

PMinter

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www.pminter.eu



Forecasting PM in the Czech Republic

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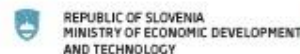


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PMinter



Forecasting PM in the Czech Republic

- Motivation
- Recent experiences with PM forecasting in the Czech Republic
- Current effort to develop a 48-hour air quality forecast system targeted towards the Czech Republic



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Motivation: DIRECTIVE 2008/50/EC



ANNEX XVI: ... timely information about actual or **predicted** exceedances of alert and any information threshold is provided to the public. Details supplied shall include at least:

....

- b) forecast for the following afternoon/day(s):
- geographical area of expected exceedances of information and/or alert threshold,
 - expected changes in pollution (improvement, stabilization or deterioration), together with the reasons for those changes;



Motivation



- measures can be taken prior AP episode starts
- output of the operation forecast can be used for annual assesment of AQ
 - is of interest especially when there is pressure on “optimization” i.e. reduction of measurement network
- CTM modelling are one option how assess contribution if secondary particles and different sources to AP level



Motivation



Annual average PM₁₀ concentration in 2011

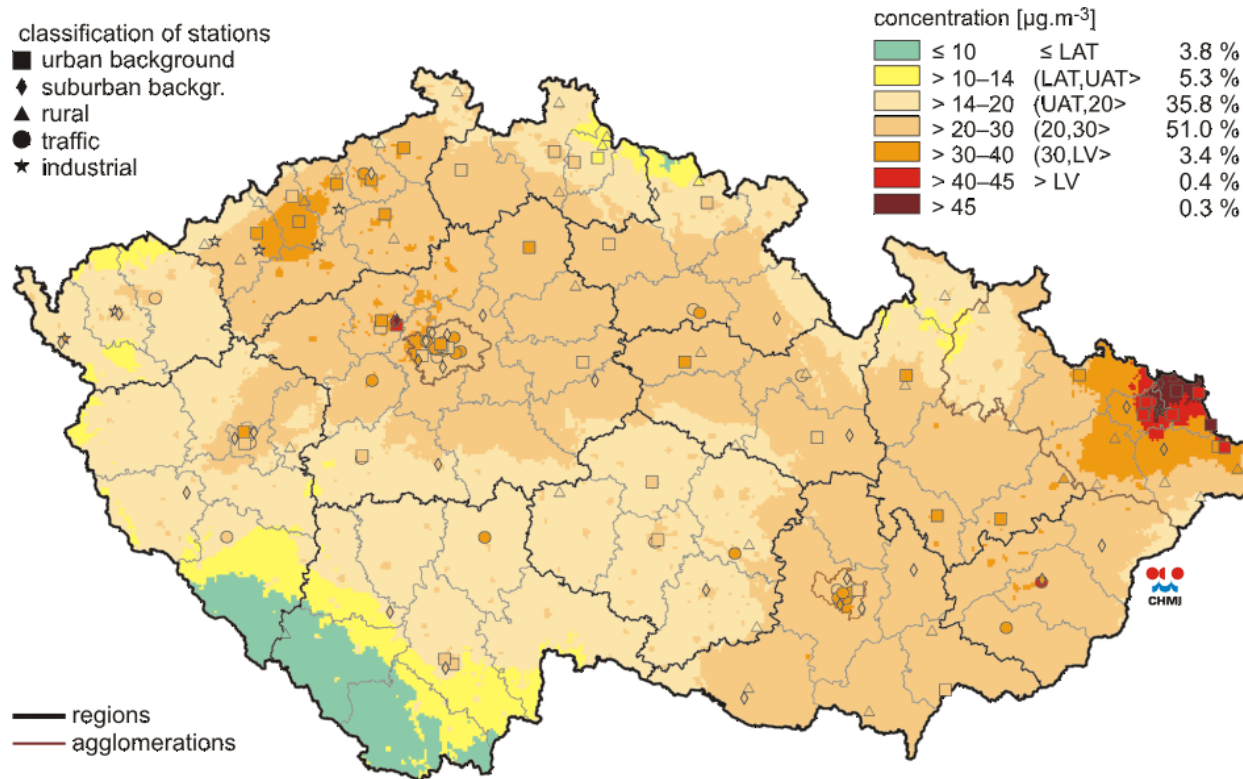


Fig. II.4.2.8 Field of annual average concentration of PM₁₀ in 2011

Motivation



Annual average PM_{2.5} concentration in 2011

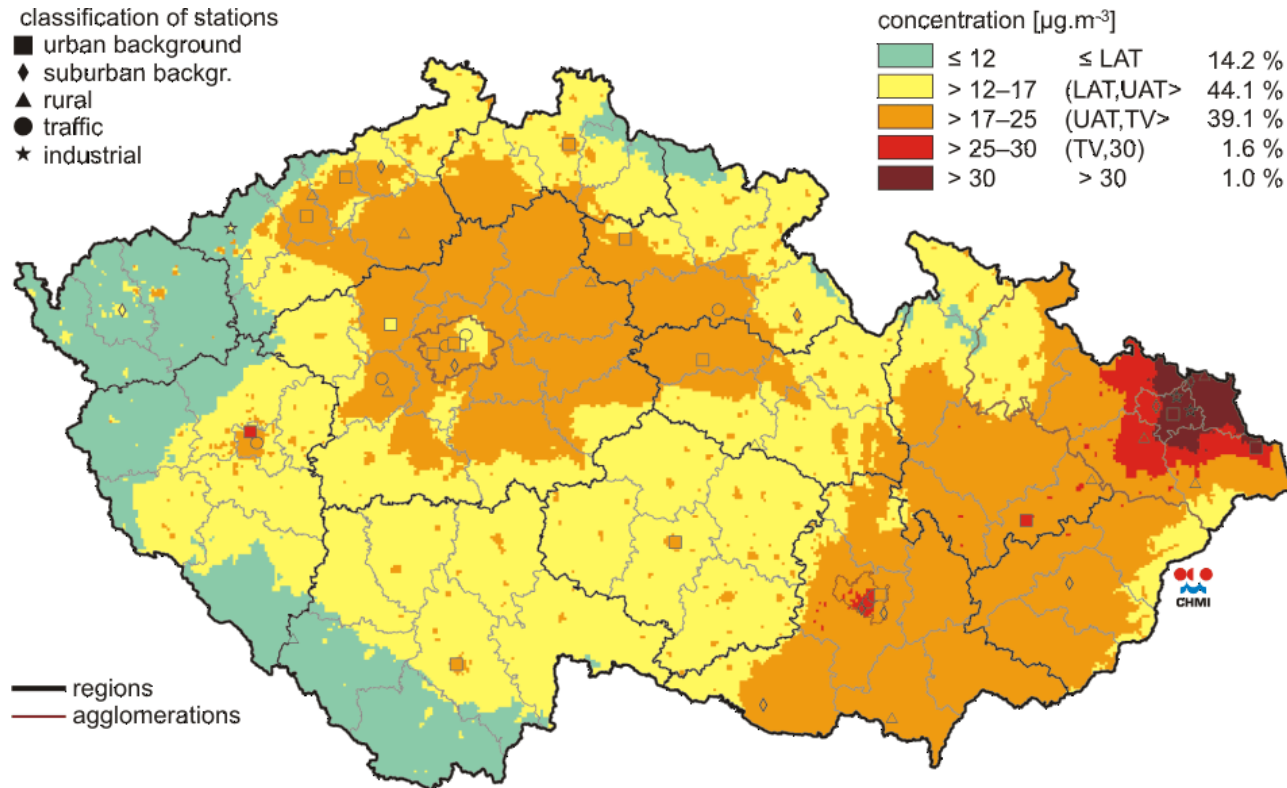


Fig. II.4.2.14 Annual average concentration of PM_{2.5} at stations in 2011

Motivation



36th highest 24-hour PM₁₀ concentration in 2011

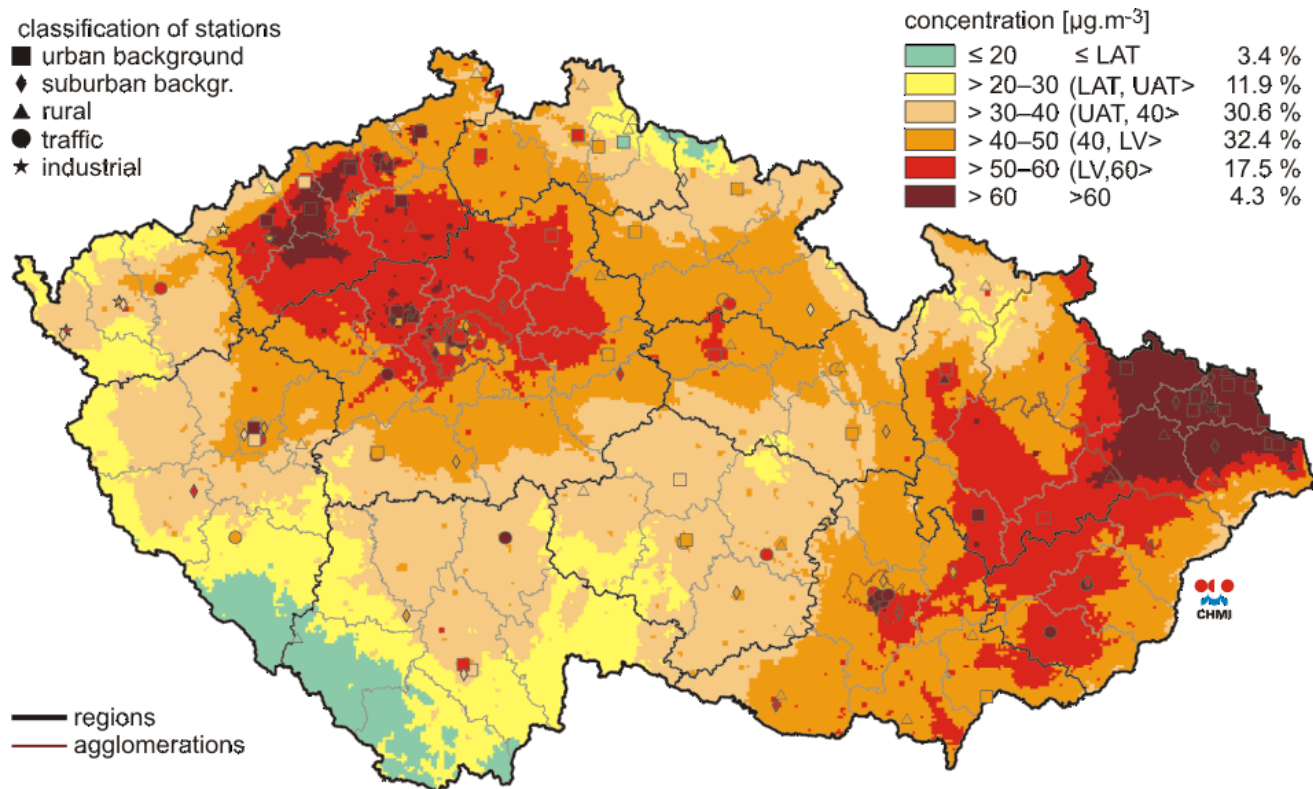


