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Earlier onset of spring in Serbia

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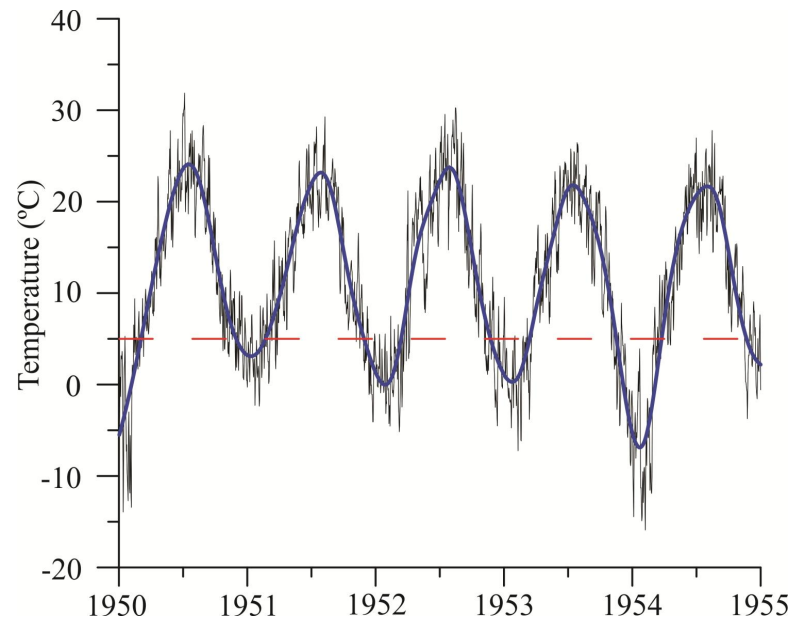


INTRODUCTION

- phenological evidence shows earlier spring onset worldwide, related to rising global temperature
- in this study the geospatial patterns of spring onset in Serbia were examined based on available meteorological data

MATERIALS - SOURCE DATA

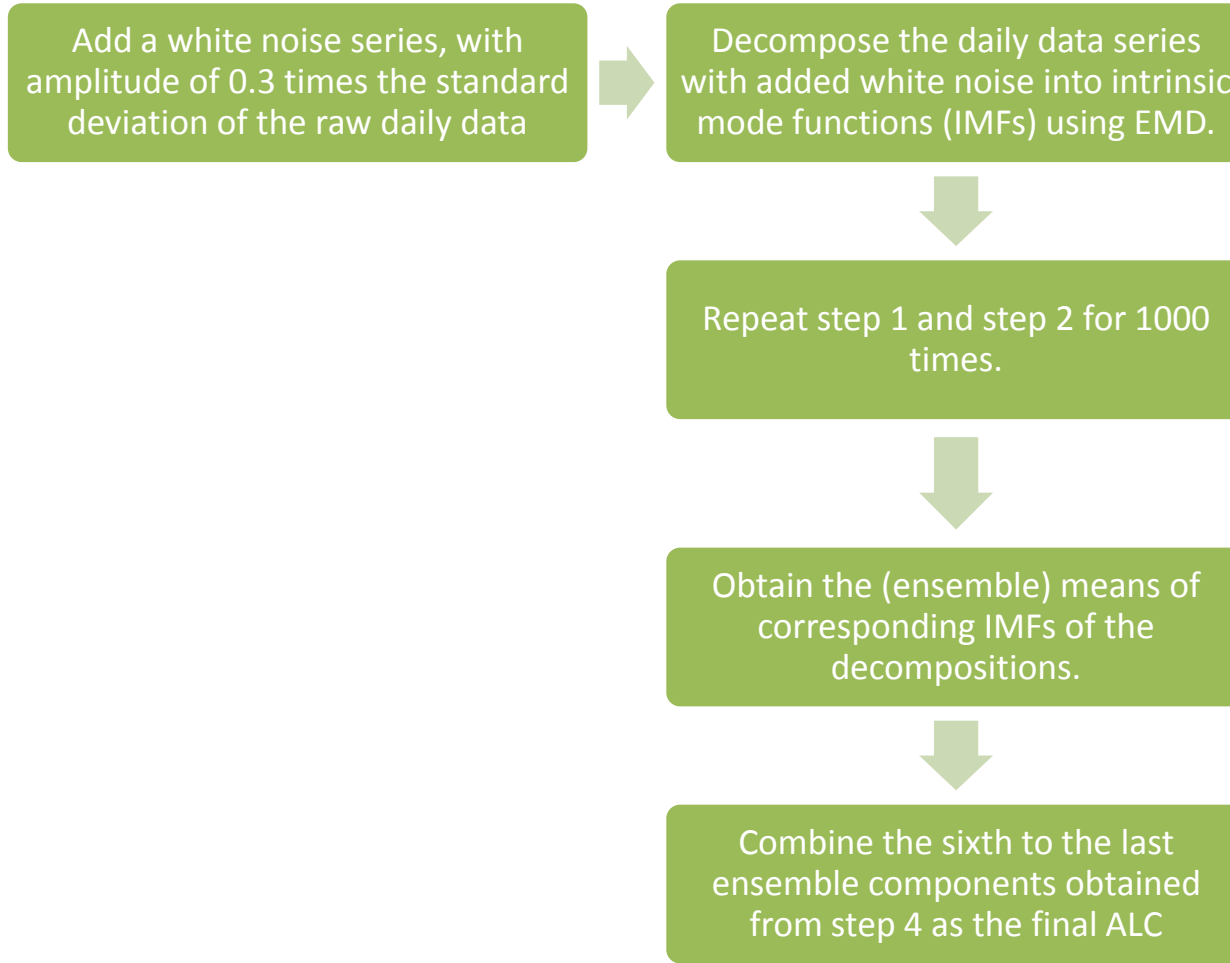
- Source data for the study: **European Climate Assessment & Dataset**
- Homogenized daily surface air temperature (SAT) datasets
- 32 meteorological stations in Serbia
- Time series: 1950 – 2013



