The Impact of Integration of Geographic Information Systems, Remote Sensing, and Global Positioning Systems Technologies in Multidisciplinary Curricula at Southern University

Namwamba, F., Stubblefield, M., and Carierre, P.

Center for Coastal Zone Assessment and Remote Sensing,
Southern University, Baton Rouge, LA 70813

Abstract

The incorporation of Geographic Information Systems (GIS) and Remote Sensing (RS), and Global Positioning Systems (GPS) in multidisciplinary curricula at Southern University has introduced a vital technology component, as well as enabling the development of a spatial data-warehouse. The Center for Coastal Zone Assessment and Remote Sensing has recently acquired fully fledged GIS/RS laboratories and initiatives, which have resulted into a major spatial sciences initiative at Southern University. Not only has the component redefined the skills of Southern University science and technology graduates, but also it has equipped the graduates with critical skills enhancing their curriculum vitae for job market. The development of spatial data warehouses has jettisoned the university to be a major player in maintenance of Louisiana State's homeland security initiatives. This paper outlines the evolution of GIS and RS in science and engineering and mathematics (STEM) at Southern University, and traces the historical perspective of GIS development in 1890 land grants schools and Historically Black Colleges and Universities (HBCUs) as a whole. The paper explores advantages of mapping and spatial data entry into GIS databases. The development of spatial sciences has provided for new K-12 initiatives, and training for K-12 school teachers. A new training center for professional development and continuing education has been established. A virtual reality visualization facility is one of many state-of-the-art technology spin offs. Southern university is now producing graduates ready for the space industry, intelligence and homeland security technology based careers. Finally the paper describes the facilities available at SUBR CCZARS and spells out the vision, challenges and future of spatial technologies at Southern University and related programs at 1890 land grant schools.

Introduction

Importance of Spatial Technologies to Higher Education

Geographic Information Systems (GIS) and Remote Sensing (RS) play an important role in science, engineering, technology and maths (STEM) studies at Southern University. These spatial sciences and technologies have been systematic incorporated into various curricula from the year 1998 and have grown into a vital component. Three programs now have fully fledged GIS/RS laboratories and initiatives which have resulted from critical GIS initiatives at Southern University. GIS applies a scientific process to the tasks for which it is used. Training and education to understand that process are critical to achieving good results. This paper outlines the role of GIS and RS in engineering, natural resources and science, traces the historical perspective of GIS development in 1890 land grants schools and Historically Black Colleges and Universities (HBCUs)as a whole. The paper explores advantages of mapping and spatial data entry. Finally the paper describes the impact of spatial technology facilities available at SUBR's engineering, natural resources and science programs, and spells out the vision, challenges and future of GIS, GPS and Remote Sensing at Southern University as well as related programs at 1890 land grant schools.

GIS, RS and GPS as Critical Training Tools

As an education tool GIS is critical as a training tool in all aspects of engineering, natural resources and science. GIS fulfils the role of a vital computer skill required for maintaining spatial data inventories and databases. Because of this, Southern University's engineering, natural resources and science graduates are acquire the required computer skills to compete in the job market, as well as perform complex tasks required of a 21st century forestry sciences professional. SUBR STEM students graduate with basic skills in desktop GIS, spatial analysis, image analysis and the basics of remote sensing.

The teaching initiatives have focused on innovative use of computers and modern equipment to enhance teaching and recruitment while the research projects have focused on using state of the art technology to develop technological-based spatial analysis methods for innovative scientific techniques. This technology-based approach has a good potential of contributing to economic development.

The research at STEM curricula involves the following areas, Global Change, Climate Change Assessment, Air Pollution Study, Hydrology, Pathology, Urban Forest Eco-physiology, Urban Forest Assessment. Even though GIS is defined as a research area, in reality GIS is also a useful tool in all other research areas. GIS is useful for preparing inventories and databases for Civil and Environmental Engineering, Transportation Engineering, Hydrology. Urban Ecosystem Analysis models useful in Global Change, and Climate Change assessment. GIS has also been a critical tool for hydrology and air pollution research, as well as urban forest assessment. In the outreach initiative, GIS has been utilized in Green Infra Structure projects in the City of Baton Rouge as well as with

Baton Rouge Green, a non profit NGO. The question is why is GIS so important in Engineering, natural resources and science?

