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## NESG Geospatial White Paper

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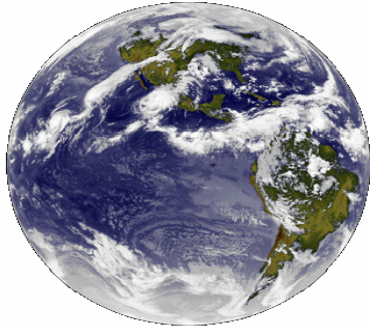
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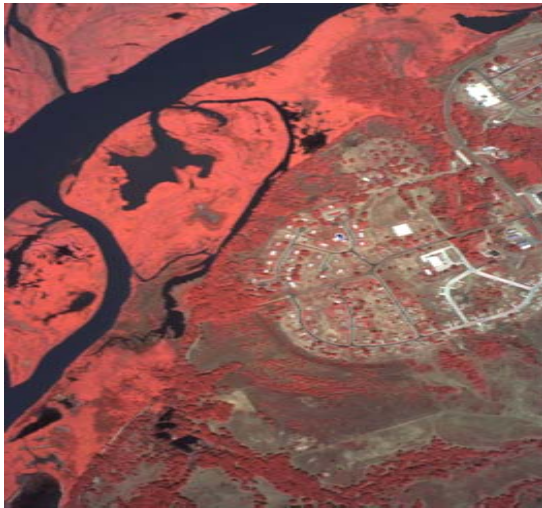
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# NEBRASKA SPACE GRANT

## GEOSPATIAL EXTENSION PROGRAM



**Santee Sioux Reservation  
Santee, NE**

**Color infrared photo taken July 25, 2002**

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Research Specialist**

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**Winnebago Reservation  
Winnebago, NE**

**Color infrared photo taken September 6, 2002**

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**Nebraska Space Grant Consortium (NSGC)**  
**Geospatial Extension Program**  
(White Paper)

**Overview of the Geospatial Extension Specialist (GES) Concept**

Geospatial Technologies

Remote sensing (RS), geographic information systems (GIS), and global positioning systems (GPS) are often referred to as the three primary geospatial technologies. These technologies have advanced rapidly since their inception. The availability of spatial data has grown tremendously over the past decade and the practical applications are limitless. The rapid advancement of these technologies has led to a gap between those who know how to harness and utilize these tools and potential users who are left behind (University of Arizona, n.d.).

The National Aeronautics and Space Administration (NASA) has stepped in and developed a pilot program to help meet the needs of potential users of geospatial technologies. The NASA Space Grant Extension Specialist in Geospatial Technology joins the missions of the NASA Office of Earth Science and NASA Space Grant with the U.S. Department of Agriculture (USDA). The goal is to implement a Geospatial Extension Specialist within the Cooperative State Research, Education, and Extension Service (CSREES) of a land grant university in each state.

Geospatial Pilot Programs

Three Geospatial Extension Programs were launched in 2000 with pilot programs at Utah State University, Mississippi State University, and the University of Arizona. Due to the success of the three pilot programs, NASA implemented more programs across the United States. In early 2002, three more programs were developed with the addition of the University of North Dakota, University of Alabama, and the University of Connecticut. Many more Geospatial Extension Specialist (GES) Programs are expected across the United States (NASA, n.d.).

The Space Grant/Land Grant Extension Program is implemented by the state Geospatial Extension Specialist. The goals and objectives of each state specialist in this program are:

- To make the public aware of the capabilities of geomatics as tools for better management of natural resources and economic development
- To train and educate Extension County Agents and potential users in geomatics
- To develop new applications of existing technologies in response to needs in their states with support from NASA
- To make NASA aware of user needs in the states and to recommend development of new sensors, technologies, and software in response to these needs

- To support the Space Grant’s mission to “promote activities that will result in greater understanding, assessment, development, and utilization of space resources” in the area of remote sensing and earth science (Utah State University, 2000).

### Geospatial Extension Specialist (GES) for Nebraska Space Grant

The NSGC hired a Geospatial Extension and Research Specialist in August 2002. According to NASA’s vision, a GES explores “how to best meet the needs of farmers, ranchers, planners, and other involved in agriculture, natural resource management, and rural development. The specialist then characterizes the needs of the different constituencies in the state and works with them to design solutions that meet the information needs within their budget and staffing constraints” (NASA, n.d.). For the purpose of the NSGC program, this person will act as a broker facilitator in accomplishing the goals of Geospatial Extension Program (Vlasek, 2002).

