New Mexico EPSCoR RII 3 Annual Report Award Year Three

Report Period: September 1, 2010 – August 31, 2011

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NM EPSCoR RII3: Climate Change Impacts on New Mexico's Mountain Sources of Water

Climate change is affecting natural environments around the world. NM EPSCoR RII3 addresses a key challenge that is of worldwide significance—understanding and forecasting the effects of climate change on water supply and sources in arid regions, as well as the socioeconomic implications. The overarching vision for the NM EPSCoR Program is to enable:

"An environment in which New Mexico scientists and educators are fully competitive in climate change research and education."

The overarching goal of NM EPSCoR RII3 is to enhance research competitiveness through investment in three strategic areas: *(1) critical Research Infrastructure, (2) Cyberinfrastructure, and (3) Human Infrastructure.* These investments will help establish NM as a laboratory for climate change research and as a model for science-based public policy. The multi-disciplinary, multi-scale effort is envisioned to transform climate change science and policymaking in NM by providing the tools required for quantitative, science-driven discussion of difficult water policy options facing the State in the 21st Century. These goals are articulated in the NM EPSCoR mission:

"Provide the critical gap infrastructure, computational support, and education and outreach opportunities to foster excellence in climate change research and education."

NM EPSCoR Key Accomplishments in Year Three

Intellectual Merit

EPSCoR Year 3 accomplishments (described below) address each of the three strategic areas: Research Infrastructure, Cyberinfrastructure and Human Infrastructure. Research investments have continued in the development of watershed-scale observational networks and climate and hydrology models needed in NM for water supply forecasting and water resources decision support. As well, significant progress continues in research on the socioeconomic impacts of basin-scale hydrologic changes to *acequias* - the traditional water supply system for agriculture in small NM communities. Cyberinfrastructure activities led to the launch of the EPSCoR data portal, a key element of the shared data infrastructure for the management, discovery, and delivery of the science data generated by the EPSCoR project. Educational activities for undergraduate students, graduate students, junior faculty and K-12 teachers enhanced NM human infrastructure by improving understanding of climate science, collaborative interdisciplinary research, and diversity issues.

Broader Impacts

Through novel projects and partnerships that are facilitated by NM EPSCoR Research Infrastructure Improvements, scientists and educators contribute to serving the needs of science, education, and the public. Over 3,600 members of the general public participated in EPSCoR-supported outreach events in Year 3, increasing their awareness of climate change impacts on natural resources. The EPSCoR-supported museum climate science exhibit opened in Year 3 and will provide information and engagement for hundreds of thousands in coming years. In addition, seed awards were awarded that integrate research and education for students at NM's non-PhD granting institutions. Innovative elements of the outreach, education and diversity programs reach a large and diverse population with an emphasis on involving and supporting the State's population of Native Americans and persons of Hispanic descent.

A summary of efforts and key accomplishments in research, diversity, workforce development, cyberinfrastructure, outreach and communication, evaluation and assessment and sustainability for Year 3 are presented below as they align with the objectives of the NM EPSCoR Strategic Implementation Plan that guides our work.

Research Infrastructure Improvements

Objective 1: Enhance climate and hydrology research infrastructure (from data acquisition through modeling).

- Upgraded 5 meteorological stations on the Navajo Nation, including installing meteroburst radios and upgrading RAWS stations with OTT Pluvio precipitation gauges.
- Calculated/estimated parameters for Rio Grande sub-basins using the Snow Runoff Model (SRM).
- Initiated process to use output of the Semi-distributed Land Use and Runoff Process (SLURP) model into hydro-economics model to assess the consequences of climate change on the competing uses of water including agriculture, urban supplies, recreation, endangered species, and power.
- Continued the development of watershed models for the Valles Caldera National Preserve and the Rio Hondo study areas using the GS Flow approach.
- In collaboration with the Water Quality Group, developed an "agent-based" modeling approach for the transport and reaction of dissolved organic matter (DOM) in hyporheic zones.
- Conducted research into the links between snowpack, surface energy fluxes and seasonal precipitation using a variety of datasets.

Objective 2: Improve water quality monitoring in high altitude stream environments.

- Instrumented a network of 34 shallow monitoring wells installed in summer 2010 at he VCNP with sondes and data loggers and real-time nutrient analyzers.
- Conducted numerous water quality studies, including tracer tests and continued monitoring of surface and groundwater to establish hydrologic connectivity between surface waters and ground waters.
- Conducted studies of nutrient variations in response to spring snowmelt and diurnal variability.
- Progressed in the development of an on-site water quality trailer which will be installed in the field in summer 2011.
- Developed interdisciplinary and multi-institution collaborative projects concerned with understanding stream water chemistry dynamics.

Objective 3: Develop interdisciplinary socioeconomics and acequia research capacity.

- Increased involvement with the acequia associations through both informal interactions and participation in community meetings.
- Continued installation of hydro-meteorology equipment to characterize acequia system flow distribution and surface-groundwater hydrological interactions.
- Initiated a graduate student experiment to determine impact of drought on varieties of chili grown in Northern NM.
- Connected economic modeling components into the Systems Dynamics model for the middle Rio Grande and ran simulations to model impacts of population changes, use of pricing or conservation incentives, changes in attitude towards water scarcity and changes in the timing of drought events.

Objective 4: Provide critical gap infrastructure for New Mexico Highlands University.
- Incorporated use of enhanced water quality laboratory facility into undergraduate courses.
- Collaborated with faculty at UNM on training and use of the analytical instrumentation as well as with researchers at UNM and NMT to carry out collaborative research projects.

Objective 5: Use Innovation Working Groups (IWG) to address key scientific, education, diversity, and workforce development challenges.
- A graduate-student led IWG, *Applications of Distributed Temperature Sensing for Climate Change Research in New Mexico,* led to collaborations in several DTS deployments.
- Researchers and educators considered the use of the NM EPSCoR data portal and other collections of climate data in K-12 classrooms in *Bridging the Gap Between Data and the 6-12 Science Classroom.*
- NM Researchers participated in four Tri-State Consortium funded IWGs.

Objective 6: Provide Critical Infrastructure Gap Seed Awards to increase the impact of NM EPSCoR on the critical student population at New Mexico's non-PhD granting institutions.
- Two proposals funded in first round: Diné College and NM Highlands University.
- Solicitation for second round of awards released; proposals due in July 2011.

Cyberinfrastructure Improvements

Objective 7: Enhance scientific data and model output generation, management, discovery, and use through cyberinfrastructure.
- Launched the NM EPSCoR data portal as an operational element within the broader NM EPSCoR portal, based upon an underlying, custom developed geospatial data and information management and delivery platform.
- Continued work on developing enhanced scientific research capacity through shared development of data interoperability capabilities.
- Deployed an initial Hydrologic Information System (CUAHSI HIS) server instance and began importing historic ET Tower data as a test dataset.
- Developed a harvesting, integration, and publication capability within the data portal that allows for the automated retrieval of new SNOTEL data from the NRCS web site.
- Developed methods for automated processing of the existing FGDC XML metadata records in the portal into corresponding valid ISO metadata.
- Supported students and faculty to attend CI-related training opportunities.

Human Infrastructure Improvements

Objective 8: Enhance diversity in all elements of the EPSCoR Program.
- In collaboration with Nevada and Idaho EPSCoR programs, developed a Tri-State Diversity Strategic Plan and further refined it at the Tri-State Meeting.
- Presented the *Best Practices Guide for Increasing the Diversity of Faculty at NM Research Institutions of Higher Education* to the Council of University Presidents for their review and approval.
- Developed, launched and maintain a database of STEM opportunities in NM for students, teachers, and the general public.

Objective 9: Enhance professional teacher development for STEM areas in northern New Mexico.
- The Northern NM Network (NNMN) coordinated and offered the third five-day field-based Teacher Summer Institute at the Valles Caldera National Preserve for middle and high school math and science teachers in collaboration with NM EPSCoR researchers.
- NNMN collaborated with NM ESPCoR researchers to provide follow-up workshops during the academic year for participants in the Summer Institute on how to use data in their classrooms.
- Teachers conducted field trips with students, implementing lessons based on their summer institute experience.

Objective 10: Develop an Undergraduate Research Opportunity Program that increases the exposure of students at non-PhD granting institutions to high quality, relevant, hypothesis-driven research.
- For the second year, successfully engaged 11 undergraduates, recruited from institutions serving large populations of Hispanic and Native American students, in nine weeks of summer research with faculty mentors from NM EPSCoR universities.
- Developed an initial week of workshops and short courses on climate change, hydrology, and water quality, which were taught by EPSCoR-supported faculty, and prepared the new UROP students for their summer research assignment.

Objective 11: Design and develop graduate research training group opportunities.
- With NV and ID, offered workshops in Climate Modeling and HIS at the Tri-State Annual Meeting for graduate students and faculty.
- In collaboration with Los Alamos National Laboratory, offering a 3-day workshop in summer 2011, *Simulating the Spatial-Temporal Patterns of Anthropogenic Climate Change: A Workshop in the Bridging Disciplines, Bridging Scale Series*.
- Seven NM graduate students attended *Interdisciplinary Modeling: Water-Related Issues and Climate Change* in summer 2010.
- Graduate students attended various CI-related workshops and seminars.

Objective 12: Inform faculty throughout NM about funding opportunities via NSF Days.
- NSF Day held March 17, 2011; nine NSF directorates represented, including those with programs for community and tribal colleges.
- Over 150 participants from 22 Institutions of Higher Education, National Labs and private industry attended.

Objective 13: Enhance leadership skills for faculty via a Faculty Leadership Fellowship Program.
- Offered a week-long training workshop for 16 early-career faculty from 9 higher education institutions in New Mexico, Idaho, and Nevada.
- Added sessions on effective teaching and mentoring to the agenda that included interactive workshops designed to enhance competitiveness and leadership skills; overall evaluation by participants was very positive.

Objective 14: Create a citizenry that is informed about climate change and its impact on NM's natural resources via public outreach and communication.
- *Degrees of Change*, a new exhibit on climate change opened on May 20, 2011 at the New Mexico Museum of Natural History and Science.

- Climate Change Educator at the Museum offered over 20 public outreach education programs on climate change impacts in New Mexico to approximately 3,600 members of the public.
- Developed and currently maintain a database of STEM Education Programs in collaboration with the NM Public Education Department and the NM Math and Science Advisory Council.
- Enhanced communication about NM EPSCoR activities to the public through a redesigned website, newsletter, Facebook, list-serv and informational materials.

NMEPSCoR Management Structure

The management of the NM EPSCoR program has multiple levels and is diagrammed on the NM EPSCoR web site (http://nmepscor.org/content/epscor-structure).A State Committee acts as the governing body; the Management Team meets regularly to provide input on science and education issues. The Strategic Plan provides guidance for program activities and timelines.

Response to NSF Recommendations from Reverse Site Visit (RSV)

Details of on-going progress in implementing plans presented in the RSV response are provided in the body of this report. Key steps taken include:

- Administration of follow-up surveys to summer teacher institute participants and undergraduate student participants in summer research program;
- Opportunities for scientific synthesis provided at All Hands Meeting, Tri-State Meeting, and regular science meetings by phone of all components;
- Initiation of collaboration among education faculty at two NM Institutions of Higher Education to incorporate climate change education in pre-service teacher education programs;
- Expansion of the Diversity Leadership Committee and increased focus on diversity at the Tri-State Consortium meeting; and
- Strengthened collaboration between water quality researchers across research institutions.

Response to External Advisory Board (EAB) Report

The EAB strongly commended the leadership of the RII3 for their overall 5 year program plan and their progress to date. Details of the EAB Report and the NM ESPSCoR response are provided in the body of the report and Appendix K. Key components are:

- The Management Team committed to finding ways to make explicit the connections between specific project activities and the larger driving questions that underlie the research that is taking place.
- Project leadership will continue to focus and update plans to sustain project benefits.
- Researchers are increasing contacts with relevant national research efforts and programs.
- Project leadership is continuing to refine and communicate project activities and benefits using a variety of communication tools and strategies.

Response to Year Two Evaluation Report

The Year Two external evaluation report (Appendix L) did not provide any significant overarching recommendations for project leadership. Changes made in response to recommendations to specific components are provided in the discussion of those activities. Other recommendations are provided in the Evaluation and Assessment section of the report.

Project Changes During Year Three of the Award

The project had no significant changes in scope or priorities in Year 3 of the award.

INTRODUCTION

The NM EPSCoR RII 3 Program
Annual Report
Award Year Three: September 1, 2010 – August 31, 2011

Structure of this Report

The NM EPSCoR RII 3 annual report for Year 3 follows the outline determined by NSF EPSCoR; the report sections and headings follow NSF guidelines. Woven throughout, the NM EPSCoR RII 3 Strategic Implementation Plan objective(s) are presented in shaded boxes as they apply to the report sections. The Implementation Plan utilizes the NM EPSCoR program's logic model of research infrastructure, cyberinfrastructure and human infrastructure capacity building. Within each of these three areas, the plan specifies 14 objectives to be met throughout the course of program delivery. The objectives are numbered following the scheme established for the Implementation Plan. The complete Strategic Implementation Plan is included as an Appendix M.

Reports of meetings and evaluation referenced in this report are available on the project's website: http://www.nmepscor.org.

Figure 1. New Mexico Tech Post-Doc candidate Jesus Gomez checks his data during a research session at the Valles Caldera National Preserve--one of NM EPSCoR's primary study sites.

PARTICIPANTS and PARTICIPATING INSTITUTIONS

NM EPSCoR RII 3, "Climate Change Impacts on Mountain Sources of Water", is a multi-institutional, multi-disciplinary collaboration across the state of New Mexico. The primary research, education and outreach entities active in the award include:

- 3 research universities: New Mexico State University (NMSU) in Las Cruces, New Mexico Tech (NMT) in Socorro, and University of New Mexico (UNM) in Albuquerque.
- 1 regional university: New Mexico Highlands University (NMHU) in Las Vegas
- 1 tribal college: Dine' College (Diné) in Shiprock
- 1 state museum: New Mexico Museum of Natural History and Science (NMMNHS) in Albuquerque
- 2 national laboratories: Sandia National Labs (SNL) in Albuquerque, Los Alamos National Labs (LANL) in Los Alamos
- 1 non-profit educational organization: The Northern New Mexico Network (NNMN) in Rio Rancho
- 1 national preserve: the Valles Caldera National Preserve (VCNP) in Jemez Springs

Although there are additional partner institutions, and many additional collaborators and participants, the following table (Table 1) lists the core NM EPSCoR scientists, educators and collaborators whose work is detailed in this report.

Table 1. Primary NM EPSCoR scientists, educators and collaborators active in Year 3 of the award

NM EPSCoR Role	Name	Institution	Department
Cyberinfrastructure	Karl Benedict	UNM	Earth Data Analysis Center
Remote Sensing	Max Bleiweiss	NMSU	Environmental and Plans Science
Education	Marnie Carroll	Dine	Executive Director Center Environment
Economics	Janie Chermak	UNM	Economics
Aquatic Chemistry	Laura Crossey	UNM	Earth & Planetary Sciences
Aquatic Ecology	Clifford Dahm	UNM	Biology
Water Resources	Leeann De Mouche	NMSU	Extension Plant Sciences
Education	Anna Espinosa	NNMN	K-12 Math Education Coordinator
Outreach	Eileen Everett	NMMNHS	Climate Change Educator
Hydrology	Alexander (Sam) Fernald	NMSU	Range Science
Water Resources	William Fleming	UNM	Community and Regional Planning
Climatology	Joe Galewsky	UNM	Earth and Planetary Sciences
Education	Lisa Majkowski	NMT	Earth & Environmental Science
Aquatic Chemistry	Edward Martinez	NMHU	Natural Resources
Ecology	Robert Parmenter	VCNP	Preserve Director
Education	Dick Powell	NNet	K-12 Science Education Coordinator
Aquatic Chemistry	Michael Pullin	NMT	Chemistry
Remote Sensing	Albert Rango	NMSU	USDA ARS Jornada Experimental Stations
Climatology	Todd Ringler	LANL	Climate, Ocean, and Sea Ice Modeling Group
Sociology	Jose Rivera	UNM	Community and Regional Planning
Cyberinfrastructure	Renzo Sanchez-Silva	UNM	Earth Data Analysis Center
Outreach	Jessica Sapunar-Jursich	NMMNHS	Director of Education
Remote Sensing	Caiti Steele	NMSU	USDA ARS Jornada Experimental Stations
Systems Modeling	Vince Tidwell	SNL	Geo-Hydrology
Hydrology	John Wilson	NMT	Earth & Environmental Science

Appendix B: RII Participants details complete participant demographics in aggregate for the entire project and for each institution; these participants have been entered into Fastlane. These data

include all participants (faculty, staff, students, external advisory board members, etc.) who are "strongly involved in the project" and are not restricted to the core project personnel shown above in Table 1. Demographics for all project participants in Years 1-3 of the award are shown in Table 2.

