Dendroclimatic Analysis for Changes of Air Temperature and Precipitation in Southwestern Bulgaria

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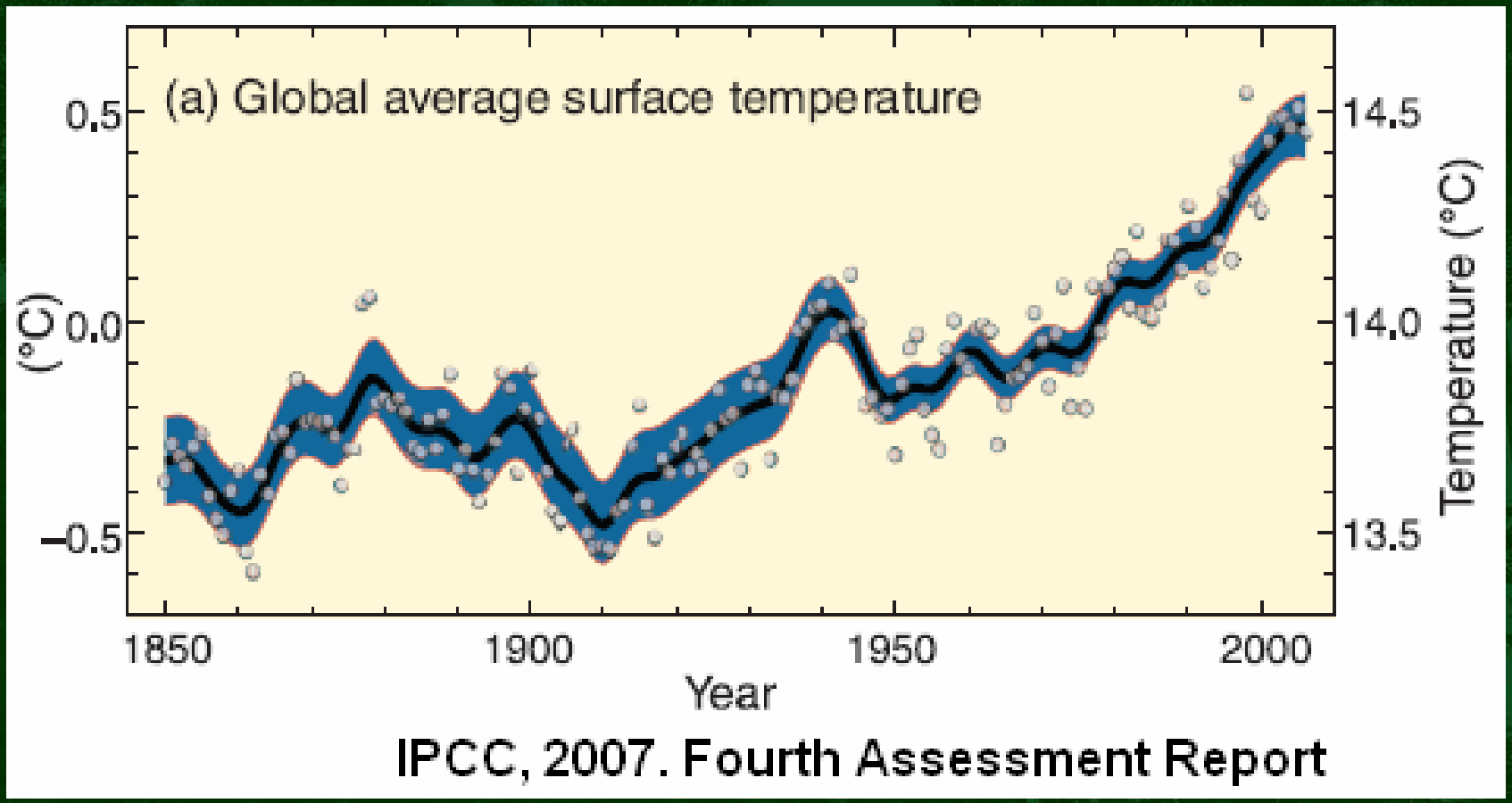
Observed change in global average surface temperature



