ArcNews

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Briefly Noted

Danish Geodata Agency Selects Esri Platform to Chart Waters
Esri has been selected by the Danish Geodata Agency (GST) to build a whole new system for creating and maintaining nautical charts of Danish and Greenlandic waters. With new shipping routes opening in the Arctic due to melting ice, it is crucial to have accurate charts in support of safe navigation and environmental protection. By partnering with Esri and its official distributor in Denmark, Geoinfo A/S, GST expects to produce charts of Danish waters more efficiently and be able to share information across departments and multiple agencies. To learn more about how Esri is modernizing maritime charting, visit p.ctx.ly/r/95kt.

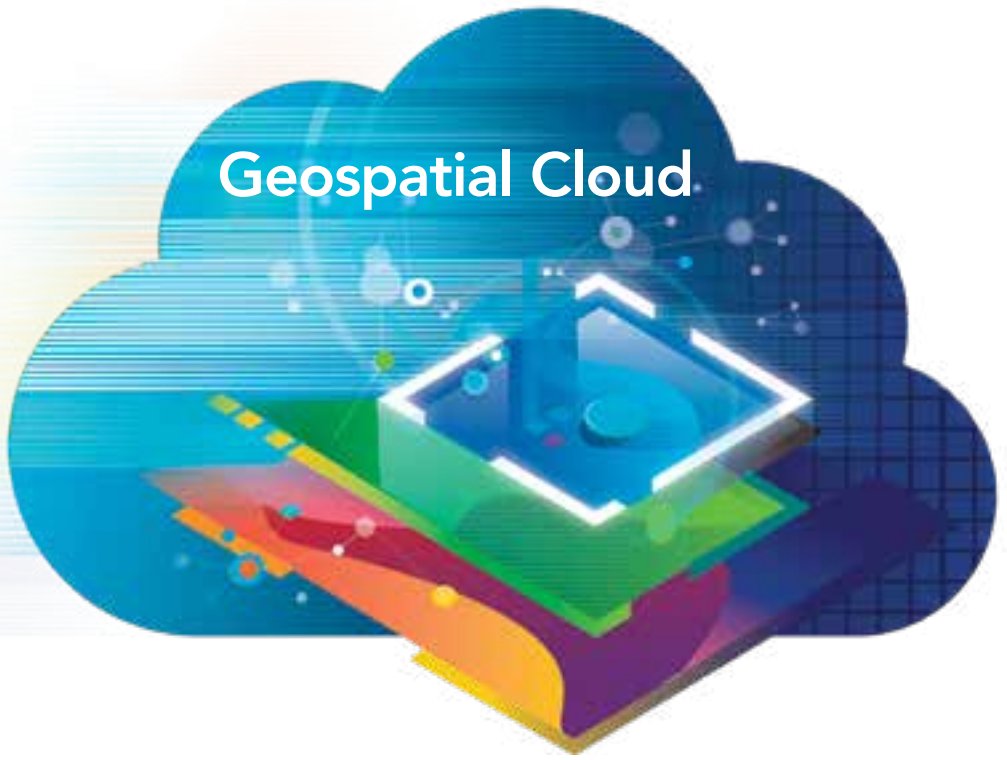
ArcGIS Hub Helps Government Agencies Meet New Open Data Requirements
In compliance with the new federal Foundations for Evidence-Based Policymaking Act, Esri's ArcGIS Hub enables federal agencies to share data in open formats with only a few clicks. They can also then feed those data catalogs directly to data.gov, the government-wide website supported in the bill. Find out more about ArcGIS Hub at p.ctx.ly/r/95kr.

ArcGIS for Developers Gets Relaunched
Esri recently relaunched ArcGIS for Developers to make it more accessible and affordable. There is a new pay-as-you-go plan for all location-based services, the price of routing transactions has been decreased, and there is a new commercial app deployment experience. Learn more at p.ctx.ly/r/95ks.

The Emergence of a Geospatial Cloud

And the Continuing Evolution of Cloud Computing

By Jack Dangermond, Esri



The combined forces of the Internet and cloud computing are dramatically changing how software companies deliver their functionality, and this is clearly impacting—some would say transforming—how end users do their work.

Today, web connectivity coupled with elastic cloud computing is giving users far greater reach and more flexibility in almost every field. The benefits are compelling: users can easily and inexpensively access an immense wealth of geographic information on almost any subject and leverage cloud computing resources to perform analysis and mapping. They can also easily share their data and combine it with other shared data in lightweight apps, fostering community and collaboration.

These forces are revolutionizing geospatial software and delivering many benefits to our users—and my sense is that this transformation is just beginning.

Geospatial Capabilities on the Web: Esri's Strategy

Over the past decade, Esri has transformed the fundamental architecture of ArcGIS to be entirely web services based. We refer to this architecture as a Web GIS platform.

This architecture has been engineered to work well in cloud environments, in on-premises infrastructure, and in hybrid networks. Web GIS manages all aspects of geospatial information—such as maps and data—but also analytical models, applications, workflows, and even data security and access. Users have the ability to easily share and integrate nearly any type of distributed georeferenced data. Web GIS is growing

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Mapping for Community Impact

Esri Maps for Public Policy App Drives Fact-Based Decision-Making

The new Maps for Public Policy web app from Esri provides free access to preauthored policy maps, allowing anyone to interactively explore various issues that communities face today. The app, announced by Esri president Jack Dangermond at the National League of Cities (NLC) City Summit in November 2018, is a bipartisan resource designed to help policy makers and citizens make fact-based decisions.

The policy maps featured in the app make data easier to understand. They highlight opportunities for users to get involved in social initiatives, fostering not only awareness but also civic engagement. The app gives users ready-to-use location intelligence and express access to policy maps, so they can skip the steps of obtaining and preparing the data.

Expediting the process of visualizing community data was a key driver for Esri to create this free app.

"Maps are something that people use to quickly understand and fathom the dimensions of situations," Dangermond said during his announcement at the NLC City Summit. "We appreciate the opportunity to support people with technology—not to go to the right or go to the left, but to go forward with data-driven policy."

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↑ The maps are preauthored, making it easy to spatially visualize data such as educational levels.

↑ Users can easily examine issues like how many people in the United States are on Medicaid.

↑ The policy maps tackle high-priority topics, such as how long commuters wait for public transit.

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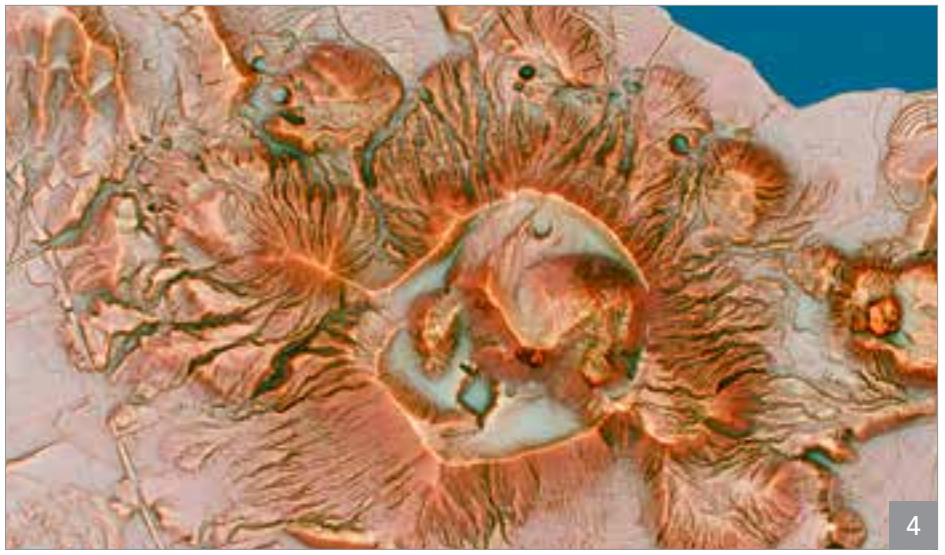

Most Esri users—including thousands of leading businesses and most local, state, and national governments—are integrating Esri's cloud-based geospatial capabilities into their operations and incorporating Esri's Geospatial Cloud services into their on-premises systems and workflows.

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continued from cover

The Emergence of a Geospatial Cloud

rapidly as well and is significantly easier to use, deploy, and integrate across the enterprise than traditional systems.

This pattern was deployed at scale with the creation of a massive geospatial cloud platform known as ArcGIS Online. The software-as-a-service (SaaS)-based platform provides hundreds of analytic and visualization capabilities delivered in easy-to-use apps. There are also tens of thousands of ready-to-use datasets and maps that users can immediately employ in their applications. This platform is opening up many new markets and enabling existing GIS users to expand their impact across their organizations.

The ease of use and affordability of this platform are attracting many new users, from fieldworkers and executives to software developers and data scientists. The open and scalable nature of this platform is also integrating the whole world of data science, artificial intelligence (AI), and machine learning.

Apps Make It Easy and Fun

Using this web pattern is easy, productive, and fun thanks to a whole suite of out-of-the-box apps that run anywhere. These apps just work, supporting things like smart mapping, field data collection, location tracking and routing, spatial analytics, situational awareness, and map-based storytelling.

Apps are increasingly how people explore and understand maps and information. They deliver an immersive and "sticky" experience that people find joy in using.

Introducing Esri's Geospatial Cloud

In 2019, we are introducing the term *Esri Geospatial Cloud* to describe the larger set of technology and products offered by Esri. This encompasses all our software and SaaS offerings, including the following:

- ArcGIS software (ArcGIS Desktop, ArcGIS Enterprise, apps, and extensions)
- ArcGIS Online (mapping and location SaaS)
- ArcGIS for Developers (APIs and SDKs)
- Geoenabled products (such as ArcGIS Indoors, ArcGIS Urban, ArcGIS Hub, and ArcGIS Business Analyst)

Esri will continue to create both software and SaaS products to help users do their work. Our offerings are also designed to operate in hybrid environments (software and services).

The advantages of cloud-based offerings include scalable computing, storage of large datasets, big data computation, and the ability to surge resources during critical events such as disaster response. The cloud can make nearly infinite computing resources available to scale up queries and tackle operations within minutes rather than days. The analytical problems we are being asked to address are scaling up as well with larger datasets and inputs from an increasing array of sensors. Tackling these challenges will benefit from leveraging these cloud resources.

Our geospatial cloud strategy allows for the quick integration and analysis of large datasets and imagery, often at the scale of cities, regions, and even the world. Here, the combination of advanced spatial analytics and new AI tools can help model and visualize complex patterns, relationships, and situations.

Big Real-Time Data

Most of today's real-time and big data problems are inherently geospatial. Examples include Internet of Things (IoT) sensors; devices such as smartphones; social media; vehicle sensors; cameras; and imaging sensors on drones, airplanes, and satellites.

Real-time IoT streams are particularly interesting when presented as maps. They can provide instant context and understanding of the data when displayed dynamically as spatial dashboards. Spatial triggers can also be useful for real-time responses. While the computing requirements for this real-time situational awareness can be demanding, the Esri Geospatial Cloud has been engineered to easily scale so it stores billions of records that users can query to ask complex questions and perform location analytics.

The geospatial cloud can also be a framework for powering AI algorithms running against data stores to automate processing and reveal insights. This architecture is a gateway to using AI services to understand and solve problem sets related to classification operations; spatial pattern detection; and, ultimately, predictive modeling. Data scientists are using this analytics, visualization, and open science platform to integrate all the leading open science tools into a geospatial framework.

An Evolving Architecture

Esri's ArcGIS architecture continues to evolve, providing new and flexible patterns for delivering geospatial capabilities. We are seeing our users deploy more lightweight applications that combine a variety of analytical functions and data services to tailor specific user-centric solutions.

In the past, data may have been tied to a specific app. Now, using web services, the same dataset can be used in multiple mapping, visualization, and analytic applications, providing whole new dynamic insights and understanding. All this capability is being brought together to create complex solutions for problems such as ride sharing, space-time optimization, and business-focused supply chain optimization.

Through the geospatial cloud, access to services and the underlying data can be managed, secured, and maintained at a granular level. Identity allows administrators to preserve role-based permissions in their organizations. Users gain portability with access to apps and maps from wherever they log in. And organizations can set defined roles in configured apps to bring together people and processes in a holistic way and address cross cutting issues.

Geospatial Cloud Deployment

Millions of people around the world are already using ArcGIS Online and making billions of maps every week. Intuitive workflows guide users through mapmaking and give them access to the world's largest collection of digital geographic information. This combination of data and apps is changing how and where GIS is used.

Tailored apps for field data collection are already erasing the boundary between field and office. Companies take these apps into the field to gather up-to-date information and empower fieldworkers to make decisions on the spot. At the same time, office workers can see real-time dashboards of fieldworkers' measurements and monitor safety with real-time employee location.

Esri's Geospatial Cloud includes wide ranging capabilities, empowering almost any organization with increased spatial understanding. These include business components that turn spreadsheets of addresses into maps that can be used to route users to various locations. Developers can use APIs to build their own apps or embed geospatial capabilities into their existing apps or web pages. New image processing workflows and machine learning algorithms can expedite going from raw pixels to image exploitation and insights. Esri's Geospatial Cloud also delivers new ways of communicating with interactive story maps that leverage the visual language of geography to express ideas and showcase events.

The Next Step

Looking forward, we at Esri will continue to focus on building capabilities that help users be more effective by applying mapping, real-time IoT, imagery, big data, and spatial analytics to their work. This technology will seamlessly integrate our traditional on-premises systems with SaaS and hybrid environments.

We see the paradigm of the geospatial cloud as the next big step to empower our users with more options and fewer limitations.

To learn more about digital transformation, visit **esri.com/digital-transformation**.

With Esri's Geospatial Cloud, users like the City of San Antonio and its partner, the Southwest Texas Fusion Center, can take advantage of real-time data to stay on top of emergency calls and incidents.

Esri's Leading Geospatial Software and the Cloud

How It Helps Business, Government, and Research Succeed

While cloud vendors may provide basic mapping and location capabilities with their cloud services, Esri is leading the way with a comprehensive geospatial cloud strategy and platform for supporting a complete spectrum of location capabilities. These range from simple mapping and location analytics to sophisticated tools for addressing complex geospatial problems.

Most Esri users—including thousands of leading businesses, as well as most local, state, and national governments—are systematically integrating Esri's cloud-based geospatial capabilities into their operations. They are incorporating Esri's Geospatial Cloud services into their on-premises systems and workflows.

Esri started providing geospatial services in 2011 with basic mapping and analytics implemented as high-performance web services. These offerings have since been improved and expanded into a complete suite of geographic information capabilities that include advanced visualization and spatial analytics.

Today, Esri offers new, flexible, role-based licensing called ArcGIS User Types, which allow customers to license and use Esri software to match their needs. Esri is also the only company delivering a full-blown, cloud-based GIS that includes hundreds of dynamic capabilities that continuously leverage a "living atlas"—a rich library of ready-to-use maps, imagery, and demographic content for the entire world. This platform is massive, scalable, and makes billions of maps daily. It contains a superb collection of apps, as well as open APIs that thousands of developers use to create both simple and sophisticated apps that embed the power of GIS in nearly everything.

Cloud-based services from Esri are easy to use and available for businesses and agencies of all sizes. These capabilities are helping thousands of organizations around the world integrate mapping and geospatial analysis into their apps, providing a whole new understanding of complex problems.

Esri's Geospatial Cloud lets users easily map and analyze their own data and combine it with thousands of other online information layers to discover new relationships and insights. The system is designed to handle and integrate both big data and real-time data flowing from the Internet of Things (IoT). It can easily connect the GIS team with the data science team.

Esri's Geospatial Cloud is open and interoperable with other technologies and offers an array of out-of-the box apps and developer tools that are easy to configure. Many of these apps support both interactive and batch geospatial analyses, which easily reveal previously hidden patterns and connections. With these apps, organizations are engaging in stronger decision-making.

Esri is creating focused, geoenabled systems for specific industries and types of work. The ways in which organizations apply this technology to their systems and workflows is broad and expanding. They range from advancing supply chain management and getting real-time field updates for utilities to helping retailers generate customer analytics and optimizing location for just about everything. The software can be configured to help businesses manage assets in the field, analyze usage trends, and reveal location-based intelligence about customer interactions.

Governments use GIS-powered location intelligence for numerous mission-critical actions and operations. Even the film industry employs the technology to build and manipulate 3D models of cities.

Here are 10 examples of how Esri combines cloud computing and GIS software to create the in-depth and ongoing location intelligence that is vital to any organization's success.

1 Real-time situational awareness

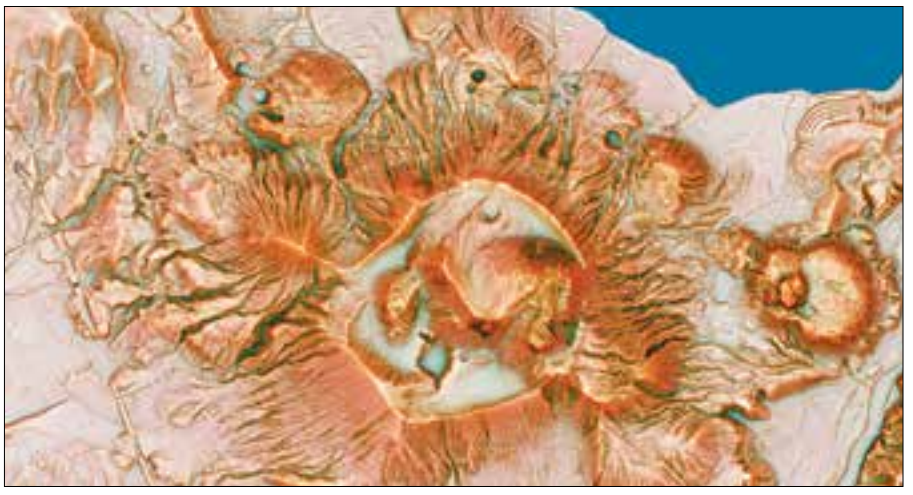
The City of San Antonio, Texas, and its security partner, the Southwest Texas Fusion Center, are supporting real-time geotracking of officers and emergency medical services (EMS) personnel at secure events, including college basketball tournaments and the city's tricentennial celebration, which took place in 2018.

The ability to provide this real-time awareness has led to the development of many innovative field apps that dramatically improve monitoring and immediate response at live events. Cities are using sensor data from the IoT for everything from monitoring infrastructure to tracking delivery services. This is helping organizations manage operations and decision-making at multiple scales. In the private sector, retailers are improving their operations, product mix, and customer engagement strategies using real-time IoT data enriched with demographics and location analytics.

2 Esri's Geospatial Cloud comes packaged with ArcGIS Living Atlas of the World

The world's largest digital geospatial content library—a repository of thousands of ready-to-use maps and authoritative datasets—is a collaborative effort from Esri and its users and partners to share the best maps and data for the planet. ArcGIS Living Atlas of the World is accessible from any device, anywhere, at any time, and it is constantly growing and improving.

Living Atlas content includes up-to-date population and demographic segmentation data. The system integrates millions of earth observations from a variety of satellite sensors that update their imagery daily. There are also many thematic data layers and real-time networks of sensors providing dynamic sources of information, such as real-time maps of weather, traffic, and changes in land use.



↑ Esri delivers a full-blown, cloud-based GIS with hundreds of dynamic capabilities that continuously leverage ArcGIS Living Atlas of the World, a rich library of ready-to-use maps, imagery, and demographics content from around the globe.

3 The integration of data science and AI toolkits enhances answers

Esri's open architecture enables the integration of available machine learning, artificial intelligence (AI), and predictive analytics that work in conjunction with GIS.

The National Oceanic and Atmospheric Administration (NOAA) developed a rigorous approach to uncover what has caused an alarming surge in instances of valley fever, a rare fungal lung infection that crops up in the southwestern United States. Using the linchpin of geography, researchers combined data from several scientific fields with spatial analysis and statistical modeling to show that the lung infection actually has a strong link to rising ocean temperatures, which affect wind patterns.

Across government agencies and in industries that extend from retail and health care to emergency management and manufacturing, machine learning is analyzing location data to create better solutions to wide-ranging problems. Organizations are combining GIS tools with AI to assess risk, improve logistics and delivery, plan and select strategic locations, and predict a multitude of spatial phenomena such as traffic accidents and crime.

4 Hybrid distributed architectures provide flexibility

Porting GIS to the cloud enhances the technology's integrative power, connecting data and workflows and delivering access to location-based insights. The software adapts to hybrid cloud architecture that can include a mix of on-premises, private cloud, and public cloud services.

A large European retailer has democratized access to and use of location intelligence across its organization. Since starting this in 2015, the retailer has doubled its revenue by identifying store locations that show the highest potential for earnings and gaining an edge over competitors.

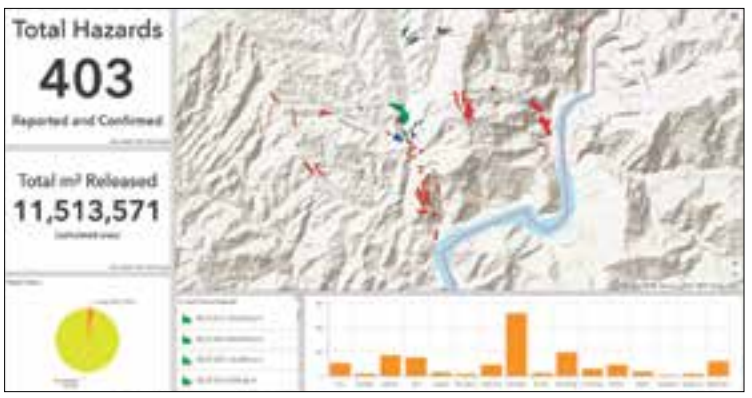
5 App-centric deployment allows access anywhere, on any device

The National Aeronautics and Space Administration's (NASA) Langley Research Center in Virginia created a detailed map of the entire center, including the interior and exterior of over 200 facilities. More than 300 curated and tailored apps use the map as a backdrop for everything, from daily maintenance and safety to flood prevention and sustainability. GIS functionality is readily integrated into workflows, where maps and spatial information aid understanding.

← At the National Aeronautics and Space Administration's (NASA) Langley Research Center, a detailed map of the entire center—including the interior and exterior of more than 200 facilities—supports daily maintenance, safety, sustainability, and more.

6 Desktop GIS operates independently and integrates with services to quickly provision apps

The Geneva International Centre for Humanitarian Demining (GICHD), which aims to find and remove land mines and other unexploded ordnance from vulnerable locations around the world, built an information management tool for office use and then converted the workflows to create web-based apps that personnel now use to review and edit data and make approval decisions. It works because ArcGIS Pro can perform just as well in a properly configured cloud or on-premises virtualized environment as on a desktop machine. The platform leverages modern hardware and computing technology to display graphics-rich maps and scenes and to perform spatial analysis.



↑ Operations Dashboard for ArcGIS, available via IMSMA Core, shows open and closed hazardous areas across Tajikistan, including total released land area and hazardous area count by administrative district. (Data courtesy of the Tajikistan Mine Action Centre.)

7 Deep imagery integration enables insight from earth observation inputs

Because of its remoteness and harsh weather, the Arctic is undermapped. So the National Geospatial-Intelligence Agency (NGA), the National Science Foundation (NSF), the University of Minnesota, Cornell University, Ohio State University, and Esri teamed up to automatically produce high-resolution, high-quality digital elevation models (DEMs) of the Arctic using optical stereo imagery. GIS can make use of the vast amounts of data in imagery sent from small satellites, unmanned aerial system platforms, and open data sources.

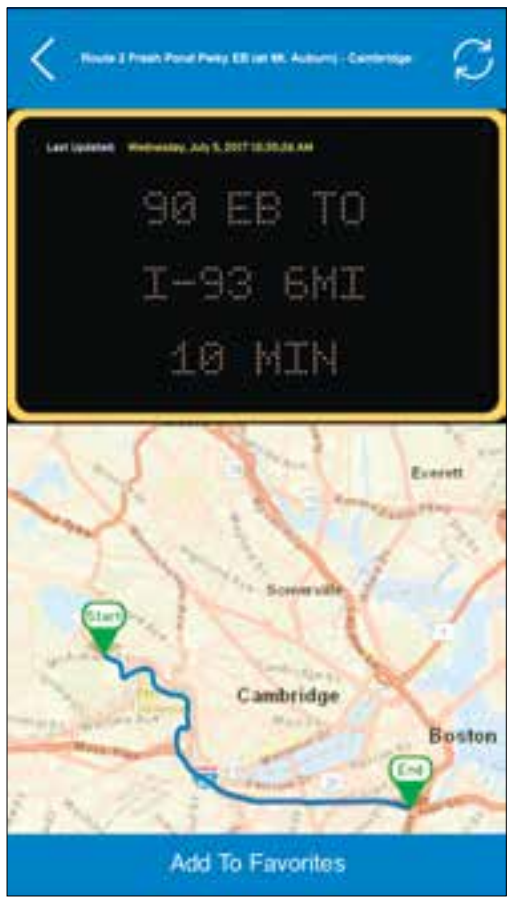
↑ The ArcticDEM was a collaborative project to automatically produce high-resolution, high-quality, digital elevation models (DEMs) of the Arctic using optical stereo imagery.

8 The ability to create digital twins delivers mixed-reality experiences

The National Capital Planning Commission in Washington, DC, created a realistic 3D "digital twin" of the US capital that it combines with models of proposed buildings in augmented reality to evaluate their visual and environmental impacts. This immersive solution helps the commission protect the city's iconic landscape while supporting continued development. With mixed reality, the National Capital Planning Commission gains a new means of engaging stakeholders. The technology also enables the commission to produce better-informed designs and iterative alternatives that optimize environmental inputs and extend the city's overall resilience. The 3D capabilities, specifically, are increasingly allowing city planners and developers to see how future structures will work in the physical world.

9 A deep developer ecosystem unleashes creative customization

Together with open APIs, Esri's Geospatial Cloud provides a developer ecosystem that makes it easy to embed advanced GIS functionality into purpose-built apps. The Massachusetts Department of Transportation (MassDOT) took advantage of this when it developed an app called GoTime for commuters and travelers who want to figure out how long it will take them to drive from one place to another. The app displays, in real time, the travel information on permanent and temporary highway signs throughout the state. Users who want to preplan a trip can see their selected route from start to finish and even save select signs to a favorites list.



↑ In the GoTime app, the travel times shown on both permanent and temporary electronic highway signs are displayed on travelers' phones.

10 Top-tier cloud infrastructure partners power scale, performance, and availability

With its adaptable software, Esri has been able to engage in a diverse mix of partnerships that benefit users. For example, the Ningxia Land and Resources Bureau in China built its foundational geospatial data platform with Esri's ArcGIS Enterprise technology on Alibaba Cloud. Other valuable partnerships include the following:

- Esri and Microsoft working together to launch Geospatial AI on Microsoft Azure
- Esri teaming up with IBM to offer cutting-edge spatial analytics to developers in its IBM Cloud
- Integrating Esri's location intelligence with SAP HANA's spatial services
- Esri customers deploying select ArcGIS licenses from Amazon Web Services (AWS) Marketplace to set up pay-per-use pricing models

Esri continues to adapt to changing business, research, and computing climates on desktop computers and mobile devices and in the cloud. We are not slowing down and will persist in exploring new territory and breaking new ground with whole new ways of applying GIS.

Enable, Engage, and Empower the Workplace with ArcGIS Indoors

ArcGIS Indoors, a new indoor mapping system from Esri, gives business owners, executives, building administrators, and employees a common understanding of their interior spaces through an interactive workplace map.

Many organizations still rely on disconnected email, paper and pen, and project files to carry out workplace planning and operations. But with Indoors, organizations can consolidate their indoor information—the people, places, and assets that make up a workplace—into a map that's accessible and easy to use.

A Tour of the System

Indoors consists of three components: a desktop add-in for ArcGIS Pro, a web app for personal computers and/or touchscreen kiosks, and native mobile apps for iOS and Android. This complete system allows organizations to create, customize, share, and apply a workplace map for everyday operations.

An organization can use the Indoors desktop add-in for ArcGIS Pro to consolidate its floor plans; CAD drawings; and information about assets, spaces, and people into the ArcGIS Indoors Information Model. This enables organizations to build a geodatabase of all their indoor information and use that to create a floor-aware workplace map that is viewable from the sitewide level down to the individual office level. It also allows for the creation of routable networks within the map, which employees and visitors can use to figure out where they need to be.

The Indoors web app, accessible via an Internet browser or a kiosk, gives users the ability to share their location—fostering better collaboration with colleagues. They can also take advantage of indoor routing, which makes it easier to find various amenities within the workplace, including restrooms, kitchens, and bike racks. With a quick search function and the ability to explore categories such as people, safety and security, and services, users can locate what they need swiftly and efficiently in either 2D or 3D. Additionally, organizations can configure various levels of access to the workplace map so users see only what they need. For instance, the security department can use named user tracking to monitor and dispatch security personnel in the field so they can respond quickly to ongoing incidents and keep the workplace safe and secure.

