

Cyberinfrastructure Development for the Western Consortium of Idaho, Nevada, and New Mexico

Year 1 Annual Report (2009/2010)

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A. Executive Summary

1. Vision, Goals, and Objectives of Project

The vision of the Western Consortium for Cyberinfrastructure Development is to transform communication, climate change science, and education in our tri-state (ID, NV, NM) region. Moreover, a key outcome will be sustained partnerships among our jurisdictions that will enhance our competitiveness for research funding and enable us to better address 21st-century, grand scientific, and societal challenges.

The overarching goal of the Consortium's Track 2 RII is to promote knowledge transfer to scientists, educators, students, and citizens within and beyond the Consortium by enhancing state cyberinfrastructure (CI) and to enable the community science that is required to address regional to global scientific and societal challenges related to climate change. To meet this goal, there are three primary objectives: 1) Promote communication and collaboration by increasing connectivity and bandwidth (*Connectivity Component*); 2) Promote discovery by supporting community-based climate change science through enhanced interoperability between models and other software components, providing improved access to and usability of Consortium data products by adopting standards-based data management and access models, and supporting new data assimilation, analysis, and visualization capabilities (*Interoperability Component*); and 3) Utilize CI to integrate research and education (*Cyberlearning Component*) by: focusing on graduate student, postdoctoral researcher, and faculty development; extending science education into middle and high schools; and improving outreach to business and industry.

2. Brief Description of Project Efforts in Specific Areas

The Tri-State Consortium began its Track 2 project with a Project Planning meeting on November 5, 2009 at the Desert Research Institute in Reno, NV. Over twenty Consortium members attended, including the PI, Co-PIs, Component Leads, and Project Administrators from NV, ID, and New Mexico, as well as the external evaluator, Dr. Rose Shaw. In the one-day meeting, the attendees reviewed goals and objectives, affirmed deliverables, milestones, and outcomes, and developed an action plan for the first year of the project. With the help of the external evaluator, project participants also identified metrics and measures for the project's detailed evaluation plan, which was completed by the evaluator in January 2010. In addition to the external evaluator, our project's *evaluation* and *assessment* component includes an eight member External Advisory Committee (EAC) that meets annually. The first EAC meeting took place on February 25, 2010 in Las Vegas, NV.

The project *management structure* is designed to encourage interaction among the three states and the various components. It includes the Management Team (State Directors, PI, Co-PIs, Project Administrators, and Education, Outreach, and Diversity Coordinators), the Component Team (Component Leads, State Leads, and component members), and the Evaluation and Assessment Team (External Evaluator, External Advisory Committee, and Internal and Evaluation Reporting). To encourage effective project *communication* and *management*, there have been monthly Leadership meetings (consisting of the PI, Co-PIs and Component Leads), as well as monthly meetings of Component members. Most meetings have occurred online via Webex or Go to Meeting, or via phone conference.

The Consortium has a number of *outreach* and *communication* mechanisms. These include the Annual Tri-State Consortium Meeting, all *Cyberlearning* activities, each state's EPSCoR web site, and presentations made at national scientific meetings. A centerpiece for communication and outreach is the annual Tri-state Consortium meeting, which facilitates collaboration and information sharing between our states. One hundred and sixty five faculty, graduate students, postdoctoral associates, and research administrators from NV, ID, and NM met for the second annual Tri-state meeting on April 6th-8th, 2010 in Incline Village, NV to discuss CI, climate change research, education, and outreach and promote collaborations among the three states. Significant outreach to the national scientific community as well as Consortium members was through the 2009 AGU Fall meeting session, "Understanding the Impacts of Climate Change on the Western U.S.", which was co-convened by the Track 2 PI and CoPIs.

A primary means for coordinating the Consortium's *cyberinfrastructure* activities is the Tri-State Cyberinfrastructure Working Group (ID, NV, NM), which met face-to-face at the 2nd annual Tri-State Consortium meeting on April 6, 2010. The CI working group began as a collaboration among the three states' Track 1 projects and is now a key linkage between our Track 1 and Track 2 projects. Discussion topics at the 2010 CI Working group meeting included: CI Architecture; CI data policy; and CI data formats and instrumentation systems connectivity. Other *cyberinfrastructure* efforts embedded in the project's *research*, education and outreach activities are described in Key Accomplishments below.

The Consortium is committed to improving access to CI for underrepresented groups and geographically disadvantaged populations. A key activity to promote *diversity* in the Consortium's RII programs was formation of a Diversity Committee. The Committee held a session on diversity and featured a keynote speaker on diversity at the April 2010 Tri-State Consortium meeting, with the goal of developing an action plan to promote achievement of first generation, low income, and under-represented minority students in STEM disciplines. Diversity is also embedded in specific project components, especially the cyberlearning activities that reach large populations of Hispanic and Native American students. Diversity is also specifically addressed in the project's detailed evaluation plan through the inclusion of accountability metrics.

The Consortium's key *workforce development* efforts are being made through its *cyberlearning* activities. The Consortium is providing outreach and training in CI, which enhances research capabilities and workforce development in the sciences necessary for analysis and understanding of climate change. These activities are described in the Key Accomplishments and are detailed in the report below.

Sustainability efforts are being accomplished in four primary ways. The first is by commitments to long-term support by individual states and institutions for Track 2 activities. The connectivity and broadband improvements accomplished in year one are being maintained by each state/institution. The second way is through development of new proposals that make use of and provide continued CI support. Several proposals have been submitted, or are in the process of being submitted this year. The third mechanism for sustainability is through creation of new partnerships and strengthened collaborations. Collaborations within the Consortium have been greatly strengthened as the result of the Annual Tri-State Meeting and other interactions. Some of these collaborations have led to successful Innovation Working Group

projects, and proposal development and submissions to Federal agencies. National partnerships developed in year one include NSF-funded programs CUASHI, CREST, CYBER-ShARE, and Shodor. The fourth sustainability mechanism is through increasing human capacity through recruiting new faculty, postdoctoral fellows, graduate students and technical support staff to participate in the Consortium's CI Track 2 project.

3. Key Accomplishments

The key accomplishments for year one are summarized below under the intellectual merit and broader impacts.

Intellectual Merit

In year one, the *Connectivity Component* focused on improving communication and connectivity within each state. The major accomplishments include upgrading networks to key researchers and their labs (ID), upgrading I1 connectivity (NV), and installation of more than 20 gateways (NM). These enhancements in connectivity will increase the research and education capabilities of Tri-State scientists. Enhanced connectivity to research universities, tribal colleges, regional universities, field stations, and other academic organizations within ID, NV, and NM will have broad-ranging impact on research and education enterprises throughout the Consortium. Our institutions and states will be linked to more than 200 other Internet2 universities, government research laboratories, companies, and many research facilities throughout the world, facilitating data-intensive research, collaborative development, distributed experiments, grid-based data analysis, and experimentation using high performance networking, social networking, and cyber-enabled learning.

In year one, the *Interoperability Component* focused on the following activities: defining the target interoperability standards that will enable streamlined communication of scientific data and metadata between ID, NV, and NM; developing draft specification documents related to the model interoperability activities; developing the initial interoperable data portal platform upon which an initial data portal interface will be built; and developing enhanced capabilities in the server and client platforms for the CUAHSI HIS system.

The intellectual merit of these activities and their related accomplishments is based upon advances in the understanding of how interoperability standards may enable research, education, and policy development. Through the development and use of the interoperable systems (model and data) described above, concrete examples of the benefits of and challenges in developing standards-based research systems will provide specific points of reference for evolving analytic and information delivery systems that will enhance collaborative research, and make more accessible the products of that research to a broader community of users. Attaining the intellectual merit aspects of the project has been facilitated through the guidance of the project's Action Plan and advice from the project's External Advisory Committee.

Broader Impacts

From its inception, the proposed CI investments in the Consortium were designed to achieve broad impact and to add value by leveraging existing resources and infrastructure within the institutions, jurisdictions, and regions. The institutions that will benefit from increased *Connectivity* include rural institutions and those that serve Hispanic and Native

American students and faculty. Open access to the data and models developed within the Consortium and made available through the data archive and the model *Interoperability* framework ensures that scientific products can be broadly disseminated and readily used by scientists, engineers, and students throughout the world. Moreover, the project will make high-quality environmental data, information, and models available for STEM education and outreach, including classroom and laboratory use and student research. The Consortium's *Cyberlearning* activities will have long-lasting effects by training the next generation of scientists and targeting a range of geographic and cultural populations. Furthermore, we are preparing the future scientific workforce with better-developed quantitative reasoning, data analysis, and modeling skills. There are three primary *Cyberlearning* activities that began in year one and will continue through the remainder of the project. The first activity is supporting graduate students, post-doctoral researchers, and faculty to attend CI training related to computation and climate change. Providing outreach and training in CI enhances research capabilities and workforce development in the sciences necessary for analysis and understanding of climate change. The second activity begun in year one is developing and disseminating educational materials for middle school and high school students, especially targeting rural schools and schools that reach large numbers of Hispanic and Native American students. The third activity is developing and supporting extracurricular CI activities to strengthen the STEM pipeline and increase involvement and learning of CI.

4. Actions from site visits, reverse site visits, evaluation reports, advisory committee visits. Changes; unusual circumstances.

The Consortium's Track 2 project has an eight member *External Advisory Committee* (EAC) consisting of internationally and nationally recognized experts in the project's focus areas. The EAC met with the project's leadership and team members for the first time on February 25, 2010 in Las Vegas, NV at the Desert Research Institute. Based on presentations made by the project team, the EAC reviewed progress toward achieving outcomes of the project, made constructive suggestions for improving and/or changing the direction of the work underway, and provided suggestions for collaborations within and outside the Tri-state region, as well as suggestions for funding opportunities appropriate to our project focus. The EAC summarized their comments and recommendations in an eight-page report to the Consortium. The project team responded to each recommendation with strategies on how we will incorporate the recommendations into the project. The 2010 EAC report, with project team responses embedded, can be found online at: <http://www.nevada.edu/epscor/nsf2-eac.html>.

The project's *external evaluator*, Dr. Rose Shaw, made two site visits during year one. Dr. Shaw attended the project's first planning meeting on November 5, 2010 in Reno, NV and helped the project team identify metrics and measures for the project's detailed evaluation plan. Dr. Shaw also attended and evaluated the 2010 Tri-State Meeting in Incline Village. The results of that evaluation will be available in summer 2010. Dr. Shaw will submit an annual external evaluation report to the project leadership team by the end of year one.

Based on the initial project planning meeting and the EAC meeting outcomes described above, along with the project's interactions with the external evaluator, the Consortium has made adjustments in project details that have and will continue to improve the project. These

adjustments, however, have not resulted in any major changes in the long-term project goals, objectives, and desired outcomes.

B. Detailed Report

1. RII participants and participating institutions.

See Fastlane entries for Idaho, Nevada, and New Mexico collaborative awards.

2. Program/Project Description.

a. Research Accomplishments and Plans.

Specific research accomplishments and plans are provided for the project's three primary objectives: 1) Connectivity; 2) Data and Software Interoperability; and 3) Cyberlearning.