Table 2. NM EPSCoR Participants Years 1-3

Demographic	2009 Number	2009 Percent	2010 Number	2010 Percent	2011 Number	2011 Percent	Change Year 1 to 3
Female	36	36%	57	40%	60	38%	2%
Male	61	61%	86	60%	98	62%	1%
Underrepresented Minority Ethnic/Race	5	18%	38	27%	45	28%	10%
Totals	97		143		158		61

As is evident from the table above, the total number of participants has increased as program activities have advanced. Additionally, *the percent of participants from underrepresented minority groups has increased significantly--from 18% to 28%. The percent of female participants has also increased, from 36% to 38%*. These demographic changes are a direct result of the RII 3 project's focus on diversity and implementation of strategic activities aimed at broadening participation by underrepresented groups as described in this report.

Not included in the numbers presented above (and Appendix B) are the K-12 teachers who participate in the Summer Teacher Institute; these teacher participants are described in Section 3 of this report.

Appendix A: Faculty Support is also attached showing NM EPSCoR support in terms of months and amount of salary on the RII project as well as their financial support from sources indicated on the template. The total dollar support columns include RII salary support for each faculty member and the faculty member's students and postdocs, including fringe benefits and overhead.

Figure 2. A panel of faculty researchers and educators at the 2010 All Hands Meeting.

PROJECT DESCRIPTION

1. Research Accomplishments and Plans

Significant progress was made in each of the objectives for research infrastructure improvement. These research efforts have also led to new collaborations within and between institutions in NM and beyond. The investments made in supporting undergraduate students, graduate students and post-doctoral scholars have produced noteworthy dividends as these junior scholars have contributed significantly to the research effort and gained valuable experience in research and scholarship.

Focus on Collaboration

In Year 3, NM EPSCoR leadership encouraged and facilitated increased collaboration between researchers across institutions and across research focus areas as well as collaboration between research and cyberinfrastructure, between research and education, and between cyberinfrastructure and education. Efforts that connect cyberinfrastructure with education and research efforts are fully described in Section 4 (Cyberinfrastructure) of this report; efforts connecting research and education are highlighted in Section 3 (Workforce Development).

In summer 2010, science meetings that brought together faculty and student researchers from all 3 research institutions (UNM, NMSU, NMT) as well as NMHU were held and facilitated by the project directors—one focused on hydrology and climate modeling, another on hydrology and water quality. Outcomes from these meetings guided collaborative research efforts in Year 3 including the use of electronic collaboration tools that students from all of the institutions have used to coordinate their fieldwork. In Fall 2011 the statewide All-Hands Meeting provided another opportunity for researchers to discuss their efforts as well as generate new ideas for collaboration. Innovation Working Groups and the Tri-State Annual Meeting facilitated collaborations across New Mexico and with our EPSCoR colleagues in Idaho and Nevada. Details of the collaborative research efforts are provided in the following section of this report.

Strategic Plan Objective 1: Enhance climate and hydrology research infrastructure.

Climate and Hydrology

The central research challenge of NM EPSCoR RII 3 is to understand how future changes in seasonal temperature and precipitation regimes will impact snowpack, snowmelt and spring runoff in the mountainous region of north central New Mexico. This region, the southernmost extent of the Rocky Mountain range, serves as the headwaters for river systems of crucial importance to NM, including the Rio Grande. In Year 3 of the award, researchers continued to upgrade and expand climate and hydrology observing networks and improve climate models to better investigate questions in the study region. Expansion of the observing networks has led to numerous collaborations with agencies and organizations both within and beyond the NM RII 3 jurisdiction. Each of the research institutions is focusing on different climate and hydrologic models that will lead to better representations of the complex interactions that are involved in climate impacts on water resources. NM EPSCoR researchers are using each other's model outputs to inform the models on which they are focused, employing a process of iterative refinement and improvement.

Instrumentation

Researchers at New Mexico State University (NMSU) continue to significantly upgrade climate and hydrology observing networks in New Mexico, with an increased focus on sites on the Navajo Nation. Necessary materials, instruments and computers for the fabrication and on-site installation of observing stations measuring precipitation including snowfall, temperature and soil hydrology were purchased. Four out of five sites for stations on the Navajo Nation have been identified, with the fifth site to be determined in summer 2011 in collaboration with the Navajo Water Development Department. An additional weather station will be installed this summer in the Rio Hondo, near Taos, NM. Meteorburst radios are scheduled to be installed on the Navajo Nation weather stations and will transmit data to the National Resources Conservation Service (NRCS) under an MOU with NRCS-NWCC. Procurement of additional meteorburst radios has been delayed due to difficulties with acquiring the equipment from the manufacturer, but all the radios will be purchased in summer 2011. Connecting the network of upgraded weather stations to the NRCS network is an important step in ensuring the long-term sustainability of the enhanced observing network.

Figure 3. Researchers install a weather station on the Navajo Reservation in Northern New Mexico.

NMSU researchers continue to work with the U.S. Forest Service, Bureau of Land Management, and the National Park Service to procure permits for OTT Pluvio precipitation gauges to upgrade their Remote Automatic Weather Stations (RAWS) network. These are all-weather precipitation gauges that use weight-based technology to measure rainfall, snow or hail. The current drought situation has delayed the Forest Service's ability to participate in the installation until July 2011; researchers will install at least 4 of the OTT Pluvios, continuing with installation in the Fall 2011.

Modeling at NMSU

NMSU faculty and post-docs have continued to develop the Snow Runoff Model (SRM) for all major snowmelt sub basins in the Rio Grande. They assembled 75% of the input data for the SRM (temperature, precipitation, and snow covered area) for all 24 Rio Grande sub basins. Based on these data, the parameter values for each sub basin are being calculated or estimated. Snow cover mapping is being refined using forest cover in the forested parts of each elevation zone. Runoff simulations will be run at the beginning of year 4 and examined for discrepancies. Climate model inputs for existing years will also be used to run SRM and compared to the actual input of climate data.

NMSU has developed strong collaborative ties with climate researchers at the University of New Mexico (UNM) and the University of Nevada Reno (UNR). NMSU supplies basin boundaries for each sub basin which UNM and UNR researchers use to produce climate inputs for current and future years to use in running the SRM. Once complete, the outputs of the SRM will provide critical data for understanding and predicting climate impacts on water availability for all areas served by the Rio Grande at a level of detail not possible before.

Building on work done in Year 2 applying the Semi-distributed Land Use and Runoff Process (SLURP) model to 47 Rio Grande basins in the model, unimpaired flows for the Rio Grande basin were simulated to assist in running different trial runs, especially for climate change. A graduate student has been recruited to begin work with NMSU faculty on using the SLURP output as input into a hydro-economic model. Work from his graduate project will be used to assess the

consequences of climate change on the competing uses of water including agriculture, urban supplies, recreation, endangered species, and power.

Modeling at UNM

The overall thrust of University of New Mexico (UNM) EPSCoR-related research into climate modeling is to better understand the large-scale controls on climate variability in arid, semi-arid, and hyper-arid regions. A particular focus of the UNM program is the use of idealized climate and weather models to understand the underlying processes that govern climate variability globally and especially in arid regions. The UNM research group, which includes EPSCoR-supported researchers at the undergraduate, graduate, post-doc and faculty levels, has advanced its research program in several important ways during Year 3 of the project.

A postdoctoral scholar has continued his research into the use of tree ring isotopic composition as a tool for paleoclimate analysis in the Southwestern United States. His initial hypothesis was that tree rings would record the passage of tropical cyclone remnants through Arizona, but his analyses have ruled out a tropical cyclone component to the tree ring record in the Hualapai Mountains of Arizona. His research has revealed a unique signature of high-resolution interannual variability in Ponderosa Pines from the region. He is developing new diagnostics that use the North American Reanalysis Dataset to provide an interpretative framework for his data.

A new PhD student joined the UNM research group and initiated a study to investigate the processes controlling mid-tropospheric aridity. She is using satellite data coupled with innovative diagnostic and modeling techniques to improve our understanding of the links between large-scale atmospheric circulation, land surface processes, and sea surface temperatures in controlling the aridity of the subtropics. In her first academic year, she developed the basic computational tools required for the satellite analysis and has started learning the required supercomputing techniques for the climate modeling component. Another new PhD student will join the UNM research group in summer 2011; she will work on developing statistical theories for convective precipitation and how such precipitation changes as a function of large-scale climate state**.**

Ms. Sarah Keller successfully completed her Master's degree; her thesis used a variety of data products to explore the links between snowpack hydrology and surface fluxes focusing in particular on the 'memory' effects of snowpack on summer precipitation. Her work has been informative for modelers at NMSU and NMT.

Undergraduate students are also working on the collection and evaluation of Landsat imagery of continental sedimentary basins and fluvial systems in these basins, including the Rio Grande Rift basin of New Mexico. The fluvial systems in these basins record the effects of past climate change and may be useful in predicting the influence of future climate change on river systems around the world.

Modeling at NMT

NMT researchers continued the development of new conceptual and mathematical models that describe how dynamically changing flow conditions influence the distribution of residence times in hydrologic systems. This work is motivated by the use of natural and manmade tracers (e.g., isotopes) to understand the circulation of water in hydrologic systems and its sensitivity to climate variability and change, and to understand related biogeochemical processes. The methods will be tested with data collected in several of the study areas (below). Among the findings is the common presence of multimodal residence time distributions with profound implications for data

interpretation. The results have implications for atmospheric science and oceanography, not just hydrology.

NMT researchers also continued the development of watershed models for the Valles Caldera National Preserve and the Rio Hondo study areas using the GS Flow approach (http://water.usgs.gov/nrp/gwsoftware/gsflow/gsflow.html) developed by the US Geological Survey. Spatial and temporal data sets for the Rio Hondo model have been assembled to provide the input information needed by GSFlow. Work is currently focusing on exploring alternative boundary locations for 3-D watershed models to determine what is most suitable in order for the model to accurately reproduce groundwater discharge, groundwater age (residence time), and other metrics for the valley of interest. Researchers at NMSU and NMT are planning a seminar for researchers at both institutions that will better inform each about the catchment and snow runoff models each are currently using and refining.

By collaborating with the Water Quality Group (NMT and UNM), the hydrology-focused researchers made substantial progress on a modeling approach for the transport and reaction of dissolved organic matter (DOM) in hyporheic zones, using an "agent based modeling" approach. To allow the agents to move, researchers selected "lattice Boltzmann modeling," which simulates transport processes at the porous media pore scale or, through up-scaling, can be used to simulate transport at the aquifer scale (e.g., a meander bend hyporheic zone).

Strategic Plan Objective 2: Improve water quality monitoring in high altitude stream

Water Quality

Climate change impacts on mountain sources of water are not restricted to hydrologic elements such as timing and flow quantity, but also affect water chemistry. There is a particular need to understand the chemical constituents of streams in snowmelt-dominated watersheds that are important for both ecosystem and human health. NM EPSCoR RII 3 is deploying state-of-the-art, near-real-time, autonomous water quality in-stream sensors for monitoring the quality of surface water in three watersheds in New Mexico fed by snowmelt--the Rio Hondo, Jemez River and Rio Chama. Research efforts focused on water quality have led to substantive collaborations between faculty, students and post-doctoral scholars both within and across three of the NM EPSCoR RII 3 institutions: New Mexico Tech, the University of NM, and NM Highlands University.

Iron Analyzer Development
During year 3, NMT focused on refining a laboratory-based model for an *in situ* colorimetric iron analyzer and constructed a prototype of an *in situ* iron analyzer that will be ready for field-testing and deployment by the end of Year 3. The instrument will be deployed at the VCNP, near the Water Quality Trailer, for the remainder of the project. The device will provide alternating measurements of total iron and iron (II) every 2 minutes, using a stream-side solar panel for power. Based on our design, we anticipate that the instrument will be able to run continuously for 30 days without human input. The resulting iron data will be interpreted in light of the additional stream chemistry data provided by the water quality trailer, described below.

Water Quality Monitoring
The water quality team—including student and faculty researchers from UNM, NMT and NMHU—has used areas of the Jemez river watershed, especially the portion located within the Valles

Caldera National Preserve (VCNP) for much of their fieldwork. Sondes have been continuously deployed in the Jemez River in Jemez Springs, NM to examine salinity, temperature, pH, dissolved oxygen and pH changes to allow site data to be connected to larger scale systems such as the Rio Grande. A network of 34 shallow monitoring wells was installed in June 2010 along a 250-meter reach of the East Fork Jemez River within the VCNP. Wells were instrumented with two YSI sondes and 32 data loggers beginning in May 2010. Two YSI sondes were also deployed in the surface water at this time. In fall 2010 two real-time nutrient analyzers, were test deployed at the study site.

Figure 4. A group of shallow monitoring wells along the East Fork Jemez River in the Valles Caldera National Preserve

Throughout Year 3, numerous water quality studies have been carried out, including tracer tests and continued monitoring of surface and groundwater. The data collected will be used to establish hydrologic connectivity between surface waters and ground waters at the study site and quantify how flowpaths vary on a variety of temporal scales. Additional studies are investigating nutrient variations in response to spring snowmelt and diurnal variability. Continuous data obtained from the study site has been and will be supplemented and validated with water quality and biological grab samples on a regular basis.

Water Quality Trailer

NMT has continued efforts to equip a 10' cargo trailer with a variety of water quality sensors; the trailer will be installed in summer 2011 in the VCNP to provide continuous, year-round water quality data. The trailer will be located at the East Fork Jemez River meander where the monitoring wells have been installed, so that data from the trailer will aid in other research efforts that explore how the hyporheic zone will affect stream water quality. Electrical service at the Valles Caldera National Preserve (VCNP) research site has been established and electrical and heating systems for the trailer have been installed. A computer control system for the trailer has been purchased and students have begun the development of the necessary software that will control and collect data from the instruments deployed in the trailer. The system will also upload data from the various sensors to a webpage, allowing researchers to monitor water quality data and other environmental parameters in real-time. Some modifications to the selection of sensors to be included in the trailer have been made to produce higher-quality data.

While the development of the trailer has been more difficult than anticipated, challenges have led to the development of several cross-disciplinary collaborations. An undergraduate electrical engineering major with 10 years of electronics experience has been able to help the graduate students in chemistry, geochemistry, and hydrology make progress on the trailer wiring and electronics. A graduate student in Chemical Engineering will be joining the team in summer 2011 who brings experience with the Labview programming and fluid control system that will contribute to the team's efforts.

NMHU Water Quality Studies

Researchers from NMHU are working in collaboration with researchers from UNM, NMT and the VCNP the several water quality projects described above. In addition, students from NMHU are involved in additional water quality studies listed on p. 11 of this report.

Strategic Plan Objective 3: Develop interdisciplinary socioeconomic and hydrologic research capacity in *acequia* systems research.

Acequia Interdisciplinary Research

Acequias are the traditional water management system of rural northern New Mexico. Their communal governance and 'ditch irrigation' management systems provide unique physiographic and cultural elements to help understand the effects of changing mountain hydrology on land and water use, ecosystem change, and stream flow. A collaborative interdisciplinary team integrates social, economic, ecological and hydrological research to understand climate change impacts on *acequias*, and *acequi*a management responses to climate variability.

In Year Three the UNM team intensified fieldwork in the gathering of additional data regarding *acequia* strategies for responding to climate variation in the context of traditional rules and customs of the *acequias* as water management institutions. In the Rio Hondo, 11 *acequias* were studied; at the El Rito Valley, 14 additional *acequias* were included. Acequias in each of these watersheds have different governing political structures as well as sources of water; the Rio Hondo is fed by snowpack releases whereas the El Rito River depends totally on water that originates at higher elevation springs. Diversions for both systems rely only on surface water flows and thus remain vulnerable during times of drought when snowpack is reduced and summer precipitation declines. Neither system of *acequias* owns or has access to storage reservoirs. As gravity flow systems, they divert surface flows only when available and do not rely on groundwater pumping or other mechanical technology.

