



Comparability and complementarity of source attribution methods for use in air quality planning

CAMEO plans and TNO viewpoint

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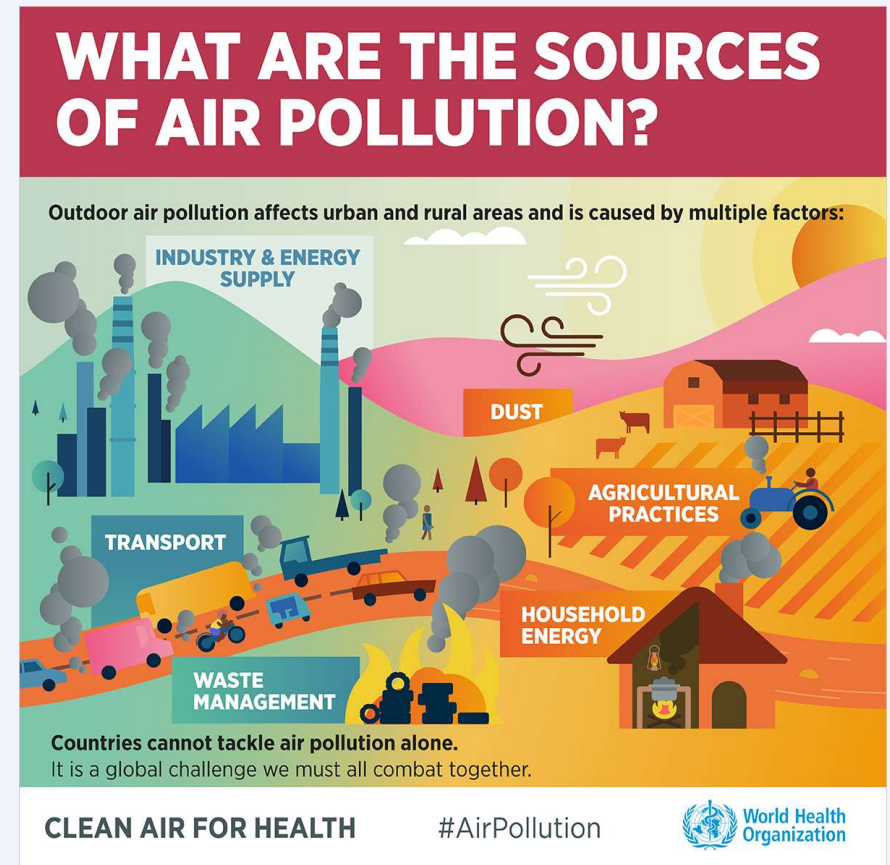
Markus Thürkow (UNI BERLIN)

FAIRMODE WG1 meeting 5 October 2023

What are the goals of TNO's source apportionment activities?

To support informed and efficient decision making by policy makers, companies and public for **improving the air quality and hence the health of the population**

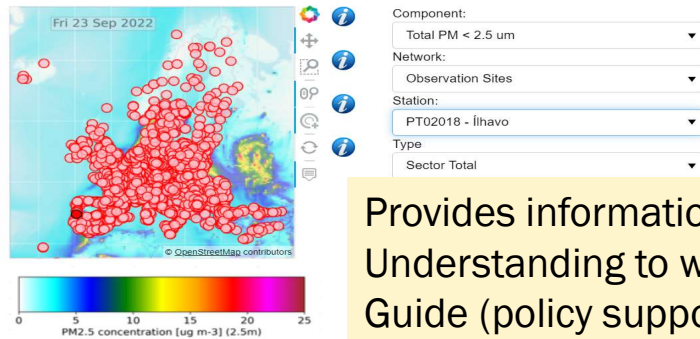
- Build a **level of understanding** by providing easily accessible information on the origin of air pollutants in their region
- Identify the most relevant source contributions and **guide (support) question articulation**
- Provide **detailed information** on the current understanding of **sources contributing** to observed air pollutant levels on an annual and daily basis, often **complemented** by analyses on **effectivity of mitigation directions**
- To evaluate, **improve** and build **confidence in the emission information and source receptor calculations** underlying further policy support activities
- To explain, **interpret**, illustrate the **results** of many policy and science related LOTOS-EUROS model calculations



