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“By administratively reorganizing into the GeoResources Institute, we will have more resources to address some pressing issues, including water quantity and quality, efficiency of agricultural production, and invasive species monitoring and management.

Bringing these four centers together at MSU allows us to further develop our common goals, as well as pool our talents and resources on research and educational projects. It allows us to enhance already strong relationships with various academic and research departments and colleges throughout the university and to pull teams of faculty together for multidisciplinary projects that develop solutions to meet the needs of society and our stakeholders.”

David Shaw, Director

Our mission is to understand Earth’s natural and managed systems and provide comprehensive solutions for socioeconomic and environmental requirements, leading to an improved quality of life.
Until recently, Mississippi State University had several centers and institutes conducting and coordinating research and educational activities in geospatial technologies and natural resource management (agriculture, forestry, and water resources). However, MSU determined that closer coordination of the activities between these units would provide tremendous benefits through:

- Synergy of activities between subject areas (e.g. computation, agriculture, water resources)
- Development and implementation of common goals
- Synergy of management
- Avoidance of duplication of effort
- Highly coordinated approach to research and educational project development
- Service as the primary point-of-contact in the geospatial and water resource management
- More effective leveraging of resources and activities into extramural funding

Therefore, the GeoResources Institute was created at MSU in July 2002.

**Institute objectives include:**

- Increase the fundamental understanding of Earth’s natural resources systems
- Develop natural resources management capabilities which engage computer-based Decision Support Systems that protect and enhance land and water resources through applications of science-based knowledge
- Enhance the productivity and profitability of agricultural and forestry systems through science and advanced technologies
- Optimize land-use management practices by converging technologies and capabilities
- Develop watershed management strategies and knowledge to promote sustainable economic development, community viability and natural resource conservation
- Maximize information that can be derived and utilized from remote sensing and other geospatial technologies for socio-economic benefits
- Help maintain an informed and receptive public
Researchers are involved in rural economic development projects where the GRI is working with county governments, county economic development foundations and private industry to plan and build surface water impoundments in the state of Mississippi. The GRI is providing critical grants and project management skills to these projects.

The Bienville Resources and Development Council is a formal inter-local agreement between Smith, Covington, Simpson, Rankin and Jasper counties of Mississippi that is planning a water impoundment project in South Mississippi. The GRI has administered an Economic Feasibility Study with the assistance of the MSU Department of Forestry, developed a Master Plan with the MSU Department of Landscape Architecture, and is now heading up development of a Site Evaluation/Selection Matrix for the Council.

The GRI is also assisting the Choctaw County Economic Development Foundation and county officials by participating in the site evaluation and selection process of an impoundment project for that county. Funding has been provided by the Natural Resource Conservation Service through county supervisors.

In Madison County, the GRI is working with county supervisors and the Madison County Economic Development Foundation on strategic planning. The GRI has been asked to play a role similar to that taken with the Bienville Resources and Development Council with a potential Fiscal Year 2005 earmark. The economic impact from these GRI projects will include an increased property tax base, secure new industrial prospects and create more jobs for Mississippi.
Impoundments for Rural Economic Development

Bienville Forest Lake Project
Primary Master Plan

Choctaw County
Recreational Lake Project

The GRI works closely with Economic Development and government officials
The Gulf Coast includes dense urban areas intermixed with designated natural areas, which influence or constrain development within the area.
Researchers at the GRI are exploring ways whereby remote sensing and spatial technologies can be used to assist corridor planning in the Southeast United States. Through a joint effort by NASA and the U.S. Department of Transportation, the GRI manages the Environmental Consortium (one of five member consortia) of the National Consortium for Remote Sensing in Transportation (NCRST-E) that develops innovative ways to improve transportation planning and management by applying remote sensing data and spatial information technologies. The overall goal of the NCRST-E is to increase the speed and efficiency with which statutory environmental assessments are conducted. Faculty in Civil and Electrical Engineering from the Bagley College of Engineering have played strong leadership roles in this effort.

Previous projects have demonstrated that the most cost- and time-consuming project tasks involve assimilating relevant geospatial data. The data often are available, but acquisition can be time-consuming due to the fact that the data are owned by multiple agencies in multiple formats, and each data owner may have a different distribution policy. The NCRST-E is creating a regional database which will provide critical resources to transportation projects by integrating imagery and geospatial data for the region and readily provide such information to involved agencies.