The native iOS and Android mobile apps for Indoors expand the web app's capabilities for use on the go. In addition to facilitating location sharing and routing, employees can sync the mobile app with their calendars, which is useful for finding and navigating to meeting areas, conference rooms, and other ideal spaces for connecting with colleagues. The mobile app is integrated with Survey123 for ArcGIS as well, so users can easily report workplace issues such as broken equipment or plumbing. This not only allows an organization to crowdsource indoor incident reports, but it also captures an issue's exact location and creates a route to get there so the appropriate department can fix the problem efficiently.

The complete Indoors system empowers all people within an organization to be comfortable in and connected to their workplace environment.

Putting Indoors to Work

With Indoors, organizations from all industries can capture and visualize indoor operations on a map to spatially enable planning, analyze and isolate bottlenecks, and increase throughput. All this makes it easier to administer a safer and more engaging environment, as well as save money and generate increased revenue.

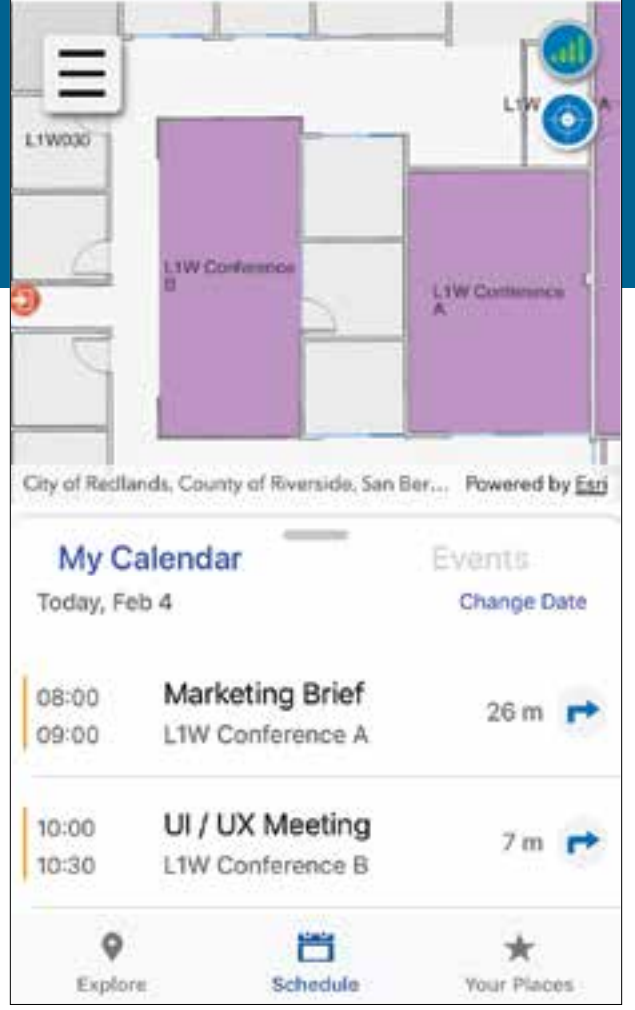
Using the full Indoors system, leaders of corporate buildings, state and local facilities, and academic campuses can also get a complete operating picture and better understand how to manage and allocate resources. Is space being properly utilized? Are workplace services being delivered quickly and efficiently? Is the identity and status of every single asset available and easy to access? These are the types of questions organizations can now answer strategically.

Airports, for example, can use Indoors to bring together disparate datasets in one workplace map. This system of record enables them to streamline their operations, getting workers, assets, and people from point A to point B efficiently. With the higher levels of productivity that come with this, airport operations staff can ensure that travelers get through and on to their final destinations more quickly, pleasantly, and safely.

Maximizing the Value of the Built Environment

The value that an easily accessible workplace map provides to an organization, its employees, and visitors is an optimized experience with, and a greater connection to, the built environment. This allows organizations to see, plan, and act more effectively, as well as better allocate and manage resources. They can advertise corporate events and help people figure out where they're located on an indoor map. This boosts productivity; maximizes the value of the built environment; and saves time, effort, and money.

So many organizations and industries will benefit considerably from implementing the Indoors system. Learn more about the technology at go.esri.com/indoors.



↑ The mobile app lets users sync ArcGIS Indoors with their calendars, so when meeting or event reminders pop up, they can easily figure out where to go.

↑ With Indoors, organizations can consolidate their indoor information—people, places, assets, and services—into a workplace map that not only makes buildings more accessible but also renders them more secure.

↑ The Indoors web app enables location sharing and routing. Users can view the maps in either 2D or 3D.

Los Angeles County's Vision for ArcGIS Indoors

With more than 10 million residents, Los Angeles (LA) County is the most populous county in the United States. Its government—which consists of 37 departments; approximately 200 committees and commissions; and more than 500 political districts such as school boards, water districts, and sanitation boards—is responsible for delivering a wide variety of programs and services to residents and visitors. These include law enforcement, property assessment, public health protection, social services, parks and recreation, and cultural activities.

LA County operates and maintains approximately 4,000 facilities. This asset portfolio is more extensive in both quantity and value, as well as more diverse in terms of building types and facilities owned and operated, than most agencies. That makes it an ideal testing ground for Esri's new indoor mapping system ArcGIS Indoors.

A Transformative Moment

The Internal Services Department (ISD) at LA County plays an important role in providing a range of support services to other county departments in the areas of purchasing, contracting, facilities, information technology, energy and environmental programs management, parking, and mail services. To keep county facilities and technology running smoothly, ISD staff are regularly deployed across this highly distributed workplace, which spans over 4,000 square miles, to help out and collaborate with the county's more than 100,000 employees.

Within ISD, the enterprise GIS team supports the authoritative geospatial information that underpins countywide operations, decision-making, and public services. LA County was Esri's twentieth customer, so GIS-based mapping of the outside world has a long history there. Mapping, managing, and navigating interior spaces, however, present their own unique challenges and opportunities.

But LA County's geographic information officer (GIO), Dr. Steve Steinberg, sees this as a moment of transformation.

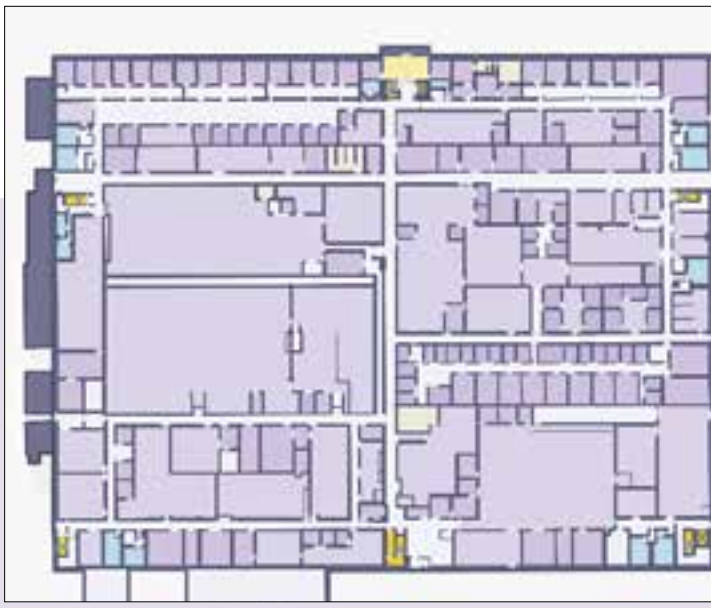
"Currently, county staff responding to a wide variety of both maintenance and technical service requests across hundreds of buildings can find it difficult to locate a specific room," Steinberg said.

The public faces similar challenges when looking for the correct office or counter to access county services, which range from applying for a permit or paying a bill to attending a public meeting or getting a flu shot.

"Most people know how to use their phone to navigate to the correct building," Steinberg continued. "What we face now is a 'last mile' issue: how to find where to go after walking into the lobby of a facility."

To engage effectively with county staff and community stakeholders, Steinberg and his team wanted to explore new and innovative solutions that would make it easier for them to accomplish their objectives. As the GIO for the county, Steinberg believes that there is tremendous opportunity to proactively leverage emerging technologies that will provide even more efficient and effective government services.

"LA County is a leader in public sector innovation, and we want to continue to push the boundaries of geospatial technologies," said Steinberg. "The ability to rapidly test, create a prototype, and adopt technology that can improve organizational workflows is an important opportunity for our county."



↑ Los Angeles (LA) County is implementing ArcGIS Indoors to solve its "last mile" issue: after people get to a building, how they figure out where to go once they're inside.

↑ After searching for where they need to go, users will receive landmark-based directions in a side panel of the app that navigate them around recognizable building features such as staircases and conference rooms.

↑ As an early adopter of Indoors, LA County is exploring opportunities to deliver a comprehensive workplace map to everyone who uses its spaces.

Complete Indoor Mobility

Indoor mapping has the potential to develop more effective maintenance programs, improve how space is utilized, provide navigation options that are compliant with the American Disabilities Act, and furnish better services to county employees and the public going forward. That's why Steinberg is leading LA County's initiative to beta test Indoors.

Indoors offers off-the-shelf apps for workplace operations, planning, and wayfinding that are accessible via the web, mobile devices, and kiosks or digital signs. With easy indoor navigation available across every device, the workforce and visitors have complete mobility across familiar and unfamiliar workplaces. Indoors also comes with an add-in to ArcGIS Pro that enables organizations to create and manage indoor maps from CAD or building information modeling (BIM) software and allows them to keep these constantly changing indoor maps up-to-date.

As early adopters of Indoors, Steinberg and his team are keen to use this new geospatial technology to make county workplaces more accessible to constituents, more functional for employees, and easier to service.

Better Navigation, Better Service

Citizens who are looking for county-facilitated programs, services, or meetings are typically lost the moment they enter an unfamiliar LA County building. When Indoors is fully implemented, however, citizens in the LA area will be able to search for their events, services, and county officials using a map that's accessible in two ways: on their individual mobile devices via the web or a native app or on public-facing kiosks located in the lobbies of county buildings. Once people search for what they need—an amenity, a room, a service, or a person—on their preferred device, landmark-based directions to the nearest result will be returned in a side panel that navigates visitors around recognizable building features such as staircases, conference rooms, and water coolers.

County employees will receive a more detailed map of the workplace that gives visibility into additional infrastructure such as private or secure offices, tech closets, electrical and plumbing shutoffs, and other spaces necessary for maintenance and planning purposes. The county's ISD field technicians and dispatchers will likely have comprehensive maps that include the ability to see dozens of workplace layers, live updates to service requests, and the real-time locations of operators and contractors.

Under Steinberg's guidance, LA County's ISD is piloting Indoors with the goal of transforming its workplace. As an early adopter of the technology, the county is exploring opportunities to deliver a comprehensive workplace map to everyone who uses its spaces via functional, off-the-shelf apps. People will finally know where to go, regardless of who they are or what building they're in, making LA County much more accessible.

Latest Release of ArcGIS Software, Apps, and Developer Products Takes Big Leaps

As the GIS industry continues to evolve and advance, Esri is maintaining its commitment to bringing diverse, cutting-edge software, apps, and services to its users. The latest release of ArcGIS is big. Take a look at what you'll find.

ArcGIS Pro

ArcGIS Pro 2.3 is the most significant release of ArcGIS Pro to date, with more new and updated features than any previous release. It includes enhancements that improve workflows for mapping, analysis, and data management. The redesigned and improved startup experience, which lets users launch ArcGIS Pro without first creating a project, means you can get going faster than ever before. ArcGIS Pro 2.3 includes color ramps for polygon outlines, reports, a new Deep Learning toolset, and new tools for measuring and interpolating 3D data.

ArcGIS Image Analyst

The ArcGIS Image Analyst extension has been augmented with several advanced capabilities and features. In addition to gaining the Deep Learning toolset and Motion Imagery, which is the evolution of the Full Motion Video add-in for ArcMap, Esri placed a strong focus on making quality improvements to and fixing bugs in the extension's stereo and image space capabilities.

ArcGIS Data Reviewer

ArcGIS Data Reviewer has new capabilities for automating quality control workflows. Many of the automated validation checks in Data Reviewer can now be configured as Attribute Rules, which enforce data integrity during the data creation and editing process. Additionally, the Delete Reviewer Session is a new custom step available for use with the ArcGIS Workflow Manager extension. When used in conjunction with the Create Reviewer Session step, it enables the automatic deletion of error results associated with a job.

Topographic Mapping

The Esri Defense Mapping and Esri Production Mapping extensions have a slew of new toolsets, including ones for automating production workflows; refining cartographic data; generalizing data for different geometry types; identifying narrow and wide portions of a polygon; and turning polygons into centerlines, which is useful for hydrography. Users can also now add a Slope Guide to their maps, which dynamically shows the percentage of slope on a map based on its scale and contour intervals.

ArcGIS for Aviation

The release of ArcGIS Pro 2.3 adds new functionality to ArcGIS for Aviation: Airports. A new parameter was added to all the tools in the Obstruction Identification Surfaces toolset that allows users to customize obstruction identification surfaces. Import FAA 18B Shapefiles and Export FAA 18B Shapefiles in the Data Exchange toolset enable users to switch data out of the data model and into the Federal Aviation Administration's (FAA) specified format and vice versa. Analyze LAS Runway Obstacles, in the Analysis toolset, determines if lidar points are penetrating obstruction surfaces. To make it easier to analyze and display polygon, polyline, and multipatch obstacles, Esri has updated some of the capabilities in the Generate OIS Obstacle Data tool and the Terrain and Obstacles Profile element.

ArcGIS Pipeline Referencing

In the latest release of ArcGIS Pipeline Referencing, Esri updated service-based network editing, service-based support for geoprocessing tools, and conflict prevention for multiuser editing. New tools have also been added to the Location Referencing toolbox, including Generate Calibration Points and Remove Overlapping Centerlines.

ArcGIS Enterprise

ArcGIS Enterprise 10.7 makes advances in data, publishing services, distributed collaboration, web mapping, administration, and more. In data, coded value domains are now available for hosted feature layers. Offline map areas can be created from web maps. Shared instances reduce the memory footprint of services and make it possible to support many more services than in the past. Enhanced distributed collaboration features means users can share items from Insights for ArcGIS and copy hosted feature layer views. New relationship style symbology helps show the relationship between attributes on a map. Webhooks allow users to get notifications when something specific happens in the ArcGIS Enterprise portal, such as an item being added to a public group. ArcGIS Enterprise 10.7 also features User Type licensing for ArcGIS Enterprise portal members to better match users' GIS capabilities with organizational workflows.

ArcGIS GeoEvent Server

Several key areas of ArcGIS GeoEvent Server have been enhanced. Users can boost real-time analysis on their streaming data with six new processors: Add XYZ Values, Bearing Calculator, Event Joiner, Event Volume Controller, Feature to Point, and Range Fan Calculator. Data sources in the spatiotemporal big data store now support z-values, and users can export delimited text from the spatiotemporal big data store to an Azure or Amazon cloud store right in GeoEvent Manager. Published feature services from GeoEvent Manager now support hosted views, allowing users to apply different editor settings, styles, or filters. To better manage system resources, it is possible to set user-defined refresh intervals on the Monitor page of GeoEvent Manager. Users can also access documentation quickly for all the available connectors and processors directly in GeoEvent Manager with the new embedded help.

ArcGIS GeoAnalytics Server

ArcGIS GeoAnalytics Server has new big data tools to fuel users' data management and analysis workflows. Clip Layer, Dissolve Boundaries, and Merge Layers make it easier to manipulate data. In data analysis, new statistics tools such as Forest-Based Classification and Regression and Generalized Linear Regression improve users' ability to find relationships and make predictions. Users can now keep their data in one place by writing their analysis results back to the data sources instead of writing results back as a web layer in ArcGIS Enterprise. With 10.7 also comes a best practices documentation topic on planning for and scaling a GeoAnalytics Server site.

ArcGIS Excalibur

ArcGIS Excalibur 1.0—a cloud-based image exploitation app that allows users to easily search, discover, and work with imagery in fully integrated workflows—is available for use in ArcGIS Enterprise 10.7. It offers a new way for analysts, imagery specialists, and managers to collaborate and deliver timely geospatial intelligence to decision-makers. Imagery projects in Excalibur allow users to access all their resources in one location, including geospatial reference layers that provide context to imagery tasks and tools that streamline image-based workflows. Users can also employ imagery projects to share and manage their imagery exploitation tasks.

ArcGIS Notebook Server

The launch of ArcGIS Notebook Server puts a built-in Python-scripting environment in ArcGIS Enterprise 10.7. Users can jump-start scripting with ready-to-use samples and boost workflow automation and spatial data science work—right in their Web GIS setups. Python libraries include ArcGIS API for Python, ArcPy, and open-source statistical and machine learning libraries.

ArcGIS Monitor

The latest release of ArcGIS Monitor, a tool uniquely tailored to monitor the health of ArcGIS implementations, includes several improvements. A new Status page lets users get a quick view of the status of their enterprise GIS infrastructure, databases, and more; Root Cause Analysis capabilities swiftly identify the sources of alerts and their downstream impacts; and there are now targeted usage reports for ArcGIS Server and Portal for ArcGIS. ArcGIS Monitor now has log counters and a new API as well.

ArcGIS for INSPIRE

The newest update of ArcGIS for INSPIRE—Esri's Web GIS solution to ensure compliance with the European Union's spatial data sharing requirements—supports three additional data themes: Agricultural and Aquaculture Facilities, Production and Industrial Facilities, and Energy Resources. This release includes enhancements to existing geodatabase templates; Atom feed validation for INSPIRE Predefined Dataset Download services; and other improvements to INSPIRE Feature Download services. The product also addresses many validation issues and is more compliant with INSPIRE specifications.

ArcGIS GeoAnalytics Server has new big data tools, including the Build Multi-Variable Grid tool. It can show, for example, the areas in New York City that are most removed from the parks system, with parks in red and these areas in blue.

ArcGIS Apps

Tracker for ArcGIS

Tracker for ArcGIS is now available for use in ArcGIS Enterprise and will be supported by ArcGIS Online with the June release. Location tracking, a new capability within ArcGIS, allows organizations to keep a record of where users are and where they've been, so their location tracks can be monitored and analyzed using the ArcGIS platform. Tracker for ArcGIS includes a Track Viewer app that an organization's ArcGIS administrator can use to create track views, which control who can see and use an individual's location tracks. The Track Viewer web app enables supervisors to explore, visualize, and interrogate tracks. The Tracker mobile app is a lightweight, native mobile app for iOS and Android devices that is optimized for tracking user locations in the background with minimal impact on the device's battery. When using the mobile app, users are in full control of when they are tracked.

ArcGIS for Insights

The latest release of ArcGIS for Insights introduces the Insights Analyst User Type, available in ArcGIS Enterprise and ArcGIS Online. This new User Type gives non-GIS analysts access to Insights without the extra capabilities of a Creator or GIS Professional User Type. So analysts outside the GIS department get only what they need while still being able to scrutinize every aspect of data—temporal, qualitative, quantitative, and spatial. Additionally, new capabilities in Insights include a new home screen for managing data and projects, Python and R integration, and support for distributed collaboration and PostgreSQL data.

ArcGIS Maps for Power BI

With the updated version of ArcGIS Maps for Power BI, users get enhanced mapping and analysis capabilities, demographic data, and compelling visualizations. There is an improved user interface, boundary data for more than 130 countries, and the new Find Similar tool that helps users find locations with similar attributes. Plus, users can access even more infographic data and easily pin maps with as many as 5,000 addresses on dashboards.

Operations Dashboard for ArcGIS

The latest update to Operations Dashboard for ArcGIS provides more flexibility for configuring dashboards with the introduction of new configuration options through URL parameters. Designed to trigger specific actions at run time—such as loading the dashboard based on a certain spatial extent or with a particular filter applied—there are several parameter types available, including category, numeric, date, feature, and geometry.

ArcGIS Business Analyst

The newest update of ArcGIS Business Analyst allows users to create dot density maps that represent data variable value in a specific area. It also makes it possible to download infographic templates from one organization and import them into another. Additionally, there is a new way for users to control how they share all-in-one PDF reports: when adding an email address to courtesy copy, they can now make PDFs private or public or share them with their organization's members.

ArcGIS Maps for Adobe Creative Cloud

The latest version of ArcGIS Maps for Adobe Creative Cloud gives users more creative freedom to design with data-driven maps inside Adobe Illustrator and Photoshop. The Mapboard now lets users define an extent from a data layer, map, or file saved on their computers. And the new Favorites button allows users to indicate which layers or web maps they prefer, as well as better organize frequently used content. For those times when creative decisions take a turn, there are new redo/undo actions within the Compilation window as well.

AppStudio for ArcGIS

AppStudio for ArcGIS 3.2 includes updated dependencies: ArcGIS Runtime 100.4 and Qt 5.11.2. A number of improvements were made to Email Composer in AppStudio Desktop Edition, and there is now notification and vibration support for Universal Windows Platform (UWP) apps. AppStudio Player now supports downloading and viewing public apps without signing in. It also has a new onboarding page and a dark theme. Several AppStudio templates, such as Map Tour and Quick Report, have new features and fixes as well.

Survey123 for ArcGIS

In Survey123 for ArcGIS, Esri added direct support for external Global Navigation Satellite System (GNSS) receivers, enabling users to collect highly accurate location data through smart forms. The Survey123 field app can connect to a receiver via Bluetooth, serial, or a USB port. GNSS metadata from the receiver can be used to provide user warnings and even enforce data validation rules at the time field data is collected. For example, a survey can be configured to warn users if the location provided by the GNSS receiver is not using a differential GPS fix type or is not meeting a particular horizontal accuracy threshold. All GNSS metadata can be stored as GIS attributes to support quality assurance and postprocessing office workflows. For more information about compatible receivers, visit p.ctx.ly/r/96xw.

↑ Interactive analysis tools in ArcGIS Earth allow users to complete projects and analysis work more quickly and efficiently.

Web AppBuilder for ArcGIS

Web AppBuilder for ArcGIS has two new widgets: the Threat Analysis widget, which helps public safety personnel and first responders identify safe distances and zones for planning events, and the Visibility widget, which determines what's visible based on distance, the observer's height, and a field of view. Existing widgets have been improved as well. The Directions widget now allows users to configure barriers from their map layers. The Analysis widget adds three new tools: Find Centroids, Find Point Clusters, and Summarize Center and Dispersion. And the 3D Search widget enables users to search feature layers.

Collector for ArcGIS

The 18.1.0 release of Collector for ArcGIS is a significant one for the iOS platform. Esri's beta community of more than 2,000 users recommended enhancements and features that make this app highly productive. Its engine supports vector tiles, labeling, and advanced symbology. The update also includes simplified ways to complete common, repetitive workflows. When gathering data in areas without connectivity, users can now create offline maps in the office to download to their devices and autosync edits from within the map. Additionally, this new Collector can run side by side with the former version of Collector for ArcGIS (iOS), which is now known as Collector Classic.

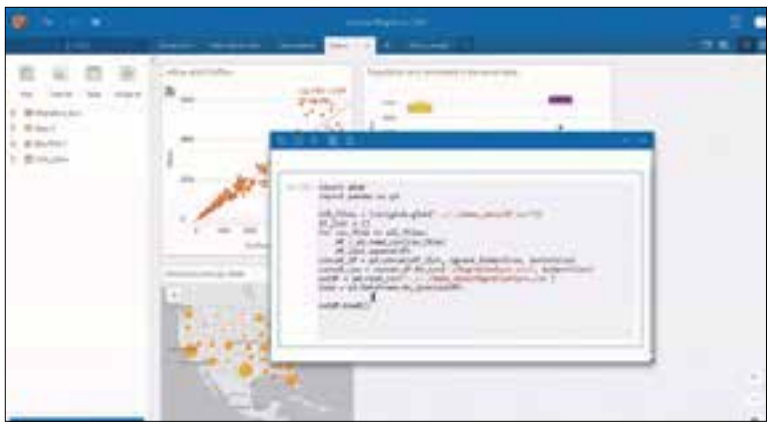
ArcGIS Earth

ArcGIS Earth is now available on Android devices and Windows desktop. The app has been optimized for quick browsing of 2D and 3D content in both offline and online modes. With interactive analysis tools—such as Elevation Profile, Line of Sight, Viewshed, and 3D Measure—users can now complete an array of projects and analysis work quickly and efficiently.

New Developer Capabilities

ArcGIS API for JavaScript

Version 4.10 of ArcGIS API for JavaScript introduces a considerable amount of new and improved functionality. Esri took major strides in advancing editing workflows with the new FeatureTemplates widget. There are now 2D and distance measurement widgets as well, and all the layers in the map are now drawn using a single WebGL context, which boosts performance. WebStyleSymbols enhance the 3D experience, there is a new building layer type for visualizing buildings with detailed interiors, and a new widget reveals obstructed content in a 3D scene.



↑ Leverage the power of Python and R directly with the Insights for ArcGIS interface. Convert a pandas DataFrame to a dataset, and with a simple string of code, bring it into Insights for analysis.

ArcGIS API for Python

ArcGIS API for Python versions 1.5.1 and 1.5.2 include new functionality and some bug fixes to further enhance the user experience. Users can now add a map legend and use comma-separated strings to return a query as a DataFrame. Esri also introduced a new Survey123 module in the Python API to bring the power of automation and insight to Survey123 data.

ArcGIS Hub

Recent enhancements to ArcGIS Hub, which assembles teams of collaborators around initiatives, make it easier for organizations and their communities to put together plans, organize activities, accomplish projects, and achieve goals. With new search capabilities and support for file geodatabase downloads, ArcGIS Hub makes it simpler to find and share data. Updates to the gallery card, plus a new media card, make it quicker to add content to hub sites. And a new site dashboard allows users to see how many views their hub sites get over time. User profiles and notifications have been updated as well. And key workflows for how teams build sites, manage content, and share information have been streamlined thanks to redesigned navigation and Site Editor enhancements.

↑ ArcGIS Hub has more streamlined workflows that make it easier for teams to build sites, manage content, and share information.

What's New in ArcGIS Online

To help users keep innovating with ArcGIS Online, Esri is continually building in new features, tools, and capabilities. Take a look at some of the latest updates to this central component of the Esri Geospatial Cloud, including new filters, configurable apps, and security features.

Filter Content by Location

When searching for layers, users now have a new filter: location. With this filter, users can pick a place or region of interest and see only items for that location. The filter works by referencing map extents. To take advantage of this search functionality, item creators must specify extents for their items.

Two New Configurable Apps

Users can bring their own or publicly shared maps, layers, or apps together using the new Category Gallery configurable app. This app is an excellent way to organize items into categories and allow viewers to interact with them. The categories give viewers the flexibility to filter and find relevant items. For example, a hiking association could use this app to make its own maps more accessible. By categorizing its maps based on trail type, location, ease of use, and accessibility, the group would make it possible for people to quickly find the hiking maps that fit their interests.

Another new configurable app, Interactive Legend, makes it easier for viewers to explore data by letting them turn layers on and off, as well as highlight and filter data, right in the map legend. If a city has a large, published dataset of crime types, for instance, it could employ the Interactive Legend app to let citizens explore which crimes have occurred in specific areas. A local resident could then search for his or her address, turn off all the crime types except burglary, and see how many burglaries have happened in the neighborhood.

Create Bins Based on Extent, Shape, and Size

The Generate Tessellations tool allows users to create bins determined by a specified extent, shape, and size. A forester could use this tool to divide harvested areas into regularly shaped areas (bins) to understand the number of seedlings needed to effectively reforest the area. After using Generate Tessellations, the forester will have a dataset of appropriately sized bins for the complete project area.

The bins are generated in a custom, area-preserving projected coordinate system. The specified size dimension is used to ensure that the sizes are equal and appropriate for the area of interest. An equal-area projection and parameters are chosen based on the geographic extent. The result is projected either to Web Mercator or the projection of a custom basemap.

Build Out Features in ArcGIS Basemaps

ArcGIS Online users now have a convenient way to improve ArcGIS basemaps. With the new Community Maps Editor app, they can build out detailed basemap features, such as buildings; trees; and facilities for school campuses, business parks, and recreation areas. The app includes powerful data creation and editing tools that let users clip and cut polygons, snap features to edges, and create features with straight and curved segments. Stencils are also included to make feature creation faster and easier. Visit go.esri.com/communitymapseditor to watch an introduction video for this new app.

New Password Aids and Increased Security

ArcGIS Online helps users resist the urge to create simple passwords. A new password strength meter helps users and administrators assess and improve their passwords. ArcGIS Online also has more rigorous password requirements for new and updated accounts.

To maintain privacy and data integrity among apps that communicate over a network, ArcGIS Online uses Transport Layer Security (TLS), a widely accepted security protocol. There are three versions: 1.0, 1.1, and 1.2. To improve ArcGIS Online transport security and align with industry best practices for security and data integrity, ArcGIS Online no longer supports TLS versions 1.0 and 1.1. To learn more about TLS and security, privacy, and compliance, visit trust.arcgis.com and see "ArcGIS Security Update May Require Immediate Action" on page 11.

Out of Beta: OpenStreetMap Vector Basemap

OpenStreetMap vector basemap, fully maintained and hosted by Esri, is no longer in beta. In organizations that have enabled vector basemaps, users can access it via the basemap gallery. Small areas of OpenStreetMap vector basemap can be exported for offline use.

