THE ROLES OF SHALLOW AND DEEP STORAGE ON DROUGHT AT A SMALL FORESTED, WATER-LIMITED WATERSHED NEAR ATLANTA, GEORGIA

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Southeastern U.S. experiences recurring hydrological droughts, which can reduce water availability needed for human consumption and aquatic ecosystems and can result in water-limiting conditions that can reduce plant growth and health. Long-term monitoring at Panola Mountain Research Watershed, a small 41-hectare forested watershed in the Piedmont near Atlanta, Georgia, was used to study and quantify the roles of shallow and deep storage on drought. Watershed storage (WS) was estimated monthly from 1985 through 2015 using a water budget approach combined with a baseflow-WS relationship. Shallow storage (SS) was assessed using data from a soil moisture profile for 2005 and 2007–2015. Water-limiting conditions occurred by the end of summer in most years as SS was depleted by evapotranspiration (ET) while deeper storage was unavailable for ET during dry conditions. The majority of deeper storage recharge occurred during the winter and required SS to first be recharged to a wetted state. Low WS at the end of the previous fall and low winter precipitation (P) resulted in low WS at the beginning of the growing season that almost always resulted in low stream base flows and drought conditions during the summer—as little recharge occurred in the summer. Summer recharge required wet SS conditions and exceptionally high P that exceeded high potential ET. A hydrologic persistence analysis was performed to assess the importance of past hydrologic conditions on WS, Monthly-standardized WS was significantly correlated (p-value <0.05) with past monthly-standardized WS for the previous 19 months and with past monthly P for the previous 11 months. These results are in contrast to a recent study of five nearby non-water-limited watersheds that indicated P was a more important control than WS on WS persistence. These differences likely result from summer P rarely contributing to increases in WS in the water-limited watershed.

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