

Primary Scientific Findings for 2005

Basin-Scale Water Balance

As demonstrated in research publications published in 2005, primary findings can largely be classified into three categories: *semiarid mountain ecohydrology*, *desert ecohydrology*, and *semiarid mountain hydrometeorology*. Within the semiarid mountain ecohydrology arena, the papers demonstrated significant advances in the quantification of land/atmosphere energy and water balances in complex mountain terrain, estimation of vegetation cover from remote sensing, and runoff generation processes. The desert ecohydrology publications pushed back the frontier of scientific knowledge regarding the roles of ecological communities and climate in determining the dynamics of deep desert vadose zones, and shallow redistribution of precipitation and its implications for the ecological dynamics of deserts. The semiarid mountain hydrometeorology publications focused primarily on improving estimation of precipitation distribution (particularly snow) over mountainous areas. Interesting contributions were also made to the issues of feedback between precipitation distribution/timing and large-scale climate and to the influence of atmospheric teleconnections on temporal variations in precipitation. Taken together, these publications represent an impressive advance to the state of science at the intersection of ecology, hydrology, and climate in arid/semiarid regions, which has up till now been virtually a blank spot on the map of scientific knowledge.

River Systems

- A geochemical tracer study coordinated with the Upper San Pedro Partnership (USPP) overturned the commonly accepted conceptual understanding of the source of water maintaining riparian stream flow. The study pointed to the importance of storm water recharge to the alluvial aquifer in sustaining flow.
- In the Rio Grande, the river-riparian-hyporheic system can serve at best as a weak N sink, while the combination of agricultural fields and drains serve as a strong nutrient sink. This finding has the potential to influence agricultural producer's fertilization behavior.
- The experimental protocols developed under the EPA storm water trading project are undergoing review by the Office of Management and Budget. With further development, these protocols could provide the foundation for storm water trading markets analogous to EPA's clean air markets.
- Water and carbon cycling of semi-arid riparian ecosystems is fundamentally altered by woody plant encroachment. Woody plant encroachment is a global phenomena and these findings can help explain its potential large-area impacts.

Integrated Modeling

Efforts within the Integrated Modeling macro-theme in 2005 were primarily focused on the development of scenarios, the SAHRA GeoDatabase, conceptual model, and various integrated models or sub-models. Specifically,

- A five-phase iterative scenario development strategy was established for developing SAHRA scenarios, which is considered to be appropriate for most environmental modeling studies;
- A conceptual site model was developed, which indicated that at a medium scale (1 km), groundwater flow would be the dominant flow process in the Rio Grande;
- New model (or model components) developed include a coarse-resolution institutional model for water banking, a medium resolution physical system model for water banking, a parallelized version tRIBs model, a snow hydrology module, a general integrated water

management dynamic simulation system for San Pedro, and an interactive dynamic model for the Middle Rio Grande.