Working Group 3 Source Apportionment

Claudio A. Belis

Institute for Environment and Sustainability
Unit Air and Climate

Fairmode Plenary Meeting, Baveno, 11/02/2014

FAIRMODE
Forum for air quality modelling in Europe

Outline of the presentation

1. Why is it important to identify sources?
2. Methodologies for source apportionment
3. Summary of previous work
4. Proposed activities for future work
5. Topics for discussion

What do AQ Directives say about pollution sources ?

DIR 2008/50/EC

Reduction of emissions at source (Preamble point 16)

Local, regional and national air quality plans (Annex XV A item 5)

Background measurements (Annex IV A)

Ozone precursors (Annex X A)

Natural sources, road salting and sanding (Articles 20 and 21)

Public information (Annex XVI item 4)

One of the overarching principles of the Thematic Strategy on Air Pollution.

Emitted quantities and transboundary sources responsible for pollution are to be listed when drafting air quality plans.

To judge the enhanced levels in more polluted areas, assess long-range transport, support source apportionment analysis and understanding of specific pollutants.

Measurements to monitor the efficiency of emission reduction strategies, to check the consistency of emission inventories and to help attribute emission sources.

To provide evidence of exceedances attributable to natural sources or winter sanding or salting of roads.

Information about exceedances of alert thresholds including indication of main source sectors or categories and recommendations for action to reduce emissions.

What do AQ Directives say about pollution sources ?

Localization of monitoring stations (Annex III B item c)

Urban background locations shall be located so that their pollution level is influenced by the integrated contribution from all sources upwind of the station.

DIR 2004/107/EC

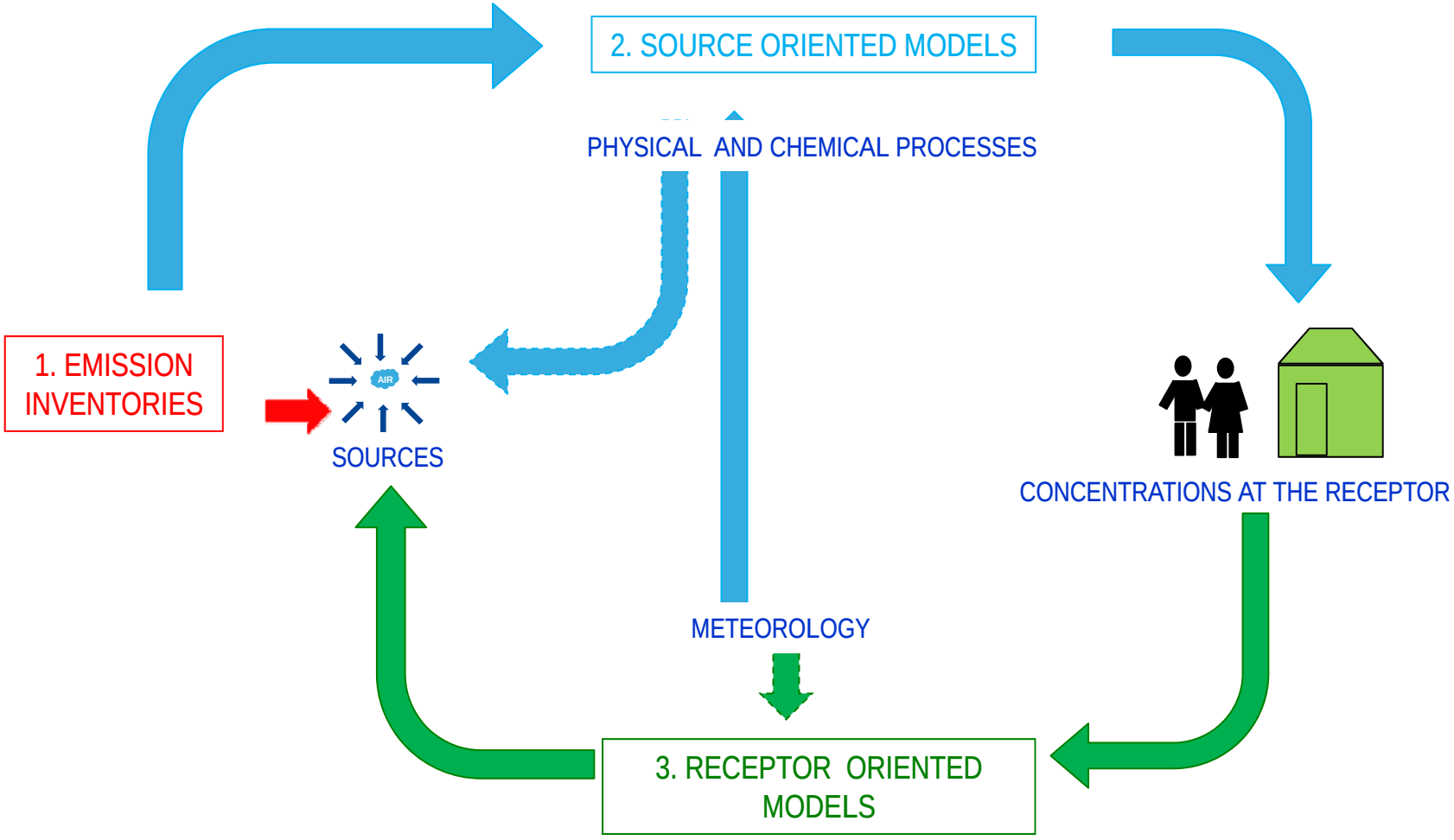
Target Value exceedances (Article 3 item 3)

Aiming at implementing measures to attain target values, MS are requested to specify zones and agglomerations where such values are exceeded and to indicate source contributions.

