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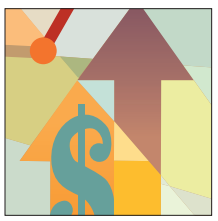
Integrated Models and Grand Challenges

By Michael Batty, Centre for Advanced Spatial Analysis, University College London



The term *model* has gained widespread currency in the last 25 years as computers have come to dominate our working lives. In this context, we use the term to describe some simplification of our system or problem of interest, which means that we extract and abstract the essence from the situation, developing structures that reflect processes that simulate how geographic systems have developed and evolved. In a sense, we throw away much of the problem and its system when we build a model, for there are strong limits on what we can

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Saudi Arabia Implements New Postal Code System Based on GIS Analysis

Saudi Postal Corporation (Saudi Post) is the government-operated postal service for the Kingdom of Saudi Arabia. In an effort to improve the efficiency of mail delivery services, Saudi Post decided to align the postal services with global standards. A key objective in doing this was to create a mailing and residential address system for the entire kingdom.

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ArcGIS API for iOS Now Available

Coming off a successful early adopter beta program, Esri recently released the ArcGIS API for the Apple iOS platform. ArcGIS API for iOS enables developers to build and deploy custom iPhone, iPod touch, and iPad applications. This API uses the powerful mapping, geocoding, geoprocessing, and editing capabilities that ArcGIS Server provides. It is designed to use Web services available from ArcGIS Server and ArcGIS Online. Users can access dynamic, tiled, and image map services; overlay graphics; search for and identify features; locate addresses; collect and update data; and perform GIS analysis. Users also have the ability to embed ArcGIS maps and tasks into their line-of-business applications. The API can now be accessed from the Esri Resource Center at no cost.

Students and faculty at the University of Oregon use the ArcGIS API for iOS.

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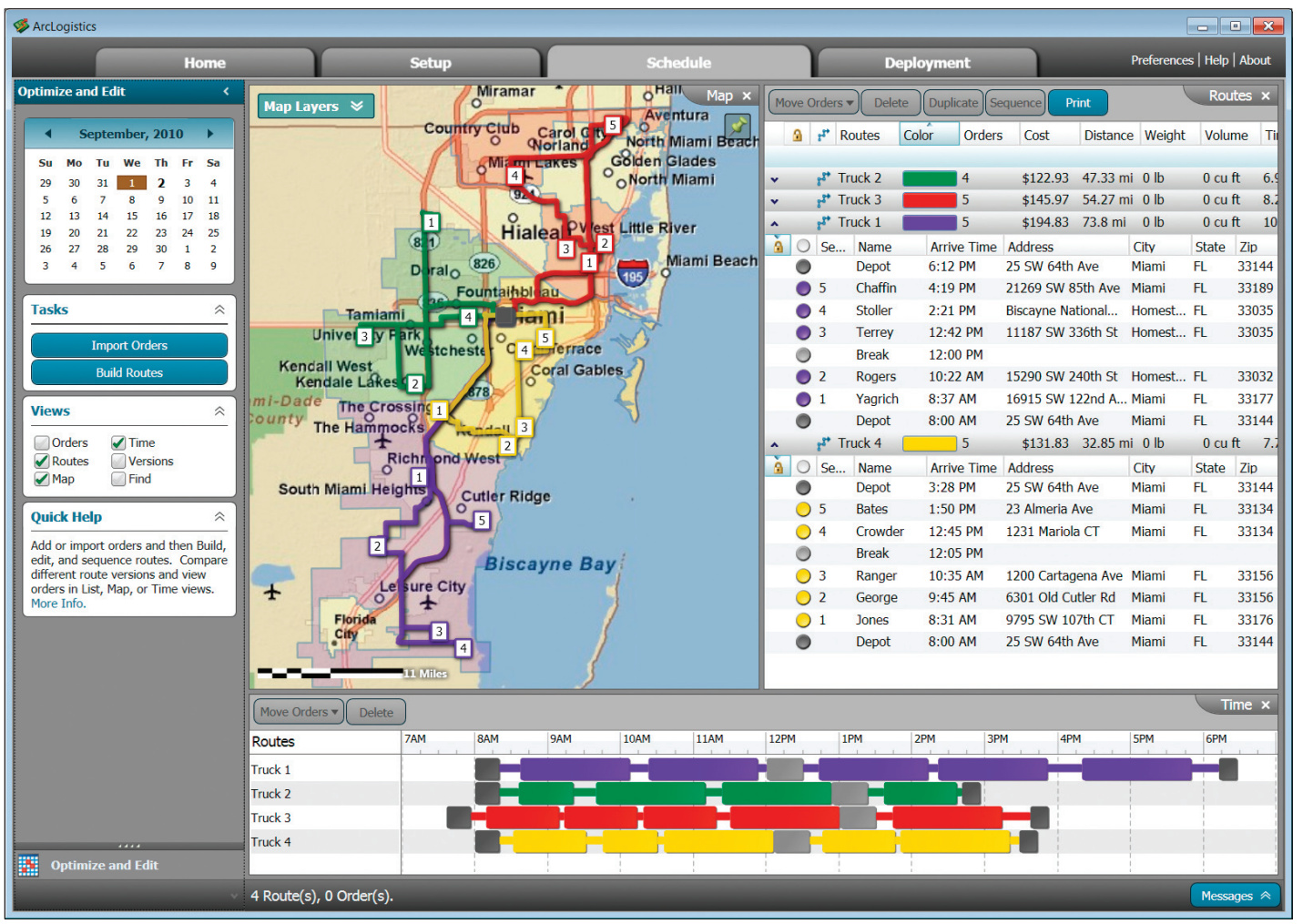

ArcLogistics, *Esri's routing and scheduling software for vehicles and mobile workers, now includes a free single-vehicle subscription option: Create optimum routes and schedules based on specific business operations, including vehicle capacities, driver specialties, and customer time windows. See the article on page 13.*

Increasing Transparency, Accountability

Recovery.gov Rapidly Evolves

For more than a year, Recovery.gov has given U.S. residents the ability to see how the government is spending money from the Recovery Act in their neighborhoods and across the country.

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NASA Moves Ahead with Enterprise Agreement

The National Aeronautics and Space Administration (NASA) recently signed an enterprise license agreement (ELA) with Esri, making ArcGIS software tools available for unlimited use by authorized NASA employees and contractors.

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Technical Certification Program Launched

Esri has set the industry standard for GIS technology and is now establishing benchmark standards for individuals who use Esri software with the recently launched Esri Technical

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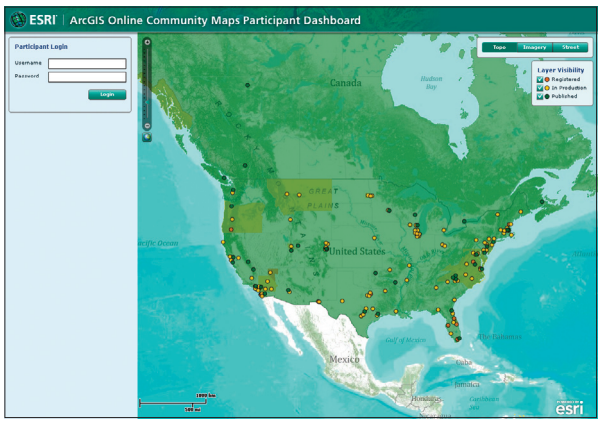
Community Maps Program Newsletter

Community Maps Program is a monthly e-newsletter that provides information about the latest participants who have joined the Community Maps Program and contributed their local content: tips and tricks for building basemaps, success stories, workshops, training, and more. Subscribe at **esri.com/communitymapsnews**.



The dashboard provides information about local content that has been provided by program participants.

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Technical Certification Program Launched

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Certification Program. The program consists of 13 certifications recognizing expertise in desktop, developer, or enterprise use of ArcGIS. Users achieve certification by successfully completing computer-based examinations, which are offered in more than 5,000 testing locations in 165 countries.

Beginning in January 2011, users will be able to test for five certifications. The remaining eight are still in development and will be available later in the year.

Establishing an industry-recognized benchmark of expertise in using Esri software will

- Improve success with GIS by creating a community of professionals proficient in using Esri software.
- Help organizations maximize their investment in Esri products by employing a workforce certified in using best practices.
- Create professional development opportunities.
- Provide an opportunity for individuals, partners, consultants, and other organizations to distinguish themselves among their peers.
- Assist hiring organizations in assessing candidate skills and abilities.

Esri technical certification differs from another GIS professional certification, the Geographic Information Systems Professional (GISP) certification. Esri certification is based on best practices using Esri software and complements the GISP certification, which is awarded to individuals who've met standards for ethical conduct and professional practice as established by the GIS Certification Institute (GISCI).

How Were Esri Requirements Established?
Developing criteria for examinations and scoring has been a research-intensive, multiyear process involving Esri staff and outside consultancies that have helped create similar programs for other IT and software providers.

A roundtable of GIS professionals and Esri subject matter experts recommended skills to be measured for each certification. These were then vetted through extensive online surveys completed by Esri partners, international distributors, employees, and selected users.

Survey responses drove development of the examinations, which were beta tested with recruits from the same audience. Beta testing of exams verified that the appropriate questions were being asked, determined the optimal number of questions for each exam, and established final scoring models.

*Certifications in bold are available in January 2011. * denotes certifications available later in the year.*

This process will continue for the eight certifications still in development.

Examinations
Workplace experience, combined with GIS education and Esri training courses, is the best preparation. The Esri Technical Certification Web site lists specific skills that will be assessed in each exam, as well as training courses that aid in acquiring and improving these skills.

Esri Technical Certification exams are offered worldwide through Pearson VUE, Esri's global testing partner. The computer-based exams consist of 90–95 multiple-choice questions and take approximately two hours to complete. Currently, they are offered in English only.

Within five days of taking an examination, candidates are notified via e-mail as to whether they achieved a passing score. Each exam has a unique scoring standard for passing, which is a result of extensive beta testing.

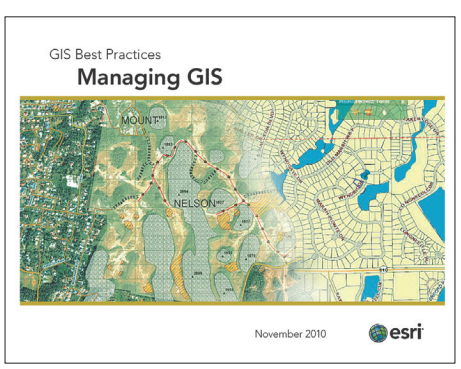
Candidates who do not achieve a passing score may retake the examination two weeks after the first attempt. If they are not successful in the second attempt, they must wait 90 days before taking the exam a third time.

The cost of taking an exam is $225, with payment made at the time of online registration.

For more information, visit **esri.com/certification** or e-mail certification@esri.com. To register, visit **pearsonvue.com/esri**.

New Best Practices from Esri and URISA

Featuring a wide variety of important GIS management topics from spatial data management to enterprise GIS, these 14 articles are reprinted from "Managing GIS," a regular column in *ArcNews* written by members of the Urban and Regional Information Systems Association (URISA) focusing on GIS management issues. Download it from **esri.com/library/bestpractices/managing-gis.pdf**. *(See URISA articles on pages 42 and 43.)*



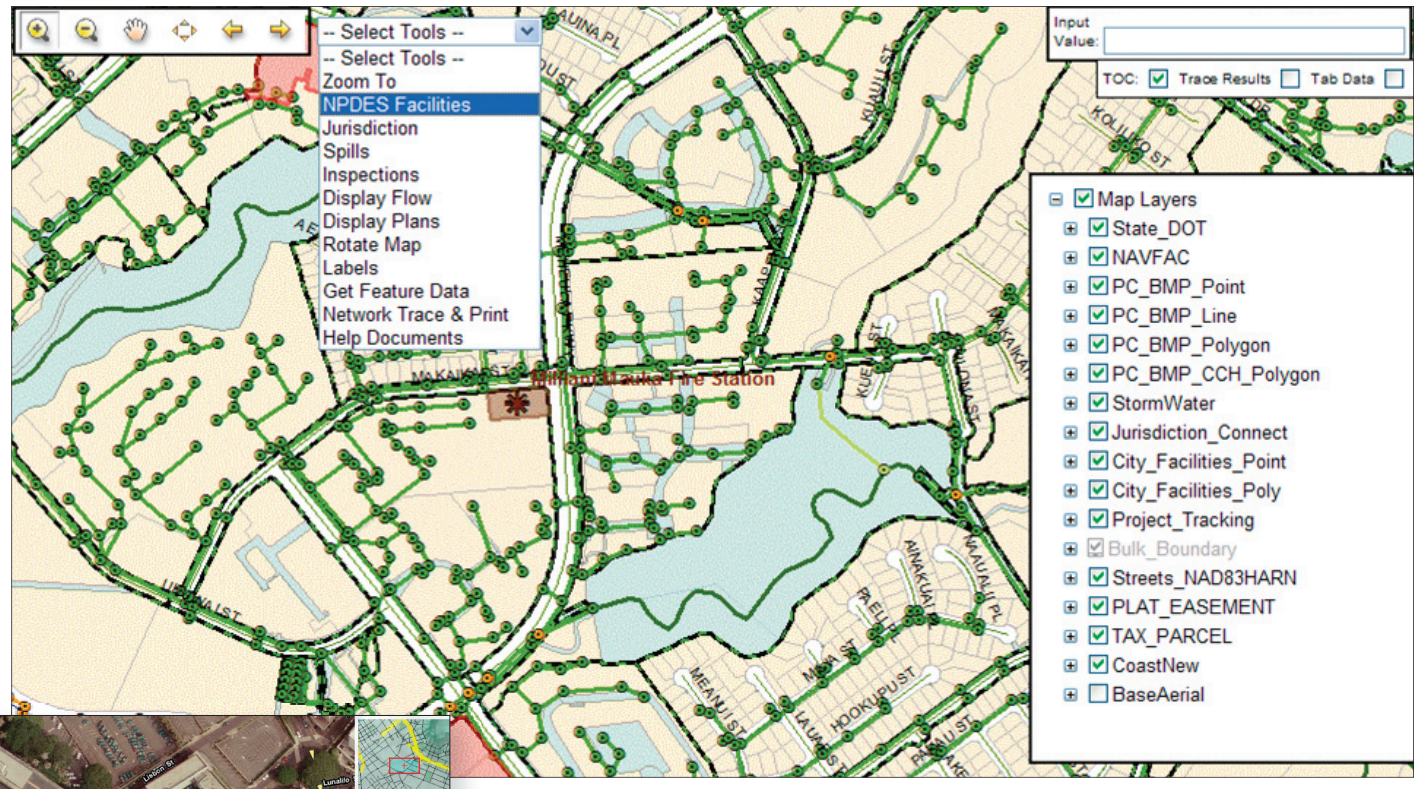
GIS Administrator Inspired to Make a Difference

Ken Schmidt

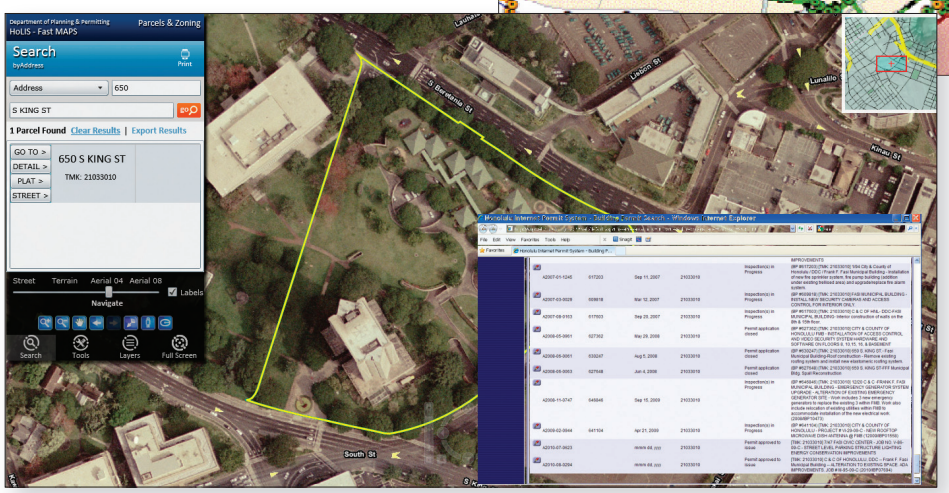
Using GIS to enhance the way government works is what drives the City and County of Honolulu's (Hawaii) GIS administrator Ken Schmidt. "Improving the efficiency of government operations makes people's lives better in many different ways and helps us protect the citizens in our communities," he says.

Beyond the direct impact on the lives of Honolulu's residents, he believes GIS also plays an important role in protecting the island environment. "We're protecting what makes Hawaii unique—the aesthetics of Honolulu—by having better information to make better decisions about issues such as development patterns, water resources, or how the sewer system operates. We're using GIS to create livable and sustainable communities."

After more than 20 years in Honolulu, this GIS hero has established a strong enterprise-wide GIS program, including centralized GIS data management, GIS-based work management systems, and public-facing online maps at gis.hicentral.com.



The recently updated Storm Water Drainage System viewer, which meets National Pollutant Discharge Elimination System permit requirements.



The online permitting system was created to modernize the permitting process.

"There's no doubt that the success of the City and County of Honolulu's GIS program is due to Ken's vision, strong leadership, and single-minded determination," says Arthur Buto, GIS coordinator for the State of Hawaii Department of Land and Natural Resources and president of the Hawaii Geographic Information Coordinating Council (HGICC). "Through at least five mayors and acting mayors, he guided the growth of the program from its infancy to the nationally recognized program it is today. He and his team demonstrated the value of geospatial data not only to their bosses but to state leaders and to the general public with the introduction of online mapping and permitting systems, building on early successes with parcel and infrastructure data."

Charting His Course

Schmidt began his career with a company in Florida, mapping wetlands in the northern United States and Canadian provinces for the U.S. Fish and Wildlife Service in association with Ducks Unlimited. Soon, a position opened up at the Suwannee River (Florida) Water Management District for a GIS analyst. "It was the early '80s, and I wasn't quite sure what that job was at the time," jokes Schmidt.

Graduating from Southwest Texas State University (now Texas State University) with a geography degree a few years earlier, Schmidt didn't know what he was going to do with his degree, but the emerging field of geographic information system technology would end up playing a key role. "GIS was becoming a profession, and I happened to get in at the right time," he says.

At the Suwannee River Water Management District, Schmidt began using ArcInfo to map drainage basins, land use, and watershed protection. "It was inspiring, but the potential of the technology we were using was still an unknown," he says. "Yet I knew GIS was going to provide a very useful tool to policy makers, especially at that point for those involved in managing the water resources in the area."

Soon, the Southwest Florida Water Management District asked him to migrate its legacy mapping operations into ArcInfo. Five years later, with that task complete, he accepted a job as the GIS coordinator for the City and County of Honolulu.

Building Community

Beyond the work that he does for Honolulu, Schmidt is dedicated to educating people about geography and GIS. In addition to the GIS Day events his department hosted for many years, which spawned GIS education programs in local schools, he has been involved in the National Geographic Bee for some time. The contest tests the geographic knowledge of fourth through eighth graders. "It's been an honor to participate in that, either as a moderator or judge," he says. "It's really rewarding to see these kids learning about geography."

Schmidt also helped start a GIS user group on the island in the early 1990s. "He lives and breathes GIS," says Henry Wolter, U.S. Geological Survey geospatial liaison, Hawaii and Pacific Basin Islands. "Even during our biweekly tennis matches, he's talking about whether the ball landed in the right polygon, or a project he's working on for the county."

The user groups he helped create have evolved into various other user groups and GIS conferences in the region. He was also a founding member of HGICC, which promotes communication, data sharing, interagency coordination among GIS professionals, and education of the public and policy makers about the benefits of GIS. HGICC has also assumed the primary role in hosting GIS Day on Oahu.

"During his two terms as president, Ken helped lead HGICC through a number of trying times," says Wolter. "He was fiscally conservative, looked at our needs, and determined what would work. He always reminded us that we needed to share our data and get it out to our partners and clients in the GIS community who need it."

"Hawaiian values have a very strong sense of community and its connection with the land and water that sustains them," he says. "We embraced those values in our program with the motto 'Palapala aina o ka mokupuni o Oahu,' which translates to 'describing the land of the Island of Oahu,' or simply 'mapping our island.'"

For more information, contact Ken Schmidt, GIS administrator, City and County of Honolulu (e-mail: kschmidt@honolulu.gov).

Integrated Models and Grand Challenges

continued from cover

represent formally in a computer environment, and this means that "good" models must distill the essence of the problem into a form where we can work with it in making good predictions.

A model of a geographic system draws mainly on theoretical notions about the nature of the system whose form and structure we want to predict and from the stakeholders who may want to use that knowledge in policy. The process of representing the relevant geographic system (early desktop GIS, for example) and building a simulation model that captures its essence requires many decisions that are usually considered separately from one another *(see sidebar on page 5)*. At one end of the sequence of representation–simulation–prediction, models of the processes involved depend on our theoretical understanding of the system of interest and their implementation in software that links their digital representation to available data. At the other end, model structure and function depend on what predictions are required, the problem they are being designed to inform, and the stakeholders who will use these models in their decision making.

However, as policy has begun to respond to much bigger challenges, such as climate change, and larger-scale models have begun to develop, there has come a need for *coupling* larger models to form integrated assessments of impacts across a range of spatial and temporal scales.

In this article, we discuss these issues, using as an example the long-term impacts of sea level rise and energy change in the Greater London region.

Integrated Assessment: The Grand Challenge of Climate Change

Ever-larger models and systems of models are being proposed for tackling a new generation of policy problems that are referred to as *grand challenges*. Chief among these are problems of climate change, energy depletion and transition to alternative sources, demographic aging, and global migration. These kinds of problems are cross-disciplinary in that they are characterized by the meshing of physical and human domains and by transitions across many scales in both space and time. Here we will examine two of these—climate change and its impacts in terms of sea level rise for large cities and energy change through the pricing of gasoline and its impact on short- and long-term transportation behavior.

Our example revolves around an assessment of the potential rise in sea level over the next 100 years in and around the east coast of Britain, with a focus on the impact of such rises on the floodplain of the Thames, the major river on which London sits and whose catchment covers an area with some 20 million people. The worst-case Intergovernmental Panel on Climate Change scenario for sea level rise is two meters by 2100, and if this were to occur, much of the south bank of the river would be flooded in the central area, making several square miles of what is now high-value commercial and residential real estate uninhabitable. Of course, the key issue in assessing such a forecast is to note that over the next 100 years, various mitigation measures will be put in place, which will lead to changed behaviors and reduction of this impact, but as a first shot, we need to simulate this long-term future to get some sense of the scale of the impact. In essence, in the face of population growth over the next 100 years, the question is, what will be the likely impact of such flooding in areas of affected population not only now but in the run up to 2100? To reveal the nature of the problem, we showed the current floodplain and pictured London's current response to rising sea levels—the Thames Barrier (or barrage), on which construction began in 1974 in response to severe flooding due to surge tides that occurred in 1953 (when climate change had barely been thought about).

To handle this kind of forecast, we need some sense of the demographic and economic future, and to this end, two kinds of models are being built by different groups and are being stitched together to produce the future demography and economy of the London region. The MoSeS model, developed by Birkin and his colleagues at Leeds, is a microsimulation model of the UK demographic space and can be run to provide age profiling for fine-scale populations over variable time periods. Its key feature is that it is based on predicting individual spatial behaviors through the construction of a synthetic profile. In contrast, the input-output model MDM-E3 is being adapted by Kohler, Yin, and Barker at Cambridge Econometrics to assess the future employment growth of the region. Both these models generate global forecasts for the London region for different employment and population groups, which are then factored down to small areas and entered into the land-use transportation model (LUTM) to produce population predictions for small areas covering those that are likely to be impacted by flooding. This model has been developed by our group at University College London, but the transport networks that represent four modes of travel—car, bus, rail, and tube—are constructed using the shortest routing representations and algorithms in a GIS, then entered into the LUTM. The group at Newcastle doing this is also building a finer-scale GIS model to translate the activity predictions at the LUTM zonal level to 50-meter grid squares necessary for testing the impact of flooding using flood models, also operationalized by the Newcastle group.

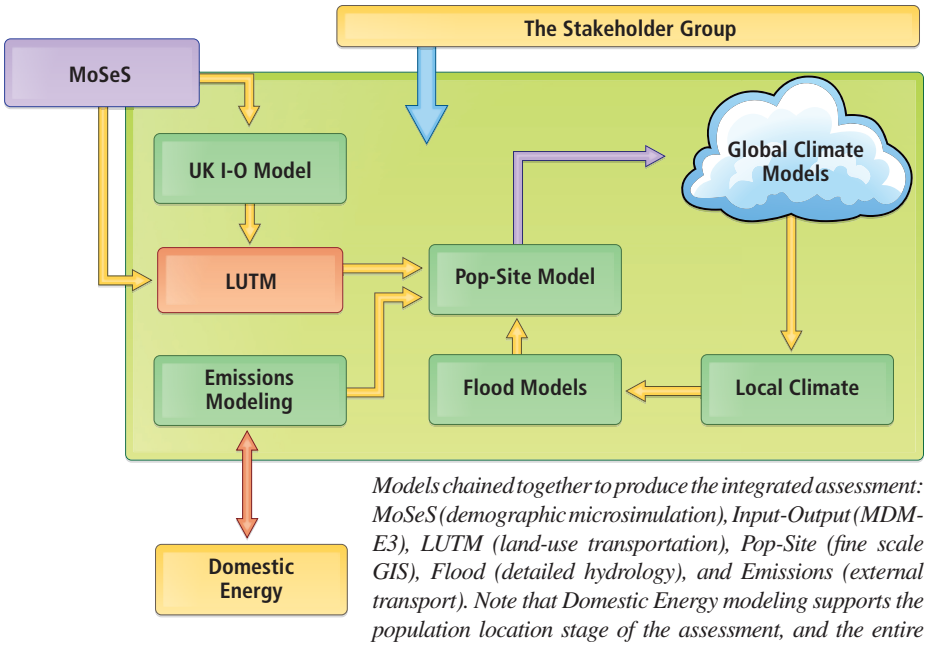
It is quite clear that no one group has the professional and/or intellectual or even practical expertise to construct all these different models. In fact, an important part of the integrated assessment is the use of these models to inform policy through a stakeholder group that represents the key professionals involved in decision making concerning flood risk in Greater London—the UK Environment Agency, Transport for London, the Greater London Authority, etc. To this end, in LUTM, we are developing a rapid prototyping of the land-use transport model, which is visually driven and can generate forecasts quickly (in a matter of seconds) on the desktop and thus can be and is being used directly with the stakeholder group. In this model, we integrate basic desktop GIS functions for visualization, but these are written directly for this purpose and are not loosely coupled to other GIS software. Furthermore, we link these visualization capabilities to external software using free geovisualization software to not only display several layers from the model simultaneously (which the model cannot do) but also capture model outputs as KML files and let users put other raster data into the context so that model outputs can be compared with such external data.

The various models assembled here can also be used to explore many what-if types of scenarios, which can be fashioned in the stakeholder context or generated offline for model testing. There are clearly some very important decisions with respect to how accessible these models are to experts and stakeholders and our capabilities to speedily and effectively visualize and disseminate their results. To this end, there has been a veritable explosion of graphics and multimedia to enable effective communication.

Modeling Changing Energy Regimes

We have also used our LUTM to model the transition to different energy regimes. In terms of our climate change example, a major problem of forecasting long-term change is the altered spatial behaviors that will clearly take place during the long period over which the forecast is being made. If sea level were to rise two meters by the year 2100, then individuals and governments would begin to respond ever more directly and quickly as the year approached. This would lead to natural as well as involuntary changes in location and travel, and this feedback would make itself felt in ways that the models are completely unable to anticipate. This is why such models are largely useful in structuring the debate for mobilizing action and policy rather than providing forecasts that may never be borne out.

In the much shorter term, however, changes in energy prices that are likely to herald the end of the use of oil and other fossil fuels as a serious way of powering conventional transport technologies will have much more immediate impact. When oil rose to $145 a barrel in July 2008, the impact was immediate. People began to switch modes, although switching back was rather fast as soon as oil began its precipitous fall back to its recent longer-term average of about $70 a barrel. To test the immediate impact of such changes, we have used our LUTM to predict mode switching from cars to other forms of public transportation when



Models chained together to produce the integrated assessment: MoSeS (demographic microsimulation), Input-Output (MDM-E3), LUTM (land-use transportation), Pop-Site (fine scale GIS), Flood (detailed hydrology), and Emissions (external transport). Note that Domestic Energy modeling supports the population location stage of the assessment, and the entire process informs the stakeholder group.

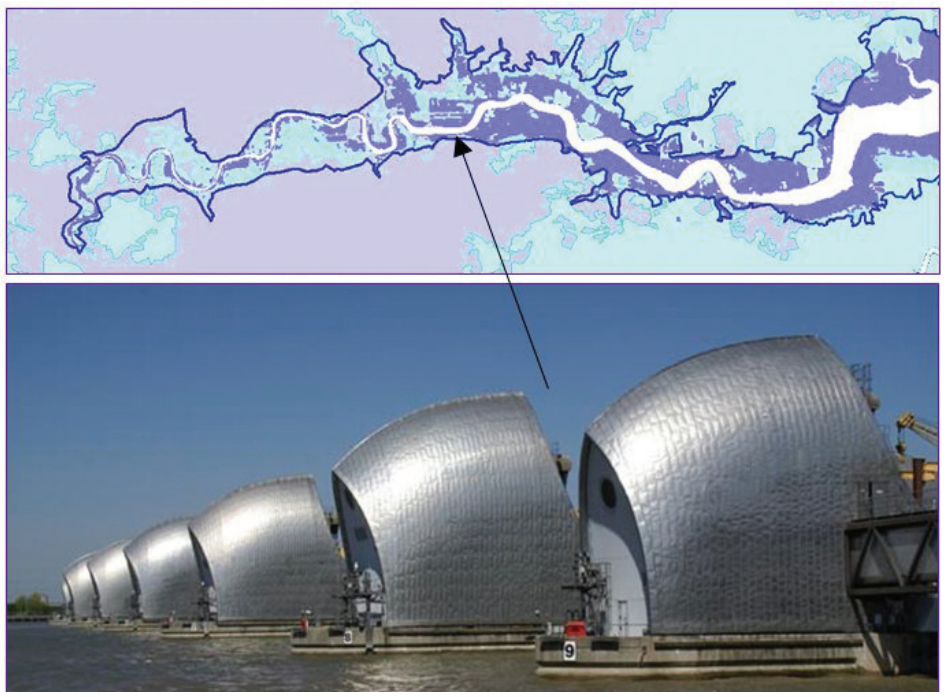
the price of gasoline is doubled. When this occurs, there is a big switch to other modes, as half of all car riders move to public transportation (note that Greater London has some 38 percent traveling by car in a city area of some 8 million people and the rest by public transport or walking). However, there is a severe limitation in this kind of forecasting. LUTM does not model the supply side of transportation, and thus it is quite impossible for other transport modes to accommodate this surplus of car riders, as these other modes do not have the capacity to respond so in the short term.

In fact, although the elasticity of demand for car travel appears far too high in these predictions—largely because we are not able to assign the predicted trips to a network at a finer scale (in short, because we do not have an integrated transport model within this package)—the actual shifts in population location occasioned from these switches in travel demand are quite small, only in the order of about 3 percent. This is an interesting finding, in that it means that there are many degrees of freedom in the trip-making context that do not show up very much when we compute the trips attracted to each residential area.

Next Steps: Chains of Integrated Models

The problem of integrating multiple models in this fashion was stated in 1968 by William Alonso, who argued that such chains of models might lead to the perpetuation of errors in a way that was uncontrollable. The notion that errors would cancel one another out rather than perpetuate is a matter of blind faith, and there is no way of knowing what will happen if each model is constructed separately and simply chained to its predecessor and successor. This is an argument, then, against integrated modeling, for if a model is constructed "all of one piece," it is likely that the model builder or user will have more sense of the way errors perpetuate within its structure. Alternatively, the whole process might be seen as one piece with the models being tested by the consortium of model builders under controlled conditions. This is equally demanding, but it is possible, at least in principle, and some testing of this kind must be in place to ensure that the overall integrated chain of model operations is stable.

In responding to problems of an interdisciplinary nature in which the grand challenges are the most high profile, integrated modeling of the kind proposed is here to stay. In a world where interconnections across spatial scales from the local to the global and from very short- to very long-term horizons are the norm, it is necessary to embody many different viewpoints in the form of different models that will inform analysis of such problems. In this, it is likely that loosely coupling strings of models, as well as different kinds of software, will become the received wisdom. Urgently required, however, are strategies for dealing with such model structures that need much deeper and extensive verification and validation than the models that now comprise current practice. We began this note with a concern for how models might be integrated with representation and prediction and end it with a new quest to extend representation, simulation, and prediction to many scales and time periods in the search to address major problems such as climate change.



Above: The River Thames Floodplain—Dark blue is 50 percent risk and light blue is 25 percent risk of severe flooding with 2-meter sea level rise (adapted from the Area Vulnerability Map, Environment Agency, UK Government). Below: The Thames Barrier, constructed to combat surge tides in the North Sea (Credit: www.freefoto.com—Creative Commons).

About the Author

Michael Batty is Bartlett professor of planning at University College London, where he directs the Centre for Advanced Spatial Analysis. His research has focused on developing computer models for cities that build on ideas in social physics with an emphasis on visualization and planning support. Trained as an architect-planner, he directed the State University of New York-Buffalo site of the National Center for Geographic Information and Analysis from 1990 to 1995. He is a fellow of the Royal Society.

For additional information, contact Michael Batty (e-mail: m.batty@ucl.ac.uk, Web: casa.ucl.ac.uk). Full references can be found online at esri.com/arcnews.

Integrating GIS, Models, and Predictions: The Background

Until comparatively recently, models were developed quite separately from their representation. With the development of full-fledged computer graphics in the 1980s—spatial representation becoming digital and visual for 2D through early desktop GIS and for 3D through CAD—there began various attempts at a strong coupling of desktop GIS with modeling, but for the most part, this was restricted to models designed in separate software but linked on the desktop.

In fact, models have been more heavily influenced by their use in participatory contexts, where visualization is of course important but where the predominant mode is to simply pick and choose from available software and engage in a loose coupling wherever such a coupling is required. Such is the modus operandi of planning support systems.

Insofar as models have been integrated with various representations and model types, the focus has been on a limited extension of one model type with its close neighbors rather than with major forms of representational or planning support systems, largely because the overhead of implementing a large-scale model in these systems was too great. It has been much easier to take elements from each of these related software packages and build these directly into models, a strategy demonstrated in the model in the main article describing long-term impacts of sea level rise and energy change in the Greater London region.

These sorts of models require good representation and predictive capabilities to input and output their data, and outcomes for rapid understanding and dissemination by scientists and stakeholders alike are usually regarded as large scale.

In an urban context, these are land-use transportation models (LUTM), sometimes referred to as land-use transport interaction (LUTI) models, that simulate the workings of the city system in terms of transportation flows between different land-use activities and the operation of housing and related markets in determining the location of activities at a cross-section in time.

These models have been widely developed since the 1960s, and as computers have gotten ever more powerful and spatial data ever richer, these models have grown in scale. There has been considerable integration of their various parts—for example, in transportation models, notions about integrated distribution and assignment have been widely advanced—while links to demographic and econometric forecasting at higher spatial scales in the form of demo-economic models have been explored. Links to environmental models are somewhat looser but in parallel, some of these model structures have been dissembled in the quest to simulate in ever more detail various subsectors, such as the retail system and the housing market.

These models are often termed *operational*, in that they are widely used in urban policy making—particularly in large cities—but are still quite distinct from the new generation of urban models that simulate finer-scale movement patterns and change, particularly local movement of individuals and specific changes in urban development. The former style of model is called an agent-based model, while the latter, which attempts to forecast the change in locational activity, is called a cellular automata. The key features of these models are that they are qualitative in their predictions, usually forecasting the spread or movement of development. They have little numerical forecasting of population transitions, travel demand, or housing market clearing as reflected in the prediction of supply or in the determination of prices. There has, however, been progress in stitching these kinds of models into desktop GIS through various plug-ins, such as agent-based modeling routines that interface with open source software.

There is little doubt, however, that one of the basic reasons it is difficult to couple different types of models to their representational software depends on the different professional expertise needed to effect such linkages. For example, linking traffic models to land-use models is hard enough because very different conceptions of these activities are required—land use depends on the urban economy, while transportation is reflected more in detailed design considerations and ideas about traffic flow, more the product of engineering. One of the reasons the development of agent-based modeling has become popular is because it tends toward no specific discipline, in that the conception of an agent and its interactions can be applied, at least at a casual level, to any kind of system. But this is also its Achilles' heel, as invariably, the detail in such models falls far short of that required for strong disciplinary development of theory or for professional policy-making purposes. Such models thus tend to be pedagogical rather than predictive.

Revolutionary Visualization

Now, however, the open nature of many new visualization technologies, particularly now on the Web in the form of online mapping, has spurred the development of all kinds of loose coupling that was hitherto largely unanticipated. There are many software products, some open source, that can now combine, for example, GIS and simulation, and this means that modelers have a cornucopia of possibilities when it comes to extending their models to embrace good representations and simulations.

—Michael Batty

Geographic Knowledge: Our New Infrastructure

By Jack Dangermond

Thanks in large part to the Internet, we've recently seen a fundamental change in the way GIS is delivered and used. The next 10 years will see an explosion of faster, more powerful mobile devices, and the line dividing cell phones and personal computers will fade. Mobile devices will continue to grow to support more geospatial functionality, and they will easily connect to systems around the world to use and create geographic knowledge. Democratization of data—both its widespread use and its universal creation—will result in a new kind of infrastructure: a geospatial infrastructure that powers our digital earth.

As we move from an industrial economy to a knowledge-based economy, our reliance on physical infrastructure is being supplemented by reliance on knowledge infrastructure, of which geographic knowledge will form a key component.

At the 2010 Esri International User Conference, keynote speaker Richard Saul Wurman stated that "Understanding precedes action." Geographic knowledge represents our best opportunity to understand the world around us, and this geographic knowledge drives human action. Leveraging this knowledge can make a huge difference in our daily lives; it not only guides business and government but also helps us create a more sustainable world.

"Understanding precedes action."
—Richard Saul Wurman

What Is Geographic Knowledge?

Geographic knowledge—collected information describing the natural and human environment on earth—includes

- Data
- Data models that provide structure to the data
- Models and analytic environments that show predictions or suitability
- Encapsulation of cartographic expression of the data
- Geospatial workflows
- Metadata, which describes the five components above and is key to sharing, discovery, and access

Geographic knowledge is already changing how we abstract our world. It is also changing how we reason, both in the professional world and in broader society, by introducing spatially integrated thinking. It lets people more easily visualize and think about cause-and-effect relationships.

"Geographic knowledge is the product of geographic thinking and reasoning about the world's natural and human phenomena."
—Reginald G. Golledge, University of California, Santa Barbara

Shared geographic databases, in concert with geospatial data viewers, such as Google Maps and Bing Maps, are also changing how we organize and communicate within and between agencies and organizations. Looking beyond the maps, people are doing more spatially integrated thinking, introducing a whole new approach for problem solving. And this is just the beginning. We're in the midst of a geospatial revolution, and this framework will come to embrace all types of knowledge and ultimately achieve a societal infrastructure for human behavior and social action.

Building the Infrastructure

GIS is the technology we rely on to build, operate, and maintain components of the emerging geographic knowledge infrastructure—spatial databases, maps, models, etc. Emerging Web environments provide new ways to make geographic knowledge accessible by non-GIS audiences. As location becomes a core component of more applications we use every day, our dependence on this knowledge infrastructure will increase exponentially, and that puts an increased level of responsibility on the geospatial professionals who build, operate, and maintain this infrastructure.

The first 40 years in GIS have been all about measuring, analyzing, modeling, and managing geographic information. The next major step will be to use all this geographic knowledge as a foundation for designing our future.

Using the Infrastructure

Infrastructure is very basic and universal to the way we live, but it is often overlooked or almost invisible because it is taken for granted. A lot of us are committed to build, operate, and maintain this infrastructure, but these activities pale in comparison to the actual use of the infrastructure. When you flip a light switch, the light comes on—you don't need to know the complexities of how the electricity was created and transmitted to your house. And that's where we are heading with this geographic knowledge infrastructure. Leveraging this all-encompassing infrastructure will expand our understanding of the physical and cultural dynamics that shape our world and help us devise action plans for a more sustainable future.