METHODS – Empirical Mode Decomposition

Ensemble Empirical Mode Decomposition (EEMD) was used to isolate the **amplitude-frequency modulated annual cycle (MAC)** and to determine adaptively the temporally varying trend from a homogenized daily temperature series.

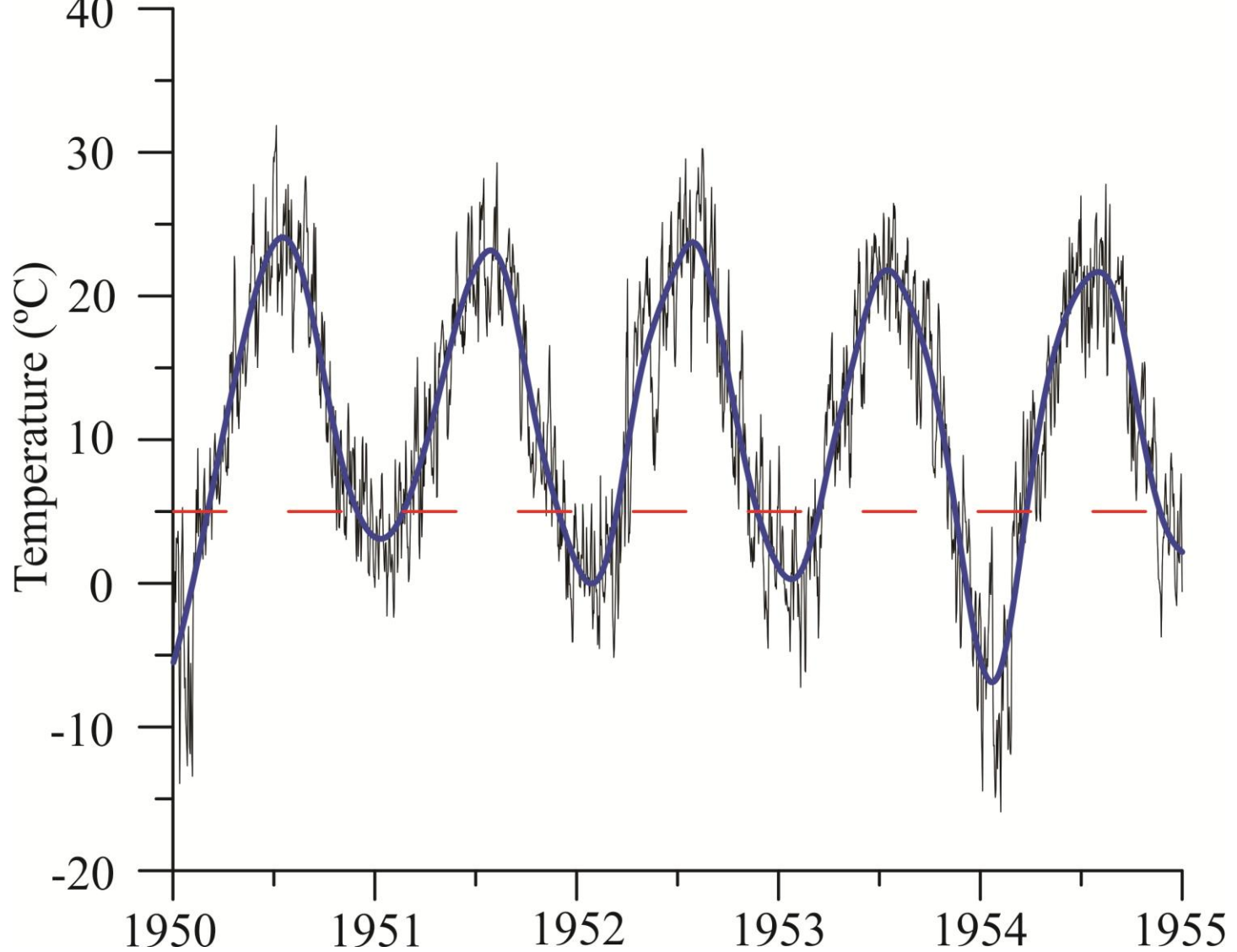
Empirical Mode Decomposition work flow



SPRING ONSET

SPRING IS DEFINED IN THIS STUDY AS

the date of the first appearance of 5°C in an adaptively and temporally locally determined low-frequency part of the daily temperature series containing annual cycle and longer timescale component (ALC).



The raw surface air temperature (SAT) data (black) at Novi Sad and the sum of its annual cycle and longer timescale component (blue line) for 1950–1955. The red line indicates 5°C threshold.

