Source Apportionment (SA) Guide: history and present status

History

- idea to make an SA guide launched by Claudio Belis at FAIRMODE Technical Meeting 27-29 June 2016, Zagreb, Croatia
- first outline of the SA guide presented at FAIRMODE Plenary meeting 14-15 February 2017, Utrecht, The Netherlands
-first request of contributions in the FAIRMODE community on 7 April 2017
-a survey about available studies on estimation of particulate matter source contributions with source oriented models (SM) and/or receptor models (RM) distributed on 19 May 2017
-presentation of survey results at FAIRMODE Technical Meeting 19-22 June 2017, Athens, Greece ,and request of contributions before 15t September 2017
- distribution of an updated outline of SA guide and second request for contributions before 1 November 2017

Present status

The contributions received on SA with RM and SM put forward the idea of two separate documents:

-Update of Source Apportionment Guide with Receptor Models (RM) published by Belis et al. (2014, JRC Report)

-Source Apportionment Guide for estimating particulate matter source contributions with source oriented models (SM) and with combination of source oriented and source receptor models (SM&SR)

…discussion is open on this matter…

Contributions received to update the Source Apportionment Guide with Receptor Models (RM)

1. Wind and trajectory analysis in source apportionment. The advantage of Trajectory Statistical Methods and Classifications of Atmospheric Circulation Patterns (**Pedro Salvador**, Unit of Atmospheric Pollution Characterization and POC, Department of Environment CIEMAT; **Stergios Vratolis**, Institute of Nuclear and Radiological Science & Technology, Energy & Safety, National Center for Scientific Research "Demokritos", Athens, Greece)

2. Use of spectrometric techniques for SA of the fine aerosol organic fraction (AMS, ACSM, etc.) (**Stefania Gilardoni**, National Research Council of Italy – Institute of Atmospheric Sciences and Climate (CNR-ISAC), Bologna, Italy)

3. Methods for the apportionment of the carbonaceous fraction (aethalometer - **Lila Diapouli**, Environmental Radioactivity Laboratory, Institute of Nuclear and Radiological Science & Technology, Energy & Safety, National Center for Scientific Research "Demokritos", Athens, Greece)

4. Revise CMB section (**Roy M. Harrison** and **Imad El Haddad**, School of Geography, Earth & Environmental Sciences, University of Birmingham, UK)

5. PMF uncertainities (**Manousos-Ioannis Manousakas**, Institute of Nuclear and Radiological Science & Technology, Energy & Safety, National Center for Scientific Research "Demokritos", Attiki, Greece)

6. Use of Proton-Nuclear Magnetic Resonance (1H-NMR) spectroscopy datasets to improve the identification of source contributions to the aerosol water soluble organic carbon (WSOC). (**Marco Paglione** and **Stefano Decesari**, National Research Council of Italy – Institute of Atmospheric Sciences and Climate (CNR-ISAC), Bologna, Italy)

Survey summary: 115 RM studies (28+14+28+45) published or carried out after 2010

28: reported by Greece 9, Italy 5, Hungary 4, Czech Republic 4, Netherlands 3, Serbia 1, Poland 1 and Bulgaria 1

14: reported by UK

28: reported by France

45: reported by US and cover Asia, Africa, North America and Europe

Most of them use PMF (different versions), very few PCA and CMB.

Almost all are research studies.