Fig. II.4.2.7 Field of the 36th highest 24-hour concentration of PM₁₀ in 2011

Recent experiences: CITEAIR project



CITEAIR II project

- hybrid forecasting methods for Prague and Brno were tested
- regional forecast model CHIMERE was used and a statistical relationship with auxiliary data to improve forecast results
- forecasting was aimed at prediction of the Common Air Quality Index (CAQI) which primarily includes PM_{10} , $PM_{2.5}$, NO_2 , and O_3



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Recent experiences: CITEAIR project



Aim to improve the performance of a pure deterministic CTM forecast, or a persistence or climatology-based forecast.

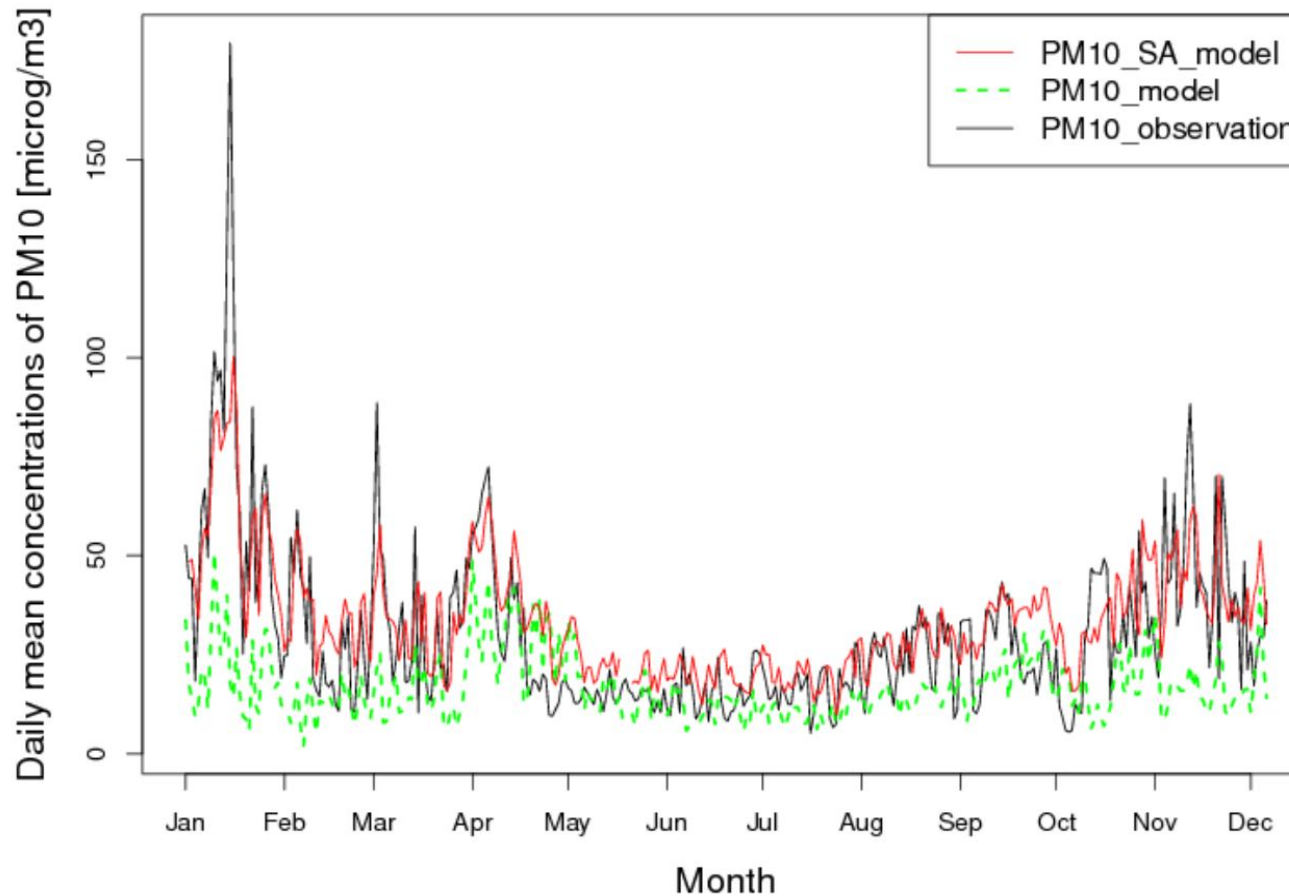
- the project demonstrated that this could be achieved
- forecast performed well around the mean and less-so at higher concentrations
- still performance was much better than the CTM and further improvement would be gained by use of better input data (e.g. a better performing CTM for the region)
- need for two year-long datasets of inputs and observations (one for building the forecast and one for validation on independent data)



CITEAIR project



Timeserie for station 03009



Pasodoble AQ forecast for Prague

- Done by VITO within the PASODOBLE project
- Eulerian CTM AURORA
- 1 km nested domain around Prague
- 72-hour forecast once a day
- Forecast of NO₂, O₃, PM₁₀, and PM_{2.5}
- Service still running but future?
- Detailed validation still not available...

Pasodoble AQ forecast for Prague



redmine@vito.local 14:13 (před 15 h) ☆
komu: guy.driesen, lisa.blyth, nele.veldeman, peter.viaene, stijn.janssen, koen.de
angličtina > čeština Přeložit zprávu Pro jazyk angličtina překlad vypnout ×

**Prague
agglomeration**

Daily forecast - Prague: 15-09-2013
Pasodoble



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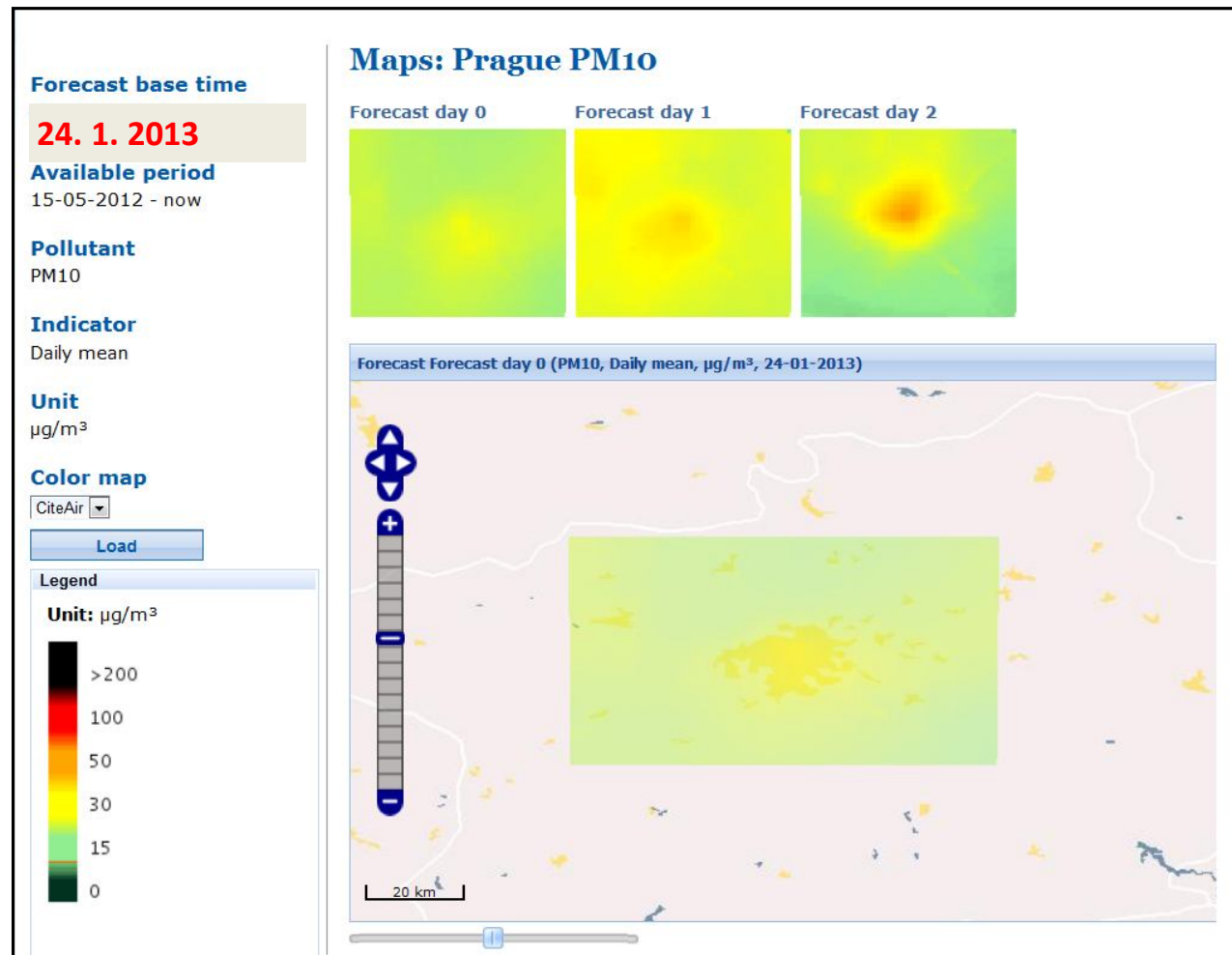
Pasodoble AQ forecast for Prague



