SHERPA

A tool to support the design of regional air quality plans

P. Thunis, E. Pisoni, D. De Marchi, A. De Meij, S. Zauli, A. Rey Pommier, R. Vignotto

SHERPA
Screening for High Emission Reduction Potential on Air

European Commission
Joint Research Centre

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

Agenda

INTRODUCTION

- 10:00 Introduction (E. Pisoni, JRC)

WHAT IS SHERPA? HOW DOES IT WORK?

- 10:05: SHERPA methodology: what it is and how it works (P. Thunis, E. Pisoni, JRC)
- 10:30: SHERPA demo (D. De Marchi, JRC)

FUTURE DEVELOPMENTS

- 10:45: SHERPA future development: downscaling (A. Rey-Pommier, JRC)
- 11:00: How to construct a “local” version of SHERPA (E. Pisoni, JRC)

APPLICATIONS OF SHERPA

- 11:15: SHERPA Asia (B. Bessagnet, LMD-IPSL)
- 11:30: SHERPA DE (A. Pseftogkas, TNO)
- 11:45: SHERPA NL (E. van der Swaluw, RIVM)
- 12:00: SHERPA–SALURBAL (O.L. Sarmiento Dueñas, Universita de los Andes)

Q/A AND CONCLUSIONS

- 12:15: Q/A and conclusions

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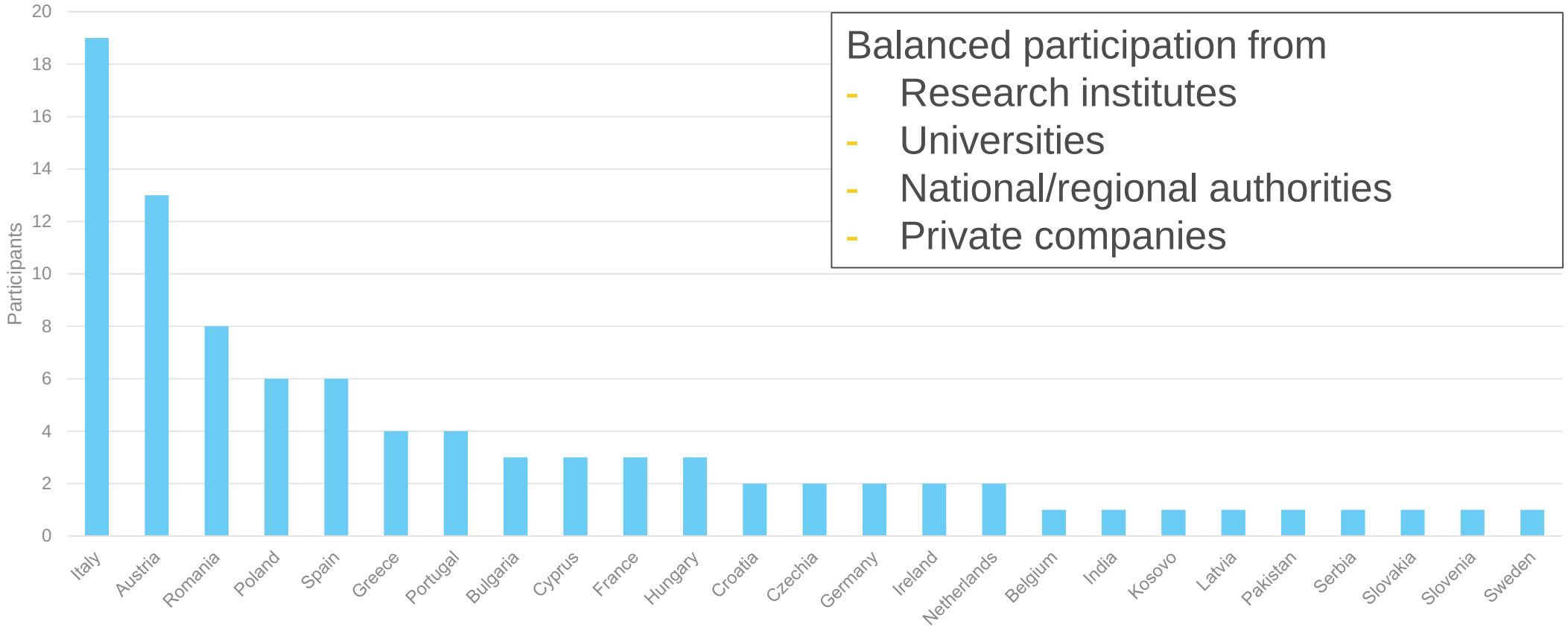
Participants (92 participants)



Balanced participation from
- Research institutes
- Universities
- National/regional authorities
- Private companies

