



Operational Procedure for Emission Reduction Assessment

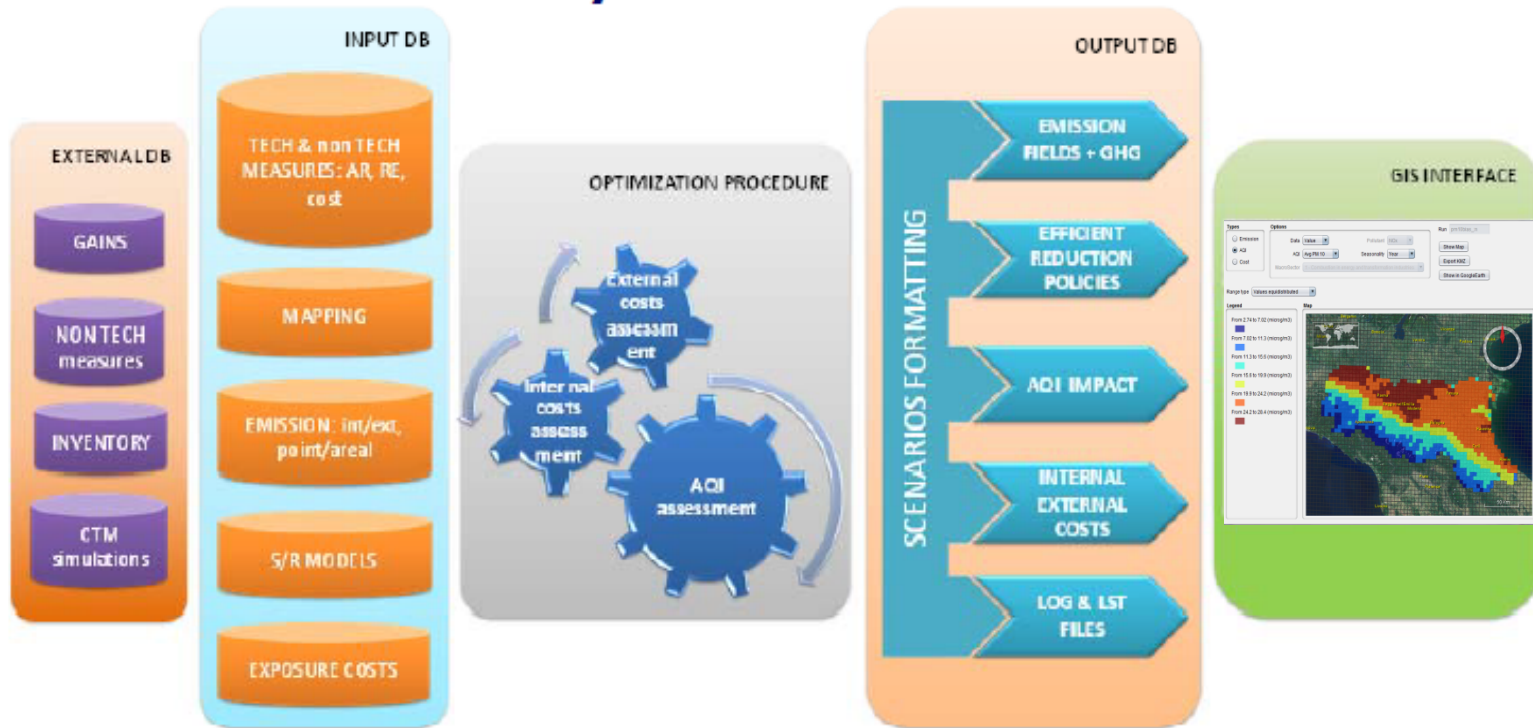
LIFE09 ENV/IT/000092 (2010-2013)