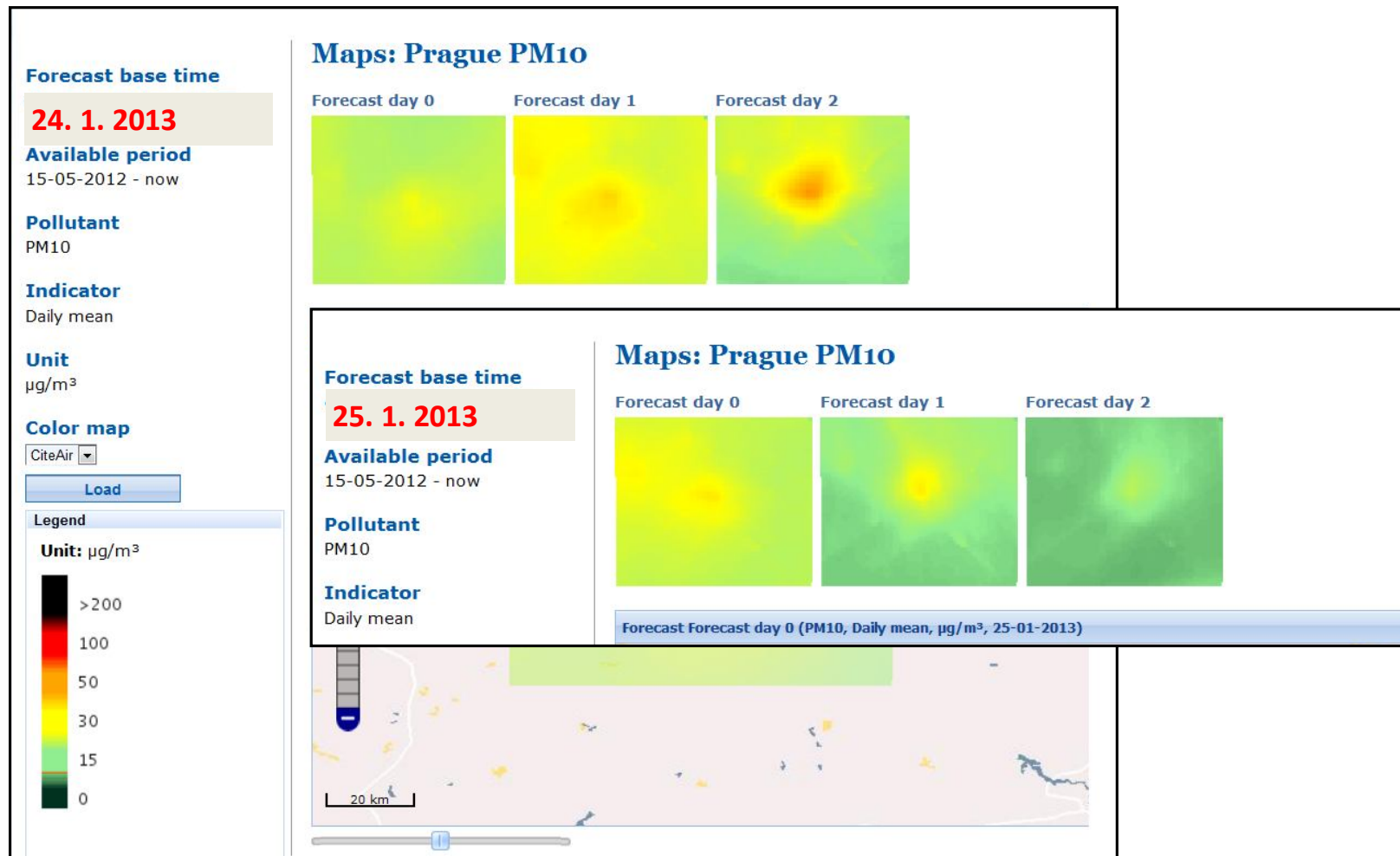
Region	Prague					Central Bohemia Region			
	ARIEA	ALIBA	AKOBA	ASUCA	ASTOA	ALIBA	SMBOA	SKLSA	SPRIA
21. 1. 2013	85	91	80	91	85	91	93	103	60
22. 1. 2013	77	86	68	80	78	86	66	96	132
23. 1. 2013	83	94	71	85	93	94	84	110	163
24. 1. 2013	80	85	69	80	77	85	96	90	92
25. 1. 2013	124	140	115	120	125	140	126	163	92
26. 1. 2013	57	55	62	69	54	55	75	109	46
27. 1. 2013	43	45	43	52	41	45	59	64	33

Daily average PM ₁₀ [µg.m ⁻³]	
-1	Unavailable data
43	≤ 50
58	> 50 and ≤ 100
125	> 100 and ≤ 150
175	> 150
	Smog situation
	Regulation

