

Working Group 3 Source Apportionment

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Fairmode Plenary meeting, Baveno, 12-13/02/2015

ROAD MAP

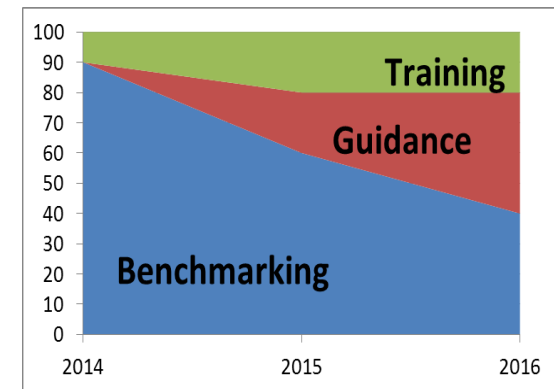
FAIRMODE WG3 – Planned activities 2014-2016

Main activities

- 1. Inter-comparison** for receptor-oriented and source-oriented models in collaboration with EURODELTA
Development of indicators and evaluation methodology
- Development of **website with repository** for European source profiles
- 3. Capacity building** initiatives

Other activities

- Test and update current **Common Protocol** for Source Apportionment – feed back from users.
- Explore **spatial representativeness** of source contribution estimations
- Validation of **EIs**



WG3 Technical meeting – Need analysis

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

Identified needs:

1. Quantification of model performances **Done/ new intercomp. in prep.**
2. Harmonisation of SA methodologies **Common Protocol for RMs/ extension to other models**
3. Promote availability and quality check of input data **SPECIEUROPE/ contributions from users needed**
4. Extension of technical work to CTMs, Lagrangian and other SA techniques **planned**
5. Mutual validation and integration among different SA techniques (including EI) **planned collab. with WG2**
6. Promote capacity building in MS **Partially done and planned in collab. with other projects**
7. Seek feed back from users and authorities **in progress**
8. Extend the range of pollutants: PM, NO₂, VOCs , O₃ **possible in intercomp. (tbd)**
9. Implement quantification of both source categories and geographic areas **possible in intercomp. (tbd)**

FAIRMODE WG3 – Technical meeting highlights

- 1. RMs and CTMs are complementary** and not mutually excluding because the strengths of one are useful to understand the weaknesses in the other and viceversa
- The **Common Protocol** received appreciation and participants agreed to promote the implementation in future studies and provide feed-back.
- The repository of source profiles (**SPECIEUROPE**) is of transversal interest (WG2 and WG3).
- E-reporting: WG3 expressed **concern about** the current provisions in the **IPR** that are not fully consistent with the most up-to-date source apportionment methodologies.

Collaborations with other projects

The United Nations International Atomic Energy Agency (IAEA) promotes Regional Technical Cooperation Programmes.

The project “Supporting Air Quality Management Phase II” involves :

- EU MS (BG, FI, GR, HR, HU, LT, PL, PT)
- non-EU countries (AL, BA, KAZ, MK, ME, MD, RS, TJ, TU).

The project pursues the application **of source apportionment and trajectory analysis techniques** to determine the sources and the geographical origin of PM.

Benefits for FAIRMODE: extend the harmonisation, dissemination of good practices and capacity building objectives to institutions in a wider range of countries (MS and EU neighbours).

Joint activities: training, intercomparison

Capacity building

REGIONAL TRAINING COURSE ON METHODS AND TOOLS TO IDENTIFY SOURCES OF AIR POLLUTION AND APPORTIONEMENT IN ATMOSPHERIC PM

Organised in the framework of the IAEA Regional project :

[Supporting Air Quality Management](#)

Instituto Superior Técnico, Campus Tecnológico e Nuclear;
Sacavém, Portugal, 02 –06 June, 2014

For 2015 activities were not established yet

Possible alternatives:

