ArcNews

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Strengthening the GIS Profession

David DiBiase, Director of Education, Industry Solutions, Esri

Is GIS a profession? If so, what's its relationship to other professions in the geospatial field? How can you tell if someone who calls herself a GIS professional—or a GIS educator for that matter—knows what she's doing? You might be surprised to learn that these are contentious questions in the United States and other parts of the world. They're contentious because the demand for GIS work

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ArcGIS Online Will Change How You Think About Mapping and GIS

This month, Esri officially released ArcGIS Online for organizations. Through the purchase of an annual subscription, an organization gets a private instance of Esri's secure, multitenant cloud that's scalable and ready to use. No additional hardware or software has to be purchased or installed. It also gives users in the organization access to tools, basemaps, and other content to make and share maps and applications.

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City of Charlotte ArcGIS Online home page to match its own brand.

Study Ranks Esri US Demographic Data Most Accurate

Many people assume that using accurate data is not a particularly important element of an overall project; however, incorrect data can negatively impact the results of any analysis and have dramatic consequences for affected populations. Data inaccuracies may occur either by overestimating or underestimating populations or households.

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Using Web Maps to Tell Your Story

For centuries, maps have been telling stories—chronicling discovery and conquest, documenting an understanding of the patterns and interrelationships that underlie human and natural systems. But only in the past few years have new technologies and new media vastly expanded the potential of maps to weave narratives.

Maps are now interactive. They enable and reflect data analysis; they're constantly updated; and they're enriched with multimedia content. Maps are newly supercharged by digital technologies: GIS, the web, the cloud, and mobile communications. Now, maps can take users from globe to street corner in seconds; they can dynamically show change over time; they can organize and present charts, graphs, photos, and video. With the swipe of a fingertip across a tablet, map users can compare one theme with another, ask questions of maps, add their own information to maps, and cast votes on maps.

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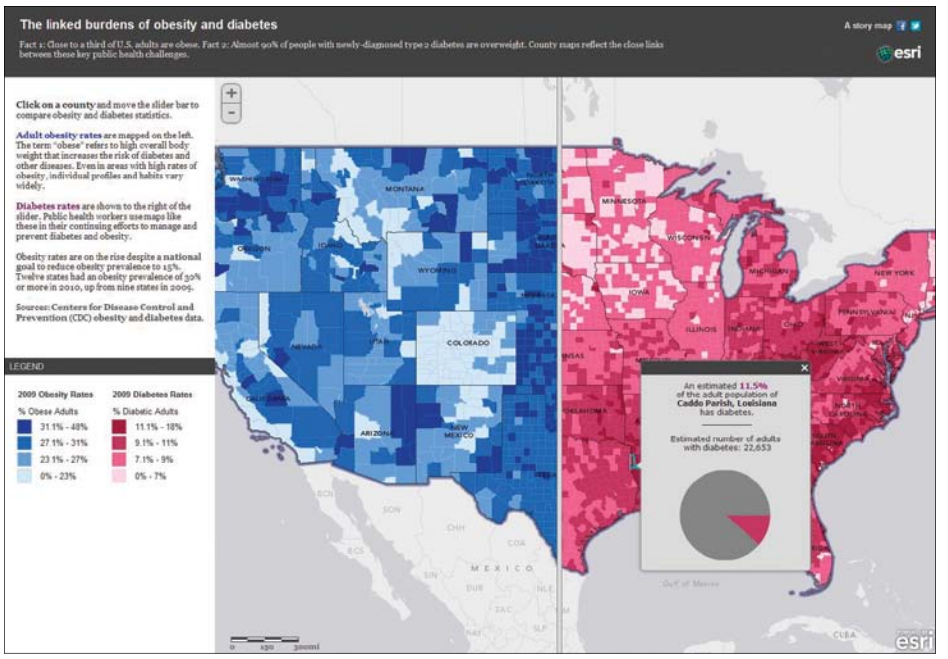

The swipe tool helps users quickly compare different maps—in this case, obesity and diabetes rates. Also, see the dramatic poster in the center of this magazine.

$776 Million Saved During 18 Years

King County Documents ROI of GIS

Home to Microsoft, Amazon.com, and Starbucks, King County, Washington, has a population close to two million people. GIS is critical to serving these citizens. Today, King County's GIS program supports an estimated 1,000 county employees in 42 agencies who use GIS data and applications in their daily work.

An economist at the University of Washington recently conducted a study measuring the return on investment (ROI) of the enterprise GIS program, which the county has operated for the past two decades. The study indicated that the county has accrued net benefits between $776 million and $1.7 billion during an 18-year period, with costs of about $200 million.

GIS applications help staff improve operations in a wide range of departments, including the Department of Natural Resources and Parks (DNRP) and the Department of Community and Human Services. Citizens also use GIS frequently through public-facing maps like My Commute, which shows road closures and traffic conditions. The county estimates that its popular iMap, which allows users to create customized views of spatial information, receives almost 15 million hits a month from 150,000 user sessions.

In addition to traditional GIS applications, the county uses GIS to support key campaigns like the Equity and Social Justice initiative. This agenda aims to ensure that the county

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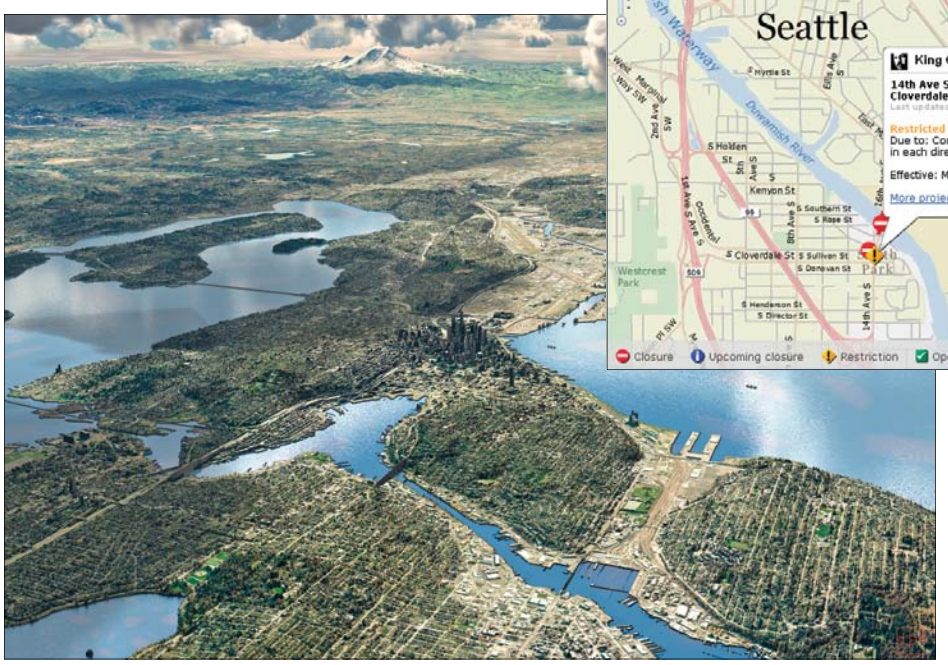
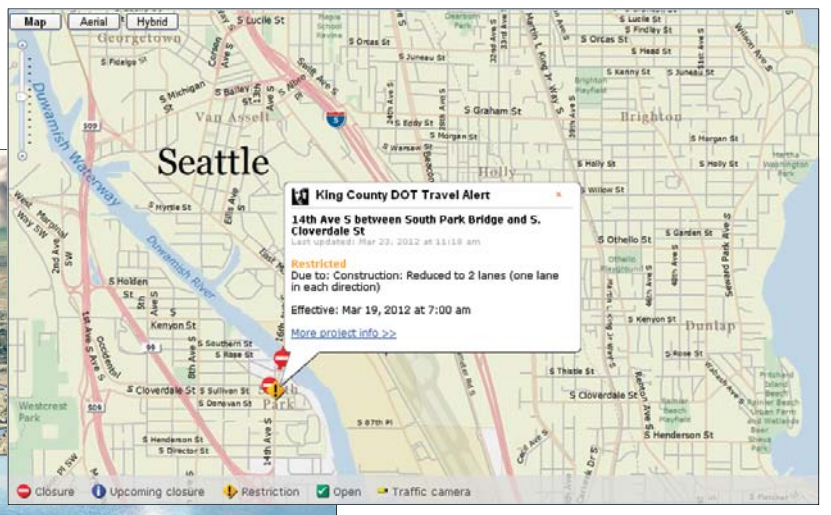


This simulated aerial view over Seattle can provide King County planners with an eye in the sky wherever they need one. (Created by Victor High, senior GIS analyst)



King County's My Commute map keeps citizens up-to-date on road closures and traffic conditions.

More *ArcNews*—Online-Only Articles

The Summer 2012 issue of *ArcNews* Online (esri.com/arcnews) presents the following special online-only articles:

Florida's Department of Transportation—District 4 Turns to GIS for Better Project Management

Charlotte Fire Department Links Live Data, Multiple Systems

Amica Mutual Insurance Maps Real-Time Data, Providing Better Service to Policyholders

Project Atlas Promotes Transparency and Progress for Puget Sound Restoration

A Conversation with Carl Steinitz

Featured in This Issue

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$776 Million Saved During 18 Years

King County Documents ROI of GIS

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distributes services equitably and that all citizens experience fairness and equal opportunity. For example, GIS services help county leaders determine whether communities have enough parks and if social services are distributed fairly to all neighborhoods. GIS is also used to site waste transfer stations to ensure equity for county areas by not overloading them with certain types of facilities.

"Waste transfer station siting and disaster debris planning are important," says Gary Hocking, King County Information Technology service delivery manager, who oversees GIS for the county.

Like Hocking, Greg Babinski, King County GIS Center finance and marketing manager, knows the GIS program provides value to users, the county government, and citizens, but he wanted to see numbers.

Determining Value

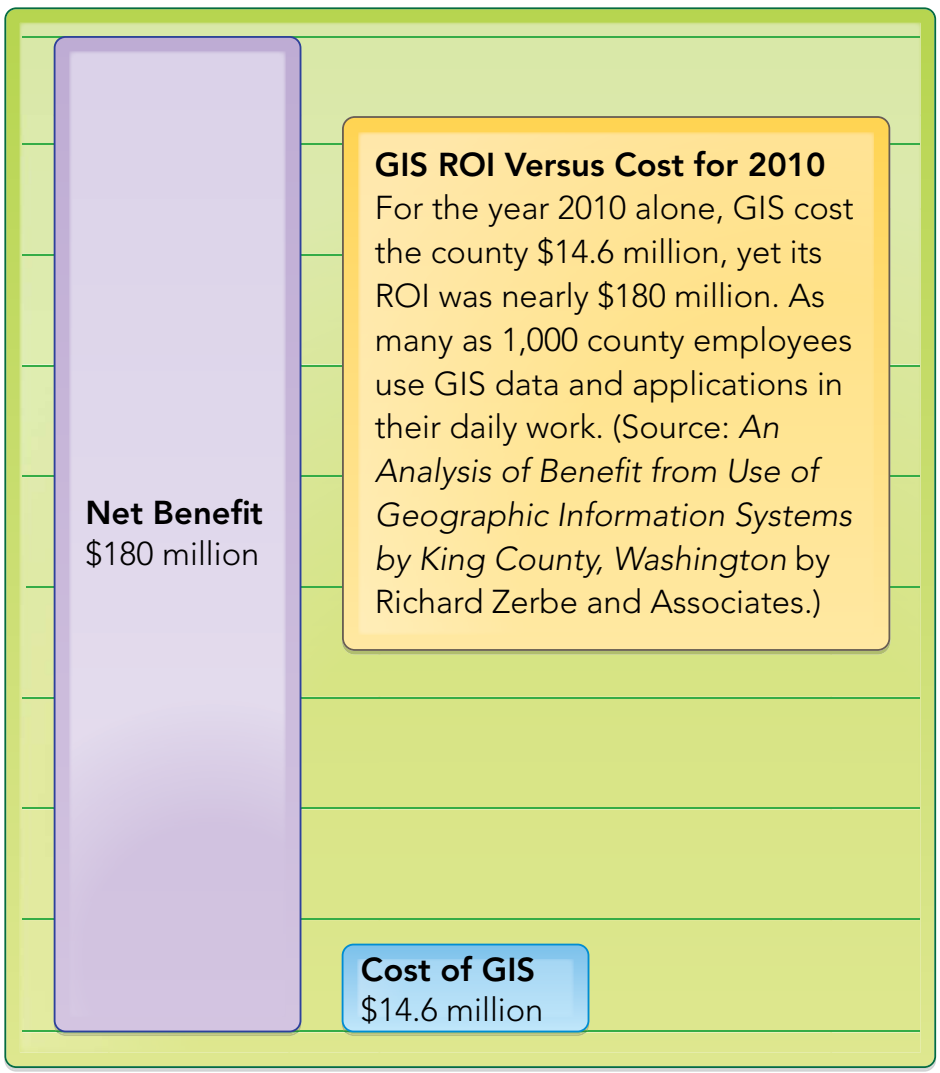
Babinski began talking with fellow URISA board member and Oregon geographic information officer Cy Smith in 2008 about doing a return on investment study with an independent economist to measure the ROI that has accrued as a result of the King County GIS program.

Those discussions led Babinski to the cost-benefit analysis work of Dr. Richard Zerbe, a renowned economist at the University of Washington and director of the UW Benefit-Cost Analysis Center at the Evans School of Public Affairs. Zerbe agreed to conduct an ROI study on the county's GIS program. He and his associates studied the 18-year period from the beginning of the GIS program in 1992 until 2010, with Babinski participating in the study as the project manager. King County and the State of Oregon cofunded the study. Smith explained that an extensive literature review conducted for the study indicated that no such study to measure the accrued ROI for an enterprise GIS program had been done before.

To begin their research, Zerbe's team met with county staff. They conducted face-to-face interviews with 30 county employees to gauge the role of GIS in various agencies and to better understand the kinds of work GIS facilitates. The team then sent a survey to employees to determine current production levels and the pre-GIS levels. One hundred seventy-five GIS professionals and users responded to the survey.

The savings in time and effort were monetized based on salary figures and full-time employee statistics to determine what it would cost agencies to replicate their pre-GIS level of output with GIS technology as well as the cost of replicating current GIS-aided production levels without GIS technology.

For 2010, for example, they determined that the cost of GIS was $14.6 million and the net benefit was approximately $180 million. The study by Richard Zerbe and Associates used a "with versus without" approach. While costs for all years were available, estimating benefits for the 18-year period was challenging. How opportunity cost was calculated had a substantial effect on the resultant ROI value. In addition, benefits are measured in outputs that are quantitatively and qualitatively better with GIS, leading to increased demand for these outputs. Assigning a dollar value to these more useful outputs is difficult. These factors were expressed in the three estimates in net benefits between 1992 and 2010: a conservative estimate of net benefit of approximately $776 million, a less conservative benefit level of $1.76 billion, and the least conservative estimate of almost $5 billion. *(See the original report for a complete description of the methodology used: esriurl.com/KCROI.)*



"It's important in this day and age in government to be able to validate your benefits and provide cost-benefit analysis for investments," says Hocking. "We had our own anecdotal evidence of the value of GIS, but now we have solid evidence of that value."

King County chief information officer Bill Kehoe agrees and views the GIS service as a trailblazer for IT-based county services. "Our GIS service is an example of a high-performing IT service that is providing a large amount of customer efficiency for the investment," he says. "The GIS service is a model that we want all our services within King County IT to aspire to."

The ROI study doesn't just validate King County's investment in GIS; it also provides strong evidence other governments can use to show that GIS improves government operations and delivers significant value.

To view the full ROI study, visit esriurl.com/KCROI. For more information about King County Information Technology, contact Gary Hocking, King County (e-mail: gary.hocking@kingcounty.gov), or visit www.kingcounty.gov/operations/it.aspx, or contact Chris Thomas, Esri (e-mail: cthomas@esri.com).

Strengthening the GIS Profession

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has surpassed the demand for other kinds of geospatial work, despite the fact that GIS is a relatively new branch of the field. The rightful roles and qualifications of GIS pros are in dispute, and there's competition for who gets to decide.

Do you consider yourself a GIS professional? Or are you thinking of becoming one? By *GIS professional*, I mean someone who makes a living through learned professional work *(see table below)* that requires advanced knowledge of geographic information systems and related geospatial technologies, data, and methods. If that's what you do, or what you might want to do, then you have a stake in the dispute. Your right to make a living doing GIS work, your ability to be part of an open and innovative GIS community, and your chance to be part of something big that's making a difference in the world all depend on how those contentious questions are answered.

I've been interested in the professionalization of GIS work since Bill "Hux" Huxhold and others raised these questions in the 1990s. Hux was, and is, a respected member of the GIS old guard. With his piercing blue eyes and close-cropped white hair, Hux looks a bit like Mr. Clean with eyeglasses. But unlike that cheerful ally of housekeepers everywhere, Hux was mad in the late 1990s, and he wasn't going to take it anymore.

Hux was angry that there were no standards to ensure the qualifications of GIS professionals. "Can it be," he asked, "that anyone can pass himself off as a 'GIS professional'?" Hux also railed at the absence of a formal quality control mechanism for GIS education. "Can it be that anyone can pass herself off as knowing what to teach GIS students?" To fill these gaps, Hux, Nancy Obermeyer, and a few others crusaded for a formal professional certification program for GIS professionals. Hux convinced the Urban and Regional Information Systems Association (URISA) to establish a certification committee to study the problem and recommend a solution. He also argued for a formal accreditation program for GIS in higher education.

Creating the GIS Profession

I was an educator at Penn State University at the time, and these arguments made a strong impression on me. Like many other educators, I was skeptical about the potential of certification and accreditation to ensure competence and quality. But the more I read and thought, I became convinced something more than competence is at stake. What's at stake in the professionalization of GIS is the right of GIS practitioners—some of whom are my students—to work side by side as respected peers with other geospatial professionals.

From the time that the US Department of Labor Employment and Training Administration (DOLETA) showcased geospatial technology as a high-growth industry, it warned that the absence of a coherent definition and public awareness of the field posed an obstacle to its growth. As the philosopher Michael Davis said, "Just as nobody likes a wise guy, nobody likes a definition" (2002). But to define something is, in a sense, to create it. I believe that the early crusaders and their successors have helped create a flourishing GIS profession that is just now coming of age.

The Geospatial Work Force

Until recently, we had to be content with anecdotal evidence about the GIS profession's size and scope. Reliable estimates of GIS employment didn't exist in the United States or most anywhere else. However, the anecdotal evidence was enough to worry DOLETA and others that work-force needs were growing faster than the capacity of the geospatial education infrastructure. Good students tended to get good jobs. Then confidence waned somewhat during the recession, when good jobs of every kind became much harder to find and keep.

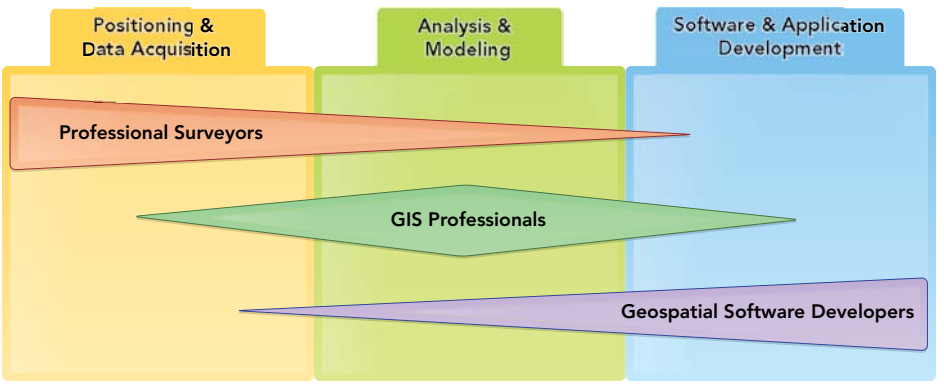
The size and scope of the GIS work force came into sharper focus when DOLETA established two new GIS occupations—geographic information scientists and technologists and GIS technicians—in late 2009 and when it identified the core competencies of geospatial professionals in 2010. Along with the new occupation definitions came the first rough estimates of the size and growth of the US GIS work force.

The employment estimates and growth projections in the accompanying table don't add up because some estimates overlap. However, even when the overlaps are accounted for, the estimates are still impressive: nearly 425,000 geospatial professionals were employed in 2010 in the United States, DOLETA work force analysts say, and almost 150,000 additional positions will be created by 2020. Significantly, the two GIS occupations account for the largest share of those employment estimates—about half of all US geospatial workers in 2010, and nearly more than one-third of new positions to be created by 2020. Estimates of the size of the geospatial work force beyond the United States are harder to find, but some reckon that there were about two million professional GIS users worldwide in 2005 (Longley et al. 2005).

Occupation	Estimated Employment (2010)	Projected Growth (2010–20)	Projected Growth Rate (2010–20)
Geospatial Information Scientists and Technologists*	210,000	51,600	3%–9%
Geographic Information Systems Technicians*	210,000	51,600	3%–9%
Remote-Sensing Scientists and Technologists*	30,000	13,300	3%–9%
Remote-Sensing Technicians*	62,000	33,500	10%–19%
Precision Agriculture Technicians*	62,000	33,500	10%–19%
Geodetic Surveyors*	51,000	24,200	20%–28%
Surveyors	51,000	24,200	20%–28%
Surveying Technicians	57,000	20,000	10%–19%
Mapping Technicians	57,000	20,000	10%–19%
Cartographers and Photogrammetrists	14,000	6,100	20%–28%
Totals	**~424,000**	**~148,700**	

*New occupations established in late 2009. The geospatial software programmer is not yet recognized as a distinct occupation.

Estimated 2010 US employment for 10 geospatial occupations, along with projected employment growth through 2020. (Source: US Bureau of Labor Statistics, available at onetonline.org)



The work roles of three geospatial professions cross boundaries of the geospatial industry sectors and overlap one another. Each profession has a "center of mass" within one sector. Not all geospatial professions are depicted.

Meanwhile, GIS employment prospects are good in many locations. According to Richard Serby, president of GeoSearch Inc., a leading personnel recruitment firm specializing in the geospatial industry, employment opportunities in most sectors have already rebounded to prerecession levels in the United States, recovering faster than most other industries. Serby points out that Indeed.com, which aggregates job postings worldwide, listed more than 11,000 geospatial jobs just for the period February 15 to March 15, 2012. Half of the geospatial jobs had *GIS* in their titles, and all but a few jobs included *GIS* in their requirements.

Scoping the GIS Profession

In 2010, DOLETA issued a Geospatial Technology Competency Model (GTCM) that identifies the specialized knowledge and abilities that successful geospatial professionals possess. The GTCM is useful for geospatial workers, who can use it to guide their continuing professional development plans. Employers can use it for job descriptions and interviews. Students can use the GTCM to assess what they know, what they need to learn, and which educational programs fit their needs. Educators can use it to assess how well their curricula align with work force needs. And certification and accreditation bodies can use it as a basis for their requirements. The GTCM is freely available for use and reuse, without restriction, at www.careeronestop.org/competencymodel.

In addition to 43 essential competencies common to most of the geospatial occupations, the GTCM identifies 19–24 essential competencies for each of three industry sectors: positioning and data acquisition, analysis and modeling, and software and application development. The sectors represent "clusters of worker competencies associated with the three major categories of geospatial industry products and services." The diagram above shows the scope of responsibilities for three geospatial professions in relation to the industry sectors and to one another.

Debates about the rightful roles of GIS professionals arise because their activities tend to overlap those of other geospatial professions. Overlaps cause tensions but also afford opportunities for cooperation. J. Alison Butler, an experienced and outspoken champion of the GIS profession, points out that overlaps tend to be complementary. For example, professional surveyors and GIS professionals do many similar things but usually at different geographic scales ("Surveyors work at a 1:1 scale," Butler says, in contrast with GIS professionals, who "work at smaller scales and do not need to be so precise."). And although professional roles overlap, each geospatial profession exhibits a distinctive "center of mass," or concentration within one sector *(see diagram above)*.

The GIS profession's center of mass is analysis and modeling. GIS professionals tend to be end users of geospatial data and software. They're employed in a wide range of allied industries, such as natural resources, government, and defense and intelligence. The character and geographic distribution of GIS employment differs from one industry to the next. However, the core responsibility of most GIS professionals is to use specialized software technology to render actionable information from geospatial data. In addition, many GIS professionals also acquire and process geospatial data (within the constraints of government regulation over data collection activities that pose risks to public safety and welfare). Others design and implement geospatial databases or develop customized software applications.

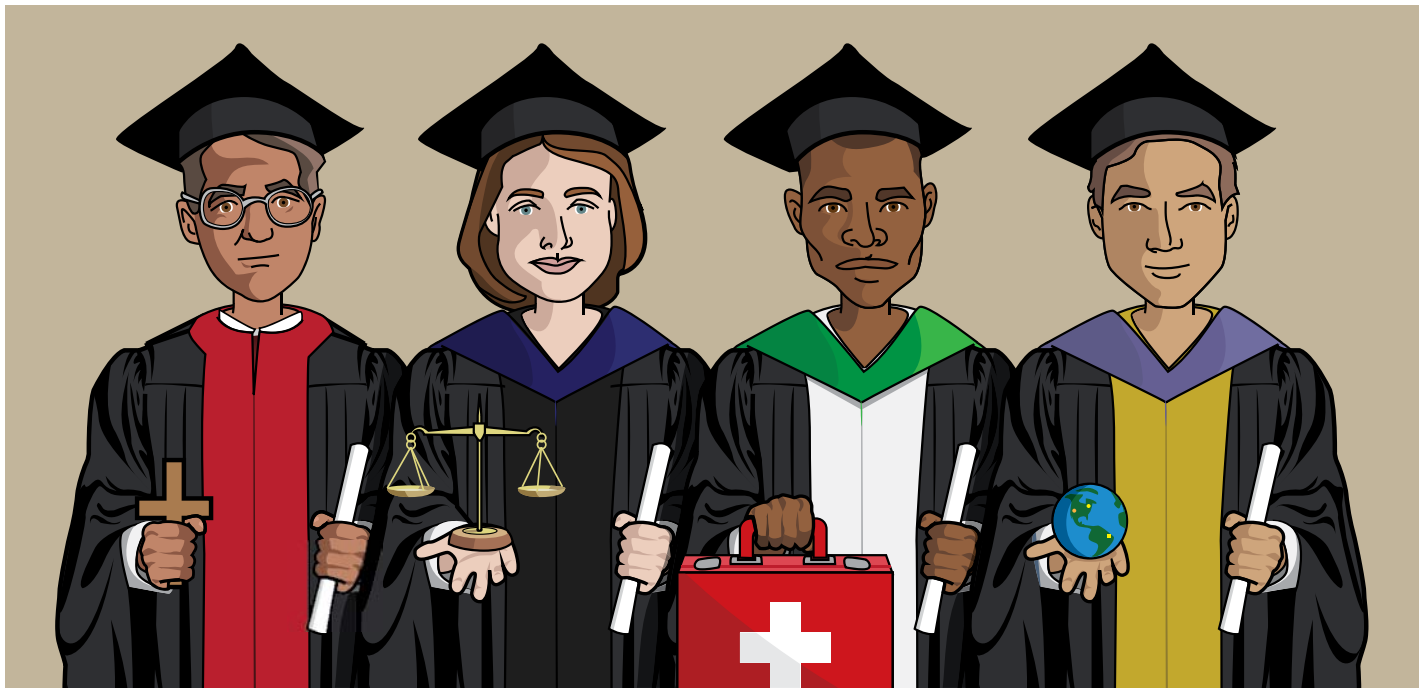
In this article, I define *GIS professional* narrowly, as one who makes a living doing GIS work. Some object to scoping the field so narrowly. Directions Media editor in chief Joe Francica points out that "non-GIS people are becoming more 'location aware' and thinking spatially." Gone are the days, Francica and others observe, when knowledge workers had to rely on "the map guy" to provide location-based information. Now "everyone is becoming a 'map guy.'" Even so, neither widespread access to mapping capabilities nor crowdsourced or "volunteered" geographic information have displaced GIS professionals. On the contrary, as the employment estimates above suggest, the demand for GIS professionals seems to be increasing even as location awareness proliferates.

GIS as a Learned Profession

Not everyone agrees that a GIS profession exists. Debates about whether GIS qualifies as a true profession date back more than 20 years. Today, however, by almost any definition, there's not much room left for debate. Consider, for example, the definition of *learned professional* in the US Department of Labor's Fair Labor Standards Act (FLSA). To qualify as a learned professional under FLSA, a worker's primary duties must require advanced knowledge, involving the "exercise of discretion and judgment." Advanced knowledge "must be in a field of science or learning" (comparable to the traditional professions of medicine, law, theology, accounting, engineering, teaching, and others) and "must be customarily acquired by a prolonged course of specialized intellectual instruction."

Advanced Knowledge

The advanced knowledge that distinguishes the GIS profession is now well defined. The first comprehensive attempt to specify the knowledge that characterizes the broad geospatial field was the University Consortium for Geographic Information Science's (UCGIS) Geographic Information Science and Technology Body of Knowledge (2006). Building on that foundational work, DOLETA issued the GTCM in 2010. As discussed above, DOLETA also provides detailed descriptions of 10 geospatial occupations, including geospatial information scientists and



technologists and geographic information systems technicians.

Specialized Education

Formal, specialized education is commonly included in GIS job requirements and is required for GIS professional (GISP) certification. Many thousands of students now pursue specialized certificates and degrees in GIS at colleges and universities worldwide. Some 7,000 colleges and universities worldwide—including over 85 percent of the institutions included in *The Times* of London's ranking of the top 400 institutions—maintain low-cost education licenses of Esri's ArcGIS software. And since Esri made free, one-year educational software licenses available for individual student use in fall 2005, over 450,000 students worldwide have requested DVDs or downloaded the software. The availability of no-cost ArcGIS software that students can use on their personal computers has helped educational institutions offer advanced GIS education online for adult learners who can't put their lives on hold to participate in traditional campus-based education.

GIS seems clearly to qualify as a learned profession under the FLSA definition. The advanced knowledge that distinguishes the profession is well defined. Prolonged courses of specialized intellectual instruction are widely available, attracting large and increasing numbers of enrollments.

Professional Ethics in GIS

Professions are more than just occupations, and the distinction involves more than just specialized knowledge and education. One of the distinguishing characteristics of a profession is its specialized code of professional ethics.

In the early 1990s, Will Craig—another pioneer of urban and regional information systems and GIS—pointed out the need for a code for the GIS profession and set out to write one. Craig began by examining the existing codes in use in other fields. He found "surprising similarity" among them. Most reflected a "duty-" or "obligations-based" approach to ethics. "Obligations to society," he observed, "usually override other considerations" in the codes he studied. At its founding in 2004, the GIS Certification Institute (GISCI) endorsed the GIS Code of Ethics he completed (with help from many members of the GIS community) and later developed its own complementary Rules of Conduct. To qualify for certification as a GISP, applicants must pledge to uphold the code and rules. Coming to terms with its ethical challenges is another sign of a profession that is coming of age.

Certification and Licensure

Another distinguishing characteristic of professions is specialized certification or licensure. We typically think of these as mechanisms to ensure that individual practitioners are competent and trustworthy. However, another way to think about certification is as a road map for continuing professional development. GISCI has conferred its GISP certification on more than 5,000 professionals who document sufficient formal education, experience, and contributions to the profession. To qualify for renewal of certification, GISPs must document continuing formal education and contributions. These requirements strengthen the profession by ensuring that professionals "keep current in the field through . . . professional development" (GIS Code of Ethics Item II. 1.).

Unlike the state licensure required for professional surveyors in the United States, GISP certification remains voluntary (though one state, South Carolina, requires that surveyors who use GIS be licensed as "GIS surveyors"). In part, this difference is due to the fact that GIS is a much younger profession than surveying. However, recent developments suggest that GIS certification may not remain voluntary for long. According to Max Baber of the US Geospatial Intelligence Foundation, the US undersecretary for defense intelligence has mandated a formal policy for certification of geospatial analysts. The policy is to be in place at the National Geospatial-Intelligence Agency by September 2012. Baber believes that GIS professionals in the civilian side of government may be affected in the longer term. It appears that GIS certification is finally taking root.

GIS Professional Organizations

Another characteristic of GIS and other professions is specialized membership organizations dedicated to advancement of the profession. Such organizations typically aim to serve members through continuing professional development opportunities and through advocacy on their behalf in the policy arena. (A list of organizations for geospatial professionals is available at **edcommunity.esri.com**.) Voluntary, active participation in such organizations is one example of what GISCI means by "contributions to the profession."

Toward a Moral Ideal for GIS

The GIS field has all the trappings of a profession, including a distinctive body of advanced knowledge, specialized educational offerings, a code of professional ethics, mechanisms for professional certification, and specialized membership organizations. What's lacking is a certain ethos—a characteristic spirit evident in the shared beliefs and aspirations of mature professions like medicine, the law, and even accounting. Darrell Pugh, the author so often cited for his checklist of the defining traits of professions, includes one he calls a "social ideal." For Michael Davis, serving a shared "moral ideal" is a defining characteristic of all professions. Physician and ethicist John W. Lewis argues that a profession's "core product and service is [its] pledge to put the interests of others ahead of [its] own while providing [its] specific services." At the 2012 Esri Partner Conference, Jack Dangermond reminded attendees "we have a driving purpose to make a difference in the world."

How can the GIS profession advance society's interests? What is the GIS profession's moral ideal? For starters, here's my suggestion:

> The GIS profession's moral ideal is to apply geospatial technologies and spatial thinking to design sustainable futures for people and places everywhere.

Challenges

The GIS profession is relatively young. It has weaknesses and faces some very real threats. Some critics question the profession's legitimacy, citing the facts that GIS professional certification remains voluntary and that no formal GIS accreditation process is in place to hold colleges and universities accountable. Others seek to monopolize the use of GIS and related technologies through government regulation. Given these challenges, GIS professionals need to do everything we can—individually and collectively—to strengthen our profession.

Seven Things Every GIS Professional Can Do to Strengthen Our Field

1. Become certified as a GISP or its equivalent (depending on where you are and what you do). Professional certification is a public commitment to competence, ethical practice, and continuing professional development. (Technical certifications like Esri's are valuable, too, but are no substitute for professional certification.) Formalizing that commitment, and fulfilling it throughout your career, is one of the most significant things you can do to strengthen your profession. And the larger your GIS professional community grows, the better your chances to control your own destiny.

2. Map out a professional development plan that includes continuing formal education and contributions to the profession. Whether you opt in to certification or not, use the requirements for renewal of GISP certification—and the GTCM—as guides.

3. Join and be actively involved in one or more organizations that advance the interests of the GIS profession. Wise employers will help support your participation. If you don't enjoy such support in your job, participate anyway and look for a better job.

4. Be able to explain the nature of your profession, its history, and its code of ethics.

5. Cultivate respectful working relationships with colleagues in kindred professions. Participate in efforts to increase cooperation among the geospatial professions but stand up for your profession when its legitimacy is challenged. Keep in mind that your adversaries are usually not your professional colleagues but rather the lobbyists and lawyers who stand to gain the most by monopolistic regulations.

6. Volunteer for GIS activities that benefit society. Help increase public awareness on GIS Day (**www.gisday.com**). Become a mentor for a schoolteacher who wants to teach with GIS (**edcommunity.esri.com/geomentor**). Volunteer to serve on an industry advisory board for a GIS certificate and/or degree program at a nearby higher education institution. Encourage such programs to use the GTCM to assess their curricula and students and to embrace accreditation.

