Working Group 3 Source Apportionment

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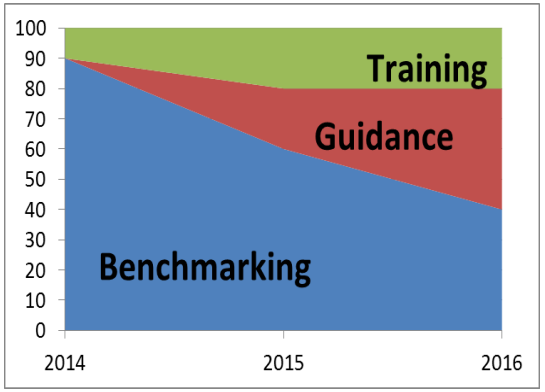
Fairmode Plenary meeting, Baveno, 12-13/02/2015

FAIRMODE
Forum for air quality modelling in Europe

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
2. Development of **website with repository** for European source profiles
3. **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. Validation of **EI**s

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, NO_2, VOCs , O_3 — 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
2. The **Common Protocol** received appreciation and participants agreed to promote the implementation in future studies and provide feed-back.
3. The repository of source profiles (**SPECIEUROPE**) is of transversal interest (WG2 and WG3).
4. 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

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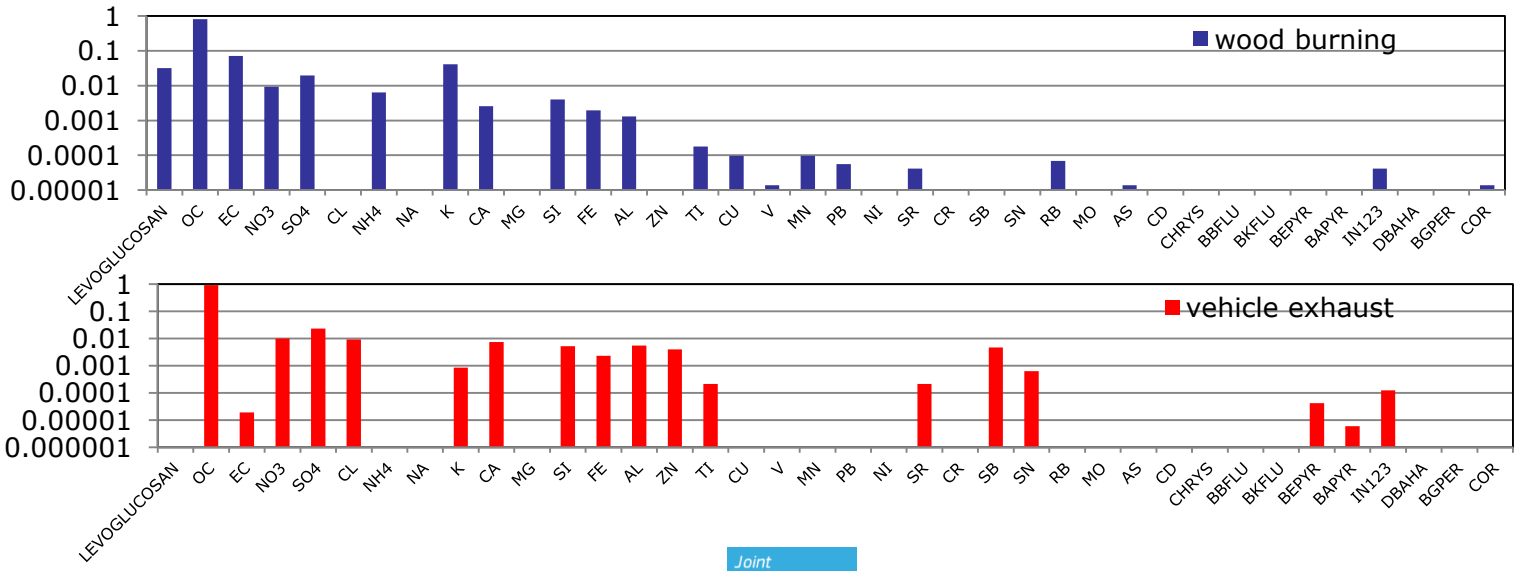
What is a source profile?

