The European Commission's science and knowledge service

Joint Research Centre

WG 3
Source Apportionment tools

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Outline of the presentation

- **What is source apportionment (SA)?**
- **SA techniques**
- **SPECIEUROPE online repository of source profiles**
- **DELTASA tool**

- **Technical documents to support SA**

- **How can these tools be useful for you?**

Source apportionment

Source apportionment is the practice of quantifying the contribution of pollution sources to the concentration of pollutants in the atmosphere

Commonly used

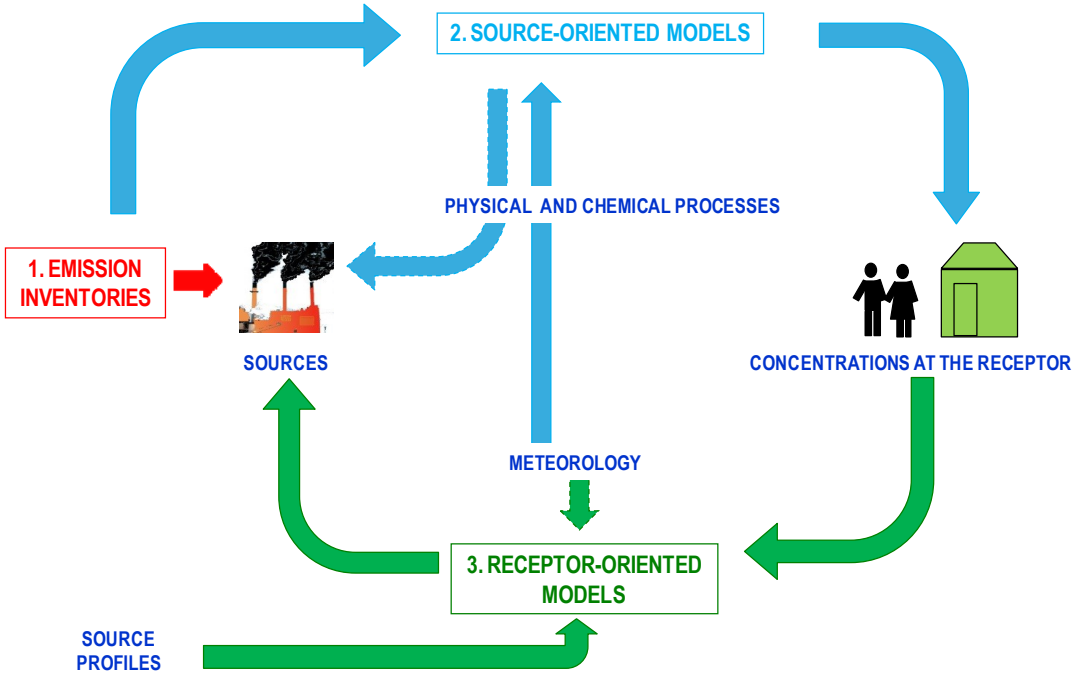
SA techniques are:

- Receptor oriented models (RM)
- Source oriented models (SM)

