GIS Best Practices

Higher Education

February 2011

Table of Contents

Table of Contents

What Is GIS?

Making decisions based on geography is basic to human thinking. Where shall we go, what will it be like, and what shall we do when we get there are applied to the simple event of going to the store or to the major event of launching a bathysphere into the ocean's depths. By understanding geography and people's relationship to location, we can make informed decisions about the way we live on our planet. A geographic information system (GIS) is a technological tool for comprehending geography and making intelligent decisions.

GIS organizes geographic data so that a person reading a map can select data necessary for a specific project or task. A thematic map has a table of contents that allows the reader to add layers of information to a basemap of real-world locations. For example, a social analyst might use the basemap of Eugene, Oregon, and select datasets from the U.S. Census Bureau to add data layers to a map that shows residents' education levels, ages, and employment status. With an ability to combine a variety of datasets in an infinite number of ways, GIS is a useful tool for nearly every field of knowledge from archaeology to zoology.

GIS around the Campus and around the World

The role of higher education is to assist students in becoming effective thinkers with the knowledge and skills that will lead them toward becoming meaningful contributors to society. Geographic information systems in higher education provide an integrated solution to assist faculty and students with their educational goals.

GIS is no longer just for geography departments. By putting information in the context of location, GIS can be applied across several fields of study to enhance learning and teaching. GIS can give students the skills they need for careers in health, marketing, environmental studies, engineering, natural resource management and, of course, geography.

Kingston University London: 20 Years of GIS Education

By Kenneth Field, Course Director, Kingston Centre for GIS

In the United Kingdom, Kingston University London (KUL) holds a special place in the history of academic programmes in geographic information systems. In 1989, Kingston was the first higher education institution (HEI) in the world to design and offer a three-year bachelor's degree wholly in GIS. September 2009 marked 20 years of the course as it comes of age and welcomes its 21st intake.

With more than 650 graduates of the bachelor's degree course, 50 master's graduates, and more than 400 students of our distance-learning training course for professional in-service training, as well as successful doctoral candidates, the university has many students who have gone on to develop careers in the geographic information (GI) industry.

At least 10 KUL graduates currently work for Esri, and many students work for data and solutions providers. KUL GIS graduates are in demand by diverse organizations, including environmental agencies; local government; retail, commercial, mapping, transportation, and utilities organizations; and software firms. One of our first master's graduates, Armen Asyran, recently helped compile *Earth*, which is the world's largest atlas published by Millennium House.

KUL has been a world leader in GIS throughout its first 20 years and firmly intends to remain so. Since the initial decision was made in 1988 to establish the first bachelor's degree course and a centre of excellence in GIS, many changes have taken place, but the current faculty is committed to developing interesting, cutting-edge courses, undertaking research and consultancy, and maintaining and developing links to the GI industry to support common goals.

The GIS faculty at KUL has pioneered a number of developments subsequently taken up by the university. Tim Linsey and Ed Parsons were responsible for making online resources available via the Mosaic Web browser in the early 1990s with GISWWW and its own bulletin board. Parsons also built his own local area network within the university for the distribution of GIS resources. Faculty members are also routinely involved in national-level resource initiatives, such as the development of MasterMap Download, the academic interface for Ordnance Survey's MasterMap data, which faculty helped shape prior to its rollout to all UK universities.

With a strong team of former faculty members and alumni who continue to support KUL, there exists a unique group of academics and professionals who have shaped this major contribution to the development of GIS.

Close liaison with the GIS sector keeps the course current and directly relevant to the needs of employers. Links with suppliers, consultants, bureaus, and a wide range of users have been established, resulting in student visits, internships, and guest lecturers. This collaboration provides crucial support for the course and helps maintain KUL's reputation among employers.

High-quality, externally funded research has characterized the work of the faculty and informed teaching in areas such as remote sensing of hazards and upland forests, spatial statistics and the handling of geographic information, image-based systems, multimedia, and virtual reality development in GIS, as well as the application of GIS to environmental problems. Ongoing is a two-year project to explore use of students' personal technologies for data gathering and sharing and the role of social networking sites, such as Twitter and Facebook, for the creation of collaborative geolearning environments and innovative Twitter maps—which, taken together, I call "cartoblography."

Research, Consultancy, and Commercial Links

Under the consultancy name Kingston Centre for GIS, the faculty has delivered training workshops and seminars at GI industry events for the past 20 years, such as the annual Solutions Centre events at UK GIS conferences. The Kingston Technical workshop series is now delivered at the annual Association for Geographic Information (AGI) GeoCommunity conference. KUL also gets involved in GIS Day by hosting a day of events for local schoolchildren, and plans are under way to take part in the National Geographic Society/Esri GeoMentor scheme. Vanessa Lawrence, CB, Ordnance Survey's CEO and director, is a fellow of KUL and recipient of an honorary doctorate and visits regularly to deliver a keynote lecture that is normally timed to contribute to GIS Day. KUL also supports and encourages growth in GIS courses elsewhere. In 2006, KUL led a major European-funded project to establish a GIS curriculum, course, lab, and staff training at the University of Sarajevo, Bosnia-Herzegovina. KUL also runs an annual GIS summer school in conjunction with AGI.

Commercial and academic links feed directly into the course through our innovative Contemporary Issues in GIS invited-speaker series, which has seen a number of illuminating speakers over the years. Faculty members are also in demand by other institutions as advisers, adjunct tutors, and external examiners, such as Penn State's Masters in GIS (James O'Brien), the UNIGIS MSc programme (Nigel Walford), and the Royal School of Military Survey MSc course in defence geographic information (Kenneth Field). Such networks are important to share expertise, disseminate findings and experience, and support healthy inter- and intrasectoral collaboration.

KUL is also supporting Esri (UK) Ltd. in developing its Enterprise Training Lab based on applications and student projects developed over recent years.

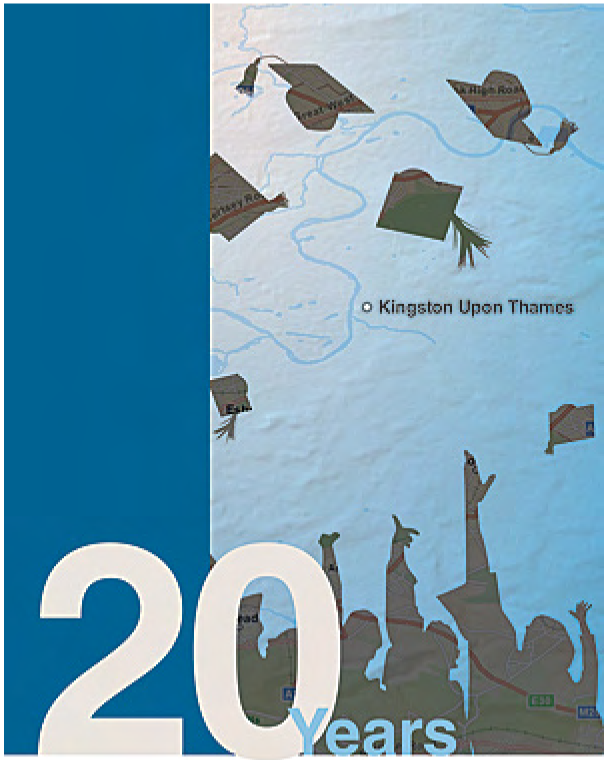


Illustration by Kyle Heinemann, Esri

The GIS Road Map at KUL: Another 20 Years and Beyond

The last 20 years have seen phenomenal change and growth in technology, data, software, and the GI industry. KUL has been part of that growth and has led initiatives to keep courses at the forefront of GIS education. As KUL embarks on the next 20 years, there are echoes of 1989 and the drivers that stimulated the initial development of the course.

Perhaps now, more than ever, an increasingly democratized approach to handling spatial data and mapping has caught the public's imagination and illustrated the power of the geographic approach. Ever more jobs and careers require graduates to be highly skilled and trained professionals in GI systems and science. The impact of online data providers and the rapid diffusion of mobile and Internet mapping applications have reignited interest in the combination of geography and technology that should provide a steady supply of students to courses and serve the now maturing discipline well in the future. Many more pivotal positions in GI-related careers will be needed—careers for people who can now gain professional recognition as Chartered Geographers with expertise in the field of GIS (CGeogGIS).

The recent review and events marking the 20th anniversary of the milestone *Chorley Report on Handling Geographic Information* (1987) in Britain (see below) reaffirmed the position of GIS at the heart of spatial data infrastructures. The Infrastructure for Spatial Information in Europe (INSPIRE) initiative promotes data interoperability and sharing of spatial information and provides a framework across Europe. The newly released *Location Strategy for the United Kingdom* (Geographic Information Panel, 2008) puts the nature of place, where events happen and impact the people and assets at that location, at the centre of national, regional, and local initiatives and service delivery. The purpose is to better plan and to manage risk and use resources more efficiently, maximizing the value of geographic information to the public, government, and UK business and industry.

This is a crucial document in shaping the information economy for the coming years and emphasizes the continued need for suitably knowledgeable and well-trained graduates in GI systems and science. In 2008, GIS was officially included as a core component of the school geography curriculum, meaning that every schoolchild will now be formally introduced to GIS. Along with KUL, other universities and Esri (UK) are making great strides to support development of GIS at the school level, which should see a thriving graduate and postgraduate market emerge.

In honor of this 20th anniversary, I would now like to reflect on the history of the course and reveal some of the stories that have characterized GIS at Kingston.

The Early Years in Kingston upon Thames: From Idea to Inception

Since 1947, the School of Geography at Kingston Polytechnic had developed a strong reputation for its bachelor's degree course in geography. The cartography component had always been a core component of the course, and staff research interests with Ph.D. awards at the time focused on digital cartography and expert systems. Courses in digital cartography; remote sensing; and, in 1986, an option in GIS were introduced into its geography course.

Only 250 metres along the road, the Environmental Studies Department of Kingston College of Further Education (KCFE) had been involved with cartography and related subjects since the 1960s. Demand for suitable qualifications in cartography by people working within established cartographic agencies led to the development of two-year part-time Ordinary and Higher National certificates in 1968 and 1970, respectively. These incorporated all aspects of cartographic practice, theory, and production methods, as well as surveying, photogrammetry, mathematics, and geography.

The rapid expansion of digital cartography in the 1980s and development of the new discipline of GIS had a major effect on the education programmes of both institutions. These developments provided the context for the institutions, in the late 1980s, to jointly develop a new range of educational and training courses in GIS that reflected the strong growth of technology in geography during that decade as geographers sought to develop links between increasingly available data and the computer's ability to facilitate effective storage, manipulation, and analysis. A proposed bachelor's degree course in GIS emerged as a collaborative development concerned with spatial data handling and the application of GIS technologies to a wide spectrum of problems and their solutions. The aim of the course was to enable students to acquire knowledge, skills, and expertise in GIS, integrated with mapping technology, for the purposes of spatial data management.

Justification for the world's first degree course in GIS gained support on the basis of an expanding market for GIS specialists identified in two key publications. Both the 1984 *Report on Remote Sensing and Digital Mapping* (House of Lords Select Committee on Science and Technology, 1984) and the 1987 *Report to the Secretary of State for the Environment of the Committee of Enquiry into the Handling of Geographic Information*, chaired by Lord Chorley, identified the need for degree courses in GIS. The Chorley Report particularly stated "it is apparent that there continues to be a serious gap between education and training requirements and actual provision in the geographic handling areas. In our view, this gap is a factor holding back the use of technology for handling spatial data and the shortage of trained personnel could be even more of a constraint in the future as demand increases." The *Chorley Report* concluded that there was "a need to increase substantially, and at all levels, the provision of trained personnel."

Evidence from both the U.S. and UK markets suggested that the rapid expansion of GIS technology would lead to the establishment of whole new GIS-based employment areas, including local government, utilities, commerce (in particular, sales and marketing), and environmental management. The AGI formed as a direct consequence of recommendations in the *Chorley Report* and identified a growth in demand for spatial information, computer systems that utilize this data, and trained personnel who can operate such systems. In the UK, £70M had been spent on GIS technology by the end of 1988, with an annual cost of £30M by the turn of the decade. Many HEIs subsequently incorporated GIS units into existing geography courses, and one-year master's courses began to appear. The appropriateness of the "bolt-on" GIS unit, the problems of what to teach and how to properly resource practical exercises, and the lack of experience within existing staff were all problems that had to be addressed. The need for individuals with multiple skills in underlying subject areas, such as geography, engineering, and business; in conceptual and practical considerations of GIS; and in broader IT and management issues demanded a more substantive educational approach.

Illustration by Elizabeth Davies, Esri

At the school level, the inclusion of geography in the national curriculum and the general popularity of the subject was leading to oversubscribed geography degree programmes. The rise in interest in computing and information technology subjects and the increasing role of computers in society also suggested that the development of a new academic course that married these together could provide a popular subject. This potential was supported by the fact that the GIS unit in the geography degree course at KUL was itself oversubscribed.

Market research of 45 leading firms and establishments that had some involvement with GIS found overwhelming support for a bachelor's degree course and a growing need for graduates. Further support and advice on the course design were received from the AGI, British Cartographic Society, British Computer Society, and Ordnance Survey. The survey response was also crucial in the naming of the course, a decision which, with hindsight, was remarkably astute. The course was originally to be titled *Environmental Information Management and Mapping Systems*. On recommendation, the title changed to *Geographical Information Systems*, reflecting a terminology that was to become ubiquitous. With impetus established, a committed group of people in the School of Geography at the Polytechnic, alongside staff from KCFE, prepared course documents in January 1989 that were ratified by the Council for National Academic Awards (CNAA) in June. The first intake of 35 students in September 1989 was impressive for such an innovative course and fully justified its development.

Within two years, there were more than 40 students majoring in GIS, and in 1991, a Higher National Diploma (HND) course in GIS was added to its portfolio, with an intake of 20. In 1992, the Polytechnic was granted permission to become a university, and Kingston University London was born as the first cohort of students graduated with the highest student retention rate in the university, along with the highest level of graduate employment within six months of taking the course. By 1997, there were approximately 70 students per annum studying GIS.

The aim of the bachelor's degree course was to provide students with the skills and understanding necessary to apply GIS technology to a wide range of environments. This provided a framework for understanding GIS concepts and how they are integrated into broader information technology strategies. Objectives were to

- Provide an interdisciplinary and integrated approach to GIS.
- Develop critical and analytic skills for problem solving through the use of GIS.
- Enhance students' ability to undertake effective decision making.

- Develop skills in evaluation, application, and management of information systems.
- Provide a sound understanding of the role of spatial data in decision-making processes.
- Understand the business, social, and environmental implications of GIS.
- Provide students with a range of skills and knowledge to undertake a range of GIS-related jobs.
- Help students adapt to the rapid changes taking place in information technology and be able to respond flexibly and positively.

