

SUMMARY OF FY2003 PROGRESS SOUTH DAKOTA SPACE GRANT CONSORTIUM

<http://www.sdsmt.edu/space/>

Throughout the 2003 project year, the South Dakota Space Grant Consortium (SDSGC) has continued to broaden and strengthen its fundamental role in communication of educational and technological issues. The SDSGC has become one of the key organizational forums in South Dakota for bringing together talented people, their ideas, and collaborative projects in research, education, and technology-based economic development. The Consortium is headquartered at the SD School of Mines & Technology (SDSM&T), with institutional members consisting of SD State University (SDSU), Augustana College, and the USGS EROS Data Center. These four institutional members and the Consortium's 30 affiliates in higher education, government and industry have worked together to expand opportunities for all the people in South Dakota to understand and participate in NASA's aeronautics and space programs by supporting and enhancing science and engineering education, research, and outreach programs. The scientific and technological interests of both NASA and South Dakota have benefited as a result of the Consortium's educational and research efforts in remote sensing, satellite imagery, GIS, global and regional geoscience, environmental science, and K-12 educational outreach. This report summarizes key accomplishments made in 2003 in the following seven categories: 1) Research Infrastructure, 2) Higher Education, 3) K-12 Outreach, 4) Other Public Service, 5) Fellowships and Scholarships, 6) Workforce Development, and 7) Administration.

Although not necessary for review of this Progress Report, a valuable database of SDSGC goals, efforts, and activities is available at the SDSGC website <http://www.sdsmt.edu/space/>. Several website addresses are given throughout this report, but none need to be accessed to complete a review of this "stand alone" report. The websites are referenced simply as additional sources of information.

1. Research Infrastructure

As a "capability enhancement" state in NASA's Space Grant Program, development of research infrastructure within South Dakota continues to be one of the seven focus areas of SDSGC activities mentioned above. Highlights in research areas over the past year include the following.

- South Dakota's NASA EPSCoR Program <<http://www.sdsmt.edu/space/nasaepscor/>> continued to improve research infrastructure within the state and collaboration with NASA Centers and staff through use of resources available in the core grant titled "The Use of Remote Sensing for Monitoring, Prediction, and Management of Hydrologic, Agricultural, and Ecological Processes in the Northern Great Plains".

A meeting of the SD NASA-EPSCoR Program "Technical Advisory Committee" (TAC) was held on July 31, 2003. The purpose of the TAC is to 1) Advise on related State research and economic priorities, 2) Assist in planning research areas that align with applicable State priorities, 3) Provide technical and political guidance to the State NASA EPSCoR program, 4) Identify new potential sources of cost share, and 5) Review program progress and accomplishments. The TAC website is <http://www.sdsmt.edu/space/nasaepscor/TAC.htm>.

The following is a summary of the work continued in 2003 on the following two NASA EPSCoR research projects:

A) "Leaf Area Index (LAI) for Fire Chronosequences of the Black Hills and Southern Siberia: A Comparative Study" (PI - Dr. Lee Vierling of SDSM&T).

This project is a collaborative effort among researchers at SDSM&T, Augustana College, the USGS EROS Data Center, and NASA-Goddard Space Flight Center to investigate issues relating to LAI along fire chronosequences. The research team is conducting studies in the Black Hills of South Dakota and in southern Siberia to develop techniques for improved LAI derivation as well as to test the global applicability of these techniques. Described below are four lines of research currently underway as a part of this project, with analyses spanning fire chronosequences from 0 to >100 years in age. This work is the foundation of a larger set of collaborations (listed below) that have already created numerous synergistic

activities, described below, to strengthen the research capabilities of South Dakota- and NASA-based scientists. Six presentations regarding this project were given at national meetings and two publications were completed.

Study #1: Improved satellite-based methods for deriving LAI in a burned ponderosa pine ecosystem - The purpose of this portion of the study is to investigate the accuracy and various potential improvements of leaf area index (LAI) derivations from satellite sensors over a ponderosa pine dominated forest that has recently experienced fire. A suite of optical measurements (LAI-2000, Tracing of Radiation and Architecture of Canopies (TRAC), hemispherical photos, understory digital photographs and spectral reflectance) and forest measures were conducted within each established plot. Ground based LAI was calculated using established methods and compared with spectral data from the Landsat ETM+, IKONOS, and MODIS sensors. This work is currently being synthesized by SDSM&T graduate student Rachel Smith and will constitute her MS thesis as well as an article to be submitted to a peer-reviewed journal. Algorithms used in these analyses will be applied to the sister sites established in Siberia to determine their transferability and global usage.

Study #2: Improved ground-based methods for deriving LAI in a burned conifer-dominated ecosystem - To investigate the minimum surface measurements of LAI required to adequately characterize a plot, subsets of the regular sampling intensity were used to create a low intensity sampling design. As a further improvement of ground LAI sampling techniques in conifer forests, light detection and ranging (LiDAR) technology is being tested as a novel approach to perform ground truth for important biophysical factors such as needle clumping, understory composition, and ground fuels. The researchers are exploring the use of ground LiDAR data to substitute for destructive sampling to derive clumping indices at the needle to shoot scales. During the past year, we have utilized two systems for ground LiDAR sampling (RIEGL and CYRA).

Study # 3: Leaf Area Index and Vegetation Indices Analyses for a Fire Chronosequence in Southern Siberia - In this portion of our research, field inventory data and multi-resolution remotely sensed data (including 4m resolution IKONOS, 30m resolution Landsat ETM+ and 500/1000m resolution MODIS products) acquired in summer 2000 were used to analyze LAI at forest sites representing three post-fire burn ages north of the Siberian city of Krasnoyarsk. These three sites were established by NASA-GSFC researchers led by Dr. Donald Deering. The preliminary results are currently being refined and similar analyses will be conducted for comparison sites in the Black Hills (e.g. Study #1, above) to examine the broad-scale applicability of these procedures. Overall, this work provides baseline data that can be used when scaling plot-level measurements of forest density to regional-level estimates with satellite remote sensing. This work is a part of the Ph.D. dissertation of SDSM&T doctoral student Xuexia Chen and will also serve as the basis of a peer-reviewed journal article to be submitted in late 2003 or early 2004.

Study #4: Use of SWIR Reflectance Bands to Improve LAI Derivation in Semi-arid Forests and Grasslands Susceptible to Frequent Fire - Forested sites across a range of LAI values in the Black Hills are being examined to determine how well the Reduced Simple Ratio/Shortwave infrared can be used to predict the site water status of pine forests. During the summer of 2003, researchers collected field data to investigate couplings between the site water status and spectral signature of the vegetation using Landsat ETM+, and ASTER data. This work is a component of the MS thesis of SDSM&T graduate student Michael Toomey and will be completed by Spring 2004.

Synergistic Activities - Aside from five joint planning and field work meetings involving NASA and SD scientists, this NASA-EPSCoR project has led to the following synergistic activities to broaden the collaborative research base of SD and NASA scientists: 1) Invitation of Dr. Changhui Peng (Vierling collaborator) to become involved with the scientific planning of the Northern Eurasia Earth Science Partnership Initiative: Status and Opportunities or "NEESPI" (Don Deering, project coordinator). 2) Collaboration between Dr. Bill Capehart (project participant) and Dr. Gennady Panin, Russian Academy of Sciences, to develop a project relating to their common interests and NEESPI. 3) A transfer of a pneumatic boom suitable for lifting remote sensing instrumentation above the forest canopy from the Deering research group (GSFC) to the Vierling research lab (SDSM&T). 4) Cooperative agreements between SDSM&T,

Horizon's Inc. of Rapid City, SD, and Lamp-Rynearson Inc. of Omaha, NE to provide airborne and ground-based discrete-return LIDAR data for forest ecosystem analyses. 5) A research proposal submitted to NASA NRA-03-OES-02 entitled, "Use of MODIS Land Products to Drive Estimates of Biogenic and Wildfire Emissions for Regional Chemistry and Transport Models", Christine Wiedinmyer, NCAR, PI (L. Vierling, Co-PI). 6) A research proposal submitted to NASA-New Investigator Program entitled, "Integrating remote sensing and forest growth models for monitoring forest dynamics", Chengquan Huang, EROS Data Center, PI (L. Vierling, collaborator). 7) The initiation of a collaboration between Drs. Lee Vierling (SDSM&T), Paul Gessler (U. of Idaho) and Lloyd Queen (U. Montana) to form the "Forest Public Access Resource Center—ForestPARC". This collaboration is being made possible using NASA funds through the Upper Midwest Aerospace Consortium.

B) "Cross-Calibration of Landsat and IKONOS Sensors for Use in Precision Agriculture" (PI - Dr. Dennis Helder of SDSU).

Work was conducted on the following "Agricultural Research Components" of SDSU's project:

- Using Landsat Data to Predict Corn, Soybean, and Wheat Yields
- Earthscan 101
- Assessing Error of Several Radiometers.
- Detecting Weeds in Production Fields.
- Evaluating Nitrogen and Water Stress Impact on Crop Reflectance, Yield and Water Use Efficiency.
- Using Remote Sensing to Assess Interspecies Competition for Water and N.

Work was also conducted on the following "Calibration and Cross-Calibration Components" of SDSU's project:

- Background: Satellite Calibration Group - For the 2003 phase of the satellite calibration group's work, three primary areas of work were designated. The first was to complete the numerical analysis of the extensive 2002 vicarious calibration data collections. The second was in establishing and enacting a follow-up field campaign for the summer of 2003 based on the results of the 2002 work. The third was in further developing the tools and techniques necessary to accomplish the goals of the precision agriculture project team.
- Analysis of the 2002 Field Work.
- Landsat Calibration Activities.
- 2003 Data Collections in support of Vicarious Calibrations.
- Tool and Technique Development - A primary continuing goal of the satellite calibration group is to develop a set of tools for data reduction that are well documented and can be directly applied by various users for data analysis.

SDSU reported 9 publications, 2 guideline papers, 8 Proceedings papers, and about 16 invited and other presentations under this project.

- A total of nine SD NASA EPSCoR "Program Initiation Grant" (PIG) projects were funded in 2003 using Core Grant funds. In February 2003, after the SD NASA-EPSCoR Steering Committee met to review ten submitted proposals and make recommendations for selection, the following six PIG projects were awarded:
 - Development of an Instrumentation System for Real Time Irradiance Reference Monitoring and Scattering Detection (SDSU, PI's L Leigh and D. Aaron)
 - Large Scale Models of Sugarbeet Quality from Multi-Spectral Satellite Imagery (SDSU, PI D. Humberg)
 - The effects of fire suppression and fire on soil organic carbon in Newton Hills State Park and in the Black Hills (Augustana College, PI D. Matzner)
 - Heritage and Future: Transitioning from AVHRR to MODIS (Augustana College, PI's D. Swets and B. Reed)
 - Determining the Global Importance of Biogenic MBO Emissions through Measurements and Models Driven by Remotely Sensed Data from the Terra Satellite (SDSM&T, PI B. Baker)

- Use of Remote Sensing to Monitor Impacts of Land Use and Seasonal Land Cover Changes on Missouri River Water Chemistry and Sediment Loads (SDSM&T, PI E. Duke)

In July 2003, another Call for Proposals for NASA EPSCoR PIG's was released. On Sept. 10, 2003 the SD NASA-EPSCoR Steering Committee met to review the five proposals submitted and make recommendations for selection. The following three projects received awards:

- Collaborative Research: Investigating the Role of Prairie Wetlands on the Northern Great Plains Pre-Storm Environment (SDSM&T/SDSU/NWS, PI's B. Capehart, M. Hjelmfelt, D. Todey, K. Harding)
- The Use of LiDAR Remote Sensing to Determine Avian Diversity (SDSM&T, PI K. Vierling)
- Development of Hydrazine/Nitrogen Dioxide Fiber Optic Sensor (SDSU, PI A. Andrawis)

Metric: The two large NASA-EPSCoR research projects and 9 smaller PIG projects discussed above are a good measure of SDSGC's success in 1) closely integrating SD Space Grant and NASA-EPSCoR research activities, 2) developing earth system science infrastructure in SD, and 3) encouraging cooperative programs among universities, industry, and Federal, state and local governments.

