EVALUATION OF COINCIDENCE IN ENVIRONMENTAL PROCESSES

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- An external forcing influence initiates oscillations in environmental processes dynamics and, due to its nature, should be expressed in a certain a priori similarity of the elementary processes induced by this influence.

- The coincidence is suggested to be evaluated by matching of essential features to be further defined.

- The algorithm suggested is based on the isolation of the components characterized either by their coincidence (coincident signs – CS) or noncoincidence (noncoincident signs – NS) in time series of the parameters being studied

Algorithm 1.

$$x_{k,l};\;\; l \in G;\;\; k,\nu \in [0,\, N-1]$$

$$X_{\nu,l} = \frac{1}{N}\sum_{k=0}^{N-1} x_{k,l}\, \mathrm{e}^{-i2\pi\nu k/N} \qquad M_\nu = \Omega_\nu \sum_l \operatorname{sign} X_{\nu,l}$$

"co-filtering" 1

$$Y_{\nu,l} = \begin{cases} X_{\nu,l}, & |M_\nu| = \Omega_\nu \cdot N \\ 0, & |M_\nu| < \Omega_\nu \cdot N \end{cases}$$

"co-filtering" 2

$$Y_{\nu,l} = \begin{cases} X_{\nu,l}, & \operatorname{sign} X_{\nu,l} = \operatorname{sign} M_\nu \\ 0, & \operatorname{sign} X_{\nu,l} \neq \operatorname{sign} M_\nu \end{cases}$$

common signal

$$y_{k,l} = \sum_{\nu=0}^{N-1} Y_{\nu,l}\, \mathrm{e}^{i2\pi\nu k/N}$$

similarity coefficient

$$C(G,l) = \frac{1}{(b-a)N}\sum_{\nu=a}^{b} \mathsf{h}\left(\operatorname{sign} Y_{l,\nu} \times \Omega_\nu \sum_l \operatorname{sign} Y_{l,\nu}\right)$$

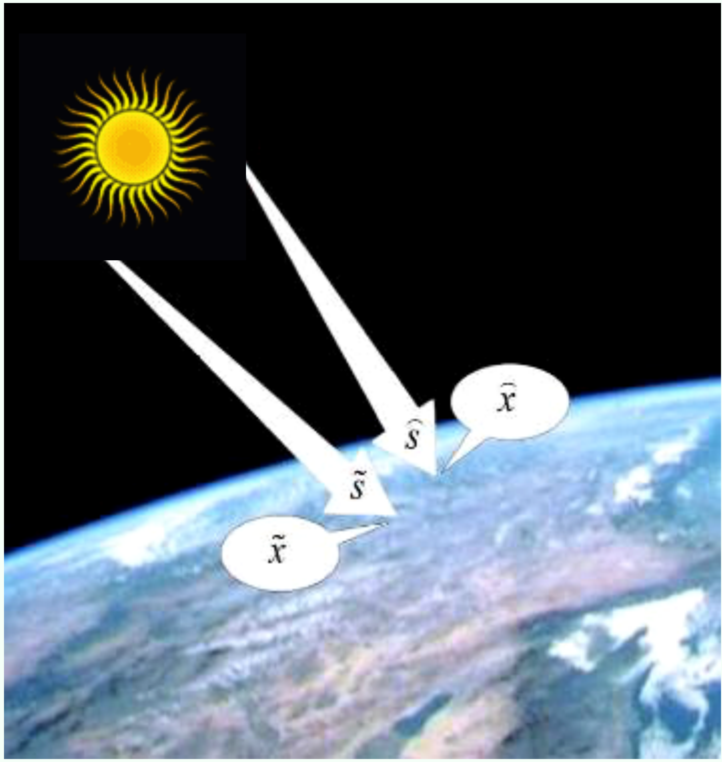
↓

Algorithm 2.