Once this infrastructure is in place, it will support a myriad of applications and activities. One of the most intriguing and exciting applications is GeoDesign—a set of GIS-based methods and tools that allow users to easily sketch out alternative designs and quickly consider the consequences of these alternatives. GeoDesign is about creating a sustainable future, guided by geographic knowledge. By making geography and the concepts of GeoDesign more widely available, people will be more likely to make decisions guided by geographic knowledge.

GIS has traditionally been very focused on analysis and modeling, often in an attempt to predict the future—a difficult task. With GeoDesign, we move beyond trying to predict the future and toward a mindset where the future can be invented or created in a logical, scientific, and purposeful manner. Carl Steinitz at Harvard University says that "GeoDesign is geography by design." We are moving beyond a world composed primarily of what might be considered "accidental" geography toward a more intelligent approach based on a deep understanding of the long-term consequences of our design on society and the environment.

As we move from an industrial economy to an information economy, our reliance on physical infrastructure is being supplemented by reliance on a new type of infrastructure: geographic knowledge.

Creating New Knowledge

Mobile and location-based technologies are fundamentally changing the way we create geographic knowledge; we're seeing the widespread embracing of crowdsourcing—geographic knowledge contributed by everyday citizens. Long the keepers of purely authoritative data, geospatial practitioners are beginning to take crowdsourced data very seriously. This gives ordinary citizens the opportunity to provide feedback directly to the government. It can significantly augment authoritative datasets at a fraction of the traditional cost. It provides extraordinary opportunities for citizen science. And it can put a large group of resources on a large project in short order.

GIS tools supporting crowdsourcing will change the way organizations collect and manage spatial data. Some of these tools are already available and give users the ability to modify geographic content within any Web mapping application and provide a venue for online communities to become active contributors to geospatial databases. Web editing makes it easy to capture ideas and observations for distributed problem solving and extend GIS editing capabilities to more people within an organization. These capabilities allow everyone—from authoritative data editors to citizens on the street—to contribute content to geospatial databases. This will enrich GIS, giving GIS practitioners new types of data to use, manage, interpret, and incorporate into their work.

Challenges Ahead

As the geographic knowledge infrastructure becomes pervasive, some of the issues we have to overcome as an industry and as a society include privacy concerns, data ownership, standards for collecting and structuring the data, and making sure we use the data in appropriate ways. These are very complex issues that we need to tackle at the same time we are trying to make everything easier and available to a much broader audience.

Building spatial data infrastructure and performing spatial analysis are difficult, complicated tasks, and they will remain so. In a way, one of our primary responsibilities as geospatial professionals is to hide the complexity. Obviously, what you expose to a GIS professional or a city planner is going to be very different from what you expose to a citizen with a cell phone. We need to determine what geographic knowledge is relevant for a given situation or a particular audience and build our applications around that knowledge.

More people using geographic knowledge will result in more highly evolved interfaces. But we must be extremely careful here. Information can so easily be taken out of context or misused. As the volume of information increases and we make it easy to access and available to more people, the opportunities for misuse increase exponentially. Even highly trained scientists can make mistakes with data. Our approach needs to be deliberate; we need to deliver the appropriate knowledge to the right people at the right time, but we also need to package it in a way that gives the best opportunity for correct use and interpretation.

Our Shared Responsibility

Over time, society will become increasingly dependent on geospatial infrastructure, much as it has become dependent on other, more traditional forms of infrastructure, such as electrical grids, rail systems, and highway networks. With this dependence will come added responsibilities for the geospatial professionals who build, operate, and maintain the infrastructure.

When technology is so universally accepted that it can be considered infrastructure, people become highly dependent on it. If your electricity was turned off for a week, how would that impact your life? If all public roads and highways were closed for a month, how would you get by? In the near future, we might add the question, How would it impact your life if you no longer had access to the world's geographic knowledge?

Recovery.gov Rapidly Evolves

continued from cover

Highlights

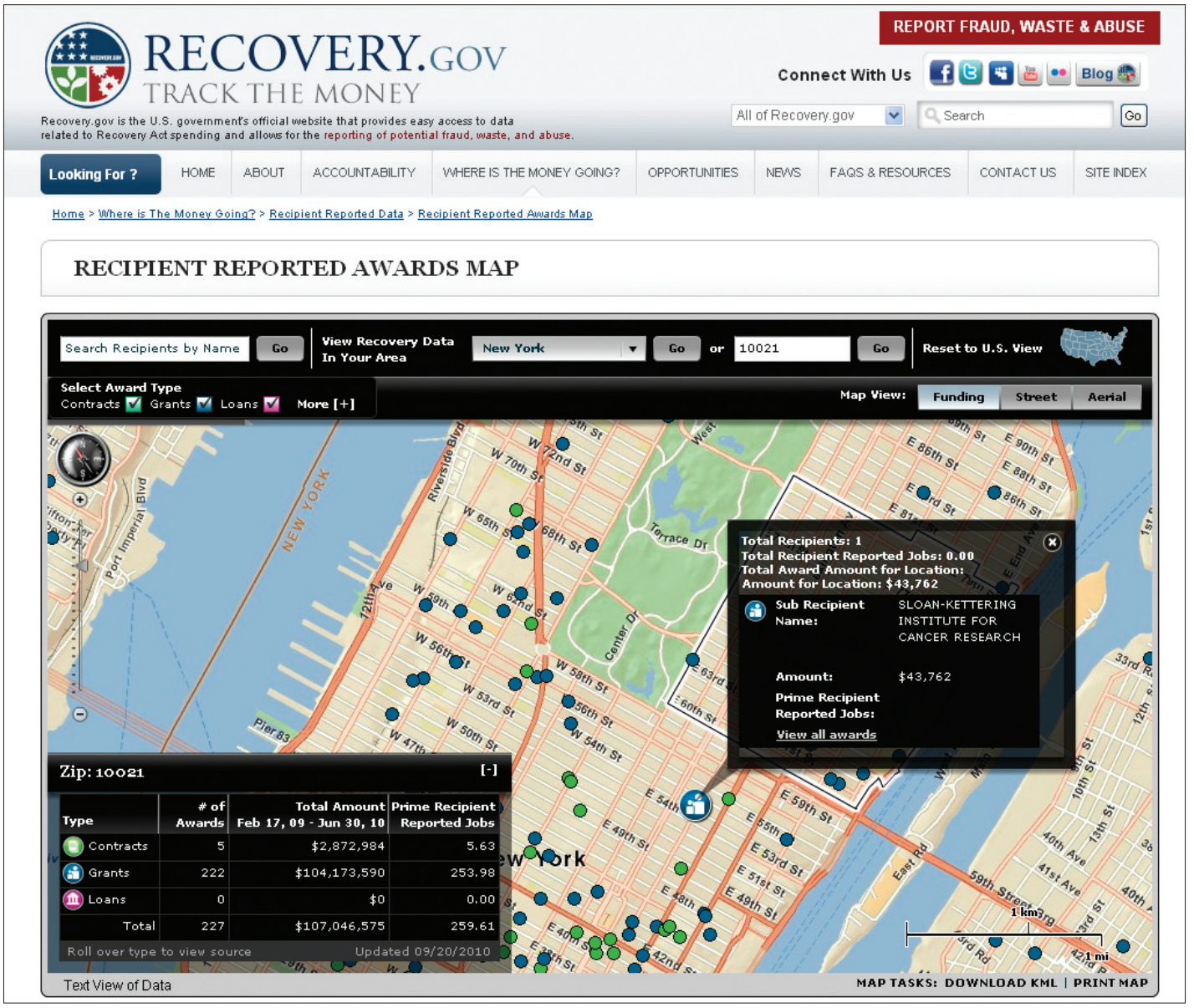
- Recovery.gov has added a map gallery and developer center.
- Maps compare areas of need with recovery investments.
- It is the first government-wide system to move to the cloud.

A rich, online map of recipient-reported data provides the primary view into this comprehensive data depicting where award recipients are investing the allotted $275 billion from contracts, grants, and loans.

"When we built the site, one of our principal goals was to make it relevant for citizens, not Washington insiders," says Mike Wood, director of **Recovery.gov**. "The easiest way to do that was with maps that allow people to do a ZIP Code search and see what money is being spent and where the projects are in their local community."

The Recovery.gov Web site gives people the necessary tools and data to ask questions and draw conclusions about how and where the money is being spent, exemplifying President Barack Obama's call for transparent and accountable government. Using GIS provides a streamlined way to bring in huge amounts of data and make it available in a way that all citizens can easily understand.

"This sort of transparency in government spending has never existed," says Earl E. Devaney, chairman of the Recovery Accountability and Transparency Board. "The challenge was to design a system to capture the data [**FederalReporting.gov**] and a separate system to display that data to the public in a visually pleasing, easy-to-understand, and interactive way—the maps being the biggest piece in that."



Midtown Manhattan shows the locations of awards as dots that reveal details of Recovery Act funding for the area.

Building on Success

In October 2010, the Recovery.gov team, led by Maryland-based prime contractor Smartronix, launched several new features on the Web site to improve user experiences, including a new map gallery and developer center that enhance the site's ability to deliver transparency and accountability.

Results from focus groups and stakeholder meetings made one thing abundantly clear: People wanted to know how recovery money was impacting their own neighborhoods. Responding to this insight, the board's technical staff and the Smartronix team worked to implement new features, like the map gallery, that showcase maps to allow richer interaction and analysis by mashing up recipient reports with other interesting and relevant data.

The map gallery primarily features interactive thematic maps; many of them compare areas of need with recovery investments, for example, job training awards versus unemployment, community-oriented policing services versus U.S. population density, and education awards versus population under 18 years of age. New maps will be added to the gallery over time.

"Showing areas of need can help decision makers understand where to invest, and for the money that's already out there, we can see if it is meeting existing needs," Wood points out.

Other maps in the gallery show the progress of recovery projects that have not been started, are in progress, or are completed. Edward Tufte, member of the recovery board's advisory panel and professor emeritus of political science, statistics, and computer science at Yale University, created the map titled *Lights-On,* which gradually lights up to show the distribution of awards from February 17, 2009, to September 30, 2010.

The Recovery.gov team also added a developer center to include information pertaining to machine-readable access to recipient-reported data. These resources include a state data summary widget to post data summaries on personal or business Web sites and an ArcGIS mapping API for developing high-performance, simple-to-use mapping applications that users can easily embed in Web pages. Developers can use this authoritative data to create their own mashups, widgets, and applications. Recovery.gov invites and encourages developers to share their results with others through the Recovery.gov site.

"It's important to make the data easier to use with APIs, because we hope developers and other people will take the data and create innovative maps or use it in an application to analyze it in a way we might not have thought of," says Wood. "I think that's the real power in making this information available in new ways that will make it even more transparent than it is now."

Trailblazing

In addition to the groundbreaking nature of this site, the speed with which the recovery board's team built the site was remarkable. Contracting, development, construction, testing, and deployment for Recovery.gov and the site where recipients actually report their spending—**FederalReporting.gov**—had to be completed in five months.

In addition to the site being completed on time, the recovery board continues to respond quickly as new data comes in. Since October 1, 2009, recipients have been reporting on the progress of their recovery projects each quarter. Incoming data is reviewed for errors and posted on Recovery.gov within a few weeks, or earlier if possible.

"If you look at traditional federal methodology, the feds generate data and take months and months to climb through it," says Wood. "By the time they put out reports, the information is stale. With Recovery.gov, the data is almost real time. We're collecting data at the end of a quarter in a 10-day period, and we're posting it 20 days later. That's light speed for financial information."

On the recipient-reported data map, data includes the amount of the award, jobs created, and the status and description of the project. Citizens, watchdog groups, and local governments can examine the details of investments and report suspicions of fraud, waste, and abuse in their neighborhoods on the site.

The recipient-reported data provides a comprehensive look at recovery efforts around the nation with a compliance rate for recipient reporting that is slightly more than 99 percent. Since reporting began in 2009, noncompliance continues to drop, and Recovery.gov leaders, including Wood and Devaney, believe that transparency is driving this compliance as the board posts the names of those who failed to report.

After recipients report their data, the Recovery.gov team pulls the information it needs into a sophisticated data warehouse. Then the data is brought into the mapping application running on ArcGIS Server and hosted in the Amazon Elastic Compute Cloud. This cloud-based approach improves efficiency and provides flexibility and scalability for varied demand. Wood also explains that it reduces costs for hardware administration. It is the first government-wide system to move to the cloud.

"My job is transparency," says Wood. "I don't want to worry about how many servers I have or if the hardware is operating appropriately. I am able to pass that to Amazon for them to worry about, and I can focus on transparency and making the data available."

For more information, visit **Recovery.gov**. In July 2009, Smartronix, Inc., a Maryland-based firm experienced in federal and military IT projects, was awarded the Recovery.gov 2.0 project. The team includes three subcontractors—KPMG, Synteractive, and TMP Government—and technology partners Microsoft, SAP, and Esri, among others.

Saudi Arabia Implements New Postal Code System Based on GIS Analysis

continued from cover

Highlights

- Sorting machines connect to GIS for address verification and routing.
- Couriers deliver packages to right location using mobile GIS.
- GIS provides an information infrastructure that benefits other government agencies.

Traditionally, home and street addresses did not exist in Saudi Arabia. Mail sorting had been done manually, so mail delivery was a difficult and time-consuming job. There was no system in place for delivering mail to businesses or homes, so people picked up their mail directly from the post office.

Using GIS, Saudi Post built the Unified National Addressing System and created a postal code system for the nation. GIS was instrumental in modernizing the workflow to make it more efficient and timely. New sorting machines are connected with geodatabases to verify address interpretation. A sorting machine reads the postal code, along with the exact coordinates of the home address, and allocates the mail piece for routing to the appropriate distribution center. GIS allows users to calculate the distribution route for each delivery courier, sort the mail piece, and generate a distribution plan for it. Sorting employees gather the mail into bundles and deliver them to designated distribution centers. Data about the mail is registered in the database.

GIS also provides an information infrastructure that benefits other government agencies and contributes to the development of the kingdom's e-government and e-commerce initiatives.

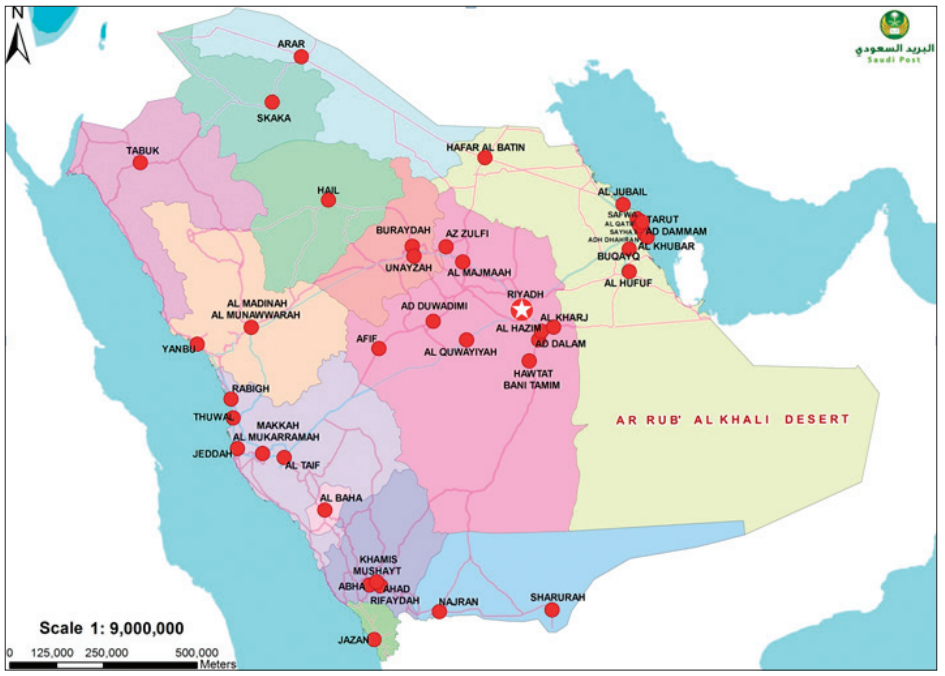
Following evaluation, the project team chose ArcGIS because it meets the criteria of having a rich development environment and powerful tools. The team also liked ArcGIS for its ability to quickly manage and access data and meet project goals on time. Saudi Post's GIS consists of ArcGIS Server and ArcGIS Desktop, as well as Microsoft SQL Server. GIS joins the geodatabase to Saudi Post's strategic services data and integrates with other core systems, such as the mail dispatching and customer relationship management systems.

ArcGIS played an important role as a solution for approaching this geographic problem of assigning postal codes and addresses for improving mail services. Saudi Post divided the Kingdom of Saudi Arabia into postal regions, then divided these into branches, which were further separated into divisions. The divisions were then broken into postal quarters, which were assigned postal codes. This 5-digit number represents region, sector, city, and zone.

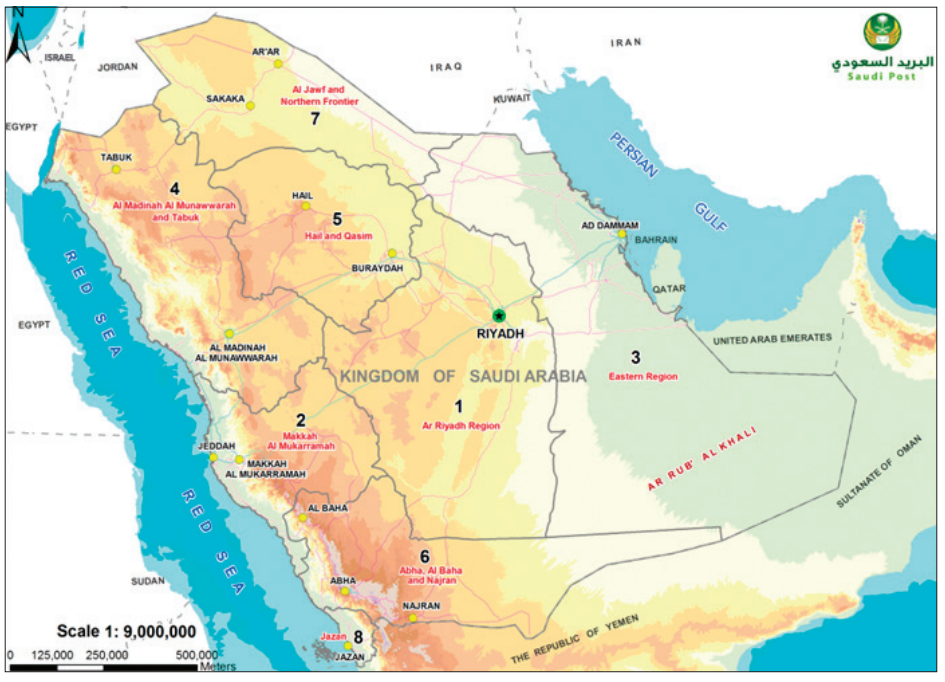
With the launch of the Unified National Addressing System, Saudi Post began assigning postal addresses by calculating x-coordinates with an absolute value between 2000 and 5999 and y-coordinates with an absolute value between 6000 and 9999 for each location inside the kingdom. The x-coordinates are the building numbers. The y-coordinates are the additional numbers for buildings that face an east–west road. Conversely, for the buildings that face a north–south road, the y-coordinates are the building numbers and the x-coordinates are the additional numbers. Also, the building is assigned an odd number if it is on the right side of a north- or eastbound road, and the building is assigned an even number if it is on the left side of a north- or eastbound road. This way, Saudi Post succeeded in assigning a unique and systematic postal address for each location inside the kingdom, with each 13-digit address consisting of a unique combination of 5 digits for the postal code, 4 digits for the building number, and 4 digits for additional numbers.

ArcGIS Mobile has made it possible for Saudi Post's mail dispatch management system to accurately track and efficiently route courier delivery. Envoys at the distribution center disburse bundles along with a list of mail recipients to couriers, who carry handheld mobile GIS/GPS devices. Using these devices, they upload the address list to Saudi Post's GIS, which in turn computes it and provides each courier with the best route, thereby speeding the delivery service. When a courier reaches a delivery point, the handheld system reads a chip implanted in the mailbox, which confirms that the courier reached the box. These handheld devices contain a locator so that couriers can be tracked by each delivery center. Couriers also use the device to update and make edits to the database from the field.

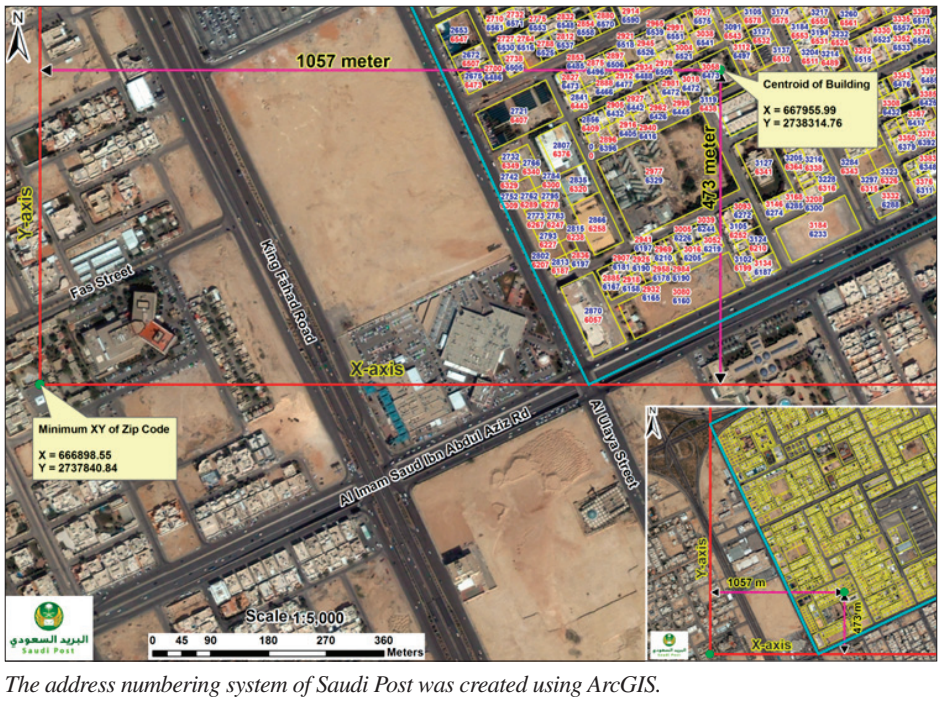
Saudi Post uses GIS for other types of analyses. A road network data analysis and distribution analysis includes evaluating relationships of road centerline data layers, parcels and point layers, and postal code polygons. A buffer analysis is used to equally distribute home and building route assignments to couriers.



These Saudi Arabian cities have now implemented the new postal system.



The eight postal regions of Saudi Arabia.



The address numbering system of Saudi Post was created using ArcGIS.

"Our huge database is an integration project that serves our demanding e-services and applications," notes Ali H. Bakheet, GIS director of Saudi Post. "It reflects daily updates."

These e-solutions add value to Saudi Post's GIS and geodatabase. The team developed an online postal Web locator that allows government, businesses, and the public to interact with postal data via an interactive map. Web tools on the back end of the Web site help staff and contractors maintain addresses, postal plates, and box data for every parcel in the kingdom. Government and private authorities, including banks, are using the system to verify addresses for clients and customers. Commercial establishments, such as fast-food companies, also access the GIS to help them deliver their products to customers. A new integrated service, e-mall, makes it possible for a person to buy a product via the Web site and have Saudi Post deliver it to the customer's home.

Saudi Post now annually delivers 900 million pieces of mail. The immensity and quality of the change has been noticed by the international community. In 2009, Saudi Post received Esri's prestigious GIS Technology Innovation Award, as well as awards from Cisco, Microsoft, and Oracle. The United Nations Universal Postal Union also recognized Saudi Post's innovative program as a proof-of-excellence project.

For more information, contact Ali Bakheet, GIS director, Saudi Postal Corporation (e-mail: ahbakheet@sp.com.sa). Learn more about ArcGIS Server at **esri.com/arcgisserver**.

Conservation Data Sharing Web Site Off to a Fast Start

By James R. Strittholt, Executive Director, Conservation Biology Institute

Data Basin is a Web-based conservation data sharing and learning system (**databasin.org**) launched this past summer by the Conservation Biology Institute [*see* ArcNews, *Summer 2010, Volume 32, No. 2, p. 34*]. Since midsummer, Data Basin has seen a fourfold increase in registered users from diverse backgrounds and has undergone huge growth in the number of spatial datasets uploaded (more than 2,000), with the number of maps, galleries, and groups created by users steadily on the rise.

Users are finding the many technical and social features provided by the ArcGIS.com site-supported Data Basin easy to use and powerful in helping them achieve their conservation goals and objectives. For example, professor Janet Silbernagel from the University of Wisconsin, Madison, created a forest scenarios group in Data Basin to advance strategic conservation planning for the Upper Great Lakes region (United States). Dr. Fernanda Zermoglio has created a group to strengthen disaster risk management for Mozambique in response to climate change, and Elizabeth Mather and her fellow group members are using Data Basin to help the Western Reserve Land Conservancy in northeastern Ohio review and exchange spatial data.

Users are publishing galleries to highlight collections of datasets and/or maps. Richard Nauman uploaded a gallery of 18 datasets on temperate rainforest distributions for various parts of the world. These datasets appeared as maps in a new book entitled *Temperate and Boreal Rainforests of the World,* edited by Dominick DellaSala and published by Island Press. Those who want to learn more about climate change projections for the Pacific Northwest can explore a series of datasets (credited to Chris Daly, Oregon State University) and maps from a gallery posted by Dr. Dominique Bachelet. They can also locate the latest protected areas datasets for the United States aggregated by the Conservation Biology Institute. Users can view these and other content-rich galleries in Data Basin or create their own.

Significant improvements have been made to the way datasets are branded, tagged, and credited, and users can more easily determine the peer review status of each dataset. Data Basin users are now being encouraged to upload their own datasets to the system. Links to external map services, enhanced searches, improved metadata and map pages, improved group functions, and the ability to share content outside Data Basin are also among the new functions.

The Data Basin team is also very excited about offering a select number of simple yet powerful analytic tools to users. For example, the Conservation Biology Institute recently deployed a prototype model called Benchmark Builder, developed by researchers at the University of Alberta, that aids in the selection of new ecological reference sites that can serve as fully functional protected areas throughout the boreal regions of Canada. Other analytic tools under development focus on helping users avoid environmental risk, evaluate green energy impacts, and plan and design wildlife corridors.

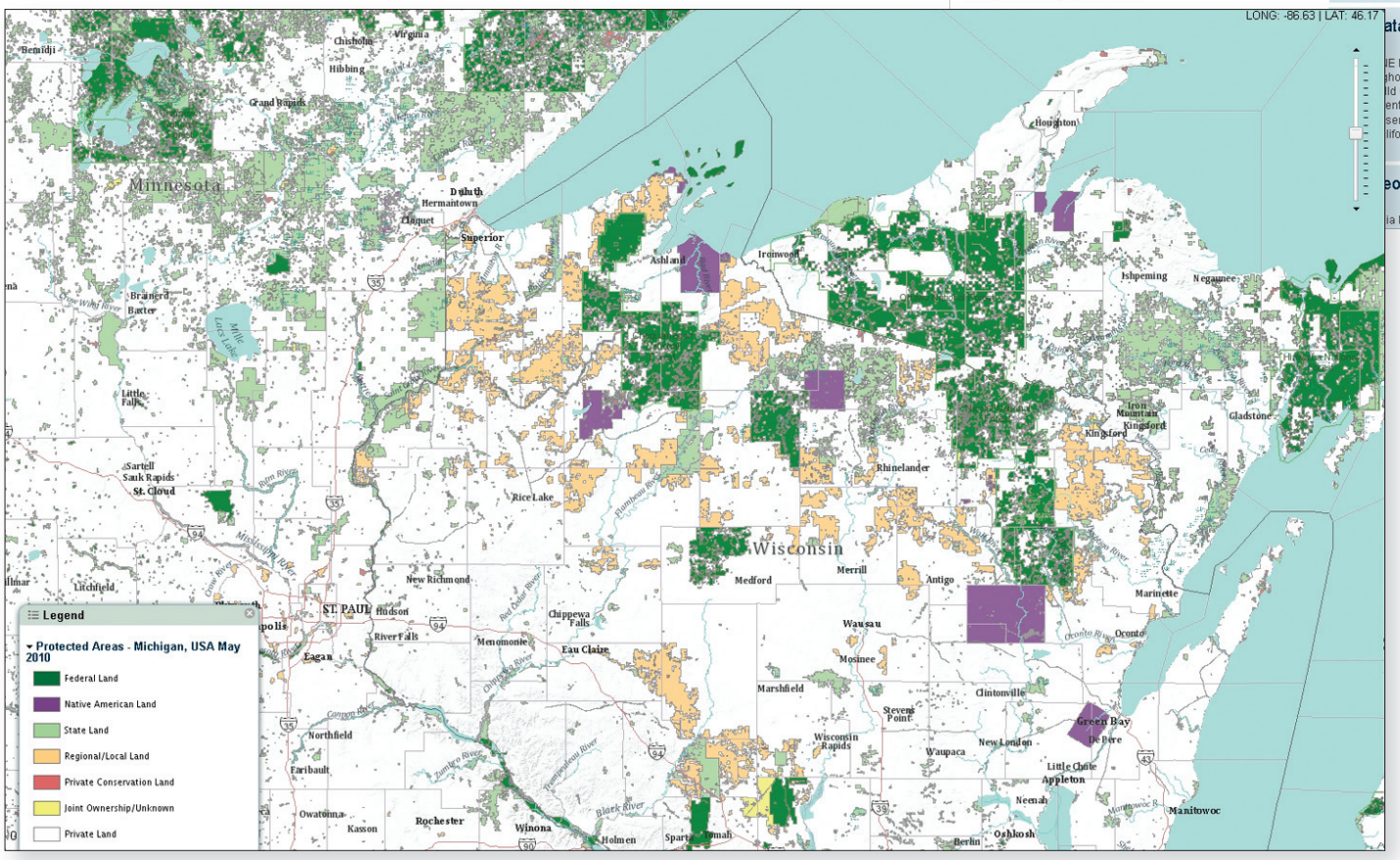
Data Basin recently launched its newest center, the Connectivity Center, that focuses on the opportunities and challenges pertaining to connecting with wild nature. Here, users will gain direct access to some of the most useful spatial datasets, tools, and working groups focused on this important conservation topic. Some of the initial efforts featured in the Connectivity Center include recent modeling that identifies potential wildlife corridors in California and Colorado and ongoing multistakeholder conservation measures in the southern Sierra region of the United States.

Perhaps the most exciting new development in Data Basin is the debut of a series of new Gateways—specific content and tools developed and branded for specific user groups or institutions. Data Basin's first gateway is sponsored by the Forest Stewardship Council (FSC). The gateway is intended to directly support forest certifiers and others interested in applying the FSC Controlled Wood Standards for sustainable forest management—those that balance social and environmental considerations. Additional gateways are also under development, including one for the Inter-American Biodiversity Information Network that will involve linking five data networks throughout Latin America using Data Basin as the integrating technology.

In the months ahead, a number of new advances are scheduled. The global demand for Data Basin has prompted us to offer the site in multiple languages, and that work is currently under way. Geographic search functionality, more visualization tools (e.g., animation), more analytic tools, and more social networking functions will also be coming soon. One of the most exciting new developments will be the integration of Data Basin with the growing number of conservation-focused citizen science initiatives, empowering a new group of people to participate in and help find solutions to conservation issues in new ways.

The future is exciting, and the Conservation Biology Institute invites you to become a member to explore, create, share, and learn. When you do, please provide us with feedback, enabling us to better serve you so you can better serve the planet.

From the Connectivity Center landing page, users access spatial datasets, tools, and working groups.



Protected areas for a portion of the Upper Great Lakes region of the United States.

For more information, visit **databasin.org** or contact Jim Strittholt, executive director, Conservation Biology Institute (e-mail: stritt@consbio.org; tel.: 541-757-0687, extension 1) or Tosha Comendant, Data Basin project coordinator, Conservation Biology Institute (e-mail: tosha@consbio.org, tel.: 707-266-4270).

National Spatial Data Infrastructure Advances

Building the Geospatial Platform

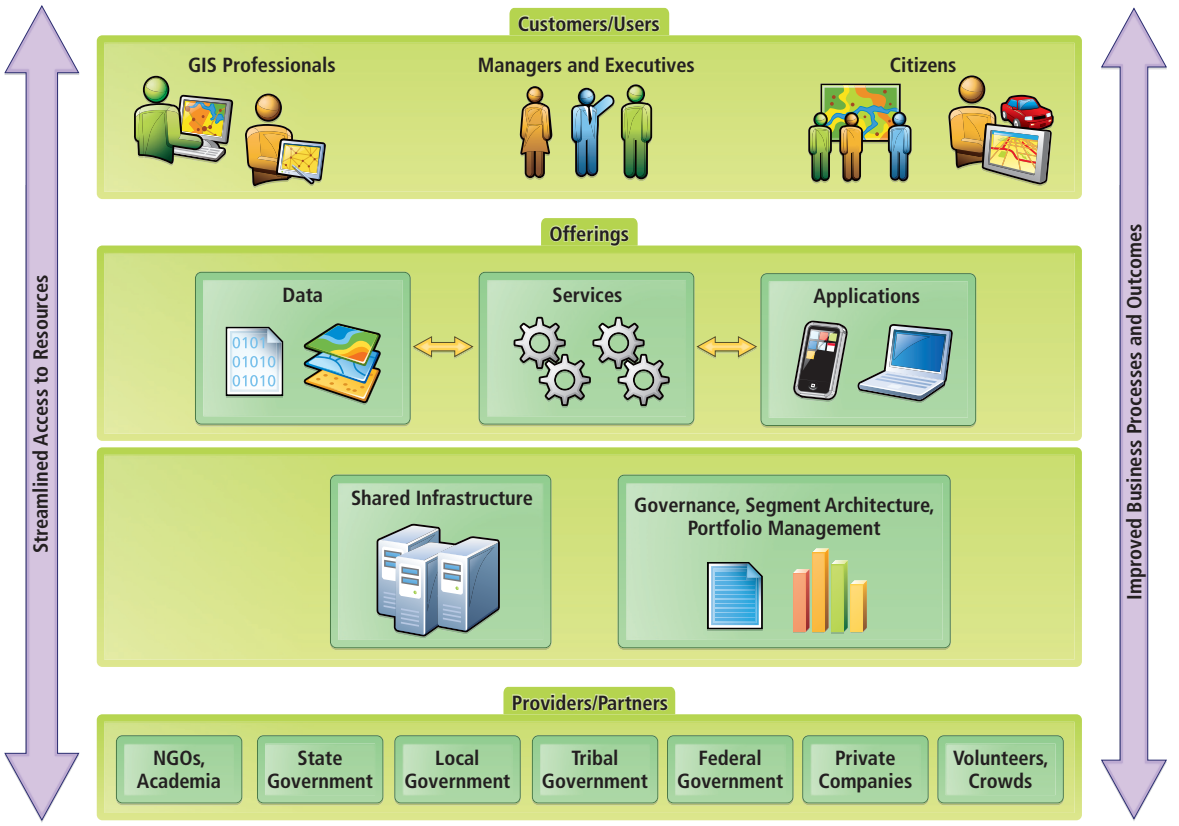
One of the most exciting and progressive advancements for the National Spatial Data Infrastructure is the recent call by the administration for the creation of a geospatial platform to promote the sharing of geospatial data, services, and applications to support all levels of government; the vision for this managed portfolio is for it to be

- Contributed to and administered by authoritative sources
- Hosted on a shared infrastructure
- Meeting the needs of government agencies and partners

The platform will provide the environment and leadership to drive technology investments and capabilities to maximize increasingly tight budget resources to meet growing public demands for services. The platform will leverage the expertise and data holdings of geospatial organizations and enhance the nation's development of and access to all things geospatial.

As the concept for the platform developed, the National Geospatial Advisory Committee (NGAC) provided feedback, comments, and suggestions. NGAC, which includes representatives from the private sector, nonprofit organizations, academia, and all levels of government, approved the following resolution in support of the platform earlier this year:

The NGAC endorses the Geospatial Platform concept model as described in the Platform Roadmap and encourages the Administration, along with federal agency leadership, to adopt, support, and implement this initiative in partnership with State, local, regional and Tribal governments.



Geospatial platform conceptual model.

Says Anne Hale Miglarese, NGAC chair, "The NGAC is highly encouraged that the administration has directed federal geospatial managers to develop a geospatial platform that incorporates common services, portfolio management, place-based initiatives, and an emphasis on addressing intergovernmental requirements. We look forward to continued collaboration on this important initiative."

The partner agencies of the Federal Geographic Data Committee (FGDC) and its stakeholders in government, academia, and the private sector are developing the foundational plans for the platform, which will promote information sharing throughout the geospatial and other communities and provide opportunities to conduct business in new and innovative ways.

"Coordinating the development and delivery of the nation's geospatial data and services is a complicated task," says Ivan DeLoatch, executive director of FGDC, "but the geospatial platform provides a means for us to work together as a community to provide these critical products and services."

Implementing the platform strategy will result in a set of future benefits where

- Commercial, academic, and nonprofit organizations, as well as all levels of government, work collaboratively with a common set of geospatial policies, procedures, standards, and data models; share common goals and objectives; and coordinate and leverage their efforts.
- Authoritative and interoperable geospatial information and tools are available, accessible, consistently delivered, and routinely used.
- Incentives are in place to ensure equitable technology cost sharing, cost-effective initiatives, continuous progress, and innovation.
- Economies of scale drive technology investments to help leverage increasingly tight budget resources in the face of growing public demands for services.

As a means to provide an organized approach to the development of this geospatial infrastructure, FGDC agencies have developed a high-level implementation plan, the Geospatial Platform Modernization Roadmap. The road map is available at **geoplatform.gov**. The key components are

Common data, services, and applications—The platform will deliver trusted and registered geospatial data, services, and applications that are valuable to multiple agencies or customers to meet their business requirements.

Shared infrastructure—The platform will promote and foster utilization of contemporary IT solutions (e.g., cloud computing) and shared investments across multiple partner organizations.

Geospatial segment architecture—Platform components will be designed and deployed through a process-driven approach that can be readily used in solution architectures by partners collaborating on geospatial data and services.

Collaborative governance—The platform will be managed in a collaborative manner, allowing partners and stakeholders to help shape its structure, functions, and capabilities.

Portfolio management—The platform will support the prioritization, selection, and allocation of resources to maximize value in geospatial data, services, and applications.

Stakeholder Engagement

FGDC is seeking community input on the development of the geospatial platform. The outreach process includes use of a social media Web site—**geoplatform.ideascale.com**—to generate dialog and seek suggestions on how to improve the platform proposal. Comments can also be sent to geoplatformcomments@fgdc.gov. Following completion of the initial stakeholder engagement process in December 2010, FGDC will revise and update the implementation plan to incorporate feedback received from partners and stakeholders.

For more information about the geospatial platform, visit **geoplatform.gov**. To provide your input, you are invited to join in the conversation at **geoplatform.ideascale.com**.