Pasodoble AQ forecast for Prague



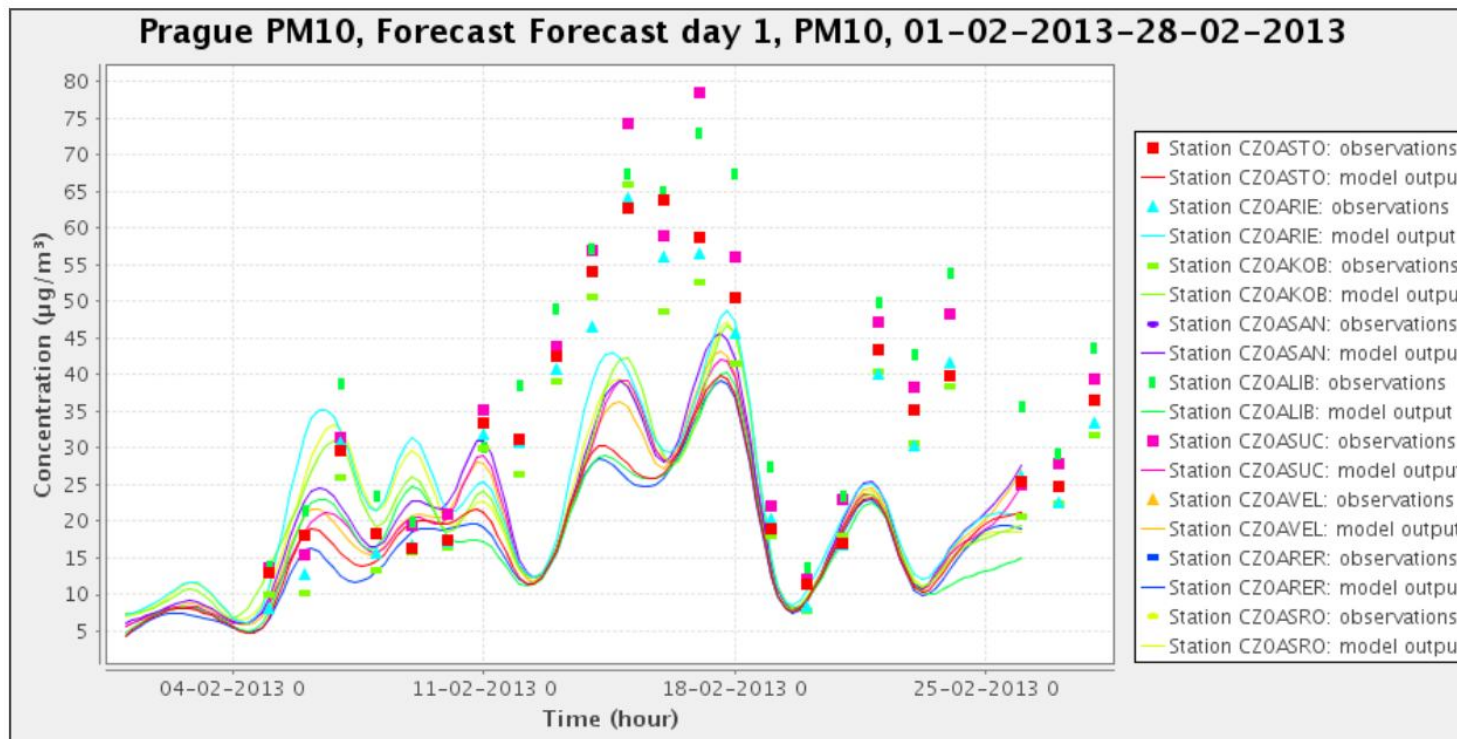
Pasodoble AQ forecast for Prague



Pasodoble AQ forecast for Prague



Time series



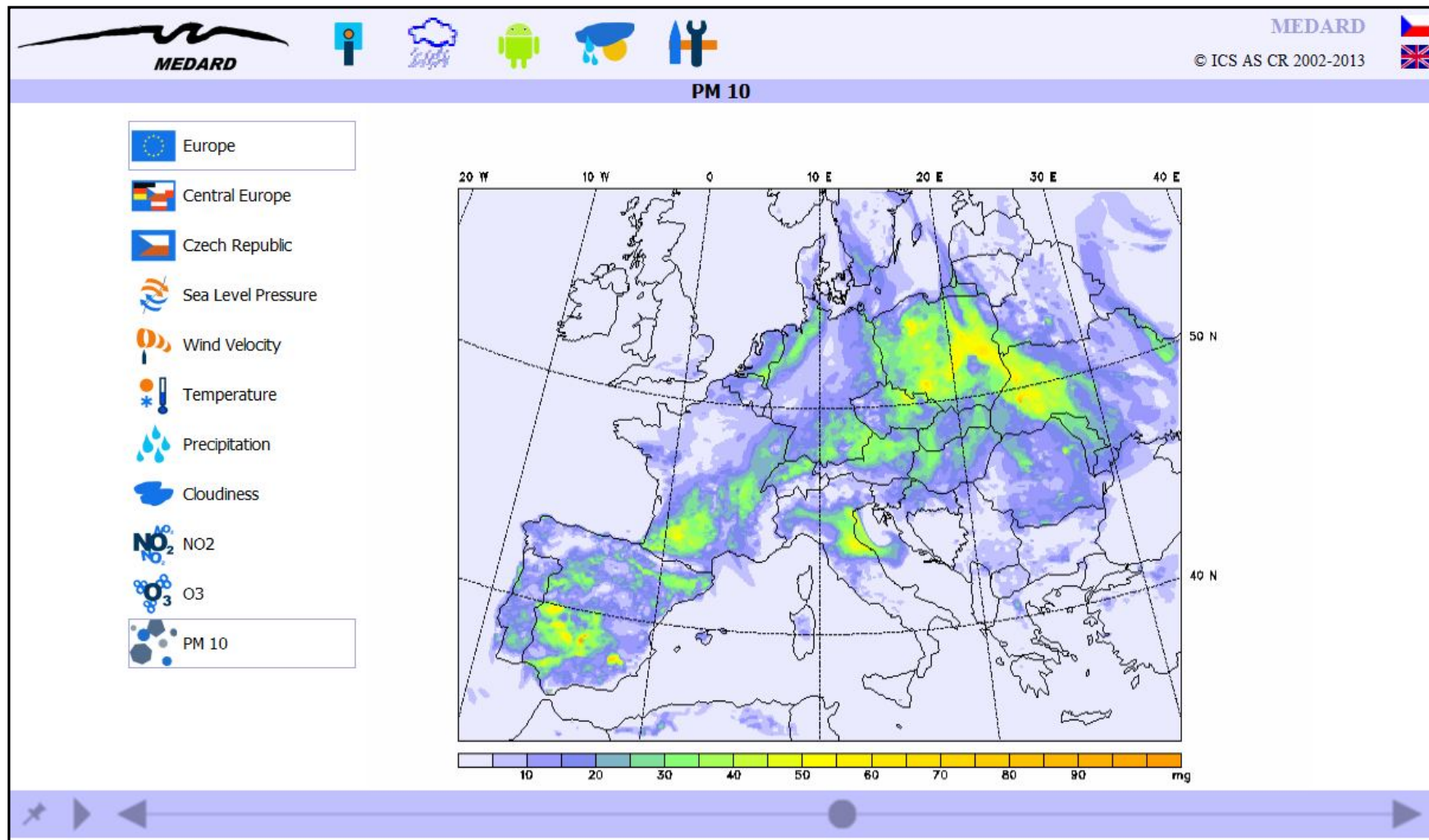
MEDARD forecast for Czech Rep.



- Institute of Computer Science, Academy of Sciences of the Czech Republic
- Weather (WRF) and AQ (CAMx) forecast
- 9 x 9 km and 3 x 3 km domain
- Forecast provided, but system needs to be tuned and evaluated
- www.medard-online.cz



MEDARD forecast for Czech Rep.



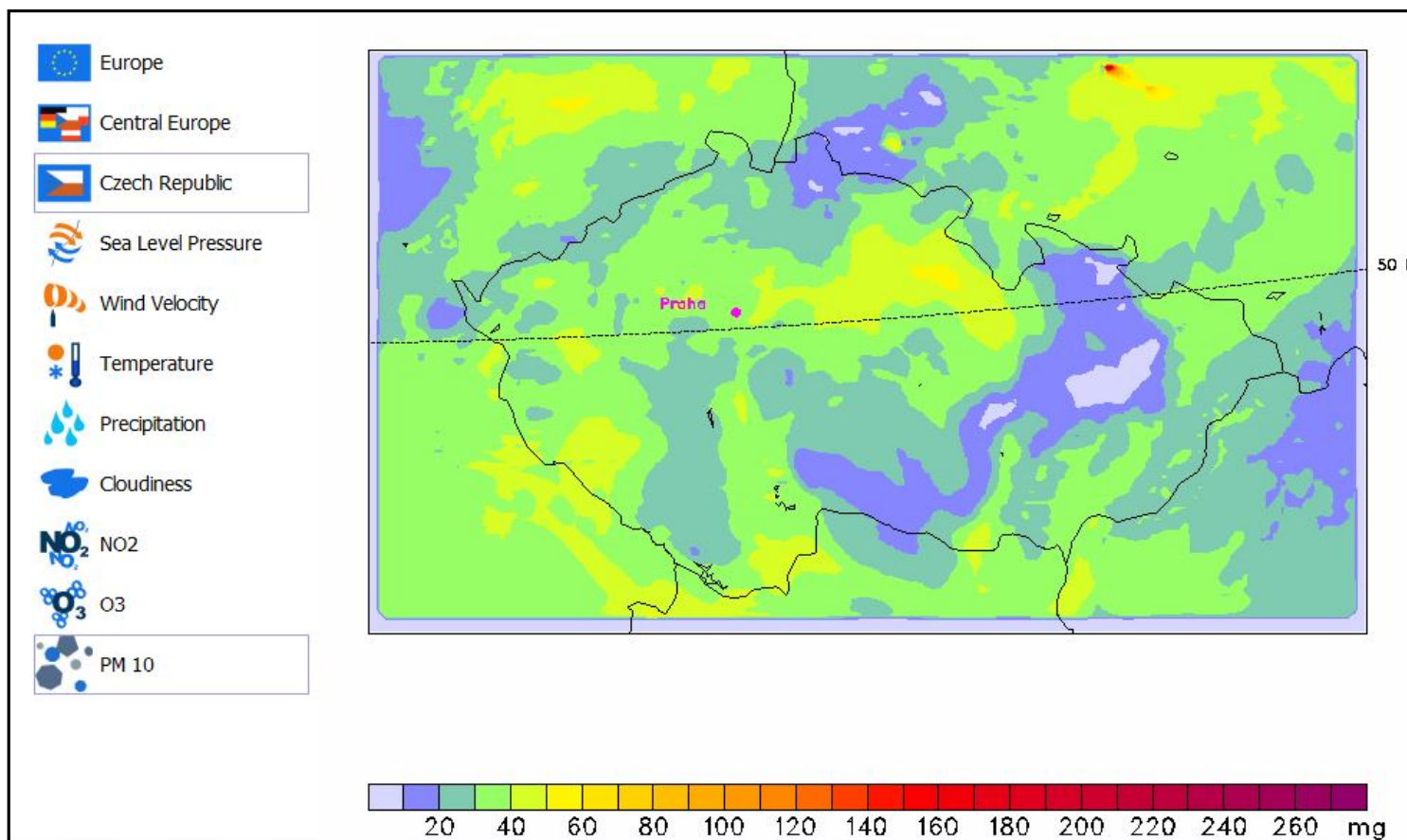
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MEDARD forecast for Czech Rep.



