



Paleoclimate reconstructions based on combined annual time series from lake sediments, tree rings and ice core in Altai Mountains (South Siberia)

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Combined reconstruction of summer temperature is made for Altai mountain region using several geochemical parameters of lake sediments together with independent biological series and ice core records. The result appears to be more universal than separate reconstructions by sediments, tree rings and ice core.

The bottom sediments in Teletskoe Lake are studied as a source material for the mathematical treatment. 10 geochemical parameters: Ca, Ti, Mn, Fe, Br, Br/Rb, Br/Sr, Br/Y, Co/Inc, Sr/Rb are considered. The element content are measured by X-ray fluorescence analysis on synchrotron radiation with scanning step 0.2 mm along the sediment core for the time interval AD 530-2010. Geochemical time series are calibrated on meteorological data from local weather stations within AD 1840-2000. All series and meteorological data were preliminary averaged by window 50 years (according to climate definition).

Availability of basic geochemical series and biomarkers (biomarkers and diatoms) extends the scope for quantitative reconstructions of sought quality. Also we added tree-ring and $\delta^{18}O$ series from Belukha ice core for calculation of transfer function.

Temperature (T) and precipitation (Pr) are taken as the main reconstruction (target) climatic parameters. Next target parameter "regional climate type" is formulated as representing different combinations of T and P, "warm-dry" type ($T > 0,83^{\circ}C$ and $Pr < 465mm$), "warm-wet" ($T > 0,83^{\circ}C$ and $Pr > 465mm$), "cold-dry" ($T < 0,83^{\circ}C$ and $Pr < 465mm$) and "cold-wet" type ($T < 0,83^{\circ}C$ and $Pr > 465mm$). Reconstruction of target parameters is made by three methods - regression, discrimination and nearest neighbor. These mathematical approaches yielded very similar results, which increases the reliability of the constructs. Two climatic stages are distinguished in all reconstructions: a "warm-dry" climatic type was dominated in the range of AD 650-1100 years, and "cold-wet" one - in the range of AD 1200-1880 years. Duration of stages was 600-700 years. Transition between different "climatic types" was quickly enough - within 80-100 years. Estimated periodicities have been used to predict climate change in the nearest decades.