Opera

Operational Procedure for Emission Reduction Assessment

Application of RIAT+ on the Emilia Romagna region (Italy)

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Summary

- Some characteristics of Emilia Romagna
  - Geographical economical and demography contexts
  - Current challenges in Air quality: NO_2 and PM10
- Towards Air Quality Action Plan
- Air quality model system in ARPA Emilia Romagna
- RIAT+ results
  - Output of Artificial Neural Networks (ANNs)

Emilia Romagna region

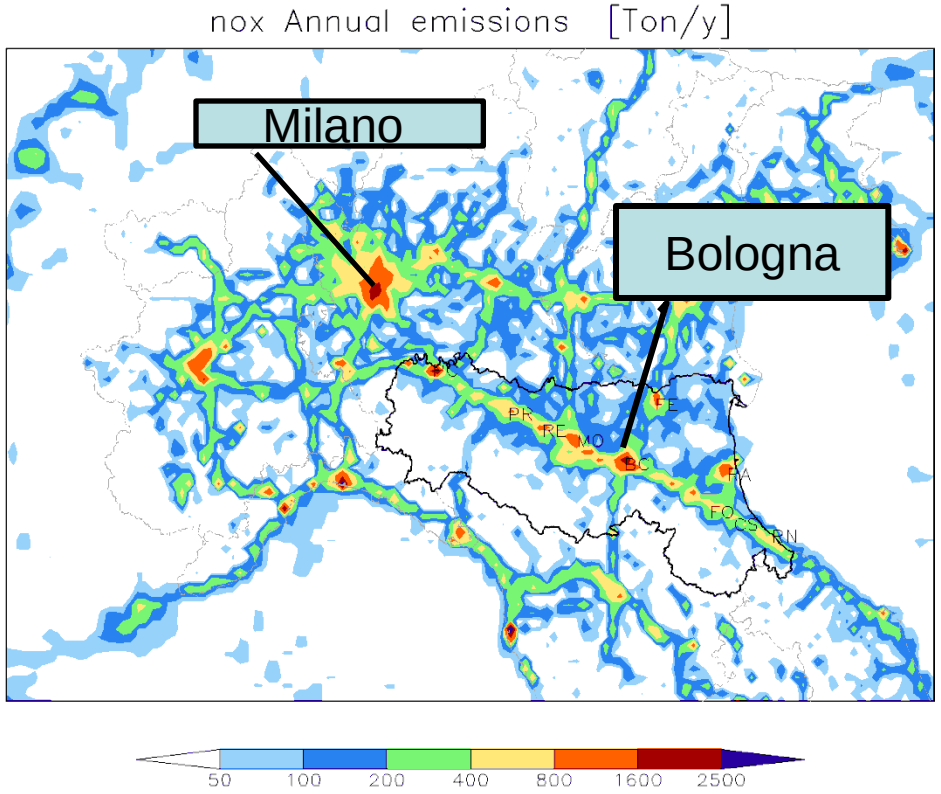
Emilia Romagna region is geographically heterogeneous and complex and includes hills, mountains, valleys, coastal areas and a relevant part of the Po river plain. The Po Valley is surrounded by the Alps in the North, the Apennine mountains in the South and bordered by Adriatic Sea in the East. The frequently stagnation of air masses often leads during winter to very strong air pollution episodes and in summer to high ozone values

Emissions in Po Valley

Highly populated area with several cities along the main roads.
(>35% of italian population lives in Po Valley)

