

## Briefly Noted

### Esri Developer Tools Now in IBM's Bluemix

In an expansion of Esri's three-decade partnership with IBM, Esri developer tools, geoservices, and data are now available in Bluemix, the IBM cloud environment. With access to the ArcGIS platform in IBM's cloud infrastructure, as well as in other cloud environments supported by Esri, developers can benefit from a new level of content, functionality, and scalability.

### New Image Platform Bundles

Esri introduced four new image platform bundles in ArcGIS 10.5 that enable users to process imagery in a fraction of the time it takes most desktop or enterprise image processing technologies. Learn more about the Image Analysis, Image Management, Image Analytics, and Ortho Mapping bundles at [arcgisimageplatform.com](http://arcgisimageplatform.com).

### Esri No. 11 on Forbes' Best Midsize Employers List

Forbes magazine ranked Esri as number 11 on its list of America's best midsize employers. This is the second consecutive year in which Forbes has honored Esri, a company the magazine recognizes for being both a great place to work and a strong business partner.

### National Geographic Includes Dangermond on Board

The National Geographic Society elected Esri president Jack Dangermond to its board of trustees. Read on page 3 about how National Geographic is ramping up its efforts to get the next generation excited about geography.

## Visualize the Changing Planet with New Landsat Explorer Web App

The new Landsat Explorer web app from Esri enables users to wield Landsat imagery to explore geology, vegetation, agriculture, and cities anywhere in the world. The app, driven by publicly accessible image services, offers a way to better visualize the planet and understand how the earth has changed over time.

Using the app is simple: Open it in a web browser, search for a location, and apply analysis tools on the fly to get immediate, dynamic results. With no download required, Landsat Explorer users get instant, interactive access to an extensive collection of multispectral, multitemporal Landsat imagery.

Landsat satellites have been collecting information about the earth's surface for almost 45 years. Each Landsat image contains multiple bands of spectral data gathered at different wavelengths. More than just offering pictures of the planet, Landsat's different bands can be combined and analyzed to learn about what is happening on the ground, beyond what the eye can see.

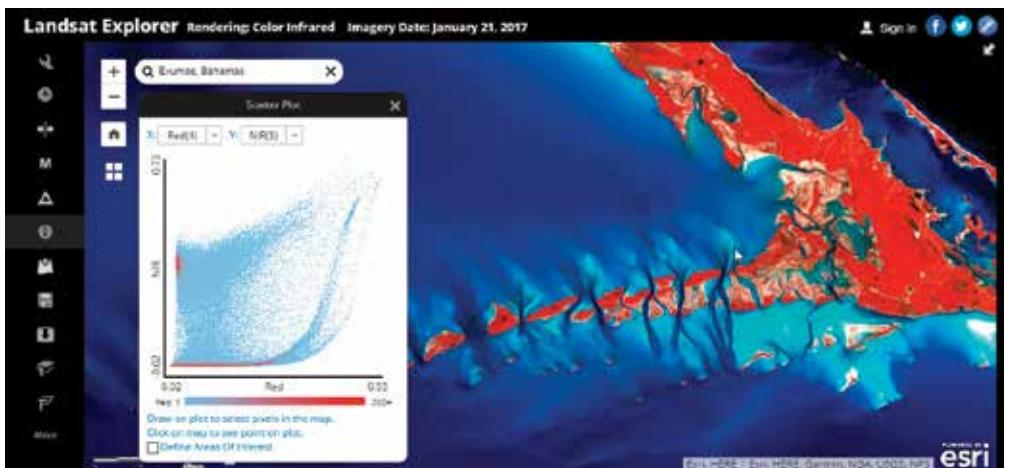
Landsat Explorer is powered by Esri's Landsat image service, which includes more than 500,000 Landsat scenes with over 500 new scenes added daily. This is made possible in part by Amazon Web

Services (AWS) and its Landsat on AWS dataset, which hosts Landsat 8 scenes (from 2013 to present) for free. Esri's Landsat image service combines this massive Landsat 8 collection with the Landsat Global Land Survey (GLS) datasets from 1975, 1990, 2000, 2005, and 2010. The result is four decades of global coverage. And while the Landsat

Explorer app is a simple way to interact with this dataset, the Landsat image service can also be used directly in a wide range of other Esri apps and software, including ArcGIS Pro.

Beyond enabling users to instantly view half a million Landsat images using different band

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↑ A false color band combination, where vegetation appears in red, delineates the Exumas Islands in the Bahamas. With the Scatter Plot tool, users can select two bands to plot on a graph, with the more frequent occurrences appearing on this graph in red.

## Esri Adds Detailed Global Elevation Data to ArcGIS Online

### Acquisition of Airbus' WorldDEM4Ortho Means Esri Provides Most Accurate Global Satellite-Based Elevation Data Available

As the newest addition to Esri's world elevation layers, WorldDEM4Ortho is part of the growing Living Atlas of the World, available in ArcGIS Online. This detailed elevation data adds to the more than 5,000 maps and layers now available to over 4 million ArcGIS users worldwide. Through multiple elevation layers that are published by Esri, this data will not only be available for end-user applications but also for developers who wish to create specific apps that are fueled with elevation information.

WorldDEM4Ortho is based on the global WorldDEM dataset from Airbus and features vertical accuracy of 4 meters in a 24-meter-by-24-meter raster. Covering the earth's entire land surface, this elevation model is the most homogenous and accurate

for orthorectification data on a global scale. The Airbus data will be included in Esri's existing elevation layers, which automatically select the best data source based on scale from familiar datasets like the Global Multi-resolution Terrain Elevation Data 2010 (GMTED2010), the General Bathymetric Chart of the Oceans (GEBCO), the Shuttle Radar Topography Mission (SRTM), the NASA/IPAC Extragalactic Database (NED), and community lidar.

Users can apply these elevation layers broadly, including for elevation analytics such as slope, aspect, and visibility studies. The data will also be used extensively in improving cartographic base-maps with beautiful multidirectional hill shading, as well as to advance 3D views inside ArcGIS Pro and the ArcGIS scene viewer.

"The addition of this remarkable new dataset in Esri's world elevation map will greatly enhance regional, national, continental, and even global earth science," Esri president Jack Dangermond observed.

"Our collaboration with Esri will provide millions of GIS users around the world with access to our WorldDEM4Ortho within their Web GIS environment," said François Lombard, head of the intelligence division at Airbus Defence and Space. "Enabling end users to easily access this layer within ArcGIS will empower them to not only improve their existing applications but also create new business opportunities."

Learn more about this new elevation data addition and much more by visiting the Esri Living Atlas of the World booth at the 2017 Esri User Conference.



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For Syrians living in Jordan's expansive Zaatari refugee camp, an innovative project called RefuGIS empowers them to learn and build the GIS services needed to support the camp's growing community.



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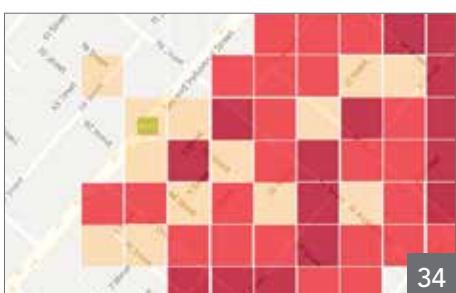
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Tell readers around the world how your organization saved money and time or acquired new capabilities through using GIS.

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# WHY National Geographic Is Optimistic About Geography

By Gary E. Knell, President and CEO,  
National Geographic Society

When I was an undergrad at the University of California, Los Angeles, studying journalism, I ended up taking a class in Chinese history. It was an elective, something different and seemingly unrelated to my journalism major. The course gave me a perspective I never had before: an appreciation for a culture and geography that I recognized only from the pages of the *National Geographic* magazines I devoured as a kid.

The class also changed my life. It influenced my career. Years later, I ended up working in Hong Kong—an opportunity I seized given what I had learned back in school. I then lived in Bangkok and have since traveled extensively around the world. And more than three years ago, I jumped at the chance to join the institution I revered as a child, an organization created to increase and diffuse geographic knowledge: the National Geographic Society.

One of our goals at National Geographic is to get the next generation as excited about geography as we are—and always have been.



↑ National Geographic Giant Traveling Maps are powerful tools for introducing geography and map-reading skills to students in grades K–8. (Photo by Scott Schilling.)

## National Geographic's Early Days

In 1888, 33 top scientific and intellectual leaders met in Washington, DC, at the Cosmos Club and formed a society dedicated to understanding “the world and all that is in it.” Many of these founders were in their 20s and 30s—the Millennials of their day. They sought funding for exploration and were eager to share what they learned. But without Twitter and Facebook, they instead printed a 50-cent journal with a plain brown cover.

That is, until Alexander Graham Bell took over as the Society’s president in 1898. Bell was the Steve Jobs of his day—*inventor, teacher, and visionary; the original disrupter*. It was his decision to make photographs a key feature in the magazine—you could even call it the original Instagram. This caused quite a scandal, and some board members even threatened to resign. But we all know how that turned out!

## National Geographic Today

National Geographic has grown exponentially since its humble beginnings. Today, it’s a broad and expansive organization encompassing media, mission, and education.



At a BioBlitz, scientists, families, students, teachers, and other community members work together to get an overall count of the plants, animals, fungi, and other organisms that live in a place. (Photo by Eric Leifer, National Geographic.)

Our brand reach is bigger than ever: 730 million people across the world. The magazine publishes in 33 languages. The channel airs in 172 countries and 43 languages. And National Geographic has the largest noncelebrity Instagram account, with more than 76 million followers—and we won’t sleep until we catch up to Kim Kardashian!

Thanks to an expanded relationship with 21st Century Fox, with whom we’ve partnered on the National Geographic Channel for many years, we now have more resources to invest in exploration and education—including an endowment worth more than \$1 billion. National Geographic reinvests 27 percent of its revenue—proceeds from for-profit activities such as the channels, magazines, and travel—into work that allows us to pursue solutions to our greatest challenges.

We know these challenges all too well: a warming planet, a growing global population, and a race for resources. This is why supporting science and exploration—and understanding geography—is more important than ever. And yet, our young people lack geographic knowledge.

## Survey Says...

In the summer of 2016, National Geographic fielded a survey with the Council on Foreign Relations to try to gauge global and geographic literacy among college-aged Americans. The survey results showed that American students have a lack of understanding of the world and their place in it.

We found, for example, that

- When asked whether more Mexicans have left the United States than entered over the past five years, only 34 percent answered correctly that more have left.
- Less than 50 percent could identify Iraq, Iran, or Israel on a map.
- Only 29 percent correctly identified the United States as having a larger economy than China.

For us, this signaled an opportunity to do more, starting with education.

## Cultivating Young Explorers

Today at National Geographic, we’re seeking to combine academic and experiential learning earlier in kids’ educational paths. It is critical that we keep pace with how they learn.

It starts with cultivating the “explorer mind-set.” We have developed a K-12 learning framework that describes the attitudes, skills, and knowledge that embody the mentality of an explorer—an informed, curious, and capable citizen who makes the world a better place.

To help teachers foster this mind-set, we provide a free and robust online library of lesson plans, digital mapping tools, and other activities at [natgeoed.org](http://natgeoed.org). We also publish *Explorer* magazine

for classrooms, engaging more than half a million K-6 students at approximately 10,000 schools with stunning photos and stories about science, geography, and exploration.

But we also know the value of experiencing geography first-hand. So we have student matinees where kids can meet National Geographic Explorers; Google Hangouts where they can connect directly with researchers in the field; and programs like BioBlitz—a partnership we had with the US National Park Service—where students of all ages could get their hands dirty out in the parks with rangers, finding their way with trail maps and documenting new species.

Finally, this year we’re focusing on Geo-Inquiry, which, similar to Esri’s GeoInquiries, teaches the steps that geographers take when looking at the world, such as articulating questions, acquiring information, analyzing data, and sharing stories about their findings.

## Grant Making for More

Recently, we expanded our grant making around the world to encompass a wider set of disciplines—from education and technology to storytelling, which includes mapping. We believe educators and geographers are explorers, too, and we want to make sure they have access to the funding and tools they need to make a difference.

While we have supported geographers in the past, these grants have been primarily academic, oriented toward scientific or archaeological research. Our expansion of funding for storytelling, technology, and education is an attempt to cultivate those able to most effectively tell the stories of geography and make it exciting, meaningful, and relevant to students and the public.

## Going Further

At National Geographic, we are optimistic about geography—and about the next generation of geographic learners. We fund hundreds of grant recipients each year who honor the study of geography and are masters at sharing it, enriching us all as a result.

That survey I mentioned earlier? The one that showed a great lack of geographic knowledge? Let me share two other data points from the findings. The survey also showed that the students understand the importance of global and geographic literacy and that they have the desire to learn more.

We can’t underestimate the ability of our young people to solve the challenges we face. Together with the Esri community, we can give them the geographic skills and tools they need to succeed.

We’re looking for geographers!  
Apply for a grant at [natgeo.org/grants](http://natgeo.org/grants).

Zaatari Refugee Camp in Jordan is a large and complex environment that requires GIS for managing infrastructure and planning. (Photo by Brian Tomaszewski.)

# GIS for Refugees, by Refugees

By Brian Tomaszewski, Rochester Institute of Technology;  
Jean-Laurent Martin, United Nations High Commissioner for Refugees;  
and Yusuf Hamad, Syrian Refugee and RefuGIS Team Member



With the conflict in Syria now in its sixth year, more than 659,000 Syrians have fled to neighboring Jordan to seek refuge as of May 2017, according to the United Nations High Commissioner for Refugees (UNHCR). Of the Syrians in Jordan, the UNHCR says that more than 79,000 are living in the Zaatari refugee camp, making it one of the world's largest refugee camps in terms of population.

Zaatari is a unique camp in that it is essentially a small city, requiring the same GIS services that any city planner's office would need to manage infrastructure, such as electrical and water networks, and support community services. But until recently, Zaatari didn't have sustained GIS services, so it was difficult for anyone to make informed decisions.

What's more, Zaatari's residents not only face basic living challenges, like shortages of food and water and insufficient medical care, but they are also confronted with a much more systemic problem: lack of access to livelihoods and education.

To mitigate these two distinct yet related issues, UNHCR, along with the Rochester Institute of Technology (RIT) and International Relief and Development (IRD), created Refugee GIS, or RefuGIS, an innovative project that empowers refugees living in Zaatari to learn and build the GIS services needed to bolster the camp's continually growing community.



↑ Using Collector for ArcGIS, participants in RefuGIS gathered information about Zaatari's infrastructure. (Photo by Brian Tomaszewski.)

→ As part of the RefuGIS project, Syrian refugees learn how to use ArcGIS Desktop, ArcGIS Online, and Collector for ArcGIS. (Photo by Brian Tomaszewski.)

## Wholly Involved in Decision-Making

Although a number of capacity-building initiatives have been implemented for refugees around the world, RefuGIS—which is funded by a grant from the UNHCR Innovation Fund—is the first project wherein refugees are wholly involved in community decision-making processes, from emergency planning to infrastructure classification. By employing their newly acquired GIS skills, participants in RefuGIS can create the maps that support discussions about camp management and community engagement.

"We see GIS as a very important educational opportunity for refugees," said Irene Omondi, a UNHCR community services officer in Zaatari. "The skills the refugees are learning through the RefuGIS project are being implemented in important ways to serve the camp, such as offering unique information products to address community issues."

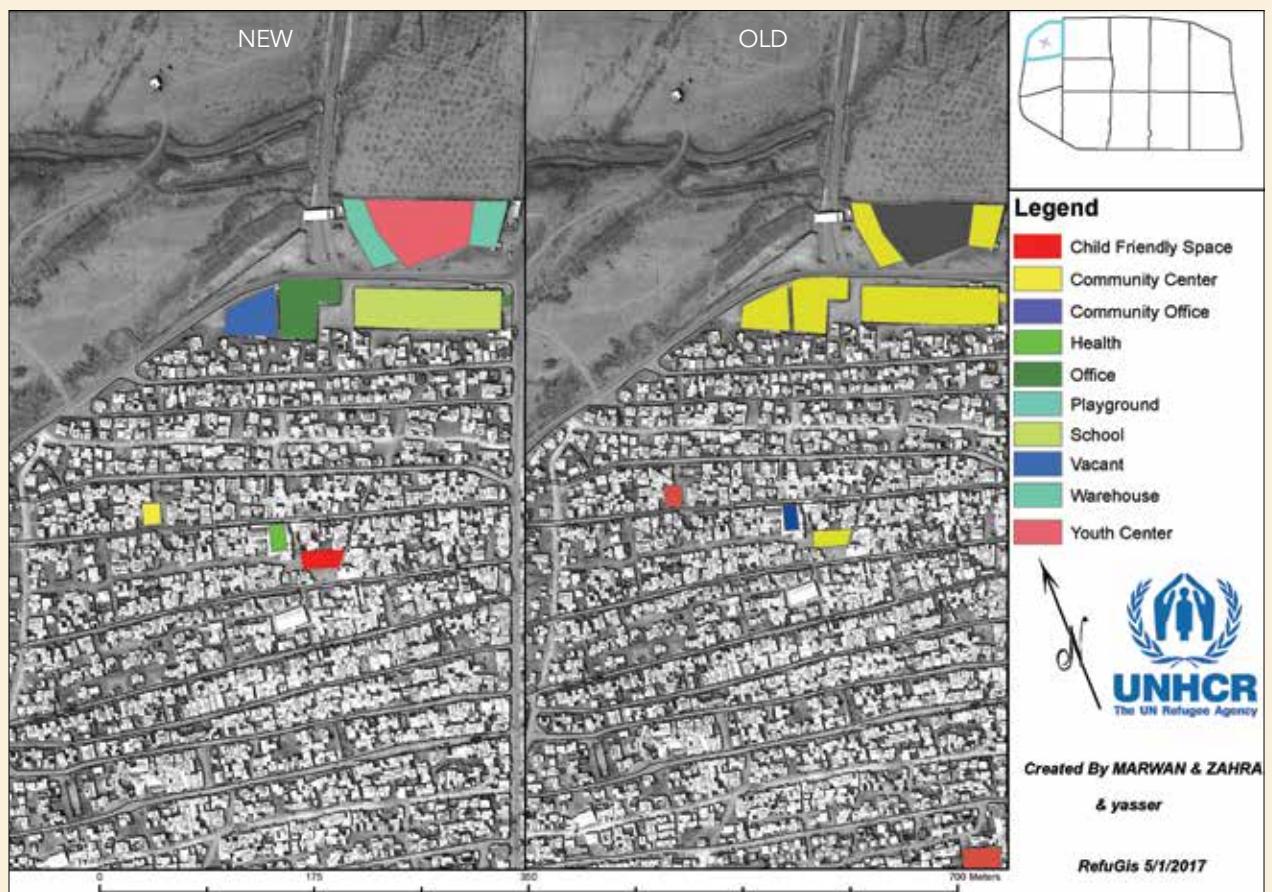
At the start of the project, coordinators contacted people who had applied for an information technology (IT) technician position to gauge their interest in participating in RefuGIS. UNHCR, in partnership with RIT, then administered a spatial thinking aptitude test and conducted interviews with the applicants to find out who had a strong desire to learn GIS and related IT skills. From the candidates, a core group of 12 Zaatari residents was selected to launch RefuGIS—and none of them had a background in GIS.

After the core group was chosen, UNHCR used the innovation funds to acquire the educational resources, along with the software and hardware, needed to begin the project. IRD used additional innovation funds to purchase 12 ArcGIS Desktop licenses through Esri's Nonprofit Organization Program. The partners also procured 12 personal computers and 12 Android tablets so the project participants could employ ArcGIS Online and Collector for ArcGIS for field data collection, storage, and dissemination. Esri technology is at the center of RefuGIS.

With all the materials in hand, RefuGIS established a dedicated GIS computer lab, open every day to program participants, to facilitate ongoing training and continual work on projects. This is believed to be the first GIS computer lab in Zaatari or any other refugee camp in the world.

## Teaching the Basics

Dr. Brian Tomaszewski from RIT has been training the core 12 RefuGIS participants in GIS and related IT skills. Trainees primarily use ArcGIS Desktop to learn about mapping concepts, such as coordinate systems and thematic mapping, as well as software-specific topics, like working with digital datasets, map



↑ Members of the RefuGIS team mapped changes in infrastructure around Zaatari. Two months before making this map, none of them had ever used GIS.

layers, and cartography in ArcGIS. They are also becoming familiar with related programs, such as Microsoft Excel and Access, Open Data Kit, and the Adobe Creative Suite.

Additionally, professors from local Jordanian universities have been teaching participants the basic principles of graphic design and the fundamentals of database management.

"We are very excited to have the opportunity to provide education and training to our Syrian brothers and sisters," said Dr. Nijad Al-Najdawi of Jordan's Al-Balqa Applied University.

"We are all morally obliged to help our Syrian neighbors in one way or another," added Dr. Sara Tedmori of Princess Sumaya University for Technology in Jordan. "I see this as *[an]* opportunity to make a unique contribution to helping refugees through education and training, which will ultimately allow them access to decision-making."

## A Dual Effect

The impact of RefuGIS so far has been twofold: Not only have the core 12 participants built a GIS that enables them and their fellow Zaatari residents to make informed decisions, but they have also experienced personal growth.

In just four months, the RefuGIS team conducted several successful GIS projects in Zaatari. For example, the team used Collector to gather information about the camp's infrastructure. Participants also employed ArcGIS Desktop and ArcGIS Online to make reference maps of the facilities around Zaatari, such as community centers, health offices, schools, playgrounds, and warehouses. UNHCR and its implementing partners, as well as all the camp's residents, can use these maps.

While these projects are certainly important, the personal growth that RefuGIS participants say they have experienced is the most rewarding aspect of the project.

"When I started working on RefuGIS, I no longer felt like a refugee," said Marwan Theeb Alzoubi, a Syrian refugee who has been living in Zaatari for more than four years and is part of the core team that launched RefuGIS.

"There are other jobs available in Zaatari camp, but I passed them up so I could be a part of RefuGIS," added Ibrahim Alhamad, another member of the core team who came from Syria and has been living in Zaatari for three years. "I see GIS as an important tool for the refugees and my own future."

Ideally, the refugees who participate in RefuGIS will be able to translate their new GIS skills into further job opportunities both within the camp and beyond—in Jordan, Syria, if they are able to return; and elsewhere—since GIS-related jobs are in high demand.

## Extending the Benefits

RefuGIS also has an internal education program, where instructors from RIT and other project partners are training the core team to teach GIS to other refugees. Initially, the RefuGIS trainers taught the fundamentals of GIS and how to use ArcGIS to others who joined the project. But it didn't take long for the training to extend beyond RefuGIS, with the new trainers teaching other refugees, as well as UNHCR and its implementing partners, how to do field mapping. The training program is intended, in part, to sustain RefuGIS in the long term. But it is also meant to extend the personal growth opportunities offered by GIS to as many refugees as possible.

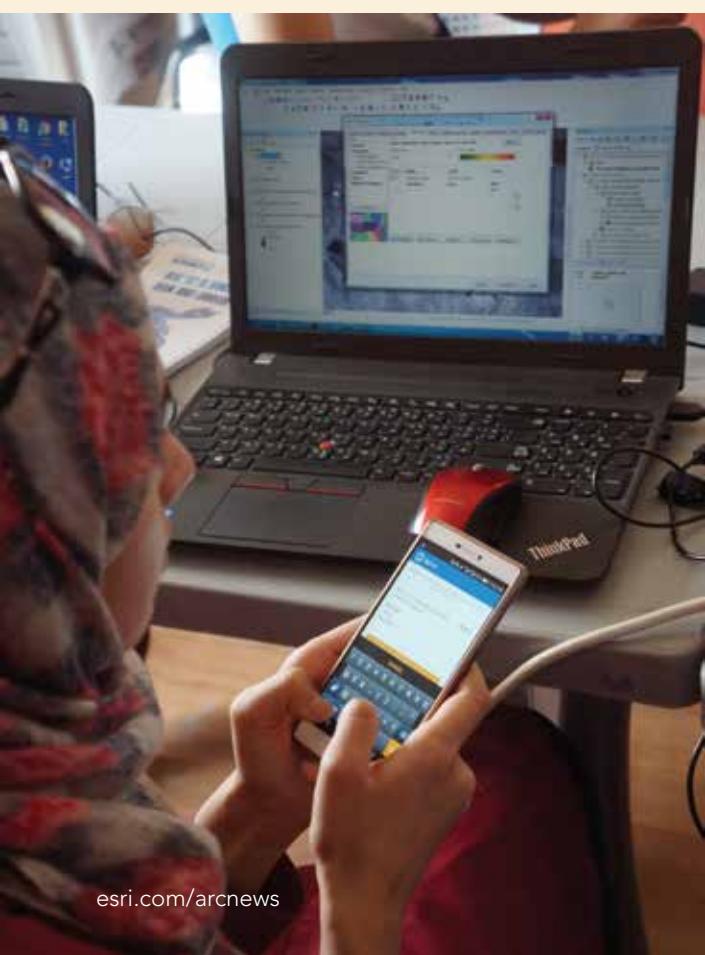
Refugees all over the world are tremendously interested in building skills that can provide them with livelihoods in their host countries. Although nonprofits and tech companies often provide refugees with training in IT skills, such as programming and web development, GIS has not been emphasized. RefuGIS is addressing this gap by being the world's first GIS project for refugees, by refugees.

The aim is that, over time, RefuGIS participants will be able to manage Zaatari's information themselves and address community issues by making their own spatially based decisions. The ultimate goal, however, is to scale the project worldwide, since all refugees have unique spatial situations and could benefit from the educational and economic opportunities that GIS can provide.

## About the Authors

Brian Tomaszewski, PhD, is an associate professor of geographic information science and technology (GIS&T) at RIT in the United States. Jean-Laurent Martin is an information management officer for UNHCR. Yusuf Hamad is a Syrian refugee living in Mafraq, Jordan.

For more information about RefuGIS, email Martin at martin@unhcr.org.



# Data Sharing with No Delays

At the Texas Department of Transportation, ArcGIS Pro and ArcGIS Open Data Pave the Way for Smooth Workflows

It's not a cure-all for Texas traffic, but the state's department of transportation, TxDOT, eases two major pains with ArcGIS Pro and ArcGIS Open Data: data publishing and data requests.

Chris Bardash, a TxDOT GIS analyst, used ArcGIS Pro to implement a single project that can publish services for the entire organization. This allows TxDOT to easily share its data both internally and externally via ArcGIS Online and its ArcGIS Open Data site. On the whole, the solution cuts the time it takes to publish data and reduces the number of data requests that TxDOT's data management team has to process manually.

## Automating Service Updates

Prior to implementing ArcGIS Pro, TxDOT was juggling too many distinct datasets and services. The two-person GIS team had built a custom web mapping app for statewide planning using ArcGIS API for JavaScript. But Bardash and his colleague, Adam Breznicky, knew that because of the mutable nature of planning projects—with changes in project locations, marker positions, speed limits, and the like—the services for the map would need to be updated on a regular basis.

Initially, they had created a single map document for each service—that is, one map for every service—so there were approximately 40 map documents sitting in a folder.