↑ Interactive Legend allows users to turn layers on and off right in the map legend.

↑ Generate Tessellations lets users create bins according to a specified extent, shape, and size.

↑ The new Community Maps Editor app lets users build out basemap features.

↑ OpenStreetMap vector basemap is now out of beta.

ArcGIS Security Update May Require Immediate Action

Esri will require TLS 1.2 connections for ArcGIS Online services as of April 16, 2019. Immediate action may be needed for any clients or systems that connect to ArcGIS Online.

Esri strives to implement the highest security standards across its entire suite of products by using the most robust, widely accepted security protocols, including Transport Layer Security (TLS) for privacy and data integrity. The ArcGIS platform uses the TLS protocol as a key component of its security for web and service API connections, including connections between other Esri software products.

ArcGIS Online currently supports connections using TLS versions 1.0, 1.1, and 1.2. To continue providing strong security, Esri will require TLS 1.2 connections for ArcGIS Online services as of April 16, 2019. Action may be required prior to this change to ensure continued access to ArcGIS Online services.

Impact on the ArcGIS Platform

Esri has released patches and instructions on how to update existing software to support these connections. Some Esri software, such as ArcGIS Pro, is already TLS 1.2 enabled, while other Esri technology, such as ArcGIS Desktop, requires a patch or configuration change to support TLS 1.2 connections. Visit support.esri.com/tlsproducts for a list of affected products and information on actions you may need to take.

Who Is Affected?

If any of the following use cases apply to you or your organization, you may need to enable TLS 1.2 connections by April 16, 2019:

- **If your workflows require access to ArcGIS Online basemaps, story maps, ArcGIS Living Atlas of the World, hosted items, or other ArcGIS Online services**, the software you use that accesses ArcGIS Online will need to support TLS 1.2 connections to those services.
- **If you host a GIS portal with ArcGIS Enterprise that connects to ArcGIS Online**, then you need to ensure that your ArcGIS Enterprise deployment—including ArcGIS Server instances and Portal for ArcGIS—is updated to support TLS 1.2 connections to ArcGIS Online.
- **If you utilize ArcGIS apps or third-party apps built on ArcGIS Runtime SDKs that access ArcGIS Online from your desktop or mobile devices**, verify that those apps and device operating system configurations support TLS 1.2 connections.
- **If you have built any custom apps that access ArcGIS Online**, make sure that those apps and device operating system configurations support TLS 1.2 connections to ArcGIS Online.
- **If your organization is raising its network security requirements to demand TLS 1.2 or later and disabling previous TLS and SSL versions**, ensure that your software and operating system environments are updated to support those new internal IT requirements with TLS 1.2.

Next Steps

Use the following resources to help determine whether you need to take any action to update your software or operating system configurations to support TLS 1.2 with the ArcGIS family of products. If your apps are affected, you must take action to ensure continued access.

- Esri software that requires action includes ArcGIS Desktop, apps that are built on and extend ArcGIS Desktop, ArcGIS Enterprise, apps built with ArcGIS Engine (ArcObjects), and partner extensions that access ArcGIS Online services. Go to support.esri.com/tlsproducts to look up the Esri products you have and determine whether you use Esri software that will be impacted.
- Perhaps you have questions about the ArcGIS Online implementation of TLS 1.2 and how this affects the ArcGIS platform. To ask a question or see a list of frequently asked questions, please refer to the TLS 1.2 FAQ technical support page at go.esri.com/TLS.

To stay up-to-date on security, privacy, and compliance-related announcements for the ArcGIS platform, subscribe to the RSS feed in the ArcGIS Trust Center at **trust.arcgis.com**.

A REVOLUTION in Remote Sensing Is Under Way

Remote sensing, weather forecasting, and climate science are undergoing a drastic change. Nanosatellites, which cost much less to produce and launch than traditional satellites, can now collect vast amounts of extremely accurate atmospheric data using a technique called radio occultation. This data collection method wields GPS to monitor all sorts of variables between the earth's surface and the top of the stratosphere—from atmospheric refractivity to moisture, pressure, and temperature.

The pioneer behind this science is Dr. Thomas Yunck, a leading expert on GPS and the founder, chairman, and chief technology officer of a startup called GeoOptics.

"This is a huge revolution," said Yunck, who first looked into using GPS for science in 1979 while working as an engineer at the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL). He wrote the first-ever proposal to use GPS signals to measure the earth's atmosphere from space in 1988, and he has been deeply involved in developing and validating this technology ever since.

"It's disruptive technology that could replace the traditional, old, slow way of collecting modern, high-resolution weather data," said Lawrie Jordan, Esri's director of imagery and remote sensing.

An Ideal Solution to a Lot of Problems

Forty years ago, when GPS was brand-new, Yunck looked into how to apply the technology to science.

"We were using it to support deep space navigation at JPL, so we were investigating it for that purpose," Yunck recalled.

After studying GPS for what he believes was about two weeks, he wrote an unassuming report stating that it was promising technology for the future.

"Little did I know that one day, it would consume my life," he said. "As time went on, we found that GPS was essentially an ideal solution to a lot of problems: navigating spacecraft, determining the locations of points on the ground, determining Earth's rotation, and much more. All these things could be addressed extremely efficiently with GPS."

Throughout the 1980s, he and his colleagues at JPL devised a variety of precise techniques for using GPS to help map the topography of the ocean's surface and measure tectonic plate motion, which had never been observed before. The applications for GPS grew even further in the 1990s, and Yunck kept devising new ways to use the technology.

"It occurred to me that we could use GPS receivers on satellites to observe GPS signals passing through the atmosphere," he said. "If we could point antennas on satellites at the horizon, we could watch signals rise and set in the atmosphere, and we could observe the atmosphere itself. This was a rather novel idea for GPS."

It would also turn out to be an entirely different method for measuring the atmosphere, leading to more precise weather forecasting and studies on climate change.

NASA funded the early development of this idea, and that started the worldwide discipline for radio occultation. But the technology is highly disruptive, especially now.

Shrinking Technology and Shifting the Paradigm

While Yunck and his colleagues at JPL were developing radio occultation, technological devices were shrinking physically.

"A cell phone is basically what, 20 years ago, would have been a super computer in a room," said Yunck. "Cell phones, computers, and other consumer-type devices like flat-screen TVs—they've all gotten a lot smaller and/or cheaper."

The same kind of technology that facilitated the compression of consumer devices is now making it possible to build very powerful satellites that weigh 10 kilograms, have a volume of 6 liters, and cost under $1 million to build and a few hundred thousand dollars to launch.

"It's that kind of technology that allows us to miniaturize spacecraft that used to be as big as a bus or a minivan and cost a billion dollars to build," explained Yunck.

But the aerospace industry has been slow to get on board with miniaturization, mostly because government agencies have always had vertical control over space-based data collection—from developing the technology and getting it into orbit to gathering the data and using it.

In 2005, Yunck realized that the revolution he was trying so hard to push would have to materialize from the outside. He got a few colleagues on board and formed GeoOptics, a small, private company based in Pasadena, California. One of his earliest supporters was Esri president Jack Dangermond.

"We're overturning a decades-long paradigm of having many government-owned assets in space and shifting to privately owned assets, where small companies are gathering, generating, and delivering data to governments," said Yunck. "Over the next 10 to 15 years, everything about remote sensing is going to change."

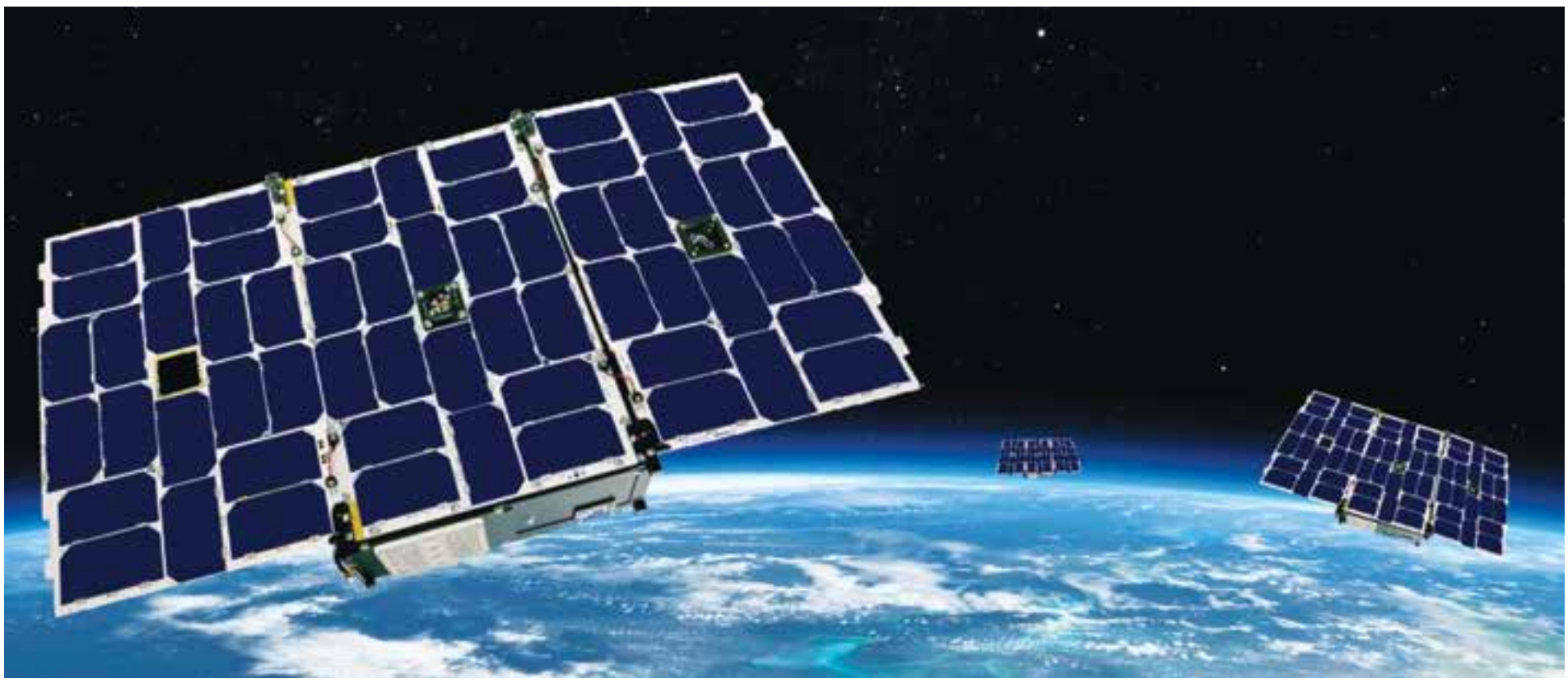
Much More Accurate Atmospheric Data

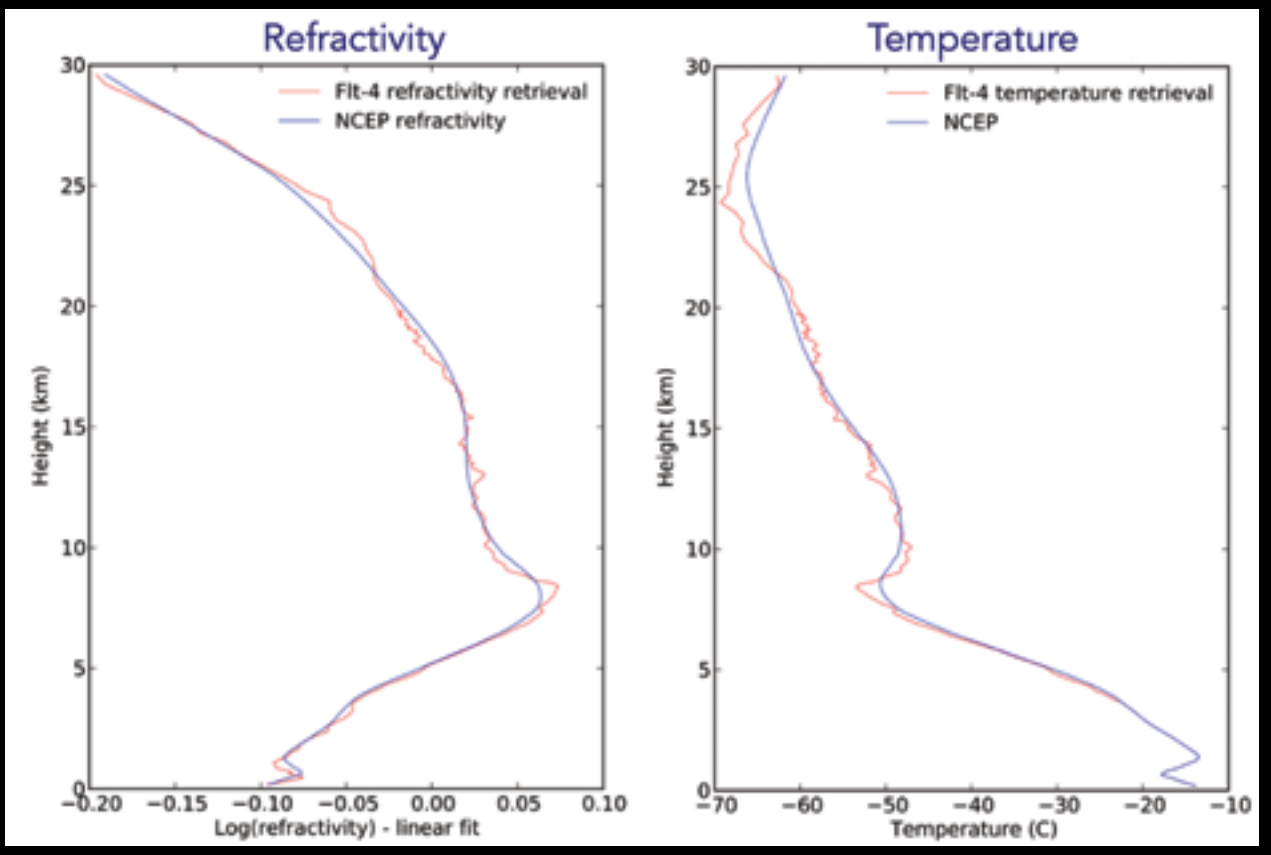
Since its founding, GeoOptics has faced some technological and financial difficulties. But the company now has three operational nanosatellites in orbit and, as of November 2018, is under contract to deliver its science-quality radio occultation data to the National Oceanic and Atmospheric Administration (NOAA) and the US Air Force.

"In the last couple years, they have come around to the concept of buying data from a private company because it's much more cost-effective," said Yunck.

Working with another Southern California-based startup, Tyvak, which builds the nanosatellites, Yunck and his team aim to put a group of satellites into space. They call this the CICERO constellation, which stands for Community Initiative for Continuous Earth Remote Observation.

↓ GeoOptics is putting a constellation of nanosatellites into space. Radio signals collected by these satellites yield 100- to 500-meter vertical resolution.





→ The red line shows atmospheric measurements made by CICERO satellites, while the blue line reflects the data model used by the National Oceanic and Atmospheric Administration (NOAA). The two lines essentially match, but the measurements taken with the nanosatellites are much more detailed and precise.

"I expect that within 10 years, we will have over 100 satellites," said Yunck. "That's going to change the world."

Using radio occultation, these nanosatellites produce better data than typical satellites, according to Yunck. They collect active radio signals passing through the atmosphere to detect the atmosphere's refractivity. This lets scientists observe atmospheric density, pressure, temperature, and moisture. They can also derive information about high-altitude winds from that data.

A radio signal collected by a CICERO satellite goes from the earth's surface to the top of the atmosphere in about 60 seconds and yields 100- to 500-meter vertical resolution. This allows them to measure over 150 levels of the atmosphere—far more than bigger instruments, such as radiometers, which typically measure 6 to 10 levels.

"It's very high-resolution, high-frequency data," said Jordan. "It's much more accurate, which will improve weather forecasts."

"These satellites will have a direct impact on all the regimes of weather forecasting, such as 1- to 15-day weather forecasts, seasonal and longer climate forecasts, and severe storm forecasts," said Yunck.

When monitoring a hurricane, for example, knowing the atmospheric pressure and moisture levels is critical to determining where the tropical storm is heading and how strong it will be when it makes landfall. More accurate data will allow forecasters to make more specific predictions much farther in advance.

It is also more useful for assessing how weather patterns change over time—i.e., climate change. Currently, indicators of rising temperatures around the globe are derived from measurements taken on the earth's surface. While that's useful, Yunck says we also need to know what's happening in the atmosphere. This is much more difficult. But nanosatellites using radio occultation can get an abundance of three-dimensional atmospheric measurements, which Yunck says is critical for studying climate change.

"Our technique is so precise that our ability to measure temperature in the atmosphere is at least 20 times more accurate than any other known technique in space," said Yunck. "So far, it's the only technique that can observe global warming over a short period of time—months or a few years, as opposed to 5 or 10 or 20 years."

A Boon to Esri Users

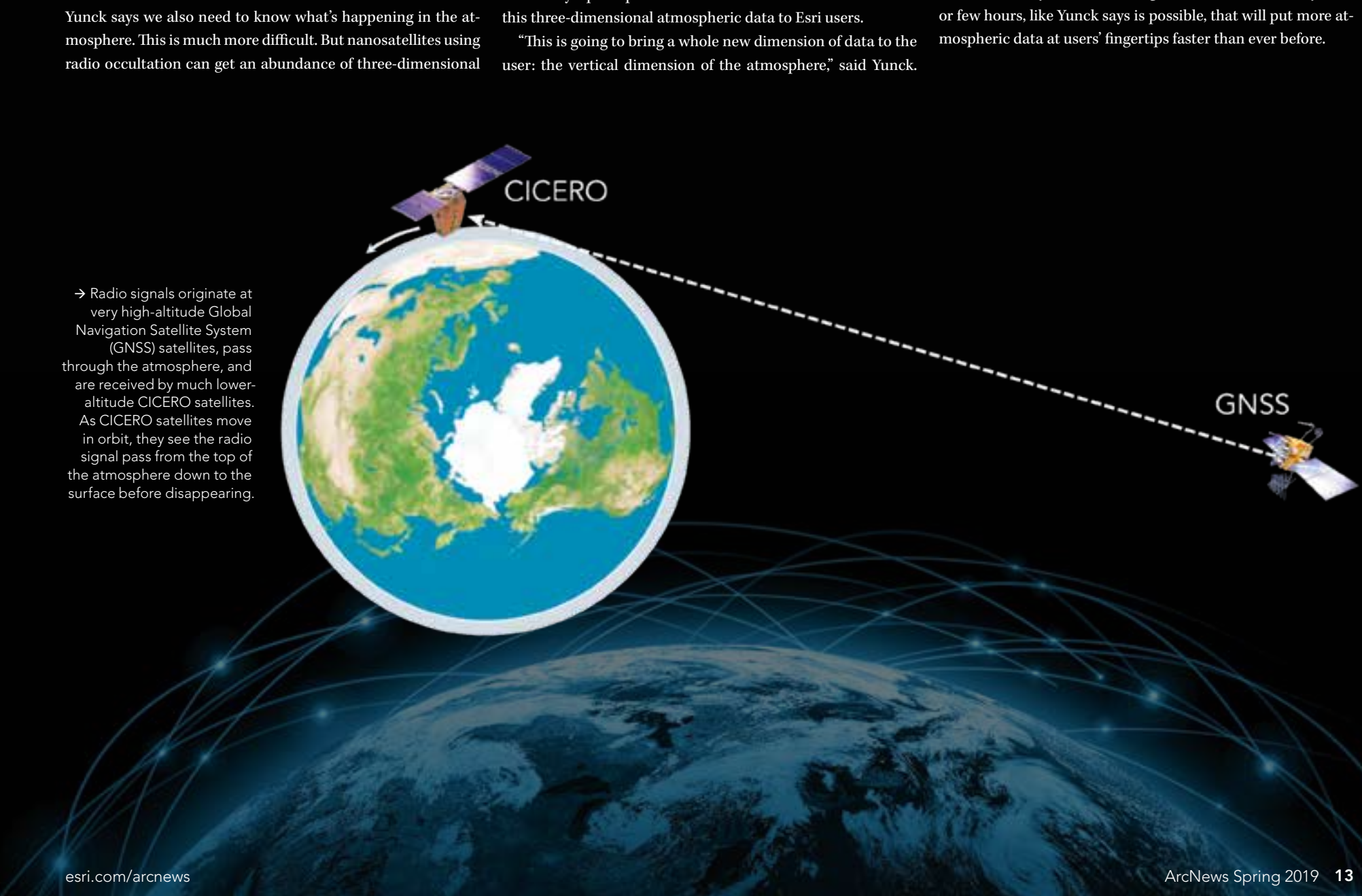
Eventually—perhaps even in 2019—Yunck wants to introduce this three-dimensional atmospheric data to Esri users.

"This is going to bring a whole new dimension of data to the user: the vertical dimension of the atmosphere," said Yunck. "Radio occultation has never been available to this kind of user. It will extend the use of climate-type data from surface-based applications throughout the atmosphere and into space."

Although the details still need to be worked out, Esri is excited about this prospect as well.

"We would like to have this data flow directly into ArcGIS Online," said Jordan. "It would be a remarkable addition to ArcGIS Living Atlas of the World."

If GeoOptics can succeed in ramping up its data delivery from once a day, which it's doing for NOAA now, to every hour or few hours, like Yunck says is possible, that will put more atmospheric data at users' fingertips faster than ever before.



→ Radio signals originate at very high-altitude Global Navigation Satellite System (GNSS) satellites, pass through the atmosphere, and are received by much lower-altitude CICERO satellites. As CICERO satellites move in orbit, they see the radio signal pass from the top of the atmosphere down to the surface before disappearing.

continued from cover

Mapping for Community Impact

Esri Maps for Public Policy is powered by the extensive portfolio of authoritative data available in ArcGIS Living Atlas of the World, the foremost collection of geographic information from around the globe. The data layers are "living," meaning they're regularly updated for accuracy and curated for quality. There are datasets on demographics, infrastructure, gross domestic product, and the environment that come from sources including the American Community Survey (ACS), the US Census Bureau, and the US Department of Housing and Urban Development (HUD). A team of Esri geographers preauthored the app's policy maps, performing analysis on high-priority social, economic, health, infrastructure, sustainability, and environmental issues to furnish a collection of useful data that is relevant to today's changing political environs.

To explore this collection of preauthored policy maps, open the app—accessible at esri.com/policymaps—in a web browser, select a location of interest, and choose a topic to examine: population, housing, or education. A collection of map cards then appears, which users can search and filter. Anyone can personalize the app by adding and removing cards while browsing the more than 400 available maps. When users select a card, the data populates ready-to-use maps of the selected location. Users can then click on the map to see pop-ups with additional information.

Esri Maps for Public Policy offers users the opportunity to investigate data at the local, state, and national levels so they can better understand how location impacts policy. The app includes data on social equity and health, economic opportunity, transportation and infrastructure, resilience and sustainability, the environment and natural resources, and public safety. By examining this data, policy makers and citizens can work together to tackle numerous issues facing their communities.

For some, Esri Maps for Public Policy can be a starting point for doing further analysis and executing more comprehensive GIS projects. Within the app, the title of each card links to the map source in ArcGIS Online. Current ArcGIS Online users can log in and open the preauthored policy map layers to perform their own research and exploration. Users can add Living Atlas layers to the policy map or import other community data to support specific causes.

The app's sharing capabilities also make it easy to collaborate. After users have collected their maps of interest, they can simply click the Share icon in the upper right-hand corner of each map. Options for sharing include email, Twitter, and Facebook. Anyone who receives the link can then view the collection of maps as the sharer intended them to be seen, eliminating the need for users to re-create the same map and collection experience during each app session.

Esri Maps for Public Policy helps people map for community impact and, if needed, take action. Together, everyone can move forward with facts.

To get started with policy mapping, visit esri.com/policymaps and browse the map collection, discover Learn Lessons, and read blogs and literature to gain inspiration.

Here are some resourceful ways to use the Maps for Public Policy app.

Build a Healthy Community

Understand how geography affects people's access to health care and mental health clinics. View drug poisoning or overdose mortality rates, drug drop-off locators, and opioid prescription claims. Take a look at the Environmental Protection Agency's (EPA) National Air Toxics Assessment and develop a greater understanding of how poor air quality constrains public health.

Promote Equal Opportunity

Browse neighborhoods by housing affordability and compare this to homeownership and homelessness rates. Visualize how race, gender, age, and educational attainment affect income levels. Research areas where poverty persists, and see the risks and opportunities for improvement for neighborhoods below the poverty line.

Plan Eco-Friendly Developments

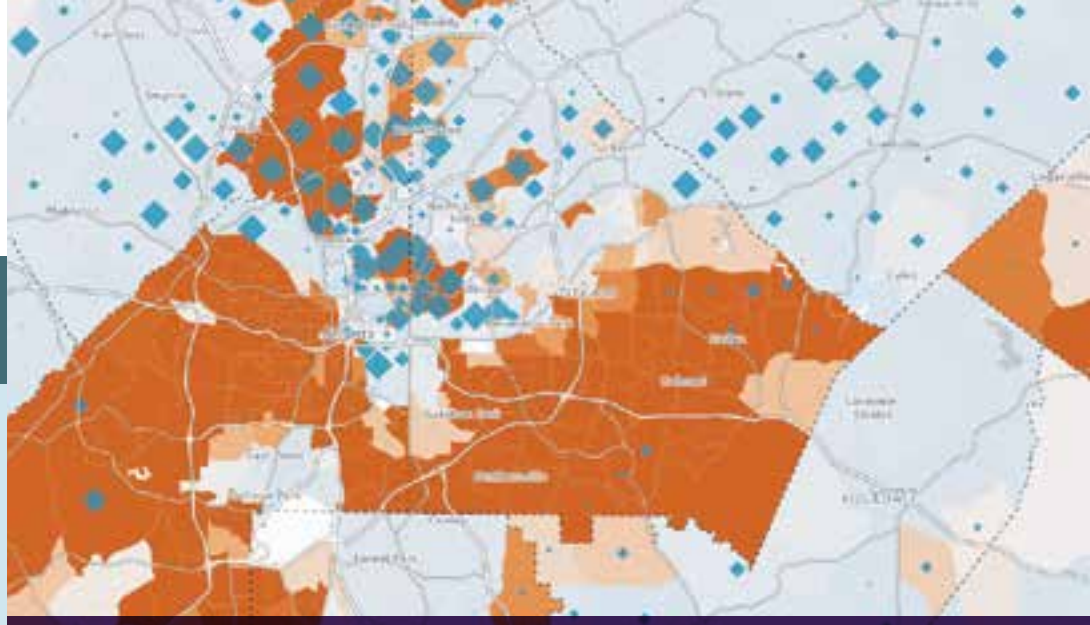
View the US census tracts that have been identified as certified economic opportunity zones. Analyze national foreclosure rates to discover demographic variations. Look for areas that would be ideal for implementing green infrastructure, get a better understanding of conservation land use, and learn about ecological integrity.

Design Cities That Work

Find the best route for your morning commute. Analyze daytime population and traffic patterns to see how cities can design better infrastructure. Learn how job accessibility is being transformed by public transit, teleworking, and hypercommuters (people who spend more than 90 minutes traveling to work).

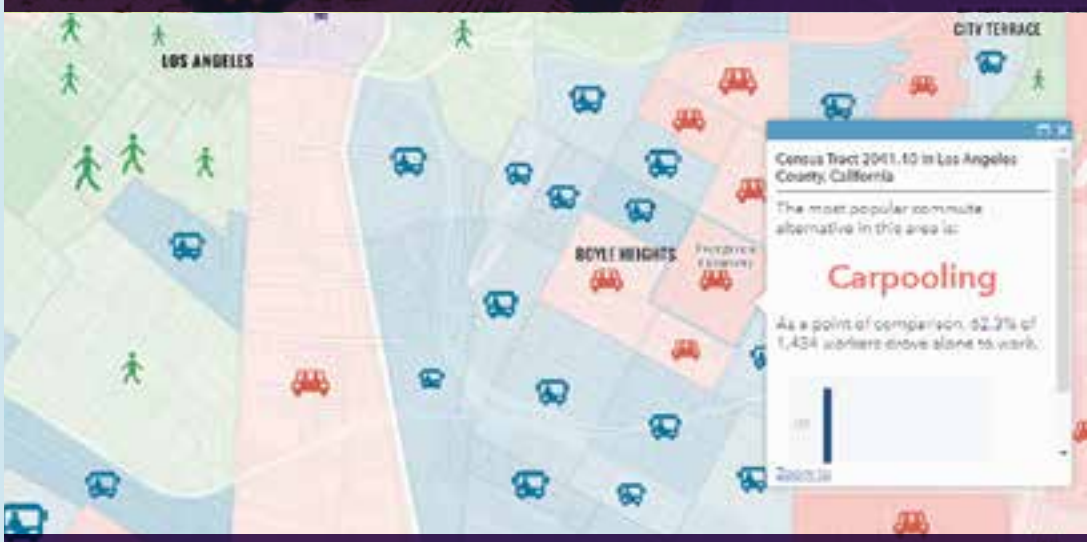
Address Public Safety

Plan efforts to overcome environmental hazards by looking at areas that are prone to wildfires and surveying patterns of human movement during a hurricane. View national firearm fatality and drug poisoning rates to decipher how crime takes a toll on communities.



