



Operational Procedure for Emission Reduction Assessment

RIAT+ methodology and tool for local and regional IAM

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METHODOLOGY

15th November 2012

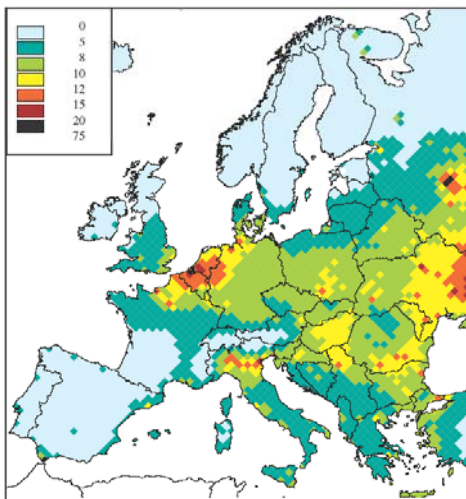
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Background

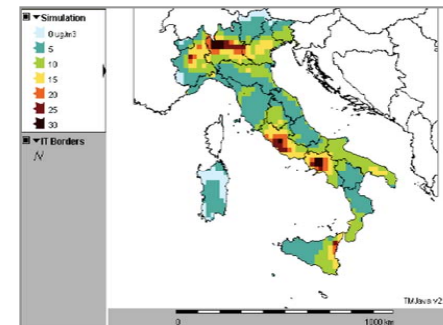
European scale

- ➔ Rains/Gains by IIASA



National scale

- ➔ GAINS Italy by ENEA
- ➔ GAINS-Netherlands
- ➔ FRES-Finland
- ➔





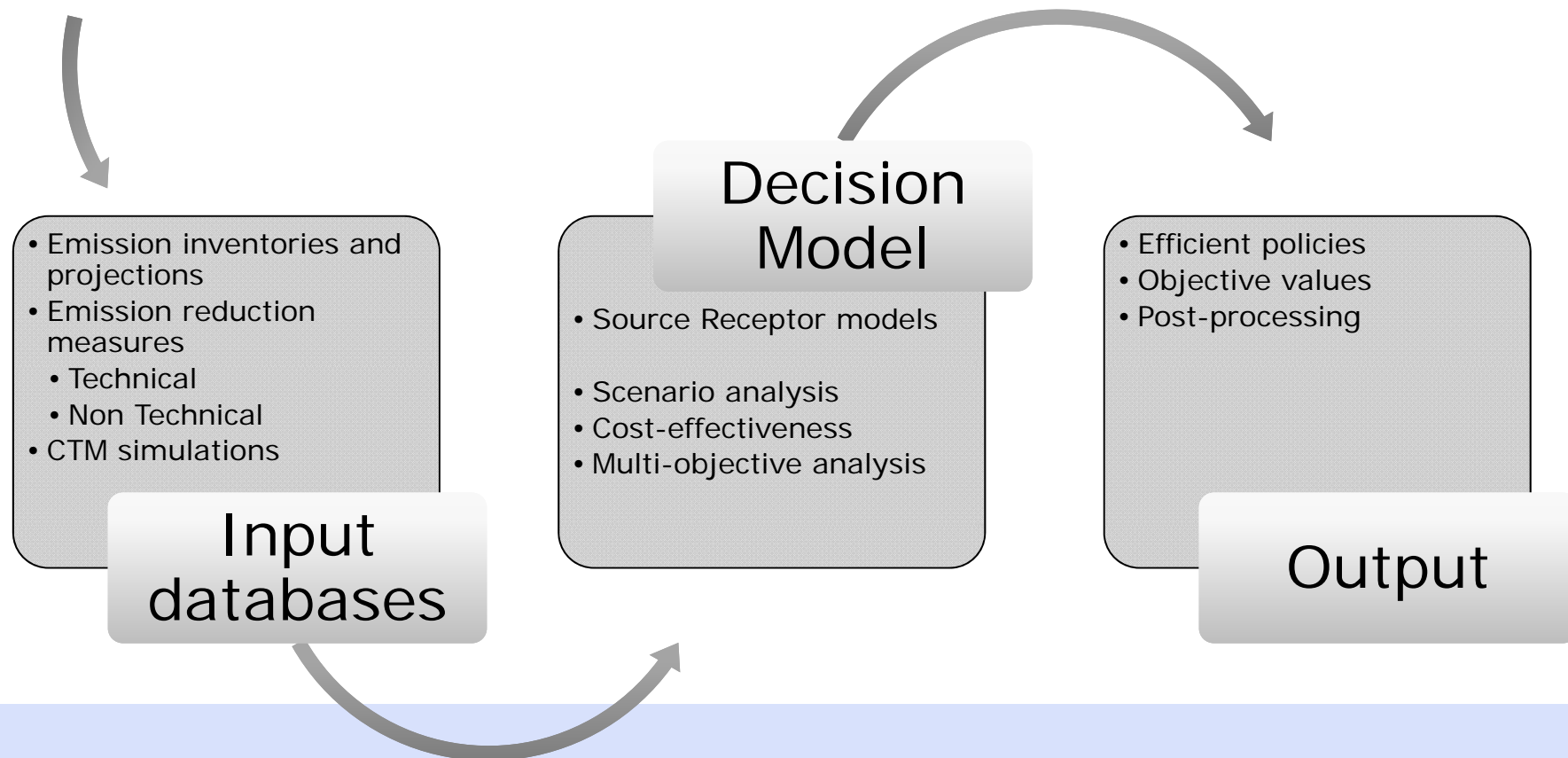
Project objectives

- To set-up a methodology to assist sub-national authorities in:
 - preparing, implementing and monitoring air quality plans, to reduce population and ecosystems exposure;
 - Integrating regional air quality plans with national and European ones;
 - assessing the synergies to reduce the burden of poor air quality and at the same time limiting climate change impacts.

- ➔ To develop an integrated assessment tool (**RIAT+**) to support the proposed methodology.

