CT1 - Source apportionment

Exercise SA Practices Methods

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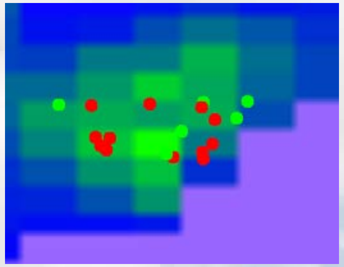
TRANSAIRE

Objective: Long term action plan

- ***Estimate sector reductions necessary to achieve compliance with the new AAQD in the city of Barcelona***

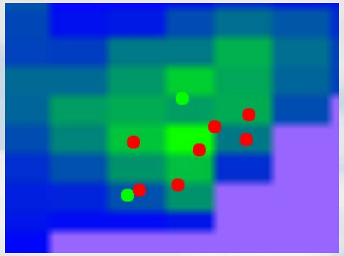
PM_{10}: New annual limit value of 20 µg/m^3 exceeded at 12 stations in 2023

- **Max. value: 26.2 µg/m^3**
- **Reduction of 24% required for compliance**



$PM_{2.5}$: New annual limit value of 10 µg/m^3 exceeded at 7 stations in 2023

- **Max. value: 15.6 µg/m^3**
- **Reduction of 36% required for compliance**



Step 1: Identification of contributing sectors *(example for PM_{10})*

Tools used:

SHERPA

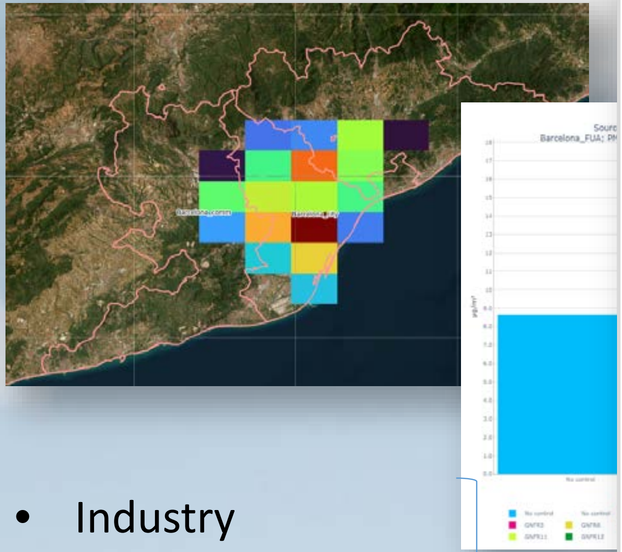
https://aqm.jrc.ec.europa.eu/Section/Sherpa/Background

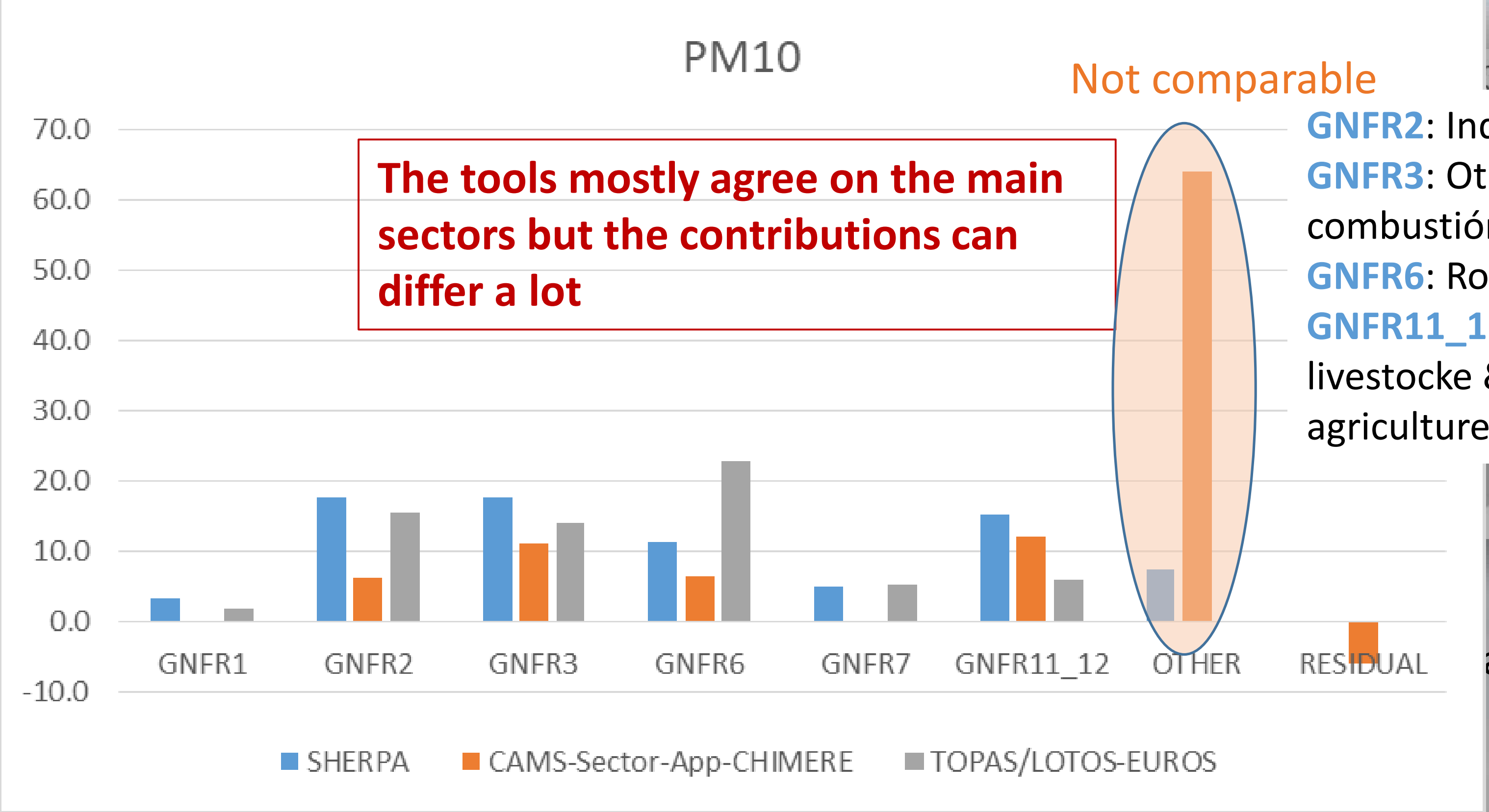
CAMS Sector Apportionment (CHIMERE)

https://policy.atmosphere.copernicus.eu/daily_source

TOPAS (LOTOS-EUROS)

https://airqualitymodeling.tno.nl/topas/





GNFR2: Industry
GNFR3: Other stationary combustión
GNFR6: Road Transport
GNFR11_12: Agriculture livestocke & other agriculture

- Industry
- Other Stat. Comb.
- Road Transport
- National Shipping
- Livestock

(contr

- Other?

natural)

al

- Agriculture

(Besides natural)

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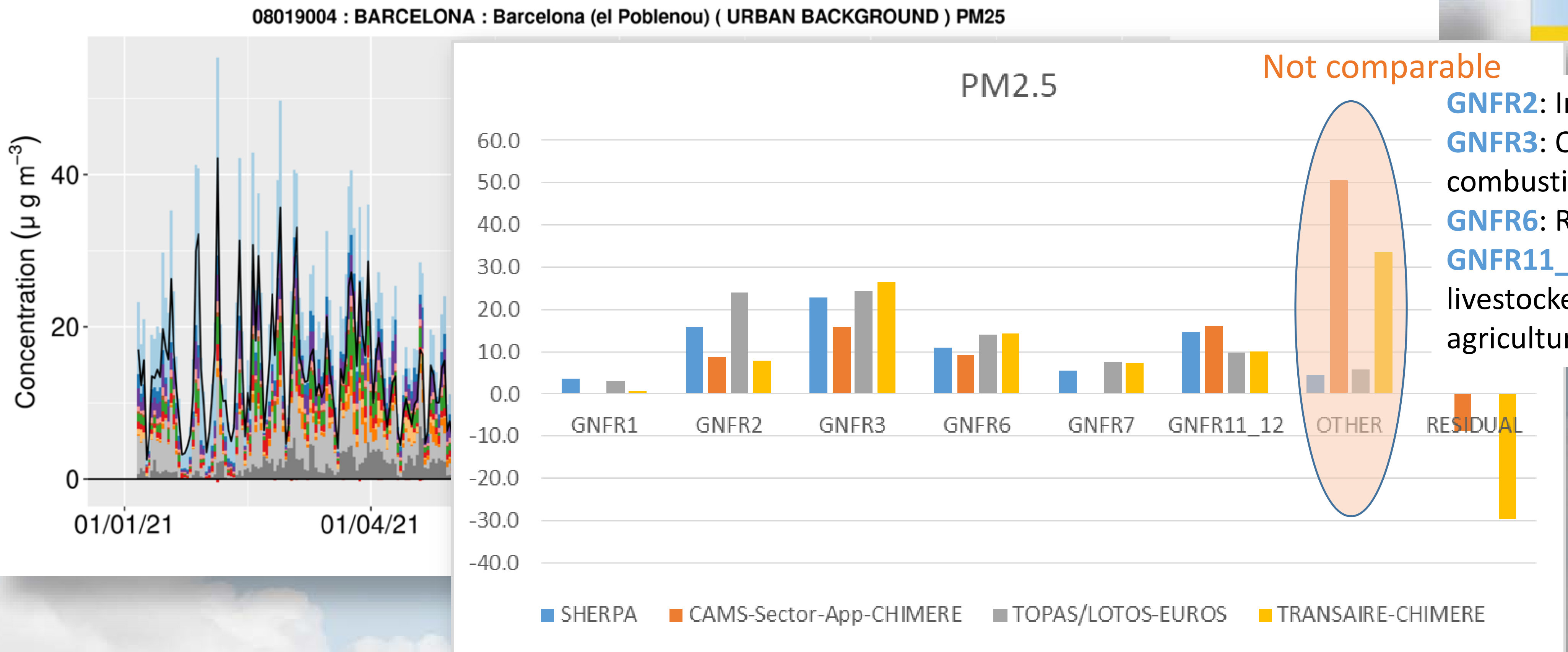
Step 1: Identification of contributing sectors

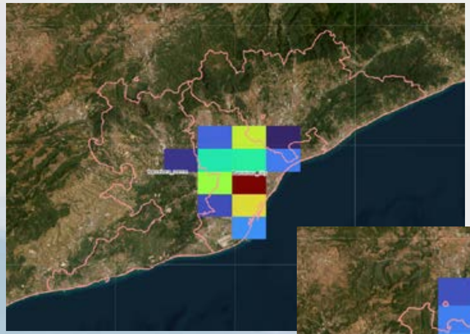
For $PM_{2.5}$ we also compared e results with our own source allocation study (TRANSAIRE Project; CHIMERE)



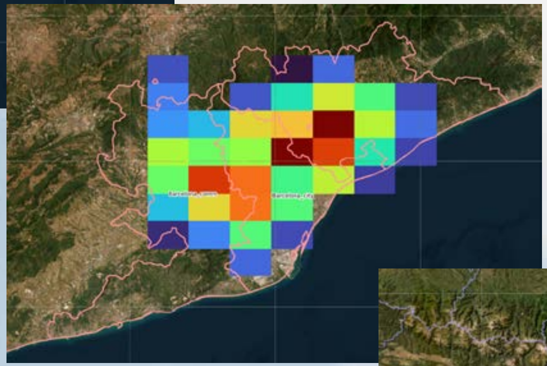
Not comparable

GNFR2: Industry
GNFR3: Other stationary combustión
GNFR6: Road Transport
GNFR11_12: Agriculture livestocke & other agriculture

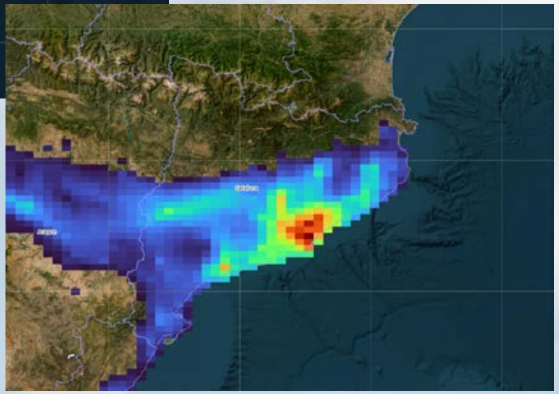
Step 2: Estimating impacts for different areas in SHERPA



Barcelona City (BC)



Barcelona commuting zone (BCZ) (excluding BC)



Spain (includes Barcelona FUA)

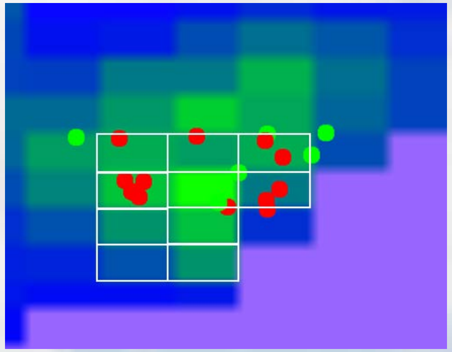
Download as TIF

Download as TIF

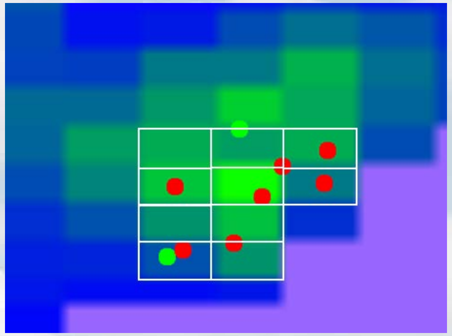
Download as TIF

Extract data in R script to get impacts for the grid cells with observed exceedences

PM_{10}



$PM_{2.5}$



Example of impacts of a given sector

FUA: functional urban area =BC + BCZ

Step 3: Devise reduction plan (e.g. $PM_{2.5}$)

i) Sum potential impacts in Excel (no interactions):

RELATIVE POTENTIALS (%)								
	GNFR1	GNFR2	GNFR3	GNFR6	GNFR7	GNFR11	GNFR12	GNFR11_12
CITY	2.6	9.2	11.1	6.9	4.9	4.1	0.2	4.4
COMMUTING ZONE	0.5	7.9	12.1	4.4	0.4	2.8	0.4	3.2
SPAIN	3.6	14.6	20.2	10.2	5.4	9.1	3.4	12
POTENTIAL REDUCTION	72%							
PLAN (EMIS. REDUCTION %)								
	GNFR1	GNFR2	GNFR3	GNFR6	GNFR7	GNFR11	GNFR12	GNFR11_12
CITY	50	50	50	50	50			
COMMUTING ZONE		50	50	50				
SPAIN								50
PLAN REDUCTION (%)								
	GNFR1	GNFR2	GNFR3	GNFR6	GNFR7	GNFR11	GNFR12	GNFR11_12
CITY	1.3	4.6	5.5	3.4	2.4			
COMMUTING ZONE		4.0	6.1	2.2				
SPAIN								6.2
PLAN REDUCTION	36%							

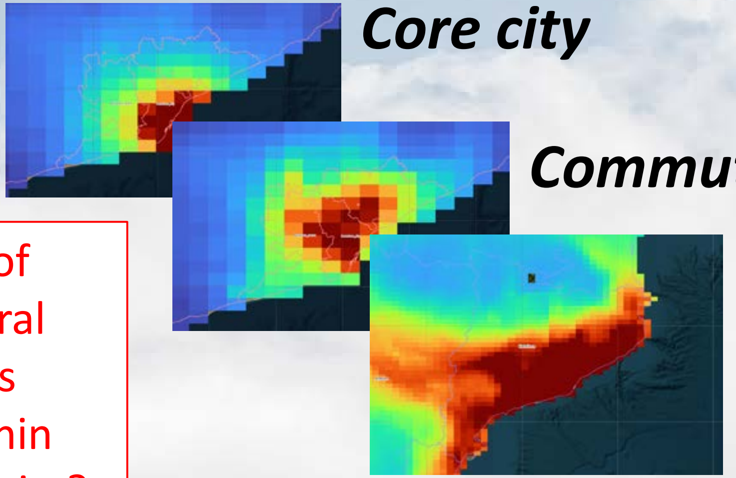
Potential impact when reducing emissions by 100%

Selected emission reduction (SER)

Potencial Impact (100%)*SER

Sum of all the sector reductions (meets objective)

ii) Test scenarios (3) in SHERPA and sum impacts in R



Impacts of agricultural emissions from within the core city?

Gives a mean concentration reduction of 27% in the cells with exceedances (because of interactions)

Not sufficient for compliance

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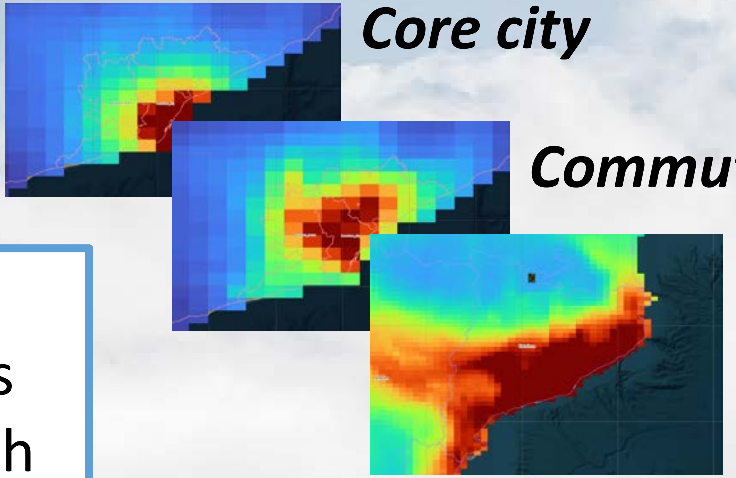
Step 3: Devise reduction plan (e.g. $PM_{2.5}$)

iii) Refine scenario to obtain required reduction (%) in concentrations in grid cells with exceedances

RELATIVE POTENTIALS (%)								
	GNFR1	GNFR2	GNFR3	GNFR6	GNFR7	GNFR11	GNFR12	GNFR11_12
CITY	2.6	9.2	11.1	6.9	4.9	4.1	0.2	4.4
COMMUTING ZONE	0.5	7.9	12.1	4.4	0.4	2.8	0.4	3.2
SPAIN	3.6	14.6						
POTENTIAL REDUCTION	72%							
PLAN (EMIS. REDUCTION %)								
	GNFR1	GNFR2	GNFR3					
CITY	75	75						
COMMUTING ZONE		75						
SPAIN								50
PLAN REDUCTION								
	GNFR1	GNFR2	GNFR3	GNFR6	GNFR7	GNFR11	GNFR12	GNFR11_12
CITY	2.0	6.9	8.3	5.2	3.6			
COMMUTING ZONE		5.9	9.1	3.3				
SPAIN								6.2
PLAN REDUCTION	51%							

In reality there are an infinite number of reduction combinations that can meet the objective. Which are more realistic/viable?

iv) Test revised scenarios (3) in SHERPA and sum impacts in R



Core city

Commuter zone

Spain

Gives a mean concentration reduction of 36% in the cells with exceedances (because of interactions)

Sufficient for compliance

Results

$PM_{2.5}$

PLAN (REDUCTION %)						
	Puiblic power	Other Stat. Comb.	Industry	Road Transport	National Shipping	Agriculture
CITY	75	75	75	75	75	
COMMUTING ZONE		75	75	75		
SPAIN						50

PM_{10}

PLAN (REDUCTION %)						
	Puiblic power	Other Stat. Comb.	Industry	Road Transport	National Shipping	Agriculture
CITY		75	75	50		
COMMUTING ZONE		75	75			
CATALUÑA						25

More drastic reductions required to comply with $PM_{2.5}$ limit value (larger reductions, more sectors, larger areas)

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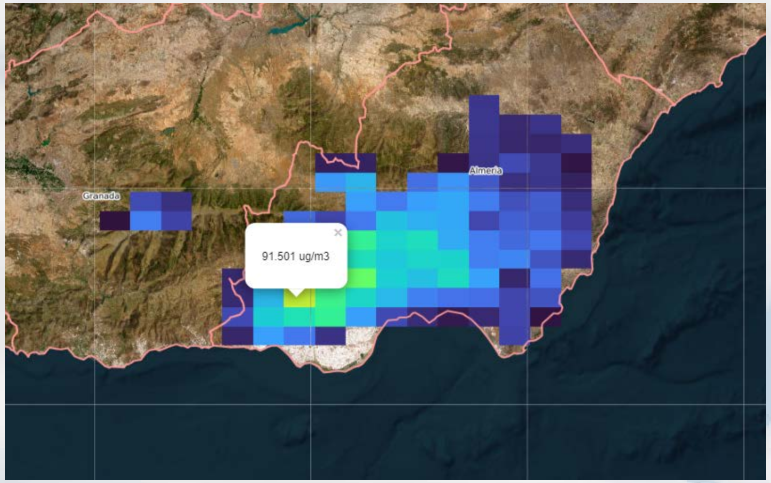
Comments and suggestions (SHERPA)

- It would help to have a list of sector names (have to put mouse pointer over the GNFR codes)
- Can’t save calculations for future analyses (e.g. the next day)
- Sometimes you can’t load a calculation that you saved (although it appears on the list)
- Agriculture in the city?
- Can’t map emissions used for base case
- How realistic is the base case?
- Can’t simulate complex scenarios

(e.g. reductions for different sectors over different areas)

- Location of sites (selection of grid cells)
- It is only part of the solution

The results need to be combined with information/optimisation of costs/viability



PM_{10} concentrations > 90 µg m^{-3} in the **south of Spain**

Thanks!