IPCC, 2007. Fourth Assessment Report

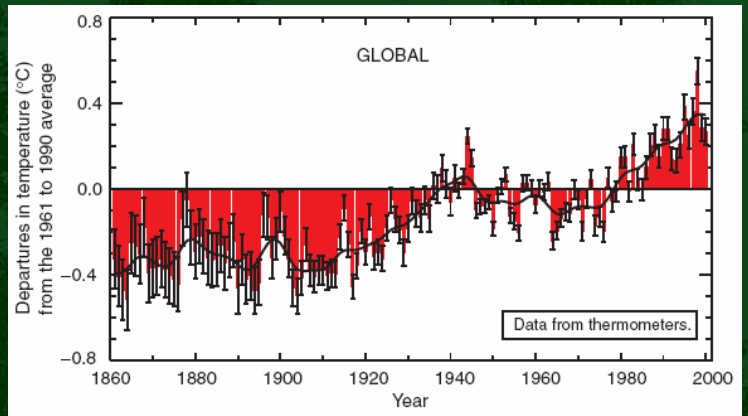
Effects of extreme whether

Effects of extreme whether

Effects of extreme whether

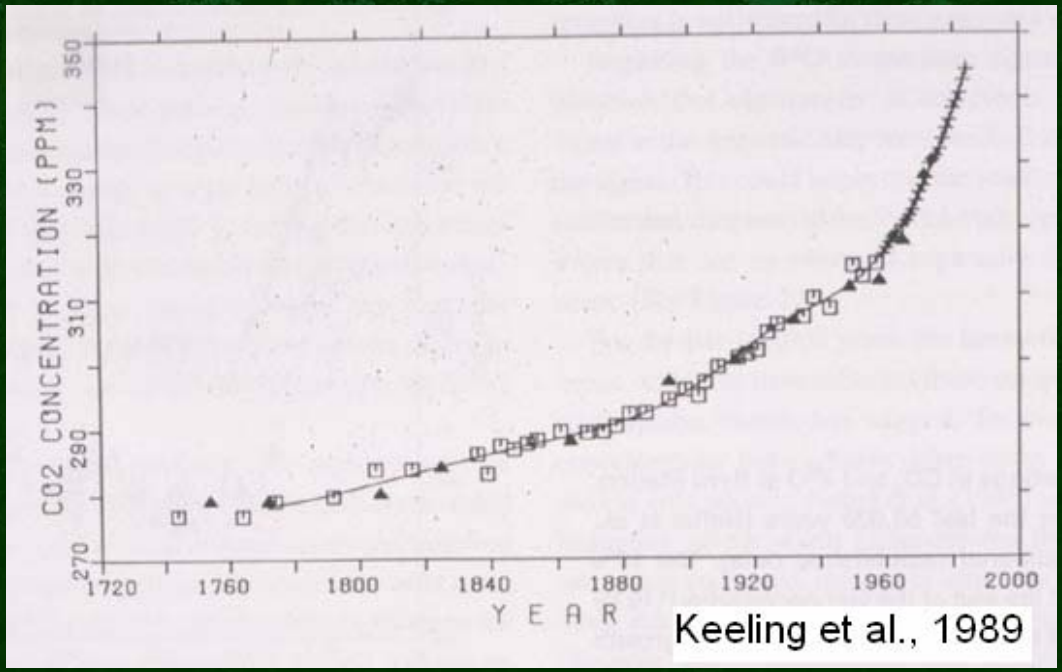
Effects of extreme whether

Causes of change – anthropogenic drivers



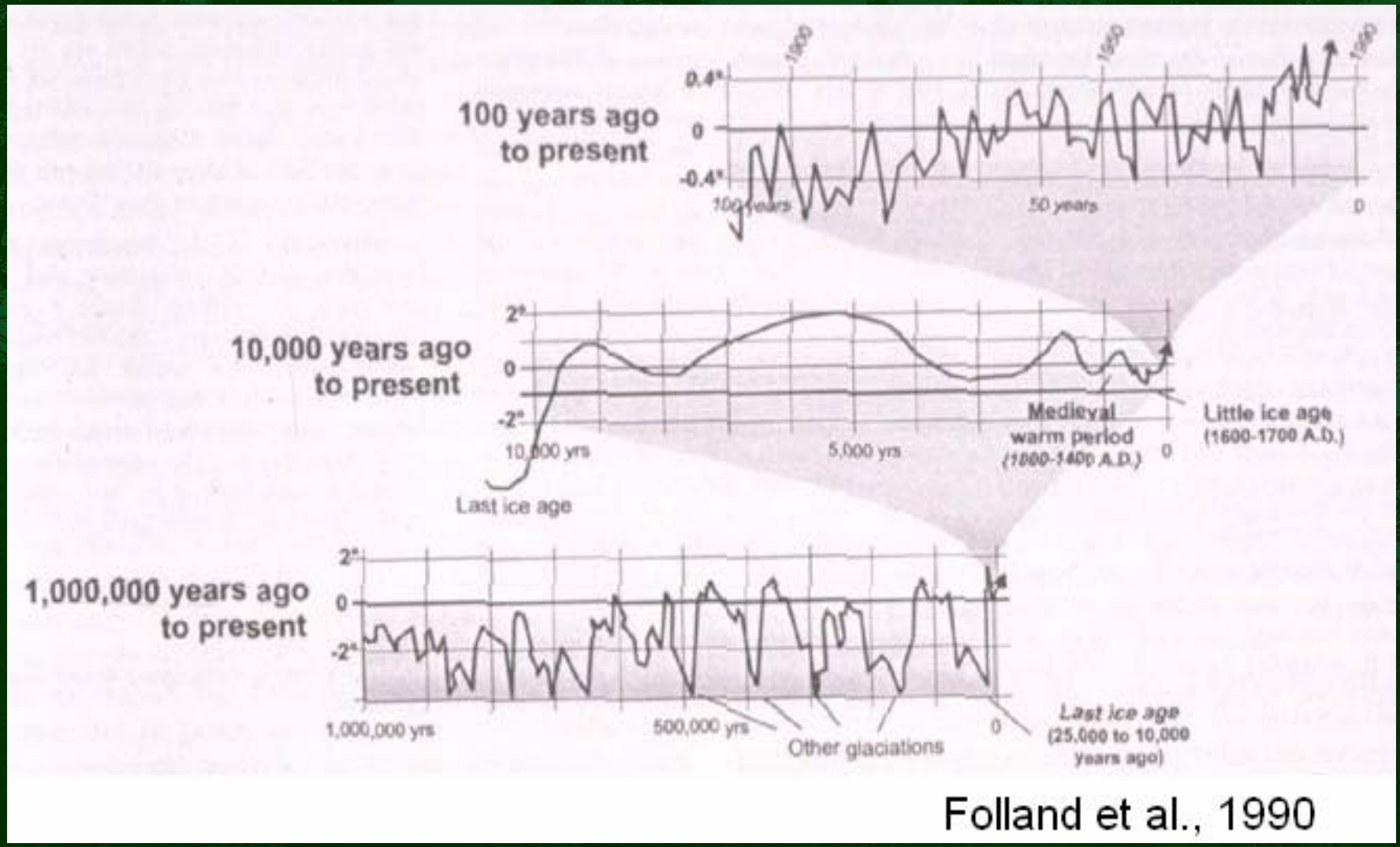
IPCC, 2001. Climate Change 2001: Synthesis Report.

Variations of the Earth's surface temperature for the past 140 years



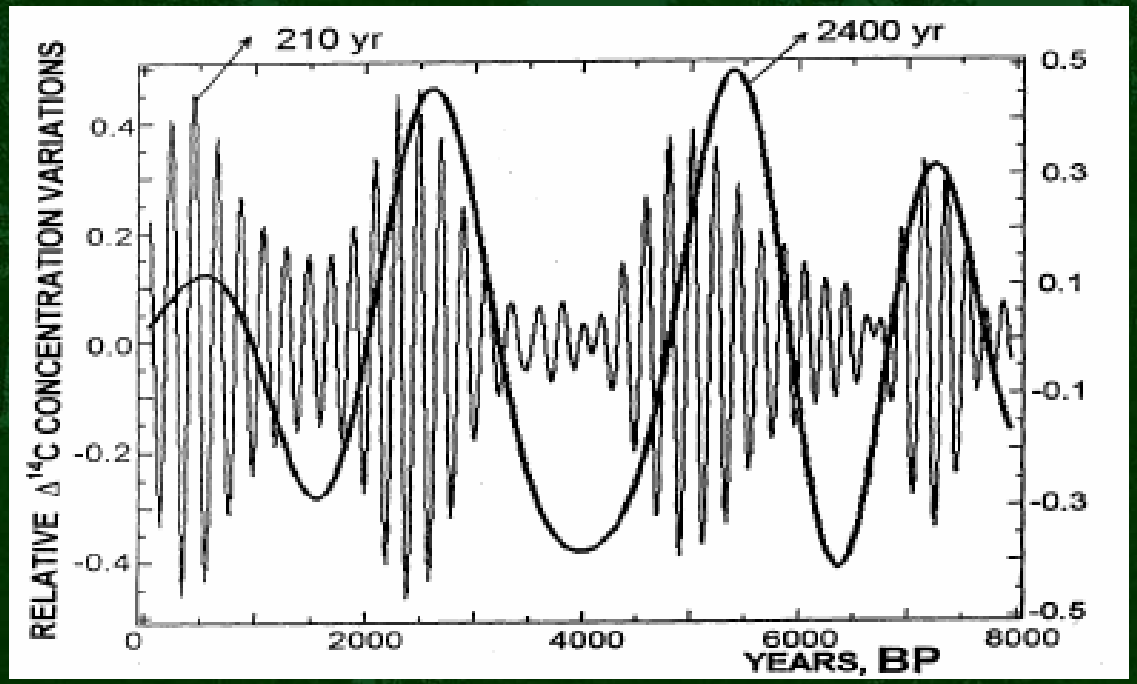
Atmospheric CO2 increase in the past 250 years

Climate change viewed over different periods



Folland et al., 1990

Causes of change – natural drivers



Northern Russia:
Raspopov *et al.* (2004)
Kozlov and Berlina (2002)

Sweden:
Gunnarson and Linderholm (2002)
Klingbjer and Moberg (2003)

Finland:
Lee *et al.* (2000)
Helama *et al*. (2002)
Eronen *et al*. (2002)

Iceland:
Hanna *et al.* (2004)

Objective and research tasks

The main purpose of the study is reconstruction of air temperature and precipitation by means of tree-ring analysis of increment cores.

Research tasks:

- to build long-term chronologies for the increment of Oak and Common Beech in Bulgaria;
- to express the mean standardized sequences as functions of air temperatures and precipitations;
- to reconstruct air temperatures and precipitations for the last 200 years.

Research objects

Oak (*Quercus frainetto* Ten.) stand in Maleshevska Mountain

Common Beech (*Fagus sylvatica* L.) stand in Central Balkan Mountains

Methods

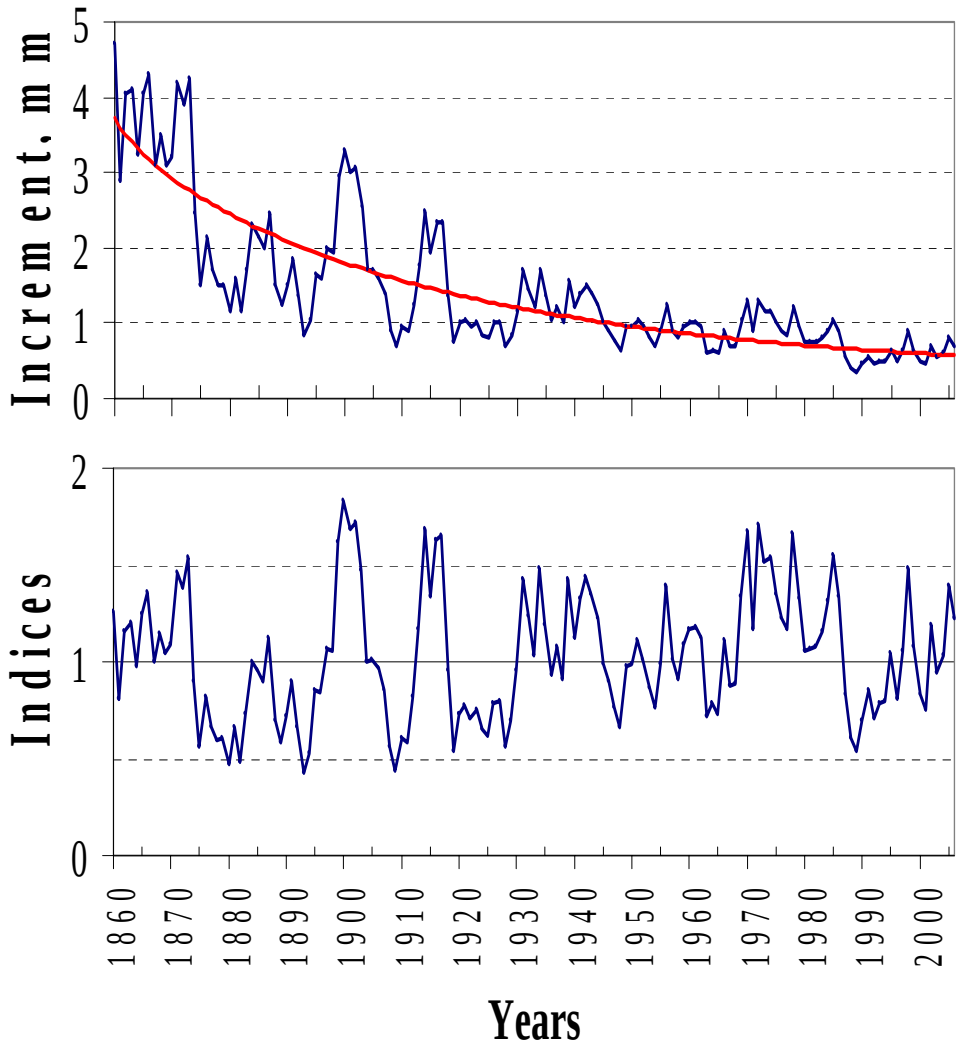
- standard dendrochronological methods (Fritts, 1976; Cook and Kairiukstis, 1990; Mirtchev et al., 2000);
- simple and multiple regression analysis (Fritts, 1976);