Implementing of RIAT+ in Emilia Romagna

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RIAT+ tool





Input data for RIAT+

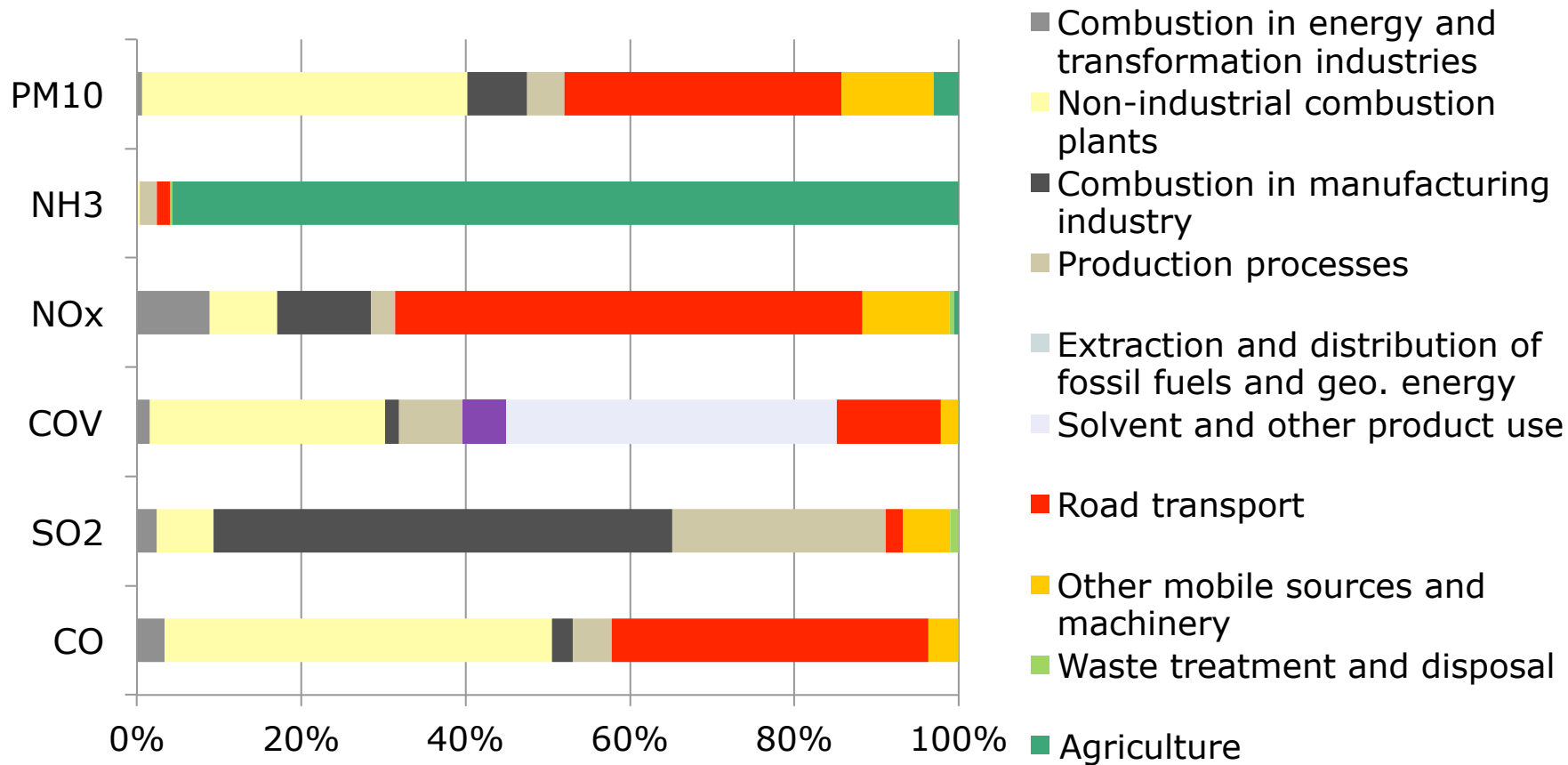
- Emission inventory with areal and point emissions on the defined domain
- "Mapping" between GAINS database and inventory classification (SNAP)
- Definition of non-technical measures
- Preparation of technical/non-technical measure data base
- Set up of several emission scenarios to define all possible evolutions
- Simulations with chemical transport model (NINFA system)



Regional Emission Inventory

- The regional inventory of atmospheric emissions has been undertaken by ARPA Emilia Romagna on behalf of the Emilia Romagna Region, with reference to the year 2010 using INEMAR
- INEMAR (INventario di EMISSIONi in ARia - Air Emission Inventory) is a database developed in order to carry out an atmospheric emission inventory, that is say, to estimate emissions of different pollutants for different activities (heating, road transport, agriculture, industry, etc.)

Emilia Romagna inventory 2010





”Mapping” between GAINS and SNAP inventory classification

SNAP				GAINS	
MS	SECT	ACT	COMB	SECT	ACT
...
Non industrial combustion	Residential	Boiler <50 Kw	Natural gas	DOM	GAS
Agriculture	Organic waste water	Pig	No Comb	AGR_PIG	PL
Road Trasport	Car	Urban	Gasoline	TRA_RD_LD4C_URBAN	GSL

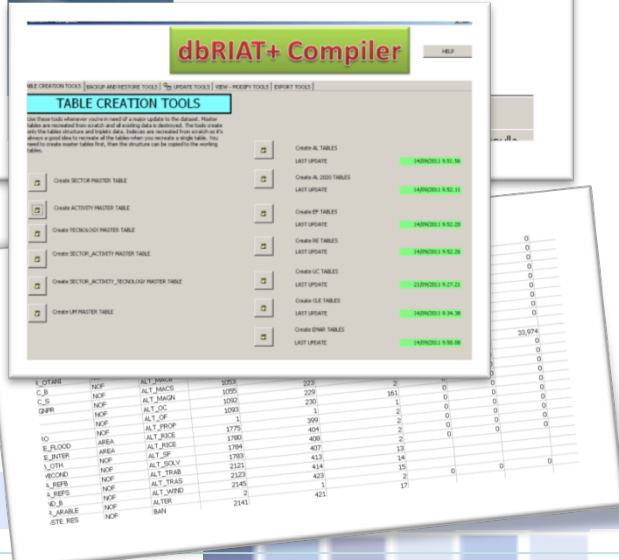


Preparation of technical measure data base (1/2)

