



New Mexico
EPSCoR

New Mexico EPSCoR RII 3 Annual Report
Award Year Four

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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 Four

Intellectual Merit

EPSCoR Year 4 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 8,500 K-12 students and 750 teachers participated in EPSCoR-supported outreach events in Year 4, increasing their awareness of climate change impacts on natural resources. The EPSCoR-supported museum climate science exhibit provides information and engagement for approximately 200,000 members of the general public each year. 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 4 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).

- Eight new SCAN-type stations are prepped for installation in summer 2012; stations installed in Year 3 are generating data available through the NRCS.
- Continued to work on optimizing the parameters for the Snowmelt Runoff Model in 24 sub-basins of the Upper Rio Grande.
- Developed new software tools for analyzing the links between large-scale flow and atmospheric hydrological process.
- Developed models for small-scale (1-100 m) hyporheic exchange and larger scale (1-100 km) basin flows, and models demonstrated for dynamic flows ranging from individual storm events up to seasonal, decadal, and longer time scales.
- Isotopic and aqueous geochemical data from precipitation, stream flow, springs and wells has been assembled and analyzed to help diagnosis flow paths and residence times in selected watersheds.

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

- Conducted a detailed assessment of the effects of the Las Conchas fire on water quality in study area.
- In collaboration with hydrology group, continued studies of meander site at Valles Caldera National Preserve.
- Continued water quality studies in the Jemez and Hondo watersheds.
- Completed development of an on-site water quality trailer, which is scheduled for installation in June 2012.

Objective 3: Develop interdisciplinary socioeconomics and acequia research capacity.

- Continued involvement with the acequia associations through both informal interactions and participation in community meetings.
- Initiated a study to determine the water balance to the Northern NM acequia farmers.
- Monitored riparian health at both the El Rito and Rio Hondo sites while developing a student and stakeholder driven partnership in a long-term riparian monitoring program.
- Completed an empirical analysis of the impact of conservation incentives utilized by the Albuquerque Bernalillo County Water Utility Authority.
- Conducted studies on the impacts of climate change on water resources and adaptation opportunities in the agricultural sector of New Mexico

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

- Incorporated use of enhanced water quality laboratory facility into undergraduate research activities.
- 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.

- *Connecting Communities: Engaging Stakeholders in Research* brought researchers together with acequia association members to discuss research plans and outcomes.
- Collaborators at the Santa Fe Institute led *Developing an Online Network for Teacher Professional Development in Computational Science/Modeling and Simulation*
- Faculty from the Utton Center at the UNM School of Law convened *Water, Agriculture and the Environment in the Southwest under a Changed Climate: Policy Implications*.
- In June 2012, *Water, Energy, and Culture Through Time in the San Juan Basin*, will consider the effects on local indigenous cultures of water use and energy development through the lens of planning and design.

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.

- Three proposals funded in second round: NM Highlands University, Eastern NM University and UNM-Los Alamos.
- Solicitation for final round of awards released; proposals due in July 2012.

Cyberinfrastructure Improvements

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

- Continued development of 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 to evolve systems for automated processing of the existing FGDC XML metadata records in the portal into corresponding valid ISO metadata, and development of template-based metadata creation tools for bulk metadata creation in support of researcher data integration into the EPSCoR Data portal
- Developed a system for the automated retrieval of new SNOTEL and SCAN data from the NRCS web site for New Mexico, Arizona, Colorado, Utah, Nevada, and Idaho.
- Significantly improved computer hardware capacity through the addition of the UNM Research Storage Consortium storage system (a 280 TB tiered storage system) to the pool of available storage capacity.

Human Infrastructure Improvements

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

- In collaboration with Nevada and Idaho EPSCoR programs, participated in a Diversity Working Group to implement activities in the Tri-State Diversity Strategic Plan.
- Developed Guidelines for Infusing Diversity into RII Proposals for project leadership.
- Revised and updated a database of STEM opportunities in NM for students, teachers, and the general public.
- Increased the number of under-represented minority students supported by NM EPSCoR.

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

- Conducted the annual five-day field-based Teacher Summer Institute at the Valles Caldera National Preserve (VCNP) for middle and high school math and science teachers in collaboration with NM EPSCoR researchers.
- Provided follow-up workshops during the academic year for participants in the Summer

Institute on how to use data in their classrooms.

- Participating teachers conducted overnight field trips to the VCNP with students and implemented lessons based on their summer institute experience.
- Supported teacher workshops in environmental education using Project Wet curricula.
- Supported teacher workshops in complex modeling and computation with Project GUTS.

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.

- Engaged 10 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.

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

- With NV and ID, offered workshops in Climate Modeling and Hydrologic Information Systems (HIS) at the Tri-State Annual Meeting for graduate students and faculty.
- In collaboration with NV and ID, offering *Interdisciplinary Modeling* course at NMSU for 30 students from the tri-state consortium.
- Supported graduate students attendance at various climate science and CI-related workshops and seminars.

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

- Administered a follow-up survey one year after the successful NSF Day event.

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

- Offered a weeklong training workshop for 21 early-career faculty from 11 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.

- Conducted an evaluation of the *Degrees of Change* exhibition at the New Mexico Museum of Natural History and Science and implemented improvements.
- Educators at the Sandia Mountain Natural History Center included climate impacts into their field ecology program, which served over 8,500 students in the middle Rio Grande area.
- Planned and delivered a Town Hall meeting on the impacts of drought-enhanced fires on water quality, economy and land use in northern New Mexico.
- Updated and enhanced NM EPSCoR electronic communication tools.

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 the 2011 Reverse Site Visit (RSV)

Details of on-going progress in implementing plans presented in the first RSV response are provided in the body of this report. The full response to the second (2011) RSV is provided in the "Jurisdictional Specific Terms and Conditions" report section. Key steps taken include:

- Held extensive pre-town hall coordination and planning meetings;
- Included in the annual report a chart showing completion of Strategic Plan components;
- Revised the evaluation reporting to include more detailed outcome metrics;
- Continued integration of project data with libraries and national data repositories;
- Updated the Strategic Plan; attached as Appendix M.

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 EPSCoR response are provided in the body of the report and Appendix K. Key components are:

- Continuing to articulate the science focus of the project at all major meetings;
- Developing a graphical representation to show alignment of science foci and researchers;
- Working with researchers to populate the project's data portal;
- Leveraging institutional funds to expand education and outreach activities;
- Encouraging faculty and students to increase their publications output.

Response to Year Three Evaluation Report

The Year Three 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 Four of the Award

The project had no significant changes in scope or priorities in Year 4 of the award. The subaward to the Northern NM Network for the design and delivery of the summer teacher institute was terminated when the Network notified NM EPSCoR they would be unable to fulfill the contracted statement of work due to internal administrative changes. The NM EPSCoR office received NSF approval to move those funds to the University of New Mexico so the State Office could manage these activities for the remainder of the award; the change did result in a slight increase in administrative costs of the project.

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INTRODUCTION

The NM EPSCoR RII 3 Program
Annual Report
Award Year Four: September 1, 2011 – August 31, 2012

Structure of this Report

The NM EPSCoR RII 3 annual report for Year 4 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, updated as requested by the 2011 RSV, is included as an Appendix M. In addition, a chart clearly showing progress made on project components is included as Appendix W.

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



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: NM Museum of Natural History and Science (NMMNHS) in Albuquerque and its outreach facility, Sandia Mountain Natural History Center in Cedar Crest
- 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 (withdrew in Year 4)
- 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 graphic, developed in response to our External Advisory Committee’s recommendation, illustrates the core NM EPSCoR scientists whose work is described in this report.

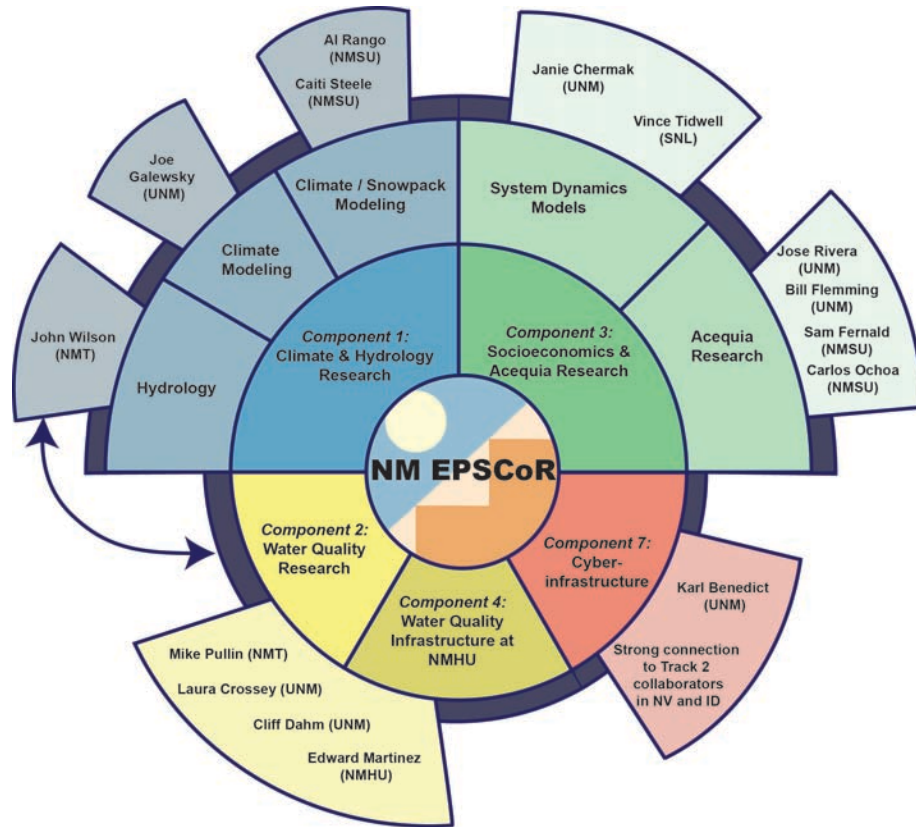


Figure 1: Primary NM EPSCoR scientists active in Year 4 of the award.

Project Description: Research Accomplishments

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 Figure 1. Demographics for all project participants in Years 1-4 of the award are shown in Table 2.

Table 1. NM EPSCoR Participants Years 1-4

Demographic	2009 Number	2009 Percent	2010 Number	2010 Percent	2011 Number	2011 Percent	2012 Number	2012 Percent	Change Year 1 to 4
Female	36	36%	57	40%	60	38%	76	41%	5%
Male	61	61%	86	60%	98	62%	109	59%	-2%
Under- represented Minority	5	18%	38	27%	45	28%	47	25%	7%
Totals	97		143		158		185		88

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--from 18% to 25%. The percent of female participants has also increased, from 36% to 41%.*

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.

The project's external evaluator included in his Year 3 Evaluation Report (Appendix L) another accounting of project personnel that includes “*all individuals who have been individually identified*” such as participants in the K-12 summer teacher institute, the Junior Faculty Leadership Program and NM IWG's. Table 2 shows these data and is an indication of NM EPSCoR's reach in both research and education.

Table 2. Number/Percent of Underrepresented Minority and Female Participants by Program Year and Cumulative [from External Evaluation Report, Year 3]

Category	Year 3	Unduplicated Count (cumulative)
Underrepresented Minority (URM) -Ethnic	58 (29%)	64 (21%)
URM-Female	27 (13%)	30 (10%)
URM-Male	31 (15%)	34 (11%)
Female	87 (43%)	132 (43%)
Total Participants	203	306

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 financial support from other 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. NM EPSCoR provides minimal salary support for faculty; most salary support is for students and postdocs.

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 4, NM EPSCoR project personnel continued and expanded productive collaborations that had been established in previous project years. Collaborations exist between researchers across institutions and across research focus areas as well as collaborations 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).

One of the NM EPSCoR study sites, the Valles Caldera National Preserve (VCNP) has been a focus for numerous collaborations. Researchers in hydrology and water quality have focused efforts on a meander study site that has involved students and faculty from UNM, NMT, and NMHU. A PhD student researcher convened a meeting in December 2011 of those working in this study site and included representatives of the CI component. They discussed data collected and plans for the coming year. The Summer Teacher Institute brings K-12 teachers together with researchers in the VCNP. In Fall 2012 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. In Year 4, collaborations with a variety of stakeholders have been furthered through an IWG that brought together researchers and rural water managers and through the Town Hall, which focuses on impacts of wild fires on water resources. Details of the collaborative research efforts are provided throughout this report.