Course content was organized around four underlying themes. The environmental information theme examined sources and character of social, economic, and physical data operating over various spatial and temporal scales and their measurement and description. Information collection methods covered principles of data collection and capture, photogrammetry, remote sensing, surveying, and social and economic surveys. Data analysis explored GIS and other information systems for data management, intelligent data manipulation, spatial and statistical analysis, and system design and evaluation. Finally, information management and communication focused on cartography and digital mapping, report compilation and desktop publishing, management, and budgeting implications. The course engendered an applied philosophy so students gained knowledge and understanding of the application of GIS to effectively examine and solve spatial questions.

Back to the Now

The general framework survives to this day, though the balance and course content have changed considerably to both reflect developments in GIS and lead curriculum initiatives in the science and delivery of GIS. Core modules in GIS are now delivered to all students of geography, environmental science, geology, and forensic science in Year 1 (approximately 250 students). This reflects the maturation of GIS as a discipline and the enabling role it plays for all geoscience subjects. It also reflects the philosophy of embedding GIS as a framework for study across a range of subjects in the university that extends to landscape architecture, computing, business, and surveying. Modules in photogrammetry and topographic techniques have long gone but have been replaced by emerging areas, such as mobile GIS and GeoWeb applications, which keep the course on the cutting edge.

The current curriculum introduces GIS across four Year 1 modules: Digital Earth, GIS Techniques, Applications of Geoanalysis, and Fundamental Programming Concepts. In Year 2, modules offered include Digital Mapping, Remote Sensing, Spatial Databases, Geographical Analysis and Modelling, GIS Software Development and Customisation, GIS for Enterprise and Research, and Mobile GIS. The final year promotes specialties in a wide range of options, including geovisualization, GeoWeb applications, crime pattern analysis, GIS and health, GIS and hazards, systems analysis and design, high-definition surveying, and geodemographic analysis. The bachelor's degree course now also has Joint Honours options where students can combine a major in GIS with a minor in computing, Web technologies, business administration, or landscape architecture. This provides tremendous scope for linking GIS with a range of other subjects at KUL.

In 2003, fieldwork was embedded into the programmes to take GIS out of the classroom, and this has since provided a focus for some innovative work in mobile GIS, fast becoming a contemporary area of expertise at KUL. Current curriculum initiatives are focusing on server-based GIS both in class and for mobile GIS and high-definition surveying with terrestrial lidar for data gathering, handling, manipulation, and visualization.

Alongside the bachelor's degree course, KUL has successfully delivered a Continuing Professional Development (CPD) distance-learning training course for professional in-service training since 1994. This is a nonaccredited option that many hundreds of employees have studied part-time in distance-learning mode. Despite preeminence in the provision of a bachelor's degree course, it wasn't until 2002 that KUL added a master's programme to its portfolio. The Masters in Applied GIS combined a major in GIS with a minor in environmental science. In 2008, provision was extended by the addition of a distance-learning Masters in GI Systems and Science. Both programmes are recruiting strongly as GIS becomes ever more pervasive in a wide range of activities that require professionals to retrain and seek professional development and qualifications in GIS.

KUL will continue to support state-of-the-art GIS education and make it available to all those who join the world's first GIS course as it embarks on the next 20 years.

Esri Development Center

KUL is also extremely proud of its recent accreditation as an Esri Development Center (EDC), which provides recognition and special status to university departments that have exemplary programs. Being an EDC site brings a number of benefits, including an annual student of the year award that was conferred for the first time in 2009, suitably commemorating 20 years of the course.

The 20th Anniversary Celebration

To celebrate the 20th anniversary, KUL will be holding a reunion reception for past and present GIS staff, alumni, and current students in 2010. For details of the event, contact Dr. Kenneth Field through the Kingston Centre for GIS Web site (kingston.ac.uk/centreforGIS).

Changing Faces of GIS Faculty, Keeping Pace with Change, and Recognition and Rewards

Many people have contributed to GIS at KUL. Some remain, while some have moved on and made other significant contributions in academia and business, leaving openings where new faculty have taken up the reins. KUL has also benefited from its relationship with a number of major figures in GIS over the years. A substantial financial commitment was made in terms of staffing and computer technology to launch the course. This was vital to success, and resourcing remains a vital aspect of quality course provision. Over the years, the Kingston Centre for GIS has frequently been recognized and honored. Visit esri.com/arcnews/kingston or kingston.ac.uk/centreforGIS for a list of key individuals, important technology, and awards.

Acknowledgments

Many thanks to all those past and present faculty members who contributed to this review. As ever, it's a team effort.

About the Author

Dr. Kenneth Field is course director and principal lecturer at Kingston Centre for GIS, Kingston University London. He has been editor of *The Cartographic Journal* since 2005 and is a member of the Council of the British Cartographic Society. His teaching and research focus areas are cartography and geovisualisation, as well as mobile GIS and mobile mapping.

(Reprinted from the Winter 2009/2010 issue of *ArcNews*)

GIS for Higher Education: Teaching

Introduction

When students use GIS, they develop analysis and critical thinking skills, regardless of their field. GIS is a learning platform for conceptual modeling. Students also learn technical skills that will help them with their future employment. Spatial thinking skills acquired in the classroom deepen their understanding of the relationships that exist in the world and the complex problems facing society today.

New Freshwater Studies program is first of its kind

The Water Studies Institute at Northwestern Michigan College (NMC) has announced the launch of the first Associate in Science and Arts Degree for Freshwater Studies in the United States. Enrollment is now underway for the 2009 fall semester.

"No other community college in the country has this unique set of institutional and human resources, and certainly not this privileged location for a learning laboratory," said Hans VanSumeren, Water Studies Institute director.

Students will choose one of three concentrations within the program: science and technology, global freshwater policy and sustainability, or economy and society. Each will be geared toward preparation for rapidly-emerging career paths including governance, planning, sustainable agriculture, sustainable energy, water quality, management and reclamation.

The Freshwater Studies degree builds on existing NMC courses such as watershed science and oceanography. New courses being added include introduction to water studies, introduction to GIS (geographic information systems), a field experience, and internships.

"This science-based program has an interdisciplinary approach designed to offer students flexibility and a variety of opportunities that are especially critical in these challenging economic times," said VanSumeren. The degree is intended both for students who aspire to enter the professional arena as well as those who wish to further their studies at a four-year school.

"We want to support our students so they can compete favorably in a global economic environment," said Dr. Constanza Hazelwood, Education and Outreach Coordinator for the Water Studies Institute. "In a region where water is abundant, we can readily forget that it is a scarce resource in so many areas of the globe."

The Water Studies Institute is located in NMC's Great Lakes Campus on West Grand Traverse Bay. It has an on-site water analysis laboratory and will utilize the T/S Northwestern as a floating classroom for exploration of the Grand Traverse Bay. The Institute has also been collaborating with NMC's Aviation program to collect water samples on inland lakes using NMC's float plane.

Students in this program will also have access to:

- Research initiatives with university and community partners including the Grand Traverse Bay hydrographic survey project and Grand Traverse Bay Observing System
- Remote investigations with underwater vehicles
- Fieldwork opportunities overseas
- Internships

VanSumeren and Hazelwood will be among the instructors for the freshwater-related courses.

VanSumeren has a bachelor's degree in Naval Architecture and Marine Engineering and a master's of science degree in Marine Environmental Engineering, both from the University of Michigan. He has conducted water-related research with the University of Michigan Marine Hydrodynamics Laboratories around the Great Lakes and in the oceans along the U.S. coastline.

Hazelwood received a bachelor's degree in Biology from Los Andes University in Bogotá, Colombia. She received a Ph.D. in Curriculum, Teacher Education and Policy from Michigan State University. Hazelwood has worked with educators in the Grand Traverse region and globally as a professional development facilitator in science education. She also is a former science teacher and NMC Spanish instructor. Hazelwood is a consultant for international projects at Harvard University.

(Northwestern Michigan College press release, June 17, 2009)

Inside the Metaverse

A "Second Life" for GIS Education

By Michael N. DeMers, New Mexico State University

With online delivery of education becoming more prevalent, emerging technologies will have a profound and lasting impact on how GIS courses are taught in the near future. One such technology, the metaverse or digital universe, provides exciting possibilities for building learning communities, enhancing social presence, and creating shared intellectual landscapes than ever before.

One such world, called Second Life, is already providing opportunities for in-world discussions, project collaboration, GIS consulting, and even re-creation of real worlds inside the metaverse. Second Life is one of the better-known metaverses and has long been involved both in the development of a social network and the application of its digital environments to education.

Dr. DeMers and some of his GIS students at New Mexico State University get together to study for lecture exams on Aggie Island in Second Life.

Both free and paid accounts are available from the Second Life Web site (secondlife.com). After obtaining an account, choose an avatar name, download the client software, and enter the brave new digital world. Decide what the avatar will look like. Avatars can be male, female, or even furry. The next stop is Orientation Island to learn how to get around, do commerce, communicate, and even purchase land (with a paid account).

New Mexico State University (NMSU) is one of a growing number of universities that have purchased virtual land inside Second Life to use for teaching. At NMSU last semester, some students in the *Fundamentals of Geographic Information Systems* course joined Second Life and formed study groups on a portion of virtual land called Aggie Island. Every week, they provided a selection of the Microsoft PowerPoint slides from the previous week's lectures that were converted to JPEG files so they could be uploaded to a functional display board on Second Life.

These students got together to study every Sunday evening. Because the students were required to respond to the instructor's questions by typing, they not only learned the material but practiced the responses they would eventually use in essay exams. This radically improved these students' test scores.

This semester, the GIS students will be using Second Life to collaborate on project-based learning laboratories; visit their instructor during virtual office hours; and, optionally, build three-dimensional models and animations that demonstrate their understanding of GIS concepts and software implementations. The instructor and students belong to a group that provides group chat environments, member lists, and profiles, and their roles (if they have permission to add new members). Former students in the *Fundamentals of Geographic Information Systems* course have been assigned alumni status and will be paid in virtual money to act as tutors and consultants to the current cohort of students. This allows former students to become part of a larger and ever-expanding learning community.

Other institutions are also demonstrating some really clever ways that Second Life can benefit the GIS learner.

The University of Texas, Arlington, has created a kiosk for its GIS users to get help with the software and even individual teaching or research applications. The University of Illinois has a site that displays GIS-derived maps of the state for people to examine.

There's even a GIS coordinator and part-time instructor from the City of Berkeley, California, who is transforming real lidar data to three-dimensional Second Life objects called sculpties. These models allow people to view real-world topographic features up close in Second Life.

These objects can be made large enough to re-create real environments so students working on GIS projects, through the use of their avatars, can actually experience the environments they are modeling with GIS. Imagine, for example, being able to use virtual worlds to experiment with real-world modeling scenarios, do ground truthing, and even collect data on locations of individual avatars using the in-world maps that are available in Second Life.

DeMers' avatar.

The possibilities for using Second Life for GIS and spatial analysis education are nearly limitless. Much like GIS itself, these applications are limited only by the creativity of the user (apologies to Jack Dangermond for paraphrasing). Metaverses are the future of education as well as commerce. Corporations that have presence in Second Life include Coca Cola, IBM, and SONY. Other organizations—publishers, such as John Wiley and Sons, Inc.; federal agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA); and government bodies, such as the United States Congress—exist in Second Life and often conduct real business.

There are groups of educators who are getting together to explore how Second Life can be used for learning. The Educator's Coop from the University of Texas (educatorscoop.org/) and Technology Enhanced Learning and Research (telr.osu.edu/) at The Ohio State University are two examples of these groups.

Even Linden Laboratories, the creator of Second Life, has developed forums for sharing ideas about the myriad possibilities for using Second Life for learning (sl-educationblog.org/). The possibilities of using this content-rich environment for GIS education are exploding.

(Reprinted from the Winter 2009 issue of *ArcUser*)

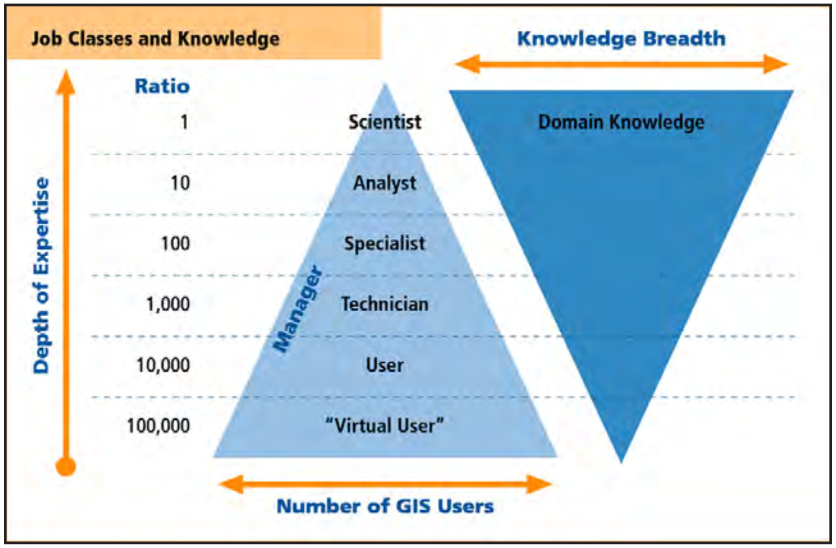
Developing a GIS Curriculum

By Ann B. Johnson, Former Esri Higher Education Solutions Manager
UC GIS Model Curricula Body of Knowledge 2006

Academic research has driven both the development and use of GIS and related geospatial technologies in many workforce domains. Courses and programs at universities in geographic information science and technology (GI S&T) have increased rapidly as the demand from industry has grown.

The National Center for Geographic Information and Analysis (NCGIA) Core Curriculum was one of the many efforts to help educators develop GI S&T programs. The University Consortium for Geographic Information Science (UCGIS) Model Curricula Project and the Body of Knowledge (BoK) are ongoing efforts to assist educators who are developing curriculum for GI S&T programs.

Although this is its first edition, BoK can help build GI S&T curricula and serve as a basis for future editions as the domain continues to be defined. It is proving valuable to the geospatial industry and related organizations for purposes not strictly related to curriculum development.



Relationship between experience, domain knowledge, and types of GIS users.

GI S&T Curriculum

Academic programs within the United States that focus on GIS increased from a handful of institutions doing research at the graduate level in the 1980s to hundreds of institutions that offer courses, certificates, and degree programs incorporating the use of GI S&T. There have been many efforts by academia, professional organizations, and industry in the United States to develop methods to define the content of programs related to GI S&T. Early efforts included NCGIA Core Curriculum.

NCGIA Core Curriculum

The NCGIA Core Curriculum grant, funded by the National Science Foundation (NSF), created a set of units for three courses. While this has been called the Core Curriculum, the units more closely resemble a set of lecture notes. First distributed in 1990, Core Curriculum has since been translated into many languages and continues to be used by educators. Later efforts to update and expand the curriculum have been less successful according to Karen Kemp, founder and former director of the International Masters Program in GIS at the University of Redlands, California. The latest version is available from ncgia.ucsb.edu/giscc/.

Another effort to develop more technology-related curricula was the NCGIA Core Curriculum for Technical Programs, which was also funded by the NSF. This effort helped spread the technology into lower division programs, but it has not been maintained or updated since 1999.

