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Elastic Stem Measurements of Above Ground Tree Mass Change

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Trees and shrubs govern to an important extent land-atmosphere interactions through transpiration and evaporation. In order to understand better their hydrological role, practical and accurate methods are needed to measure the water balance of these plants. We present a new approach to monitor water intercepted and stored in tree crowns.

Tree water is stored internally in xylem and leaves, and externally as dew and interception water. Both internal and external vegetation water is subject to change caused by transpiration through leaves and evaporation form the canopy. Canopy interception has been found to be as high as 60% of gross rainfall in moderate climates and up to 30% in semi-arid climates. The movement of water within trees has been widely studied using sapflow techniques. Interception of leaves and branches has yet to be addressed through an in-situ non-destructive method suitable for trees found in natural settings. The method we developed measures total changes in water content of tree crowns.

Our approach measures the trunk compression caused by the increase in water stored in or on the canopy. Using three mechanical displacement sensors over a distance of one meter along the tree trunk, we measure the shortening of the trunk as a function of water storage. The tree trunk basically functions as a (near-)linear spring. The method provides a direct and non-destructive method to measure canopy interception and internal tree water storage over time.