"Then we realized we could use the map tabs within ArcGIS Pro to contain all the *[map documents]* in a single product," recalled Bardash.

So they started by building an ArcGIS Pro project to import all the map documents. Now, there is a single ArcGIS Pro project on a network drive that anyone in the data management section of TxDOT can access. Additionally, all the data is sourced on an enterprise database, so users can just open the ArcGIS Pro project and it's already connected to the data.

"Any time you need to update services, you open the project and go to the map tab for that service," explained Bardash. "Everything is already symbolized and connected to the data source. You just click overwrite to *[edit]* the service in ArcGIS Online."

By automating some manual steps, such as removing extraneous fields, ArcGIS Pro performs the quality control that has to be conducted before publishing a service.

"We want to clean up some fields before we publish them," said Bardash. "In some cases, we might delete certain fields."

So the team wrote a Python script that can check to see if the service has any of the fields that need to be deleted.

"We couldn't write a script specific to each layer, so we wrote a script that searched for any fields in a list of about ten of them," explained Bardash.

When a user activates that ArcGIS Pro task (a set of preconfigured steps that guide someone through a workflow), the delete fields script gets triggered automatically. From there, the user overwrites the service and reviews the item details page in ArcGIS Online to make any final adjustments, such as removing underscores from the item names and changing settings, like optimizing layer drawing, that aren't available to set when publishing.

"In the past, this would have been a part of our standard operating procedure that someone would have to remember to do," said Bardash. "Now, the task just walks you through it."

## Sharing Data Externally

To help with transparency, TxDOT has also implemented an ArcGIS Open Data site.

"People can visualize the work we are doing—planned projects, traffic volumes, congested roadways, classifications for each road, *[and]* asset locations," said Bardash. "Our entire inventory of things like that is out there for people to consume. They can download it or use it in their own web apps."

To reduce the time it took to handle the number of labor-intensive data requests the department received, TxDOT was looking for a solution to share data externally.

"We were preparing to build our own site when our Esri contacts informed us about the out-of-the-box ArcGIS Open Data solution available to us for free as part of our Esri account," recalled Bardash.

With very little preparation, Bardash and Breznicky were able to quickly stand up an open data site. From there, it could share the services it had already prepared and made available in ArcGIS Online.

"It did not require any purchases and needed very little configuration," said Bardash. "Basically, we added our branding to the site, set our services to be available on the open data portal, and published it."

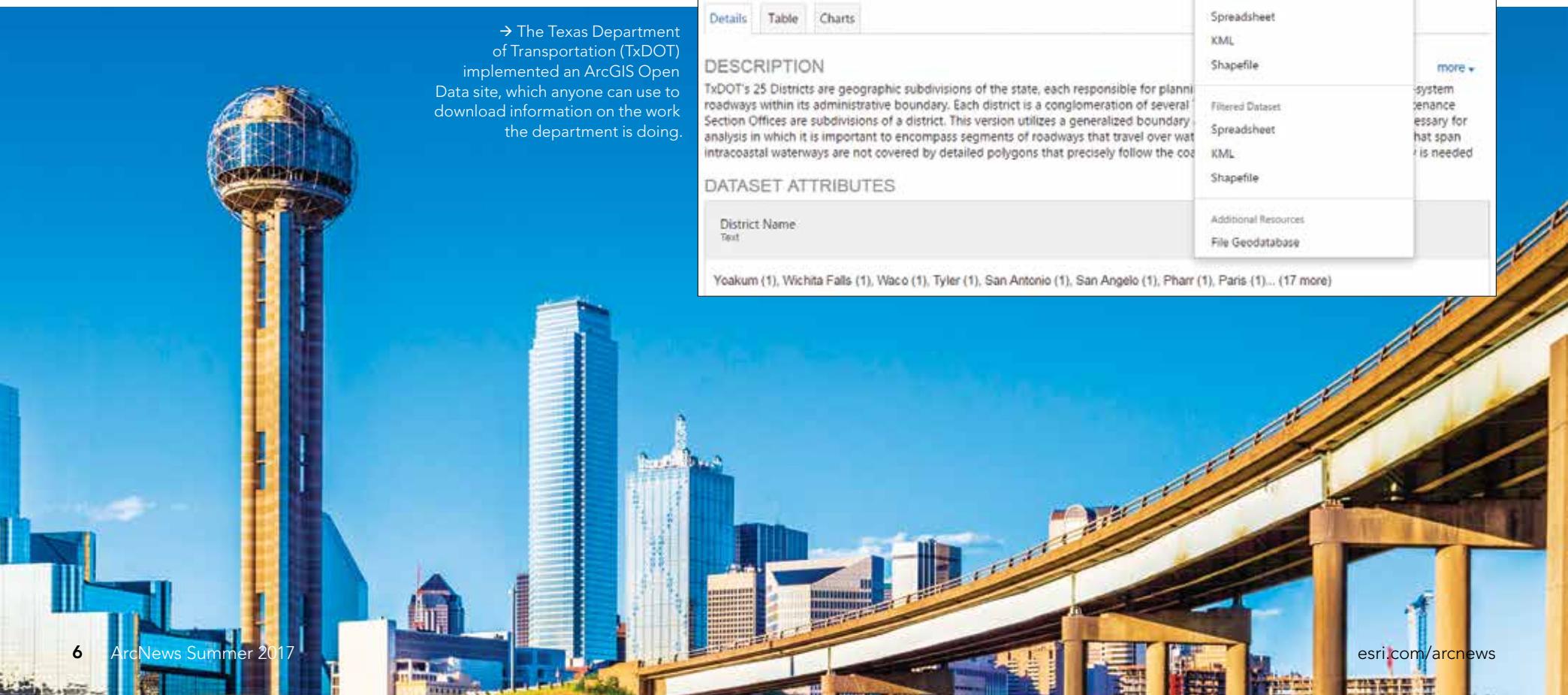
Now, if consultants working on a TxDOT project need to get ahold of official highway data to put on a map, the data management section no longer has to find the data and send the specialists a zipped geodatabase file. Instead, the team can give them a link to TxDOT's open data portal, and the consultants can find the data themselves.

"ArcGIS Pro makes it easier for us to get that data out there faster and ensure a certain level of quality," Bardash conveyed. "With any given data request, *[we]* can save the minutes or hours it takes to assemble all that data, depending on the request."

To learn more about ArcGIS Pro, visit [pro.arcgis.com](http://pro.arcgis.com). To find out how to implement an out-of-the-box ArcGIS Open Data site, head to [opendata.arcgis.com](http://opendata.arcgis.com).

The screenshot shows the TxDOT ArcGIS Open Data website. At the top, there's a search bar labeled 'Search for open data' and a 'SEARCH WITHIN MAP' button. Below the search bar is a map of Texas divided into 25 districts, with labels for major cities like Las Vegas, Phoenix, El Paso, and Austin. To the right of the map, there's a sidebar with links for 'My Activity', 'Home', and 'APIs'. The main content area is titled 'TxDOT Districts' and includes tabs for 'Details', 'Table', and 'Charts'. Under 'DESCRIPTION', it says: 'TxDOT's 25 Districts are geographic subdivisions of the state, each responsible for planning roadways within its administrative boundary. Each district is a conglomeration of several Section Offices are subdivisions of a district. This version utilizes a generalized boundary analysis in which it is important to encompass segments of roadways that travel over water. Intra-coastal waterways are not covered by detailed polygons that precisely follow the coast.' Under 'DATASET ATTRIBUTES', there's a table with one row showing 'District Name' as 'Text'. At the bottom, there's a link to 'Additional Resources' and a 'File Geodatabase' button. A dropdown menu on the right side offers options like 'Full Dataset', 'Spreadsheet', 'KML', 'Shapefile', 'Filtered Dataset', 'Spreadsheet', 'KML', 'Shapefile', and 'more'.

→ The Texas Department of Transportation (TxDOT) implemented an ArcGIS Open Data site, which anyone can use to download information on the work the department is doing.



# With GIS, Virginia Allocates Transportation Funds Based on Merit

Measuring the time it takes to travel from one place to another has little bearing on determining how livable an area is. Instead, what really indicates the livability of a place is multimodal access to jobs and how easy it is to accomplish everyday tasks, such as going to the grocery store or exercising.

The Commonwealth of Virginia evaluates this kind of accessibility by calculating how long it takes to walk, bike, or drive to and from public transportation stations; how reliable the public transit is; and wait and transfer times. These measurements constitute part of SMART SCALE ([smartscale.org](http://smartscale.org)), a statewide program that helps officials choose which transportation projects to fund to ensure the best use of state tax dollars. Proposals are scored based on an objective, outcome-focused process that is transparent to the public and holds decision-makers accountable to taxpayers.

The backbone of SMART SCALE is Sugar Access, an ArcGIS extension from Esri partner Citilabs that helps communities analyze, manage, and visualize their transportation networks. Employing all their own local data on roads, highways, and public transportation systems, as well as census data, planners can use Sugar Access to discern how easy or difficult it is for residents of a certain neighborhood, city, or region to get to and from common places like work, school, stores, and parks. They can then use the program to conceptualize different transportation scenarios and figure out which ones work best for particular places.

## Getting More Robust Measurements

Prior to implementing SMART SCALE, Virginia faced two key issues when evaluating transportation plans.

First, the state was using a narrow set of variables to calculate the effects that proposed projects would have on the connectivity between people and their destinations. It was simply routing vehicular trips through a street network, taking very little account of the fact that people use other modes of transportation to get to and from a place.

Second, Virginia had to hire a consultant to perform all this analysis. While this worked in general, it didn't allow local

agencies to score their own projects to generate the maximum benefit for their communities.

So the Virginia Department of Transportation (VDOT) partnered with Renaissance Planning Group ([citiesthatwork.com](http://citiesthatwork.com)) to implement more robust accessibility measurements for each project across the state. For the 2018 fiscal year, VDOT selected Citilabs' Sugar Access as the standard tool for conducting the evaluations.

With Sugar Access, planners can conceptualize, understand, and communicate the benefits of multimodal systems in a comprehensive manner. After compiling all the accessibility data, planners can save it in a geodatabase and publish it in ArcGIS Online to conduct mapping and analysis and share data with decision-makers or the public. Then, using the Sugar Network Editor for ArcGIS Desktop, they can create different transportation scenarios to increase the livability of an area—whether that means adding more bike lanes that lead to downtown or changing bus routes.

"With the multimodal analysis capabilities of Sugar Access, changes in access scores are sensitive not only *to* transit service improvements, but *also* potentially *to* pedestrian projects affecting access to transit," said Citilabs' engineer Matt Pettit. "It was designed specifically to calculate all aspects of a transit trip: the time it takes to walk to transit, wait time, time on transit, transfers, and more."

## Judging Projects Based on Merit

Being able to gauge potential transportation projects based on their ability to provide better accessibility—along with their safety prospects, capacity to mitigate congestion, likely environmental effects, economic development opportunities, and proposed land use—has enabled Virginia to judge transportation projects based on their merits rather than political wrangling.

"Citilabs and their Sugar Access platform have been instrumental in our ability to help Virginia with *its* SMART SCALE program," said Renaissance Planning Group president Chris Sinclair.

In fact, using Sugar Access—and conducting analyses concurrently in the cloud as opposed to subsequently on



local machines—Renaissance was able to evaluate more than 400 projects in about two months just before the end of 2016.

"By running the analyses simultaneously in the cloud, Sugar Access allowed us to evaluate twice as many projects as the prior year," continued Sinclair. "We were able to quickly get started with the included datasets and easily edit the transit networks directly in the program. This provided a tremendous flexibility to measure the impact of projects."

With accessibility so easily scored, the Commonwealth Transportation Board is able to select the most advantageous transportation projects to fund.

To learn more about Sugar Access and Citilabs, visit [citilabs.com](http://citilabs.com) or call 1-888-770-2823.

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# Visualize the Changing Planet

continued from cover

combinations or enhancements, Landsat Explorer offers extensive analytical capabilities. The visualization and analysis tools let users do the following, all on the spot:

- Visualize the data using custom indexes and band combinations
- Filter and select specific dates to analyze and compare
- Interactively compare two images using a swipe tool
- Create custom masks
- Perform change detection
- Generate spectral and temporal profiles
- Create scatterplots using spectral bands
- Add data (city roads, for example) from ArcGIS Online

This means that users can calculate the Normalized Difference Vegetation Index, or NDVI (which employs different spectral bands to indicate the presence of healthy green vegetation), on demand anywhere in the world. They can also compare NDVI values at two points in time, visualizing increases or decreases in NDVI as they pan and zoom. To get a better idea of how to employ all the app's tools, users can check out the included tutorial, which exhibits the app's full capabilities.

Users can apply Landsat Explorer's analysis tools in myriad ways. Perhaps a user is curious about how her hometown has expanded since childhood. To find out, she can zoom to her hometown and use the app's time slider to dynamically compare before and after images. Maybe a student would like to quickly quantify areas of agriculture usage or forest burn. He can use the Mask tool to identify specific types of land cover, like farmland, and interactively set thresholds to increase the results' precision. Additionally, a journalist might want to measure the extent of a flood, such as the one that occurred in Allahabad, India, in 2016. She can quickly find the answer by selecting images before and during the flood and then using the Change Detection tool to highlight the affected areas. If the journalist then wants to share her discoveries, she can save her results to ArcGIS Online or as a local file.

Landsat Explorer also serves as inspiration for users who want to develop their own apps to engage with imagery. Landsat Explorer is open source, developed using ArcGIS API for JavaScript, so interested developers can find more information about building similar apps at [developers.arcgis.com](http://developers.arcgis.com).



↑ The Change Detection tool identifies flooded areas in Allahabad, India, in green. The tool calculates a water index, then discerns the difference between a Landsat image taken before the flood and one taken during the flood. (The threshold for what counts as a change can be adjusted dynamically to improve precision.)

Users who want a more supported experience can create similar imagery apps using Web AppBuilder for ArcGIS and its wizard-like, what-you-see-is-what-you-get interface in conjunction with the Web AppBuilder for Image Services (WABIS) add-in widgets. For more information on this, go to [github.com/Esri/WAB-Image-Services-Widgets](http://github.com/Esri/WAB-Image-Services-Widgets).

Landsat Explorer joins Esri's existing suite of Landsat apps, including the Landsat Arctic and

Antarctic Apps (more information on these can be found at [esriurl.com/LandsatOnAWS](http://esriurl.com/LandsatOnAWS)). Whether users answer their own questions by applying Landsat Explorer's powerful analysis tools or take the small leap to create their own imagery apps, it's never been simpler to instantly visualize and dynamically analyze the earth's surface.

## What's New in ArcGIS Online

Since its launch in 2012, more than half a million people have created nearly 10 million maps, apps, and datasets in ArcGIS Online, the world's most prominent software-as-a-service (SaaS) mapping platform. And this year's midyear update infuses the complete, cloud-based solution with even more impressive capabilities.

### Enhanced User Experience

The group pages and search results page have been redesigned with improved workflows, performance, and layout. For group members, the pages provide more ways to explore content. For group owners and administrators, the new design makes it easier to configure and manage group properties, content, members, and settings.

The pages also include new functionality for exploring and working with groups. For example, users can now search for and filter group members. In addition, owners can put delete protection on their groups to prevent the accidental deletion of the

group. They can also promote group members to managers to get help with group management tasks.

### Doing More for Less

Hosted tile layers are now more efficient, automatic, and economical. When publishing hosted tile layers from hosted feature layers, users can create tiles automatically. This means the tiles are generated only when requested, such as when a user zooms to an area on the map. Once the tiles are created, they are cached in users' hosted storage so they don't have to be generated again. Tiles also automatically refresh when the features in the source feature layer are updated. And Esri has reduced the cost of publishing tiles, so it only takes one credit to generate 10,000 tiles.

Users can now enable high-accuracy metadata collection on feature layer templates to use with Collector for ArcGIS. When including this option, preconfigured fields and associated domains are added to the feature layer template schema that Collector uses to write metadata about the collected data.

Hosted feature layers can also be published from Microsoft Excel files and exported as KML and Excel files. Publishing hosted scene layers from hosted feature layers is no longer in beta, so organizations that do this will now consume credits.

### Pop-Ups That Pop

At ArcGIS 10.5, Esri released ArcGIS Arcade, a new cross-platform expression language for ArcGIS, and now pop-ups have enhanced support for defining Arcade expressions. Users can dynamically create new attributes from their features. They can also use attribute expressions anywhere they work with regular attributes—showing a value in meters instead of feet, for example, or dynamically creating a URL based on the attributes of a

feature. And when a map is ready, users can choose to print it with a legend.

### Content Is King

Organizations can now include vector or raster basemaps in their map viewer and scene viewer basemap galleries.

Vector basemaps have been updated to support several different languages. Users who configure vector basemaps to be the Esri default in the basemap gallery will see the basemap versions for the language specified for their organization.

Esri improved the *World Imagery* basemap with additional sets of DigitalGlobe imagery for several countries, including the United States and Canada, with detailed imagery for hundreds of areas.

Demographic maps have also been updated and now feature the latest 2017 current-year estimates and 2022 five-year forecasts for the United States, as well as the latest 2017 estimates for Canada. In addition, updates have been released for more than 30 other countries using the latest Michael Bauer Research (MBR) data.

The National Agriculture Imagery Program (NAIP) image services have been updated with NAIP 2016 imagery for 24 states in the United States. The *World Elevation* map has also been updated with global 24-meter elevation data at 4-meter vertical accuracy. Users can access the data in the Esri 2D elevation image services, as well as the Esri 3D terrain services.

### Operational Update

Microsoft ended support for older versions of Internet Explorer on certain operating systems on January 12, 2016. Because of this, beginning with the June 2017 update, ArcGIS Online will no longer fix bugs specific to Internet Explorer 9 or 10, test those versions, or list limitations in help. This includes configurable apps and the map viewer.

To learn more about the updates to ArcGIS Online included in this release, visit the ArcGIS Online What's New page and check out the ArcGIS Online blog at [blogs.esri.com/esri/arcgis/category/arcgis-online](http://blogs.esri.com/esri/arcgis/category/arcgis-online).

# Sowing Real Geography in Online Gaming

## Location-Based Agricultural Game Makes GIS a Central Component

In the map-based board game *A Complete Tour Round the World*, devised by English mapmaker Thomas Jefferys in 1770, factual geographic information was key. As players moved their tokens around the map, they were required to read aloud a description of each place on which they landed, lending the game a strong educational element. But in the more contemporary strategy-centered board game *Risk*, wherein players try to seize territory from one another, the game's geographic content is quite disconnected from real-world geography and the populations that actually inhabit the six continents depicted in the game.

Thinking about this encouraged Ola Ahlqvist, an associate professor in the geography department at Ohio State University (OSU), and his colleagues to see if they could develop tools that others could use to create location-based learning games that made geography—and GIS—a fundamental component for game players.

"This all began back in 2007 as an independent study project by an undergraduate student [who] wanted to create a computer-based game that involved the building of railway lines to specified locations in Canada—similar to the popular *Ticket to Ride* board game," said Ahlqvist. "We decided to see what would happen when we infused small pieces of real information into the game we were developing. For example, if you tie the gross domestic product or the population to a country that is depicted in a board game, you will have a much more realistic view of the actual potential for the development of a railway or success in invading another country, as the case may be."

And so GeoGame—a simulation framework for games of strategy based on the ArcGIS platform—came to be.

### An Open Communication Framework

With the vast collection of maps and databases available online, Ahlqvist began creating a

prototype to test whether or not a game could be played in real time on an actual online map. Students involved with the project built APIs to demonstrate the concept. Ultimately, Ahlqvist received a two-year grant from the National Science Foundation to study how to implement GIS technology in the online gaming environment for educational purposes.

"What we wanted to do was build the framework for developing real-time online games on top of a true GIS so that we could use actual data with the processing capabilities of the geospatial toolset to create simulations, which are very much like games," explained Ahlqvist. "You can simulate hydrology, for example, and say, 'Okay, let's see what happens if it rains more. How would that affect the flooding downstream?' That's a simulation. It doesn't have a gaming aspect to it. But if you insert something like a competition for resources and how downstream flooding affects those resources, then it can become a game."

The development team—which is now made up of OSU faculty members and graduate students in geography, computer science, physics, and education—constructed a web-based platform that runs a massively multiplayer online game (MMOG) on top of ArcGIS to create a learning environment that allows users to interact with real-world data and simulation models. The computing environment includes two server applications: ArcGIS Server maintains the GIS data, while the GeoGame web server handles the game transactions.

"The game server constantly listens to the clients or game players," said Ahlqvist. "It's almost like an open channel that we created between the game server and the players. So every time a player performs an action that requires everyone to know about [it], the game server instantaneously pushes that information to the other players."

But this kind of open web communication was revolutionary when Ahlqvist and his team first started developing GeoGame—before WebSockets, which makes open communication between a user's browser and server, became an accepted standard.

"Our development team had to figure out how to do this because there were no APIs available for ArcGIS that would perform this function," said Ahlqvist. "Usually, when you send a request to a server, you send it, it is received, and then the communication loop is automatically closed. In our software, it was important to have a continuous two-way communication to push any updates caused by one player's action from the server to other players so they can act on it in real time."

The developers used ASP.NET's SignalR library to instantly communicate any changes from the server side to all the connected clients. Now, the newer stream services for ArcGIS could provide similar functionality.

### Where Geography Is Real

The prototype game that Ahlqvist and his team ended up creating is called Green Revolution. The idea for the content came from an OSU instructor teaching a world regional geography course who thought that the variables available in GIS could help her students analyze agricultural trade-offs. As the name suggests, the team based the game on the Green Revolution, an initiative from the mid-twentieth century that increased agricultural production in the developing world using techniques such as planting high-yield cereal crops, using chemical fertilizers, controlling water supplies, and practicing new cultivation methods.

"We developed this simulation to give players a real-world challenge and a sense of what life is like for farmers in the developing world," said Ahlqvist. "Players take turns, and each determines what to do before every growing season.

Should you take your cash and buy fertilizer, buy enhanced seed, maybe invest in irrigation or mechanized labor? Or should you save your money for a bad year when there's a drought or a pest attack? Random events like this are embedded into the simulation."

Since GIS is a fundamental component of the game framework, players can purchase actual parcels from a real map. This leads to some interesting cost analysis, according to Ahlqvist.

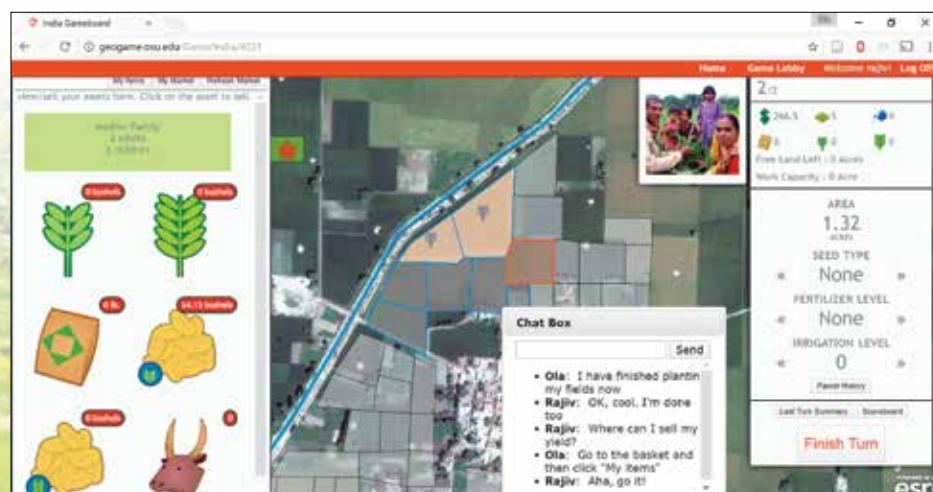
"For example, if you buy land close to a water resource, it would be cheaper to irrigate than if you are far from that river and have to install long lines of irrigation pipes," Ahlqvist said. "However, the land further from the water source may be cheaper to buy. We implemented a simpler water model with actual water flow to add another dimension to the game."

The team also built social impacts into the game. For instance, players can determine the family structure. If an entire extended family lives together on a farm, there are more helping hands, but the land also has to support a large number of people. So players have to take that into consideration when making their purchases.

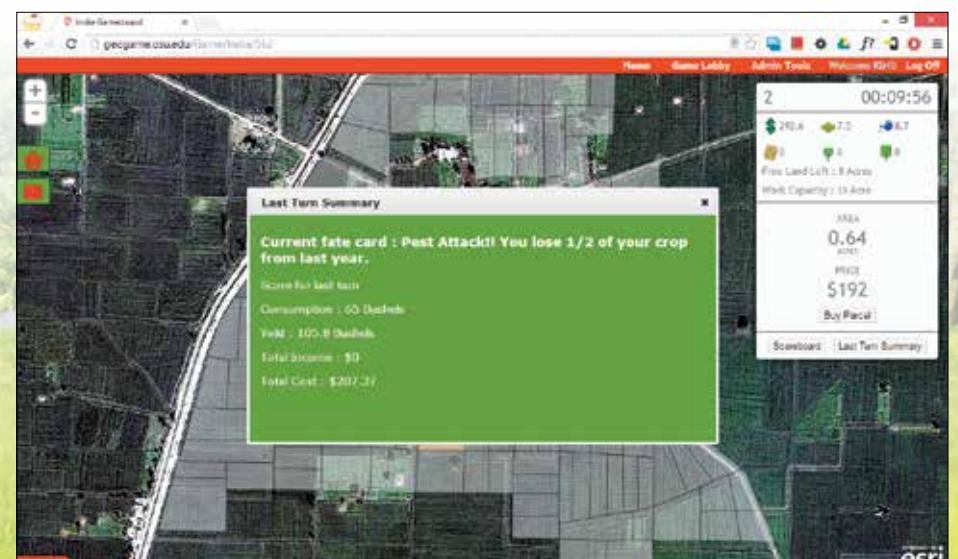
"We can add similar processes if we wanted to calculate the market value of the harvested crops, as well as other simulation models, because they are designed in a modular way and the game employs a true GIS," Ahlqvist explained.

The development team made the GeoGame framework highly adaptable for different locations and scenarios, so different feature or geoprocessing services—such as climate, soils, water resources, demographics, weather, traffic, and social media—can be added to the game rules.

"I believe that [the GeoGame framework] has great potential for analyzing interdisciplinary topics in education, research, and policy making through its use of the geospatial perspective," concluded Ahlqvist.



↑ Each time a player performs an action that everyone needs to know about, the game server instantaneously pushes that information to the other players.



↑ Random events like pest attacks are embedded into the simulation.

The simulation gives players a sense of what life is like for farmers in places like Indonesia. (Photo courtesy of Ola Ahlqvist.)



# MAP WOMAN

## THE QUEST FOR INSIGHT

As a GIS professional, Mapwoman understands the value of great analysis. This is how she brings to light an abundance of insight that may otherwise go unseen.

But it is not always easy being an analysis hero. Like all great quests, working through data often involves battling extraordinary analytical challenges. Here is how Mapwoman handled a recent GIS odyssey.