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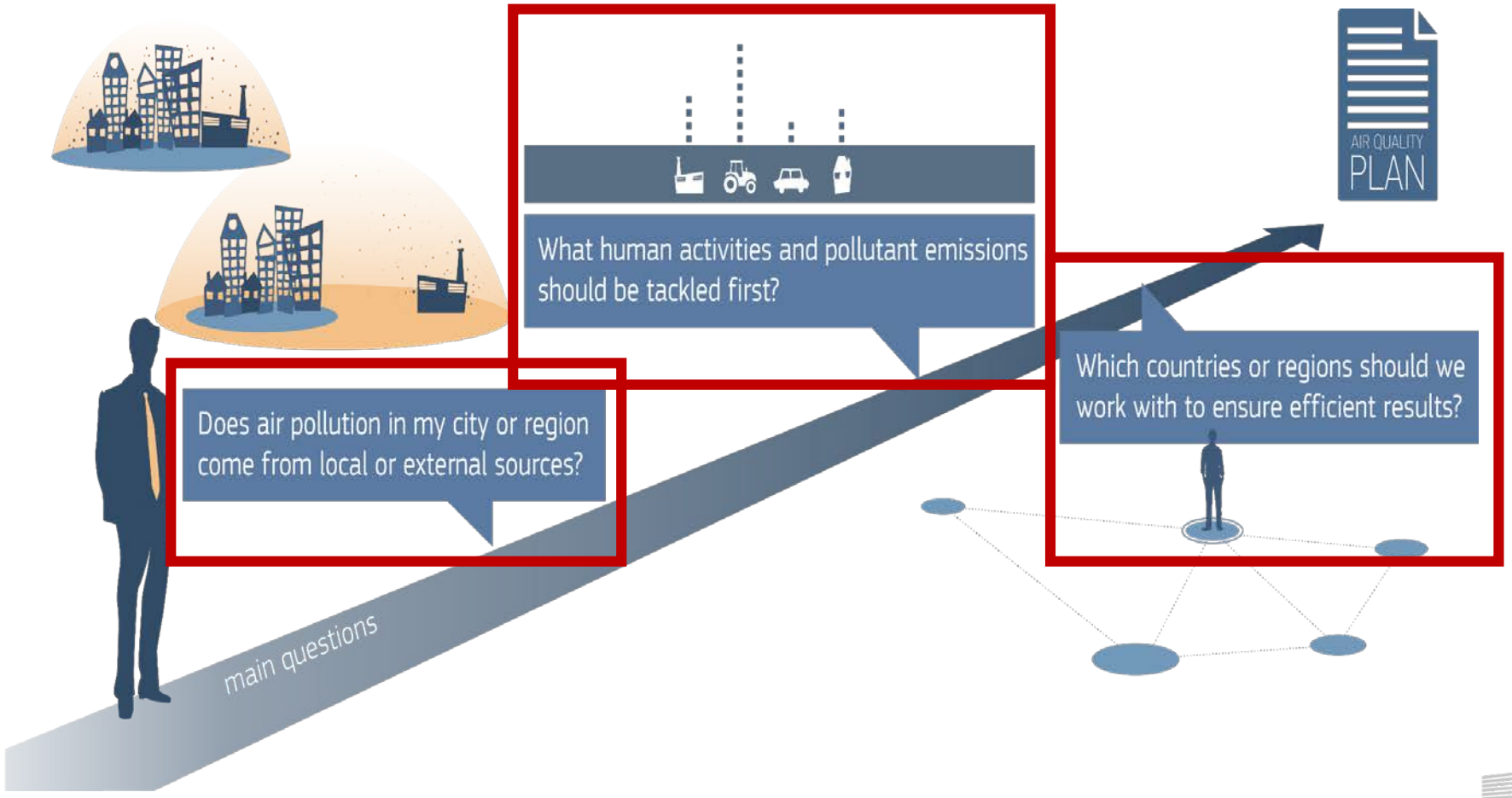
A tool to support the design of air quality plans



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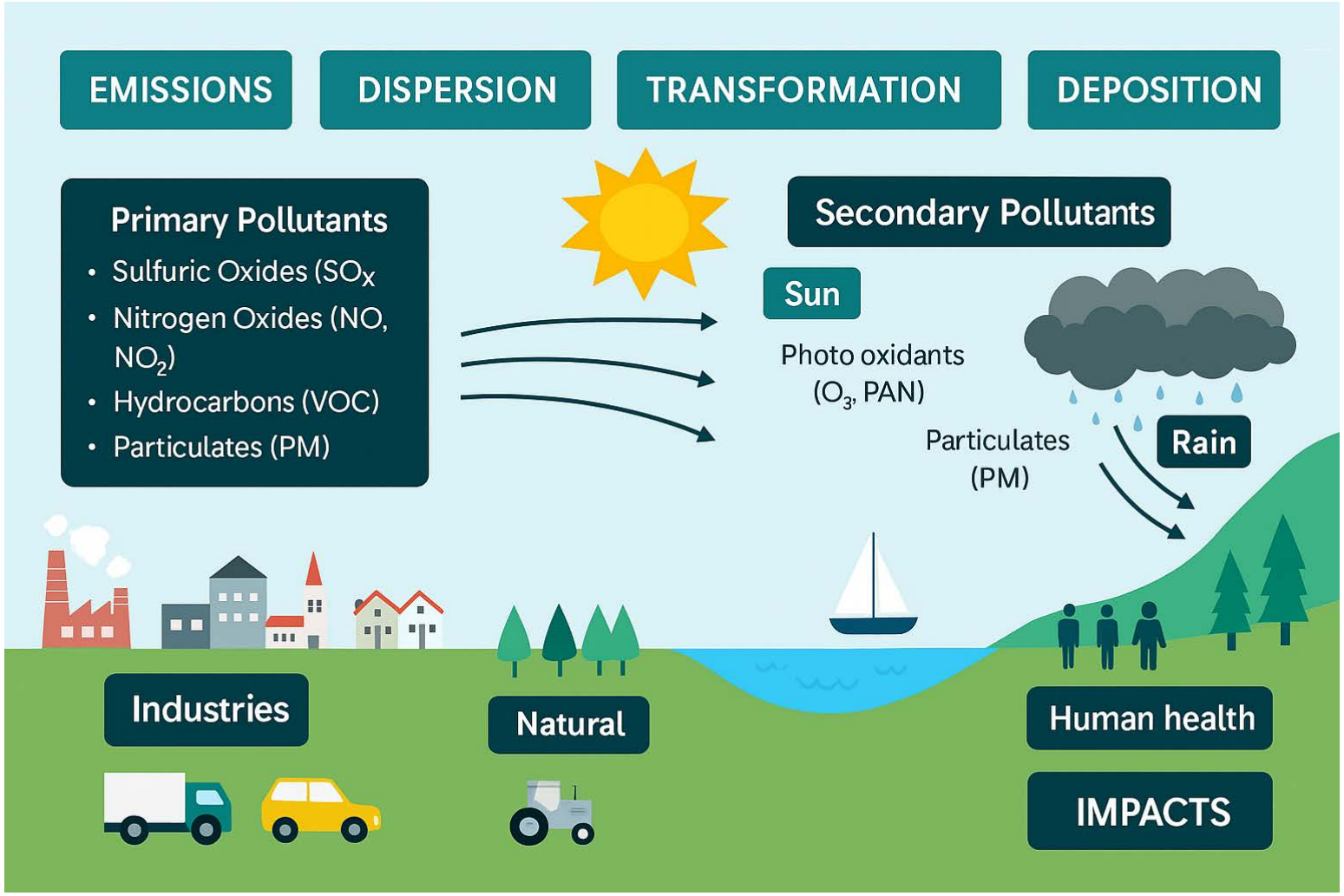
Air Quality is a complex issue