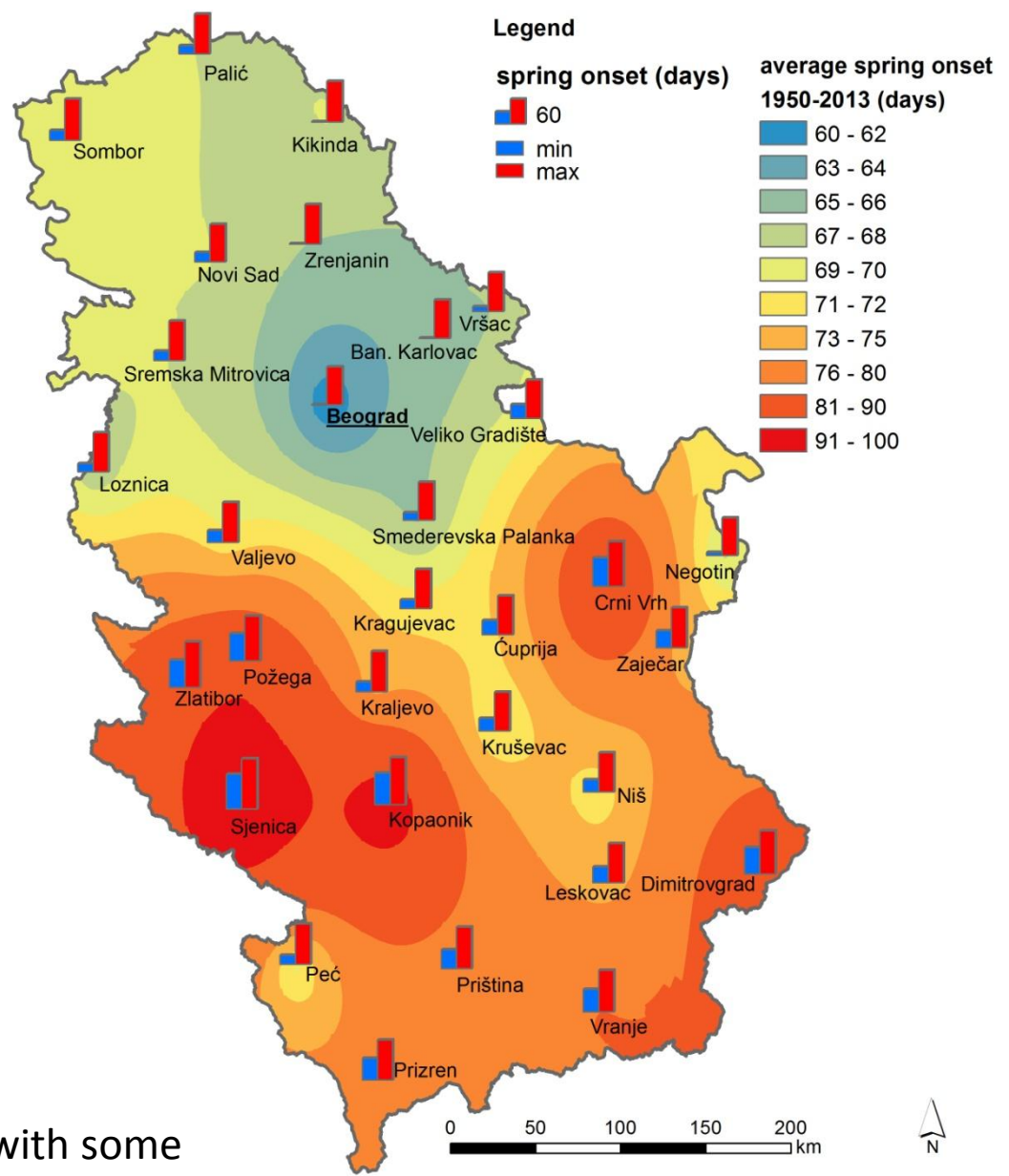
RESULTS

All 32 stations showed the trend of earlier spring onset

7 of 32 stations showed statistically significant trend ($p < 0.05$) based on Mann-Kendall test

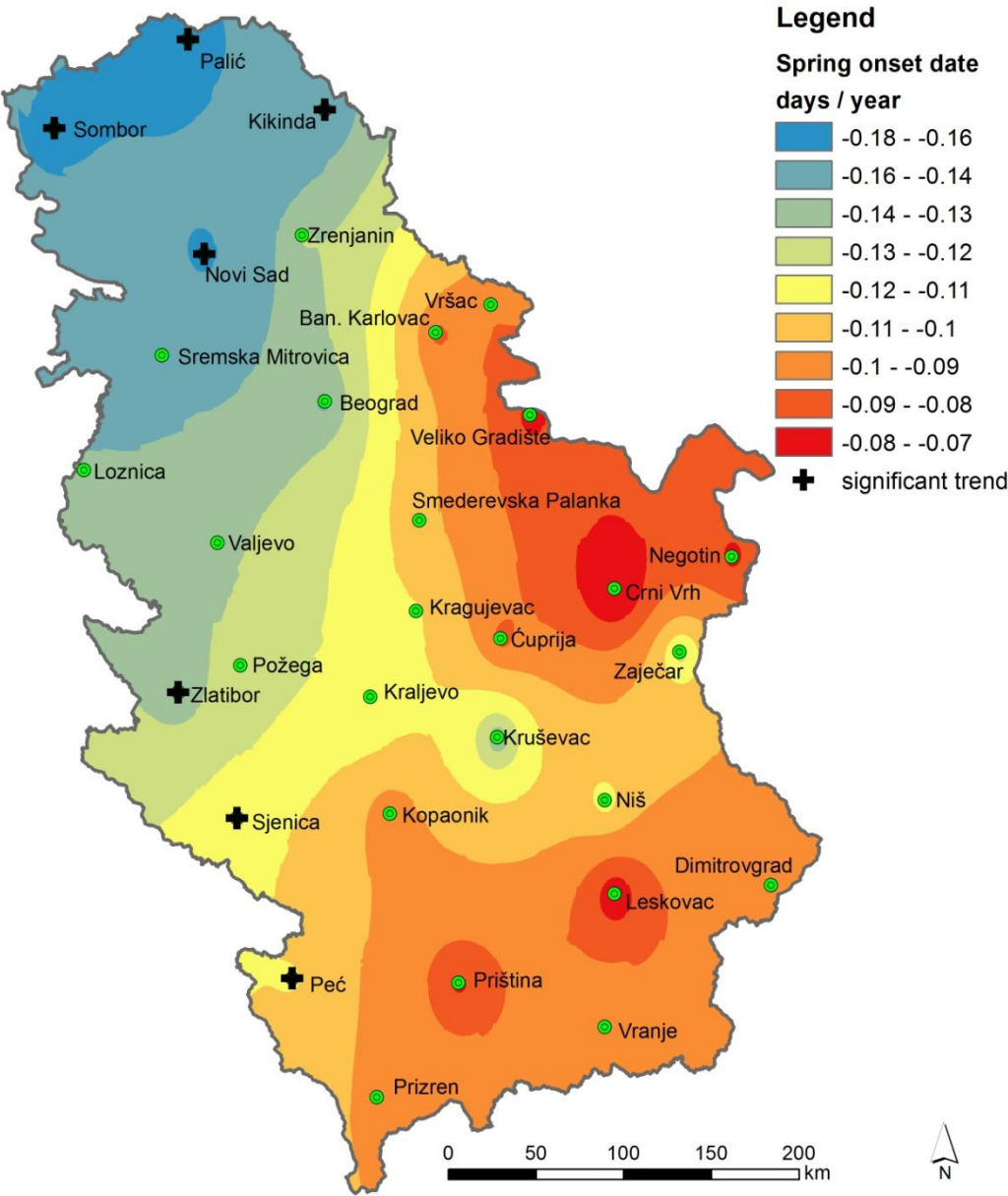
8 additional station have significance with reduced statistical confidence ($p < 0.1$)

