Noise as an indicator of traffic and ultrafine particles in Huelva city

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Noise caused by road traffic is one of the main environmental problems in many European urban areas. The noise associated to road traffic is a source of pollution. In urban environments, vehicle exhaust emissions are the major source of ultrafine particles (diameter smaller than 0.1 µm).

We present a study on noise as an indicator of traffic and ultrafine particles in Huelva city. The study is based on measurements of noise levels, number of particles coarser than 2.5 nm (PN), black carbon concentrations (BC), PM_{10} levels, gaseous pollutants concentrations and meteorological parameters monitored during 2009 in the University Campus monitoring station.

In order to identify the process contributing to ultrafine particles concentrations (PN), two components (PN1 and PN2) were segregated following the methodology of Rodríguez and Cuevas (2007). PN1 accounts for primary vehicle exhaust emissions and may also include compounds nucleating/condensing immediately after emission. PN2 accounts for new particle formation due to nucleation and rapid particle growth to detectable sizes.

The space-time evolution between PN and noise levels showed a high correlation suggesting the environmental noise is linked to traffic as a main source in urban areas. The decreasing in noise levels from working days to weekends is also observed.

During the winter season (Fig. 1A) a linear correlation between LAeq and PN1 (fresh vehicle exhaust emissions) was observed, with a value of the PN1 / LAeq slope of 720.32 particles / dB. During the summer season (Fig. 1B), an exponential relationship between PN1 and LAeq was observed, with a PN1 / LAeq slope value of $0.7469e^{0.1783}$ / dB.

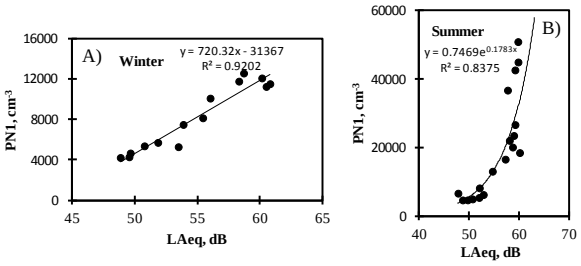

Figure 1. Hourly average values of PN1 vs. noise levels (LAeq) for every hour of the day during winter (A) and summer (B) during 2009 in the University Campus monitoring station.

A Principal Component Analysis (PCA) identified vehicle exhaust emissions as a main source. The association of noise levels in this factor suggests the road traffic as key factor in noise pollution.

According to the chemical composition of the particles and their influence on noise levels, this study points the high correlation between the noise levels and road dust elements. During the morning rush hours, especially on working days, high concentrations of crustal elements (Al, Fe) associated with pavement, brakes and tires were observed. Simultaneous increases in noise levels were registered, pointing the clear relationship between noise and vehicle exhaust emissions.

In order to quantify the relationship between PN1 and LAeq with road traffic intensity, PN1 and LAeq concentrations were averaged at 100 vehicles / hour intervals during peak rush hours in winter and summer mornings (Fig. 2). The results showed a high linear correlation with the number of vehicles / hour during the winter and summer mornings. From PN1 versus LAeq equations obtained in winter and summer, ultrafine particle concentrations related with traffic emissions have been calculated from noise data. Noise levels increases by 1 dB per 100 vehicles / hour. This is equivalent to 1000 particles per vehicle.

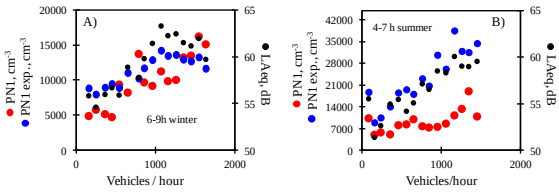

Figure 2. Hourly average values of PN1 and PN1 experimental particles and of LAeq vs. vehicles / hour on winter and summer mornings. Data were average at 100 vehicles / hour intervals.

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