In 2006 the Texas State Board of Education (SBOE) voted to require a fourth year of science for graduation from high school and to authorize the creation of a new senior level Earth and Space Science course as an option to fulfill that requirement. The creation of the new Earth and Space Science capstone course is an important opportunity to promote long-lasting transformation in the teaching of earth system science in Texas, a state with a minority school-age population of over 50%, impacting hundreds of thousands of teachers and students over many years. UNAVCO is playing a role in the K-12 Earth Science revolution taking place in Texas by providing high quality, rigorous curriculum resources to support teacher preparation projects being carried out by The University of Texas at Austin Jackson School of Geoscience (JSG) is carrying out in collaboration with the Texas Regional Collaboratives for Excellence in Science Teaching (TRC). TRC is a statewide network of teacher mentors and science teachers with a 15 year history of exemplary teacher professional development.

UNAVCO materials and resources were used in the following projects: The “Texas Earth Science Revolution Workshops”, a series of three two-day earth science professional development academies offered in fall 2006 to minority-serving teacher mentors and Texas Education Service Center science education specialists by the JSG’s Institute for Geophysics, the TRC and TERC. The Texas Education Agency funded these workshops. “Special Topics in the Geosciences”, a course taught by UTIG* researchers to undergraduate STEM majors and pre-service teachers at Huston Tillotson University, an HBCU**, in spring 2006. The course was part of an NSF-sponsored pilot project to promote diversity in the geosciences and incorporated instructional strategies designed to prepare teachers to teach science by inquiry, rather than by lecturing, and use online resources such as UNAVCO’s Jules Verne Voyager. Jr.

The new Texas capstone course is truly a rigorous and dynamic change to the way Earth and Space science has been presented before anywhere in the U.S. and will continue to provide additional opportunities for professional development and the dissemination of suitable earth and space science curriculum. UNAVCO will nurture the relationship established in Texas and seek suitable opportunities to collaborate with academic institutions, school districts, and organizations on geoscience education projects that advance earth science education in Texas and which are compatible with UNAVCO’s mission.

*University of Texas Institute for Geophysics  
**Historically Black Colleges & Universities
We have created a new, interactive, web-based map utility that can make EarthScope-related scientific results accessible to a large number and variety of users. The tool provides a user-friendly interface that allows users to access a variety of maps, satellite images, and geophysical data at a range of spatial scales. The EarthScope Voyager map tool allows users to interactively create a variety of geographic, geologic, and geodynamic maps of the EarthScope study area. The utility is built on the “Jules Verne Voyager” suite of map tools, developed by UNAVCO for the study of global-scale geodynamic processes. Users can choose from a variety of base maps (including satellite imagery, global topography, geoid, sea-floor age, strain rate and seismic hazard maps, and others), add a number of geographic and geophysical overlays (coastlines, political boundaries, rivers and lakes, earthquake and volcano locations, stress axes, etc.), and superimpose both observed and model velocity vectors representing a compilation of 5170 geodetic measurements from around the world. Users can select from 26 frames of reference, allowing a visual representation of both ‘absolute’ plate motion (in a no-net rotation reference frame) and relative motion along all of the world’s plate boundaries. For the EarthScope Voyager, we include maps of proposed USArray and Plate Boundary Observatory sites and “Did You Know” educational modules, which provide examples of EarthScope-related scientific results linked to EarthScope study areas. Two versions of the tool are available: (1) a Java-based map tool “EarthScope Voyager”, a server-based map creation system which allows users complete control over base maps, overlays, and map scale; and (2) “EarthScope Voyager, Jr.”, an HTML-based system that uses pre-constructed GIF maps and overlays, allowing the system to rapidly create and display maps to a large number of users simultaneously. The tool allows users to zoom among at least four map scales. In addition, we have developed companion educational materials, on the “Exploring our Dynamic Planet” website, a JavaScript-based interface that incorporates explanatory material for the map tool and curricular activities that encourage users to explore Earth processes using the Voyager map tools. We have also created an entirely new user interface for the “Jules Verne Voyager” suite, which allows users to make ‘maps on demand’ using a new user-friendly menu interface. The map tool and associated educational materials can be viewed through the Jules Verne map portal http://jules.unavco.org.

This work was supported by NSF grant EAR-0346180.
Transferring modern research to practical classroom experiences can be a challenge and time consuming; and yet it is very important to the development of young scientists to have them interact with real world data and experience the process of science. UNAVCO has partnered with the Earth Exploration Toolbook (EET, a project of the National Science Digital Library Program) and the Science Education Resource Center at Carleton College to bring modern research in crustal deformation into the classroom and to support the use of data in the classroom to study plate tectonics.

TERC education specialists teamed with data tool developers from UNAVCO to create the first chapter, “Creating Custom Map Images of Earth and Other Worlds” and are currently developing a new EET chapter entitled, “Analyzing Tectonic Plate Motion with GPS Data.” Creating Custom Map Images introduces educators and students to Jules Verne Voyager, a freely available online map tool that includes data for Earth as well as 19 other planets and moons. Users explore the range of data that are available to create map images: 100 different types of data are available to characterize portions of Earth. Recent data for Jupiter, Saturn, and many of their moons are also available which allows students to apply comparative planetology techniques.

The next EET chapter, Analyzing Tectonic Plate Motion with GPS Data, will provide step-by-step instructions to walk users through a case study in which they access UNAVCO GPS data and use analysis tools to explore crustal movement and deformation. In the course of completing a chapter, users produce and analyze GPS time-series plots and velocity vector maps. The ultimate goal of each EET chapter is to build user's skills and confidence so they can use data to conduct their own investigations of the Earth system.