Researchers from NMSU and UNM worked to establish new contacts at both sites, conducting informal discussions regarding water availability in times of drought versus times of relative abundance and how these changed conditions affected *acequia* management decisions about water sharing, crops and land use, conservation practices, and other impacts. Students also developed and tested a preliminary model to assess *acequia* functionality in terms of physical characteristics, ecological health of the ditch, and *acequia* governance and community uses. In collaboration with the NMSU technician, they helped install a gauging station, a radio transmitter station, and weather instrumentation.

Figure 5. *Congreso de las Acequias*, annual meeting of the New Mexico Acequia Association, November 13, 2010.

A highlight of Year 3 work for this project component was their increased involvement with the *acequias* associations. In November 2010 student and faculty researchers attended the annual meeting of the New Mexico Acequia Association called the "*Congreso de las Acequias*" at which they presented posters that described the NM EPSCoR research efforts. At the Rio Hondo site, the UNM and NMSU teams were invited to participate in a meeting of the *acequias* convened by the Taos Valley Acequia Association at which the community discussed management issues in light of the anticipated drought conditions. Plans were made for working with NMSU technicians to monitor *acequia* operations and hold a later meeting that will include NMSU and UNM researchers to discuss how to implement or modify the flow sharing agreement especially during times of water scarcity.

UNM and NMSU also participated in an El Rito Valley focus group discussion convened by the President of the El Rito Acequia Association. It was noted that NMSU had already installed gauges and other instrumentation to measure water flows in El Rito River and some of the *acequias*. Discussion included a focus on climate change factors and how water management of the *acequias* could be affected in the event of prolonged drought periods. An EPSCoR graduate student presented a draft of the Acequia Functionality Assessment as a process to obtain feedback on the physical characteristics of ditches, the range of ecological benefits, and how to rate *acequia* governance and community uses of the ditch. At the conclusion of the meeting, it was suggested that the youth of the community should be recruited to conduct these assessments as a way of learning about *acequia* irrigation systems and the importance of the agricultural traditions that need to be passed on to the new generation.

In collaboration with NMSU, plans will be developed to schedule additional focus group sessions during Year 4 when more streamflow data will be available in order to share with the *acequia* partners at Rio Hondo Valley and the El Rito Valley. Both sites appear ready to look at models and scenarios of possible climate change effects on snowpack conditions and flows in the streams during times of water scarcity in the future and to then plan appropriate water management responses. Additionally, a joint questionnaire for use by both NSF funded projects (NM EPSCoR and NSF CNH) will be finalized during the summer months to include data collection needs of the two projects and to avoid any duplication of effort.

Acequia Chili Project

Beginning in summer 2011 an NMSU graduate student will experiment with different varieties of chili at different water consumption levels. Work is being done with the intent to provide potential higher value crop mixes to the Northern NM *acequia* farmers. For hundreds of years, Pueblo Native Americans in the Chimayo area of northern New Mexico have grown Chimayo chili peppers. These chilies are known throughout the region for their distinct flavor, fruit shape, and ability to withstand drought conditions. The ability to quantify how much water is going onto Chimayo chili crops and how their yield responds to drought conditions is extremely important to farmers in Chimayo because the data collected will help them understand how their crops will respond to certain situations and how they can increase their yield.

Socioeconomics and System Dynamics Model

A primary goal of this research is to support the expansion of the System Dynamics (SD) economic-behavioral-physical model to include more robust residential demand models for Albuquerque, as well as a population model tied to both natural growth and economic growth. This expansion of the SD model will provide one of the most extensive interactive models of a watershed system with equal attention to the physical and behavioral worlds.

The main accomplishment for Year 3 has been the connection of economic modeling components into Sandia National Laboratories' SD Toolbox model for the Middle Rio Grande. The model now allows us to consider the simultaneous interactions between physical and behavioral components and assess the impact of various policies and events. For example it is possible to model impacts of pricing and/or educational policies, population growth, or drought events on the river, the aquifer, and the water sharing compacts.

The baseline model for the SD model combines a cohort-based population model for Bernalillo County with a residential water demand model. Combining this with the physical model from the

Sandia Toolbox allows researchers to consider numerous scenarios; all simulations are run over a 35-year time horizon. Simulations have been run to consider the impact of population changes, use of pricing or conservation incentives, changes in attitude towards water scarcity and changes in the timing of drought events. A number of scenarios that include a combination of these basic changes have been and continue to be run and analyzed. There are more scenarios that we will develop, including a wider range of physical scenarios (e.g., drought periods that exceed the historical both in duration and in number) and changes in economic activity.

Preliminary work has begun on determining the socio-economic components for an *acequia* model. Work being done with the *acequia* associations should produce information that can be incorporated into an *acequia* SD model. It will be based on qualitative data rather than on econometrically estimated functions.

Strategic Plan Objective 4: Provide critical gap infrastructure for New Mexico Highlands University.

Aquatic Chemistry Laboratory at New Mexico Highlands University (NMHU)

In Year 1, NM EPSCoR funded the establishment of an aquatic chemistry laboratory at NMHU for state-of-the-art water quality analysis that enhanced the institution's ability to perform research on climate change and water resources. A primary incentive for the laboratory upgrade was to improve the quality of graduate student research at NMHU, and to provide training in the use of analytical instruments for graduate and undergraduate students.

Since its installation, Dr. Edward Martinez (NMHU) has collaborated with faculty at UNM on training and use of the analytical instrumentation as well as with researchers at UNM and NMT to carry out collaborative research projects. Year 3 projects include:

- *Seasonal Variation Influences on the Bioavailability of Dissolved Organic Carbon (BDOC) in High Mountain Meadow Streams, Valles Caldera, NM.*
- *Seasonal and Diurnal Nutrient Variations of the Jaramillo and East Fork Creeks: Valles Caldera, New Mexico*
- *Diurnal and Seasonal Variations of Dissolved Iron and Arsenic Jaramillo and East Fork Creeks: Valles Caldera, New Mexico*
- *Fate and Distribution of Geothermal Solutes in Valles Caldera National Preserve Streams and Biota.*
- *Characterization and Paleolimnology in McAllister Lake, Northeastern New Mexico, San Miguel County.*

The first three projects listed above have one full year of data and students are working on data and results for Master's Thesis and Senior Project preparation and publication. Prior to the EPSCoR grant NMHU did not have the capacity/instrumentation needed to conduct studies such as the ones described. Previously, it was necessary send samples to other labs for analysis at a high cost (labor, instrument use, and consumables). Now the analysis can be done in-house at a much lower cost with the added benefit that the students gain experience in these analyses. Since the instrumentation cost has been eliminated, funding for such projects is more attainable. NMHU intends to eventually accept samples for analysis from other researchers at a cost that will generate funds to maintain the instrumentation, consumables and support the lab tech position.

The benefits to students of the enhanced laboratory facility extend to learning in the classroom as well. For example, in a Water Science course, students conduct a research project investigating arsenic contamination in private wells in rural northern NM. Without the instrumentation purchased with the EPSCoR funding students would only be able to read and discuss the issue of arsenic in drinking water. With the instrumentation they can investigate this issue directly, which provides a great learning experience for the students and instructors.

As a result of the laboratory upgrade, faculty at NMHU are now better able to apply for research funding and to collaborate with other researchers. For example, Edward Martinez is currently collaborating with other faculty from NMHU and the University of California Riverside on a proposal to the NSF Nanotechnology program. The instrumentation purchased through EPSCoR will be used in this research project if funded. Additionally, Edward Martinez and his students have collaborated on several projects with researchers from other institutions. Many students at NMHU have been exposed either through a course or working on an EPSCoR project to experiences that were made possible due to the EPSCoR funding. Currently, two graduate students are finalizing their Master's Thesis and will be submitting their manuscripts for publication. Their investigation of copper sulfate in drinking water reservoirs would not have been possible without the instrumentation purchased by the EPSCoR grant.

2. Diversity and Broadening Participation, including Institutional Collaborations

Strategic Plan Objective 8: Enhance diversity in all elements of the NM EPSCoR Program.

Following the Reverse Site Visit in Year 1, the diversity plan in the NM EPSCoR Implementation Plan (see Appendix M) was revised to include a strategic objective to encourage and support leadership by women and underrepresented groups on EPSCoR-supported projects, as required by NSF. In program solicitations, such as Innovation Working Groups and SEED Awards, preference is explicitly given to proposals that provide leadership opportunities for women and underrepresented groups. Diverse faculty and post-docs are invited and encouraged to lead presentations and discussions at science meetings, including the annual All Hands Meeting and Tri-State Consortium Annual Meeting. Leadership training will continue to be provided through the annual Junior Faculty Leadership Workshop; diverse EPSCoR faculty will be recruited to attend.

2a. Diversity Strategic Plan

Going beyond the directive from the NSF Reverse Site Visit, a Western Consortium Tri-State Diversity Working Group was formed at the 2010 Tri-State annual meeting. Leaders from that working group submitted a successful proposal for a Tri-State IWG focused on Diversity (see p. 38), which was convened in the fall of 2010. The IWG produced a Tri-State Diversity Strategic Plan in which six strategies are detailed with action items and timelines for each. The six strategies are:

1. **Engage Interest Early**: Engage the interest of URM students and women by providing information that allows them to explore and prepare for a career in the field.
2. **Early Research Experiences**: Enhance the retention and advancement of URM students and women by ensuring early research experiences, utilizing a reward system for students and faculty based on an analysis of their needs.
3. **Social Networking**: Facilitate the recruitment, retention, and advancement of URM students and women by designing, developing, and maintaining a social networking system that provides academic and social support for these students.
4. **Mentoring**: Develop the capacity of faculty members to be successful mentors for URM students and women by supporting professional development activities and by sponsoring appropriate rewards to recognize faculty contributions.
5. **Best Practice Research**: systematically research approaches and best practices for under-prepared STEM-interested students and use data-driven analysis to better understand potential barriers for STEM-interested students
6. **Coordinated Efforts**: Facilitate coordinated action in the recruitment, retention, and advancement of URM students and women through a state (then regional) hub.

Figure 6. Diversity Working Group, Sept. 2010.

The complete Diversity Strategic Plan is attached as Appendix N.

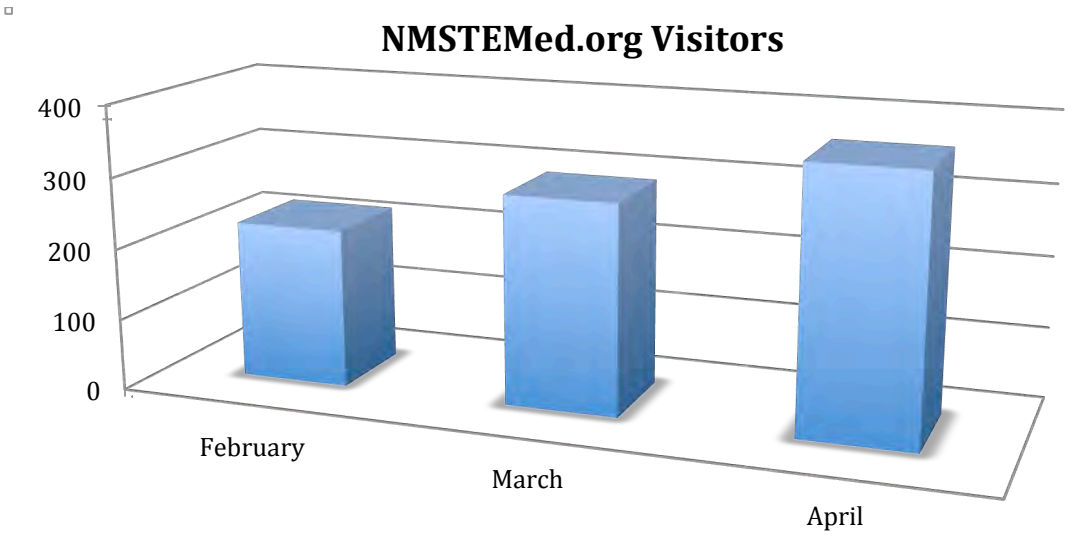
A Diversity Working Group session at the 2011 Tri-State Annual Meeting revisited the plan and reported progress made towards each of the six strategies. A collaborative on-line website has been established to share resources and continue the work listed in the plan. NM EPSCoR has made progress on several of the strategies and continues to focus on these efforts.

NM STEM Database

One action listed in strategy #1 of the Diversity Strategic Plan is to create a website that lists opportunities in science, technology, engineering, and mathematics (STEM) offered in the state. NM EPSCoR, in collaboration with the NM Department of Public Education and the NM Math and Science Advisory Council, has developed and maintains the New Mexico STEM Database (www.nmstemed.org), a searchable listing of STEM programs, opportunities and events for students, teachers, and members of the community. Creation of a database was recommended in *NM Project 2012*, a plan for transformational change in K-12 math and science education in New Mexico (www.ped.state.nm.us) as well as in the Tri-State Diversity Plan. The goals of the New Mexico STEM Database are to:

- Increase statewide participation in New Mexico science, technology, engineering and mathematics by providing a cohesive and searchable database with multiple educational programs and opportunities.
- Increase access to science, technology, engineering and mathematics learning opportunities within New Mexico for all students, including women and those from underrepresented groups.
- Provide a statewide clearinghouse of science, technology, engineering and mathematics programs available to K-12 students and teachers, undergraduate and graduate students, and community members in the State of New Mexico.

In its first six months, the database has had over 60 programs submitted; visitation has been increasing, as seen in the graph below.



Graph 1. Visitors to the New Mexico STEM Database from February-April 2011.

Social Networking
Strategy Three of the Diversity Plan focuses on using social networking tools to increase recruitment and retention of URM and women. NM EPSCoR launched a Facebook site (www.facebook.com/NewMexicoEPSCoR) and has been exploring ways to use this mechanism most effectively. NM EPSCoR currently has 66 followers, numerous posts, hundreds of images, and useful information for all involved with NM EPSCoR. It has also inspired the members of the Western Consortium (Nevada EPSCoR & Idaho EPSCoR) to begin launching their own Facebook pages. Discussions continue to develop on the advantage of social media within the Western Consortium.

Leadership/Presentations
Providing opportunities for URM and female researchers to communicate their work as well as develop leadership skills is a strategy in both the NM EPSCoR diversity plan as well as the Tri-State Strategic Diversity Plan. At the NM EPSCoR All Hands (state-wide) meeting, of the 19 students who presented posters of their research, 9 were female (47%) and 6 (32%) were members of underrepresented minority groups (URM). At the Tri-State meeting, of the 15 New Mexico students who competed in the student poster session, 6 were female (40%) and 5 were URM (33%). In addition, a female graduate student was the lead investigator on a funded Innovation Working Group (Applications of Distributed Temperature Sensing for Climate Change Research in New Mexico) and the PIs on both of the awarded Seed grants are URM, one is also a female. At the Tri-State Consortium annual meeting, 64% of the 28 session presenters/moderators from New Mexico were URM or female.

Workforce Development
Both the Undergraduate Research Opportunities Program (UROP) and the Summer Teacher Institute are focused on broadening the participation of URM students in STEM and are described in Section 3 of this report. The UROP program is an exemplar for Strategy 2 of the Tri-State Diversity Strategic Plan, Early Research Experiences.

2b. Institutional Collaborations

Engagement in NM ESPCoR project activities continues to grow throughout the state and beyond. Faculty and students from 19 NM institutions, including primarily undergraduate and minority serving institutions, have participated one or more NM EPSCoR activity in Year 3, including Innovation Working Groups, the Undergraduate Research Opportunities Program, NSF Day, and the Junior Faculty Leadership Workshop. Each of these programs is described in the body of this report. The All Hands Meeting (annual state EPSCoR meeting) had 67 representatives from 6 colleges and universities, 6 K-12 schools, 2 state agencies, 1 national laboratory and 2 educational non-profits.

Each of the project components has established collaborations with partners who are not part of the NM EPSCoR project in order to carry out their research and education efforts. A summary of these collaborations is included in Table 1 below; additional information on collaborations in included in Appendix C.

