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CHARACTERIZING STREAMFLOW RESPONSE TO IRRIGATION USING COUPLED HYDROLOGIC AND AGROECONOMIC MODELS

Doug Brugger
douglas.brugger@umontana.edu

Marco Maneta
University of Montana - Missoula

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The reservoirs, diversions, and wells used for irrigation in a watershed form a network that substantially alters the timing and magnitude of surface water flows. If the irrigation network in a watershed is not adequately represented in a computational hydrologic model, the model might not accurately forecast surface water response to climate forcing. This is notably important during periods of drought, when irrigation demand is high and water availability is low. The behavior of irrigators depends on more than just water availability; other factors include market prices of inputs and commodities, policies & regulations, and the feasibility of alternative crops. We address this by coupling a rainfall-runoff and water distribution model (HEC-HMS) to an economic model of agricultural production, which both simulates irrigator behavior (namely allocation of inputs such as land, water, and labor) and quantifies yields and revenues. The coupled model simulates the impact of farming decisions in the hydrologic network, such as reduced water availability for downstream irrigators due to upstream water use. The result is a spatial depiction of both streamflow response and irrigation network response to climate forcing. We present a case study of drought conditions for the Bitterroot River watershed in Montana that quantifies 1) the economic effects on irrigators, 2) the effect of irrigation on the water budget, and 3) the sensitivity of the system to variations in climate forcing. The case study shows that reductions in agricultural productivity do not scale proportionally with reductions of available water.