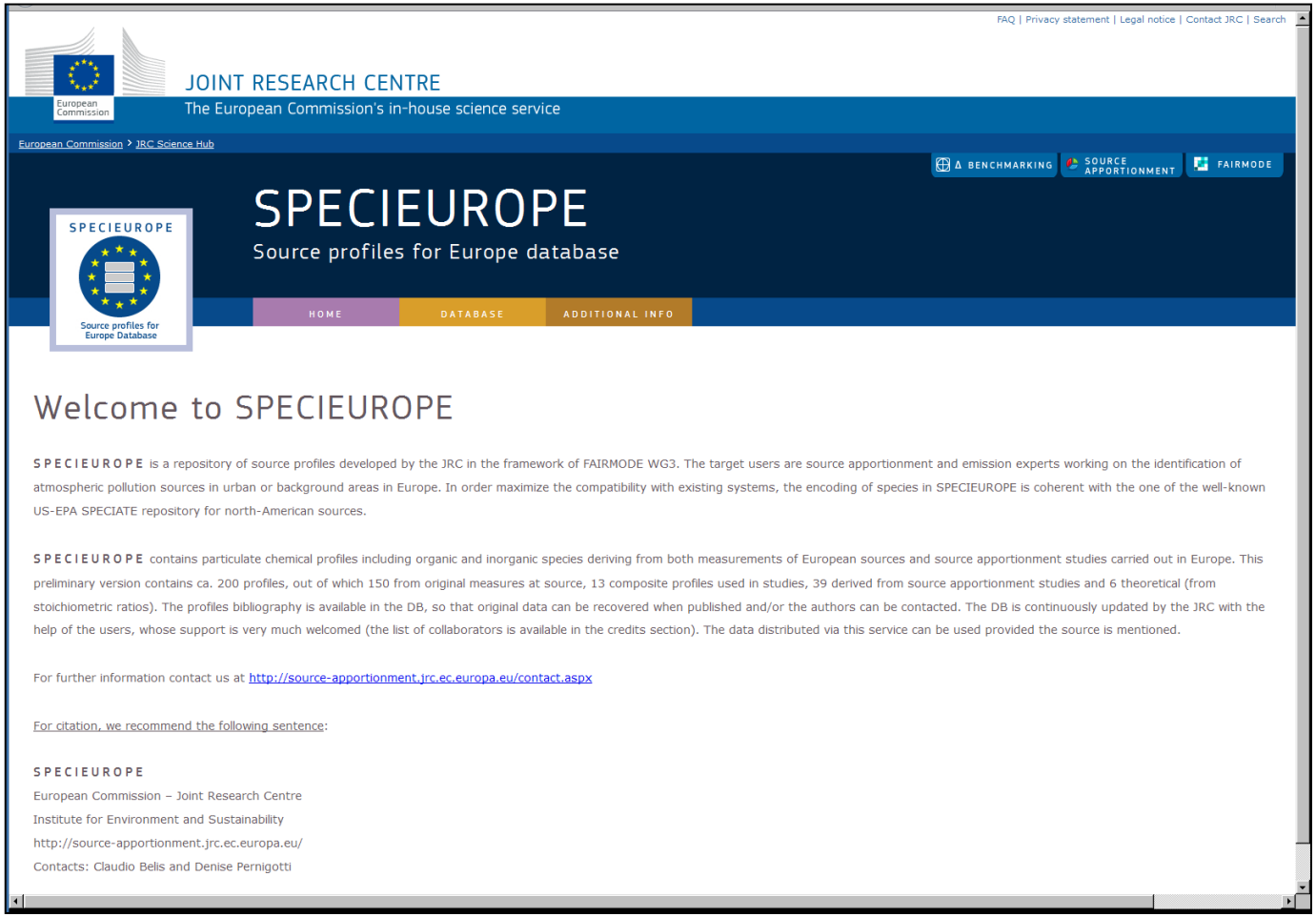
A source profile describes the chemical composition of a source by listing the relative concentration of the emitted chemical species

