



Snowpack loss and the cascading hydrologic impacts due to climate change

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Abstract:

Water management in the western United States (WUS) has a long-held reliance on snowpack, but anthropogenic climate change is decreasing seasonal snowpacks globally, posing substantial, potentially even catastrophic consequences on water resources. This seminar will present a synthesis of 21st century WUS snowpack projections and discuss the trickle-down impacts on the greater hydrologic cycle to better constrain the timeline of impending water failures. Through a new definition of low-to-no snow and a framework to contextualize the sequencing of snow drought years, results show that across the WUS, snow water equivalent is expected to decline ~25% by 2050, with losses comparable to historical trends. Using this framework, models suggest low-to-no snow will become persistent in ~35–60 years in the WUS if greenhouse gas emissions continue unabated.

These changes have potentially outsized impacts on the integrated hydrologic cycle. Many approaches struggle to infer the specific impacts given competing factors such as increased evapotranspiration, altered vegetation composition, and changes in wildfire behavior in a warmer world. Coupled atmosphere-through-bedrock models driven by high performance computing are powerful tools to disentangle non-linear and co-evolving processes across the critical zone in montane environments. Examples of recent advancements will be discussed, with a focus on the fundamental physical drivers of change. These include the role in which large precipitation events (including rain-on-snow events typical of atmospheric rivers) play on groundwater, as well as how atmospheric changes in future nearly snow-free years result in more ephemeral streams. These snow and hydrodynamic changes undermine conventional WUS water management practices. However, proactive implementation of soft and hard adaptation strategies provide a potential avenue to build resilience to extreme, episodic and, eventually, persistent low-to-no snow conditions. State and Federal investments offer a timely opportunity to address these vulnerabilities, but such investments require a portfolio of activities that can only be targeted by research that cross historically siloed physical and disciplinary boundaries.

Speaker Bio: Dr. Erica Siirila-Woodburn is a Research Scientist in the Earth and Environmental Sciences Area at Lawrence Berkeley National Laboratory studying above-and-below-ground connections in the water cycle in the face of climate change, with a focus on computational hydrology. Her work includes studying how shifts in precipitation patterns, climate extremes, wildfires, and land cover change impact water partitioning. Erica holds a PhD and MS in hydrology from the Colorado School of Mines, a BA in geology from the University of Colorado at Boulder, and spent two years at the Polytechnic Institute of Barcelona for a postdoctoral fellowship before joining LBNL in 2015.