Table 3. Collaborations with others OUTSIDE NM EPSCoR (not participants)

Component	NM Institutions	External Institutions	# of Individuals
Acequia Interdisciplinary Research	6	0	13
Climate and Hydrology Research	4	3	7
Cyberinfrastructure	3	10	47
Diversity	3	6	10
K-12 Professional Teacher Development	2	0	2
Public Outreach	9	1	10
State Office Management	1	0	1
Water Quality Research	1	0	1

Collaborations between EPSCoR participants have also expanded, as described throughout this report.

Western Tri-State Consortium

New Mexico has joined the Nevada and Idaho NSF EPSCoR programs in forming a consortium of EPSCoR states with similar research agendas related to climate change and water resources. The consortium model significantly increases opportunities for scientific collaboration and enhances each state's ability to secure competitive funding and tackle complex climate change research agendas.

Tri-State Meeting

Each year the Western Tri-State Consortium of Idaho, Nevada and New Mexico (#0814387, #0814372, and #0814449) conduct an annual meeting of current NSF EPSCoR participants. The primary purpose for this meeting is to foster collaborations among the NSF EPSCoR RII projects and participants in our respective states and to identify common challenges and solutions related to the themes of our states' RII programs. The meeting agendas and presentation formats, facilitated sessions, working group breakouts, etc., are specifically and carefully developed to spur collaboration among program directors, cyberinfrastructure scientists, research scientists, education professionals, and outreach and diversity program coordinators. The meeting rotates among the three EPSCoR jurisdictions.

Figure 7. Attendees of the 3rd Annual Tri-State Meeting listen to keynote speaker Craig Allen.

Nearly 200 researchers and educators from New Mexico, Nevada, and Idaho gathered for the 3rd Annual EPSCoR Western Consortium Tri-State Meeting at the Hyatt Tamaya Resort Hotel and Spa, Santa Ana, NM on April 6-8, 2011. The theme of this year's meeting, "Collaborations Connecting Climate Change Science, Education, and Policy," highlighted the connections that have been developing across institutions and disciplines throughout the consortium. Researchers shared the outcomes of their work, discussed implications and possible synergies between their efforts, and clarified questions that will guide their work into the future. The three-day meeting featured 15 concurrent sessions, keynote

speakers and a student poster competition; the full agenda is available on the project website (http://nmepscor.org/content/3rd-annual-tri-state-meeting). In addition, there was a half-day workshop on Hydrologic Information Systems and a daylong Climate Modeling workshop.

Cyberinfrastructure is a major focus area of the Tri-State meeting and of the overall tri-state collaboration; the collaborative tri-state activities to support cyberinfrastructure development are described in Section 4 (Cyberinfrastructure) of this report.

Tri-State IWGs

Another mechanism for facilitating collaborations is the Tri-State's Innovation Working Group (IWG) Program, which supports collaborative, trans-disciplinary work by the three member states. The IWG provides a venue for engaging scientists and educators, along with key nationally and internationally recognized experts, to address the grand challenges that can transform science and education. This program supports week-long working group activities that are modeled after those hosted by the highly successful NSF-supported National Center for Ecological Analysis and Synthesis (NCEAS). The Tri-State Consortium awarded four IWGs in Year 3 of the project: *Western Tri-State Diversity IWG, CyberEnabled Science, Indicators of Ecological Thresholds,* and *Mountain-to-Valley Ecohydrology at Multiple Spatial and Temporal Scales.* Descriptions of these IWGs are in Section 7 (Sustainability) of this report.

Tri-State Training

The Tri-State Consortium also collaborates to provide access to additional graduate training and is hosting a summer 2011 workshop on Parallel Computing. The Consortium also developed a new interdisciplinary modeling course that was offered in summer 2010. Evaluation of the course was extremely positive and has resulted in on-going collaborations between participants as evidenced through joint presentations at the Tri-State Consortium Annual Meeting and Innovation Working Groups.

The Junior Faculty Leadership Workshop, an activity designed to address one of NM EPSCoR's RII 3 strategic objectives, was opened in Year 2 to Nevada and Idaho post-doctoral scholars and junior faculty, making it another component of tri-state collaboration. In the 2011 workshop there were 3 participants from Idaho and 1 from Nevada. This activity is more fully described in Section 7 (Sustainability) below.

3. Workforce Development

NM EPSCoR's efforts in Workforce Development overlap significantly with our efforts to broaden participation in the project and in research and STEM education in New Mexico. Investing in the Human Infrastructure necessary to carry out research now and in the future is one of our key strategic areas. Refer to Section 2 (Diversity and Broadening Participation) for more information about other efforts to broaden participation.

Strategic Plan Objective 9: Enhance teacher professional development for STEM areas in northern New Mexico.

NM EPSCoR Teacher Summer Institute

NM EPSCoR partners with The Northern New Mexico Network for Rural Education (NNMN), an educational cooperative of 29 school districts in northern New Mexico that serve 30,000 students, for the RII 3 teacher professional development component. The NNMN has developed long-term relationships with school districts located in the mountainous northern part of the State in which our climate change research is focused. These school districts are small, rural, and serve predominantly Hispanic student populations; nearly 75% of the population speaks Spanish as the primary language in their homes. Three of the school districts have a majority of Native American students, (Apache, Navajo, and Taos pueblo). The NNMN uses 'circuit riders' - math and science pedagogy professionals who travel from school to school and assist teachers on-site throughout the school year; a crucial component for implementing learning from summer experiences.

In collaboration with NM EPSCoR, the Northern Network provides a one-week inquiry-based summer institute for secondary science teachers and teams of science/math teachers at the Valles Caldera National Preserve (VCNP), another NM EPSCoR partner and field research site. The program, "Rim to River," engages teachers in the development of curricula on climate change in New Mexico, using field studies in water, soils, botany, and sampling methods. Teachers receive a stipend for their week of attendance, and all housing and food costs are paid. Over the course of the grant to date, teachers from 27 schools in Northern New Mexico have participated in the Summer Institute, a significant portion of the secondary schools in the region. Fifteen teachers will participate in summer 2011; 7 of them (47%) are URM. The agenda for the 2011 Summer Teacher Institute is found on the NM EPSCoR website (http://nmepscor.org/content/k-12).

An important aspect of the Teacher Professional Development program is the follow-up and support for classroom implementation that is provided through the school year. In fall, 2010 an EPSCoR faculty researcher and her student offered a one-day workshop for teachers who had attended the summer institute that addressed how to access and use environmental data in their classrooms. A spring workshop was held for both past participants and the teachers selected to attend the upcoming summer (2011) institute. The combined session was facilitated by a master teacher and focused on science inquiry, student engagement in science classrooms and some physical science concepts. Expectations and plans for the upcoming summer were presented and past participants shared their experiences in the institute. The NNMN is fostering a community of learners in which teachers from around the region are able to support each other in their classroom implementation. The NNMN Circuit Rider also assisted several of the teachers in providing field experiences for their students.

Impacts/Outcomes
The NM EPSCoR external evaluator conducted an evaluation of the Year 2 Summer Teacher Institute (included in Appendix L). He found:

> Program participants found little fault with the program. The design and content of the program appears to be meeting the needs of teachers… As opposed to the prior year, there were a good number of EPSCoR scientist involvement (sic) in the Institute. Teachers rated the scientists well and appeared to enjoy the field work and working with the scientists. NM EPSCoR scientists were able to include the teacher participants in fieldwork on the Valles Caldera and be able to make the linkage between the equipment use and its relationship with climate change research.

The evaluation report also measured the increase in skills the teachers attributed to their attendance in the institute:

> The two areas where almost all (88%) participants reported their skills increased 'A lot' or 'A great deal' were: 'Using environment as an outdoor classroom' and 'Your field observation skills'. Three-fourths (75%) of the teachers reported an increase in skill in: 'Integrating science disciplines, math and writing in field work'; 'Developing lesson plans integrating science and math'; '... science content knowledge', '... field observation skills'; 'Skill in water testing' and 'Skill in soil testing'. The one area teachers did not report a substantial increase in skills was 'computer skill'. Computers were not a focus of the institute and in fact are not widely available at the Valles Caldera.

Figure 8. Participants of the 2010 Summer Teacher Institute take notes while conducting field work at the VCNP.

Strategic Plan Objective 10: Develop an Undergraduate Research Opportunity Program that increases the exposure of students at non-PhD granting institutions to high quality, relevant, hypothesis-driven research.

The NM EPSCoR Undergraduate Research Opportunities Program (UROP)

Figure 9. Participants of the 2010 Undergraduate Research Opportunity Program at the VCNP Science & Education Center.

The NM EPSCoR UROP is a summer undergraduate research program specifically designed to broaden participation from under-represented groups in science and technology. Application is available to students attending two-year, tribal, or four-year non-Ph.D.-granting colleges in New Mexico. Recruitment methods included campus visits, a website, and mailings.

Program announcement posters were also utilized as a recruitment method. A full color 8.5"×14" poster and letter describing our program was mailed to the Chemistry, Biology, Earth Science, Environmental Science, Natural Sciences, Computer Sciences and Engineering department chairs and faculty at all of the non-Ph.D. granting two and four year colleges in New Mexico. A total of 216 separate recruitment packages were sent out this year.

The UROP program hosts a website at New Mexico Tech (http://www.nmt.edu/~climate/). The website was created by the PI and contains general information about the program, research projects and application materials. The posters refer students to the web site for more information and application materials.

Required application materials included an application form that assessed the student's motivation for applying, expectations of the program, future education and career goals, ranking of preferred research projects and how the student learned about the program.

UROP Applicants for Summer 2011
Application materials were submitted by 16 students. The program also received applications for the first time from the Grants and Alamogordo campuses of New Mexico State University (both Primarily Undergraduate Institutions). The program continued its trend of increasing applications received from Native American students and underrepresented minority (URM) students.

Table 4. Demographic Trends for UROP Applications

	Year 1	Year 2	Year 3
% Native American	20	40	44
% URM	47	67	81

The faculty leading the undergraduate research projects reviewed applications from students who had ranked the project as their first or second choice. The PI and program manager made the final decision on the applicants, taking into consideration the faculty/scientist ranking, while making a strong effort to choose participants from a variety of schools.

Table 5. 2011 UROP Application Demographics

Demographic	Number	Percent
Gender		
Female	8	50%
Male	8	50%
Race/Ethnicity		
African American	0	0%
Asian	0	0%
Caucasian	3	18.8%
Hispanic	6	37.5%
Native American	7	43.8%
Pacific Islander	0	0%
Unknown	0	0%
Total Underrepresented Minorities	13	81.3%
Educational Level		
Freshmen	2	27%
Sophomore	11	37%
Junior	3	13%
Senior (non-graduating)	0	20%
Unknown	0	3%
Colleges		
Diné College	4	
Eastern New Mexico University	1	
Navajo Technical College	1	
New Mexico Highlands University	3	
Northern New Mexico College	0	
San Juan College	2	
Santa Fe Community College	0	
Southwestern Indian Polytechnic Institute	1	
Western New Mexico University	1	
NMSU Grants	2	
NMSU Alamorgordo	1	

2011 UROP Participants

Student participants and their demographics for Summer 2011 are listed in Table 6. The program has achieved 60% female participation. Underrepresented minority participation is also very high at 70%. Participants come to the program from seven different schools.

Table 6. 2011 UROP Participant Demographics

Demographic	Number	Percent
Female	6	60%
Male	4	40%
Underrepresented Minority	7	70%
Hispanic/Latino	2	20%
Native American	5	50%
Colleges		
Diné College	3	
Eastern New Mexico University	1	
Navajo Technical College	1	
New Mexico Highlands University	1	
NMSU - Grants	1	
San Juan College	2	
Southwestern Indian Polytechnic Institute	1	

Program Activities

Year 3 of the NM-EPSCoR UROP program runs from May 29 through July 30, 2011. Ten UROP students will participate in five research projects hosted at various NM-EPSCoR research institutions across the state (see Table 6). As part of the program, the students are enrolled in a graded, four-credit, upper division interdisciplinary science course at New Mexico Tech. Students will receive their tuition, housing, travel expenses, food allowance, and stipend through the program.

UROP students will spend the first week of the program at New Mexico Tech attending mini-courses focused on climate change and the environment. UROP students will be housed at their project research institutions for weeks 2-9. During this time, the UROP students will formulate a research question, conduct field and laboratory research, collect data and prepare a formal research report/presentation. The program will culminate in a research conference, to be held at New Mexico Tech on Friday, July 29, 2011. Student participants will present their research results to an audience of faculty, graduate students, peers and the public.

2011 UROP Week 1 Mini-Courses

The UROP program begins with a week of mini-courses to cover a range of topics focused on climate change. The mini-courses are designed to provide students from different disciplines with basic knowledge on the relationship between climate change, water, and people in New Mexico. Additionally, the mini-courses provide a mechanism to address the potential lack of junior and senior-level coursework faced by the freshmen, sophomore, and/or 2-year college participants. The mini-courses are typically four hours long and consist of a variety of classroom lectures, hands-on laboratory work and field trips. The courses and the instructors are under development.

2011 UROP Projects

The 2011 UROP program is sponsoring five research projects, listed in Table 7; descriptions of the projects are provided in Appendix P.

Table 7. 2011 UROP Research Projects

Institution	Project Lead	Project Title	UROP Participants
NM State University	S. Fernald	Hydrology and Water Quality of Ancient Acequia Irrigation Systems and Their Contributing Forested Watersheds	2: Diné
NM Tech	J. Wilson	Groundwater/Surface Water Interactions in Northern New Mexico	1: NTC 1: SIPI
Univ. of NM	L. Crossey	Hyporheic Zone Effects on Water Quality	1: SJC 1: Diné
NM Highlands University	E. Martinez	Distribution and Fate of Geothermal Solutes in Valles Caldera National Preserve Streams and Biota	1: NMHU 1: ENMU
NM Tech	M. Pullin	The Dynamics of Dissolved Organic Matter in Streams in Valles Caldera National Preserve	1: NMSU-Grants 1: SJC

Program Year 2 Evaluation and Follow-Up

An external evaluation was conducted for the Year 2 UROP and results were shared with the Program PI and Program Managers. UROP collaborated with over 20 ESPCoR researchers and mentors as presenters and mentors for students. These included faculty at research and undergraduate institutions. A post survey was administered this year, but less than half of the UROP students responded.

As part of the long-term follow up for the UROP program, surveys will be sent out annually to prior participants to ascertain their educational progress and how the program has influenced their future in graduate school and science careers. The survey is under development and will be sent out during the summer 2011.

4. Cyberinfrastructure

Strategic Plan Objective 7: Enhance scientific data and model output generation, management, discovery, and use through cyberinfrastructure.

NM Cyberinfrastructure Activities

Year 3 EPSCoR Track 1 CI development activities concentrated on two key areas of work: continued development of key system components and developing enhanced scientific research capacity through shared development (with the Tri-State EPSCoR Track 2 project, coordinated through the Tri-State CI Working group) of data interoperability capabilities.

Development and Deployment of Key CI Components

The key capability developed and deployed during the current project year is the EPSCoR Climate Data Portal (Figure 10) as an operational element within the broader NM EPSCoR portal. The data portal is based upon an underlying, custom developed geospatial data and information management and delivery platform (Figure 11) designed to provide efficient and scalable data that can be integrated into a variety of applications, both web-based and desktop (i.e. desktop GIS, Google Earth, statistical/analytic). Specific capabilities available through the data portal include: data discovery via a variety of methods, file based data delivery in a variety of formats (as appropriate for specific data types), metadata (documentation) access in multiple formats, an interactive live preview of each dataset (as available), and interoperable data and visualization services (as appropriate). Members of the NM EPSCoR team have met with other RII 3 science researchers in the development of the portal to ensure that it will serve their needs for data storage and retrieval. Work is beginning with representatives of K-12 education to tailor outputs for their educational uses.

In parallel with the development of the portal and underlying platform, New Mexico has also deployed an initial Hydrologic Information System (CUAHSI HIS) server instance. We have begun importing historic ET Tower data as a test dataset in preparation for integration of data streams originating from the instrumentation systems being deployed as part of the NM EPSCoR RII 3 research components.

Additionally, in preparation for delivery of SNOTEL data from deployed EPSCoR instrumentation into the NRCS SNOTEL system, the NM EPSCoR CI team has developed a harvesting, integration, and publication capability within the data portal that allows for the automated retrieval of new SNOTEL data from the NRCS web site (http://www.wcc.nrcs.usda.gov/snow/) for New Mexico, Arizona, Colorado, Utah, Nevada, and Idaho (with the latter four states' data also supporting our Tri-State EPSCoR partners in their work).