- Project TED2021-132431B-I00 (TRANSAIRE: Transition to cleaner air in Spain) funded by MCIN/AEI/ 10.13039/501100011033 and by the European Union NextGenerationEU/PRTR

- We also thank the Ministry for the Ecological Transition and Demographic Challenge (MITERD)

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CT1 - Source apportionment

Exercise SA Practices Methods – Ineris

Case study 1 : MILAN - Italy

The question we are trying to answer when we use Source Apportionment method chosen is :

What emission reduction policies should have been put in place to stay below the 50 mg/m3 threshold for PM10 during this extremely high pollution episode in Milan?

Tools used is **CAMS-ACT**

Point where exceedance occurs : **Milan**

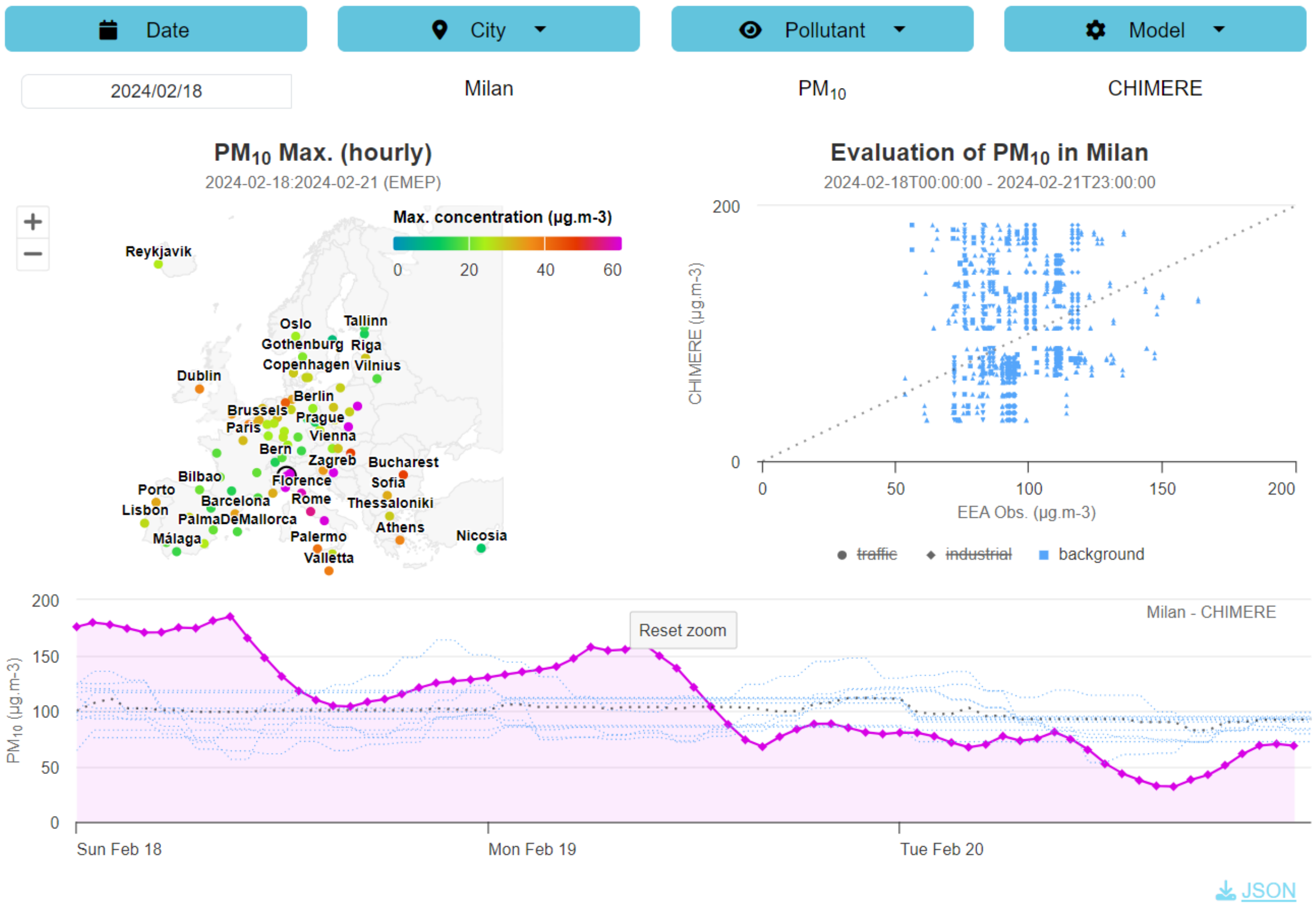
The method applied to a short-term (episodes) using a long-term approach. We focus on particular on the episode occurs on **18/02/2024**

Procedure applied

How did we manage to answer the question?

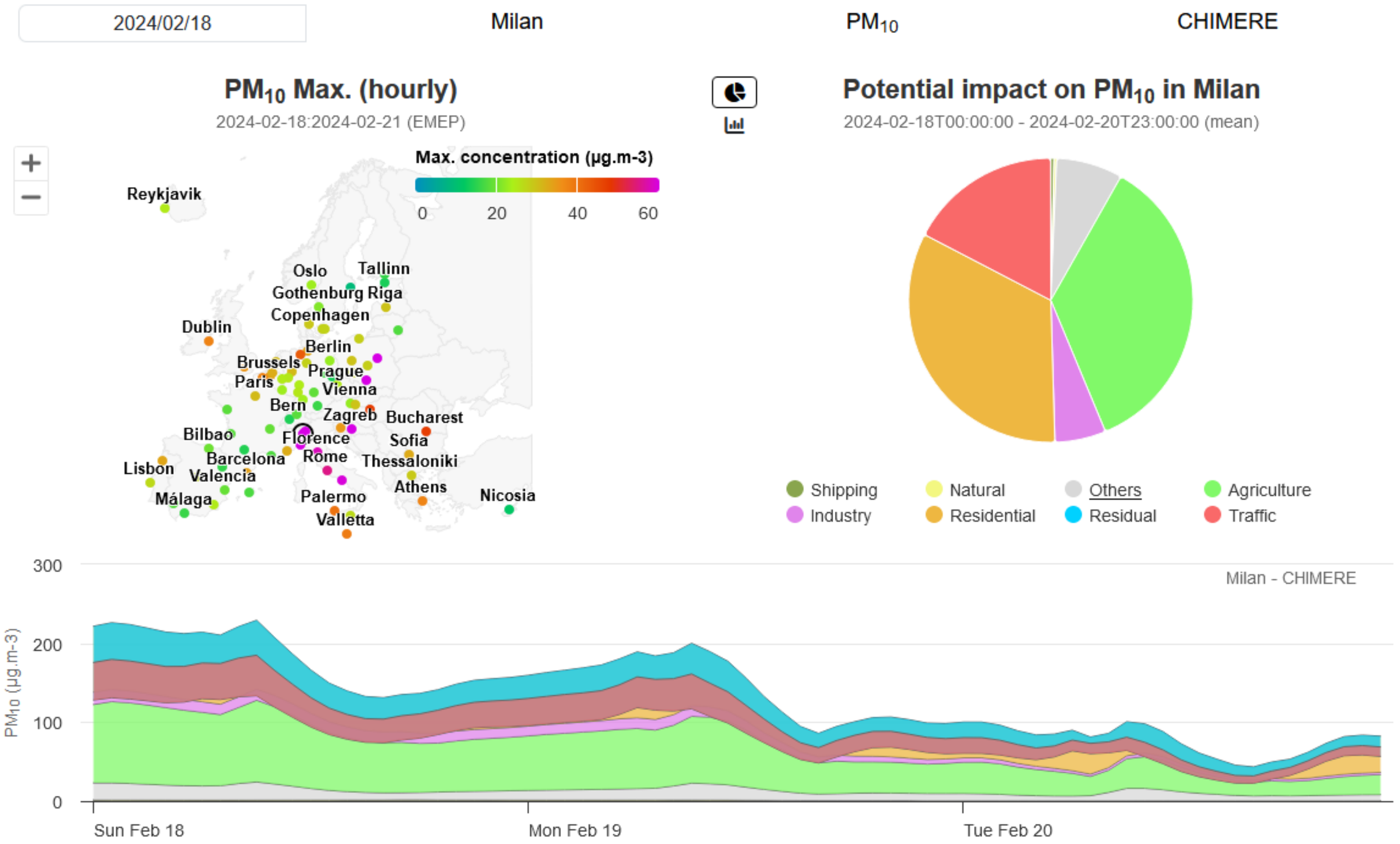
Using the tools available on :
https://policy.atmosphere.copernicus.eu/

Case study description



https://policy.atmosphere.copernicus.eu/daily_source_attribution/model_evaluation.php

Source Apportionment



https://policy.atmosphere.copernicus.eu/daily_source_attribution/sector_apportionment.php

PM_{10} concentration distribution

- ○ Total concentration
- ◉ Anthropogenic fraction

◉ Concentration ○ Absolute difference ○ Relative difference

Design your emission scenario
(uniform reduction)

Traffic
reduction: 0% — reduction: 100%

Industry
reduction: 0% — reduction: 100%

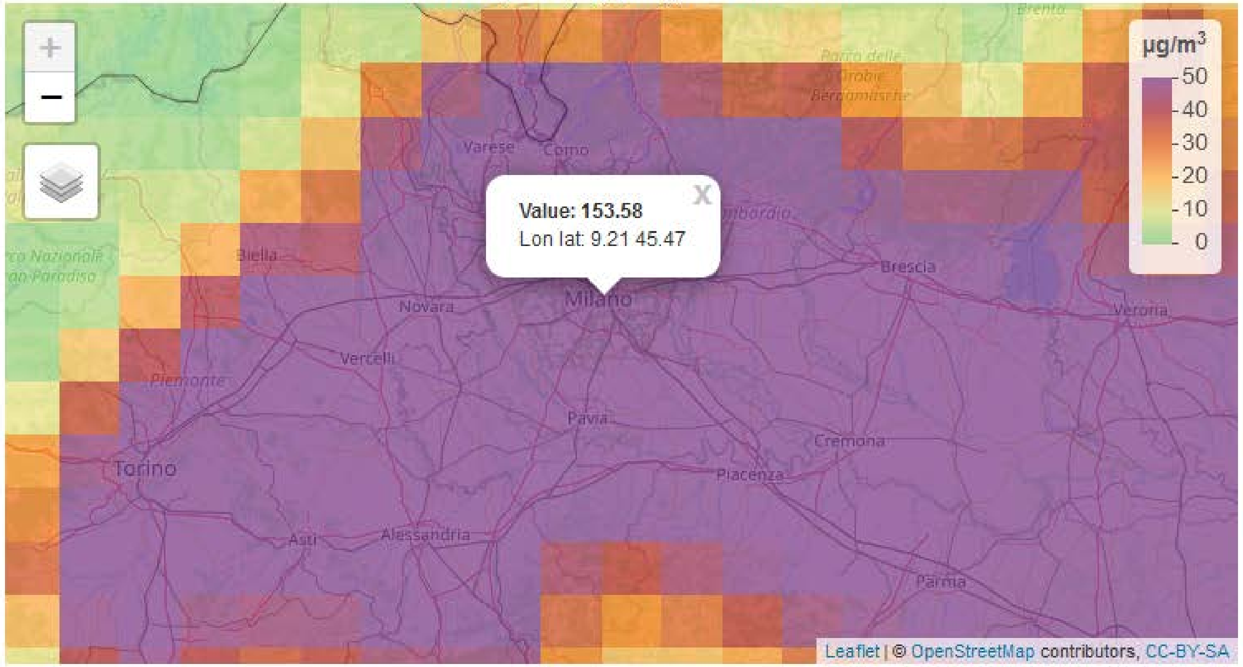
Residential
reduction: 0% — reduction: 100%

Agriculture
reduction: 0% — reduction: 100%

Shipping
reduction: 0% — reduction: 100%

Other sectors
reduction: 0% — reduction: 100%

PM10 daily mean (µg/m^3), 2024-02-18 D+0



PM10 (daily mean) reference map including the main anthropogenic sources (agriculture, industry, traffic, residential heating, shipping and other) . The natural emissions (such as dust or sea salt) as well as other hemispheric sources are excluded.

Get map

Emission reduction by sectors

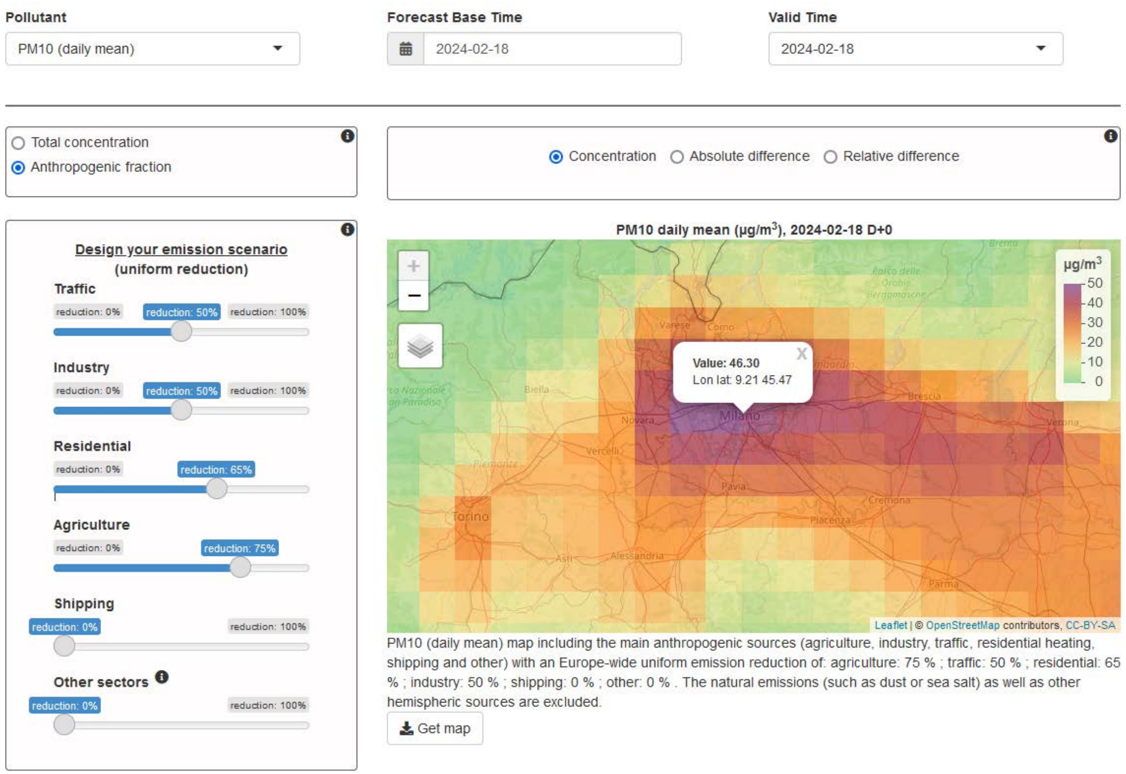
	Emission reduction								
Agriculture	0%	50%	0%	0%	0%	75%	0%	0%	0%
Residential	0%	0%	50%	0%	0%	0%	75%	0%	0%
Traffic	0%	0%	0%	50%	0%	0%	0%	75%	0%
Industry	0%	0%	0%	0%	50%	0%	0%	0%	75%
Shipping	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other sectors	0%	0%	0%	0%	0%	0%	0%	0%	0%
Concentration	153.58	143.57	118.43	132.58	146.19	112.35	100.85	121.76	142.38
% of reduction		6.52%	22.89%	13.67%	4.81%	26.85%	34.33%	20.72%	7.29%

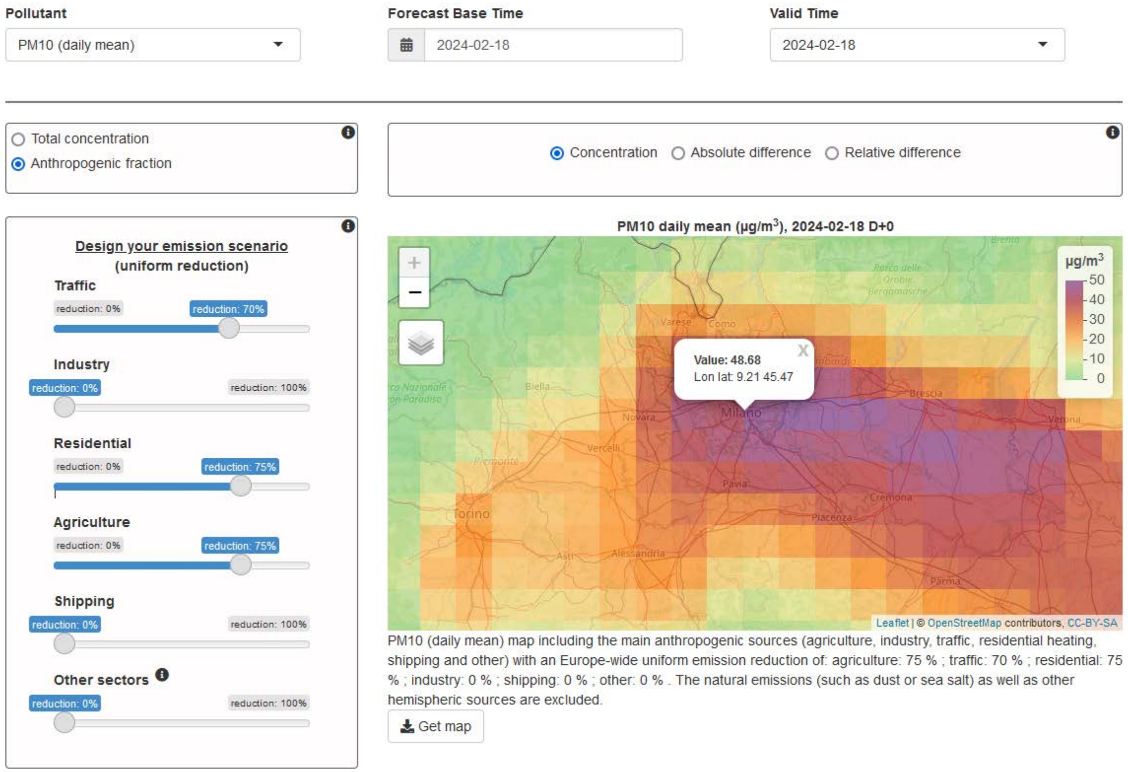
Possible solutions

Sector recommended to act on and possible reductions :

	Emission reduction		
Agriculture	0%	75%	75%
Residential	0%	65%	75%
Traffic	0%	50%	50%
Industry	0%	50%	0%
Shipping	0%	0%	0%
Other sectors	0%	0%	0%
Concentration	153.58	46.30	48.68
% of reduction		69.85%	68.30%

Resulting concentration





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Exercise lesson

What issues did you find when answering the survey? What suggestions can you make to improve it?

