BIOAEROSOLS: CONNECTIONS WITH METEOROLOGICAL PARAMETERS AND ATMOSPHERIC POLLUTANTS

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INTRODUCTION

Air pollutant and bioaerosols present in the atmosphere can interact with each other increasing their adverse impacts on human health. The meteorological parameters can play an important role in determining their concentrations and, hence, their relationship. In this study, the long-term trends and the correlation between pollutant concentrations and meteorological parameters with *Fraxinus*, Poaceae and *Populus* pollen concentrations in León were evaluated.

STUDY AREA AND METODOLOGY

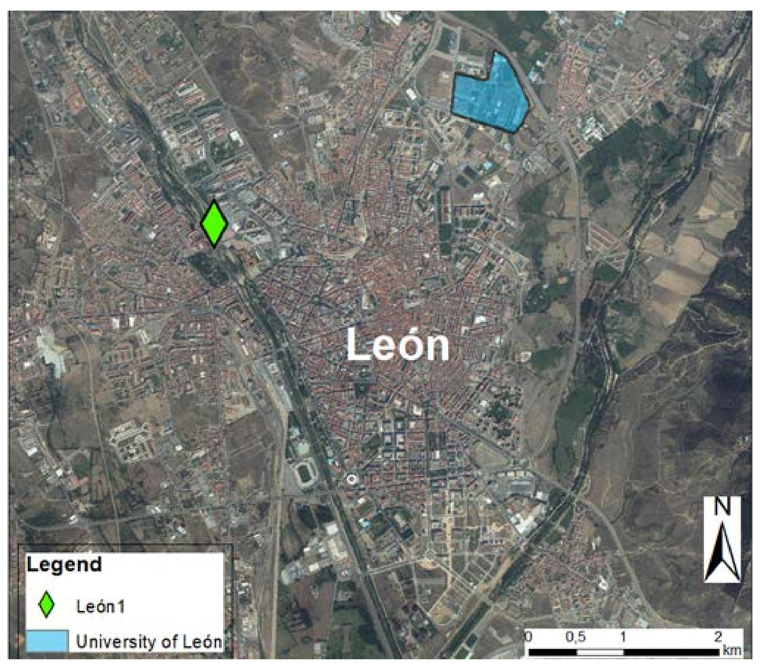


Fig. 1. Location of the sampling point and station León1

- Atmospheric pollen was sampled at the terrace of the Faculty of Veterinary of the University of León (42° 36’ 50” N, 5° 33’ 38” W) (Fig.1) from 1994 to 2016, using a Hirst volumetric trap (Hirst, 1952) (Fig.2).
- The data available in the Air Quality Network of Junta of Castilla y León, from 1997 to 2016, for the station León1 (42° 36‘ 14“ N 05° 35‘ 14“ W) (Fig.1), for CO, NO, NO_2, O_3, PM_{10} and SO_2, were analized.

Fig. 2. Hirst volumetric trap VPPS2000 (Lanzoni©)

- The meteorological parameters were provided by the State Meteorology Agency (AEMET).
- Trends were calculated using the nonparametric Mann-Kendall test. The correlation among pollen concentrations and pollutant concentrations and meteorological parameters was determined using the nonparametric Spearman’s correlation method.
- The Main Pollen Season (MPS, period when the atmosphere contains significant concentrations of pollen) (Galán et al., 2017) was comprised between the 2.5% and the 97.5% of SPIn (Andersen, 1991).

RESULTS AND CONCLUSIONS

During the study period, the pollinitation period of *Fraxinus*, Poaceae and *Populus* had an average duration of 77, 136 and 37 days, respectively. The seasonal pollen integral (SPIn, the integral over time of pollen concentration expressed as pollen day m^{-3}) registered values between 38 and 732 pollen*day m^{-3} for *Fraxinus*, between 1625 and 7072 pollen*day m^{-3} for Poaceae and between 296 and 2992 pollen* day m^{-3} for *Populus* (Fig. 3).

