ArcNews

Esri | Winter 2014/2015 | Vol. 36, No. 4

Briefly Noted

Register for Esri UC
The world's largest GIS conference will be held July 20–24, 2015 in San Diego, California. Visit www.esri.com/uc to register.

Living Atlas receives cartographic awards
Esri's digital atlas, the Living Atlas of the World, received three major cartographic awards from the International Map Industry Association (IMIA): the Global Product Award, the Americas Region Best Digital Product, and the Best Overall Product. See it yourself at doc.arcgis.com/en/living-atlas.

SciPy integrated with ArcGIS
SciPy, an open-source library built using Python, adds modules for scientific and engineering functions to make developing scientific and technical geoprocessing tools and scripts easier.

Web AppBuilder for ArcGIS
Now a fully supported release, Web AppBuilder for ArcGIS lets you create customized map-based apps that run on browsers, tablets, and smartphones without writing code.

Attention Developers, Coders, and Hackers
Esri DevSummit, a forum for the latest proven solutions in geographic programming, will be held March 10–13, 2015 in Palm Springs, California. Visit www.esri.com/devsummit to learn more.

ArcGIS Online constantly increasing in value
With every release, ArcGIS Online gives you more maps, apps, online tools, services, solutions, updated content, and developer tools. Learn about all the things that are included with your ArcGIS Online subscription at esri.com/neverknew.

Mapping the Earth's Ecology

In December 2014, Roger Sayre of the US Geological Survey (USGS) and Esri unveiled a whole new way to classify, organize, and see the world: the Global Ecological Land Units (Global ELU) map. The map and underlying data (provided as layers) are available from ArcGIS Online and provide new knowledge of geographic patterns and relationships, presenting a better platform for science and a useful accounting framework for conservationists, resource managers, and land planners.

The Global ELU map divides the land surface of the planet into 62,500-square-meter squares. The map tells the story of each square in terms of land cover, landform, climate and surface rock type. With the Global ELU map and the data behind it, scientists, planners, conservationists, and the public can access information about the environment using a common framework, a common language, and a common spatial unit.

"The global ELU map advances an objective, repeatable, big-data approach to the synthesis and classification of ecologically important data layers into distinctive and meaningful georeferenced land units," said Sayre, senior scientist for ecosystems at the USGS Land Change Science Program.

Demonstrating the Value of Open Data

Data in the map for some regions was already available. The difference is that the Global ELU uses four environmentally important data layers to describe each 250-by-250-meter square of land using common terms. Three of the characteristics—landform, climate, and rock type (or lithology)—influence the fourth characteristic, land cover.

ELUs are a blending of the classifications of these four elements. For instance, Warm Dry Hills on Metamorphic Rock with Sparse Vegetation or Cool Moist Plains on Carbonate Sedimentary Rock with Mostly Deciduous Forest are classifications familiar to middle and high school science students so ELUs can be understood by a broad audience. And for the first time, those terms are comparable anywhere on the planet.

Without a common language for reference, it can be difficult or impossible to develop understanding at a global scale. "Take energy usage. Now, the conversation is difficult because everyone uses their own terms,"

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↑ Using the Global Ecological Land Units map and the data behind it, scientists, planners, conservationists, and the public can access information about the environment using a common framework, a common language, and a common spatial unit.

Geospatial Technology and the Future of the City

By Jack Dangermond, Esri President

A few months ago I was asked by the City of Los Angeles to share a few technology trends about the future of GIS in cities and how these enabling trends would make cities smarter.

Over the past four decades, GIS technology has systematically impacted local government by improving basic record keeping and data management as well as automating a wide variety of geospatially-related workflows including mapping. Most of these improvements have been in departmental systems focused on specific mission areas.

We are now entering a period in which geospatial (and other) data about cities is growing enormously. This data is increasingly being directed to address the growing challenges facing cities today. Managers and policy people are searching for approaches that better leverage this digital data to improve decision making and government management. Finally, there is strong interest in making government data openly available to the public and businesses

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The Global Ecological Land Units global dataset provides science with a platform for better understanding and accounting for the world's resources. page 1.

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Monica Pratt

Graphic Designer
Takeshi Kanemura

Illustrator
Daniel Gill

Founding Editor
Karen Hurlbut

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ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100 USA
arcnews_editor@esri.com
Tel.: 909-793-2853, ext. 1-1660
Website: esri.com/arcnews

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↑ Rear Admiral Timothy C. Gallaudet, commander of the Naval Meteorology and Oceanography Command, with Brian Lehman of the Esri Defense team, discussing the marriage of ocean science and GIS.

Agreement with US Navy Fosters Better Battlespace Awareness

A three-year agreement between the the US Navy's Naval Meteorology and Oceanography Command (NAVMETOCCOM) and Esri, signed in September 2014, will use ArcGIS to substantially improve battlespace awareness by integrating data, incorporating expert knowledge, and using GIS-based analytical tools.

Currently, a navy decision maker at sea must assess risks by mentally integrating data from many digital and nondigital sources such as nautical charts, reports on atmospheric and ocean conditions, and operational reports. The process is cumbersome and suboptimal.

However, by exporting all data to a GIS, data can be integrated and analyzed. Local patterns and mission area expertise can be incorporated into the analysis process. Commanders can ask what-if questions and receive immediate, map-based answers.

During the first year, the agreement established four main goals:

- To found a prototype lab at Stennis Space Center, Mississippi, using the ArcGIS platform for geospatially enabling naval oceanography
- To create a proof-of-concept Intelligent Decision Map (IDMap) that will organize services-based data and structure analytics so the analysis process is easily reproduced and automated
- To design a sustainable training plan for US Navy METOC personnel to deploy and use GIS capabilities in their operations
- To test key Open Geospatial Consortium Inc. (OGC), application standards and profiles for ocean and atmospheric analysis and decision making

At the same time, the navy will also be standardizing processes it uses for provisioning warships with charts, imagery, and maps from the National Geospatial-Intelligence Agency. The San Diego-based Space and Electronics Warfare Command (SPAWAR) plans to field common datasets for battlespace awareness. A data appliance modeled after Data Appliance for ArcGIS will provide access to nautical charts and maps of land features. Sailors on provisioned ships can organize all analysis, intelligence, and operational planning efforts using a foundation of common, authoritative basemaps. Map-based products will include imagery and nautical charts.

Preprovisioning ships with basic geospatial datasets will save precious satellite bandwidth. Only updates and real-time data from remote sensors will then need to be transmitted to warships at sea, resulting in more timely decisions and less dependence on satellites.

A longtime user of ArcGIS in its many subordinate commands, NAVMETOCCOM uses GIS to explore weather forecasts to predict their impact on ship movement and air operations as well as inform naval commanders of the effects weather, hydrology, and oceanography might have on naval missions. The agreement contributes to more effective and safer operations for the US Navy.

Three Things about ArcGIS 10.3 That Will Change How You Use GIS

ArcGIS Pro
Portal for ArcGIS
Easy Web Apps

They come together in ArcGIS 10.3 to transform the way your organization uses GIS to do its work.

1. ArcGIS Pro

This brand-new app is included with ArcGIS for Desktop. It enhances desktop GIS and makes GIS easy for new users. With its 64-bit architecture and new display engine, this multithreaded app provides much faster geoprocessing than ArcMap. You can design and edit in 2D and 3D. You can work with multiple displays and multiple layouts. With ArcGIS Pro you can easily make your maps accessible across the entire platform by publishing them to ArcGIS Online or Portal for ArcGIS. See the accompanying article, "ArcGIS Pro," for more information.

2. Portal for ArcGIS

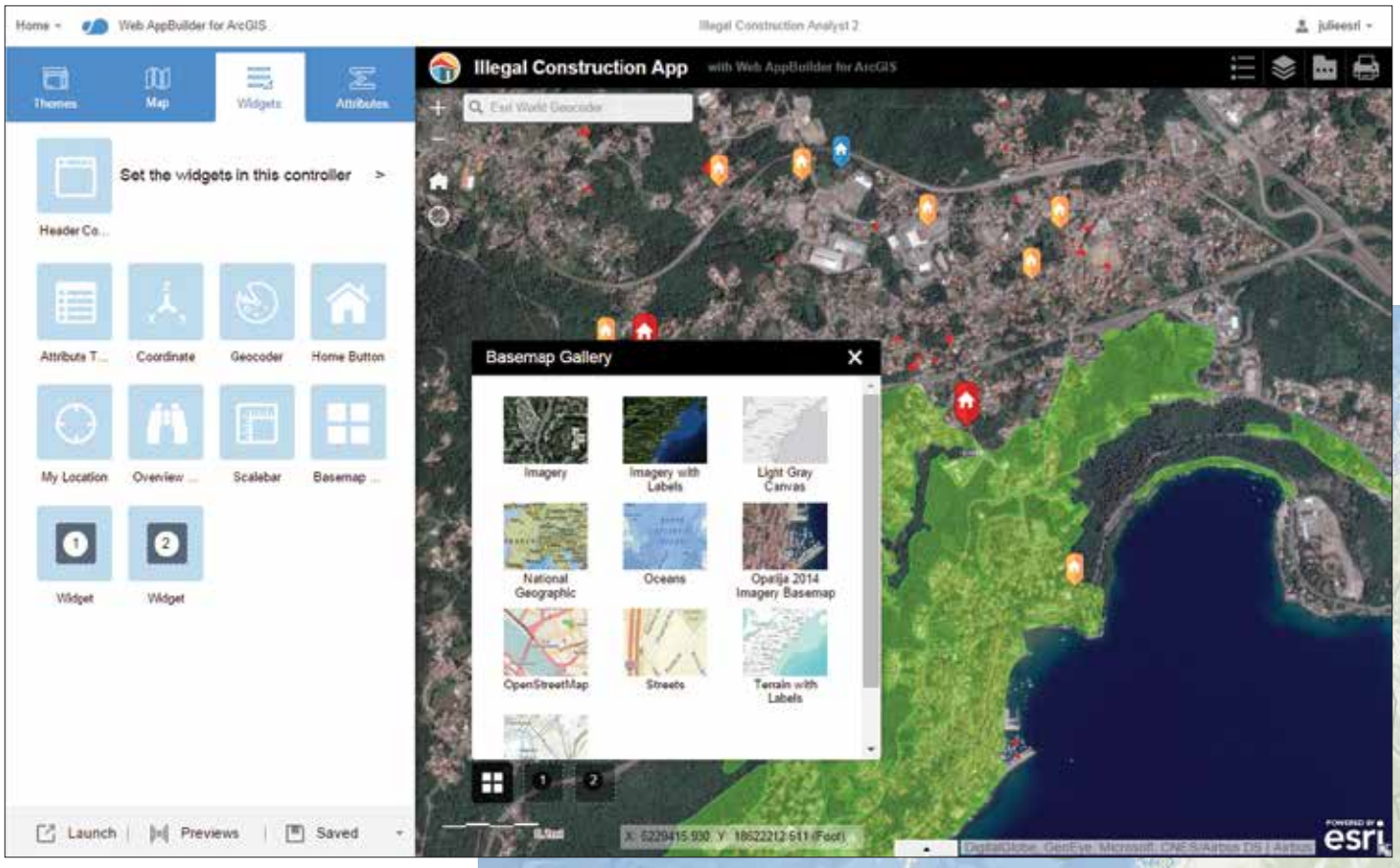
Portal for ArcGIS is a front end to ArcGIS for Server that expands the use of maps and GIS throughout your organization. People can find, use, create, and share maps and GIS apps built on top of ArcGIS for Server. This makes mapping and spatial analysis more accessible even for people who may not be very familiar with GIS.

Portal for ArcGIS includes a powerful suite of mobile and desktop apps, such as Collector for ArcGIS, Operations Dashboard for ArcGIS (both the desktop version and the cool new web version), Esri Maps for Office, and Explorer for ArcGIS. These apps provide you with a great way to boost productivity.

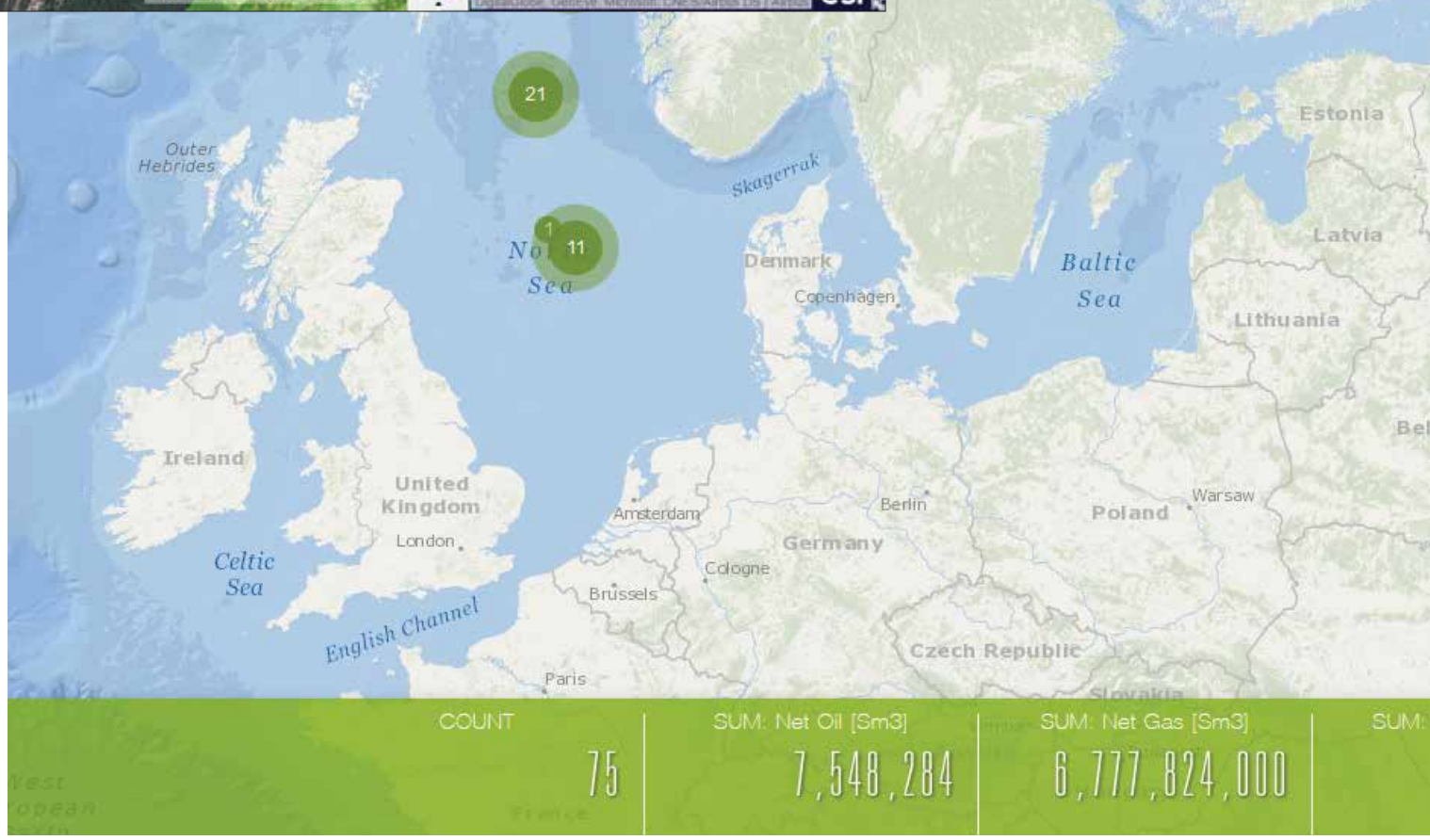
Portal for ArcGIS works with ArcGIS Pro, allowing you to publish and manage the maps you create with ArcGIS Pro. From an enterprise perspective, Portal for ArcGIS provides organizations with a well-defined process and the tools to manage maps and perform spatial analysis. Portal for ArcGIS allows organizations to effectively create, store, secure, and manage information products and access geographic tools in a central location. At ArcGIS 10.3, customers with ArcGIS for Server Standard and Advanced licenses get Portal for ArcGIS at no additional cost.

3. Easy Web Apps

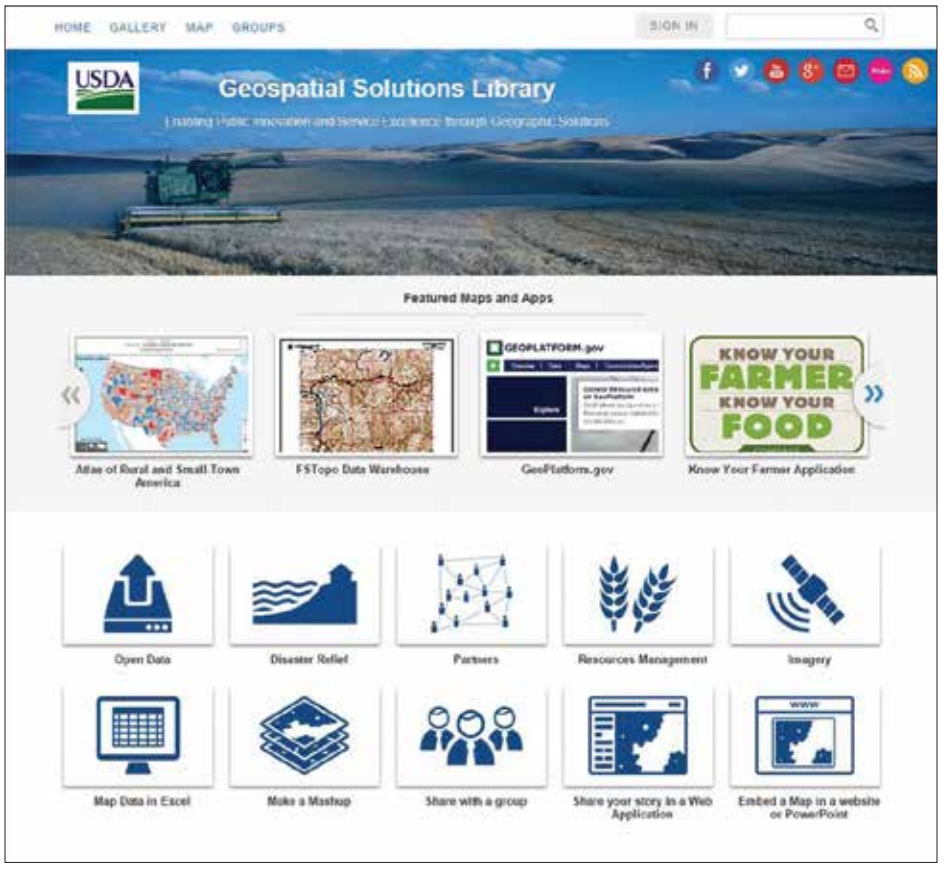
ArcGIS 10.3 gives two easy ways to create web apps. You get out-of-the-box configurable web apps that use templates, and you get Web



↑ Web AppBuilder gives you a way to create web applications in ArcGIS from scratch without writing a single line of code.



→ One of the out-of-the-box configurable web apps, Summary Viewer, is a dashboard that summarizes the numeric attributes of features in a specific operational layer of the map extent.



↑ Portal for ArcGIS is a front end to ArcGIS for Server that expands the use of maps and GIS throughout your organization.

AppBuilder for ArcGIS. ArcGIS 10.3 includes an incredibly powerful collection of tools for creating web mapping applications. The Web Application Templates include the Summary Viewer, a dashboard that summarizes the numeric attributes of features in a specific operational layer of the map extent, and Local Perspective, which highlights features from a web map based on a location or address you select. Web Application Templates deliver great experiences for users performing everyday tasks. These templates can be easily configured so you can create web apps quickly using just these out-of-the-box tools.

Web AppBuilder is yet another way to create web applications in ArcGIS. Using Web AppBuilder, you can configure applications that include both out-of-the-box and custom widgets and themes. You control which tools are added to your app without writing a single line of code. Web AppBuilder includes advanced tools for geoprocessing so you can take advantage of the most advanced spatial analysis capabilities in ArcGIS for Server. Your apps will not only work on desktop browsers but also in browsers running on tablets and smartphones so you can easily share your work with the rest of the ArcGIS community.

Developers can take advantage of the Web AppBuilder extensibile framework by downloading and installing Web AppBuilder (Developer Edition) on a local machine. Organizations with web development skills can use the Developer Edition to further refine capabilities and the look and feel of their web applications.

A New Foundation for Your Work

Used together, ArcGIS Pro, Portal for ArcGIS, and Web AppBuilder create a new foundation for the ArcGIS platform that allows you to extend the reach of Web GIS throughout your organization whether you are running it on your own infrastructure, online hosted by Esri, or some combination of the two.

ArcGIS Pro

ArcGIS Pro is the desktop GIS you've been dreaming of, and now it's here.

This new application available with ArcGIS 10.3 for Desktop is just plain fun to drive. It taps into the full processing power in your desktop machine and lets you accelerate through geoprocessing and editing tasks.

ArcGIS Pro also takes advantage of your visual cortex by providing a new and intuitive interface designed especially to help you see and interact with the whole geographic picture at once. Improved geoprocessing performance and options for creating automated analyses will help you crank out results faster than ever. No more drumming your fingers on the desk waiting for a process to finish.

No more getting lost in contextual windows and dialog boxes, either. A new project workflow has been created that lets you organize your workspace, tools, and data right away and get busy getting your work done. You can work at speed and have fun while you're doing it.

ArcGIS Pro works side by side with ArcMap, so you don't have to choose between them. You can also import your work from ArcMap into ArcGIS Pro. With your ArcGIS for Desktop license, you already have an ArcGIS Online account. ArcGIS Pro is connected to your ArcGIS Online account, so you can immediately pull in relevant content from ArcGIS Online to begin or augment a project.

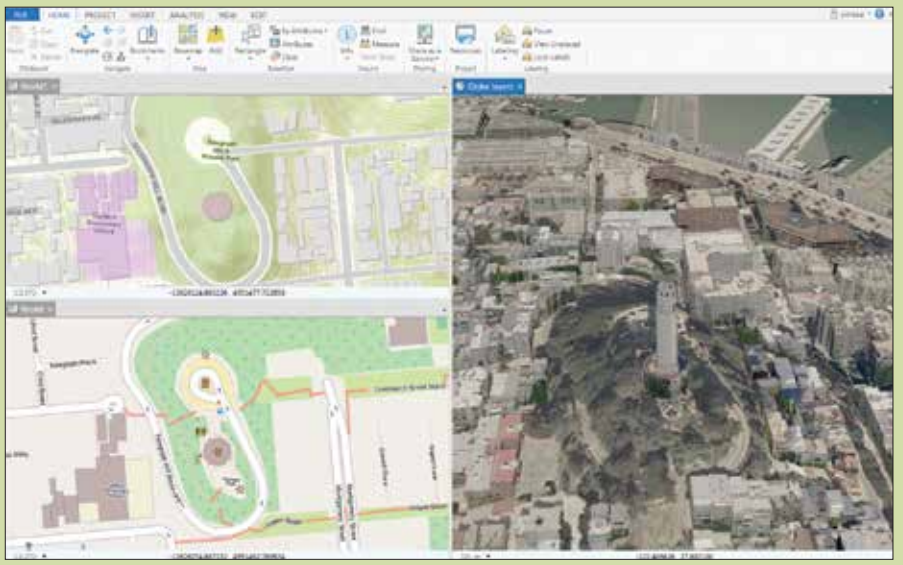
Because editing is easier and less complicated, you can get more work done in less time. Multipane views let you visually inspect and compare changes and edit side by side in 2D and 3D. Galleries and analytical tools displayed on the ribbon make it easier to quickly find the right tools for the job.

Make great looking, impactful maps that display and share your work using cartography and design tools that have been added or improved.

Sharing, collaborating, and showcasing your work can be done simply and effectively and that will help you shine. You can share layers, components, single maps, and even entire projects. You can create web maps and 3D web scenes that can be shared with others using just a web browser.

When a new version is available, ArcGIS Pro will prompt you to update, eliminating worries about keeping track of installations and updates.

ArcGIS Pro is available at no extra cost to all ArcGIS for Desktop customers who are current on maintenance. However, because it is a separate application from ArcMap, you need to download it separately onto each computer that you will use ArcGIS Pro on. ArcGIS Pro licenses are activated through an ArcGIS Online organizational account by an ArcGIS Online administrator for that account.



↑ The multipane views in ArcGIS Pro let you compare changes and edit side by side in 2D and 3D.

More Accurate Geocoding and Routing with StreetMap Premium

Accurate street data can mean all the difference—it can save lives as well as money. Access to accurate street data is critical for any organization that must move people and/or products safely and on time to locations across the United States or around the world.

This type of data is available from Esri. Strong partnerships with leading street data providers, such as TomTom, HERE, and increment P Corporation (iPC), enable Esri to offer street data for key geographies around the world. StreetMap Premium for ArcGIS is an out-of-the-box, on-premises data product that users can deploy rapidly behind the firewall.

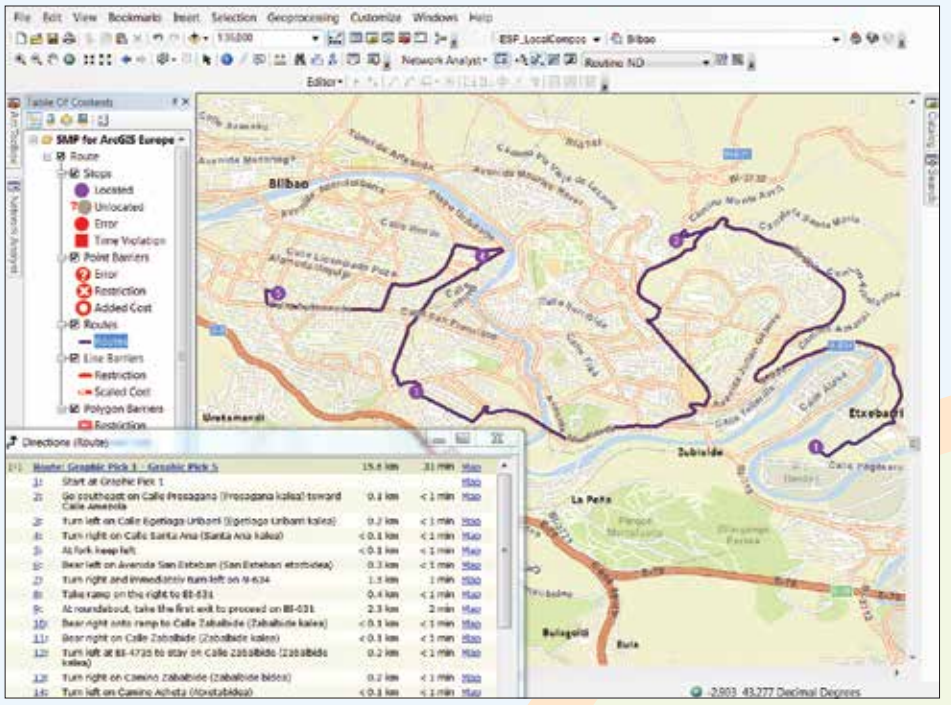
This turnkey product is designed to support GIS applications delivering multiple business functions across departments, organizations, or enterprises. ArcGIS for Desktop and ArcGIS for Server can use StreetMap Premium as a source for ready-to-use, enriched street data for map display, geocoding, routing, and historical traffic data.