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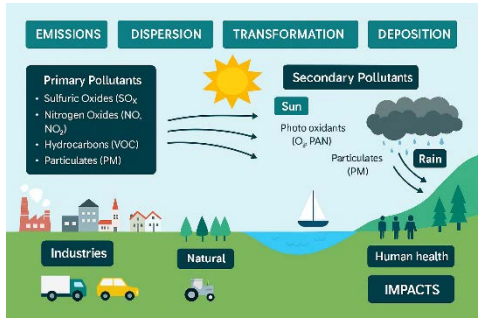
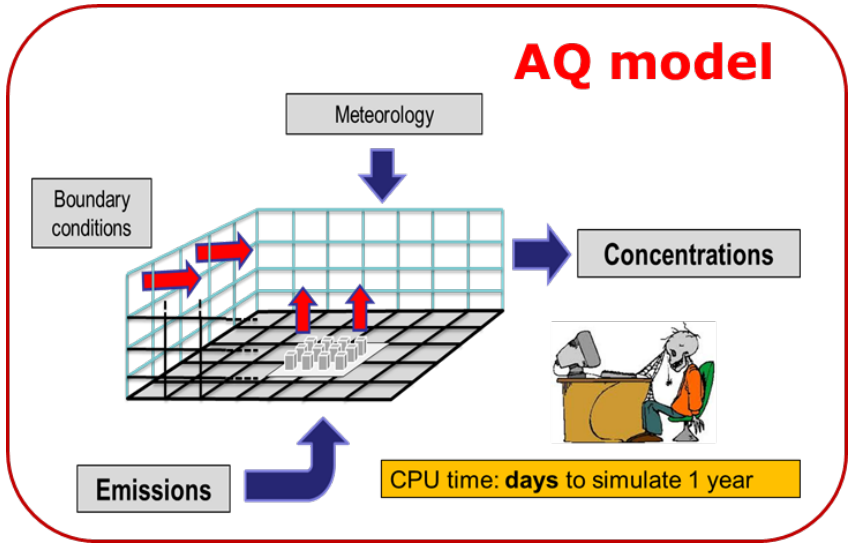
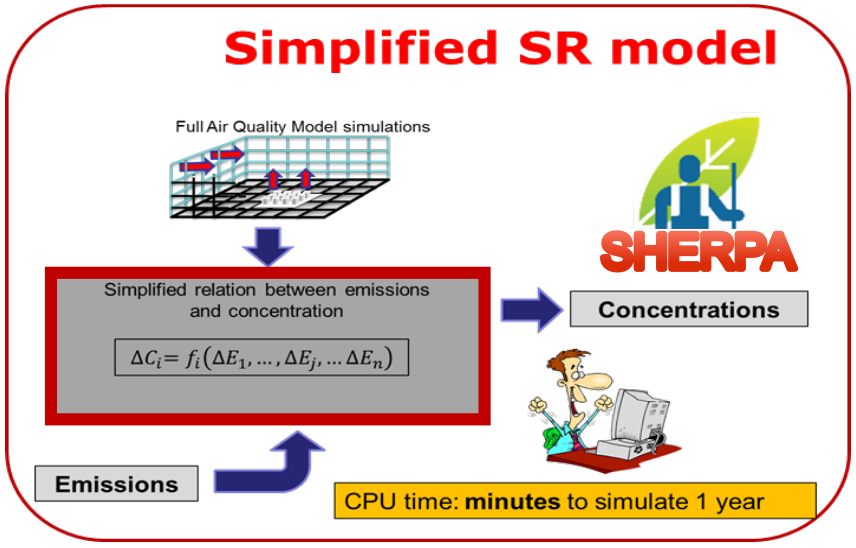
Main challenges and response tools







ELSEVIER
Environmental Modelling & Software
Volume 176, May 2024, 106031

Position Paper

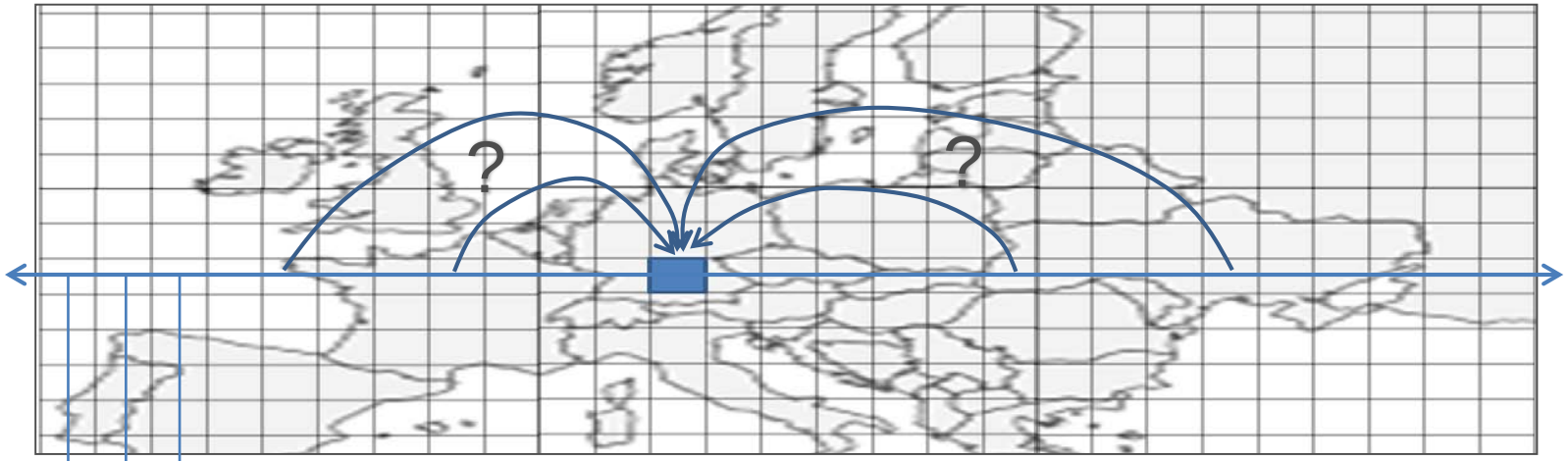
SHERPA-Cloud: An open-source online model to simulate air quality management policies in Europe

Enrico Pisoni [a], Davide De Marchi [a], Alberto di Taranto [b], Bertrand Bessagnet [a], Stefano Zauli Sajani [a], Alexander De Meij [c], Philippe Thunis [a]

