Regional model to forecast airborne Olea pollen season in Extremadura (SW Spain)

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Purpose

Olive pollen allergens are considered to be one of the most important causes of respiratory allergic disease in the Mediterranean region (Figure 1). Traditionally, correlation and regression analyses statistical techniques has been employed to study pollen-season trends. In the present study a parametric model is proposed, been calibrated with the Shuffle Complex Evolution Metropolis Algorithm (SCEM-UA) using as optimization function the Root Mean Square Error (RMSE). The main objective is to model the Olea pollen concentration (CO) from the relation with the temporal distribution of five different meteorological variables for 21 years (t) of continuous recording.

Fig. 1. Inflorescence *Olea europaea*

Design, Methodology or Approach

Daily airborne pollen grains per cubic meter concentration was obtained by using a Hirst type pollen trap located at the roof of a building at the University of Extremadura of Extremadura in Badajoz (SW Spain). Olea data from the period 1993-2013 were compared using time series analysis. Meteorological parameters as rainfall (R), relative humidity (RH), maximum (Tmax), mean (Tmean) and minimum temperature (Tmin) were taken into account. To test the confidence of the model, it has been analyzed the goodness for an approach based on a differential time step of 1, 3 and 5 previous days. Finally, it has been validated the model for the last year, using the previous 20 years as reference for the calibration of the parameters.

Results/Findings

Olea main pollen season (5-95%) lasted on average 34 days, ranging from 21 to 48 days, from 5th May to 8th June (Figure 2). The model proposed to forecast the airborne pollen concentration is described by the eq. (1)

$$CO^t = a \cdot \frac{\sum_{i=t-10}^{i=t} CO^i}{10} + CO^{t+1} \left(b \cdot {T_{max}}^t + c \cdot {T_{mean}}^t + d \cdot {T_{min}}^t + e \cdot \frac{\sum_{i=t-10}^{i=t} {T_{mean}}^t}{10} + f \cdot R^t + g \cdot \sum_{i=t-10}^{i=t} R^t + h \cdot RH^t \right) \quad (1)$$

where a, b, c, d, e, f, g and h are the coefficients to be calibrated for our time series of climatic and airborne pollen concentration. It is composed by the integration of the different climatic variables for each time step regarding to the actual airborne pollen concentration value join to the mean concentration value of the previous 10 days for each time step. Beside the value of each variable is evaluated for every time step, it has been added the aggregated variables of the mean temperature for 10 previous days as well as the cumulative rainfall of the 10 previous days to analysis the influence of the temporal variation of these variables over the airborne pollen concentration. Regardless the degree of influence of some meteorological variables could be previously neglected by its apparently low relevance, it has been therefore considered appropriate to maintain them due the range of variations are different among them as well as its mean value. In the Table 1 are shown the values obtained for each parameter for the 21 years analyzed, and the value obtained of the coefficient of determination (R2). The model has been validated for the last year considering the rest of the data for the calibration process (Figure 3) obtaining a correlation (R^2= 0.77) between the observed data (1993-2012) and simulated (2013).