Increasing Interest in GI S&T

Expanding use of GI S&T has led to several efforts by United States government agencies such as the $700,000 grant by the Department of Labor to the Geospatial Information and Technology Association (GITA), to study workforce readiness for jobs in the geospatial sector. The University of Southern Mississippi, University of Mississippi, and other two-year schools and universities have adopted DACUM (Developing a Curriculum) processes for identifying the duties and tasks for GIS professionals. Organizations that deal with the geospatial industry—such as the Association of American Geographers (AAG), the URISA, GITA, the American Society for Photogrammetry and Remote Sensing, and recently the United States Geospatial Intelligence Foundation (USGIF)—have been active in supporting development of the curricula, supporting materials and courses, and activities that help define geospatial workforce skills and competencies. Detailed discussions of these efforts are beyond the scope of this article but are summarized in the UCGIS GI S&T Draft Body of Knowledge 2006 online at the UCGIS Web site and included in a soon-to-be-published BoK by the AAG.

UCGIS and Model Curricula Body of Knowledge

UCGIS was founded in 1994 to promote GIScience. In 1997, UCGIS proposed a number of challenges including one that led to the Model Curricula project led by professor Duane Marble. Marble based this effort on the highly successful Computer Science and Information Systems curriculum format. This approach focused on undergraduate curriculum development and encompassed the subdomains of GIScience, GIS (geospatial) technologies, and applications of science and technology.

Many meetings with advisors from academia and industry and funding support from vendors led to the publication of the Strawman Report in 2003. The Strawman Report included a Body of Knowledge for GI S&T, divided into 12 Knowledge Areas (KA), which were subdivided into units, then into topics. The Model Curricula was not to be a static document of set course content and structure but would allow the inclusion of a common set of core topics; additional appropriate topics from the 12 KAs; supporting topics/courses from other disciplines; and integrative experiences, such as internships, to create a curriculum pathway appropriate to a specific curriculum outcome. Thus, by specifying different topics and other additional supporting courses, the same BoK could be drawn upon to support the creation of very different curriculum outcomes. This multipath approach was seen as necessary due to the multidisciplinary nature of GI S&T. Lack of funding support from the NSF slowed the progress on the Model Curricula project.

New Plan for the Model Curricula Project

In 2004, the UCGIS, under the leadership of David DiBiase, proposed a new three-year plan. Due to the increased interest in GI S&T, an accelerated one-year plan was requested by industry. A revised work plan that focused on the content within the BoK KAs was outlined. This new accelerated plan necessitated postponing inclusion of some original elements including specific (i.e., exemplar) pathways, suggestions for supporting elements from other disciplines, mastery levels for topics, discussion of cross-cutting themes, and pedagogy and implementation issues.

The BoK underwent extensive reviews by an advisory board of scholars and experts. Comments and recommendations were reviewed and incorporated as needed into the document and a final document prepared in February 2006. During the BoK development and review process, the scope was expanded to include graduate and post-baccalaureate/ professional degree curricula KAs, units, and topics and combine or reorganize units within 10 rather than the original 12 KAs.

Structure and Format for the Body of Knowledge

The 10 BoK KAs encompass the domain of GI S&T. Each KA is made up of units that focus on the concepts, methodologies, techniques, and applications specific to that KA. Each unit includes a Knowledge Area—two letter code (KA) and description title and brief description that helps users understand how it relates to the KA and, where applicable, includes references to other relevant KAs. Core units have been identified and represent units that should be covered at some mastery level in certificate or degree programs. Units are made up of topics that include a short descriptive title and bulleted educational objectives. An attempt was made to include examples of educational objectives with varying levels of mastery for each topic. More than 350 learning objectives in 79 units are included in 10 KAs. The basic structure of a KA is shown below.

Knowledge Area—two letter code (KA) and description
Unit—Number and title with a brief description (references as applicable)
Topic—Unit number and individual number and descriptive title • At least one educational objective • Key Readings—References to materials for the KA

Current and Future Use of UCGIS BoK

AAG will publish the BoK document in summer 2006 as low-cost printed and electronic versions. This will be the first edition in a continuing effort to define the GI S&T domain. Work on a second edition should be started as soon as possible with other supporting materials created including exemplar pathways. It has been suggested that relationships between KAs may be further identified by using new information visualization techniques, which may suggest relationships and overlaps between KAs.

Additional Uses of the BoK

Although the Model Curricula was originally conceived as a tool primarily for academics who are creating curricula, the BoK can serve many purposes. In addition to initial curriculum development, the BoK is useful in curriculum review, program evaluation and assessment, accreditation, articulation, professional certification, employee screening, and program comparison by students. Interest in the document has also come from educators in Europe and Asia Pacific.

Possible future efforts could include development of a tool for program self-assessment based on the BoK KA, units, topics, and educational objectives. The Strawman version of the Model Curricula has been used as a course evaluation tool for the GIS Certification Institute's GIS Professional Certification process, and BoK will be used in an update process. BoK has also served as a tool for the USGIF Academy accreditation program. The USGIF used the GI S&T BoK to identify what content should be included in accredited geospatial intelligence analyst programs.

Conclusion

With continuing expansion of geospatial technology use and increased ability of institutions to collaborate worldwide to create GI S&T modules and programs, the BoK should provide a common format and structure for sharing content and comparing programs. While the BoK was developed to satisfy the needs of educators in the United States, it may serve as a starting point for other national and regional geospatial curricula efforts. It will also serve as the basis for creating exemplary pathways that can be used to define discipline-specific geospatial and nongeospatial courses for many different workforce domains and educational disciplines. Continued participation and interest from government, professional organizations, and industries in defining the geospatial industry will also benefit from, and help build, new editions of the BoK and ancillary tools and materials. With ongoing review and input from all parties interested in GI S&T, the BoK should continue to be an excellent resource for educators and geospatial technology users.

(Reprinted from the July–September 2006 issue of *ArcUser*)

GIS to Understand Dance, and Vice Versa

The Ohio State University Cross-Disciplinary Team Explores Complex Structures of Interaction

Highlights

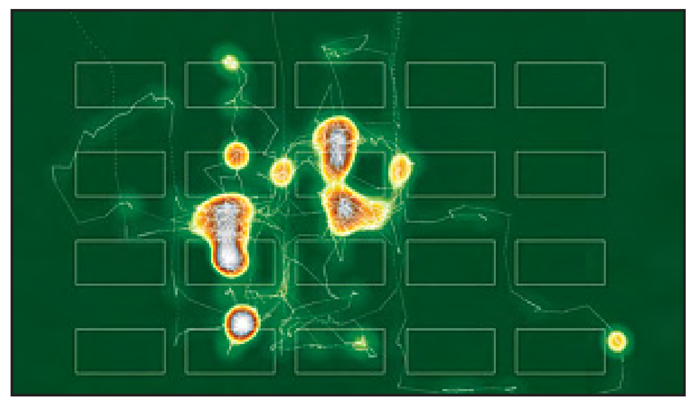
- Geographers used ArcGIS to summarize and investigate spatial patterns of dancers.
- ArcGIS Spatial Analyst was used to generate density surfaces for each dancer.
- ArcGIS 3D Analyst showed final density surface as a topographic landscape.

When choreographer William Forsythe invited scientists from across all disciplines to investigate dance and choreography using their disciplinary lenses, it was not obvious that geography and spatial analysis could provide new insights. One of the goals was to make dance more accessible so that anyone, within a matter of seconds, would "get it," and also to explore the possibilities for placing dance at the center of cross-disciplinary dialog and research. After exploring the spatiotemporal data that was generated from tracking each dancer with centimeter and millisecond (ms) precision, a group of geographers saw some familiar and some unfamiliar spatial patterns emerge. Now their findings and visual explanations and those of other researchers at The Ohio State University (OSU) are presented in a new Web project, Synchronous Objects for *One Flat Thing, reproduced* (synchronousobjects.osu.edu/content.html#/movementDensity), which Forsythe developed in collaboration with Ohio State's Department of Dance and Advanced Computing Center for the Arts and Design.

Forsythe's bold, contemporary works have revolutionized classical ballet for our time, and he is widely viewed as the greatest innovator in this field since George Balanchine. With the formation of the Forsythe Company, based in Germany, he continues to actively explore his multidisciplinary interests in new forms and new modes of presenting his work. His installations constitute progressive additions to his extensive oeuvre: installations for galleries and public spaces, video works, digital media, and publications. The Synchronous Objects project is part of his idea to allow the transformation of choreographic principles from one manifestation—a performance on the stage—to an array of other possibilities, including digital information, animation, and installations.

The entire dance involved 17 dancers, and about 16 minutes of activity was recorded. The minute detail of the records, down to centimeter precision and temporal increments of 40 ms, resulted in a dataset of around half a million points.
(Video still from One Flat Thing, reproduced *by William Forsythe.)*

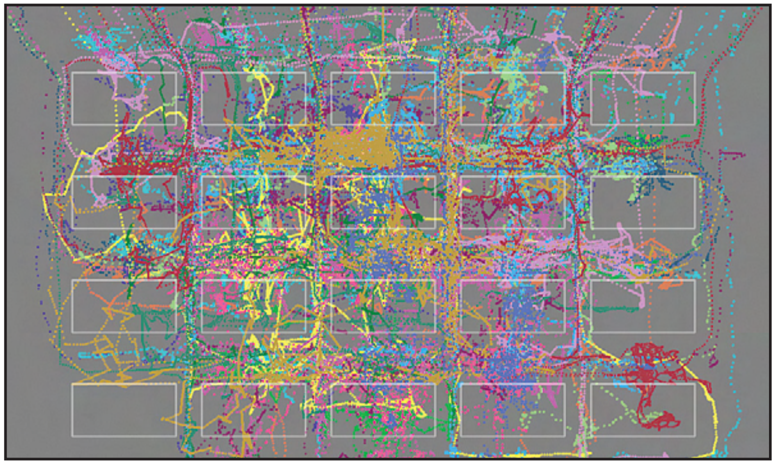
Researchers at Ohio State wanted to explore structures in the dance that were not apparent from watching the dance or might not even be known by the dancers and choreographer themselves. Starting with Forsythe's ensemble dance *One Flat Thing, reproduced* as the research resource, a diverse team of collaborators from OSU's Computer Science, Dance, Design, Philosophy, Geography, Statistics, and Architecture departments and schools sought to understand the complex structures of interaction in the dance through an array of creative tools, expressive animations, and information



One dancer's point data together with outlines of the tables on the dance floor and a density surface generated with Spatial Analyst from all those points.

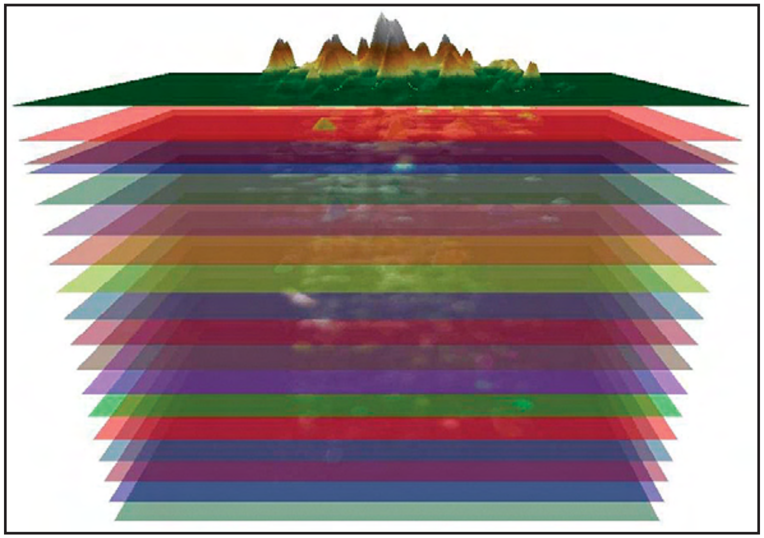
graphics. Among these, a team of geographers used ArcGIS software (through its Esri university site license) to summarize and investigate the spatial patterns of dancers throughout the dance. The spatiotemporal data consisted of point records of each dancer's location in three dimensions as well as a time stamp for each record. The entire dance involved 17 dancers, and about 16 minutes of activity was recorded. The minute detail of the records, down to centimeter precision and temporal increments of 40 milliseconds, resulted in a dataset of around half a million points.

The recorded positions of the dancers left a trace of points wherever they moved. To explore potential spatial patterns, the researchers used ArcGIS Spatial Analyst and generated density surfaces for each dancer. Density surfaces are created by superimposing a raster dataset onto the stage, essentially dividing the stage into many small areas represented by pixels, and counting how many points there are within each pixel or within a particular distance from each pixel. A graded color scheme was then added to represent the number of points counted in each area, and the variation in color across the stage informed the researchers about when and where dancers had moved.



The entire point dataset is shown with outlines of the tables on the dance floor. Each color represents a different dancer, and their locations were recorded at 40 ms intervals.

By generating a series of density surfaces with 10-second increments, it was possible to create an animation of how the dance evolved through time, and patterns started to emerge as certain areas were used more than others by the dancers. Halfway through the dance, hot spots, or places that were most used by the dancers, showed up as intense, brown-red areas, and places with little activity remained in green shades. The most obvious pattern that emerged from watching the density surface was that most of the activity happened in the center of the stage, but researchers could also observe how the tables that were part of the stage set seemed to act as a structuring element in this dance. Many of the hot spots were located around the back side of the tables.



A topographic rendering of the density surface summarizing all 17 dancers' activity (top layer), and individual dancer density surfaces also rendered as 3D topographies of different colors (underlying stack of layers).

To further enrich the visual experience, researchers used the ArcGIS 3D Analyst extension to turn the final density surface into a topographic landscape where the number of points was used as elevation values, creating a dance landscape of mountains, peaks, and valleys. In this representation, sometimes referred to as a statistical surface, the hot spots are depicted as mountaintops or ridges, and the deep valleys and flatlands represent little or no dancer activity. Separate surfaces for each dancer were visualized using this technique through which differences in individual dancer patterns could be explored. These helped highlight distinct patterns where some dancers were very active across the entire dance floor, while others spent most of their time in only a few areas. Most of the animations were created directly in ArcGIS 3D Analyst and exported to movie files for use on the Web site. The Web site and associated blog will also be used as a continually evolving area for communicating and discussing new findings, thoughts, and uses of these objects as tools for communication, discovery, and teaching.