Each transportation corridor project typically lasts 10 to 20 years, and each project possesses unique principle issues. The NCRST-E has selected actual on-the-ground active projects for its research that are of various scopes and at different stages in their project life cycles. For example, the GRI-administered environmental consortium is assisting the U.S. Highway 98 Coastal Corridor project with issues such as coastal topographic constraints, sensitive environmental elements, and vulnerability to natural disasters such as hurricanes - issues which characteristically add complexity to coastal transportation corridor planning processes.
Geospatial technologies developed by researchers at MSU’s GeoResources Institute are being applied to determine and manage issues associated with agricultural crops and earth’s natural resources. New capabilities are emerging from research and development within the GRI that can provide a consultant or grower with very effective management tools. MAFES, FWRC, MSU Extension Service, and Engineering faculty have worked collaboratively in developing these real-world applications.

Active projects include those such as catfish pond management where researchers at the GRI are using wireless sensors, geographic information systems (GIS) and communication technologies to monitor and analyze environmental and physical conditions of catfish ponds. Geospatial technologies are being used to assess crop conditions and locate insect infestations in the field. Researchers at the GRI are using imaging techniques to take advantage of the subtle effects of reniform nematodes – microscopic animals that live in the soil and feed in the roots of the cotton plant. Sweetpotato producers have been searching for an innovative approach to increase U.S. No.1 grade sweetpotato yields, and GRI research in the area of geospatial technologies has been welcomed.

Spatial Technologies

One example of new site-specific technology being developed in the agricultural arena is the introduction of new ways to identify and control problems such as weed infestations. Weeds typically occur in patches across agriculture fields. To add to the complication, there may be a myriad of patches – each different in size, location, and weed species composition. Applying the correct herbicide and achieving control has been virtually impossible until now. Researchers at MSU’s GeoResources Institute are developing new uses for a suite of geospatial technologies including global positioning systems, computerized sprayers, remote sensing imagery, and mapping software to precisely treat only the specific areas of the fields that are infested. The technologies, merged into a geospatial-based information system, identify weed patches and recommend control methods. Results have been so promising that new commercial products are emerging and offering growers a revolutionary way to control weeds – one that is economical while providing tremendous environmental benefits.

High-resolution imagery also adds a new dimension to managing wildlife habitat. Natural resource managers are challenged with the task of effectively allocating limited conservation resources in a manner that optimizes wildlife habitat benefits. This is especially important for those involved in managing declining species such as the northern bobwhite quail. High-resolution satellite imagery provides necessary tools for identifying habitat deficiencies at the “operational” or “on-the-farm” level, where most habitat management decisions are usually made.
In Agriculture & Natural Resources

- Multi-spectral image of cotton field depicting weed infestation
- Spectral image of sweetpotato field
- Spectral image depicting catfish ponds in blue
- Reniform Nematode feeding on root of cotton plant
Among the areas of expertise within the GRI is the visualization of computed datasets for optimal human understanding. Through collaborations between Forestry and Engineering faculty, a visualization system for timber management has been developed to aid in stand improvements, pre-commercial or commercial thinnings, and the harvest at economic maturity of the stand. Management information can now generally be tied to location within stands by use of spatial technologies.

Field surveys for timber management identify the approximate distribution of wood in a stand but fall far short of indicating the positions of individual trees. Landscape visualization techniques are largely driven by the desire to provide realistic depictions of how terrain features look at various points in time or under different land alteration scenarios. The GRI has developed visualization tools which generate graphic models of forest stands based on measurement of location and size of trees from remotely sensed data.

An operational scenario for use of such a landscape model might someday be analogous to technology associated with science fiction such as the television series “Star Trek: The Next Generation.” In this series, a starship surveys a planet with highly sophisticated sensors prior to sending a landing party to the planet’s surface. The sensors record in detail relevant information on all objects on the planet. Now imagine that the remotely sensed information were
to be transferred to the starship’s “Holodeck” (a 3-D virtual reality environment in a room) so that the landing party could use a virtual model of the planet to plan their exploration and data collection along the most meaningful, efficient and safe pathways.

At the GRI, a stand visualization system based on trees identified and measured with LiDAR data (LiDAR utilizes laser-ranging technology to determine distances) has been developed within an immersive virtual environment domain. High-density LiDAR datasets are used to generate canopy surfaces from which tree locations are extracted. Total height and other crown measurements based on relationships to height are used to construct graphic representations of all identified trees in their proper geospatial positions. The tree graphics are aggregated into stands for viewing in an immersive virtual environment called a CAVE - a 4-surface (three walls and floor) 10x10 foot room that utilizes stereo projection technology to provide users with the ability to interact with 3-dimensional information. This provides the forester with a powerful means of understanding the capabilities of the LiDAR system and interpreting the remotely sensed data. The results of this project will be used to refine and eventually implement this technology on the office desktop.
Water is perhaps the most precious of our natural resources and directly affects everyone on a daily basis. Increasingly, water quality and quantity concerns are becoming contentious issues even in water-rich areas such as Mississippi.

