



PMF source apportionment of PM_{2.5} daily and hourly aerosol data in Tuscany (Italy)

Silvia Nava (1), Franco Lucarelli (1), Giulia Calzolai (1), Massimo Chiari (1), Silvia Becagli (2), Roberto Udisti (2), Martina Giannoni (2), Francesca Pieri (2), and Alessandra Cincinelli (2)

(1) INFN-Firenze, Physics and Astronomy Dpt. Florence University, Sesto Fiorentino (FI), Italy (nava@fi.infn.it, +39 055 4572641), (2) Chemistry Dpt. Florence University, Sesto Fiorentino (FI), Italy

PATOS2 (Particolato Atmosferico in TOScana 2) is the first extensive field campaign for the PM_{2.5} characterisation in Tuscany. It follows a previous project focused on PM₁₀ and it has been entrusted by the Regional Government mainly to investigate the aerosol sources and trace their contribution to PM_{2.5}.

Three sites representative of areas of different typology have been selected: Florence - Via Bassi (urban background), Florence - Viale Gramsci (urban traffic) and Livorno - Villa Maurogordato (suburban-regional background). The sampling campaign lasted one year, from March 2009 to March 2010. Aerosol samples were simultaneously collected on Teflon and Quartz fibre filters, on a daily basis (00:01-23:59), by FAI-Hydra sequential samplers (EN 12341, 2.3 m³/h, two inlets), thus allowing the application of different analytical techniques. PM_{2.5} daily mass concentrations were obtained gravimetrically. Samples collected on Teflon filters were analysed by PIXE to measure the elemental composition, by IC to quantify the ion content and by ICP-AES (selected metals). Samples collected on Quartz fibre filters were analysed by TOT to measure EC and OC concentrations, and by GC-MS to determine n-alkanes and PAHs concentrations. During shorter periods, the aerosol was collected also by means of a streaker sampler and a multistage cascade impactor (SDI, Dekati): PIXE analysis of these samples allowed the assessment of hourly resolution elemental time trends and elemental size distributions, respectively.

The comprehensive chemical characterisation allowed us to obtain the aerosol mass closure. Positive Matrix Factorisation (PMF) has been applied to the whole data set (daily and hourly samples). Input data were prepared using the procedure suggested by Polissar and PMF results for multiple values of FPEAK were systematically explored to find out the most reasonable solution. Six main sources have been identified in all sampling sites: traffic, biomass burning, secondary sulphate, secondary nitrates, soil dust and marine aerosol. Two contributions to traffic emissions have been disentangled in Florence. In Livorno, an additional source, connected to ship emissions and harbour activities, has been detected. Traffic and secondary sulphate are the most important sources in Florence, but also biomass-burning gives an important contribution to PM_{2.5} mass. The contribution of the "natural" components (mineral dust and marine aerosols) to PM_{2.5} is on average moderate, but it reaches higher values during Saharan dust intrusions (in the most intense episode, the mineral dust component accounted for ~ 20% of the PM_{2.5} concentration). High time resolution and size segregated data were used to corroborate and validate these results. It is worth noting that many aerosol sources can vary on a time scale of few hours or less. As a consequence, the use of hourly concentration datasets can be of great help for, at least, two reasons: the high resolved time patterns can improve the source identification and more accurate source profiles can be obtained.