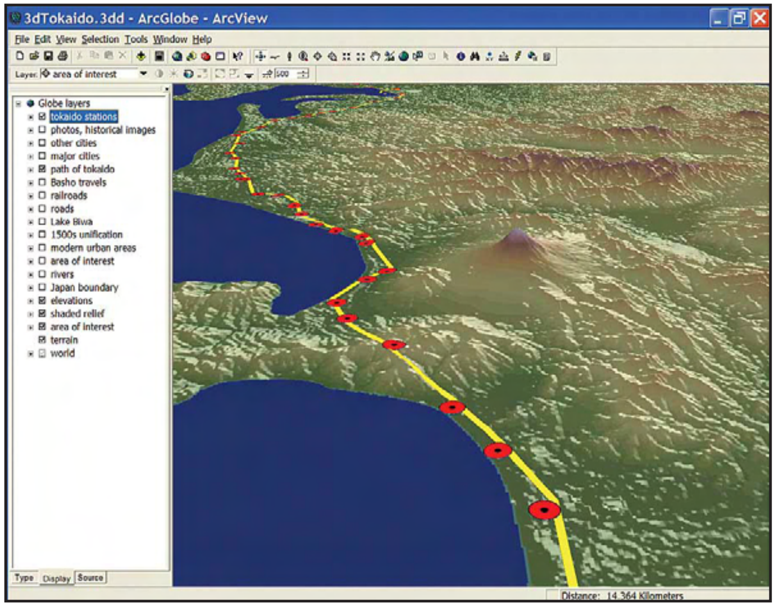
(Reprinted from the Summer 2009 issue of *ArcNews*)

AEGIS Project Weds Geotechnology and Traditional Liberal Arts

By Sean Flynt and Eric J. Fournier, Samford University, Birmingham, Alabama

A grant from the National Science Foundation's Course, Curriculum, and Laboratory Improvement program is helping faculty at Samford University develop GIS modules suitable for use in introductory-level courses in a surprising variety of academic disciplines.

Former Samford geography professor Max Baber (now at the University of Redlands, California) developed and directed the university's $195,000, three-year Academic Excellence and Geographic Information Systems (AEGIS) project, now entering its evaluation stage. According to Baber, the project's goal was to help faculty help students understand and integrate the technology into their studies and careers.



Samford University students in professor Jim Brown's classes explore the "Great Roads" of history using GIS. Here is a perspective of the Tokaido, a route between Kyoto and Tokyo widely regarded as the world's busiest road during the Tokugawa Japan era (1600–1868). Travelers enjoyed overnight respite and hospitality at 53 stations along this route, and students accessed documents about each of these stations by activating hyperlinks associated with the station symbols.

"The broader impacts of this project are far reaching," Baber says. "The integration of introductory GIS into a diverse array of arts and sciences courses is leading to further development of GIS modules for advanced courses and is enhancing student research skills by providing students with multiple opportunities to engage in spatial data acquisition and analysis activities."

The AEGIS project graduated 14 faculty participants in two groups of seven. Participants spent two weeks learning the fundamentals of the

ArcCatalog, ArcMap, and ArcGlobe applications in ArcGIS Desktop, then developed modules for use in their classes. The modules were then tested on other participants, fine-tuned, and used in a variety of classroom settings throughout the university. Participants, who received stipends for the work, were sometimes spotted wandering Samford's quad in clusters, hunched over handheld GPS receivers. Others gathered in the Geography Department's GIS lab (also an Esri regional training center) to process data and create student-friendly applications. When they returned to their own classrooms, they helped students use the technology in diverse undergraduate research projects and classroom exercises, from tracking wildlife to revealing the influence of ancient cultures to exploring political redistricting.

The practical value in both career and classroom is apparent to the faculty who volunteered to participate in the AEGIS project. Professor Ron Jenkins and his colleagues in Samford's Biology Department were especially interested in the technology. "GIS and GPS can be big pluses in conducting environmental research," Jenkins says. "Being able to map distributions of animals can give the biologist a better understanding of the animals and their biological roles." Jenkins comments that Samford biology students used ArcMap in their study of the flora and fauna of Shades Creek, which runs alongside Samford's lush hilltop campus and has served as an outdoor biology lab for many years.

Classics professors Shannon Flynt and Doug Clapp saw applications for GIS in even the most traditional of the liberal arts. "Those nebulous people of history, be they Greek, Roman, or your great-grandparents, did not live in a vacuum or on page 243 of a textbook but in a real place where it even rained sometimes," says Clapp. "The AEGIS project can help those of us who introduce students to their cultural roots through cultural perspectives courses or through Greek and Roman history by providing a geographical anchor for the printed page that is our primary teaching tool." Clapp's students used ArcGlobe to create a series of teaching maps of ancient Greece. Flynt, who specializes in Roman archaeology, led her students to create maps documenting the diffusion of distinctively Roman architecture in ancient Britain.

For historian Jim Brown, knowing the roads is the key to understanding world history. Students in his introductory classes use ArcMap to construct a series of maps that show the routes of renowned roads in history, including Jordan's King's Road, Cortez's route from the sea to Mexico City, and roads of feudal Japan. The students brought no GIS skills to the class, but within a few class periods, they were following Brown's manual to open .mxd files, add layers, change symbology, and ultimately construct their own maps of these famous roads. While the students developed some GIS skills, Brown was more interested in using the technology as a tool to help them understand history. For students interested in taking GIS beyond the classroom modules, Samford's Geography Department offers a full range of GIS classes, including a GIS certificate program.

The challenge now is to sustain Samford's interdisciplinary focus on geotechnology. A new cohort of professors from psychology, history, and biology plans to carry on the work of the project in a variety of classes without the use of the grant-related funds. Baber says the university's growing emphasis on mentored undergraduate research should help carry forward the aims of the AEGIS project, as should the project's proven utility. "Geotechnologies continue to grow in usefulness and applicability across a wide range of disciplines," Baber notes. And however unlikely this marriage of technology and traditional liberal arts might seem to some, Samford University is demonstrating that the match can be a happy one.

More Information

For more information, visit Samford University's AEGIS project Web site (howard.samford.edu/geography/content.aspx?=2147486413).

(Reprinted from the Fall 2007 issue of *ArcNews*)

GIS for Higher Education: Research

Introduction

Educators are using the power of GIS in more than 100 different academic disciplines to spatially enable their research. Researchers often focus on advancing GIScience theory and methodology or use GIS as an analytic tool in their specific scientific discipline. For programmers, the Esri Development Center (EDC) program provides additional support for those research groups focused on GIS application development.

GIS Contributes to Groundbreaking Carbon Emissions Inventory

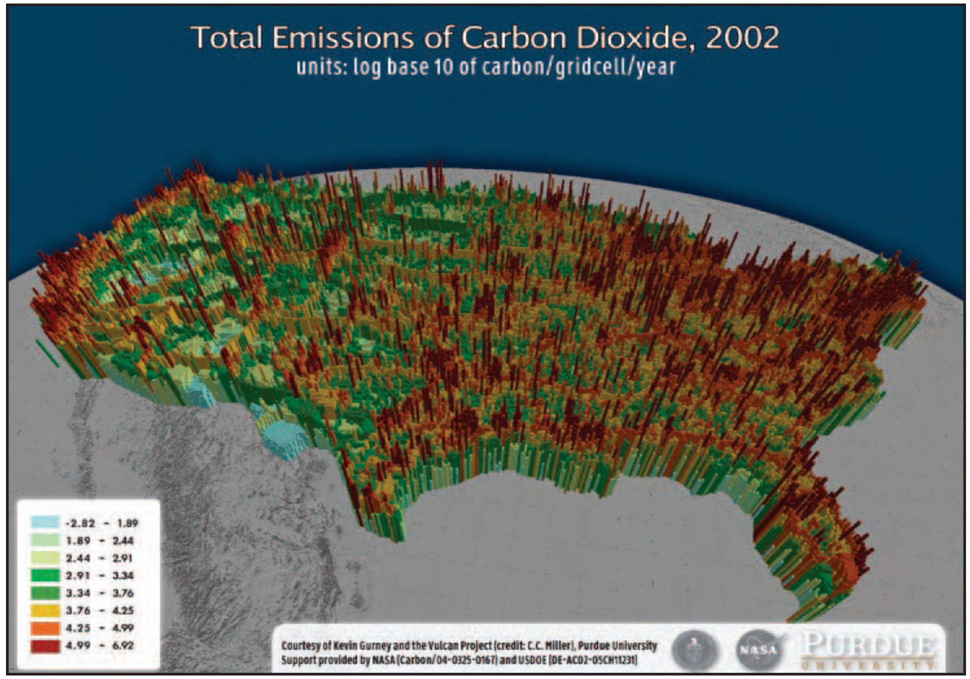
Library supports project and GIS use across campus

By C. C. Miller, Purdue University, West Lafayette, Indiana

Researchers from Purdue University's Project Vulcan developed processes for aggregating carbon emissions data from multiple sources and formats. Valuable GIS support for this project came from an unlikely source: the university's library.

Vulcan is a two-year-old project funded by the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy (DOE) and led by Kevin Gurney, assistant professor of earth and atmospheric sciences at Purdue University in West Lafayette, Indiana. Its mission is to quantify North American fossil fuel carbon dioxide ($C0_2$) emissions at higher spatial and temporal scales than ever before.

The project's spatial component called for significant amounts of geoprocessing. The majority of these operations, accomplished with ArcGIS, resolve input geographies (points, roads, counties) with 10-kilometer square grid cells. GIS was also used to place surrogate emissions into grid cells using population, land-use, or some other meaningful proxy when necessary. *[Emissions surrogates are used as indicators of emissions activity. The spatial distributions are assumed to be representative of the geographic distribution of emissions sources.]* Software, custom-built by team members, could then process all input data at a common unit of geography and an hourly temporal scale for an entire year.

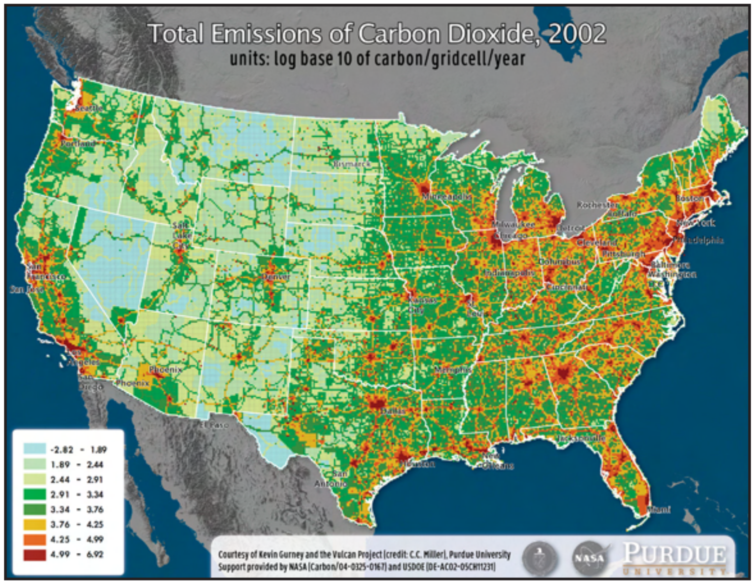


The purpose of the Vulcan project is to quantify North American fossil fuel carbon dioxide ($C0_2$) emissions at higher spatial and temporal scales than ever before.

Although much of the Vulcan workflow was ripe for GIS input, GIS was late to the party. Purdue University Libraries hired its first GIS librarian in late 2006 to help push new efforts to apply library science expertise to data and information problems facing researchers in labs and centers across campus. Faculty librarians at Purdue were encouraged to assist any department—Communications, Agronomy, Hospitality, and Tourism Management—with data and information problems. The nature of GIS meant these librarians were likely to find work in all these areas.

Response from collaborating faculty and teams has been swift. Purdue librarians have been welcomed onto teams and into collaborations not traditionally inclined to allocate a portion of grant funds for librarians' salaries. In particular, information and data—geodata especially—is so unruly and fluid that apparently researchers appreciate the benefits of having a librarian around who knows GIS, is familiar with the geodata, and can handle classic and developing technologies in GIS and geoinformatics.

Consequently, in late 2006, Vulcan project team members who needed to visualize some county data approached the libraries. Just as traditional library reference transactions tend to do, these requests evolved. Requestors asked increasingly complex questions: What could GIS do with data from multiple sources and programs? How could it represent $C0_2$ emitters in different formats? As more questions were answered using GIS, the librarian became part of the Vulcan workflow, supplying GIS support to the team and nagging about the importance of metadata and data archiving.



The project is funded by the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy (DOE) and led by Kevin Gurney, assistant professor of earth and atmospheric sciences at Purdue University in West Lafayette, Indiana.

The rest would have been history, but the response to the initial release of Vulcan data, as well as an emerging sister program at Purdue University, the Hestia project, indicates there is plenty of additional work for all parties. *[Hestia combines diverse data about the flow and metabolism of the energy-emissions-climate nexus in an intuitive, interactive, photorealistic, three-dimensional visualization of the Earth.]*

Contributing GIS and geospatial technologies to an atmospheric sciences project was not accomplished without some disruption. The lexicons that atmospheric scientists and librarians use to communicate do not always equate, nor do the dictionaries of GIS and atmospheric modeling. In addition, the small Vulcan team is required to move large datasets from place to place.

There has not been time to fully develop all the infrastructure needed to automate and streamline the project's work. However, as part of the academic trend toward more interdisciplinary scholarship and research, Vulcan is already producing valuable data and tools. Atmospheric science has been the primary beneficiary; computer graphics, geoinformatics, and data librarianship will also benefit from the labor dedicated to and lessons learned from Project Vulcan.

While all Vulcan's components are scheduled for improvement, the data used to surrogate emission sources and the automated spot-check mapping infrastructure used to quickly examine model output will be among the first enhanced. Future additions to the project will include intelligent, automated data archiving and online interaction with data. These additions will ensure that—while the computer scientists, computer graphics specialists, and atmospheric scientists will have their hands full with software, visualizations, and important new analysis—there will still be plenty of work for the resident librarian.

Some geoinformatic aspects of Vulcan were used in an inaugural geoinformatics course taught by Purdue faculty members (including the author of this article) in spring 2008. Project members expect that successful models for working with and disseminating Vulcan data will filter into other initiatives for improving accessibility to geodata across the Purdue campus.