Collaboration with this and other projects

Organisation of a FAIRMODE training on SA

SPECIEUROPE

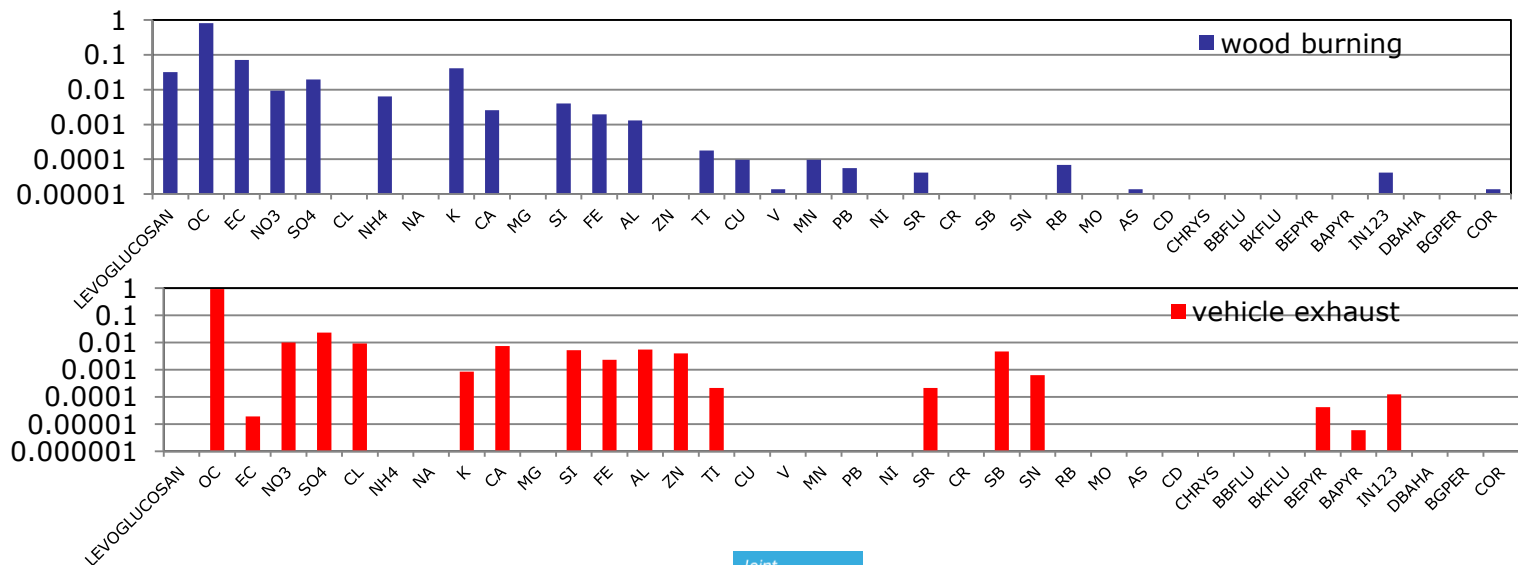


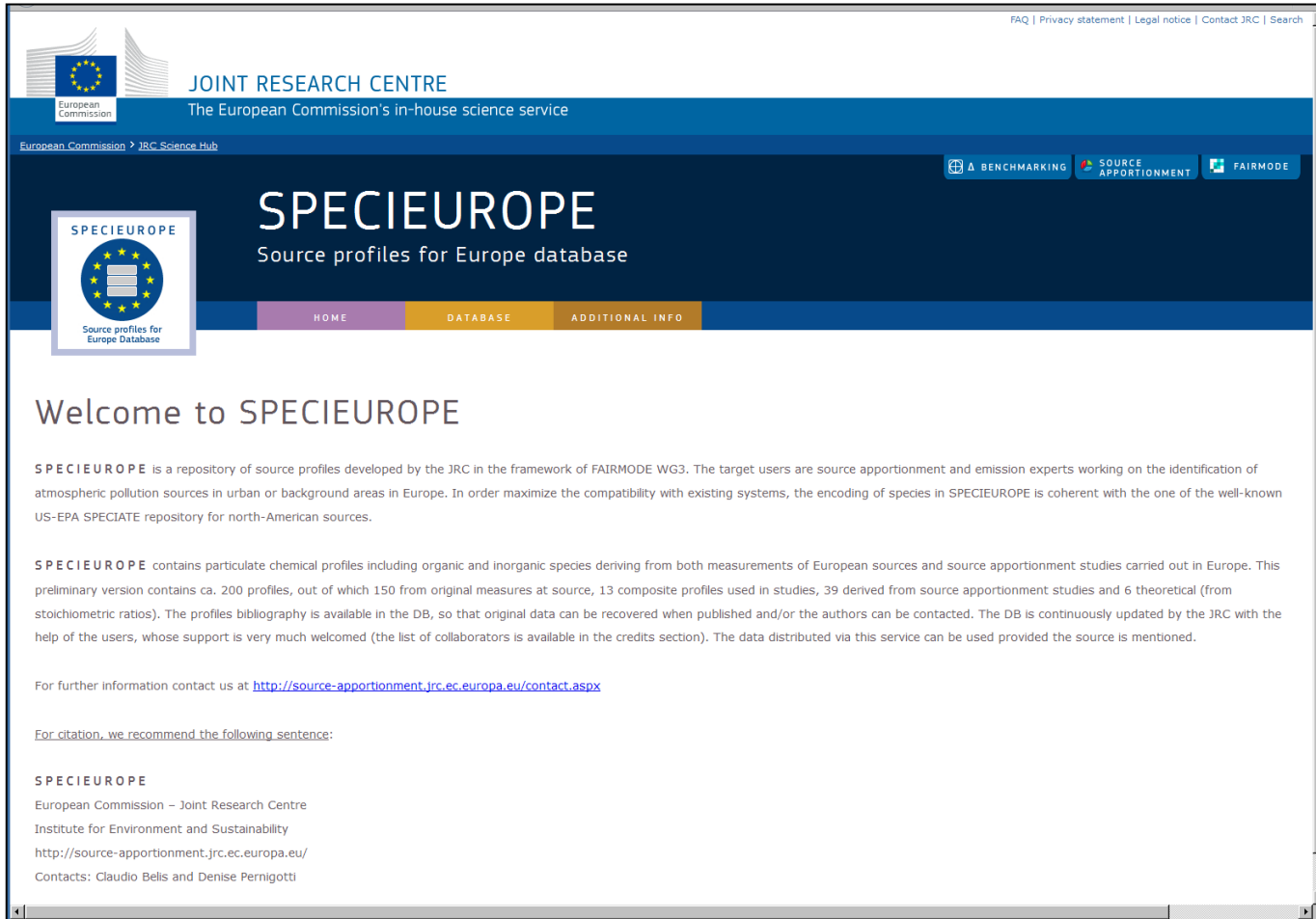
What is a source profile?

