Institute for Environment and Sustainability

Air quality & Integrated Assessment Modeling over the Po-Valley

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POMI

Po-Valley Model Inter-comparison exercise

Groups: FUB (D), VITO (B)
INERIS (F), CESI (I),
Met.NO (N), USB (I)

Focus: Yearly O3 and PM levels

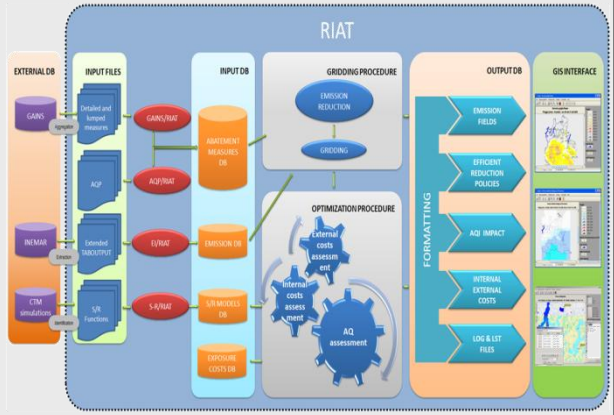
Scenarios: BC / Policy / Sensitivity

Emissions

Scenarios

SRR

RIAT



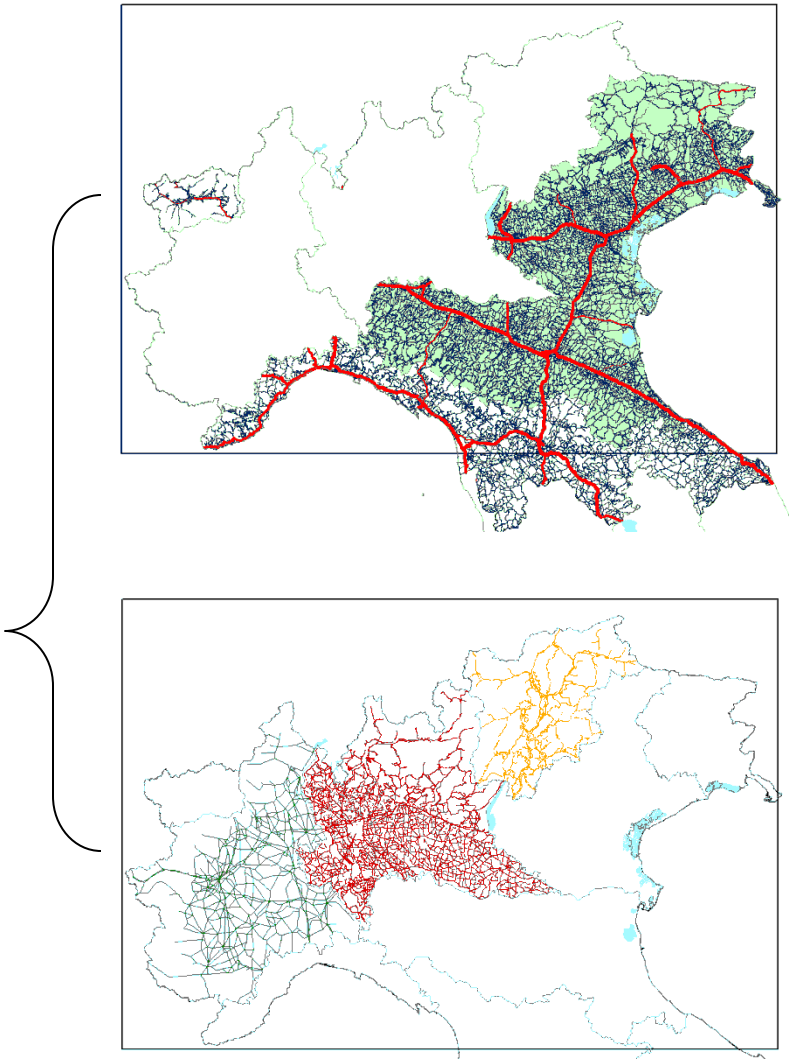
POMI

Objectives:

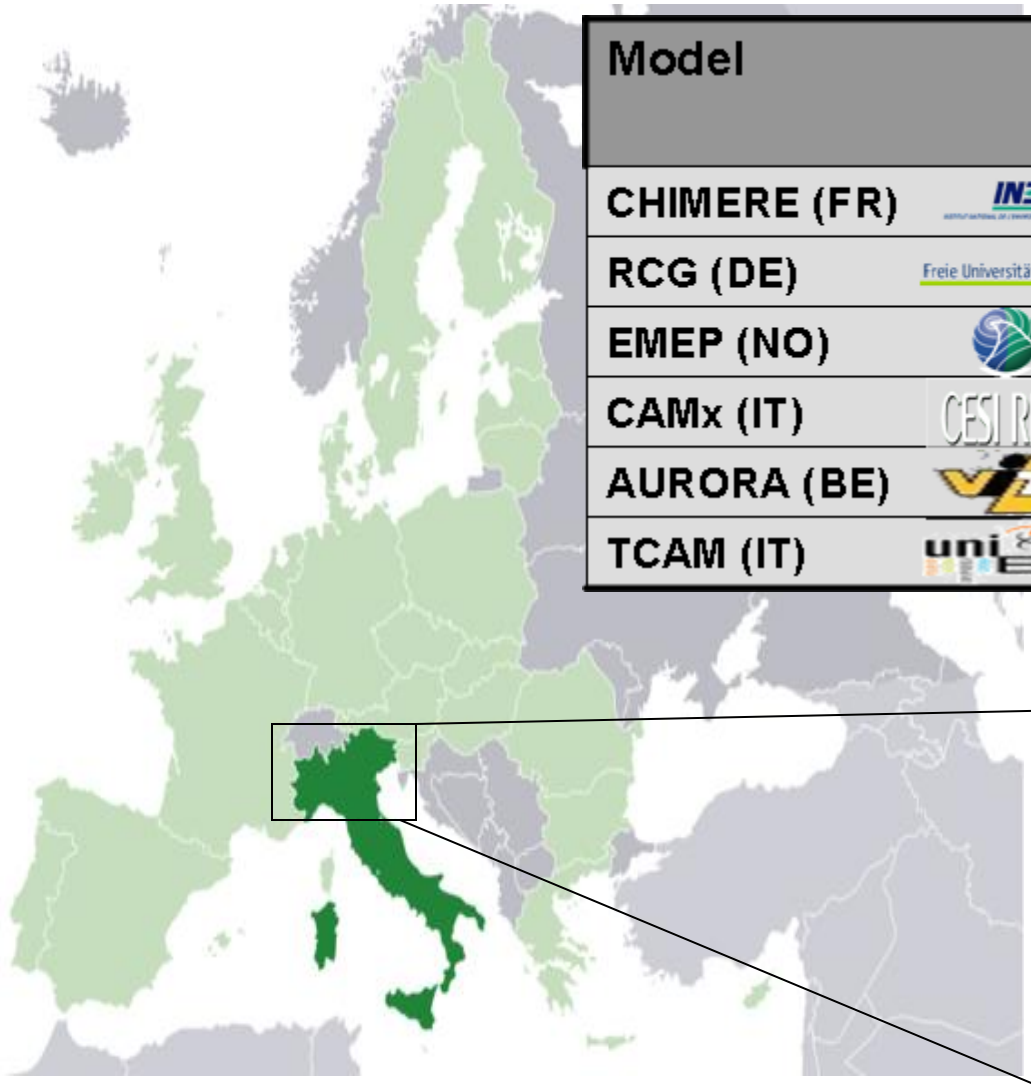
- Analyse the effectiveness of regional emission abatement measures on air quality within the Po-Valley for different time horizons (2010 → 2020). Investigate the added value of regional .vs. European scale measures.
- Assess uncertainties in model responses to emission scenarios (multi-model approach)
- Sensitivity analysis to different factors, e.g. scale, spatial resolution, emissions, boundary conditions, meteorology, …
- Make use of the most updated information to feed AQ models (construction of an emission inventories covering the entire Po-Valley)