Strategic Plan Objective 1: Enhance climate and hydrology research infrastructure.
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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 4 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

Project Description: Research Accomplishments

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, including sites on the Navajo Nation, as well as maintain stations installed in previous project years. Eight new SCAN-type stations are being assembled and tested at New Mexico State University before installation in the field in summer and fall 2012 and weather station locations are being investigated for approval by landowners. Several of the stations installed in Year 3 are generating data available through the NRCS: http://www.wcc.nrcs.usda.gov/scan/New_Mexico/new_mexico.html. Data from stations not communicating with the NRCS SCAN program will become available after installation of modems or meteorburst radios, which is expected to occur in summer 2012. NMSU is seeking additional funding (external to EPSCoR) to create a facility for receiving and disseminating the climate data.

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. All input data for the SRM (temperature, precipitation, and snow covered area) for all 24 Rio Grande sub basins has been assembled and three years of data has been prepared for each basin. For each sub-basin, three years were selected between 1984 and 2000 where stream flow was high, moderate, or low in anticipation that SRM parameters should be adjusted for different stream flows for climate change modeling. To date, SRM parameters have been calculated for moderate stream flow years. NMSU researchers have continued to work on optimizing the parameters for the Snowmelt Runoff Model in 24 sub-basins of the Upper Rio Grande. The range of years 1984 - 2000 were chosen to correspond with the available Landsat data (1984 - present) and the historic climate data (1971 - 2000) used by collaborators at UNR to calibrate their downscaling method. UNR collaborators have supplied predictions of temperature and precipitation data from different climate models and under different climate scenarios for each of the climate stations in the Upper Rio Grande that are being used to run SRM. Once SRM has been parameterized for all basins for the different stream flows, researchers will be well positioned to generate ranges of predicted values for each SRM simulation under future climate conditions—work planned for Year 5. In addition to these Sub-basins researchers will be working on simulating stream flow in the El Rito basin, which was recently fitted with a stream gauge by the NM EPSCoR Acequia group. NMSU faculty and postdocs have also been collaborating with the NRCS in Idaho with the intention of using their approach to operational forecasting using an enhanced version of the snowmelt runoff model.

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 4 of the project, including:

Project Description: Research Accomplishments

- An analysis of water vapor isotopic composition from the Quellcaya Ice Cap, Peru with numerical modeling studies linking observations to the large-scale flow; An analysis of CloudSat data to evaluate tropical convection as a critical phenomenon;
- An evaluation of surface roughness on alluvial fans using LANDSAT imagery and bi-directional reflectance properties to characterize surface processes (e.g., debris flow, sheet flood, and fluvial) active on the alluvial fans; results will elucidate hill slope processes and response to changing hydrology in the catchments in response to Quaternary climate change;
- A study on the lakes in the Nhecolandia region in the Pantanal Basin of Brazil using remote sensing techniques to evaluate the hydrology controlling geochemistry of these lake and to evaluate genesis of these lakes and possible links to past climate changes and megafan development;
- An evaluation of the use of LANDSAT Thermal bands to evaluate annual soil moisture variability on megafans in the Himalayan Foreland Basin in India; this work also has significant implications for fluvial sedimentology and evaluation of ancient soil types associated with position in the sedimentary basin, offering an alternative hypothesis to evoking climate change for soil type successions.

In addition, undergraduate student projects have been supported:

- Fluvial sedimentology of active sedimentary basins database--compiling LANDSAT and SRTM data for modern sedimentary basins around the world for evaluation of fluvial systems in these basins;
- Sedimentology of the Morrison Formation Aquifer, San Juan Basin, New Mexico--focuses on evaluating the distribution and form of the Morrison Formation aquifer across New Mexico.

Researchers have developed new software tools for analyzing the links between large-scale flow and atmospheric hydrological process and have begun development of a software infrastructure for analyzing cloud fields and precipitation satellite records.

Modeling at NMT

Work continued on 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. This data is now invariably interpreted by assuming that water circulation is steady (not changing in time), a clearly limiting assumption. Models were developed for small-scale (1-100 m) hyporheic exchange and larger scale (1-100 km) basin flows, and demonstrated for dynamic flows ranging from individual storm events up to seasonal, decadal, and longer time scales.

The methods are being 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 continued the development of watershed models for the Valles Caldera and the Rio Hondo using the GS Flow approach (<http://water.usgs.gov/nrp/gwsoftware/gflow/gflow.html>) developed by the US Geological

Project Description: Research Accomplishments

Survey and began model development for the El Rito watershed and for Saguache Creek watershed, other tributaries of the upper Rio Grande. The Rio Hondo and El Rito models are being produced in collaboration with an NSF funded research project on acequia hydrology and sociology led by New Mexico State University, another spin-off of the EPSCoR project. The Saguache Creek model is part of the new NSF funded project on residence time. It also leverages previous NSF funded work of the SAHRA Science and Technology Center. Spatial and temporal data sets for the Rio Hondo, El Rito, and Saguache Creek models have been assembled to provide the input information needed by GSFlow. Isotopic and aqueous geochemical data from precipitation, stream flow, springs and wells has been assembled and analyzed to help diagnosis flow paths and residence times.



Image 1: New Mexico Tech students test out equipment near the Rio Hondo.

Several student researchers have contributed important results that have led to the development and refinement of the hypothesis that there can be significant deep groundwater circulation in mountain blocks. This research is timely and has important implications for our fundamental understanding of process behavior at large watershed scales as well as our understanding on how these systems will respond to future change. Watershed models are being developed to explore the impact of alternative boundary locations, including the surface water divide, the next adjacent stream, and the next ridge. These studies are determining how far out the model boundaries should be located in order for the model to

accurately reproduce groundwater discharge, groundwater age (residence time), and other metrics for the valley of interest.

The Water Quality (NMT and UNM) and Hydrology groups have worked together to make substantial progress on the development and instrumentation of a meander study area along the East Fork of the Jemez River, in the Valles Caldera National Preserve. The site is aimed at the investigation of hyporheic exchange between a stream and aquifer. Work is continuing on the improvement of the mathematical simulation model of the meander area, which is used to design and interpret field observations and experiments. Also in collaboration 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. By selecting the correct set of rules the model can mimic sorption and microbial mediated transformation, as parameterized and validated through laboratory experiment and field observation. To allow the agents to move we 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).

In May 2012 two NMT graduate students successfully defended their Masters theses.

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 El Rito. 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.

Water Quality activities in Year 4 include:

- Purchasing and installing additional equipment (pressure transducers)
- Continuing site activities in the Jemez and Hondo watersheds
- Documenting Las Conchas forest fire effects on water quality and expanding the water quality network to look at downstream effects on the Jemez River and Rio Grande
- Making numerous presentation of science results at multiple science meetings (Geological Society of America, Society for Freshwater Science, National EPSCoR, Tri-State EPSCoR, Annual NM EPSCoR)
- Collaborative research with the Hydrology and Social Science teams

Las Conchas Fire

A substantive part of the activities this year has been linked to the Las Conchas fire. The fire burned from June 26, 2011 until early August with about half of the catchment in which the water quality instrumentation resides being burned by the fire. The excellent data from the sondes, the nitrate analyzer, and the phosphate analyzer from before the fire allow detailed assessment of the fire effects to the site. Monsoonal precipitation events have produced large increases in phosphate, nitrate, turbidity, and specific conductivity with sags in pH and dissolved oxygen. Dissolved oxygen sags have propagated through the stream and river network producing anoxic conditions in the Rio Grande and closure of the drinking water diversion for the City of Albuquerque for two months due to water quality concerns. An additional sonde also has been continuously deployed in the Jemez River in Jemez Springs to examine salinity, T, pH, DO and turbidity changes to allow site data to be connected to larger scale systems such as the Rio Grande. This is part of a larger network put in place to assess water quality effects from the Las Conchas fire.

VCNP Meander Site

A network of 34 shallow monitoring wells was installed in June 2010 along a 250 meter reach of the East Fork Jemez River and this site continues to be maintained and upgraded in 2011 and 2012. Wells have been 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. A CycleP (phosphate analyzer) and a Satlantic SUNA (nitrate analyzer) have been deployed at the study site for most of 2011 and 2012 except for the winter months when the stream was frozen. Continued monitoring has occurred through the winter to the present day for both surface water and groundwater with the sondes and pressure transducers. All of these data are being statistically analyzed and compared to local high-frequency climate and discharge data. Groundwater sonde

results, along with pressure transducer data, are being used to establish hydrologic connectivity between surface waters and ground waters at the study site and quantify how flow paths vary on a variety of spatial and temporal scales. 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.



Image 2: Jesus Gomez (left) and Paul Gabrielson check data from the meander wells.

Water Quality Trailer

NMT has continued efforts to equip a 10' cargo trailer with a variety of water quality sensors; the trailer is scheduled to be installed June 18, 2012 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 developed 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.

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. 20 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. Traditional gravity flow irrigation methods enhance vegetative cover and diversity, support wildlife habitat, recharge

Project Description: Research Accomplishments

shallow aquifers, sequester carbon, improve air and water quality, retain storm-water flow, control flooding, and provide nutrient cycling and soil formation, ecotourism and environmental education, extension of the irrigation season, and aesthetic enrichment of the landscape. A rating system is currently underway through a combination of GIS and field methods to evaluate the relative extent of ecosystem services and determine riparian health. A collaborative interdisciplinary team integrates social, economic, ecological and hydrological research to understand climate change impacts on *acequias*, and *acequia* management responses to climate variability.

In Year Four the UNM team continued to collect data on the socio-cultural components of NM EPSCoR research regarding the role of community acequias in water management. To maintain a connection to and receive feedback, the students presented a poster at the annual meeting of the New Mexico Acequia Association, the Congreso de las Acequias, held in Santa Fe November 2011. Several student projects were carried out in year 4, including:

- Development and refinement of an Acequia Functionality Assessment;
- Documentation of the "Paisaje del Agua" (and cropping patterns) on the Rio Hondo;
- Development of a Rio Hondo Watershed Stakeholder's Handbook;
- Riparian health surveys at local farms;
- GIS analysis of the Rio Hondo watershed to better understand the geography and natural resources in terms of policy implications.

In addition, faculty researchers continued to monitor riparian health at both the El Rito and Rio Hondo sites while developing a student and stakeholder driven partnership in a long term riparian monitoring program, one of the EPSCoR research objectives. Research and education efforts have been coordinated through student projects and on-farm demonstrations with acequia stakeholders. Nine additional sites at El Rito and three sites at the Rio Hondo were surveyed during field trips. Thirty graduate students from two different courses participated in a field trip at the El Rito watershed that included a special presentation by two acequia stakeholders and visits to the diversion structures and the stream gauges installed by NM EPSCoR. They engaged the students by describing the history and current practices of water sharing "a tiempos" and how the community depends on the health of the watershed for both irrigation and domestic water supply.



Image 3: Students visit the El Rito study site.

Beginning in summer 2012 an NMSU graduate student will conduct an experiment to study the surface water and ground-water interactions on a flood irrigated field to develop a better understanding of the hydrological processes and determine the water balance to the Northern NM acequia farmers. The ability to determined water balances for this acequia and flood irrigation fields is exceptionally important to the farmers in Northern New Mexico because the data collected will help them to understand how much of the water they are actually using, how

Project Description: Research Accomplishments

much is percolating and contributing to aquifer recharge; and how much water is going back to the river. This knowledge will help them to make better water management decisions.

Impacts of Climate on Agriculture Studies at NMSU

A graduate student at NMSU graduate student is researching the effects of deficit irrigation on chili heat level, extractable color and biomass. This research is highly relevant because chili is one of New Mexico's most valuable and leading horticultural commodities and communities in Northern New Mexico have deep-rooted traditions of cultivating chile spanning back over hundreds of years. Recent pressure on farmers to conserve water has intensified due to drought conditions and less available water. Initial results suggest that growers may be able to reduce current water applications without adversely affecting yield

Another NMSU grad student worked on the impacts of climate change on water resources and adaptation opportunities in the agricultural sector of New Mexico. In this study, he disaggregated the elements of the agricultural sector to estimate the best possible crop mix, land use, and crop-water use under three different future climate scenarios within an optimization framework. Since climate change alters the amount and the timing of runoff, and also increases the demand for water due to higher temperatures (shifts the demand and supply schedules), the study used a nonlinear hydroeconomic model to find the new equilibrium point between the shifted demand and supply. The results show the changes in welfare in both municipal and industrial, and agricultural sectors.

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 economic modeling components for residential water use in Albuquerque was completed and calibrated. Scenario analysis was undertaken to ascertain the impact various scenarios including economic and population growth; incentives (pricing, education, rebates); and drought. In addition, an empirical analysis of the impact of conservation incentives utilized by the Albuquerque Bernalillo County Water Utility Authority was completed.