In addition to data management capabilities within the portal, progress has also been made in the area of metadata. Specifically, in support of anticipated utilization of ISO 19115-2 geospatial metadata for data replication between New Mexico, Idaho, and Nevada as part of the Tri-State EPSCoR Track 2 work, the NM EPSCoR CI team has been developing methods for automated processing of the existing tens-of-thousands FGDC XML metadata records in the portal into corresponding valid ISO metadata. These processed metadata records are being dropped into a "web accessible folder" (labeled "Metadata WAF" 9 in) for harvesting by the NM EPSCoR GeoNetwork Open Source catalog services platform, which will then be registered with a number of national and international catalog services for broad discovery of EPSCoR data products and services.

Figure 10. NM EPSCoR Data Portal with Highlighted Interface Elements

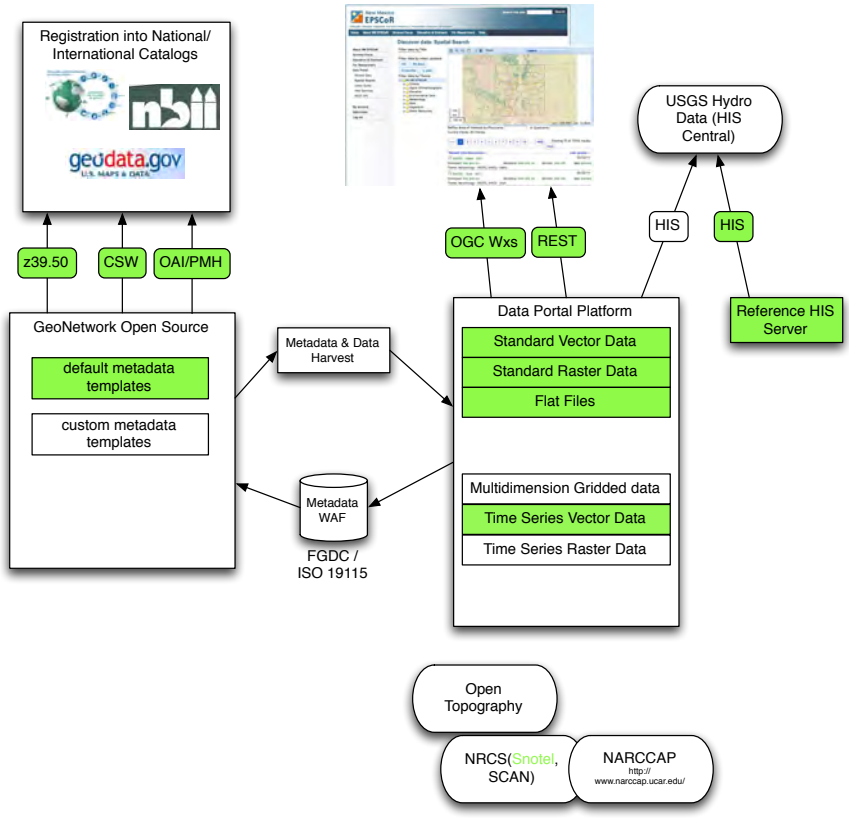


Figure 11. High-level Component Diagram for the NM EPSCoR Data Portal Platform. Elements highlighted in green are complete.

Computer hardware capacity has also been improved through the current project year through the addition of an additional 20TB of usable storage space provided by an additional SAN system which will be used to relieve current disk capacity limitations. Also, for the past year EDAC has been participating in UNM's Research Storage Consortium (RSC) in developing an RFP for a shared, enterprise level, scalable storage system, part of which will be used to house EPSCoR data products in support of published data products and services.

Data Interoperability Capabilities

In an effort to both maximize the impact of EPSCoR data and CI investments both within and beyond the EPSCoR project, a wide range of open interoperability standards have been identified (as a cooperative activity within the Tri-State CI working group) as target standards for CI development. These standards related to three broad areas of interoperability: data access and visualization, metadata and catalog services, and connectivity with other national networks and programs. The specific standards and specifications implemented by the NM EPSCoR project during the current project year are listed in Appendix Q.

In addition to facilitating data exchange within the NM EPSCoR jurisdiction and between the Tri-State EPSCoR collaborating states, the implementation of the above standards, specifications, and protocols is informed by, and will enhance the ability of NM EPSCoR collaborators to integrate their products into other national and international systems and projects.

Data/metadata Exchange and Technical Information Exchange

The CI researchers have had extensive interactions with other CI activities within and outside New Mexico focused on both integration of data and metadata exchange and technical interactions. Following are some examples of of these areas of interaction.

- The development team (providing the lead in the CI development efforts for the RII-3) at the Earth Data Analysis Center (EDAC) have contributed metadata to the NBII network, developed and hosted a number of clearinghouse nodes within the Federal Geospatial Data Committee's (FGDC) network, and provided some of the earliest web accessible metadata records into the Geospatial OneStop.
- Initial ingest of historic SNOTEL data from the NRCS servers (representing over 32 million individual observations) has been completed, providing data download of individual station data via web interfaces. These data will periodically he harvested into the EPSCoR data portal, through which they are republished using the enhanced services available through the portal.
- EDAC was one of the early recipients of funding from the FGDC CAP program for the development and delivery of metadata training and has continued to provide training for over 15 years.
- Karl Benedict (UNM) serves as EDAC's representative to the Open Geospatial Consortium, the DataOne Data User's Group (DUG), and the Federation of Earth Science Information Partners.
- Developers of EPSCoR CI capabilities have met with members of the LTER Network Office staff in exchanging information about evolving geo-portal technologies, particularly in the area of integration of geospatial application components into the Drupal content management system.
- Through face-to-face meetings at the bi-annual meetings of the ESIP Federation and the first meeting of the DataOne DUG Karl Benedict has had extended discussions with the

developers of NEON's CI, both about their planned development and deployment efforts, but also about service models that would facilitate the integration of NEON data products and services into broader networks of users.

- Through a Tri-state IWG, CI leaders from all three states (including NM) met with the OpenTopography developers at the San Diego Supercomputing Center to discuss the capabilities of their systems, and the underlying APIs for automated interaction with their LiDAR data processing services. This has led to an emerging model of integrating OpenTopography services into the back-end of NM's data portal to enable access and discovery of LiDAR data to NM researchers and other users.

CI Sustainability

One aspect of sustainability that is intrinsic in the CI development that is being accomplished through the RII-3 is the integration of developed technologies into existing long-standing data infrastructure within New Mexico. Specifically, the data portal development efforts are based upon a common platform with New Mexico's Resource Geographic Information System (http://rigs.unm.edu), a clearinghouse for geospatial data within New Mexico that has been in existence for 20 years, and has a very broad base of users across domains.

A second aspect of sustainability is the strategic support of open interoperability standards at the core of the CI system's capabilities. The use of a technical foundation that is based upon standards that are well defined, and broadly adopted across science, education, and policy communities, provides maximum flexibility in the continued evolution of the systems beyond the end of support from the EPSCoR program, particularly as new use cases for the underlying data and data services are defined through time.

5. Outreach and Communication

Strategic Plan Objective 14: Create a citizenry that is informed about climate change and its impact on NM's natural resources via public outreach and communication.

Climate Change Exhibit and Outreach at the New Mexico Museum of Natural History & Science

Figure 12. Visitors, including Vice President of Research for UNM Dr. Julia Fulghum, examine the Magic Planet feature of the new climate exhibit.

NM EPSCoR has partnered with The New Mexico Museum of Natural History & Science (NMMHS, or Museum) to provide public programming and a museum exhibit focused on climate science. The exhibit, *Degrees of Change, New Mexico's Climate Forecast,* opened in May 2011 and will be maintained well beyond the period of this grant. Dr. Dave Gutzler, a climatologist on the faculty at UNM, served as a guest curator for the exhibit which includes several unique components, including:

- A "Magic Planet" that provides an interactive, 3-dimensional global representation of climate data;
- A new prototype "AmbientTable" that uses cutting edge visualization technology that will allow visitors to explore New Mexico's hydrologic cycle, how it exists today, and how it might change if water cycle variables change from what they are now;
- An original video in which Hispanic, Anglo, and Native American New Mexicans whose families have lived in NM for generations, describe changes to the landscape and animals they have noticed that may be related to climate changes;
- Panels describing New Mexico researchers who are contributing to our knowledge of climate science;
- Interactive components that address behaviors and choices that we can make that will impact resource use and long-term sustainability issues.

The New Mexico Museum of Natural History and Science is the New Mexico's largest natural history museum and is also a public institution with a mission to "foster an understanding and appreciation of the diverse natural history and physical sciences of New Mexico and the Southwest for the benefit of residents of, and visitors to, New Mexico. The Museum provides educational experiences and promotes scientific inquiry through focused collections, research, public programs and exhibitions." The Museum has over two decades of proven successes in effectively communicating to a diverse community. Given that the topic of climate change communication is composed of varying degrees of public understanding and misconception, media and political trust, the museum is well situated to bridge the gap between science and community. With an annual visitorship of 250,000, the impact of this exhibit is anticipated to be quite large.

The NMMNHS has also offered numerous Climate Change Education program events throughout the year for educators, policy makers, and members of the general public. NMMNHS partnered with the National Association of Science and Technology Centers (ASTC) as a sub-award recipient on their NSF grant "Communicating Climate Change". By leveraging ASTC funds as well as building collaborations with educational organizations and agencies, the NMMNS was able to present events that reached over 4,000 New Mexicans. Public outreach events for Year 3 included:

- "What's for Lunch?"--An activity looking at how food production impacts greenhouse gas emissions which ultimately influences climate change. Participants learn how different food choices require different energy inputs into the food production system and thus will release different amounts of greenhouse gases. This activity has been developed for a variety of age groups and has been used in both formal and informal educational settings, including the NM State Fair, the National American Indian Science and Engineering Fair, Albuquerque Recycling Festival, and Sustainability Day at the NM State Legislature.

- Presentations to NM Environment Department's Climate Masters Program participants: "Educating and Talking about Climate Change" and "Renewable and Non-Renewable Sources of Energy."

- "Our Changing Planet Family Day" featured hands-on, bilingual activities, plays and songs and. A book reading and signing with John Fleck, science writer for the Albuquerque Journal and author of *The Tree Rings Tale: Understanding Our Changing Climate*.

- "Climate Change and Birds"-- An introduction to climate change and current impacts on bird species, mainly impacts on migration timing and location to participants of a Bosque del Apache NWR bird watching field trip.

- "Earth Hour Extravaganza"-- An event for all ages to celebrate Earth Hour; a worldwide event where millions of people switch off their lights for one hour to raise awareness about global climate change. The event held at the NMMNHS included hands-on, bilingual activities for the whole family.

- BioBlitz 2011: Discover Your Bosque at the Rio Grande Nature Center State Park. The New Mexico Museum of Natural History and Science, The Nature Conservancy, Rio Grande Nature Center State Park, Los Griegos and Taylor Ranch Public Libraries created a day of natural discovery and citizen science. Throughout the day, scientific experts led walks to explore the middle Rio Grande ecosystem and find different groups of living organisms. An emphasis was placed on linking current and predicted climate change impacts on species and ecosystems.

- "Talking about Climate Change"—part of the Sunday Science Lectures series. Las Vegas National Wildlife Refuge, will hosted an afternoon lecture that explored the science behind our changing climate and tools to find reliable sources of scientific information.

NMSU Teacher Materials Development

Researchers at NMSU will be collaborating with the Chihuahuan Desert Nature Park to develop materials that will be used to conduct a teacher workshop using SRM and SLURP. The materials will be designed to assist science teachers in using information from these models and climate change scenarios in the K-12 classroom. Additional workshops will also be developed in Year 4 for water resource managers.

Water Quality Outreach

UNM researchers have begun to collaborate with the 2009 NM recipient of the Presidential Award for Excellence in Math and Science Teaching for science and the local school district on a curriculum development effort. The focus is on introducing a water quality theme to project-based learning curriculum development at the Sandia Mountains Natural History Center (SMNHC). Once complete this work is anticipated to impact over 10,000 students who visit the Center annually.

Outreach to Acequia Associations

As described above (page 9), students and faculty worked provided information and resources about climate change impacts to New Mexico Acequia Association members who attended the Congreso de las Acequias and the special meetings and focus group discussions at the Rio Hondo Valley and the El Rito Valley.

Public Events

New Mexico EPSCoR undergrads Ryan Schwingle (New Mexico Tech) and Tyler Van Riper (UNM) attended Math and Science Day at the Legislature to talk to students from around the state about NM EPSCoR's research. Ryan brought his research poster and a working example of a digital water temperature sensor, and Tyler created an interactive representation of all the water in the world.

NM EPSCoR also sponsored NSF Day (described in the Sustainability section of this report) at which the NM EPSCoR Director and Associate Director described project activities and intiatives. Participants were encouraged to network with each other; 49% of evaluation respondents reported their attendance did contribute to developing collaborations.

NM EPSCoR's New Communication Tools

New Mexico EPSCoR launched several new communication tools in Year 3 in order to better communicate with researchers, students, educators and the general public. A Public Information representative has been added to the state office staff to coordinate communication activities and tools including:

- The project website (www.nmepscor.org) which has been significantly revised to improve access to the general public while still serving the communication needs of project personnel;
- An email listserv to quickly communicate with all New Mexico EPSCoR personnel about events, due dates, opportunities, and any other information pertinent to EPSCoR and its partners;
- A quarterly newsletter that is posted on the NM EPSCoR website and delivered (either electronically or by mail) to those involved with NM EPSCoR and used at outreach events statewide;
- The NM EPSCoR Facebook page (facebook.com/NewMexicoEPSCoR) (described in Section 2, page 30).

6. Evaluation and Assessment

NM EPSCoR has three external evaluation mechanisms: 1) a 7-person External Advisory Board of science, education and outreach scientists and professionals providing expert guidance in their field, 2) a contracted sub-award with the American Association for the Advancement of Science for site visit and overall program review, and 3) an external consultant evaluator, Kirk Minnick and Associates, for data collection and assessment assistance to the NM EPSCoR Management Team.

External Advisory Board (EAB)

The External Advisory Committee met in October 2010 in Albuquerque, NM; the members of the EAB are listed in Section 8 (Management Structure). The EAB's summary statement commended NM EPSCoR's progress and noted improvements since their initial review:

> The review demonstrated very significant progress towards all major goals and objectives of the project since last year. The EAB very much appreciated the extensive involvement of research faculty in the review. They clearly demonstrated strong evidence of progress in collaboration and coordination within EPSCoR. The Integrated Working Groups (IWG) and the variety of EPSCoR meetings like the "All Hands Meeting" seem to have created a real sense of community, which was the key element that seemed lacking when the program was reviewed in January 2010.

The EAB recommendations and the NM ESPSCoR response are provided below; the complete EAB report is provided in Appendix K.

1. *As evidenced in the reviews, very significant progress has occurred in the research programs, but the driving research questions in a number of the programs were not clearly articulated and their relationship to the key climate change/water issues in the Southwest region were not well defined. The EAB recommends further work by the leadership team in this area. This will enhance both the scientific merit of the program and the value by the external stakeholders.*

NM EPSCoR Response

The Management Team will continue to work to make explicit the connections between specific project activities and the larger driving questions that underlie the research that is taking place. During the EAB presentations, researchers focused on their specific activities in an effort to demonstrate progress to date; in some cases there was insufficient time to connect these efforts to the larger overall aims of the project and to the larger, regional efforts to which these activities will ultimately contribute. The Management Team recognizes the importance of paying attention to the context to which these research efforts will contribute.

In terms of climate research, we are developing linkages between global climate model outputs at coarse scales to the Rio Grande sub basin scale in a simple downscaling framework. Water quality efforts to develop stream sensing and monitoring networks investigate a variety of potential impacts of climate change. All of these efforts have a large educational component, providing graduate and undergraduate students opportunities to further their understanding of specific questions but they must be placed in the broader context. The Cyberinfrastructure, Education, and Outreach activities all support the development of the state's capacity to carry out this research.