# POW!



### THE DATA IS JEOPARDIZED

The project to bring new residents to the outskirts of Plotland is in peril. Sadie Silo, an evil sorceress, has placed a curse on the new Metadata Meadows development by putting into a vortex all the subdivision's street names and addresses, as well as the demographic information about who is supposed to move into which house. To lift Silo's spell, it is up to Mapwoman to explore the data and break the curse.

# BOOM



### THE QUEST BEGINS

#### Mission 1: Gear Up

Since Mapwoman isn't sure what obstacles she'll encounter, the more diverse and encompassing her supplies are, the better.

Like the Swiss Army Knife, ArcGIS Enterprise has all the instruments needed to tackle any project. It includes powerful capabilities, such as ArcGIS GeoAnalytics Server to triumph over large datasets and ArcGIS GeoEvent Server to master rapidly changing data in real time.

Most importantly, ArcGIS Enterprise has something new: *Insights for ArcGIS*. With this browser-based analytic workbench, Mapwoman can swiftly conduct powerful, iterative data exploration to make big discoveries in Plotland's data and break down the curse.

Making *Insights for ArcGIS* her app of choice, Mapwoman embarks on her quest.

## Mission 2: Unscramble the Data

With all this data swirling around in a bewildering vortex, Mapwoman's goal is to not get bogged down by it but to uncover meaning. Just as a subdivision has multiple streets that either lead somewhere or circle back in on themselves, so does Plotland's data.

Using Insights for ArcGIS, Mapwoman quickly discovers patterns and trends in the data that lead her through the spatial and nonspatial pathways of Silo's curse. She brings together information that was once stored in separate but powerful enterprise databases, such as SAP HANA, Microsoft SQL Server, and Teradata. She also uses Insights for ArcGIS to work simultaneously with various forms of ArcGIS content, including the demographic and lifestyle data of current and arriving Plotland residents, plus the geodatabases and Microsoft Excel workbooks that contain all the city's information. What's more, Mapwoman can see all this in one bird's-eye view via the page she has put together in an Insights for ArcGIS workbook.



## Mission 3: Break the Curse

Now that Mapwoman can bring together critical data components from various sources, she needs to get it organized so that she can break Silo's curse. She uses Insights for ArcGIS to transform the city's data into a map, which not only shows all of Plotland but also includes attributes describing the new development.

Next, Mapwoman takes advantage of the app's drag-and-drop interface to turn data that is specific to Metadata Meadows into slick maps, charts, and tables. No matter how many datasets Mapwoman encounters, she can quickly organize them into easy-to-use cards, which she can use to aggregate the data numerically, draw buffers, apply spatial filters, enrich with additional information, calculate density, and more.

With most of the data now organized into maps, charts, and tables, Mapwoman activates the ultimate analytical power of Insights for ArcGIS: simultaneous visualization and analysis. The app allows Mapwoman to link the cards so that she can interact with more than one map or chart at a time.

With this, Mapwoman can now see where all the houses in the new development go—with accurately geocoded street names and addresses—and which new families are supposed to move into each unit. A job well done!



## THE ODYSSEY'S NOT OVER

But while Mapwoman is patting herself on the back, thinking of how to spend the rest of her afternoon (since the mission took far less time than she thought it would), she learns that Silo's wizarding brother, Joe Jumble, is planning to sabotage other new developments with comparable demographic and lifestyle compositions. But Mapwoman doesn't know which subdivision he will target first or when he is planning to strike.



## Mission 1: Forecast the Future

Confident in her GIS skills, Mapwoman decides to take on this quest as well. To ensure success, she knows she will need to predict and model spatial phenomena using the discoveries she made in Insights for ArcGIS. This is a job for ArcGIS Pro.

The ultimate in spatial analytics, ArcGIS Pro has an assortment of powerful geoprocessing tools that can tackle the most complex problems. Mapwoman easily brings in her findings from Insights for ArcGIS as a feature layer. Using tools that conduct statistical analysis, interpret imagery, and do analysis in 3D, Mapwoman easily evaluates, accesses, and deciphers Jumble's travel patterns. In no time, she identifies the three new developments that the wizard is planning to strike and on which specific days. She immediately alerts Plotland's authorities so that they can take action to protect their subdivision data.

## Mission 2: Share the Whole Shebang

Just in case a similar issue ever arises again, Mapwoman sends officials the Insights for ArcGIS workbook that she created when diffusing the initial Metadata Meadows situation. Authorities can then use the workbook, plus the workflow steps that Insights for ArcGIS automatically modeled and recorded, to repeat her analysis with a different dataset or delve deeper.



## THE FINAL MISSION

Make this tale a reality and be the GIS hero in your organization. Visit [go.esri.com/InsightQuest](http://go.esri.com/InsightQuest) to learn more about Insights for ArcGIS.

# Hamburg Secures Big Events with Smart Policing

With the risk of terrorism and public violence growing in certain parts of the world, emergency responders face an immense challenge: to get dangerous situations under control quickly without restricting too many freedoms. Maintaining this balance requires figuring out which measures are necessary and what actions might step over the line, as well as how modern technology can help track these risky situations.

When the Ministerial Council of the Organization for Security and Co-operation in Europe (OSCE) met in Hamburg in early December 2016, the German city had to conduct the largest police operation it had ever orchestrated, with 14,000 police officers providing security and protection. And this was only a warm-up for the G20 conference that's scheduled for July, when government and financial leaders from industrialized and emerging economies around the world will gather in Hamburg to discuss how to shrink disparities in development and minimize poverty.

Although police work often involves bringing a wide range of data—such as live traffic feeds, maps of emergency responder positions, and

geodata from different government agencies—together in command centers, the Hamburg Senate determined that these two events required a new solution. The idea was to pool all the data together in a shared geoplatform where people working at every level of the command structure could access the information in real time. The backbone of the geoplatform—and of Hamburg's smart policing initiative—would be ArcGIS.

## Sharing Data Rapidly and Securely

To make everyone's information work together seamlessly, Esri partner Eurocommand built CommandX, a 64-bit system that communicates with ArcGIS Server and Portal for ArcGIS—both components of ArcGIS Enterprise, which lets users run enterprise GIS on their own infrastructure and behind firewalls. CommandX enables data to be shared rapidly and securely. It has a bidirectional interface with ArcGIS, so users get live access to the basemaps, layers, and data and can edit services and save web maps.

With this, personnel at all levels of the police and firefighting command structures can use the layers and local data—which are housed in a central geoplatform—to describe the on-site situation. Additionally, staff in operations centers now use Bluetooth-enabled electronic whiteboards from hardware and software developer SMART Technologies to adjust situational

data simultaneously. So everyone involved in the exercise can always see the most current planning and situational information on a map.

With CommandX and the new hardware, all members of the command structure can receive a realistic picture of the on-site situation without being there themselves. Thus, emergency responders for the OSCE meeting in Hamburg were going to have a crucial advantage that they hadn't had before: the ability to get ahead of a problem and act with confidence instead of merely reacting to an escalating situation.

## Making Crucial Decisions Right Away

Getting to this point meant that there was a lot to do in a short amount of time. In all, it took three months for the Hamburg police—working with Esri, Eurocommand, SMART Technologies, and information and communication service provider Dataport—to implement the concept. Additionally, Esri and Eurocommand spent four weeks training the 700 police staff who would be engaging with the system as viewers, publishers, and administrators.

The first trial run of the geoplatform happened on October 8, 2016—the day Germany's national men's soccer team played the Czech Republic in a 2018 FIFA World Cup qualifier game at Hamburg's Volksparkstadion. Not only did the German team play together smoothly, winning 3–0, but all the agencies running security for the game, which drew a reported 51,000 fans to the stadium, worked together seamlessly as well. The reconfigured technology delivered good results.

On December 8, the Hamburg police were ready to coordinate security for the two-day OSCE meeting. For the event, 10,500 local police officers worked with 2,700 members of the German federal police and 700 members of special forces units. Approximately 3,000 police vehicles were on the road to protect the 1,500 accredited conference participants.

Before the OSCE meeting got under way, employees from the top command unit of the police assembled in front of a large video screen with liaison officers from the fire department, homeland security organizations, the federal police, the elevated railway system, and the armed forces. With all the information in front of them, they were able to make crucial decisions about unit movement and road barriers on-site, right away. The OSCE meeting took place without any incidents, thanks in large part to the coordinated security.

## Smart Policing Every Day

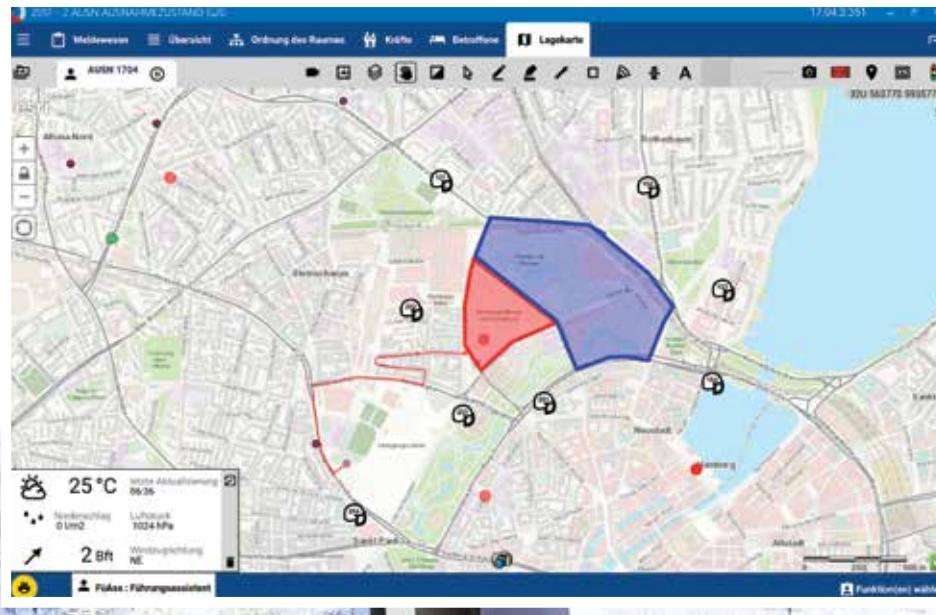
Using the new system for the OSCE meeting was largely a learning opportunity for how to use trailblazing technology and get a large command staff to work together and with people in the field. In the lead-up to the G20 conference, the Hamburg police have optimized digital connectivity between police headquarters and on-site personnel so that everyone uses the same digital map to get the same view of the event. Additional content has been added to the geoplatform, and further infrastructure improvements have been made as well.

Using CommandX, along with the geoplatform and other smart technologies, doesn't have to be limited to coordinating security for big events, either. In the long term, the Hamburg police intend to use components of this system to support their everyday work in smart policing. Having such a vast network of interconnected data could help the police analyze burglary statistics, for example, to predict where organized groups of burglars are most likely to strike. Additionally, the department could survey social media data to forecast protester movements during demonstrations.

By making security forces more effective every day, this system also makes Hamburg safer and more secure.

For more information, email Heiko Claußing of Esri Deutschland GmbH at [h.claussing@esri.de](mailto:h.claussing@esri.de).

▼ In the lead-up to the G20 conference, the Hamburg police have optimized digital connectivity between police headquarters and on-site personnel so that everyone gets the same view of the event.



For a recent meeting of the Ministerial Council of the Organization for Security and Co-operation in Europe (OSCE) in Hamburg, local police officers worked with federal agencies using a shared geoplatform so that people at every level of the command structure could access information in real time.



# USC Students Analyze Crime with Los Angeles GeoHub

A group of students from the University of Southern California (USC) recently used open data from the Los Angeles GeoHub to build an app that better explains crime in the city over the past 10 years. The project, called A Spatial Analysis of Street-Level Crime Trends in Los Angeles, was initiated in fall 2016—less than a year after Los Angeles launched its GeoHub, a public platform that allows anyone to explore, visualize, and download location-based open data.

The USC students used GeoHub data and geocoding to assign a street to each crime. They created a mapping app that brought the crime data together with social and built-environment characteristics, incorporating variables such as unemployment rates, the presence or absence of street lights, and proximity to metro rail and bus stops. The team then analyzed the data according to specific street segments.

"We want our students working on real problems with real people and real data," said spatial sciences and sociology professor John Wilson, who also directs the USC Dornsife Spatial Sciences Institute (SSI).

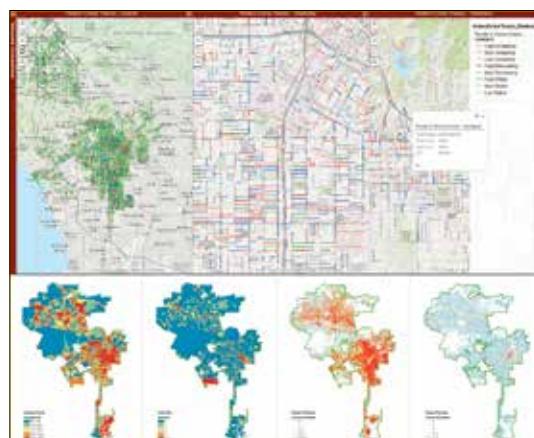
The SSI research team—which consisted of USC postdoctoral research associate Noli Brazil, GIS project specialist Beau MacDonald, graduate student Yuqing Qian, and undergraduate students Robin Franke, Izzy Mitchell, Leo Ngo, Kyra Schoonover, and Richard Windisch—presented its findings to Los Angeles mayor Eric Garcetti's deputy mayors, his data team, the Los Angeles Police Department (LAPD), and representatives from other city departments and agencies. The presentations demonstrated how a mapping app can uncover important crime patterns and how, by implementing a street segment approach, city leaders can better understand where and when crime occurs.

"The students brought us an innovative approach that will be tremendously useful as the mayor's office, LAPD, and other city stakeholders work to develop policies

and strategies to improve community safety," said Brian Buchner, Garcetti's policy director for public safety. "This mapping application is an important addition to our toolbox and directly supports the mayor's emphasis on making data-driven decisions."

Windisch, a Los Angeles native and a junior at USC majoring in geodesign, is enthusiastic about the potential of data troves like GeoHub to help cities run more smoothly. "I was able to see the importance of my degree in spatial sciences and how it can benefit an entire city, as well as improve the understanding of Los Angeles' working parts through the lens of different city departments," Windisch said. "I truly envision the LA GeoHub opening a door to better understand spatiotemporal patterns in crime occurrence, support the ability to better deploy city resources, and make policy changes that improve public safety."

Explore Los Angeles' open data at [geohub.lacity.org](http://geohub.lacity.org).



↑ The students created a mapping app that brought geocoded crime data together with social and built-environment characteristics, such as unemployment rates and the presence or absence of streetlights.

# A New Experience for ArcGIS Developers

The new ArcGIS Developer Program has arrived. It is simpler and more flexible, and members get access to the software and resources they need to build, manage, and deploy apps as quickly as possible.

Members of the ArcGIS Developer Program receive a new, free ArcGIS Developer subscription and credits for developing and testing apps. They also have access to web and native client APIs and SDKs; conceptual API reference documentation; a vast library of developer samples; basic online app builders; and a large GIS developer community to collaborate with via GitHub, blogs, and forums.

To leverage the capabilities of the ArcGIS platform, members can choose a subscription plan that best aligns with their development skills and business objectives. Plans are tailored to development work and provide cost-effective access to ArcGIS developer products. This makes it easier to enhance, supplement, and complement ArcGIS capabilities or build complete industry-focused solutions.

The Esri Developer Network (EDN) is also now unified with the new ArcGIS Developer Program, so members get the best of both programs while receiving the benefits that EDN developers have grown accustomed to.

All developers who enroll in the ArcGIS Developer Program automatically receive the **Essentials** plan—which they can use to build, test, and deploy apps—along with 50 monthly service credits and access to community support. To reflect how different types of developers use the ArcGIS platform, Esri also now offers four new paid subscription plans: the **Enterprise** plan for advanced analysis and high-end cartography; the **Premium** plan, which has a complete set of GIS editing capabilities; the **Professional** plan for automating tasks and creating new functionality in ArcGIS Enterprise and ArcGIS Pro; and the **Builder** plan, which helps developers kick-start projects using configurable apps and builders.

Whether building GIS apps for the first time or extending the ArcGIS platform yet again, the ArcGIS Developer Program now has a subscription to match any developer's needs.

To learn more about the new ArcGIS Developer Program and enroll in it, visit [developers.arcgis.com/pricing](http://developers.arcgis.com/pricing).

An advertisement for Trimble and Esri. It features a surveyor in a wetland area, wearing a yellow vest and holding a surveying instrument. The background shows water and greenery. The text on the left reads: "With Trimble and Esri® delivering innovative ways to collect and output the highest quality data to and from your GIS, your organization is empowered to make the best decisions leading to better business outcomes. See how Trimble solutions provide you with enhanced deliverables in ArcGIS®. Visit us at Esri UC 2017, Booth #1627." The Trimble logo is at the bottom right.

# Feasting on Geospatial

## Geospatial App Developers Devoured Information

Developers and partners play a highly important role in the ecosystem of geospatial app development for Esri. They take Esri technology, customize it, and create apps for colleagues and customers, all while offering Esri feedback. These apps are used in various ways: to help companies plan and manage fiber-optic networks, enable utilities to track power outages, and aid scientists in monitoring climate change. If there's a location-based job to do or analysis to run, there's likely an app for it.

In opening the 2017 Esri Developer Summit (DevSummit) in March, Jim McKinney, the chief technology officer for desktop software development at Esri, underscored how crucial developers and partners are to Esri's mission.

"You, as developers and as partners, do make the maps and apps that run our world," he told the audience of 1,800 people during the Plenary Session.

Over four days, attendees feasted on information in tech sessions devoted to both Esri-built technology and the tools the company leverages to power developers' apps: ArcGIS Runtime SDKs, ArcGIS API for JavaScript, ArcGIS Enterprise, ArcGIS API for Python, Python and R, Calcite maps, Esri CityEngine, ArcGIS GeoAnalytics Server, ArcGIS GeoEvent Server, Insights for ArcGIS, and Web AppBuilder for ArcGIS.

People also attended packed sessions and demo theaters to learn about topics such as emerging technology for indoor routing and tracking, big data and real-time analytics, extracting feature data from imagery, and how to customize map pop-ups using Cascading Style Sheets (CSS) and JavaScript.

Andrea Hemphill, a system administrator for the Riverside County Fire Department in California, goes to the DevSummit every year to find out where Esri technology is heading. The event is always a learning experience.

"It inspires innovation and to think outside the box," Hemphill said.



# Technology

## at the Esri Developer Summit

### The Science of Where

At the root of such innovation and outside-the-box thinking is what Esri president Jack Dangermond calls The Science of Where.

"It's the science of geography and the tech of GIS brought together," Dangermond said in his welcome remarks.

For developers who use the ArcGIS platform, melding geographic science and GIS technology to produce apps can be powerful.

"The Science of Where transforms the world by unlocking the full potential of data within organizations everywhere," Dangermond said.

Esri partner 3-GIS taps into The Science of Where when using Esri technology to develop GIS solutions that help plan, design, and manage fiber-optic networks. Tom Counts, the company's president and chief executive officer (CEO), said municipalities that invest in fiber-optic networks need to analyze data to find out where it makes the most financial sense to lay the initial fiber-optic cable.

"They still want to cover all of their constituents, but if we can give them a build order—and I think Insights for ArcGIS and ArcGIS GeoAnalytics Server can help us do that—*[it will]* start returning value on that big capital expenditure they are going to *[make]*," he said. "It's The Science of Where, absolutely."

The tech sessions led by Esri staff were popular with many attendees. Counts and his developers were devouring as much information as possible from the presentations.

"What's got me kind of jazzed *[is]* Insights for ArcGIS *[with]* the ability to allow our customers to get more value out of their data," Counts said.

He's also excited about ArcGIS GeoAnalytics Server and its powerful new analytical tools that make sense of big data.

"I *[had]* a bunch of guys in *[a session]*...absorbing as much about GeoAnalytics Server as possible," Counts said.

### For Developers, By Developers

The summit's theme is always For Developers, By Developers. The technical sessions and product showcase are built around that mantra, as is the Plenary Session, where Esri staff take the stage to talk developer to developer.

This year, Esri director of software development Sud Menon kicked off the presentations and demos with a brief, high-level overview of the ArcGIS platform, a system for managing and applying geographic information.

"Users are working with information and using applications that connect to the platform," Menon said. "The platform provides identity—an information model that's made up of maps and scenes, layers, analytics, and also dashboards, *[and]* story maps, as well as other information products."

The platform is powered by services, Menon said. "Those services expose and work with data," he explained. "This makes this platform truly distributed. You can implement it on-premises or in your chosen cloud."

Menon called the new ArcGIS Enterprise 10.5—which includes ArcGIS Server, Portal for ArcGIS, and ArcGIS Data Store—"a really big release."

"It's a complete GIS in your own infrastructure, and it includes all of the familiar components that you expect," he said. "It's got the portal, it's got GIS servers, and data stores."

But Esri added a number of new capabilities, such as the specialized servers, which include ArcGIS Image Server, ArcGIS GeoEvent Server, ArcGIS GeoAnalytics Server, and ArcGIS Business Analyst Server.

"*[The servers have]* become more decoupled; they've become more focused on their purposes," Menon said.

ArcGIS Enterprise 10.5 also supports portal-to-portal collaboration, Menon pointed out. Enterprise systems in each department can share live content through a central, enterprise-wide portal using item replication. For example, in a large organization, departments such as operations, engineering, planning, and customer service could share information with one another.

Menon's subsequent presentation on ArcGIS Online included some eye-popping statistics: the cloud-based mapping platform has 3.8 million current users, 1 billion map views per day, and 18.8 million open data downloads.

"ArcGIS Online is ArcGIS available as SaaS," or software as a service, he said. "It's very popular. You're making amazing use of it."

## Building Native Apps

For native app developers, Esri's chief technology officer of developer technologies, Euan Cameron, shared some good news: there will be two updates this year to the ArcGIS Runtime SDKs version 100.0. One of the updates, scheduled for November, will be for stand-alone apps.

"It's to support building apps that are completely stand alone from the platform...completely disconnected," Cameron said. Developers using ArcGIS Engine or MapObjects to build their apps will be able to move to ArcGIS Runtime. Their apps will have superior performance, and they can target all the modern mobile devices.

Cameron also introduced the new open-source ArcGIS Runtime Example apps, which focus on real-world scenarios. Built with ArcGIS Runtime SDKs, Example apps can help developers get started on their next Runtime apps.

Sandie Peters, from Esri's Android Runtime team, demonstrated an Example app for indoor mapping. Using the mobile Example app with an indoor map of Esri headquarters, she created a route from her office to the site of an on-campus meeting. The app even calculated the time it would take Peters to make the walk.

Robert "Bert" Meier enjoys seeing what's new from Esri each year. As an app developer and employee-owner at Esri partner Bartlett & West, an engineering and technology company headquartered in Kansas, Meier is always looking for timesaving technology. He does a lot of work for railway companies, creating complex mapping apps for managing infrastructure and property.

Meier believes he has found a time-saver in AppStudio for ArcGIS. He arrived in Palm Springs

before the official start of the DevSummit to take the presummit hands-on training session Build Native Apps Using AppStudio for ArcGIS.

AppStudio for ArcGIS gives developers the ability to create mobile apps for iOS, Android, Windows, Mac OS X, and Linux devices by writing code once rather than having to rewrite the code for each environment.

"This lets you write it once *[for]* all those different platforms," Meier said. "It's going to be a big time-saver."

Attending the Esri DevSummit is important for Meier because he wants to keep up with what's happening in the ArcGIS world and with technology overall. There's a lot to know, and that makes Meier's job challenging.

"It's harder in the respect that there is so much to know *[now]* as a developer," said Meier, who began using Esri technology in 1992. "The breadth of what you need to know or can know is so wide. And things change so fast that you have to be willing to change with it or *[you'll]* get left behind. If you realize that and embrace it, you shouldn't have a problem."

### Data Streams

Things also are changing fast in the world of live data streaming. Todd Greene, cofounder and CEO of PubNub, gave developers a taste of what's new and what's coming next for data streaming during his DevSummit keynote speech.

His company provides customers with a real-time data stream network in the cloud, as well as APIs for developers who create mobile, web,

and Internet of Things (IoT) apps. In addition, the company offers real-time analytics, presence, and secure access control.

"The demands of data streams and data stream-based real-time applications are completely changing what we need from an infrastructure perspective," said Greene, who believes that data and technology are going through another big revolution.

He said PubNub provides real-time communication APIs that let developers do things such as create real-time messaging apps and embed app logic in the network using PubNub BLOCKS, which allow developers to build real-time apps without worrying about infrastructure. Esri has released a geocoding BLOCK, for example, that gives developers the ability to use Esri's geocoding service and apply it to real-time data. PubNub developers can use the ArcGIS REST API: World Geocoding Service to convert addresses or place-names into latitude and longitude coordinates and map them in their app.

Greene said that PubNub's network has a quarter-second latency period. "Any message that's published in our network will be received by any other device in a quarter of a second," he said.

Common uses for PubNub's real-time data stream network include chat, taxi dispatch,



Todd Greene

↑ The keynote speaker said that real-time data streams are altering what's needed from an infrastructure perspective.

and smart home apps; multiplayer games; and drones that send real-time information to and from the Internet.

Real-time data streaming also works well with mapping, according to Greene. He showed how a live data feed of community-sourced airline flight data published in PubNub could be displayed on an Esri basemap.

"Usually you see explosions in the adoption of new technology—in this case, real-time mapping—when (a) the data and the APIs are available *[and]* (b) the ease of being able to leverage them is exposed to a much wider audience," he said.

Greene's talk fascinated app developers, including Jamie Thompson from Esri partner GEO Jobe.

"I thought that was insanely interesting," she said. "I am going to check out PubNub to see what I can do to get started."

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# Geospatial Maturity Matters

## Smart Communities Need to Be Technologically Fit for the Future

By Simon Navin, Ordnance Survey

Increasingly, cities and citizens are having to confront global trends such as growing urbanization, escalating poverty, reductions in public services, and financial pressures from governments and administrations. But over the last decade, technology development has been exponential, creating a brave new world of opportunities to harness geospatial intelligence for societal good. High-quality geographic data can now enable effective decision- and policy-making in government. It can support sustainable development and deliver real benefits to a community, region, or nation.

Having accurate location and attribution information, combined with a working knowledge of assets and resources, helps authorities design and focus public services and engage

citizens early in these processes. And as cities get smarter through the proliferation of sensors and the Internet of Things (IoT), the way these services work can be adjusted in near real time. Thus, governments and businesses around the world are recognizing that they need to be geospatially fit for the future.

That is why Ordnance Survey, Great Britain's national mapping agency, created the geospatial maturity assessment ([os.uk/gma](http://os.uk/gma)). Organizations and administrations can use the tool to gauge how advanced they are at data collection, corporate governance, stakeholder engagement, operations management, and more. Since geospatial information affects everything—from policies and the economy to an individual's life chances—knowing

the geospatial data a community has available and how to use it most efficiently is key.

Organizations and administrations that have a rich understanding of information about location and place are more likely to respond skillfully to evolving global challenges. With the right infrastructure, the right data management methods, the right technology, and the right capabilities, cities can realize their geospatial potential.