Climate data

- Sandanski meteorological station;
- Teteven meteorological station

Some of the sampled trees

Results and discussion

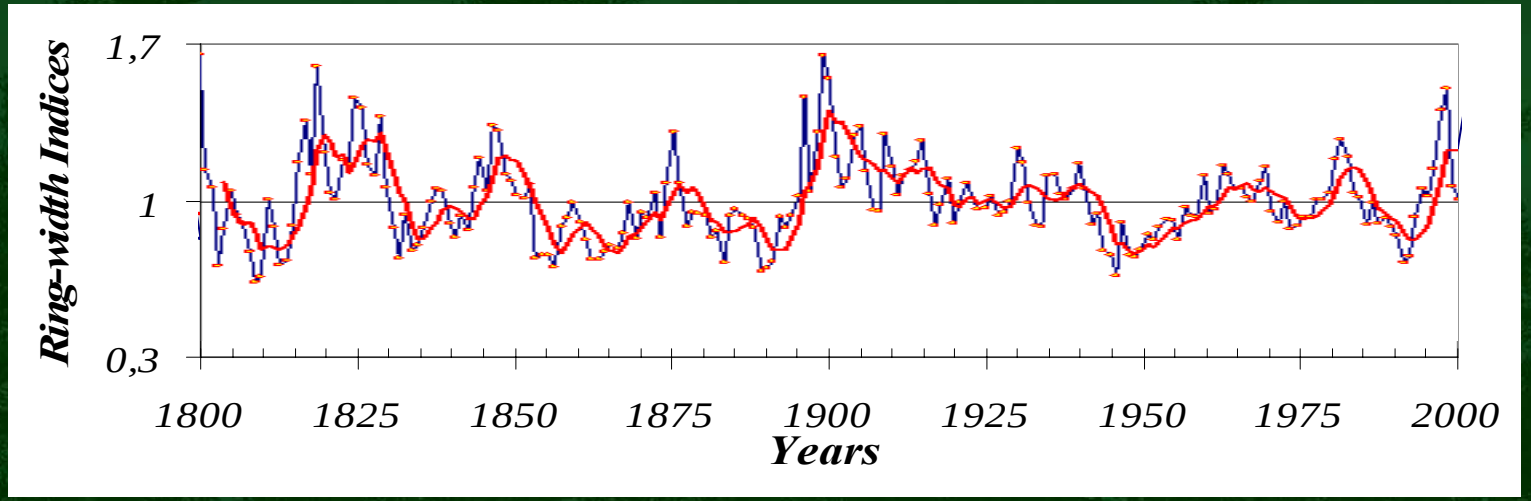


31 wood samples were collected (16 from Oak and 15 from Beech).

The obtained tree-ring series were standardized and index chronologies were obtained.