A source profile describes the chemical composition of a source by listing the relative concentration of the emitted chemical species

The source profile is a fingerprint of an air pollution source and makes it possible to identify it.

Examples of source profiles





European Commission

JOINT RESEARCH CENTRE
The European Commission's in-house science service

European Commission > JRC Science Hub

BENCHMARKING SOURCE APPORTIONMENT FAIRMODE

SPECIEUROPE
Source profiles for Europe database

HOME DATABASE ADDITIONAL INFO

Welcome to SPECIEUROPE

SPECIEUROPE is a repository of source profiles developed by the JRC in the framework of FAIRMODE WG3. The target users are source apportionment and emission experts working on the identification of atmospheric pollution sources in urban or background areas in Europe. In order to maximize the compatibility with existing systems, the encoding of species in SPECIEUROPE is coherent with the one of the well-known US-EPA SPECIATE repository for north-American sources.


SPECIEUROPE contains particulate chemical profiles including organic and inorganic species deriving from both measurements of European sources and source apportionment studies carried out in Europe. This preliminary version contains ca. 200 profiles, out of which 150 from original measures at source, 13 composite profiles used in studies, 39 derived from source apportionment studies and 6 theoretical (from stoichiometric ratios). The profiles bibliography is available in the DB, so that original data can be recovered when published and/or the authors can be contacted. The DB is continuously updated by the JRC with the help of the users, whose support is very much welcomed (the list of collaborators is available in the credits section). The data distributed via this service can be used provided the source is mentioned.

For further information contact us at <http://source-apportionment.jrc.ec.europa.eu/contact.aspx>

For citation, we recommend the following sentence:


SPECIEUROPE
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Institute for Environment and Sustainability
<http://source-apportionment.jrc.ec.europa.eu/>
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<http://source-apportionment.jrc.ec.europa.eu/>



Available source categories

Name
All sources (209)
Ammonium nitrate (4)
Ammonium sulfate (3)
Beech burning (2)
Biomass burning (25)
Boiler (8)
Brake dust (5)
Cement (11)
Ceramic (6)
Closed fireplace (16)
Coal burning (12)
Coke burning (7)
Construction dust (1)
Densin salt (6)
Dust (7)




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European Commission > JRC Science Hub

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BENCHMARKING SOURCE APPORTIONMENT FAIRMODE



Available species

Name	Symbol
1,2,3-Benzenetricarboxylic Acid (4)	C9H6O6
1,2,4-Benzenetricarboxylic Acid (4)	C9H6O6
1,2-Benzenedicarboxylic acid, 4-methyl- (4)	C9H8O4
1,3,5-Benzenetricarboxylic Acid (4)	C9H6O6
1,3-butadiene (9)	BUD113
17a(H),21b(H)-30-Norhopane , also noted as 'ab30nh' (4)	C29H50
17a(H),21b(H)-Hopane , also noted as 'ab_hop' (4)	
17a(H)-22,29,30-Triisnorhopane (4)	
18a(H)-22,29,30- trisnormehopane (4)	C27H46
20R&S-5a(H),14R(H),17B(H)-ergostane (4)	
20R-13B(H),17a(H)-diacholestane (4)	
20S-13B(H),17a(H)-diacholestane (4)	C27H48
22R-17a(H),21b(H)-homohopane (4)	C31H54
22S-17a(H),21b(H)-homohopane (4)	C31H54
2-Ethylhexanoic acid (4)	C9H18O2



Profile: 51 - Exhaust

Download profile

Code	51
Name	Exhaust
Source	Traffic
Country	Denmark
Place	Copenhagen
Test year	2003
Type	D
Latitude	55.676
Longitude	12.568
Reference	Wahlin et al., 2006, 10.1016/j.scitotenv.2006.08.011
Notes	PM10-PM2.5 Stacked Filter Unit
Sampling Methods	COPREM output on road increment