A Call to Action

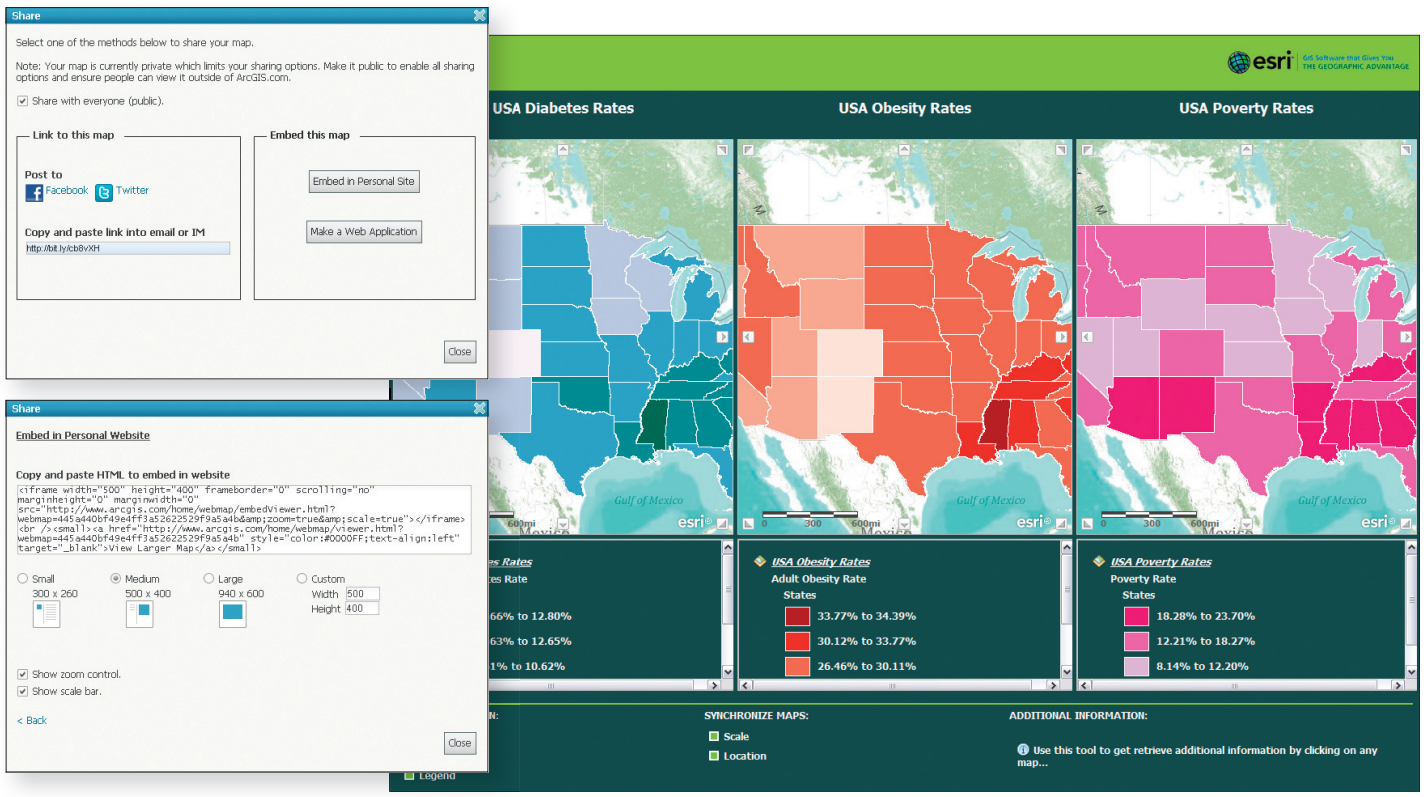
President's Budget Fiscal year 2011:
In 2010 and 2011, federal data managers for geospatial data will move to a portfolio management approach, creating a Geospatial Platform *(see diagram)* to support GeoOneStop, place-based initiatives, and other potential future programs. This transformation will be facilitated by improving the governance framework to address the requirements of State, local and tribal agencies, Administration policy, and agency mission objectives. Investments will be prioritized based on business needs. The Geospatial Platform will explore opportunities for increased collaboration with Data.gov, with an emphasis on reuse of architectural standards and technology, ultimately increasing access to geospatial data.

Sharing Your Maps Has Never Been Easier

Embed Your Maps and Create Custom Apps with No Programming

Highlights

- Quickly embed maps in Web pages, e-mail, or social media sites.
- Leverage custom Web application templates, along with ArcGIS Online maps.
- The side-by-side map application template shows relationships between three maps.



Maps can be embedded in Web pages and Web applications with just a few clicks. Users choose the size of the map and what controls to include.

As access to maps has become more and more ubiquitous in the online world, most people now expect to see a map as part of a story or even have the map tell the entire story. ArcGIS users and other professionals now have an easy way to share their maps with a broad audience and leverage templates to quickly customize maps to fit their needs.

Embedding Maps

Any map created with or that can be opened with the ArcGIS.com viewer, including basemaps that have been published by Esri—for example, the World Topographic Map—can now be embedded in a Web page with just a few simple steps. One way to quickly share a map is to copy the long URL that appears in the Web browser address bar of the ArcGIS.com viewer and paste it into an e-mail or Web browser. Another way is to use the Share button in the ArcGIS.com viewer. Here, you can choose to share your map via your Facebook or Twitter account with the click of a button, or you can just copy a shorter URL and paste it into an e-mail, instant message window, or Web browser. You can also choose to embed a map in a personal Web site or Web application.

To get started with embedding a map, first choose the size of your map and decide whether you want to include a zoom control and scale bar. Then all that's left is to copy and paste the HTML code into a text editor like Notepad (any text editor will do) and save the file as an HTML extension. Double-clicking the saved file will bring up the HTML page with the map in it. Bloggers and others who want to add a map to their Web page that has an existing layout can follow the same process, but instead of being copied into a text editor, the HTML code is copied to the View Source page and saved. Now, within seconds, anyone can add a map to a Web page to support a story and tell it more effectively.

Using Custom Application Templates

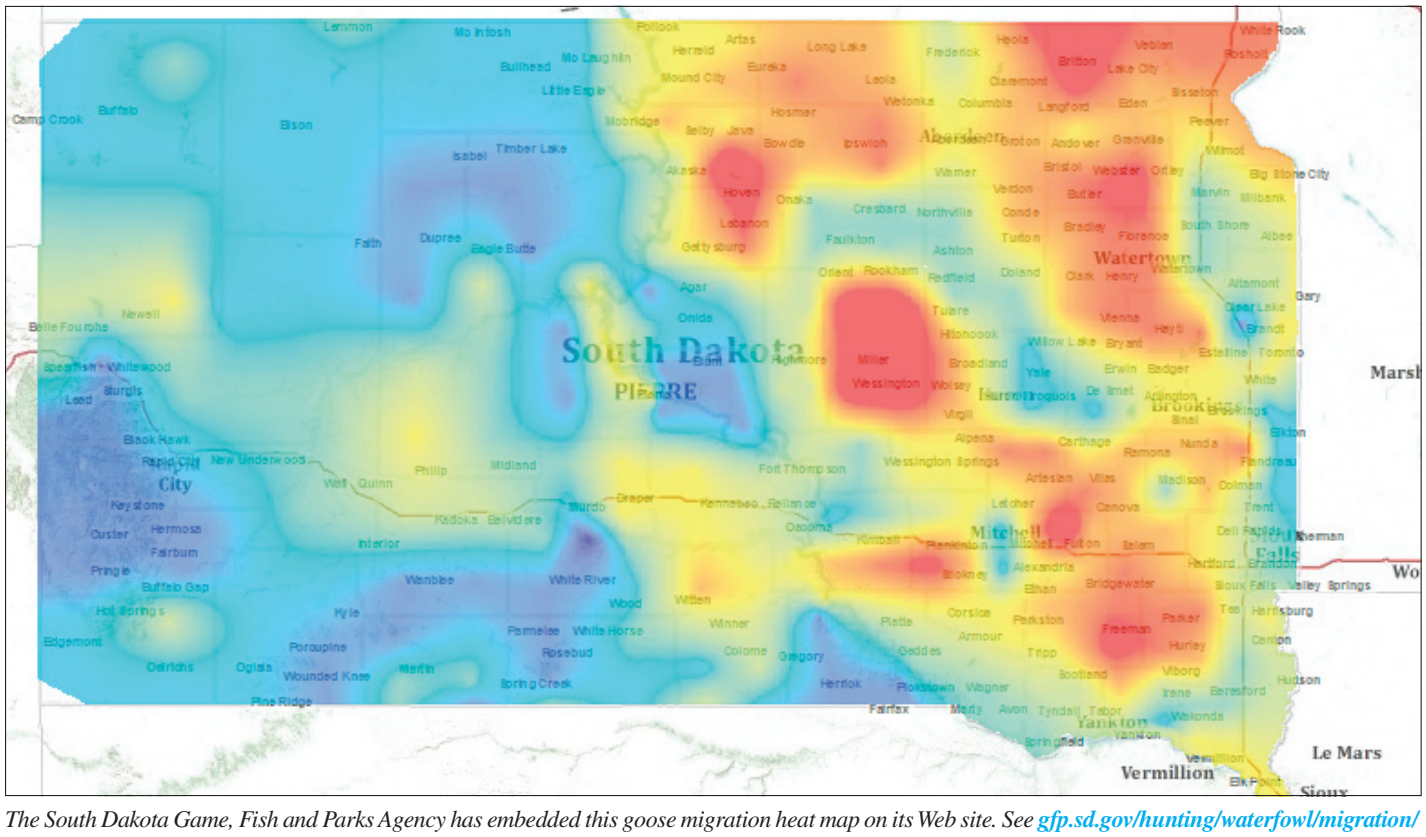
To help you create apps more quickly, custom JavaScript applications have been created that can be used directly with ArcGIS Online maps. You can now access more than 20 application templates through the ArcGIS.com viewer and leverage them with any of your saved maps in My Content in ArcGIS.com. Or you can simply select a basemap from the basemap gallery, such as World Street Map or World Topographic Map. Once the map has been opened in the ArcGIS.com viewer, click the Share button in the ArcGIS.com viewer and select Make a Web Application. You can review each application template before deciding which one to use. After downloading the template, you will be prompted to save a ZIP file containing everything you need to create the Web application, including step-by-step instructions. Another way you can use the application templates is to copy and paste the URL that appears in the preview window of the application template.

Like Web maps, each application has a unique and permanent identifier that can be used to share the application with others. Some of the templates available through ArcGIS.com are also available at the ArcGIS Resource Center for ArcGIS API for JavaScript under the ArcGIS.com samples. Just go to **resources.arcgis.com** and click Web, then Web APIs, then JavaScript. Select the Samples tab and scroll down to ArcGIS.com on the left side. There, you can preview live samples of the templates, and you can see the unique identifier in the browser address bar, expressed as a URL parameter. You can also publish any map by simply copying and pasting the source code found in the sample documentation into an HTML file and saving it.

One particular example of a custom application is the new map comparison template. With this template, available only through the ArcGIS.com viewer, you can compare three ArcGIS Online maps side by side. For instance, you can look at individual maps about diabetes, obesity, and poverty rates and compare them in one view. All three maps are synchronized, so when you zoom and pan in one map, the other two maps will automatically adjust to the same scale and location. Information about the maps, such as description, content, and legend, is also synchronized to display on all three maps. When you use the Identify tool, information about features at the same location is displayed in all three maps. This provides you with a visually compelling and intuitive way to compare the different maps at the same time and gain a common understanding of several themes and the relationships between them. You also have the ability to modify the JavaScript source and adjust the look and feel of the template to meet your needs, add your own tools, and much more.

Embedding maps and using custom application templates are just two of the latest improvements in ArcGIS Online.

Visit arcgis.com today to start embedding your maps more quickly.



The South Dakota Game, Fish and Parks Agency has embedded this goose migration heat map on its Web site. See gfp.sd.gov/hunting/waterfowl/migration/default.aspx.

Free ZIP Code Lookup Gives the Scoop on Any Area in the United States

Highlights

- Get a free demographic snapshot of any ZIP Code in the United States.
- Profile markets for more accurate targeting.
- Take the analysis farther with Business Analyst Online.

The new ZIP Code Lookup tool allows anyone to enter any ZIP Code in the United States and quickly learn about the people who live in that area. The tool displays valuable demographic and market information, such as household type, income, employment, vehicle preferences, and leisure activities.

Once a user enters a ZIP Code, the browser-based Silverlight application instantly generates the top three Tapestry segments for that area. These segments are based on Esri's Tapestry Segmentation, a system for classifying U.S. residential neighborhoods into 65 unique market segments based on socioeconomic and demographic characteristics. The power of Tapestry Segmentation lies in the ability to profile and, therefore, more accurately target diverse markets.

The Tapestry segments provide portraits of the many and diverse U.S. consumer markets. For instance, the *Laptops and Lattes* segment is made up of middle-aged singles with bachelor and graduate degrees. They are primarily white, prefer to bank online, own iPods, and shop at Banana Republic. *Urban Villages* residents are in their early 30s; have some college education; and are primarily white, Asian, or Hispanic.

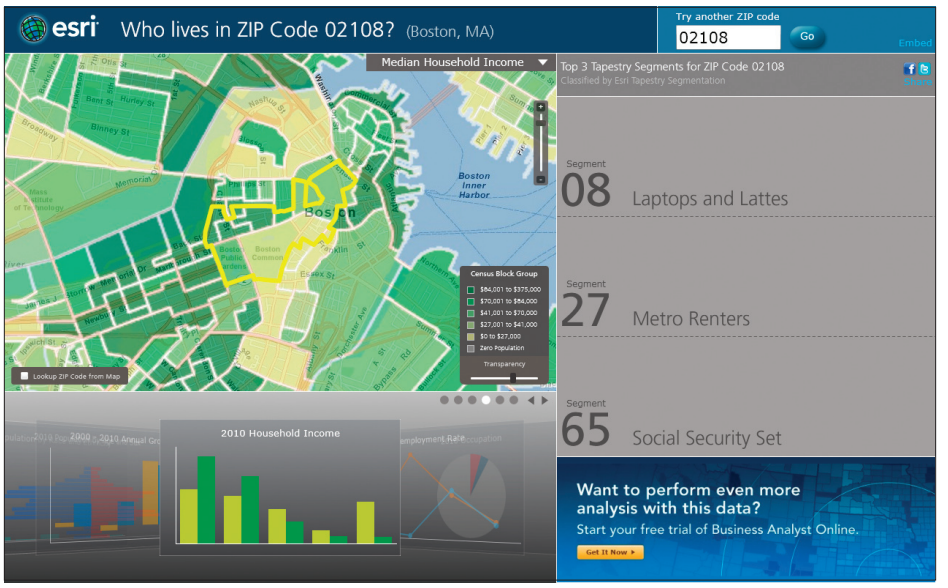
In addition to the Tapestry data, the ZIP Code Lookup tool also provides specific demographic information, such as household income, unemployment, and age and race/ethnicity breakdowns for specific ZIP Codes, along with the U.S. averages. The information is displayed in bar and chart diagrams, making it easy to quickly see how the area stacks up against the rest of the country.

All this valuable information is available for free through the application. It provides a quick overview of the people in an area, helping users get an idea of the marketability of a location or just learn more about the neighborhood. The tool can also easily be embedded on any Web site by simply copying and pasting the code provided in the application into a blog or Web page.

Those that want to get even more detailed analyses can utilize the browser-based, on-demand market analysis tool, Business Analyst Online (BAO). All the Tapestry Segmentation and demographic data used in the ZIP Code Lookup tool is available in BAO, along with consumer spending, business, and market data. BAO combines this data with GIS technology to deliver even more detailed information about various populations and their lifestyles and buying behaviors, as well as information about businesses in a specific market area. Users can perform drive-time analyses, evaluate sites, and identify their most profitable customers and reach more like them.

Look up any ZIP Code in the United States at esri.com/zipcodelookup.

To learn more about BAO and sign up for a free trial, visit esri.com/bao. The Tapestry Segmentation and demographic data in the ZIP Code Lookup tool and BAO is also available for the iPhone or iPad with BAO for iOS. Download the free app today to get the information needed to instantly evaluate an area on the go. Visit esri.com/baoforios for more information and to download the app.



Enter any U.S. ZIP Code in the ZIP Code Lookup tool and find out demographic and lifestyle information for people living in that area.

For Additional Information About Esri Products

Inside the United States, please call Esri at 1-800-447-9778.

Contact your local office:
esri.com/locations

Contact your local Esri reseller:
esri.com/partners

Multistop Route Optimization Now Online

ArcLogistics Provides Free Single-Vehicle Routing

Anyone in the United States in need of scheduling and routing multiple stops throughout the day for a single vehicle can now use ArcLogistics free of charge.

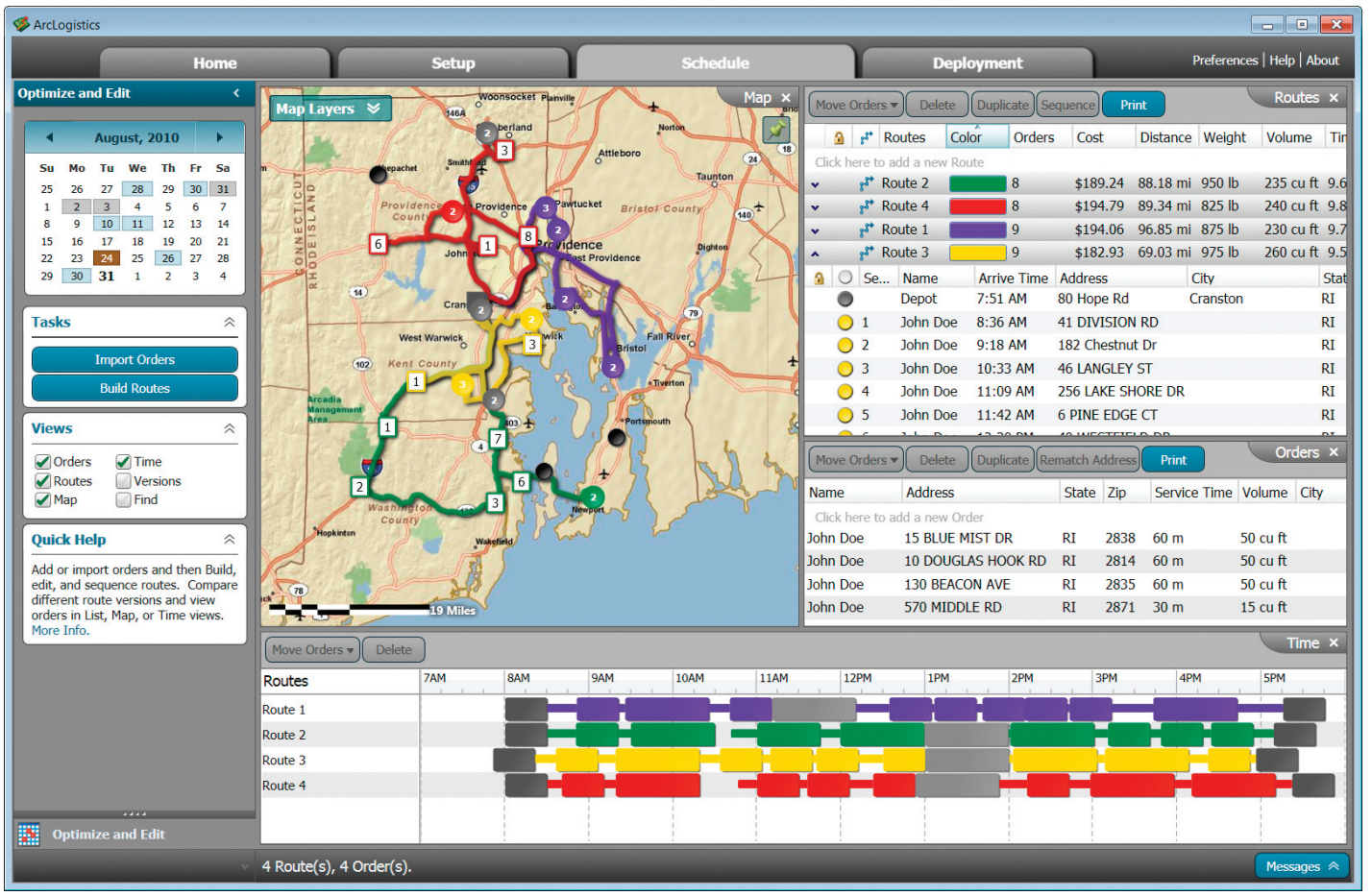
Esri's cloud-based vehicle routing and scheduling solution now includes a free single-vehicle subscription option that's perfect for sales professionals, lawn and pool services, or anyone who needs to find the best routes for a single vehicle.

ArcLogistics is used to create optimum routes and schedules based on specific business operations, including vehicle capacities, driver specialties, street network restrictions, and customer time windows. The solution is designed to help anyone who needs to move goods and services to the right place at the right time for minimum costs. Customers who use ArcLogistics to plan their routes typically save up to 30 percent on overall vehicle-related costs.

Now, single-vehicle operators can take advantage of the free ArcLogistics subscription and improve business operations by creating optimized routes that eliminate unnecessary driving and tighter schedules that improve delivery time windows.

Additionally, larger organizations with multiple vehicles can use their free one-vehicle subscription to determine whether ArcLogistics will help the rest of their fleet.

The latest version of ArcLogistics also includes the following key enhancements:



Routes and schedules created with ArcLogistics are easy to edit and can be changed as needed.

- *Setup wizard*—Each time a new routing project is started, the option of using a quick wizard is provided to set up the basic attributes of the fleet. This helps reduce the time it takes to import vehicles, drivers, and orders.
- *Improved address management for orders*—If an address is manually edited or moved, ArcLogistics will retain the edit and place it in the desired location next time it is imported or entered, reducing the time it takes to deal with problem addresses each time they are visited.
- *Secure services*—Esri-hosted mapping, routing, and geocoding services have been updated to use the secure HTTPS protocol.

To start a free one-vehicle subscription, visit esri.com/arclogistics and sign up for a 30-day trial, which allows the routing and scheduling of up to 50 vehicles. After 30 days, the trial converts to a one-vehicle-for-free yearly subscription.

Esri Podcasts

Esri podcasts are a free and easy way to get the latest news from Esri and its users and partners. Esri Instructional Series podcasts focus on new and updated software features. Visit esri.com/podcasts.

ArcGIS API for iOS Now Available

continued from cover

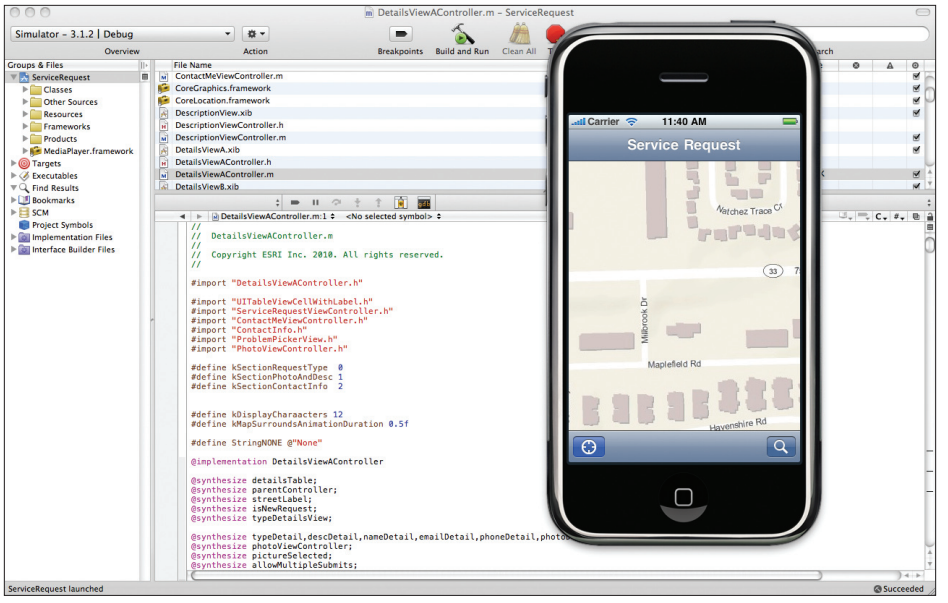
What Users Can Do with the API
With the API, users can

- Display and use maps that blend map services from ArcGIS Online and/or their ArcGIS Server.
- Execute sophisticated geoprocessing tasks and display their results.
- Search for and identify features.
- Create useful reports of features they've found.
- Collect locations by sketching on the map or using the GPS embedded in their iOS devices.
- Match addresses to specific locations.

What the API Includes
The API provides the following resources for use in iOS applications:

- *Maps and Layers*—The API supports the display of both dynamic and cached (tiled) map services. With ArcGIS API for iOS, users can display maps in any projection.
- *Graphics*—The API can enhance applications by allowing users to draw graphics or by providing informational pop-up windows when a user taps on a graphic feature.
- *Tasks*—It provides common GIS tasks such as querying, searching for and identifying features, finding addresses and places, geoprocessing, and collection.

The API enables organizations to create mobile solutions that extend to a wider market via the Apple App Store. Developers and Esri partners can also use the API to create applications for both external and internal use. The API includes native Objective-C libraries, sample applications, templates, samples, and help guides that can be used within the Xcode integrated development environment. In addition, there are a variety of community resources, including forums, blogs, and code galleries, available to help users get up and running quickly.



Code built using ArcGIS API for iOS.

To get started using ArcGIS API for iOS, visit **resources.arcgis.com/content/arcgis-iphone/api**.

University of Oregon Uses ArcGIS API for iOS

Creates Custom iPhone Application for Students and Faculty

As an existing ArcGIS Server user and key ArcGIS API for iOS early adopter, University of Oregon's (UOregon) InfoGraphics Lab set out to provide a free, useful mobile mapping application for the university's 20,000 plus students and faculty members. With support from the Department of Geography and Office of Communications, the InfoGraphics Lab built an official campus-themed iPhone application that would provide practical maps and tools for the entire University of Oregon campus.

The lab consists of graduate student developers, undergraduate cartographers, staff, and faculty who worked together to design the UOregon application using ArcGIS API for iOS. The team had previous GIS experience using Esri's Web mapping APIs and was able to build the initial iPhone prototype application in just a couple of weeks. They wanted to go beyond geocoding points on Google Maps and needed an application that could accommodate high-resolution vector overlays that would render correctly and run effectively. With ArcGIS API for iOS, the team had plenty of resources already intact, along with the ability to serve maps as a tiled image cache.

One of the team's biggest challenges was rethinking and redesigning all the existing campus maps to fit the iPhone's limited screen real estate. The InfoGraphics Lab was able to integrate search and map features contained in the ArcGIS API into its own application.

"We took inspiration from Esri's ArcGIS API for iOS application," says Ken Kato, assistant director of UOregon's InfoGraphics Lab. "There were a number of aspects in Esri's iPhone application that we thought were great, and we incorporated some of them into the development of ours—in particular, the clean simplicity of the search function that presents the user with an entire page to view results and make selections, as well as the interface for browsing and selecting custom map services."

The UOregon application includes a GPS feature that shows users where they are on campus; provides point-by-point map directions showing the most accessible walking and bicycle routes and the safest routes at night; parking and transit maps; and aerial map overlays with campus images from 2008, 1947, and 1913. There is also a useful Walk Me feature that displays a route of start and end points anywhere on campus, including estimated walking time.

UOregon iPhone app provides valuable resources for students and faculty.

University of Oregon's mobile mapping technology also helps students find their classes, access campus security in the event of an emergency, locate on-campus activities, and keep up with social media. Application users can also stay up to date on UOregon news and events, view the 295-acre campus with a continuously updated feed of photos and videos, and listen to the Oregon Marching Band play the school's fight song, "Mighty Oregon."

With more than 5,000 students and faculty currently using the UOregon iPhone application, as well as positive feedback and very favorable ratings in the Apple App Store, it won't be long before other colleges and universities integrate mobile GIS mapping capabilities to create an immediate, on-the-go experience that is always available for students right at their fingertips.

For more information on the UOregon iPhone application, visit **uoregon.edu/mobile**.

Business Analyst Online Provides Free Market Facts on the iPhone

New Version of BAO for iOS App Now Available

Highlights

- Instantly evaluate any area in the United States on-site.
- Access demographic reports and maps on an iPhone or iPad.
- Add free industry-specific FactPaks.

The free Esri Business Analyst Online (BAO) for iOS app provides on-the-go access to market and demographic analysis, allowing users to instantly evaluate any area in the United States using an iPhone or iPad. BAO for iOS provides the facts needed to answer three key questions about a location:

- What types of people live here?
- How do they differ from people in another location?
- Is this a good location based on specified needs?

The latest version of the app allows users to do even more. Now optimized for the iPad in addition to the iPhone, BAO for iOS includes the ability to customize the analysis areas and get industry-specific facts, such as the amount of money spent on travel and the percentage of people that regularly read magazines.

BAO for iOS is a mobile version of the full BAO Web application, a solution that combines GIS technology with the latest demographic, consumer spending, and business data to generate market reports and maps. With this subscription-based solution, users are able to analyze their business and trade areas to make informed decisions to sustain and grow their organizations.

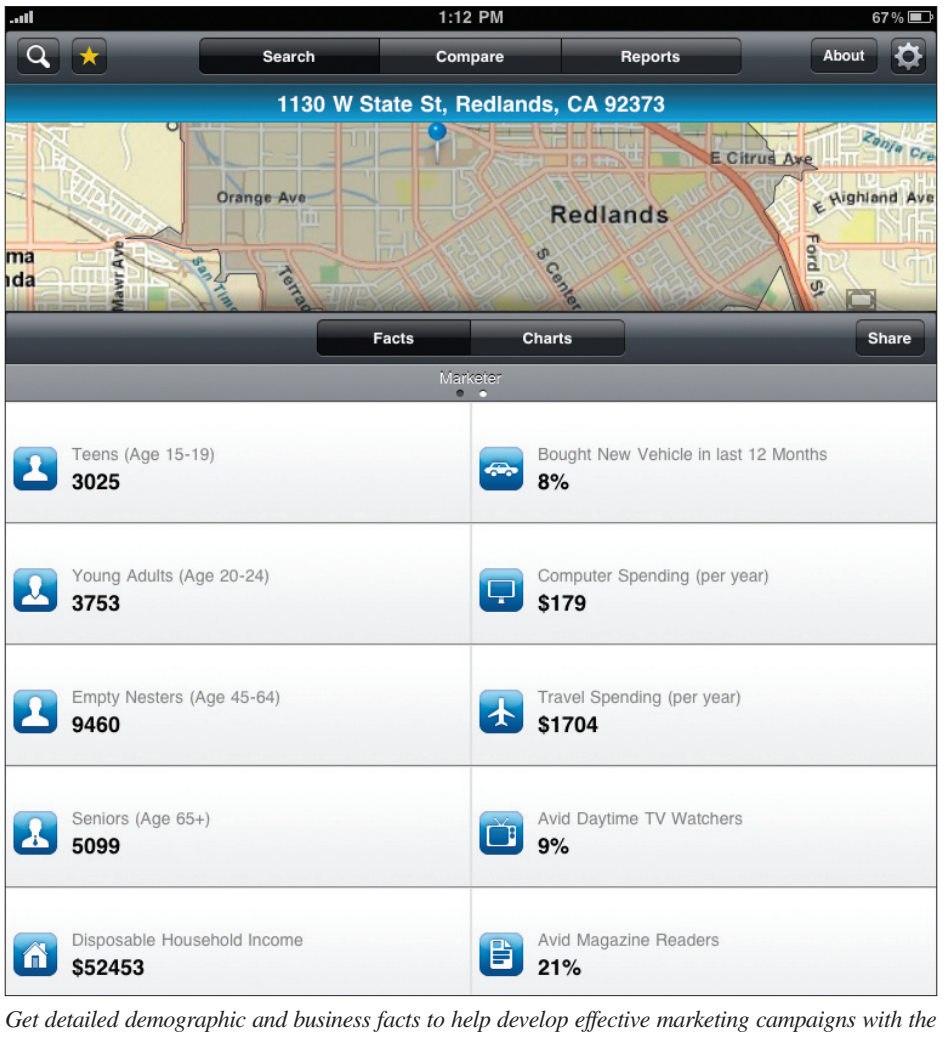
Subscribers to the full BAO application can now also access all the reports and maps included in their subscription on an iPhone or iPad. Users no longer have to be at their desk to access the detailed data; they can now pull up reports right on their mobile device.

iPhone and iPad users who have a subscription to the full BAO application also have the ability to adjust their areas of analysis. Users without a subscription are restricted to a 1-mile radius or a 1-minute drive-time area. Subscribers can adjust the analysis area to anywhere from a 1- to 100-mile radius or from a 1- to 60-minute drive time, allowing them to generate more customized reports on the fly.

BAO for iOS now goes beyond demographic and business data to provide industry-specific facts. These free FactPaks are made up of key variables pulled from the extensive collection of data in the full BAO Web application. In addition to the basic FactPak for Demographics & Lifestyles, which is called "The Basic Facts," there is now one for Marketers, which is called "Facts for Marketers." Each collection of variables provides key information that allows users in the relevant industry to make more informed business decisions.

For example, Facts for Marketers includes information such as disposable household income, population by age, percentage of avid daytime TV watchers, and percentage of people that purchased a new car in the past year. Marketing professionals can leverage the FactPak to help better target new customers and retain existing ones. These FactPaks are available for free from within the app; no subscription is required. The next release of the BAO for iOS app will include even more FactPaks, focusing on different issues and industries such as health, government, retail, and travel/tourism.

For more information and to download the free BAO for iOS app, visit **esri.com/baoforios**. To learn more about the full BAO Web application and subscription options, visit **esri.com/bao**.



Get detailed demographic and business facts to help develop effective marketing campaigns with the new free Facts for Marketers FactPak in the BAO for iOS app.

Add Demographic Data and Reports with New ArcGIS Desktop Tool

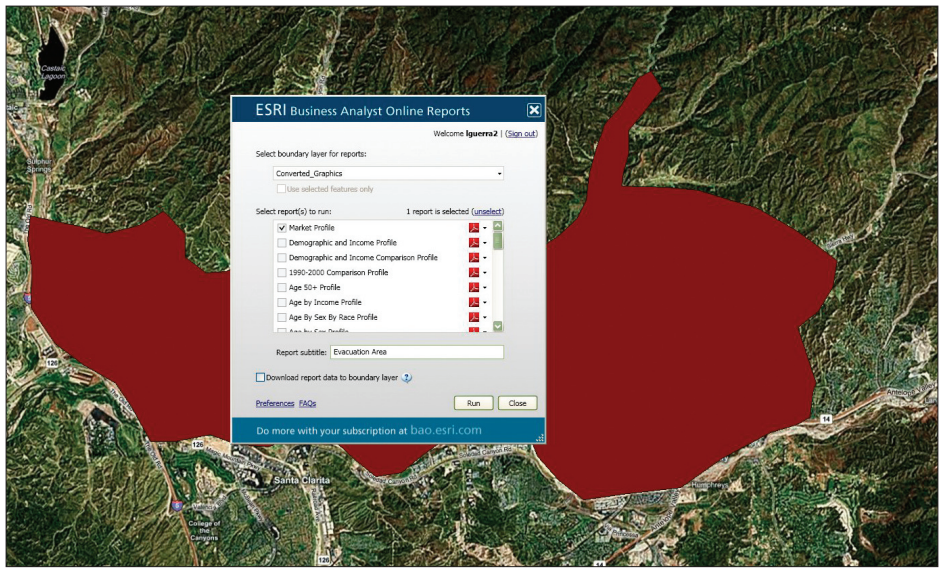
Highlights

- Expand ArcGIS Desktop applications with demographics.
- Generate demographic reports and maps for areas created in ArcGIS Desktop.
- Leverage the latest demographic, business, and consumer spending data.

ArcGIS users can now quickly and easily add U.S. demographic data and reports to their GIS projects with the Esri Business Analyst Online (BAO) Reports Add-in. This downloadable tool connects ArcGIS Desktop with the latest demographic, consumer spending, and business data and reports from BAO. A Web-based solution, BAO combines GIS technology with extensive analytic data to allow users to generate boardroom-ready reports and maps on demand.

GIS professionals can now seamlessly leverage the data and tools in BAO in their ArcGIS applications to generate demographic reports for trade areas and sites they have defined on their desktop. They can obtain and consume the latest demographic and business data to create presentation-quality reports in PDF and Excel formats. Users can attach this data as attributes of map layers for use in their everyday ArcGIS mapping workflows.

Additionally, BAO Reports Add-in users can access the BAO Web application (bao.esri.com), where they can search for businesses, thematically map areas, create trade areas, compare sites, and create customized reports.



Generate and share demographic reports and maps for an evacuation area.

Demographic and business data and analysis not only benefits those in retail, real estate, and traditional business industries, it is crucial for any organization that involves people, whether customers or constituents, and their lifestyles, behaviors, and characteristics. Almost any ArcGIS Desktop user can benefit from incorporating the BAO Reports Add-in into their analyses.

For example, a fire department needs to estimate how many people will be displaced if they need to evacuate due to a fire. Various groups of people must be kept current on the situation, including city and county officials, the news media, other fire departments, and the public. With the BAO Reports Add-in, the department can connect ArcView with the data it needs to generate reports identifying vulnerable populations. This information can be shared with all parties to coordinate evacuation and fire response efforts and develop an efficient response plan. The add-in also allows reports to be easily updated if the evacuation area changes.

Health care professionals who need to track a disease outbreak can also benefit from the BAO Reports Add-in. They can easily track incidents using ArcView, and by adding demographic data from BAO, they can now determine if the outbreak is related to age, ethnicity, income, or other demographic factors. The GIS analyst simply downloads and appends data to features in ArcView to generate reports and thematic maps to better visualize the situation.

The add-in provides ArcGIS users with a straightforward and cost-efficient way to incorporate the latest demographic and business data into their applications. Esri's annual updates for demographic, consumer spending, and business data are available in BAO before being released in any other Esri solutions, giving ArcGIS Desktop users access to the most current data for their GIS projects.

ArcGIS Desktop users interested in the BAO Reports Add-in can get a free seven-day trial, after which they will need to purchase a subscription to continue accessing the reports and data.

For more information or to get started, visit esri.com/baoaddin.

Esri Empowers SharePoint Users with ArcGIS Mapping

ArcGIS Mapping for SharePoint enables Microsoft SharePoint users to add maps and GIS analytic tools to their SharePoint content. ArcGIS Mapping for SharePoint works with SharePoint 2010 and allows administrators to quickly add rich, interactive mapping capabilities with which SharePoint users can share maps and tools.

GIS Applications Transcend Department Silos

GIS departments can share their work by delivering maps and GIS analytic tools within SharePoint for use throughout the organization. An organization that uses SharePoint to track and share performance metrics, such as a retail enterprise investigating sales by region or store, can display those statistics graphically on a map. Symbology can be selected to display each store as a low-, medium-, or high-performing location based on preselected values. This mapped data reveals patterns and trends not visible in tabular data, making it a powerful but easy-to-use analytic tool. For example, a map may reveal where stores are competing with one another, negatively impacting sales for both locations. Another map might expose where a business' best customers exist and identify other locations to reach similar demographic markets.

Executives can now independently access mapping tools and perform advanced analysis on their data in SharePoint, gaining greater insight into their businesses. A common, shareable view enables widespread efficiencies and successful collaboration, as users access existing maps, workflows, and content in their individual projects, then share them with the enterprise.

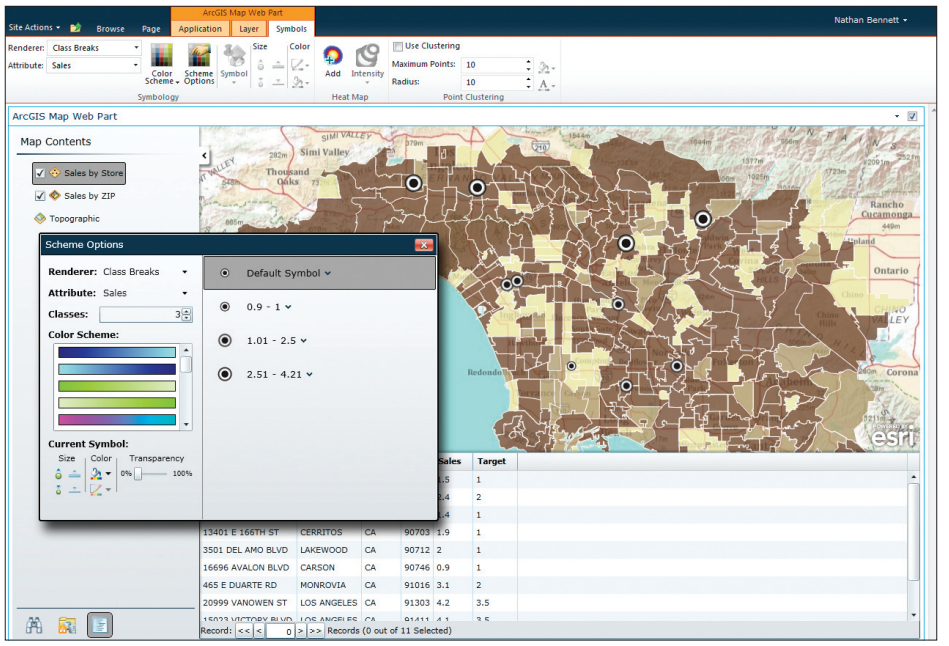
Empowering SharePoint users to create their own maps reduces demands on an organization's GIS professionals while increasing the opportunity to benefit from enterprise-wide use of mapping. ArcGIS Mapping for SharePoint includes tools that enable SharePoint users to create revealing maps, such as heat maps, that can be used for actionable results.