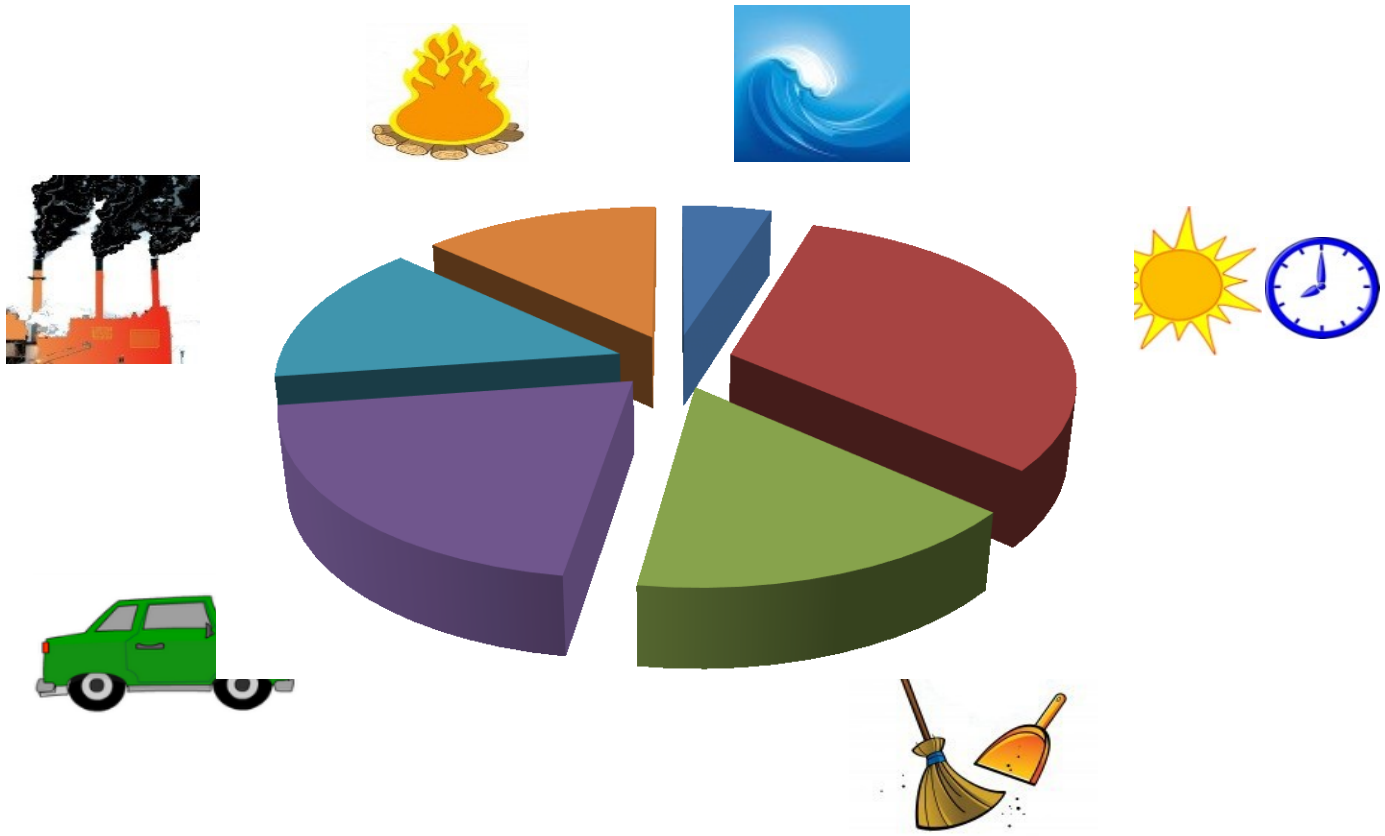
a) Lagrangian models

b) Gaussian models

c) Eulerian models



Typical source apportionment output

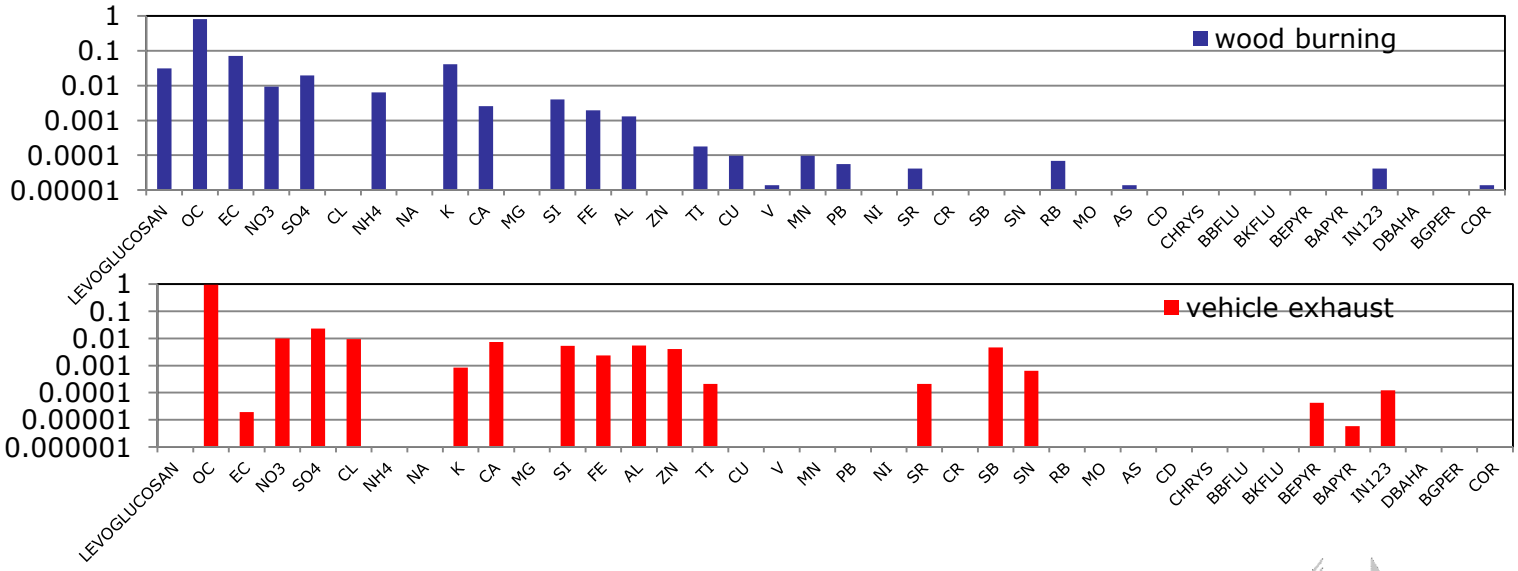


What is a source profile?

It describes the chemical composition of a source by depicting the relative concentration of the chemical species that compose that source