A Benefit Transfer Model is under development in order to expand the economic behavioral component to include Rio Rancho and Santa Fe within the Systems Dynamics Model. The residential demand for Albuquerque is being modified in order to better represent these additional communities.

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

Project Description: Research Accomplishments

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. He effectively connects research with education through supervision of student projects, including:

- 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 Palaeolimnology in McAllister Lake, Northeastern New Mexico, San Miguel County;
- Utilizing the Las Conchas Fire to Develop a Standardized Burn Severity Classification System and Nutrient Contribution Determination in Surface Water Runoff from Various Wildfire Severity Classes in the Jemez Mountains, Northern New Mexico.

Without the instrumentation purchased with the EPSCoR funding, student research opportunities would be severely limited. Several of the student research projects have involved students in the Undergraduate Research Opportunities Program (UROP), further extending the benefits of this laboratory upgrade.

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 portion of the NM EPSCoR Strategic 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 Infrastructure 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 convened an Innovation Working Group in the fall of 2010 at which they produced a Tri-State Diversity Strategic Plan (Appendix N). This plan has continued to guide diversity activities in New Mexico as well as in the Tri-State Consortium as a whole. The plan includes six overarching strategies:

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.

Through teleconferences, collaboration with leadership in the other states of the Consortium has provided valuable input and feedback on jurisdiction activities. A Diversity Working Group session at the 2012 Tri-State Annual Meeting revisited the plan and reported progress made towards each of the six strategies. Following one of the action steps of the Diversity Plan, the Working Group also developed a Guidance document to assist each jurisdiction's leadership to infuse diversity into their next RII proposals (Appendix U). In New Mexico, this document was distributed to all Steering Committee members at proposal planning meetings.

Project Description: Diversity and Broadening Participation

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. In Project Year 3, NM EPSCoR, in collaboration with the NM Department of Public Education and the NM Math and Science Advisory Council, developed 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. In Year 4, the database was revised to improve functionality and impact. 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.

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 posts Science Stories of the Day as well as program-specific announcements and events. NM EPSCoR currently has 154 followers, numerous posts, hundreds of images, and useful information for all involved with NM EPSCoR. NM EPSCoR has also initiated a Twitter account and uses it to send "Scweets"—Science Tweets.

Project Description: Diversity and Broadening Participation

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 22 students who presented posters of their research, 11 were female (50%) and 5 (23%) were members of underrepresented minority groups (URM). At the Tri-State meeting, of the 16 New Mexico students who competed in the student poster session, 9 were female (56%) and 7 were URM (44%). In addition, all three NM IWG's funded in 4 were led by females; one of whom is a post doc (Connecting Communities: Engaging Stakeholders in Research). At the Tri-State Consortium annual meeting, 57% of the 14 session presenters/moderators from New Mexico were female and 29% were URM.

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. In addition, NM EPSCoR has leveraged institutional funding to provide additional outreach activities (see p. 36-37), including workshops to engage and support young women in computing.

Proposals to Address Diversity

Four proposals for funding (total \$3,449,014) were submitted by NM EPSCoR educators and researchers, aimed at improving the diversity of students pursuing and succeeding in STEM fields. Dr. Edward Martinez, an EPSCoR researcher at NM Highlands University, has been very productive, receiving one award (Pathways to Achievement and Success in STEM) for over \$1 million dollars from the US Dept. of Education, a \$500,000 award (Achieving in Research, Math and Science Center) from the Kellogg Foundation, and just over \$500,000 from NSF for DUE: Achieving in Research, Mathematics and Science Scholarship Program. These proposals are included in Template E.

2b. Institutional Collaborations

Engagement in NM EPSCoR 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 4, including Innovation Working Groups, the Undergraduate Research Opportunities Program, and the Junior Faculty Leadership Workshop. Each of these programs is described in the body of this report. The 2011 All Hands Meeting (annual state EPSCoR meeting) had 88 representatives from 6 colleges and universities, 4 K-12 schools, 2 national laboratories and 4 other agencies/organizations.

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 is included in Appendix C.

Project Description: Diversity and Broadening Participation

Table 3. Collaborations with others OUTSIDE NM EPSCoR (not participants) Year 4

Component	NM Institutions	External Institutions	# of Individuals
Acequia Interdisciplinary Research	10	4	27
Climate and Hydrology Research	11	9	13
Cyberinfrastructure	2	8	23
Diversity	0	3	3
K-12 Professional Teacher Development	6	0	6
Public Outreach	17	1	19
SEED Awards	5	0	10
State Office Management	1	0	1
Water Quality Research	4	0	9

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) conducts 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.

Nearly 200 researchers and educators from New Mexico, Nevada, and Idaho gathered for the 4th Annual EPSCoR Western Consortium Tri-State Meeting in Sun Valley, Idaho on April 3-5, 2012. 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 12 concurrent sessions, keynote speakers, and a highly regarded student poster competition; the full agenda is available in [In addition, there were Working Group meetings and workshop on Hydrologic Information Systems, Climate Modeling, and Systems Modeling, and C4D Educational materials. Presentations and electronic versions of 65 posters are available for viewing on the Tri-State Meeting website. Specifically, several cyberlearning sessions were](#)

Project Description: Diversity and Broadening Participation

offered including: Engaging Pre-and In-Service Teachers in Climate Change Literacy; a Cyber-Learning Panel; Nevada's Climate Change Cyberlearning Curriculum Development: History, Findings, and Future; Climate Education Resources; and Infrastructure for Cyberlearning. Faculty from within and outside the Cyberlearning Group presented at these sessions.

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 two IWGs in Year 4 of the project: *Carbon and Nutrient Dynamics in Semi-Arid Ecosystems* and *The Role of Downscaling Methods on Climate Impact Modeling in Complex Terrain*. 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 hosted a summer 2011 workshop on Parallel Computing. In June 2012, the Consortium will be offering an interdisciplinary modeling course and NM State University that is modeled on a highly successful course that was offered in summer 2010 in Nevada. 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 2012 workshop there were 3 participants from Idaho and 3 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

In Years 1-3, NM EPSCoR partnered with The Northern New Mexico Network for Rural Education (NNMN) to plan and deliver the RII 3 teacher professional development component. In Year 4, the Network underwent internal transitions, as a result of which the organization was no longer able to carry out its contracted work with NM EPSCoR. However, the consultants employed by the Network were able to continue their work through professional service contracts with the NM EPSCoR office. These consultants have personally 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 Summer Teacher Institute is 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. Over the course of the grant to date, over 50 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 2012; 4 of them (27%) are URM.



Image 4: Participants of the 2011 Summer Teacher Institute

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, 2011 teachers participated in a weekend workshop using Project Wet materials. In Spring 2012, an

Project Description: Workforce Development

EPSCoR faculty researcher led a one-day workshop for both past participants and the teachers selected to attend the upcoming summer (2012) institute. The combined session focused on conducting field experiments related to water chemistry. Expectations and plans for the upcoming summer were presented and past participants shared their experiences in the institute. The Summer Institute has resulted in a community of learners in which teachers from around the region are able to support each other in their classroom implementation.

Impacts/Outcomes

The NM EPSCoR external evaluator conducted an evaluation of the Year 3 Summer Teacher Institute (included in Appendix P). He found:

Overall, the PDTP program was successful at providing participants with hands on science research skills and knowledge. It was less successful at accessing the NM EPSCoR climate change researchers, data and models being developed by our own New Mexico scientists.

In order to strengthen the connection between EPSCoR science and the summer teacher institute, two research graduate students have been involved in the planning of activities for this summer (2012) and will attend part of the institute. In addition, Dr. Edward Martinez, an EPSCoR researcher from NM Highlands University, has led the follow-up workshop in the spring of 2012.

NM EPSCoR was able to support three teachers to conduct overnight field trips with their classes to the Valles Caldera National Preserve as a follow-up to the Summer Institute. These teachers reported the experience was a valuable learning experience for their students.

Implementation of curriculum has not been systematically evaluated, but teachers did provide some testimonials that are included as Appendix Q. Below is one example:

I was a participant for the very first Valles Workshop. Today, that is still the top professional development training I have had. I not only was able to be immersed into a rare ecological setting, I was able to network with other teachers that had similar interests and scientists who had the latest in research. I have utilized the activities and data collection methods in my classes and have even taken kids to visit the Valles. I will be teaching a high school Environmental Science course this coming year and am looking forward to using all I learned during my visit to the Valles.

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)

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.

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. Required application materials include 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.

2012 UROP Participants

Ten students were selected to participate in the 2012 UROP Program, as follows: 6 males and 4 females. Four of the students are Native American and two are Hispanic. Students attend six primarily undergraduate institutions: Navajo Tech, NMSU-Grants, Clovis Community College, Santa Fe Community College, Southwestern Indian Polytechnic Institute (SIPI), and UNM-Taos.

Program Activities

Ten UROP students will participate in five research projects hosted at various NM-EPSCoR research institutions across the state. 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 the end of July. Student participants will present their research results to an audience of faculty, graduate students, peers and the public.



Image 5: 2011 UROP Participants

4. Cyberinfrastructure

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

NM Cyberinfrastructure Activities

Year 4 EPSCoR Track 1 CI development activities concentrated on four key areas of work: continued development of key system components, 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, focused integration of research data products into the developed data management system, and establishing new collaborations and projects that build upon and will improve the CI capabilities developed.

Development and Deployment of Key CI Components

The continued development of the EPSCoR Climate Data Portal (Figure 3) as an operational element within the broader NM EPSCoR portal has been a continuing activity during this project year. The data portal is based upon an underlying, custom developed geospatial data and information management and delivery platform (Figure 4) designed from the ground up to provide efficient and scalable data management for the diverse data being generated by, and delivered to the EPSCoR community. Specific capabilities available through the data portal include: data discovery via a variety of methods (thematic keywords, date of last update, free text within dataset titles, measurement type, time period, and spatial searches based upon geographic place names, topographic quadrangle names, and through a map interface), 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).

These capabilities are built atop a core set of standards-based web services that are published by the developed platform (Figure 4) for integration into a variety of applications, both web-based and desktop (i.e. desktop GIS, Google Earth, statistical/analytic).

In parallel with the development of the portal and underlying platform, New Mexico continued to host its reference HydroServer instance (containing historic ET Tower data as a test dataset) as a component with both the New Mexico data ingest workflow and as an evaluation platform for comparison for the HIS/Water OneFlow service capability that is being built atop the custom project data portal platform.

Additionally, in addition to historic data already obtained from NRCS for the Snotel and SCAN data collections, EDAC has developed a system for the automated retrieval of new SNOTEL and SCAN 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 state's data also supporting our Tri-State EPSCoR partners in their work).

In addition to data management capabilities within the portal, continued progress has also been made in the area of metadata. Specifically, in support of planned 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 continuing to evolve systems for automated processing of the existing tens-of-thousands FGDC XML metadata

records in the portal into corresponding valid ISO metadata, and development of template-based metadata creation tools for bulk metadata creation in support of researcher data integration into the EPSCoR Data portal.

Computer hardware capacity has also significantly improved through the addition of the UNM Research Storage Consortium storage system (a 280 TB tiered storage system) to the pool of available storage capacity. Additionally, a new cluster of 5 database servers has been acquired in support of the GStore data portal platform (upon which the EPSCoR data portal is built), enabling the deployment of a new document-based database capability for observational data (based upon the MongoDB platform) and an expansion of the current PostgreSQL/PostGIS database capacity.

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/maintained by the NM EPSCoR project during the current project year are listed in Appendix R.

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 such as the geo.data.gov system and the GEOSS data registry.

Data/metadata Exchange and Technical Information Exchange

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:

- New Mexico has established an HIS instance for the initial capture and documentation of point time-series data into the HIS service model. This HIS instance provides one path for the ingest of data into the NM EPSCoR data portal while also providing publication and discovery through the CUAHSI network.
- Initial ingest of historic SNOTEL and SCAN data from the NRCS servers (representing over 470 million individual measurements) has been completed, providing data download of individual station data via web interfaces. These data will periodically be 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 metadata training for over 15 years. This year EDAC organized an ISO 19115 training session (held at UNM's LTER Network Office computer lab) in which a team from NOAA provided metadata training to a combination of EPSCoR Tri-State and LTER participants.
- Karl Benedict (Director of EDAC, and CI lead for NM'S RII-3 Track 1 project and for the Tri-State Track-2 project) 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.