A three-phase plan has been established to implement a full-time Geospatial Extension Specialist in Nebraska:

- Phase 1 entails the scope of the GES to focus on Native American communities in Nebraska through the NASA Workforce Development Initiative. This phase incorporates the following academic affiliates: Nebraska Indian Community College, Little Priest Tribal College, University of Nebraska at Lincoln (UNL)/Center for Advanced Land Management Technologies (CALMIT), University of Nebraska at Omaha (UNO), and Creighton University. Through this addition, Nebraska will become an active participant in the NASA Earth Grant program.
- Phase 2 broadens the scope to include Cooperative Extension’s Metro Extension Planning Unit (Douglas, Lancaster, and Sarpy counties) to serve the highest population of Nebraska farms and urban areas. This second phase will be funded through the NASA Designated Upgrade Proposal.
- Phase 3 will expand the program statewide through the pending application at the National Science Foundation and other avenues for funding (University of Nebraska at Omaha, 2002b).

### Nebraska’s Need for Geospatial Technologies

NASA’s Earth Science Enterprise Strategic Plan identifies objectives that focus on the need for the development of remote sensing technology. The Earth Grant concept furthers this goal through the collaboration of NASA, USDA, and National Oceanic and Atmospheric Administration (NOAA) efforts to apply geospatial data which can benefit Nebraska’s rural and urban communities in a variety of ways. Nebraska’s geographic, economic, and production characteristics make it the ideal state for placement of a GES. The citizens of Nebraska face complex problems which can be addressed through the application of geospatial data (e.g., satellite images, precipitation, soils, terrain characteristics, vegetation type and condition, population characteristics, political infrastructure, transportation and utility systems, and land use). Challenges include managing agricultural ecosystems to ensure sustainability and productivity; protecting wildlife, soil productivity, and groundwater and surface water resources;

assessing and responding to natural hazards such as severe storms or drought; developing and siting new industries (e.g., biofuels); and allocating and routing transport (e.g., rail cars) appropriately to areas of greatest demand during grain harvest.

Geospatial data is increasingly important at the agricultural level. Precision-farming methods are being adopted to enable farmers to enhance production and to reduce expenses while simultaneously maintaining or improving environmental quality. Geospatial data and technologies, used together with sophisticated farm machinery, can, for instance, be used to apply farm chemicals in locations and amounts apportioned to soil and crop requirements. It is clearly critical that business managers, natural resource specialists, agronomists and farmers, public policy-makers, and other decision-makers have comprehensive, accurate, current, and appropriately detailed digital geospatial data. They must have computational tools that will enable them to efficiently and effectively identify, access, archive, integrate, manipulate, visualize, and analyze such data. In addition, they require technology to support and facilitate collaborative decision-making that increasingly will involve interdisciplinary teams working in different locations sharing data.

The information age has the potential to change the agricultural landscape; therefore, it is critical that trained extension staff convey pertinent aspects of geospatial technologies not only to producers, but also to agribusiness personnel. It is critical that Nebraska develop an “extension presence” in the geospatial area given the interest in and widespread demand for, access to, and knowledge about “precision technologies.” Nebraska Space Grant affiliates are positioned to implement geospatial extension and the significance of such a development will undoubtedly have a substantial impact on Nebraska.

#### Transferring Knowledge and Technology Across Nebraska

Nebraska’s expertise in remote sensing research will allow the NSGC to effectively apply remote sensing research to the needs of Nebraska citizens. The GES for Nebraska will collaborate with Cooperative Extension to allow for applied research, technology transfer, and education/demonstration projects to be implemented which best meet the needs identified in Nebraska. These demonstration projects will target rural and urban users that want to employ remote sensing data to improve the quality of life in the state.

Nebraska has a remote sensing data acquisition capability that was funded by a leveraged award from the National Science Foundation. This aircraft-based facility allows Nebraska an exceptional opportunity to utilize airborne remote sensing data for research and applied utilization. This has been developed under the direct supervision of NASA Stennis Technical Monitors Drs. Bruce Davis and Nathan Sovic. Through this facility, Nebraska will also expand its ongoing collaborations with the Minnesota Sea Grant Program. In the area of research, Nebraska will offer the Minnesota Sea Grant access to this facility for the purpose of specifically-targeted watershed data acquisition.