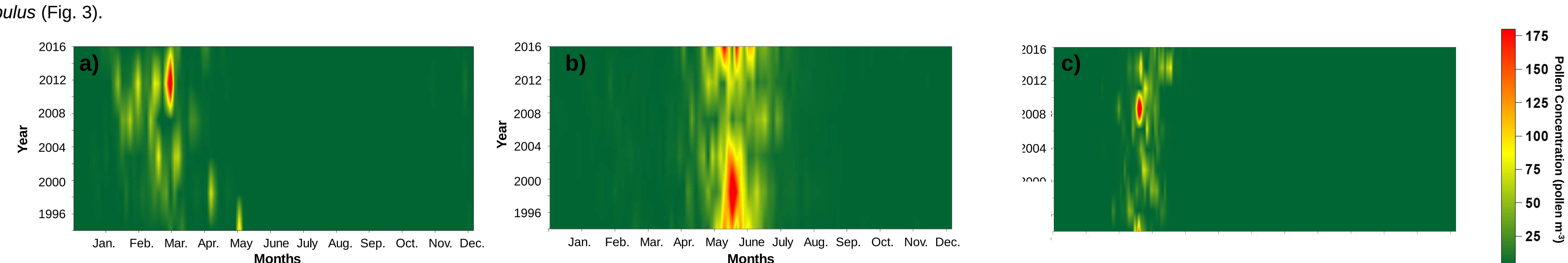


Fig. 3. Evolution of the daily pollen concentration between 1994 and 2016 for a) *Fraxinus* (concentrations × 5), b) Poaceae and c) *Populus*

Table 1. Spearman coefficients between pollen concentration parameters (SPIn and MPS) and air pollutants *Fraxinus*, Poaceae and *Populus*.

	Fraxinus		**Poaceae**		***Populus***	
	SPIn	**MPS**	**SPIn**	**MPS**	**SPIn**	**MPS**
Annual						
CO	**-0.484***	-0.096	0.262	-0.080	-0.186	-0.337
NO	**-0.468***	-0.223	0.194	-0.121	-0.056	-0.338
PM_{10}	**-0.553***	-0.084	0.292	-0.111	-0.313	-0.243
SO_2	**-0.531***	-0.105	0.248	-0.028	-0.287	-0.361
January-April						
CO	**-0.598****	-0.138	0.313	-0.177	-0.215	-0.377
NO	-0.379	-0.210	0.182	-0.056	0.086	-0.321
PM_{10}	-0.376	-0.155	0.189	0.110	-0.241	-0.399
SO_2	-0.383	-0.133	0.179	0.031	-0.075	-0.438
May- August						
CO	**-0.450***	-0.041	0.338	-0.088	-0.144	-0.272
NO	**-0.600****	-0.154	0.239	-0.096	-0.274	-0.319
NO_2	**-0.532***	-0.318	0.029	-0.041	0.027	-0.274
PM_{10}	**-0.555***	-0.090	0.286	-0.098	-0.245	-0.279
SO_2	**-0.641****	-0.005	0.317	-0.120	-0.418	-0.252
September- December						
CO	**-0.484***	-0.086	0.111	0.042	-0.214	-0.418
NO	**-0.502***	-0.138	0.135	-0.175	-0.107	-0.132
O_3	-0.533	**-0.637***	-0.170	0.217	0.159	-0.228
PM_{10}	**-0.576****	0.067	0.323	-0.184	-0.409	-0.205
SO_2	**-0.644****	0.128	0.340	-0.087	-0.430	-0.196

** *p*< 0.01, * *p*< 0.05

The principal source of the three studied taxa is located close to the sampling point and in the NE sector (Fig. 4), where the Torío river is located. The prevailing pollen types come from native species characteristic of these habitats and in very small quantity from those cultivated as ornamentals next to the sampling collector.

