Models for forecasting airborne Cupressaceae pollen levels in southwest Iberian Peninsula

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Introduction

Cupressaceae family includes an important number of species cultivated as ornamental in the urban environment and it is an anemophilous family. They pollinated essentially in winter and their pollen is captured by aerobiological samplers mainly in two months. The main objective is to model the Cupressaceae pollen concentration (CC) from of the relation with the temporal distribution of different climatic variables for 21 years (t) of continuous recording.

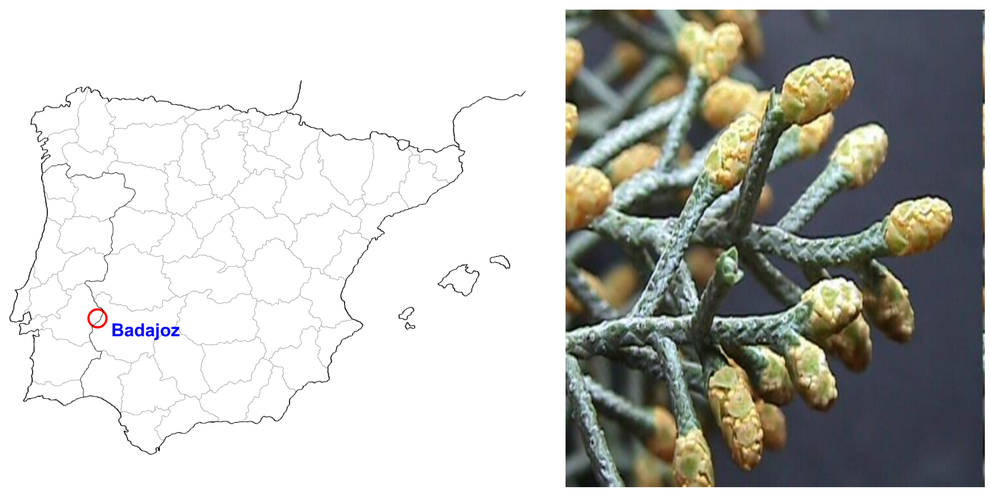


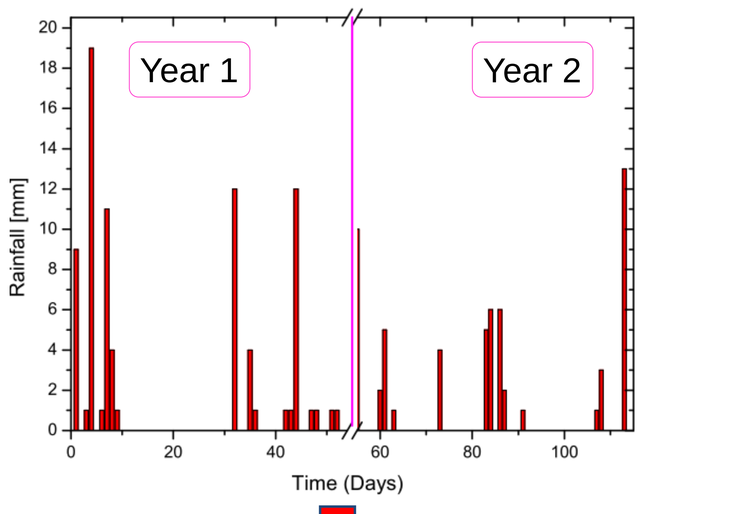
Fig. 1. Location of pollen trap (left) and *Cupressus arizonica* inflorescence (right).

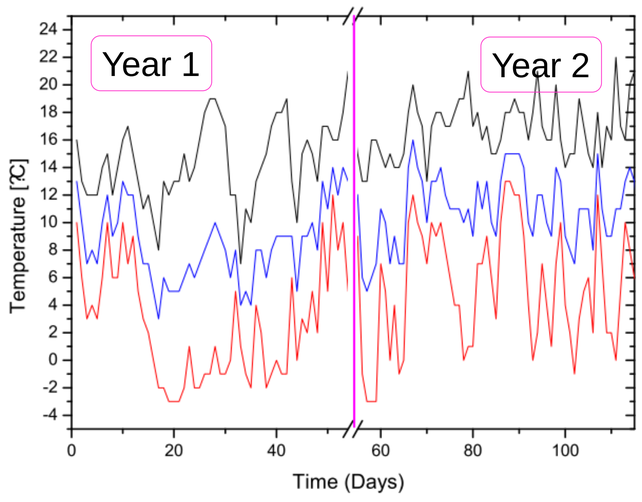
Material and methods

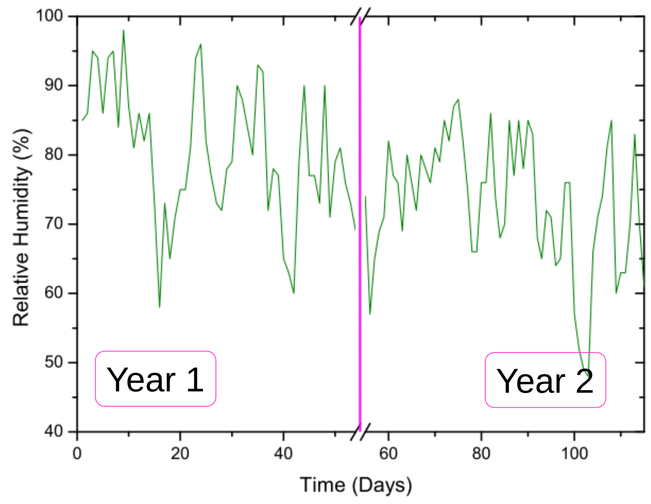
Daily concentration of airborne pollen concentration were obtained by using a Hirst type pollen trap located at the roof of a building at the University of Extremadura of Extremadura in Badajoz (SW Spain). Data were provided in daily pollen grains concentration for cubic meter. Cupressaece data from 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) were studied with a proposed parametric model which was calibrated with the Shuffled Complex Evolution Metropolis algorithm SCEM-UA (Vrugt et al, 2003) using Root Mean Squared Error as optimization function.

