

# **Report of the NSF EPSCoR Tri-State Cyberinfrastructure Project (Track 2) External Advisory Committee (EAC)**

## **Year 2 Review**

Conducted February 17, 2011

Center for Advanced Energy Studies, Idaho Falls, ID

## **Introduction and General Findings/Recommendations**

The External Advisory Committee (EAC) for the NSF EPSCoR Tri-State Cyberinfrastructure Project (Track 2) met on February 17, 2011 with project management and participants to review the status of the effort. The meeting was held in the Center for Advanced Energy Studies in Idaho Falls, ID and was hosted by the Idaho EPSCoR office. The EAC appreciates the opportunity to improve the project by providing feedback on its activities and directions. Through this report, the EAC offers its comments on, questions of, and recommendations for the Tri-State Cyberinfrastructure Project (Track 2) (TSCP). This summary begins with general findings and recommendations and then addresses the three areas of the TSCP activity: (1) cyberinfrastructure, (2) model and data interoperability, and (3) cyberlearning.

The following are general findings and recommendations of the committee.

1. The EAC commends the TSCP leadership group for adding the Innovation Working Groups. The process for soliciting and evaluating proposals appears sound. We look forward to hearing of success from proposals and projects generated by these working groups.
2. The TSCP leadership should think more deeply about assessment metrics. The classic measures of scientific output (publications, presentations, etc.) are not especially relevant ways to measure the outcomes that were proposed, i.e., enabling climate research and integrating that research into education. Publication quality and quantity, for example, are more accurate measures of the scientific team than they are of cyberinfrastructure (CI) per se. So while this information is relatively easy to collect, it is not necessarily a substantive endorsement of the project.

Instead, the EAC recommends collecting examples of how the CI has enabled users to address previous barriers or tackle new types of scientific problems (e.g., those that require new inter-institutional collaborations or ready access to large volumes of data not available without the TSCP). Much of this qualitative evidence could be in the form of “testimonials,” or first-hand accounts of what a research group was able to do that would not have been possible without the TSCP infrastructure.

The EAC, however, cautions project leadership to distinguish between useful testimonials and simple anecdotes when offered as evidence of success. The latter are expressions of opinions or reactions to new possibilities (e.g., “Now I see new possibilities.” or “It was exciting to find other people concerned with similar issues.”). Useful testimonials, on the other hand, describe specific accomplishments that were achievable only because of the

TSCP project (e.g., “I was able to integrate X data into my Y models, which wasn’t feasible using our methods and infrastructure prior to the work of the TSCP.”).

**Response:** As of April 2011, the project has a new external evaluator, Dr. Lisa Kohne of SmartStart. We have discussed assessment metrics and have a plan for collecting meaningful testimonials and have included it as part of her contract.

3. Apropos of the metrics that the project personnel have identified, the EAC was concerned to see that the project evaluator’s report cited some of the very metrics (e.g., number of data tables) that we called out last year as meaningless or irrelevant. Metrics are critical to clarify the efficacy of the project’s accomplishments, but the key to their value is that they be measures of the quality and value of TSCP activities and not just statistics. We urge the TSCP leadership to work with the project evaluator to cull the poor metrics and replace them with ones that are meaningful or that can support changes in project direction.

**Response:** We have brought this to the attention of the new external evaluator and she will work with the leadership team to update the metrics.

4. The New Mexico group already has a feedback survey available that, with a little tailoring, could be leveraged more broadly. The EAC suggests that project leadership specifically work on mechanisms that will improve the rate and quality of survey responses, and it offered three examples. First, EAC members have found it possible to achieve significant improvements in response rates by sending individualized emails (to one recipient at a time and beginning with the person’s first name and perhaps their institution or field of study) rather than using distribution lists. Another trick-of-the-trade is to motivate responses in some way. For example, giveaways can be offered when responses are turned in at the annual meeting, or field sites can be encouraged to respond by saying that their evidence will be used in determining priorities for upgrades.

**Response:** We will look at the New Mexico feedback survey and consider utilizing it in our Track 2 project. The new external evaluator has extensive experience with successful feedback surveys, which should increase the project’s rate and quality of survey responses.

5. The long-term impact of the project would be substantially strengthened by tying both CI objectives and CI outcomes to STEM research outcomes. In particular, the project should identify specific STEM research outcomes that were not possible without the improved CI, but that became possible upon completion of the CI; this would be extremely valuable for demonstrating the return-on-investment of the TSCP.

