Ultrafine particle monitoring at two urban background sites of Northern Italy

S. Ozgen[1], G. Lonati[1], M. Sacco[2], F. Lollobrigida[2] and A. Pannocchia[2]

[1] Department of Civil and Environmental Engineering, Politecnico di Milano, Milan, 20133, Italy
[2] Department of Turin, Piedmont Environmental Protection Agency, Turin, Piedmont, 10135, Italy
Keywords: ultrafine particles, urban background, number concentration, size distribution.
Presenting author email: senem.ozgen@polimi.it

Monitoring of ultrafine particles (UFP) has increased in recent years given the associated health effects. The concentration levels monitored at urban background (UB) stations would provide important information for exposure analyses of the "general urban population" in a given area. However, UB locations may cover different pollution levels within the territory which may not be revealed by the comparison of the regulated pollutants since they may be spatially homogeneously distributed being regional pollutants (e.g., PM2.5). On the contrary, particle number concentration (PNC), given its different spatio-temporal variability, may better represent local conditions.

The present study reports the PNC data for two urban background sites in Northern Italy: Milano (UB1) and Torino (UB2). Although both classified as "urban background" the two monitoring sites are influenced by road-traffic emissions to a different degree. UB1 placed closer to near-by roads, though not directly exposed, may represent general city-wide exposure, whereas UB2 located in a park is more likely to represent the exposure in areas less dominated by traffic. The number size distributions of atmospheric particles in the mobility diameter range from 20 to 1000 nm were determined for April to July and December 2013 with two identical particle measurement instruments (TSI UFP monitor model 3031) equipped with nafion-dryer. Particle number concentrations in various size fractions, their diurnal and seasonal variations and size distributions were derived and compared.

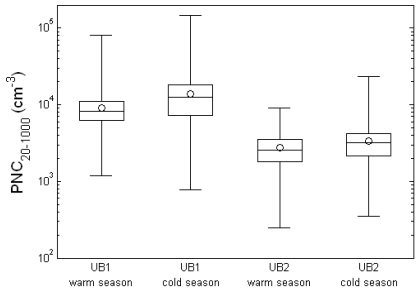

Figure 1. Box-plots for hourly $PNC_{20\text{-}1000nm}$ data (o mean, —— median, □ IQR, □ min and max).

Average levels of $PNC_{20\text{-}1000}$ were around 9.6×10^3 particles/cm^3 and 2.8×10^3 particles/cm^3 for UB1 and UB2 sites respectively (Figure 1). In agreement with the different exposure to traffic emissions, PNC values at UB1 are about 3 times higher than at UB2. As expected, the highest values were registered in the cold season for both sites. Even though average PNC did not vary significantly, the size distribution of the particles showed notable seasonal changes (Figure 2) for both sites.

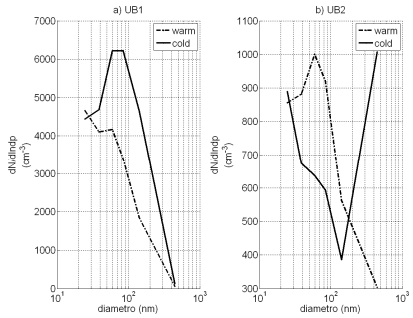

Figure 2. Seasonal median particle size distribution at the two monitoring sites.

Diurnal variation of the mean $PNC_{20–100}/PNC_{100–1000}$ ratio (Figure 3) revealed increasing new particle formation in warm season mid- and late- afternoon hours. In particular, at UB1 site the particle formation activity is observed with the UFP levels becoming about 10 times higher than larger sized particles. The minimum ratio (<1) is observed at UB2 site during winter nights and early morning hours before the traffic rush-hour.

The observed inter-site differences in PNC levels and size distributions may are likely due to the different local conditions of the measurement sites mentioned above. The results of the study shows that areas with a very wide range of characteristics can fall into the current classification of urban background, thus suggesting the need for a more accurate and objective definition of the features of the sites

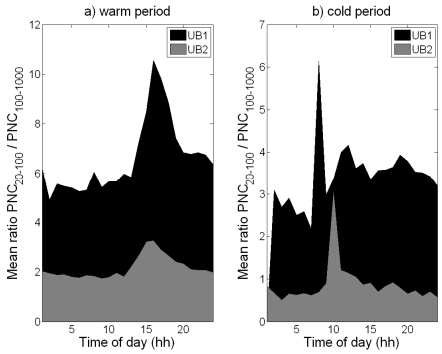

Figure 3. Diurnal variation of the mean $PNC_{20–100}$ / $PNC_{100–1000}$ ratio.