Map Display

StreetMap Premium for ArcGIS comes with a map document that contains prerendered layers at multiple scales. Each group layer contains thematic group layers such as Places, Roads, Boundaries, Hydrology, and Landmarks. This scale-dependent approach to layer organization categorizes all the layers of the same scale range contained within a single group layer.

Thematic group layers can be easily expanded to show the various datasets available at that scale so that an entire group layer or a particular layer within a group can be turned on or off with a single click.

Dynamic label placement is used throughout the entire map document. The labeling is scale-dependent and based on size or importance. For some layers, label classes have been defined but are not turned on by default. StreetMap Premium offers this same consistent look and feel no matter which geography is used.



↑ Dispatchers and drivers can easily follow the turn-by-turn directions using the Routing option in StreetMap Premium.

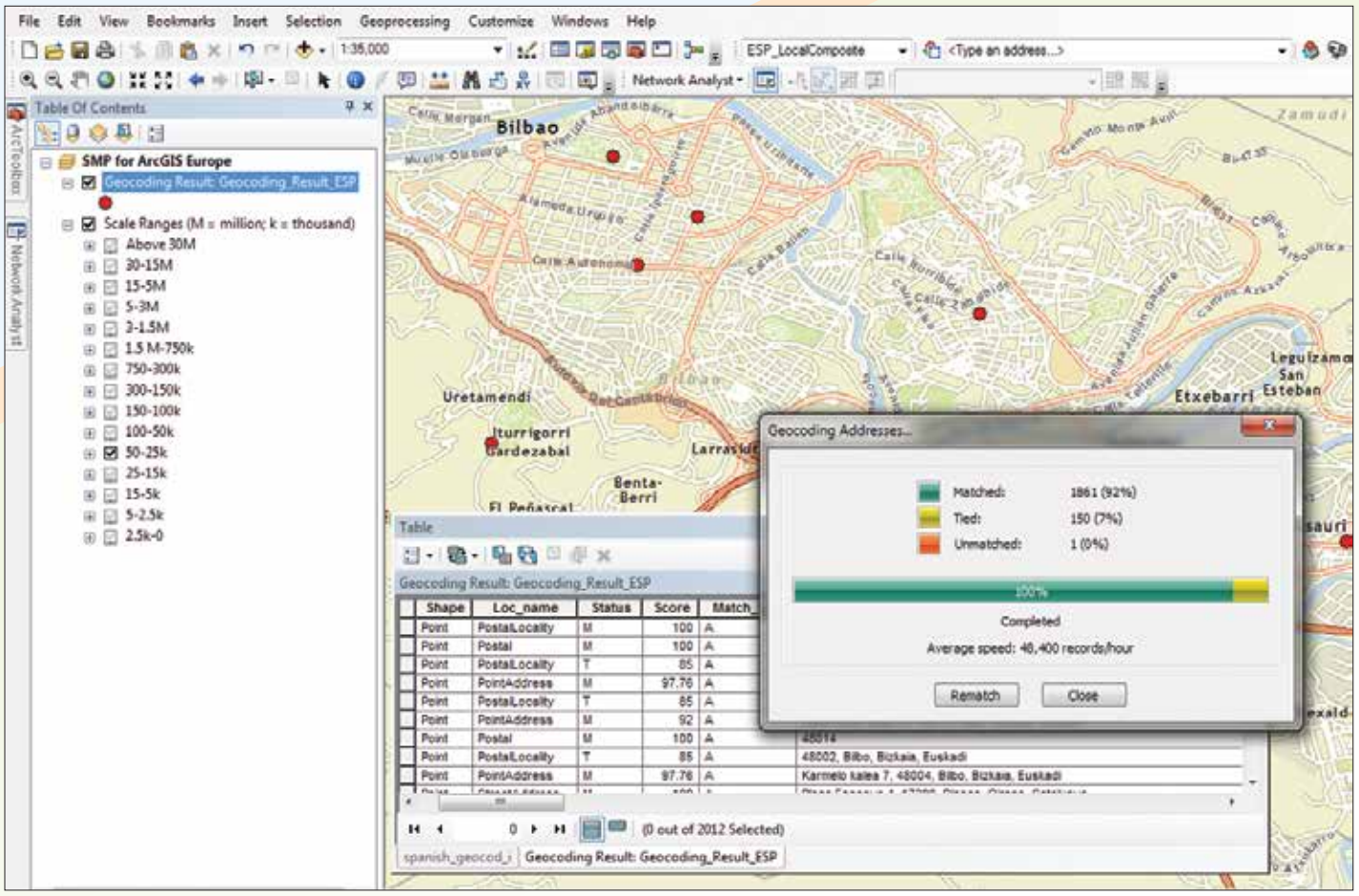
Geocoding

A core task for any GIS project, geocoding converts location information such as a street address into spatial *x,y* coordinates that can be displayed as a feature on a map. The address locators available with StreetMap Premium for ArcGIS enable users to geocode either by a single line or in batch mode and also to reverse geocode addresses.

Because a location element is in nearly all data, adding data to a map gives you spatial insight into your market and enables your organization to make better strategic decisions. Even when all location data is not of the same quality, Esri's cascading geocoding capability maps the data as precisely as possible.

With points adjusted to the road, you can geocode down to the most precise address location—the building level. Although address structures for foreign countries differ from those of the United States, Esri provides the same geocoding speed and precision for global data as domestic data.

↓ The Geocoding option in StreetMap Premium geocodes a greater percentage of records more quickly.



Routing

The routing component of StreetMap Premium for ArcGIS enables you to manage transportation restrictions more effectively with turn-by-turn directions and route optimization for automobiles and trucks. Detailed road attributes such as physical and legal restrictions and points of interest specific to the transportation industry are included.

Users can create routes in ArcMap using the Find Route tool or the ArcGIS Network Analyst extension. Route accuracy can be improved by using the trucking restriction attributes or applying historical traffic data (where available).

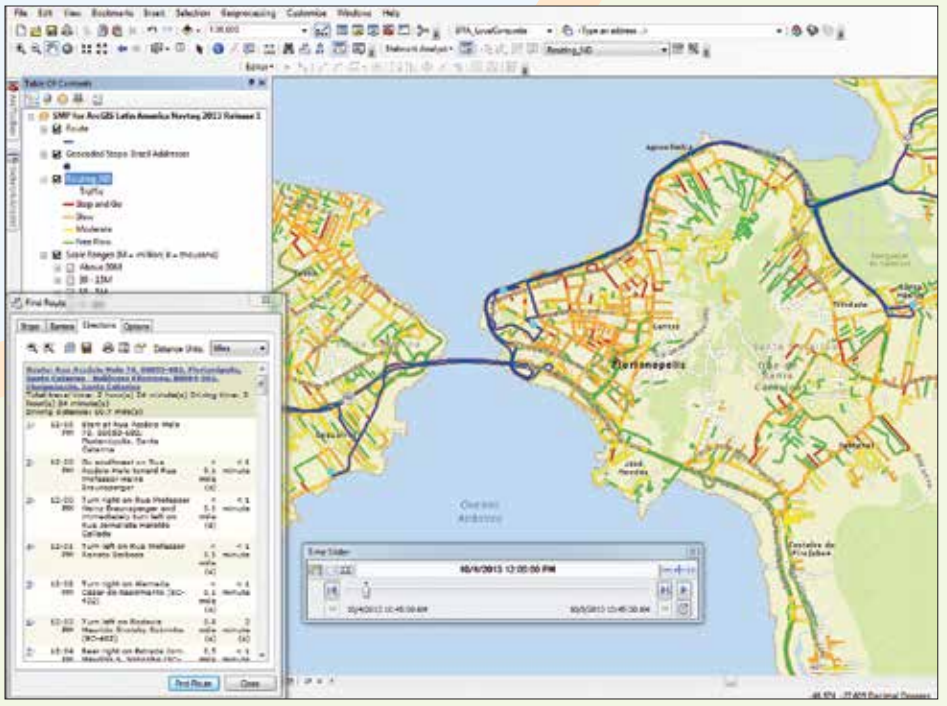
Historical Traffic Data

Historical traffic data is available by day of the week and the time of day to make more accurate arrival time projections or avoid traffic congestion. Information about the average speed of travel for specific sections of roadways is included.

Historical traffic data can be utilized by specifying start times when creating routes using the Find Route tool in ArcMap or the ArcGIS Network Analyst extension. Users can also display the traffic data by using the Time Slider tool.

Available impedance options for routing include: Kilometers and Miles (for finding the shortest route distance-wise) and Minutes, TravelTime, and TruckTravelTime (for finding the shortest route time-wise).

Using TruckTravelTime, with or without specifying a start time, will use either the truck speed limit or the average speed, whichever is the smaller value as calculated from historical traffic data. Using the Minutes impedance, with or without specifying a start time, will use average speed values previously calculated from the historical traffic data, resulting in quicker



↑ Up-to-the-minute information about traffic conditions provides dispatchers with options for more efficient routing.

performance than when TravelTime impedance is selected, because Minutes impedance uses the actual historical traffic data based on time of day.

Access StreetMap Premium for ArcGIS

StreetMap Premium can be licensed from Esri annually and added to your license for ArcGIS for Desktop and/or ArcGIS for Server. The flexible licensing model allows you to license StreetMap Premium for ArcGIS based on your GIS needs, the geography desired, and the platform used.

You can choose either Map Display with Geocoding or Map Display with Geocoding and Routing as your usage option. Select the geography option that best fits your needs: State/Province (e.g., California, New York, Quebec), Region (e.g., North America, Latin America), or Country (e.g., United States, Japan). To learn more about how StreetMap Premium for ArcGIS data can help you, call 1-800-447-9778 or visit esri.com/data/streetmap.

Your Key to Accessing ArcGIS Wherever You Are

Named user credentials give you a unique, secure identity on the ArcGIS platform. Basically, a named user is a person licensed to use ArcGIS software. As a named user, you access the platform using permissions given to you by your administrator. You can join groups and access resources that you own or that have been shared with you.

What Does Identity Mean for You?

Your named user credential is your identity on the ArcGIS platform. It lets you own an item and share it with others. You can save items under your name and access them later. Keep items private until you're ready to share them with another person, another group, or the public. Your identity also keeps track of your favorites.

Your Identity Travels with You

Any privileges, from special to full administrative, are assigned using your identity. Your identity associates those privileges with you no matter where you are. Log in to any app on any device, anytime and have access to the same maps, apps, data, and analysis. This portability functions in a similar way to identity in Salesforce, SharePoint, and SAP.

How It Works

As a named user, you get access to a comprehensive suite of apps and maps that come with the ArcGIS Online subscription. You can use these apps in your day-to-day work including

- Collector for ArcGIS
- Operations Dashboard for ArcGIS
- ArcGIS Open Data
- Web AppBuilder for ArcGIS
- Esri Maps for Office
- Esri Maps for SharePoint
- Esri Maps for Dynamics CRM
- Esri Maps for IBM Cognos
- Esri Maps for MicroStrategy
- Esri Maps for SAP BusinessObjects
- Esri Maps for Salesforce

Your identity also provides access to premium apps such as ArcGIS Pro, Esri Business Analyst Online, and Esri partner apps that have been purchased.

One Login Unlocks Everything

Because ArcGIS supports the notion of identity, you can tie into other identity management systems. For example, you can connect ArcGIS to single sign-on systems. Just log in once to have access to ArcGIS and everything your organization allows you to access.

Mapping the Earth's Ecology

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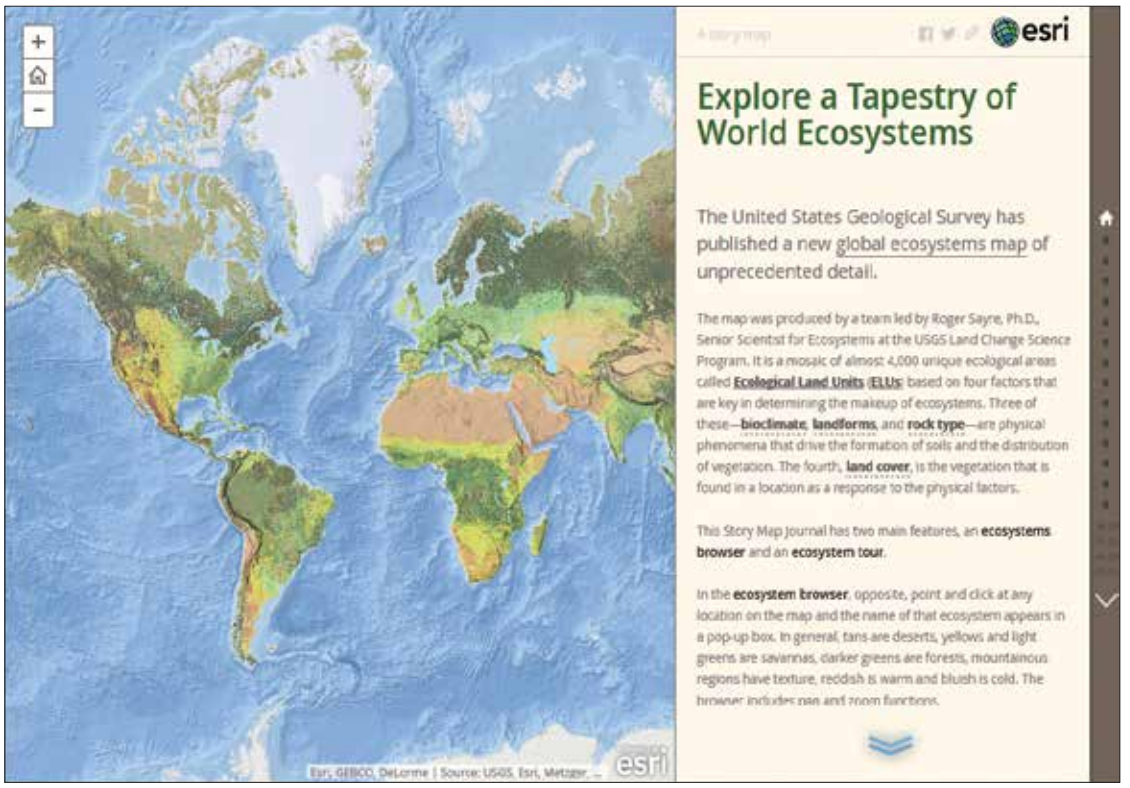
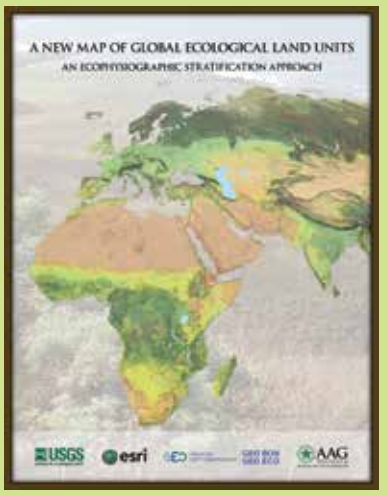


← This story map at esriurl.com/elu introduces ecological land units and lets you explore more than 100 places of high diversity.



← In December 2014, the American Association of Geographers published the peer-reviewed paper, *A New Map of Global Ecological Land Units: An Ecophysiographic Stratification Approach*, which describes the methodology employed in the creation of Global Ecological Land Units.

noted Peter Aniello of Esri, who is a member of the team that developed the Global ELU map. What one country calls a *mountain* might be a *hill* somewhere else.

ELUs still don't provide the entire picture. ELUs are medium scale. They fill a gap between fine-grained and macro views. While they do not include the complexity of biotic, species-level information, they do include physical and biological elements that drive the conditions that make it possible for a species to exist and thrive.

"The ELUs lend themselves to the study of ecological diversity, rarity, and evolutionary isolation," said Randy Vaughan, another team member from Esri Professional Services. "For example, we can identify the most diverse landscape in terms of ELU composition or we can search for the rare or isolated ELU instances for further study. Understanding diversity can point the way to conservation and preservation planning."

Building a GIS of the World

The foundation for the Global ELUs is publicly available data already shared by scientists and governments around the world. The team that created the Global ELU map is a public-private partnership that considers this effort an example that illustrated the value of open data.

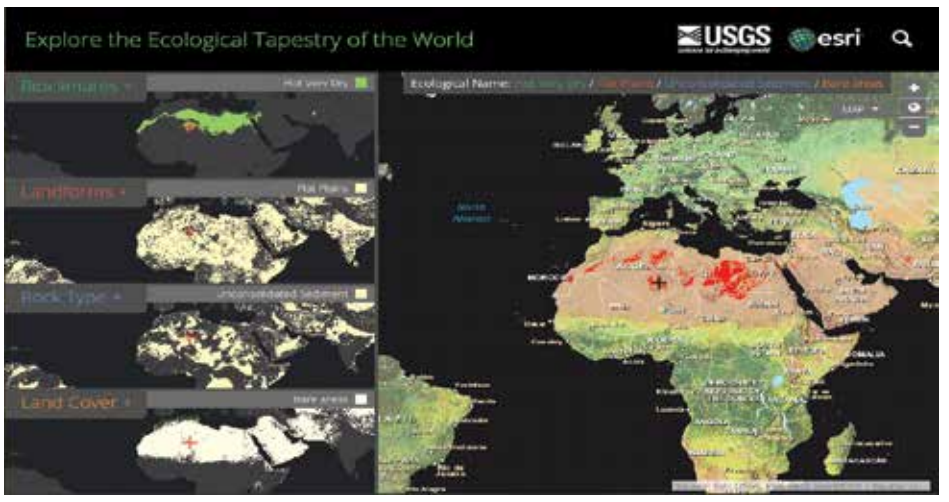
To create ELUs, Esri and the USGS began in 2013 by building a GIS of the world using a 250-by-250-meter grid that contains 3.5 billion cells. Each grid included all four elements that comprise an ELU as well as data from many other datasets. A collection of historical maps was used to validate and corroborate this data. The USGS and Esri vetted each of the input datasets, ensuring each was the best available at the time, and evaluated each to understand the data quality.

After canvassing the globe and describing it in terms of the four different data layers, Sayre and the team came up with 47,500 distinct categories that they called "ecological facets."

Since there were too many categories to represent on a map, these facets were compressed further into 3,923 ELUs. The classifications of the source data were reduced to the simplest—yet still ecologically meaningful—set of groupings by summarizing or simplifying the underlying attributes. Work to make better use of advanced spatial and statistical analysis, GIS processing, cloud computing, and geographic science to produce a single dataset of ELUs is ongoing.

After compiling the Global ELU map, the team analyzed it to see what it revealed. The initial findings showed where the planet's most ecologically diverse regions are located. The most diverse region was found in east-central California, about 300 miles northwest of Las Vegas in the Sweetwater Mountains.

In December 2014, the American Association of Geographers (AAG) published the peer-reviewed paper titled *A New Map of Global Ecological Land Units: An Ecophysiographic Stratification Approach*. Sayre was its primary author. Also in December, US Interior Secretary Sally Jewell introduced the new Global ELUs at a Washington, DC, conference of professionals, researchers, and policy makers involved with ecosystem services known as ACES: A Community on Ecosystem Services.



↑ The Ecological Tapestry of the World online explorer application (esriurl.com/EcoTapestry) lets you look at the ecological data behind the Global ELU map.

In addition—to help expose the Global ELUs to a broad audience—the team engaged Esri Professional Services to create the Ecological Tapestry of the World web application and the Esri Story Map team to create the story map *Explore a Tapestry of World Ecosystems*.

Call to Action

The team behind the creation of the Global ELU map is asking users to exploit this new platform for global, physical, and ecological science, planning, and management and provide feedback. Climate change impact assessments, conservation planning and priority setting, and assessments of the economic and social value of ecosystem goods and services are among the many potential applications. The team also anticipates that analyses done with the ELUs will change as the data behind them is updated.

"Users of ELU data may help by documenting deficiencies in the current layers and suggesting improvements to the data structures to facilitate synthesis and analysis," Sayre said. Both the map and data layers are available on an open database for use in any GIS effort.

The team is already planning to go further with the new GIS of the world, which they consider to be a platform for better environmental understanding and management. "The approach used to aggregate and classify data may also be used for other endeavors such as human geography or ocean science," Vaughan said. "We are in the early stages of investigating what combinations of human and cultural data might be usefully combined."

For more information, contact Roger Sayre at rsayre@usgs.gov or Randy Vaughan at rvaughan@esri.com.

The Big Picture

***Esri Insider* Blog:** esriurl.com/8671
Web Application: Ecological Tapestry of the World or Eco-Tapestry, esriurl.com/EcoTapestry
Story Map: Explore a Tapestry of World Ecosystems, esriurl.com/elu
AAG Publication and Methodology: www.aag.org/global_ecosystems
Access to the Content in ArcGIS: arcgis.com/home/group.html?owner=esri&title=Landscape%20Layers

A Team Player on the Lookout for Enterprise Opportunities

GIS Hero

↑ Bert Granberg

A veteran of more than 15 years in Utah's state government, Bert Granberg remains enthusiastic about public service. "Working in state government is rewarding to me because the scale of it, especially in a state the size of Utah, makes it possible to build meaningful and productive connections horizontally and vertically."

Granberg is currently the director of the Utah Automated Geographic Reference Center (AGRC), a position he has held since September 2012. Originally, the Columbia, Missouri, native was not headed for a career in either public service or GIS. He received a bachelor's degree in political science from Carleton College in Northfield, Minnesota, where he specialized in technology and public policy.

After receiving that degree, he moved to Utah to take a break before going on to graduate school. He was captivated by the state and "its place-based amenities including southern Utah's spectacular red rock landscape, the alpine ski terrain perched just above Salt Lake City, and of course all the trails, parks, and wild lands that are easy reachable on weekends."

Although Granberg didn't want to leave Utah, he still wanted to go to graduate school. A master's level certificate in urban planning offered by the geography department at University of Utah seemed aligned with his interests. However, once at the university, Harvey Miller, one of the department's professors, convinced Granberg to pursue a degree in GIS instead. He did, and in 2000 he received a master's degree in GIS.

While completing that degree, he worked as a GIS programmer/analyst at the University of Utah DIGIT Lab, becoming its interim director upon his graduation. Granberg then left the university to join AGRC, where he became the manager of the State Geographic Information Database (SGID) for the next 11 years.

AGRC is a division of the Utah Department of Technology Services (DTS). It has about a dozen full-time staff members who work on application development, facilitate local and state GIS coordination, operate a GPS base station network, and—most important—maintain SGID. It has a hybrid business model. Part of its budget comes from general funds, and part is generated by offering desired services through interagency agreements and grant programs.

Established in 1984 by Utah's farsighted lawmakers, based on a belief that location and spatial relationships are of fundamental value in serving the state, AGRC has been working to eliminate information silos in government for more than 30 years. With SGID, AGRC has created and carefully curates one of the most outstanding repositories of geographic information in the nation. This one-stop resource for Utah's geoinformation is free and accessed by users worldwide. In addition to agency contributions, AGRC has partnered with agencies and institutions across the state and the nation. Participation by all state agencies in populating SGID was codified into state law in 1991.

AGRC, an early adopter of Esri technology, was among Esri's first 100 customers. Granberg, too, has been using Esri products for a long time, starting in graduate school when the software was just transitioning from command line-based ARC/INFO to GUI-based ArcView GIS. Thanks to his ARC/INFO experience, Granberg received a solid grounding in command line, digitizing, and pen-plotters. He is also thankful for "the view under the hood of GIS design that I got from learning and using Avenue and later ArcObjects." Both gave him a fundamental understanding of the technology.

That understanding of GIS has helped him see opportunities for expanding the technology across the enterprise. Of the many projects he has been involved in while at AGRC, Granberg is very pleased with the benefits accrued from projects that leverage the connectivity of the web. The clearinghouse websites at gis.utah.gov have been successful in providing access to data as well as news and software tips. AGRC's web services, the geocoding API, basemap services, and spatial query API at api.mapserv.utah.gov "leverage Esri technology but allow others to benefit without having a specific technology stack or knowing the details and formality of GIS web services," Granberg noted.

Another project he points to is the implementation of a GIS foundation for the assignment of new precincts and districts to registered voter records. "I think this was a first at the state level." AGRC also has collaborative funding partnerships for high resolution aerial photography and lidar. A current project to realize operational efficiency increase goals set by Governor Gary Herbert employs GIS as part of agency strategies. "This is just getting started but the interest from executive management is really encouraging."