European Commission

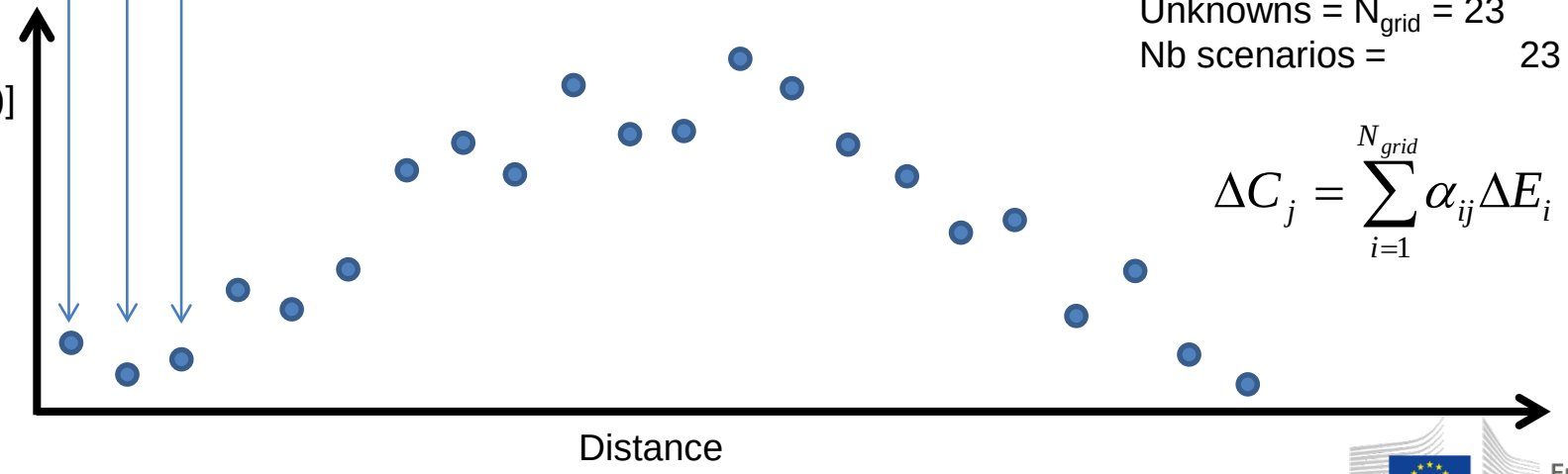
SHERPA SRR – A simplified approach

Grid-to-grid SRR



Unknowns = N_{grid} = 23
Nb scenarios = 23

$$\Delta C_j = \sum_{i=1}^{N_{grid}} \alpha_{ij} \Delta E_i$$



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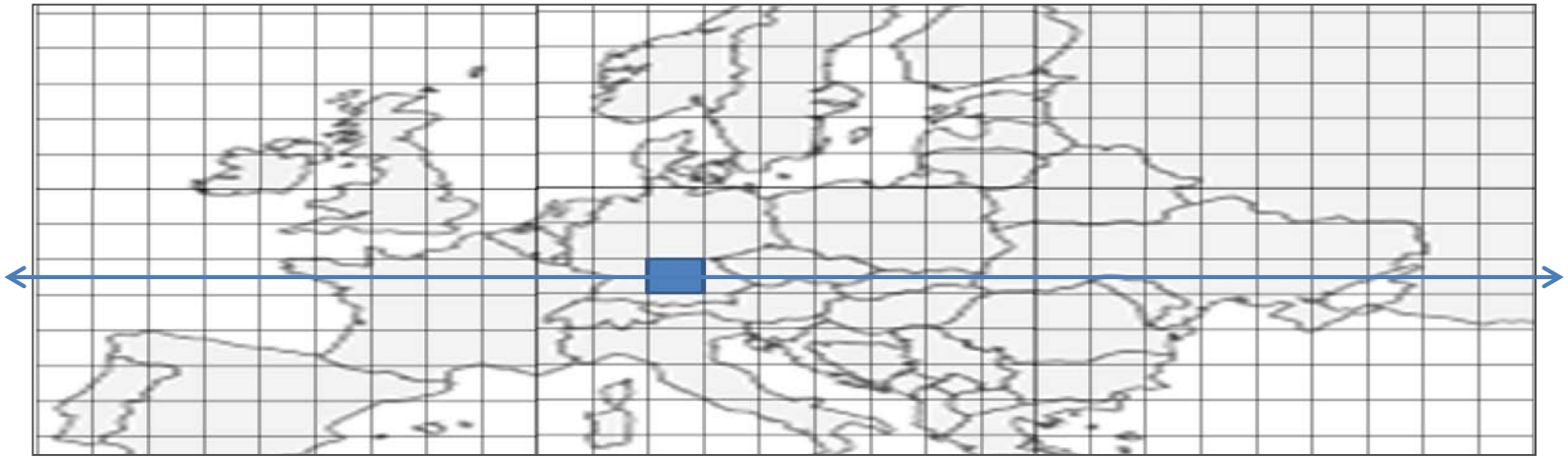
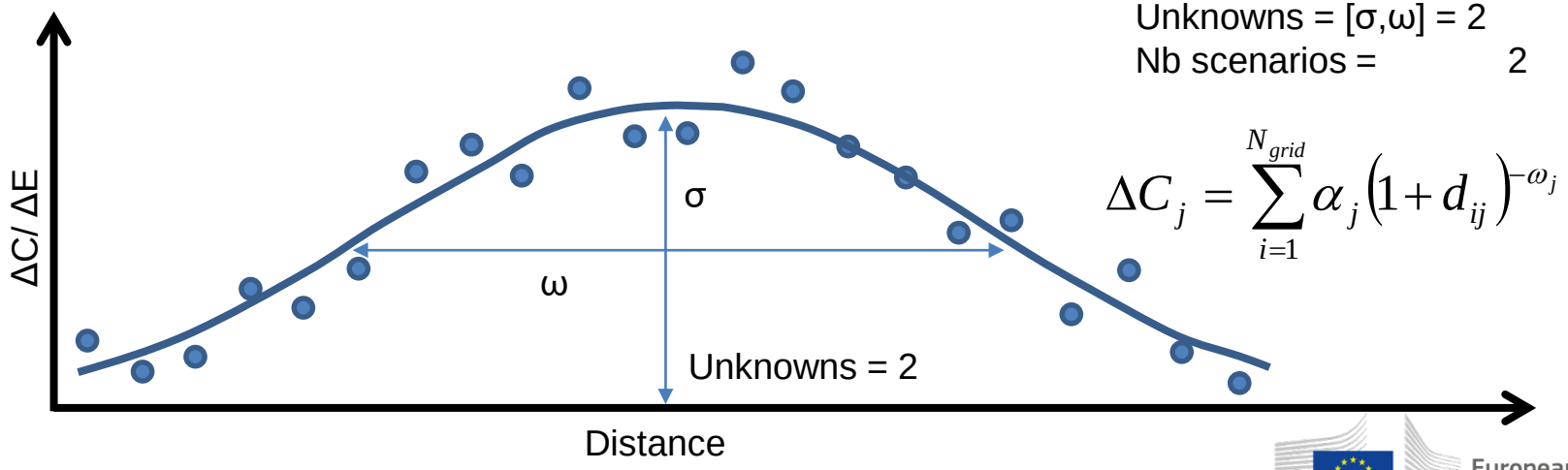
SHERPA SRR – A simplified approach