Data

	Relative Mass	Uncertainty	Analytical Method	Uncertainty Method
292 - Aluminum	-0,004	0,014	PIXE	standard deviation
296 - Antimony	-0,001	0,00099	PIXE	standard deviation
298 - Arsenic	0,000056	0,000068	PIXE	standard deviation
300 - Barium	-0,0019	0,002	PIXE	standard deviation
329 - Calcium	-0,024	0,021	PIXE	standard deviation
347 - Chromium	-0,0013	0,0013	PIXE	standard deviation
380 - Copper	-0,0016	0,0015	PIXE	standard deviation
468 - Gallium	0,00013	0,00012	PIXE	standard deviation
488 - Iron	0,021	0,019	PIXE	standard deviation
520 - Lead	-0,00031	0,00032	PIXE	standard deviation
526 - Manganese	-0,00038	0,0007	PIXE	standard deviation
586 - Molybdenum	0,00031	0,00028	PIXE	standard deviation
612 - Nickel	not detected	not detected	PIXE	standard deviation
689 - Potassium	0,0006	0,0026	PIXE	standard deviation
689 - Rubidium	0,000038	0,000064	PIXE	standard deviation
693 - Selenium	0,00005	0,000045	PIXE	standard deviation
694 - Silicon	-0,008	0,013	PIXE	standard deviation
697 - Strontium	-0,000025	0,000084	PIXE	standard deviation
700 - Sulfur	-0,0063	0,0081	PIXE	standard deviation
714 - Tin	-0,0005	0,0006	PIXE	standard deviation
715 - Titanium	-0,0005	0,0008	PIXE	standard deviation
767 - Vanadium	0,00019	0,00024	PIXE	standard deviation
778 - Zinc	0,00063	0,00096	PIXE	standard deviation
779 - Zirconium	-0,00025	0,00024	PIXE	standard deviation

Why is SPECIEUROPE important?

- It provides information about European pollution sources
- It contributes to a better definition and identification of sources
- It is expected to become a reference for SA studies in Europe
- The source profiles are useful for RMs and CTMs.
- Profiles are also relevant for emission inventories

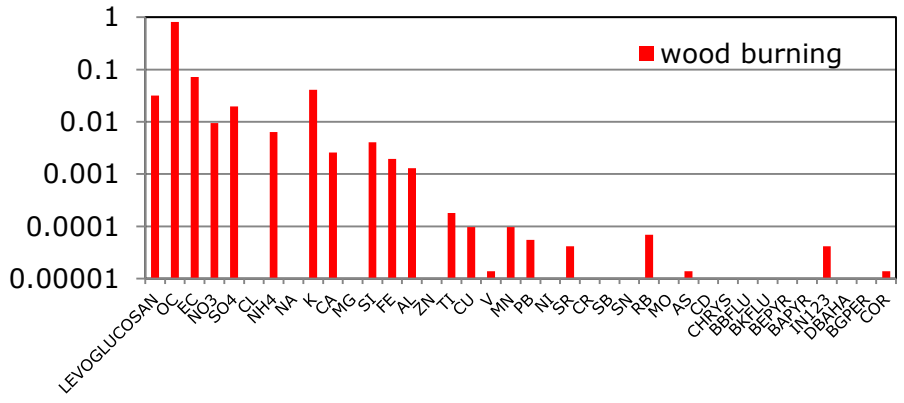
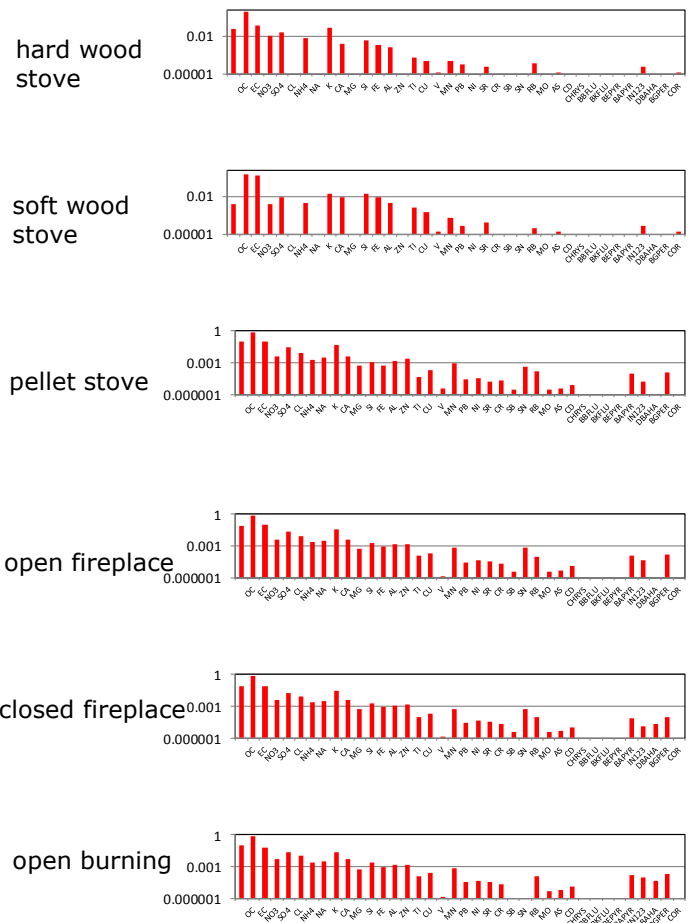
SOURCE