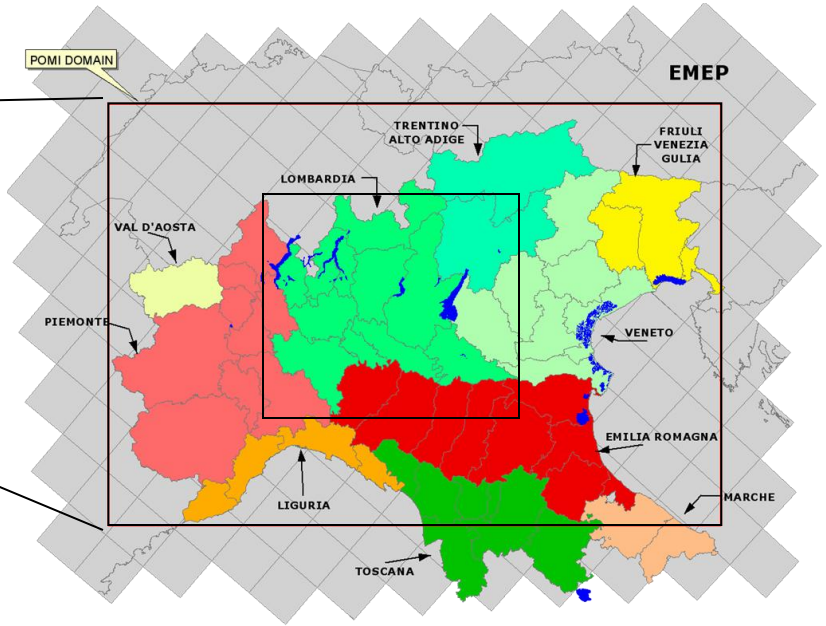
An illustration of the complexity to ensure consistency among different information sources

SNAP	SNAP DESCRIPTION	LOMBARDIA	PIEMONTE	VALLE D'AOSTA	TRENTINO ALTO ADIGE	VENETO	FRIULI VENEZIA GIULIA	LIGURIA	EMILIA ROMAGNA	TOSCANA	MARCHE	OUT OF ITALY AND SEA
1	COMBUSTION IN ENERGY AND TRANSFORM. INDUSTRIES	INEMAR	INEMAR	APAT	INEMAR	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	EMEP
2	NON-INDUSTRIAL COMBUSTION PLANTS	INEMAR	INEMAR	APAT	INEMAR	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	EMEP
3	COMBUSTION IN MANUFACTURING INDUSTRY	INEMAR	INEMAR	APAT	INEMAR	INEMAR (75% Poll)	APAT	APAT	APAT	APAT	APAT	EMEP
4	PRODUCTION PROCESSES	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	APAT	APAT	APAT	APAT	EMEP
5	EXTRACTION. & DISTRIBUTON OF FOSSIL FUELS+ GEOTHERMAL. ENERGY	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	APAT	APAT	APAT	APAT	EMEP
6	SOLVENT AND OTHER PRODUCT USE	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	APAT	APAT	APAT	APAT	EMEP
7	ROAD TRANSPORT	INEMAR	INEMAR	APAT	INEMAR	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	EMEP
8	OTHER MOBILE SOURCES AND MACHINERY	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	APAT	APAT	APAT	APAT	EMEP
9	WASTE TREATMENT AND DISPOSAL	INEMAR	INEMAR	APAT	INEMAR	APAT	APAT	APAT	APAT	APAT	APAT	EMEP
10	AGRICULTURE	INEMAR	INEMAR	APAT	INEMAR	APAT	INEMAR (75% Poll)	APAT	APAT	APAT	APAT	EMEP
11	OTHER SOURCES AND SINKS	INEMAR	INEMAR	APAT	INEMAR	APAT	INEMAR (VOC Only)	APAT	APAT	APAT	APAT	EMEP