Mean index series

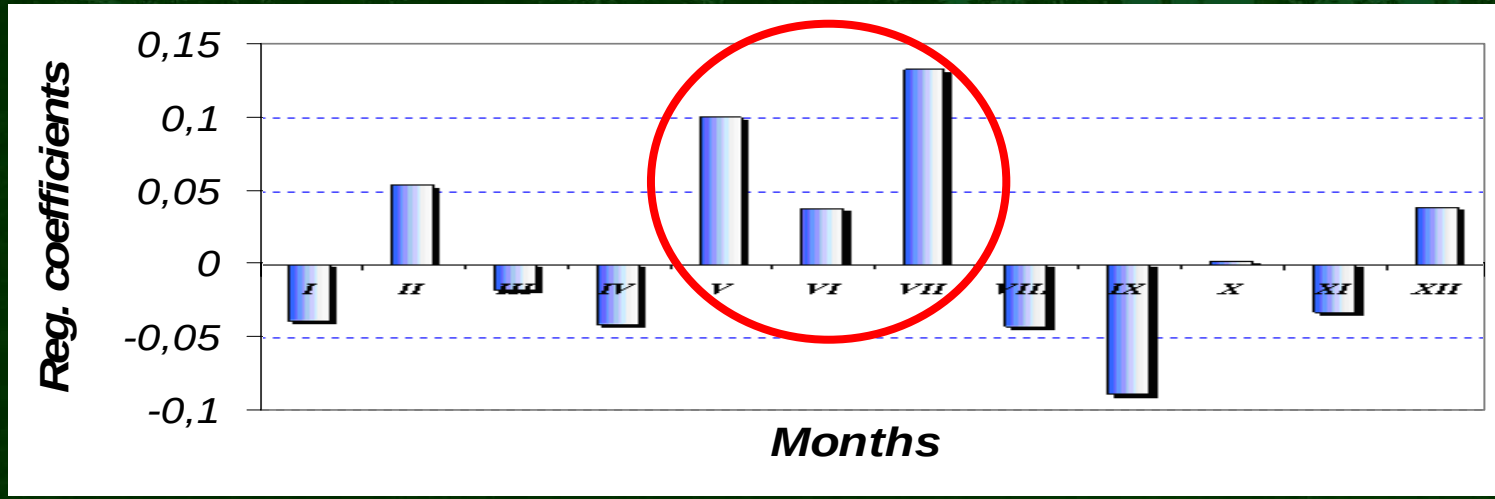
Oak chronology



Influence of the climatic factors on tree growth

Oak chronology

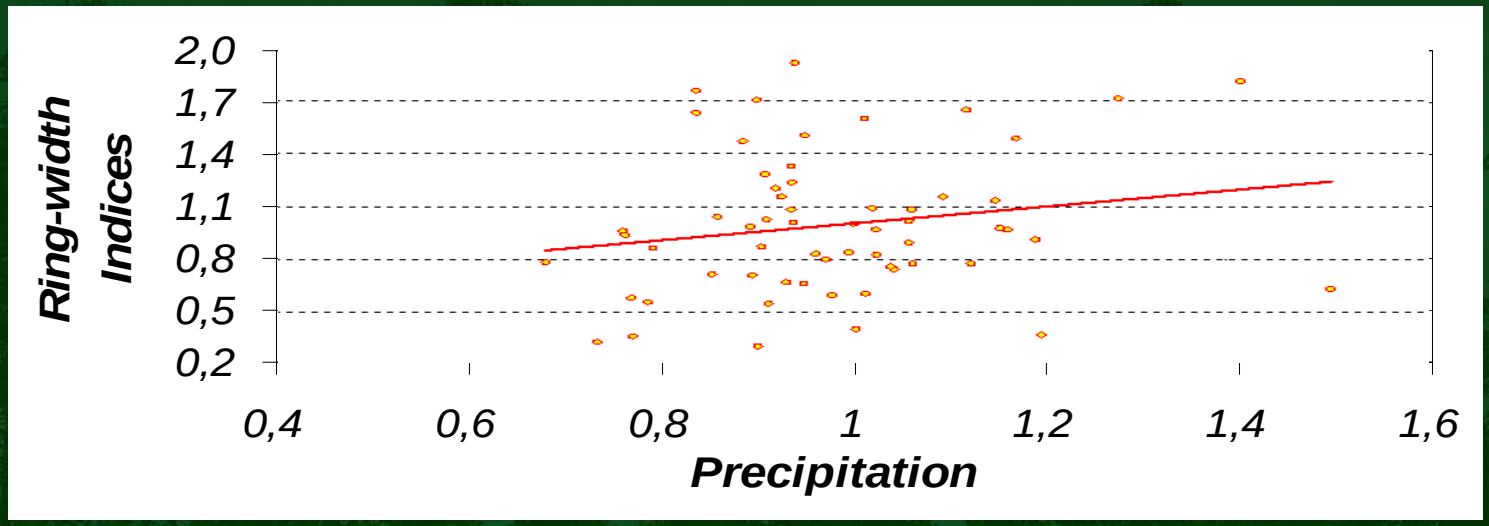
Precipitation



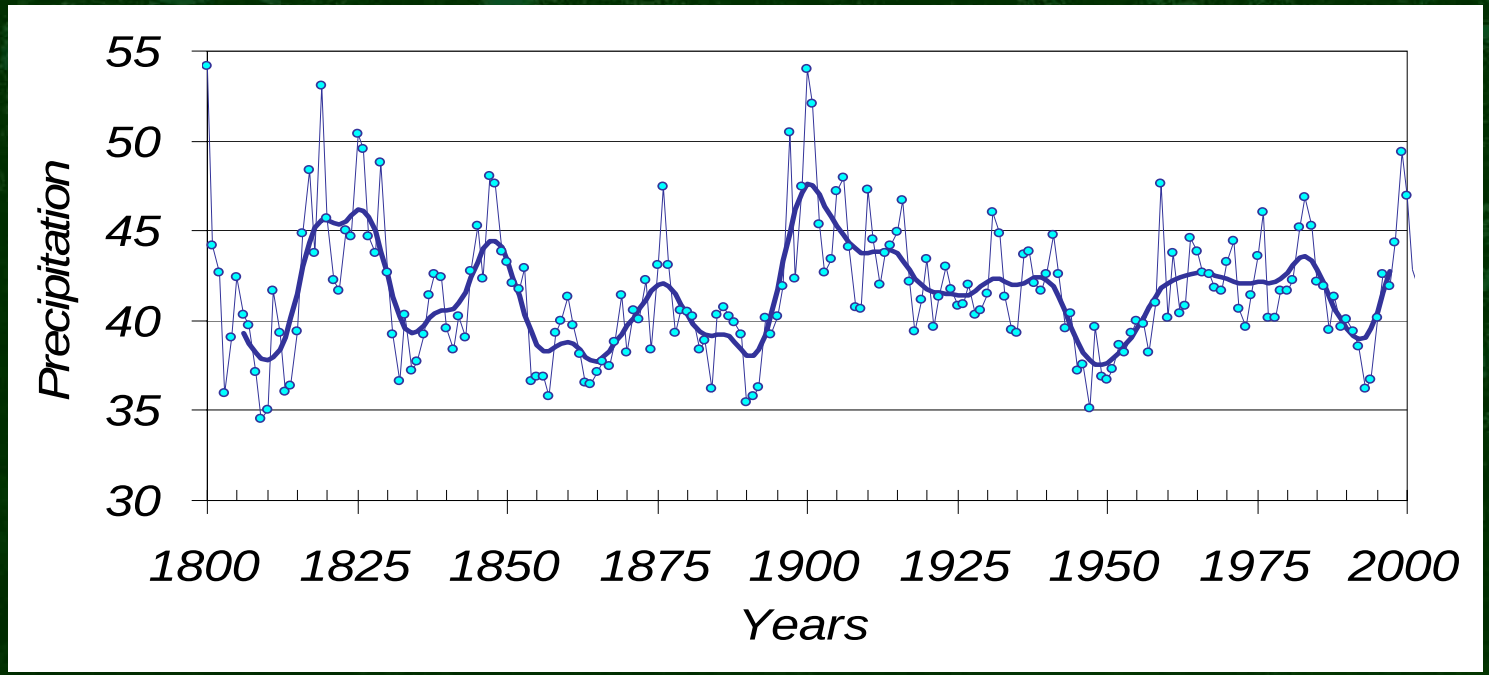
Model of the climate-growth relationship