Remote sensing plays a major role in monitoring the status of our nation’s water resources. Maps are derived from remotely sensed imagery and used as inputs for predictive water quality models. Remote sensing can also detect chlorophyll and sediment concentrations in oceans and lakes, helping to assess water quality. Remote sensing can help a farmer decide which fields should be irrigated or what conservation practices are needed.

GRI research projects include correlating changing land use/land cover patterns with water quality conditions in Mississippi’s Upper Pearl River Basin. In addition, the GRI is assisting the Pearl River Enhanced Water Development and Management Program.

Aerial image of Ross Barnett Reservoir
Water is perhaps the most precious of our natural resources and directly affects everyone on a daily basis. Increasingly, water quality and quantity concerns are becoming contentious issues even in water-rich areas such as Mississippi.

Remote sensing plays a major role in monitoring the status of our nation’s water resources. Maps are derived from remotely sensed imagery and used as inputs for predictive water quality runoff models. Remote sensing can also detect chlorophyll and sediment concentrations in oceans and lakes. Remote sensing can help a farmer decide which fields should be irrigated or what rivers and streams need more conservation practices.

GRI research projects include correlating changing land use/land cover patterns with water quality conditions in Mississippi’s Upper Pearl River Basin. In addition, the GRI is assisting the Pearl River Valley Water Supply District to incorporate geospatial technology into their day-to-day operations and long term planning. Specifically, the GRI is using remotely sensed imagery and GIS to map fire hydrants, water lines, sewer lines and manhole covers in the PRVWSD’s properties. The GRI is also working in public/private partnerships with several Mississippi counties to plan multi-use/multi-purpose water impoundments. These efforts have involved the Departments of Civil Engineering, Electrical and Computer Engineering, and Landscape Architecture, as well as internal GRI faculty and staff.

The GRI works closely with Mississippi’s state, regional and local governments and agencies to develop and apply geospatial technology to increase the efficiency and accuracy of water development and management decision-making to promote Mississippi’s economic development. This will help ensure that our nation and state’s waters are used for the maximum benefit of all their inhabitants - from tadpoles to humans.
State and federal agency land managers are excited about site-specific invasive species research being conducted within the GeoResources Institute. Remote sensing technologies being developed at MSU offer land managers the tools to identify and monitor Mississippi invasive weeds, such as cogongrass and kudzu.

An automated image and analysis-based system is under development to detect populations of invasive weeds, and will provide an accurate location and estimate of total acres infested. This information can then be used to develop precise treatment maps for herbicide application only to the infested areas using ground or aerial application equipment. Images taken over time will provide an evaluation of the success in eliminating weed infestations. The result is accurate detection, efficient planning, and effective control of invasive weed populations.
The GRI has the capacity to bring together multidisciplinary research teams comprised of university and government researchers to address diverse questions on the management of invasive species. Faculty from Plant and Soil Sciences, Biological Sciences, Entomology and Plant Pathology, Forestry, Wildlife and Fisheries, Electrical Engineering, and GeoSciences at MSU are working together. A number of state and federal agencies, as well as private and non-profit organizations, are collaborating in these programs. In its role as a regional coordinator, the GRI is facilitating the formation of Invasive Species Alliances in Mississippi and other Mid-South states, to enhance the exchange of information, database networking, and coordination of management efforts between public and private entities across the Mid-South Region.
Awards & Recognition

Valentine Anantharaj
- NASA/MSCI Graduate Research Fellowship 2003-2004

Jeffery A. Ballweber, JD
- Mississippi Water Resources Association (MWRA) - Vice President
- Mississippi Water Resources Association - Board Member
- MS Department of Environmental Quality’s State-wide Basin Approach - Member
- Resource Agency Partners Forum - Member
- Pearl River and South Independent Streams Basin Team - Member
- TMDLs and CWA 303(d) List - Team Leader
- Liaison between Ground/Drinking Water and Surface Water Quality Teams
- Named Senior Fellow, Radvanyi Chair in International Security Studies
- International Advisory Committee for annual International Conference on Safe Drinking Water (Boreholes, Inc.)

Lora Ballweber, PhD
- American Association of Veterinary Parasitologists Young Investigator Travel Grant Award to Kelsey McNally to attend 49th Annual Meeting to present the paper “Habitat suitability estimates for Amblyoma maculatum in Mississippi”.

