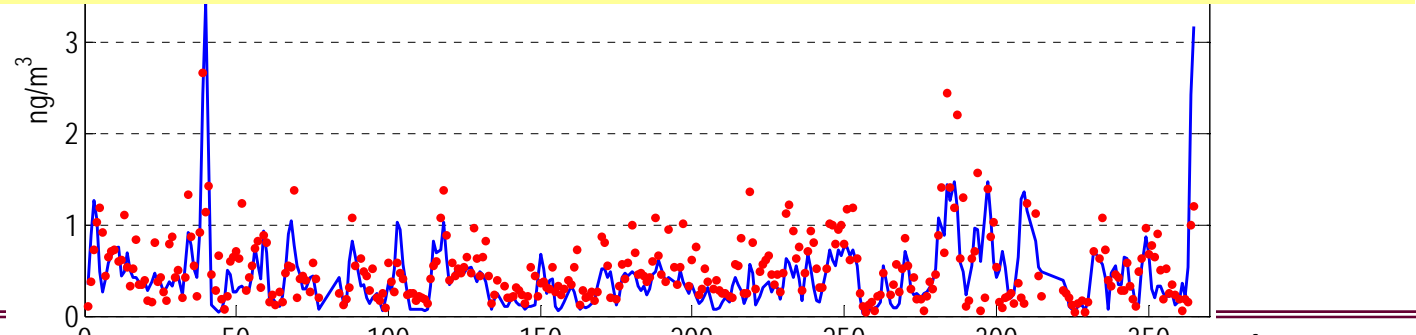
2008 Se ANNUAL EMISSIONS (g/cell)



2008 - SELEN (ng/m³)



Cut-off value:	MB	NMB	NMAE	
Annual mean value	ng/m ³	%	%	
Se	1	-0.277	-20.09	45.58

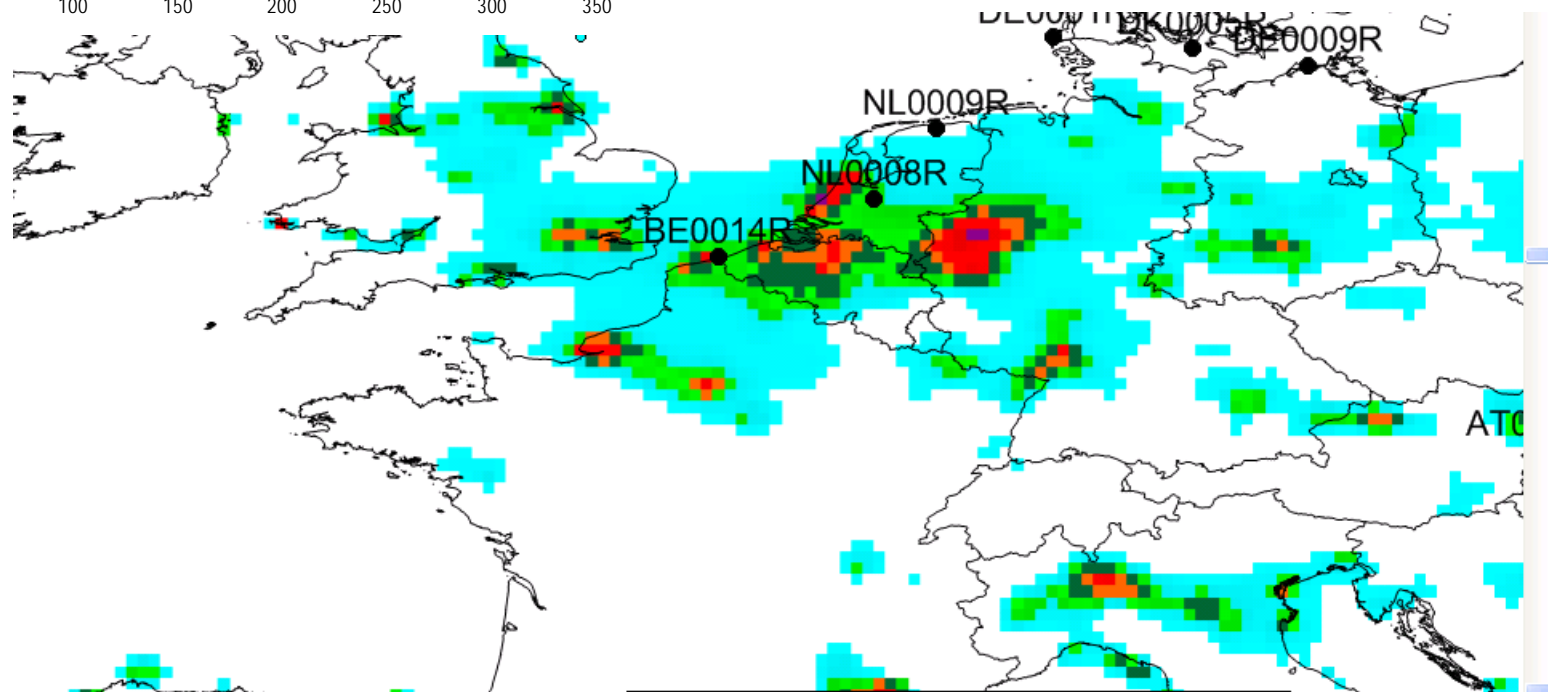
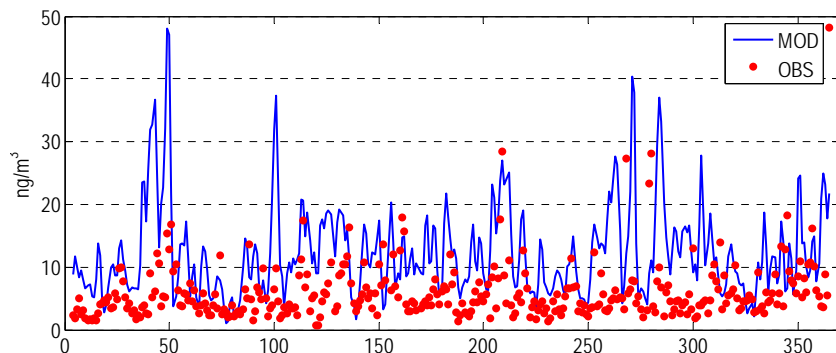


