ArcNews

Esri | Summer 2015 | Vol. 37, No. 2

Briefly Noted

ArcGIS Pro as a DaaS
ArcGIS Pro can now be deployed as a Desktop-as-a-Service (DaaS), the next phase of virtualization. See the article on **page 4.**

Innovation in public health
With Esri's support, the National League of Cities' 2015 Multi-City Innovation Campaign encouraged developers and community leaders to create scalable solutions in public health that will make cities smarter and change the way they serve citizens. Check out the winners at 2015cityinnovation.populr.me and see which cities will be implementing their solutions.

Identifying water loss
Esri's new Nighttime Flow Analysis Solution, a commercial off-the-shelf (COTS) configuration, helps utilities identify water loss in metered service areas. It helps narrow down areas with high water loss by analyzing household water consumption at night, when water is typically used the least, and finding water that's flowing but isn't reaching a meter.

Transferring data to enterprise systems
Esri and Safe Software partnered to develop and openly share a Common Information Model (CIM) template for data exchange. The template is one approach to translating network data from an Esri ArcGIS database into CIM XML format. The XML can then be shared with other enterprise systems.

Policy Makers Increasingly Use ArcGIS Online to Understand, Explain Issues

The highest levels of government are using ArcGIS Online to better inform decision making and more effectively communicate with the public.

In addition to making ArcGIS a cornerstone of several important policy plans, the White House now frequently uses Esri Story Map apps to more clearly explain government issues. Likewise, a growing number of legislators in US Congress are using online web maps to communicate with constituents about matters that affect their districts.

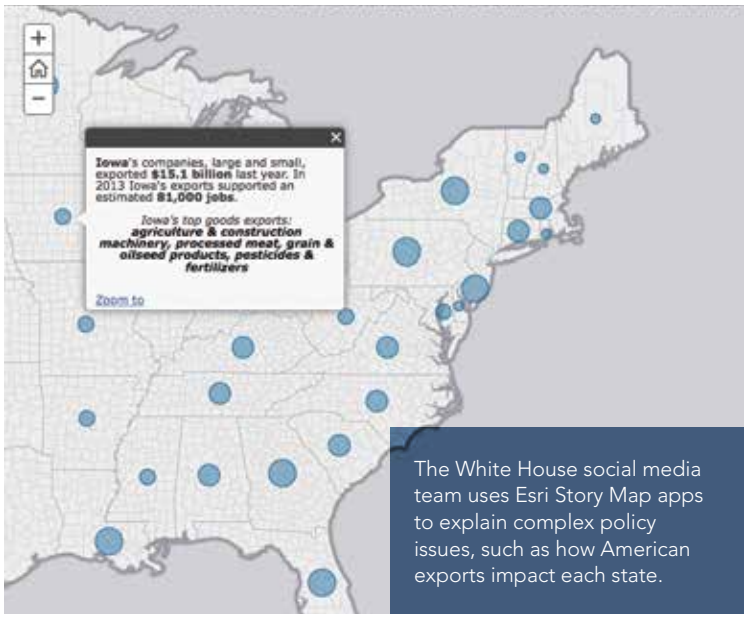
A More Geospatial White House

Over the past two years, Esri has partnered with the White House on several high-priority initiatives that use geospatial data to better understand complex issues and more comprehensibly convey their impacts to the American public.

To help generate resiliency to climate change, Esri is supporting US president Barack Obama's Climate Data Initiative, which uses open data and tools to facilitate better decision making. Spatial data and GIS visualization are key.

"It's important to expose data and then see how technology can inform people of the impacts that are taking place," said Esri technology evangelist John Yaist. "Bringing GIS into the

continued on page 5



The White House social media team uses Esri Story Map apps to explain complex policy issues, such as how American exports impact each state.

AppStudio for ArcGIS: A New Platform for Building Native Apps

ArcGIS users can now easily build native apps that run on any device using AppStudio for ArcGIS, a groundbreaking tool from Esri.

Build an app once, and it runs on Android, iOS, Windows, OS X, and Linux devices.

Already using ArcGIS? Convert your maps directly into native apps that are ready to use.

These beautiful, simple native GIS apps can be shared with the public through all popular app stores or securely within an enterprise.

Expand Your Reach

Companies and organizations—particularly cities and local governments—need to broaden their reach and engage community members with useful content to promote the good work they do.

What if, for example, there was an easy way for residents to report streetlights that have gone out, share and view popular dining spots, or

continued on page 8

↓ AppStudio for ArcGIS lets users build native apps once and deploy them across multiple devices and platforms.

US Department of Commerce Launches Open Data Initiative

In the next step of a major program to make federal government data more accessible, the US Department of Commerce convened a committee of leaders in technology to advise it on open data.

The Commerce Data Advisory Council (CDAC) brings together 19 technology industry leaders from private business, academia, state and local government, and nonprofit organizations to guide the Department of Commerce in revolutionizing its data assets and creating an ecosystem around its data products. The ultimate goal is to foster innovation, create jobs, and spur better decision

continued on page 5

ArcNews

Esri | Summer 2015 | Vol. 37, No. 2

The National Audubon Society used ArcGIS to broaden its data collection and management strategies while keeping true to the organization's decentralized structure. Page 22.

Table of Contents

Executive Editor
Monica Pratt

Editor
Citabria Stevens

Graphic Designer
Takeshi Kanemura

Illustrator
Daniel Gill

Manage Your *ArcNews* Subscription

To subscribe, unsubscribe, or make changes to your Esri publications, please go to **esri.com/updates**.

Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit **esri.com/distributors**.

Article Submission Guidelines

Before writing an article, read and follow the publication guidelines at **esri.com/ansubmission**.

ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100 USA
arcnews_editor@esri.com
Tel.: 909-793-2853, ext. 1-2730
Website: esri.com/arcnews

ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA. *ArcNews* is written for the Esri user community as well as others interested in mapping and geographic information system (GIS) technology. It contains material of interest to planners, foresters, scientists, cartographers, geographers, engineers, business professionals, and others who use spatial information.

Map Gives New Insights into Global Population

Esri's World Population Estimate Is Now Available in ArcGIS Online

By Charlie Frye, Esri Chief Cartographer

Knowing where people live is important. During a natural disaster, having information on the size and location of the impacted population facilitates better response and recovery. In a disease outbreak, being able to tell where people are acquiring the disease—and whether certain populations are in its path—is crucial. In ecological studies, humans are often the primary source of disturbance to naturally occurring habitats, so knowing where people live is instructive.

Esri has developed a new way to estimate global population—and it is now available in ArcGIS Online. This method combines information from datasets on global land cover, roads, and placenames to produce a probability surface. The probability surface is calibrated using census data and, where there is none, national population estimates to calculate residential population.

This World Population Estimate (WPE) map, originally released in December 2014 with an update scheduled to come out summer 2015, is the brainchild of Earl Nordstrand, a senior researcher at Esri with more than 35 years of experience in geography and GIS. A geographer by training, Nordstrand has always been interested in demography and spatial analysis. For years he led Esri's data team, which produced the first versions of Business Analyst, a complete GIS software system that helps businesses understand customers, competition, and market trends. Over the past few years, however, he has worked exclusively on refining the model for producing global population estimates.

Why the WPE Is Unique

The WPE is different from other estimates of global population, though they all have their merits. For instance, the Gridded Population of the World (GPW) dataset from the Center for International Earth Science Information Network (CIESIN) at Columbia University illustrates the distribution of humans around the world, but the dataset is based on census data so it does not get very specific in locating rural populations. LandScan, from Oak Ridge National Laboratories, models ambient population—where people are located on average over a 24-hour period—which essentially shows where people are during the day but not where they live at night.

The WPE, an analysis-friendly raster surface, displays where people live—and establishes where people do not live.

How the WPE Works

Nordstrand's method starts with land-cover data from MDA Information Systems LLC's NaturalVue, natural-color satellite imagery of the world capable of defining areas with surface water and permanent snow or ice—that is, places where people do not live. These locations can be eliminated from the WPE's population estimates. Nordstrand's method also uses a texture-detecting model to find areas with high levels of texture, often indicating buildings and roads, which suggest where people may live.

Nordstrand uses additional data, such as road intersections and areas with extreme climates, to increase the specificity of where people are likely and unlikely to take up residence. To avoid arbitrarily eliminating known populated places, he uses place-name points from GeoNames, a geographic database that contains more than 8 million location names. But that does not define how large or spread out these places are, so Nordstrand employs census data where it exists to do that. In some cases, census data identifies airports, industrial complexes, and the like—more places where people do not live.

Based on this, plus additional information sources, each cell in the WPE raster is populated with an estimated count of people living within that cell.

Where People Live

Using data from 1990 to 2013, the WPE estimated that the number of people in the world in 2013 was 6.89 billion, which is consistent with other world population estimates for that time. When Esri staff evaluated the data, they found that if they defined urban areas with a density of 2,500 persons per square kilometer, then the WPE shows that 55.5 percent of the world's population is urban, while 41 percent is rural.

Per the World Bank, the earth contains a little more than 129.7 million square kilometers of land area (not including inland bodies of water or Antarctica). The WPE shows that humans live on 7.9 percent of this land area, with urban areas occupying only 0.56 percent of the earth's surface. That means that more than half of the world's population lives on less than 1 percent of land area.

Ongoing Development

The WPE is still being expanded and improved. In the map's initial release, Esri staff assessed that the information about the remaining 3.5 percent of the population, ostensibly living in very rural areas, is unreliable. This is because in areas where the number of people estimated to be living within a cell is fewer than 25, the land-cover data was not very accurate, making texture detection more difficult. For example, in agricultural areas, many textures being identified are barns and outbuildings. As textures, they increase the probability that more people live there; but in this case, that probability may be artificially high.

Nordstrand acknowledges that the WPE's first release contains some uncertainties about extremely rural areas. Indeed, he has already addressed this by weighting each land-cover class (grassland, urban, or water, for example) with a baseline probability so that when a texture is detected, the WPE will know that human settlement is most likely the reason for it. Additionally, Nordstrand began using a new, higher quality land-cover dataset from MDA called BaseVue as the basis for land-cover classification. The resultant estimate will be available in summer 2015.

Using the WPE

The WPE yields new ways of looking at the world's population. For instance, it can find the world's most crowded locations while excluding political boundaries and biases. In fact, the five most crowded places on earth, irrespective of city borders, are Jakarta, Indonesia; Delhi, India; Dhaka, Bangladesh; Tokyo, Japan; and Shanghai, China. According to political boundaries, however, Tokyo is the largest, followed by Jakarta.

The WPE's calculation of crowdedness works by using ArcGIS to count the people within certain radii of each one-kilometer cell of Nordstrand's data. To give a practical example, Los Angeles, California, is only the twenty-fifth most crowded city in the WPE when the analysis is run with a 40-kilometer radius. That is because there is no location within or near the city's WPE cells that has even half as many people as there are within a 40-kilometer radius of cells in the top five cities for this measurement.

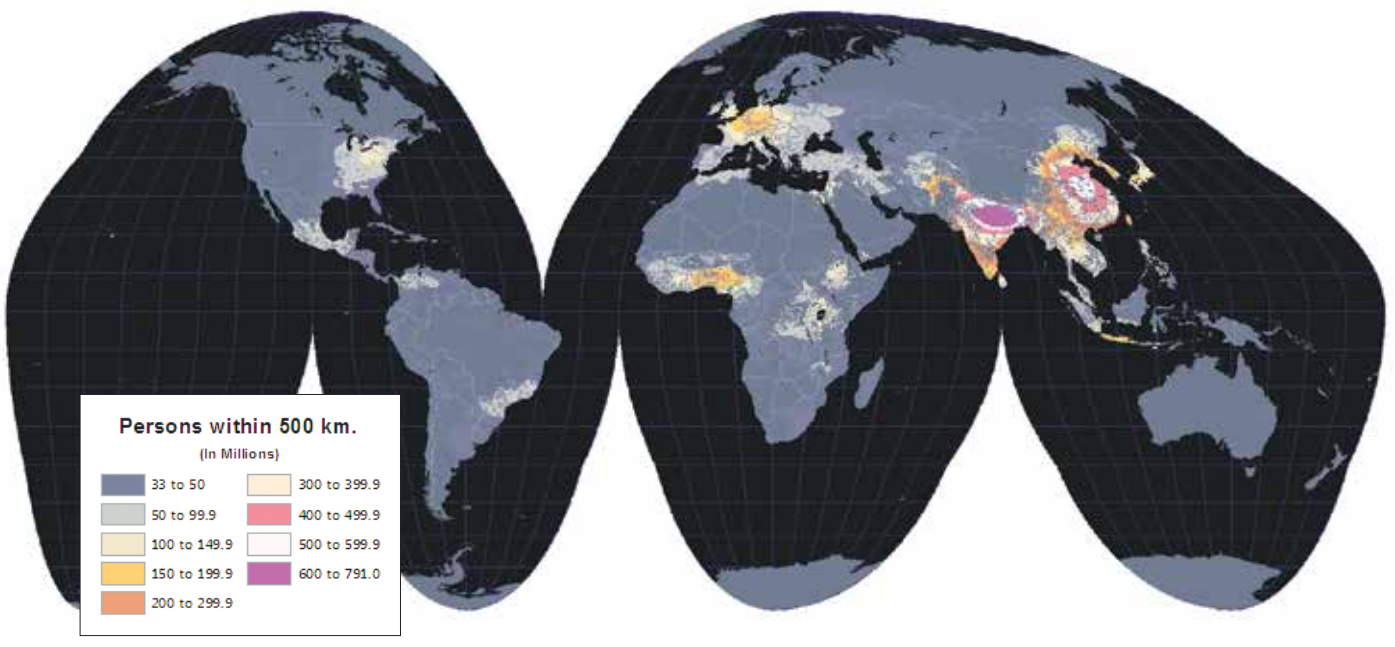
The Bigger Picture

Objective global population datasets such as the WPE are essential for analyzing how humans—as agents of change, stewards of land, and consumers of resources—affect their surroundings and the state of the earth. And with more attention being given to climate issues, with mandates such as US president Barack Obama's 2013 Climate Action Plan and the US Congress's 2014 Global Climate Change Initiative, being able to understand global issues in unbiased, comparable ways is becoming more important.

In addition to the WPE, Nordstrand's method produces a set of point features with population counts. With nearly a billion locations represented, these point features are big data. The geographic data enrichment tools that add demographic and lifestyle data to maps depend on those points to describe the characteristics of local populations in countries that lack censuses or that do not make detailed census data available. Esri uses these point features behind the scenes in software such as Business Analyst Online, Community Analyst, and Esri Maps applications.

It is Esri's hope that people will use the WPE, plus additional global datasets in ArcGIS Online, to gain more awareness about what it means to have 7.3 billion people on earth today.

Users with ArcGIS Online organizational accounts can access the World Population Estimate for free and use it throughout the ArcGIS platform to help with visualization and analysis.



Continental Population Centers in 2013
Estimate based on the sum of people within 500 km.

↑ Running a World Population Estimate map analysis using a 500-kilometer radius, northeastern India has the largest population in the world, followed by eastern China.

Using ArcGIS Pro in DaaS Cloud Environments

Technology and IT trends are propelling companies and organizations to virtualize their physical desktops, making it easier for employees to work from anywhere and still be able to access all of their organizations' internal websites and applications.

ArcGIS Pro, the newest addition to the ArcGIS for Desktop suite, is a modern, 64-bit, multithreaded application that provides integrated 2D and 3D spatial analysis and visualization in one package. As with ArcMap, ArcGIS Pro is expected to be successfully virtualized by countless companies and organizations.

At Esri, ArcGIS Pro has been heavily tested in all major virtual desktop infrastructure (VDI) platforms. This includes VMware Horizon with View, Citrix XenDesktop, and Microsoft's Hyper-V VDIs. Testing has found that in some cases when ArcGIS Pro is used with 2D data, the user experience is fine without a graphics processing unit (GPU). When ArcGIS Pro is used with complex 2D data and any 3D data, however, a GPU is needed.

Delivering that user experience on a physical workstation is relatively easy with common hardware such as a GPU integrated with a computer's central processing unit. Getting that same level of user experience—or perhaps even better—is also possible in a virtualized environment. The major virtualized environments employ shareable GPU technology, such as the NVIDIA GRID cards, to deliver that user experience.

The Next Phase in Cloud-Based VDI—DaaS

Many companies are now considering the next phase of virtualization: cloud-based VDI, where a centralized server hosts desktop operating systems within a number of virtual machines. Desktop-as-a-Service, or DaaS, is a VDI delivered by a cloud computing provider. The provider supplies the hardware, operating system, and management capabilities needed to run the virtual desktops—though operating system licensing does vary among providers.

Companies can then customize the virtual desktop supplied by the DaaS provider. They can add the business, application, and utility software their end users need, including Microsoft Office and ArcGIS for Desktop, and any necessary data.

A DaaS can be used when a small business or consulting firm needs temporary employees for a short-term project or when an organization needs to give some permanent employees short-term access to certain programs such as ArcGIS software. For example, if a project requires 10 additional GIS analysts for six months, instead of purchasing desktop workstations and software licenses for the employees and then installing and configuring the software and maintaining the workstations, the company can give its temporary users a DaaS workstation that is ready to go on day one. The virtual desktop is centrally maintained during such a project and then simply removed from the computers when the assignment is over.

ArcGIS Pro in DaaS Now

ArcGIS Pro delivers a great interactive experience when working with 2D and 3D data. When users pan and zoom, the smooth animation feels remarkably gamelike. These visualization capabilities are also a way users can measure how well the program works in DaaS.

ArcGIS Pro has been preinstalled in several leading DaaS deployments, including NVIDIA Test Drive (www.nvidia.com/object/vmware-trygrid.html). Allocated from multiple data centers around the world, NVIDIA Test Drive furnishes an entire Windows desktop with multiple graphics-intensive applications already installed to demonstrate how graphics-intensive applications can be successfully delivered and provide an impressive user experience.

ArcGIS Pro is one of the installed graphics-intensive applications. Its rendering engine, which uses DirectX or OpenGL libraries to render, drives the program's fluid, highly animated visualization. Those are the same libraries used for gaming software, and when used with GPUs, their capabilities are maximized.

The ArcGIS Pro user experience in the NVIDIA Test Drive DaaS is enhanced because the virtual desktop provided by the DaaS is supported by a shareable GPU. The NVIDIA Test Drive environment uses NVIDIA GRID cards that are specifically designed for virtualization environments.

Putting ArcGIS Pro in DaaS

To successfully deploy ArcGIS Pro in a DaaS, there are a few important considerations to keep in mind.

Using 2D data that is relatively simple and doesn't have symbology does not typically require a DaaS supported by a GPU. For more complex 2D and 3D data, however, it is necessary to use a shareable GPU-supported DaaS.

When a shareable GPU is required, the DaaS provider must be able to support the use of a GPU such as a NVIDIA GRID K2 card in its hypervisor. This can have a dramatic impact on the end users' experience. Although many large DaaS providers do not yet provide shareable GPU support, the ones that do include Europe's Cloudalize and Exponential-e and the United States' NaviSite. Moreover, existing providers are extending their service areas into more geographic regions, and new providers are scheduled to come online.

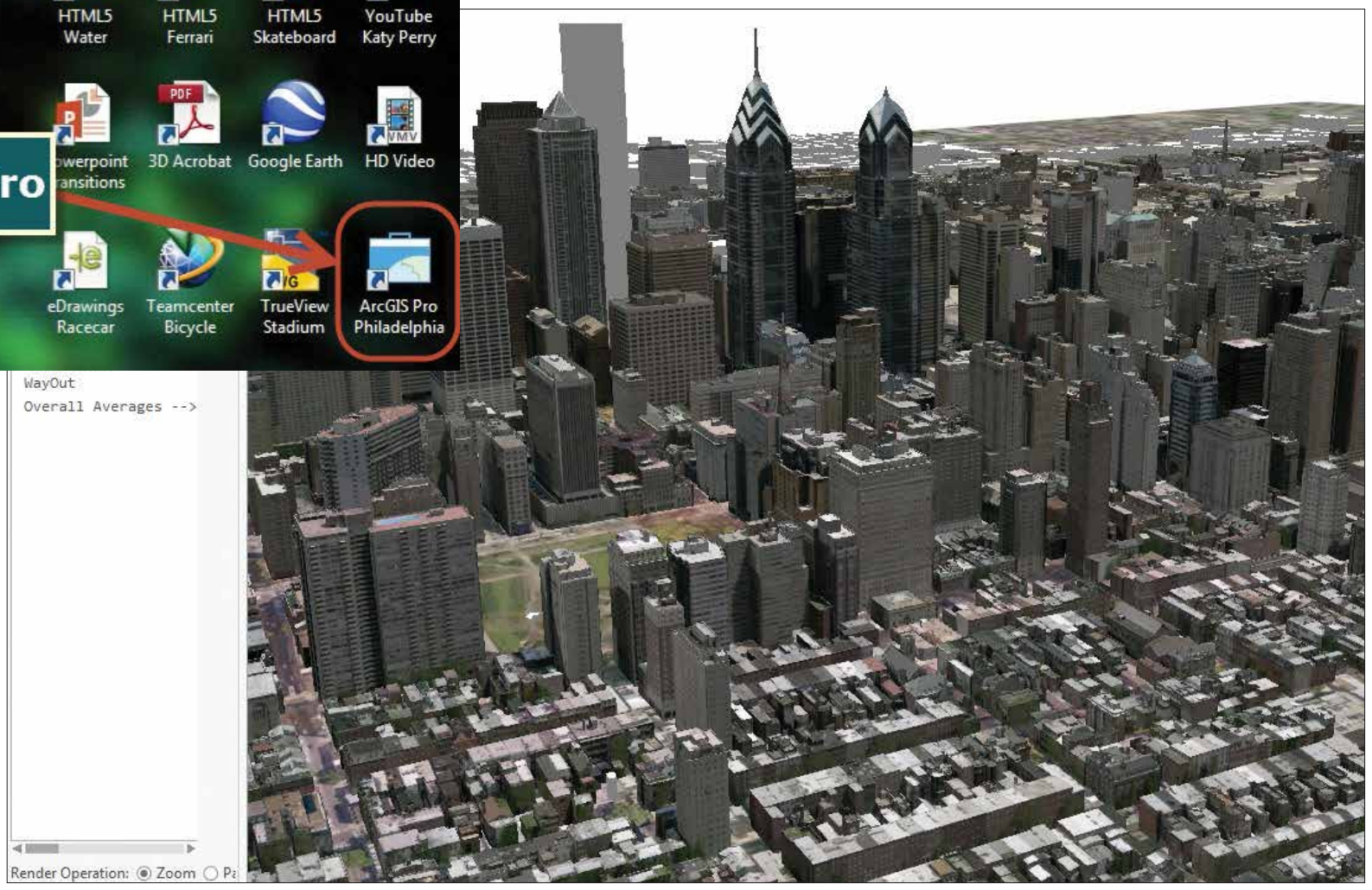
Where to Go from Here

DaaS is a trend that will only continue to grow as more companies migrate from physical desktops in the office to on-premises VDI environments and cloud-based DaaS. Keeping up with this progression will require confronting myriad challenges, but the evolution will not stop or be redirected.

ArcGIS Pro can be deployed into a DaaS environment and deliver a great user experience. There are many providers and options available to make that happen now. Esri is working with several DaaS providers to determine the levels of user experience they offer through their services so that Esri and these providers can work together to provide best practices, configuration, and guidance to users.

Find more on ArcGIS Pro in DaaS and virtualization environments at blogs.esri.com and pro.arcgis.com.

↑ ArcGIS Pro has been preinstalled in several leading Desktop-as-a-Service, or DaaS, deployments, including NVIDIA Test Drive.



→ Esri has tested ArcGIS Pro in all major virtual desktop infrastructure (VDI) platforms. The user experience is fine without a graphics processing unit (GPU) when using basic 2D data, though a GPU is needed when using complex 2D data and any 3D data.

