Hydrologic Sensitivity of a Critical Turkish Watershed to Inform Water Resource Management in an Altered Climate

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November 21, 2023

Abstract

The fertile Anatolian lands in Turkey, supporting about 80 million people, rely on abundant water resources. The Kızılırmak River basin in Anatolia is vulnerable to global warming, mainly due to snowmelt in its headwaters. Quantifying the upper watershed's climate sensitivity is crucial for assessing water availability. Instead of using Global Climate Model (GCM)-driven projections, a sensitivity-based approach was employed with the Variable Infiltration Capacity (VIC) hydrologic model to assess the region's hydrological vulnerability to potential future climatic changes. Considering the consistent projections of increasing temperature (T) over this region in GCMs, the system was perturbed to examine gradients of a more challenging climate, characterized by warming and drying conditions. The sensitivity of streamflow, snowpack water equivalence, and evapotranspiration to T and Precipitation (P) variations under each perturbation or "reference" climates was quantified. Results indicate that streamflow responds to T negatively under all warming scenarios. Streamflow responding to P increases nonlinearly as P decreases in the reference climates. These results suggest that there will be heightened difficulty in managing water resources in the region if it undergoes both warming and drying due to the following setbacks: 1) water availability will shift away from the summer season of peak water demand due to the warming effects on the snowpack, 2) annual water availability will likely decrease due to a combination of warming and lower precipitation, and 3) streamflow sensitivity to hydroclimatic variability will increase, meaning that water managers will likely need to plan for a system that is more sensitive to weather variations.

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