Connectivity: The main goal of the connectivity objective is to promote communication and collaboration by improving connectivity infrastructure within the Consortium, as our efforts to improve research competitiveness, STEM education, and economic development rely on this basic infrastructure. Year one activities and accomplishments are shown by state below:

Idaho upgraded switches in various key researcher buildings across the state. These upgrades are increasing network connections up to 1Gbps. ISU has installed the network backbone improvements and the core network switches to upgrade several buildings. Planning is under way for connectivity upgrades to IRON and several remote laboratories.

Nevada: In year one, Nevada upgraded the I1 connectivity in the south from 2Gbps to 10 Gbps. In the north the shared I1 and I2 connectivity upgrade is out for bid and when awarded will change the connectivity from 1Gbps to 10 Gbps. Planning for other network upgrades and video upgrades identified in the project plan is underway.

New Mexico has installed 20 Gateways to date, fulfilling the state's cost share commitment. An additional 23 Gateways are scheduled to be installed over the next 12 to 18 months. The Gateways are currently being used for collaboration, research and education activities listed below.

- Statewide collaboration between colleges and universities as high-definition videoconferencing for meetings and distance education where students at multiple campuses are connected together taking a common course.
- High-definition 3D stereo visualization as a decision theater in which complex problems (water systems, smart grids, traffic flow, etc.) are modeled in advance of real-time changes in conditions to understand possible options in addressing an issue.
- Scientific rendering/display/analysis of output (large scale datasets) for numerous scientific purposes, including: molecular dynamics, nanoscience, molecular genomics/computational biology (gene expression microarray data), particle physics, climate modeling, computational electromagnetics, and computational mechanics.
- Upper Hondo Water Availability and Decision Support Model for Lincoln County.
- Computational services for the residents of Espanola area; teaching regular engineering courses that are part of the program at Northern New Mexico College.

- Dual credit High School programs to seven Hobbs area high schools.
- Broadcast of online courses for Renewable Energy Curriculum, Electrical Applications, Energy Career Explorations; collaboratives with Louisiana Energy Services, Waste Isolation Pilot Plant, Enrichment Technology US, Waste Control Services; distance Learning for Nuclear Energy Education Program.

Data and Software Interoperability: The main goal is to promote discovery by supporting community-based climate change science through enhanced interoperability between models and other software components, providing improved access to and usability of Consortium data products by adopting standards-based data management and access models, and supporting new data assimilation, analysis, and visualization capabilities. In year one, the *Interoperability* team focused on three specific activities:

- 1) Development of model interoperability technologies that streamline research requiring the integration and use of climate, hydrologic, and surface model outputs and other data sources.
- 2) Development of interoperable data portals that enable efficient management, discovery, access, and use of diverse Earth Science data products in research, education, and policy development.
- 3) Development of capabilities to integrate Track 1 and 2 science products into national networks, with the CUAHSI HIS being the initial integration target.

Key accomplishments of the *Interoperability* team during the first year of support include:

- Software development and capacity building for integration with national networks
- Expansion of human resources for meeting project human capital development goals, and project deliverables
- Identification of key interoperability standards that will be used in the development of each state's cyberinfrastructure
- Initial creation of foundation documents and specifications for project data portals and model interoperability framework capabilities, and
- Initial development of the specific platform upon which the interoperable data archive for New Mexico will be based, providing interoperability with other state data archives that implement the same set of open standards-based services.

As is described in the individual state discussions below, progress has been made in all of these areas. Through collaboration between the three Consortium states the following key interoperability standards have been identified for use by all three states:

- 1) Open Geospatial Consortium Interoperability Standards: Web Mapping Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS), Catalog Services for the Web (CSW), Web Processing Service (WPS)
- 2) Federal Geographic Data Committee Metadata Standard for Geospatial Metadata
- 3) ISO 19115 and related Geospatial Metadata standards

Substantial progress has been made in the area of integration with Hydrologic Information Systems (HIS), particularly with the software development efforts in Idaho. Frequent interaction of New Mexico and Nevada collaborators in the team's regular telecon meetings and participation in the HIS workshop held at the second annual Tri-State Consortium meeting have established a heightened level of knowledge of the HIS system, which will streamline implementation of HIS support in New Mexico and Nevada by the end of the first project year.

The *Interoperability* team telecon meetings have also contributed to draft specification documents that have been developed by the Nevada team on climate databases, and the model interoperability concept that is still under development – particularly in response to comments provided by the project's External Advisory Committee in February, 2010.

Finally, significant progress has been made on the Open Source interoperable data archive platform that has been under development at the Earth Data Analysis Center with support from the New Mexico Resource Geographic Information System (NM RGIS), EPSCoR Track 1 and EPSCoR Track 2 projects. With the platform nearly finished, the development of New Mexico's EPSCoR Project Data Portal will soon start, with early interface components planned for completion by the end of the project year.

State-specific *Interoperability* accomplishments are detailed below.

Idaho Interoperability activities focused on four main areas in year one: 1) development of HIS servers; 2) workshops and trainings; 3) development of HydroDesktop; and 4) building human capacity.

1) Deployment of HIS Servers: We have begun work on coordination of development of four HIS servers in the state. At the present time HIS servers have been set up at BSU and UI-Boise and Moscow. We made an initial effort of developing an HIS server in Pocatello at ISU, but ran into unforeseen technical challenges associated with hardware and software. This effort is continuing under additional funding recently received for a STEM undergraduate female engineer, Tifani White, who was recently hired to finish setting up and begin populating our HIS server at ISU.

2) Workshops and Trainings: An HIS Workshop was held in August 2009 in Boise where 10 data managers, technicians, and project team members in the EPSCoR project gathered to study the CUAHSI HIS system and begin adding data to their servers. A workshop was also presented on HIS and the client software, HydroDesktop, at the 2nd annual Tri-State Consortium meeting in April 2010. Also, a HydroDesktop/HIS workshop was presented in Orlando, Florida to 15 people at the 1st International MapWindow GIS Users and Developers Conference. Most recently an HIS/HydroDesktop workshop was presented at the Intermountain GIS conference in Bozeman, Montana to 15 paid attendees.

3) Development of HydroDesktop: ISU has received complementary funding under an NSF grant in conjunction with the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc (CUAHSI) and the University of Texas at Austin to develop a desktop-based client tool to access data stored on Hydrologic Information System servers. This grant began in Spring 2009 and continues until Spring 2011. We have used these resources to fund a graduate student and visiting scholar to help with the software development activity. Our current EPSCoR Track 2 funding includes partial-to-full support for a Masters of Science in Geographic

Information Science student. In January 2010, we brought Mr. Dinesh Grover to the project to be funded as an EPSCoR graduate student to work with our existing HydroDesktop team members (Mr. Jiri Kadlec and Ms. Yang Cao).

Together the team has made significant progress on the project including the release of an alpha version of the software at the American Water Resources Association GIS and Water Resources Conference in Orlando, Florida in March 2010. Presently, the project is being managed using a web-based system called "CodePlex" where all source code, binaries, issues, and user documentation are stored and are publicly accessible through an open source license. The project and all associated information can be found at <http://www.HydroDesktop.org>.

In addition to the specific activities involving the HIS, Idaho has conducted interviews to hire a CI coordinator. This person will provide support for CI developments and activities associated with the current RII Track 1 project, facilitate planning and communication among the project's statewide partners, and promote growth in the utilization of CI applications and technologies across the state. This person will also be responsible for ensuring that the data portal for Idaho EPSCoR adheres to the Tri-State Consortium's interoperability standards. By the end of year one, Idaho plans to hire a data manager to facilitate the archival and sharing of EPSCoR data products. It is envisioned that this person will directly help researchers to properly archive data within the statewide CI structure, and to field data requests from various users.

Nevada Interoperability activities focused on three main areas in year one: 1) building human capacity; 2) model matrix and software interoperability framework development; and 3) collaborations with NV Track 1 and ID and NM partners:

1) **Building Human Capacity:** Nevada hired two graduate research assistants (GRAs) and one post-doctoral associate. In addition to the two NV faculty members participating in the *Model and Data Interoperability* component, Drs. Sergiu Dascalu and Frederick C. Harris Jr., the project now includes the participation of Dr. Rakhi Motwani, hired in April 1, 2010 as post-doctoral research associate; Mr. Jigar Patel, PhD student, hired in March 1, 2010 as a GRA working on model interoperability; and Ms. Aarti Dhone, Master student, hired as a GRA in February 15, 2010, working on research and development of data archives. All the above personnel are in the Computer Science and Engineering (CSE) Department at the University of Nevada, Reno (UNR).

2) **"Model Matrix" and Software Interoperability Framework Development:** In collaboration with our Idaho and New Mexico partners, the following work has been accomplished: defining metrics for project progress assessment; writing a survey report on existing environmental models that could be coupled for research purposes (a "model matrix" identifying essential model properties, strengths and limitations, and potential for interoperability); and developing the requirements specification document for the first version of the model interoperability software framework.

3) **Collaboration with Track 1 Nevada team members and Idaho and New Mexico partners:** A model of collaboration has been established within the Nevada team that allows synchronization with research being done by the Nevada Track 1 CI Component (also at CSE, UNR). Specifically, the two software development professionals hired in Track 1, Eric Fritzingler (software developer) and Mike McMahon (database specialist) have been designated to

collaborate with Track 2 member Dr. Rakhi Motwani and to supervise GRAs Jigar Patel and Aarti Dhone (also in Track 2). Research developed in Track 2 will be integrated in the Nevada Climate Change Data Portal built as part of Track 1 project in Nevada. Regular channels of communication and collaboration with Idaho and New Mexico partners have also been established through the regular team meetings described above, and through the Tri-State CI Working group.

New Mexico Interoperability activities focused on the Interoperable Data Archive in year one. UNM's Earth Data Analysis Center made significant progress in the development of the shared (with New Mexico's Resource Geographic Information System) data infrastructure for the management, discovery, and delivery of the science data generated by the EPSCoR projects. This work has been jointly funded through New Mexico's EPSCoR Track 1 and Track 2 awards, and has resulted in the following capabilities:

- A base data model that is optimized for the storage of 2d and 3d vector (point, line, and polygon) and raster data in conjunction with consistently encoded temporal data capture for each spatial object in the system. This data model is generalized for storage of observations and measurements taken in 4-dimensions, with uniform representation of spatial and temporal values for cross-observation discovery by location and time.
- REST web services as the primary means of interacting with the data model and external applications and services that access the contents of the data model. These services provide the following interfaces:
 - Create, Read, Update, Delete functions for managing data objects in the system
 - Metadata request and reformatting functions
 - Data generation request functions
 - Automatically generated Open Geospatial Consortium Web Map, Web Feature, and Web Feature services for delivery of data system content through a wide variety of interfaces: web, desktop Geographic Information Systems, or as "mashups" with external products that implement the OGC services.
- An initial instance of the GeoNetwork Open Source platform for the creation and management of metadata for science data products managed within the system. This platform supports a variety of distributed search standards, including the Open Geospatial Consortium Catalog Services for Web (CSW), the library community's z39.50, and the OAI PMH standards.