$$H_{\nu,l} = \begin{cases} 1, & \operatorname{sign} S_\nu = \operatorname{sign} X_{\nu,l} \\ 0, & \operatorname{sign} S_\nu \neq \operatorname{sign} X_{\nu,l} \end{cases}$$

$$\hat{S}_{\nu,l} = \begin{cases} S_\nu, & H_{\nu,l} = 1 \\ 0, & H_{\nu,l} = 0 \end{cases}, \quad \hat{s}_{k,l} = \sum_{\nu=0}^{N-1} \hat{S}_{\nu,l}\, e^{-i2\pi\nu k/N}$$

$$\tilde{S}_{\nu,l} = \begin{cases} 0, & H_{\nu,l} = 1 \\ S_\nu, & H_{\nu,l} = 0 \end{cases}, \quad \tilde{s}_{k,l} = \sum_{\nu=0}^{N-1} \tilde{S}_{\nu,l}\, e^{-i2\pi\nu k/N}$$



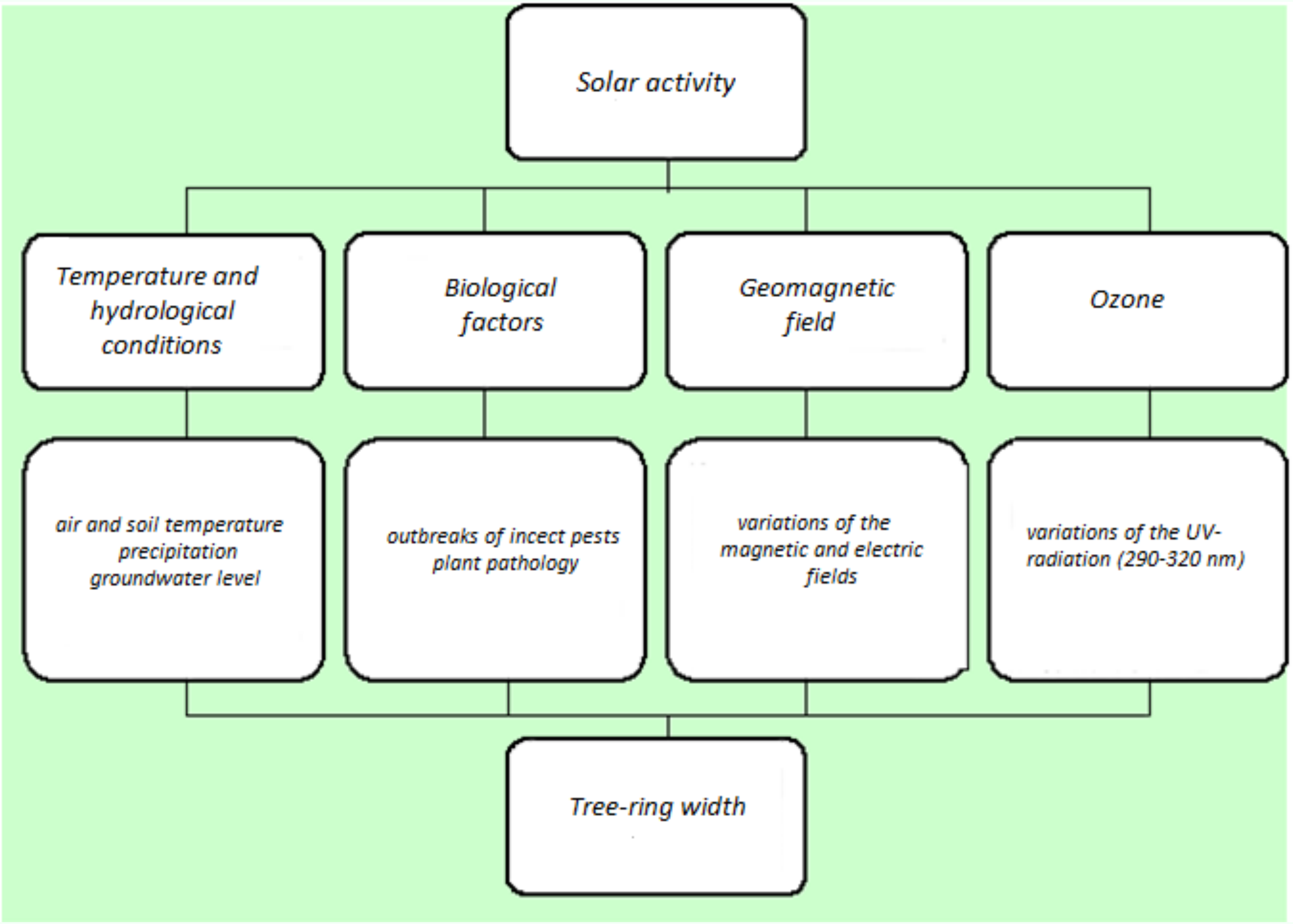
$$\hat{X}_{\nu,l} = \begin{cases} X_{\nu,l}, & H_{\nu,l} = 1 \\ 0, & H_{\nu,l} = 0 \end{cases}, \quad \hat{x}_{k,l} = \sum_{\nu=0}^{N-1} \hat{X}_{\nu,l}\, e^{i2\pi\nu k/N}$$