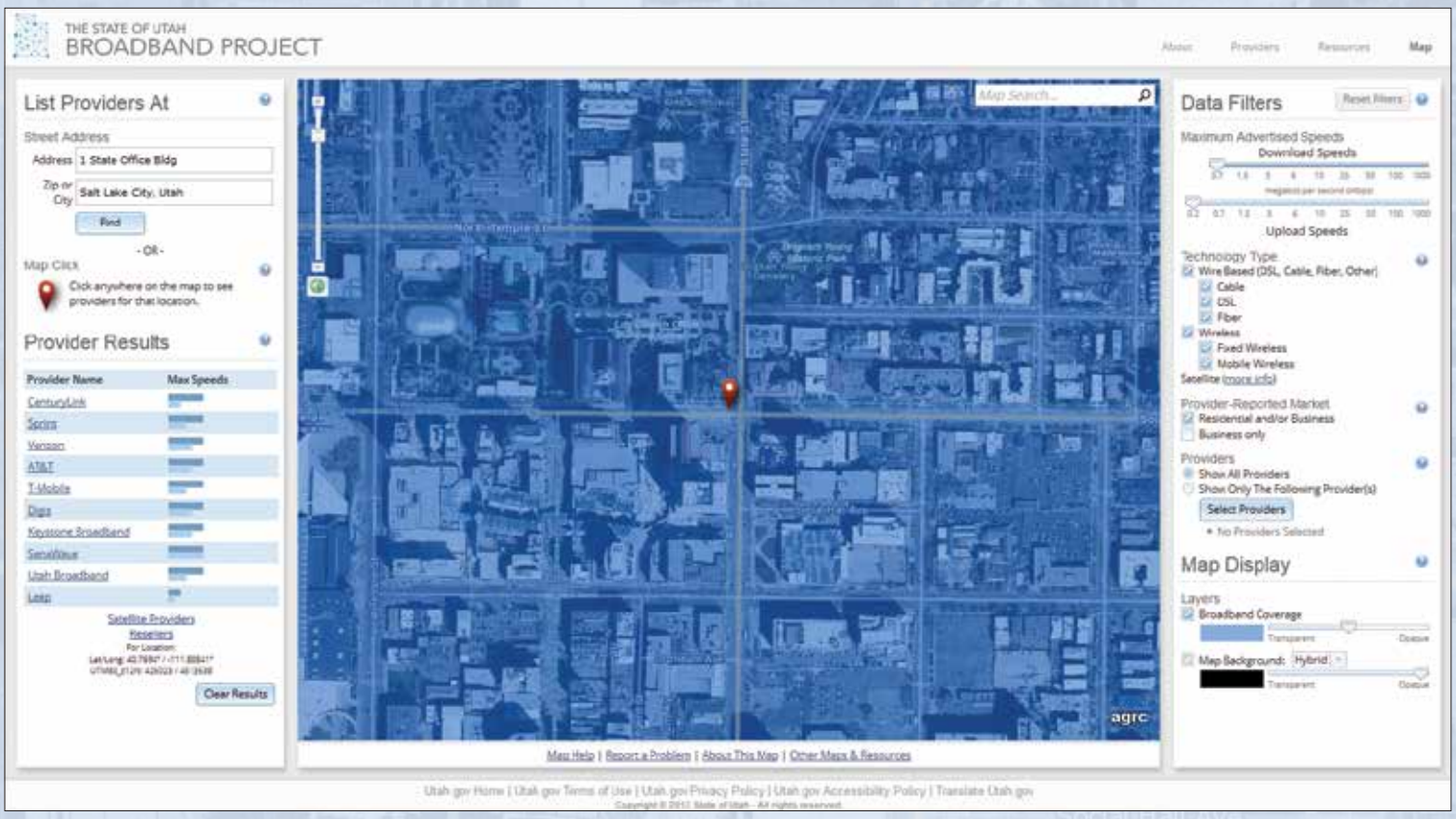
When asked about his role in AGRC's success, Granberg is characteristically self-effacing. "The real story has little to do with me, but rather is what decision makers, managers, and GIS professionals, past and present have been able to build in Utah," said Granberg. "Where we've had success as a state, it is almost always, fundamentally, a team effort that sources its strength from the dedication individuals pay to their agency mission, but while occasionally keeping an eye open for the enterprisewide value that can be gained through sharing data and building products and services that impact a broader audience."

"To the extent that I am associated with Utah's success, I really have to credit the folks who laid the foundation, including my predecessor Dennis Goreham and the perennial leaders of the Utah Geographic Information Council, including Kevin Sato, Nick Kryger, Dave Henrie, and Don Wood who also represent the commitment to GIS made across city and county government in Utah," noted Granberg.

Throughout his career, he has been actively supporting more intelligent use of geospatial information on state and national levels. He is currently a member of the National Geospatial Advisory Committee and has been a board member of the National States Geographic Information Council (NSGIC) for more than five years. He is also a former member of the Utah Geographic Information Council. Interaction with peers has been beneficial to him and his organization.

"I also greatly value the opportunity to participate with colleagues from other states who are active with NSGIC," said Granberg. "Almost every idea that we consider implementing at AGRC has benefited in some way—new ideas, feedback on ideas, strategy, coordination advice, etc.—from the peer-to-peer networking that NSGIC facilitates."

Information gathered through participating in the larger GIS community has helped Granberg enhance AGRC's ability to serve its ultimate customer: the business of government and the people and organizations that it serves.



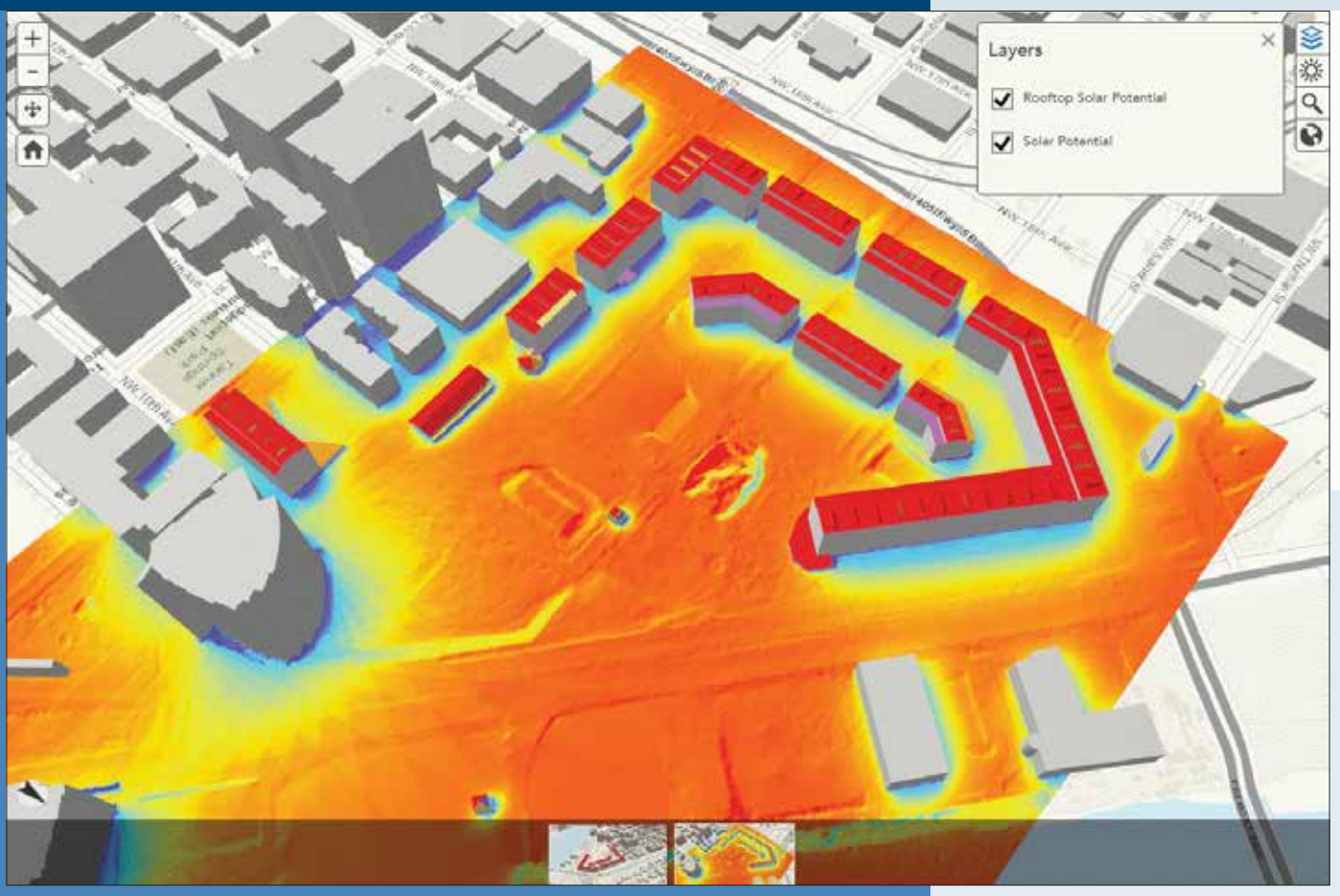
← AGRC uses geographic information to improve service to Utah residents. This web app lets residents find out which broadband providers are available in their neighborhood.

ArcGIS Online **What's New**

The December 2014 update added more valuable functionality, content updates, and configurable apps as well as improved workflows, and more ways for organizations to discover, use, make, and share maps.

Improved Hosted Feature Layers

By giving users and app developers the ability to import and publish layers from GeoJSON or export GeoJSON from an existing hosted feature layer, ArcGIS Online has become even more open. In addition, feature layers can be exported to feature collections, and CSV files can be imported as tables even without spatial references.



↑ ArcGIS Online now includes a 3D scene viewer that enables anyone to explore 3D data and discover information from a web browser.

Map Viewer Improvements

To make it easier to create, interact with, and share maps through the map viewer, options for embedding maps and including zoom controls, basemap selection, legends, and locations search have been added at this release. Pop-up windows containing related data from the Collector for ArcGIS app can now be viewed and edited.

Web AppBuilder for ArcGIS Available

Web AppBuilder for ArcGIS, no longer in beta, is a fully supported release. Create map-based apps that run on browsers, tablets, and smartphones from ready-to-use widgets and customize the look and feel with configurable themes using Web AppBuilder for ArcGIS.

More Tools for Administering ArcGIS Online

Organizations can now allow members with ArcGIS accounts to set up multifactor authentication. Multifactor authentication provides an extra level of authentication at sign-in by requesting a verification code in addition to a user name and password.

Activity-based metrics, real-time reports, and other useful information about your organization's ArcGIS Online site that were available from the Activity Dashboard app have been integrated into ArcGIS Online so administrators can use these tools to manage their site.

A New 3D Viewer

ArcGIS Online now includes a 3D scene viewer that enables anyone to explore 3D data and discover information from a web browser. The scene viewer allows you to easily interact with a scene published by ArcGIS Pro or create 3D scenes using your own layers, either hosted in ArcGIS Online or on ArcGIS for Server, such as terrain and elevation layers. You can combine 2D and 3D datasets to tell a story and add pop-up windows and infographics to display important information.

Do More with Geocoding

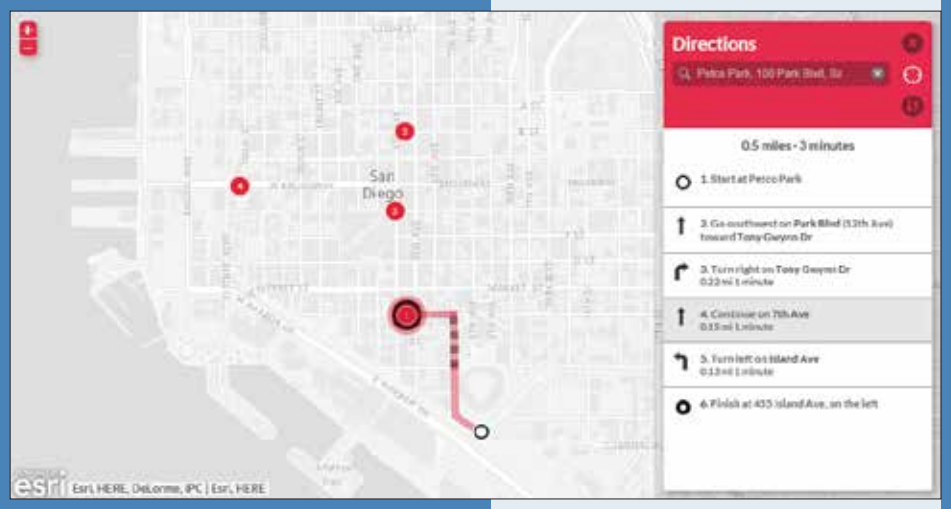
Esri added 1.7 million new unique points of interest (POI) overall and added POI data for eight new countries. Geocoding results and accuracy were expanded for Germany, the United Kingdom, France, Croatia, and Bulgaria.

Work Offline with Hosted Tile Layers

Earlier this year, Esri added the ability to take your hosted feature layers offline with Collector for ArcGIS for use when disconnected from a network. Now, you can also take your own hosted tile layers offline.

New to ArcGIS Online?

Sign up for a free trial. As part of your ArcGIS trial, you also get to try out ArcGIS for Desktop, which includes ArcGIS Pro and a number of other apps, such as Explorer for ArcGIS, Collector for ArcGIS, Operations Dashboard for ArcGIS, and Esri Maps for Office. You get to invite up to four other colleagues to the trial so you can see how easy it is to make maps and share content. Sign up today at esri.com/agoleval.



↑ Perform routing using ArcGIS Online

New Language Support

Vietnamese is the newest language supported by the user interface for the ArcGIS Online website, bringing the total languages supported to 27.

Open Data

ArcGIS Open Data allows organizations to use the ArcGIS platform to provide the public with open access to their authoritative data. With the December release, Open Data supports the use of custom basemaps and introduces a new activity feed to communicate download status to people using the site.

Expanded Analytics

Expanded spatial analytics capabilities help you discover and communicate meaningful patterns in your data. You can now connect Origins to Destinations so you can create many routes at the same time. You can create viewsheds of what an observer at a specified position can see. You can create watersheds or upstream contributing areas. You can trace downstream to determine a flow path. The Extract Data tool now supports attachments. You can verify expressions when calculating a field. Many existing tools, such as Enrich Layer, Summarize Nearby, Find Nearest, and Plan Routes, take can use trucking and walking as travel modes.

ArcGIS Content

Your ArcGIS Online subscription provides enormously valuable and diverse collection of ready-to-use content that is continuously expanded and updated with data from commercial providers as well as contributions from user organizations through the Community Maps Program. Highlights of recent updates include the following:

Imagery
Updates to the World Imagery basemap that include SPOTMaps 2.5 meter imagery and Pléiades 0.5 meter imagery at larger scales, where it improves the quality or currency of existing high-resolution imagery.

Demographic Data
New, detailed demographic data for Germany, Australia, and India that you can use for mapping and data enrichment has been added. You can use the new demographic maps on consumer spending and market potential for the United States, and new global landscape layers for regional planning.

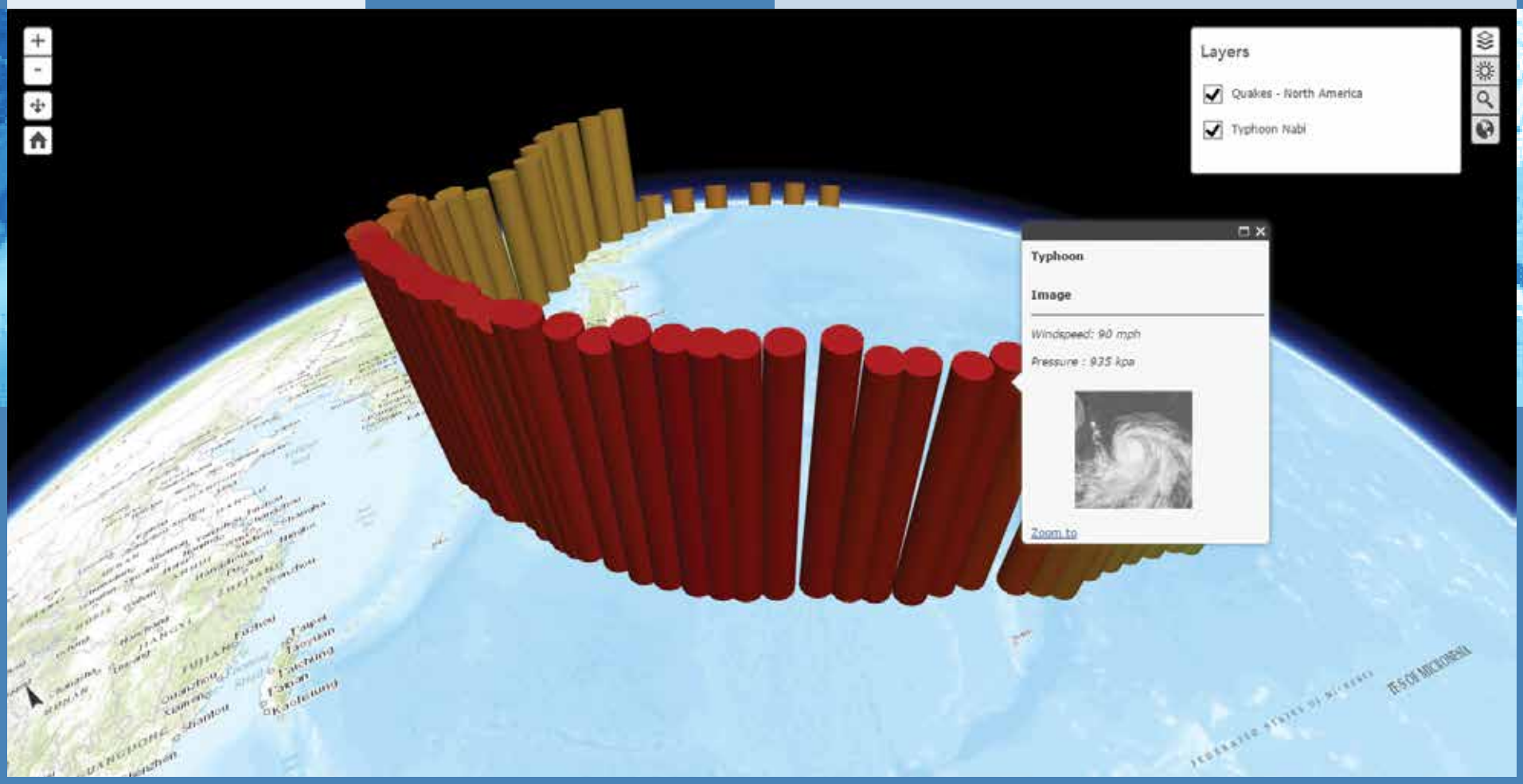
NAIP Imagery
In 2014, Esri published a new set of image layers featuring recently available 1 meter resolution, multispectral imagery for the continental United States, from the US Department of Agriculture Farm Service Agency National Agriculture Imagery Program (NAIP). NAIP acquires aerial imagery during the agricultural growing season in the continental United States. The image layer published by Esri provides access to NAIP imagery by state in four bands, with the option to display the imagery as false color or to display the Normalized Difference Vegetation Index (NDVI) showing relative biomass of an area. The December update includes NAIP 2013 imagery that is available for 23 states. The NAIP image layer is currently in beta and available to users with an ArcGIS Online subscription (paid or trial).

Elevation Services
The White House announced it will release Shuttle Radar Topography Mission (SRTM) elevation data globally over the next year. Esri will continually improve World Elevation services as more data is released. In the most recent update, World Elevation services include more detailed 1 arc-second (~30 meters) Shuttle Land Elevation Data for Africa.

Elevation Analysis
The Elevation Analysis tools, now out of beta, provide ArcGIS for Desktop users and developers with new capabilities for performing analytical operations such as viewshed and profile against data hosted by Esri. These tools are available to members of ArcGIS Online organizations that have the correct privileges. (These tools use service credits.)

New Basemap
New Dark Gray Canvas basemap can be used for maps and applications that benefit from a dark, neutral background map to emphasize thematic layers.

↓ The 3D scene viewer allows you to easily interact with a scene published by ArcGIS Pro or create 3D scenes using your own layers, either hosted in ArcGIS Online or on ArcGIS for Server, such as terrain and elevation layers.



Geospatial Technology and the Future of the City

continued from cover

in the belief that this can stimulate innovation and provide more government transparency. As a result, GIS is being more widely recognized as a powerful platform for local governments to achieve these goals. Its ability to manage, integrate, analyze, and visualize very large and complex data is making it an essential platform for creating the sustainable cities of the future.

GIS systems have traditionally been based on database-centric approaches that generate information products, such as maps, reports, or views, from centralized DBMSs (geodatabases). While there are some exceptions such as Geneva, Switzerland, these GISs have been largely implemented as departmental systems.

Over the last decade, due largely to the emergence of faster computing and networks, the vision of distributed enterprise systems created by integrating departmental systems began emerging. This vision leveraged services-oriented architecture for dynamically combining data from multiple distributed databases. As a result, we have seen the development of applications that can access, join, overlay, and view distributed data as if it was supplied by a single DBMS or geodatabase. This capability has eliminated the need to normalize and physically integrate data into a single centralized system. This distributed, federated architecture has dramatically accelerated with the maturing and acceptance of web standards as a backbone for enterprise architecture.

A New Web GIS Pattern

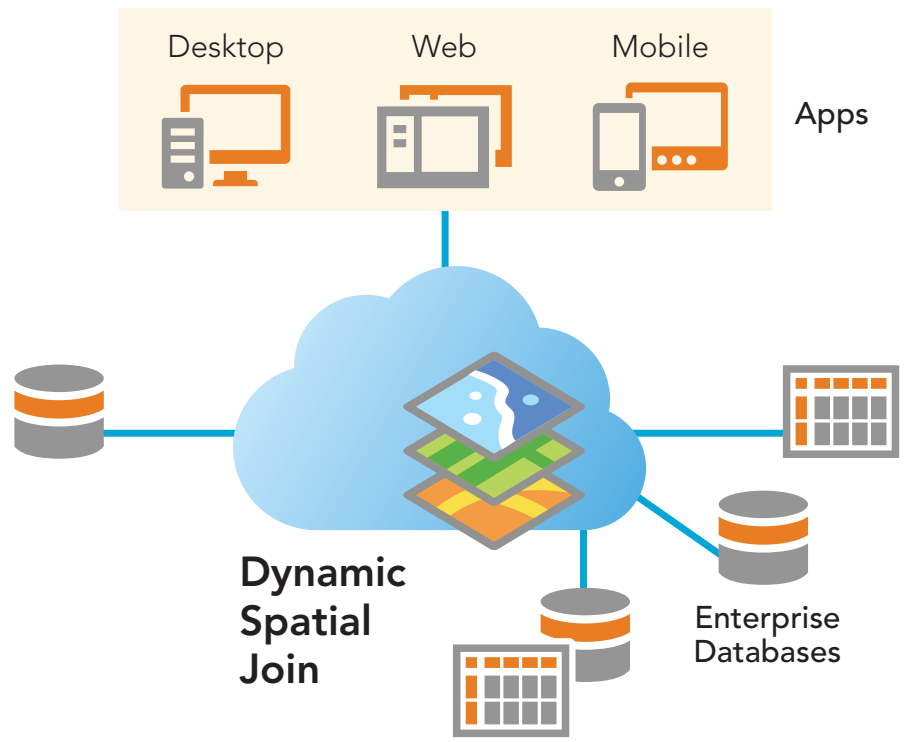
Today patterns of distributed data mashups (both tabular and map) are increasingly being implemented in cities. This is helping unify and integrate information from many sources across the enterprise and beyond. This new work pattern is facilitated by the web and web services. While not replacing the need for good traditional database design, it creates a much more agile framework for developing and deploying GIS apps. It is actually helping realize the data integration vision of enterprise GIS.

To make this type of dynamic database integration work in a tabular database world requires common keys among and between distributed datasets so that data can be easily integrated. Common to most local government data and services is some form of georeferencing or location. This georeferenced data can be x,y coordinates, an address, a placename, or geographic area such as ZIP Code or administrative area. GIS provides the tools that interrelate this data via spatial joins. For example, GIS can associate a table of data of points (such as crime incidents) with a table of areas (such as police districts). This capability is increasingly being recognized as playing a major role in integrating of all types of data across the enterprise.

The other key building block enabling this new architecture is the exposing of data as services using protocols such as REST. These services are increasingly used to support a whole new world of GIS application development that supports operational workflows, analytics, decision support, and citizen engagement.

More real-time data about cities is becoming available. Massive networks of stationary and mobile devices that measure and track everything that moves or changes are being created. This includes traffic, utility usage, environment, and smart building data, which are exposed as services. Over time crowdsourcing will also be integrated as an information source enabling citizens as well as city employees to report their observations and interpretations. Finally, service-enabling operational data (data maintained in enterprise systems) will mean that data can be easily connected and dynamically integrated.

Serverizing all local government data will transform GIS and make it more easily deployed to make cities smarter. This framework allows GIS professionals to easily mash up data and create apps that traditionally required far more resources. As a result, processes that involve tasking and resource allocation—such as dispatching repair crews, responding to emergencies, and deploying law enforcement—will become more rational and reliable.



Citizen interfaces to government services will increasingly be done using a services platform. The so-called e-gov revolution will be supported using web services that provide access to distributed data sources. A whole new suite of capabilities for performing tabular, statistical, geospatial analytics, and visualizations will be built on these services.

GIS already provides many tools to do this and will increasingly be used to turn local government data into actionable information that cities can use to improve services and the quality of life for their citizens.

The Future City

Future cities will be much smarter. Everything will be measured in real time and in fine detail through the deployment of sophisticated arrays of sensors. GIS will play a major part in integrating mountains of real-time data so it can be understood and acted on. It will improve applications that range from managing environmental quality and the built environment to land-use and transportation planning. The result will be better decisions, more efficiency, and improved communication.

Cities will increasingly make their information available as open geospatial services (maps). These maps will help tell stories about the state of those cities and the policies they have taken. All transactions and changes will be illustrated virtually, resulting in citizens who are both more informed and engaged. They will visit city hall more frequently—virtually instead of physically—and most local government transactions will be done on the web.

The Role of GIS Professionals

GIS professionals will play a major role in creating this future. They will implement GIS-based smart 2D and 3D maps as the new user interface for communicating, integrating, analyzing, and understanding everything about cities. They will geoenable all databases and expose this data as open web maps and web scenes. These map services will be used for creating all sorts of apps available everywhere on any device. They will provide reports, tell stories, and reference locational activities. They will enable a better understanding and provide a rational basis for the analysis of complex situations and support for place-based planning and decision making.

Longer Term

As cities enable their information, people everywhere will be able to openly compare cities. Technically, this is already possible. It is being done by the Urban Observatory (www.urbanobservatory.org), which is an early prototype of what will come. We are also seeing exciting work done by organizations such as The Trust for Public Lands, which is providing new scoring measures that compare cities based on differences in the amount of open space and parks. This type of GIS-based scoring system will evolve into a framework for scoring everything in cities. My vision and hope is that GIS professionals will facilitate this process and provide an integrated, transparent, and comprehensive science-based framework that will help evolve our urban settlements into smarter and more sustainable cities of the future.