(Reprinted from the Winter 2008 issue of *GIS Educator*)

Leading the Way in Health GIS

Incorporating GIS into research and teaching programs

By Susan Harp, Esri

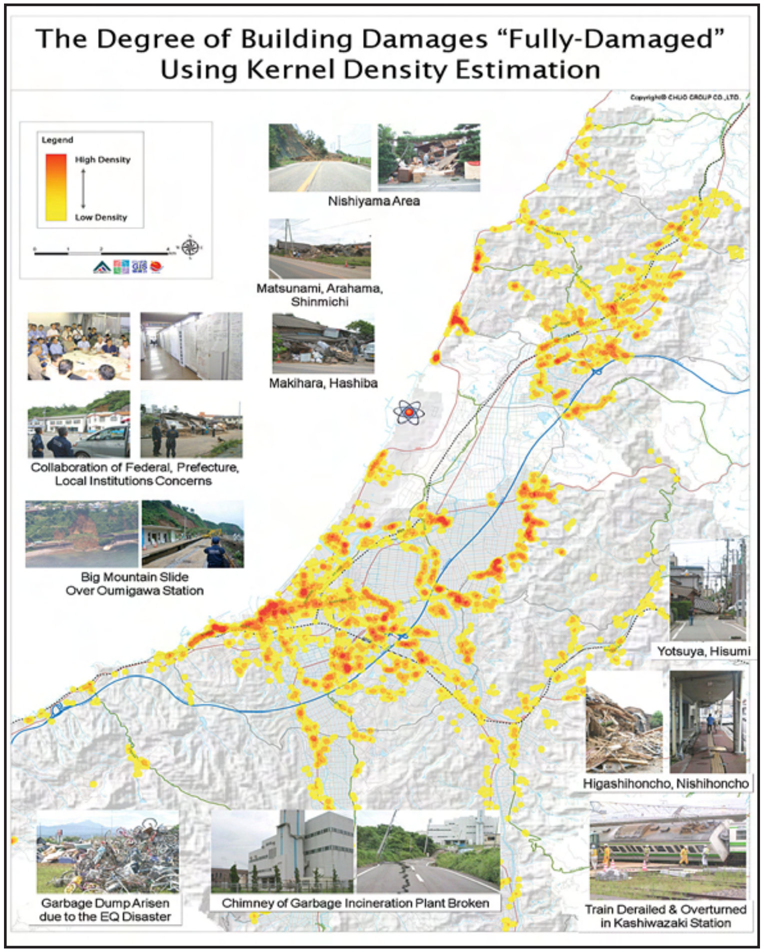
During the Third Health GIS International Symposium in March 2008 in Niigata, Japan, Loma Linda University in Loma Linda, California, and Niigata University announced a five-year memorandum of understanding. This agreement will promote cooperation in education, research, and related fields with a particular focus on the advancement of health geoinformatics. It is part of Niigata University's incorporation Niigata University's incorporation of GIS into both research and teaching in its health and environmental programs.

The two universities will share resources in technology, faculty, and students. The symposium's keynote speaker, Wendy Guan, Ph.D., director of the Center for Geographic Analysis, GIS Research Services, Harvard University, spoke on embracing geographic analysis beyond geography. Seth Wiafe, assistant professor, Loma Linda University School of Public Health, spoke on using geoinformatics for advancing public health preparedness and response through collaboration.

"This collaborative agreement strongly supports the concept of creating seamless health geoinformation technology advancement that embraces the idea of preparing a competent health GIS workforce for the 21st century," said Wiafe.

The agreement is part of Niigata University's pursuit of collaborative GIS training and research for health and environmental education. Located about 250 kilometers north of Tokyo on the coast of the Japan Sea in Niigata City, the university's School of Medicine offers advanced degrees in medicine and health sciences. Niigata University's charter calls for an innovative approach to education that promotes excellence, interdisciplinary and public-private collaboration, and international involvement. The university's International Academic Support Office guides the development of these goals and provides support for GIS development in the School of Medicine and School of Science.

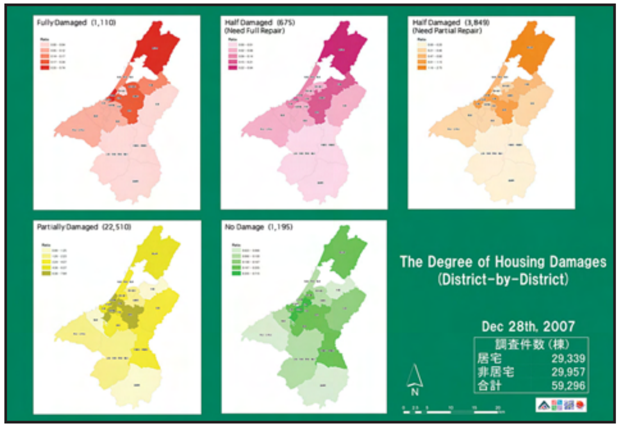
When the university started a long-term action plan to establish GIS education programs in its schools of Medicine and Science in 2005, the School of Medicine quickly established a technical laboratory; began promoting awareness of the applications of GIS in health, locally and internationally; and introduced a model of public-private collaboration for health GIS programs.



This map poster was made of the disaster site, Kashiwazaki City. This map was also displayed at the 2008 Esri International User Conference Map Gallery.

The university joined the Niigata GIS Association, a local GIS user group that was started by representatives from several corporations to promote GIS literacy and data infrastructure development. Niigata Prefecture received a 2008 Esri Special Achievement in GIS Award for promoting GIS.

To make it easy for all departments to acquire GIS technology, the university purchased an Esri ArcGIS site license with all extensions in 2006 and offered an orientation seminar to introduce students to GIS and its practical applications. The same year, the School of Medicine hosted the First International Symposium on Applications of GIS in the Fields of Medicine and Public Health. The symposium sought to raise interdisciplinary, local government, and public awareness of GIS in the Niigata community. It also introduced a model for public-private collaboration in the use of GIS in health.



This map of degree of housing damage was made of the disaster site in Kashiwazaki City.

The following year, the university established two technical instruction centers, one for human health GIS and the other for environment and disaster mitigation GIS. Courses combine selections from the Esri Virtual Campus course series with applied research work. As a result, students and researchers began using GIS in investigations of infectious disease, medical facilities usage, cancer, and suicide. International outreach programs initiated GIS epidemiology research projects in Zambia and Vietnam.

At the Second International Symposium, researchers and academics from China, Korea, and Russia spoke. Conference presentations increased awareness and shared knowledge about GIS applications in health, disease control, and environmental health activities in these countries. They also encouraged discussions on how to optimize workflows such as information gathering, visualization, and evaluation.

In less than three years, the school has established a health GIS teaching and research program with an international scope and a collaborative approach. In 2007, Esri presented Niigata University with the Esri Vision Award for its achievements in going beyond the traditional use of GIS within a health or human services organization.

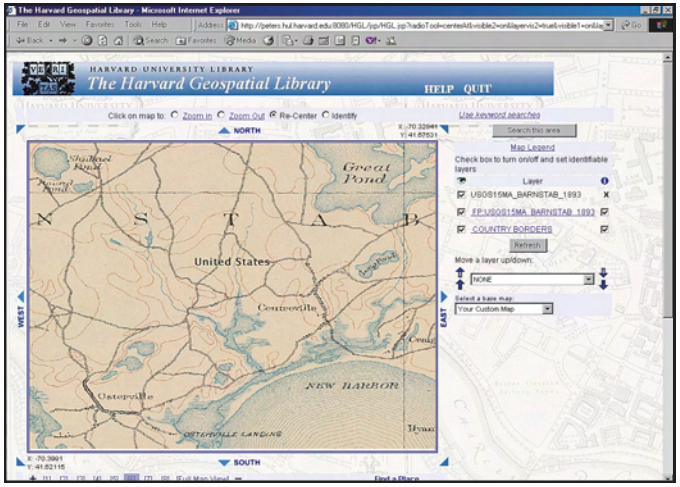
(Reprinted from the January 2009 issue of *ArcUser*)

Expanding Access to Large Geospatial Repositories

Harvard University's Geospatial Library and Center for Geographic Analysis

By Bonnie Burns and David E. Siegel, Harvard University

A university environment exerts particular pressures on the campus GIS infrastructure. The users' experience levels range from complete novice to expert. Data requirements are just as varied. Urban planning students need building footprints, social scientists need census demographic information, and environmental studies concentrators need global elevation and land cover. Finally, the types of tasks being performed run the gamut from simple cartography to complex modeling and analysis. Meeting these needs demands flexibility in data collections, user support, and data access.



HGL is a catalog and repository of geospatial data that contains georeferenced historic maps, vector data, and satellite imagery.

The Harvard Geospatial Library (HGL), a catalog and repository of geospatial data that contains georeferenced historic maps, vector data, and satellite imagery, is continually being expanded and enhanced. It has been identified as the foundation of a university-wide platform that supports all areas of teaching and research using geospatial analysis.

Faced with the expectations of a diverse user community, all aspects of the system must be extended to a broad array of applications and services without abandoning the library's roots. The Center for Geospatial Analysis (CGA) at Harvard has been tasked with synthesizing data from different sources, such as the Harvard MIT Data Center; providing community and user-specific interfaces to the repository; and capitalizing on open communications protocols. Enhancing existing access capabilities and developing new ways for client interaction are the center's top priorities.

While most GIS activities on campus are decentralized and handled by individual schools or departments, HGL is available to the entire university community and the public. HGL, supported by the Harvard Map Collection and the Harvard University Library, maintains 5,000 data layers such as global ecoregions; historic maps of the United States; and building footprints for the city of Boston, Massachusetts. Users can locate data by searching Federal Geographic Data Committee (FGDC)-compliant metadata using geography or text strings. This metadata is created by a library cataloger. Once located, relevant datasets can be displayed together in the browser or downloaded and clipped to an area of interest.

In this environment, CGA was created. A part of the Institute for Quantitative Social Science, CGA is now a much-needed centralized home for GIS activities on campus. CGA staff provide help desk-style support as well as consultation on longer-term projects for researchers without dedicated GIS staff in their departments. They are also researching ways to spatially enable large social science data repositories on campus. The creation of CGA has generated new demands on HGL, which is the campus data distribution infrastructure. In a time of limited resources, HGL's challenge has been to meet those demands and expand access and functionality while continuing its commitment to creating high-quality metadata and providing persistent access to historical data.

Persistent Custom Map Services

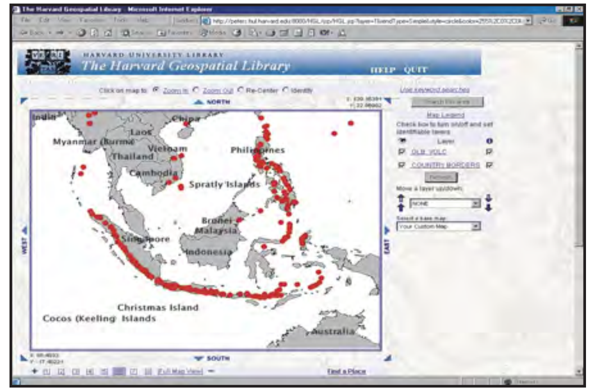
From the beginning, HGL has allowed users to create custom map services from the layers in the repository. Users can select multiple layers from search results lists, and HGL will create an ArcIMS map service of those layers and display it within the Web browser using a customized JavaServer Pages (JSP) viewer. Requests have been made for added functionality that would let users access those services from within ArcGIS Desktop and have those services persist for a specified length of time. This would provide read-only access to data through a Web service without downloading shapefiles. One of the main areas where this is very useful is in teaching labs.

A teaching fellow or instructor can preselect relevant data and create an ArcIMS service in HGL so students can access the service in class. This provides all students with the same layers at the same time and eliminates the need to install the data locally either on PCs or on department networks. It also ensures that the students in the class are working with the right data. Users can also create individual ArcIMS services, access data through ArcMap, and avoid downloading large files. This also eliminates the need for HGL to manage many user names and passwords for direct connections to the ArcSDE instance.

The main drawback to this solution is the limited cartographic options allowed by ArcIMS. The solution to this limitation is to implement an ArcMap service. Another drawback is the need to determine who is allowed to create services. Should it be limited to instructors and teaching assistants or open to anyone in the Harvard community? Services containing large datasets can eat up system resources. If many users start up many services, it could impact performance.

Direct Connections to the Repository

Another step in providing more open access to the data in HGL was to allow direct connections to the data repository, bypassing the Web interface and the download mechanism. Staff at CGA had a need for read-only access to the same datasets repeatedly for display or as a starting point for data extraction or analysis. The HGL data repository is an SDE instance running on top of Oracle, and the simplest solution was to create a read-only account for the CGA staff that let them connect directly to SDE. They were given a user name and password and all the necessary connection information. This provided them with the access they wanted, but there are drawbacks to this type of solution. A direct connection to ArcSDE lists all the layers in alphabetical order. Once an instance holds more than a hundred or so layers, navigating becomes difficult and browsing the list can be slow. In addition, there are limits to the number of characters that can be used in an SDE layer name, which leads to some fairly cryptic entries. Naming conventions are helpful, but a user needs to be very familiar with the database to really be able to use a direct connection effectively.



Users can select multiple layers from search results lists, and HGL will create an ArcIMS map service of those layers and display it.

There are things that can be done to make this a more useful and open method of access. First of all, creating layers as feature classes within a geodatabase allows for longer file names, which can alleviate part of the problem. Another solution to be implemented is the development of a search/browse tool within ArcMap that helps users identify the data they want by searching the HGL metadata schema.

Alternative Web Mapping Services

A third area where users have been requesting added functionality is in providing Web maps outside the HGL front end. Many collections and museums on campus want to provide interactive mapping within their Web pages but don't want to have to manage all the data, software, and hardware associated with a Web mapping server. The investment in the HGL infrastructure will be leveraged to serve maps to clients using open standards such as the Open

Geospatial Consortium's Web Map Service (WMS) and Web Feature Service (WFS). Simple viewer code will also be provided to client departments that will allow them to implement (as is or with improvements) within their own Web pages.

As an example, the Milman Parry Collection at Harvard is a unique repository of South Slavic and Balkan oral traditions. It owns many valuable recordings of songs and stories collected in the 1920s and 1930s throughout the Balkan region, and each recording is tagged with the location where it was made. The notes and interviews that accompany each recording allow researchers to trace the interesting spheres of influence in the region over time. Curators of the collection would like to allow visitors to the Web site to plot on a map the location of any particular recording from their online database. Users could then display other data related to contemporary political boundaries or linguistic or religious boundaries, depending on their interests.

Client departments will be responsible for creating any additional data layers that are to be used in the maps such as the political boundaries in the Milman Parry Collection example. These layers will be added to the HGL data repository and distributed in the same way as all other layers, thus increasing the HGL collections and the visibility of the new layers. Clients will also be responsible for setting up the service on HGL and implementing the WMS client code within their own design.

Sharing Metadata

In addition to improving access to the data in the HGL repository, another goal is sharing metadata within the catalog as much as possible. The HGL project staff includes a geospatial resources cataloger. HGL has built a strong catalog of FGDC Content Standard for Digital Geospatial Metadata (FGDC-STD-001-1998)-compliant documentation. This metadata is available to the public, even though the data is not available through the Web interface. This catalog of FGDC records could be used by other libraries for copy cataloging or searched by other GIS portals to help users from around the world locate interesting and useful data.

There are many protocols for sharing the metadata catalog. HGL currently has some federated cross-catalog searches enabled across various library catalogs. Users can simultaneously search the HOLLIS catalog, the Harvard online library system; the Visual Information Archive (VIA); the Online Archival Search Information System (OASIS), a database of finding aids for manuscripts; as well as HGL. In the future, the HGL catalog will be opened to Z39.50 federated searches *[portal-based searches that use the Z39.50 client server protocol for searching remote databases and retrieving data]* and Open Archives Initiative (OAI) harvesting of the catalog. Other databases at the university have already implemented OAI harvesting on their systems, and HGL is working with those groups to identify holdings that can be spatially enabled and whose metadata could usefully be stored in the HGL database.

