Backward air trajectory models for detecting pollen airborne sources of *Castanea* in Ronda (South Spain)

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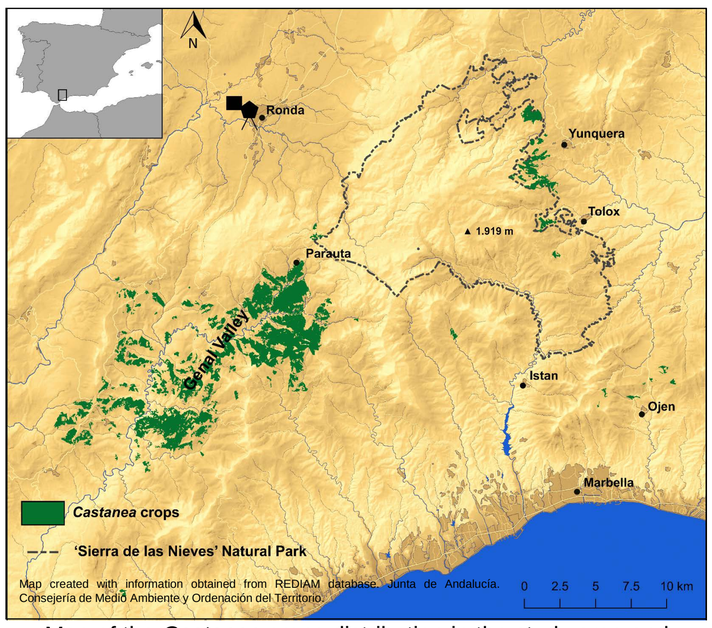


Map of the *Castanea* crops distribution in the study area and location of the sampling station.

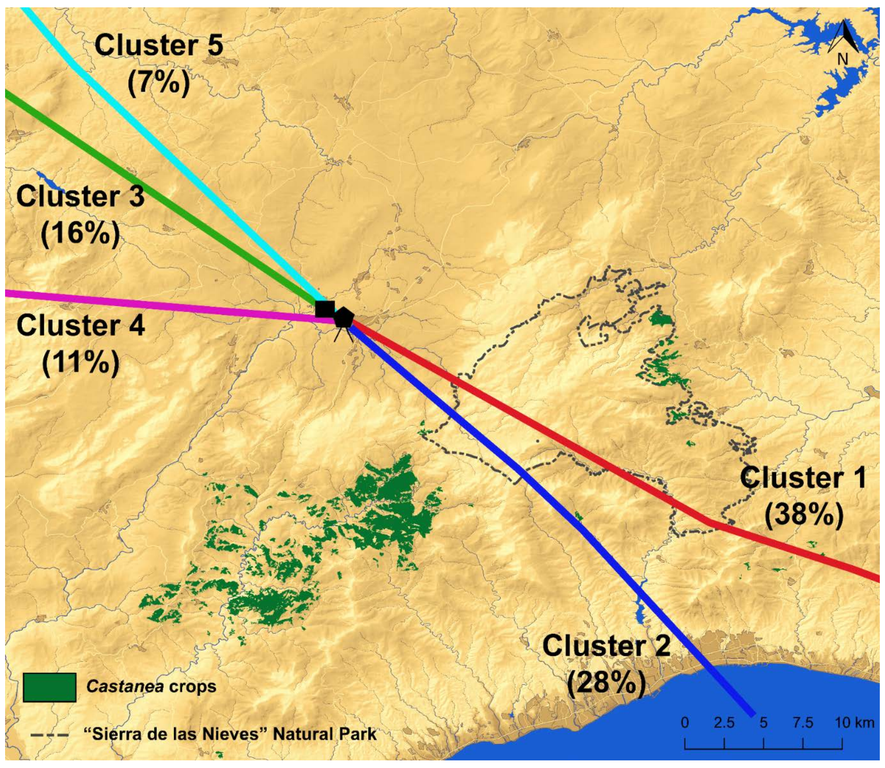
Introduction

Since December 2016, the Aerobiology research team of the University of Malaga has been sampling and studying the atmospheric pollen content in Ronda, the biggest city in the northwest of Malaga province (South Spain). Ronda is located in a rural area close to the Natural Parks 'Sierra de Grazalema' and 'Sierra de las Nieves', surrounded by crops, natural and seminatural vegetation. The Genal Valley, which is located at the southwest of Ronda, is the biggest *Castanea sativa* Mill. crop area in Southern Spain but there are also others *C. sativa* crops in different areas close to Ronda. This increases the *Castanea* atmospheric pollen levels in Ronda, the highest in Malaga province. *Castanea* pollen has been cited by different authors as potentially allergenic (Halse, 1984). Moreover, its cross-reactivity with *Quercus*, *Betula* and *Corylus* pollen has been proved (Ickovic & Thibaudon, 1991). The objective of this preliminary study was to determine the main sources of *Castanea* pollen detected in Ronda during the period in which the highest concentrations were detected along the year 2017.