7. Articulate a "moral ideal" for GIS that expresses your professional commitment to society.

So, what's your moral ideal?

About the Author

David DiBiase is Esri's director of education industry solutions. Before joining Esri in 2011, he founded the Penn State Online master's degree and certificate programs in GIS. As a member of URISA's Certification Committee, he helped design the criteria by which more than 5,000 GISPs have been certified. He is a past president of GISCI.

For more information, contact David DiBiase (e-mail: ddibiase@esri.com).

References

Butler, J. A. (2008). "Redefining Who We Are." *Professional Surveyor Magazine*, April. **www.profsurv.com/magazine/article.aspx?i=2117**.

Davis, Michael (2002). *Profession, Code, and Ethics*. Burlington, VT: Ashgate.

GIS Certification Institute. *Code of Ethics and Rules of Conduct*. **www.gisci.org**.

Lewis, John W. (2001). *Ethics and the Learned Professions* (white paper). The Institute for Global Ethics. **www.globalethics.org/files/wp_professions.pdf/20**.

Longley, P. A., M. F. Goodchild, D. J. Maguire, and D. W. Rhind (2005). *Geographic Information Systems and Science*. 2nd ed. Chichester, UK: Wiley.

Obermeyer, Nancy J. (2007). "GIS: The Maturation of a Profession." *Cartography and Geographic Information Science* 34, no. 2: 129–32.

US Department of Labor (revised 2008). "Fact Sheet #17D: Exemption for Professional Employees Under the Fair Labor Standards Act (FLSA)." **www.dol.gov/whd/regs/compliance/fairpay/fs17d_professional.pdf**.

Will Breadfruit Solve the World Hunger Crisis?

New Developments in an Innovative Food Crop

By Matthew P. Lucas and Diane Ragone, National Tropical Botanical Garden

Highlights

- Using ArcGIS, monthly rainfall and temperature data was represented on maps.
- ArcGIS was used to create a map indicating areas of the globe ripe for growing breadfruit.
- The results can help guide potential breadfruit-growing countries in planning and implementing planting projects.

A map can be a powerful visual tool, but can a map help solve world hunger, rejuvenate agricultural soil, and prevent mosquito-borne infections? Can a map help slow global warming and spur sustainable economic development in tropical regions around the world? Perhaps a map alone can't do these things, but a map can help display the real potential of a very special tree, the breadfruit.

Breadfruit (*Artocarpus altilis*) is a tropical tree originally from Papua New Guinea with a rich and storied history. This starchy staple crop has been grown in the Pacific for close to 3,000 years and was first introduced to other tropical regions more than 200 years ago. The trees are easy to grow and thrive under a wide range of ecological conditions, producing abundant, nutritious food for decades without the labor, fertilizer, and chemicals used to grow field crops.

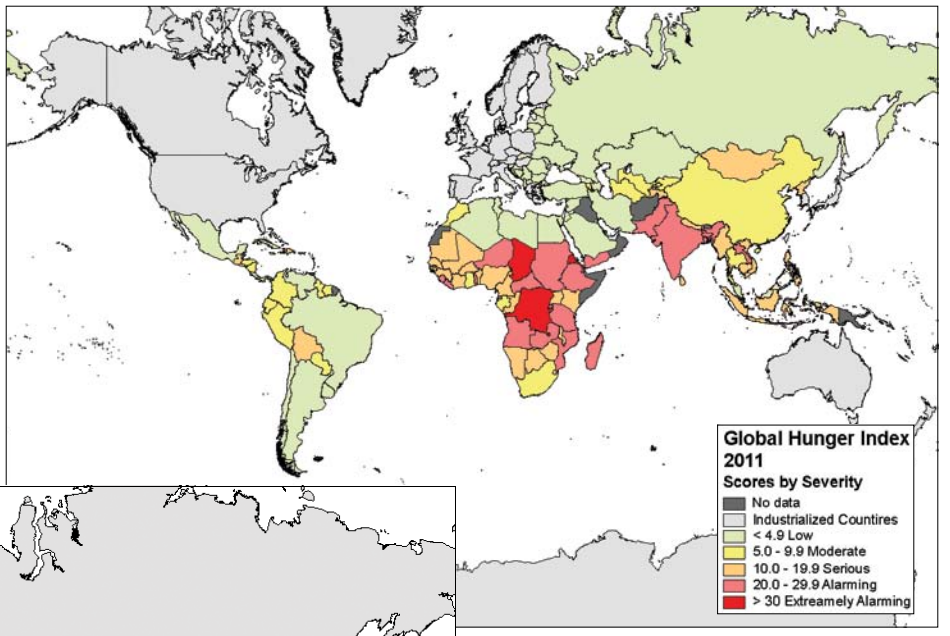
These multipurpose trees improve soil conditions and protect watersheds while providing food, timber, and animal feed. All parts of the tree are used—even the male flowers, which are dried and burned to repel mosquitoes. Because of its multiple uses and long, productive, low-maintenance life, breadfruit was spread throughout the tropical Pacific by intrepid voyagers. Hawaii is one of the many island chains where breadfruit, or *ulu* in Hawaiian, was cultivated as a major staple. It is fitting that now Hawaii is home to the headquarters of an organization devoted to promoting the conservation and use of breadfruit for food and reforestation around the world.

NGO Non-Governmental Organization

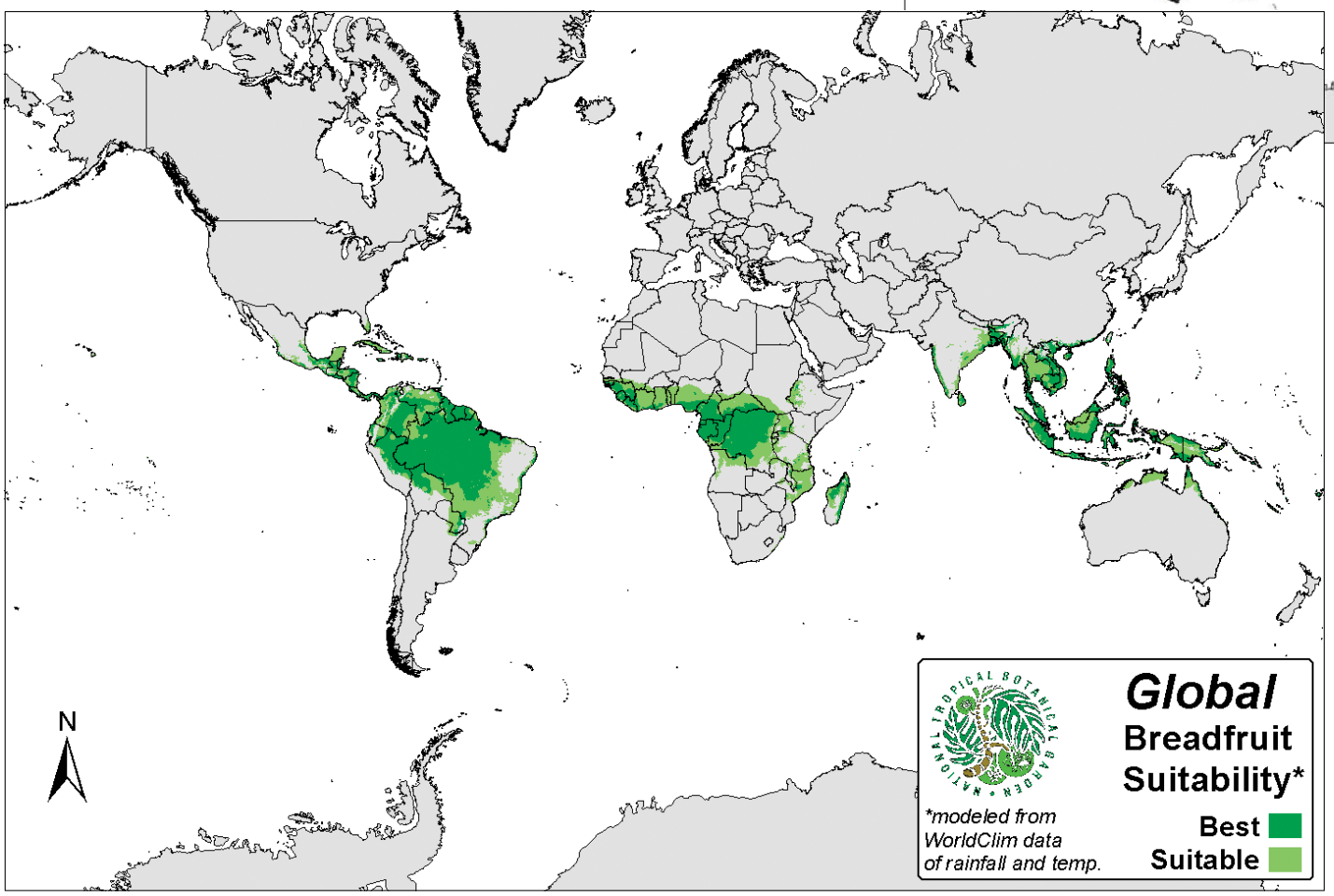
The Breadfruit Institute, within the nonprofit National Tropical Botanical Garden (NTBG), is a major center for the tree's conservation and research of more than 120 varieties from throughout the Pacific, making it the world's largest repository of breadfruit. As a result of this work, the institute has received requests from numerous countries seeking quality breadfruit varieties for tree-planting projects. To address this need, the Breadfruit Institute has developed innovative propagation methods, making it possible to produce and ship thousands, or even millions, of breadfruit plants anywhere in the world.

These breadfruit tree-planting projects can help alleviate hunger and support sustainable agriculture, agroforestry, and income generation. Most of the world's one billion hungry people live in the tropics—the same region where breadfruit can be grown. However, as Dr. Diane Ragone, author and director of the Breadfruit Institute, has learned, stating these facts and illustrating them are two very different things. A strong realization is made when a person sees the data from the United Nations Food and Agriculture Organization global map on world hunger (www.fao.org/hunger) coupled with a map showing areas suitable for growing breadfruit.

Different varieties of breadfruit are conserved in the world's largest collection of breadfruit at the Breadfruit Institute in Hawaii. (Photo credit: © Jim Wiseman, courtesy of the Breadfruit Institute)



This Hunger map is based on the 2011 Global Hunger Index score displayed per country.



Map showing zones of "best" and "suitable" growing conditions for breadfruit.

It was originally this type of powerful visual aid Ragone wanted when she began working with NTBG's GIS coordinator and coauthor Matthew Lucas. To create such a map, Lucas began by constructing a model within ArcGIS using WorldClim (www.worldclim.org) 30-second resolution global raster datasets of interpolated climate conditions compiled from the past 50 years (Hijmans et al. 2005). With the GIS, monthly rainfall and temperature data was condensed into total annual rainfall, mean annual temperature, and minimum and maximum annual temperature. Then, the annual climate data was reclassified.

"Suitable" and "best" ranges of rainfall and temperature were identified after referring to the breadfruit profile written by Ragone for *Traditional Trees of Pacific Islands* (Elevitch 2006). The best ranges in mean temperature and rainfall were given a value of 2, whereas suitable conditions were given a value of 1; conditions that were deemed too low or high were

given a value of -10. ArcGIS was used to combine all the reclassified climate datasets. The final output resulted in a global dataset that now displayed areas deemed unsuitable for growing breadfruit as < 0, areas assumed suitable with a value of < 4 and > 0, and best areas with a value of 4. This data was displayed in combination with 2011 Global Hunger Index scores entered into a vector dataset of countries. The resultant map helps the viewer see the real potential breadfruit development could have for tropical regions.

With this new visual aid completed, Ragone and Josh Schneider, cofounder of Cultivaris/Global Breadfruit, a horticultural partner that propagates breadfruit trees for global distribution, attended the World Food Prize symposium in October 2011. The breadfruit suitability map was shared with Calestous Juma, professor of the practice of international development and director of the Science, Technology, and Globalization Project at the Belfer Center for Science and International Affairs at the Harvard Kennedy School. Juma has extensive experience and contacts in Africa.

The map was also shared with the former president of Nigeria, Obasanjo Olusegun. It was at Olusegun's invitation that Schneider visited Nigeria and met with government officials and researchers to discuss breadfruit planting projects. Due to the relatively fine scale (1 km) of the original datasets, a more detailed map of Nigeria showing areas suitable for growing breadfruit, along with roads and cities, was an invaluable tool during discussions.

The World Food Prize meeting also spurred other similar country-specific maps that have been created and shared with organizations and individuals working in Haiti, Ghana, Jamaica, Central America, and China. The maps provide government officials, foundations, and potential donors with clear information about the potential of breadfruit in specific areas. The maps have spurred the question, What other countries are best suited for growing breadfruit? ArcGIS was used to combine the breadfruit suitability data with a vector layer of country borders. This not only resulted in a list of countries that could possibly grow breadfruit but also made it easy to identify and rank the amount of area each country has that is suitable and best for growing breadfruit.

Breadfruit is extremely productive, producing an average of 150–200 and up to as many as 600 nutritious fruits per season.

It became clear that this map, the data, and the ArcGIS methodology used to construct it provided not only a powerful visual aid but also a useful research tool. Armed with these maps and the information they convey, Lucas and Ragone are continuing to pair what has been learned about breadfruit cultivation with ArcGIS to help understand and display future breadfruit potential. They are currently working on a climate change analysis that uses predicted climate datasets of various future climate models and scenarios in an attempt to quantify areas that would have the highest likelihood of sustainable breadfruit development. They are also working on publishing an online map displaying global breadfruit growing potential. Finally, it is the hope of the Breadfruit Institute and NTBG that future breadfruit development will be expanded and that ArcGIS will help guide potential breadfruit-growing countries in planning and implementing planting projects of this very special tree.

About the Authors

Matthew Lucas is the GIS coordinator for the Conservation Department at the National Tropical Botanical Garden. As a graduate of the University of Hawaii, Hilo, Department of Geography, Lucas hails from a conservation background where he uses models and maps to guide more efficient decision making and problem solving. Diane Ragone, PhD, is director of the Breadfruit Institute at the National Tropical Botanical Garden. She is an authority on the conservation and use of breadfruit and has conducted horticultural and ethnobotanical studies in more than 50 islands in Micronesia, Polynesia, and Melanesia.

For more information about the Breadfruit Institute and NTBG, visit www.ntbg.org/breadfruit. To help support the work of the institute and breadfruit tree-planting projects, visit ntbg.org/breadfruit/donate/plantatree.php. For more information on Global Breadfruit and how you can help, visit www.globalbreadfruit.com.

Citations

Hijmans, R. J., S. E. Cameron, J. L. Parra, P. G. Jones, and A. Jarvis (2005). "Very High Resolution Interpolated Climate Surfaces for Global Land Areas." *International Journal of Climatology* 25:1965–1978.

Ragone, D. (2006). "*Artocarpus altilis* (breadfruit)." In *Traditional Trees of Pacific Islands*. Elevitch, C. R. (ed). Holualoa, HI: Permanent Agroforestry Resources, 85–100. Available at www.traditionaltree.org.

Von Grebmer, K., M. Torero, T. Olofinbiyi, et al. (2011). "2011 Global Hunger Index: The Challenge of Hunger: Taming Price Spikes and Excessive Food Price Volatility." International Food Policy Research Institute, Bonn. Available at www.ifpri.org/sites/default/files/publications/ghi11.pdf.

An Interview with Jack Dangermond

URISA at 50

Jack Dangermond

URISA—the Urban and Regional Information Systems Association—will celebrate its 50th anniversary at the 2012 GIS-Pro Conference in Portland, Oregon, September 30–October 4. Here, Jack Dangermond shares memories of URISA's early years, as well as thoughts about its future. Dangermond earned URISA's Horwood Distinguished Service Award in 1988.

URISA: How and why did you get involved with URISA?

Dangermond: I was a young graduate of the Harvard Lab when Alan Schmidt advised me to attend the 1969 URISA meeting in Los Angeles. I wasn't really sure what URISA was, but I traveled to the meetings for three days and met many interesting people. It was there I first met Ed Horwood, Tom Palmerlee, Bob Aangenbrug, Bob Dial, and other people who introduced me to early concepts of urban information systems.

At that time, there were a lot of innovative people and organizations thinking about urban information systems in the Los Angeles area, and many of them showed up at the URISA meeting, for example, the Community Analysis Bureau (CAB) in the city and the Southern California Regional Information Study (SCRIS), an outgrowth of the Census Use Study activities sponsored by the Census Bureau in New Haven, Connecticut. People I remember meeting were Caby Smith, Matt Jaro, Ross Hall, Lee Johnson, Al Evans, Ken Duecker, and Mike Kevany. They were playing around with everything from the first generation of ADMATCH address geocoding and census DIME files to transportation modeling. I realized this was a special meeting where public-sector people, private consultants, and entrepreneurs were mixing and sharing ideas about applications of computers and information systems within local government.

I discovered that URISA wasn't just another academic conference. It was a place where professional relationships were established and new concepts were discussed. In those days, the atmosphere of the meetings was highly charged and competitive. People were actively trying to forward their vision, create business, and get business. At least a third of the participants were consultants like me, who talked about their offerings and wares in various sessions.

I got one small computer mapping job for the 1970 election campaign for George Leyland, with whom I'd worked at Harvard and who later became head of the Federal Emergency Management Agency.

URISA: How did URISA evolve as the GIS industry matured?

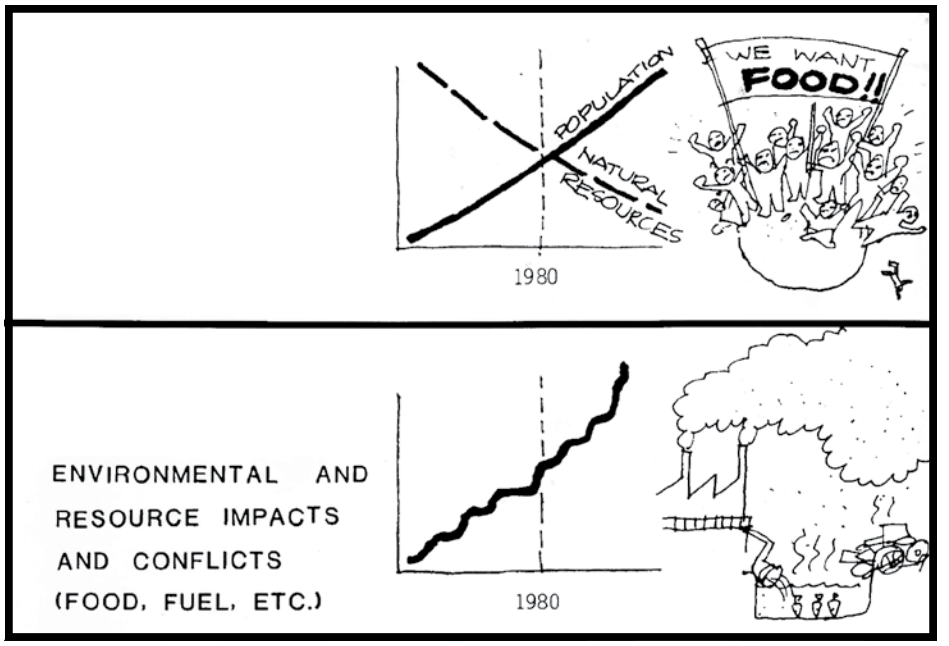
Dangermond: I liked URISA because it provided a forum of colleagues where a young professional and entrepreneur like me could share my work. People were genuinely interested and would give me feedback. We talked about technology and approaches to the kinds of problem solving that eventually became known as urban GIS. This kind of open culture of sharing and learning flourished, especially during the 1970s and early 1980s. Around 1982 or 1983, URISA decided to invite vendors to exhibit at the annual meeting. At that point, the complexion of URISA began to change.

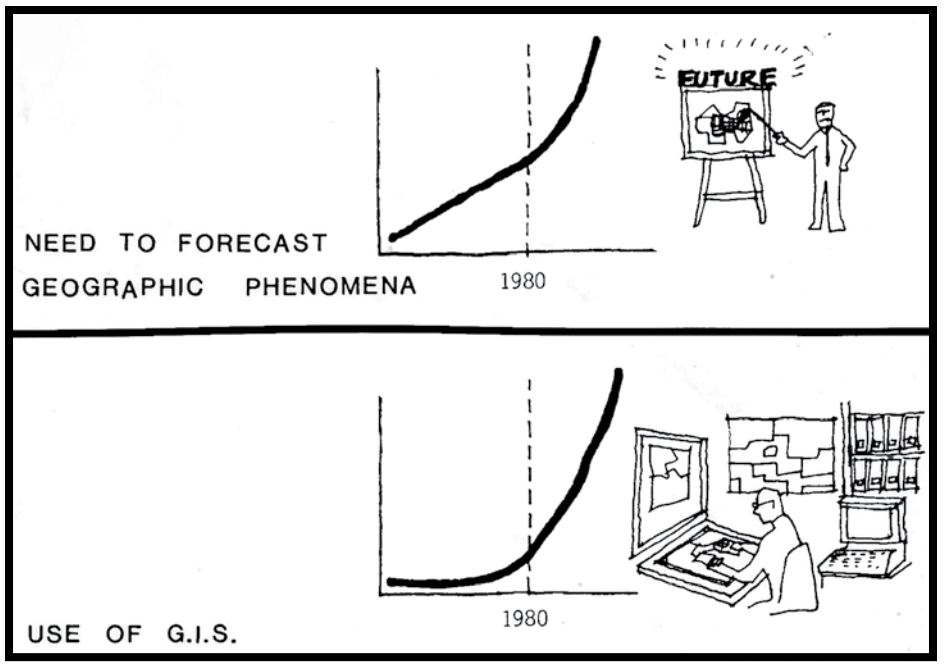
By the late 1980s, URISA had become identified with local government GIS. The membership grew dramatically into the thousands. But at the same time, the association took on a more commercial aura with a strong trade show emphasis. And as the GIS industry began to shake out, the trade show business fell off, and attendance also declined. Discussions shifted to planning, organization, implementation, and policy issues. Likewise, the original core people who had founded or nurtured URISA as a venue for sharing ideas and best practices continued to come and dialog. I liked this. URISA gradually became one of the homes where GIS professionals could get together and discuss issues.

URISA: Which URISA people come to mind who really made a difference in the GIS field?

Dangermond: URISA's founder, Horwood, was a big influence on me. He was also a really fun guy. Horwood liked the idea of using computational methods for doing transportation planning. He especially liked getting people together to share their experiences in urban information systems.

Dial was another key visionary and influencer. He pushed some of the early thinking about urban information systems. His thinking, writing, and presentations led to a Housing and Urban Development program that funded experiments in implementing automated methods within cities around the country. This got the private sector interested in selling hardware, software, and services to build these experimental systems.





Left and above: Jack Dangermond produced these drawings by hand for the 1979 URISA conference. Here he looked into the future with 1980 as a near-future milestone.

Dial was one of the first to envision how the multiple fiefdoms in cities could share common databases. I grabbed that notion personally to drive some of the concepts of urban GIS in the early days of ArcInfo, and it really worked. I credit Scott Morehouse for listening to my rants and systematically implementing a toolbox of tools that could be customized (using ARC Macro Language) to build application views to a common, shared database. We saw eager adoption—by planning departments, public works, land records organizations, and environmental agencies—of this vision of sharing a common GIS database.

Duane Marble was another early leader. Marble brought in systematic user needs assessment methodology and later the whole concept of doing geographic and GIS research in the academy. All this activity eventually led to the National Center for Geographic Information Analysis at Santa Barbara, California; Buffalo, New York; and Maine. Marble's research thinking, together with that of Aangenbrug and Roger Tomlinson, and others, helped balance out the somewhat aggressive commercial forces that were pushing URISA along.

URISA: Why did URISA gravitate to GIS?

Dangermond: URISA was, in a sense, one of the birthplaces of information system technology for local governments. This was a hot topic at the time—kind of like social networking is today. Remember that the best computers we had were huge, very expensive mainframes, and there really wasn't much of a database management technology at all. IMS [IBM's mainframe system] was a hierarchical data structure and considered the best of breed. This technology was designed primarily for accounting systems and financial back-office work. In those days, if you put simple things like property records into a database and could get lists of them, it was rocket science. So there was a need for a forum where people could come together and share, because computers and information systems were so new. Only a few people in transportation and urban planning were interested in computational approaches and database approaches. URISA brought these people together.

When GIS began to emerge as a commercial product in the late 1970s and early 1980s, it attracted more people from more organizations. They were excited to discover that GIS was a real information system just like an accounting system or a financial system or a permitting system, all of which had already been commercialized. So the introduction of a commercial off-the-shelf platform for sale from multiple vendors caused a stir and a lot of common interest. People and organizations wanted to buy these products because they saw their value, and there was lots of competition during the 1980s and 1990s for brands from different vendors.

URISA: Do you think Esri's User Conference has affected URISA?

Perhaps. As more organizations purchased and implemented this software, some of those who attended URISA to help select a platform now attend our conference because of its strong emphasis on supporting users with technology refreshers and training. What the User Conference does not replace is a forum for discussion of data policies, professional standards, new methods, new approaches—the kinds of conversations that URISA was known for.

URISA: Looking ahead, URISA has proposed a new emphasis on GIS management. What's your perspective on this potential new role?

Dangermond: Today, GIS is maturing as a technology and as a profession, and GIS operations within organizations are maturing as well. There's a need for a forum to bring together the professionals who are responsible for managing large, complex GIS operations. URISA is the logical place where managers come together to talk about how to use new technology and new methods to make cities better places.

I have, year after year, supported URISA because I believe it's one of the best places where local government professionals can get together and discuss their common interests with respect to information system technology. It was certainly one of the birthplaces of urban GIS and continues to have much to offer its members.

During URISA's first two or three decades, there was perhaps a greater spirit of excitement when the meetings were held. URISA's number-one asset was its ability to get people together to share ideas, renew old friendships, have a chance to share their work, get acknowledgment from friends, network, and also have a great party. These were the magical ingredients that kept URISA alive through thick and thin. Reengaging that spirit is what's needed. And the 50th anniversary conference in Portland this October is a good time and place to start.

GIS Hero

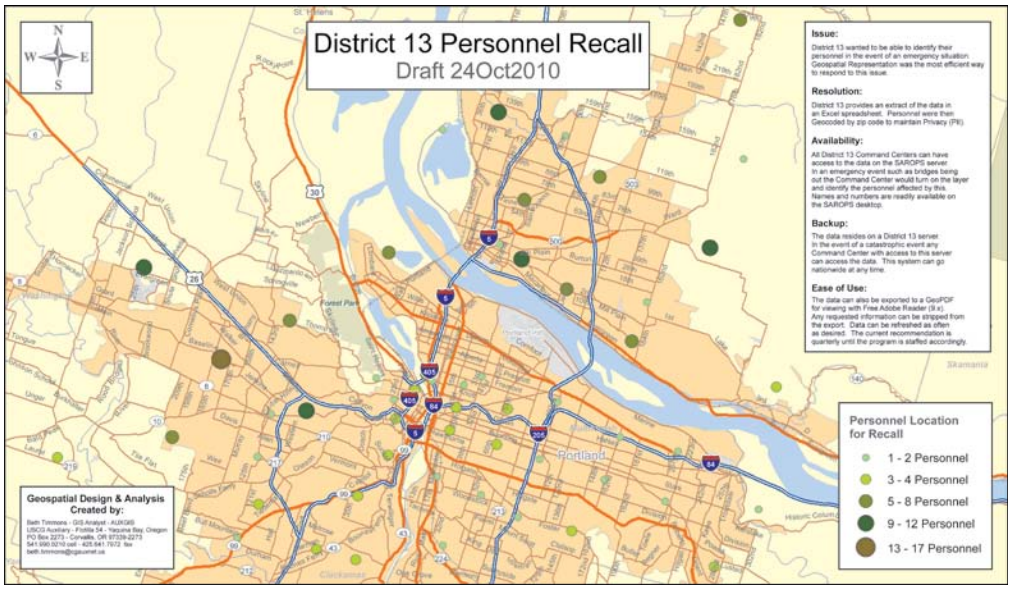
Volunteering Is Heroic

Beth Timmons

GIS professionals understand workflows, development, and technology. They are proficient problem solvers who understand how to analyze and approach a project, plan it, complete it, and educate others. Many of these on-the-job skills can be applied to helping a local organization or community better address its concerns and meet its goals. GIS volunteers apply their talents in ways that make huge differences. Esri acknowledges the work of many volunteers by highlighting one of them, Beth Timmons, as a GIS Hero.

Timmons is a full-time GIS professional employed by GeoLogics as a contractor for Natural Resource GIS in Corvallis, Oregon. She also serves in the volunteer branch of the US Coast Guard, where she donates her GIS expertise an average of 50 hours per month. Along with having expertise in soil and GIS, which is highly valued by GeoLogics, Timmons has experience and is very interested in using GIS for emergency response. She looked for opportunities with the Coast Guard to see if it needed her GIS skills. The answer was a resounding "Yes!"

District 13 of the Coast Guard includes Idaho, Montana, Oregon, and Washington. The Coast Guard has an enterprise license agreement with Esri for ArcGIS but doesn't have the trained staff it needs to take full advantage of it. Rolling up her sleeves, Timmons began by leveraging the existing datasets to create geospatial products that staff could use on their desktops. For example, she worked with the Citizens Action Network, a group of local volunteers who have a view of waterways and can confirm problems that have been called into the Coast Guard. She digitized information from the pages of the Command Center's three-ring binder and turned these into a geospatial layer for map display. If the Coast Guard receives a distress call, the user sees the location on a map along with contact information about the nearest volunteer to call and get visual verification.



Beth Timmons is a GIS volunteer for the US Coast Guard. District 13 needed to identify its personnel in the event of an emergency, so Timmons digitized information from the Command Center's three-ring binders.

Other key projects Timmons has created are a geoenabled PDF of tribal fishing zones and a Coast Guard Auxiliary personnel locator; the latter is used should members be in a disaster area and need assistance. She also mapped accidents and fatalities in inland lakes and waterways to show Coast Guard personnel the most dangerous locations. Her crab trap project convinced people not to lower traps into the shipping lane. Traps get caught in propellers and rudders and jam steering mechanisms. Overlaying a nautical chart with Oregon Department of Fish and Wildlife data, she created a map that shows that the best crabbing spots are actually outside the channel.

The benefits to the Coast Guard staff extend far beyond the maps Timmons has produced. She has saved it money by explaining how to use its existing system to solve a problem rather than buy new technology. One of her roles has been to train staff members to use ArcGIS on their desktops. Her teaching process is first to create a geoenabled PDF so that staff can get accustomed to a GIS map using familiar Adobe Reader skills. Once they are comfortable, she moves them to ArcGIS Explorer or ArcReader. The next step is working with them to use GIS. Coast Guard personnel move every few years. Timmons not only trains new people who rotate into a position; she also provides stability to the organization. Moreover, the people she has trained take these skills to their next assignment. They may even become GIS evangelists at their next assignment, saying something like, "In District 13 we could just turn on this layer and do such and such."

GeoLogics, where Timmons works, also benefits from her volunteerism. "On my volunteer projects, I get to do GIS the way I want to do GIS," says Timmons. "Working on these projects has increased my GIS skills because I have had the freedom to explore other options and come up with a better way of doing something. I have learned what works and what doesn't. This makes me a better employee. I can say, 'I can do that because I have already done it for a volunteer project.' The proof of concept has already been completed."

A self-proclaimed volunteer freak, Timmons contributes to the Oregon Framework Implementation Team for Emergency Preparedness, the Region 10 Regional Response Team for Oil Spill Response, and the West Coast Regional Ocean and Coastal Data Framework for Ocean and Coastal Health. She also started a local GIS user group. A few years ago, she got together with some other GIS users at the local pizza restaurant to talk about GIS. This GIS social continues to be a regular event that gives local users an opportunity to learn from their peers, share tips and tricks, and get advice.

Timmons enjoys her natural resource GIS day job but says that it is hard to ask a job to be 100 percent fulfilling. She finds her volunteer work to be highly gratifying and encourages other professionals to get involved locally.

Timmons offered suggestions for getting started as a GIS volunteer in a local community:

- Join the US Coast Guard Auxiliary and become part of its GIS team.
- Attend a city council meeting and listen for opportunities to use GIS skills.
- Reach out to small cities that don't have a GIS and offer assistance.
- Do a simple project, such as mapping culvert locations using existing data. Create the PDF and send it to the department's manager.
- Talk with the fire department. Perhaps you can help improve its response system.
- Check in with city or county park departments. Put a department's data layers over a basemap from ArcGIS Online and give park staff a planning map to post on a wall.

"I believe everyone should volunteer at some level," Timmons says. "We can use our GIS skills to do even a tiny project, such as overlaying flood zone data on the town's topography and creating a PDF. It could make a big difference."

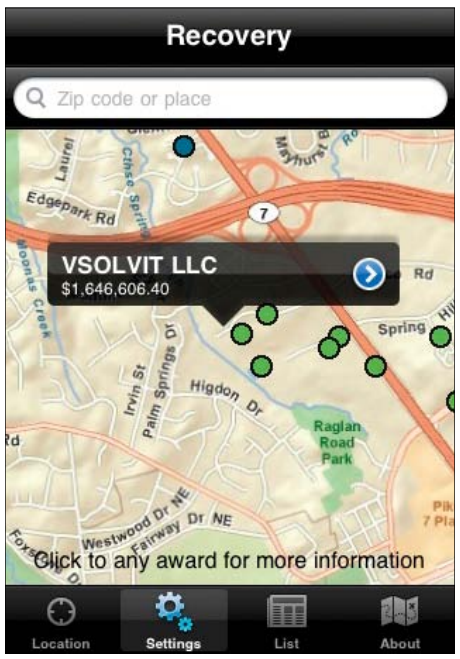
For more information, contact Beth Timmons (e-mail: beth.timmons@gmail.com).

Beyond Visualizing Spending, the Application Enables Reporting of Fraud and Waste

Mobile Application Illustrates US Recovery Projects

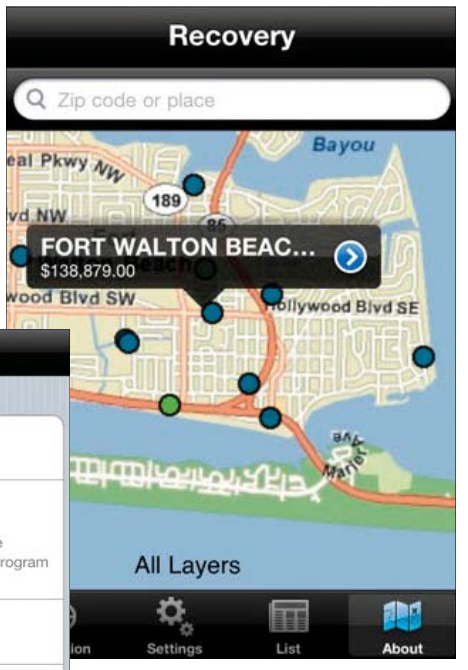
Citizens can now use their smartphones to see just how the United States government is spending stimulus funds from the American Recovery and Reinvestment Act of 2009 (ARRA). Shortly after the act passed, the Recovery Accountability and Transparency Board launched a web application based on Esri technology that enables the public to track the $276 billion being spent on contracts, grants, and loans throughout the country. In late 2011, the board released a mobile version of the application for iPhone and iPad that offers the same functionality on the go.

