

SHERPA application: guided exercise

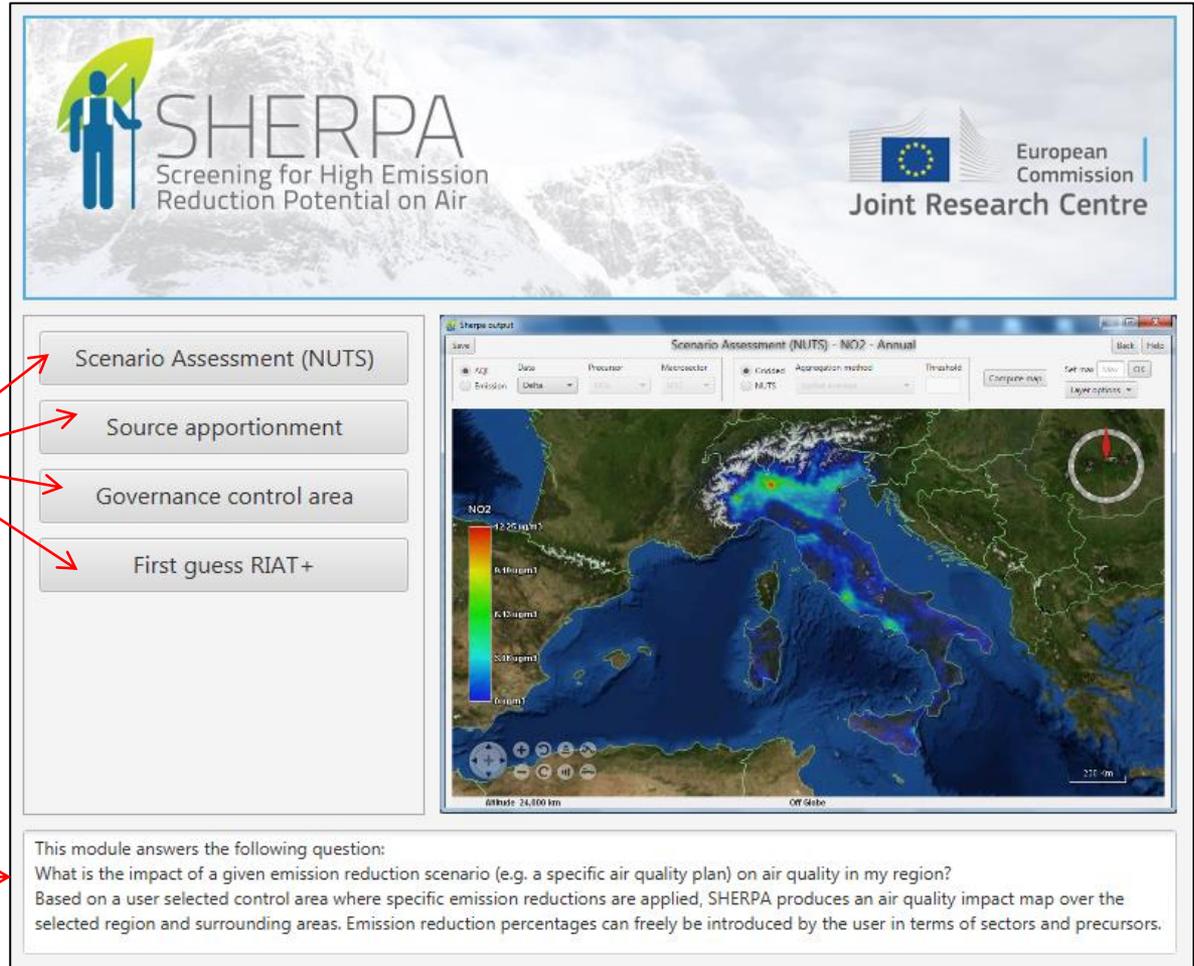


SHERPA
Screening for High Emission
Reduction Potential on Air



Software developed by TerrAria
under the Contract Procedure
no. JRC/IPR/2014/H.2/0023/NC

The SHERPA Tool



The screenshot displays the SHERPA tool interface. At the top, the logo features a stylized figure with a green umbrella and the text "SHERPA Screening for High Emission Reduction Potential on Air". To the right is the European Commission Joint Research Centre logo. Below the header, a vertical menu lists four modules: "Scenario Assessment (NUTS)", "Source apportionment", "Governance control area", and "First guess RIAT+". To the right of this menu is a window titled "Sherpa output" showing a map of Europe with an NO2 concentration overlay. The map includes a color scale from 0 to 12.25 µg/m³ and various interface elements like "save", "Data", "Precursor", "Microsector", "Gridset", "Apportionment method", "Threshold", "Compare map", "Layer options", "Set map", "View", and "Close". Below the map, a text box explains the module's function.

Scenario Assessment (NUTS)

Source apportionment

Governance control area

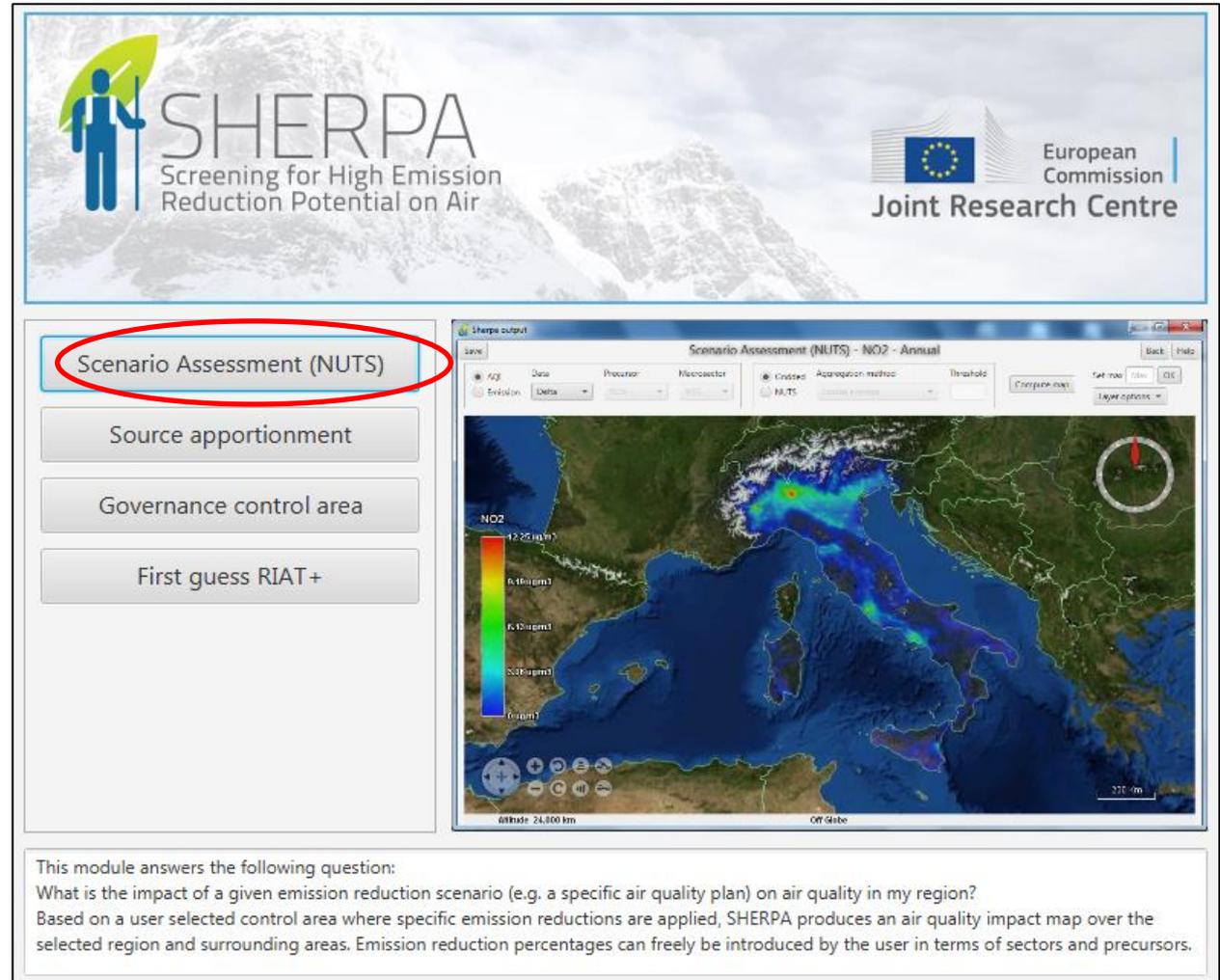
First guess RIAT+

This module answers the following question:
What is the impact of a given emission reduction scenario (e.g. a specific air quality plan) on air quality in my region?
Based on a user selected control area where specific emission reductions are applied, SHERPA produces an air quality impact map over the selected region and surrounding areas. Emission reduction percentages can freely be introduced by the user in terms of sectors and precursors.

4 possible modules

Additional information concerning the selected module

Scenario Assessment



The screenshot displays the SHERPA web interface. At the top, the SHERPA logo is on the left, and the European Commission Joint Research Centre logo is on the right. The main content area is divided into two panels. The left panel contains a vertical menu of buttons: "Scenario Assessment (NUTS)", "Source apportionment", "Governance control area", and "First guess RIAT+". The "Scenario Assessment (NUTS)" button is highlighted with a red oval. The right panel shows a "Scenario Assessment (NUTS) - NO2 - Annual" map. The map displays a color-coded air quality impact over Europe, with a legend on the left indicating NO2 concentrations in µg/m³: 0, 200, 400, 600, 800, and 1200. The map includes a scale bar (24,000 km) and a north arrow.

This module answers the following question:
What is the impact of a given emission reduction scenario (e.g. a specific air quality plan) on air quality in my region?
Based on a user selected control area where specific emission reductions are applied, SHERPA produces an air quality impact map over the selected region and surrounding areas. Emission reduction percentages can freely be introduced by the user in terms of sectors and precursors.

Selection of “Scenario Assessment”

Scenario Assessment

Scenario Assessment (NUTS)

Load config Save config

AUSTRIA
BELGIUM
BULGARIA
SWITZERLAND
CYPRUS
CZECH REPUBLIC
GERMANY
DENMARK
ESTONIA
GREECE
SPAIN
FINLAND
FRANCE
CROATIA
HUNGARY
IRELAND
ICELAND
ITALY
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
LATVIA
REPUBLIC OF MONTENE
FORMER YUGOSLAV RE
MALTA
NETHERLANDS



Altitude 19,650 km Off Globe

	ALL	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10
ALL	100	100	100	100	100	100	100	100	100	100	100
NOx	100	100	100	100	100	100	100	100	100	100	100
NMVOc	100	100	100	100	100	100	100	100	100	100	100
NH3	100	100	100	100	100	100	100	100	100	100	100
PPM	100	100	100	100	100	100	100	100	100	100	100
SOx	100	100	100	100	100	100	100	100	100	100	100
AR											
PT											