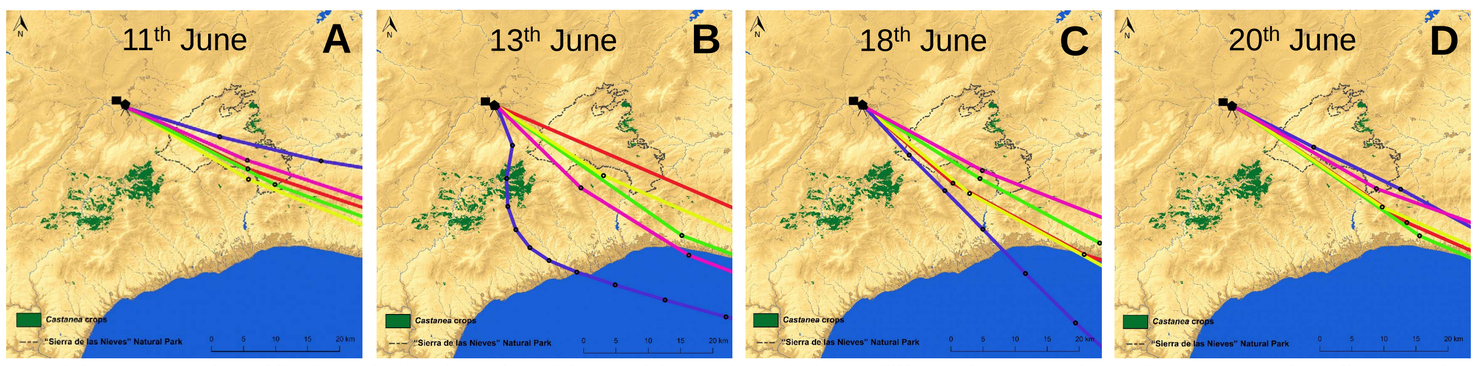
Material and Methods

The pollen samplings were made by means of a Hirst-type volumetric pollen trap (Hirst, 1952) placed on the roof of the 'Pérez de Guzmán' High School (Ronda, 36°44'N, 5°10'W, 751m a.s.l.) The samples obtained were mounted and counted according to the methodology proposed by the Spanish Aerobiology Network (REA) (Galán *et al*., 2007). Backward air trajectories were calculated according to HYSPLIT 4 model at 750m above ground level (Stein *et al*., 2015; Rolph *et al*., 2017). Meteorological data were obtained from the US National Oceanic and Atmospheric Administration (NOAA). Models were elaborated five times a day by using R software for the whole month of June 2017. Cluster analysis implemented in the HYSPLIT model were used to extract patterns over the study period. Five clusters were taken into account according to variations in total spatial variance (TSV) by adding or extracting clusters. Correlations with meteorological variables were made to understand their association with the *Castanea* pollen concentrations detected. As the data did not follow a normal distribution according to a Shapiro-Wilk test, Spearman correlation tests were chosen. Spearman correlations were done with the daily values of June 2017. The meteorological data used for the correlations were provided by the Meteorology Statal Agency (AEMET) and were recorded at 'Ronda-Pérez de Guzmán High School' station.

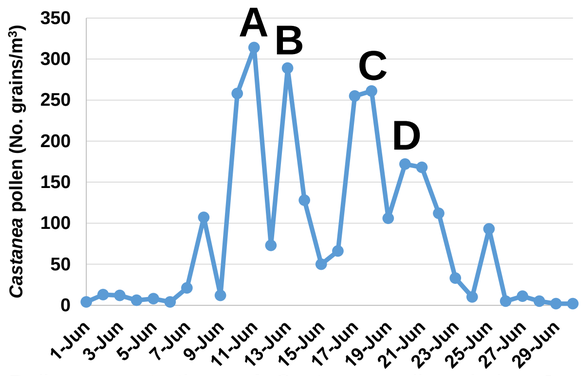
Results



Spatial representation of mean air trajectories during June 2017 in the study area. The number in parenthesis is the percentage of trajectories included in each cluster. *Castanea* crops are represented in green and the limits of "Sierra de las Nieves" Natural Park are delimited with a dashed line.



Spatial representation of backward air trajectories elaborated for each peak day at different hours. Red at 00h; green at 06h; yellow at 12h; blue at 18h and pink at 23h. The distance between two points in each trajectory shows the movement of the air mass in one hour. Capital letters correspond to each peak day of *Castanea* pollen (graph below).



Daily concentrations of *Castanea* pollen during June 2017. Capital letters correspond to the peak days.

	Correlation Coefficient	P Value
Mean Temperature	0.672***	0.000
Maximum Temperature	0.623***	0.000
Minimum Temperature	0.714***	0.000
Relative Humidity	-0.433*	0.017
Mean Wind Speed	0.061	0.748
Frecuency of 1 st Q (NE) Wind	0.013	0.947
Frecuency of 2nd Q (SE) Wind	0.467**	0.009
Frecuency of 3rd Q (SW) Wind	0.979*	0.039
Frecuency of 4th Q (NW) Wind	-0.458*	0.011
Frecuency of Calm	-0.075	0.694

Spearman correlation tests results between *Castanea* pollen concentration and several meteorological variables using daily values of June 2017. Quadrant (Q); p≤0.05 (*), 0.01p≤0.01 (**), p≤0.001 (***)

Conclusions

- The dominant air trajectories during the studied period came from the southeast of Ronda and passed over the *Castanea* crops located in Istan and Ojen bringing large amounts of pollen from these places.
- Very high *Castanea* pollen levels were detected in Ronda. In the days in which relative maximums of *Castanea* pollen were found, the air masses passed over these *Castanea* crops instead of the bigger ones located in the Genal Valley.
- Despite some of the *Castanea* pollen oscillations observed can be explained by changes in the air trajectory, some of the variations are also explained by changes in the metheorological variables.
- Since no significant correlations were found between *Castanea* pollen levels and wind speed and calm frecuency, *Castanea* pollen should come from short distance.
- Predictive models for *Castanea* pollen in Ronda should take into account the backward air trajectory in future researches in order to prevent allergic diseases in population.
- Cross pollination events between *Castanea* populations in the area can be estimated in future researches by studing air trajectory models.

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