Lightweight, Extensible Framework

Built on ArcGIS API for Microsoft Silverlight/ Windows Presentation Foundation (WPF), extensions can be developed through an included flexible extensibility API. This allows developers to create Silverlight extensions to interact with the map, display other content inside the Web part, and communicate with Web services and other external components.

ArcGIS users can now bring the advanced spatial analysis capabilities of their existing geoprocessing workflows and tools to SharePoint. Geoprocessing services allow the automation of repetitive GIS tasks that may be simple or complex, such as buffering features on a map. The real strength of geoprocessing services is their ability to perform advanced spatial analysis in an efficient way. The ability to deliver ArcGIS geoprocessing services in SharePoint allows non-GIS users throughout the organization to more thoroughly analyze their data.

ArcGIS Mapping for SharePoint includes a basemap gallery that provides a variety of map types—aerial, topographic, street, and hybrid—so the most effective type of map for a project is readily available. Additionally, an easy-to-use interface with ArcGIS.com allows users to search for, describe, save, or create a map.



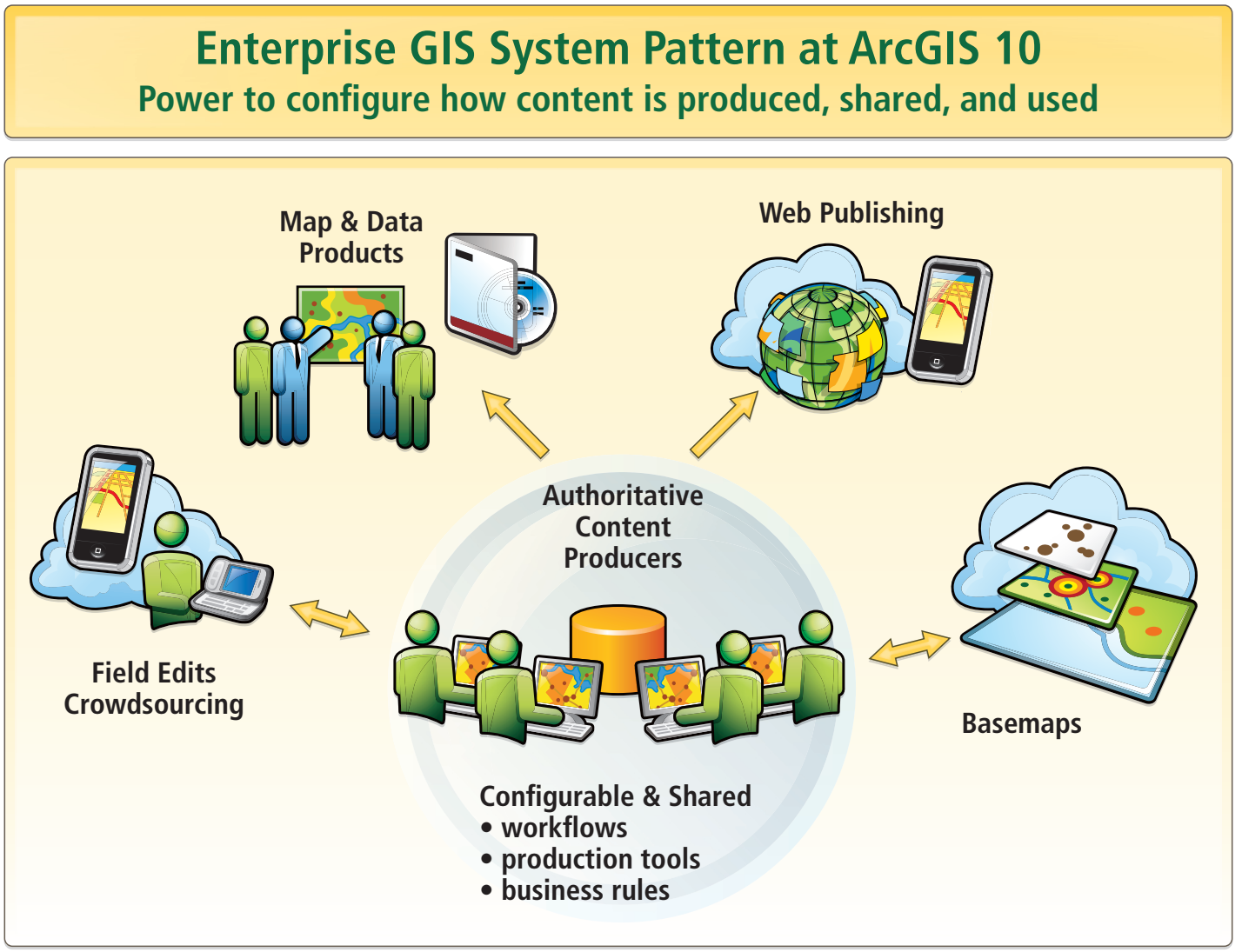
Map symbology can be easily modified to help reveal patterns and relationships within the data.

ArcGIS Mapping for SharePoint is available as a download and is easy to deploy to a SharePoint installation. To download ArcGIS Mapping for SharePoint or to get more information, visit **esri.com/sharepoint**.

The COTS Approach to Enterprise GIS

ArcGIS 10 represents a significant milestone in GIS technology. At version 10, ArcGIS is a complete system for geographic information. It is easier to use and more powerful than previous releases, and it's designed to be pervasive—people can access the system through a variety of clients regardless of their experience with GIS.

With this release, ArcGIS provides the tools, capabilities, and capacity to support enterprise GIS using commercial off-the-shelf (COTS) software. The potential cost savings and improvements to efficiency of a COTS-based system are significant. Esri, through its Professional Services Division, has proved this concept by implementing enterprise GIS for customers using ArcGIS 10 COTS software. The lessons Esri has learned from those real-world experiences are shared here.



Benefits of a COTS Approach

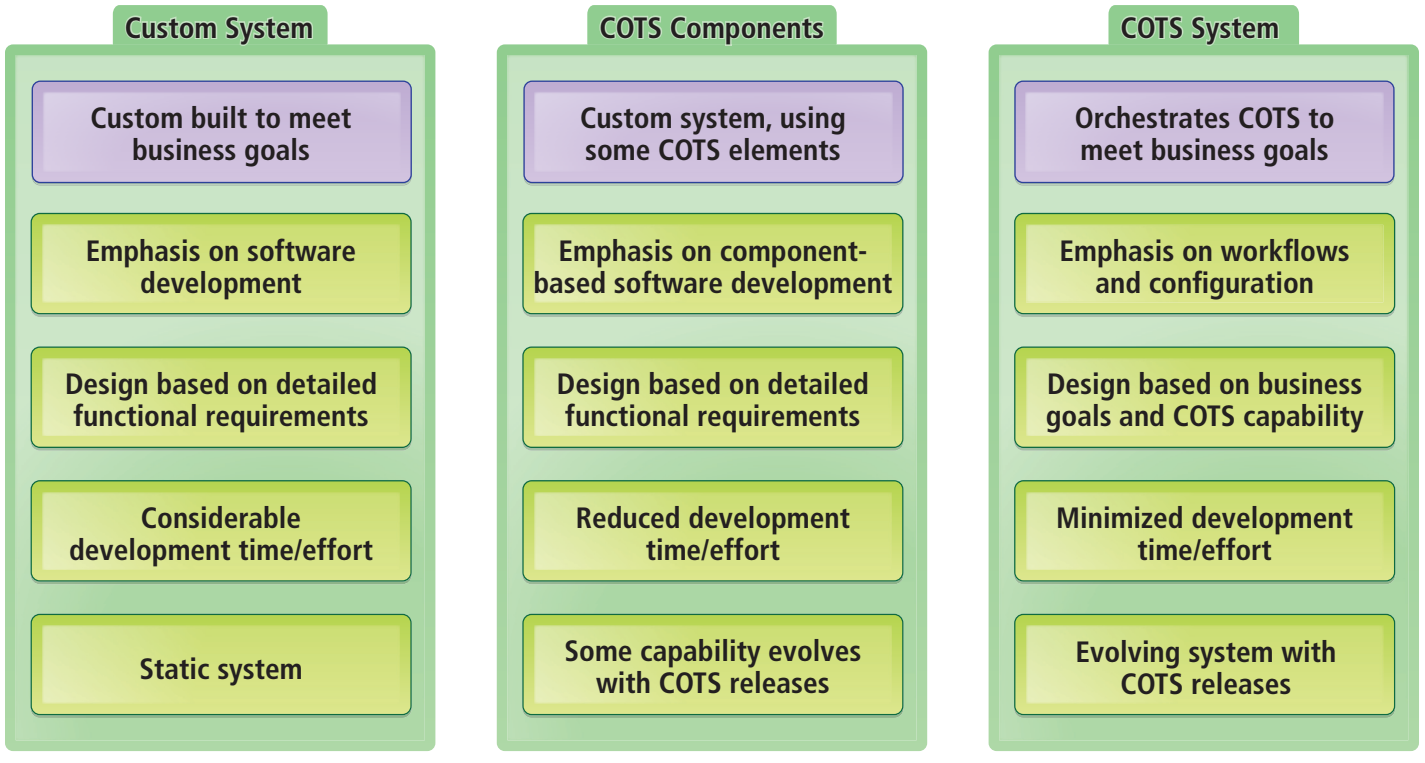
ArcGIS 10 is designed to deliver geographic information via a variety of clients, from the desktop to Web-based and mobile clients, ensuring that everyone who needs the information has access to it without requiring special software or skills. In other words, the delivery of geographic information has been uncoupled from its management, making it possible to configure the system to support multiple departments and business processes without compromising the underlying data. "Simple" and "ready to use" are prevailing principles.

This means that an enterprise GIS is no longer built by stitching together individual software packages but instead is a federated system that can support many different uses. As a result, the user experience can be significantly tailored to each type of user through configuration rather than customization of the system. Users can orchestrate the system to meet the needs of a business or operating unit and, by doing so, bring operational systems online more quickly and for much less expense. The system will then evolve as COTS releases increase its capability over time.

There are a lot of benefits to this approach. Commercial software is developed based on years of working with customers to understand what they need, building in the best practices learned along the way. Implementing a COTS-based enterprise GIS allows organizations to benefit from those best practices rather than reinventing the wheel and creating new processes from scratch. In this way, a system can evolve with the technology, allowing users to benefit from new capabilities as they become available.

The fundamental premise of a COTS approach is to exploit all the power and functionality the commercial software has to offer and implementing that capability as designed. One of the most notable differences a COTS implementation affords over a custom one is the ability to get functionality into the hands of users early and often. By utilizing COTS, much of the functionality is ready for users to exercise quickly. This leads to better acceptance by end users and dramatically improved feedback when compared to the traditional approach of doing a needs assessment and gathering requirements, where end users have less understanding of the capability of the new system. The COTS approach relies on users to provide feedback continually and participate actively in the configuration of the system. Implementation time for a COTS system is significantly reduced because there is no development to be done. Maintenance requires fewer specialized resources—users can leverage standard technical support and a wider labor pool trained in the COTS technology.

A COTS solution will most likely provide the best long-term return on investment (ROI) as well. While the perception may be that it is less expensive to build versus buy, any initial savings are reduced greatly by having to take on responsibility for isolating and correcting any design problems, providing ongoing technical support and training, adapting the product to advances in technology, and providing data migration tools to move data from one release to the next when the product data architecture is modified.



Enterprise GIS systems are built following three basic patterns: custom systems, COTS component systems, and COTS systems. The trade-offs between patterns need to be considered before embarking on a system implementation.

Barriers to a COTS Approach

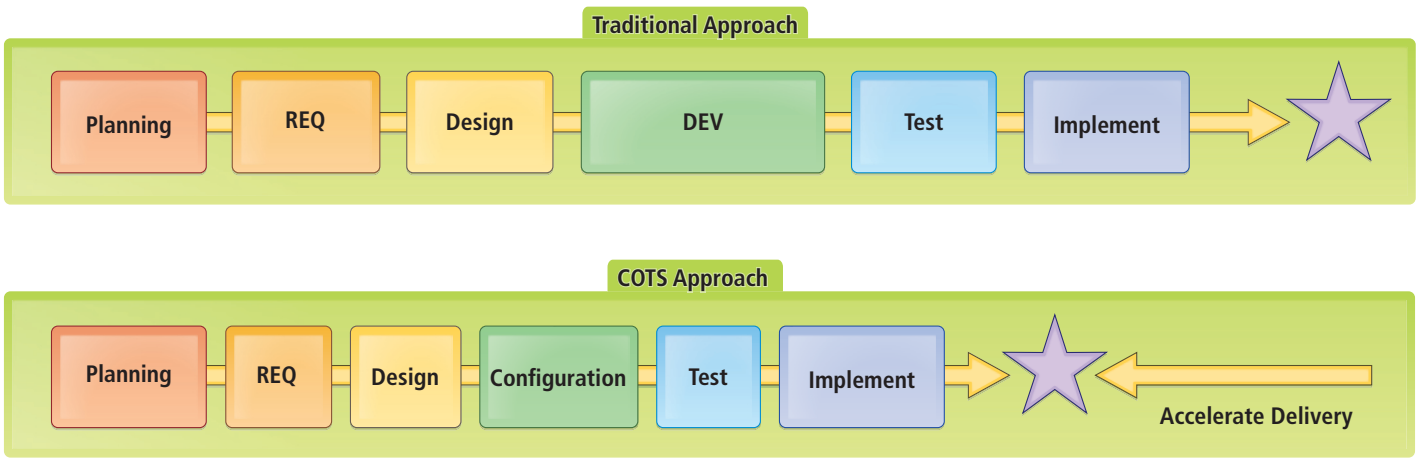
COTS-based enterprise GIS may not be the right approach for an organization if its culture, history, and structure won't support it. Taking a COTS approach versus building an enterprise GIS requires fresh thinking, leadership, and agility. The COTS approach is predicated on a focus on business goals instead of a list of detailed feature functions—it puts the emphasis on *what* the system needs to do, not *how* the system will do it.

This can be challenging in environments where there is a history of procurements to build custom systems. In large organizations, determining core

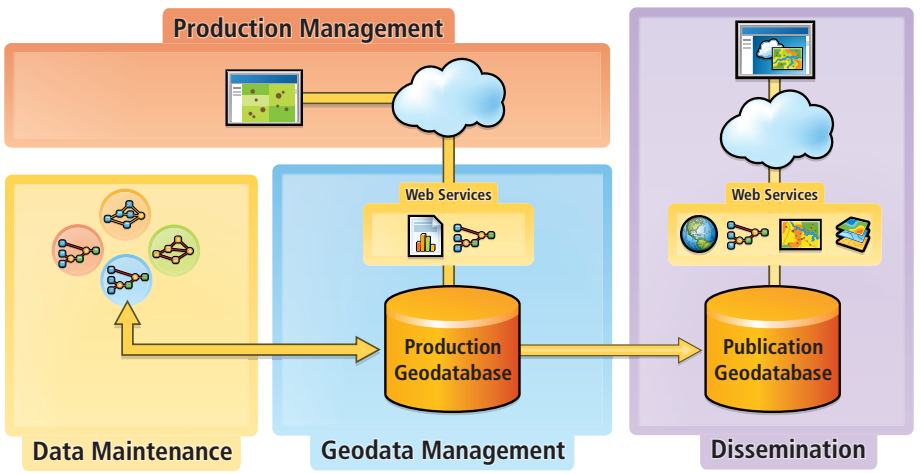
business requirements is often easier said than done. Internal user groups brought in to help the process often have difficulty separating business requirements from technology or design requirements in their minds.

A COTS approach also asks users to consider new business processes, which can challenge the change management capabilities of an organization. Traditional system procurements often fall into the trap of re-creating old workflows out of new software, usually because people and organizations resist change. It takes leadership, communication, and follow-through to overcome the tendency to stick with the familiar way of doing things.

Even when a system has been proclaimed a COTS implementation, the best intentions of many people often push systems toward customization. Some customization may be required to support particularly complex processes. The trade-offs of custom development, however, must be kept in mind to avoid moving a COTS-based system into a custom- or component-based implementation (COTS modules mixed with custom modules). Many heavily customized COTS systems cannot be easily scaled or extended because there is inadequate design documentation; the technology on which it is based is no longer supported; resources with needed skill sets are no longer available; or the COTS versus custom modules are not clearly delineated, creating dependencies between components that minimize the potential for reuse.



Implementation time for a COTS system is significantly reduced because there is no development to be done.



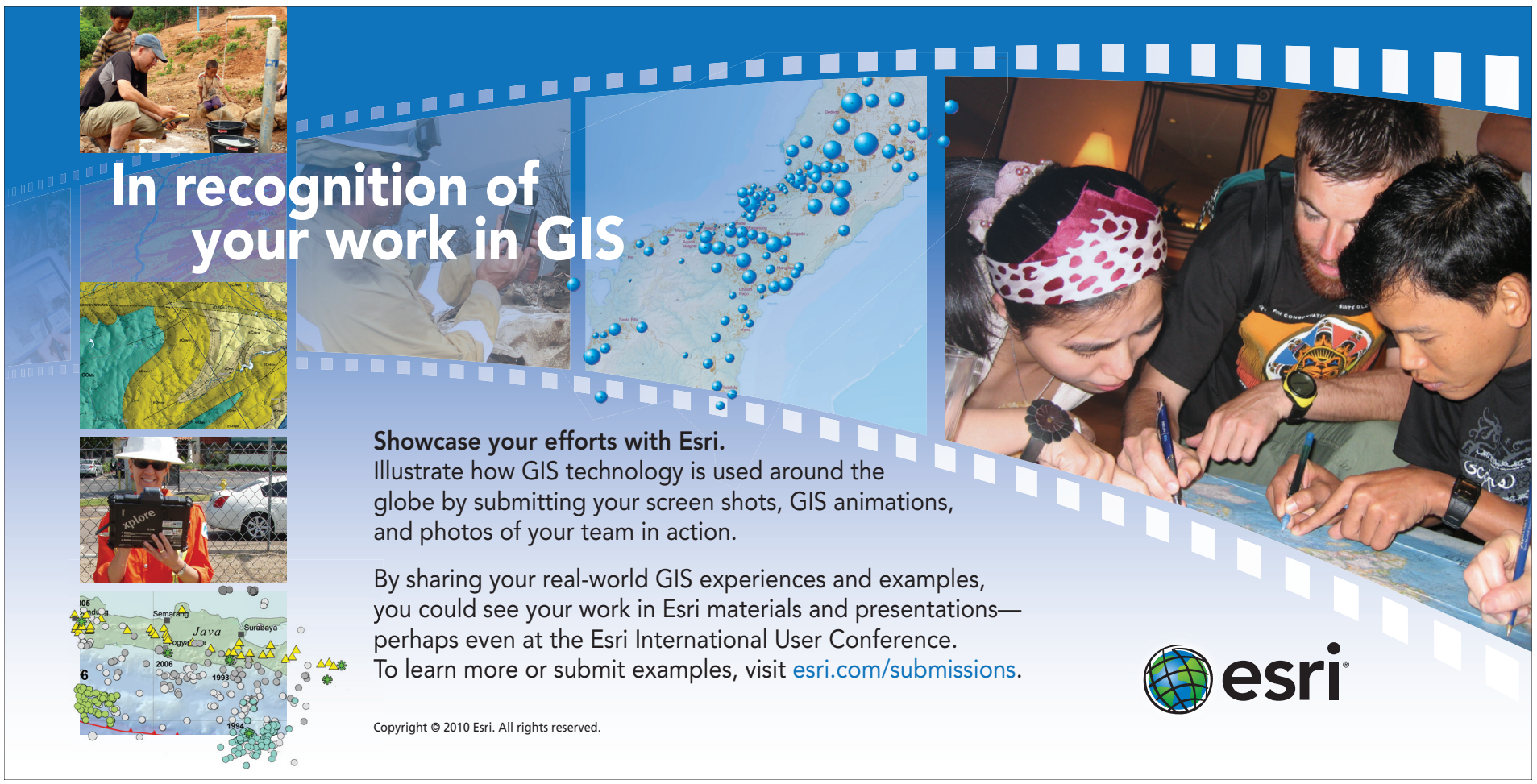
ArcGIS 10 provides a COTS platform that supports the major activities required by an enterprise GIS system, including production management, geodata management, data maintenance, and dissemination.

Considering the ROI

With the advent of ArcGIS 10, GIS technology has matured sufficiently to make COTS-based enterprise GIS implementations feasible, potentially offering significant cost savings and productivity improvements. A COTS system is easier to maintain and allows the system to evolve with new capabilities of the software, ensuring a better ROI in the long run even if the initial costs are more than they would be for building a custom system.

Deciding whether to use COTS or to build a custom enterprise GIS needs to start with an organization's business requirements and should take into account the core competencies, culture, capacity, and capabilities of the organization. If ArcGIS 10 is aligned with an organization's business and technology strategy, it can meet the majority of business requirements, and the organization will use most of the functionality it offers over time, a COTS-based system will be an effective choice.

For more information, contact Brian Cross, department manager, Esri Professional Services (tel.: 909-793-2853, ext. 1-1158; e-mail: bcross@esri.com).



Contiguous Coastal Mapping Provides Critical Marine Information

The Pacific Northwest ShoreZone Project Maps 100,000 Kilometers with GIS

Highlights

- Datasets and imagery are essential for resource planning.
- In Alaska, approximately 47,000 kilometers of shoreline are mapped or being mapped.
- As various pieces of the shoreline are connected, increased opportunities to develop regional models emerge.

Coastal and Ocean Resources Inc. (CORI), based in Sidney, British Columbia, Canada, has been supplying professional consulting services to the geologic and environmental sciences industry since 1987. Its focus is the marine environment from the coastline to the deep sea. Of the many projects this group has undertaken, one of the most significant is the ShoreZone coastal habitat mapping program, which has been widely used in the Pacific Northwest over the past 20 years.

The program is a coastal habitat mapping and classification system in which low-altitude georeferenced aerial imagery is collected specifically for the interpretation and integration of geologic and biologic features of the intertidal zone and nearshore environment. The system's datasets and imagery provide a critical backbone for a variety of applications and uses, from resource monitoring, planning, protection, and consumption to hazard mitigation and policy formation. The ShoreZone coastal mapping program has involved a wide-ranging partnership of scientists, GIS specialists, Web specialists, nonprofit organizations, and governmental agencies. CORI has executed most of the field programs, including information management, data processing, and product deliveries, with project partner Archipelago Marine Research Ltd., based in Victoria, British Columbia, Canada.

The project was originally developed in the early 1980s by the Province of British Columbia as a physical habitat mapping system that was applied primarily as an oil spill response tool. Since then, the entire coast of Washington (~5,000 km) and British Columbia (~38,000 km) has been mapped, and an aggressive inventory program is under way in Alaska with approximately 47,000 kilometers of shoreline mapped or being mapped.

The dark band at the water's edge is an eelgrass bed that can be classified and mapped and becomes part of the 47,000-kilometer Alaska ShoreZone dataset.

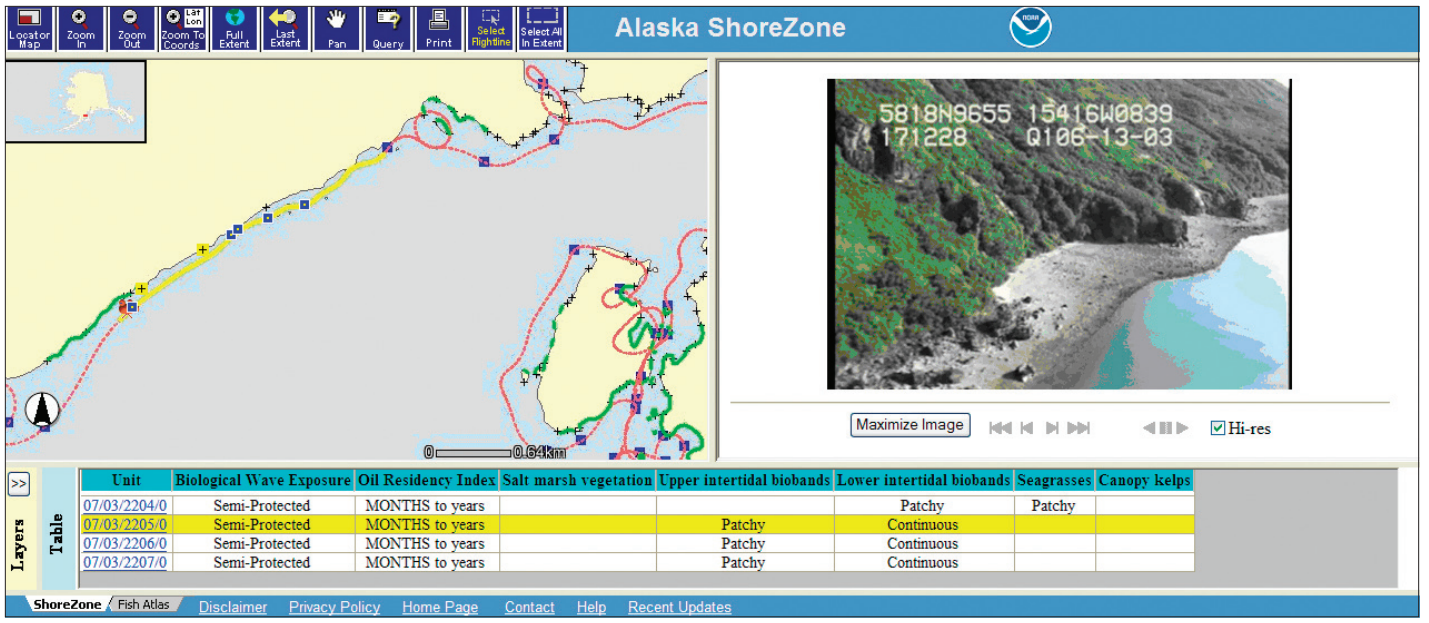
In the 1980s, ShoreZone consisted of paper maps and associated tables. To enhance efficiency, by the mid-1990s, the Washington and British Columbia inventories were converted into GIS data using ArcView. CORI has since continued to move forward with Esri technology to take advantage of new developments in ArcGIS Desktop and ArcGIS Server technology. Since it started using GIS, CORI has been able to map approximately 10 times the amount of coast that it was able to process before.

"The move to GIS enabled us to capture and manipulate many times the amount of data that we were able to previously and has made the process of data maintenance, analysis, and sharing more efficient and accurate," says John Harper, marine geologist and CORI president.

Before moving to GIS, CORI's database of choice was inherently detached from the maps, so linkages were vulnerable. Now, incorrect linkages are immediately flagged, which saves many hours that were previously devoted to data proofing while dramatically improving data accuracy. The classification and mapping system is based on oblique aerial video imagery and still photography of the shoreline that is georeferenced, time synchronized, and collected specifically for the project. At the time of capture, this imagery is accompanied by continuous, simultaneous commentary by a geologist and biologist aboard the aircraft that is later used to assist with the vector data creation and mapping of the shoreline. Imagery is targeted for low tide during the lowest tides of the year so that most of the intertidal zone is exposed when the imagery surveys are performed. By capturing imagery at extremely low tides, CORI is able to map substantially more shoreline information.

The imagery is interpreted initially by geomorphologists who segment the shoreline into discrete units of homogenous morphology (form and substrate type) and exposure. The units are digitized in ArcView and the physical attributes recorded in the geodatabase. Then the dataset is passed to biologists who interpret and record observed biota (such as intertidal organisms, subtidal algae, and some subtidal fauna) for each shore unit.

Once the data capture process is complete, program partners (often government and not-for-profit organizations) use this data internally, and some post it to their online sites. ShoreZone data provides a spatial framework for coastal and nearshore habitat assessment on local and regional scales. Individual resources, such as eelgrass occurrence in Prince William Sound, can be displayed and plotted, or combinations of resources



The Alaska ShoreZone Web site is hosted by NOAA. The left panel shows the aerial flight track and locations of still photographs; also shown is shoreline with eelgrass (highlighted in green). The right panel shows the image player, allowing the user to "fly" the shoreline.

with multiple attributes can be displayed together to reveal new information, patterns, and trends. For example, substrate type and wave exposure levels are used to predict shorelines sensitive to oil spill retention.

"The dataset is being used in all sorts of applications that we never anticipated," says Harper. "Recreational users find the online imagery especially useful in trip planning for kayak expeditions, fishery managers use it to identify shorezone attributes of high-value spawn sites, and oil spill contingency planners are able to identify accessibility of the shore to alternative types of response equipment."

These applications are critical to support the efforts of online site visitors focused on ecological sustainability, environmental hazard mitigation, and public use of these areas for recreation and education. The dataset is particularly useful for regional marine planning programs such as The Nature Conservancy's (TNC) Bering to Baja marine conservation initiative, where sensitive or rare habitats are identified. TNC can identify these habitats and add their locations to its land acquisition strategy.

Using GIS, CORI is also able to create a standardized digital shoreline so that its data integrates seamlessly with clients' thematic data. Because clients are quoted a unit mapping price per kilometer of mapped shoreline, a standardized digital shoreline is essential to quickly determine costs. GIS enables the client to immediately see the extent of shoreline to be mapped for its planned level of expenditure.

"ShoreZone has been a great tool for making the Alaska coast more accessible," says Sue Saupe, science director of the Cook Inlet Regional Citizens Advisory Council and original proponent of ShoreZone in Alaska. "By making the imagery and data Web accessible, the project has attracted many nontraditional users that don't have access to GIS, while sophisticated GIS users appreciate the richness of the dataset that now extends along thousands of kilometers of shoreline."

This dataset provides a framework that underlies detailed site-specific research and supplies a tool for tying together a wide range of nearshore studies. Ultimately, the Alaska ShoreZone program has so many applications that it has helped build capacity for the overall coastal programs and develop partnerships among organizations that may not have typically coordinated their goals in the past.

By adding a spatial element, GIS has made a significant scientific contribution to the program. For example, in late 2009, Harper assembled a 20,000-kilometer shoreline dataset as a deliverable for the National Oceanic and Atmospheric Administration (NOAA). Through the use of GIS, he was able to determine that important fish habitats, including salt marshes, eelgrass beds, understory kelps, and canopy kelps, collectively accounted for 87 percent of the shoreline. Scientists always had an ecological understanding of these habitats but no idea where they were located and how much existed.

In January 2010, the Alaska ShoreZone Partnership was presented with the Coastal America Spirit Award at the Alaska Marine Science Symposium, an annual gathering of about 800 scientists and researchers. The Coastal America Spirit Award recognizes exceptional projects that demonstrate the spirit of teamwork for group efforts that are poised to address challenging coastal issues.

Future Plans

An exciting new CORI project is to develop a nearshore habitat model using ArcGIS for the Queen Charlotte Strait that is based on observed ShoreZone data. This nearshore model, which predicts substrate, slope, and biotic assemblages of the shallow nearshore area, will serve as a planning framework for nearshore mapping projects, targeting sensitive habitats for higher-resolution seabed multibeam and videography surveys.

For more information, contact John Harper, marine geologist and CORI president (tel.: 250-658-4050, e-mail: john@coastalandoceans.com).

Digital Mapping: The Next Generation

Georgia's Coastline Benefits from Lidar-Created DEMs

Highlights

- Using lidar data, water flow can be simulated in ArcGIS based on elevation.
- Planners and managers build three-dimensional data models of cities and the countryside using the lidar data and GIS.
- Utilities can measure and model water runoff with higher precision, ensuring that the tax rate is equitable.

The State of Georgia's coastline has been experiencing significant population growth over the past few decades, putting increasing pressure on available natural and economic resources. Much of this growth is occurring in low-lying coastal areas that are vulnerable to the effects of tropical cyclones and have limited infrastructure for the booming population. Resources are needed to manage and accommodate this rapid development.

A longtime user of GIS software, the Coastal Regional Commission of Georgia (CRC), under the direction of GIS/IT director Chris Chalmers, MS, GISP, is working with multiple agencies to ensure that geospatial data is created in the area for current community planning and mitigation of any future natural disasters that may affect the area.

CRC encompasses the six coastal counties in Georgia, as well as four inland counties, covering a total land area of more than 5,110 square miles. Meandering rivers flow from low plains to meet the Atlantic Ocean, converging on an area of America's Eastern Seaboard that is a prime destination for those looking for a getaway focused on recreation, culture, or history.

The best data for both planning and disaster management mapping is high-resolution elevation data. Currently, the best available digital elevation data for the entire coastal area of Georgia is from United States Geological Survey (USGS) 30-meter digital elevation models (DEMs). While this data is practical for regional use, more accurately mapped information is necessary for local planning initiatives. Capturing one- to two-foot contours was required to create elevation data suitable for building local datasets that can support such activities as economic planning and infrastructure development and improvements, including transportation, power, water and sewer distribution, land-use planning, and environmental monitoring.

Lidar Acquisition Becomes a Community Effort

To create these contours, CRC formed the Coastal Georgia Elevation Project (CGEP) to invest in light detection and ranging (lidar) technology. Lidar is a remote-sensing technology that measures the time delay between a light pulse transmission and its reception by a sensor. It is represented in its raw data format as a series of x, y, and z points. Highly accurate DEMs can be created within the commission's ArcGIS software from the postprocessed data and used for the mapping needs of the community.

A collection of cities, counties, educational institutions, state and federal agencies, and private-sector organizations within the Georgia coastal county region came together to accomplish this massive task. Chalmers and his team worked diligently, gaining the collaboration of every county within the commission and ensuring that the buy-in was equitable to everyone. "The big question was, how do you break the costs down per county?" says Chalmers. "Some of the smaller counties have greater populations than those with more landmass. These bigger counties will be using more lidar but have less of a tax base to support funding."

The counties finally agreed to fund the project by calculating the cost of the project based on both how much population and how much landmass was contained in each county. CRC secured a grant from USGS through a cooperative agreement to promote the CGEP. At the request of the Georgia Department of Natural Resources Coastal Resources Division, CRC presented the project to the Coastal Advisory Council (CAC), which manages funds for the Georgia Coastal Zone Program. CAC voted to provide a coastal incentive grant to match local funds raised for the CGEP. Additionally, the Georgia Association of Regional Commissions has an enterprise site license for Esri software that provides broader access to GIS technology to members of the state's 12 regional commissions, including CRC. CRC communicates with stakeholders, interested parties, and member governments on the status of the CGEP.

The Georgia coast is approximately 100 miles of open coastal shoreline between the Savannah and St. Marys rivers. (Photo credit: Center for Watershed Protection)

Applications Abound

CRC acquired lidar-derived, high-resolution elevation data for the entire coastline of Georgia, from the Atlantic Ocean to 50 miles inland, an area of approximately 4,703 square miles.

"The number one priority for redoing our mapping is to save lives and protect property," says Chalmers.

One of the first applications was redefining the flood boundaries of the area by remapping Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRM). "If we know an area is mapped as a high-risk flood area, and if we know people could be in danger and buildings could be damaged, then it makes sense to take reasonable protective steps when we develop and build," says Chalmers.

Related to this is storm surge, an offshore rise of water that is associated with tropical cyclones, something that is all too common along the Georgia coast. Using the lidar data, the flow of water can be simulated in ArcGIS based on elevation, making it useful data for public safety. "If you can predict where water is going to flow, you become a very powerful building planner," says Chalmers. "Local planners can put buildings where they want them, and with this type of analysis, we can almost guarantee where the water will go."

Building three-dimensional data models of cities and the countryside using the lidar data allows planners and managers to ask many new questions of the data. "If a 20-foot storm surge hits us, we can ask what is the rate, and where? If Interstate 95, which runs along the coast, is going to be underwater according to the model, then we can reroute traffic," Chalmers explains.

Other applications include economic development and more accurate taxation. Effingham County uses the data for tax parcel assessment, particularly to recover monies from untaxed outbuildings. Since lidar shows changes in elevation, the data can be used to assess how many outbuildings are actually on a parcel of land using the line of sight from the horizon.

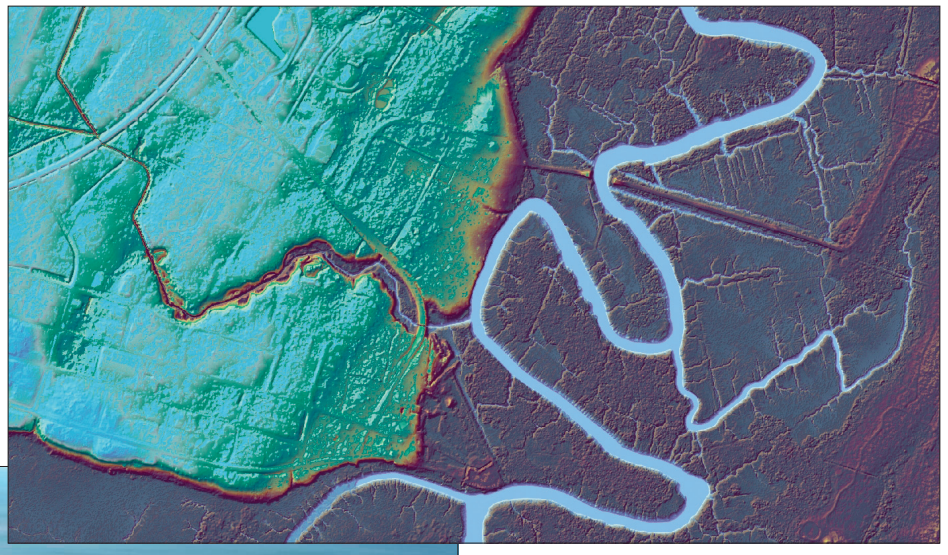
Measuring impervious surfaces is another way to ensure more accurate taxation. Lidar can help utilities measure and model water runoff with higher precision, ensuring that the tax rate is equitable.

Smart economic development can save the private sector money as well, and in today's economy, helping local businesses is a priority of many governments. "The first thing you have to do when you locate to a community is a survey—it's mandatory," says Chalmers. "If we have this lidar data, this is one thing they don't have to purchase. We can provide this as a free service. This is good for attracting the right businesses into our local communities, as well as ensuring that the development is sound."

Lidar Acquisition Standards

The project is within the 50-mile Atlantic coastal priority area defined by the National Geospatial Program and supports homeland security requirements of the National Geospatial-Intelligence Agency. The CGEP is using the lidar quality guidelines set up by the Florida Division of Emergency Management, since these were developed for the mostly flat terrain that is common to the lower Atlantic coastal plain, including coastal Georgia.

The lidar data was collected using sensors approved by CRC, with a maximum field of view of 40 degrees (20 degrees off nadir). Routine sensor calibration and maintenance ensured proper function of the lidar system. A point cloud was created with one-meter post spacing in unobstructed areas. A horizontal, or bare earth, accuracy of 18.5 centimeters RMS minimum and a vertical accuracy in vegetation of 37 centimeters RMS minimum were required.



Lidar data showing the City of Darien, McIntosh County, Georgia, with one of many meandering rivers that converge on America's Eastern Seaboard.

The aerial extent of lidar includes the entire land area of each county plus a one-kilometer buffer beyond the county edges. Because certain areas in the eastern portion of some counties may change significantly due to beach and dune migration and other geophysical processes, it is required that all these areas be captured, including the salt marshes, wetlands, hammocks, and sand shoals.

CRC did not require that its lidar data be tiled according to any previous index, but only that the counties in question all be flown in the same pattern, from north to south. Metadata is required to list all dates and times of acquisition in conjunction with each tile identifier.

Acquisition occurred during "leaf off" time, when deciduous trees were bare, to minimize obstruction from the canopy and other vegetation during December, January, and February. Since this is a coastal zone, low tide, defined as the lower third of the tide cycle, was also required for optimal acquisition and was an important component of the project. Areas had to be flown within a four-hour window, two hours before and two hours after low tide, to meet this requirement.

Hydrologically corrected breaklines are being generated, and a gridded one-meter DEM in raster binary format is being compiled. With those products, a one-foot contour can be generated for the entire Georgia coast. The breaklines are delivered in ArcGIS geodatabase format. Separate feature classes are delivered for each breakline feature type, including

- Closed water body
- Linear hydrographic, such as streams, shorelines, and canals
- Coastal shorelines
- Road features and soft features, such as ridges, valleys, and tops of banks
- Low-confidence areas, including vegetated areas that are considered too obscure to generate an accurately defined digital terrain model
- Island features

All partners that help fund this project will receive a full copy of all data, and it will also be posted on USGS's *National Map* Web site. "In the economic times we find ourselves in, improving the quality of service to our local governments is not only the goal of this commission but also the goal of the Georgia Association of Regional Commissions," says Chalmers. "Working together to obtain the most highly accurate data to help our citizens is the first step."

