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Optimal Reservoir Storage and Climate Change

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Climate change is likely to impact the economic demand and supply for water resources. Changes in temperatures and effective precipitation will shift evapotranspiration and hence demand, while climate change throughout a watershed will change both the timing and quantity of water supplies.

In this paper, we attempt to systematically consider optimal reservoir management strategies under changing water demand and supply. Using a dynamic model of intra-year water management decisions for a single reservoir, we seek to identify the impact of, for example, earlier but smaller peak runoff on optimal reservoir size and release patterns. The work builds upon our previous research which suggests that economic benefits of consumptive water use are maximized at reservoir capacities well below those present in some major river basins of the western United States. While that work suggests increased possibilities for restoration at the river basin scale, the present research offers a more nuanced picture by emphasizing seasonal storage demands in smaller watersheds. With this focus the current paper is likely to be relevant to a substantial number of proposals for dam reoperation or removal.

We find that optimal storage in these smaller watersheds will increase when the primary effect of climate change is to shift the timing of snowpack dependent runoff to earlier in the year. The increase in optimal storage is partially mitigated by increased early season water demand. If the primary impact of climate change is to decrease total runoff, but the timing of flows does not substantially change, then optimal storage is reduced. We conclude with specific scenarios from the climate change literature from which we derive changes in economic demand and supply, and hence the optimal changes in reservoir storage.