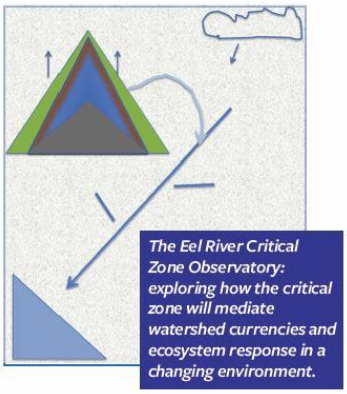
National CZO Program | CRITICAL ZONE OBSERVATORIES
studying the zone where rock meets life
funded by NSF

Eel River Critical Zone Observatory

Research Focus: Watershed Currencies & the Critical Zone

The Eel River CZO is tracking watershed currencies including water, solutes, gases, sediment, biota, energy and momentum through intensive field monitoring. These currencies move through the subsurface physical environment and microbial ecosystem into the terrestrial ecosystem, up into the atmosphere, and out through diverse drainage channel networks, which mediate the delivery of nutrients to coastal ecosystems.

The critical zone (schematic, at right) of vegetation (*green*), soil and weathered bedrock with perched water table (*red to blue*), overlying fresh bedrock (*grey*) that exchange currencies (*arrows*) with atmosphere (clouds) and mediates effluents (*curved arrow*) to the channel network (*lines*) which drain to the ocean (*blue triangle*).

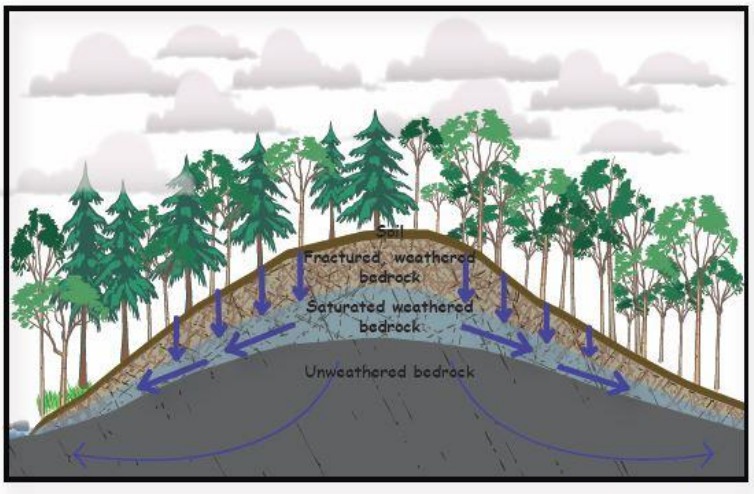

The Eel River Critical Zone Observatory: exploring how the critical zone will mediate watershed currencies and ecosystem response in a changing environment.

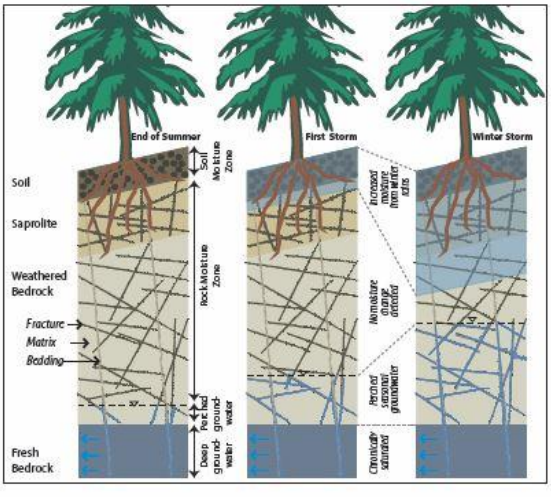
Research Questions:

1. Does lithology control rock moisture availability to plants and therefore overall resilience of vegetation to climate change in seasonally dry environments?
2. How are solute and gas effluents from hillslopes influenced by biota in changing moisture regimes?
3. What controls the spatial extent of wetted channels in the channel networks of seasonally dry environments?
4. Will changes in critical zone currencies induced by climate or land use change lead to threshold-type switches in river and coastal ecosystems?

Modeling Framework:

Our Atmosphere, Watershed, Ecology, Stream and Ocean Model (AWESOM) will predict watershed currency dynamics as mediated by the critical zone and link them to climates in four distinct ecosystems: forests, subsurface (soil to the base of the weathered bedrock), streams, and coastal oceans. AWESOM will build upon existing models to explicitly explore critical zone influence on watershed currencies and relate these dynamics to ecosystem fates in a changing world.