Coincident components or CS : $\hat{x}_{k,l}$ $\hat{s}_{k,l}$

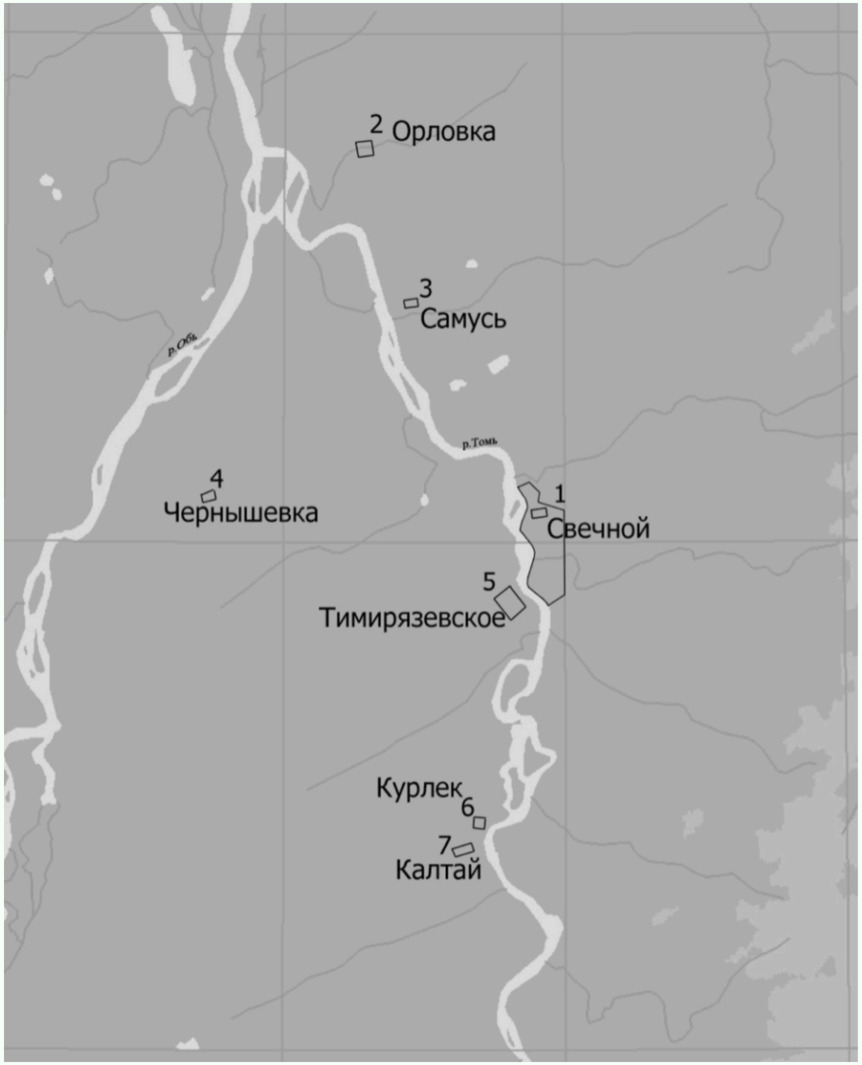
Noncoincident components or NS: $\tilde{x}_{k,l}$ $\tilde{s}_{k,l}$

$$\tilde{X}_{\nu,l} = \begin{cases} 0, & H_{\nu,l} = 1 \\ X_{\nu,l}, & H_{\nu,l} = 0 \end{cases}, \quad \tilde{x}_{k,l} = \sum_{\nu=0}^{N-1} \tilde{X}_{\nu,l}\, e^{i2\pi\nu k/N}$$