Student Impact

At Southern University GIS has successfully been integrated into Civil and Environmental Engineering, Urban Forestry, and Public Policy (Environmental Option) curricula. Over 150 students have received training in GIS. 21 graduate students have conducted research related work graduated with MS degrees during this period of time. 32 students received certified training in GIS, 48 received training in Remote Sensing software, 44 received training in GPS acquisition. Related work by SUBR faculty resulted in publication of at least three management plans for the Army Corps of Engineers, at least 12 journal papers, technical manuals, and several articles. More than 120 students have attended the Louisiana Annual GIS/Remote Sensing Conference.

Spatial Technologies

What is A GIS?

Geographic Information Systems is a set of computer hardware, software and databases for the capture, storage, analysis, and display of spatial data. Godfrey (2000) reports that unlike a CAD map, a GIS map has the power of a database behind it; with GIS, the database can be queried. Holden (2003) reports that Geographic information systems assume an increasingly large role in North American land use planning. Tsihrintzis(1997) implemented an application of GIS-aided modeling at an area in South Florida. A Geographic Information System (GIS) was interfaced with a nonpoint source pollution model to facilitate data storage, management and display; derivation of model input parameters; and effective presentation of results.

Remote Sensing

The Earth is continuously monitored from dozens of satellites orbiting the planet and collecting data. Other responsible imaging vehicles are airplanes and space shuttles. This process is called remote sensing (RS). There are many forestry applications that remote sensing can be used for. Some of these applications include terrain analysis, forest management, re-cultivation, updating of existing forest inventories, forest cover type discrimination, the delineation of burned areas, and mapping of cleared areas. The ability of satellites to image the earth is well known but there are some limitations to this process, like the effects of rain and cloud cover. The two atmospheric conditions cause problems with topographic photography of the Earth's surface, especially with forestry applications, when the majority of the world's forests are in tropical areas where cloud cover is almost year around.

Global Positioning Systems

Establishment of Spatial Technologies at SUBR

Issues Considered when integrating GIS into university curricula

The process of creating an engineering, natural resources and science GIS, is essentially the same, whatever institution is in question (Godfrey, 2003). This process required the examination of five criteria which centered on the users of the proposed system. These were: 1) Needs/Requirements of the end users 2) Hardware/Software Requirements 3) Requirements of the GIS 4) Database Design Requirements 5) System Maintenance/Updating Requirements.

The needs and requirements of the end users were usually the first criteria to be examined when creating SUBR's GIS programs. It was important to outline and understand exactly the type of information the faculty, staff and students would put into the system and utilize on a regular basis. The needs were identified through the use of questionnairea, and when necessary personal interviews that helped identify the needs. Many times the specific conditions of needs and challenges in industry and job market played a role in defining the characteristics of the required GIS.

GIS/RS Laboratories at SUBR

Hardware

SUBR's Engineering, natural resources and science program presently has three GIS/RS laboratories. The nucleus of hardware was acquired from a USDA capacity building grant. From the initial grant the initial SUBR's GIS facility was setup with a Gateway AL-9200 server, hosting a network of eight Gateway E-520 workstations. Data acquisition is through two Calcomp III digitizers. The laboratory is networked with the rest of Southern University's internet network. The lab has a Hewlett-Packard network printer, coupled with a HP 1220 Inkjet color printer for class exercises. For high quality laser publishing the laboratory has a Canon CLC 900 color printer that also serves as a color copier. High quality maps and photo-glossy posters are produced using a wide format Colorspan DM 4200 Plotter. The Agricultural Center GIS Laboratory has 4 high performance computers, including and SGI-Octane workstation for high quality graphics. It also houses the GIS Library (with about 50 volumes and manuals), and 4 Trimble GPS units. In addition to the Trimble GPS units the laboratory houses a Red-Hen Video GPS unit. SUBR's latest GIS/RS laboratory is under development. It is Southern University's CCZARS's GIS/RS laboratory and will house a computer server with 20 Dell-Precision workstations.

GIS/RS Software

SUBR's engineering, natural resources and science GIS program use mainly the popular ESRI's suite of GIS products. Software used presently includes 20 ARCVIEW 3.2 licenses and ARCGIS software. The university has site licenses from ESRI. For Remote Sensing, SUBR Engineering, natural resources and science program has 15 ERDAS

Imagine licenses from ERDAS Inc. The program will also soon host and Integraph Geo-media GIS laboratory, as well as host Micro-Station GIS for transportation studies.

The Role of GIS and Decision Making

Considering that today's students are the future decision makers who will serve as executive level staff it is critical that they be familiar with benefits of GIS technology. Those decision makers who understand various IT technologies need to be recruited to act as champions of the technology.

