Predominance of soot-mode ultrafine particles in Santiago de Chile: Possible sources

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A monitoring campaign was performed in Santiago de Chile during a winter month of 2003 and 2006 (July) using several instruments to measure the size distribution of particulate material. For the first time, the size distribution of ultrafine particles was measured in Santiago, and an estimation of its sources was done by analyzing its temporal variation. The study was performed in three sites; one of them is located in the eastern part of Santiago, a sector with low particle concentration and about 100 m from a busy street. The other site is located in the western part, which is the sector that has the highest concentration of fine and coarse particle matter during winter, also located far from a street. The third site is located within 5 m from the busiest street in Santiago.

In all stations traffic is the dominating source for fine and ultrafine particles and the size distribution is peaked towards 60 – 100 nm (soot mode). Figure 1 presents the particle size distribution in the three sites during morning rush hour.

Figure 1. Particle size distribution at three sites during 7-10 AM.

Only in the site near the street, it is possible to see a clear peak towards smaller sizes (10 – 30 nm). The sites far from the street (Pudahuel and Las Condes) show a predominance of the soot mode particle size (60 – 100 nm) even during rush hour. The size distribution measurements presented here indicate that aerosol dynamics play a more important role for the Santiago case as compared to cleaner cities in Europe. Changes in the particle size during different hours of the day reflect both variations in meteorological mixing conditions as well as effects of aerosol dynamic processes such as coagulation, condensation and dry deposition. The size distribution seen in Santiago is more like large polluted cities in Asia (Li et al., 2007, Mönkkönen et al, 2005). The size distribution at sites outside the vicinity of trafficked streets is peaked at 70-100 nm during most of the day, indicating that there is a dominance of the soot mode over the nuclei mode.

The size distributions registered at the three locations, as well as a time series analysis of number concentrations of some particle sizes together with PM2.5 mass measurements, indicate that small nuclei size mode particles (20-30 nm) are rapidly removed by coagulation with larger soot mode particles. Only very close to the source, or during special conditions with low aerosol concentrations, can nuclei mode particles survive the transport from the streets to the urban background stations that forms the Santiago monitoring network.

A relative increase in the number of the larger ultrafine particles (d ≥ 70 nm), as compared to the number of smaller particles (d < 70 nm) correlated with wind speed is an indication of pollution transport with aged particles from other parts of the city.

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