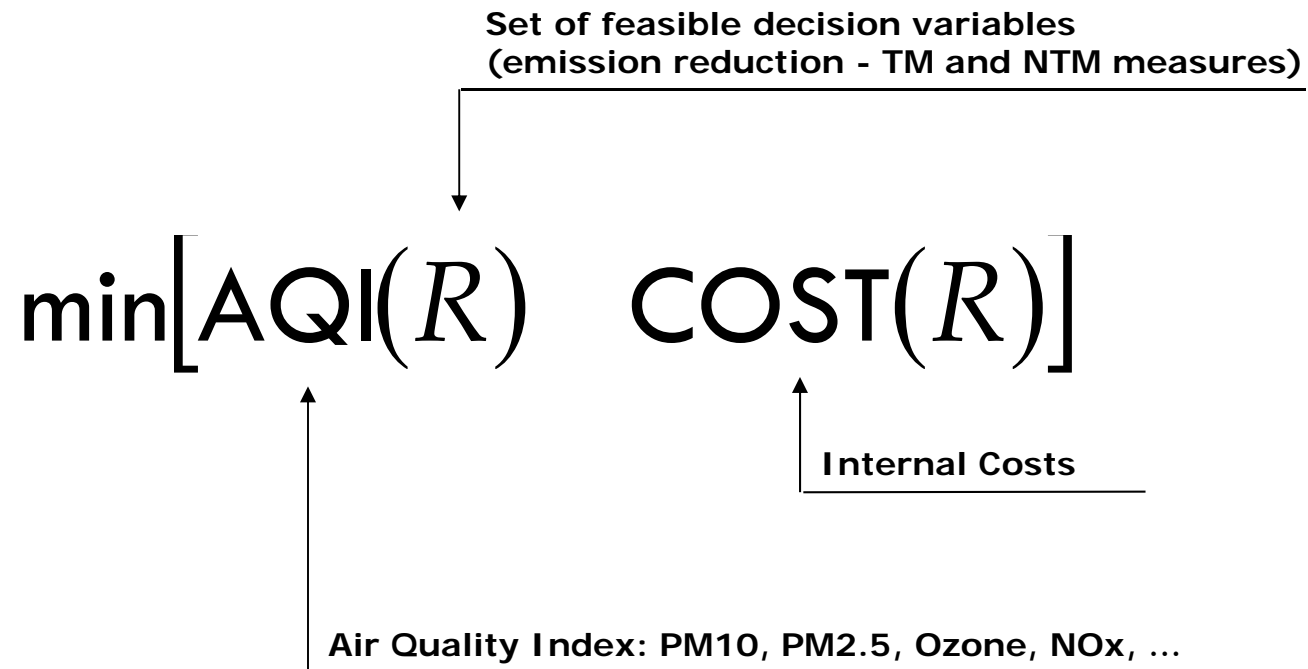


RIAT+ methodology





Decision problem





AQI: indexes (1)

- Air Quality Index (AQI)
 - PM: # of daily PM10 exceedances, mean PM10 and PM25
 - O3: AOT40, SOMO35, mean MAX8h
 - NO2: mean NO2
- Time aggregation
 - Year
 - Seasonal
- Spatial aggregation
 - Average (simple or population weighted)
 - # cells over threshold



AQI: models (2)

- Nonlinear functions: based on Neural Networks
- Input data for training:
 - emissions -> air quality simulations -> concentrations



- to derive the minimum set of air quality simulations:
 - Design of Experiments



AQI: Design of Experiment (3)

SCENARIOS	AREAL EMISSIONS					POINTEMISSIONS				
	NOX	VOC	NH3	PM	SO2	NOX	VOC	NH3	PM	SO2
0	B	B	B	B	B	B	B	B	B	B
1	L	L	L	L	L	B	B	B	B	B
2	H	H	H	H	H	B	B	B	B	B
3	H	L	L	L	L	B	B	B	B	B
4	L	H	L	L	L	B	B	B	B	B
5	L	L	H	L	L	B	B	B	B	B
6	L	L	L	H	L	B	B	B	B	B
7	L	L	L	L	H	B	B	B	B	B
8	H	H	L	L	L	B	B	B	B	B
9	H	L	H	H	H	B	B	B	B	B
10	H	L	H	L	L	B	B	B	B	B
11	H	L	H	L	H	B	B	B	B	B
12	B	B	B	B	B	L	L	L	L	L
13	B	B	B	B	B	H	H	H	H	H
14	B	B	B	B	B	H	L	L	H	H
15	B	B	B	B	B	L	L	L	L	H
16	B	B	B	B	B	H	L	L	L	H
17	H	H	H	H	H	H	H	H	H	H
18	H	L	H	H	H	H	L	L	H	H
19	L	L	L	L	H	L	L	L	L	H
20	H	L	H	L	H	H	L	L	L	H
21	H	H	L	L	L	H	H	L	L	L

B = cle2010
H = mfr2020
L = average of B,H



Cost Index

- ➔ Linear functions:

- ➔ Data used:
 - Activity level:
 - local DB and GAINS
 - Unit costs:
 - GAINS
 - Technologies penetration levels:
 - Control variables



Control variables

- Technical (GAINS) and non-technical (local DB) measures:
 - Sector-activity
 - Removal efficiencies
 - Application rates at CLE
 - Maximum penetration levels
 - Unit costs

NOTE: for NTM, much more uncertainties on data



Constraints

- Technology feasibility
 - Penetration level between minimum and maximum values
- Measures complementarity
 - Mass conservation
- Technology increasing efficacy
 - Optimal removed emissions higher than CLE



