

Briefly Noted

Scaling GIS for Sustainable Development

For nations in need of geospatial data to help accelerate their work toward achieving the United Nations (UN) Sustainable Development Goals (SDGs), Esri is joining other organizations around the world—including governments, foundations, universities, and civil society groups—to develop virtual centers of excellence for geospatial information. These centers will make it easier for more people to access SDG data hubs, which allow countries to measure, monitor, and report on the SDGs in a geographic context.

Esri and SAP Advance Partnership

ArcGIS Enterprise now supports SAP HANA Cloud, enabling users, especially large organizations, to accelerate their adoption of cloud-based location intelligence platforms. SAP's high-performance cloud environment acts as a central repository to unify disparate databases and provide a complete overview of data. "Migrating to SAP HANA Cloud [has provided] us with insights that were impossible to get before," said Stefan Vancraeynest, project manager for IT applications at Open Grid Europe, which manages Germany's largest natural gas pipeline. "We can go beyond mere maintenance of data to visualizing business and operational data for real-time analysis."

Learn to Apply the Racial Equity Workflow

A new online course from Esri Training, Applying the Racial Equity Workflow Using ArcGIS, teaches participants how to use GIS to analyze inequities and foster change while engaging with their communities. Learn more and register at ow.ly/PX5d50EPC6c.

Esri Provides Open Access to Key Federal Geospatial Data

Free Open Data, Data Downloads, and Web Services

Working with federal agencies, Esri is opening up access in ArcGIS Online to dozens of high-priority, high-demand national data layers, often referred to as A-16 data. These include cartographic boundary files and demographic data from the US Census Bureau; National Agriculture Imagery Program (NAIP) data from the US Department of Agriculture (USDA); and the National Inventory of Dams (NID) database, managed by the US Army Corps of Engineers.

Esri is making three significant enhancements that will broaden access to A-16 data. First, this data collection is now publicly accessible under an open commons license agreement, making it free for anyone to use. Second, the data is available for download in a variety of interoperable formats. And third, it is served as both Esri and Open Geospatial Consortium, Inc. (OGC)-compliant services, meaning it is ready to incorporate into apps.

These open data services are provided through ArcGIS Living Atlas of the World, which significantly expands their visibility. Additionally, the new open-access license, along with added technical options for using the data services, extends their reach beyond the Esri community. This supports the vision of the



↑ The National Land Cover Database (NLCD), which was used to produce this 3D map of Anchorage, Alaska, is the result of federal agencies working together to create up-to-date, consistent land-cover products for the entire country.

Geospatial Data Act of 2018 (GDA), which seeks to empower more people to use geospatial data, and breaks down more barriers to interoperability.

The Data Is There—Now It's Time to Open It Up

Globally, the trend is toward making data more open, accessible, and reusable. The number of public open data sites provided by national agencies as well as continued on page 9

ArcGIS Pro Add-In Makes Outdoor Airflow Analysis More Accessible

By Ryo Araya, Environmental GIS Laboratory Co.,
and Takanori Uchida, the Research Institute for Applied Mechanics at Kyushu University

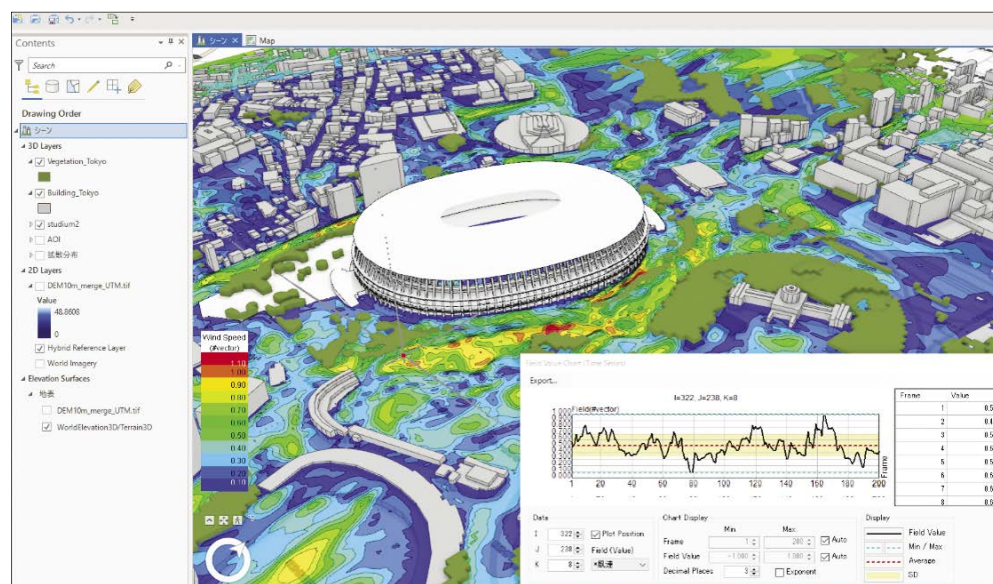
The COVID-19 pandemic has transformed people's lifestyles beyond measure. Because exposure to infectious respiratory droplets and aerosol particles is the primary way humans contract the disease,