- EPSCoR Centers Development Initiative (CDI) in cooperation with SD EPSCoR held its first regional conference on Nanoscience and Engineering in Rapid City, SD on Aug. 21-22, 2003. Nanotechnology is an umbrella term that covers many areas of research dealing with objects measured in nanometers, a billionth of a meter, or a millionth of a millimeter. The purpose of the conference was to summarize current nanotechnology research areas in the region (ND, MT, ID, NE, WY and SD) and to identify potential for new collaborative research areas and development of core research groups in theme areas related to the National Nanotechnology Initiative. Another goal of the conference was to work toward collaborative development of large-scale Nano Science and Engineering proposals. SDSGC Director Dr. Sherry Farwell and SDSM&T's Dr. Jon Kellar, Chair and professor at SDSM&T's Department of Materials and Metallurgical Engineering, organized the conference. Nationally recognized experts, including Dr. Mihail Roco of the National Science Foundation and chair of the National Nanotechnology Initiative, Dr. William Mullins of the Department of Defense, and Dr. Neal Shinn of the Department of Energy, spoke about nanotechnology research opportunities and the current status of research efforts in the region. More information about the conference, and ongoing resource links for nanotechnology, is available at http://www.sdsmt.edu/nano_conf
- SDSGC continued to pursue efforts associated with the proposed National Underground Science and Engineering Laboratory at the Homestake Mine. A 5-year, collaborative proposal has been submitted to NSF to convert the Homestake Gold Mine in Lead, SD, which closed in 2001, into a National Underground Science and Engineering Laboratory (NUSEL) focusing on neutrino research <<http://mocha.phys.washington.edu/NUSEL/>>. In addition to subterranean physics, a whole range of "underground science" has become evident including solar, atmospheric, long-baseline, supernova and high energy astrophysical neutrinos, double beta decay, and dark matter searches; precision and sensitive assay of radionuclides; materials science and engineering; nuclear astrophysics cross-section measurements; hydrology, seismology, rock mechanics and other topics in geoscience; microgravity experiments via long drop tubes; and the study of the evolution and subsistence of biological organisms under extreme environmental conditions. In addition to an extensive outreach program for tourists visiting the Black Hills, if NUSL were to become a reality, it could potentially provide on-site and distance education curricular experiences for K-Ph.D. students, distance education opportunities for the general public, astrophysical data outreach to scientists around the world, and special participation opportunities for individuals and institutions in regional and national EPSCoR states. In its interpretative activities, NUSL could recognize the special significance of the Black Hills to the Native American community and could use both its special place and the excitement of its science to reach out to all communities, especially those underrepresented in U.S. science and technology. The existing outreach network contained within the National Space Grant College and Fellowship Program and the NASA EPSCoR Program will be relied upon extensively for this purpose.
- At the request of the Louisiana Board of Regents, Dr. Sherry Farwell participated as the lead reviewer in a panel of four external individuals who traveled to New Orleans during June 12-13, 2003 to assess the Louisiana NASA-EPSCoR Program. Subsequent to the on-site meeting and discussions with representatives from the

Louisiana Board of Regents, the State's NASA-EPSCoR Program Office, and the State's NASA-EPSCoR Research Projects, Dr. Farwell prepared a written report entitled "Assessment of Program Management Elements and Their Alignment with NASA and Louisiana Goals". This report was submitted on June 26 and subsequently accepted by Mr. Jim Gershey, the Executive Director of Special Programs in the Louisiana Board of Regents Office.

- Oglala Lakota College was awarded an SDSGC "Program Initiation Grant" in Summer 2003 to conduct a research project titled "Preliminary Assessment of Natural Spring Potential to Enhance Drought Recovery on the Pine Ridge Reservation". The project was conducted by Native American undergraduate students and faculty. The planned outcome of this research is a much-needed preliminary assessment of drought relief potential using existing but under-evaluated surface and subsurface water sources. This data will be made available to the public through OLC and natural resources agencies at the federal, state, and tribal levels. This initial phase of research provides the foundation for and serves to jump-start another more comprehensive, multi-year, interdisciplinary project proposal titled "Tatanka Waste (Good Bison)" submitted to the USDA under their 1994 Land Grant Institution Program, in which the biocomplexities of the interaction between people, bison, plant species, soil and water will be examined. This is a good example of how seed projects funded through Space Grant "Program Initiation Grants" can be combined with projects and proposals outside of NASA to initiate, nurture, and grow other valuable research endeavors. In both projects described here, remote sensing, GIS, and GPS technologies are used.
Metric: This project is a good measure of SDSGC's success at recruiting and training underrepresented minorities for careers in science and technology.
- SDSGC Director Dr. Sherry Farwell continued to provide assistance to the Western Research Alliance (WRA) <www.w-research-alliance.org>. The objective of this broad based organization is to provide a regional forum for academic researchers, entrepreneurs, state and federal agencies, and local economic developers who are interested in the promotion of research, technology transfer, and business development. A meeting was held at SDSM&T on March 29, 2003 on the subject of Medical Sciences and Research in the Black Hills. The workshop provided a forum for researchers, physicians, and others to learn about research activity in Rapid City and to stimulate collaborative efforts. Similarly, a Biotechnology & Biomedical Engineering Colloquium was held at Black Hills State University on October 25, 2003.
- Technical and financial support was provided for GIS-remote sensing and image processing laboratories at member universities and educational affiliates, including Native American Tribal Colleges. This support is for research and educational projects involving GIS and remote sensing curriculum development, precision agriculture, algorithm development for NDVI data, plant science, climate change, and land surface processes. These projects involve interaction with the USGS EROS Data Center (EDC) located in South Dakota.
- SDSM&T investigators continued both basic and applied research into carbon sequestration. The South Dakota Carbon Sequestration Project provides a traceable method to determine the Carbon Emission Reduction Credits (CERCs) for registered land.
- Badlands Observatory in Quinn, SD <<http://www.sdsmt.edu/space/bo.htm>>, an educational affiliate of SDSGC, successfully continued its Near Earth Object (NEO) asteroid observations and identification in participation with the international Spaceguard Foundation. Participating observatories around the world are cataloguing all of the NEO's that may represent a global impact hazard to the Earth. The dark skies in western SD, combined with the extremely sensitive research-grade telescope at Badlands Observatory, places the observatory in the company of some of the world's best astronomical research facilities. It is host to an f/4.8 Newtonian Telescope with a 26" diameter mirror, the largest telescope in the local three-state area. Observations are reported to the Minor Planet Center at the Harvard-Smithsonian Center for Astrophysics. See Badlands Observatory's educational project titled "Dark Skies & Bright Minds" that was implemented at participating schools in 2003 described in the K-12 Outreach section of this report.

- Augustana College Research Projects (in addition to NASA EPSCoR projects listed at the top of this section):
 - “NDVI Smoothing and Land Cover Analysis, University of Mauritius,” Fulbright grant awarded and taken by Dr. Daniel Swets, 2002. NASA Space Grant supported activities by Dr. Swets that led to the receipt of this grant. Participation in this Fulbright activity has led Dr. Swets to establish a satellite image processing research group with colleagues from Augustana College, University of Lancaster, and the University of Mauritius. Additional research collaboration in traffic simulation with members of staff at the University of Mauritius has enabled Dr. Swets to expand research capabilities both at Augustana College and at the University of Mauritius, and pursue further funding for such research and this relationship. All this activity was possible only because of the initial Space Grant seed funding that laid the groundwork.
 - “Recycled computers,” NASA Space Grant project at Augustana College, Dr. Daniel Swets, PI. This project involved faculty member Dr. Daniel Swets, computer science, and undergraduate students Mr. Cory Ranschau and Mr. Brad Bishop. The proliferation of inexpensive computing equipment has rendered a glut of well functioning, older, slower computer hardware. Is our only recourse for this equipment the trash heap? This project involved the use of this older hardware to determine the functionality of existing hardware, create a network infrastructure for implementing a cluster computer concept with the older equipment, and analyze the relative time difference between runs on a current, state-of-the-art machine versus a cluster of older networked computers.
 - “Computational Complexity and Efficiency Analysis,” NASA Space Grant project in conjunction with a USGA EROS Data Center project, Dr. Daniel Swets, Space Grant PI; Dr. Brad Reed and Ms. Jess Brown, USGS Co-PIs. This project involved faculty member Dr. Daniel Swets and undergraduate student Mr. Ali Ashraf. The project examined the efficiency of various processing, storage, and I/O techniques for large data sets to enable further efficiency implementations in future algorithm development for satellite imagery processing.
 - “Parallel NDVI Smoothing Algorithm Comparison: A study using a Windows®-based PVM cluster and a multithreaded implementation,” NASA Space Grant project at Augustana College, Dr. Daniel Swets, PI. This project involved faculty member Dr. Daniel Swets and undergraduate students Mr. Timothy Stavenger and Ms. Jerilyn Peterson. The project investigated competing parallelization techniques and demonstrated the utility of a parallel implementation for an algorithm for smoothing an NDVI signal. Two basic approaches were used, with competing techniques in each approach: (1) cluster computing on a Parallel Virtual Machine (PVM); and (2) multithreaded computation on a single workstation. By focusing on separating the disk operations from the smoothing computations in addition to the parallelization of the computations themselves, inefficient CPU usage was reduced. This yielded a runtime 220 times faster than the serial implementation when run on a PVM cluster with thirteen nodes. Working more closely on finer-grain parallelization of the computations, our second approach involved the use of the POSIX threads (PThreads) software package on both Windows 2000 and Linux machines to develop multithreaded algorithms for use on single machines, yielding an eleven-fold runtime improvement.
 - “Biofriendly synthesis, characterization and modeling of room-temperature ionic liquids,” NASA Space Grant at Augustana College, Dr. Gary Earl, PI. This project involved faculty members Dr. Gary Earl and Dr. Duane Weishhaar, chemistry department at Augustana College, and undergraduate students Mr. James Nelson, Ms. Jamie Kapplinger, and Mr. Robbie Heegle. This project began work on the development of a greener route for synthesis of industrially important quaternary ammonium compounds (quats) using dimethyl carbonate with some efforts resulting in more biofriendly quats as well. The project started work on the synthesis, determination of kinetics, analysis of the purity and extent of reaction, and characterization of solubility, viscosity, electrochemical properties, critical micelle concentration, conductivity, melting points, and other phase changes of this biofriendly route for obtaining these quats. The students used both NMR and HPLC to follow the course of the reactions. They constructed a simple apparatus to collect cooling curves of these quats using a computer data acquisition system to collect temperatures from a thermocouple. We found phase transitions for these ILs were quite complex so more sophisticated equipment is required to sort out the details. One quat was found to melt below the dry ice/acetone bath temperatures (-78 degrees C). The group then characterized the product’s tendency to

form micelles in water (CMC) using the newly purchased Wyatt Technologies Mini-Dawn Light Scattering detector. The Wyatt instrument, used in the batch mode with flow injection, worked well. The tributylmethyl ammonium methyl carbonate did not form micelles, but the dimethyldioctadecyl ammonium methyl carbonate and dimethyl di(ethyl dodecanoate) ammonium methyl carbonate exhibited surprisingly low CMCs.