It was possible to arrive quickly and easily at an estimate and get an idea of which sectors are most important for reducing concentrations. More importantly, by taking into account the non-linearity of the system in this approach, it was also possible to see from which percentage emission reductions we can have a significant impact on concentrations (see example of the agricultural sector).

We did not attempt to combine these results with the Country/City CAMS Policy Tools to further analyze the importance of the local and non-local sources. (but it could have been done)

Case study : PARIS

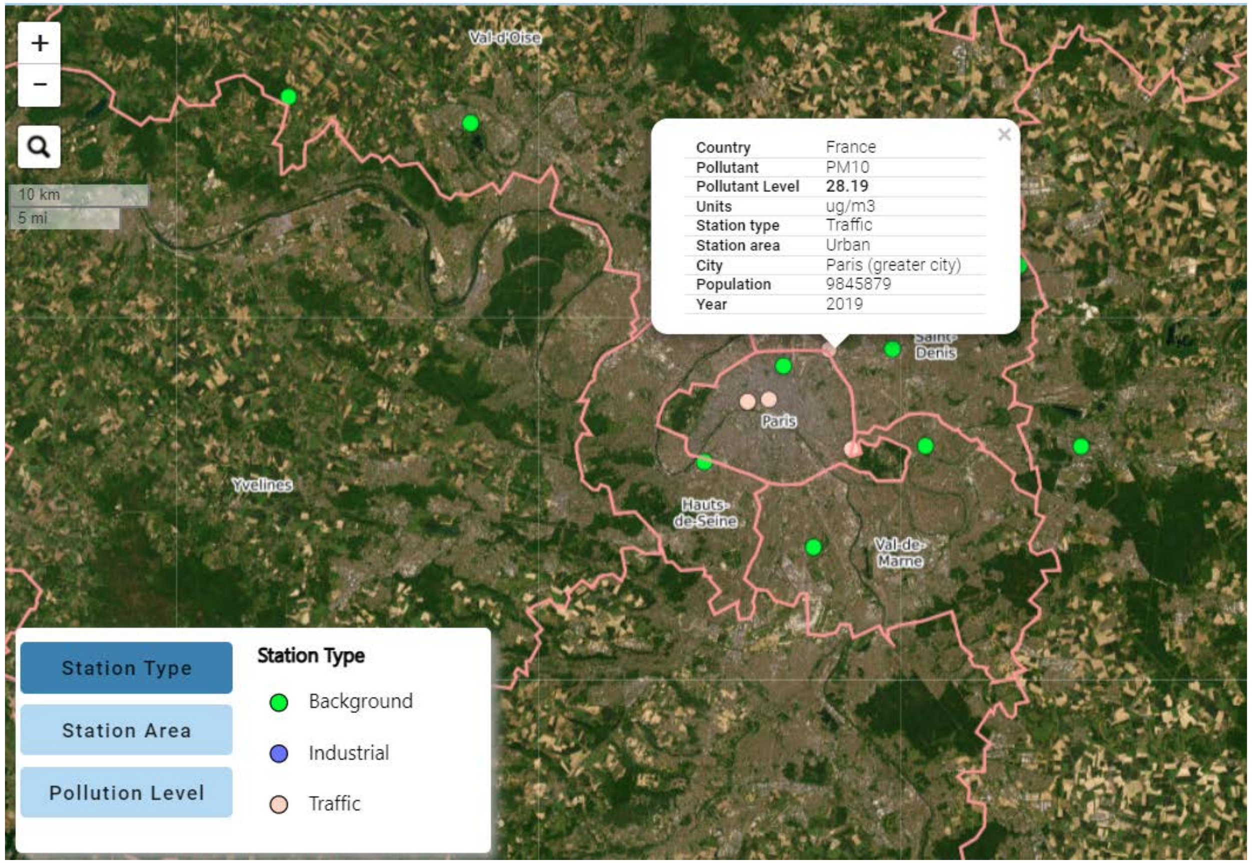
Location of the receptor (point where exceedance(s) occur(s)) : **Paris**

The method applied to a long-term (episodes) using a long-term approach. The year is 2019 (available in SHERPA website)

Tools used is **SHERPA**

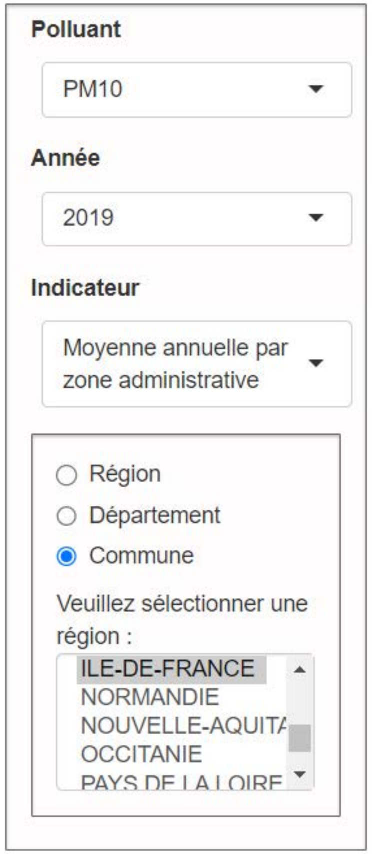
Aim: we want to compare local reduction with reduction over All France

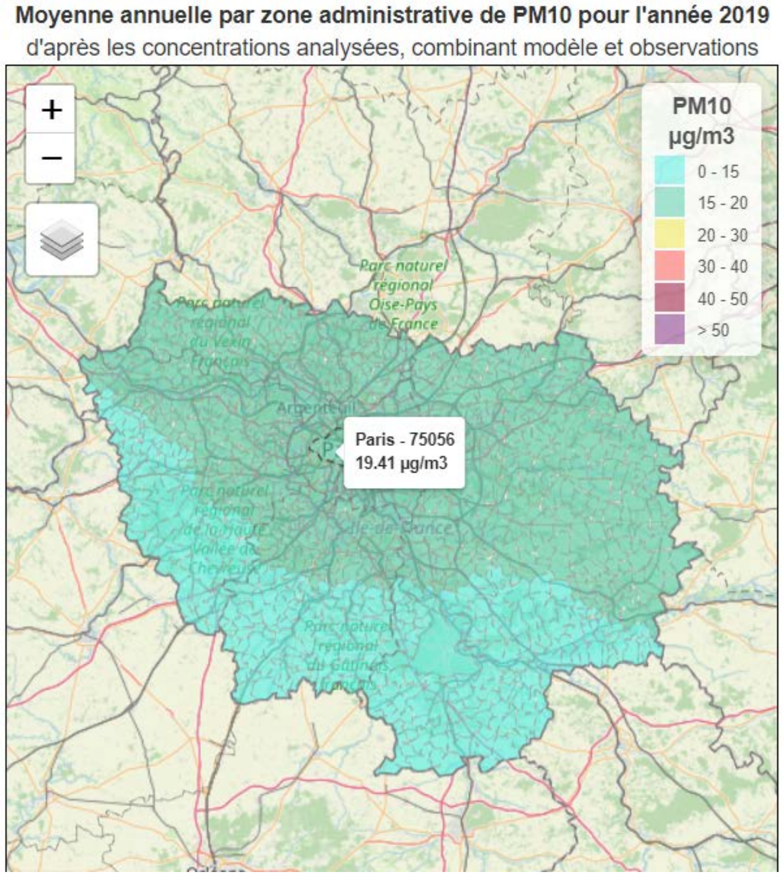
Case study



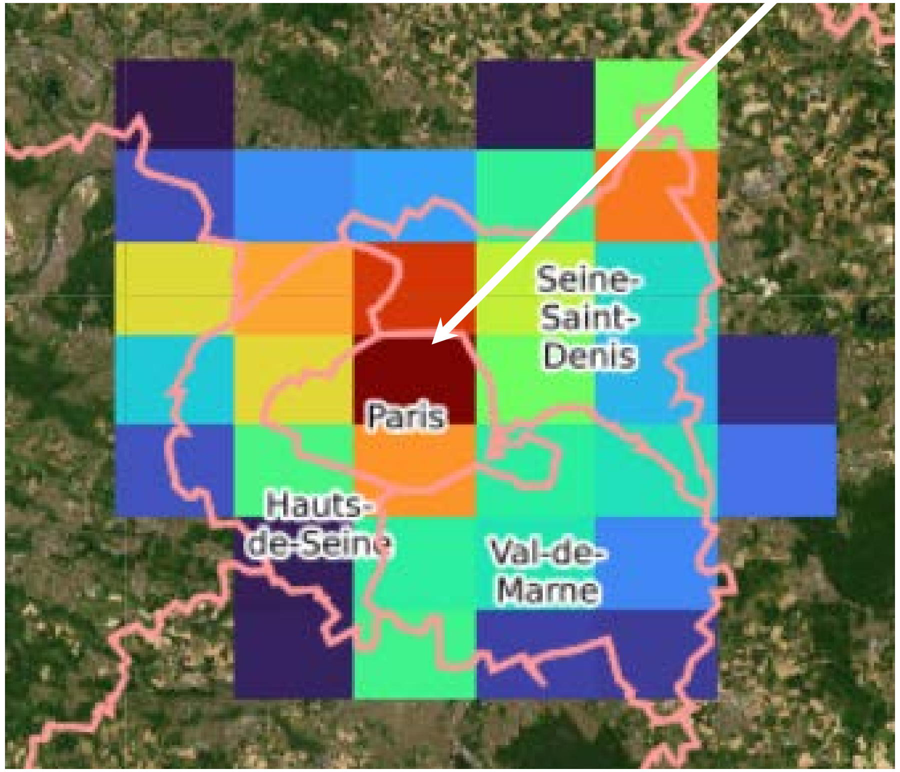
This station shows exceedance of the EU 2030 PM10 LV (20 µg/m3). A reduction of PM10 concentration by 28% is necessary to avoid exceedance

Maps



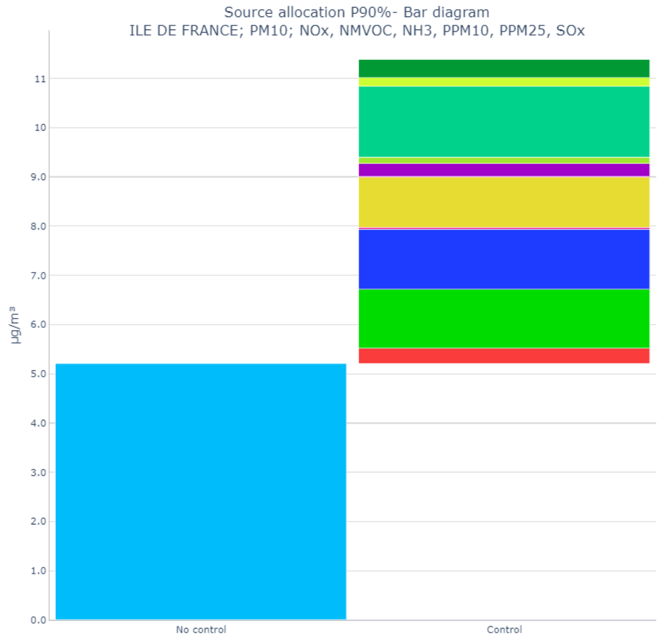


13 µg/m3



https://www.ineris.fr/fr/recherche-appui/risques-chroniques/mesure-prevision-qualite-air/qualite-air-france-metropolitaine

Source Apportionment : PM10



- Impact of Emission reduction in the greater Paris Area (Ile de France)

https://jeodpp.jrc.ec.europa.eu/eu/dashboard/voila/render/SHERPA/Sherpa.ipynb

Note: Surprisingly high importance of the « waste » sector

Emission reduction by sectors

	Emission reduction over Paris Region									
Agriculture	0%	50%	0%	0%	0%	100%	0%	0%	0%	0%
Residential	0%	0%	50%	0%	0%	0%	100%	0%	0%	70%
Traffic	0%	0%	0%	50%	0%	0%	0%	100%	0%	70%
Industry	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shipping	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Waste	0%	0%	0%	0%	50%	0%	0%	0%	100%	70%
Concentration (µg/m3)	12.9	12.65	12.103	12.234	11.777	12.40	11.31	11.57	10.66	9.28
% of reduction	0.225	1.94%	6.18%	5.16%	8.71%	3.88%	12.36%	10.33%	17.40%	28.06%

Note: Linear response (by design)

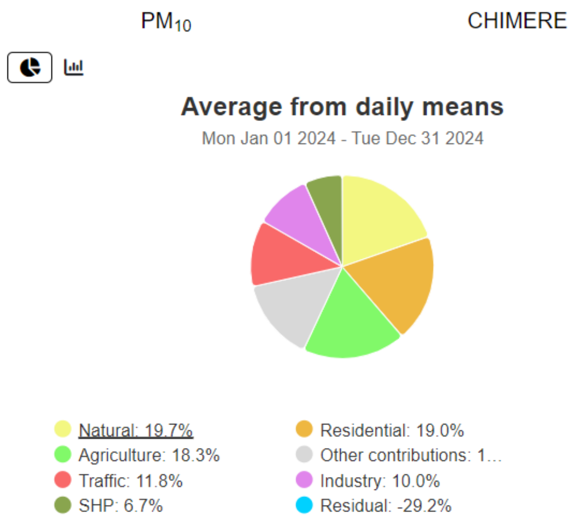
Some results

Sector recommended to act on:

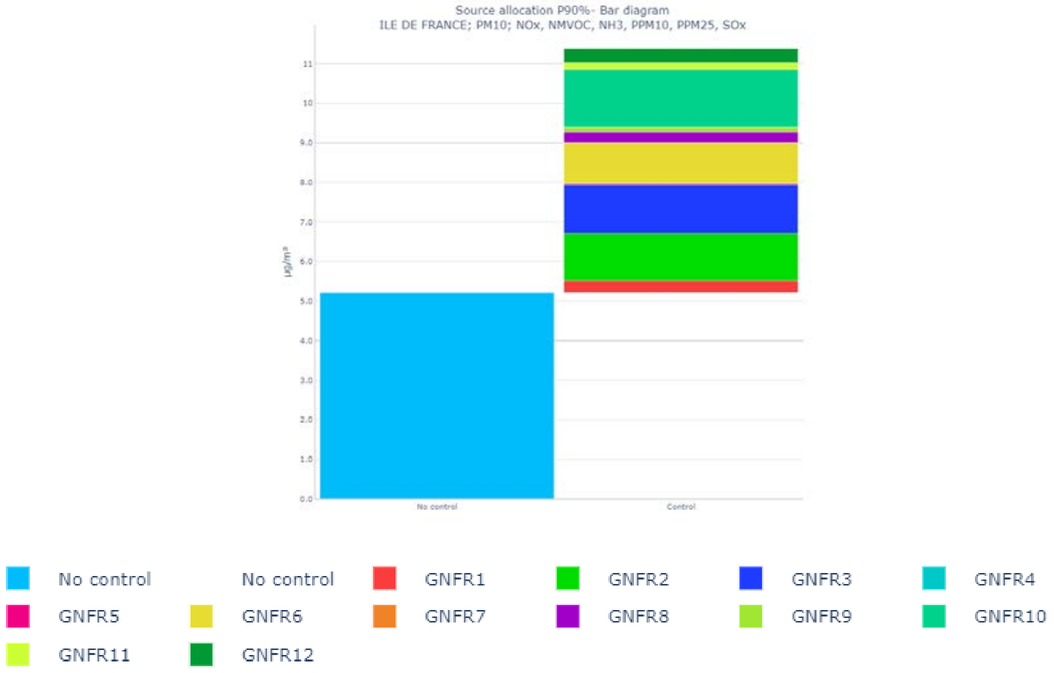
	Emission reduction	
	Only over Paris area	All France
Agriculture	0%	55%
Residential	70%	55%
Traffic	70%	50%
Industry	0%	0%
Shipping	0%	0%
Waste	70%	0%
Concentration (µg/m3)	9.28	9.20
% of reduction	28.06%	28.68%

Annual potential impact comparison : PM10

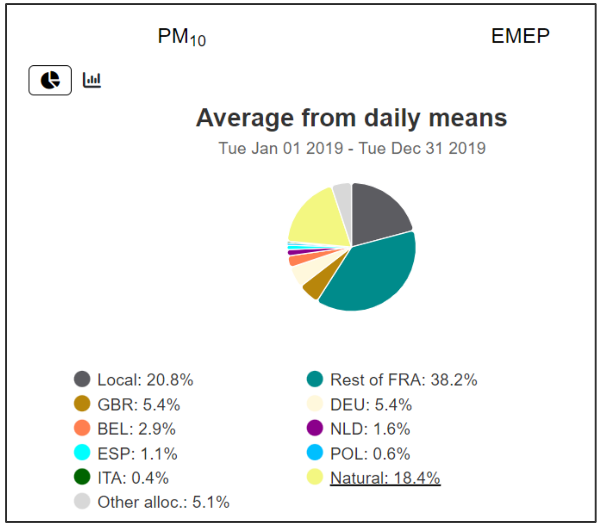
CAMS ACT/CHIMERE (2024*)



SHERPA (2019)



CAMS SR/EMEP (2019)



SHERPA estimates that we can control almost roughly 50% of concentrations through reductions over Ile de France (roughly 100x100km2)
The city S/R in CAMS Policy tools estimate roughly a 20% impact through reductions in a 42x42km2 square

Some general remarks

- SHERPA:
  - for easier understanding, replace “GNFR1”, “GNFR2” etc… by the name of the sector, or at least “GNFR-A”, GNFR-B” etc..
  - The name of the pollutants should appear on all graphs (risk of confusion PM10/PM25)

- SHERPA: is it possible to apply different emission reductions on different country ?

