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Multi-year predictability of Colorado River water supply using a drift-free decadal climate prediction system

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Skillful multi-year climate forecasts provide crucial information for decision-makers and resource managers to mitigate water scarcity. Yet, such forecasts remain challenging due to unpredictable weather noise and the lack of dynamical model capability. In this research, we demonstrate that the annual water supply of the Colorado River in the United States is predictable up to several years in advance by a drift-free decadal climate prediction system using a fully coupled climate model. Observational analyses and model experiments show that prolonged shortages of water supply in the Colorado River are significantly linked to sea surface temperature precursors, including tropical Pacific cooling, North Pacific warming, and southern tropical Atlantic warming. In the Colorado River basin, the water deficits can reduce crop yield and increase wildfire potential. Thus, a multi-year prediction of severe water shortages in the Colorado River basin could be useful as an early indicator of subsequent agricultural loss and wildfire risk.