"We felt that in order to do what we do, which is ensure transparency and accountability," says Edward Pound, director of communications for the Recovery Accountability and Transparency Board, "we have to stay current and keep up with the ways people are accessing information and communicating. You can really get to a lot of information from the app. It's very easy for anyone to use."



Anyone can download a free application from the Apple App Store to an iPhone or iPad to see how ARRA funds are being spent.

The mobile application launches with a view from the user's GPS location to provide an immediate view of projects in the area. Users may also search for projects by entering a specific location. By touching a colored dot on the map—green for contracts, blue for grants, or pink for loans—users can access project details, including the amount of the award and the jobs funded. They can also send feedback on projects, along with an image, or use the application to report fraud or waste related to recovery funds.



Award details are provided for each selected project location, and citizens can send feedback or report misuse of funds directly from the application.

In February, the application was named the 2011 Government Mobile App of the Year by the Government Technology Research Alliance at its GOVTek Awards gala in Washington, DC. The awards recognize government and industry IT leaders whose work improves the way government delivers services, interacts with citizens, shares information, and protects national assets.

"While all the nominees were worthy of the recognition," says Parham Eftekhari, director of research at the Government Technology Research Alliance, "we felt that the Recovery app was one of the best examples of how mobile technology can be used by the government to provide transparency and communicate with citizens by sharing data in an app that is easy to use and understand."

The custom application is available free through the Apple App Store at **store.apple.com**. Search for "Recovery.gov" to find the application. To view the board's mapping application online, visit **www.recovery.gov** and select Where is the money going? Anyone can download the free application from the Apple App Store and use it on an iPhone or iPad to see how ARRA funds are being spent.

Keynote Highlights How Geospatial Analysis Is Transforming Global Challenges

US Ambassador Betty King Addresses GIS for UN Conference

More than 200 attendees from the United Nations, academic fields, nongovernmental organizations, and the private sector participated in the GIS for the United Nations and the International Community Conference held in Geneva, Switzerland, April 3–5, 2012, at the World Meteorological Organization headquarters. The conference opened with a keynote from Ambassador Betty E. King, the United States' permanent representative to the United Nations Offices in Geneva. King spoke on the role of technology and information as a transformative tool empowering local actors to address global challenges and development opportunities.

"On behalf of the US government and President Obama, I applaud your use of technology in your work," stated King. "The world's current resources are insufficient to address all the major global development and humanitarian crises that we face. Through the use of science and technology, including innovative uses of GIS applications, we can become more effective and efficient in this endeavor and stretch the power of limited resources."

Ambassador Betty King presenting at the Geographic Information Systems (GIS) for the United Nations and the International Community Conference. (Photo credit: US Mission/Eric Bridiers)

The United Nations (UN) Institute for Training and Research's (UNITAR) Operational Satellite Applications Programme (UNOSAT) and Esri organized the conference to demonstrate and discuss the role of GIS in global challenges. Attendees gathered to discuss how GIS can provide the analytic knowledge required to make better decisions on issues that are critical for the planet.

The aim of the conference was to bring together experts from the United Nations and other international and nongovernmental organizations, government agencies, and the private sector. During breakout sessions, panel discussions, and networking opportunities, they learned how to best apply geographic information science to devise better responses to regional and global challenges.

"This conference was a good opportunity to take stock of geographic information technology and its benefits for the international community at large, especially for decision makers," said Francesco Pisano, manager of UNOSAT. "The more GIS is understood and adopted, the more our work as experts in satellite analysis will be useful and relevant. I am very pleased with the partnership with Esri."

UNOSAT is a program of UNITAR that uses specialized skills to perform satellite imagery analysis, design integrated solutions in GIS and geopositioning, and develop the capacity of agencies and countries via training and technical support. UNOSAT is designed to produce concrete output for identified users and beneficiaries. It does this by turning technology into concrete and usable applications for UN agencies, member states, and communities in a variety of areas with prime focus on humanitarian affairs and relief coordination, damage and impact assessment, human security and human rights, and territorial planning and monitoring.

Attendees participated in 10 sessions focused on advancing the use of GIS and spatial analysis for the missions that humanitarian and international agencies commonly undertake. The final day of the event included a postconference workshop where attendees learned how to extend the reach of their GIS using various free resources from Esri. The workshop included presentations on implementation, resource topics, and demonstrations from Esri staff as well as a hands-on exercise showing how to get started with ArcGIS Online.

"In today's world, we face many global challenges brought on from natural and man-made events," said Jack Dangermond, Esri president. "From an office in Geneva to a refugee camp in Africa, GIS enables better collaboration and visualization and rapid dissemination of critical information when and where it's needed most. No matter the mission, geography is at the heart of a more resilient and sustainable future."

UNITAR's UNOSAT and Esri jointly organized the conference. Astrium, Esri Suisse SA, GeoEye, and TomTom sponsored the event. The conference will be held again next year and will be attended by humanitarian and development senior executives, practitioners, researchers, nonprofit consortia, and others.

To read King's address in its entirety, visit **geneva.usmission.gov/2012/04/04/gis**.

ArcGIS 10.1 Simplifies Sharing of Geographic Information

Changes the Way Users Think About Their Geospatial Content

Users are already finding that ArcGIS 10.1 makes it simpler to put mapping and geospatial analytics into the hands of more people. GIS professionals can now deliver any GIS resource as a web service. These resources include, but are not limited to, maps; spatial analysis tools; and different file types containing location data, such as shapefiles, and KML, GPX, and CSV files.

This newest release encompasses a host of improvements that will satisfy desktop, server, and mobile users, as well as provide developers with a richer, more accessible environment in which to build, test, and deploy applications and solutions.

Desktop

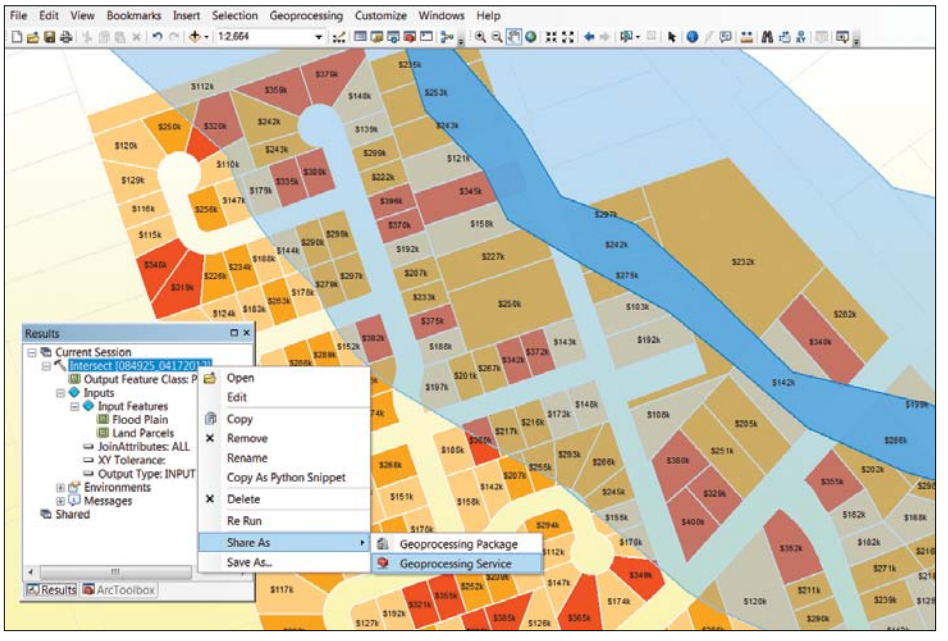
ArcGIS for Desktop has hundreds of new improvements at 10.1. Many of them make it easier to create and share content, while others improve a user's ability to clearly visualize the patterns and trends in complex data. A user can edit virtually any aspect or component of a map, including feature-level metadata. ArcGIS for Desktop also has dozens of new spatial analysis tools, such as spatial autocorrelation, which allows users to predict and explain things better.

Esri is advancing a new world of 3D GIS. One of the ways this is being done is through the integration of Esri CityEngine into ArcGIS 10.1. CityEngine provides users with a unique conceptual design and modeling solution for the efficient creation of 3D cities and buildings.

In addition, imagery is further integrated into the ArcGIS system. Enhanced tools for analyzing, creating, and editing mosaic datasets simplify all aspects of working with large collections of imagery and raster data in ArcGIS. Imagery is easier to add to ArcGIS with the introduction of raster product support that automates the setup of functions to process traditionally complex data. The imagery also looks better, with many new ways to enhance its appearance; and automated image-to-image georeferencing enables images to be easily georeferenced to each other for better analysis.

ArcGIS 10.1 directly supports lidar. Lidar Log ASCII Standard (LAS) files can be directly viewed as point clouds, surfaces, and rasters, enabling access to a wealth of information, such as ground surface information, tree canopies, or the structure of buildings and electrical lines. Users can take advantage of combining lidar with other features to perform QC of lidar data; change classifications; and view, measure, and perform analysis. Lidar can also be served directly as image services, making lidar data accessible to large numbers of users.

At 10.1, desktops are connected to servers more than ever before. A user can author a beautiful map, a model, or analytics and simply right-click and send it over to a server. The server then caches the data, tiles it, and makes it available as either feature services or visualization services. In other words, a user doesn't have to be an administrator to create services—he or she can take whatever work is done in ArcGIS for Desktop and then deploy it immediately and share it as services. This is also true for imagery.



Example of sharing a geoprocessing service from a desktop in ArcGIS 10.1.

Server

The primary engine for geospatial infrastructure is ArcGIS for Server, which allows users to turn any location-based resource into a fast, dependable service that can be used in web, desktop, and mobile applications.

At 10.1, ArcGIS for Server is completely rearchitected, making it much easier (and quicker) to install. It is now a native 64-bit application that runs on Windows and Linux. Servers can be deployed on physical, virtualized, and cloud infrastructures or any combinations of these.

Administration tools make ArcGIS for Server more versatile and secure. ArcGIS for Server has a completely new architecture that does away with the previous server object manager/server object container model. Instead, ArcGIS for Server is deployed as a "site." A site can contain one or more GIS server machines; each running ArcGIS for Server. This new architecture makes installation much easier, but more importantly, it simplifies the process of adding and configuring new GIS servers to the site. The Manager application has been redesigned to simplify remote access and provides an improved look and feel for managing services, deploying server object extensions, and monitoring server logs. Sites can be organized into clusters, which can be configured to run dedicated subsets of services. ArcGIS for Server includes an administrative API for scripting complex or repetitive tasks, including setting e-mail alerts when a service is unavailable, querying log files, or granting permissions to services.

In addition to these back-office capabilities, ArcGIS for Server includes a collection of ready-to-use services, such as the geometry service (for an expanded set of geometric calculations), the search service (for creating a searchable index of an organization's GIS content), and the print service (for configuring high-quality printing in web applications).

All editions of ArcGIS for Server (Basic, Standard, and Advanced) include the Spatial Data Server, a separate installation that allows feature-service-only access to geometries, attributes, symbols, and template information for vector data stored in a database or geodatabase.

In addition, the ArcGIS Web Adaptor, an optional setup, is included for configuring a custom URL for a site with multiple machines and integrating with an organization's web server security model.

Mobile

The world is becoming increasingly mobile, which is why Esri supports a spectrum of mobile platforms—both with open SDKs that are customizable for developers and with end-user applications that can be downloaded from app stores and marketplaces. These applications can be used to access intelligent web maps and can also be used to share data. In this way, crowdsourced information can be exploited, with every person a sensor. This will affect how people approach science, public service, and citizen engagement. It also affects people's ability to take GIS with them wherever they are and access knowledge in context.

Developer

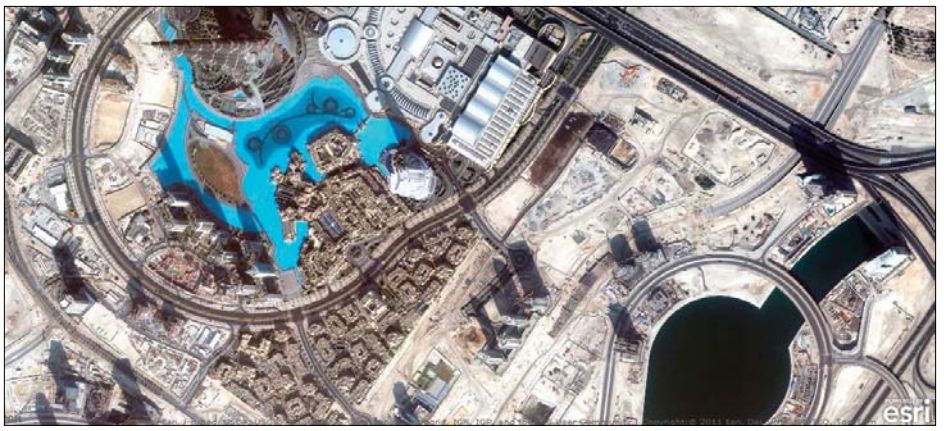
Esri continues to support multiple platforms and APIs for application development. The new ArcGIS Runtime SDK for WPF and Java allows developers to build applications that are easy to deploy and fast, plus they have a small footprint *(read "Build Dynamic Mapping Applications with ArcGIS Runtime SDK" on page 18 to learn more).* In addition, Esri now has two levels of Esri Developer Network (EDN)—Standard and Advanced. EDN Standard includes ArcGIS Runtime SDK and has optional add-ons for ArcGIS Online and ArcGIS for Desktop (Basic, Standard, or Advanced). EDN Advanced also includes ArcGIS Runtime SDK, as well as ArcGIS Online and ArcGIS for Desktop Basic, along with all ArcGIS for Desktop extensions. Developers have the option to add ArcGIS for Desktop Standard or Advanced to EDN Advanced.

Online

Underlying many of the powerful sharing capabilities in ArcGIS 10.1 is ArcGIS Online *(read "ArcGIS Online Will Change How You Think About Mapping and GIS" on page 1 to find out about this important technology that is helping carry ArcGIS into the future).*

For more information about ArcGIS 10.1, visit esri.com/whatsnew.

ArcGIS Online What's New?



GeoEye's IKONOS one-meter resolution imagery expands coverage and adds more detail to the World Imagery Map.

This regular column contains information about the latest updates to ArcGIS Online basemaps, including content contributed by the user community through the Community Maps Program, and new features and capabilities in ArcGIS Online.

Basemap Updates

Last year Esri announced the acquisition of a large set of high-resolution imagery from GeoEye IKONOS, which will add almost 50 million square kilometers of one-meter-resolution imagery to the World Imagery Map. The first updates have been released; they include expanded coverage for Korea, Nigeria, multiple countries in the Middle East, Northern Africa, and Southeast Asia. In addition, more recent and detailed imagery from the National Agricultural Imagery Program and other data sources was added for the United States and Puerto Rico from 1:36K down to 1:1K.

The World Topographic Map was updated with several contributions from the global user community, which include new and updated content for the country of Slovakia from 1:577K to 1:4K; the country of Ghana from 1:9K to 1:1K; and the state of Maryland from 1:577K to 1:18K. Content was updated for several areas in Canada, including the Northwest Territories, Ontario, and British Columbia, as well as for Alaska and other areas in the United States.

World coverage for the Ocean Basemap has been expanded to 1:577K, and the basemap now also includes the Great Lakes region of North America down to 1:72K. Originally released in June 2011, the Ocean Basemap is now being used by many ocean GIS users around the world. Due to its great success and to enrich and improve data resolution, the Ocean Basemap is now part of the Community Maps Program and open to receive bathymetric data contributions from users and organizations worldwide. If you are interested in contributing your bathymetric data, e-mail us at oceanbasemapteam@esri.com.

Esri maintains and expands the level of detail of World Topographic, World Street, and World Imagery maps through the contributions of GIS organizations around the world. Authoritative data from these organizations is contributed through the Community Maps Program, blended into one of the three basemaps that are published and hosted by Esri, and made freely available to anyone. The World Topographic Map is updated on a monthly basis, and the World Street Map is updated at least twice annually. To get the IKONOS imagery into the hands of users faster, the release schedule for the World Imagery Map has been accelerated to a monthly release schedule. For a complete list of all Community Maps updates and more details, visit the Community Maps resource center at **resources.arcgis.com/content/community-maps/about**.

For users who cannot access these online maps or need to provide these maps securely behind their organization's firewall, Data Appliance for ArcGIS is a great solution. It provides the same mapping content on a network-attached storage device that plugs right into the organization's internal network. Visit **esri.com/dataappliance** for more information.

Give Us Feedback

Users who see a problem or think something is incorrect in the World Imagery Map, World Street Map, or World Topographic Map can easily give us feedback. Enter the keyword *Feedback* in the search box on **arcgis.com** (make sure the search preference is set to Search for Maps) and follow the steps outlined under Description. All feedback is reviewed by the ArcGIS Online team and considered for inclusion in one of the future updates.

Map Viewer Improvements

New templates have been added to the map viewer. These include three configurable story map templates that provide different layout options for telling better stories with maps, and the Elevation Profile template, which includes a service that has been integrated into the template and provides the elevation data for any map used with the template. There are now a number of preconfigured templates in the template gallery users can choose from to quickly and easily embed and share their maps with others. Some templates have been retired from the gallery but are still available in the Web Application Templates group in ArcGIS Online. These can be found by entering the group name in the search box on **arcgis.com**. The search preference must be set to Search for Groups.

Users can now add a CSV or text file that contains up to 250 addresses to their web maps. Previously, addresses were not supported in the map viewer; the file needed latitude and longitude information. Now features can be added from files based on address or latitude-longitude.

Because of user feedback, the ArcGIS Online team has added the ability to set the visibility (or scale) range on an editable layer. Before, users could only set a scale range on feature layers in ArcGIS for Server map and feature services. Now they can also set the scale range on editable layers they create in the map viewer.

ArcGIS Online Is Now Localized

In addition to English, ArcGIS Online is now available in 14 languages, including Arabic, Chinese (Simplified Han), French, German, Polish, Spanish, and more. Specific content for 40 regions around the world is now also available. This includes Argentina, Belgium, Bolivia, Iraq, Ireland, Kenya, Morocco, the Netherlands, New Zealand, Russia, South Korea, and many other regions. The language users see when signing in to ArcGIS Online will automatically be presented based on the browser/machine language settings. Users can switch to the language of their choice simply by changing those settings. Regional content, such as featured maps and applications, also becomes visible after signing in and updating an ArcGIS Online account profile with a region preference. Once users have updated their profile, the ArcGIS Online home page and gallery will be updated with content for the preferred region, and the map viewer basemap will default to a country-specific basemap extent as a starting point for authoring new web maps. The ArcGIS Online team worked with Esri's international distributors to identify and feature numerous maps and applications for each region and will be adding support for more languages and content for different regions in upcoming releases. For a complete list of all supported languages and regions, visit Help on **arcgis.com** and go to "Getting started: Setting language and region" in the table of contents.

To start using ArcGIS Online basemaps, content, and capabilities, visit **arcgis.com**. For more details on what's new, go to Help.

Organizations Can Purchase ArcGIS Online Subscriptions and Immediately Unlock Their Geospatial Content

ArcGIS Online Will Change How You Think About Mapping and GIS

continued from cover

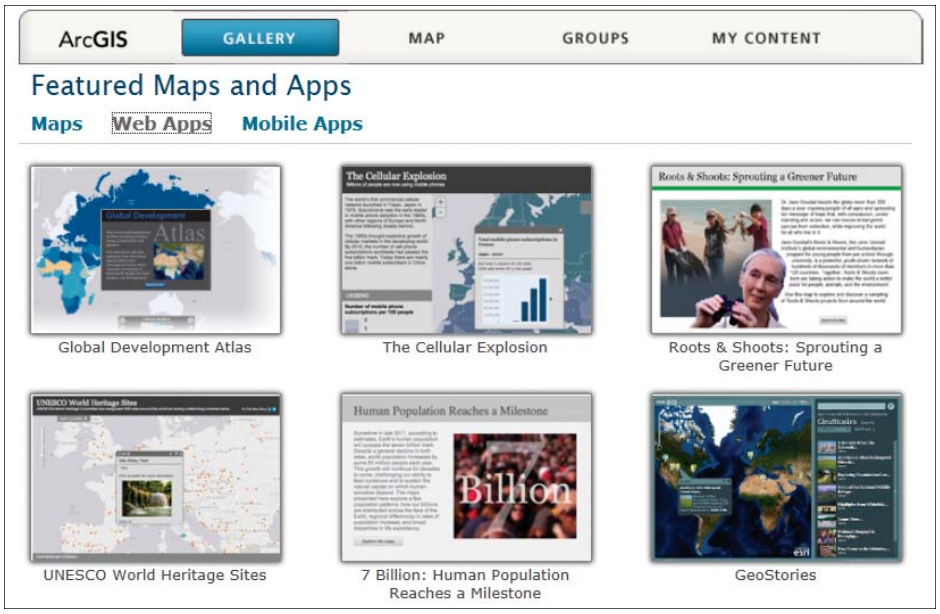
Highlights

- GIS professionals can now easily make their maps accessible to others in the organization.
- Organizations can customize their home pages to represent their brand and identity.
- A flexible, annual subscription plan can accommodate organizations or departments of different sizes.

Users can catalog and discover maps and applications; set up groups to collaborate; and share items with each other, the entire organization, or publicly. For example, without any programming, any user that's part of an ArcGIS Online organizational account can quickly share maps by embedding them in a website or blog, through social media, or by using a preconfigured web application template.

ArcGIS Online is a totally new technology for mapping and GIS. It provides existing GIS users with a cloud-based content management system for maps, applications, and data. At the same time, it empowers organizations by providing easy access to their authoritative content using web and mobile applications that are easy and freely available. Early adopter organizations have realized immediate benefits by using ArcGIS Online to extend their existing GIS. Enterprise users are discovering how to easily make maps with their tabular data across their organization.

Finally, users are seeing increased collaboration among teams and departments, the ability to provide self-serve mapping, and making geospatial content accessible to anyone. These have created new insights and opportunities for organizations. ArcGIS Online is essentially changing how GIS managers and professionals think about mapping and GIS.



You can feature maps and applications in your organization's web and mobile gallery.

Integration with ArcGIS for Desktop and ArcGIS for Server

Because ArcGIS Online is integrated with ArcGIS for Desktop and ArcGIS for Server, maps created by GIS professionals can now be made accessible to others in the organization using the same system. Everyone in the organization can view and interact with these maps via a browser, smartphone, tablet, or other mobile device. Registering ArcGIS for Server services in ArcGIS Online only takes a few steps and puts the services into the hands of those who need this information to get their work done. In addition, non-GIS professionals, such as knowledge workers who have a need for GIS, now have a way to quickly create maps from the unstructured information they work with in spreadsheets and text files and share these maps with others, who can access them on any device. This type of on-demand and self-serve mapping frees up GIS professionals from having to respond to constant requests for maps and instead allows them to concentrate on making and publishing authoritative information products. An ArcGIS Online subscription also includes access to an API that developers in the organization can use to extend the system or integrate a custom solution with the ArcGIS Online system.

Flexible Subscription Options

A flexible, annual subscription plan structured to accommodate organizations or departments of different sizes is available—from a small workgroup plan to an enterprise-wide implementation. Which plan to purchase depends on the size of an organization and the online resources to be consumed. Separate subscriptions can be purchased for each department or one large subscription for the entire organization. The subscription plans start as small as 5 named users and 2,500 service credits and increase to a multidepartment plan with 1,000 users and 110,000 service credits, or even larger for an enterprise plan. Regardless of the plan an organization chooses, more users and service credits can be added to the plan at any time.

Service credits are the currency of the ArcGIS Online system. Each service credit entitles an organization to consume a set amount of ArcGIS Online services, such as storing feature services or tile services (e.g., map packages and layer packages) in Esri's cloud, and geocoding. Providing a pool of credits gives an organization a lot of flexibility to use the system that best fits its organizational workflows and other needs. Organizations that have an existing enterprise license agreement (ELA) with Esri receive an ArcGIS Online subscription as part of their agreement, with a certain number of service credits allocated and unlimited users.

Managing Your ArcGIS Online Account

There are three roles in ArcGIS Online: administrators, publishers, and users. Administrators of the ArcGIS Online subscription have the ability to publish and use content and also monitor service consumption through a dashboard. If the dashboard indicates that the service credits are at a low level, more credits can be purchased either online or by contacting Esri. Administrators also have the ability to invite and add users, remove users, assign user roles, delete content and groups, and set and manage the security policy. Publishers do not have administrative privileges but can publish and use content published by others, whereas users can only interact with and consume content. It is important to note that organizations retain all the rights and title to and interest in any content they publish in ArcGIS Online.

Administrators also have the ability to customize an organization's ArcGIS Online home page to represent the organization's brand and identity. Customization options include adding a logo and banner, creating a custom URL, and featuring maps and applications important to the organization. As a best practice, organizations should assign more than one person to be an administrator.

For organizations that didn't have the opportunity to participate in the ArcGIS Online beta program or be part of the early adopters program, a 30-day evaluation is available.

To get more details about ArcGIS Online and sign up for the evaluation, visit **esri.com/agol**.

ArcGIS Online Facilitates Effortless Data and Map Sharing

Collaboration Is Easier in Sussex County, New Jersey

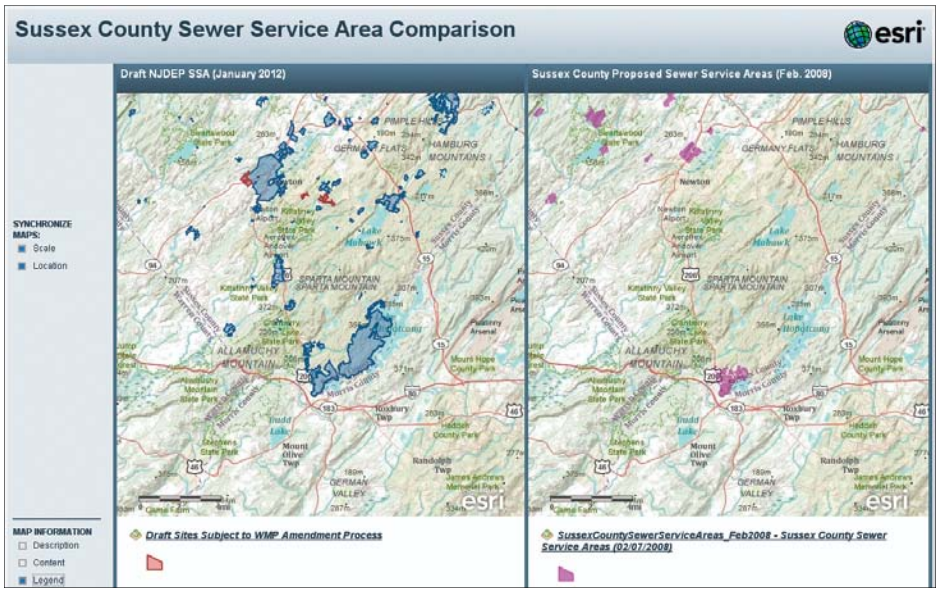
Highlights

- ArcGIS Online is a cloud-based, collaborative content management system for maps, applications, data, and other geographic information.
- The county is hosting a map of its common places in Esri's cloud.
- Departments throughout the county are using ArcGIS Online to communicate with each other.

Sussex County, New Jersey, in the northwest corner of the state, is a rural place with 40 miles of the Appalachian Trail, 80 lakes and streams, and historic one-room schoolhouses. Though its character is unique, the county is like most across the United States in its desire to improve communication inside the organization and with partners and citizens.

Historically, when a county division, such as engineering, wanted to make citizens aware of activities (e.g., road or bridge closures), someone in the division would request a map from the GIS department. Then a PDF of a map, which was often outdated soon after it was created, would be posted on the county website—standard operating procedure for many governments.

When GIS manager David Kunz discovered he could use ArcGIS Online to post current, dynamic maps with information like bridge closures, he began taking advantage of the technology to improve workflows.



The Sewer Service Area (SSA) application shows proposed areas in 2008 (right) compared with proposed and existing SSAs in January 2012.

"ArcGIS Online provides us with an easy-to-use way to distribute our data out to the public," says Kunz. "They are able to view applications, like our polling place app and the bridge and road closures, so they're able to access information in a way that's easy to understand, up-to-date, and available 24/7."

To create the bridge and road closure application, the GIS department provided a simple database where the engineering staff could input a bridge identifier and status (open or closed, and reason for closure). As information changes, the map service that is published in ArcGIS Online is automatically updated. Adding this feature service to a basemap gives the Board of Elections an internally editable map it can share with the public.

"We wanted to develop tools that allow staff to work independently so they can manage their own GIS data," says Kunz. "Now they don't have to wait for the GIS department to create maps for them—it's automatic."

In addition to improving the speed with which they post geographic information online, departments throughout the county are using ArcGIS Online to communicate with each other. A private group gives them a place to collaborate. Instead of sending data and maps back and forth, group members can share real-time data and comment through the ArcGIS Online group.

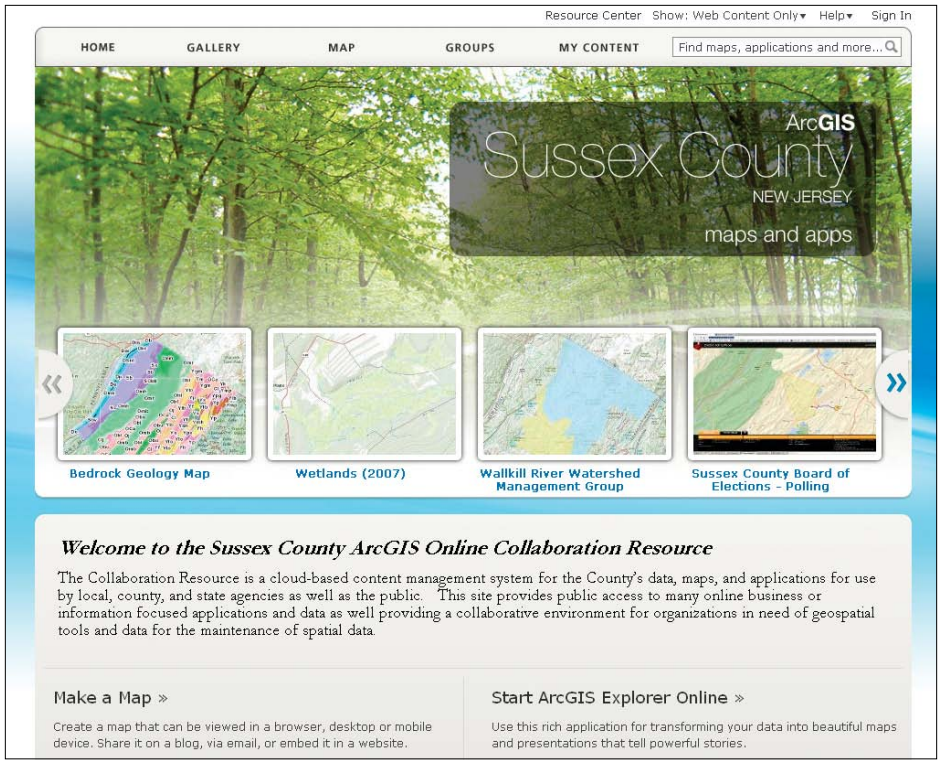
"The use of the ArcGIS technology has afforded the county the opportunity to more quickly and effectively address both ongoing and emerging constituent issues," says John Eskilson, county administrator. "The emergency road and bridge closure mapping during Hurricane Irene is a perfect example of how the technology can be used to better communicate with the public. A second but no less important benefit has been to allow ease of access and sharing of data among the many county departments and divisions, saving time and ensuring the common data is used to address issues that cut across departmental boundaries."

Creating Mapping Power

ArcGIS Online is a cloud-based, collaborative content management system for maps, applications, data, and other geographic information. Although Sussex County has GIS servers, Kunz notes that having Esri host maps and applications in the cloud benefits the county.

"We have hardware and our own private cloud," he says. "But with Esri's cloud, we now have the flexibility to choose where we want to host our content."

The county is choosing to host a map of its common places in Esri's cloud. The Sussex County 911 Common Places and Dispatch Zone map allows public safety staff to add location



The Sussex County home page created with ArcGIS Online.

data, such as names of popular businesses, and other well-known places with a valid address.

Members of the sheriff's office and police departments had been submitting this information in Excel spreadsheets and via e-mails requesting that the GIS department geocode them. That workflow created a lag in getting the places identified on a map. When a name changed, it wasn't quickly reflected on the map; public safety staff had to request deletions or changes. Now that public safety staff members have a map on ArcGIS Online, they can update names and post new ones immediately, which is proving to be a tremendous benefit to the municipalities.

"We created a small, easy-to-use editing application built on one of the editor templates in ArcGIS Online, and now they can create or edit existing records in the database," says Kunz. "They know the data better than I do, so they can post it and verify that it's correct."

The Common Places application, which uses Esri's ArcGIS for Local Government Information Model, is generating a single authoritative source for addresses in the county. This source will be used to improve the 9-1-1 dispatch system and support a new paperless inspection application in the health department.

"An advantage of using ArcGIS Online is that it's hands off. I don't have to send data updates; I don't have to be concerned about what the data structures are," says Kunz. "I can just have my service sitting on ArcGIS Online for a department or a municipality to access when they want current data. It's not a copy; it's not a ZIP file; it's our live, current data that people can consume without having to wait for us to send it."

Changing the Way Governments Operate

The Sussex County government has long supported the GIS needs of its municipal partners, since many of them don't have GIS resources. If they do, the resources are limited. Now the county is improving the way it extends its resources to the municipalities.

For Byram Township, the county created a mapping application to show information related to dog ownership, registration, and reported problems. The county health department and public safety staff will also be able to use the application to understand incidents, such as dog bites.

As the Division of Planning updates sewer service areas, municipalities provide critical input. Effectively sharing information on where there is existing infrastructure and the potential for infrastructure in the future is core to the project.

"ArcGIS Online facilitates a good dialog between the county and municipalities in trying to finalize these boundaries," says Kunz. "In the past, we would have used hard-copy maps that would have been distributed to all the municipalities for review and comment. This year, we have one map in one place, and they can review it at their own pace. Unlike the hard-copy maps, they can zoom in to clearly identify where the boundaries should be."

When Kunz looks ahead, he sees the potential to improve data sharing up to the state level.

"A lot of the state's data comes from the counties, so the county GIS program sits in a very unique position to support the local governments, as well as provide the information we obtain from them to the state," says Kunz. "With ArcGIS Online, we are better able to serve the needs of governments at all levels."

For more information, contact David Kunz, GIS manager, County of Sussex (e-mail: dkunz@sussex.nj.us).

Download Free Application from Amazon Appstore for Android

ArcGIS for Android Now Available on Kindle Fire

Esri users can now access ArcGIS data and mapping capabilities on Amazon's popular Android tablet, Kindle Fire. In addition to Android, the ArcGIS application is also supported on iOS devices and Windows Phone. It lets users access, edit, and share maps. With this release, the free application can be downloaded directly from the Amazon Appstore for Android.

ArcGIS for Android Application

ArcGIS for Android is a native application that serves as a mobile gateway into the ArcGIS system and promotes collaboration and information sharing between users and GIS communities. The application provides an intuitive user experience for viewing rich map content, querying map layers and data, and collecting GIS features. With it, users can quickly access their own maps and data authored in ArcGIS Online, as well as collect and edit geographic information. For example, users can access the application to edit specific GIS features and attribute information while collecting field data or performing inspections in real time.

ArcGIS for Android also includes a Favorites feature to access popular maps quickly; a tool for measuring area and distance; and the ability to display data in pop-up windows that support images, charts, links, and more.

