AIRUSE LIFE+: Size segregated chemical patterns of PMx in Barcelona, NE Spain

A. Karanasiou[1], P. Sanderson[2], F. Amato[1], A. Alastuey[1], X. Querol[1], J.M. Delgado-Saborit[2] and R.M. Harrison[2†]

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain
[2]School of Geography, Earth & Environmental Sci., Univ. Birmingham.Edgbaston, Birmingham B15 2TT, UK
[†]Also at Department of Environmental Sciences / Center of Excellence in Environmental Studies, King Abdulaziz University, PO Box 80203, Jeddah, 21589, Saudi Arabia

Keywords: size distribution, sources, MOUDI, metals
Presenting author email: angeliki.karanasiou@idaea.csic.es

The chemical characterization of size segregated particles is valuable for understanding the physical and chemical characteristics of aerosols, their emission sources and formation mechanisms, and also for implementing mitigation measures to improve air quality (Harrison et al., 2012). This may be particularly important in the Mediterranean basin, where the combination of diverse emission sources (e.g: significant contributions of road dust, shipping emissions, African dust intrusions) with the complex climatology significantly enhance PM levels (Karanasiou et al., 2014).

The objective of the present study is to investigate the distribution patterns of size-segregated particles in a typical traffic and urban background site. Aerosol samples were collected at two sites in Barcelona, one roadsite with heavy traffic (Valencia Road) and one urban background site (Palau Reial) during May 2013. An 8-stage Micro-Orifice Uniform Deposit Impactor (MOUDI) having cut points of 12, 6.7, 3.8, 2.2, 1.2, 0.67, 0.38, 0.22 μm, was employed in Palau Reial and a 10-stage MOUDI with cut-offs at 18, 10, 5.6, 3.2, 1.8, 1.0, 0.56, 0.32, 0.18, 0.056 μm was installed in Valencia Road. The concentrations of major and trace metals were determined by acid digestion followed by ICP-AES and ICP-MS analysis.

The mass concentration of Na was the highest, followed by Al and Fe. Most of the trace elements revealed two or more modal peaks covering the fine and coarse particle ranges except Al and V which had unimodal distributions with the peak found in the coarse and fine mode respectively.

Strong similarities in the mass size distributions were observed between Fe, Cu, Sb and Ba in both sites, suggesting a common emission source as these metals are typical brake wear tracers. In Valencia Road the mass concentrations of Fe, Cu, Sb and Ba exhibited bimodal distributions with the two peaks occurring in the coarse mode at 5.6–10 μm and >18μm. In Palau Reial these metals showed two peaks in the coarse mode (3.6-6.7 μm and >21 μm) but also a third important peak in the fine mode at 0.67-1.2 μm (Figure 1).

Elements associated with industrial emissions such as Zn, Cr, Mn and Pb had a major peak in the fine mode at 1.0-1.8 μm in Valencia Road and at 0.67-1.2 μm in Palau Reial. This difference could be attributed to the proximity of Palau Reial site to the industrial zone of Barcelona being more influenced by fresh industrial emissions. These metals they also exhibited several peaks in the coarse particle sizes as a result of resuspension.

Significant correlations were found between Ni, V and S mostly in the urban background site. In Barcelona these elements originate mainly from shipping emissions. In Palau Reial they exhibited similar distributions with the major peak found in the fine mode at 0.67-1.2 μm. The association of Ni, V and S was less strong in Valencia Road. Ni and S showed a peak at 0.32-0.56 μm while V was finer peaking at 0.18-0.32 μm.

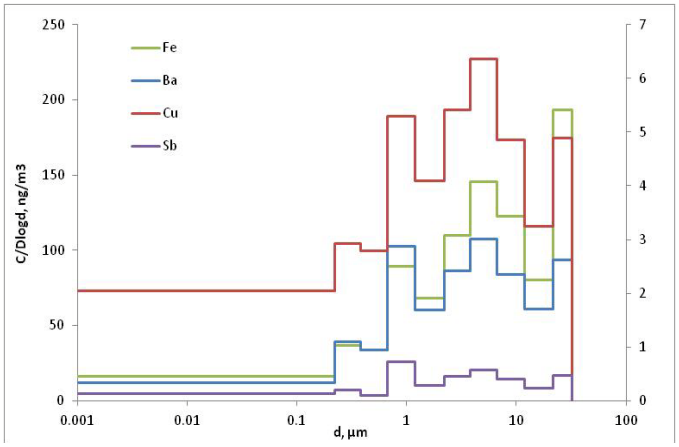

Figure 1. Average mass distributions of Fe, Cu, Sb and Ba in Palau Reial

Potassium had different size distributions between the two sites. In Palau Reial the predominant peak was observed in the fine mode (0.67-1.2 μm) and several peaks in the coarse fraction while in Valencia Road K was mostly coarse. Biomass burning is the main source of fine K, while the coarse K reflects marine aerosol and also the contribution from road, soil dust resuspension.

This work was funded by the AIRUSE LIFE+ EU project (LIFE11 ENV/ES/584).

Harrison, R.M., Jones, A., Gietl, J., Yin, J., Green, D., (2012) *Environ. Sci. Technol*. **46**, 6523–6529.
Karanasiou, A., Querol, X., Alastuey, A., et al. (2014) *Atmos. Env.* **488-489**, 297-315