Training in engineering, science and public policy should be effective in identifying potential GIS users. There are many tasks in local governments and state agencies that would be more efficient if they adopted GIS technology. The university community should be a technical resource to those struggling to employ GIS technology. A scientist or engineer with GIS skills would be the technical person within each organization to provide them with training and support that they need.

Status of GIS Education At HBCUs

The development of GIS in HBCU Education curricula is emphasized by the 2002 White House Initiative on HBCU[1]s/US Department of Education. GIS development at SUBR Engineering, natural resources and science program can be put in context by considering the development of GIS at other HBCUs.

Over 20 years ago, the U.S. Geological Survey with the National Parks Service began a summer workshop to train less than a dozen HBCU faculties in GIS. Howard University has been carrying out a HBCU GIS Training workshop for 20 years to this date. From the SOFSEC initiative North Carolina A&T has published materials (in Microsoft PowerPoint) for GIS instruction.

Padgett (2000), reports that by the year 2000, a number of historically Black institutions employ GIS tools and technologies in their academic departments. In addition to Tennessee State, Clark Atlanta University, Alabama A&M University and Southern University-Baton Rouge are among a small group of historically Black institutions that make extensive use of GIS tools and techniques. Of the HBCUs offering forest sciences curricula, Alabama A&M, Florida A&M, and SUBR all had fully fledged GIS programs.

At Alabama A&M, the GIS program is centered at the University's HSCaRS and its predecessor, the Alabama Center for Applications of Remote Sensing (ACARS) is the oldest of the Centers within the department. It is currently involved in research related to hydrology, soil climatology and remote sensing. To develop a comprehensive research program investigating hydrologic processes with emphasis on remote sensing measurements and modeling of soil moisture utilizing microwave and multispectral radiometric data; Utilization of airborne and space-borne platform data in surface soil classification, land use classification, environmental assessment, nutrient stress detection, and natural resource inventory and management.

At the 18th annual HBCU GIS Summer Faculty Workshop, Dr. David Padgett announced that he had undertaken the GIS survey to nearly 50 HBCU faculty members (Padget, 2001). The conference, hosted by the Howard University Continuing Education Urban Environmental Institute this past July, was held in Washington and Silver Spring, Md. In a study carried out by Padgett (2000) preliminary findings of the 85 schools surveyed by Tennessee State University include the following: a) 6 percent offer degrees in geography, b) 60 percent offer geography courses , c) 12 percent offer courses with the words "GIS" in the course title, d) 20 percent offer courses that use GIS in their content , e) 20 percent are actively using GIS in research , f)19 percent have some presence of GPS and/or Remote Sensing technology . Padgett, who is director of the geographic information sciences lab at Tennessee State, says the survey results will be published on a Web site by the end of this month. The intention of the survey and its publication is to spread awareness of GIS technology and curriculum within the HBCU community, according to Padgett. Padgett (2000) added that GIS is quite popular in agriculture programs at HBCUs. "GIS is something that farmers can utilize to improve cultivation of their fields. They can pinpoint through satellite imagery how to efficiently spread fertilizer and to conduct other tasks," he says. Detailed information was available at a website. Padgett stated that the Web site survey would be updated periodically.

Since 1999, Howard University Continuing Education's Urban Environment Institute has expanded the summer workshop with funding from various agencies and the partnership of numerous companies. Government agencies generate nearly a third of all GIS sales of technology products and services and greatly need GIS services. Over 40 or a third of all HBCU's have had faculty trained at this summer workshop.

Spatial Technologies and Stem Disciplines

Civil and Environmental Engineering Program

The Need to be Geospatially Literate in Engineering
Technological advancements at the dawn of the 21st century have redefined the role geo-spatial scientific work in engineering. Developments in information technology have resulted in high speeds, efficiency and productivity in both field and office. Improvement in GPS and RS technologies have completely changed the spatial data acquisition. On the other hand GIS and 3D computer graphics have transformed spatial data management and display techniques respectively (Fosburgh 2001).

Geographic Information Systems (GIS) technologies have revolutionized spatial queries, an advantage over CAD. However, in an increasingly information-based, service-orientated society, the professional roles tend to loose some special distinction, privileges are shared and prestige or status is diminished. GIS development saw many professions feeling they would play a leading role in an information age. Among them were lawyers, planners, engineers and surveyors who were keen on understanding the complexity of the graphics, communications and file handling systems necessary for effective GIS

functionality. However, computer programmers and information systems experts have become primarily responsible for systems development [Micky 1996].