CHMI's AQ modelling system



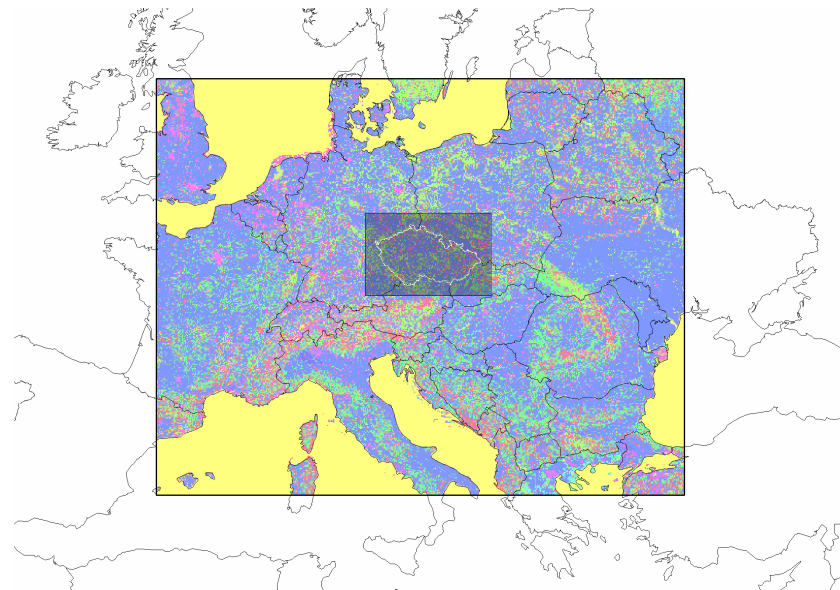
- NWP model ALADIN
- CTM model CAMx
- TNO emission for Europe
- National emission for the Czech Republic
- Emission processing by SMOKE
- Boundary conditions from MACC fnyp system (IFS – MOZART couple)
- Biogenic emission from BEIS model (part of SMOKE)



CHMI's AQ modelling system



- Outer domain 14.1 x 14.1 km
- Inner domain 4.7 x 4.7 km
- Vertical extent cca 15 m – 9 km



CHMI's AQ modelling system



Czech emission inventory

- Point sources (large and medium size)
 - Emission of main pollutants
 - Coordinates and stack parameters
 - Total cca 60 000 sources
- Area sources (local heating and solvent use)
 - Per cadastral units (redistributed using census data)
- Mobile sources (grided in $0.01^\circ \times 0.01^\circ$ grid)



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CHMI's AQ modelling system



TNO emissions

- No stack parameters
 - large Czech sources divided per SNAP97 and emission of dominant pollutant to 18 categories and emission-weighted stack parameters assigned to corresponding groups in TNO ptsrc



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CHMI's AQ modelling system



Speciation

- VOC ... based on SNAP97 according to Passant (2002) profiles for UK
- PM ... based on speciation used in AQMEII project (TNO) or calculated for different source types (Czech sources)



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CHMI's AQ modelling system



Boundary conditions

- from the (MACC) project (available by the Forschungszentrum Jülich Web Coverage Service)
- 5-day forecast with time resolution 3 hour
- In fnyp MOZART v3.5 is coupled to the ECMWF's IFS
 - Provides BC, OC, PM, seasalt, SO_4^{-2} , ethane, formaldehyde, CH_4 , CO, HNO_3 , isoprene, NO, NO_2 , O_3 , hydroxyl radical, peroxyacetyl nitrate and SO_2).



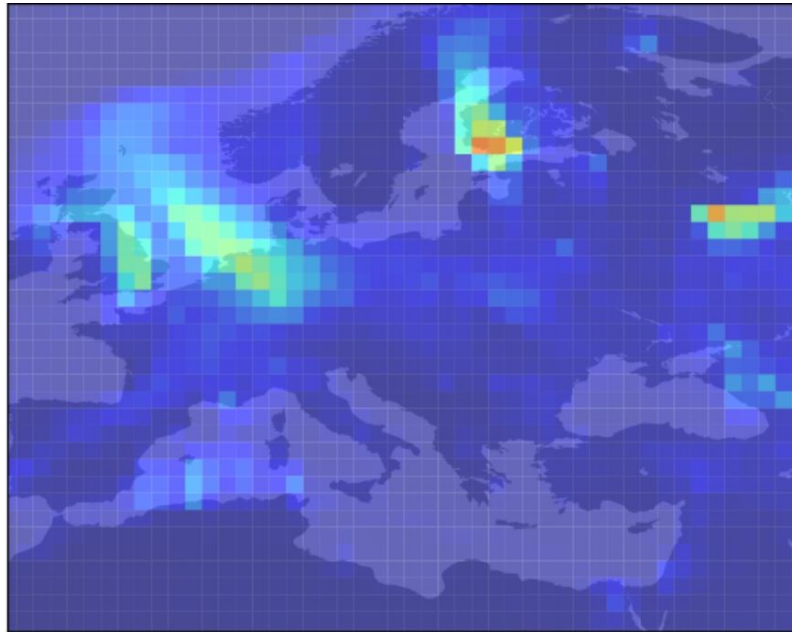
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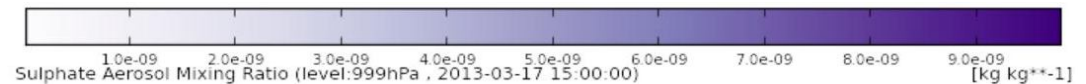
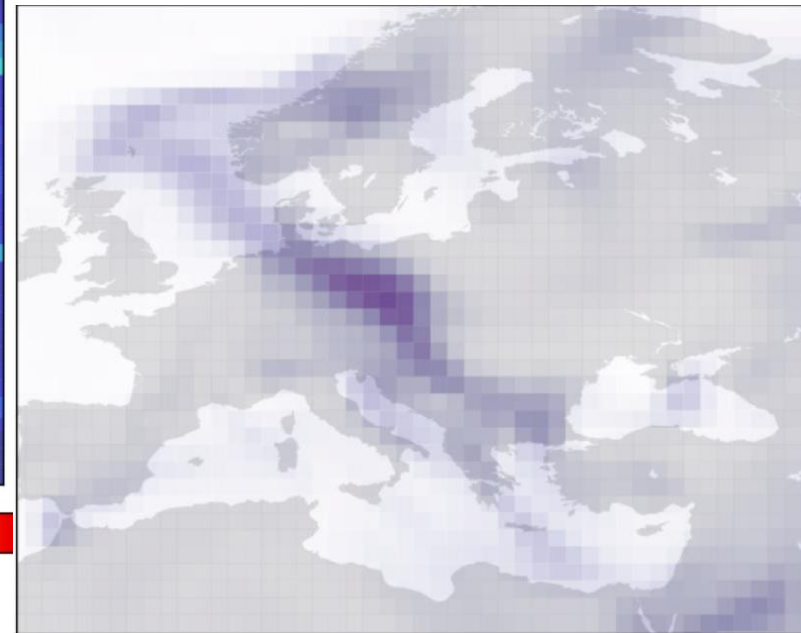
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CHMI's AQ modelling system



Forecasted mixing ratio of NO₂ from the MACC project (18th Mar 2013 15:00).



Forecasted mixing ratio of sulfate aerosol from the MACC project (18th Mar 2013 15:00).



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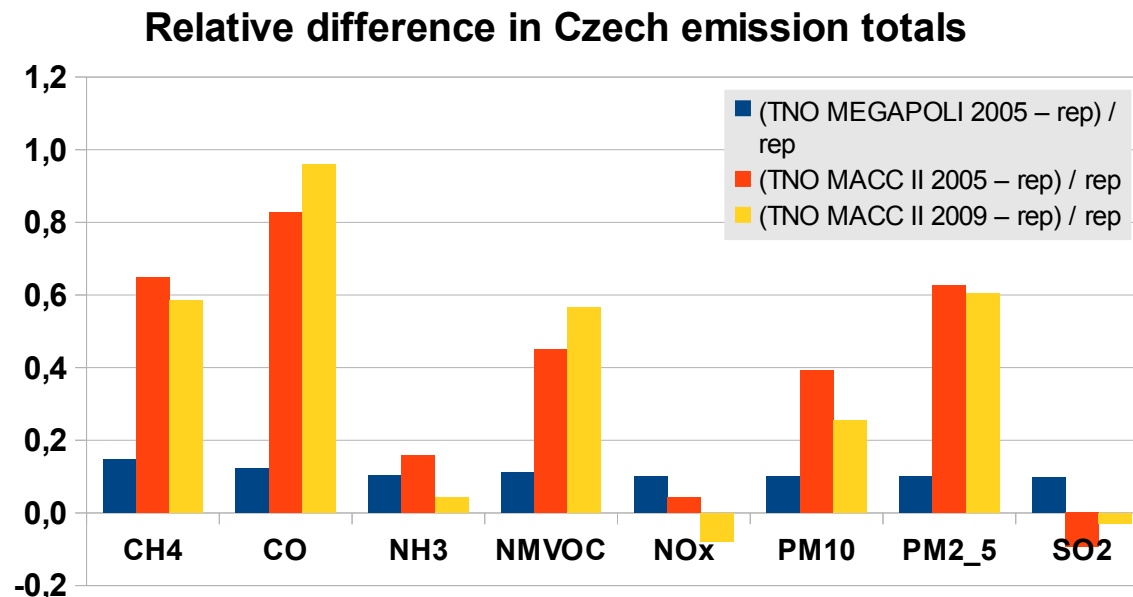


CHMI's AQ modelling system



Issue with combining TNO and Czech emissions

- For TNO MACC II did not use Czech emissions since it did not pass quality checks

