# Overview of selected source apportionment studies from European COST633 Action member countries

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## 1. Introduction and methods

The objective of this work is to provide an overview of the source apportionment (SA) methods in use throughout Europe. A questionnaire on SA studies was designed within COST633 Working Group 3 (Sources, Emissions, Modelling, Economic Aspects) and distributed amongst the Action's participant countries. Even though replies to the questionnaires were not obtained from all the member countries, the return may be seen as a useful overview on SA activities in Europe. However, this overview does not include all of the SA studies performed in the European COST633 Action member countries.

## 2. Results

### 2.1. SA methods

The replies to the questionnaires reported 46 publications on SA in 7 countries (Austria, Belgium, Germany, Portugal, Spain, Switzerland), based on 10 different methodologies (Figure 1).

- COPREM-Constrained Physical Receptor Model
- PCA-Principal Component Analysis
- CA-Cluster Analysis
- CMB-Chemical Mass Balance
- Traj.-Trajectory analysis
- Lenschow-Lenschow approach
- PMF-Positive Matrix Factorisation
- UNMIX-UNMIX receptor model
- ME-Multi-linear Engine
- IMB-Isotopic Mass balance

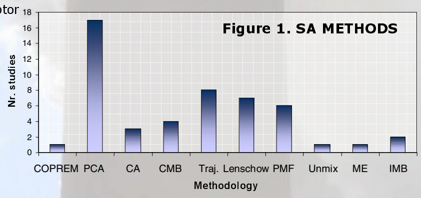


Figure 1. SA METHODS

The most frequently used method was PCA (34% of the studies), followed by back-trajectory analysis (16%), the Lenschow approach (14%) and PMF (12%). Regarding the number of research groups applying the different techniques, PCA and the Lenschow approach appeared to be most widely used (in 7 and 6 different countries, respectively), whereas PMF was applied in 4 countries.

### 2.2. Target metrics and sample types

The most common target metrics in the different studies were PM10 (50% of the studies) and PM2.5 (30%), even though models were also occasionally applied to PM1, PM2.5-10 (fraction between PM10 and PM2.5), TSP and very fine particles (cut-off <1 µm). SA studies included in this work were mostly performed on 24 hour high-volume samples (HVS, 46%). Other sample types such as 24 hour low-volume samples (LVS) and automatic data were also relative common (12% each).

Figure 2. TARGET METRICS

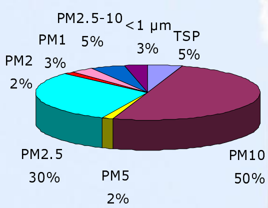
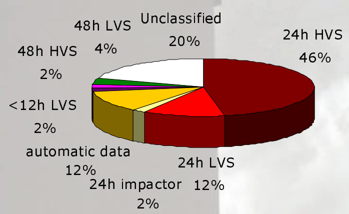


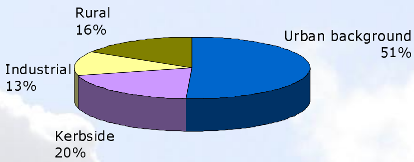

Figure 3. SAMPLE TYPES




### 2.3. Receptor sites

Receptor sites at which models were applied were described as urban background (51%), kerbside (20%), rural (16%, including remote and agricultural sites) and industrial (13%), indicating that current source contribution analyses are focused on urban environments (mainly residential, suburban).

Figure 4. RECEPTOR SITES




### 2.4. SA results

Results from a number of the SA studies on PM mass reported in the questionnaires are shown in Figures 5 (PM10) and 6 (PM2.5). It is important to note that data was not available for all of the studies. Results from other studies (e.g. Szidat et al., Almeida et al., Spindler et al., Prendes et al.) are not included as they deal with SA of specific PM fractions (e.g. carbonaceous or secondary aerosols) or sources (e.g. soil re-suspension by traffic).

## 3. Summary of results

- **Methodology**: **PCA** is the most commonly used methodology in EU COST633 countries, both in number of studies and number of research teams.

- **Location: urban background** environments are the major focus of SA studies from COST633 countries. Should future research continue in this direction or be directed towards highly polluted environments (industrial, kerbside), taking into account not only ambient concentrations but also exposure?