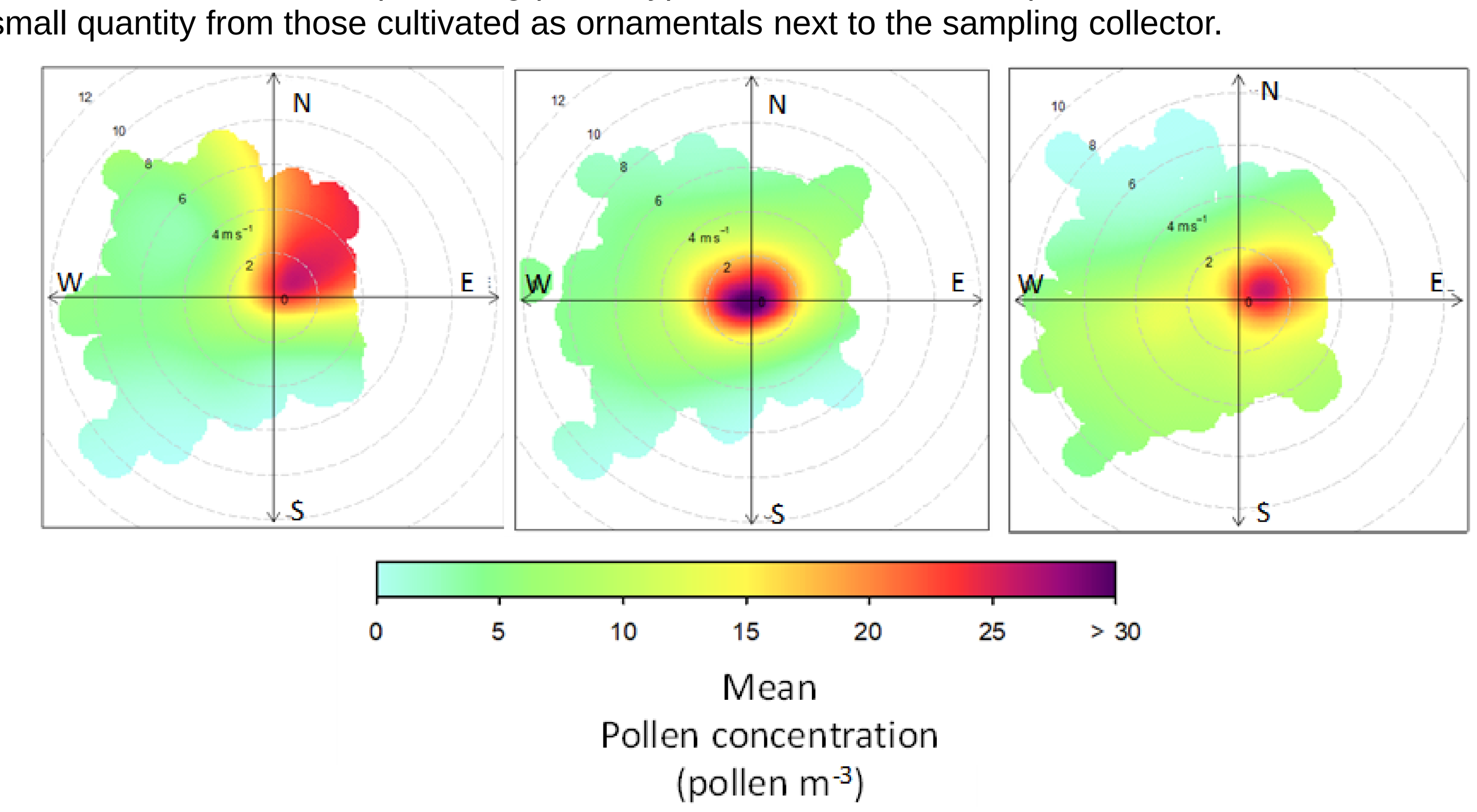
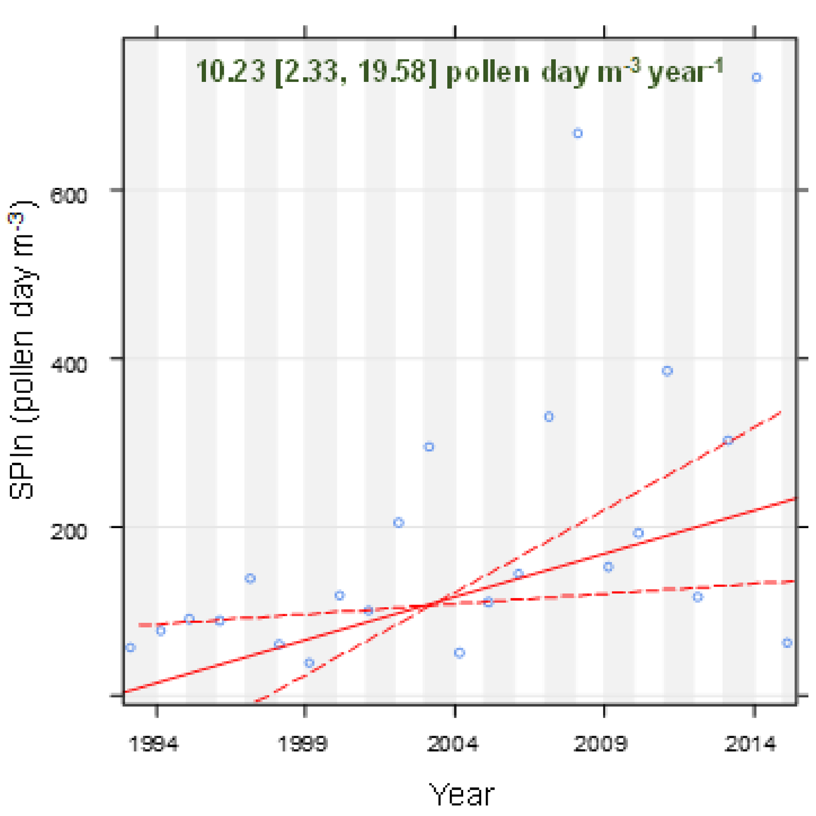


