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Sahra Integrated Modeling Approach to Address Water Resources Management in Semi-Arid River Basins

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SAHRA INTEGRATED MODELING APPROACH TO ADDRESS WATER RESOURCES MANAGEMENT IN SEMI-ARID RIVER BASINS

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Water resources decisions in the 21st Century that will affect allocation of water for economic and environmental will rely on simulations from integrated models of river basins. These models will not only couple natural systems such as surface and ground waters, but will include economic components that can assist in model assessments of river basins and bring the social dimension to the decision process. The National Science Foundation Science and Technology Center for Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) has been developing integrated models to assess impacts of climate variability and land use change on water resources in semi-arid river basins. The objectives of this paper are to describe the SAHRA integrated modeling approach and to describe the linkage between social and natural sciences in these models. Water resources issues that arise from climate variability or land use change may require different resolution models to answer different questions. For example, a question related to streamflow may not need a high-resolution model whereas a question concerning the source and nature of a pollutant will. SAHRA has taken a multiresolution approach to integrated model development because one cannot anticipate the questions in advance, and the computational and data resources may not always be available or needed for the issue to be addressed. The coarsest resolution model is based on dynamic simulation of subwatersheds or river reaches. This model resolution has the advantage of simplicity and social factors are readily incorporated. Users can readily take this model (and they have) and examine the effects of various management strategies such as increased cost of water. The medium resolution model is grid based and uses variable grid cells of 1 – 12 km. The surface hydrology is more physically based using basic equations for energy and water balance terms, and modules are being incorporated that will simulate engineering components such as reservoirs or irrigation diversions and economic features such as variable demand. The fine resolution model is viewed as a tool to examine basin response using best available process models. The fine resolution model operates on a grid cell size of 100 m or less, which is consistent with the scale that our process knowledge has developed. The fine resolution model couples atmosphere, surface water and groundwater modules using high performance computing. The medium and fine resolution models are not expected at this time to be operated by users as opposed to the coarse resolution model. One of the objectives of the SAHRA integrated modeling task is to present results in a manner that can be used by those

making decisions. The application of these models within SAHRA is driven by a scenario analysis and a place location. The place is the Rio Grande from its headwaters in Colorado to the New Mexico – Texas border. This provides a focus for model development and an attempt to see how the results from the various models relate. The scenario selected by SAHRA is the impact of a 1950's style drought using 1990's population and land use on Rio Grande water resources including surface and groundwater. The same climate variables will be used to drive all three models so that comparison will be based on how the three resolutions partition and route water through the river basin. Aspects of this scenario will be discussed and initial model simulation will be presented. The issue of linking economic modules into the modeling effort will be discussed and the importance of feedback from the social and economic modules to the natural science modules will be reviewed.

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