SHERPA
grid-to-grid SRR





Unknowns = [σ,ω] = 2
Nb scenarios = 2

$$\Delta C_j = \sum_{i=1}^{N_{grid}} \alpha_j \left(1 + d_{ij}\right)^{-\omega_j} \Delta E_i$$

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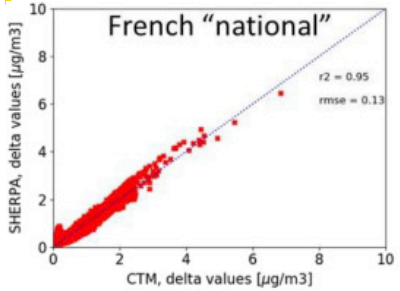
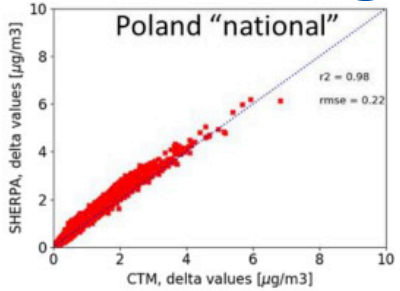
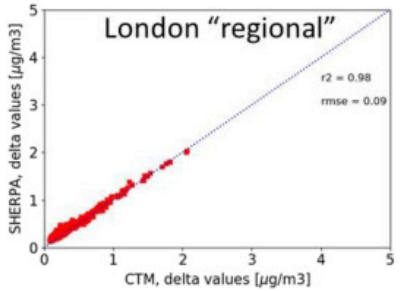
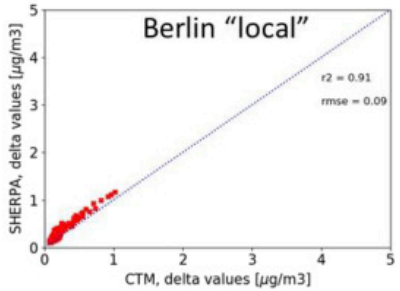
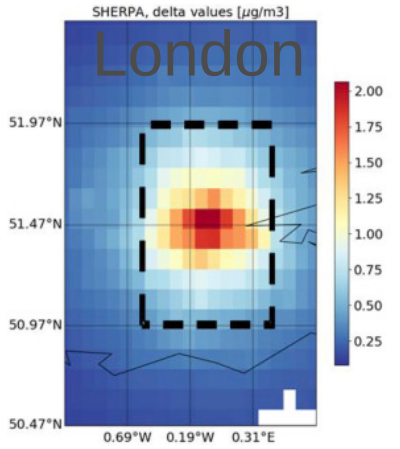
SHERPA training & validation

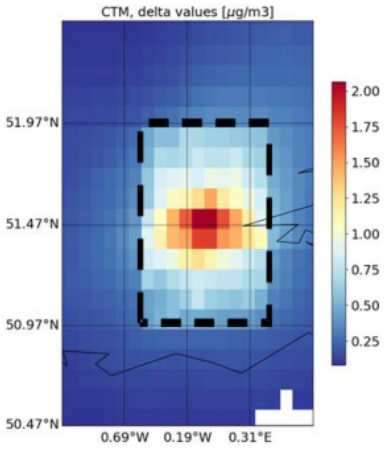


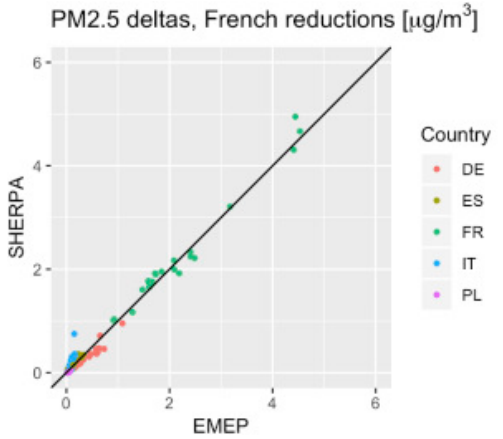


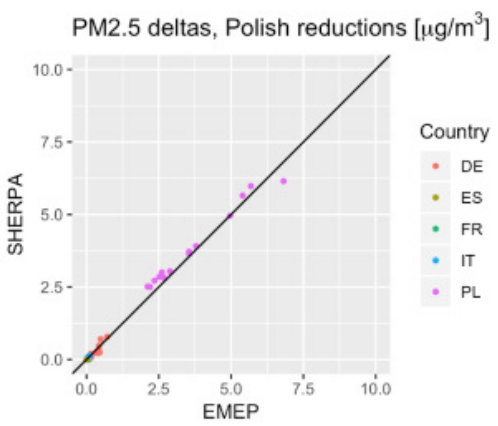


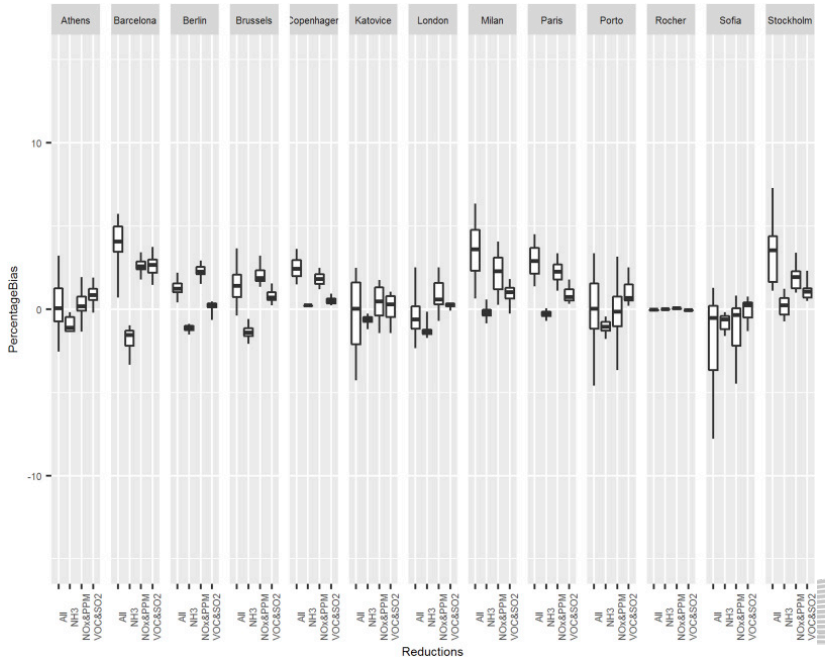












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For further aspects on methods / validation

