Global Estimates of the Storage and Transit Time of Water Through Vegetation

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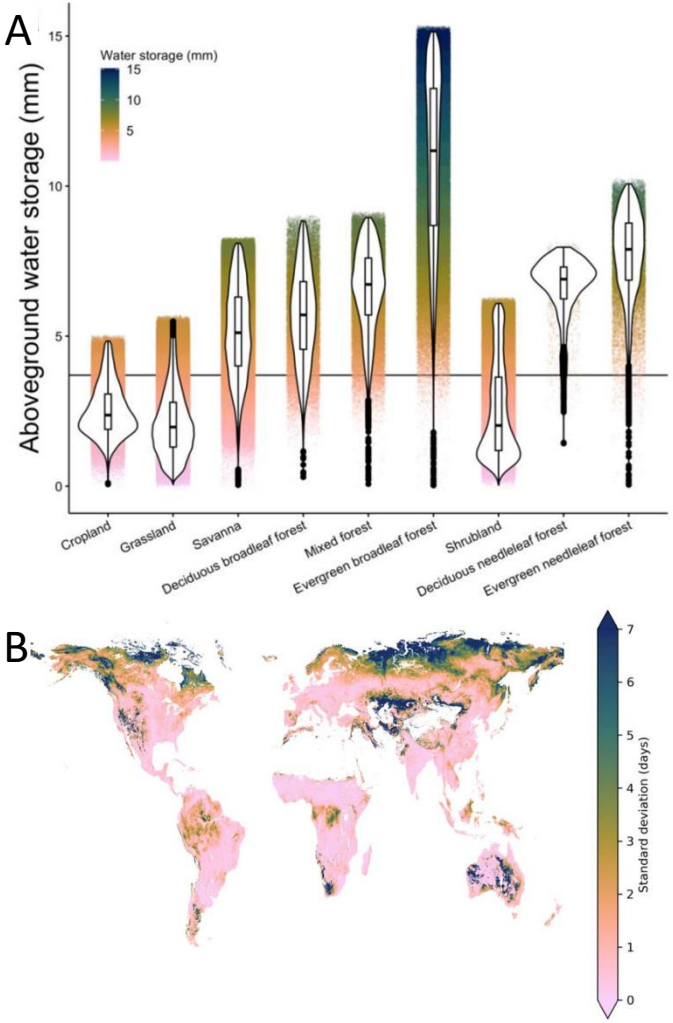
Background: The time it takes for water to transit from the ground back to the atmosphere affects weather, climate, biogeochemistry and ecosystem function. The transit time of water through vegetation, or the age of water transpiring from vegetation since time of entry, is a particularly understudied aspect of the terrestrial hydrologic cycle.

Main Findings: This study used a synergy of satellite remote sensing measurements over a five-year period to estimate global aboveground vegetation water storage, found to be on average 484 km^3 (Figure A). Roughly half of this is stored in Earth's water-limited savannah, grassland and shrubland ecosystems.

These storage estimates were then combined with additional remotely sensed data of transpiration to understand water transit periods (Figure B). The mean transit times of water through aboveground vegetation vary from ~5 days in croplands to ~18 days in evergreen needleleaf forests, with a global median of 8.1 days. In herbaceous-dominated land cover types with comparatively low water storage and high seasonal water use, such as grasslands, the water stored in biomass may be frequently transiting in less than one day.

Impact: This study's estimates contribute to resolving the role of vegetation in the terrestrial hydrologic cycle; plants store little water compared to other pools, and the time it takes to return that water to the atmosphere is among the fastest components of the hydrologic cycle. These estimates improve an understanding of Earth's hydrologic cycle which can inform predictions of water availability, resilience to weather extremes, and responses to land use.



Global patterns of aboveground vegetation water storage.

Aboveground water storage as violin- and boxplots among different land cover types, where the horizontal line represents the global median (3.74 mm). Boxplots depict the median (center), the 25th and 75th percentiles (lower and upper hinges), and whiskers which extend 1.5 times the interquartile range from each hinge.

Interannual variability in transit times.

Five-year (2016-2020) standard deviation in mean (annual) transit time for pixels with an average of at least four months of transit time data; each pixel depicts interannual variation in mean transit time estimates.

Felton, A.J., Fisher, J.B., Hufkens, K., **Purdy, Adam J.**, *et al*. Global estimates of the storage and transit time of water through vegetation. *Nat Water* **3**, 59–69 (Jan 2025). https://doi.org/10.1038/s44221-024-00365-9