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

Examples of source profiles



European Commission



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

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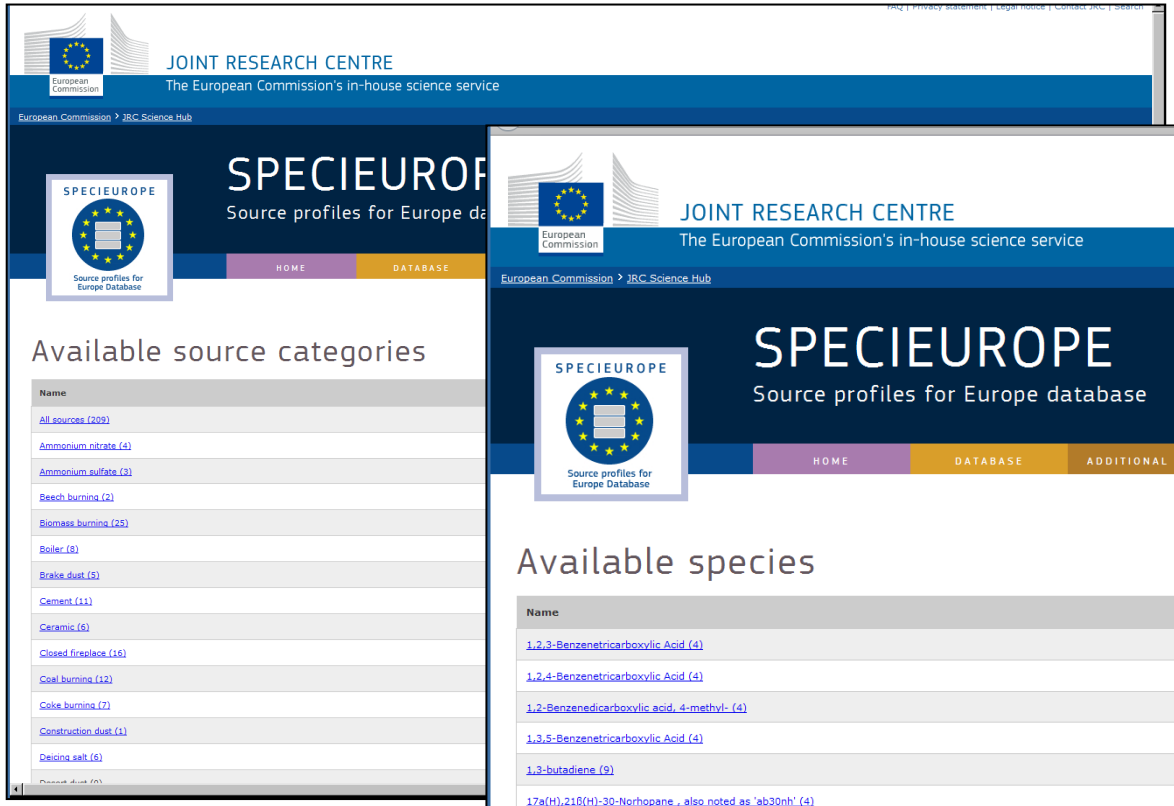
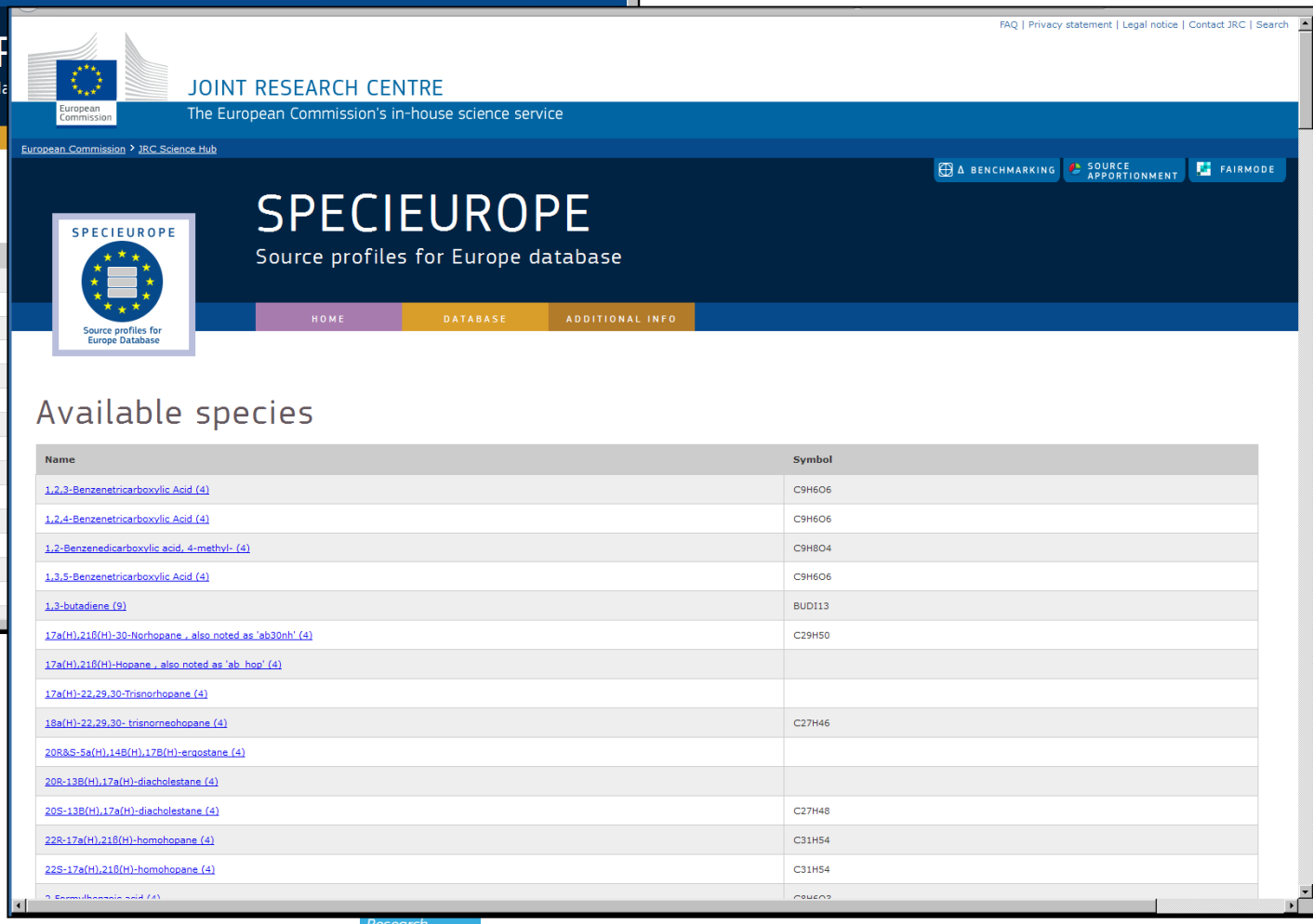
European Commission





