

The Modular Modeling System (MMS): A Toolbox for Water- and Environmental-Resources Management

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Abstract: The increasing complexity of water- and environmental-resource problems require modeling approaches that incorporate knowledge from a broad range of scientific and software disciplines. To address this need, the U.S. Geological Survey (USGS) has developed the Modular Modeling System (MMS). MMS is an integrated system of computer software for model development, integration, and application. Its modular design allows a high level of flexibility and adaptability to enable modelers to incorporate their own software into a rich array of built-in models and modeling tools. These include individual process models, tightly coupled models, loosely coupled models, and fully- integrated decision support systems. A geographic information system (GIS) interface, the USGS GIS Weasel, has been integrated with MMS to enable spatial delineation and characterization of basin and ecosystem features, and to provide objective parameter-estimation methods for models using available digital data. MMS provides optimization and sensitivity-analysis tools to analyze model parameters and evaluate the extent to which uncertainty in model parameters affects uncertainty in simulation results. MMS has been coupled with the Bureau of Reclamation object-oriented reservoir and river-system modeling framework, RiverWare, to develop models to evaluate and apply optimal resource-allocation and management strategies to complex, operational decisions on multipurpose reservoir systems and watersheds. This decision support system approach has been developed, tested, and implemented in the Gunnison, Yakima, Rio Grande, and Truckee River basins of the western United States.