UNAVCO professional development programs for teachers are profiled in the SERC resources aimed at helping geoscience faculty better prepare teachers to teach Earth Science.
Research Experience in Solid Earth Science for Students (RESESS)

Rajul Pandya » University Corporation for Atmospheric Research  
Susan Eriksson » UNAVCO, Boulder, CO

Significant Opportunities in Atmospheric Research and Science (SOARS) and Research Experience in Solid Earth Science for Students (RESESS) are dedicated to ensuring that the next generation of geoscientists both reflect and serve an increasingly diverse nation and multicultural world. SOARS has extended educational opportunities to college and university students from diverse backgrounds for 12 years. In 2005, the National Science Foundation’s program of Opportunities for Enhancing Diversity in the Geosciences funded the RESESS program to partner with the SOARS program. RESESS extends the SOARS model of research, multidimensional mentoring, and a supportive learning community into the fields of geophysics and geology.

Each year, with support from multiple mentors and peers, protégés embark upon a summer of scientific investigation, personal growth and professional development. Our combination of hands-on research, practice in scientific communication, and leadership training prepares our protégés to contribute to future scientific endeavors. SOARS and RESESS protégés can participate in up to four summers of research, receive funding for professional conference travel, and apply for supplemental funding for undergraduate and graduate programs. Through these efforts, SOARS and RESESS seek to create the next generation of leaders in the geosciences whose investigative expertise is complemented by strong leadership and communication skills.
Girls On Ice

Erin Pettit » University of Alaska Fairbanks

*Girls on Ice* is a wilderness science education program for high school girls. The program offers opportunities for students to explore and learn about mountain glaciers and the alpine landscape through scientific field studies with geologists and glaciologists. Our purpose is to give students a feeling for the natural processes that create the alpine world and provide an environment that fosters the critical thinking necessary to all scientific inquiry. The program is offered free to girls age 15 through 18 through the North Cascades Institute, a non-profit organization offering outdoor education programs for the general public, and is available through the generosity of the North Cascades Institute, the Katherine Olson Foundation, Wings WorldQuest, and the National Science Foundation.

We encourage the girls to think like scientists by making observations and inferences, and to develop their own experiments to test ideas about glacier dynamics and geomorphology. In addition to scientific exploration, we engage the students in discussions about the philosophy of science and its role in our everyday lives. Our program exemplifies the success of hands-on, inquiry-based teaching in small groups for science education in the outdoors. The wilderness setting and single gender field team inspires young women’s interest in science and provides a challenging environment that increases their physical and intellectual self confidence. Our aim is to increase interest in science and research, particularly in the earth sciences, by girls in the latter years of high school, a time when the attrition rate of female participation in science is particularly high.

The activities are designed to instill an understanding of the process of scientific inquiry. All the activities begin with assumption-free observations of the natural world. The students are then encouraged to formulate questions and hypotheses, recognize assumptions and consider the implications of the conclusions. Once they have formulated hypotheses, we engage the students in developing experiments to test these hypotheses. Examples of experiments we help them develop include setting up ablation grids to correlate snow ablation rates and amount of debris cover, developing grids to map crevasse size and growth, and testing a variety of environmental factors to determine which factors are of importance in the development of suncups.

*Figure 1.* Students from Girls on Ice working on glacier.

*Figure 2.* In 2006, UNAVCO loaned GPS equipment to Girls on Ice for measuring glacial position for mass balance calculations. Dr. Erin Pettit (right) and program participant (left) are holding the survey controller and Trimble 5700 receiver.
Growth of Geosciences Within the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)

Aaron Velasco » University of Texas, El Paso

For over 30 years, SACNAS has provided strong national leadership in improving and expanding opportunities for minorities in the scientific workforce and academia; mentoring college students within science, mathematics and engineering; as well as, supporting quality pre-college science education. SACNAS’ annual National Conference and K-12 Teacher Workshops, student chapters, e-Mentoring Program, and online internship/job placement resources are tools that help a diverse community of undergraduate and graduate students, professors, administrators, and K-12 educators achieve expertise within their disciplines.

Until recently, biological and biomedical sciences have dominated the science content of the SACNAS Annual Conference. However, in 2004, SACNAS established a Geoscience Task Force to help manage an NSF Opportunities for Enhancing Diversity in the Geosciences (OEDG) award. The Task Force also helps plan activities and develop strategies to increase the participation by geoscientists and students of geoscience in SACNAS activities. UNAVCO has played a key role in growing geoscience at the annual conference. For example, in 2005, UNAVCO worked with the Task Force to develop a day-long field trip to accompany the annual meeting in Denver, Colorado. UNAVCO sponsored the day’s travel to several regional sites including the UNAVCO, NCAR, USGS National Earthquake Information Center in Golden, and the USGS Ice Core Facility in Denver. The success and student interest of this event prompted a second field trip prior to the 2006 Tampa, Florida meeting, and interest continues to grow. UNAVCO sponsorship has solidified geoscience at the SACNAS annual conference and we hope to continue this popular annual event.

Finally, UNAVCO’s role in EarthScope Education and Outreach has helped facilitate other partnerships with SACNAS including professional development for SACNAS teachers at the recent annual SACNAS conference and 2007 EarthScope National Meeting.

**Figure 1.** SACNAS member, Ricardo Flores from Antelope High School in the Los Angeles area, attended the EarthScope Science Workshop in March, 2007. Teachers from around the country participated in a four-hour workshop given at the EarthScope National Meeting. Teachers learned about EarthScope, explored the Earth Structure through a hands-on activity, discussed fault creep by using the earthquake machine and investigated episodic tremor and slip in the Pacific Northwest in a hands-on activity using GPS data from the Plate Boundary Observatory.

**Figure 2.** Undergraduate students visited UNAVCO on a SACNAS-sponsored field trip.