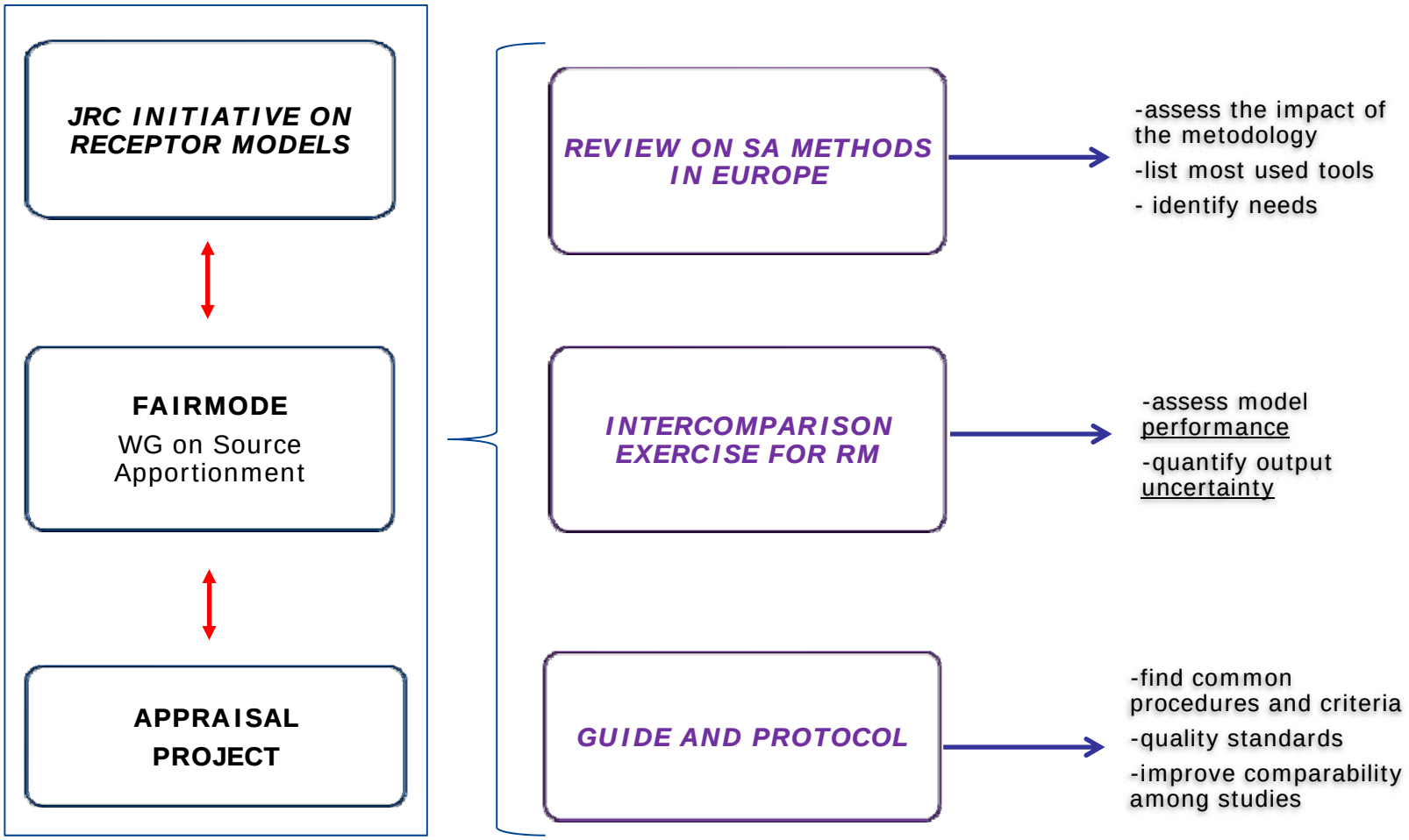
Transmission of information and reporting (Article 5 item d)

MS shall forward to the Commission information concerning the sources contributing to the exceedances.