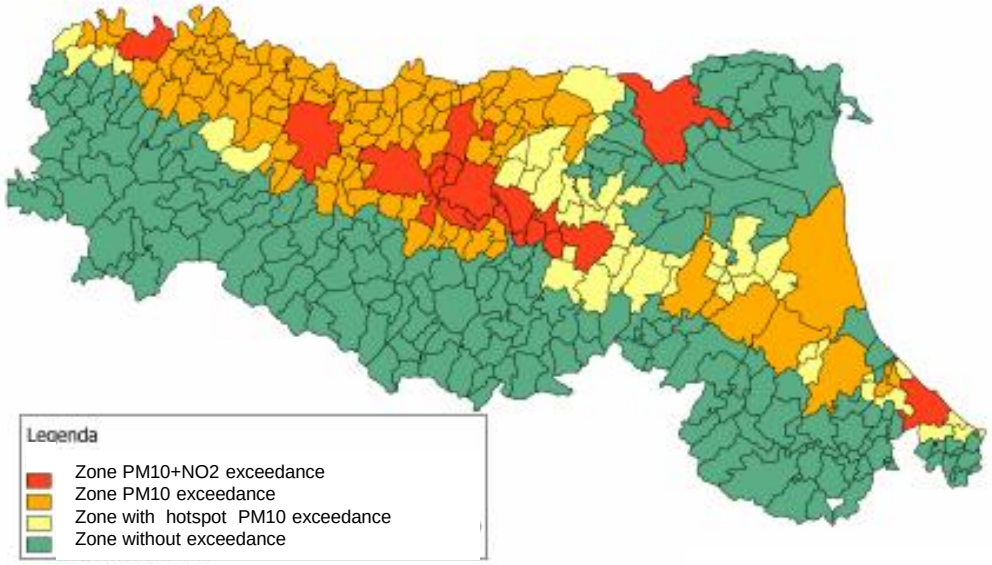
Several industrial sites.

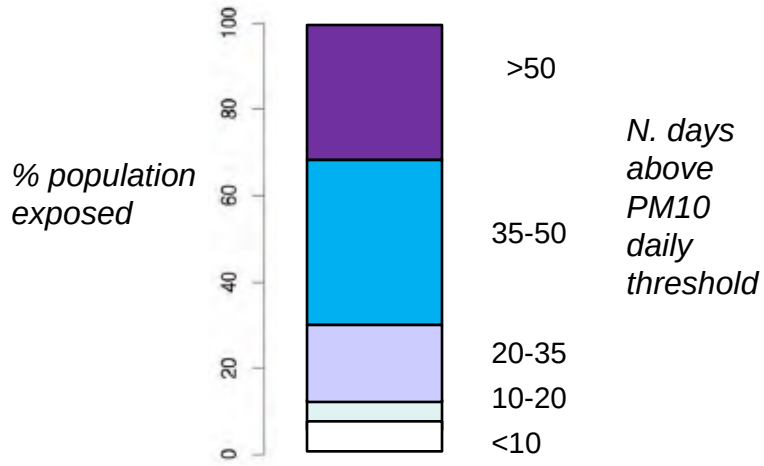
Heavy road traffic.