- SHERPA-Cloud: An open-source online model to simulate air quality management policies in Europe (2024), Environmental Modelling and Software, Volume 176, 106031 (Enrico Pisoni, Davide De Marchi, Alberto di Taranto, Bertrand Bessagnet, Stefano Zauli Sajani, Alexander De Meij, Philippe Thunis)
- Design and implementation of a new module to evaluate the cost of air pollutant abatement measures (2022) Journal of Environmental Management, Volume 317, 115486 (Bessagnet, B., Pisoni, E., Thunis, P., Mascherpa, A.)
- Application of the SHERPA source-receptor relationships, based on the EMEP MSC-W model, for the assessment of air quality policy scenarios (2019) Atmospheric Environment: X, 4, art. no. 100047 (Pisoni, E., Thunis, P., Clappier, A)
- PM2.5 source allocation in European cities: A SHERPA modelling study (2018) Atmospheric Environment, 187, pp. 93-106 (Thunis, P., Degraeuwe, B., Pisoni, E., Trombetti, M., Peduzzi, E., Belis, C.A., Wilson, J., Clappier, A., Vignati, E)
- Adding spatial flexibility to source-receptor relationships for air quality modeling (2017) Environmental Modelling & Software, Volume 90, Pages 68-77 (Pisoni, E., Clappier, A., Degraeuwe, B., Thunis, P.)
- A new approach to design source–receptor relationships for air quality modelling (2015) Environmental Modelling & Software, Volume 74, Pages 66-74 (Clappier, A., Pisoni, E., Thunis, P.)

Conclusions

- Sherpa mimics the behavior of a CTM for emission scenarios over given area/sector with an accuracy of 5 to 10% -> use as screening tool
- Simulation time for one scenario is 1-2 minutes (vs. days for a CTM)
- SHERPA covers the entire EU at 7/10 km resolution with default data but it can be fed by other AQ model /emissions. Effort ~ 10 CTM runs
- It currently works for yearly averaged PM10, PM2.5 and NO2 concentrations, using CAMS v8 (2022 emissions) and EMEP v4.45.
- On request: low and high level source, seasonal SRR
- More info: https://knowledge4policy.ec.europa.eu/fairmode/sherpa_en

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Scenario analysis

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Screening for High Emission Reduction Potential on Air

Help ?

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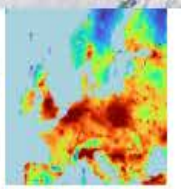
Area specific analysis

Assess the impact of simple/complex emission reduction strategies over your selected domain

Compute the sectorial apportionment of concentrations over your selected domain

Compute the precursor apportionment of concentrations over your selected domain

EU-wide overviews



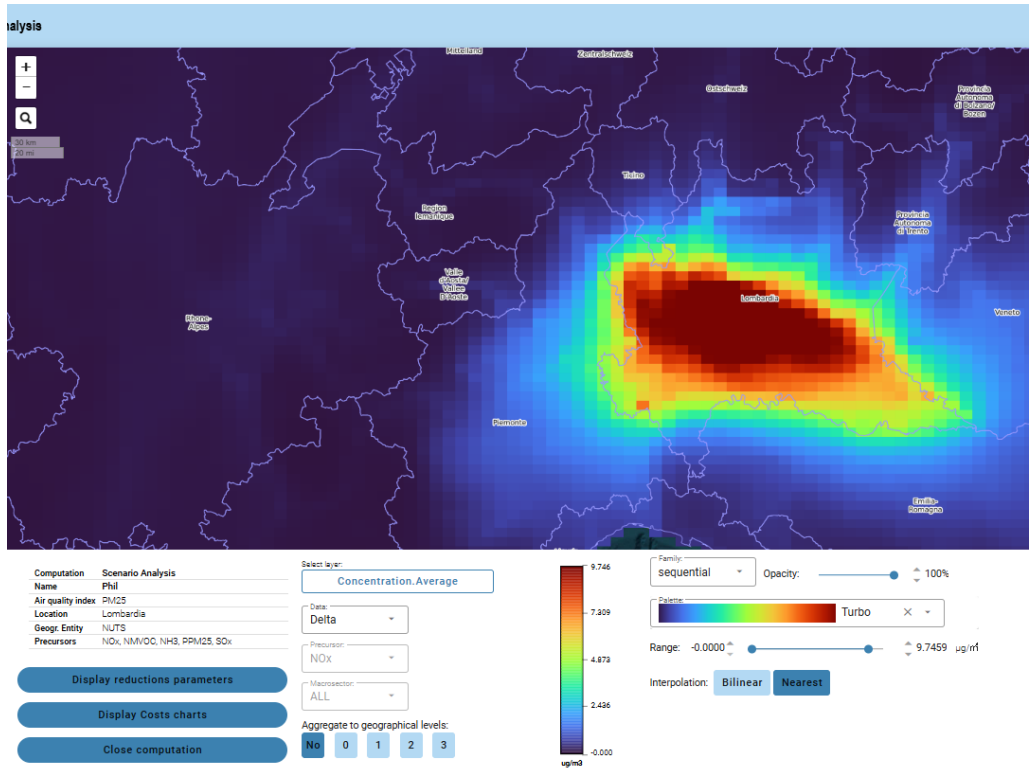
Compare the impact of a given AQ measure across the EU

Access source apportionment results for 700 pre-selected cities in Europe

Module 1: Scenario Analysis

What is the impact of a given set of emission reduction on concentration / exposure?