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SPECIEUROPE
Source profiles for Europe Database

Sou

Profile: 51 - Exh

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 at., 2006, 10.1016/j.a
Notes	PM10-PM2.5 Stacked Filter Unit
Sampling Methods	COPREM output on road increm

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
669 - 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?

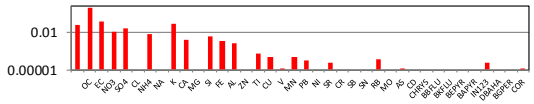
- It provides information about European pollution sources
- It contributes to a better definition and identification of sources
- It is expected to become a reference for SA studies in Europe
- The source profiles are useful for RMs and CTMs.
- Profiles are also relevant for emission inventories

SOURCE APPORTIONMENT MODEL PERFORMANCE

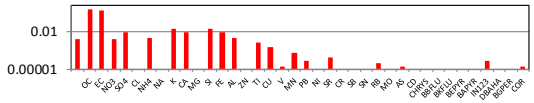
Example of source category

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

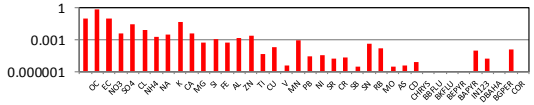
hard wood stove



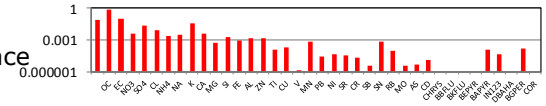
soft wood stove



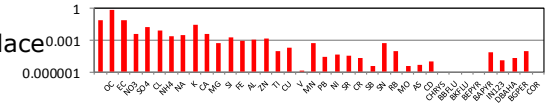
pellet stove



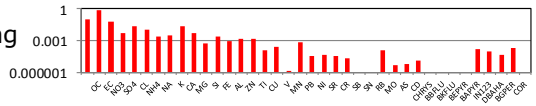
open fireplace

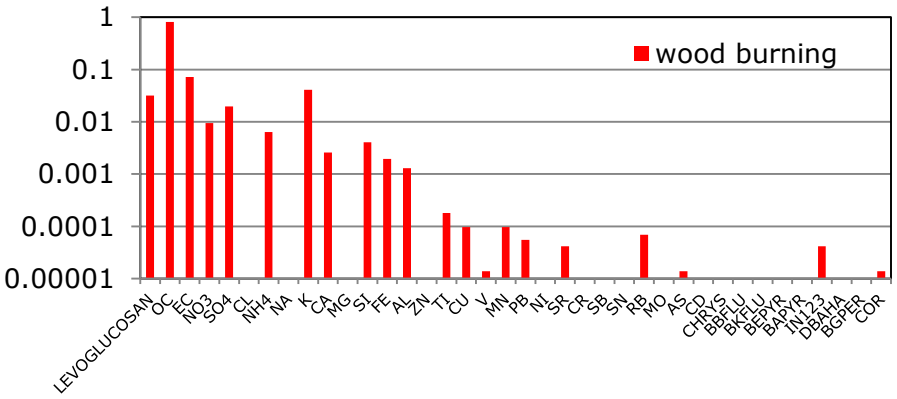


closed fireplace



open burning





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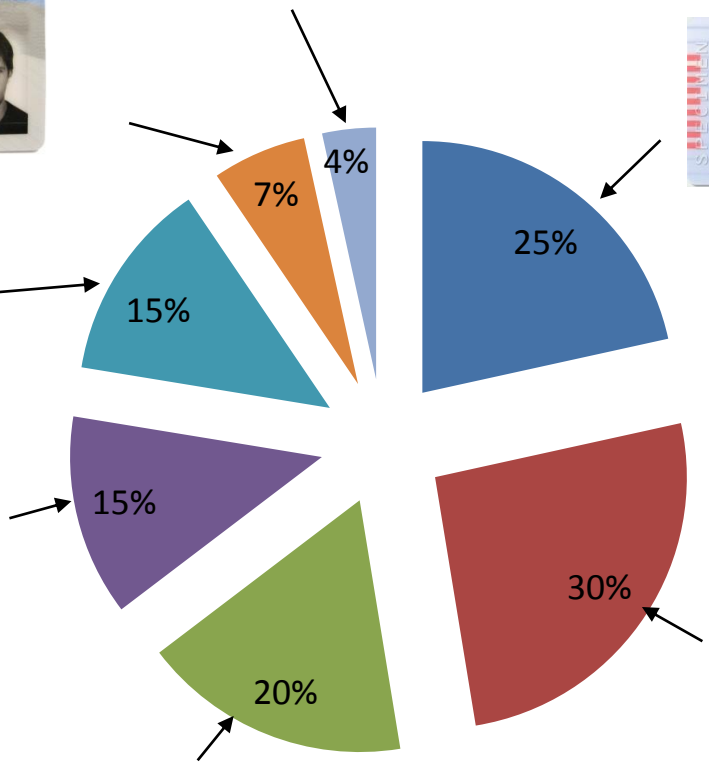
Example of SA output



Source categories

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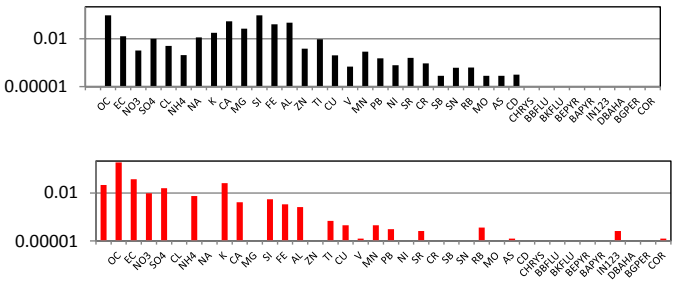
Performance indicators are based on both chemical profiles and time trends

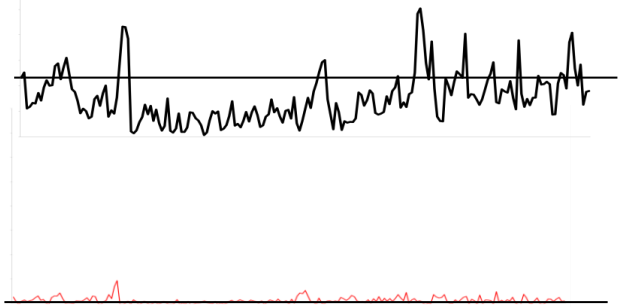
The contribution of sources to a given area is unknown. The reference is obtained from the average of different models/teams or is set by definition in synthetic datasets.



