Influence of weather types and meteorological conditions on pollen concentration in NW Spain

F. Oduber[1], C. Blanco-Alegre[1], A.I. Calvo[1], A. Castro[1], D. Fernández-González[2,3], R.M. Valencia-Barrera[2], A.M. Vega-Maray[2], A. Rodríguez-Fernández[2] and R. Fraile[1]

[1]*Department of Physics (IMARENAB), University of León, León, Spain*
[2]*Department of Biodiversity and Environmental Management, University of León, León, Spain*
[3]*Institute of Atmospheric Sciences and Climate, National Research Council, Bologna, Italy*

INTRODUCTION

Meteorological conditions influence the atmospheric processes of dilution, transport and elimination of bioaerosols. The concentration of bioaerosols in the atmosphere is also linked to the occurrence of specific weather characteristics (including wind speed and velocity) induced by mesoscale processes. Thus, the main objective of this study is to analyze the concentration of 20 pollen types under different circulation weather types (CWT) and the relationship with the meteorological conditions.

STUDY AREA

The sampling campaign was carried out in the Campus of the University of León, at León city, Spain (42º 36′ N, 05º 35′ W and 838 m a.s.l) (Fig. 1), between 2012 and 2018.

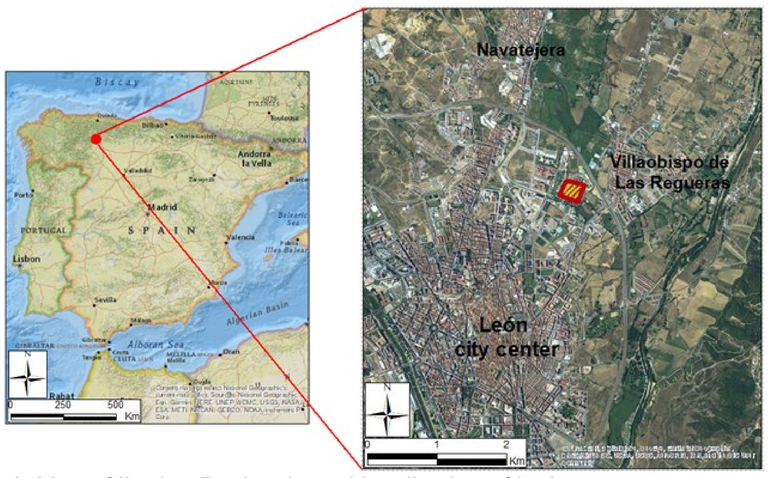

Fig. 1. Map of Iberian Peninsula and localization of León

Sampling

Automatic weather station recorded temperature, wind speed and direction, and relative humidity

Hirst volumetric Trap: sampling atmospheric bioaerosol at 24 hour intervals.

The identification and daily count of the pollen types was carried out by means of optical microscopy

Fig. 2. Sampling instrumentation

Circulation Weather Types

Table 1. Original weather types CWTs, with 2 pure types controlled by geostrophic vorticity (A and C), 8 directional types, 16 hybrid types (Source: Fernandez-Raga et al., 2017; Trigo and DaCamara, 2000)

Lamb's weather types							
Pure		Directional types		Cyclonic hybrid		Anticyclonic hybrid	
C	Cyclonic	NE	Northeasterly	CNE	Cyclonic northeasterly	ANE	Anticyclonic northeasterly
A	Anticyclonic	E	Easterly	CE	Cyclonic easterly	AE	Anticyclonic easterly
		SE	Southeasterly	CSE	Cyclonic southeasterly	ASE	Anticyclonic southeasterly
		S	Southerly	CS	Cyclonic southerly	AS	Anticyclonic southerly
		SW	Southwesterly	CSW	Cyclonic southwesterly	ASW	Anticyclonic southwesterly
		W	Westerly	CW	Cyclonic westerly	AW	Anticyclonic westerly
		NW	Northwesterly	CNW	Cyclonic northwesterly	ANW	Anticyclonic northwesterly
		N	Northerly	CN	Cyclonic northerly	AN	Anticyclonic northerly

