The daily pattern of black carbon, ultrafine and fine particles and its dependence on air mass origin

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Air pollution in urban sites is one of the main problems of humanity in the 21st century. Evidence of this is that, in 2019, air pollution was considered by WHO as the main environmental risk to human health. The study of the daily pattern of atmospheric pollutants is essential to establish mitigation measures. These actions will directly impact on multiple essential policy objectives such as air quality, economy or traffic restrictions (Viard and Fu, 2015).

The main aim of this study is to characterize the daily pattern of black carbon (BC), fine and ultrafine particle concentration in León (Spain). A methodology has been established to fit the daily pattern of any pollutant. Further, the daily pattern characteristic of every air mass origin has been analyzed.

A sampling campaign was carried out between January 2016 and March 2017 in León. Three sampling instruments were used: i) nanoparticle size distributions were measured on a six minutes basis using a high resolution nanoparticle sizer (SMPS Model 3938) between 14 and 1000 nm in 104 channels; ii) an AE31 Aethalometer for measuring eBC (equivalent black carbon) concentration; iii) a weather station to monitor some meteorological variables. Besides, in order to determine the origin of the air masses during the study period, HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) four-days back-trajectories were calculated every day at 1000 m (https://ready.arl.noaa.gov/HYSPLIT_traj.php).

The contribution of the main sources of eBC, fossil fuel (eBC_{ff}) and biomass burning plus coal combustion (eBC_{bb+cc}) can be estimated by applying the Sandradewi et al. (2008) approach. Each peak of daily patterns was fit to a Gaussian model (R^2 higher than 0.9 in all cases).

The preliminary results indicate that Saharan and Continental origins shows the highest number of aerosol particles with diameters higher than 100 nm, likewise they showed the lowest number of particles in nucleation and Aitken modes. On the other hand, North America, North Atlantic and Arctic origins presented a similar pattern, but North America showed the higher values (Figure 1).

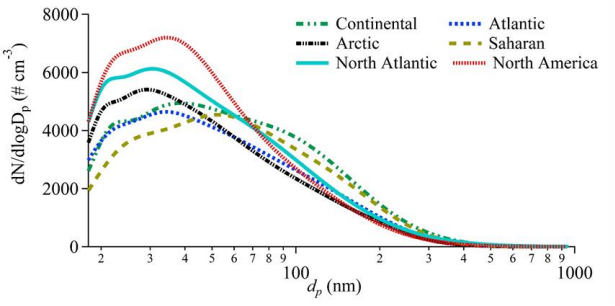

Figure 1. Mean aerosol particle size distribution for each air mass origin during the study period.

During cold months, the eBC_{ff} daily evolution presented four peaks, probably caused by entries and exits of jobs and schools, and eBC_{bb+cc} presented five peaks related to heating devices, mainly in the afternoon and night after work time.

The study of the daily evolution of pollutants in the northwest of the Iberian Peninsula will allow to improve air quality models. In addition, a methodology is proposed to adjust the daily patterns of any pollutant in order to apply mitigation/corrective measures.

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