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Short-term climate prediction for South-Western Siberia, based on comparison of reconstructed annual temperature variability between recent 430 yrs interval and Roman era warming

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The new microstratigraphic and chronological approaches became available for research of sediment records in situ due to automated high resolution analytical technique for the last 10 years. It provides to obtain continuous series of several physical and chemical parameters along the fresh opened core and in solid preparates as well. Scanning X-ray fluorescence analysis on synchrotron radiation (SR-XRFA) as a high-efficiency method of microelement analysis is adapted to determine more than 35 elements with minimal step 0.1 mm. So it allows revealing intraannual variability of parameters as well as annual- multiannual changes after smoothing.
Teletskoye Lake sediments are studied for the inference of a robust record of climatically driven solid detrital supply from the catchment, because there is no industry and agriculture in this almost non populated area. Sedimentation is rather continuous here because annual clastic supply and deposited mass are the same. The Teletskoye Lake (51°39'N, 87°40'E, 434 m a.s.l.,) is a tectonic lake in the northern part of the Altai Mountains. It has a length of 78 km, a width of 3-5 km and an average depth of 174 m and has a dimictic mixing regime. The combination of extracting sub millimeter resolution SR-XRFA data, isotope Cs-Pb-C age models, and regression based calibration methods were used to reconstruct past environmental changes for the last 3100 yrs beyond instrumental and tree ring limits.
Geochemical parameters used as environmental proxies were following. Br content appeared to be broadly correlative with mean annual temperature variations because of changes of vegetation productivity in catchment. Sr/Rb ratio and Ti content reflected the proportion of the unweathered terrestrial fraction. X-ray density (XRD) appeared to reflect water yield regime and sediment flux. Multiple regression analysis was applied on normalized values in order to obtain the environmental reconstruction. Calibration was conducted with Barnaul instrumental temperature and precipitation data for 1840-1991, with lake level measurements in Yailu station for 1930-2006, with local dendrochronologies and other time series. Before calibration linear scale was transformed to time scale using XRD values as a portion of water content for correction on each step. Both time series of proxies and environmental data were preliminary smoothed by the same run average according to desired time scale.
Variability of annual temperature and of generalized climate index (Dev. T – Dev. P) [1] was considered to search analogues between recent and past time intervals. The best coincidence was obtained for intervals 310BC – 120AD and 1560-1990AD, where correlation coefficient amounted to 0, 44 for 2000 points. The more smoothing of source data was applied – the correlation was higher. Also, sum of single periodicities after spectral Fourier analysis of primary time series showed the same results.
Taking into account this good coincidence, the prolongation of the past temperature profile (moved forward on 1870 years) is possible to consider as predicted time interval after AD1990. The authentic duration of prediction may be accepted not less than 10% of compared time intervals i.e. 40 years. Certainly, it concerns only to natural component of climate variability. Real excess of temperature $\tilde{2}$oC in AD1990-2005 is explained by human impact.

[1] I. Kalugin et al. The 800 year long annual records of air temperature and precipitation over Southern Siberia inferred from high-resolution time-series of Teletskoye Lake sediments. Quaternary Research. 67 (2007) 400–410.