Community colleges will be important in the delivery of geospatial data. In addition to establishing data centers at three community colleges the first year, the NSGC would also

institute 2+2 programs for GIS and remote sensing at NSGC community colleges to further workforce development. The NSGC would expand the number of geospatial-related educational outreach programs by collaborating with Blanche Meeson at Goddard Space Flight Center and Ramona Travis at Stennis Space Center (University of Nebraska at Omaha, 2002a).

### Workforce Development Initiative

“In building a future workforce, our Nation must begin to understand the qualities and challenges that will be encountered in constructing it. That means preparing future workers with the skills necessary to compete.” The words of NASA Administrator Sean O’Keefe provide guidance for NSGC’s new workforce focus. A new initiative is currently under development to encourage the state’s Native American citizens to pursue aerospace-related careers. The Native American Workforce Training focus is closely tied with the implementation of a GES in Nebraska. Due to the state’s strategic use of NASA and state funding in the past 11 years, there is considerable capacity in place in Nebraska to intensify geospatial research, education, and outreach efforts. The NSGC includes partnerships with Land Grant; Cooperative Extension; UNL/CALMIT; and remote sensing faculty at Creighton and UNO. It also includes emerging collaborations with the Minnesota Sea Grant. The GES will develop linkages between academic programs and commercial entities to result in both economic and workforce development for Nebraska. The GES will transfer the technology of products resulting from geospatial research in the state to the public and corporate communities through applied research, demonstration projects, and educational programs. The GES will contribute to workforce development in Nebraska through the implementation of continuing education credits, training, and workshops in this field (University of Nebraska at Omaha, 2002b).

### **Geospatial Extension Program Phase 1: Native American Communities in Nebraska**

#### Environmental Systems Research Institute (ESRI) Community Atlas Site Development and Reservation Data Collection

A demonstration project was completed in the summer of 2002 on the Santee Sioux Indian Reservation in Santee, NE. This project combined GIS, GPS data collection, airborne/satellite remote sensing data, and ESRI curriculum (a leader in GIS & mapping software). This project involved faculty from UNO and UNL in the training and outreach areas of geospatial data. Data collected in this project is poised to be an invaluable aid in precision farming, management of watersheds, analysis of crop yields, identification of population shifts, and mitigation of the impact of impervious surfaces on the land (among other beneficial uses). In addition to agricultural implications, this information will impact economic, social, and cultural issues. Teams of faculty and students from Native American high schools and community colleges were formed. The Tribal faculty prepared a proposal for submission to ESRI for a Community Atlas site using ESRI curriculum to train the future workforce of Native Americans in GIS applications and interpretation.

Through training workshops and seminars conducted by Tribal, UNO, and UNL faculty, students surveyed key points on the reservation utilizing hand-held GPS receivers. Their data will eventually be incorporated in the Community Atlas site, providing a resource for decision makers regarding the agricultural, social, and economic issues being explored. The summer projects conducted by the Santee Sioux students were showcased at a Science Fair in October, 2002. Members of the Santee Sioux community, Santee students, and students from the Nebraska Indian Community College were present during the Science Fair. The student presentations were followed by a community forum which showcased the 54 overflight airborne remote sensing images conducted over the summer. The forum provided for an exchange of dialogue about reservation land issues and exposed the community to geospatial technologies.



A Santee student using a GPS receiver to complete her summer project.



A Santee student presents his summer project at the Science Fair.



Karisa Vlassek and Dr. Hank Lehrer display and explain the overflight photographs of the Santee Sioux Reservation.

### Community Development

The infusion of GIS applications into the tribal communities is a major deliverable and may be most easily disseminated by employing local educational seminars, classes, and/or workshops. There are two educational goals for this project. One is to educate the members of the community-at-large as to the use of GIS, and the other is to better prepare future users—such as students at community schools—in such technology. The Native American school administrators, faculty, staff, and students, as well as academic partners at UNO and UNL, are ideally positioned to play significant broker/facilitator roles and similar leadership roles in both educational endeavors. Nebraska’s tribal governments will be able to utilize data in a multitude



of ways. The following activities have been identified as potential spinoffs over the next five years:

1. Influence the long-term water cycle of Lewis & Clark Lake on the Missouri River;
2. Create a sense of community involvement in future land planning on the reservation;
3. Utilize the land in a more productive manner;
4. Determine the best location for future reservation impervious surfaces, buildings, and homes;
5. Realize the full potential of all lands under cultivation.