Ex-post analysis

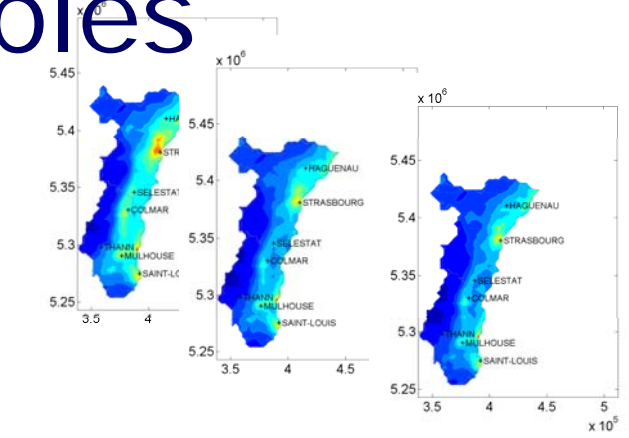
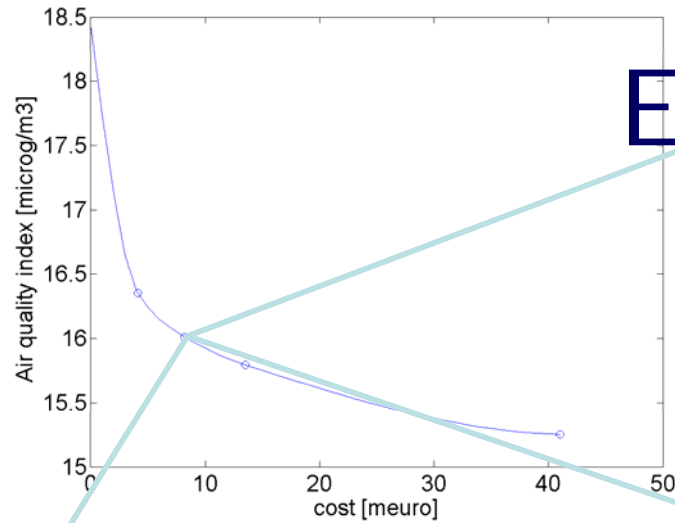
For air quality optimal control policies

- ➔ GHG budget (CO₂, CH₄, N₂O, F-gases)
 - Using activity levels and GAINS GHG emission factors
- ➔ External costs (mortality and morbidity) for PM₁₀
 - YOLL
 - Respiratory problems
 - Cardiovascular diseases
 - ...



Examples

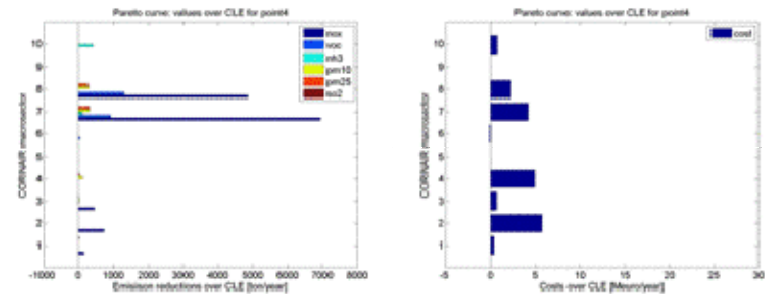
Optimal AQI and emissions maps

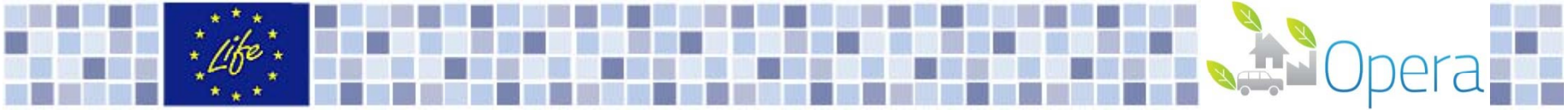


Optimal costs and emissions per ms

List of optimal measures to be applied

MS	sector	activity	technology	NO _x	VOC	NH ₃	PM10	PM2.5	SO ₂
2	Residential-commercial: fireplaces	Fuelwood direct	Fireplace improved	0	0.00002	0	1.4	0.4	0
8	Other transport: agriculture & forestry	Medium distillates (diesel, light fuel oil, includes biofuel)	Stage 3B control on construction and agriculture mobile sources	3	0.000008	0	0.5	0.1	0
4	Construction activities	No fuel use	Spraying water at construction places	0	0	0	0.4	0.02	0
3	Ind. Process: Aluminium production - secondary	No fuel use	High efficiency deduster-industrial processes	0	0	0	0.06	0.01	0





TECHNICAL IMPLEMENTATION

15th November 2012

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What is RIAT+?