2. *As the program progresses into year three, the EAB recommends that the leadership articulate and formalize a sustainability plan. Many of the programs appear to have a natural sustainability pathway after RII-3 is complete, but there may be some significant gap areas. The formalization of a plan will allow the leadership to more clearly see gaps and enhance the long-term impact of RII-3.*

NM EPSCoR Response

The Implementation Plan that was developed at the start of this project includes efforts to promote sustainability for each of the project's components. The EAB's recommendation serves as a timely reminder that we need to review and chart our progress in achieving those activities that will ensure sustainability of project achievements. As the research and education activities mature, new opportunities for sustainability can emerge and we need to be sure to take advantage of those options.

As was intended and noted in the initial Project Implementation Plan, the meteorological station upgrades and additions have consistently been connected to national networks that will maintain their usefulness beyond the length of this grant. The addition of new NRCS SCAN and SNOTEL sites, USFS/BLM RAWS stations, and New Mexico Climate Network sites will be in place for up to 25 years with real-time data available via the World Wide Web.

In addition, transfer of the modeling techniques for evaluating climate change effects on NM's mountain hydrology will be conducted through workshops for state water resources agencies arranged by the NM Water Resources Research Institute.

One aspect of sustainability that is intrinsic in the CI development that is being accomplished through the RII-3 is the integration of developed technologies into existing long-standing data infrastructure within New Mexico. Specifically, the data portal development efforts are based upon a common platform with New Mexico's Resource Geographic Information System (http://rigs.unm.edu), a clearinghouse for geospatial data within New Mexico that has been in existence for 20 years, and has a very broad base of users across domains.

A second aspect of sustainability is the strategic support of open interoperability standards at the core of the CI system's capabilities. The use of a technical foundation that is based upon standards that are well defined, and broadly adopted across science, education, and policy communities, provides maximum flexibility in the continued evolution of the systems beyond the end of support from the EPSCoR program, particularly as new use cases for the underlying data and data services are defined through time.

3. *The Climate Change, water chemistry and hydrology themes of RII-3 have a lot of common elements to other programs across the nation and world. The EAB recommends that the program leaders and researchers pay more attention to connectivity to external research efforts, particularly in the sensor area and in the environmental data storage and analyses areas.*

NM EPSCoR Response

NM EPSCoR appreciates the specific suggestions provided by the EAB for connecting our project's efforts with others happening across the nation. Following the EAB's recommendation, the Water Quality group has initiated contacts with both NEON and CUAHSI. In addition, the Western Tri-

State Consortium Meeting in April provides an opportunity to connect with other regional and national research efforts and organizations.

Areas of interaction with other CI activities within and outside New Mexico include both integration in the areas of data and metadata exchange and technical interactions. Following are some examples of these areas of interaction that will be detailed in our annual report:

- Contributed metadata to the NBII network;
- Developed clearinghouse nodes within the Federal Geospatial Data Committee's (FGDC) network;
- Provided web accessible metadata records into the Geospatial OneStop;
- Established an HIS instance for the initial capture and documentation of point time-series data into the HIS service model;
- Retrieving SNOTEL data from the NRCS servers to be harvested into the EPSCoR data portal;
- Use funding from the FGDC CAP program for the development and delivery of metadata training;
- Participated in the Open Geospatial Consortium, the DataOne Data User's Group (DUG), and the Federation of Earth Science Information Partners;
- Collaborated with LTER Network on evolving geo-portal technologies,
- Discussing integration of NEON data products and services into broader networks of users;
- Through a Tri-state IWG, working to integrate OpenTopography services into NM's data portal to enable access and discovery of LiDAR data to NM researchers and other users.

Report Recommendation:

4. *It is still not clear "What is EPSCoR" and where it sits as an initiative unto itself versus where it sits as a means for leveraging other projects. There is no question that EPSCoR provides a means to integrate multiple projects and serves as a systems organizer; but, it would be useful for both EPSCoR and NSF to see how EPSCoR both fits into and serves the "big picture." For example, what would be happening without EPSCoR? Why is EPSCoR necessary to NM's progress? Answers to these questions would be useful toward building a case for the next proposal.*

NM EPSCoR Response

Communicating the value and contributions of the NM EPSCoR project is necessary to generate broad support for a future proposal as well as to build credibility in the state so that policy makers and resource managers will trust and use EPSCoR research findings, which is a long-term goal of the current project. We have begun to address this through development of communication tools that target a broader general audience including a newsletter, restructured web site, and other informational pieces that are distributed at public meetings and events. We have created a session at the upcoming Tri-State Consortium Annual Meeting (Track 2) that focuses specifically on communicating climate science to non-scientists, which is one avenue for clarifying what EPSCoR contributes to the state.

We will continue to refine our message and work to communicate the results of the research and education efforts both to those within the EPSCoR community as well as to policy makers and the general public. We will focus on specific achievements, such as examples of infrastructure that has been installed with EPSCoR funds, improving the observational networks in NM to be comparable with adjacent non-EPSCoR states in the region.

AAAS Program Review

The Research Competitiveness Program (RCP) of the American Association for the Advancement of Science (AAAS) convened an expert review panel to provide external and independent review and guidance in Albuquerque from November 15-18, 2010. NM EPSCoR invited AAAS to conduct an external evaluation of the program and requested that the panel assist NM EPSCoR with developing an effective process for identifying the vision and direction for the next EPSCoR RII (Track 1) proposal. The meeting agenda and full report are attached as Appendix R.

The panel's report states:

> *Overall, it is evident that NM EPSCoR has established a strong foundational program for research and education in the state of New Mexico, fully deserving of sustained support from the state and of a renewed and expanded commitment from New Mexico's major research universities. The review panel strongly endorses: (1) the process and anticipated timeline for planning the next EPSCoR proposal, to be submitted in November 2012; (2) the choice of a research focus across the themes of Climate, Water, and Energy, which leverages and expands current programmatic strengths; (3) the commitment of the NM EPSCoR leadership to building the research program on a foundation of interdisciplinary teams within and across institutional partners; and (4) the commitment of the NM EPSCoR leadership to an expanded role for Tribal issues in the vision and mission of the program, and to increased participation of Tribal Colleges in all aspects of the program.*

The AAAS panel provided substantive, specific recommendations that will guide us in the remaining years of the current project as well as in our work toward preparing our next RII proposal. They identified four general concerns that we are working to address in the near term, to the extent possible:

(1) the lack of institutional memory connecting back to the creation of the first EPSCoR program in the state; this hinders the current leadership from taking advantage of the lessons learned--past successes and failures of the program--in particular, in areas of education, outreach and diversity;
(2) insufficient evidence of a strong and balanced commitment to EPSCoR by all major research universities in NM;
(3) insufficient understanding of issues of priority to the Tribes, and lack of established networks to gain and sustain such understanding; and
(4) lack of an apparent niche in NM's challenging K-12 system in which NM EPSCoR can have a sustained positive impact.

External Evaluation Report

The external evaluator, Kirk Minnick of Minnick and Associates, worked closely with the EPSCoR state office to develop processes and procedures for documenting project activities and outcomes. Activity Evaluation Reports were prepared for the Junior Faculty Leadership Training (JFLP) program, K-12 Teacher Summer Institute, and the Undergraduate Research Opportunity Program (UROP). These reports were used to make program improvements in Year 3 and are described in other sections of this report.

Minnick also prepared an overall Year 2 Evaluation Report, which is included as Appendix L. In it, he summarizes:

> All components, both research and outreach, are on schedule and following the strategic plan developed at the start of the project. There is a lot of integration between and among the research areas and education, which speaks well for creating that critical mass of researchers needed to study the impact of changes in snow pack on climate change.

Recommendations for specific components are reported in the relevant section of this report. The only overall concern expressed in the evaluation report was:

> The only concern is whether New Mexico has the depth of researchers to continue the work that has been started. As more and more data is collected, there will be an increasing need for more expertise in the field as well as in the laboratory to analyze the data. The need for well educated and trained people at all levels is critical

Improving the capacity of the human infrastructure in NM to carry out climate research is one of the fundamental goals of the entire project and drives much of our activity.

Many of the key recommendations in past evaluation reports related to the research components of the NM EPSCoR RII project focused on increasing the documentation of collaborations and project outputs through publications and presentations. The number of scientific presentations continues to increase as seen in Table 8.

Table 8. Year 3 NM EPSCoR Science Presentations

	2010 Number	2011 Number	Change
Invited Talk	20	13	-7
Panel	3	2	-1
Conference Presentation	12	42	+30
Poster	19	39	+20
Total	**54**	**96**	**+34**

Additional information about these presentations is in Appendix S.

7. Sustainability and Outcomes

Many NM EPSCoR researchers have established partnerships and collaborations that will contribute to the sustainability of their research efforts. The meteorological observing networks are connected to the NRCS network. Negotiations are underway with the Taos Ski Valley to maintain hydrologic observing equipment in the Rio Hondo area and collaborations with the acequia associations across northern NM will support the long-term maintenance of equipment installed in those watershed areas. The CI sustainability efforts were described in Section 4, p.27. Additional activities, described below, focus on building the long-term human capacity to carry out science research across the state.

7a. Seed Funding / Emerging Areas

Strategic Plan Objective 6: Provide Critical Infrastructure Gap Seed Awards.

Infrastructure Seed Grants

The Infrastructure Seed Grant (ISG) program is designed to increase the impact of NM EPSCoR on the undergraduate student population at New Mexico's non-PhD granting institutions. The intent of the ISG program is to increase the access of undergraduate students, especially women and members of underrepresented groups, to research experiences by increasing non-PhD granting institutions' capacity to provide research experiences for students.

Proposals were solicited and reviewed by the NM EPSCoR Management Team in fall 2010 and two one-year awards were made, beginning in January 2011. The majority of the instrumentation and activity are scheduled to occur in summer 2011. Each of the awards is described below.

New Mexico Highlands University; Lead Investigator: Dr. Edward Martinez
Late Pleistocene to Holocene Paleoclimate of the Las Vegas National Wildlife Refuge and Adjacent Great Plains, northern New Mexico: A Multidisciplinary Science Educational Endeavor
The project will conduct an integrated, paleoclimatic study of sediment cores collected from the Las Vegas National Wildlife Refuge (LVNWR) and surrounding region to determine late Pleistocene to Holocene paleoclimatic variations in northeastern NM. This research is part of a new and exciting collaborative endeavor between teamed faculty-student researchers at New Mexico Highlands University (NMHU) and will provide training for numerous minority undergraduate students.

Diné College; Lead Investigator: Marnie Carroll
The Whiskey Creek Educational Watershed: A Collaboration between Diné College and New Mexico Tech
The proposed project will purchase, install, and use a set of environmental sensors in educational efforts at Diné College. The hydrology and water quality instrumentation specified in the proposal will be used to develop an educational watershed at Whiskey Creek on the Navajo Nation, near Diné College. New Mexico Tech will collaborate on the implementation of this project by setting up the instruments, training faculty in their use, helping to supervise students using the instruments as part of a summer undergraduate research program, and in the use of the instruments in the classroom at Diné College. This project will make a lasting impact on Diné College's ability to provide field experiences and authentic research experiences to its students.

A second round of proposals was solicited in the summer of 2011 to be funded in the fall of 2011 (program Year 4).

Strategic Plan Objective 5: Use Innovation Working Groups (IWGs) to address key scientific, education, diversity, and workforce development challenges.

Innovation Working Groups

Innovation Working Groups (IWG) support multi-day working group activities that are modeled after those held at the highly successful NSF-funded National Center for Ecological Analysis and Synthesis (NCEAS). An IWG supports a small group of scientists or educators to work together on challenges in the climatological, hydrological and socioeconomic sciences, as well as education, outreach and diversity.

The IWG Request for Proposals (RFP) was designed to solicit succinct proposals that emphasize:

- Topic aligned with EPSCoR Track 1 (or Track 2) research and education agenda
- Diversity of Institutions (minimum of two NM institutions represented)
- Significant participation by women and members of underrepresented groups
- Multi-and trans-disciplinary participation
- Intellectual merit and transformative nature of the project

Beginning in Year 2, Tri-State Innovation Working Groups were also solicited, using mostly the same criteria as the NM-specific RFP. Tri-State IWGs have a higher budget limit ($15,000) and require participation from at least two of the three Consortium States.

Innovation Working Groups have proven to be an effective mechanism for building productive and persistent collaborations across disciplines, institutions, and states. As such, they are an important component for fostering efforts that will be sustained beyond the duration of the grant.

The RFPs for both types of IWG proposals are available on the NM ESPCoR website at http://nmepscor.org/content/innovation-working-groups.

The Year 3 IWG's are listed below; complete reports are available at the website above.

Applications of Distributed Temperature Sensing for Climate Change Research in New Mexico. Lead Investigator: Jevon Harding, New Mexico Tech (graduate student)

Figure 13. Members of Jevon Harding's IWG test the DTS after deployment in the East Fork.

This Innovation Working Group (IWG) was designed to insure that Distributed Temperature Sensing (DTS) technology was introduced to NM researchers in such a way that it will be incorporated into ongoing and future NM climate change and hydrology research in the most productive and beneficial way possible. As stated in the original NM EPSCoR RII3 proposal, "NM needs a more robust hydrologic infrastructure to fill in critical gaps needed to develop a better understanding of the relationship of high elevation events to downstream water supplies." Distributed temperature sensing (DTS) is a powerful tool that can provide the kind of monitoring data necessary for validating climate and other environmental models. However, these resources cannot be used to their full potential unless NM EPSCoR researchers are aware of the applications and availability of this technology.

Outcomes: As a result of this IWG, several promising ideas and collaborations emerged including applications with the potential for immediate implementation.

Bridging the Gap Between Data and the 6-12 Science Classroom. Lead Investigator: Dr. Matthew Nyman, University of New Mexico

Since the development of national and state science standards and benchmarks there has been a strong emphasis on teaching K-12 science using inquiry-based methods. The expected student outcomes from more inquiry-based instruction include development of science content knowledge, learning how scientific knowledge is constructed, development of critical thinking skills and cultivating investigative and evidence-based habits of mind that can be applied over a range of disciplines. Part of inquiry-based instruction should involve using real data to investigate authentic problems that directly impact students. However, without sufficient training and support, it can be difficult for teachers to implement the use of real data in their classrooms. The first-order goal of this IWG is to identify and address the issues of using real scientific data in 6-12 science classrooms, with a specific focus on water and climate data. Within this general goal are several specific questions:

- What is the current status of using data in middle and high school science classrooms in New Mexico?
- What are the best practices for preparing and encouraging teachers to use real data about climate and water as part of their curriculum?
- How can climate and water data be used across disciplines so biology, chemistry and physics teachers can integrate these data into their practice?
- What are some of the impediments of using real data in middle and high school classrooms?

Increasing the Diversity of the Western Tri-State Consortium. Leads: Michele Casella, NV EPSCoR, Mary Jo Daniel, NM EPSCoR, Sarah Penney, ID EPSCoR
The purpose of this IWG was to develop a comprehensive strategic action plan that can be implemented throughout the Consortium to increase participation of and support for underrepresented minorities and women in EPSCoR scientific research and, more broadly, in STEM disciplines. The IWG drew upon research, best practices, and the initial work of the Consortium to answer the question: What can Idaho, Nevada and New Mexico EPSCoR projects do that will have a significant impact on the recruitment and retention of underrepresented minorities and women in STEM?

Outcome: During the meeting, working group members participated in several full group and small group sessions and came to consensus on six core strategies that would increase the participation of and support for URM students and women in EPSCoR scientific research and, more broadly, in STEM disciplines and produced a detailed report that outlines the six core strategies. This Diversity Strategic Plan is included in this report as Appendix N.

EPSCoR CyberScience: Lead: Dr. Karl Benedict, University of New Mexico
This IWG focused on the collaborative development of new CI capabilities (with funding obtained through new grant proposals) in support of mountain hydroclimate research, and the development of documentation (through published papers) of science problems and related workflows that may be enabled through the targeted application of CI capabilities. The purpose of this IWG was to engage in structured dialog with researchers in all three states in the Tri-State Consortium to identify specific research processes, data management and analytic tools, barriers and limitations to successful execution of those processes, and ultimately the CI capabilities that can enable those processes.

