Project Outcomes
CREST-Cyber-ShARE Center of Excellence-Phase I
A Center for Sharing Resources through Cyberinfrastructures to
Advance Science and Education

The Cyber-ShARE Center of Excellence at the University of Texas at El Paso (UTEP) conducts research on complex interdisciplinary problems and develops a workforce that is capable of contributing to research that integrates knowledge across disciplines. Cyber-ShARE brings together experts in computer science, computational mathematics, education, earth science, and environmental science to advance and integrate cyber-enhanced, collaborative, and interdisciplinary education and research through technologies that support the acquisition, exchange, analysis, and integration of data, information, and knowledge. During the initial funding period, Cyber-ShARE conducted research and supported subprojects within the following areas:

- Knowledge representation that focuses primarily on the challenge of providing information to scientists and other users of cyberinfrastructure (CI) that allows them to trust the data and products that they can automatically retrieve;
- Earth's Structure that addresses the challenges of integrating geophysical data from diverse sources to obtain a more coherent understanding of the structure below the earth's surface that results in earthquake activity; and
- Environmental Science that addresses issues of integrating data collected at different spatiotemporal scales (from sensors at field sites to sensors in space), to better understand the exchange dynamics and biophysical controls of land-atmosphere carbon, water, and energy exchange in several extreme environments.

INTELLECTUAL MERIT

The merit of the Cyber-ShARE Center lies in its success of the following: developing interdisciplinary research capacity at UTEP; educating diverse scientists and engineers who can work in interdisciplinary teams and are knowledgeable in using state-of-the-art CI technologies; and developing center and institutional-level CI that can exploit and contribute to emerging national-level CI. All Cyber-ShARE projects involve faculty and student researchers from multiple disciplines. Through workshops, training, and immersion, students learn how to work in interdisciplinary teams.

In its efforts to support collaboration and use of disseminated scientific results, the researchers from the *Knowledge Representation* subproject developed software products and methods for documenting the steps of a scientific analysis from initial data collection, through processing and analysis, to publication and sharing of results. In its effort to generate a better understanding of the structure beneath the Earth's surface, and its relationship with earthquakes, the research from the *Earth Structure* subproject has resulted in algorithms for the fusion of seismic data and geophysical models. The subproject has produced a novel model fusion approach to create more accurate models of Earth structures from velocity models, an angular density approach for processing seismic data that uses innovative techniques to quantify spatial resolution of the resulting geophysical model, and an optimization method that provides a robust approximated model in terms of satisfying geophysical constraints, accuracy, and efficiency. The *Environmental Science* subproject has developed new CI to improve understanding of the exchange dynamics and biophysical controls of land-atmosphere carbon, water, and energy exchange in several extreme environments. The data from the project is being contributed to national and international networks and prototype software are being tested by colleagues within the field, which has generated positive feedback.

Cyber-ShARE has funded 71 student Cyber-ShARE Scholars since 2007 and involves an additional ten students leveraged from other funding sources. Of these students, 54 are citizens or permanent

residents. The ethnicity of the students who are citizens or permanent residents are as follows: 45 students are Hispanic, one student is African American, two students are Asian/Pacific Islander, and six students are white. Of these students 22 are female and 32 are male. Compared to the national averages for geology, environmental and computer sciences graduate students (NSF 2008), Cyber-ShARE students are 83.3% Hispanic while the national average is 4.7%, and 40.7% female while the national average is 30.8%.

The first cohort of PhD students graduated in summer and fall 2011. Dr. Pearl Brazier is a professor at the University of Texas Pan American; Drs. Irbis Gallegos and Aida Gandara are Subject Matter Experts with the El Paso Intelligence Center (a Department of Justice organization); Dr. Santonu Goswani is with Oakridge National Laboratory; Dr. Leonardo Salayandia is an entrepreneur in the international manufacturing industry; Drs. Nicholas del Rio is a research scientist at the Air Force Research Laboratory in Rome, NY. The center has graduated 15 Master's students; three are entering Ph.D. programs. Of the nine undergraduate students, eight have continued to Master's programs.

BROADER IMPACTS
The Cyber-ShARE Center's development of CI resources, such as software tools, online services, data repositories, ontologies, and workflows has far-reaching implications for local and national research projects (e.g., NSF-funded projects such as EarthScope and NEON, both of which collect multivariate data over large spatial areas). The Center's interdisciplinary expertise contributes to a robust computational science doctoral program, CI-focused curriculum, and tools that integrate research and education. By offering research experiences to students from a variety of backgrounds, providing workshops, and supporting a *Distinguished Lecture Series*, the Center contributes to the development of a diverse workforce with CI proficiency.