Policy Makers Increasingly Use ArcGIS Online to Understand, Explain Issues

continued from cover

forefront offers new ways of thinking and looking at information so we can try to solve some of these problems."

The White House has partnered with Esri on several associated initiatives, including using GIS to help communities recover more quickly from natural disasters; make Americans more resilient to fluctuations in the food supply; encourage water conservation; investigate climate change impacts on ecosystems; and, most recently, see how climate change affects health.

To encourage innovation and greater engagement on this front, Esri is sponsoring its second climate change app challenge that focuses on climate change and health. The goal is to help hospitals and health systems better anticipate, understand, and address climate impacts on community health. Esri is giving developers free access to open-data services and its developer tools.

Esri is also participating in Obama's recently launched Police Data Initiative, which entails having 21 American cities release 101 datasets on topics such as use of force and officer-involved shootings. The program seeks to use open data to strengthen police accountability, reduce police brutality, and ultimately rebuild community trust. To make this happen, Esri and the Police Foundation are building the open data portal the public can use to access this police information.

GIS is also a central component of Obama's ConnectED Initiative, which aims to improve learning and better prepare American students for the twenty-first-century job market by getting them to use state-of-the-art technology. With Esri's donation of $1 billion worth of ArcGIS Online accounts, plus teacher training, to K–12 schools across the United States, geospatial thinking will become the norm for the next generation.

The White House has embraced ArcGIS Online in its own work as well. Story maps made with Esri software populate various White House initiative websites, such as its page on rebuilding America's infrastructure. The social media team also regularly uses story maps to explain complex policy issues, such as how American exports impact each state and the difference between two budget proposals. By giving these data-filled storylines geographic context, the White House's story maps allow people to better understand how decisions at the highest levels of government could affect their everyday lives.

Congressional GIS

The White House is not the only federal government branch setting a precedent with GIS. Congressional offices have begun employing ArcGIS Online more regularly too.

Senator James Risch (R-Idaho), cochair of the GIS Senate Working Group, is a driving force in urging more government officials to use GIS. Risch has a robust ArcGIS software-based map gallery on his website that illustrates issues ranging from high school graduation rates and active wildfires across Idaho to projected state population growth.

Other government leaders are incorporating GIS into their communication strategies as well. Senator Ron Wyden (D-Oregon), also cochair of the GIS Senate Working Group, supported his collaborative Better Care, Lower Cost Act by having his office use ArcGIS Online to show that many Medicare beneficiaries who suffer from chronic illnesses lack access to integrated models of care. The office of Representative Mark Takano (D-California) similarly used Esri software to show gaps in access to public transportation in the congressman's district. And Senator Sherrod Brown's (D-Ohio) office uses ArcGIS Online to develop and share maps on topics such as potential job gains across Ohio, structurally deficient bridges in each county, and locations where Ohio residents can safely dispose of prescription drugs.

ArcGIS Online: An Indispensable Government Tool

As the White House and members of Congress increase their use of GIS and, specifically, ArcGIS Online, decision makers and the general public will continue to gain a more comprehensive perspective on complex government issues.

Learn more about how the ArcGIS platform can help inform and manage government activities at esri.com/industries/government.

US Department of Commerce Launches Open Data Initiative

continued from cover

making. Esri president Jack Dangermond is among those selected to participate.

The creation of CDAC is the next step in the Department of Commerce's effort to more robustly realize its capacity as America's data agency. With data-heavy agencies such as the US Census Bureau and the National Oceanic and Atmospheric Administration (NOAA) under its jurisdiction, US Secretary of Commerce Penny Pritzker believes that if the department partners more wisely with the private sector—especially via a common platform—its data can make governments smarter, businesses more competitive, and citizens better informed. It may even help inject more than $3 trillion of additional value into the global economy, according to a study published by consulting firm McKinsey & Company.

"The Department of Commerce has the tools necessary to develop, test, and grow the next phase of the open data revolution," said Pritzker in a speech at the 2014 Esri User Conference, where she announced her plan to hire the department's first chief data officer and subsequently convene the council.

The US federal government and other governments around the world are increasingly embracing the open data movement, making their data freely available to other governments, agencies, university researchers, and the private sector. And they are learning from organizations that have already made headway in this realm.

A number of companies in the private sector have leveraged open data to foster innovation. Zillow, the American real estate information website, not only provides detailed property information to real estate professionals and homeowners, buyers, and renters but also openly publishes real estate and rental data for anyone who wants to take a deeper look at the numbers. Commercial weather companies have historically used a range of weather data—from NOAA datasets and international forecasts to satellite imagery and surface observations—to plan shipping routes; analyze climate change; and, of course, forecast weather.

The world of geospatial information, however, is just beginning to be heavily leveraged—and Esri is at the helm. ArcGIS Online, for example, gives users access to a trove of Esri- and contributor-based maps and datasets, which can be combined in myriad ways to give geographic context to any situation or issue. And with ArcGIS Open Data, a free technology for all ArcGIS Online subscribers, users can make their own data available to the public in various formats, including streaming services and multiple-format data downloads. Open Data allows organizations to build open data portals hosted on their own websites. Esri's Open Data website (opendata.arcgis.com) is also a portal where the public can search open data in a comprehensive commons environment.

Already, almost 1,900 organizations worldwide have embraced Open Data, including around 250 cities and more than 200 counties, and have shared more than 26,000 open datasets.

↑ US Secretary of Commerce Penny Pritzker spoke at the 2014 Esri User Conference, where she announced her plan to convene a council of technology leaders to advise the department on open data.

While open data is now becoming a cornerstone for Department of Commerce bureaus and offices, many of them have actually been making their data available to the public via the ArcGIS platform for years. Not only does data from NOAA and the Census Bureau infuse maps and layers in ArcGIS Online, but NOAA also leverages ArcGIS Online to access its GeoPlatform, which lets anyone browse story maps on topics such as rising sea levels, ocean economies, and how offshore minerals coalesce with coastal tourism.

With CDAC aiming to make Department of Commerce data easier to find, access, use, and combine with other datasets, geospatial data will become an even more valuable form of information. Esri users will also benefit from access to additional open data sources.

As Andrew Turner, Esri's chief technology officer for research and development in Washington, DC, said, "Location is a common context across all the different domains that data touches, and if we can bring Esri's perspective and geospatial focus [to CDAC], it can bring a lot of geographic context, expertise, and insight to the project."

Esri Developer Summit Offers an Equation for Smart Geosolutions

Besides great technical skills and creativity, what makes a good developer? According to Esri president Jack Dangermond, it's having a sense of curiosity.

"One of the things that makes you special is that you are *interested*, not simply *interesting*," Dangermond told 1,800 developers gathered for the 2015 Esri Developer Summit in Palm Springs, California, in March.

Success comes "when software developers are interested in solving problems," said Dangermond. "You get it right, you get it clear, and you understand what the problem is. Then, using your algorithms and tools and creative thinking, you come up with the solution to what's needed and wanted."

Dangermond said it's imperative to mentor the next generation of creative and curious developers. One person dedicated to doing that is will.i.am, the global music artist, philanthropist, and tech entrepreneur. Besides creating a tech company, he is supporting young people studying technology and encouraging them to get involved in tech.

"A couple of years ago," Dangermond told the audience, "I became friends with a very special person: will.i.am. He is not only one of the greatest entertainers in the world—he [cofounded] The Black Eyed Peas—but he is also a genius with respect to tech. He's building various kinds of wearable devices, and his development team is embedding geography into personal devices."

↓ Music artist, philanthropist, and tech entrepreneur will.i.am spoke with Esri president Jack Dangermond about getting young people to develop new technologies and build tech companies.

Calling in via Skype, will.i.am spoke with Dangermond about the importance of getting young people interested in being tech developers and entrepreneurs.

The fashion/tech company i.am+, which will.i.am founded, is currently developing the PULS smartband, which includes maps and routing supported by Esri ArcGIS. will.i.am also wants young people to follow in his footsteps, developing new technologies and building tech companies. So he has thrown his support behind at-risk students at Roosevelt High School in his hometown of Boyle Heights in East Los Angeles, California, through his i.am.angel foundation program called i.am College Track. Working with Dangermond and other giants in the tech world, the program provides students with software, such as GIS tools, along with hardware for class projects.

His efforts began, said will.i.am, after he attended a tsunami relief event several years ago. "I realized there is a tsunami every day in the neighborhood that I come from," will.i.am said. "It's a tsunami of neglect; no education, no funding, no type of real skill sets to prepare these kids for tomorrow."

Today, many students in the i.am angel foundation's Science, Technology, Engineering, Arts, and Math (STEAM) initiative have increased their grade point averages and are building mapping and other types of apps and working on robotics projects. Some i.am College Track students who graduated from Roosevelt High School with top grades are attending the University of California at Irvine on full scholarships, said will.i.am. The i.am.angel foundation also sponsors i.am STEAM hackathons to teach students how to code. One event, the CodeDay LA Hackathon, was held recently at the i.am+ headquarters in Los Angeles.

will.i.am said he hopes the students use the computer and other tech skills they learn to improve their communities. "I would tell the kids, 'Don't try and get out of the ghetto. Let's try and change the ghetto forever. Let's be the [community] developers. Let's educate ourselves and transform our neighborhoods.' "

Dangermond urged the audience to take their inspiration from will.i.am and mentor young developers. "Share your talent," he said. "A big interest we have is growing the next generation of developers. We need to invest in those people who will solve the problems."

Mobile App Development: Joys and Sorrows

One of the problem solvers in mobile app development is John Tomizuka, cofounder and chief technical officer of Taqtile, a mobile app development firm based in Seattle, Washington. Taqtile has developed apps for online retailers, President Obama's inauguration in 2012, and NBC's coverage of the wedding of the United Kingdom's Prince William to Kate Middleton in 2011.

Tomizuka took the stage to talk about the trials and triumphs of developing mobile apps. He exhibited two mobile app designs: one that he called narcissistic and another that he said was empathetic. He advised developers to avoid being narcissistic, developing for themselves, and

← Tom Sellsted, from the City of Yakima, Washington, used the developer edition of Web AppBuilder for ArcGIS to create a widget that displays a running total of the segments measured.

instead opt for being empathetic, developing for their end users. "[Not] putting yourself in someone else's shoes . . . is deadly for mobile apps."

As an example of a narcissistic app, he used one that Taqtile designed for the 2012 Democratic National Convention in Charlotte, North Carolina. The app included a feature that allowed users to point their cell phone cameras at a logo of the City of Charlotte to get more information about the area. However, that idea was driven by someone who worked for the city rather than by the user. "That's not thinking about your user," he said. "That's not being empathetic."

He contrasted that with developing a mobile app for Netshoes, an online sporting goods retailer in Brazil. Taqtile interviewed potential app users and collected data on how they used e-commerce apps. The app was a hit, with one of the most successful aspects being a real-time chat feature that let the customers chat with a Netshoes employee about a product or the status of an order.

"This is a big success," said Tomizuka, adding that the app had 750,000 downloads and 500,000 active monthly users and generated a large number of purchases.

Working Collaboratively

Geosolutions are needed to solve the world's major problems, and Esri wants to work cooperatively with developers as the company builds technology to tackle those issues, Dangermond said.

Since knowledge about Esri's code will be key, Esri will continue to pop open the hood of ArcGIS technology to help geodevelopers build great things. "Our technology is modular and structured into thousands of components," Dangermond said. "These are the components that Esri's developers use to build the platform. In the last couple years, we've opened up that structured code—some with open source and APIs—so that you guys develop with exactly the same code that our own software engineers do." Dangermond said he wants developers to be Esri's colleagues in advancing geosolutions. "We want you to be . . . part of the fabric of what we're working on," he said.

Christopher Moravec, director of products for Eagle Information Mapping (an Esri Gold Tier partner) in Houston, Texas, likes Esri's philosophy of working collaboratively with developers like himself while always upping the ante and improving ArcGIS.

"I like the culture of the company—to push the [technology] limits," said Moravec, whose firm creates data management and analysis tools for companies with oil and gas pipelines.

A collaborative relationship also makes developing geospatial solutions easier, said Moravec, who uses the entire ArcGIS platform with ArcGIS for Server as the core. "I'm focusing on my industry and my needs while Esri provides basic functionality such as the mapping, disconnected editing, and analysis [tools]," he said. "Esri does the hard part, and I do the fun part."

Trending at DevSummit

Esri director of software development Sud Menon kicked off the technology demonstrations by providing a holistic overview of the ArcGIS platform.

He explained how the platform includes ArcGIS for Desktop, apps, and APIs powered by ArcGIS Online and ArcGIS for Server in the cloud or in an organization's infrastructure. "We have been working hard on building a cohesive platform that knits all these elements together for enterprises, organizations, developers, and their audiences," he said.

He highlighted Esri's new 3D web GIS technology, which includes web scenes that represent 3D maps. Scene layers depict features displayed in 3D including points, lines, polygons, 3D objects, and 3D meshes. "You can also work with map and image tiles and dynamic map and image layers," he said.

Menon emphasized the platform's ready-to-use maps, apps, imagery, demographic information, and other data that Esri offers. The apps include Esri Story Map apps, Explorer for ArcGIS, templates, Operations Dashboard for ArcGIS, Collector for ArcGIS, GeoPlanner for ArcGIS, Esri Maps for Office, Web Scene Viewer, ArcGIS Open Data, and a crowdsourcing solution template.

Menon also underscored the recent release of ArcGIS Pro, the new application in ArcGIS for Desktop that provides powerful analysis, editing, and visualization in 2D and 3D, and a guided workflow called Tasks—preconfigured steps that walk users through a business process. "We are excited about [ArcGIS] Pro and the power it brings to people who need to do analysis on the desktop," he said.

To help people quickly build apps, Esri released Web AppBuilder for ArcGIS, which is also available as a developer edition that provides an extensible framework for creating custom widgets and themes. "It allows you to build HTML/JavaScript applications by using a predefined gallery of widgets," Menon said. "This is something we had a lot of requests for. As a developer, you can also extend this framework by creating your own widgets."

That is exactly what Tom Sellsted did. A supervising senior analyst for the City of Yakima, Washington, Sellsted said he always leaves the summit with tools, techniques, and insights from peers and Esri staff to create new information products.

"For me, you can't walk away from here without being inspired," said Sellsted, who used the developer edition of Web AppBuilder for ArcGIS to build a custom measure widget for his organization. The widget provides a running total measurement for each segment (e.g., area units, such as square feet, square miles, or hectares, or distance units, such as feet, meters, and miles) as it is being drawn.

Sellsted took advantage of Esri's hood popping. "This was based on an [Esri] draw widget," he said. "I copied the code in order to create a new kind of measure widget."

Other well-received technology at the summit included smart mapping in ArcGIS Online, which helps people quickly make beautiful, useful maps with the data they have on hand. With data-driven workflows, smart mapping provides smarter initial settings for the map being made, including color, scale, and styling.

"Some cartographic options just aren't appropriate," said Mark Harrower, an Esri product engineer. "The software is offering the right choices at the right time."

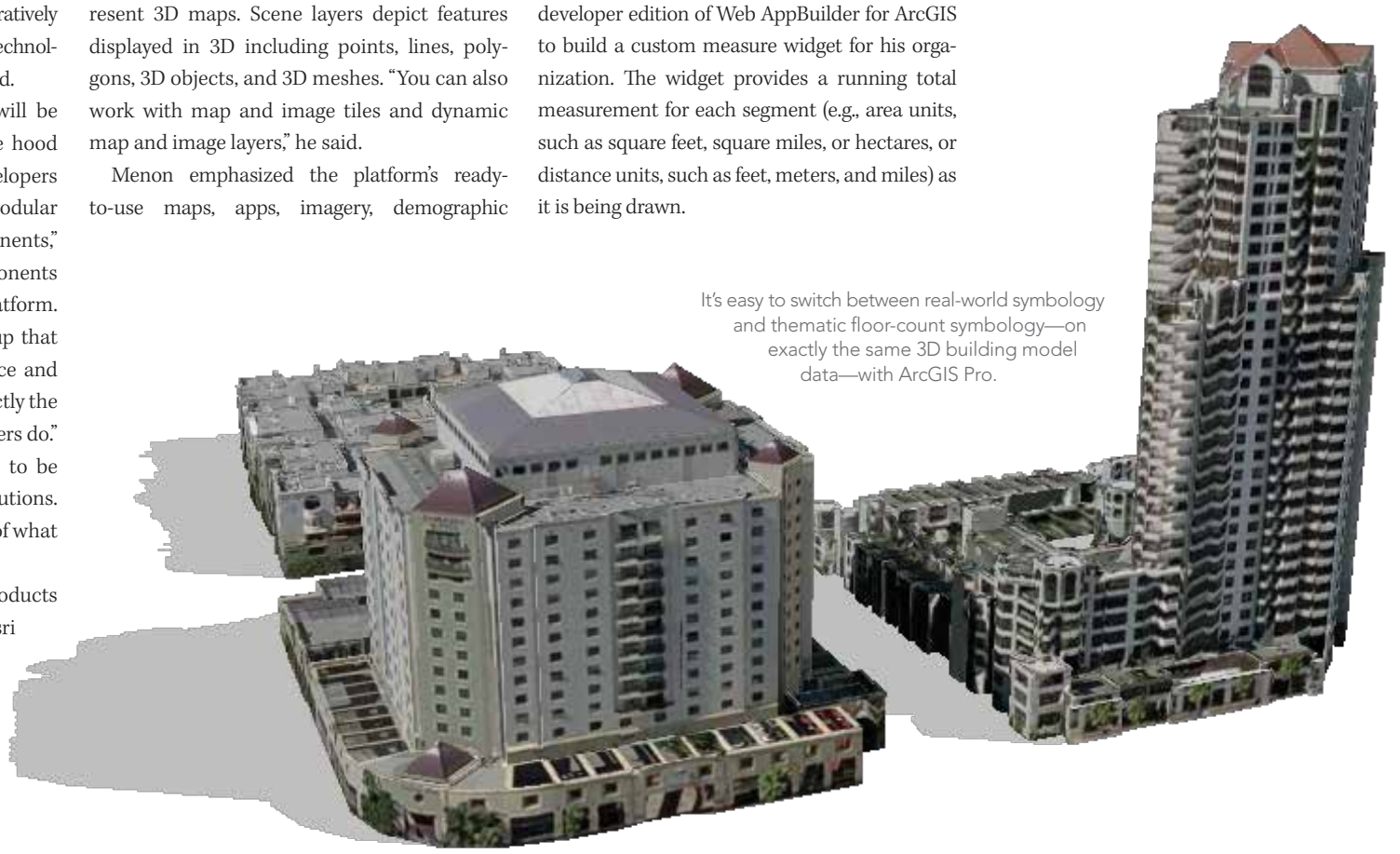
The audience clapped when Esri's Marc-Olivier Briat announced that later this year Esri would support creating and displaying maps in the vector tile format, which enables fast, high-quality display of content and reduced cache sizes.

Another crowd pleaser was AppStudio for ArcGIS, which developers can use to build a single mapping app that will run natively on multiple platforms, including Microsoft Windows, Apple iOS and OS X, Android, and Linux.

In closing the technology demonstrations, Jim McKinney, Esri ArcGIS program manager, told the audience that in 2015, Esri will have in place a huge amount of innovative capabilities for developers. "Think of the entire platform as your development space," he said.

Esri's next developers' summit, DevSummit Europe, is happening November 10–12 in Berlin, Germany. To register, visit esri.com/events/devsummit-europe.

The next Esri DevSummit in Palm Springs will be held March 8–11, 2016, with preconference training sessions scheduled March 6–7. Visit esri.com/devsummit for more information.



It's easy to switch between real-world symbology and thematic floor-count symbology—on exactly the same 3D building model data—with ArcGIS Pro.

AppStudio for ArcGIS: A New Platform for Building Native Apps

continued from cover

find mountain biking trail maps? To make these things accessible, organizations need to expand their web presence into the Google Play, Apple, and Microsoft app stores.

This can be challenging in the face of tight timelines, restricted budgets, and scarcity of GIS developer resources.

AppStudio provides a cost-effective way to create and distribute apps to the public. Organizations can leverage their existing GIS work and exploit the developer capacities they already have. AppStudio was designed to enable anyone with GIS skills to configure out-of-the-box templates; no coding is required.

That said, if an organization wants to take a deeper dive with developer tools to customize apps or build them from scratch, AppStudio comes with an integrated development environment and provides the source code for its templates, which developers can use as a starting point.

Your Apps Everywhere, on Any Device

GIS managers under pressure to deliver GIS apps and data quickly can use AppStudio to let their departments focus on what's important—sharing their work—rather than worrying about app development.

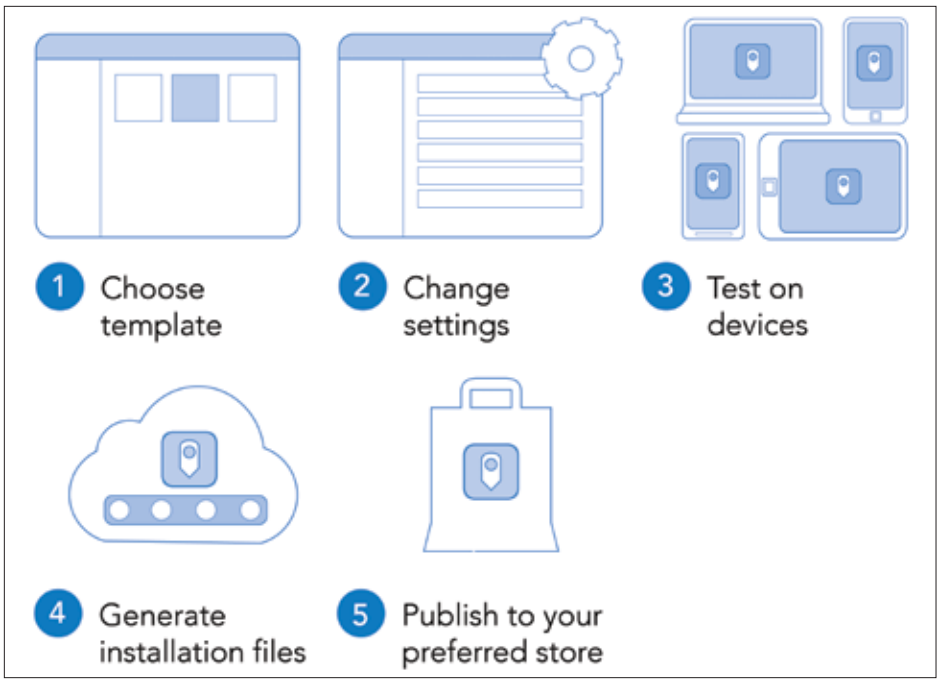
Whereas GIS departments previously had to build a separate app for each platform they supported—one for iOS, one for Android, and one for Windows—they can now build one app for all platforms. After using a step-by-step app building wizard, users check a box for each platform they want the app to run on. AppStudio then automatically generates the installation files for each of the selected platforms.

Organizations also have the option to share apps internally only. While this enables GIS departments to limit app distribution altogether, it is also a way for them to do centralized testing or debugging before sharing new apps more widely.

Great for Developers

AppStudio makes GIS developers much more efficient. Being able to produce apps that function across multiple devices is useful now that more and more organizations are letting employees bring their own devices to the workplace.

Additionally, AppStudio gives developers options for customization. They can either dig into the templates that come with the tool or start coding from scratch. Developers can also include advanced GIS functionality by bringing into play device hardware such as graphics processing units (GPUs), RAM, cameras, microphones, and accelerometers.



↑ After using a step-by-step wizard to build an app, users check a box for each platform they want the app to run on and AppStudio for ArcGIS automatically generates the installation files for all selected platforms.

Gain Power over Constraints

AppStudio gives power back to GIS organizations. No longer constrained by having to create five separate apps for five different devices, organizations can now build apps as quickly and as customized as they wish and share them as widely—internally or externally—as they want.

By allowing organizations to further leverage their investments in ArcGIS, AppStudio lets even more people benefit from the valuable work being done by GIS departments—on any device.