To maintain maximum flexibility while still adhering to standards, all FGDC metadata files are stored complete within a single column in a single Oracle database table. Using Oracle interMedia indexing allows simplification of search syntax while allowing explicit searches for specific tags in a document. The next step is to explore using XML Path Language (XPath) instead of interMedia and XMLTypes instead of character large objects (CLOBs).

Conclusion

Through a variety of strategies, HGL is adapting to the new demands that have arisen from a more GIS-literate community. CGA is increasing awareness of the power of geospatial analysis at a university that hasn't had a geography department for 50 years. This increased awareness can only benefit the community. HGL's challenge is to keep up with the needs of this new group of users and make finding and accessing data as easy and flexible as possible.

About the Authors

Bonnie Burns is the GIS coordinator for the Harvard Map Collection, part of the Harvard College Library, a position she has held since 1999. She began her career with the National Conference of State Historic Preservation Officers, working closely with the National Park Service using GIS to aid in the preservation of cultural and natural resources around the country. Her professional interests include the application of geographic analysis techniques to questions of historic research and landscape preservation.

David E. Siegel joined the Harvard University Library, Office for Information Systems, in 2000 as a geospatial data and informat,ion software engineer. In 2006, he began sharing his time with the Center for Geographic Analysis where he consults on several projects and institutional initiatives. His professional interests include developing Web mapping solutions for discovering and delivering geospatial data.

(Reprinted from the April–June 2007 issue of *ArcUser*)

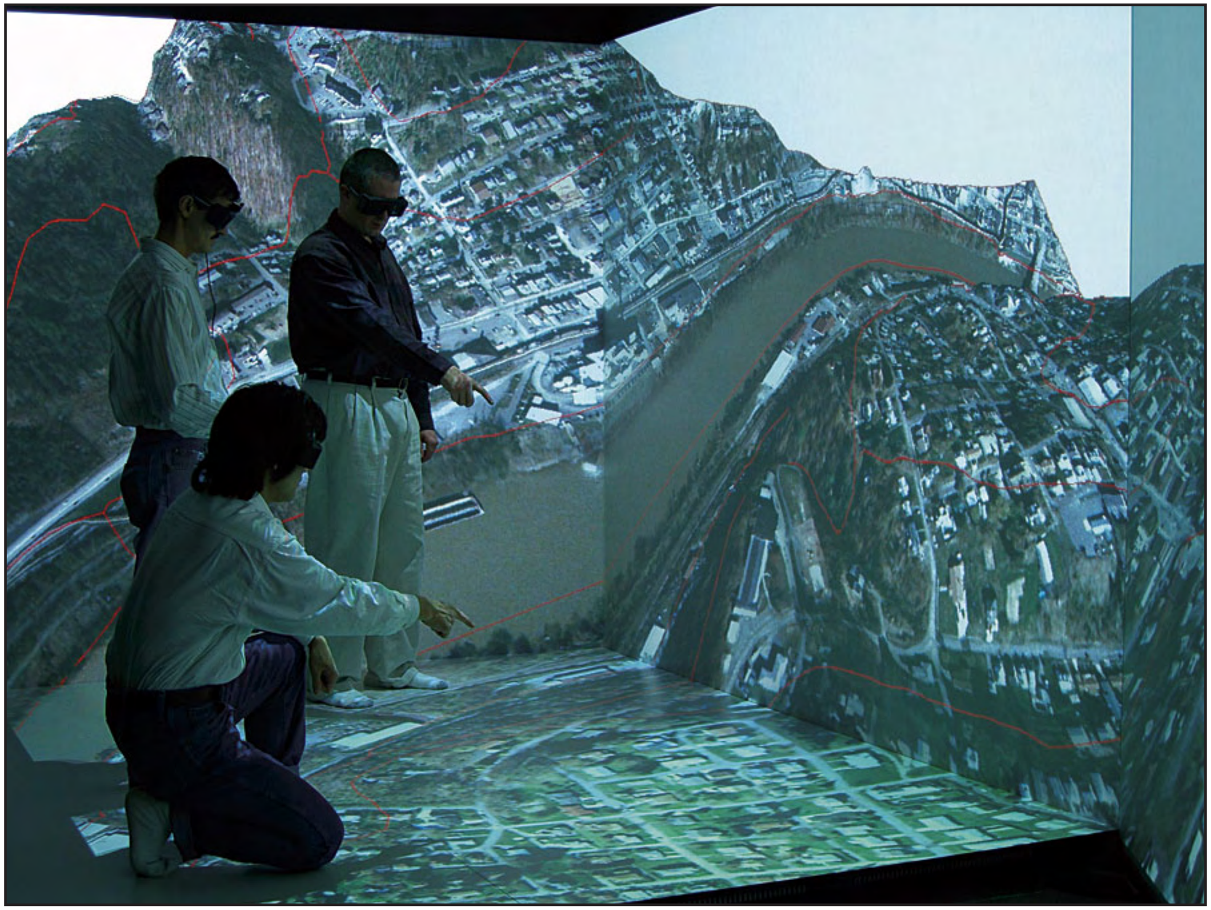
Immersive Visualization System Promotes Sense of "Being There"

Using GIS, West Virginia University Provides New Tool for Researchers and Analysts

Geovisualization has always been critical to GIS. The focus on digital maps as the mainstay of cartographic representation has, of course, now been extended considerably to include contemporary Web-based mapping technologies, which are predominantly two dimensional. Now multidimensional geobrowsers, including ArcGIS 3D Analyst software's ArcScene and ArcGlobe applications, present the data in a form that assists users in the interpretation of the available information in a more intuitive and innovative manner. Simultaneously, the browsers offer interactive and dynamic navigation tools that greatly facilitate rapid data exploration. These trends have been augmented through initiatives led by Dr. Trevor Harris and D. Vic Baker in the Department of Geology and Geography at West Virginia University (WVU) by the addition of state-of-the-art immersive technologies and the coupling of GIS with these powerful visualization technologies.

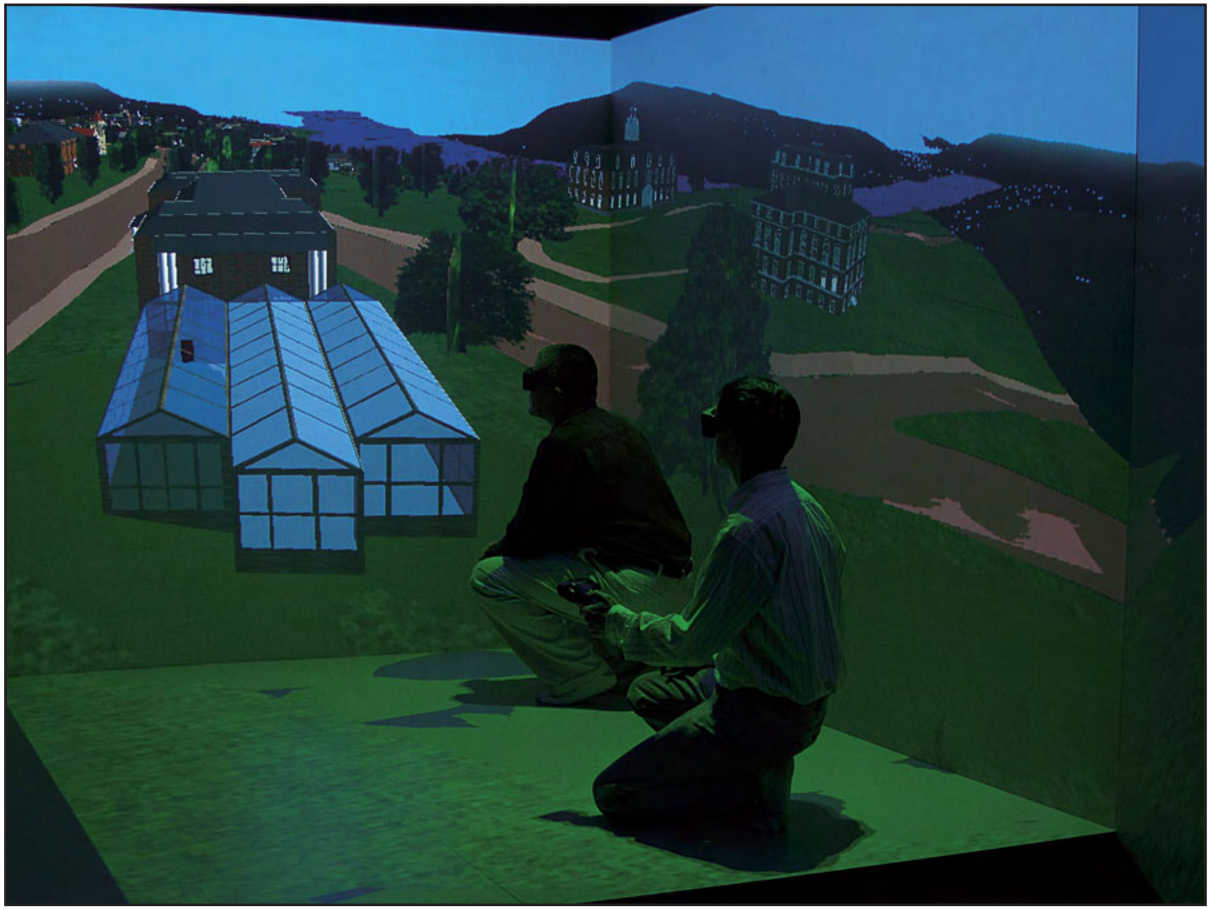
In August 2006, the GeoVirtual Laboratory (GVL), housed within the Department of Geology and Geography at WVU, working with Mechdyne Corporation (Marshalltown, Iowa) subsidiaries Fakespace Systems Inc. (Marshalltown, Iowa) and Esri Business Partner VRCO Inc. (Virginia Beach, Virginia), completed the installation of a four-wall stereoscopic immersive visualization system. Called the FLEX VR system, this is a room-sized interface consisting of rear-projected front, left, and right walls and a ceiling-mounted floor projection. The FLEX VR system (commonly referred to as a CAVE) utilizes head tracking and orientation sensors, as well as shutter glasses that work in tandem with the stereoscopic projection system and cluster computing to provide the user with total visual immersion.

The FLEX VR system is the world's first commercial, reconfigurable visualization solution for users whose viewing, collaboration, and presentation requirements could not be met within the confines of a single, fixed visualization environment. Its innovative hinged wall design allows a single person to quickly reconfigure the space as a long, flat wall display, an angled immersive theater, or an immersive room. As part of the installation, VRCO Inc. linked ArcGIS 3D Analyst extension's ArcScene and ArcGlobe applications to its Conduit middleware that enables desktop applications to operate natively on PC cluster computers and within large-scale virtual reality environments, without any change to the desktop application.



Visualizing information using the FLEX system allows for immersion in the scene and new collaborative opportunities.

Now with ArcGIS 9.2, ArcGIS Explorer, and ArcGIS Server, integration of immersive visualization is evolving to allow for better and more rapid spatial analysis and interpretation within a collaborative virtual environment.

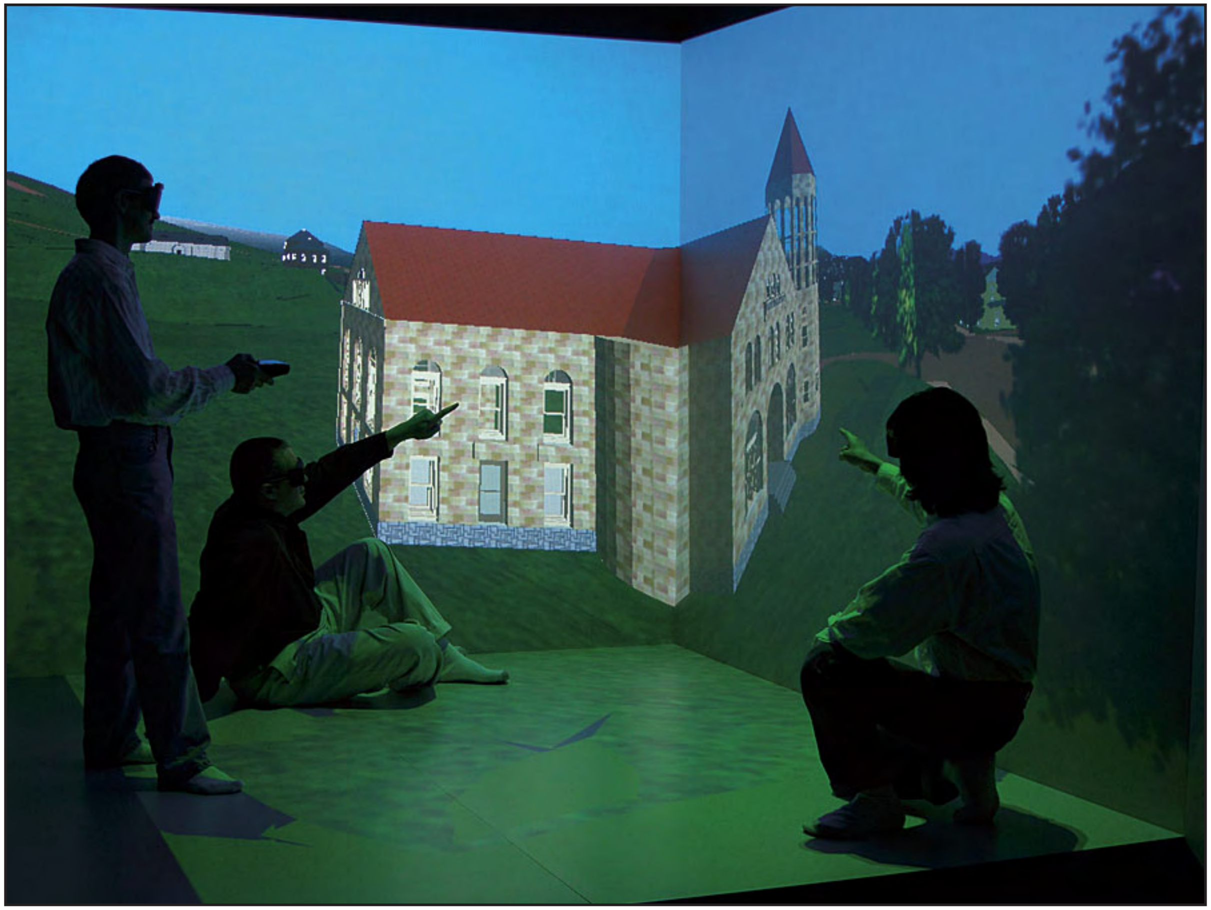


Researchers using the FLEX VR system.

Researchers at WVU are now taking full advantage of the advanced immersive and interactive display capabilities provided within the system. Proprietary spatial software has been written to work within the FLEX VR system, yet having access to Esri's commercially available software enables rapid development of GIS visualization content. Furthermore, users across the WVU campus are able to generate content without the need for direct access to the system. Interaction with the spatial data in the immersive environment is very intuitive. A wireless motion-tracking system monitors the user's position and changes the on-screen images in real time to maintain proper viewing perspective. Navigation through the data scene is accomplished effortlessly using a wireless, handheld virtual wand.