Air Quality Index
PM25
Seasonality
Annual

Map

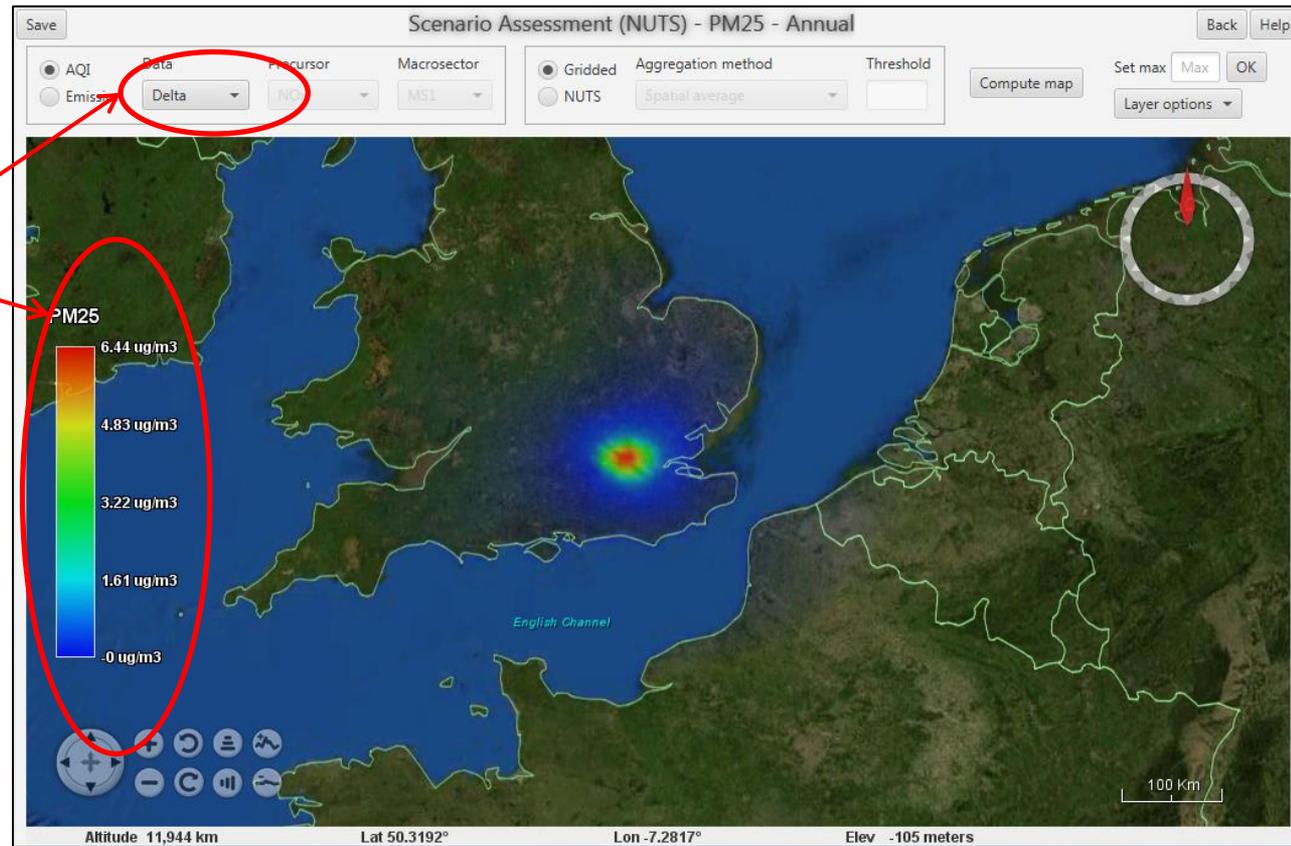
Select:

- the region
- the Air Quality Index
- The activity sectors or precursors

Ask to plot the diagram

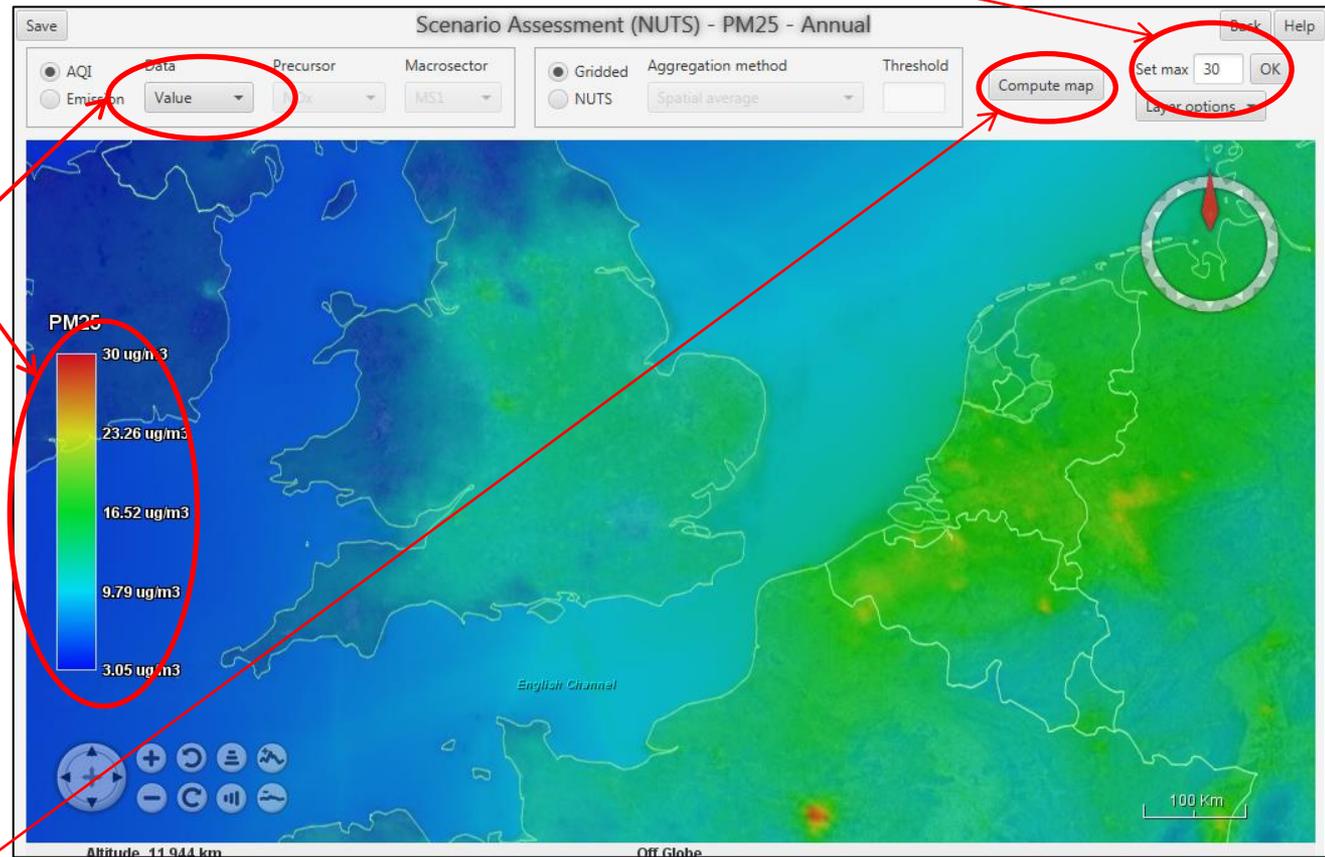
Scenario Assessment

Concentration changes
(i. e. Delta values)



Scenario Assessment

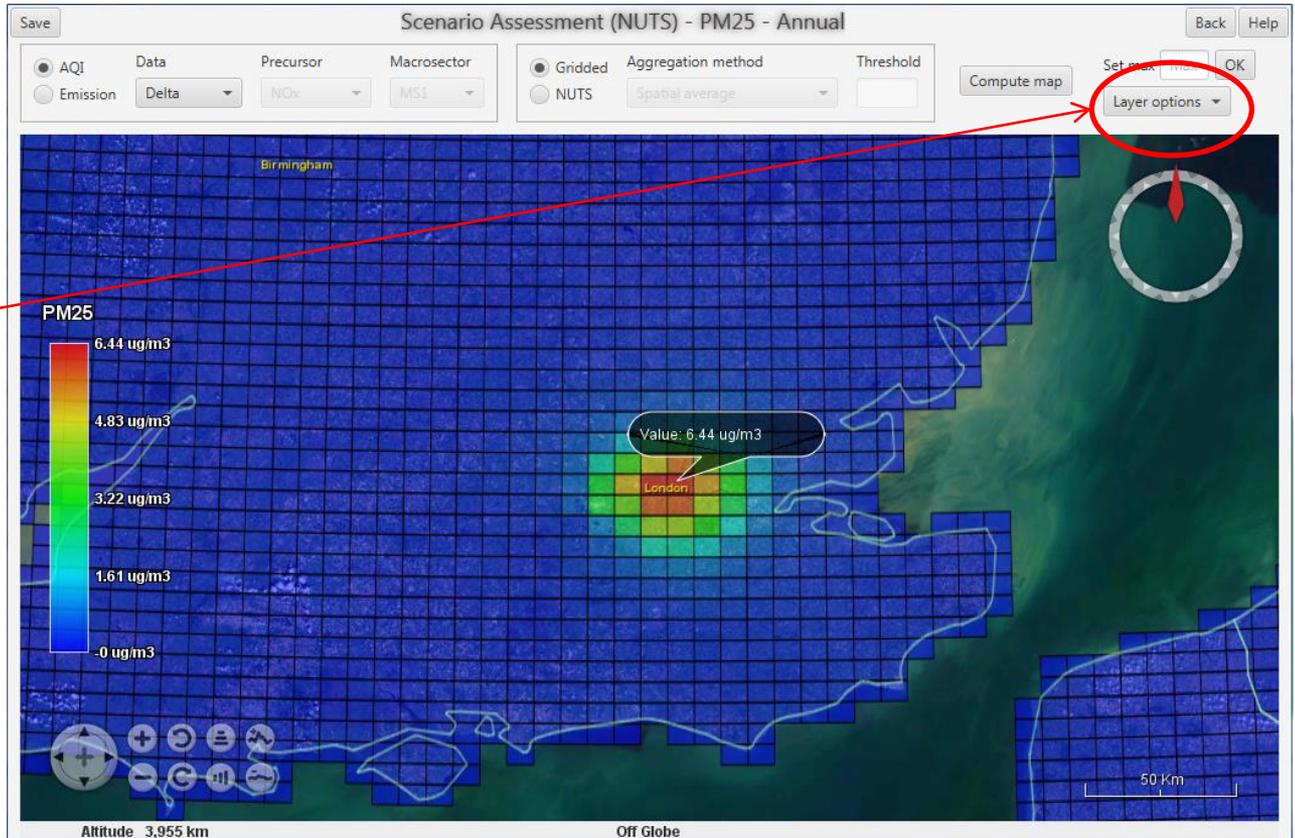
Maximum value for the color scale



Absolute concentrations
(i. e. Value)

Compute a new map

Scenario Assessment



Zoom and
Layer option "Gridded"

Exercise: Scenario Assessment

Select the option “Scenario assessment” of SHERPA.

Select the London area (NUTS called “LONDON”), the Air Quality Index “PM25” and 0% emission reduction for all precursors and all macro sectors.

Using the option “Values”, the map produced by SHERPA shows the base case absolute concentrations of PM25 (i.e. without any emission reductions).

Answer to the following questions:

1. What is the maximum PM25 concentrations appearing in the London region ?
2. What are the coordinates (in latitude and longitude) where the maximum appears?

