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Tree ring isotopes of beech and spruce in response to short-term climate variability across Central European sites: Common and contrasting physiological mechanisms

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The combined study of tree-ring width and stable C and O isotopes provides insight in the coherences between carbon allocation during stem growth and the preceding conditions of gas exchange and formation of photosynthates as all influenced by environmental variation.

In this large-scale study comprising 10 sites across a range of climate gradients (temperature, precipitation) throughout Central Europe, we investigated tree-rings in European beech (*Fagus sylvatica*) and Norway spruce (*Picea abies*) trees. The sampling design included larger and smaller trees. The short-term, i.e. year-to-year, variability in the isotope time series over 100 yrs was analyzed in relation to tree-ring growth and climate variation. The generally strong correlation between the year-to-year differences in $\delta^{13}C$ (corrected for the atmospheric shift due to ^{13}C-depleted CO_2 from fossil combustion) and $\delta^{18}O$ across most sites emphasized the role of stomatal conductance in controlling leaf gas exchange. However, the correlation between both isotopes decreased during some periods. At several sites this reduction in correlation was particularly pronounced during recent decades. This suggests a decoupling between stomatal and photosynthetic responses to environmental conditions on the one hand, and carbon allocation to stem tissue on the other hand. Variability in the isotopic ratio largely responded to summer climate, but was weakly correlated to annual stem growth. In contrast, climate sensitivity of radial growth in both species was rather site-dependent, and was strongest at the driest (in terms of soil water capacity) site.

We will also present results of isotope responses with respect to extreme climate events.

Understanding the underlying physiological mechanisms controlling the short-term variation in tree-ring signals will help to assess and more precisely constrain the possible range of growth performance of these ecologically and economically important tree species under future climate conditions.

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