- “Monthly fractional green vegetation cover associated with land cover classes of the conterminous USA,” NASA Space Grant travel support. This project involved faculty member Dr. Daniel Swets and undergraduate student Mr. Aaron Cusher. In an effort to further understand vegetation patterns, scientists at NOAA gathered the percent fractional green vegetation cover (fgreen) for each of the top 3 most dominant land cover types within 20 km by 20 km square regions. These grid cells checkerboard the conterminous United States along with parts of Canada and Mexico. For each 20 km grid cell, data was gathered pertaining to the three most dominant land cover classes, together with the fractional area and the monthly fgreen values associated with each of the classes, and the fractional area covered by water. This data has been archived in 79 raw image files, with each data set equating to a specific piece of information. Using these archives, we developed a Java applet to extract and display the data in a textual and graphical format to enable it’s viewing and study by vegetation change researchers. The interface is a point-and-click map of the research area, producing a breakdown of all land cover type and fgreen information, along with the coordinates of the grid selected. This applet is available on the Internet to provide the widest availability to worldwide researchers in land cover/change analysis. This research was possible through collaborations with NOAA and USGS scientists, and funding from both NASA and NSF. The Space Grant supported this effort in the past, and presentation of research results was invited to the Council on Undergraduate Research Posters on the Hill session in Washington, DC.

- Augustana College *summary and statistics* of faculty and student research support through Space Grant (Augustana was able to support 15 undergraduate students for projects, 20% of whom were women and minorities):

Projects:	5	
Faculty supported:	3	Dr. Daniel Swets Dr. Gary Earl Dr. Duane Weisshaar
Undergraduate students:	15 (3/15 or 20% women and minorities)	Mr. Cory Ranschau Mr. Brad Bishop Mr. Sven Lerseth Mr. Ali Ashraf Mr. Andrew Reinartz Mr. James Nelson Ms. Jamie Kapplinger Mr. Robbie Heegle Mr. Paul Marshall Mr. Stuart Ness Mr. John Schneiderman Mr. Roy Tewalt Mr. Jason Ranschau Mr. Timothy Stavenger Ms. Jerilyn Peterson
Disciplines represented:	2	Computer science Chemistry
Agencies involved	6	Augustana College NASA USGS EROS Data Center NOAA NSF

- SDSU and SDSM&T continued active participation in the Upper Midwest Aerospace Consortium (UMAC) activity with precision agriculture and remote sensing and in the Public Access Resource Center (PARC) project. Scientists from SDSGC were involved in the Educational PARC (EdPARC) components of this NASA-funded project by providing a teacher-training workshop in GIS, GPS and remote sensing technology on June 9-13, 2003 at the USGS EROS Data Center titled "Earth Science Tools for Educators". There were 19 teachers in attendance (two from Little Priest Tribal College in Nebraska, two from OLC, and the remainder from K-12 school throughout SD).

2. Higher Education

- SDSM&T undergraduate Geological Engineering student John Keefner participated in the prestigious 2003 NASA Ames Astrobiology Academy. This year's Academy group project took advantage of the rare opportunity to explore deep-sea hydrothermal vents. The group sent a variety of materials (metals including copper, brass, stainless steel, steel, gray iron, and aluminum as well as thermally resistant space shuttle tiles) to the Menez Gwen vent environment, where they were left for an extended period of time by the Russian Mir submersible. An additional apparatus was deposited atop a hydrothermal vent at Snake Pit. After retrieving the samples and shipping them back to Ames Research Center, the Academy examined the relative extent of corrosion on each sample. Using exciting microscopy techniques (Scanning Electron Microscopy and DAPI DNA staining), the Academy evaluated the possibility that potential differences in corrosion are related to microbial metabolism. Mr. Keefner spoke with NASA Administrator Sean O'Keefe at the Academy. His group's July 2003 "Presentation to NASA Administrator" was entitled "Microbiologically Induced Corrosion at Deep Sea Vents" <<http://academy.arc.nasa.gov/2003/group/okeefpresentation.ppt>>. As part of their group project, the Academy compiled several lesson plans for grades 5-9 focusing on the topic of astrobiology. More information on the 2003 Academy is located on the SDSGC website at <<http://www.sdsmt.edu/space/AcademyOutreach.htm>>.

Metric: Mr. Keefner's successful participation in the 2003 NASA Academy is a good measure of SDSGC's success in recruiting and training U.S. citizens for careers in NASA-related science and technology. Prior to being accepted into NASA Academy, Mr. Keefner participated in the KC-135, USRP, and other NASA summer research experience programs, all with SDSGC's assistance.

- SDSGC has been very successful at recruit and training underrepresented minorities for careers in science and technology in 2003. SDSM&T has articulation agreements with Oglala Lakota College (OLC), Sinte Gleska University, Si Tanka College, and Sisseton Wahpeton Community College. American Indian students studying science and engineering are able to transfer Tribal college credits to SDSM&T to complete their four-year degrees.

Metric: SDSM&T now has the highest number (84) of Native Americans attending classes in the history of the institution. In May 2003, SDSM&T graduated 7 American Indian students. In Fall 2003, SDSM&T enrolled 20 Native Americans as freshmen, which is a new record. There are 11 American Indian students currently involved in SDSM&T's Center of Excellence for Advanced Manufacturing and Production (CAMP) Project Teams.

- SDSGC students John Keefner and Brian Glover were part of a selected multi-institutional KC-135 NASA Reduced Gravity Student Flight Opportunity Program project team in 2003. The team consisted of representatives from Purdue University, SD School of Mines & Technology, Georgia Institute of Technology, Colorado School of Mines, and St. Louis University. The project titled "Solar sail Operations Linking Academic Researchers" (S.O.L.A.R.) was split into two components: Alpha (Gossamer Spacecraft Deployment in Microgravity) and Beta (Nanosatellite Frame Deployment in Microgravity). More information on the 2003 KC-135 experiments can be found at <http://www.solarvision.org/intro.html>

Metric: This multi-institutional KC-135 project involved not only the two SDSM&T students, but also eight other students and four other universities.

- On September 19, 2003, SDSGC representatives Tom Durkin and graduate students Bull Bennett and Pat Kozak attended the Tribal College Forum II, "NativeView: Geospatial Technology with a Vision"

<<http://www.sinte.edu/nativeview/>> at the USGS EROS Data Center. NativeView is a partnering and merge of Western Geo-Science and empirical Native American knowledge. NativeView is a coordinated and sustained Tribal College initiative with Federal, State and Industry partners for a geospatial education effort spearheaded by the AmericaView consortium and the United States Geological Survey. Sinte Gleska University is the lead for the Tribal College NativeView initiative to integrate Earth Science technologies for the benefit of: Education, Agriculture, Resource Management, and Economic Development. Driven by relevant needs, NativeView is an innovative approach to technology-transfer and empowerment within Indian Country through access to geo-spatial/ spectral data and existing research.

- SDSU was a successful recipient of a Year 2 funding for “SouthDakotaView” (SDView) project through the USGS and AmericaView. The project will begin indexing and distributing remote sensing data to SD users. Meetings were held in Chamberlain and Pierre, SD among the Consortium membership. SDSM&T representatives attended the meetings and Tom Durkin represented the SDSGC. AmericaView is a consortium to expand remote sensing education through a network of numerous state consortia. South Dakota is a charter member of the newly formed AmericaView organization. AmericaView is a locally controlled and nationally coordinated program to advance the availability, timely distribution, and widespread use of remote sensing data and technology through education, research, outreach, and sustainable technology transfer to the public and private sectors. The vision for the pilot model consortium (OhioView) was to propagate the pilot into a national program by identifying organizations that require delivery of natural science data in near-real-time and ensuring the infrastructure is in place to support such a program. These goals were accomplished for Ohio in 2000. For AmericaView, the customers are state-based consortia for which formal agreements have been made. The USGS in conjunction with the AmericaView Consortium is leading the national expansion of this Program focusing on the growth of remote sensing. Educating consortium members and the public on remote sensing and its applications will continue to provide dividends in the future as uses for satellite information continue to expand. Individual consortia focus on promoting the use of satellite and geospatial data through research, curriculum development and outreach, while USGS ensures affordable satellite data in user friendly formats (GIS ready) with increased and simplified access to remote sensing data.
Metric: This example of outside funding and the SDView project associated with it is a good measure of our success in building educational, research, and public service projects in SD.
- SDSM&T hosted the Second Annual UMAC Graduate Student Conference on Nov. 19-23, 2003. The UMAC Graduate Student Conference is designed for graduate students partially or fully funded by UMAC to share research direction and experiences with other graduate students from the consortium via presentations and poster sessions. The conference is an excellent opportunity to network and seek collaboration with other graduate students providing needed understanding of systems in the Northern Great Plains. UMAC fully funds the conference, travel expenses including lodging, and refreshments for the event.
- In 2003, SDSGC supported an “Introduction to Astronomy” course (Physics 185) and summer Space and Earth Camps at SDSM&T in conjunction with Badlands Observatory, as well as a summer Space Camp on the Pine Ridge Indian Reservation taught by SDSM&T’s Tom Campbell.
- Sherry Farwell, Tom Campbell, and Tom Durkin of SDSM&T and Dan Durben of BHSU traveled to Goddard Space Flight Center in January 2003 to meet with Ted Gull, Bob Gabrys, Dick Fahey, Blanch Meeson, and others to discuss possible collaborative education and research efforts.
- SDSGC maintained its "Educational Opportunities (Higher Ed.)" website.
<<http://www.sdsmt.edu/space/EdOpp-HigherEd.htm>>
- Dr. Larry Stetler of SDSM&T attended the “Starting Student Hardware Programs Workshop” in Boulder, CO in June 2003 that was geared toward introducing attendees to the possibilities of starting a student program aimed at building and flying low-cost satellites from helium balloons into near space. Dr. Stetler took information learned at the workshop and developed a freshman engineering design project and incorporated it into SDSM&T’s GE 115 course titled “Professionalism in Engineering and Science” during the Fall 2003 semester. Student teams designed a smaller version of the BalloonSats flown at the workshop. For AY 2004, the satellites

will focus primarily on acquisition of a temperature profile (due to cost). The balloon will also fly 1 pressure probe, solar cells, and camera, with the data to be distributed to all teams. The GE 115 1st-year engineering program's balloon design project is called SEESat ("Student Engineered Electronic Satellites") <<http://ge115.sdsmt.edu/seesat/seesat.htm>>. Upon launch, they are hoping to achieve an altitude of 85,000 feet and collect photos and data on temperature, solar radiation, and altitude (pressure) from 45 student built satellites. They plan to track the flight by flying a GPS-HAM radio that will be tracked using a ground station HAM radio. Ideally, they will drive right to the landing spot to recover the payload. Dr. Stetler reported that it is their intension to develop a sustained BalloonSat effort at SDSM&T for the purpose of flying scientific experiments such as basic temperature, pressure sensors, cameras (moving to digital cameras), solar cells, panels, etc. Potential exists for flying other types of instruments such as IR probes, IR cameras, various RS probes, gravitation equipment, atmospheric chemistry probes, etc.