Air quality in Emilia Romagna

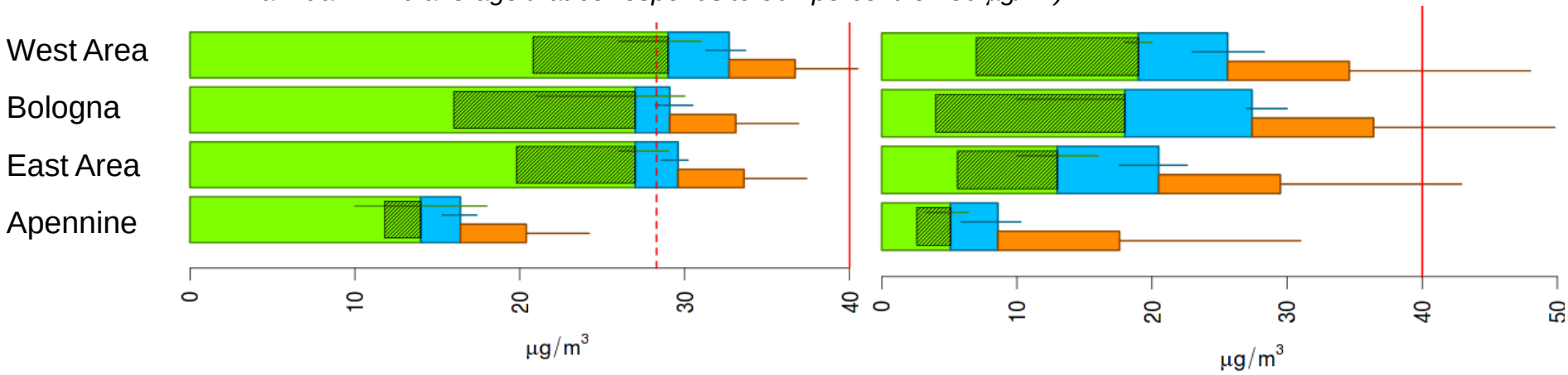
Exceedance of air quality targets





PM10 and NO_2 different scale contribution

Large scale (average and 25-75th percentile) and
Emilia Romagna contribution
Urban background (average and 25-75th percentile)
Local (50th and 90th percentile)
Vertical lines show air quality thresholds (dashed line represents the annual PM10 average that corresponds to 36th percentile >50 μg/m^3)