Source estimation methods



Harmonization of source apportionment methods 2010-2013



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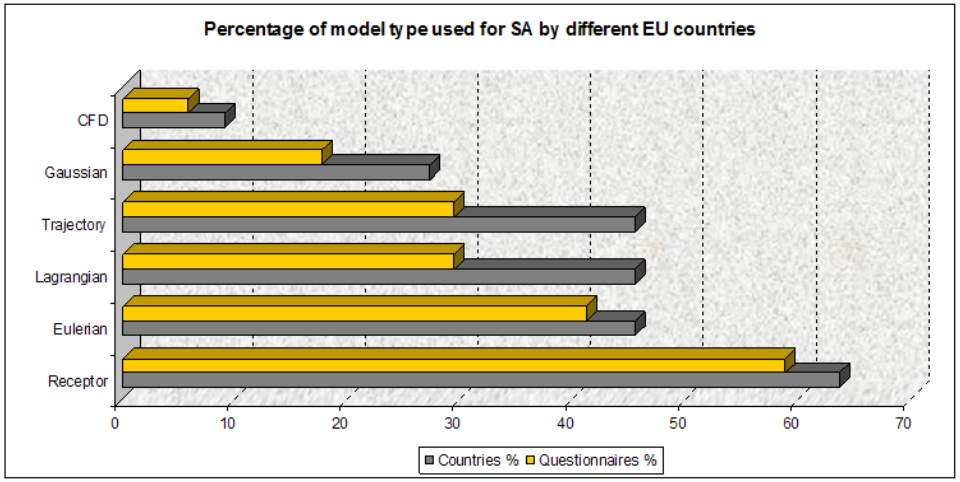
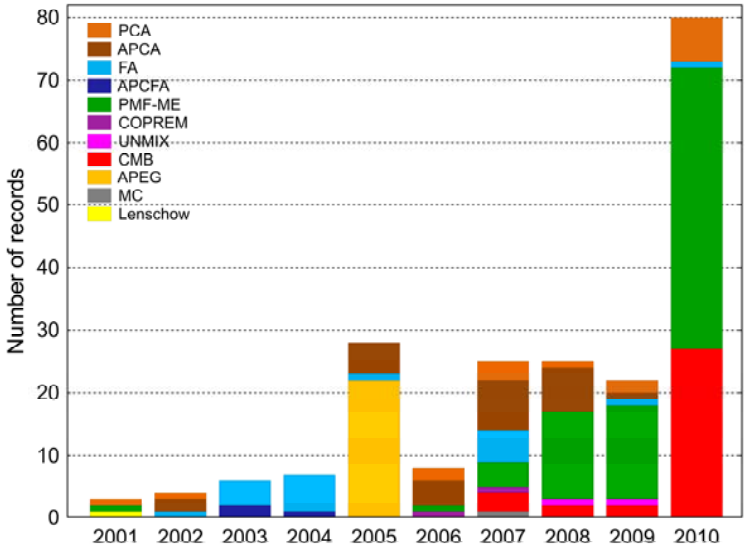
SA methods used in Europe



Model type	Number of countries	% *
Lagrangian	7	41
Eulerian	10	59
Receptor	5	29
Gaussian	6	35
Computational Fluid Dynamics (CFD)	1	6
Combination of models	12	71

Fragkou et al., 2012 IJEP 50



Karagulian & Belis, 2012 IJEP 50

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Critical Review of RM methods and quantification of PM Sources in Europe

- Critical discussion of methods used in Europe
- Meta-analysis of 272 records present in more than 100 papers and reports published until the beginning of 2012:
- Identification of main source categories.
- Description of geographical and seasonal variation of these sources were studied and mapped.
- A special analysis of PM concentrations was made to assess the causes of exceedances

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Review

Critical review and meta-analysis of ambient particulate matter source apportionment using receptor models in Europe

C.A. Belis [a,*], F. Karagulian [a], B.R. Larsen [b], P.K. Hopke [c]

[a] European Commission, Joint Research Centre, Institute for Environment and Sustainability, Via Enrico Fermi 2749, Ispra (VA) 21027, Italy
[b] European Commission, Joint Research Centre, Institute for Health and Consumer Protection, Via Enrico Fermi 2749, Ispra (VA) 21027, Italy
[c] Center for Air Resources Engineering and Science, Clarkson University, Box 5708, Potsdam, NY 13699-5708, United States