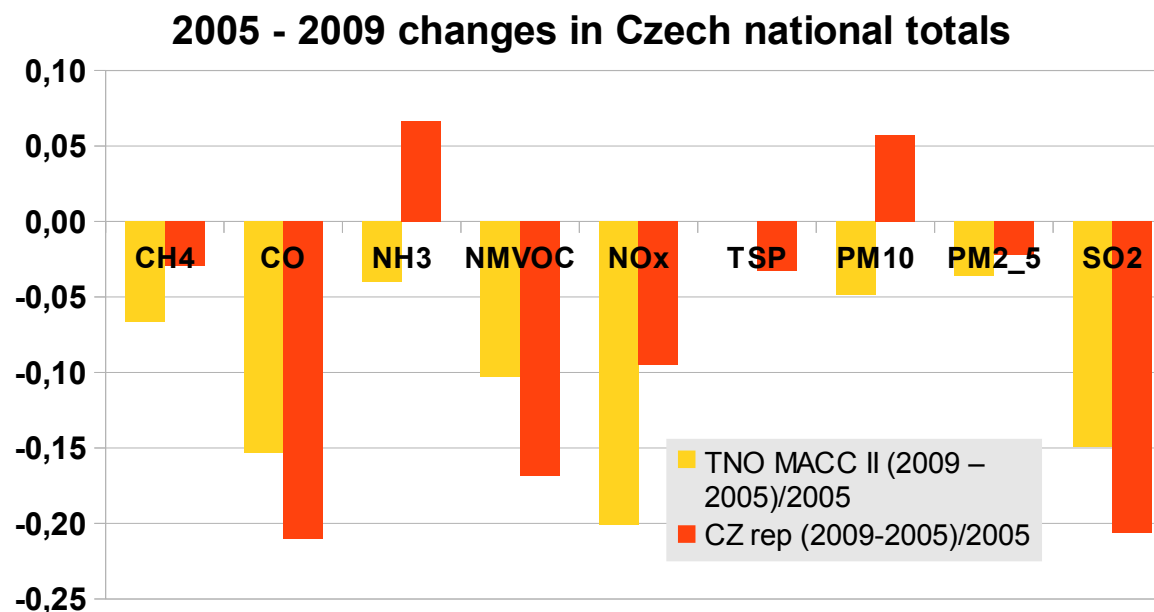


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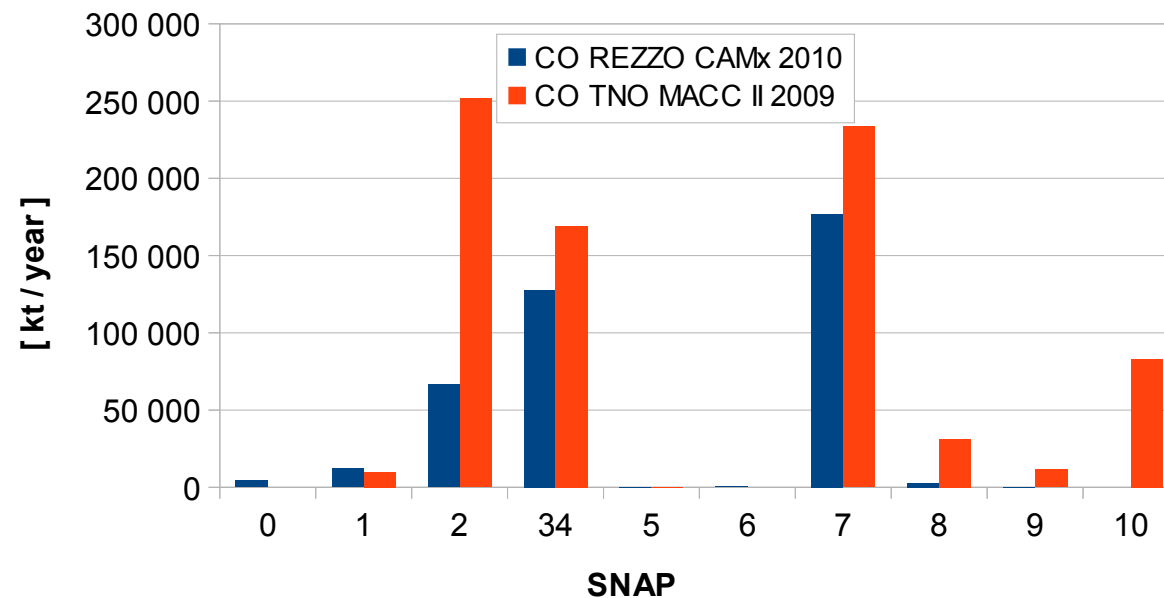


CHMI's AQ modelling system



Issue with combining TNO and Czech emissions

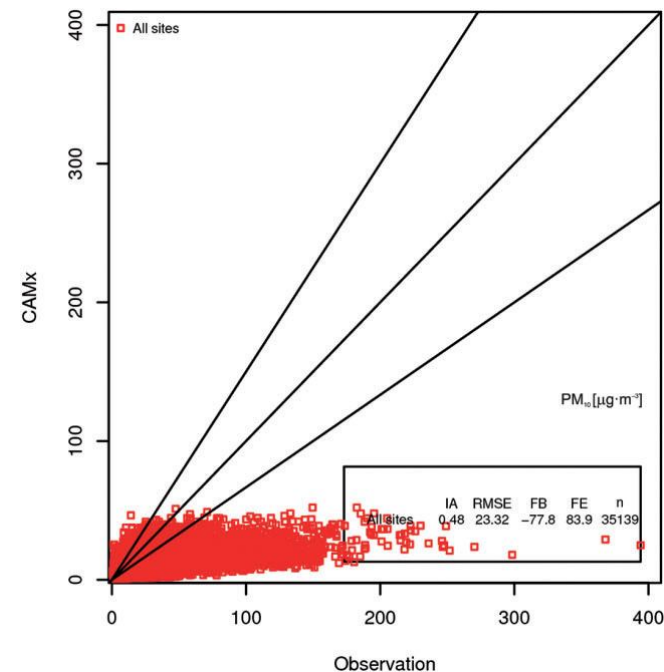
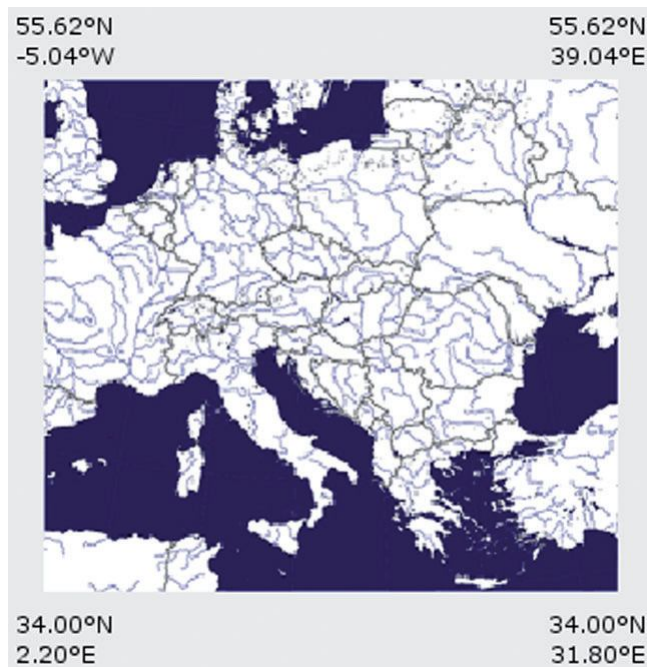
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CHMI – old offline system



