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Daily behavior of urban Fluorescing Aerosol Particles in northwest Spain

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ABSTRACT

Measurements of ambient aerosol particles at the University of León, León, Spain, were made in May and June 2015 with a Wideband Integrated Bioaerosol Spectrometer (WIBS). The WIBS detects Fluorescing Aerosol Particles (FAP) in the size range from 0.5 to 20 μm. These measurements were complemented with an analysis of pollen concentrations assessed with optical microscopy of samples captured with a volumetric Hirst spore trap. The total particle, FAP and pollen concentrations show clear, daily cycles. Whereas the total particle concentrations maximize at 0800 and 2200 UTC, the FAP concentrations have peaks at midnight and 0800 UTC while the pollen has a broad peak between 1200 and 2000 UTC. The FAP larger than 2 μm represent 15–35% of the total particle population in this size range, maximizing at midnight UTC. Similar to what has been found by investigators at other locations, there is a strong positive correlation of the WIBS measured FAP with relative humidity; however, the pollen concentration is positively correlated with the temperature and anti-correlated with the relative humidity. Back trajectory analysis indicates that the largest FAP to total particle fractions are found in air masses arriving from the northeast with the second largest coming from the southwest. Given the location of the university in relation to the city and forested areas, this implies that the higher concentration FAP are coming from rural, probably natural, sources; however, more local, anthropogenic sources cannot be ruled out as a secondary source. The majority of the FAP that are identified from microscopy are fungal spores (*Cladosporium*, *Aspergillus*, *Alternaria*, *Oidium*) and pollen grains (mainly *Poaceae*, *Quercus*, *Plantago*, *Rumex* and *Urticaceae*). A comparison of the fluorescence fingerprints between laboratory generated FAP and the ambient particles showed some similarities; however, a significant fraction of the FAP are those whose fluorescence patterns do not match any of those that have been previously classified in the laboratory.

1. Introduction

Atmospheric bioaerosols, also referred to as primary biological aerosol particles (PBAP), form a unique class of particles that are ubiquitous in nature, morphologically complex and are produced from a wide range of natural and anthropogenic sources (Després et al., 2012; Fröhlich-Nowoisky et al., 2016) that include microorganism (bacteria, archaea and viruses), dispersal reproductive units (pollen and fungal spores) and various fragments or excretions (algae, plant debris and trichomes, proteins, etc.). These PBAP are found in a wide range of sizes, from tens of nanometers to hundreds of micrometers, and in a variety of shapes, e.g. spherical, with rod-fiber-, disk- or platelet-like geometries (Sturm, 2012).

Recent reviews have summarized important compilations of information regarding PBAP characteristics: types, sources, sampling techniques and environmental impacts (Després et al., 2012; Fröhlich-Nowoisky et al., 2016; Ghosh et al., 2015; Jonsson et al., 2014; Walser et al., 2015). These particles play an important role in: i) climate and the hydrological cycle, as they can act as cloud condensation nuclei (CCN) and ice nuclei (IN) (Bauer et al., 2002; Christner et al., 2008; Kallawicha et al., 2016; Pratt et al., 2009; Sun and Ariya, 2006); ii) public health, where they have been associated with infectious diseases, allergies, acute toxic effects and cancer (D'Amato et al., 2015; Douwes et al., 2003, 2017; Kallawicha et al., 2016; Sturm, 2012); iii) exchange of plant genetic material, participating in the dispersal of reproductive units and in the spread of organisms (Fröhlich-Nowoisky et al., 2016) and iv) agriculture and livestock that can be infected with pathogenic microorganisms, similar to humans (Brown and Hovmøller, 2002; Fisher et al., 2012).

Depending on location and season, PBAP can constitute a significant

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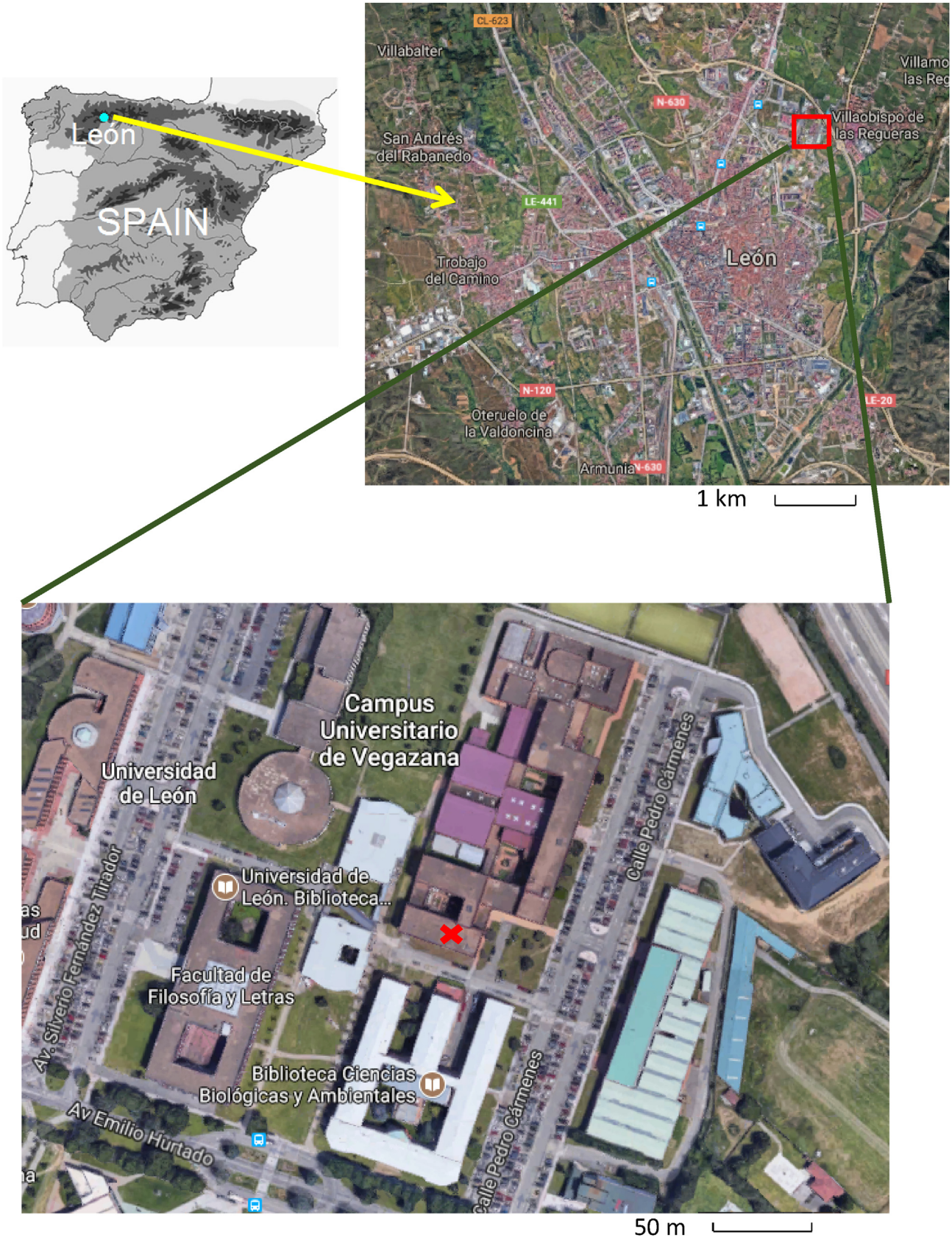

Fig. 1. Study zone in the province of León, Spain. Location of the sampling point (red cross).