- CAMS/ACT: it would be interesting to add an interactive viewer of emission scenario for annual indicators and not only the day-to-day forecast. At present only the overall potential impact is available only for yearly statistics

- In general,
  - A reflexion is needed on bias correction in modelled source apportionment
  - Potential impact information is interesting to visualise which sector should be targeted but a real scenario with reduction on the different sector at the same time is needed.

Thank you for your attention

WG1 - SA Exercise

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arpae emilia-romagna

FAIRMODE Technical Meeting Dublin, 7-9 October 2024

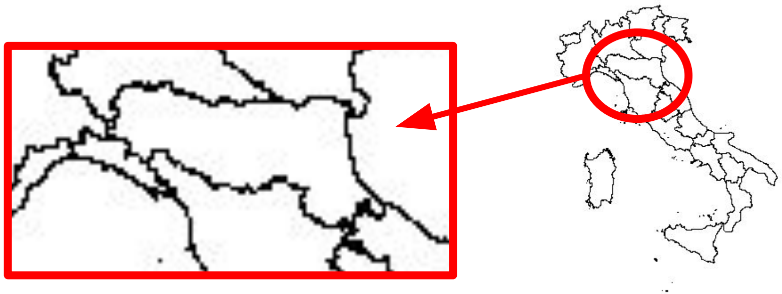
1. What question are you trying to answer when you use a Source Apportionment method (whether or not using online tools)?

2. How did you arrive at your conclusions based on the tools you used? (You can illustrate your explanation with graphs or figures).

3. What issues did you find when answering the survey? What suggestions can you make to improve it?

1. What question are you trying to answer when you use a Source Apportionment method (whether or not using online tools)?

Local government requires Arpae to support in defining the best and more fruitful measures to be taken in Emilia-Romagna AQ plans.
Which are the main emitting sectors that contribute to pollution in Emilia-Romagna?
Which actions are to be done to attain AQ requirements in the whole Emilia-Romagna territory?

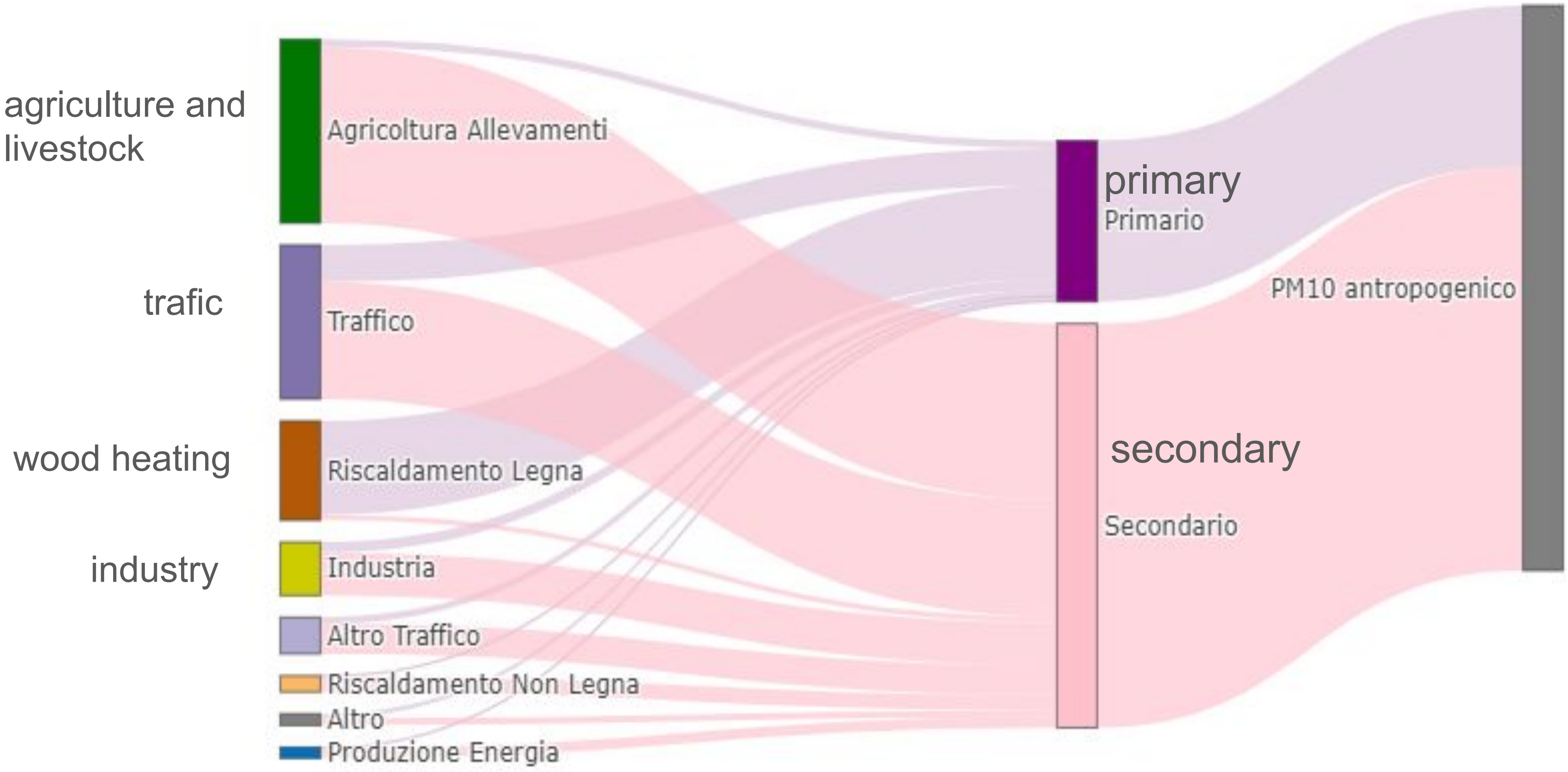


2. How did you arrive at your conclusions based on the tools you used?

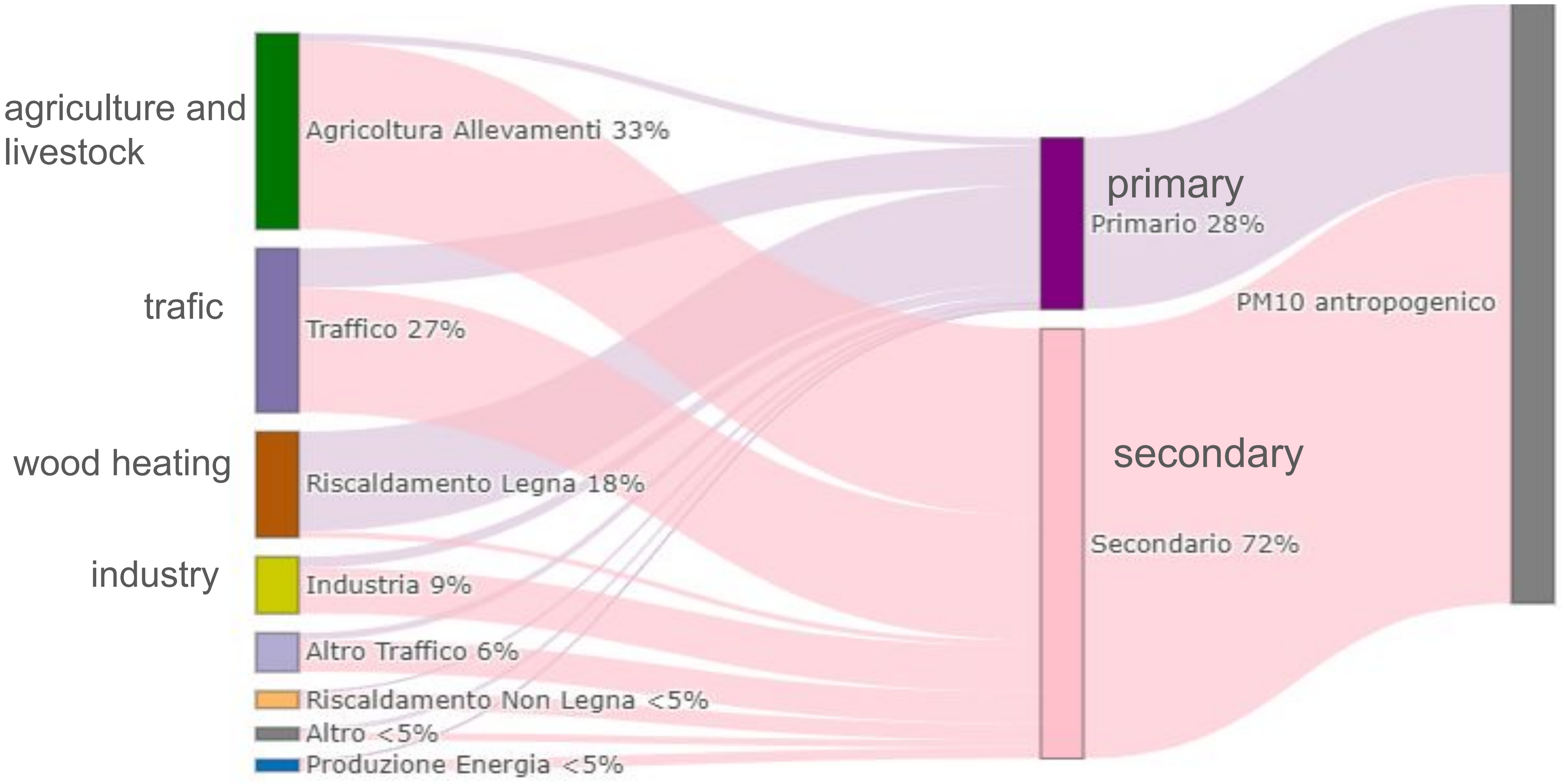
First Step

A **Brute Force Method** has been applied.
Potential impacts have been computed by reducing the emission of primary PM and precursor gases: 9 sector X 2 type of pollutant reduction = 18 scenarios. A surrogate model (RIAT+) has been used to simulate concentrations instead of explicit simulations

Percentage contribution to anthropogenic PM10 by sector - Emilia-Romagna



Percentage contribution to anthropogenic PM10 by sector - Emilia-Romagna



2. How did you arrive at your conclusions based on the tools you used?

Second Step

RIAT+ tool has been used to define which actions must be implemented.
These actions mainly involve agriculture and biomass: not only primary PM but also NH_3, NO_x, VOC
The Emilia-Romagna AQ plan is in addition to CLE2030 that provides for a significant reduction in traffic emissions.

3. What issues did you find when answering the survey? What suggestions can you make to improve it?

We reported our experience, so that some questions related the web tools are not fitting for our case

Q10 table was focused on primary PM, we split it in sectors and pollutant or precursors

to solve PM10 daily exceedances			
sector	**Area**	**pollutant/precursor**	**By how much %?**
S2	Emilia-Romagna	PM10	46
S7	Emilia-Romagna	PM10	3
S10	Emilia-Romagna	NH3	38
S7	Emilia-Romagna	NOx	98
S3+S4	Emilia-Romagna	PM10	4
Emission reduction compared to CLE2030 scenario: results from RIAT+ optimisation			

CT1 - Source apportionment

Exercise SA Practices Methods

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FAIRMODE

Forum for air quality modelling in Europe

RSE Ricerca Sistema Energetico

Université de Strasbourg

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Fill-in Template [1]

1 - Location of the receptor (point where exceedance(s) occur(s))
MILAN OR LOMBARDY REGION

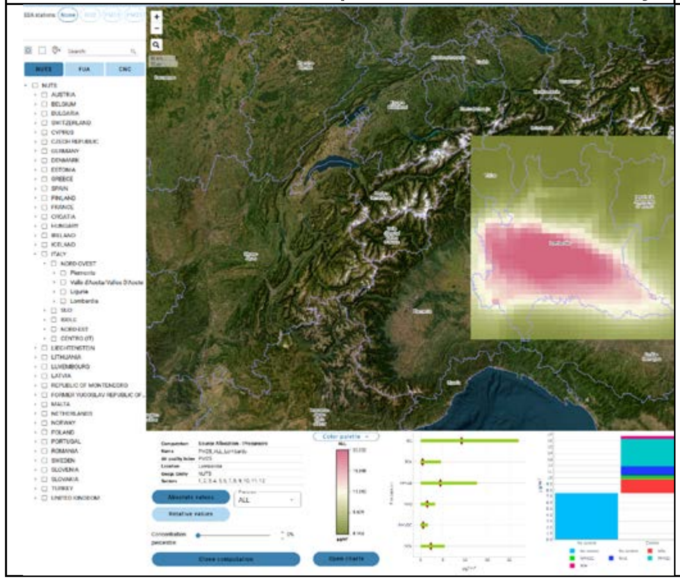
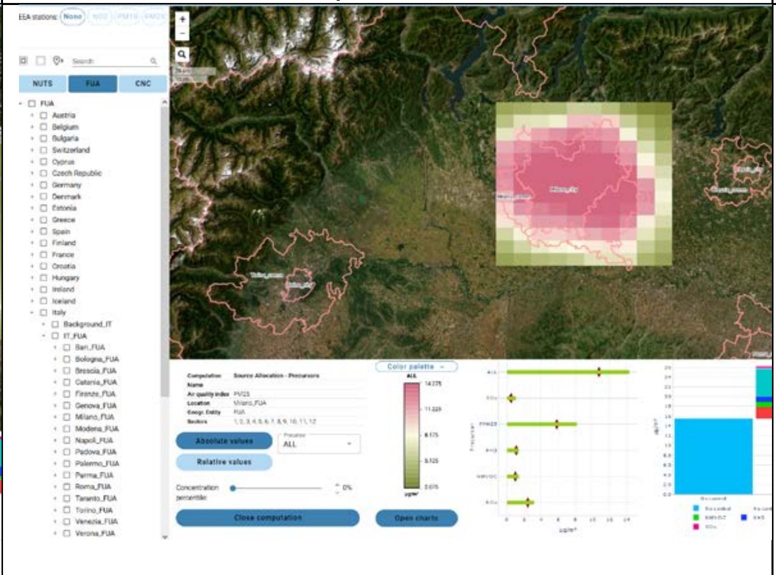
2 - Short or long-term? Are SA results aiming at supporting short-term (episodes) or long-term (years) action plans?
We use long-term; short-term is quite different from different methods

Fill-in Template [2]

3 - Use of mandatory SA

A. Did you use SHERPA results? If yes, how (targeted sectors and areas) and why? If not, why?

SHERPA MODE 1: Source Allocation – Sectoral

PM25, all sectors, all pollutants, Lombardy	PM25, all sectors, all pollutants, Milano FUA	PM25, all sectors, all pollutants, CNC Milano
		

- About 50% of PM2.5 depends on sources outside the region
- No more than 50% could be managed by regional actions plans (i.e. 20% is residential GNF3 and 10% is traffic GNF6)

Fill-in Template [2]

3 - Use of mandatory SA

A. Did you use SHERPA results? If yes, how (targeted sectors and areas) and why? If not, why?

SHERPA MODE 2: Source Allocation – Precursors

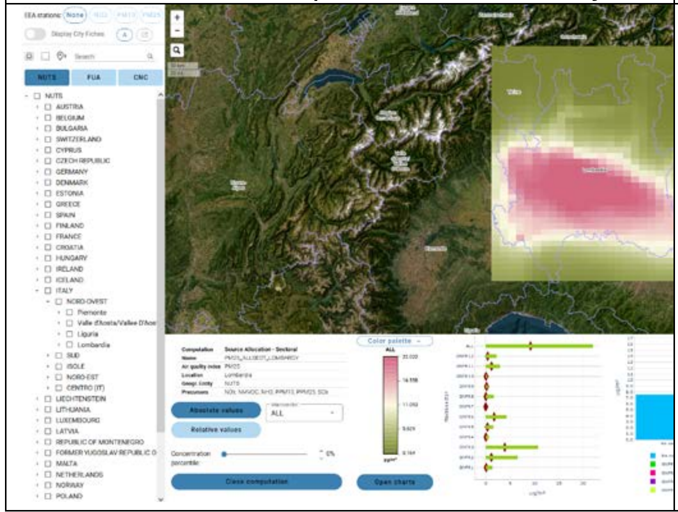
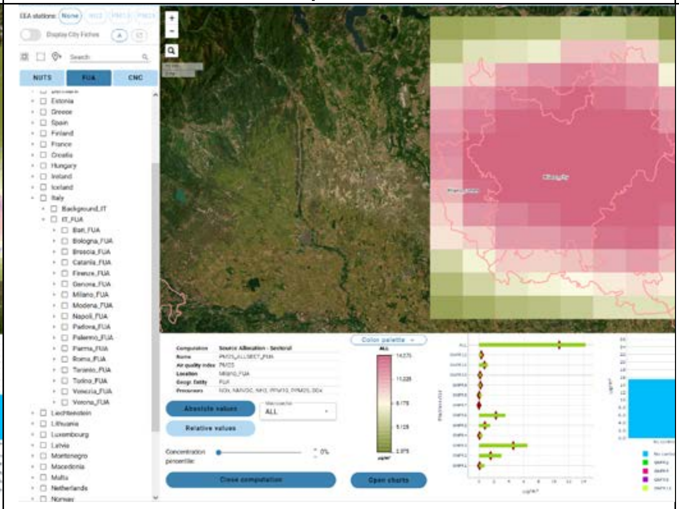
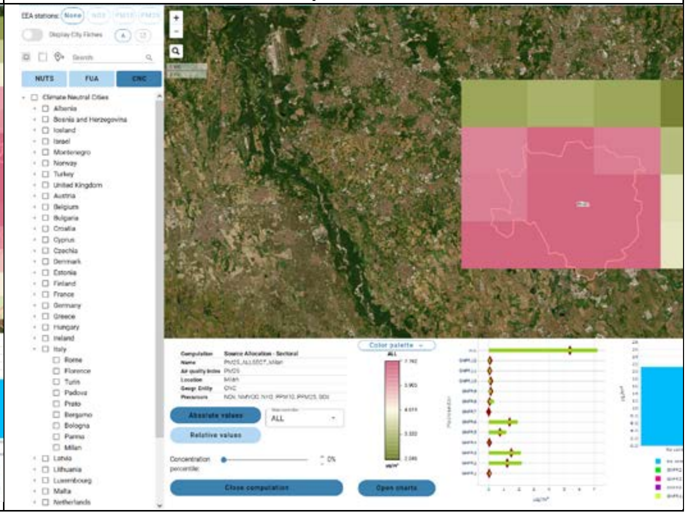
- About 50% of PM2.5 depends on sources outside the region (OBVIOUSLY EQUAL TO FORMER)
- In terms of emission contributions, share of PM is about 20% whereas NOX is 15%, NH3 is comparable with NOX.