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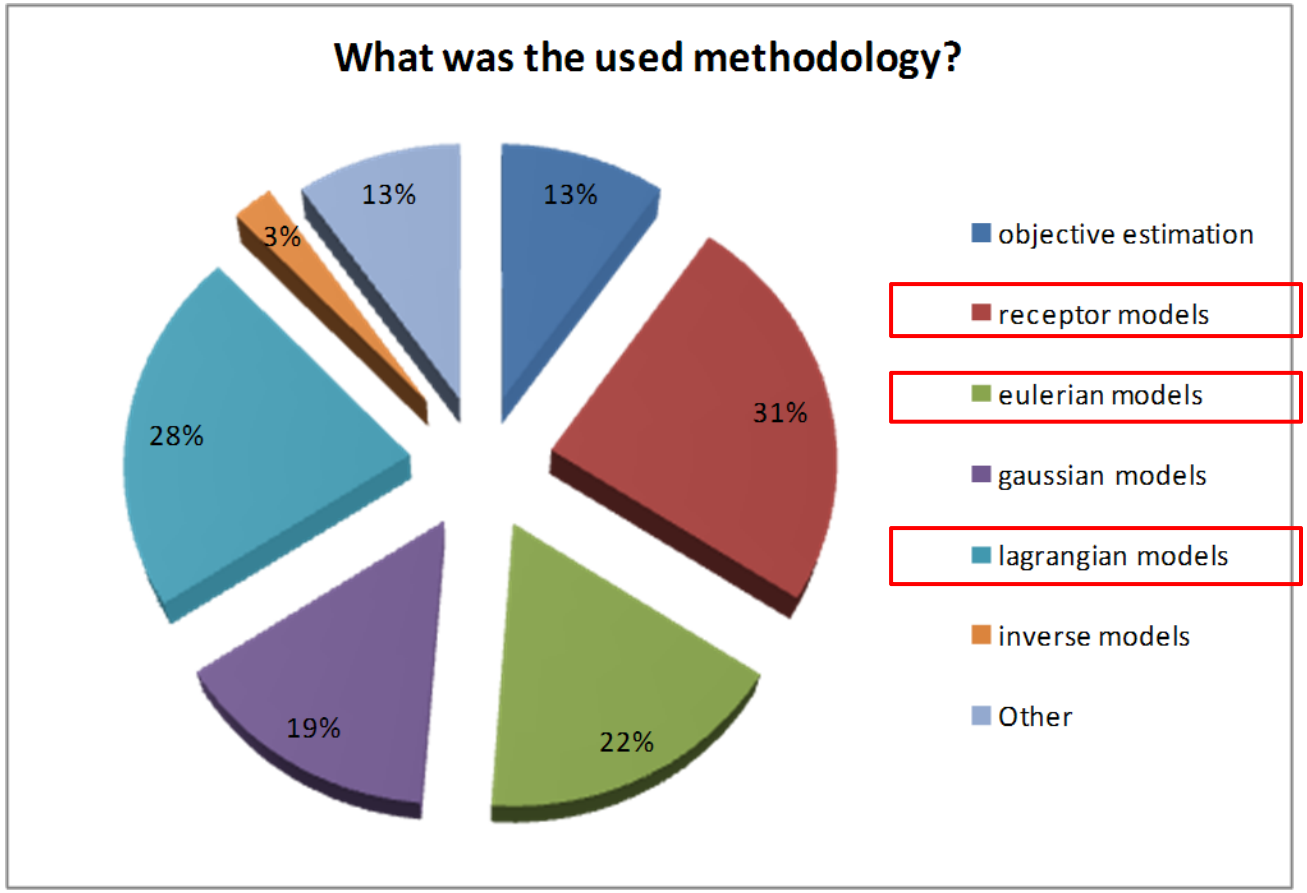
Source apportionment in integrated assessment studies



Source: Appraisal deliverable 2.6 - http://www.appraisal-fp7.eu

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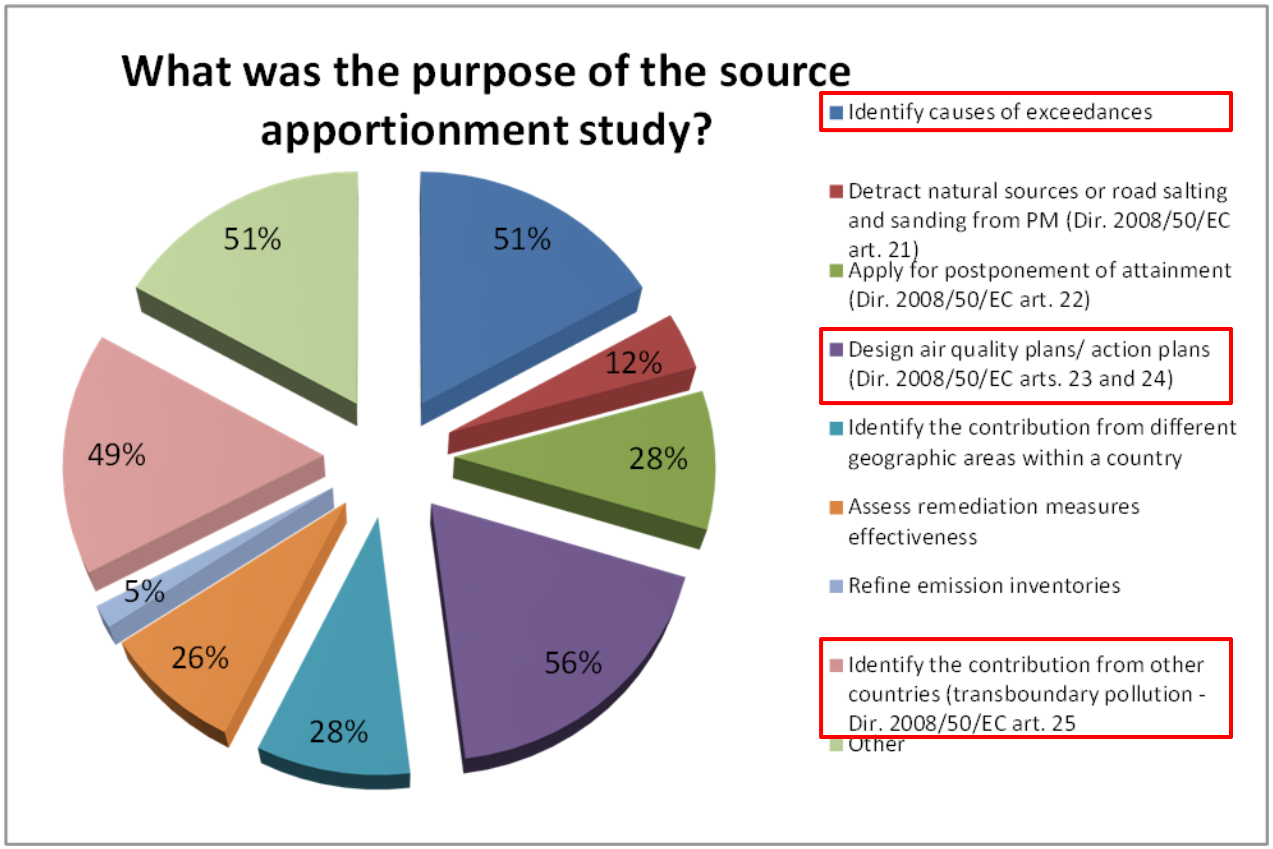
Source apportionment in integrated assessment studies