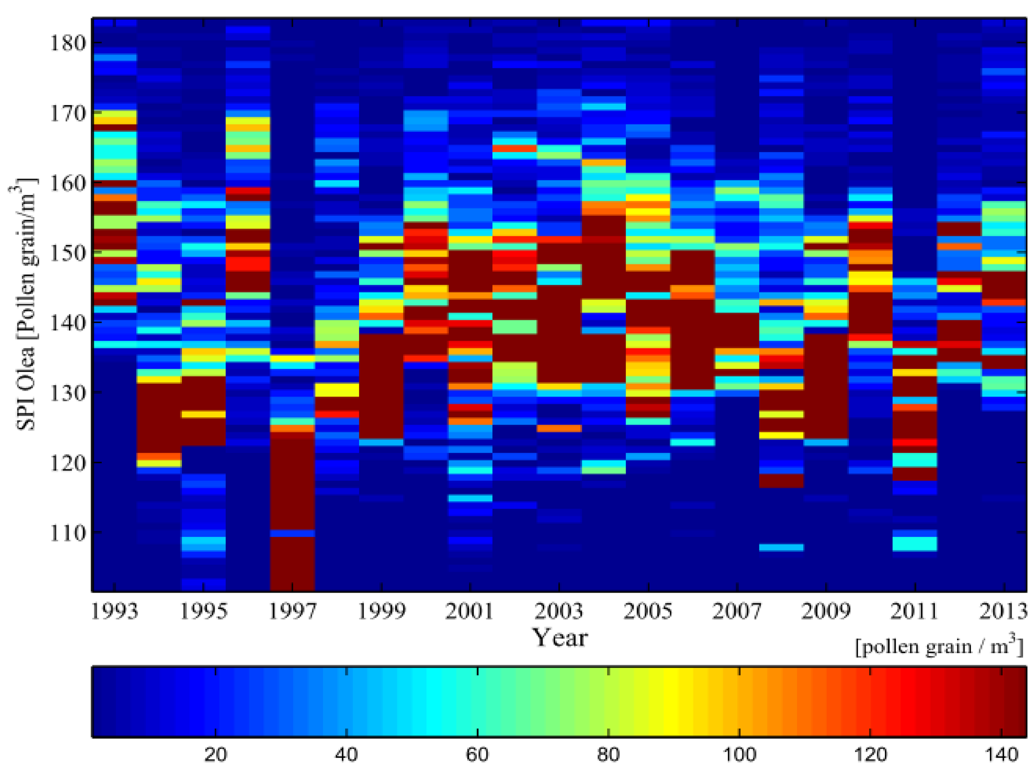

Fig. 2. Pollen Season characteristics

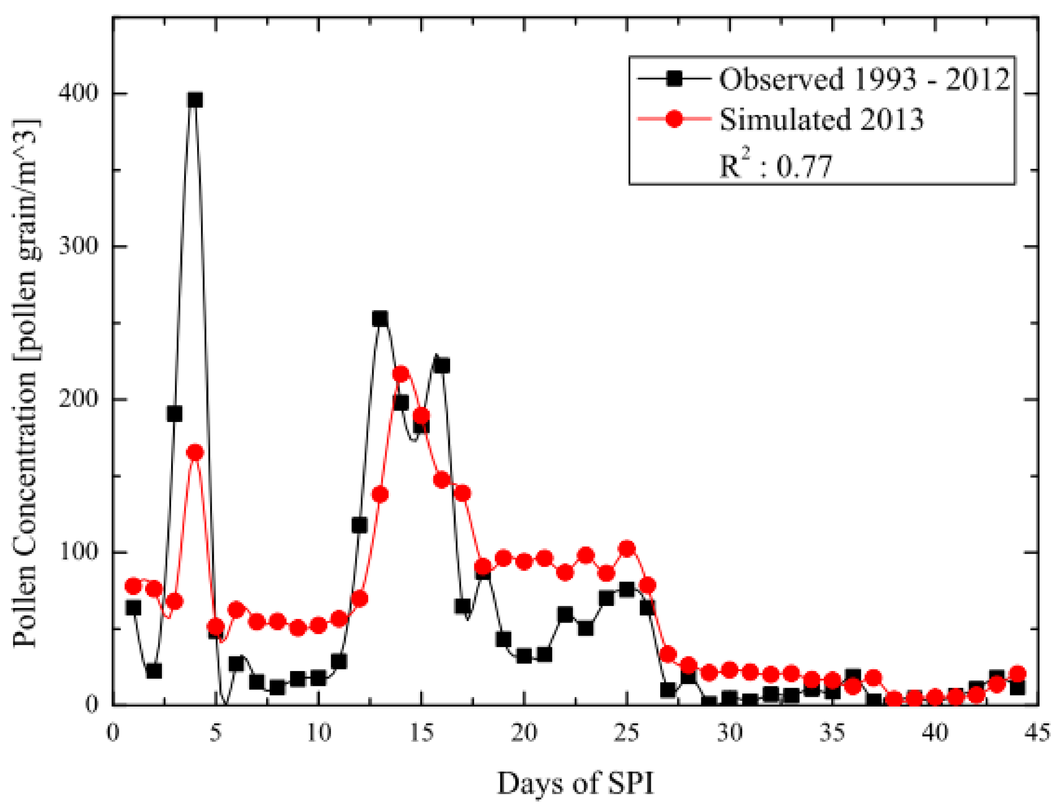

Fig. 3. Validation of the model for the last year

	Value				Value		
Coefficient	**1D**	**3D**	**5D**	**Coefficient**	**1D**	**3D**	**5D**
a	0,64	0,79	1,11	R^2	0,56	0,45	0,42
b	0,00	-0,12	0,00	RMSE	116,32	143,02	166,68
c	-0,08	-0,07	0,03				
d	0,12	0,29	0,02	CO obs total years			127,84
e	0,00	0,00	0,00	CO sim total years			133,44
f	-0,18	-0,58	-0,01				
g	-0,01	0,01	0,00				
h	-0,04	-0,05	-0,05				

Table 1. Parameters and statistical analysis of the model proposed to predict airborne pollen concentration (D: previous day).

Conclusions

Due to the allergenic characteristics of this pollen type, it should be necessary to forecast its short-term prevalence using a long record of data in a city with a Mediterranean climate. *The model obtained provide a good level of confidence to forecast olive airborne pollen concentration*.

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