- June Thormodsgard, EROS, and Kevin Dalsted presented an overview of the USGS EROS Data Center and the SDSGC to SDSU Deans, Directors, and Department Heads at a management meeting with the goal to encourage SDSU faculty to develop further linkages to EROS scientists.
- FACULTY and STAFF TRAVEL SUPPORT

SDSM&T

- Tom Durkin, Sherry Farwell, and Tom Campbell, Goddard Space Flight Center, Washington, DC (January 22-24, 2003)
- Tom Durkin, SDSGC Deputy Director, Joint Conference of the SD Science Teachers Assoc. and SD Council of Teachers of Mathematics, Huron, SD (February 6-7, 2003)
- John Keefner, SDSM&T Student and Project Coordinator for FIRST Robotics Program attended FIRST Regional Competition, St. Louis, MO (March 2003).
- Dr. Sherry Farwell, SDSGC Director, National Council of Space Grant Directors Spring Meeting, Washington D.C. (April 2003)
- Tom Durkin, Sherry Farwell, and Tom Campbell, SD Space Days 2003, Sioux Falls, SD (May 16-17, 2003)
- Larry Stetler, SDSM&T professor, "Starting Student Space Hardware Programs: A How-To Workshop", Boulder, CO (June 2003)
- Carter Kerk, SDSM&T, BEST New Hub Workshop, College Station, TX (Nov. 21-22, 2003)

SDSU Faculty and staff travel support:

- Vinoly Seromony, presented paper at Signal Processing Conference, Houston, TX
- Sung Shin, presented two papers at ISCA-CATA03 Conference, Honolulu, HI
- Suzette Burckhard, conducted a workshop at American Soc. for Mining & Reclamation, Billings, MT
- David Galipeau, chaired two sessions at IMAPS Microelectronics Symposium, Boston, MA
- Larry Browning, conducted Astronomy Course at Flandreau Indian School, SD
- Kevin Dalsted, Western Regional Space Grant Meeting, Rapid City, SD
- Kevin Dalsted, National Directors Space Grant Meeting, Wichita, KS

Augustana College

- Dan Swets and Marlys Van't Hul, SD Space Days 2003
- CUR Posters on the Hill session, Washington, DC, March, 2003, for research poster presentation.
- Technology summit, Sioux Falls, SD, May, 2003, attendance.
- SCI conference, Orlando, FL, July, 2003, attendance.
- Western Region Space Grant Consortium annual meeting, Rapid City, SD, September, 2003, participant.
- International Symposium on Remote Sensing of the Environment, Honolulu, HI, 2003, research paper and poster presentations.

- SDSM&T Publications and Presentations related to Space Grant/SD NASA-EPSCoR:
 - Teets, Donald A. 2003. Predicting Opportunities for Viewing the International Space Station. *The Journal of Undergraduate Mathematics and Its Applications*, 24 (1) (2003), pp. 3-26.
 - Teets, Donald A. 2003. "Predicting Opportunities for Viewing the International Space Station". Presented at national summer meeting of the Mathematical Association of America, Boulder, CO, July 31-August 2, 2003.
 - Landguth, Erin. 2003. "Space Shuttle Maneuvers and Orbital Transfers." Presented at national summer meeting of the Mathematical Association of America, Boulder, CO, July 31-August 2, 2003.
 - Kozak, P.K., Duke, E.F., Ernst, W.G., and Van de Ven, C.M., 2003, Distribution of metamorphic minerals in siliceous dolomites associated with the Birch Creek pluton, White Mountains, California; analysis of AVIRIS imaging spectrometer data: Geological Society of America Abstracts with Programs, v. 35, no. 6.
 - Kozak, P.K., Duke, E.F., and Roselle, G.T., 2003, Mineral distribution in contact-metamorphosed siliceous dolomite at Ubehebe Peak, California, based on airborne imaging spectrometer data: *American Mineralogist*, in review.
 - Mannel, S, D. Hua, and M. Price, Forest classification of the northern Black Hills, U.S.A. using a decision tree classifier on multi-date Landsat TM data, in prep.
 - Mannel, Sylvio, M. Price, M. Rumble, D. Baldwin, and D. Hua, Using a Variable-plot Technique for Establishing Fixed-radius Circular Plots, *Wildlife Society Bulletin*, in revision.
 - Price M., 2003. *Mastering ArcGIS*, 1st ed., McGraw-Hill, New York, 580 pages, 448 figures, 880 video clips, and data CD.
 - Price, New GIS Text Features Video Clips, GIS Educator, ESRI, Fall 2003, invited.
 - Price, M., A Multimedia Approach to GIS Training, South Dakota Geospatial Information Forum, Pierre, SD, Oct 28-29, 2003, invited.
 - Zimmerman, P.R., Price, M., Peng, C., Capehart, W.J., Updegraff, K., Kozak, P., Vierling, L., Baker, E., Kopp, F., Duke, G., and Das, C. C-Lock (Patent Pending): a System for Estimating and Certifying Carbon Emission Reduction Credits for the Sequestration of Soil Carbon on Agricultural Land. *Adaptation and Mitigation Strategies for Global Change*, in review.
 - Zimmerman, P., M. Price, W. Capehart, L. Vierling, C. Peng, E. Baker, G. Duke, F. Kopp, H. Mott, C. Das, K. Updegraff, and C. Groseth. "C-Lock: a method for maximizing carbon sequestration in agricultural systems." In: Second Annual Conference on Carbon Sequestration: Developing and Validating the Technology Base to Reduce Carbon Intensity. DOE-NETL 2nd Annual National Conference on Carbon Sequestration, Alexandria, VA, May 5-8, 2003. Online: <http://www.carbonsq.com/proceedings.cfm>
 - Chen, X., Vierling, L., Rowell, E., and DeFelice, T. Using Lidar and Effective LAI Data to Evaluate IKONOS and Landsat 7 ETM+ Vegetation Cover Estimates in a Ponderosa Pine Forest. *Remote Sensing of Environment*, in press.
 - Toomey, M. and Vierling, L. A synthesis of developments in remote sensing of leaf area index for arboreal studies. *Photogrammetric Engineering and Remote Sensing*, in review.
 - Vierling, L., Frykholm, J., and Glasson, G. "The Earth Systems Connections Elementary Curriculum: Contextual Learning Opportunities for Building Ecological Knowledge." Poster presentation at the Ecological Society of America annual meeting, Savannah, GA, August 2003.
 - Smith, R., and Vierling, L. "Improved ground- and satellite-based methods for deriving LAI in a burned ponderosa pine ecosystem." Presentation at the Ecological Society of America annual meeting, Savannah, GA, August 2003.
 - Vierling, L., Frykholm, J., and Glasson, G. "Connecting Elementary Children with Earth Systems Science Using Satellite Imagery, Mapping, and Mathematics." Presented at the National Science Teachers Association annual meeting, Philadelphia, PA, March 2003.

- Glasson, G., Frykholm, J., and Vierling, L. "Using Traditional Ecological Knowledge to Develop an Earth System Science Elementary Curriculum." Presented at the National Association for Research in Science Teaching annual meeting, Philadelphia, PA, March 2003.
 - Vierling, L., Chen, X., Conley, A., Deering, D., Derr, K., Matzner, S., Rowell, E., Smith, R., Swets, D., and Toomey, M. "Remote Determination of Leaf Area Index Along Fire Chronosequences in the Black Hills and Southern Siberia." Presented at the NASA EPSCoR Annual Conference, Washington, DC, March 2003.
 - Vierling, L.A., Chen, X., Fersdahl, M., and Zimmerman, P. "The Short Wave Aerostat-Mounted Imager (SWAMI): A Novel Hyperspectral Remote Sensing Instrument Platform" American Geophysical Union Fall Meeting, San Francisco, CA, December 2003.
 - Vierling, L.A., Frykholm, J., and Glasson, G. "Bringing Cutting-Edge Concepts to the Elementary Classroom: The Earth Systems Connections Science, Math, & Technology Curriculum." Presented at the annual NASA AESP/ERC educational resource workshop, NASA-Langley Research Center, November 2003.
 - Anderson, S.W., McColley, S., Hudson, R., and Fink, J.H., 2004. Flow processes in lava flow interiors revealed through analog experiments; GSA Memoir on Lava flow dynamics and kinematics, in prep.
- SDSU Publications and Presentations related to Space Grant/SD NASA-EPSCoR:
 - Chang, J. D. E. Clay, C. G. Carlson, C. L. Reese, S. A. Clay, and M. M. Ellsbury 2004. The Influence of Different Approaches to Define Yield Goals and Management Zones on N and P Fertilizer Recommendations. *Agron. J.* (In review).
 - Clay, D. E., S. A. Clay, D. J. Lyon, and J. M. Blumenthal. 2004. Can ¹³C discrimination in corn (*Zea mays*) grain be used to characterize intra-plant competition for water and nitrogen? *Weed Sci.* (submitted 8/03, in review).
 - Chang, J., S. A. Clay, and D. E. Clay. 2004. Detecting weed free and weed infested areas of a soybean (*Glycine max*) field using NIR reflectance data. *Weed Sci.* (In review)
 - Chang, J., D. E. Clay, K. Dalsted, S. A. Clay, M. O'Neill. 2004. Use of spectral radiance at multiple sampling dates to estimate corn (*Zea mays*) yield using principal component analysis. *Agron. J.* (in press).
 - Clay, D. E., S. A. Clay, J. Jackson, K. Dalsted, C. Reese, Z. Liu, D. D. Malo, and C.G. Carlson. 2003. C13 discrimination can be used to evaluate soybean yield variability. *Agron. J.* 95:430-435.
 - Chang, J., D. E. Clay, C. G. Carlson, S. A. Clay, D. D. Malo, R. Berg, and W. Wiebold. 2003. The influence of different approaches for defining nutrient management zone boundaries on N and P recommendations. *Agron. J.* (in press).
 - Chang, J., S. A. Clay, D.E. Clay, D. Aaron, and D. Helder. 2004. Comparing spectral reflectance data collected from two different spectroradiometers for ground reflectance measurements. *Com. Soil and Plant Anal.* (In review).
 - Liew, S. W. and D. Helder. "Landsat 5 Thematic Mapper Cold Focal Plane Characterization." *International Journal of Remote Sensing*, Vol. 24, No. 2, January 2003.
 - Black, S., and D. Helder, S. Schiller. "Irradiance-based cross-calibration of Landsat-5 and Landsat-7 Thematic Mapper sensors." *International Journal of Remote Sensing*, Vol. 24, No. 2, January 2003.
 - Dalsted, D., J. Paris, D. Clay, S. A. Clay, C. Reese, and J. Chang. 2003. Selecting the Appropriate Satellite Remote Sensing Product for Precision Farming. SSMG 40. Clay et al. (Ed) *Site Specific Management Guidelines*. Potash and Phosphate Institute. Norcross, GA.
 - Gaspar, P., C. G. Carlson, and D. E. Clay. 2003. A "Cookbook" approach for determining the point of maximum economic return. SSMG 39. Clay et al. (Ed) *Site Specific Management Guidelines*. Potash and Phosphate Institute. Norcross, GA.
 - Paz, J. O., W. D. Batchelor, D. E. Clay, S.A. Clay and C. Reese. 2003. Characterization of Soybean Yield Variability Using Crop Growth Models and ¹³C Discrimination. ASAE meeting presentation # 033044.
 - Jackson, J., S. A. Clay, and D. E. Clay. 2002. Influence of landscape position and weeds on water stress in soybean. In Robert et al (eds.). *Proceeding of 6th International Conference of Precision Agriculture* July 14-17 2002, Minneapolis MN.