↑ Visualize how race, gender, age, and educational attainment affect people's income levels in Atlanta, Georgia.

↑ Users can see where people have ample or inadequate access to supermarkets in places like Detroit, Michigan.



↑ Discover how people get to work if they don't drive by themselves—an especially important question in traffic-heavy Los Angeles, California.

↑ Maps are multiscale, so users can analyze data—such as the number of households in the Washington, DC, area in which smartphones are the only owned computing devices—at various levels.

Reporting Voting Issues Takes a New Form

By Deepak Puri, Democracy Labs

Citizen reporting is a valuable way to gain an understanding of the issues a community is facing. This knowledge can influence the public narrative and even policy. But doing timely citizen reporting on a large scale can be challenging.

For the November 2018 midterm elections in the United States, Democracy Labs, an organization that operates as a technology and innovation hub for progressive causes, wanted to ensure that citizens could report, in real time, any voting issues that they encountered. Whether they were ballot problems, voting machine issues, closed or moved polling places, long wait times, or other disruptions, the team at Democracy Labs (also known as DemLabs) sought to find these reports quickly enough so it could verify them and alert the media of any major problems or patterns.

But it was just 11 days before the midterms, and DemLabs found out that there were no mechanisms available to do real-time reporting on election issues. With a tiny budget, the small team decided to build something using Esri software. It created its system—called See Something, Say Something, or See Say for short—using Survey123 for ArcGIS for data collection and an Esri Story Maps app for presenting its findings to the public. Then, it had to get the word out in a big way to ensure that voters and election observers knew where to report problems on Election Day.

Building the Citizen Reporting System

To get the project started, the team at DemLabs determined that the platform it built had to meet the following requirements:

- Make it easy for voters and election observers to report problems from their smartphones.
- Be able to handle a large number of reports within a short time (i.e., on Election Day).
- Enable voters, DemLabs volunteers and partners, and members of the media to access the system remotely and simultaneously.
- Present voter issues in a clear and easy-to-understand manner.
- Have strong security.

DemLabs has been an Esri user since its founding in 2017, so the organization had a stack of geoenabled software and apps to choose from.

The team decided to build its reporting app using Survey123, taking advantage of the app's simple, location-based smart forms. When citizen reporters submitted their issues via the form, the data would feed directly into ArcGIS Online, where it was automatically mapped in a staging area. To ensure that all the submissions were valid, DemLabs planned to have a group of volunteers screen every report that came in before releasing it to the public-facing map, which would be hosted in a tabbed Esri Story Maps Series app. This would make the reports and findings easy for the media and the public to visualize. They could view them all in one map or take a more focused look at distinct issues by clicking on the various tabs.

While the system did not provide legal help, it included information for whom to call or text.

Getting the Word Out

Once the Survey123 form was built, the next step was to promote it so that voters knew it existed.

↑ Via See Say, Democracy Labs recorded 623 voting issues during the 2018 US midterm elections.

DemLabs connected with several groups to share See Say across a range of channels. The local affiliate of NBC in the San Francisco, California, area did a report on the app, and the Open Source Election Technology (OSET) Institute, which had experts embedded with NBC News and MSNBC on election night, advised people to use See Say to report voting problems so its team could monitor any big issues. Television personality Samantha Bee released a political trivia game just before the midterms and added See Say as a challenge to it to encourage its more than 310,000 players to report voting issues if they encountered any. And organizations such as Rock the Vote and Center for Common Ground, which try to galvanize young and underrepresented people to vote, publicized See Say as well.

Gathering and Disseminating Reports

On Tuesday, November 6, 2018, voters across the United States reported 1,133 election issues via See Say. Volunteers at DemLabs reviewed each report; removed submissions that were spam; and verified that the remaining reports came from valid User-IDs, had email addresses, and made sense.

These screenings yielded 623 reports of voting problems, which were broken down into seven categories: ballot issues, closed or moved polling places, long wait times, poll worker issues, voter check-in issues, voter intimidation, and voting machine problems. From there, 63 incidents were deemed important enough to share with the media.

On Election Day and over about the next month, DemLabs' map of voting issues received more than 248,000 hits. Viewers could interact with this publicly accessible story map. They could look at the different tabs to see a breakdown of each type of voting issue, click specific dots to find out more details about each complaint, and scan the entire map to discern whether there were any patterns in voting problems.

Having location-based citizen reporting apps like See Say can give community issues some structure, more so than a melee of posts on social media. They can also make it easier to alert the media to potential stories so they can extend public awareness.

About the Author

Deepak Puri is the cofounder of DemLabs. He is a former Silicon Valley executive who is new to GIS.

Esri Partners Make

Cities, Ports, and Events Run Smoothly

Esri partners are breaking fresh ground with ArcGIS implementations that span countries, industries, purposes, and capabilities. From creating a city's comprehensive master plan and instituting enterprise GIS at a critical port to building apps for a big event and making street-level imagery more accessible, the organizations that make up the Esri Partner Network do extraordinary things with location intelligence and advanced spatial analytics. Check out some recent projects to get just a taste of what working with Esri partners can ignite.

Advanced Spatial Analytics Reveals Redevelopment Opportunities in Michigan

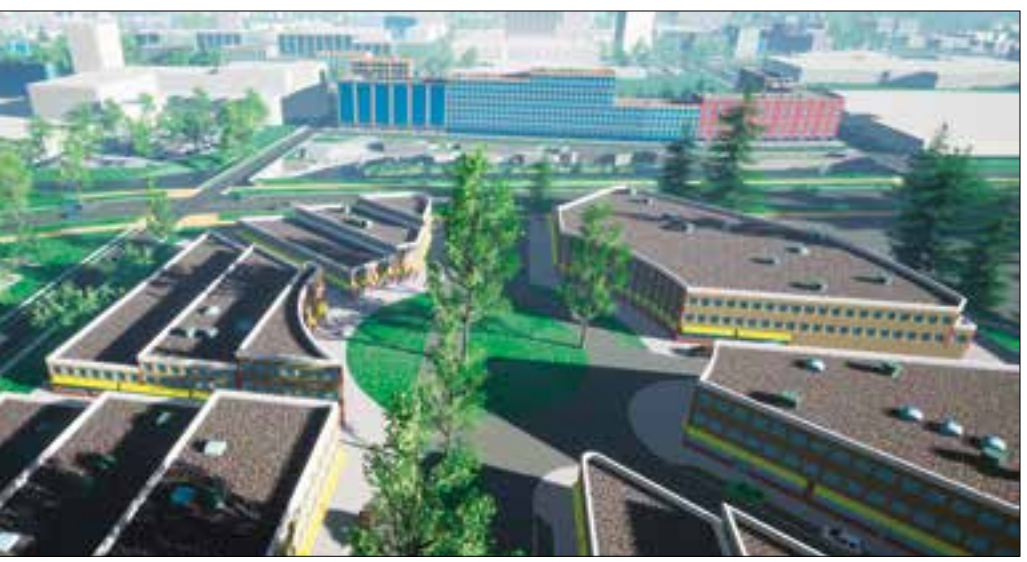
Often dubbed Cereal City because it hosts Kellogg's global headquarters, Battle Creek is a regional economic center in western Michigan that was looking for some direction in planning for future development and investment. Recently, the city partnered with **Houseal Lavigne Associates** (hlplanning.com) to update its master plan, which incorporates spatial data heavily to help guide the area's evolution.

First, Houseal Lavigne Associates used ArcGIS Business Analyst to assess the city's demographic trends and market potential. The company then turned to ArcGIS Pro to spatially analyze existing conditions and create the master plan's attractive maps and graphics. It produced more detailed blueprints for specific areas of Battle Creek as well. For Columbia Avenue, an aging auto-oriented corridor in Battle Creek, Houseal Lavigne Associates made a detailed corridor plan that recommends explicit actions to take to improve the area. It also employed Esri CityEngine to come up with a thorough redevelopment concept for the lakefront area near a key intersection of the community.

Battle Creek's new master plan—which places strong emphasis on land use and development in a postrecession era—is a prime example of geodesign in practice, underlining how important map-based analysis and comprehensive graphics are to the future of planning. Using geospatial data more prominently than it ever has before, Battle Creek can now more easily identify its most pressing issues and determine the best solutions to them.

Shortly after Battle Creek adopted the new master plan, the city reengaged Houseal Lavigne Associates to develop an interactive model that would allow city leaders to visualize various ways the redevelopment plan could work based on the master plan's recommendations. Using Esri CityEngine again, Houseal Lavigne Associates created a web scene that detailed the land use for various place types—e.g., downtown, commercial corridor, and residential neighborhood—outlined in the master plan. This gives the city a good idea of how it could change in the future.

The entire project, underlaid with GIS and spatial analytics, is fostering a holistic approach to planning and redevelopment in Battle Creek. The master plan takes into account the unique appearance and built character of distinct areas and examines how planning will affect different districts within the community. And the web scene is being put to good use. Currently, the city's economic development agency, Battle Creek Unlimited, is employing it to promote the area's full potential and market available properties to prospective buyers and business owners.



↑ Battle Creek was looking for some direction in planning for future development and investment. The city partnered with Houseal Lavigne Associates to update its master plan.

Port NOLA Enters a New Era with Enterprise GIS

The Port of New Orleans (Port NOLA) in Louisiana is a modern multimodal gateway for global commerce and an in-demand cruise port that delivers seamless, integrated logistics solutions among river, rail, and road. As one of the United States' most intermodal seaports, Port NOLA has been experiencing tremendous growth in the cargo and cruise industries, which has put additional demand on aging infrastructure.

In April 2017, the port embarked on a plan to implement enterprise GIS for its critical infrastructure. But it needed technical assistance with developing, integrating, and maintaining the technology. Port NOLA solicited proposals and chose **Environmental Science Services, Inc.** (es2-inc.com)—known as Es²—to set up ArcGIS Enterprise, which Port NOLA is now using to support its mission to drive regional economic prosperity by maximizing the flow of international trade and commerce.

With enterprise GIS, Port NOLA can now analyze complex operational and land-use questions and make truly data-driven decisions—something that would not have been possible before implementing GIS. Previously disparate data sources are now combined and analyzed to identify gaps in the data.

"GIS is enabling more efficient management of critical infrastructure and analysis of key issues facing the port," said Amelia Pellegrin, Port NOLA's director of sustainable development.

One of the most pivotal components of this project was that Es² deployed GIS in the field. The Esri partner used Collector for ArcGIS and Suvery123 for ArcGIS to develop configured apps that employees in the port's maintenance and operations departments can use to increase their efficiency when conducting inspections, performing maintenance, and making repairs. Es² also employed Web AppBuilder for ArcGIS to develop web-based apps that real estate management personnel now use to inventory all available Port NOLA properties. Not only does this help them manage the port's current assets, but it also enables them to analyze properties that could potentially be acquired.

Enterprise GIS is already demonstrating its value for solving operational problems within the port's existing footprint, and its potential for evaluating expansion opportunities is limitless. With ArcGIS Enterprise now in full use, Port NOLA has launched a new era of modernization and efficiency.

↑ With enterprise GIS, the Port of New Orleans (Port NOLA) can identify gaps in its data, analyze complex operational and land-use questions, and make truly data-driven decisions.

In New Zealand, Fieldays Gets a Comprehensive Site Plan and a Great Visitor Experience

Each June, the Mystery Creek Events Centre in Hamilton, New Zealand, hosts Fieldays, the largest agricultural event in the southern hemisphere. For three days, more than 130,000 visitors and roughly 1,000 exhibitors descend on the center to see demonstrations of the latest agricultural technology, participate in competitions, watch live shows, do some shopping, and indulge in chef tastings.

The event site covers 114 hectares (280 acres) of land and includes a network of permanent and temporary roads and buildings and a vast area for exhibitor sites, which are typically tented. To help with planning, setup, and event management, Mystery Creek needed an accurate site plan for the space. So a couple years ago, the center turned to **GPS-it** (gpsit.co.nz), which made the first truly spatial dataset of the site. It includes everything from imagery, contours, roads, and buildings to individual exhibitor sites, car parks, toilets, coffee carts, and first aid stations.

GPS-it then used Web AppBuilder for ArcGIS to develop a web app that Mystery Creek staff employ to plan the layout of the event site. The app allows staff to view proposed site plans overlaid on various imagery datasets that GPS-it collected both during previous events and when nothing was happening at the center. This helps Mystery Creek staff verify that the layout of the Fieldays site fits the permanent infrastructure, including roads; buildings; and underground services for telecommunications, power, and sewage.

To celebrate the fiftieth anniversary of Fieldays in 2018, Mystery Creek commissioned GPS-it to create a new visitor app as well. The company used AppStudio for ArcGIS to build the mobile app and deliberately designed it to be very map-centric. Using ArcGIS Desktop, GPS-it's GIS experts created a network dataset that enables users to easily navigate the event site. They can even calculate how to get to particular exhibitors, regardless of whether they're indoors or outdoors.

The app was hugely successful. It was downloaded more than 34,000 times, elevating it to the second most downloaded app in the App Store in the New Zealand region during the event. Additionally, the mobile app captured more than three million location-based metrics, such as which exhibitors were designated as favorites by users, what routes were being calculated the most, and whose exhibitor listings got viewed most often. Both GPS-it and Mystery Creek staff are now analyzing these results to better understand visitor behaviors and needs.

GPS-it and Mystery Creek are continuing to employ the power of the ArcGIS platform to make Fieldays a great experience for staff, visitors, and exhibitors alike. Exciting upgrades are already under way for the upcoming 2019 event.

↑ The visitor app allowed users to calculate how long it would take to get to particular exhibitors, whether they were located indoors or outside.

With Fresh Street-Level Data, the City of Johns Creek Saves Years of Work

The City of Johns Creek, Georgia, is somewhat of a tech role model for local governments. Since its founding in 2006, the city has prided itself on providing open data and smart solutions to its more than 76,000 residents.

With those goals at the forefront of its agenda, the Johns Creek GIS team set out in 2016 to find the freshest geospatial data available. This brought the city to **Mapillary** (mapillary.com) and its computer vision technology.

The GIS team was eager to build a comprehensive dataset of city assets, but manually capturing the location data would have been expensive and time-consuming. Now, Johns Creek can upload street-level imagery to the Mapillary platform—which includes ArcGIS integration—and automatically extract map data from each image using computer vision, a subset of artificial intelligence (AI) that involves the automated understanding of digital images.

To help gather all this data, Johns Creek actively encourages residents to get involved in mapping their community—especially since all they need is a smartphone plus the Mapillary mobile app, or an action camera along with one of the company's other uploading options. Participating in Johns Creek's #CompleteTheMap campaign, city workers and residents have mapped almost 350 miles of their city. The app geotags the images using the phone's internal GPS and then uploads them directly to the Mapillary platform.

Mapillary's computer vision technology then automatically extracts 1,500 different classes of street signs and their GPS locations from the images. Having a complete and up-to-date inventory of street signs is important, since they are key to road safety but require constant upkeep. As Johns Creek's chief data officer Nick O'Day pointed out, using Mapillary saved the city years of painstaking work collecting street sign data manually.

"If we were to go out and try to capture all of these street sign locations across the city, we would have to carry a GPS unit and collect each point one by one, which would take a long time and cost a lot of money," O'Day said.

Having up-to-date street-level imagery allows city workers to respond to issues faster than ever before. They can look at Mapillary images on their computers first, which often saves crews from having to go out into the field to investigate reports. The city is now usually able to fix issues in a single trip.

Johns Creek is also an early adopter of Mapillary's map features, 42 additional object classes—such as fire hydrants, benches, and streetlights—that get automatically extracted from street-level imagery. They are available as shapefiles to use as feature layers in the ArcGIS platform.

Anyone can explore images of Johns Creek as well via the Johns Creek DataHub. The city built the open data site using ArcGIS for Developers, a complete mapping and location analytics platform for developers, along with the rich sources of mappable information in ArcGIS Online.

Working with Mapillary allows the City of Johns Creek to keep its geospatial records up-to-date while saving time and money and encouraging citizen engagement.

↑ Using computer vision technology, Mapillary automatically detects objects in street-level imagery. By combining multiple detections, the company is able to triangulate the location of each object on the map.

Esri partners represent a rich ecosystem of organizations around the world that work together to amplify The Science of Where by extending the ArcGIS platform and implementing it in distinct ways to solve specific problems. Their products and services range from configured apps, add-ons, widgets, and custom-built solutions to complete ArcGIS system implementations, content, and hardware. Search for and discover partners, solutions, and services that meet your needs at **esri.com/partners**.

With GIS-Based Site Selection Solution, Corpus Christi, Texas, Gains an Economic Development Edge

By Michael Cleary, GIS WebTech

The Corpus Christi Regional Economic Development Corporation (CCREDC) is a nonprofit organization dedicated to attracting, building, and growing projects that foster economic development in and around Corpus Christi, Texas, which is situated along the Gulf of Mexico. As with other economic development organizations (EDOs), it is paramount for CCREDC to get Corpus Christi and the other cities and counties located in what's called the Coastal Bend on the short list for projects that will bring investment, jobs, tax revenue, and quality-of-life improvements to the area.

The site selection process for economic development projects is largely anonymous. Prospects—businesses or companies that are looking to potentially relocate or expand—start with a long list of communities where they might want to establish their projects. They then reduce those options by conducting self-guided research on EDO websites for the places they're interested in. Prospects typically don't reach out to an EDO until that EDO has made the short list, so this is a data-driven process that can end up being critical for communities in need of development and economic opportunity.

In 2015, Tommy Kurtz joined CCREDC as vice president of business and strategic development. With a focus on implementing a targeted business recruitment program and attracting major industrial and manufacturing projects to the area, Kurtz's first decision was to license ArcGIS Desktop and ArcGIS Business Analyst so the organization could use Esri data and tools to respond to requests for information about the community and various properties and make detailed pitches to prospects.

"Esri is the GIS leader and has the gold-standard data my prospects want to see," said Kurtz. "Speed, quality, and depth matter."

But CCREDC's publicly accessible solution did not align with Kurtz's vision of what was required to compete for and win projects. It did not integrate with Esri software; it was not user-friendly, resulting in frequent user abandonment; it didn't contain valuable infrastructure data for each community in the area; and it didn't let users manage key data to target specific prospects.

"The site selection process is getting quicker. Data and technology are increasingly becoming more important," explained Kurtz. "EDOs have to provide solutions, and those who provide the solutions that are the fastest and the easiest to use are the ones winning."

To come up with a working solution, Kurtz wanted to find an Esri partner that focused on economic development. His account manager at Esri soon introduced him to Esri startup partner GIS Web Tech, LLC (giswebtech.com), whose flagship site selection solution, Recruit, is built natively on the ArcGIS platform. Recruit is a public-facing solution that enables users to conduct research and perform analysis to identify locations of interest.

Connecting, Synchronizing, and Targeting Data

According to a 2016 report from the International Economic Development Council (IEDC), "the factors most influential in making location decisions are available sites and buildings; infrastructure and utilities; workforce characteristics; wages; and labor market characteristics."

For many communities, much of this data is only available via their EDO. But the report goes on to say that 79 percent of site selectors will only contact an EDO after they have developed a short list of potential communities. Why? Because site selectors and businesses are time crunched to make informed decisions. At this stage of the process, it is faster and easier for them to access publicly available data than to engage with EDOs. Thus, providing the right data, helpful analytical tools, and a user-friendly solution is critical to making the short list.

GIS WebTech takes a client-centric approach to data and solution management. Because Recruit is built natively on the ArcGIS platform, it taps directly into Esri Demographics, a large collection of demographic, psychographic, and socioeconomic data. Clients with licensed access to ArcGIS Online can add virtually any data from ArcGIS Online into Recruit—including federal opportunity zones, railroads, airports, and sewer and water lines—and display it for their users to view either publicly or privately. Additionally, Recruit is the only solution that enables clients to add, activate, or deactivate data as needed to target specific audiences.

To bring data together from the City of Corpus Christi and several surrounding counties, the team at GIS WebTech collaborated with these stakeholders to get the map layers and services they each host in their own ArcGIS accounts and add them to Recruit's Layers feature. This allows each authoritative data source to maintain control over its own system of record while ensuring that Recruit has consistent and up-to-date data. It also gives CCREDC access to all the most current and available data from these communities without having to take further action.

"The City of Corpus Christi was very favorable *[to sharing data]*, as were the other counties and municipalities," said Kurtz. "A few of the counties, like San Patricio, and cities like Corpus Christi, were already Esri users, so being in the same platform made this collaboration and sharing process much easier. Many federal and state GIS layers were already available through Esri, so it was easy to get access."

To the Top of the Short List

Kurtz and his colleagues at CCREDC have been pleased with their new public-facing, ArcGIS software-based solution.

"With Recruit, I am able to demonstrate the solution online and take it on-site with prospects to show all infrastructure layers, including sites that are most attractive for industrial development," said Kurtz. He can now easily show "sites that are not in flood zones *[and]* are near four-lane highways, key pipelines, rail lines, etc."

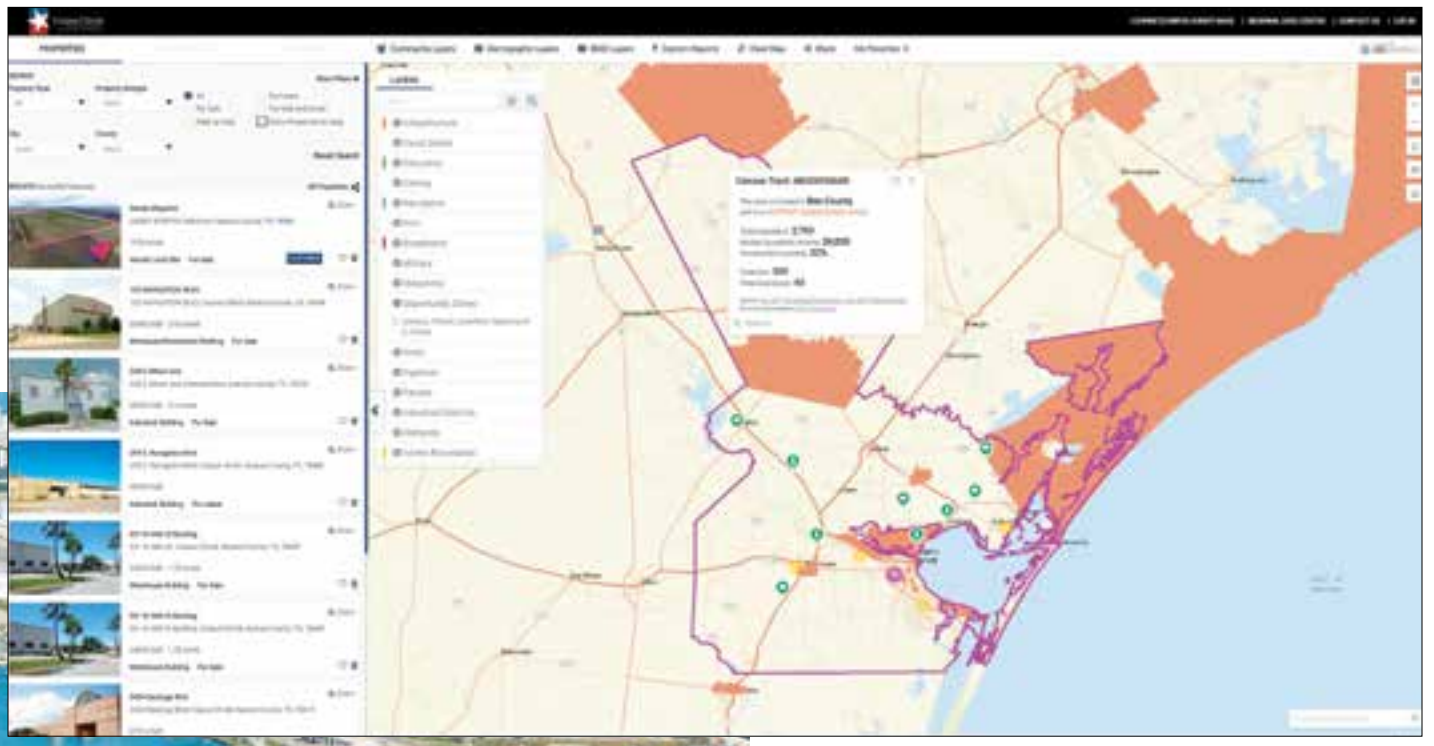
Since adopting Recruit two years ago, CCREDC is making more short lists and winning more projects than it ever has before. Currently, the organization is working on more than $13 billion in investment in Corpus Christi and is bringing more than 2,000 jobs to the area. Prospects, both foreign and domestic, are very impressed with Recruit's responsiveness, as well as how accessible and complete CCREDC's data is.

"There is no substitute for this solution to show this kind of information," concluded Kurtz.

About the Author

Michael Cleary is GIS WebTech's chief operating officer. For more information about GIS WebTech or Recruit, email him at michael@giswebtech.com.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Learn more at **developers.arcgis.com/startups**.



↑ Clients can choose the layers they want to present to their users, such as federal opportunity zones, railroads, pipelines, and water and sewer lines.

← Corpus Christi is located in southern Texas, along the coast of the Gulf of Mexico.

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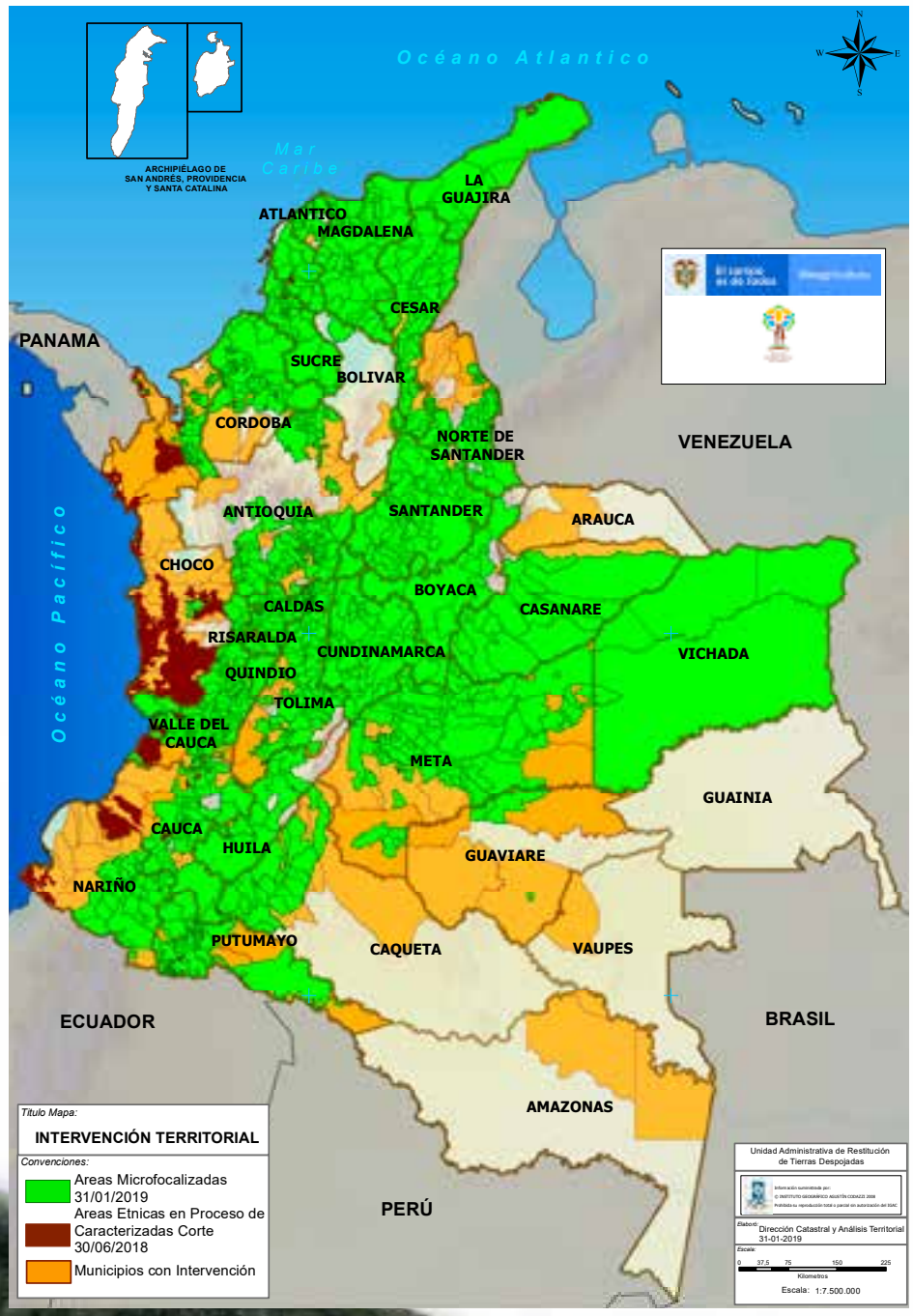
In Colombia, GIS Defines Land Restitution for Forcibly Displaced Persons

Versioning, Modeling, and Satellite Imagery Allow Conflict-Weary Country to Update Cadastres and Ensure Accurate Land Rights

"During the decades-long conflict, many poor farmers in Colombia lost their land. However, due to the actions of former president *[Juan Manuel]* Santos, we are settling that historic debt, and land is no longer the fuel of war."