ArcGIS Runtime SDK for Android

The ArcGIS for Android application is built on Esri's ArcGIS Runtime Software Development Kit (SDK), which adds the power of the ArcGIS system to Android applications. This Java-based SDK lets developers create custom spatially enabled applications for Kindle Fire and other Android devices and is designed to use web services available from ArcGIS Online and ArcGIS for Server. It also lets users add cached basemaps, which are stored locally on the Kindle Fire or other Android device, to their maps. ArcGIS Runtime SDK for Android can be downloaded from the ArcGIS Resource Center.

Java developers and Esri Partners can use the SDK to build custom applications that work with their own published web services. The SDK includes a plug-in to the Eclipse integrated development environment that provides a set of tools, documentation, sample applications, and templates to help developers create powerful geospatial solutions that extend GIS to a wider audience. These applications can be deployed within the enterprise or to the public via the Amazon Appstore for Android and Google Play.

To learn more, visit esri.com/android. To **download** the ArcGIS application, visit the Amazon Appstore for Android or download it directly from your Kindle Fire.

Left: Browse featured content in ArcGIS Online using the ArcGIS for Android application on Kindle Fire. **Above:** Soil survey thematic map from the United States Department of Agriculture's Natural Resources Conservation Service shown here on the Kindle Fire.

Introduction to Esri's New Developer Technology for Desktop and Mobile Devices

Build Dynamic Mapping Applications with ArcGIS Runtime SDK

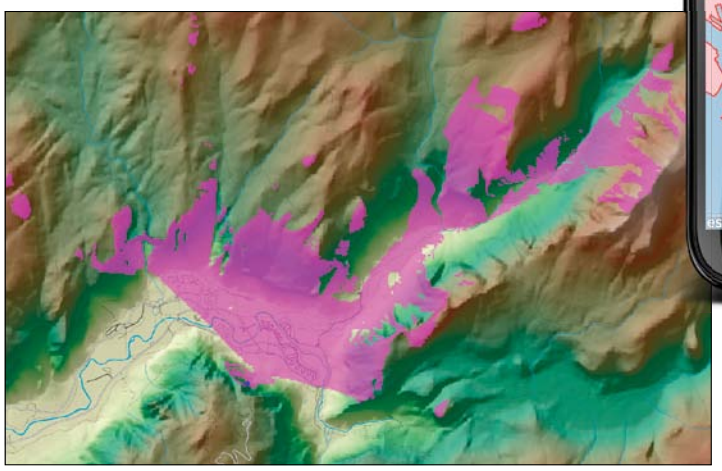
ArcGIS Runtime SDK is a new developer technology from Esri for creating powerful, lightweight GIS applications that are fast to display, are fast to deploy, and work with the entire ArcGIS system. It features a new modern architecture for developers to build focused, standalone mapping applications for both desktop and mobile devices. Software development kits (SDKs) are available from the Esri Developer Network (EDN) and make it easy to create compelling custom applications that integrate geospatial data and GIS capabilities. ArcGIS Runtime SDK is designed to support very simple deployments, as easy as plugging in a USB drive.

ArcGIS Runtime SDK on Desktop Devices

Developers can use Windows Presentation Foundation (WPF) or Java to embed dynamic mapping and geospatial applications into existing applications or custom build new ones. Users can author maps, content, and GIS functionality in ArcGIS for Desktop or publish web services that can be consumed in a custom application. An ArcGIS Runtime SDK application can be a client to ArcGIS for Server or run completely disconnected. Advanced geoprocessing, editing, and analytical capabilities can also be integrated into applications built using ArcGIS Runtime SDK.

Why Use ArcGIS Runtime SDK on Windows or Linux?

- Rapidly build GIS-enabled apps with out-of-the-box developer controls, templates, and samples.
- Navigate and display maps and data created with ArcGIS for Desktop.
- Create and edit geographic features stored in enterprise and file geodatabases.
- Perform geographic operations that leverage the power of ArcGIS geoprocessing tools.



ArcGIS Runtime for WPF lets developers build rich GIS mapping applications that take full advantage of the WPF platform.

Custom tsunami evacuation zone application built by the City and County of Honolulu using ArcGIS Runtime SDK for Android.

What Can Users Do with ArcGIS Runtime SDKs for WPF and Java?

- Create focused applications that are easy to deploy.
- Select the desired capabilities, from simple map viewing and navigation to powerful spatial analysis.
- Build touch screen applications for laptops, tablets, or in-vehicle mounted systems.
- Develop location-aware applications that use GPS.
- Create applications using local content, online content, or a combination of both.

ArcGIS Runtime SDKs for Java and WPF are now in prerelease for all current EDN subscribers, Esri Partners, and Esri Developer Summit attendees. The official 1.0 release is expected in Q3 2012.

ArcGIS Runtime SDK on Mobile Devices

ArcGIS Runtime SDK on mobile devices consists of a collection of SDKs for building and deploying custom mobile mapping applications. These SDKs are integrated with the ArcGIS system and make developing, testing, and deploying applications faster and easier. They combine geospatial data and maps into intuitive mobile applications. Users can access local data and web services in both connected and disconnected environments, collect and report data, perform GIS analysis, and take advantage of the wealth of user-contributed content from ArcGIS Online. After a custom mobile application has been created and tested, it can be distributed through various application stores, marketplaces, or private enterprise networks. Users who have been developing and deploying applications with previously released SDKs for smartphones and tablet devices are already taking advantage of ArcGIS Runtime SDK technology.

Currently, Esri supports ArcGIS Runtime SDKs on the following mobile platforms:

- ***ArcGIS Runtime SDK for iOS***—Developers can build and deploy applications for iPhone, iPod touch, and iPad. This SDK is integrated directly with Apple's Xcode integrated development environment (IDE) and uses Apple's Objective-C programming language for iOS devices.
- ***ArcGIS Runtime SDK for Android***—Developers can build Java-based mobile applications for the Android platform. This SDK includes a plug-in for the Eclipse IDE that provides a set of tools and a rich Android-specific API to help developers create custom mobile mapping applications.
- ***ArcGIS Runtime SDK for Windows Phone***—This SDK takes advantage of the Windows Phone application platform, which supports Visual Studio, Expression Blend, Silverlight, and XNA Framework.

To learn more, visit esri.com/runtime.

For Additional Information About Esri Products

Visit esri.com/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

The Power of Place in Retail

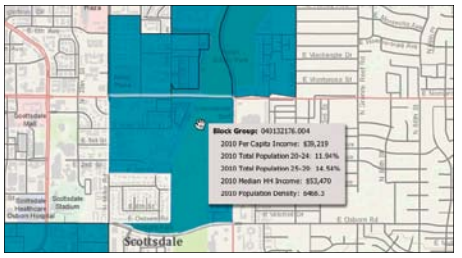
Technology and the recession have changed retailing forever. Gone is "Clonetown USA"; its repetitive retail landscape has been redesigned to engage customers on their own terms. Today, it's all about doing business locally—bringing stores to the customer rather than expecting the customer to seek out products at particular stores. More and more potential customers are using smartphones to do this.

Recent statistics have shown that more than half of shoppers consult their smartphones and other mobile devices while shopping in order to compare prices or find the best place to purchase products. If these mobile shoppers search for a store, they usually visit it, and a little more than half make a purchase. While this may seem positive, these numbers reflect a marketplace where consumers have many ways to search for a particular item. Once found, that item can be easily located at the nearest store at a price the customer is willing to pay. To make matters even more competitive, smartphone applications can provide incentives that drive customers out of one store to a competitor's site. Suddenly, all the work a store owner has done to optimize the price, quantity, and assortment mix of merchandise may be lost.

Esri Business Analyst provides location intelligence to retailers and other business owners who want to harness the power of location intelligence and put themselves back in the driver's seat when it comes to attracting customers. By merging demographic and business data, detailed maps, advanced spatial analytics, and their own data, they can make more accurate decisions about business operations, including how best to engage customers and create a more profitable marketplace.

Place Matters in Retail

Retailers are realizing that they need to keep on top of these trends, and that means place matters. Where they open their storefronts and whether they can reflect the locality in their businesses are the new normal. Many companies now differentiate merchandise assortments so they are tailored to local tastes and market potential. In today's competitive



Using Business Analyst Online helps retailers get the full picture of all the data that is crucial to making a more informed business decision, including geographic location, income, and population counts.

marketplace, every retailer understands that its bricks-and-mortar strategy has got to be about fulfilling customers' needs in every store, in every market, everywhere.

This shift to local, store-specific awareness means an explosion in the size and types of data that need to be tracked, stored, analyzed, cross-tabulated, and made sense of. Data from customer relationship management systems, loyalty programs (such as grocery store club cards), online and web marketing, local promotions, coupons, and store-level transactions all need to be collated.

That's where location analysis and Business Analyst come in. Business Analyst enables users to identify, track, and understand every customer shopping at that particular store and get actionable intelligence about why, shifting the power back to the retailer. With Business Analyst Online, retailers can access this location analysis from a smartphone. Using this technology, key demographics and market facts about any location in the United States can be accessed on an enterprise scale, from the corporate office to each retail location. The very systems that marketing managers are using to optimize the competitive landscape in corporate headquarters are now also the very ones that can enable savvy shop owners to shift their focus and understand their local customers better.

For more information, visit esri.com/ba.

Mobile Access to Market Data

The Business Analyst Online free mobile application provides smartphone or tablet access to key demographic and market facts about any US location.

This anytime, anywhere access is key for market planning and real estate professionals who are frequently out in the field.

New Enterprise Capabilities

Beginning this summer, new enterprise capabilities will be added to the application when it's combined with a subscription to the Business Analyst Online web application. Users will be able to do the following:

- Access all reports available in the web application, including reports generated using proprietary data
- Collect data on-site to share, or update corporate data, including adding attributes and photos
- Access and edit feature services in ArcGIS Online

These new capabilities make the mobile application a critical, and truly integrated, component of an enterprise Business Analyst system. For instance, while out in the field, a market planning specialist for a national retailer may see a competitor preparing to open in a new nearby strip mall. The location can be pinpointed on a map, pictures can be added, and then all can be uploaded to the corporate database, giving everyone in the company immediate access to this new data. The viability of the site under consideration could change when the new information from the field is built into predictive models of market share generated by Business Analyst.

For more information and to download the iOS or Android applications, visit esri.com/baoapp.

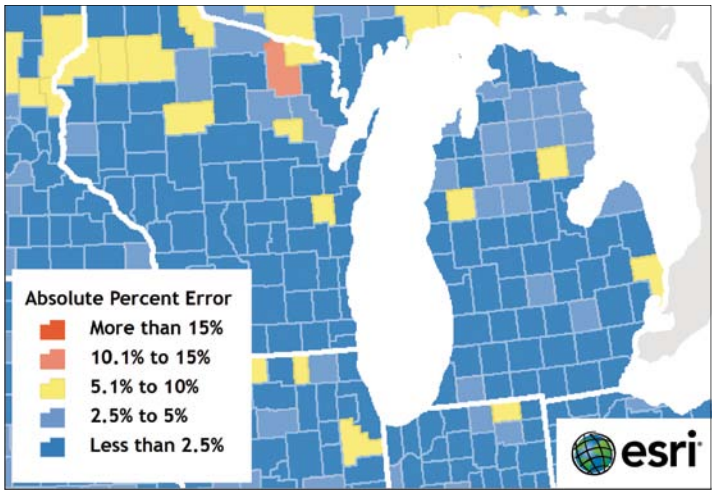
Left: Quickly pull up demographic information on any location in the United States on an Android phone or iPhone. **Above:** With the Business Analyst Online application, retailers can compare demographics of a location to county, state, and national populations.

Study Ranks Esri US Demographic Data Most Accurate

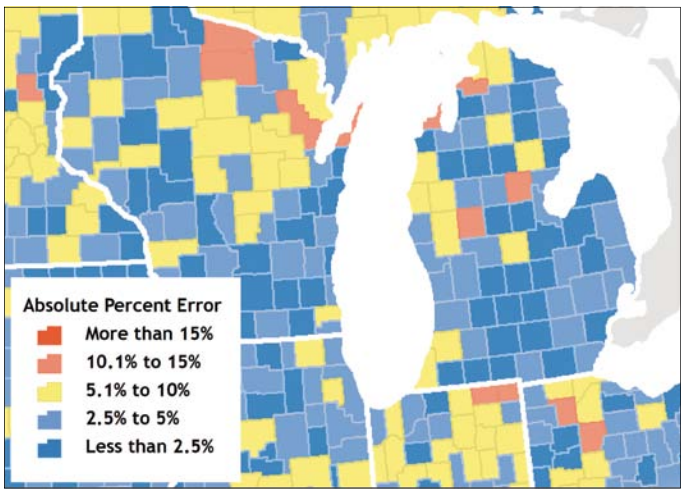
continued from cover

Highlights

- Independent, blind study by credentialed researchers ranks Esri's demographic data best among five vendors.
- Study proves that Esri's demographic update methodologies produce the industry's most accurate demographic data.
- Esri's demographic data is benchmarked to US Census 2010 results.



The researchers conducted the study for all 50 states. This map inset of data from vendor 2 (Esri) shows a less than 2.5 percent error for most counties in Michigan and Wisconsin.



Data from a leading competitor was significantly less accurate. This map inset of data from vendor 5 illustrates the percentage of error for the same areas of Michigan and Wisconsin.

Faulty population data could cause health care providers to underestimate the population and miss vaccinating vulnerable people or waste doses by overestimating numbers. Retailers that locate a new store based on overestimated population data risk losing significant revenue and market share. Local government officials could lose grant funds if poor data is used to calculate the area population. Public safety and risk management agencies could overlook special needs populations before, during, and after a disaster. Does data accuracy matter? Indeed it does—in terms of dollars, health, grants, service—or perhaps life itself.

Geography	Vendor 1	Esri	Vendor 3	Vendor 4	Vendor 5
Total US	315.9	**247.7**	276.7	295.7	304.7
State	21.4	**12.6**	17.9	19.3	29.7
County	49.2	**39.8**	52.1	46.5	55.7
Census Tract	106.6	**89.5**	93.3	106	99.6
Block Group	138.7	**105.8**	113.4	123.9	119.7

Population and household data. Lowest score reflects highest accuracy.

How Do Data Providers Verify Accuracy?

The release of each US decennial census enables data vendors to evaluate the accuracy of their annual demographic estimates, because these estimates are benchmarked against census results. Data vendors can also learn how their data compares to those of other providers. In 2011, Esri took advantage of this once-a-decade opportunity and commissioned an independent study to obtain an unbiased answer to the question of its data accuracy.

Research Team

The eminent research team of Matthew Cropper, GISP, Cropper GIS; Jerome N. McKibben, PhD, McKibben Demographic Research; David A. Swanson, PhD, University of California, Riverside; and Jeff Tayman, PhD, University of California, San Diego, conducted the study. Cropper has a broad background in GIS and demographic analysis. McKibben, Swanson, and Tayman are noted authorities on small-area forecasts and measures of forecast accuracy. They have written and presented papers extensively on these subjects.

The data was provided to the research team without identifying the individual vendors, enabling a completely blind study. The researchers had no idea which vendor data was included or which methodologies were used by the respective vendors. Esri's motivation for the study was twofold: to test the accuracy of Esri's demographic data to identify areas for improvement in its update methodologies, and to ensure that Esri is providing the most accurate data to its users.

How the Study Was Conducted

The researchers compared the total population and total households data variables from Esri and four other major data vendors. The team conducted the study for the entire United States at the state, county, census tract, and block group geographies. All the vendors, including Esri, had created their forecasts using 2000 Census geography. To analyze the accuracy of the vendor forecasts without modifying their data or compromising the original results, the 2010 Census counts were assigned to 2000 Census geography.

The research team investigated and evaluated a range of direct and supporting measures to assess vendor accuracy and reported the results as a scorecard. The scorecard was then used to measure forecast accuracy across three dimensions of accuracy—Precision, Bias, and Allocation—to obtain a total (unweighted) score. The lowest score denoted the highest accuracy.

Esri data was confirmed to be the most accurate overall.

Precision measures the percent difference between a forecast and a census count and is particularly accurate at measuring small-area forecasts. Therefore, because Precision is the best single measurement of accuracy, it is discussed in the excerpted study report located at **esri.com/accuracy**.

Esri Ranked First for Precision

The results are in: Esri ranked first for Precision among the five vendors at each geography level. Esri's estimates were also the closest to the Census 2010 results.

The researchers note in their study summary, "After reviewing the results for all quartiles at all levels of geography, it is concluded that Esri had the lowest Precision error total for both population and households. The results also show that at smaller levels of geography, which are more difficult to forecast, Esri tends to perform even better, particularly for households."

What Does This Mean to Data Users?

This study proves that Esri's demographic update methodologies produce the industry's most accurate demographic data. Users can be confident that Esri's Updated Demographics data will provide them with the best possible analysis results.

About Esri's Data Development Team

With more than a century of combined experience, Esri's data development team is composed of geographers, demographers, statisticians, economists, and programmers. This team has compiled a distinguished record of producing innovations to Esri's demographic update methodology to continually improve the accuracy of the data.

How to Access Updated Demographics Data

Esri's Updated Demographics data is available as a database in a variety of formats, including shapefile, file geodatabase, and Microsoft Excel. Updated Demographics is also available in Business Analyst Online, Community Analyst, Business Analyst Desktop, Business Analyst Server, the Business Analyst Online APIs, and the Community Analyst APIs.

To learn more about Esri's Updated Demographics data, visit **esri.com/demographicdata**.

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Using Web Maps to Tell Your Story

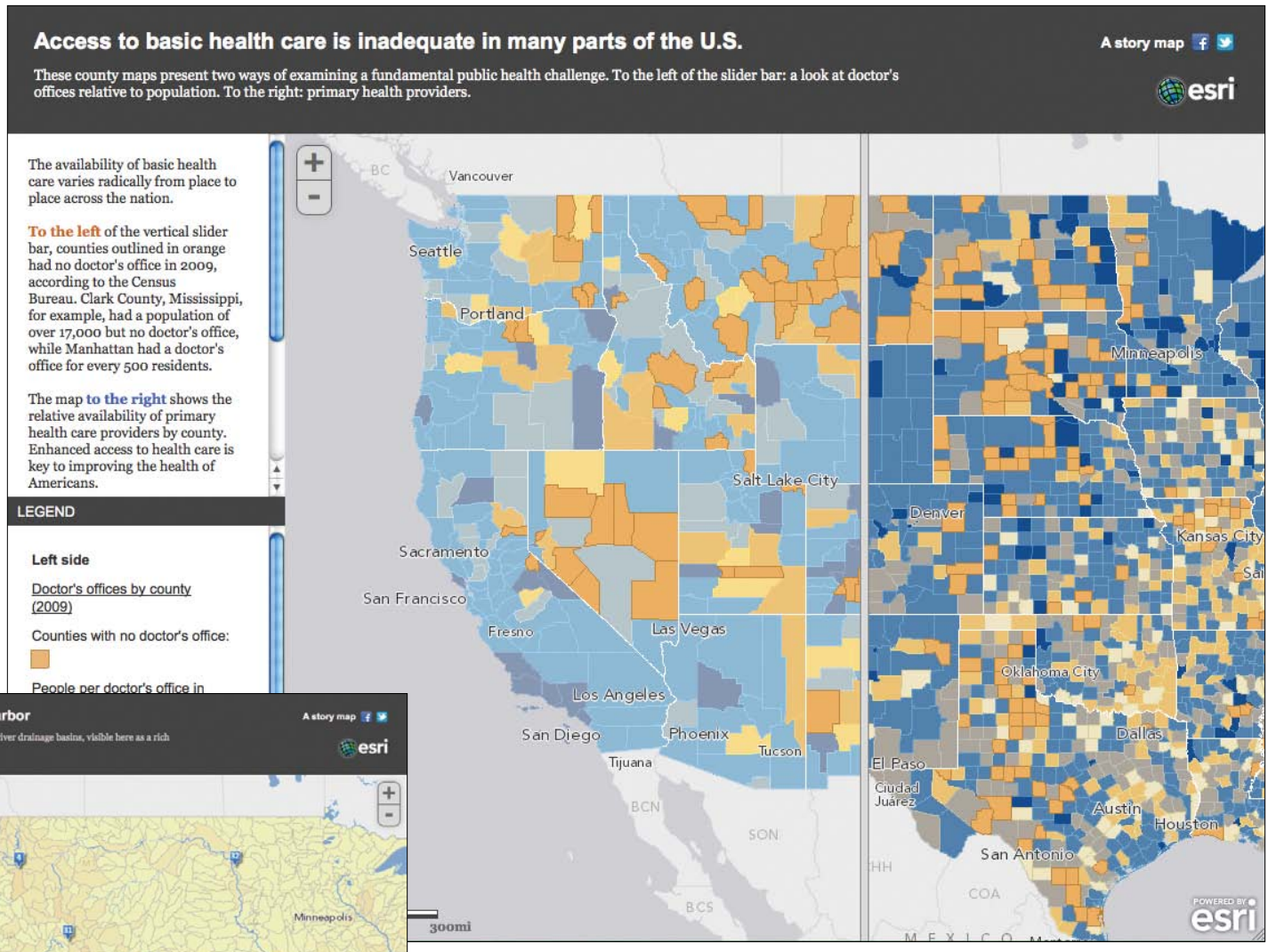
continued from cover

Highlights

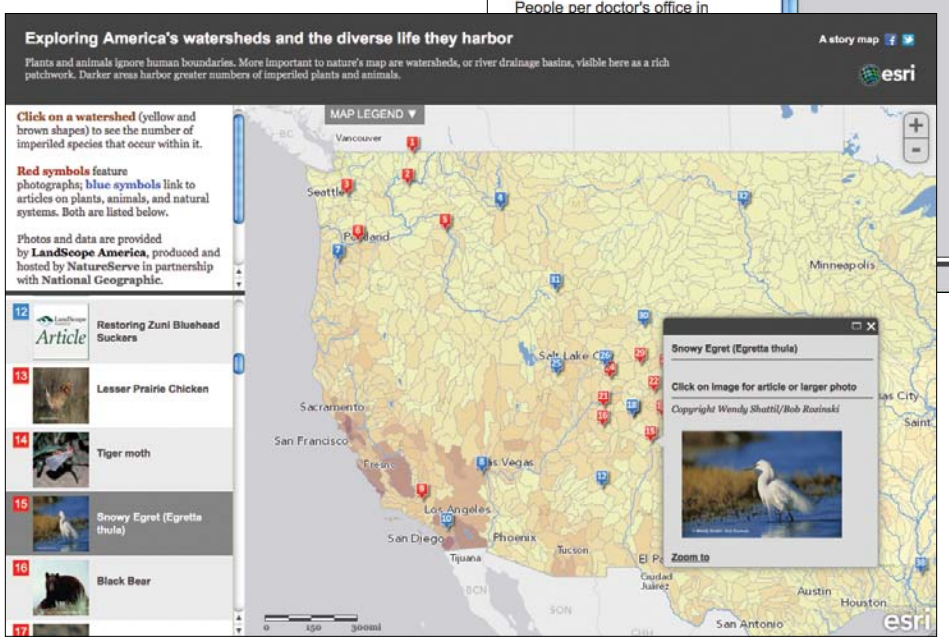
- Use ArcGIS Online to tell stories with maps.
- ArcGIS Online now includes intelligent web maps and storytelling templates.
- Geographic data once secured within organizations can now serve new audiences.

Some maps may still hang idly on walls and lurk in glove compartments, but more and more they flash and sparkle on web browsers, tablets, smartphones, and flat screens. The storytelling potential created by these exciting changes has barely been tapped.

Storytelling is rapidly becoming one of the most important reasons that organizations use GIS. A result is that GIS is emerging from the back office and becoming accessible—and useful—to everyone. Similarly, geographic data that used to be secured within organizations is being released by them to serve new audiences. The uses of GIS for analysis, planning, management, and decision support remain vitally important,



A swipe tool helps users view the distribution of health care in the United States.



Users can explore this story by clicking map icons or perusing a thumbnail list.

Thinking About Story Maps

Creating a story map requires strikingly different thought processes than many of the traditional tasks of GIS. A map that tells a story for a general audience, for instance, will likely look different from a map that shows the results of a spatial analysis.

Before assembling a story, GIS users should ask some basic questions:

- What is the story? What am I trying to communicate? A good first step is to summarize the story concept in a sentence or two. A second step might be to sketch out a storyboard that diagrams the basic elements of the story and the means by which users will access it.
- Who is the audience? What background or contextual information does my audience need to understand the story I'm telling?
- What things do I need to tell my story? Can I tell my story with a single map? Do I need two or more maps? How will I set the stage for my story with text? What sorts of additional content—graphs, charts, photos, video—will I need to tell the story?
- Does my map do its job? An effective GIS map usually isn't the same as an effective story map. Colors, symbols, and categories should be clear and simple.
- What don't I need to tell my story? The key to an effective story (and an effective map) often lies in what is omitted. Simpler is usually better.
- What parts of my story can be told visually? Introduce the story and interpret the maps using as few words as possible. Maps are powerful purveyors of information; they should do most of the talking.
- How will users navigate my story? Traditionally, stories are linear narratives. More often than not, story maps are not linear. Effective story maps usually introduce a topic within a user experience that requires little or no explanation and then enables users to explore and discover on their own.

but organizations now perceive the need to tell the story of their analyses, plans, and decisions.

Esri is exploring storytelling techniques and developing new tools to empower this new medium and to more fully enable organizations to build and publish their own map-based stories. The primary expression of this work is the story map.

What Is a Story Map?

Story maps are interactive and combined with text and other content to tell a story about the world. Typically, story maps are designed for nontechnical audiences. They include all the elements required to tell a story: web-enabled maps, text, multimedia content, and functionalities that enable users to interact with them.

Story maps can be built not only by graphic designers and journalists but also by GIS users, web developers, and anyone with a basic familiarity with web and mobile platforms. They can serve not only the general public but also other audiences, including managers, policy makers, special interest communities, and organizations.

ArcGIS Online to Tell Stories with Maps

Many map-based stories are custom produced by GIS professionals, web programmers, and other specialists who build map viewers and functionalities from scratch. Knowing that these skills are often beyond the reach of many users, Esri is facilitating storytelling by providing two key capabilities on ArcGIS Online: intelligent web maps and storytelling templates.

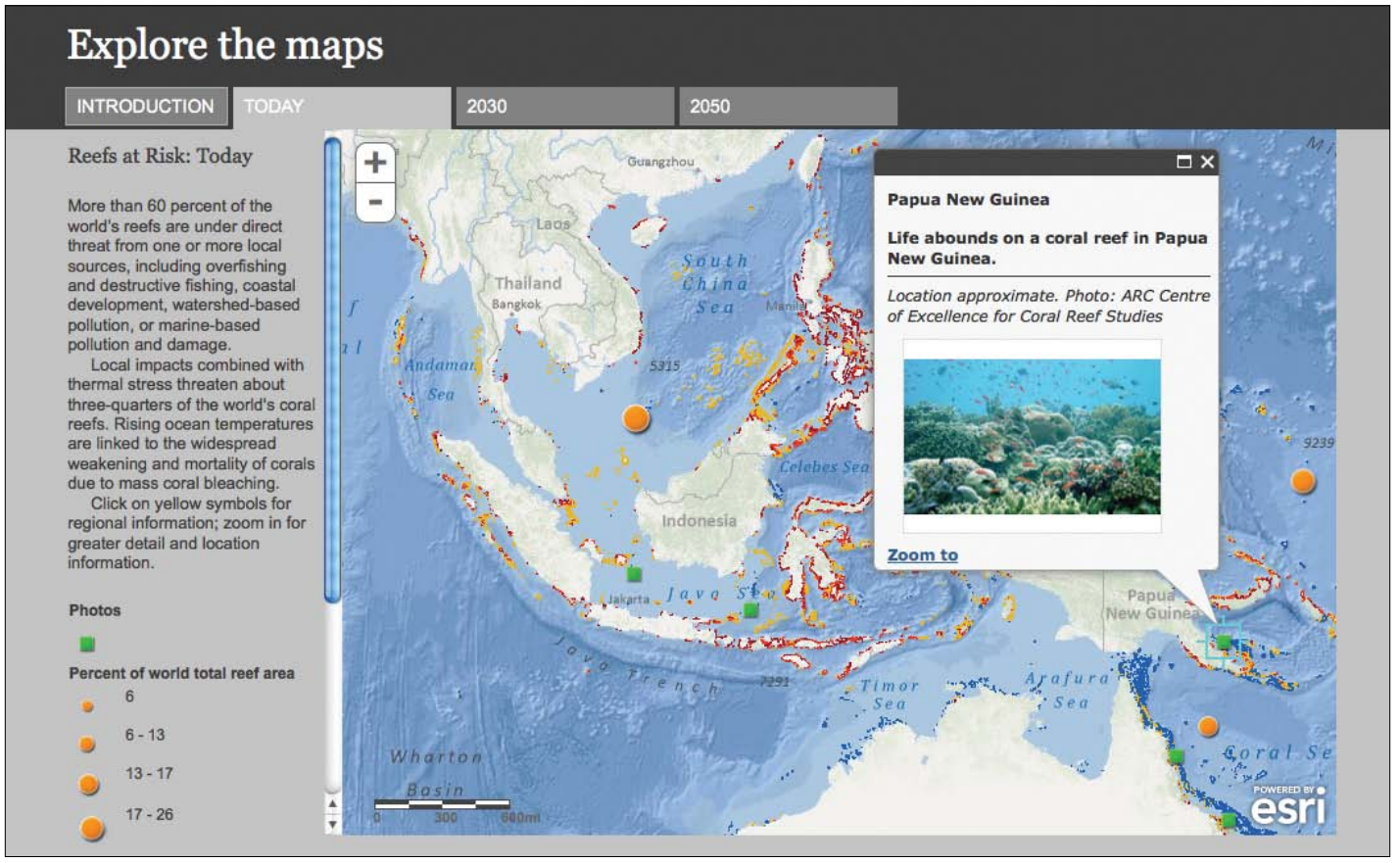
Users can build and edit web maps on ArcGIS Online from several components:

- A *basemap* is chosen from the gallery of options (including topographic, street, satellite, and reference maps) provided by ArcGIS Online. It's easy to change the basemap at any point in the process of creating a web map.
- A *web map* usually includes one or more map services. These might be chosen from among the thousands of existing services available on ArcGIS Online. Frequently, users will create a map in ArcGIS for Desktop and enable it as a map service to incorporate into a web map.
- *Tabular data* from a spreadsheet can be added to a web map. Spreadsheet data can include URL links to photos, statistical data to be visualized as charts and graphs, and text for titles and descriptions.
- *Pop-up windows* are a key component of web maps. A user's mouse click on a point or polygon spawns a pop-up window that can contain text, charts, and photos derived from elements of the map service and/or spreadsheet. ArcGIS Online allows story creators many ways to customize, or configure, these pop-up windows.
- *Title and text descriptions* accompanying web maps usually become a component of the story map.

The process of creating web maps is described in greater detail in the ArcGIS Online resource center and in a Workflows and Best Practices document available at **storymaps.esri.com**.

The web maps are then published into templates that provide the remaining key story elements, including title and subtitle and places for text and map legends, as well as functionalities for interacting with web maps. Esri has developed a series of templates to enable various kinds of storytelling, summarized below.

This process of assembling raw materials, building web maps, and publishing them into templates makes it relatively easy to create story maps without a large investment and without needing special programming skills.



Tabs provide access to maps predicting coral reef risk levels.

Esri Story Maps

Allen Carroll, former chief cartographer at National Geographic, leads a team at Esri that publishes story maps; they're viewable at **storymaps.esri.com**. Producing these stories helps Esri discover and develop storytelling techniques, tools, and best practices. More importantly, the stories have spurred development of templates and other resources with the goal of enabling thousands of people—GIS professionals, web developers, graphics specialists, and others—to build and publish their own story maps.

Kinds of Story Maps

Maps tell many kinds of stories. They can summarize a situation, trace a route, and show change over time. They can examine causes and effects and reveal interrelationships. They can help people make plans, predict or model the future, and support decisions. Different kinds of stories suggest different designs and functionalities. To that end, Esri is developing storytelling techniques and templates to support a variety of needs. Here are some examples.

Describing a place or a series of locations—Many times, a map depicts a location or region to give users a sense of its character. Combining a reference or thematic map with pop-up-enabled point features can vividly describe a place or places. A story on World Heritage sites used a basic map viewer with pop-up windows illustrating each site. See **storymaps.esri.com/worldheritage**.

A playlist viewer goes one step further by adding a browsable list of thumbnails in a panel beside the map. In the story map at *the far left,* the playlist provides previews of photos and articles depicting America's watersheds.

Explaining a geography-related topic—Many maps are made to explain something: the extent of damage from an earthquake, the number of registered voters in an area, or the pattern of vegetation in a national park. Simple but effective stories combine a web map with clickable points or polygons within a template that displays a text summary and the map legend in a side panel. For an example, see **storymaps.esri.com/wealthandpoverty**.

Comparing two or more themes—Story maps often compare and draw parallels between two or more phenomena or themes. Comparison maps can take many forms and serve many purposes. They frequently seek to explain a phenomenon or trend by comparing it to other themes that may be causes or influences on the subject being explored. The story at **storymaps.esri.com/uninsured**, for instance, relates patterns of health insurance coverage to the distribution of Hispanics and to median household income. Thematic web maps are published in a template that displays them in a series of tabs.

Another storytelling template uses a swipe tool to enable easy comparison of two themes. The template consumes a single web map with two thematic layers, exposing the layers to the left and right of the slider. The story shown on the cover compares obesity and diabetes rates (see **storymaps.esri.com/stories/doctors**).

A third alternative places two or three separate web maps next to each other. As users pan and zoom on one map, the other one moves along with it. A story at **storymaps.esri.com/diversity** uses census data to highlight the rapid increase in ethnic diversity between 2000 and 2010.

Esri has developed a thematic atlas viewer that enables users to quickly browse a dozen or more map themes. A Health in America Atlas at **atlas.esri.com/Atlas/Health_Atlas.html** enables users to click on counties to spawn informational windows displaying clear, simple bar graphs.

Showing a distribution pattern—Many maps use points, graduated circles, or polygons to represent distribution or density. Story maps can bring topics like these to life. A map depicting the hometowns of *Titanic* passengers, for instance *(see following poster)*, looks cool and dispassionate at first glance, but clicking the locations reveals passenger details that evoke human dramas of disaster and survival.