Manchester, in the United Kingdom, is leading an IoT/smart city demonstrator project called CityVerve, in which geospatial data is being used to support and empower citizens and decision-makers. Ordnance Survey has captured location and attribution data about thousands of street-based assets—such as lampposts, road signs, and manholes—and is using ArcGIS Online and other editing tools to manage and visualize the data. The mapping agency is also sharing the information with project partners, who are working with community groups to understand the problems they need to solve and how CityVerve can help them create solutions. All this is helping Manchester reach its geospatial potential.

Making certain lamppost information public, for example, not only aids Manchester's city council in managing and maintaining a resilient lighting system, but it can also help city officials plan the deployment of air quality and noise sensors or assist startups in developing urban navigation solutions. Having data on parking and road markings can support the city council in capacity planning and ensuring compliance with regulations. It can also assist technology companies or transportation authorities with building real-time services for drivers.

What's more, making this geospatial data available through an open standards approach promotes interoperability and innovation. Ordnance Survey actively champions the development of open standards to maximize the value of organizations' location data, allowing

their information to reach more users and create more opportunities.

Accurate and open data from Ordnance Survey already underpins IoT, 5G, and driverless vehicle test projects, as well as other smart ventures, in Manchester and across the United Kingdom. Having mature geospatial data and services is the only way to support undertakings like these, which ultimately help cities make smarter location-based decisions, save money, and improve the lives of their citizens.

When organizations, cities, and regions understand how mature their geospatial data and processes are, they can begin to meet their objectives—opening up more data, ensuring better transparency, and reducing costs. Ordnance Survey International can help organizations and administrations refresh their geospatial strategies, improve the management and flow of information, and optimize their operational processes.

Take the geospatial maturity assessment now at [os.uk/gma](http://os.uk/gma) and see how making improvements to geospatial data and services can help transform your city.

*Ordnance Survey maintains Great Britain's fundamental geospatial reference base, OS MasterMap. Ordnance Survey International, which helps customers all over the world develop their geospatial capacity, is a wholly owned subsidiary of Ordnance Survey.*

### About the Author

Simon Navin is the program manager for smart projects at Ordnance Survey. He currently manages, coordinates, and delivers the organization's smart/IoT sector ventures, including CityVerve, the United Kingdom's key IoT demonstrator project. Navin is a chartered surveyor (MRICS) and a member of the Chartered Institution of Civil Engineering Surveyors (MCIInstCES), Anglia and Central Region committee. Follow him on Twitter at @sharkholio.



↑ Administrations that have a rich understanding of data about location—like Manchester is getting of air quality issues—are more likely to respond skillfully to evolving global challenges.

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# Interoperable Data Formats Enhance Policy Decisions in the Arctic

## Web Mapping App from Esri Canada Helps Diverse Countries and Indigenous Populations Share Data

The Arctic is getting a lot of attention these days. Sea ice in the region was at a record low this winter for the third straight year, according to scientists at the National Aeronautics and Space Administration (NASA) and the National Snow and Ice Data Center in Colorado. So governments around the world are more concerned than ever with monitoring and assessing the Arctic's environmental challenges, resource potential, sea transport, and sovereignty. These issues are primarily pan-Arctic, and addressing them often requires international collaboration.

The Arctic Council, a high-level intergovernmental forum that promotes cooperation among Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States, plus local indigenous communities, is a leading organization for action on Arctic issues. To improve pan-Arctic decision-making through enhanced geospatial data sharing, the council initiated the development of a spatial data infrastructure (SDI) for the Arctic in 2009. A voluntary cooperation among the eight Arctic countries' national mapping agencies—including the United States Geological Survey (USGS) and Natural Resources Canada (NRCan)—the Arctic SDI seeks to give

politicians, governments, policy makers, scientists, and private enterprises access to reliable and interoperable geospatial data, tools, and services.

In 2015, to support the strategic goals of the Arctic SDI, the USGS and NRCan began the Arctic Spatial Data Pilot (Arctic SDP) project, which demonstrates the advantages of enhanced data sharing. The pilot project, managed by the Open Geospatial Consortium (OGC), was completed in early 2017.

Esri Canada was significantly involved in the Arctic SDP project, which was designed to exhibit the value of interoperability standards by demonstrating how different systems can be integrated when they connect to geospatial web services and data repositories. After the project sponsors decided to focus on policy issues related to Arctic food security, Esri Canada developed a demonstration app that would serve as a "policy workbench" for examining Arctic food security issues.

### Building the Policy Workbench

Because policy analysis, development, and monitoring require input by and communication among many policy makers, Esri Canada decided that a shareable web mapping app would be used as the technology behind the Policy Workbench. This would allow policy makers to use a single tool to view, analyze, and share maps and data.

Esri Story Maps apps, available in ArcGIS Online, were selected as the best solution to meet the requirements of having a comprehensive, one-stop, simple-to-use, multiparticipant app for Arctic policy makers. Esri Canada chose the Esri Story Map Series app template in a tabbed layout to clearly present various types of information.

With the story map, a policy maker could look for information related to polar bears, for example. To find and view geospatial data, the policy maker would go to the Find Data tab; select a catalog search site, such as Esri Geoportal

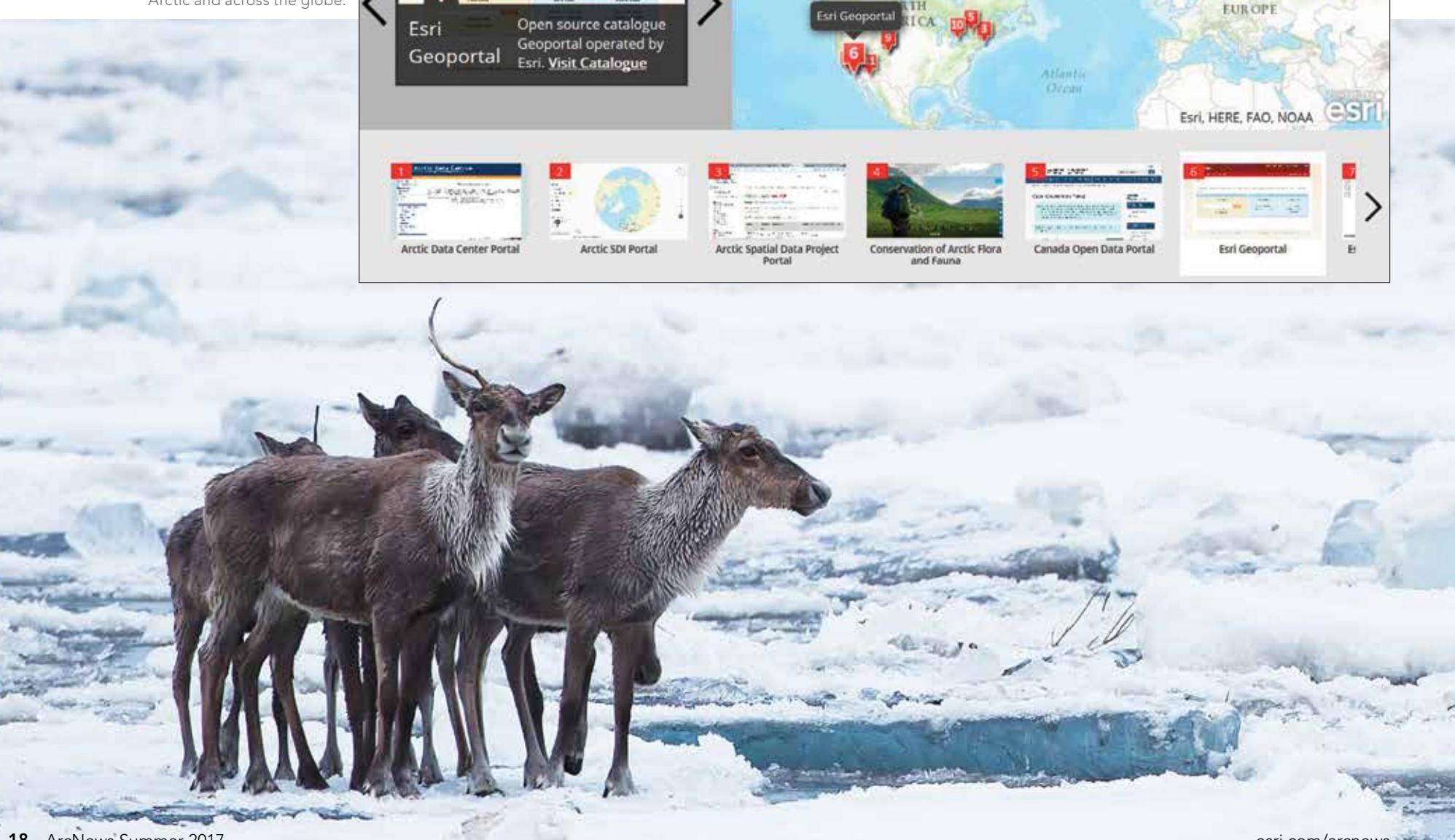
Server, and run it outside the story map in ArcGIS Online; search for the term "polar bear"; and examine the results. Once the policy maker selects a dataset, he or she can copy the service URL from the catalog site and paste it into the Add Web Layer box in ArcGIS Online. With the data loaded, the policy maker can examine the polar bear data in relation to other Arctic spatial data.

### Detecting Change Through Imagery

The Policy Workbench also provides users with immediate and dynamic access to Esri's massive Landsat imagery services collection, which contains more than 30 years of Landsat satellite imagery. The demonstration app interacts with Landsat services using the ArcGIS REST API, which makes it easy for peers to exchange information in a decentralized, distributed environment. Policy makers can also load their own map services on top of the Landsat base image to provide further context.

The screenshot shows the "Arctic Spatial Data Catalogues" application. At the top, there is a search bar with the placeholder text "Find a metadata catalogue and search it for Arctic data". Below the search bar is a map of the Arctic region with numbered callouts (1 through 12) pointing to specific locations. The map includes labels for "NORTH AMERICA", "EUROPE", and "ATLANTIC OCEAN". In the bottom left corner of the map area, there is a callout for "Esri Geoportal". Below the map, there is a grid of seven smaller map thumbnails, each with a number (1 through 7) and a brief description: 1. Arctic Data Center Portal, 2. Arctic SDI Portal, 3. Arctic Spatial Data Project Portal, 4. Conservation of Arctic Flora and Fauna, 5. Our Country's Land, 6. Canada Open Data Portal, and 7. Esri Geoportal. The Esri logo is visible in the bottom right corner of the main map area.

→ Esri Geoportal Server lets users discover and apply geospatial resources—including datasets, images, and web services—in the Arctic and across the globe.



Home

Goal

Food Policy

Find Data

Ref Maps

Landsat

Elevation

Store Food

Country Food

Local Data

Demonstration Application of Arctic Food Security Policy for the OGC Arctic Spatial Data Pilot Project.

The purpose of the project is to demonstrate the use of standardized data exchange formats and interoperability interfaces over the Web in a real world type simulation / application.

A workbench was developed to demonstrate this spatial data interoperability using food security policy issues across the Arctic.

The Web service interoperability method for each example is highlighted in this panel in RED. For example this picture is simply loaded via HTML from URL [http://www.nunatsiaqonline.ca/pub/photos/top\\_photo\\_5.jpg](http://www.nunatsiaqonline.ca/pub/photos/top_photo_5.jpg).



↑ The demonstration Policy Workbench app, built by Esri Canada, presents an array of information, including background on food security and instructions on how to find data, reference maps, and Landsat imagery.

Additionally, the Policy Workbench gives users instant access to the ArcticDEM using the OGC Web Map Service (WMS) standard. This high-resolution, high-quality digital elevation model (DEM) of the Arctic is being produced through a public-private initiative between US and Canadian government agencies, the University of Minnesota's Polar Geospatial Center, and Esri. National mapping agencies from the eight Arctic countries, including the Canada Centre for Mapping and Earth Observation at NRCan, are providing sustainable support for the Arctic DEM initiative by making continuous improvements to the data. The hillshade, slope, and aspect models that are part of the DEM and thus available in the workbench have proved very useful for making policy decisions, since they show, for example, the rugged and steep areas where caribou (an important food source in the Arctic) are unlikely to be located.

### Mapping Food Security

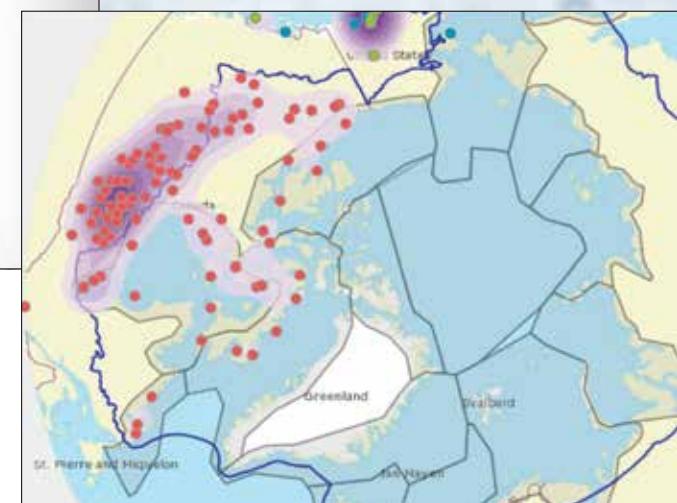
Food security has complex policy implications. That is why the Policy Workbench has maps that show the different aspects of store-bought food, including the locations of major retail food stores, the spatial density of these food stores, transportation routes, and local language areas. These data layers can give policy makers some indication about the propensity of the population in various areas to purchase store-bought food.

If people in a certain region do not have access to store-bought food, they may rely on what's called country food, meaning they regularly engage in hunting, fishing, and gathering. Those who harvest country food can be significantly affected by animal populations, pollution, ice melt, and other issues. However, the country food section of the Policy Workbench currently only provides demonstration information on a fraction of what affects country food, such as land cover and where hunting, fishing, and gathering are not allowed.

Food security, or food scarcity, is often a localized issue that affects only certain areas. The Policy Workbench demonstrates how integrating local large-scale map data with available smaller-scale map data can aid in examining food security policy issues.

### A Game-Changing Venture

As the Policy Workbench demonstrates, mapping technology and web services are immensely helpful for informing policy decisions in a place as large, diverse, and critical as the Arctic. The workbench also aids both the United States and Canada in achieving their domestic objectives for open data standards and interoperability. It is imperative that the information coming from various governments, companies, nonprofits, and communities can work together, which is why the Arctic SDP project was so pivotal.



↑ The Policy Workbench has maps that show where store-bought food is available in Arctic regions.

"The [Arctic SDP] project will ensure that the facts we collect in their data formats are interoperable and can be shared from local to global partners in a seamless way," explained Prashant Shukla, the director general of the Canada Centre for Mapping and Earth Observation at NRCan. "To date, there has been no such effort to do this, and this project is, for the Arctic, a game changer."

To learn more about the Policy Workbench, read the Esri Canada blog post, "How can an SDI be used for policy decision-making in the Arctic?" at <http://p.ctxly/r/47lp> or contact Gordon Plunkett, Esri Canada's director of SDI, at [gplunkett@esri.ca](mailto:gplunkett@esri.ca).

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# Predicting the Weather with Advanced GIS

Employing Big Data, Weather Decision Technologies Conducts Analysis in the Cloud

Earth's ever-changing weather patterns are deceptively simple to explain. The sun warms our planet unevenly (think of the hot and humid equatorial regions versus the frigid north and south poles), and that causes weather. Our atmosphere redistributes this heat, creating high and low areas of pressure throughout the world. This results in the development of clouds, winds, precipitation, and widely varying temperatures.

Because of the size and complexity of these weather patterns, they can be very difficult to predict more than a few days in advance. So researchers continually refine their instruments and processes to better understand the climate and make more accurate weather forecasts.

Today, with an abundance of satellites and remote-sensing devices monitoring weather systems all over the world, meteorologists have more data available to them than ever before. But more data doesn't necessarily translate into improved predictions, which is why Esri partner Weather Decision Technologies (WDT) uses advanced GIS to better organize and analyze this big data.

## Advances in Weather Surveillance

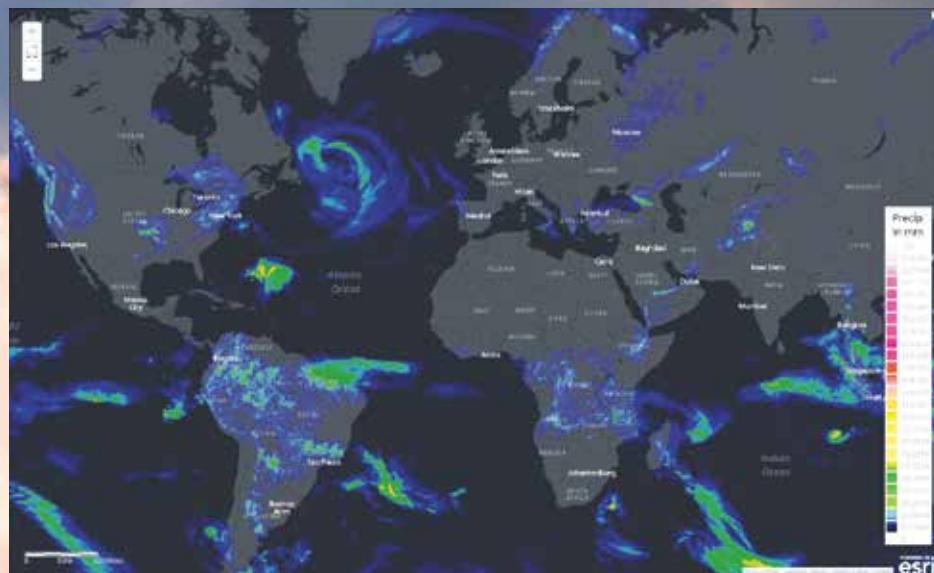
Weather has always had an enormous impact on our planet and the things happening around it. Monsoons reportedly hindered the Mongols from invading Japan in the thirteenth century, and winds certainly played a role when, in 1588, the English defeated the Spanish Armada, since the powerful flotilla could only sail with the wind at

its back. Clouds spared the Japanese city of Kokura from being the target of the second atomic bomb in 1945, and over the last few years, drought in the western United States has affected food production and prices all over the country. That is why monitoring the weather has always been imperative.

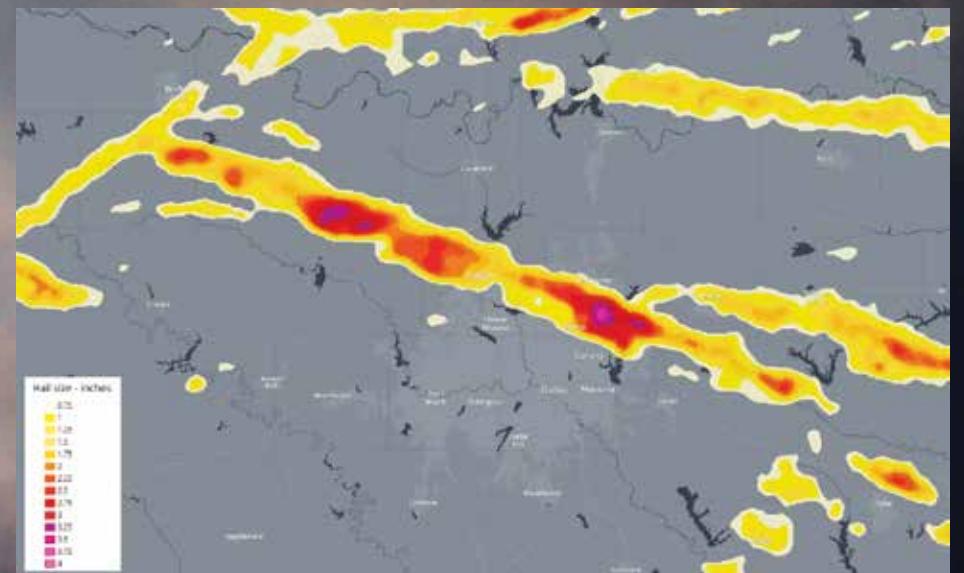
During the Renaissance, inventors created various instruments to measure local weather phenomena, including temperature, humidity, and atmospheric pressure. When Samuel Morse developed the telegraph in the 1800s, local weather observations and measurements were connected in a rudimentary weather surveillance system. The secretary of the Smithsonian Institution at the time, Joseph Henry, envisioned that the telegraph would "furnish a ready means of warning the more northern and eastern observers to be on the watch for the first appearance of an advancing storm." By the end of 1849, 150 volunteers throughout the United States were helping to make that a reality by regularly reporting weather observations to the Smithsonian. That's when the science of meteorology emerged.

When computer technology was introduced to weather forecasting in 1950, a group of meteorologists at the Institute for Advanced Study in New Jersey produced the first numerical weather prediction. This ushered in the era of modern meteorology and greatly expanded research opportunities.

To better understand developing weather patterns, however, researchers needed



↑ With Weather Decision Technologies' time-enabled global forecasts map service, users can see each day of a 10-day precipitation forecast, like this one.



↑ Users can quickly add past, present, and future weather data to their maps and apps to analyze, for example, how hail in North Texas contributed to more than \$1 billion in losses.

satellite imagery. This came in 1964 with the introduction of the Nimbus program. These satellites were specifically designed for meteorological research and paved the way for most of the earth observation satellites launched by the United States over the last 30 years. The satellites provide tremendous amounts of data.

### Analyzing Clouds in the Cloud

All the data from satellites and remote-sensing devices found both on land and in the oceans is greatly helping to improve weather forecasting services.

"The amount of data that we collect is enormous, about one terabyte per day," said Matt Gaffner, GIS solutions expert at WDT. "Over the years, we have assembled an archive of almost half a petabyte of weather data."

WDT provides weather forecasting and mapping services to a number of industries, including energy corporations, to help them predict electrical outages and keep offshore oil rigs safe; agriculture agencies for crop insurance; freight transportation companies to aid with route design; and concert and sporting event organizers for planning and safety. The company currently uses ArcGIS Server to develop all its map services for customers, though it plans to upgrade to ArcGIS Enterprise later this year.

"One of the great things about the ArcGIS Server platform is that it's extremely easy to publish live, dynamic, rapidly

updated data and then host it as a service for use with other applications," said Gaffner. "This allows our users to quickly add past, present, and future weather data to their maps and apps."

It also enables WDT's partners that build apps for specific vertical markets, such as utilities, to add weather data to their apps using WDT's map services.

Because of the quantity of data WDT collects and analyzes, cloud computing is key to its operations. The company uses Amazon Web Services (AWS) to deploy the analytical and mapping services provided by ArcGIS Server.

"There are so many advantages available to us by using Amazon Web Services," Gaffner pointed out. "For one thing, it allows us to implement the 'fail faster' mantra. Because ArcGIS Server has an Amazon Machine Image (AMI) capability, we can easily stand up a version of the server in the cloud and try something new—like using different machine hardware specifications or configuring data services differently—to see if it works or not. If it works, great. If it doesn't work, then we stand up another instance and try something else."

With cloud services, the company can stand up multiple machine instances of ArcGIS Server to determine the operational stack that runs the best.

"AWS provides us with reliability because if something goes wrong, we can easily replicate ArcGIS Server on another machine in the cloud," said Gaffner. "It

also provides us with load balancing—that is, we can redistribute the many requests we receive for weather data and map services between our servers. This extra demand normally happens when the weather changes and storms begin to develop. Our datasets increase in size then because there is more radar data accumulating and our customers need access to that data."

WDT is also currently doing a lot with time-enabled map services. For example, users can loop through the last 60 minutes of radar data to see where a storm has been and where it is headed. WDT is also launching a time-enabled global forecasts map service that will provide both daily and hourly forecasts for all the normal weather variables—such as temperature, precipitation, wind speed, and direction—out to 10 days.

Because the company is serving out bigger datasets to accommodate more requests, using cloud services makes WDT's servers scalable at critical times.

### Environmental Conditions Affect Business—and Decisions

WDT's ever-growing collection of big geospatial datasets allows users to conduct unique analyses across time and space. For example, one of its customers—an oil and gas company—wanted to determine how much the weather affected the productivity of its crews in Oklahoma versus Colorado.

"They wanted to figure out the productivity of each, but they wanted to statistically normalize that comparison by taking

into consideration the local weather conditions," explained Gaffner.

During the summer, it could be 90 degrees in both Oklahoma and eastern Colorado, but with more humidity in Oklahoma, the heat index would likely be higher than in Colorado.

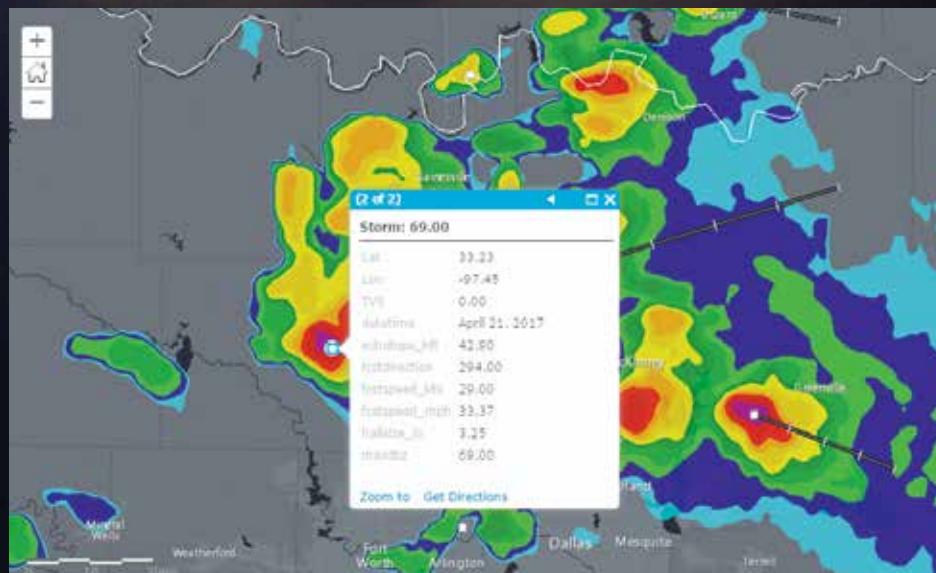
"By using historical weather data," said Gaffner, "we were able to perform this analysis and found that weather can impact crews in two ways: decrease worker efficiency under heat stress and push the heat index above a critical threshold where workers are required to take mandatory breaks."

WDT is also considering the impact that the Internet of Things (IoT) will have on geospatial analysis.