Outcomes: To facilitate further coordination between the participants in the workshops in the development of follow-on products, a collaboration site has been established with EDAC's Basecamp site. This site will be used to collaboratively develop White Papers defining collaborative research topics, research proposals, and materials for publication in appropriate peer-reviewed journals. Additionally, based upon feedback from the workshop participants, the Tri-State CI team plans on continuing the dialogue between researchers and CI specialists through sessions in the annual Tri-State meetings and other venues as the opportunities arise.

Identifying complementary indicators of ecological thresholds in a changing climate. Lead: Dr. Robert Heinse, University of Idaho

Ecosystems respond nonlinearly to environmental stressors, which can lead to drastic and irreversible change. This Innovative Working Group (IWG) met to identify cross-disciplinary approaches for detecting trends of ecosystem response amidst natural variability via complementary and quasi-orthogonal indicators. We convened a cross-disciplinary group of researchers to explore a collaborative process of model development including a wide spectrum of metrics. The interdisciplinary nature of the problem suggested a unique opportunity to leverage efforts across disciplines and apply it to study risks in coupled ecosystem-human interactions. IWG participants represented ecology, hydrology, socioeconomics, sociology, statistics, and remote sensing, with foci's integrating across different spatial and temporal scales.

Outcomes: The IWG enabled the team to brainstorm and formulate new ideas regarding the identification of key gaps in the current knowledge of ecological drivers, triggers, responses and thresholds. The major outcome was development of a framework to move beyond traditional conceptual models towards quantitative models that integrate the complex and nonlinear relationships among drivers of critical thresholds. Proposals based on this IWG are being prepared for submission to the NSF Dimensions on Biodiversity and USDA-AFRI Thresholds in Agroecosystems programs.

Mountain-to-Valley Ecohydrology at Multiple Spatial and Temporal Scales. Lead: Alexandra Lutz, DRI (being held at the time this report is being prepared)
This IWG will integrate via an interactive, interdisciplinary workshop, a unique confluence of new observatories, improved modeling capability, remote sensing data, planned field experiments, and proxy records of environmental change. Challenging research and management questions that the group proposes to explore include: (1) What is the contribution of mountain ecosystems to groundwater recharge in arid to semi-arid, topographically complex environments? and (2) How can disturbances (e.g., wildfire, insect outbreaks) in a changing climate affect mountain ecosystems and their contribution to carbon and water cycling? Such questions will be addressed with a focus on the critical zone (i.e., the layer bounded by the top of the forest canopy and the base of the weathering horizon). Spatial scales will range from meters to watersheds with 30 m resolution, and temporal scales will span from minutes to the Common Era with seasonal resolution. Outcomes include developing and writing proposals to target NSF, NOAA, and/or NASA programs on key interdisciplinary issues that provide the scientific community, water and natural resource managers, federal and state agencies, policy makers, and the general public with improved predictive tools for understanding dynamic and complex environments.

7b. Education / Human Resources Development

Strategic Plan Objective 13: Enhance leadership skills for faculty via a Faculty Leadership Fellowship Program.

Junior Faculty Leadership Workshop

The third annual NM EPSCoR Junior Faculty Leadership workshop continued a track record of success in providing training for early-career faculty and post-docs that enhances their leadership skills and increases their competitiveness for national–level funding opportunities. The three-day workshop, January 4-6, 2011, focused on improving the communication skills and productivity of the participants. This year's agenda continued and expanded the highly successful "Communicating with Media" interactive session from past years and included additional sessions on effective teaching and mentoring as previous attendees requested. There were sixteen participants from nine different institutions across New Mexico and our Tri-State partner states of Idaho and Nevada. The workshop was held at the Valles Caldera National Preserve Science and Education Center in Jemez Springs, NM. The remote location and residential program allowed for extensive informal networking and new collegial synergies among participants.

Highlights of the 2011 Workshop included:

- Sandra Blakeslee, former science reporter for the New York Times presented tips for communicating effectively with the media. Participants then engaged in mock interviews with invited newspaper and television reporters using information about their research they had provided to Ms. Blakeslee. The interviews were observed and discussed by the entire group.
- Carl Moore, from The Community Store, modeled several effective facilitation strategies and processes while providing a context for participants to think carefully about their own leadership styles, priorities, and professional goals. The session provided hands-on experience with each of the facilitation tools presented by Dr. Moore.
- Gary Smith, Director of UNM Office to Support Effective Teaching presented strategies for effective teaching in a university setting.
- Mary Jo Daniel and Bill Michener led an evening session on professional ethics using scenarios drawn from news reports of actual issues.
- In small groups, participants used the ideas presented by Robert Gropp, Director of Public Policy at the American Institute of Biological Sciences, to develop a brief "pitch" to a legislator about the importance of funding basic scientific research. Participants demonstrated flexibility as they responded to the "legislator"—whether he was supportive or not.
- Bill Michener, NM EPSCoR Project Director, shared productivity tools and strategies and a logic model for organizing an effective proposal and Scott Collins, Director of the Sevilleta LTER Program at UNM and former NSF Program Officer, provide insights into successful proposal writing.

<u>Impacts</u>

A post workshop survey was emailed to the participants immediately after the end of the workshop and was completed by all participants. It asked the workshop attendees to provide their feedback on the quality of the content, presentation and visual materials/handouts of each session, as well as provide an overall rating of the workshop. Respondents were also asked to provide comments on

what they felt were the most and least useful about the program, as well as future topics to include in the training. According to the Jr. Faculty Leadership Workshop Evaluation Report (Appendix T):

> The overall program was highly rated by the participants, and was probably the most successful Faculty Leadership Program to date. The EPSCoR staff had adjusted the program emphasis based on the participant feedback from the prior year and had eliminated those sessions that were not well received or perceived as not useful by the attendees; such as evaluation and assessment, the future of science and engineering in NM and engaging students from diverse backgrounds. In their place, sessions were added that addressed those topics suggested by the prior year workshop attendees. These included sessions on teaching effectiveness, how to write an effective proposal, professional ethics, and mentoring.

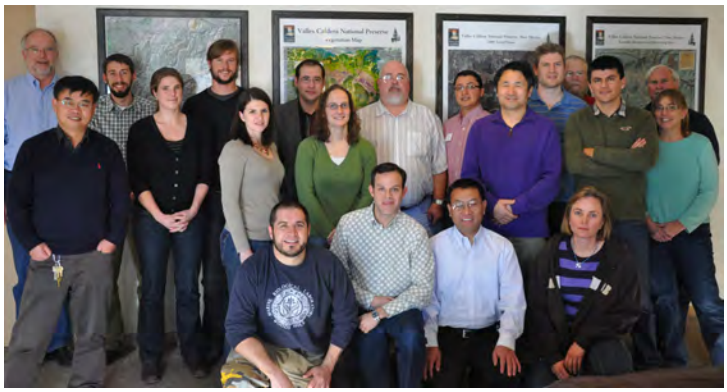


Figure 14. The 2011 Junior Faculty Leadership Workshop participants.

Sample Participant Comments:

"This workshop is probably the most useful program I have attended over my career. I appreciated the emphasis on developing practical skills, and the breadth of subjects covered was excellent. In particular I found the workshops on dealing with the media, and communicating with decision makers very engaging and useful. The sessions on personal productivity, grant writing and facilitating meetings were also excellent."

"Not to suggest that the other things weren't useful, but I was looking forward to learning more about how to be productive, particularly in the field of grant/proposal writing. The workshop did not let me down and after the presentations on the first day I could barely get to sleep as I was filled with so much inspiration and new ideas. Thank you so much!"

"The program was really great. I felt that it was organized and truly based on our needs."

Strategic Plan Objective 12: Inform faculty throughout NM about funding opportunities via NSF Days.

NSF Day

New Mexico EPSCoR hosted "NSF Day" on March 17, 2011 in Albuquerque; over 150 people from 22 institutions of higher education, 2 national laboratories and 10 private companies took this opportunity to learn about upcoming funding opportunities and priorities at the NSF. Topics included the NSF proposal and merit review process and discussions of potential research proposals.

A special session for tribal and community colleges was included. Representatives from eight NSF directorates, the Office of International Science and Engineering, and the Office of Integrative Activities made presentations. The Vice Presidents for Research at both UNM and NMSU supported the program by sponsoring the registrations of junior faculty from their institutions.

This workshop was primarily designed for researchers and educators less experienced in proposing to the NSF; however, more experienced proposers attended as well. Based on data from an on-line evaluation survey administered to all attendees, over half (52%) of the survey respondents had not submitted an NSF proposal in the last two years and 33% had submitted 1-2 NSF proposals. However, 70% of the survey respondents indicated they planned to submit a proposal to NSF within one year and 79% agreed the information presented at NSF would help them to be successful when submitting a proposal to NSF. Finally, approximately half (49%) agreed their attendance helped facilitate a collaborative relationship with a colleague, even though the agenda did not allow a significant amount of time for networking.

Figure 15. NM EPSCoR Director Bill Michener addresses the crowd at NSF Day.

The evaluation concluded:

> For the most part, survey respondents expressed satisfaction with the NSF Day program. They indicated that they learned a lot and benefitted from the information provided and the opportunity to meet the program officers from the various directorates. Specific suggestions for improvements by the survey respondents mostly focused on the need to be able to attend multiple directorate sessions and either shortening the morning session or making it more interaction.

The suggestions for improvement were communicated to the NSF representative who organized the even with NM EPSCoR. The complete NSF Day evaluation report is attached as Appendix U.

Strategic Plan Objective 11: Design and develop graduate research training group opportunities.

Graduate Research Training

NM EPSCoR has publicized CI-related training opportunities and supported student and faculty attendance through its Track 2 project. In addition, workshops in Hydrologic Information Systems (HIS) and Climate Modeling were offered at the Tri-State Consortium annual meeting. Nine participants from NM, 44% URM, participated in the Climate Modeling workshop and 5 NM participants attended the HIS workshop. Through its tri-state partnership with ID and NV EPSCoR projects, NM EPSCoR is hosting a 3-day workshop in Parallel Programming and Cluster Computing, offered by the National Computational Science Institute (NCSI) in summer 2011.

Interdisciplinary Modeling Course

In summer 2010, the Western Tri-State Consortium funded the development of a new four-hour graduate credit course, *Interdisciplinary Modeling: Water Related Issues and Changing Climate,* which was offered at University of Nevada Reno. Seven students from NM took the course; 3 of the

instructors were from NM. Course evaluation indicates the students rated their gains in understanding highly overall. Plans are in place to repeat the course in summer 2012.

Los Alamos National Laboratory Partnership
Los Alamos National Laboratory, in collaboration with NM EPSCoR, is offering a 3-day workshop in summer 2011, *Simulating the Spatial-Temporal Patterns of Anthropogenic Climate Change: A Workshop in the Bridging Disciplines, Bridging Scale Series*. NM EPSCoR faculty and post-docs are scheduled to attend. An intended outcome of the workshop is the development of a hierarchical framework to compare various approaches to regional climate simulation in different settings.

7c. Leveraging NSF funded programs

A brief listing follows for the more significant NSF funding and programs that have been leveraged in the past year.

- *Acequia Water Systems Linking Culture and Nature: Integrated Analysis of Community Resilience to Climate and Land Use Changes*. Funded by NSF's Dynamics of Coupled Natural and Human Systems (CNH) program. PI: Sam Fernald (NMSU); Co-PI's: John Wilson (NMT), Jose Rivera (UNM), Vince Tidwell (Sandia National Labs)
- NSF has designated the Jemez River Basin Critical Zone Observatory (JRB CZO) for funding. The Jemez River Basin lies within the NM EPSCoR study area. Discussions are underway to give NM EPSCoR researchers early access to LiDar data gathered by CZO of the study area.
- *Cyberinfrastructure Development for the Western Consortium of Idaho, Nevada, and NM (RII Track 2)* has enabled a significant leveraging of NSF funds. Four tri-state IWG proposals have been funded in Year 3. The Tri-State Consortium Annual meeting has afforded NM EPSCoR researchers the opportunity to interact with and strengthen relationships with colleagues from around the region that enrich and extend their research activities.
- The NMMNHS is recipient of an NSF award to ASTC that was combined with the NM EPSCoR funds to hire a full time Climate Change Educator for the Museum.
- The climatology group at UNM, working under Joseph Galewsky, has very close ties with the NSF-funded National Center for Atmospheric Research and has been awarded Computational & Information Systems Laboratory (CISL) computing support. In addition, NCAR is assisting UNM with graduate student training on-site at NCAR in the WRF model.
- *Valles Caldera, A Land Grant Experiment: Communicating Climate Change Research to Public Audiences.* Funded by NSF's Informal Science Education Communicating Research to Public Audiences (CRPA) program. PI: William Michener (UNM)
- *C2: Improving Broadband Connectivity for Tribal and Regional Colleges in New Mexico*
- *DataOne*: There are numerous opportunities for collaboration between the Tri-State Western Consortium and DataONE and several are underway. In particular, representatives from two of the three states serve on DataONE Working Groups and were Founding Members of the DataONE Users' Group. Those individuals and members of the DataONE Leadership Team are currently planning to establish DataONE Member Nodes at institutions within Idaho (USGS NBII FRAMES Node and the University of Idaho) and New Mexico (Earth Data Analysis Center and the University of New Mexico). Other opportunities will be explored as they arise.

8. Management Structure

The management of the NM EPSCoR program has multiple levels and is diagrammed on the NM EPSCoR web site (http://nmepscor.org/content/epscor-structure). The NM EPSCoR office leadership staff is Dr. William Michener, Executive Director, Dr. Mary Jo Daniel, Associate Director, and Anna Morrato, Program Administrator. Mary Jo Daniel was hired in January, 2010 and assists the Director in program management and oversees project database development and data collection per NSF requested standards. Fiscal and contract management is performed by Anna Morrato. Part-time support staff include: Accounting - Megan Gallegos, Data Management – Laura Arguelles, Public Information/Communication-Natalie Willoughby, Administrative Support—Melissa Coverdale. IT support is provided through an MOU with UNM's IT Field Agent Program.

NM EPSCoR State Committee

The NM EPSCoR governing body is the State Committee, composed of Vice Presidents and Deans from every institution of higher education in the State, along with key individuals from the National Laboratories, State Government, and private industry; a complete list of members is on the project website (http://nmepscor.org/content/nm-epscor-state-committee). The State Committee met twice during Year 3 of the award: September 2010 and April 2011. At each meeting NM EPSCoR directors reviewed project activities and discussed plans and strategies for developing the next RII proposal. Members of the State Committee also met with their counterparts from NV and ID EPSCoR programs at the Tri-State Meeting to discuss possibilities for sustaining collaborations in areas of mutual interest for the three states.

External Advisory Board (EAB)

The External Advisory Board met in October 2010 in Albuquerque, NM. Their recommendations and NM EPSCoR's response are detailed in Section 6. Members of the EAB are listed in Table 9 below. There was one change in the EAB; Bridget Scanlon resigned from the EAB due to increased work demands and was replaced by Emily Stanley from the University of Wisconsin.

Table 9. NM EPSCoR External Advisory Board

Advisor	Institution/Organization
Elsa Bailey	Elsa Bailey Consulting
Stephen G. Borleske	Director, Delaware EPSCoR
L. Ruby Leung	Pacific Northwest National Laboratory
Emily Stanley	University of Wisconsin
Steven Semken	Arizona State University
Amy Ward	University of Alabama
Mark W. Williams	University of Colorado

The full EAB Report and the NM EPSCoR response to its recommendations are provided in Appendix K.

NM EPSCoR Management Team

The RII 3 project has a 16 member Management Team plus the Director and Associate Director. The group has convened by conference call at least quarterly over the past year, responded to relevant problems, and made determinations on science and education issues of importance to the project. The Management Team is listed in Table 10. The Management Team is 22% URM and 50% female.

Table 10. NM EPSCoR Management Team 2010-2011

	Name	Organization
1	Karl Benedict	University of NM
2	Marnie Carroll	Dine College
3	Janie Chermak	University of NM
4	Laura Crossey	University of NM
5	Anya Dozier-Enos	NM Public Education Dept.
6	Anna Espinoza	Northern NM Network
7	Sam Fernald	NM State University
8	Joe Galewsky	University of NM
9	Lorie Liebrock	New Mexico Tech
10	Edward Martinez	NM Highlands University
11	Al Rango	NM State University
12	Todd Ringler	Los Alamos National Lab
13	Bob Parmenter	Valles Caldera Nat'l Preserve
14	Mike Pullin	NM Tech
15	Jessica Sapunar-Jursich	NM Museum of Natural History and Science
16	John Wilson	NM Tech

Jurisdictional and Other Support

The NM EPSCoR state office administers NSF EPSCoR programs. The University of New Mexico provides space for the NM EPSCoR office, which includes collaboration space and access to video and web conferencing facilities. In addition, the UNM Office of Vice President for Research and Economic Development provides 4.8 months of salary support for the Project Director as a cost contribution to the project.