A paragraph about each such achievement should be produced, focusing on: (a) what could not be accomplished before CI deployment and the CI’s impact on research productivity; (b) what new capabilities were enabled by the new CI; and (c) what STEM research outcomes resulted from the new capabilities. This would be especially valuable in the context of the climate change science topic of the TSCP. Comparable examples from outside the climate community could, however, demonstrate the impact of the CI improvements beyond the nominal scope of your project— and thus provide evidence of greater return-on-investment

than originally anticipated. In addition, impact on both users and institutions arising from leveraging the TSCP, in terms of tangibles such as external funding awarded and career outcomes such as tenure decisions, should also receive attention (e.g., “The TSCP was integral to my being awarded a \$X grant from agency Y’s program Z.” or “The research I did using the TSCP played a key role in my university’s decision to award me tenure.”).

**Response:** We have discussed these suggestions with our external evaluator and have a plan to strengthen our assessment of long-term impacts.

6. The EAC concurs that diversity is a concern. We hope to hear next year that the project was able not only to implement suggestions from the IWG on diversity, but also to achieve better representation in project-enabled activities.

**Response:** The Tri-State Diversity Working Group (which convened the IWG) organized a session at the annual 2011 Tri-State Meeting in New Mexico. They reviewed the Tri-State Diversity Strategic Action Plan (an outcome of the IWG) and developed a path forward for implementing the Action Plan. This is a very enthusiastic working group that is very committed to increasing diversity in the Track 2 and other NSF EPSCoR projects in the Tri-States.

### **Cyberinfrastructure Connectivity** (*Change made by G. Dana to reflect heading that should be used here*)

The TSCP project includes substantial improvements in connectivity for all three states, varying in scale from individual sites to statewide. The leadership team reports that all of the physical CI components (except those for Hagerman and Kimberly, ID) have been deployed.

The EAC was pleased to note that the project’s agenda was structured to frontload the physical CI deployments into project year one. This allowed those capabilities to be in place by the start of year two, ready to be used not only by the interoperability and education teams of the TSCP, but also by other efforts external to the TSCP. The latter include projects not specifically related to the TSCP science topic (climate change), thus demonstrating a better return-on-investment than proposed.

Now that the connectivity improvements are in place, the central task for physical CI is to establish its value to the tri-state STEM research enterprise. Doing so will require identifying metrics that clearly depict not only how the physical CI has improved research productivity, but especially, how it has given rise to new research capabilities and outcomes that were not possible before this deployment. For example, traditional network usage statistics are not particularly compelling as metrics for this project. Knowing aggregate data transfer rates before and after deployment is not necessarily a useful indicator of better science being enabled. The TSCP team should develop metrics that are more clearly related to the program goals of enabling research and of the integration of research into education.

The project team should also clarify the broader impacts of the CI in all three states. The following are examples.

- A potentially useful approach would be for the team to request at least a few sites (e.g., the McCall site) to log the events where the CI was used for specific group activities, as opposed to general access to the Internet for individual use. The sites should be encouraged to provide testimonials of usage, such as: “We couldn't have gotten specialist X to participate in the workshop without the new CI capabilities.”, or “This helped me carry out task Y, which previously I couldn't do.” Do this longitudinally for relevant STEM research and/or education teams. That is, get near-term responses at the event itself (“What might you accomplish?”) and then follow up a year or two later to see what they actually accomplished.
- At the TSCP annual meeting, conduct a CI usage survey to identify which groups and individual researchers are exploiting the CI, how they're exploiting it, and to what effect. To improve the response rate, withhold swag until they submit their completed survey.

Other miscellaneous questions of the EAC are as follows. First, how sustainable is this effort? Will the infrastructure be supportable after the project, through known sources of funding or planned efforts to get sustaining funding? Second, is additional capability (e.g., bandwidth) already needed and/or anticipated?

**Response:** We have been discussing metrics and are still working on coming up with new ones. We think testimonials of research enabled will be very beneficial here. As mentioned earlier we have discussed collecting meaningful testimonials with the new external evaluator. We are also looking at the New Mexico feedback surveys and consider utilizing it. The external evaluator will assist us in this process. The infrastructure put in place through this grant is being sustained by campus and state networking, so sustainability is already covered, and the need of additional capability has not been an issue to this point.

### **Model and Data Interoperability**

The EAC recognized the importance of the efforts to improve data and model interoperability, as these are important elements for the TSCP to gain understanding of climate changes where there are multiple disciplines involved. The committee likes the capability that is being developed to help scientists better manage data and provide access to data, especially field data. The committee compliments the project team on their work in publishing data using standards-based approaches as part of the CUAHSI Hydrologic Information System.

