OPTIMIZATION OF HYDROLOGICAL PARAMETERS OF CONIFER TREES IN THE SOUTHERN SIERRA NEVADA

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Understanding the hydrologic response and finding the properties of soil-plant-atmosphere continuum (SPAC) systems with large trees, requires unique modeling and parameter optimization approaches. Our case studies include two different conifer trees in a mid-latitude montane forest ecosystem, located in the King's River Experimental Watershed as part of the Southern Sierra Critical Zone Observatory (CZO). Each system is monitored with sensors measuring soil water potential, soil water content, stem matric potential and sap flux, spatially distributed around and within the tree plot. Additionally, meteorologic data is used to acquire atmospheric conditions and forcings, and specifically for evaluating potential evapotranspiration (ET).
The SPAC is modeled as variably saturated porous media, utilizing the HYDRUS finite-element code, that includes the interactions between the different domains: soil, tree, and atmosphere, in a continuum approach. Actual ET and root uptake (RU) are modeled by accounting for canopy and root distributions together with matric potential stress in the soil-tree domains.
We wrap this model in a statistical optimization framework to estimate the van Genuchten parameters of the tree and the soil, critical Feddes parameters of the root domain and a multiplier that acts on the ET to retrieve site specific boundary conditions. The optimization makes use of Markov Chain Monte Carlo (MCMC) in applying current versions of the DREAM_ZS optimization code. We present results of the parameter optimization for time periods in different seasons, discuss the viability of simultaneous use of sap flux and soil water content measurements and use the optimized parameters to study the influence of soil water stress on the soil-root-tree system.