WALTER SCOTT, JR.
COLLEGE OF ENGINEERING
COLORADO STATE UNIVERSITY

AGU Hydrology Days

Examining Annual Peak Snow Water Equivalent (SWE) and the Sensitivity of SWE to Climate Change in Colorado.

Gillian Gallagher, Kaitlyn Bishay, Nels Bjarke, Ben Livneh
Department of Civil, Environmental and Architectural Engineering, University of Boulder Colorado

Abstract. Snowpack is an essential source of water in the Western United States, particularly in semi-arid, mountainous regions. Throughout the winter season, snow accumulates at higher elevations, creating a natural reservoir of water that gradually releases during the spring. This annual cycle is important for water supply forecasting as it directly influences the availability and distribution of water in the region. Decreased snowfall and milder winter temperatures are anticipated outcomes of climate change. These changes alter the traditional timeline of winter snowpack behavior, which threatens future water security by shifting the peak date of snowpack earlier and accelerating the ablation processes. In this study, a statistical framework centered on multivariate regression is used to try to capture trends in the drivers of mountain-snowpack in Colorado. The primary goal is to assess the ability of a data-driven model to quantify the sensitivity of snowpack to various predictors, in a way that maintains simplicity and interpretability. For the period 1985-2020, the relationship between the snow water equivalent (SWE) on April 1st, and the following predictors is examined: seasonally accumulated precipitation, temperature, seasonal radiative flux, and elevation. Historical observations are taken from high resolution gridded datasets including the UCLA Snow Reanalysis (500m) and DAYMET (1000 m) products. Multiple snow-dominated basins in Colorado, chosen on the basis of being snowmelt-dominated, are used to build a data-driven model. The strength and sensitivity of the relationships between SWE and the predictor variables are assessed using leave-one-out (LOOCV) jackknifing, in conjunction with a sensitivity analysis. This approach aims to evaluate how changes in predictor variables influence variations in snow water equivalent (SWE) and to identify climate-influenced snowpack thresholds, which may be useful for improving future water supply predictions.