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Collector for ArcGIS Offline Capabilities Energize Utility Management

A Montana electric cooperative has eliminated yellow notepads and hours of data input in its system surveying procedure.

Sixty miles south of the Canadian border, Montana's largest electric cooperative serves more than 48,000 members who live in an area of wilderness, ski slopes, and glaciers. Flathead Electric Cooperative manages more than 4,500 miles of overhead and underground power lines.

In 2013, Flathead started a systematic surveying project. At that time, Flathead's fieldworkers used yellow notepads for field data collection. Synthesizing these handwritten notes was a manual process that used various software systems and took months.

One of Flathead's interns collected as many as 100 data points in a day. It took GIS specialist Amanda Opp about seven months to manually input the intern's data into Flathead's software systems. Although Flathead had ArcGIS for Desktop, the co-op wasn't ready to use the Collector for ArcGIS app. This app lets fieldworkers capture data on a mobile device instead of paper.

At the time, the app required connectivity so the utility didn't use its ArcGIS Online account. "We live and work in a rural area that oftentimes doesn't have cell coverage," Opp said. "And who wants to pay for an expensive data plan anyway?"

An ArcGIS Online update released in 2014 allowed Collector to be used offline—a transformative capability in rural areas without Wi-Fi access or data plans. Suddenly Opp could use ArcGIS Online, and she seized the opportunity.

"The offline release was massive," said Russ Roberts, an Esri product engineer on the Collector for ArcGIS team. "It took a whole crew of teams working together seamlessly so we could flip the switch one night and get this Collector and ArcGIS Online release out together."

The switch flipped at Flathead too. "We realized in March with the release of Collector that this was big," Opp said. "I didn't realize how big until we started using it."

Opp spent two months configuring the app for Flathead's needs. She uploaded layers and maps and defined data that needed to be collected using drop-down menus. She used large, familiar symbols that were legible on a tablet and could be discerned if several of the same asset were in close proximity. Opp created a green triangle for a transformer, an orange star for a distribution pole, and a blue dot for a high-voltage transmission pole. A blue dot set on top of a green triangle on top of an orange star indicates a distribution pole and a transformer in the same spot.

Opp got an iPad from the director of engineering and loaded the app on it. She gave it to Matt Stahlberg, an electrical engineering student who had just started an internship with Flathead.

"The first time I used it was on the first day," Stahlberg said. He had no prior GIS experience. "I wouldn't say any of it was challenging," he said. "Everything was clear-cut with how to interface with it."

Initially, Collector drained the device battery before the day was over. Saving a data point could take hours. Stahlberg and Opp voiced their concerns on GeoNet, Esri's social media networking site that helps users collaborate with Esri product engineers.

"I was really impressed with how fast everything was updated," Stahlberg said. "It took forever to save data points, and someone was right there to fix that. In the next update, the save time goes down to two seconds; battery life doubles. If there was something they needed to change, it was pretty much right away."

Roberts helped Opp fix an issue with querying map layers. This was a must for a company with 45,000 poles and many other assets. Roberts dug into Flathead's web maps and saw the issue in the code. He brought the code to the ArcGIS Online team, and they fixed it.

Stahlberg's data improved the accuracy of Flathead's survey over the paper-based surveying. "With a system this big, there's always morphing data and mistakes," Opp said. "But to get it closer to accurate is always the goal."

Much of the surveying work was old. Some had been done 20 years ago. The GPS on the iPad was significantly more accurate than those old surveys. "Generally large structures you could see from a distance," said Stahlberg. "But now we were able to see them down to within a few feet of a point rather than a hundred yards or more."

Not only was the data more accurate, it was also coming in faster. Opp's work preparing Collector for Stahlberg let him do twice as much work in a day. Opp said he was moving so fast she couldn't keep up with him.

One of Opp's configurations included loading old survey data into the layers Stahlberg could access. One day Stahlberg resolved a discrepancy between the old survey and his GPS observations. The discrepancy was close to 200 feet. Previously he would have written down the information, gone back to the office to check it, and then gone back to verify everything. Instead everything was on the iPad, so he could make the correction in the field.

Opp has become a Collector evangelist. She was an ArcGIS Online novice when she started configuring Collector. "I was a baby," she said. "I hadn't even been in GIS a year." Opp worked as a cashier for 10 years before—with encouragement from friends—she put a civil engineering degree to use at Flathead.

Now, she writes posts for GeoNet and LinkedIn telling people how to build ArcGIS Online maps and collect data while using the minimum number of credits. "I want to encourage other utilities to go boldly in this direction because it is a huge time saver," she said.

Opp admits being initially perplexed. "Trust me, I hit a wall a time or two." But she encourages novices to use GeoNet. "There are users on there who have done what you're doing."

With Stahlberg back in school, Opp has taken charge of the iPad and is locating and labeling transformers before winter comes. This winter, Flathead hopes to use Collector to survey 1,100 light poles in Kalispell, the county seat of Flathead County. The co-op has shown interest in learning how to use Collector for meter surveys.

"Once it catches fire, it really does," Opp said. "We're streamlining our system survey with spatial data and marrying the two in a way where I can bring it into my map all at once."

↓ Montana's largest electric cooperative, Flathead Electric Cooperative, serves more than 48,000 members.
Photo courtesy of Nomadic Lass/Flickr

GIS Helps Improve Groundwater Management in Kuwait

↑ Elevated water tank
Photo by Eyad Ghatasheh

Information on brackish groundwater, which is important to Kuwait's water supply, is being more effectively managed through an enterprise GIS.

The regional hydraulic system underlying Kuwait consists of two aquifers. The upper one, the Kuwait Group, is composed of a layer of sediments and elastic rock saturated with water. It has a total dissolved salts (TDS) value between 4,000–9,000 particles per million (ppm). The lower aquifer, the Dammam formation, contains layers of consolidated limestone and has a TDS value between 3,000–6,000 ppm. Groundwater in Kuwait moves continuously with the slope direction.

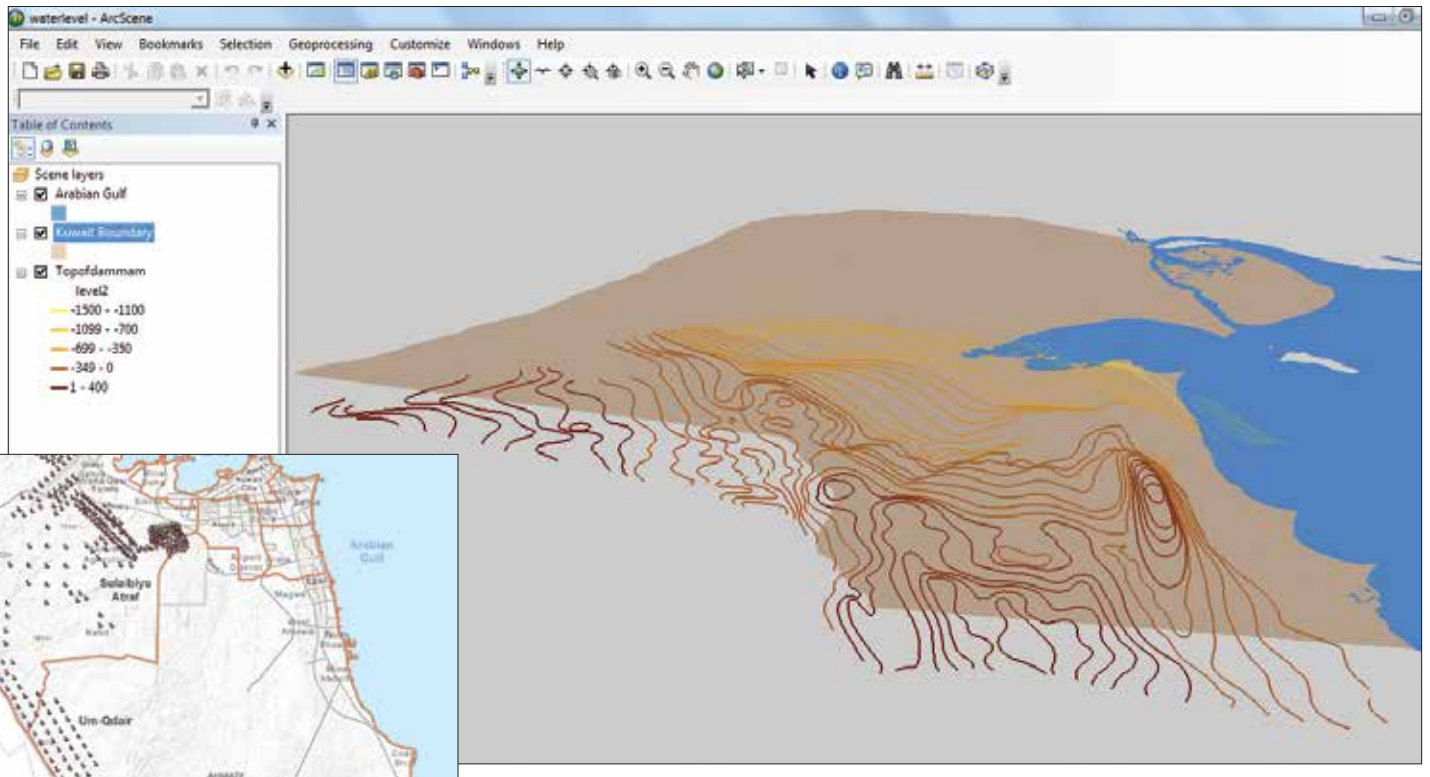
Brackish, saline, and fresh groundwater are found in these acquifers. Drilling and groundwater field construction, which was started by the Gas and Water division in 1950, was shifted to the Groundwater Administration in 1970. Hundreds of groundwater projects have been constructed through the cooperative efforts of the Department of Groundwater Projects and Water Networks Projects department. These projects resulted from the recommendations of groundwater studies and research departments. The water produced by these fields is used in blending processes for freshwater production, irrigation, and other consumption.

Brackish water in the Kuwait Group and Dammam aquifers stretches from the east of the Arabian Peninsula and slightly sloping toward the Arabian Gulf. Brackish water wells are mainly located in the Sulaibiya, Shigaya, and Umm Gudair fields. In addition, the Al-wafra and Al-Abdaly fields are utilized by Kuwait Oil Company (KOC). Kuwait has 13 groundwater fields that support a total of 1,180 wells. These wells are dedicated to specific tasks such as drainage, exploration, monitoring, observation, and production.

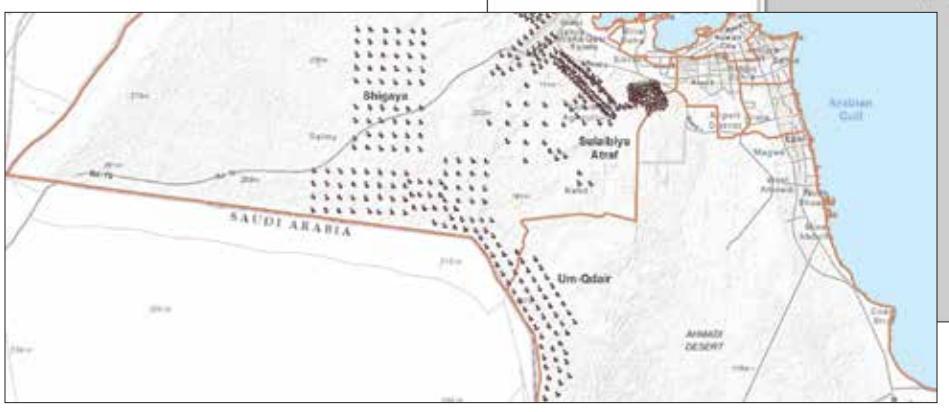
Several projects to make use of brackish water were established cooperatively by Water Projects Administration and Groundwater Administration. The water would be distributed to consumers through a separate pipe parallel to the freshwater distribution pipe. ArcGIS 10.2.1 for Desktop from Esri and ArcFM Desktop 10.2.1 from Schneider Electric were used to generate, update, analyze, and archive all spatial and tabular data related to this groundwater.

The present total output of the installed capacity is about 126 Million Imperial Gallons per Day (MIGPD), and the maximum consumption in summer hits 87 MIGPD. Cylindrical groundwater tanks are used for storage. Their contents can be pumped directly into the distribution network or to elevated water tanks via transmission pipes after the water has been blended with distilled water. These tanks handle the hourly variation in demand for water and maintain constant pressure in distribution mains. Brackish water is available to 79,000 consumers. Other related programs have been proposed to step up production capacity through new fields in different areas.

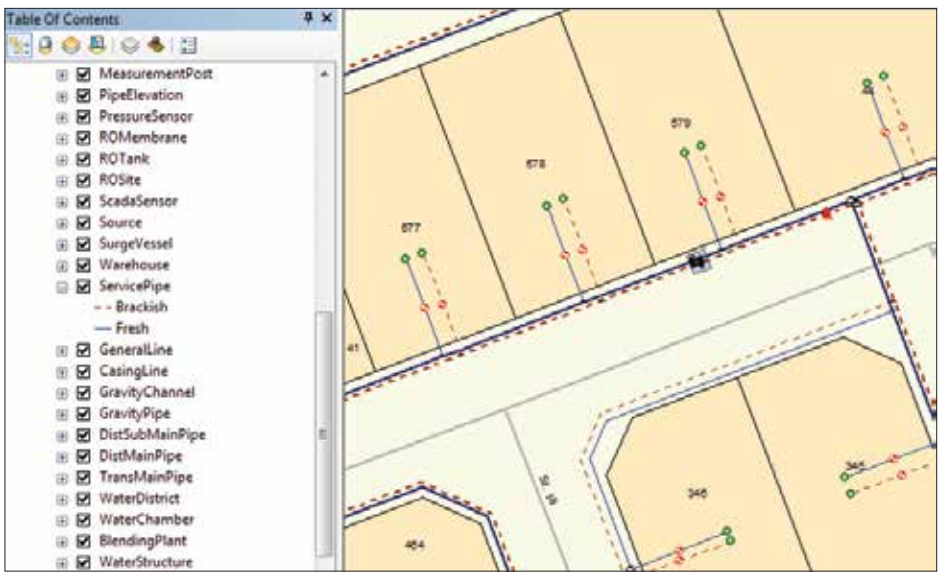
Recently, the Groundwater Administration started using GIS in all aspects of its operations. The ArcScan for ArcGIS extension was used to digitize scanned hard copies of sketches and maps. A survey of the location and condition of all related assets—water wells, transmission pipes, distribution pipes, pumps, and all fittings joining all these assets—was needed.



↑ Dammam layer beneath the surface showing the slope toward the Arabian Gulf.
Modeled by Eyad Ghatasheh



↑ Distribution of groundwater fields and wells. Source: MEW Enterprise GIS System



↑ Water distribution network showing submain pipes and service pipes of fresh and brackish water.
Provided by MEW Enterprise GIS System

The process of collecting this data was handled using Trimble PDAs connected to a base station to enhance accuracy. Postprocessing was used to get more accurate readings using Trimble's Pathfinder software. A special data dictionary, created for the PDAs, was used for capturing asset attributes while acquiring the assets' coordinates.

This data was verified using up-to-date satellite images with a resolution of 0.6 centimeters. After comparison, 5 percent of the captured data was surveyed again by Water Administration engineers for verification and data approval before loading asset data into the enterprise geodatabase accessed in part or in whole by end users, editors, and surveyors, depending on the level of privileges assigned.

Groundwater Administration engineers who were superusers worked to fully utilize the capability of the software. This project was accomplished through the cooperative efforts of the client, the Ministry of Electricity and Water; OpenWare, the Esri distributor and project contractor; and the subcontractor Khatib & Alami. An overall workflow was established to handle all issues associated with data capture, archiving, and validation and the approval process with each party maintaining its rules and subworkflow.

For more information, contact Eyad Ghatasheh, OpenWare senior software engineer for the MEW GIS project, at e.ghattasheh@openware.com.kw or 00965-60402910.

Getting Citizens Involved in Reducing Water Waste

According to the National Weather Service, 2013 was the driest calendar year on record since 1877. The southwest United States, particularly California, has been experiencing a serious drought and desperately needs rain.

The primary intervention strategy for water agencies in combating this problem is reducing water consumption and water waste. Daily usage can be reduced through targeted marketing campaigns that encourage the public to cut back on total water usage and restrict unnecessary watering patterns. For example, watering lawns and washing cars are nonessential activities that result in water waste and need to be greatly restricted during times of drought.

However, limiting water waste can be a difficult and nontrivial task for water agencies. Wasting as little as one drop per minute (the rate of water loss from a leaky faucet) equates to over 2,000 gallons of water wasted per year.

Water agencies have field crews to combat water waste, but they can only tackle issues they know about. Members of the public may not know who to call or how to report water waste, which results in citizen disengagement, apathy, and frustration.

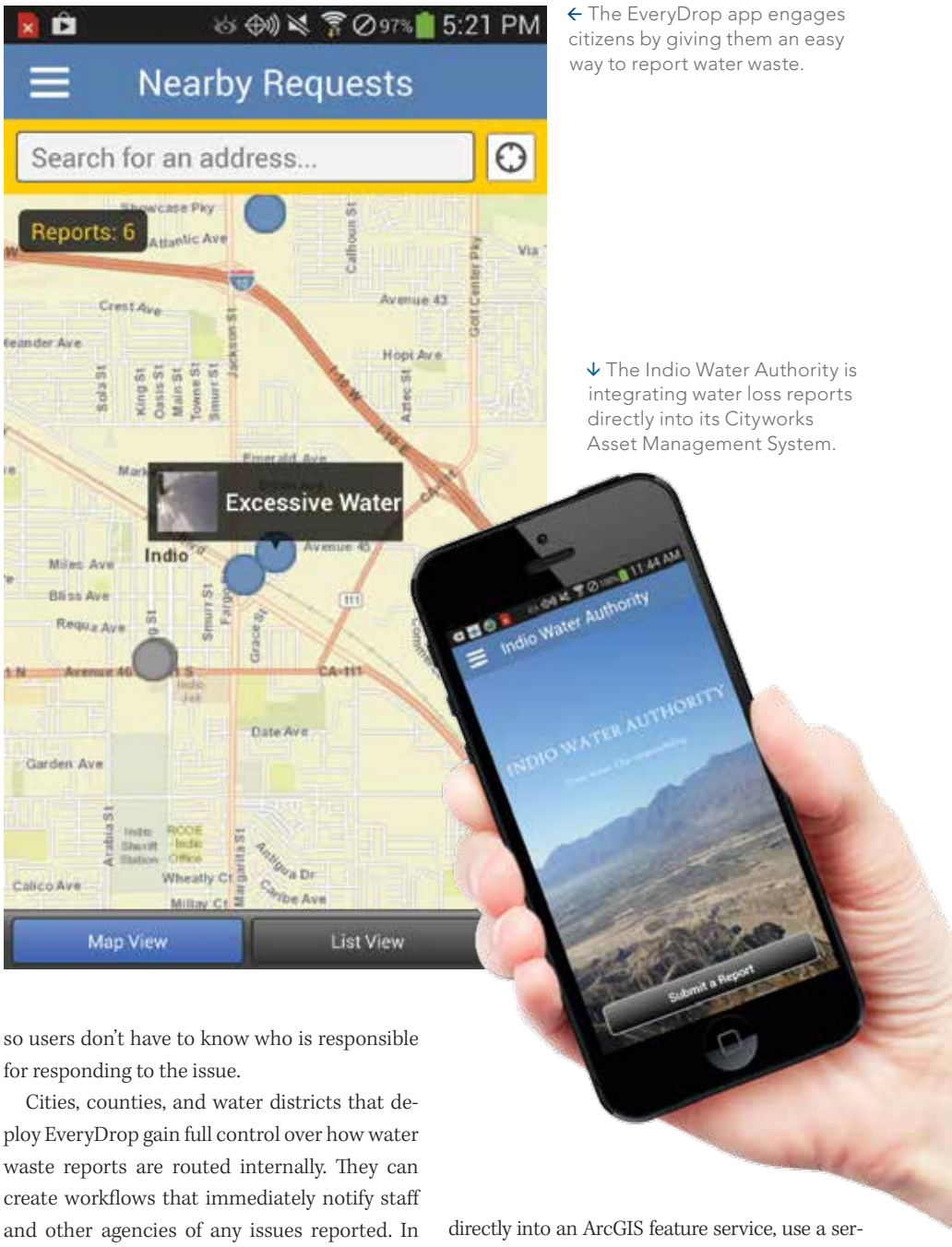
Fortunately, public-facing reporting tools such as smartphone apps, have emerged. These tools greatly simplify the process of reporting water waste. Most important, these reports go straight to the water agencies that address these problems. By turning to the public and enabling the citizens to report water waste, agencies can become aware of waste issues more quickly.

In response to President Barack Obama's Climate Data Initiative, which encourages tech innovators to use data in compelling ways to help make smart choices in the face of climate change, Esri Silver Tier partner CitySourced created EveryDrop, a water conservation website and app that engages citizens by giving them an easy way to report water waste and educates them in ways to better conserve water.

For the public, EveryDrop is available both as a website and a downloadable app for Android and iPhone. The app allows users to

- Identify and report water waste directly
- View incidents of water waste around them
- Receive alerts to conserve when it's absolutely essential
- Educate themselves on conservation techniques
- Engage with the water community through social media

To identify and report water waste, the user simply opens the app, snaps a photo of the problem, uses the GPS capabilities of the device to provide a location, and clicks a button in the app to submit the issue. Using location and various other factors, the report is automatically routed to the correct agency and department so users don't have to know who is responsible for responding to the issue.



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

↓ The Indio Water Authority is integrating water loss reports directly into its Cityworks Asset Management System.

Cities, counties, and water districts that deploy EveryDrop gain full control over how water waste reports are routed internally. They can create workflows that immediately notify staff and other agencies of any issues reported. In addition, agencies can push these reports into existing work order management systems.

For example, the Indio Water Authority in Southern California is integrating water loss reports directly into its Cityworks Asset Management System so operations staff don't have to manage and administer a new software system. Crowdsourced reports from EveryDrop are integrated into the existing workflow, which saves time and ultimately reduces costs.

For organizations not currently using a software tracking system, EveryDrop's web-based management Console gives water agencies full control over the submitted water waste reports. Departments can be automatically notified based on configurable rules, conditions, and other user-submitted data such as location. Additionally, executive leadership can use the Console to see what, where, and how frequently water waste is being reported.

EveryDrop is tightly integrated with mapping technology from Esri. GIS technicians at the Indio Water Authority leverage ArcGIS for Server and ArcGIS Online to produce valuable insights on water loss, which can be fed back to colleagues and the public in an effort to produce long-term, actionable change. They use EveryDrop in conjunction with Esri technology to push reports directly into an ArcGIS feature service, use a service on ArcGIS Online to reproject that data, and query ArcGIS feature services in real time.

Taking this integration one step further, ArcGIS for Server or ArcGIS Online users are monitoring key performance indicators (KPIs) inside Operations Dashboard for ArcGIS, available as a Windows app for the desktop or browser app for online or tablet viewing. For example, water department operation teams are quantifying how much water is being wasted. This data is then analyzed to make better decisions; displayed on maps for visualization; and summarized in charts and graphs for reporting to executive leadership.

Water agencies are looking for new, innovative methods to engage citizens in their fight to reduce water waste. Agencies are increasingly turning to technologies like EveryDrop to streamline reporting and response to water waste. Employing this GIS-based technology allows the public to be better served, helps conserve precious and limited water resources, and allows better decisions.

For more information, contact Andrew Kirk, vice president, sales and marketing, at CitySourced at andrew@citysourced.com or 424-270-9438.

GIS Ties Utility's Shore Management System Together

A public utility in the Pacific Northwest that relies on hydroelectric power developed a comprehensive and efficient shoreline management system for the shorelines around its dams' reservoir that relies on GIS.

In the 1930s, less than half of Grant County, Washington, had electrical service. Rural residents formed a grassroots organization to create a countywide public utility district that would provide electrical service for everyone—and thus grow the economy and provide a higher quality of living for the economically depressed region.

In 1938, residents voted into existence the Grant County Public Utility District No. 2 (Grant PUD). A quarter century later, Grant PUD had built two dams on the Columbia River: the Priest Rapids and Wanapum, together known as the Priest Rapids Hydroelectric Project. Today these dams generate over 2,000 megawatts of electricity. More than 46,000 county residents directly benefit from the hydroelectric project—and so do millions more, served by 23 northwestern utilities that purchase Grant PUD energy.

In 2008, the Federal Energy Regulatory Commission (FERC) approved another 44-year license for Grant PUD that will allow it to continue operating the project. In April 2013, FERC approved the utility's Shoreline Management Plan (SMP) to protect the two dams' reservoir shorelines. To support the SMP, Grant PUD needed a database system that inventoried the shoreline, tracked permits, and monitored permit compliance.

"In knowing that, we wanted to choose something structurally sound that we can build upon," said Lisa Anderson, a lands specialist for Grant PUD. "We recognized a need to have a comprehensive system that would tie all the big pieces together, including shoreline inventory, permitting, and compliance monitoring."

Shoring Up the Shoreline with a Full GIS

Over many years, homeowners had built docks, trails, and landscaping features along the shore. Some had permits; others didn't. The result was a Grant PUD-owned shoreline that—in places—looked like private property and was, therefore, less than welcoming to public recreators.

The FERC-approved plan required protecting natural and cultural resources as well as providing public recreation. Another requirement—part of a monitoring and compliance plan FERC approved in 2013—identified periodic inspections and reports on land-use compliance.

Edrie Risdon, Grant PUD lands specialist, was excited to take the Tracker app for its first run.

In the past, GIS had helped the utility manage land assets, make maps, educate shoreline homeowners, and provide district services. Now, Anderson said, "There is an increasing awareness throughout the district of what GIS really is and how it can be used as a management tool."

Based on this previous experience, Grant PUD turned to GIS as the primary application to support meeting its SMP requirements. "It was time to really take a comprehensive look at the shoreline and see what was there and what people were doing," Anderson said.

