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Stable isotopes (δ^{13}C and δ^{18}O) in Larix Sibirica tree rings under dry conditions in the forest-steppe in Siberia during the last 150 years

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Tree ring width, density and ratio of stable isotopes (^{13}C/^{12}C and ^{18}O/^{16}O) in wood and cellulose were determined for larch (*Larix sibirica* Ledeb.) growing under water deficit conditions in the forest-steppe zone in Central Siberia. Dendroclimatic analysis of the chronologies indicated precipitation to be the most important factor determining tree-ring structure. Precipitation of June is significantly correlated with tree ring width (TRW) and maximum density (MXD) (r=0.36 and 0.43, p<0.05, respectively). Relations of δ^{13}C and δ^{18}O to precipitation are similar, but the most important month is July (r=-0.47, p<0.05 for δ^{13}C; r=-0.29, p<0.05 for δ^{18}O). Further, δ^{18}O is positively related to the mean temperatures of July (r=0.30, p<0.05). Carbon and oxygen isotope ratios in wood and cellulose showed strong negative trends for the last 100 years. The main reason for this decrease most likely is a shift of the beginning of the vegetation period to earlier dates (up to 1 week) in spring and the use of increased precipitation water stored in soil from October of the previous year. Thus, an earlier start of the vegetation period could lead to tree-ring formation during a period with higher water availability, resulting in stronger isotopic fractionation and ^{13}C-depletion, while using water from October precipitation of the previous year results in the uptake of depleted ^{18}O. The incorporation of this isotopically lighter water during photosynthesis is reflected in the wood and cellulose of tree rings. While growing season precipitation is decreasing at this location, our results show that changes in the seasonality (more winter precipitation, earlier start of growing season) may more than compensate the reduction in summer precipitation and therefore lower the drought stress for trees in the forest steppe.