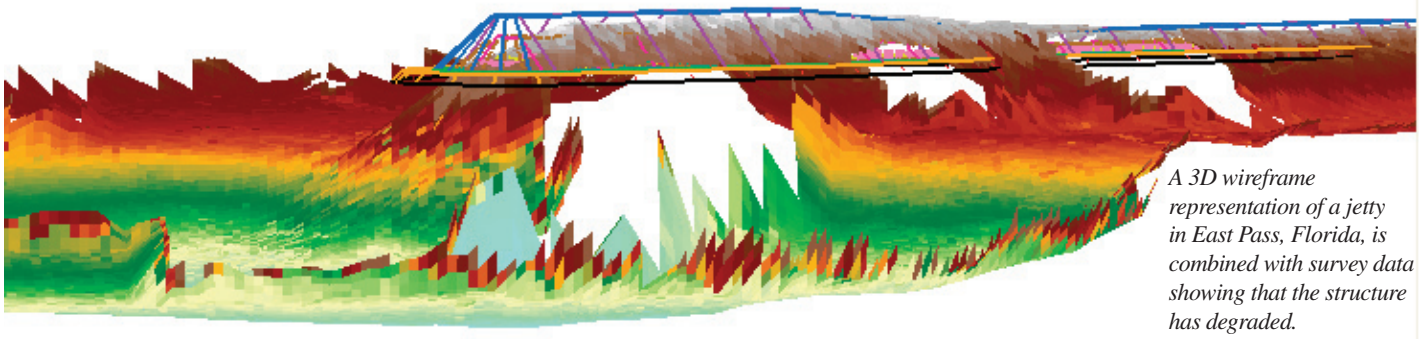
For more information, contact Chris Chalmers, GIS/IT director, Coastal Regional Commission (e-mail: cchalmers@crc.ga.gov). For more information on how Esri GIS works with lidar and other remotely sensed data types, visit **esri.com/imagery**.

eCoastal Program Fosters an Enterprise Approach to Data Management

United States Army Corps of Engineers Protects 12,000 Miles of U.S. Coastline

Highlights

- Program users search by keyword or category, then load data directly from their own or other Corps districts.
- ArcGIS software-based applications support the development of enterprise GIS in and across coastal divisions.
- The eCoastal program gives districts the analytic tools, best practices, and data structure they need.



A 3D wireframe representation of a jetty in East Pass, Florida, is combined with survey data showing that the structure has degraded.

From the beaches of Hawaii to the harbors of Maine, the United States Army Corps of Engineers protects and restores the shoreline many people call home and even more call the perfect vacation spot. Though images of peaceful waters and pristine sand may be fixed in our minds, the more than 12,000 miles of U.S. coastline are fragile and ever changing.

As they address issues such as coastal flooding, navigation, regional sediment management, erosion, and hurricane damage, Corps districts, like the Mobile (Alabama) District, collect unique data to support engineering, environmental, and economic decisions. Their projects require information such as regional coastal mapping data, the date and time shoreline imagery is collected, detailed designs of coastal structures, and much more.

Historically, as the Corps districts in these areas collected data for coastal projects, it remained siloed in the confines of the project. "An engineer might not ever know the data she needs already exists, even if she sits five cubicles away from the person who has it," says Rose Dopsovic, eCoastal project manager, U.S. Army Corps of Engineers, Mobile District, Spatial Data Branch.

To improve data sharing and acquisition, the Mobile District developed the eCoastal program—the letter *e* stands for enterprise. It focuses on optimizing data access in each district, preferably in a geodatabase. The program utilizes Corps spatial data standards and implements national policy to provide a customized framework for spatial data standards, geodatabase structure, and ArcGIS software-based GIS applications that supports the development of enterprise GIS in and across coastal divisions.

"Now, regardless of which project data was collected for, if it's indexed and archived properly, anybody who's interested in the data can find it and apply it to his own project," says Dopsovic. "We tried to put together a standardized architecture to allow people to find the data they need—even if they didn't pay for it themselves."

The program also addresses the requirements of districts that don't have GIS experts in-house. It gives districts the analytic tools, lessons learned, and data structure they need to effectively use their geospatial information.

Coastal Customization

Generally, Corps engineers use the Department of Defense's spatial data standard, known as the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE). The standard includes hundreds of data models, but only a few are relevant to coastal engineers. To make it easier for coastal engineers to access the models they use, the eCoastal program isolates the pertinent portions.

The Mobile District also requested changes to the Spatial Data Standards committee. For example, coastal engineers need to include the intricacies of CAD drawings in GIS. Historically, a coastal structure would look like a simple line in a GIS. The data model now supports integration of those drawings, giving engineers geometry that accurately represents coastal structures so they can analyze them effectively.

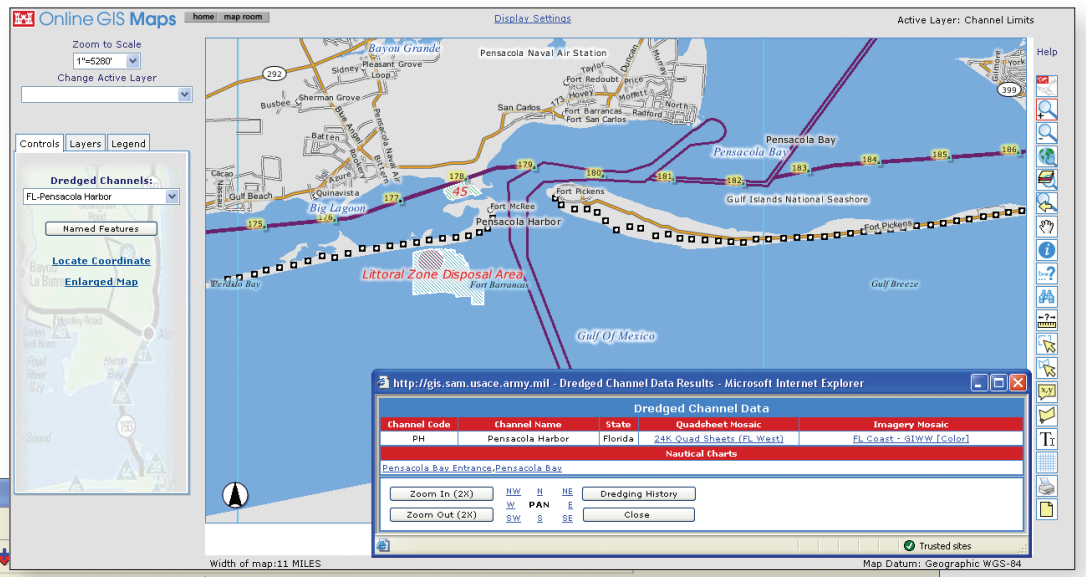
In addition to providing data models, eCoastal includes a suite of custom tools. For example, the eCoastal Datapicker tool allows a user to easily find and connect to needed data. With the ArcGIS Desktop software-based tool, users can search by keyword or category, then load data directly from their own or other Corps districts.

The Coastal Structures Condition Assessment (CoSCA) tool, developed by the Mobile District and the Corps's Engineering Research and Development Center's Navigation Research and Development Program, allows users to make 3D models of structures, such as jetties. A 3D CAD drawing is overlaid on survey data to calculate composition of and damage to structures. Then, engineers can calculate repair costs.

The Mobile District freely shares the eCoastal documentation and source code with other districts, as well as entities outside the Corps, such as the Florida Department of Environmental Protection, universities, and the public. Much of the complimentary material is available on the Web site at **ecoastal.usace.army.mil**. However, if an organization would like help setting up its GIS, it can access experts from the Mobile District.

Many districts are taking advantage of this program, adopting all or part of the suggested framework. Buffalo, New York; San Francisco, California; New Orleans, Louisiana; and Charleston, South Carolina, have implemented the full eCoastal architecture. Those that have implemented some elements of the program include Honolulu, Hawaii; New York, New York; Los Angeles, California; Philadelphia, Pennsylvania; and Jacksonville, Florida.

For more information, contact Clint Padgett, chief, Spatial Data Branch, Operations Division, U.S. Army Corps of Engineers, Mobile District (e-mail: Clint.Padgett@usace.army.mil).



Top: The eCoastal Online Map Viewer allows Corps engineers to select a navigation channel and view dredged channel information, including historical data. Bottom: The eCoastal Datapicker tool allows users to easily search a Corps district for data and related metadata.

Mapping in a Mo

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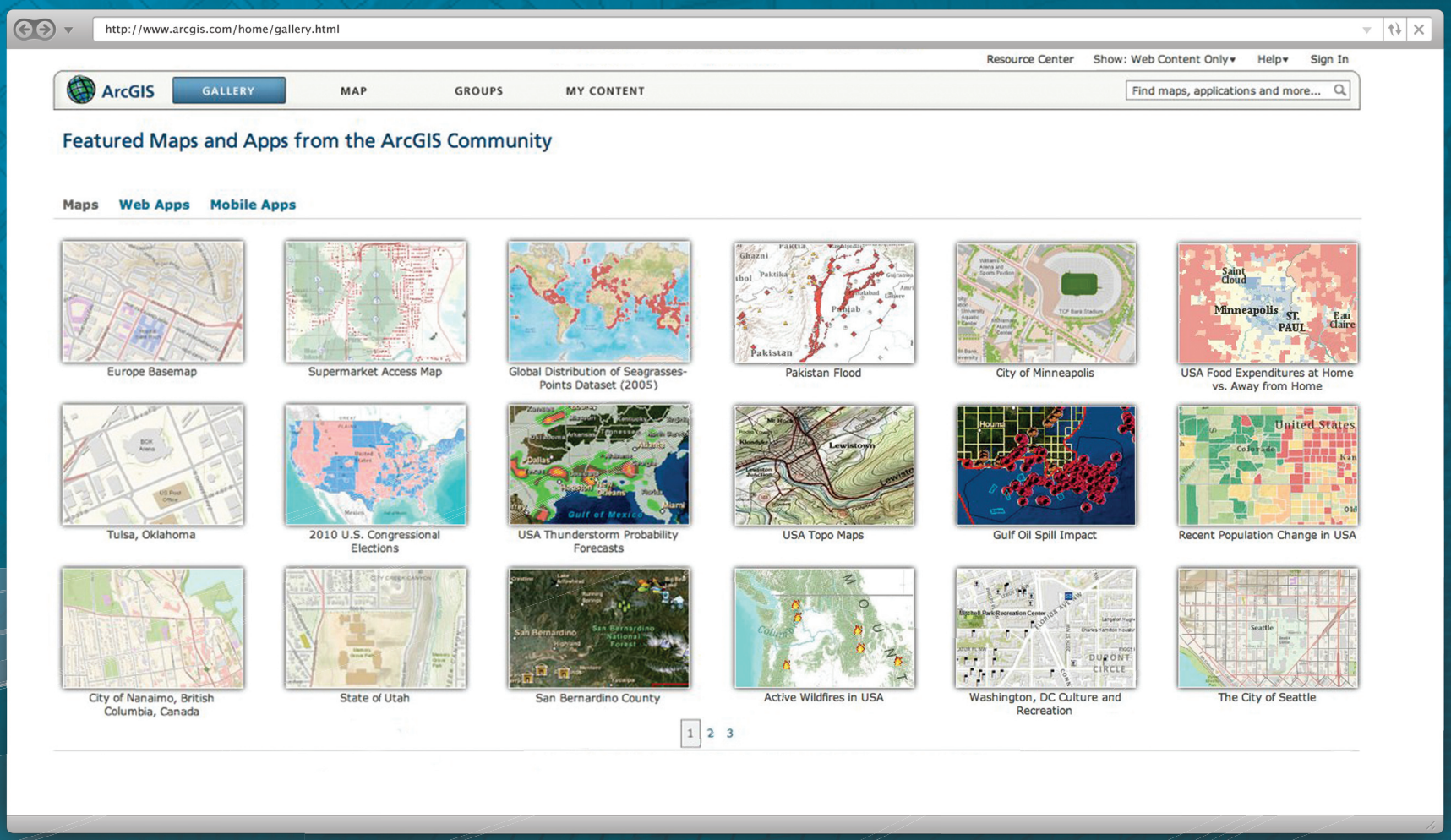

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Live on Everest Web Application Shares a Teenager's Amazing Journey

An Online Mashup Tells the Story in Near Real Time Using Esri Technology

Many dream of conquering Mount Everest, known in Nepal as Sagarmatha, or "goddess of the sky." Some climbers reach the lofty goal and—for a few minutes, at least—stand victorious atop the 29,035-foot mountain. But very few are able to take a global audience with them, as 13-year-old Jordan Romero did.

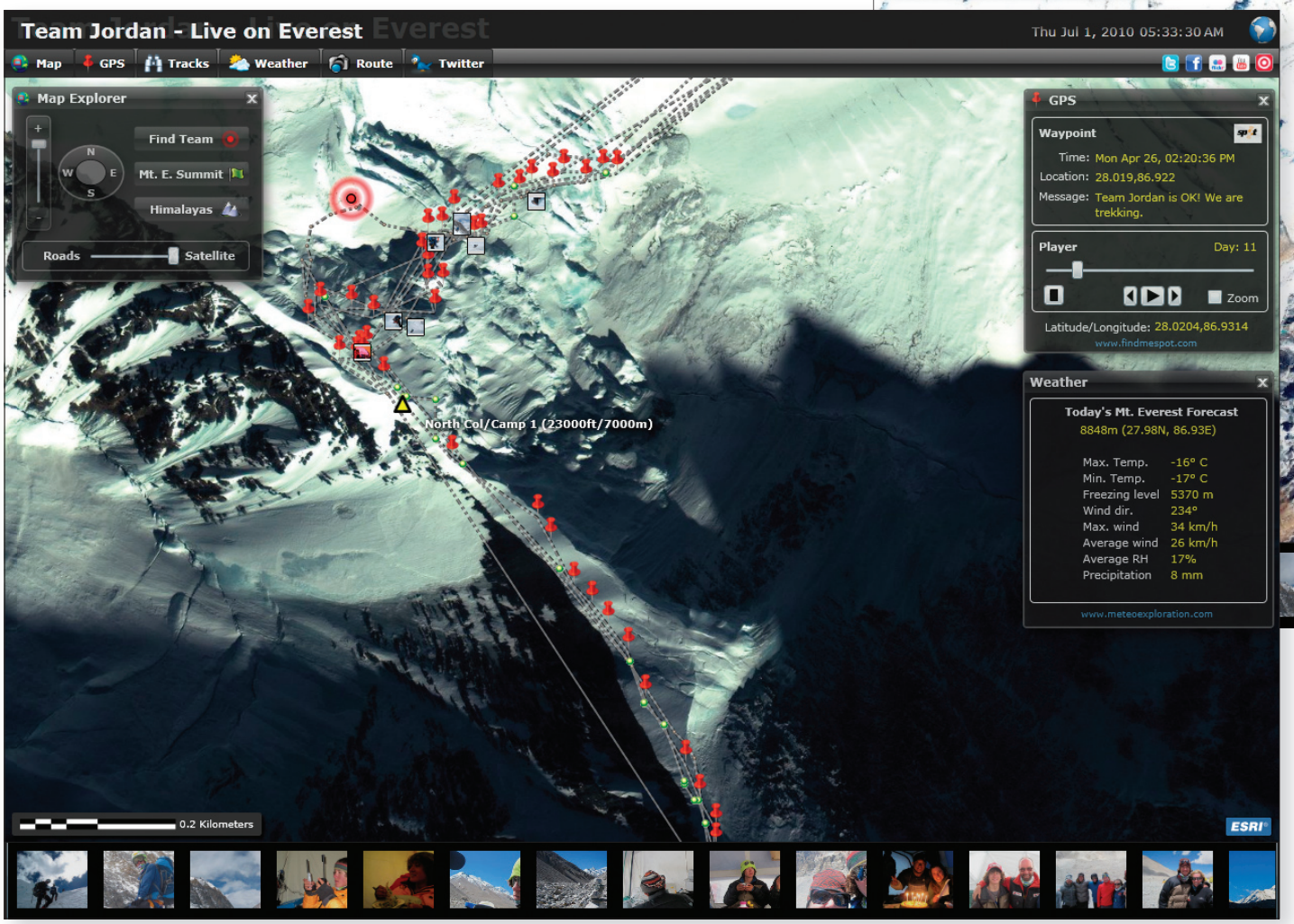
On a clear night in May 2010, in subzero temperatures, Jordan started his final, 26-hour leg of the steep and dangerous climb up Everest. The boy from Big Bear Lake, California, was on his way to becoming the youngest person ever to scale the world's highest summit.

Around the world, followers kept tabs on Jordan's journey via Live on Everest, a Web application provided by Esri. They were glued to a GPS-supported digital map on their computers as they watched a trail of red dots ascend the northeast ridge of Mount Everest—each dot marking his progress in 10-minute intervals. A circle that pulsed softly, like a heartbeat, reported each new location. Superimposed on the map were live Twitter exchanges from the members of Team Jordan, including Jordan; his father, Paul Romero, and stepmother, Karen Lundgren; and guides Ang Pasang Sherpa, Lama Dawa Sherpa, and Lama Karma Sherpa, as they closed in on the summit.

Back in the small community of Big Bear Lake, cheers erupted inside the home of Naomi Nelson, a schoolmate of Jordan's who was following the dots on the map with her family. At 9:45 a.m., Everest time, on May 22, she saw the red dot pulsating from the peak and knew Jordan had bagged his dream.

"I watched him on the map with my parents and sisters, and when he made it to the top, we went crazy," she says. A host of others watched, too. Hits on Live on Everest skyrocketed to 18,000 on that record-breaking day.

"I know technology is saving lives every day, and in this case, it did make our team safer and [kept us] in contact with rescue and even friends and family," says Jordan about Live on Everest after returning home in June. "Feedback was just unbelievable. We were praised as likely having the most professional and most-watched expedition ever on Mount Everest."



Tuning in to Live on Everest, viewers could see a variety of information, including the latest Mount Everest weather forecasts.

Team online submissions recorded the group's travel experiences. Tweets and photographs captured the initial excitement as Jordan explored the streets of Kathmandu, Nepal. On the mountain, Jordan wrote about the three Sherpa guides as well as the cook, Kumar, saying "Kumar's kitchen…[is] not glamorous, but it's amazing." Then the mood turned serious as team members attended a traditional climbers ceremony to pay homage to the mountain before beginning the dangerous ascent.

Team Jordan's Live on Everest brought the conversation about the climb on Twitter into view.

Using a Mapcentric Interface

The Live on Everest application used Esri ArcGIS technology to bring various types of online information together into one simultaneous view. In addition to showing the map with nearly live tracking and Twitter exchanges, the application aggregated and displayed social media information from the team's Facebook blog and Flickr photos. Visitors at Live on Everest could access local weather forecasts, explore a terrain profile that calculated daily distance and elevation gains, and see a side view of the climbing route.

"It was a fascinating feeling to be so remote, so disconnected, yet having the whole world watch our every move," Jordan says. "Having family and fans connected to us provided energy; it provided pride to another level about our quest. Pretty cool stuff, almost like being on the moon and having so many people watch our every move."

Jordan and his team had not only planned every step of the climb but also ensured that anyone with an Internet connection could visualize their journey. They carried some of the technology with them: a SPOT Satellite GPS Messenger location receiver and transmitter, satellite mobile phone, and notebook computer along with solar technology for recharging batteries. Throughout the journey, the ArcGIS application, hosted by Esri, provided the platform to combine maps, satellite images, geolocation, and social media in a single, online viewer.

Team Jordan originally envisioned using a live mapping application and, having heard of Esri, contacted the company to help make it a reality.

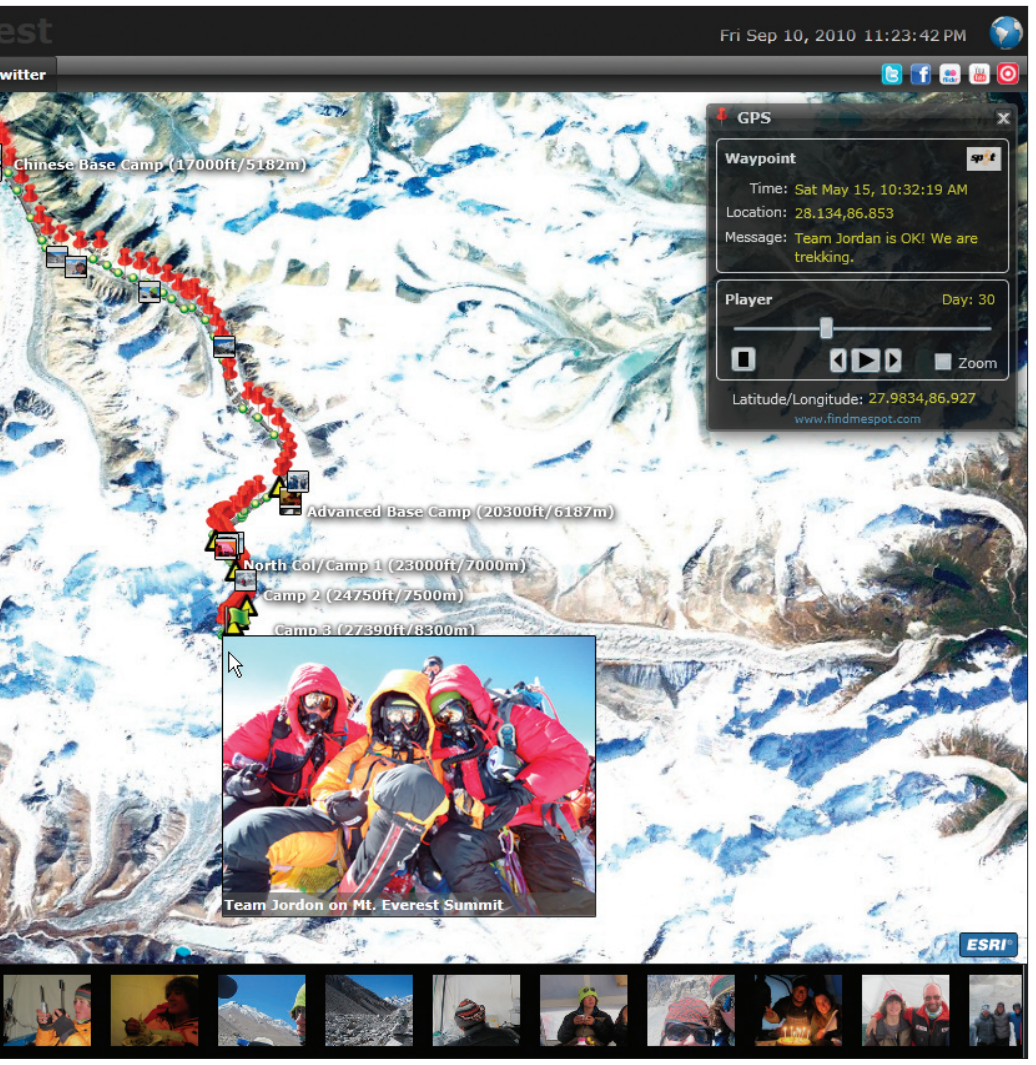
"The Esri platform integrates well with online services and social media and can quickly provide map and satellite images at any scale," says Randy Frantz, Esri manager for the telecommunications and location-based service industries. "The application provides a mapcentric interface that brings everything that's relevant together. It gives the viewer the ability to quickly understand what is going on."

Frantz worked with the application team of Allan Laframboise and Andy Gup, both Esri Developer Network technical leads, to launch Live on Everest.

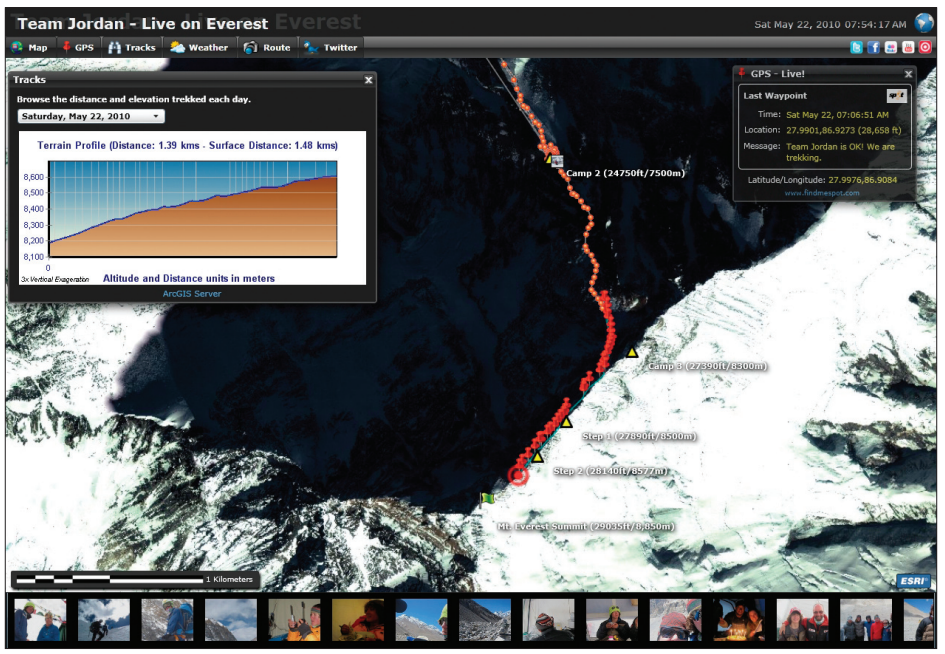
"It's an excellent example of how GIS services and social media can be combined to build the next generation of geolocation applications," says Laframboise. "We have seen how using social media and geolocation has helped in situations such as the Gulf of Mexico oil spill [esri.com/oilspill]. With the increased availability of location-aware platforms and devices, now even on cell phones, I think this is just the beginning of a new frontier of GIS software development."

Developing the Application

In just three weeks, the technical team members implemented the Esri ArcGIS platform to support the project. They used Esri's ArcGIS Server to automate a number of back-office operations, such as acquiring and storing the team's



A status report and photograph from Team Jordan.



Live on Everest visitors were able to explore a terrain profile that calculated daily distance and elevation gains by Jordan and his team.

geolocation and social media data. They used a combination of Esri server, online imagery, and desktop technology to create, author, and publish the location data and related information as geospatial services. The back end of the system was fully automated, so Team Jordan members could use GPS equipment and social media technology as they normally would without having to carry out additional software tasks to keep their locations tracked on the Web site. This was accomplished with the ArcGIS API for Microsoft Silverlight/Windows Presentation Foundation (WPF), which provides the mapping interface that delivers live information from Web services such as Twitter. The API enables the creation of rich Internet and desktop applications that use the powerful mapping, geocoding, and geoprocessing capabilities provided by ArcGIS Server and Bing Maps services.

For Live on Everest, the ArcGIS API for Microsoft Silverlight/WPF helped viewers automatically navigate to the team's last reported GPS position and simultaneously see what Team Jordan and others were saying on social networks. It also added the educational components, such as weather forecasts and a terrain model.

The result was a viewer that could bring Team Jordan into numerous school classrooms and living rooms, not to mention help comfort family members back in California.

Says Jordan, "Perhaps through this technology, I'm actually going to inspire some kids to get out and set some big goals and dreams."

To learn more about Jordan and his Everest summit, visit **jordanromero.com**, where you can click Live on Everest (**edn1.esri.com/everest/default.html**) to see the map.

The New Gateway to Green Building

Highlights

- GBIG is built with ArcGIS Server and ArcGIS API for Flex and is hosted by Amazon Web Services.
- The GBIG mobile application is free and available for Apple's iOS operating system for iPad, iPhone, or iPod touch.
- The application helps green building practitioners find information on nearby projects.

Over the past decade, green building has gone from the fringe to the mainstream of the building industry. In many communities, buildings have "gone green" by adopting strategies such as integrative design, energy modeling, commissioning, enhanced energy efficiency, renewable materials, attention to daylight and views, water conservation measures, and on-site renewable energy generation. Use of these green building strategies in new and existing buildings can dramatically reduce energy consumption, greenhouse gas emissions, and water use while creating more comfortable and satisfying indoor environments. The green building movement seeks to sustain and accelerate these trends with the goal of driving permanent shifts in practice to benefit people and the environment.

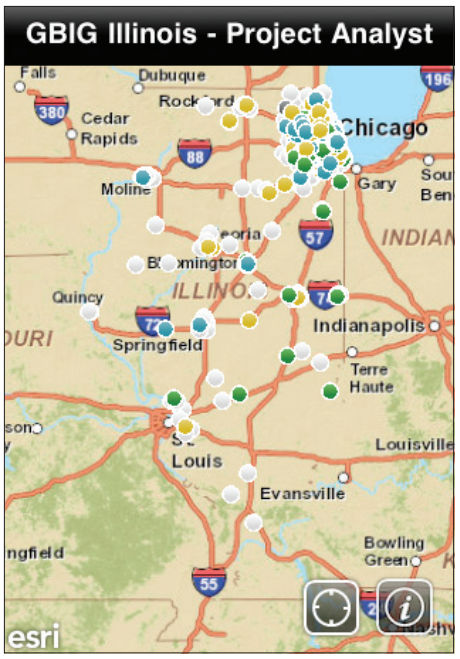
The U.S. Green Building Council (USGBC), located in Washington, D.C., helps advance this vision with its Leadership in Energy and Environmental Design (LEED) series of rating systems. The U.S. Green Building Council is a 501(c)3 not-for-profit organization. LEED helps identify and prioritize best practices related to location and planning, sustainable sites, energy and atmosphere, water efficiency, materials and resources, and innovation in design. Ten years ago, the initial release of the LEED system focused on new commercial construction. Today, LEED 2009 encompasses a family of systems that reach throughout the life cycle of built environments, including neighborhoods, commercial buildings, health care facilities, schools, and homes. LEED provides a consensus-based national standard for green building practices linked to rigorous third-party review and certification.

A Portal to Green Projects

Helping users explore and navigate green buildings is the Green Building Information Gateway (GBIG), built with ArcGIS Server and ArcGIS API for Flex. GBIG is hosted by Amazon Web Services and is being made available in phases to cover large metropolitan statistical areas (MSAs) across the United States. The first MSA available is focused on Chicago, Illinois, to be followed by Washington, D.C. GBIG's Web-based, mapcentric portal combines both a mobile application and a Web-based analytic environment.

GBIG provides an unprecedented ability to explore, navigate, and compare green buildings over both space and time. Using tools within ArcGIS, projects can be animated to show their growth over time. This illustrates the dynamic landscape of green building practices while providing valuable context for the next generation of high-performance projects.

GBIG users can find LEED-certified buildings (that is, buildings that have been formally recognized as using environmentally friendly building practices) using a combination of text-based searches of project attributes and geographic searches for addresses, such as searching by proximity or travel time. These capabilities allow green building practitioners to quickly identify practices and performance metrics for similar projects in a specified area. Over the next year, these spatial- and attribute-based searches will be expanded to include information about associated LEED Accredited Professionals, USGBC member organizations, operational project performance metrics, educational materials, and products and services. Developing GBIG with ArcGIS Server technology provides the interoperability needed to connect to third-party data sources and understand green building attributes in the context of data such as occupancy rates, rents, or demographic forecasts.



Projects are seen as points on a map and display attributes indicating levels of performance with respect to categories of green building.

"We hope that by developing a means for people to systematically search green building projects, they are inspired to build better and exceed the current level of prevailing practice," says Dr. Chris Pyke, vice president of research, USGBC.

A mobile application provides the potential to explore green building in the field by locating green building activities close to a user. Built on Esri Business Analyst, the GBIG mobile application is free and available for Apple's iOS operating system for iPad, iPhone, or iPod touch. Users can see their location and information about nearby LEED-certified projects. These projects, shown as point locations on the map, can include neighborhoods; new construction; and offices, retail facilities, schools, or other public buildings. Project attributes indicate levels of performance with respect to categories of green building strategies or specific issues, such as the new LEED 2009 Carbon Index.

This is useful for practitioners interested in understanding green building practices and project performance in an area. "It's difficult to know what is happening around you today, because market conditions are changing quickly, and we have no systematic way of seeing what projects have achieved in a given area," says Pyke. "This application allows green building practitioners to find out information on nearby projects, providing transparency and disclosure—core missions for our organization."

Making LEED Certification Regional with GIS

LEED 2009 represents USGBC's state-of-the-art family of rating systems. LEED 2009 consists of a combination of mandatory prerequisites and elective credits. Projects must satisfy all prerequisites and a certain number of credits to achieve certification. The number of points allocated to each LEED credit reflects its relative value for reducing a set of 13 environmental impacts developed by the U.S. Environmental Protection Agency. These categories include greenhouse gas emissions, fossil fuel use, and water consumption, among other factors.

LEED 2009 uses an analytic framework that estimates building-related impacts and applies this information to allocate points to each credit in the rating system. The credits that address the most important impacts receive the greatest number of points. Today, USGBC refines national benchmarks with a ZIP Code-based approach that customizes LEED 2009 rating system requirements for different regions. USGBC is exploring GIS-based solutions that help create, identify, and prioritize green building strategies for local conditions and regional priorities.

For example, GIS-based approaches will help refine ZIP Code-level analyses to facilitate consideration of geographic variation in population density, regional electricity generation mix, availability of public transportation, and water supply characteristics. Combinations of these factors vary significantly between regions; between neighborhoods within a city; and, in some cases, from block to block.

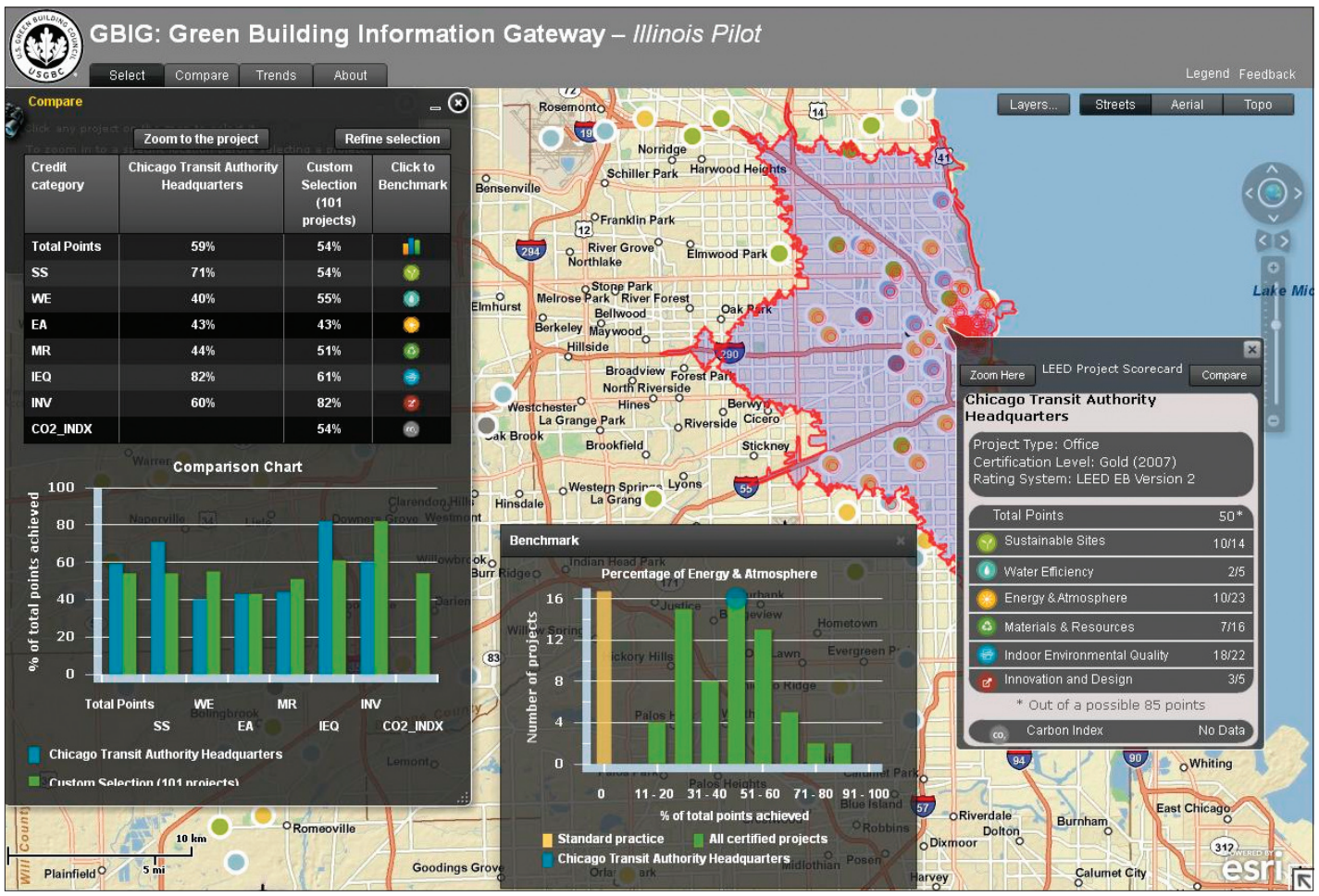
Understanding Market Patterns and Trends

ArcGIS and Business Analyst help USGBC members understand spatial patterns in green building certification, first by sharing spatial data on LEED-certified and -registered projects through ArcGIS.com. "We see this as providing a platform for analyzing market conditions and making decisions toward most effectively meeting the demand for green real estate at a specific location," says Pyke.

Real estate professionals can overlay LEED project data on other sources of supply-and-demand indicators to determine the size and character of the market for sustainable space. These types of analyses offer the potential to map a wide variety of relationships to understand current patterns and create market forecasts and scenarios.

"GIS is rapidly becoming part of the future of green building," says Pyke. Green building practitioners are beginning to recognize the need to move information technologies to the front of the sustainable design process. A spatially aware, analytically driven green building practice will include clear processes to define performance metrics throughout the life cycle of built environments, application of fundamental geodesign principles, and advanced technologies to monitor performance over time.

For more information, contact Dr. Chris Pyke, vice president of research, U.S. Green Building Council (e-mail: cpyke@usgbc.org, tel.: 202-445-0041).



The Green Building Information Gateway allows users to explore, navigate, and compare green buildings.

Going Green at Pomona College

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

Members of the Pomona College audit team.

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.

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

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 *(see article on page 28)*. 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.

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."

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."

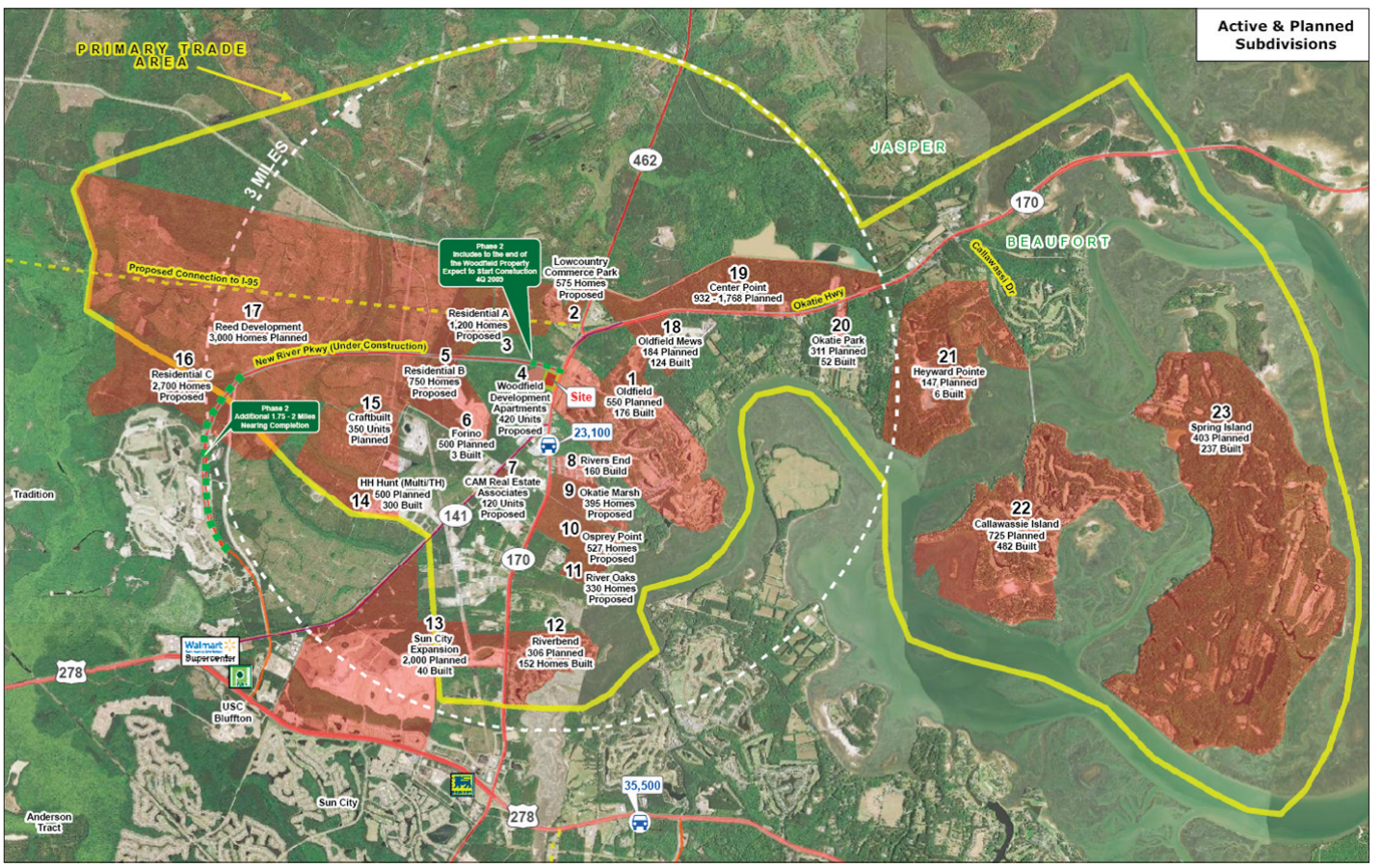
For more information, contact Jon Roberts, principal consultant, director of building sciences, CTG (e-mail: jroberts@ctgenergetics.com, tel.: 949-428-6285) or Bowen Close (e-mail: bowen.close@pomona.edu, tel.: 909-607-1765).