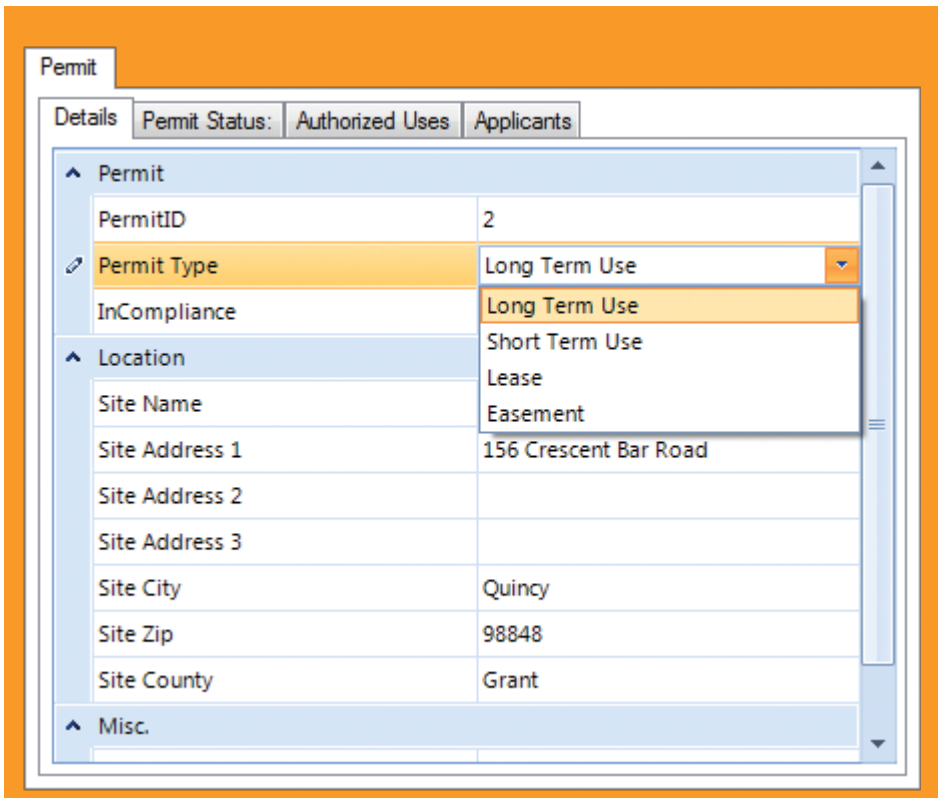
Getting Started with the SMP

Grant PUD hired Erlandsen & Associates, a GIS services and engineering company in the state of Washington, to complete a GIS needs assessment and implementation plan. Erlandsen outlined the development of a shoreline management GIS database that supported tracking and monitoring of the shoreline inventory and permits.

Erlandsen recommended using ArcGIS for Server to store and distribute the database. In its implementation plan, Jeff Berry, a senior GIS analyst and the author of Erlandsen's plan wrote, "ArcGIS *[for]* Server will allow the PUD to centralize GIS data in an enterprise database, support mobile GIS operations, and serve web-based GIS applications to PUD staff."

Erlandsen also recommended developing a suite of GIS applications for desktop, web, and mobile. The first of these, an ArcGIS for Desktop extension, lets GIS staff administer the shoreline management geodatabase and configure and monitor permitting and inspection tasks. The second application, a web app, enables planning staff to track and update shoreline permits through the approvals process. The final application, for Windows tablets, that lets field staff generate compliance inspection reports on shoreline inventory and permits. All three applications use map services published by ArcGIS for Server.

With these applications in place, Grant PUD could effectively issue and track shoreline permits, monitor permit compliance, and reliably track shoreline inventory—thus giving it a much clearer understanding of how people use the project shorelines. Grant PUD already had licenses for ArcGIS for Server with its Esri enterprise license agreement (ELA), so deploying ArcGIS for Server created no additional cost.



↑ Grant County's Shoreline Management Plan (SMP) asks landowners to apply for a variety of permit types, such as a long-term use permit or a short-term-use permit for an event.

GIS Undocks from the Office

For the initial SMP effort, the GIS team built a customized data dictionary with TerraSync, software for Trimble mobile devices that facilitates GIS data collection in the field. The dictionary lets workers without GIS training instantly capture shoreline inventory data by selecting from predefined feature sets.

"We set it up to be structured in a way that we could just get up and go with it," Anderson said. Crews swept the shoreline for a full inventory in 2010 and updated this in 2013. The second sweep put crews on boats and on foot to gain new vantages. Crews identified both noncompliant features (e.g., nonpermitted docks) and compliant features (e.g., approved landscaping).

Grant PUD also utilizes high-resolution aerial imagery, acquired in March 2014, as a backdrop layer to digitize shoreline features, supplementing and updating the original inventory.

"We can save field time and update the inventory even when the snow is flying outside, thanks to this aerial data that will allow us to refine our dataset from the comfort of the office," Anderson said.

Grant PUD notified homeowners it would revoke all existing permits in 2015 and requested that homeowners submit new permit applications to homogenize all permit records in the new SMP.

Moving forward, the utility plans to use the mobile GIS app from Erlandsen to complete additional inventory mapping and report on compliance inspections. In addition, crews can use the app to support private landowners through the permitting process. The app shows homeowners where their property boundaries exist in relation to Grant PUD properties and how their permit will affect the landowners' property use.

"We will be able to update the inventory on the screen as we go along," Anderson said. "We can spatially account for unauthorized use, whether a dock or landscaping feature has been extended, or whatever the case may be, in the field."

A Plan That Goes with the Flow

Grant PUD is meeting FERC requirements while gaining an efficient permit and compliance tracking system. The elimination of redundant data entry has already increased efficiency. The suite of GIS applications encourages the utility's Natural Resources Department projects and also emerging projects in other departments. Perhaps most impressive is that most of the effort has been proactive.

With the 44-year FERC license, vision is critical. Anderson has already met with Esri staff to discuss setting up Portal for ArcGIS—a firewall-based version of ArcGIS Online—to secure information. A new server and Portal for ArcGIS were installed in December 2014.

The goal is a protected shoreline everyone can enjoy. "We believed if we thought about the long term, we'll ultimately be saving time and money," Anderson said. "We will be able to capitalize on this in a big way. It makes sense to everyone," Anderson said. But, she added, "It's an incremental process."

Campaigning for and getting the ELA were first steps, Anderson said. The installation of ArcGIS for Server was the second, and finishing implementation of the shoreline management system is the next.

At a recent rollout to the lands manager and shoreline administrator, Anderson got good feedback. "There were several mentions of, 'This is awesome.'"

More Precise Paperless Reappraisal Process Integrated with GIS

By Matthew DeMeritt, Esri Writer

Moving from a cumbersome paper-based reappraisal process to a digital one that is integrated with its GIS has saved an Ohio county time and improved the accuracy of its processes.

Computer-assisted mass appraisal (CAMA) relies on a fair share of analog coordination—at least for some tax offices. These days, many auditors still depend on printing paper maps and land records to equip assessors for their on-site property inspections.

The Wayne County, Ohio, Auditor's Office phased out its paper-based process and replaced it with a digital reappraisal solution that has improved the integrity of the data its employees enter into CAMA. The solution earned the county a Special Achievement in GIS Award at the 2013 Esri User Conference.

↑ The PRS Mobile Property Card allows appraisers to digitally review and create property data rather than carry physical cards to their on-site inspections.

Card Stacking

Under state law, the auditor's office in every Ohio county must conduct a reappraisal of all real property in the county every six years to update values for taxation purposes. CAMA databases contain information such as property condition, size, land cost, and other variables that are used by appraisers to determine the most accurate market values.

In Wayne County, Ohio, staff began its mass reappraisal by supplying a team of contract appraisers with printed route maps and property cards. Staff then arranged the maps on tables and stacked the cards beside them. This tedious and time-consuming task was an obvious place to start improving the reappraisal process.

"That process required the appraiser to make two trips to each property toting maps, cards, and documentation that they wrote on," said Jarra Underwood, Wayne County Auditor. "Back at the office, a data entry team directly entered the written information from the cards into the CAMA database."

Regardless of market conditions, property owners equate higher market values with higher tax bills. The paper-based valuation process made accuracy and consistency difficult to maintain, values difficult to support, and challenges harder to fend off. Until the county replaced this process, more accurate valuation for Wayne County was not in the cards.

Digital Overhaul

In 2012, the state of Ohio slashed funding to all municipal and county governments while the office was in the midst of a large parcel boundary mapping project spearheaded by GIS consulting firm Bruce Harris and Associates (BHA), an Esri Silver Tier partner. To maintain continuity, Underwood chose BHA to design a new geospatially integrated reappraisal workflow.

"It made sense for BHA *[staff]* to design the new reappraisal system because of their familiarity with our office," said Underwood. "Also, the parcel maps they created would be an integral piece of the new appraisal system."

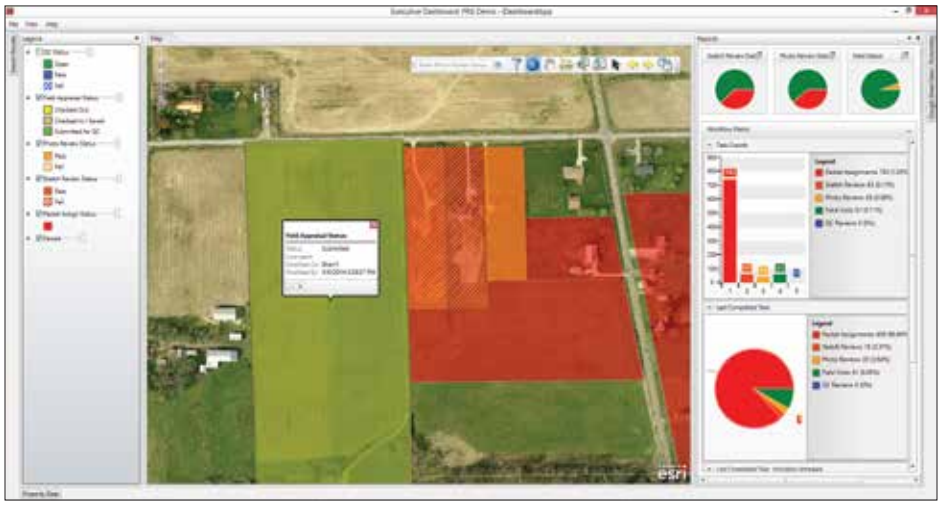
BHA began interviewing county staff to become familiar with the workflow throughout the county's six-year mass reappraisal cycle. After that discovery phase, BHA created a schematic showing how the paperless system would work. The document detailed how each component of the Paperless Reappraisal System (PRS) would integrate and interact with the county's CAMA. The system would give appraisers the digital tools to directly update tabular data themselves rather than handing off cards and documentation to data entry staff.

After months of development, the county had the fully operational PRS, consisting of a suite of six configurable ArcGIS for Local Government applications. The suite provided appraisal team members with routing to guide them to scheduled field inspections and a QA/QC process for data creation.

"When appraisers open the digital property record on their Windows tablets, they see parcels organized in 'packets' that optimize logistics without the previous constraints of a hard-copy tax map," said GIS director Travis Gregorich. "PRS also tracks revision history and any other changes that appraisers make, giving us the ability to promptly identify and resolve problems before updating databases."

All apps in the PRS suite connect to the county's GIS platform. A sketch reviewer tool accesses imagery and feature layer services from ArcGIS Online that display building footprints, allowing appraisers to verify building dimensions. To eliminate unnecessary visits, a photo reviewer lets the inspectors make virtual inspections of property.

"Appraisers can see building sketches as vectors from the county's CAMA," said Gregorich. "Oblique imagery and map services validate the existence and size of dwellings. Failed validations can be flagged and annotated."



↓ Staff use the PRS Executive Dashboard to get a real-time overview of inspection progress via maps and reports.

Operations Dashboard for ArcGIS was used by the management team to monitor reappraisal activity back at the office. The dashboard provides a real-time overview of progress displayed in thematic maps, graphs, and reports.

Discrepancies Discovered and Fixed

Comparing CAMA property data descriptions with GIS layers, the county uncovered some worrisome incongruities in its database that it corrected. Between main structures, additions, and improvements, the county added or corrected nearly 8,000 residential, 4,000 agricultural, and 500 commercial records. In reviewing these records, the county discovered almost 9,000 new improvements and 3,000 new additions.

"Seeing the building data and polygons overlaid on imagery helped us see things that our generic CAMA sketches didn't show," said Gregorich. This new information resulted in a nearly $24 million increase in market valuation resulting in additional tax revenue. The office has also experienced tremendous time savings with the new system. In 2008, the first phase of the appraisal process took a full year to complete compared to just seven months for the same process in 2014—a 42 percent improvement. The office also significantly cut map and property card printing costs.

"The 2008 reappraisal process generated at least two paper copies *[each]* for approximately 59,000 parcels, while in 2014, hard copies were nearly eliminated for residential and agricultural parcels," said Gregorich. "We also cut our temporary staffing budget in half compared to 2008."

Solution Shared

By providing appraisers with an ordered list of on-site assignments and desktop review capabilities, the appraisal staff spent less time in the field, so the paperless solution saved fuel as well as trees. The solution was so successful and adaptable to most county reappraisal workflows that BHA developed PRS into a commercial off-the-shelf solution for all small governments to download and use. It's currently available at ArcGIS Marketplace.

Underwood's initial goal wasn't saving money but increasing efficiency and accuracy to better serve the county's property owners. Between a shortened time line, reduced workforce, and lower mileage, the improvements in the reappraisal process from PRS far exceeded what the county had expected.

Story Map Journal App Tells Penny Tax Story

By Carla Wheeler, Esri Writer

Rather than rely solely on pamphlets and PDFs to inform the citizens of Leon County, Florida, about the projects a proposed penny sales tax would support, the county decided to use the Esri Story Map Journal app.

In advance of the November 4, 2014, referendum on extending a one-cent local government infrastructure sales tax for 20 years, Leon County launched Penny Sales Tax Extension at leonpenny.org, an interactive Esri Story Map Journal app. County staffers felt that a vote on such an important issue demanded lively, interesting educational materials for the public to review before they voted.

Esri's Journal app uses a mix of multimedia—maps, narrative text, video, images, pop-ups, and—in some cases, music—to tell a story. Although the app is popular for topics about history, travel, and conservation, the team from Leon County decided the mapping app was a perfect fit for answering the taxing question, How will the money be used?

"The map tells an engaging story," said Vincent S. Long, Leon County administrator. "We wanted a way to communicate not only the nuts and bolts of each penny sales tax project but also tell the story of how this extension would shape our community for generations to come."

A User-Friendly Mapping App

The mapping app's left panel displays text and images that summarize and illustrate the 29 infrastructure improvement and economic development projects in Leon County that would be paid for with the penny tax. These projects include street and sidewalk improvements, new bike lanes, revamped bus stops, county fairgrounds beautification, and added park and green space.

As users of this map app scroll down to each new section, a map on the right displays icons that show the general location of each individual project. Clicking an icon brings up a pop-up with a short description of the project and a related image such as a photo or artist's rendering.

The user can click for more information on this project link in either the story or map to obtain estimated project costs, a PDF with a more detailed map, and a form to fill out to connect with Leon County staff.

Cristina Paredes, the county's Intergovernmental Affairs and Special Projects coordinator, said voters are fans of leonpenny.org and its interactive map, whether or not they support the penny tax. They love the interactive map and being able to see where the projects are located. The interactive map, which has garnered thousands of views, is a more compelling way to present information than a simple document such as a PDF, according to Paredes.

Mathieu Cavell, public information specialist, said Leon County thinks outside the box to get people engaged in civic affairs. "Old, stale government reports are not the way to relate to people," he said. "The story map is appealing, accessible, and actually pretty fun."

The story map also emphasizes the geographic diversity of the projects in 702-square-mile Leon County by showing that these projects are distributed all over the county so everyone will benefit.

The App of Choice

Creating the interactive map was a collaborative effort by Tallahassee-Leon County GIS, Community and Media Relations, DesignWorks, and the Leon County planning department's urban design team.

GIS systems integration specialist Ned Cake said the original plan was to display the projects using Esri's Story Map Tour app or a custom version of a story map with tabs. However when Leon County GIS manager Scott Weisman saw Esri president Jack Dangermond introduce the Story Map Journal app at this year's Esri User Conference, Weisman was sold on the app.

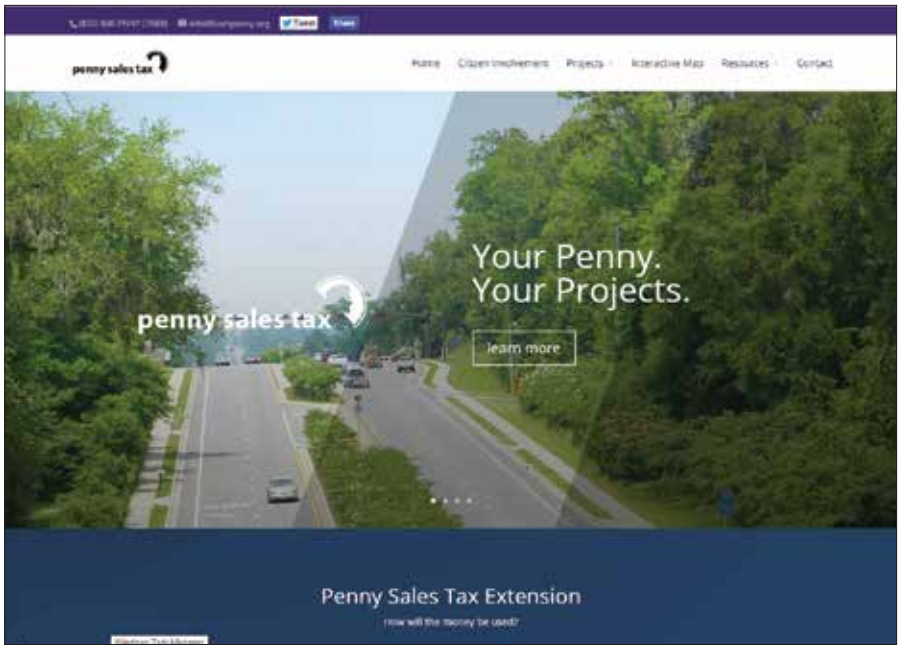
Cake used Leon County's ArcGIS Online organization subscription to launch Map Journal Builder and create a skeleton app. He loaded the Esri World Topographic basemap into the app, along with narrative text and photos and other images provided by Cavell's office.

He created a web map with editable features, and Community and Media Relations began populating the map with points. Cake worked with an intern to develop the pop-ups. DesignWorks created colorful custom icons for the map that matched the colors of the section headlines in the narrative panel. "It's almost a work of art. We love it," Cavell said.

The app was not only created and launched using ArcGIS Online, but the app runs on it, too, so it is a 100 percent cloud solution.

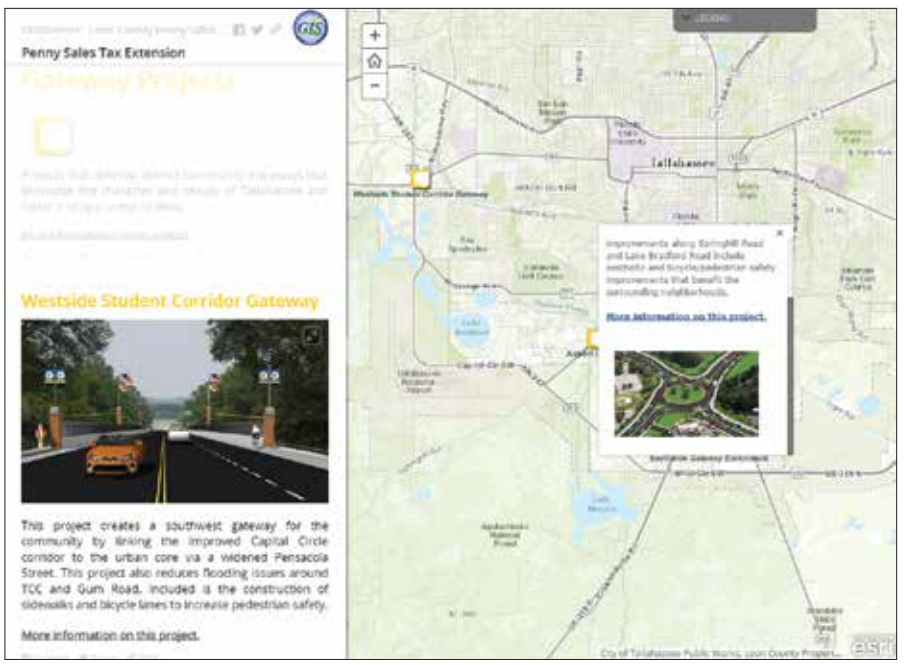
For Leon County staff, it was important to showcase the results of two and a half years of work by the Leon County Sales Tax Committee and thousands of residents who offered their input about the penny tax projects. (The referendum passed on Nov. 4, 2014.)

"We wanted to impress upon the viewer that a lot of thought and energy went into each infrastructure or economic development project," Cavell said. "The story map application represented the perfect blend of narrative and analytics."



↑ The Story Map Journal App Penny Sales Tax Extension is a central part of the user-friendly website leonpenny.org.

↑ The mapping app summarizes and locates the 29 projects in Leon County that would be paid for with the penny tax.



↑ The user can click project links to get estimated project costs, a PDF with a more detailed map, and a form to fill out to connect with Leon County staff.

Weeding Out Invasive Grass and Data Errors

An invasive nonnative species of grass that was threatening to push out native flora and fauna living in hundreds of acres of salt marsh in the bays surrounding San Francisco, California, has been knocked back using a one-two combination of ArcPad and ArcGIS Data Reviewer.

Spartina alterniflora, a species of cordgrass native to the East Coast, was intentionally introduced in the 1970s in an attempt to restore marsh habit in the bay. This species of cordgrass is genetically similar to the native variety. When it bred with the native cordgrass, the hybrid produced spread much faster, thrived in a wider ecological range, and grew more densely than the native variety.

Spartina alterniflora and its hybridized forms have blanketed shores along the south and central portions of San Francisco Bay and its estuaries. As it spreads, it edges out the slower-growing native variety as well as other indigenous plants, spoiling the habitat for dozens of native and endangered species.

Conservationists working to eradicate the robust hybrid form of *Spartina alterniflora*, have used ArcGIS successfully for a decade to gradually gain ground against the invader. They recently added ArcGIS Data Reviewer, an extension to ArcGIS for Desktop and ArcGIS for Server, to their geospatial arsenal and believe it will play a key role in their continued success even as operating budgets shrink.

The San Francisco Estuary Invasive Spartina Project (ISP) was launched in 2000 by the California State Coastal Conservancy in response to the threat posed not only to coastal ecosystems but also to surrounding flood control and mosquito abatement efforts.

Before the "hybrid swarm," as it is called, could irreversibly tip the balance of the salt marsh ecosystems, ISP began its tracking and eradication program. Herbicide is selectively sprayed to eliminate hybrids. Initially, it could be sprayed using helicopters, airboats, and tanker trucks with long hoses. Increasingly, backpack sprayers are required to reach isolated or remote stands. The herbicide is only effective during the May to November growing season.

In some locations, the endangered California clapper rail (recently renamed the Ridgeway Rail) has taken to the taller and denser invasive species for cover from predators, so eradication is restricted in these areas. Also, without DNA testing, which may take weeks or months, the immature hybrid is hard to distinguish from the native variety.

From a peak coverage of more than 800 acres in 2005, the nonnative variety was reduced to 38.4 net acres by 2013. The entire operation, directed with GIS, is shifting its focus—and budget—to revegetation. However, the process of identifying and eliminating the remaining infestation remains central to the project. Accurate data provides the foundation for this work.

"From a project management point of view, bad data quality could result in unnecessary expense treating misidentified *Spartina*; inaccurate reporting of progress toward eradication; or just scientifically questionable data, which would cause a deterioration of trust in and support for the project," said Peggy Olofson, the ISP project director.

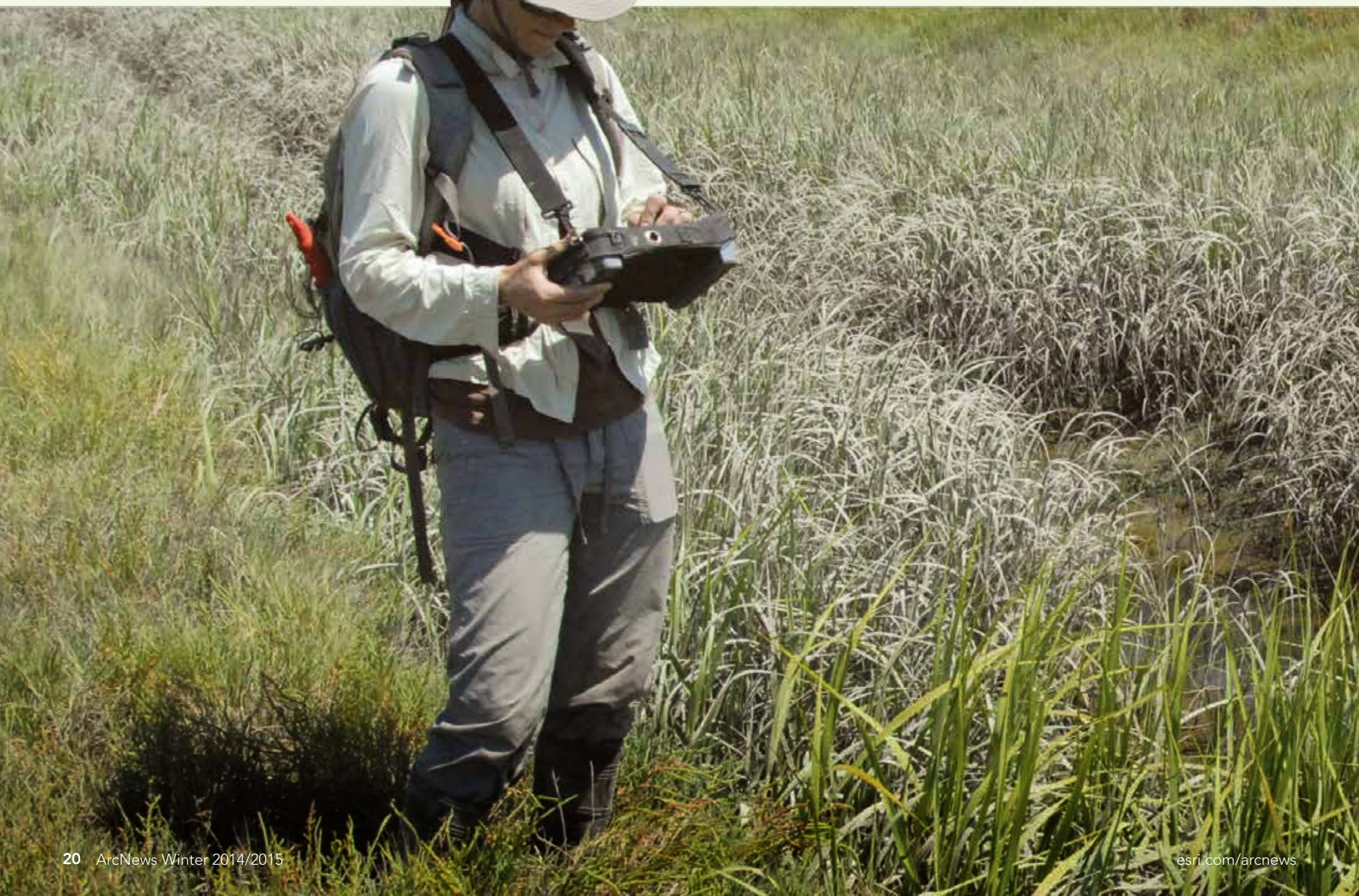
Field teams painstakingly gather that data, said Ingrid Hogle, GIS manager for ISP. The 15 staff members create 30,000 records per year or an average of 2,000 records per staff member. Field teams had to visually double-check each feature collected and indicate that they had checked it.

