

## A New Estimate of North American Montane Snow Water Equivalent: Validation Challenges and Large-Scale Implications

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### ABSTRACT

Despite the importance of seasonal snow to the hydrologic cycle, global mountain snow storage estimates are highly uncertain. Observation networks in mountainous regions are sparse, and satellite retrievals can perform poorly in mountains. Models are one of the few options for estimating snow over large geographical areas, such as entire mountain ranges or entire continents. Here we use a regional climate model to produce a new estimate of mountain seasonal snow accumulation for North America. From this work, we suggest there is 1006 km<sup>3</sup> of snow water storage (SWS) across the continent's mountains, which nearly three times more SWS than previous estimates. Over the entire continent, we estimate a peak SWS of 1684 km<sup>3</sup>, 55% greater than previous estimates. However, a larger challenge is evaluating our new climatological estimate. In situ measurements may not be representative of the surrounding area, which is problematic when comparing to a 9 km model grid cell. Evaluating against other models is difficult since every model estimate has its own uncertainties; additionally, previous work suggests that many global data products underestimate mountain snow. Nevertheless, we evaluate our North American SWS dataset against in situ observations from snow pillows (bias of -89 mm), remotely sensed snow cover fraction, model-estimated snow water equivalent (bias of +12 mm, compared to SNODAS), and terrestrial water storage anomalies from GRACE. Though a formal model validation is impossible, from the comparisons presented here, we are able to determine whether our estimate is reasonable for SWS. Perhaps more importantly, from these evaluations, we are able to consider mountain seasonal snow accumulation in the broader perspective of the entire continental water budget.

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