dbRIAT Compiler

Download of the GAINS dataset

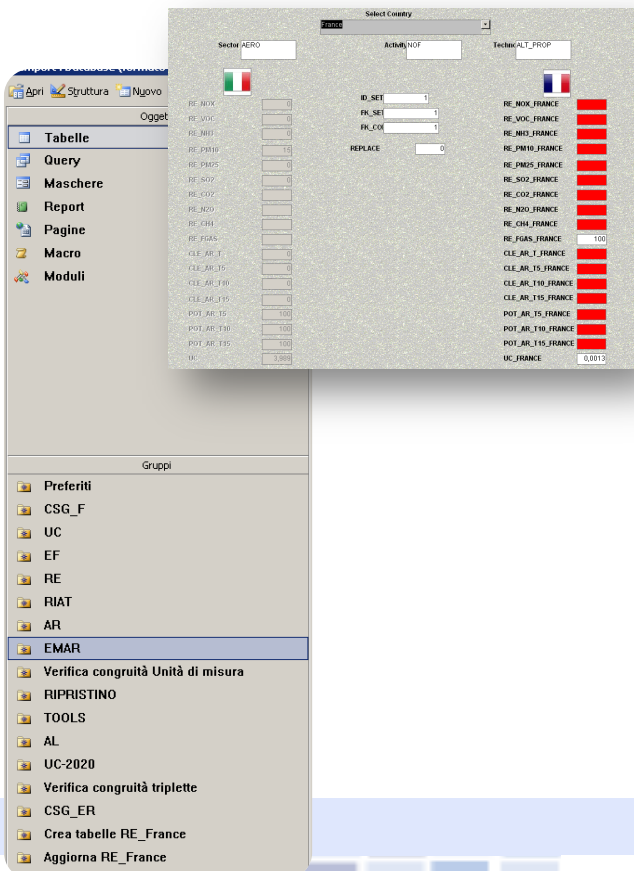
Microsoft Access Tool



- It simplifies the update process of the entire dataset
- It produces a RIAT compatible dataset in less than two minutes after an update of the entire dataset
- Tables can be filtered easily. Any manual update can't destroy the integrity of the full dataset

Preparation of technical measure data base (2/2)

dbRiat Compiler



_The tool is localized in English. All the updates are automatized by pressing a button

_The update process is fully controllabile and single parts of the entire dataset can be updated individually

_The software should work with every GAINS dataset as long as the base structure doesn't change



Definition of “non-technical “(energy) measure

Domestic:

- Coimbentation
- Heat_pump
- Wall_insulation
- Condensation Boiler
- Solar panel
- Double glass
- Thermostatic valve

Traffic:

- Cycling line
- TLZ
- Velocity Reduction
- Electric car
- Electric bike

Energy production:

- Hydroelectric
- Wind
- Photovoltaic



The structure of measure data base

2226 measure
2146 "technical"
80 "non technical"

For each measure is defined:

1. Removal efficiency (RE) for each pollutant (i.e. NO_x, PM₁₀, etc.)
2. Application rate (AR) for different years (i.e. 2010, 2015, 2020, etc)
3. Maximum application rate
4. Unit Cost
5. Further flags useful for the tool