The EAC felt, however, that the CI efforts of this project fell a bit short in terms of interaction with, or connection to, users. It is not clear who the real target users are and whether the capability being developed really responds to their needs and priorities. The EAC has several suggestions in this vein.

First, the committee suggests that TSCP leadership identify specific target users and work directly with them to identify realistic requirements. This will involve identifying the shortcomings of existing systems— indeed, clarifying why existing coupled systems are inadequate or are not being used— and is critical in order to avoid duplicating the development efforts of other coupled regional climate model (RCM) systems. Work with the same users to identify specific requirements for any future system; that is the only way to ensure that the data

interoperability and modeling capability being developed actually address user needs. In this context, “users” are the scientists who would be using the new CI to do research. It is particularly important to clarify why existing RCMs and modeling/data tools do not meet user needs and how the CI being developed by the TSCP fills those gaps.

**Response:** The Cyber-science Innovation Working Group (IWG) Workshop that was held in all three states is a start towards addressing this overall need to have more regular and systematic interaction with the researchers in all three states. As part of the IWG we spent a significant amount of time in discussion with the participating researchers in identifying barriers to their research that CI might be able to address. The results of the IWG and a subsequent targeted session at the April 2011 Tri-State meeting are contributing to the ongoing planning and development of the CI for the Track 2 project. We plan on a continued and ongoing exchange with project researchers throughout the remainder of the Track 2 (and Track 1) projects. Additionally, information from all three state’s researchers was collected at the Tri-state meeting (and now in a subsequent online survey developed in consultation with our new Track 2 External Evaluator) relating to anticipated data products that will be generated by the researchers. This information – and the associated contact information for the submitting researchers – will provide the foundation for direct interaction with numerous researchers in all three states as we initiate the process of large-scale data ingest into the three state’s respective data portals.

The EAC further suggests that the project choose a small number (3–6) of projects needing the regional climate modeling system, as targets for special attention as “early adopters”. Assign staff to work with these groups to help them tailor the new CI capabilities to overcome their scientific problems more effectively. The committee emphasizes that this should be done while the CI is still under development, rather than waiting until it is considered stable enough for general release (“release early and often”). The point is to ensure that the CI products and tool are really useful to representative users and can be changed if necessary before it is too late.

In return for the project’s help, these “target users” can help keep it on track and focused on the aspects that are most important to the beneficiaries. Because the TSCP will be their partners, these users can help the interoperability team with evaluations (e.g., feedback on the features that are most useful and on the improvements/additions that would be most valuable). Finally, if the project is successful, the users can be valuable advocates for promoting the CI to other potential users— and will be more effective in doing so than the TSCP would be on its own. Consider that aspect in choosing the target projects; select individuals who are well-respected among tri-state researchers and who will speak out on your behalf.

**Response:** The researchers that have come forth to participate in the Cyber-science IWG and our subsequent session at the Tri-state meeting are our initial pool of researchers that we plan on engaging with in developing specific demonstration activities that both highlight the CI capabilities developed in the project, and provide direct feedback in specific areas of improvement or development in the CI capabilities that can be enhanced to better match the specific use-case requirements exposed through these collaborations.

The committee notes that progress metrics are an important aspect of this project. However, it was not clear what metrics were being considered to quantify progress in the area of model and data interoperability and how they informed changes in project direction. In addition, the committee suggests addressing, as a metric, specifics on how the CI developed has enabled work or yielded results not possible without it.

**Response:** The Tri-state meeting held in New Mexico in April, 2011 provided the CI Team's first opportunity to interact with the new Track 2 External Evaluator. Her participation in our CI-Working Group session on the first day of the meeting allowed us to identify key strategies (an activity already planned for the session, but greatly enhanced by her presence) for capturing and tracking "impact" metrics from users of the CI being developed in all three states. We are in the process of coordinating with the External Evaluator to refine the methods and instruments that will be used to capture these metrics in the long run.

We look forward, at next year's review, to hearing detailed information about the project's activities to engage users directly in shaping the directions and priorities of project CI. Lastly, the EAC notes that many of the goals of the data interoperability aspects of the TSCP align with the goals of DataOne (and perhaps other NSF DataNet projects). The committee would have liked to have heard more on whether, and how, there is synergy between DataOne and this project.