Learn more about AppStudio for ArcGIS at appstudio.arcgis.com.

Find out all the details about the July ArcGIS Online update at links.esri.com/arcgisnew.

EXELIS

Visual Information Solutions

Transition your image analytics to the cloud

Harness the processing power of the cloud to quickly get from data to decisions

Quickly access cloud based analytics from web and mobile applications

Develop data analytics for rapid deployment to cloud environments

ENVI

ENVI® products work seamlessly within any ArcGIS® environment. When everyone from your organization can access and share geospatial analytics and products, they make quicker, more informed decisions regardless of geographic location.

Attending the Esri UC?
Stop by booth #1417
to see our solutions!

www.exelisvis.com/Esri-UC

esri
Partner
Network
Platinum

Planning Fiber-to-the-Home Construction in Three Hours

A few years ago, Farmers Telephone Cooperative (FTC), which has provided South Carolina with telecommunications services for more than 60 years, began offering customers faster Internet and voice services by connecting them to fiber-optic cables where available. Because FTC has a 3,000-square-mile (4,830-square-kilometer) service territory in five counties, it needed a simple way to keep track of where it was installing fiber to the home (FTTH) and where it could expand this service. GIS was the incontrovertible answer.

Getting Rid of Redundant Data

Prior to 2007, FTC operated for nearly nine years on a computer-aided design (CAD) system. Designers who draft telecommunications networks would extract the data they needed from a master record and work in individual CAD files. They could not transfer their work back to the master file, though, because there was a danger of overwriting someone else's work. So the designers sent their work to a drafter who re-entered the data into the living master CAD file.

"There was redundant data everywhere," said FTC's plant design supervisor, Mark Brown.

Around the same time, telecommunications business began soaring. There was more competition and pressure to operate on tighter budgets, as well as more data than ever.

"We needed a more robust software to manage it," said Brown. "Our old CAD system was great, but each exchange was its own file, and we were limited [to] one user at a time."

In 2007, FTC switched to using Esri and Enghouse software to manage its data in GIS—and never looked back.

Strengthening Data Records

Strong business decisions start with the data, Brown said. Strengthening FTC's data records—and maintaining them—became his primary goal.

"You don't know what you need until you know what you have," he said. "The best way to waste money and appear incompetent is to build a cable you do not need, or to realize once you have finished [that] there was a spare duct available."

FTC contracted a local engineering company to record more than 70,000 GPS points of "anything you could see above ground," said Brown. It located offices, utility poles, pedestals (which house different types of telecommunications equipment), and more, with subcentimeter accuracy. FTC then matched these points to its existing CAD data and brought everything into the new GIS.

Mapping a Five-Year Project in One Day

In 2012, FTC launched a five-year plan to expand its fiber network.

New fiber designs were becoming much more complex. FTC not only had to take into account the existing fiber, it also had to plan for future needs such as additional backbone cabling (the foundation of a telecommunications network) and sturdier network designs that could support more users and data.

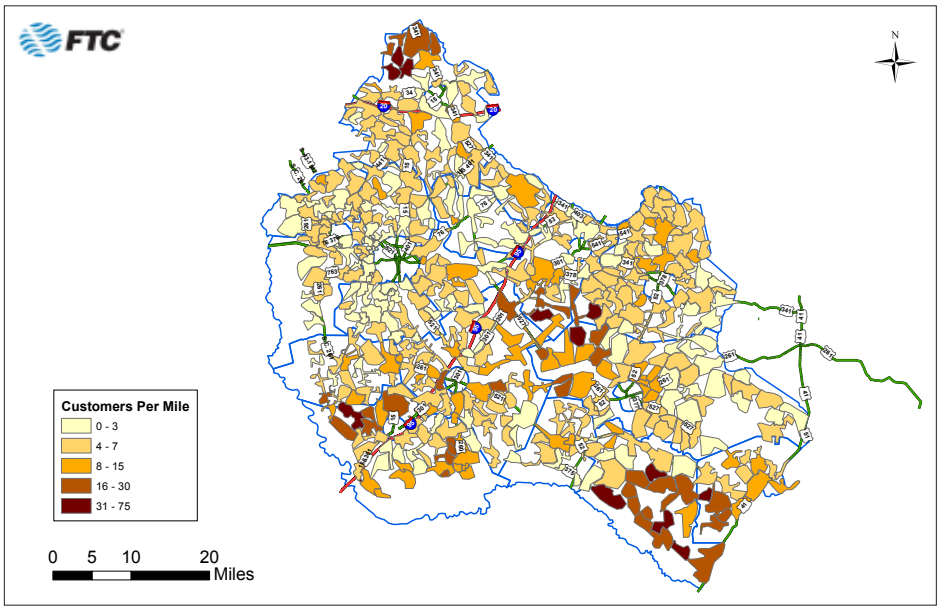
The company assigned Brown and his department to come up with a strategy for its largest-ever FTTH rollout. Management's directions were simple: hit the highest-density service areas first—the higher the customer concentration, the more sales.

The data that Brown and his team had spent years gathering was ready.

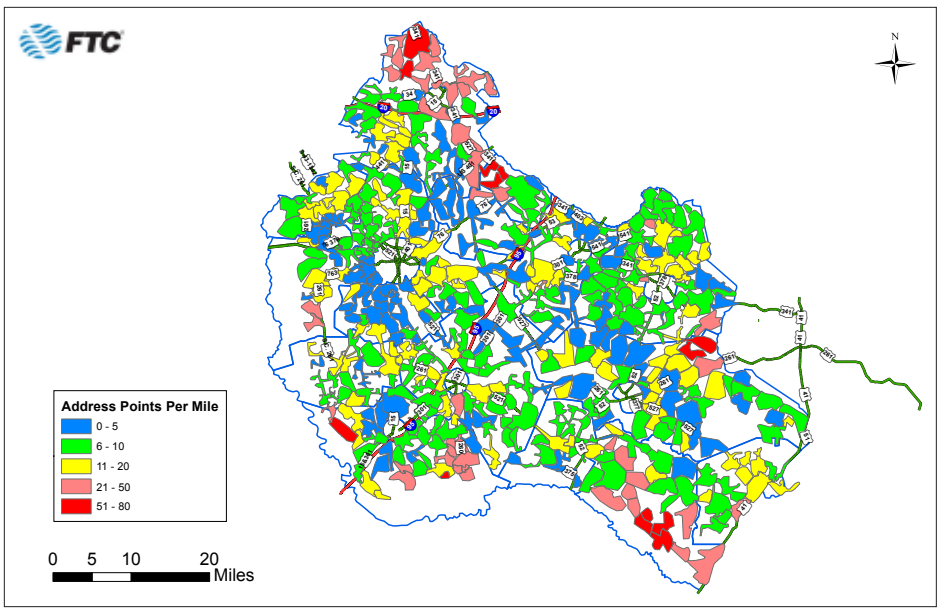
Brown got address point records from FTC's various counties and joined them to existing polygons that show where copper-wire networks are. Within minutes, he could see where FTC's customers were and where they weren't.

"We quickly had really detailed maps that color-coded the whole service area from light to dark, based on concentration," Brown said.

FTC used the Esri Field Calculator tool, which lets users perform simple or advanced calculations on existing records, to tally all the customers and address points in each square mile. With this, Brown could see where FTC should prioritize its fiber rollout.



↑ Customer density maps revealed where Farmers Telephone Cooperative needed to prioritize its fiber-to-the-home construction.



↑ Maps of address points per mile offered an additional perspective on fiber-to-the-home construction and enabled Farmers Telephone Cooperative to efficiently target marketing campaigns as new network services became available.

"In less than three hours, I had chosen the areas we were going to build for five years," said Brown. "These areas would have been impossible to identify and prioritize in a timely manner with our current staff," he continued. "The design and drafting department was given a perfect opportunity to show management what their investment could now accomplish. Esri and its native ability to handle, sort, and display large amounts of data had proved itself as a sound investment."

While executing the detailed design work for the project still took time, having initially identified the areas to focus on using GIS made FTC's more granular construction design efforts more efficient.

"If you had to develop this plan in a CAD environment, it would have taken at least six months," Brown said.

Marketing Fiber with Ease

FTC builds roughly 200 miles of fiber per year. Then the cooperative has to sell it.

Using GIS in its marketing and customer service departments has helped FTC cut down on a lot of the legwork that goes into publicizing new services.

The organization's marketing team targets priority FTTH areas with GIS-based direct mail campaigns. It sends flyers to geospatially targeted residents to let them know not just about the work going on but also that once it's completed, they will have more telecommunications services available. FTC sends a second flyer once the services are up and running.

Moreover, when customers call to inquire about whether fiber is available to them, customer service representatives have answers at their fingertips. FTC built an in-house map that runs on ArcGIS for Server. Customer service representatives use it to find out quickly if a customer can or will soon be able to have fiber or if fiber has not yet been planned for that area.

Additional Advantages

Brown views his organization's FTTH project as just one example of a GIS paying for itself over time. Another is workforce maintenance.

During the past several years, a few members of FTC's GIS team have retired. But the team has not skipped a beat. What in 2007 was an 11-person department now operates with only six people, including Brown.

"And even though we have a lot [fewer] people, we are accomplishing more work than we ever have," he said.

That is thanks to GIS.

Learn more about Esri for telecommunications at esri.com/industries/telecom.

Enterprise Solution Fosters Transportation Collaboration

↑ The Washington, DC, Department of Transportation's dashboard, built on Operations Dashboard for ArcGIS, allows fieldworkers, office staff, and managers to see progress on asset maintenance and infrastructure projects.

When organizations outgrow their existing IT infrastructures, workflows tend to slow substantially. Recently, that was happening to the Washington, DC, Department of Transportation (DDOT).

"We have numerous systems, but at the time, we had no sensible way to share data or monitor operations," said DDOT's chief information officer, José Colón. "For any staff to generate a report, they needed to drill down into each individual DDOT system to extract the data, run it through business intelligence software, and create the report."

DDOT decided to improve interdepartmental communication by upgrading information access and increasing transparency. It created an internal, map-based website on the ArcGIS platform called the Transportation Integrated Enterprise Solution (TIES), which ties all its divisions together, reinvigorating workflows.

Envisioning Automated Processes

In 2012, Colón and a former GIS colleague had an idea for how to fix the problem but had no way to execute it. They dreamed of a platform that would automatically process DDOT's operational data at the end of each day and then load it into a central repository for enterprise-wide access. Executives and other staff would then be able to retrieve that pool of resources and create reports full of timely information to distribute at meetings and include in presentations.

DDOT didn't have the in-house resources to build its own application, so it hired GIS consultants and Esri partners Prime Source Technologies and JMT Engineering to create the blueprint of a solution.

A Data-Fed Dashboard

To realize that blueprint, DDOT identified potential data sources for initial inclusion in TIES. These included systems for permit tracking, work order management, project coordination, and pavement management, along with the department's own Street Spatial Database, which models roadways and intersections. Prime Source and JMT helped DDOT configure the back-end processes to extract, transform, and load the data into TIES. They also helped create the database pathways that would populate the maps with data. But the most visible piece of the project—the operational dashboard—hadn't even been designed when Colón and one of JMT's GIS experts attended the Esri User Conference together in 2012.

"The first day, one of the Plenary [Session] speakers showcased Operations Dashboard for ArcGIS, and our jaws just dropped," said Colón. "That was the application we needed."

Though JMT no longer needed to design an operational dashboard from scratch, the company still had to complete the critical side of the solution that would feed data to the dashboard and optimize the creation of reports.

Monitoring Incidents and Performance

Using the dashboard and mobile tools, team leads and executives at DDOT can now target resources where needed. For instance, maps show DDOT where there's a high volume of construction in public spaces or where the bulk of potholes is throughout the city. In TIES, those activities and problems are expressed as reporting layers with pop-ups that give more detail when the features are clicked.

"This year, we had over 30 snowstorms that created over 40,000 potholes that needed to be recorded in our database," said Colón. "The map tells that story better than 311 calls on an Excel spreadsheet, visually showing senior management exactly where to send crews. They can also see . . . key performance indicators to chart the progress of repairs and so forth."

Additionally, Washington, DC, has 1 million traffic signs, so detailed monitoring of these signs, traffic lights, and even urban forestry is both crucial and traditionally expensive. Instead of using PDAs or creating a mobile field collection app from scratch, DDOT field crews use Esri's Collector for ArcGIS mobile app on their iPhones and Android devices to gather information about everything from trees to traffic signage. They take pictures of each asset and fill out a custom form describing its condition and identifying details, then upload it to the database. The app far surpasses the ability of dedicated hardware devices that can't report live updates the way Collector does.

Tying the Department Together

TIES now serves as the operational barometer for DDOT, gauging the department's performance (how many work orders have been fulfilled, for example) while also delivering transparency and detailed oversight. Operations Dashboard for ArcGIS created an easy report-making workflow, enabling senior management to see key performance indicators, documentation, and resource allocation details from a simple map-based interface that has tied a formerly disconnected department together.

"Being able to view an aggregation of information from multiple sources was critical for DDOT executives to oversee Washington's transportation infrastructure and plan response," said Colón. "It was the perfect tool to [integrate] information throughout the department and put everyone on the same page."

Palestine Uses GIS to Centrally Manage Urban Development

By Jamal Numan, Spatial Information Systems Department Director, Palestine's Ministry of Local Government, and Saed Abu Helwa, Technical Director and Chief Technology Officer, GISTEC

Palestine's Ministry of Local Government (MOLG) oversees municipalities and village councils in the West Bank and the Gaza Strip. It needed a way to effectively manage urban development in these two unconnected pieces of land. A team developed an enterprise GIS that disseminates real-time spatial information from one central location, reducing the time, cost, and manpower needed to collect and analyze this data.

Centralizing Urban Master Plans

One of the ministry's key responsibilities is approving urban master plans in all of Palestine's cities, towns, and villages. Urban master plans assign land usage rights (whether a property will be residential, commercial, or agricultural, for example) and classify road networks (their placement, width, and slope) to inform planning and construction regulations. Given that the West Bank and the Gaza Strip are relatively small in size at around 3,700 square miles (6,000 square kilometers) with a small population of about 4 million people, MOLG wanted to be able to house all urban planning information in one database and have its Spatial Information Systems Department edit and manage data in real time at the local, regional, and national levels. MOLG also wanted to provide a user-friendly public portal whereby other government officials and the general public could easily access planning information for any location in the West Bank and the Gaza Strip.

After studying its requirements, MOLG decided that a robust web mapping application would best serve its needs. With full funding from the German Agency for International Cooperation (known by its German acronym *GIZ*) and development assistance from GISTEC, the official Esri distributor in the United Arab Emirates, a GIS team within the ministry created the Integrated Spatial Information System of the Palestine Ministry of Local Government, or GeoMOLG.

The Structure Behind the System

While the end product is a straightforward web mapping application, the data manipulation efforts required to support the team's ongoing operations are both extensive and critical. To keep within budget constraints, substantial efforts were made to reduce development and define areas of efficiency.

The team used CAD software to draw out land usage and road network features and implemented Safe Software's FME Desktop to convert hatches to polygon feature classes. All the urban master plans are stored in a single enterprise geodatabase on Microsoft's SQL Server to enable multiuser editing. The feature classes in the geodatabase are added to a map document in ArcGIS for Desktop and published using ArcGIS for Server, which makes sharing easy. End users then interact with and manipulate the spatial data using web viewers powered by Latitude Geographics' Geocortex. Additionally, field teams use ArcPad to continuously collect data—mostly on public utilities and facility locations—which can be uploaded straight to ArcGIS for Server and reflected on GeoMOLG in real time.

Connecting Data More Than Collecting It

Based on the success of the initial web mapping application, the ministry made additional data available on GeoMOLG beyond urban master plans, including land parcel specifications, agricultural classifications, local authorities' administrative boundaries, electoral districts, and even aerial photographs.

The ministry also allowed other government institutions to apply for access, which meant that not all the data would come from MOLG and that the end-user base would have varied interests. To manage the first issue, the team ensured that all users uploaded authoritative source data as map services, which maintains a link to the original source and displays this new information almost immediately on GeoMOLG. The team also worked with GISTEC to further customize the types of files users could add directly to the web application. Thus, GeoMOLG became more about connecting data than simply collecting it.

A Road Map for Future Development

With such a large amount of geographic information available in one place, GeoMOLG soon began fostering cross-disciplinary communication and collaboration on an unprecedented scale within the government and with nongovernmental organizations and academic institutions. It quickly became the most important source of spatial data in Palestine. In fact, at the application's official launch in November 2014, Palestinian Prime Minister Rami Hamdallah stressed the importance of further developing GeoMOLG by incorporating additional data and adding capabilities to expand its reach.

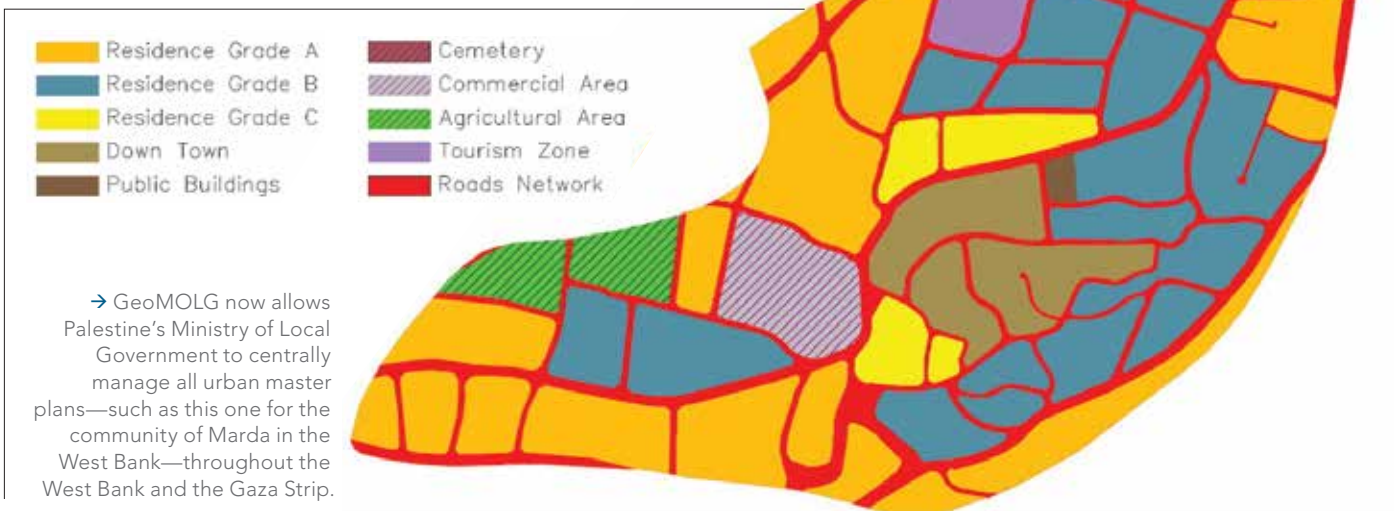
GeoMOLG has substantially increased the availability of spatial information and the efficiency of accessing it. By creating one space for users to access many types of spatial data, GeoMOLG has made it easier to make informed, fact-based decisions. It is no surprise, then, that this tool has become the key to defining strategies and formulating road maps for future development in Palestine.

About the Authors

Jamal Numan, who holds a master of science degree in GIS and has a background in civil engineering, is the enterprise spatial information systems expert at the Palestine Ministry of Local Government. He may be contacted at jamaln@molg.pna.ps.

Saed Abu Helwa is the technical director and chief technology officer at GISTEC. He has a master of science degree in communications and electronics and a bachelor of science degree in electrical engineering.

↑ GeoMOLG, pictured here, is a straightforward web mapping application that has helped Palestine's Ministry of Local Government collect data about land use and management and connect data with other government departments, nongovernmental organizations, and academic institutions.



→ GeoMOLG now allows Palestine's Ministry of Local Government to centrally manage all urban master plans—such as this one for the community of Marda in the West Bank—throughout the West Bank and the Gaza Strip.

ArcGIS Content Can Enrich Your Public-Facing Maps and Apps

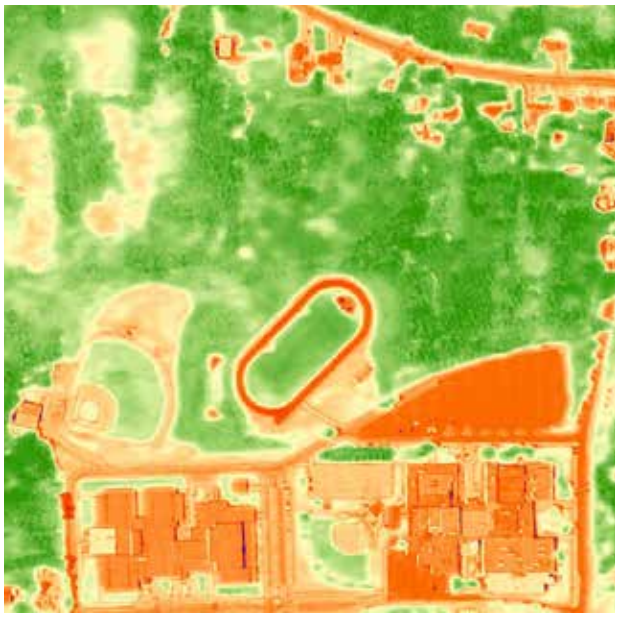
ArcGIS Online subscribers have access to a number of content layers, such as demographics, imagery, elevation, landscape, and historical maps. In some cases, such as demographics, these map layers consume ArcGIS Online credits and would be considered premium content services. In most cases, however, these layers are available at no additional cost to your ArcGIS subscription.

You are entitled to use these content layers in the maps and apps accessed by named users in your organization. You can also include these content layers in your public-facing maps and apps.

ArcGIS Online subscribers can use the content layers in maps and apps that they create and share with external users (e.g., customers, partners, public citizens), who can access them anonymously. For example, users can include a live map on a public website, such as a detailed demographic map of median home value to help attract and retain residents, or a live traffic map to help people avoid road closures and congestion during a local event.

Users can also take advantage of a dynamic image layer from the National Agriculture Imagery Program (NAIP) or Landsat 8 imagery, for instance, when working with other agencies or partners that need periodic access to this information but are not ArcGIS users. During a natural disaster, users may want to support response activities by including a reliable and scalable map layer that shows a live feed of the incident alongside other geographic information they are publishing such as open shelters or evacuation routes.

There are tools and workflows available through ArcGIS Online for you to create maps and apps that use your organization's own accounts to access these content layers on behalf of your users. Learn more at goto.arcgisonline.com/premium/share.



↑ This high-resolution aerial imagery from the Normalized Difference Vegetation Index (NDVI) shows vegetation in contrast to built areas around a residential neighborhood in the United States.

Esri Releases ArcGIS Server on Microsoft Azure

ArcGIS 10.3.1 for Server is now available on the Microsoft Azure cloud platform. It allows users to quickly deploy ArcGIS for Server applications and services to the Azure cloud rather than buying and maintaining the infrastructure themselves.

ArcGIS Server on Microsoft Azure consists of Esri virtual machine images—essentially, virtual computers running in the cloud—and ArcGIS Server Cloud Builder, a free, lightweight desktop application that lets users configure and deploy ArcGIS Server sites from their desktops.

Esri customers can find this new offering in Microsoft Azure Marketplace and can use their existing ArcGIS 10.3.1 for Server Standard or Advanced licenses to activate the system. The images include everything customers need to get their ArcGIS Server sites up and running on Microsoft Azure.

Users can choose from two deployment options: a full web GIS or a stand-alone GIS server.

With the web GIS deployment option, users get a complete ArcGIS platform running on Microsoft Azure infrastructure. This option allows customers to configure a federated and hosting ArcGIS Server site. Users can create and share maps with their organizations on their own branded portal websites, via Portal for ArcGIS, to organize and control access to their organizations' GIS assets.