The main reasons are associated to obligations deriving from the AQD:

- to design air quality plans or action plans,
- to identify the causes of exceedances, and
- to identify transboundary pollution

Source: Appraisal deliverable 2.6 - http://www.appraisal-fp7.eu

Appraisal project

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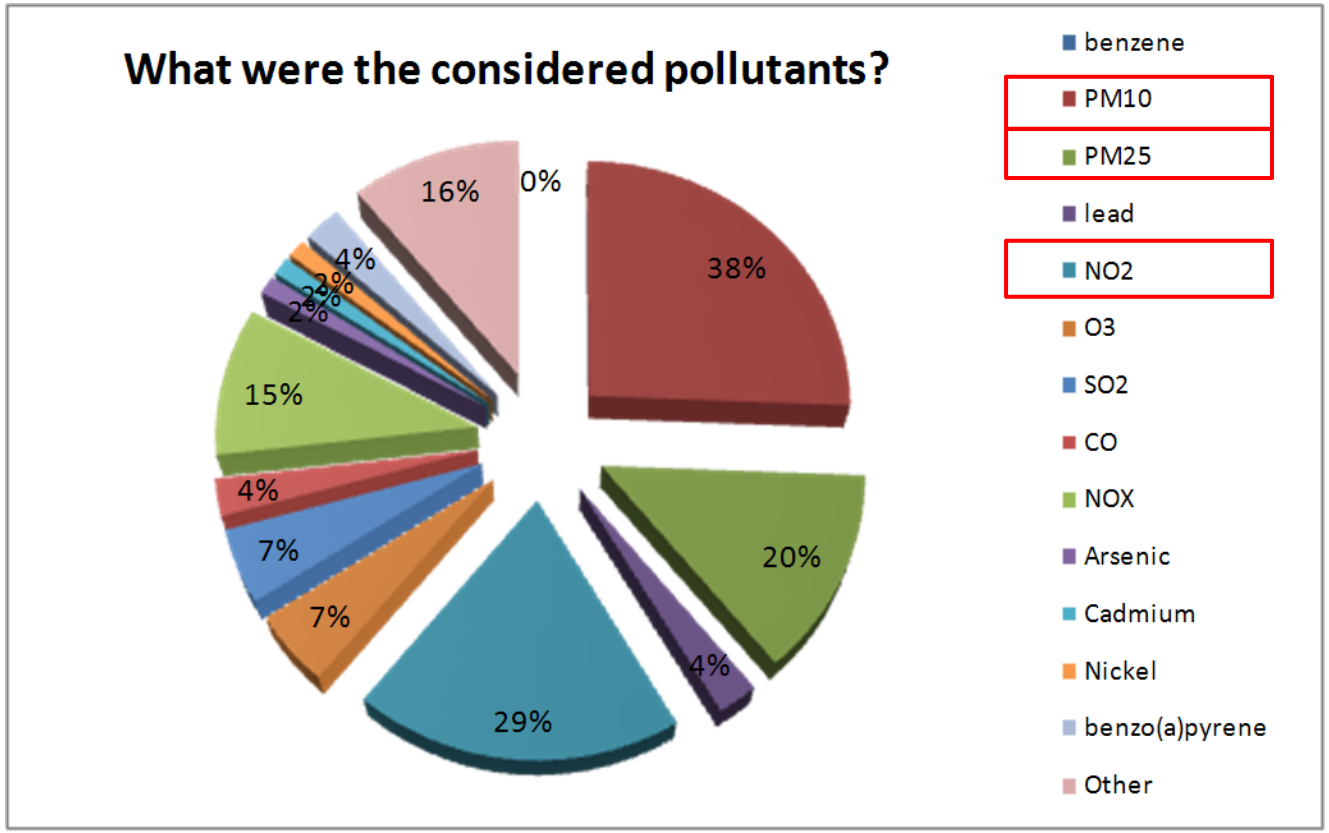
Source apportionment in integrated assessment studies



Source: Appraisal deliverable 2.6 - http://www.appraisal-fp7.eu

Appraisal project

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INTERCOMPARISON EXERCISE FOR RM

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First step (real-world dataset)
16 participants