RESULTS AND CONCLUSIONS

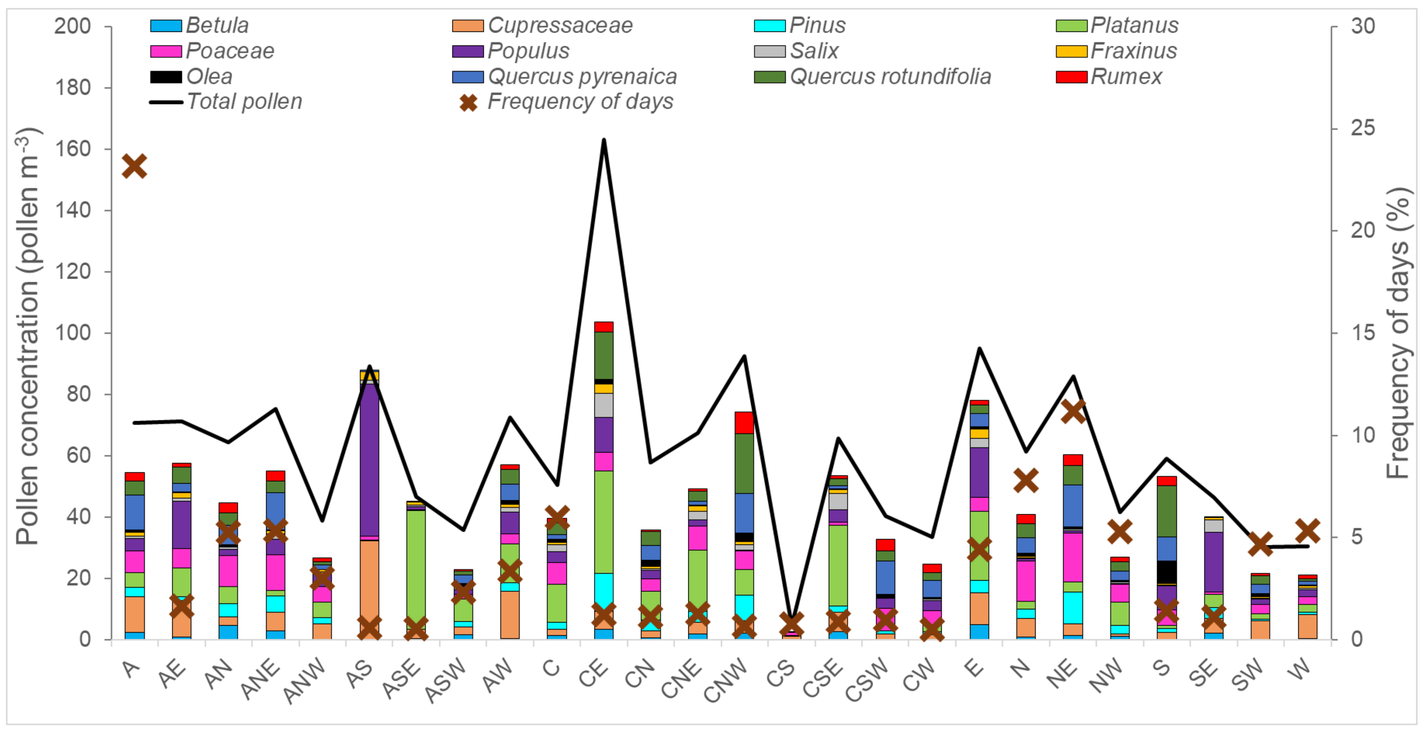

Fig. 3. Mean pollen concentration for each weather type and frequency of days with each weather type during the sampling period

The cyclonic easterly weather type, CE, has the highest total daily pollen concentration (163 pollen m^{-3}), followed by easterly, E, and cyclonic northwesterly, CNW (95 and 93 pollen m^{-3}, respectively) (Fig. 3). The occurrence of these CWT is less than 5% of the total sample days, and the frequency is higher during spring.

Populus and Cupressaceae showed the highest concentration in AS weather type (Fig. 3). Days with this CWT are more frequent in autumn (69%).

Platanus and Quercus showed the highest concentration in CE, E, CNW weather types (Fig. 3). Days with these CWTs are characterized by low precipitation (mean of 0.1 mm day-1 for CE and E, and 5.1 mm day-1 for CNW), by mean temperatures of about 12 ºC and relative humidity of 54% (CE, E) and 70% (CNW) (Fig. 4).

The lowest total pollen concentration was recorded in the cyclonic southerly type, CS (4.7 pollen m^{-3}). This CWT is more frequent in autumn (65% of the days) and is characterized by a precipitation of 1.1 mm day^{-1}, a mean temperature of 10.4 ºC and a relative humidity of 78%.