APPORTIONMENT

MODEL PERFORMANCE

Example of source category

A **source category** is a group of sources that emit pollutants with similar chemical composition and time trends

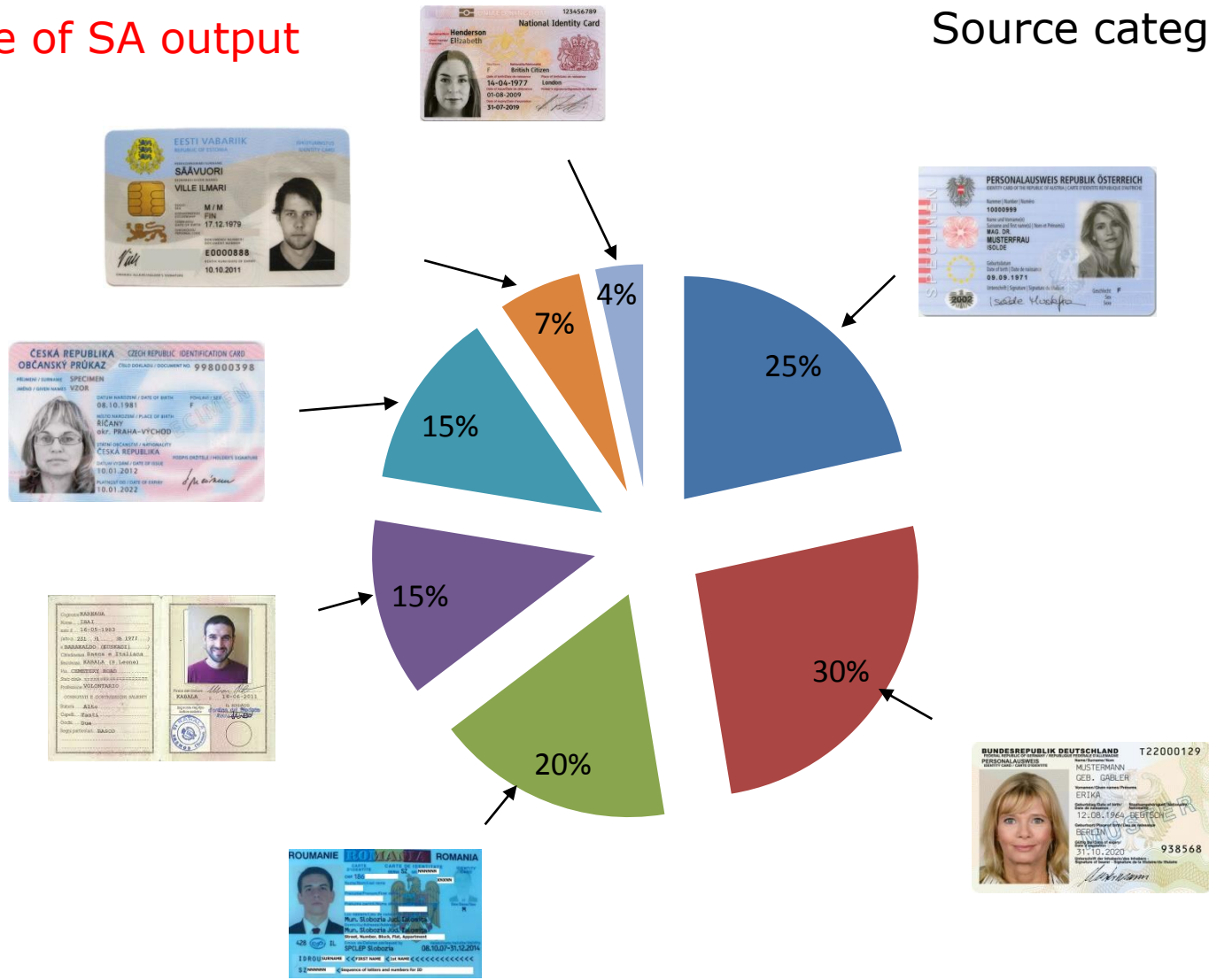




European

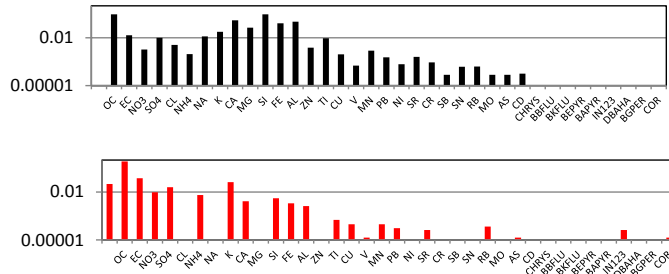
Example of SA output

Source categories



Performance indicators are based on both chemical profiles and time trends

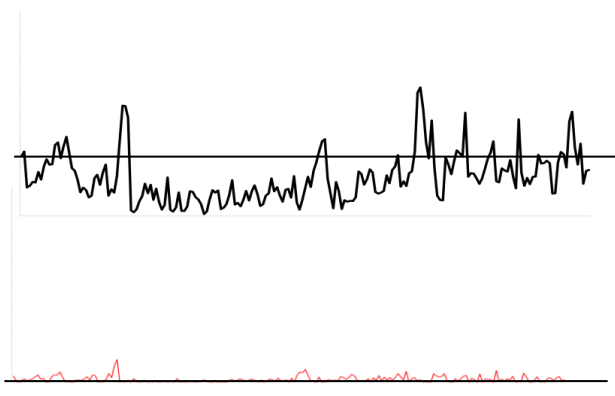
The contribution of sources to a given area is unknown. The reference is obtained from the average of different models/teams or is set by definition in synthetic datasets.



p_{ref} $p_{ref}(u)$

p_1 $p_1(u)$

Chemical profiles (ID)



• \bar{x}_{ref} } $sd t_{ref}$

• \bar{x}_1 } $sd t_1$

Profiles time trend
(behaviour)



The proposed indicators

Pearson

Standard Identity Distance (SID) 

Weighted Difference (WD) (Karagulian & Belis, 2012)

To compare
sources/factors

Z-scores

Zeta-scores

ISO 13528

RMSE_u

(Thunis et al., 2012)

Performance indicators

