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Allison Goodwell

Allison bio:
Allison is a new assistant professor in Civil Engineering at CU Denver, with a sub-focus in environmental engineering, sustainability, and hydrology. She is originally from Indiana, and received her PhD from the University of Illinois in 2017. Her research area is in complex systems and information theory applications to understand ecosystem and ecohydrologic behaviors. At CU Denver, she currently teaches CVEN 2200, Computational Methods for Civil Engineers, and CVEN 5407, Complex Systems Modeling for Sustainability Analysis. In her spare time, she has been busy exploring Colorado and doing crochet projects based on hydrologic datasets.

Title:
It’s raining bits: How information measures reveal connectivity in ecohydrologic systems

Short abstract:
Ecohydrologic fluxes within atmosphere, canopy and soil systems exhibit complex and joint variability. This complexity arises from direct and indirect forcing and feedback interactions that can cause fluctuations to propagate between water, energy, and nutrient fluxes at various time scales. In this talk, I will present two recent studies where we construct Temporal Information Partitioning Networks (TIPNets), based on information theory-based measures, to identify time-dependencies between variables. First, we relate process connectivity to varied flux responses to moisture-related perturbations based on flux tower transect data from two Critical Zone Observatories (CZOs). Second, we apply information partitioning metrics to a gage-based rainfall dataset to assess how rainfall persistence, or temporal structure, varies over the continental U.S. and over time. These studies present novel ways to gage the responsiveness of ecosystem fluxes to disturbances, and characterize changes in temporal structure of rainfall occurrences that may propagate downstream. Results are relevant to ecosystem resilience under a changing climate, and can lead to a greater understanding of shifting behaviors in many types of complex systems.

Abstract (detailed version)
Ecohydrologic fluxes within atmosphere, canopy and soil systems exhibit complex and joint variability. This complexity arises from direct and indirect forcing and feedback interactions that can cause fluctuations to propagate between water, energy, and nutrient fluxes at various time scales. A characterization of the time-dependent and multivariate connectivity between processes, fluxes, and states can help us understand how ecohydrologic systems respond to a range of disturbances. In this talk, I will present two recent studies where we construct Temporal Information Partitioning Networks (TIPNets), based on information theory-based measures, to identify time-dependencies between variables. First, we relate process connectivity to varied flux responses to moisture-related perturbations based on flux tower transect data. At the Reynolds Creek Critical Zone Observatory (CZO) in Idaho, we detect a significant network response to a large 2015 dry season rainfall event that enhances microbial respiration and latent heat fluxes. Along a transect in the Southern Sierra CZO in California, we explore network properties in relation to drought responses from 2011 to 2015. Next, we apply information partitioning metrics to a gage-based rainfall dataset to assess how rainfall persistence, or temporal structure, varies over the continental U.S. and over time. While predictability, in the form of information content, is highest in the western U.S, we find that the relative influence of longer time-lagged histories on predictability is highest in the east. These studies present a novel use of information theoretic measures to gage the responsiveness of ecosystem fluxes to disturbances, and characterize changes in temporal structure of rainfall occurrences that may propagate downstream. These results are relevant to ecosystem resilience under a changing climate, and can lead to a greater understanding of shifting behaviors in many types of complex systems.