RIAT+ (Regional Integrated Assessment Tool +) developed by University of Brescia and TerrAria for IES-JRC **is a software designed to identify cost-effective Air Quality abatement strategies** at regional scale.

RIAT+ covers the chain from emission abatement technologies and related costs to PM, NO₂ and O₃ concentrations and impacts, applied by Regional Authorities to evaluate the efficiency of Air Quality abatement plans.

RIAT+ have "**Non-commercial purposes**":

- i. academic research or other scholarly activity
- ii. activities by public authorities for their own purposes



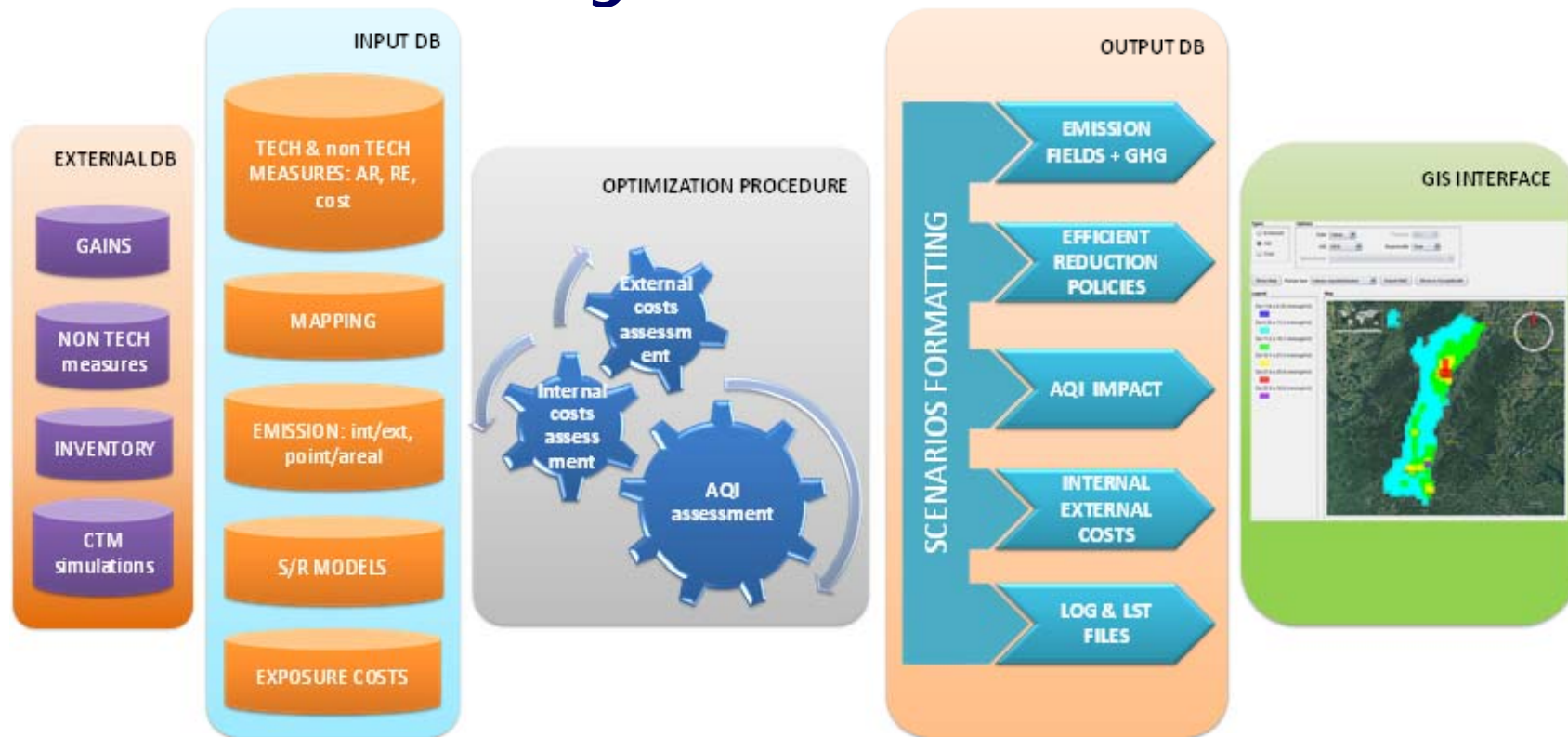
Why a tool?