What is known about the influence of solar activity on the tree growth?



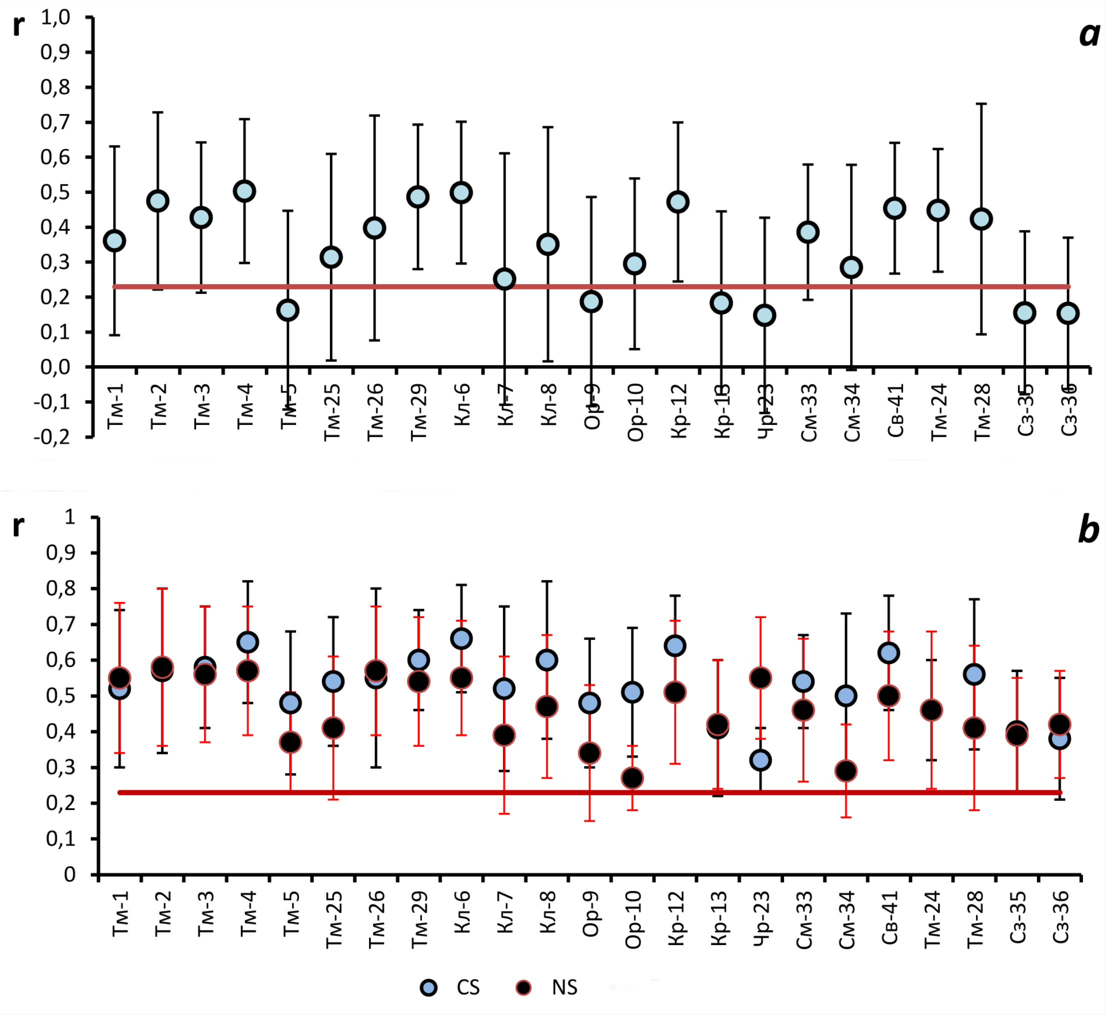
Sampling locations



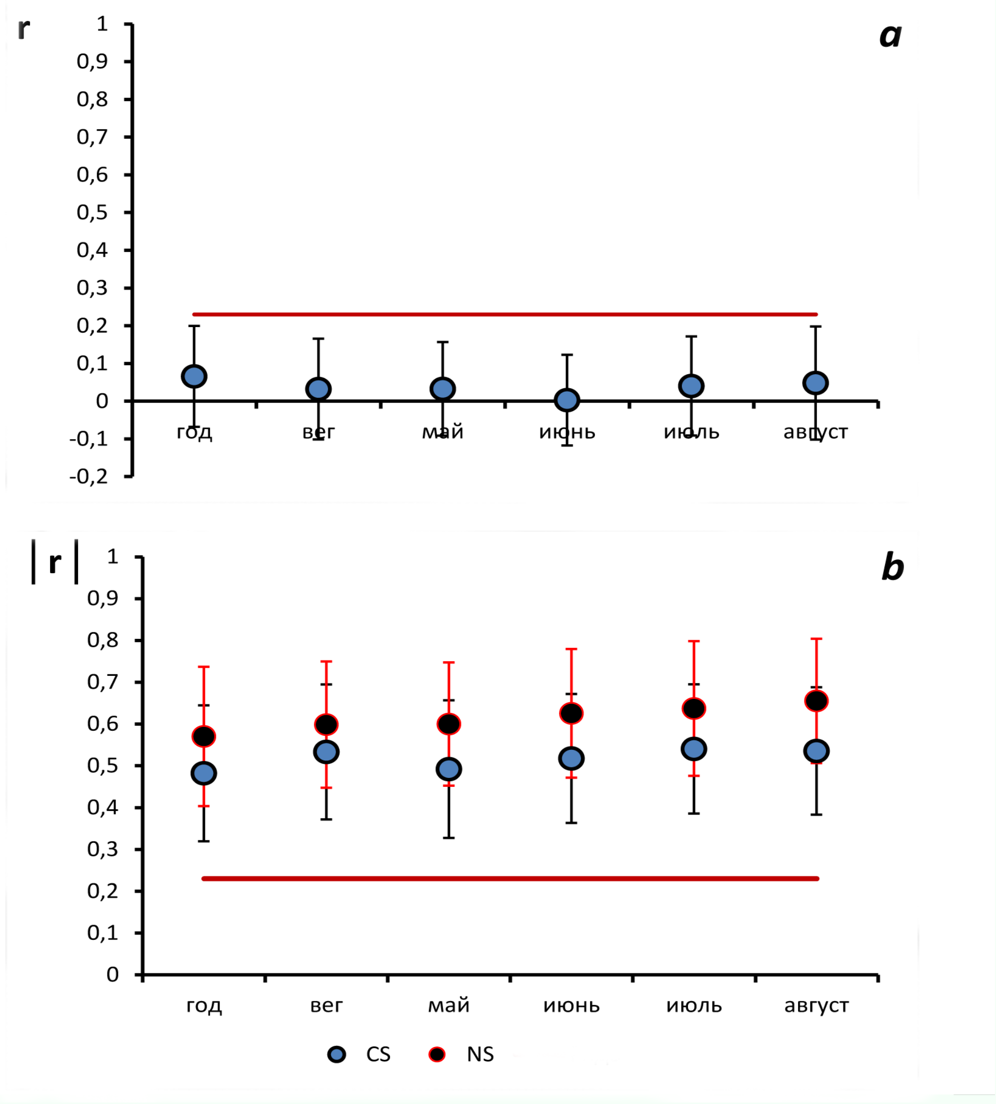
Data

- 518 wood samples were collected.
- Ring width measuring, cross-dating, standartisation were performed using well-known techniques (Rinn,1996; Cook et al., 1990).
- 23 sets of tree-ring series were obtained.
- The tree-ring series with $C \geq 0.7$ were left in each set and used for creating 23 chronologies.
- The sunspot time series were obtained from ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/