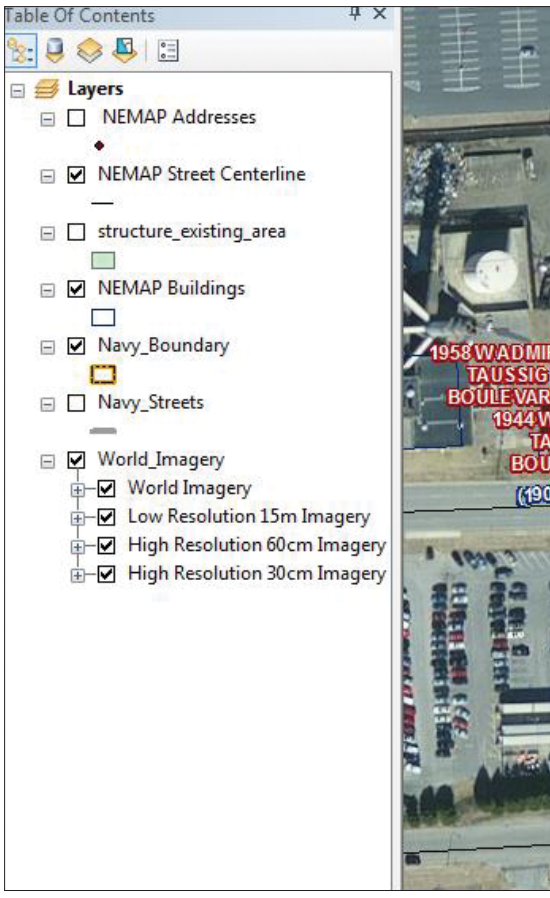
Web GIS deployment also gives customers access to all the applications that come with Portal for ArcGIS, including ArcGIS Pro; productivity applications such as Collector for ArcGIS, Operations Dashboard for ArcGIS, Explorer for ArcGIS, and Web AppBuilder for ArcGIS (an easy-to-use tool for creating and configuring web apps without coding); and more than 150 solution templates.

Alternatively, customers can deploy a stand-alone ArcGIS Server site. In this configuration, users can publish maps directly to ArcGIS for Server using ArcMap. Users can set up multiple ArcGIS for Server instances and configure them as highly available clusters of GIS servers, meaning that if one instance of ArcGIS for Server fails, another instance is available immediately to ensure continuous operation with minimal downtime.

For more information about ArcGIS Server on Microsoft Azure, contact your local Esri representative.

Navy 911: GIS Modernizes the US Navy's Emergency Response Systems

By Amy Hrdlicka, GISi, and Marvin Garland, Serco, Inc.



A man entered the Soldier Readiness Processing Center, which prepares soldiers for deployment, at Fort Hood, Texas, on November 5, 2009. He sat at an empty table, paused for a few seconds, stood up, shouted, and began firing a weapon.

Within 10 minutes, 13 people were dead and more than 30 others were injured. Two minutes and 40 seconds after the first call to 911, first responders from on base were at the scene. A minute and a half later, officers shot the suspect. Ambulances arrived two and a half minutes after that, once the suspect was taken into custody.

Although emergency responders from off base arrived at Fort Hood quickly, there was no way for them to locate the victims. That is because Fort Hood, like many US military bases, did not have standard street addresses like the ones found in cities and towns across the United States.

Soon after the Fort Hood shooting, the US Navy decided to create standardized addresses and improve the Navy Emergency Response Management System using enterprise, geospatially enabled dispatch capabilities supported by Esri technology.

This project, called the Navy Emergency Management Addressing Project (NEMAP), gives naval facilities conventional addresses and maps out all the streets on base. It then incorporates this data into dispatch systems at the navy's regional dispatch centers, which route all 911 calls placed on naval installations. The navy is also sharing this data with local governments near the bases to improve collaboration during crises.

Upgrading the Navy's 911 Systems

Independent reviews of the Fort Hood shooting found that most military installations did not have sufficient 911 capabilities. In 2010, the US Secretary of Defense directed all Department of Defense facilities to implement Enhanced 911 (E911) services, which automatically notify dispatchers of a caller's location, even if the caller is using a cell phone, and broadcast emergency notifications to select geographic locations. The goal was to create a military response system that works in tandem with local government systems to handle emergency situations more quickly and efficiently.

To do this, the Commander, Navy Shore Installations Command ordered that standardized base addressing—routable street centerlines and corresponding addresses—be set up in a GIS for every facility at every navy installation in the United States. Working with services company Serco, Inc., and location technology consulting firm GISi (an Esri Platinum Tier partner), the Space and Naval Warfare Systems Command Systems Center Pacific (SSC Pacific) executed the NEMAP effort by developing the addressing data to integrate into the Navy Emergency Response Management System.

Collecting and Managing Data Using ArcGIS

Designing a standardized addressing system was not easy. The NEMAP team had to develop and process thousands of address points and street centerlines for more than 65 navy commands and 300 navy sites, and the data had to be agile and scalable.

SSC Pacific implemented Esri's ArcGIS for Desktop, ArcGIS for Server, and ArcGIS Online to manage, store, and edit the address data. To ensure and retain the quality of the information being gathered—especially the topology of the street centerlines—the team used ArcGIS Data Reviewer, an ArcGIS for Desktop extension. It also employed Esri Platinum Tier partner GeoComm's GeoLynx DMS, which automated the creation of centerlines and assigned addresses, to add another level of data integrity.

Additionally, because state and local governments were providing much of the addressing guidance and because the NEMAP data had to integrate easily into local government GIS and response systems across the country, the team modeled its centerline and address point data after Esri's ArcGIS for State and Local Government emergency response solutions. This ensured that the data would be compliant with the National Emergency Number Association and the Federal Geographic Data Committee.

NEMAP's Secret Sauce: Workflow

When the project began in 2013, the team developed a workflow, dubbed the NEMAP Secret Sauce, that gelled as the project progressed.

First, the team collected existing GIS data on the navy's structures and facilities. It analyzed each installation and identified any unnamed roads and special locations such as restricted areas, special storage units, and fenced-in facilities. Next, the team went out into the field to verify any questionable sites and devised addressing systems for them. Finally, the team established a rapport with local government authorities and navy stakeholders to come up with an addressing plan that would match each base's local master street address guide, which emergency responders use to find specific addresses.

This addressing gives both the navy and local governments a set of 911-compliant addresses and topologically correct street maps for every place on military bases.

← The addressing process is done in ArcGIS for Desktop. Users can see address labels, centerlines, street names, and the street ranges.

Best Practices Unique to Military Addressing

Implementing the addressing system, however, was far trickier than collecting the data. Some bases have historic building numbers while others have implemented their own addressing systems, and some of these needed to be changed to match local emergency response systems—including, in certain cases, addresses for base housing. Creating routes through weapons storage areas was problematic, as was determining whether airfields needed to be mapped out like streets. The team also had to pay special attention to facilities that the general public could access, since these are not completely under navy control and may have distinct addresses. And then, after all that, each military installation needed to physically change building numbers and street signs, update mailing addresses, and modify most public relations materials.

Because of these unique issues, the NEMAP team developed a set of best practices that suit the navy's needs.

Paramount to the team's concerns was that the people who live and work on base experience the lowest impact. Thus, every effort was made to preserve established addresses, especially for family housing, publicly accessible facilities, and the commanding officer's building.

For groups of structures—such as clusters of buildings that are accessed via one location, facilities that are gated or fenced in, and weapons storage areas—the team found it beneficial to give them all one address. It treated these like apartment complexes by assigning each structure a unit number. This practice satisfied security personnel because it ensured that emergency responders would only enter through one access point, accompanied by an escort.

Additionally, many bases have common, unnamed routes that cut through the installation; rarely used trails in isolated rural areas; and, occasionally, long access roads that lack location points such as driveways. For these, the team implemented a generic naming convention that identified what these were (a road or a driveway, for example), which allowed the navy to quickly identify where actual names were needed.

Collaboration Made Possible by ArcGIS Online

To make all of this work, the team had to seek input from navy stakeholders such as the housing, supply, public works, and safety departments; Real Property and the GeoReadiness program; and, in some cases, even an installation's commanding officer. It also had to collaborate with local government authorities such as emergency managers, addressing coordinators, planning departments, and local fire departments.

Using ArcGIS Online, SSC Pacific constructed a collaboration website, the NEMAP Workspace, where local government authorities and any navy stakeholders that conduct reviews can access and view interactive maps of their areas of interest. They need little to no prior knowledge of GIS to successfully navigate the website and its maps.

The navy and local governments can collaborate in one central section of the website called Review Maps and use map notes to highlight areas of interest or concern on a map. As data is completed and stored, it is published to the Facility Address Search Tool and is available for all long-term NEMAP stakeholders to quickly reference if they need an address.

Saving Lives with Better Emergency Management

All navy bases in the continental United States now have 911-compliant addresses and routable street centerlines. NEMAP has given addresses to about 35,000 facilities at more than 300 navy sites and has processed more than 13,000 miles of street centerlines.

NEMAP is a small part of the overall infrastructure of the Navy Emergency Response Management System, but the data it has gleaned is essential to the system's effective operation. The Navy Emergency Response Management System currently includes three main functions: 911 routing and management service, computer-aided dispatch, and GIS. When the navy eventually transitions to an enterprise format, the system will be centralized and could include real-time mobile field dispatch capabilities.

Dispatchers at the navy's regional dispatch centers will no longer have to rely solely on asking, "What is the location of your emergency?" They will be able to see the location of the emergency on their computers or mobile devices as the call comes in. That is how NEMAP data will save lives.

For more information on NEMAP, email Ronald Anderson, the NEMAP contract lead for the Space and Naval Warfare Systems Command Systems Center Pacific, at Ronald.Anderson@navy.mil.

About the Authors

Amy Hrdlicka, GISP, is a geospatial project manager at GISi. She has been supporting geospatial applications for the navy for more than seven years. Her work focuses on facilities, asset management, and emergency response for the GISi Navy program. She can be reached at Amy.Hrdlicka@gisinc.com.

Marvin Garland, GISP, works for Serco, Inc., supporting the Space and Naval Warfare Systems Command Systems Center Pacific. He is the geospatial/GIS subject matter expert and project lead for the Navy Emergency Response Management System and NEMAP. He can be reached at Marvin.Garland@serco-na.com.

→ Established addresses on base, such as those for US Navy family housing units, sometimes had to be renumbered. But the NEMAP team did its best to avoid making already itinerant military families update their addresses an additional time.

GIS Empowers Community Engagement

Geography Can Serve as a Starting Point for Building Strong, Lasting Relationships with Communities

Have you ever walked through your neighborhood and seen a geyser of water shooting up from a broken sprinkler head, or a fallen tree branch lying in the middle of the street, or graffiti scrawled across a bus stop shelter, and wondered how you could notify the right people to come and take care of it? It's a common situation people find themselves in, not only in their neighborhoods but also in almost any type of community they belong to.

Governments, companies, nonprofit organizations, and even loosely connected social groups such as bird watchers and people who like farmers' markets face similar issues because they're not set up to gather people's observations and manage that information in a meaningful way. They lack the tools to facilitate community engagement.

Geography can serve as a starting point for building a community engagement strategy. And GIS technology can provide the tools to accomplish it. Maps and spatial analytics form a universal translator that allows individuals living and working in communities to build strong, long-lasting relationships with other people simply by sharing geographic information.

Here are three ways to get started with community engagement using ArcGIS.

1. Empower your community with crowdsourcing apps.

Crowdsourcing is the process of collecting volunteered information from people. If you give them the right tools, they can become your eyes and ears on the ground. But if social media has taught us anything, it's that when you ask people to volunteer their observations, you may end up with more than you can handle. To avoid information overload, focus on a specific problem or a manageable set of choices.

Surveys are one form of crowdsourcing. Conducted person-to-person or via a website, they can be used to create inventories, gather information about people's experiences, or take stock of what a community is thinking about certain issues. When combined with geography, surveys can demonstrate how important a place or the surrounding environment is to the matters in question.

ArcGIS Online subscribers can create and deploy location-based surveys using the GeoForm template, which generates responsive, web-based forms. For example, an emergency management organization could develop an inventory of medical personnel for disaster preparedness activities by asking doctors and nurses to visit its website and fill out an identification form.

GeoForm makes conducting surveys simple and straightforward and gives them a sense of urgency that a community can understand. Its source code can be downloaded on GitHub.

The Esri Crowdsource Reporter app template also makes it easy to integrate geography with important issues. The template, available from ArcGIS Online (with the source code on GitHub as well), allows developers to configure responsive apps that work on smartphones, tablets, and desktop browsers to maximize community engagement.

The City of Los Angeles, for example, began a concerted water conservation effort called EveryDrop to help tackle California's current serious, decadelong drought. The project's mission is to provide applications to the public and government agencies so they can help curb water waste and promote water conservation. As part of the EveryDrop platform, the city offers a free crowdsourcing app for Apple and Android phones that allows citizens to report the location of water waste. The app also teaches users how to better conserve water.

↑ The EveryDrop app engages citizens by giving them an easy way to report water waste.

Empowering people to send in their observations is one thing; doing something with the data is another. A critical process for maintaining a crowdsourcing channel is to aggregate the crowdsourced data, analyze it, and then take action.

Crowdsource Manager, a companion application to Crowdsource Reporter, helps organizations do just that. It presents data in both map and table formats and includes tools for finding patterns, reviewing details, updating statuses, and assigning responsibilities. This template is also available for free with an ArcGIS Online subscription.

2. Tell stories to your community.

Telling people a story that's relevant to their location is powerful—especially if it's related to an issue they care about. Storytelling is also a great way to communicate with stakeholders inside an organization, including managers and executives.

Giving a narrative form to geographic information impresses it with realistic character that just doesn't come across in charts or graphs. Story maps, which combine interactive maps with multimedia content, provide an engaging way to explore data and navigate information nuances.

The Glen Canyon Institute, a nonprofit that seeks to restore and preserve southern Utah's Glen Canyon, which was flooded in the 1960s when part of the Colorado River was dammed, has a loyal community of members and people who want to get involved in its conservation projects. One of the ways the institute communicates the importance of its mission is by providing a

← The Glen Canyon Institute used the Esri Story Map Journal application to create its story map, The Place No One Knew.

story map on its website that takes viewers on a virtual tour of the Colorado River, using more than 100 photos of key points of interest.

ArcGIS Online subscribers can create and share their stories using Esri Story Map applications, including Esri Story Map Journal, the one that the Glen Canyon Institute used. While creating a story map may seem like a daunting task, it is actually just a matter of organizing and presenting the information; the Story Map template takes care of the rest.

3. Use dashboards to help drive your community engagement strategy.

Dashboard applications, which consolidate complicated and often dynamic information into one simple view, are escalating in popularity. That's because everyone wants to know the status of a project or get minute-by-minute updates on events in progress such as elections or emergency management operations.

Dashboards help people absorb information with just one glance, much like looking at the dashboard of a car. These applications can be specific to project activities or organization assets and can outline the progress of a program as a whole. This makes dashboards especially important for decision makers and other people who need to stay on top of unfolding situations. They need to know what's going on and where things are happening—in one look.

Geography works well with dashboards. Maps again become the universal translator that helps people orient themselves to the information at hand. However, unlike crowdsourcing, which can evolve into a long-term dialog between communities, and in contrast to story maps, which can be used to reinforce the scope and commitment of one community to another, dashboards get more personal and go behind the scenes. They can help organizations monitor and evaluate their community engagement strategies.

The Summary Viewer solution template, available with an ArcGIS Online subscription, can turn a map into a dashboard to report metrics. It summarizes the numeric attributes of features in a specified map layer and displays the ones that appear on the visible area of the map. The summaries can be configured to show the sum, average, minimum, and maximum of specified field values.

So, for example, the owner of a chain of retail stores could see all his stores in a given geographic area, plus the total number of employees, the square footage, and the sales amounts for those stores, all on one dashboard.

Everything Rolled into One Community Engagement Project

To give a more encompassing example, let's say a city is looking to streamline its processes for fixing potholes. It could develop a crowdsourcing app that encourages the community to report potholes on city streets. An operations manager could use the Crowdsource Manager app to organize and validate reports and then assign work appropriately. The city could then put up a public-facing story map that displays the crowdsourced information and shows the potholes that have been fixed to assure the community that their reports are making a difference. Meanwhile, project stakeholders could use an internal dashboard to stay abreast of how the project is going and what is being accomplished.

Building Apps, Building Relationships

Community engagement initiatives hinge on active listening, participation, and trust. Geography and mapping technology can play a key role in opening up and sustaining the communication channels necessary to successfully support communities both inside and outside an organization. Getting started with a few simple GIS applications can help organizations build strong, long-lasting relationships with their communities.

↑ Summary Viewer is a configurable dashboard for reviewing complex statistics at a glance.

GIS Helps Spur Rural Tourism in Peru's Andes Mountains

By James Valenza and Aaron Ebner, the Andean Alliance for Sustainable Development

Indigenous communities in Lares, Peru—about 90 miles (150 kilometers) north of Cusco—live at 12,000–14,500 feet (3,660–4,420 meters) above sea level, high in the Andes Mountains. Men tend the fields while women weave high-quality textiles that they sell intermittently at markets. Children attend school until they are also needed to work in the fields or help out with household duties.

The district of Lares straddles the last eastern high passes of the Andes and descends into the tropical highlands. The closest market is at least three hours away by bus on a one-lane dirt road that winds precariously along steep mountain drop-offs. The nearest communities are about four hours away by foot, accessed via a network of well-trodden trails. Although the people living in the Lares region persevere despite limited resources and harsh living conditions, these factors—coupled with fragmented government aid and a dearth of infrastructure—render these communities relatively inaccessible to visitors.

Tourism is a huge industry in Cusco, though. While some travelers do venture out of the city to visit natural hot springs around the Lares district, in general they do not utilize the trail networks, nor do they make it into these small communities. To provide its people with opportunities for economic development, the Lares district government is attempting to take advantage of this market by promoting rural tourism.

The Andean Alliance for Sustainable Development (AASD), which works with Peruvian communities to identify ways to address livelihood challenges, is supporting this initiative by employing GIS. Specifically, the AASD is using ArcGIS Online—and adventurous volunteers—to create a map of the trail networks that connect Lares and its surrounding districts. The result will be a rural tourism circuit that takes travelers beyond the hot springs and into these communities.

When volunteers arrive in Lares, they are provided with local guides and fitted with Garmin GPS units to collect the track lines of these previously unmapped trails. They also use a smartphone survey app to collect area-of-interest points such as guesthouses, markets, camping and recreational areas, and hot springs. These locations are collected and stored offline, since there are no active cellular zones in the region. The volunteers then use a wireless Internet connection each night to synchronize the data with a database, and a GIS specialist loads the information into a geodatabase on an as-needed basis.

This data conversion process is tedious, however, so the AASD is currently implementing Collector for ArcGIS 10.3 so that when volunteer hikers enter an area with cellular or wireless Internet coverage, their data will automatically sync into AASD's ArcGIS Online geodatabase. Additionally, the app can be downloaded to Android and iOS devices, which will allow the volunteers to use their own smartphones.

AASD trekkers have already mapped approximately 60 miles (97 kilometers) of trails. And they are learning about mapping and GIS while doing it.

"The AASD mapping project allowed me to get valuable field experience while mapping thousand-year-old trails that have never been mapped before," said Kenneth Eggering, who hiked and collected data for some Lares trails during the summer of 2014. "The beauty of these trails is that they are used every day by indigenous communities."

↑ The AASD has mapped approximately 60 miles (97 kilometers) of trails, including this one that goes from Quishuarani to Cucani.

↑ 2013 summer program volunteer Kevin Zavoral collects data in Choquecancha in Peru's Lares district. Volunteers typically cover more than 3.7 miles (6 kilometers) per day at very high altitudes.

Once the trails are mapped, tourists will use an interactive map application—which was originally created in ArcGIS for Desktop Advanced and will be published to the AASD's ArcGIS Online account—to design their own hiking trips by selecting a trail or a series of trails around the Lares district to trek. After the trekkers define an area of interest on the map and select an appropriate scale, they will be able to either download it to their portable devices or print it out to take with them (ideally both, in case of electronic malfunction).

Beyond providing tourists with the opportunity to explore Peru's isolated areas and trails, these detailed maps will bring the market to the locals. Rather than having to regularly travel long distances and deal with middlemen to sell their goods, members of these expansive rural communities will be able to welcome tourists and sell their goods within their own environs.

The AASD obtained its ArcGIS software through the Esri Nonprofit Organization Program. For more information on this project, contact Aaron Ebner at taebner@gmail.com or Jim Valenza at jim.valenza@gmail.com, or visit the AASD website at alianzaandina.org.

Accurate GIS on Tablets: The Choice is Yours

Features

- **High accuracy on Android mobile devices**
- **Ready to be used with any GIS application**
- **Compact, light weight and configuration-free GNSS receiver**
- **SPACE control application for all required GNSS settings, free of charge**

MobileMapper® 300

The new **MobileMapper 300** is a smart antenna designed to be used with a wide variety of mobile devices, including smart phones, tablets, and notebook computers. The MobileMapper 300 solution is compatible with Android mobile devices and is ready to work with any GIS application.

The MobileMapper 300 receiver and its control application **SPACE**, offer you the ability to use your preferred GIS application and run it on your preferred mobile device, whatever it is, and still benefit from the best of Spectra Precision GNSS technology.

AMERICAS

Spectra Precision Division
10368 Westmoor Drive
Westminster, CO 80021, USA

+1-720-587-4700 Phone
888-477-7516 (Toll Free in USA)

www.spectraprecision.com

EUROPE, MIDDLE EAST AND AFRICA

Spectra Precision Division
Rue Thomas Edison
ZAC de la Fleuriaye - CS 60433
44474 Carquefou (Nantes), France

+33 (0)2 28 09 38 00 Phone

ASIA-PACIFIC

Spectra Precision Division
80 Marine Parade Road
#22-06, Parkway Parade
Singapore 449269, Singapore

+65-6348-2212 Phone

SPECTRA PRECISION

Mapping a Future for Kenya's Amboseli Elephants

By Mark Sowers, Vicki Fishlock, and Tal Manor, Amboseli Trust for Elephants

An organism with the sheer magnitude of an elephant—weighing up to roughly six tons—requires proportional amounts of space and resources for survival.

The elephants of Kenya's Amboseli National Park ecosystem have always needed far more space than the relatively small, 242-square-mile (390-square-kilometer) reserve can provide. Amboseli elephants roam freely inside and outside the park, covering a broad swath of habitat at the foot of Mount Kilimanjaro that spans southern Kenya and traverses what, to them, is an invisible international border with Tanzania.

This landscape is changing rapidly, however. Increasing human populations and expanding development are putting pressure on available wildlife habitat. With humans consuming ever-larger shares of resources, elephant conservation is facing new challenges.

The Importance of Amboseli Elephants

Researchers with the Amboseli Trust for Elephants (ATE) have continuously monitored the Amboseli elephant population since 1972, when Dr. Cynthia Moss and Dr. Harvey Croze founded the Amboseli Elephant Research Project. Amboseli is unusual in that it is home to one of the few relatively undisturbed elephant populations left in Africa. As poaching to fuel the illegal ivory trade has made a comeback across much of the rest of the continent, the Amboseli elephants have been largely spared.

With an estimated 35,000 African elephants being lost to poaching annually, Amboseli's elephant population has become increasingly valuable for understanding how these animals can navigate a changing landscape and adapt to increased human presence within their ranges.

A Rich History of Spatial Research

Documenting the spatial distribution of Amboseli elephants has been key since the project began. Every elephant sighting in the project database is associated with a one-kilometer square within a grid covering the study area, and sightings records since 1999 include a corresponding GPS point. In the early days, to define the full extent of elephant ranges and their movements in and out of the national park, researchers also fitted several elephants with radio collars; however, that technology provided such a limited amount of data relative to the risk of traumatizing the elephants while putting the collars on that their use was curbed.