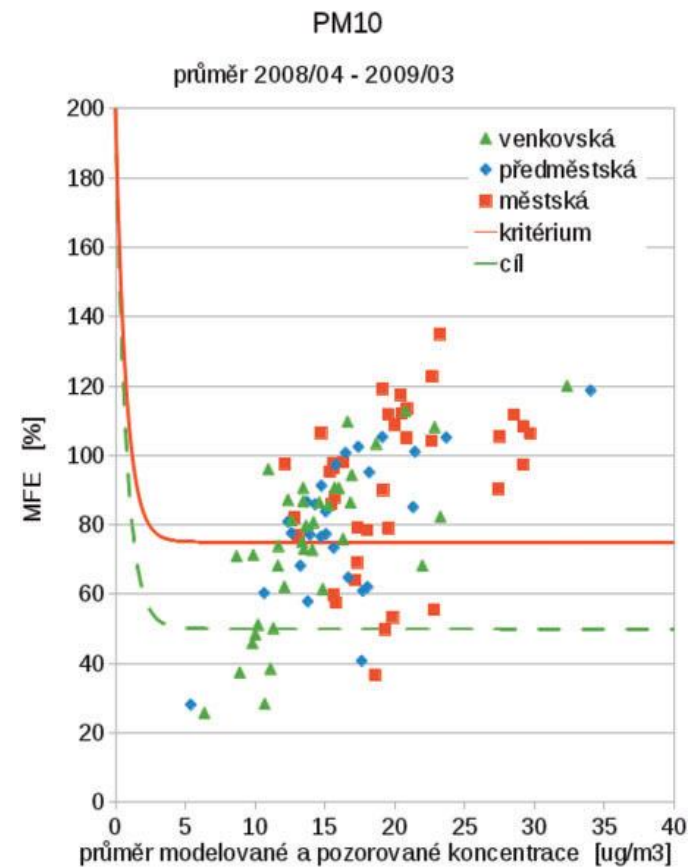
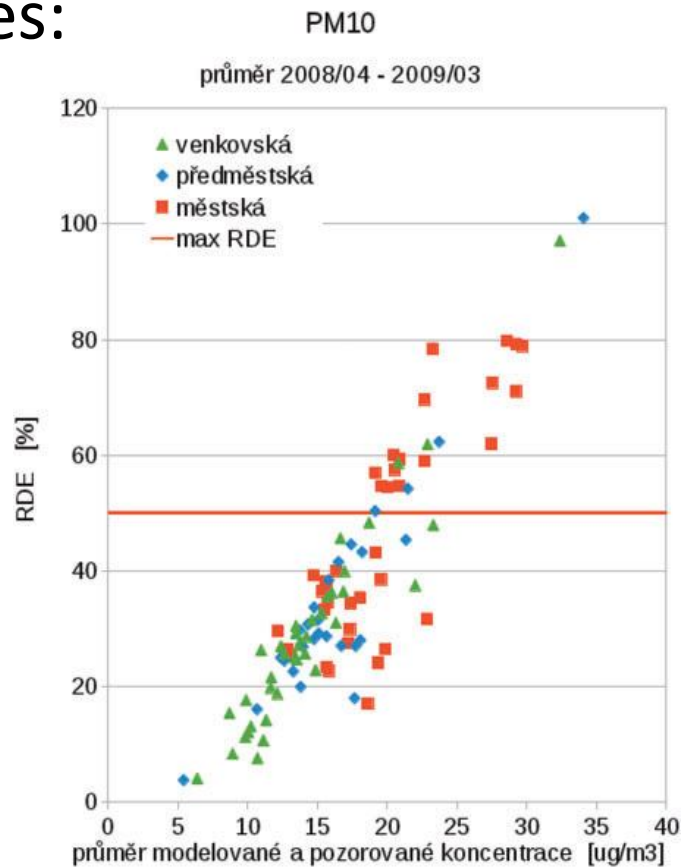
- 8.9 x 8.9 km resolution, 16 vertical levels
- EMEP 50 x 50 km emissions
- 2008/3 – 2009/3 test run



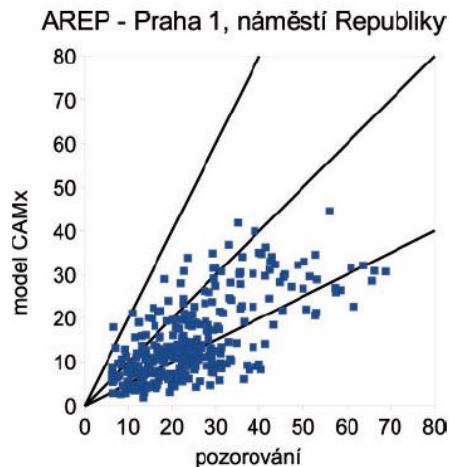
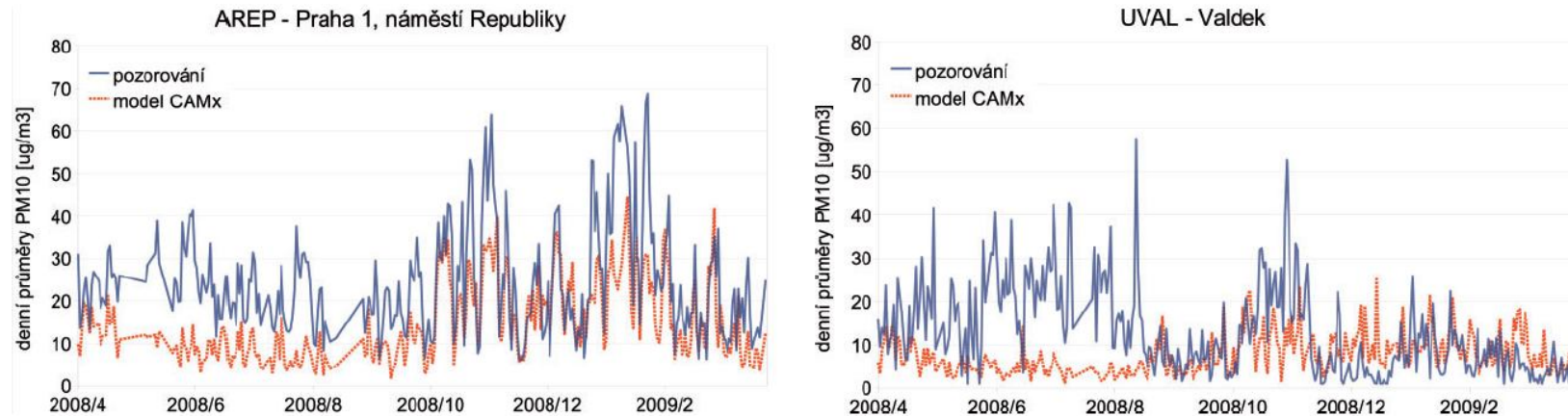
CHMI – old offline system



Legislation quality requirement (RDE) met just for rural sites:

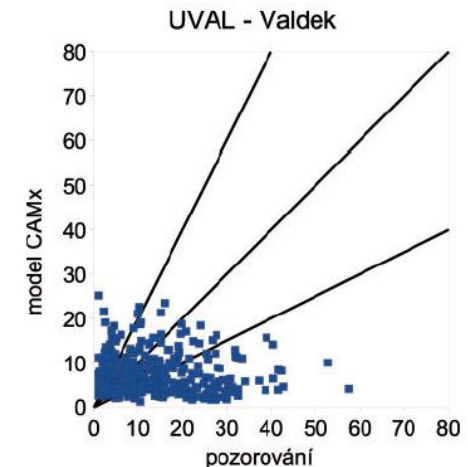


CHMI – old offline system



Obr. 5 Časové řady a rozptylové diagramy denních průměrů PM_{10} . Vlevo: stanice AREP (Praha 1 – náměstí Republiky) s nejvyšším dosaženým indexem shody ($IA = 0,67$); vpravo: stanice UVAL (Valdek) s nejnižším dosaženým indexem shody ($IA = 0,38$). Období 2008/04–2009/03.

Fig. 5. Time series and scatter plots for daily averages of PM_{10} . Left: station AREP (Praha 1 – náměstí Republiky) with the highest index of agreement ($IA = 0,67$); Right: station UVAL (Valdek) with the lowest index of agreement ($IA = 0,38$). Period 2008/04–2009/03.