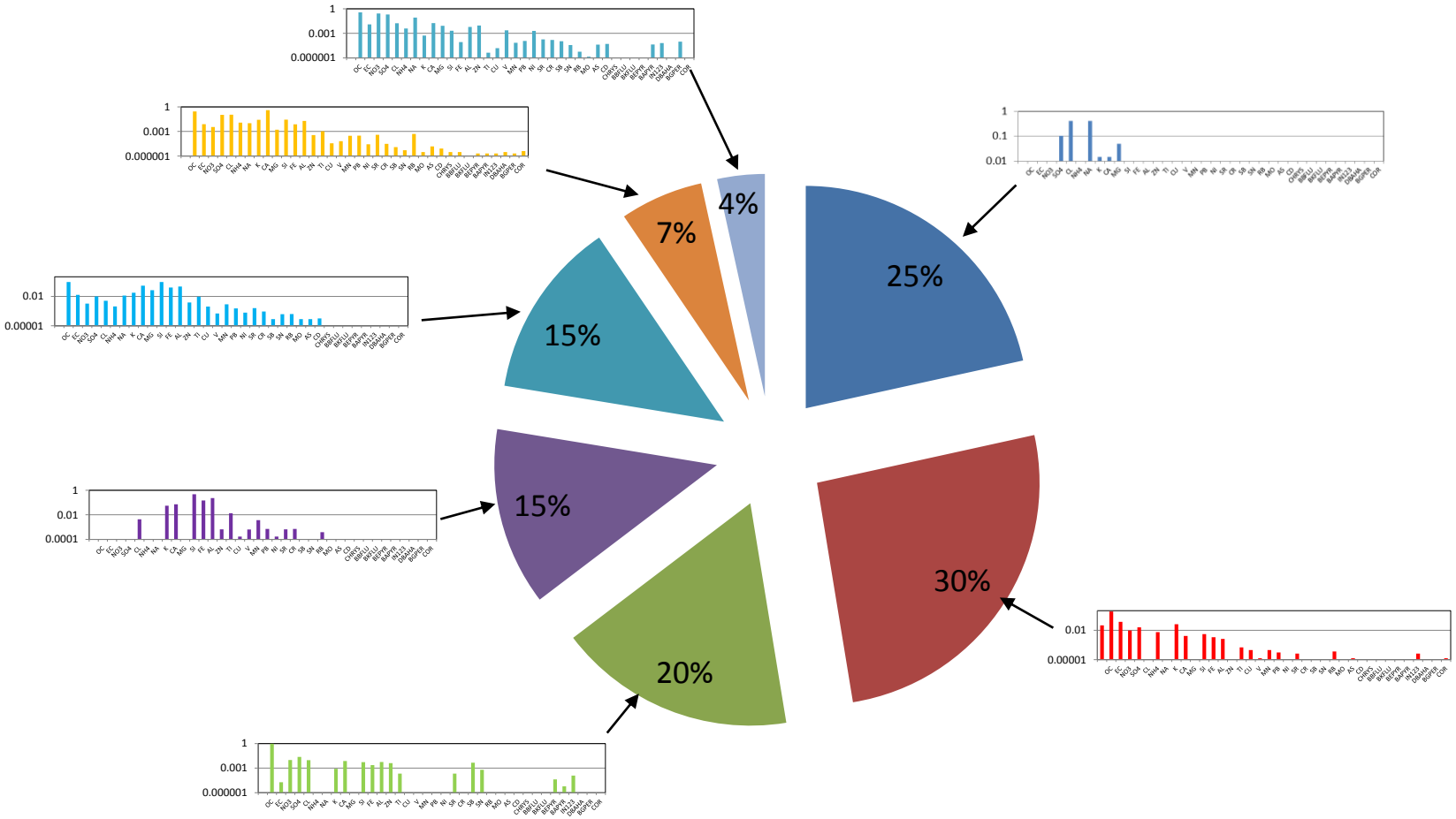
The source profile is the fingerprint of an air pollution source and makes it possible to identify it.

Examples of particulate matter source profiles



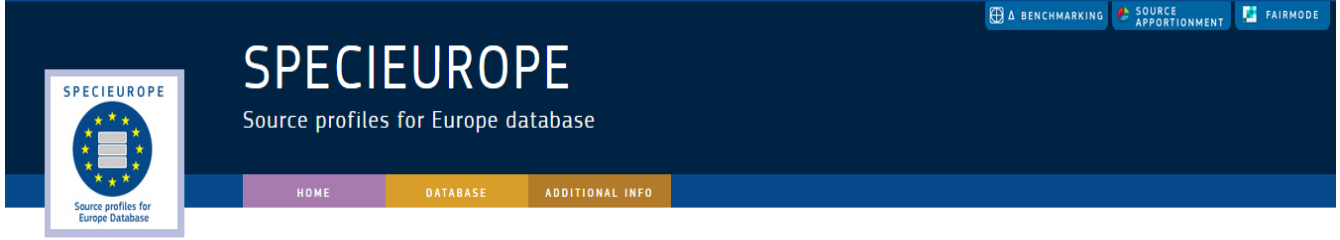
Example of SA output

In RM the souce profiles identify the source categories



Web site: https://sourceapportionment.jrc.ec.europa.eu/Specieurope/index.aspx

Pernigotti, D., Belis, C.A., Spanó, L., 2016. SPECIEUROPE: The European data base for PM source profiles. Atmospheric Pollution Research, 7 (2), pp. 307-314. DOI: 10.1016/j.apr.2015.10.007



srcID	Source category name	#prof	srcID	Source category name	#prof
1	**Traffic**	**28**	24	Metal smelting	4
5	Road dust	15	54	Hard wood burning	4
20	**Industrial**	**77**	33	Natural gas burning	3
40	**Biomass burning**	**24**	43	Pellet burning	3
10	Soil dust	20	53	Soft wood burning	3
41	Wood burning	18	44	Beech burning	2
30	Fuel oil burning	11	46	Leaves burning	2
47	Closed fireplace	16	55	Open burning	2
37	Ship exhaust	14	14	Volcanic dust	2
2	Exhaust	12	35	Petrochemical	2
25	Cement	11	49	Olive oil burning	2
28	Power plant	10	60	Second. inorg. Aer.	2
34	Boiler	8	6	Tyre wear	1
66	Deicing salt	6	7	Brake dust	1
31	Coal burning	12	23	Refineries	1
21	Iron & steel prod.	7	26	Incinerator	1
32	Coke burning	6	42	Pine burning	1
12	Marine aerosol	3	50	Oak burning	1
29	Fertilizer prod.	9	51	Spruce burning	1
22	Foundries	6	52	Larch burning	1
27	Ceramic	6	61	Ammonium nitrate	1
3	Diesel exhaust	5	62	Ammonium sulfate	1
4	Gasoline exhaust	4			

Each profiles is associated to one or more **source category**, which are **hierarchically organised** (see table).

