Coupling Modeling with Monitoring to Assess Water Availability in the Mississippi Alluvial Plain

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The Mississippi Alluvial Plain (MAP) is one of the most important agricultural regions in the United States, and crop productivity relies on groundwater irrigation from a system that is poorly understood. Groundwater use from the Mississippi River Valley alluvial aquifer has resulted in substantial groundwater-level declines and reductions in baseflow in streams within the MAP. These impacts are limiting well production and threatening future water availability for irrigation in the region.

Accurate and ongoing assessments of water availability in the MAP region are critically important for making well-informed management decisions about sustainability, establishing best practices for water use, and identifying predicted changes to the regional water system over the next 50-100 years. To provide stakeholders and water-resource managers with information and tools to better understand and manage available water resources within the MAP, the U.S. Geological Survey (USGS) initiated a regional water availability project funded by the Water Availability and Use Science Program (WAUSP). The MAP project couples modeling with monitoring to improve the characterization of the alluvial aquifer system in an existing numerical-groundwater-simulation model. The premise of the investigation is to evaluate the existing groundwater model and produce an estimate of the uncertainty of the model inputs, such as hydraulic conductivities, storage, streams, recharge, and water use. Based on the uncertainty results, additional data are collected (monitoring) to improve the model. After which, the uncertainty will be estimated again, and the process will be repeated as necessary. For example, initial uncertainty results indicated that better knowledge of streambed conductances could improve the precision of simulated groundwater levels. In response to this data need, waterborne geophysical data were collected along 180 km of streams in the Mississippi Delta. The geophysical data identified areas of coarse- and fine-grained material in the streambed that may control the amount of water passing between the alluvial aquifer and the stream. The results of the geophysical investigation can be used to adjust the relative streambed conductance (increase for coarse-grained sediment and decrease for fine-grained material) and input into the numerical model to determine if the precision of simulated water levels improve. Through this iterative method of modeling and monitoring, a more dynamic ‘living’ numerical model will be available to more accurately represent groundwater flow in the system. The MAP groundwater model can then be used to help manage the water resource evaluate potential future effects of water-use changes, conservation practices, construction of diversion-control structures, or climate change.