



Source apportionment of fine aerosol in Marseille city

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This study presents the results of an extensive field campaign in a coastal Mediterranean city (Marseille, France) in the summer 2008 (30/06-14/7). The campaign was carried out at an urban background site in July 2008, within the FORMES program. Several on line instruments (C-TOF-AMS, HS-PTR-MS, SMPS, and VHTDMA) were employed to investigate in detail fine particles and VOC's with high temporal resolution. In addition filter-based measurements were used for the measurement of a large array of chemical species including EC and OC, ionic species, metals, and molecular speciation of organic matter.

Total NR-PM1 mass concentration in Marseille accumulates over days and rapid cleaning occurred when the meteorological conditions changed, due mainly to the Mistral wind. Sulphate and organics were the major NR-PM1 components while the concentrations of nitrate and chloride were generally quite low. Significant amounts of ammonium, which most of the time were consistent with sulphate present as ammonium sulphate, were also present in particles. In several periods the aerosols were acidic and more than 40% of sulphate was in the form of ammonium bisulphate. The accumulation mode was dominated by sulphate that appears to be internally mixed with organics, while combustion-emitted organics are often the main component of the ultrafine particles (except during nucleation events). The ultrafine-mode organic aerosols were mainly associated with combustion sources (likely traffic). Few nucleation events were observed and they were always preceded by very high concentration of SO₂ (industrial sources nearby the city of Marseille).

Various source apportionment exercises, including Positive Matrix Factorization and Chemical Mass Balance, were undertaken to evaluate the organic contribution of to total particulate matter. Positive matrix factorization (PMF) was used for the aerosol mass spectra to identify the main components of the total organic aerosol and their sources. The PMF retrieved factors were compared to measured reference mass. Four main factors were found to explain the variance in the data and could be assigned either to sources or to aerosol components such non oxygenated fraction (HOA), and two other partly and highly oxygenated organic aerosol fractions (OOAI and OOAI) and a non-defined 4th factor called 'industrial' which perfectly correlated with "hot spot of PAHs" (not related to traffic emissions).

We found an excellent agreement between CMB and PMF analysis of the three major components of the fine organic aerosol during the summer campaign in Marseille. Also a very good correlation between the time series between the 4th factor identified by PMF analysis and a CMB source assigned to "industrial" OM was found.

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