Results

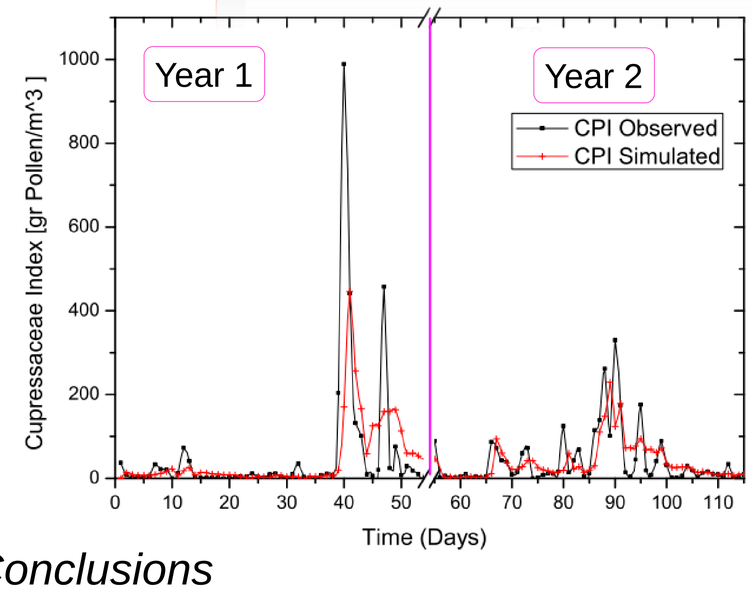
The model proposed to forecast the airborne pollen concentration is described by,







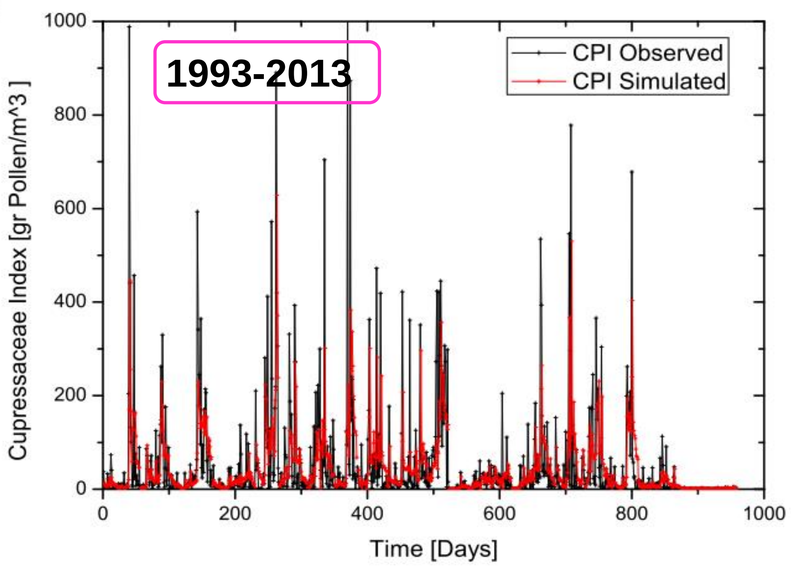
$$CC^t = a \cdot \frac{\sum_{i=t-10}^{i=t} CC^i}{10} + CC^{t+1}\left(b \cdot {T_{max}}^t + c \cdot {T_{mean}}^t + d \cdot {T_{min}}^t + e \cdot \frac{\sum_{i=t-10}^{i=t} {T_{mean}}^t}{10} + f \cdot R^t + h \cdot RH^t \right)$$



Parameters and statistical analysis of the model proposed

Statistical Analysis	
$\overline{CPI_{obs}}$	49,71
$\overline{CPI}$	48,48
R^2	0,3
NS	0,44

Parameters	*Value*	*Parameters*	*Value*
a	0,933	e	-0,083
b	0,038	f	0,012
c	0,014	g	-0,001
d	0,016	h	0,033



Conclusions

The main advantage of the model proposed is the integration of more climatic variables than conventional models in Aerobiology, even accumulative values of the climatic variables to add a register of the inertial of the temporal distribution of the airborne pollen concentration. This model represents a good approach for a continuous balance model of the CC concentration, being corroborated by the closest between observed and predicted mean concentration. The low values of the R2 and NS are conditioned by the non-linearity behavior of the CC concentration regarding to climatic conditions in the cases of very high concentration of it, highlighting the necessity to improve the predictability for these scenarios.

Reference: *Vrugt, J. A., H. V. Gupta, W. Bouten, and S. Sorooshian (2003), A Shuffled Complex Evolution Metropolis algorithm for optimization and uncertainty*

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