AGU FALL MEETING
San Francisco | 12–16 December 2016

EP41F-07: Ecohydrological Consequences of Critical Zone Structure in the Franciscan Formation, Northern California Coast Ranges

Thursday, 15 December 2016
09:30 - 09:45
Moscone West - 2003

Water availability regulates ecosystem function, particularly in seasonally dry climates where lack of moisture in the growing season acts as an ecological bottleneck. Water within hillslopes is extracted by plants during transpiration and also delivered to streams to support baseflow for riparian ecosystems and human use. How water is stored and then released from hillslopes is strongly influenced by the structure of the critical zone (CZ) that emerges from the complex interaction of lithology, climate, and tectonics. Here we show how contrasting CZ development has extreme ecohydrological consequences in the seasonally dry climate of the Northern California Coast Ranges. To explore how the CZ transmits and stores water, we studied hydrologic dynamics at two sites with similar climate across belts of the Franciscan Formation in the Eel River CZO. We monitored plant water use, precipitation inputs and stream runoff, groundwater and vadose zone moisture dynamics and documented near-surface hydraulic conductivity and runoff-generation processes. We investigated CZ structure via boreholes and geophysical methods. We find that CZ thickness determines the extent to which hillslopes 'shed' or 'store' wet season precipitation, and fundamentally controls the structure of plant communities and summer low-flows. In a climate where winter precipitation regularly exceeds 2000 mm, the thin CZ of the sheared argillite matrix Central belt rapidly fills, resulting in wet-season saturation overland flow that drives flashy winter runoff in channels that then quickly run dry in the early summer. The maximum unsaturated moisture storage of approximately 200 mm is sufficient to host an ecologically diverse yet sparsely forested oak savanna. In contrast, the thick CZ of the interbedded argillite and greywacke Coastal belt stores up to 600 mm of winter precipitation in the unsaturated zone and a seasonal groundwater system within fractured bedrock provides year-round flow to channels, supporting dense mixed coniferous-broadleaf evergreen forest and native resident salmonids. These findings underscore the importance of understanding how the structure of the CZ develops by directly pairing hillslope moisture storage and release to the composition and resilience of terrestrial and aquatic ecosystems.

Authors

William Jesse Hahm *
University of California Berkeley

Sky Lovill
University of California Berkeley

William E Dietrich
University of California Berkeley

Daniella Rempe
University of California Berkeley

Todd E Dawson
University of California Berkeley

Find Similar

View Related Events

Day: Thursday, 15 December 2016