Planned NM accomplishments for the remainder of the project year include the following:

- Consultation with science and education stakeholders in New Mexico to identify key interface capabilities for development in the data portal that will be built on top of the developed platform.
- Development of a round-trip synchronization between the GeoNetwork platform and the developed data portal platform for standards-based discovery through the

GeoNetwork interfaces and data service and client interfaces hosted by the project's data portal.

New Mexico also worked on climate model enhancement in year one. The WRF climate model system that was previously implemented on New Mexico's Computer Applications Center by project researchers in the Department of Earth and Planetary Sciences at UNM has been enhanced with an isotopic physics software package.

The Model and Data Interoperability team plans to work on the following activities in year two:

- Implementation of the CRUD services for management of archive objects within the mirrored systems: Deployment.
- Development of required database and file systems, and configuration of those systems for replication across all three states: Operational Prototype.
- Develop complete use case(s) and specific scenarios using the interoperability framework (e.g. involving HIS, WaterML, OpenMI): Initial Prototype.
- Design, development, and usability testing of a generic software interoperability framework: Operational Prototype.
- Development of prototype Initialize, Run, Finalize (IRF) wrapper code for WRF for coupling with surface process and hydrologic models focusing on hydroclimatic and hydrometeorological time scales.
- Build out full-featured coupling software infrastructure for WRF and selected surface process and hydrologic models.

Cyberlearning: The primary goal is to enhance learning by utilizing CI to integrate research with education. The project is focusing on graduate student, postdoctoral researcher, and faculty development; extending science education into middle and high schools; and improving outreach to business and industry. There are three primary *cyberlearning* activities which commenced in year one and will continue in years two and three: 1) offer and support CI training related to computation and climate change for graduate students, post-doctoral researchers, and faculty; 2) develop and disseminate educational materials for middle and high school students; and 3) develop and support extracurricular CI activities. Progress during the first year of the project on each of these activities is described below.

1) Offer and Support CI training: The *cyberlearning* group (ID, NV, and NM) developed a listing of available CI-related trainings (e.g TeraGrid) and a protocol for graduate students, post-doctoral researchers, and faculty to apply for travel awards to attend trainings. Each state announced the CI training opportunities on their web site in May 2010 (as an example, see <http://www.nevada.edu/epscor/nsf2-training.html>), and we are starting to receive applications.

2) Development and Dissemination of Educational Materials for Middle and High Schools: The *Cyberlearning* group developed teams (including collaborations between Idaho and Nevada) to develop the educational materials and begin initial identification of science themes for the materials.

Idaho has assembled a team that includes McCall Outdoor Science School (MOSS) education director Karla Bradley Eitel, graduate student Todd Buxton and teacher Jason Torgrimson to develop a cyberlearning website for the MOSS. This site will include background information related to research being conducted under Idaho's Track 1 funding, profiles of scientists, explanations of climate modeling, and most importantly, we will establish data collection protocols for MOSS and a simple interface for students to upload hydrologic data to the CUAHSI HIS database. We are working with Dan Ames (Track 1 and Track 2 Co-PI) on the development of this interface, with the idea that once it has been piloted for MOSS students, we can also include other schools and citizen scientists in data collection and uploading data to the database.

Nevada has identified and hired a faculty collaborator in year one (Schrader) and a graduate student for year 2 (Skaza). A project development leadership team has been created that includes faculty, students, and representation from the Southern Nevada Regional Professional Development Program. The leadership team is meeting biweekly to plan for a curriculum development session and professional development experience for a small group of teachers from the Clark County School District who will be collaborating on the curriculum development efforts. This session will occur during August 2010, and the teacher participants are being recruited. We have established a design framework and delivery system for the cyberlearning curriculum materials. Using multidisciplinary participants from across the Tri-state Consortium, we are in the process of completing a document analysis and survey project to establish the big ideas of regional climate science. Finally, we are in the process of building the user interface and initial content for a learning portal to support our efforts across time and space.

New Mexico hired an education/outreach coordinator, Nico Marrera. Nico has substantial experience in visualization and some experience with distance delivery of courses at New Mexico Tech. He is developing and adapting templates for middle and high school courses and providing expertise in visualization.

3) Develop and Support Extracurricular CI Activities: In year one, *New Mexico* had two primary activities. The first NM activity supports teams and educational material development for two programs: Growing Up Thinking Scientifically (GUTS) and the New Mexico Supercomputing Challenge. GUTS is a summer and after-school science, technology, engineering and math (STEM) program primarily for middle school students. GUTS promotes learning to look at the world and ask questions, develop answers to the questions through scientific inquiry, and design solutions to such problems. The New Mexico Supercomputing Challenge promotes computational thinking in science and engineering so that the next generation of high school graduates is better prepared to compete in an information-based economy. Through Track 2 funding, each of these programs supported three new teams this year. The three new GUTS teams were middle school teams from Cameo (a K8 school), Las Vegas (a combination of two middle schools' clubs), and Penasco (a K8 school). The three new Supercomputing Challenge teams were high schools teams from Deming, Edgewood, and Quemado. The Supercomputing Challenge award ceremony included more than 250 middle and high school students and their teachers. About 70 of the 98 teams that started the Challenge last fall presented projects at the Expo. The goal of the year-long competition is to increase knowledge of science and computing, and expose students and teachers to computers and

applied mathematics. GUTS and Supercomputer Challenge have begun assembly of new materials specifically focused on climate change for use in next year's programs.

For the second NM activity, building a middle and high school educational material development team has commenced. Middle and high school teachers have been and continue to be contacted to participate in STEM teaching material development and/or enhancement by utilizing cyberinfrastructure. In addition, science experts, including some participants from NM's Track 1 project, are being contacted to serve as content consultants to teachers. The distance delivery group at NMT, the education/outreach coordinator, GUTS, New Mexico Supercomputing Challenge, and NMT's PI complete the persons contributing to teams and material development in NM.

b. Diversity and Broadening Participation, including Institutional Collaborations.

i. Diversity and Broadening Participation

The Consortium is committed to improving access to CI for underrepresented groups and geographically disadvantaged populations. A key activity to promote *diversity* in the Consortium's RII programs was formation of a Diversity Committee. The Committee held a session on diversity at the April 2010 Tri-State Consortium meeting in Incline Village, NV, with the goal of developing an action plan to promote achievement of first generation, low income, and under-represented minority students in STEM disciplines. The Committee has had several follow-up meetings via teleconference to facilitate implementation of the action plan. The Tri-State meeting also featured a keynote speaker, Dr. Frank Tuitt, who spoke on "Signals and Strategies for Increasing Campus Diversity". Dr. Tuitt is on the faculty at Denver University and a former research associate for the Harvard National Campus Diversity Project. Diversity was also addressed in the detailed project evaluation plan developed in year one, by including accountability metrics on diversity. The project encourages broad participation by students from community colleges, women, underrepresented racial/ethnic minorities (Hispanic/Latino; American Indian or Alaskan Native; Black or African American, and Native Hawaiian or other Pacific Islander), people with disabilities and first-generation/low socioeconomic status students.

There were also state-specific efforts for broadening participation:

Idaho: The *Cyberlearning* group in Idaho is addressing diversity and broadened participation by inviting middle and high schools from across the state to participate in using our cyberlearning materials and uploading data to the database.

Nevada: The *Cyberlearning* group in Nevada is broadening participation by recruitment of a diverse group of teacher participants that work in ethnically diverse schools that serve large numbers of Hispanic students. To increase knowledge and skills in broadening participation, the Nevada's *model interoperability* member, Dr. Sergiu Dascalu (UNR) attended the NSF-supported More Graduate Education @ Mountain State Alliance (MGE@MSA) full-day workshop on mentoring graduate students from underrepresented groups (held at UNR on November 10, 2010). In addition, in April 2010 Dr. Dascalu visited Langston University, OK, a historically Black University where he exchanged experience on teaching, research and outreach with faculty and students from the university.

New Mexico: As an extension of the work on the data portal platform (part of the *Interoperability* component), the Earth Data Analysis Center at UNM has begun a collaboration with the CYBER-ShARE Program at the University of Texas at El Paso, which is a designated Hispanic Serving Institution. This collaboration has resulted in the development of an NSF CI-TEAM proposal, as well as the experimental development of semantic provenance generation as an integral part of science data product generation and processing. Diversity and broadening participation is also being addressed in New Mexico's *Cyberlearning* activities, as evidenced by one of the GUTS clubs. The GUTS club in Las Vegas, NM is led by Elizabeth Ratzlaff and Carla Romero, both of whom are employed by New Mexico Highlands University. The eight students who participated in the club came from two different middle schools in Las Vegas. Of the eight students, six identify themselves as Hispanic/Latino and two identify themselves as Caucasian/white. Three are in seventh grade and five are in eighth grade. Five are male and three are female. This group represents the type of diversity and broad participation that we are striving for across the state. In year two, New Mexico plans to address diversity and broadening participation by implementing the extracurricular activities that provide for a wide array of geographic, ethnic, cultural, physical, and gender diversity. We will continue to expand our focus on delivery of educational opportunities to underserved communities. Such communities are widespread in New Mexico and include large populations of both Hispanic and American Indian students, in addition to substantial numbers of females. We integrate a diverse geographic population through our programs and this will be expanded as the use of distance delivery is integrated in our programs.

In year one, the total number of participants (as of May 2010) in the Track 2 Tri-State Consortium including faculty, staff, and students, was 43. Of the total, 28% were from Idaho, 39% were from Nevada, and 33% were from New Mexico. The percentage of women, underrepresented minorities (URM), and persons with disabilities in the Consortium was 33%, 5%, and 2%, respectively.

Demographics of Track 2 Tri-State Consortium Participants					
Institution	Male	Female	Totals	URM	Disability
Idaho					
University of Idaho	6	2	8	1	
Idaho State University	2	1	3		
Boise State University	1		1		
<i>Total</i>	<i>9 (75%)</i>	<i>3 (25%)</i>	<i>12</i>	<i>1 (8%)</i>	<i>0</i>
Nevada					
DRI	2	1	2		
UNR	7	2	9		
UNLV	2		2		
NSHE	1	2	3		
<i>Total</i>	<i>12 (71%)</i>	<i>5 (29%)</i>	<i>17</i>	<i>0</i>	<i>0</i>
New Mexico					
UNM	7	5	12	1	1
NM Tech	1	1	2		
<i>Total</i>	<i>8 (57%)</i>	<i>6 (43%)</i>	<i>14</i>	<i>1 (7%)</i>	<i>1 (7%)</i>
All Three States					
<i>Total</i>	<i>29 (67%)</i>	<i>14 (33%)</i>	<i>43</i>	<i>2 (5%)</i>	<i>1 (2%)</i>

ii. Institutional Collaborations.

The project has engaged in institutional collaborations both within the Consortium and with institutions outside the Consortium.