Scenario Assessment

Scenario Assessment (NUTS) - PM25 - Annual

Save | Back | Help

AQI | Data | Precursor | Macrosector
 Emission | Value | PPM | MS7

Gridded | Aggregation method: Spatial average | Threshold:
 NUTS

Compute map | Set max | Max | OK | Layer options

PPM

6.9 Mg/km²

5.18 Mg/km²

3.45 Mg/km²

1.73 Mg/km²

0 Mg/km²

Altitude 14,513 km | Lat 51.9723° | Lon -7.0909° | Elev 0 meters

EUROPE | 200 Km

FRANCE

CROATIA

HUNGARY

IRELAND

ICELAND

ITALY

LIECHTENSTEIN

LITHUANIA

LUXEMBOURG

LATVIA

REPUBLIC OF MONTENEGRO

FORMER YUGOSLAV REPUBLIC OF SERBIA

MALTA

NETHERLANDS

Scenario Assessment (NUTS)

Back | Help

Altitude 19,650 km | Off Globe

EUROPE | 200 Km

Reduction table

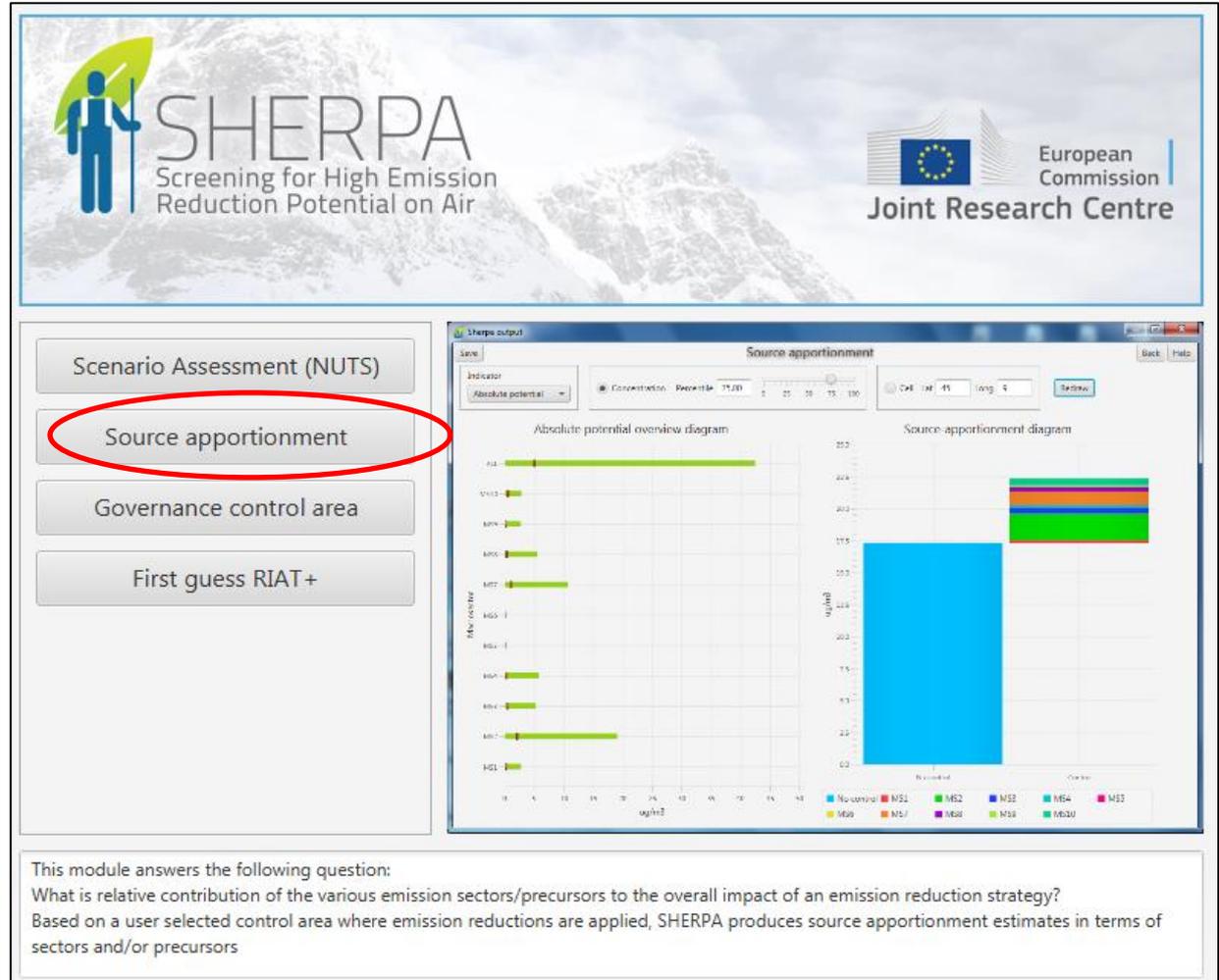
	ALL	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10
ALL	100	100	100	100	100	100	100	100	100	100	100
NOx	100	100	100	100	100	100	100	100	100	100	100
NMVOc	100	100	100	100	100	100	100	100	100	100	100
NH3	100	100	100	100	100	100	100	100	100	100	100
PPM	100	100	100	100	100	100	100	100	100	100	100
SOx	100	100	100	100	100	100	100	100	100	100	100
AR											
PT											

Air Quality Index: PM25

Seasonality: Annual

Map

Source Apportionment



The screenshot displays the SHERPA software interface. At the top, the SHERPA logo is shown with the text "Screening for High Emission Reduction Potential on Air" and the European Commission Joint Research Centre logo. Below the header, a sidebar contains four buttons: "Scenario Assessment (NUTS)", "Source apportionment" (highlighted with a red oval), "Governance control area", and "First guess RIAT+". The main window shows the "Source apportionment" module with two charts: "Absolute potential overview diagram" and "Source apportionment diagram". The "Source apportionment diagram" is a stacked bar chart showing the relative contribution of various emission sectors/precursors to the overall impact of an emission reduction strategy. The legend for the "Source apportionment diagram" includes: No control, MS1, MS2, MS3, MS4, MS5, MS6, MS7, MS8, MS9, MS10, MS11, MS12, MS13, MS14, MS15, MS16, MS17, MS18, MS19, MS20, MS21, MS22, MS23, MS24, MS25, MS26, MS27, MS28, MS29, MS30, MS31, MS32, MS33, MS34, MS35, MS36, MS37, MS38, MS39, MS40, MS41, MS42, MS43, MS44, MS45, MS46, MS47, MS48, MS49, MS50, MS51, MS52, MS53, MS54, MS55, MS56, MS57, MS58, MS59, MS60, MS61, MS62, MS63, MS64, MS65, MS66, MS67, MS68, MS69, MS70, MS71, MS72, MS73, MS74, MS75, MS76, MS77, MS78, MS79, MS80, MS81, MS82, MS83, MS84, MS85, MS86, MS87, MS88, MS89, MS90, MS91, MS92, MS93, MS94, MS95, MS96, MS97, MS98, MS99, MS100.

This module answers the following question:
What is relative contribution of the various emission sectors/precursors to the overall impact of an emission reduction strategy?
Based on a user selected control area where emission reductions are applied, SHERPA produces source apportionment estimates in terms of sectors and/or precursors

Selection of "Source apportionment"

Source Apportionment

Source apportionment

Back Help

Load config Save config

AUSTRIA
BELGIUM
BULGARIA
SWITZERLAND
CYPRUS
CZECH REPUBLIC
GERMANY
DENMARK
ESTONIA
GREECE
SPAIN
FINLAND
FRANCE
CROATIA
HUNGARY
IRELAND
ICELAND
ITALY
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
LATVIA
REPUBLIC OF MONTENE
FORMER YUGOSLAV RE
MALTA
NETHERLANDS

Altitude 18,219 km Off Globe No Network

Reduction table	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10	ALL
NOx	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NM VOC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NH3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PPM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SOx	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ALL	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
AR											
PT											

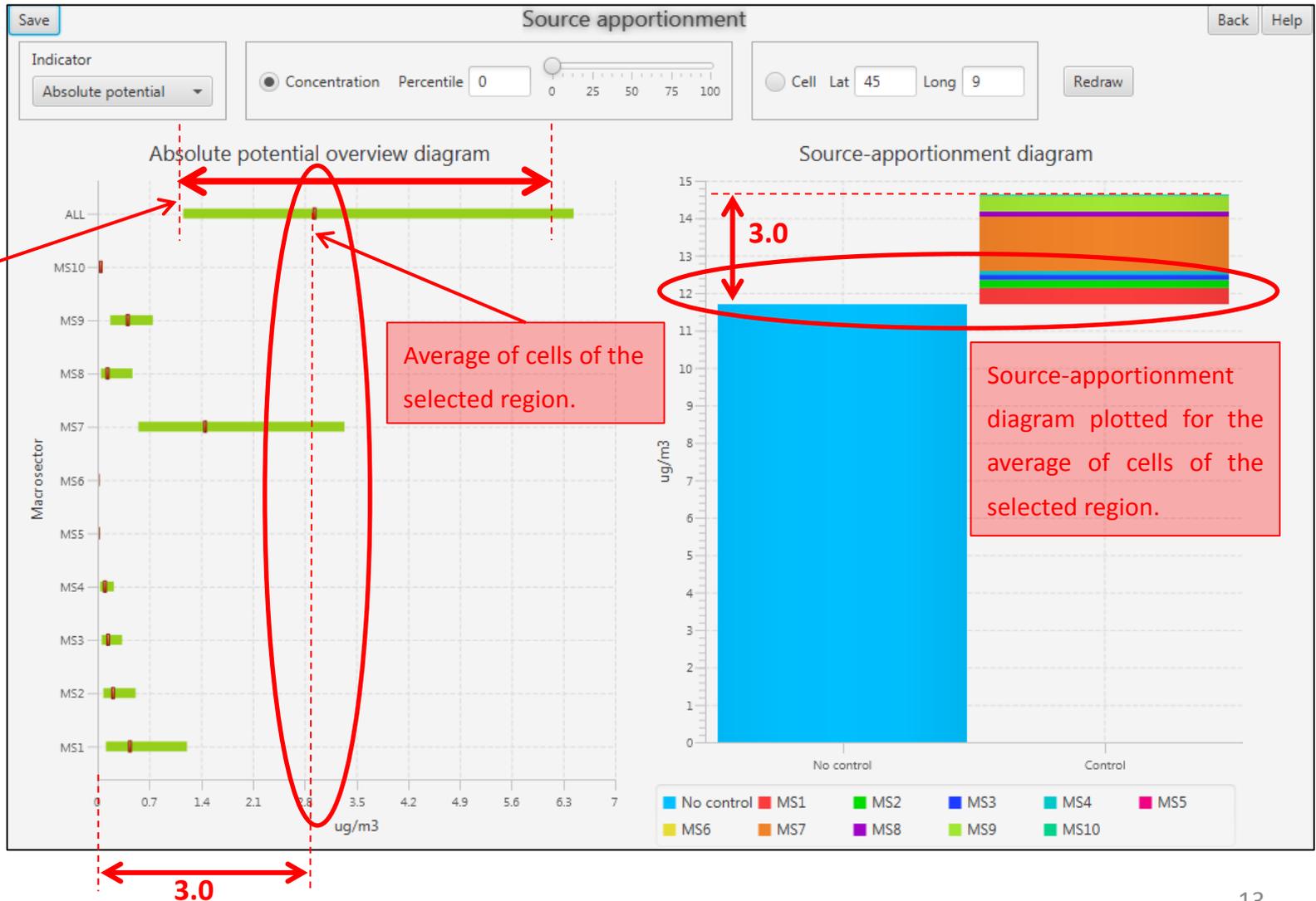
Air Quality Index
PM25
Seasonality
Annual
Diagram

Selection of:

- the region
- the Air Quality Index
- the activity sectors or precursors

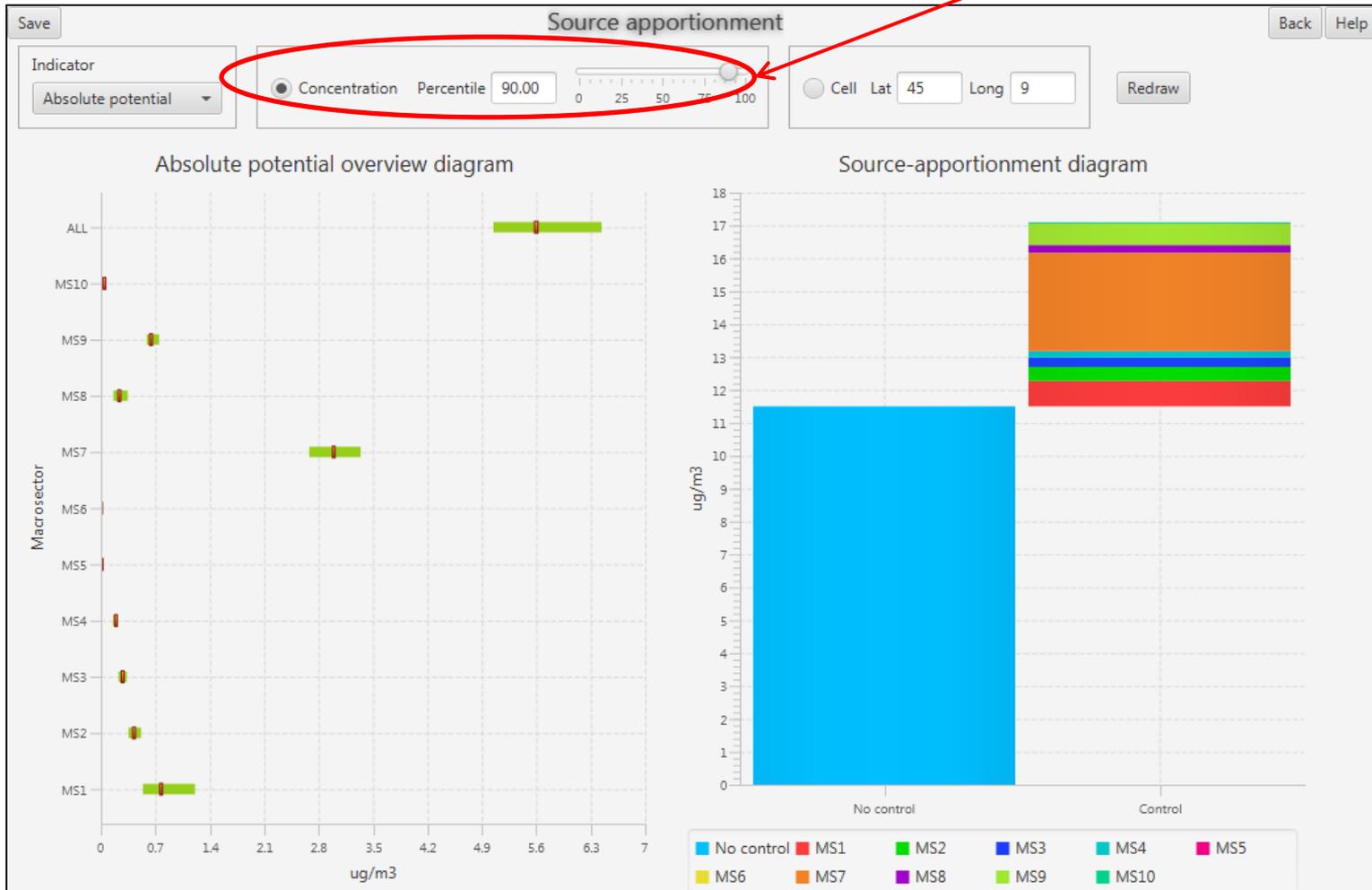
Ask to plot the diagram

Source Apportionment



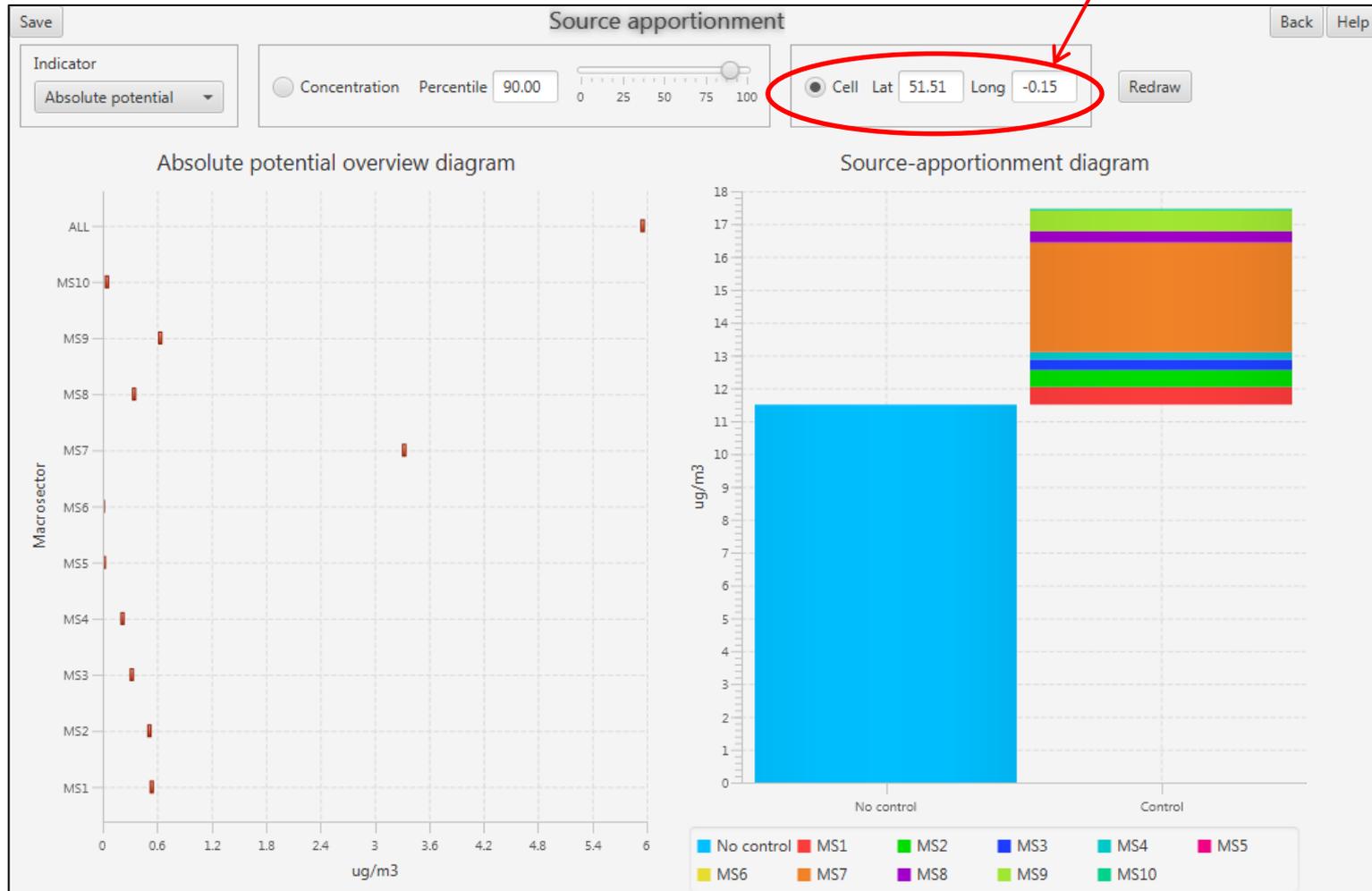
Source Apportionment

Concentration percentile: 90



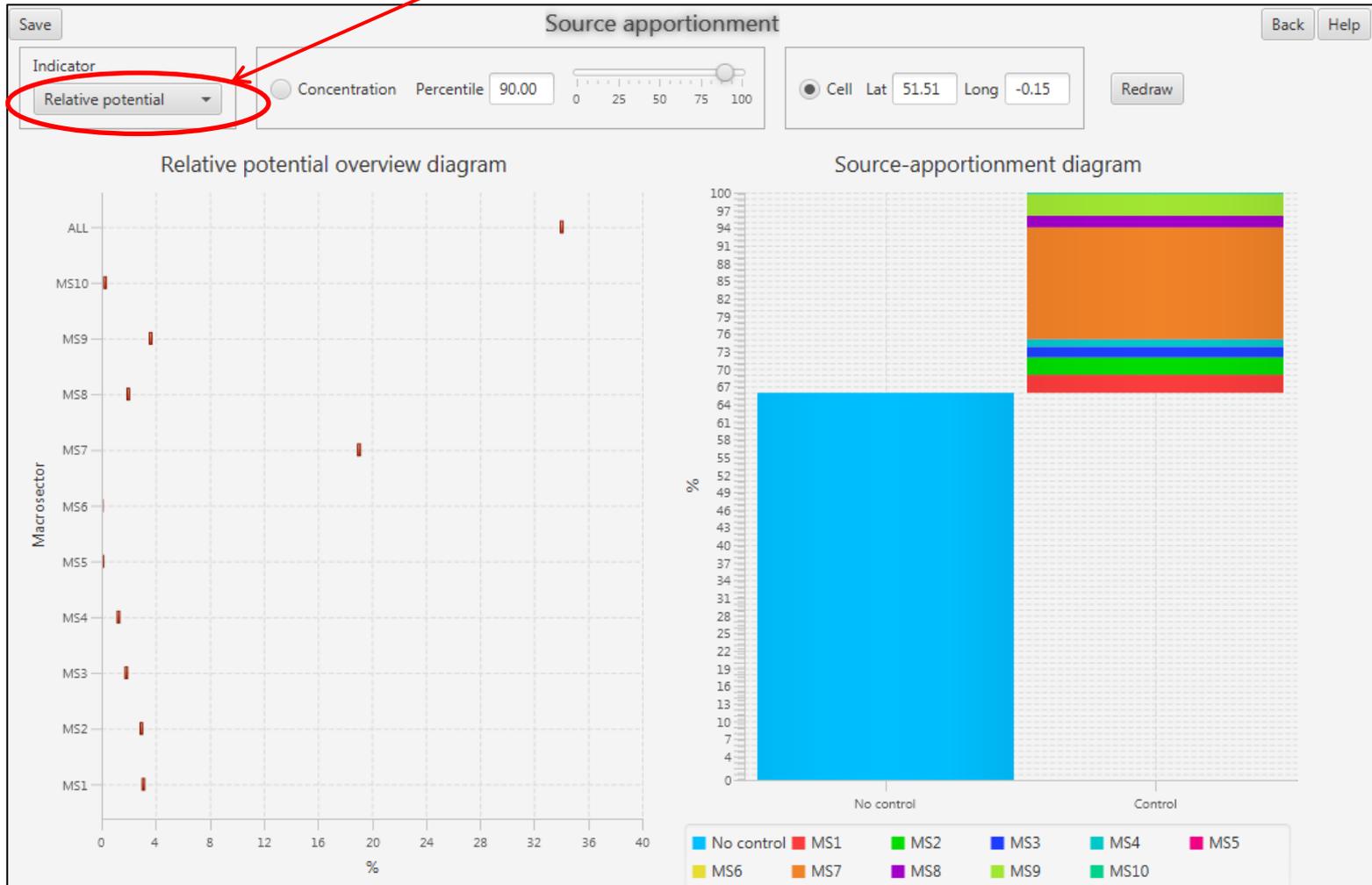
Source Apportionment

Cell coordinates: - 52.51 Lat . ; -0.15 Long.