Ricardo Sabogal, former director, Unidad de Restitución de Tierras



↑ Using GIS helps Unidad de Restitución de Tierras (URT) establish where land claims overlap with specific microzones, ethnic areas, and more than one municipality or department (state).

Inequality in landownership has persisted in Colombia since the country won its independence from the Spanish Empire in 1819. To pay for the massive war debt it incurred, the newly sovereign nation quickly sold off vast tracts of poorly documented public land, which often ended up in the possession of already wealthy landowners.

During the mid-1960s, guerrilla groups formed—most notably the Revolutionary Armed Forces of Colombia (known by its Spanish acronym FARC). These groups existed to promote greater equality throughout the country, but they fast became a polarizing force. This exacerbated political and social problems throughout Colombia, particularly in the rural areas, where guerrilla or opposition paramilitary groups often controlled villages and their surrounding lands after forcibly displacing the original landowners. Over the course of its six-decade duration, the Colombian Conflict resulted in 260,000 deaths and the displacement of 6.9 million people.

In 2010, former Colombian president Juan Manuel Santos announced in his inauguration speech his intention to return the land to those who were displaced by the Colombian Conflict. "It is not only an inescapable historical debt, but it is also a first step towards the construction of peace in the rural areas of the country," Santos said.

The amount of disputed land totals 7 million hectares (17.3 million acres). This includes private properties and vacant and unclaimed land.

The following year, Congress approved Law 1448, the Victims and Land Restitution Law, which specifies the legal procedure for restoring lost land to victims who were forcibly removed from their properties. The procedure consists of two parts: one is administrative, which includes formally registering the land claim, and the other is a judicial appeal for restitution.

"The Land Restitution Law is one of the most important acts of the Colombian government in providing a lasting solution to the humanitarian crisis precipitated by the decades-long conflict," said Ricardo Sabogal, former director of Unidad de Restitución de Tierras (URT), Colombia's land restitution office. "It is an effective administrative and judicial mechanism that resolves, in a just manner, the complicated issues for the millions that were displaced from their land. It also encourages lasting peace and a consolidation of democracy in our country. The process consists of both an administrative step to formally register the land claim by the displaced farmer and a judicial action to resolve the land restitution claim made by both parties. In this sense, it is a combined process because it includes involvement by both the country's executive and judicial branches."

The URT performs the administrative procedures. The office receives, reviews, and makes a determination for all property claim applications. The National Land Agency then officially records the disputed land, which is an essential legal step in the restoration process.

"Because of the well-known informality regarding land possession in Colombia's rural regions, Law 1448 also specifies that the URT must physically and legally define those properties that did not previously have cadastral or registry information associated with them so that they could be included in the records of the Oficina de Registro de Instrumentos Públicos (ORIP), the nation's land registry authority," said Sabogal.

Fully complying with this requirement demands using GIS technology, which has proved invaluable in helping the URT collect and analyze data that identifies distinct properties and specifies their precise location and size.

"Law 1448 stipulates that in order to collect information for restitution requests, it is necessary to first examine the available institutional information, such as ownership records, for the physical identification of the properties," Sabogal continued. "Unfortunately, the rural cadastral property information is not the most reliable. According to the Consejo Nacional de Política Económica y Social *[National Council of Economic and Social Policy]* document of 2016 (CONPES 3859), 28 percent of the national territory does not have cadastral records, and 63.9 percent has

↑ URT starts the land claim process by getting information from the applicant to make a preliminary determination of the location of the land and then combining that with official government data. That associates the land with URT-generated microzones and sets in motion the administrative process.

outdated cadastres, which totals 722 municipalities. Also, among those 187 municipalities in the country identified as having a high incidence of armed conflict, 79 percent do not have basic cadastral information. The document further states that only 41 percent of the national territory has appropriate basic cartography at a scale needed for technical cadastral work. Added to this is the fact that, as a rule, the cadastre only identifies those who have some sort of document indicating an affiliation with a property, which excludes the majority of land claimants."

To establish landownership, the URT collects data in the field and gathers historic information concerning each property's years of abandonment or dispossession. Staff from the URT also take a tour around the boundaries of the property along with the applicants and their neighbors to determine accurate dimensions, boundaries, terrain details, and/or conflicts that are added to the evidence presented to the restitution judges. The URT uses satellite imagery and aerial photographs as well to conduct cartographic and cadastral archaeology, which helps the office establish property boundaries at submeter precision.

For applicants going through the administrative and judicial processes of recording a land claim, the use of GIS technology has played a significant role in validating the size, location, and ownership of each property.

"Technical and cadastral professionals from the URT, with assistance from Esri Colombia, are using ArcGIS to design methodologies to capture, structure, define, analyze, and exchange geographic information to determine the correct identification of an applicant's land," said Helena Gutiérrez, president of Esri Colombia SAS, Esri's official distributor in Colombia. "The process involves the creation of a sequence of versions of the property as the investigation progresses. The process of this technical adjustment of the mapped polygon representing the property is called its 'cadastral life.'"

"The URT has created a data portal using ArcGIS Online to provide easy access to geospatial services in support *[of]* this work," said Jorge Bonil, the URT's cadastral technical director. "In addition, we used ModelBuilder to create an automated reporting application that accesses and processes massive amounts of information from multiple sources and performs various analyses on that data. The tool identifies conflicting claims for the same land, claims in protected areas, unusual economic activities related to a particular piece of land, identification of the licensing or construction of infrastructure and energy production, and so on. Reports from these analyses are then generated for the administrative and judicial procedures."

The land restitution initiative also uses thematic cartographic data produced and maintained by different Colombian governmental agencies. This includes data on national protected areas; mining and hydrocarbon extraction; road and energy infrastructure construction; strategic conservation, such as wetlands of international importance; government land usage and planning; land mines and unexploded ammunitions; and proprietary information prepared by the URT, such as applications for micro- and macrozones.

In addition, the URT employs satellite imagery and aerial photography to determine access routes to specified properties and the physical characteristics of the landscape and topography. For land disputes, it is sometimes used to divide parcels and determine equivalent land assets. Imagery analysis also helps the URT ascertain the status of collective territories and current land use.

"The restitution laws have set an important precedent for the availability and exchange of information among the government agencies," Gutiérrez pointed out. "It has changed the institutional perspective towards sharing information by highlighting common objectives, which strengthens our government."

Previously, she said, getting access to government data was complex from both a technological and legal standpoint.

"As part of the land restitution program, the URT participated in the development and testing of the LADM-COL model for land administration," explained Gutiérrez, referring to a version of the international Land Administration Domain Model (LADM) standard that was adapted for Colombia. "This has allowed us to test and adapt those workflows needed for the supply and delivery of cadastre information within the established standards that should be included in the procedures implemented by the government."

"The application of GIS technology to the process of land restitution assures that the land restored to its owner has been accurately identified and documented for legal inclusion in the land registry database," added Sabogal. "GIS also helps with identifying the ways the property is related to nearby land to determine potential environmental implications, mining and energy production, and infrastructure policies—thus guaranteeing a proper use of the land without impacting the regulatory frameworks of other policies. It has also allowed us to perform geostatistical modeling to determine trends and explore scenarios so that we can develop land administration polices using more accurate data."

The second, judicial stage of the process is carried out by judges who specialize in land restitution proceedings. Judicial authorities decide if the claim is legally and materially admissible, in which case the property is included in the Superintendence of Notaries and Registries. In cases where restitution of the property is impossible, the judges have the authority to order compensation in favor of the victim or in favor of third parties, as long as their actions were done "in good faith." The government has processed 1.5 million hectares of land so far with a goal of processing 100 percent of the land restitution claims in the next four years.

The URT also has an important role in these judicial proceedings because it provides free legal representation to victims who request it. As part of this service, the office created a Mobile Victim Attention and Orientation Unit. Representatives from the National Victims Unit, the Public Defender's office, and the Ministry of Justice drive a custom-made vehicle into rural municipalities to provide legal aid to people who have been displaced. This ensures that their interests are being respected, as specified in the law.

The land restitution process in Colombia not only provides legal services to thousands of displaced people, but landownership also allows them access to credit that can help them further develop their land. In addition, as owners of their land, they pay taxes on it, which helps improve government budgets.

"The speed in applying Law 1448 to the land restitution process has gained a level of success that has never been achieved by any other judicial mechanism in the country," concluded Sabogal. "This has been made possible due to the foresight and determination of our government and its implementation by various agencies. It is important to remember that some of this work was carried out in the middle of the armed conflict, which created a unique series of complexities and difficulties in its implementation."

ArcGIS Hub Gets Mixed-Use Community Involved in Retail Decision-Making

The Kentlands development in Gaithersburg, Maryland, located north of Washington, DC, offers residents a high density of services, restaurants, and entertainment. Inspired by the New Urbanism design movement of the 1980s, the Kentlands aims to promote environmentally friendly habits. It is a walkable, mixed-use community that combines pedestrian-friendly streets and live-work buildings.

From a residential perspective, the Kentlands (also referred to simply as Kentlands) has been a success, with more than 8,000 inhabitants living in the development and its sister community, Lakelands. But the town has had challenges on the retail side, including assembling an ideal group of businesses that will have long-term success.

According to Kevin McMaster, principal at Esri partner SymGEO and a proud resident of the community, "Kentlands has been struggling to find the right mix of retail for the neighborhood. As a result, the community felt disconnected from the commercial decisions made around *[it]* and *[residents]* voiced frustration at several public meetings."

In line with the initiative to energize Kentlands' retail businesses and boost economic development, SymGEO—a Maryland-based company that specializes in geospatial data analytics—developed Downtown: Energize! Kentlands. The web-based community engagement platform, built on ArcGIS Hub, is designed to inform the public about future plans for Kentlands and provide a feedback mechanism for residents to express what kinds of retail offerings they would like to see.

"The site serves two purposes for the public: to share plans for existing and planned retail and to give the option to voice an opinion on what is needed," explained McMaster. "By keeping the content fresh and relevant, the public benefits from a site that grows with the community and gives *[residents]* a sense of ownership in the direction of the community."

Features and Functions for Productive Engagement

SymGEO chose ArcGIS Hub to create Downtown: Energize! Kentlands because, as McMaster explained, it is "the only platform that can easily access the geospatial information that is critical for informing the public on existing and planned retail and a plethora of other local issues."

The site combines a number of components of the ArcGIS technology suite, including Survey123 for ArcGIS, GeoForm template, Collector for ArcGIS, Operations Dashboard for ArcGIS, and Web AppBuilder for ArcGIS for the retail locator. It also features a fun and visually stunning "Can you picture your business here?" 3D web scene that uses Esri CityEngine textured models derived from building footprints and lidar information processed in ArcGIS Pro. The web scene allows site visitors to virtually fly through the neighborhood.

The surveys on the site, which were created using the form-based questions in Survey123, have garnered the most excitement from the public, according to McMaster.

"The site has provided the voice that people have been missing," he said. "It has helped relieve considerable frustration."

Employing ArcGIS Hub was a substantial improvement over the town's older methods of gathering public opinion, McMaster said. Previous solutions involved a series of Facebook pages, disconnected websites, and social media posts, which made it difficult to track progress and find information. Additionally, social media comments were quickly lost, and there was no permanent record of posts and comments.

By implementing ArcGIS Hub, McMaster can now track evolving word clouds, with keywords pulled from the filled-out Survey123 forms, to understand residents' opinions and impressions about the neighborhood.

"The summary word cloud is an excellent snapshot of the residents' ideas on what retail is needed, as well as the general feeling about Kentlands," he said.

A database of commercial properties, hosted in ArcGIS Online as a feature service, fuels an Explore Existing Retail app on the hub site as well. The database includes each business's name, its square footage, the business type, its web URL (if available), and whether or not the property is occupied. McMaster got much of this information from parcel data, the three large commercial property owners in the area, and assessor data from the City of Gaithersburg. He then filled in the blanks by gathering additional data in the field using Collector and GeoForm template. The hub app is dynamic and connected directly to these data sources, so site visitors will always find the latest information.

Moreover, the flexibility of ArcGIS Hub allows McMaster to continually add new features to the site and improve its capabilities. For example, he recently populated the commercial database with local business data and expanded it to include all sections of the neighborhood. McMaster also incorporated a community calendar that shows all the local happenings. Residents can search the Downtown: Energize! Kentlands site for all retail offerings in Kentlands, and planners can see immediately calculable summary statistics—such as the number of businesses per business category and/or locale—to aid in doing gap analyses for future retail offerings.

"The goal of informing the public has been easily accomplished by keeping the spatial data up-to-date as new retail is announced or observed," McMaster said.

Use of ArcGIS Hub for Downtown: Energize! Kentlands has also made it quicker and easier to gather community feedback.

"The time saved by the site is most easily quantified by the ease in which a community survey was set up and distributed," said McMaster. "What would have had to have been done either as part of a community event, mailer, or some other mechanism was now done with Survey123 apps on the hub site quickly and easily."

Open Data and the Future

Residents' support for this new community engagement platform has been strong and generally positive. McMaster said that Downtown: Energize! Kentlands was recently mentioned at a public meeting as an example of how people can voice their opinions and have the results aggregated and given to key retail decision-makers. Local businesses have been supportive of the platform as well because the site enables users to search a list of existing businesses.

"There is no other site that offers the comprehensive, updated list of all retail establishments, so it is great for people wanting to get a feel for what is available," said McMaster.

Two local development boards, the Kentlands Downtown Working Group and the One Main Street Initiative, have taken an interest in Downtown: Energize! Kentlands. The groups are so enthusiastic about the platform that they are now exploring options to have complementary sites built using ArcGIS Hub technology.

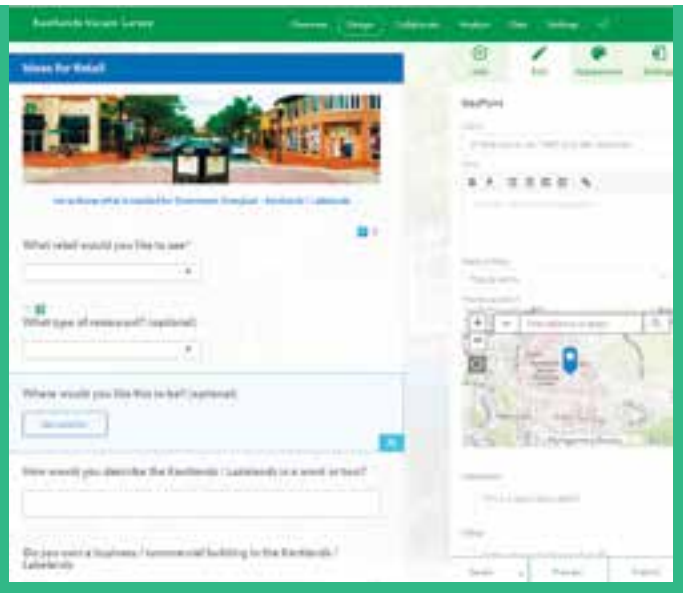
The use of open data in an area like Kentlands means members of the public can stay informed, connected, and up-to-date with what is happening in their community. McMaster encourages this trend toward open data.

"The more open and transparent, the better," he said. "*[It is important]* to show citizens that the work being done by local government is meaningful and can help inform community decisions."

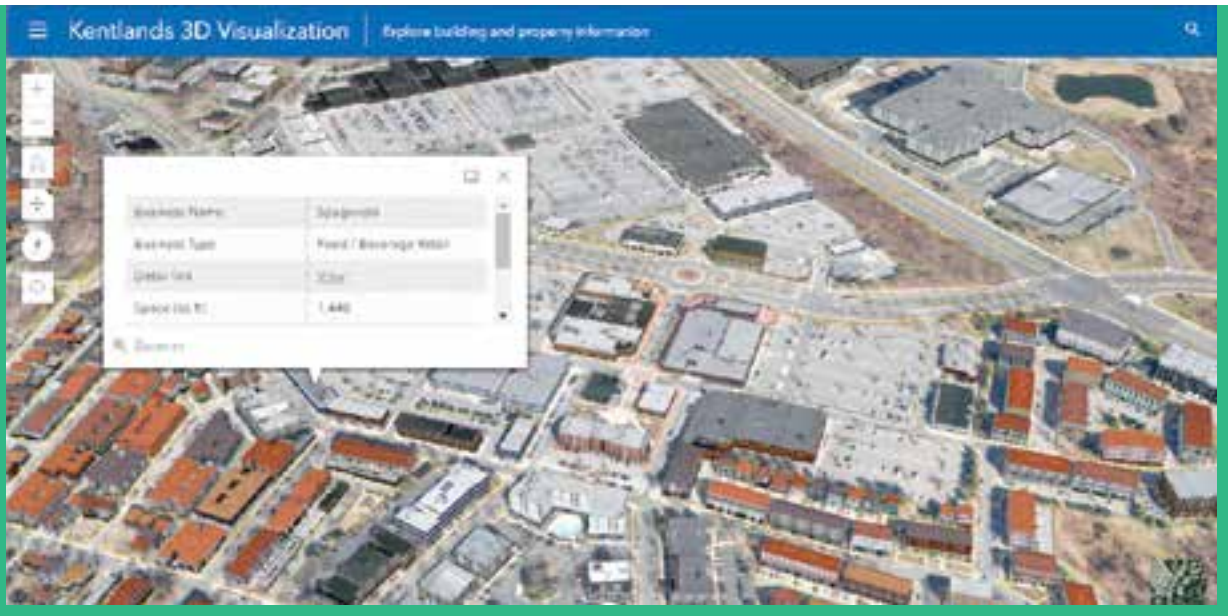
McMaster, who developed the site pro bono, said he's at the stage where residents and local officials are just becoming familiar with GIS technology and its possibilities. They are seeing firsthand how GIS, together with open data, can help transform a community. He hopes other cities will adopt the platform as well.

"Personally, I would love to have other small communities say this is exactly what they need. I think it provides *[an interesting look]* at how to help a community use new and innovative technology," he said. "So many cities have the tech and don't know they are sitting on it—and that they can do this if they wanted to."

Whether taking on an issue that's similar to retail development or addressing something else that residents want to see improved, McMaster believes it is very rewarding to get a community's residents engaged, excited, and energized about an idea and then facilitate action using this platform.



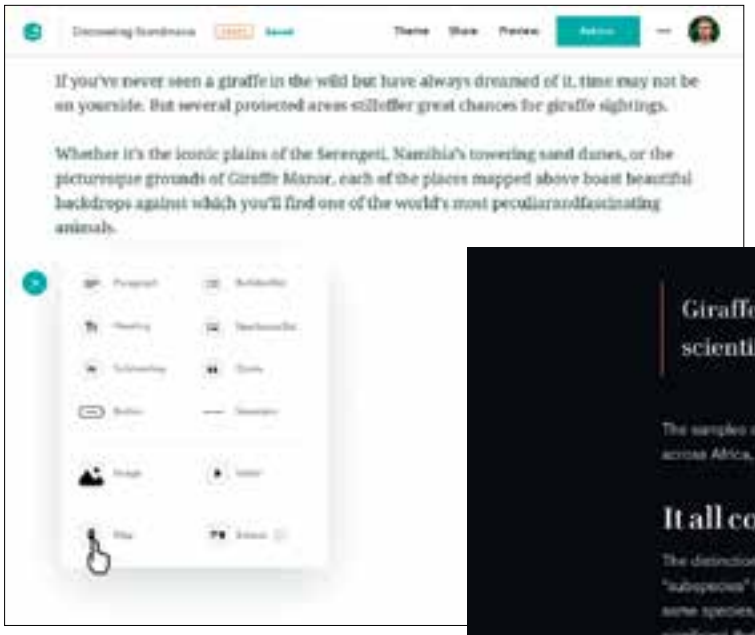
↑ The surveys on the site, which SymGEO created using Survey123 for ArcGIS, are providing residents with the voice they feel they have been missing and are helping to relieve considerable frustration.



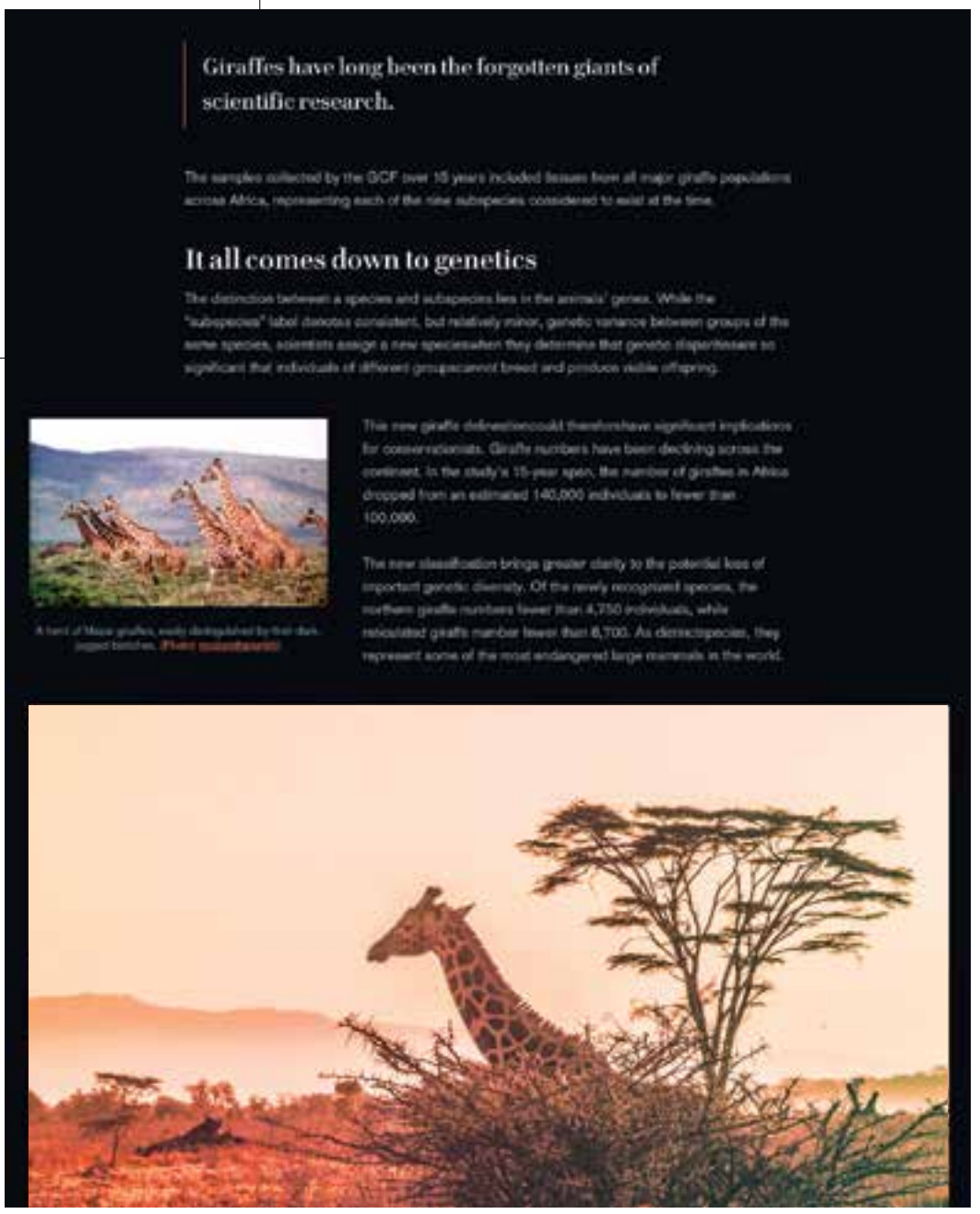
↑ Downtown: Energize! Kentlands features a 3D web scene that lets site visitors virtually fly through the neighborhood to get a better idea of whether their businesses will fit in with the mixed-use community.

ArcGIS StoryMaps
The Next Generation of Map-Based Storytelling

On a typical weekday, the Esri community generates well over 1,000 story maps, and within the last eight years, users have created more than 800,000 of these map-based stories. Nonprofits use story maps to inform the public about their work and rally support for their causes. Students create story maps as alternatives to conventional research projects. Public information officers use them to disseminate emergency information, and public relations professionals employ story maps to get the word out about events and trends. People from all over the world share countless mapped stories on social media each day. And the Esri Story Maps Gallery features hundreds of exemplary story maps on topics ranging from how China attracts investors and a tour of famous baseball park foods to the history of fighting for fair housing in the United States and an in-depth look at the influx of Rohingya refugees in Bangladesh.



← Users can build their stories as they go, choosing from a variety of content blocks—including Map, Image, Paragraph, Button, two different types of lists, and Quote—and arranging them in whatever order they want.



↓ Esri refreshed its map-based storytelling tools with the beta release of ArcGIS StoryMaps.

With such widespread use and an ever-increasing corps of storytellers, Esri decided it was time to refresh and renew its storytelling tools. Esri is releasing a beta version of ArcGIS StoryMaps, which delivers a more elegant and streamlined experience for making and sharing story maps.

Some of the major improvements in ArcGIS StoryMaps include the following:

Express Mapmaking

Although resources like ArcGIS Living Atlas of the World provide rich map content, people without GIS skills often find it difficult to create basic maps. ArcGIS StoryMaps incorporates an easy-to-use map creator right in the builder that enables users to quickly make beautiful custom maps that match the look and feel of the rest of their story.

A Single Builder with Many Looks

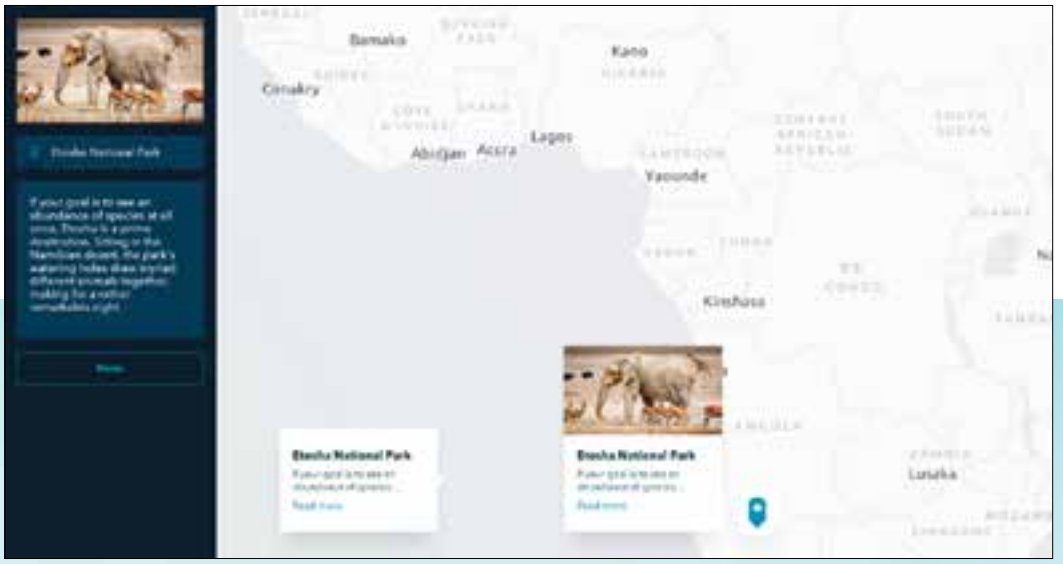
Instead of having to choose from eight types of story maps—such as Cascade, Journal, and Tour—before getting started, users can now take advantage of a single builder to create any story map they want. With a variety of content blocks to choose from, users can arrange the elements of their story in whatever order they prefer. Having this flexibility in a unified builder boosts productivity and enables users to more effectively combine media types and layouts to best communicate with their audiences.

Anyone Can Be a Storyteller

According to Allen Carroll, Esri's program manager for storytelling, the most exciting thing about ArcGIS StoryMaps is how many more storytellers it will empower. "Whether you're a designer, an adventurer, a communications professional, an educator, a researcher, or a world citizen, ArcGIS StoryMaps is accessible—even if you have no idea what GIS is about," he said. "It is opening up the possibilities of place-based storytelling to millions of new users and potentially introducing even more people to the power and potential of GIS."

Try the Beta Version

The ArcGIS StoryMaps beta is available now, with the public release anticipated in mid-2019. For more information or to sign up for the beta program, visit esri.com/storymaps.



↑ ArcGIS StoryMaps has an easy-to-use map creator right in the StoryMaps builder.

THE DISASTER RESPONSE PROGRAM

Ready to Help and Prepare You for What's Next

Esri founders Jack and Laura Dangermond started their company 50 years ago to help address some of the world's most difficult challenges: land-use issues, resource management concerns, population shifts, changes in the environment, and much more. Since its founding, Esri has always stood shoulder to shoulder with its users. That's no different when disaster strikes.