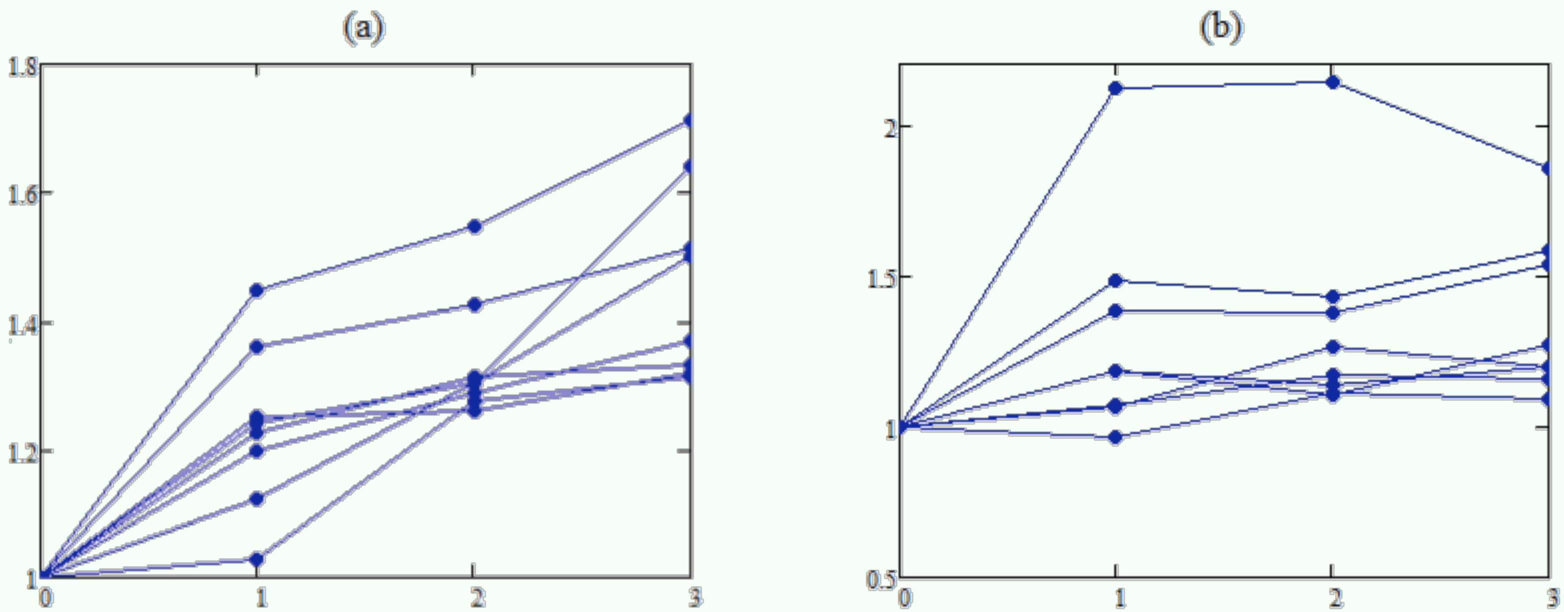
Correlation between original tree-ring chronologies (a), their CS – and NS- components (b).



Correlation between tree-ring chronologies and Wolf sunspot number series (response function)



Tree-ring chronology response on variations of the solar activity



$$R_n^2 = (\hat{r}_n \cdot \vec{r}_n)/(\hat{r}_0 \cdot \vec{r}_0)$$

месяцы	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
s	95,9	94,3	94,2	94,0	96,0	97,5	98,1	100	99,9	98,8	93,1	99,1

Спасибо за внимание!

ИМКЭС СО РАН

CS/NS ГРАНИЦЫ - НУЛЕВЫЕ ИЗОТЕРМЫ