Annual evolution of ultrafine particles and new particle formation in León (NW Iberia)

C. Blanco-Alegre[1], A.I. Calvo[1], F. Oduber[1], A. Castro[1], A. Martínez-Fernández[1], E. Blanco-Alonso[2] and R. Fraile[1]

[1] Department of Physics, IMARENAB University of León, 24071 León, Spain
[2] Centre for Energy, Environment and Technology Research (CIEMAT), Department of the Environment, 28040 Madrid, Spain
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Presenting author email: cblaa@unileon.es

Atmospheric aerosol particles present a high negative impact on human health, air quality and global climate change. Numerous studies have proposed that ultrafine particles (UFP; particle diameter <100 nm) are more toxic compared to larger particles of same composition. Furthermore, the adverse health effects caused by UFP number concentrations have been indicated to be stronger than those by the fine particle mass concentrations (Nel, 2005). UFP fraction is divided into two size modes: nucleation (<30 nm) and Aitken (30-100 nm). Large particles are classified in accumulation mode (100 nm-1 µm) and coarse mode (>1 µm). New particle formation (NPF) events, along with traffic, are the main sources of UFP particles in urban backgrounds. Several studies have revealed that NPF is generally favoured under high insolation, low relative humidity, high wind speed, and low pre-existing particle surface area.

The study site is located at the campus of the University of León (Spain), a city placed in the NW of the Iberian Peninsula (42° 36′ N, 05° 35′ W and about 838 m above sea level). León has a population of around 200,000 people, including the metropolitan area. The data collection was carried out between March 2016 and February 2017 in an urban background site.

UFP size distributions were measured continuously every six minutes using a high resolution nanoparticle sizer (TSI-SMPS Model 3938) between 14.3 and 661.2 nm in 107 channels. The TSI-SMPS system consists in a particle classifier (DMA 3081) connected to a condensation particle counter (CPC 3772). Next to SMPS, a Davis Weather Station was used for continuously registering meteorological variables.

Table 1. Mean concentration of nucleation, Aitken, accumulation modes and the total particle concentration (# cm^{-3}).

Season	<30 nm	30-100 nm	100-661 nm	Total
Winter	1029	2313	873	4215
Spring	1527	2398	704	4630
Summer	1468	2928	861	5257
Autumn	692	1631	562	2885

The annual mean number concentrations for nucleation, Aitken and accumulation modes were 1168, 2319 and 761 particles cm^{-3} (Table 1). The total concentration was dominated by Aitken (52-57%) and nucleation (24-33%) modes. The pattern observed matches with a behavior characterized by traffic emissions, NPF and effect of temporal evolution of the mixing layer (Wu *et al*., 2008).

The nucleation mode presents temporal variations along the year, with maximum in summer months and during midday hours (high insolation). Throughout the year peaks at work entries and exits in daily pattern were registered (Figure 1).

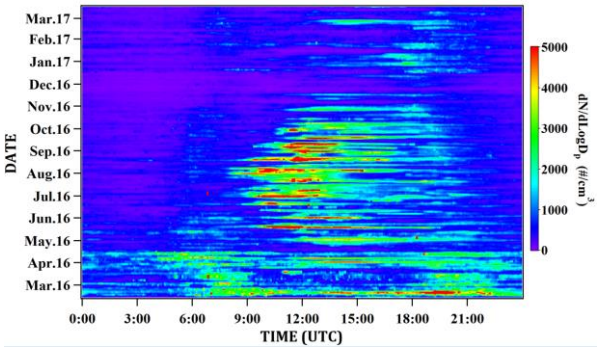

Figure 1. Temporal variations and daily pattern of nucleation mode particle number concentration.

The size distribution at León shows a bimodal distribution with peaks at ~20 nm and ~38 nm in all seasons, similar to other European cities (Hama *et al*., 2017). With regard to NPF events, preliminary results reveal they occur primarily between 1200 and 1500 UTC, mainly in spring and summer. The values of formation, growth rates and condensable vapour source rate of nucleation mode particles, during NPF events, will be studied in detail.

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