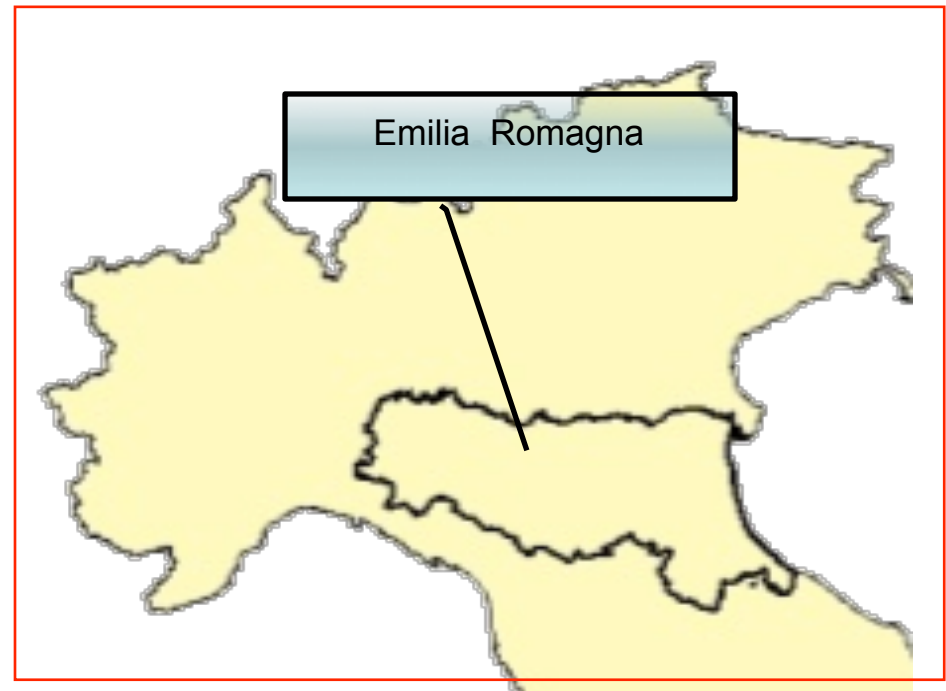


Example of measure defined in the data base

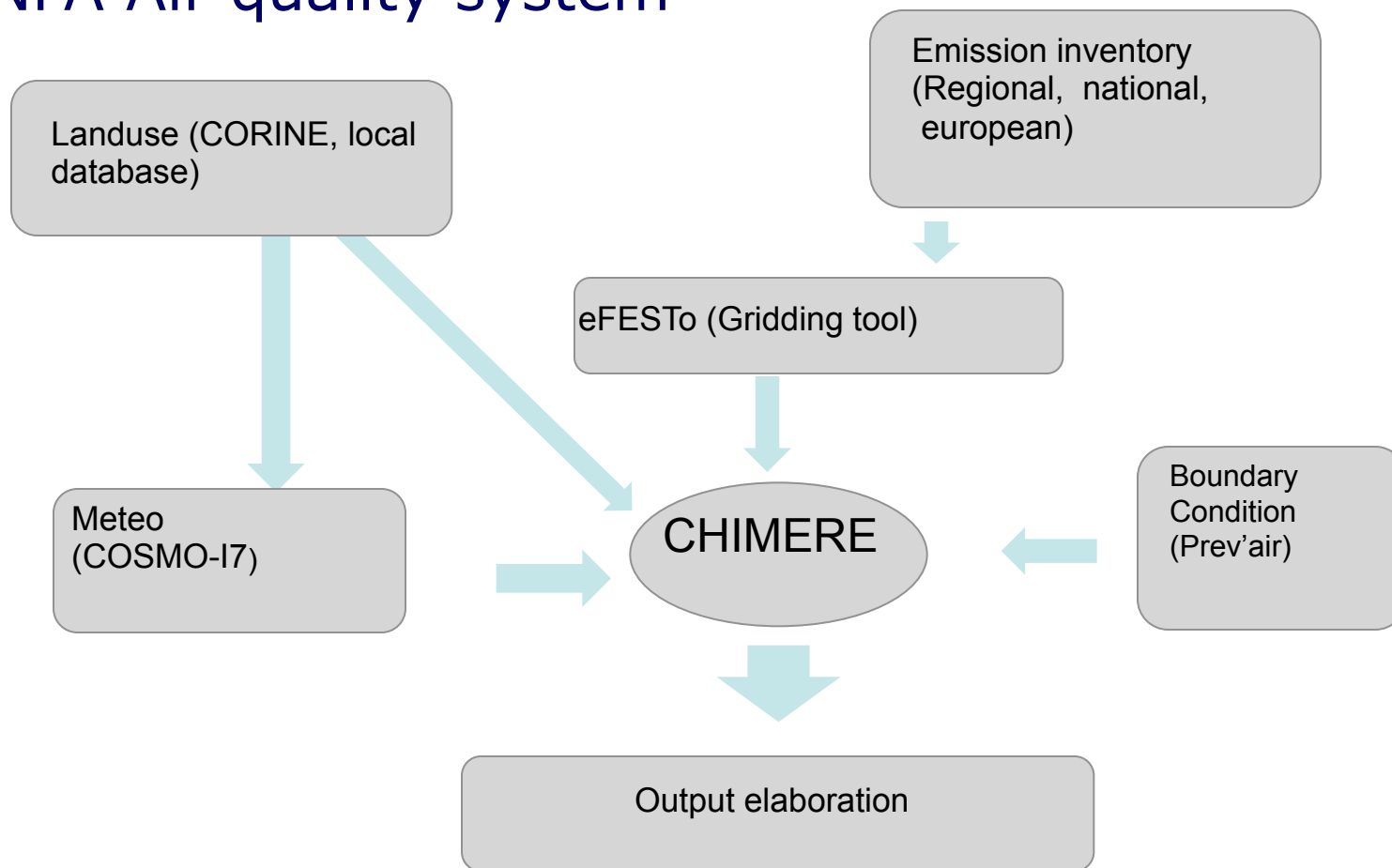
SECT	ACT	TECH
Agriculture:Livestock pigs	Pigs - liquid (slurry) systems	Combination of LNF_BF_CS_LNA
HDV – trucks	Medium distillates	EURO V on heavy duty diesel road vehicles
Industry: Comb. in boilers	Natural gas	No control
LDV: cars and smallbuses	LPG	EURO 6
LDV: light comm. trucks	Medium distillates	EURO 4
Motorcycles with 4-st. en.	Gasoline	Stage 2 control on motorcycles
Ot. Tran.: agriculture	Medium distillates	Stage 3B control
Residential Fireplaces	Fuelwood direct	Fireplace improved
Residential, commercial	Natural gas	Heat pump
Residential, commercial	Natural gas	Insulation of walls and floors
Residential, commercial	Natural gas	Vacuum-sealed solar thermal panels
Residential, commercial	Natural gas	Replacement of single glazing with double glazing

Model simulation setup for Artificial Neural Network (ANN)

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



NINFA Air quality system





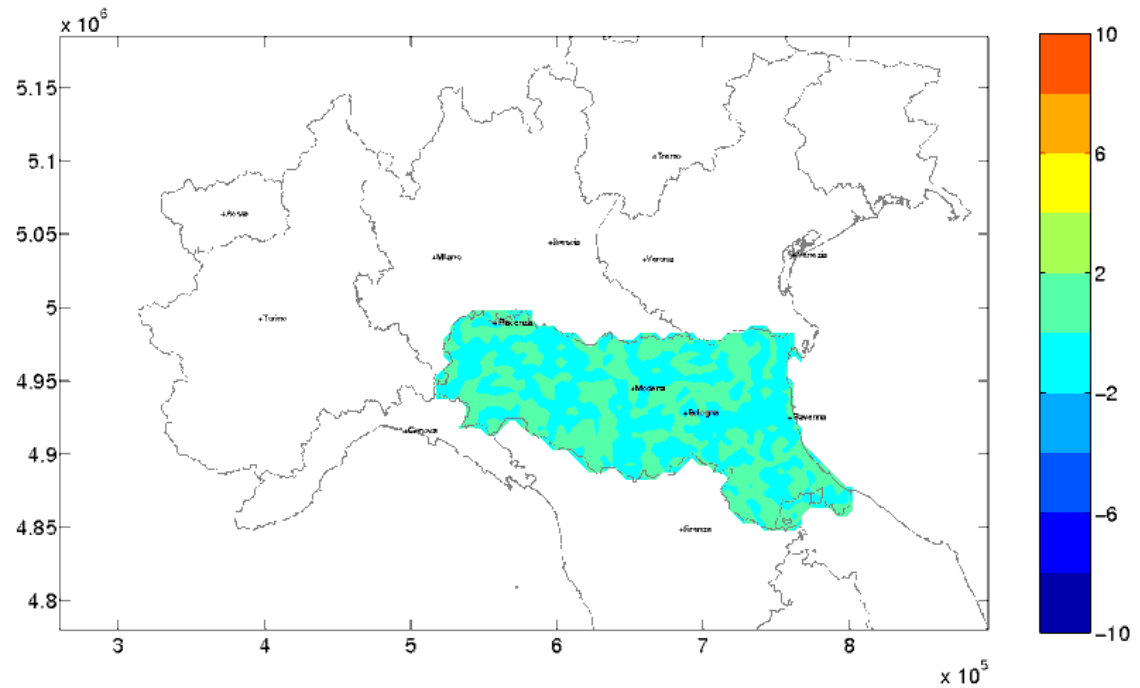
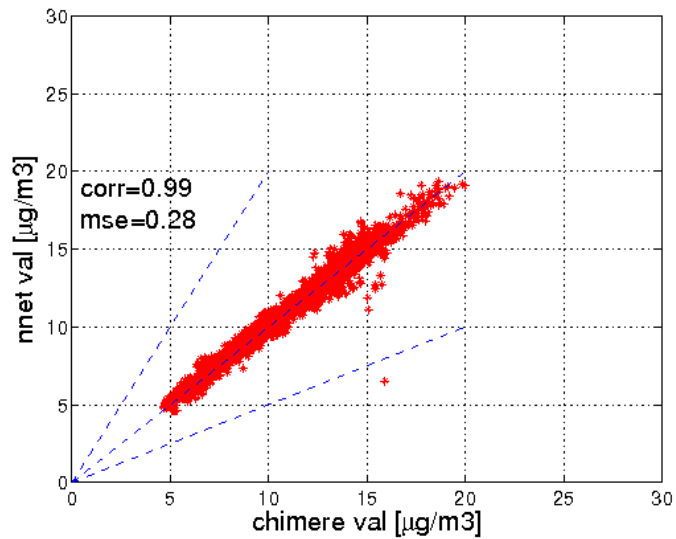
ANNs Emission Scenarios