The proposed methodology assess all the aspects of a SA model output

INTERCOMPARISON EXERCISE

Joint FAIRMODE EURODELTA Source Apportionment Intercomparison

OBJECTIVES

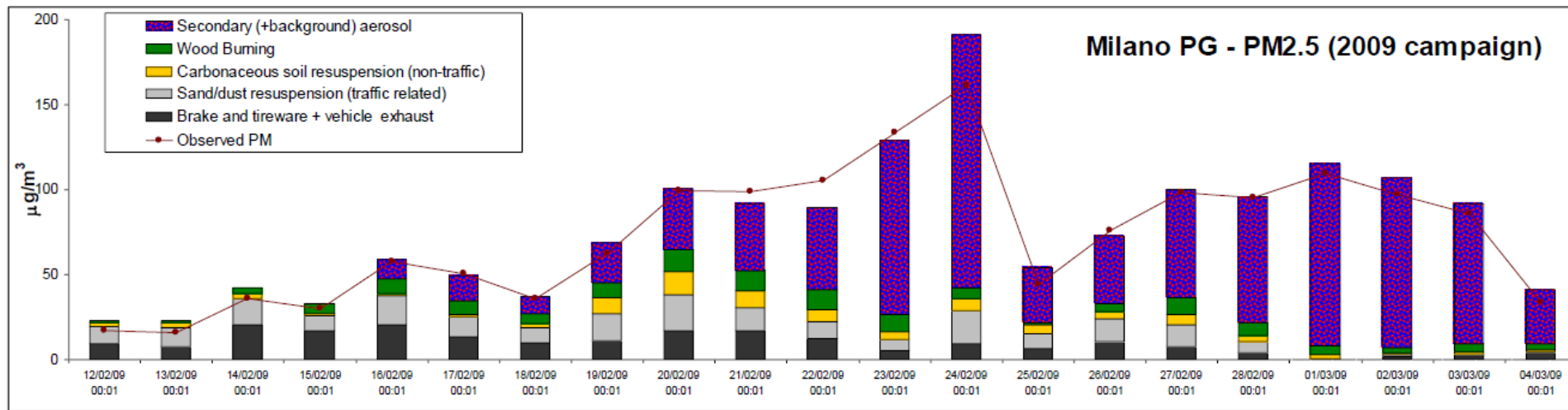
MAIN OBJECTIVES

- Further development of the assessment methodology
- Assess model performances
- Quantify model uncertainties
- Compare different approaches
- Test the areal representativeness (relevant for e-reporting)

OTHER OBJECTIVES

- Identify synergies between different models/approaches
- Identify strengths and areas for improvement of models / approaches
- Harmonize definition of key concepts
- (e.g. definition of source category, source contribution estimates)
- Agree common rules (e.g. for SCE reporting)
- Set up QA/QC procedures

JOINT SA INTERCOMPARISON – Some facts **Receptor oriented model**



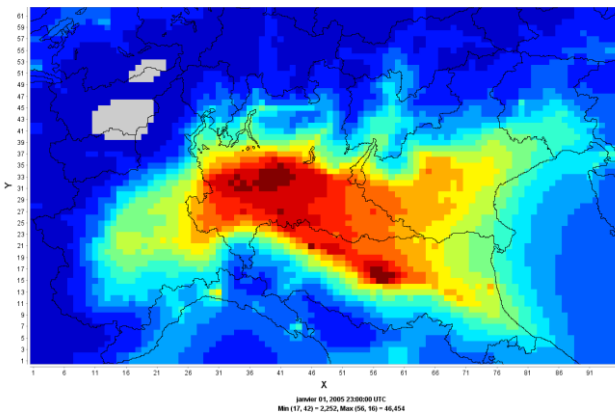
JRC,2011 - 9th intermediate technical / scientific report - Collaborative Research Project for Air Pollution Reduction in Lombardy Region (2006- 2010)