- Through face-to-face meetings at the bi-annual meetings of the ESIP Federation and continued annual meetings 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.
- EDAC has served as a regional point of contact for a high-demand LiDAR data collection that was obtained through the Critical Zone Observatory program, handling incoming data requests and coordinating with the CZO project collaborators to obtain permission for limited distribution of these data while they are still under an embargo for general release.

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.

A third dimension of sustainability for the EPSCoR funded CI developments is the increased integration of the developed system into a growing list of national Earth science information networks through the expansion of the supported service interfaces implemented for the system. The planned addition of DataOne and CUAHSI Water OneFlow service interfaces to the developed data platform will contribute the increasing value and flexibility of the platform, enabling more opportunities for obtaining additional support for the continued evolution of the system's capabilities. Furthermore, the collaboration between the New Mexico CI team and the CZO project focused at the Valles Caldera for the distribution of LiDAR data has the potential to build a relationship that we look forward to expanding in the future as new opportunities arise – again building upon the capabilities developed through the current EPSCoR project.

The final aspect of sustainability relates to the strategic identification of funding opportunities that build upon the developed system capabilities, but expand them in directions that keep the system moving forward as data discovery and access models evolve. In particular, two recently funded projects (NASA ROSES 2011 ACCESS and NSF CI-TEAM) both focus on leveraging the existing data platform and beginning the expansion of its capabilities to include the capture and representation of data provenance information, both as components that may be embedded within ISO metadata and using emerging semantic web data models.

CI Outreach

Data Portal Teacher Advisory Group

The Data Portal Teacher Advisory Group was convened in Fall 2011 to provide advice to NM EPSCoR about how to make the data portal more accessible to teachers and students. Over the course of two conference calls and two face-to-face meetings, the group of 14 educators looked at a number of other data portals, investigated data tools, and made recommendations about features they would like to see incorporated into the EPSCoR data portal.



5. External Engagement

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.

Outreach to the General Public/Stakeholders

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

NM EPSCoR has partnered with The New Mexico Museum of Natural History & Science (NMMHS, or Museum) to provide public programming and a museum exhibition focused on climate science. The exhibition, *Degrees of Change, New Mexico's Climate Forecast*, opened in May 2011 and will be maintained well beyond the period of this grant. The New Mexico Museum of Natural History and Science is 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." With an annual visitorship of approximately 200,000, the impact of this exhibit is anticipated to be quite large.

Since the opening of the exhibition, NM EPSCoR has supported the Museum in conducting an evaluation of the exhibit's components and developing plans for making improvements. Elsa Bailey, a member of the NM EPSCoR External Advisory Council and an expert in evaluation of informal science education programs, acted as a consultant to this evaluation process in collaboration with NM EPSCoR's external evaluator. Dr. Bailey helped the Museum develop visitor surveys and trained Museum staff in exhibition evaluation techniques that will enhance the Museum's capacity to conduct similar assessments on other Museum exhibitions. Improvements to the *Degrees of Change* exhibit include installation of more effective and efficient lighting, Spanish translations of the video components and changes to text panels to enhance effectiveness for visitors of all ages.

Town Hall on New Mexico Fire and Water

NM EPSCoR is partnering with NM First to convene a Town Hall Meeting that will focus on the impacts of drought-enhanced fires, such as the Las Conchas Fire, on water and other NM resources. The Town Hall, scheduled for June 5-16, 2012, will begin with a few speakers who will help set the context, but the bulk of the two-day

meeting is comprised of small group discussions among participants who care about the issues and want to create practical recommendations for change. Prior to the Town Hall, participants received a background report that was authored by NM EPSCoR researchers; this report outlines the key issues and serves as a basis for discussions held during the town hall. One hundred participants have registered for the Town Hall.



Acequia Associations

As described above, students and faculty 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. An IWG (page 45) focused specifically on engaging members of acequia associations into the research efforts in northern New Mexico.

Weather Instrumentation Training

Researchers at NMSU offered a two day course on “Weather and Climate: instrumentation, monitoring, data QC and application in water resources” for the Navajo Hydrology group and associates. Eleven people participated in the training (3 from NAPI, Navajo Nation; 6 from Department of Water Resources, Navajo Nation, 1 from Water Resources Department, Flandreau Santee Sioux Tribe, South Dakota).

Environmental Literacy Plan Kickoff

NM EPSCoR partnered with the Environmental Education Association of NM (EEANM) to host a meeting in Santa Fe on January 5, 2012 to kick-off the Environmental Literacy Planning process. Fifty-seven people who represented the most experienced and dedicated environmental educators and teachers in the state participated. The NM State Land Office co-hosted the event and Commissioner Ray Powell gave the keynote. Representatives from state and federal government as well as the NM Public Education Department attended. The kick-off led to a series of additional planning meetings around the state; the Environmental Literacy plan is expected to be completed by summer 2013.

Climate Masters

NM EPSCoR is supporting the Santa Fe Watershed Association to coordinate a session of New Mexico Climate Masters during the summer 2012. Up to 25 participants will be selected to attend the 30 hours of programming occurring over a 10-week period. This program is being offered free of charge and participants will be required to complete at least 30 hours of community service before they receive the title of “Climate Master.” The community service can be a combination of planned activities offered by the Santa Fe Watershed Association including river cleanups and tree plantings, and self-created outreach projects approved by the Education Director.

The curriculum focuses on climate change and water issues, specifically how recent and current forest management in the Upper Santa Fe Watershed, including prescribed burns, forest thinning, and reservoir management have increased the health of forests and will help protect our watershed from catastrophic wildfires. Weekly, expert guest speakers will provide an in-depth presentation in one of the topic areas. The Santa Fe Watershed Association Education Director will provide activities to reinforce the concepts shared that day. Participants in this program will also be taken on a field trip into the Upper Santa Fe Watershed to witness first-hand the efforts already undertaken to protect the watershed. In addition to distributing Climate Masters handbooks, *A Great Aridness: Climate Change and the Future of the American Southwest* will be used as supplementary reading and Bill DeBuys will be the expert speaker for the last class session.

Outreach to K-12 Students and Teachers

Ecology Field Program for K-12 Students

The Sandia Mountain Natural History Center (SMNHC), an informal education center jointly run by the NM Museum of Natural History and Science and Albuquerque Public Schools, carried out NM EPSCoR-supported outreach activities. The SMNHC uses student-led research as a primary vehicle for teaching about ecosystems and climate change. Students have done research on

topics such as forest health, air quality, species diversity and dendrochronology.

Through EPSCOR funding, the SMNHC reached approximately 8,000 students with field-based, hands-on education about climate change, the human impacts on ecosystems and how ecosystems work. This education was centered on students in the Albuquerque area but also reached communities such as Silver City, Grants, Gallup, Belen, Los Lunas, Rio Rancho and Moriarty. About 67% of the students reached with this programming were underserved minorities.



Image 6: Students in the Ecology Field Program at SMNHC.

The Museum also upgraded the Visitor Center at the Sandia Mountain Natural History Center and added an exhibit on global climate change. This new exhibit will reach an additional 2,000 - 3,000 New Mexicans through public programming at the SMNHC.

In August 2012, the SMNHC will be the site of this year's BioBlitz--a day of natural discovery and citizen science. Throughout the day, scientific experts will lead walks to explore the mountain ecosystem and find different groups of living organisms. An emphasis will be placed on linking current and predicted climate change impacts on species and ecosystems.

GUTS Teacher Professional Development

Project GUTS (Growing Up Thinking Scientifically (<http://www.projectguts.org/>)) is a summer and after-school science, technology, engineering, and math (STEM) program for middle school students. NM EPSCoR has supported the expansion of GUTS through its Track 2 award. This year, we leveraged additional institutional funding to support four one-day professional development workshops in two locations (Santa Fe and Las Cruces) to prepare club leaders, facilitators, and student mentors to implement the Project GUTS unit for the upcoming semester and/or help student teams on their projects for the Supercomputing Challenge. A total of 123 teachers participated in the workshops.

Project GUTS Club

Project GUTS offered a Project GUTS Club for 12 GUTS y Girls alumnae. The goal was to offer a girls only club environment for girls to continue to deepen their understanding of complex systems and build their skills as computational modelers. Participants in the club ranged from 12 to 14 years old. All were past participants in the GUTS y Girls program and three had also participated in the Project GUTS program in prior years. Sixteen club meetings were held between September 24th, 2011 and April 21st, 2012. Each Saturday club meeting ran for two hours from 10:00 am – 12:00 noon. The GUTS club for GUTS y Girls alumnae provided social and technical supports for girls interested in computing and technology. The mixture of social and computing time further supported the growth of girls' confidence and the appeal of STEM/computing as a career and/or educational goal.

Scientifically Connected Communities, GUTS, and Supercomputing Challenge

Researchers from NMSU have collaborated with Scientifically Connected Communities (SC2) to provide summer teacher institutes in the Las Cruces area. The theme for the 2012 Institute is "Making Meaningful Connections." NM EPSCoR researchers will contribute presentations on satellite sensor imagery, mapping snow and the importance of the annual snowpack in the Upper Rio Grande. SC2 has also been collaborating with the Supercomputing Challenge and Project GUTS to provide opportunities for Las Cruces area students to learn how to create computer models to answer scientific questions. NM EPSCoR funding has been used to help recruit GUTS coaches and organize professional development workshops and student Roundtable events to support the growing computer modeling community in southern NM. Project researchers have made presentations at a variety of Project GUTS/Supercomputing challenge activities and NM EPSCoR sponsored a Supercomputing Challenge prize for a student project related to water research.

Project Wet Teacher Workshops

In partnership with the Environmental Education Association of NM (EEANM), NM EPSCoR supported three Project Wet workshops for K-12 teachers, held in locations around the state: Las Vegas, Farmington, and Las Cruces. The workshops focused on activities and materials for teaching about watersheds and the impacts of climate change on mountain sources of water. In total, 54 teachers participated.

Children's Books

NM EPSCoR partnered with Earth's Birthday Project (www.earthsbirthday.org) to publish and provide 3000 copies of *Otter Water* and 6000 copies of *The Lovejoys' Most Marvellous Pond* to primary grade students throughout NM. These picture books strive to inspire NM children and their families to care for our endangered rivers. In both books, families were introduced to the theme of how precious river water is. In addition, they were encouraged to conserve water at home and to collect coinage that would purchase water for our rivers. Classrooms that collected \$20 from families received butterflies and family packets of Giant Sunflower seeds for planting at home.



Las Cruces Water Festival



Image 7: Students at the Las Cruces Water Festival

NM EPSCoR researchers participated in the "Las Cruces Water Festival" on March 15, 2012. Students from NMSU set up a booth and presented model kits on energy production from wind and water, a thermo infrared camera and its use in water resources application, and physical properties of water demonstrations to children. NMSU participant provided transportation for 1000 third and fourth grade students to attend the festival.

Outreach to Higher Education

Becoming the Messenger

In April 2012, NM EPSCoR hosted NSF's Science: Becoming the Messenger workshop. Approximately 80 faculty, students and public information officers attended the first day of the workshop and 14 were selected to participate in Day 2.

Proposal Planning Workshops

In preparation for developing the next RII proposal, NM EPSCoR held three community engagement meetings over three months in the fall of 2011. Nearly 100 faculty attended the meetings at which they learned about NSF EPSCoR, generated ideas for the science focus of the proposal, and initiated collaborations to develop the science and education components of the proposal.

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 6-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 Board met in November 2011 in Santa Fe, NM; the members of the EAB are listed in Section 8 (Management Structure). The EAB's summary statement commended NM EPSCoR's progress:

The EAB highly commends the New Mexico EPSCoR Team for their very significant progress in a very complex and diverse program over the last three years, especially in Year three. The program has methodically put in place the key components for a long-term sustainable capability critical to New Mexico's future. Year one was spent acquiring and installing physical infrastructure; Year two built a community of faculty and students, and Year three focused strongly on the science both in research and education. The EAB was particularly gratified to see that the leadership team clearly focused on issues identified in the year two EAB meeting and made very significant progress in articulating the scientific focus and major progress in developing an effective cyberinfrastructure.

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

1. *You have done an excellent job articulating the scientific focus and potential value to New Mexico in the leadership team. This vision needs to be more broadly imbibed throughout the New Mexico EPSCoR network. If this is done well, then it will be a major component for ensuring sustainability of the RII initiatives. This can be accomplished through:*
 - a. *Using the scientific focus as the framework and theme for the upcoming annual meeting; ensure that the scientific focus and impact are components of any other major network meeting.*
 - b. *In addition to describing the EPSCoR network by infrastructure category (as currently done on the New Mexico EPSCoR web page), showing how the network, particularly the scientific leaders, align with the science focus (e.g., develop an organization chart using science focus).*
 - c. *Developing a road map of programs organized by scientific focus and impact.*

NM EPSCoR Response

The NM EPSCoR leadership followed recommendation 1.a. in planning the agenda for the 2011 All Hands Meeting. We also discussed the scientific focus and impacts of the project at a state-specific session at the 2012 Tri-State Meeting. There were 44 NM EPSCoR participants in attendance, half of whom were students. In response to recommendation 1.b., we created a visual representation of the alignment of the NM EPSCoR researchers with their science focus. This appears on page 10 of this document.