Applying different emission control strategies (using emissions values varying between CLE-current legislation and MFR–maximum feasible reduction), a number of 12 alternative emission reduction scenarios have been simulated.

SCENARIOS	AREAL AND POINT EMISSIONS					OUTSIDE REGIONAL DOMAIN
	NOX	VOC	NH3	PM	SO2	
0	B	B	B	B	B	B2 (cle2020)
1	L	L	L	L	L	B2 (cle2020)
2	H	H	H	H	H	B2 (cle2020)
3	H	L	L	L	L	B2 (cle2020)
4	L	H	L	L	L	B2 (cle2020)
5	L	L	H	L	L	B2 (cle2020)
6	L	L	L	H	L	B2 (cle2020)
7	L	L	L	L	H	B2 (cle2020)
8	H	H	L	L	L	B2 (cle2020)
9	H	L	H	H	H	B2 (cle2020)
10	H	L	H	L	L	B2 (cle2020)
11	H	L	H	L	H	B2 (cle2020)

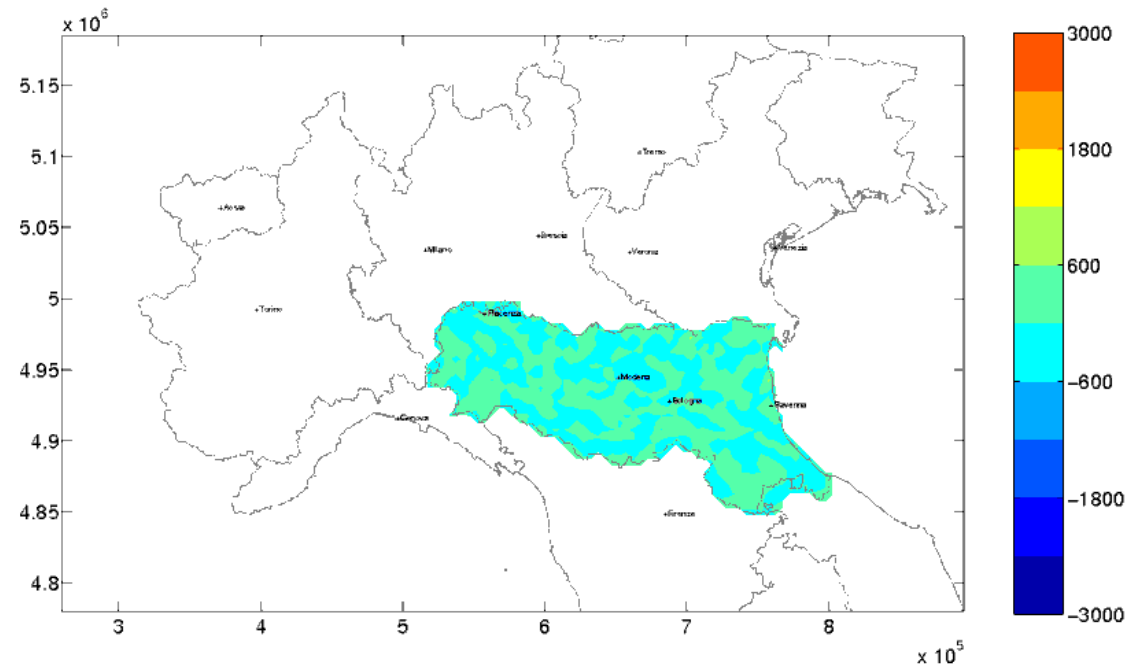
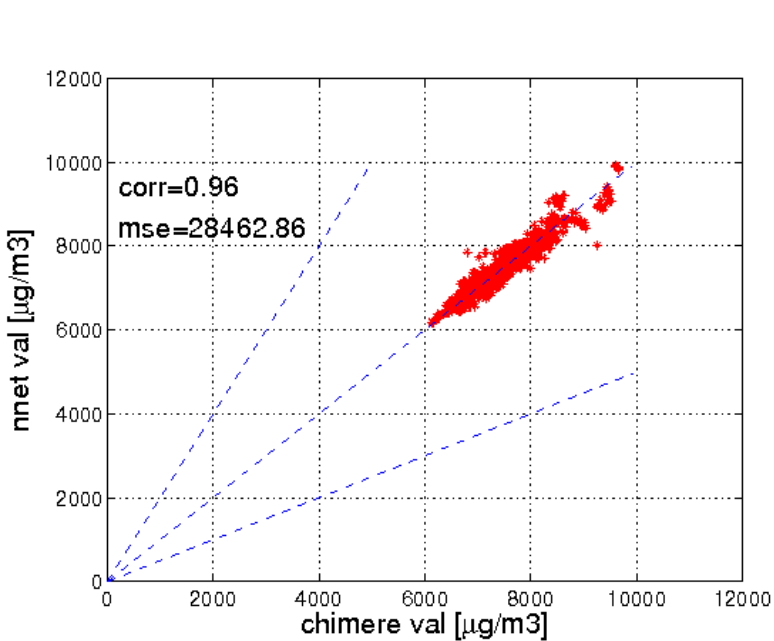
- **B** represents the 2015CLE incremented of 15%
- **H** represents the 2015MFR reduced of 15%
- **L** represents the average reduction between **B** and **H**
- **B2** represents the 2020CLE