**Response:** Due to time limitations we did not have a chance to go into detail regarding the interactions between our Tri-state CI Working Group and other organizations/networks. As we illustrated on slide 7 of the presentation, our team is working with/targeting several organizations for both data interoperability (developing capacity for exchanging data with external systems/networks) and technical exchange (engaging in collaborative information exchange about planned/emerging capabilities in complementary systems).

There are numerous opportunities for collaboration between the Tri-State Western Consortium and DataONE and several are underway. In particular, representatives from two of the three states serve on DataONE Working Groups and were Founding Members of the DataONE Users' Group. Those individuals and members of the DataONE Leadership Team are currently planning to establish DataONE Member Nodes at institutions within Idaho (USGS NBII FRAMES Node and the University of Idaho) and New Mexico (Earth Data Analysis Center and the University of New Mexico). Other opportunities will be explored as they arise.

## **Cyberlearning**

The EAC in its review of the cyberlearning (CL) activities of the project found several positive aspects to the activities undertaken in year two. These activities fall into two major categories: higher education and pre-college.

In terms of higher education activities, the number and content of workshops offered for graduate students, post-docs, and faculty seemed appropriate and, based upon the limited metric of open-ended evaluations, well-received. However, this activity, as mentioned earlier in this report, lacks metrics to measure the effectiveness of the activity beyond the surface level. In collaboration with the project evaluator, the project directors in this area should develop some more in-depth measures to gauge the effectiveness of the workshops. An example would be to

ask workshop participants questions such as, “What are you going to be able to do after the workshop that you could not have done before?” Questions like this would help make the case that the overall project has helped increase knowledge and productivity.

**Response:** We will discuss these suggestions with our external evaluator order to strengthen our assessment of the effectiveness of the workshops.

A key issue in our assessment of the CL achievements is the effectiveness of how the CI improvements have impacted the education initiatives. While the educational and training interactions appear useful, and the number of instructors and students involved are significant, the committee wonders if these activities could still exist in the absence of the CI improvements funded by the grant. It is recommended that the cyberlearning activities be presented with the rationale of how the CI enabled them.

**Response:** We will discuss the interaction of the CI improvements and the CL achievements with the CI group and present our findings together in the future.

The pre-college-level activities have made considerable progress from the previous year, and vary considerably from state to state. The work in Nevada seems the most advanced, with the teacher professional development and the development of curricular materials having the potential for use in multiple environments. The Idaho work is focused on the McCall Outdoor Science School; teacher workshops have been conducted and there is a start on field-based materials for other teachers to use. The New Mexico activities seem most positioned towards informal education activities such as GUTS and SCC, oriented towards under-represented students. A detailed analysis of each site’s curricular offerings was beyond the time allocated for this review, but generally the activities seem to be following the 5E model design and appear to be age/grade appropriate.

The EAC cautions the TPSC leadership that in order to have a lasting impact, it will be important to involve as many middle and high school teachers as possible in the field testing of the materials. This may be limited by funds, but field trials are extremely important in the development cycle.

**Response:** We agree and there are quite a few teachers involved, at varying levels, in all 3 of the states. We will keep this comment in mind as we design and implement materials in Year 3.

It was noted in the CL presentation that a task for year two included “compiling data to develop an evaluation of education materials.” The evaluation of the impact of curricular materials is not a trivial task. Even a simple pre-test to post-test evaluation will require substantial development or finding of instruments (both cognitive and attitude). The EAC suggests that an external consultant with expertise and background in this area be engaged to work with the TSCP project staff.

**Response:** We agree and a complete evaluation was out of the scope and funding for this project. However, while we will not have a full assessment / evaluation of the

curricular materials, we are compiling information from participants who have used the data in Years 1 and 2. This information will be provided in the final report.

The examples of specific CL activities during the first year focused almost exclusively on use of climate system modeling and model data generated in the tri-state area. The EAC notes that there are also significant educational services and offerings on climate study provided by other groups and available across the U.S. and the world. An issue to address is how the new and improved CI in the tri-state group can provide greater access to these resources for educational use.

**Response:** We feel that we are providing greater access to these resources by incorporating the Climate Literacy Framework (<http://climateliteracynow.org>) as one example.

### **Summary**

In summary, we note that the level of activity that the TSCP has stimulated to date is impressive. The effort has been particularly effective in leveraging Track 1 and other sources of funding. It is clear that the project has strong project leadership and solid organization, with the organization of the review meeting and project overview at the meeting being evidence of this. The CI investments being made by this project are showing initial indicators of success. We encourage the TSCP team to use carefully-selected metrics to prove the return on these investments in the coming years, so as to establish a basis for applying for further support in the future.

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