Fig. 4. Polar Plots (variation of the pollen concentration during the pollination period as a function of wind speed and direction) for a) *Fraxinus* (concentration × 5), b) Poaceae and c) *Populus*.



A significant correlation between seasonal pollen integral (SPIn), main pollen season (MPS) and air pollutant concentrations was observed mainly in the months before the pollination period for *Fraxinus*. *Populus* and Poaceae concentrations do not show a clear correlation with the pollutant concentrations (Table 1).

The long-term trend of SPIn shows that only *Fraxinus* has a statistical significant trend (p< 0.01, started in 2006), with an increase of 10 pollen day m^{-3} $year^{-1}$ (Fig. 5).

Fig. 5. Long-term trend of *Fraxinus* SPIn. The solid red line shows the lineal trend estimated and the dashed red lines show the 95% confidence intervals for the trend. The overall trend is shown at the top and the 95 % confidence intervals in the slope.

Table 2. Spearman coefficients between pollen concentration parameters (SPIn and MPS) and meteorological parameters (mean temperature (T), relative humidity (RH), minimum temperature (T_{Min}), and accumulated precipitation (P)) for *Fraxinus*, Poaceae and *Populus*.

	Fraxinus		**Poaceae**		***Populus***	
	SPIn	MPS	SPIn	MPS	SPIn	MPS
Annual						
T	0.02	-0.02	-0.08	0.21	0.03	**-0.45***
T_{Min}	-0.36	0.06	-0.20	0.06	-0.20	**-0.44***
January-April						
RH	-0.10	**0.51***	0.27	-0.23	-0.28	0.30
T_{Min}	-0.21	**0.44***	0.28	0.12	-0.23	-0.08
P	-0.15	**0.59****	**0.52***	-0.23	-0.16	0.19
May-August						
P	-0.13	0.15	**0.44***	-0.22	-0.17	-0.14
September-December						
T_{Min}	-0.20	-0.33	-0.30	**-0.42***	0.04	**-0.45***

** *p*< 0.01, * *p*< 0.05

The *Populus* and Poaceae MPS have a negative significant correlation with the minimum temperature before the flowering. Poaceae concentrations show a significant positive correlation with the rainfall before and during the flowering period (Table 2).

- ✓ The results show that the long-term trends of the pollen integral, as well as the influence of the meteorological parameters on the pollen integral and the length of the pollen season, depend to a large extent on the type of pollen.
- ✓ The flowering and pollination period depends largely on the minimum temperature, relative humidity and precipitation before this period.

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