Model	50 km Europe	6 km Po-Valley	3 km Lombardy
CHIMERE (FR)	X	X	X
RCG (DE)		X	X
EMEP (NO)	X	X	
CAMx (IT)		X	X
AURORA (BE)		X	X
TCAM (IT)		X	





POMI Exercise: Scenarios

Base Case 2005

Policy oriented scenarios
(2012 – 2015 – 2020)

- → *Current Legislation (CLE)*
- → *Maximum Technical Feasible (MTFR)*
- → *Air Quality Plan (AQP)*

Sensitivity scenarios
(process understanding)

- → *Regional and trans-boundary backgrounds*
- → *Boundary conditions*
- → *Meteorology*
- → *Emission inventory*
- → *Specific processes (SOA, biogenics…)*
- → *Model configuration*

RIAT scenarios
(IAM robustness)

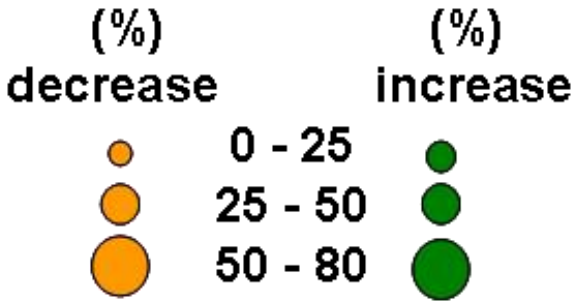
- → Cost effective scenarios

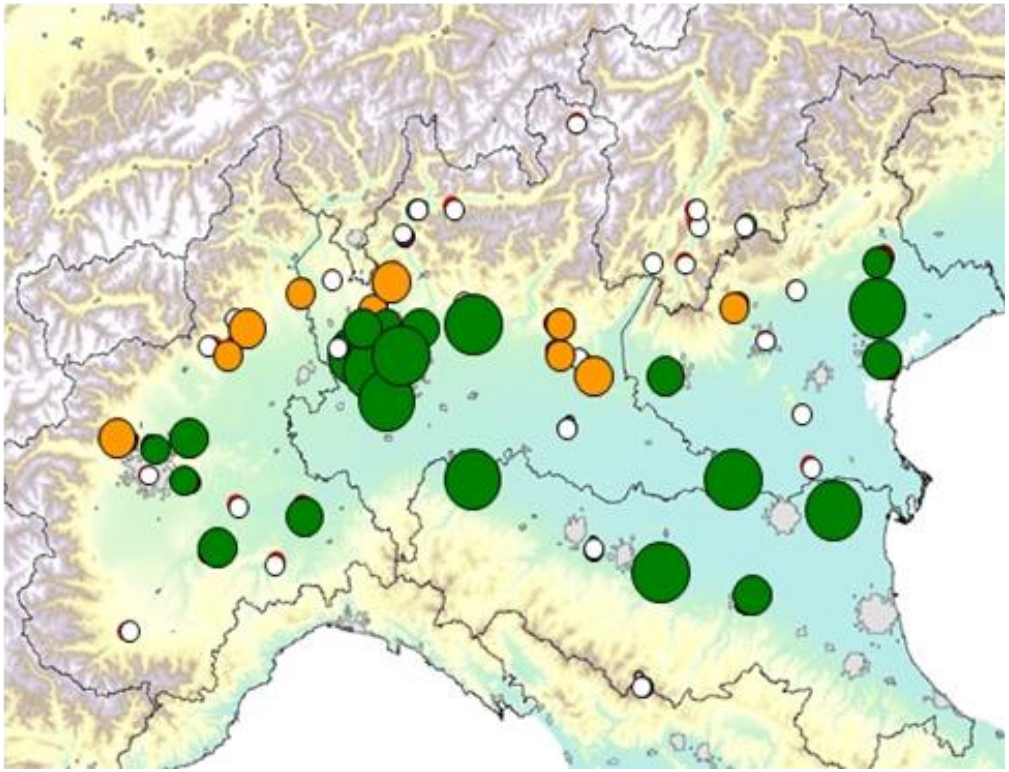
2005 Base Case

Despite the improvements made in preparing the emission inventory and developments made in AQ models in the last years, models exhibit difficulties to reproduce accurately AQ fields in the Po Valley area.