- Clay, D. E., S. A. Clay, C. Reese, and C. G. Carlson. 2002. Using remote sensing and C13 discrimination to understand yield variability. *In* Robert et al (eds.). Proceeding of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN
- Clay, D. E., J. Chang, C. Reese, and S. Christopherson. 2002. Landscape position influence on soybean quality. 2002. *In* Robert et al (eds.). Proceedings of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN.
- Chang, J., D. E. Clay, C. G. Carlson, S. A. Clay, and D. D. Malo. 2002. The influence of different classification approaches on N and P fertilizer recommendations. Proceedings of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN.
- Clay, D. E., K. Dalsted, M. O'Neill, C. Reese, and P. Thanapura. 2002. Teaching farmers how to use remote sensing. 2002 *In* Robert et al (eds.). Proceeding of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN.
- Ellsbury, M., S. A. Clay, D. E. Clay, D. D. Malo, and C. G. Carlson. 2002. *In* Robert et al (eds.). Increased incidence of extended diapause in northern corn rootworm and evidenced by georeferenced adult emergence. Proceedings of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN.
- Reese, C. L., D. Clay, D. Long, C. G. Carlson, and D. Beck. 2002. *In* Robert et al (eds.). Using protein and 13C discrimination to determine the influence of nitrogen and water stress on wheat yields. Proceedings of the 6th International Conference of Precision Agriculture July 14-17 2002, Minneapolis MN.
- Clay, D. E., C. G. Carlson, and J. Chang. 2003. Site Specific Assessments of Water Stress. Presented at the InfoAg 2003conference, July 30-August 1, 2003, Indianapolis, IN
- Carlson C. G., D. Clay, and S. Murrell Mapping profitability: Using Yield Data in Innovative Ways. Presented at the InfoAg 2003conference, July 30-August 1, 2003, Indianapolis, IN
- Carlson, G., C. Reese, and D. E. Clay. 2003. One Year Yield Data Analysis. Presented at the InfoAg 2003conference, July 30-August 1, 2003, Indianapolis, IN
- Carlson, C. G., and David Clay. 2003. Normalizing Yield Data. Presented at the InfoAg 2003conference, July 30-August 1, 2003, Indianapolis, IN.

Metric: These 45 publications and significant presentations are a measure of enhanced research productivity and capabilities that have benefited from SDSGC and EPSCoR support.

3. K-12 Outreach

The Consortium's full-time Deputy Director/Outreach Coordinator at our lead institution (SDSM&T) and part time Outreach Coordinators at SDSU, Augustana College, and the USGS EROS Data Center develop and coordinate the Consortium's K-12 programs. Highlights from the past year include:

- South Dakota Space Days 2003 was successfully held at the Kirby Science and Discovery Center at the Washington Pavilion in Sioux Falls, SD on May 16-17, 2003. South Dakota's own astronaut Col. Sam Gemar was the featured speaker. About 2,600 people (mainly K-12 students) were in attendance and were assisted in participating in the various structured programs by over 100 Space Days volunteers. Other presentations included SD's Solar System Ambassador Dr. Bob Polcyn, who gave several presentations on "New Discovery's about the Sun", and two speakers from the USGS EROS Data Center presented "How to Design a Spacecraft". The International Space Station (ISS) traveling exhibit trailers from NASA's JSC were open to school groups and the general public on May 15-17, 2003 and were a big hit. Numerous other exhibits were available on earth and space science, as well as telescope viewing of the moon and planets by the Sioux Valley Astronomy Club. Space Days was ushered in by a total lunar eclipse the evening before Space Days activities began! The Washington Pavilion supplied all teachers at Space Days with a mail-back post card for feedback. In conjunction with the new Wells Fargo CineDome film, *Cosmic Voyage*, the Kirby Science Discovery Center featured the new traveling exhibit *Hubble Space Telescope* from Feb. 1 - May 11, 2003. The exhibit employed videos and numerous interactive components to take visitors on a tour of the universe and let them experience other planets, exploding stars, ancient galaxies, and black holes. <<http://www.sdsmt.edu/space/SpaceDay2003.htm>>.

Metric: The 2,000 students and members of the general public reached by SD Space Days 2003 is a good measure of SDSGC's outreach to pre-college students and teachers and promotion of both 1) a strong STEM education base from elementary through secondary levels, and 2) NASA's unique mission.

- SDSGC provided \$500 to Dakota Valley school district in South Dakota to participate in the Sixth Annual Mars Settlement Design Competition at NASA's Johnson Space Center on Feb. 20-22, 2004. The JSC Mars Settlement Design Competition is an exciting industry simulation game for high school students set in the middle of the 21st century, where a call has been issued to industry to propose a design and operating plan for a new Mars base. The Competition emulates the experience of working as a member of an aerospace company team in developing a design and operations proposal for the new Mars base. Dakota Valley's participation in this Competition is in conjunction with the participation of about 140 high schools other students and 20 teachers from high schools in Iowa, Nebraska, and South Dakota brought together for this purpose by the NASA Educator Resource Center in Sioux City, Iowa.
- Badlands Observatory's "Dark Skies & Bright Minds" project was pilot tested in 2003 with the help of numerous volunteers and then implemented at four K-12 schools in South Dakota. This project, which took advantage of about \$23,000 in State funds that SDSGC was successful in obtaining from former SD Governor William J. Janklow in the summer of 2002, allows the 26-inch telescope at Badlands Observatory in Quinn, SD to be used online, via the internet as an educational and research tool. SDSGC provides \$5,000 per year in co-funding to help participating schools pay the use-rate costs for remote operation of the telescope. A Space Grant fellowship for an SDSM&T student allowed the student to work with Ron Dyvig of Badlands Observatory in support of the telescope project. The project takes advantage of the common attraction that most students have toward space, astronomy, and the study of the universe. NASA and the South Dakota Space Grant Consortium have used the "attention grabbing effect" that space science offers to students as a platform for teaching math, science, engineering, and technology. This program also takes advantage of the very dark skies in western South Dakota and Ron Dyvig's extremely sensitive research-grade telescope, which places Badlands Observatory in the company of some of the world's best astronomical research facilities. For these reasons, the educational opportunities that have been made available to students within South Dakota through this program are both unique and exciting. Allowing other students to experience the excitement of conducting their own astronomical observations at Badlands Observatory via the Internet provides them with opportunities to expand their scientific interests beyond the classroom. The SDSGC will also continue to serve as the host for The Badlands Observatory's website www.sdsmt.edu/space/bo.htm.

Metric: This example of combining State funds and SDSGC funds for the telescope project is a good measure of our success in building educational, research, and public service projects in SD. An estimated 60 students will be reached by the end of the 2003 project period and several hundred will likely be reached in 2004. This project is also a good measure of our success in building partnerships with State Government and the Governor's Office.

- The collaborative project titled "Earth Systems Connections" <www.ias.sdsmt.edu/ESC/> continued to develop curriculum for students in grades K-5. This project is funded by NASA's Earth Science Enterprise and co-developed at SDSM&T, Virginia Tech, and the University of Colorado. The educational goal is to show that the Earth's physical, chemical, biological, geological, economic and cultural systems are intimately intertwined. Earth Systems Connections is a hands on, multifaceted, interactive mathematics, science, and technology curriculum where elementary students are challenged to explore how many of the Earth's systems operate and connect with one another. SDSM&T's Dr. Lee Vierling, the PI of the project, has incorporated Little Wound School (Kyle, SD) and Woodrow Wilson Elementary School (Rapid City, SD) into the project as pilot schools. To motivate children to learn about satellites and remote sensing, Dr. Vierling developed a cartoon character named "Pixel the Satellite" (see image at right) and has produced 10 short animated features for teachers and children to view in concert with or independently of the curriculum. SDSGC provided funds for the addition of Native American video clips into the curriculum of this project, an exciting way to include Lakota culture into a nationally-available curriculum for elementary children. Dr. Lee Vierling presented his Earth Systems Connections project at the Western Regional Space Grant Meeting in Rapid City in September 2003. Additionally, his product passed the 2003 Earth Science Enterprise Office of Space Science Education Products Review and he was invited to present his educational materials at the 2003 NASA Earth and Space Science Education Products Workshop at NASA Langley Research Center in November 2003. The workshop



is held annually to train representatives from NASA Educator Resource Centers, AESP, and OSS Broker/Facilitators on the use of outstanding NASA Earth and space science education products. After being trained on the use of these products, representatives then use them across the country.

Metric: This example of NASA funding outside of Space Grant for the "Earth Systems Connections" project is a good measure of our success in building educational, research, and public service projects within and outside of SD.

- Augustana College's annual Science Day 2003 – Attended by 250 student and teacher participants, 25 of whom (10%) were Native American students. Science Day provides high school juniors and seniors a day filled with hands-on science opportunities and experiences. The day is designed to encourage students to study and understand the sciences and to eliminate the fear that the word science sometimes portrays. A special invitation went to Native American and female students in order to break down the stereotypes that science has produced. To entice these targeted groups to attend, Augustana College waived the tuition normally associated with student attendance. As a result of this event, two students receive \$8,000 scholarships to attend Augustana College and to major in the sciences.
- The 2003 FIRST Robotics season was the first veteran year for nine (9) high school teams sponsored by NASA along with one (1) rookie self-funding team for a total of ten (10) mentored teams in South Dakota. The SDSGC effectively established outreach relationships in South Dakota among education administrators, high school students, area businesses, and SDSGC professionals in 2002 that expanded in 2003. The teams attended various regional competitions according to preferred times and places to compete. The FIRST Robotics Competition is an exciting, nationwide competition that teams professionals and young people to solve an engineering design problem in an intense and competitive way. The following 10 high school teams from SD were mentored by SDSGC university institutional members SDSM&T (3 teams), SDSU (6 teams), and Augustana College (1 team): Rapid City Central, Rapid City Stevens, Sioux Falls O'Gorman, Sturgis, Sisseton, Brookings, Woonsocket, Watertown, Faulkton, and Volga, SD. After developing competition strategies, each team designs their robots using high-tech computer design software. They then gain mechanical skills and learn invaluable lessons on teamwork during construction and competition. Depending on each team's preference for a Regional Competition site, they went to St. Louis, MO, Houston, TX, or Evanston, IL. Two teams went to Houston for the 2003 National Championships. One of those two teams, the Woonsocket Team, was both the highest ranked rookie team ever (ranked 13th) at the previous Nationals competition in 2002 and earned Rookie Team of the Year. South Dakota's participation in the program was funded by a \$100,000 grant from NASA and FIRST, administered through the SDSGC. The FIRST Robotics Program gave the students from these ten high schools an excellent appreciation of the importance of science, engineering, and technology, and of how mastering these subjects benefits society. SDSGC is proud to support this unique educational program and we have submitted a proposal to NASA to continue doing so in 2004 with a second self-funding team from Flandreau Indian School. Additional details are on the web at <<http://www.sdsmt.edu/space/first.htm>> for SDSMT, <<http://www.sfcss.org/OgormanHS/Departments/robotics/>> for Augustana, and <<http://www3.sdstate.edu/Academics/CollegeOfEngineering/EngineeringResourceCenter/FIRSTRobotics/Index.cfm>> for SDSU. Significant efforts were undertaken by SDSGC management in 2003 to request additional funding from the Governor's Office and Senator Daschle's office to continue robotics programs in South Dakota (both FIRST and BEST Robotics programs) after the NASA FIRST funding sunsets.
Metric: This robotics program is an excellent measure of SDSGC's success at raising additional NASA funding to be combined with outside funds raised by the individual high school teams to reach an estimated 100 students at ten South Dakota high schools in this outstanding educational program and to prepare them for SMET-related college and professional careers.
- SDSGC continued to support "Scientific Knowledge for Indian Learning and Leadership" (SKILL) Program the local chapter of the American Indian Science and Engineering Society (AISES) on SDSM&T's campus. Native American SKILL students often come from affiliate Tribal colleges with articulation agreements with SDSGC's lead institution, SDSM&T.
- The SDSM&T and BHSU AISES (American Indian Science and Engineering Society) Chapters hosted the 2003 AISES Region V Conference on April 3rd, 4th and 5th, 2003 at the SDSM&T Campus. AISES is a non-profit organizations that nurtures building of community by bridging science and technology with traditional