ANNs PM10 - YEAR



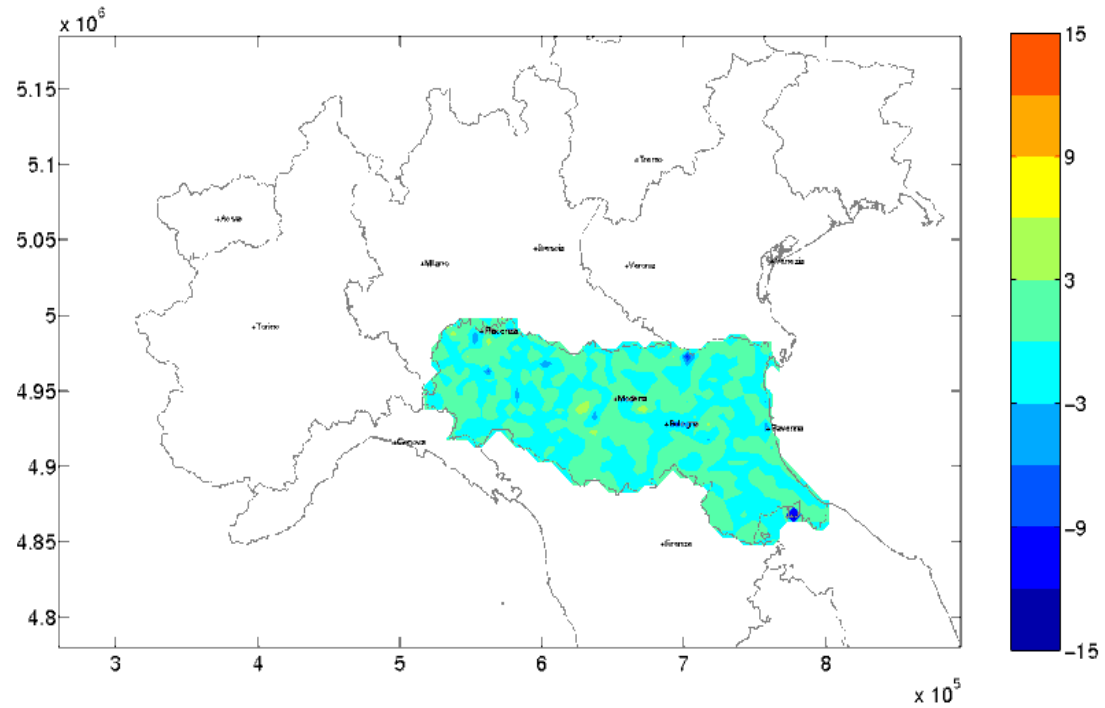
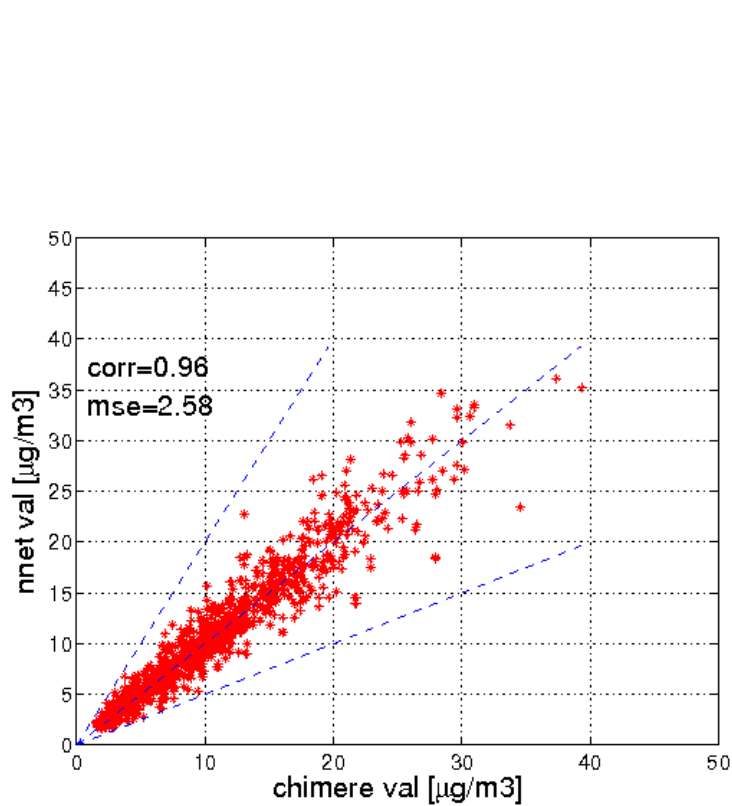
Error Map – Scenario 2

