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Francisco José Sáez-Martínez, Elena Jiménez, Gilles Lefebvre and Matthias Beekmann

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FORECAST MODEL OF ALLERGENIC HAZARD USING TRENDS OF POACEAE AIRBORNE POLLEN OVER AN URBAN AREA IN SW IBERIAN PENINSULA (EUROPE)

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FORECAST MODEL OF ALLERGENIC HAZARD USING TRENDS OF POACEAE AIRBORNE POLLEN OVER AN URBAN AREA IN SW IBERIAN PENINSULA (EUROPE)

1. Purpose

Cities are becoming bigger, being necessary the knowledge of associated natural hazards from organic and inorganic aerosols. This hazard could be included in the context of urban air quality and climate change as environmental risk factors of allergy. Nevertheless, there is a lack of previous articles published to consider the airborne pollen as natural hazard. Overall, grass pollens are the most important cause of pollinosis in Europe due to its high allergenicity and extensive distribution.

2. Design, Methodology or Approach

The main objective of this work was to model daily average *Poaceae* airborne pollen concentrations from an urban area placed in a city in the SW of the Iberian Peninsula, in relation to the temporal distribution of five different meteorological variables from 23 years of continuous recording. This was achieved using a combination with the Shuffle Complex Evolution Metropolis Algorithm used as an optimization function the Root Mean Square Error. Aerobiological sampling was conducted from 1993 to 2015 in Badajoz (SW Spain) using a seven-day Hirst type volumetric sampler.

3. Results/Findings

The *Poaceae* Main Pollen Season lasted, on average, 89 days, ranging from 41 to 144 days, from April 17th to July 14th (Figure 1). The model proposed to forecast airborne pollen concentrations is described by one equation composed of two terms. The first term represents the resilience of the pollen concentration trend in the air according to the average concentration of the previous 10 days and the second term is obtained from considering the actual pollen concentration value, which is calculated based on the most representative meteorological variables multiplied by a fitting coefficient (eq 1):

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

The fit of the model was examined for a forecast horizon of 1, 7, 15 and 30 days. The R^2 values obtained were 0.70, 0.69, 0.62 and 0.57, respectively, which show a trend in decreasing order (Table 1). These results confirm the suitability of the proposed model.

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

Parameters	1-Day	7-Days	15-Days	30-Days
a	0.491	1.286	0.941	0.819
b	0.006	0.074	-0.003	-0.003
c	0.082	-0.092	0.032	0.027
d	-0.066	0.061	-0.007	-0.007

e	-0.041	-0.079	-0.035	-0.028
f	-0.017	-0.015	0.001	-0.009
g	0.004	0.002	0.001	0.001
Comparison criteria				
R^2	0.704	0.689	0.622	0.573
RMSE	95.47	95.34	92.92	65.73
Ccobs			103.677	
CCsim	100.869	98.194	82.279	68.370

4. Conclusions

This research highligths the importance to study the climate change as environmental risk factors of allergy and to quantify the natural risks hazards from organic aerosols, *Poaceae* pollen, as natural hazard in the context of urban air pollution in Badajoz (SW Spain). Furthermore, these results obtained may benefit allergy sufferers, medical professionals and those who produce and stock health care products in Badajoz. The model obtained provides a good level of confidence to forecast *Poaceae* airborne pollen concentration with an R^2 of 0.70, 0.69, 0.62 and 0.57 for a forecast horizon of 1, 7, 15 and 30 days, respectively (Figure 2). These results and the values of probability distribution function by parameters and R^2 have confirmed the suitability of the proposed model.

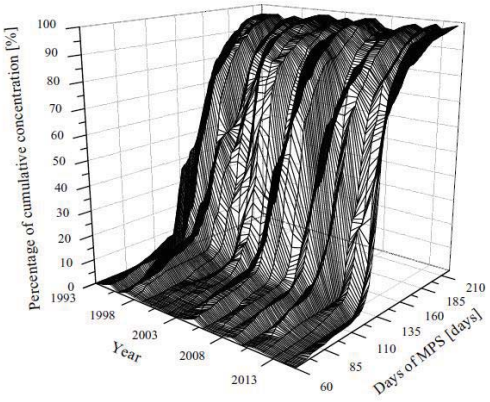

Figure 1. *Poaceae* pollen season characteristics.

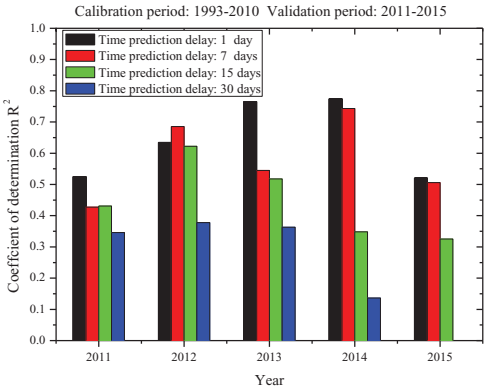

Figure 2. Validation of the model for the last five years.