Collaborations among Consortium Institutions. The project was set up with a management and research structure that facilitates collaborations among faculty from the different Consortium campuses (see diagram below in Management section). For example, researchers in Idaho, Nevada, and New Mexico have developed strong collaborations between UNM, UNR, UNLV, DRI, NMSU, NM Tech, ISU, USU and University of South Carolina through the collaborative work in the *Interoperability* Component on model and data interoperability and the infusion of time series data products into the systems for both delivery and capability testing.

Collaborations have also been fostered through the *Cyberlearning* Component. Faculty from Idaho's MOSS program and the University of Nevada, Las Vegas (UNLV) have met several times to discuss the opportunities for leveraging materials development for middle school and high school by sharing ideas and targeted audiences. Additional institutional collaborations in Nevada involve the Clark County School District and the Southern Nevada Regional Professional Development Program. As of 2006, the Clark County School District (CCSD) served a K-12 student population numbering more than 300,000 and ranked 5th largest in the United States. CCSD covers nearly 8,000 square miles (including the greater Las Vegas metropolitan area) and includes rural, suburban, and urban schools. In 2007, Hispanic student enrollment in CCSD reached majority status at 40%. The Southern Nevada Regional Professional Development Program (SNRPDP) is a state supported program responsible for the design and delivery of professional development to teachers throughout the state of Nevada. In New Mexico, NM Tech, which is a minority serving institution, is collaborating with statewide programs that reach middle and high school students and teachers. In the coming year, we will continue the development of cyber-infrastructure supported educational materials for middle and high schools. Further, we will extend dissemination through collaboration with other undergraduate and minority serving institutions, e.g., NM Highlands University.

The Consortium has incorporated five other mechanisms to promote collaborations among the Tri-State Institutions: 1) Annual Tri-State Consortium Meeting; 2) Cyberinfrastructure Working Group; 3) Innovation Working Groups; 4) Junior Faculty Leadership workshop; and 5) Interdisciplinary Modeling Course.

1) Annual Tri-State Consortium Meeting: The first Tri-State meeting, held in Boise ID in 2009, attracted 100 participants from ID, NV, and NM. The second Tri-State meeting took place April 6-8, 2010 in Incline Village, NV, where 165 faculty, graduate students, postdoctoral associates, and research administrators of the Tri-State Consortium met to discuss climate change research, education, and outreach and promote collaborations among the three states. Different aspects of the 2010 meeting have been discussed throughout this report. The third annual Tri-State Meeting will take place in early April 2011 in New Mexico.

2) Cyberinfrastructure Working Group: The CI Working Group was formed in 2008 to leverage existing CI resources and expertise both nationally and in the tri-state region, to support climate change research, and to identify and evaluate interoperability standards and

solutions that can be deployed regionally. Details on 2010 accomplishments of the CI Working group are described in the Cyberinfrastructure section below.

3) Innovation Working Groups: The Tri-State's Innovation Working Group (IWG) Program 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 IWGs that convened during the performance period are described here:

- The first Tri-State IWG, "The effects of climate change on ecosystems and societies: A Focus on Native American and Hispanic communities" convened on October 19-21, 2009 at Hyatt Regency Tamaya in Albuquerque, New Mexico (Lead Investigator, Karletta Chief, Desert Research Institute). The workshop was co-hosted by the Desert Research Institute, the University of Idaho, and the University of New Mexico. The purpose of this IWG was to develop research ideas that will couple the effects of climate change on ecosystems and societies while focusing on potential impacts to Native American and Hispanic communities. Hydrologists, ecologists, and social scientists convened to (1) hear stakeholders and experts offer their perspectives and concerns on potential impacts, and discuss how potential impacts and mitigation can be incorporated into long-term planning related to climate change; (2) discuss how climate and hydrological models can be improved to identify and mitigate risks to these vulnerable populations; and (3) jointly write a cross-cutting proposal to NSF that takes a holistic approach to addressing complex interactions of socio-political and biophysical systems affected by climate change.

The IWG members were Jan Boll, Associate Professor, Biological and Agricultural Engineering, University of Idaho; Karletta Chief, Post-Doctoral Fellow, Division of Hydrologic Sciences Desert Research Institute; Julie Coonrod, Associate Professor, Civil Engineering, University of New Mexico; Barbara Cosens, Associate Professor, College of Law, University of Idaho; Terry Fisk, Ph.D. Student, Graduate Program of Hydrologic Sciences, University of Nevada, Reno; Alex Fremier, Assistant Professor, Fish and Wildlife Resources, University of Idaho; Mahesh Gautam, Post-Doctoral Fellow, Division of Hydrologic Sciences Desert Research Institute; Susan Kelly, Interim Director, Utton Transboundary Resources Center, University of New Mexico; Asako Stone, Post-Doctoral Fellow, Division of Hydrologic Sciences, Desert Research Institute; and Mark Stone, Assistant Professor, Civil Engineering, University of New Mexico.

- "Paleo-rainfall and Groundwater Recharge in Southern Nevada over the Past 11,000 Years from Cave Calcite Deposits." This group will work to generate a paleorainfall and paleoclimate history for southern Nevada via the stable and radiogenic isotopic analysis of cave stalagmites from the Spring Mountains, southern Nevada. (Lead Investigator: Matthew S. Lachniet, Department of Geoscience, University of Nevada, Las Vegas; Co-Investigators: Yemane Asmerom, University of New Mexico; Victor Polyak, University of New Mexico.). This group's IWG convened March 12-14, 2010.

- “Integrated Environmental Modeling Software Systems.” This group will convene a workshop June 7-8, 2010 regarding NSF Software Development for Cyberinfrastructure (SDCI) or related opportunities focused on developing a web-services-based meta-framework for environmental modeling. The proposed modeling framework will be developed explicitly to support the Water Resources in a Changing Climate theme of the EPSCoR projects in Idaho, New Mexico, and Nevada. (Lead Investigator: Daniel P. Ames, Department of Geosciences, Idaho State University; Co-Investigators: Karl Benedict, Earth Data Analysis Center, University of New Mexico; Sergiu Dascalu, Department of Computer Science and Engineering, University of Nevada, Reno; Collaborators: Nancy Glenn, Department of Geosciences, Idaho State University; Jeff Horsburgh, Utah Water Research Laboratory, Utah State University; Jon Goodall, Department of Civil and Environmental Engineering, University of South Carolina.)
- “Identifying the Most Relevant Spatial and Temporal Scales of Climate Change with Respect to Surface Hydrologic Processes.” May 25-27, 2010. This group’s goal is to outline a clear path forward in approaching a key question: what are the most relevant spatial and temporal scales of climate change with respect to surface hydrologic processes? To achieve this goal, experts in a broad swath of earth science fields will congregate in a three-day workshop to distill what the essential problems and possible solutions are, identify who would best be suited to undertake these issues, and which grant opportunities and granting agencies would be more appropriate for the proposed research topics. (Lead Investigator: Amanda White, Earth and Environmental Science, New Mexico Institute of Mining and Technology; Co-Investigators: Joseph Galewsky, Earth and Planetary Sciences, University of New Mexico; Sam Fernald, Department of Animal and Range Sciences, New Mexico State University; John Wilson, and Environmental Science, New Mexico Institute of Mining and Technology; Todd Ringler, Climate, Ocean, and Sea Ice Modeling Group, T-Division, Los Alamos National Laboratory; Al Rango, U.S. Department of Agriculture-Agricultural Research Service Jornada Experimental Range, New Mexico State University.)

4) Junior Faculty Leadership Workshop: The Junior Faculty Leadership program, offered by NM EPSCoR, is designed to provide training for early-career faculty that enhances their leadership skills and increases their competitiveness for national-level funding opportunities. Nineteen faculty members, graduate students, and post-doctoral scholars from eight different institutions spent three days in the foothills of the Sangre de Cristo mountains at the 2010 Faculty Leadership Workshop. Nevada EPSCoR sent four participants (three faculty and one postdoc) and Idaho EPSCoR sent two participants (one community college member and one university faculty member) to the Workshop. The Santa Fe Institute hosted the event that provided participants with skills to better communicate their research, write successful research grants, manage research projects, and promote diversity.

5) Interdisciplinary Modeling Course: As a result of a collaboration developed at the first Annual Tri-State Meeting in Boise ID last year, Dr. Laurel Saito (UNR), Dr. Alexander Fernald (NMSU), and Dr. Timothy Link (UI) collaborated to develop a three week graduate level course that will be taught at UNR during July 12 -20, 2010, entitled “Interdisciplinary Modeling: Water-Related Issues and Climate Change”. Students will be introduced to models that are available

in different disciplines and how such models might be applied together to address interdisciplinary modeling of climate change impacts on water resources. The course will address the advantages and limitations of using models, different spatial and temporal scales that specific disciplines are concerned with, differences in degrees of uncertainty of data and models, interdisciplinary modeling options, communication between disciplines, and interactions with stakeholders and the public. Students will gain experience in working in interdisciplinary teams to apply interdisciplinary modeling approaches to increase knowledge about climate change impacts on water resources. Students will use common software to do an interdisciplinary modeling project. The course will be co-taught by Saito, Fernald and Link, along with 16 other ID, NV, and NM instructors and guest lecturers. As the result of a competitive application process, the course will be attended by 24 students from NV, ID, and NM. Support for travel and lodging will be provided by the Idaho, New Mexico, and Nevada EPSCoR offices.

Collaborations with Institutions Outside of the Consortium. Consortium researchers collaborated with faculty from several universities and organizations outside the Consortium, including: U. South Carolina, U. Austin Texas, U. Texas, El Paso, and NCAR. Additionally, the faculty from the following universities and organizations attended the 2010 Tri-State Consortium Meeting: U. California, Santa Barbara, University of Denver, Utah State U., USDA Agricultural Research Service, and the USGS. The Consortium was particularly excited that Dr. Richard Hooper, President and Executive Director of CUASHI, participated in the Tri-State Annual Meeting.

c. Workforce Development

The Consortium's key *workforce development* efforts are being made through its *cyberlearning* activities. The Consortium is providing outreach and training in CI, which is enhancing research capabilities and workforce development in the sciences necessary for analysis and understanding of climate change. These activities are described in the *Cyberlearning* section, under Research Accomplishments and Plans section above.

d. Cyberinfrastructure.

The Tri-State Cyberinfrastructure (CI) Working Group met at the Tri-State Consortium Meeting on April 6, 2010 in Incline Village. The CI Working Group was formed in 2008 to leverage existing CI resources and expertise both nationally and in the tri-state region, to support climate change research, and to identify and evaluate interoperability standards and solutions that can be deployed regionally. Twenty people attended the CI Working Group meeting in 2009; participation grew to 55 faculty, postdocs, and graduate students at the 2010 meeting. The CI Consortium was further solidified with the three year, NSF EPSCoR Track 2 collaborative award issued to the three states in September 2009. The three CI sessions convened at the 2010 meeting, Data Policy, Architecture, and Data Formats and Instrumentation Systems Connectivity, were identified as the three top priority topics at the 2009 Tri-state CI Working Group meeting in Boise, ID.