ANNs SOMO35 - SUMMER

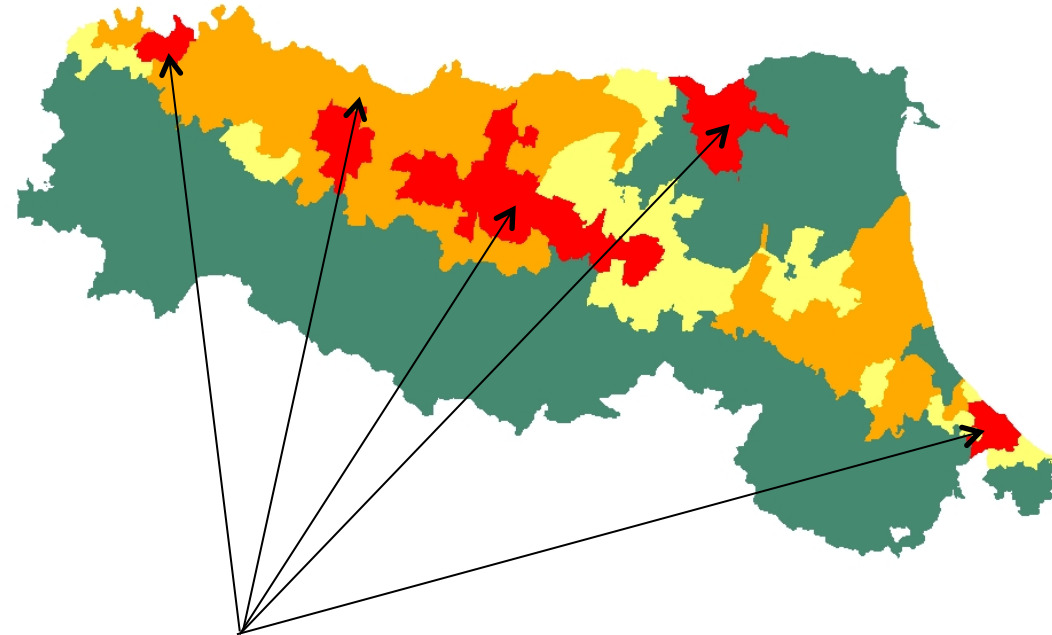
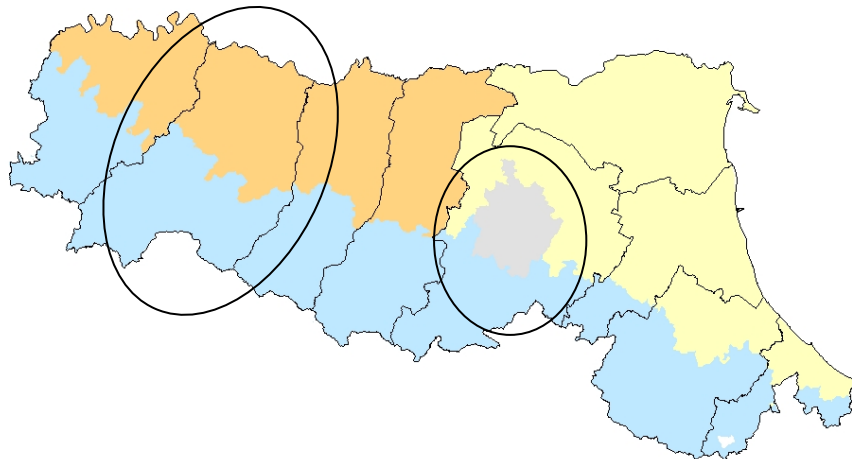
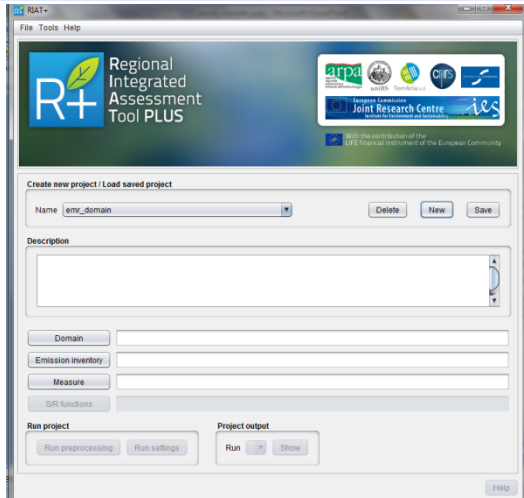