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

p_1 $p_1(u)$

Chemical profiles (ID)



• $\overline{x}$ ref } sd t_{ref}

• $\overline{x}_1$ } sd t_1

Profiles time trend (behaviour)

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The proposed indicators

Pearson

Standard Identity Distance (SID) NEW!

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

Belis et al., 2015 submitted

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INTERCOMPARISON EXERCISE

Joint FAIRMODE EURODELTA Source Apportionment Intercomparison

OBJECTIVES

MAIN OBJECTIVES

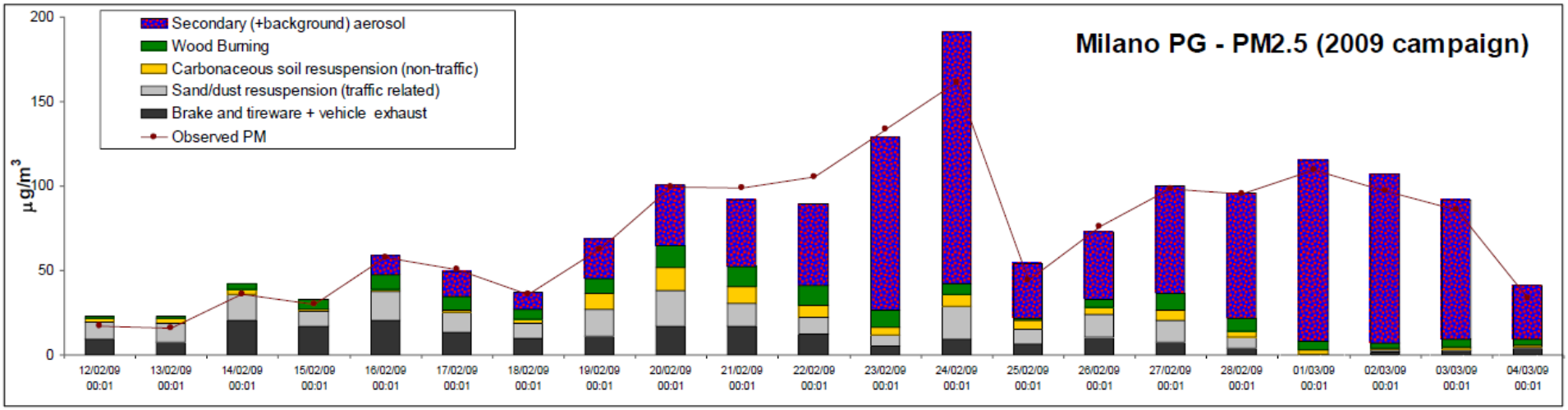
- Further development of the assessment methodology
- Assess model performances
- Quantify model uncertainties
- Compare different approaches
- Test the areal representativeness (relevant for e-reporting)

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

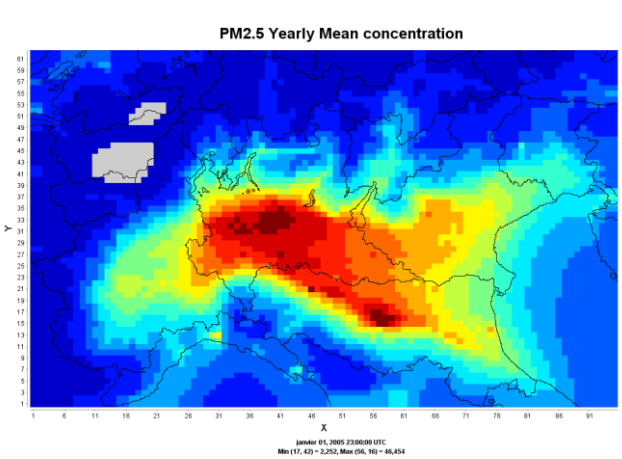


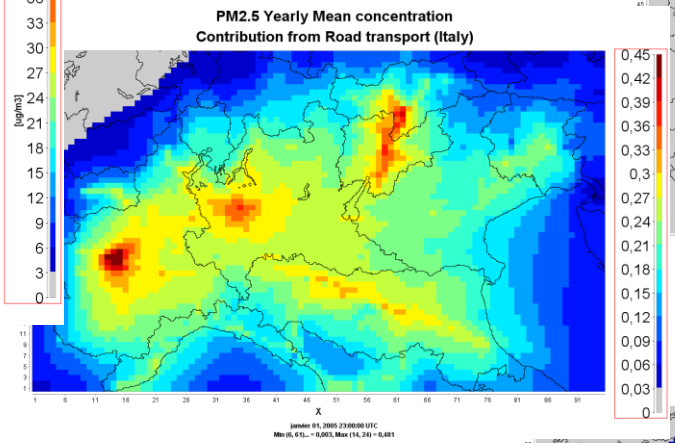
JRC,2011 - 9th intermediate technical / scientific report - Collaborative Research Project for Air Pollution Reduction in Lombardy Region (2006- 2010)