In 2002, researchers used the GPS points, satellite imagery, and Esri software to perform GIS analysis on the study's first 30 years of elephant location records. The results provided a clear, long-term picture of how elephant family units and independent adult males use the national park and how they change the location and size of their home ranges (the extent to which they move during the course of daily activities) over time. Fascinating patterns on both annual and seasonal scales emerged, but the vast majority of these sightings fell within the core study area inside and immediately adjacent to the national park itself—just a small fraction of the elephants' total range.

Resurrecting Collar Tracking

To conduct research that addresses current knowledge gaps in elephant behavior, which could aid in creating informed conservation decisions for elephant populations that are less fortunate than Amboseli's, ATE has increasingly turned to innovative geospatial tools. Modern satellite tracking collars can collect fine-scale temporal and spatial data, so investing in them is more practical now. These more accurate, longer-lasting collars can allow researchers to extrapolate major movement patterns for much of the elephant population by deploying tracking collars on just a few carefully selected individuals. That is because, although each elephant family has a unique strategy and pattern in how it utilizes the Amboseli ecosystem, the patchiness of resources, particularly water, means that different

An elephant family roams freely in Kenya's Amboseli National Park. (Photo courtesy of the Amboseli Trust for Elephants.)

subsections of the population tend to make use of the same food and water sources, moving in similar geographic spaces.

In 2011, ATE deployed five satellite collars on adult female elephants from different families around Amboseli. These individuals—known to researchers as Ida, Lobelia, Maureen, Vicky, and Willow—were chosen because, while their families roam in different areas from each other inside and outside the park, they are still illustrative of where other elephant families in their subgroups tend to go.

Over the following two years, these elephants' collars recorded more than 78,000 GPS location points logged at hourly intervals. This wealth of data was analyzed using ArcGIS Spatial Analyst tools to investigate a variety of range metrics and movement parameters for the tracked individuals.

Developing a Deeper Understanding of Elephants' Movements

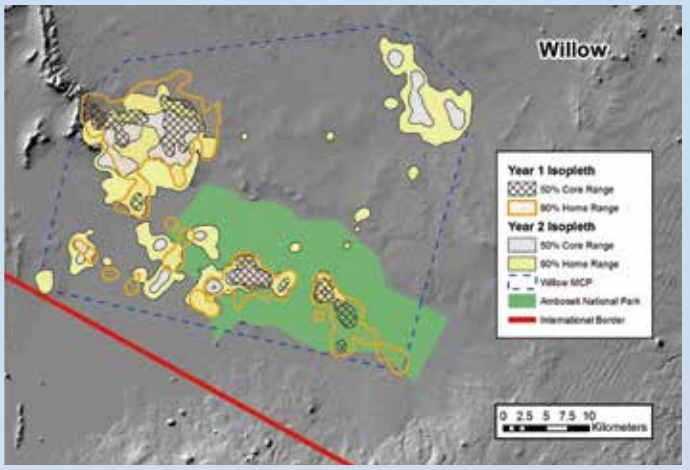
The results provided valuable additions to the already detailed understanding of the population. We now know, for example, that elephants make seasonal movements to and from the permanent swamps in the core of Amboseli's ecosystem in response to rainfall and available vegetation in outlying areas—a pattern that was detected in field observations and confirmed using the satellite collars. We also now have clear answers to questions that could not be easily explained using direct observations, such as which areas Willow and her family utilize during their long absences from the park; how far Maureen ranges into Tanzania; and what route Vicky uses to reach her feeding area north of the park.

The satellite collars also identified new patterns that may have otherwise gone undetected, suggesting new directions for further research. For instance, we now want to investigate why Ida and Lobelia, in the eastern part of the ecosystem, have smaller home ranges and spend more time inside the park than the individuals that use other areas. We are also curious about what caused Maureen to decrease the size of her home range and shift out of Tanzania in the second year.

The kinds of spatial datasets obtained with satellite tracking collars can provide insights into elephant behavior as well. One important focus of our current research is understanding how elephants perceive and respond to the risks associated with living in close proximity to humans. Analyses done using ArcGIS have shown that Amboseli elephants increase their travel speed while moving through human-populated areas and that they avoid these places altogether during daylight hours. The data has also confirmed the locations of frequently used habitat areas and corridors where elephants move long distances, which can help with conservation planning by identifying places that need additional monitoring resources and protection.

The results of this project, along with the outcomes of future collaring operations, will help guide ATE and other stakeholders in securing space for all of Amboseli's wildlife. Ultimately, we want the future of the Amboseli ecosystem to be one of peaceful coexistence between humans and elephants for generations to come.

Visit ATE at elephanttrust.org or email info@elephanttrust.org to get more information.



← This map of Willow's annual ranges during the two-year tracking period shows that she made a pronounced shift to a new dispersal area in the second year.

National Audubon Society Reshapes Its Approach to Data

By A. J. Mangum

Five years ago, the National Audubon Society, the century-old conservation group devoted to protecting bird populations and habitats, embarked on an ambitious plan to reinvent itself by using ArcGIS to change the way it collects and manages data.

With its roots in an 1890s movement to fight the slaughter of waterbirds for the hatmaking trade, Audubon started as a loose-knit network of state-level groups. It has long relied on that decentralized framework to reach widely and empower local efforts. But Audubon's federated structure—with 467 local chapters and a long roster of independent, grassroots conservation projects across the Northern Hemisphere—created data-management challenges.

Reporting methods varied wildly, generating a haphazard assortment of data. Redundancies and flawed—even conflicting—datasets were commonplace. Despite the volume of information potentially available to decision makers at the regional and national levels, vital intelligence was still far out of reach.

↑ When Audubon committed to large-scale conservation projects in 2010, it adopted a new organizational structure based on four flyways traveled by migrating birds. (Screen shot courtesy of the National Audubon Society.)

"In that scenario, our [incoming information] wasn't quality controlled," said Doreen Whitley, Audubon's geospatial information officer. "It was simply up to users, those generating spatial data, to do the best they could with the information they had. I could make maps, but I'd have to pull from back-of-napkin resources with no assurance of accuracy."

Acquiring Situational Awareness

In 2010, Audubon's leadership committed to pursuing large-scale conservation projects that would require situational awareness across multi-state regions. The group restructured itself, creating a new organizational alignment based on four North American flyways, the north–south paths traveled by migratory birds each spring and fall.

State and local chapters typically pursued independent conservation initiatives that were based on strategies that seldom reached across state lines. Audubon hoped that under this new configuration, these chapters could begin to see their efforts in the context of wider regional pictures. This new approach would reduce redundancies and promote interchapter partnerships. The database required for such an overhaul, though, simply didn't exist.

As the first step in its retrofit, Audubon created an experimental protocol. Chapters in each north–south flyway systematically

reported every four months on their progress with ongoing projects. Whitley led the effort to compile and organize the incoming data, using ArcGIS to build a comprehensive new picture of Audubon's efforts.

"It was the first time [chapters] could see across state boundaries," said David Yarnold, Audubon's president and CEO. "What none of us expected was that this experience would trigger a series of management changes where a new generation of collaborative leaders took over and brought with them a 'one Audubon' approach to conservation that's fired up our entire network of 4 million."

The experiment set the stage for the development of enterprise GIS. This transition saw Audubon evolve from an organization with some 90 users of ArcGIS—each creating and managing spatial information on a local level—to an intelligence-centric culture with more than 1,000 network members using the Esri platform on a widespread basis to gain ownership of authoritative data.

That reinvention began with a cultural shift.

Molding GIS to the Culture

Audubon's leadership faced a unique challenge: broaden the group's use of GIS while staying true to its decentralized organizational structure.

An enterprise GIS strategy had to be molded to fit Audubon's existing culture. In that culture, data management skills, data needs, and access to technology varied chapter by chapter. Whitley knew that, for Audubon, GIS implementation would need to be both creative and agile.

"Our goal wasn't to create more spatial-data experts but to make it easier to access and use data," she said. "For us, the starting point was the idea of the value of authoritative data. In

Esri Founders Receive Prestigious Audubon Medal

↑ Esri founders Jack and Laura Dangermond.

The National Audubon Society awarded Esri's founders, Jack and Laura Dangermond, the Audubon Medal at its annual gala dinner on March 31.

The award acknowledges exceptional work in conservation and environmental protection. It is one of the highest distinctions in the field.

The Dangermonds were recognized for their accomplishments in technology and conservation innovation, as well as their support for research institutes, schools, and nonprofits.

Audubon president and CEO David Yarnold presented the award. He pointed out that the Dangermonds' commitment to the environment and their development of innovative GIS technology have allowed his organization to support conservation solutions and share empowering data with citizen scientists throughout the United States.

Jack Dangermond spoke on behalf of himself and Laura. He accepted the medal on behalf of their colleagues at Esri, the company's nonprofit partners, and Esri software users worldwide, noting that the award was "special because it acknowledges the work that we've been doing."

Esri equipped Audubon with $11.2 million worth of software, which has helped, among other things, to preserve one of the world's most important bird breeding grounds—11 million acres in Alaska that attract birds from all seven continents.

"The maps aggregate different types of data, from soil type to rainfall to demographics of people living in those places," said Yarnold. "You can put all those together and you can actually see the potential outcomes."

In his acceptance speech, Jack Dangermond said that if we can unify the two worlds of nature and technology—like the National Audubon Society has done—he "will have a lot more hope for the future."

← Audubon volunteers collect data for a project in the Bahamas. (Photo by Walker Golder/courtesy of the National Audubon Society.)

any organization, whether it's decentralized or centrally focused, the key is understanding that value and recognizing the datasets that drive your mission. Focus on those and flexible ways to distribute them. Everything grows from there."

Whitley led an organization-wide exercise to identify core spatial datasets such as species populations, habitat locations, migration patterns, and climate measurements. The effort helped clarify the importance of consistency and accuracy in gathering and sharing geospatial information. It brought the organization together, bonding personnel through a shared newfound trust in a single authoritative dataset.

"Soon everyone in the organization appreciated that there weren't five answers to the same question," Whitley said. "At that point, no one's resistant and people are looking to use geospatial data to create solutions. That's how GIS builds connective tissue."

Using a single server, Audubon's GIS team input newly quality-controlled spatial data layers into ArcGIS for Server. Maps were then created in ArcMap and published as map services via ArcGIS for Server, making them available online for users throughout the organization. End users with local chapters could then incorporate the material into their own initiatives and campaigns. The value of Audubon's data increased as its directional flow changed.

Lights Out Program

With an improved data structure in place, Audubon introduced GIS-empowered initiatives and retooled existing efforts to better use spatial information. Audubon's Lights Out program, for example, works to mitigate the risk that migrating birds will be killed at night by flying into buildings. Many bird species migrate at night and rely on the moon and stars for navigation. Brightly lit windows in tall buildings can disorient birds, causing them to strike urban structures. According to Audubon, more than 100 million birds die annually from such strikes.

Prior to Audubon's widespread adoption of GIS, volunteers monitoring buildings for signs of overnight bird strikes might have compiled data consisting of little more than the building's address. Now, volunteers can use Collector for ArcGIS to record specific strike locations on a building's exterior. Audubon has begun using Esri CityEngine to build 3D models of the environments in which these strikes occur.

The technology has changed the tone of Audubon's conversations with building owners. Rather than requesting that all lights in a building be turned off overnight, Audubon instead asks to limit lighting in specific locations on specific floors. That change in tone has actually prompted many building owners to be voices for the Lights Out cause.

A More Collaborative Approach

"We see opportunities in these 467 chapters, with the volunteers that have committed to the organization," Whitley said. "The more we can arm them with technology, the stronger their voices will be and the more successful they'll be."

Yarnold sees GIS as a vital component for nonprofits of the future. He said that organizations like Audubon will always reflect the visions of their leaders, but he adds that, in groups that embrace GIS, those visions can be shaped, refined, and strengthened by meaningful data. He expects GIS to enable nonprofits to move away from what he calls traditional models—those in which advocacy heroes make decisions while other participants are relegated to supporting roles—and shift toward more collaborative approaches in which all players have the tools and data to participate in strategy making.

A. J. Mangum is a Colorado-based writer, photographer, and editor.

A Collaborative Approach to Storm Recovery

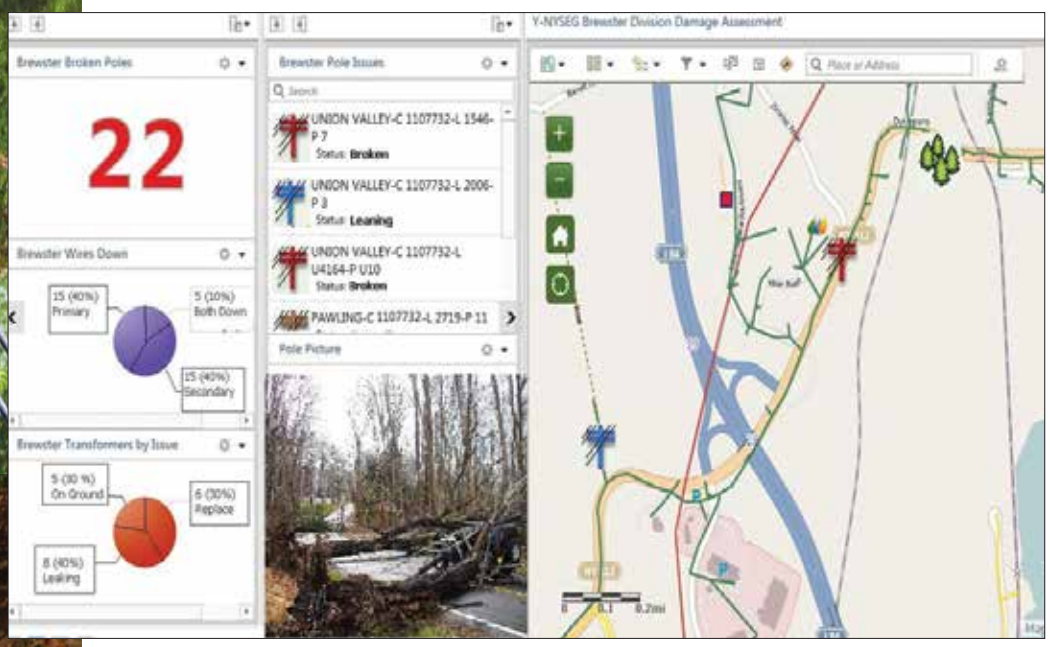
Using Esri's Collector for ArcGIS app on iPad minis, Iberdrola USA field staff can now report broken poles, downed wires, and damaged transformers in real time using online and offline editing modes.

In the aftermath of Hurricane Sandy, which struck the northeastern United States in 2012, New York State Electric and Gas (NYSEG) and Rochester Gas and Electric (RG&E) saw an opportunity to enhance their emergency response planning by improving data collection. Not long into the modification process, these two Iberdrola USA-owned companies used Esri solutions to turn their plans for hurricane response improvement into a new, all-events assessment strategy—a cost-effective overhaul that would impact nearly 3 million electricity and natural gas customers in upstate New York.

The Catalyst: Hurricane Sandy

Hurricane Sandy, a superstorm packing torrential downpours and 80-mile-per-hour (129-kilometer-per-hour) winds, roared into the northeastern United States on October 29, 2012. With damages totaling more than $65 billion, Hurricane Sandy is the second most destructive hurricane in US history, behind the Gulf Coast's Hurricane Katrina in 2005.

While Long Island and New York City bore the brunt of the damage from wind, rain, and storm surge, more than 117,000 NYSEG and 27,000 RG&E customers were without power.



↑ Supervisors now use an in-house dashboard in ArcGIS Online to monitor incoming data from the field.

Shortly after the hurricane, New York governor Andrew Cuomo established the Moreland Commission to make recommendations for how New York State's power utility companies could improve their responses to extended power interruptions. One outcome of the commission was the development of a utility scorecard, filed with the New York State Public Service Commission, to report on key performance indicators during outages lasting 72 hours or longer.

An essential performance measurement is how quickly utility companies can do a preliminary damage assessment. To comply with this feature of the scorecard and to improve their emergency response systems, the two New York-based Iberdrola USA companies, plus the Central Maine Power Company (CMP), sought to change from a manual damage assessment method to an automated system designed around a central data repository.

Pre-Sandy Storm Response

Although Iberdrola USA companies had begun enhancing their restoration processes—particularly their damage assessment practices—before Hurricane Sandy, these operations were still quite labor-intensive and time-consuming.

By 2012, damage assessors from NYSEG and RG&E were no longer bringing paper maps and tally sheets into the field. Iberdrola USA had gotten PDAs in 2006, which ran a customized version of Esri's ArcPad. But six years later, the maps were only semiautomated; the geodatabases were only a bit quicker to access; and office staff still had to collate the data after collection, usually after hours. What's more, the devices were stored at each division office, so before a storm, NYSEG's GIS and mapping project manager, Stephen Hope, had to pack them up and drive them—sometimes through threatening conditions—to affected locations for fast deployment.

Working with Local Authorities

Local municipalities and counties had been looking for ways to leverage their own resources to assist with postemergency damage assessments as well, particularly in areas that had a lot of ground to cover. Hurricane Sandy made the need for collaboration even more apparent.

After the hurricane, secondary roads were in such disrepair that utility workers couldn't access their equipment to complete even preliminary assessments of broken poles, downed wires, and damaged transformers. The municipalities asked if there was a way that their own workers could report damage to Iberdrola USA companies rather than having to wait for company assessors to get to their areas. Municipalities wanted to have access to Iberdrola USA's database to record downed poles or blocked roads, for instance, complete with geographic coordinates, pictures, and details.

The utility companies thought this was a good idea, so Iberdrola USA's IT applications manager, Paul Booker, and programmers Dean Hartley and Dick Abram worked in ArcGIS Online to make that happen. Moreover, this aspect of the project fell in line with the Moreland Commission's recommendation that utilities collaborate more with municipalities.

A New Kind of Storm Recovery Collaboration

NYSEG, RG&E, and CMP were looking for a damage assessment solution that could be ready within about a year. With guidance from Esri, they came up with one that could be deployed quickly and easily and that fit their licensing packages.

In November 2014, the Iberdrola USA companies released a three-part GIS solution to make postemergency damage assessments more swift, collaborative, and comprehensive. It was one part mobile, one part web maps, and one part dashboard.

Part One: Mobile Damage Assessments

To help with its own damage assessments, Iberdrola USA launched the Esri Collector for ArcGIS app on 300 iPad minis with data plans and individual phone numbers. Hope worked with NYSEG's manager of electric distribution quality assurance and quality control, La Wanda Ervin, to distribute these devices evenly across the company's New York and Maine service areas so that damage assessors could be deployed quickly wherever a storm hit.

Field personnel can now more accurately report damaged assets in real time using online and offline editing modes. The iPad minis communicate with the utilities' central geodatabase as soon as they enter cellular service zones. And data collection is map based.

"We did not use maps on the PDAs because the screen was so small," Hope said. "With the tablets, the maps are large and easy to use."

As fieldworkers record damage data, the tablets' GPS automatically pans to that location. Technicians can drop pinpoints to mark assets that need to be repaired, and the back-office programming automatically identifies each asset by drawing location data from the nearest utility pole. Field crews can also input photos, enter the type and extent of the damage, and report nearby conditions. What's more, assessors can communicate to and from the field using email or texting.

This system is more efficient and user-friendly than any of the utilities' previous procedures, and it saves time and money.

"The feedback we received has been wonderful," said Ervin. "The data coming in is more accurate, and most of our field technicians already used iPhones, so the technology is familiar to them. They love it."

Part Two: Collaborating with Municipalities Using Web Maps

Right after a storm or other emergency, municipal workers can now call their dispatchers to report preliminary damage to utility infrastructure and access points. The dispatchers can then log in to the municipalities' ArcGIS Online accounts and record the damages in the appropriate Iberdrola USA web map. Municipal personnel require minimal training to input the data, and the interface furnishes a simple way for municipalities and utility companies to work together to record damage assessments.

NYSEG has so far piloted this approach in three municipalities. Iberdrola USA hopes that more of the nearly 1,000 municipalities in its two-state service area join the initiative. They must have ArcGIS Online named user accounts, though, before they can participate.

Part Three: Monitoring Operations via a Web-Based Dashboard

Supervisors at all three utilities no longer have to wait to get field information compiled overnight. They can now monitor incoming data from the field on an in-house, Esri technology-based web application.

This higher-level dashboard view, available through ArcGIS Online, summarizes information such as the locations of downed primary and secondary wires, where transformers are leaking or need replacing, and how many broken utility poles there are. Training was minimal for this application too, said Hope, since the interface is so simple and intuitive.

Ticking All the Boxes—and Then Some

This three-pronged mobile, web, and dashboard solution was just what the Iberdrola USA companies needed. The quickly executed project lets utilities enter real-time damage assessment data, facilitates municipal involvement, and gives managers timely awareness of the overall situation.

Putting the system into practice was exceedingly cost-effective too. It took less than $100,000 to implement, including initial payments for licensing, devices, and other equipment.

And, as Ervin points out, the payoffs for being able to restore power more quickly exceed the monetary benefits.

"Imagine the cost savings in a storm like Sandy if you can leverage technology to get the power on one day faster," she said. "The payoff is also increased customer satisfaction and improved municipal relations."

Forest Atlas Informs How Woodland Changes Affect Earth

An interactive GIS atlas tells a story about what the world was like in the past, what it's like right now, and what we can ask of it in the future. The US Forest Service (USFS) has one such GIS atlas, the *Forest Atlas of the United States*.

The *Forest Atlas* "represents a new strategy and architecture for sharing data, information, and knowledge with policy makers, resource managers, landowners, and constituents," explained project manager and research soil scientist Charles "Hobie" Perry.

Built on Esri technology, the *Forest Atlas* is a resource for answering questions about how changes in forests affect people and the earth.

A Bountiful Archive of Forest Maps

Forest maps have a long history in the United States. In 1873, William H. Brewer of the US Census Bureau produced one of the first maps of forests and woodlands. In 1898, George B. Sudworth, a dendrologist in the early Forest Service, published his *Check List of the Forest Trees of the United States, Their Names and Ranges*. From that, he and his team used contour maps of the United States to record where various forest flora could be found. The Forest Service and the US Geological Survey then published these maps in a loose-leaf volume in 1913—the first *Forest Atlas of the National Forests of the United States*.

But due to all the legwork that went into producing this, only one volume was published.

Forest Inventories Help Track Change

In 1928, the USFS began the Forest Inventory and Analysis (FIA) program, which manages information on forest conditions and reports on sylvan trends. FIA inventories describe the location, health, age, and tree species of forests. Forest managers need this information to write sustainable forest plans; understand the risks of fire, insect, and disease outbreaks; and schedule treatment activities such as harvests—all to maintain forest health.

This information has wider reaching applications as well. Water resource managers use forest data to trace water life cycles. State forest managers use it to track insects, diseases, and invasive species so they can implement effective treatments. Scientists rely on forest measurements to calculate how much carbon dioxide should be captured and stored for carbon sequestration. Natural resource planners also build strategies and design policies using forest changes measured over time.

Reviving the *Forest Atlas*

Because more forest analysts and scientists are incorporating geospatial analysis into their work, FIA is paying more attention to geospatial technology. Recently, the USFS decided to revive the *Forest Atlas* project to better organize its tremendous amounts of spatial data, and it used Esri technology to rebuild the resource.

The foundation for the new *Forest Atlas* is a set of highly accurate forest maps derived from FIA and other research projects. FIA inventories nearly 1,000 different plant species across 12 time zones, from Puerto Rico and the Virgin Islands in the Atlantic Ocean to the Marshall Islands and Palau in the Pacific Ocean. FIA recognizes species according to the US Department of Agriculture's Plants Database to eliminate the inherent biases that can arise when people inventory forests according to their own needs.

In addition to showcasing FIA inventory data, the *Forest Atlas* features datasets and information from across the agency. This includes the Forest Health Technology Enterprise Team's National Insect and Disease Risk Map, the Monitoring Trends in Burn Severity Program's burn severity and fire perimeter maps, and other researchers' historic tree species migration maps and future range projections.