- Documentation & tracking of the approach with a user-friendly system
- Use of common tool/methodology, integrating local knowledge (regional emission inventory, modeling system, etc)
- European sharing of technologies, policies
- European reporting

Form 5 Details of measures beyond those already required by existing legislation	
a.	Code number of the exceedance situation
b.	Code(s) of the measure(s)
c.	Planned timetable of implementation
d.	Indicator(s) for monitoring the progress
e.	Funding allocated (years; amount in EURO)
f.	Estimated total costs (amount in EURO)
g.	Estimated level in the years when the limit value has to be met, taking the additional measures into account
h.	Comments for clarification if needed



RIAT+ system flow chart





RIAT+ : software solution



RIAT +

Regional Integrated Assessment Tool Plus

A DSS for air quality planning developed by



ARPA
Emilia Romagna(I)



Centre National de la
recherche scientifique (F)



Université de
Strasbourg(F)



DII, Università di Brescia (I)



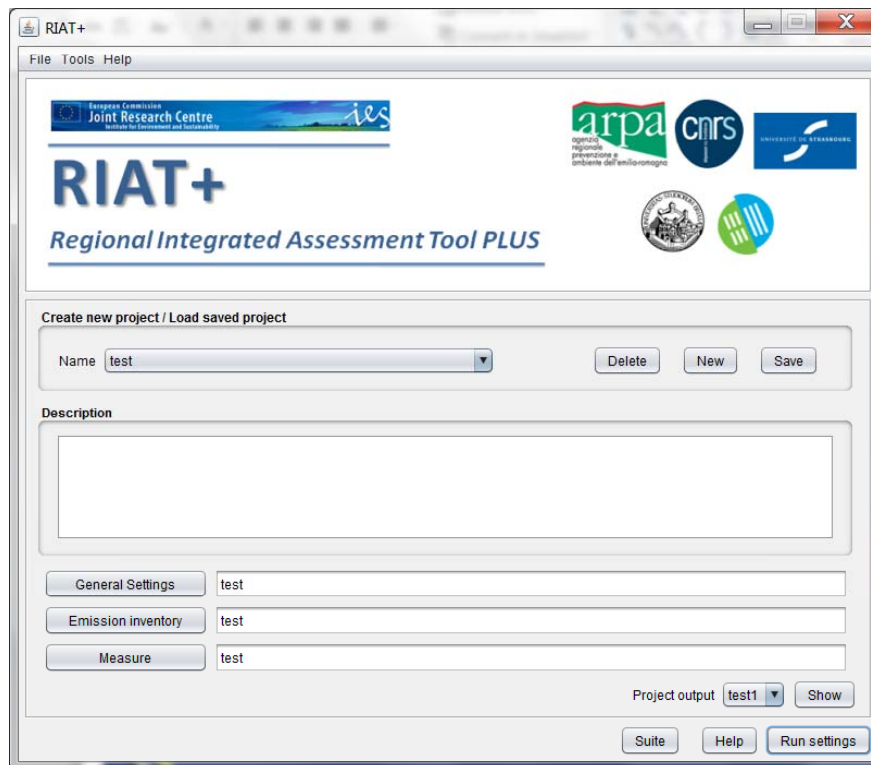
TerrAria srl (I)

RIAT+ system **is developed on J2SE platform** (java 2 standard edition). RIAT+ pre- and post-processing is managed by FORTRAN executable. Optimization module and S/R are MATLAB functions. RIAT+ dbase is Apache Derby (open source in Java). RIAT+ GIS interface is NASA World Wind.

RIAT+ system is developed with open-source technologies.