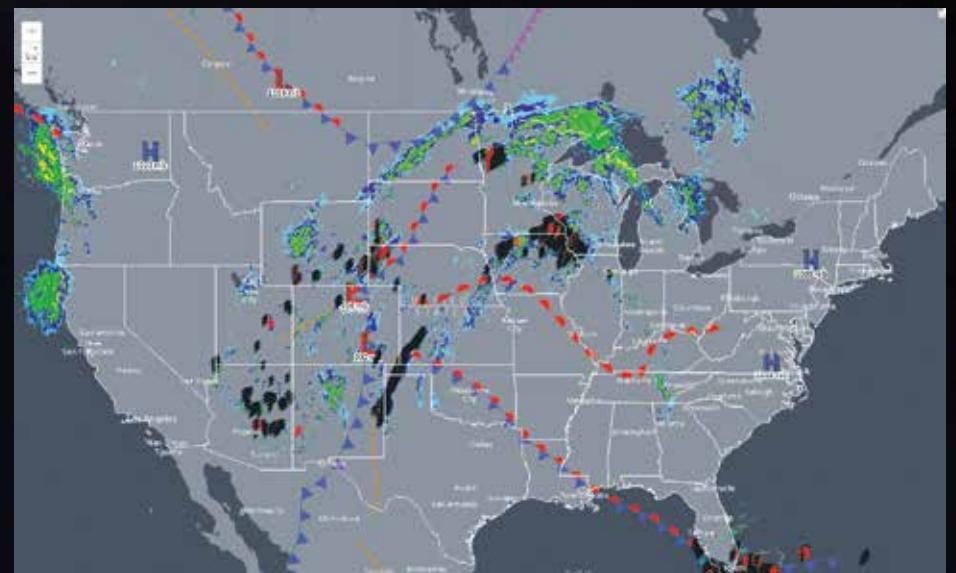
"Take, for example, the connected car," said Gaffner. "We can provide real-time weather or a weather forecast to your car that might tell you, 'Hey, you should probably stop driving to avoid that storm,' or 'There's a line of thunderstorms moving through your area; you might as well stay at work for another 20 minutes and wait until it passes through and then drive home.'"

If weather and environmental data are thus combined, they can help mitigate risk and enable people to make smarter decisions. And, as Gaffner hopes, the confluence of big data with smart analysis can save lives and property in the long run.

For more information about WDT, visit [wdtinc.com](http://wdtinc.com). To learn more about Esri's big data and IoT solutions, head to [esri.com/bigdata](http://esri.com/bigdata).



↑ Overlaying storm motion vectors (the white lines with tick marks) onto radar data with storm attributes lets users see where a storm is moving and how fast.



↑ The ArcGIS platform makes it easy to publish live, dynamic, rapidly updated data. This real-time map service, for example, shows frontal analysis (updated every three hours), North American weather radar (updated every five minutes), and lightning data (updated every minute).

# Tourists Become Citizen Scientists with Sea Turtle Tracking App

Researcher Easily Built His First-Ever App Using AppStudio for ArcGIS

Though sea turtles have cruised the oceans for more than 100 million years, nearly all seven species are now classified as endangered, according to the National Oceanic and Atmospheric Administration. Yet sea turtles can frequently be spotted swimming along ocean currents or crawling onto beaches to lay their eggs.

To help researchers keep track of these marine reptiles, a new smartphone app is giving snorkelers, scuba divers, and beachgoers around the world the power to upload photos and information about sea turtles. The app, called TURT (which stands for Turtles Uniting Researchers and Tourists), ensures that sea turtle sightings can be easily reported by anyone, turning tourists into citizen scientists.

When TURT app users see a sea turtle, they can submit photos, comments and observations, weather conditions, the date and time of the siting, and the geographic location. Once data is added to the TURT app, it is automatically and instantaneously uploaded to a global sea turtle database via a web map stored in ArcGIS Online. Researchers and conservationists can then use the information to analyze trends and hot spots to assess the distribution, health, and migration activities of various sea turtle species.

Dustin Baumbach, a PhD student and researcher at Loma Linda University in California, built TURT using AppStudio for ArcGIS. He worked with Stephen Dunbar, a professor in the Loma Linda University School of Medicine's department of earth and biological sciences. Dunbar has been studying sea turtles for 10 years across the Caribbean and Pacific coasts of Honduras. Baumbach joined Dunbar in his research the past two summers, and in 2014, Baumbach got the idea for a smartphone app that would help sea turtle conservation researchers.

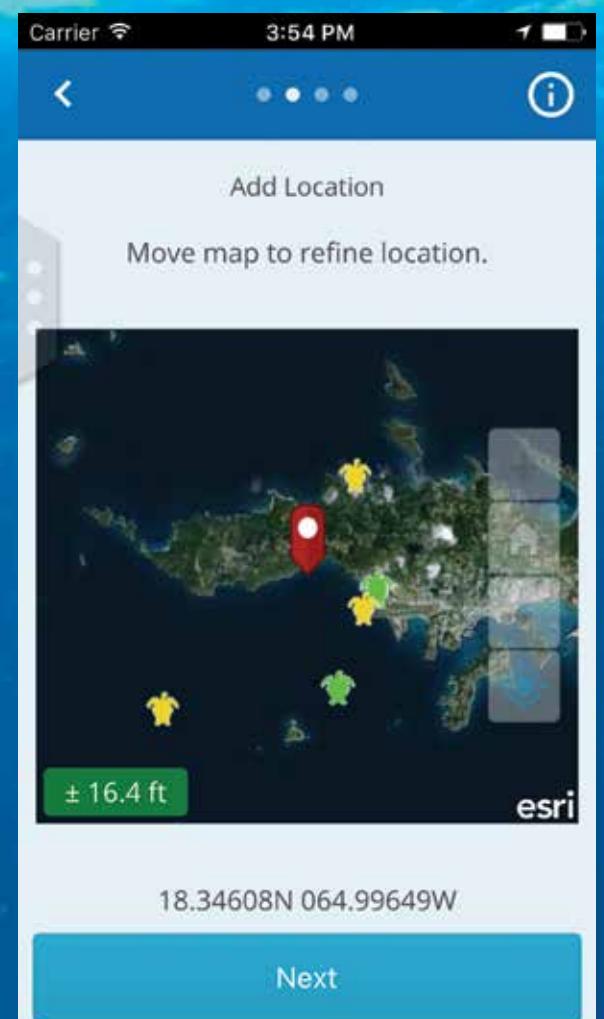
"Researchers are not able to be at their field site all year long, but divers are there every day," Baumbach said. "Sea turtles are a critically endangered species, and this app can help conserve them while also educating other researchers and the public."

Baumbach selected AppStudio for ArcGIS to build TURT because it allowed him to create a consumer-friendly mobile app that works with Android, iOS, Windows, Mac OS X, and Linux. The app can be used in offline mode, so divers in remote areas without cell phone coverage can still record their sightings. Moreover, using AppStudio for ArcGIS let Baumbach publish TURT to app stores using his own brand. In this case, he employed branding from Dunbar's nonprofit organization, Protective Turtle Ecology Center for Training, Outreach and Research (ProTECTOR, Inc.).

"I had never made an app before, but AppStudio was very simple to use," Baumbach said. "I downloaded the app, put all my info into the quick report template, and then customized it using the AppStudio language. Being able to deploy the app across platforms is a big benefit. And it's good that we can brand it through our organization."

Baumbach and Dunbar have started promoting the app to dive operators around the world with a focus on the Caribbean, Thailand, Malaysia, Australia, and Indonesia, since those are places where people have already started uploading sightings. Additionally, the app allows users to map places where sea turtle products, such as souvenirs made from their shells or sea turtle meat, are being sold to help curb these illegal dealings.

The TURT app is free and can be found in the Apple and Google Play app stores.



↑ When users spot a sea turtle, they can use the app to submit photos, weather conditions, and the location and time of the siting.



# Meal Deliveries Get More Efficient with Optimized Routing

For any delivery driver or member of a field workforce, managing a day of stop locations can be tedious and difficult. It's often hard to know the best order in which to visit each destination and tough to determine the quickest routes to take.

In Atlantic County, New Jersey, this problem was presented to Matthew Duffy, a GIS specialist for the Atlantic County Office of Geographic Information Systems (ACOGIS) within the Regional Planning and Development Department. A couple years ago, Duffy and his team used their existing ArcGIS Network Analyst software to create optimized routes for county workers. But they hit a roadblock when it came time to share those routes with drivers in the field.

Then Esri introduced Navigator for ArcGIS for Android devices. Right away, Duffy recognized Navigator as a simple, low-cost solution his team could use to deliver optimized routes directly to drivers via smartphones or tablets.

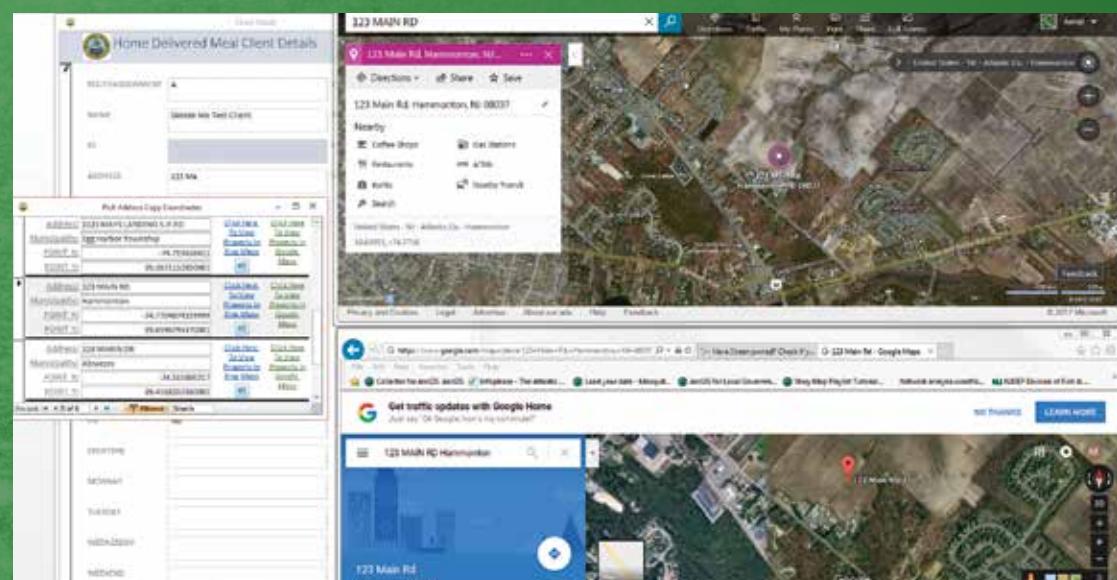
To test Navigator, ACOGIS created a project for the Home Delivered Meals (HDM) program, run by Atlantic County's Department of Human Services supervising manager Alan Knudsen. The HDM program uses five food trucks to deliver nutritious meals to disadvantaged or elderly citizens who are unable to independently make or gain access to meals. The program is supported by five regular

drivers each day, with two or three backup drivers filling in when a regular driver is unavailable.

There were a number of requirements for setting up a Navigator solution for HDM. First, the people serviced by the program often become attached to the drivers who deliver the meals, so Knudsen and his team needed as much consistency as possible in driver route assignments. They also had to develop a routing solution for times when regular drivers were unavailable. They needed to create a solution for when new routes were implemented in one of the county's municipalities as well, considering that two new HDM program routes are expected to be put in place soon in Atlantic City. Additionally, the solution had to be flexible enough to change any given route throughout the week, since there are day-to-day changes in stops when one of the regular meal recipients is away from home or does not need service.

Duffy and his team took all these constraints into account. Using a \$2,000 transportation grant to fund the necessary additional hardware and software, they developed a solution using ArcGIS.

HDM updates its delivery information in a database. ACOGIS accesses this



↑ Drivers access their assigned routes via Navigator for ArcGIS on Android tablets mounted inside their vehicles.

database every afternoon to run a geoprocessing model (created with ModelBuilder) that assigns and sequences the stops and then produces routes for each driver. These routes are then automatically shared with the drivers, who access them via the Navigator app on Android tablets mounted inside their delivery vehicles. Navigator then efficiently guides drivers to each meal delivery location. The app's offline capabilities allow drivers to stay on schedule even when they pass through areas of the county that do not have cell phone coverage.

For HDM program organizers and meal recipients, using Navigator has been effective.

"It's increased efficiency," said Knudsen. "We have noticed fewer calls from meal recipients inquiring about their deliveries."

The solution has also been validated by the drivers. Although they were initially skeptical of the app, they have commended how easy it is to use. Knudsen reports that the HDM drivers appreciate

that they can use the app when they need it and easily turn down the volume when they don't.

"It's given us a lot more flexibility," said Knudsen. "With Navigator, any driver can deliver to any route, whether that is a regular driver following a familiar route or a new or backup driver who is unfamiliar with the routes."

Optimized routing saves the county money and improves the reliability of its services. That is why ACOGIS is planning to expand the use of Navigator to mosquito site inspectors, ideally this season.

In addition, Atlantic County's recent upgrade to ArcGIS Enterprise will now permit the GIS team to create custom Navigator maps using its own authoritative data. This will allow Atlantic County to consistently use its own data (which is maintained in the office) out in the field via Navigator.

To learn more about how to optimize routes with Navigator for ArcGIS, visit [esri.com/navigator](http://esri.com/navigator).

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# Getting a More Accurate Census of the Homeless Population

## Survey123 for ArcGIS Helps the City of Aurora Identify Those in Need

Every year in late January, communities across the United States conduct a count of their local homeless populations. These one-night snapshots are reported to the US Department of Housing and Urban Development (HUD) to provide a better understanding of the scope of homelessness and to measure progress in the effort to reduce it.

In Colorado, the City of Aurora's new homelessness program director, Shelley McKittrick, found a way to get a more accurate count for this year's point-in-time homeless census. She worked with Aurora's GIS team, led by GIS coordinator Bill Keever and GIS specialist Ryan Witsell, to switch from a paper-based system to a map-based app. Using a survey built with Survey123 for ArcGIS, the city—which has a population of about 360,000—identified over 100 more homeless people than the 2016 count recorded and easily documented each person's location.

"We're not trying to sweep our homeless people away," said McKittrick. "We are trying to invite them in and provide them with services.

A dot on a map is not going to help somebody. But it will help to put a dot on a map where we can find someone and offer them socks and food and bring them in for a meal or to see a medical provider."

### Creating the Map-Based App

Building the app was simple. McKittrick sent Witsell a list of questions for the count, and then he used Survey123 to spin them up into a web-based survey.

"The easy-to-use *[user interface]* made it a quick process to drag and drop certain question templates; indicate whether *[the questions]* were multichoice, free form, etc.; and determine whether or not the question was required," recalled Witsell. "In all, the process took me a little over a half an hour."

Less than an hour later, McKittrick's team was out in the field testing the survey. Since using the app didn't require a download, all they had to do was click a link using their mobile devices, and it took them straight to the survey.

### Conducting the Count

On the night of the count, Aurora's 40 volunteers loaded the survey onto their smartphones. McKittrick and Aurora's GIS team conducted a 10-minute training on how to use the survey just before deploying the volunteers into the field. Volunteers then rode around their designated areas collecting data on a no-contact basis, meaning they recorded just what they saw.

The survey form included categories for what type of place each person was staying in, such as a tent, a car, a sleeping bag, a bench, a building alcove, or a park. It also asked about each person's relative age and whether he or she was inside or outside a business district. Additionally, given that the volunteers were largely social services providers, people experiencing homelessness, city council members, police officers, parks and recreation workers, and faculty from the University of Colorado, the survey also asked whether the person collecting the data was familiar with the homeless individual.

At the end of each entry, surveyors dropped a pin on the map to indicate where the homeless person was located and provided notes as to which services—such as medical care, food, and showers—would be most helpful.

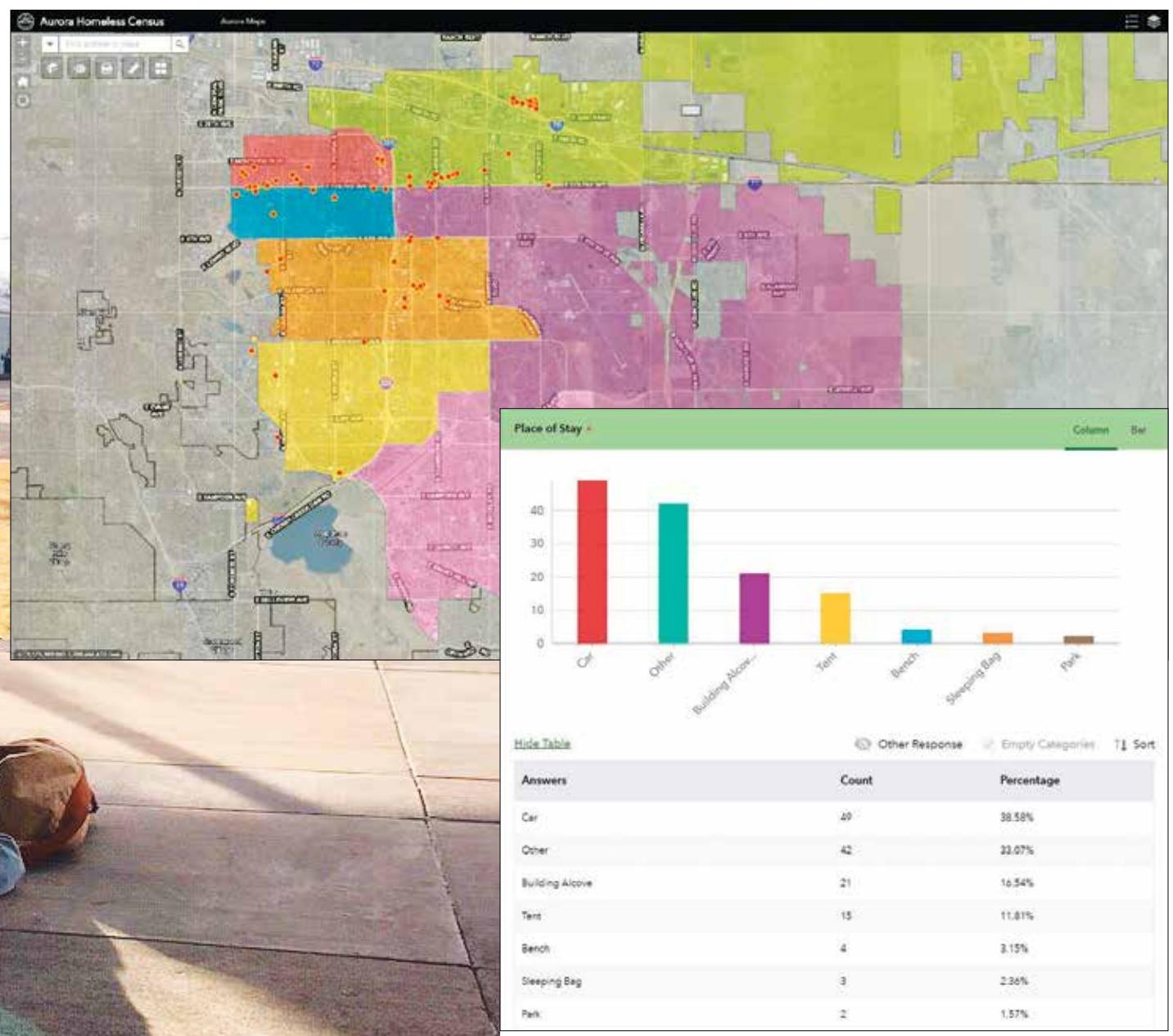
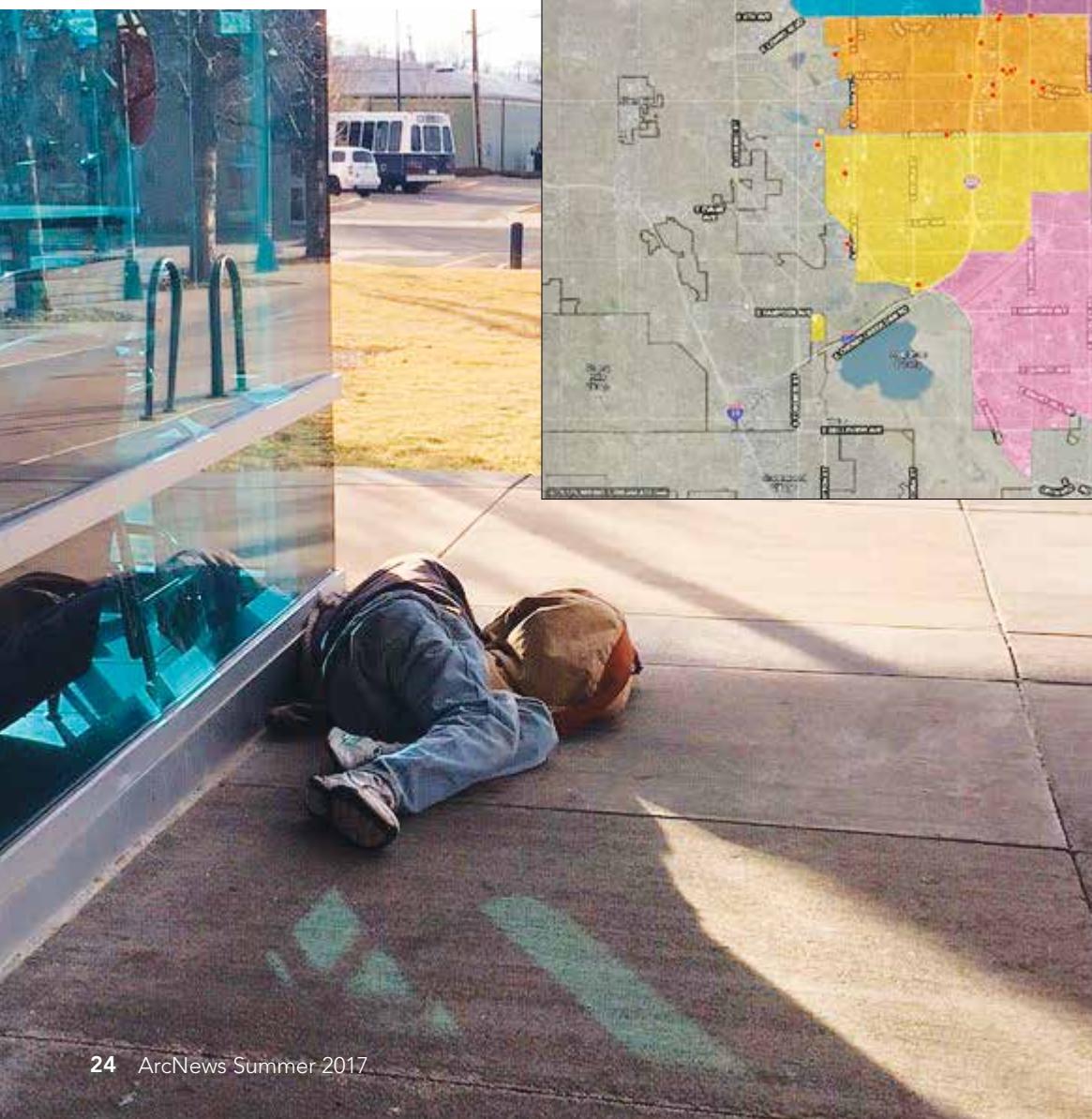
Survey data was updated in real time on the city's homeless census, which saved workers time and effort.

"Real-time GIS data helped ensure that the city maximized its resources, as census takers could tell at a glance where other teams had or had not been already," Witsell said. "As soon as they identified someone, it would appear on the map that the location had been visited."

Once the survey was finished, the GIS analysis helped identify pockets of homelessness that had previously gone undetected. Sending that data to HUD will inform the agency as well as help the City of Aurora reach out to people in need. The city is also sharing its information from the count with the Metro Denver Homeless Initiative, which will collate and analyze data from throughout the region to address homelessness on a wider scale.

→ Knowing where each homeless person is can help the city offer clothing, food, showers, and medical care.

↓ Using Survey123 for ArcGIS, the City of Aurora, Colorado, easily documented the location and specifics of each homeless person in the area during its point-in-time homeless census.



↑ The survey form included categories for what type of place each person was staying in, such as a tent, a car, a bench, or a park.

## The Relevance of Cartography

### A Cartographer's Perspective

A column by Menno-Jan Kraak

President of the International Cartographic Association



# Inspiring Lifelong Learning in Cartography

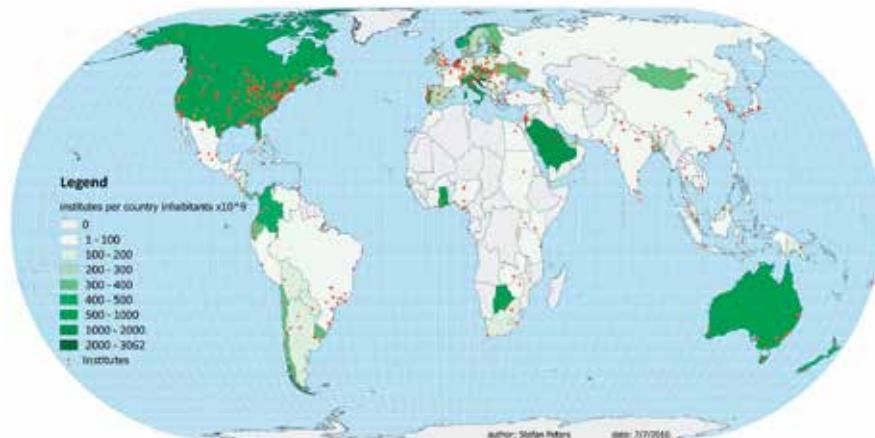
The International Cartographic Association (ICA) exists to stimulate, promote, and advance the cartographic discipline. While, at first glance, this might seem like a pretty static task, the context in which the basic principles of cartography are being applied is currently changing rapidly. That is why the ICA takes a diversified approach to teaching people and organizations sound cartographic and GIScience practices.

The primary way in which the ICA champions and enhances the field of cartography is via the activities of its commissions and working groups. The organization's Commission on Education and Training, for example, is central to the ICA's educative mission. The commission's priority is to conduct workshops—both in person and online, and, at times, in conjunction with other ICA commissions—that especially transfer knowledge to ICA members in developing countries.

Additionally, the ICA has launched an initiative to offer welcome workshops to new ICA members. A country can select a topic based on one or more of the commissions' profiles, and the ICA will send one or two representatives to run the workshop. The workshop can be used to bring together the local cartographic community, as well as to introduce attendees to new topics and enhance their skills on matters that are relevant to them. Recently, for example, the ICA conducted a workshop in Georgia on modern thematic mapping.

In a sense, all the activities organized by ICA's commissions are related to education in some way or another. Participants engage in these activities to learn new things from their international colleagues. The organizers often make sure that younger attendees, such as PhD students and young professionals, get an opportunity to present their ideas and have discussions with more senior colleagues, who, in turn, pick up new insights from their more junior counterparts. This exchange of knowledge, experiences, and opinions is very valuable. And while this kind of self-education might not be as well organized as the curricula put together by universities, it is still constructive because it offers in-depth instruction in topics that might not (yet) be part of more conventional courses of study.

As far as more structured cartography courses go, though, scores of colleges and universities around the world offer at least basic cartography classes—and some even have specializations in cartography and GIS. The map below, from ICA's Commission on Education and Training, shows a sampling of where these programs can be found.



↑ Formal cartography and GIS courses can be found all over the world.

There is still a need for traditional textbook learning as well. That is why in 2016, the ICA published an online book called *The World of Maps* in honor of International Map Year. The purpose of the book, which was put together by ICA's Working Group of the International Map Year, is to broaden the general public's knowledge about cartography and geographic information and instill a love of maps in schoolchildren especially. The book, accessible at [mapyear.org/the-world-of-maps-book](http://mapyear.org/the-world-of-maps-book), is available in six different languages.