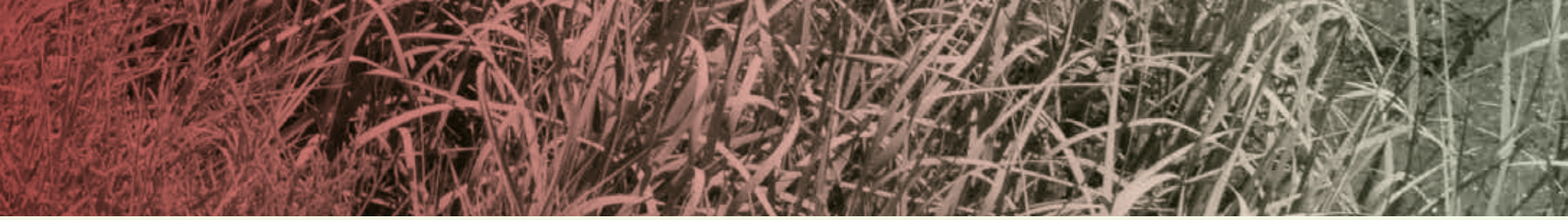
Much of the quality assessment work on those records had to be postponed until after the busy field season. The long interval between recording and checking made it difficult to recall specific issues related to the data.

Among the ISP's top concerns related to data quality were

- Missing data (either feature or attribute data)
- Mistakes in domain attributes
- Spelling mistakes in the comments field
- Different surveyors mapping the same area
- Duplicate check-ins of data (still possible

↓ A field-worker for the San Francisco Estuary Invasive Spartina Project (ISP) using ArcPad to carefully document the position of a patch of an invasive grass species.





now but less likely because ArcPad Exchange Formt (AXF) checkouts are used in ArcPad).

- Logically inconsistent attributes (i.e., attributes that make no sense, given other attributes for that feature)
- Misplaced decimal points and other data entry errors in critical patch size values
- Bad offsets that result in errors such as placing an invasive marsh plant in a parking lot
- Tangled vertices

Using Data Reviewer, Hogle has automated many checks so they can be done closer to collection times. As a result, data checking is faster and teams still tasked with eradication can spend more time in the field. With ArcGIS Data Reviewer, Hogle said the time needed to quality-check data should be reduced by 75 percent.

With Data Reviewer, she can set up and validate rules specific to individual datasets. For the varied tasks the ISP faces, that level of configuration is important. For example, Hogle can identify and delete duplicate features as soon as the staff member handling check-ins alerts her. Handling that step quickly can prevent edits from being made to each duplicate entry that would require time to identify and reconcile.

ISP field staff use ArcPad to collect data and sync it to the ISP geodatabase. For each DNA sample, a point feature class is collected. In addition, staff are required to log a second feature near the patch where the sample was found. If entered correctly, each point would have just one patch associated with it.

Data Reviewer will flag all entries with more than one patch. It will also tell Hogle if the patch data collected in the field is not where it should be, which could also be a sign of bad data. Without such a check, incorrect DNA data can enter the database and lead to treatment of desirable plants and missed treatment of the invasive plants. Moreover, it can also lead to misidentification in future years based on the incorrect data and could lead to inaccurate categorization of the hybrid's site-specific characteristics.

"We have had to throw out data when a field biologist makes a mistake in labeling by using the same sample code for two different samples, for example. And in the past, I spent many hours trying to unravel such mysteries," Hogle said. The combined features of ArcPad and Data Reviewer have resolved that scenario, she explained.

Data Reviewer has also helped Hogle administer the process for fixing data errors. After she runs Data Reviewer, it generates a sorted list of errors that she can prioritize. She can delegate simple issues to non-GIS staff freeing her and her GIS team to tackle any critical issues first.

"There are only so many hours in a day to fix data issues before tomorrow's fieldwork," Hogle said. "I'm a really big fan of Data Reviewer."

A longtime Esri user, Hogle discovered Data Reviewer in her search for technology that would help ISP apply as much of its resources in the field as it could. She now hopes to integrate even more of the ArcGIS platform into her work.

For more information, contact Ingrid Hogle, Invasive Spartina Project at 510-536-4782, ext. 205 or ibhogle@spartina.org or Jay Cary, Data Reviewer manager, Esri Professional Services solutions team at 909-793-2853, ext. 4859 or jcary@esri.com.

"We have had to throw out data when a field biologist makes a mistake in labeling by using the same sample code for two different samples, for example. And in the past, I spent many hours trying to unravel such mysteries."

Ingrid Hogle
Invasive Spartina Project

A Geospatial Network for Latin America and the Caribbean

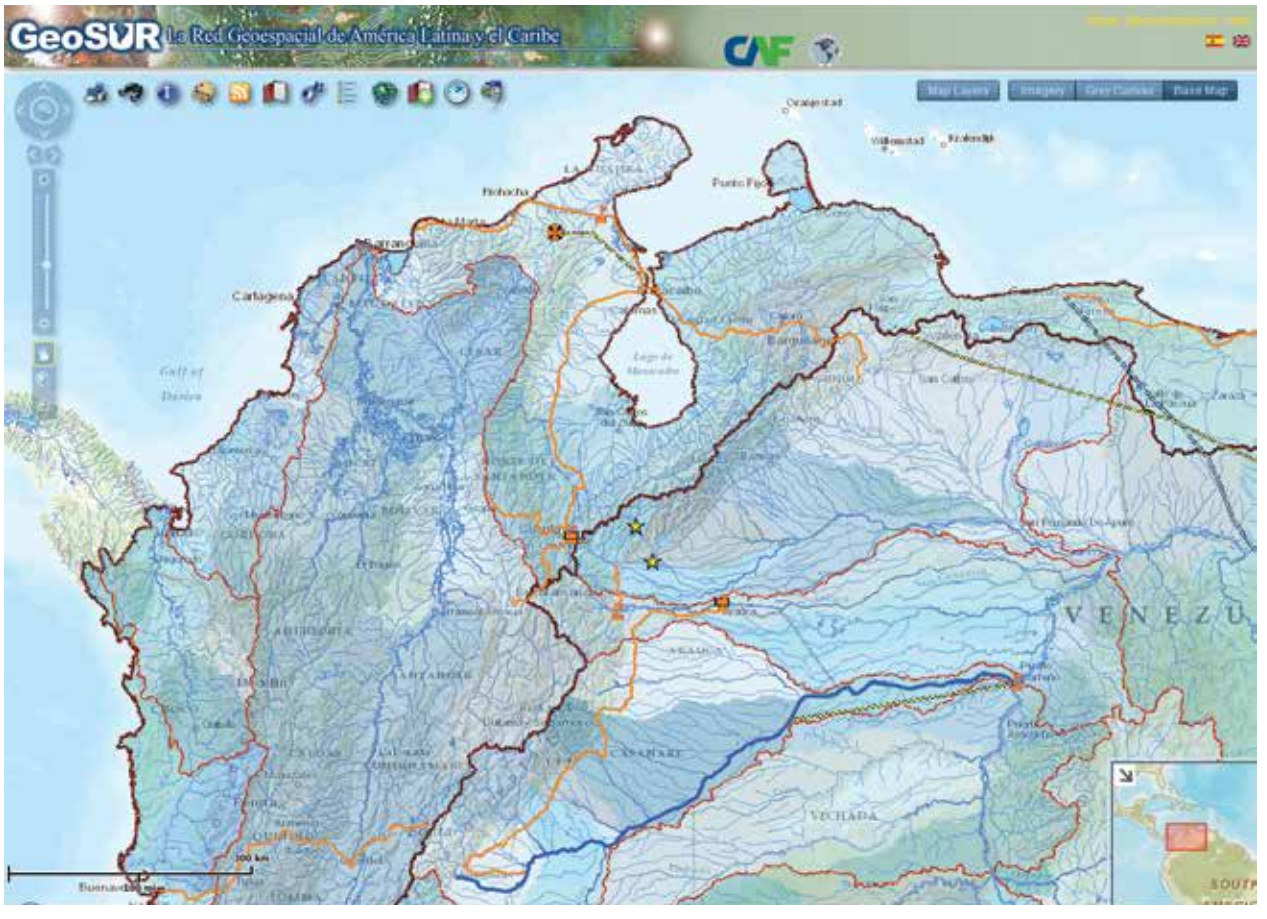
The development of a regional spatial data infrastructure (SDI) is helping countries in Latin America and the Caribbean address issues such as an increasing population, environmental degradation, climate change, and biodiversity loss as well as responding to floods, earthquakes, and tsunamis.

The spatial data needed to respond to these threats is typically produced and managed on the national level. The great challenge now is to transcend national boundaries and promote collaborative efforts to produce, manage, and integrate data at the regional and global levels.

A few initiatives have gone beyond the national level: Eurogeographics and Infrastructure for Spatial Information in Europe (INSPIRE), and GeoSUR in Latin America and the Caribbean (LAC). These initiatives have been instrumental in making regional geoinformation available as geoservices that provide accurate and timely information for decision makers.

GeoSUR was set up by CAF Development Bank of Latin America, and the Pan American Institute of Geography and History (PAIGH) in 2007 to help the region make sense of its territory and view it from a regional perspective. A network of more than 100 spatial data providers from 26 countries participate in GeoSUR. They have put tens of thousands of maps and other GIS resources on the web, making them available via easy-to-use applications.

The deployment of GeoSUR has been a real challenge, given the size and diversity of the region it serves. LAC encompasses 33 countries, 588 million inhabitants living in an area that covers approximately 7.8 million square miles. An area this vast requires the use of digital spatial information available to the public online so forests, coral reefs, infrastructure, soils, and agricultural resources can be monitored.



↑ GeoSUR opens up GIS resources so they can be used to make better decisions and conserve resources in Latin America and the Caribbean.

"There is a need in LAC to open up GIS resources for the benefit of our community, as many decisions taken today don't leverage geospatial data, which often results in poor decisions and a waste of resources," said Antonio Juan Sosa, vice president of infrastructure for the CAF. "Much of this information is available today, but it is not within the reach of decision makers."

GeoSUR has developed four main components: a regional geoportal, a decentralized network of map services, a regional topographic processing service, and a regional map service. It also furnishes geoprocessing tools for hydro power assessment and flood mapping. The portal features more than 300 Open Geospatial Consortium, Inc. (OGC) compliant services, 14,000 harvested metadata records, 220,000 searchable metadata records, and 110 map viewers. GeoSUR relies on a decentralized system architecture that keeps data close to its producers.

The regional components of GeoSUR leverage Esri Geoportal Server for the regional geoportal, ArcGIS for Server for the regional viewer and regional topographic processing service, and ArcGIS Online for the lightweight version of the regional geoportal. Esri technology was selected because it provides a reliable and robust foundation for building a cradle of regional geoservices. All services were built with support from and are operated by the US Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center.

The GeoSUR Viewer maintains what is today the biggest collection of online supranational maps of LAC with key holdings of GIS resources in topics such as coral reefs, urban expansion, mangroves, land-use cover, land-cover change, deforestation, habitat loss, forest biomass, climate, hydropower potential, mineral resources, floods, river flow estimations, and infrastructure projects. More than 700 regional datasets produced by 30 international agencies are now available through this mechanism, and some of this information can't be found online elsewhere.

Users in the LAC region are putting this information to good use. In February 2014, the floods experienced by the Beni province of Bolivia were the most deadly ever recorded in the region. Typically flood maps would have been generated after the event and would not have been particularly useful for emergency response. However, GeoSUR was able to offer near real-time flood maps of the area, courtesy of its recent collaboration with the Dartmouth Flood Observatory (DFO) of the University of Colorado. Using this information, Bolivian authorities were able to correctly assess the extent of the areas affected, evaluate the negative impacts to environmental and agricultural resources, and establish which towns needed immediate emergency support.

GeoSUR is making data available about LAC near real-time as well as historic flood maps and daily estimates of river flow that are obtained using remote-sensing techniques. The new system can monitor other water-related conditions such as the level of reservoirs and unusual river flow in addition to flooding.

A recent survey of GeoSUR users shows that 22 percent have used GeoSUR's online tools for decision making. Reported uses include river mapping, modeling landslides and flooding events, mapping slope for agricultural use suitability, emergency relief efforts, watershed analysis, road planning, ecological planning; analysis of school accessibility, expansion of protected areas, impact of new infrastructure, vulnerability to climate change; environmental monitoring in the Andean Amazon region, land-use scenarios; and viewshed analysis for cellular companies.

GeoSUR continues to expand into new fields including GIS-based hydropower assessments that allow governments to identify the best locations for building small and medium hydropower plants. These assessments use hydrological and climate data with Shuttle Radar Topography Mission (SRTM) 30-meter digital elevation model (DEM) data that has been edited and improved by the USGS for GeoSUR.

Studies have been completed (or are under way) in Brazil, Peru, Argentina, and Bolivia. In Brazil, the São Paulo Energy Secretariat is using the data to promote the incorporation of small and medium hydropower producers into the energy grid. In Peru, authorities are identifying key watersheds that could potentially be sites for developing large hydropower plants that would meet the country's growing energy needs.

GeoSUR also supports efforts to harmonize and integrate regional datasets. In collaboration with the USGS, PAIGH, and the geographic institutes of Central America, GeoSUR assisted in the development of the first Regional Central American Map at a 1:250,000 scale, which is now available in the GeoSUR Viewer. The project developed methodologies that could be applied to the creation of an integrated Latin American map.

GeoSUR partners face technical limitations for building geoservices, such as limited bandwidth, expensive and difficult to replace hardware, lack of scalability, information security issues, and a limited number of information and communication techology specialists.

With support from Esri, GeoSUR is helping partners overcome these limitations and migrate their data and services to the cloud. The Geographic Institute of El Salvador was the first mapping agency in LAC to operate a service in the Amazon Cloud using ArcGIS for Server. GeoSUR is helping 10 other partners move to the cloud.

These examples show how a regional SDI, such as GeoSUR, can build geoservices and applications with real social benefits. To prosper, national SDIs need to build useful applications with tangible benefits and clear outcomes, lest they remain intellectual exercises and end up losing political support or fall out of favor with the public.

"GeoSUR has brought GIS resources much closer to the decision maker and the public, and it can provide a model for building regional SDIs in other areas of the world," said Rodrigo Barriga, secretary general for PAIGH.

In 2010, GeoSUR received the Esri Special Achievement in GIS award, and in 2012 received the Esri Venezuela North American Serials Interest Group award, and the Esri President's Award.

For more information on GeoSUR, contact Eric van Praag at 58-212-209-6554 (Venezuela) or evanpraag@caf.com.

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Constant Pavement Monitoring without Disrupting Traffic

By Salar Shahini Shamsabadi, Ming Wang, and Ralf Birken, Northeastern University, Boston, Massachusetts

A new pavement condition monitoring system that incorporates GIS provides a simple, inexpensive way to detect surface and subsurface roadway defects. The Versatile Onboard Traffic Embedded Roaming Sensors (VOTERS) project enables continuous network-wide monitoring of roadways without setting up hazardous work zones and provides up-to-date pavement condition information to decision makers.

Road defects must be identified. Traditionally, this has been done by conducting road inspections, which are disruptive to traffic flow. They involve road closures and cause congestion in work zones. In addition to wasting time, the stop-and-go traffic that inspections produce cause excessive air pollution.

It is neither efficient nor feasible to carry out surveys frequently, so road survey information becomes quickly outdated, which renders maintenance schedules ineffective. When a city finally discovers there is a problem with a road, it's already too late.

There is a smarter way to do inspections. By outfitting vehicles with inexpensive, autonomous sensors that are capable of assessing road conditions, information on road defects such as cracks and potholes can be collected as those vehicles are driven. The VOTERS project has developed a framework and working prototype based on this concept.

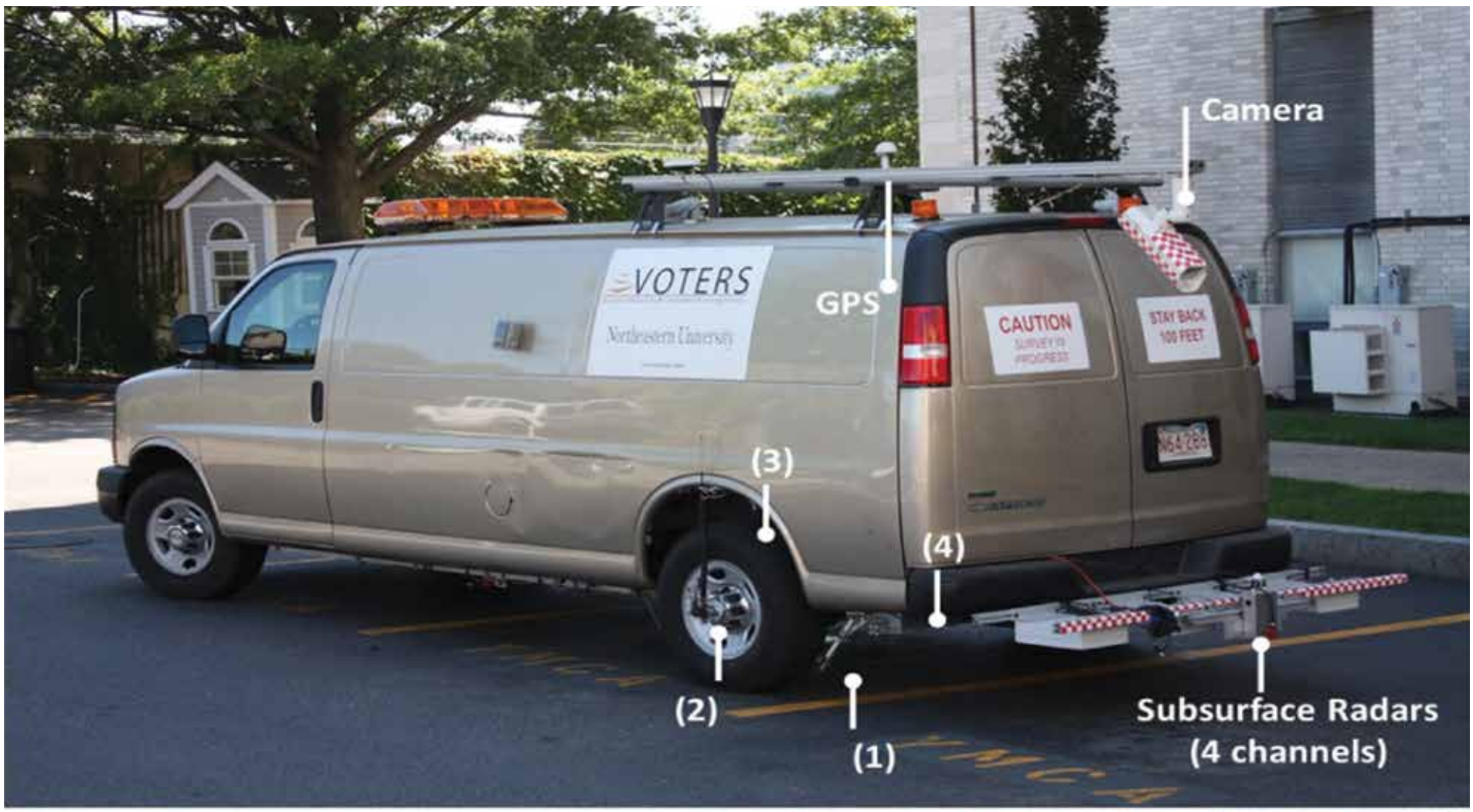
The VOTERS approach was born when Dr. Ming Wang, a professor of environmental and civil engineering at Northeastern University, heard a loud noise as he drove over a pothole. He realized that the sound tires make while interacting with the road can indicate how rough the road is. The National Institute for Standards and Technology (NIST) granted Wang and his team $18 million to further explore this idea. After five years of intensive studies and experimentation involving more than 40 graduate students, professional engineers, and faculty members, VOTERS has become more than an idea.

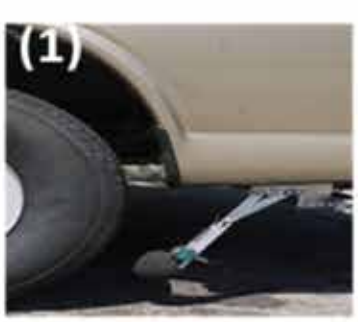
The VOTERS system consists of multiple lightweight, inexpensive sensors that record three main modalities of acoustic, optical, and electromagnetic waves. When mounted on a vehicle, the system can scan more than 100 miles of road per day and identify existing and potential road distress.

As this vehicle drives over the road surface, a small sensor inside the tire monitors changes in tire pressure that indicate the roughness or bumpiness of the road. A carefully calibrated microphone detects sounds produced by objects on the road. A unique radar system scans the surface between the wheels to ensure no road defect has been missed by the acoustic sensors. A video camera installed on the back of the VOTERS vehicle captures pavement pictures and automatically assesses damaged areas.

With these sensors, VOTERS collects

↓ The VOTERS vehicle inspects the roadway for surface and subsurface defects as it drives.





Directional Microphone

Dynamic tire pressure sensor

Rear axle accelerometer

Surface radar array (5 sensors)

↓ PAVEMON supplies a color-coded overview of the roadway network's condition that can be queried by segment or user-defined area.

availability of Internet nearly everywhere, a web-based interface was used to enable global access. This was accomplished using ArcGIS for Server and the ArcGIS API for Flex. Using Esri technology, the VOTERS project team developed a pavement monitoring system called PAVEMON to accommodate and leverage VOTERS outputs for front-end users.

Each VOTERS survey generates more than 80,000 images and 200 GB of data. The processed information from each survey appears on PAVEMON in days rather than months at a fraction of the cost of methods traditionally used to document road inspection.

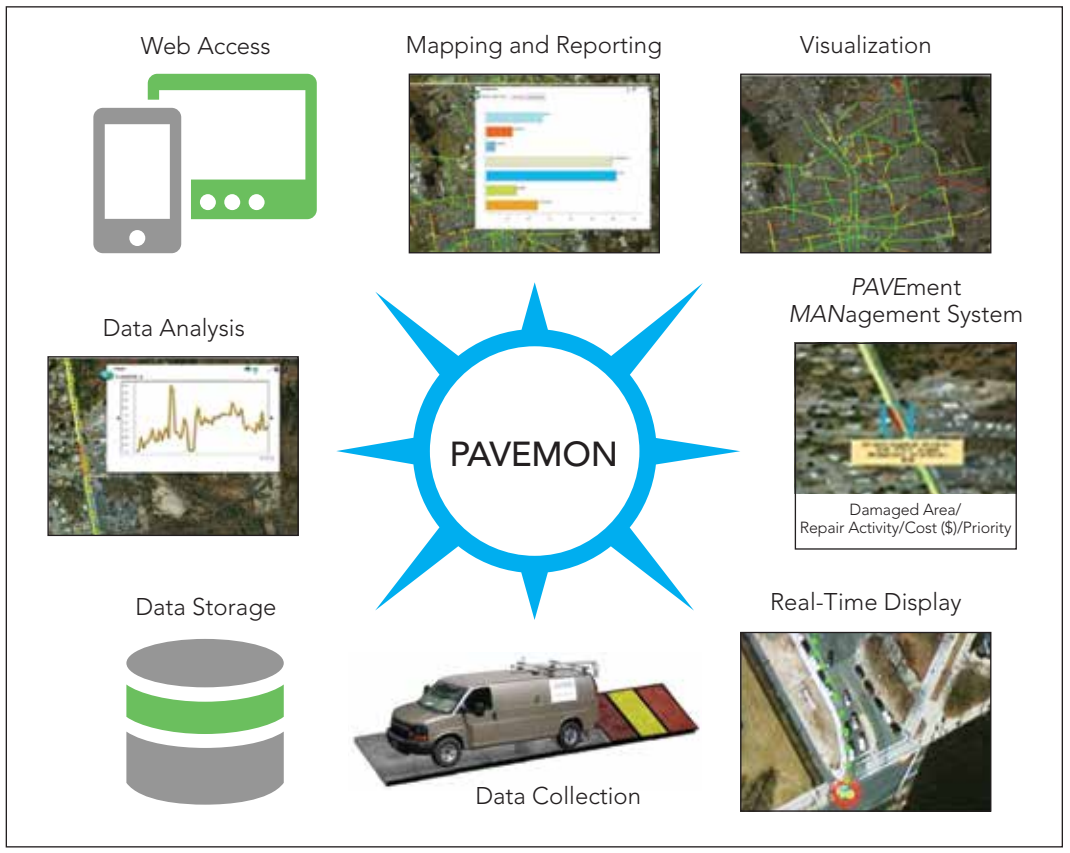
Users can perform different types of analyses through a web browser without installing any software. PAVEMON has custom toolboxes and interfaces that have been created using a combination of ActionScript and Python scripts. For example, the PAVEMON Pavement Management Module allows decision makers to do budget planning and maintenance scheduling from the numerous datasets managed by this application. Esri Tracking Server has even made PAVEMON capable of displaying the VOTERS vehicle in real time as it is collecting data.