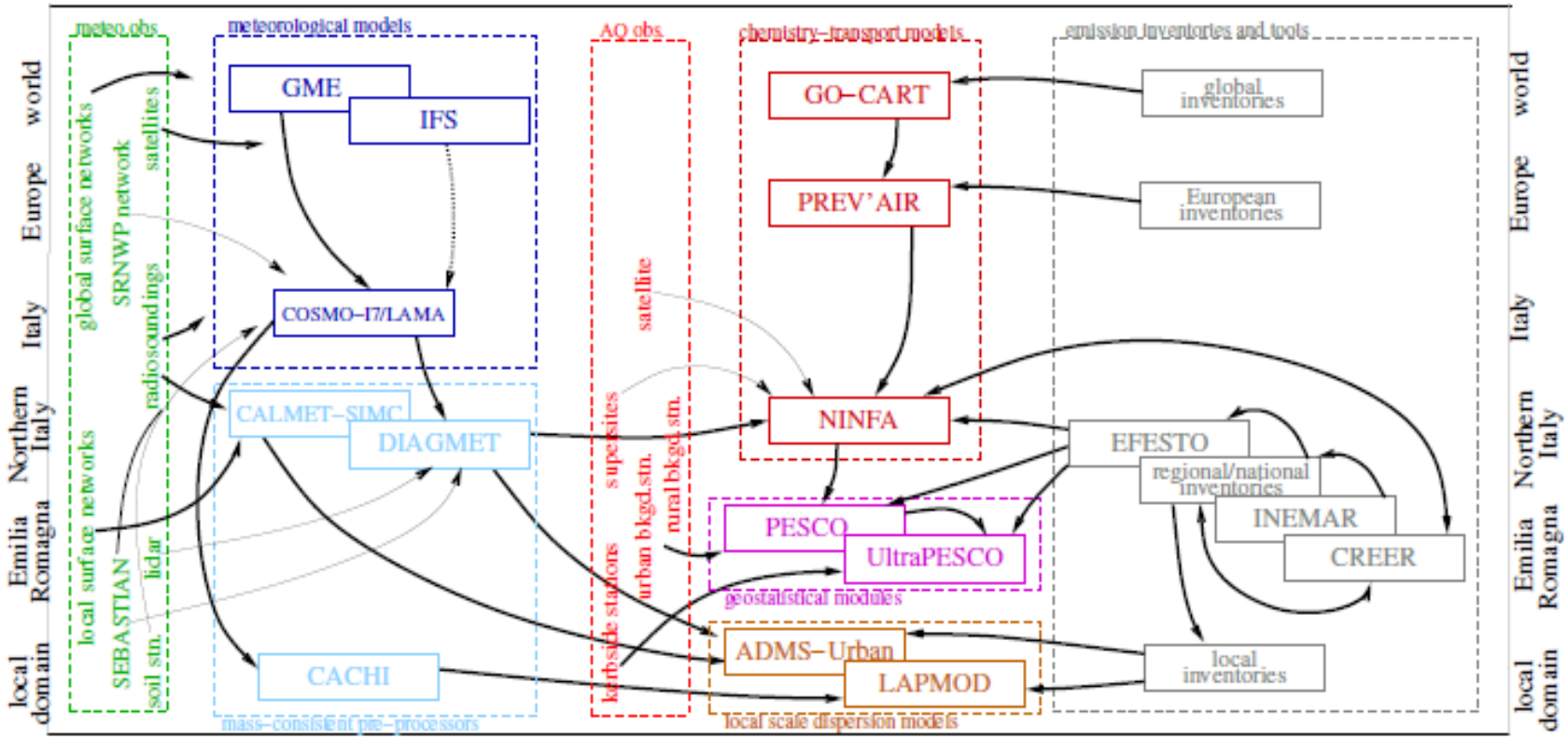
PM10 concentration

NO_2 concentration

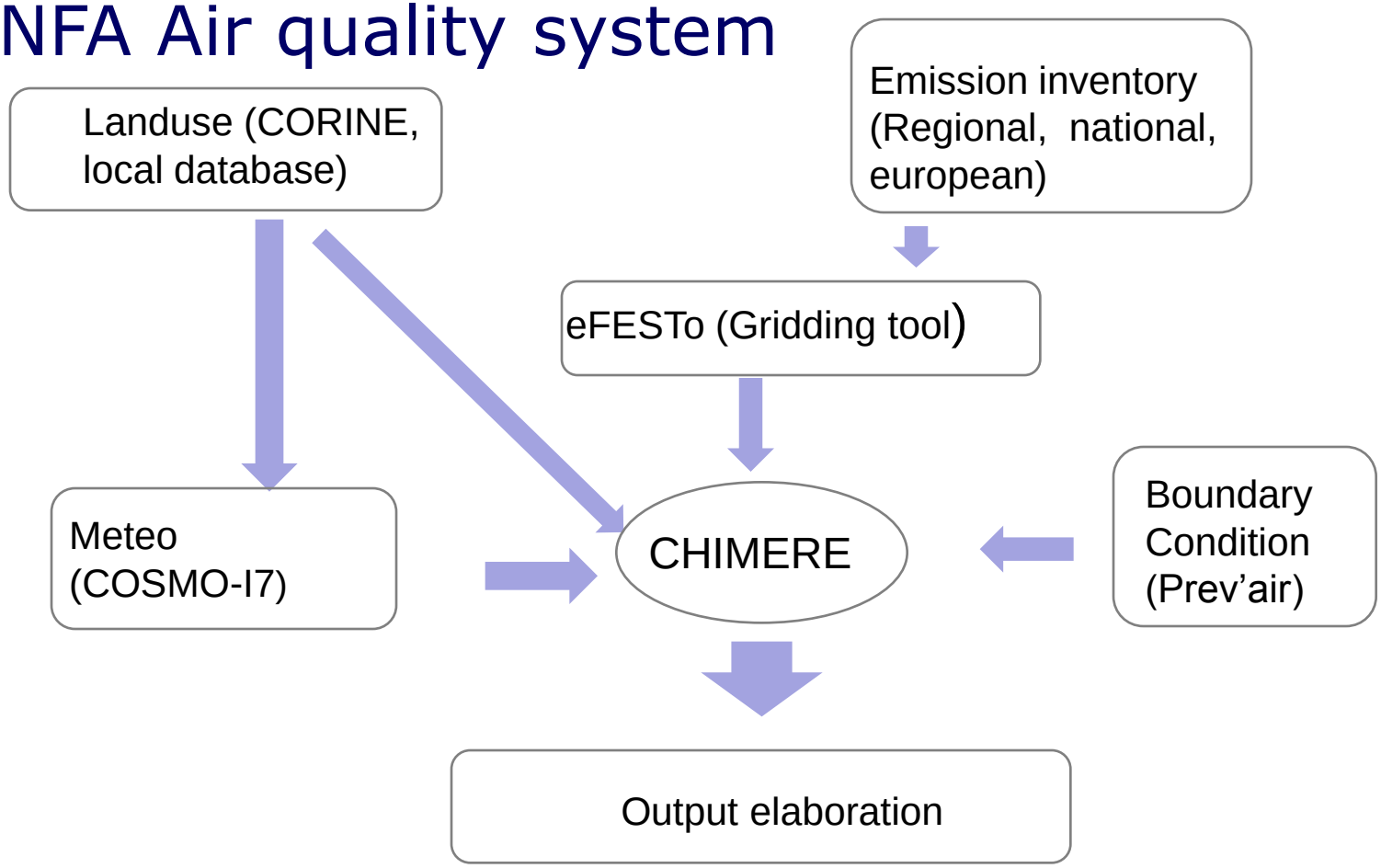
Towards Regional Air quality action plan