Average spring onset date

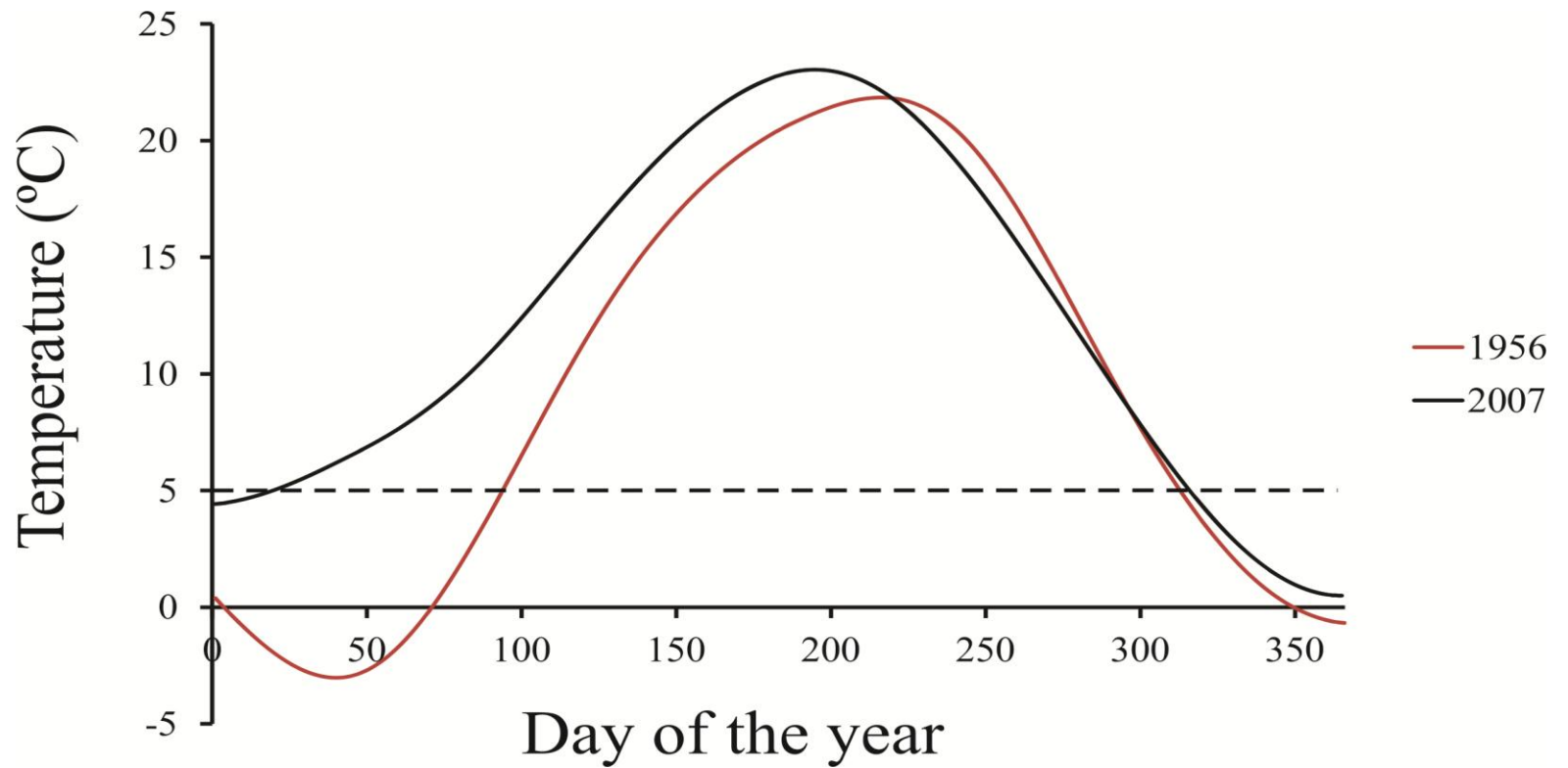


Mostly correlates with elevation, with some exceptions:
Southern Morava valley, observed amplitudes are lower than the stations with the similar elevation

Annual rate of change in spring onset date (days).