The team is currently exploring new research areas using the FLEX in a variety of topics, such as forensics, low vision, historical and archaeological reconstructions, architectural design and review, education, and geovisualization. The team is focusing on integration of mobile technologies and the FLEX system to provide seamless communication and data sharing between the FLEX, desktop users, and mobile clients.

The vision of the GeoVirtual Laboratory is to pursue research that draws extensively upon the tight coupling of the spatial analytic capabilities of GIS with the powerful visual and immersive capabilities provided through the FLEX display system. The unique experiential nature of the immersive display system and the feeling of "being there" and immersed in the data scene provide powerful insights into complex spatial data and landscape forms. Examining the viewsheds and potential visual intrusion of cell towers or electrical transmission lines becomes so much more powerful when explored by users immersed in the virtual landscape and able to navigate freely through the landscape as if in a helicopter. Similarly, re-creating historic landscapes and historic urban centers using a combination of historic maps and photographic evidence is relatively easily achieved and displayed in the FLEX such that users may immerse themselves in the three-dimensional scene and interactively access data through the GIS interface. Such capabilities are a long way from the traditional two-dimensional map. Furthermore, the immersive space supports multiple users simultaneously and provides a powerful collaborative decision-making environment that is immersive, dynamic, and interactive and a long way from the single screen display of most GIS users.



Researchers examine a FLEX VR environment.

Utilizing commercial off-the-shelf applications with advanced visualization displays, it is possible to shift time and focus from the development of proprietary applications to the creation of rich content, dynamic interaction, and a powerful interpretive environment.

(Reprinted from the Winter 2006/2007 issue of *ArcNews*)

GIS for Higher Education: Administration

Introduction

Centralized database management and GIS work together to provide a cost-effective way to deliver high-quality data and deployment options for faculty, students, and administrators in every department on campus. Campuses benefit from using GIS for student recruiting, alumni tracking, emergency preparedness and response, facilities management, and campus mapping. For example, facilities managers can make better use of campus resources by using GIS to determine room capacities, schedule availability, and maintain infrastructure. Schools can also serve campus maps publicly on the Web or via an intranet.

Going Green at Pomona College

The "College in a Garden" Performs Comprehensive Audit of Energy Systems Using Spatial Data

Highlights

- ArcGIS provides a comprehensive approach for one million square feet of facilities including 60 buildings.
- Student auditors used map books created from ArcGIS for a more accurate field assessment.
- Area calculations were performed on spatial data captured in the geodatabase.

Pomona College is the founding member of the Claremont Colleges, a unique consortium of seven affiliated institutions that also includes the Claremont Graduate University, Scripps College, Claremont McKenna College, Harvey Mudd College, Pitzer College, and the Keck Graduate Institute of Applied Life Sciences. Pomona College, located in Claremont, California, had a vision to be "a college in a garden" from its inception in 1887. Today, ivy and palm trees coexist under the warm, sunny skies of Southern California.

The college is committed to sustainability. Recently, it built three buildings to Leadership in Energy and Environmental Design (LEED) building standards. One of those, the Richard C. Seaver Biology Building, was awarded a Silver LEED certificate, placing it in the top 1 percent of all academic laboratory buildings in the country in terms of energy-conscious design.

In 2007, Pomona College president David Oxtoby signed the President's American College and University Climate Commitment, an agreement that commits Pomona College to a variety of deadlines and programs for moving toward carbon neutrality. One of the first milestones was to conduct a campus-wide greenhouse gas inventory. Pomona College expanded the inventory to include a holistic range of sustainability and tied it to the academic mission of the college. The college worked with Esri Partner CTG Energetics, Inc., based in Irvine, California, to develop an innovative approach to the inventory. CTG trained and coordinated a team of six students who spent most of the summer conducting the inventory. At the end of the audit, the college hired its first director of sustainability to ensure that the college continues to move toward a greener future.

A Central Repository for Data Collection

The college maintains a site license of Esri software and used ArcGIS as the central data repository and analysis platform for significant portions of the audit, including landscape water use, embodied greenhouse gas emissions, green waste generation, storm water management, and on-site renewable energy potential. An aerial topographic survey, producing an accompanying aerial image of Pomona College, was performed in 2006 and saved in CAD file format. The CAD file was processed in AutoCAD to hide all the layers except the key landscaping elements that were required. The file and accompanying image file were then imported into ArcGIS and Microsoft Access and digitized by a student with prior class experience using the software. The result was a detailed geodatabase of Pomona's landscaping, including layers for building footprints, roof sections, streets, sidewalks, hardscape, landscape zones, and tree canopy.

Once the area was digitized, including 60 buildings and one million square feet, the audit team, consisting of six students, used the digital map data to create customized landscape audit forms that characterized Pomona College's landscape and identified irrigation and storm water conservation opportunities. Map books consisting of ten 11" x 17" pages reflecting the different zones of the college were used to assist with collecting the information accurately. Data from the field surveys was entered into the geodatabase.

Members of the Pomona College audit team.

Data on the number of roof segments, including slope, orientation, roofing material, and shading; parking lots; and other information, was also captured on the audit forms. This was later used to calculate solar energy generation potential on rooftops and parking lots; irrigation water use; water conservation measures, including "California-friendly" landscaping; and storm water management measures, such as permeable paving, green roofs, and other low-impact development (LID) strategies.

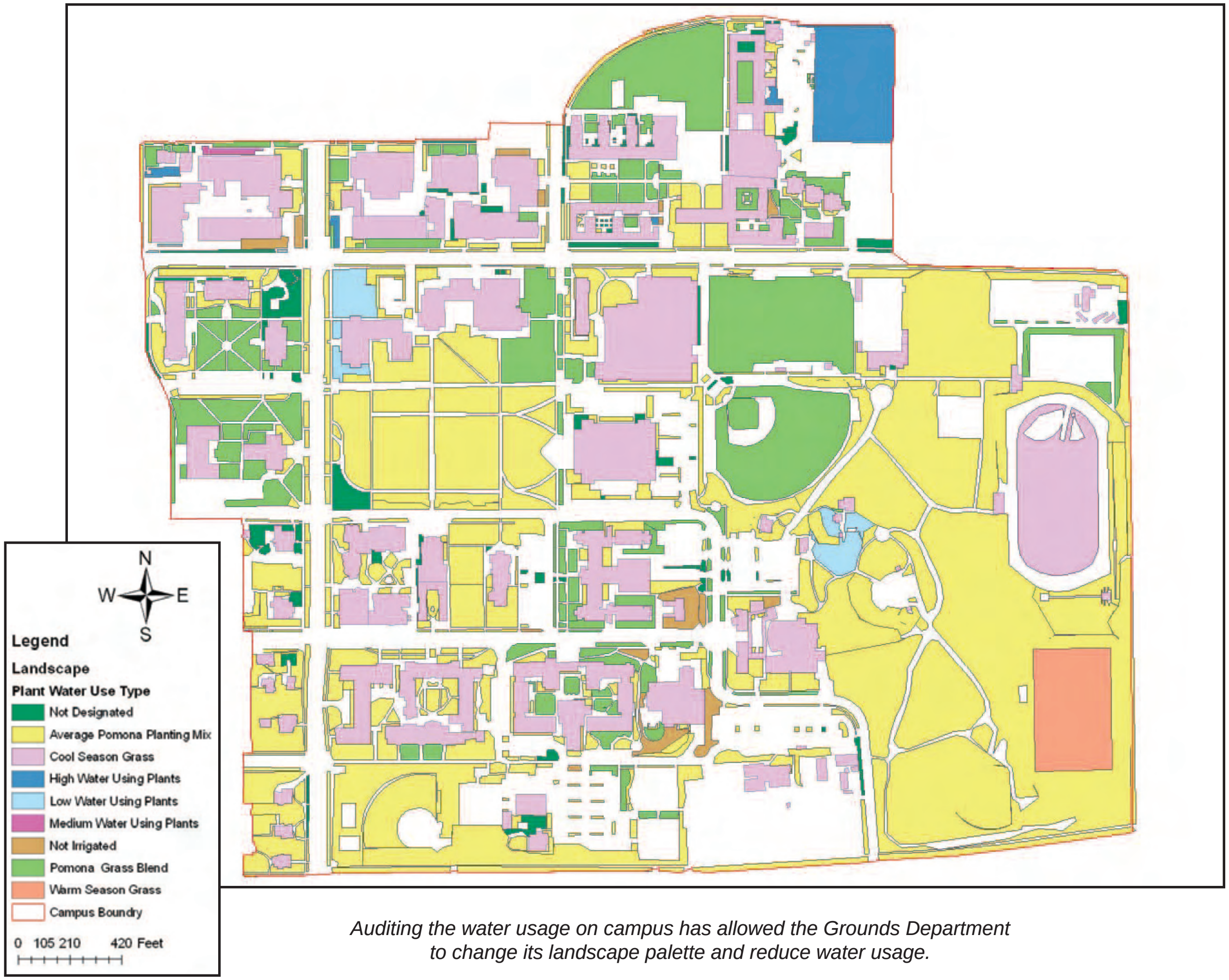
Translating Book Knowledge to the Real World

CTG provided background training sessions to introduce the student auditing team to the basic issues, technology, and auditing processes for each sustainability issue. The training sessions were held both indoors and outdoors and took two to four hours. This helped ensure data quality and consistency.

CTG and the audit team also visited various campus sustainability examples and LEED-rated green buildings—the Richard C. Seaver Biology (Silver certified) and the Lincoln and Edmunds Buildings (Gold certified), Pitzer's new LEED-rated dorm, and Harvey Mudd's LEED-rated Hoch Shanahan Dining Hall. The team examined the low-water-use landscape features of these buildings, as well as storm water measures and other relevant green building features. Permeable paving, low-water-consumption plant palettes, efficient irrigation systems, landscape shading, and building energy impacts were all examined. This direct experience of sustainability measures aided the student auditors in identifying appropriate areas for additional applications as they conducted their field surveys.

Once the training was complete, the students fanned out across the campus to conduct the auditing fieldwork and entered the results into audit forms. The GIS database was then updated to reflect changes on the ground identified by the audit team. The geodatabase and supporting data were used to analyze current resource use, including current landscape irrigation requirements and estimated storm water runoff, then analyze a range of sustainability measures and on-site renewable energy potential.

"Using GIS allowed us to perform the survey in a more efficient way," says Jon Roberts, PhD, principal consultant, director of building sciences, CTG. "There was a tremendous amount of data that we were able to process and use to make informed decisions that we couldn't have done any other way."



Auditing the water usage on campus has allowed the Grounds Department to change its landscape palette and reduce water usage.

Findings on Campus

According to the survey results, the campus should continue to move toward a California-friendly landscaping palette, which includes water efficient, drought-tolerant plantings; increased use of permeable hardscape, such as mulch; and reduction of the use of turf grass.

The Grounds Department used the information found by using ArcGIS to identify areas for changing landscape plant choices and irrigation technology. Since the completion of the audit, the department has

- Reduced water days on all landscaped areas by one day
  - Reduced the water schedule on planter beds to two days/week
  - Reduced watering of turf areas to four days/week (excluding newly planted areas)
- Changed 5,148 square feet of shrub area from spray irrigation to drip
- Changed 1,705 square feet of turf to mulch
- Changed 21,179 square feet of shrub area to mulch
- Changed 1,428 square feet of turf to shrubs with drip irrigation
- Changed 1,641 square feet of ground cover to mulch

"Using GIS to view and analyze this vast amount of data had a significant impact all the way around," says Bowen Close, LEED Accredited Professionals, director, Sustainability Integration Office, Pomona College. "Incorporating spatial data into our audit was very helpful; we could calculate areas that we wouldn't have had time to solve by hand otherwise."

Providing a mechanism for everyone to view the campus data and analyze energy use introduced a systems-based approach to the analysis. "I'm starting to see others view GIS as a critical tool for collecting sustainability data," says Roberts. "Seeing the various meters, such as energy and water meters, and knowing which buildings feed which data is so much more organized and efficient than having to take file cabinets full of data and organizing it."

(Reprinted from the Winter 2010/2011 issue of *ArcNews*)

Taking Efficiency to the Next Level at City College of San Francisco

ArcGIS Server Based Central Repository and Accessibility for Facilities Management

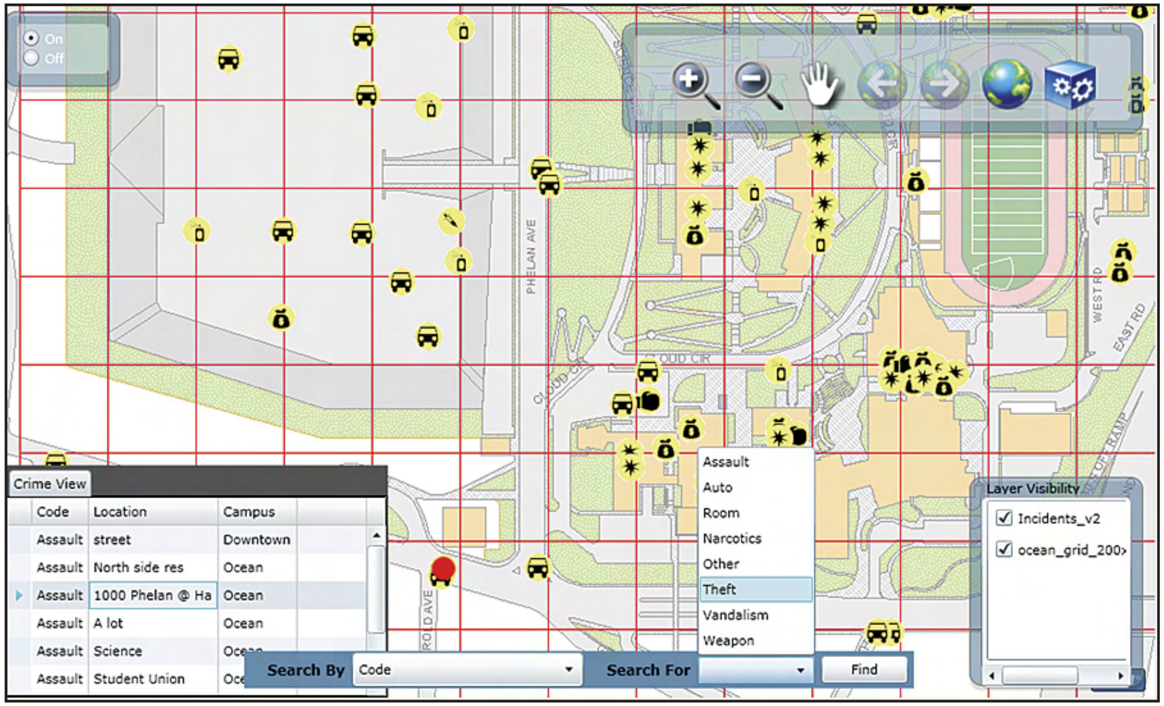
Highlights

- The ArcGIS Server built-in AJAX capability makes it easy to manage and deploy.
- Web applications were created on top of GIS for building cross-browser and cross-platform Internet applications.
- With its Esri campuswide site license, CCSF employed existing GIS-knowledgeable staff.

