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Quantifying intra- and interspecific competition effects on water use of different tree stands using sap flow, terrestrial lidar scan and advances in stable water isotopy

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The ecological impacts of climate change encompass significant consequences on the interactions of soil-plant-atmosphere-continuum and flux dynamics and will thus affect forest ecosystems. Much work needs to be done to understand the distribution of ecosystem specific flow pathways and the characteristic timescales of water movement. Understanding the linkages and interactions between water use strategies, water storage and competition effects can thereby provide valuable knowledge about drought resilience of different tree stands.

We assessed water fluxes and their water stable isotopy at high temporal and spatial resolution to evaluate ecohydrological processes and competition effects on water use strategies in a mixed forest in south-west Germany. Measurements in pure and mixed tree stands with two temperate tree species, European beech (*Fagus sylvatica,* n=18) and Norway spruce (*Picea abies,* n=18), include sap flow, stem water content, in-situ water isotopy, radial stem growth and climate conditions. Furthermore, a terrestrial lidar scan provided tree anatomical characteristics. Our central hypothesis is that species identity and water competition between tree species is a major driver for ecohydrological flux dynamics. Thus, we aim to gain a comprehensive knowledge of water use strategies of the two dominating tree species and their competitive balance.

First results from the wet summer of 2021 indicated that, spruce trees showed lower sap flux densities in mixed stands compared to pure stands. Inversely, beech trees in mixture with spruce had higher sap flux densities than in pure stands. Although we only observed small species-specific differences in stem water content, a competitive impact could be shown on spruce trees by a reduced leaf area density in mixed stand trees. Dynamics in water isotopy of beech trees provided further insight in water use strategies between different stands. Future work will focus on exploring ecohydrological feedback processes and water transit times with high temporal resolution in situ isotope and sap flow measurements and labelling campaigns.