The Disaster Response Program (DRP) at Esri exists to help users respond to and enhance their GIS operations when hurricanes, fires, earthquakes, oil spills, and other crises overwhelm their organizations and demand escalated action. Assistance from the DRP comes in many forms and can involve getting users access to ArcGIS software and available data, assisting with workflows, and providing technical support.

"It's one of our contributions back to the community," said Ryan Lanclos, Esri's director of public safety industry solutions and lead for the DRP. "Our core team is here to help our users when they need it most, but we also want them to know how to better prepare."

A Deep History of Disaster Response

The first activation of the then-unofficial DRP was 25 years ago, when authorities dealing with the aftermath of the 6.7-magnitude Northridge Earthquake reached out to Esri for help. The destruction throughout Southern California was extensive: buildings cracked and crumpled, freeway overpasses collapsed, and at least 57 people died while an estimated 9,000 suffered injuries.

"After the earthquake, we had strong users reaching out to us for assistance," said Lanclos. "We saw that we not only needed to get them help, but we also needed to understand what the impact was. Taking our expertise from the GIS and public safety worlds, we helped them do damage assessments and augmented their capabilities when they were in a really tough spot."

Another big activation for the DRP was in New York City after September 11, 2001. When the twin towers located at 1 and 2 World Trade Center collapsed, the city's state-of-the-art emergency operations center (EOC), located at 7 World Trade Center, was damaged beyond repair. Within a few days, the city relocated the EOC to Pier 92, a large shipping terminal on the Hudson River, and Esri was there to help.

"They printed over 20,000 maps in the weeks following the terrorist attacks," said Lanclos. "We were honored to be in the thick of it, helping the City of New York, and the nation as a whole, respond to and recover from that incident."

For Hurricane Katrina in 2005, the DRP provided direct aid to several agencies. It helped put together a regional database, assisted with search-and-rescue operations, supported damage assessments, and did map production.

When the BP oil spill happened in the Gulf of Mexico in 2010, Esri provided the GIS capabilities to get multiple organizations with wide-ranging needs to collaborate and gain a common situational awareness.

"That was where we really saw how we could support not only traditional public safety agencies but also other types of organizations and needs all over the world," said Lanclos.

It was then that the DRP really began to formalize. Internally, Esri established how the DRP could best respond to and prepare for emergencies, as well as how to have users activate the program when they needed it.

"Just like cities and counties activate their operations centers at different levels based on what they anticipate their needs to be, we do the same thing," Lanclos explained. "We monitor hurricane forecasts, snow forecasts, flood forecasts, and more. We proactively reach out to users to make sure they're ready, and we have a team on standby to field requests."

"We are on call 24/7/365 to monitor, review, and process requests to support emergencies or events anywhere in the world," said Brenda Martinez, the disaster response and public safety marketing specialist at Esri. "After we receive a request, it is reviewed to determine the specific need and then sent to the appropriate Esri staff members or departments for processing."

The DRP has responded to countless hurricanes and wildfires, helped map disease outbreaks all over the world, and even provided assistance when multiple agencies from different countries needed to rapidly share geospatial data after Malaysia Airlines flight MH17 was downed in Ukraine in 2014.

Two years ago, the DRP experienced its busiest year on record with three major hurricanes—Harvey, Irma, and Maria—striking the Caribbean and the southern United States within about a month of one another, plus multiple devastating fires and severe flooding elsewhere.

Reacting to Emergencies and Preparing for the Next One

Unsurprisingly, the work never stops. When Hurricane Michael struck the Florida panhandle in October 2018 as a category 4 storm, Bay County sustained extensive damage. The 10-foot storm surge cut the barrier island of Cape San Blas in two and devastated the small town of Mexico Beach.

"We reached out to Bay County before the hurricane, but we didn't hear anything until about 24 to 48 hours after landfall," said Keith Cooke, an account executive for local government at Esri.

"They contacted us by satellite phone after the storm," added Will Meyers, an Esri solution engineer. "They had very little communication."

This was a rare occasion when Esri opted to deploy people on-site, so with support from the DRP, both Cooke and Meyers went straight to Bay County to help out. They assisted with general mapping, established a Web GIS presence within the EOC, and helped develop a damage assessment workflow. The two also built dashboards that officials used in their morning and evening EOC briefings, including one that showed how badly the storm had affected local businesses.

"We did some really cool stuff," said Cooke. "But if it hadn't been for the DRP team—with whom we had twice-daily calls—we would have been bogged down in phone calls, emails, and other minutiae in a place that didn't have great connectivity."

"There were so many people working on this behind the scenes, whether it was processing drone imagery, or working out logistics to get us what we needed, or just helping to connect the dots," added Meyers. "It felt like we were sort of the middle man between a great resource team—the DRP—and the people on the ground."

Esri's DRP jumped into action for the November 2018 Camp Fire, too, which burned more than 150,000 acres, destroyed almost 19,000 structures, caused 86 fatalities, and devastated the town of Paradise in Butte County, California.

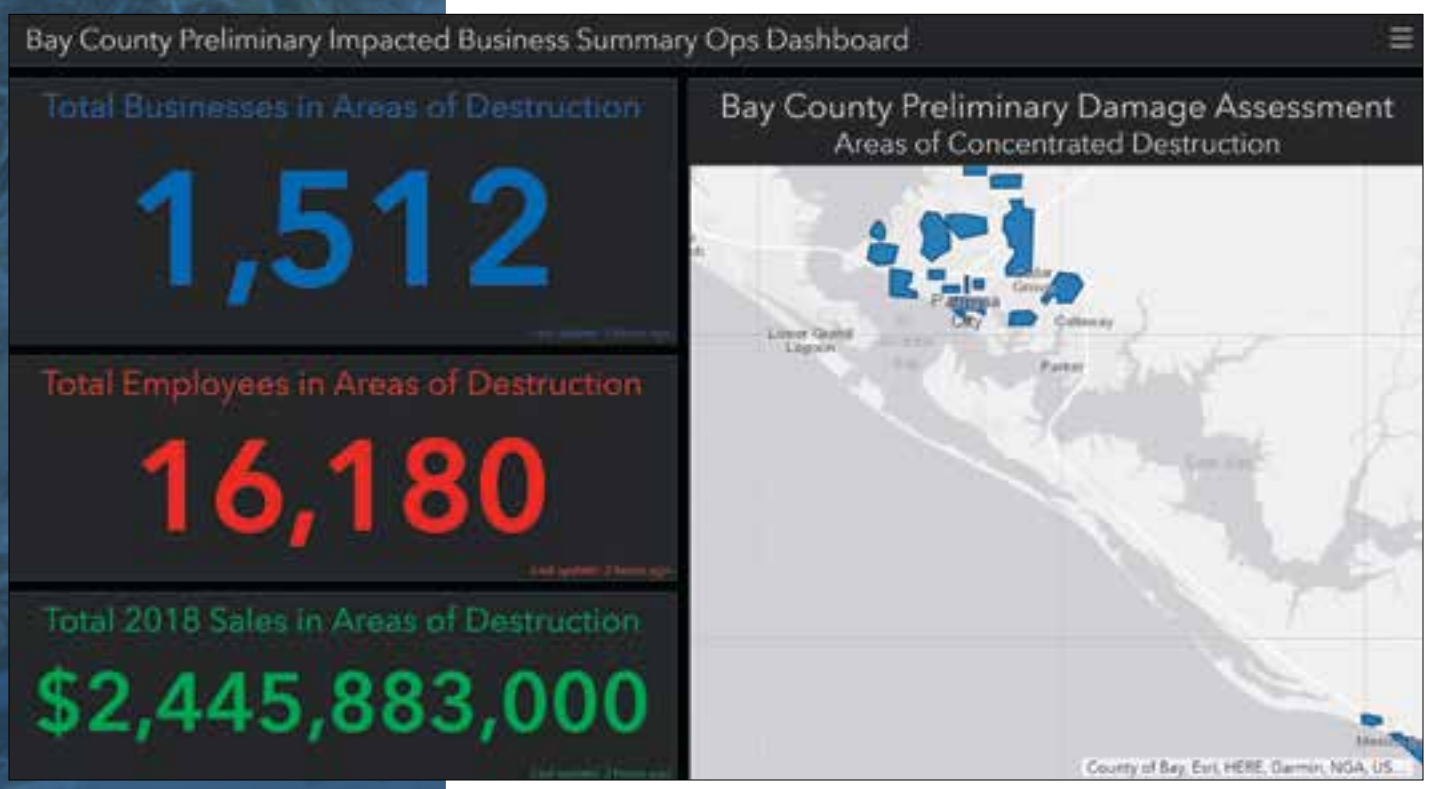
"I knew about *[the DRP]*, but in the heat of the moment, everything is going crazy, and people are just pulling you in a thousand different directions," recalled Jim Aranguren, Butte County's GIS manager. "I think Esri reached out, or maybe I said, 'Yeah, I need to contact them.'"

Esri DRP member Chris "Fern" Ferner jumped in to help Aranguren and Butte County manage their emergency needs.

"I didn't even know what to ask for," Aranguren said. "Esri was saying, 'Do you need help with this map?' And I'm like, "yes, yes, yes, and yes. What can you do for me?' Esri immediately came in, contacted me, assessed what I needed, and brought in Fern to help out."

With Ferner engaged, the DRP opened up Butte County's ArcGIS Online organizational account, assisted with the surge of staff by giving it additional named users, and helped fix an app it was having trouble with. Interestingly, Butte County was actually prepared for a big wildfire, as well

↓ A dashboard showed Bay County officials how the storm had affected local businesses.



↑ According to its GIS manager, Butte County was actually prepared for a big wildfire, just not enough for this one. It quickly turned from a wildland fire into an urban fire when it entered the town of Paradise.

as flooding, given where it's located—in the foothills of the Sierra Nevada mountains, amid a lot of woodland. It just didn't have enough resources to support the scale of this incident, which quickly turned from a wildland fire into an urban fire when it tore into the ridge town of Paradise.

"I'm trying to think now of preparing for another scenario like we experienced. What do we do?" asked Aranguren. "Our ArcGIS Online experience and presence on the web wasn't that big. We thought about maybe migrating our services to the cloud, so that could be something we think about doing down the road. Also, what *[mobile]* applications do we need to have waiting in the wings? What would the schema look like? Do we have all the pieces in place for the people going out in the field to get the information they need? Let's build those, get them set up, and have them ready to go so we will be ready if this happens again tomorrow."

Esri's Emergency Management Operations Solution

The DRP's long history has led to a better understanding of how organizations can prepare for the next event.

"We have learned a lot over the past 25 years," said Lanclos. "We want to share this with others in hopes that they can start preparing now."

A new solution for emergency management operations, accessible at esri.com/emergencymanagement, provides an integrated set of tools that address common workflows related to disasters. It was developed based on the DRP's real-world experiences.

"People typically need to think about three main areas," explained Lanclos.

First, assess how to maintain situational awareness and how to use GIS to do it. Second, figure out how to get teams out in the field to collect data and then get it back to the EOC. Third, determine how to manage public information so citizens know which actions to take and when.

"The solution we've created addresses all this and is based on requirements and feedback from users," said Lanclos. "If organizations use it as a road map for getting started with preparedness efforts, they can be ready for the next incident. They should do this today, even without the DRP."

To learn more about the DRP, go to **esri.com/disaster**. To get started with the emergency management operations solution, visit **esri.com/emergencymanagement**.

How the Ferguson Fire Extended GIS in the Field for Resource Advising

By Michelle Barry, US Fish and Wildlife Service, and Elizabeth Hale, National Park Service

During wildfires and other emergency incidents, emergency responders, public safety officers, and others work tirelessly to protect life and property. Perhaps lesser known is that a host of other professionals often partner with emergency responders to advise them on how to protect at-risk cultural and natural resources. Resource Advisors (READs) can be biologists, hydrologists, archaeologists, tribal liaisons, or specialists from other disciplines who, during an incident, focus on minimizing the impact of disaster response and recovery operations on ecosystems, archaeological sites, and protected species.

More than 80 READs worked on the Ferguson Fire that burned almost 97,000 acres in California in July and August 2018. As the fire spread across the Sierra and Stanislaus National Forests, Yosemite National Park, the homelands of five different Native American tribes, and swaths of private land, READs located sensitive resources and developed measures to protect them. Throughout all phases of the fire, they used Collector for ArcGIS to streamline their work and ensure that various teams had access to the most up-to-date and relevant information.

The two of us worked together as a GIS specialist and a READ during the suppression repair phase—when the Ferguson Fire was contained but many miles of dozer and hand line, plus hundreds of impacted sites, still needed to be repaired. While GIS has been used in fire operations for decades now, things were different for us in this fire. The recent adoption of Collector and ArcGIS Online transformed what was once a cumbersome process into a near real-time GIS operation.

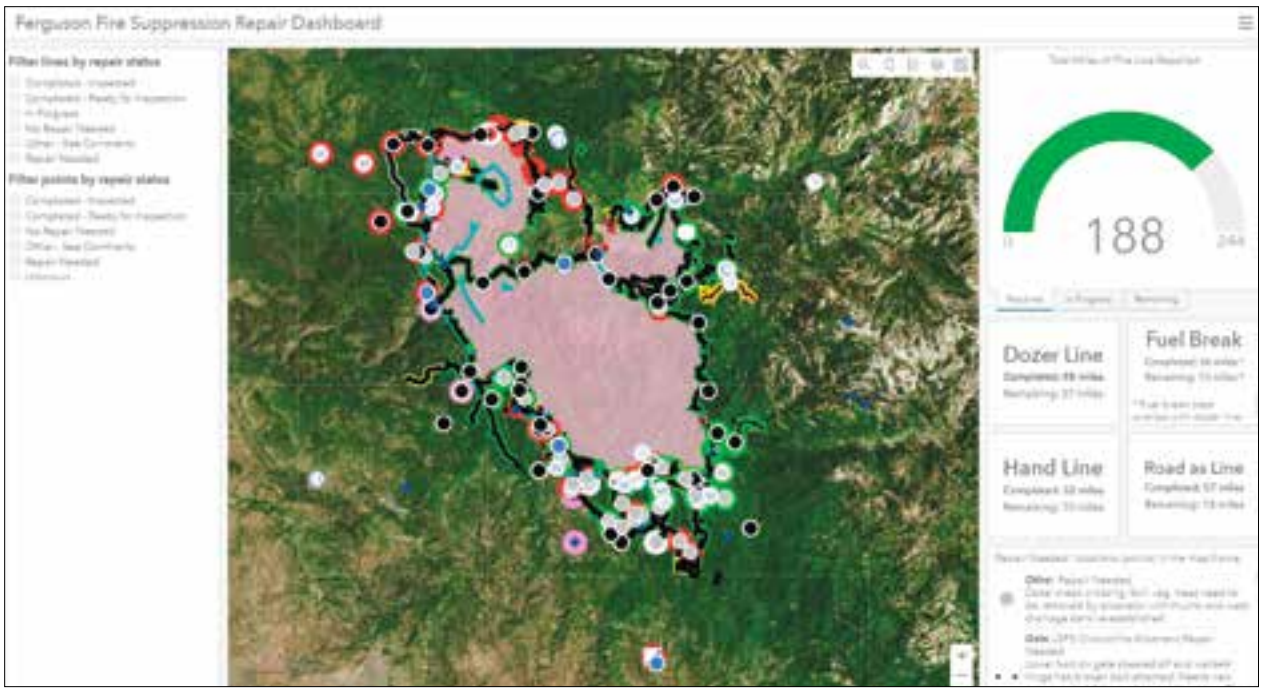
From Hand-Marked Paper Maps to Digital Dexterity

On a fire, READs go into the field alongside fire crews to recommend and help implement measures to safeguard cultural and natural resources. In a typical day, READs can be seen protecting a sensitive archaeological site from being destroyed by equipment or saving historic buildings by wrapping them with fire-resistant foil. They recommend where to use lower-impact hand crews rather than heavy equipment. And after the fire has been contained, they help develop repair plans that specify how to restore slopes to limit erosion, where to disperse vegetation to benefit wildlife, and more.

To do all this, they rely on the same maps and GIS data that fire crews use, and then some. While READs are keeping track of fire operations, they also check up on sensitive sites and map areas that need to be repaired. Before they had Collector, they did this with a mix of paper maps, GeoPDFs, and handheld GPS devices. Each night, READs delivered their updates—often a combination of GPS files and paper maps marked with different-colored highlighters—to a GIS specialist, who would digitize the new information and print out maps for READs to mark up by hand the following day.

During the Ferguson Fire, however, the lead READs saw an opportunity to expand the use of mobile GIS. They brought on GIS specialists to support the READ team directly. For the first time, all READs had access to a frequently updated map in Collector, rather than a standard poster-sized paper map. This gave them attribute information and better feature clarity than they had before. They could toggle various layers on and off to focus on specific aspects or areas of the wildfire. And because everyone was using a common data platform, READs could more easily communicate with incident managers, agency land managers, and public information officers about the status of sensitive habitats, historic sites, and other important resources that were scattered across a large and complex landscape.

It was a big shift—one that had distinct implications for each of us in our different yet intertwined roles as GIS specialist and READ. Here, we offer a closer look at what this digital transformation meant for repairing sensitive areas after the Ferguson Fire.



↑ GIS specialist Elizabeth Hale created a dashboard that automatically summarized how many miles of fire line had been repaired, were in progress, or still needed attention.

Supporting GIS in the Field

GIS Coordinator, Yosemite National Park

Using Collector and ArcGIS Online during the Ferguson Fire moved incident GIS staff, like myself, away from "let me map that for you" to "see for yourself." With READs able to edit data themselves and sync their updates directly from Collector to the National Incident Feature Service (NIFS), I spent little time digitizing data and downloading GPS files.

That's not to say there weren't growing pains. Since I no longer facilitated data transactions, data quality assurance had to be managed on new fronts. I had to establish deadlines for syncing edits and make sure READs were not editing the same feature offline. Issues arose with duplicate lines in NIFS, so I had to track down the lines that had accurate attributes. Also, I ended up reviewing the edits and new records for each day's field efforts after they were incorporated into NIFS rather than before.

Overall, though, I really saw this transition enhance communication. Once a wildfire is contained and crews transition to suppression repair, incident GIS staff know that the incident planning team will start asking for daily updates on repairs: What is the status of all the dozer and hand lines? What about the roads that served as fire lines? How many miles have been repaired, and how many still need to be taken care of? We usually write the answers to these questions on a whiteboard in the GIS tent or trailer so the situation leader, plans chief, or lead READ can see them when they pop in.

On the Ferguson Fire, I did something different. I built a dashboard with Operations Dashboard for ArcGIS to report the status of suppression repair. I figured it would save me the time and effort it took to recalculate the numbers each morning from a series of queries and selections in the attribute table. The dashboard automatically summarized how many miles had been completed, were in progress, or still needed repair. I broke this up based on fire line type as well. This took reporting to the next level because not only did the dashboard display concrete numbers, but it also let incident managers filter the map layers by repair status to see, on a web map, where specialized equipment or repairs were still needed.

I ended up demonstrating the product to the lead READs and agency administrators from the US Forest Service and the National Park Service. This initiated a productive dialog about how much more GIS could do to support incident response and recovery.

Using GIS in the Field

Conservation Planner, US Fish and Wildlife Service, Pacific Southwest Region

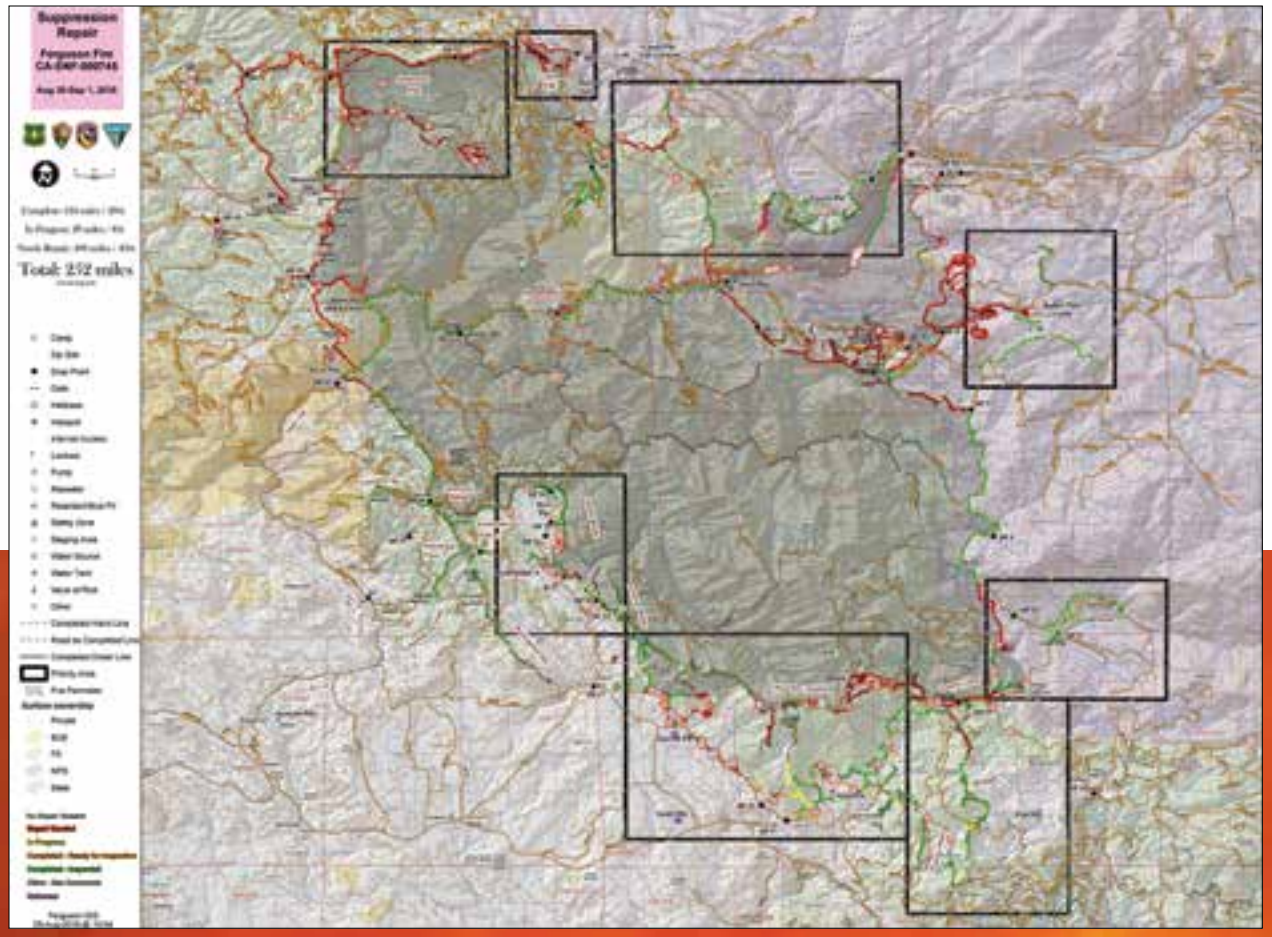
As a planner for national wildlife refuges with the US Fish and Wildlife Service, I am occasionally asked to work as a READ for fires or other emergency responses. During the Ferguson Fire, I provided coordination and leadership for more than 30 other READs. It was a challenging assignment involving a large fire area, a sizable READ team, and several agency land managers.

It was clear to me from the beginning that GIS was being used heavily for resource advising during the Ferguson Fire. Upon arrival at the incident command post, my first instructions were to visit the GIS trailer, create a user name in the National Interagency Fire Center's (NIFC) ArcGIS Online organizational account, and download Collector on my smartphone. Soon, I learned how to access geospatial information for the entire expanse of the fire, make notes directly in Collector while out in the field, and later sync any information I gathered so the GIS specialist could incorporate it into the incident map.

As a first-time user, I found Collector to be nimble and user-friendly. It was also very useful for coordinating the READ team. Because the fire spanned such a large geographic area, some READs were stationed hours away from the incident command post. Knowing that they would all sync their updates with ArcGIS Online each night ensured that the NIFS was current across the entire fire area. Thus, when I was asked by agency land managers or others for information on specific sites, I had almost all the data from the READ team at my fingertips. I could tell them how much repair work was still needed in certain areas or how much time it would take for heavy equipment to complete repair work in particular locations.

At some point while working the fire, I remembered being introduced to GIS by my late dad, Mike da Luz. As a wildland fire hotshot, a district ranger, and a regional branch chief of fire and aviation (among other roles at the US Forest Service and, later, Esri), he understood early on how geospatial analysis could better inform land management decisions. More than 25 years ago, he showed me a simple GIS map of forest conditions on the (former) US Forest Service Alsea Ranger District, which encompasses parts of the Siuslaw National Forest in Oregon. As he printed the map, we watched together while four primary-color markers rendered rudimentary symbology on plotter-sized paper. I recall him saying, "GIS will play an important role in natural resource management in the future." It was obvious then that GIS was a valuable tool, but at the time it was also cumbersome and time-consuming.

Now, I can access far more geospatial data on my phone than ever could have been plotted on that piece of paper. My dad had been right: GIS is playing an increasingly integral role in informing resource management. He would have been delighted to see the advancement of GIS in complex fire management scenarios, as exemplified by the Ferguson Fire.



GIS and the Future of Incident Management

GIS has advanced exponentially over the last 25 years. As we continue to look forward, it will be exciting to see what geospatial analysis can bring to future resource management in general—and to fire incident management specifically.

For more information about how GIS was used for fire incident and resource management during the Ferguson Fire, contact Michelle Barry at Michelle_Barry@fws.gov or 530-889-6525 or Elizabeth Hale at Elizabeth_Hale@nps.gov or 209-379-1307.

← Before the fire was fully contained, Resource Advisors (READs) and GIS specialists worked together to start mapping what needed to be done during the suppression repair phase. (Map created by Elizabeth Hale, National Park Service.)

About the Authors

Michelle Barry is a conservation planner with the US Fish and Wildlife Service, Pacific Southwest Region. Working the Ferguson Fire holds a special place in her heart, as the first fire her dad ever worked was in the Stanislaus National Forest exactly 50 years prior, and it was nice to think she followed in some of his footsteps.

Elizabeth Hale is a GIS coordinator for the National Park Service in Yosemite National Park. While she has been on various wildfire assignments in the last five years, the Ferguson Fire was her first time being embedded directly with READs. It was also the first time she worked on a fire she had also been personally evacuated from.

A Business Need Turns into a Passion and a Means for Gaining a Voice—and Using It

Throughout her career, Hoang Chi Smith, the former GIS division chief for the California Office of Emergency Services (Cal OES), has been driven by a desire to help people and give a voice to those who don't have one.

"I feel a lot of empathy," she said, "because I've been a refugee. I didn't have a voice, and I had no control whatsoever of my destiny."

Born in Vietnam, Smith migrated to the United States as a refugee at the end of the Vietnam War in 1975—just days before the North Vietnamese government seized Saigon, the capital of South Vietnam, and consolidated power. Her father was a colonel for the South Vietnamese Army, so had the family of nine stayed, they likely would have suffered political persecution, been denied economic and educational opportunities, or worse. Instead, they spent five weeks journeying by land, sea, and air to get to California via Guam.

"When we landed in Guam from Vietnam, the people from the Red Cross were there and the marines were there to hand out food," she recalled. "They set up tents and tended to the sick, and it made an impact on me. I was 13, and that's an age when things kind of form your view in life."

Education was important in her household, so after completing high school, she attended California State University, Fresno, where she majored in industrial technology with an emphasis on manufacturing and design.

"I was always the only girl in the class and always the only girl after college to work in the field," Smith recalled.

After graduating, she worked as an engineering technician for electrical connectors and did 3D drafting and design for aircraft components. She did a lot of work with CAD. It wasn't until she was employed at a geotechnical engineering firm, Wallace-Kuhl & Associates, that she got introduced to GIS.

"Initially, it was a business need," she said. "We did a lot of drawings and site plan studies for construction, for home development. Very quickly I learned that GIS provides spatial solutions and markedly improves data management because everything is location based."

Smith ended up spearheading the GIS program there.

"We went from paper maps to creating geodatabases of all the sites," she recalled. "And we tried to relate the data so it wasn't fragmented."

Soon, what had begun as a job requirement became Smith's passion. She started taking classes in GIS to learn more about it. But when the 2008 recession hit, she was laid off.

She got a job right away with CH2M Hill, but less than a year after she started, the company sold her division to Critigen (and the entire company was later bought out by Jacobs). It was a tumultuous period, she remembered.

Around this time, in 2010, the 7.0-magnitude Haiti earthquake hit, and it struck a chord with Smith. She donated money to earthquake relief, but she wanted to do more.

"I felt a lot of empathy because I've been a refugee," Smith said.

She remembers telling a senior manager at work that she was worried about being laid off again because her hours had been reduced, so she'd decided to take this opportunity to do more volunteering.

Smith started working with a local homeless shelter, which not only feeds visitors but also informs them about social services they can take advantage of.

"I saw the paper maps that they gave their clients. I was looking at *[them]*, and I thought, 'How on earth can people find their way to social services or bus stops and all that?'" she recalled. "I thought, 'This is it.' So I created a map for them and gave it to them."

The project made Smith realize that she had some gaps in her mapmaking knowledge, so she went back to school to earn a certificate in GIS.