Enhancing Shopping Center Performance

Highlights

- Business Analyst Online and ArcGIS Mapping for SharePoint help real estate companies create accurate reports for clients.
- Information once presented in a 300-page binder enhances understanding when aggregated into map form.
- Real-time models can be built based on market conditions.

The golden rules for creating a successful shopping center—have a good location and strong anchor store—don't always apply in today's retail environment. Instead, the smallest nuances in a market can make or break a business. The success of shopping centers is based on generating the best mix of retailers and creating high-profile developments that are optimally aligned with neighborhood need and market opportunity. Finding and understanding the data to perform these functions in a traditional manner—through spreadsheets and by hand—can be difficult. Many commercial real estate owners and developers are finding that GIS opens the door to a new way of doing business.



Combining city data with updated information through Bing Maps and Esri demographic data ensures that Edens & Avant has the most current information for its clients.

SharePoint and ArcGIS Give United Properties an Edge

One shopping center owner, United Properties, provides a wealth of research to its leasing agents to help them develop critical insights into their trade areas. United Properties, with its sister company and leasing agent NorthMarq, of Minneapolis, Minnesota, is the owner of 20 shopping centers in the midwestern United States, providing a full range of commercial real estate services nationwide.

Too often, however, the agents didn't understand how best to leverage this information. "Giving a 300-page binder of data to our leasing agents just wasn't proving effective," says John Breitinger, vice president of NorthMarq.

The companies partnered with sister company Inetium to develop a program called re-lytics that offers proprietary research, analytics, and a Web-based toolkit supporting both leasing and asset management.

Re-lytics: 15 Minutes to a Great Site

After reviewing several options, the companies chose ArcGIS Server, ArcGIS Mapping for SharePoint, and Business Analyst Online (BAO) API. These were the only solutions they found that would provide access to the geographic datasets, internal information, and assessment tools that agents need to do their jobs, as well as a secure site to collaborate and share information. The team also uses geographic data from ArcGIS.com. With the software and data, leasing agents can now see all the information they need on a map to help their clients find the most appropriate space.

The re-lytics program surveys and assesses more than 134 categories of goods and services in each shopping center trade area. Using ArcGIS, the data can be organized to determine spending potential, competitive dynamics, and consumer preferences for every category of retail goods and services in the marketplace. The program is a quick and simple evidence-based approach since, as Breitinger points out, "Even the best insights are not useful if they aren't easy to use."

One component of re-lytics is a 15-minute tactical analysis. Users employ tools to quickly assess the market potential for a particular business, evaluate existing competition, and create custom marketing materials, including a comparison report that puts everything in context for a prospect. An agent begins by reviewing consumer spending and market potential reports to get a feel for the market potential.

Next, the agent uses the map-based tools to review current competition and property availability and see spatial relationships. The agent makes comparisons by selecting the trade areas to be compared by creating either a custom polygon or a radius or drive-time distance around an address. The agent then selects the categories that need to be considered for that particular retailer, such as key demographics, consumer expenditure, and employment information. A report is generated and made into an Excel spreadsheet. It only takes a few minutes for the agent to add information and a local perspective, such as anchor store and traffic information. A report like this is used to compare a retailer's existing sites to potential sites.

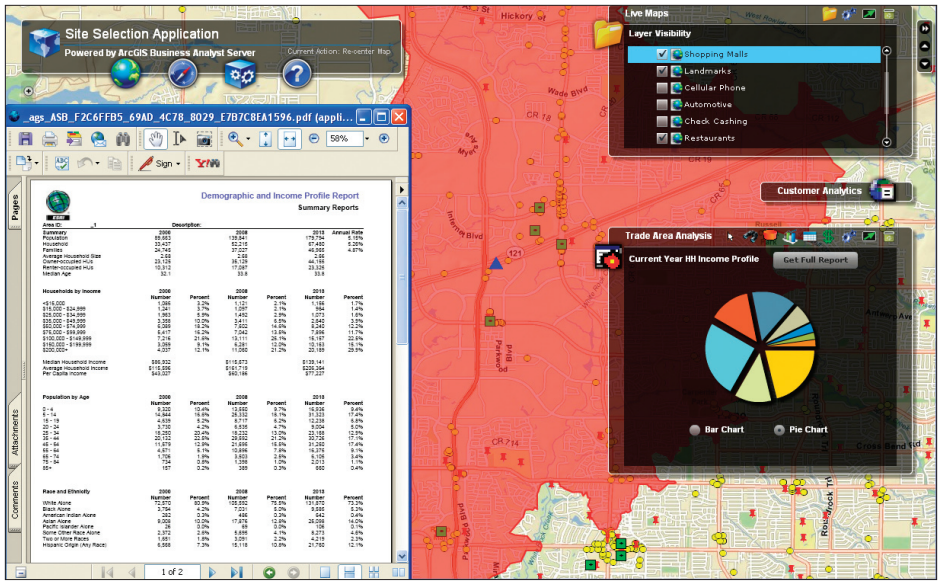
"Working with Esri software, we were able to provide custom materials to support each pitch, including comparison reports and very useful maps," asserts Breitinger. "This was a breakthrough in providing context for every decision. We are all overwhelmed with data. We have found GIS to be a rich platform to aggregate information from many sources and create much better insights and visualizations. This has resulted in more customer engagements and much more substantive discussions."

For more information, contact John Breitinger, vice president of retail services, NorthMarq (e-mail: john.breitinger@northmarq.com).

Nationwide Analysis for Real Estate Transactions

Edens & Avant, headquartered in Columbia, South Carolina, owns, operates, and develops community-oriented shopping centers in primary markets throughout the East Coast. More than 130 centers in 14 states make up its portfolio. The company's clients include regional and national retailers such as Fresh Market, Whole Foods, Publix, Starbucks, and Target.

Information is consolidated into one system, allowing Friedman Real Estate Group to better visualize and analyze CMBS data.



United Properties agents collaborate online to view information about different shopping center locations using Esri Business Analyst and SharePoint.

Creating Healthy Shopping Centers

Whether a retailer is looking to open a new store, add a second store, or move across town, the company has to be ready with the correct information and a strong case for the retailer to move into an existing shopping center or a new development. Purchasing one-off reports to research each shopping center—the company's traditional way of doing business—becomes inefficient when dealing with hundreds of locations that have rapidly changing information like demographic data.

In addition, instead of banking on the promise of growth driven by the housing boom—the standard model a few years ago—developers must now develop projections based on less robust growth and more conservative economic projections. "Healthy shopping centers are the ones that are located in markets with a diverse workforce and good balance of daytime-to-household population," says David Beitz, director of GIS, Edens & Avant. As a result, the company needs to analyze, aggregate, and display accurate demographic information on a daily basis.

Edens & Avant turned to Esri Business Analyst Desktop software and BAO to help its clients make the most informed decisions. Clients can see and understand all information available for each shopping center location, including address, major roads, competition, population density, and growth. BAO is used to generate a customized six-page report annually for each shopping center that is then used by investment leasing and development group agents so they can better visualize and understand their markets. The software helps identify new markets that are similar to those in which the retailers are already successfully operating. If staff members need customized reports or maps, they can request them from the GIS group.

Integration with Bing Maps provides monthly updates to aerial, road, and hybrid (aerial with labels) maps. "Using GIS and Bing Maps, we are able to find locations fast," says Beitz. "Being able to view aerial images allows us to give a better context to our clients about location. This is particularly helpful when looking at larger areas."

Business Analyst streamlines operations. The company looks carefully at optimizing its shopping center portfolio by selling properties in secondary and tertiary markets and buying properties in primary markets with dense populations in core-based statistical areas. GIS is used to look at daytime population and income and population changes, among other information, and to research markets and assist in quickly leasing space by providing spatial information via maps and reports that uniquely characterize neighborhoods and are specific to each retailer.

"It is very important to know the demographics in order to find areas that will perform best in this new economic climate," says Beitz.

Edens & Avant can now serve its clients' needs internally without outsourcing to third parties. The ability to combine city building permit data ensures that Edens & Avant has the most current information for its clients. As a result, two planned grocery-anchored shopping centers are going forward in areas where population doubled even though residential construction recently slowed down. Being able to find and track this growth with Business Analyst allowed the company to minimize the carry time of the land and provide the shopping center sites based on the retailers' timelines. Concludes Beitz, "Without the information to support these decisions and an accurate and appropriate way to communicate it, these projects wouldn't have been as successful."

For more information, contact David Beitz, director, geographic information systems (e-mail: dbeitz@edensandavant.com).

Friedman Real Estate Group Invests in Analysis

Friedman Real Estate Group, of Farmington Hills, Minnesota, a real estate company serving the Midwest, uses a solution based on GIS to help analyze and better organize Commercial Mortgage-Backed Securities (CMBS). Friedman had access to simple mapping tools and data for CMBS loans that allowed it to do analysis on behalf of its clients, but it was unable to do site analysis without a lot of work. Asking a few questions to get a more accurate picture of the investment performance of a particular area or property could take a few days and cost several thousand dollars.

Kirkshire Site Selection Services, a company specializing in technology solutions for Detroit-area real estate businesses, worked with Geographic Information Services, Inc, an Esri partner, to create the solution with ArcGIS Server using an ArcObjects component framework. The new system was created in two weeks.

Says Ian Burnstein, Kirkshire's owner, "The most exciting thing for me was helping Friedman implement a solution that someone with very little technology experience could use. We had to simplify a very complicated procedure so it would be a onetime, up-front expense instead of several thousand dollars each time they asked us to do an analysis."

GeoRSS Gives an Accurate Picture of the Market

Friedman uses a subscription-based service for the CMBS data from Investcap Advisors LLC. Investcap can define its own criteria to create more than 50 data filters, providing Friedman with a way to scrutinize underlying loan and property characteristics. This data is available in a GeoRSS, which is loaded into ArcGIS Server; queried; and segmented by the most relevant criteria for each market situation, such as distressed or performing assets. Analytic real-time models are then built based on market conditions. Dots are created on the map using Adobe Flex and deployed on cross-platform Internet applications based on the Adobe Flash platform using ArcGIS Web Mapping API for Flex. Because different executives want to see different data, they now have the ability to define their own criteria and queries.

In one scenario, the distressed asset group of a real estate firm in Michigan is looking for properties in Florida to represent or broker. A simple query returns all the distressed assets in that state that match the firm's core competencies—for example, retail and multifamily residential units. Displaying these results on a map reveals several clusters of these distressed assets in the Miami area. After choosing the properties of interest, the analyst runs demographic reports of the properties to better understand why there was a failure or a success. Was it due to the general market condition, bad financing, or mismanagement? For a real estate company, understanding these variables can be a key to success.

For more information, contact Katie Irwin, Geographic Information Services, Inc (e-mail: kirwin@gisinc.com). For more information on how businesses can operate more effectively with GIS, visit **esri.com/business**.

Where Wild Winds Rule

Understanding Mountain Gravity Waves Helps Optimize Glider Flights over the Andes

By René Heise, Director, Mountain Wave Project

Highlights

- GIS was used for visualizing the flight path and the bands of wave lift in the complex terrain of the Andes.
- The ArcGIS Desktop tools verified forecasts through comparison with weather satellite images.
- GIS makes it possible to generate a simplified wave climatology of the Andes and visualization of turbulence.

In a field where science and adventure sports meet, the team of the Mountain Wave Project (MWP) (mountain-wave-project.com) is trying, in connection with the scientific section of the Organisation Scientifique et Technique du Vol à Voile, to carry out targeted research on internal gravity waves (i.e., the interface between the mountain and the atmosphere) in the atmosphere and put its findings to work in record-setting glider flights. This glider-based "research lab" demonstrates impressively how modern forecasting methods can be applied to identify relevant atmospheric structures (such as mountain waves).

The longest-ever distance flown in a glider—more than 3,000 kilometers in the mountain waves of the Andes in South America (at Formula 1 speed, at an altitude between 4,000 and 8,500 m over a flight time of 15 hours)—has set new standards in aeronautical sports. For this unprecedented flight, and for many others listed in the Fédération Aéronautique Internationale's gliding world record compendium, GIS was used for visualizing the flight path and the bands of wave lift in the complex terrain of the Andes, as well as displaying the relevant weather satellite images with charts from high-resolution numerical weather prediction models. Since its first Andes expedition in 1999, MWP has been acquiring data from more than 100 flights in Andean wave systems, all of them documented with Global Navigation Satellite System (GNSS) flight recorders.

Evaluation of GNSS Flight Recorder Data

During motorless sections of gliding flights, upward motions of the atmosphere ("lift") need to be used for the sailplane to gain altitude. There are several forms of lift, and it is of great interest in the analysis of long-distance gliding flights to distinguish between these different forms:

- The upward moving branch of mountain waves
- Lift related to the slopes in the landscape ("ridge lift")
- Lift related to warm air rising by convection ("thermals")

GNSS data recorders are commonly used to log GPS position fixes (time, latitude, longitude, altitude) every 1 to 15 seconds. A mathematical-statistical data analysis method was used to identify the lift related to mountain waves in these datasets, taking into account the height of the underlying terrain (SRTM30 data) and meteorological considerations.

More than 100 flights carried out in the mountain waves of the Cordillera of the Andes during the period from 1999 to 2010 were analyzed in this manner to yield lift diagrams.

The flight path of the 2,256-kilometer world record gliding flight in a straight distance demonstrates good correlation with the bands of statistically derived areas of prevalent wave climbs.

Above: Examples of wave climbs. Below: More than 100 flights carried out in the mountain waves of the Cordillera of the Andes between 1999 and 2010 were analyzed.

Comparisons

For numerical weather forecasting, high-resolution, nonhydrostatic models (2 km horizontal grid distance) are being developed that are able to resolve mesoscale atmospheric phenomena such as mountain waves, foehn storms, anabatic and katabatic wind systems, and land/sea breeze circulation.

In the development of such models and their testing and operational application, visualization techniques using ArcGIS Desktop software's Naval Meteorology and Oceanography (METOC) and MWP Turbulence tools are valuable for verifying forecast products, such as vertical motion, air temperature, humidity, and wind fields, by comparison to observational data gathered from weather satellite images or derived products, such as temperature retrievals.

Turbulence Markers Downwind of the Andes

Although mountain waves themselves require laminar (and thus smooth) airflow, they can be related to severe or even extreme turbulence in the form of rotor-like air movements below, or breaking waves. Such turbulence can create severe hazards to commercial airline operations and other flights. It is therefore important to be able to predict areas that have a high potential of such turbulence.

While in the southernmost areas of the Andean mountain ranges (Patagonia), mountain waves—and with them the potential areas of severe turbulence—are often indicated by the occurrence of lenticular clouds, there is rarely sufficient moisture content available farther north for the generation of such clouds. This is particularly true for the busy air corridor between Buenos Aires and Mendoza, Argentina, and Santiago, Chile.

To overcome this lack of turbulence indicators, turbulence markers created from the wave climbs as analyzed from the glider flights can be used for planning commercial flights under conditions conducive to the occurrence of mountain waves. Pinpointing areas of high mountain wave probability, visualized by ArcGIS tools, allows easy recognition of altitude, frequency, and intensity of likely turbulence encounters. With the aid of GIS, light tracks of aircraft can be analyzed, evaluated, and used to optimize flight routes.

Zoomed view of green inset box above: *In January 2010, a world record gliding flight was attained—2,256 kilometers straight from El Calafate, Argentina, to San Juan, Argentina. GIS analysis of mountain wave climbs (i.e., rising air) aided this success. Red turbulence symbols designate moderate to heavy turbulence with vertical speeds of 6 to 10 meters per second. Purple symbols depict extreme turbulence of over 10 meters per second.*

About the Author

René Heise is project founder and director of the nonprofit Mountain Wave Project. He has studied physics and meteorology at the Humboldt-University of Berlin and has presented all over the world.

For more information, contact René Heise, MWP director (e-mail: rene.heise@t-online.de).

The author wishes to thank the Behörden und Organisationen mit Sicherheitsaufgaben (BOS) team at ESRI Deutschland GmbH for its support in modifying the METOC tool.

Integrating Scientific Research with Indigenous Knowledge in Arctic Alaska

By Wendy R. Eisner, Department of Geography, University of Cincinnati

Highlights

- The elders of the North Slope Borough are keenly aware their way of life is under siege.
- Investigators combined remote sensing, GIS, field data collection, and Iñupiaq ecological knowledge to study landform processes.
- A Web site was created to be an open portal to access the Iñupiaq Web GIS.

Living in one of the harshest environments on earth, the Iñupiat Eskimos of the Alaskan North Slope have a more intimate relationship with their land than most of the world's people. They are heavily dependent on hunting and fishing for much of their food, and they must be highly trained to cope with environmental extremes: winter temperatures of -40°C, blizzards, dense fog, and hoards of mosquitoes. Their lifestyle demands that they be cognizant of the potential hazards of traversing their land, since mistakes can be life threatening. Adding to these hardships, the Iñupiat are witnessing unprecedented environmental changes that are often beyond the experience of seasoned hunters and elders. They watch the landscape with concern: the lakes are draining, the permafrost is thawing, and the coastline is eroding. They must now adapt to changes that are rapid and unpredictable. To top it off, climate change has been more pronounced in the Arctic, causing greater disruption to landscape, vegetation, and animals than anywhere in the world.

The Iñupiat are profoundly tied to their environment not only through their subsistence lifestyle but also their cultural identity. The elders of the North Slope Borough (a Wyoming-sized region of northernmost Alaska with 10 villages and 7,500 people) are the custodians of all accumulated environmental and cultural knowledge. They have expressed concern about the changing landscape, interest in scientific findings about those changes, and a desire to share their knowledge of local ecosystems with scientists. They are aware that their way of life is under siege and that they represent a vanishing breed. Community members of all ages have indicated that they want the ecological and historical knowledge of their elders to be documented and archived for future generations.

Because much of their knowledge is location-specific, one way of achieving this goal has been through the creation of a GIS database of indigenous knowledge. Fifty-two Iñupiat elders, hunters, and berry pickers from the villages Barrow, Atqasuk, Wainwright, and Nuiqsut were interviewed, and more than 50 hours of videotaped interviews were produced. During the interview, an elder would identify a location using topographic maps and satellite images. Observations on the landforms, environmental change, human activities, and other phenomena were geocoded and entered into the GIS. Some of the major categories or features were classified as drained lakes, freshwater springs, erosional features, resources (caribou, fish, berries), historic sites, and travel routes. The dataset was created using ArcGIS Desktop applications through an Esri university site license agreement.

The impetus for this project grew out of the environmental research conducted by a team of scientists interested in the landscape evolution of the Arctic tundra. For more than two decades, geoscientists Wendy Eisner and Kenneth Hinkel of the University of Cincinnati, Ohio, have been studying the Arctic Coastal Plain of northern

This satellite image clearly shows that the landscape is densely covered with lakes. The inset shows an example of a linked video clip of an elder describing one of these lakes.

Alaska, which includes the North Slope Borough. The dominant landscape process in this area of continuous permafrost is the formation and drainage of lakes. In 2004, Eisner, Hinkel, and University of Georgia collaborator Chris Cuomo began to explore the intersection of Iñupiaq knowledge and landscape-process research in the Arctic. With support from several programs at the National Science Foundation, they combined remote sensing, GIS, field data collection, and use of Iñupiaq ecological knowledge to study landform processes. One of the unique aspects of this project was the combination of western science with traditional knowledge. The material obtained greatly exceeded the original scope of the project and has expanded into wider realms, including life stories, cultural history, and human impacts on the land.

An important goal of the project was to develop a methodology for returning this body of knowledge to the local community for use as an educational and resource management tool. The Internet permits the seamless transfer of data and knowledge and has the ability to reach a large number of people. To that end, the Iñupiaq Web GIS was incorporated into a Web-based platform using ArcGIS Server.

While it was deemed important to create a Web site with a number of spatial analysis tools, it was also important to understand the stakeholders involved. Many people of the North Slope have limited Internet access and computer/technological knowledge. Thus, the layout of the Iñupiaq Web GIS is straightforward, containing a table of contents, overview map, basic toolbar, main map viewer, and advanced toolbar. The inclusion of links to video clips of interviews is another feature of the Web GIS.

A Web site, Arctic Cultural Cartography (**northslope.arcticmapping.org**), was created to be an open portal through which the Iñupiaq Web GIS could be accessed. Since the information contained in the GIS has the potential to be culturally or politically sensitive, the proprietary rights of the owners needed to be addressed. To ensure that the data remains secure, the portal site is public, and users are asked to register for access to the GIS.

The information in the Iñupiaq Web GIS represents only a portion of the database that has been collected. This is a demonstration site, and it is anticipated that the feedback received from visitors will lead to the development of a complete interactive site in the near future.

The people of the Arctic have witnessed rapid and catastrophic changes in the landscape during their lifetimes. Their insights provide a level of understanding that is not often available through traditional scientific methods. By providing the means for the stakeholders to participate in this process, it is anticipated that the community will assume control of data collection, thereby preserving their own culture and creating a living document.

About the Author

Wendy Eisner, associate professor of geography at the University of Cincinnati, Ohio, was the principal investigator of this National Science Foundation project.

Acknowledgments

Ken Hinkel, professor of geography, University of Cincinnati, Ohio, and Chris Cuomo, professor of philosophy and women's studies at the University of Georgia, were coprincipal investigators. Jessica Jelacic earned a master's degree from the geography department, University of Cincinnati, for her thesis on the development and implementation of the Iñupiaq Web GIS. Dorin del Alba, Integrative Group, Fairbanks, Alaska, is an IT Web consultant who designed the Web site, and Changjoo Kim, assistant professor of geography, University of Cincinnati, lent his expertise to the realization of the Web GIS. This project would not have succeeded without the cooperation and dedication of a number of other people, not least the Iñupiat people of northern Alaska.

For more information, contact Wendy Eisner (e-mail: wendy.eisner@uc.edu). Visit the Arctic Cultural Cartography Web site at **northslope.arcticmapping.org**.

NASA Moves Ahead with Enterprise Agreement

continued from cover

The agreement reflects NASA's extensive and growing use of Esri's ArcGIS software to bring geospatial intelligence to a wide variety of mission-critical efforts, from streamlining operations to enabling research and exploration.

"NASA is one of the most innovative users of geographic information system technology," says Esri president Jack Dangermond. "NASA has demonstrated the power of geospatial thinking by applying GIS to a wide variety of areas to solve problems and advance understanding of our world and the universe."

GIS plays a key role in NASA's earth science research initiatives, which involve global efforts to monitor and study the factors of climate change. Esri technology supports collaboration between NASA and other organizations worldwide by providing a strong platform for sharing and analyzing geospatial data.

"GIS increases our understanding of the world around us through the visualization of information," says Stennis Space Center environmental GIS lead Kelly Boyd. "Esri's ArcGIS platform provides the tools to leverage this understanding each day to inform decisions in our work."

The NASA Langley Research Center pioneered the use of GIS in facilities management to reorganize its 800-acre campus to cut costs while fully supporting existing activities, a move that could save hundreds of millions of dollars in the coming years for NASA and other facilities.

For more information about Esri government ELAs, visit **esri.com/ela**.

Providing Building Blocks for Haiti Reconstruction

The Salvation Army Brings GIS into the Streets to Plan Transitional Shelters

Non-Governmental ngo Organization

Highlights

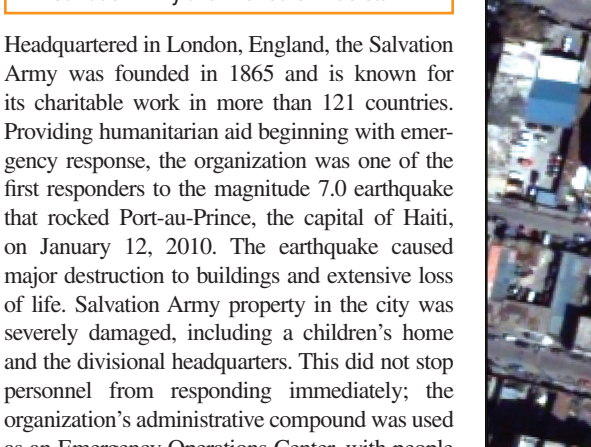
- Using ArcPad, the data is captured and can be edited and displayed while out in the field.
- The team performs a damage risk assessment once data from field assessments is compiled.
- Maps and reports created from this information are shared throughout the Salvation Army and with other NGO staff.

Headquartered in London, England, the Salvation Army was founded in 1865 and is known for its charitable work in more than 121 countries. Providing humanitarian aid beginning with emergency response, the organization was one of the first responders to the magnitude 7.0 earthquake that rocked Port-au-Prince, the capital of Haiti, on January 12, 2010. The earthquake caused major destruction to buildings and extensive loss of life. Salvation Army property in the city was severely damaged, including a children's home and the divisional headquarters. This did not stop personnel from responding immediately; the organization's administrative compound was used as an Emergency Operations Center, with people sleeping in the parking lot.

Today, the Salvation Army serves as a UN-designated "lead agency" for approximately 20,000 Haitians who are living in tents within a soccer stadium near the organization's Port-au-Prince headquarters. The Salvation Army is making it a priority to transition refugees from this camp into temporary shelters and has established a New Recovery and Development Office in Haiti, hoping to better match international assistance with local need. This office will continue the work the planning group of the Salvation Army World Service Office Incident Management team has been doing for the past eight months. GIS has been a main tool used to ensure that the transitional shelters are built.

This team began a Haiti Earthquake Transitional Shelter project to assess the need for shelter around the area of Jacmel, a city on the Caribbean coast in southeast Haiti, about 86 kilometers south of Port-au-Prince. Jacmel serves as the capital city of the southeast department, one of 10 in the country.

In March of this year, the team completed a 12-day shelter site assessment, logging 400 assessments in the townships of Jacmel, Cay Jacmel, Bainet, and Decouze. Later, in May, the planning group returned to the country to begin construction of the shelters. This fall, the group returned once again to complete construction of 1,500 more temporary shelters.



The earthquake severely damaged property in Port-au-Prince.

The 7.0 earthquake that rocked Port-au-Prince on January 12, 2010, caused major destruction to buildings, as seen in these before and after images.

Using GIS on the Ground for Disaster Relief

A significant aspect of the field assessment was to accurately map and record shelter site locations. The team used high-performance GeoXT/Nomad Trimble data collectors combined with ArcPad to digitally record transitional shelter site locations. Assessment teams have two members: an interpreter and an interviewer.

The interpreter records the GPS location of the home site and photographs the people present, as well as the home, to assess condition and need. The interviewer obtains host family information, such as who the owner is; the number of people present; and demographics, including whether amputees or single women live at the home site. Other important information the team captures is the distance to freshwater sources and latrines. This data helps disaster recovery unit members decide which site to attend to first.

"The teams were effective in gathering information because they successfully established key relationships with community leaders, kazaks, and other humanitarian aid workers," says Finn Dahl, GIS director at DES, Inc. Dahl is responsible for managing GIS operations in Haiti for the Salvation Army Transitional Shelter Project.

Using ArcPad, the data is captured and can be edited and displayed while out in the field. The data from these field assessments, along with other GIS data layers, is then compiled using ArcGIS in the evenings back in a makeshift office. From this, the team performs a damage risk assessment. Homesteads that belong to women with young children and structures that have sustained significant damage and either no longer exist or are dangerous to inhabit are put at the top of the list. Maps and reports created from this information are shared throughout the Salvation Army and with other NGO staff to plan shelter construction.

Colorado Pine in Haiti

Construction began in May with lodgepole pinewood from the Colorado forests. The lumber has been milled by Intermountain Resources, LLC, in Montrose, Colorado, from trees killed by the mountain pine beetle. The beetle is the size of a grain of rice and affects trees in northern and central Colorado. As long as the tree that has been affected is cut down within 8 to 10 months of dying, the wood's integrity is preserved, and it is structurally sound. Using this lumber provides an environmentally conscious solution for the use of the wood, and milling it has opened up job opportunities in the state of Colorado.

The transitional shelters are composed of two rooms, house five people, and are able to withstand winds of up to 30 miles per hour. Raised wooden floors prevent Haitians from risking disease by using water flowing through their homes for hygiene or cooking. In many instances, these homes provide a safer and more structurally sound environment than has been available traditionally to the people in Haiti.

The Salvation Army trains crews and hires local workers in Haiti to construct the shelters, which not only creates jobs through cash-for-work programs but also provides technical skills, such as carpentry, for Haitians to use in future construction projects.

Lyle Laverty, a volunteer with the Salvation Army and former assistant secretary of the interior for Fish, Wildlife and Parks, along with a technical working group, designed the frame specifications and a proposal for what the shelter should look like, as well as what construction materials were needed.

A model was built in one day and used to demonstrate the construction process to U.S. Agency for International Development (USAID). It is hoped that construction of transitional housing will be complete by the end of the year. This is an optimistic goal, as almost the whole city of Port-au-Prince has been demolished, and many estimate it will take a year just to clear the rubble.

Viewing Field Data in the Home Office—in Real Time

This fall, the team will be bringing some heavy GIS artillery out into the field—many licenses of GIS software that will send data as it is collected to those who need it, all over the world. The Salvation Army is using BlackBerry devices donated by Research in Motion—a company based out of Ontario, Canada, that designed and manufactures the BlackBerry smartphone—to provide the mobile access necessary to publish GIS data directly from the field. Working in concert with the Trimble devices, the smartphones are equipped with Freeance, a Web mapping application from Dayton, Ohio, Esri partner TDC Group, Inc.

Freeance allows the assessment teams to work directly with those not out in the field by making the GIS data available to everyone, regardless of their location. Assessment team members use their BlackBerry handsets to browse their local GIS data stored on ArcGIS Server, as well as reading and writing to custom forms that have been created. Freeance Mobile uses GPS location to ensure that the data position is accurate. GIS applications display live data on a map as the data is logged by the assessment teams, displaying live map features and the location of field crews and providing users with the ability to search records created in the field.

Dahl created a Web-based Silverlight application using the ArcGIS API for Microsoft Silverlight to ensure that people can easily browse the data that is collected and to save money and time by providing the data online instead of relying on printed maps to convey information. "This provides the transparency that countries need to ensure that the donation monies provided are put to good use," says Dahl.

Providing Transparency from the Ground Up

Transparency is an important issue in the United Nations and its umbrella organization, the International Organization of Supreme Audit Institutions (INTOSAI). INTOSAI, based in Vienna, Austria, is an autonomous and nonpolitical organization that works with the United Nations Economic and Social Council (ECOSOC) to set forth policy recommendations for promoting higher standards of living around the world.

"Our study on transparency, accountability, and the audit of the tsunami-related aid in Indonesia made us realize that there is added value in using geospatial data for the planning, coordination, monitoring, accountability, and audit of disaster-related aid," says Egbert Jogsma, Netherlands Court of Audit. "INTOSAI concluded that, in order to ensure long-term accountability and transparency, geospatial data should be immediately included in the information structure of agencies involved in the reconstruction of Haiti."

The Salvation Army is taking advantage of Esri's Nonprofit Organization Program, which is designed to bring humanitarian organizations an affordable means of acquiring ArcGIS software and services. "Before," adds Jogsma, "the Salvation Army had to rely on consultants to provide it with the necessary GIS software. This program will allow us to build up our capacity around the world and more efficiently share the data we collect with Salvation Army headquarters."

For more information, contact Daniel Starrett, executive director, Salvation Army World Service Office (e-mail: Dan_Starrett@USN.salvationarmy.org).

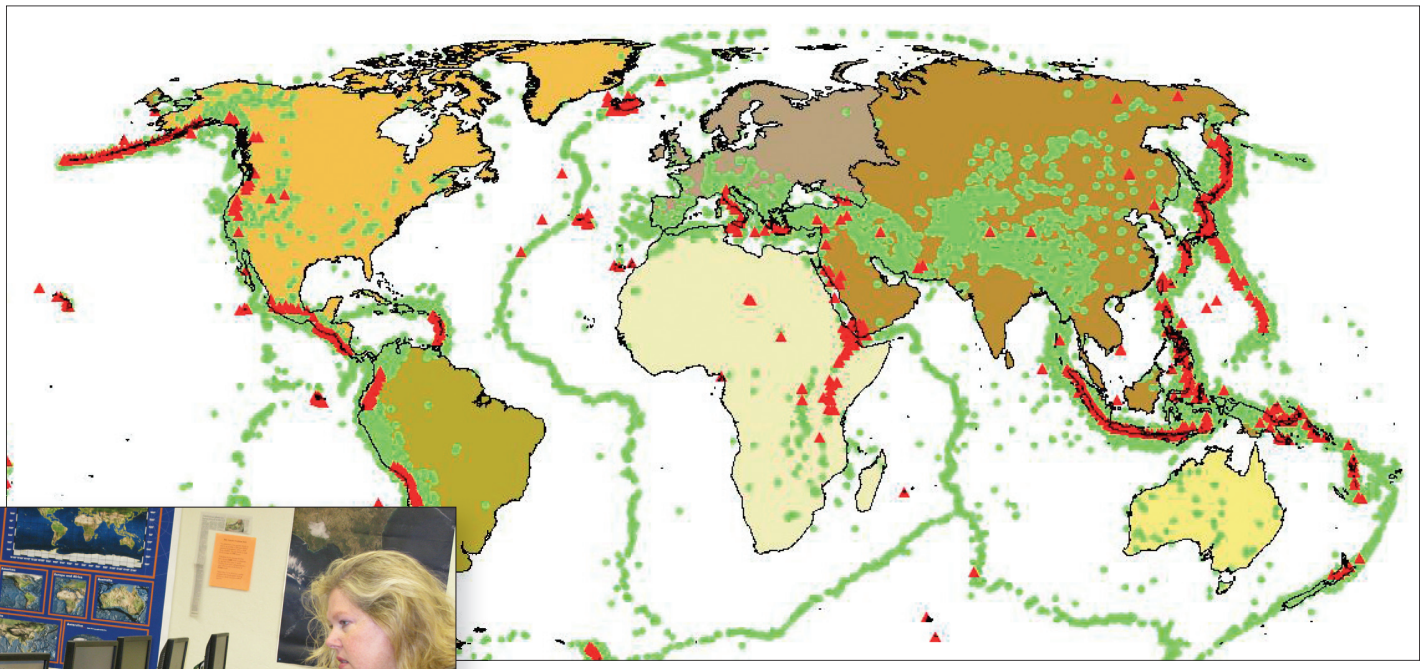
Making the Grade

Florida's Palm Beach County School District Successfully Raises Academic Achievement

By Donna L. Goldstein, GIS Coordinator, Palm Beach County School District, Florida

Highlights

- GIS can easily be infused into existing curriculum, such as science and social studies.
- Integrating GIS into K–12 curriculum raises students' academic achievement.
- The benefits of infusing GIS into K–12 curriculum extend far beyond the classroom.



Above: The students charted volcanoes and earthquakes across the planet. Left: Teacher Susan Oyer with students.

Traditionally, GIS has been used at the Palm Beach County School District in Florida at the operational or administrative level, in departments such as the facility management planning department, for demographic analysis, student population projections, boundary assignments, and school loading. However, in 2007, this author, the district's GIS coordinator and planning director, recognized the powerful potential of GIS as a teaching aid, and she also understood the overwhelming marketability of GIS skills and pursued the prospect of integrating GIS into the curriculum. The coordinator was aware of research indicating that integrating geospatial technologies into the classroom is beneficial, but she also knew that there had been no conclusive studies regarding the impact this instruction has on raising academic achievement test scores. She was up to the challenge of evaluating this.

The Palm Beach County School District is the twelfth largest school district in the nation. Contrary to popular belief, the county's population is composed mostly of middle and lower socioeconomic classes and has a very diverse student population. There are more than 170,000 students speaking 149 languages and dialects other than English, and more than 50 percent qualify for free and reduced-cost meals. The importance of utilizing Palm Beach County School District for this project lies in the diversity of the population, which is a microcosm of the nation and reflects national trends toward increased Hispanic and African American populations.

> "One of the most interesting findings was that all students who had GIS instruction improved their high-stakes comprehensive reading scores."
>
> —Donna L. Goldstein

However, one of the elements both educators and administrators struggle with in education is validating the benefits of new, innovative applications, such as GIS. In general, because the focus is on high-stakes standardized test scores and class grades, it has been difficult to persuade policy makers to incorporate GIS into the curriculum.

Thus, it was necessary to convince school district authorities that integrating GIS into the already crowded existing curriculum would promote learning, including enhancement of students' critical thinking skills, analytic abilities, and communication skills, while helping raise academic achievement—the holy grail of education. Current educational reform mandates allow for little deviation from the prescribed curriculum; however, GIS can be infused into existing curriculum, such as science and social studies, and the GIS coordinator offered to train the teachers. Always cognizant of the ever-decreasing funding for K–12 education, they were able to dismiss stakeholders' financial concerns by obtaining the cost-effective site license solution for school districts offered by Esri.

GIS Project Charter

A business model approach to developing a collaborative team was utilized to promote broad involvement and begin expanding use of GIS technology into the classroom. In 2007, a GIS steering committee was formed that included membership from career academies, curriculum planning, educational instruction, information technology, facilities management, and school police. At the initial meeting, the committee was presented with the outline for the project charter, which aligned school district goals and objectives with the integration of GIS into existing curriculum. Discussion ensued, milestones were identified, and members were assigned roles and responsibilities.

With the educators on board, the district purchased GIS lesson plan books for middle and high schools—*Mapping Our World: ArcGIS Desktop Edition, GIS Lessons for Educators* (Malone, L., A. M. Palmer, C. L. Voight, E. Napoleon, and L. Feaster 2005). The social studies curriculum planner noted that the "tie-in with the ArcGIS Desktop lessons to national and state learning standards would be very beneficial." The lesson plans come complete with datasets, step-by-step instructions for using the ArcGIS Desktop software with the subject material, and assessment tools. These books were used for the teacher training, then leveraged in the classroom with the students. Utilizing this method provided a smooth transfer of knowledge, and teachers gained a comfort level with the new technology.

The school district's GIS K–12 effort also had community involvement from GIS users in the business community. South Florida Water Management District and Palm Beach County government GIS users assisted with teacher training and also gave presentations to the students. The students gained valuable insight from these GIS professionals as to how GIS is used in the real world. The community partnerships that were formed reinforce the GeoMentor program goals introduced in 2009 by Esri, which are designed to offer educators assistance from GIS professionals.

Finding the Holy Grail

In an effort to provide a platform for expansion of GIS throughout the district, analysis was performed to measure test scores, including a comparison of high-stakes mandated tests of those students who had received GIS instruction versus those who had not. In addition, the students who had received GIS instruction completed a survey to help gauge whether they believed learning GIS helped raise their academic achievement and their overall perceptions of the program. The students used ArcGIS in the classroom to complete the GIS lessons.

The test score results support the students' overall perceptions that integrating GIS into the curriculum does in fact motivate and engage them in the learning process and, as suspected, raise their academic achievement. One of the most interesting findings was that all students who had GIS instruction improved their high-stakes comprehensive reading scores, with the most dramatic improvements being noted among the students who spoke English as a second language. When asked why reading scores increased, the teacher stated, "The students really wanted to complete the lesson and create the final map—it motivated them to read, reread, and comprehend the lesson material and instructions." Science and social studies grades improved as well; with science becoming such an important facet of this country's future, these results support the continued infusion of GIS into the K–12 curriculum.

