



CT1 - Source apportionment

Guidance and Recommendations

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FAIRMODE

Forum for air quality modelling in Europe

Joint
Research
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CT1 – Source Apportionment

- Guidance on Source Apportionment
- Updated Recommendations about Source Apportionment Methods
- Other Open Issues on Comments

Source Apportionment Guidance

European Commission

JRC TECHNICAL REPORT


Source apportionment to support air quality management practices

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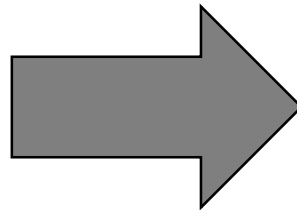
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Guerreiro, C., Monteiro, A., Dupont,
H., Riffaut, V., Waersted, E., Hellebust,
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A., Angyal, A., Bonafe, G., Montanari,
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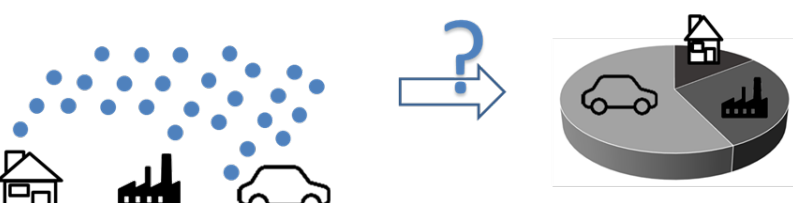
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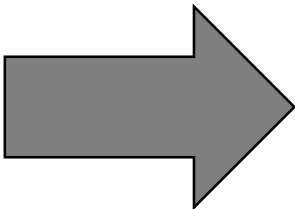
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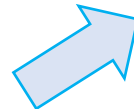
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Guide to Receptor Modelling

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Annexes

ANNEX 1. Incremental assumptions

V 4.0

1 Introduction

2 What is source apportionment?

3 Which methods to use for source apportionment?

- 3.1 Potential impacts
- 3.2 Contributions
- 3.3 Increments
- 3.4 Combined methods

4 Types of atmospheric pollutants: linear vs. non-linear

5 Relation between source and receptor: Mathematical formulations

- 5.1 Formulations for linear compounds
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6 What are the properties of SA methods?

- 6.1 Unambiguity
- 6.2 Additivity
- 6.3 Dynamicity
- 6.4 Consistency
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7 Source allocation: Potential impacts that preserve consistency and additivity

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- 11.3 Distinction between source identification and apportionment
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- 11.5 Source apportionment to support the ex-post assessment of AQP

12 REFERENCES

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ANNEX 1. Incremental assumptions

ANNEX 3. Application of SA approaches to NO₂

ANNEX 4. A dummy's guide to receptor modelling

ANNEX 5: Support to the quality assurance of AQ modelling

SA definition and Reporting

V 3.1

1 INTRODUCTION

PART I: METHODS AND CONCEPTS

2 Which methods to use for source apportionment?

- 2.1 Potential impacts
- 2.2 Contributions
- 2.3 Increments
- 2.4 Combined methods

3 Types of atmospheric pollutants: linear vs. non-linear

4 What are the properties of individual source apportionment methods?

- 4.1 Measurement vs. Model-based
- 4.2 Unambiguity
- 4.3 Additivity
- 4.4 Dynamicity
- 4.5 Consequences for the interpretation of SA results
- 4.6 Consistent and additive potential impacts: the case of source allocation

PART II: AN ILLUSTRATIVE (THEORETICAL) EXAMPLE

5 Sectorial apportionment

- 5.1 Receptor contribution
- 5.2 Tagging contribution
- 5.3 Potential impacts
- 5.4 Increments
- 5.5 Comparative overview

6 Spatial apportionment

PART III: Which source apportionment method for which purpose?

7 Support to the design of AQ Plans

8 Support to the quality assurance of AQ modelling

- 8.1 Tagging vs. receptor contributions
- 8.2 Increments vs. other methods
- 8.3 Potential impacts vs. tagging/labelling contributions
- 8.4 "Intra"-comparison of approaches
- 8.5 Summary overview

PART IV: OPEN ISSUES

9 Extension to other pollutants

10 Distinction between linear and non-linear pollutants

11 Use of RM to improve model based approaches: the case of organic aerosol (OA)

12 Distinction between source identification and apportionment

13 Combined source allocation / tagging approach to support planning

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ANNEX 4. A dummy's guide to receptor modelling