Considering that the initial investment required to develop and implement a modern spatial information system was substantial, many organizations are integrating Information Technology (IT) as part of their business operations. The result has necessitated that engineers transform to fit in a changing environment due to these rapid changes. Todays engineers have to be knowledgeable about the impact of the Internet (as communication media) and how GIS technology and operational procedures, costs, functional resources and benefits impact their fields in the 21st century.

Application of Spatial Techonologies at SUBR's Civil and Environmental Engineering

Following in the footsteps of the urban forestry program, SUBR's Civil and Environmental Engineering department has been key in adoption of spatial technologies. The department has provided space for the establishment of the CCZARS remote sensing and GIS laboratory. The department was recently re-accredited. The GIS facility was critical in the definition of academic excellence of SUBR's CEE department. The laboratory is a state of the art GIS and remote sensing facility with the latest software and hardware. The laboratory is equipped with ESRI, ERDAS, Global mapper, and ENVI from RSI laboratories.

GIS and Remote Sensing have been integrated as electives in the CEE curricula. Students in CEE have been encouraged to take GIS and RS classes cross registered with the Urban Forestry program. Undergraduate students from the CEE program have been beneficiaries of the CCZARS scholarships. Graduate students from CEE have received CCZARS graduate assistantships and worked in the GIS laboratory. Research faculty in CEE stand to benefit from the Hydrologic and spatial modeling that are part of the CCZARS facility.

GIS and RS in the Urban Forestry Program

Urban Forestry Studies at Southern University

The Urban Forestry Program is the first 4-year Urban Forestry BS degree-granting program in the nation. It was established in 1992, with $650,000 seed money and a five-year grant from the USDA forest service. The undergraduate program offers a Bachelor of Science in 2 options, Urban Forestry Science and Urban Forestry Management and Policy. The graduate program offers a Masters of Science Urban Forestry. Keeping with the land-grant mission of the university, the program has 3 pivotal goals namely 1) Education 2) Research and 3) Outreach. Geographic Information Systems plays a major role in all the three pivotal roles in urban forestry.

Godfrey (2000) explains that in urban forest management, GIS software works by joining together tree information data to the tree point location. RS allows one to identify tree or timber stands. In most tree inventories, the information data tables come from tree

management software, and the tree point location is entered into the GIS via digitization or the use of GPS (Global Positioning Systems). Most GIS programs work on similar principles: data tables are joined together on a common field. The common field is usually a unique ID number generated by the tree management software when the tree is surveyed. Visualizing the tree data is easier, making GIS a very powerful tool for the management of engineering, natural resources and science data.

Traditional Forestry Surveys versus GIS/GPS based

Godfrey (2000) reports that traditional survey inventories were limited to counting trees and recording their address, condition, dbh, Genus, species, and maintenance needs. State-of-the-art tree management software packages like GIS allow for entry of tree information, tracking of work requests and work histories, and facilitating the creation of custom reports for urban forest resource management purposes. Utilization of GIS allows municipal arborists to take inventories one step further they can map trees and work with their information.

Hence, GIS programs allow municipal arborists to, a) Map trees while allowing quick visual surveys. B) make it easier to locate a tree in the field when a map is provided to indicate its location. C) utilize maps as powerful tools to illustrate needs and situations. And D) utilize a GIS capability to excel at powerful queries with visual results.

Urban Forestry Data Entry with GIS

Godfrey (2000) recommends that in order to effectively incorporate a GIS program into an urban forest data-base, several questions have to be addressed. The firsts question is whether the trees already in a management software program? Secondly one has to consider whether an institution already has a GIS program? Thirdly one has to consider what kind of system it is and what kind of base map it uses? Even more critical is its coordinate system? Finally the last question to be considered is how accurate, and how old the base maps are. With good organization in a municipal authority information technology or planning departments can provide the answers to some of these questions. This information is crucial because it can have a profound affect on how tree location data can be handled. The data must be collected in the most cost-effective manner, so it is important to know what is already available.

Global Positioning Systems (GPS) and Tree Inventories

A popular method of tree position entry is to locate the trees using GPS -- Global Positioning Systems. GPS is a network of satellites. Their ground station receivers are used to triangulate positions on the earth. Trees can be located to within a meter with proper data handling. Inexpensive GPS units can locate a tree to within 10-20 feet. To obtain data accurate enough for practical forestry map use, higher-end GPS hardware and software is necessary. Many engineering, natural resources and science consulting firms will provide a qualified urban forester to evaluate the tree and collect the GPS data with proper processing for accurate locations.