"My ultimate goal was *[to work]* with a big organization that would help people in need *[during]* disasters—man-made or natural," she said.

Smith shifted her career toward GIS. She interned at the US Forest Service and did a student assistantship at the California Department of Water Resources. She worked her way into GIS analyst and technician roles at the county and state levels before joining Cal OES as a geospatial systems analyst.

Her first activation at Cal OES was the ongoing drought in the region. Each day for about six or seven months, she and her colleagues published seven or eight rolls of very large maps to send to the governor, the Cal OES director, and the different affected regions. She's not sure if anyone ever looked at the maps. They seemed to be available just in case someone needed them.

For a while, she kept her head down and learned a lot. But then the 6.0-magnitude Napa earthquake struck in 2014, and that proved to be a turning point. Her manager called the Esri Disaster Response Program (DRP) for assistance but then had to leave because of a medical emergency. Smith and her team were essentially on their own.

"We were overwhelmed. We didn't have the capabilities. Everything was on paper," she said. "When things like that happen, executives want to know what the impact is. And we didn't have any way of summarizing the impact or coordinating the data. We didn't know how to get things like damage assessments."

Through the DRP, Esri sent technical marketing specialist Jon Pedder to help out.

"I introduced myself to him and said, 'I'm the most junior person here, but I really care about this,'" she said.

Pedder showed Smith some tools that Esri had available, including Collector for ArcGIS, which Cal OES could apply to damage assessments, and the Esri Story Maps Journal app, which the agency could use to create a common operational picture of the situation. Smith was so enthralled by all this that, somewhat against convention, she took it to the chief of the state operations center and then the director of Cal OES. They decided to implement the technology immediately.

"That was my biggest milestone—to go from paper to digital to online," said Smith. "After Napa, we had the authority and the ability to…set good examples, to say, 'Here is a model of what we can do during an activation, and quickly.'"

When she eventually took over as the GIS division chief for Cal OES, Smith focused on building relationships and fostering trust among other agencies so they could share their authoritative data and work with GIS online. During big wildfires, for example, Cal OES worked very closely with CAL FIRE, so it helped if the two organizations had the same data. It was similar with the California Highway Patrol, since the law enforcement agency had maps that showed emergency escape routes and closure areas.

"We used a lot of diplomacy, held a lot of exercises together, and had a lot of meetings and functions," Smith recalled. "I think that's why it was really successful during my tenure there."

Smith enjoyed working at Cal OES and felt like she was really helping people in need when fires, earthquakes, and other disasters displaced them in their own state. But she was increasingly feeling a tug to use her own experience as a refugee to be a voice for others.

For years, she had been writing a memoir of her experience growing up in Vietnam and being a refugee. At first, she'd intended only to give it to her American-born children to show them how different her life had been from theirs. But more and more, she felt like her story could resonate with other refugees and potentially be the voice that many of them felt they lacked.

"I felt like I had done my work at OES," she said. "Could I have stayed and done more? Of course! But it's my obligation to speak out because, if I don't, maybe nobody will."

Under her pen name, Hoàng Chi Trương, she published her memoir, *TigerFish*, in 2017. But she hasn't left her experiences at Cal OES behind, nor has she abandoned GIS.

She recently published a children's book, *No Ordinary Sue: The Tale of a Heroic Pumpkin*, which follows a pumpkin who escapes from a flood and finds herself helping others along the way.

"There are some questions in the back to encourage *[adults]* to talk about disaster preparedness with their kids," she said. "If I hadn't worked at OES, I wouldn't have thought about the importance of publishing that book."

In addition to writing and doing public speaking engagements, Smith stills makes use of GIS.

"I am working on some map journals to share with local groups who help…refugees from the Asian-American and Pacific Islander community," she said. "We are not monolithic, and we have different challenges."

Which is something she knows that GIS can help articulate.

↓ Hoang Chi Smith, who publishes under the pen name Hoàng Chi Trương.

GIS Hero

Utility's First Location-Based Damage Assessment Kick-Starts a Digital Transformation

When a historic windstorm swept through eastern Washington and northern Idaho on November 17, 2015, the local utility company, Avista Utilities, expanded its use of the ArcGIS platform to give mobile workers the tools they needed to quickly assess the utility's infrastructure. By extending its existing GIS technology—using Collector for ArcGIS, Survey123 for ArcGIS, and Operations Dashboard for ArcGIS—the utility gained the ability to share information from its system of record throughout the company, as well as with contractors who were assisting with the restoration effort.

This prompted Avista to further augment its use of GIS for damage assessments, incorporating ArcGIS Online more extensively and building in other field apps. The utility underwent a significant digital transformation.

The Calm Before the Storm

Prior to the windstorm, damage assessments at Avista revolved around a spreadsheet. Although this tabular record was packed with information—more than 50 fields—it took the utility a lot of time to get a complete picture of the damage to its infrastructure. This made it difficult for Avista's decision-makers to assess and prioritize work, rapidly deploy field crews, and share information.

During a meeting geared toward improving the damage assessment process, Allen Cousins, a senior GIS analyst at Avista, was pulled in to see if GIS could help. Cousins was candid about the inherent problems of spreadsheet-based inventories and suggested a more effective path forward. By configuring Collector, Survey123, and Operations Dashboard, he said, Avista would be able to get damage assessment data into its existing GIS much faster, where it could help decision-makers prioritize recovery work.

"There was a better way to record and share information using mobile apps that would feed *[into]* a digital dashboard *[to provide]* an overview of inventory," said Cousins.

Assessing Damage and New Opportunities

The 2015 windstorm caused the largest outage event in Avista's history. About half its customers—approximately 180,000 people—were without power, and the utility's infrastructure sustained significant damage.

Initially, the company attempted to collect information about its damaged infrastructure using the old spreadsheet method. But it quickly became apparent that this was woefully inadequate.

Cousins and his team prepared a Collector app to use for post-storm damage reassessments. Within three days, they'd configured and deployed the app to nearly 70 users, who reassessed Avista's infrastructure over the next six weeks. The assessors captured all windstorm damage and made sure that the repair work done by outside crews and contractors met company construction standards.

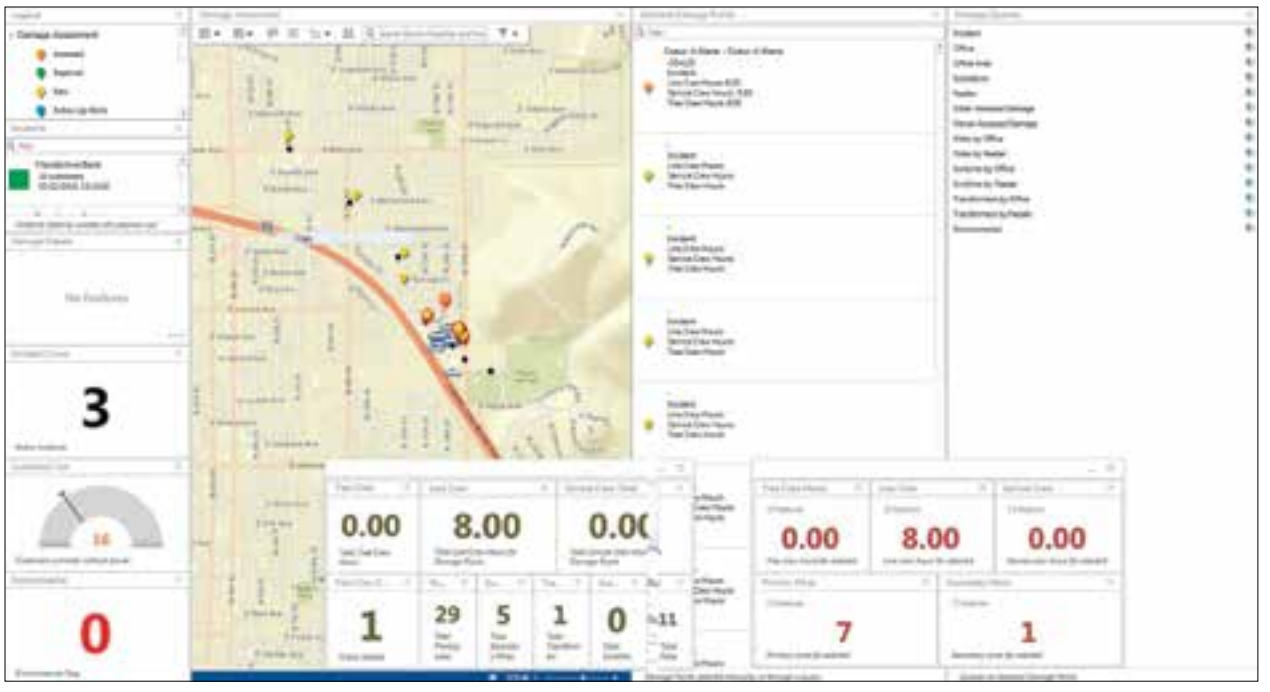
Impressed by how easy it was to configure and use mobile GIS apps, Avista opted to modernize its damage assessment plan to fully incorporate mobile GIS alongside Esri's desktop apps and ArcGIS Online. Because ArcGIS Online could be tethered to the utility's databases, it became the center of Avista's damage assessment process.

The new GIS-centric process would allow damage assessors to collect the least amount of data required to estimate the major materials and time needed to make repairs. Now, instead of having to identify all the construction components of a broken pole, an assessor would just have to note that a pole was broken, and Avista would leverage the facility data already stored in its GIS to determine the necessary materials. Additionally, damage assessors would no longer have to fill out location information for each asset, since the GIS-based mobile apps could automatically apply this data to each damage assessment.

Using an app on their iPhones or iPads, damage assessors who visit outage areas now select a specific damaged facility on a map in Collector and fill out a survey—complete with photographs of the damage—with Survey123.

↑ Users begin damage assessments with the Identify Damage app, which is based on Collector for ArcGIS.

↑ After identifying a damaged asset, crews use a simple form, built with Survey123 for ArcGIS, to gather assessment details.



↑ Crews record and update damage to Avista's infrastructure in real time, and decision-makers back at the office can see this information in a dashboard built with Operations Dashboard for ArcGIS.

"With this new system, crews are able to record and update, in real time, the details of damage to Avista's infrastructure," said Cousins. "While other field assessors and crews see these changes on their mobile app, decision-makers in the office see this information in an executive dashboard based on Operations Dashboard."

Ready for the Next One

Avista's new damage assessment solution consists of a suite of interrelated apps that each play a role in the outage management chain.

Identify Damage, based on Collector, is similar to the prototype that was configured following the 2015 windstorm. This is the entry point for Avista's damage assessment solution. Users tasked with collecting damage data start here by identifying the facility and marking it as Repair or Assess Only. The app then executes the appropriate Survey123 survey.

Assess Damage, based on Survey123, is a simple form that crews use to gather assessment details. The selected data about each facility is passed from Collector to Survey123 so the user doesn't have to reenter known attribute data.

The View Outages app, based on Explorer for ArcGIS, allows users to see Avista facilities in the field alongside information about existing electrical outages. Users can click on most of the facilities and view attribute data or even select a customer to call from within the app.

The Damage Assessment Overview, based on Operations Dashboard, presents all the data collected in the field to Avista decision-makers so they can act on it.

With its new suite of apps, Avista is ready to respond to the next storm that threatens its electric grid.

Crossing Borders

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

Dealing with Geoprivacy and Confidential Geospatial Data

Creating and analyzing geospatial data are now central to most scientific domains and ubiquitous in governments and businesses. However, the unique confidentiality characteristics of location data present special challenges for geospatial research and its societal applications.

The opportunities and benefits of using geospatial data for scientific and governmental collaboration are often constrained by the need to protect research subjects' locational privacy and confidentiality. When geospatial data is presented in maps and visualizations or combined with sensor data or other related datasets, it may be possible to identify individuals.

Challenges to Using and Sharing Confidential Geospatial Data

The ability to replicate and reproduce research is a cornerstone of the scientific method. To ensure that this is possible, researchers funded by the National Science Foundation (NSF) and the National Institutes of Health (NIH) who generate or use confidential geospatial data also need to be able to share that data so it can be safely accessed, analyzed, and built on by the larger scientific community.

But in the health sciences, data confidentiality is increasingly cited as the primary reason for resisting data sharing. NSF policy explicitly indicates, though, that researchers should share data "in a form that protects the privacy of individuals and subjects involved." Furthermore, the new Geospatial Data Act of 2018 also establishes new layers of data privacy oversight for most other federal agencies.

An Integrated Approach to a Persistent Dilemma

Fortunately, promising new options are emerging for addressing confidential geospatial data management concerns and restrictions. In the past five years, the American Association of Geographers (AAG), the University of Michigan's Inter-university Consortium for Political and Social Research (ICPSR), and the University of Illinois at Urbana-Champaign (UIUC) received NSF grants to conduct collaborative research on addressing key issues associated with using and sharing confidential geospatial data. As a team, we have already achieved proof of concept and developed an experimental and testable Geospatial Virtual Data Enclave (GVDE), a virtual machine environment designed specifically for geospatial confidentiality research needs. It lets researchers share, use, and analyze remotely hosted geospatial data on their desktop computers but doesn't allow them to download it. The GVDE includes advanced GIS, spatial statistical, and other analytical and modeling tools, as well as masking and encryption methods to enable anonymized maps or data visualization to also be removed from the GVDE after review.

While we are currently focused on addressing the unmet needs of NSF researchers who wish to share yet protect their confidential geospatial research data, we also see many ways in which governments and businesses can apply our core technology for their geoprivacy and geospatial confidentiality needs. The GVDE system we have developed is an integrated, robust, and reliable geospatial confidentiality management infrastructure that can be adapted to multiple other applications.

We are currently conducting research on four interrelated program components that are required to create and implement a robust and reliable GVDE system for widespread use by NSF and, later, adaptation by other entities that rely on confidential geospatial data. Our integrated approach to achieving this goal involves using NSF-funded research to do the following:

- **Develop the GVDE and its core functions.** We are undertaking a research and implementation program that's necessary to address the specific challenges of working with geospatial data in a secure, virtual environment. This component of the project will also evaluate and integrate various software tools and procedures (e.g., data management, GIS, analytics, modeling, and spatial statistics) to enable researchers who use confidential geospatial data to share it, access it, analyze it, replicate it, and build on research within the GVDE—all remotely and in a virtual environment.
- **Evaluate and implement masking and encryption capabilities for the GVDE.** To allow researchers to anonymize and then export the maps, analyses, and visualizations they derive from confidential geospatial data, we are also examining multiple masking and encryption methods to include in the GVDE. This will make it easier for researchers to use this kind of geospatial data in publications, presentations, and other public-facing bodies of work. This component of the project consists of testing anonymization methods and related disclosure risks for specific types of geospatial data, such as points, lines, polygons, rasters, and vectors. We are also evaluating this for newer sources of confidential geospatial data, such as GPS trajectories, crowdsourced information, and data from social media.
- **Develop a GVDE researcher credentialing system.** We want to ensure that only trained and trusted researchers have access to restricted data in the GVDE, as well as in multiple scientific and related data repositories. That's why we are developing and implementing an innovative, robust, and reliable system to provide authorized researchers with a durable digital identifier that operates as a sort of research passport. This will allow large numbers of credentialed researchers to safely access and use the GVDE, increasing opportunities for them to collaborate and build on the important and extensive body of geospatial and GIS research now being carried out.
- **Ensure the GVDE's sustainability.** To assure that researchers can make widespread use of the GVDE for years to come, the system will be maintained as part of ICPSR's portfolio of ongoing data management and stewardship services. This will ensure that the GVDE has the financial and technical support of ICPSR's 770 member universities and other institutions. Additionally, to expand use of the GVDE to the broader geospatial research community and NSF grantees, we are developing training and outreach activities that cover how to use the system, data confidentiality ethics, credentialing requirements, and policies and best practices. The GVDE operates in a secure cloud environment that meets both Federal Information Security Management Act (FISMA) and Federal Risk and Authorization Management Program (FedRAMP) compliance standards, which provides an Authority to Operate (ATO) for use by federal agencies, including the US Census Bureau, the Department of Defense, NIH, and the Internal Revenue Service (IRS), among many others.

Together, the AAG, ICPSR, and UIUC bring significant, complementary expertise and experience to the long-standing issues associated with sharing confidential geospatial data. Through its strong management, research, and outreach capacities, the AAG is uniquely positioned to lead and successfully implement this complex research program. With its extensive experience in dealing with privacy and confidentiality protection—and as the custodian of large, data-intensive social science archives—ICPSR is uniquely positioned to help develop the digital research passport being used with the GVDE. And because of its long history of doing cutting-edge research in GIScience, geospatial data analysis and management, and GPS data and methodologies, UIUC is uniquely positioned to oversee how to securely and efficiently protect analytical outputs, including maps, that anonymize data.

Practical Solutions for Working with Confidential Geospatial Data

Our scientific and technological research program is providing workable and sustainable solutions to key geospatial data confidentiality issues, both for research purposes and within broader society.

These solutions will enable more people to use GIS and other geospatial technologies for health and scientific research. The GVDE is creating important new research infrastructure that scientists can use to share confidential geospatial data so they can replicate and build on one another's work. This also has the potential to transform how businesses and government agencies apply geospatial data and research to their own ventures and can provide a new resource to help them comply with current and evolving data confidentiality policies and regulations.

For more information on the GVDE program, contact Doug Richardson at **drichardson@aag.org**.

This article was written with input from UIUC geography and GIScience professor Mei-Po Kwan and ICPSR director Margaret Levenstein.

GIS and Change

By Brett Horr, Town of York, Maine

Managing GIS
A column from members of the Urban and Regional Information Systems Association
URISA Fostering Excellence in GIS
www.URISA.org

The GIS industry uses the word *change* regularly but in varying contexts. We use GIS to detect change in our landscapes. We use software that requires constant change. And GIS itself is a change agent.

Considering how often the word *change* is used, it is not usually discussed as something that organizations can manage or plan for. Past articles in this Managing GIS column have focused on strategic planning and leadership. Now it is time to integrate change into the conversation. And the most appropriate context might be how change factors in to putting together a new GIS implementation or expanding an existing one.

The Nature of Change

Change impacts everyone on a personal, organizational, and societal level. It is how change affects people that determines their responses to it. Individual reactions to change may include panic, rebellion, reflection, and acceptance.

Considering that organizations are made up of individuals, when a business, agency, nonprofit, or other institution implements change—from new hires and new technology to project kickoffs and retirements—there will be similar reactions. Employees might feel self-conscious and hyperaware of what is going on around them. Some may experience a sense of loneliness, even if a large group of people is undergoing the same change.

Knowing that these feelings exist and might occur can help an organization manage change.

Foster Understanding

GIS is certainly a change agent. For GIS to be successful, an organization must know how the technology will support its strategic plan, how it improves operations, and how it benefits the organization overall.

But not everyone understands what GIS is and what it can do, so education is paramount. Explaining GIS to someone who is unfamiliar with it is not easy, yet it is necessary to get those employees to embrace the technology and participate in implementing it. Taking the time to outline how incorporating GIS into day-to-day activities can improve both individual and organizational operations is key. Describing the forces of change that are occurring—from internal forces, such as revisions in IT business standards, to external ones, such as new federal laws—will help employees understand why the GIS implementation is needed.

It can be daunting to manage the concrete changes required to incorporate GIS into specific operations or even a business as a whole, but for the process to work, it is imperative that leaders and managers confront people's expectations and clearly communicate their roles in the endeavor. This aids in establishing priorities and ensures that management can plan developmental activities, such as forming teams and brainstorming, to support those priorities.

Once those developmental activities have gained momentum, leaders must then harness that energy to keep the implementation on track.

Control the Risks

Employing effective risk management methods can help organizations control change as it occurs, reducing the likelihood that staff will refuse to adopt the GIS implementation altogether. Some of the risks might include technical problems, such as unclear specifications for positional accuracy, which can lead to inaccurate analyses; financial issues, such as lack of properly trained staff who can use GIS; and organizational risks, such as unfulfilled commitments from senior management on promised training or restructuring.

The best risk management plans seek to avoid, mitigate, or transfer these kinds of hazards. Avoiding risk can be as simple as eliminating untested technology or making fewer, but better, commitments. Mitigating risk can include building in contingencies or tracking the commitments that have already been made. Transferring risk can revolve around creating and using well-designed contracts for third parties.

Risk management must also include monitoring the GIS implementation and coming up with a mechanism to intervene when things don't go according to plan. When implementing GIS on an organizational level, it is imperative to constantly monitor the project's scope, schedule, and costs. Without this, the GIS implementation risks losing acceptance, support, and participation from employees.

Understanding the uncertainties, developing risk management plans, and keeping an eye on the logistics of the implementation can decrease the stresses associated with change and ensure that the new GIS has a greater chance of success.

Communicate Openly and Effectively

Leaders should know their organizations' cultural landscapes. This helps them determine the best methods for communicating upcoming change with employees and finessing the often-accompanying office politics.

It is important that leaders don't hide during the communication process and address their organizations directly about change. To be effective, any correspondence about the GIS implementation should be open and invite employee participation.

Every GIS implementation—whether completely new or an expansion of already-existing technology—precipitates a transition period that causes stress for all the involved parties. Leaders should not use this stress as an excuse to overcommit on what GIS can do for an organization.

Acknowledging that change causes strain, leaders should schedule either group or individual meetings (or both) with employees to disclose as much reliable information as possible about the new technology, updated processes, recently developed workflows, and anything else that is pertinent to the change at hand. Group meetings can be great for providing all employees with the same information, at the same time—but they can allow vocal and negative people to set the tone if these meetings are not handled effectively. One-on-one meetings, on the other hand, allow for privacy but may inadvertently send different messages to different staff members. If leaders take the time to understand the culture of their organizations, however, they can determine which messages to deliver and when and where to communicate them.

Putting It All Together

Change is inevitable. Change can be scary. And change is usually stressful. But managing organizational change like implementing GIS does not have to be scary.

One must define why a GIS implementation is needed, understand the forces working for and against it, develop a risk management plan to protect the implementation, and provide the organization with clear messaging about GIS and the changes that come with it. Following these steps will enable leaders to set up and expand GIS in a way that makes the technology part of an organization's cultural landscape and helps it achieve its strategic goals.

About the Author

Brett Horr has more than two decades of experience working in GIS and is currently the director of GIS and technology for the Town of York, Maine. He has served as secretary, president, and ex officio of the New England Arc Users board of directors and was a member of the board of directors for the New England chapter of the Urban and Regional Information Systems Association (URISA). Horr is also a state-certified reserve police officer, a certified forensic investigator and forensic mapper for crash and crime scenes, and a Federal Aviation Administration (FAA)-certified small drone pilot.

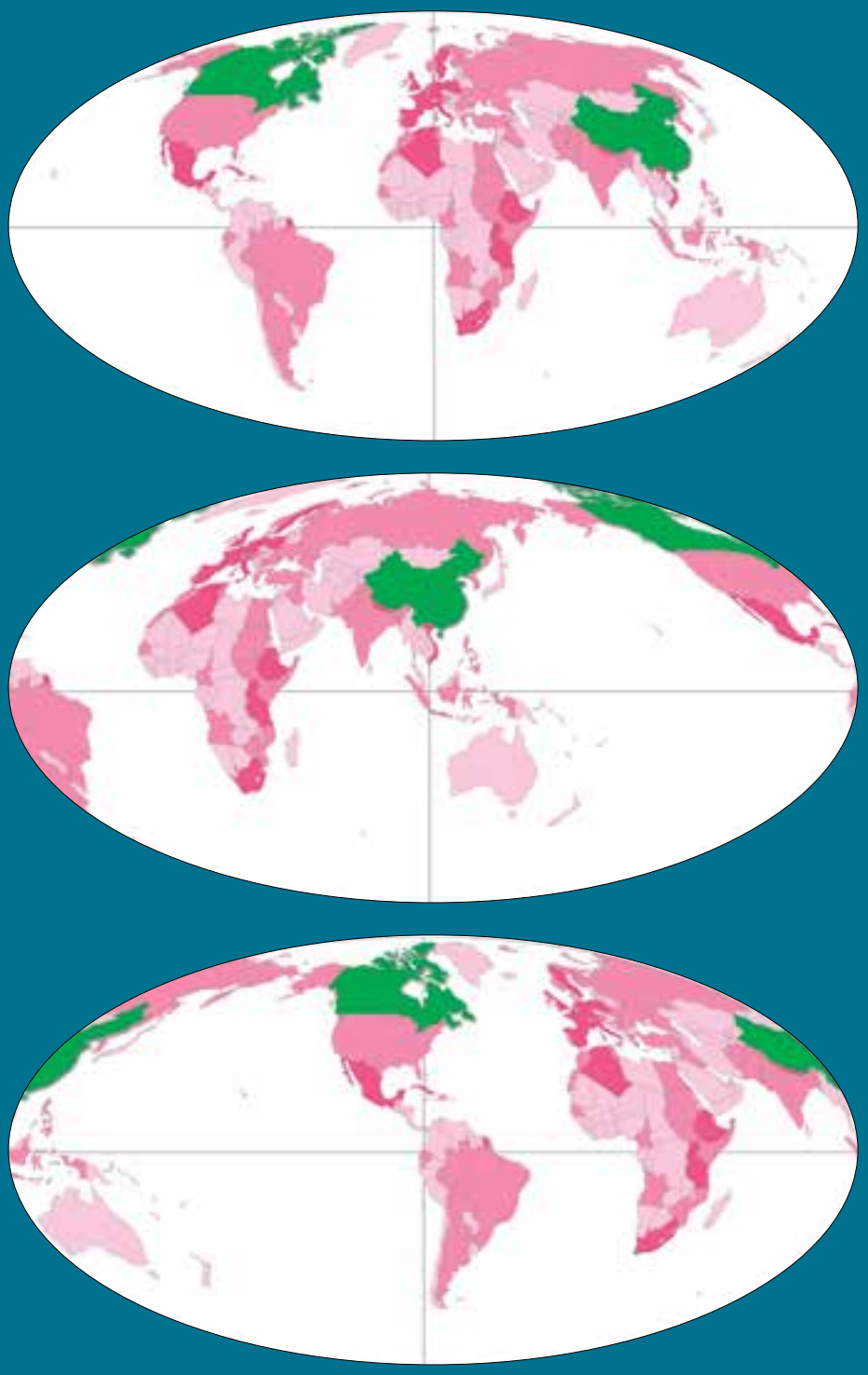
The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak
President of the International Cartographic Association

Local Perspectives at GLOBAL CONFERENCES

As an academic—and especially now as president of the International Cartographic Association (ICA)—I attend quite a few conferences. The best ones, I have found, provide attendees with a balanced combination of exchanging knowledge and networking. Participants present their ideas and get constructive feedback while also listening to and looking at other people's presentations to get inspired. They talk to old friends and usually make a few new ones (lest they stay in their comfort zones too much). Conferences with small, in-depth workshops really boost learning, while larger events enhance opportunities to meet new people.



↑ Different world maps show the globe from different perspectives. Does that influence the information we get from each map?

The myriad communication aspects of conferences intrigue me. I find it interesting that a lot of attendees go home with notes consisting of keywords that represent whole ideas, a bunch of references to read and URLs to visit, and new acquaintances' contact information to both record and act on. But in many cases, all this ends up in a postconference pile because day-to-day affairs inevitably get in the way. (Or am I the only one who has these problems?) The mobile apps that are popping up for specific conferences are certainly making it easier to structure all this information and, later, integrate it into postconference workflows. But I digress.

What I am really fascinated with is how the maps we use at conferences communicate different ideas—especially for those of us who routinely use world maps to display our findings on a global scale. For example, think about the maps that are used to illustrate the Sustainable Development Goals (SDGs)—the 17 objectives created by the United Nations General Assembly in 2015 that aim to eradicate poverty, end hunger, achieve gender equality, clean up the ocean, and do more by 2030. They typically have to cover the entire world, since the SDGs are global initiatives.

Over the course of my travels to conferences around the world, however, I have observed that even global-minded scientists are influenced by renowned cartographer Waldo Tobler's first law of geography: "Everything is related to everything else, but near things are more related than distant things." This is partly due to how locally biased geography education is. First, we learn about our own region and country; then we learn about our continent; and finally, we zoom out to the whole world. Recall the atlases you used in school as evidence of this.

I call this a local-global perspective, and I often wonder how it comes across at conferences and whether these differences in local perspectives are problematic. When a presenter puts North America at the center of a world map, for instance, how do attendees from other parts of the world—say, Europe—experience the map and the information it presents? Are they able to make the mental transformation needed to apply the North America-focused presentation to their own world view?

Take a look at the maps to the left. We see three different world maps, all choropleths of the same SDG-related topic made in the equal-area Mollweide projection. This allows viewers to compare individual values among countries. However, the positioning of the world—the location of the central meridian—is done locally. For Europe, I put the meridian over my hometown—Enschede, the Netherlands—at about six degrees west. This results in a typical Euro-centric perspective on the world. For Europeans, New Zealand is always on the edge of the map, and sometimes it isn't even there at all (which recently led New Zealand prime minister Jacinda Ardern and comedian Rhys Darby to start asking why as part of a tourism campaign for the country). On the map from the Asian perspective, which puts the meridian on Xian, China, New Zealand moves toward center stage. But what about other countries that are split, appearing in two locations on the map, like China in the New York-centered map or Canada in the Xian-centered map? Do we value them twice, since we see them in two locations? Or do we more or less ignore them because they are far away and on the edge?