TOPAS - SOURCE ATTRIBUTION WITH LOTOS-EUROS

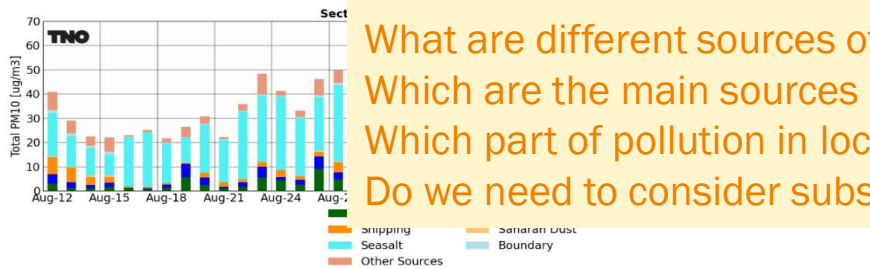


<https://airqualitymodeling.tno.nl/topas/>

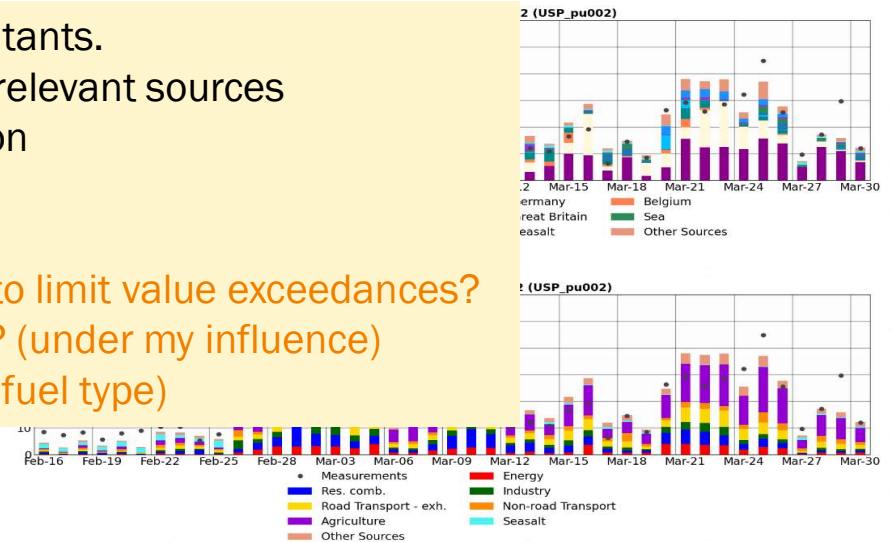
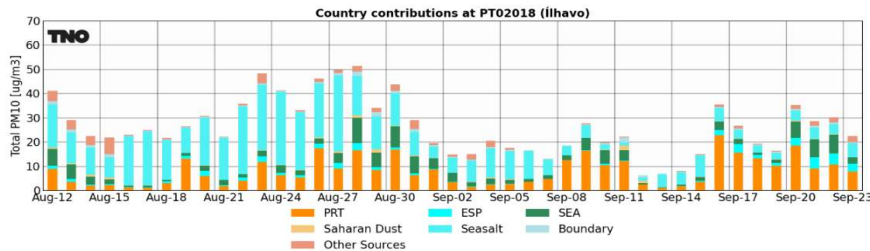


TOPAS-NL at 1x1 km
PM10, PM2.5, NO2 and SO2
official monitoring and citizen science sensor locations
<https://airqualitymodeling.tno.nl/topas/topas-netherlands/>

Provides information on the origin of pollutants.
Understanding to wide range of users on relevant sources
Guide (policy support) question articulation



What are different sources of pollution?
Which are the main sources contributing to limit value exceedances?
Which part of pollution is local or natural? (under my influence)
Do we need to consider subsectors? (e.g. fuel type)