- **Target metric: PM10** is most common target metric. Given the increasing evidence on health effects related to the finer grain-sized fractions, these results highlight the need for further research on PM2.5 sources and source contributions.

- **Sample types**: **high-volume** samplers are the most frequently used instrumentation in studies consulted. Further research with this type of samplers would favour EU-wide inter-comparison of results.

- **Sources**: relatively larger heterogeneity of sources and source contributions observed for PM2.5 than for PM10 throughout EU. Identification of certain sources seems to depend on the study, e.g. sources containing S as a main tracer are found labelled as "industrial source" but also as "secondary aerosols", "regional aerosols" or "transboundary pollution". This might be the origin of some of the variability observed in PM2.5 sources.

- **Possible future research directions**
  - SA of indoor air concentrations, and their relations to exposure
  - Clear differentiation between background secondary aerosols and industrial emissions
  - SA of specific sources (e.g. shipping emissions)
  - Identification of natural sources
  - Comparability of SA methods
  - Identification of basic needs for SA

Figure 5. PM10 source contribution (%)

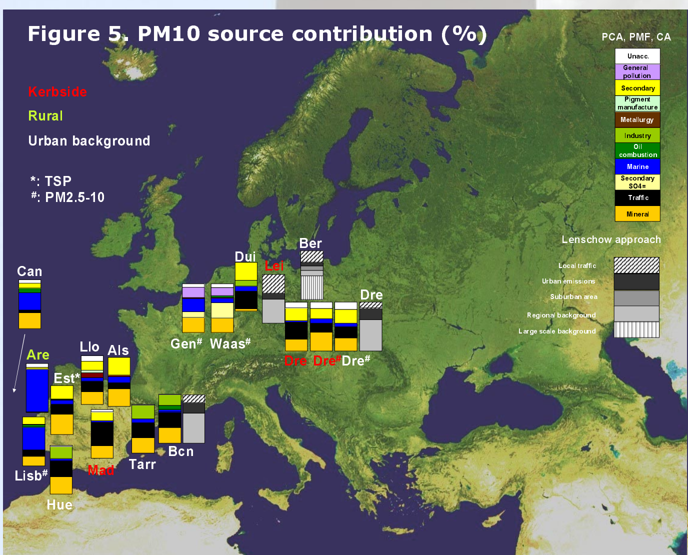
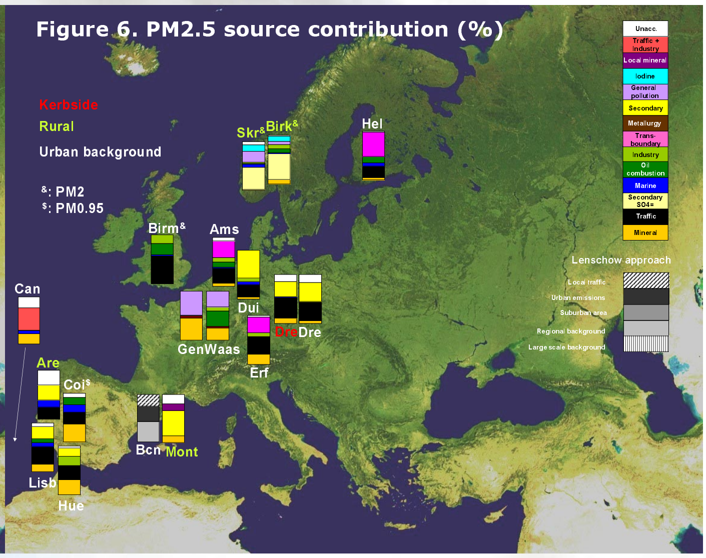



Figure 6. PM2.5 source contribution (%)




Alsasua (Als), Amsterdam (Ams); Areao (Are); Barcelona (Bcn); Birkenes (Bir); Birmingham (Bir); Berlin (Ber); Canarias (Can); Coimbra (Coi); Dresden (Dre); Duisburg (Dui); Erfurt (Erf); Estarreja (Est); Gent (Gen); Helsinki (Hel); Huelva (Hue); Leipzig (Lei); Lisbon (Lisb); Llodio (Llo); Madrid (Mad); Montseny (Mont); Skreådalen (Skr); Tarragona (Tarr); Waasmunster (Waas)

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