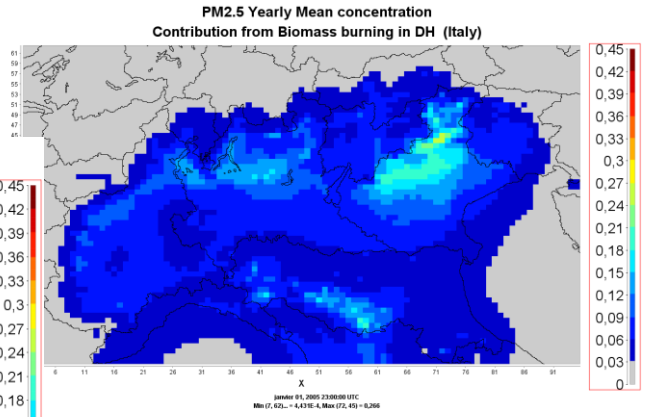
- Widely used approach
- Receptor analysis based on observed data
- Secondary fraction and area contributions not easily apportioned
- Statistical model

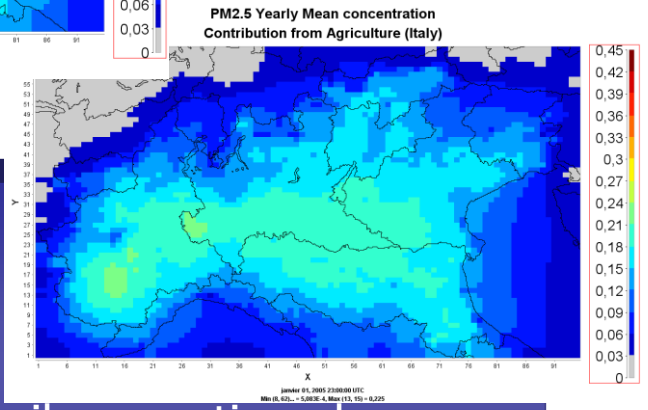
JOINT SA INTERCOMPARISON – Some facts

Source oriented models





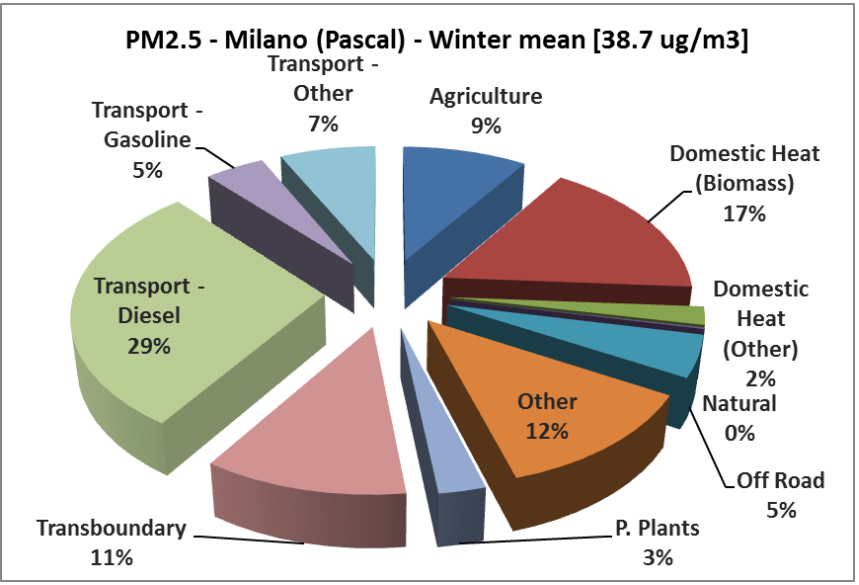


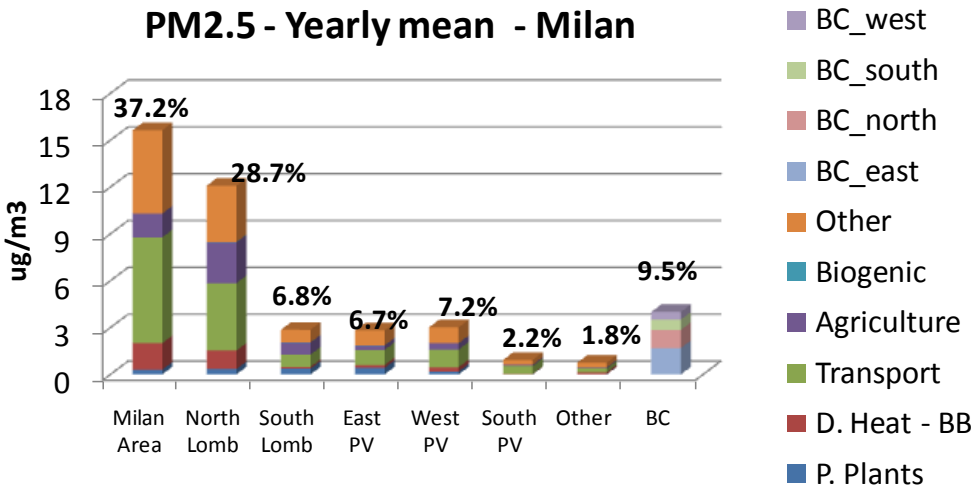


- Fully modelled approach
