Poster #21-11

On Dry Season Transpiration

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BER Program: SBR
Project: University Award

Water is the principal regulator in biosphere-atmosphere interactions. High-frequency observations at a steep hillslope in the Mediterranean climate of northern California show that different proximate evergreen species have very different transpiration seasonality. A surprise is that Pacific Madrones show maximal daily transpiration in the dry summer season, with concomitant on impacts local energy and CO2 exchange (Link et al. 2014). We hypothesize that the tree roots at the site have access to a deep store of water, as the water table some 20 meters below the surface exhibits very dynamic fluctuations with every rain storm. With DOE support, we have developed a stochastic parameterization of hydraulic conductivity that takes into account preferential flow through weathered bedrock (Vrettas and Fung, 2015), and applied the Richards Equation with the new parameterization to investigate the impact of subsurface water storage capacity (especially in the weathered bedrock) and rooting structure on the timing and magnitude of transpiration (Vrettas and Fung, 2017). The results show that it is the root mass below 4 meters that access the moisture in the weathered bedrock.

We have analyzed USDA Forestry Inventory and Analysis DataBase (FIADB) and mapped the spatial distribution of the 98 tree species in California. Our analysis shows tree mortality during the 2012-2016 drought does not map onto precipitation deficits for the period, but corresponds with differences in the root structure of the different species. We thus hypothesize that deep water stores accessible to deep roots are not unique to the research site, and could explain differential resilience to droughts and insect infestations across a landscape.

References:
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