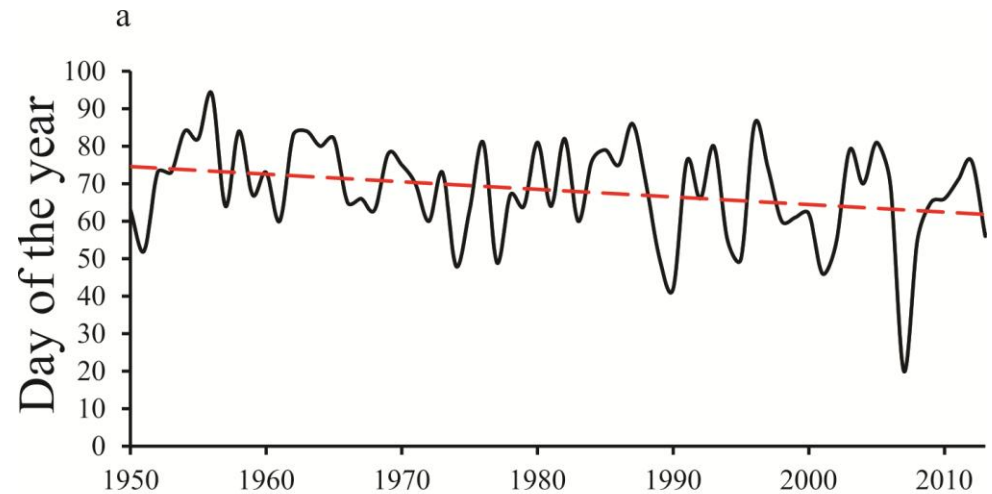


Novi Sad

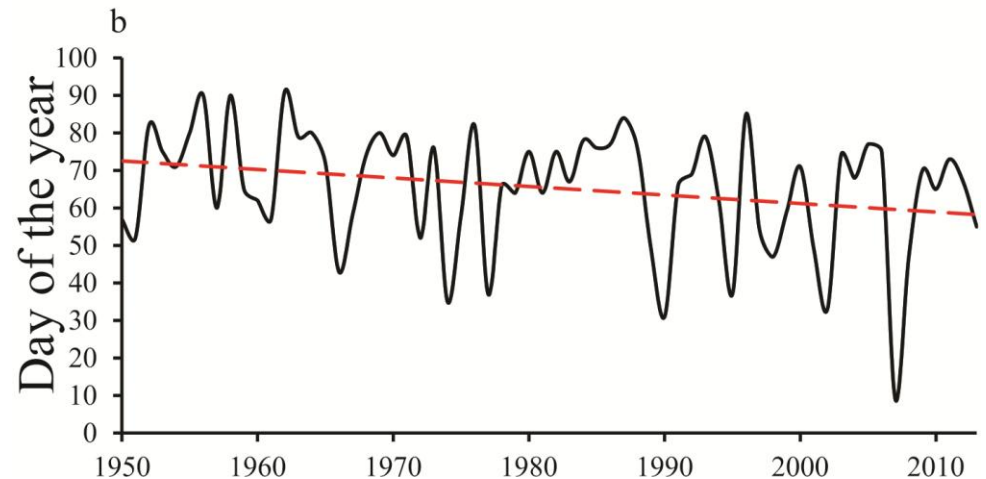


Novi Sad

a.
Spring onset dates associated with the annual cycle component obtained using EEMD and its linear trend line;



b.
spring onset dates determined using the 30-day-window running mean of daily temperature series.



CONCLUSIONS

- The spring onset dates are advancing in Serbia which is in good agreement with the studies done worldwide
- The topographic setting plays an important role for spring onset dates, but it is not always a predominant factor.
- Using the modulated annual cycle in Serbia the results of linear trends indicate that the start of the spring is advancing between 0.1 and 0.25 d/yr during the last 63 years
- Further studies are needed in order to better understand the advancing trend of spring onset in Serbia

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THANK YOU FOR YOUR ATTENTION!

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