When developing a new urban forest inventory to include a GIS by using GPS, one has to examine all the options. After reviewing available tree management soft-ware for compatibility with desired aims and goals, one has to consider these urban tree inventory options. The first option is how the tree management software deals with GIS programs. The second issue is whether it is compatible with current municipal tree software. The third issue is how tree GPS data would be collected and how accurate its position would be. And finally the larger question is how tree GPS data and tree information be would moved into the GIS software These steps should allow for the use of resources already available within the system, getting more out of the municipality's software investment.

The Center For Coastal Zone Assessment And Remote Sensing (CCZARS)

Southern University was recently awarded a $6 Million Grant to set up a Center for Coastal Zone and Remote Sensing. Four of the PI's are from the Engineering, natural resources and science faculty. The grant will help set up state-of-the-art GIS/RS lab with 20 powerful workstations, and the latest hardware and software required for spatial analysis. The new facility indicates the future direction of Southern University's GIS program. Southern University's Center for Coastal Zone Assessment and Remote Sensing (CCZARS) is designated as a National Aeronautics Space Administration (NASA) Group 3 HBCU University Research Center (URC). CCZARS supports the Earth Science Applications at NASA's Stennis Space Center (SSC) under program NRA 02-OEOP-01. This project conducts research in areas pertinent to the SSC's mission. The CCZARS provides among other things:

- Remote Sensing Applications and Training
- GIS/GPS data collection and warehousing
- Coastal Education Outreach Program
- Coastal and Marine Fisheries Resource Evaluation
- Undergraduate and Graduate Research Experiences

CCZARS Research Involving Spatial Technologies

CCZARS University Research Center, has invested resources in building capacity, training, and initiated long term research initiatives. Satellite data acquired by satellite and high-resolution aircraft borne imagery was be used to evaluate submerged aquatic vegetation (SAV). In the past 2 years the project used image analysis and characterization to evaluate marshland environments using remote sensing, Geographical Information System (GIS), and Global Positioning System (GPS) technology. Initial results of the research give a very optimistic future. The thrust has utilized strong partnerships with partners at LSU Coastal Studies Institute. In perspective, this research thrust identified the northern Lake Ponchartrain region, as a pilot area from whence the geographic coverage would be extended to other Louisiana Gulf Coast hot spots. Pertinent data sets was be identified, collated and analyzed to make this possible. In the short term, the study examined the Gulf on Mexico Coast.

The Louisiana State University (LSU) Earthscan Laboratory, and Stennis Space Center (SSC) NASA were part of the team that investigated the use of airborne hyperspectral remote sensing imagery for automated mapping of submersed aquatic vegetation in the Lake Ponchartrain and generally the Gulf of Mexico. The algorithms and databases that to be developed in this study will be useful with the investigation under the CCZARS Gulf of Mexico fisheries habitat study, the main objective, which is to relate the remote sensing to fisheries habitat ecology communities in Louisiana.

CCZARS Impact on Spatial Technologies Infrastructure Improvement

Infrastructure Improvement

In terms of infrastructure development the research thrust acquired a suite of laser GPS, and mobile GPS to update the GIS facilities. It has set up a framework where stakeholders can access fisheries habitat information directly and easily. The fisheries habitat research thrust is also using its affiliation with the Urban Forestry program in the use of Remote Sensing and GIS technologies to strengthen its technological capability. The Fisheries habitat research thrust now has access to the latest GIS and RS software, as well as GPS equipment (in collaboration with the Urban Forest affiliates). The thrust continues to manage other related partner projects. CCZARS has acquired Trimble GPS equipment to facilitate field acquisition of spatial data, as well as navigation during data gathering. State-of-the-Art GIS and GPS facilities have enabled the thrust to remain at the cutting edge in environmental research.

CCZARS began by using existing ArcVIEW 3.2 software. In the cause of the last two years many government and educational GIS users have switched to ArcGIS (which is a combination of ArcView 8.2, ArcINFO and ArcEDIT). There has been a need to update CCZARS GIS facilities to reflect this urgent change. CCZARS GIS facilities have therefore been equipped with Arc GIS. The arcGIS front ends, menus and operational algorithms are completely different from ArcView 3.2. This reality has necessitated Dr. Namwamba, Dr. Lyles and graduate students to attend ArcGIS training workshops to be current and uptodate. The vision of the CCZARS GIS facility is to host an electronic Internet Map Server (IMS). CCZARS has acquired the necessary software and is training its personnel to be implement the IMS. CCZARS will also host a GIS-Data Warehouse, and has acquired ESRI's Spatial Decision Engine (SDE) whose implementation will be complete at the end of the financial year. For remote sensing CCZARS has obtained adequate ERDAS Imagine licenses (the full suite) for imagery analysis.

