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GROUNDWATER—LAND SURFACE—ATMOSPHERE FEEDBACKS: IMPACTS OF GROUNDWATER PUMPING AND IRRIGATION ON LAND-ATMOSPHERE INTERACTIONS

Ian M. Ferguson* **and Reed M. Maxwell†**

Colorado School of Mines
Geology and Geological Engineering Department
1500 Illinois Street, Golden, CO 80401, USA
*e-mail: imfergus@mines.edu
†e-mail: rmaxwell@mines.edu, web page: http://inside.mines.edu/~rmaxwell/

Summary. Recent studies have shown that interactions between groundwater, surface water, and land surface processes significantly influence the land surface water and energy balance. These studies suggest that water management practices which alter the distribution of water between the subsurface and near-surface—viz., groundwater pumping and irrigation—will impact land surface water and energy budgets, with potentially significant feedbacks across the hydrologic cycle. Here we use an integrated watershed model to examine impacts of groundwater pumping and irrigation on terrestrial water and energy budgets. For a study area in the Southern Great Plains region of North America, pumping is shown to impact groundwater levels throughout the watershed and root-zone saturation and land-atmosphere fluxes over regions of shallow and intermediate groundwater depth throughout the year. By contrast, irrigation impacts groundwater levels, root-zone soil moisture, and land-atmosphere fluxes only over irrigated areas and during the growing season. Impacts of combined pumping and irrigation are shown to depend on local water table depth: irrigation impacts on surface fluxes are greatest for crop areas with water table depths greater than 2m, while impacts of groundwater pumping are greatest for areas with water table depths less than 2m. Further analysis is needed to evaluate feedback of water management practices on the atmospheric boundary layer and local and regional climate.

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