Survey summary

- **SM –** 6 studies in support to air quality management, 1 for support for derogation from limit values and 3 for air quality management and legislation compliance

Study area	Pollutant	CTM	SA approach	Resolution	Year	
Berlin	PM10	LOTOS-EUROS		7 x 7 km	2015	
Dutch territory	PM10, PM2.5	LOTOS-EUROS	labeling routine	7 x 7 km	2007-2009	
Flanders	PM10, PM2.5	LOTOS-EUROS	labeling routine	7 x 7 km	2007-2011	
Slovakia	PM10	CALPUFF		horizontal resolution of 200–500 m, depending on the complexity of the terrain.	-	Lagrangian air quality model
Europe AQMEII	PM2.5	CAMX	OSAT/PSAT	23 km	-	
Iberian Peninsula,the Azorean, Balearic and Canary archipelagos	PM10	-	Hidden Markov models (HMM)	-	2009-2013	Quantification of Saharan dust contribution
from a street canyon to a whole city/several cities	PM10	EURAD, LASAT, Miskam, EURAD-IM, EURAD-Fladis	-	from single meters to 250 m, in some cases up to 1 km	-	
Italy	PM10	AMS-MINNI	brute force method	20 km	scenarious 2011	
Flanders	PM10, PM2.5	BelEUROS	brut force method	60km, 15 km	2007, scenarious 2020	
port of Ghent, Flanders	PM10, PM2.5	RIO-IFDM-OSPM	-	-	-	

SM&RM – research studies

Country	Pollutant	RM	CTM	SA approach	Resolution	Year
Italy, Lombardy, 2005	PM2.5	CMB	CAMX	PSAT	5 km	2005
Italy, Genoa, May-October 2011	PM2.5 and PM10	PMF	CAMX	PSAT	1.1 km	June - August 2011 November, 15 - December, 15 2011

Source Apportionment Guide for estimating particulate matter source contributions with source oriented models (SM) and with combination of source oriented and source receptor models (SM&RM)

Why a Source Apportionment Guide for SM and SM&RM ?

….is necessary…

-The AQD has set up an air quality management scheme under which Member States (MS) identify the main emission sources contributing to PM concentrations above AQD limit values. If the exceedances are not due to transboundary contributions, adverse climatic conditions or site-specific dispersion characteristics (or to a combination of these factors), *source apportionment techniques have to be used* to identify the main pollution sources precise enough to allow an understanding of which measures should be taken to address them.

-SA also support assessments of population exposure to PM concentrations according to source type

….SM has the following advantages:

-is not limited to few sites where monitoring data are available

-allow to distinguish among different sources of the same type while SR techniques identify generic sources such as sulfate, nitrate, etc.

-allow to distinguish the individual contribution of meteorology and of emissions, natural and anthropogenic, to ambient pollution

At present there is no technical guide on the use of SM for PM source apportionment

Target audience

This document is intended to provide support to the organizations, companies, institutions, etc which carry out source apportionment studies in support to authorities responsible for developing, implementing and evaluating official air quality plans under Directive 2008/50/EC.

The document will also provide a framework to assist the authorities in the interpretation of the modelling results for source apportionment purposes.

The document also aims to help the air quality modellers, independent of the level of experience, to approach the source apportionment issues.

PM Source Apportionment Guide for SM and SM&SR: discussions

What should the Guidance describe?

The Guidance should describe "the best practices" to perform source apportionment

This requires a preliminary consensus on:

What Source Apportionment is

What Source Apportionment produces

Is more efficient to have one single guide for both SM and RM or to keep them separated?

According to the previous definitions which SM techniques should be proposed/described in the Guidance? (Reactive Tracer methods such as Tagged Species, etc, Sensitivity Analisis methods suc as Brute Force Method, etc)

Do we need to address all known methods or just the most used? Do we have to include the same level of detail in their description?

Which are the main steps in the development of an SA study?

-define the domain and the period to investigate, evaluate the availability and the quality of data used as input for model simulation and for validation

-reproduction of the actual pollution levels (base simulation) and its validation

-application of a proper SA technique, analysis and interpretation of SA results

What are the additional aspects to be considered in a model application focused on SA?

- modelling of specific sources (e.g. natural sources, road dust,…)

- emissions validation/evaluation (for example with Delta Emissions Tool?)

- model performance evaluation with particular emphasis on "marker" species?

- comparison with RMs results?

- …more..

If you are interested to contribute to the guide, send a message to the email address: mihaela.mircea@enea.it