- Regional Air quality plan will be approved in the next year and ARPA will prepare technical documents according to regional and national laws
  - Identify target for emission reduction
  - Definition of best practices for the implementation of the measures described in the plan
- The Air quality plan will be closely coordinated with plans already approved:
  - Regional traffic plan
  - Regional Energy plan (i.e. biomass burning, residential and commercial heating)
  - Rural Development plan (i.e. ammonia emission)

ARPA-EMR Air quality system



NINFA Air quality system

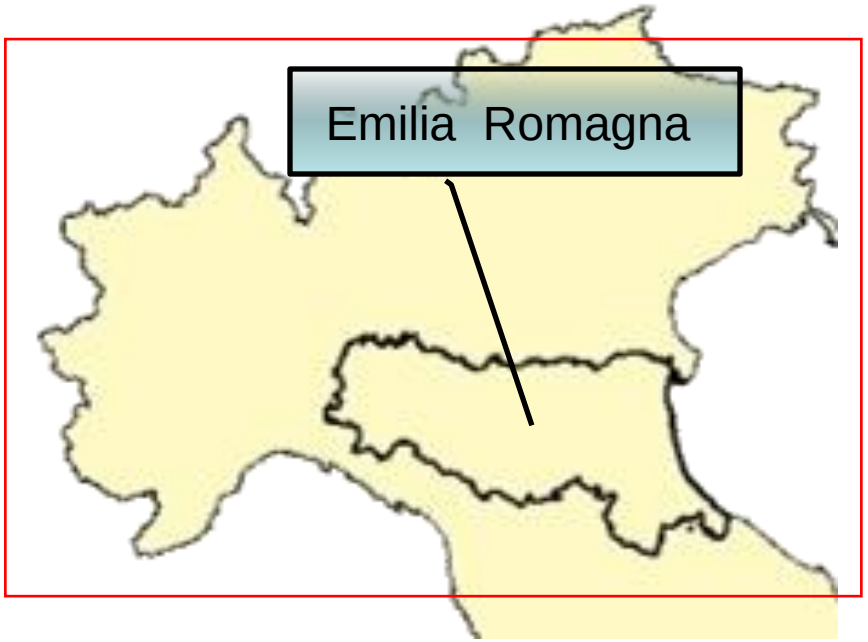


Preparation of data set and model simulation

- Discussions with local decision makers (Emilia Romagna region)
- Emission inventory with areal and point emissions on the defined domain
- Definition of non-technical measures
- "Mapping" between GAINS database and inventory classification (SNAP)
- Preparation of 22 emission scenarios to define all possible evolutions
- Simulation with chemical transport model (NINFA system)
- Calculation of air quality indicators