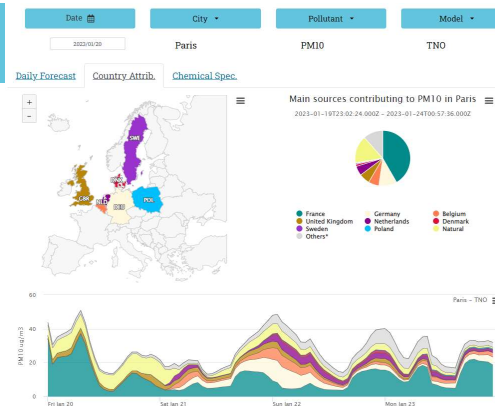


- Prototype also set-up for Northern-Colorado Front-Range and Santiago de Chile (AQ-WATCH)
- Planned extensions for ozone, black carbon, methane and oxidative potential



CAMS policy support service

Provides source allocation information for Europe
<https://policy.atmosphere.copernicus.eu/>



Three models and three allocation methods

TNO
LOTOS-EUROS
 Tagging
 PM (+ NO2, SO2)



Relevance of sources at given location and time

Metnorway
EMEP
 Sensitivity 15% reductions
 Scaled to 100%
 O3 and PM



Potential impact of ER (scaled to 100%)

INERIS
CHIMERE
 Surrogate model (ACT) = Fitting of polynomials to BF training runs
 O3 and PM



Estimate of potential impact of measures

In CAMEO: Evaluate uncertainties and comparability of methods

- Comparisons of 3 CAMS methods but also several methods in 1 model (to exclude model dependencies)
- In LOTOS EUROS: BF/sensitivity vs tagging vs surrogate modeling

Under what circumstances do the methods provide similar or different results → applicability of methods

CAMEO – When are the method interchangeable and when complementary?

In collaboration with RI-urbans and Life-Remy projects

CAMS
CT- models + source attribution

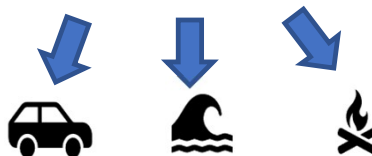


Observations
PMF

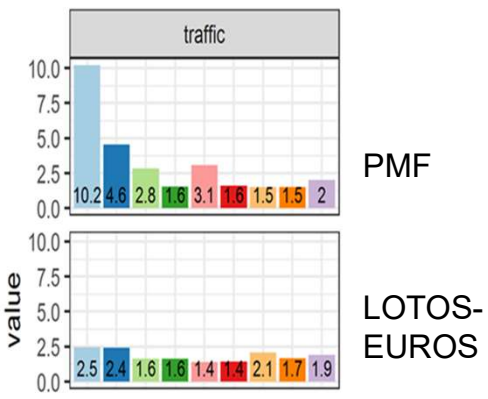
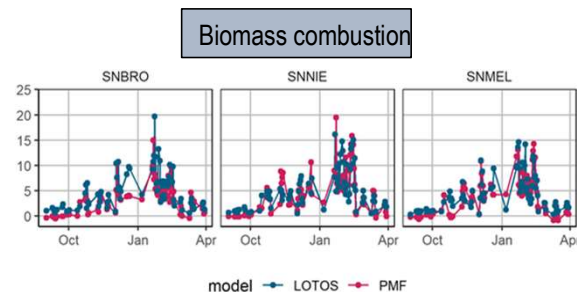


Statistical model
resolves factor
profiles and
contributions

PM10, PM2.5, OC, EC, SIA, Metals,
Levoglucosan (tracer biomass burning)