Fill-in Template [2]

3 - Use of mandatory SA

A. Did you use SHERPA results? If yes, how (targeted sectors and areas) and why? If not, why?

SHERPA MODE 3: Scenarios

PM25, all sectors, all pollutants, Lombardy	PM25, all sectors, all pollutants, Milano FUA	PM25, all sectors, all pollutants, CNC Milano
		

- 50% all sector NOX-NH3
- 50% all sector NOX NH3 only agricultural sector
- 50% all sector NOX NH3 only transport sector

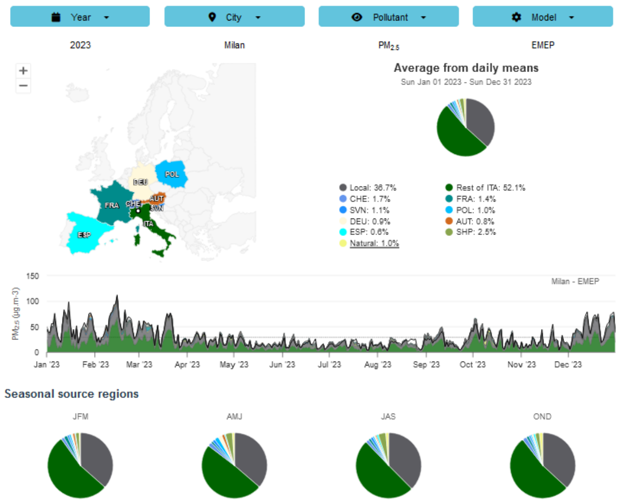
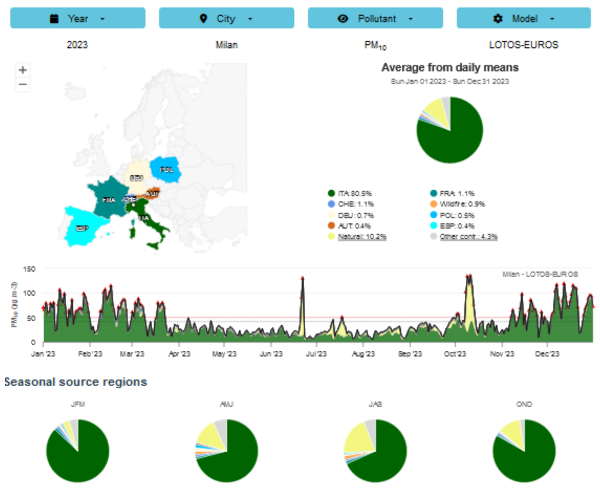
These results could be compared to CTM FARM brute force modelling already done within a Regional Project. We think that the use of this section is useful to validate CTM results or to make a priori evaluation where to act some air quality Plan.

Fill-in Template [2]

3 - Use of mandatory SA

A. Did you use CAMS-EMEP-SR results? If yes, how (targeted sectors and areas) and why? If not, why?

A. Did you use CAMS-LOTOS-EUROS results? If yes, how (targeted sectors and areas) and why? If not, why?

What is the potential impact of local and country emissions reduction on PM10/2.5? (Emission perturbation method for source attribution)	What are the contributions from countries to $PM_{10/2.5}$ concentrations? (Tagging approach for source attribution)
	

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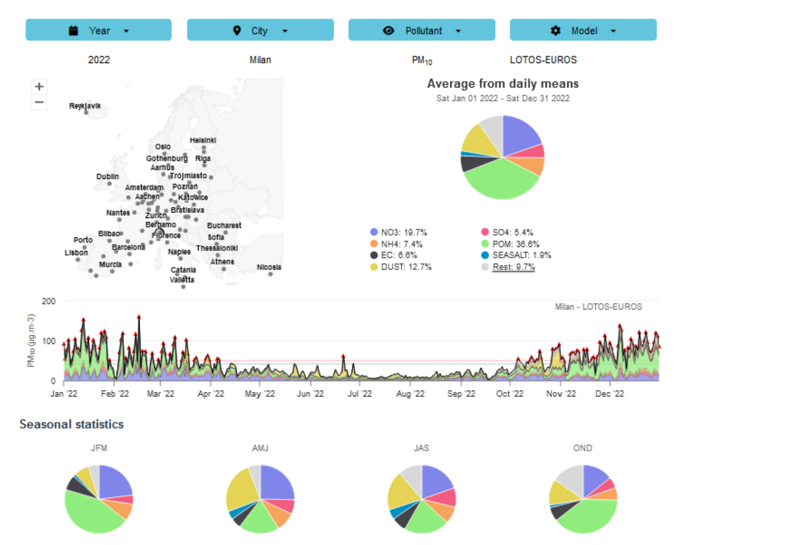
Fill-in Template [2]

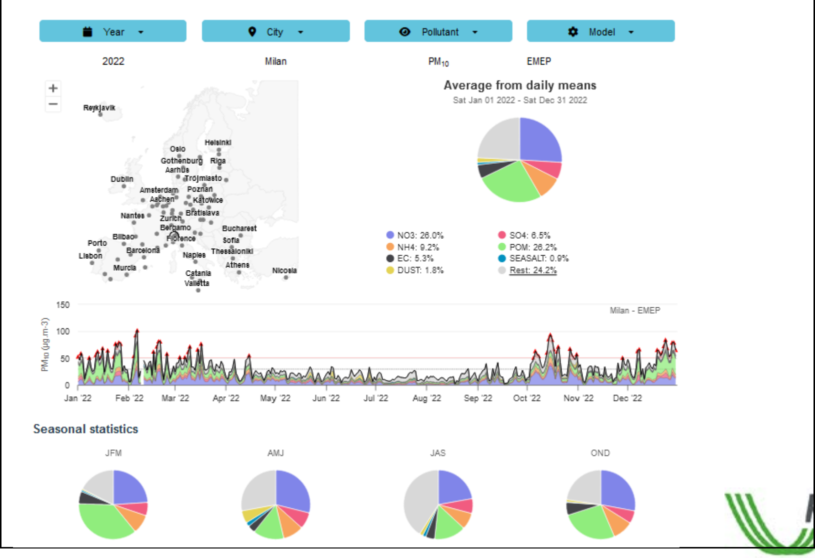
3 - Use of mandatory SA

The two pie graphs are quite similar but there are some differences:

- REST is considered in a different way (it is obviously higher in EMEP)
- DUST is considered in a different way (LOTOS consider both natural and anthropogenic)
- TOTAL PM: what is total PM simulated? (https://policy.atmosphere.copernicus.eu/yearly_air_pollution_analysis/model_evaluation.php?dmin=2022-01-01&dmax=2022-12-31&year=2022)

REST LOTOS-EUROS: rest of PPM (PPM-EC-POM) DUST: natural windblown dust and anthropogenic dust (traffic resuspension and agricultural): from January 2024, these will be provided as separate dust contributions	REST EMEP: SOA, rest of PPM (PPM-EC-POM), PM water, and PM from forest fires DUST: natural windblown dust only (from IFC Boundary conditions and produced within the domain)





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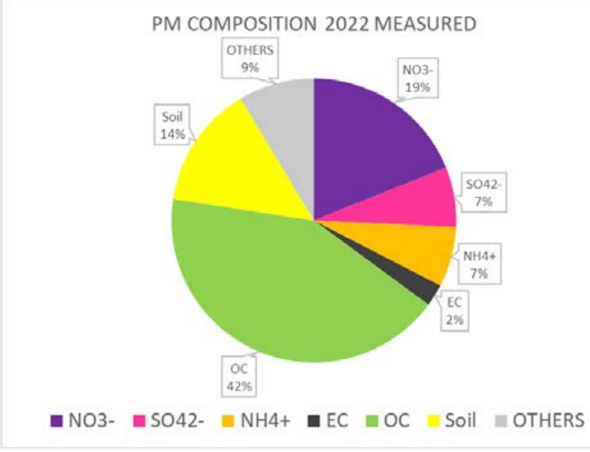
Fill-in Template [3]

5 - If you used methods in complement to each other, explain how and why

COMPARISON BETWEEN DIFFERENT MODELLING SYSTEM AND DATA VALIDATION

In order to understand better the CAMS product a comparison has been made:

- OC/POM is similar except for EMEP (26%)
- SOIL and DUST measured is similar for MEASUREMENTS AND LOTOS (natural+human)
- SO4 is similar except for FARM MODEL
- NO3 is similar for all pie graphs

<table>
<tr><th>MEASUREMENTS IN PASCAL MILANO</th><th>FARM MODEL</th><th></th><th></th></tr>
<tr>
<td>
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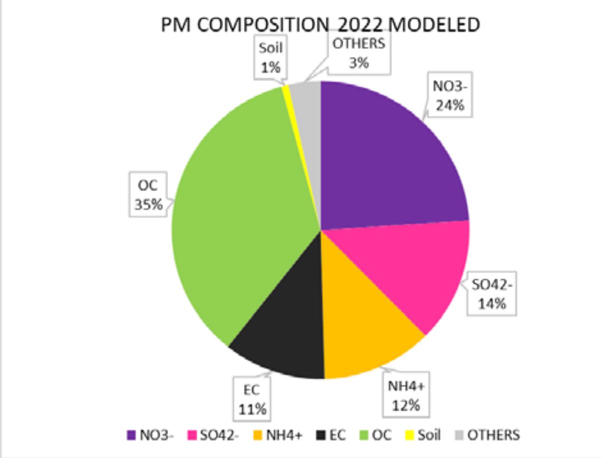
<td>
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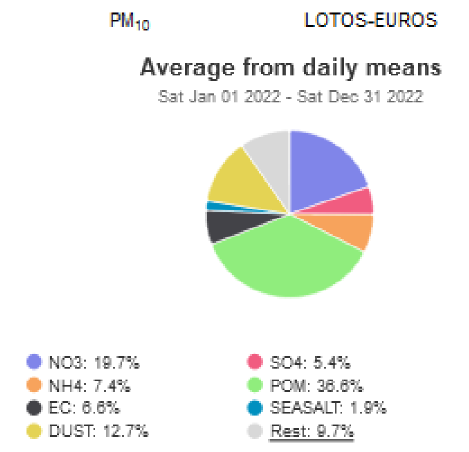
<td>
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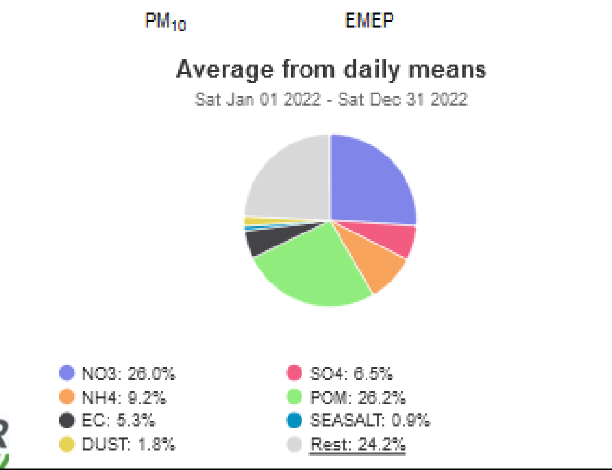
<td>
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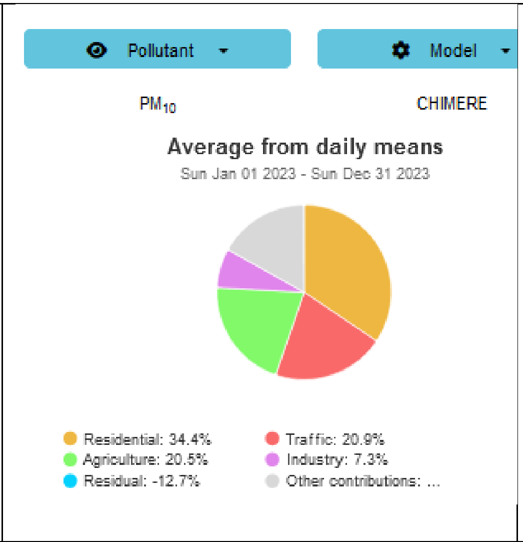
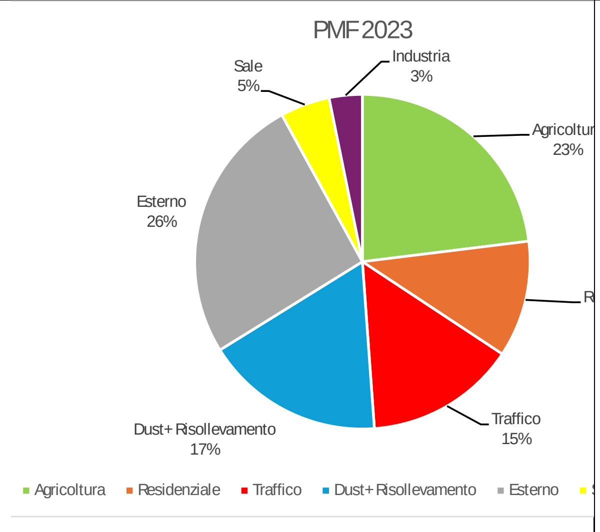
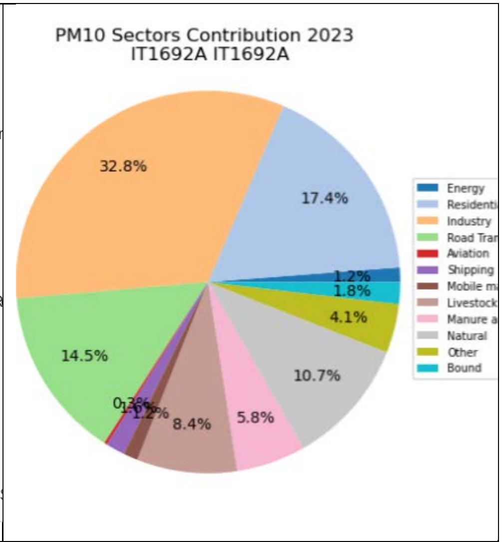
Fill-in Template [3]

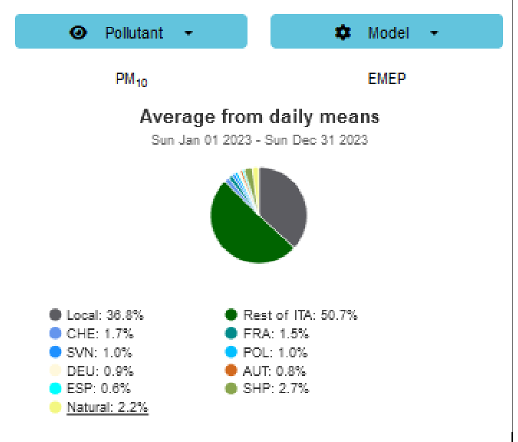
SECTORAL

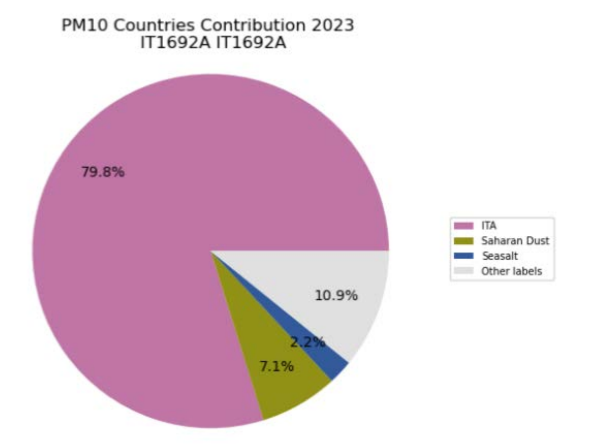






COUNTRY





MAIN ISSUE

- They consider also secondary pollution or not?
- Seasonality presented is 3-monthly based, is it correct?
- Which is the total concentration of PM10? (https://policy.atmosphere.copernicus.eu/yearly_air_pollution_analysis/model_evaluation.php?dmin=2022-01-01&dmax=2022-12-31&year=2022)
- GNFS vs SNAP?
- Different results should be analysed in a deeper way (i.e. Different emission, different meteo, different models)

Fill-in Template [4]

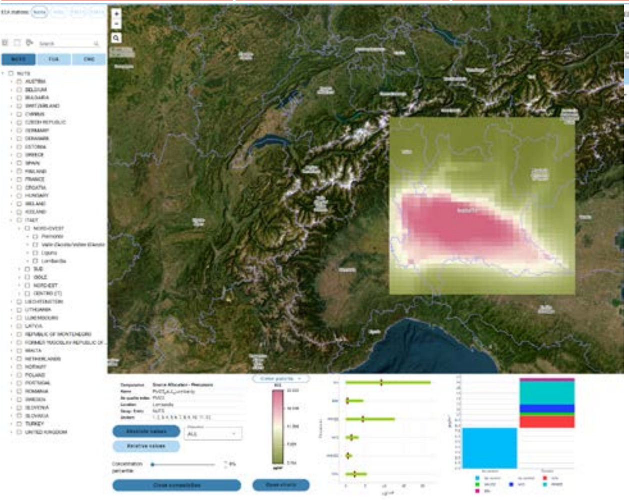
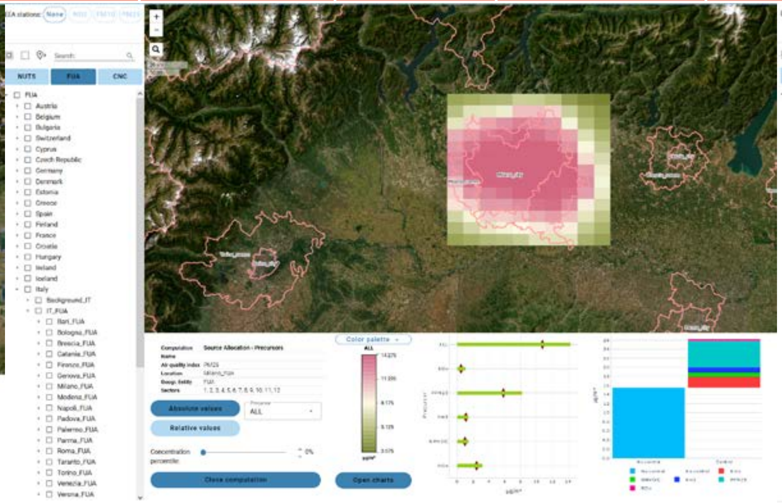
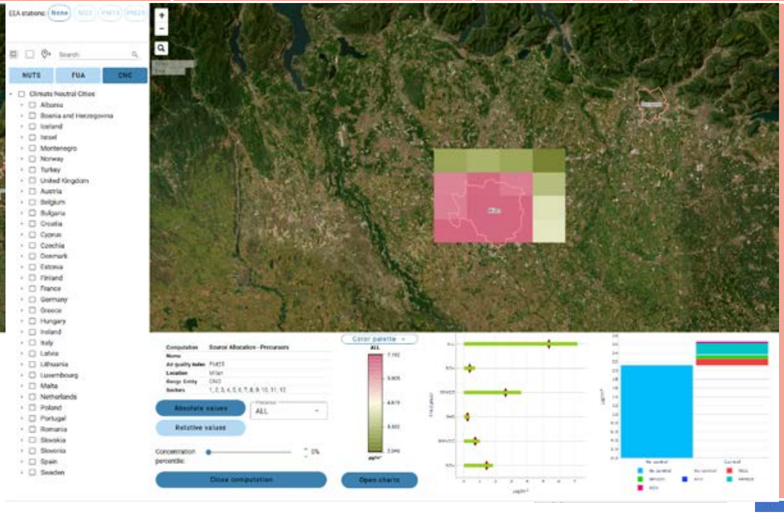
6 - Which sector(s) do you recommend to act on? At which scale?

Based on results, we have observed different percentage rate of sectoral impact

For example: Milan Sector Residential is not unique values based on different SA method

	Area 1	Area 2	Area 3	Area 4	Area 5	...
Sector 1						
Sector 2						
Sector 3						
Sector 4						
Sector 5						
...						