In the *Forest Atlas*, this information is combined with other forest attributes to tell a comprehensive story about the forces shaping US forests and the ecosystem services they provide.

"Good data tells a very significant story," said FIA's national program manager Greg Reams. "This helps us demystify reasons why species shift in the forest. Geospatial analyses tell a story of change, [allowing] us to track invasive species and understand how these events are occurring."

The *Forest Atlas* addresses other related but broad forestry concerns as well, including changes in employment trends, biomass availability, land cover, and land use. It also helps the USFS, firefighters, and other responders better manage wildfires and aids scientists in analyzing carbon sequestration potential.

More Inclusive Fire Management Strategies

Fires are a natural event in any wooded landscape. When strategically managed, they help forests grow stronger and healthier. But native and invasive pests, overcrowded clusters of forest, and drought conditions reduce forests' resilience to fire and increase the likelihood that fires will be catastrophic.

The USFS and its partners need to integrate fire as a critical natural process in land and resource management but control wildfires that pass through properties with various ownership structures, all while implementing the best available science.

The *Forest Atlas* lets stakeholders and policy makers share essential knowledge for making environmentally sound and cost-effective fire management decisions. Sharing open data on GIS platforms ensures that everyone can understand and participate in these critical decisions.

Forecasting Carbon Sequestration Capabilities

US forests offset about 16 percent of the nation's annual carbon emissions, according to the USFS, making the *Forest Atlas* invaluable for designing carbon mitigation strategies.

People involved in discussions about climate change and carbon are very interested in forests' past; current; and, most of all, future carbon sequestration rates. These people are particularly keen on seeing various mapped-out scenarios that project carbon storage rates over the next 10 to 30 years.

Using Esri model building tools, researchers can construct simulations of future carbon sequestration based on variables such as population growth, fluctuations in gross domestic product, and changes in forest age and density. Forest Service scientists can also use projected climate scenarios—ranging from warm dry seasons to mild wet seasons—to calculate the effects these different conditions would have on future forest growth, including changing forest areas and carbon sequestration rates over the next 30 years. Analysts can then use these projections to forecast economic development such as housing starts, future lumber demand, and the quantity and quality of water that will be derived from forested ecosystems.

Complex and connected scenarios such as these are easier to understand when presented as geospatial displays. For example, positive and negative carbon storage levels can be represented as a range on a map so the resource community can see areas that need management action and policy makers and city planners can see what the effects will be.

Making the *Forest Atlas* Accessible

The *Forest Atlas* is available on the USFS GIS platform and is published in accordance with the Federal Geographic Data Committee's metadata standards. This makes it easy to integrate the information with other open data across government organizations.

"I see us aligning with other agencies, not just in a statistical manner but in a geospatial manner," Reams concluded. "Geographic metadata makes it easier to track monitoring information such as the shifts among land-use and land-cover categories, particularly forests, agriculture, and urban landscapes. The open-source data platform enables data integration among agencies in ways that will prove highly meaningful."

The general public can also access the atlas via ArcGIS Online and through the US government's open-source spatial data website, www.GeoPlatform.gov.

This 30-meter digital data of tree canopy cover has superseded William H. Brewer's map of woodland density from 1873.

GIS Makes Citizen Science More Accessible

How the General Public Can Regain the Thrill of Scientific Discovery

By Dr. Lei Lani Stelle, University of Redlands

Science means "knowledge" in Latin (*scientia*), with modern definitions focused on obtaining this *scientia* through systematic observation and experimentation to learn about the natural world.

This sounds straightforward. Why, then, is science met with such controversy and unease when presented to the general public?

This stems from a basic misunderstanding of how science works and what we can do with this knowledge. Mistrust may arise from poor education, media sensationalism, or stigma. As an educator myself, I have been shocked by students claiming that they don't like biology because it is not hands-on. This grossly inaccurate perception is due to a lack of experience actually doing science, a consequence of focusing on testing memorized facts rather than on the development of critical thinking skills.

Many other students (and adults) state that while scientific topics are interesting, they just can't think like scientists. I remind them that children display an innate scientific mind by constantly observing, manipulating, and testing their deductions to infer general principles that help them understand their surroundings. Sadly, this early application of the scientific method is often lost and many are scared away from the sciences.

But the public's understanding of science can be greatly improved. One way to do this is by including people in the quest for *scientia* as citizen scientists.

Citizen science—the involvement of interested members of the public in collecting and/or analyzing data for scientific projects—is not a recent phenomenon. Bird watchers have formally contributed avian observations to the annual Christmas Bird Count since 1900, five years before the United States' National Audubon Society was even officially founded, and the Cornell Lab of Ornithology currently receives an average of 1.6 million bird reports per month through its eBird web tool. I have also been involved with citizen science for more than 20 years, working with Earthwatch Institute-funded projects to involve volunteers in investigating human impacts on marine mammals.

This rich history of citizen science is now being enhanced considerably. The widespread availability of mobile devices has enabled the development of apps that can easily include the public in generating important data to monitor populations, climate, and other natural phenomena. Not only can this improve the public's understanding of both scientific concepts and methodology, but it can also directly benefit researchers whose monitoring projects—which are essential for conservation—are often made more difficult by lack of funding and increased expectations.

In 2013, I launched just such a project. With funding from the California Coastal Commission, GIS developer Melodi King (smallmelo.com) helped me create Whale mAPP, a web- and mobile-based application that uses GIS to allow anyone to monitor marine mammals anywhere in the world.

Many marine mammal species are endangered or threatened, and baseline data is lacking for most populations. Millions of people observe whales every year, and these encounters are often recorded with photographs and videos. Yet this information is rarely shared with anyone other than a few friends and family members.

Whale mAPP allows anyone equipped with a GPS-enabled Android device to submit sightings of marine mammals to Whale mAPP's website, whalemapp.org, and share their observations via an online geodatabase that is freely accessible to researchers and the public. The website displays the sightings in an interactive map along with photos, video clips, graphics, and educational details on different species and conservation efforts.

In the classroom, students can further utilize GIS to view marine mammal sightings and locations, formulate hypotheses, and then test their conjectures using the collected data. This develops the students' scientific inquiry, spatial reasoning, and critical thinking skills while increasing their knowledge of the natural world.

To date, around 100 Whale mAPP users have collected more than 2,000 sightings from over 330 surveys in the United States, Canada, and the Caribbean, documenting more than 25 different marine mammal species. With marine mammals acting as charismatic megafauna, people are also enticed to learn more about marine life.

When citizens are directly involved in scientific research and recognize the relevance of their work, they are inspired to be passionate about and dedicated to conservation. For instance, when volunteers on my Earthwatch project observe plastic trash scattered amid a pod of dolphins, those people are likely to make positive changes in their own actions.

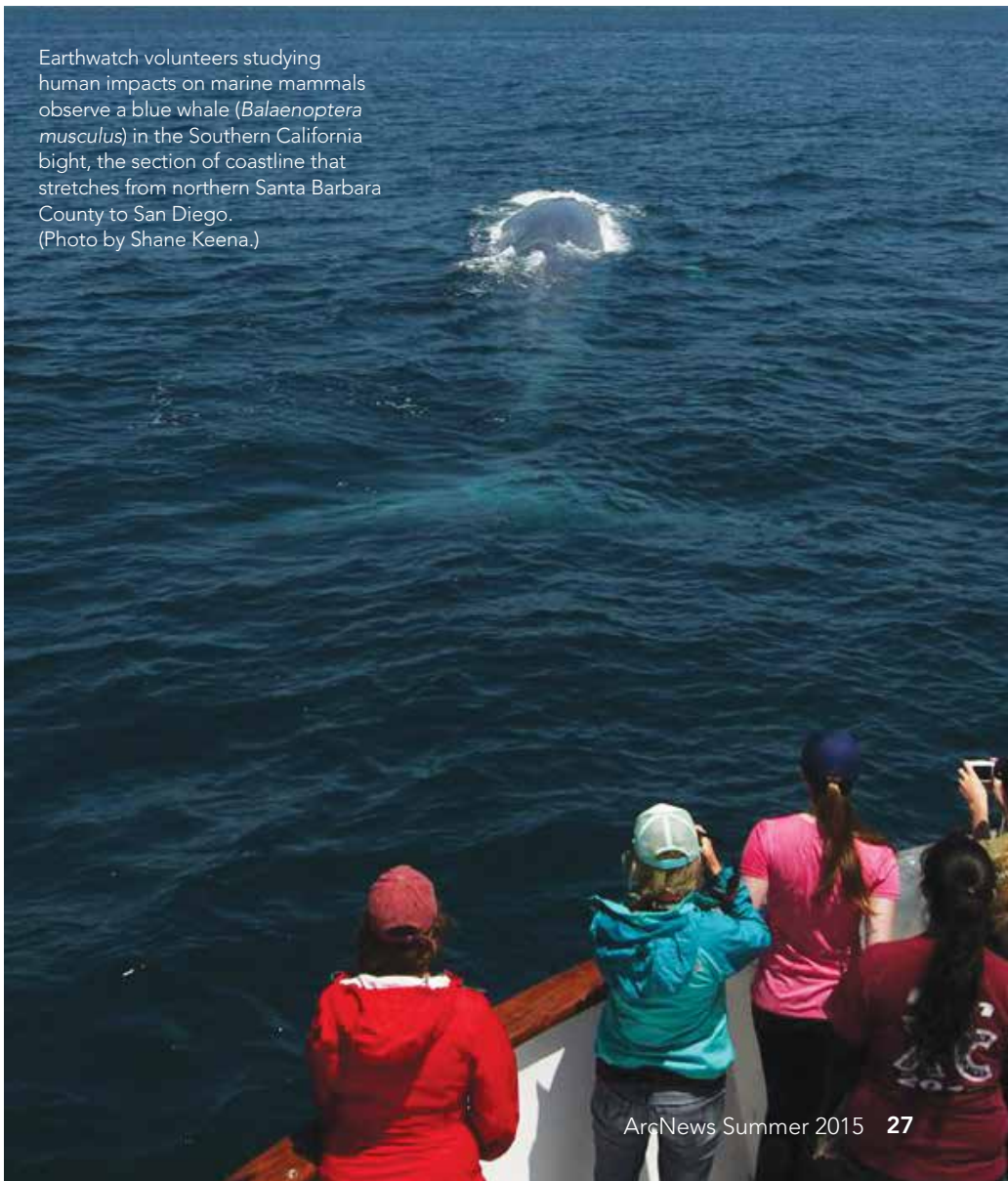
Community members with a renewed appreciation for the thrill of scientific discovery are invaluable to scientists as well. Citizen scientists collect new data and expand the geographic coverage of a study—all for free. Although some scientists question the reliability of volunteered data, this is easily managed by providing appropriate training, outlining clear expectations, and using technology that reduces the number of details that must be reported manually (e.g., location, date, and time, which can be automatically recorded by mobile devices) and requires data entry verification (e.g., photo submissions so scientists can confirm recorded species).

The growing trend of conducting citizen science projects like Whale mAPP is a positive force that provides necessary long-term data and promotes collaboration between researchers and stakeholders—two key components of successful conservation efforts. Moreover, empowering citizen scientists may reduce the gap that has historically divided the public, researchers, and policy makers in environmental management efforts. Collaborative projects enable scientists and citizens alike to recognize our shared mission as seekers of *scientia*, given that we are all, by our very human nature, scientists.

About the Author

Dr. Lei Lani Stelle is an associate professor of biology at the University of Redlands in Southern California. She is also the principal investigator for the Earthwatch Institute expedition Whales and Dolphins Under the California Sun, which monitors marine mammal behavior along the coast of Southern California. Whale mAPP can be downloaded for free at whalemapp.org.

↑ Whale mAPP allows anyone to record sightings of marine mammals to aid in research, education, and conservation.



Earthwatch volunteers studying human impacts on marine mammals observe a blue whale (*Balaenoptera musculus*) in the Southern California bight, the section of coastline that stretches from northern Santa Barbara County to San Diego. (Photo by Shane Keena.)

Scientist Finds Life's Work in Digitally Mapping the Earth's Ecosystems

GIS Hero

↑ Roger Sayre

People understand how important the earth's ecosystems are. Terrestrial, marine, and freshwater ecosystems give humans goods and services that are critical to our survival. Yet most people don't know what these ecosystems really are or even where to locate them.

That is why Roger Sayre feels that his current project mapping global ecosystems—on land and in oceans and freshwater—at fine resolution is the most exciting and important work he has ever done.

"The concept for ecosystems has been around for a long time, and you have a lot of ecologists who study how ecosystems work," said Sayre, senior scientist for ecosystems at the US Geological Survey (USGS) Land Change Science Program. "What we haven't had," he continued, "is this long tradition of the science of ecosystems geography—understanding what ecosystems are out there and where they're located."

Sayre received a commission from the United Nations (UN) Group on Earth Observations to lead this project. The goal is to bring the power of earth observation to a larger community by mapping all of the world's ecosystems so that more people can use this to try to solve some of society's most pressing problems.

Sayre uses 250-meter resolution data—the finest spatial resolution available for this kind of map—to show geographic patterns and relationships at a level of detail that is useful to not only scientists but also land planners, resource managers, and conservationists. The final product almost looks like a satellite image, but it is built using datasets rather than sociopolitical boundaries or expert opinions.

Under the UN commission, Sayre began by making ecological maps of individual continents rather than of the whole globe. At the time, that was all he had the resources to do.

In 2013, he launched his ecological map of the African continent at the AfricaGIS Conference, where Esri founder Jack Dangermond was giving the keynote speech. The two had coffee, and Dangermond expressed how important he thought it was for the world to have a basemap of global ecosystems. Dangermond told Sayre he would help with putting together the global ecosystems maps, and within a year, a whole team was working on the project.

In December 2014, the USGS and Esri unveiled the Global Ecological Land Units (Global ELU) map. "I never expected it to go so quickly," Sayre said of the Global ELU project, "but I never doubted that [it] would happen."

Sayre has always been interested in maps and the natural world. His father was an avid backpacker and took him on backpacking trips every summer, where Sayre, who was intrigued even then by spatial relationships, learned to read topographical maps from the USGS.

He went on to study plant sciences at the University of California, Riverside. His then-girlfriend (and now, wife) convinced him to take a field botany class from Dr. Frank Vasek. Although he was reluctant to study "flowers," as he recalled, Sayre now cites Vasek as a strong inspiration for his current mapping projects.

"That's where I really started to think about the distribution of vegetation and ecosystems on the landscape," said Sayre.

Vasek taught his students the history and geography of desert and coastal areas in Southern California, and that's when Sayre realized what he wanted to do in life.

Before continuing his studies, Sayre spent four years in Africa with his wife. They went into the Peace Corps together in Swaziland, where he was a science teacher and she taught math. Sayre credits his time living in and traveling around Africa with shaping his views on open data.

"You just have to help people out and give them what they need," he said, "and giving data is fundamentally important."

When Sayre returned to the United States, he got a master's degree in forestry from Pennsylvania State University and then a PhD in natural resources from Cornell University.

It was at Cornell, while he was doing research on acid rain, that he stumbled upon GIS for the first time at the Cornell Remote Sensing Lab.

"I saw some people on computers looking at maps," he said. "They were digital."

He thought that spatial analysis was indispensable, so he convinced his adviser to let him learn GIS. Using ARC/INFO, Sayre became skilled at doing spatial analysis with some of Esri's earliest software.

As he neared the end of his PhD program, Sayre saw an advertisement for a GIS manager position at The Nature Conservancy for its Latin America and Caribbean science program. He got the job, and that was his real start in GIS.

Sayre was the organization's first GIS manager. He soon moved up the ranks, becoming the manager of all information programs, then the director of science programs, and finally the director of The Nature Conservancy's whole international conservation science program. This took him away from mapping for a while.

But in 2005, Sayre accepted a senior scientist position at the USGS, which got him back into mapping and GIS.

Now that the Global ELU map has been released, Sayre is working with Esri and a number of ocean scientists on the next phase of the UN-commissioned project: the Global Ecological Marine Units map.

The project, launched in February, is in the very early stages of development. It has complicated components, including having to map two 2D surfaces—the top of the water and the seafloor—and the 3D volume in between. But Sayre hopes that in a year, the group will have a really good understanding of marine ecosystems and perhaps even a draft map.

According to his colleagues, Sayre is the consummate scientist to have such an important role in all three ecological mapping projects.

"He is really interested in collaboration and moving the discussion forward on what's going on," said Esri director of product engineering Clint Brown, who has known Sayre for almost a decade. "I am awestruck by his ability to engage with people in such a positive way."

Perhaps that comes from the enthusiasm Sayre has for what he does.

"Five o'clock comes, and I don't want to go home," Sayre said. "I've ended up being able to do that thing for which I really have a passion."

What drives Sayre is the freedom to think big and work with like-minded, committed people to do something really important.

He even gets to see the payoffs when he goes backpacking with his own family. They make it out to California's High Sierras when they can, where Sayre often finds himself wondering if he and his team have mapped things correctly.

"It looks like granite with conifer forest," he finds himself thinking.

It seems that the work is never done when mapping all the world's ecosystems.

← The Global Ecological Land Units map reveals geographic patterns and relationships using 250-meter resolution data, giving scientists, land planners, resource managers, conservationists, and the public new insights into the interrelated nature of our world.

Crossing Borders

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

Making a Difference for Students in Our Communities

It is no secret that many US schools are struggling to provide the globally competitive and informed education that students need and deserve and that the nation requires. There are many political and vested-interest reasons for this failing, and bringing needed change—particularly in addressing the glaring need for teaching geography and GIS in the K–12 education system—has been a slow and frustrating process.

While there has been an explosion of innovation, investment, implementation, and jobs in the geography and GIS fields in business, government, higher education, and society at large, the K–12 world has been slow to adapt. High school and middle school students in the United States are unprepared to exploit these national needs and take advantage of these employment trends.

What Can Be Done to Improve K–12 Geography and GIS Education

Fortunately, there is hope that this situation can be changed. First, we can work to add dedicated funding for K–12 geography and GIS education into the upcoming reauthorization of the federal Elementary and Secondary Education Act (ESEA), also known as the No Child Left Behind Act. Second, Esri's recent donation of ArcGIS Online software to all K–12 schools in the United States through president Barack Obama's ConnectED Initiative offers an extraordinary opportunity to jump-start geography and GIS education in our schools right now.

To help achieve this end, the Association of American Geographers is working together with Esri to develop the national GeoMentors program to support schools and teachers as they bring GIS (and, by extension, geography) into their classes and curriculum. We invite and encourage everyone within the geography and GIS communities to consider helping out in schools across the United States by volunteering for the ConnectED GeoMentors program.

How to Become a GeoMentor

We welcome the entire GIS community—from GIS professionals and geographic information scientists to educators and undergraduate students—to volunteer as GeoMentors. As a GeoMentor, you will play a pivotal role in improving GIS and geography education by sharing your skills and experiences. GeoMentors will have access to a wide array of online materials to help teachers and schools incorporate GIS projects and geographic learning into their classrooms.

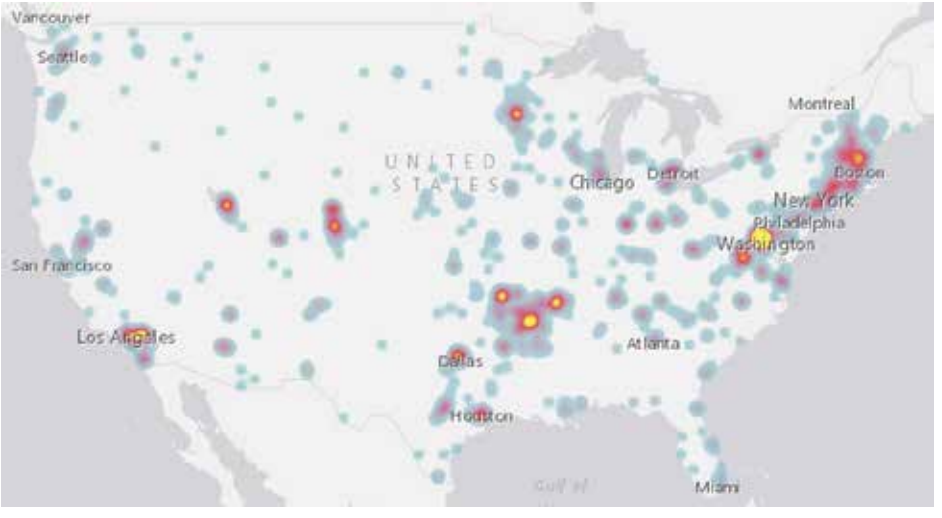
To become a GeoMentor, visit geomentors.net and click Participate.

↑ Many GIS professionals want to help educators and youth use GIS, as this map of the current GeoMentors network shows. These GeoMentors have provided links for learning about and connecting with them. Go to geomentors.net/participate to volunteer as a GeoMentor.

AAG and Esri are now building a diverse and talented network of GeoMentors with whom you can share your experiences, challenges, success stories, and best practices. We are seeking volunteers from all scientific disciplines engaged with GIS—from social and physical scientists to engineers building transportation systems and historians doing GIS-based research projects. Professionals across the public, private, academic, and nonprofit sectors are part of this exciting opportunity to build student understanding of and enthusiasm for the ubiquitous applications of GIS in their communities and around the world. Whether your expertise is on the fundamental geographic concepts of space, place, time, and dynamic maps or you are an expert GIS user with advanced spatial analysis skills, you can play an important role as a GeoMentor in the ConnectED Initiative.

Getting Started as a GeoMentor

Getting started in the GeoMentors program is easy. The first step is to reach out to your personal and professional networks to find opportunities to improve geography and GIS education in your community. You can begin by contacting local schools, school districts, or teachers you know in your area to see if they are taking advantage of ConnectED's GIS donation program. You could check with the schools your children, relatives, or neighbors go to, or even your own alma mater. If your local school administrators do not know about the program, you can help bring free GIS technology and geographic learning to them and their school districts.



↑ This heat map shows the increase in the number of schools getting GIS through the ConnectED Initiative. Blue represents areas with the fewest number of schools using GIS through ConnectED; red indicates areas with increased usage; and yellow shows areas with the greatest number of schools using GIS. For resources and an ArcGIS Online request form for your school, visit connected.esri.com.

If your local schools are already participating in the ConnectED Initiative, you can help educators acquire and improve their GIS skills or help develop geographic activities and GIS projects to use in classrooms. You can begin preparing now by going to geomentors.net/prepare to learn more about ArcGIS Online resources for educators and find sample activities for students to do in their classes.

Contributing to your community and improving geography and GIS education in the United States is rewarding in its own right. Working with and learning from other GeoMentors in the program is a great way to create professional networks of knowledgeable, caring, and civic-minded colleagues like yourself. Most important, by coming together with the GeoMentors network and Esri, we can all make a real difference in the quality of education in our schools and in the lives of students throughout the nation.

Thanks in advance for your support and participation in this crucial GeoMentors program.

Contact Doug Richardson at drichardson@aag.org
Visit geomentors.net

Pioneer in Applied Geography Awarded Anderson Medal

The Association of American Geographers awarded Bill Derrenbacher, Esri's executive adviser, the 2015 James R. Anderson Medal of Honor for his distinguished service to the profession of geography.

Having devoted 40 years to the innovative application and understanding of geographic science, Derrenbacher has influenced untold organizations. A leader and a driving force in modern-day applied geography, he has played a significant role in the proliferation of GIS around the world. Derrenbacher and the team he built at Esri have designed geospatial data methods and tools that have become best practice standards for land management and geodesign. Because of his work, more than 1 million organizations have a better understanding of the world and are making wiser decisions.

Derrenbacher joined Esri's founder, Jack Dangermond, in the mid-1970s to help build what is now the foremost GIS company in the world. Esri's early projects often involved the systematic assessment of land capability and suitability using digital databases. Derrenbacher performed these assessments by applying a new methodology called integrated terrain unit mapping, which consolidates a number of terrain features, such as vegetation and soils, into map units to help evaluate land-use opportunities and constraints and, in turn, determine best uses and management practices.