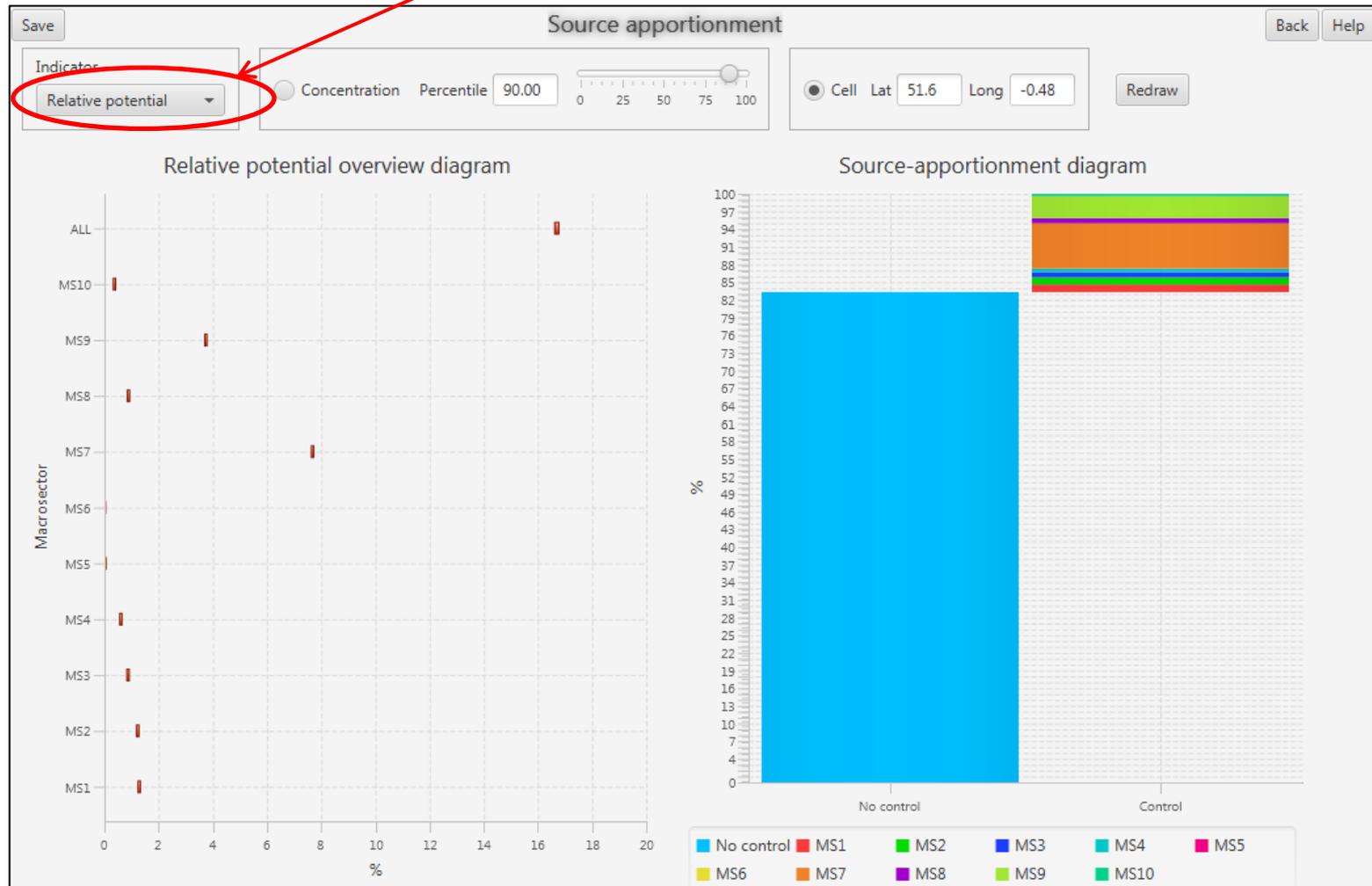
Source Apportionment

Absolute or relative potential



Source Apportionment

Absolute or relative potential



Exercise: Source Apportionment

Select the option “Source apportionment” of SHERPA.

Select the London area.

All answers can be found running the option “Source apportionment” **only once**.

Answer to the following questions:

1. Which concentration can be reached, in average over the all London area, if the emissions of all macro sectors are reduced in this area?
2. Same question as 1. if only the traffic emissions (macro sector 7) are reduced in this area?
3. Same question as 1. if only 10% of the highest concentrations (90% percentile) are considered?
4. Same question as 1. considering only a cell in the city center (Lat.: 51.51 ; Long.: -0.15) and, then, a cell in the western suburb (Lat.: 51.60 ; Long.: -0.48)?
5. What could you conclude concerning the “background” concentration over London area?

Exercise: Source Apportionment

Answer to the following questions:

6. Which percentage of concentration can be reduced, in average over the all London area, if the emissions of macro sectors are reduced in this area?
7. Same question as 6. but if only 10% of the highest concentrations (90% percentile) are considered?
8. Same question as 6. considering only a cell in the city center (Lat.: 51.51 ; Long.: -0.15) and, then, a cell in the western suburb (Lat.: 51.60 ; Long.: -0.48) ?
9. What is the contribution in percentage of the traffic (macro-sector 7) and the agriculture (macro-sector 8) in the points used in question 8. ?

Source Apportionment

Selection of European countries

Source apportionment

Altitude 87,089 km Off Globe Downloading

Reduction table	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10	ALL
NOx	<input checked="" type="checkbox"/>										
NMVOG	<input checked="" type="checkbox"/>										
NH3	<input checked="" type="checkbox"/>										
PPM	<input checked="" type="checkbox"/>										
SOx	<input checked="" type="checkbox"/>										
ALL	<input type="checkbox"/>	<input checked="" type="checkbox"/>									
AR	<input type="checkbox"/>										
PT	<input type="checkbox"/>										

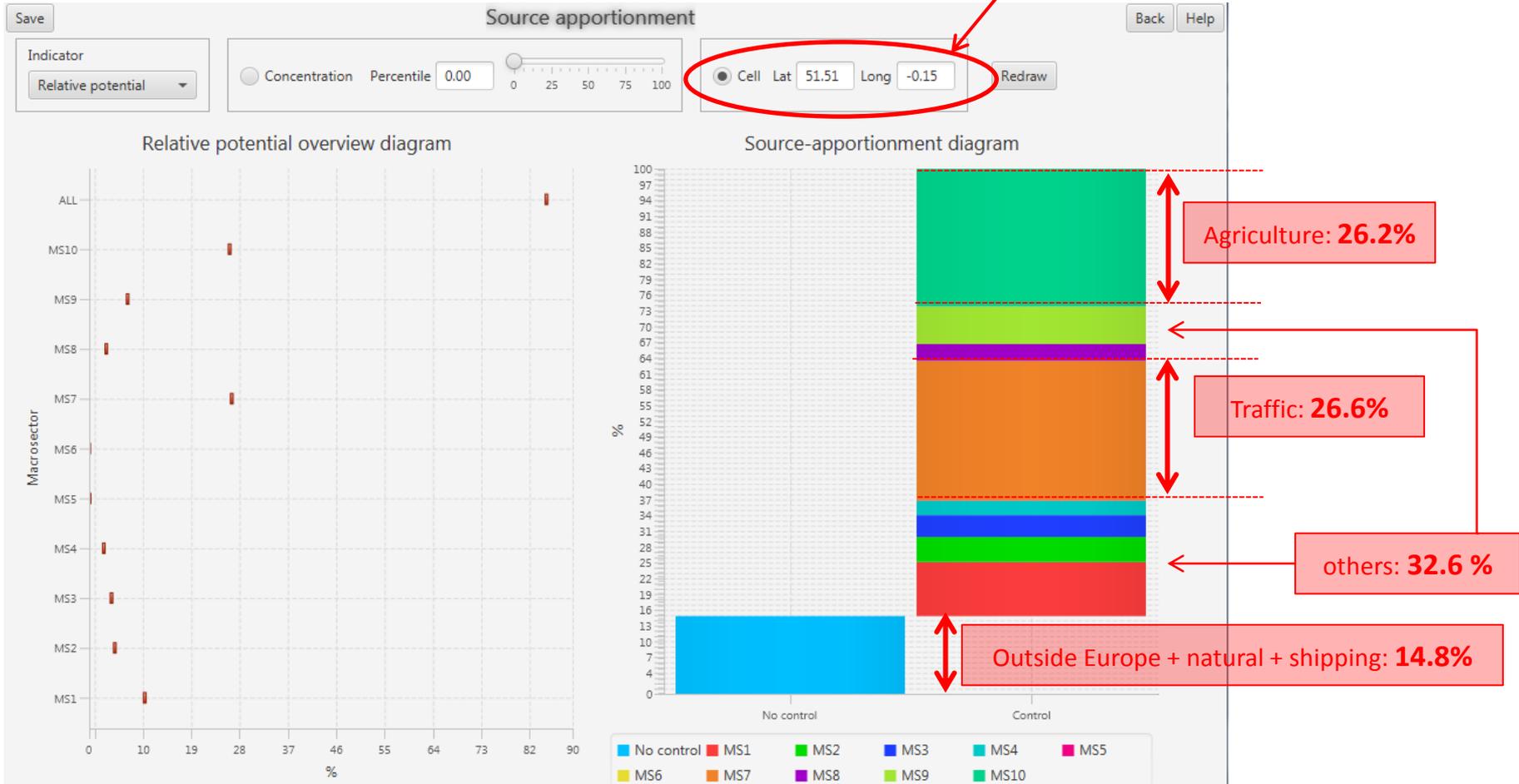
Air Quality Index: PM25
Seasonality: Annual

Diagram

Selection of all precursors

Source Apportionment

London center :- 52.51 Lat . ; -0.15 Long.



Source Apportionment

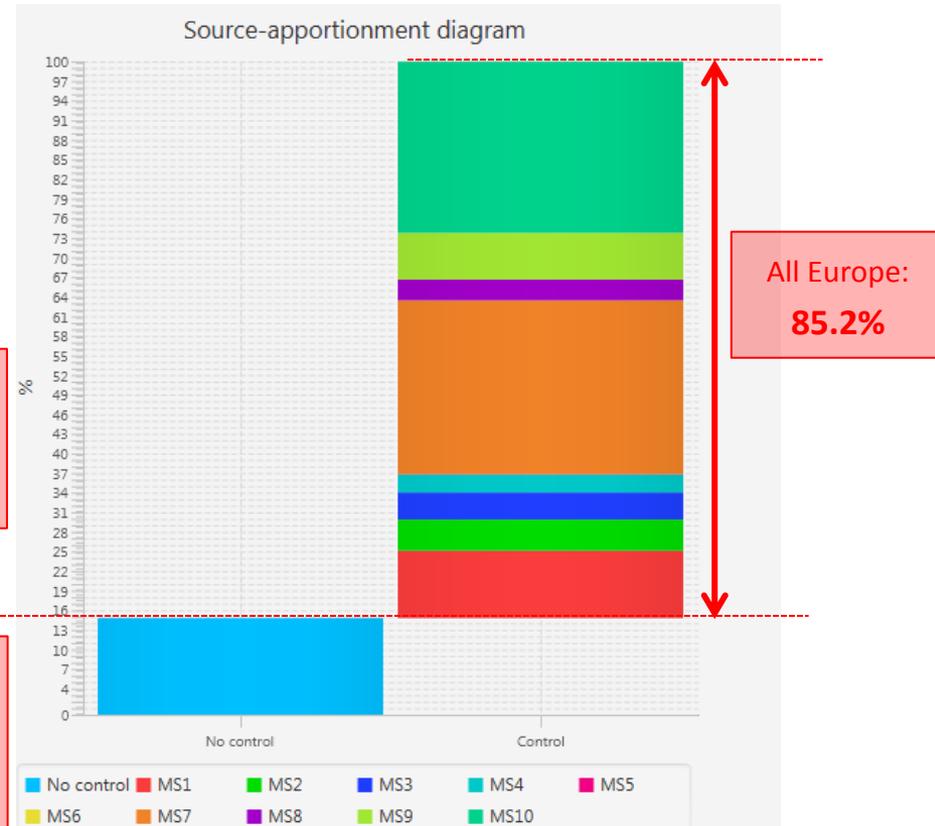
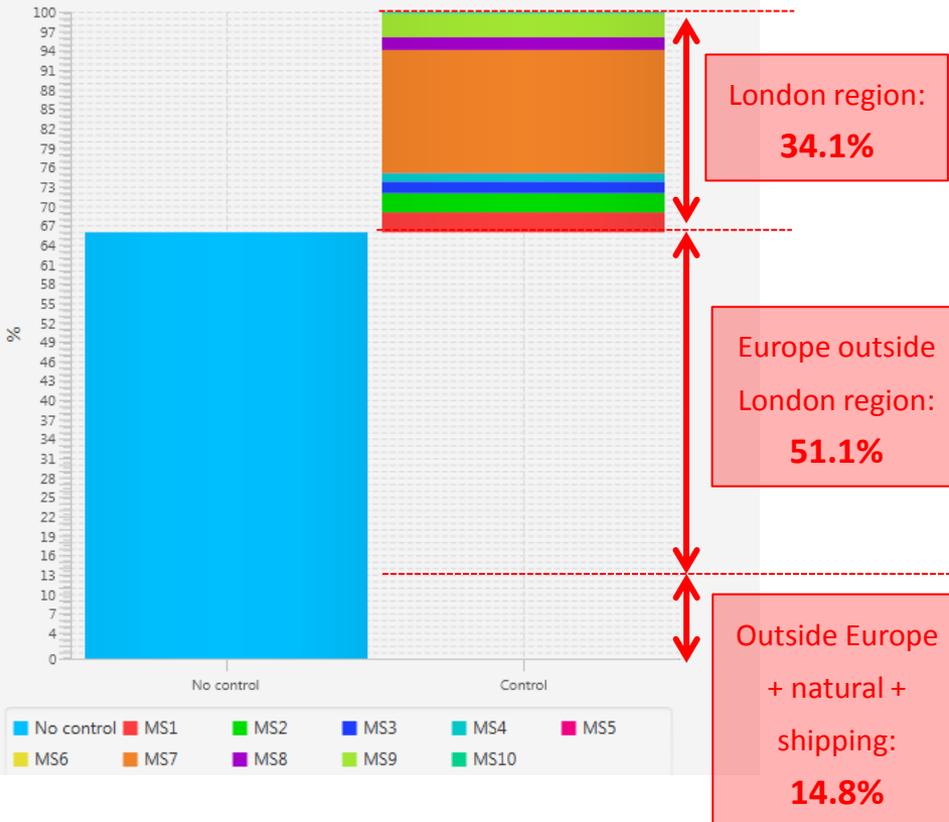
London center :- 52.51 Lat . ; -0.15 Long.