It generates a color-coded map showing road conditions. Users can look at an image of specific roadway locations while querying for different road characteristics. Suggested repairs are generated by the system for a road segment or a user-defined area of the network.

VOTERS technology is an autonomous sensor package that not only maps surface defects but can also locate potential pavement failures before they occur. Using ArcGIS, five years of studying the use of VOTERS have been showcased using PAVEMON. The positive reception it has received is a reflection of the VOTERS team's hard work and Esri's well-developed platform.

The possibility that PAVEMON—a web map that allows municipalities as well as the public to see current roadway conditions—could become a global road condition app is intriguing. Cities would no longer need to close roads for inspections, because they would have more detailed information readily available.

For more information about the VOTERS project or the PAVEMON application, contact Salar Shahini Shamsabadi at shahini.s@husky.neu.edu.



↑ PAVEMON makes the results of inspection and analysis available through a web browser.

accurate and comprehensive data about the road surface. In addition, the VOTERS system locates areas with weak subsurfaces that will soon become potholes. This information could not be discerned by just inspecting the road surface. VOTERS gathers this information using various types of radar that can penetrate into the pavements and gauge the internal damage to sublayers. Positioning sensors is a crucial aspect of this mobile platform because it provides the location where each measurement was taken.

The data collected feeds into a workstation that determines the condition and any repairs required for each road segment. Since VOTERS measurements are closely tied to geography, ArcGIS has been an ideal test-bed for processing and mapping VOTERS results. Esri has provided all the functionality necessary to deal with processing and georeferencing this complicated, diverse, and large dataset.

Through the use of Python scripts with ArcGIS for Desktop, data can be automatically analyzed and georeferenced, a crucial requirement for VOTERS given the rate that the system collects data. Compatibility with different types of databases (Oracle in this case) means that large amounts of data can be processed simultaneously and efficiently—a very valuable capability when multiple data sources are involved.

A variety of users can benefit from the information VOTERS collects—from researchers and engineers to decision makers and infrastructure managers. With the current

↑ The conventional approach to road inspections is inefficient and disrupts traffic.

About the Authors

Salar Shahini Shamsabadi is a research assistant at Northeastern University in Boston, Massachusetts. Ming Wang is a distinguished professor at Northeastern University. Ralf Birken is a research assistant professor at Northeastern University.

Crossing Borders

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

Give Back—Become a GeoMentor

Do you remember the first time you got excited about geography or GIS?

Do you recall your first experience with geospatial technology and that key person who helped you along the way?

A single moment of discovery can open up an entire new world of thought and possibility. That first fascination with a subject—at any age—can be a life-changing experience and one that can lead to a lifelong passion and new career path.

Now you can help inspire a new generation of young geospatial technology users and innovators and yourself in the process by becoming a ConnectED GeoMentor.

Building the ConnectED GeoMentor Program

Esri and the Association of American Geographers (AAG) are working together to develop a nationwide GeoMentoring network of knowledgeable GIS users and educators to support the US government's ConnectED Initiative. This will maximize the benefits of Esri's remarkable donation of $1 billion in ArcGIS Online software to all K–12 schools in the United States.

The ConnectED Initiative, announced by the Obama administration in June 2013, is designed to enrich K–12 education by promoting Internet connectivity and use of educational technology. The introduction of GIS software and associated geographic concepts into classrooms will be an important component of the ConnectED Initiative.

AAG is building a diverse and talented network of GeoMentors by recruiting from its own membership and working with all interested organizations to reach the broader GIS user community including all disciplines engaged with GIS from the social to the physical sciences. Individuals across all sectors (public, private, academic, *[nongovernmental organizations]* NGOs) are invited to be part of this exciting opportunity to build student interest in and enthusiasm for the endless application of GIS.

The ConnectED GeoMentor program will be carefully managed and evaluated by Esri and AAG on an ongoing basis to ensure quality mentoring experiences for GeoMentors as well as K–12 teachers, schools, and school systems. AAG will help train GeoMentors to work effectively with teachers and facilitate linkages between qualified GeoMentors and teachers or schools based on needs, expertise, and interests.

Everyone involved—mentors, teachers, and students—can provide ongoing feedback and assessment about the program and their experiences to the AAG to aid in program development, evaluation, and improvement. In an effort to broadly engage the GIS user and education communities, the ConnectED GeoMentors program will pursue outreach and involvement of all interested organizations and individuals.

The GeoMentors program will also work with schools at multiple levels. This includes engaging individual educators in helping with ArcGIS Online curricular materials or GIS projects, assisting schools and teachers with existing ArcGIS Online access, and reaching out to interested schools without ArcGIS Online to facilitate their implementation of the free software and participation in the program. AAG will also provide materials on career options and career guidance to program participants and an array of educational and outreach resources.

Meeting the Needs of Teachers

Teachers are a resilient and dedicated group of individuals who often do more with less every day. While the gift of state-of-the-art technology is a wonderful asset, that asset can remain underutilized if proper resources and assistance for its integration into the classroom are not also provided to educators. Esri and AAG want to assure that ArcGIS Online software in K–12 schools is made as accessible, digestible, and useful as possible to teachers and students alike.

The ConnectED GeoMentor program is carefully structured to meet the goals of the ConnectED initiative and the needs of the K–12 schools and teachers involved. The program will integrate curriculum materials specifically designed to complement the classroom setting and be easily adopted into existing lesson plans. Schools and educators will need assistance with not only the use of GIS technology but also help in aligning it with state educational standards to meet those standards.

Role of GeoMentors

As a GeoMentor, you will have the opportunity to engage in a range of roles depending on your expertise and interests and the needs of schools and teachers. You can become involved in your local community schools or assist schools and educators located throughout the US via online resources and interactions.

Engagements between GeoMentors and educators (or schools) may range from advocating GIS technology adoption in a local high school to assistance with tailoring GIS activities for a specific subject and grade level. The variety of outreach opportunities is as diverse as the application potential of GIS itself.

As a GeoMentor, you will have access to online materials that illustrate effective strategies for GIS implementation in the classroom. GeoMentors will also be part of an online ConnectED GeoMentor community where you can learn from other volunteers as well as communicate with and learn from AAG or Esri program facilitators.

By serving as a GeoMentor, you will enrich the educational lives of students, teachers, and yourself. Further, you will be playing a pivotal role in improving GIS and geography education, and more broadly, science, technology, engineering, and math (STEM) education in the United States, one mentoring experience at a time. Visit www.GeoMentor.net for more information.

By Doug Richardson and Dr. Candice Luebbering, GeoMentoring Program Coordinator.

Learning More at the Czech Republic User Conference

By Jan Soucek, ARCDATA PRAHA, s.r.o.

Which stream in Peru forms the origin of the Amazon River?

What are the latest applications of GIS in hydrology?

What are the most current Esri GIS technologies?

Answers to these questions and more were provided to 850 users who attended at the 2014 Czech Republic User Conference, which was held on October 22–23, 2014, in Prague.

Esri conferences offer users the opportunity to explore the latest advancements in geospatial technology, exchange ideas with peers, and learn about the many ways GIS technology is being applied today.

GIS is now an important tool for researchers in an ever expanding number of disciplines. Speakers at this year's conference discussed their use of ArcGIS in exploring areas that ranged from archaeology to voter fraud.

Egyptologist Miroslav Barta talked about the ancient Egyptian empire. He discussed the influence of water on its social, economic, and religious practices and the reasons for the empire's collapse. Political scientist Tomáš Lebeda analyzed the potential for election fraud by examining invalid ballots. Jan Danhelka and Jakub Langhammer discussed the latest applications of GIS in hydrology.

↑ Technical talks gave attendees the latest information on Esri technology.

The Headwaters of the Amazon River

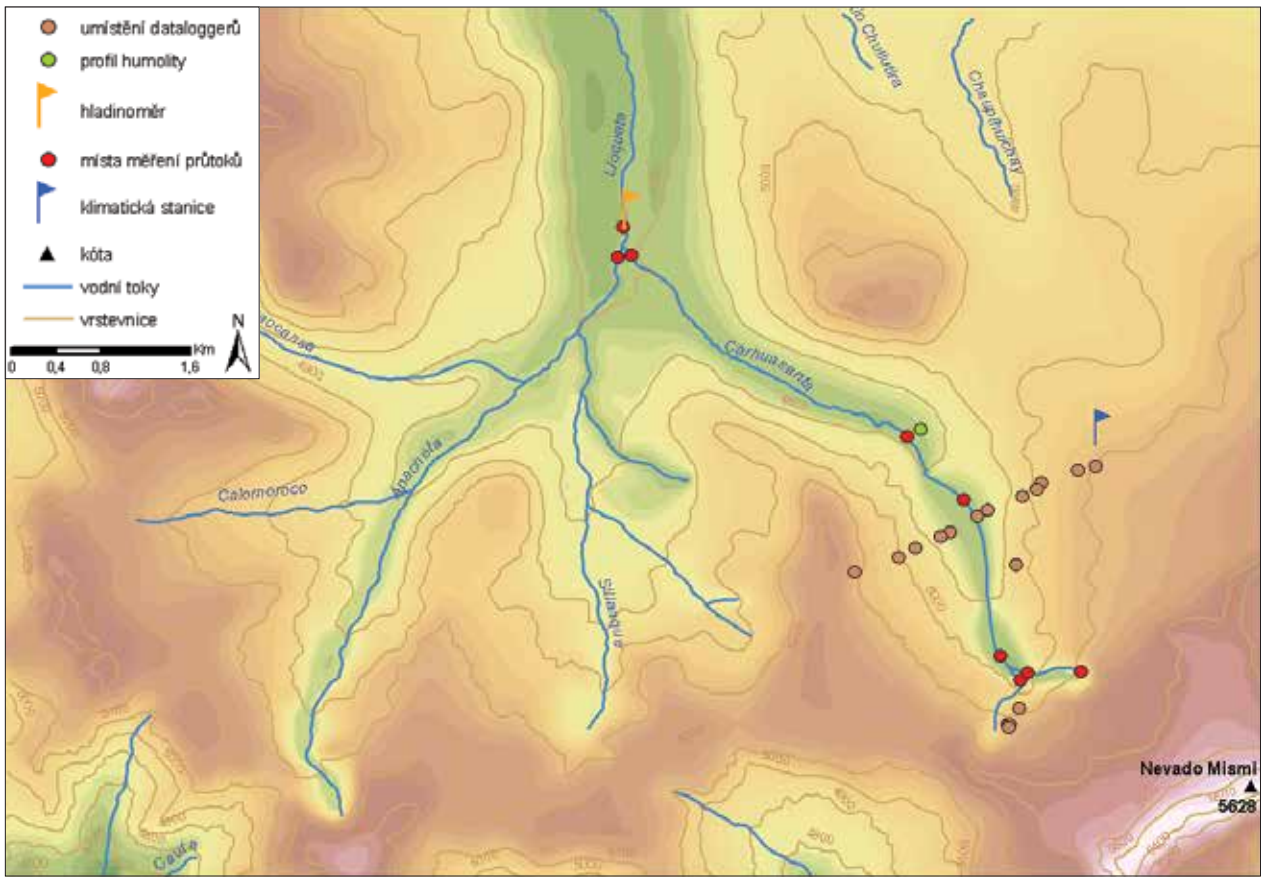
Dr. Bohumír Janský of the Charles University in Prague, who has dedicated his research to finding the true headwaters of the Amazon River, detailed how GIS was used in his studies in his Keynote Address.

More than 470 years have passed since Spanish explorer Francisco de Orellana returned from South America and disclosed the existence of the Amazon River to King Philip II of Spain. Because of its length and inaccessibility, speculation about the origin of the "Queen of Rivers" produced several hypotheses. The first was formulated in the 17th century by Jesuit Father Samuel Fritz, a Czech from Trutnov in Bohemia. He presented the first cartographic sketch of the Amazon River to the Viceroyalty of Peru, a Spanish colonial administrative district. This sketch showed the Lauricocha Lagoon in the Central Cordillera of the Peruvian Andes as the source of the river, a conclusion that was accepted until the 1930s.

During the past 80 years, scientists and explorers, equipped with sophisticated instruments and detailed cartographic information, have determined that the source area of the Amazon lies in the mountains of Cordillera Chila in the southern Peruvian Andes. However, opinions have differed as to the exact location of its source.

Janský's plenary presentation detailed the results of his rigorous scientific work to definitively establish the location of the Amazon headwaters. For several years, he collected the most recent maps, aerial photographs, and satellite imagery of the river. He worked in the field with scientists and technicians from some of the leading research institutions in Peru including National Geographic Institute; Geological, Mining and Steel Institute; National Meteorological and Hydrological Service; National Service for Air Photography; National St. Marcos University; and National St. Augustine University in Arequipa. Supporting measurements and data were obtained using highly accurate measuring devices to ensure superior quality and precision.

He concluded that the stream of Carhuasanta is the main source of the Apurímac River and subsequently the Amazon River. He also determined that the two source streams of the Amazon River emerge at the foot of the Nevado Mismi massif of the Cordillera de Chila in south Peru. His presentation reminded attendees that even today there is still the opportunity to make major discoveries through applied geographic technologies, allowing us to know our world that much better.



↑ Dr. Bohumír Janský of the Charles University in Prague described how he used GIS in his research locating the true headwaters of the Amazon River. This map shows the catchment area of Carhuasanta, the Amazon River's main source.

Advancing GIS and Geoinformatics

The conference also showcased Esri's latest technology. Jim McKinney, program manager for ArcGIS software development, who discussed ArcGIS Pro, a new application for ArcGIS for Desktop, in his Keynote Address and in a widely attended workshop.

User presentations showcased the use of ArcGIS in various industries including local government, utilities, facilities management, geology, natural conservation, and education.

The GIS Apps showcase featured the Czech Army's artillery application and apps by local municipalities such as a cemetery plot locator.

Copies of the *Atlas of the Czech Republic's 2011 Census* and the *Academic Atlas of Czech History* were available, and many attendees browsed through these notable cartographic publications.

Three 8-by-13-foot maps produced by the Geographical Service of Czech Army, T. G. Masaryk Water Research Institute, and the capital city of Prague were also popular.

Contributing to a Better World

The plenary talks, user presentations, and workshops assured conference attendees that geospatial technology can be applied in many ways to make the world a better, more sustainable place for ourselves and the generations to come.

GIS Executives Meet to Address the Caribbean's Geospatial Challenges

By Cecille Blake, Jamaica, and Valrie Grant, GeoTechVision

Managing GIS

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

URISA
The Association For GIS Professionals
www.URISA.org

At the Third High Level Geospatial Information Management Forum, held in October 2014 during the 7th URISA Caribbean GIS Conference at the Santa Barbara Resort in Curaçao, senior personnel from the public and private sectors and academia discussed strategies for addressing the geospatial information management challenges faced by Caribbean states.

Given their geography, the global economic crisis, and the increasing need to provide sustainable futures for their people, Caribbean states have recognized the importance of collecting, managing, and using geospatial information to make informed decisions to facilitate the management of their resources and support national development.

At a strategic visioning session during the 3rd Caribbean URISA GIS Conference in November 2006, 60 participants representing 15 countries agreed that to facilitate practical and efficient utilization of geotechnologies in a coordinated manner throughout the wider Caribbean, a number of barriers and issues must be addressed. The resolution they prepared addressed 10 areas of concern that included the need for a regional spatial data infrastructure (SDI) coordinating body, the importance of geotechnologies (including GIS, global navigation satellite systems, and remote sensing), the need for capacity building, and the development of SDI policy and legislation.

Focusing on SDI Development

Subsequent regional meetings on developing a regional SDI were held under the URISA Caribbean chapters umbrella. The decision to address 5 of the 10 issues considered relevant to SDI development in the Caribbean was made at the first high-level meeting.

The five challenges chosen were

- Creating a regional institutional framework for geospatial information management
- Capacity and capability building
- Accessing fundamental datasets and regulating the quality of spatial data
- Creating a common regional geodetic infrastructure
- Leveraging trends in information technology

Creating a Framework for Geospatial Information Management

Countries such as the Bahamas, Belize, Guyana, Jamaica, St. Lucia, and Trinidad and Tobago have taken serious steps in developing national SDIs. This indicates the potential that exists for developing a regional framework.

However, an appreciable amount of work will be required to obtain the support of the heads of government and private sector companies and lobby regional bodies such as the Caribbean Community Secretariat (CARICOM) to create an institutional body that possesses the supporting policies and framework that will facilitate the creation, management, and exchange of regional geospatial information.

Capacity and Capability Building

Education and training are integral components for improved geospatial information use and management in the region as well as increasing the pool of trained personnel, particularly in the areas of GIS database management and design, data analysis, GIS applications programming, remote sensing, project management, web mapping, and network administration.

Ensuring Access and Quality

Access to fundamental datasets and regulation of the quality of geospatial information are imperatives for informed decision making and sustainable development. Caribbean states are challenged by similar geospatial data management problems such as lack of data exchange policies; inaccessible or inaccurate spatial data; no metadata; few mechanisms for data discovery; and prohibitively expensive data acquisition costs.

Creating a Regional Geodetic Infrastructure

There is a need for a common regional reference frame aligned with global initiatives to support geospatial information management. There have been a number of attempts to establish a regional datum. By working in collaboration with the United Nations Initiative on Global Geospatial Information Management (UN-GGIM) Americas and Sistema de Referencia Geocéntrico para las Américas (SIRGAS), a global datum will be adopted for the Caribbean.

Leveraging Trends in Information Technology

Information technology is constantly changing and encompasses a variety of platforms (mobile app, browser-based app, social media, cloud computing); sources (commercial off-the-shelf software or COTS, free and open source (FOSS) as well as digital cities, virtualization, and the use of big data. As these technologies develop, they extend the use of geospatial information and its benefits.

The application of expanding forms of information technology will be a great asset in the development of a regional infrastructure. Consequently, it is imperative that emphasis is placed on knowing what technologies exist and how they can be best applied to solve problems.

Results of the 2014 Meeting

The forums held in 2014 continued the discussions and reviewed the progress made from the Second Caribbean GIS High Level Meeting held in 2013. This meeting focused on capacity and capability building across the region. Strategies and action plans to address this challenge were identified.

Through the Ministries of Education and the Caribbean Examination Council, GIS will be formally introduced into geography and social sciences curricula at the secondary level, building on work already done in Jamaica. Jamaica's GIS in Schools Education Programme (GISSEP) will be used as a pilot program for other countries that will show the benefits of GIS to students.

Increased emphasis will also be given to GIS Day events across the region. Professionals in each country are encouraged to support the planning and staging of annual GIS Day activities to increase the exposure of more students and teachers to GIS and show them its benefits. The private sector was also asked to participate and expose students to GIS technology through open houses, mentorship programs, internships, and even by holding annual GIS camps (such as the ones currently held by a private sector company in collaboration with government agencies in Jamaica and Guyana).

The University of the West Indies (UWI) in St. Augustine, Trinidad, will take the lead in preparing a Caribbean journal that will be affiliated with the URISA Journal. This journal will provide a body of knowledge and an avenue for GIS professionals to share and learn from and about regional work, best practices, research, and achievements. The UWI will also examine additional avenues through which it can support continuing education for GIS technicians and professionals across the region.

The Value of a Regional SDI

The major benefits derived from creating a regional SDI include cooperation across member states that will minimize research and development investment, share best practices, and facilitate technology transfer to meet the demand for geospatial data at the regional, national, and global levels. This is especially important given the limited resources of these islands. With greater collaboration and integration of the objectives of national SDIs, a regional SDI can be created. GIS technology can bring these states, which are predominately islands, together.

From all indicators, the Caribbean GIS executives at the 2014 meeting are committed to overcoming existing challenges and ensuring that geospatial technologies are recognized as indispensable tools for solving the region's most enduring problems and building sustainable societies.

The Relevance of Cartography

A Cartographer's Perspective

A column by Georg Gartner
President of the International Cartographic Association

Is Cartography a Science?

As I understand it, a scientific discipline tries to gain new knowledge about particular areas of interest. In more practical terms, this means there must be questions in those areas that have not been answered. To find the answers, science develops and applies methods. Scientific disciplines differ in nature, but they have something in common—the attempt to gain knowledge.

So, is cartography a science? What are the areas of interest, the questions, and the methods used to shine light on those questions? What new knowledge does cartography seek to gain?

Before trying to answer these questions, it is important to agree on our understanding of cartography. If it is a discipline dealing with the question of how to make maps, then it relates more to a technology rather than a science. If it is a discipline dealing with the question of how to design maps, then it relates more to art than to science. But if we understand cartography as a discipline that tries to communicate spatial information efficiently, then it relates to science.

The communication of spatial information encompasses several areas of understanding: understanding humans and their context, needs, demands, and abilities; understanding the data, models, and algorithms of spatial information; and understanding how to communicate that spatial information to users efficiently by applying technologies, graphics, and methods of communication.

A couple of examples will illustrate these differences. If I draw a beautiful map, I am acting as an artist. If I program algorithms that allow the derivation of a map from a database, I am acting as a technologist. If I answer a question from a human user using a map, and I know how and why this is an efficient method, I am a scientific cartographer. This is cartography as a science.

The ability of maps and geographic information to connect and integrate datasets by the inherent geographic location and present the information in a user-friendly and understandable visual and tactual way is not only recognized as an intrinsic property of the map artifact but as a subject or research area. This leads to questions concerning why and in which ways maps communicate spatial information efficiently.

The International Cartographic Association (ICA), as an organization that is well-represented globally and internationally visible, has a special role as a promoter of the development of cartography and GIScience. Research and development at ICA aims to create theory and methods for cartography and geoinformation (GI) handling. By applying theories and methods in various fields, new tools can be created for cartographic and GI practice.

That is why ICA is running a research agenda that gives guidelines on actual and potential contributions to scientific research within cartography; documents current research activity in the field; suggests areas where more intensive or renewed effort is required; and discusses methods by which some of this research can be undertaken.

The scope of the agenda is wide, including both cartographic and GIScience issues, and addresses areas of interest described by these keywords: geographic information, metadata and SDIs, geospatial analysis and modeling, usability, geovisualization, map production, cartographic theory, and the history of cartography, education, and society. (To learn more about this agenda, visit icaci.org/research-agenda/introduction.)

This leads to a clear yes to the question, Is cartography a science? This conclusion is supported by the research agenda and the activities it reflects as well as the acceptance by the International Council for Science (ICSU) of ICA as a Full International Scientific Union Member at ICSU's 31st General Assembly.

ICSU (www.icsu.org) is an international nongovernmental organization devoted to international cooperation in the advancement of science. Its members are national scientific bodies and international scientific unions. It comprises 120 multidisciplinary National Scientific Members, representing 140 countries and 31 international, disciplinary scientific unions. It is, in a way, a very exclusive group of sciences. The good news for cartography is that, from now on, ICSU will have 32 International Scientific Union Members, and cartography—through ICA—will have a strong voice in the world of science.

The importance of cartography was also validated by a resolution made at the fourth session of the United Nations Committee of Experts on Global Geospatial Information Management in August 2014. The resolution reads as follows:

The committee endorses the International Map Year 2015–2016 as proposed by the International Cartographic Association as a valuable means to promote the importance of maps and geoinformation.

I see the adoption of this ICA initiative as more proof of the relevance of maps and cartography and the importance of research in this domain. The International Map Year (IMY) 2015–2016 (internationalmapyear.org) is a celebration to illustrate to the general public as well as decision makers the importance of making and using maps in a global context. IMY will be a joint effort by the ICA and the United Nations initiative of Global Geospatial Information Management (UN-GGIM). It will also be in line with the Rio+20 Agenda signed by the UN Secretary General. IMY will be formally launched at the ICA conference in Rio de Janeiro on August 23, 2015, and will continue until the end of 2016. Planning for national events associated with IMY will start in the beginning of 2015.

International Map Year 2015–2016 has four target groups: the general public, schoolchildren, professionals, and governments. Activities can include every action that is related to its aim of illustrating the use and creation of maps. The objectives of the resolution are to provide recognition by the United Nations and its member states of the importance of maps and geospatial information to society as well as encourage member states to further support making maps and geospatial information more accessible; better inform the general public of the availability of national maps and the use of maps and geospatial information; and provide recognition for the work of cartographic professionals and local governments.

You can help with these efforts by participating in the International Map Year 2015–2016. Document instances that illustrate the importance of making and using maps and share that information with ICA. Highlighting the importance of maps to decision makers and others will eventually lead to a better understanding and awareness of all geodomains, which will benefit all of us.

Check out www.icaci.org to find out more!

WE ♥ MAPS

INTERNATIONAL MAP YEAR 2015–2016

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 his habilitation from the Vienna University of Technology. He was awarded a Fulbright grant to the University of Nebraska at Omaha in 1997 and a research visiting fellowship to the Royal Melbourne Institute of Technology in 2000, to South China Normal University in 2006, and to the University of Nottingham in 2009. He is a 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 on Location Based Services* by Taylor & Francis. He serves as president of the International Cartographic Association.

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

ArcGIS Expresses Your Open Data

ArcGIS Open Data lets you quickly serve open data to communities and organizations through map-based websites. Below are some organizations that use their ArcGIS Online subscriptions to share open data for a variety of purposes.

South Suburban Mayors and Managers Association
ssmmaopendata.ssmma-gis.opendata.arcgis.com/
South Suburban Mayors and Managers Association (SSMMA) is an intergovernmental agency that provides technical assistance and joint services to 43 municipalities in Cook and Will counties, south of Chicago, Illinois. This open data site provides geospatial data related to transportation, economic development, housing, demographics, hydrology, and imagery.

Wake County Open Data
wakeopen.wake.opendata.arcgis.com/
Wake County Open Data provides open data for the entire county, which contains the city of Raleigh, the capital of North Carolina. It includes demographic, public safety, health, and other data for use in spreadsheets, geospatial analysis, and apps.

Halifax Open Data Catalogue
catalogue.hrm.opendata.arcgis.com/
The Halifax Open Data Catalogue provides citizens and businesses public with access to the city's datasets to improve citizen engagement and enhance transparency and accountability of the local government. The catalog provides data that is complete and accurate, frequently requested, and free of private information.