In one of the most far-reaching undertakings of his career, Derrenbacher organized and led a large team to devise the modern data format standard for the United States' Defense Mapping Agency's (now the National Geospatial-Intelligence Agency) digital vector map products. The team created the Digital Chart of the World, the first global GIS database. The production tools developed for this project are now used by national mapping agencies around the world.

Esri subsequently released its own version of the Digital Chart of the World. It became the starting point for Esri's initial digital data products and, eventually, the data content that is now developed and maintained by Esri in ArcGIS Online. Users can now stand up map and associated data in ArcGIS Online to conduct ever deeper and more wide-ranging analyses.

Derrenbacher also established the Esri Professional Services division, which, under his leadership, was (and still is) integral to advancing applied geography methods that effectively address real-world opportunities and challenges. Esri Professional Services regularly breaks new ground, driving novel requirements and functionality into Esri's ArcGIS platform. The team then shares its tools, workflows, and lessons learned with Esri users and partners.

← Esri executive adviser Bill Derrenbacher received the Anderson Medal of Honor on April 25. (Photo courtesy of the Association of American Geographers.)

While working on projects, Derrenbacher and Esri Professional Services created a framework and workflows that other organizations could use to collect, build, and analyze data. This led to the 2014 release of GeoPlanner for ArcGIS, a web solution built out of proven geodesign methodologies that provides planners with a geographic data- and science-based structure to use to address local and global issues.

Since the early days of Esri, Dangermond and Derrenbacher's ideology of sharing knowledge and building understanding has remained foundational to increasing the use of GIS in applied geography. This vision continues to inspire and allow the company to be open, agile, and innovative.

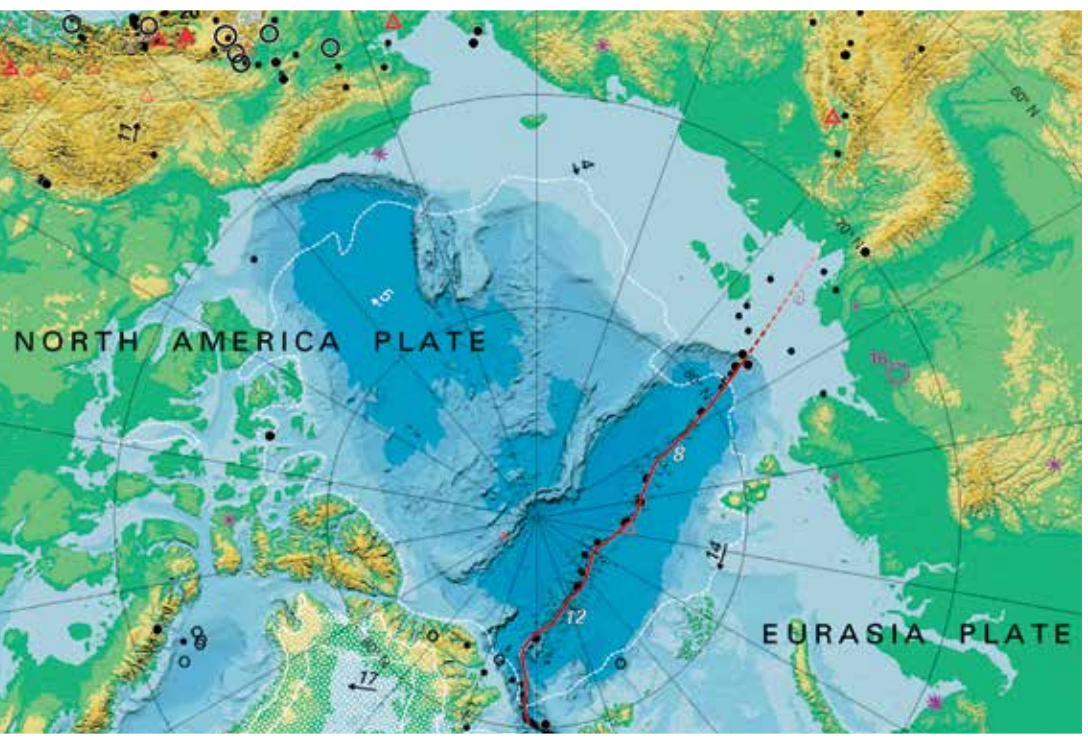
Derrenbacher continues to inspire the next generation of geographers and GIS professionals, and the Anderson Medal of Honor is a fitting tribute to his contributions to the field of applied geography.

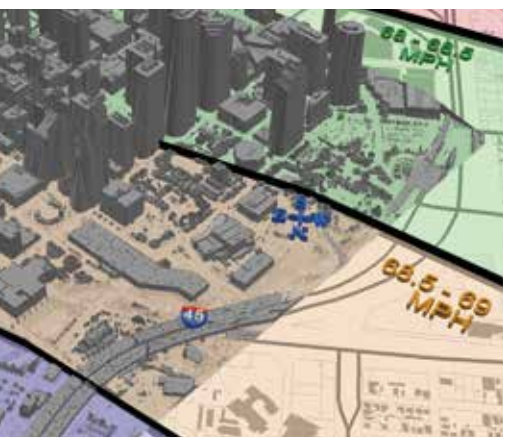
Derrenbacher held the position of director of the Esri Professional Services division until 2014. He currently serves as Esri's executive adviser.

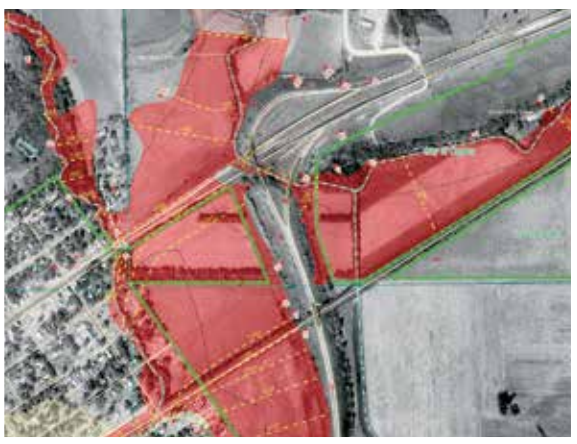
Learn more about Derrenbacher's influence on GIS and applied geography at esri.com/aagaward.

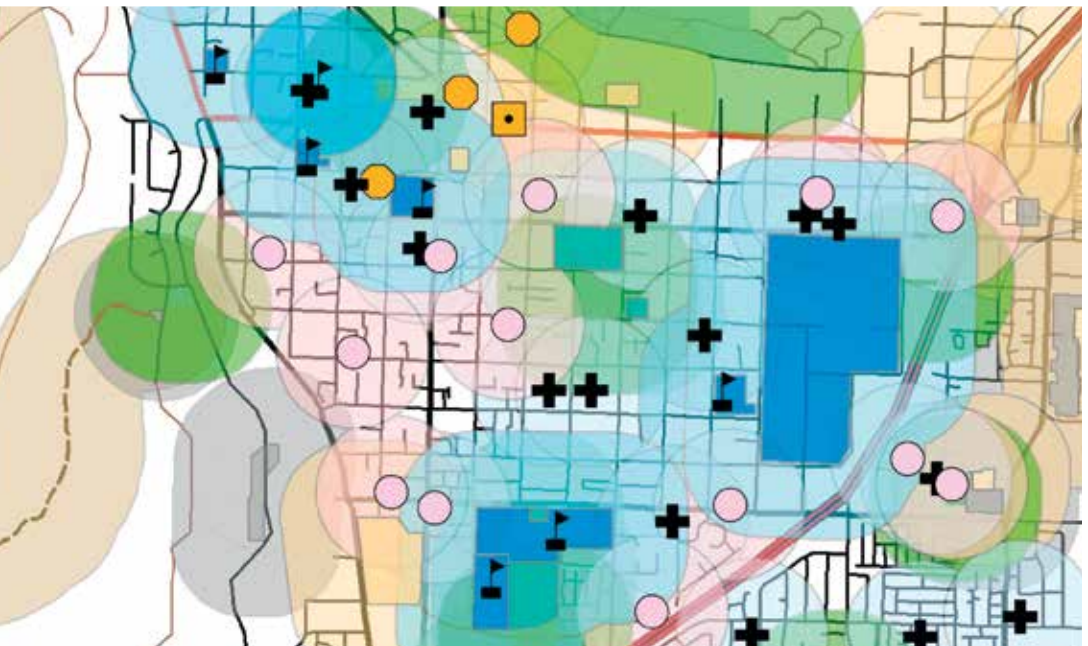
↑ From left to right, Kent Smith, Bill Derrenbacher, and Jack Dangermond—three of Esri's trailblazers in the 1970s.

↑ Bill Derrenbacher was trained as a geographer at the University of California, Berkeley.









Aggregate. Analyze. Act.

Resolve Real-World Challenges

MS in Geographic Information Systems

- Learn cutting-edge GIS science and theory
- One-year, full-time residential program (two-year option available)
- Access to extensive Esri® resources
- Small classes and workshops led by distinguished faculty
- For professionals and recent grads with GIS experience/education

UNIVERSITY OF
Redlands

(909) 748-8128
msgis.redlands.edu

Adapting GIS Strategy to Changing Needs

By Ellen West Nodwell, Vice President of Geospatial Services, IntegraShare Solutioneering, Inc.

Geospatial technology has matured over the last decade. Whereas it used to be the toolset for people who make maps, it now serves all levels of the GIS user community, from authors and analysts to administrators and consumers.

GIS managers are aware that their user community has become more diverse. They have seen the GIS team's role evolve from making maps to building solutions, just as they have seen their own responsibilities expand.

When I was the GIS manager at a large energy company, my team and I oversaw this evolution. With some guidance from one of the founding fathers of GIS, the late Dr. Roger Tomlinson, we changed our orientation to better serve our growing user community, allowing the company to mature in its GIS use more rapidly than we originally thought it would.

GIS Users Change—and So Must the GIS Team

GIS users are no longer siloed in the GIS team. GIS interface development has progressed so that a wider range of consumers use the technology and a more functionally diverse set of people now apply GIS to almost any type of business problem. Thus, GIS practitioners are found on many business teams in an expanding array of organizations.

This puts GIS managers in a unique position: They can unite various groups around geospatial information, or they can be squeezed between competing interests when things go south. To avoid the latter, the GIS manager must build the right strategy to address the organization's business goals while also supporting those using GIS for analysis and decision support.

Developing and Marketing GIS from the Ground Up

In my case, when the company's upper management decided to implement GIS, it required hiring a GIS manager—me—and creating a GIS group to support the new technology throughout the global organization.

On day one, I had to begin analyzing the organization's baseline maturity in GIS use so that I could start building the plan. It took several months to assess the company's needs and design our system, but after it was approved by the chief information officer a few months later, we implemented our enterprise GIS according to contemporary best practices.

To encourage employees to use GIS, it was initially marketed as an innovative decision-support technology that people could learn to use themselves. The GIS team demonstrated how GIS could be applied to a variety of business issues, and employees were encouraged to work with the tools live rather than rely on printed maps made by others, to avoid snapshot reporting.

The organization's use of this new technology began to grow, as did my role as GIS manager. In addition to having custody over the technology itself, my team and I acted as stewards and facilitators for the company's array of users, encouraging their work to evolve alongside the technology and vice versa.

A Shift in Perspective

A year and a half into the implementation, my GIS team and I attended Tomlinson's class on planning and managing a GIS. Our main takeaway from this talk was that GIS cannot be implemented using a field-of-dreams—if we build it, they will come—approach. Rather, the GIS team needed to research and comprehend the business's goals to set the right strategic approach. (Tomlinson elaborated on this in his book *Thinking About GIS: Geographic Information System Planning for Managers*—a must-read for all GIS managers.)

This really changed our perspective. We realized that we needed to be more proactive and strategic rather than reactive and tactical, guided by the business's strategic goals rather than simply taking orders. We needed to understand our users' various roles to be able to support them as business partners.

As a result, and with continued mentoring from Tomlinson, we changed our strategic direction.

A New Strategic Approach

My team and I reexamined our earlier analysis of the company's user community, and we found that four distinct roles emerged. First, there were the authors, the smallest group, who created the information. Next, there were the analysts, who examined, refined, and synthesized the data. Then there were the administrators and publishers, who made the content available to the last group, the consumers, who viewed and utilized the information to complete tasks and make decisions. This was a pattern that emerged across all user groups.

We implemented this methodology—evaluating the business goals, categorizing user profiles, and assessing user requirements—whenever we had to come up with new design strategies, and we used the results as key benchmarks. We also worked with our internal business partners to better understand our organization's distinct business life cycles so that we could coordinate our geospatial data life cycles along the same lines.

After our reevaluation, the GIS team's modified strategy was to provide good quality, fit-for-purpose data via intuitive interfaces to help our organization meet its annual goals and longer-term objectives. We designed GIS products that were oriented toward solutions, and we only released them after they were fully functional and accepted by the business partner (which we thought of as our client).

We also became the company's in-house GIS consultants, coaching employees throughout the organization on various elements of the technology. For example, positional accuracy was important to the organization's operational integrity, as were the health and safety of our employees and customers. My team and I therefore focused on educating our internal business partners in best practices for information gathering and recording to ensure that the GIS content consumers were basing their decisions on contained the most accurate and reliable data.

More GIS Users Should Support Business Strategy

By shifting our strategy from pushing geospatial technology onto our business teams to letting the company's business strategy guide our GIS use, we significantly increased our return on investment in the technology.

Over the years, the GIS team partnered with the business side of the company on a number of projects. We tested how business intelligence integrated with GIS; we figured out how to manage driver safety by using real-time data; and we even built a more robust emergency response portal that our company could use during an emergency, not just afterward.

Within just a few years, GIS became a key feature of the toolset executives used to manage the company's strategic assets and investments—whereas before, there had been no GIS at all. It was obvious that, for our company, GIS's true value became clear when our group better understood the business strategies and geared our projects toward those goals.

Ellen West Nodwell and her team won the Special Achievement in GIS (SAG) Award from Esri in 2010 for their development of a holistic GIS program that could be used by both the operations and business branches of their company, not just the GIS team.

Managing GIS

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

URISA
The Association For GIS Professionals
www.URISA.org

Colloquium Urges GIS Specialists to Look to the Past to Inform the Future

Comic strip character Dick Tracy got his two-way radio wristwatch back in 1946, yet smart watches are only now becoming serviceable for the general public because of the ubiquity of cellular networks and mobile computing capabilities. In the 1960s animated television series *The Jetsons*, families from the future used flying cars every day, but these are only now being developed in earnest and have yet to hit mass markets.

Dr. Barry Wellar, professor emeritus in the University of Ottawa's geography department, is asking GIS specialists to look back in time to see what long-lost ideas we might be able to bring to fruition using many of the resources—extensive software suites, cloud computing, and big data, for example—that have emerged relatively recently.

The notion originated from a conference Wellar held in Ottawa, Canada, in 1983 called AutoCarto Six.

"If you look at the people who attended it, it was almost like the Who's Who of GIS today," said Gordon Plunkett, Esri Canada's director of spatial data infrastructure, who worked on one of the papers presented at the conference. The meeting happened just as digital cartography was emerging, and the people in the room wanted to make sure the new technology endured. Plunkett recalled that a lot of ideas were put forward.

According to Wellar, that conference had a prodigious impact on the origins and growth of automated cartography, GIS, remote sensing, geomatics, and related fields. For the conference's thirtieth anniversary, he put together a book called *AutoCarto Six Retrospective*, which followed up on what happened with the work that attendees were doing in the 1980s.

Evidently, this sparked an idea.

In February, Wellar held a colloquium at Esri centered on the question, How can looking back at what has been done, or not been done, in the field of GIS contribute insights into why and how the field of GIS could and should evolve in the coming years? What Wellar is proposing is that GIS specialists dig up old conference proceedings, reread outmoded industry and academic literature, recall past experiences, and even examine vintage popular culture to find "GIS nuggets"—ideas that have fallen through the cracks or were perhaps just not feasible in the past—that could potentially be developed now that we have more technological know-how.

This development, as Wellar sees it, should focus on three related core missions: designing, developing, and implementing GIS technology; defining and elaborating the methods, techniques, and operations of GIScience; and getting more people in a wider range of professions and with varied interests to use GIS technology and GIScience.

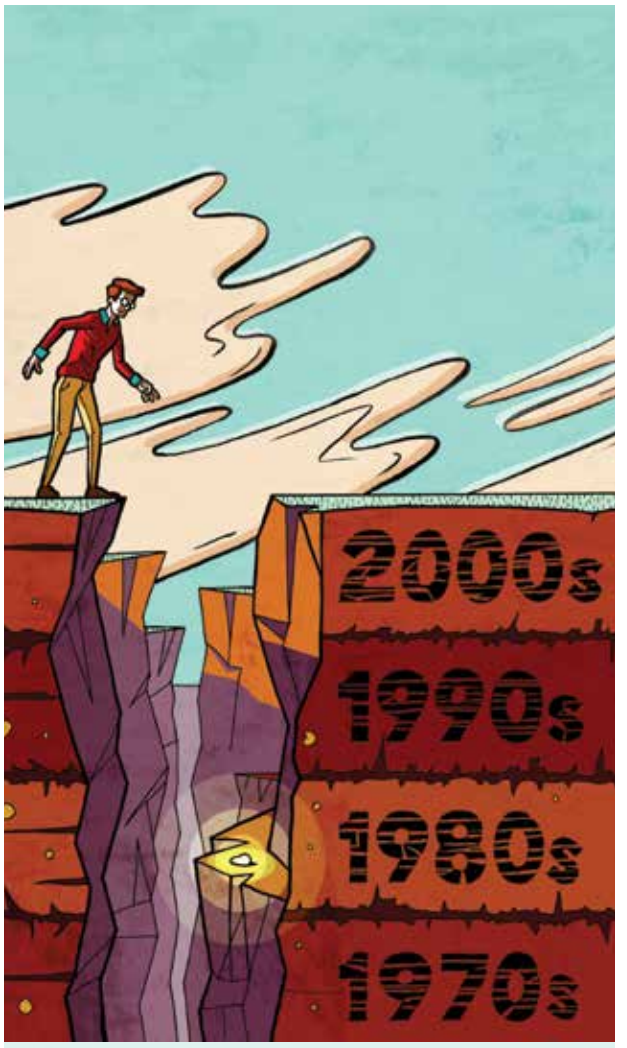
Wellar believes that this retroactive mining of GIS nuggets should be inclusive as well, simultaneously considering GIS technology, GIScience methods and techniques, and how these are used. Not only that, but the questions asked while mining should be manifold: How can this promote continuity among members of the GIS community? How did best practice concepts affect GIS evolution? How has GIS affected urban design, the social sciences, or the news media? How have GIS and geo-based data contributed to pedestrian safety?

The purpose of February's colloquium was to have some of the most respected GIS and GIScience experts come up with a solidified methodology for retroactively mining GIS nuggets. With that accomplished, Wellar plans to build on what came out of the colloquium by holding an applied research seminar at the Esri Federal GIS Conference in 2016. There, selected GIS practitioners with an emphasis on federal government will present the findings of their own retroactive GIS nugget mining projects, which will then form the basis of seminar discussions.

"The results that come out of this . . . could be broad based," said Plunkett.

Although the project is largely research based right now, if someone does find constructive GIS nuggets, it could help inform how GIS professionals do their jobs and, ideally, expand the use of GIS and GIScience across industries, professions, and interests.

Materials from February's Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets can be viewed at wellar.ca/wellarconsulting/home.html.



Dr. Barry Wellar is a professor emeritus in the geography department at the University of Ottawa, Canada. He is president of the Information Research Board, Inc., and owner and principal of Wellar Consulting, Inc. He is a past president of the Urban and Regional Information Systems Association (URISA) and a member of the GIS Hall of Fame. His awards include the Anderson Medal of Honor, the Horwood Distinguished Service Award, the Edward L. Ullman Award, the URISA Leadership Award, and the Canadian Association of Geographers' Service to Government Award.

The Relevance of Cartography

A Cartographer's Perspective

A column by Georg Gartner
President of the International Cartographic Association

Assessing Where Cartography Is—and Where It Will Go

The fields of cartography and geoinformation science are becoming more relevant than ever. Without maps, people would be spatially blind. Knowledge about spatial relations and the locations of objects is extremely important for enabling economic development, managing and administering land use, handling disaster and crisis situations, and even simply showing people how to get from one place to another.

Cartography is also becoming more contemporary, thanks to new and innovative technologies. Maps can now be derived automatically from geodata acquisition methods such as laser scanning, remote sensing, and sensor networks. Cartographers can also build smart models of geodata, which allows in-depth analysis of structures and patterns. Additionally, maps can now be presented in a range of forms, from maps on mobile phones to augmented reality presentations that let viewers see live, real-world environments with amplified features using computer-generated sensory data.

To probe deeper into these ideas and developments, the International Cartographic Association (ICA) is looking forward to hosting the International Cartographic Conference (ICC) 2015 in Rio de Janeiro, August 23–28. There will be high-profile keynote speakers; exciting technical sessions; cartographic and technical exhibitions; a children's map competition; a Brazilian side program—including a soccer game at Rio de Janeiro's famed Maracanã Stadium—and, of course, the opportunity to be where the people and ideas of modern cartography are converging.

With a wealth of rich topics on offer, the International Cartographic Conference will give attendees the opportunity to learn about the newest developments, results, ideas, and products of modern cartography. Some sessions will cover practical issues such as cartography for sustainable development, while others will be more conceptual and classic, focusing on cartographic theory or topographical mapping. Still others will be technical, bringing attention to subjects such as GIS cloud computing, location-based services, and 3D and 4D cartography.

ICC 2015 will bring together an array of cartography and geoinformation researchers and practitioners from around the world to reflect on the relevance, attractiveness, and contemporaneity of maps and cartography.

To enhance the list of attendees, I would like to cordially invite all of you to join the global family of cartography and GIScience by participating in the International Cartographic Conference 2015 in Rio de Janeiro. For more information, visit icc2015.org.

About the Author

Georg Gartner is a full professor of cartography at the Vienna University of Technology. He holds graduate qualifications in geography and cartography from the University of Vienna and received his PhD and habilitation from the Vienna University of Technology. He was awarded a Fulbright grant to the University of Nebraska at Omaha in 1997 and research visiting fellowships to the Royal Melbourne Institute of Technology in 2000, South China Normal University in 2006, and the University of Nottingham in 2009. He is the responsible organizer of the International Symposia on Location-Based Services and editor of the book series *Lecture Notes on Geoinformation and Cartography*, published by Springer. He is also editor of the *Journal of Location Based Services*, published by Taylor & Francis.

Univ. Prof. Mag. Dr. Georg Gartner
Research Group Cartography
Department of Geodesy and Geoinformation
Vienna University of Technology
A-1040 Vienna, Austria
georg.gartner@tuwien.ac.at or
president@icaci.org

Well-Traveled Esri T-shirts and Magazines

↓ Three-year-old superhero twins Alex and Dominic Tieman don GIS T-shirts and capes to protect their neighborhood in Redlands, California.

↑ Laura Hall and Bill Di Paolo, of Di Paolo Consulting, hold up a recent *ArcNews* article about ancient water sources in Yucatán, Mexico, as they stand in front of a Mayan pyramid at Chichen Itza, Yucatán. The couple recently traveled through Yucatán, Campeche, and Chiapas, Mexico, on an archaeological tour of the northern Mayan kingdoms. During the trip, led by Dr. William Saturno of Boston University, they discussed the applications of GIS and remote sensing in archaeology.

Improve Information Products with the Living Atlas of the World

The Living Atlas of the World, available through ArcGIS Online, provides easy access to one of the largest, highest-quality collections of ready-to-use geographic information. This collection is available from any device, anywhere, at any time and is constantly growing and changing as maps, apps, and layers are added or updated by Esri and the ArcGIS user community. One of the primary goals of the Living Atlas is to make the best information easy to discover and use.

