Retrospective dual-isotope tree-ring analysis reveals higher responsiveness of crown gas exchange to environmental variation with reduced competition in ponderosa pine (Pinus ponderosa)

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We analysed the oxygen isotopic values of wood (δ18Ow) of 12 ponderosa pine (Pinus ponderosa) trees from control, moderately, and heavily thinned stands and compared them with existing wood-based estimates of carbon isotope discrimination (Δ13C), basal area increment (BAI), and gas exchange to examine if increases in water availability and thus changes in stomatal conductance (gc) were causing higher growth rates after thinning. We conducted a sensitivity analysis to identify additional factors that may influence observed differences in δ18Ow among treatments. We found that heavy thinning (HT) led to more depleted δ18Ow relative to the control throughout the first post-thinning decade, whereas moderate thinning (MT) was not significantly different from controls in δ18Ow. Both HT and MT treatments varied more in ☐18Ow after treatme
analysis suggest six potential drivers of δ18Ow, including source water, environmental drivers and physiological effects. When modelling δ18Ow time-series of the first post-thinning decade using surrogate data of multiple potential drivers at once, the best fit with measured time-series was obtained with a model including relative humidity and δ18O of source water. We conclude that direct effects of physiological parameters were only a minor determinant of δ18Ow in our trees. However, we found insufficient reasons to assume that the ☐18Ow signal an
in relative humidity or source water usage between treatments. Rather, as modelled δ18Ow time series overestimated the magnitude of δ18Ow variation for all treatments but most for control trees, a higher environmental sensitivity maybe due to decreasing reliance on remobilized compounds after thinning. Consequently, the more depleted δ18Ow of HT trees was likely caused by a greater expression of the common trend towards more depleted δ18Ow apparent in all series in the post-thinning period.