- Source area (NUTS, FUA, CNC)
- Emission reduction strategy (precursors, sectors)
- Pollutant (NO2, PM2.5, PM10)



- Gridded concentrations (and deltas)
- Gridded population exposure (and deltas)
- Gridded health benefits (and delta)
- Gridded technical costs (based on BAT)

- Best suited for users who wish to define their test cases precisely for the source area and strategy

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Source apportionment

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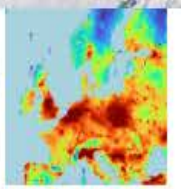


Compare the impact of a given AQ measure across the EU

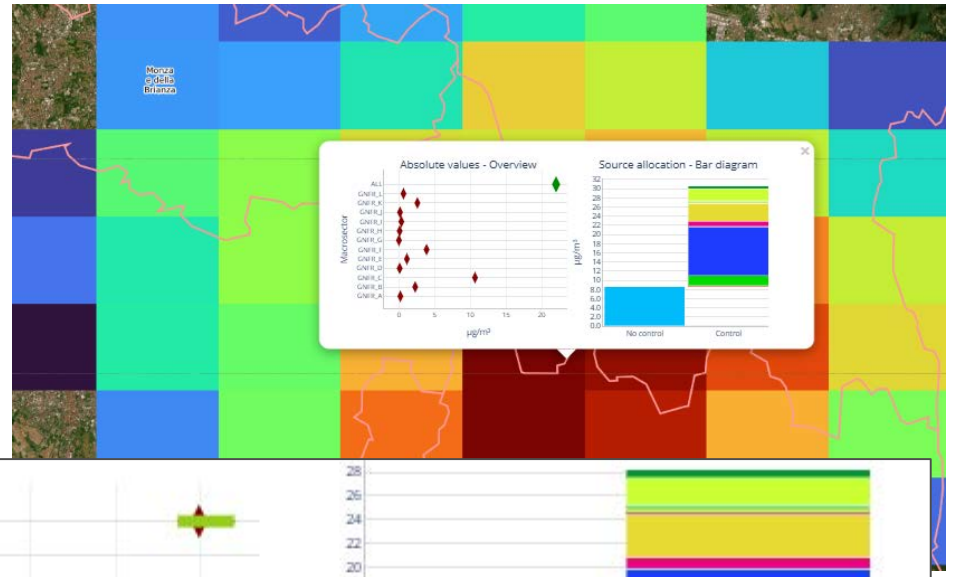
Access source apportionment results for 700 pre-selected cities in Europe

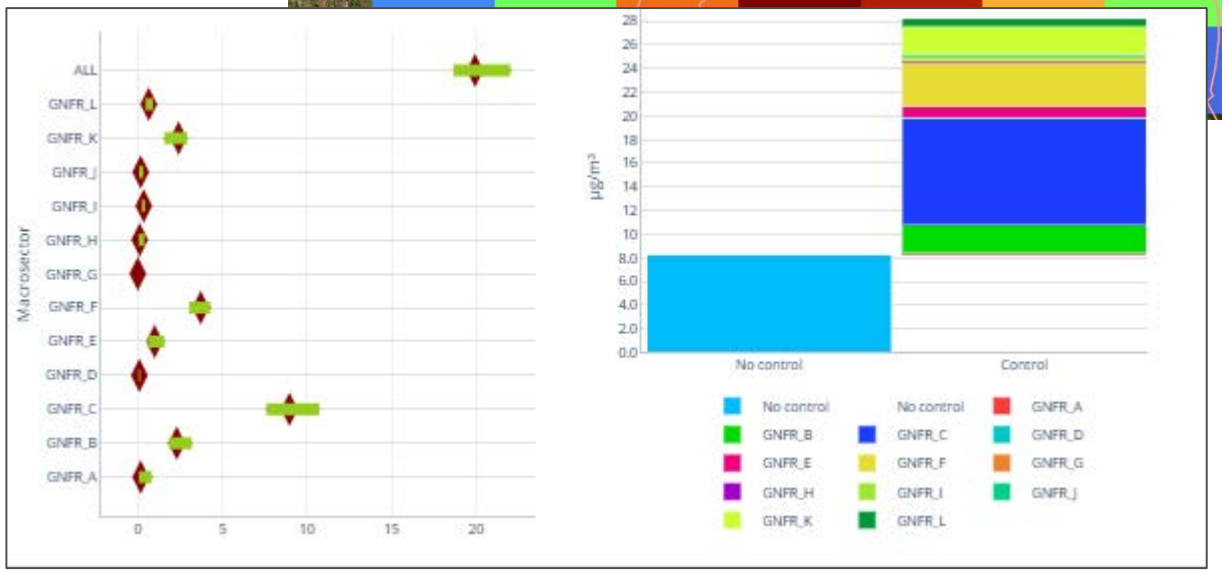
Module 2: Source apportionment
(example for sectoral)

What are the priority sectors/pollutants to act on for abating air pollution?

- Source area (NUTS, FUA, CNC)
- Precursor(s)
- Pollutant (NO2, PM2.5, PM10)

- Gridded sectorial src. apport.
- Domain min/average/max potential impacts
- Control vs. no-control





- Best suited for users who wish to define their test cases precisely for the source area

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Interactive SA maps

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Screening for High Emission Reduction Potential on Air

Help ?

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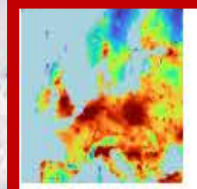