Session A1: CI Data Policy: This session focused on data policies being developed by the individual EPSCoR states, which includes the sharing of data and final products between the scientists and research projects. Key Session Outcomes:

- Challenges include resistance to application of emerging CI tools and to data sharing
- There is a need for integrating into existing scientific workflows to lower barriers to data publication and sharing
- There are many issues surrounding metadata including:
 - Both “use” metadata for non-domain experts and enhanced detailed process metadata for scientific users are needed
 - Need to capture and encode access limitation data (i.e. social science data), and build data access models that reflect those limitations
 - Need to provide access both to "Raw" data in addition to higher level products based upon those data

Session A2: CI Architecture: This session focused on guidance and reference documentation on CI architecture issues related to the tri-state collaboration projects. Presentations included architecture development for Nevada’s climate data, portal, and software frameworks, CUAHSI HIS, and New Mexico’s standards-based interoperability architecture for science data sharing. Key Session Outcomes:

- A diverse set of approaches are being used by each state - ID and NM are building on existing activities and capabilities, whereas NV is developing a new system
- The importance of interoperability standards for connecting the systems used by each state was reinforced, along with the importance of providing data and metadata exchange
- Diverse software implementations are fine as long as they can be connected using interoperability standards
- CUASHI
 - There is a need for 2D, 3D, and 4D data and possibly support for service standards, provider technologies, and clients
 - One size doesn't fit all - different user communities approach their analysis/visualization processes in different ways

Session A3: CI Data Formats and Instrumentation Systems Connectivity: This session focused on coordinating common data ingest formats and how instrumentation data should be compiled and organized to enable shared observation system data processing models across states. Presentations included design, data acquisition, data transport, and ingest workflows for Nevada’s and New Mexico’s environmental monitoring and instrumentation systems and an introduction of the HydroDesktop as an element of the HIS system. Key Session Outcomes:

- There is a challenge posed by higher bandwidth requiring sensors; may need diverse collection of connection models for solving "first mile" problem
- There is a need to understand specifics of particular sensor systems and understand "one off" nature of some data flow problems

Action Items resulting from the 2010 CI Working Group include: 1) Begin focused work with science and education groups to identify and refine products and interface models to support specific use cases (submit IWG proposal); and 2) Develop science and education use cases for targeted capability development.

e. Outreach and Communication.

The Consortium has a number of outreach and communication mechanisms. These include the Annual Tri-State Consortium Meeting, Cyberlearning activities, each state's EPSCoR web site, and presentations made at national scientific meetings.

A centerpiece for communication and outreach is the annual Tri-state Consortium meeting, which facilitates collaboration and information sharing between our states. One hundred and sixty five faculty, graduate students, postdoctoral associates, and research administrators from NV, ID, and NM met for the second annual Tri-state meeting on April 6th-8th, 2010 in Incline Village, NV to discuss CI, climate change research, education, and outreach and promote collaborations among the three states.

Outreach and communication is embedded in all of the *cyberlearning* activities described above under the Research Accomplishments and Plans section. This includes outreach to middle and high school teachers, stakeholders, RII participants, and underrepresented groups through the CI Training program, the development and dissemination of educational materials (e.g., through the MOSS and UNLV programs), and through CI extracurricular programs (e.g., GUTS, National Supercomputing Challenge).

A key outreach activity to the national scientific community was accomplished by Consortium Co-PIs (G. Dana, V. Walden, W. Michener) teaming with leaders from U. of Washington (N. Mantua), and Oregon State University (P. Mote) to Co-convene a Union Session at the Annual Fall Meeting of the American Geophysical Union in San Francisco, CA, during December 2009. The session, "Understanding the Impacts of Climate Change on the Western U.S.", included eight oral presentations and 26 poster presentations. Many Consortium members presented at the session, along with contributors from across the U.S.

New Mexico RII participants made the following presentations during the reporting period:

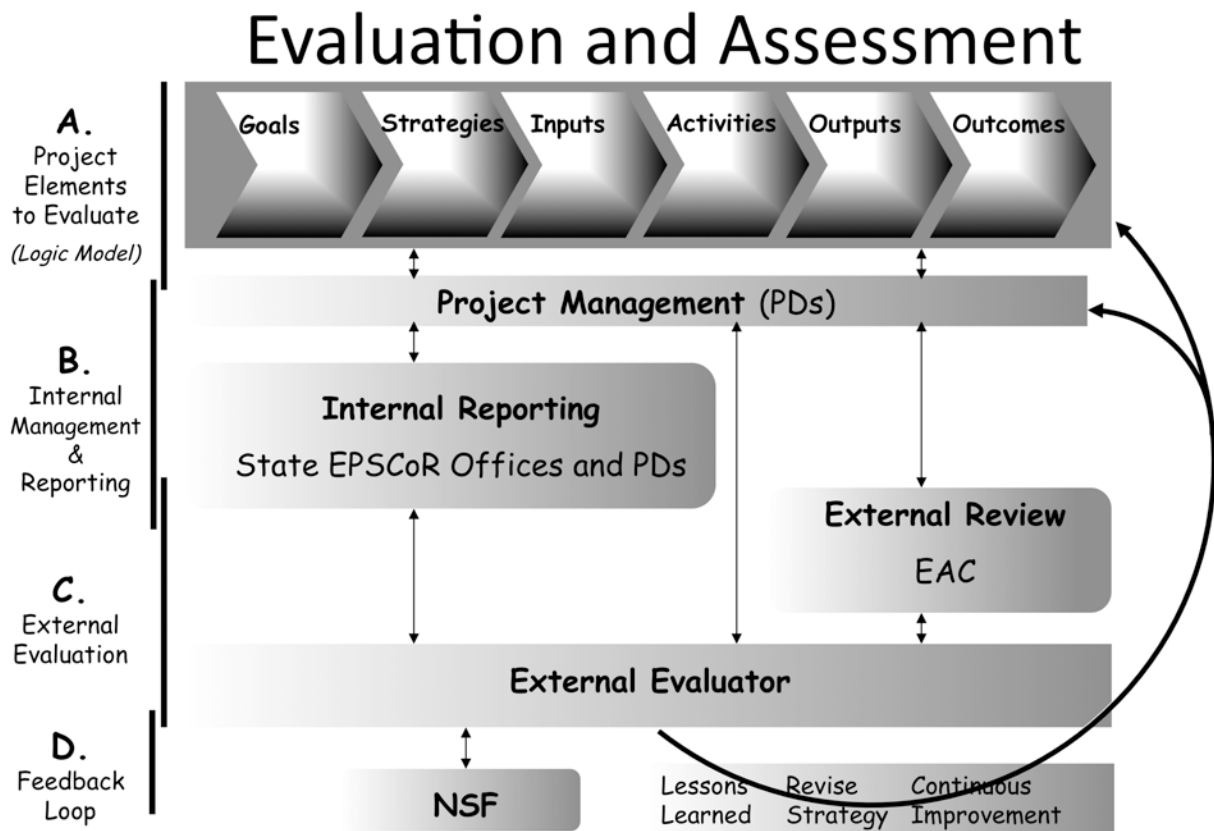
- Stephen Brown – "Overview of Hydro Desktop": graduate level river restoration class
- Karl Benedict – "RGIS 2.0" : ASPRS/MAPPS Conference (11/17/2009)
- Karl Benedict – "RGIS 2.0" : New Mexico Geographic Information Council (11/13/2010)
- Karl Benedict – "RGIS 2.0" : American Geophysical Union (12/18/2010)
- Karl Benedict – "RGIS 2.0 - An Interoperable, Open Source SOA for Geospatial Information Delivery" : Federation of Earth Science Information Partners (1/5/10)
- Karl Benedict – "Service Oriented Architectures for the Exchange of Science Information" : Seminar in Interdisciplinary Biology and Biological Sciences (SiBBs) (3/10/2010)
- Karl Benedict – "The development of standards-based geospatial applications at EDAC - perspective from 10 years of evolution" : CyberShARE Distinguished Lecture Series (3/26/2010)

Idaho RII participants made the following presentations during the reporting period

- 1st International MapWindow GIS Users and Developers Conference (this conference was organized by Dr. Dan Ames)
- AWRA Spring Specialty Conference on GIS and Water Resources
- Community Surface Dynamics System Meeting

f. Evaluation and Assessment.

The project’s management team works in concert with the External Evaluator (Dr. Rose Shaw) and an External Advisory Committee to monitor how well the project is moving towards its goals. The External Evaluator uses formative and summative evaluation processes and provides an annual evaluation report to the project management team. At the November 2009 project planning committee meeting, the External Evaluator helped Track 2 participants to identify metrics and measures for the project’s detailed evaluation plan, which was completed by the evaluator in January 2010. In addition to the external evaluator, our project’s *evaluation* and *assessment* component includes an eight member External Advisory Committee (EAC) that meets annually. The first EAC meeting took place on February 25, 2010 in Las Vegas, NV. A summary of, and outcomes from, the meeting are detailed above in the Executive Summary section “Actions resulting from site visits, reverse site visits, evaluation and assessment reports, advisory committee visits.” A schematic of the project’s evaluation and assessment program is shown below.



g. Sustainability and Project Outputs.

Sustainability efforts are being accomplished in four primary ways. The first is by commitments to long-term support by individual states and institutions for Track 2 activities. The connectivity and broadband improvements accomplished in year one are being maintained by each state/institution.

The second way is through development of new proposals that make use of and provide continued CI support. Several proposals have been submitted, or are in the process of being submitted this year. Proposals and awards by Consortium members are shown below.

Idaho:

Proposals Funded

- "Understanding relational social networks within complex, nonlinear systems: geographically-integrated history and dynamics GIS". NSF (National Science Foundation). Submitted 5/2009. Amount Requested: \$1,761,897. PI: Jack Owens. Co-PI's: Daniel Ames, Emery Coppola, Aldo Gangemi, Vitit Kantabutra. Funded . Amount Funded: \$1,761,897. 8/1/2009 to 9/30/2013
- "INRA Water Resources Steering Committee". INRA (Inland Northwest Research Alliance). Submitted 1/2009. Amount Requested: \$25,000. PI: Daniel Ames. Co-PI's: Ben T Crosby, Bruce Savage. Funded . Amount Funded: \$25,000. 9/1/2008 to 12/31/2009
- "Development and Implementation of ICEWATER HIS Tools". INRA (Inland Northwest Research Alliance). Submitted 1/2009. Amount Requested: \$91,000. PI: Daniel Ames. Funded . Amount Funded: \$91,000. 9/1/2008 to 12/31/2009
- "Towards an Integrated Feedstock Modeling Architecture: Feedstock Data Web Services". INL (Idaho National Laboratory). Submitted 5/2009. Amount Requested: \$50,000. PI: Daniel Ames. Funded . Amount Funded: \$50,000. 7/1/2009 to 9/30/2010
- "Technical Support for D4EM and FRAMES Model Migration". EPA (Environmental Protection Agency). Submitted 3/2009. Amount Requested: \$30,000. PI: Daniel Ames. Funded . Amount Funded: \$30,000. 4/1/2009 to 3/31/2010
- "Big Sky Partnership and the Mafic Rock Atlas". DOE (Department of Energy). Submitted 3/2009. Amount Requested: \$108,181. PI: Daniel Ames. Co-PI's: Scott Hughes. Funded . Amount Funded: \$108,181. 4/1/2009 to 2/15/2009
- "HIS Desktop Software and Community Development". NSF (National Science Foundation). Submitted 1/2009. Amount Requested: \$65,000. PI: Daniel Ames. Funded . Amount Funded: \$65,000. 1/1/2009 to 5/31/2010
- "Transmission Siting Decision Support LDRD". DOE (Department of Energy). Submitted 2/2010. Amount Requested: \$242,008. PI: Michael Louis. Co-PI's: Juliet Carlisle, Daniel Ames. Funded . Amount Funded: \$242,008. 5/15/2010 to 9/30/2012
- "Integrated Environmental Modeling Software Systems Innovative Working Group". University of Idaho. Submitted 12/2009. Amount Requested: \$9,010. PI: Daniel Ames. Other Collaborators: Nancy Glenn, Jeffery Horsburgh, Karl Benedict, Sergiu Dascalu, Jon Goodall. Funded . Amount Funded: \$9,010. 1/1/2010 to 12/1/2010
- "CZO Desktop". NSF (National Science Foundation). Submitted 10/2009. Amount Requested: \$35,000. PI: Daniel Ames. Funded . Amount Funded: \$35,000. 9/22/2009 to 8/31/2010