- All models show a large variability with O3 and PM. Some models show satisfactory skills regarding O3 modelling but almost all models fail to reproduce PM correctly.
- PM concentrations are largely underestimated especially in the wintertime (~40%)
- Model variability is highest (~25 ug/m3) in high concentration areas (i.e. urban areas for PM and pre-Alpine regions for O3)
- The coarse and organic PM fractions are strongly underestimated especially in winter but speciated measurements are only available at a single station (Ispra)
- Meteorological modeling is a key factor.

Differences in PM10 concentrations (January) obtained with an observation nudged and non nudged meteorological drivers (MM5)





About 80 yearly AQ simulations have been performed in the frame of POMI

Policy scenarios: CLE, AQP and MFR in 2012, 2015 and 2020)

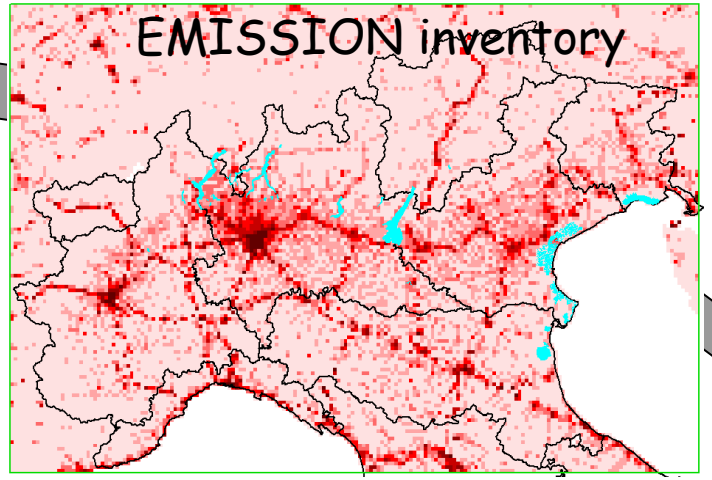
Sensitivity scenarios (B. Cond., SOA, biogenic, background…)

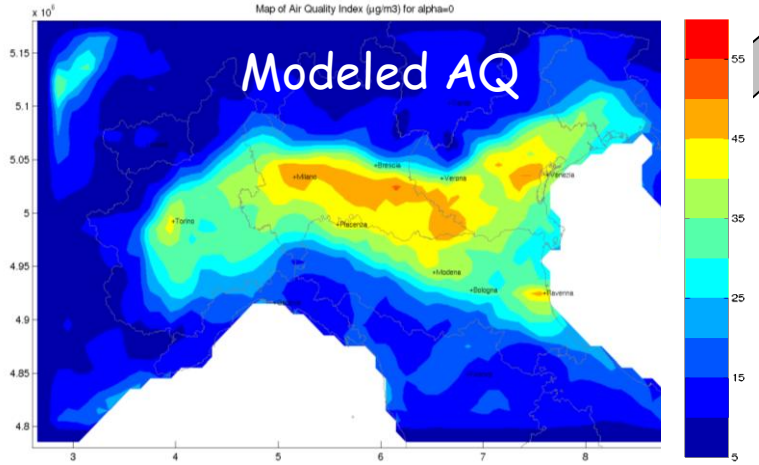
- PM10 levels in RL are mostly a local phenomena (75% from R. Lombardy, 80-85% from Po Valley). With larger percentages in winter time.
- Model responses to emission scenarios are very consistent in relative terms (model bias is corrected)
- More model variability with O3 responses than with PM10
- More consistent responses on mean values than on exceedances

