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How well can adaptive planning thresholds classify long-term water supply vulnerabilities in the Western U.S.?

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Abstract: Recent water resources planning studies have proposed adaptive pathways in which infrastructure and policy actions are triggered by observed thresholds or "signposts". The success of an adaptive pathway depends on whether these thresholds can be accurately linked to future vulnerabilities. This study investigates the ability of adaptation thresholds to identify decadal-scale shifts in average water availability, using GCM-based streamflow ensembles for 45 reservoirs in the Western United States. We propose an illustrative case study in which vulnerable scenarios contain the lowest 10% of mean annual flow by the end of the century. Adaptation thresholds are then defined through time for each site, based on the level of observed mean streamflow below which a specified fraction of scenarios is vulnerable. We perform a leave-one-out cross-validation to compute two error metrics: the frequency of incorrectly identifying, or failing to identify, a vulnerable scenario (false positives and false negatives, respectively). Results show that in general, adaptive thresholds can accurately identify vulnerable scenarios in advance, with low false positive rates. However, for many reservoirs the false negative rates remain higher than random chance until roughly 2060. This reduces confidence in near-term adaptation thresholds, and highlights the tradeoff between frequently triggering unnecessary action, or failing to identify potential vulnerabilities until later in the century. Finally, results explore the sensitivity of the approach to parameter assumptions. A similar testing framework could apply to different planning timescales, such as thresholds for drought identification, or to different application areas, such as sea level rise.

***Keywords**:* climate adaptation, water resources planning, deep uncertainty