Error Map – Scenario 2

ANNs NO2- YEAR

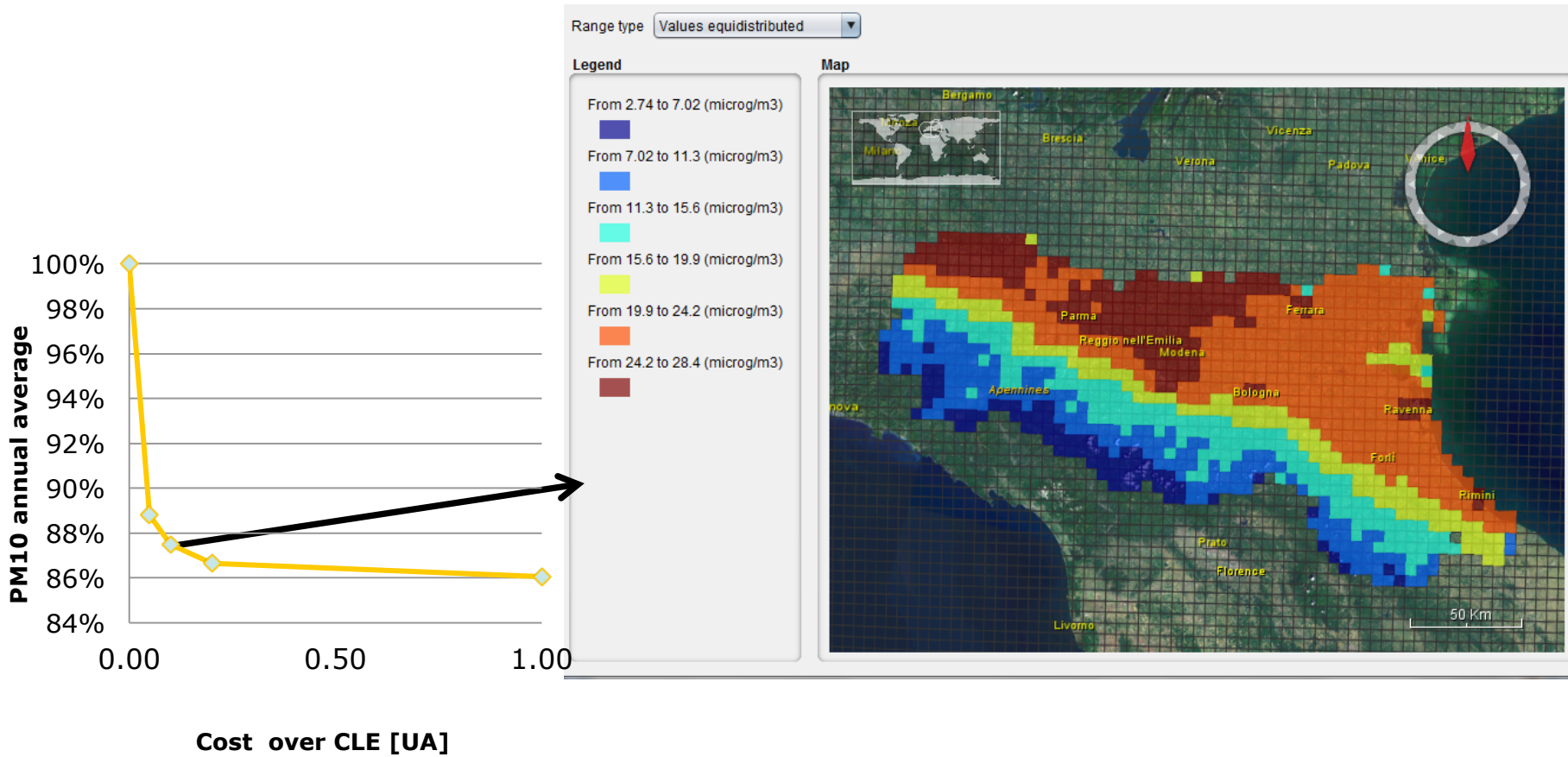


Error Map – Scenario 2



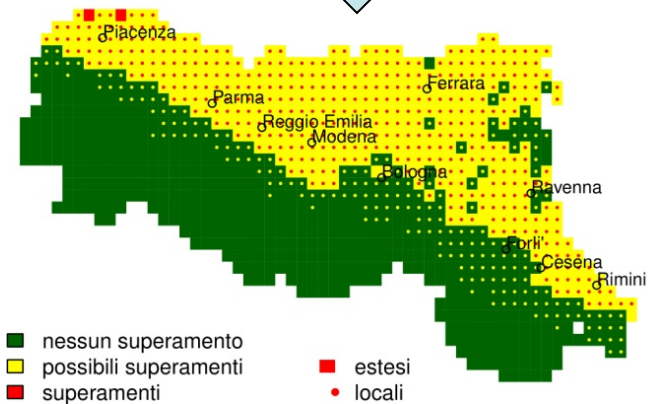
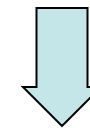
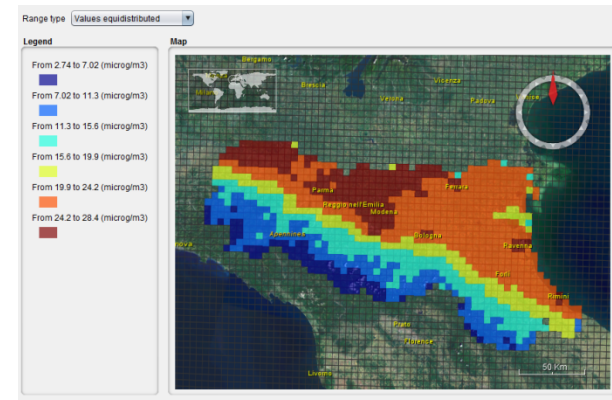
RIAT+ can be apply to different subdomain

PM10 annual (weighted over population)



Postprocessing pm10 output

- Meteorology variability has been estimated from multiannual model simulation
- Sub grid variability has been estimated comparing the model basecase output with higher resolution interpolation of observed data performed with kriging algorithm





Conclusion and remarks

- A data set of technical and not technical (energy) measure has been prepared for Emilia Romagna.
- The nonlinear relations between emissions and air quality indexes are identified for Emilia-Romagna region by means of Artificial Neural Networks (ANNs), tuned processing NINFA deterministic air quality modeling system simulations.
- The results confirm that the neural network system ensures very high capability to simulate the non linear source-receptor relationship between AQIs and the emission of their precursors.
- RIAT+ has been applied to define the regional action plan and can be useful to estimate the effectiveness of measures contained in the plan.



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Operational Procedure for Emission Reduction Assessment

An integrated assessment methodology to plan local cost-effective air quality policies harmonized with national and European actions.

The goal of the project is to develop a methodology, a software (RIAT+) and the relative guidelines to support local authorities for the planning of regional policies integrated with national and European actions in order to comply with National and EU air quality standards, considering potential synergies with actions to reduce GHG emissions. This project will be performed in the context of existing agreements between national and regional administrations to reach a common goal in a consistent and efficient way.

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THANK YOU

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