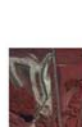


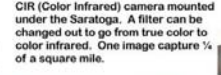


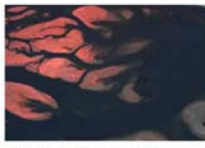





The Winnebago Tribal Council was recently shown overflight photographs of their lands.



Feedlot near Emerson, NE. The Winnebago Water Quality Specialist requested this photograph. Run-off from the feedlot is possibly entering Reservation streams and rivers.

**Nebraska Space Grant Consortium  
Nebraska Geospatial Extension  
"Integrating Science and Native American Culture"**

<p><b>Winnebago Reservation Airborne Remote Sensing Mission</b> September 6, 2002</p>  <p><b>Winnebago Tribal Council</b> The Winnebago Council is extremely interested in utilizing geospatial technology to make wise land-use decisions.</p>  <p><b>Winnebago, NE and Vicinity</b> The Winnebago Indian Reservation is located South of Sioux City, IA in Northeastern Nebraska. The Reservation is divided by the Missouri River with approximately 90% of the land holdings on the Nebraska side of the river and 10% on the Iowa side.</p>  <p><b>Feedlot Emerson, NE</b> The Winnebago Water Quality Analyst requested an overflight photo of this area. The Reservation is experiencing problems with run-off into streams and rivers from this feedlot.</p>  <p><b>Village of Winnebago, NE</b> The Winnebago Tribe hired a GIS/GPS Specialist through a USDA Grant to serve the Reservation.</p>	<p style="text-align: center;"><b>Airborne Remote Sensing Equipment</b></p>  <p>The Piper Saratoga was purchased with a National Science Foundation Grant. The grant facilitates the use airborne remote sensing technology across Nebraska.</p>  <p>CIR (Color Infrared) camera mounted under the Saratoga. A filter can be changed out to go from true color to color infrared. One image capture 1/4 of a square mile.</p>  <p>Winnebago, NE mission in progress. Researcher Jeff Moon rapidly fires the color infrared camera over the village of Winnebago.</p>  <p>Researcher Jeff Moon works on the AISA (airborne imaging spectrometer) equipment. Future applications of the AISA include detecting crop health and conducting a water quality analysis from the air.</p>	<p style="text-align: center;"><b>Santee Sioux Reservation Airborne Remote Sensing Mission</b> July 25, 2002</p>  <p><b>Missouri River Santee, NE</b> A major concern for the Santee Sioux people is the silting of the Missouri River.</p>  <p><b>Village of Santee, NE</b> The Santee Sioux Indian Reservation is located in North Central Nebraska. The Reservation encompasses 9,449 acres of land. The maintenance and protection of the land is extremely important to the Santee people.</p>  <p><b>Utilizing Technology</b> Santee students using GPS receivers during a summer GIS workshop. The students worked on individual projects over the summer and presented them during a Fall Science Fair.</p>  <p><b>Community Participation</b> The Science Fair brought members of the community together with Santee students. During the Community Forum, 54 images from the remote sensing overflights were shown.</p>
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Poster presentation, NASA Space Grant Director's Meeting  
Dorado, Puerto Rico, October 28-29, 2002



## Relevance to NASA

Validation of the importance of such a program came from NASA Administrator O’Keefe in June 2002:

*“Extending our reach to underserved and underrepresented communities is critically important to me and to NASA. . . . The challenge before NASA as well as our Nation is reaching out to those communities that have traditionally not been a part of such a mission and opening the door of opportunity to invite them to take part.”*

The Nebraska Native American Outreach Program endeavor has earned praise from NASA researchers for its efforts to extend science education and technology to underrepresented and underserved populations. The implementation of a Nebraska Geospatial Extension Specialist position has been endorsed by NASA Program Manager Julius Dasch. It is an important component of the national Earth Grant program initiative between USDA, NASA, and NOAA (University of Nebraska at Omaha, 2002b).

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### Further Information

If you would like further information regarding Nebraska's Geospatial Extension Program or would like to collaborate with NASA Nebraska Space Grant and EPSCoR, please contact:

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