- Less tested and evaluated
- Secondary fraction and area contributions easily apportioned
- Deterministic model (uncertainty not easily defined)

JOINT SA INTERCOMPARISON – Some facts

Source oriented models





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

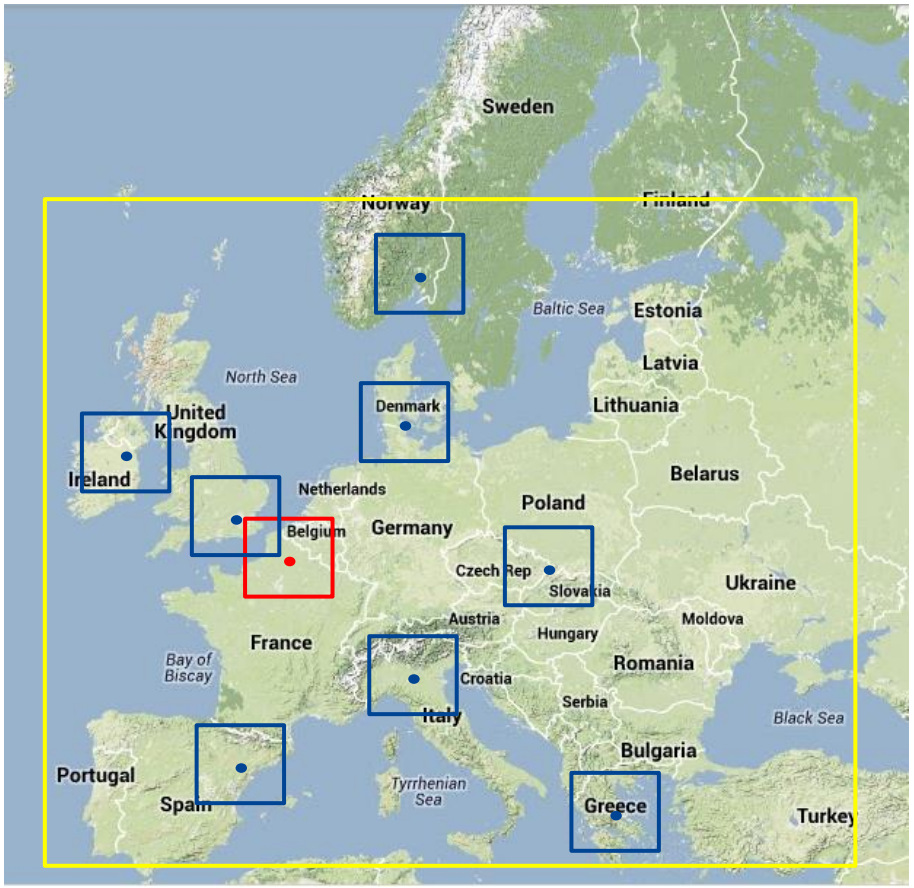
JOINT SA INTERCOMPARISON - PROPOSED SET UP

RMs

- 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