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Water and light improvement after thinning at a xeric site: Which weights the most? A dual isotope approach

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Reductions in stand density foster individual tree growth due to increases of resources such as water, light and nutrients. Detailed knowledge of the short- to long-term physiological response underlying the growth response to thinning is crucial for the management of forests already suffering from recurrent drought-induced dieback.
We applied a dual isotope approach together with mechanistic isotope models such as MuSICA to study the physiological processes underlying growth enhancement in a long-term thinning experiment in a xeric Pinus sylvestris forest in Switzerland. This approach allowed for identifying and disentangling changes in stomatal conductance and assimilation rate. Our results indicate that an increase in stomatal conductance outweighs an increase in assimilation, meaning that the observed growth releases in heavy thinned trees at our xeric site are primarily driven by enhanced water availability rather than by the increase in light availability. We conclude that in areas with isohydric species (drought avoiders) that tend to grow close to their physiological limits, thinning is highly recommended to maintain a less negative water balance and thus foster tree growth, and ultimately the survival rate of individual trees and forests.