American Indian values. AISES builds partnerships of support with tribes, schools, and other non-profit organizations, corporations, foundations and government agencies to provide academic, financial and cultural support of American Indian and Northern Natives from middle school through graduate school. Through AISES programs, talented young people are able to overcome many obstacles to success at the high school, college and university levels. As they become young professionals pursuing careers in science and technology, they serve as role models and mentors for younger Indian students. An ultimate goal of AISES is to be a catalyst for the advancement of American Indians as they grow to become self-reliant and self-determined members of society. The AISES Regional Conference offers career and educational opportunities to American Indian university/college students and professionals in the science, engineering, mathematics and technology field as well as business education. Approximately 90+ college students from Region V (South Dakota, North Dakota, Minnesota, Nebraska, Iowa, Upper Michigan, Illinois and Canada) and local middle and high school students attended the conference. Speakers involved with SDSGC activities included: 1) Mr. Leonard Little, Oglala Sioux Educator and great great grandson of Chief Big Foot who was massacred with 300 followers at Wounded Knee, South Dakota, on December 29, 1890. Mr. Little Finger presented “Lakota Perspectives on the Environment From Mother Earth to the Heavens”, and 2) Mr. James Rattling Leaf of Sinte Gleska University, who presented on the subject of GIS.

- SDSU staffed and supported a UMAC EdPARC teacher-training workshop in GIS, GPS and remote sensing technology on June 9-13, 2003 at the USGS EROS Data Center titled “Earth Science Tools for Educators”. Nineteen teachers were in attendance (two from Little Priest Tribal College in Nebraska, two from OLC, and the remainder from K-12 school throughout SD). In the past, SDSGC has supported two of these workshops per year. The reason we only had one in 2003 is that the SD Department of Education also did several GIS/GPS workshops around the state. This is a good indication that the technology is catching on in SD.
- SDSGC maintained working relationships with the two NASA Educator Resource Centers (ERC's) in South Dakota to help assure their continuing use by teachers and students. One ERC is located at Black Hills State University's Center for the Advancement of Math and Science Education in Spearfish and the other at the Kirby Science Center in Sioux Falls.
- SDSU's Aerospace Career and Education (ACE) Camp 2003 was held in July with 24 high school participants.
- SDSGC agreed to participate in and financially support several “Women in Science” (WIS) conferences to be held throughout the state in 2004. A WIS planning committee meeting was held on Nov. 19, 2003 at the South Dakota Discovery Center & Aquarium, an educational affiliate of SDSGC. Planning for the 2004 WIS conferences includes a keynote speaker, breakout sessions led by professional women in SMET careers, vendor booths, and an optional field trip.

Metric: The WIS conference is a good measure of our success in recruiting and training women for careers in science and technology, as it will reach an estimated 100 high school girls and their parents and educators.
- The South Dakota Discovery Center & Aquarium sponsored a Space Science Lecture in 2003 with NASA's Jack Bacon who works on the design of the International Space Station. SDSGC is planning to assist in developing a “Space Science Lecture Series” at South Dakota's three science centers in 2004.
- Student recruitment and diversity in underrepresented groups was enhanced in 2003 by SDSU's Flandreau Indian School (FIS) “Success Academy”. About 400 Native American FIS freshman, sophomores and juniors had their grasp of NASA career opportunities enhanced through a combination of hands-on SDSGC workshops, NASA events, and SD Space Days. More detail on this program is found under Section 6 (Workforce Development) of this report.

Metric: The FIS Success Academy at SDSU is a good measure of SDSGC's success in recruiting and training 400 Native American students for careers in SMET-related careers.
- Tom Durkin presented several space talks to St. Elizabeth Seton pre-school, K, 1st and 2nd grade classes in April 2003, as well as to two Rapid City Central High School physics classes.

- In July 2003, Tom Durkin presented talks on space, NASA, and satellites, to three Rapid City school groups at Bergquist, General Beadle, and Knollwood schools (~140 students) with high Native American enrollment through a summer educational program for grades 1-5.
- Tom Durkin judged High Plains Regional Science and Engineering Fair at SDSM&T in March 2003.
- SD Space Grant Consortium provided a \$200 scholarship to Jessica Weidenbach, a high school student in Armour, SD, to attend Space Camp in Huntsville, AL in the summer of 2003. Ms. Weidenbach attended ACE Camp at SDSU in summer 2002, which inspired her to seek more direct contact with NASA through the Huntsville Space Camp in 2003.
- In February 2003, SDSGC Headquarters Office offered an open house and continuous presentations on “Satellite Remote Sensing and Space Technologies” to several hundred of middle and high school students visiting campus during SDSM&T’s annual Engineer’s Week (E-week) celebration. This is a very successful and well-appreciated event by students, teachers and parents.
- SDSGC again participated in the 2003 "Student Signatures in Space" Program by providing signature opportunities at SD Space Days 2003 and at a school in Conde, SD. Enthusiasm for the space program remains very high among SD's K-12 school students with an estimated 1,500 signatures by students, teachers, and parents.
- 1st grade class from Wagner, SD participated in the Kitty Hawk "Weather Contest of the Century". <http://www.centennialofflight.gov/2003FF/index.html>
- SDSGC maintained "Educational Opportunities (K-12)" website for SD teachers, students, and parents <<http://www.sdsmt.edu/space/EdOpp-K-12.htm>>.

4. Other Public Service

- In April 2003, SDSGC’s Tom Durkin, with assistance from Black Hills Astronomical Society members and friends, presented a course entitled “Introduction to Astronomy and Current Events in Space” through the Career Learning Center of the Black Hills Community Education Program in Rapid City. The four-session course focused on A) the current view of the solar system; B) the Milky Way Galaxy; C) constellations; D) NASA missions, such as the Cassini Mission to Saturn; E) telescopes; and F) the construction and mission of the International Space Station, G) local research of near-Earth asteroids conducted at Badlands Observatory , H) reflections on the Columbia tragedy, and I) other NASA and space-related subjects. One evening included a demonstration in StarLab, a portable planetarium and another, a trip to a local observatory for a star party.
Metric: The course was attended by 22 adult members of the public. Due numerous requests for more courses like this, it is planned to become an annual event sponsored by SDSGC. The popularity of this course is a measure of SDSGC’s success at providing information and activities to increase public appreciation for the direct and indirect benefits of NASA-sponsored research and education.
- Tom Durkin presented the SDSGC booth at 30th anniversary open house at EROS Data Center on Sept. 20, 2003. Speakers at this event included SD Senators Tim Johnson and Tom Daschle.
Metric: This event reached over 10,000 members of the public that attended the EROS 30th anniversary open house. It was an excellent way of promoting NASA and Space Grant opportunities to the public.
- In addition to the presentations given to school children referenced under the “K-12 Education” section of this report, SDSGC’s Tom Durkin gave numerous presentations to teachers and the general public about Space Grant throughout the state in 2003, including:
 - Jan 3, 2003 PowerPoint Talk to Kiwanas Club in Spearfish.

- Feb 6-7, 2003 joint presentation with Angelo Casaburri of NASA AESP titled "Fill Your Head with Space!" at annual joint conference of SD Science Teachers Association and SD Council of Teachers of Mathematics in Huron, SD. Also presented SDSGC exhibit booth.
 - Feb. 17, 2003 PowerPoint Talk to Black Hills Astronomical Society titled "Space Grant and Satellite Remote Sensing".
 - Feb. 18, 2003 PowerPoint Talk to SDSM&T's Physics 385 class titled "Space Grant and Satellite Remote Sensing".
 - Feb. 25, 2003 PowerPoint Talk to SDSM&T's Forum titled "Reflections on Columbia". Attended by 60 members of the campus community and general public. Covered by two local TV crews.
 - April 7, 2003 joint presentation with Angelo Casaburri of NASA AESP and Dr. Andy Johnson (NASA ERC in Spearfish, SD) titled "NASA Share-a-Thon" at the Technology and Innovation in Education (TIE) Conference in Rapid City, which attracted about 1,200 teachers from the state and region. Also presented SDSGC exhibit booth.
 - Sept. 20, 2003 SDSGC exhibit booth presentation at EROS Data Center 30th Anniversary attended by over 10,000 members of the general public (referenced above).
 - Oct. 9, 2003 luncheon presentation to SD Municipal League conference in Pierre, SD attended by 300 mayors, city leaders, and engineers. The presentation focused on SDSGC, NASA educational programs, and satellite remote sensing was very well received by this large group of city government leaders.
 - Metric: These presentations reached about 12,000 people with information on NASA's unique mission and NASA Space Grant's educational and research opportunities.
- Mentioned above, Tom Durkin gave a presentation in February 2003 at the SDSM&T Forum (sponsored by United Campus Ministries and Office of Multicultural Affairs) titled "Reflections on Columbia". This special talk focused on the Columbia tragedy and information about the astronauts and the scientific details of the mission that may not have been given much attention by the media. A Space Shuttle tile that had flown on Challenger and been rejected in 1985 was made available for display. This presentation was well advertised, very well attended, and given significant coverage by the news media.
 - Dr. Bob Polcyn of Hot Springs, SD remained extremely busy as South Dakota's Solar System Ambassador in 2003. He was appointed by NASA's JPL Solar System Ambassador Program in early 2002. Dr. Polcyn presented over a dozen talks throughout the Black Hills area on specific NASA missions and astronomy/space-related subjects. Presentations were made to the general public, various groups such as the Black Hills Astronomical Society, school groups, civic groups, SD Space Days 2003, the Fall 2003 Western Regional Space Grant Meeting in Rapid City, etc. Classroom groups averaged about 25 students and other groups ranged from about 10 to 65 people in attendance, with three groups as big as 300 people each at SD Space Days.
 - Support was provided to the Black Hills Astronomical Society (BHAS) and related summer Star Parties open to the public at Hidden Valley Observatory and Badlands Observatory. SDSGC created and maintains public service websites for BHAS, <<http://www.sdsmt.edu/space/BHAS.htm>>, Hidden Valley Observatory, and Badlands Observatory <<http://www.sdsmt.edu/space/bo.htm>>.
 - SDSGC continued its support of StarDate, a daily PBS radio broadcast in South Dakota as part of the McDonald Observatory astronomy program. This broadcast provides a very effective means of informing the public about the Consortium's resources and reaches tens of thousands of listeners every day.
 - Numerous notices and various informational presentations about Consortium activities, noteworthy celestial events, aerospace programs, etc. were published and presented to the general public in 2003.

5. Fellowships and Scholarships

SDSGC supported a number of graduate and undergraduate students through fellowships, scholarships, and assistantships. We have established a Diversity Enhancement Fellowship program to provide research and educational opportunities for faculty and students at Tribal Colleges and other Native American institutions in South Dakota. The total amount of Consortium support for faculty and students through these avenues exceeded the minimum required amount of \$50,000 over the project year. (Note: Workforce development fellowships are discussed separately under Section 6 of this report).