METHOD					INDICATORS	SOURCES				RECEPTORS	
Name of the method and type (tagging, brute force,…)	Goal	Link	Modelling charactristics		For which indicator is the SA performed?	Which emission pollutants?	Which emission sectors?	Over which time period?	Areas	Over which time average period	which spatial average area
			Spatial coverage & resolution	Temporal coverage & resolution							
SHERPA (brute force – source allocation)	Estimate responses on PM2.5 levels of emission reductions applied over different spatial areas	https://aqm.jrc.ec.europa.eu/Section/Sherpa/Background	EU at 6 km	Year based on hourly data	PM2.5 yearly average	NOx, NH3, SO2, PPM25	Transport, residential, agriculture, shipping, industry, …	yearly	City core (e.g. Paris intra-muros), greater city (e.g. Ile de France), country, EU	yearly	hot-spot concentration grid-cell within the core city

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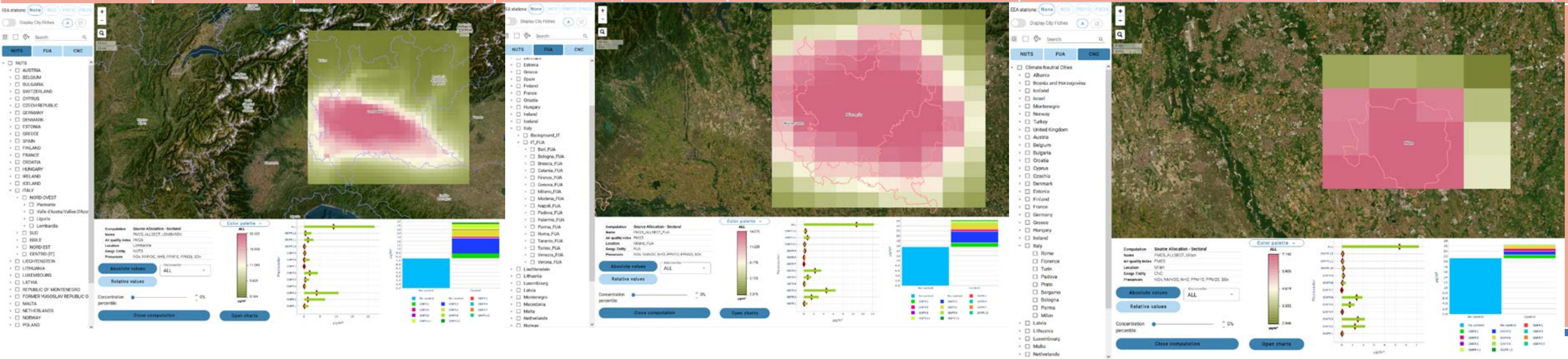
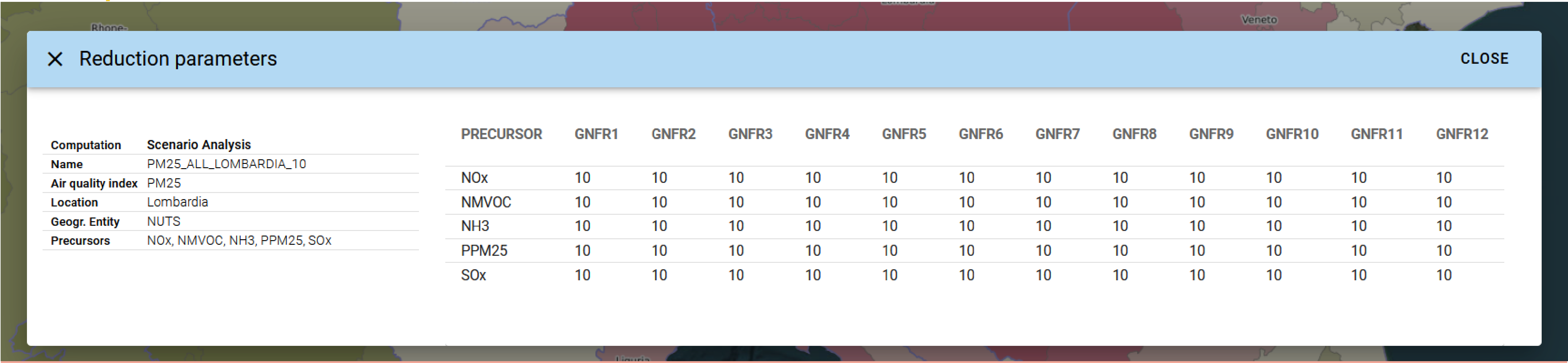


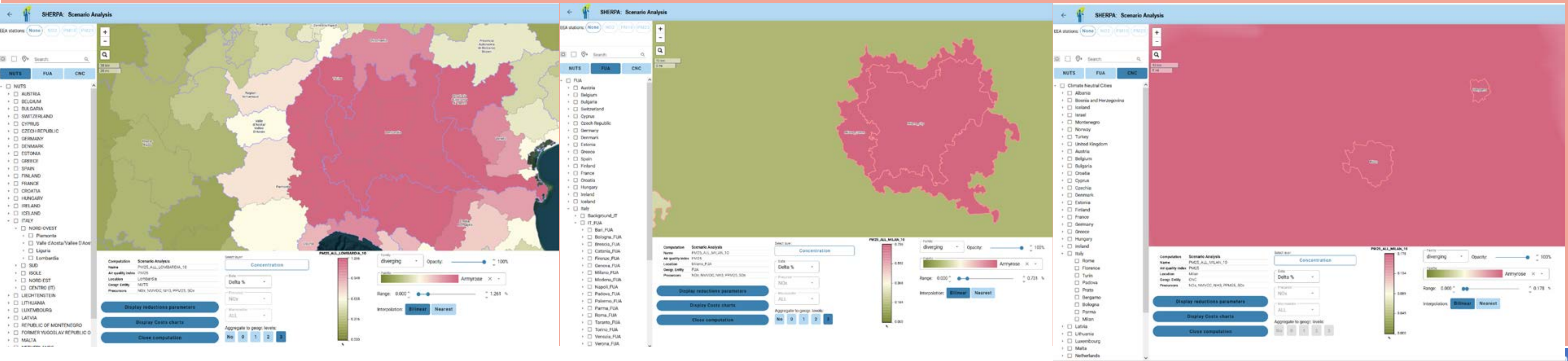


Reduction parameters

CLOSE

Computation	**Scenario Analysis**
Name	PM25_ALL_LOMBARDIA_10
Air quality index	PM25
Location	Lombardia
Geogr. Entity	NUTS
Precursors	NOx, NMVOC, NH3, PPM25, SOx

PRECURSOR	GNFR1	GNFR2	GNFR3	GNFR4	GNFR5	GNFR6	GNFR7	GNFR8	GNFR9	GNFR10	GNFR11	GNFR12
NOx	10	10	10	10	10	10	10	10	10	10	10	10
NMVOC	10	10	10	10	10	10	10	10	10	10	10	10
NH3	10	10	10	10	10	10	10	10	10	10	10	10
PPM25	10	10	10	10	10	10	10	10	10	10	10	10
SOx	10	10	10	10	10	10	10	10	10	10	10	10



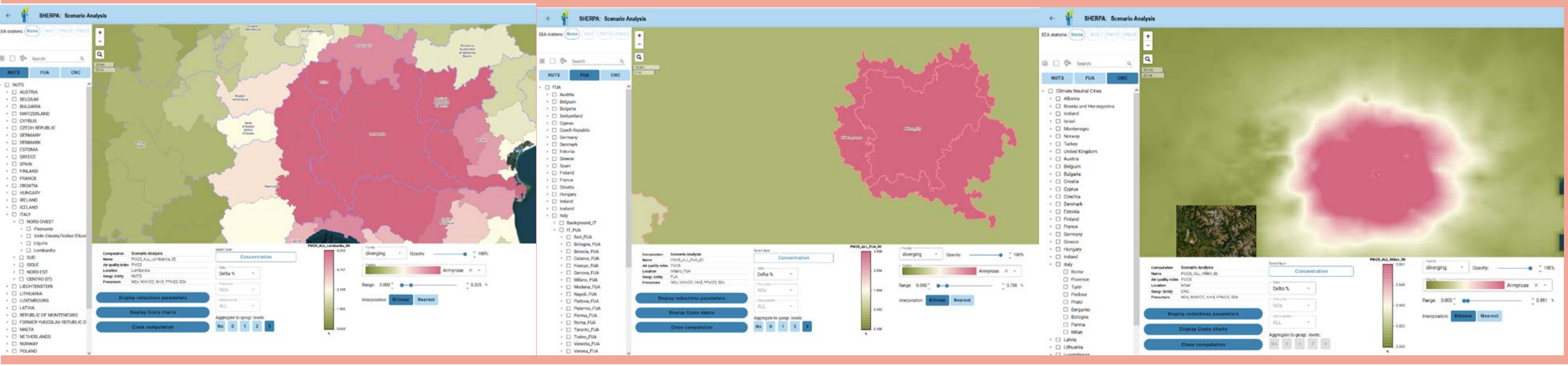
de Strasbourg

Reduction parameters

CLOSE

Computation	**Scenario Analysis**
Name	PM25_ALL_Lombardia_50
Air quality index	PM25
Location	Lombardia
Geogr. Entity	NUTS
Precursors	NOx, NMVOC, NH3, PPM25, SOx

PRECURSOR	GNFR1	GNFR2	GNFR3	GNFR4	GNFR5	GNFR6	GNFR7	GNFR8	GNFR9	GNFR10	GNFR11	GNFR12
NOx	50	50	50	50	50	50	50	50	50	50	50	50
NMVOC	50	50	50	50	50	50	50	50	50	50	50	50
NH3	50	50	50	50	50	50	50	50	50	50	50	50
PPM25	50	50	50	50	50	50	50	50	50	50	50	50
SOx	50	50	50	50	50	50	50	50	50	50	50	50



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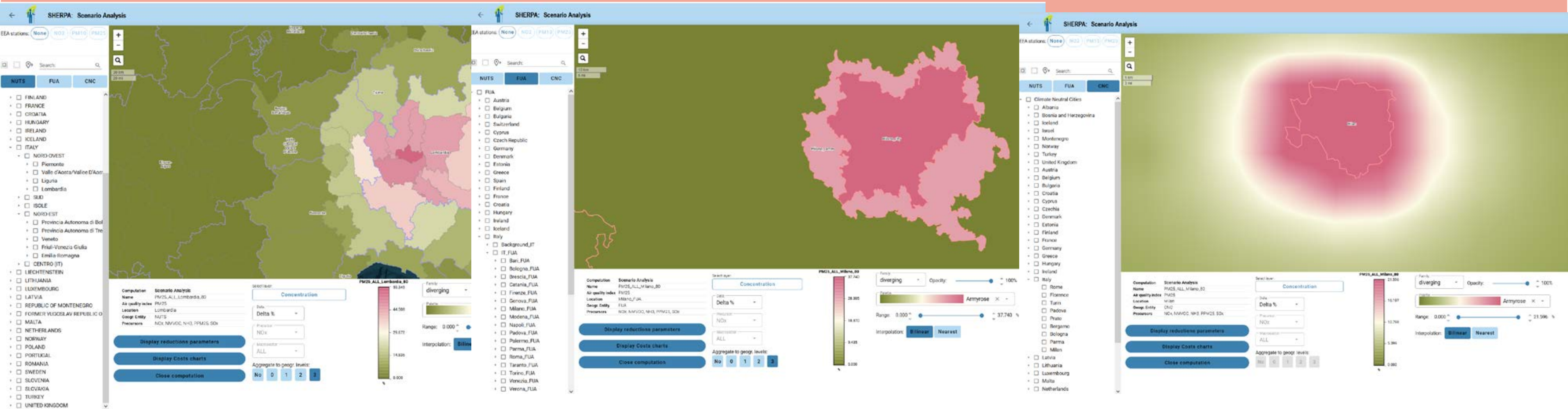
Reduction parameters

CLOSE

Computation	**Scenario Analysis**
Name	PM25_ALL_Milano_80
Air quality index	PM25
Location	Milano_FUA
Geogr. Entity	FUA
Precursors	NOx, NMVOC, NH3, PPM25, SOx

PRECURSOR	GNFR1	GNFR2	GNFR3	GNFR4	GNFR5	GNFR6	GNFR7	GNFR8	GNFR9	GNFR10	GNFR11	GNFR12
NOx	80	80	80	80	80	80	80	80	80	80	80	80
NMVOC	80	80	80	80	80	80	80	80	80	80	80	80
NH3	80	80	80	80	80	80	80	80	80	80	80	80
PPM25	80	80	80	80	80	80	80	80	80	80	80	80
SOx	80	80	80	80	80	80	80	80	80	80	80	80



Default Available EU Informations (mandatory)

METHOD					INDICATORS	SOURCES				RECEPTORS	
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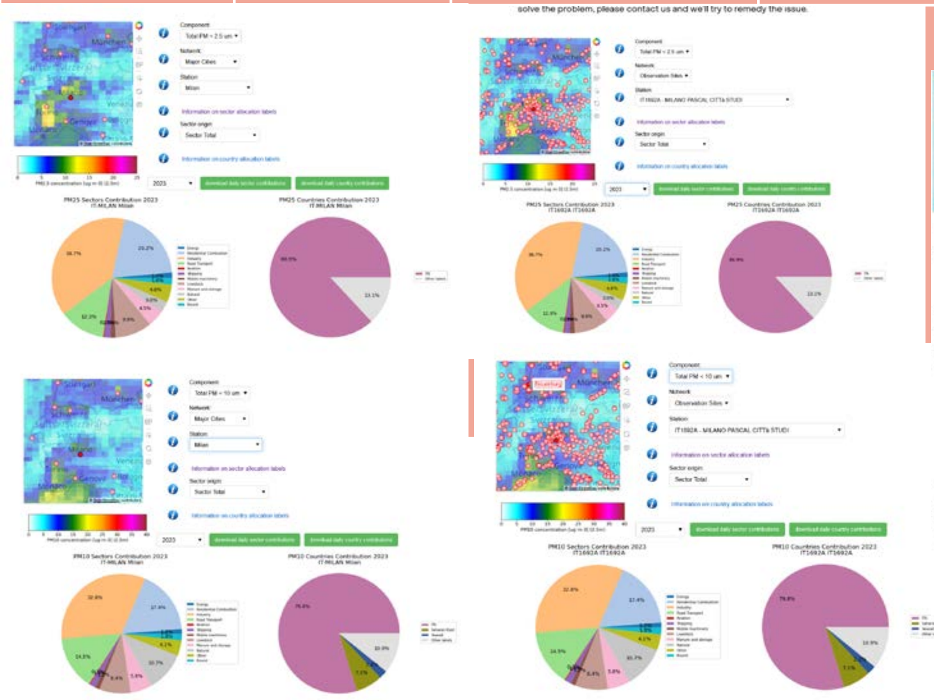
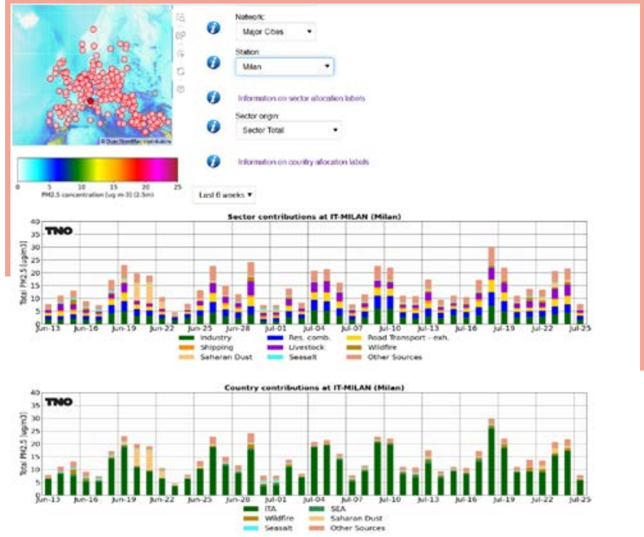
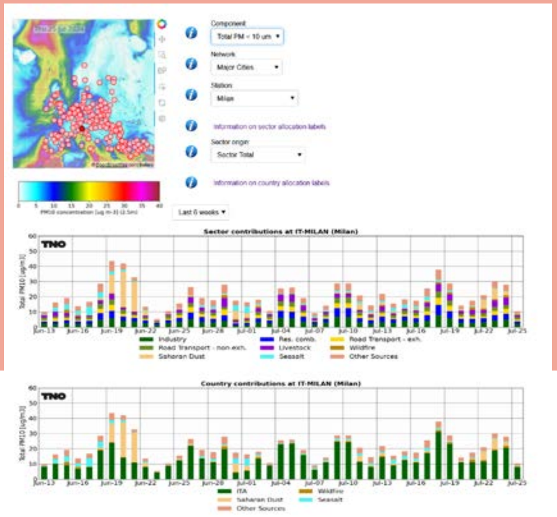
			Spatial coverage & resolution	Temporal coverage & resolution							
TOPAS (tagging)	Provide region or sector contributions to air pollution levels at any place and time	https://airqualitymodeling.tno.nl/topas/	EU 0.2x0.1°	2019-today hourly	PM_{10}, $PM_{2.5}$, (NO_2, SO_2)	NOx, NH3, SOx, PPM25, PPM10, NMVOC	Energy, Residential combustion, Industry, Fuel production, Solvent use, Road transport exhaust, road transport non-exhaust, shipping, aviation, mobile machinery, Waste, livestock, manure and storage, wildfire, saharan dust, seasalt, biogenic		Countries (also included in CAMS policy service)	hourly, daily and yearly	Major cities and eea observation sites







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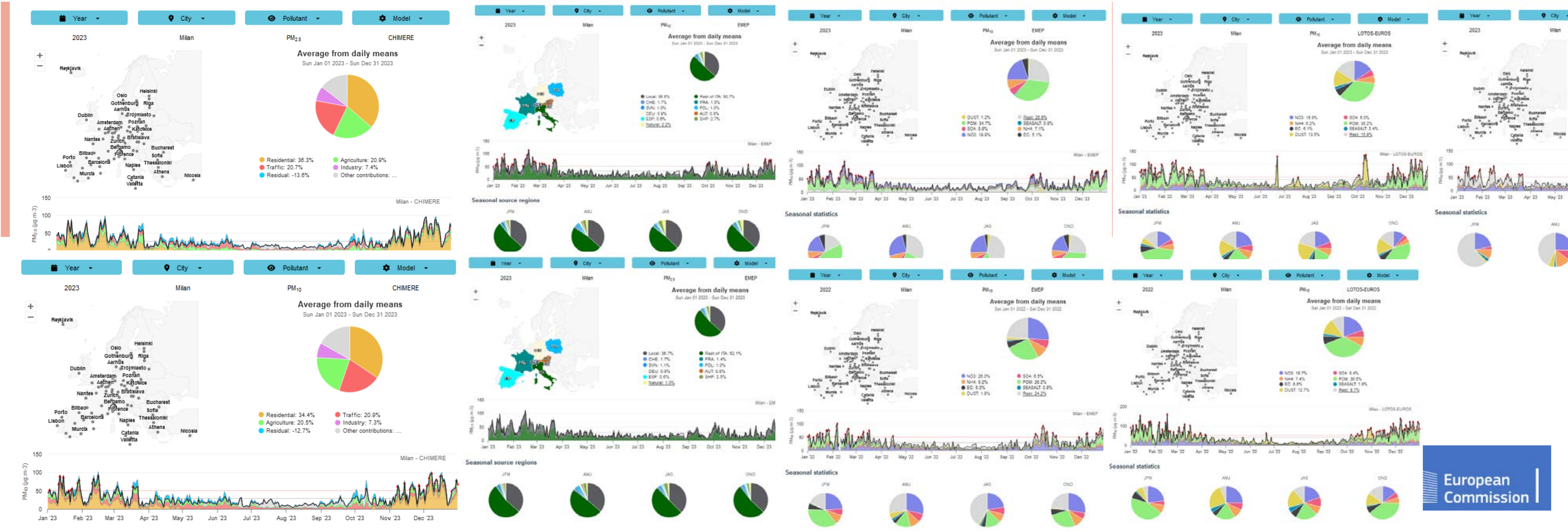
Name of the method and type (tagging, brute force,…)	Goal	Link	Modelling characteristics		For which indicator is the SA performed?	Which emission pollutants?	Which emission sectors?	Over which time period?	Areas	Over which time average period	which spatial average area
			Spatial coverage & resolution	Temporal coverage & resolution							
CAMS/EMEP SR (emission perturbation/brute force - impact)		https://policy.atmosphere.copernicus.eu/yearly_air_pollution_analysis/country_impact.php https://policy.atmosphere.copernicus.eu/daily_source_attribution/country_impact.php	CAMS domain (30-72°N 30°W-45°E) 0.2x0.1°		PM10, PM2.5 (yearly) PM10, PM2.5, O3 (4-day forecasts)	NOx, NH3, SOx, PPM25, PPM10, NMVOC	Countries	Long term	City (ca 42x42 km2), country, shipping, BIC	Hourly, daily, yearly Since 2019	80 EU cities (average of grid cells corresponding to ca 42x42 km2)



Thank you for your attention

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CT1 - Source apportionment

Exercise SA Practices Methods - comments

Velimir Milić

Darijo Brzoja

Dublin, October 7, 2024.