4th HARMO

Kos Island, Greece, 2-6 October 2011

	Cut-off value 10% AL ng/m3	Annual limit (or target) value ng/m3	MB ng/m3	NMB %	NMAE %
Cd	0.5	5	-0.398	-30.19	65.53
Ni	2	20	3.643	99.61	131.32
As	0.6	6	-0.481	-23.03	53.81
Pb	50	500	-16.882	-3.67	59.29
	Annual mean value				
Cu	2		-2.939	-19.27	64.6
Cr	0.7		-0.432	-37.7	61.07
Zn	15		1.463	22.11	60.77
Se	1		-0.277	-20.09	45.58

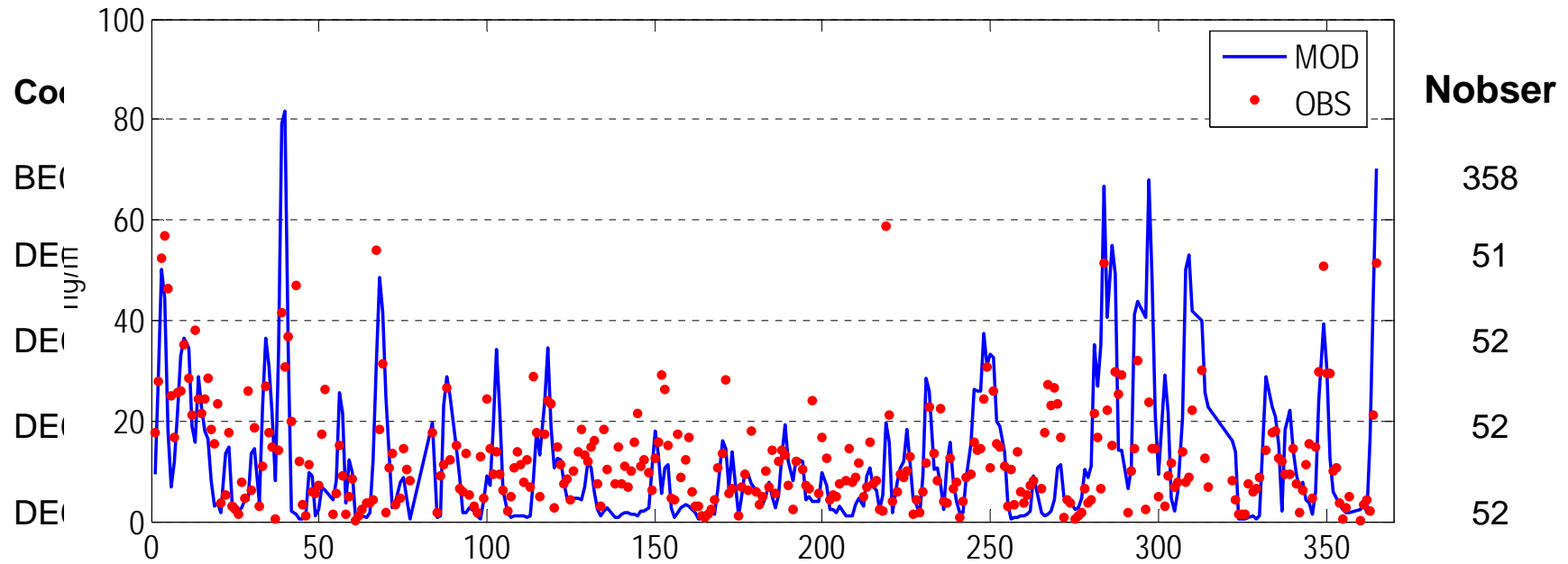
Ni 2008 BE0014R



Ni

	Cut-off value 10% AL ng/m3	Annual limit (or target) value ng/m3	MB ng/m3	NMB %	NMAE %
Cd	0.5	5	-0.398	-30.19	65.53
Ni	2	20		69.98	5.73
As	0.6	6	-0.481	-23.03	53.81
Pb	50	500	-16.882	-3.67	59.29
Annual mean value					
Cu	2		-2.939	-19.27	64.6
Cr	0.7		-0.432	-37.7	61.07
Zn	15		1.463	22.11	60.77
Se	1		-0.277	-20.09	45.58

Zn 2008 DK0005R



DK0005R	10.733	54.733	10	-3.031	54.61	-10.73	97	336
NL0008R	5.2	52.117	5	2.423	50.68	20.28	165	180
NL0009R	6.277	53.334	1	-9.899	48.01	-19.38	120	180
SK0004R	20.283	49.15	808	-4.284	41.66	-21.71	13	52

Conclusions I

- More information on **heavy metals emissions** is necessary. For most heavy metals no recent information is available. For some of the metals in European Normative no information is available in EMEP database (As, Ni)
- More information on temporal disaggregation of metal emissions is required; in EMEP data base emissions for Pb and Cd in 2009 do not include SNAP activities contribution and thus temporal

Conclusions II

- Better EMEP observed information in some parts of Europe is required regarding a) **temporal and spatial coverage** b) **analytical techniques**
- Some discussion on how to evaluate this kind of pollutants with **very low bulk values** would be wellcome. Very low bulk values drive to extremely large normalized errors.

Thank you very much

