



Relationship between climate and stable isotope ratios in tree rings and its temporal stability

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Tree rings can be used as archives of climatic and environmental data with annual resolution.

Investigations of stable isotopic C, H, and O compositions in α -cellulose extracted from tree rings of pines (*Pinus sylvestris* L.) growing in the ecologically clean Suwalki Region (54°06'N, 22°57'E), North Eastern part of Poland, were undertaken. Climatically, the Suwalki Region substantially differs from other regions of Poland. It is the coldest part of Poland apart from mountains. The instrumental meteorological data used for the investigation date back to 1931, in case of temperature and precipitation, and to 1954, in case of humidity and insolation. Presented isotope records cover the period of 1900-2003. Those measurements constitute a part of the record used for more complex investigations of stable isotopic composition in tree rings for this region of Poland for last 400 years in the frame of European project ISONET.

Values of $\delta^{13}C$ were corrected due to changes of atmospheric CO_2 since industrialization. After making the correction, a strange behavior of $\delta^{13}C$ was observed, especially since 1985 year. For that time almost all values are above the mean value of $\delta^{13}C$ calculated for the period of 1900-2003.

Autocorrelation function estimates for isotope chronology of $\delta^{13}C$ and CO_{2atm} corrected $\delta^{13}C$, $\delta^{18}O$ and δ^2H were determined. It can be concluded that isotope chronologies are not fully random and they exhibit significant deterministic components.

Relationships between isotope values of tree rings and monthly climate data (temperature, sum of precipitation, mean humidity and insolation) were modeled using bootstrapped correlation function in DendroClim2002. Relations between isotopic and meteorological data demonstrate that precipitation influences the stable isotopic carbon, oxygen and hydrogen ratios to a lower extend than temperature. Considering all investigated elements, the hydrogen exhibits the highest correlation with the mean July temperature ($r=0.57$, $n=73$, $p<0.001$). Furthermore, these correlation were proved for various periods of the growth season: May-August, June-August, July-August and August-September. The correlation between annually δ^2H values and mean temperature for June-August is the highest with $r=0.60$ ($n=73$, $p<0.001$). Obtained results confirm that stable isotope compositions of carbon, oxygen and hydrogen can be regarded as indicators of climatic changes.

The temporal stability of climate-proxy connections is an important issue in palaeoclimatic reconstruction. Using a moving interval technique, the temporal stability of correlation between isotope chronology and climate was investigated. The correlations were calculated using DendroClim2002 program for 25-year moving windows for the months and seasons of the highest correlation between climatic and isotopic data. The highest time stability of correlation was found for hydrogen isotope ratios and July temperature.