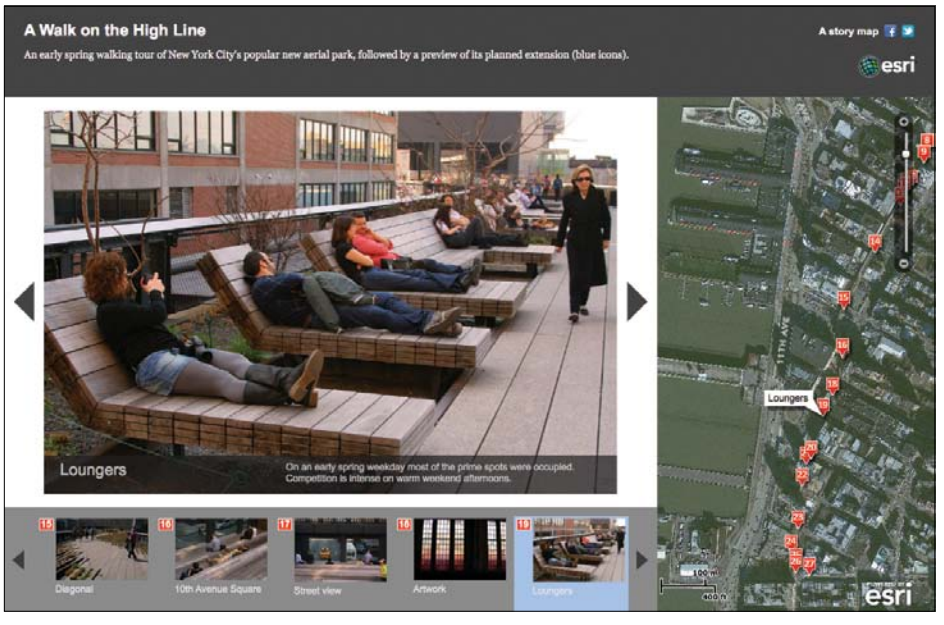
Showing change over time—Most maps represent the earth's three-dimensional surface on a two-dimensional sheet or screen. Some maps also seek to represent the fourth dimension of time. Just as maps compress space through scale, temporal maps compress time by a variety of techniques.

An example is a story featuring the rapid adoption of cell phones around the world at **storymaps.esri.com/mobilephones**. Its simplified time slider enables users to view maps in rapid sequence, simulating an animation, and to pause to more closely study individual maps.

Then-and-now pairs of images or maps can effectively reveal change over time. The story at **storymaps.esri.com/wordpress/change** provides a guided tour of locations around the globe that have changed dramatically in the last 20 years.

Forecasting the future—Stories can use similar techniques to show projected change. The World Resources Institute provided data for the above story map predicting a dire future for the world's coral reefs. It uses the tabbed theme viewer to present coral reefs today, in 2030, and in 2050.

Providing a place-based narrative—In some sense, all story maps are narratives. But some stories are best told by presenting a series of location-specific items in sequence. A story on New York City's High Line uses a format that combines a map, carousel (below) viewer, and series of photos and captions to document an early-spring walk through the park.



A narrative viewer presents a virtual walk in New York City.

Summarizing a status or situation—Many professionals in fields such as emergency response, utilities, or facilities management use maps to monitor the status of systems or help keep track of an ongoing issue or crisis. This sort of map can be informative for general audiences as well. Esri publishes situational maps that combine near real-time data, such as earthquake epicenters, with location-based social media feeds (see **esri.com/services/disaster-response/global-viewer.html**).

Enabling participation—Web and mobile applications enable users to actively participate in mapping. OpenStreetMap is perhaps the best-known example of volunteered geographic information (VGI); VGI is also a key component of more specialized maps and applications that enable users to add their own content or express their own opinions. Esri's PollMap template enables users to place votes by location and has been used to map team loyalty for sporting events like the Super Bowl. The map at **esri.com/news/maps/2012/elections/voting-persona-map/index.html** invites users to share their voting persona.

Presenting a briefing—Story maps can assist managers and policy makers in understanding issues and making decisions. Traditionally, briefing documents have been static, with maps playing a minor supporting role. Briefing documents can now do much more, with web maps providing interactivity, allowing continual updating, and enabling users to sketch and comment on maps. ArcGIS Explorer Online lets users assemble PowerPoint-style presentations featuring interactive maps. An example is a guided tour of the National Geographic basemap at **storymaps.esri.com/stories/nationalgeographic**.

Esri is developing a briefing book template that will combine a text narrative with one or more web maps. In fact, the story maps team is continuing to develop innovative ways to tap the power of maps to weave narratives. As these techniques are refined, new templates will be made available on the **storymaps.esri.com** site and ArcGIS Online. Some of these templates will be fully configurable, requiring no web programming skills. All will be available for download, enabling users to make their own modifications. Users are encouraged to develop and share their own storytelling tools as well.

As with any new medium, there is a time lag between the availability of new tools and their full and effective use. The Esri story maps team is exploring this exciting realm in hopes that thousands of people will soon be making and sharing their own story maps. In that event, society will surely benefit.

Story

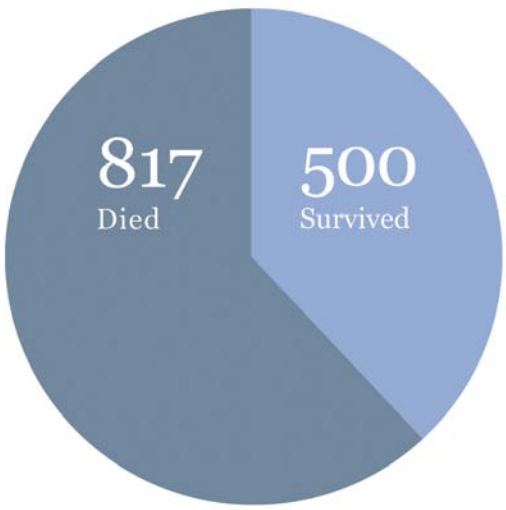
Geography, class, and fate: Passengers on the *Titanic*

A century ago, the *Titanic* collided with an iceberg in the North Atlantic and sank. Mapping travelers' hometowns reveals the immigrant status of most third-class passengers, who also suffered the highest fatality rate.

Select a class to view survival rates and hometowns

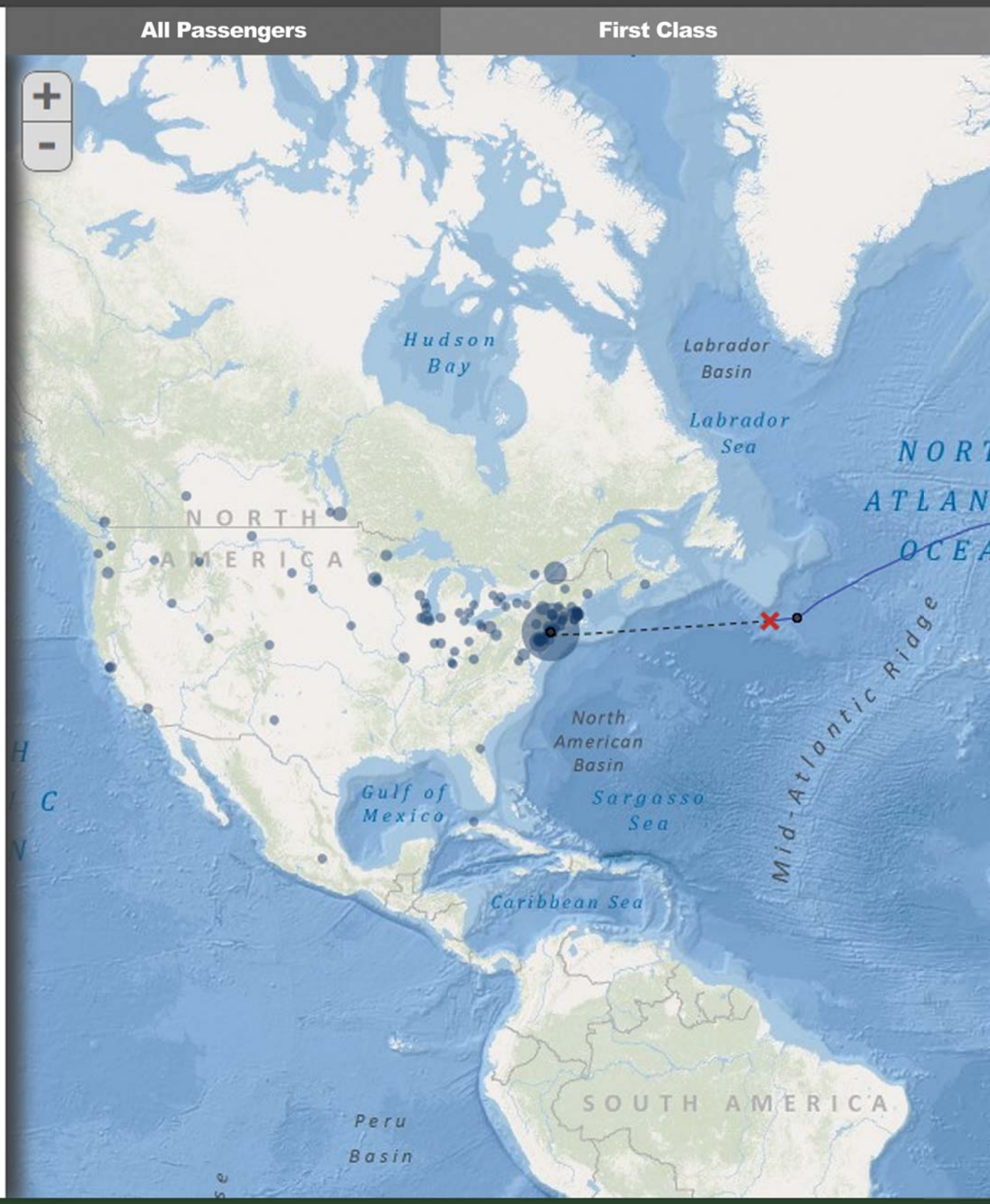
Click on locations for passenger lists and destination cities

1,317
Passengers



Totals do not include Titanic's *crew of nearly 900 people.*

Source: Wikipedia's list of *Titanic* passengers



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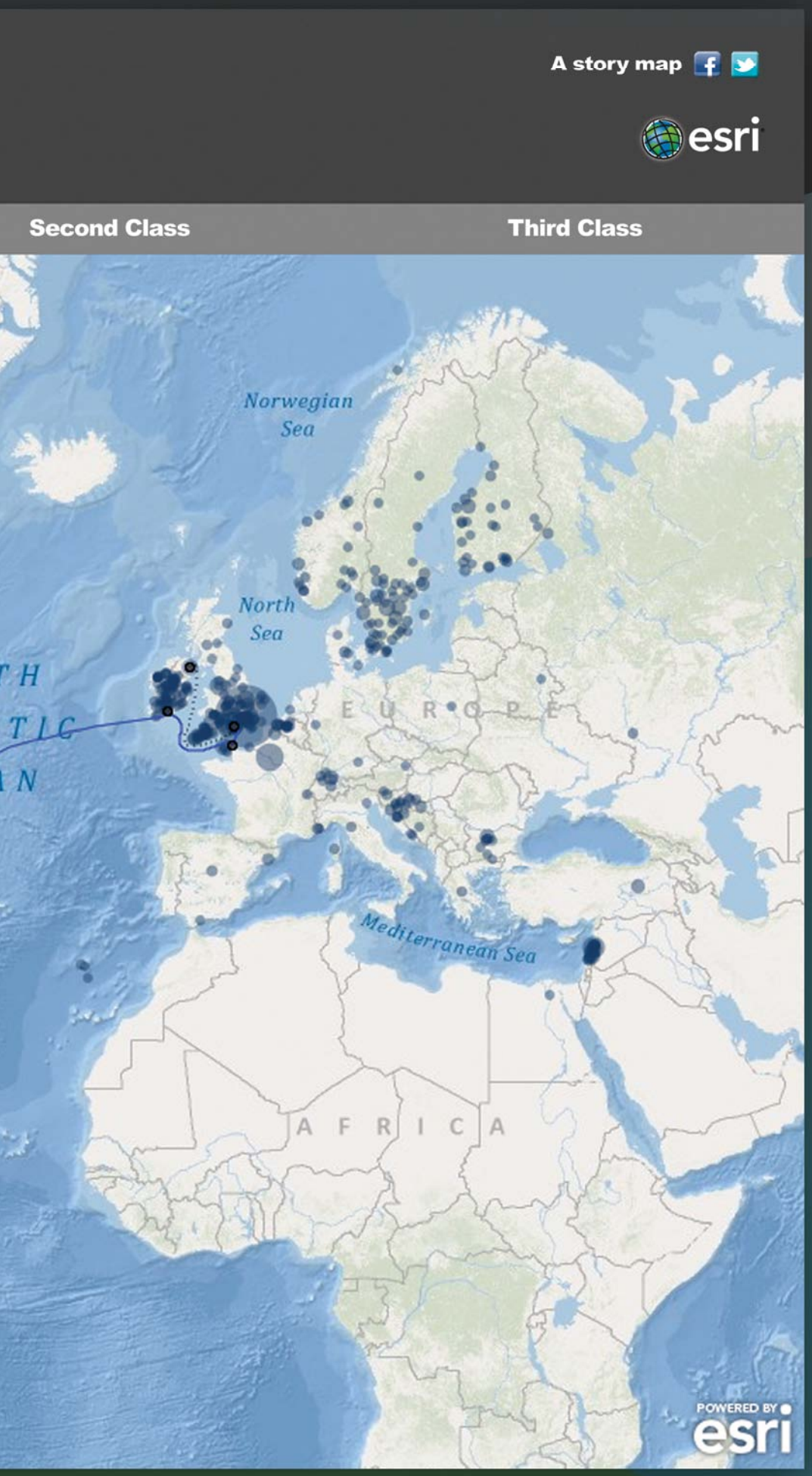

storymaps.esri.com/stories/titanic

GIS helps us understand our world . . . and tell stories about it.

Some 2,200 people were on board the *Titanic* when it struck an iceberg and sank in 1912. In 2012, the story of the *Titanic*'s passengers is told in a new way by tapping the power of ArcGIS℠ Online to build, refine, and publish intelligent maps.

Map-based storytelling enables you to serve your colleagues, customers, and constituents by combining geospatial data with text and multimedia content into compelling and intuitive user experiences.

Visit Esri's map gallery:

esri.com/mapgallery

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GIS Takes Public Prague's Development Plans

Highlights

- The web system for remark collection and processing was the only efficient way to handle the enormous number of entries.
- An online application form built with ArcGIS software allowed citizens to provide their remarks on the plan.
- The digital system made possible the collection and assessment of 16,000 public comments.

Prague, the capital of the Czech Republic, is regarded by many as one of Europe's most charming cities. While its historical center is listed on the UNESCO World Heritage List, the town itself is home to more than 1.3 million inhabitants, expanding with residential houses on the outskirts. What is needed to control the growth of this pulsating town?

City Development Authority—GIS and Mapping Hub

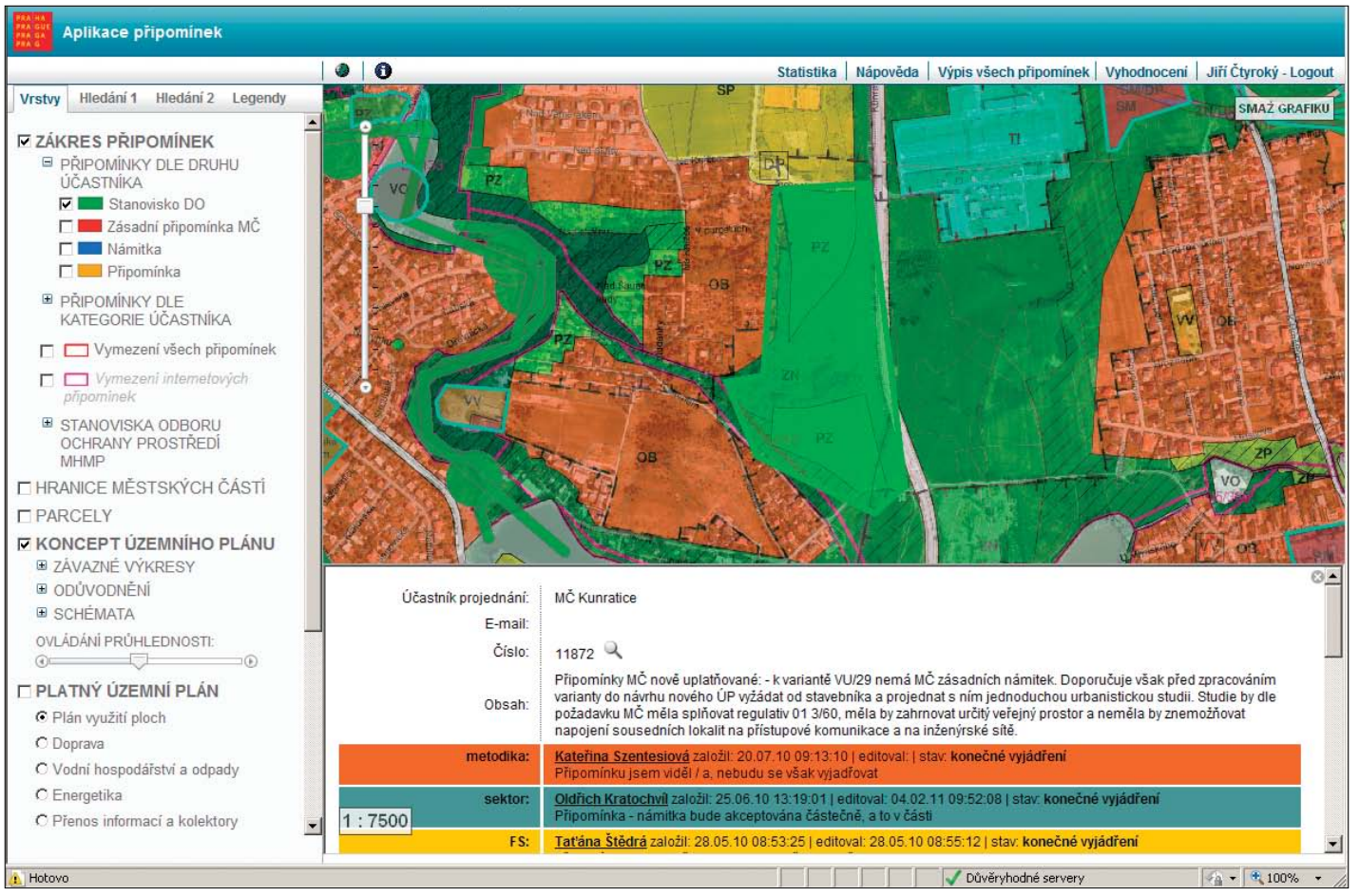
City Development Authority (Utvar rozvoje hl. m. Prahy [URM]), based in Prague, supplies professional services in development planning, as well as GIS and mapping, for the city administration. The core activities in planning are preparation and maintenance of the citywide planning documents and the analytic materials, as well as strategic planning expert services.

Supporting all activities of public government that depend on map or geographic information, URM is also the municipal center for geographic data collection, processing, administration, and distribution. URM provides a high-accuracy basemap, the Digital Map of Prague; orthoimagery; 3D modeling of the city; and a rich collection of frequently updated thematic datasets (cadastre, utilities, buffer zones, demographic data, transportation, etc.). This GIS data warehouse and these GIS services form an essential platform for all planning activities.

Development Plan for Prague

Development and building activities in the Czech Republic at the local level are regulated by development plans. The core of the development plan is the zoning and spatial regulation map, setting the binding building constraints for each zone type. The scale of Prague's zoning regulation map is 1:10,000. The currently valid development plan has its origin in the mid-1990s and, during its lifetime, has been affected by more than 2,000 minor alterations and several large-scale systemic changes. To reflect the present-day economic and social conditions, opportunities, limits, and development challenges, the municipal assembly decided to provide the new development plan at the end of 2007.

Work on the development plan for a million-resident city is a long-distance run. The guidelines for the new plan were approved in May 2008. In November 2009, a draft of the new development plan was finished for public proceedings. The plan draft, containing 26 thematic maps in scales from 1:10,000 to 1:50,000, covers an area of 500 square kilometers. The draft proposals are elaborated in variants, two for each map. The draft had been presented to the public by an extensive information campaign covering information days, a website, leaflets, announcements in newspapers or public transport areas, etc. The aim of the campaign was to raise general awareness of the development plan and the planning process and promote the unique opportunity to make remarks on and objections to the draft plan.



Users can show detailed information about the content of a remark and statements of involved planners.

Remarks and Objections Collection System

After the draft had been finished and published, the one-month period for public remarks and collection of objections took place. This period was the highlight of the draft elaboration, as everyone had a chance to express his or her opinion on the development plan content. The expectation was to collect around 10,000 remarks and objections. To address this wide spectrum of stakeholders, it was decided that the public remarks and objections would be accepted in any form—far beyond the legal requirements: mail, e-mail, and personal entry at the information office. In addition, a special web GIS application form (with interactive maps) was developed for public use. Entries into this form were geolocated and aided city staff to evaluate the results.

At the end of the collection period, 16,000 entries were collected, of which 2,500 were entered directly through the web form, the rest being via the other means of delivery. The degree to which the web form was utilized represents a clear success, considering that this was the first development plan with electronic commenting available in the Czech Republic. All the nondigital remarks and comments were then manually entered by city staff into the same application that the general public used. A PDF scan of each remark was also provided and stored in the database store.

The web entry form was built with ArcGIS API for JavaScript and the PHP application system and based on an Oracle Spatial database (geometry was stored as ST_Geometry data type). The general public could enter its remarks and objections after a simple login into the application system. When the nondigital data was entered afterward, city staff were then able to administer and evaluate this huge volume of geolocated data. Users were allowed to enter point, polyline, and polygon geometries. Registered users could access their entries (locked for further editing after confirming submission) anytime later and download them as PDF documents.

Processing and Evaluation as Web GIS Task

The full power of the application system was revealed during the sorting, study, and evaluation of the collected remarks and objections. Each record was adjusted for the sake of clarifying meaning and to validate spatial location. In many cases, the initial study requirements had to be reworded completely to better reflect the language of development plan regulation. Similar requirements were identified and grouped. Entries with multiple remarks and objections were split into separate items. Also, an overall completeness check of the database was provided—no delivered remark or objection could be missing. This process took nearly six months.

After all entries were adjusted and checked, each remark and objection was examined and assessed in terms of its relevance and how it fit the overall planning conception. The assessment was provided simultaneously from many views: urban structure, zoning regulation, transport, utilities, greenery, environmental impact, etc. This process was facilitated by another special web GIS application derived from the public commenting website. This new application had two main user interfaces: map centered and table centered.

The map interface provided a quick spatial overview of the distribution of entries within the Prague area. The application supported strong search functions (search for entries, addresses, and parcels) and contained a rich collection of basemaps and thematic datasets to concentrate all relevant decision support map materials at one place.

The table interface provided access to the records in the form of well-arranged lists. Entries could be sorted and filtered by many fields: IDs, applicants, type of entry, etc. Information detail on each entry was editable by planning experts until a final statement on how the remark or objection would be handled was negotiated. Both map and table interfaces are cross-linked.

For consequent political negotiations, the application system was enriched with PDF report generation functionality. Development plan remark and objection assessment was finished at the end of 2011.

Conclusion

The development of an application system for the collection and further processing of remarks and objections has proved to be the only feasible way to handle the enormous number of entries. ArcGIS API for JavaScript, together with PHP, provided a reliable, flexible, and easy-to-use platform. During the collection period, users recorded no critical problem with user-friendliness or general performance. The assessment period has been followed by ongoing adjustments and by extending the application functionality together with new needs and requirements of users and planning experts. The success of the project marked the way for the decision to develop a new version of the application system, which should be used in further phases of preparation of planning documentation. The expectation is to optimize the search and general system response performance and provide further improvement of the user interface.

For more information, contact Jiri Ctyroky, Spatial Information Department, Utvar rozvoje hl. m. Prahy (e-mail: ctyroky@urm.mepnet.cz, web: www.urm.cz), or Jan Soucek, ARCDATA PRAHA, s.r.o. (e-mail: jan.soucek@arcdata.cz, web: www.arcdata.cz).

Understanding Deforestation in Eastern Democratic Republic of Congo

By Fabiano Godoy, Conservation International, and Wegener Vitekere and Luc Lango, Tayna Center for Conservation Biology

Highlights

- ArcGIS is used to integrate local knowledge and science.
- GIS helps improve the management of reserves.
- ArcGIS maps the drivers of deforestation.

Created in 1998, the Tayna and Kisimba-Ikobo Nature Reserves are located in the province of North Kivu in eastern Democratic Republic of Congo (DRC). Both reserves were created and are administered by the local customary powers given to the Bamate, Batangi, Kisimba, and Ikobo traditional communities, with the intention to preserve the biologic heritage and foster social development. In 2006, after dialog with the Ministry of Environment and the Congolese Wildlife Authority, the reserves were recognized, opening a new model of community-managed conservation areas.

Together, the reserves cover an area situated between the lowlands of the Congo Basin and the highlands of the Albertine Rift. This area is noted for its globally significant biodiversity, containing more than 45 threatened species of fauna and flora recorded in the Red List by the International Union for Conservation of Nature. In addition, there are high numbers of endemic and restricted-range species, like the eastern lowland Grauer's gorilla (*Gorilla beringei beringei*), the okapi (*Okapia johnstoni*) and the African elephant (*Loxodonta africana cyclotis*). The region contains the largest remaining block of intact forest in the Congo Basin, which is at the headwaters of the Congo River and plays a crucial role regulating local and global climate and soil protection.

Despite great effort from local communities to protect the reserves, the surrounding region is under a great and imminent threat. Forest fragmentation is one of the greatest threats to the health of the environment, isolating species communities and degrading important environmental services. Local villages also rely on

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the natural resources, primarily firewood, fish, clean water, and plants for food and medicine.

Habitat destruction, mainly caused by forest conversion to agriculture and unsustainable logging, is advancing toward the reserves and jeopardizing the integrity of ecosystem services. According to the atlas produced by the Observatoire Satellital des Forêts d'Afrique Centrale, between 2005 and 2010, DRC lost 1,976,000 hectares of forest, the equivalent of about 1,000 soccer fields, per day. Local human population has grown in the same period, increasing the timber demand for housing materials and land for crops and pasture.

In response to these issues, the local communities have partnered with Conservation International to implement a project to improve human well-being while conserving the natural resources and the provision of ecosystem services. To better design strategies to mitigate the causes of forest loss, local leaders and experts are engaged in a consultation process to identify the main agents and drivers of deforestation in the region. They are also working to determine the correlation with the underlying causes and map the distribution of threats in the past (approximately 2000 to 2010) and in the future (approximately 2010 to 2020). Six major threats to the forest were identified: conversion to agriculture, conversion to pastureland, infrastructure/new settlements, mining, firewood collection, and illegal logging.

The data was compiled and analyzed by Conservation International, an organization with an Esri nonprofit organization site license agreement. Conservation International used ArcGIS to digitize the maps depicting the threat distribution, assign the severity in each polygon, and generate the cumulative threat map; such processing was done for past and future threat locations. Due to the subject nature of defining physical boundaries of threats, the limits of the cumulative threats were not the best representation of the results. The polygon-vector files were then converted to rasters and the boundaries smoothed. To generate the soft surface, random points were allocated over the study area, and the kriging interpolation tool was applied. Local knowledge was validated by comparing the past threat distribution map with the actual deforestation map generated by satellite imagery classification. The future threats maps will be used to validate the output from a deforestation model. "This approach was an excellent example of combining local knowledge and science, and the final product could be a very powerful management tool for the communities," says Susan Stone, senior director for social policy and practice at Conservation International.

Field researchers collecting biodiversity data in the nature reserves. (Photo © CI/Photo by John Martin)

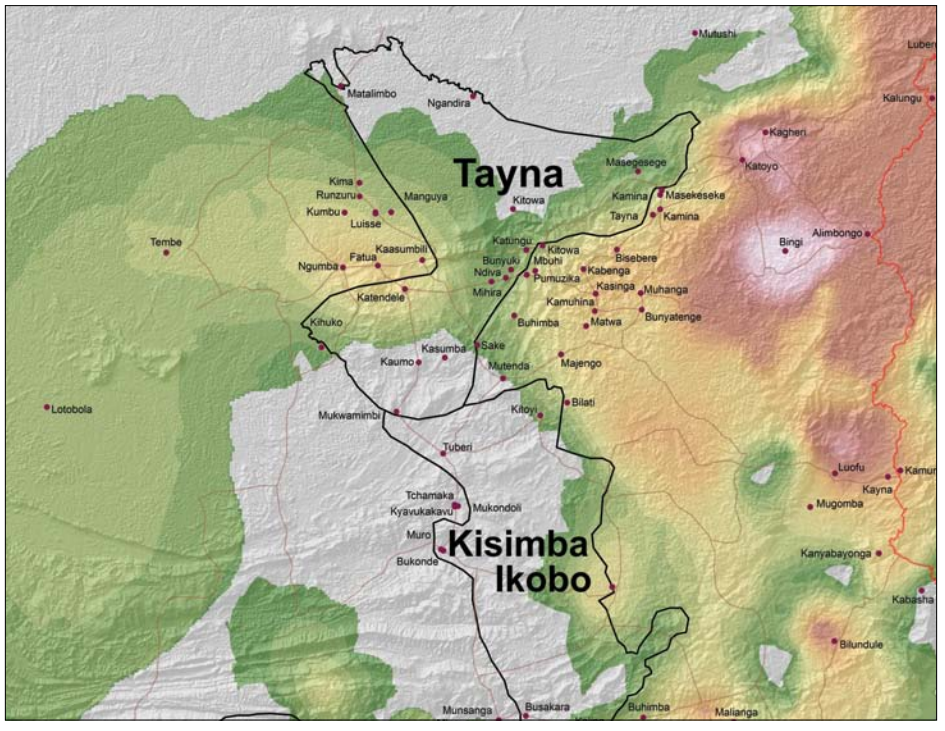
Information about biodiversity is currently being added to the GIS—for example, observations of gorilla and chimpanzee groups and nests that have been collected by the communities since 2002. This data will be used to measure the impact of mitigation activities on biodiversity. In addition, maps depicting deforested areas, critical areas for conservation, and potential areas for sustainable use are being used to raise conservation awareness in the community and among the students of the Tayna Center for Conservation Biology (TCCB). Wegener Vitekere, a lecturer at TCCB, highlights that "The GIS should not be considered only as a tool but also as a service that should be present in the management of a protected area and be beneficial to the people living in the protected areas."

Another output from the public consultation was a conceptual model that provides a comprehensive overview of the causes and illustrates the relationship between contributing factors and deforestation. Together with the threat maps, the conceptual model is being used to identify key areas to implement mitigation strategies, as well as to define expected impacts and establish a monitoring system.

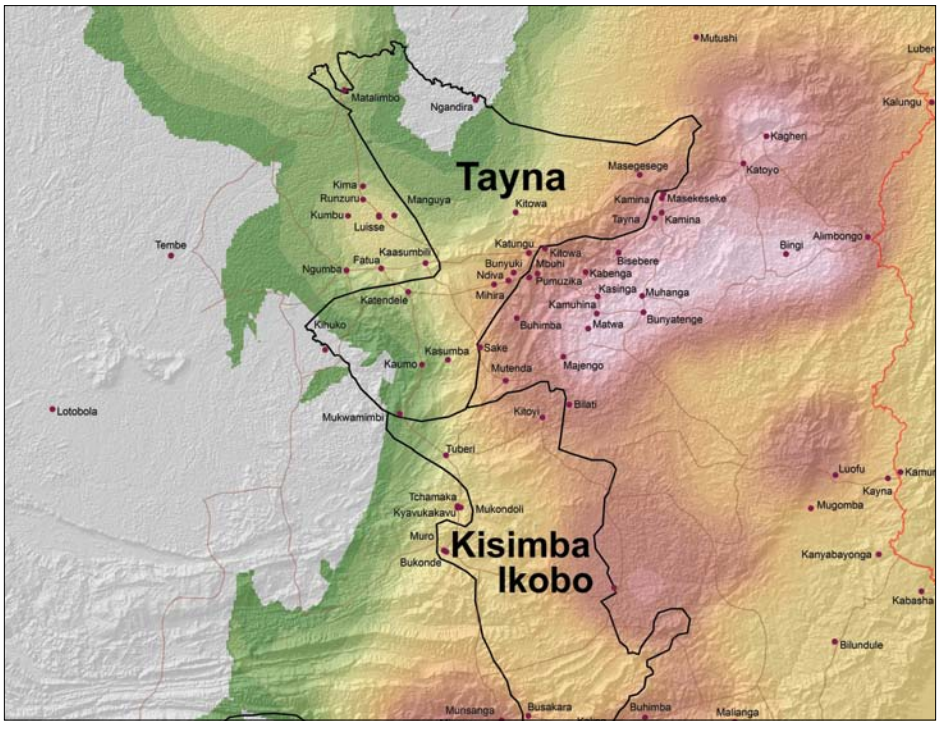
About the Authors

Fabiano Godoy is a cartographic engineer with an MSc in sustainable development and conservation biology. He has been working at Conservation International since 2006 developing deforestation models. Wegener Vitekere has been a junior lecturer and researcher at the Tayna Center for Conservation Biology since 2010. Luc Lango is from the Batangi community and since 2008 has been working as research manager at Tayna Center for Conservation Biology. He holds a BSc in ecology and animal resources management.

For more information, contact Fabiano Godoy, Science and Knowledge Department, Conservation International (e-mail: fgodoy@conservation.org).



The distribution of the major drivers of deforestation in the recent past (approximately 2000–2010) was mapped based on local knowledge and validated with the actual forest cover and change imagery.



The distribution of the major drivers of deforestation in the future (approximately 2010–2020) was estimated based on local knowledge.

Cultural Heritage Management and GIS in Petra, Jordan

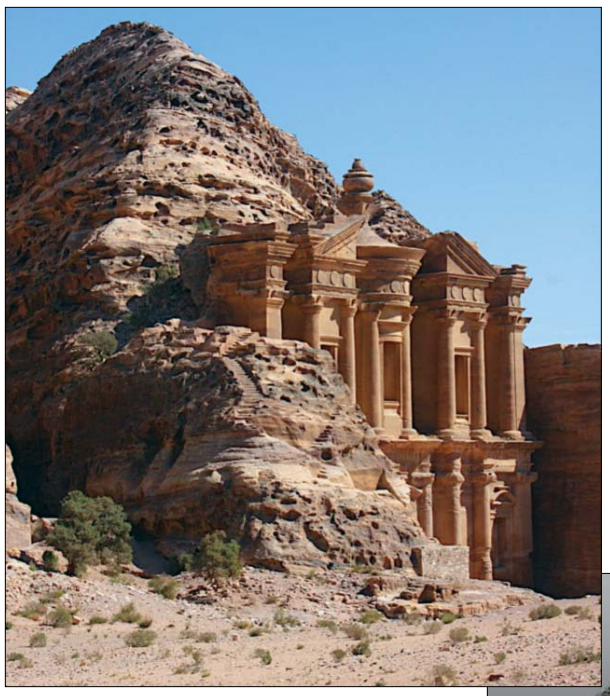
Geospatial Technology Drives Research

By Thomas R. Paradise, Department of Geosciences, University of Arkansas, and Douglas C. Comer, Principal, Cultural Site Research and Management

Highlights

- Researchers use satellite data to build a GIS database for research and management.
- Mapping in ArcGIS reveals rapid pace of deterioration from weathering and erosion.
- Data informs plans for mitigating the effects of rain runoff and tourism in the area.

The now-ruined city of Petra lies hidden in a deep valley surrounded by steep, eroded sandstone walls and winding earthquake-created gorges in the arid expanse of Jordan's great southern desert. However, it is the allure of Petra's mesmerizing rock-hewn architecture rather than its beautiful geologic setting that primarily draws tourists to the area. The brilliant craftsmanship and urban planning of Arab Nabataeans two millennia ago ensured the city's place in history. Those Nabataeans carved elaborate structures directly into the towering reddish-brown cliffs and ingeniously harvested meager rainfall to create fountains and water pleasure gardens under a sun hardly ever hidden by clouds.