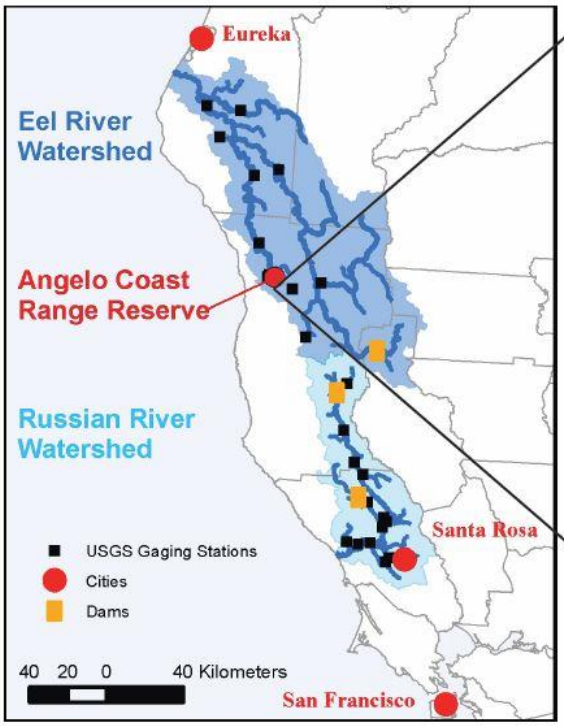


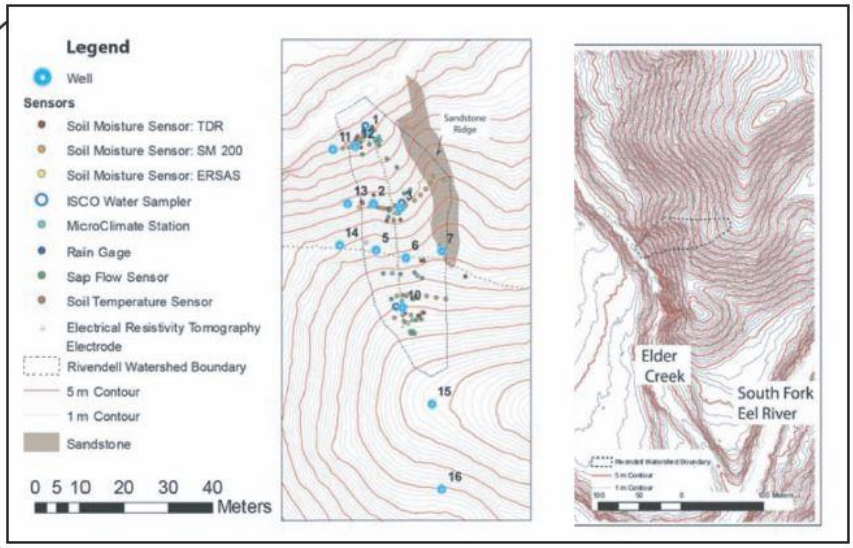


Idealized cross-section through the hillslope (left) and profiles (right) showing vertical structure and seasonal rapid injection of winter rain via fracture flow to perched water table, as soil and saprolite and weathered bedrock more slowly gain moisture (Salve et al. 2012).

Northern California Study Sites:

The Eel River watershed (9540 km^2) and its southern neighbor, the Russian River watershed (4260 km^2) offer an ideal opportunity to conduct fine scale research in the critical zone, including following currencies to the atmosphere, streams and oceans as they drive, and are altered by, a succession of ecosystems and exploring how these variables impact management practices with changing climate and land use.





We have been intensively monitoring a ~4000 m² north facing hillslope underlain primarily by mudstone adjacent to Elder Creek in the South Fork Eel River watershed since 2007. We plan to expand the monitoring to the south facing hillslope and to add another, less instrumented hillslope on mélange.

Recent publications:

Dralle, D.N., Boisrame, G.F.S. & **Thompson, S.E**. *in press*. Spatially variable groundwater recharge and the hillslope hydrologic response: Analytical solutions to the linearized hillslope Boussinesq equation. Water Resources Research.

Kim, H., Bishop, J.K.B., Dietrich, W.E. & **Fung, I.Y.** 2014. Process dominance shift in solute chemistry as revealed by long-term high-frequency water chemistry observations of groundwater flowing through weathered argillite underlying a steep forested hillslope. Geochimica et Cosmochimica Acta 140: 1-19.

Muller, M.T., **Dralle, D.N.,** & **Thompson, S.E.** *in press*. Analytical model for flow duration curves in seasonally dry climates. Water Resources Research.

Rempe, D.M. & **Dietrich W.E**. 2014. A bottom-up control on fresh-bedrock topography under landscapes. Proceedings of the National Academy of Sciences 111 (18): 6576-6581.

Vico, G., **Thompson, S.E**., Manzoni S., Molini, A., Albertson,m J.D., Almeida-Cortez, J.S., Fay, P.A., Feng, X., Guswa, A.J., Liu, H., Wilson, T.G. & Porporato, A. *in press*. On the interplay among climate, ecophysiological traits and leaf phenology in shaping plant ecohydrological strategies in seasonally dry ecosystems. Ecohydrology.

Berkeley
UNIVERSITY OF CALIFORNIA

Eel River CZO website: http://criticalzone.org/eel/
Keck Hydrowatch data: http://sensor.berkeley.edu

Director: William E. Dietrich
Deputy Director: Sally Thompson
Project Coordinator: Jennifer Hunter
Data Manager: Collin Bode
Co-PIs and senior personnel at UC Berkeley:
Jill Banfield, James Bishop, Stephanie Carlson, Todd Dawson, Mary Firestone, Inez Fung & Mary Power

CZO National Program: http://criticalzone.org/national