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# List of Abstracts

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## REGIONAL MODEL TO FORECAST AIRBORNE OLEA POLLEN SEASON IN EXTREMADURA (SW SPAIN)

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## REGIONAL MODEL TO FORECAST AIRBORNE OLEA POLLEN SEASON IN EXTREMADURA (SW SPAIN)

### 1. Purpose

Olive pollen allergens are considered to be one of the most important causes of respiratory allergic disease in the Mediterranean region. In the northern hemisphere, the growing season is becoming longer; spring is starting earlier, and autumn later. This trend is well documented in northern Europe and North America, but less is known about Mediterranean species. In the case of *Olea* pollen, some studies have detected a general advance of the pollen season onset in the Mediterranean area including different sites in South Spain. In wind-pollinated species, both pollination timing and also intensity, expressed by the Season Pollen Index (SPI) as the annual sum of daily airborne pollen counts, vary considerably from year to year due not only to weather-related factors but also to a number of species-specific characteristics. 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). Long-term trends in olive flowering phenology were analysed using a 21-year database of *Olea* pollen records for Badajoz. The main objective is to model the *Olea* pollen concentration (CO) from of the relation with the temporal distribution of five different climatic variables for 21 years (t) of continuous recording.

### 2. Design, Methodology or Approach

Daily concentration of airborne pollen concentration were 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). Data were provided in daily pollen grains concentration per cubic meter. *Olea* data from the period 1993-2013 were compared using time series analysis. Climate parameters as rainfall (R), relative humidity (RH), maximum (Tmax), mean (Tmean) and minimum temperature (Tmin).

### 3. 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 1). The model proposed to forecast the airborne pollen concentration is described by the eq. (1)

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

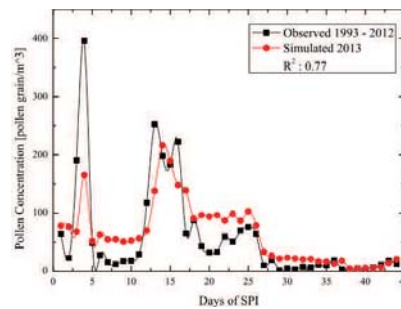
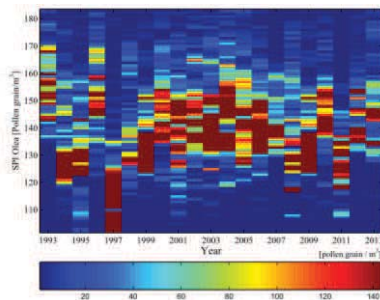




where a, b, c, d, e, f, g and h are the coefficients to be calibrated for our time series of climatic and airborne pollen concentration. It is composed by the integration of the different climatic variables for each time step regarding to the actual airborne pollen concentration value join to the mean 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 climatic 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 ( $R^2$ ). The model has been validated for the last year considering the rest of the data for the calibration process (Figure 2).

**Figure 1.** Pollen Season characteristics

**Figure 2.** Validation of the model for the last year



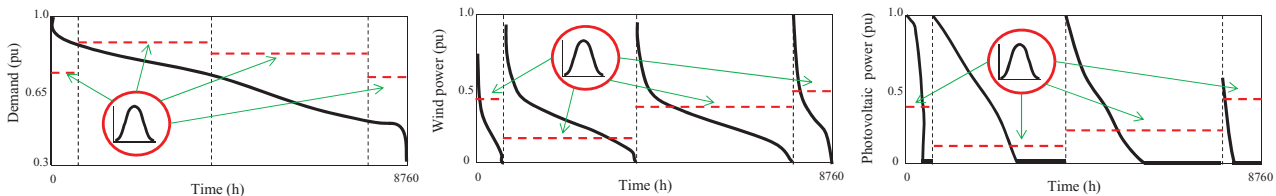
**Table 1.** Parameters and statistical analysis of the model proposed to predict airborne pollen concentration (D: previous day).

Coefficient	Value			Coefficient	Value		
	1D	3D	5D		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				

#### 4. 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. With the purpose to solve this need it has been developed an autoregressive model, taking into account five different climatic variables. 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, obtaining a correlation ( $R^2= 0.77$ ) between the observed data (1993-2012) and simulated (2013).

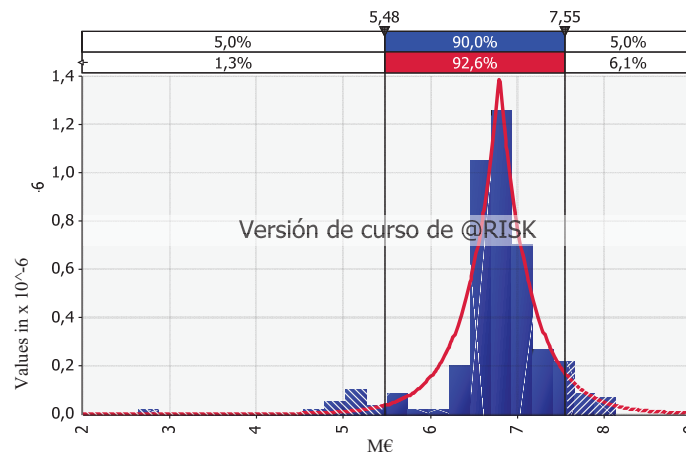
*Mobile level:* Initially, the first step of the "traditional" model first step is done. Then, each block is fitted to a probability density distribution. In this way, a new load level for each demand block is obtained in each iteration (Figure 3).



**Figure 3.** Probability density functions of demand, wind power and photovoltaic power.

### 3. Results

To test the new uncertainty modeling method, a Monte Carlo simulation with 250 iterations, has been carried out. The probability density function and its best fit for the total cost distribution are depicted in Figure 4.



**Figure 4.** Probability density function and best fit of the total cost of the mobile level.

### 4. Conclusions

The main advantage of having a probabilistic approach is that risk analysis can be performed, providing information about the variation of the range of values. That allows the investor to do a better assessment of renewable generation projects.

In general, in renewable distributed generation planning problems, it is necessary to manage the variability of demand, wind and irradiation using probability density functions. The objective is to do an exhaustive analysis of the investment costs to make the correct decisions.