ORGANIZATION	COUNTRY
IDAEA CSIC	SPAIN
Univ. Aahrus	DENMARK
University of Genoa	ITALY
Finnish Meteorological Institute	FINLAND
INERIS/LSCE	FRANCE
University of Birmingham	UNITED KINGDOM
Norwegian Institute for Air Research (NILU)	NORWAY
Department of Physics University of Florence	ITALY
University of Milan Bicocca	ITALY
C.N.R. Institute for Atmospheric Pollution Research	ITALY
IUTA e.V.	GERMANY
NCSR Demokritos, Environmental Research Laboratory	GREECE
Dept. of Physics - University of Milan	ITALY
Paul Scherrer Institut Laboratory of Atmospheric Chemistry	SWITZERLAND
C.N.R - I.S.A.C.	ITALY
JOINT RESEARCH CENTRE	European Commission

Second step (synthetic dataset)
22 participants

ORGANIZATION	COUNTRY
IDAEA CSIC	SPAIN
Univ. Aahrus	DENMARK
University of Genoa	ITALY
Finnish Meteorological Institute	FINLAND
University College Cork	IRELAND
University of Birmingham	UNITED KINGDOM
University of Florence Department of Physics	ITALY
Faculty of Science Charles University in Prague	CZECH REPUBLIC
National Institute of Public Healt and the Environment (RIVM)	THE NETHERLANDS
C.N.R. Institute for Atmospheric Pollution Research	ITALY
Miguel Hernández University	SPAIN
NCSR Demokritos, Environmental Research Laboratory	GREECE
University of Milan Dept. of Physics	ITALY
Paul Scherrer Institute - Laboratory of Atmospheric Chemistry	SWITZERLAND
C.N.R - I.S.A.C.	ITALY
Aristotle University of Thessaloniki	GREECE
University of Milan Bicocca	ITALY
University of Aahrus	DENMARK
University of Lisbon	PORTUGAL
Pontificia Universidad Católica de Chile	CHILE
University of Sao Paulo	BRAZIL
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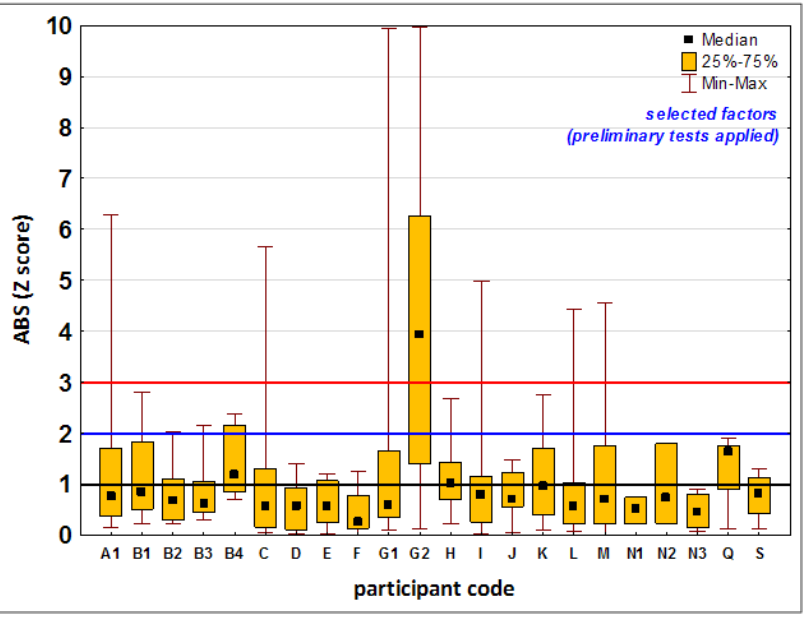
Overall evaluation

STEP 1 Real-world dataset



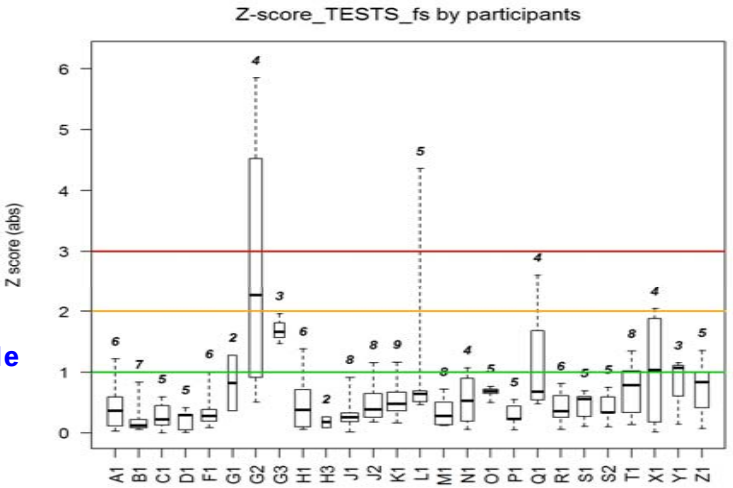
STEP 2 Synthetic dataset

action

warning

acceptable

OK



The intercomparison exercises demonstrated that more than 80% RM results are consistent with a 50% maximum uncertainty criterion.

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Guide and Harmonised RM Protocol - target audience

- practitioners involved in the model execution and in the interpretation of results,
- air quality managers interested in the output of RMs for the design of abatement measures,
- air quality experts and atmospheric scientists not familiar with this methodology.

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Guide and Harmonised RM Protocol - driving elements

- The main objective is to promote the best available operating procedures and to harmonize their application across Europe.
- The text is structured in different levels of complexity according to the reader skills
- Contains tutorials, technical recommendations and check lists
- It is not meant to report all the information but to orient the reader to the relevant information sources

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Guide and Harmonised RM Protocol - structure

Part A. Introduction to source apportionment with RMs

describes the basic elements of SA and RMs.