SDSM&T Graduate and Undergraduate Student Fellowships:

- Patrick Kozak - SDSM&T Geological Engineering graduate student sponsored by Space Grant. Specialty: remote sensing using Landsat and AVIRIS, field spectroscopy. Presented several papers at professional conferences throughout the year.
- John Keefner – SDSM&T Geological Engineering undergraduate student sponsored by Space Grant. Participated in Summer 2003 NASA Academy and was part of multi-institutional Summer 2003 KC-135A flight project titled “Solar sail Operations Linking Academic Researchers” (S.O.L.A.R.).
- Charlie Senn – SDSM&T Computer Science undergraduate student sponsored by Space Grant to assist with Badlands Observatory telescope project “Dark Skies & Bright Minds”.
- Melissa Campbell, SDSM&T Graduate Student in Geology.
- Erin Landguth – SDSM&T Graduate Student in Atmospheric Sciences.
- Cassie Soeffing – SDSM&T Graduate Student in Atmospheric Sciences.

T. Bull Bennett – SDSM&T AEWB graduate student sponsored by Space Grant. Specialty: Ungulate interactions in managed short grass prairie systems using remote sensing and GIS. Although Mr. Bennett did not receive a fellowship directly from Space Grant, he was supported in 2003 through a NASA Earth Systems Science Fellowship.

SDSM&T Graduate Student Summer 2003 Fellowship at USGS EROS Data Center:

- Patrick Kozak - SDSM&T Geological Engineering graduate student. Specialty: remote sensing using Landsat and AVIRIS, field spectroscopy.

SDSU Graduate Assistantships* and Undergraduate Summer Research Positions**:

- Corey Mettler (EE, remote sensing and calibration)*
- Charnel Petersen (Rural sociology/AEWB, outreach education coordinator)*
- Sara Landau (Physics) **
- Joseph Schenkel (Electrical Engineering) **

SDSU Faculty Summer 2003 Fellowship at USGS EROS Data Center:

- Robert Watrel, Geography, Assistant Professor who worked on land cover mapping.

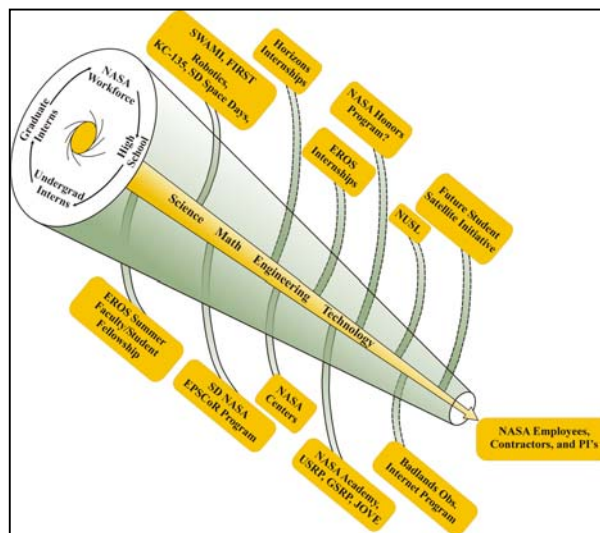
Augustana College Fellowships and Scholarships:

- Mr. Cory Ranschau
- Mr. Brad Bishop
- Mr. Ali Ashraf
- Mr. James Nelson
- Ms. Jamie Kapplinger
- Mr. Robbie Heegle
- Mr. Paul Marshall
- Mr. Stuart Ness
- Mr. John Schneiderman
- Mr. Roy Tewalt
- Mr. Jason Ranschau
- Mr. Timothy Stavenger
- Ms. Jerilyn Peterson

6. Workforce Development “Augmentations”

SDSGC was awarded \$91,882 in September 2002 for a project entitled “An Expanded NASA Workforce Development Program in Science, Engineering & Technology for South Dakota”. Additionally, SDSGC received \$5,750 over its normal annual Space Grant budget in 2003 to be used as workforce development (WFD) fellowships (half awarded to Augustana College and half to Black Hills State University).

The primary goal of SDSGC’s 2003 WFD efforts was met (i.e., to enlarge and enhance the resource pool, or “pipeline” of quality scientists and engineers that become involved with NASA as employees, contractors, or PI’s). Members of the SDSGC utilized their institutional resources, facilities, and programs to provide students (especially Native Americans), educators, and faculty members with a) SMET education, b) exposure to NASA-relevant projects, and c) internship experiences at EROS Data Center, Kennedy Space Center, and Goddard Space Flight Center. The WFD program provided additional internships/fellowships for talented, prospective undergraduate and graduate students from South Dakota Space Grant member institutions, including those SD Tribal Colleges and Universities that have a strong interest in working on NASA-related SMET. The adjacent figure shows a simplified schematic of the NASA pipeline that was employed during 2003. Creating internships and fostering eventual workforce staff at participating institutions only benefits NASA’s workforce development goals, but also helps bolster much needed workforce development opportunities within SD.



Eight “NASA Workforce Development Student Internships/Fellowships”, were awarded to the following 8 students at four schools. Each student is discussed separately under the WFD efforts listed for the following four schools.

1. SDSM&T - Tom Campbell, Jim Sanovia, Kevin Whirlwind Horse Jr., and John Keefner
2. SDSU - Josephine Santiago
3. Black Hills State University - Richard Hudson
4. Augustana College - Andrew Reinartz and Sven Lerseth

Student interns/fellows learned about NASA-relevant science and engineering by working on NASA-oriented projects at NASA Centers (Goddard and Kennedy Space Centers), EROS Data Center, and the SD universities/colleges that they attend.

SDSM&T’s Workforce Development Efforts:

SDSM&T’s WFD efforts enhanced diversity in underrepresented groups by supporting numerous Native American projects and individuals, some of which are summarized below with associated metrics used to measure success. In terms of metrics, it is noteworthy that SDSM&T now has the highest number (84) of Native Americans attending classes in the history of the institution. In May 2003, SDSM&T graduated 7 American Indian students. In Fall 2003, SDSM&T enrolled 20 Native Americans as freshmen, which is a new record. There are 11 American Indian students currently involved in SDSM&T’s Center of Excellence for Advanced Manufacturing and Production (CAMP) Project Teams. SDSM&T has articulation agreements with Oglala Lakota College (OLC), Sinte Gleska University, Si Tanka College, and Sisseton Wahpeton Community College. American Indian students studying science and engineering are able to transfer Tribal college credits to SDSM&T to complete their four-year degrees. In part, the future of workforce development is dependent upon sustained efforts in linking the Indian and non-Indian community in South Dakota. Hence, we believe the SDSGC can lead the way via the operating NASA pipeline. We have found that the projects noted below provide the structure and support a Native student needs to

successfully complete a degree in science and engineering. If the pipeline is to bridge more American Indians into NASA research, projects, positions and contracts, a directive approach is necessary. American Indian students need mentoring and role models in order to accept and build upon their academic talents. A new component of our pipeline, SDSM&T's Office of Multicultural Affairs, maintains a center for American Indian students and provides academic advising, tutoring, mentoring, scholarships, coop/internship placements, career guidance, and cultural support.

- Two American Indian students at SDSM&T were approved in 2003 to receive WFD fellowships: Jim Sanovia and Kevin Whirlwind Horse Jr. Mr. Sanovia is a tribal college transfer student completing his degree at SDSM&T in Geological Engineering. In the summer of 2001, Mr. Sanovia, Justin Hooper and Santiago Handboy attended an Undergraduate Research Program at NASA-GSFC where each of the students completed a research project. Mr. Sanovia has been working closely with Janie Nall and Wanda David at GSFC and has been invited to present his research at the December AGU in California. Mr. Sanovia's presentation is titled "Interactions with Native America and Tribal Colleges and Universities". Another good example of successful WFD fellowships to Native American students is Kevin Whirlwind Horse, Jr., who was a recipient of a WFD fellowship in the Fall 2003. Kevin Whirlwind Horse, Jr. is a first time American Indian freshmen and a major in mathematics and computer engineering. Kevin is also president of the SDSM&T AISES Chapter, is active in undergraduate research, and will apply for a NASA Summer Undergraduate Research Experience. His career goal is to become a NASA Astronaut.
- Tom Campbell, SDSM&T Graduate Student in Geology was awarded WFD fellowship funds. Mr. Campbell worked as SDSGC's Workforce Development Coordinator in 2003 and recruited students into the NASA pipeline by informing them of NASA educational and workforce development opportunities. He traveled to Goddard Space Flight Center on several occasions to develop workforce collaborations with NASA personnel. He also provided Space and Earth Camps in the summer of 2003 at SDSM&T in conjunction with Badlands Observatory, as well as a summer Space Camp on the Pine Ridge Indian Reservation.
- As discussed in more detail under Section 2 of this report (Higher Education), John Keefner, SDSM&T undergraduate Geological Engineering student, participated in the prestigious 2003 NASA Ames Astrobiology Academy. A NASA WFD fellowship stipend was awarded to Mr. Keefner to assist him in this endeavor.
- Kurtis Nelson, an SDSM&T Institute of Atmospheric Science graduate student was supported by an EROS Data Center project in the summer of 2003. He worked on the LANDFIRE project, a very important project at EROS Data Center, and went to Southern Utah on a field trip to develop fire fuel mapping algorithms. EROS personnel indicated that Mr. Nelson was an effective intern for them and reported their appreciation in working with SDSM&T and having such excellent students from which to choose. They also indicated their appreciation for SDSM&T's help and support in training these students to become hardworking and knowledgeable employees.
- The Native American Honors Program, a cooperative pre-college program, was operated by Oglala Lakota College (OLC) for six weeks on the campus of SDSM&T. The program provided approximately 100 high school student participants with supplemental curriculum enrichment that emphasized SMET and encouraged these Native American students to pursue university degrees in SMET-related areas. The Honors Program is funded by OLC and was developed by SDSM&T's SKILL (Scientific Knowledge for Indian Learning and Leadership) via a previous NASA grant. There are currently five SKILL graduates attending SDSM&T.
- The American Indian Science and Engineering Society (AISES) is a national organization founded to increase the number of American Indians in SMET fields. SDSM&T has had an active AISES Chapter since 2000 and in 2003 hosted the first AISES Regional Five Conference in SD with 150 Native American students and staff attending. SDSM&T has the largest AISES Chapter in Region V.
- In the summer of 2003, Dr. Kerri Vierling, SDSM&T Professor and Dr. Jacquelyn Bolman, Director of SKILL (Scientific Knowledge for Indian Learning and Leadership) took 15 American Indian Upward Bound Students

on a one-week summer research experience that will be expanded to two weeks in 2004. Additionally, there are now two internships (each \$18,000) at EROS Data Center for American Indian students.