Another book, called the *Geographic Information Science and Technology Body of Knowledge*, allows anyone—students, teachers, or GIS professionals—to create a methodical course of study on GIS and related technologies. Published in 2006 by the American Association of Geographers and available online from the American University Consortium for Geographic Information Science, the book takes a comprehensive look at GIS and mapping technology and how society interacts with it. The cartography and visualization section ([gistbok.ucgis.org/knowledge-area/cartography-and-visualization](http://gistbok.ucgis.org/knowledge-area/cartography-and-visualization)) covers, in a summative way, everything from the history and trends of cartography to the fundamentals of map design and interactive design techniques. Additionally, because societal and technical

developments require curriculum of this sort to be updated constantly, the online version of the *Body of Knowledge* is now being revised by separate initiatives in North America and Europe.

With today's unabating advances in technology, cartography is now a concern for a slew of new users. This raises the question of how to teach the foundations of cartography. To me, the following two points are most important. One should be able to

1. Apply cartographic design principles to different kinds of geospatial/temporal data, taking data characteristics and user issues into account.
2. Judge the appropriateness of applied design principles to existing maps.

And what about the tools? Here, it is important to be able to make judgments about the software defaults. Thematic maps, for example, often default to choropleth (showing different shades or patterns for distinct measurements), irrespective of the nature of the data. For online maps, the default map projection tends to be Mercator. But defaults like these are often not the correct solution!

Modes of education are also changing. In the past, students would get their information from live lectures and their accompanying textbooks. Today, however, this supply-driven approach—or teacher-centered learning—is not seen as the most appropriate method. On the contrary, a more demand-driven system—or student-centered learning—is finding its way into education. In this kind of flipped classroom (which nowadays is often partially virtual), students read and do an assignment first and then meet in class to discuss the results of their self-learning. Thus, the role of the teacher is now to lead discussions, answer questions, and fill in the gaps.

In a way, this is not far off from the educational options the ICA offers through its commissions. So perhaps we are beginning to bridge the gap between the structured classrooms and more amorphous learning environments that are both key to discovering and keeping up with the swiftly changing conditions in which cartography is applied.

#### About the Author

Menno-Jan Kraak is professor of geovisual analytics and cartography at the University of Twente in the Netherlands, where he has been teaching since 1996. He has a degree in cartography from the Faculty of Geographical Sciences at Utrecht University and received his PhD in cartography from Delft University of Technology. Kraak has written extensively on cartography and GIS. His book *Cartography: Visualization of Spatial Data*, written with Ferjan Ormel, has been translated into five languages. He also wrote *Mapping Time: Illustrated by Minard's Map of Napoleon's Russian Campaign of 1812*, published by Esri Press in 2014. Kraak is a member of the editorial boards of several cartography journals, including the *International Journal of Cartography*. He currently serves as president of the International Cartographic Association.

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# Introducing GIS to Colombian Social Studies Teachers

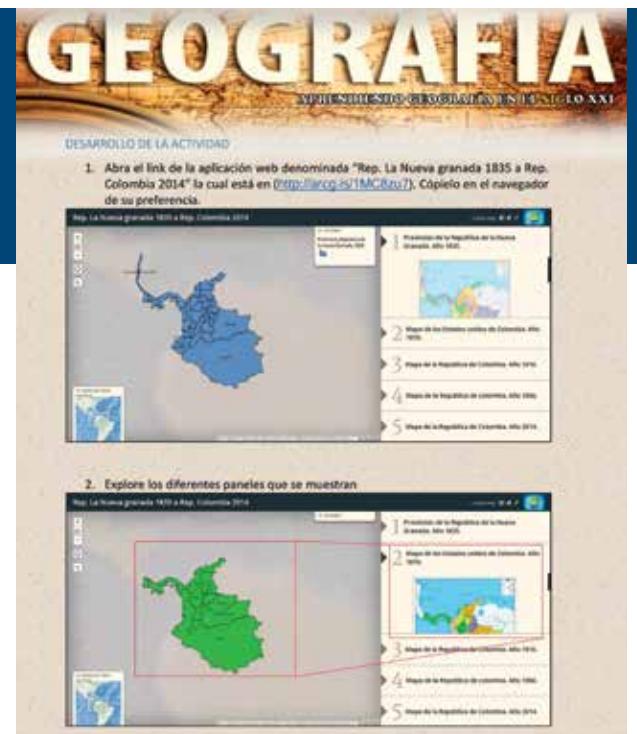
As in many other countries, geography in Colombia is taught to primary and secondary school students under the umbrella of social studies, which normally includes other topics such as history or government.

"Teaching history and geography together can be very beneficial to our students," said Luz Angela Rocha, a professor in the cadastre and geodesy engineering program at the Universidad Distrital Francisco José de Caldas in Bogotá. "It provides the students with the geographic context of where events happened, which may have had an influence on why a particular event happened. However, too often, our social studies teachers have strong educational

backgrounds in history and a limited knowledge of geography, so they naturally emphasize history in their classes."

For the past several years, members of the program's core spatial data research group (known by its Spanish acronym NIDE) have developed introductory GIS tools and courses for social science teachers. But because teachers are generally unable to attend full-time courses in a classroom setting, this approach has seen limited success. So Rocha began thinking about creating a web GIS course to attract a wider audience.

A few years ago, three of Rocha's graduate students—Diego Fernando Enciso López, Laura María Hernández, and José Luis



▲ Course materials include a syllabus, thematic maps, videos, guides, lectures, examinations, and workshops.

Romero Ariza—approached her to discuss possible capstone projects. They decided to use ArcGIS Online to develop an introductory GIS course for secondary school social studies teachers. Rocha agreed to direct the project, which ended up being called Learning Geography in the XXI Century.

The goal of the project was to create an online course that uses GIS technology to integrate geography and history lessons in a format that teachers can adapt to their social studies classes. Esri Colombia advised Rocha and her team on the best way to set up ArcGIS Online accounts for the teachers participating in the class.

Key to the project was creating a course that met the standards established by the country's Ministry of Education. For its online resources, the Ministry uses Moodle, an open-source learning management system, as the platform for Colombia Aprende, the country's education portal for primary and secondary school teachers.

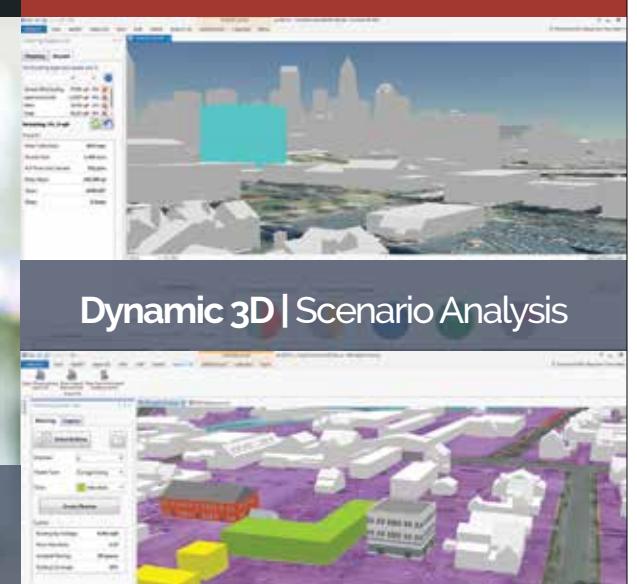
To develop the course, Rocha and her team began by conducting in-person interviews with local social studies teachers to determine

A screenshot of a Moodle-based course titled 'Campaña Libertadora de la Nueva Granada'. The interface includes a map of Colombia with historical markers, a video player showing a historical scene, and a text box with historical text. Below the main content are navigation links for 'Introducción', 'Capítulo 1', 'Capítulo 2', 'Capítulo 3', 'Capítulo 4', and 'Capítulo 5'.

▲ Learning Geography in the XXI Century uses GIS to integrate geography and history lessons in formats that teachers can adapt to their social studies classes.

A screenshot of the Impact 3D software interface. It shows a 3D model of a proposed urban development scenario, with various buildings and infrastructure highlighted in different colors. The interface includes a legend, a pie chart, and a table of data. The software is branded as 'Impact 3D Interactive Scenario Planning in ArcGIS® Pro'.

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→ Students said that GIS is an easy tool for them to use and offers a different way to augment their knowledge of history and geography.

how much they knew about GIS, whether or not they thought it would be a useful resource in their classes, and what kinds of materials should be included in the course. The results were encouraging, and from the information they gathered, the team was able to develop the course over a period of about two years.

After the Ministry of Education reviewed its methodology and materials, Learning Geography in the XXI Century was accepted for publication on Colombia Aprende. The course materials include a syllabus, thematic maps, videos, guides, lectures, examinations, and workshops. It is divided into four units, and each unit takes about four hours to complete.

"While there are exceptions, there is generally a limited knowledge and understanding of GIS by the teachers in our schools," said Sabrina González Toro, the education industry leader for Esri Colombia. "Also, many schools lack the technological resources to offer a program of this sort. This makes the efforts of professor Rocha and her team—and those educational initiatives provided by Esri Colombia—of particular importance in the introduction of GIS technology to the secondary school students in our country."

A total of 124 teachers from across the country enrolled in the first course offering, which was conducted in late 2015. Twenty-one teachers completed the class, and all but one of those teachers thought that teaching an integrated geography and history course using GIS would be applicable in their classrooms.

The three graduate students also led GIS-based social studies workshops for the students of those teachers who completed the course. The secondary school students were asked to compare traditional social studies classes with those using ArcGIS Online. The response was very positive.

Lida Buitrago from Lorencita Villegas School in Bogotá said, "It's a different way to deepen our knowledge of history and geography, particularly in preparation for our standardized national tests."



Paula Hurtado, also from Lorencita Villegas School, added, "It is an easy tool to use and interact with the topics."

Laura Tatiana Rincón from the Garcés Navas School in Bogotá said, "It's a different way to learn, and it would be cool if we could use this method in our social studies classes."

And Martha Isabel Leguizamon, a social studies teacher at the Garcés Navas School, noted, "I think this is a very good tool because students today are constantly using computers and are familiar with studying this way. It allows them to explore things in more depth to gain a better understanding of the materials and provides them with the opportunity to work with the tools and systems they will use in the future."

While Colombia Aprende is generally used by teachers in the public school system, the lessons are available to all primary and secondary school teachers in the country. Some private school teachers have begun to examine the materials to determine how feasible it would be to introduce their students to GIS and how the technology could enhance their social studies classes.

"Social studies is a regular part of our curriculum starting in the first grade," said Lesbia María Charris, a social studies instructor at the Colegio La Enseñanza, a Catholic school for girls

in Barranquilla. "In their various classes, students study world history; ancient history; and, of course, the history of Colombia. The related geography is also taught in these courses. I have had the opportunity to review some of the exercises in Learning Geography in the XXI Century, and I think the concept of using GIS as a method to engage students in history and geography lessons is very interesting."

Applying the feedback from the teachers who took the initial course, as well as their students who participated in the GIS workshops, Rocha and her team are now revising the course materials so they can offer the course again this winter.

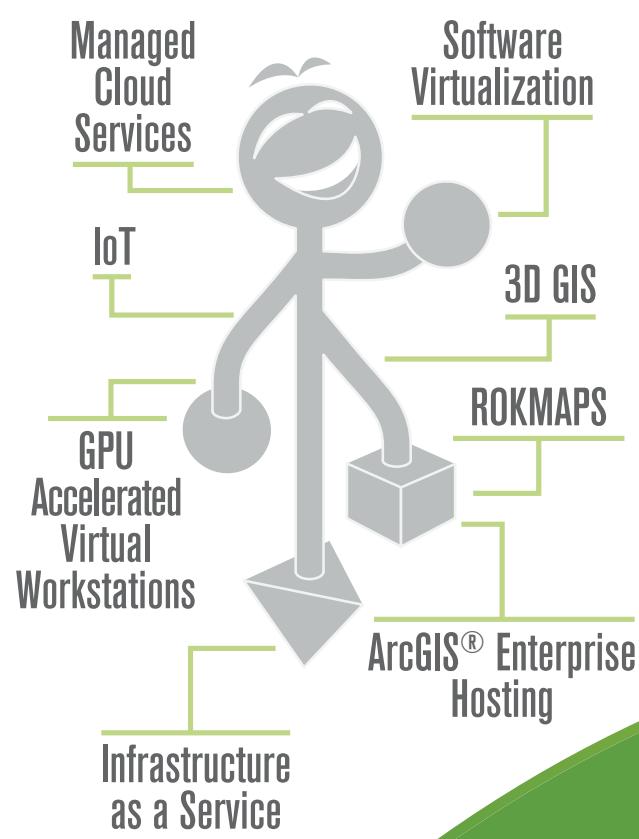
"Our strategy is to continue to improve Learning Geography in the XXI Century and offer it through the Colombia Aprende portal," explained Rocha. "We encourage the graduates of this course to try implementing ArcGIS Online in their own social studies classes."

The team is also working with Esri Colombia to get ArcGIS Online licenses for teachers who have committed to teaching the technology in their classrooms.

"There are difficulties to overcome," concluded Rocha. "But I do believe that we are on the right path to introduce GIS to our social studies teachers and their students."

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# Cultivating Global Connections Through GIS

## GIS Hero



↑ Karen Beardsley

For Karen Beardsley, GIS is more than software. It gives rise to relationships that can change the world.

"GIS is not really all about the technology," she said. "It's about connecting people."

As the director of sponsored programs and special projects for global affairs at the University of California (UC), Davis, Beardsley now spends the majority of her time bringing people together from all over the world to solve problems. While this has always been an important aspect of her career, she finds herself, for the first time, in a position that doesn't center specifically on GIS.

"I really wanted to focus some of my passion on international programs," she said about her October 2016 career move. "Our planet needs a lot of help, and I think diplomacy really happens in this case on an individual basis. The kind of work I do with groups—it's diplomacy at the level of the individual."

With a background in mathematics and computer science, a master's degree and a PhD in geography, plus plenty of experience using and implementing GIS in projects all over the world, Beardsley will always advocate for—and even still teach—GIS.

"The more I can connect people with GIS, the better," she remarked. "Whether [*people*] are conservationists, students, scientists, policy makers—if they can use GIS to further their own important work, I think that's going to help make the world a better place."

She discovered GIS in the late 1980s in Kenya, after a two-year stint in the Peace Corps. As a volunteer math and science teacher, she saw that her students were quite negative about wildlife, and she observed conflict between humans and elephants. She realized, however, that the kids had never really seen animals in the wild, so she found a truck to take her students into the park that bordered their community.

"They said things like, 'It's so cool' and, 'This is why tourists come to our country!'" she recalled. "That was a real inspiration."

When Beardsley finished the Peace Corps, she decided to see if she could stay in Kenya to do some wildlife conservation work.

"I ended up getting an offer to work on the African Elephant Database, which was an ARC/INFO database," she explained. "At that point, I had no idea what GIS was."

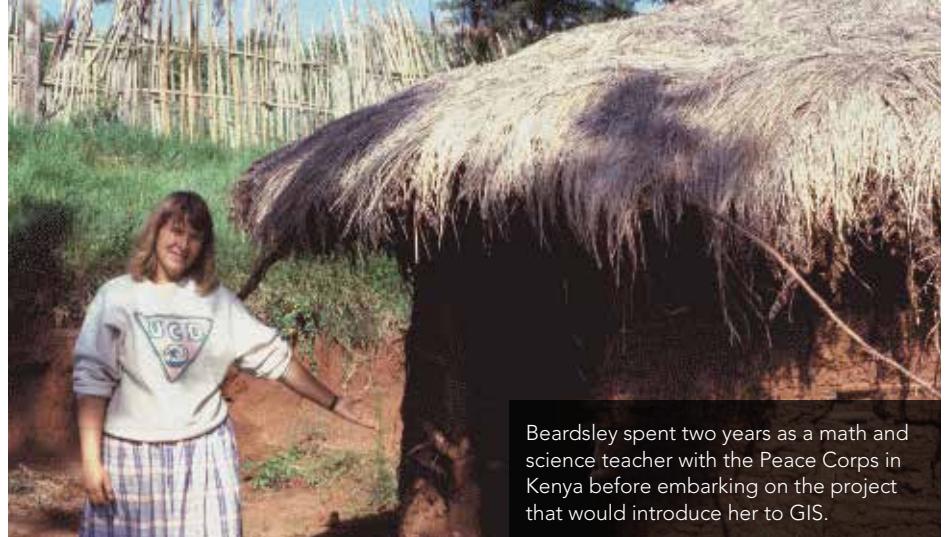
Beardsley headed back to California to see if she could get some training. To her delight, she found out that the developer of ARC/INFO, Esri, was in her home state. So she cold-called the company, and after telling her story, Esri president Jack Dangermond let her take a GIS course for free. Then she went back to Kenya to work on the database.

"She was one of the very first in the world to use GIS with conservation," said Charles Convis, the conservation program coordinator at Esri, who met Beardsley in Kenya during her database days. "She understood the vision as early as anybody that GIS was the key tool to make conservation predictable, authoritative, and mathematical."

Within months of Beardsley and her colleagues finishing the African Elephant Database, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) met and used the database to place the African elephant on the endangered species list.

"It was my first GIS experience, and the GIS work informed a decision that led to putting an entire species on the endangered species list," she recalled. "I was really hooked on GIS at that point."

When she again returned to California from Kenya, she got a job with the US Bureau of Reclamation in Sacramento digitizing township, range, and section lines.



Beardsley spent two years as a math and science teacher with the Peace Corps in Kenya before embarking on the project that would introduce her to GIS.

"That's when I realized—as I was always realizing—the more I learned of GIS, the more I realized I didn't know," she recalled.

She wanted to get a solid education in it, so she entered a master's degree program for geography at UC Santa Barbara and focused on remote sensing. For her thesis, she aspired to develop a map of all the protected areas in the world.

"Having worked on the elephant database, I realized there was really nothing" said Beardsley. "There wasn't an authoritative protected areas map for Africa, and there certainly wasn't one for the whole world."

Though, for time's sake, she ended up focusing her thesis on the southwest ecological region of California, another student continued her project, and it has since evolved into the Protected Areas Database of the United States (see the *ArcNews* article on this at <http://p.ctx.ly/r/4clo>).

After receiving her master's degree, Beardsley moved to UC Davis, where she worked for the Information Center for the Environment (ICE). She was hired to set up GIS and get a handle on the quality and status of California's rivers while helping state and federal agencies move their projects forward.

It was around this time that Beardsley helped start the Society for Conservation GIS (SCGIS). It began as an informal meeting of conservationists at the Esri User Conference and has expanded to now host an international scholarship program in which the organization brings young conservationists from around the world to California to receive training in GIS, attend the Esri User Conference, and participate in the SCGIS conference held at UC Davis.

"The training program that we've been running at UC Davis, we've probably impacted a couple hundred people," said John Schaeffer, who—as vice president, GIS analyst, and lead instructor at Esri partner Juniper GIS—has been working with Beardsley for years to support the SCGIS scholars. "And then they go back and they spread GIS everywhere."

Observing how these young professionals apply GIS to their ideas inspires Beardsley.

"So many of them are just doing unique things and trying to make the world a better place," said Beardsley. "Seeing how some of them can take a technology like GIS and really apply it to what they're trying to do is pretty amazing."

While working at ICE and organizing SCGIS, Beardsley got her PhD in geography from UC Davis. That brought her back to Kenya for her dissertation, where she studied and modeled different development scenarios based on an urban growth model she created for use in California.

"There was some influence from the [Kenyan] government indicating that [*the Maasai people*] should settle down instead of being nomadic, as they'd been for thousands of years," recounted Beardsley. "I wanted to see if I could apply the urban growth model to a rural area in Kenya."

She did (read the *ArcNews* article at <http://p.ctx.ly/r/4clp>), and she figured out that it made more sense for the Maasai to remain pastoral. Though forces well beyond her control have compelled many Maasai to settle down, Beardsley said the model was instructive.

Upon completing her PhD, Beardsley moved into the role of managing director at ICE. And at a climate change seminar that the organization runs every year, she met someone who would lead her to her next GIS adventure: establishing a GIS program in Bhutan.

In 2013, Beardsley and her family took a vacation to Bhutan to visit her friend. While there, they went to Royal Thimphu College (RTC) and talked to the associate dean, who was thrilled when he found out that Beardsley did GIS.

"He said, 'We want to start a GIS program here!'" recalled Beardsley.

They kept in touch. And in 2014, Beardsley returned to Bhutan as an Esri Education Ambassador to set up the university site license that Dangermond agreed to donate to the college. By the end of her trip, she had built a fully functioning GIS lab. (See the *ArcUser* article at <http://p.ctx.ly/r/4clq>.)

Beardsley had also applied for a Fulbright scholarship to get to Bhutan, and in 2015, she received it. This enabled her to go back for a full year to kick-start RTC's GIS curriculum.

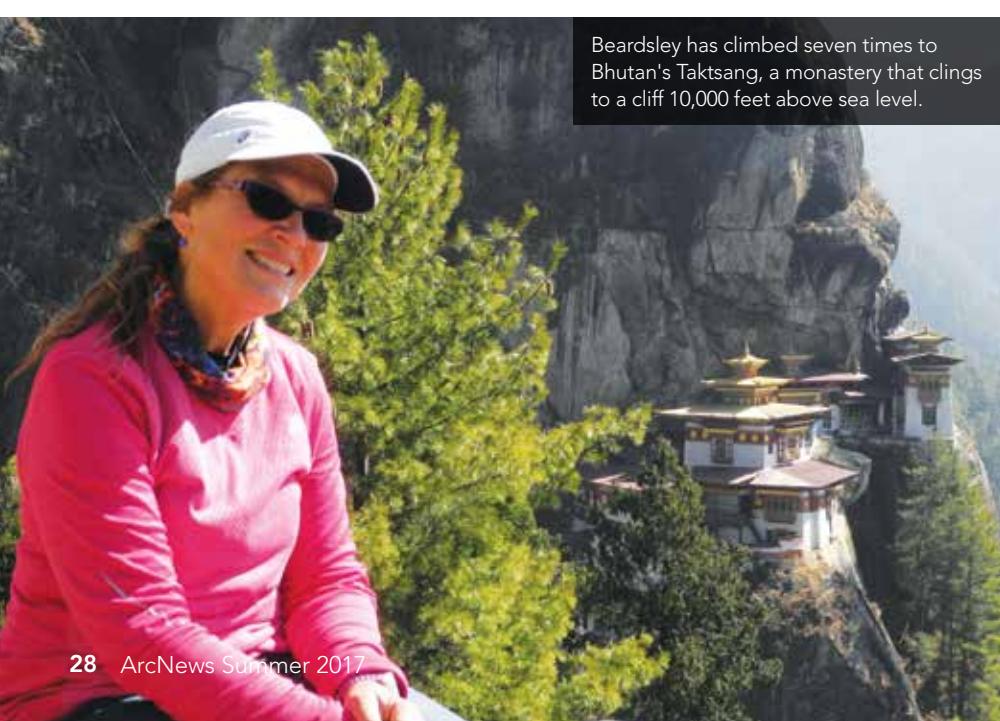
"Now, GIS is a major part of their bachelor's of science in environmental management," said Beardsley.

Additionally, RTC hosts workshops to provide government officials in Bhutan with further GIS education. And that is thanks, in large part, to Beardsley.

"She's really stretched what's happening there," said Schaeffer, who taught a monthlong GIS course at RTC to Bhutan's National Land Commission. "She actually set up a program that's ongoing."

With plans to return to Bhutan this fall to conduct a workshop for RTC faculty on how to teach GIS and another trip scheduled for summer 2018 with a cohort of UC Davis study-abroad students, it doesn't look like Beardsley is going to slow down anytime soon.

"She has a tremendous dedication to the international community of conservation GIS," said Convis. "And I think her greatest contributions lie ahead of her."



Beardsley has climbed seven times to Bhutan's Taktsang, a monastery that clings to a cliff 10,000 feet above sea level.

# UnderstandingUnderstanding

The Science of Where is our tree. Data feeds the trunk. The leaves, the flowers, and its fruits are understanding. Understanding precedes decisions and actions. We map to achieve such an orchard of understanding.

**Richard Saul Wurman**, with **Jack Dangermond** and **Esri**, has created a new publication to realize some useful patterns, often idiosyncratic. These patterns—some numeric, some graphic, some visual, some comparative, some conversational, and some computational—allow us to understand the world around us.

**UnderstandingUnderstanding** is eclectic, as was the TED conference that Wurman created in 1984. It explains the diversity of patterns of understanding. All maps are patterns that give us the ability to perceive. This capacity is the seed of the **GIS** and **information architecture** thinking revolution created by Dangermond and Wurman 50 years ago. Below is a list of contributors to this new book, each of them contributing their particular method of understanding.

## Selection of Contributors

<b>Richard Benson</b> Former Dean of Yale School of Art	<b>Ben Fry</b> Data Visualization Expert	<b>Nigel Holmes</b> Graphic Designer	<b>David Macaulay</b> Author of <i>How Things Work</i>	<b>Stefan Sagmeister</b> Graphic Designer
<b>David Blaine</b> Magician	<b>Kai-Fu Lee</b> Computer Scientist	<b>Steven Johnson</b> Author and NOVA Host	<b>Peter Menzel &amp; Faith D'Aluisio</b> Photographer and Writer/Editor	<b>Vaclav Smil</b> Policy Analyst and Author
<b>Juan Enriquez</b> Academic, Businessman, and Author	<b>Frank Gehry</b> Architect	<b>Jon Kamen</b> CEO of @radical.media	<b>Walt Mossberg</b> Former WSJ Columnist	<b>Lara Stein</b> Creator of TEDx
<b>David Ferrucci</b> Team Lead for IBM's Watson	<b>Milton Glaser</b> Graphic Designer	<b>David Kelley</b> Founder of IDEO	<b>Nathaniel Pearlman</b> Political Technology Consultant	<b>Geoffrey West</b> Theoretical Physicist

## Sample of Table of Contents - The Last 7 Chapters

**Urban Atlas**  
**1967**  
I met Edwin Higbee through Governor Terry Sanford of North Carolina, who later became president of Duke University, when I was 26. Ed was an urban geographer who came to my class, heard me talk and saw a book I'd done on comparison of cities. When he got his next round of money from the Twentieth Century Fund, he wrote me into the grant to travel with him in 2-to-3 week trips to the major cities in the United States, meeting the mayors and heads of city planning, sometimes police commissioners and others, the potentates of various cities who had something to do with planning. We even spent half a day with Harry S. Truman in his library in Independence, Missouri. In any case, I had all this stuff sent back to me and it became the basis for my later analysis and development of *The Urban Atlas: 20 American Cities*. I'd brought the material to Dean Joseph Passonneau of the School of Architecture at the University of Washington St. Louis, which turned into this atlas that was published by MIT Press. **600**

**Man-Made Philadelphia**  
**1972**  
The first time I got serious about guidebooks was with *Man-Made Philadelphia*. John Andrew Gallery was head of housing and community development in Philadelphia, he later became my boss when I became assistant director in the department, and I decided to do a guidebook for Philadelphia. **616**

**Yamanote Line Map**  
Wurman's map for the circular loop Yamanote Line, and the cross-town Chūō-Sobu Line in Tokyo for Tokyo Access

**Newport and Charleston**  
**1990s**  
I moved to Newport, RI, and there were no good guidebook so I thought I'd do my own.