Part B. Harmonised Receptor Model Protocol

is the core of the document. It contains a description of the steps to be taken in carrying out the most common and widespread RM techniques, with particular reference to Chemical Mass Balance and Factor Analysis.

Part C. Advanced Models

describes innovative and advanced methods, most of which are under continuous development. It also includes methods which, although they have been available for a long time, have not yet been exploited to their full potential.

GUIDE AND PROTOCOL

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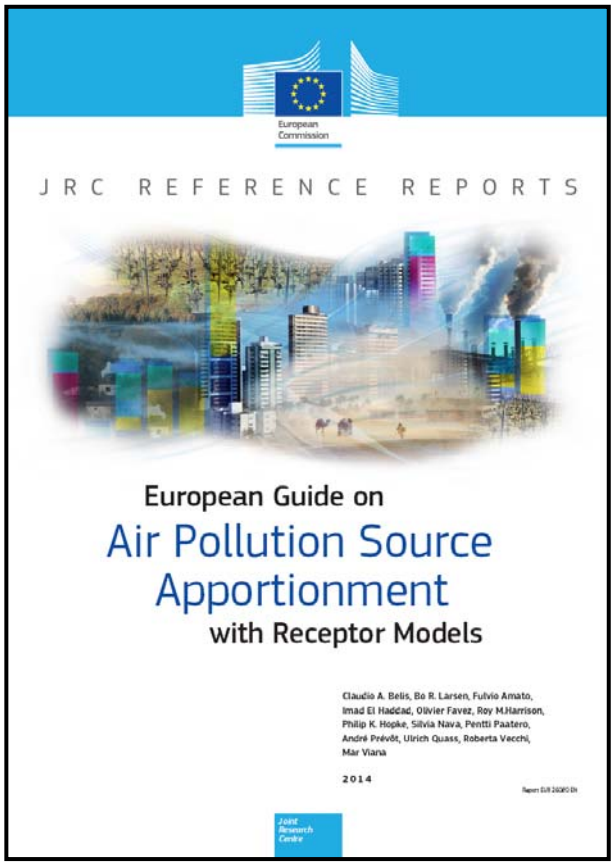
Guide and Harmonised RM Protocol



INFORMATION ABOUT SA AND DOWNLOADS:

http://source-apportionment.jrc.ec.europa.eu/

Your feedback is important for improving

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Previous Work - Concluding Remarks

-In the review process, needs and priorities for the other tasks were identified

-It was observed that RMs, Lagrangian and Eulerian models are most used in SA. Chemical Mass Balance and Positive Matrix Factorization are the most common RMs.

The intercomparison exercises demonstrated that RM outputs are consistent with a 50% maximum uncertainty criterion.

-The common protocol is a first answer to the need of harmonised procedures and criteria. However, continuous update is required to catch up with new and evolving techniques and to include other methodologies.

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THANKS TO ALL THE COLLEAGUES WHO CONTRIBUTED TO THIS INTIATIVE

Intercomparison exercises for RMs :

F. Karagulian, M. Almeida, F. Amato, G. Argyropoulos, P. Artaxo, D.C.S. Beddows, V. Bernardoni, M.C. Bove, S. Carbone, D. Cesari, D. Contini, E. Cuccia, D. Contini, E. Diapouli, K. Eleftheriadis, I. El Haddad, O. Favez, R.M. Harrison, S. Hellebust, I. Hovorka, E. Jang, H. Jorquera,T. Kammermeier, M.Karl, F. Lucarelli, D. Mooibroek, S.Nava, J. K. Nøjgaard, M. Pandolfi, M.G. Perrone, J.E. Petit, A. Pietrodangelo, G. Pirovano, P. Pokorná, P. Paatero, P. Prati, A.S.H. Prévôt, U. Quass, X. Querol, C. Samara, D. Saraga, J. Sciare, A. Sfetsos, G. Valli, R. Vecchi, M. Vestenius, J.J. Schauer, J.R. Turner, E. Yubero

Harmonised RM protocol :

B. R. Larsen, F. Amato, O. Favez, I. El Haddad, R.M. Harrison, A.S.H. Prévôt, S. Nava, U. Quass, R. Vecchi, M. Viana, P. Paatero

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Future Work – Need analysis

Starting from lessons learned during the first phase of the activity.

