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Abstract: Effective water management requires knowledge of both natural and engineered hydrologic systems. With a changing climate and strained water resources, it is increasingly important to assess and adapt current water management strategies to more efficiently use the available water supplies to meet demands. Traditional approaches to water management have treated natural and engineered hydrologic systems as separate entities, making simplistic assumptions about each component. To properly assess water management strategies, these approaches should be integrated to account for the interactions between the two systems. In addition, the uncertainties associated with each modeling approach and the parameterization of the models need to be considered when assessing strategies. The Lower Republican River Basin (LRRB) is an example of a heavily managed basin with conjunctive water use where the effects of recent droughts indicate that water management strategies are integral to future regional sustainability. Water in this basin is distributed in accordance with an interstate compact, ratified in 1942, that has been subject to litigation before the Supreme Court several times in recent decades. The compact and associated Supreme Court final stipulation settlements require efficient management of both the surface water and groundwater in this basin. This work describes the approach taken to assess water management alternatives available for irrigators in the LRRB by linking a surface water operations model (OASIS) with a surface/subsurface hydrologic model (HydroGeoSphere; HGS). The HGS/OASIS model framework is used to evaluate the interactions and dependencies between engineered and natural hydrologic systems under historic and projected future climatic conditions to guide water management decisions, including structural and operational changes to reservoir management. In addition to accounting for uncertainty associated with the two different numerical approaches and model parameterizations, this modeling approach incorporates other complex uncertainties, many of which are not routinely considered. This work discusses some of these uncertainties as they arose in the LRRB modeling effort and how they will be quantified and/or minimized in future work.

Keywords*:* surface water/groundwater interactions, hydrologic modelling, conjunctive water use, surface water operations, water management