$R^2 = 0,34$

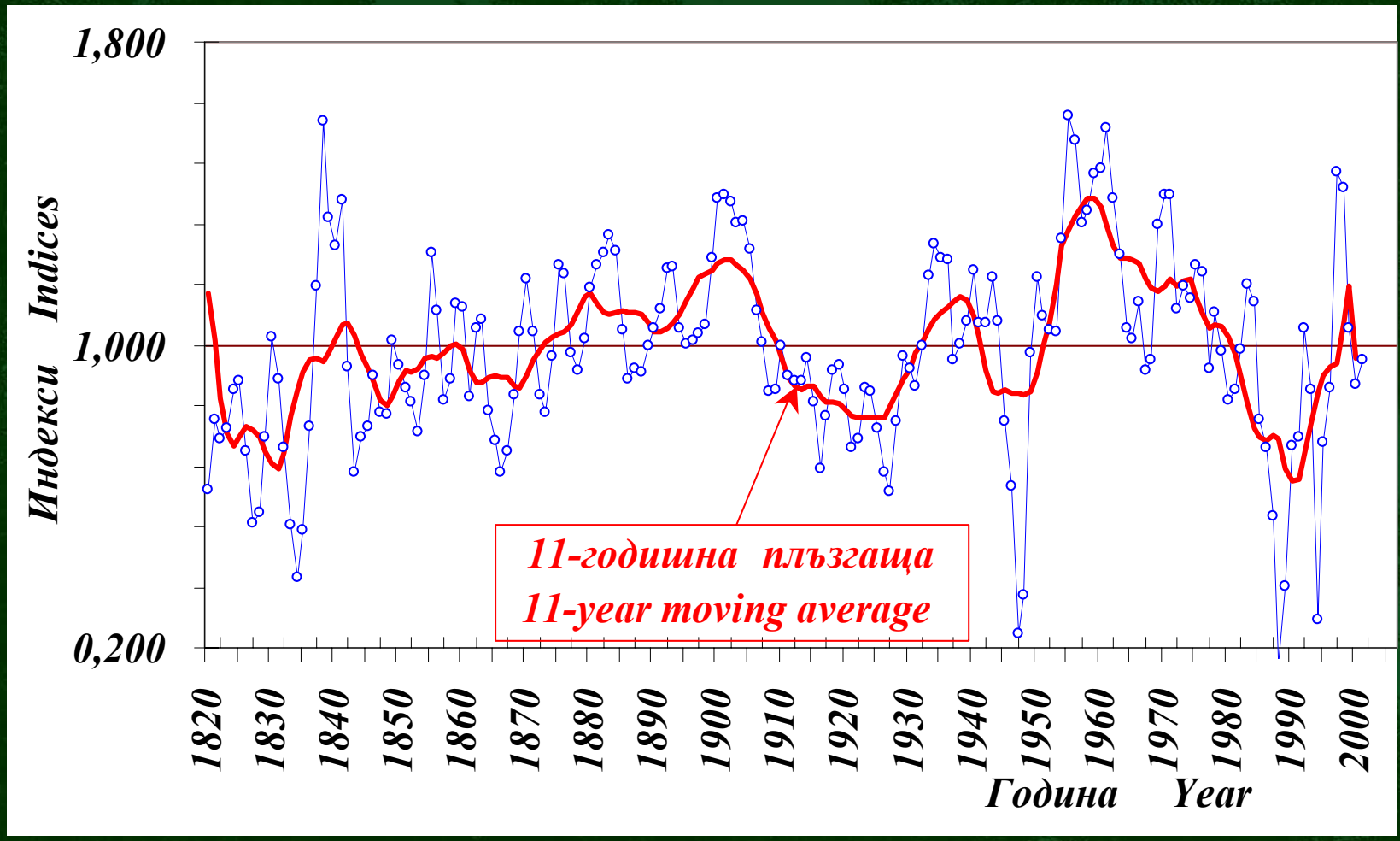
$y = 0,48x + 0,53$



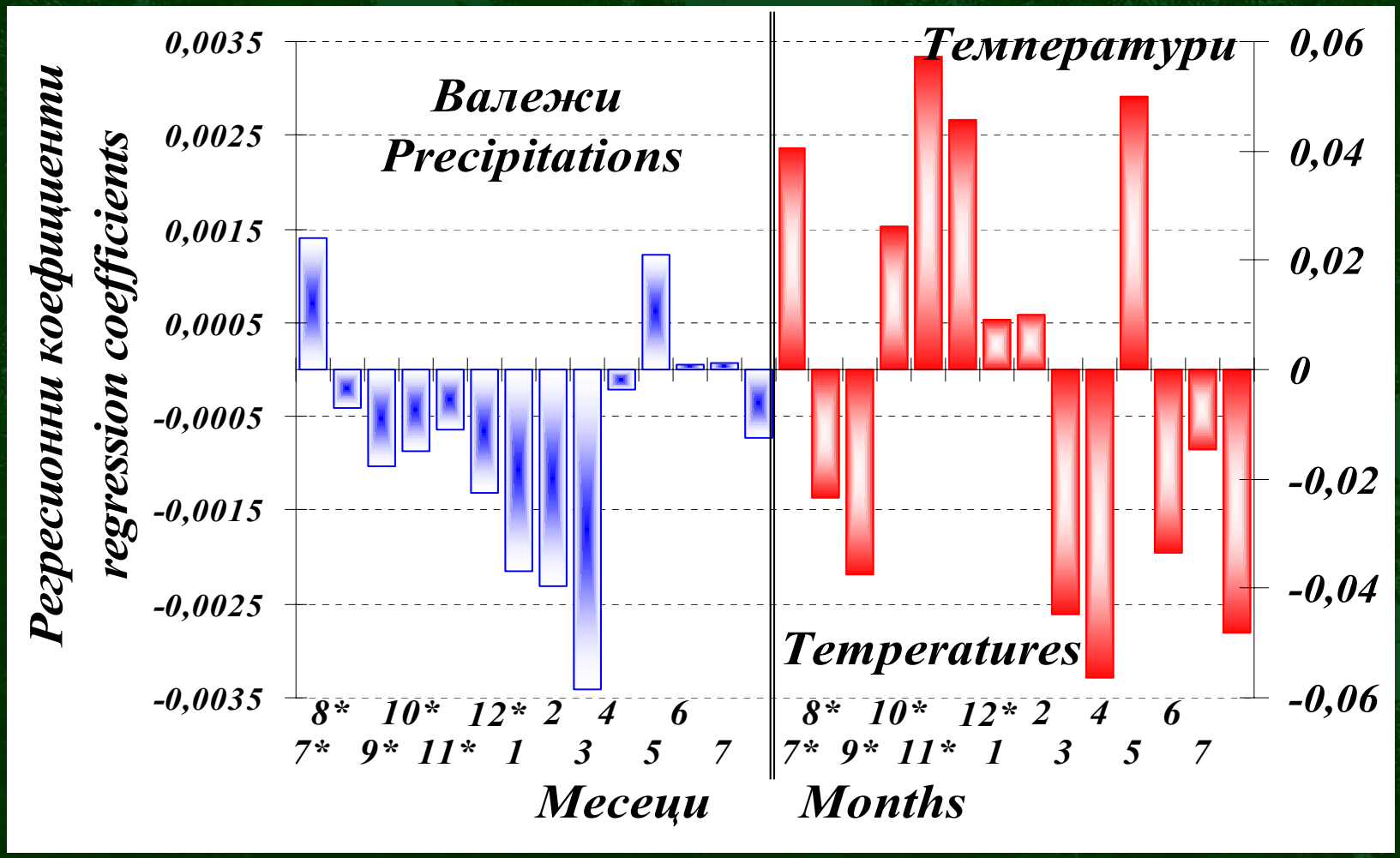
May-July precipitation reconstruction



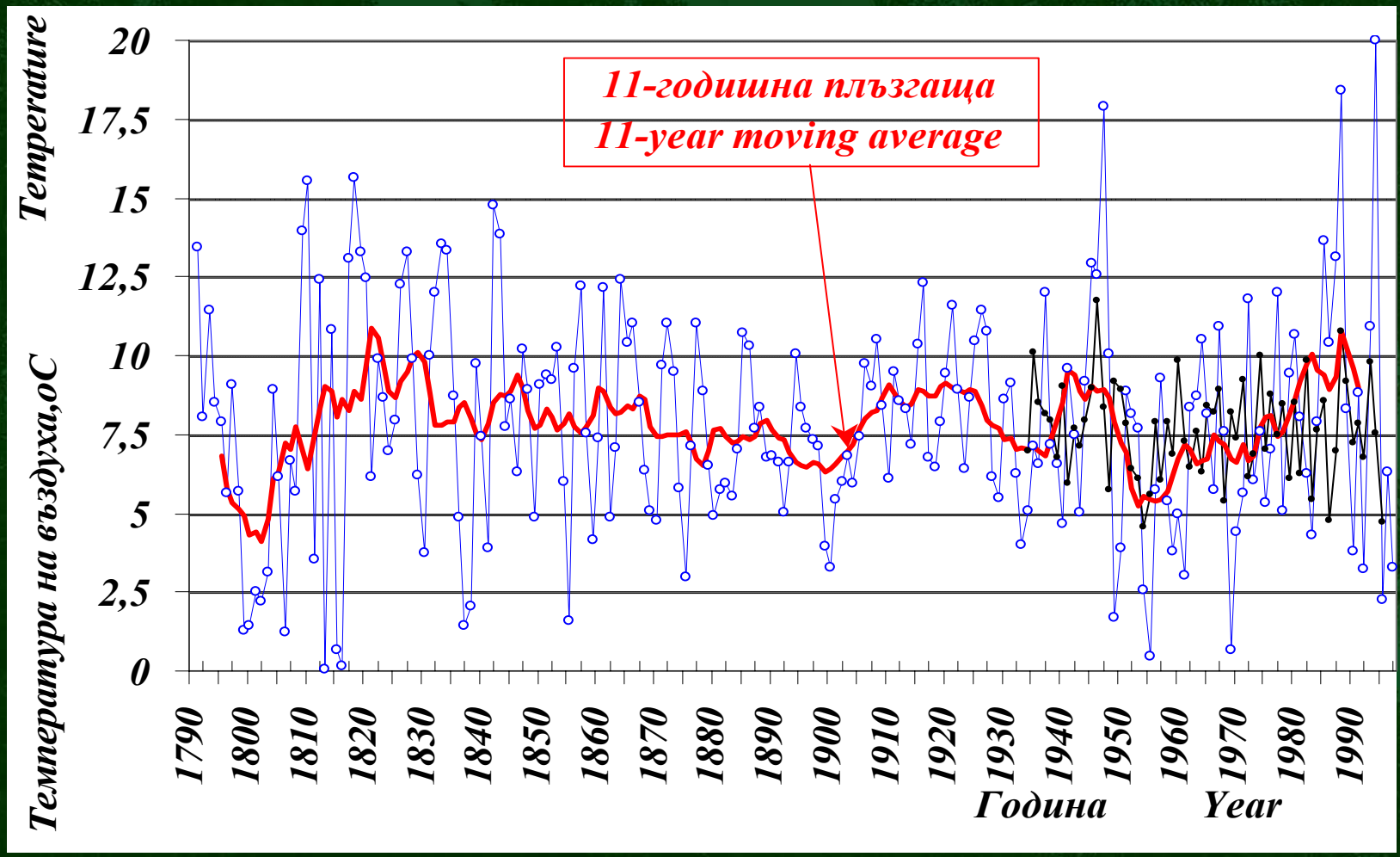
Mean indices for the radial increment of Fagus sylvatica and periods with growth suppressions



Influence of the monthly air temperatures and precipitation sums on the indices for the radial increment



Measured mean air temperatures during March and April (black) and reconstructed values (blue)



Dendroclimatic Analysis for Changes of Air Temperature and Precipitation in Southwestern Bulgaria

- *Nikolay Zafirov, PhD*
- *Assoc. Prof. Stefan Mirtchev*

University of Forestry

Sofia, Bulgaria

Objective and research tasks

The main purpose of the study is reconstruction of air temperature and precipitation by means of tree-ring analysis of increment cores.

Research tasks:

- to build long-term chronologies for the increment of Scots pine and Austrian pine in Southwestern Bulgaria;
- to express the mean standardized sequences as functions of air temperatures and precipitations;
- to reconstruct air temperatures and precipitations for the last 150 years;
- to reveal by spectral analysis the cyclical components in the reconstructed series.

Research objects

Scots pine (*Pinus sylvestris* L.) stand in Rila Mountain

Austrian pine (*Pinus nigra* Arn.) stand in Pirin Mountain

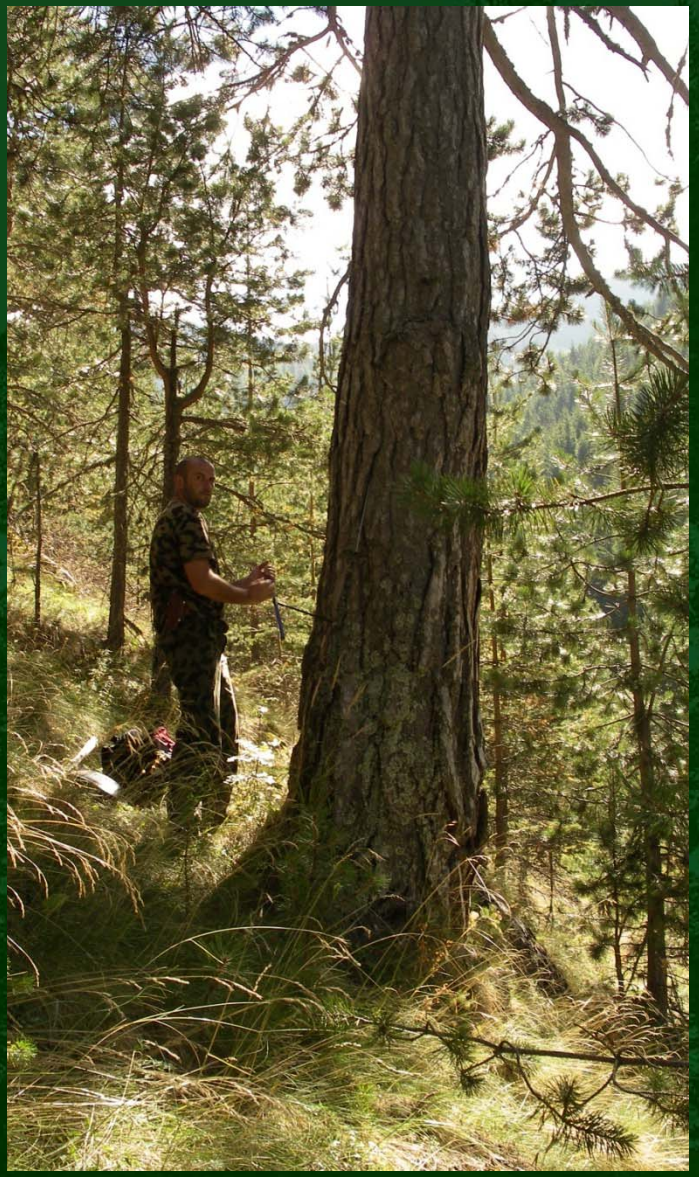
Methods

- standard dendrochronological methods (Fritts, 1976; Cook and Kairiukstis, 1990; Mirtchev et al., 2000);
- simple and multiple regression analysis (Fritts, 1976);
- spectral analysis (Kairiukstis and Shiyatov, 1990).