Reduction over London region only

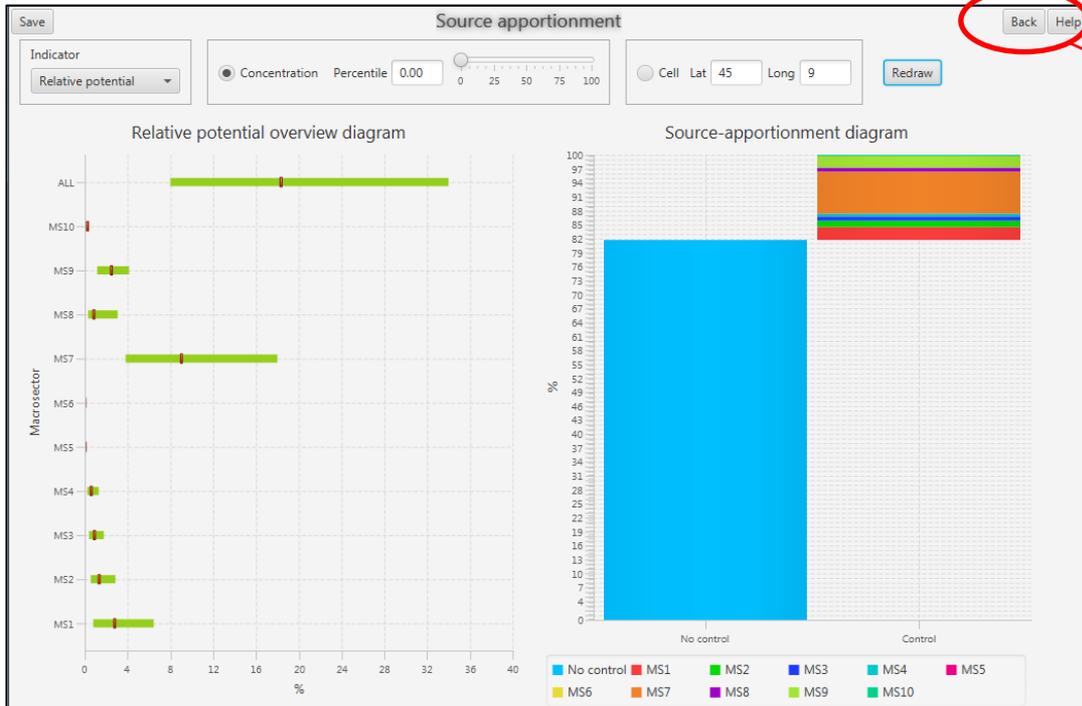
Reduction over all Europe

Source-apportionment diagram

Source-apportionment diagram

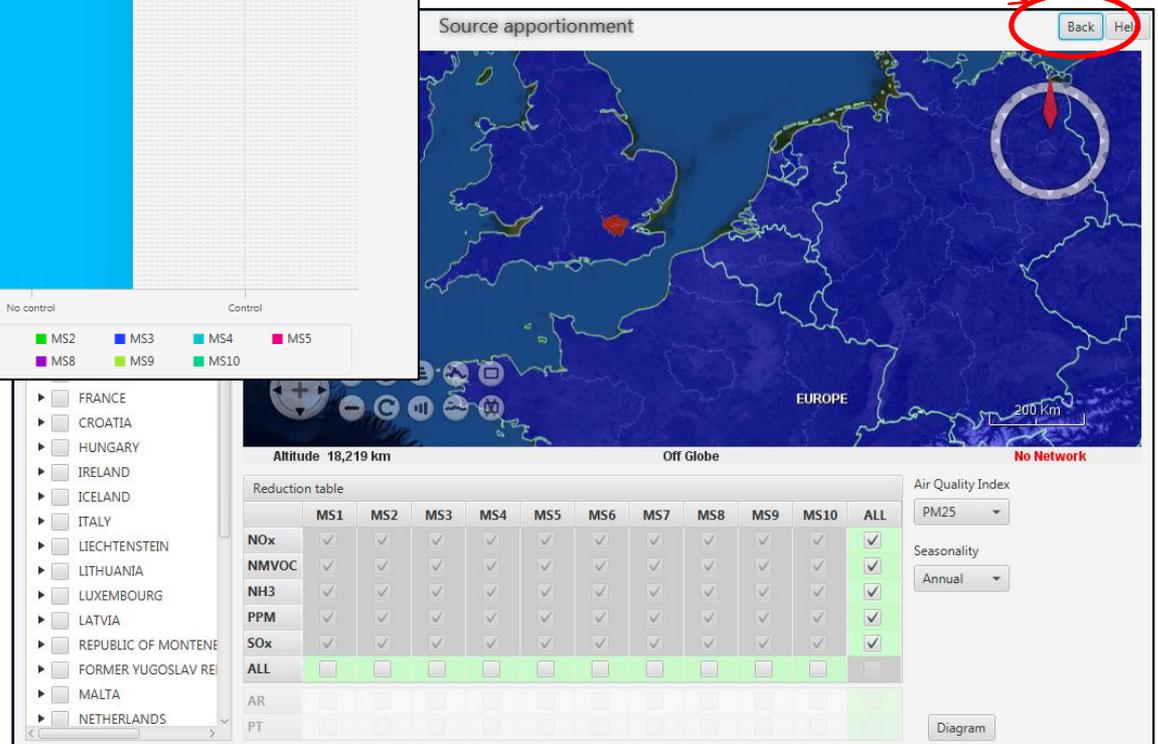


Source Apportionment

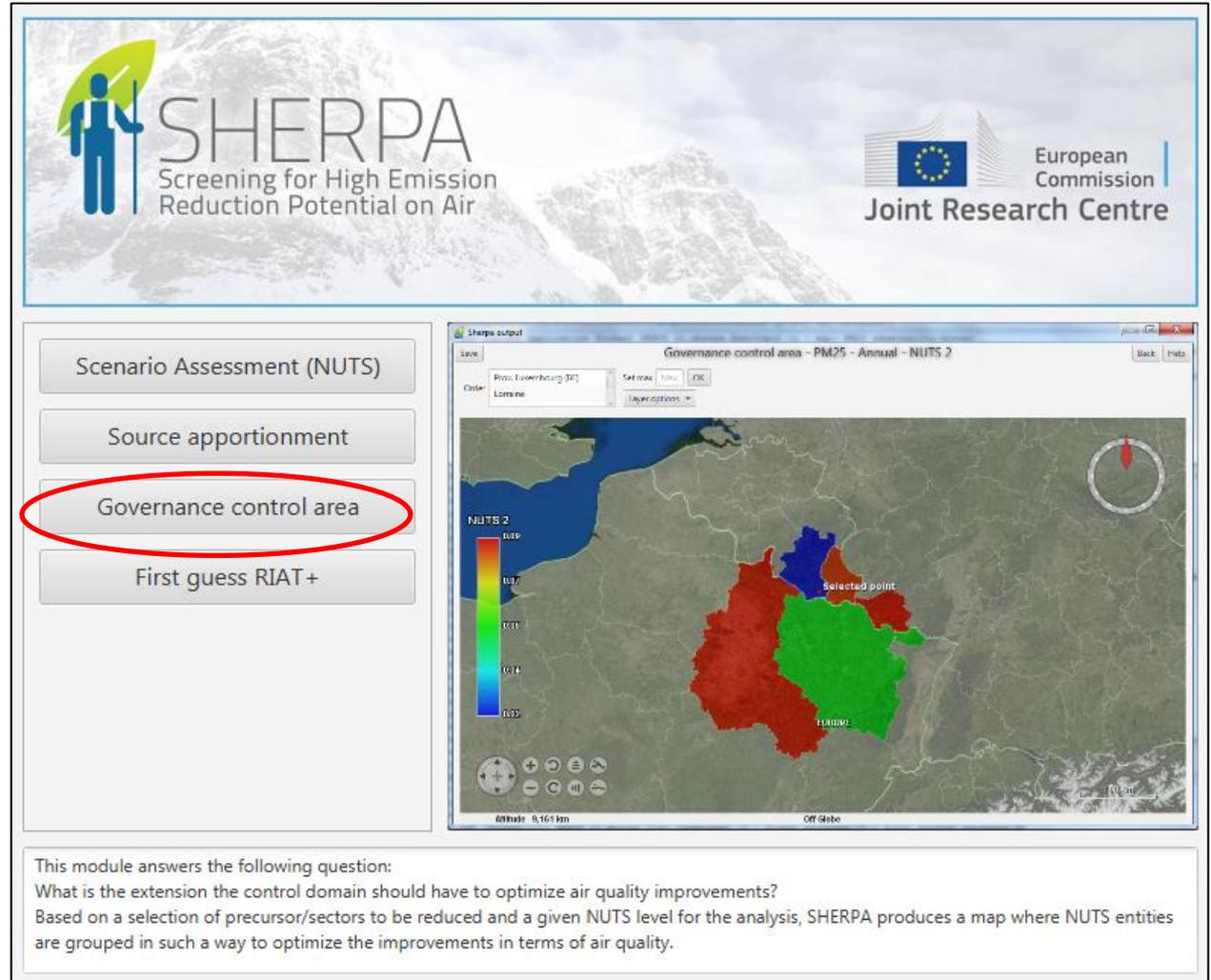


Back Help

Go back to main menu



Governance control area



The screenshot displays the SHERPA web application interface. At the top, the SHERPA logo is on the left, and the European Commission Joint Research Centre logo is on the right. The main content area features a vertical menu on the left with four buttons: 'Scenario Assessment (NUTS)', 'Source apportionment', 'Governance control area' (highlighted with a red oval), and 'First guess RIAT+'. To the right of the menu is a map window titled 'Sherpa output' showing a map of Luxembourg with a color-coded governance control area. A legend on the left of the map indicates NUTS 2 levels from 0.00 to 0.09. A 'Selected point' is marked on the map. Below the map, the text reads: 'This module answers the following question: What is the extension the control domain should have to optimize air quality improvements? Based on a selection of precursor/sectors to be reduced and a given NUTS level for the analysis, SHERPA produces a map where NUTS entities are grouped in such a way to optimize the improvements in terms of air quality.'

