GEODSS: Spatial Basin-Scale Water Quantity and Quality Modeling in the Lower Arkansas River Valley

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Abstract. This paper describes the water quantity and quality modeling modules of the GEODSS spatial decision support system for the Lower Arkansas Valley in Colorado. The Water Quantity Module is implemented using a geo-referenced version of the MODSIM river network flow and administration model. The Water Quality Module is developed to complement MODSIM by providing conservative constituent routing through out the river basin. Geo-MODSIM is implemented directly from the functional ESRI Geometric Networks objects and using the MODISM version 8 user-dialogs to enter and edit the water resources system related data. Tools were developed as part of GEODSS to facilitate importing and processing water rights, and measured flow and diversion time series. An automatic calibration procedure has been implemented to calculate river system gains and losses based on the available measured data. The calculated gains and losses can be used in predictive runs to account for historical unmeasured tributary contributions, and direct runoff from irrigation or precipitation events. The stream-aquifer interaction can be modeled in GEODSS using a regional scale trained ANN that predicts flow and salt load at the stream and aquifer interface based on learned relationships between spatial explanatory variables and the detailed output of regional finite-difference ground water flow and transport models. In Geo-MODSIM, the model output is made accessible directly in the Geographical Information System Interface (ESRI-ArcMap). The Water Quality Module consists of a spatial Graphical User Interface (GUI) and a conservative constituent model that couples with MODSIM to calculate salt movement in the system. The GUI uses the network nodes to provide access to measured or predicted salt concentrations. The GUI reads and writes the network water quality data from/to a database. The Water Quality Model analyzes the network topology to establish a logical node order for accurate mass balance calculation. The model uses the converged flows in MODISM and the user-specified salt concentrations to calculate a mass balance at all nodes in the system. The GEODSS presented herein is an unprecedented tool for evaluating the basin-scale impacts of implementing field-scale and regional-scale strategies for improved salt and water management.

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