# Submitted Abstract

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| **Title** | On The Use Of Bedrock Through Atmosphere Models To Understand Mountainous Hydrologic Shifts In A Low-To-No Snow Future. |
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## Abstract

Water management in the western United States (WUS), like many places globally, has a long-held reliance on snowpack, but anthropogenic climate change is decreasing seasonal snowpacks worldwide, posing substantial, potentially even catastrophic consequences on water resources. We 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 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.