Model simulation setup for Artificial Neural Network (ANN)

- Meteo: COSMO-I7
- BC: Prev'air CLE 2020
- Emission inventory: Regional Inventory, National Inventory, European Inventory (MACC project)
- CTM:CHIMERE, version 2008c
- Horizontal resolution: 5km
- Vertical level:8
- Domain:128*82



ANNs Emission Scenarios

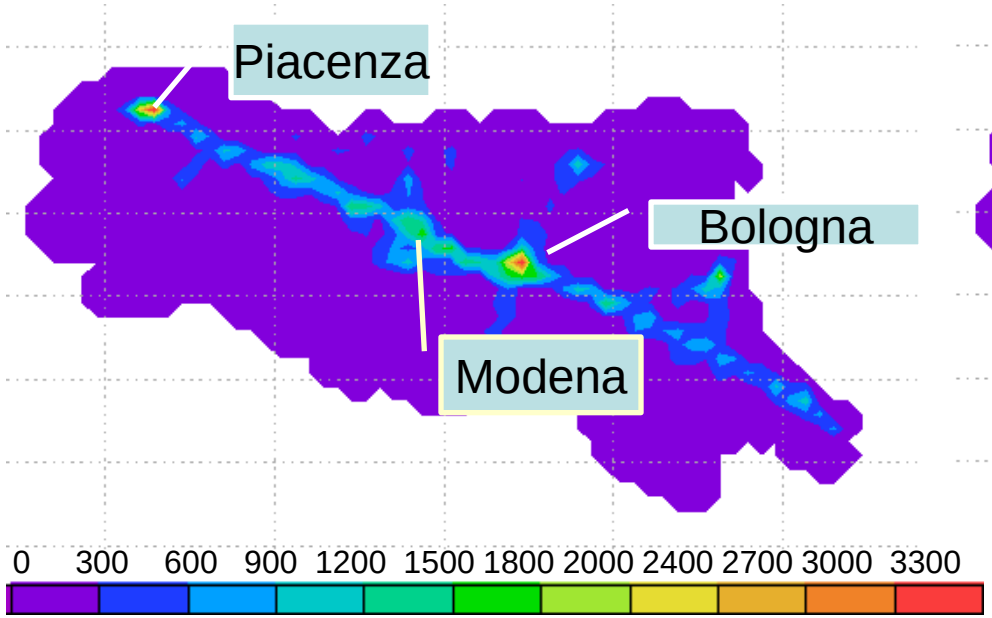
- B cle2010+15%
- L (cle210+mfr2020)/2
- H mfr2020-15%
- B2 cle2010 "average"

Inside Emilia-Romagna (ER)