2. *Year one focused on physical infrastructure, year two and three focused on achieving collaboration among people who rarely previously worked together and getting the CI engine in place. We recommend that you consider developing a number of formal training*

opportunities on the systems in place to maximize their full potential. Specifically we recommend:

- a. Training on Data Portal system capabilities*
- b. Training for young faculty and grad students on publications*

NM EPSCoR Response

The CI team, led by Karl Benedict of the Earth Data Analysis Center (EDAC), provided training on the Data Portal system capabilities at the 2012 Tri-State meeting. In addition, his team has worked with researchers individually so their data can be imported and the system used productively by researchers. A teacher advisory group met throughout the year and learned how to navigate the portal system as one component of their focus on how to make the data useful for K-12 education. In response to recommendation 2.b., the Management Team discussed how to better leverage the training opportunities already provided by the research universities for student publication. A list of those opportunities has been created and will be updated and shared with students and faculty on a regular basis.

- 3. Start to develop a road map of sustainability. Define the key RII products; show where they will reside and how they will continue after the current RII is complete.*

NM EPSCoR Response

This is being developed. A table of physical infrastructure purchased through the project with its location and how it will be maintained/sustained is nearly complete. Other project activities/products, such as education and outreach components, will be added into complete document that will be completed in summer 2012.

- 4. Consider expanding the support for education and outreach (now only 8-10%) building on success at NMHU. One very specific recommendation is to work with the NMHU leadership to find a way to continue/grow support for the research and education efforts developed by Dr. Edward Martinez.*

NM EPSCoR Response

Through leveraging institutional funds and collaborating with community partners, NM EPSCoR has been able to increase its support of education and outreach efforts. These activities are described in section 5 of this report. Dr. Martinez has been successful in acquiring additional funds to support his research and education efforts at NMHU.

- 5. The EAB believe that NM EPSCoR is understating the RII impact as demonstrated by grants and publications. These measures should be based on the EPSCoR communities developed through all the RIIs, not just those involved in the current project. We urge you to check, and if appropriate, upgrade the parameters you are using to measure EPSCoR success (e.g., are you claiming credit for grants and publications from RII-1&2 as well as the current RII-3?).*

NM EPSCoR Response

NM EPSCoR Management is working with the project's external evaluator to compile a more comprehensive list of EPSCoR grants and publications, including those related to previous RII awards.

- 6. The EAB urges the leadership team to place a high value and priority on publication of peer reviewed articles both from the current and previous RII projects.*

NM EPSCoR Response

NM EPSCoR Management has continued to express the high value placed on publication in all meetings with students and faculty. The number of publications has increased (see Template E).

- 7. Explore the potential to leverage the value of the mobile water quality analytical lab (Mike Pullin's van) beyond the scope of the current RII project. Does the design have any intellectual property value and ultimately commercial application? Are there other scientific programs that would benefit from this technology?*

NM EPSCoR Response

The mobile water quality analytical lab is still in its initial implementation/testing phase. Once this phase is complete, consideration of its potential commercial application will be done.

- 8. Reorganize and support where possible the programs that are lacking current leadership (e.g., the museum program and the program at Dine College.)*

NM EPSCoR Response

The Museum has recently hired a new Director who has become very engaged with NM EPSCoR. With his leadership, the evaluation of the Museum exhibition has been completed and new opportunities for additional collaboration are being pursued. A member of the faculty at Dine College has been identified to carry out the activities of the Infrastructure Seed award.

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 in May 2012. NM EPSCoR invited AAAS to conduct an external evaluation of the program and requested that the panel assist NM EPSCoR review potential science concepts for the next EPSCoR RII (Track 1) proposal. We are now awaiting the panel's report.

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 Program (JFLP), K-12 Teacher Summer Institute, the All Hands Meeting, and NM Innovation Working Groups (IWGs). These reports were used to make program improvements in Year 4 and are described in other sections of this report.

Minnick also prepared an overall Year 3 Evaluation Report, which is included as Appendix L. In it, he summarizes:

Overall, NM EPSCoR is on schedule and following the strategic plan developed in Year 1 of the project. There have been minor changes in activities as the research and outreach developed but no significant changes that would warrant a change in project scope or impact. There is considerable 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.

As the project moves towards its final two years, it is important to revisit the strategic and evaluation plans to ensure that the project will complete all its deliverables and be able to document what it has accomplished. A strategic planning session immediately prior to the

annual reporting process may result in the best outcome for both the annual report as well as the strategic plan.

Recommendations for specific components are reported in the relevant sections of this report.

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 4.

Table 4. Year 3 NM EPSCoR Science Presentations

	2010 Number	2011 Number	2012 Number	Change (Yr 2 - Yr 4)
Invited Talk	20	13	17	-3
Panel	3	2	1	-2
Conference Presentation	12	42	64	+52
Poster	19	39	41	+22
Total	54	96	123	+69

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. Three ISG awards were made in Year 4:

Eastern NM University: Tracing the Impacts of Prehistoric Climate Change: Eastern New Mexico's Water Resources across the Pleistocene-Holocene Transition

The project provides undergraduate students the opportunity for classroom, field, and lab-based educational experience in paleoclimate studies. Students will investigate hydrologic and ecological variation relative to climatic changes at the end of the last Ice Age. In two complementary 8-week classes, students learn to investigate hydrologic changes through reconstructing past depositional environments, to investigate corresponding ecological changes through the collection and analysis of paleo-environmental data, and to report results in a scholarly format. As the Pleistocene-Holocene transition represents the most recent analog to modern global warming, a better understanding of its effects stands to provide information relevant to understanding and

anticipating changes to New Mexico water resources as a result of contemporary climate change. Blackwater Draw Locality 1 provides a record of changes in surface water due to changing environmental conditions over the past



Image 8: Students analyze sediment samples in ENMU's new geoarchaeology lab.

Project Description: Sustainability and Outcomes

15,000 years, and provides an ideal venue to offer students experience in the scientific investigation of climate change.

NM Highlands University: Synergistic effects of climate change and invasive species on native fauna in a highland aquatic ecosystem.

As climate change progresses, the impact of these changes in New Mexico is expected to produce increases in temperature and longer and more intense droughts. These increased droughts create new stresses on local fauna and flora and in particular have the potential to intensify negative impacts of invasive species on native species. This project will evaluate the impact of a predominant introduced aquatic species, the American bullfrog, on native aquatic vertebrates in Northeastern New Mexico in relation to heightened droughts. This research is part of a collaborative effort between several faculty members at New Mexico Highlands University (NMHU) and Wind River Ranch and provides numerous opportunities for training minority undergraduate students in several STEM disciplines.

UNM-Los Alamos: Bringing Climate Research to UNM Los Alamos: Development and Infrastructure Improvement for the Environmental Science Program

UNM Los Alamos (UNMLA) is developing a new Environmental Science (ES) program with emphasis on earth systems science and climate change that will include hands-on field experiences and research opportunities for our undergraduate students. The environmental course offerings will include American Meteorological Society based courses and will emphasize an integrated thematic instructional model that carries our environmental theme into cross-curricular core subject classes. With this proposal, we will initiate a new, enhanced program of studies with a flagship research component centered on climate change and its impact on our regional water resources. We will investigate local microscale and mesoscale climate fluctuations focusing on annual precipitation studies and models using proxy data primarily derived from tree ring analyses. Students will study the periodicity and severity of highly localized drought/wet cycles and will make projections on the future availability of local water resources and the periodicity of heightened fire threat conditions. A key component of this project is for a suite of modern instrumentation necessary to achieve high-quality research work and to increase UNMLA's capacity to provide research experiences for our students.

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)

Project Description: Sustainability and Outcomes

- 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 4 IWGs are listed below; complete reports are available at the website above.

Connecting Communities: Engaging Stakeholders in Research. Lead: Dr. Caiti Steele, NM State University

The primary goal of the "Connecting Communities" Innovation Working Group was to create innovations in communication at the interface between natural and social science related to acequia community hydrology, ecology, culture and economics. It was also agreed that involving the acequia communities in this IWG would be critical for (i) reaching integrated understanding of the systems; (ii) bringing together academic disciplines and (iii) creating useful extension products for those most affected by this research.

Climate Change, Agriculture, and Water Policy. Lead: Professor Denise Fort, University of New Mexico School of Law



Image 9: Climate Change, Agriculture, and Water Policy IWG

The ultimate goals of this IWG are to develop ideas that could lead to a proposal to NSF on water policy and to develop other scholarly and academic benefits from our collaboration. To that end, the following were intermediate workshop goals:

- Identify research questions in order to be addressed in upcoming NSF proposals, using the expertise of all present;
- Discuss current/previous research of all participants to determine effective collaborations;
- Create a white paper based on previously identified research questions.

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

Project Description: Sustainability and Outcomes

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.

Designing an online Professional Development Network for Project GUTS. Lead: Dr. Irene Lee, Santa Fe Institute

The goal of the IWG was to design the online professional development network that was capable of supporting and nurturing teachers to become computationally enabled STEM teachers confident and practiced in implementing computational science curricula and developing the expertise of our community such that members of the community can help each other. The IWG was focused on answering a set of four guiding questions:

1. What are the specific needs of teachers who act as club leaders that are not met through teacher professional development workshops?
2. How might these needs be met with an online network and Web 2.0 tools?
3. Which existing tools/platforms fit the needs, capabilities, and technology access of teachers?
4. Which user interface design elements or metaphors will provide teachers with quick access and ease of use of materials and functions on the network?

Carbon and Nutrient Dynamics in Semi-Arid Ecosystems. Lead: Dr. Marie-Anne de Graaf, Boise State University

This IWG included seven faculty and students from BSU, DRI, and NMSU. The primary goal of the "Carbon and Nutrient Dynamics in Semi-Arid Ecosystems" Innovation Working Group was to write a review paper addressing the uncertainties associated with soil C cycling in semi-arid and arid ecosystems in the northern hemisphere, and to use this paper as a foundation for development of a competitive proposal to be submitted to the National Science Foundation. The participants are in the process of writing a review paper, which should be completed this summer 2012. A pre-proposal was submitted to the NSF, Carbon dynamics in arid ecosystems: mechanistic responses to climate variability and climate change from microsite to landscape scales, in response to the RFP: DEB-Ecosystem Studies. If accepted, a full proposal will be written that sets out to evaluate how changes in precipitation will affect carbon cycling processes across desert ecosystems.

The role of downscaling methods on climate impact modeling in complex terrain. Lead: Dr. John Abatzoglou, University of Idaho (awaiting final report)

This IWG spurred an effort to quantify the fractional uncertainty of climate change projections at local scales due to the choice of downscaling method. The group is conducting a coordinated inter-downscaling comparison building off the downscaling methodologies developed within the Tri-State consortium, and will be applying these data to both hydrologic and ecological models to better contextualize the choices of downscaling methods for assessing climate impacts in complex terrain. The IWG was designed to better address this gap in scientific knowledge that has both theoretical and practical implications, and to increase synergy between groups in the Tri-State consortium in preparation for the next round of models created for the fifth assessment report of the Intergovernmental Panel on Climate Change.

Sustainable Native Communities

As an innovative project, NM EPSCoR is partnering with the Global Center for Cultural Entrepreneurship (GCCE) to cultivate a network of tribal leaders, entrepreneurs, and entities

interested in supporting the launch and sustenance of the Sustainable Native Communities project. NM EPSCoR worked with GCCE in its Track 2 project to provide computer training for small business entrepreneurs on the Navajo Nation and Ohkay Owingeh pueblo. During that project GCCE established important connections in these tribal communities. The long-term goals of the partnership are to equip communities with the skills and resources to implement planning, design, and construction processes that more effectively address environmental, economic, and cultural challenges and opportunities. The project will also launch the nation's first Sustainable Native Communities Initiative in 2013. These goals will be primarily accomplished through research, community engagement and network building. Additionally, specific tools and resources will be created to support community engagement and small businesses.

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 fourth 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, 2012, 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 nineteen participants from eleven 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.



Image 10: Participants in the 2012 Junior Faculty Leadership Workshop work collaboratively on leadership and communication activities.