The fisheries habitat research thrust identified the unavailability of databases easy to download as a major impediment to community accessibility to environmental information. With ARCVIEW software the Fisheries habitat research thrust embarked on converting different natural resource maps to ARCVIEW format. The data was then updated by groundtruthing with Digital Ortho Quad Quarter aerial photos (DOQQ). This information will be used later for hydrologic and water quality modeling.

3-D Software for CAVE

Southern University's college of Engineering has a virtual reality facility referred to as the CAVE. CCZARS has acquired 5 licences of VGeo for virtual reality visualization within the CAVE environment. The CCZARS Co-PI and the lab manager had to travel to Richmond Virginia for training to handle RS and GIS 3-D visualization on VGeo. The fisheries habitat research thrust identified the unavailability of databases easy to download as a major impediment to community accessibility to environmental information. With ARCGIS software the Fisheries habitat research thrust embarked on converting different natural resource maps to ARCGIS format. The FH staff has devised format conversion procedures to transact between the ARCGIS, ENVI, ERDAS and VGeo platforms. The data was then updated by groundtruthing with Digital Ortho Quad Quarter aerial photos (DOQQ). This information will be used later for hydrologic and water quality modeling.

GIS Training for Non-Traditional Students and Professionals

Training Initiatives

K-12 Education

GIS educators universally agree that students who are exposed to geospatial technology in elementary and middle schools are much more likely to be effective users of the technology as they move on to high school and college. Teaching materials should be age appropriate therefore GIS teaching materials should be divided into a minimum of four levels of difficulty. The Louisiana Center for Educational Technology (LCET) divides their "Quest for GIS" teaching materials into the following groupings; K-2nd grade, 3rd -5th grade, 6th – 8th grade, and 9th -12th grade. Middle and high schools should incorporate GIS in their social studies classroom for "real world" problem solving. The various summer programs at Southern University (particularly CCZARS) have been holding GIS 2 day seminars for middle and high school students. The pioneer students of such programs have been registering for GIS classes when they reach college.

On April 16, 2005, the CCZARS Lab was host to 28 middle school kids for the "1st CCZARS GIS Mini-Camp for Middle School Kids." The mini-camp participants were given a tour of the CCZARS GIS Lab, an introduction to GIS and were allowed to track and manipulate data using Trimble Geo-XM GPS units. The participants were told about the importance of the research of the Fisheries Habitat and other CCZARS' thrusts. Following this short training session, the participants viewed a film at the Louisiana Arts and Science Museum entitled, "Coral Reefs," that linked Fisheries Habitat research with the prevention of the destruction of the coral reefs across the globe. On April 17, 2005 the Mini-Camp participants enjoyed the Baton Rouge Celebration of Earth Day and were allowed the opportunity to learn more about our wetlands and the research that helps protect them.

Training the Teachers

The key to effective use of GIS technology was the ability of teachers to incorporate GIS technology into their teaching curriculum. Southern University is now among the Louisiana universities with Education degree programs that incorporate GIS technology into the curriculum. CCZARS has facilitated about 6 GIS training workshops and summer programs for teachers. CCZARS is now working on an initiative for teachers to receive Continuing Education Unit credits, recognized by the Department of Education for participating in GIS workshops, an initiative that would aid in advancing GIS training among teachers.

The Louisiana Center for Educational Technology (LCET) INTECH Social Studies Curriculum is a Department of Education sponsored program for exposing K –12 teachers to advanced GIS training techniques and creating appropriate training materials. LCET incorporates GIS in their social studies curriculum. Furthermore, LCET holds workshops throughout the state to train their regional and parish technology coordinators in the use of GIS technology. The contact at LCET for GIS training is: Margo Murphy, Assistant Director, Instructional Technology. Southern University has funded grants with Science and Technology components for K-12, these programs provide stipends for teachers and students to receive GIS training.

The Louisiana Department of Education has GIS training for Agricultural Sciences teachers in place. The contact for this program is Ms Oneitha Wheeler with Louisiana Department of Education. The department would benefit from working more closely with those universities that are developing GIS modules for use by educators. GIS software vendors have provided free software packages and textbooks for K-12 teachers, with GIS classroom exercises eg “Mapping Our World”. GIS software vendors have been in the forefront of providing training resources to advance the spread of the technology.