Compare the impact of a given AQ measure across the EU

Access source apportionment results for 700 pre-selected cities in Europe

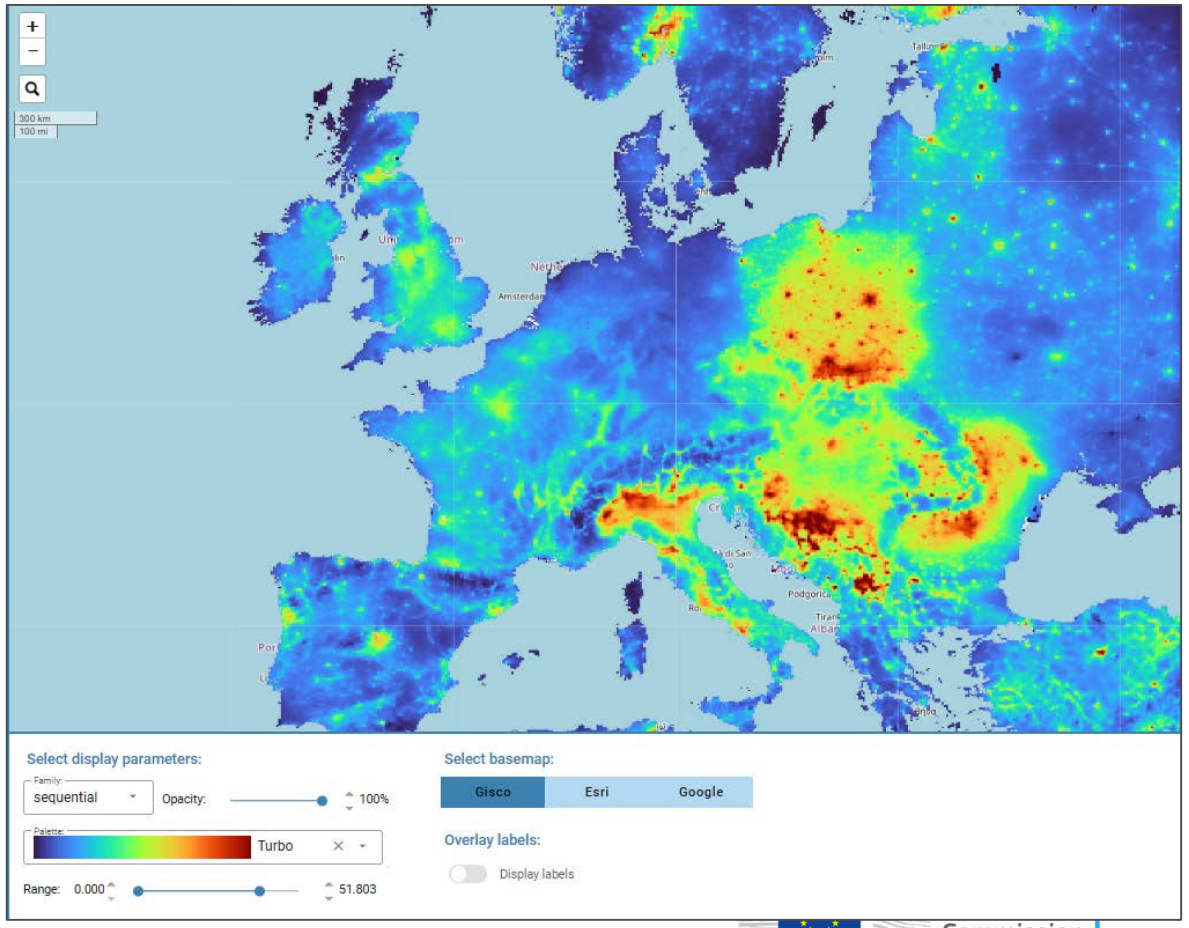
Module 3: Interactive SA maps

How do AQ strategies impacts compare across Europe?

- Source areas (from 7x7 to 1800x1800 km^2)
- Specific sector (or all)
- Specific precursor (or all)

- EU gridded potential impacts harmonized in terms of source area / sector and precursor

- As it is designed with simplified default settings (source area), it is better suited for screening



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Urban PM2.5 Atlas

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Screening for High Emission Reduction Potential on Air

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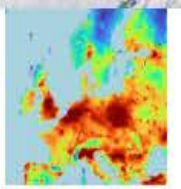


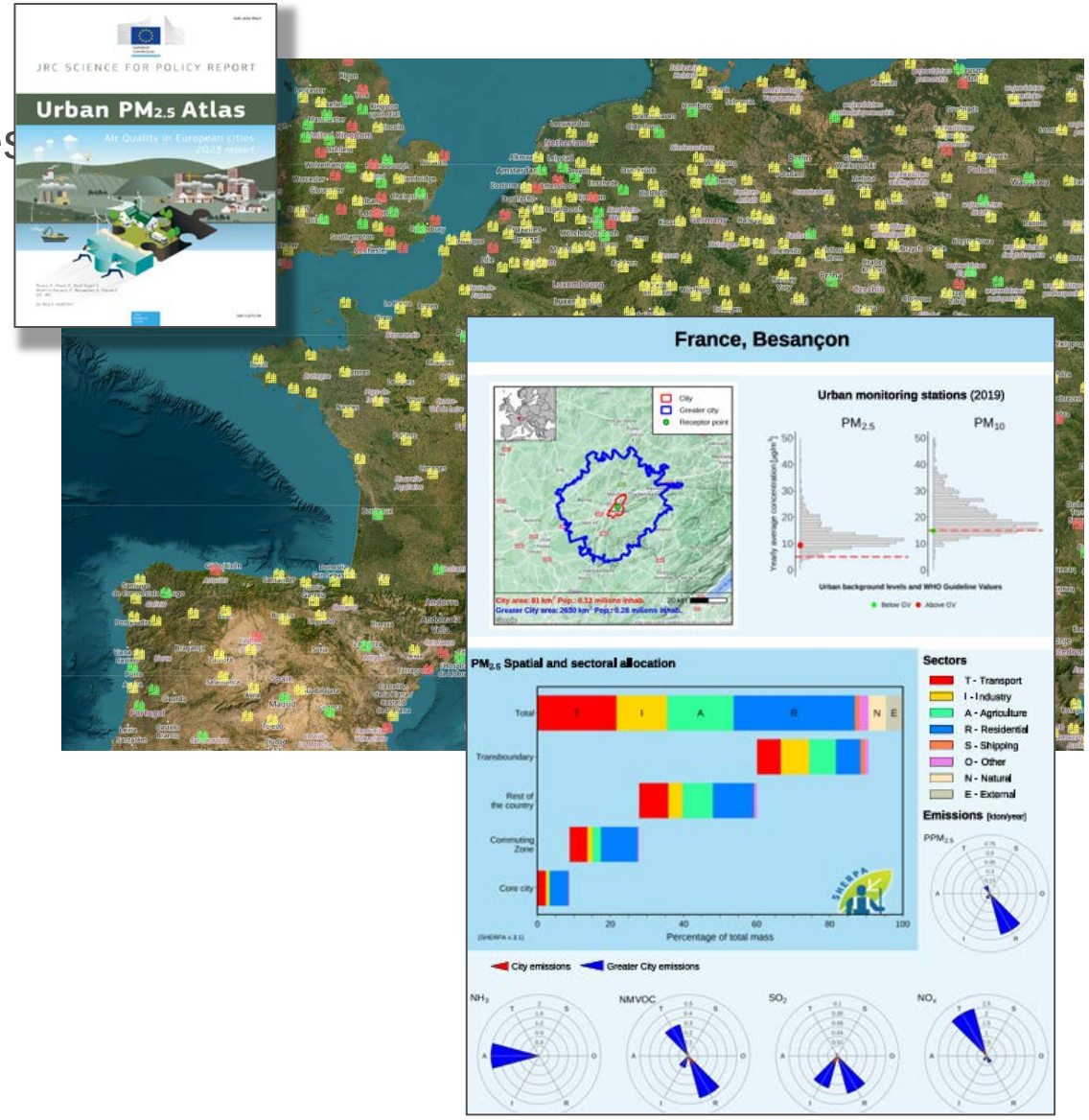
Compare the impact of a given AQ measure across the EU

Access source apportionment results for 700 pre-selected cities in Europe

Module 4: Urban PM2.5 Atlas

How does source apportionment compares across cities?

- City (about 700 are available)
- Source allocation overview including sectorial and spatial details
- Pre-computed results only! Best suited for city comparisons



Thank-you

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