The CS weather type is more frequent in autumn, which is a cold and rainy season in León, helping to clean the atmosphere by causing a decrease in the concentration of bioaerosols.

Less than 3 km northeast of the city of León there is a large mass of plants, which provide a large amount of biogenic material and may be responsible for the increase in pollen concentrations observed for the weather types associated with the east and north. Furthermore, spring is the flowering period in León for many of the pollen species, favoring the high concentration of pollen in the air, so the most frequent weather types during this season showed the highest concentration of pollen.

The knowledge of weather types and meteorological conditions could be a helpful tool for daily pollen forecast and trend analysis.

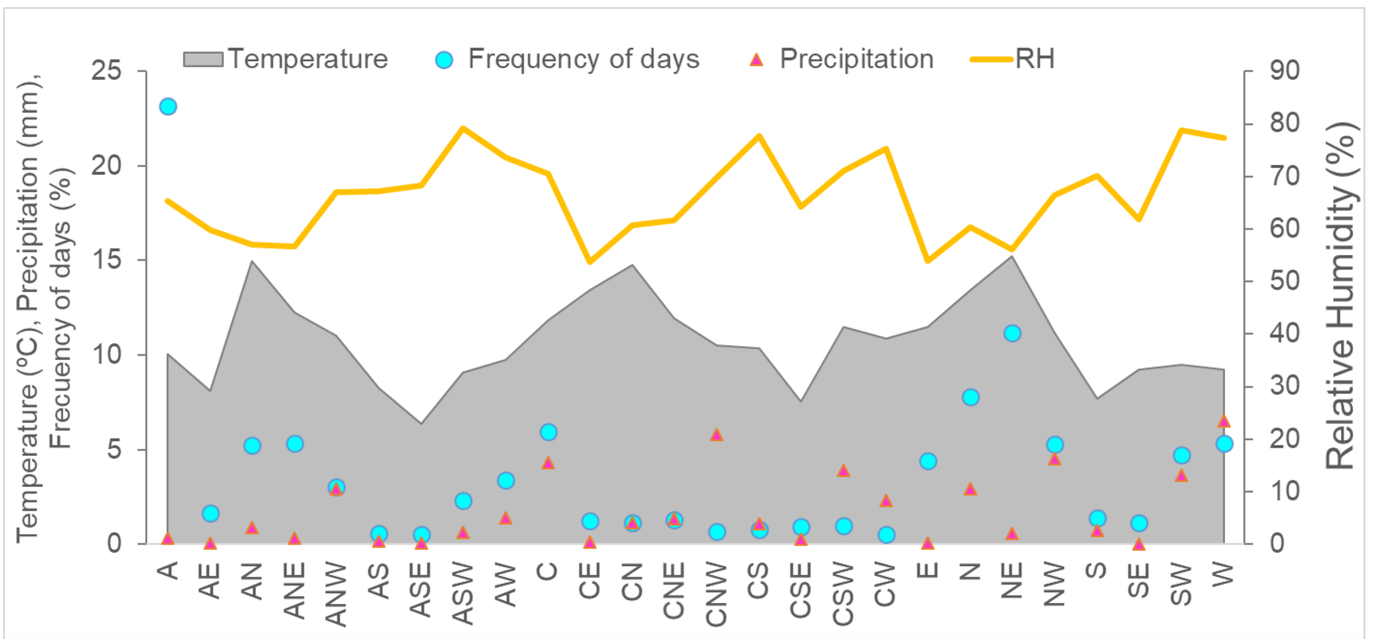

Fig. 4. Evolution of temperature, precipitation, relative humidity (RH) for each weather type and frequency of days with each weather type during the sampling period

ACKNOWLEDGEMENTS

This work was partially supported by the Spanish Ministry of Science, Innovation and Universities (Grant RTI2018-098189-B-I00), the AERORAIN project (Ministry of Economy and Competitiveness, Grant CGL2014-52556-R, co-financed with FEDER funds), the University of León (Programa Propio 2015/00054/001 and 2018/00203/001) and the AEROHEALTH project (Ministry of Science and Innovation, Grant PID2019-106164RB-I00, co-financed with European FEDER funds). F. Oduber acknowledges the grant BES-2015-074473 from the Spanish Ministry of Economy and Competitiveness. C. del Blanco Alegre acknowledges the grant FPU16/05764 from the Spanish Ministry of Education.

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