Ad-Deir, or the Monastery, high above the valley—one of the largest of the hewn structures in Petra. (Photo courtesy of Thomas Paradise)

Twenty years ago, Cultural Site Research and Management (CSRM) and the University of Arkansas Department of Geosciences embarked on a project to begin understanding the accumulating effects of nature and foot traffic at Petra. Over time, researchers constructed a sophisticated system for managing, accessing, and analyzing aerial and satellite views of Petra. Through that research, the teams learned that human influence and meager rainfall have greatly increased Petra's physical decline. Remote-sensing imagery and geospatial technology have revealed the effects of commercial development and precipitation in Petra, increasing the urgency of conservation efforts there.

Gathering and Processing Imagery

The effort to construct a GIS database for use in research and management in Petra began in 1997 through the Cultural Landscape Analysis

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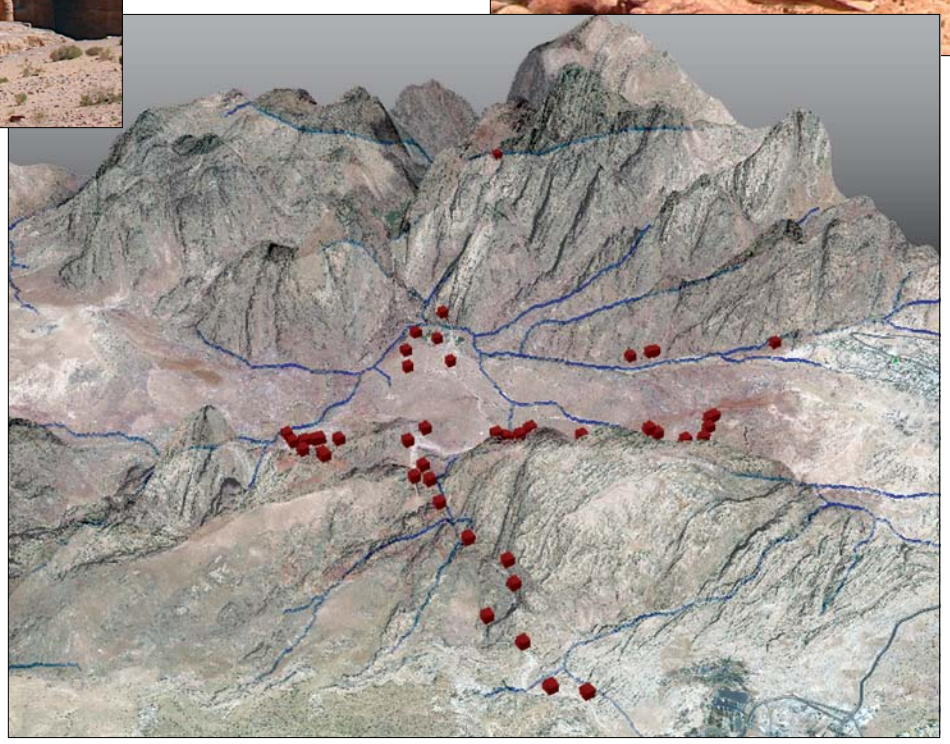
Initiative of the United States Committee for the International Council on Monuments and Sites (US/ICOMOS), with the financial support of the Kaplan Fund and software donated by the Esri Conservation Program. Researchers led by professor Talal Akasheh spent two months acquiring on-ground coordinates with early post-processing GPS equipment. These coordinates were used to rectify synthetic aperture radar imagery developed from data collected by the space shuttle *Endeavor*, declassified US Corona satellite imagery acquired during the Cold War, SPOT and Landsat imagery, and scanned versions of black-and-white aerial pairs dating to the 1950s provided by the Royal Geographical Society of Jordan. Soon after, GeoEye donated IKONOS four-band satellite imagery, and the National Aeronautics and Space Administration (NASA) provided Advanced Spaceborne Thermal Emission and Reflection Radiometer imagery, which Michael Abrams of the Jet Propulsion Laboratory (JPL)/NASA processed to create a digital elevation model (DEM).

That gold mine of satellite and DEM data formed the backbone of a dynamic and ongoing GIS program in Petra, the Petra GIS Project, which explores technology for the furtherance of preservation research at Petra. Powered by ArcGIS and the cooperation and collaboration of many organizations, the project has contributed greatly to the understanding of this fabled city. Petra's GIS functions as a model of the archaeological landscape. Beyond its conservational purpose, it aims to help researchers answer important archaeological questions, such as why the nomadic Nabataeans, who had amassed great wealth by controlling the trade in precious goods over the vast desert, decided to settle in



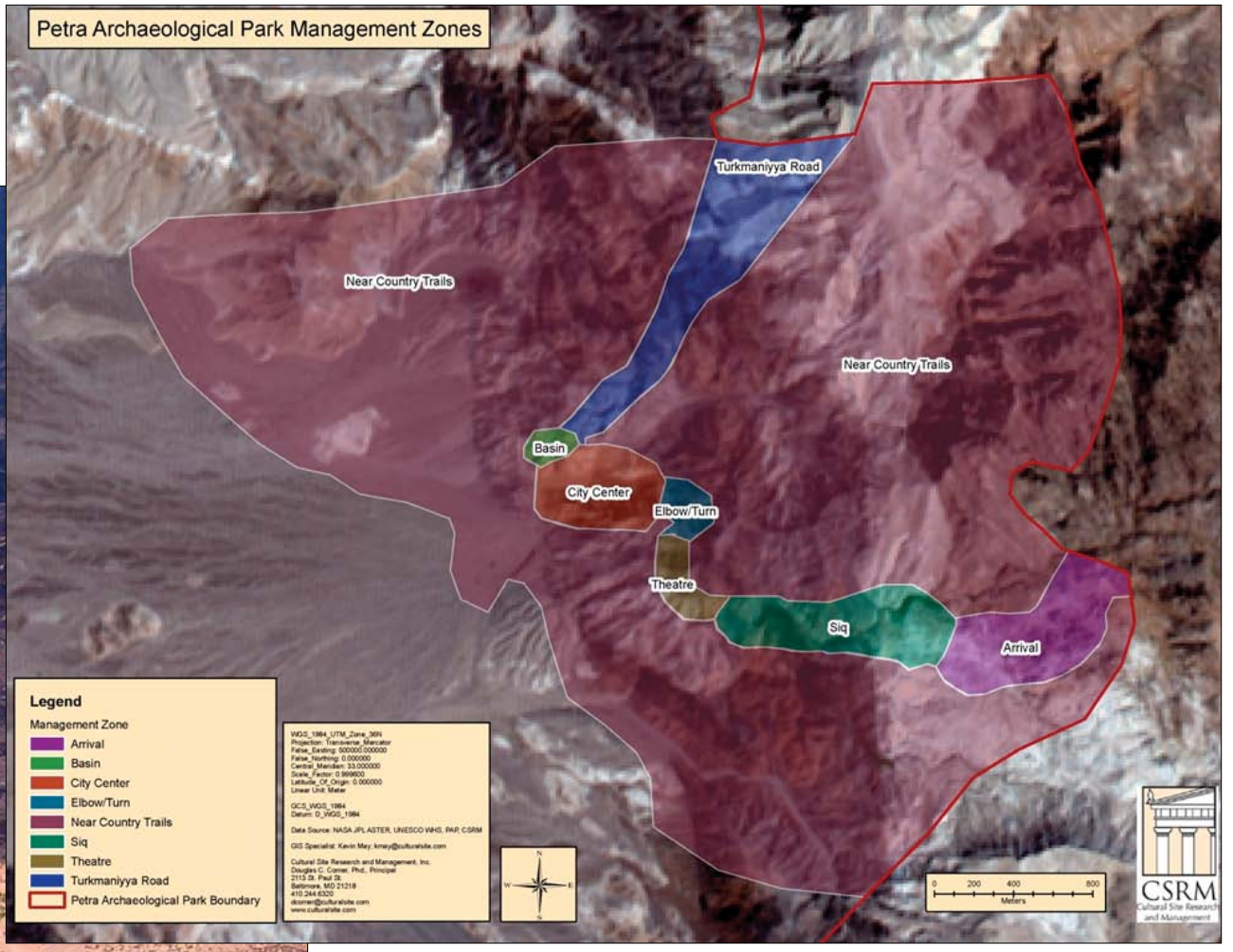
Oblique view of Petra with the Bedouin village of Umm Sayhoun (upper right) and the adjacent city of Wadi Musa (lower right). Blue lines represent ephemeral watercourses (wadis), and red cubes represent GPS markers at primary tomb facades. The map was created by Christopher C. Angel in ArcGIS (2012).

the area and build one of the most spectacular cities of the ancient world. Because of its historical and cultural significance, the model is currently being developed and applied by CSRM and a research team from the University of Arkansas Department of Geosciences to explain why the millennia-old monuments in Petra have drastically deteriorated in recent years.

GIS for Interpretation and Preservation

Field studies in Petra conducted by the University of Arkansas's Department of Geosciences over two decades originally included the assessment of sandstone weathering across Petra at Al-Khazneh (the Treasury), the "theater," Urn Tomb, and various tombs and facades. New studies have attempted to link the various aspects of this diverse landscape and have included physical components, like fungus identification, measurement, and mapping, and the assessment of climatic influences, such as rainfall, on the environment. Researchers used ArcGIS to analyze the imagery data of the Petra landscape in ways that highlighted changes in regional hydrology produced by tourism development in nearby communities. Analysis

View overlooking the carved theater, and the main roadway into the valley. (Photo courtesy of Thomas Paradise)



Petra Archaeological Park management zones in Petra.

revealed that these changes have vastly increased the pace of structural deterioration at Petra. Specifically, the construction of roads, hotels, restaurants, and other visitor amenities have created impermeable surfaces that prevent the absorption of rain runoff. During rare but intense storms, that water rushes into the canyon where the tombs are located. The water, which contains salt, is absorbed by the porous sandstone, leaving salt crystals in the structure that force sand grains apart. This cyclical process obliterates the delicate tomb facades. Development in Petra has also destroyed ancient Nabataean agricultural terracing and the barrage dams and channels that once directed water to cisterns and reservoirs that were used by the approximately 30,000 people who once inhabited the area.

Petra's GIS has also played a pivotal role as a database from which to develop management zones, such as those used in urban planning. Management zones specify the appropriate uses and conditions within a given area. GIS also provides the framework for an automated monitoring system that will eventually be used to detect changes in conditions that, left unchecked, would ultimately destroy irreplaceable archaeological remains.

Natural and Anthropogenic Influences

Across Petra, the University of Arkansas research team make use of submeter scales to investigate the effects of microclimatic variations on the development and growth of tafoni (small cave-like features found in granular rock, such as sandstone), honeycomb weathering, and the overall surface recession of Petra's tombs, structures, and monuments. Work at this scale is vital in assisting deterioration research, since weathering has the greatest influence on surface recession and the overall integrity, stability, and condition of the architectural surfaces.

Studies in Petra at the meter-to-decameter level also help researchers examine both natural influences, such as aspect and sunlight effects on recession, and anthropogenic factors. As researchers study more surfaces, monuments, facades, and structures, they spatially correlate their data to weathering features, dimensions, and deterioration rates in ArcGIS. The measurements, mapping, and assessment of these features and surfaces, though typically not thought about as being useful at this scale, increasingly have proved instrumental in evaluating the effects of the anthropogenic and natural influences on large human-made objects from antiquity.

Anthropogenic influences, such as surface recession from human contact, are now being assessed, measured, mapped, and linked within GIS. To understand the erosion and weathering of Petra from tourism alone, research teams counted visitors across the valley, noting location, time of day, and number of tourists. They compared those numbers to each day's total visitor numbers and linked them to elevation (isohypsometric) and structure (footprint, planimetric) maps of the valley. After a month of data collection and mapping tourist movement over time and space, they were able to assess who was where, when, and for how long; which paths and corridors they used; previous sites visited; and subsequent destinations and paths each day. These synoptic cartographic methods not only helped the team understand the erosive effects of tourism in Petra but also helped researchers create diurnal visitor movement models.

Spatial Data Networks

The linking of point-specific relationships to integrated spatial and temporal networks has been a crucial advancement in preserving Petra's unique setting and sustaining and protecting its cultural resources. Petra GIS is now working toward the continual development of spatial data networks from various study sites across Petra to create a broader association of factors that influence Petra's physical, cultural, and human landscapes. What began as the modeling and assessment of a sensitive architectural and archaeological site has grown into an extensive arid lands project that links various scales and influences across different sites and elevations using ArcGIS, remote-sensing imagery, and GPS technologies with the goal of better understanding and protecting a truly unique World Heritage site. Only when enough point-based data has been collected site by site, then classified, analyzed, linked, and mapped across the valley, can trends and influences be identified, links understood, and possible causes and effects comprehended. This seems the best approach to understanding desert landscapes and sandstone architecture while effectively managing one million visitors each year.

The next objective of the Petra GIS project is to acquire more lidar data to build an extremely precise surface model that will guide engineering efforts to mitigate the flooding problem at Petra and prevent further deterioration of the tombs. Further research that investigates the natural, anthropogenic, and geospatial influences on architectural decay and environmental degradation in Petra must be done before the effects become irreversible.

About the Authors

Thomas R. Paradise, PhD, professor, Department of Geosciences, and former director of the King Fahd Center for Middle East Studies, University of Arkansas, comes from a diverse background in geography and geology, architectural history, stone conservation, cultural heritage management, Middle East and North Africa geography, and cartography/GIS. His expertise in stone architectural deterioration has been requested by countries across the Mediterranean and Middle East. Douglas C. Comer, PhD, is principal for Cultural Site Research and Management, Inc., president of the CSRM Foundation, and copresident of the ICOMOS International Scientific Committee on Archaeological Heritage Management. He is the recipient of research grants from a number of organizations and agencies and has published widely on the use of aerial and satellite remote-sensing technologies in archaeology and cultural resource management.

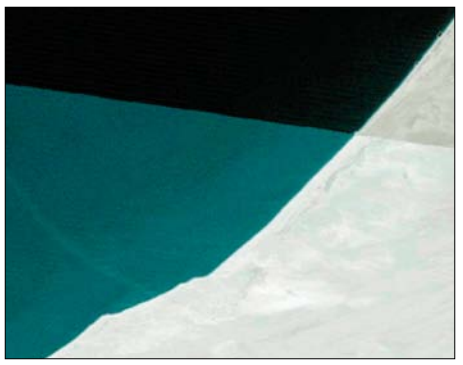
For more information, contact Thomas R. Paradise, Department of Geosciences, University of Arkansas (e-mail: trparadise@gmail.com), or Douglas Comer, principal, Cultural Site Research and Management (e-mail: dcomer@culturalsite.com).

Landsat Provides the Longest Continuous Data of Our Changing World

Happy Anniversary, Landsat!

1972 was an exciting year. The Rolling Stones were the number-one band, Bobby Fischer became the world chess champion, and the Dow Jones Industrial Average closed above 1,000 for the first time. At the US Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA), a group of forward-looking engineers and scientists were preparing to launch the first spacecraft designed to monitor and report the earth's resources through remote sensing, Landsat 1. On July 23, 1972, they successfully launched the craft.

On the 40th anniversary of the first Landsat launch, Esri would like to take a moment to reflect on the significance the Landsat program has had on global research and understanding. Landsat data remains one of the best ways to visualize and analyze earth changes because of the coverage, quality, and length of time this data has been collected. In fact, Landsat data provides the longest continuous record of earth changes as seen from space. The Landsat program provides access to the data people need to undertake serious projects that affect all of us, including environmental change mitigation and land-use planning, deforestation, natural disasters, and pollution. It is used to understand and monitor our freshwater supplies and evaluate agricultural productivity and is detailed enough to witness the effects of urban growth. In addition, Landsat data provides a window in time for young people to see how the earth around them has changed over their parents' lives and their own. This gives them a great perspective on the effect we have on nature.



Dubai, 1975.

Dubai, 2005.

The earth is constantly changing, and for the last 40 years, Landsat imagery has made it possible for people worldwide to study, question, and investigate the changes around them. 2008 marked a turning point in the use of Landsat, when Secretary of the Interior Dirk Kempthorne announced that all the Landsat data in the USGS archive would be free to the public by the end of the year. People worldwide are trying to solve complex environmental challenges, and fast and easy access to Landsat data, without fiscal constraints, has made a tremendous difference. This has opened the data usage to academic institutions, field researchers, and scientists that may not have had the ability to purchase Landsat data previously.

Congratulations, USGS and NASA, on over 40 years of successful missions! The future for Landsat looks promising, with the Landsat Data Continuity Mission in the final phases of design and fabrication and the launch scheduled for January 2013. With all the technical advances, two new spectral bands, improvements in technology and performance, and probability of capturing more cloud-free scenes, Landsat is not only getting better with age but looks better too. Happy anniversary!

Esri GPS Base Station Joins National Network

Esri recently installed a GPS base station to assist its GIS developers and support surveyors, engineers, scientists, and those in public works and public safety in the community surrounding the Esri campus in Redlands, California. The base station, named GISA, has been accepted by the National Geodetic Survey (NGS) and incorporated into the national Continuously Operating Reference Station (CORS) network.

The Esri GPS base station, GISA, is mounted to a building In Redlands, California.

NGS manages the CORS network that provides data to support 3D positioning, meteorology, space weather, and geophysical applications throughout the United States, US territories, and a few other countries. The CORS network is made up of more than 1,800 independently owned and operated stations and 200 entities, including government, academic, and private parties. As organizations such as Esri share data with NGS, NGS analyzes and distributes the data free of charge.

"GPS, originally designed as a US Department of Defense system, has become part of everyday life, with technology in all types of devices from smartphones to shipping containers," says Brent Jones, Esri surveying and engineering manager. "The Esri GPS base station is a great benefit to the community, as professionals can use it in surveying and positioning to achieve accurate locations in real time."

Mounted on an Esri-owned building in Redlands, GISA operates a Trimble NetR9, dual-frequency GPS/Global Navigation Satellite System (GNSS) receiver with a Zephyr Geodetic Model 2 antenna. GISA broadcasts real-time GPS/GNSS data on the Internet in industry-standard Radio Technical Commission for Maritime Services formats, which allows GPS users to obtain real-time centimeter positions.

"As the use of GPS and GNSS continues to grow, the demand for more precise positioning data also increases," says Kevin M. Kelly, the Esri geodesist who led the effort to establish the base station. "The transportation, surveying, engineering, and environmental communities are employing high-accuracy field units capable of receiving precise GPS and GNSS signals offering positional accuracies of one inch or better."

The City of Redlands allowed access to the Redlands Municipal Airport for testing of GISA. Allen Instruments and Supplies of Anaheim, California, performed a terrestrial laser scan of the GISA site.

GISA stores GPS and GNSS signals in data files on a secure Esri server accessible to the public via the Esri website at **gnss.esri.com**.

For more information, visit **gnss.esri.com**.

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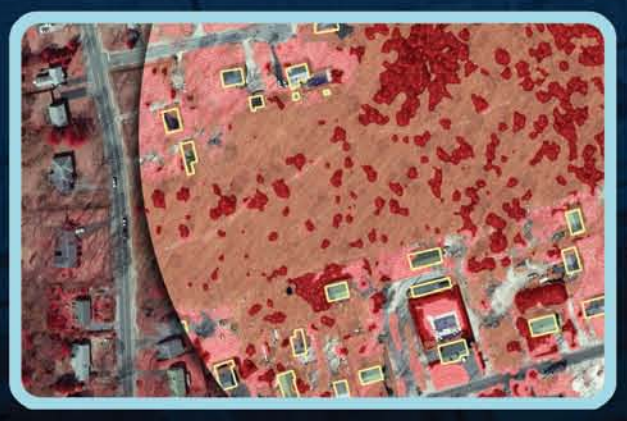

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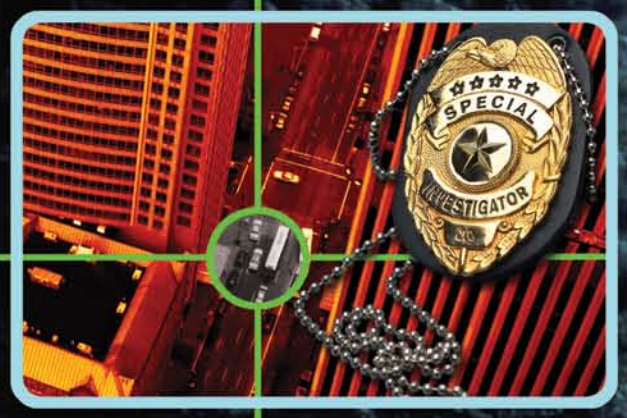

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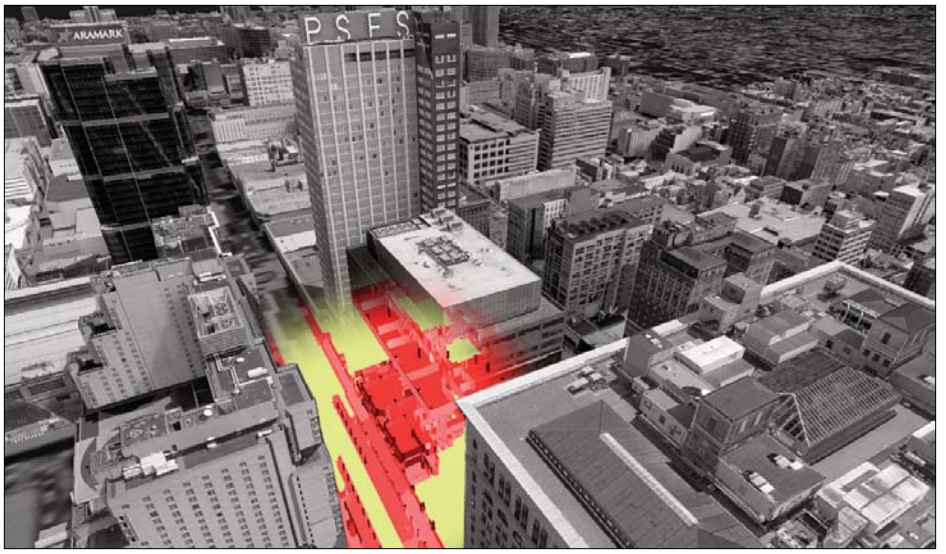
Philadelphia Uses Robotics and GIS to Map Below Market Street

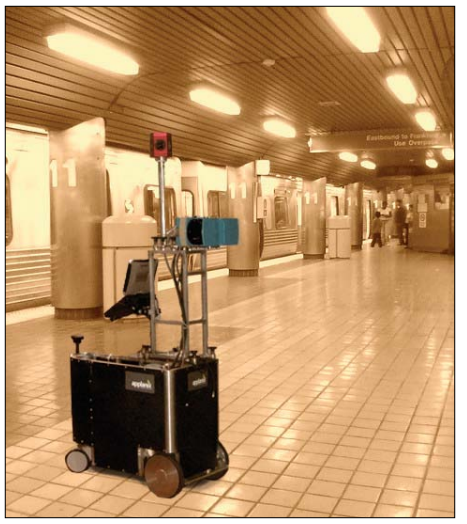
Lidar Speeds Up Mapping of Bustling Center City

Highlights

- The city needed comprehensive spatial data information to understand its public infrastructure better.
- The mix of GIS, lidar, and robotics produced a view of the infrastructure inside and out.
- Staff took 20 hours to collect all the data, a fraction of the time needed using traditional collection methods.



Using robotic lidar technology, Penbay staff created an accurate floor map of the underground infrastructure in Center City, Philadelphia, that connects several buildings along Market Street.



A Trimble TIMMS unit was used to collect data points of every object in the space that was mapped, from walls to doors to desks and chairs.

Center City in Philadelphia, Pennsylvania, is a confluence of transportation, shopping, business, and government agency activity, with several multilevel spaces (including underground) within a few blocks. The fifth-biggest city in the nation, Philadelphia also boasts the third-largest downtown population. The City of Philadelphia is committed to encouraging business and real estate development in the area and has embarked on an innovative project to build up the area while at the same time making certain the downtown area remains ready for business every day.

One important aspect of this project was that the city staff understand their building infrastructure better. They were interested in seeing the relationship between pedestrian concourses with platforms, corridors, stair locations, and ramps; ingress and egress points; emergency access and air vent facilities; and connections between levels. To effectively analyze and manage this critical public infrastructure, they needed access to accurate and comprehensive spatial data information. This included data about space, like rooms, and how it is being used; asset data, such as fire extinguishers; and other components found within the rooms. Images needed to be collected to guide anyone who needs to access the space, such as public safety officials, so they can get a real sense of what a space looks like.

PenBay Solutions, an Esri Partner headquartered in Brunswick, Maine, was contracted by the city to provide facility management mapping services for a pilot project aimed at testing the effectiveness of a total 3D GIS solution. This service included interior data collection using an innovative robotic platform employing 3D lidar. The robotic platform collected thousands of data samples as it was guided by a surveyor through the buildings. The data was precisely geolocated to a point on a high-resolution map of the interior space. This allowed staff to develop spatially accurate floor map data of the underground infrastructure that connects several notable buildings along Market Street in Philadelphia.

While the city has been a longtime user of ArcGIS, like most traditional local government GIS installations, its database did not include data for the insides of the Center City buildings or the vast building infrastructure under the streets. To maintain and grow the city effectively, staff needed a complete view of the infrastructure—both inside and out—of buildings, railways, and surrounding areas for their facilities management, public transit, public safety, space planning, and real property departments.

Understanding from the Inside Out

A site assessment and requirements validation was conducted at the client site to plan for collecting the data necessary to help the city. The

goals of this activity were to validate deliverable requirements and define data collection specifications; identify project logistical support requirements; discuss and validate project staging, access, and scheduling dependencies; and visually inspect project areas of interest.

Upon completion of the site, a detailed list of priorities, points of contact, access dependencies, and geographic proximity that allowed the creation of a project plan and schedule to capture the data was created. Center City facilities are complex and have a high volume of pedestrian traffic. Minimizing survey time and disruption was of high importance to the city. The decision was made to operate a two-person crew on-site under the control of a project manager. This plan optimized the use of staff so that there would be a minimal impact on building occupants and client resources.

Open During Construction

Once the dates for the survey visit were determined—the survey itself took place in the fall of 2010—PenBay started the logistics necessary to mobilize the equipment and staff needed to execute the data collection phase of the project. Upon arrival at the site, the survey team closely coordinated its collection activities with the client.

The robot that the surveyors used was pushed through each hall and room at a normal walking pace. Lidar was used by the robot to measure the distance to each object by illuminating the target with light from a pulsating laser. Data points were collected illustrating where every object in the space is located, from walls and doors to desks and chairs. The robot also took spherical images with a camera that takes 360-degree pictures inside the building and then georeferences them. This provided a continuous image of the space that can give a more accurate representation of the real buildings.

Since data collection happened mostly at night to keep with Center City's mission of not impacting the community, security escorts were provided by the city's public transit agency, the Southeastern Pennsylvania Transportation Authority, for safety, as well as to provide unencumbered access to all areas, such as the subway system and secure buildings. In total, the team collected 340,000 square feet of designated infrastructure. The survey provided the city with a clear and accurate view of how its underground infrastructure links to its aboveground buildings and roads. The combination of GIS and robotics provided the ability to measure pertinent space in a fraction of the time it takes with traditional collection methods. Staff took only 20 hours to collect all the data necessary for the pilot project.

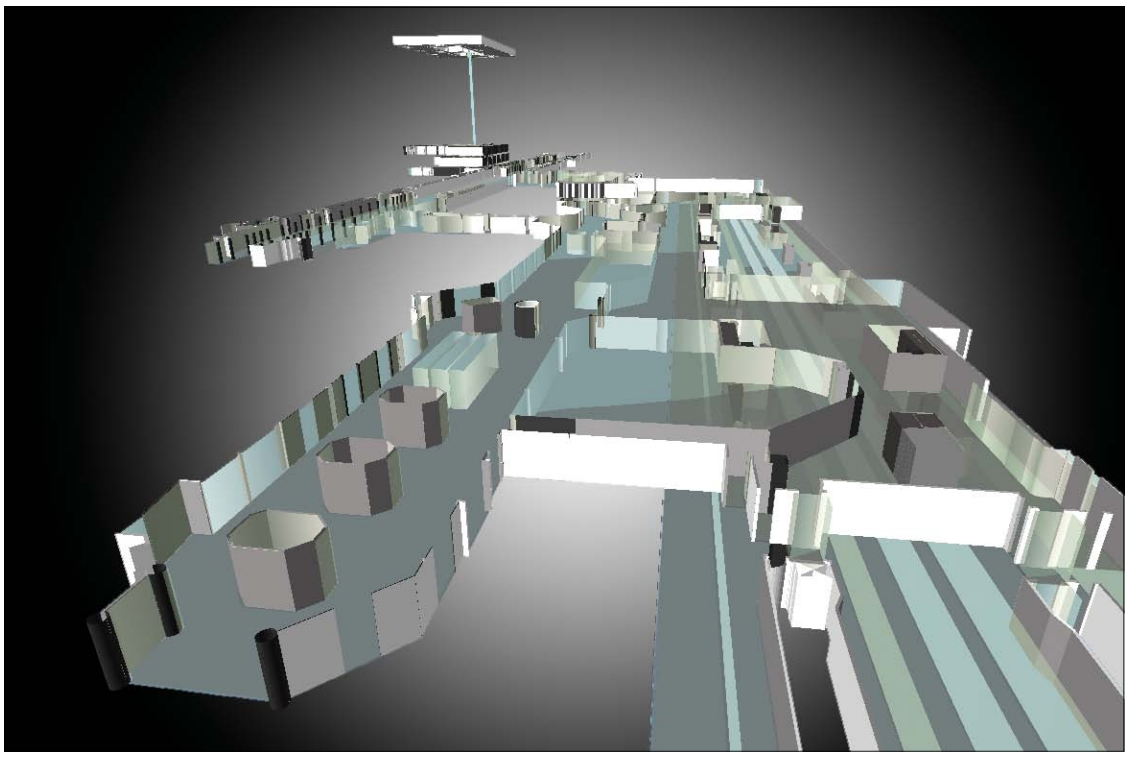
One Cloud—Many Datasets

PenBay provided this data to the city in a building information system data model-compliant dataset that included CAD (AutoCAD) and 3D building information modeling (Revit) files of the area of interest and a primary deliverable of an ArcGIS geodatabase. Using ArcGIS for Server and the geodatabase, city staff have access to the data files easily over the web.

A 3D video dataset was also collected for the entire captured area. This is of particular interest to public transit and the public safety community for planning and preparedness workflows, which provide assistance to facilities managers in condition assessment and asset inventory.

Through this pilot, the city learned how reliably critical deliverables can be created to support its facilities management initiative using GIS and lidar. Discrete spaces were defined accurately on maps, including where boundaries, such as hallways and rooms, begin and end; floor plan data was captured to represent interior space and structure accurately; and facility surveys can be performed quickly, safely, and cost-effectively.

For more information, contact James Querry, GIS director, City of Philadelphia (e-mail: james.querry@phila.gov), or Stu Rich, PenBay Solutions (e-mail: SRich@penbaysolutions.com).



The new dataset includes data for the inside of the Center City buildings and the vast infrastructure underneath the streets in the area.

From Urban California to Rural Kenya

Applying the UPlan Model

By Karen Beardsley, Managing Director, Information Center for the Environment, University of California, Davis

Highlights

- Researchers used the UPlan urban growth model to model and visualize land-use issues facing the Maasai in Kenya.
- UPlan has been instrumental in helping planners see what California's future might look like.
- ArcGIS can be designed to predict multiple potential outcomes for a rural region experiencing rapid land-use change.

NGO Non-Governmental Organization

After centuries of a pastoral way of life, with livestock providing the basis for sustenance, many Maasai pastoralists in southern Kenya have been transitioning from communal land tenure to individual parcel ownership. The introduction of private landholdings frequently leads to a more sedentary, crop-based livelihood, and the land is often demarcated with fences. Effects of land subdivision go beyond the direct changes to people's landownership to include landscape-scale habitat fragmentation, reduced resistance to drought, and a decrease in wildlife populations. Some of the group ranches in southern Kenya have completely converted from communal lands to individual landownership, while others still have a choice in setting their land-use policies but are struggling with decisions about the future of landownership, subdivided or not.

There have been few if any systematic methods for estimating longer-term impacts of differing land-use scenarios on wildlife and other environmental resources in Africa. At the University of California, Davis, Information Center for the Environment (ICE), researchers endeavored to model and visualize some of the land-use issues facing the Maasai in Kenya with UPlan, an urban growth GIS modeling tool *(see sidebar)*. UPlan was developed to simulate growing urban areas of California and is widely used for long-range planning in rapidly growing cities. This would, at first glance, seem to have nothing in common with sparsely populated pastoral lands in East Africa. But the author, one

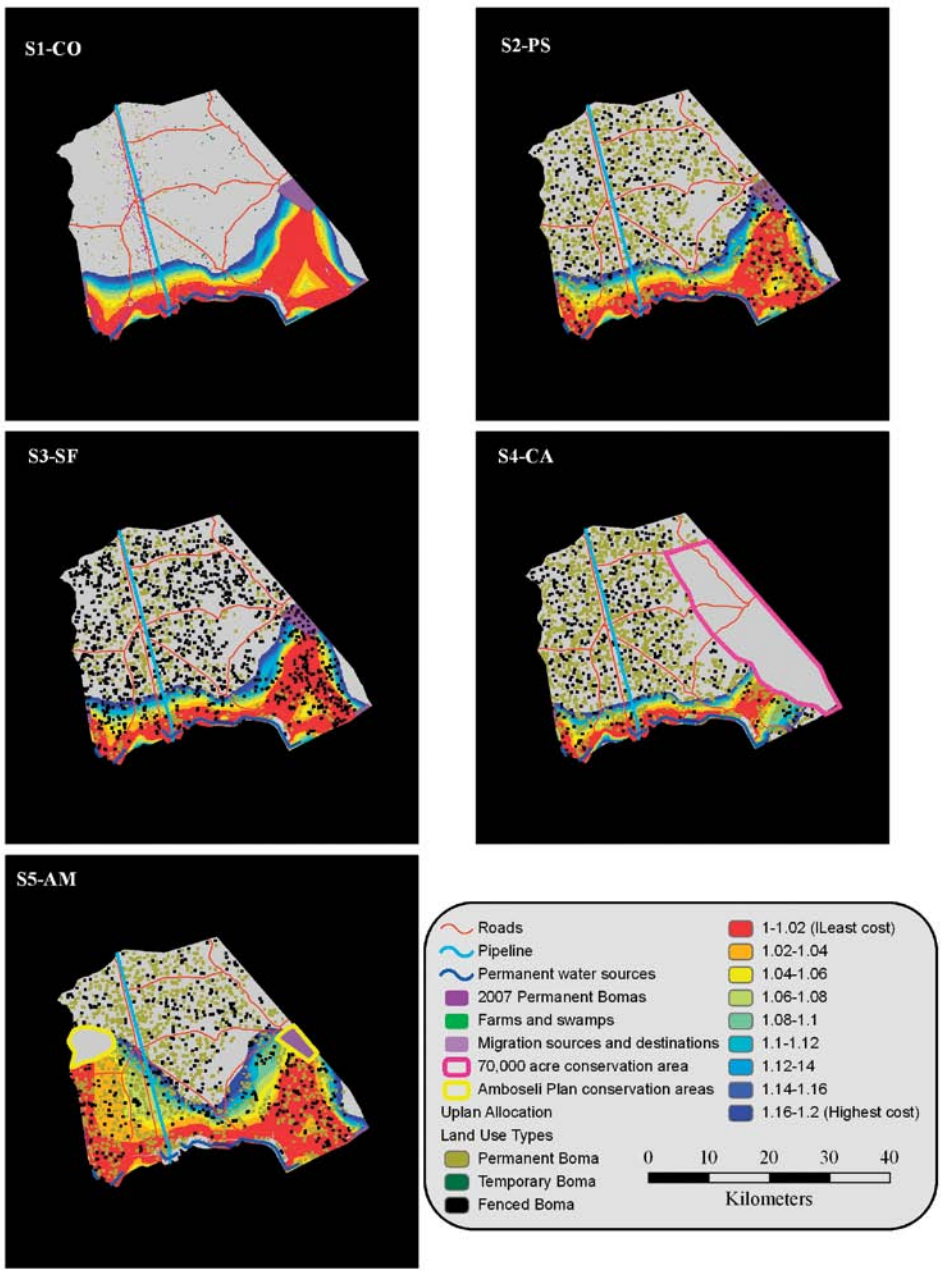
A Maasai herdsman.

of the ICE researchers, had been a Peace Corps volunteer in Kenya 20 years earlier and has connections (through the Society for Conservation GIS) with the African Conservation Centre (ACC) based in Nairobi, Kenya (www.conservationafrica.org).