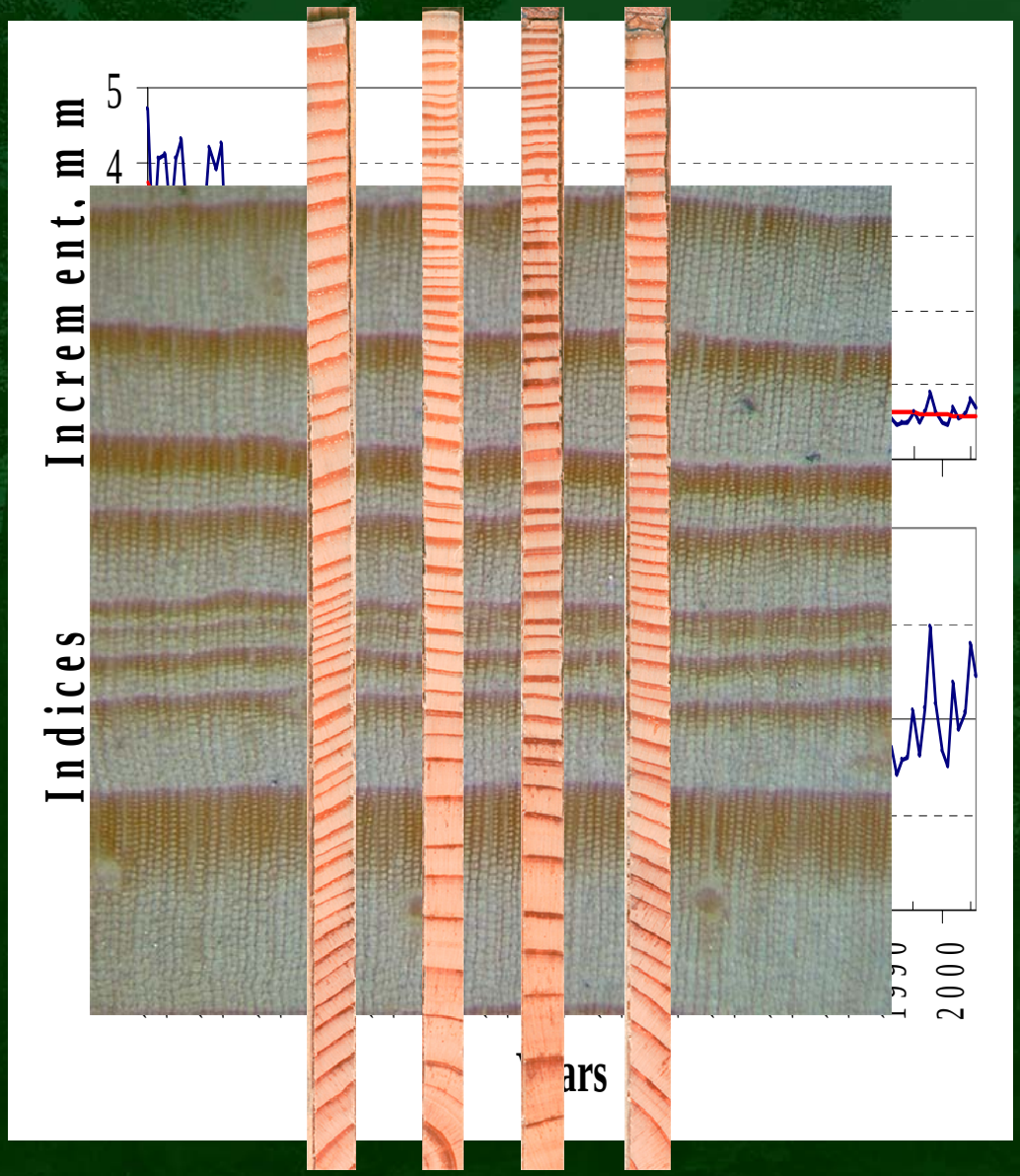
Climate data

- Bansko meteorological station (936 m a.s.l.);

Some of the sampled trees



Results and discussion

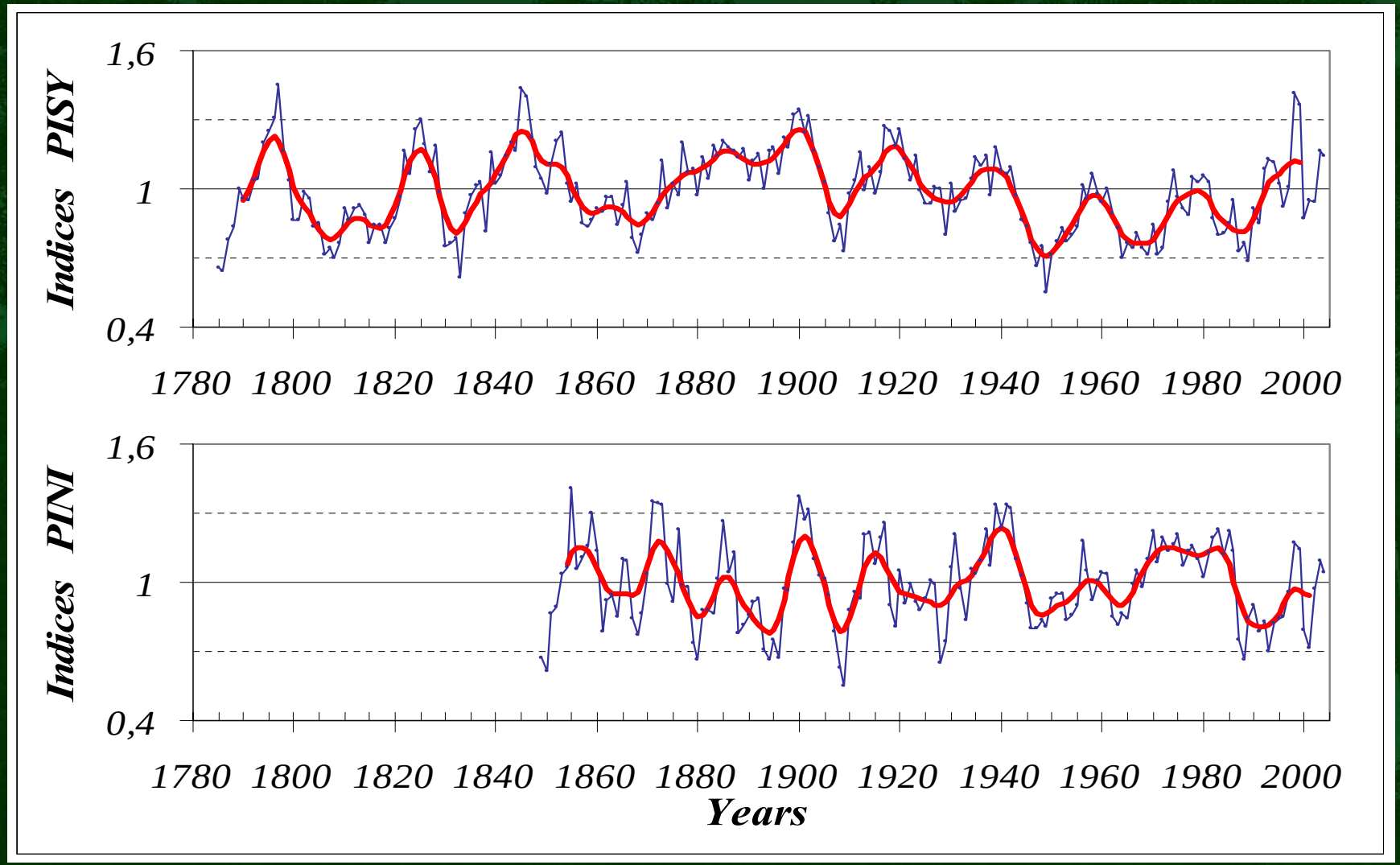


35 wood samples were collected (20 from Scots Pine and 15 from Austrian pine).

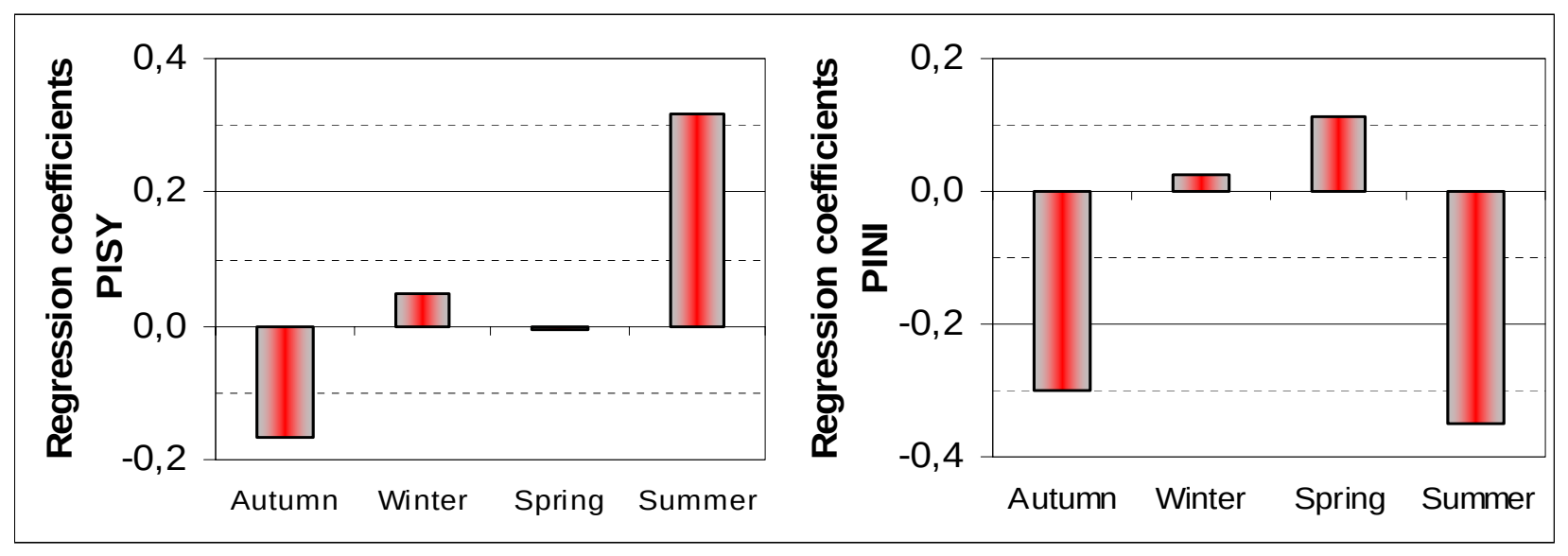
The samples were crossdated and the tree-ring widths were measured.