RIAT

Scenario Approach

AQP (abatement measures)	
TRANSPORT	HDVs, LDVs
	Passenger cars
	Mopeds and motorcycle
	LPG & CNG
	biodiesel
	Improvements in the railways sector
	Improvements in the public transport sector
	Improvements in the public transport sector
	Pollution charge
ENERGY	Non-industrial combustion plants
	Energy certification of buildings
	Lighting
	Heating accounting
	Domestic equipment
	Waste incineration of municipal waste
	Biogas from waste
	Systems with heat pumps
	Empowering of old electrical equipment
	Centralized energy-efficient
	Renewable source and district heating
	Motor challenge European project





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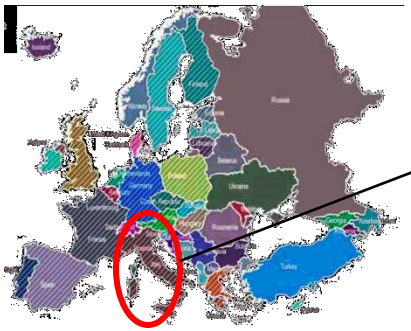
Towards integrated Assessment at the regional scale



EUROPE (GAINS)

Sources: Countries

SRR: 50 km

Measures: Technical

Effects: Health
Ecosystems

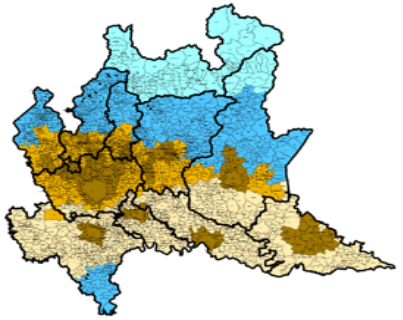
Italy (RAINS)

Sources: Regions

SRR: 20 km

Measures: Technical

Effects: Health
Ecosystems



Lombardy (RIAT)