CCZARS has teamed up with non-profit organizations, like Baton Rouge Green, in implementation of programs utilizing GIS for K-12 instruction in environmental restoration. Programs such as these, demonstrate the usefulness of GIS as tool in environmental and natural resource studies.

Vendor Training

CCZARS has developed initiatives where geospatial hardware and software vendors have developed authorized training centers at Southern University to certify their user base. Often training is included for those clients making multiple hardware purchases or acquiring enterprise wide software licenses. These vendor training sessions can be as short as a three hour orientation or as long as two weeks. Costs vary considerably depending on the length of the training and the expertise of the trainer. The advantage of vendor led training is that the new user becomes familiar with the same software and software version, that will be used in their office, rather than receiving generic GIS instruction.

Southern University, has an ESRI authorized partnership centers that offer training using material and software from ESRI. Instructors for the ESRI authorized courses have to undergo specified ESRI training routines to be endorsed to offer ESRI training.

The courses offered are two or three days intensive training workshops that provide the trainees with skills that give them competence to utilize the software to a standard of usership defined by the vendors. The trainees are not necessarily faculty or students, but professional users of GIS technology, environmental non-governmental organizations, and the general public.

Vendors often provide free informational seminars on specific topics or in response to the release of new software versions or new products. These can be extremely useful to the geospatial user community. The disadvantages of vendor instruction are the cost and the limited number of locations that provide software specific training.

Professional Organizations

Professional organizations provide an important training function to the geospatial community. Organizations like the International Association of Assessing Officers (IAAO) provide training courses that are hosted by state associations (LAA). The state provides the training sites and registration logistics, while the IAAO ensures that its members meet certain minimum training requirements. Continuing Education Unit (CEU) Credits are an incentive to attending these training programs. Other professional organizations like the Urban Regional Information Systems Association (URISA) and the American Society of Photogrammetry (ASPRS) have GIS Certification programs that provide a recognized standard for judging a professionals breadth of knowledge.

There is a need among local governments to train geospatial professionals in a cost effective manner. Most local governments cannot afford to provide the same level of training as is provided to GIS professionals in the private sector. They rely on professional organizations and free vendor seminars to train their staff in the use of GIS technology. There is also a need for advanced training for local government GIS practitioners. Professional organizations have not been able to keep up with the demand for software and hardware specific training.

Outreach

The key to outreach in the future is the development of “partnerships”. There is urgent need for partnerships across the public, private, non-governmental, and education domains. Partnerships allow for the sharing of scarce resources and the ability to leverage the capabilities of two different organizations.

Awareness of GIS technology could be enhanced, by providing the media and decision makers with recent GIS “success stories”. The DSS Fraud Investigation program is a Louisiana “success story” that demonstrates how GIS technology can improve

government services and save money. Baton Rouge Green and environmental organization in Louisiana has had success in using GIS in community and education outreach. GIS has not been featured extensively in the mass media. There is need for GIS success stories to be publicized in various media. These "success stories" need to be widely disseminated for maximum effect.

GIS Day

There are a number of events that help promote awareness of GIS technology. One of the most successful are "GIS Day" and "Earth Day". GIS Day occurs on the second Wednesday in November and involves creating GIS awareness among students at all levels. GIS practitioners open their shops and agencies and display their maps for school groups and the general public. Many governmental agencies organizations create special events at local schools including geo-caches, a treasure hunt using GPS technology. LAGIC has been actively involved in GIS-Day for the last five years sponsoring school events and coordinating the annual Governor's GIS Day Proclamation.

The GIS council members, the private sector and universities need to do a better job of publicizing the impact of GIS technology on their business process. Where GIS has been used to provide more efficient services, it is essential that the beneficiaries of these improved services let the public know how the improvements were made and how these changes impact individuals**.**

Examples of GIS Outreach

Baton Rouge City as Laboratory Project

The project involves a partnership of students, educators, businesses, and government officials in a cooperative effort to implement a student curriculum for engineering, natural resources and science. The engineering, natural resources and science, geographic information, and global positioning skills that the students learn aid in identifying and maintaining a healthy urban tree population. Students conduct field inventories and work together to find constructive solutions to manage their urban forest's growth and identify key areas where they find significant problems.

Modeling using CityGreen™ Software

SUBR's GIS curriculum trains students to CityGreen software from the American Forests. This GIS application calculates dollar benefits based on natural systems, including the economic value of tree growth. American Forests is the nation's oldest citizen based conservation organization and a leader in the engineering, natural resources and science movement. American Forests sponsors several programs including Urban Ecological Analysis, Global ReLeaf, and Cool Communities.