Selection of “Governance control area”

Governance control area

Selection of:

- a NUTS level
- a point
- an Air Quality Index
- an activity sector or a precursor

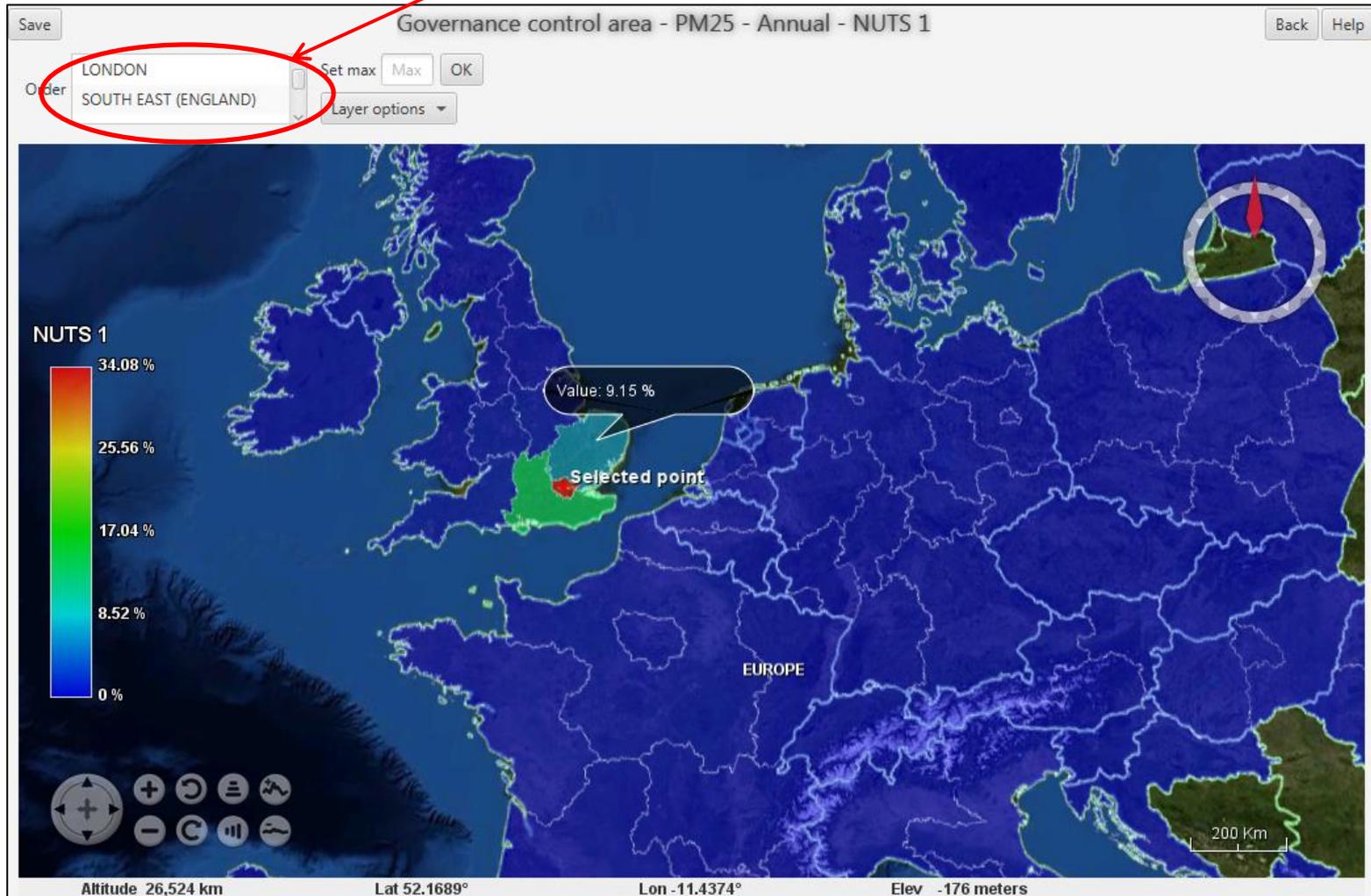
Altitude 24,000 km Off Globe

Reduction table		MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10
ALL	<input checked="" type="checkbox"/>										
NOx	<input checked="" type="checkbox"/>										
NMVOc	<input checked="" type="checkbox"/>										
NH3	<input checked="" type="checkbox"/>										
PPM	<input checked="" type="checkbox"/>										
SOx	<input checked="" type="checkbox"/>										
AR	<input type="checkbox"/>										
PT	<input type="checkbox"/>										

Ask to plot a map

Governance control area

List of regions ordered by decreasing contributions



Exercise: Governance control area

Select the option “Governance control area” of SHERPA for the NUTS 1 level

Select a point at the center of London (Lat.: 51.51 ; Long.: -0.15) .

Answer to the following questions:

1. Identify the regions showing more than 1% contribution when all precursors and all macro sectors are selected?
2. What is the contribution in percentage of the regions identified in question 1.?
3. The source apportionment study have shown that all European countries contribute to 85.2% of the PM. What could you conclude from the results of question 2.?
4. Same question as 1, 2, 3 but selecting only the macro sector 7 (traffic)?
5. Same question as 1, 2, 3 but selecting only the macro sector 10 (agriculture)?

SHERPA application:

work on a region you choose



SHERPA
Screening for High Emission
Reduction Potential on Air



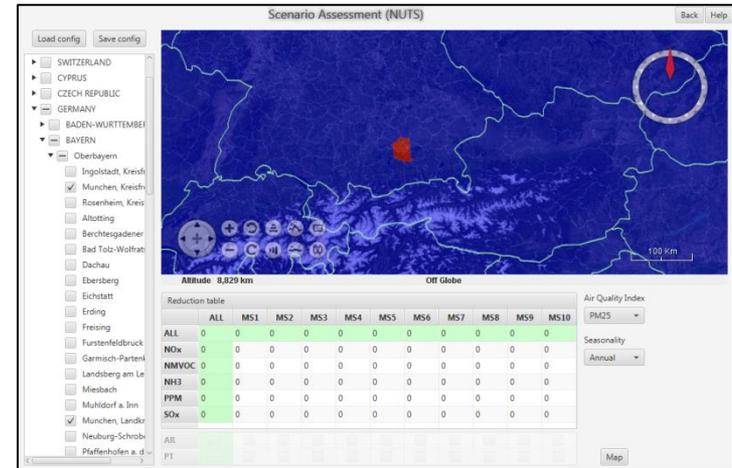
Software developed by TerrAria
under the Contract Procedure
no. JRC/IPR/2014/H.2/0023/NC

Option « Scenario assessment »

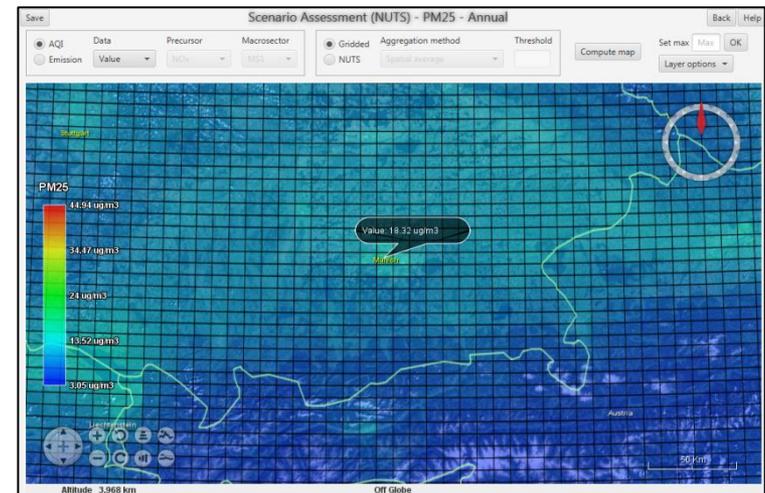
Example

- identify the region you want to study.
- generate the PM25 concentration map choosing 0% emission reduction.
- choose the cell where you want to focus and note the approximate coordinates (longitude and latitude) of the cell center.

Munchen Landreis and Munchen Kreisfreistadt



Lat. 48.15 ; Long. 11.56 ; concentration: $18.32 \mu\text{g}\cdot\text{m}^{-3}$



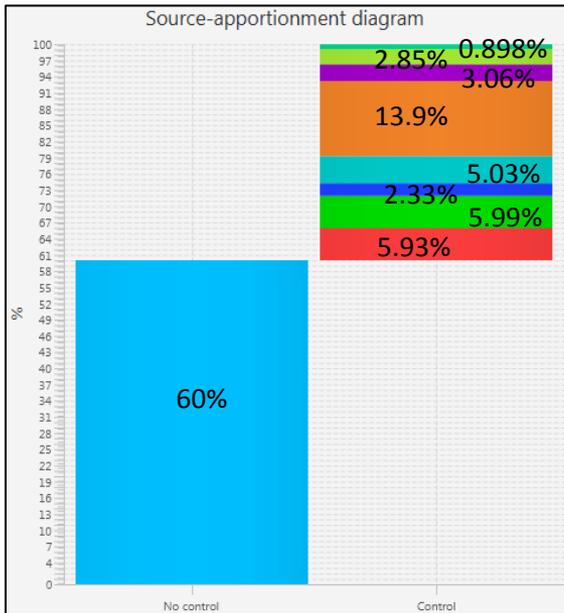
Option « Source apportionment »

- Select your chosen region and plot the source apportionment graphic for relative contributions and for the cell center, copy the graphic and note the different contributions.
- Same but selecting all European countries, find the main contributions.

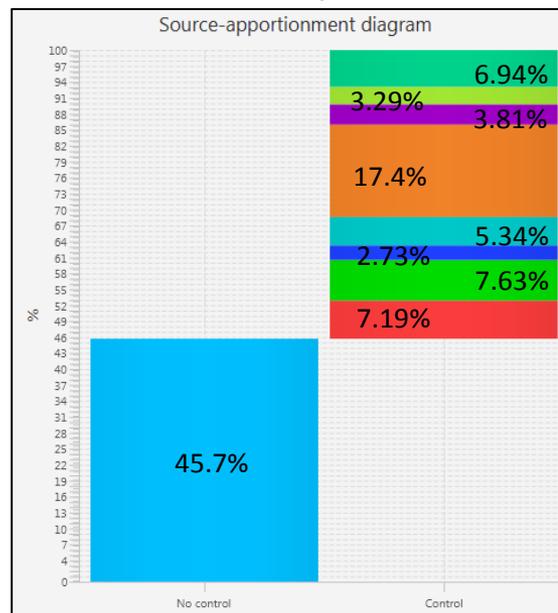
Example

Selected point: Lat. 48.15 ; Long. 11.56 ; concentration $18.32 \mu\text{g}\cdot\text{m}^{-3}$;

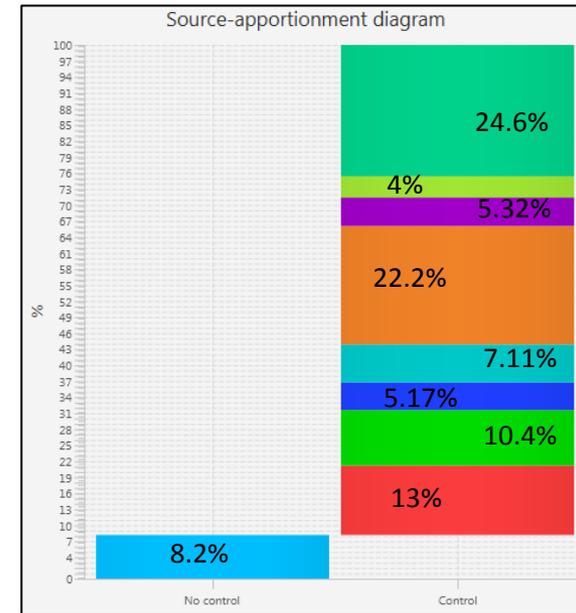
Munchen Landreis and Munchen Kreisfreistadt



