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# Forest - water dynamics in a Mediterranean mountain environment.

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In semi-arid Mediterranean mountain environments, the soil layer is very shallow or even absent due to the steep slopes. Soil moisture in these environments is limited, but still vegetation thrives. There is limited knowledge about where the vegetation extracts the water from, how much water it uses, and how it interacts with other processes in the hydrological cycle. The main objective of this study is to quantify the water balance components of a Pinus brutia forest at tree level, by measuring the tree transpiration and the redistribution of the water from trees to the soil and the bedrock fractures. The study area is located on a forested hill slope on the outside edge of Peristerona watershed in Cyprus.

The site was mapped with the use of a total station and a differentially-corrected GPS, in order to create a high resolution DEM and soil depth map of the area. Soil depth was measured at a 1-m grid around the trees. Biometric measurements were taken from a total of 45 trees. Four trees were selected for monitoring. Six sap flow sensors are installed in the selected trees for measuring transpiration and reverse flows. Two trees have two sensors each to assess the variability. Four volumetric soil moisture sensors are installed around each tree at distances 1 m and 2 m away from the tree trunk. An additional fifth soil moisture sensor is installed in soil depths exceeding 20-cm depth. Four throughfall rain gauges were installed randomly around each tree to compute interception losses. Stemflow is measured by connecting an opened surface plastic tube collar at 1.6 m height around each tree trunk. The trunk surface gaps were filled with silicon glue in order to avoid any stemflow losses. The plastic collar is connected to a sealed surface rain gauge. A weather station monitors all meteorological variables on an hourly basis. Results showed a maximum sap flow volume of 77.9 L/d, from November to January. The sensors also measured a maximum negative flow of 7.9 L/d, indicating reverse flow. Soil moisture ranged between 10 to 37 % at all sensors.

Soil moisture contents showed an increase over 100% after rainfall events, but decreased quickly. Also individual sensor peak values were recorded when rainfall was not occurring, indicating soil moisture increase as a result of reverse flow. Interception losses revealed values, ranging from 10% to 50 % of the total rainfall. Stem flow was recorded after intense rain fall events.

To our knowledge, this is the first water use quantification study for Pinus brutia trees. The negative sap flow implies that these trees have the ability to harvest water from the air moisture and redistribute it in the ground. Perhaps part of the intercepted water is captured by the tree and thus contributing to the negative sap flow. All the variables will be monitored for two more years to quantify the role of the trees in the water balance of the area.