- Widely used approach
- Receptor analysis based on observed data
- Secondary fraction and area contributions not easily apportioned
- Statistical model

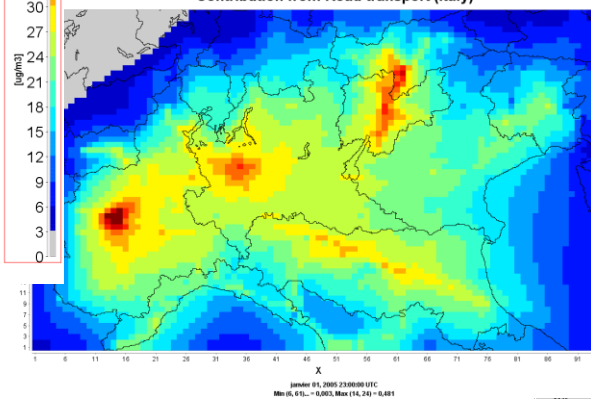
JOINT SA INTERCOMPARISON – Some facts

Source oriented models

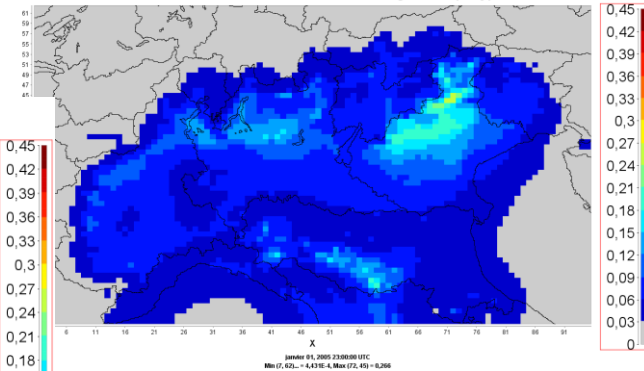
PM2.5 Yearly Mean concentration



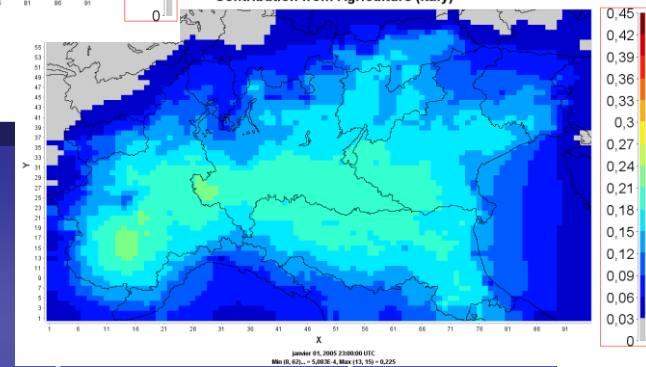
PM2.5 Yearly Mean concentration
Contribution from Road transport (Italy)



PM2.5 Yearly Mean concentration
Contribution from Biomass burning in DH (Italy)



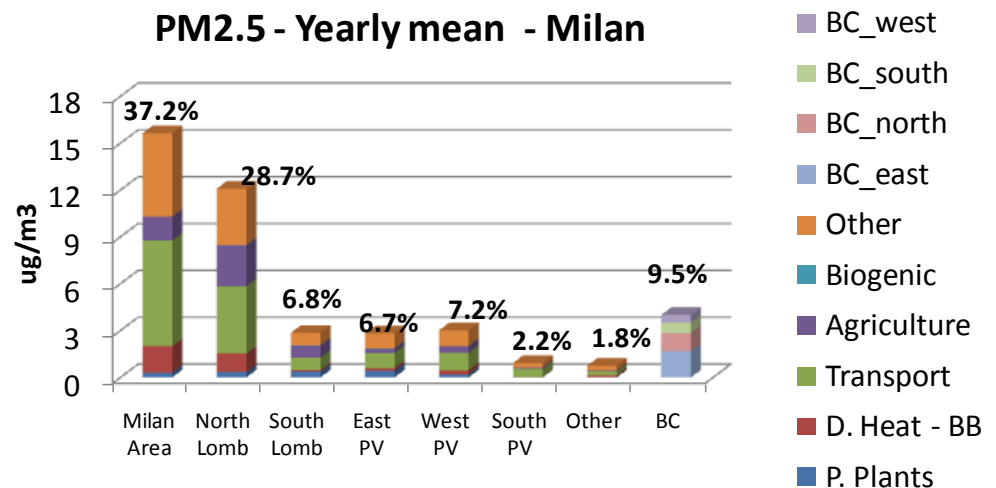
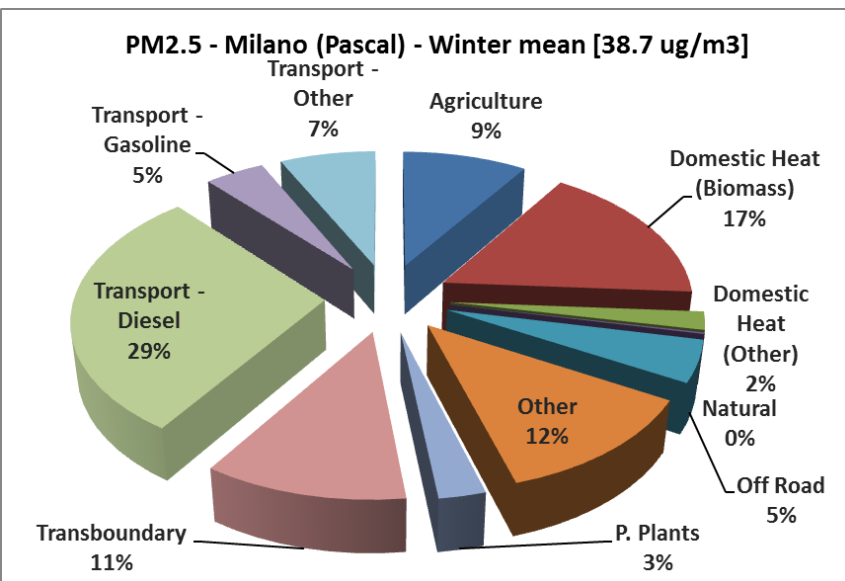
PM2.5 Yearly Mean concentration
Contribution from Agriculture (Italy)



