Measurement and analysis in space and time of ultrafine particle number concentration in ambient air. The case of Parma

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Several studies have analysed the influence of ultrafine particles (UFP) on human health in atmosphere (e.g., Pope et al., 1995). Even though preliminarily, such works suggest that motor vehicles are a significant UFP source (Kittelson at al., 2006). Additionally, this source could be even more important than for PM_{10} (Harrison et al., 1999).

In this work, the major objective was to collect a data-set of UFP number concentration in a middle-size urban area in Italy (Parma) with the aim to evaluate possible connections with local traffic sources.

Measurements were taken every 2 seconds at two urban sites, 700 meters far each other: a traffic site (less than 1 meter from the road) and a urban background site (around 100 meters from the closest road). UFPs were measured during winter and summer time of 2007 (both week-days and week-ends) by using two tandem Water CPCs (TSI, mod 3781).

UFPs concentrations were relatively low (fig.1-4) when compared to similar works (e.g., Harrison et al., 1999).

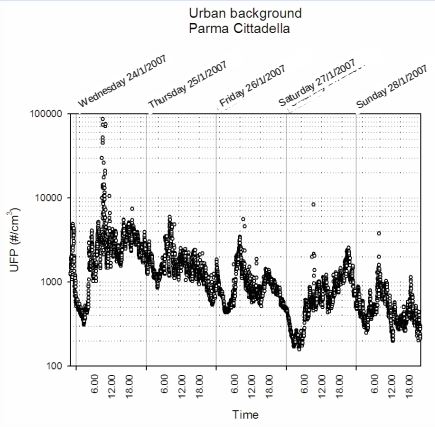

Figure 1. UFP number concentration during the winter campaign at an urban background station in Parma.

As found in previous studies (e.g., Zhang et al., 2004), UFP concentrations measured at the two sites showed significantly different tendencies. Differences related mainly to two factors (fig.1-4): at the traffic site (i) higher concentrations and (ii) faster and more intensive dilution processes were measured.

Beyond a more rapid reduction of UFP number, the faster dilution processes at the traffic site could also trigger other physical processes (such as nucleation) in connection to other parameters (such as solar radiation).

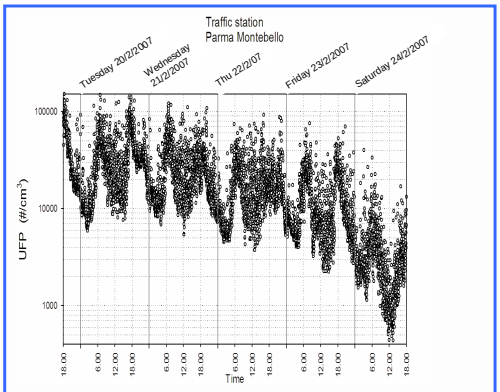

Figure 2. UFP number concentration during the winter campaign at a traffic station in Parma.

UFPs measured at the traffic site clearly shows (fig.2 and 4) as expected (e.g., Shi et al., 1999) the two peaks related to the traffic rush hours indicating traffic emissions to be the prevailing source.

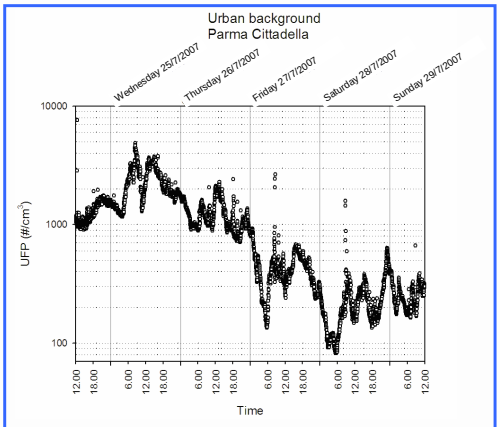

Figure 3. UFP number concentration during the summer campaign at a urban background station in Parma.

The influence of the traffic flows can also be recognised at the urban background site likely in connection to transport phenomena (e.g., due to wind speed). At this site, the influence of meteorology can easier be analysed.

This is particularly true for a clear correlation with the total solar radiation (Harrison et al., 1999). Its influence can be seen at both the sites: in effect, beyond the rush hours peaks, the traffic site shows clearly a third peak at midday (fig.1-4).

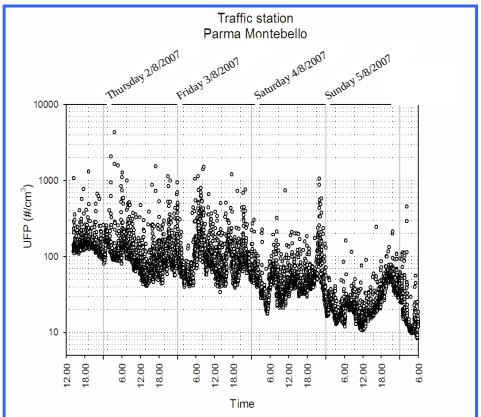

Figure 4. UFP number concentration during the summer campaign at a traffic station in Parma.

The analysis of all the measurements and the comparison between winter and summer time, week-days and week-end showed, in summary, three major contributions. Firstly, a very low urban background UFP concentration (lower than 1000 #/cm3) particularly visible in summer. Secondly, a significant contribution due to local traffic sources, up to 100000 #/cm3 (traffic site in winter time). Finally, a significant contribution due to secondary processes closely linked to meteorology, particularly solar radiation, and evident at midday.

This work was financially supported by the Italian Ministry of Environment, Land and Sea.

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