- "Technical Support for a Linked Watershed Modeling LDRD Project - yr 2 Addendum". DOE (Department of Energy). Submitted 6/2009. Amount Requested: \$51,508. PI: Daniel Ames. Funded . Amount Funded: \$51,508. 8/1/2009 to 9/30/2010

Proposals Submitted

- "Leveraging Geotechnologies Education Capabilities in the Wood River Valley and Beyond". Idaho State Board of Education. Submitted 1/2010. Amount Requested: \$150,000. PI: Nancy Glenn. Co-PI's: Daniel Ames. Pending
- "GIS-based Watershed Management Decision Support System Development for Lake Sidney Lanier". National Science Foundation. Submitted 1/2010. Amount Requested: \$350,000. PI: Sudhanshu Panda. Co-PI's: Daniel Ames. Pending
- "Virtual Great Lakes System: A Regional GEOSS Element". EPA (Environmental Protection Agency). Submitted 2/2010. Amount Requested: \$3,100,000. PI: Barbara Minsker. Co-PI's: Brian K Miller. Other Collaborators: Daniel Ames. Pending
- "Geothermal Resource Potential of the Blackfoot Lava Field, SE Idaho: Implications of Young Bimodal Volcanism and Dike-Related Fault Systems". DOE (Department of Energy). Submitted 5/2009. Amount Requested: \$599,200. PI: Michael McCurry. Other Collaborators: Daniel Ames. Pending
- "Using Technology to Teach Technology: The Idaho Geotechnologies Education Network (IGEN)". Idaho State Board of Education. Submitted 1/2009. Amount Requested: \$95,000. PI: Daniel Ames. Denied
- "STRESS - Spatial Tool for Rapid Ecoservices Stressors Simulation". EPA (Environmental Protection Agency). Submitted 5/2009. Amount Requested: \$499,000. PI: John Teem. Co-PI's: Robert Cantrell, Chris Cosner, Mitsunori Ogihara, Juan Gutierrez, Daniel Ames. Denied
- "Economics of Land Use Change on Water, Air, and the Economy of Idaho". State Board of Education Research. Submitted 9/2009. Amount Requested: \$. PI: Sian --- Mooney. Co-PI's: Scott Lowe, Daniel Ames, Kelly Cobourn. Denied

Nevada:

Proposals Awarded

None

Proposals Submitted

- "Online Numerical Methods Laboratory", NSF CCLI Pavel Solin (PI), Sergiu Dascalu, Ed Keppelman (co-PIs). \$600,000. 09/2010 - 08/2013. Pending.
- "Advanced Parallel Neural Simulation Platforms: Usability, Adaptability, and Performance Enhancements to NCS", NIH Software Improvements, Fred Harris (PI) and Sergiu Dascalu (co-PI), \$1,286,000, 09/2010 -08/2014, Pending.
- "Collaborative Research: WSC-Category 2. Integrated Assessment of Singular and Compounding Effects of Human Use and Changing Climate on Arid Land Hydroecology in E. Nevada." NSF Saxon Sharpe (PI) and 7 co-PIs including Sergiu Dascalu, 4,700,000, 10/2010-9/2015.

New Mexico:

Proposals Awarded

None

Proposals Submitted

- "CI-TEAM Implementation: CyberShARE-TEAM- Cyberinfrastructure Training, Education, Advancement, and Mentoring of Hispanic Teachers and Students". NSF Paulo Pinheiro da Silva (PI) UTEP, 4 Co-PIs, including Karl Benedict. \$995,895. 9/2010-8/2013.

The third mechanism for sustainability is through creation of new partnerships and strengthened collaborations. Collaborations within the Consortium have been greatly strengthened as the result of the Annual Tri-State Meeting. Some of these collaborations have led to successful Innovation Working Group projects, and proposal development and submissions to Federal agencies. Other collaborations are detailed above in the Institutional Collaborations section above. National partnerships developing in year one include NSF-funded programs CUASHI, CREST, CYBER-ShARE, and Shodor.

Sustainability of CI developments relating to the *interoperable* data archive in New Mexico have been accomplished in close collaboration with New Mexico's Resource Geographic Information System (NM RGIS), the geospatial data clearinghouse for the state of New Mexico. NM RGIS has a long-standing history (18 years) as the state clearinghouse and is a stable platform through which the science data products of the EPSCoR project will be continuously published beyond the funding window provided by NSF for the current RII. This partnership and integration of science data into the RGIS system will provide long-term sustainability for availability of products for years to come. Also, the development of the www.hydrodesktop.org web site – where all hydrologic information systems-related development associated with this project is being presented in an open source fashion – is focused on fostering collaborative development of the system with expected long-term sustainability by building a large group extending beyond the EPSCoR team.

Sustainability of the *Cyberlearning* Component has focused on development of partnerships and strengthening existing partnerships for leveraging activities. For example, we have developed a partnership with MOSS in developing and disseminating educational material that will be leveraged to increase additional support of activities in the future. We have also strengthened the partnership with the Supercomputing Challenge to incorporate CI materials into an existing program, which will sustain the impact long after the end of this project. In Year 2 we also plan to develop proposals within the tri-state consortium and with outside partners (e.g. Shodor, see below).

The fourth sustainability mechanism is through increasing human capacity through recruiting new faculty postdoctoral fellows, graduate students, and technical support staff to participate in the Consortium's CI Track 2 project. In year 1 the following new hires were made:

Undergraduates

Idaho: Tifani White (mentor: Dan Ames). Contribution to Project: Populating HIS server with data from ISU science teams.

New Mexico: Stephan Brown. Advisor, Julie Coonrod, UNM, Topic: HIS integration.

Graduate Students

Idaho: Dinesh Grover (mentor: Dan Ames). Contribution to Project: Developing HydroDesktop HIS data client.

Nevada: Aarti Dhone, UNR. advisor Fred Harris, topic Data Archives

Nevada: Jigar Patel, UNR. advisor Sergiu Dascalu, topic Software Framework for Model Interoperability

Postdoctoral Associates

Idaho: Dr. Harold Dunsford (mentor: Dan Ames). Contribution to Project: Developing core mapping tools used by HydroDesktop HIS data client software.

Nevada: Dr. Rakhi Motwani, UNR. Topic: Software framework for model interoperability and data archives.

New Mexico: Dr. Li Dong. UNM. Advisor Dr. Joe Galewsky. Topic: climate model development and enhancement.

Education/Outreach Coordinator

New Mexico: Nico Marrero, New Mexico Tech

i. Seed Funding and Emerging Areas

Seed funding to develop interdisciplinary and inter-institutional proposals and publications across states is being funded by the Consortium's Innovation Working Group Program. This program, and groups that received IWG funding in year one are described above in the Institutional Collaborations section of the report. Seed funding is incorporated into the Cyberlearning Component through the sponsorship of CI training support for Consortium participants, which is described in more detail above in the *cyberlearning* part of the Research Accomplishments and Plans section.

ii. Human Resources Development.

The project's human resources development activities and outcomes includes recruitment and retention of new postdoctoral fellows, students, and technicians, workforce development, and workforce and education activities. These activities are described in detail in prior sections of this report.

iii. Leveraging NSF Programs.

Linkages, coordination, and collaboration with other NSF-funded programs are occurring at the component level of the project. Primary leveraging in the *Interoperability* Component is through our involvement in the NSF-funded Consortium of Universities for the Advancement of Hydrologic Sciences (CUAHSI) Hydrologic Information Systems (HIS) project, which we are using extensively to support the point observation data interoperability work in this project. Also, the *Interoperability* group is leveraging EDAC's emerging collaboration with the CYBER-ShARE program at the University of Texas, El Paso, which has created a connection with NSF's CREST program, as CYBER-ShARE is funded through this program. As noted above, this collaboration is also leading to new proposals to NSF programs that provide support for semantic annotation of

scientific workflows and products. The *Cyberlearning* Component may leverage existing NSF funded Shodor in the future to assist in providing CI training to Idaho EPSCoR participants.

h. Management Structure.

i. EPSCoR governing committee meetings and relevant actions.