RIAT+ interface



Main RIAT+ modules:

- Project setup
- Domain & S/R
- Emission inventory
- Measure database
- Run setup
- Run results



RIAT + decision: run settings

Run Settings

Decision approach

Scenario
 Cost effectiveness
 Multi objective

Constraint

Internal cost over CLE (M€)

MS budget constraint

Time limit

Air Quality Objective

PM

Avg PM 2.5
 PM 10

Avg
 Exceed

a
b

None

Ozone

AOT 40
 SOMO 35
 Max 8H

None

NO2

Avg NO2
 None

Weight

Type:

AOT 40

SOMO 35

Max 8H

Avg PM 2.5

PM 10

Avg NO2

Spatial AQI Aggregation

AOT 40

SOMO 35

Max 8H

Avg PM 2.5

PM 10

Avg NO2

Policy Application Domain

Subdomain:

Region:

AQI target Domain

Subdomain:

Region:

Non technical

Yes No

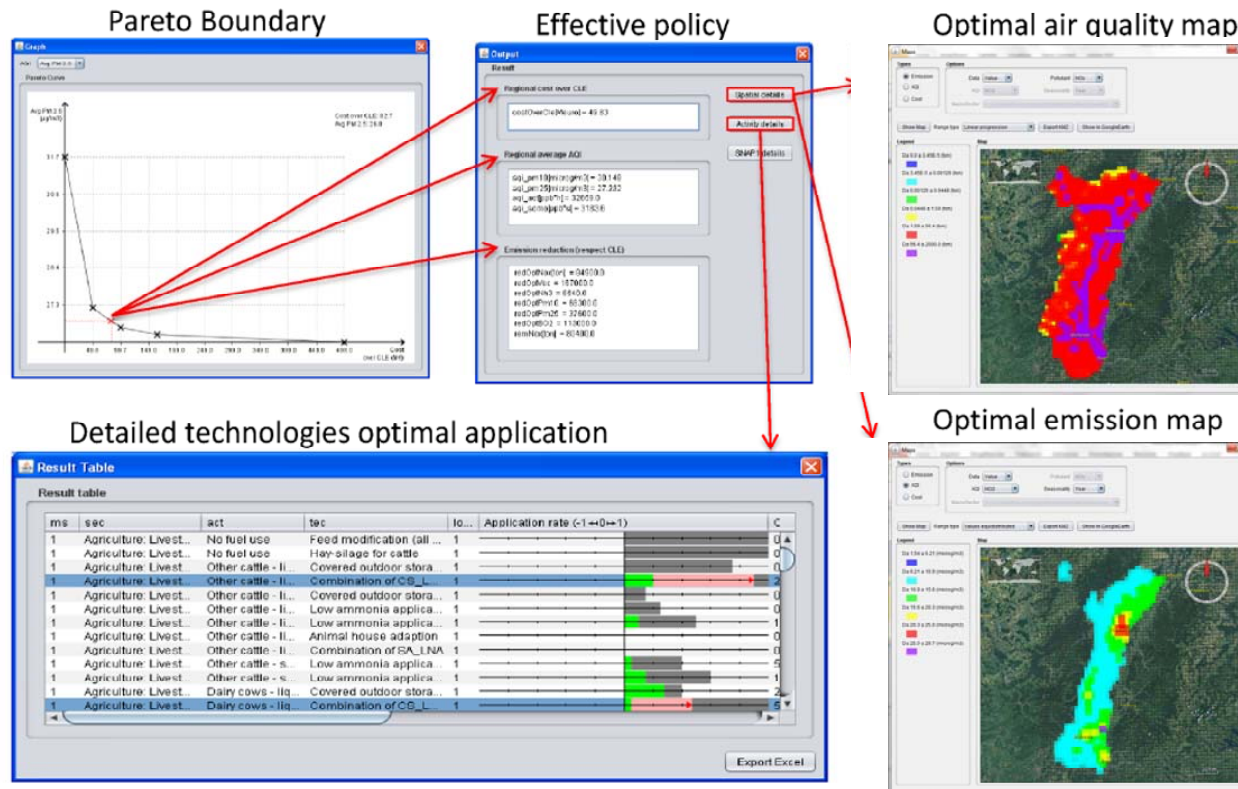
Technology Replacement

Yes No

Measure Selection



RIAT + OUTPUT





OPERA «plot»

1st act: Emilia Romagna S/R
functions

2nd act: Alsace optimization
results

3rd act: Prototype demo