Working with Citizen Action Groups and Non-Governmental Organizations

Engineering, natural resources and science's GIS Facilities have been used for Environmental Justice studies of neighborhoods around Southern University. These are participatory research initiatives with Baton Rouge Green and Community Against Drug and Violence (CADAV) organizations.

CONCLUSIONS

The establishment of Spatial technologies (GIS, RS, and GPS) into STEM Discipline curricula and public policy at Southern University has made a major impact in redefining the job market skills of Southern University graduates. Spatial technologies have revolutionized the impartment of IT skill to students, faculty and staff. The spatial technology facilities have been critical as a staff development tool at the university. The computer facilities at Southern University now place it as among the leading institutions with spatial technologies at HBCU. The facilities also provide continuing education to non-traditional students, industry and government scientists and engineers. The involvement of vendors in setting up training facilities ensure very high professional standards that exposes SUBR students to 21st century technologies.

REFERENCES

1. Godfrey, C. G. 2001. GIS and GPS in Engineering, Natural Resources and Science. *City Trees,* Journal of the Society of Municipal Arborists. Vol 37, Number 3

2. Holden, M. 2000. GIS in Land Use Planning: Lessons from Critical Theory and the Gulf Islands Journal of Planning Education and Research, Volume 19, Number 3,

3. Myeong, S.P. Hopkins, R.H. Brock, and D.J. Nowak. 2001. Urban cover classification using digital, high resolution aerial imagery. In: Proceedings of the American Society for Photogrammetric and Remote Sensing Annual Conference: 2001 April 23-27; St.Louis, MO. Bethesda, MD: American Society for Photogrammetric and Remote Sensing: (published on CD).

4. Nowak, D.J., 1992. Remote Sensing and Engineering, natural resources and science. Proceedings of the American Society for Natural Conservation. Bethesda, MD. : The Society, 1985
1992. p. 103-108.

5. Nowak, D.J. 1993. Remote sensing and engineering, natural resources and science. In: Proceedings of the 1992 Society of American Foresters National Convention, October 25-28, 1992; Richmond, VA: Society of American Foresters: 103-108.

6. Nowak, D. J., J. Walton, S. Myeong, P.F. Hopkins, and R.H. Brock, Jr. 2001. Chapter 2: Tree cover in Syracuse. In: Nowak, David J.; O'Connor, Paul R.; comps. 2001. Syracuse urban forest master plan: guiding the city's forest resource into the 21st century. Gen. Tech. Rep. NE-287. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 6-8.

7. Padgett, D. 2002. "Community-University Initiatives for the Establishment of Urban Environmental Education Centers to Assist Stakeholder Communities: Major Environmental Justice Issues Associated with Urban Colleges and Universities" . Second National People of Color Environmental Summit Policy Paper Series

8. Padgett, D. and Crayton, C. 2001. Historically Black College And University (HBCU) Geographic Information Systems Utilization Status. http://gislabtsu.freehomepage.com/hbcugisweb2.htm

9. Padgett, D., and Imani, N. O. 1999. "Qualitative and Quantitative Assessment of Land-Use Managers' Attitudes Toward Environmental Justice" The Environmental Professional December 1999.

10. Roach, R. 2001. Taking Stock of GIS Technology at HBCUs. Black Issues in Higher Education, www.blackissues.com and http://gislabtsu.freehomepage.com/BIhbcugis01.html

11. Tsihrintzis, V. A., Fuentes, H.R. Gadipudi, R.K. 1997. GIS-aided modeling of nonpoint source pollution impacts on surface and ground waters. Water resources management. June 1997. v. 11 (3) p. 207-218.: Dordrecht : Kluwer Academic Publishers

DR. FULBERT LEON NAMWAMBA serves as an Associate Professor in the Urban Forestry Program. He is a Co-PI of the Center for Coastal Zone Assessment and Remote Sensing. His research interests include hydrology, GIS, Remote Sensing, and Water Resources Management. He is a member of the Louisiana Groundwater Commission.

DR. MICHAEL STUBBLEFIELD serves as an Associate Professor in the Urban Mechanical Engineering. He is a Director and PI of the Center for Coastal Zone Assessment and Remote Sensing. His research interests include engineering science, material science, and metal composites. He is a registered engineer.

DR. PATRICK CARRIERE serves as Professor in the Civil and Environmental Engineering Department. He is the Chair of Department as well as Director of Graduate Studies for the College of Engineering. His research interests include environmental engineering , hydrologic and groundwater modeling. He is a registered engineer.