Exercise

- Contribute designing an air quality plan in the framework of the EU directive over your chosen domain for PM.
- Consult all <default available EU information> (SHERPA, CAMS ACT, TOPAS...)

- Chosen domain was Zagreb FUA (Croatia)
- Long-term planning for PM10 using 2023. data

Results : short overview

- All available sources were consulted
- GNFR 3 (C) has the largest influence on surface concentrations of PM10

- SHERPA
  - Largest annual average concentration of PM10 within FUA Zagreb is just over the proposed target value with 20.037 µg/m3
  - Reduction of GNFR 3 in Zagreb FUA by 30% would lead to reduction up to 1.361 µg/m3
  - Very probable additional benefit would be reduction of number of daily exceedances

Aim of SA method – important questions

- We are not directly responsible for creating action plans, but we are obliged to provide support in identifying important sources, estimating impacts and providing comments on future plans.
- There are few important categories of questions:
  - How much of pollution is „local” (within control)
  - What are the dominant antropogenic sources of pollution within domain?
  - Estimating impact of specific scenarios.

Comments on available tools

- SHERPA (online dashboard)

1. Source allocation – sectoral : without reductions to get „baseline”. Largest contribution from GNFR 3 (21.19%) followed by GNFR 2 with (7.84%) ...
2. Source allocation – precursors : without reductions to get „baseline”. Largest contribution from PPM10 (36.4%) followed by NOx (6.22%)
3. Further exploration on possible impacts of specific reduction scenarios...

Comments on available tools

- CAMS ACT

1. Looks to be more oriented at short term plans, so i focused on D+0 horizon for multiple different dates
2. Looking at seasonal impacts, it is evident that GNFR 3 plays important role during winter
3. Very easy and intuitive to adjust scenarios and to illustate impacts
    - Example : pick a day with daily exceedance and see if proposed measures will be effective.

Comments on available tools

- CAMS : EMEP-SR, LOTOS-EUROS, CHIMERE
- All available tools provided are very informative and provided consistent results
  1. country potential impact : about 50% pollution is from outside HRV
  2. Sector apportionment : GNFR C stands out
  3. Chemical speciation

TOPAS

- One of the first available tools that was used.
  1. Country and sector relative contribution (tagging)
  2. Speciation data for entire year can be downloaded for specified cities (including Zagreb)
  3. Results show that largest impact comes from GNFR C (29.4%) and local contributions (HRV 63.5%)

General comments

- Available policy tools provide excelent starting point
- It would be nice to see/hear feedback from other interested parties (policy makers...)

WG1

Experience with SHERPA/CAMS-ACT for Portugal

Alexandra Monteiro, Laura Silveira
University of Aveiro, Portugal

Default Available EU Informations (mandatory)

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Name of the method and type (tagging, brute force,…)	Goal	Link	Modelling characteristics		For which indicator is the SA performed?	Which emission pollutants?	Which emission sectors?	Over which time period?	Areas	Over which time average period	which spatial average area
			Spatial coverage & resolution	Temporal coverage & resolution	√	√					
SHERPA (brute force – source allocation)	Estimate responses on PM2.5 levels of emission reductions applied over different spatial areas	https://aqm.jrc.ec.europa.eu/Section/Sherpa/Background	EU at 6 km	Year based on hourly data	PM2.5 yearly average	NOx, NH3, SO2, PPM25	Transport, residential, agriculture, shipping, industry, …	yearly	City core (e.g. Paris intra-muros), greater city (e.g. Ile de France), country, EU	yearly	hot-spot concentration grid-cell within the core city
CAMS/EMEP SR (emission perturbation/brute force - impact)		https://policy.atmosphere.copernicus.eu/yearly_air_pollution_analysis/country_impact.php https://policy.atmosphere.copernicus.eu/daily_source_attribution/country_impact.php	CAMS domain (30-72°N 30°W-45°E) 0.2x0.1°		PM10, PM2.5 (yearly) PM10, PM2.5, O3 (4-day forecasts)	NOx, NH3, SOx, PPM25, PPM10, NMVOC	Countries	Long term	City (ca 42x42 km2), country, shipping, BIC	Hourly, daily, yearly Since 2019	80 EU cities (average of grid cells corresponding to ca 42x42 km2)
Air Control Toolbox (Emulator of emission perturbation/brute force - impact)		https://policy.atmosphere.copernicus.eu/daily_source_attribution/sector_apportionment.php	CAMS domain (30-72°N 30°W-45°E) 0.2x0.1°		PM25,PM10,NO2, O3	NOx, NH3, SOx, PPM25, PPM10, NMVOC	Transport, residential, agriculture, shipping, industry, other	Long term	EU	Hourly, daily, yearly Since 2023	80 EU cities (average of grid cells corresponding to ca 42x42 km2)
LOTOS-EUROS tagging		https://policy.atmosphere.copernicus.eu/yearly_air_pollution_analysis/country_contribution.php https://policy.atmosphere.copernicus.eu/daily_source_attribution/country_contribution.php	CAMS domain (30-72°N 30°W-45°E) 0.2x0.1°		PM10, PM25 (other species available on TOPAS site)	NOx, NH3, SOx, PPM25, PPM10, NMVOC	Countries (sectors available on TOPAS site)	Long term	Countries, shipping, BIC	Hourly, daily, yearly Since 2019	80 EU cities (average of grid cells corresponding to ca 42x42 km2)
							Energy, Residential combustion, Industry, Fuel production, Solvent use, Road		Countries		

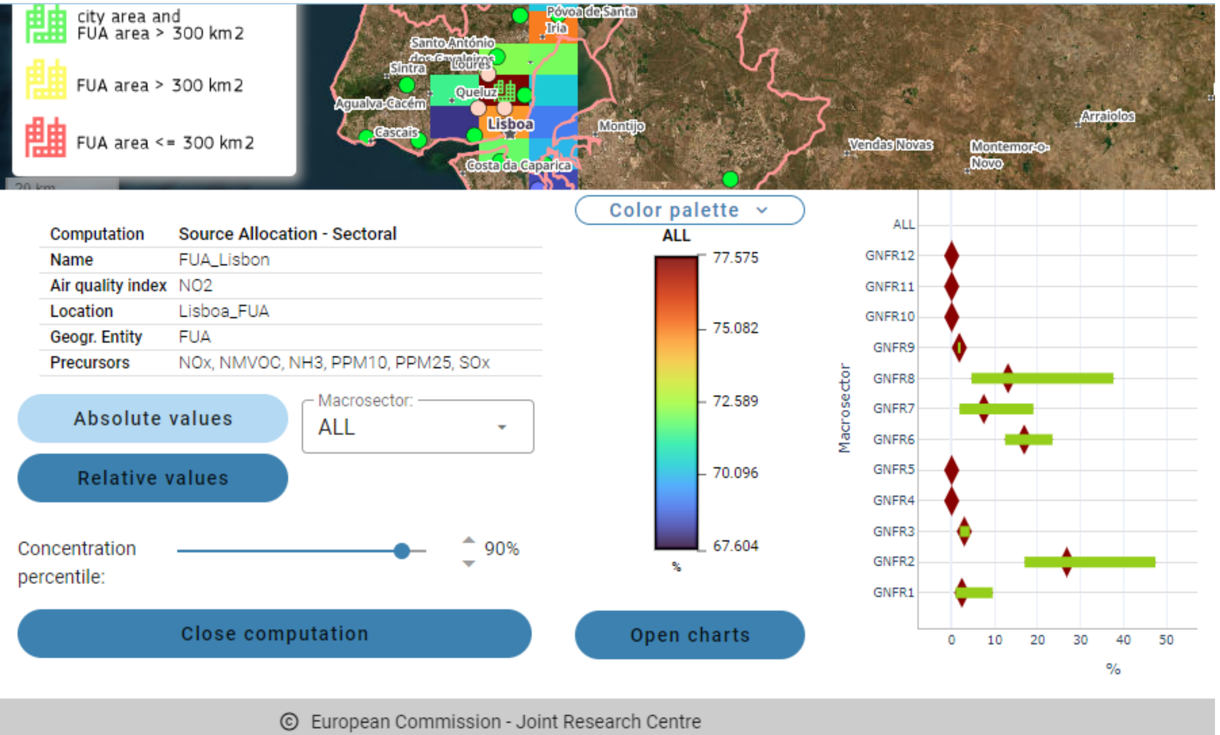
1. What question are you trying to answer when you use a Source Apportionment method?

- What is the relative contribution of the various emission sectors?

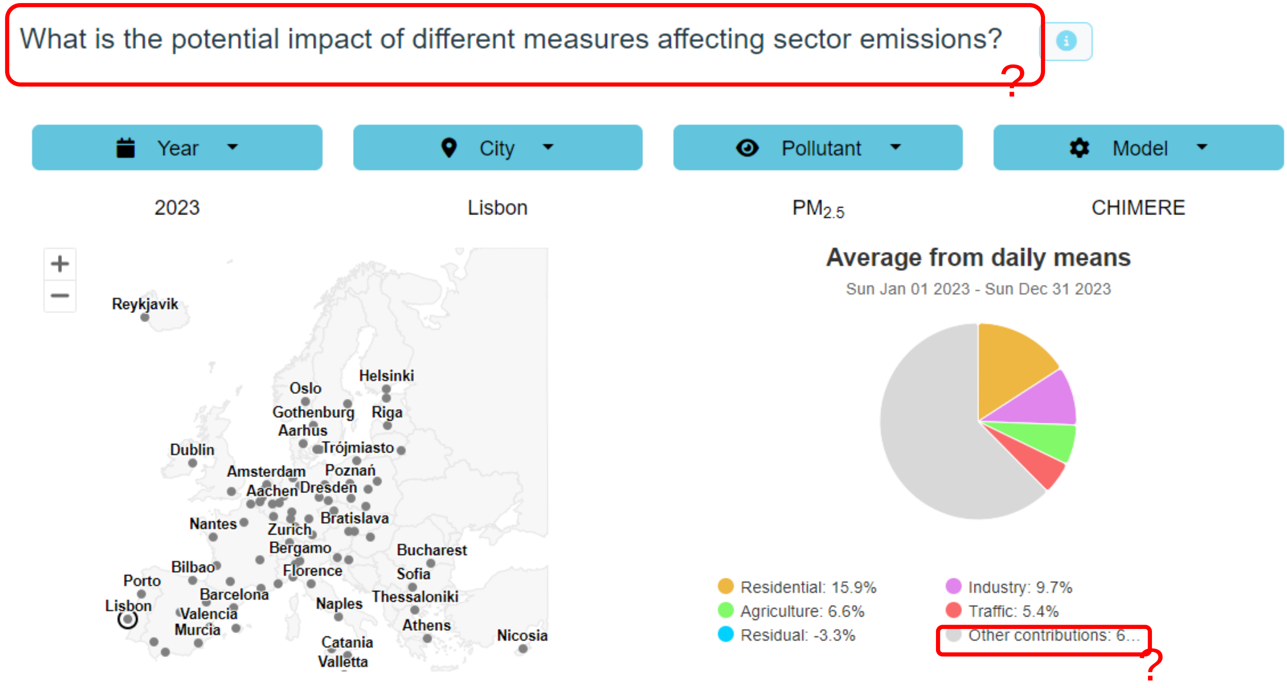
- What is the potential impact of different measures affecting sector emissions?

2. How did you arrive at your conclusions based on the tools you used?

Area: Lisbon city
Pollutant: NO2
Year: 2023

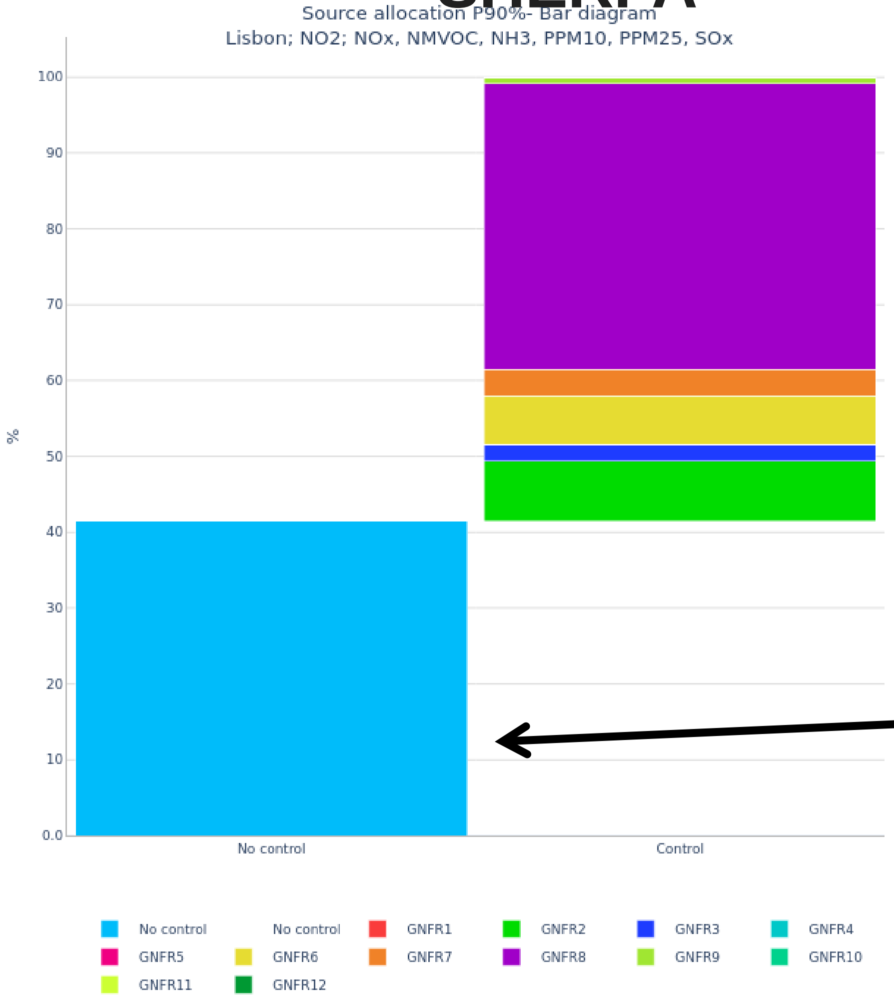


Yearly air Pollution analysis/Sector apportio



2. How did you arrive at your conclusions based on the tools you used?

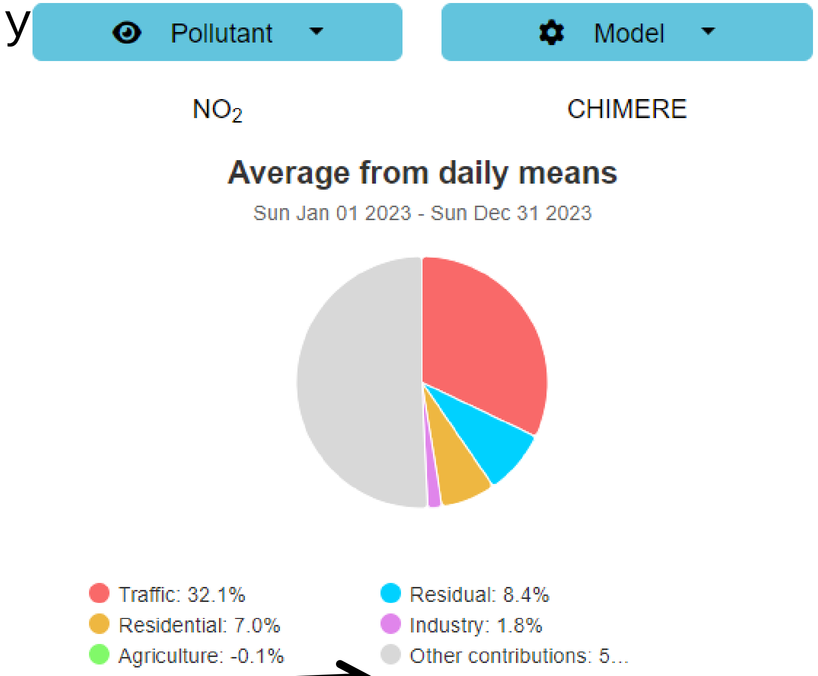
SHERPA

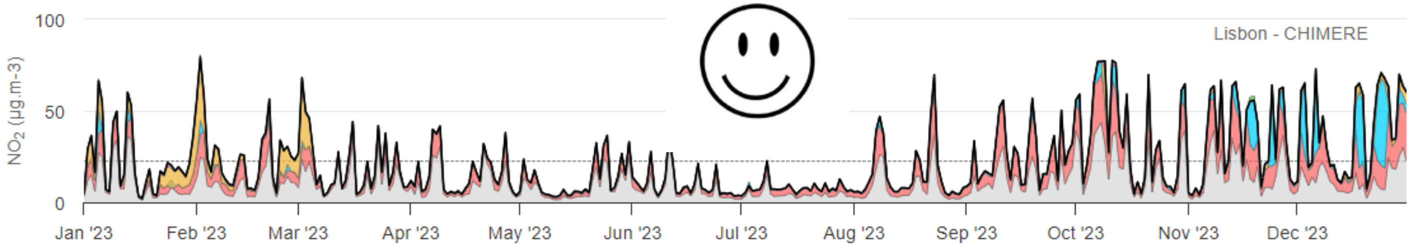


Area: Lisbon city
Pollutant: NO2
Year: 2023

?