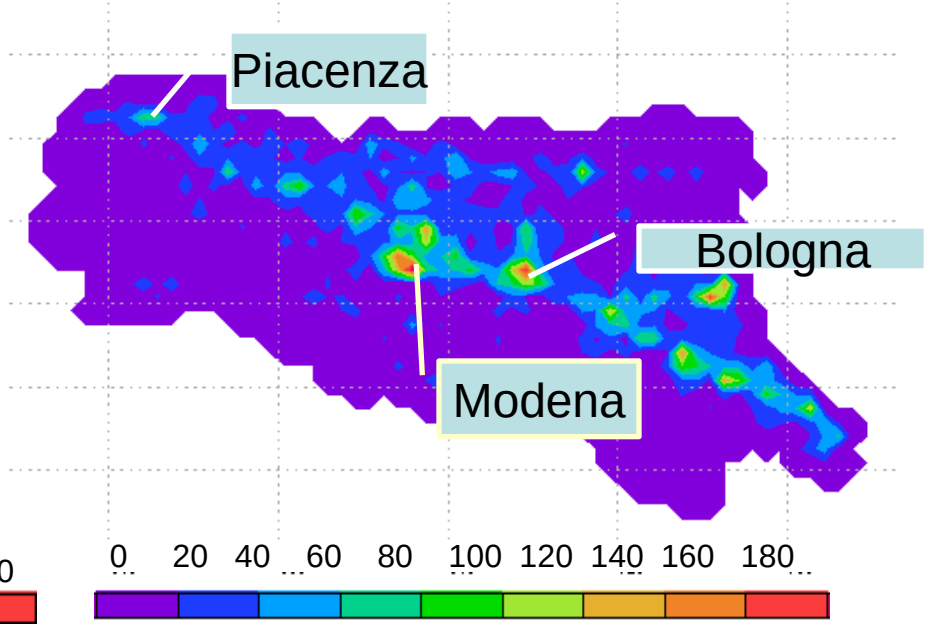
Outside ER

	Areal sources					Point sources					All sources	Annual variation inside domain					
Scenarios	NO_X	VOC	NH_3	PM	SO_2	NO_X	VOC	NH_3	PM	SO_2	All pollutants	NOx	VOC	NH3	PM10	PM25	SO2
0	B	B	B	B	B	B	B	B	B	B	B2	0%	0%	0%	0%	0%	0%
1	L	L	L	L	L	B	B	B	B	B	B2	-37%	-33%	-28%	-27%	-29%	-7%
2	H	H	H	H	H	B	B	B	B	B	B2	-66%	-60%	-50%	-49%	-52%	-14%
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
15	B	B	B	B	B	L	L	L	L	H	B2	-2%	0%	0%	0%	0%	9%
16	B	B	B	B	B	H	L	L	L	H	B2	-4%	0%	0%	0%	0%	9%
17	H	H	H	H	H	H	H	H	H	H	B2	-70%	-59%	-50%	-49%	-52%	-4%
…	…	…	…	….	…	…	…	…	…	…	…	…	….	…	…	…	….
21	H	H	L	L	L	H	H	L	L	L	B2	-70%	-59%	-28%	-27%	-29%	-1%

Emissions scenarios



NOx: base scenario-high reduction scenario (tons/year)



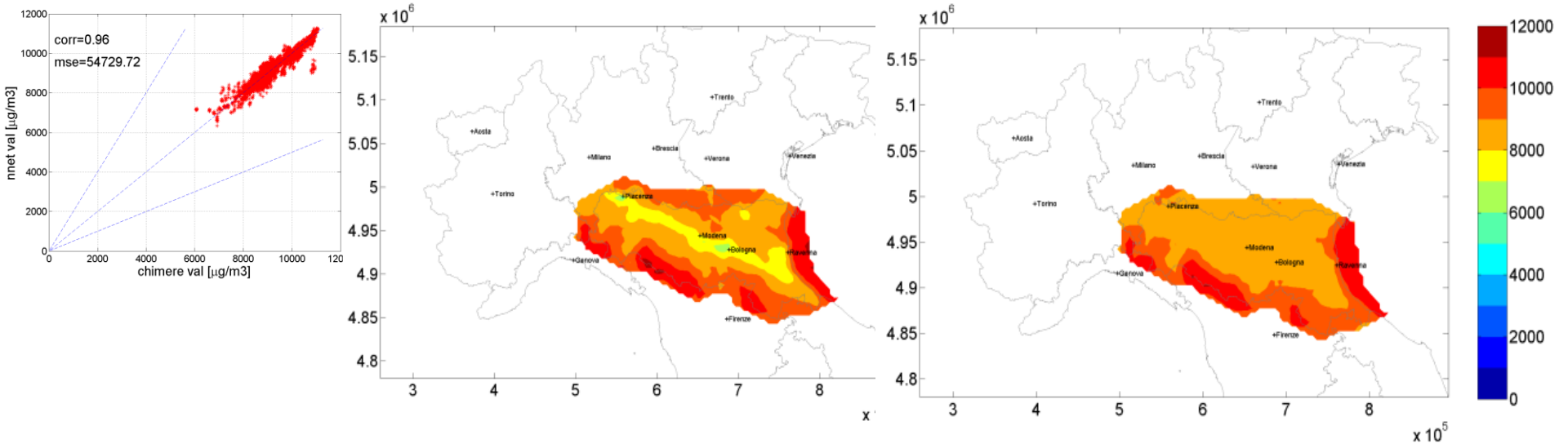
PM10: base scenario-high reduction scenario (tons/year)