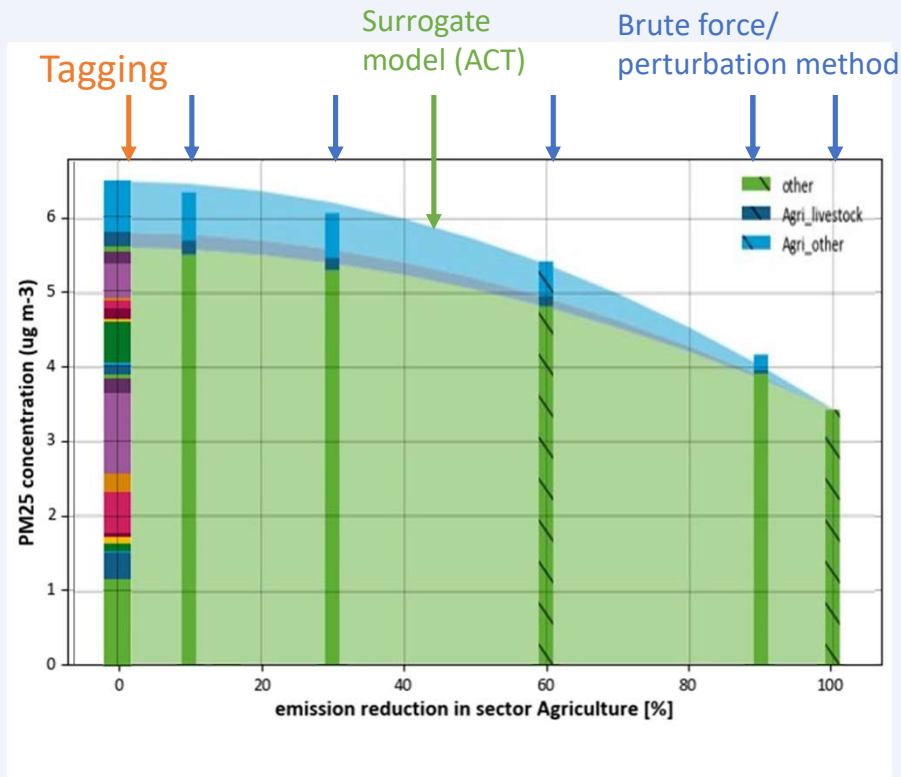
→ Also provides hints for underestimated/missing sources in the model



We are interested in available PMF datasets from European sites, please let us know if you have any datasets you would like to share to contribute to this evaluation exercise in CAMEO
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tagging vs brute force vs surrogate model

3 – 11 April 2019 Europe



LOTOS-EUROS model

Complementary tools

Differences currently being evaluated a.o. EU CAMEO project

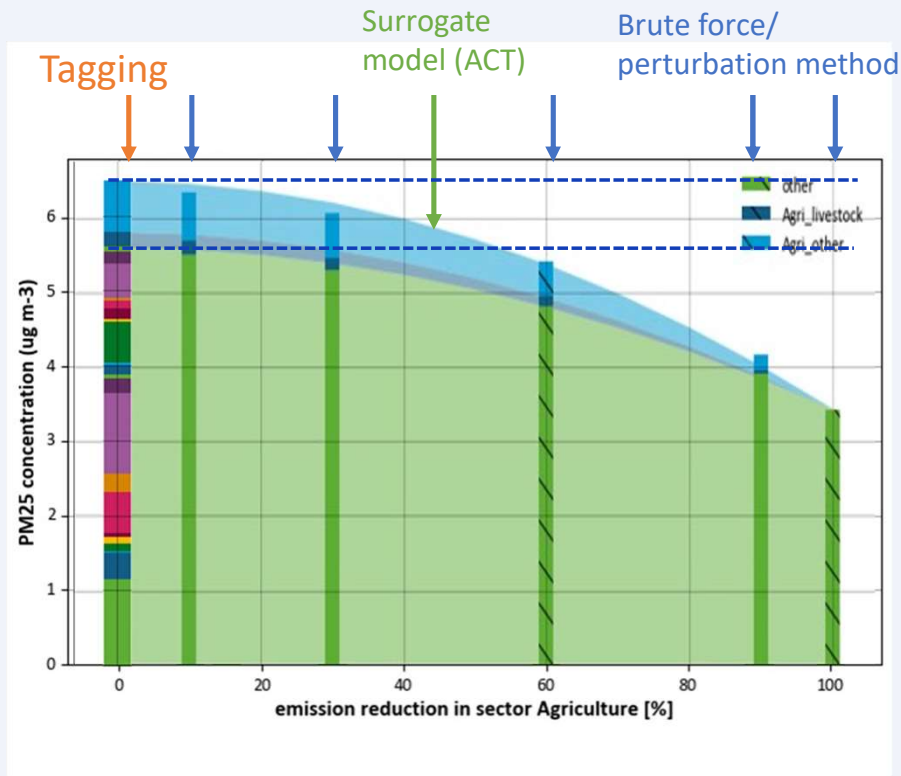
tagging = contributions @ place and time