- Fully modelled approach
- Less tested and evaluated
- Secondary fraction and area contributions easily apportioned
- Deterministic model (uncertainty not easily defined)

JOINT SA INTERCOMPARISON – Some facts

Source oriented models



- Gridded and receptor based analysis
- High temporal resolution
- Apportionment of PM bulk concentration, composition and precursors

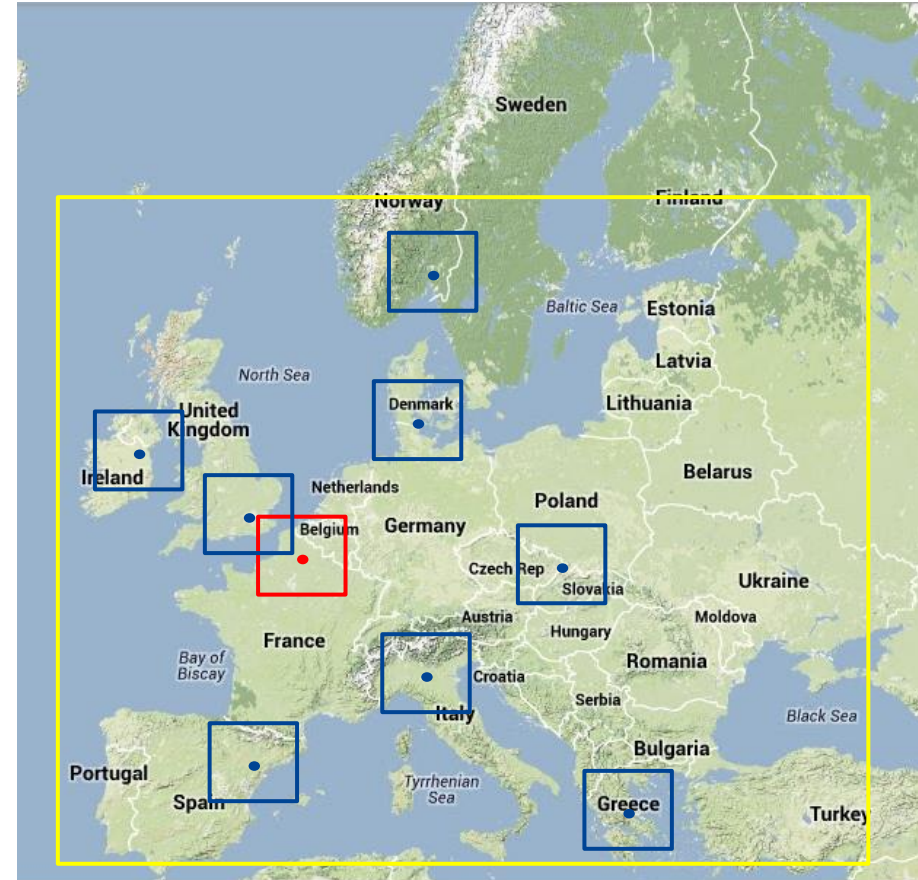
JOINT SA INTERCOMPARISON - PROPOSED SET UP

RM

- One reference site with a dataset suitable for RMs provided by the organisers
- Secondary sites in the areas selected by participants where datasets are available

CTMs

- Large European domain (EURODELTA) at medium resolution (ca. 28x28km)
- Many smaller National/Regional domains around the reference and secondary sites at higher resolution (ca. 7x7 km)



Thank you for your attention