Some ANNs results

O3 (SOMO35, annual value)

For the year, the correlation between neural network system and CTM computed SOMO35 for the validation dataset is 0.96.

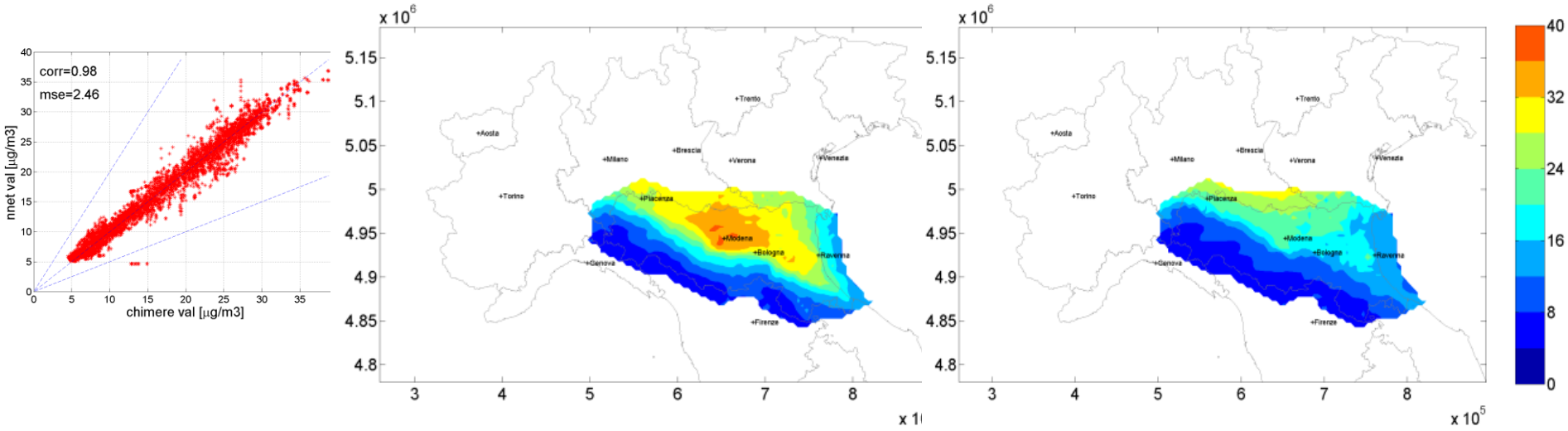
The scatter plot confirms that the neural network system ensures very high capability to simulate the source-receptor relationship between O3 concentration and the emission of its precursors. In high reduction scenario O3 value are higher than in the base case around the cities



Scatter plots for SOMO35 (left), map for base scenario (central), map for high reduction scenario (right)

PM10 (winter average)

In winter the correlation between neural network system and CTM computed PM10 mean concentrations for the validation dataset is 0.98.
Mean PM10 maps show that the highest concentrations are in the central/northern part of the domain.
The high reduction scenario returns a strong decrease of PM10 levels.



Scatter plots for PM10 (left), map for base scenario (central,) map for high reduction scenario (right)

Next steps

- Further sensitivity analysis
- Application of optimization tool to Emilia Romagna domain
- Further discussion with regional and local stakeholders
- Application of RIAT+ to prepare a demostrative Emilia Romagna action plan

Thank you for your attention!