Over the past few years, Esri has been expanding the types of content that it makes available through the Living Atlas. Maps cover a wide range of topics related to people (human systems), the earth (physical systems), and life (natural systems). Human systems content includes demographic and lifestyle maps for the United States, Canada, and more than 120 other countries. A wide assortment of Esri Story Map apps, categorized by topic, can be accessed from the Living Atlas. Layer content includes multispectral imagery, elevation layers, and ecological land units.

What began as a way to build the best, freely available online basemaps is now a resource that extends far beyond basemap layers to encompass imagery, elevation, hydrology, 3D, and other types of content that can support a wide range of mapping and analysis activities.

The value of the Living Atlas has been recognized not only by the many users who have integrated Living Atlas content into their maps and apps but also by the larger mapping community. In late 2014, the International Map Industry Association (IMIA) honored the Living Atlas of the World with the IMIA's Best Digital Map Product, Best Overall, and Global awards.

Joining the Living Atlas Community

Living Atlas content is constantly improving through the efforts of contributors and curators. Members of the ArcGIS community can contribute to the Living Atlas directly by publishing content through ArcGIS Online or indirectly by participating in the Community Maps Program.

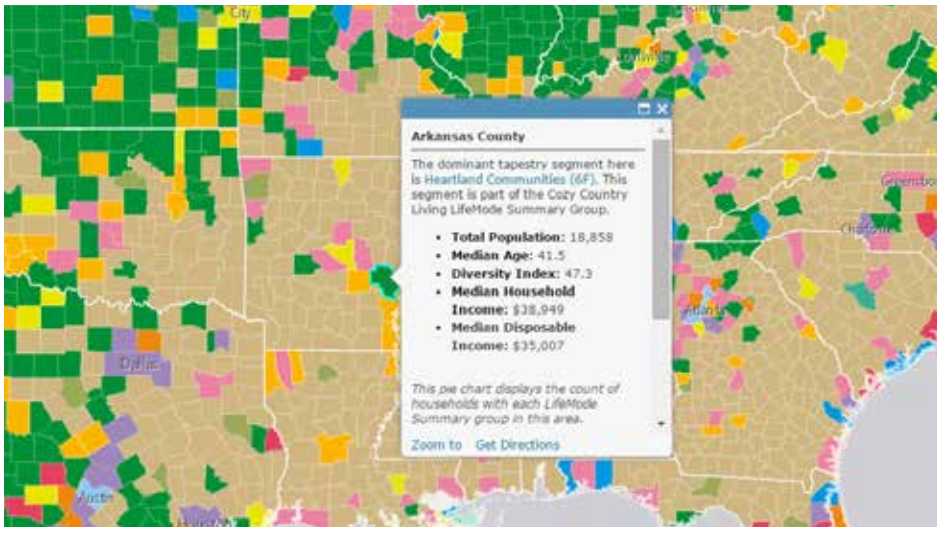
Initially, Esri provided ArcGIS Online users with a small set of basemaps and some foundational services, such as geocoding and routing, so users could easily publish and share maps and apps.

Subsequently, many ArcGIS users offered to share their geographic data with Esri, which led to the Community Maps Program. This program has significantly improved the quality and coverage of the Living Atlas over the last four years. Several hundred organizations have been sharing their authoritative content and making it accessible to the entire GIS community. By the end of 2014, more than 134 million features had been added through Community Maps contributions. In addition, many ArcGIS users began publicly sharing maps and layers created in ArcGIS Online, substantially expanding content for the Living Atlas.

Content submitted to the Living Atlas is reviewed by curators. These curators, who are Esri staff and other GIS professionals around the world, review content to ensure that it is useful and reliable and adds value. Content that meets the acceptance criteria is included in the Living Atlas and featured in ArcGIS Online for other users to discover and access.

Take Advantage of These Resources

Improve the information products your organization produces by using the Living Atlas. This resource will help you more quickly create apps, improve analyses, gain insights, and enhance story maps and presentations by using current, authoritative data. Start exploring it in ArcGIS Online.



↑ The Living Atlas of the World makes available one of the largest, highest-quality collections of ready-to-use geographic information.

Partner Offerings

Esri has relationships with more than 1,800 global partners that provide customer-focused, geoenabled solutions. Partner-provided solutions and services span Esri's core industries and range from custom-built applications to complete ArcGIS system implementations.

This issue recognizes partners that won awards at the 2015 Esri Partner Conference for their pioneering solutions to real-world problems and their contributions to advancing GIS.

For a complete list and description of Esri partners and their offerings, visit esri.com/partners.

Conservation

Blue Raster
blueraster.com
Award category: Public Web Application
Solution: Global Forest Watch Fires (online platform)

Fires set illegally across Southeast Asia, often to clear land for agriculture or in a conflict, are among the biggest threats to the region's environment, economy, and people. To address the problem, Blue Raster created the Global Forest Watch Fires (GFW Fires) online platform, which uses near real-time data on land cover, land use, weather conditions, and fire locations to better monitor and respond to fire activity. The platform was built using Esri's ArcGIS for Server and ArcGIS API for JavaScript.

Federal Government

GISi
gisinc.com
Award category: Private (Internal) Web Application
Solution: ProjectMapper, US Army Corps of Engineers, Philadelphia District

The Philadelphia District of the US Army Corps of Engineers needed to be able to share project information quickly and efficiently. ProjectMapper—which uses ArcGIS 10.3 for Server, Web AppBuilder for ArcGIS, and ArcGIS API for JavaScript—is a single portal created by GISi that links to the Philadelphia corps' data. Users can easily view, share, and customize standardized project maps. The solution simplifies project management and can be scaled up to support other business applications.

Water Resources

Innovyze
innovyze.com
Award category: ArcGIS for Desktop Based Application
Solution: InfoWater

InfoWater is a fully GIS-integrated water distribution modeling and management tool used by water utilities to design, operate, secure, and optimize their distribution centers. Built by Innovyze using the latest Esri ArcObjects and Microsoft .NET component technologies, InfoWater allows engineers and GIS professionals to work simultaneously on the same platform. Users can create and manipulate network models and instantly display, review, and query simulation results.

Utilities

OSIsoft
osisoft.com
Award category: Innovation Application
Solution: PI Integrator for Esri ArcGIS

PI Integrator for Esri ArcGIS combines OSIsoft's real-time intelligence with Esri's spatial analysis capabilities to give companies a new way to understand and share critical data. The solution integrates the ArcGIS platform's visualization and analytic capabilities with the real-time data infrastructure provided by OSIsoft's PI System, allowing users to build real-time operational data layers on an ArcGIS map. By taking physical location into account, companies can give their operational data more context, making it more revealing and complete.

Homeland Security

Witt O'Brien's
wittobriens.com
Award category: Organizational Use of ArcGIS Online
Solution: Incident Command System COP

Maintaining situational awareness during emergencies and planned events is vital. Witt O'Brien's Incident Command System Common Operating Platform (COP) gives emergency management and public safety organizations access to essential information and real-time data via dynamic maps. Powered by the Esri ArcGIS Online platform and integrated with CommandPro, the COP can be used to map out an incident and is scalable as needed. It can provide an entire incident command system, with the forms and maps required to develop an incident action plan, and has a filterable, outward-facing public information module that can be activated when appropriate. Deployed in a Software-as-a-Service model, it is accessible by Internet-connected computers and smart mobile devices.

Electric and Gas

SSP Innovations
sspinnovations.com
Award category: Initial Operating Capability Services Implementation
Solution: ArcGIS Online Jumpstart for EGUG & TELUG

SSP Innovations, an ArcGIS Online Specialty partner that provides GIS product implementation, customization, and systems integration, developed an ArcGIS Online jump start package for electric, gas, and telecommunications companies. SSP Innovations helps these organizations set up their ArcGIS Online accounts, learn how to use the service, and incorporate it into other ArcGIS software and services.

Government

GEO-Jobe GIS Consulting
geo-jobe.com
Award category: Innovative ArcGIS Marketplace Provider
Solution: Admin Tools for ArcGIS Online

Admin Tools for ArcGIS Online is a free suite of tools for ArcGIS Online administrators, offered by GEO-Jobe GIS Consulting on the Esri ArcGIS Marketplace. The suite helps administrators minimize the time they spend doing essential administrative tasks and gives them more time to make maps. Admin Tools for ArcGIS Online grows with the company as the number of items, members, and groups in an organization increase.

Intelligence

Lockheed Martin Corporation (IS&GS)
lockheedmartin.com
Award category: Integrated Enterprise System Services Implementation

Lockheed Martin, a leading federal services and information technology contractor, collaborated with Esri to deliver an implementation of the Portal 10.2 for ArcGIS capability to the Amazon Web Services commercial cloud services environment. Using a single, secure, cloud-based portal, agencies all over the world can more easily organize, share, and analyze geospatial intelligence.

GIS Services

WebMapSolutions
webmapsolutions.com
Award category: Best Practices in Community Outreach

WebMapSolutions was recognized as an energetic, aligned partner that consistently blogs and Tweets to promote Esri technology. The company helps organizations quickly implement ArcGIS Online, data services, and Esri app templates and also builds products to geoenable non-GIS systems and improve the mobile ArcGIS experience.

Public Works

BlueReview
bluereview.net
Award category: Best New Partner

BlueReview, acclaimed as Esri's best new partner, provides a web-based tool and mobile app that uses ArcGIS to help public and private utility owners manage One-Call Center utility location requests and fieldwork in real time. The product allows users to keep track of work orders, assets, customer information, files, photos, and notes.

New Training and Certification Offerings from Esri

Training

Foundational ArcGIS Courses

Foundational courses are designed for professionals with all levels of GIS experience. Classes cover fundamental GIS concepts, core ArcGIS platform capabilities, and widely used workflows. View all courses at esri.com/arcgisfoundation.

- *ArcGIS 1: Introduction to GIS*
- *ArcGIS 2: Essential Workflows*
- *ArcGIS 3: Performing Analysis*
- *ArcGIS 4: Sharing Content on the Web*

Instructor-Led Courses on Special Topics

Courses on special topics use industry-specific examples and data to teach contextual geospatial concepts and best practices for ArcGIS.

- *Geospatial Concepts for Intelligence Operations*
- *Market Analysis Using Esri Business Analyst*
- *Using ArcGIS for Geospatial Intelligence*
- *Using ArcGIS for Mining Geoscience Workflows*
- *Working with Geometric Networks for Utilities*

Certification Exams for ArcGIS 10.3

Esri technical certification exams recognize expertise in desktop, developer, and enterprise use of ArcGIS. Two version 10.3 exams are available now, with more to follow soon. View complete information for all Esri technical certification exams at esri.com/certification, and register at pearsonvue.com/esri.

Open for Registration

- *ArcGIS Desktop Associate*
- *Enterprise Administration Associate*

Opening in Late July

- *ArcGIS Desktop Professional*
- *Enterprise System Design Associate*
- *Enterprise Geodata Management Associate*
- *Enterprise Geodata Professional Associate*

Opening in Late August or Early September

- *Web Application Developer Associate*
- *ArcGIS Desktop Entry*

Esri Press

Esri Press e-books are available through the Esri Books app at esri.com/landing-pages/esri-press/e-books or from online retailers.
For information on all Esri Press publications, visit esri.com/esripress.

Getting to Know Web GIS

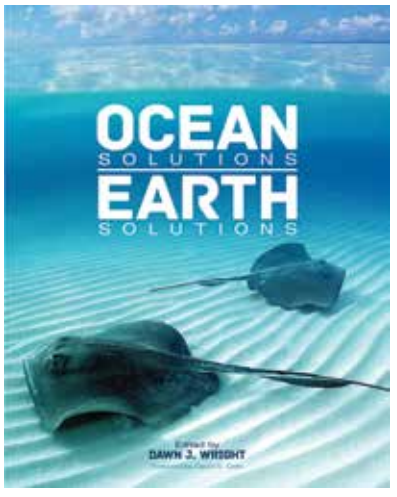
By Pinde Fu

Getting to Know Web GIS uses step-by-step exercises to teach readers how to build engaging web GIS applications quickly and easily. Treating web GIS technologies as a holistic platform, Pinde Fu has students develop an application in each chapter using both server- and browser-based ArcGIS products, including ArcGIS Online, Portal for ArcGIS, ArcGIS for Server, Web AppBuilder for ArcGIS, web app templates, ArcGIS API for JavaScript, the Collector for ArcGIS mobile app, ArcGIS Runtime SDKs, and 3D web scenes. Little to no programming is required. Data files are available from the Esri Press book resources page at esripress.esri.com/bookresources. March 2015. 392 pp., Paperback ISBN: 9781589483842 and e-book ISBN: 9781589484030.

Ocean Solutions, Earth Solutions

Edited by Dawn J. Wright

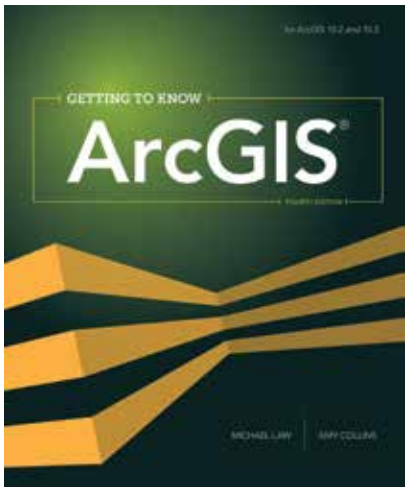
What affects the oceans affects terra firma. *Ocean Solutions, Earth Solutions* gathers the insights of more than 50 ocean and coastal science researchers exploring ocean components and their relationships, patterns, and trends over time and space. The book's 16 chapters highlight GIS best practices and include additional online resources. The book is edited by oceanographer and Esri chief scientist Dawn J. Wright and features a foreword by oceanographer David Gallo, director of special projects for the Woods Hole Oceanographic Institution in Massachusetts. July 2015. 550 pp., Paperback ISBN: 9781589483637 and e-book ISBN: 9781589483651.



Getting to Know ArcGIS

By Michael Law and Amy Collins

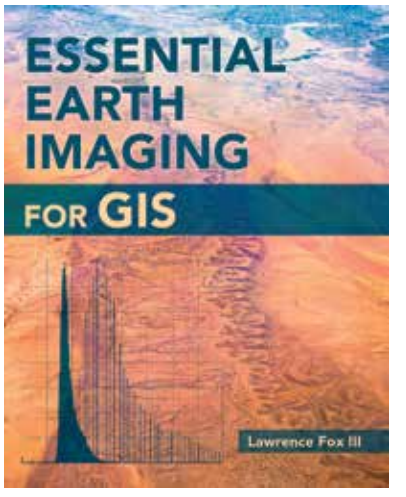
Getting to Know ArcGIS is a comprehensive introduction to the features and tools of the ArcGIS platform. Through hands-on exercises, readers will discover, use, make, and share maps with meaningful content. The fourth edition includes new exercises on map sharing and georeferencing; new datasets and scenarios; and an introduction to ArcGIS Pro, a powerful new part of ArcGIS for Desktop. The book is suited to classroom use and independent study and as a reference. Data for completing the exercises and a 180-day trial of ArcGIS 10.3 for Desktop are available for download at esripress.esri.com/bookresources. July 2015. 768 pp., Paperback ISBN: 9781589483828 and e-book ISBN: 9781589484283.



Essential Earth Imaging for GIS

By Lawrence Fox III

Essential Earth Imaging for GIS is a technical reference guide for using imagery with GIS software. Readers will learn about the characteristics of earth images obtained from aircraft and spacecraft, as well as how to enhance, register, and visually interpret multispectral imagery and point clouds. Understanding these fundamentals will allow readers to effectively use existing imagery and exploit future imaging technologies. The book's conceptual information is reinforced with online companion exercises available at esripress.esri.com/bookresources. July 2015. 226 pp., Paperback ISBN: 9781589483453 and e-book ISBN: 9781589484313.



Esri Corporate Headquarters

esri.com

Esri Technical Support
esri.com/support

Esri Desktop Order Center and Software Information
Tel.: 1-800-447-9778 (USA only)

Esri Products
esri.com/products

Esri Store
esri.com/store

Esri Developer Network
edn.esri.com

Customer Care Portal
my.esri.com

Esri US Regional Offices

Boston—Middleton, MA
Tel.: 978-777-4543

California—Redlands, CA
Tel.: 909-793-2853, ext. 1-1906

Charlotte—Charlotte, NC
Tel.: 704-541-9810

Denver—Broomfield, CO
Tel.: 303-449-7779

Minneapolis—St. Paul, MN
Tel.: 651-454-0600

Olympia—Olympia, WA
Tel.: 360-754-4727

Philadelphia—Chesterbrook, PA
Tel.: 610-644-3374

San Antonio—San Antonio, TX
Tel.: 210-499-1044

St. Louis—St. Charles, MO
Tel.: 636-949-6620

Federal Office

Washington, DC—Vienna, VA
Tel.: 703-506-9515

For additional information about Esri US regional offices, visit esri.com/usa.

Esri Distributors Worldwide

Esri Australia Pty. Ltd.—Australia
www.esriaustralia.com.au

Esri BeLux N.V.—Belgium
www.esribelux.com

Esri Bulgaria Ltd.—Bulgaria
www.esribulgaria.com

Esri Canada Limited—Canada
www.esri.ca

Esri Chile S.A.—Chile
www.esri.cl

Esri China (Beijing) Holding Co. Ltd.—China
www.esrichina.com.cn

Esri Colombia SAS—Colombia
www.esri.co

Esri Northeast Africa—Egypt
www.esrinea.com

Esri Finland Oy—Finland
www.esri.fi

Esri France S.A.—France
www.esrifrance.fr

Esri Deutschland GmbH—Germany
www.esri.de

Esri China (Hong Kong) Limited—Hong Kong
www.esrichina.hk

NIIT GIS Limited (Esri India)—India
www.esriindia.com

Esri Italia Sp.A.—Italy
www.esriitalia.it

Esri Japan Corporation—Japan
www.esrij.com

Esri Eastern Africa Limited—Kenya
www.esriea.co.ke

Esri Lebanon sal—Lebanon
www.esrilebanon.com

Esri Southern Africa—Mauritius
www.esri-southernafrica.com

Esri Nederland B.V.—The Netherlands
www.esri.nl

Esri Muscat Co LLC—Oman
www.esrimuscat.com

Esri Panama, S.A.—Panama
www.esri.pa

Esri Polska sp. z o.o.—Poland
www.esri.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.—Portugal
www.esri-portugal.pt

Esri Romania S.R.L.—Romania
www.esriro.ro

Limited Liability Company ESRI CIS—Russia
www.esri-cis.ru

Esri Saudi Arabia Ltd.—Saudi Arabia
www.esrisaudiarabia.com

Esri South Africa (Pty) Ltd.—South Africa
www.esri-southafrica.com

Esri Korea, Inc.—South Korea
www.esrikr.com

Esri South Asia Pte. Ltd.—Singapore
www.esrisa.com

Esri España Geosistemas S.A.—Spain
www.esri.es

Esri Sverige AB—Sweden
www.esri.se

Esri (Thailand) Co. Ltd.—Thailand
www.esrith.com

Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.—Turkey
www.esriturkey.com.tr

Esri (UK) Ltd.—United Kingdom
www.esriuk.com

Esri Ukraine Ltd.—Ukraine
www.esri.ua

Grupo Esri de Venezuela, C.A.—Venezuela
www.esriven.com

Esri has more than 80 distributors in other countries around the world. For more information, contact Esri (tel.: 909-793-2853, ext. 1-1235; fax: 909-307-3070) or visit **esri.com/distributors**.

Career Opportunities

Esri is hiring smart people with all levels of experience for positions at our headquarters, regional offices, and R&D Centers. Your work will affect the way people live and how organizations solve problems. We offer exceptional benefits, competitive salaries, profit sharing, and a collaborative and stimulating environment. Join us and be part of Esri's mission to make a difference in our world.

Software Development and ArcGIS Product Engineering

Software Developer—DevOps: Work closely with a talented team of dynamic engineers to design, build, and operate ArcGIS Online, used by thousands of organizations around the world.

Software Developer—Imagery/Defense and Intel: We're seeking talented developers with experience in remote sensing to create next-generation imaging, mapping, and apps for the defense and intelligence communities.

Network Analysis Product Engineer—Online Services: Help build next-gen online services for the ArcGIS platform. You'll work with the core development team to design and test web APIs; write samples; plan online infrastructure; and optimize system provisioning, hosting, and monitoring.

Product Manager—Imagery Content: Be the primary product interface for Esri's imagery content in working with development staff, regional offices, international distributors, and business partners to provide pre- and postsales support.

Solution Engineer—Utilities: Use your passion for GIS to help build and deliver industry-specific applications, maps, and tools on the ArcGIS platform. Your work will involve the development of domain-specific solution templates leveraging the power of ArcGIS.

Spatial Analyst Product Engineer: Push the envelope of ArcGIS software's raster analytical capabilities and help advance the ArcGIS Spatial Analyst extension, used to solve complex spatial analytical and modeling problems.

GIS Services

Software Application Engineer: Help drive strategy among a growing community of users and programmers who are becoming more interested in location. As an advocate of technology, you will help ensure our customers' success and assist in the evolution of Esri products and APIs.

Technical Adviser: Use your strong technical know-how, business acumen, and collaborative skills to help new and existing customers develop best practices for deploying our platform to realize their business goals.

Technical Support

Support Analysts—GIS, Server, Database, and Programming: Provide high-quality support to end users of Esri software by helping them solve technical problems quickly and effectively.

Sales

Account Managers and Account Executives: We're seeking seasoned sales professionals to prospect business development activities and focus on selling Esri solutions in a number of domains in locations across the United States.

Presales and Solution Engineering

Solution Engineers: Are you a self-starter, problem solver, and natural evangelist who is passionate about technology? Put these qualities to work to shape and deliver strategies to prospective customers on the effective use of Esri's ArcGIS platform.

Marketing

Product Marketing Strategists: Create and gain buy-in from key stakeholders to develop and execute a global, strategic, cross-functional marketing plan that includes measurable business goals; develop product positioning and messaging that differentiate our products in the market.

Esri is an equal opportunity employer (EOE). All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

esri.com/careers **Follow @EsriCareers on Twitter**

HERE Reality Lens

Map, measure and model the real world from your computer.

Map

GIS Grade Accuracy – 1M

Rapidly create or correct existing GIS data or other 2D/3D spatial database content.

Measure

Reliable Precision – 2CM

Take accurate measurements of height, width, length, area and volume of the built environment.

Model

Engineering Project Scoping

Generate geometric objects for use in engineering CAD software.

For more information about HERE Reality Lens visit realitylens.here.com

here
Maps for Life

Subscription Additions and Address Changes or Deletions

Subscribe, unsubscribe, or update information at **esri.com/updates**.
Outside the United States, contact your local distributor.
To request other publication services, see page 2.

146894

380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri

WELCOME TO THE *future*... OF TECHNOLOGY

Get plugged in.

You know their software. Now, get to know their community. Once you do, you'll want to be here too.

Redlands, California is home to Esri®, the world leader in GIS mapping software, solutions and services, and it's a company that continues to thrive in a community that blends the best of Southern California's work and play lifestyle.

From a supportive business environment to an exceptional quality of life, from small-town appeal to big-city amenities, Redlands provides tech businesses and their employees with everything they need to build a brighter future.

Established companies, start-ups and entrepreneurs enjoy attractive flex/office work environments, robust digital infrastructure, higher education opportunities and tech-centric energy.

Add to that a layer of amenities like a historic, walkable downtown, year-round cultural and recreational opportunities, a wide range of housing choices and a location within an hour of beaches, mountains and deserts, and you've just mapped your way to Redlands.

It's time. You bring the innovation, we'll provide the inspiration.

FIND YOUR *future* IN **REDLANDS**

CITY OF REDLANDS

For more information about moving your company to Redlands, contact the City of Redlands Economic Development Division.
(909) 335-4755 or RedTeam@CityofRedlands.org