CAMS





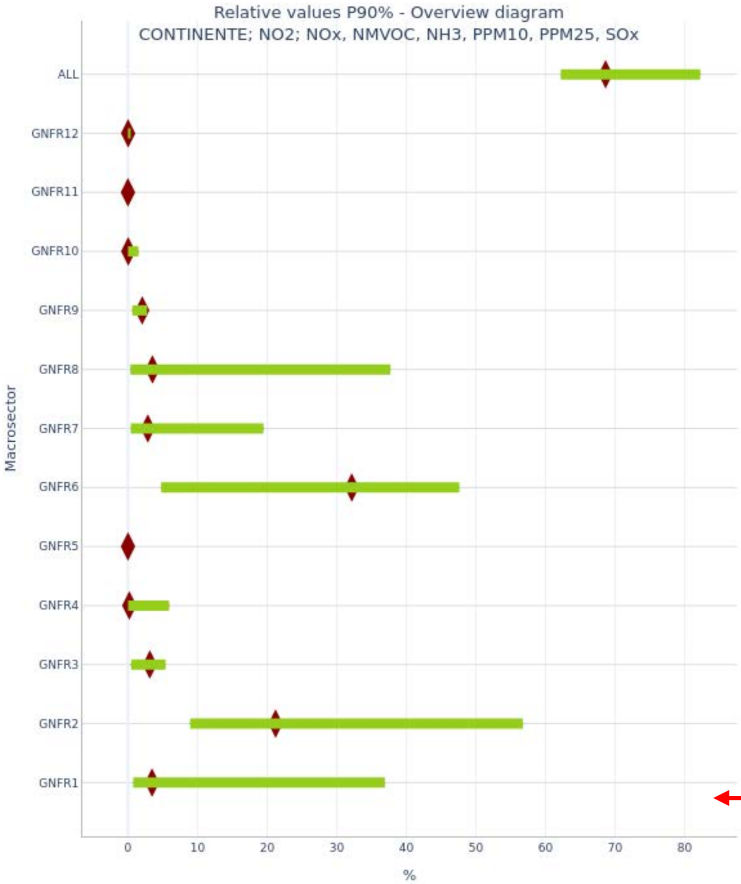
SHERPA: diversification in plotting results

☺

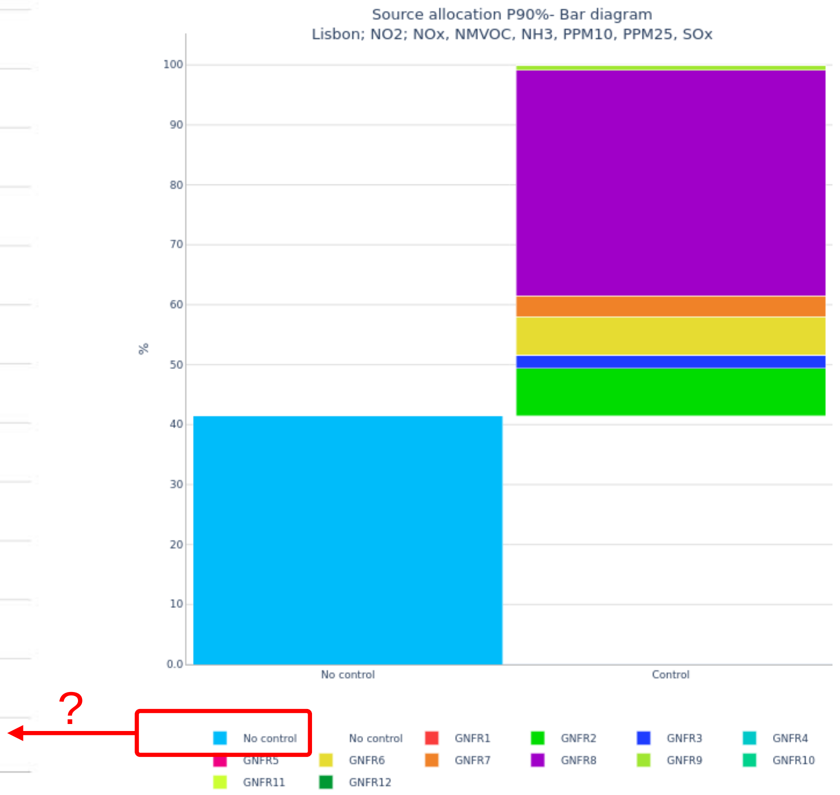
Absolute/relative

NO2	Mainland	
Sectors	Abs. Values (µg/m³)	Rel. values (%)
All	5.36	68.63
GNFR12	0	0.03
GNFR11	0	0
GNFR10	0	0.04
GNFR9	0.15	2.05
GNFR8	9.02	3.52
GNFR7	0.28	2.85
GNFR6	2.45	32.15
GNFR5	0	0
GNFR4	0.02	0.19
GNFR3	0.25	3.13
GNFR2	1.59	21.21
GNFR1	0.27	3.46

Overview diagram

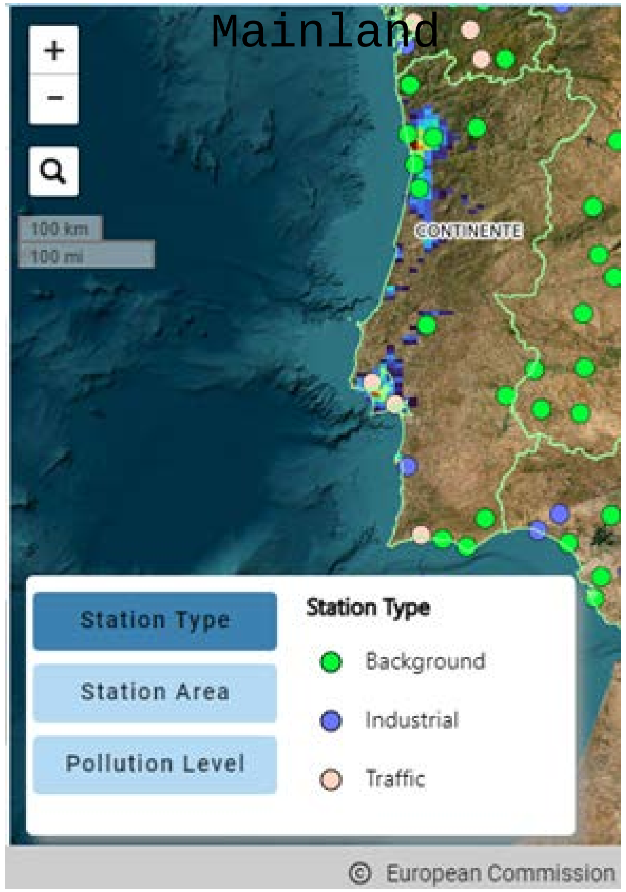


Bar diagram

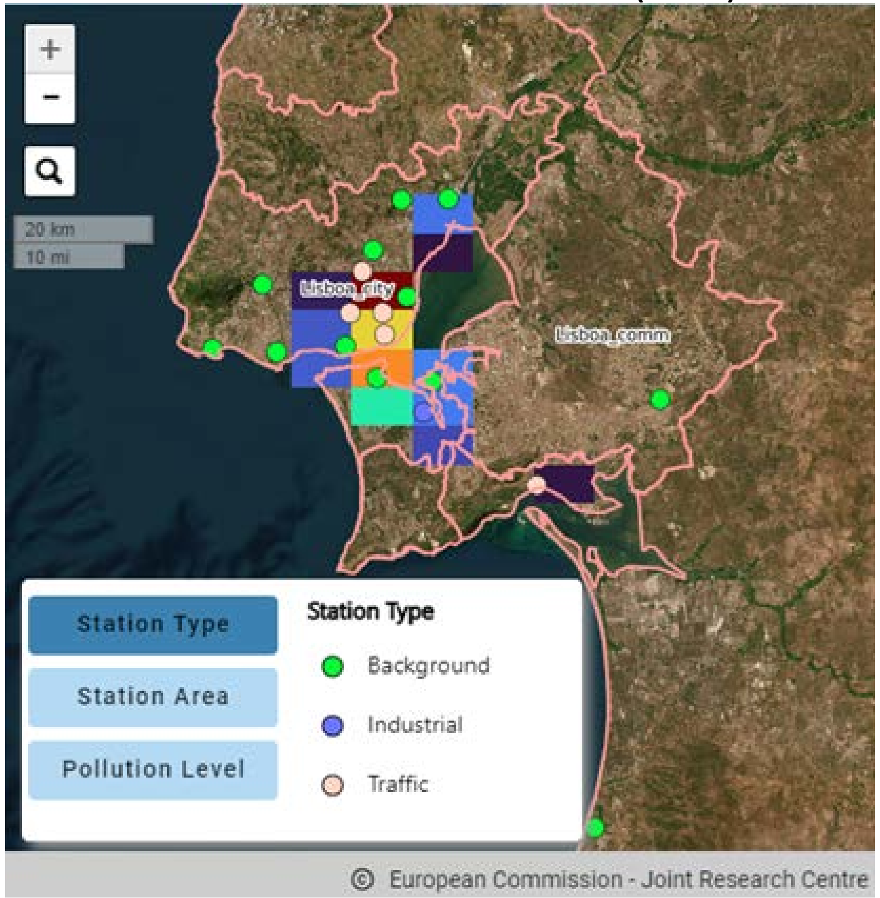


SHERPA: spatial analysis

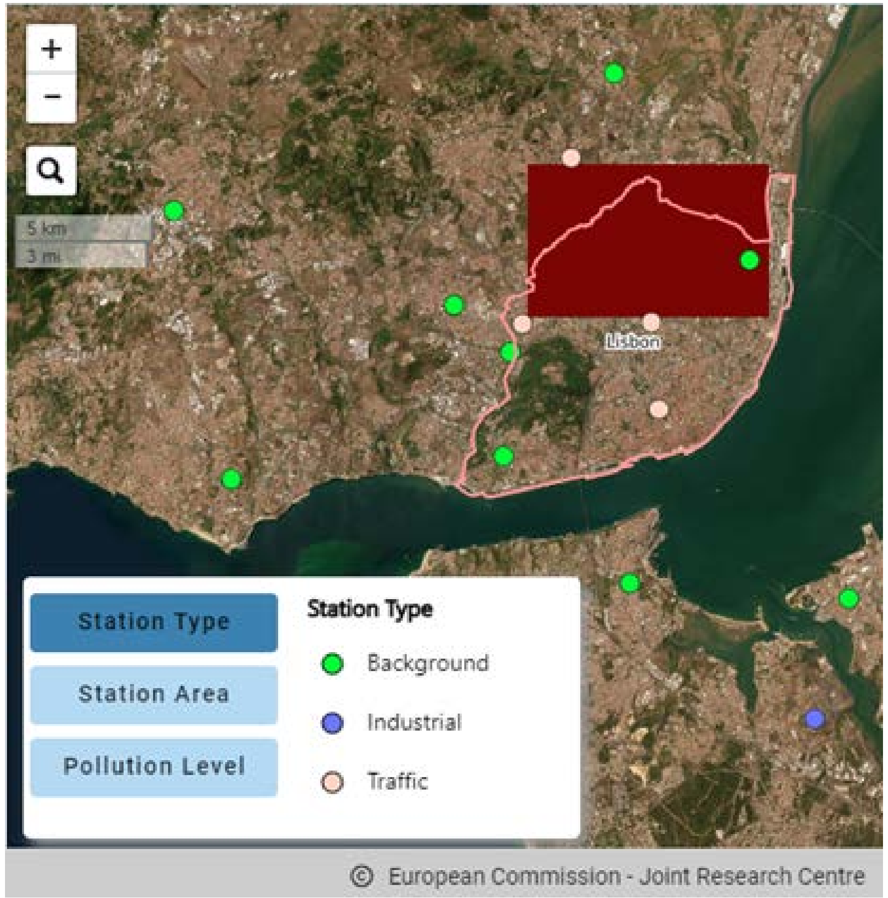
Portugal Mainland



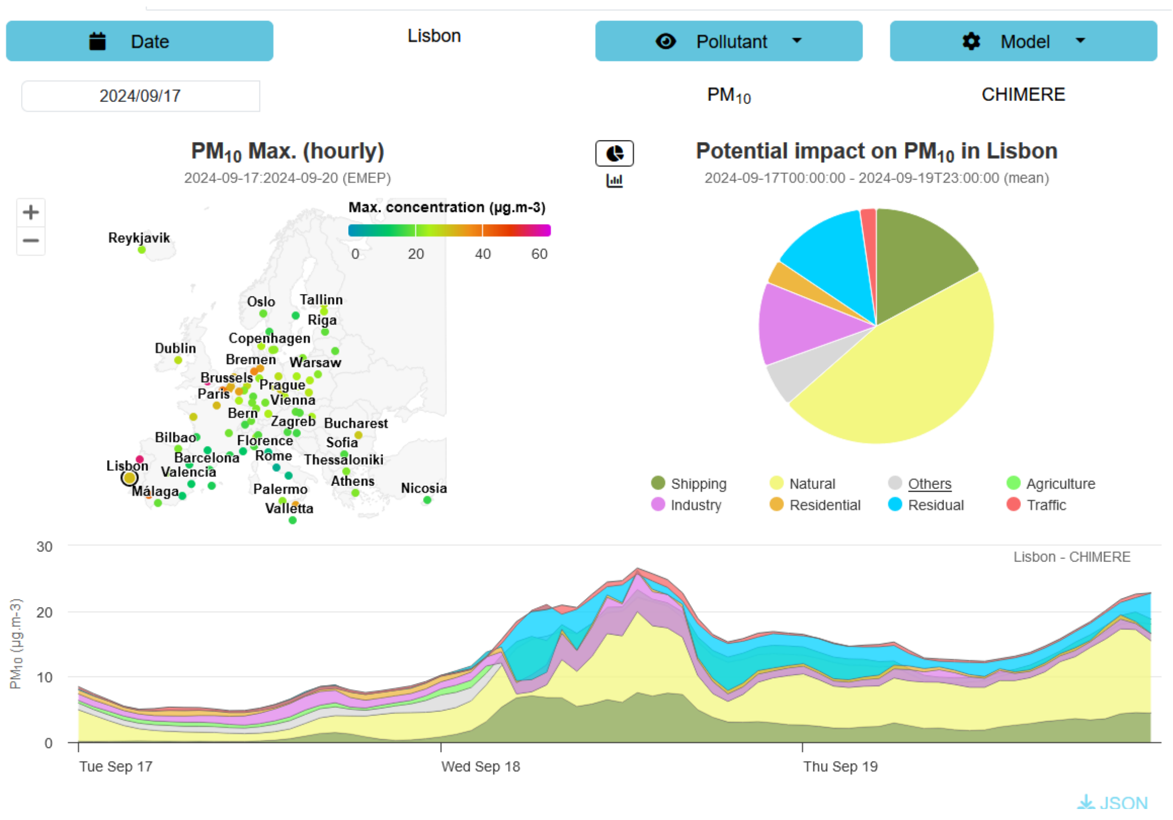
Functional Urban Areas (FUA)



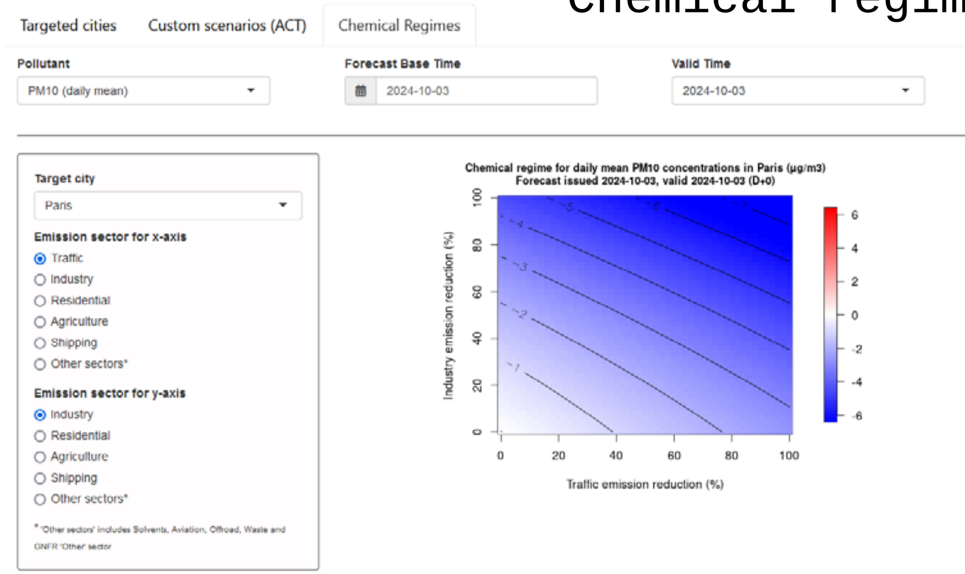
Lisbon region



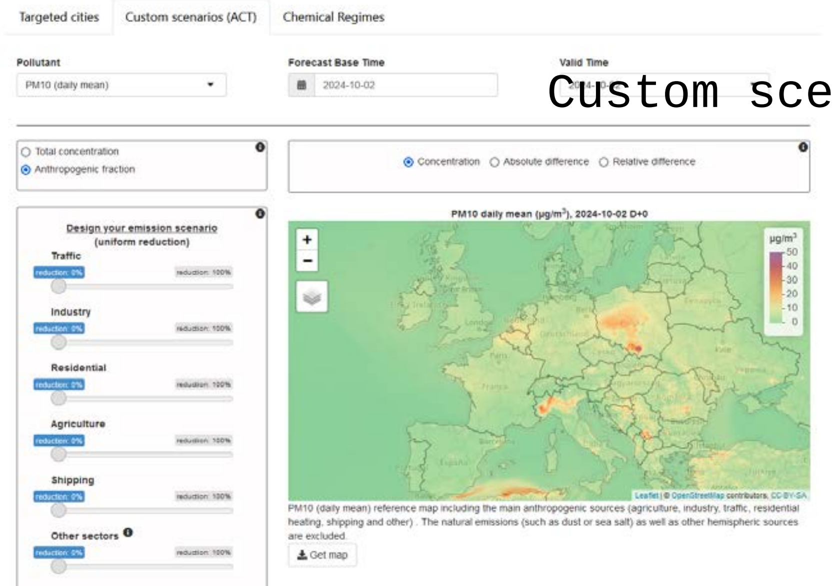
CAMS-ACT: daily/episode analysis



Chemical regim



Custom scenari



3. What issues did you find when answering the survey? What suggestions can you make to improve it?

SHERP

Advantages:

- Provides a more detailed mapping of the sectoral analysis of the contribution to pollution
- Offers absolute and relative potential pollutant concentrations for each sector

Limitations: temporal analysis

CAMS-ACT

Advantages:

- Overview related to temporal analysis over a one-year period and regional influences on the impact of emissions
- Useful for regional assessments and for understanding the impact of international and natural contributions
- Provides a more detailed temporal analysis and territorial boundaries of the contribution pollutants

Limitations: spatial analysis.

3. What issues did you find when answering the survey? What suggestions can you make to improve it?

- Clarify and distinguish the purpose of the different tools. It would be an advantage to have different tools for different goals/purposes
- GNFR vs SNAP?? More homogeneity?
- “Sector apportionment” & “potential impact of measures”?