ANNEX 5: Support to the quality assurance of AQ modelling

Time line

mid-May: availability of version 4.0 to the whole FAIRMODE community

mid-June: feedback from the whole FAIRMODE community through comments

end of June: release of the final version 4.0

Updated Recommendations about SA Methods

- a) **The incremental approach** is **not recommended** for air quality planning applications. This is because the increment is defined as a spatial gradient which differs from a source apportionment unless the background concentrations are spatially homogenous and the background location is not influenced by the source. The validity of these two assumptions cannot be assessed with the method itself.
- b) **Emission sensitivity-based** approaches are **recommended for identification and quantification** of emission sources in the context of air quality planning applications because they reflect directly the impact of emission reduction, however for non-linear species their applications are **limited in terms of emissions strength**, hence the need to carefully assess their range of applicability.
- c) **Mass-transfer methods** based on tagging species algorithms built into the air quality model are **suited to identify** the sources that contribute to pollution. These methods can also be used to **complement emission sensitivity-based approaches beyond their range of applicability**. In the case of pollutants involved in linear processes, that is, those characterised by a linear relationship between emission and concentration changes these methods are also suited for quantifying the impact of sources.
- d) **Mass-transfer methods based on receptor models** are **suited for the identification and quantification** of pollution sources but only for pollutants involved in **linear processes**.

Nomenclature of emission sources

Issue

The nomenclatures of the emission sources used in different source apportionment studies, both with receptor and source-oriented models are not always consistent

Proposed recommendation

Nomenclature for classifying emission sources: Following the recommendations for emissions, we recommend to adopt the nomenclature used under the NEC Directive for reporting emissions as basis for the source apportionment activities under the AAQDs. In this way, better consistency between the different Directives and higher level of transparency would be ensured, harmonising with the classification of emission sources at macro sector level given as the GNFR (Gridded Nomenclature for Reporting).

Nomenclature of emission sources

Comments

- 76 - Within receptor models it is possible a **mixture of various emission sources** are found in a factor profile. Hence, as no clear source can be defined, the nomenclator of the found profile often reflects the most dominant source emission
- 88 - I am not familiar enough with the nomenclature under the NEC Directive for reporting emissions to establish if all categories are available and **if there is room to name the commonly SIA related factor profiles.**
- 90 - What about **factor profiles that contain two or more emission sources**? How should we name these? Some guidance on this would be helpful
- 169 - How should this work in practice (**taking into account secondary aerosol formation**)?
In addition, for planning purpose **the nomenclature used under NEC seems not to be sufficient** (NEC report overall “traffic emissions” but air quality planning needs more specific information, i.e. emissions for different segments of the car fleet (Euro 4 diesel, Euro 5 diesel, ...)
- 254 - FR - **there is inherent limitations in the receptor models based on observations to use such a classification** (availability of characteristic profiles for each of these activity sectors in the PFM analysis)

Nomenclature of emission sources

Proposed recommendation (updated version)

Nomenclature for classifying emission sources: Following the recommendations for emissions, we recommend to adopt the nomenclature used under the NEC Directive for reporting emissions as basis for the source apportionment activities under the AAQDs. In this way, better consistency between the different Directives and higher level of transparency would be ensured, harmonising with the classification of emission sources given as the GNFR and NFR Nomenclature for Reporting.

In the case of receptor models guidance need to be developed in order to harmonize the nomenclature to classify emission sources with the above.

For example:

- «Secondary ammonium nitrate» should be classified as «not apportionable» because no information on the exact precursor sources can be inferred
- «Mineral» could be related to «road resuspension», «non-exhaust emissions» and «natural dust»

Nomenclature of emission sources

Questions

- Do you agree with the proposal to remove the final part of the original recommendation, so to not limit the level of detail in the source classification? (i.e. not limiting it to the macro sector level)
- Do you agree with the proposal to introduce the concept of «not apportioned» with an accompanying note?
- Do you agree with the proposal to develop guidance that could help in harmonizing the accompanying notes?
- If yes, would you be willing to contribute?

Protocols and benchmarking tools

4.4 Implications

...Suitable approaches should be fit for purpose (recommendation 1) and their performances and uncertainties been tested with FAIRMODE benchmarking tools and technical protocols where available (recommendation 2).

Comments

93 - For “general” use of receptor models I agree. Out of curiosity, what to do with more complex receptor models like for example the multi-time ME-2? When data with multi time resolution is used, the general recommendations will not always be applicable.