In summer 2007, the author spent three weeks in Kenya working with scientists at ACC visiting areas outside park boundaries, where ACC focuses most of its conservation efforts, and learning more about the issues facing the historically pastoralist communities. Potential land-use conflicts included a complex and interacting mix of livestock grazing lands, wildlife corridors, agricultural lands, and human settlements. Combining her knowledge of UPlan and ArcGIS with her interest and experience living in Kenya, she and ACC developed a plan for this collaborative work, adapting UPlan for use in a rural setting far away from its traditional applications in the cities of California.

In general, people prefer pictures or maps over reams of numbers to help them understand the world now and in the future. Geographic tools, such as ArcGIS, provide a visual framework within which to view the future or, better yet, a variety of possible futures. When dealing with the past or the present, scientists typically seek complete, unbiased data at the maximum resolution practical. This is not so when looking into an unknowable future. The UPlan urban growth model is an appealingly simple and easy-to-understand tool, built in ArcGIS, that has been far more instrumental in helping planners see what California's future might look like than similar, but more complex, models. The application of UPlan to rural Kenya explores some of the ways that ArcGIS can be designed

Maasai cattle raising dust in the South Rift region of Kenya. (Photos: Karen Beardsley)



UPlan's output from five different Mbirikani scenarios, based on past trends, various degrees of fencing, and different management plans involving Mbirikani, will assist researchers and ultimately local ranch members with land subdivision decisions.

to peer into the future at a low resolution and with multiple potential outcomes for a rural region experiencing rapid land-use change.

ICE researchers gathered existing data from many sources, including ACC, the United Nations Environment Programme in Nairobi, and several other researchers working in this part of Kenya. With very minor modifications to the urban version of the model, ICE scientists adapted UPlan to model different land-use choices in rural areas of southeastern Kenya. They modified UPlan to work within the Kenyan policy framework by developing five land-use scenarios for the Mbirikani Group Ranch in the Amboseli ecosystem in Kajiado District, Kenya. California projections use urban variables, such as general plan boundaries, distance to freeways and major arterials, residential/commercial/industrial land uses, and employment statistics. UPlan for the Mbirikani region includes temporary/permanent/fenced *bomas* (living areas), distance from water sources and villages, suitability of habitat types for farming and grazing, and proposed locations of new conservation areas.

The output from five different Mbirikani scenarios, based on past trends, various degrees of fencing, and different management plans involving Mbirikani, will assist researchers and ultimately local ranch members with land subdivision decisions. Taking this one step further, ICE researchers combined the pattern of human settlement from each scenario with possible wildlife migratory routes modeled across Mbirikani. Not surprisingly, the results pointed to the scenario with the highest level of subdivision and fencing having the most detrimental effects on migratory patterns of zebra and wildebeest in a landscape connecting some of the world's best-known wildlife areas.

Californian city and county planners and Maasai group ranch leaders are not as different as one might think when it comes to interpreting maps and developing and evaluating alternative future scenarios. When applied to rural locations, such as southeastern Kenya, overlaying potential wildlife corridors with modeled future human habitation patterns using ArcGIS is a powerful method that can facilitate decision making in ways not previously envisioned. This study demonstrated the applicability of the UPlan model to rural Kenya and provided an example of how the model and its output can be used to evaluate different land-use options. Principal wildlife management stakeholders, including the local community, private

conservancies, nongovernmental organizations, and the government, could work collaboratively (despite potentially opposing planning priorities) to determine a mutually agreeable way to plan for future uses of the land.

The goal in conducting this research was to develop the ideas and test the methods for applying UPlan in rural, group-managed lands in Kenya, recognizing all along that these methods and results should be taken back to the local people for their full value to be realized. The expectation is not that ArcGIS applications like UPlan be placed in the hands of Maasai herdsmen. Rather, local support organizations such as the ACC would manage the technical aspects of the process and work with local stakeholders to visualize and evaluate model results. ACC could operate the models, produce maps, and work directly with the local people using the Swahili or Maasai languages instead of English. An iterative process of developing alternatives, observing potential outcomes, and modifying parameters as needed to develop and evaluate new alternatives (following the geodesign paradigm) would keep people involved and engaged at all levels of the process. ACC has expressed a keen interest in moving forward with this work. The main obstacles, as is so often the case with international collaborations, have been time and funding.

It will be an informative experiment to take the next steps and make these methods and results available locally and see how they are used to support Maasai group ranch subdivision decisions.

About the Author

Karen Beardsley, PhD, GISP, has worked for the Information Center for the Environment, Department of Environmental Science and Policy, at the University of California, Davis, since its inception in 1994 and is currently the codirector of ICE together with professor James F. Quinn. She has a master's degree in geography from the University of California, Santa Barbara, and a PhD in geography from the University of California, Davis.

For more information, contact Karen Beardsley (e-mail: kbeardsley@ucdavis.edu) or Lucy Waruingi, head of Programmes, GIS and Information Science, African Conservation Centre (e-mail: lucy.waruingi@gmail.com), or visit www.conservationafrica.org.

How UPlan Works in California

UPlan is a rule-driven, ArcGIS software-based urban growth model suitable for rapid scenario-based modeling. Originally developed by researchers at the Information Center for the Environment (ICE) at the University of California, Davis, more than 10 years ago, UPlan is continually maintained by ICE and has been widely applied in California and adapted to planning needs in other USA states, as well as several international settings, including China, Egypt, and Kenya *(see main article)*. Input parameters, including urban growth attractions, discouragements, masks, and planning datasets, are easily collected and configured using UPlan. While not an explicit economic model, UPlan uses "attraction" and "discouragement" factors that score the attractiveness of each modeling grid cell to each kind of potential development, generally based on economic factors understood to drive land-use decisions. UPlan uses a raster, cell-based environment within ArcGIS for Desktop with the Spatial Analyst extension. The model is available online and free of charge (ice.ucdavis.edu/doc/uplan/download).

The basic assumptions of UPlan are the following:

- Population growth can be converted into demand for land use by applying conversion factors to employment and households.
- Urban expansion (population growth) will conform to "general plans" (or an analogous land-use plan boundary defining allowable extent of growth) until demand exceeds the spatial capacity of the plan.
- Some cells, such as lakes, wetlands, publicly owned land, and existing development, will not be developed.
- Cells have different scores denoting attractiveness for development because of legal status (e.g., zoning in the United States); accessibility to transportation; infrastructure; and necessary resources, such as water.
- Other cells, such as high slopes or rare habitat types, will discourage new growth.

UPlan allocates growth into each land-use category based on demographic inputs, such as average household size, employees per household, and the percentage of housing development going into specified densities of residential or employment categories. Three primary factors determine where each land-use class will be allocated: city and county general plans (or comparable boundaries indicating where future growth types may be allocated), areas where growth is prohibited (masks), and site development attraction and discouragement factors. Attraction and discouragement factors are representations of physical, political, or economic effects that make a particular location either more or less attractive for future growth of a given land-use category. First, areas permitted to each land use under the general plan are identified. Then, areas with other growth prohibitions (lakes, very steep slopes, publicly owned lands, or existing development) are removed from the available space. Finally, the attraction and discouragement factor values are established for the remaining cells based on a location's potential suitability for growth. These values permit systematic prioritization of development within the UPlan model for each land use, resulting in an attraction grid. This is a purely additive process, with user-weighted attractions adding values and discouragements subtracting values. Population growth allocation occurs on a raster cell basis starting with the highest-value net attraction and working incrementally downward until either all the available land has been occupied or all the demand has been met.

Currently, about one-quarter of the 58 counties in California are using UPlan, many with technical support from ICE staff. In particular, rural counties rely on UPlan for their planning process as part of the California Rural Blueprints process, which is a long-term public visioning exercise run by counties and regional planners and funded by the California Department of Transportation. In California, UPlan has proved to be an effective and popular tool for visualizing future growth in part because it is adaptable, it runs quickly, and the assumptions are transparent. Problems in implementation have risen where political will is lacking, access to high-quality data is difficult, and personnel resources are limited.

UPlan lends itself well to the geodesign concept based on Carl Steinitz's framework. ICE is currently working with several counties to help them revise their planning process using a geodesign approach, with UPlan serving as a tool for developing alternative scenarios and iteratively evaluating the impacts of potential future growth outcomes on such features as wildlife habitat corridors, agricultural lands, water resources, and transportation needs.

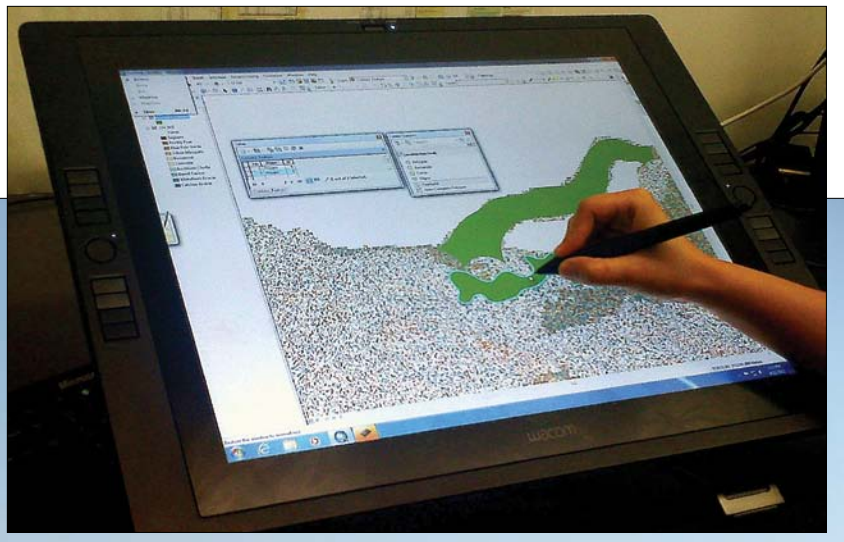
Geodesign and Wildlife Corridors

By Ryan Perkl, Assistant Professor, School of Landscape Architecture and Planning, University of Arizona

Highlights

- ArcGIS was used to develop a new tool for wildlife corridor design.
- The Automated Design Module populates modeled corridors with optimal vegetation types and patterns to increase wildlife movement.
- Development of the module represents an application of geodesign in conservation planning.

Over the last decade, wildlife corridors have become a cornerstone for promoting species persistence within conservation planning. While corridors have become an increasingly viable conservation strategy, issues still remain in translating modeled corridors beyond plans into implementable designs. Although modeled corridors result in the delineation of boundaries, they lack planning and design guidance for programming the appropriate vegetative types and patterns that may be desirable throughout the corridor. This represents a considerable implementation gap for practitioners interested in employing corridors as part of a conservation or land-use planning strategy.



Above: Saguaro and mesquite are among the many plants that should populate the corridors through the Sonoran Desert. **Top inset:** Landscape elements are digitized using a Wacom monitor and incorporated as part of the pattern generator process within the Automated Design Module (ADM). Integrating such an interface allows vegetation clustering and linearity to be addressed in the final corridor designs and represents the inclusion of geodesign-based methodologies.

The desert tortoise and mountain lion are among the many animals that would negotiate the corridors.

This University of Arizona team proposes that a modeled corridor by itself is not a design but rather a first step toward design. Design requires attention to site-specific characteristics; functions; and even more qualitative variables, such as aesthetics, as a means of informing the fine-grained decisions necessary for implementation. Further, the team believes that the growing field of geodesign holds promise in moving toward this end, as it strikes the needed balance between developing the analytically based methods required in conservation planning and the graphic and communicative language necessary for design implementation. As a result, this article illustrates and discusses the development of a new tool while showcasing the marriage of geodesign with real-world applications in conservation planning and design.

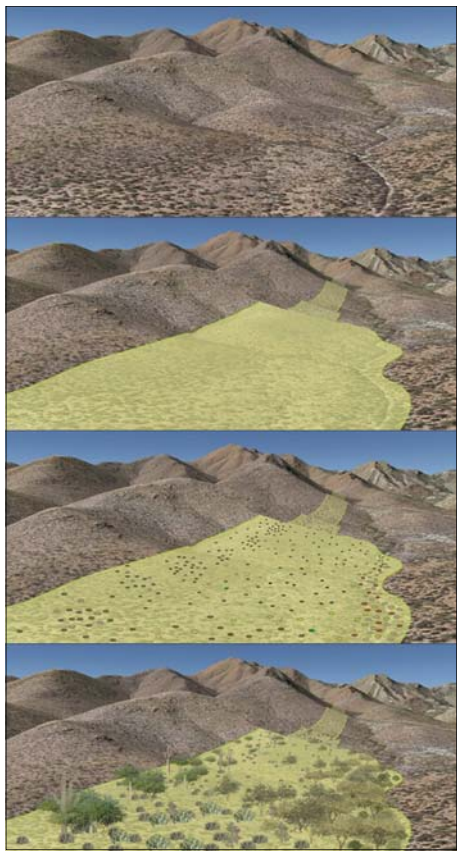
A New Tool—ADM

The Automated Design Module (ADM) described here was used to inform the design of wildlife corridors within the Sonoran Desert, an incredibly biologically diverse region that spans southern Arizona and California in the United States and Baja California and Sonora in Mexico. Corridors were modeled between Saguaro National Park east and west. Located adjacent to the city of Tucson, Arizona, Saguaro National Park comprises two distinct districts, which are separated by the city. The wildlife in this area includes the mountain lion, bobcat, bighorn sheep, mule deer, javelina, gila monster, desert tortoise, red-tailed hawk, and the charismatic pygmy owl, among others.

The ADM was created using Spatial Modeler within ArcGIS 10. The ADM starts by evaluating the landscape's capability to support various species of native vegetation specific to the Sonoran Desert. Vegetation species include the iconic saguaro cactus, palo verde, agave, cholla, cottonwood, creosote bush, prickly pear, and velvet mesquite, among others. Individual capability models were developed utilizing a standard raster-based overlay process that parameterized landscape characteristics and factors known to impact the distribution and persistence of each plant species. The resultant output of each model yields a capability surface that delineates the portions of the landscape most capable of supporting each plant type. The end result of this process yields a library of scored capability surfaces for each plant type.

The ADM then employs a selection algorithm that identifies the plant type from the library that exhibits the highest capability score for each cell within the corridor. This results in the selection of the plant type that is most appropriate for each cell. An additional query is then initiated to identify the next best plant type for each cell, and a corresponding dataset for each of these processes is derived. Where cells are equally capable of supporting multiple plant types, a random selection generator is employed to break ties. Together, these surfaces are utilized as the foundation for populating the modeled corridor's interior with the most appropriate site-specific vegetation.

The selection process can be further refined based on the requirements of the focal wildlife species for which the corridor is being designed. Individual wildlife species may require varying levels of vegetation diversity and/or density to facilitate movement. As such, vegetation diversity is a parameter within the ADM that can be used to populate the modeled corridor with the desired level of variation among plant types. For focal species, such as the pygmy



A typical Sonoran Desert scene (top), followed by a modeled wildlife corridor (second), followed by specific vegetation types and patterns generated by the ADM represented as points populating the corridor (third), and a final corridor design as derived from the ADM vegetation library (bottom).

owl, which requires the presence of saguaro cacti, the ADM can be parameterized to select the most optimal plant type for each cell while still meeting the desired criteria of the focal species. For species like mountain lions, however, which prefer more diverse conditions, the ADM can derive more assorted assemblages of vegetation through employing a random selection algorithm across all optimal and second-best plant types for each cell until the desired level of vegetation diversity is achieved.

The ADM employs a similar selection algorithm for determining the relative density of vegetation within the corridor. For example, the pygmy owl prefers more densely vegetated conditions. When these conditions are desired, the ADM selects and populates all or most of the available cells. Bighorn sheep, on the other hand, are more comfortable with moving through less densely vegetated conditions. In these instances, the ADM drops cells from being populated to achieve the desired condition. Additionally, the ADM can link vegetation density with other modeled connectivity outputs, such as flows of wildlife movement. When linked with current-flow surfaces of species movement, for example, the ADM can be parameterized to populate the corridor interior with greater vegetation density in areas where greater species movement has been modeled, and vice versa.

Vegetation Patterns

The ADM also has the ability to place vegetation in patterns that are known to either facilitate or impede wildlife movement. A series of pattern generators are employed to alter the relative dispersal, clustering, and linearity of the spatial locations of all vegetation assemblages to encourage movement where it is desirable throughout the interior of the corridor. Conversely, where movement is to be discouraged, the ADM can be parameterized to include linear patterns that have been documented to reduce species movement. Such patterns may be desirable along the periphery of the corridor, where species conflicts with adjacent land uses and mortality may be elevated. In this way, the ADM uses patterns to direct movement to where it is most desirable within the corridor and discourage it elsewhere, thus increasing the corridor's function through design.

Once all cells within the corridor are populated with the desired vegetation type, in the desired density and diversity, and are arranged in the desired spatial patterns, the ADM converts each cell to an appropriately coded and spatially explicit point. The ADM then links each point with a symbol unique to each plant type as a graphic component from the initial library. The result yields a modeled corridor that has been populated with unique vegetation types arranged in space. This output provides a physical design of the corridor's interior that is based on vegetation capability and customizable to address the requirements of varying species, such as the desert tortoise or javelina, and integrates patterns for guiding species' movement in the desired way. This represents a stark contrast to the ambiguous interior of a stand-alone modeled corridor and is envisioned to be a useful step in moving modeled outputs toward informed designs.

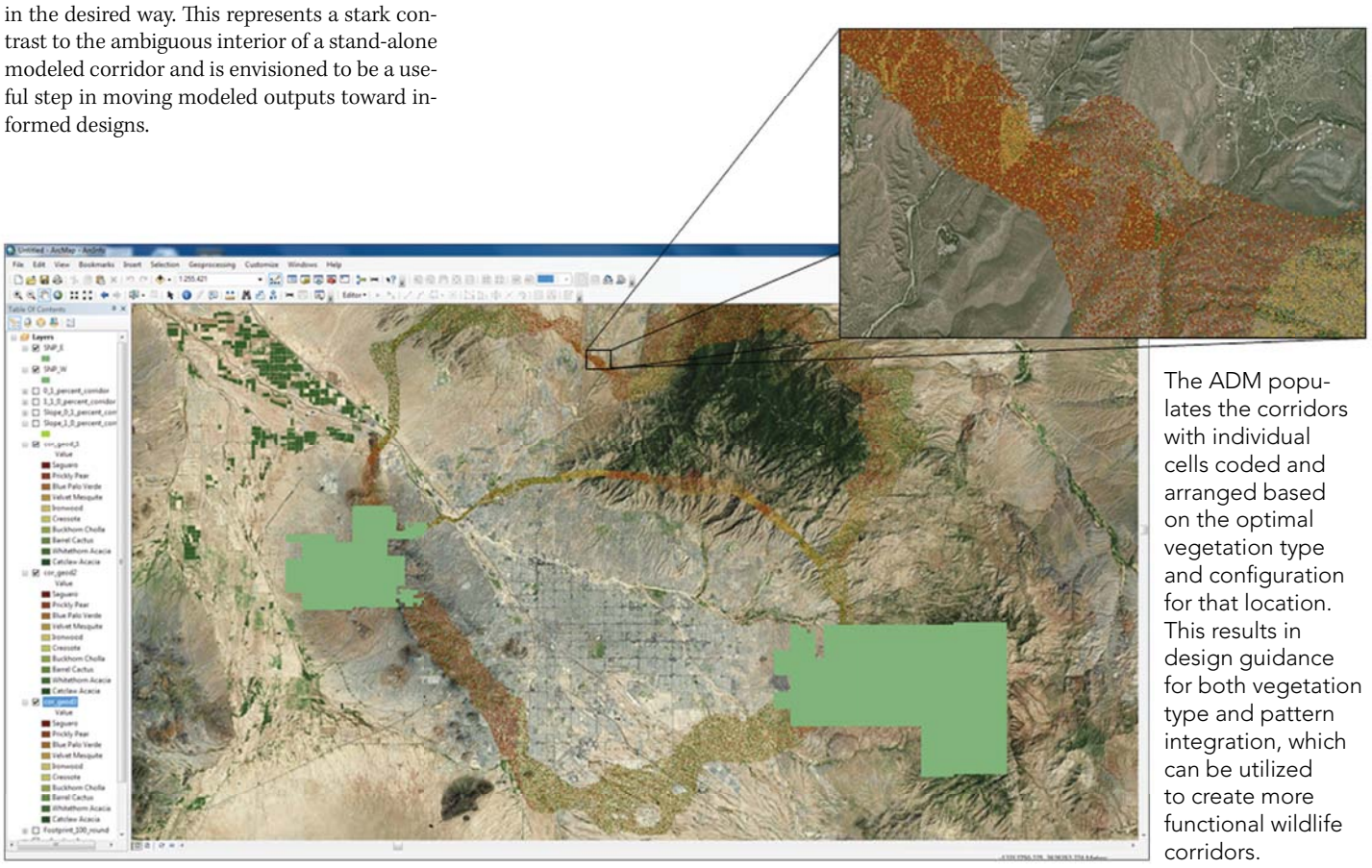
Additionally, development of the ADM provides a more seamless design interface, allowing analysis, modeling, and design all to be completed within the ArcGIS environment without the need to export geospatial data to an alternative graphic design platform. This can be accomplished by using ADM-derived outputs within ArcScene. Additionally, this team believes that tools such as the ADM will aid in the development and design of functional wildlife corridors and contribute to the effectiveness of corridors as an increasingly viable conservation planning strategy. Further, the team believes that such developments will aid in spanning the gap between modeling, planning, design, and eventual implementation of wildlife corridors in a wide spectrum of planning applications.

About the Author

Ryan Perkl, PhD, is an assistant professor in the School of Landscape Architecture and Planning at the University of Arizona who specializes in environmental planning, wildlife connectivity modeling, and the emerging field of geodesign. Contributors to this work include Samuel Chambers, a doctoral student in arid lands resource sciences, and Brandon Herman, Wanyi Song, and Garrett Smith, all graduate students in planning at the University of Arizona.

For more information, contact Ryan Perkl (e-mail: rperkl@email.arizona.edu) or visit **www.planning.arizona.edu** to learn more about the Planning Master's Degree Program at the University of Arizona.

This work will be showcased in a talk entitled Employing an Automated Design Module (ADM) in Wildlife Corridor Design at the 2012 Esri International User Conference in San Diego, California.



The ADM populates the corridors with individual cells coded and arranged based on the optimal vegetation type and configuration for that location. This results in design guidance for both vegetation type and pattern integration, which can be utilized to create more functional wildlife corridors.

The Importance of Connecting Protected Areas

Given the recent trends of urban expansion, species decline, and habitat conversion and fragmentation, conservation planners have developed a wide spectrum of tools devoted to inventorying and analyzing environmental conditions, simulating and forecasting change, and identifying and prioritizing areas for conservation action. More recently, a subarea of conservation planning known as connectivity conservation has resulted in an emphasis on the importance of combating the negative effects of landscape fragmentation on species populations. Connectivity conservation recognizes the importance of setting aside natural areas for protection purposes but goes a step further by stressing the importance of connecting these areas so that they may function as larger systems rather than isolated units. It is believed that such an approach may hold the most promise for protecting the greatest number of species, given the shifting environmental conditions due to climate change.

As a result, connectivity conservation has yielded a number of tools and approaches for modeling landscape connectivity within ArcGIS and other platforms. All approaches make assumptions about how wildlife will move through the landscape, given their individual interactions with local landscape conditions. These interactions and subsequent movements are represented as the relative permeability of the landscape or as the cost of movement to the individual. While connectivity modeling tools vary greatly in their underlying methodological processes and employ different techniques to model permeability and cost, the most common output is the delineation of spatially explicit wildlife corridors that link user-defined locations. Such outputs result in linearly arranged polygons that represent either structural connections between locations with given landscape characteristics or functional paths through which individuals are expected to move. While useful for planning purposes, such outputs lack the specificity necessary for informing the physical design of their interiors upon implementation.

The Automated Design Module (ADM) is intended to provide additional insight and guidance in the physical design of a wildlife corridor's interior by populating it with vegetation arranged in patterns known to impact wildlife movement in desired ways. Developing such a tool sheds light on the suggested physical structure and design of the modeled corridor's interior, aspects that current tools do not address. Additionally, the automated nature of this tool allows large swaths of the landscape to be designed based on widely available data pertaining to landscape characteristics and considerations, such as soil, terrain, and vegetation, among others. Until now, designing such large portions of the landscape has been impractical due to the massive time constraints that are required to manually develop such designs. Finally, the ADM allows analysis, modeling, and design to all be accomplished within an ArcGIS environment without the need to employ other graphic design platforms, resulting in a more streamlined workflow.

Geodesign Books from Esri Available This Summer

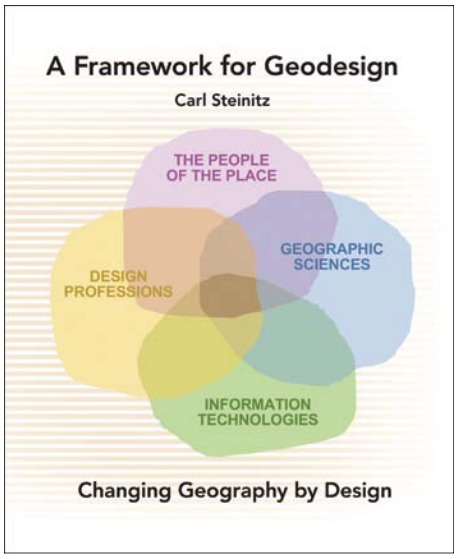
A Framework for Geodesign: Changing Geography by Design
By Carl Steinitz

A Framework for Geodesign: Changing Geography by Design focuses on design in general and geodesign in particular. As an idea, geodesign has the potential to enable more effective and symbiotic collaboration among several design professions, geographically oriented sciences, information technologists, and people impacted by change ("the people of the place") when all these groups aim to influence major environmental and social change for the better. According to author Carl Steinitz, this collaboration is essential.

Steinitz's framework, described here in detail, can contribute to that goal. It is clear that for serious societal and environmental issues, designing for change cannot be a solitary activity. It inevitably is a team endeavor with many participants from the design professions and geographic sciences, linked by technology from several locations for rapid communication and feedback, and reliant on transparent communication with the people affected by change. These demands create opportunities for geodesign and the need for organizing that collaboration.

Part I of the book is about the necessary but sometimes difficult collaboration between designers and scientists and also focuses on key aspects of study areas, scale, and size, which influence how geodesign is organized and carried out. Part II presents Steinitz's framework and addresses six key questions and their related types of models, which must be integrated in geodesign. Part III features nine case studies that illustrate different ways of designing for change, while Part IV explores the future of geodesign in research, education, and practice.

A Framework for Geodesign is not a how-to text or technical manual. It is a highly personal and sometimes opinionated and polemical book that is based on the author's longtime experience. It looks mostly to the future, with a primary intention of helping the collaborating participants achieve, in the words of the author, "practical benefits from geodesign." ISBN: 978-1-58948-333-0, 224 pp., $79.95.



Geodesign: Case Studies in Regional and Urban Planning
By Shannon McElvaney

Geodesign: Case Studies in Regional and Urban Planning is a foundational text that describes how designers, planners, landscape architects, engineers, natural resource managers, public health officials, and others, use geodesign to meet or exceed sustainability, regulatory compliance, cost reduction, and social equity goals.

Geodesign promotes designing with geography instead of designing around geography. Geodesign integrates science and social and aesthetic values into landscape planning with geospatial tools that enable rapid, iterative evaluation of design alternatives against their probable outcomes. These tools let planners explore issues, collaborate with stakeholders, and resolve conflicts more easily, enhancing their chances for achieving the best possible design solutions.

Whether creating a growth strategy to increase open space and maintain rural character or optimizing a master plan to meet sustainability goals, the case studies in this book exemplify key steps, processes, and technologies crucial to solving the complex, interdependent issues that have become common to our rapidly changing world. They are meant to be educational and illustrative of the burgeoning need for near real-time impact simulation that enables decision makers to test design assumptions before committing dollars to construction.

Globalization, urbanization, population growth, climate change, and increasing demand on resources will drive the demand for smarter, more innovative design solutions that take into account the cumulative impact on the whole. ISBN: 978-1-58948-316-3, 160 pp., $19.95.

For more information about these books, visit esri.com/esripress.

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2012 Esri Regional User Conferences to Celebrate the Power of Geographic Understanding

Make plans to connect and collaborate with ArcGIS users in your region this fall, when the Power of Where will draw thousands to Buenos Aires, Oslo, and Auckland to witness the latest geospatial technology at Esri's three regional user conferences (UCs).

The Latin America, European, and Asia Pacific user conferences in October and November are more than seminars and papers, map galleries and vendor showcases, keynotes and technical training: they are gateways through which scientific, social, economic, business, and environmental innovators will pass to discover new geospatial knowledge that extends beyond the convention center walls to mold our planet.

"By attending the 2012 regional conferences, you'll become a thought leader in the analysis, management, and deployment of natural and collective resources," says Esri president and founder Jack Dangermond. "You will bring this experience back to your region and organization to shape the way you work today for tomorrow."

And if you're at the Esri International User Conference (Esri UC) in July, be sure to visit the Regional UC booth to learn why these are must-attend events for all users in each region—not just those based in host countries Argentina, Norway, and New Zealand.

At the booth, host distributors will empower you to connect and collaborate with colleagues via Tweets and tools that will create buzz for your region. Meet the host distributor for the conference in your region, learn more about the event, and make plans to attend—right from the Esri UC. The Regional UC booth is not to be missed!

Whether you're a novice user of Esri software or a longtime professional, the regional UCs are where you'll learn cutting-edge information, talk to people making the software, and improve your problem-solving skills. You'll come away smarter; more connected; better able to tackle spatial challenges; and equipped to answer tough questions from senior leadership, partners, and clients in today's demanding new business world.

Esri Latin America User Conference

From Puerto Peñasco to Tierra del Fuego, users in the Latin American region are invited to experience the Power of Where in the cosmopolitan city of Buenos Aires, Argentina, at the Esri Latin America User Conference to be held October 4–5.

"The Esri Latin America User Conference is a gathering for GIS experts throughout the region that nobody should miss," says Carlos Viola, president of Aeroterra S.A., Esri's distributor in Argentina. "It is a place for collaboration and where one can connect and be inspired by the experiences of others. Together with Esri, our company, Aeroterra S.A., is proud of being able to organize this important event and provide an excellent and limitless opportunity to create and expand the potential of the GIS users in Latin America."

Be more than just an attendee by submitting a paper for consideration. The call for papers is open until June 30. Go to **esri.com/lauc** for information about submission guidelines. Several registration options are available as well.

Esri European User Conference

Users in the European region will unite in the city of Oslo, Norway, from October 15 to 17 for the Esri European User Conference. This year's event will include preconference seminars and technical workshops, as well as give users an interactive experience to explore the new functionality of ArcGIS 10.1.

"We are really looking forward to welcoming the GIS community in Europe to Oslo to see how GIS can help solve some of the biggest challenges in today's society," says Geir Hansen, managing director of Geodata AS, Esri's official distributor in Norway. "The European User Conference is a great opportunity to learn from each other, to learn from Esri, and to showcase your own innovative application of GIS. Geodata AS is proud of hosting this conference, and we hope to see many of you in Oslo in October!"

Oslo at night.

Presentation submissions are open until mid-September, so don't miss out on your opportunity to get involved in the event. For information on submitting a presentation or to register, visit **esri.com/euc**.

Esri Asia Pacific User Conference

The City of Sails—Auckland, New Zealand—is the setting for this year's Esri Asia Pacific User Conference, hosted by Esri's official distributor in New Zealand, Eagle Technology Group, Ltd., and to be held November 5–7. The SkyCity Convention Centre is where hundreds of peers from the Asia-Pacific region will congregate for this three-day conference. A packed-full agenda of technology trends and workshops, in a setting that is both inspiring and stunning, awaits users from the region.

"We are very excited about hosting the Esri Asia Pacific User Conference in Auckland," says Gary Langford, CEO of Eagle Technology. "New Zealand has a strong Esri user group whose members, with Eagle Technology, embrace the opportunity to welcome others from the greater region to share knowledge, learn new skills, and showcase our beautiful country."

Be where knowledge and imagination come together by submitting a paper for consideration at the Asia Pacific User Conference. Paper submissions are open until Friday, August 10. Registration is open for the event. Visit **esri.com/apuc** for more information about registration options and paper submissions.

November 14, 2012

GIS Day Is Coming

GIS Day will be celebrated by thousands of users in more than 60 countries around the world on Wednesday, November 14, 2012. We invite you to participate by hosting, attending, or volunteering at a GIS Day event—and showing the world why GIS is important to you.

GIS demonstrations, corporate open houses, map gallery tours, hands-on GIS technology training and workshops, and expos on educational and career opportunities in the field are all ideas for you to kick-start your GIS Day event planning. New resources on the **gisday.com** website to promote and share at your event will be available leading up to November 14 so that you can create buzz surrounding your own festivities.

If you are attending the Esri International User Conference (Esri UC) in San Diego, California, this year, get the latest information about GIS Day at the GIS Day interactive booth. From event consultation to special activities during Family Night, the GIS Day booth at the Esri UC is your one-stop location to flex your creativity and learn innovative ways to host a GIS Day event. The booth will be located on the mezzanine level, directly across from the GeoLounge.

By participating in GIS Day—by either hosting, attending, or volunteering at an event—you will leave with an understanding of geospatial technology and the positive force it can play in your life and business, as well as helping to share this energy with your community.

The following event recaps should get you excited about GIS Day 2012.

Zombie Maps Enthrall Missouri Students

In the American Heartland, GIS Day is alive and well. In a display of the technology's playful, creative side, participating high school students spent more than a month at the Columbia Area Career Center creating "zombie" maps depicting the best places to take refuge if a "zombie apocalypse" hit Missouri today. The fanciful maps demonstrated that it would be best for Missourians to avoid cities—including Columbia—and hide out in the state's vast hinterland from the teeming hordes of undead,

At the 2011 GeoTech Camp sponsored by the University of Missouri, Department of Geography.

says Shannon H. White, PhD, geospatial extension specialist at the University of Missouri Department of Geography in Columbia.

"The exercise received coverage from the local press and TV news and was touted as 'kitschy and fun,'" recalls White. "[T]he applied GIS behind those maps was rooted in emergency management."

