



## Characterization of aerosol chemical composition with aerosol mass spectrometry in Central Europe: an overview

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Real-time measurements of non-refractory submicron aerosols (NR-PM<sub>1</sub>) were conducted within the greater Alpine region (Switzerland, Germany, Austria, France and Liechtenstein) during several week-long field campaigns in 2002–2009. This region represents one of the most important economic and recreational spaces in Europe. A large variety of sites was covered including urban backgrounds, motorways, rural, remote, and high-alpine stations, and also mobile on-road measurements were performed. Inorganic and organic aerosol (OA) fractions were determined by means of aerosol mass spectrometry (AMS). The data originating from 13 different field campaigns and the combined data have been utilized for providing an improved temporal and spatial data coverage.

The average mass concentration of NR-PM<sub>1</sub> for the different campaigns typically ranged between 10 and 30  $\mu\text{g m}^{-3}$ . Overall, the organic portion was most abundant, ranging from 36% to 81% of NR-PM<sub>1</sub>. Other main constituents comprised ammonium (5–15%), nitrate (8–36%), sulfate (3–26%), and chloride (0–5%). These latter anions were, on average, fully neutralized by ammonium. As a major result, time of the year (winter vs. summer) and location of the site (Alpine valleys vs. Plateau) could largely explain the variability in aerosol chemical composition for the different campaigns and were found to be better descriptors for aerosol composition than the type of site (urban, rural etc.). Thus, a reassessment of classifications of measurements sites might be considered in the future, possibly also for other regions of the world.

The OA data was further analyzed using positive matrix factorization (PMF) and the multi-linear engine ME (factor analysis) separating the total OA into its underlying components, such as oxygenated (mostly secondary) organic aerosol (OOA), hydrocarbon-like and freshly emitted organic aerosol (HOA), as well as OA from biomass burning (BBOA). OOA was ubiquitous, ranged between 36% and 94% of OA, and could be separated into a low-volatility and a semi-volatile fraction (LV-OOA and SV-OOA) for all summer campaigns at low altitude sites. Wood combustion (BBOA) accounted for a considerable fraction during wintertime (17–49% OA), particularly in narrow Alpine valleys. BBOA was often the most abundant OA component. HOA/OA ratios were comparatively low for all campaigns (6–16%) with the exception of on-road, mobile measurements (23%) in the Rhine Valley. The abundance of the aerosol components and the retrievability of SV-OOA and LV-OOA are discussed in the light of atmospheric chemistry and physics.

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