Brute force = potential impact of emission reduction in sector or region

Mitigation tool = surrogate model for **potential impact** fitted on a number of brute force runs

tagging vs brute force vs surrogate model

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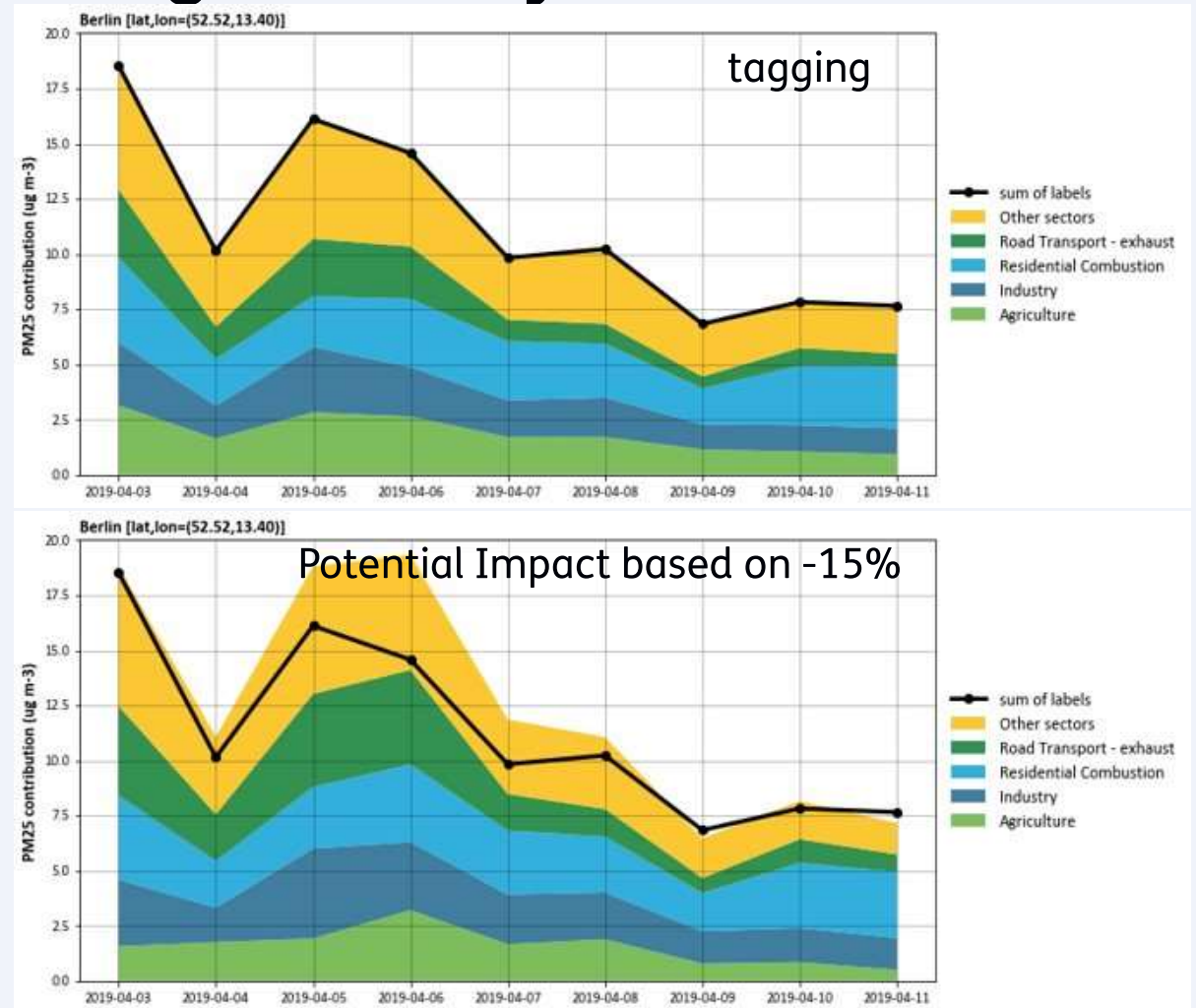
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Tagging does not provide you the effectiveness of measures for large emission reductions (non-linear processes, sec. PM)
For low emission reductions close to BF results
BF results for small emission reductions can not be extrapolated to large emission reductions and vice versa