Sources: Zones & sectors

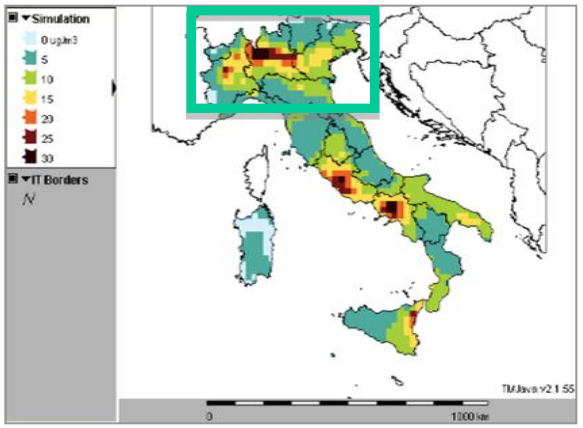
SRR: ≤ 5 km
Neural Methods

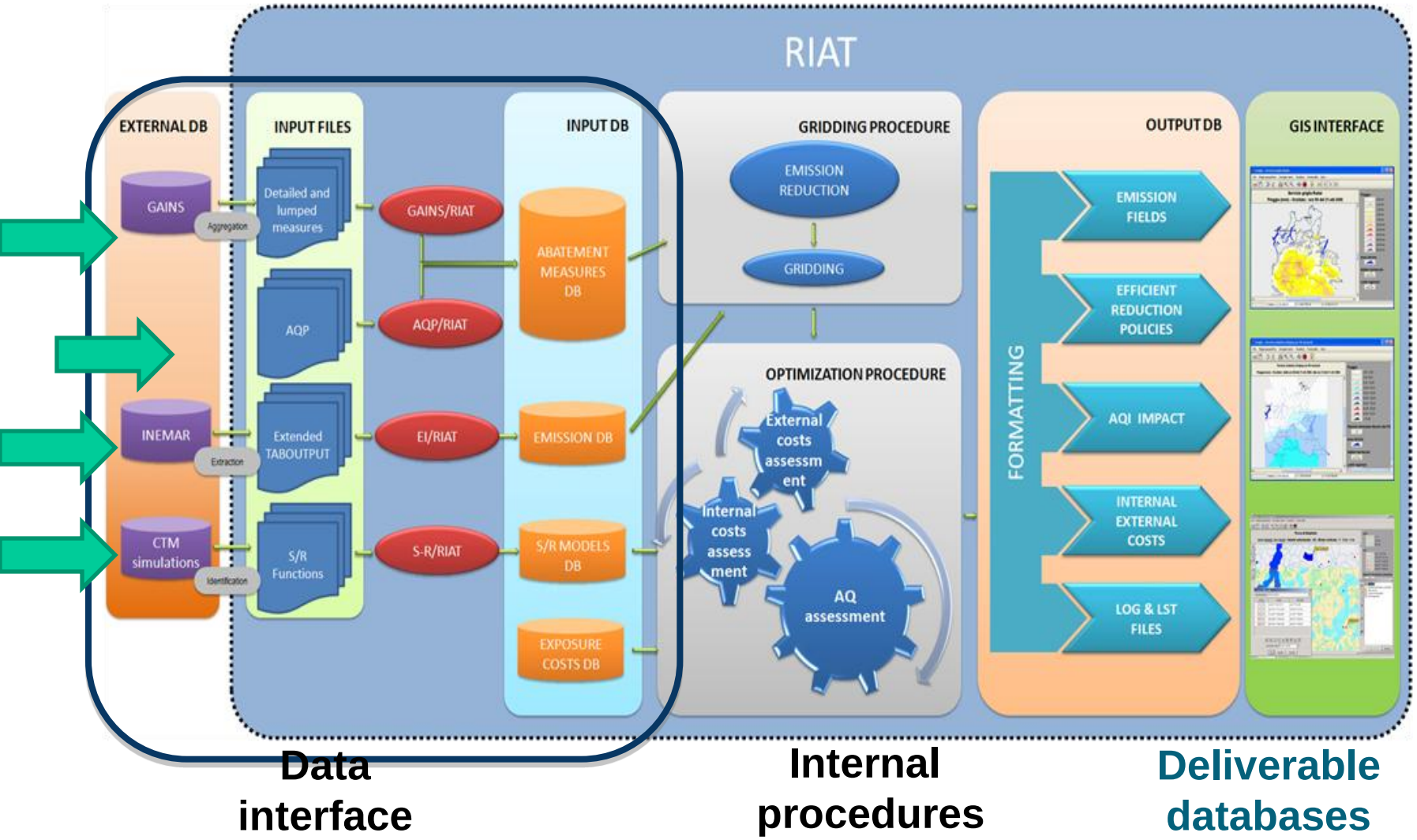
Measures: Technical
Non technical

Effects: Health
Ecosystems

Identification of efficient sub-national and local policies

- Consistent with national and EU air quality standards
- Focused on local/regional scale:
  - specific features of the area
  - the meteorological and chemical regimes of the domain
  - Flexibility in the definition of AQP
- Technological constraints
- Exploration of the optimized solution