The obtained tree-ring series were standardized and index chronologies were obtained.

Mean ring-width index series
up – Scots pine, down – Austrian pine



Influence of the temperature on tree growth



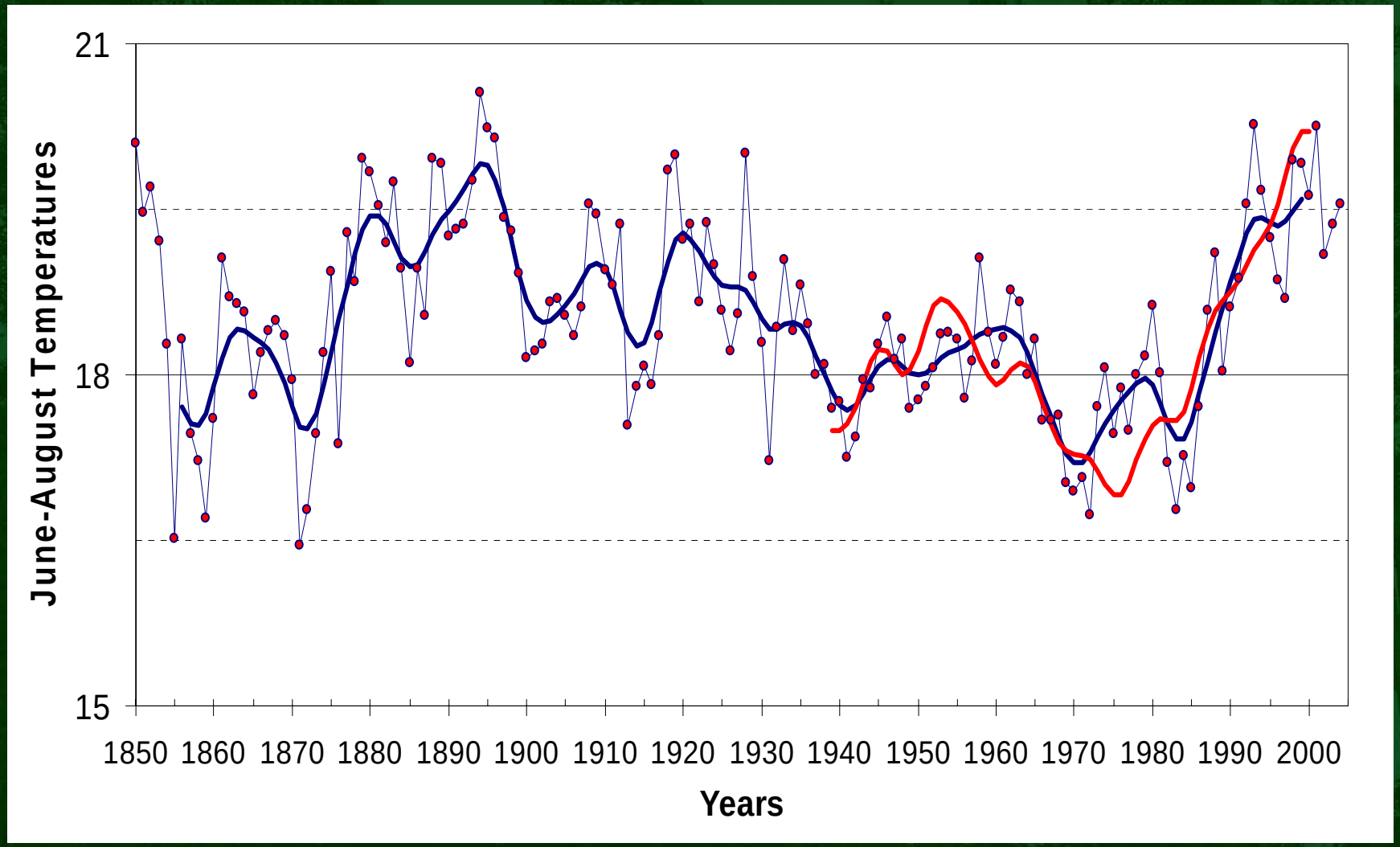
Model for the temperature-growth relationship

$$T_{Summer} = 5.1\,I_{PISY} - 6.1\,I_{PINI} + 25.4$$

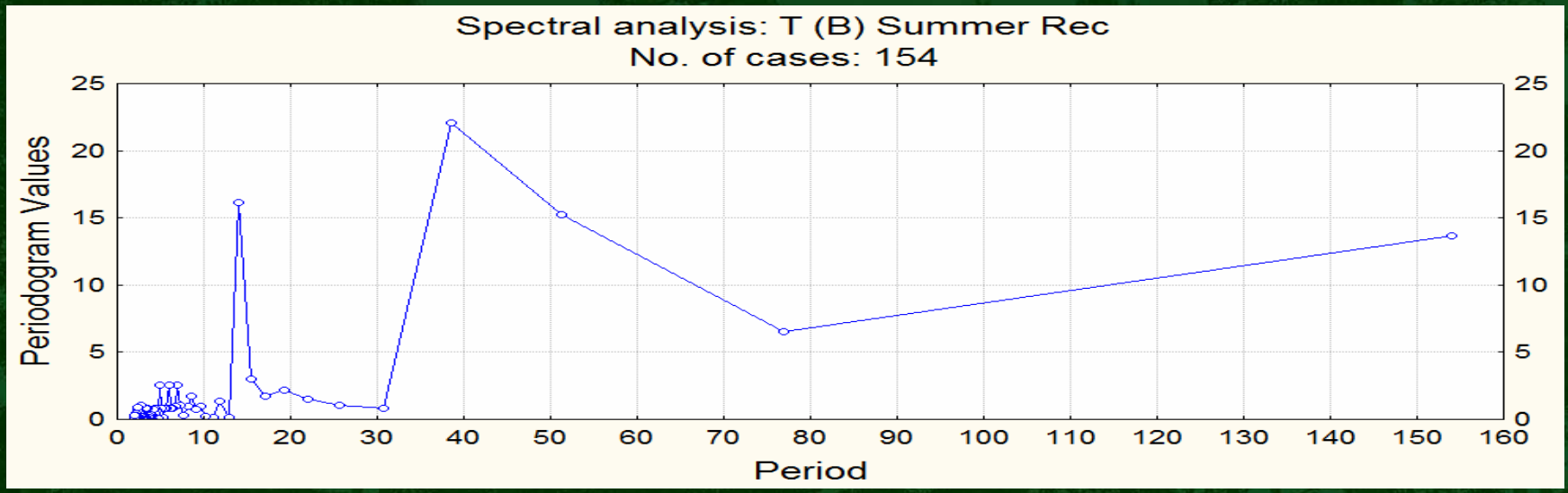
$$R^2 = 0.40$$

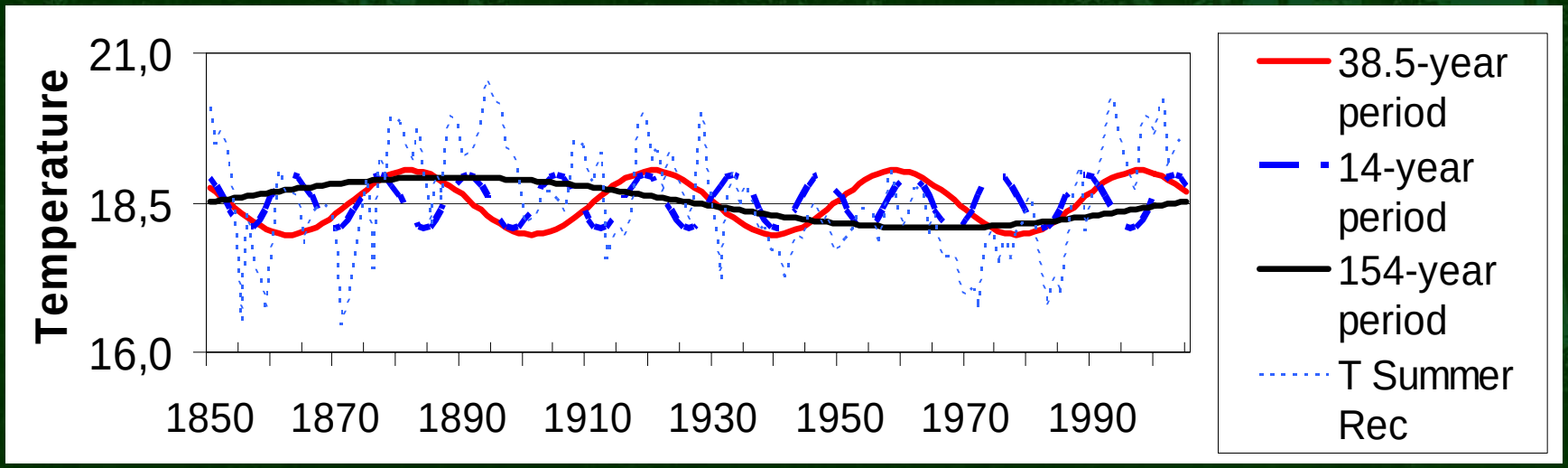
$$p_{PISY} < 0.05; \quad p_{PINI} < 0.05; \quad p_{Intercept} < 0.05$$