Return on Investment—Extra Credit

The benefits of infusing GIS into K–12 curriculum extend outside the classroom. GIS integration will provide our youth with the technology tools needed to compete in an ever-growing global marketplace. With the emergence of geospatial technology in virtually every industry, students with GIS experience will be well equipped to enter a myriad of careers or vocational trades. In fact, the U.S. Department of Labor (Employment & Training Administration 2009) has said, "Because the uses for geospatial technology are so widespread and diverse, the market is growing at an annual rate of almost 35 percent, with the commercial subsection of the market expanding at the rate of 100 percent each year." Clearly, the U.S. government recognizes the tremendous growth and urgent need to develop a workforce aptly skilled in geospatial technologies. Educational reform can be adjusted to address the future economic and business requirements, thus ensuring our ability to compete at the global level. As our nation forges ahead to meet the needs of this ever-changing society, one way may be to infuse GIS into our educational system.

About the Author

Dr. Donna Goldstein has 30 years of GIS experience working in various industries, including engineering, architecture, planning, zoning, and building. She has held the position of GIS coordinator at Palm Beach County School District since 2001. She received her PhD in educational leadership and has a bachelor's degree in business administration. Goldstein has been instrumental in integrating GIS into existing K–12 curriculum.

For more information, contact Donna Goldstein, GIS coordinator, Palm Beach County School District, Florida (e-mail: donna.goldstein@palmbeachschools.org).

Maine High School Geography Teacher Emphasizes Geospatial Thinking

Highlights

- With GIS, students can see things in new ways.
- Students are encouraged to ask geographic questions, acquire geographic resources, explore geographic data, analyze geographic information, and act on geographic knowledge.
- Year-end projects are focused on the analysis of local or regional issues.

Longtime Bangor High School geography teacher Margaret Chernosky's epiphany came nearly 10 years ago in an advanced placement (AP) human geography training course.

"The instructor showed us some of the Atlanta [Georgia] demographic data in a desktop GIS, and I sat there completely enthralled. Completely. I realized that this is how you teach geography."

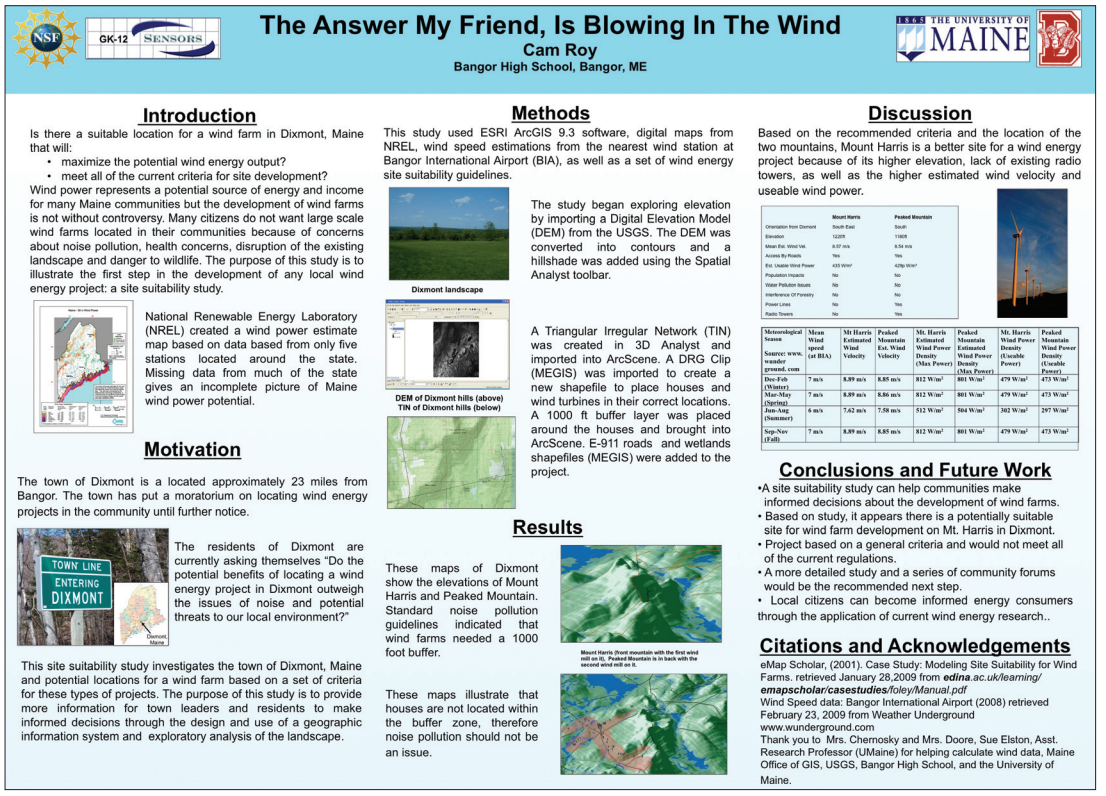
Chernosky knew that to successfully integrate GIS technology into her own classroom instruction, she would have to first master it herself. Initially, she took online classes. Later, she attended training seminars in Colorado, Costa Rica, and New Zealand. "Besides being fun," says Chernosky, "the travel brought me into contact with people around the world that were equally enthusiastic about GIS. I'm still in contact with many of the people I met at the seminars. It's a real community."

During this period, in addition to her full-time teaching responsibilities, Chernosky earned a masters of education degree in geospatial education. "My motivation was to not only learn as much about geospatial technology as I could but also to learn how to think geospatially. And this is what I try to bring to my students—this new way of looking at the landscape."

Throughout this period, Chernosky had become familiar with ArcGIS software and Esri's training courses. When she introduced GIS to Bangor High School students in small steps, she assigned participation in Esri's Community Atlas project to her 2005 AP human geography class. Students and teachers throughout the United States annually contribute to the Community Atlas by examining aspects of where they live, then posting descriptions and maps of their community related to their findings.

The following year, Chernosky proposed the addition of an elective class, GIS in geography, to the Bangor Area School District, which was subsequently approved. Today, because of strong student demand, two sections of the GIS in geography course are offered. While they are open to all students, Chernosky encourages sophomore participation so that those students can apply the GIS skills they have gained to their other high school courses, such as history and science. The maximum class size for the GIS course is 16 students. Because the classes have a limited number of students and the required projects that the students work on are completed in pairs, there is a great deal of interaction and cooperation among the students. Stacy Doore, a GK12 Sensor fellow, University of Maine, Spatial Engineering, has worked with Chernosky for several years to develop and teach the GIS in geography course.

The five steps of geographic inquiry provide the basis of instruction that Chernosky employs in her classroom to direct her students in the creation and completion of GIS projects. The steps include the following: ask geographic questions, acquire geographic resources, explore geographic data, analyze geographic information, and act on geographic knowledge. She introduces the concepts gradually to the class, discussing articles found in *ArcNews* and *ArcUser* so that students can gain a greater understanding of the geographic inquiry method.



Bangor High School students created this poster and many more using geospatial analysis and ArcGIS.

Students complete two major projects during the year. The first is participation in National Geographic's annual Geography Action! program. Themes change each year and focus on either a location, such as Europe and Africa, or an aspect of physical or human geography, for example, conservation, cultures, and habitats. Chernosky tries to get her class to complete this project by mid-November in time for Geography Awareness Week. She has forged a relationship with the local newspaper, *Bangor Daily News,* and the editor publishes a full-page color spread highlighting the classroom work for five successive days.

Says Chernosky, "We have a relatively small, close-knit community here in Bangor, and the newspaper is truly committed to education. In addition, the editor and I have developed a reciprocal relationship. When needed, I help him with graphics that require maps. For example, on election night I plot the results in ArcGIS Desktop in time for him to meet the press deadline for the next morning's newspaper."

The students' year-end capstone projects focus on the analysis of local or regional issues that have a direct impact on the students themselves or their community. Chernosky initially holds a brainstorming session with the class, and they discuss local issues to develop the related geographic questions necessary to direct their projects.

"Basically, we look for projects that are of local interest, deal with local concerns, and have relevant data available," explains Chernosky. "The majority of our data comes from the Maine Office of GIS. Its rich datasets are online and downloadable. From there, we get topographic maps, contours, rivers, roads—really high-quality, complete base files to work with. We acquire other required geospatial data from local agencies. Or if need be, we create our own data." The students have a variety of GIS software available to them, including ArcGIS, ArcGIS 3D Analyst, ArcGIS Spatial Analyst, ArcGIS Network Analyst, ArcGIS Publisher, and ArcLogistics.

The completed capstone projects are subsequently entered into the Maine State GIS Championships, where the students personally present their finished work to the judging panel. In the 2009 contest, a sampling of the projects included "The Answer, My Friend, Is Blowing in the Wind," "Optimizing School Bus Routes," "Air Quality Monitoring in Penobscot County, Maine," "Determining Wireless Signal Using Indoor GIS," "Access to Health Care in Rural Maine," and "Cancer and Poverty in Maine." In 2010, students examined the temporal and spatial patterns of crimes to motor vehicles in Bangor. After the contest, students presented their work to the Bangor Police Department.

Concludes Chernosky, "I'm not necessarily trying to convince my students to follow careers in GIS, though I believe there are many very exciting opportunities open to them. My goal is to get them to see things in a new way. I want them to really understand the spatial component of the steady stream of information bombarding their daily lives and how geospatial thinking can provide them with a greater understanding and awareness of the many things they will encounter.

For more information, contact Margaret Chernosky, geography teacher, Bangor High School (e-mail: Margaret_Chernosky@umit.maine.edu).

The University of Redlands Integrates Spatial Thinking and GIS Campus-Wide

A Spatial Literacy Initiative in Higher Education

Spatial thinking is an ability to visualize and interpret location, distance, direction, relationships, movement, and change through space. Spatial concepts are fundamental within not only geography, math, and natural sciences but also the arts, humanities, and social sciences. As an approach to learning, however, spatial thinking is rarely an explicit inclusion.

For this reason, the University of Redlands, Redlands, California, has invested in a campus-wide initiative to use spatial thinking and geospatial tools to inform and support its curriculum, research, and operations. At the heart of these activities is an ambitious goal: to promote a spatially infused learning community within the university. This initiative harnesses the integrative power of geography and GIS to help people visualize knowledge, solve problems, and understand relationships through a spatial lens.

GIS has had a presence on the U of R campus for many years, in multiple forms and for diverse audiences. The master of science degree in GIS (MS GIS), founded in 2001, is now hosting its eighteenth cohort of students. The Redlands Institute conducts grant-funded applied research involving GIS and spatial decision support. The School of Business offers a GIS emphasis in its MBA Program and has GIS-focused courses for its undergraduate students as well.

Over time, these campus activities generated new interest among other faculty to integrate spatial approaches in their own research and teaching. By focusing on the pedagogic objectives of critical thinking and problem-based learning, faculty from many departments and disciplines began to appreciate the value of spatial thinking, often, but not always, realized through GIS.

To coordinate this cross-campus effort, in 2007 the university created a new academic position for a director of spatial curriculum and research and launched an initiative called LENS: LEarNing Spatially.

LENS creates opportunities for faculty and students to use maps, mapping, and spatial perspectives in their teaching and research. Complementing and building on the university's GIS expertise, LENS supports faculty development, student internships, workshops, collaborative research, and new partnerships. These activities are designed to accommodate diverse faculty and student interests at different levels of skill and comfort. As a result, the use of GIS and spatial tools on campus is emerging and evolving organically at multiple scales and intensities.

For example, faculty in the business school are using Esri's Business Analyst and ArcGIS Desktop to research transportation and logistics networks and analyze patterns in global competitiveness while modeling for their students the value of spatial thinking in the business world. Faculty in the College of Arts and Sciences are using spatial approaches in an impressive array of projects, including calculating lines of sight from hundreds of Native American archaeological sites via ArcGIS Server and displaying series of biogeographic datasets with ArcGIS Explorer as students consider vegetation patterns along elevation gradients.

Spatial Data Infrastructure for K–12 School Attendance Boundaries

Highlights

- The system uses GIS to collect and disseminate school attendance boundaries to researchers and the public for free.
- Users have access to the detailed population characteristics of children who live within each school zone.
- The national clearinghouse uses ArcGIS to help government agencies administer educational services.

School attendance boundaries matter to us all. They are as vital to home buyers, who want to make sure their children will attend an excellent elementary school, as they are in the conference rooms of the U.S. Department of Education, where matters of policy and funding are decided.

Even well into the twenty-first century, the United States has lacked a central database that delineates elementary, middle, and high-school attendance boundaries. This informational deficiency has spawned inefficiency among local, state, and federal agencies and has hampered the ability of researchers to conduct large-scale research studies related to educational outcomes among schoolchildren.

Creating a national database requires reconciling a massive amount of spatial information that is scattered across thousands of school districts and stored in inconsistent formats. This is because K–12 education is controlled by local school boards, and no federal law governs how local school districts should draw their K–12 school attendance areas.

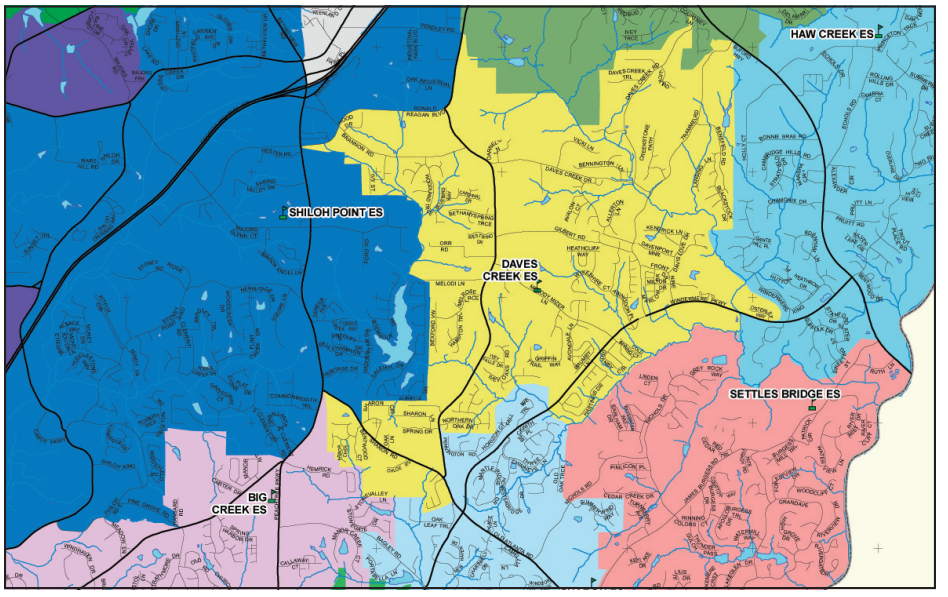
How to collect geographic data is only part of the problem. Schools do not follow consistent grade structures between school districts—and even within single school districts, there are "elementary" schools with grades spanning K–1, K–3, K–4, 5–6, and K–8. Middle and high schools are just as varied and have grade spans such as 5–8, 8–9, and 9–12. Piecing together the geography for these varied grade structures is challenging.

In addition to coping with inconsistent grade spans, it is difficult to assemble school zone information scattered between private consulting firms, county GIS offices, and school districts—and stored in a wide variety of incompatible, spatially incoherent GIS formats, as paper maps, as narrative descriptions, or in databases listing the addresses served by each school. Collecting such information requires thousands of phone calls and e-mails. In the past, researchers who wanted to conduct studies that demanded spatial data delineating school attendance boundaries have been forced to develop their own maps for just a handful of school districts at great time and expense. Even federal agencies have been daunted by the task.

Taking on the Challenge

One of the first people to take on the challenge of using school zones in academic research was Salvatore Saporito, a sociology professor at the College of William and Mary. Saporito first began using school attendance boundaries in the mid-1990s for his doctoral thesis. His research asked a novel question: How does the demographic composition within school attendance zones influence a student's decision to enroll in a private school? To answer this question, Saporito collected school attendance boundaries for the 22 largest school districts in the United States. Using GIS data allowed Saporito to locate students within school attendance zones. Findings showed that white children who lived in a school attendance zone with higher rates of nonwhite students were more likely to apply to a private school—even when their locally zoned neighborhood school was very good.

Following the publication of his research, Saporito's colleagues requested the GIS data of school attendance boundaries that he collected—they wanted the data for their own research. The high demand for digital GIS data inspired the creation of the School Attendance Boundary Information System (SABINS), which is a National Spatial Data Infrastructure project supported with a $1,000,000 grant from the U.S. National Science Foundation. SABINS data can be downloaded from the National Historical GIS (**nhgis.org**) housed at the Minnesota Population Center. Much of the data collection, processing, and integration are completed at William and Mary's Center for Geospatial Analysis, an interdisciplinary laboratory that was created to facilitate GIS in teaching and research.



Detail of Forsyth County, Georgia, elementary school attendance zones (2009–2010). Many school districts use GIS to create maps of their school attendance boundaries and post them on their Web site. SABINS requests the electronic GIS files and enters them into a uniform database.

Roughly half of the information collected is in digital GIS format—most often stored as Esri shapefiles or geodatabases—and the prevalence of data stored in Esri format is just one reason why SABINS makes extensive use of ArcGIS software (through its Esri university site license). The quality of the local GIS data varies, and this presents two challenges that can be overcome with functions available in ArcGIS Desktop. First, much of the GIS data that the SABINS project receives has gaps and overlaps between school attendance boundaries, and these topological errors need to be corrected. In many cases, elementary, middle, and high school attendance boundaries do not share a common line even when it is evident that they should. A second challenge is harmonizing the inconsistent grade structure of school attendance boundaries within and between school districts. The solution is to create grade-specific attendance boundaries, and SABINS data consists of separate layers for kindergarten through twelfth grade.

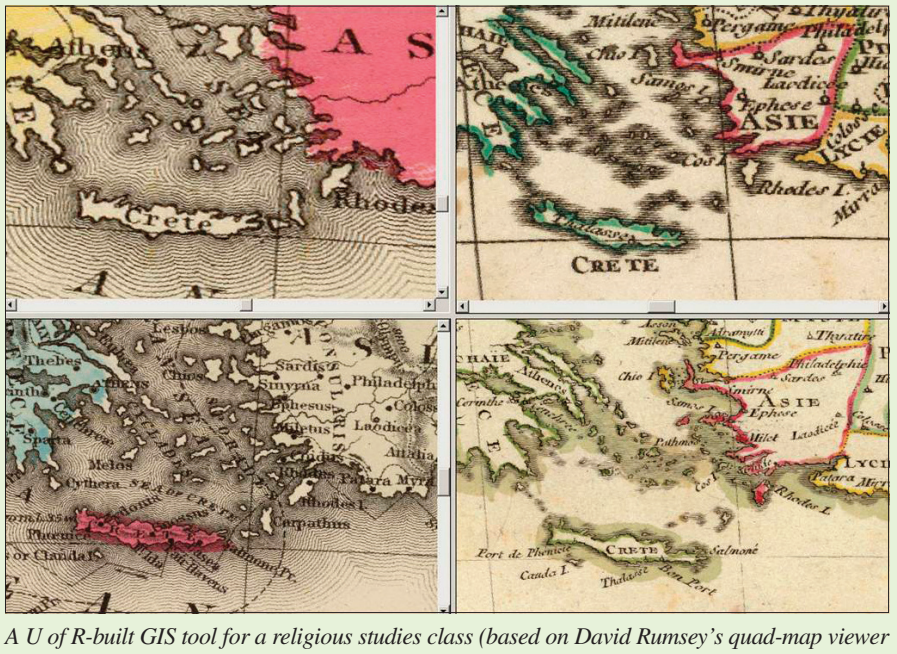
Students Learn GIS Through Real Situations

The SABINS project serves as an ideal teaching ground for undergraduate students who want to learn GIS. Saporito teaches a studio course in which the challenges of collecting, processing, cleaning, and storing school attendance boundaries are at the core of a hands-on learning experience. Saporito says, "The goal is to teach a course that avoids fabricating examples of how GIS might work in the real world. Instead, by analyzing original GIS data, students encounter real situations that researchers have not seen before because we don't fully understand how different districts delineate their school geography. Students have to use GIS to solve the unique challenges they encounter."

Undergraduate students who complete Saporito's course are hired as undergraduate research assistants and work on the SABINS project. Many of Saporito's former students now work with GIS in organizations such as the U.S. Census Bureau—which also relies on Esri software.

All the school boundary data is linked with school-level information from the U.S. Department of Education. This information provides student enrollment data by ethnicity and poverty status. School attendance boundaries are also integrated with U.S. Census data that provides detailed demographic information of the children who live in each school zone. In addition to aiding researchers, SABINS also has the potential to save government agencies and school districts money. For instance, the U.S. Department of Agriculture (USDA) oversees $17 billion in subsidized school meals. Districts give free-lunch applications to students, and completed applications are used to tally the number of children in a school who are eligible for a subsidized meal. This approach is expensive and has spurred the USDA to work with SABINS to explore ways that school attendance boundaries can be used to distribute lunches—potentially saving local districts millions of dollars in administrative costs.

For more information, contact Salvatore Saporito, associate professor, Department of Sociology, the College of William and Mary (e-mail: sjspao@wm.edu).



A U of R-built GIS tool for a religious studies class (based on David Rumsey's quad-map viewer for georeferenced historical maps).

Introducing students to the notion of spatial inquiry becomes a "pre-GIS" skill that the university cultivates. It also acknowledges the essential need for adequate support staff and technology to give faculty the time and resources to learn and explore. The university was fortunate to receive a grant from the W. M. Keck Foundation that provides curricular and technical support to develop new mapping ideas and GIS tools that enrich student learning.

Perhaps the greatest benefit is that this spatial initiative is fostering interdisciplinary collaboration and building a sense of community across the campus and beyond. MS GIS students are partnering with faculty and technical staff to build cutting-edge applications. Administrators are using concept mapping tools to generate visualizations of proposals and agendas to share their ideas with faculty more effectively. The School of Education is partnering with the local school district to integrate maps and mapping into its secondary school curricula.

The University of Redlands is committed to creating a spatially infused learning community. In a world where data-rich visualizations, location-based services, and geospatial tools are the norm, the university believes that spatial literacy is a significant and marketable asset for its faculty, students, and staff. While this initiative is still evolving, the university is finding its path for integrating spatial thinking and GIS throughout the curriculum and the institution.

For more information, contact Dr. Diana Stuart Sinton, director, Spatial Curriculum and Research, University of Redlands (e-mail: Diana_Sinton@redlands.edu, Web: **spatial.redlands.edu**).

GIS Users Prepare for Unlimited Possibilities at Esri's Annual International User Conference

"The UC is the one mandatory event that I need to go to every year," says J. B. Akin, GIS technology manager, SandRidge Energy. "If I don't come here, then I end up not knowing how to plan for the year. And when I come here, I see the new tools and what people are developing, and it helps me decide what we need to do and how to spend our resources."

This coming summer, July 11–15, 2011, thousands of professionals from across the globe will travel to the San Diego Convention Center in San Diego, California, for the highly anticipated annual Esri International User Conference (Esri UC).

"This event is about connecting with our users and making ourselves available to help them," says Jack Dangermond, Esri president. "At the same time, we want them to realize the incredible community they're part of and collaborate with one another on the work they do."

A Valuable Experience

"The User Conference, like always, is great for reconnecting with people," remarks Ron Schell, EAM manager, Metropolitan Utilities District of Omaha. "I get to meet the Esri people I work with, and my program managers and I can get in touch with a lot people, like the technical support staff I frequently talk to."

While Esri UC has long been renowned for the practical solutions, technical tips, and comprehensive training available to attendees, new innovations introduced at last year's event proved to be just as popular.

"The GeoLounge was a fantastic upgrade this year," said Brian Quinn, GIS analyst, County of Marin, in reference to the new networking area that provided a relaxed setting, comfortable seating, and computer access.

Equally successful was the first-ever GIS Open Managers' Summit, a unique "nonconference" event where GIS managers and technology evangelists dictated the agenda and drove discussions. "The GIS Open Managers' Summit was the single most engaging experience I've had at an Esri User Conference to date," said Seth Johnstone, information manager, Wachs Water Services.

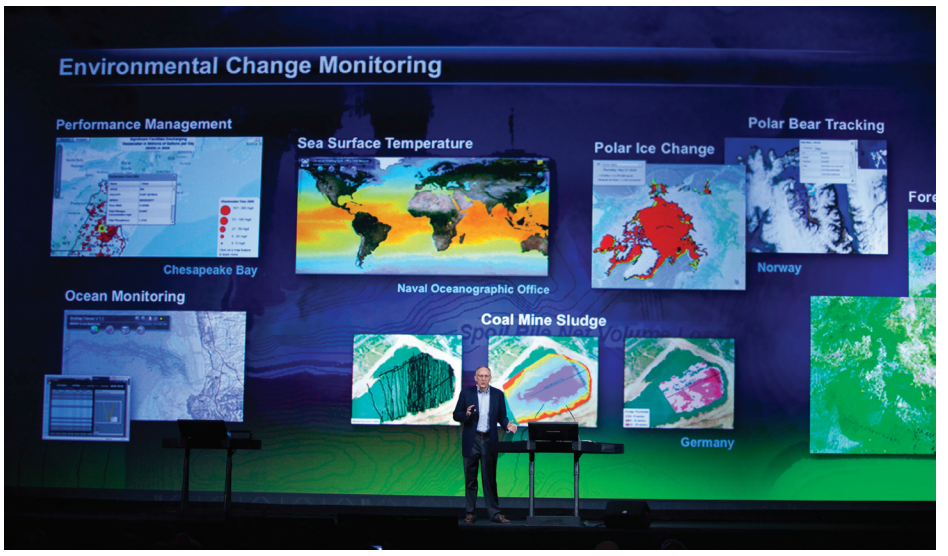
When asked why they make the annual trip to San Diego, attendees also refer to the numerous focused sessions from their peers; the availability of Esri staff, partners, and exhibitors; and the inspiring Plenary Session.

"What's always inspirational to me is just seeing all the people who are wandering around with the same look in their eyes, that they're going to go back and fix it, and do it right," says Ken Bates, GIS extension specialist, Kentucky State University. "You meet people who have the same interests, the same problems, and you can share all that and go back home with renewed interest in what you're doing."

What to Expect

The week begins with Monday's Plenary Session, where Dangermond shares his vision regarding the role of GIS in today's world and recognizes unique projects making a difference in a variety of industries around the planet. Esri product engineers and other staff then showcase enhancements to various tools and functions in the latest GIS technology and demonstrate how these changes can help attendees in their work back home. The session ends with awards for outstanding work and provocative discussions from distinguished keynote speakers.

The rest of the week is packed with technical sessions, user presentations, industry/product workshops, and Regional User Group/Special Interest Group meetings, as well as the impressive Exhibit Pavilion. Attendees can also explore the Map Gallery, which showcases hundreds of maps from GIS users around the world.



Esri president Jack Dangermond presenting at the 2010 Esri International User Conference Plenary Session.

A variety of industry socials and activities are also interspersed during the week where attendees can network with each other and Esri staff in less formal settings. The big party takes place on Thursday night, and it's a great way to wind down the conference experience as Esri staff and attendees alike dine, dance, and play games.

Finally, Dangermond and Esri directors host an interactive closing session on Friday morning that serves as an open forum to get answers and provide feedback about the future of Esri and GIS.

Get Involved

Even though Esri UC only occurs during one week in the summer, the conference fosters an active social network year-round. Get involved in the ongoing discussions and sharing on

- **Twitter—**Join the conversation year-round.
- **Facebook—**Join the community and post your thoughts, photos, and videos.
- **LinkedIn—**Maintain your new connections and discuss your experience.
- **YouTube—**Watch videos of the plenary, technical sessions, and more.
- **Flickr—**Upload images to be featured in the Plenary Session.

This conference is for all Esri GIS users. Complimentary registration is a benefit that comes with some software products. Get the latest 2011 Esri UC news at **esri.com/uc** and subscribe to the *UC Insider.* We are working on more new ideas for 2011. Submit your new ideas on our Facebook page at **facebook.com/esriuc**. We look forward to meeting you in San Diego.

Registration Still Open for APUC in January

Successful UCs in Europe and Latin America Connect Regional Users

More than 2,400 users from 91 countries attended Esri regional user conferences (UC) in Mexico City and Rome in the last part of 2010. More will converge at the Asia Pacific User Conference (APUC) in January, Esri's first regional UC of 2011. "This is an exciting end to 2010 for our GIS users, and a great beginning to 2011," says Esri founder and president Jack Dangermond. "With ArcGIS realized as a fully integrated system, our users are able to more effectively collaborate within their fields and share that information with their peers throughout these regional user conferences."

2011 Esri Asia Pacific User Conference—Don't Miss the Event in January

Users in the Asia Pacific region still have time to register for the 2011 APUC, to be held January 26–27 at the Edsa Shangri-La Hotel in Manila, Philippines. Hosted by Geodata Systems Technologies, Inc., Esri's distributor in the Philippines, APUC will showcase the community collaborative aspect of the ArcGIS 10 system through the theme "One Community. One Map."

The first day of APUC will lead off with Dangermond, who will discuss the future of GIS and Esri. The Plenary Session will give attendees a look into new and exciting features of ArcGIS 10. Users from throughout the region will see maps contributed by their peers in the Map Gallery. More than 50 user maps are expected to be showcased at the event.

"We are looking forward to hosting users from across the Asia Pacific region in January," says Geodata executive vice president Francisca N. Dayrit. "The response we've seen for papers and submission of maps has been overwhelming, showing the level of excitement for this event. We hope that all users gain invaluable insights from the conference while enjoying the fantastic city of Manila."

There will be four technical tracks, each focused on a different aspect of GIS and ArcGIS. Tracks such as What's New, Web GIS, GIS Implementation, and Online GIS will give users an opportunity to personalize the content to what they specifically want to learn at APUC. There will also be industry tracks on disaster management, utilities, agriculture, transportation, and logistics. Sessions will be conducted by experts from Esri and Geodata.

Registration for the event is still available. Please visit **esri.com/apuc** by January 22 to register online. On-site registration will also be available at the Edsa Shangri-La Hotel.

2010 Latin America User Conference Wrap-up

The XVII Esri Latin America User Conference (LAUC) was held September 22–24 in Mexico City, Mexico. Hosted by Sistemas de Información Geográfica, S.A. (SIGSA), Esri's distributor in Mexico, this conference provided many opportunities for the more than 900 attendees from 16 Latin American countries to learn about GIS alongside their peers and industry leaders. This year's theme, "Geography Facing Social Challenges," was a perfect fit, bringing the practitioners and users of GIS data together to exchange information and experiences. Technical sessions, workshops, and presentations of more than 100 papers were well attended during the conference.

The Special Achievement in GIS Award was presented to the Mexican Geological Survey.

"[The LAUC was] a great way to keep updated about what is currently happening in the geomatics industry and also an opportunity to have a good time while networking and mingling with others. It was an amazing experience," says Roberto Zárate from the Mexican Institute of Petroleum.

Federico Medevilla from the Mexican Railway Systems says, "The integration and new features of ArcGIS 10 and ArcGIS Server were the most interesting. Congratulations to SIGSA for a spectacular event."

The 2010 LAUC Special Achievement in GIS Awards were granted to users from eight different Latin American countries. They included honorable mentions from the Department of Cadastral Information System, Government of the State of Morelos (Mexico); Engineering, Information and Technology CA (Venezuela); the Mexican Geological Survey; Ministry of Education (Chile); Ministry of Environment (Peru); Municipality of Escazú (Costa Rica); National Federation of Coffee Growers (Colombia); Tourism Authority (Panama); and YPFB Chaco SA (Bolivia).

A GIS in Education Conference under the cosponsorship of the Latin America Society for Remote Sensing and Spatial Information Systems; Monterrey Institute of Technology and Higher Education; National Autonomous University of Mexico (UNAM), Pan-American Institute of Geography and History; UNIGIS; and University of Talca, Chile, was also held in advance of the Esri Latin America User Conference; such topics as teaching GIS in different levels of education and discussing contemporary issues in the field of education were presented, and a number of demonstrations were given. This conference brought together educators and students from renowned universities throughout Latin America.

"The conference was brilliant," says UNAM geography student Sandra Itzel López. "I met many important people, [and it was] an excellent opportunity to learn about how the benefits of technology improve the quality of our lives."

For more postconference information, visit **www.sigsa.info/lauc2010**. The 2011 LAUC will be held September 28–30 at the Hotel Real Intercontinental in San Jose, Costa Rica.

Europe, Middle East, and Africa User Conference Wrap-up

The 2010 Europe, Middle East, and Africa (EMEA) User Conference was held October 26–28 in Rome, Italy. This conference brought together 1,500 users from 75 countries throughout the region, from Iceland to South Africa. The conference was hosted by ESRI Italia S.p.A., Esri's distributor in Italy.

"I think that the conference was a big success," says Bruno Ratti, president of ESRI Italia S.p.A. "It brought people together from many nations and gave them an opportunity to exchange their experiences with GIS in their daily jobs."

The opening plenary consisted of presentations from Chris Steenmans of the European Environmental Agency and Daniel Eriksson of the Geneva Center for Humanitarian De-mining and demos of the latest in ArcGIS 10. Before Jack Dangermond started his keynote presentation at the plenary, he was awarded the Premio Mondo d'oro (Lifetime Achievement Award) by the GeoKnowledge Foundation chaired by Professor Rodolfo Guzzi.

The technical workshops proved to be very successful, with standing room only for many of the hot topics. Most of the technical sessions are available online at **esri.com/events/emea**.

More than 550 people attended the gala party, which took place in the magical, but cool, surroundings of the Villa Medici on top of the famous Spanish Steps. One of the highlights of the evening was the cutting of an enormous cake to celebrate the 20th anniversary of ESRI Italia S.p.A.

For post-event information about the 2010 EMEA UC, visit **esri.com/events/emea**. The 2011 Esri European User Conference will be held October 26–28 at the North Convention Center, IFEMA, Feria de Madrid, in Madrid, Spain. The 2011 Esri Middle East and Africa User Conference will be held November 1–3 at the Habtoor Grand Hotel in Beirut, Lebanon.

NATIONAL GEOGRAPHIC™

"Geo Learning"

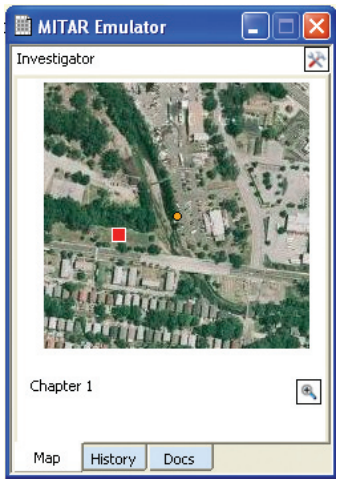
A column by Daniel C. Edelson,
Vice President for Education, National Geographic Society

Tricorders—The Next Tool for Geographic Learning?

If you're of a certain age, you probably find yourself looking around and remarking on how much today's world looks like the world that Gene Roddenberry imagined in the original *Star Trek* series. OK, we don't have transporters or warp drives. But we do have computers you can talk to, two-way video communications, and devices that work like communicators and tricorders.

There is a lot of discussion these days about what impact these *Star Trek* technologies might have on education. In just the last two weeks, I attended a one-day summit on the promise of wireless technologies for education and a two-day workshop on the use of mobile devices for citizen science.

For geoliteracy, I think these devices offer amazing opportunities to move learning outside the school building, and we've been designing software at National Geographic that students will be able to take into the world on handhelds that will enable them to record observations, combine them with observations of others, and analyze them for geospatial patterns. However, an inescapable challenge of learning in the real world is that the real world is complex and unpredictable. Sometimes it is too complex and unpredictable to enable you to be sure that you can teach specific relationships or skills through real-world experiences.



Tricorder or augmented reality?

One solution to this problem is to create virtual worlds that eliminate the messiness of the real world. For example, you can create a simulated world that students interact with on a computer screen where all the water quality probes are properly calibrated and the relationship between water quality and ecosystem health follows predictable patterns. Unfortunately, these simulations sacrifice the experience of moving around and using actual devices for the benefits of predictability.

However, in recent years, I've been hearing about some very clever people who have been designing what they call "augmented reality" environments to get the best of both worlds. Here's an example:

Researchers from the Missouri Botanical Garden and Massachusetts Institute of Technology (MIT) are working with upper elementary and middle school teachers to design games in which students move around in the real world but interact with simulated characters on the screen of a handheld and use the handheld to make observations and measurements that are generated by a simulation. Some of the scenarios that they have explored in their games include watershed studies, food web investigations, and a cemetery-based scavenger hunt where students "meet" people who had lived in their community through minibiographies crafted from historic census records.

I asked Bob Coulter, the director of the project at the Missouri Botanical Garden, what playing one of these games feels like, and he described it like this:

Imagine you have already learned a bit about watersheds, point and non-point source pollution, and some basic measures of water quality. As part of your study, you now have the opportunity to investigate a water pollution problem in the park down the street. To start, you watch a short video of a local water quality expert on your GPS-enabled handheld. After the expert introduces your challenge, the handheld guides you to relevant sites where you can "sample" the water and make other observations.

The handheld screen displays your position on an aerial photograph as you move toward your next stop, indicated by an icon on the screen. At each location, a simulated expert poses provocative questions and encourages student investigators to observe salient features. With limited time to complete your investigation, you have to draw on what you already know and what you learn from the simulation to make wise choices.

The advantage of this kind of augmented reality experience over "ordinary" reality is that students' experiences can be designed to provide the optimum amount of complexity and challenge for their stage in the learning process. Middle school students can operate in a world where everything follows predictable patterns. College students can operate in a world with sensor error and statistical anomalies. They can also carry learning resources, like field guides, with them in the field, and they can communicate with each other in real time.

The advantage over virtual reality is that students are able to move around on real terrain and develop real-world skills, like coordinating between an overhead map and their on-the-ground view. For designers, augmented reality enables them to take advantage of all the attributes of the local setting without being limited by them at all. The project at the Missouri Botanical Gardens is taking advantage of the MIT Augmented Reality (MITAR) authoring tools, created by Eric Klopfer and his colleagues, which allow teachers to create their own learning games for their own students and their own locale.

Right now, this is all still in the experimental stage. The researchers are working out how to blend real and simulated worlds and help teachers design effective learning activities. Once they have figured all these things out, though, these *Star Trek* technologies are going to take real-world geographic learning to a whole new level.

For more information, contact Daniel C. Edelson (e-mail: dedelson@ngs.org).

Participants Discuss the Importance of Geography

The twelfth annual GIS Day celebration was a big success, with more than 600 organizations worldwide hosting events. Many event organizers invited local press to events and received media coverage that helped spread the word about GIS Day in their communities. Each event provided different activities depending on the age group. Many universities participated this year by having a department open house with speakers; map galleries; and, of course, cake! Counties and cities around the world also opened their doors on GIS Day, allowing citizens the opportunity to learn about how GIS is used by local government. GIS Day events will continue to happen throughout the year, with elementary schools receiving visits from GIS professionals to discuss the importance of geography. Whether your celebration is large or small, it helps create geographic awareness and highlights the important work that you do for your organization. GIS Day 2011 will be held on November 16, during Geography Awareness Week, a geographic literacy initiative sponsored by the National Geographic Society (**mywonderfulworld.org/gaw**). Start planning your event early by visiting **gisday.com**.

Forsyth County and Sawnee Electric Membership Corporation employees celebrating GIS Day in Cumming, Georgia.

Arkansas River Valley GIS Users Group

The Arkansas River Valley GIS Users Group sponsored GIS Day 2010 with "Mapping the River Valley 1 Point at a Time." The event catered to local schools, with students ranging from third to twelfth grade. In all, 289 students and 75 adults from 12 different schools attended. Tina Thompson, River Valley GIS Users chair, says, "Our goal is to get students excited about GIS and teach them how it is being used right here in their area." The event has given the students a better understanding of the world around them. Student Tesa Harris says, "It's like finding out things you never knew you could find out." The introduction of GIS in local schools has given the students higher expectations for the future; student Courtney Hancock expects that by learning about GIS now, she will have an edge once she leaves school. "I'm glad I know about it now, because in the future there will be more technology to deal with and learn about." With successful events in consecutive years and a 33 percent attendance growth from 2009, the Arkansas River Valley GIS Users Group is already hard at work planning GIS Day 2011.