**USAtlas**  
**1990s**  
The epiphany I had when I looked at the Rand McNally atlas was that you don't drive across the United States alphabetically. That's sort of a joke, but it's the truth; you don't drive alphabetically, you drive state to state and my atlas was organized state by state, and there was a key map showing where you were in the US going from one state to the other. **636**

**Planning Scenario App**  
Planning scenario app for Los Angeles, California using GIS technology.

**Urban Observatory**  
The Urban Observatory provides a comparative understanding of our world. It tells the story of the global community through analysis of our largest, most unique urban cities. Users compare facts and live data about multiple cities through the use of interactive maps and standardized sets of information in a side-by-side layout of maps for comparing places. **690**

**Jack Dangermond**  
Jack Dangermond, his wife, Laura, and his company, Esri, are simply remarkable. And Jack's involvement, his encouragement and belief in this book, has allowed it to happen. Belief, enthusiasm and encouragement are my fuel. And I think his thoughts are intertwined with mine on every page. **648**

For more information on **UnderstandingUnderstanding**, head to [www.uursw.com](http://www.uursw.com). There you can read about the contributors and view the full table of contents.

**UnderstandingUnderstanding** | Hardcover | 708 pages | 10" x 10" | Retail: \$75 | Available on **Amazon** July 15, 2017

# Moving from Bits and Bytes to Dollars and Cents

## Developing GIS Leaders

By Wendy Nelson, Urban and Regional Information Systems Association

In a recent article in *Governing* magazine, columnists Katherine Barrett and Richard Greene address some of the serious human resources challenges facing local and state government. The lure of high-paying private sector jobs coupled with the dwindling benefits, such as pensions and health care, that were once mainstays of public sector careers make it even more difficult to attract and retain top-performing employees.

But a survey from the Institute for Public Sector Employee Engagement, which Barrett and Greene reference, indicates that "professional development is one of the top three factors that keep employees engaged and thus reduce their likelihood of leaving. (The other two are an employee's own work and the ability of leaders to manage change.)"

Following the recession of the late 2000s, the public sector training budget was practically nonexistent. Lately, however, more and more government agencies have been recommitting to employee training and professional development.

With a growing number of government workers on the cusp of retirement, the challenge of cultivating the next generation of leaders is even more important. For government employees who work in the GIS realm, gaining the sort of professional development needed to rise to the next level can be attained by attending the Urban and Regional Information Systems Association's (URISA) GIS Leadership Academy.

### Why a URISA GIS Leadership Academy?

More than a decade ago, URISA recognized that, within its membership, there was a training gap. GIS professionals had plenty of technical expertise. But as they moved up the ranks within their organizations, many did not have the education needed to tackle the management and leadership responsibilities that came with those career advancements. So a committee of URISA members—all recognized leaders in the profession and all Certified GIS Professionals (GISPs)—developed a unique, five-day GIS management and leadership training program: the URISA GIS Leadership Academy (ULA).

The program covers topics spanning from GIS strategic planning and return-on-investment reporting to hiring and change management. It includes interactive exercises, small group discussions, team-building activities, and opportunities to delve into topics in a way that's not possible to do at large conferences. Participation is intentionally limited to about 50 people to encourage such interaction. Each session is updated with the most current industry information, and the content is peer-reviewed.

Mirroring URISA's membership, ULA attendees are employed by a variety of organizations, including government agencies of all types and sizes, private sector firms, universities, and research institutions. Participants comprise a

### Managing GIS

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



Fostering Excellence in GIS

[www.URISA.org](http://www.URISA.org)

range of career experience as well—from young professionals to midcareer managers—and consist of both current and future GISPs.

Some organizations have made ULA attendance a critical part of their GIS staff training and development. Matt Gerike, the geospatial services manager for the City of Columbia, Missouri, encourages—and has even budgeted for—his four GIS staff members to go to ULAs in recent years.

"Returning staff look beyond success as a map or a database and more toward organizational success with processes for managing projects and strategies for communicating achievements," he reflected.

### Bonding over GIS

ULA is truly one of my favorite URISA programs. Attendees are excited to be part of a group of GIS professionals who are all working to elevate their GIS programs. They share experiences and challenges and form enduring friendships. Many can't believe how much they can learn in one week, and some have even credited ULA with being the best training they have ever received. Others realize that, while they aren't managers yet, they can be agents of change for GIS within their organizations.

After taking part in ULA, numerous participants have rapidly advanced their careers, progressing into leadership roles and moving up within their own organizations. Several former

attendees have even become ULA faculty as well, sharing the lessons they've learned with the next generation of GIS professionals.

### Now to Develop Leadership Skills

Due to increased demand, URISA is offering ULA twice in 2017. One session was held in April in San Diego, California, and there will be another one in Providence, Rhode Island, in late July. Additionally, the Ohio URISA Chapter has already requested a ULA in Columbus in 2018, so keep an eye out for event updates.

Although training budgets are improving, funds are still limited. So some GIS professionals may only be able to go to certain events—those that are closer to home or that coincide with other meetings, for example. That is why, for this October's GIS-Pro 2017 Conference in Jacksonville, Florida, URISA has devoted an entire program track to GIS management and leadership, giving conference attendees a taste of the topics covered at ULA.

To see the sessions being offered at GIS-Pro 2017, head to [gis-pro.org](http://gis-pro.org). For more information about ULAs, visit [urisa.org](http://urisa.org).

### About the Author

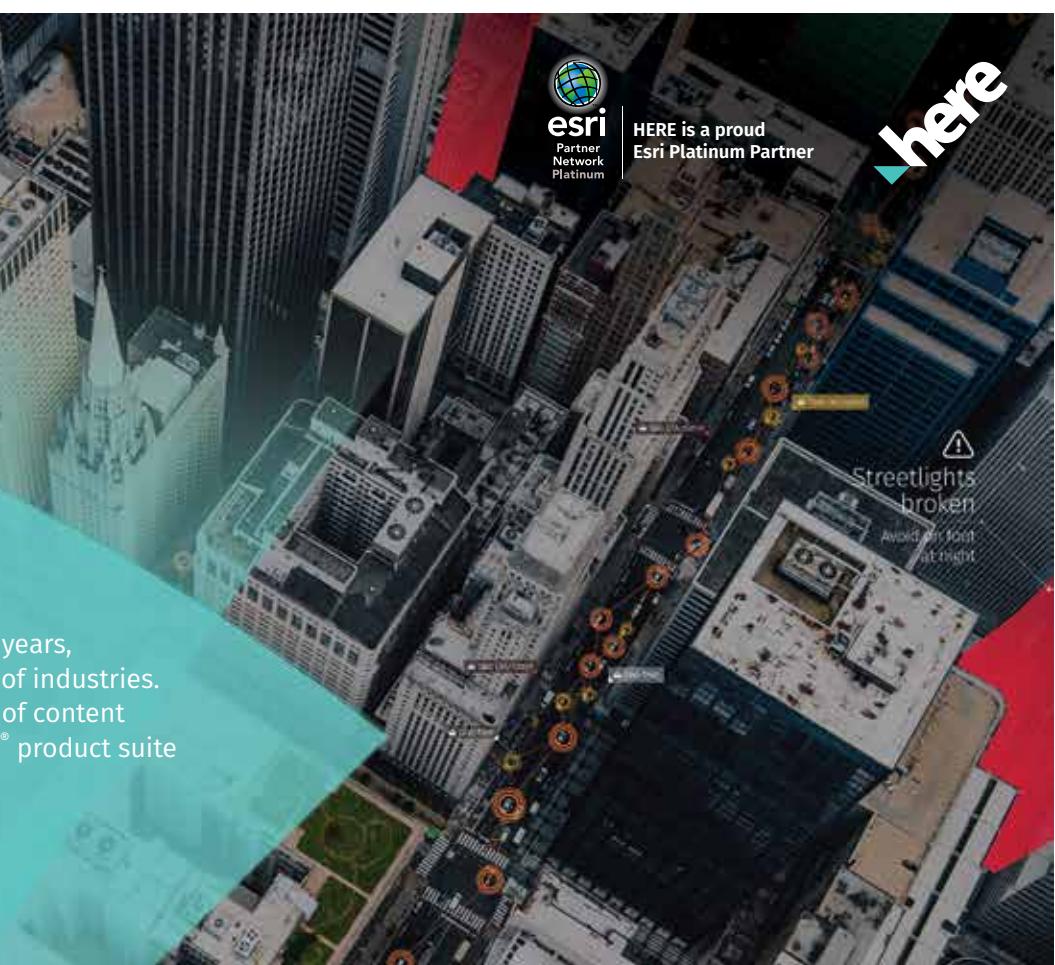
Wendy Nelson is the executive director of URISA. For more information, email her at [wnelson@urisa.org](mailto:wnelson@urisa.org).

## Pinpoint Success with the Power of Location

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## Crossing Borders

A column by Doug Richardson

Executive Director, American Association of Geographers

# Five Tech Trends Driving New Geospatial Development

There is a revolution happening in geographic science and technologies, and it is transforming every aspect of the US economy and government, benefiting the nation and the world.

A recent report from the National Geospatial Advisory Committee (NGAC) identified new and emerging technologies that will gain importance for federal agencies and the broader geospatial community over the next decade.

The report, entitled *Emerging Technologies and the Geospatial Landscape*, first examines five overarching technology trends that will drive new geospatial development. Then it discusses specific emerging technologies in five core areas of GIS and geospatial activity: data collection and generation, data analytics, infrastructure, access, and workforce.

Below are some excerpts from the report (which have been edited for clarity). These trends will likely impact all GIS users in the years ahead.

### The Technology Trends

The NGAC has pinpointed five technology trends that are facilitating, structuring, and propelling development in geospatial technologies. They are:

#### 1 The Real-Time Revolution

Although real-time spatiotemporal data is now being generated almost ubiquitously and its applications in research and commerce are widespread and rapidly accelerating, the ability to continuously create and interact in real time with this data is a recent phenomenon. This innovation

is functioning as a core change agent in geography, cartography, GIScience, and many related geospatial fields. It is profoundly realigning traditional relationships and structures; expanding research horizons; and transforming the ways in which geographic data is now collected, mapped, modeled, and used in geography and science and society more broadly. This immediate interaction between space and time remains today the underlying process that is generating the current explosion of fused spatiotemporal data, new geographic research initiatives, and myriad mobile geospatial apps in governments, businesses, and society.

#### 2 Miniaturization of Technologies

The capacity to create small and often inexpensive devices and sensors with wireless connectivity is driving an explosion of the Internet of Things (IoT). Miniaturized and lower-cost sensors lead to an increase in what, when, where, and how much data is collected and, more importantly, the ability to attune the sensor to the specific data collection needed.

#### 3 Proliferation of New Mobile Geospatial Sensor Platforms

The rapid miniaturization of technologies has made it feasible to explore new modalities for sensor distribution, such as small satellites (small-sats) and unmanned aircraft systems (UAS, or drones) that can be rapidly designed and deployed with orbits or flight paths tailored to the mission. These mobile geospatial sensor platforms

greatly expand the abilities of individuals, businesses, and governments to collect volumes of remotely sensed data for diverse and mission-critical purposes, including disaster response, environmental monitoring, and public safety.

#### 4 Expanding Wireless and Web Networks

Faster and broader wireless and web networks are beginning to address, in part, the growing demand for improved methods of data transmission and geospatial data distribution to end users. This is laying the groundwork for governments and consumers around the world to more broadly share and use spatiotemporal data, including for real-time apps.

#### 5 Advances in Computing Capacity for Geospatial Research, Apps

High-performance computing networks (including CyberGIS) and cloud computing services (including cloud GIS) are providing governments and others with conduits through which they can more easily and quickly access and contribute to growing repositories of geospatial data, tools, and services.

### The Changing Geospatial Landscape

According to NGAC, the technologies that are emerging from these trends are impacting the geospatial landscape in five core areas of GIS and geospatial activity. Those are:

#### Data Collection and Generation

This includes technologies that enable collecting or processing spatial and spatiotemporal data, introduce new data types, and have other significant implications for data delivery and use. The impacts affect existing and de facto standards, real-time data generation and use, data confidentiality and privacy, and the big datasets generated using these new technologies.

#### Data Analytics

This encompasses new technologies or methods that support analyzing big and small data, multidimensional information, and spatiotemporal data. The emerging technologies include human-guided and autonomous machine learning systems.

### Infrastructure

New frameworks are needed to support data collection, processing, storage, and sharing, as well as the protection of these systems.

### Access

The relatively recent diffusion of technologies and data has been facilitated by improvements in access (via modifications in wireless systems and Internet use, for example). These changes affect who has access to new technologies and data, how we interact with those improved tools, and how we protect sensitive information.

### Workforce

Changes in the technological landscape of today necessitate being aware of the critical spatial thinking and technology skills that the next generation of spatial analysts will need, as well as taking heed of how to broaden and diversify the geospatial workforce.

### Shaping the Future

A full discussion of the GIS and geospatial technology trends impacting tomorrow's geospatial landscape is available in the NGAC report at [aag.org/emerging-technologies](http://aag.org/emerging-technologies). These trends will be critical to the work of federal agencies, as well as for the larger GIS and geospatial communities.

I look forward to engaging in productive dialog with you on these emerging technologies as we plan and shape our GIS and geospatial landscapes of the future.

Contact Doug Richardson at [drichardson@aag.org](mailto:drichardson@aag.org).

The following members of the NGAC Emerging Technologies Subcommittee authored *Emerging Technologies and the Geospatial Landscape*: Doug Richardson (chair), Sarah Battersby (vice chair), Pat Cummens, Matt Gentile, Jack Hild, Jeff Lovin, Rebecca Moore, Carl Reed, Gary Thompson, Jason Warzinik, David Wyatt, and May Yuan.

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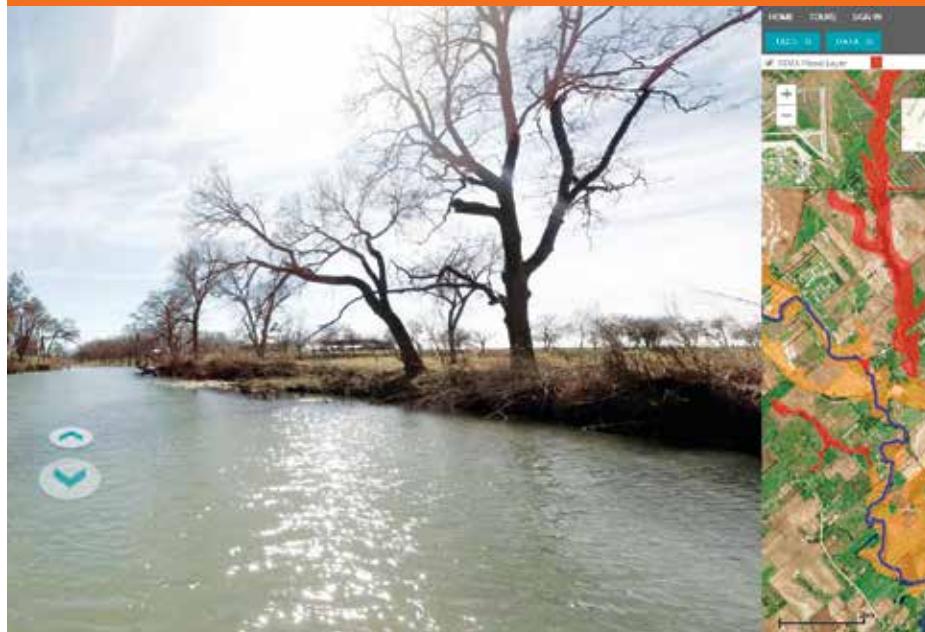


# Startups

## Propel Engagement with Remarkable Visualizations

One of the ways Esri encourages geospatial innovation is by helping newly launched businesses add location analytics to their products and services. Through the Esri Startup Program, hundreds of entrepreneurs have fast-tracked their business goals. Some use ArcGIS to enhance community engagement, while others employ the platform to strengthen collaboration. Read on to see how the following startups are doing this in both the natural world and workplace settings.

### Constructing Virtual River Expeditions



↑ FishViews offers virtual river tours with snapshot 360-degree views taken midstream. GIS shows a corresponding map and river status records.

The United States has 3.5 million miles of rivers and streams and more than 25,000 miles of navigable waterways. And one small startup wants to connect people to all these environments via a digital atlas.

**FishViews** ([fishviews.com](http://fishviews.com)) is embarking on this prodigious project one mile at a time, offering high-definition, 360-degree imagery that turns those simple blue lines on a map into colorful virtual water tours. But the company is not doing this alone. FishViews has invited the waterway community—governments, businesses, conservation groups, and all their stakeholders—to add to the curated map via ArcGIS.

Using rafts and boats (and going on foot when necessary), the FishViews team takes images from the middle of the river (or just off to the side). From this centerline, users can pan the images to see beautiful riverscapes and even go below the water, where they truly get a fish's perspective. The app is user-friendly and provides two-way communication through tagging, wherein FishViews tags points of interest in the imagery, and viewers can respond to those tags.

Users can contribute additional data—including their own geolocated imagery—to the atlas as well so that they can analyze various environmental concerns, from habitat loss to water pollution. FishViews curates the data and makes it available in ArcGIS Online and on its own website. So users can publish their content in a wide-reaching platform while contributing to a data resource that's valuable to scientists, kayakers, and kayaking scientists.

At Olympic National Park in Washington, scientists included FishViews in a multiagency riverscape atlas expedition to locate the biota and habitat features of the major rivers on the Olympic Peninsula. Project team members geotagged information about the distribution of fish and habitat features along the South Fork Hoh River from its source to the sea. Adding location information and visual context to the scientific measurements, FishViews created dynamic maps and built a portal to give the public access to the data collection. The resultant riverscape highlights biological hot spots along the river that are inhabited by the endangered bull trout.

Because FishViews' imagery and geographic context make data-heavy scientific findings more interesting, conservationists were able to use the riverscape atlas to communicate their environmental concerns to policy makers. In addition, users can view the riverine photography and videos through virtual reality headsets, which really allows the river tours to come alive.

### Collaborating Without Losing Control



↑ Working in the VizworX visualization environment, collaborators can view sensitive data without sharing it.

How can organizations work collaboratively without having to surrender their sensitive geospatial data? Startup **VizworX** ([vizworx.com](http://vizworx.com)) has a solution: an interactive data viewer in which users come together in a common visual environment powered by ArcGIS Online.

With GeoViz, everyone can effectively communicate and participate in group decision-making because all meeting attendees can see their data in the context of what other group members are viewing. Yet, at the same time, nobody has to give access to or lose control over their data. This makes it easier for city planners, for example, to work with developers, businesses, environmentalists, and contractors. It also helps emergency responders get that critical common operating picture during a crisis.

Say a petroleum company wants to lay pipeline to connect an oil refinery with an existing pipeline a few states away. The oil company would probably prefer not to divulge detailed data that could make its pipeline infrastructure more vulnerable to attacks by vandals or terrorists. Likewise, a conservation group would likely prefer not to hand over its comprehensive species data, which could expose some animals to poaching.

Using GeoViz, a pipeline engineer, a conservationist, and a road planner could meet in person over a digital touchscreen table. They would each log in to their ArcGIS accounts, open their project data, and share it on the screen via the table's map interface. Within the VizworX visualization environment, the three group members would bring their data together to see how the proposed pipeline corridor, sensitive wetlands, and planned road systems intersect. Each member would only show the level of detail that is appropriate for the meeting at hand. And, with the data presented in context, everyone would be able to rationally discuss problems and create solutions. Additionally, if the three professionals could not meet in person, they could also share data remotely via mobile devices. Again, collaborators would not be able to save or download anyone else's information, but they would be able to fully engage with the data.

The VizworX visualization environment includes basemaps, image files, shapefiles, geolocated objects, photos, and other types of data. Its client software app runs on a Windows operating system that connects to ArcGIS Enterprise and accesses each user's data via ArcGIS Online.

With interactive visualization technology from VizworX, organizations can engage with their data more effectively, ensuring better communication and solid decision-making.

#### Get Started with the Esri Startup Program

Companies founded less than three years ago that build software or platform-as-a-service products and generate less than \$1 million annually may be eligible to participate

in the Esri Startup Program. This three-year program provides qualified businesses with free ArcGIS platform technology to integrate spatial functionality into their products. Learn more about the Esri Startup Program at [developers.arcgis.com/startups](http://developers.arcgis.com/startups).

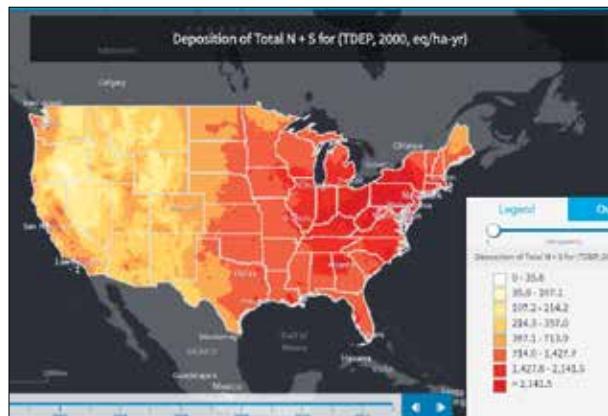
# Small Businesses

## Freshen Up GIS at the Federal Level

### Partner of the Year

Blue Raster  
[blueraster.com](http://blueraster.com)

As partner of the year, Blue Raster showed achievement across all areas of the award criteria—including FSBS program participation, marketing, customer successes, and alignment with Esri technology—when it developed the Environmental Protection Agency's (EPA) Critical Loads Mapper ([blueraster.com/epa-critical-loads-mapper](http://blueraster.com/epa-critical-loads-mapper)). This public, online app, which is part of the EPA's Global Change Explorer platform, assesses the effects of nitrogen and sulfur pollution on ecosystems. A collection of three web tools that Blue Raster built on the ArcGIS platform, the app allows users to access, visualize, and compare spatial data that illustrates potential future environmental change. This can serve as a starting point for figuring out how vulnerable air, water, ecosystems, and human health are to climate change, alterations in land use, and other large-scale environmental stressors.



### Innovation Partner

GISInc  
[gisinc.com](http://gisinc.com)

GISInc is this year's innovation partner, meaning the company introduced a solution that leveraged the ArcGIS platform while also adopting emerging Esri technology and ensuring that employees maintain up-to-date GIS skills. The company's solution, SmartSpace, moves military installations and other federal agencies beyond simply implementing smart lighting by giving them a comprehensive energy and facility management solution. SmartSpace is part of GISInc's Geospatial Internet of Things (GeoloT) integration, a program that helps companies integrate IoT equipment into their operations. Using highly configurable platforms, SmartSpace connects vital facility management systems, IT networks, and devices so that users can monitor building operations in real time and maintain energy compliance. Additionally, having secure, wireless-controlled automation and connectivity enables organizations to easily customize and upgrade their systems.



### New Partner

INCATech, LLC  
[incatech-corp.com](http://incatech-corp.com)

An Esri partner for less than two years, INCATech won the FSBS New Partner Award for demonstrating a strong commitment to the program and successfully collaborating with the Esri sales and/or professional services team on a project. The fully woman-owned small business deployed an update to the US Department of State's Bureau of Consular Affairs' travel website ([travel.state.gov](http://travel.state.gov)) that incorporates dynamic maps into travel alerts and warnings. The new maps fuse data from both the Department of State and Esri so that pertinent information for travelers—such as contact information for US embassies and consular district boundaries—is easy to find, dynamically displayed, and interactive. The maps are even mobile friendly, which improves the website's overall user experience—especially for busy travelers.



To find out more about the FSBS program and its partners, visit [go.esri.com/federal-small-business-specialty](http://go.esri.com/federal-small-business-specialty).

An advertisement for LANDinfo Worldwide Mapping LLC. It features a circular logo with "LANDinfo" and "WORLDWIDE MAPPING LLC". Below the logo, sections for "SATELLITE &amp; AERIAL IMAGERY" and "TOPO MAPS &amp; NAUTICAL CHARTS" are listed. The "SATELLITE &amp; AERIAL IMAGERY" section includes details about aerial photography, UAS, and various satellite sensors. The "TOPO MAPS &amp; NAUTICAL CHARTS" section mentions a global archive of digital map data. The bottom of the ad includes contact information: "tel +1.303.790.9730 • fax +1.303.790.9734" and "sales@landinfo.com • www.landinfo.com".

An advertisement for Digital Data Services, Inc. It features the company logo "DDS DIGITAL DATA SERVICES, INC." and the text "Geocortex® Implementation &amp; Customization Services". A list of services includes: Geocortex® Installation &amp; Configuration, Application Design &amp; Implementation, Advanced Workflow Development, Report and Map Template Design, and Geocortex® Custom Development. Below this, there are images of a smartphone, a tablet, and a computer monitor displaying GIS data. The bottom of the ad includes the website "www.DigitalDataServices.com", the phone number "303-986-6740", and logos for "Geocortex® BUSINESS PARTNER" and "esri Partner Network Silver".

An advertisement for Collin College's Online GIS Program. It features the text "Collin College Online GIS Program" in large red letters, followed by "Earn a Certificate in GIS". Below this, it says "(successful completion of five classes)" and lists several GIS courses: GISC 1411, Introduction to GIS; GISC 2420, Intermediate GIS; GISC 1421, Introduction to Raster-based GIS; GISC 2402, Raster Analysis; and GISC 2231, Advanced Problems in GIS. The bottom of the ad includes the text "100% online Financial Aid, GI Bill Available", contact information "Contact gjackson@collin.edu", and the Collin College logo.

An advertisement for GeoSystems Monitor. It features the text "Monitor Your GIS Platform" in large red letters, followed by a close-up image of a person's eyes looking at a screen. The bottom of the ad includes the text "Reduce the Impact of Service Failures", a list of monitoring features: "Monitor ArcGIS® for Server &amp; More", "Real-Time Performance Monitoring", "Instant Text and/or Email Alerts", "Rapidly Pinpoint Issues", "Charts, Graphs, &amp; Historical Database", "Customized User Interface", "User Defined Monitoring Points", and "Easy Installation &amp; Setup". It also mentions "Also Available for ArcGIS® Online in ArcGIS Marketplace" and the VESTRA logo.