On source apportionment using sensitivity simulations

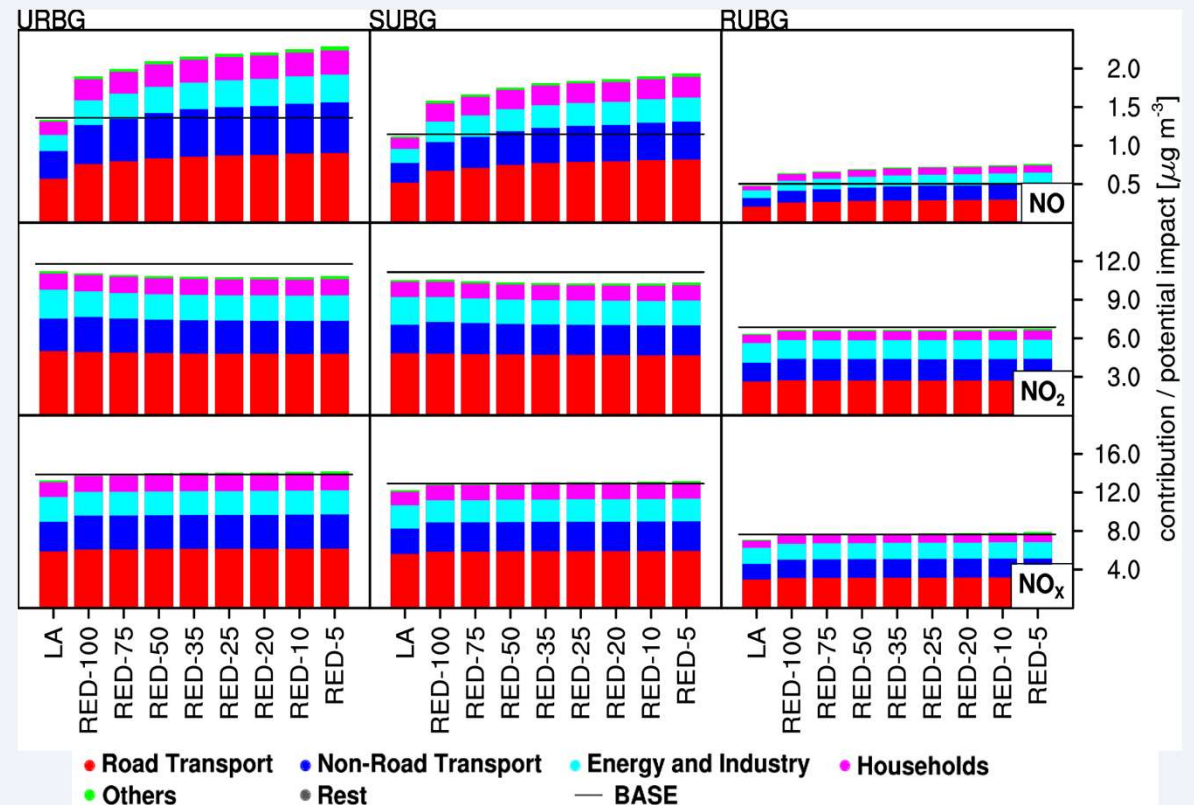
- Equivalent to tagging for linear species
- For non-linear compounds upscaling impacts systematically over or underestimates the base line
- Differences for NO_x are largest for urban stations
- Performance and result based on the sensitivity simulations depends on reduction (RED-x) percentage used
- This implies that a single sensitivity simulation can not be used to address source attribution, all sectors should be addressed simultaneously