Proposal

To periodically check the need to update guidance, tools and protocols according to the ongoing development of modelling tools

Reporting information under the IPR

7.2.3 *Source apportionment*

In this section, suggestions are made to update the reporting of information on source apportionment (data flow I) under the IPR to improve consistency and ensure comparability. It includes additional metadata fields (type of approach used, range of applicability, spatio-temporal averages applied at the receptor, spatio-temporal characteristics of the source, etc.) and ensure the consistency of the requested information with the GNFR emission classification.

Reporting information under the IPR

Comments

- 214 - SE - Regarding reporting of source apportionment, **it is difficult to expect municipalities to do very detailed and expensive studies every single time an action plan is needed**. There needs to be good tools / support available at EU or national level to provide contributions to regional background, and preferably even urban background.
- 215 - SE - Where available & where traffic is the main reason for exceedance, **request a breakdown of contributions of different types of vehicles, non-exhaust particles, etc.**
This can provide vital information for identifying and assessing the most suitable measures.
- 216 - SE - Same as traffic, but when industry emissions are main reason for exceedance – i.e. **which industrial plant or plants are contributing most?**
- 261 - FR - **Did not understand why each sector may not apply for each of the different geographical origin.**
For instance local natural sources can have a significant impact also at the local scale.
- 265 - Do we need to report this information for **any exceedance?**

Reporting information under the IPR

7.2.3 *Source apportionment*

In this section, suggestions are made to update the reporting of information on source apportionment (data flow I) under the IPR to improve consistency and ensure comparability. It includes additional metadata fields (type of approach used, range of applicability, spatio-temporal averages applied at the receptor, spatio-temporal characteristics of the source, etc.) and ensure the consistency of the requested information with the ~~GNFR~~ emission classification **proposed in section 4.3. A flexible, comprehensive and consistent interface to report emission sources should be developed under IPR. An example of the proposed entries for data flow I can be detailed** are as follows:

Reporting information under the IPR

Questions

- Do you agree with the proposal to confirm the need to update and integrate reported information under the IPR with respect to the additional metadata?
- Do you agree with the proposal to confirm the need to introduce a suitable classification of the emission sectors, but without defining a final list of entries?
- Do you agree with the proposal to develop a flexible, comprehensive and consistent interface to report emission sources?
- If yes, would you be willing to contribute?

Limitations of air quality modelling

Comment 161

“There should be a chapter called Limitations of air quality modelling in the context of the AQD, in which open questions or subjects FAIRMODE and/or the scientific community is currently working on are described. This should also be clearly communicated to the policy in the executive summary. The most important limitation is probably the fact that air quality models have problems to reproduce short-term high percentile values”

Limitations of air quality modelling

Comment 161

“There should be a chapter called Limitations of air quality modelling in the context of the AQD, in which open questions or subjects FAIRMODE and/or the scientific community is currently working on are described. This should also be clearly communicated to the policy in the executive summary. The most important limitation is probably the fact that air quality models have problems to reproduce short-term high percentile values”

Discussion...

1. All “limitations” (or weaknesses...) affecting air quality modelling assessment have the influence on SA results (e.g. if a model fails in reproducing short term episodes, it will fail also in reproducing the contribution of each single source, at least in terms of absolute values; if my model results are uncertain in reproducing Organic matter, my SA results will be uncertain too, etc...)
2. in addition to point 1 there could be other “limitations” (or weaknesses...) related only to specific sources; a few examples:
 - a) the uncertainty related to the estimation of PM emissions from Residential wood combustion (RWC) influences only such sector
 - b) the uncertainty related to the role of SVOC (= condensable) and IVOC emissions on Organic matter influences mainly RWC and road transport
 - c) The uncertainty related to the quantification of road resuspension influences only road transport
 - d) the uncertainty related to shipping emissions influences only such sector
 - e) etc.... natural emissions?

A key issue for the second group is that the quantification of the effects of such uncertainties on SA results is very difficult, because -as we know- non direct observations are available for Source Apportionment.

Limitations of air quality modelling

Questions

- Do you think the discussion on “limitations” should be part of the Recommendations or it should be addressed in specific guidance?
- How could such limitations be better quantified and constrained?
 - Performing intercomparison exercises?
 - Further developing validation methods?
- Do you think there is a lack in observed data (e.g. tracers) that should be filled in order to better quantify limitations and uncertainties in SA results?

A row of European Union flags on tall poles in front of a modern building with a curved facade. The image is faded and serves as a background for the text.

Thank you for your attention