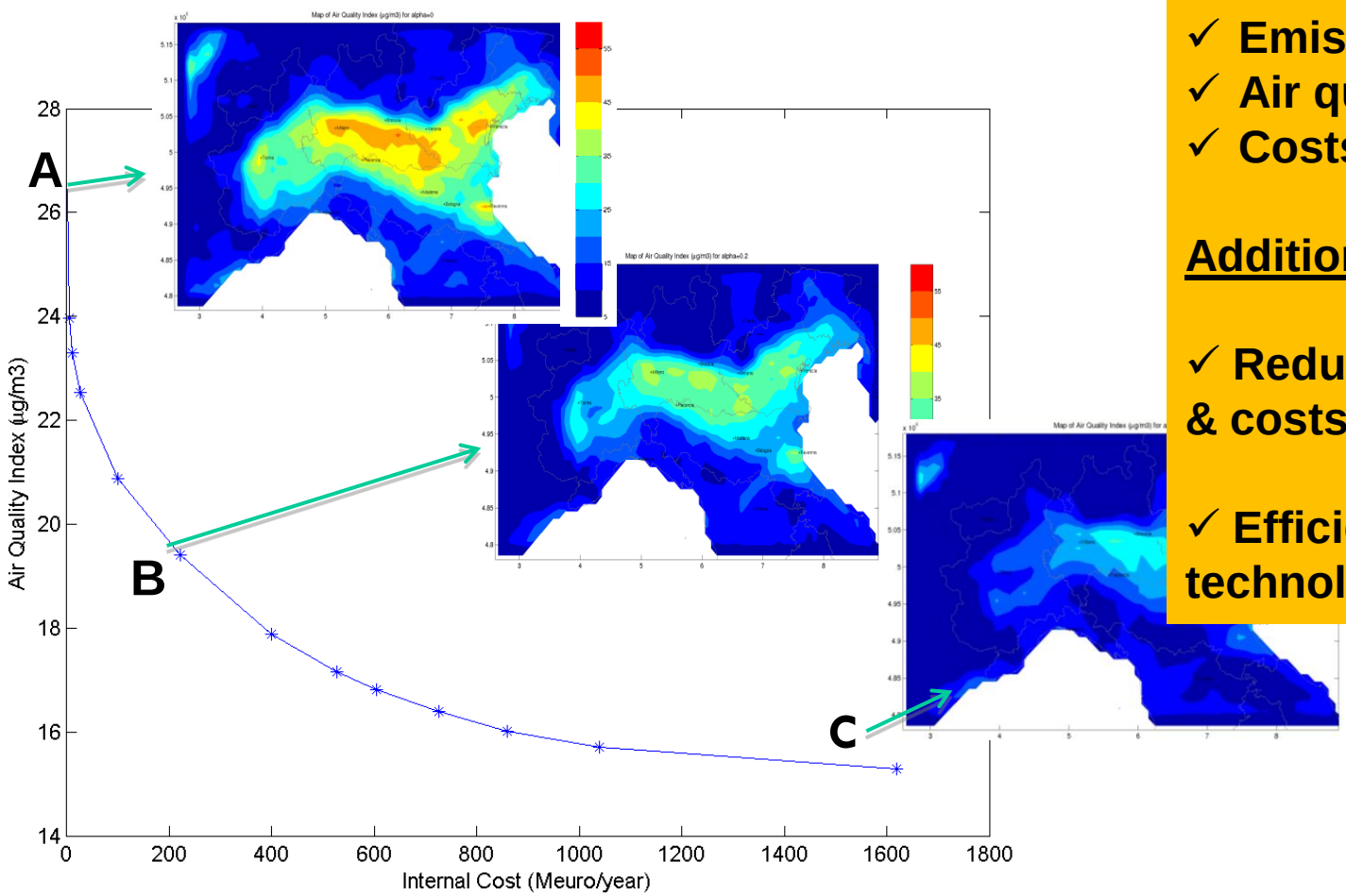


Data interface

Internal procedures

Deliverable databases

PARETO Boundary



Associated Maps:

- ✓ Emissions
- ✓ Air quality
- ✓ Costs

Additional information

- ✓ Reduced emissions & costs per sector
- ✓ Efficiency per technology

Conclusions

- **Although AQ modeling remains a challenge in the Po Valley area, some insight has been gained through the POMI exercise. And the exercise has been a good test case to build confidence in the AQ simulations used in RIAT.**

- **RIAT is one of the few regional IAM existing at present. It makes use of new methodologies (e.g. non-linear ANN), accounts for locally designed measures and via its exploration of the possible optimized solutions provides help to policy makers in their decision taking.**