Highlights of the 2012 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.
- Carl Moore, from The Community Store, modeled several effective facilitation strategies and

Project Description: Sustainability and Outcomes

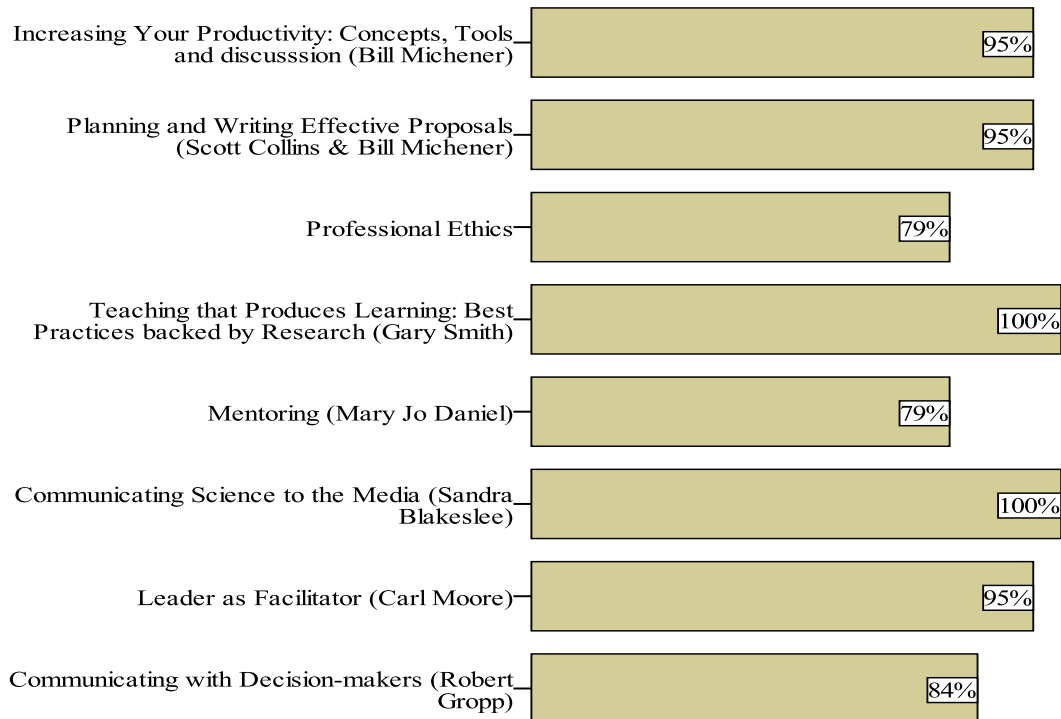
processes while providing a context for participants to think carefully about their own leadership styles, priorities, and professional goals.

- 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
- 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, provided insights into successful proposal writing.
- Mary Jo Daniel, NM EPSCoR Associate Director, led a session on Mentoring, drawing from *On Being a Mentor: A Guide for Higher Education Faculty*, by W. Brad Johnson.

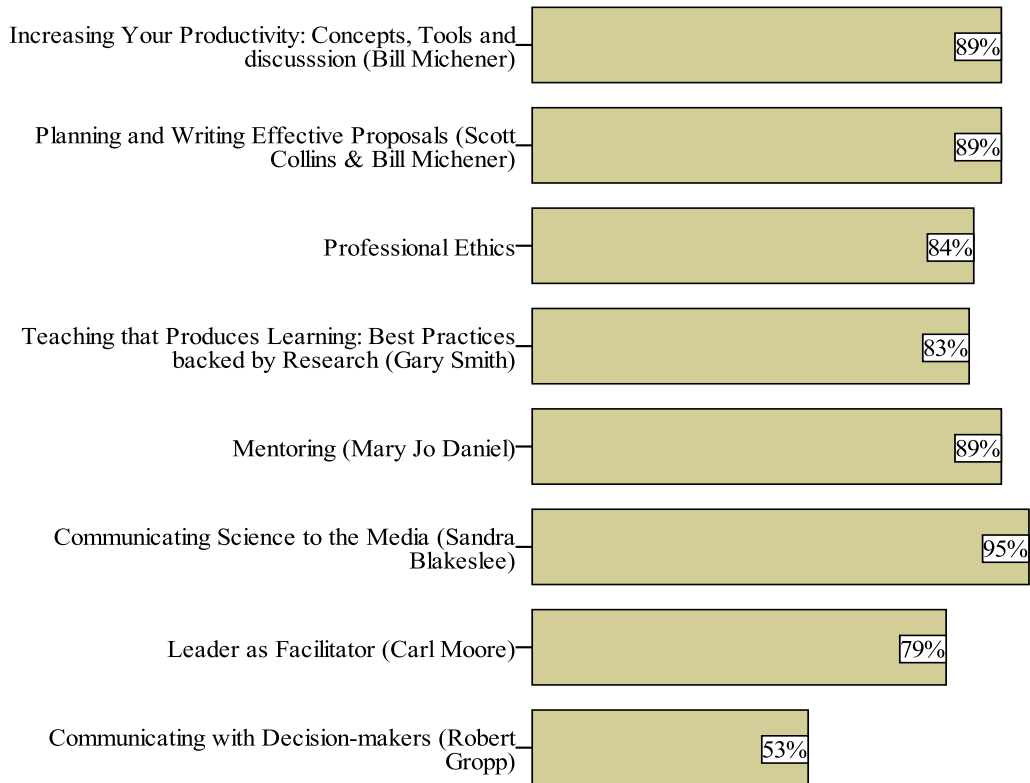
Impacts

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. Two of the key graphs from the Jr. Faculty Leadership Workshop Evaluation Report (Appendix T):

Session CONTENT Meeting Program Goals Percent of Respondents Rating as Excellent ('4' or '5')



**Session PRESENTATION Meeting Program Goals
Percent of Respondents Rating as Excellent ('4' or '5')**



Sample Participant Comments:

"The sequestered environment during a down time of the year with the perfect number of diverse colleagues was perfect. This workshop filled a need I didn't fully realized I had! But now that I have it, I feel I now have significantly great capacity and access to helpful tools. I plan to lead a few lab meetings with my group so I can disseminate some of the knowledge and tools to my own group, which I'm really excited about too. Day one (productivity, proposals, teaching) was especially great covering topics which many of us really haven't had access to formal training in".

"Communicating science to the media and to decision makers - both the media presentation and the decision makers presentation will be useful at all levels, from convincing my chair to my neighbors that what I want to do is worthwhile and has a broad impact."

"It is obvious that this program has already had the benefit of honing and improvement. A couple minor suggestions: 1) a chance to go outside and exercise/hike. A group trip to the caldera might have been nice -- and we could have worked later into the evening to recoup the time. 2) Not having phone was not a bad thing, necessarily. However, poor Internet access was a bit frustrating during the evening when I was trying to keep on top of other work."

Based on the evaluation report, NM EPSCoR Management is working to incorporate a session on work-life balance as requested by participants.

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

NSF Day

New Mexico EPSCoR hosted "NSF Day" in Year 3 of the award 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.

In Year 4, the external evaluator distributed a one-year follow-up survey to NSF Day attendees who had responded to the initial evaluation survey administered immediately after the event. He is completing the analysis of that survey, but provided quotes from participants:

This event opened up new opportunities and more importantly gave me a few more strategies that I didn't know about before going to NSF Day.

From the workshop, I understood that it is better to submit first white papers. So, this is what I did and found appropriate programs to submit full proposals... I also established collaboration with NSF as a panel reviewer and participated twice in reviews.

I have a much more clear understanding of the structure of the NSF, and how to choose an appropriate office for project funding. The workshop was very helpful.

It was an excellent event that I've shared with others including grad students.

I have yet to have any success. Fingers crossed....

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

NM EPSCoR supported 46 graduate students in Project Year 4. These students were actively engaged in research and education activities at their home institutions, but also participated in poster sessions and presentations at the NM EPSCoR annual meeting, the Tri-State Consortium Annual Meeting, the national NSF EPSCoR meeting and numerous professional association meetings. The full list of presentations is attached in Appendix S.

Graduate Training Opportunities

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.

Interdisciplinary Modeling: Water-Related Issues and Changing Climate

In this course, offered in summer 2012 at NMSU, students will be introduced to models that are available in different disciplines and how such models might be applied together to address water-related issues regarding climate change, address issues of variability and uncertainty in implementing interdisciplinary approaches, and gain experience in working in interdisciplinary teams to apply interdisciplinary modeling approaches to increase knowledge about water-related issues regarding climate change. Students will use common software to do an interdisciplinary project regarding the New Mexico acequias project. The course is offered in

collaboration with Idaho and Nevada EPSCoR and builds upon a similar course, *Interdisciplinary Modeling: Water Related Issues and Changing Climate*, which was offered at University of Nevada Reno in summer 2010.

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.
- Developing the Saguache Creek model (Hydrology group) leverages an NSF project on residence time (*Dynamic Groundwater Age Distributions: Exploring Watershed Scale Subsurface Systems, Award #EAR 1015100*) and leverages previously funded work of the SAHRA Science and Technology Center.
- *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 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, Director, Dr. Mary Jo Daniel, Associate Director, Anna Morrato, Program Administrator and Megan Gallegos, Program Financial Analyst. Mary Jo Daniel assists the Director in program management and oversees project database development and data collection per NSF requested standards. Anna Morrato manages subawards and notifications in FastLane and Megan Gallegos oversees fiscal management of the project. Part-time support staff include: Laura Arguelles, Web Site Administrator; Natalie Willoughby, Public Information/ Communication; Melissa Coverdale, Administrative Support, and Arman Barsamian, Accountant. 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 4 of the award: October 2011 and June 2012. At each meeting NM EPSCoR directors reviewed project activities and discussed plans and strategies for developing the next RII proposal. Minutes from the meetings are available at <http://nmepscor.org/content/epscor-reports>. 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 November 2011 in Santa Fe, NM. Their recommendations and NM EPSCoR's response are detailed in Section 6 and their report is attached as Appendix K. Members of the EAB are listed in Table 4 below. In Year 4, Steve Semken notified NM EPSCoR that he would not be able to continue on the EAC, due to increased work demands. He was not replaced.

Table 4. 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
Amy Ward	University of Alabama
Mark W. Williams	University of Colorado

NM EPSCoR Management Team

The RII 3 project has a 15 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; minutes are available at <http://nmepscor.org/content/epscor-reports>. The Management Team is listed in Table 5; Marnie Carroll withdrew when her employment with

Project Description: Management Structure

Diné College was terminated. Jessica Sapunar-Jursich resigned from the NM Museum of Natural History and Science and was replaced by Alicia Borrego-Pierce. The Management Team is 20% URM and 40% female.

Table 5. NM EPSCoR Management Team 2011-2012

	Name	Organization
1	Karl Benedict	University of NM
2	Janie Chermak	University of NM
3	Laura Crossey	University of NM
4	Anya Dozier-Enos	NM Public Education Dept.
5	Anna Espinoza	Education Consultant
6	Sam Fernald	NM State University
7	Joe Galewsky	University of NM
8	Lorie Liebrock	New Mexico Tech
9	Edward Martinez	NM Highlands University
10	Al Rango	NM State University
11	Todd Ringler	Los Alamos National Lab
12	Bob Parmenter	Valles Caldera Nat'l Preserve
13	Mike Pullin	NM Tech
14	Alicia Borrego-Pierce	NM Museum of Natural History and Science
15	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 and funding through return of overhead costs as a cost contribution to the project. This institutional funding has been leveraged for additional education and outreach activities.

Planning Updates

No significant changes were made to the RII 3 Strategic Implementation Plan or the State's Science and Technology Plan (*Technology21*). However, a review of the Strategic Implementation Plan was conducted by the Management Team in Spring 2012; the update is attached as Appendix M.

9. Unobligated Funds

This summary provides the salient features of Year 4 financial status for NM EPSCoR.

NM EPSCoR RII 3 Year Four Funds

Awarded	Obligated	Unobligated	% Unobligated
\$3,000,000	\$3,004,313	(\$4,313)	-0.14%

Year 4 funding for the NM EPSCoR award was \$3.0 million. Obligated expenses exceed this amount through expenditure of unobligated funds carried forward from previous years. For Years 1-4 (cumulative), 4.1% of funds remain unobligated. These amounts are derived from actual expenditures, encumbrances, and projected expenditures through August 31, 2012.

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 4 Reverse Site Visit (RSV) for those areas the committee required annual updates.