Berlin, April 2019, PM_{2.5}



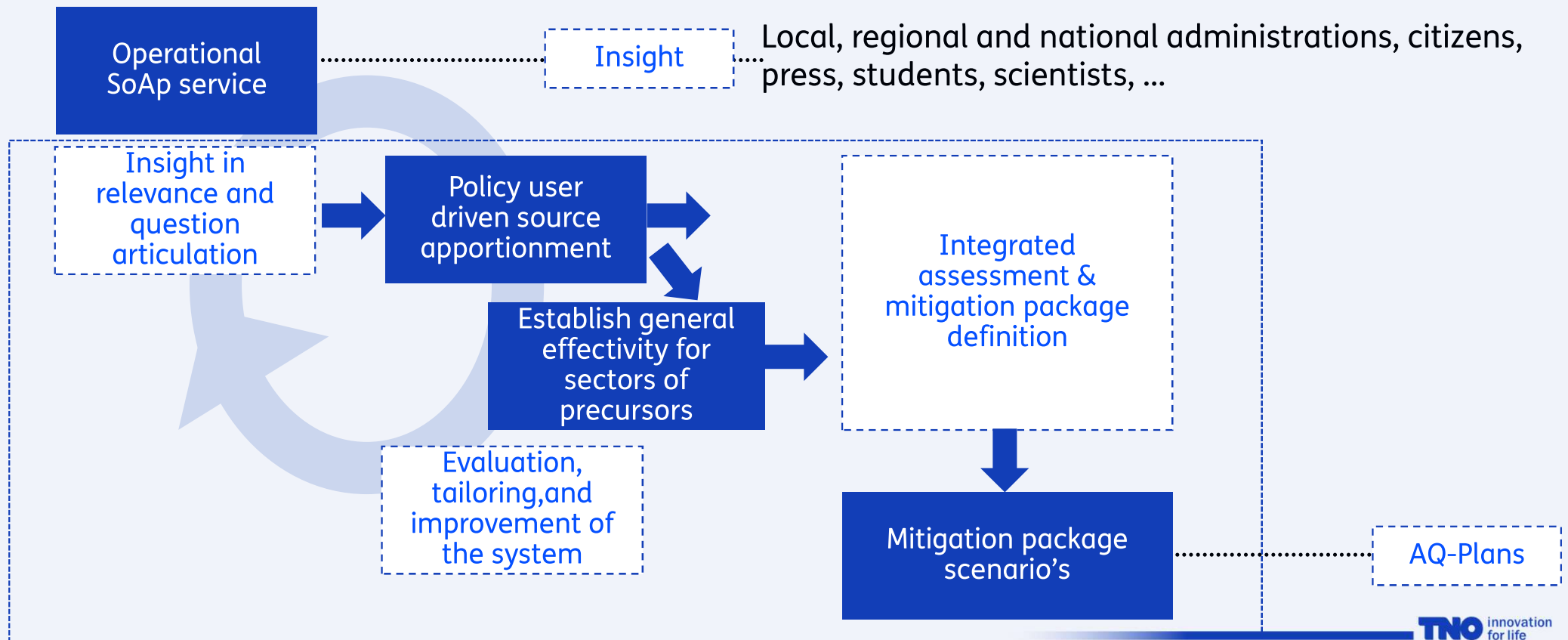
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Thurkow et al, 2023 10.1016/j.atmosenv.2022.119412

An attempt to visualize how we use source apportionment in relation to policy support and complementarity of tools



THANK YOU FOR YOUR
ATTENTION

QUESTIONS?

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TNO innovation
for life

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