Eötvös Loránd University, Budapest, Hungary

The Department of Cartography and Geoinformatics at Eötvös Loránd University celebrated GIS Day with the participation of 35 children in grades 5 through 8 from Remetekertvarosi Elementary School in Budapest. The activity was organized in three parts: First was a welcome speech from professor Laszlo Zentai (head of department) discussing the growing presence of GIS in our daily life and the important role that GIS plays in the country's economy. He was followed by Jesus Reyes Nunez, who presented a general introduction to GIS, talking about the connection between geography, cartography, and GIS. Eszter Dombovari-Simonne (from the Technical University of Vienna, Austria) presented map-based Web games that she designed, giving students the opportunity to play the games. The last theme was related to GPS; Bela Kovacs presented some of its theoretical principles. The day concluded with a geocaching activity, where children sought small "treasures" around the buildings of the university.

GIS Day cupcakes by Jessica Klug, planner, Town of Midland, Ontario, Canada.

Memphis Area Geographic Information Council—Memphis, Tennessee

The tenth anniversary of Memphis Area Geographic Information Council (MAGIC) GIS Day at the Great Hall of Germantown is a true testament to all the hard work president Dr. Esra Ozdenerol and the board of directors have put in. All the past presidents were acknowledged for their groundwork at the anniversary celebration. Attendees enjoyed a special GIS Day display with the conference theme "GIS Miracles at the Workplace" and a delicious cake. Guest speaker David Gisclair, Louisiana Oil Spill Coordinator's Office technical assistant program director, addressed the luncheon with a keynote related to GIS data management and lessons learned pertaining to oil spills and other natural disasters. In addition to the luncheon, the event included a series of lightning talks, an exhibit hall of sponsors showcasing their products, a map competition featuring some of the best work by students and government employees from many disciplines, and a panel on GIS career opportunities designed to enhance the collaboration between students at Memphis-area colleges and GIS professionals.

Resources Available

There are many more event examples and success stories available at **gisday.com/success**. The success stories are great ways to get ideas for your next GIS Day event, including hands-on GIS workshops, training seminars, special presentations and talks, map galleries, treasure hunts, and field trips. Once an idea is in the works, users are encouraged to access the resources and support provided online, including sample agendas, proposal letters, white papers, how to do a GIS Day proclamation in your area, and how to create a GIS Day cake.

"Crossing Borders"

A column by Doug Richardson,
Executive Director,
Association of American Geographers

AAG
ASSOCIATION of AMERICAN GEOGRAPHERS

Rebuilding Geography and GIS Capacity in Haiti

Five years ago, the Association of American Geographers (AAG) mobilized its membership and geographers around the world to respond to the devastation left behind by Hurricane Katrina in New Orleans. The online disaster coordination clearinghouse and a special fund that we organized with support from AAG members helped bring GIS, GPS mapping, and remote-sensing expertise to respond to the immediate needs of the disaster, then later helped rebuild geography programs and departments in the hardest-hit areas. We continue to hear from faculty and students in those departments about the difference these resources have made in their personal and professional recovery. For the AAG, this experience helped us appreciate, in a very direct way, the importance of coordinated disaster response and of understanding the long-term nature of recovery.

Since Katrina, we have continued to witness and respond to disaster—some at a distance, others closer to home. In 2010, some of the more visible examples include the devastating earthquake in Haiti; recent floods in Pakistan that inundated one-fifth of the country; and the explosion of the Deepwater Horizon well that spilled five million barrels of oil into the Gulf of Mexico, another disaster challenge for Louisianans and their neighbors. The number of disasters around the world each year has been steadily increasing, and this trajectory is unlikely to waver given predicted changes in climate and corresponding impacts. All require resources for response and recovery. Geographic knowledge and information, geospatial technologies, and Web-based networking, not to mention the expertise to work in this context, are resources that have become increasingly essential in disaster planning, vulnerability assessment, response, and recovery.

In the five years since Katrina, the AAG and its members have become more engaged in collaborative efforts to build capacity for disaster response and recovery, with an emphasis on the contributions of geography and GIScience to these efforts. For example, the AAG has participated in a range of activities to support rebuilding in Haiti. Individual AAG members have also independently taken action to assist Haiti (and other disaster-impacted regions). At a broader level, we are working on international efforts to create a rapid response infrastructure and capability for global disaster reduction and recovery. These efforts are described in further detail below.

Haiti

On January 12, 2010, at 16:43:10 local time, a 7.0 magnitude earthquake struck Haiti, centered near its capital, Port-au-Prince. More than 300,000 people were killed. Another 300,000 were injured. About 1.5 million now live in tent encampments. Individuals important to the geography community in Haiti were among those who were tragically lost; key infrastructure was destroyed or severely damaged.

The headquarters of Haiti's National Center for Geospatial Information (CNIGS) was destroyed, and its gifted director, Gina Porcena Meneus, and five staff members were killed. Established in 2005 with support

from the United States and European Union, CNIGS's role was to develop geospatial information for sustainable development and natural hazard mitigation. Operating under the Haitian Ministry of Planning, CNIGS's geospatial data and imagery archive was one of the most comprehensive in the region prior to the earthquake. However, much of this spatial data infrastructure, now desperately needed for recovery planning and redevelopment, was lost. CNIGS was also the headquarters for Haiti's national chapter of the Pan-American Institute of Geography and History (PAIGH).

George Anglade, distinguished Haitian-Canadian geographer, writer, and political activist, also perished in the earthquake along with his wife of 43 years. He was one of the founders of the University of Quebec at Montreal (UQAM) and a professor of social geography there for more than 30 years before retiring in 2002. Professor Anglade actively participated in actions for a democratic Haiti.

Haiti's leading universities, eight of which are members of Agence Universitaire de la Francophonie (AUF), were devastated. The State University of Haiti (UEH), by far the largest, with approximately 15,000 students and 11 faculties in locations around Port-au-Prince (and 10,000 students in the provinces), saw most of its buildings (more than 90 percent) destroyed or severely damaged in the earthquake. UEH has a developing geography program with expertise in human, economic, rural, and population geography.

The AAG and its members have been involved in responding to the Haiti earthquake in many ways, from providing aid and information in the immediate aftermath of the disaster to capacity-building activities focused on long-term efforts to rebuild the country. The AAG headquarters office helped coordinate and respond to requests for geographic expertise in the days and weeks following the earthquake. Geographers from the United States and around the world volunteered their time and expertise through organizations such as the International Network of Crisis Mappers, OpenStreetMap, and GISCorps to acquire critical data and create maps guiding emergency responders in initial rescue and relief efforts.

The AAG has engaged with the U.S. State Department, private industry, and other organizations on how to rebuild CNIGS, including how to use the data collected during the earthquake response to reconstitute its lost assets, replace equipment and infrastructure, and build GIS expertise. We have also been working to help identify senior-level candidates for a proposed new position of chief geospatial information officer (CGIO). The CGIO will coordinate the use of geographic information and advise the Interim Haiti Reconstruction Commission and government of Haiti on planning and reconstruction activities. A geographic knowledge and information strategy is urgently needed for Haiti's recovery and development activities.

The recovery and development also require long-term engagement in capacity building. In support of this goal, the AAG cosponsored and participated in a workshop organized by the American Association for the Advancement of Science (AAAS) and its Caribbean division. The workshop, entitled Advancing Capacity for Haitian Science and Science Education, was held July 10–18, 2010, in San Juan, Puerto Rico, and in Haiti. Haitian scientists and educators, along with colleagues from the United States, Puerto Rico, Canada, and Africa, participated in developing seven strategic goals and nearly 40 specific preliminary recommendations to advance science and science education in Haiti. A final report (coauthored by AAG staff) and recommendations will be released by AAAS in early 2011. Separately, AAG member Robert Maguire, associate professor of international studies at Trinity Washington University and chair of the Haiti Working Group at the U.S. Institute of Peace, shared his expertise and views about rebuilding Haiti in testimony presented before the U.S. Senate's Subcommittee on International Development and Foreign Assistance, Economic Affairs, and International Environmental Protection. Professor Maguire has worked in Haiti since 1974 and shared his vision for Haiti's future in an op-ed to AAG members.

Infrastructure for Global Disaster Reduction and Recovery

The AAG will continue its engagement with several long-term efforts to support Haiti's recovery and reconstruction. We also have created and encourage donations by geographers and others to the AAG Haiti Recovery and Reconstruction Fund to help support the rebuilding of university geography and GIS educational and training programs in Haiti, including the reestablishment of CNIGS, with both their institutional and human capital needs. This fund will also be used to subsidize no-cost membership in the AAG for interested Haitian geographers and their students through the AAG's existing Developing Regions Membership Program. While membership is already substantially discounted, such support is essential given the dire situation affecting Haitian universities. When the AAAS report and recommendations on advancing science and science education capacity is finalized, we will continue to work closely with AAAS on its dissemination to key stakeholder groups (e.g., donor community) and identify specific areas in which the AAG and its members can contribute to and act in collaboration with the geography and GIS community in Haiti. We have also organized several high-profile sessions at the AAG 2011 Annual Meeting in Seattle, Washington, focused on geographers' activities and research—immediate and long term—relevant to response, recovery, and reconstruction in Haiti.

The response to the earthquake and other disasters of the early 21st century demonstrates the necessity of harnessing geographic knowledge, technologies, and data to coordinate relief and recovery. Yet, as Haiti illustrates, challenges to reducing disaster vulnerability, risk, and loss of life and infrastructure remain. At the same time, opportunities exist to strengthen and leverage existing programs and networks for better coordination, positioning, and delivery of needed resources and to improve response time frames through a comprehensive, global network of rapidly accessible geographic information at multiple scales.

Beginning in early 2010, the AAG met several times with representatives of the Abu Dhabi Global Environmental Data Initiative (AGEDI), the Clinton Foundation, the United Nations Environment Programme (UNEP), Esri, and others, to discuss plans for the Eye on Earth (EoE) Summit to be held in 2011 and hosted by the government of Abu Dhabi. The purpose of the summit is to address the needs associated with creating international information networks that provide access to the best available environmental and social data for decision making from local to global scales. At the suggestion of the Clinton Foundation, this working group is developing the concept of a rapid response infrastructure focused on disaster relief and recovery in connection with EoE called the First Assist Locator and Coordinated Operations Network (FALCON) Initiative. This initiative is envisioned "as a public-private partnership (PPP) to address GIS and spatial data infrastructure capacity building for more effective disaster planning and response and climate change adaptation with special emphasis on those most vulnerable communities and countries in the world." FALCON is conceived as building on current capacity in disaster reduction and recovery available through, for example, the Global Facility for Disaster Risk and Reduction (GFDRR) of the World Bank, United Nations International Strategy for Global Disaster Reduction (UNISDR), United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), and other governmental and nongovernmental organizations that are part of the disaster and humanitarian communities. The AAG will continue its work with AGEDI, the Clinton Foundation, and others, to develop and refine this initiative over the next year. We look forward to sharing updates about this and other activities in future issues of *ArcNews* and on the AAG Web site.

If you wish to support recovery efforts for Haitian GIS specialists and geographers or university geography and GIScience programs, please consider making a tax-deductible donation to the AAG Haiti Recovery and Reconstruction Fund. For more information or to make a donation, visit **aag.org/Haiti**. Thank you for your support of the AAG's efforts to help rebuild geography in Haiti.

Doug Richardson and Jean McKendry
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jmckendry@aag.org

URISA—Developing GIS Leaders

URISA has recently introduced numerous programs to help our members achieve their professional goals. We even adopted the tagline, "The Association for GIS Professionals" to illustrate the point!

We also rebranded the URISA annual conference as GIS-Pro: URISA's Annual Conference for GIS Professionals and renamed our bimonthly newsletter *The GIS Professional*.

The URISA Leadership Academy (ULA) is a perfect example of this emphasis. The ULA is a five-day course that focuses on developing crucial GIS leadership skills. During the academy, participants learn key GIS leadership and management techniques, successful team development, organizational capacity building, program investment and justification, GIS politics, change management, situation assessment, and problem solving, all required skills for a successful GIS leader. Visit **urisa.org/ula** to check out the ULA, to be held May 16–20, 2011, in St. Louis, Missouri.

Elsewhere in this issue of *ArcNews* ("Managing GIS" column, page 43), you will learn about the GIS Capability Maturity Model that URISA is developing for local governments. The model will allow a local GIS operation to gauge its capability and maturity against a variety of standards and measures to identify areas of improvement. GIS leaders are using their experience and expertise to make this important effort happen.

In fact, all the "Managing GIS" articles that have appeared in *ArcNews* since 2006 have been authored by URISA members who are happy to share their lessons learned—what a collection of GIS management talent!

URISA is reaching out to young GIS professionals through the establishment of its Vanguard Cabinet. Young professionals are not only the future of our organization but also the future of the profession.

Part of professionalism is being sure to "pay it forward." URISA's GISCorps (**giscorps.org**), which provides GIS volunteer assistance to a wide range of programs around the world, is a great example of how URISA members are using their GIS talents to help underserved populations and support disaster recovery efforts.

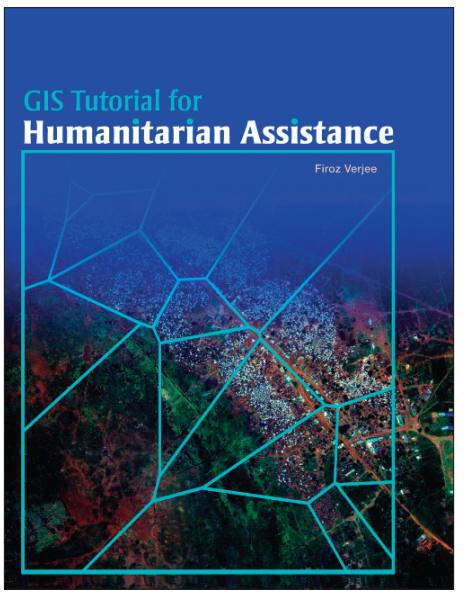
URISA connects great ideas and great people to inspire leadership and achievement. Give URISA another look by visiting **urisa.org** today.

For more information, contact Wendy Nelson, URISA executive director (e-mail: wnelson@urisa.org). Also see page 2 for information about the new *Managing GIS* best practices from URISA and Esri.

Improving Situational Awareness During Disaster Relief Events

Esri Press Tutorial Provides Guidance

GIS is an essential tool for improving situational awareness during humanitarian emergencies, including how to optimize the impact of goods and services to affected populations. New from Esri Press, *GIS Tutorial for Humanitarian Assistance* specializes in teaching the humanitarian applications of GIS. The book builds upon the recent experience of leading practitioners from around the world and establishes basic principles for the analytic applications of ArcGIS in humanitarian aid operations.



The book was written by Firoz Verjee, a senior research associate at the Institute for Crisis, Disaster, and Risk Management at George Washington University, Washington, D.C., and coordinator of the Aga Khan Development Network's Seismic Risk Management Initiative, based in Dushanbe, Tajikistan. For more than two decades, Verjee has specialized in the application of remote sensing and GIS, primarily within the fields of disaster risk reduction and humanitarian assistance.

GIS Tutorial for Humanitarian Assistance follows a step-by-step instructional format. Exercises help teach core cartographic skills, spatial data management, planning logistics, and route optimization and encourage disciplined, standardized data management, all within the context of humanitarian assistance. Designed as a complete training system for disaster relief responders, as well as students, the book exposes readers to a range of ArcGIS functionality.

Scenarios from the book are based on real-world humanitarian aid issues, including food distribution in Ethiopia, determining suitable campsites for internally displaced persons, and assisting victims of the 2008 earthquake in Pakistan.

The book includes a 180-day trial of ArcGIS Desktop 9.3.1 software on DVD and a CD of data for the book's exercises. Resources for teaching in a classroom, such as lesson plans and lecture slides, are also available.

For more information about *GIS Tutorial for Humanitarian Assistance* and other books from Esri Press, visit **esri.com/esripress**.

"Managing GIS"
A column from Members of the
Urban and Regional Information Systems Association

URISA
The Association For GIS Professionals
www.URISA.org

URISA Proposes a Local Government GIS Capability Maturity Model

By Greg Babinski, GISP, Finance and Marketing Manager, King County GIS Center

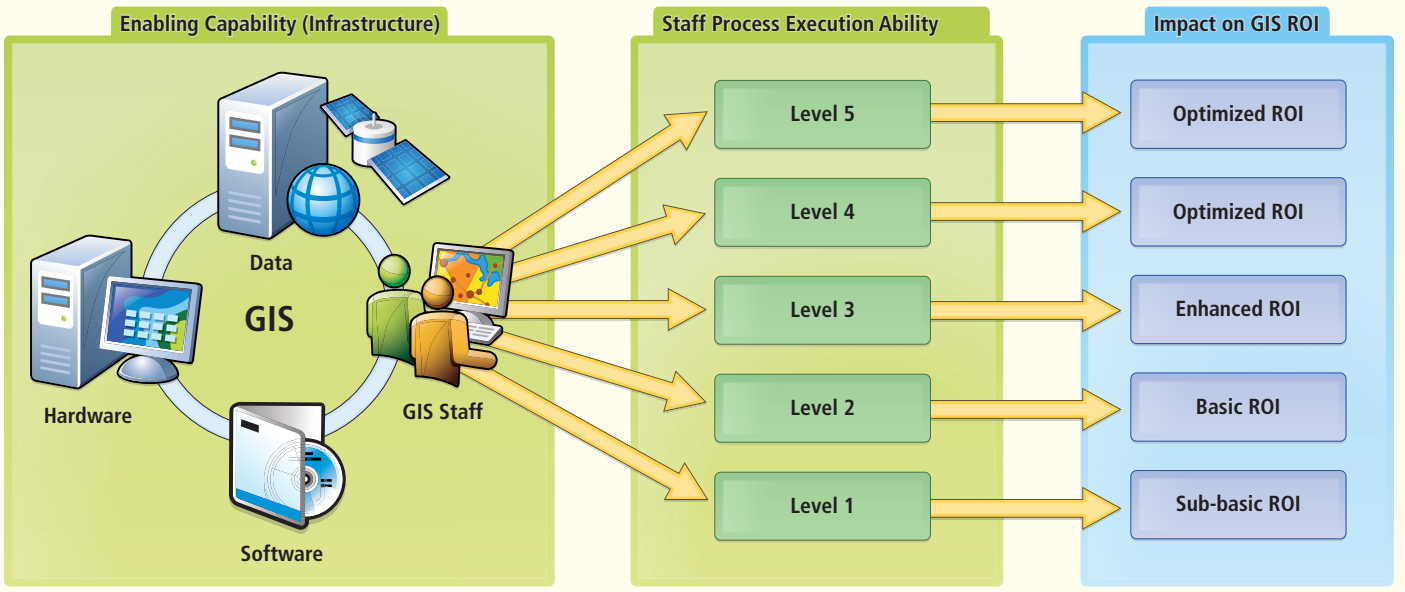
One Saturday shortly after moving into my first house, I awoke to hear a *drip, drip, drip* sound coming from the bathroom. "Honey," my wife said, "there's a leak in the bathroom sink." "No problem," I replied, even though I had never repaired plumbing before. "I'll git 'er done right after breakfast."

Six hours later, after a bumped head; scraped knuckles; and three trips to the hardware store for tools, fittings, and gaskets, I had "got 'er done." The next time I had a leak, the repair process went much faster, because I applied my previous experience.

I didn't realize it, but I had just progressed through the first two stages of a process capability maturity model (CMM). My first effort was ad hoc and chaotic. I advanced to a repeatable process, recalling and applying steps I had used to fix the problem before.

Homeowners manage complex systems that provide shelter and safety; a means to store and cook food; and a place to rest, socialize, and recreate.

As local government GIS managers, we operate and maintain systems that are more complex than our abodes and represent huge investments supporting a wide range of government business needs. The maturity level of our processes relates directly to the effectiveness of our GIS.



Local Government GIS Capability Maturity Model.

What Is a Capability Maturity Model?

A capability maturity model assesses an organization's ability to accomplish defined tasks. The CMM concept originated with the Software Engineering Institute (SEI), which published *Managing the Software Process* in 1989 to assess software contractors' ability to successfully complete large software development projects.

The CMM concept has since been applied to system engineering, project management, risk management, and information technology services. A CMM assesses an organization's maturity level based on how it executes individual processes. The maturity levels are usually defined as

- Level 1: Ad hoc (chaotic) process
- Level 2: Repeatable process—Based on the previous successful methodology
- Level 3: Defined process—Successful processes documented to guide consistent performance
- Level 4: Managed process—Documented processes measured and analyzed
- Level 5: Optimized process—Defined and managed processes refined by ongoing process improvement activities

GIS Development Life Cycle: When Is GIS "Complete"?

GIS development ideally progresses toward full maturity. Often begun as a project to create the "best GIS possible" with limited funds, GIS program development involves frequent compromises. Components of an ideal GIS program are often deferred to go operational quickly and start delivering return on investment (ROI) for the agency. The end of a GIS implementation project does not mean that the agency has a complete or mature GIS.

Managers usually know their GIS could benefit from refinement, but funds, staff, or time for further development are difficult to acquire. Enhancements may be developed as part of GIS operations but rarely on a systematic basis with a desired end goal.

GIS Benchmarking Studies and Maturity Assessments

Benchmarking studies compare an agency's GIS with other peer organizations. They can identify industry best practices, resource and service-level imbalances, and process improvement areas. Because of the significant time and cost required, benchmarking studies are rare.

Maturity assessments are not well developed within the realm of local government GIS, but the National States Geographic Information Council (NSGIC) is developing a statewide Geospatial Maturity Assessment (GMA).

Why Develop a Local Government GIS Capability Maturity Model?

An old management adage states, "You can't manage what you don't measure."

For any local government GIS program, ROI increases as the process capability maturity level of the GIS staff increases. If we accept this hypothesis, a GIS CMM can provide an indication of the ability of local agencies to realize the potential benefits from their GIS investments.

Many of the processes that have had the CMM approach applied in the past are themselves components of GIS. It is useful to think about a GIS operation in theoretical terms, then analyze and measure individual GIS operations against this ideal end state. A GIS CMM allows local GIS operations to gauge their capability and maturity levels against a variety of measures, including

- A theoretical end state of GIS data, hardware, and software infrastructure
- A theoretical end state of GIS organizational development
- The maturity level of other peer GIS organizations, either individually or collectively
- The maturity level of the subject organization over time
- The maturity level of the organization against an agreed target

URISA's Proposed Local Government GIS Capability Maturity Model

URISA's proposed model indicates progress by an organization toward GIS capability that maximizes the potential for the use of state-of-the-art GIS technology, commonly recognized quality data, and organizational best practices appropriate for local agency business use. The URISA GIS CMM assumes two broad areas of GIS development: enabling capability and process execution ability.

The GIS CMM assumes that mature agencies have well-developed enabling technology and resources and that their processes maximize the effectiveness of their GIS infrastructure. Enabling capability includes technology components, data, professional GIS staff, organizational structure, and other resources and infrastructure. Execution ability is the competence of the staff to use the available capability and provides an indication of the potential for increased ROI.

The enabling capability assessment includes 21 components with a scale modeled after the NSGIC GMA. Because GIS-enabling capability is dependent on resource availability, the GMA scale (with its resource-commitment focus) is well suited to indicate capability.

The execution ability assessment includes 14 components and is modeled after the typical CMM process-based, five-level scale. Because the execution ability of a GIS depends on its process performance, the typical CMM assessment scale (with its focus on process execution) is well adapted to measure ability.

Current Activity and Next Steps

URISA's draft GIS CMM was completed in 2009 by 12 counties and 19 cities in Washington state. Results were presented at the 2009 URISA Annual Conference and at GIS conferences in Oregon and Washington in 2010. A three-hour GIS CMM workshop was held at GIS-Pro 2010 in Orlando, Florida. Feedback has been solicited and agencies invited to complete the assessment to expand the base of knowledge about the maturity level of local government GIS.

NSGIC has been informed of GIS CMM development, and there is interest in utilizing local agency GIS CMM assessments to inform state-level GMAs. The GIS CMM was presented to the National Geospatial Advisory Committee (NGAC) in Washington, D.C., in September 2010. NGAC is interested in the development of metrics for the National Spatial Data Infrastructure (NSDI) and sees potential for the GIS CMM, the GMA, and the Coalition of Geospatial Organizations' (COGO) proposed National Geospatial Technology Report Card to provide the means for measuring development of the NSDI.

The URISA Board has indicated its support of further development of the GIS CMM. Future refinement of the model itself and a means of institutionalizing the model are needed. One suggestion is to use an approach similar to the Green Building Council's LEED Certification program. For the GIS CMM, this might mean the submission by local agencies of a portfolio with the self-assessment for a peer-based review process to certify an agency's maturity level.

URISA is currently considering a means of refining the model and developing recommendations for implementing it on a sustainable national basis.

To see the current version of the model, visit **tinyurl.com/GISCMM**.

About the Author

Greg Babinski, GISP, is the finance and marketing manager for the King County GIS Center in Seattle, Washington, where he has worked since 1998. Previously, he worked for nine years as GIS mapping supervisor for the East Bay Municipal Utility District in Oakland, California. He holds a master's degree in geography from Wayne State University, Detroit, Michigan. Babinski is the president-elect of URISA, to become president in October 2011.

For more information, contact Greg Babinski, GISP, finance and marketing manager, King County GIS Center, and URISA president-elect (tel.: 206-263-3753, e-mail: greg.babinski@kingcounty.gov).

ArcGIS Server Disseminates Geospatial Services

Esri's ArcGIS Server adds geographic data and analysis to Web applications that serve organizations and communities in a variety of ways. To submit your ArcGIS Server site address and view other Web sites powered by ArcGIS Server, visit esri.com/serversites.

Honolulu Parcels and Zoning Viewer
gis.hicentral.com/fastmaps/parcelzoning
Based on the Silverlight platform, Honolulu Parcels & Zoning is designed to be simple and fast, using cached services and no more than five dynamic layers. Map reports are packed with information and a dynamic location map with links to external databases that are refreshed nightly.

American Heart/Stroke Association
maps.heart.org/quality
In conjunction with Stroke Awareness Month, this Flex API/ColdFusion-based application helps people find the nearest hospitals that specialize in stroke care.

Johnson County, Iowa, Property Information
gis.johnson-county.com/piv
The Johnson County, Iowa, Property Information Viewer provides Johnson County staff and the public they serve with quick and easy access to several years' worth of aerial photography, elevation data, flood hazard layers, and land records.

Show Me My City
arcgis.dmgov.org/extmaps/index.html
Show Me My City was created by the Des Moines, Iowa, Information Technology department using Esri ArcGIS API for Flex, online samples, and custom code. Along with interactive tools, such as locators and searches, it provides easy access to base, zoning, parks/trails, and aerial maps.

Esri Partner Offerings

Esri maintains relationships with more than 2,000 partners that provide focused assistance to our customers. These partners have extensive experience providing GIS solutions and services across several industries, ranging from custom ArcGIS applications to complete system implementations. For a complete list and description of our partners and their offerings, visit the Esri Partners Web site at esri.com/partners.

Public Safety

Azavea
azavea.com
HunchLab
HunchLab is a Web-based crime analysis, early warning, and risk forecasting solution. HunchLab sifts through agency databases to detect changes in crime patterns over time and automatically sends alerts to appropriate officers or crime analysts. Users can select the time period, type of crime, and geographic criteria of their choice. HunchLab's Intelligence Dashboard also makes it easy to visualize crime as heat maps, charts, and reports, while its risk forecasting features use statistics to show how recent events affect the future risk of similar crimes. HunchLab uses ArcGIS Server.

Real Property Management

R&K Solutions, Inc.
rksolutions.com
GoRPM Survey
Geospatial Real Property Management Survey (GoRPM Survey) is a software application for improving condition, disaster, and space utilization assessment, as well as real property inventory, that was built on ArcGIS Engine and works with ArcGIS Server 10. Designed for laptop, tablet, or ultra mobile devices, it allows data from multiple sources, including a GIS, to be combined into surveys for field validation. Field survey results are then collected by a central GIS-enabled enterprise system, providing information to decision makers. Using the latest Esri and R&K technology, users can visualize information in areas such as forecasting, budgeting, efficiency, and sustainability.

Utilities and Natural Sciences

LoggerHead Navigation, Inc.
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LoggerHead Navigation assists a variety of industries with their plans and manages their assets with leading-edge GPS/GIS consulting, data preparation and processing, mapping equipment, data collection, sales and rentals of hardware, software, training, and support. LoggerHead's professional staff has an understanding of industry theory, analysis, and application from its in-house use of ArcGIS, ArcPad, and mobile applications. As a consultant, LoggerHead Navigation provides customized consulting, design services, and individualized attention, finding the best tools for projects and budgets.

New Training Offerings from Esri

Preparing for Your Certification Exam
Workplace experience is the best preparation for taking an Esri Technical Certification examination, but Esri training courses can also help you polish skills or fill in some gaps. Information on the Web site details skills that will be measured in each exam and also recommends courses that will help you prepare.

See the article on page 1 for more information about the Esri Technical Certification Program, or visit the Web site at esri.com/certification.

New ArcGIS 10 Training
Every day, there are more and more courses and learning resources to help you make the transition to ArcGIS 10.

New Instructor-Led Courses for ArcGIS 10
Geoprocessing Raster Data Using ArcGIS Spatial Analyst explores many of the ArcGIS Spatial Analyst tools, operators, and functions. You'll build map algebra expressions and models to execute geoprocessing workflows and manipulate raster data to make it suitable for analysis. You'll also cover basic concepts of fuzzy logic and how to apply it in modeling. (Offered in the online Virtual Classroom—one-day course)

Managing Imagery Using ArcGIS offers a complete and integrated solution for managing, serving, and consuming image data. This course introduces the mosaic dataset, a new geodatabase data model for managing and serving raster datasets, and shows how to perform dynamic image processing. (Offered in the traditional classroom—two-day course)

Recorded Training Seminars
ArcGIS 10 Deployment: Download, Installation, and Authorization (U.S.) will guide you step-by-step through the ArcGIS 10 deployment process—from downloading, installing, and authorizing the software to managing and maintaining user licenses.

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Online-Only Articles

More *ArcNews*

The Winter 2010/2011 issue of *ArcNews* Online (esri.com/arcnews) presents the following special online-only articles:

Elkhart County, Indiana, Health Department Makes Brownfield Environmental Data Accessible

A Better Way to Protect Schools: *California City Builds Tactical Response Application*

Dry Cleaning Chemicals Can Put Water Resources at Risk: *California EPA Department of Toxic Substance Control Uses Geospatial Analysis to Target Site Remediation*

Public Gardens Grow Research Capability with GIS: *UC Davis Arboretum Instrumental in Coordinating Public Garden GIS Alliance*

Also, look for the expanded Esri T-shirt section online, as well as new supplemental podcasts.

Mexico, Canada, and Afghanistan—All Roads Lead to Esri T-Shirts!

Alfie Blanch, GISP, GIS & Mapping Section supervisor, Los Angeles County, California, Fire Department, posed at a pyramid in Zempoala, Veracruz State, Mexico, the capital of the Totonac civilization at the time of the Spanish conquest. The area's history is traced from that time (1519 AD) through the Classic Veracruz culture (600–900 AD) all the way back to the Olmec culture (1500 BC). The descendants of the Totonacs still live in this region.

David Schmidt, GIS analyst, Government of Canada in Guelph, Ontario, had this picture snapped in the northern part of the province of New Brunswick on the east coast of Canada. The salmon is quite a tourist attraction in these parts. So is his T-shirt!

Alfie Blanch.

The members of the GIS Team at the U.S. Army Corps of Engineers Afghanistan Engineering District North are wearing their new T-shirts while working on their compound in Kabul, Afghanistan. Though not part of their required uniform, the shirts can be worn on Friday afternoons. The team includes (from the left) Walter Kloth—NAO (Norfolk, Virginia), Nancy Towne—ERDC (Vicksburg, Mississippi), Jacob Rothberger—SWF (Ft. Worth, Texas), and Vicky Wilkinson—SWT (Tulsa, Oklahoma).

Wear an ESRI T-shirt in a unique location and send a photograph to *ArcNews*. Photos will be considered for use in *ArcNews,* the expanded T-shirt section at *ArcNews* Online, or both. While digital photos sent via e-mail (tmiller@esri.com) are preferred, prints or slides can be sent to Thomas K. Miller, *ArcNews* Editor, *ArcNews* T-Shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews* Online at **esri.com/arcnews**.

David Schmidt.

From left: Walter Kloth, Nancy Towne, Jacob Rothberger, and Vicky Wilkinson.

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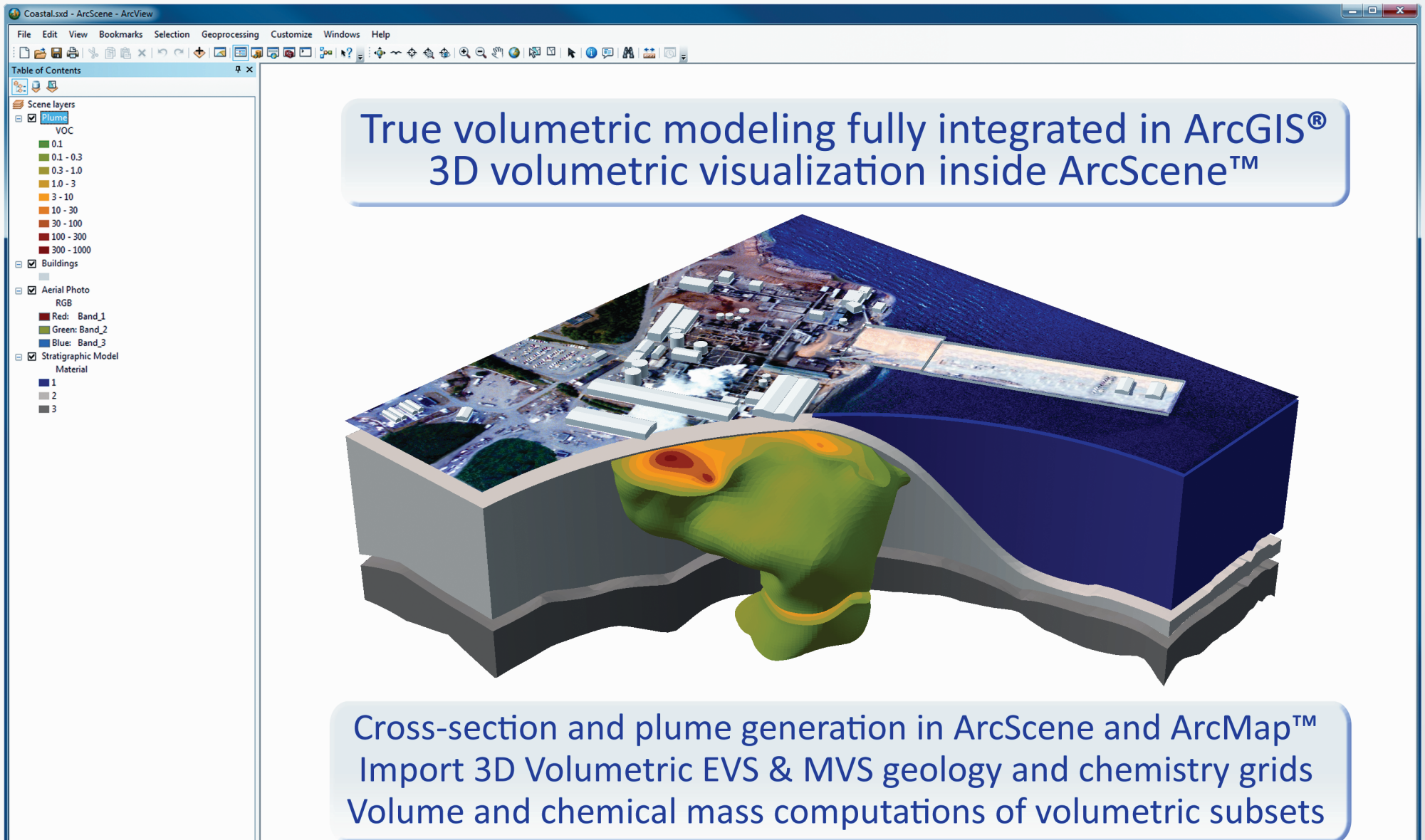

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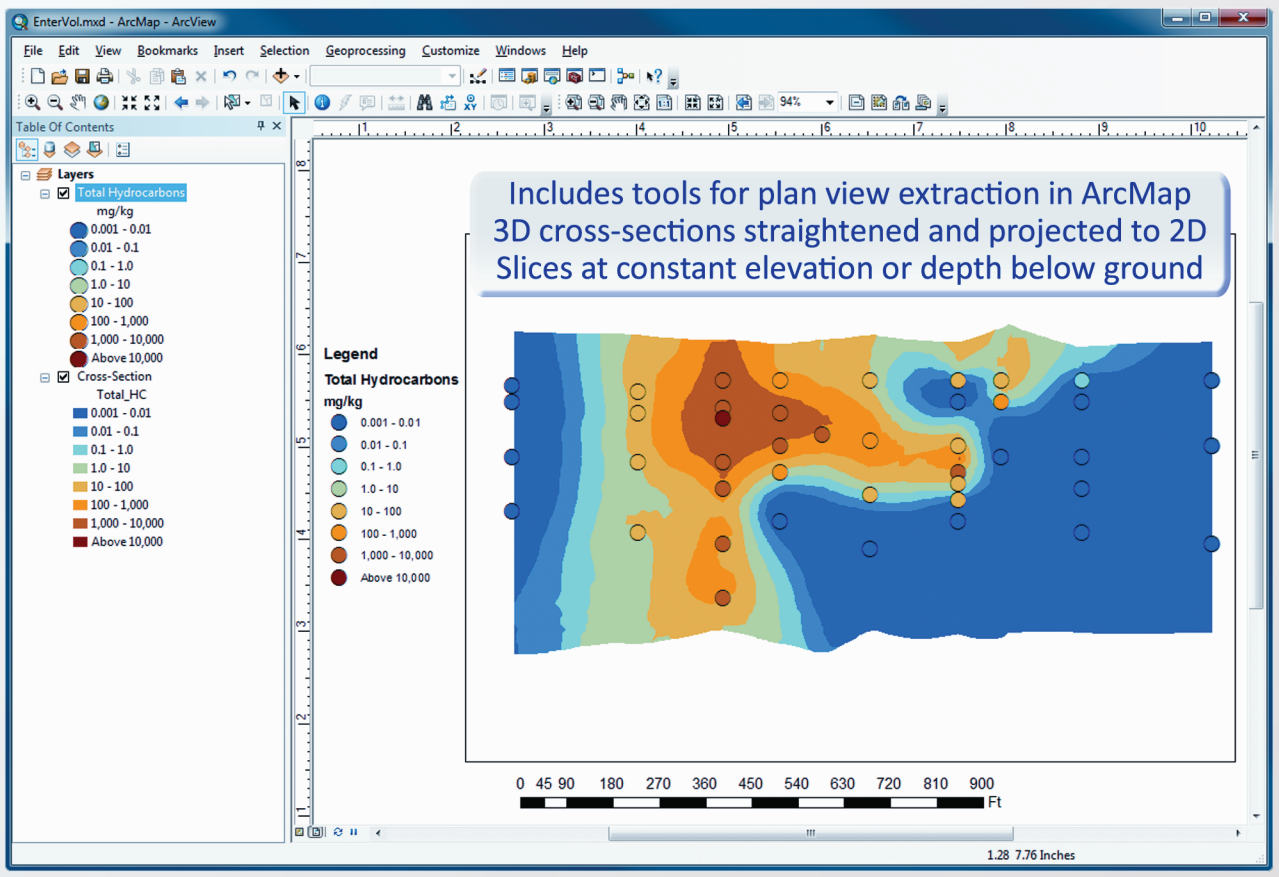

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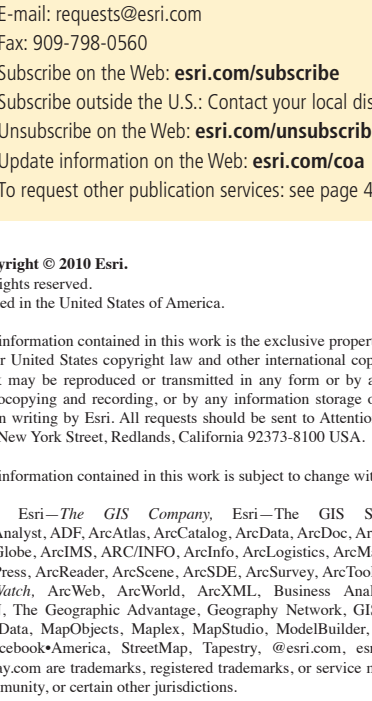

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