

SAHRA Signature Achievements

By the end of the 10 years of NSF funding, the SAHRA Center will have promoted the sustainable management of water resources through the following water resources-related science, outreach, and education achievements.

SAHRA's science and research goal is to develop new and improved multidisciplinary understanding of semiarid hydrology and is exemplified through the following signature achievements:

1. Assessed the Ecohydrologic Impacts of Vegetation Change:

- Developed observatory infrastructure and datasets for ecohydrology researchers
- Developed improved remote sensing products for water managers for estimating precipitation and ET
- Documented vegetation controls on recharge, improving estimates of basin-scale recharge
- Evaluated how the type and distribution of vegetation controls ET and snowmelt processes
- Developed new understanding of runoff generation in mountainous headwater catchments
- Using high-resolution modeling, evaluated the impacts of vegetation change for land managers

2. Provided New Understanding of Riparian System Dynamics:

- Documented saline groundwater discharge and developed comprehensive salinity budgets, leading to revised management of the Rio Grande
- Identified seasonal floods as a significant water and nutrient source for desert riparian systems
- Improved estimates of riparian ET and integrated them into a new MODFLOW package (RIP-ET)
- Assessed the hydrologic controls on the type and distribution of riparian vegetation and its sensitivity to change as a result of climate variability

3. Determined Non-Market Values of Riparian Systems:

- Assessed how vegetation and bird abundances will change under alternative hydrologic scenarios
- Quantified societal non-market value of a riparian system through stated preference surveys
- Developed benefit transfer methodology to make results applicable for riparian systems across the Southwest (San Pedro/Rio Grande)

4. Investigated a Prototype Water Leasing Market:

- Evaluated the efficiency of a water leasing market with climatic uncertainty and third-party effects
- *Integrating Hydrological Science and Political Economy: A Study of Emerging Water Markets in the Twenty-First Century* - a monograph on the use on water markets in the efficient utilization of water resources
- Developed improved understanding of the factors that determine urban water demand
- Constructed a coupled hydrologic and institutional model for water leasing in the Mimbres Basin, NM, for educating local water users, water managers with the NM State Engineer, and researchers

5. Developed Water Resource Related Scenario Science:

- *Scenario Development for Water Resources* - a book discussing a the use of scenarios for linking models and datasets with stakeholder needs for water resources decision making
- Identified critical stakeholder scenarios for the Southwest
- Collected relevant data needed to perform model runs to evaluate these scenarios
- Generated high-resolution climate scenario datasets for the Southwest using statistical and dynamic downscaling

SAHRA's stakeholder engagement and outreach goals are to enhance stakeholder/scientist dialog, develop mechanisms to support stakeholders in their decision-making, and disseminate and transfer SAHRA-relevant knowledge to scientists, water professionals, elected officials and the public. The following signature achievements relate to these goals:

6. *Initiated Unique Institutional Capability for Engaging Stakeholders in Research:*

- Engaged center researchers in coordinated stakeholder-relevant multidisciplinary hydrologic research
- Engaged stakeholders in a continuing dialog on needs for, and the application of, SAHRA products
- Supported the establishment of AWI, an institute linking Arizona stakeholders and researchers
- Placed SAHRA decision support conceptual model in context of current scholarship

7. *Built Decision Support Tools (DSS) for elected officials, resource managers, and the public:*

- Constructed the San Pedro Basin Assessment Tool (DSS) for the Upper San Pedro Partnership to evaluate costs and benefits of management options
- Developed MR2K: A Program to Calculate Drawdown, Velocity, Storage and Capture Response Functions
- Constructed the Riparian ET GIS tool for the Bureau of Land Management to evaluate hydrologic impact of prescribed burns
- Developed and used the Rio Grande DSS to educate the public on hydrologic impacts of climate variability and management options

8. *Created Innovative Web Services and Sources of Hydrologic Information:*

- *Global Water News Watch* – international web digest of news articles on water issues and email subscription service
- *Arizona Wells* – provides and visualizes Arizona well data for the public and water managers
- *Isotopes, Chemical Tracers and Hydrology* - a comprehensive resource for researchers, water managers, and educators
- *RainLog/RainMapper* – community-based rainfall monitoring network
- *SAHRA Geodatabase* – stores and provides access to SAHRA's research data
- *Terrestrial Water Storage Dynamics* - Near-real-time estimation of changes in basin-scale terrestrial water storage within the Colorado River Basin
- *AHIS* – makes Arizona water data accessible to researchers, water professionals, and the general public
- *National Phenology Network* - redesigned and implemented a nationwide environmental monitoring program related to climate change

9. *Established Southwest Hydrology*, a 44-page, bimonthly trade magazine focused on semiarid hydrology:

- Sent to over 6,300 water professionals across the Southwest, with readership estimated at 15,000.
- Readership covers broad sectors including researchers, regulators, consultants, policymakers, and NGOs
- Has received numerous local, regional, and national awards for excellence in technical communication

SAHRA's education goal is enhanced multidisciplinary hydrologic literacy of the general public and within the educational system. This is being accomplished through the following signature achievements:

10. *Educated the Lay Public* with innovative multimedia displays, demonstration sites, and informative publications:

- *Discovering Hydrology at Sabino Canyon* - multimedia display at park visited by 1 million people per year
- *Discovering Hydrology at Kartchner Caverns* - multimedia display at park visited by ~175,000 people per year
- *Water in a Desert City* – multimedia display at Phoenix Zoo visited by 1.5 million people/year
- *Urban Rainwater Harvesting* - demonstration sites at the Nature Conservancy Tucson offices and at Biosphere 2
- *Reining in the Rio Grande* – a monograph that provides a synthesis of the hydrologic and water management history and future of the Rio Grande
- *The Ecology and Conservation of the San Pedro River* – an edited book that synthesizes San Pedro research
- *New Mexico Water Policy and Management Issues* - an edited book discussing science, modeling, institutions and the future of water management policy in New Mexico

11. *Advanced the Hydrologic Literacy of K-12 educators* through novel education products:

- *WATER Kits* - basic and advanced watershed processes and urban hydrology kits used in approximately 30 classrooms per year
- *Watershed Visualization* – animated computer modules on hydrologic and watershed processes; beta testing in progress*
- *Arizona Rivers* - educates students on riparian monitoring techniques, data collection, and Arizona riparian issues and provides collaborative experiences involving students, teachers, and riparian experts.
- *Inquiry and Water Issues Workshops* - two-week summer workshop for middle and high school teachers
- *SPLASH* - Student-centered Program for Learning About Semi-arid Hydrology modules – being converted to Internet-accessible modules

12. *Educated the Next Generation* of diverse, multidisciplinary research hydrologists, educators, water managers and professionals addressing water issues. To date, over 100 SAHRA-supported students have received master's or doctoral degrees. Many postdoctoral research associates have gone on to faculty positions at a variety of U.S. and international institutions.