Summer mean temperatures reconstruction

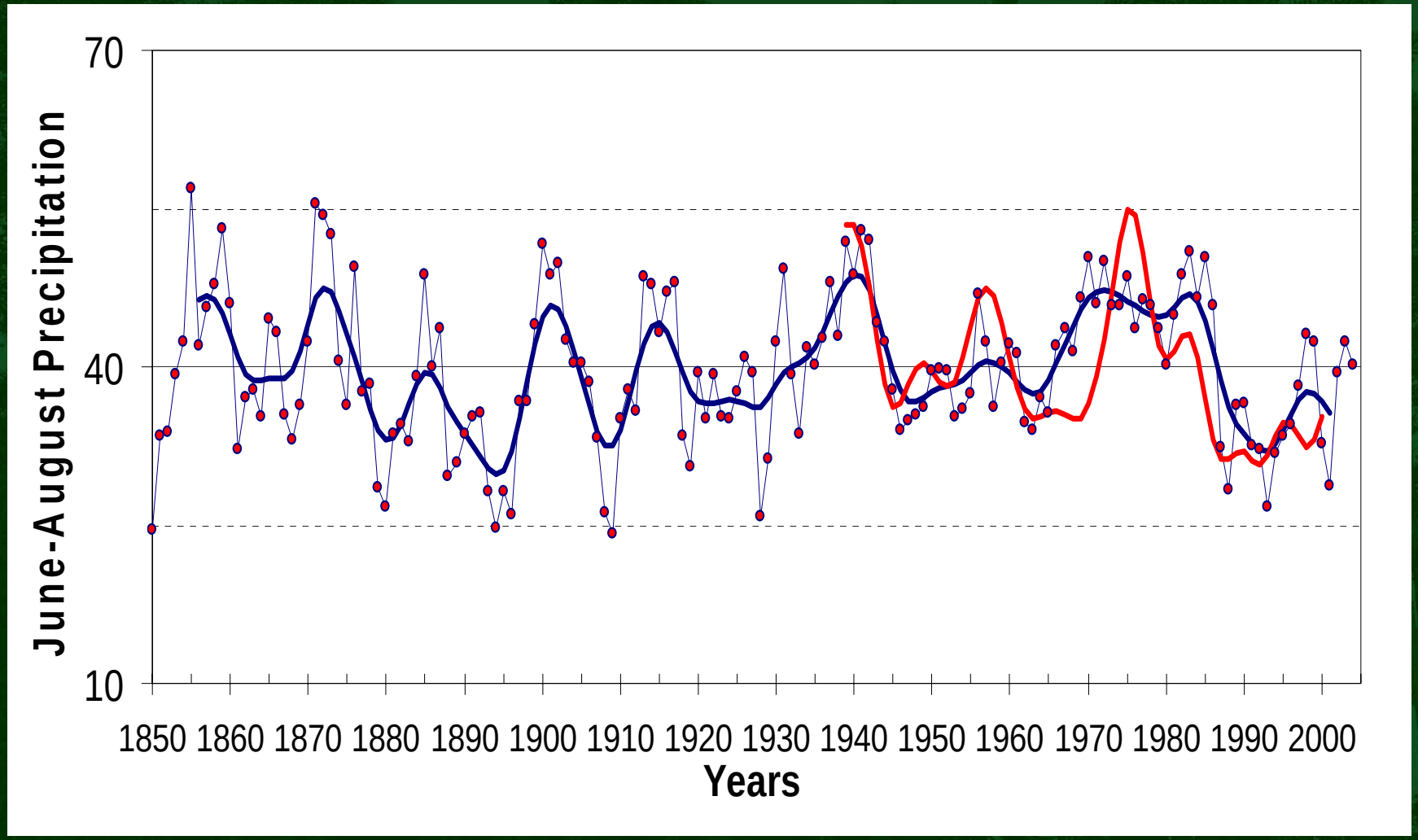


Spectral analysis of the reconstructed temperature record

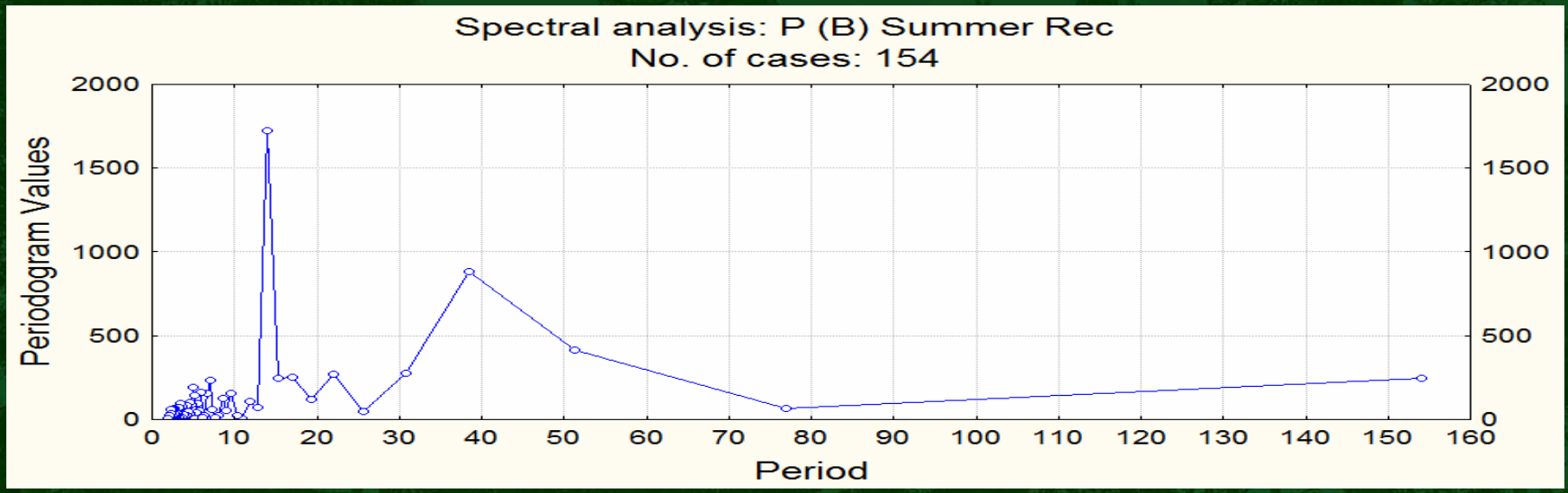


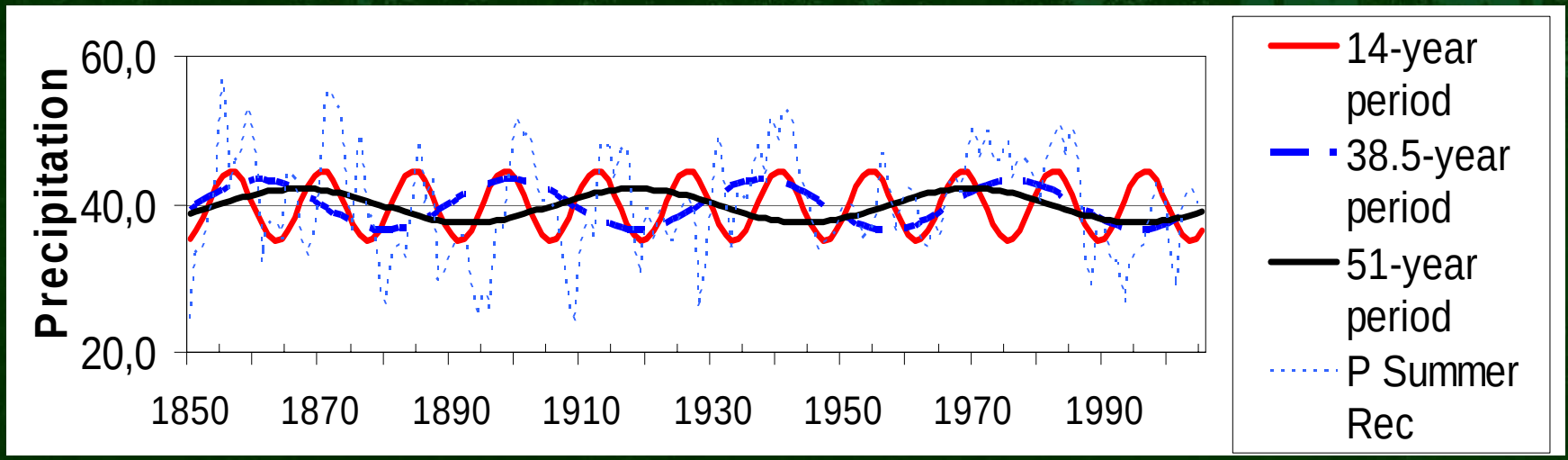


Summer precipitation reconstruction



Spectral analysis of the reconstructed precipitation record





Conclusion

Precipitation and temperature are key variables in environmental change and of primary concern for analyses of the impacts of future changes. However, their variability for the period before the instrumental measurements is still not fully clarified. Thorough knowledge in this field can help for better understanding of the effect of the different climate change drivers. This can be useful also for making more accurate future prognoses. This gap can be filled by dendrochronological analysis of old living and dead trees and by profound statistical analysis. Greater international cooperation is also needed to solve such a global environmental issue.


Thank You for Your attention!