Attended by more than 100,000 students each year, City College of San Francisco (CCSF) maintains and uses 300 facilities spread across 11 campuses in the City of San Francisco, California. People of diverse backgrounds, ages, and occupations have attended the college since its founding in 1935. CCSF is one of the largest community colleges in the country, and the college confers the most associate degrees in arts and sciences in the state of California.

College facilities are managed by two departments: Facilities Planning and Buildings & Grounds. Traditionally, these departments relied on senior engineers and personnel to maintain facility information, which was shared through paper plots or word of mouth. Some existing paper floor plan plots were digitized a decade ago for general reference, but records of maintenance and upkeep of buildings remained firmly entrenched in paper-based methods.

Although recent construction of several facilities introduced the use of computer-aided drawings, both departments lacked a system to easily manage and disseminate the data. This resulted in challenges when gathering information; time was lost searching for data and determining if it was up-to-date. The ability to decipher how many and where assets existed was difficult. The attrition of personnel was also a concern as valuable institutional knowledge was lost when staff members retired. Newly hired staff required a lot of time to learn about the facilities.



CCSF's campus crime application locates incidents using a grid across the grounds and can be queried by campus, crime type, and date.

Seeking a System for Data Sharing

CCSF needed a centralized and flexible system to help organize and deliver facility information. Part of the system needed to assist the college with correctly identifying the current level of physical accessibility in all classrooms and buildings according to the Americans with Disabilities Act (ADA). This required the collaboration of several additional departments across the campus to deliver all the information on a publicly available online Web service.

After reviewing many software packages for functionality and ease of programming, CCSF chose ArcGIS Server. Says Mono Simeone, project manager, CCSF GIS Mapping Collaborative, "The software's scalability, performance and stability, enterprise capability, and built-in AJAX capability make it easy to manage and deploy."

CCSF facility management staff contracted with i-TEN Associates, Inc., an Esri Business Partner located in Berkeley, California, which had previously digitized CCSF's facility data and made it accessible on an internal Web site.

Several departments, including Facilities Planning, Buildings & Grounds, the Campus Police, and Information Technology Services, and the American Disabilities Act and Health and Safety committees worked together to create the system. Now GIS server technology stores, manages, and displays facility and grounds data in a central repository for everyone to use.

From Paper to Empowerment

First, the team applied a data model to interior spaces or floor plans. ArcGIS Server, using an Oracle relational database management system (RDBMS), stores, edits, and displays the descriptive and spatial data accessible through a simple interface for both secure and public Web sites. Next, the team created Web applications with ArcGIS API for Microsoft Silverlight, an API for building cross-browser and cross-platform rich Internet applications on top of the GIS. The Web applications serve data for use throughout the college. "The creation of the applications was very straightforward," notes Simeone.

The first application provides access to ADA information at all campuses in the district. It displays features necessary for persons with mobility issues to navigate the campuses. These features include path of travel, parking for the disabled, accessible entrances, and elevators. The application offers several queries to find buildings, rooms, student services, and staff on campus. The result is a map with helpful features for navigation and a report on the room with a picture. The next iteration of the application will implement a routing service using ArcGIS, which provides point-to-point and optimized routing.

City College of San Francisco is spread across 300 facilities on 11 campuses.

This successful application led to more meetings with campus staff from Facilities Planning and Buildings & Grounds. There was a lot of interest in viewing utilities campuswide, including identifying individual features. An application was developed allowing staff members to use a secure intranet site to display all underground and some surface utilities. "This was the first time we have been able to view all the utility assets at one time," says Simeone.

CCSF also has a campus crime application that allows incidents to be queried by campus, crime type, and date. Incidents within buildings are easily located using a unique space identifier from the GIS. However, incident locations occurring outside buildings are captured using a grid, or mesh, that covers the entire campus. Future plans include the development of a Web-based map service tool to capture x,y coordinate locations of incidents.

GIS Exceeds Expectations

Since the college maintains an Esri campuswide site license, CCSF was able to add new GIS seats and employ existing GIS-knowledgeable staff. Both of these factors made the application implementation easy and economical.

The system now allows data to be centrally stored for more efficient management and sharing. Staff and administrators are able to view and query the facility data at any time from all over the CCSF campus. Departments can tailor a map service to meet their needs, and data can be updated and served to staff or the public in a timely manner.

This implementation of GIS for facility management has exceeded the goals created by the college. CCSF hopes to introduce GIS and facilities management as even bigger parts of how the college operates, manages its assets, and serves the community in the future.

(Reprinted from the Spring 2010 issue of *ArcNews*)

Making Louisiana State University a Storm Disaster-Resistant School

Public Safety Mission Chooses GIS

By JoAnne Castagna, U.S. Army Corps of Engineers

Highlights

- ArcGIS Desktop enables the staff to work in personal and file geodatabases.
- GIS-based maps enable the school to assess emergency situations more quickly.
- GIS is very useful where many different agencies converge on a scene.

As students begin a new semester at Louisiana State University (LSU), Baton Rouge, Louisiana, the school's security office takes a new course of action to keep its college community safe from damage from future hurricanes, like Katrina, with the assistance of the U.S. Army Corps of Engineers (USACE). The corps is working with the school to create GIS maps to make Louisiana State University a storm disaster-resistant school.

LSU wasn't damaged by Katrina, but the university still remains vulnerable to future hurricane damage due to its proximity to the Gulf region. Louisiana is a coastal state that faces possible threats from hurricanes and tropical storms year-round and especially during hurricane season.

The Pete Maravich Assembly Center is a large indoor basketball arena on the LSU campus that was used as a medical special needs shelter in the aftermath of Hurricane Katrina. (Credit: Jim Zietz, LSU Public Affairs.)

LSU is like a city within a city, and the corps is mapping the 2,000-acre campus using GIS so that when a disaster occurs, the university will have maps electronically available to help guide personnel through the emergency situation and save lives.

"The main function of these GIS-based maps is to save lives by reducing the amount of time it takes for emergency personnel to assess a given situation," says Keith Koralewski, hydraulic engineer, USACE, Buffalo District, who provided GIS services for various operations in Louisiana.

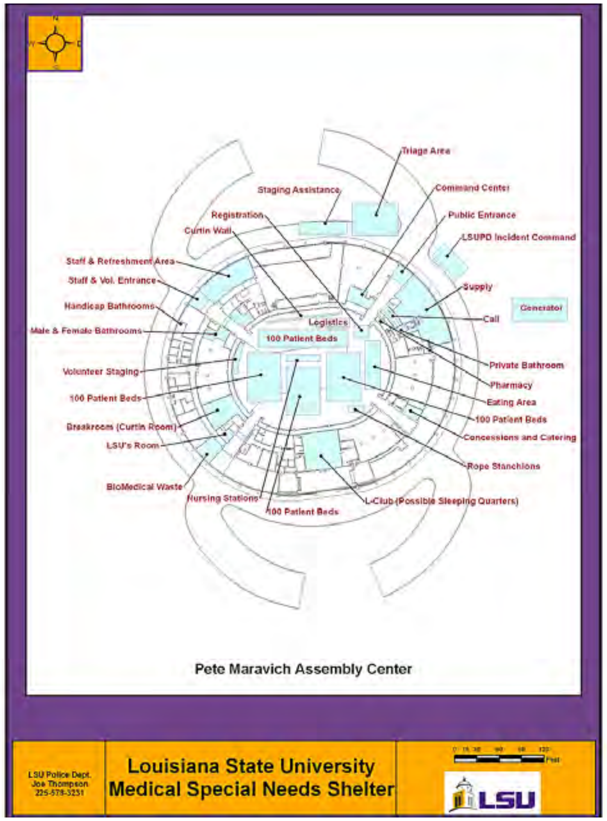
The team linked building information into the school's safety database, including building names, number of rooms, classroom numbers, room layout, square footage, and professors' names and phone numbers.

"If an emergency occurs in a particular building," says Koralewski, "they could pull up the GIS map, click on the building to see where the emergency exits and fire extinguishers are, and be able to contact professors or other personnel who are normally in that area of the campus. If a certain area of the building is damaged, this info can provide them with an idea of who may be trapped."

The GIS software of choice for both the university and the USACE is ArcGIS Desktop.

"We are using this program because this is the system in which our customer, LSU, wants the data delivered," says Roger W. Porzig, Jacksonville District, USACE. "LSU security is already running ArcGIS Desktop, so it was natural to use this platform to structure and deliver the data."

Joe Thompson, police officer, LSU Police Department, says, "If there is a fire in a lab, we



The Pete Maravich Assembly Center mapped out in GIS. The center is being prepped to be an improved medical special needs center in the event of future hurricanes. (Credit: Data provided by Joe Thompson, Police Officer, LSU Police Department and Graphics provided by Roger W. Porzig, Jacksonville District, U.S. Army Corps of Engineers.)

will be able to click on that room in the lab and see what chemicals we have presently in the lab, which is info we can provide to the fire department."

Thompson has GIS experience and works with the school's IT, IS, and emergency response systems. He worked with the USACE to map out one of the key buildings on the campus, the Pete Maravich Assembly Center, a large indoor basketball arena. The arena served as a medical shelter in the aftermath of Katrina for an influx of New Orleans residents with special medical needs. Now the school wants to better prepare it to serve as a special medical needs center in the event of another hurricane.

"I worked with the corps to digitize drawings of the arena in GIS to create electronic maps of the arena," says Thompson. "I also sat down with LSU's Department of Hospitals and Social Services to determine where beds and medicine would go in the shelter and where volunteers would be staged."

Josette Pullen, Cartographer, Honolulu District, U.S. Army Corps of Engineers and Joe Thompson, LSU Police Officer map out the university campus using GIS technology. (Credit: Brad Mooney, FEMA.)

He continues, "If a hurricane comes and that shelter is activated to start evacuating people with special medical needs, we basically have maps printed so that the employees working there know where and how to set up the beds, where to store the medicine, and where tables are set up so that we have a smooth operation that gets up and running quicker when we have that emergency response."

The ArcGIS software-based maps enable the school to assess the situation more quickly, as opposed to pulling out printed maps that may be obsolete, as roads, parking lots, and buildings may change over time.

Thompson created the arena maps with Josette Pullen, a cartographer with the USACE, Honolulu District.

Says Pullen of ArcGIS, "With this program, we were able to easily map out portions of the campus. It helps us figure out the projection of different data sources and reproject them to the desired project standard. It enables us to work in personal and file geodatabases. File geodatabases provided us with great capability to store all the project imagery because there are no size constraints. We used personal geodatabases to work with the GIS data. Not only does it facilitate loading attributes from other files easily through a matrix, but you can also open files through their Microsoft Access interface and manage the data. The geodatabase approach is very versatile. Also, these tools helped facilitate the conversion of CAD files into feature classes."

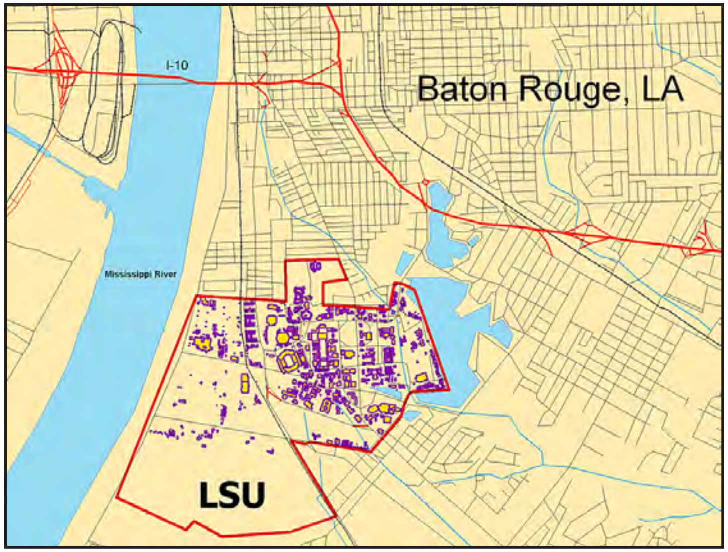
Map of Louisiana.
Credit: Roger W. Porzig, Jacksonville District, U.S. Army Corps of Engineers.

Thompson emphasizes, "Having an active campus so when you click on a building, you get the data behind it—this is what GIS is all about."

Stephen McDevitt, GIS national action officer with the USACE, New York District, is one of four national action officers responsible for deploying and managing GIS teams throughout the Gulf region to assist the Federal Emergency Management Agency (FEMA) and other agencies and volunteer organizations to help get the beaten region back on its feet.

"Getting these maps created swiftly and accurately is extremely important to this school because of its vulnerability to hurricanes," says McDevitt. "During a hurricane, these maps will enable the school's security force to rapidly access geospatial data that will help them assess problems that may arise with the school's infrastructure, which will ultimately protect LSU students and staff."

Rusti Liner, Geospatial Unit supervisor with FEMA, provided the USACE, LSU, and other agencies with resources and overall project management. She says, "Prior to the corps' development of GIS maps for the school, campus addresses were not available, and useful street data had not yet been developed. Simple package deliveries to the campus were major obstacles for staff and faculty. Due to the university's large population and its proximity to nearby rail and rivers, these data layers are vital to first responders."



Map of Baton Rouge, Louisiana.
Credit: Roger W. Porzig, Jacksonville District, U.S. Army Corps of Engineers.

"With GIS maps," says Koralewski, "one can update a map with new information immediately as opposed to paper maps, which may only be updated every couple of years or so. GIS is also very useful for situations where many different agencies may converge on a scene. The agency personnel may not know the area, so GIS maps provide a way for them to get familiar with the layout of the buildings and the campus."

USACE is providing planning guidance to LSU if a disaster hits, which will reduce vulnerability. This GIS system will also serve as a basis for a 911 system for the LSU campus.

Memorial Tower is a central feature of Louisiana State University's campus. (Credit: Jim Zietz, LSU Public Affairs.)

About the Author

Dr. JoAnne Castagna (Ed.D.) is a technical writer-editor for the U.S. Army Corps of Engineers, New York District.

(Reprinted from the Spring 2008 issue of *ArcNews*)

Since 1969, Esri has been giving customers around the world the power to think and plan geographically. The market leader in geographic information system (GIS) solutions, Esri software is used in more than 300,000 organizations worldwide including each of the 200 largest cities in the United States, most national governments, more than two-thirds of Fortune 500 companies, and more than 5,000 colleges and universities.

Esri applications, running on more than one million desktops and thousands of Web and enterprise servers, provide the backbone for the world's mapping and spatial analysis. Esri is the only vendor that provides complete technical solutions for desktop, mobile, server, and Internet platforms. Visit us at esri.com.

Contact Esri

1-800-GIS-XPRT (1-800-447-9778)
Phone: 909-793-2853
Fax: 909-793-5953
info@esri.com
esri.com

380 New York Street
Redlands, CA 92373-8100 USA

G45295
ESRI2/11ms