- The “Bridges to Success Program” is an undergraduate American Indian Summer Research Program partnership between OLC and SDSM&T that is funded by NSF through a grant from Salish Kootenai College. Graduates of the OLC Science, Engineering, and Math program are able to major in 15 different BS degree programs in SMET at SDSM&T. In the summer of 2003, 16 students attended the 6-week research program and worked in laboratories at SDSM&T. The students are in the process of completing their two-year tribal college degree and then articulate into SDSM&T to complete their four-year degree in science and engineering. The program (PI is Dr. Carter Kerk) was refunded for academic year 2003-2004. The objective is to create a support structure that aids in retention and culminates in student graduation from SDSM&T. The ultimate goal is to increase the number of quality American Indian professionals in science and engineering related fields. SDSM&T currently has 22 Tribal College Transfers in the process of degree completion.
- Funded by the Western Interstate Commission for Higher Education, Dr. Jacquelyn Bolman at SDSM&T (who also assists with NASA WFD) developed a community empowerment model titled “Empowering the School Counselor Project” to involve local businesses, chambers of commerce, political leaders, school leaders, universities, school counselors and teachers in increasing the enrollment and success of minority (American Indian), low income and rural students in accelerated learning opportunities. A major component of training is on NASA resources and programs.
- One of the objectives of the SDSGC’s WFD program was the continued use of an expanded SDSGC “Program Initiation Grant” (PIG) program to promote the development of NASA-based research opportunities for students and faculty members in SD. As described in more detail under the “Research Infrastructure” section above, Oglala Lakota College was awarded an SDSGC PIG grant in Summer 2003 to conduct a research project titled “Preliminary Assessment of Natural Spring Potential to Enhance Drought Recovery on the Pine Ridge Reservation”. The project was conducted by Native American undergraduate students and faculty and used remote sensing, GIS, and GPS technologies. This research project served to jump-start another more comprehensive, multi-year, interdisciplinary project proposal titled “Tatanka Waste (Good Bison)” submitted to the USDA, in which the biocomplexities of the interaction between people, bison, plant species, soil and water will be examined. This is a good example of how seed projects funded through Space Grant PIG grants can be combined with projects and proposals outside of NASA to initiate, nurture, and grow other valuable research endeavors.
- Kris Jensen, a recent SDSM&T graduate and previous SDSGC fellow, gained employment in 2003 with a company in Evergreen, CO called Airdat on a NASA-based and business-based project called TAMDAR (Tropospheric Airborne Meteorological Data Reporting). TAMDAR is a project that acquires meteorological data from sensors placed on aircraft to be used for weather data analysis, aircraft safety, etc. The ODS TAMDAR (EPIREP) system is a NASA backed program that offers solutions for in-flight air data collection that meet the needs of general aviation through air transport aircraft operations.
- Dr. Lee Vierling of SDSM&T accepted an invitation from NASA’s Dr. Diane Wickland, Manager of the Terrestrial Ecology Program, to serve on an EOS panel to review proposals that NASA's Earth Science Enterprise received under the NASA Research Announcement for Earth System Science Research Using Data and Products from Terra, Aqua, and ACRIM Satellites. Dr. Vierling was invited to serve on this panel due to his ability to help evaluate the proposals addressing ecological, carbon cycle, and related research questions. The panel met in July 2003.
- Although the fellowship period did not fall within 2003, the selection of Dr. Neil Chamberlain (professor, Department of Electrical and Computer Engineering at SDSM&T) for a NASA 2002 Summer Faculty Fellowship at JPL is worthwhile to report under Workforce Development activities at SDSM&T. Dr. Chamberlain was one of only about 20 faculty selected for the fellowship program from universities across the nation. Chamberlain’s supervisor and sponsor at JPL was Dr. Richard Hodges, head of the Spacecraft Antenna Group. Chamberlain worked with Dr. Hodges and Dr. Paul Rosen, head of the Radar Systems Group, on a

prototype phased array antenna for space-based radar. The project, co-funded by JPL and Air Force Research Lab (AFRL), has as its goal the deployment of a large aperture radar system in low earth orbit by 2008. Various science, military, and homeland security issues are motivating this research. Chamberlain worked on the design and evaluation of a phased array antenna with a hybrid analog/digital beamformer and various other electronic sub-assemblies that support the radar. His efforts culminated in a formal presentation to Rosen, Dr. Mark Davis of AFRL, and numerous other team members at the quarterly progress meeting held at JPL. According to Dr. Chamberlain, quoted in a Feb. 2003 article, "The presentation and work were warmly received by both JPL and AFRL with the result that I am continuing the work on contract as a consultant." He continued, "I am also currently in the process of submitting a proposal, under the JPL Director's Research and Development Fund, to develop one of the ideas that I conceived during the summer work; namely, an optical bus system for distributed real-time signal processing." He concluded, "The NASA SFF program provided excellent research and networking opportunities. We were given tours of nearby NASA facilities, such as the Deep Space Network at Goldstone, and bi-weekly mission briefs by JPL project scientists, such a designing experiments to detect life on Europa. This made for a very interesting and fulfilling summer."

SDSU Workforce Development Efforts:

The South Dakota State University Space Grant Consortium is in the process of completing two separate WFD activities funded in 2003 through NASA augmentations.

- The first activity was made possible through a summer 2003 WFD fellowship to SDSU graduate student Josephine Santiago to work at Kennedy Space Center with Rebecca C. Young on a project entitled "Development of Hydrazine/Nitrogen Fiber Optic Sensor", in cooperation with Dr. Alfred S. Andrawis of SDSU. One female, minority student participated in this activity. The expected outcome was a research progress report, which has been completed and submitted to SDSGC, Ms. Young at KSC, and Dr. Mike Freeman at KSC.
- Student recruitment and diversity in underrepresented groups was also enhanced by SDSU's second WFD activity by providing WFD funds to the Flandreau Indian School (FIS) "Success Academy", with special assistance by SDSU's MaryJo Lee. About 400 Native American FIS freshman, sophomores and juniors had their grasp of NASA career opportunities enhanced through a combination of hands-on SDSGC workshops, NASA events, and SD Space Days. Using WFD augmentation funds, full financial support was made available for nine (9) FIS students to take a 3-credit university course in astronomy (Introduction to Astronomy - Physics 185) during the fall semester of 2003. Teacher recommendations were the primary means of recruitment. The 9 students involved have, for the past three years, been participants in the SDSU-FIS Success Academy program. Success Academy is an early and intensive college preparatory program for American Indian students. Taking the three-credit college course is a capstone experience for the seniors involved, all of whom plan to enroll in college next fall. (With continued WFD funding, these same students will take Introduction to Geography at SDSU during Spring Semester 2004. Thus, they will have earned six college credits by the time they graduate from high school in May 2004). The astronomy class meets for 75 minutes, two days per week (once at FIS and once at SDSU). On certain nights at SDSU, students stay for dinner and work with SDSU staff to help prepare them for college admission. During the course of the semester, the students fill out college applications, learn about financial aid, and prepare for the ACT (all fundamental steps toward college). The tenth slot in the class is filled by an FIS teacher, who attends the astronomy class with the students to keep them on track toward college. Seven students will complete the course in December. Of those seven students, three have indicated an interest in pursuing science in college. Five of the seven have indicated an interest in attending SDSU. All seven students are in the upper 60 percent of their high school class and are qualified for SDSU admission. The most important outcome of this WFD activity is the completion of three-college credits in astronomy by seven high school seniors (one male and six females) and one high school teacher, all American Indian. A second important outcome is the opportunity for SDSU faculty to work one-on-one with the Native American students to complete the steps necessary for college admission. SDSU reports that this is especially important because the students attend boarding school. In essence, SDSU faculty and staff fill in for relatives who are far removed geographically from the students and their college preparations. Thus, they play the role of "academic parents" as the students complete high school and move toward college.

Metric: SDSU's FIS Success Academy is another excellent measure of SDSGC's success at recruiting and training underrepresented minorities for academic and professional careers in science and technology.

Black Hills State University's (BHSU) Workforce Development Efforts:

- BHSU's WFD fellowship funds allowed Richard Hudson, a white, male, sophomore undergraduate student at BHSU to start NASA-related research on planetary lava flows. With the support of this grant Mr. Hudson has 1) begun a research project on the study of fractals to the development of internal pathways in simulated lava flows, 2) traveled to Arizona State University to collect data and collaborate with other scientists involved in NASA related research, 3) purchased software to analyze his data, and 4) attended the March 2003 NASA Lunar and Planetary Geology Conference in Houston. At the meeting in Houston, Mr. Hudson was introduced to several dozen NASA employees and researchers, and was exposed to the latest research in the field. He and Dr. Steven Anderson, Professor of Geology and Planetary Science at BHSU plan to attend NASA's Lunar and Planetary Geology Conference again in 2004, where it is hoped that Mr. Hudson can present his own research. Additional outcomes of BHSU's WFD effort include a Geological Society of America Memoir to be published in 2004 and an invited presentation at the International Geological Conference in Florence, Italy in August 2004.

Augustana College Workforce Development Efforts:

- "Seasonality metrics for phenology and drought analysis," NASA Space Grant project in conjunction with a USGS EROS Data Center project, Dr. Daniel Swets, Space Grant PI; Dr. Brad Reed and Ms. Jess Brown, USGS Co-PIs. This project involved faculty member Dr. Daniel Swets and undergraduate students Mr. Andrew Reinartz and Mr. Sven Lerseth. This project continues previous work begun with the Co-PIs on smoothing NDVI signals to use this same technique for extraction of seasonality metrics, such as start-of-season, end-of-season, cumulative NDVI, and NDVI-to-date. These metrics are used in many applications, including weather models, land cover analysis/land cover change, urbanization, and leaf area index calculations.
- "Metrics reloaded: efficient implementation of seasonality metrics algorithms on a PC," NASA Workforce Development Grant at Augustana College and USGS EROS Data Center, Dr. Daniel Swets, Augustana College PI, and Dr. Brad Reed, USGS EROS Data Center PI. This activity involved faculty member Daniel Swets, Augustana College, and principal scientist Brad Reed, USGS EROS Data Center, and undergraduate Augustana College students Paul Marshall, Stuart Ness, John Schneiderman, Roy Tewalt, and Jason Ranschau. The USGS EROS Data Center has an implementation of algorithms to compute seasonality metrics on a Sun Workstation-based image processing package. The Augustana students worked closely with the USGS personnel involved in the metrics calculations to implement an efficient suite of software programs on the PC for real-time metrics calculations.

7. Administration

- SDSGC successfully hosted the 2003 Western Regional Space Grant Meeting (WRSGM) in Rapid City, SD on September 25-27, 2003. The conference was attended by 75 people from 21 states and the District of Columbia, and included representatives from numerous Space Grant Consortia, NASA HQ and NASA Centers, and Tribal Colleges. In addition to all the individual presentations, highlights included panel discussions on Native American NASA-related projects, Geospatial/GIS programs that are "Working Together with Space Grant", and NASA Center UAO activities. The WRSGM conference agenda, PowerPoint presentations, and conference photos can be found at <http://www.sdsmt.edu/space/WRSGMAgenda.htm>
- SDSGC's Director or Deputy Director at SDSM&T, or Associate Director at SDSU, attended all National Council of Space Grant Director's and Western Regional meetings during 2003.
- SDSGC held two meetings of institutional members and several workforce development meetings since the last reporting period, and several affiliate members often attended these meetings. We continued to focus on competitive allotment of SDSGC funds and the goal of nurturing projects that can attract external support.
- Augustana College reported that they continued their trend for increasing collaborations among researchers at member institutions this year. NASA Space Grant projects, NASA EPSCoR projects, and workforce

development projects have directly led to these increased collaborations among member institutions, particularly the industrial and governmental affiliates.

- SDSGC's Director and Deputy Director were successful in adding the following three new affiliates to the Consortium in 2003, bringing total membership up to 34 organizations:
 - RESPEC (Industrial Affiliate)
 - Barrick Gold Corp. - Homestake Mine Closure Project (Industrial Affiliate)
 - Lake Area Technical Institute (Educational Affiliate)

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