Response to NSF Recommendations from Reverse Site Visit

Recommendation 1

Hold pre-town hall project coordination meetings to ensure an agenda that serves the audience and demonstrates the to-date products of the project.

NM EPSCoR leadership recognized the need for careful planning of the Town Hall to ensure that it is an effective vehicle for connecting NM EPSCoR-supported research with policy leaders, water managers, business leaders, and other members of the community. We have engaged in numerous planning meetings with NM First, the organization with whom we have contracted to organize and facilitate the Town Hall. A planning committee of NM EPSCoR researchers was formed to identify the focus of the Town Hall and draft the Town Hall Background Report, which is attached as Appendix Z. The Town Hall is scheduled for June 5-6, 2012.

Recommendation 2:

The panel advises that the universities need to do more with their faculties to enhance the climate for diversity. Once faculty are recruited, activity for retention involves development of mentoring programs (including training for mentors) and attention to faculty development of faculty members from traditional groups.

NM EPSCoR developed a *Best Practices Guide for Increasing Faculty Diversity at New Mexico Higher Education Institutions*, (http://nmepscor.org/sites/all/documents/Diversity_Plan_2010.pdf) which includes strategies to retain diverse faculty under the headings:

- New Faculty Support
- Maintaining an Inclusive Community of Practice
- Institutional Commitment to Diversity

This plan has been endorsed by the Council of University Presidents and shared with department chairs and others involved in faculty hiring and retention. NM EPSCoR Management Team members also distribute the guide at their institutions when hiring processes are initiated. The NM EPSCoR State Committee has directed project leadership to update the faculty demographics information provided in the report in order to determine data on retention of diverse faculty. This will be done as the institutions publish updated data. Furthermore, each of the research universities involved in NM EPSCoR has programs designed to recruit and retain diverse faculty. NM EPSCoR leadership shares information about these programs to encourage EPSCoR faculty to participate in these opportunities at their home campuses. The Junior Faculty Workshop, offered each year by NM EPSCoR, will continue to provide sessions that focus on mentoring and working with diverse student populations as one mechanism for contributing to a climate that values diversity at all levels.

Recommendation 3:

In their annual reports they should state a clear statement of the degree of completion on the benchmarks Strategic plan reporting.

All annual reports have been structured to align reported project activities with the 14 specific strategic objectives detailed in the Strategic Plan. Attached to this annual report is an updated Strategic Implementation Plan (Appendix M) and a chart that shows the degree of completion of the yearly planned activities delineated in the Implementation Plan as Appendix W.

Recommendation 4:

Establish and utilize during the last two years of the project a parallel interactive working relationship with partners and stakeholders.

There are several planned activities that will enhance and further develop productive working relationships between researchers, partners, and stakeholders. The Town Hall that is scheduled to occur in Year 4 (described in #1 above) has an explicit goal of connecting all of these groups. In addition, plans for the final two years of the project include increased interactions across activity areas (e.g., CI and research instrumentation) as well as continued collaborations with acequia associations and other water users. Project personnel are also establishing and extending working relationships with agencies in the use and sharing of data as well as maintenance of climate-related instrumentation. All efforts to enhance and deepen interactive working relationships with partners and stakeholders will be included in future annual reports.

Of note, one of the Year 4 IWGs (*Connecting Communities: Engaging Stakeholders in Research*) was intended to create innovations in communication at the interface between natural and social science related to acequia community hydrology, ecology, culture and economics. Involving the acequia communities in this IWG was critical for (i) reaching integrated understanding of the systems; (ii) bringing together academic disciplines and (iii) creating useful extension products for those most affected by this research.

Recommendation 5:

The program should create a refined assessment plan that focuses on outcomes to ascertain if activities/initiatives are contributing to meeting Impact Area goals. This plan should cover all Impact Areas, including Research.

The external evaluator will work with program staff to update the evaluation plan to include more detailed outcome metrics that measure all project activities/initiatives, including research. We have already begun this effort by subscribing to Student Tracker for Outreach programs from the National Student Clearinghouse to track the major, institution and graduation status of EPSCoR-supported UROP students and undergraduates/graduate students in our research programs. We are also tracking the NSF funding received by EPSCoR-affiliated faculty and post-docs to measure research competitiveness; and are looking at research.gov and other sites to capture the impact from other federal grants. We have begun a bibliographic analysis using Web of Science to measure the impact of EPSCoR funding on new investigators, knowledge generation, dissemination, collaboration and the change in national visibility of New Mexico researchers as a group in climate change, hydrology and water quality. These data sources allow us to filter by time period, so that we can measure from the beginning of the award. The outcome metrics and their implementation will be designed to provide NM EPSCoR with a series of metrics from secondary data sources that can be tracked by the project after the award is over. We have also planned a one-year follow-up survey of NSF Day attendees to

measure any change in the number and success of NSF proposals submitted since attending the event in April 2011. We have a meeting scheduled with Elsa Bailey (Elsa Bailey Consulting) to help assess the impact of the climate change museum exhibit. We have struggled with defining the outcome metrics for the educational professional development, but will continue working with our professional development providers to identify metrics that are meaningful and measurable. The above information will be included in future Annual Reports.

Recommendation 6:

The project should document the benefits of data exchange. Additional data sources would clearly be a desirable direction. The move to integration with jurisdictional libraries and their institutional repositories is strongly encouraged.

The project will continue to pursue opportunities to share relevant data with other agencies and organizations involved in related work. NM EPSCoR has recently developed a process for granting researchers access to LiDAR data collected by the Critical Zone Observatory in Jemez Springs before they are made publically available. Researchers are actively sharing data with acequia associations in northern New Mexico and an advisory group has been formed to make NM EPSCoR data accessible and useful to K-12 educators.

Data are being integrated with jurisdictional, institutional libraries as well as national repositories such as DataONE and CUAHSI. Because the EPSCoR data portal uses open standards, project data can be integrated with a broad range of repositories that can be accessed by a wide range of users.

Recommendation 7:

The Strategic Plan should be updated to address the above recommendations; including modifications to the linear operation approach to facilitate better interdisciplinary synthesis.

The NM EPSCoR Management Team met in Spring 2012 to review the Strategic Plan and update it to reflect changes as appropriate using the recommendations from the Reverse Site Visit. The team also focused on identifying mechanisms to continue and extend the interdisciplinary synthesis that is already under way. The updated Strategic Plan is attached as Appendix M.

EXPERIMENTAL FACILITIES

Year 4 Equipment Purchases				
Component	Equipment	Use	Location Installed	Supervision/ Access
Climate & Hydrology	Dionex Ion Chromatograph	The ion chromatograph (IC) enhances chemical analytical services at New Mexico Tech. The ICS-5000 offers capabilities in the measurement of anions (seven standard anions provided in general chemistry analysis) plus carbohydrates and amino acids in natural waters. The chemical data provided by the purchase of the Dionex ICS-5000 will help the hydrology research group achieve its goals.	New Mexico Tech	Wilson (NMT)
Climate & Hydrology	AGI Resistivity Meter	The resistivity meter is a multichannel AGI (Advanced Geosciences Inc.) SuperSting R8/IP Earth Resistivity/IP/SP Imaging System capable of handling 56 electrodes and imaging both 2D subsurface profiles and full 3D blocks. The system is capable of imaging to depths of 150 feet, significantly greater than visible with a GPR system. It can image lithological units, geological features like faults, the pattern of soil moisture content, the groundwater table, and chemical tracer concentrations. The system comes with a meter, switch, and ancillary equipment.	New Mexico Tech	Wilson (NMT)
Climate & Hydrology	Rio Hondo Mountain Weather Station	A fully instrumented Campbell Scientific weather station, with instruments for measuring short and long wave radiation, precipitation (Pluvio heated rain gage), temperature, humidity, wind, and soil heat flux, recorded to a data logger and connected by cell phone. Powered by batteries and a solar collector.	Taos Ski Valley	Wilson (NMT)
Climate & Hydrology	El Rito Mountain Weather Station	A fully instrumented Campbell Scientific weather station, with instruments for measuring short and long wave radiation, precipitation (Pluvio heated rain gage), temperature, humidity, wind, and soil heat flux, recorded to a data logger and connected by cell phone. Powered by batteries and a solar collector.	El Rito Watershed, mid elevation	Wilson (NMT)
Climate & Hydrology	Druck Pressure Transducers	Compensatory equipment purchased for NRCS. NRCS installed 19 pressure transducers in SNOTeL stations for NM EPSCoR	SNOTeL stations	Rango (NMSU)

Experimental Facilities

Climate & Hydrology	Campbell Scientific Data Loggers	Compensatory equipment purchased for NRCS. NRCS installed 8 loggers in SNOTeL stations for NM EPSCoR	SNOTeL Stations	Rango (NMSU)
Climate & Hydrology	Solar Panel Voltage Regulators	Compensatory equipment purchased for NRCS. NRCS installed 2 Solar Panel Volatage Regulators on SNOTeL stations for NM EPSCoR.	SNOTeL stations	Rango (NMSU)
Cyberinfrastr ucture	Computer Storage System - RSC Base System (280 TB, 3-tier system)	This storage system was purchased by the UNM Research Storage Consortium (a group of research organizations on the UNM campus that was formed to define, and obtain a shared storage system for improved research storage capacity for the participating groups) with contributions from the Earth Data Analysis Center, LTER Network Office, DataONE, CARC, and the University Libraries.	UNM CARC	Benedict (UNM)
Cyberinfrastr ucture	Database Cluster (5 high-memory servers for combined PostgreSQL/Post GIS, MongoDB hosting)	The five servers in this database cluster will support database requirements for EPSCoR and other EDAC applications - specifically in support of the GStore platform developed as a common geospatial data platform that provides services to both the EPSCoR program and other projects.	UNM-EDAC	Benedict (UNM)
Public Outreach	Sandia Mountain Natural History Center Visitor Center signage and Climate Change exhibit	The signage and exhibits will be used to educate the public about various aspects of ecosystems including climate change.	Sandia Mountain Natural History Center	Mauermann (NMMNHS)
Public Outreach	Magic Planet Projector	Magic Planet® digital video globe - the digital display with a sphere-shaped screen. The Magic Planet has a broad feature set, and it can be configured to meet the diverse needs of public, private and government organizations.	New Mexico Museum of Natural History and Science	Mauermann (NMMNHS)
Public Outreach	New Computers	Computers for graphic design team		Mauermann (NMMNHS)
Water Quality	Solinst Pressure Transducers	Measure river stages and groundwater well stages at the Valles Caldera National Preserve research site on the East Fork Jemez River.	Valles Caldera National Preserve	Dahm (UNM)
Water Quality	Mac Computer	Computer for running the Aquarius software used to do quality control and quality assurance on the continuous data generated by the YSI sondes, the Satlantic nitrate analyzers, and the CycleP phosphate analyzers	Biology Annex - University of New Mexico	Dahm (UNM)

PUBLICATIONS Year 4

Component	Citation	Publication Type	Publication Status
Climate and Hydrology Research	Frisbee, M.D., F.M. Phillips, A.F. White, A.R. Campbell, and F. Liu , The Effect of Variability in the Groundwater Component of Springflow Generation on Estimates of Solute Weathering Release from Groundwater Systems, <i>Applied Geochemistry</i> , in press, 2012.	Journal Article	Accepted - Awaiting Publication
Climate and Hydrology Research	To be published in <i>Urban Forestry and Greening</i> , volume 11 (3): Mapping Land Cover in Urban Residential Landscapes Using Very High Spatial Resolution Aerial Photographs, Caiti Steele , Salman Kofahi, Dawn Vanleeuwen, Rolston St. Hilaire	Journal Article	Accepted - Awaiting Publication
Cyberinfrastructure	Application of the Occupational Analysis of Computational Thinking-Enabled STEM Professionals as a Program Assessment Tool: <i>Journal of Computational Science Education (JOCSE)</i> in press. Irene Lee , Joyce Malyn-Smith	Journal Article	Accepted - Awaiting Publication
K-12 Professional Teacher Development	CS Learning is Critical in K-8: Computer Science Teachers Association - CSTA Voice. Irene Lee	Journal Article	Accepted - Awaiting Publication
Socioeconomics and System Dynamics Models	Hurd, B. and J. Coonrod . Forthcoming. "Hydrological and economic consequences of climate change in the Upper Rio Grande region," <i>Climate Research</i> .	Journal Article	Accepted - Awaiting Publication
Water Quality Research	The Effects of Watershed Characteristics and Ungulate Grazing on Montane Grassland Streams and Riparian Areas Authors: David J. Van Horn , Carleton S. White, Edward A. Martinez , Christina Hernandez, Joshua P. Merrill, Robert R. Parmenter , and Clifford N. Dahm . <i>Rangeland Ecology and Management</i> .	Journal Article	Accepted - Awaiting Publication
Acequia Interdisciplinary Research	Ochoa C.G. and V.C. Tidwell . 2012. Looking at the human and environmental interactions of Acequia-community based agriculture systems in New Mexico: A system dynamics modeling approach. UCOWR/NIWR Annual Conference: Managing water, energy and food in an uncertain world. July 17–19. Santa Fe, NM.	Abstract	Published

