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Identification of long-range mass transport episodes of coarse and fine particulate matter through aerosol size spectrum analysis

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Long-range mass transport has been widely reported to affect the local PM measurements: for instance sulphate transport from regions with high SO_2 emission sources can be expected to have significant impact on the fine fraction, while dust transport from deserts can affect the coarse mode. In view of respecting the limits set by the European Directive 1999/30/EC and developing effective control strategies for the PM reduction, it is important to discern the occurrence of such phenomena. This communication discusses the application of a methodology based on the analysis of the temporal variation of the correlation of the aerosol size fractions. The underlying idea is that coarse and fine fractions are not correlated since they derive from completely different sources; size fractions with very close aerodynamic diameters, are expected to be highly correlated because, when pollution is dominated by local sources, very likely they have the same origin. Actually, in the case of long-range mass transport, when particles of the same size fraction but with different origins get mixed, this does not occur. In this view, two intense PM10 episode, occurring in June 2006, detected in Italy in sites as distant as 400 km, are investigated.

Aerodynamic size distributions of atmospheric aerosol were measured by means of a TSI Aerodynamic Particle Sizer 3321 (APS), counting and sizing particles in the range of 0.5 and 20 μm (aerodynamic diameters), in about fifty size channels. 30-minutes averaged size distributions were continuously taken in Rome, in an area affected both by the downtown pollution and by the autovehicular emissions due to the presences of a nearby highway.

The analysis of aerosol spectra and the transition from highly correlated size fractions to sharp drop of correlation evidenced that the first episode involved the advection of coarse PM, while the second was due to the inflow of two different air masses, one transporting coarse dust and the other fine PM.

Dust models and backward-trajectories analysis confirmed such results, showing, in the first PM10 episode, dust mass transport from the western Sahara and in the second, the movement of two air masses, one, transporting sulphate, coming from north – eastern European regions, the other, transporting dust of African origin.