For example if a fingerprint is attributed to the source category **gasoline**, it is **<u>also</u>** attributed to the source categories **exhaust** and **traffic**.

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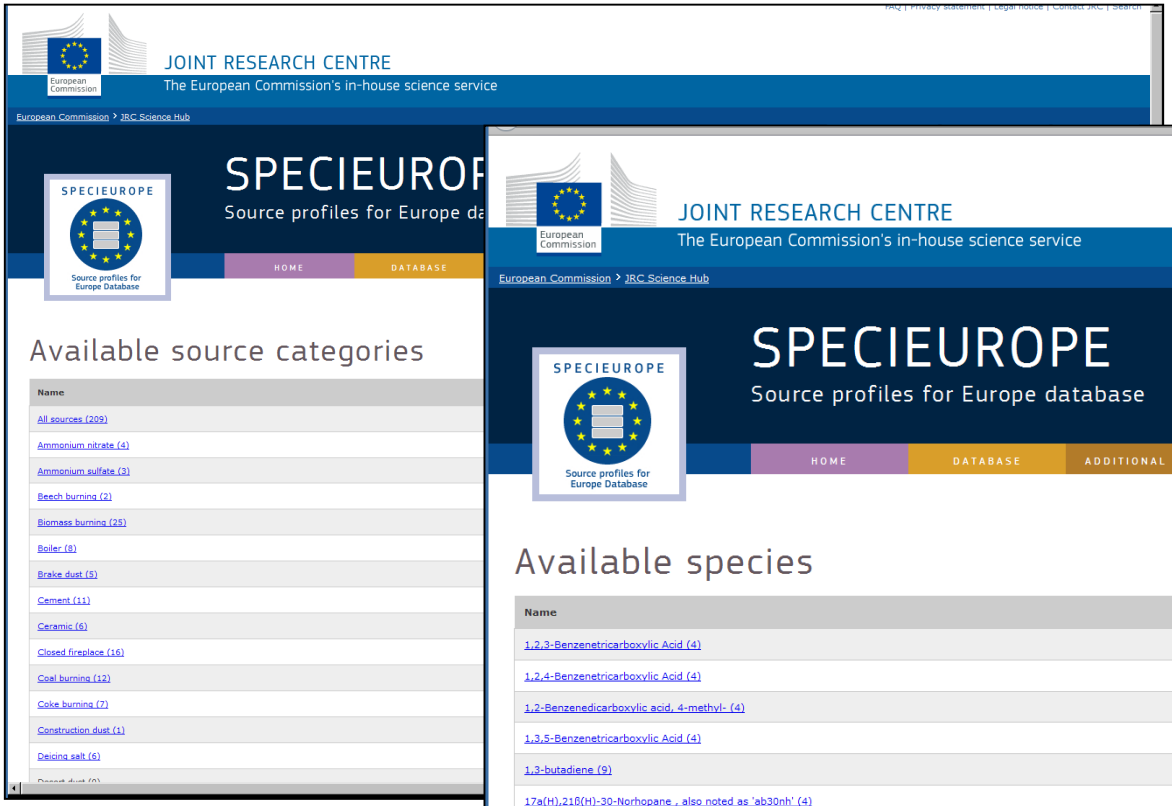
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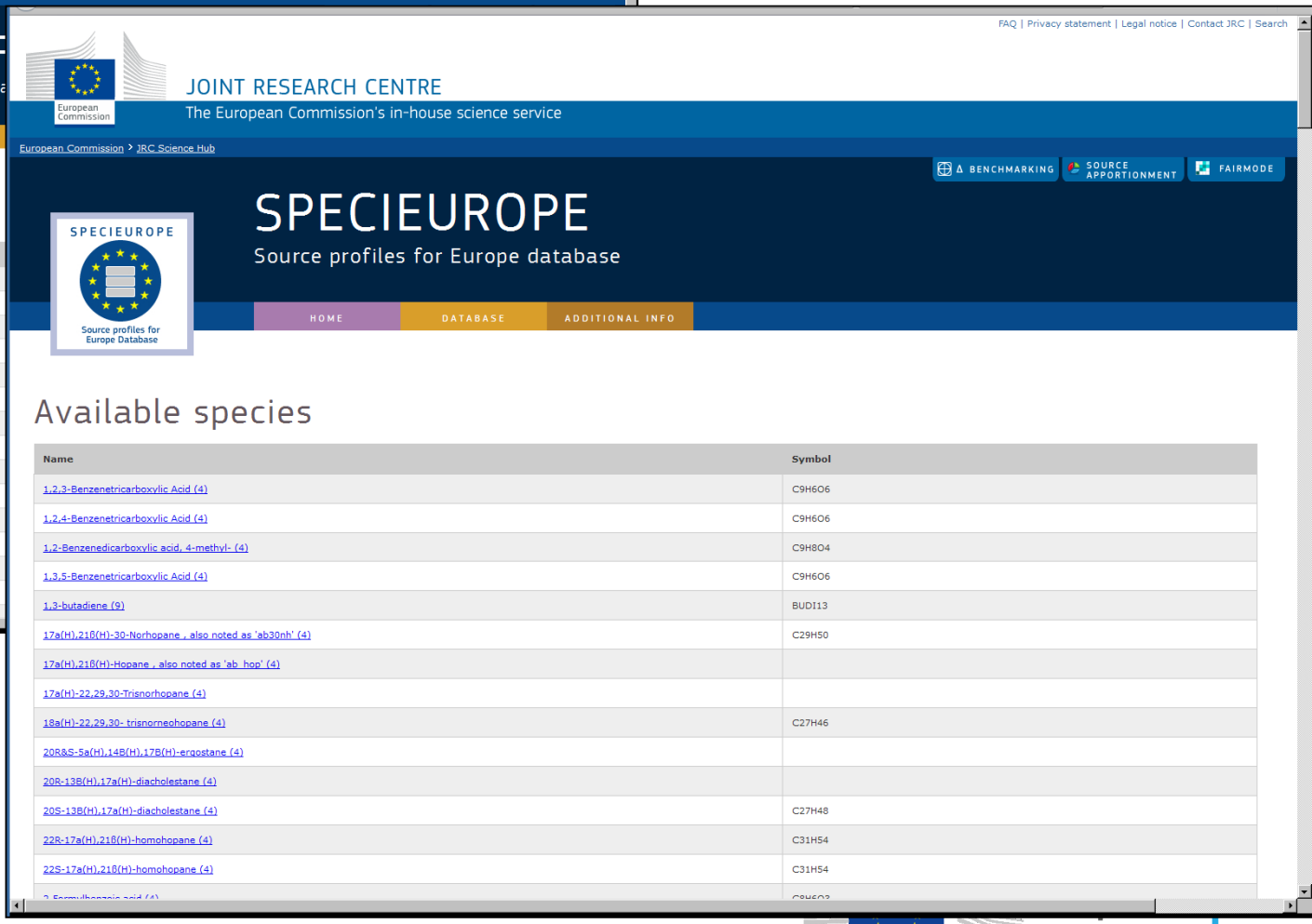
European Commission › JRC Science Hub
SPECIEUROPE
Source profiles for Europe da
HOME
DATABASE
Available source categories
Name
All sources (209)
Ammonium nitrate (4)
Ammonium sulfate (3)