The zombie maps were featured at Columbia City Hall's GIS Day event alongside more practical-minded GIS projects, including a demonstration of Columbia City View, a GIS system now on the city's website that provides map views with information layers, such as zoning designations and natural resources.

State Agency Learning Experience

Not to be outdone, the Washington State Department of Transportation (WSDOT) in Olympia has hosted GIS Day and Geography Awareness Week for the past 13 years. In 2011, WSDOT sponsored a GIS Day seminar, a hands-on workshop, and a map competition, with GIS displays set up in two locations in Olympia. More than 500 people participated, says Richard C. Daniels, GIS coordinator for the Office of Information Technology at WSDOT.

According to Daniels, the winner of last year's People's Choice Award for best map was titled *Monastery Complex Fire*. Originally produced for WSDOT's Emergency Operations Center, this map showed those portions of US Highway 97 that the fire impacted.

As the demographic focus of GIS Day events often varies widely between venues worldwide, so does that of the WSDOT.

"Over time," Daniels explains, "our audience has matured, and all agency employees now have access to GIS on demand. Our focus is now on educating our customers on changes in our GIS environment, informing them of new GIS data and applications, and ensuring that our executives are aware that this technology is now a core tool that is used throughout the agency."

For more information on GIS Day and how to host an event, visit **gisday.com**.

"Crossing Borders"

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

China and International Geography at the AAG

One of the greatest pleasures of a sometimes grueling travel schedule is the opportunity to meet with my counterparts and colleagues at other geographic societies around the world. I always try to find time to meet with them; to share information and news regarding geography and GIScience; to discuss possible collaborations; and, when possible, to participate in their annual meetings.

This past year at the AAG meeting in New York City, New York, everyone in attendance had the opportunity to welcome the leaders of geographic societies from around the globe. A set of special sessions featured dozens of reports of the status of geography and GIScience in other countries from the top officials of their national geographic associations. This kaleidoscope of international geography and GIS also provided a venue for leaders of international associations to interact with one another, as well as for AAG meeting attendees to get to know personally some of the leading geographers from other countries. These special sessions, entitled Snapshots: Geography in the World Today, will also be a featured event during the AAG's next Annual Meeting, to be held in Los Angeles, California, April 9–13, 2013. Please join me and our international guests in Los Angeles for what promises to be a fascinating exchange on the status of geography and GIS worldwide.

During my sabbatical this past year, I also was able to meet with many and varied geographic societies throughout Europe and Asia in their own countries. Many of these international associations are now working together with the AAG on ongoing projects, such as *The International Encyclopedia of Geography* (see my spring 2012 *ArcNews* column for more information) and on preparations for a geography and GIS presence at the decadal United Nations (UN) Sustainable Development Conference (also known as Rio+20), that was held in June 2012 in Rio de Janeiro, Brazil. I would like to thank Esri for its long and crucial participation in the AAG's My Community, Our Earth: Geographic Learning for Sustainable Development (MyCOE) partnership.

New Collaborations with China

As part of a two-month visiting professorship at the Chinese Academy of Sciences (CAS) this past year, I was fortunate to be able to attend the annual meeting of the Geographical Society of China (GSC), held in Urumqi (Wulamuqi) in Xinjiang Province in the far west of China, as well as to work with many others throughout China to establish and solidify collaborative initiatives between the AAG and key Chinese geographic institutions, including the CAS, the GSC, and many university geography departments.

Esri's pioneering GIS systems are in widespread use in China and throughout Asia, both in universities and in government and industry. Many of China's booming cities rely on ArcGIS to plan, design, and manage their infrastructure, as well as to understand the complex interactions between their changing urban environments and human activities.

To better understand these urban spatial processes, the AAG has joined with the Hong Kong Geographical Society and the Geographical Society of China to help organize and support the Conference on Spatial and Social Transformations of Urban China scheduled for December 13–14, 2012. (See **www.hkbu.edu.hk/curs/2012conference** for more information.) Building on the theme of this Hong Kong conference, AAG's incoming president Eric Sheppard also will be developing a track of sessions at the AAG Los Angeles conference in 2013 on international cities and urban systems, with a special emphasis on the urban explosion in Asia.

The joint projects and programs under way between the AAG and multiple Chinese geography institutions now encompass geographic research, international online education, publications, specialty scientific meetings, larger international conferences, and academic exchanges at all levels. An AAG-GSC Liaison and Coordination Committee has been established to help manage, sustain, and expand these cooperative efforts. Its initial members include eight leading geographers from China and the United States: Michael Solem (AAG), Zhou Chenghu (CAS), Liu Weidong (CAS), Zhang Guoyou (CSG), Yu Lizhong (president of East Normal China University), Mei-Po Kwan (UC Berkeley), Alexander Murphy (University of Oregon), and myself. The projects undertaken to date are topically cross-cutting and designed to produce progress in geography in both countries and foster broader personal and professional interaction among individual geographers and GIScientists from the United States and China.

The Geographical Society of China and the Association of American Geographers solidified their growing collaborative relationship and activity during a formal signing ceremony of a memorandum of understanding during the AAG's recent Annual Meeting in New York City.

Asian geographers and GIScientists are attending the AAG Annual Meeting in rapidly growing numbers each year. I encourage you to join us in welcoming our international attendees from Asia—as well as from all countries—at the next AAG meeting in Los Angeles in 2013 and to explore with them ways in which we might mutually benefit from our exchanges and strengthen geography and GIScience through our collective efforts. Thanks, and I hope you enjoy the upcoming Los Angeles conference, meeting old and new friends, enriching our discipline and ourselves intellectually and socially, and perhaps along the way also addressing the many needs of our interconnected world.—Doug Richardson

For more information about the AAG and the Los Angeles meeting, see **www.aag.org**.

URISA Heads to Jamaica

The Urban and Regional Information Systems Association (URISA) is returning to Montego Bay, Jamaica, for its Sixth Caribbean GIS Conference, which will take place November 12–16, 2012. Caribbean GIS professionals from across the region will convene to share and discuss technology, policy, and the future.

The conference theme for the event is "Spatial Technologies—Critical Thinking for Critical Times." The first Caribbean conference was held in September 2001 in Jamaica, and we're thrilled to be heading back to where it all began! Subsequent programs have taken place in Barbados (2004), the Bahamas (2006), the Cayman Islands (2008), and Trinidad and Tobago (2010).

An involved and respected conference committee reviews abstract submissions and organizes the educational content for the program. This year's conference is chaired by Valrie Grant, GISP, president of GeoTechVision Enterprises, and Nadine Brown of the Planning Institute of Jamaica.

Objectives of URISA's Caribbean GIS Conference are as follows:

- To inform a broad cross section of Caribbean users about GIS technology and applications
- To share experiences regarding GIS implementation and management issues
- To establish new relationships with the vendor/consultant community
- To provide workshops and sessions that are application driven and are relevant to the Caribbean community of GIS users
- To foster a Caribbean GIS network
- To assess the state of readiness of national and regional spatial data infrastructures

For more information, visit **urisa.org**.

ArcGIS for Server Disseminates Geospatial Services

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

Save the Children Italia
atlante.savethechildren.it
Save the Children Italia produced more than 70 maps of demographic, environmental, and fiscal spending data that highlight the economic plight of children in Italy.

Spain 2011 General Election Results
www.elmundo.es/elecciones/elecciones-generales/resultados/mapa.html
ELMUNDO.es and Esri España Geosistemas S.A., Esri's distributor in Spain, provide an interactive map of the 2011 general elections.

Cleveland GIS
www.clevelandgis.org/pub/index.html?config=land.xml
Cleveland GIS provides authoritative geospatial information to support situational awareness and better decision making across the region.

NATIONAL GEOGRAPHIC™

"Geo Learning"

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

Geo-Education: Preparation for 21st-Century Decisions

Geo-education is about preparing people to make the important decisions we will all face in the 21st century. At National Geographic, we call people who are prepared to make these decisions geo-literate.

Geo-literacy requires three kinds of understanding:

Interactions—A geo-literate individual understands that the world is composed of interacting systems that move and transform resources. These may be social systems, like political, economic, and cultural systems. They may be technological systems, like transportation, energy transmission, and communications systems. Or they may be environmental systems, like hydrological, atmospheric, and ecological systems.

Interconnections—A geo-literate individual understands that these systems connect people and places to each other. This means that events that happen in one location affect other people and places. It also means that our actions affect other people and places.

Implications—A geo-literate individual is able to use his or her understanding of interactions and interconnections to make well-reasoned decisions. This means being able to anticipate the cascading consequences of actions that result from systems interactions and interconnections among people and places. It also means being able to weigh costs and benefits for oneself, for one's community, and for other people and places when making decisions.

More important than what it requires is what geo-literacy enables you to do. Here are six categories of critical decisions that geo-literacy prepares people to make:

Community life—A geo-literate individual understands the factors that improve or degrade the quality of life in a community. These factors include everything from walkability to cultural resources to housing stock. A geo-literate individual is able to use that understanding to (1) make good personal choices about where to live and spend time, and (2) make good civic choices about how to improve the quality of life in his or her community.

Location and transportation—A geo-literate individual is able to reason through problems involving site selection and transportation planning. These problems come up in personal, professional, and civic life, but they are particularly important in professional life in the modern world. Individuals with geospatial reasoning skills are in high demand in fields as diverse as military logistics, intelligence, natural resources management, and supply-chain management.

Interactions across cultures—Our local communities are increasingly diverse, and our daily lives increasingly involve interactions with people in faraway places. Both of these trends make it important that members of our society be culturally literate, meaning able to communicate and collaborate effectively with individuals from different cultures.

Environmental and social impacts—Both the connections that knit together our world ever more tightly and the growth in our global population mean that the impacts of our actions on the environment and on other people are amplified. This makes it all the more important that we all be able to anticipate the potential environmental and social impacts of our actions and make decisions accordingly.

Global affairs—While most individuals' direct influence on global affairs is limited, people throughout the world have growing opportunities to shape global affairs through participation in political processes and public opinion. So geo-literacy is important to be able to participate in the public debate about trade, diplomacy, military action, and foreign aid.

Acts of caring—By "acts of caring," I mean actions to improve the lives of other people or care for the world that we share. This includes efforts to alleviate poverty, reduce hunger, or improve health care and education. It also includes wildlife conservation and environmental restoration. Whether one is taking action oneself or providing financial support, it is important to be able to make informed decisions about what actions are most likely to have a meaningful and lasting impact. This requires geo-literacy.

The challenge of geo-education is weaving the knowledge and reasoning skills required to make these six categories of critical decisions into the written curriculum of schools and the unwritten curriculum of home and community life. This is a challenge that we have not yet taken on explicitly in our modern society, but we must all take it on if we are to prepare today's youth for the world they will inherit.

Follow Daniel Edelson on Twitter:
@NatGeoEdelson.

URISA's 50th Anniversary

URISA's milestone 50th anniversary annual conference—GIS-Pro 2012—will take place from September 30 to October 4 in Portland, Oregon. This year's conference will be cohosted by the Northwest GIS Users Group (www.nwgis.org).

For regular updates and conference details, visit www.urisa.org and follow the conference on Twitter (#gispro2012). See you in Portland!

Esri Partner Solutions

Esri has relationships with over 2,000 Partners globally that provide customer-focused geoenabled solutions. These Partners have extensive experience providing GIS solutions and services across our core industries. Partner-provided solutions and services range from custom-built applications to complete ArcGIS system implementations. In this issue, we would like to recognize those Partners that won a 2012 Esri Partner Conference Award. These organizations have exhibited practical yet innovative applications of the latest features in ArcGIS, taking geographic visualization to a higher level.

For a complete list and description of our Partners and their offerings, visit the Esri website at esri.com/partners.

Extension to Desktop

Telvent
www.telvent.com
ArcFM Fiber Manager
ArcFM Fiber Manager addresses the need for enterprise GIS in the telecom market by providing an innovative solution that utilizes the power and flexibility of the ArcGIS 10 platform. The graphic, data-rich environment allows telecoms and utilities to get the information they need quickly and easily. It provides benefits across the organization, including traditional asset and network inventory, planning and analysis, and field mobility, and provides improved operational awareness and decision support for sales, marketing, and operations.

Private Web Application

Geo-Comm, Inc.
www.geo-comm.com
GeoLynx Server
GeoLynx Server is a web-based mapping system for public safety and law enforcement personnel. GeoLynx Server combines detailed GIS maps with real-time 9-1-1 caller locations so telecommunicators can see origins of 9-1-1 calls from landline and wireless phones, Voice over Internet Protocol (VoIP) devices, and telematics services. GeoLynx Server integrates with any computer-aided dispatch (CAD) system to map CAD incidents, provide map-based drag-and-drop dispatching, and discover the nearest available units to dispatch.

Stand-Alone Desktop Application

iWater, Inc.
www.iwater.org
www.inframapsoftware.com
infraMAP
The infraMAP software is created on ArcGIS Engine and is used as both an office desktop and disconnected mobile version. Since infraMAP was created for ease of field operator use, it has expanded beyond the original water and wastewater industry; it is used in all public utilities and as an easy interface for several work order asset management products. The out-of-the-box functionality includes disconnected geodatabase editing, real-time GPS navigation and connection for additions and updates, work location routing, photo additions, and redline documentation. All these can be synchronized and added to the geodatabase by either wired or wireless connection. The success of infraMAP is due to the easy-to-use interface for all users, simple reporting features for management, and direct connection to existing Esri data.

Public Web Application

Blue Raster
www.blueraster.com
Indonesian Rain Forest Preservation (Forest Cover Analyzer)
To preserve endangered rain forests in Indonesia, the World Resources Institute (WRI) has launched Project Palm Oil, Timber, Carbon Offsets (POTICO), a revolutionary approach to ecosystem management. Working with spatial analysis tools developed by Blue Raster, Project POTICO aims to divert planned oil palm plantations away from virgin tropical forests to already degraded lands, a swap that will prevent deforestation, reduce greenhouse gas emissions, and encourage sustainable agricultural development. Using the Forest Cover Analyzer, government agencies and nongovernmental organizations can compare current and historic satellite images of Indonesian forests to determine if oil palm companies are using degraded lands and meeting the standards of the Roundtable on Sustainable Palm Oil. In addition to using Esri ArcGIS 10 for Server and ArcGIS API 2.4 for Flex, the application uses Adobe Pixel Bender for spatial analysis and the Flickr API, allowing users to explore more than 190 field points and panoramic images collected to verify maps.

Mobile Application

EnerGov
www.enerGov.com
iG Workforce
iG Workforce by EnerGov is a government platform for the next generation of mobility. iG Workforce utilizes the latest in cloud-based architecture to centrally manage government business data extended to the Apple iPad. The line of business applications released in the iG Workforce suite of applications includes iG Inspect for government field inspection processes and iG Reviews for regulatory electronic plans review management.

Enterprise Integration Application

APOS Systems, Inc.
www.apos.com
APOS Location Intelligence Solution
The APOS Location Intelligence Solution (LIS) gives many business intelligence information consumers their first glimpse of GIS technology, complementing their existing decision workflows and enriching the decision-making environment through geospatial visualization. The APOS solution makes GIS more pervasive within the enterprise because it integrates complex business processes with GIS content rather than creating a competing workflow. In simple terms, APOS brokers the communication of data between enterprise GIS and the enterprise business intelligence, giving the traditional business intelligence user access to maps and geoprocessing and improving the GIS user's access to nongeographic business data and complex business workflows.

Visit *ArcNews* Online at esri.com/arcnews.

"Managing GIS"

A column from members of the
Urban and Regional Information Systems Association

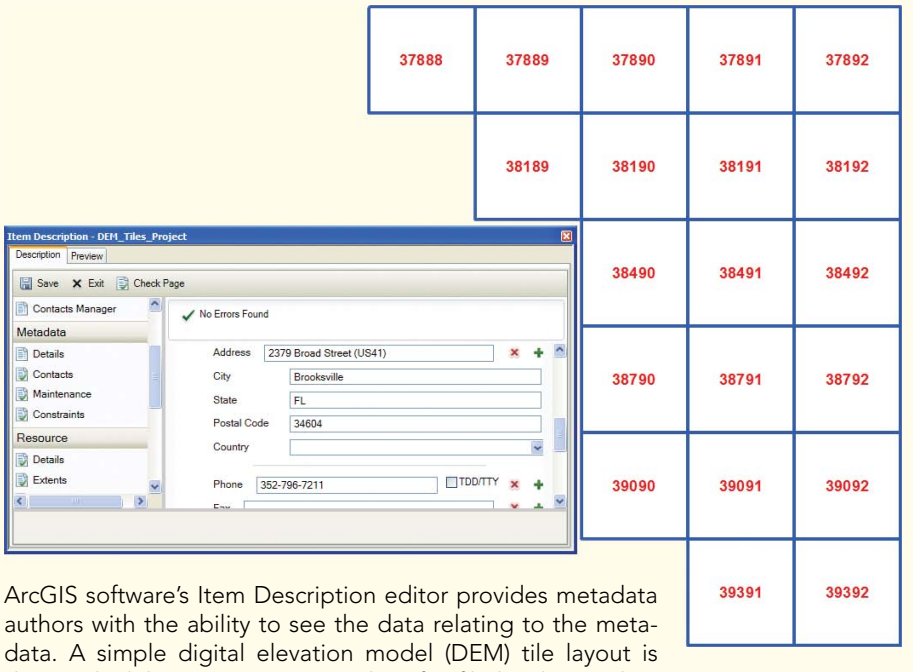
URISA
The Association For GIS Professionals
www.URISA.org

Avoiding Last-Minute Metadata Misery

By Ryan E. Bowe, GISP, GIS Technician II, Photo Science, Inc., and
April H. Davis, GISP, GIS Analyst III, Southwest Florida Water Management District

All GIS professionals have had to read metadata to determine details about the data. And some "lucky" users have had the opportunity to write the metadata. More often than not, this task is not addressed until the end of the project. Just when the end is near, someone usually chimes in with "What about the metadata?"

Everyone dreads eleventh-hour metadata requests. They seem to get tougher every time: the first project required a last-minute Federal Geographic Data Committee (FGDC)-compliant file; the next project mandated completing all optional fields relevant to the dataset. Although few metadata authors are willing to admit it, many are guilty of fixing last-minute metadata requests and then immediately trying to develop amnesia for the entire painful process. The last straw for some might be attempting to use a profile they have never used before. The problem is that no one can predict the future or read minds. Not all the variables will be known until the data you are describing has been completed. When a template is not provided, a metadata author needs a crystal ball to figure out if what they write will be descriptive enough for a user. Excuses will always be plentiful, and writing metadata will always be one of the last steps to completing a project. It's time to stop developing excuses and start planning for last-minute metadata requests.



ArcGIS software's Item Description editor provides metadata authors with the ability to see the data relating to the metadata. A simple digital elevation model (DEM) tile layout is depicted while preparing a template for file-level metadata generation. The Metadata Contact Address section is active and is an example of a section that is predetermined and could be built into a government agency's template.

Develop a Template

For a governmental agency, standard language for the data's usage, distribution information, and contact information is probably predetermined, so why not create a metadata template that already has those fields populated? Templates are the most powerful tools to ease the anguish of last-minute metadata requests. They provide a method of introduction to new software interfaces. While the occasional new requirement will arise, existing templates may provide components of sections that will be the same. For example, projections that are frequently used within an organization can be quickly added.

The Southwest Florida Water Management District (SWFWMD) held a metadata workshop with state GIS professionals and various mapping vendors. The workshop focused on developing an FGDC-compliant metadata template for orthophotos, but the same principles can apply to all types of data. In fact, SWFWMD used the orthophoto metadata template to develop a similar template for lidar. The group agreed on specific details that needed to be included in the abstract, source material, logical consistency, and process steps sections. Going through each of the sections allowed the group to decide on the best information that would benefit everyone. A template that could be distributed to any GIS firm was created; the result was a document that essentially allows users to simply fill in the blanks. When the metadata compiler opens the metadata template file, the information that needs to be populated is immediately evident. As a bonus, there is no need to worry about contact or distribution information, because this has been prepopulated in the template.

Once a new profile has been accepted by an organization, a template is nearly complete. All that remains is the insertion of some form of tag or comment to denote a field that will need to be updated when the profile is used again. Also, with one round of reviews completed, an organization will have a better idea of how users are utilizing the information provided in the metadata. A list of elements that are frequently requested or potentially difficult to populate can be compiled. Most organizations will produce and document the same types of data on a recurring basis. Templates for each data type could be developed. For example, with orthophotos, it could be as simple as having a template for four-band, half-foot; three-band RGB one-foot; and three-band color infrared one-meter templates ready to edit.

Having difficulties constructing the templates? That could be helpful! Learning more about the standard will facilitate better metadata completion. Therefore, it is best to obtain a copy of the metadata documentation to determine exactly which elements are mandatory and which are optional. Also, using an existing metadata file from your organization will help show what type of information is required and to what detail the metadata should be completed, or even perhaps what information is missing. Data stewards within an organization often receive many inquiries for information about the data. If there is a particular detail that is often requested, make sure it is included in the template. Of course, not everyone checks the metadata before calling or e-mailing, but at least having the details available gives the data steward a place to direct the user for more information.

Working with the data users within an organization, as well as with the firm producing the data, to create a template is a win-win situation for everyone. It lets the organization identify all the information it would like within the metadata, and it saves the firm creating the data from looking into a crystal ball to determine its client's exact needs.

About the Authors

Ms. Ryan E. Bowe, GISP, has been working at Photo Science, Inc., of Lexington, Kentucky, for six years as a GIS technician, as well as an alternate sensor operator. She has her bachelor of arts in anthropology and sociology from Centre College of Danville, Kentucky. April H. Davis, GISP, has been working at Southwest Florida Water Management District in Brooksville, Florida, for five years as a GIS analyst. She has her bachelor of science in geosciences from Mississippi State University and her master of science in geography from University of Florida. Both authors participated in the Department of Transportation Metadata Conference, and Davis led the Southwest Florida Water Management District metadata conference in which Bowe participated.

For more information, contact Ms. Ryan E. Bowe (e-mail: rebowe@photoscience.com) or April H. Davis (e-mail: april.davis@swfwmd.state.fl.us). To learn about metadata creation and editing in ArcGIS 10, see **esri.com/what-is-metadata**.

How Modern Geospatial Technology Helps Solve Spatial Problems

New Books from Esri Press

The Esri Guide to GIS Analysis,
Volume 3: ***Modeling Suitability, Movement, and Interaction***
By Andy Mitchell
For someone who has a well-defined spatial problem to solve, *The Esri Guide to GIS Analysis*, Volume 3, can offer considerable guidance on developing an approach or a model that considers not just technology but also goals and criteria surrounding the analysis. The book offers GIS modeling concepts and several sample applications to explore questions of interaction, site selection, routing, and scheduling. Professionals and students of GIS will appreciate Andy Mitchell's latest addition to the successful Esri Guide to GIS Analysis series. ISBN: 978-1-58948-305-7, 432 pp., $44.95.

The GIS Guide to Public Domain Data
By Joseph J. Kerski and Jill Clark
The GIS Guide to Public Domain Data gives GIS users relevant information about the sources and quality of available public domain spatial data. Students, researchers, and professionals will find this book useful as they find, evaluate, and analyze data to solve location-based problems. This guide covers practical issues, such as copyrights, cloud computing, online data portals, volunteered geographic information, and international data. ISBN: 978-1-58948-244-9, 388 pp., $49.95.

Mapping Census 2010: The Geography of American Change
By Riley Peake
Using the latest census data and GIS technology, *Mapping Census 2010* examines how our unique population is moving and changing. The large, full-color maps illustrate population density, age, and racial and ethnic composition with clarity. This book is an invaluable resource for government officials, policy makers, and citizens interested in social change. ISBN: 978-1-58948-319-4, 108 pp., $18.95.

Tribal GIS: Supporting Native American Decision Making
By Anne Taylor, David Gadsden, Joseph J. Kerski, and Heather Warren
This book collects the experiences of several tribal leaders and relates their challenges and successes in implementing a geographic information system. *Tribal GIS* documents how these sovereign nations were able to make better decisions in the areas of natural resources and the environment, transportation, cultural and historical preservation, economic development, health, education, public safety, and agriculture through an enterprise GIS. ISBN: 978-1-58948-3-200, 174 pp., $19.95.

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New Training and Certification Offerings from Esri

Training

New Instructor-Led Foundational Courses
For the past several ArcGIS releases, Esri Training Services has offered three instructor-led foundational courses to teach core GIS concepts and efficient ways to visualize, manage, and analyze geographic data using ArcGIS for Desktop.

With the release of ArcGIS 10.1, Esri has redesigned our foundational course curriculum to extend beyond desktop GIS tools and workflows. The new courses incorporate online and server GIS components to teach the latest techniques and recommended workflows for authoring, sharing, and using geographic information not only on desktops but also across organizations and over the web.

The ArcGIS 10.1 instructor-led foundational course curriculum consists of the three courses below. Together, these courses provide a learning path for new GIS users, who can learn solid ArcGIS skills, and an entry point for experienced professionals, who can learn how to exploit the ArcGIS system to more easily deliver authoritative GIS resources.

- **ArcGIS I: Introduction to GIS—**For those with no prior GIS education or workplace experience
- **ArcGIS II: Essential Workflows—**For those who have an introductory-level knowledge of GIS concepts and limited ArcGIS software experience
- **ArcGIS III: Performing Analysis—**For more experienced ArcGIS users who want to extend their GIS analysis skills

To view the ArcGIS 10.1 foundational course descriptions and class schedules, visit **esri.com/arcgisfoundation**.

Not Upgrading Quite Yet?
Esri recognizes that some users will not be upgrading to ArcGIS 10.1 immediately. The ArcGIS 10 instructor-led courses below will remain available to support those users:

- **ArcGIS Desktop I: Getting Started with GIS (10)**
- **ArcGIS Desktop II: Tools and Functionality (10)**
- **ArcGIS Desktop III: GIS Workflows and Analysis (10)**
- **Building Geodatabases (10)**

Certification

10.1 Certification Exams Coming Soon
Updated 10.1 version certification exams will be added to the existing line of version 10 certification exams very soon. The following 10.1 certification exams are scheduled to be released in 2012:

- **ArcGIS Desktop Associate 10.1**
- **ArcGIS Desktop Professional 10.1**
- **Web Application Developer Associate 10.1**
- **Enterprise Administration Associate 10.1**
- **Geodatabase Management Associate 10.1**

Remember—Esri Technical Certifications never expire, so the decision to recertify at the latest version is always up to you and may depend on the needs of your current job role. Some of the updated 10.1 exams may contain very few changes from their version 10 counterparts, while others may contain more significant changes. Updated 10.1 exams will be released according to exam popularity. Visit **esri.com/certification** for the latest information on certification exam availability.

Which Certification Exam Should I Take?
The best way to decide which certification is right for you is to review the candidate Qualifications, Skills Measured, and Training Resources sections for each exam on **esri.com/certification** to determine which certification your skills and experience align to best.

Need help preparing for your exam? Esri offers two Skills Review courses and sample question sets to help you prepare for the desktop certification exams. For more information about these resources, visit **esri.com/skillsreview**.

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Peru and Mexico—Esri T-shirts at Ancient Icons of the Western Hemisphere

Scott Rawhouser, GIS analyst, Allentown, Pennsylvania, wore his Esri T-shirt while visiting Machu Picchu in Peru. Talk about a high!

Abdiel Quezada, departmental applications specialist, Regional Geospatial Service Center, El Paso, Texas, posed with his Esri T-shirt in front of the Pyramid of the Sun in Teotihuacan near Mexico City. He was acting as tourist guide for a group of friends from the Czech Republic.

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. Upload digital photos at *ArcNews* Online or send via e-mail (tmiller@esri.com). Digital images are preferred, but prints or slides can be sent to *ArcNews* T-shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews* Online at **esri.com/arcnews**.

Scott Rawhouser in Peru.

Abdiel Quezada in Mexico.

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Web GIS Product Engineer—Are you a creative, technically strong web application developer? Join our ArcGIS Online team and bring geographic information to life.

Android Product Engineer—Use your Java and GIS experience to develop sample and demo Android applications and templates and ensure that user requirements are met.

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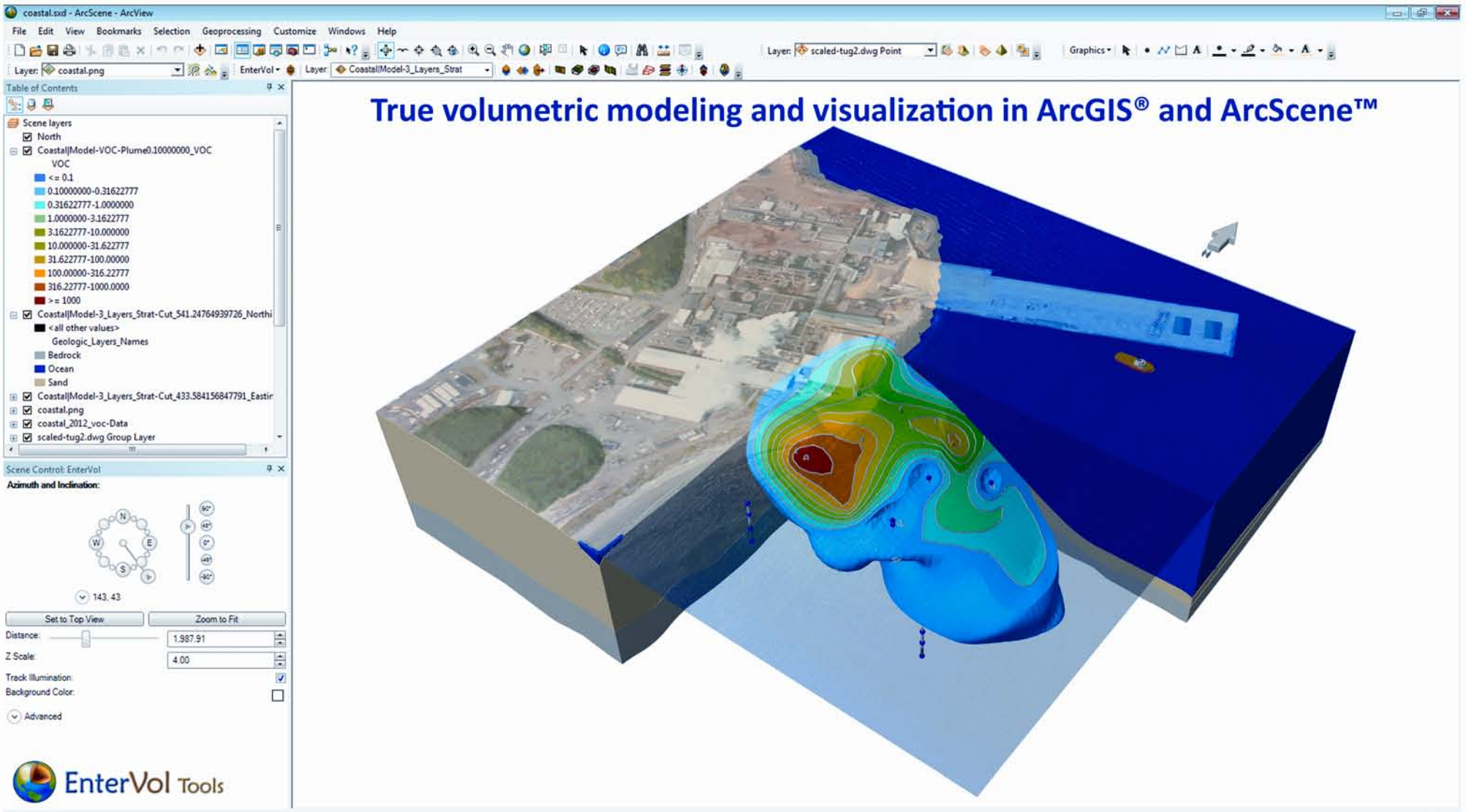

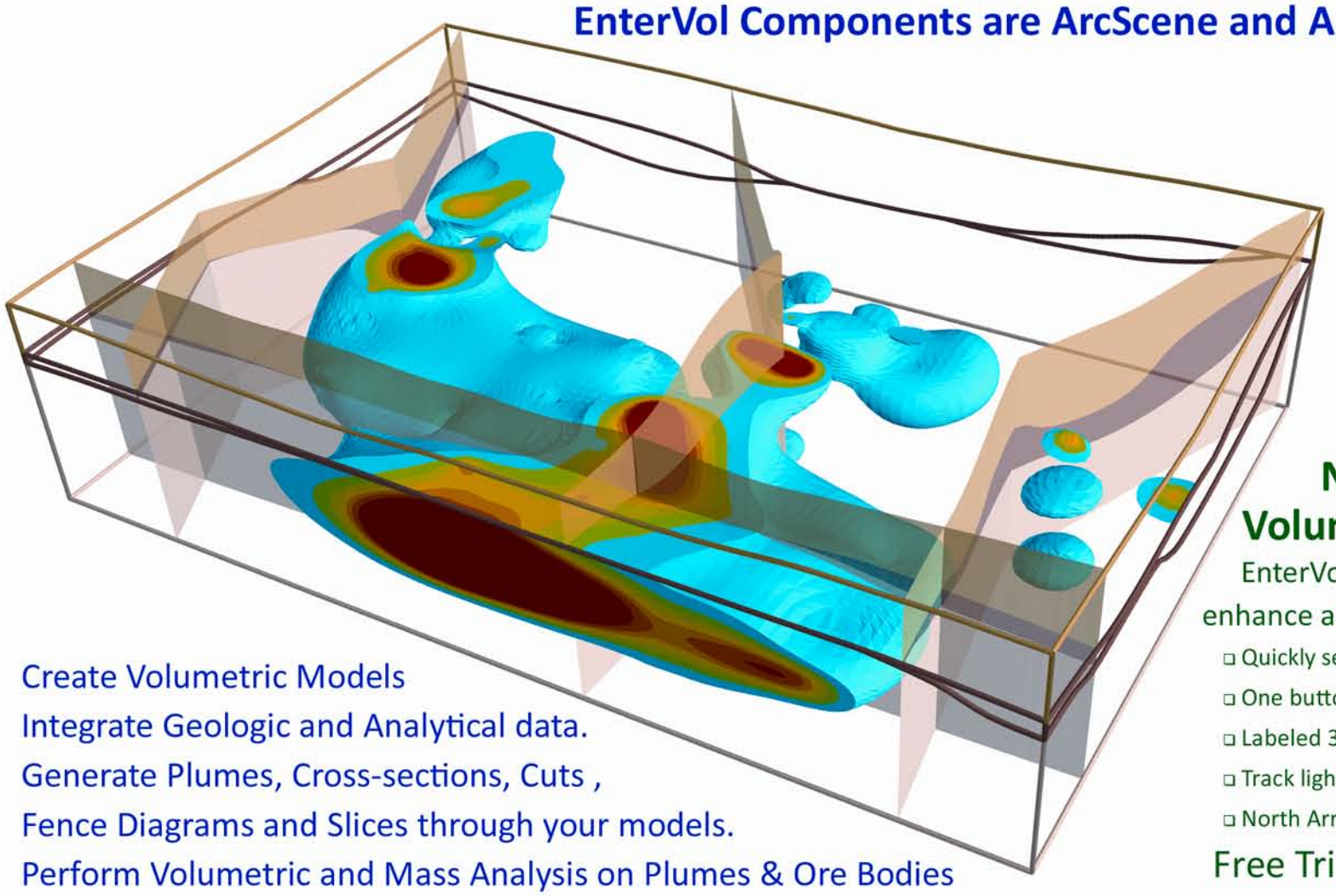

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