Oberbayern



All European countries

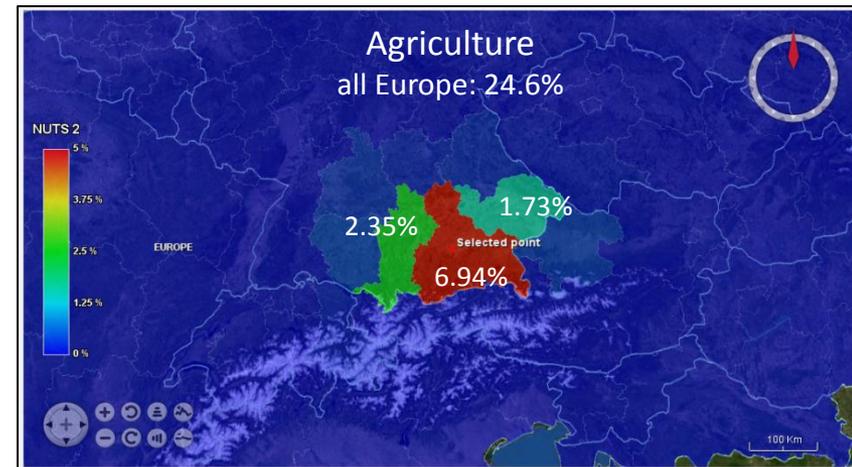
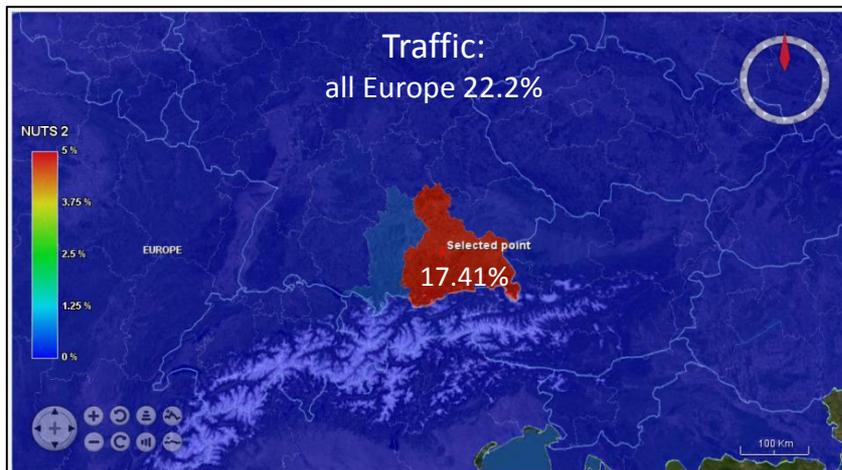
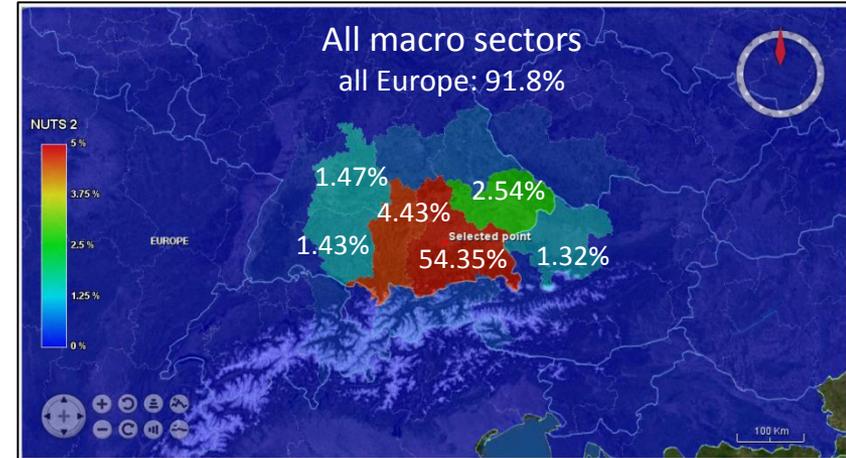


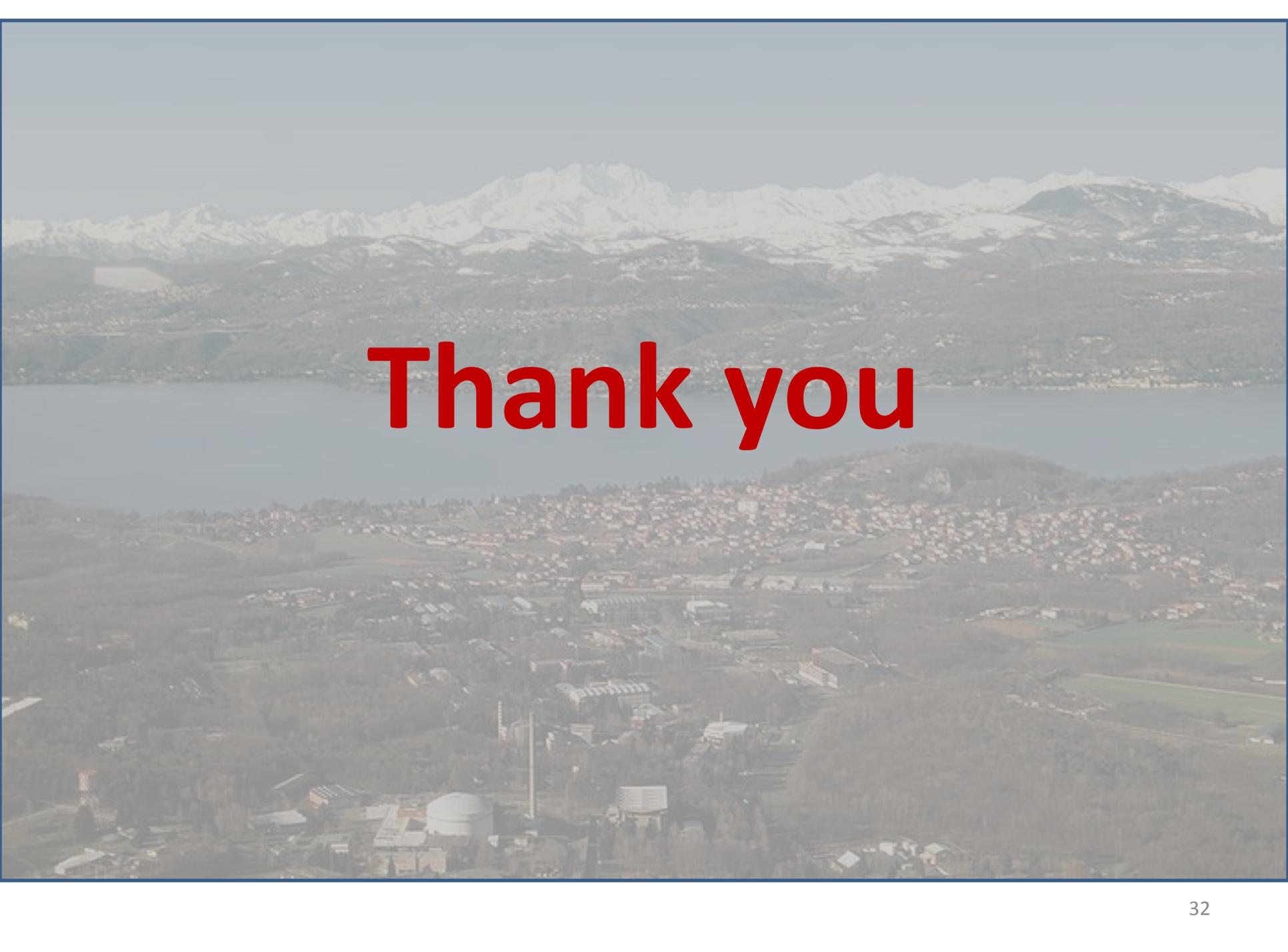
Option « Governance control area »

- Select all sector and precursors and plot the governance control area map. Note the main region contributions.
- Same for the main macro sector contributions.

Example

Selected point: Lat. 48.15 ; Long. 11.56
concentration $18.32 \mu\text{g}\cdot\text{m}^{-3}$;



An aerial photograph of a town nestled in a valley. In the foreground, there are several large industrial or utility buildings, including a prominent white spherical tank and a tall chimney. The middle ground shows a dense residential area with many houses. In the background, a large body of water is visible, and beyond that, a range of rugged mountains with significant snow cover under a clear sky.

Thank you

Correction: Scenario Assessment

1. What is the maximum PM25 concentrations appearing in the London region ?

18.06 μgm^{-3} .

2. What are the coordinates (in latitude and longitude) where the maximum appears?

Lat.: 51.53 ; Long. -0.06

Correction: Source Apportionment

1. Which concentration can be reached, in average over the all London area, if the emissions of all macro sectors are reduced in this area?

11.7 $\mu\text{g}\text{m}^{-3}$.

2. Same question as 1. if only the traffic emissions (SNAP sector 7) are reduced in this area?

14.6 – 1.45 = 13.15 $\mu\text{g}\text{m}^{-3}$.

3. Same question as 1. if only 10% of the highest concentrations (90% percentile) are considered?

11.5 $\mu\text{g}\text{m}^{-3}$.

4. Same question as 1. considering only a cell in the city center (Lat.: 51.51 ; Long.: -0.15) and, then, a cell in the western suburb (Lat.: 51.60 ; Long.: -0.48)?

11.5 $\mu\text{g}\text{m}^{-3}$ and 11.6 $\mu\text{g}\text{m}^{-3}$.

5. What could you conclude concerning the “background” concentration over London area?

The background coming from outside the region is more or less constant between 11.5 and 11.7 $\mu\text{g}\text{m}^{-3}$.

Correction: Governance control area

1. Identify the regions showing more than 1% contribution when all precursors and all macro sectors are selected?

London (34.8%), South East England (14.01%), East of England (9.15%), South West (2.52%), East Midland (1.92%), West Midland (1.88%), Nord Pas de Calais (1.02%), Bassin Parisien (1%).

2. What is the contribution in percentage of the regions identified in question 1.?

$$34.8 + 14.01 + 9.15 + 2.52 + 1.92 + 1.88 + 1.02 + 1 = 66.3\%$$

3. The source apportionment study have shown that all European countries contribute to 85.2% of the PM. What could you conclude from the results of question 2.?

$85.2 - 66.3 = 18.9\%$ is produced by countries which contribute individually to less than 1%.

Correction: Governance control area

4. Same question as 1, 2, 3 but selecting only the macro sector 7 (traffic)?

London (19.02%), South East (3.47%), East of England (2.44%) ; $19.02 + 3.47 + 2.44 = 24.93\%$; This percentage is very close to the total traffic contribution (26.6%). Traffic contribution is produced by few region which are the closest to London center.

5. Same question as 1, 2, 3 but selecting only the macro sector 10 (agriculture)?

South East (3.36%), East of England (3.04%), South West (1.82%), East Midlands (1.06%), West Midlands (1.04%) ; $3.36 + 3.04 + 1.82 + 1.06 = 9.28\%$; This percentage is much lower than the total agricultural contribution (26.2%) A large number of region contribute of a low percentage. Agriculture contribution is produced by a large number of regions which could be far from London center (note that London area which is the closest region does not contribute).

Correction: Source Apportionment

6. Which percentage of concentration can be reduced, in average over the all London area, if the emissions of macro sectors are reduced in this area?

$$100 - 80.5 = 19.5 \%$$

7. Same question as 6. but if only 10% of the highest concentrations (90% percentile) are considered?

$$100 - 67.3 = 32.7 \%$$

8. Same question as 6. considering only a cell in the city center (Lat.: 51.51 ; Long.: -0.15) and, then, a cell in the western suburb (Lat.: 51.60 ; Long.: -0.48) ?

$$100 - 65.9 = 34.1 \% \text{ and } 100 - 83.3 = 16.7 \%$$

9. What is the contribution in percentage of the traffic (macro-sector 7) and the agriculture (macro-sector 8) in the points used in question 8. ?

$$\text{MS7: } 19\% \text{ and MS10 : } 0.26\% ; \text{MS7: } 7.7\% \text{ and MS10 : } 0.37\%$$