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# Modelling Dynamic Feedbacks between Water Supply and Water Use in a Snow-Fed Agricultural Basin

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**Abstract:** Hydrologic models are used to evaluate past water budgets and future water supplies in developed river basins. Moreover, models are commonly used to evaluate alternative management options for enhancing water supply or to estimate anticipated impacts of climate and land-use change. Principal to these analyses is the realistic representation of feedbacks between water supply and water use. In agricultural basins, these feedbacks are complicated by water governance used to allocate water during periods of limited water supply. Most hydrologic studies develop models with predetermined water use and proceed to evaluate impacts on water resources. This approach has historically worked well in simulations that incorporate metered water use or where water supply is greater than water demand. However, when simulating future water-resource scenarios under a changing climate and limited water supply, useful hydrologic models must dynamically allocate water according to local water-governance frameworks. For conjunctive-use systems, supplementary groundwater pumping must be dynamically simulated using surface-water delivery shortfalls. To more realistically simulate water-supply and water-use dynamics, we developed an integrated river/reservoir operations and hydrology model called MODSIM-GSFLOW. This model provides a platform for simulating surface-water and groundwater distribution resulting from a basin's water governance, including consumption, supplemental pumping, and agricultural return flows. This approach more accurately simulates the impacts of water scarcity on water delivery and use. MODSIM-GSFLOW is applied to an agricultural basin in northern California and Nevada, where losses in snowpack due to climate change are reducing water supplies for agriculture.

***Keywords****:* water use; climate change; groundwater; river operations; integrated hydrology