Beech burning (2)
Biomass burning (25)
Boiler (8)
Brake dust (5)
Cement (11)
Ceramic (6)
Closed fireplace (16)
Coal burning (12)
Coke burning (7)
Construction dust (1)
Deicing salt (6)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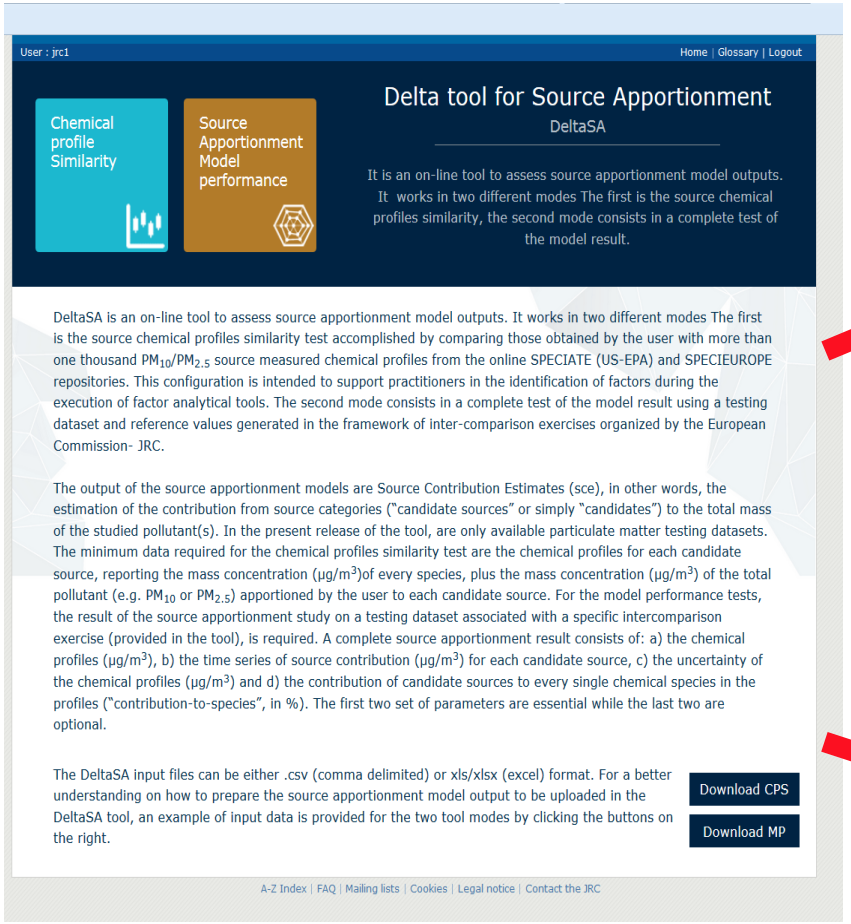
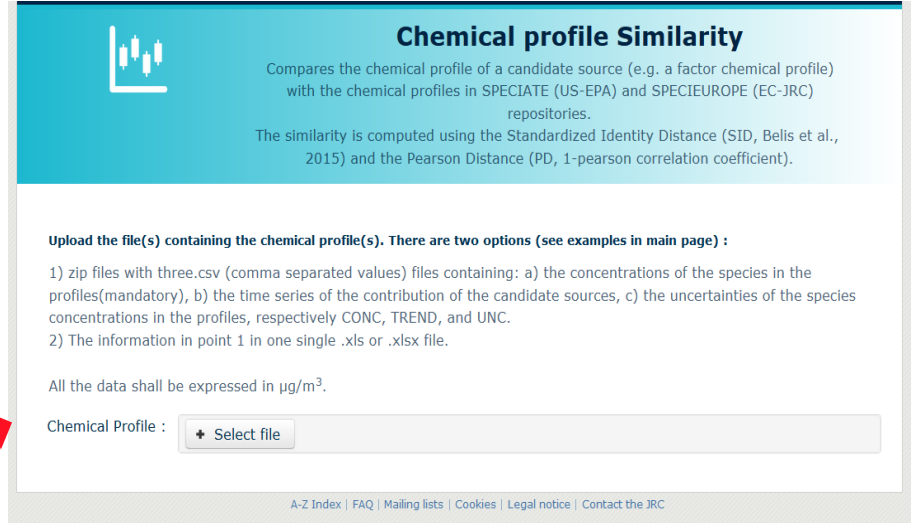
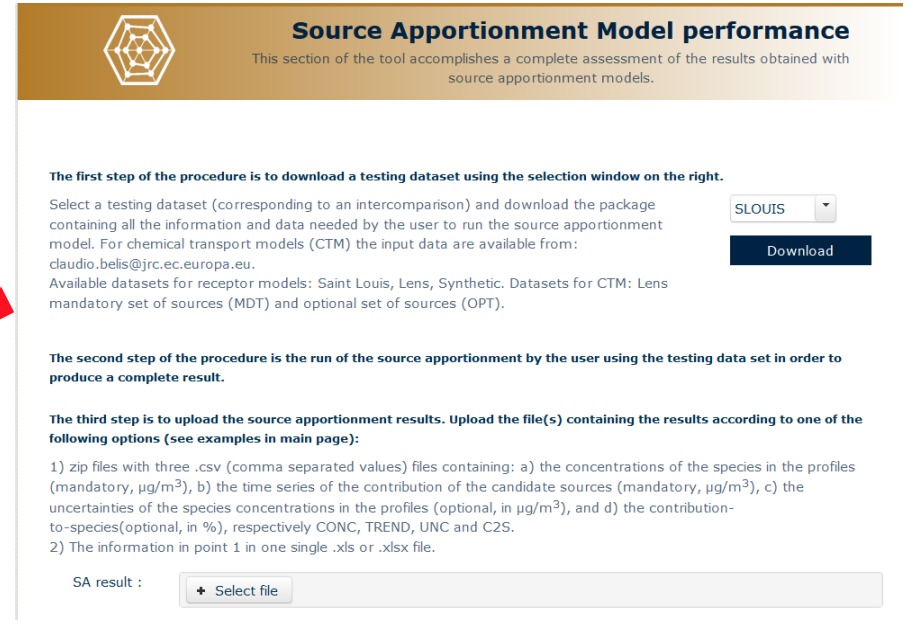
BENCHMARKING
SOURCE APPORTIONMENT
FAIRMODE
SPECIEUROPE
Source profiles for Europe database
HOME
DATABASE
ADDITIONAL INFO
Available species
Name
Symbol
1,2,3-Benzenetricarboxylic Acid (4)
C9H6O6
1,2,4-Benzenetricarboxylic Acid (4)
C9H6O6
1,2-Benzenedicarboxylic acid, 4-methyl- (4)
C9H8O4
1,3,5-Benzenetricarboxylic Acid (4)
C9H6O6
1,3-butadiene (9)
BUDI13
17a(H),21ß(H)-30-Norhopane , also noted as 'ab30nh' (4)
C29H50
17a(H),21ß(H)-Hopane , also noted as 'ab_hop' (4)
17a(H)-22,29,30-Trisnorhopane (4)
18a(H)-22,29,30- trisnorneohopane (4)
C27H46
20R&S-5a(H),14B(H),17B(H)-ergostane (4)
20R-13B(H),17a(H)-diacholestane (4)
20S-13B(H),17a(H)-diacholestane (4)
C27H48
22R-17a(H),21ß(H)-homohopane (4)
C31H54
22S-17a(H),21ß(H)-homohopane (4)
C31H54

