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Developing a coupled SWAT-MODFLOW model assessing groundwater depletion in the Republican River Basin

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Developing a Coupled SWAT-MODFLOW Model
Assessing Groundwater Depletion in the Republican River Basin

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\textbf{Abstract:} The Republican River Basin encompasses approximately 50,000 square miles in eastern Colorado, northwestern Kansas, and southwestern Nebraska, with thousands of farms irrigated by groundwater from the underlying Ogallala Aquifer. This overexploitation of groundwater resources has led to significant decline in aquifer saturated thickness in various parts of the river basin in recent decades. In addition, the duration and intensity of drought periods are expected to increase in the majority of the river basin during the next 50 years. Management strategies are sought that maintain economic prosperity and crop yield in the region while also sustaining groundwater resources, i.e. preventing significant decline in saturated thickness. The overall objective of this study is to identify sustainable management strategies for the Republican River Basin under a changing climate. This will be accomplished using the newly developed hydrologic model SWAT-MODFLOW, which couples the land surface hydrologic model SWAT with the three-dimensional groundwater flow model MODFLOW. Applied irrigation water and associated pumped groundwater volumes will be determined from MODIS evapotranspiration data and spatial distribution of irrigated lands, with model results used to compute historical and future saturated thickness for 1 km\textsuperscript{2} cells of the river basin under varying management strategies and climate scenarios. The basin incorporates 16 HUC-8 watersheds, and this project will develop models for several of these watersheds. In this presentation, we show the methodology for developing a SWAT model for one of the HUC-8 watersheds (NHD-10250003), linking it with MODFLOW, and present preliminary results of model testing and application.

\textbf{Keywords:} Ogallala Aquifer; Groundwater; Irrigation; Drawdown