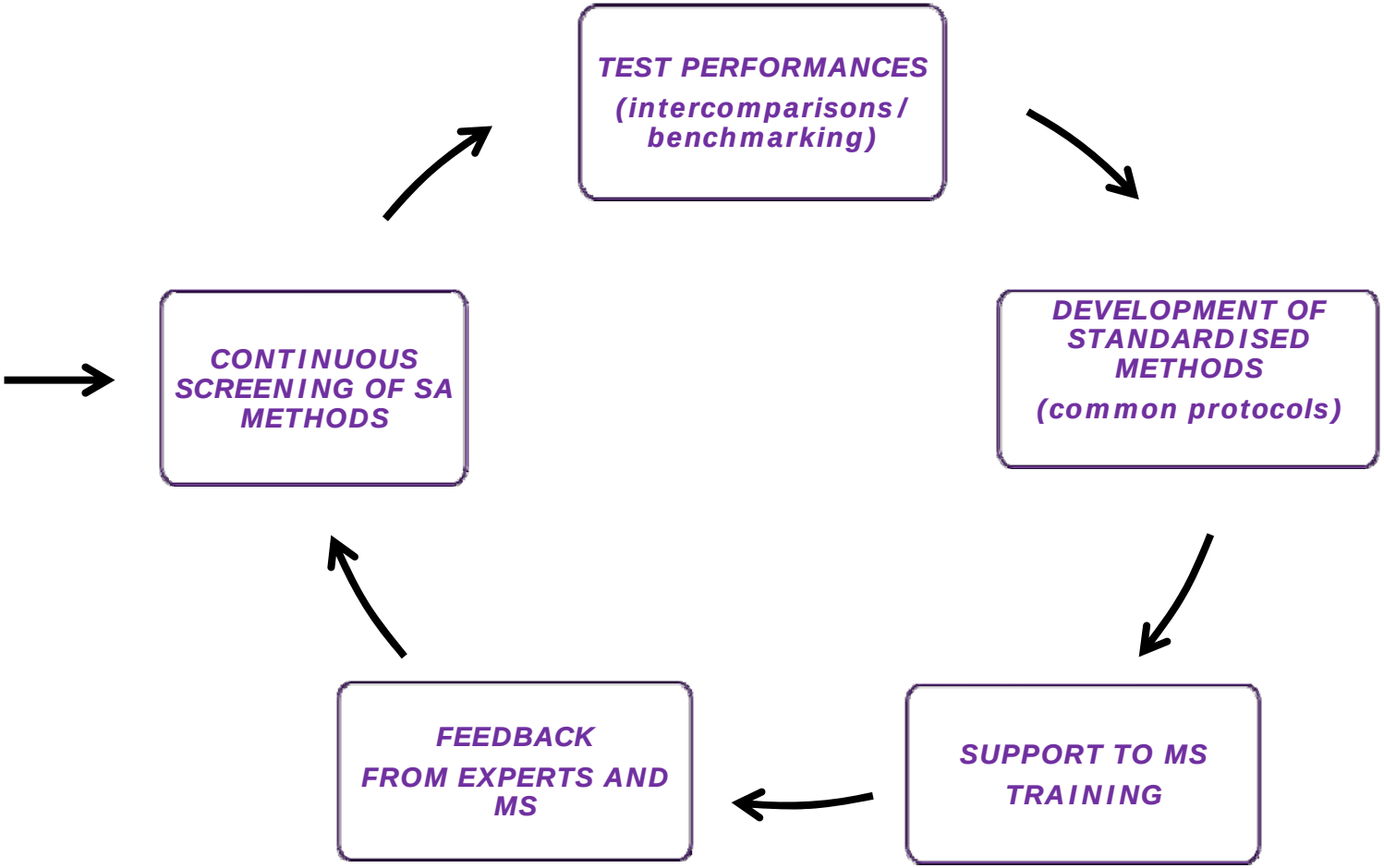
Identified needs:

1. Quantification of model performances
2. Harmonisation of methodologies
3. Promote availability and quality check of input data

4. Extension of technical work to CTMs, Lagrangian and other SA techniques
5. Mutual validation and integration among different SA techniques (including EI)
6. Promote capacity building in MS
7. Seek feed back from users and authorities

8. Extend the range of pollutants: PM, NO_2, VOCs , O_3
9. Implement quantification of both source categories and geographic areas

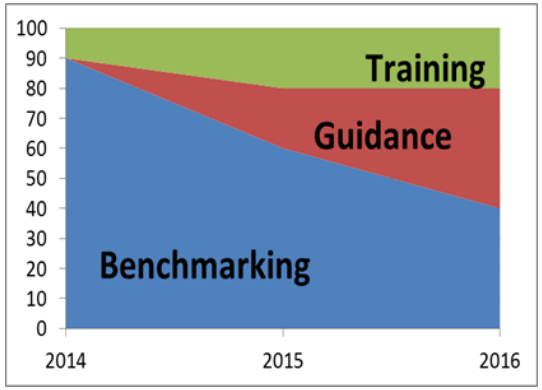
Harmonization of source apportionment methods scheme



FAIRMODE WG3 – Proposed activities 2014-2016

Main activities

1. Inter-comparison for receptor-oriented and source-oriented models in collaboration with EURODELTA (PM, NO_2?)
2. Development of indicators and evaluation methodology
3. Development of website with repository for European source profiles
4. Capacity building initiatives



Other activities

1. Test and update current Common Protocol for Source Apportionment – feed back from users.
2. Explore spatial representativeness of source contribution estimations
3. Mutual validation with EIs

FAIRMODE WG3 – Topics for discussion

1. Comments on the proposed WG3 work programme
2. What's the best way to implement a feed back mechanism for documents like the Guide and Common Protocol?
3. The harmonised methods tested under Fairmode should be used for the development of official technical standards (e.g. ISO, CEN)?
4. Is it necessary to perform further work on the quantification of Natural Sources, and Road Salting and Sanding?

Thank you for your attention