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Continuous Monitoring of Stem Water Potential in Deciduous Forests: Assessing a Novel Microtensiometer for Ecosystem Hydraulics Research

Ruth-Kristina Magh[1], Anna-Lena Günther[1], Anne Klosterhalfen[2], Sharath Paligi[3], Clara Rohde[4], Maren Dubbert[4], Gökben Demir[1,4], and Anke Hildebrandt[1,5]
[1]Terrestrial Ecohydrology, Friedrich Schiller University, Jena, Germany
[2]Bioclimatology, University of Göttingen, Göttingen, Germany
[3]Plant Ecology and Ecosystems Research, University of Göttingen, Göttingen, Germany
[4]Isotope Biogeochemistry and Gas Fluxes, Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany
[5]Computational Hydrosystems, UFZ, Leipzig, Germany

Water potential serves as the primary driver of fluxes within natural ecosystems, representing the energy of water and dictating the direction of flow. As climate change intensifies and summer droughts become more prevalent, comprehending the impact on plant hydraulics becomes imperative. The measurement of water potential in both soil and plants provides insight into the prevailing flow direction, and when coupled with soil moisture and sap flow data, facilitates the quantification of flux sizes.

Traditionally, the measurement of plant water potentials has been conducted destructively and intermittently, often employing techniques such as the pressure chamber. Therefore, datapoints were usually scarce and information unsuitable to capture faster-acting hydrodynamic processes like stomatal responses to atmospheric changes or changes in plant water pools over the diurnal cycle.

In this study, we evaluated the efficacy of a novel microtensiometer for continuous monitoring of stem water potential. Two Florapulse sensors were installed in a beech (*Fagus sylvatica*) and a hornbeam (*Carpinus betulus*) tree, respectively. Stem and leaf water potentials were concurrently measured using a pressure chamber over three consecutive days to validate the functionality of the sensors in these specific species. Notably, the continuously logging microtensiometer demonstrated strong agreement with hourly pressure chamber values (R^2 = 0.8 and 0.72 for beech and hornbeam, respectively).

Subsequently, eight microtensiometers were deployed in a natural mixed-species forest in mid-Germany, complemented by continuous measurements of sap flow, soil moisture, and soil matrix potential. This comprehensive monitoring effort spanned the entire summer of 2023. Analysis of the gathered data enabled the determination of water flow direction and fluxes throughout the monitored period, revealing minimal to negligible water stress in the ecosystem, likely attributable

to the wet summer conditions in the region.

This research showcases the potential of the microtensiometer for advancing our understanding of plant hydraulics in changing climates, providing a valuable tool for continuous and non-destructive monitoring of water potential dynamics in forest ecosystems.