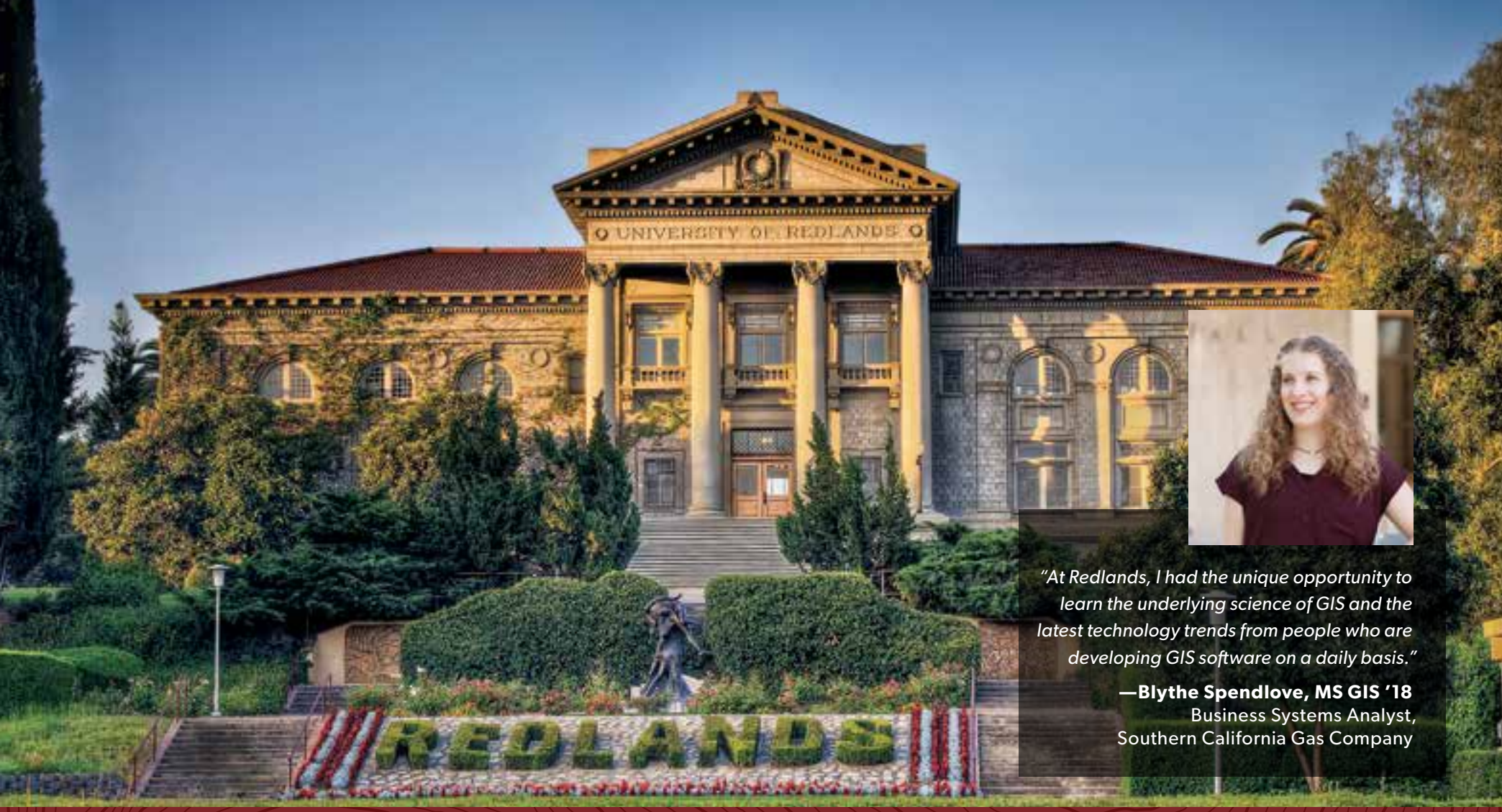
How would people from different continents discuss these mapped phenomena among themselves? And would they get enough information about them when the map is only flashed for a minute or two on a screen, before the next slide goes up? We all talk about the same data, but we come at it from different map perspectives. So do we actually talk about the same things, or do we just think we're talking about the same things?

Perhaps, in addition to conversing with one another at conferences, we could use interactive maps during our presentations, or give out paper or PDF-based maps before the presentation begins that allow other attendees to take a closer look at specific continents, countries, or regions so they can discuss the issues at hand from their own local perspectives. We might be able to come up with some interesting solutions that way.

The 2019 International Cartographic Conference (ICC) is being held in Tokyo from July 15–20. Find out more at **icc2019.org**.

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 Ormeling, 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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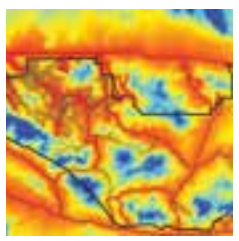

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A Colorado City Turns to Geodesign to Plan a Creek Walk

By Shannon McElvaney, Jacobs

Manitou Springs is a quaint mountain community nestled at the base of Pikes Peak in Colorado. The city has its roots in the gold rush and railroad expansion of the mid-1800s. Historic buildings and stone bridges, walls, and staircases abound along the narrow, winding roads—many of which crisscross picturesque Fountain Creek, which runs the length of the city.

Another feature that defines the area is its unique geology. Twelve natural, effervescent springs bubble up through a series of cavernous aquifers below the valley floor. Long before western expansion of the United States, Ute, Cheyenne, Arapaho, and other plains tribes stopped at the springs to enjoy its healing waters.

The beauty of Fountain Creek and the mineral springs gave Manitou Springs its identity as a place of healing. Early settlers built their homes along Fountain Creek, which provided immediate access to water and the bounty found in the lush valley. But over the years, the creek has been diverted, built over, and neglected. As a result, the creek has not manifested its full potential as a public space that connects people and promotes their well-being.

But that's about to change. The city plans to spend $12 million building a two-mile walk along Fountain Creek. The Manitou Springs Creek Walk will give residents and visitors safe walking, biking, and running routes that are connected to local shops and restaurants. In addition to promoting active living, the creek walk will reduce traffic congestion and improve environmental quality.

At the outset of the project, the city formed the Creek Walk Steering Committee, which faced the challenging task of uniting a diverse set of stakeholders who sometimes have competing interests. To analyze different design scenarios and create maps that show alternative routes, the committee employed ArcGIS technology along with geodesign—a powerful planning method that uses stakeholder input and spatial analysis to show the possible impacts of all design options.

Placemaking Meets Mapmaking

Since 1989, the City of Manitou Springs had envisioned that a creek walk would be an attractive public space where people would want to spend time and socialize. So finding the right route was important.

One of the first things the Creek Walk Steering Committee and its consultants did was traverse all possible creek walk routes, noting on a map which segments would be either suitable for such a walk or capable of supporting one. Survey123 for ArcGIS was used to map the locations of historic trees; erosion; and sites for potential low-impact development, such as detention ponds or rain gardens. There ended up being at least 12 route options to choose from, as well as several possible combinations of routes.

Based on these site investigations and preliminary discussions, steering committee members and consultants created a list of desirable attributes for the creek walk, which included the following:

- Routes should be walkable and bikeable.
- They should comply with the Americans with Disabilities Act (ADA).
- Routes should be near enough to the creek that visitors can see and hear it.
- Routes should use existing pathways and easements (or be on parcels where easements could be easily acquired).
- Areas should be dominated by parks, trees, and meadows, creating a natural setting.

These criteria would later be used to develop spatial models using ArcGIS Pro. But first they had to be vetted.

Obtaining Feedback from Stakeholders

Seeking input from stakeholders is an essential part of the geodesign process that typically helps clarify requirements and validate assumptions. The consultants conducted two stakeholder workshops to get this input.

The first was held in June 2018 with a small group of active community leaders from Manitou Springs who represented residents, business and property owners, local government executives, and visitors. These workshop attendees reviewed the list of desirable attributes and offered additions to it.

The stakeholders wanted to accentuate the value of the creek itself as part of Manitou Springs' identity. They stressed the importance of the creek's stone bridges and nearby mineral springs; the quiet areas frequented by deer, ducks, and foxes; the spots where people can get their feet wet on a hot day; and places such as restaurant patios where people can just enjoy the sound of the creek.

This aha moment was a positive, unifying realization that became an important theme of the citizen engagement workshop.

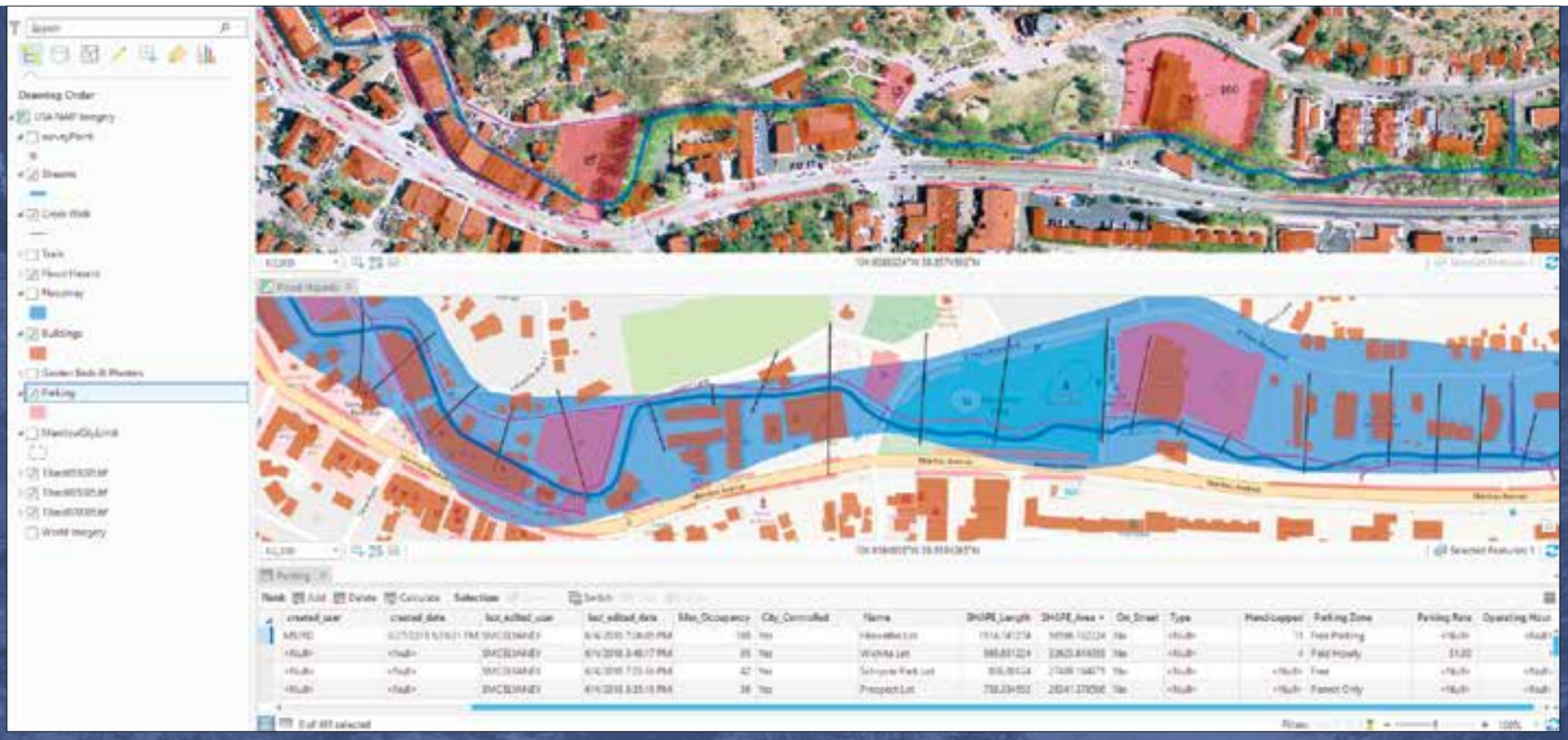
Building the Spatial Models

Next, it was time to build spatial models to evaluate alternative routes. The consultants used out-of-the-box ArcGIS Pro tools to develop route maps. They relied on heat map symbology and graduated symbols, as well as the Buffer, Spatial Join, and other tools.

To ascertain whether a route was bikeable, safety was the deciding factor. The consultants used a simple overlay of road data with vehicle speed limits and congestion to determine bicycle-friendly routes.

Shade was an important physical and temporal criterion for evaluating walkability, since people are more likely to walk along shaded pathways to avoid the hot sun. In identifying which routes have more shade, the consultants used ArcGIS Pro to create a heat map that showed the relative density of more than 2,000 trees. Alternative routes were overlaid with the resultant shade map, and locations along the routes were compared with photographs taken between 1:00 p.m. and 2:00 p.m.—typically the hottest time of day during summer—to validate the accuracy of the shade map.

Moreover, one resident said that he wanted the creek walk to be aesthetically pleasing and enjoyable. So the consultants made another



↑ During the stakeholder workshops, participants were introduced to potential hazards and construction issues that could impact safety and cost, including flood zones and parking options along the different routes.

↑ Manitou Springs, Colorado, is a quaint mountain community with historic buildings and winding roads and stone bridges that intersect with the picturesque Fountain Creek.

heat map to evaluate this subjective concept. But it raised a new question: What would that look like?

A list of criteria began to take shape: art, historic architecture and trees, beautiful views, geologic formations, ponds, and waterfalls. And when the committee added *enjoyment* to the list, the criteria grew to include benches, informal seating, outdoor dining, interesting shops, bathrooms, parking, and other amenities. To create the Aesthetics and Enjoyment spatial model, the consultants mapped all those elements and produced a heat map that shows the concentration of these important features along the various routes.

The consultants also made thematic maps that displayed the routes that passed near businesses, either directly in front of them or within sight of them. Additionally, they combined map layers showing parcel ownership, land-use type, existing right-of-way, and information on easement status to make the *Easement Status* map.

Visualizing Design Options

Equipped with 10 maps that evaluated existing conditions, the consultants used ArcGIS Pro to develop three alternative designs:

- Cyclists Rule—bicycle-friendly routes
- Nature Walk to Shop—ADA-compliant walkable routes through natural areas
- Combo Walk and Bike—the best combination of the two other options

In September 2018, the consultants presented all three design options along with the evaluative maps to approximately 50 community and organization members who attended a much larger citizen engagement workshop. Participants broke up into groups of four or five per table to map their own routes. Each group then reported its designs to the rest of the workshop attendees.

Several major themes or messages arose from the group mapping efforts. The creek walk should be a system of trails with strong connections to other trails. Walking and biking paths should be separate. Natural-setting areas and parks should be left alone and spared from concrete.

The Combo Walk and Bike option was ultimately chosen, expanded, and improved on by the stakeholders, creating an integrated system of trails. The recommended creek walk design now consists not only of a primary, paved, ADA-compliant multimodal route but also secondary walking trails, a road bike path, a potential one-way bike track, and significant connections to existing trails and important destinations.

"The creek walk project enjoys incredible popularity. That being said, we all had a different idea of what a finished creek walk experience would be," said Natalie Johnson, director of economic development for the City of Manitou Springs. "Using the geodesign process, we were able to preserve the passion and popularity of the project without turning it into a divisive issue. Geodesign is a benefit to all communities and community projects."

From Plan to Implementation

By October 2018, the City of Manitou Springs Creek Walk Master Plan was fully accepted by the planning commission and the city council, and design drawings were drafted for the first segment. What started as a $100,000 master planning project is expected to turn into a $1.3 million effort by June 2019. Completion of the creek walk is estimated to cost $12 million, the vast majority of which will be funded by grants.

That said, a plan is just that—a plan. Over time, it will likely change as people come and go. But with the right values and rationale for decision-making in place, the next leaders will be able to pick it up, understand how decisions were made, and carry the project forward. That is part of the beauty of the geodesign framework.

The City of Manitou Springs continually fosters citizen engagement, which supports community-driven decision-making. There is also a strong desire to use science to inform those decisions. Geodesign upholds those goals, improving both the quality and creativity of decision-making.

The Creek Walk Steering Committee's open, collaborative planning effort was very positive. Everyone felt that their voices were heard. The integrative, values- and science-based geodesign approach virtually eliminated conflict, making mutually beneficial deliberation possible.

By engaging stakeholders who represent economic development, residents, government, and visitors, the creek walk blossomed into an important city asset that should benefit businesses, cyclists, and nature lovers. It became something more than its individual parts.

"Due to a number of factors, communities are demanding transparency from their city leaders," Johnson said. "Geodesign enables project managers, administrators, and officials to clearly and succinctly explain the process and build confidence in citywide projects. This is a necessary—and often missing—part of so many community efforts."

↑ During the site investigation of the creek walk routes, the consultants used Survey123 for ArcGIS to map important trees and areas suitable for low-impact development, such as detention ponds or rain gardens.

About the Author

Shannon McElvaney is the director of geodesign at Jacobs, which provides advanced planning design strategies and services. He is also the chief geospatial officer at Whole Infrastructure Systems for Resilient Development (WISRD) and an adjunct professor of geodesign at Penn State University. To learn more about this project or geodesign, email McElvaney at shannon.mcelvaney@jacobs.com and follow him on Twitter at @Geozenn.

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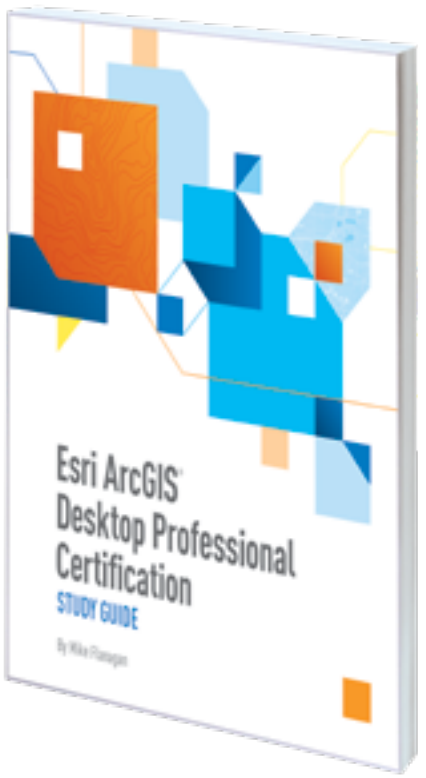
Esri ArcGIS Desktop Professional Certification Study Guide

By Mike Flanagan

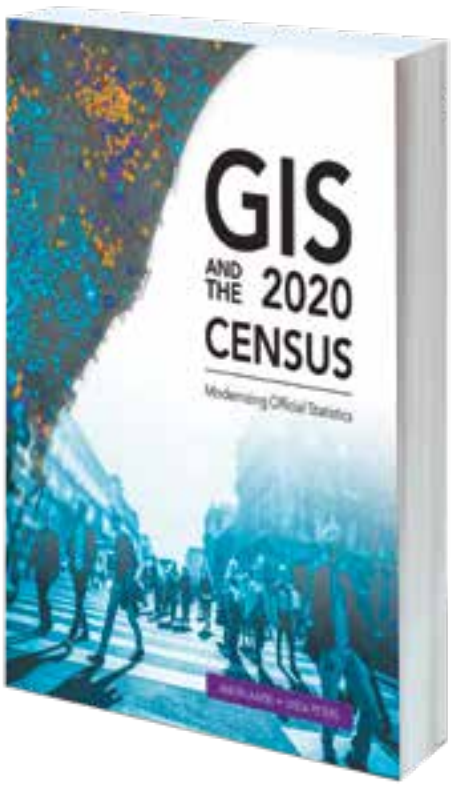
Are you ready to prove what you know as a professional ArcGIS Desktop user? The *Esri ArcGIS Desktop Professional Certification Study Guide* prepares readers to take the latest (10.5) ArcGIS Desktop Professional Certification exam. With each chapter corresponding to an exam section, the book incorporates GIS concepts alongside practical applications. Following a three-part structure, the study guide first gets candidates ready by going over the ArcGIS documentation topics they need to know for the exam, then has them practice using exercises in the book or links to continually updated online resources, and finally lets them check their skills against a list of tasks they should be able to perform. The *Esri ArcGIS Desktop Professional Certification Study Guide* is a consolidated yet complete resource for mastering the ArcGIS Desktop Professional Certification exam. February/March 2019, 120 pp. E-book ISBN: 9781589485365 and paperback ISBN: 9781589485358.



GIS and the 2020 Census: Modernizing Official Statistics

By Amor Laaribi and Linda Peters

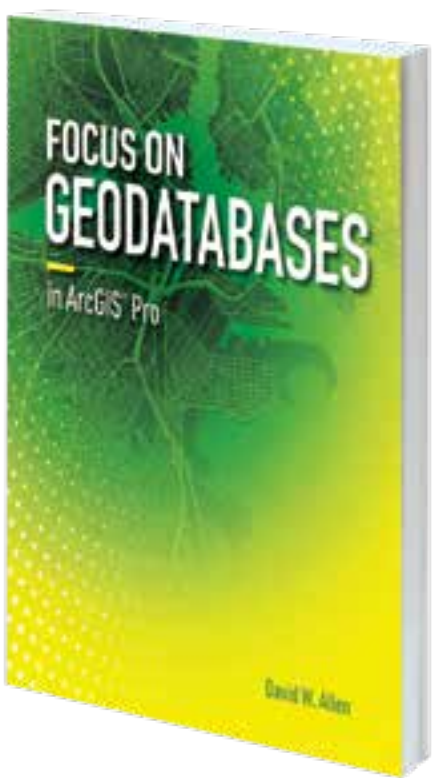
GIS and the 2020 Census: Modernizing Official Statistics outlines the latest methodologies and technological tools that statistical organizations can use to support census workers' needs in all stages of the 2020 Census. With this handbook, readers can ascertain how to plan their work with GIS; learn to use new technologies, including cloud computing and location as a service (LaaS); and get familiar with emerging data sources. *GIS and the 2020 Census* focuses on using geospatial tools during enumeration—including for field data collection and operations management—as well as to analyze, integrate, and disseminate census data quickly. It guides readers through employing geospatial technology to look at and capture information at the finest level of geography, and it illustrates the basic foundations of building a statistical-geospatial information infrastructure for censuses. Complete with case studies that exemplify these concepts in practice, this book enables readers to see how using geospatial solutions for all aspects of a census can lead to evidence-based decision-making and sustainable development. April/May 2019, 320 pp. E-book ISBN: 9781589485051 and paperback ISBN: 9781589485044.



Focus on Geodatabases in ArcGIS Pro

By David W. Allen

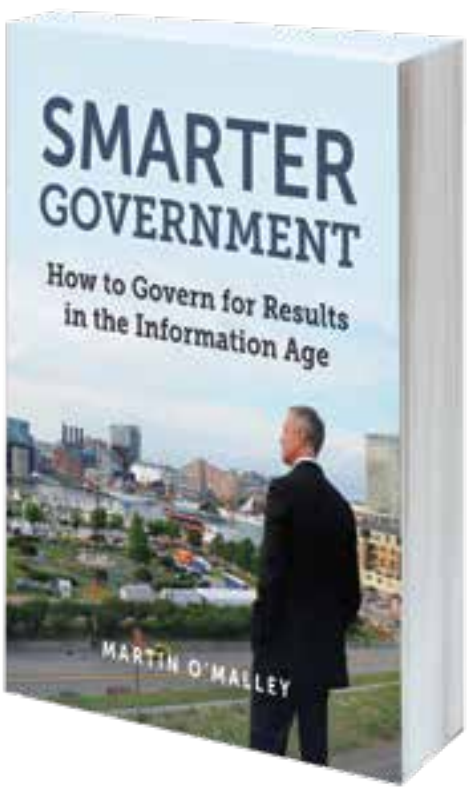
Focus on Geodatabases in ArcGIS Pro introduces readers to the geodatabase—the comprehensive information model for representing and managing geographic information across the ArcGIS platform. Author David Allen shares best practices for creating and maintaining data integrity, and chapter topics include the careful design of geodatabase schema, building geodatabases that include data integrity rules, populating geodatabases with existing data, working with topologies, editing data using various techniques, building 3D views, and sharing data on the web. Each chapter includes important concepts with hands-on, step-by-step tutorials; sample projects and datasets; "your turn" segments that have less instruction; study questions for classroom use; and an independent project. Instructor resources are available on request. May 2019, 250 pp. E-book ISBN: 9781589484467 and paperback ISBN: 9781589484450.



Smarter Government: How to Govern for Results in the Information Age

By Martin O'Malley

The time has come for the rise of the tech-savvy executive: an individual who understands the need to elevate the use of technology within and throughout an organization, all to the same level, all at the same time. As mayor of Baltimore and then governor of Maryland, Martin O'Malley did that—and more. *Smarter Government: How to Govern for Results in the Information Age* addresses this new way of governing. It looks at how using GIS technology can provide real solutions to real problems while guiding readers through how to develop a data-focused management strategy that will profoundly change any organization. March/May 2019, 420 pp. E-book ISBN: 9781589485259 and paperback ISBN: 9781589485242.



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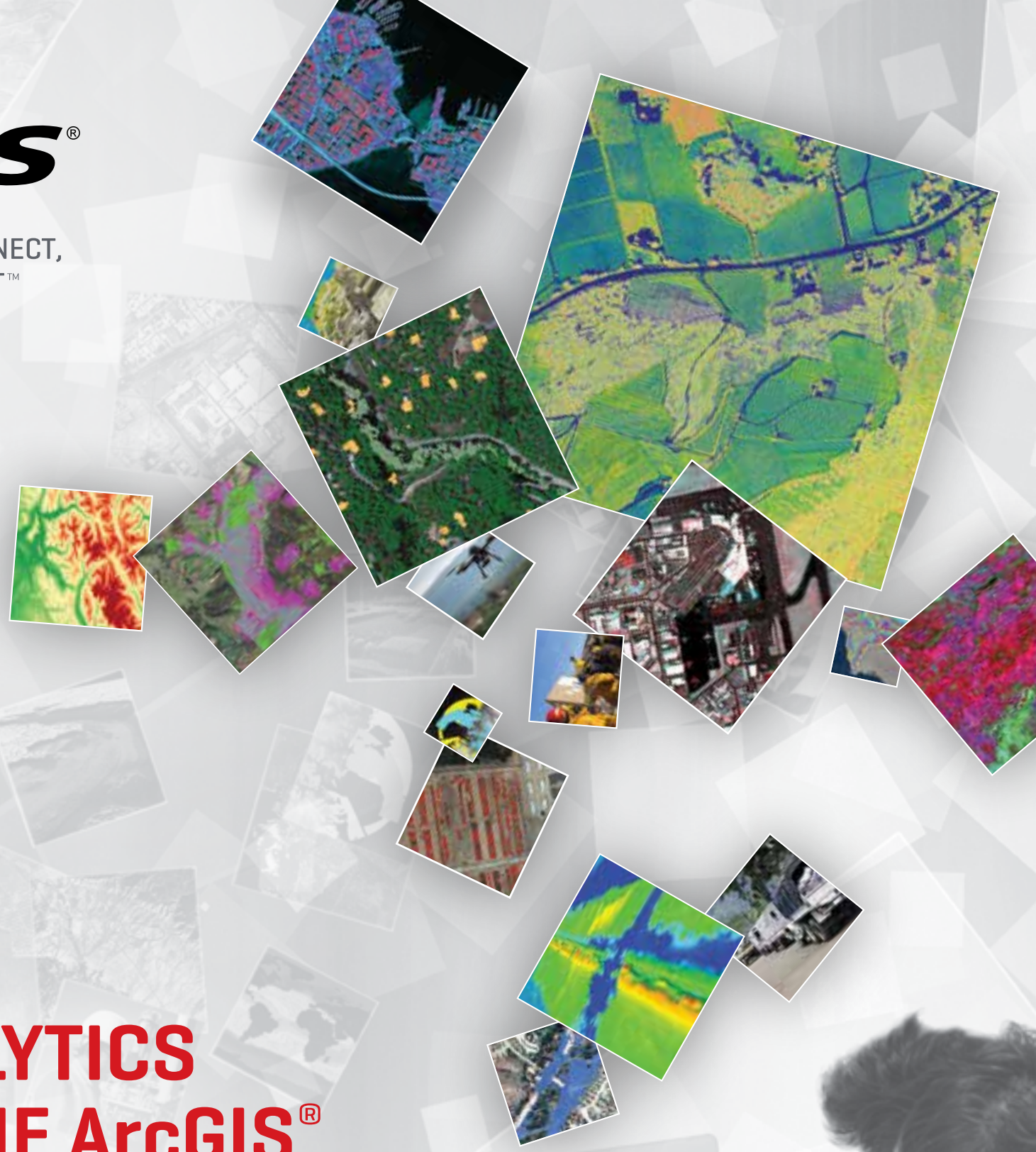

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