Planning Updates

No significant changes were made to the RII Strategic Implementation Plan or the State's Science and Technology Plan (*Technology21*).

9. Unobligated Funds

This summary provides the salient features of Year 3 financial status for NM EPSCoR.

NM EPSCoR RII 3 Year Three Funds

Awarded	Obligated	Unobligated	% Unobligated
$3,023,490	$2,975,347	$48,143	1.6%

Year 3 funding for the NM EPSCoR award totaled $3.02 million. A balance of $48,143, or 1.6% of the original budget, remains as unobligated funds derived from actual expenditures, encumbrances, and projected expenditures through August 31, 2011.

Amount awarded is $23,490 greater then the original budget of $3 million due to funds for tuition in the NMT subaward (UROP) for Years 3-5 transferred into Year 3 budget; transfer request approved by NSF.

JURISDICTIONAL SPECIFIC TERMS and CONDITIONS

The General Programmatic Terms and Conditions (PTCs) for the New Mexico EPSCoR Research Infrastructure Grant Program (RII) Cooperative Agreement were met and discussed in the Year 1 annual report. Following is an update to the recommendations and requirements from the Year 2 Reverse Site Visit (RSV) for those areas the committee required annual updates.

Response to NSF Recommendations from Reverse Site Visit

Recommendation 2 – Workshop participant follow-up:
Mechanisms appear to be in place to follow-up with the summer workshop participants. Brief reports on the tracking of the long-term outcome of student engagement and success of curriculum implementation by teachers should be included as part of the annual reports.

Follow-up surveys were administered to the participants of the Teacher Summer Institute that addressed success of curriculum implementation; those results are described in this report in Section 3 of this report. Additional follow-up with UROP student participants is ongoing.

Recommendation 3 – Succession plan:
The response demonstrates that a suitable succession plan has been developed. Changes and updates to the succession plan should be described in Year 2 and subsequent annual reports.

The only changes to the succession plan described in the response to the RSV are a result of promotion and hiring freezes implemented at all institutions in response to the current economic situation in the state. Working within those constraints, however, we are finding ways for staff in the State Office to enhance their skills and position themselves for promotion when that becomes an option. All staff members are encouraged to further their education through formal coursework and professional seminars and workshops.

Recommendation 4 – Scientific synthesis:
The response describes numerous activities in the NM EPSCoR program that support greater integration of interdisciplinary research and scientific synthesis. It is expected that the scientific integration among interdisciplinary fields would be highlighted in the annual reports.

As noted in the body of this report, efforts to increase interdisciplinary research and scientific synthesis are progressing. Innovation Working Groups (IWG's) have been key activities that support integration of science across science disciplines and have been described in this report.

Recommendation 5 – Pre-service teachers:
The plan to collaborate with education faculty to incorporate material into courses for pre-service teachers is highly appropriate. NSF EPSCoR is pleased with the plan and looks forward to reviewing the results of the collaboration through descriptions in annual reports.

Of note, one of the IWG's that has been funded in Year 3 is focused on integrating climate-related data into K-12 education. Participants in that IWG include faculty from the two largest teacher education programs in NM. An anticipated outcome will be development of strategies and materials that will be used in pre-service teacher programs.

Recommendation 6 – Multilingual dissemination:
Plans for consideration of multilingual dissemination are well-described. Original budget plans for the EPSCoR project should not be considered an impediment to bi-lingual production of educational materials. Cooperative agreements encourage active management of the budget in response to critical needs, and a request for budget reallocation to meet this need would be highly appropriate. Reports *on multi-lingual availability of educational materials should be included as part of every annual report.*

The climate change exhibit at the Museum of Natural History and Science and supporting educational materials will be available in Spanish.

Recommendation 7 – Leadership diversity:
Plans to increase the leadership diversity and include senior faculty in the working group on diversity appear to be well underway. The list of members of the working group should be provided by email to the cognizant Program Officer by March 1, 2010. The activities of the group should be described briefly in the Year 2 and subsequent annual reports.

The work of the NM EPSCoR Diversity Leadership team has been furthered through collaboration with ID and NV EPSCoR projects and development of a Tri-State Diversity Strategic Plan (see section 2, pages x-x).

Recommendation 9 – Evaluation plan:
The updated evaluation plan provided is appropriate. Reports of change in evaluation metrics, and evidence of the use of the evaluation results to guide program improvement are expected in the Year 2 and subsequent annual reports.

Descriptions of program responses to evaluation results are provided in this report as well as throughout in activity descriptions.

Additional recommendation – Plan for water quality researcher collaboration

Cross-calibration of instrumentation and the addition of a break-out session at the state-wide meeting are excellent steps to building collaboration between the New Mexico Highlands University and New Mexico Tech researchers. Collaborations initiated through the state-wide meeting should be described in annual reports.

As noted in the report of the water quality research, the collaborations between NMT and NMHU have continued to flourish and include UNM researchers as well.

EXPERIMENTAL FACILITIES

Year 3 Equipment Purchases				
Component	**Equipment**	**Use**	**Location Installed**	**Supervision/ Access**
Acequia	Acequia flow monitoring device	Several flumes have been installed and instrumented to measure acequia flow.	Rio Hondo and El Rito	Fernald (NMSU)
Acequia	Well-water level logger	Water level loggers have been installed in several monitoring wells	Rio Hondo and El Rito	Fernald (NMSU)
Acequia	El Rito Flow monitoring stations (6)	Installed, improved, and maintained 6 flow monitoring stations to monitor flows of river and acequias in El Rito river valley	El Rito, NM	Fernald (NMSU)
Acequia	Rio Hondo Flow Monitoring Stations (8)	Improved, and maintained 8 acequia flow monitoring stations in Rio Hondo Valley	Valdez and Arroyo Hondo, NM	Fernald (NMSU)
Climate	4 Weather Stations	Installation of 4 weather stations on the Navajo Nation. Fifth station is TBD later.	Navajo Nation	DeMouche (NMSU)
Climate	Ott Pluvio Installation	Installation of Ott Pluvio is planned in July, 2011. Forestry Service needs to wait for installation during the Monsoon season due to fire control. Plans are to install 4 stations year 3 with additional stations in the fall 2011.	Throughout NM	DeMouche (NMSU)
Climate	Meteorburst Radios	In process of negotiating purchase of Meteorburst Radio to be installed on the weather stations. We have additionally written a MOA with NRSC to use their meteorburst program and place the data up on the NRCS SCAN data portal.	Throughout NM	DeMouche (NMSU)
Hydrology	Meander Bend Study Area Weather Station	A fully instrumented Campbell Scientific weather station, with instruments for measuring short and long wave radiation (including net radiometers and a sensor for Photosynthetically Active Radiation), precipitation (heated rain gage), temperature, humidity, wind, and soil heat flux, recorded to a data logger. Powered by batteries and a solar collector.	Valles Caldera National Preserve	Wilson (NMT)
Hydrology	Distributed Temperature Sensing (DTS) Sysetem	Provides high-resolution (meter-scale) temperature data over large spatial areas (up to several kilometers).	Housed at NMT; used for multiple deployments	Wilson (NMT)
Hydrology	NogginPlus Ground Penetrating Radar (GPR) w 250 and 500 MHz Sensors	It will be used to profile soils and sediments on mountain slopes and near streams and acequias and will benefit research by the Hydrology, Water Quality, and Acequia groups. This GPR instrument is housed at New Mexico Tech (NMT) in the geophysics program, which is affiliated with the NSF IRIS Passcal Instrumentation Center (www.passcal.nmt.edu). NMT has the expertise to maintain, improve, and deploy the unit. The unit will also be used in teaching classes on Near Surface Geophysics to	New Mexico Tech - Field Portable	Wilson (NMT)

		graduate and undergraduate students, and employed in REU and UROP experiences for on-campus and visiting students. Because of this teaching role New Mexico Tech has also contributed $9K to the funding of this instrument.		
Outreach	Climate Change Museum Exhibit assorted equipment	All of the assorted equipment is used in the museum climate change exhibit and includes: custom built exhibit components, flat screen monitors, LED projector, computer, etc.	NMMNHS	Sapunar-Jursich (NMMNHS)
Water Quality	Dionex Ion Chromatograph	Used to analyze water samples for anion composition. Applications for both routine water quality analysis and hydrologic tracer studies.	Northrop Hall, UNM campus	Crossey (UNM)
Water Quality	5 ea. YSI Water Quality Sonde	Monitoring equipment for quantifying nutrient flux and water quality parameters; multiple deployments at VCNP study sites	Biology Dept., UNM	Crossey/Dahm (UNM)
Water Quality	4 ea. YSI Water Quality Sonde	Monitoring equipment for quantifying nutrient flux and water quality parameters; multiple deployments at VCNP study sites	Biology Dept., UNM	Crossey/Dahm (UNM)
Water Quality	3 ea. Satlantic UV Nitrate Sensor	Monitoring equipment for quantifying nutrient flux and water quality parameters; multiple deployments at VCNP study sites	Biology Dept., UNM	Crossey/Dahm (UNM)
Water Quality	1 ea. Dionex IC System	Monitoring equipment for quantifying nutrient flux and water quality parameters; multiple deployments at VCNP study sites	Biology Dept., UNM	Crossey/Dahm (UNM)
Water Quality	1 ea. WET Labs PO4 Sensor	Monitoring equipment for quantifying nutrient flux and water quality parameters; multiple deployments at VCNP study sites	Biology Dept., UNM	Crossey/Dahm (UNM)

PUBLICATIONS

Component	Citation	Publication Type	Publication Status	Publication Date
Acequia Interdisciplinary Research	**Ochoa, C.G**., **A.G. Fernald**, and **S.J. Guldan**. 2011. Deep percolation from surface irrigation: Measurement and modeling using the RZWQM. In M.K. Shukla (Ed.), Soil Hydrology, Land Use and Agriculture: Measurement and Modeling. CABI, Wallingford, UK. (in press)	Book	Accepted - Awaiting Publication	August, 2011
Climate and Hydrology Research	**Harding, J.J.** and **J.L. Wilson**, 2010. Linking mountains to valleys: exploring the influence of mountain hydrology on traditional acequia irrigation systems. Paper No. 37-1, Geological Society of America, Abstracts with Programs, 42(5), 111.	Abstract	Published	October, 2010
Climate and Hydrology Research	**Gomez, J.D**. and **J.L. Wilson**, 2010. Effects of flow dynamics on age distribution. Abstract H31J-07, presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.	Abstract	Published	December, 2010
Climate and Hydrology Research	**White, A.B.**, E.R. Vivoni, and E.P. Springer (2010). Hydrological alterations due to climate-induced regional vegetation change. Abstract H31I-05, presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.	Abstract	Published	December, 2010
Climate and Hydrology Research	Fisher, R.A., S.A. Rauscher, S.A., **A.B. White,** N. McDowell, and **T. Ringler,** 2010. What does the 2003 Southwest USA vegetation dieback event tell us about vegetation resilience to climate change? Results from a high-resolution land surface modeling exercise. Abstract B23C-0402 presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.	Abstract	Published	December, 2010
Climate and Hydrology Research	**Gabrielsen, P.J.**, 2010. Temporal evolution of hyporheic dissolved organic carbon. Abstract B23E-0431 presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.	Abstract	Published	December, 2010
Climate and Hydrology Research	**A.B. White**, Hydrological alterations due to climate-induced regional vegetation change	Abstract	Published	December, 2010

Climate and Hydrology Research	Dennis McCarville, Michaela Buenemann, **Max Bleiweiss,** and Julia Barsi, 2011: "Atmospheric Connection Of Landsat Thermal Infrared Data: A Calculator Based On North American Regional Reanalysis(NARR) Data", in Proceedings, ASPRS 2011 Annual Conference, Milwaukee, WI May 1-5, 2011.	Conference Proceedings	Published	May, 2011
Acequia Interdisciplinary Research	**Fernald, A.G**., S.Y. Cevik, **C.G. Ochoa**, **V.C. Tidwel**l, J.P King, and **S.J. Guldan**, 2010. River hydrograph retransmission functions of irrigated valley surface water—groundwater interactions. Journal of Irrigation Drainage and Engineering. 136 (12).	Journal Article	Published	December, 2010
Climate and Hydrology Research	**Ashraf El-Sadek**, **Max Bleiweiss**, Manoj Shukla, **Steve Guldan** and **Alexander Fernald**, 2010: "Alternative climate data sources for distributed hydrological modelling on a daily time step", Hydrological Processes, Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/hyp. 7917	Journal Article	Published	March, 2011
Climate and Hydrology Research	**A. El-Sadek**, **M. Bleiweiss**, M. Shukla, **S. Guldan**, and **A.Fernald**, 2010. Alternative climate data sources for distributed hydrological modeling on a daily time step. Hydrological Processes, wileyonlinelibrary.com. DOI: 10.1002/hyp.7917.	Journal Article	Published	March, 2011
Climate and Hydrology Research	**Ashraf El-Sadek**, 2011. Hydrological modelling of semi-arid watersheds using enhanced climate data. PhD Dissertaion. Plant and Environmental Sciences. NMSU. May, 2011.	Journal Article	Published	
Climate and Hydrology Research	**Sarah Keller**, Albuquerque Journal, Jan 10 2011	Newspaper Article	Published	March, 2011
Climate and Hydrology Research	**Gomez, J.D**. , M.B. Cardenas, and **J.L. Wilson**, 2011, Hyporheic exchange and residence time distributions in sinuous streams, Water Resources Research, in submission.	Journal Article	Submitted - Under Review	May, 2011
Climate and Hydrology Research	**Gomez, J.D**. and **J.L. Wilson** (2011), Exploring the dynamics of sinuosity-driven hyporheic zones, Geophysical Research Letters, in submission June 2011.	Journal Article	Submitted - Under Review	June, 2011

Climate and Hydrology Research	**Ashraf N El-Sadek**, Manoj Shukla, **Max P. Bleiweiss**, **Steve Guldan** and **Sam Fernald**, 2011: "Evaluating sensitivity analysis and autocalibration of a semi-distributed hydrologic model for a semi-arid watershed" In review, Hydrological Processes	Journal Article	Submitted - Under Review	March, 2011
Climate and Hydrology Research	**A.N El-Sadek**, M. Shukla, **M. Bleiweiss, S. Guldan** and **S. Fernald,** 2011. "Evaluating sensitivity analysis and autocalibration of a semi-distributed hydrologic model for a semi-arid watershed" In review. Hydrological Processes.	Journal Article	Submitted - Under Review	March, 2011
Climate and Hydrology Research	**Gomez, J.D**. and **J.L. Wilson** (2011). Age distributions in dynamically changing hydrologic systems. Water Resources Research. Submitted May, 2011.	Journal Article	Submitted - Under Review	May, 2011
Water Quality Research	**Van Horn, D, Martinez E, Dahm C,** Hernandez C, Merrill J, The Effects of Watershed Characteristics and Ungulate Grazing on Montane Grassland Streams and Riparian Areas	Journal Article	Submitted - Under Review	2010

APPENDICES

There are two sets of Appendices attached. The first set are the data templates provided by NSF.

APPENDIX A
APPENDIX B
APPENDIX C
APPENDIX D
APPENDIX E
APPENDIX F
APPENDIX G
APPENDIX H

The second set of Appendices provide additional or reference materials to the annual report.

APPENDIX J	Presentations
APPENDIX K	External Advisory Board Report and Response
APPENDIX L	Annual Evaluation Report
APPENDIX M	NM EPSCoR RII 3 Strategic Plan and Implementation Plan
APPENDIX N	Tri-State Diversity Strategic Plan
APPENDIX P	Summer Undergraduate Research Opportunity Program (UROP) Research Projects
APPENDIX Q	CI Standards and Specifications
APPENDIX R	AAAS Review Agenda and Report
APPENDIX S	Year 3 Science Presentations
APPENDIX T	Junior Faculty Leadership Workshop Evaluation Report (2011)
APPENDIX U	NSF Day Evaluation Report