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Near-term acceleration of hydroclimatic change in the western U.S.

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Given its large population, vigorous and water-intensive agricultural industry, and important ecological resources, the western United States presents a valuable case study for examining potential near-term changes in regional hydroclimate. Using a high-resolution ensemble climate model experiment, we find that increases in greenhouse forcing over the next three decades result in an acceleration of decreases in spring snowpack and a transition to a substantially more liquid-dominated water resources regime. These hydroclimatic changes are associated with increases in cold-season days above freezing and decreases in the cold-season snow-to-precipitation ratio. The changes in the temperature and precipitation regime in turn result in shifts toward earlier snowmelt, baseflow, and runoff dates throughout the region, as well as reduced annual and warm-season snowmelt and runoff. The simulated hydrologic response is dominated by changes in temperature, with the ensemble members exhibiting varying trends in cold-season precipitation over the next three decades, but consistent negative trends in cold-season freeze days, cold-season snow-to-precipitation ratio, and April 1st snow water equivalent. Given the observed impacts of recent trends in snowpack and snowmelt runoff, the projected acceleration of hydroclimatic change in the western U.S. has important implications for the availability of water for agriculture, hydropower and human consumption, as well as for the risk of wildfire, forest die-off, and loss of riparian habitat.