

Is PM_{2.5} the best descriptor of the atmospheric fine fraction aerosol?

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The work presented wants to highlight the importance of the study of aerosol size distribution both for health reasons and as a support to source apportionment studies. From the health stand point atmospheric Particulate Matter (PM) is regulated on mass basis through PM₁₀ and PM_{2.5} conventions by the Directive 2008/50/EC. The Directive recognizes the negative impact on human health due to fine PM (PM_{2.5}) and points out how the approach to be pursued should aim at a general reduction of PM_{2.5} concentrations in urban background. On the other hand, many studies have provided evidence that some particles become more toxic per unit mass as their size decreases and consequently have drawn the attention on particle surface area or number rather than mass, emphasizing the role of submicrometer particles, in particular of ultrafine particles. On this ground relies the importance of measuring size resolved aerosol number concentrations.

PM₁₀, PM_{2.5} and PM₁ measurements were performed in the northern periphery of Rome on November-December 2008, both as mass concentrations by β attenuation technique (SWAM 5a Dual Channel Monitor, FAI) and as size resolved number concentrations (APS 3321, TSI). β -radioactivity of short-lived decay products of Radon, with one hour time-resolution was measured (PBL Mixing Monitor, FAI) to obtain information about the pollutant vertical mass transport in the Planetary Boundary Layer (PBL).

The aerosol pollution was characterized by periods dominated mainly by local anthropic sources as on the days from December 7th to 9th, when the 0.58 μ m fraction, assumed as representative of the fine fraction, (figure 1-a) followed the same modulation as the natural radioactivity (figure 1-b). Other periods were characterized by the advection of air masses transporting coarse PM, as in the period from December 14th to 16th, when the 3.79 μ m fraction, assumed as representative of the coarse fraction increased (figure 1-a), while the levels of natural radioactivity decreased (figure 1-b), indicating the mixing of surface aerosol with upper air masses. The origin of such air masses from Saharan regions was indicated by the DREAM dust maps and the HYSPLIT backward trajectories. In the period studied, PM₁, expressed as mass concentration, represented from about 20% to about 90% of PM_{2.5} while, as number concentration PM₁

constituted more than 90% of PM_{2.5}, when pollution was dominated by local sources (figure 2). The occurrence of air mass transport from Saharan regions, determined a reduction of PM₁/PM_{2.5} ratio (figure 2). The greater relevance for human health of number concentration of submicrometric particles, together with the consideration that great part of PM_{2.5} number concentration is expressed by PM₁ and finally taking into account, as shown by the aerosol size-spectra, that PM_{2.5} may be to some extent affected by the coarse fraction of PM, raise the question whether PM_{2.5} is the best choice to describe fine atmospheric aerosol rather than PM₁.

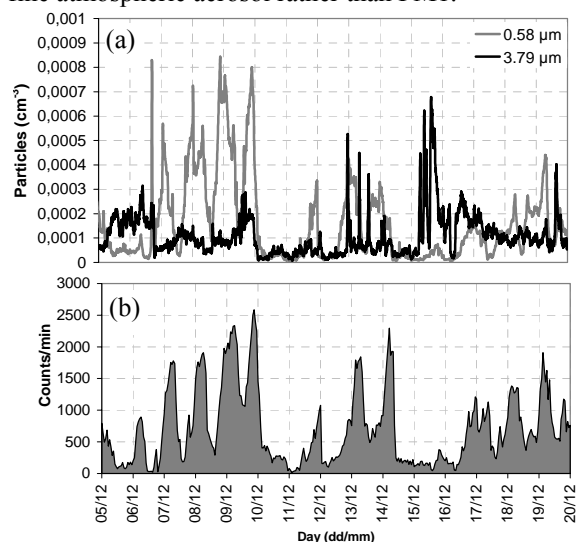


Figure 1. Daily trends of fine (0.58 μ m), coarse (3.79 μ m) fractions (a) and of natural radioactivity (b).

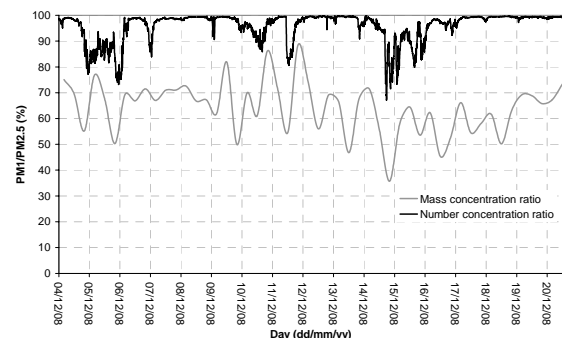


Figure 2. Daily trends of mass and number PM₁/PM_{2.5} ratios.

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