CHMI – old offline system

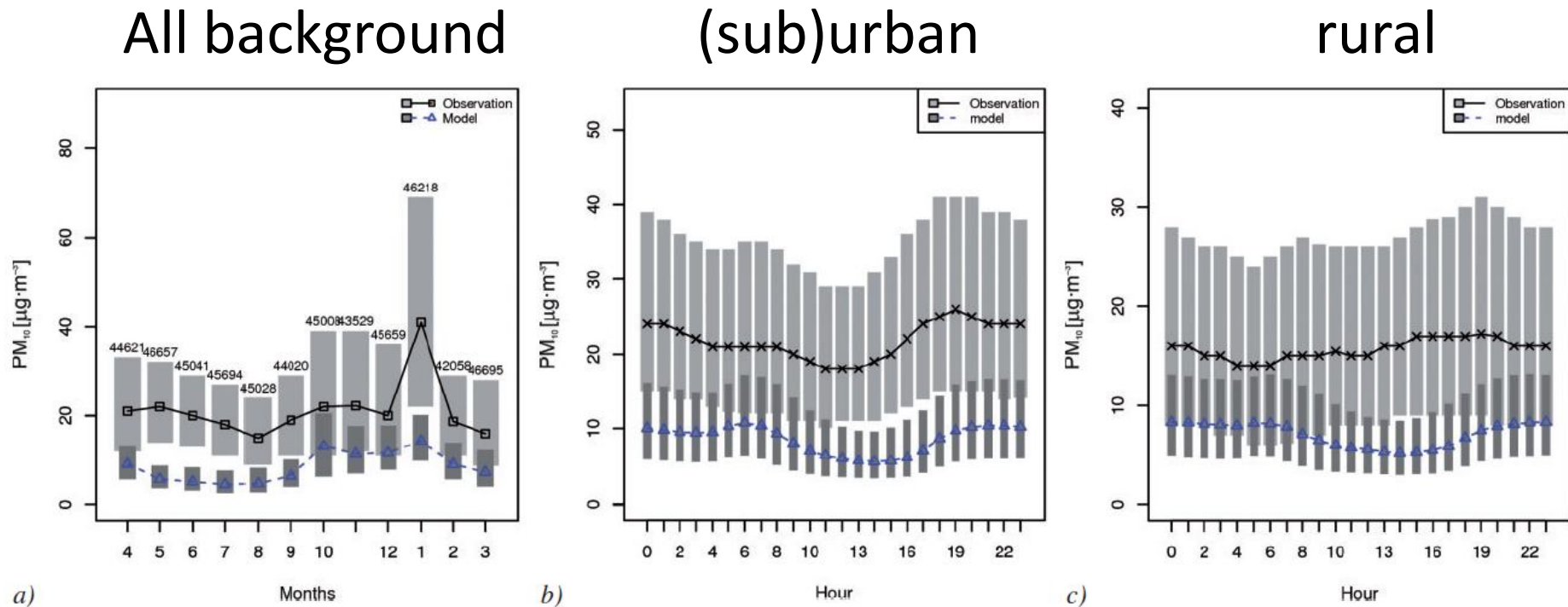
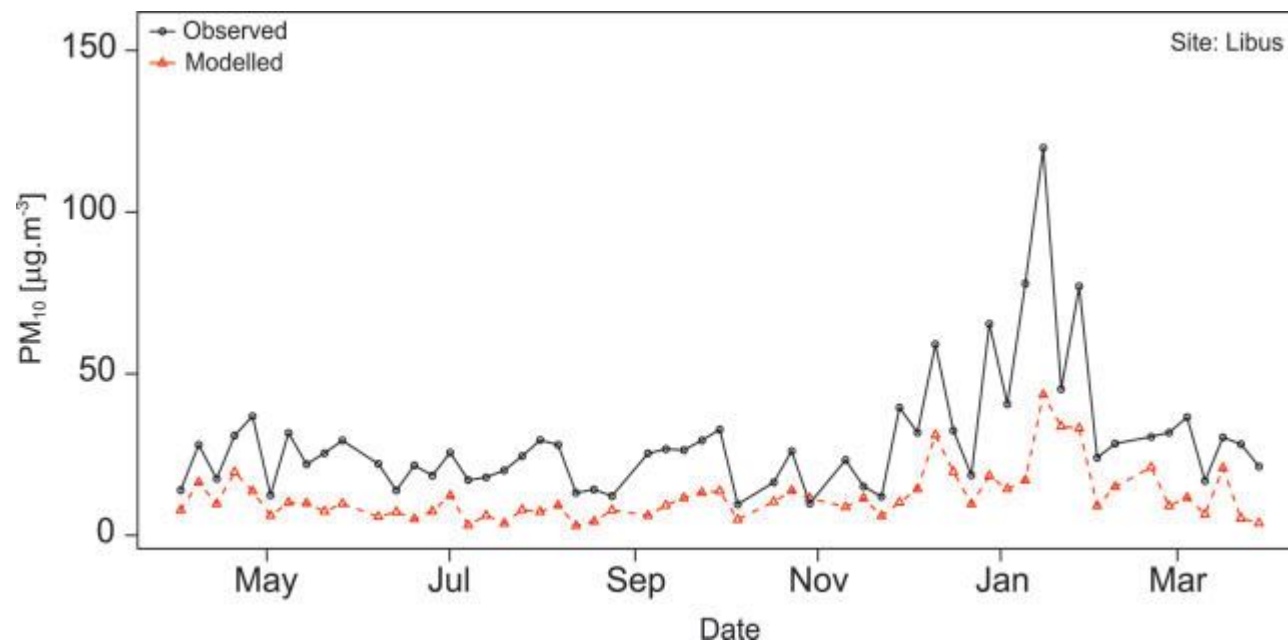


Fig. 6. a) boxplot of PM₁₀ daily concentrations for all background stations; months 2008/04–2009/03. b) – c) boxplots of PM₁₀ 1h concentrations for (sub)urban (b) and rural (c) background stations for period 2008/04–2009/03. Hours are in UTC. Observations are marked by solid line, model results by dashed line. Boxplot shows median and 25% and 75% percentile. Units are µg·m⁻³.

CHMI – old offline system



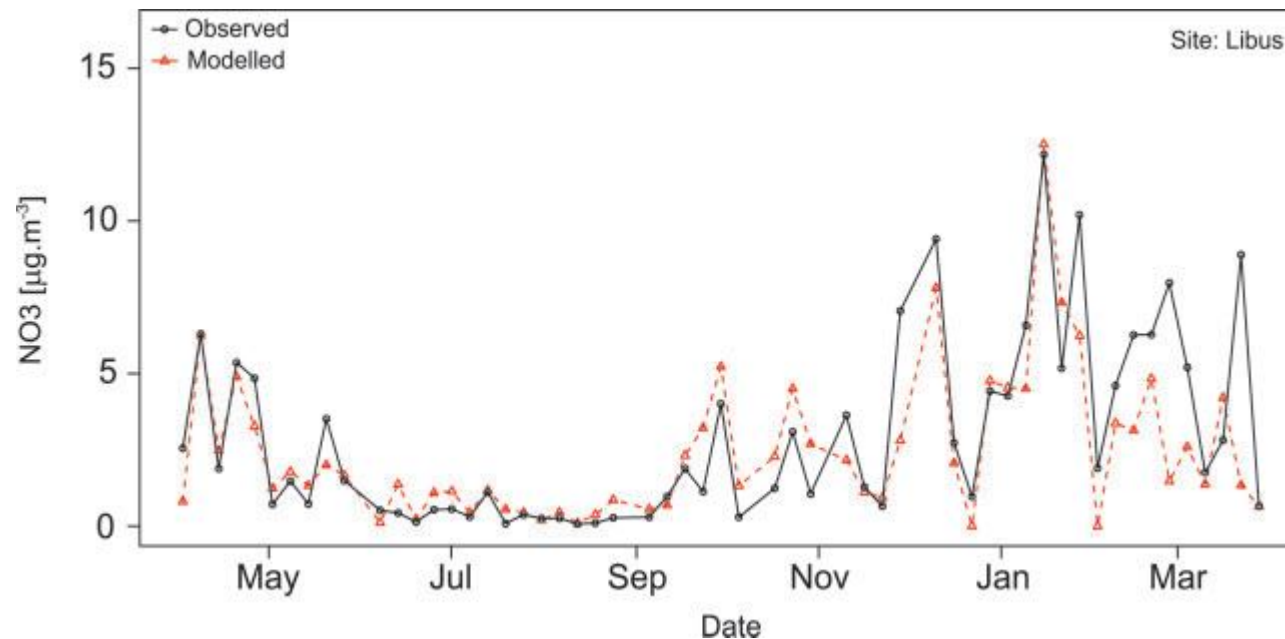
PM_{2.5} composition



CHMI – old offline system



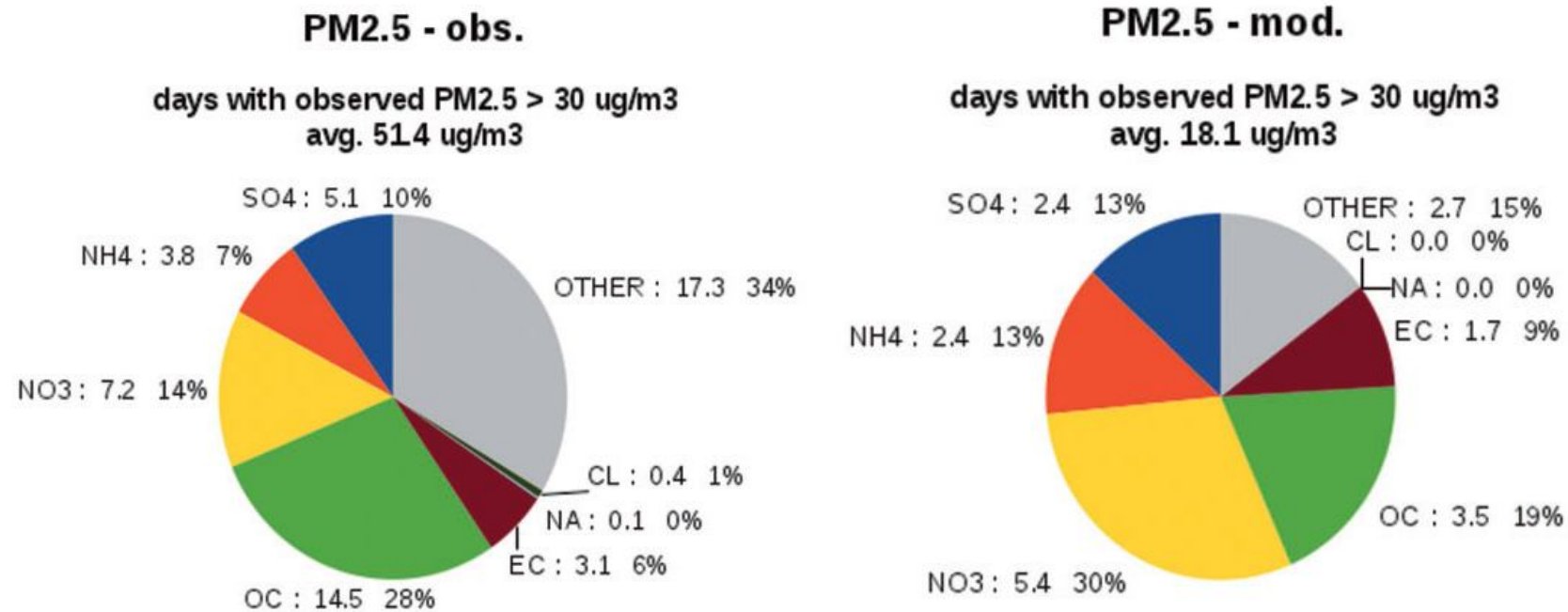
PM_{2.5} composition – best results for NO₃⁻, NH₄⁺, and EC (IA = 0,71 – 0,88). Worse for SO₄²⁻ and wrong for OC.



CHMI – old offline system



PM_{2.5} composition – days with PM_{2.5} > 30 µg.m⁻³



Thank you for your attention!