To submit your ArcGIS Open Data site address and view other websites powered by ArcGIS Open Data, visit opendata.arcgis.com.

Start-Up Businesses Develop Apps That Locate People

Find the latest GIS apps by Esri partners and distributors at Esri ArcGIS Marketplace (marketplace.arcgis.com).

Where Are the Voters?

Find them with Voter Gravity. During the 2014 midterm elections, candidates and campaign managers used Voter Gravity to locate potential voters and direct canvasing activities. Voter Gravity provided an extensive database of US voter information. In more than 35 states, campaign staff accessed data to tag and map potential voters by characteristics such as party, audience, and issue.

Canvasing coordinators quickly created up to 500 walk list maps at a time and published them as apps. Volunteers canvasing neighborhoods downloaded their assignments to their devices, turned on the map, and found the next prospect. The app included a script and a survey form. Coordinators adjusted assignment maps on the fly. The app sent information back to the Voter Gravity platform that published maps with survey results in real time. Voter Gravity kept survey information organized even during the frenzy of the final week's lead-up to Election Day.

↑ See voter information at the neighborhood level and manage canvasing activities.

Where Are the Shoppers?

Placemeter shows how space is used and by how many people. Using live video feed, it recognizes and reports vehicle and pedestrian street traffic, which can be used in GIS to analyze shopper behavior.

For example, a camera mounted on the third floor of a downtown Manhattan building focused on the retail store across a busy street in Times Square lets the store manager see if the store is effectively attracting people walking by its doors. The camera's live feed links to the Placemeter platform. In real time, Placemeter recognizes and labels each vehicle on the street as a truck, taxi, or van and shows its speed. It counts how many pedestrians pass by the store's display window and reports how many slowed down to look at the display window. Placemeter computes how many people go into the store, come out of the store, and how long they are inside. These metrics are displayed on a GIS map.

↑ Cameras at these sites link live video feed to Placemeter for analysis.

Placemeter uses Esri tools to create advanced analysis, define custom polygons, and aggregate statistics. It generates density information on a map to show how people move through the city throughout the day. An investor might use this information to see the traffic potential of a prospective location. Transportation departments can use Placemeter to determine which sections of road are most traveled by heavy trucks. Marketing researchers can use it to assess patterns and analyze customer behavior. Urban planners can ensure the safety of nighttime bicyclists and joggers by determining where more lighting might be needed on streets and paths.

Where Are the Workers?

Businesses use Sensimob to connect field teams with one another. The app combines text messaging, mapping, and data collection functionality on a secure platform. A field team's communication history, tracking information, and the data it collected can be visualized on a map. Tracking and communication history data layers can be combined with other data to make GIS-based decisions.

When Brazil conducted a national traffic inventory, the Department of Transportation used Sensimob to coordinate its field teams. The department assigned 2,000 workers to street corners around the country to count traffic. Managers used Sensimob to direct teams via text messaging and maps. On those maps, managers drew geofences around dangerous areas so an alert would be triggered if a worker crossed the boundary. A dashboard gave managers an overview of activities and helped ensure that workers were in their assigned areas. Using smartphones, workers could view their current location, assigned areas, and the location of nearby workers. They could communicate with other workers via text messaging supported on a secure platform.

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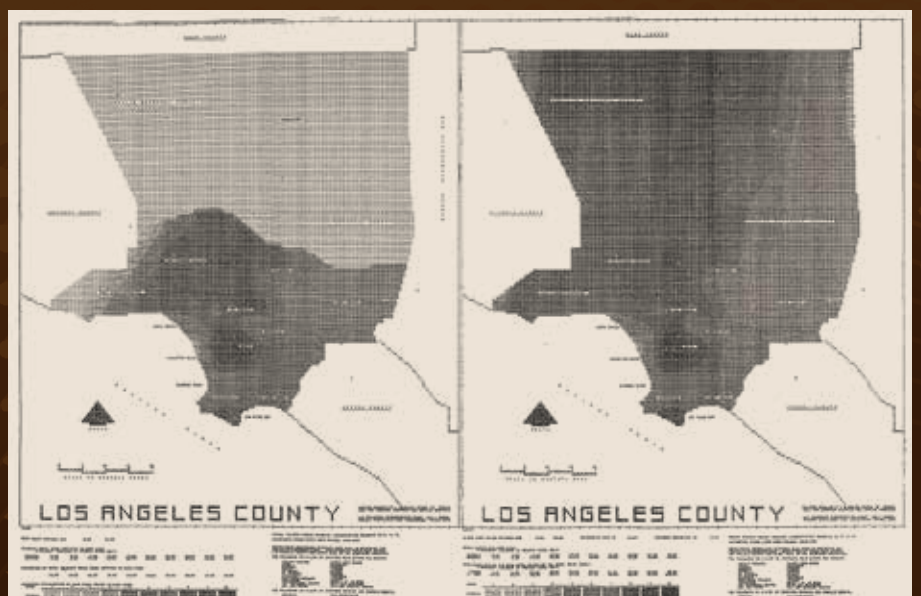
Celebrating the Advent of Digital Mapping

By Matthew W. Wilson, University of Kentucky



↑ Two maps created by Jack Dangermond when he was a graduate student at Harvard. These maps were made using SYMAP, and they demonstrate the effects of barriers when used in modeling the distribution of air pollution.

This year marks the 50th anniversary of the founding of the Laboratory for Computer Graphics (LCG) at Harvard University. A two-day commemoration is planned, April 30 to May 1, as part of the annual conference of the Center for Geographic Analysis at Harvard. This public event will bring together alumni of the lab, historical geographers, and contemporary scholars in geographic representation to reflect upon midcentury innovations in computer mapping and the implications of these developments for the field of GIScience and its related industries.

Undoubtedly, the story of Esri and ArcGIS partially began in the basement of Memorial Hall, just north of Harvard Yard. It is a story that was traced by Nick Chrisman in his 2006 Esri Press book *Charting the Unknown: How Computer Mapping at Harvard Became GIS*. LCG was founded in 1965 by the late Howard Fisher, a 1926 Harvard graduate who was then a lecturer at Northwestern University. Fisher was an architect who developed innovations in prefabricated housing and later consulted on veteran housing following World War II. However, his greatest interests were in creativity and problem solving, and that led him to computer mapping.

The establishment of the LCG within the Graduate School of Design (GSD) formalized geographic inquiry at Harvard University. Harvard had been without a geographer on its faculty since 1956, the year of Derwent Whittlesey's death. Indeed, the closure of the Institute of Geographical Exploration in 1951, following the demise of the subject and department of geography at Harvard in 1948, created a sizable void—and an eventual (if uneasy) opportunity for expansion.

The decision by Harvard president Jim Conant to remove the subject area from the curriculum sent waves through the discipline and remains central to the story of the development of geography on this continent in the 20th century. Seen in another light, Harvard's loss would see the establishment of a new and energized quantitative geography at public flagship universities.

Ed Ullman left the faculty as the Harvard department crumbled and joined the geography faculty at the University of Washington. He attracted a cohort of graduate students that would come to reshape the discipline. These students, including Brian Berry, Dick Morrill, Bill Bunge, and Waldo Tobler. He also worked with Bill Garrison (in geography) and Ed Horwood (in civil engineering). Horwood, alongside these research assistants, would develop software for the IBM 709 called CARD MAPPING.

Horwood took his software on a road show. In August 1963, he offered a short course at Northwestern University that Howard Fisher attended. Vexed by the graphic output of the Horwood method, Fisher worked with a programmer, Betty Benson, to create the synagraphic mapping system (SYMAP). In an internal memo, recalling these founding moments, Fisher wrote: "As to SYMAP there is no question that Ed's course led to its development—but as a form of rebellion against his so-called maps which were merely numbers printed on plain white paper."

As Fisher noted: "I am not a geographer and I was not a cartographer until perhaps that Saturday morning in 1963 when I invented the basic concepts upon which the SYMAP computer mapping program is based. Since that time, however, I have been engaged exclusively upon the problems of thematic map design."

Dean Sert of GSD hired Fisher away from Northwestern in 1964, and the SYMAP system came to roost in Cambridge, Massachusetts, in February 1965. With support from the GSD, Fisher founded LCG and put forward a proposal to the Ford Foundation in September 1965. Harvard was awarded $308,000 (translated into today's buying power, that would be approximately $2.3 million).

That sum came with a sizable goal as stated by Fisher: "To help raise the performance level of professional persons in city and regional planning and related fields through the more extensive and more sophisticated use of factual information—then as now increasingly made possible by the expanding field of computer science in combination with advanced statistical techniques, systems analysis, and similar analytical and decision-making procedures."

The directives of the Ford Foundation stipulated that the money was to be spent in its entirety by 1970. As director, Fisher began expanding the lab's staff. To do so, he reached out to Horwood, as well as his students and assistants. These included Waldo Tobler, Clark Rogers, and Brian Berry.

In addition to recruiting personnel, Fisher recommended the following sources of cutting-edge scholarship in quantitative spatial science: *Locational Analysis in Human Geography* (1965) by Peter Haggett, *Quantitative Geography* (1967) by Bill Garrison and Duane Marble, and *Elements of Cartography* (1960, 2nd edition) by Arthur Robinson, as well as works by Eduard Imhof, Armin Lobeck, and Gordon Dickinson.

Fisher supported hiring Allan H. Schmidt as assistant director of the Lab in March 1967. Schmidt had previously worked as assistant director of the Urban-Regional Research Institute at Michigan State University (MSU), which was designing a gaming instrument for planning. Schmidt was an advanced user of SYMAP, who had even authored a user's guide for MSU.

In 1966, 10 years after the death of Whittlesey, GSD appointed Bill Warntz as professor of theoretical geography. Warntz, who joined the lab and brought funding from the Office of Naval Research, eventually became its director in 1968. Warntz, a PhD in economics from the University of Pennsylvania, also brought a spatial analytic focus to the Lab, marked by the addition of *and Spatial Analysis* to the lab's name. Warntz would join a lab engaged in further development of computer mapping techniques including basic research on interpolation methods as redesigned by Donald Shepard, a freshman in Fisher's Harvard course on problem solving.

By 1967, the lab, now known as the Laboratory for Computer Graphics and Spatial Analysis (LCGSA), had enrolled over 500 participants worldwide in its SYMAP correspondence course—making SYMAP to the most widely known computer mapping program.

Students at GSD worked directly with SYMAP in their design projects. Carl Steinitz, who first met Fisher in 1965 while finishing his graduate fellowship at MIT, had joined the faculty at GSD and worked with SYMAP to understand development and conservation efforts on the Delmarva peninsula (Delaware-Maryland-Virginia).

↑ Howard Fisher founded the Laboratory for Computer Graphics (LCG) in 1965.

With these kinds of experiences in mind, Fisher encouraged a recent master in urban design graduate of the University of Minnesota, Jack Dangermond, to join the lab while pursuing a master of landscape architecture degree at GSD. Dangermond used SYMAP to study air pollution. He drew on those techniques after graduating in 1969 to found, with his wife Laura, a consulting firm called Environmental Systems Research Institute.

From SYMAP to the Polygon Overlay Information System (PIOS) and AUTOMAP at Esri, computer mapping emerged as an expression of an experimental and creative process. At a time when computer mapping is taken as an object of—rather than just the vehicle for—innovation, GIS practitioners may easily take this for granted. Instead, Howard Fisher's approach—not as a geographer or even as a cartographer—was to begin with "the problem as a problem," where our most trusted methods may actually disguise other ways of thinking about the solution.

While the lab would wax and wane with the selective interests of Harvard and GSD, the 50th anniversary conference this spring will serve to recall and elevate those most serendipitous yet serious discoveries in the advent of the digital map.

About the Author

Matthew W. Wilson

Department of Geography, University of Kentucky, Center for Geographic Analysis, Harvard University

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GIS Day Inspires Career Minded, Educates Newbies

GIS largely operates behind the scenes, daily coordinating and orienting our world. Like the 14 previous GIS Day celebrations, the 15th GIS Day celebration on November 19, 2014, gave educators and GIS professionals the opportunity to proudly lift the curtain on Esri technology and show it to a new audience. The day also serves another equally important purpose: to ignite the imagination of future geospatial innovators who'll move the world forward.

GISday

University of Idaho

Attendance was strong at the University of Idaho's GIS Day event, with student, faculty, and local GIS professionals from across the state participating in the day's events. Participants had the opportunity to attend presentations on everything from GIS assisting evapotranspiration investigation to GIS complementing unmanned aerial vehicle (UAV) technology. Other popular sessions included discussions of GIS career opportunities and geospatial initiatives rolled out across the state. The exhibit session bustled with activity for the better part of two hours.

"Our goal was to show the audience how we're all geospatially connected," said Bruce Godfrey, GIS librarian at the University of Idaho. "We had 15 different exhibit tables to demonstrate the variety of ways GIS impacts our lives."

↑ GIS Day at the University of Idaho featured presentations on how GIS extends GPS capabilities and assists earth science investigation.

University of Pittsburgh

The students at the University of Pittsburgh at Bradford in Pennsylvania celebrated GIS Day by demonstrating various applications of GIS in our daily lives. Everyday processes such as water utility management and transportation infrastructure oversight were illustrated in poster format to show how geospatial technology sustains the world in ways we sometimes take for granted.

"Our event stimulated interest in geospatial technologies among faculty, staff, students, and the general public," said Tami M. Wells, PhD, biological and health sciences physical and computational sciences adjunct faculty at the University of Pittsburgh at Bradford. "Students also met with administrators of the university to discuss GIS courses and labs they could register for to expand their future career opportunities."

Pakistan Geography Alumni Association

GIS is experiencing huge growth all over the world, particularly in Eurasia, where the demand for efficiency and sustainability is paramount as industry steadily grows there. The Pakistan Geography Alumni Association celebrated GIS Day with a two-day seminar to stimulate public interest and encourage new technical talent looking for a promising career. More than 15 organizations and institutes exhibited at the event, offering GIS information and showing how the technology affects the lives of Pakistanis and the world's citizens.

"GIS relates to so many aspects of *[our]* lives that many of us aren't even aware of," said Pir Mehr Ali Shaha, Arid Agriculture University of Rawalpindi. Vice Chancellor Dr. Rai Niaz Ahmad said, "Our GIS event aimed to show how the specific use of GIS in agriculture maintenance not only informs decision making in Pakistan but can actually bring prosperity if applied intelligently."

↑ The Pakistan Geography Alumni Association featured a panel discussion on the topic of expanding GIS in Pakistan to further agricultural progress.

GIS Day Open House

With the United States Department of Labor recently declaring geospatial technology as a burgeoning occupational area, today's youth are more excited than ever to learn about GIS. To guide the geospatially curious onto a promising career path, Esri president Jack Dangermond and David DiBiase, Esri education manager, hosted the GIS Day Open House at Esri's Redlands, California, headquarters. The Open House included user presentations, demonstrations of the ArcGIS platform by Esri staff, and a mentor center booth to give career advice to job seekers.

"We wanted to excite attendees about the potential for growth in this industry because there's obviously a huge need for more talent," said DiBiase. "We got more than we expected; before the end of the event, we'd already interviewed 10 candidates who we could easily hire right on the spot."

Thirteen years ago, Ralph Nader presented an idea to Dangermond: dedicate one day to show the world how geographic intelligence touches all our lives. The explosion of geospatial technology since then has grown that idea into a true global event, inspiring the next generation of GIS innovators while exposing the pervasiveness of geospatial technology.

Well-Traveled Esri T-shirts

Gwen Ford, a transportation GIS analyst for the High Point Metropolitan Organization, enjoying the view from the top of Moore's Knob (2,579 feet) in Hanging Rock State Park, Danbury, North Carolina, with her dog Mr. T. She and some friends visited a memorial to a mutual friend who passed away in July 2014 while hiking up the trail. The weather was perfect, and the views were amazing!

Dan Seidensticker, a GIS specialist for the Madison Area Transportation Planning Board, wearing an Esri T-shirt and cap, in Berchtesgaden, Germany, near the Austrian border. In the background, buried in clouds, is the Hoher Göll, the highest peak in the Göll mastiff and the site of Kehlsteinhaus or Eagle's Nest, a teahouse built at 2,300 feet for Adolf Hitler's 50th birthday.

Partner Offerings

Esri has relationships with more than 1,800 partners globally who provide customer-focused geoenabled solutions. These partners have extensive experience providing GIS solutions and services across Esri's core industries. Partner-provided solutions and services range from custom built applications to complete ArcGIS system implementations.

In this issue, partners that participated in the 2014 Esri User Conference (Esri UC) are recognized. These organizations have exhibited practical yet innovative applications of the latest features in ArcGIS and have taken geographic visualization and analysis to a higher level. To learn more about the Esri partners that participated in the Esri UC, look at the Esri partners and distributors at the 2014 Esri User Conference Story Map at 184.169.230.84/partofuc14/.

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

Urban Planning

SmarterBetterCities AG
www.SmarterBetterCities.ch
3D Visualization, SmartZoning PLUS, and CloudCities

Urban Planning presents a smart zoning tool that allows users to simplify numeric and regulatory complexities. Decision making is made easier by visualizing urban scenarios in 3D. The SmartZoning PLUS app and 3D Libraries are built on Esri CityEngine and ArcGIS Online and support the geodesign workflow. The CloudCities 3D platform allows users to easily share their 3D content on website blogs, social media, and mobile devices. Receiving feedback has never been easier and more dynamic.

Emergency Services

FireWhat, Inc.
www.firewhat.com

FireWhat Incorporated is an emergency services GIS technology company that maps emergency incidents and tracks assets in and out of the field. Its near real-time, detailed fire information data feeds have up-to-the-minute intel and can be migrated into any data management system or information product. FireWhat fire applications speed up the emergency response time through the use of ArcGIS Online, Collector for ArcGIS, and custom applications.

Natural Resources

Valarm Sensor and Remote Monitoring Solutions
www.valarm.net

Valarm is an open platform that facilitates rapid deployment of geotagged, real-time, mobile sensor networks. Valarm connects industry-standard sensors to its cloud systems or private networks, using readily available, standardized hardware, making extensive use of the ArcGIS platform including ArcGIS GeoEvent Extension for Server, ArcGIS Online, ArcGIS API for JavaScript, and Operations Dashboard for ArcGIS. Valarm-compatible connector hardware includes typical Android mobile devices and open hardware platforms from multiple vendors.

AmigoCloud
www.amigocloud.com

AmigoCloud is a mobile GIS solution provider. Esri users can collect, edit, visualize, and share geodatasets online and offline. AmigoCloud integrates seamlessly with ArcGIS Online, ArcGIS for Desktop, and ArcGIS for Server and supports more than 60 geospatial file formats. From any smartphone or tablet, start collecting all types of geodata (points, lines, polygons) and share this data in real time with members of your organization using the AmigoCloud full permission setting.

New Training and Certification Offerings from Esri

Training

Courses to Help You Go Pro

Designed to organize and streamline workflows and tasks and available with ArcGIS 10.3 for Desktop, ArcGIS Pro is sure to make life easier for many GIS professionals. Three courses are available to help you be productive with new capabilities in ArcGIS Pro:

- *Introduction to ArcGIS Pro for GIS Professionals* (instructor-led)
- *Getting Started with ArcGIS Pro* (web)
- *3D Visualization Using ArcGIS Pro* (web)

More web courses on ArcGIS Pro topics are in the works. View the latest courses by searching for "ArcGIS Pro" at esri.com/coursecatalog.

Where's the App for That?

Today's tech-savvy consumers expect to interact with content using focused apps that are accessible anytime from any device—desktops, tablets, and smartphones. Esri is offering two courses that will help you create engaging GIS apps that work across platforms and meet the needs of colleagues, decision makers, or the general public: *Developing Web Apps with ArcGIS API for JavaScript* (instructor-led) and *Configuring Apps Using Templates and Web AppBuilder for ArcGIS* (web).

Location Advantage

Understanding the impact of location is a strategic advantage that yields deeper insights into customers and market opportunities. These two courses will show how to geoenable business data by using the mapping and analytics capabilities of ArcGIS and easily create reports, maps, and apps to share the results: *Market Analysis Using Esri Business Analyst* (instructor-led) and *Exploring Market Areas Using Business Analyst Online* (web).

Integrating GIS with BI

Three courses show how to take advantage of Esri solutions that integrate with existing business intelligence software your organization is already using: *Increase Business Intelligence Using Esri Maps for IBM Cognos* (web); *Increase Business Intelligence Using Esri Maps for MicroStrategy* (web); and *Increase Business Intelligence Using Esri Maps for SAP BusinessObjects* (web).

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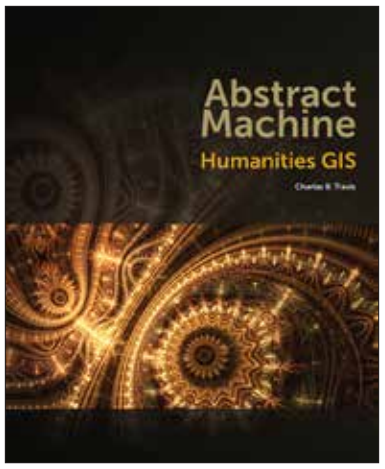
Abstract Machine: Humanities GIS

by Charles B. Travis

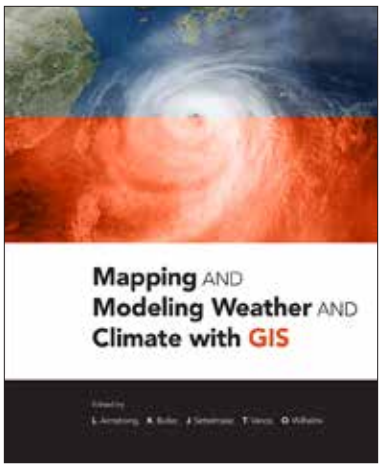
In *Abstract Machine*, author Charles Travis uses GIS technology to interpret, analyze, and visualize literary, historical, and philosophical texts. Travis's study shows how mapping language patterns, fictional landscapes, geographic spaces, and philosophical concepts helps support critical analysis. Travis bases his interpretive model on the ancient Greek and Roman practice of geographia and applies it to works by authors including Samuel Beckett, Patrick Kavanagh, Flann O'Brien, and James Joyce. Travis illustrates how scholars in the humanities can experiment with GIS to create visualizations that support and illustrate their critical analysis of humanities texts and survey, navigate, and imagine various story paths through space and time. Esri Press, February 2015, 180 pp., paperback, ISBN: 9781589483682 and e-book ISBN: 9781589483989



Mapping and Modeling Weather and Climate with GIS

Edited by Lori Armstrong, Kevin Butler, Jack Settelmaier, Tiffany. Vance, and Olga Wilhelmi

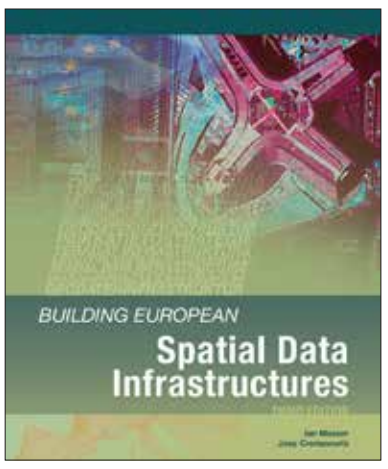
Mapping and Modeling Weather and Climate with GIS is a contributed volume from leading climatologists, meteorologists, and other experts about how geospatial cartography and analysis helps to advance atmospheric science research. Topics include data and software resources, data representation, observations, modeling, data model integration, web services, and the areas of current and potential cross-fertilization of atmospheric and geospatial sciences. *Mapping and Modeling Weather and Climate with GIS* includes concepts and practices of mapping and modeling projects, discussion of advances in GIS for atmospheric sciences, and lists of geospatial resources. Esri Press, February 2015, 370 pp., paperback, ISBN: 9781589483767 and e-book ISBN: 9781589484054



Building European Spatial Data Infrastructures

by Ian Masser and Joep Crompvoets

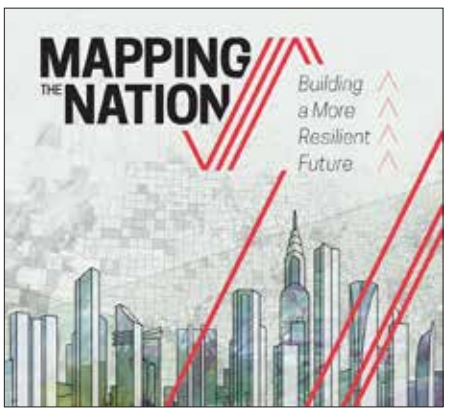
Building European Spatial Data Infrastructures, Third Edition, explores the efforts of the European Union (EU) to create a framework for a multinational infrastructure for spatial information in the European community. This framework will enable the EU to exploit the myriad opportunities created by modern GIS technologies. This edition presents an overview of the innovative activities being performed by both the public and private sectors to comply with the INSPIRE Directive and explains the rationale and the processes involved in spatial data infrastructure (SDI) development and implementation. Designed as a reference for GIS professionals and decision makers, the chapters promote a general understanding of SDI concepts and provide examples of practical applications. Esri Press, February 2015, 100 pp. paperback ISBN: 9781589483835 and e-book ISBN: 9781589484061



Mapping the Nation: Building a More Resilient Future

by Esri

Mapping the Nation: Building a More Resilient Future is a collection of GIS maps illustrating the many ways that federal government agencies rely on GIS analysis to build stronger, more resilient communities and help make the world a better place. Pulled from a broad range of departments, maps included in the book demonstrate how the technology can be used to evaluate, plan, and respond to social, economic, and environmental concerns at local, regional, national, and global levels. The topics covered, such as green government, economic recovery and sustainability, and climate protection, show how government agencies use GIS to facilitate initiatives, improve transparency, and deliver strong business models. Esri Press, February 2015, 108 pp., paperback, ISBN: 9781589483910



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Villiger provides UMBC students with access to real challenges and solutions by drawing upon his extensive GIS career and his experience as President and CEO of Global View Inc. where he provides clients with GIS and remote sensing services. UMBC's GIS Master's Program is designed to teach students how to use and **apply GIS within the field**.

▶ Find out more: umbc.edu/gis/video

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