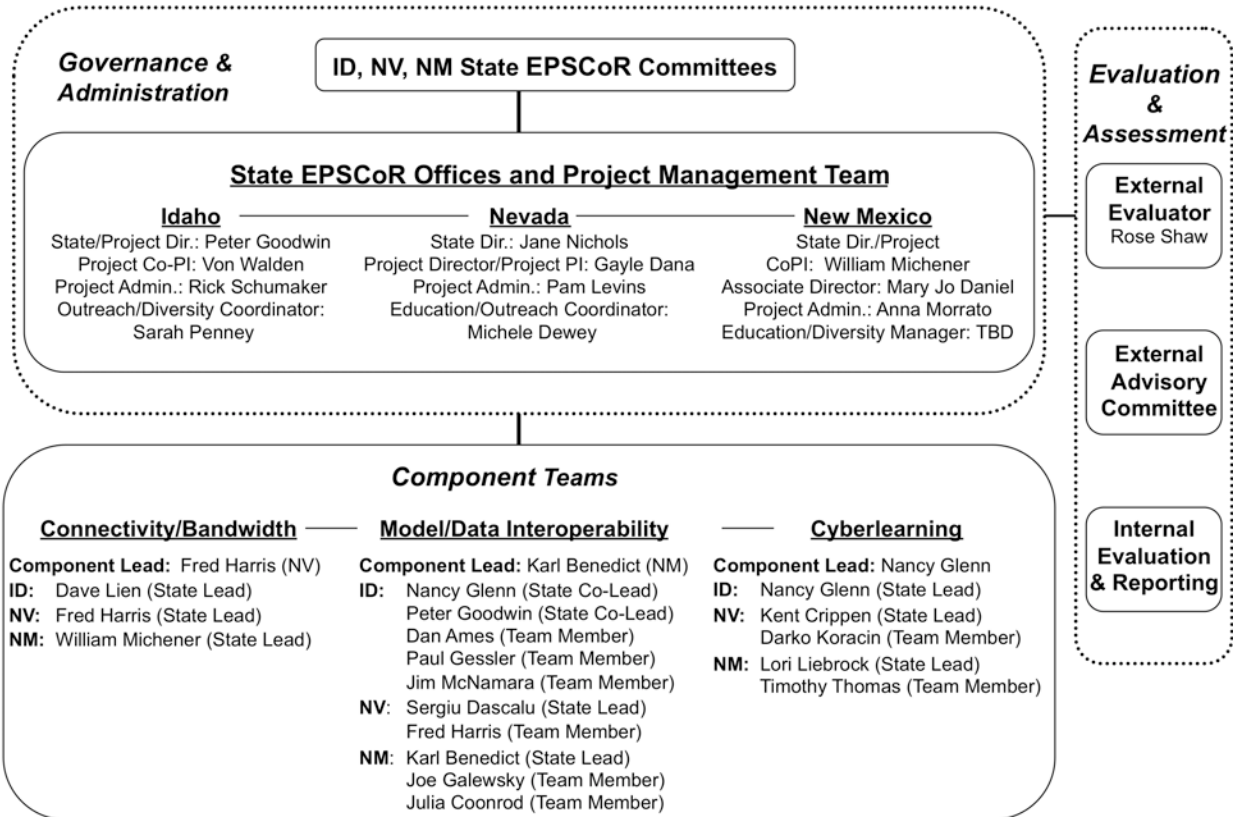
Idaho: The Idaho EPSCoR Committee held its annual meeting in August 2009, just prior to the Track 2 award announcement. The project director provided a summary of the Track 2 project proposal at that time. Since January 2010, the Idaho EPSCoR project director has provided monthly updates on RII progress through the executive committee which includes Committee officers and university vice presidents for research. The director will also provide an update of Track 2 progress to the Idaho State Board of Education in June 2010.

Nevada: The project director provided periodic updates on the Track and Track 2 projects to the State EPSCoR Operations Committee, which consists of the Vice Chancellor for Academic Affairs and the Vice Presidents for Research from the three research institutions (UNR, DRI, and UNLV). The Nevada EPSCoR Advisory Board did not meet during the reporting period.

New Mexico: The New Mexico State EPSCoR Committee met in May 2010 and reviewed Track 2 progress to date as well as the EAC Report. The committee discussed the CI Day for Industry activity that is scheduled for year two and recommended individuals who should be included in planning for the event.

ii. EPSCoR management team meetings and actions. Describe any major changes in personnel and/or succession plans for key personnel.

The project *management structure* (shown in the diagram below) is designed to encourage interaction among the three states and the various components. It includes the Management Team (State Directors, PI, Co-PIs, Project Administrators, and Education, Outreach, and Diversity Coordinators), the Component Team (Component Leads, State Leads, and component members), and Evaluation and Assessment (External Evaluator, External Advisory Committee, and Internal Reporting). To encourage effective project *communication and management*, there have been monthly Leadership meetings (consisting of the PI, Co-PIs and Component Leads), as well as monthly meetings of Component members. Most meetings have occurred online via Webex or Go to Meeting, or via phone conference. In Idaho, Mr. Hughett has retired. His responsibilities for coordination of Track 2 project connectivity improvements have been assigned to Mr. Dave Lien, assistant director of IT networks and systems at the University of Idaho.



iii. Institutional affiliation and demographics for each committee and team associated with the RII project.

The project’s leadership and management structure consists of state EPSCoR and NSF EPSCoR Project Directors, Track 2 Project PI and Co-PIs, Component Leads, and State-Specific Component Leads. The state breakdown is: ID (6), NV (7), and NM (5). The leadership and management team is distributed among eight institutions: University of Idaho (5), Idaho State University (1), Nevada System of Higher Education (3), Desert Research Institute (1), University of Nevada, Reno (2), University of Nevada, Las Vegas (1), University of New Mexico (4), New Mexico Tech (1). Females make up 50% of the leadership and management team. There is one Native American and the rest of the leadership and management team are White. Please see the table below for a detailed breakdown.

Institutional Affiliation and Demographics of Track 2 Leadership and Management Teams						
Title	State	Name	Institution	Male	Female	Ethnicity
State Director	Nevada	Jane Nichols	NSHE		1	White
Project Director and Project PI	Nevada	Gayle Dana	DRI		1	White
State and Project Director						
Model & Data Interoperability State Co-Lead	Idaho	Peter Goodwin	UI	1		White
State and Project Director						
Connectivity State Lead	New Mexico	William Michener	UNM	1		White
Associate NSF EPSCoR Project Director	New Mexico	Mary Jo Daniel	UNM		1	White
Project Co-PI	Idaho	Von Walden	UI	1		White
Project Administrator	Nevada	Pam Levins	NSHE		1	White
Project Administrator	Idaho	Rick Schumaker	UI	1		White
Project Administrator	New Mexico	Anna Morrato	UNM		1	White
Education, Outreach & Diversity Administrator	Nevada	Michele Casella	NSHE		1	White
Education, Outreach & Diversity Administrator	Idaho	Sarah Penney	UI		1	Native American
Connectivity Component and State Lead	Nevada	Fred Harris	UNR	1		White
Connectivity State Lead	Idaho	Dave Lien	UI	1		White
Model & Data Interoperability Component and State Lead	New Mexico	Karl Benedict	UNM	1		White
Model & Data Interoperability State Co-Lead						
Cyberlearning Component and State Lead	Idaho	Nancy Glenn	ISU		1	White
Model & Data Interoperability State Lead	Nevada	Sergiu Dascalu	UNR	1		White
Cyberlearning State Lead	Nevada	Kent Crippen	UNLV	1		White
Cyberlearning State Lead	New Mexico	Lori Liebrock	NMT		1	White

iv. Technical Assistance by other outside agent, e.g. consultants.

Idaho: To assist with design of sustainable and feasible plans to access and utilize IRON, a consultant (ComGroup) was hired through approved university process to help ITS develop a formal Request for Proposals (RFP). The RFP will address network needs at the proposed sites to connect to IRON with guaranteed bandwidth but with flexible approaches that can be sustained.

Nevada: The project contracts with Dr. Rose Shaw for providing services as the external evaluator. Nevada project Web site maintenance is provided by Laura Mercer, an independent contractor (consultant).

New Mexico: There was no technical assistance by other outside agents in year one.

i. Jurisdictional and Other Support.

Idaho: In Idaho, the ID EPSCoR staff administers the NSF EPSCoR projects, including this Track 2 award. A portion of the staff effort is provided through non-federal state support for the Idaho EPSCoR program. Idaho EPSCoR resources for office space, communications, and videoconferencing are also provided.

Nevada: Financial and administrative assistance to the project is provided by the Nevada EPSCoR Office (NEO), which administers all of the state EPSCoR programs. Key personnel within the Administrative Management Team include: Pamela Levins (full-time NSF EPSCoR Project Administrator) responsible for budget administration, coordination with the NSHE institutions' research offices, collecting baseline information, documenting accomplishments of project milestones, and general administration of sub-awards; Michele Casella (full-time NSF EPSCoR Research Administrator) coordinates RII evaluation activities, education outreach programs, and statewide student solicitations and works with faculty to increase diversity for project components; and Communications Specialist (Lisa Contreras) responsible information and

updates for the Web developer, design brochures for specific projects, works with the NSHE PR office for all press media relations, and works with the campus PR staff to incorporate NSF EPSCoR highlights for faculty, staff, and students. Other full-time NEO staff involved in project management include: Al Hardimon - financial administration; Lori Brazfield – sub-award preparation and monitoring; Angela Poole and Marilyn Lewis - financial and credit card transactions, travel coordination, and general administrative support. NSHE provides offices and secretarial support for all project participants. Video conferencing facilities are available to facilitate project meetings. Additionally, NSHE has video conferencing facilities that also allows file sharing and display of software presentations simultaneously between parties remotely located.

New Mexico: In New Mexico, the NM EPSCoR state office administers NSF EPSCoR programs. Key personnel include: Mary Jo Daniel, EPSCoR Associate Director; Anna Morrato, EPSCoR Project Administrator; and Megan Gallegos, Accountant. Additional support is provided by Laura Arguelles, Data Manager and Web Designer; David Danzillio, IT Support; Melissa Coverdale, Event Coordinator. The State Office provides meeting and collaboration space, including access to video and web conferencing facilities.

Jurisdictional support for the individual project components include:

Connectivity Component: Strategic planning began at the jurisdictional level before this RII was funded and will continue to be supported after the project is completed through a variety of means. In *Nevada*, assessment of needs was performed by the universities and NevadaNet. In *New Mexico* it was done by the New Mexico’s Computer Applications Center (NMCAC) and in *Idaho* it was done by the state EPSCoR committee in collaboration with the Higher Education institutions.

Data and Software Interoperability Component: The *Idaho* research team continues to make extensive use of the facilities at the Department of Energy sponsored Center for Advanced Energy Studies in Idaho Falls, ID. *New Mexico’s* team makes continuing use of the computational resources housed at the Earth Data Analysis Center, and New Mexico’s Computer Applications Center (NM CAC, a State owned supercomputer resource upon which climate models are being run by researchers at UNM). The Computer Science Department at UNR in Nevada provides office and laboratory space for faculty, postdocs, and graduate students involved with Track 2.

j. Unobligated Funds.

The percentage of unobligated funds in year one for Idaho, Nevada, and New Mexico was 13%, 10%, and 7%, respectively.

Unobligated Track 2, Year One Funds for each State						
	Awarded	Expended	Balance	Encumbered	Unobligated	%Unobligated
Idaho	\$666,666	\$28,227	\$638,439	\$313,682	\$82,474	13%
Nevada	\$666,667	\$177,918	\$488,749	\$422,696	\$66,053	10%
New Mexico	\$666,662	\$175,475	\$491,187	\$444,505	\$46,682	7%

State-specific notes on unobligated funds:

Idaho: Expended funds are through end of May 2010. This number is low, in part, due to delays in billing and invoice payments for work already performed. Delays in hiring the CI Coordinator (estimated, June 2010) and Data Manager (estimated, August 2010), both of which are 50% funded by the project, mean that associated funds will be obligated but not fully expended by the end of year one. Those funds are necessary for those positions to exist. Responses to an RFP for connectivity improvements in Southern Idaho will be in-hand by mid-July, so associated connectivity funds also will be obligated by the end of August 2010 and expended soon thereafter.

Nevada: Numbers are derived from actual expenditures and encumbrances as of April 30, 2010.

New Mexico: Numbers are derived from actual expenditures, encumbrances and projected expenditures through September 15, 2010.

3. Award Specific Terms and Conditions.

The Consortium's Track 2 project has two award specific terms and conditions.

1. Obtain from the school board or comparable authority responsible for the schools considering participation in the project, written approval prior to involvement of pre-college students in pre-college education research and development, pilot-testing, evaluation, and revision of experimental and innovative pre-college curriculum.