Alan Blaine, PhD
- National Association of County Agricultural Agents Achievement Award for “Excellence in the Remote Sensing and Precision Agriculture Program”

Lori M. Bruce, PhD
- 2003 James W. Bagley College of Engineering Outstanding Engineering Educator
- Faculty Research Advisory Committee (FRAC) (July 04 – Aug. 07)

John Byrd, PhD
- 2003 Mississippi State University Alumni Association Faculty Recognition Award for Service

William H. Cooke, PhD
- ‘MSU Researcher Studying Environmental Causes of Deadly West Nile Virus, University Relations News Bureau’, May 10, 2004
- ‘MSU Researcher Uses GIS to Examine Dangers of West Nile Virus’, GIS Development THE ASIAN GIS MONTHLY, 05/12/2004
- ‘MSU Researcher Examining Dangers of West Nile Virus’, Times Picayune, Tuesday, May 11, 2004
Awards & Recognition

James E. Fowler, PhD
• MSU Bagley College of Engineering Outstanding Research Paper, 2003

F. A. Harris, PhD
• Mississippi Entomological Association Merit Award for Service

W. Daryl Jones, PhD
• Elected to the Gulf of Mexico Fishery Management Council - Essential Fish Habitat Technical Review Committee

Roger L. King, PhD
• W. L. Giles Distinguished Professor, 2003
• NASA advisory committee – Earth Science Information Systems and Services
• Scientific Committee - ESA-EUSC 2004: Theory and Applications of Knowledge Driven Image Information Mining, with focus on Earth Observation, Madrid, Spain
• Technical Program Committee, 30th International Symposium on Remote Sensing of the Environment, Honolulu, HI
• Technical Program Committee, IEEE Workshop on Advances in Techniques for Analysis of Remotely Sensed Data, Washington, DC
• Technical Program Committee, IGARSS 2003, Toulouse, France
• Scientific Committee, Second International Workshop on the Analysis of Multitemporal Remote Sensing Images, Ispra, Italy

Gary W. Lawrence, PhD
• MSCI Research Fellow 2002 - 2003, Amber T. Kelley

Joseph H. Massey, PhD
• W.G. Powell, 2003. First Place Graduate Student Poster Award. 56th Annual meeting of the Southern Weed Science Society of America, Houston, TX.

Robert J. Moorhead, PhD
• Guest Editor, IEEE Transactions on Visualization and Computer Graphics, 2003
• Co-Guest Editor, IEEE Transactions on Visualization and Computer Graphics, May-June 2004

T. Evan Nebeker, PhD
• 2003 Ralph E. Powe Research Excellence Award at Mississippi State University

K. Raja Reddy, PhD
• Career Professional Research Award, Southern Branch of the American Society of Agronomy
• 2002 Awarded Science Award for Most Outstanding Journal Publication. Mississippi Agricultural and Forestry Experiment Station
• Session Chair - Agro-climatology and Agronomic modeling (A-3) division of American Society of Agronomy
• Onsite Proposal Peer Review Panel Member for NASA - Biomass Production Panel, Washington, DC
• Offsite Proposal Peer Review Panel Member for National Institute for Global Environmental Change, Department of Energy - NIGEC-Southeaster Center, Tuscaloosa, Alabama
Awards & Recognition

Daniel B. Reynolds, PhD
- 2003 - MSCI Fellowship - Nathan Buehring

David R. Shaw, PhD
- Fellow, Weed Science Society of America
- Research Award, Weed Science Society of America, 2003
- Newsletter Editor (since 1993), Weed Science Society of America
- Director-at-Large (since 1998), Weed Science Society of America
- Vice President, Southern Weed Science Society
- President, Mississippi Weed Science Society
- Search Committee for MSU Vice President for Research
- Search Committee for MSU Director of Institutional Research
- Chair, Research Committee, SACS Reaccredidation, MSU
- Co-chair, Technical Steering Committee, Mississippi Management Systems Evaluation Area (MS-MSEA) Project, MSU
- Member, Governor’s Advisory Commission on Remote Sensing Technology Writing Chair, Work Group III
- Mississippi Coordinating Council for Remote Sensing and Geographic Information Systems - IHL Representative
- Chair, Education/Workforce Development Committee
- Member, Selection Panel, Engineering Technical Support Firm

James S. Thomas, PhD
- National Association of County Agricultural Agents Achievement Award for “Excellence in the Remote Sensing and Precision Agriculture Program”

Mary Love Tagert
- MSCI Student Fellowship 2002-2003
- Summer Grant: Fall 2002 - Summer 2004
- Civil Rights Graduate Student Audit Committee - Plant & Soil Sciences

J. Alex Thomasson, PhD
- Feature article in *Queensland Country Life* newspaper, June 4, 2003, Queensland Australia
- 2003 Research Impact Award for paper judged most important to Mississippi Agriculture

Nick H. Younan
- Hearin Eminent Scholar for Outstanding Research and Scholarly Contributions, James Worth Bagley College of Engineering, Mississippi State University
The GeoResources Institute brings together faculty from 22 departments within 6 colleges/units at Mississippi State University. The GRI also collaborates with many other universities, community colleges, and agencies. At present there are over 150 scientists involved in active research projects focusing on agriculture, water resources, state and local government, and economic development.

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