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The impact of streamflow forecast errors on economic outcomes in future climates

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More than half of annual runoff across the montane regions of the western US and Europe originates as snowmelt, making knowledge of snowpack crucial to the quality of water supply forecasts. However, ongoing and projected warming is expected to reduce snow water equivalent (SWE) and alter snowmelt timing, thus impacting forecast skill and uncertainty. Rising temperatures are anticipated to reduce the fraction of future precipitation falling as snow by up to 30% in intermountain and continental regions of the western US. This will fundamentally alter the regional water cycle, and we posit that this will increase forecast errors and uncertainty, ultimately impacting the quality of decision-making that relies on water supply information. This research assesses the Relative Economic Value (REV) of water supply forecasts under changing snowpack regimes to understand the impact of forecast uncertainty on economic outcomes. Forecast errors will be rigorously estimated using statistical, physical, and machine learning models applied to 76 western US basins. Historical and projected future hydrology (2025-2050) will serve as a test bed for the analysis. Preliminary results over these basins suggest forecast errors on the order of +/- 25%, corresponding with changes in economic outcomes of up to +/- 15%. With findings from the proposed research, we hope to aid water entities by assessing the economic outcomes based on the skill of water supply forecasts, thereby exploring how forecast users can maximize productivity in response to changing climate conditions.