EGU2020-14815
https://doi.org/10.5194/egusphere-egu2020-14815
EGU General Assembly 2020

Linking hydrological response to forest dynamics in Mediterranean areas: a new experimental catchment in the Apennine Mountains, Tuscany, Italy

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The bi-directional ecohydrological interactions between forest dynamics and catchment hydrological response in Mediterranean forest ecosystems remain poorly conceptualized. Understanding the effect of tree water uptake and transpiration patterns on how catchments store and release water and, vice versa, on how catchment water availability affects tree physiological response is of paramount importance for forest and water resource management. This is crucial in the light of the predicted prolonged drought periods that will exacerbate the dry summer spells that characterize Mediterranean areas. In order to address these pressing issues, a new experimental mountain forested catchment for interdisciplinary ecohydrological research has been recently implemented in the Tuscan Apennines (Italy).

The catchment size is 2 km^2 and elevation ranges from 650 to 1280 m a.s.l.. Forest covers more than 95% of the area, and the main tree species are beech and oak trees, with a much smaller proportion of conifers. Mean annual precipitation is around 1180 mm. Instrument installation is currently in progress and supported by two research projects (run in parallel in Italy and Luxembourg). By spring 2020, the catchment is expected to host the following equipment: one weather station plus one additional rain gauge, including a rainfall collector for isotope analysis; four stream gauges at different spatial scales (from a 2-ha headwater subcatchment to the catchment outlet) including continuous electrical conductivity measurements; three groundwater wells (ranging from 2 to 5 m depth) equipped with water level and electrical conductivity loggers; a network of soil moisture sensors at different depths; stemflow collectors; rain totalizers for manual throughfall measurements; a network of innovative multi-parametric sensors mounted on individual beech trees for continuous measurement (logging to cloud) of physiological and micro-

meteorological parameters (sap flow, stem radial growth, canopy light transmission, stem wood temperature and humidity, 3D position over time, and air temperature and relative humidity).

Preliminary data collected in 2019 show a marked seasonality of stream runoff, with low runoff coefficients in summer (<0.1), consistent with the high drainage of forested soils and large evapotranspiration fluxes. Stream electrical conductivity values increase from upstream to downstream sections, showing a consistent spatial variability among seasons and suggesting an increasingly relevance of subsurface flow for sustaining baseflow. Marked diel fluctuations in stream water levels during sunny summer days suggest a dominant control of tree transpiration on streamflow. Near-surface soil moisture spatial patterns at the hillslope scale show strong temporal stability. Future experimental activities will assess water pools used by beech trees along a hillslope. Planned tools and research include water stable isotopes, seasonal variations in canopy interception, stemflow, and throughfall as well as the spatio-temporal variability of soil moisture patterns at the plot, hillslope, and catchment scale.