# Partners Apply The Science of Where for Success

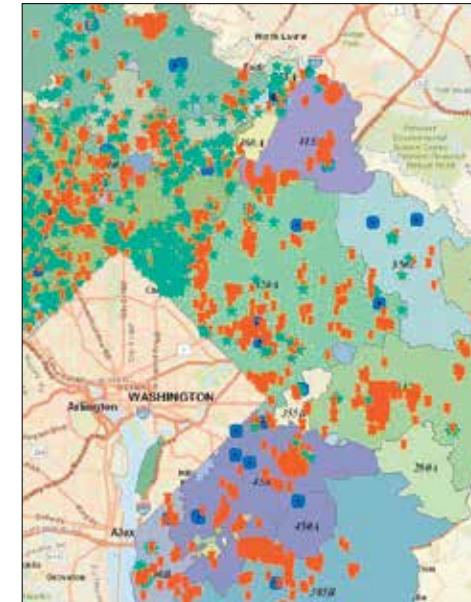
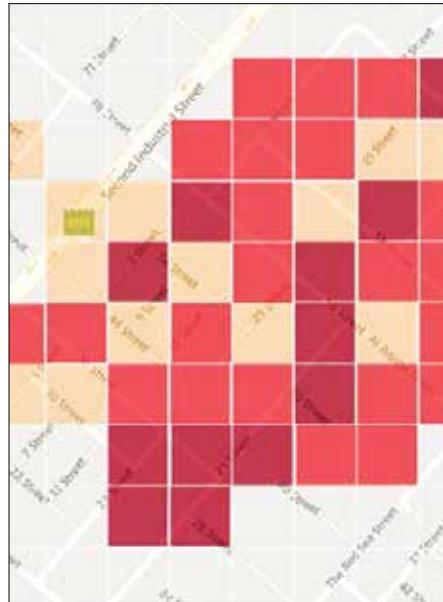
At the 2017 Esri Partner Conference, held in March in Palm Springs, California, Esri recognized partners that have made exceptional strides using The Science of Where to solve some of the world's toughest challenges.

"The members of our partner network have succeeded in areas ranging from improving operational efficiency in the workplace to helping protect the environment," said Esri president Jack Dangermond. "Esri is privileged to recognize our most distinguished partners."

This year's award winners have developed pioneering GIS solutions for the user community while also demonstrating best practices in business.



Alden Park is a five-acre park located in northwestern Edina. This hilly, grassy park is full of trees for reading or picnicking and features a beautiful path that runs through the park for walking or biking. The park also has full sized basketball court, perfect for a game of pick up. Alden Park has playground equipment for all ages as well as benches and picnic tables that offer a comfortable seat to relax and watch the scenery.



## Best Citizen Engagement

### Geographic Technologies Group

[geotg.com](http://geotg.com)

Geographic Technologies Group (GTG) delivers solutions that empower governments to engage with citizens who want to participate in planning, share feedback, and build better communities. Users of GTG's GreenCityGIS ([greencitygis.com](http://greencitygis.com)) employ ArcGIS in innovative ways by using data collected by citizens and departments to map and manage parks and recreational areas.

## Big Data Analytics

### ITWORX

[itworx.com](http://itworx.com)

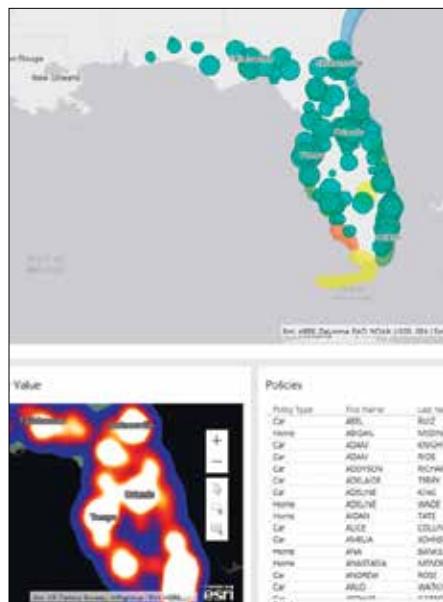
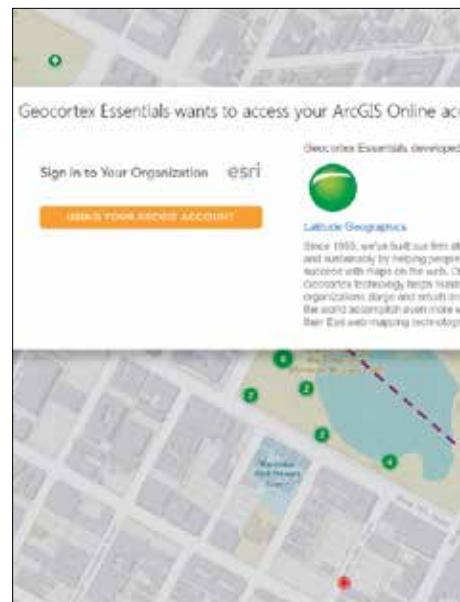
Integrating its solutions with the ArcGIS platform, ITWORX makes it easier for users in telecommunications, retail, banking, and other industries to analyze big data. Being able to visualize location data alongside big data helps these users see trends that are not discernible in reports alone, so they can make decisions more quickly.

## Lighting Up the Entire Organization

### GeoNexus Technologies

[geo-nexus.com](http://geo-nexus.com)

GeoNexus offers end-to-end business intelligence and visualization software for organizations that face asset, facility, fleet, and infrastructure challenges. The GeoNexus suite of solutions, along with the company's exceptional use of mapping and analytics technology, is expanding the use of the ArcGIS platform throughout entire organizations.



## Everyone Has an Identity

### Latitude Geographics Group

[geocortex.com](http://geocortex.com)

Latitude Geographics builds powerful web mapping solutions that leverage the ArcGIS platform and magnify results. The latest release of its Geocortex Essentials suite embraces ArcGIS identities, new patterns and information models for distributed GIS that give users access to data, apps, and analytics that are valuable for enterprise GIS. The range of capabilities included with Geocortex Essentials—from reporting and charting to integrations and workflows—lets users extend the reach of their web mapping apps.

## New Technology Integration

### Microsoft Corporation

[powerbi.microsoft.com](http://powerbi.microsoft.com)

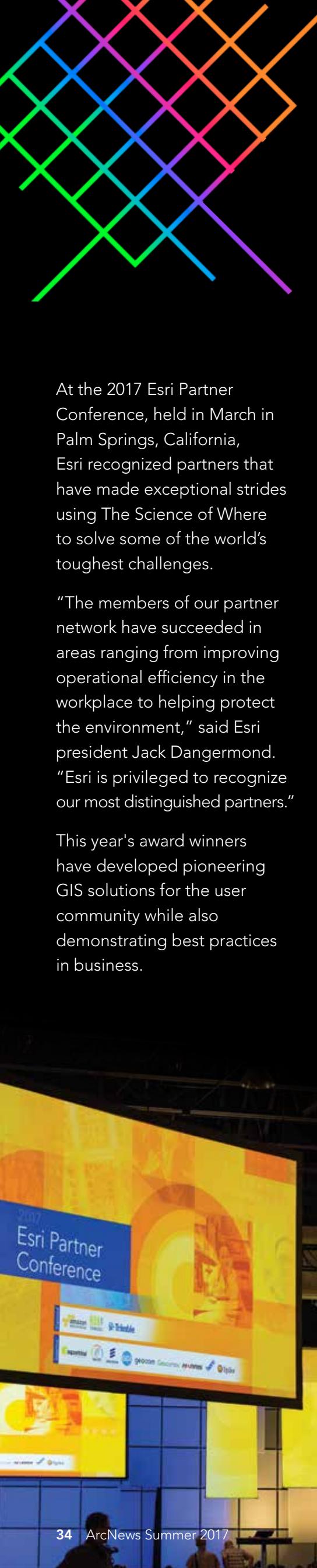
Microsoft received the New Technology Integration Award for taking map visualization and location analytics to the next level by integrating ArcGIS with Microsoft Power BI, a set of business analytics tools. ArcGIS Maps for Power BI allows users to share their observations as interactive maps layered with authoritative data—all in one seamless process, without having to export data from numerous online sources. This enables organizations to make better business decisions far more efficiently.

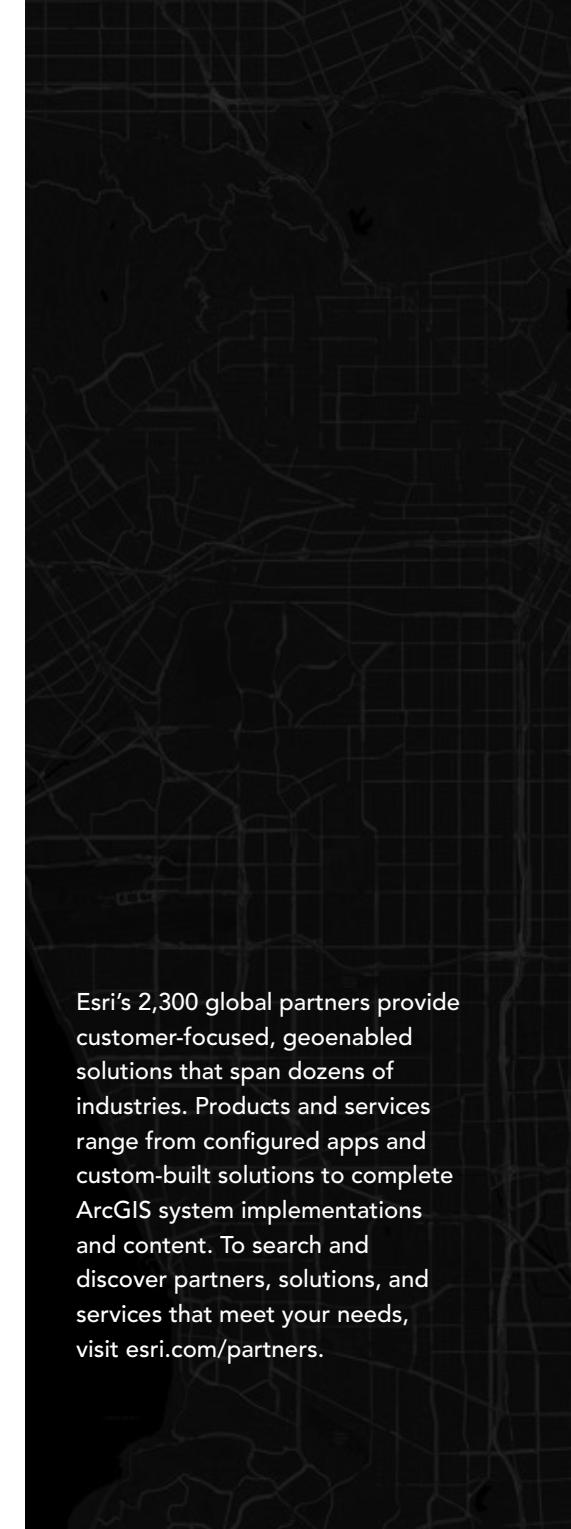
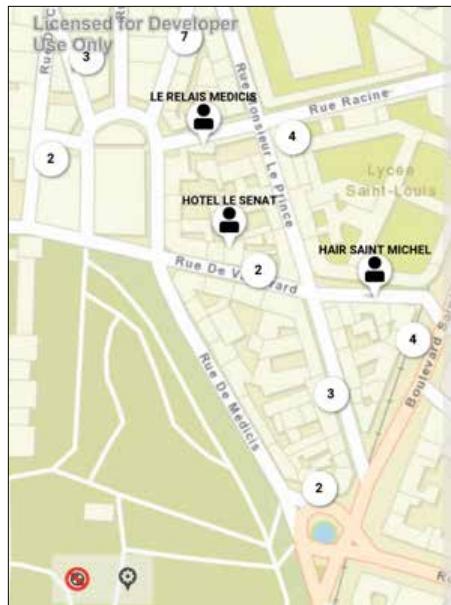
## Best New Content Partner

### Nearmap

[nearmap.com](http://nearmap.com)

Recognized as a newer Esri partner that excels in content delivery, Nearmap produces frequently updated high-resolution aerial imagery that can be easily incorporated into ArcGIS Online and other image services for ArcGIS. With the ability to access Nearmap imagery quickly (often within days of capture), as well as historical archives of before and after images, users can transform the way they work by improving planning and making more streamlined and effective decisions.





#### Best Use of Story Maps

**Stone Environmental**

[stone-env.com](http://stone-env.com)

As a company that provides scientific tools, information, and analysis to help clients meet complex environmental challenges, Stone Environmental was the perfect fit for Bennington, Vermont, when the town chose to develop a holistic plan for revitalization. The ensuing Bennington Downtown Area-Wide Plan had a vision for fostering a healthy economy, but it still needed community buy-in. So Stone built an interactive story map to present to the public, and now redevelopment projects are under way. (For more on this, see <http://p.ctx.ly/r/40mt>.)

#### Most Unique App

**Sword Group**

[sword-group.com](http://sword-group.com)

Sword offers comprehensive and integrated IT consulting and enterprise software. That is why Société des Auteurs, Compositeurs et Editeurs de Musique (SACEM), a nonprofit in France that helps musicians collect royalties, recruited Sword and Esri France to apply GIS to its operations. The resultant apps—which employ ArcGIS API for JavaScript and ArcGIS Runtime SDK for Android—encompass national planning, campaigns, and real-time updates and have been widely adopted across SACEM. (For more on this, see <http://p.ctx.ly/r/40mv>.)

#### Exceptional Partner-to-Partner Teaming

**Cityworks | Azteca Systems**

[cityworks.com](http://cityworks.com)

Receiving this award for the second year in a row, Cityworks demonstrates excellence in actively reaching out within the Esri Partner Network to find complementary partner offerings and then working together to meet users' needs. Built solely for the ArcGIS platform, Cityworks helps users maintain smart, safe, and resilient communities by streamlining how they manage public infrastructure and property assets, workflows, permitting, and operations. Combining Cityworks' proven solutions with those from other Esri partners stimulates operational excellence.

Esri's 2,300 global partners provide customer-focused, geoenabled solutions that span dozens of industries. Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content. To search and discover partners, solutions, and services that meet your needs, visit [esri.com/partners](http://esri.com/partners).

# OPEN UP A WORLD OF POSSIBILITIES

Put yourself on the map with USC's online graduate programs in **geographic information science and technology**.

- Expand your knowledge with a Graduate Certificate in GIST, Geospatial Intelligence, or Geospatial Leadership.
- Complete the M.S. GIST degree with a thesis capstone in as few as 20 months.
- Collaborate with multidisciplinary faculty through the Spatial Sciences Institute.

[gis.usc.edu/esri](http://gis.usc.edu/esri) | Visit us at Booth #207 at the Esri User Conference

**USC Dornsife**  
*Spatial Sciences Institute*



U.S. News & World Report ranks USC #23 nationally for 2017.



The USC Spatial Sciences Institute is an Esri Education Development Center.

 **USC** University of Southern California



## Esri T-shirt Twins?

Two-year-old Lena, who might be Map Girl's identical twin, flits around the playground in the T-shirt that her account manager mom brought back from the 2016 Esri User Conference.

**SAFE GRAPH**

**Where do people go and why do they go there?**

Figuring this out requires data on human movement.

SafeGraph maintains the world's largest human movement dataset based on anonymous location data from mobile devices.

**Directly Usable in ArcGIS.**

Get access to a free sample today by emailing [info@safegraph.com](mailto:info@safegraph.com).

# New Training and Certification Offerings

## Training

### New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT++ certification.

For quick yet thorough learning, see what these one-day Esri courses have to offer:

- **Creating Story Maps with ArcGIS**

Everyone loves a good story, and who doesn't love a good map? Learn how to combine the two to get a truly powerful communication medium. This one-day course—for anyone who wants to inform, engage, or inspire an audience—goes over how to use web maps with text, photos, videos, and other media to create a rich, interactive experience.

- **Migrating from ArcMap to ArcGIS Pro**

For anyone planning to transition their GIS workflows to ArcGIS Pro, this course will help yield productivity right away. Learn essential ArcGIS Pro terminology; how to import ArcMap documents and geoprocessing models into ArcGIS Pro; and best practices for completing a variety of tasks related to mapping, editing, analyzing, and sharing geospatial content with ArcGIS Pro.

- **Get Started with Insights for ArcGIS**

With drag-and-drop data discovery and analytics, the new Insights for ArcGIS app is lucid and versatile. In this one-day course, users learn how to dynamically visualize and analyze data from multiple sources on maps, charts, and tables, and then share their analysis results and workflows throughout an organization.

View all instructor-led courses at [esri.com/coursecatalog](http://esri.com/coursecatalog).

### E-Learning Spotlight: Hundreds of Resources

Since the new Esri Training website launched a year ago, the number of e-Learning resources has nearly tripled. The Esri Training catalog includes videos of technical workshops from select Esri conferences, as well as informative documents such as *Launching Your Location Platform: The Esri Guide*. Esri customers with a current maintenance subscription now have unlimited, organization-wide access to more than 600 e-Learning resources.

Explore the e-Learning collection at [esri.com/coursecatalog](http://esri.com/coursecatalog).

## Certification

The following Esri technical certification exams are now available at version 10.5.

- ArcGIS Desktop Entry
- ArcGIS Desktop Associate
- ArcGIS Desktop Professional
- Enterprise Geodata Management Associate
- Enterprise Geodata Management Professional
- Enterprise System Design Associate
- Enterprise Administration Associate

In keeping with the exam retirement policy, users can no longer schedule version 10.2 exam appointments. Once an Esri technical certification is achieved, however, it never expires.

Candidates who are ready to schedule an exam appointment may visit the Pearson VUE website ([pearsonvue.com/esri](http://pearsonvue.com/esri)) to select their preferred date and location. Pearson VUE operates more than 5,000 test centers worldwide.

To learn more about Esri technical certification exams, visit [esri.com/certification](http://esri.com/certification). Join the Esri Technical Certification group on LinkedIn as well to connect with other professionals and discuss all things certification.

Go to [esri.com/training](http://esri.com/training) for more information. Find courses at [esri.com/coursecatalog](http://esri.com/coursecatalog). Keep up with Esri training news by subscribing to the newsletter ([go.esri.com/preferences#Training](http://go.esri.com/preferences#Training)), visiting the *Esri Training Matters* blog ([esri.com/trainingblog](http://esri.com/trainingblog)), connecting with the Esri Training Community on GeoNet ([geonet.esri.com/groups/esri-training](http://geonet.esri.com/groups/esri-training)), and following [@EsriTraining](https://twitter.com/EsriTraining) on Twitter.

# Esri Press

For more information about all Esri Press publications, visit [esri.com/esripress](http://esri.com/esripress).

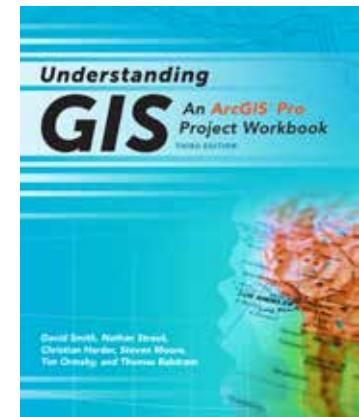
**The ArcGIS Book:**  
**10 Big Ideas about Applying  
The Science of Where, Revised and  
Expanded Edition**  
**Edited by Christian Harder**

The geospatial pioneers at Esri have revised and expanded this learn-by-doing guide to ArcGIS. Not just something to read, *The ArcGIS Book: 10 Big Ideas about Applying The Science of Where* offers GIS-based activities that readers can do in tandem with its website, [TheArcGISBook.com](http://TheArcGISBook.com). Investigate hundreds of live maps, then use your free Learn ArcGIS student account to create content about issues that matter to you and share the analytical results online as Esri Story Maps apps, web maps, mobile apps, and 3D scenes. By the end of the book, readers will have mapped the demographics of Detroit, modeled the habitat of mountain lions in Los Angeles County, and created an underwater 3D scene off the coast of Florida. Summer 2017, 172 pp. Paperback ISBN: 9781589484870.



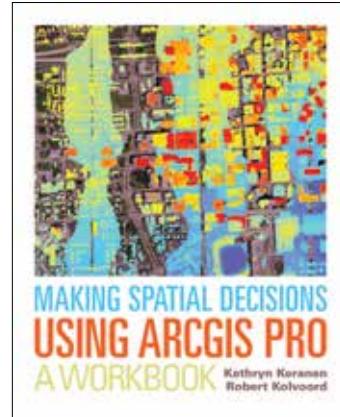
**Understanding GIS:  
An ArcGIS Pro Project Workbook,  
Third Edition**  
**By David Smith, Nathan Strout, Christian  
Harder, Steven Moore, Tim Ormsby,  
and Thomas Balstrøm**

The first single-project GIS textbook on the market, *Understanding GIS: An ArcGIS Pro Project Workbook* is an excellent resource for students and educators seeking a guide for an advanced, single-project-based course that incorporates GIS across a wide range of disciplines. In this third edition of *Understanding GIS*, readers progress through nine lessons (35 exercises), using ArcGIS Pro to find the best location for a new park along the Los Angeles River in Southern California. Each exercise offers step-by-step instructions, graphics to confirm exercise results, and explanations of key concepts. The book gives readers access to ArcGIS Desktop software, including ArcGIS Pro. Project data—which is real and updated—can be downloaded from the book's resource web page. Fall 2017, 360 pp. E-book ISBN: 9781589484955, and paperback ISBN: 9781589484832.



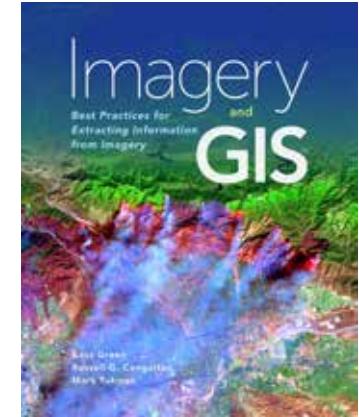
**Making Spatial Decisions Using ArcGIS Pro:  
A Workbook**  
**By Kathryn Keranen and Robert Kolvoord**

With lessons adapted from the authors' popular *Making Spatial Decisions* series and updated for ArcGIS Pro, readers of the new *Making Spatial Decisions Using ArcGIS Pro: A Workbook* get to solve real-world problems using the full range of capabilities of ArcGIS Pro. This textbook takes advantage of the integrative nature of ArcGIS software to seamlessly unite cloud-based, online, and desktop GIS. Kathryn Keranen and Robert Kolvoord use proven teaching methods so students can immediately apply what they learn as they progress through the workbook lessons. Scenarios include emergency hazards, natural disasters, social trends, law enforcement, and urban development. Summer 2017, 290 pp. E-book ISBN: 97815894844856, and paperback ISBN: 9781589484849.



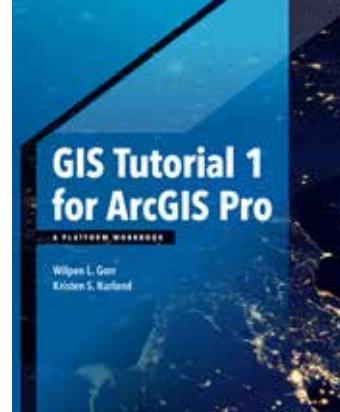
**Imagery and GIS:  
Best Practices for Extracting Information  
from Imagery**  
**By Kass Green, Russell G. Congalton,  
and Mark Tukman**

*Imagery and GIS: Best Practices for Extracting Information from Imagery* demonstrates how to successfully integrate imagery into maps and GIS projects. Readers will learn how GIS can derive value from imagery by extracting and analyzing information and providing enhanced visualizations, as well as how to efficiently manage and serve imagery datasets. With more than 150 full-color illustrations, this reference guide helps practitioners use image datasets that best satisfy their own requirements. Fall 2017, 400 pp. E-book ISBN: 9781589484894, and paperback ISBN: 9781589484542.



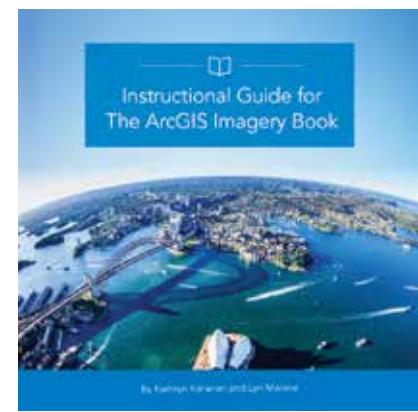
**GIS Tutorial 1 for ArcGIS Pro:  
A Platform Workbook**  
**By Wilpen L. Gorr and Kristen S. Kurland**

*GIS Tutorial 1 for ArcGIS Pro: A Platform Workbook* is an introductory text for learning ArcGIS Pro, Esri's premier professional desktop GIS app. In-depth exercises that use ArcGIS Pro, ArcGIS Online, and other ArcGIS apps feature the latest GIS technology and show readers how to make maps, create and analyze spatial data, and manage systems with GIS. The authors incorporate proven teaching methods into detailed exercises, "Your Turn" sections, and expanded homework assignments, making this book well suited to students learning GIS in a classroom setting. Resources for instructors are available upon request. Fall 2017, 650 pp. E-book ISBN: 9781589484931, and paperback ISBN: 9781589484665.



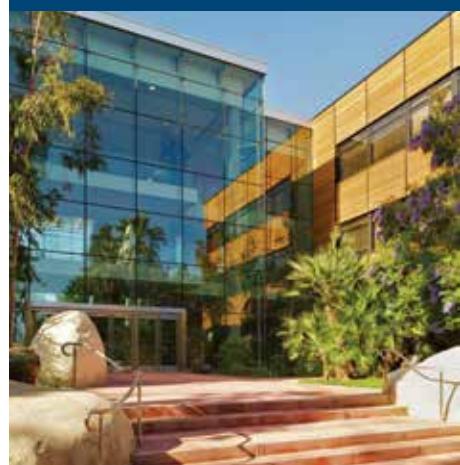
**Instructional Guide for The ArcGIS  
Imagery Book**  
**By Kathryn Keranen and Lyn Malone**

This complimentary online companion to *The ArcGIS Imagery Book: New View, New Vision* (Esri Press 2016) gives self-learners and current or future GIS instructors the materials they need to develop and apply ArcGIS imagery tools and concepts. Building on the foundational ideas laid out in *The ArcGIS Imagery Book* and using its structure as a starting point, each chapter in this instructional guide provides students and teachers with activities, resources, lessons, and data that reveal how different components of ArcGIS Online interact with each other, as well as with GIS apps for publishing to the web and mobile devices. A combination of scenario-driven and skills-based lessons—including many that don't require software downloads—lets readers practice using these tools and inspires a deeper understanding of the potential and power of enterprise GIS. Downloadable instructor resources are included. Summer 2017. Visit [esri.com/esripress](http://esri.com/esripress) for more information.



# Esri Corporate Headquarters

[esri.com](http://esri.com)



Esri Technical Support  
[esri.com/support](http://esri.com/support)

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

Esri Products  
[esri.com/products](http://esri.com/products)

Esri Store  
[esri.com/store](http://esri.com/store)

Esri Developer Network  
[edn.esri.com](http://edn.esri.com)

Customer Care Portal  
[my.esri.com](http://my.esri.com)

## Esri US Regional Offices

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

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

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

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

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

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

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

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

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

### Federal Office

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

For additional information about Esri US regional offices, visit [esri.com/about-esri-usa](http://esri.com/about-esri-usa).

## Esri Distributors Worldwide

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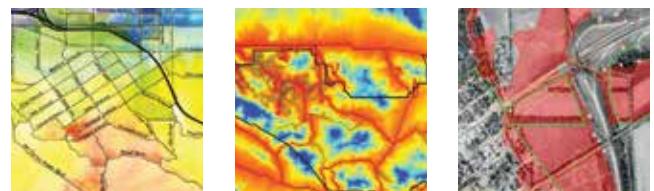
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