On-line Delta SA tool







On-line tool to test SA model performance using existing testing datasets developed by JRC.

https://delta-sa.jrc.ec.europa.eu/sadelta/html/public/login.jsf

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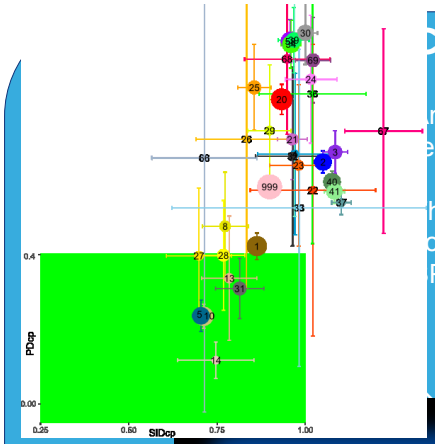
DELTASA: the online tool for the evaluation of SA models

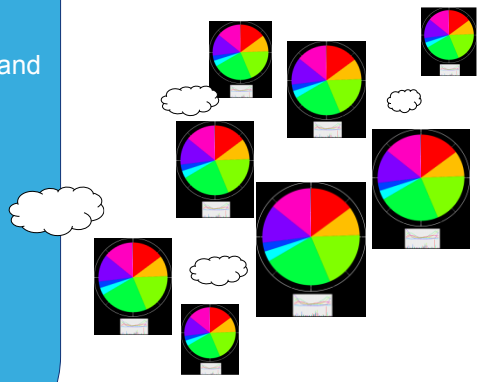


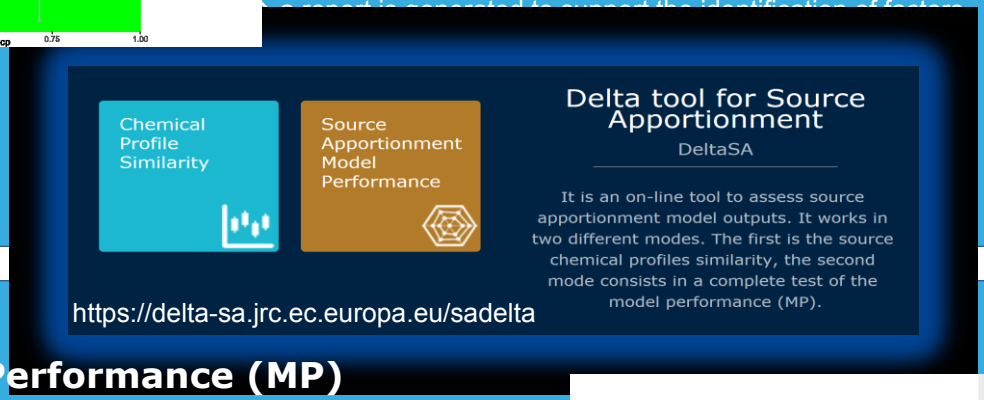
Chemical profiles similarity test (CPS)

ny registered user can upload to the server his/her chemical profile (s) in elative mass on the total PM .

he similarity test is performed with more than one thousand $PM_{10}/PM_{2.5}$ ource measured chemical profiles from the online SPECIATE (US-EPA) and PECIEUROPE repositories using as distances:

- Pearson Distance (PD=1-R)
- Standard Identity Distance (SID).





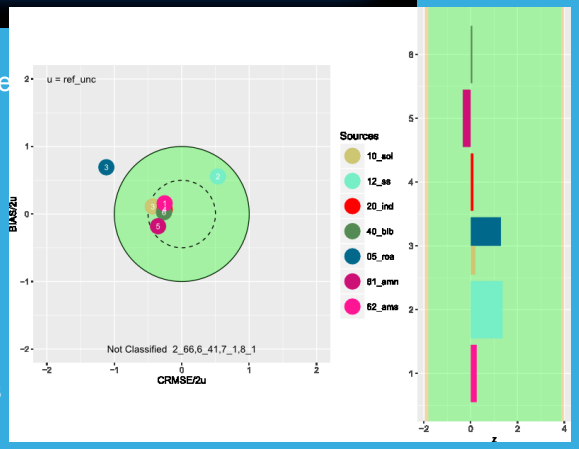
Model Performance (MP)

On-line calculation of the performances using one of the three preloaded intercomparison (IE) dataset.

The user downloads a dataset, run its model and uploads his/her results (CP, SCE, CP see methodology), attributing each candidate to one or more predefined sources.

The tool calculates for each candidate-source a measure of the performances.

→ a report is generated with a summary of the performances



The performance criteria used are:
Target ← SCT SCE → z-score

Belis et al., 2015

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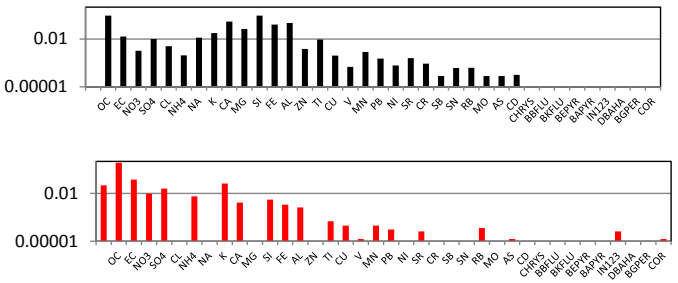
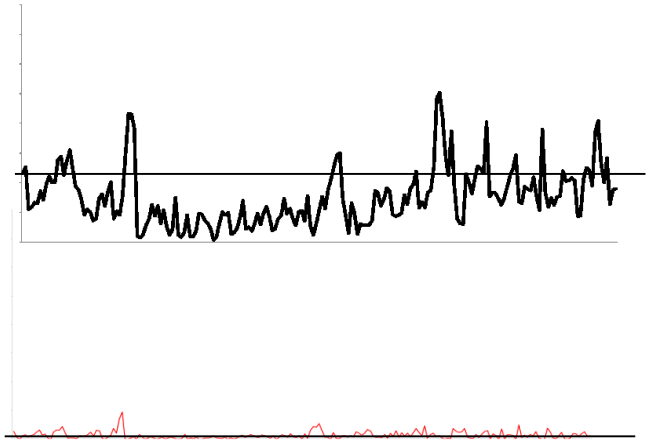
Performance indicators are based on both chemical profiles and time trends



p_{ref} p_{ref} (u)

p_1 p_1 (u)

Chemical profiles (ID)