Not applicable in year one.

2. Include in every publication, testing, or distribution agreement involving instructional materials developed under this award (including, but not limited to, teachers' manuals, textbooks, films, tapes, or other supplementary material) a requirement that such material be made available within the school district using it for inspection by parents or guardians of children engaged in educational programs or projects using such material of that school district.

Not applicable in year one.

4. Experimental/Computational Facilities.

No equipment was acquired in year one. There have been no usage fees paid with NSF RII money for accessing other NSF-funded shared facilities and networks in Nevada, Idaho or New Mexico.

5. Publications.

The following publications were from Nevada. At this time Idaho and New Mexico did not have publications to report

Journal Publications:

None

Books:

None

Other One-time Publications:

Hatchett, B.; Gronstal, S.; Slayden, M.; Koracin, D.; Ewing-Taylor, J.; Chow, J. 2010. Integrating Complex and Nonlinear Systems Thinking into the Secondary Education Science Curriculum. The 19th Symposium on Education, 90th Annual American Meteorological Society Meeting, Atlanta, GA

Koracin, D.; Vellore, R.; Hatchett, B.J.; McCord, T.; Koracin, J.; Horvath, K.; Belu, R. 2009. Variability of Climate Predictions Relevant to Hydrological Resources. Eos Trans. AGU, 90(52), Fall Meet. Suppl., Abstract U13B-0062

Vellore, R.; Hatchett, B.; Koracin, D. 2010. Climate prediction downscaling of temperature and precipitation in the Great Basin region. The 18th Conference on Applied Climatology, 90th Annual American Meteorological Society Meeting, Atlanta, GA

6. Honors and Awards.

The following awards and honors were given to RII participants in year one:

Idaho:

- Dr. Dan Ames was recognized at Idaho State University with a university-level award: ISU Distinguished Researcher of 2009 - 2010.

Nevada:

- In March 2010 Dr. Sergiu Dascalu (UNR), was Runner-up (received second prize) in the UNR Donald Tibbitts Distinguished Teacher award. There were 9 nominees across UNR, one from each college; Dascalu was the nominee from the UNR College of Engineering.
- In March 2010, Dr. Frederick C. Harris, Jr (UNR), was co-author of a paper that received Best Paper Award at the 25th International Conference on Computers and Their Applications (CATA-2010), Honolulu, Hawaii: "A Unique Instrumentation System Design for Measuring Forces on a Rotating Shaft" by John R. Kearney, Dwight Egbert and Frederick C. Harris, Jr. (University of Nevada, Reno, USA).
- Dr. Kent Crippen was recognized with the 2009 College of Education Distinguished Research Award and the COE Collaborative Group Award. Dr. Crippen was also awarded the UNLV Barrick Scholar Award. The Barrick Scholar Awards are designed to recognize faculty members who have established a record of distinguished research or have demonstrated excellence in the area of creative activity. These awards are based principally on the quality and quantity of research publication or creative activity, which is judged to be extraordinary and distinguished.
<http://www.unlv.edu/Include/coranto/fsinfo/news/April2010/1270744445.html>

New Mexico:

- Dr. Karl Benedict (UNM) was appointed by the EPA Administrator as a representative to EPA's National Advisory Council on Environmental Policy and Technology (NACEPT) beginning in February 2010, and continuing through February 2012.

C. Highlights

Highlight Number 1

Title: 2010 Annual Tri-State Consortium Meeting Attracts Researchers to Discuss Cyberinfrastructure and Climate Change in the West

Authors: Dr. Gayle Dana (Desert Research Institute), Dr. Peter Goodwin (University of Idaho), Dr. William Michener (University of New Mexico), and Dr. Mary Jo Daniel (University of New Mexico)

Over 160 researchers from of Idaho, Nevada, New Mexico gathered on the shores of Lake Tahoe in Incline Village NV, from April 6-8, 2010 for the second annual meeting of the NSF EPSCoR Tri-State Consortium. The Consortium was formed in 2008 to advance the understanding of climate change and its impact on the Western U.S. by leveraging an NSF EPSCoR-funded project (“Track 1”). The Consortium expanded its efforts in 2009 with the receipt of a new collaborative award from NSF EPSCoR (“Track 2”) that focuses on cyberinfrastructure development in the Tri-state region. The meeting included presentations from keynote speakers and sessions on cyberinfrastructure, diversity, climate change science and education, collaborative and interdisciplinary science, and a half-day workshop on Hydrologic Information Systems. A highlight of meeting was a competitive, student poster session, where 33 students presented research posters to judges and meeting participants.



Student awardees of the Tri-State Consortium Poster Competition at Incline Village, NV

This work was supported by NSF Cooperative Agreements EPS – 0919123 (Nevada), EPS – 0919514 (Idaho), and EPS – 0918635 (New Mexico) and NSF award 0814449 (New Mexico)

Highlight Number 2

Title: Growing Up Thinking Scientifically (GUTS): Cyberinfrastructure Enhanced Education in New Mexico

Authors: Dr. Lori Liebrock (New Mexico Tech)

Project GUTS – Growing Up Thinking Scientifically – is a summer and after-school science, technology, engineering and math (STEM) program primarily for middle school students. Growing up thinking scientifically means learning to look at the world and ask questions, develop answers to the questions through scientific inquiry, and design solutions to such problems. Twenty-six 5th and 6th graders from Cameo Elementary School in Clovis, NM met in the after-school GUTS club twice a month from fall 2009 through Spring 2010. The students excitedly embraced learning how to do agent based computer modeling using Starlogo TNG. They learned how to program the agents to make designs, how to create an ecosystem and add a predator to that ecosystem, and spent a good deal of time customizing their ecosystems. Through the process of modifying their ecosystems, students learned about predator-prey relationships and population growth curves as well as how to create a balanced ecosystem that was sustainable over a period of time. Next year, such ecosystem models will be extended with a temperature variable to study impact of climate change on population survival.



Cameo NM GUTS club members and leader (Photo: Paige Prescott paigeaprescott@gmail.com).

This work was supported by NSF Cooperative Agreements EPS – 0918635 (New Mexico)

Highlight Number 3

Title: New Mexico Supercomputing Challenge: Cyberinfrastructure Enhanced Education in New Mexico

Authors: Dr. Lori Liebrock (New Mexico Tech)

The New Mexico Supercomputing Challenge promotes computational thinking in science and engineering so that the next generation of high school graduates is better prepared to compete in an information-based economy. The teams completed science computational projects, some using high performance supercomputers, over the course of the academic year. This year, the award ceremony included more than 250 middle and high school students and their teachers. About 70 of the 98 teams that started the Challenge last fall presented projects at the Expo, the end of the year project expo and award ceremony (April 2010). The goal of the year long competition is to increase knowledge of science and computing, expose students and teachers to computers and applied mathematics. This year the top prize was captured by a team of three boys from Melrose, NM with their project, Control and Spread of Wildfires II. Next year the program will be expanded to include new materials specifically focused on climate change.



The finalist teams at the awards ceremony for Supercomputing Challenge 2009. (Photo: Talaya White).

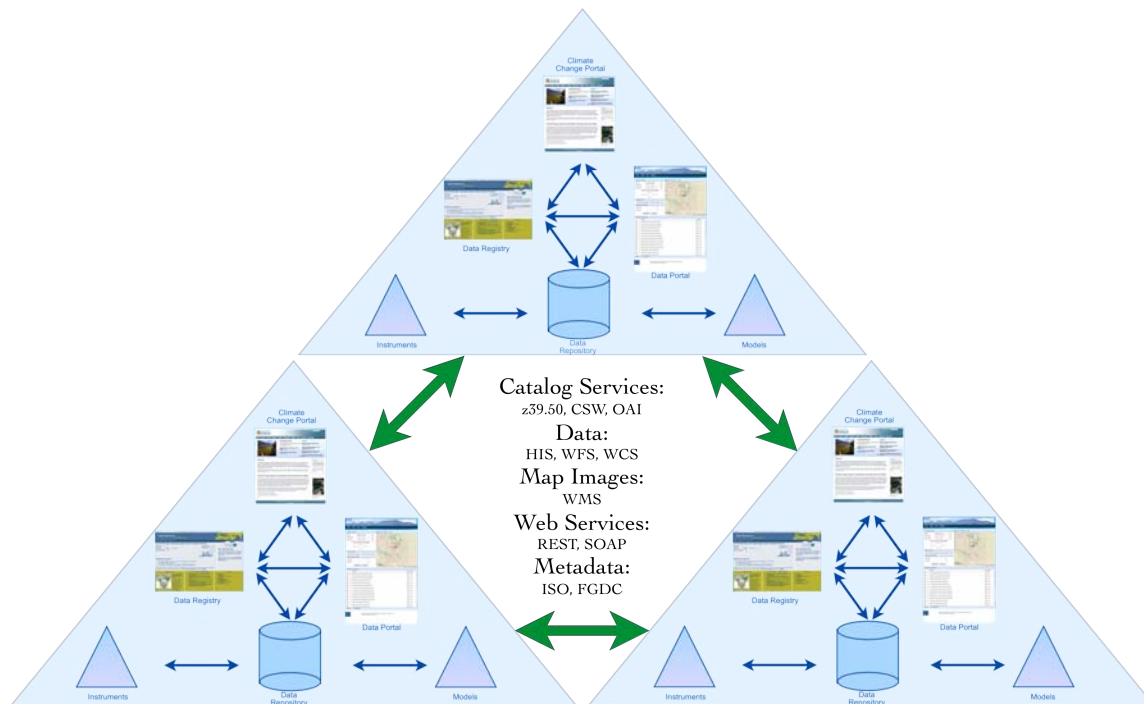
This work was supported by NSF Cooperative Agreements EPS – 0918635 (New Mexico)

Highlight Number 4

Title: Adoption of International Interoperability Standards Enables Efficient Data and Information Discovery, Exchange, and Use

Authors: Dr. Karl Benedict (University of New Mexico), Dr. Sergiu Dascalu (University of Nevada, Reno), Dr. Peter Goodwin (University of Idaho, and Dr. Nancy Glenn (Idaho State University)

New Mexico, Idaho, and Nevada are collaborating in the development of science data portals in all three states that support the rapid discovery, access, and use of research products generated by NSF funded mountain hydro-climatology research teams in all three states. Each state is developing infrastructure for the collection of measurements of meteorological and hydrologic system parameters, and are working to develop climate modeling activities that will produce outputs that may be integrated with those parameters. To maximize the usability of the data products emerging from these programs, all three states have adopted international interoperability standards as the core means for facilitating the key activities related to science data and information use: discovery of products that are applicable to specific research, education, or policy requirements; acquisition of those data products; and informed and flexible use of those products in a variety of contexts. The diagram below depicts the science data portal development structure (image by Karl Benedict, kbene@edac.unm.edu)



This work was supported by NSF Cooperative Agreements EPS – 0919123 (Nevada), EPS – 0919514 (Idaho), and EPS – 0918635 (New Mexico) and NSF award 0814449 (New Mexico)