Publications

<p>Acequia Interdisciplinary Research</p>	<p>Deep percolation from surface irrigation: Measurement and modeling using the RZWQM. Ochoa, C.G., A.G. Fernald, and S.J. Guldán. 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.</p>	<p>Book</p>	<p>Published</p>
<p>Acequia Interdisciplinary Research</p>	<p>The Historical Role of Acequias and Agriculture in New Mexico Jose A. Rivera, Chapter Six. Water Policy in New Mexico: Addressing the challenge of an uncertain future, David S. Brookshire, Hoskin V. Gupta, and Olen Paul Matthews, eds. New York: Resources for the Future Press, 2012.</p>	<p>Book</p>	<p>Published</p>
<p>Acequia Interdisciplinary Research</p>	<p>Ochoa, C.G., A.G. Fernald, and S.J. Guldán. 2011. Monitoring and modeling the hydrologic connectivity between headwaters and their snow-melt driven irrigated valleys. Annual New Mexico Water Conference. December 13–14, Alamogordo, NM.</p>	<p>Conference Proceeding</p>	<p>Published</p>
<p>Acequia Interdisciplinary Research</p>	<p>Ochoa C.G., A.G. Fernald, S.J. Guldán, M.K. Shukla, and V.C. Tidwell. 2011. Characterizing water table fluctuations and shallow aquifer recharge from irrigation in a semi-arid irrigated valley. Proceedings of the 47th Annual Conference for the American Water Resources Association. Session # 62–3. November 7–10, Albuquerque, NM.</p>	<p>Conference Proceeding</p>	<p>Published</p>
<p>Acequia Interdisciplinary Research</p>	<p>Ochoa, C.G., A.G. Fernald, and S.J. Guldán. 2011. Caracterización del balance hídrico y la recarga por retorno de riego en un valle agrícola de una región semiárida de los Estados Unidos de América. Estudios en la Zona no Saturada del Suelo. Vol. 10.</p>	<p>Conference Proceeding</p>	<p>Published</p>
<p>Acequia Interdisciplinary Research</p>	<p>Laura Mayagoitia, Brian Hurd, Jose Rivera, and Steve Guldán, "Rural Community Perspectives on Preparedness and Adaptation to Climate-Change and Demographic Pressure," Journal of Contemporary Water Research & Education, Issue No. 147, March 2012, pages 49-62. [Acknowledgement of NSF Dynamics of Natural and Coupled Systems, Grant #1010516]</p>	<p>Journal Article</p>	<p>Published</p>

Publications

Climate and Hydrology Research	Frisbee, M.D., F.M. Phillips, G.S. Weissman, P.D. Brooks, J.L. Wilson , A.R. Campbell, and F. Liu, Unraveling the mysteries of the large watershed black box: Implications for the streamflow response to climate and landscape perturbations, Geophysical Research Letters, 39, L01404, doi:10.1029/2011GL050416, 2012	Journal Article	Published
Climate and Hydrology Research	Galewsky, J., C. Rella, Z.D. Sharp, K. Samuels-Crow, and D.Ward, 2011: Surface measurements of upper tropospheric water vapor isotopic composition on the Chajnantor Plateau, Chile, Geophys Res Lett, doi:10.1029/2011GL048557.	Journal Article	Published
Climate and Hydrology Research	Harshburger, B. J., Walden, V. P., Humes, K. S., Moore, B. C., Blandford, T. R. and Rango, A. (2012), Generation of Ensemble Streamflow Forecasts Using an Enhanced Version of the Snowmelt Runoff Model. JAWRA Journal of the American Water Resources Association. doi: 10.1111/j.1752-1688.2012.00642.x http://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2012.00642.x/full	Journal Article	Published
Climate and Hydrology Research	El-Sadek, A., M. Bleiweiss, M. Shukla, S. Guldán and A. Fernald. 2011. Alternative climate data sources for distributed hydrological modelling on a daily time step. Hydrological Processes. 25(10): 1542-1557	Journal Article	Published
Innovation Working Groups	Investigating and improving the science and data literacy of pre-service elementary educators. Ellwein, A., Nyman, M.W., Strong, M, Connealy, S. and Daniel MJ, Geological Society of America Abstracts with Programs, Vol. 43, No. 5, p. 405. 2011.	Abstract	Published
Public Outreach	Background Report: New Mexico Fire and Water Impacts and Lessons Learned from the Las Conchas Fire. Janie Chermak, Bob Parmenter, Darcy Bushnell, Cliff Dahm, Heather Balas, and Vince Tidwell	Technical Report	Published
State Office Management	Strasser, C., R. Cook, W. Michener, A. Budden, and R. Koskela. 2011. Promoting data stewardship through best practices. Pages 126-131 in Jones, M.B. and C. Gries (Eds.), Proceedings of the Environmental information Management Conference 2011 (EIM 2011), University of California, Santa Barbara.	Book	Published

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State Office Management	Michener, W.K. Five new paradigms for science and an introduction to DataONE. 2012. Educause 47(2): 50-51.	Journal Article	Published
State Office Management	Treloar, A., G.S. Choudhury, and W. Michener . 2012. Contrasting national research data strategies: Australia and the United States. Pages 173-203 in Pryor, G. (Ed.) Managing Research Data, Facet Publishing, London.	Journal Article	Published
State Office Management	Alter, G., W. Michener , et al. 2011. Strategies for sustainability of biological infrastructure: Workshop report. Washington, DC: Ecological Society of America. 14 pp.	Technical Report	Published
Water Quality Research	Van Horn, D.J. , R.L. Sinsabaugh, C.D. Takacs-Vesbach, K.R. Mitchell, and C.N. Dahm . 2011. Response of heterotrophic stream biofilm communities to a gradient of resources. Aquatic Microbial Ecology 64:149-161.	Journal Article	Published
Acequia Interdisciplinary Research	Ochoa C.G., A.G. Fernald, S.J. Guldán, V.C. Tidwell , and M.K. Shukla. 2012. Characterizing irrigation-soil-aquifer relationships in a traditionally-irrigated valley of northern New Mexico, USA. European Geosciences Union General Assembly 2012. April 22-27. Vienna, Austria.	Abstract	Submitted - Under Review
Acequia Interdisciplinary Research	Water Democracies in the Upper Rio Grande Jose A. Rivera , Chapter 16. Voces de Agua y Tierra: Cultural and Environmental Histories of Upper Rio Grande Acequia Farms, 1598-2008, Devon G. Pena, Ruben O. Martinez, Joe Gallegos, and Diane Alters, eds. Tucson: University of Arizona, forthcoming 2012.	Book	Submitted - Under Review
Acequia Interdisciplinary Research	Carlos G. Ochoa, Alexander G. Fernald, Steven J. Guldán, Vincent C. Tidwell . 2012. Shallow aquifer recharge from irrigation in a semi-arid irrigated valley in New Mexico, USA. Submitted to Journal of Hydrologic Engineering.	Journal Article	Submitted - Under Review
Acequia Interdisciplinary Research	Fernald, A., V. Tidwell, J. Rivera, S. Rodríguez, S. Guldán, B. Hurd, C. Ochoa, C. Steele, M. Ortiz , K. Boykin, and A. Cibils. A multiperspective model for sustainability of water, environment, livelihood, and culture in traditional irrigation communities and their linked watersheds: Submitted to Sustainability: http://www.mdpi.com/journal/sustainability	Journal Article	Submitted - Under Review

Publications

<p>Acequia Interdisciplinary Research</p>	<p>Fernald, A., V. Tidwell, J. Rivera, S. Rodríguez, S. Guldán, B. Hurd, C. Ochoa, C. Steele, M. Ortiz, K. Boykin, and A. Cibils. A multiperspective model for sustainability of water, environment, livelihood, and culture in traditional irrigation communities and their linked watersheds. Sustainability. (submitted)</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Aquatic Chemistry Lab at NMHU</p>	<p>Sebastian Medina, A. Edward A. Martinez, Julie Trujillo, Daryl Williams, and Maura Pilotti. In Review. Do Seasonal and Diurnal Cycles Affect Water Quality as Indicated by Concentrations of Primary Nutrients and Other Solutes? River Research and Applications</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Climate and Hydrology Research</p>	<p>Gomez, J. D., and J. L. Wilson, Age distributions and dynamically changing hydrologic systems: exploring topography-driven regional groundwater flow, submitted to Water Resources Research, May 2012.</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Climate and Hydrology Research</p>	<p>Gomez, J. D., J. L. Wilson, and M. B. Cardenas, Residence time distributions in sinuosity- driven hyporheic zones and their biogeochemical effects, submitted to Water Resources Research in March 2012.</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Climate and Hydrology Research</p>	<p>Salim Bawazir, Jimmy Moreno. Investigation of the Relationship Between Evaporation Rate and Water Depth in Caballo Lake, New Mexico, U.S.A: it will be submitted to American Society of Engineers, Journal of Irrigation and Drainage before the end of August</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Climate and Hydrology Research</p>	<p>Salim Bawazir, Intended for Boundary-Layer Meteorology or Journal of Hydrological Processes: Long-Term Eddy Covariance Corrections over Elephant Butte Reservoir</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Socioeconomics and System Dynamics Models</p>	<p>Hurd, Brian, and Mani Rouhi-Rad (in review). "Estimating Economic Impacts of Changes in Climate and Water Availability," Climatic Change.</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>
<p>Socioeconomics and System Dynamics Models</p>	<p>Janie Chermak, Jeff Felardo, James Price. Low-Flow Appliances and Household Water Demand: An Evaluation of Demand-Side Management Policy in Albuquerque, NM, Journal of Environmental Management</p>	<p>Journal Article</p>	<p>Submitted - Under Review</p>

Publications

Water Quality Research	Medina,S., E.A. Martinez, J.Trujillo, D. Williams, M.Pilotti, (In Review) Do Seasonal and Diurnal Cycles Affect Water Quality as Indicated by Concentrations of Primary Nutrients and Other Solutes?, River Research and Applications	Journal Article	Submitted - Under Review
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Honors and Awards

Dr. Karl Benedict, UNM Earth Data Analysis Center, was elected in January 2012 to the presidency of the Federation of Earth Science Information Partners, an organization of over 135 Earth Science Data and Information organizations that includes members from the major US Earth Science Agencies (NOAA, NASA, EPA), academic research centers, and public- and private-sector application development groups.

EWRI-ASCE *Journal of Irrigation and Drainage Engineering* selected Alexander Fernald and co-authors to receive the 2012 Honorable Mention Paper Award for "River Hydrograph Retransmission Functions of Irrigated Valley Surface Water-Groundwater Interactions.

Mary Jo Daniel, Associate Director of NM EPSCoR, received the 2011 "Service to Science Award" from the New Mexico Science Teachers Association.

The poster "Comparative Effects of Deficit Irrigation in Landrace and Commercial Chile (*Capsicum annuum*) Cultivars," presented by Israel Calsoyas, NMSU graduate student, won the student poster competition at this year's New Mexico Chile Conference."

Three NM students won poster awards at the Tri-State Annual Meeting in Sun Valley, ID: Kenna Jackson (Kenna Jackson & Michael Pullin), "Optimization of the Simultaneous Fluorometric Detection of Ammonia and Amino Acids", New Mexico Tech

Jesus Gomez (J. D. Gomez, L. R. Sherson, T.R. Van Riper, P. Gabrielsen, J. L. Wilson, L. J. Crossey, and C. N. Dahm), "Understanding connectivity of meandering streams and shallow aquifers: Lessons learned from an observational study in northern New Mexico", New Mexico Tech

Betsy Shafer (Shafer, B.M., Sherson, L.R., Van Horn, D.J., Grace, M., Bixby, R.J., Compton, S., Parmenter, B., Crossey, L.J., Dahm C.N.), "The response of stream metabolism (productivity and respiration) to variable climate patterns (El Niño and La Niña) using in-situ instrumentation", UNM

Lauren Sherson, UNM, passed her defense of her master's thesis with distinction.

Hydrology PhD student, Lani Tsinnajinnie, from NM Tech, has been notified that she will be recipient of an EPA STAR Fellowship, pending funding of that program by Congress.