• $\overline{x}$ ref

• $\overline{x}_1$

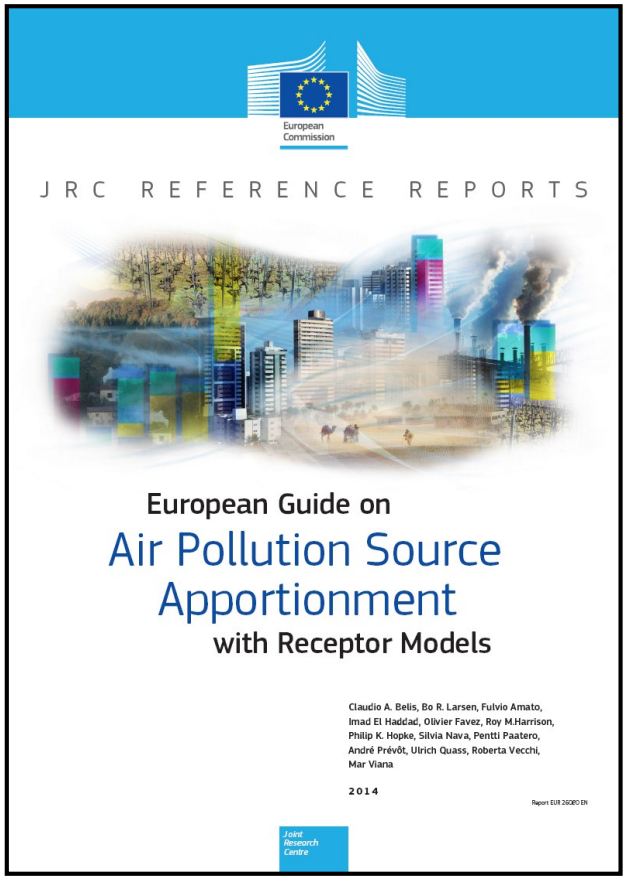
sd t_{ref}

sd t_1

Time trend (behaviour)

Guide on SA with RMs: Driving elements

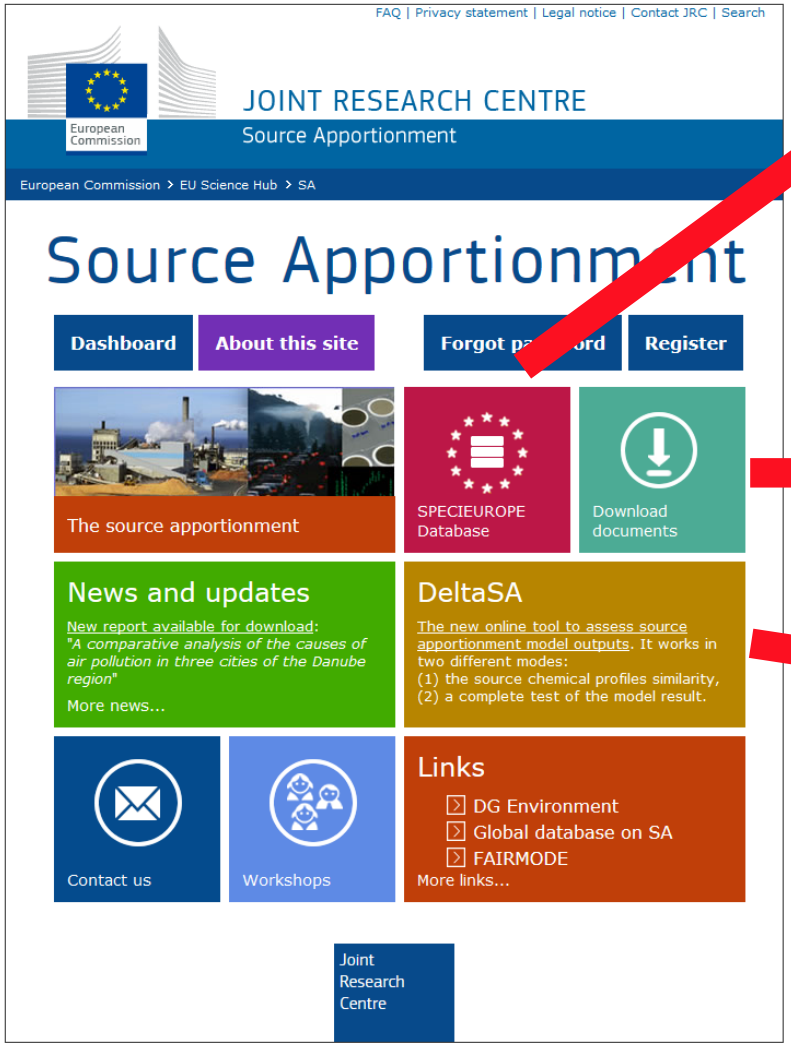
UNDER REVISION

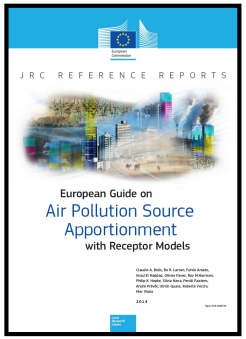


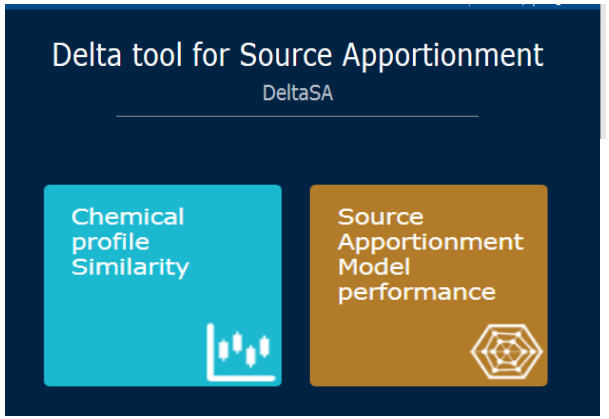
- The main objective is to promote the best available operating procedures and to harmonise their application across Europe.
- Promote implementation of quality assurance steps
- Establish a common reporting of results
- Collect the experience of European leading teams in the subject

C.A. Belis, 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

Where? -> Source apportionment JRC website







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

How these tools can be useful for you?

SPECIEUROPE:

- *definition of sources based on real-world measurements*
- *run and validation of RM and validation of SM results*
- *common reference for all SA studies in Europe*

DELTA SA

- *automatic test of user source profiles*
- *assess single user capabilities using existing datasets (training)*

GUIDE on SA with RMs:

- *harmonised procedures -> comparability of results,*
- *best practices (quality assurance),*
- *bibliographic references*

Thank you for your attention

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