much of the world has spent good portions of the last year and a half social distancing, restricting outside-the-home activities, sanitizing spaces, washing hands, and wearing masks.

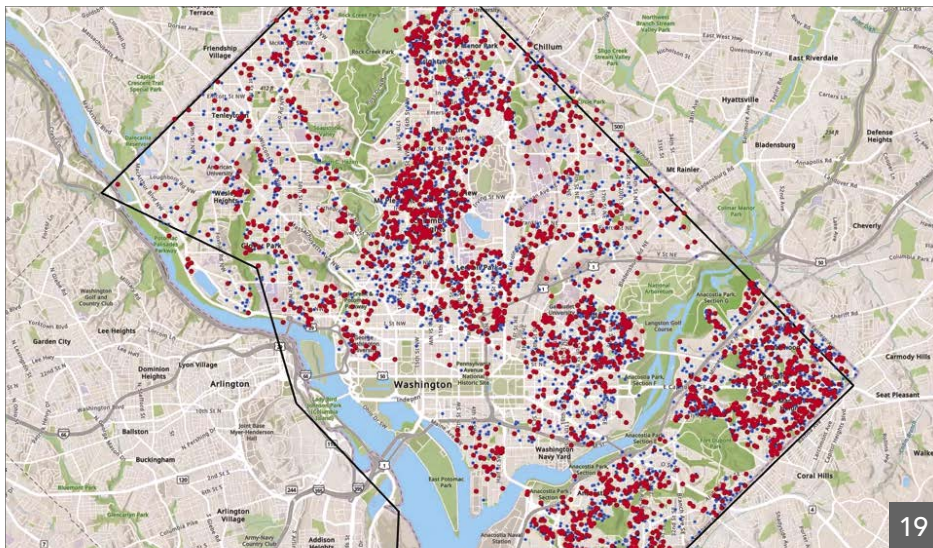
It will take time for life to return to normal. In the interim, the new normal will require continuing to reduce the risk of spreading COVID-19 by promoting ventilation in spaces where large numbers of people gather.

The World Health Organization (WHO) has published a road map for improving airflow inside buildings to protect against COVID-19. But in outdoor and semioutdoor areas like public transit stations, stadiums, and other open spaces, there is a limit to how much ventilation can be controlled by mechanical means alone. It is essential to examine natural airflow as well.

Airflow Analyst, an add-in for ArcGIS Pro, uses 3D urban models along with meteorological data to examine wind conditions and predict the ventilation performance of outdoor and semioutdoor continued on page 4



← Airflow Analyst is an add-in for ArcGIS Pro that uses 3D urban models and meteorological data to examine wind conditions in outdoor and semioutdoor spaces.



City, state, and federal health officials are endeavoring to increase confidence in the COVID-19 vaccines so that people can get back to their prepandemic activities. To help with this, Esri startup partner Epistemix models COVID-19 infections based on varying levels of population immunity. The results are easy to understand—and convincing.



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Test-Drive Imagery Capabilities in New MOOC

Esri has a new massive open online course (MOOC) debuting in August: Imagery in Action, a no-cost, six-week course that introduces the latest ArcGIS capabilities for working with imagery and remotely sensed data. Participants will learn ArcGIS workflows for tackling critical imagery and remote sensing tasks—from finding, processing, and analyzing imagery to delivering actionable insight.

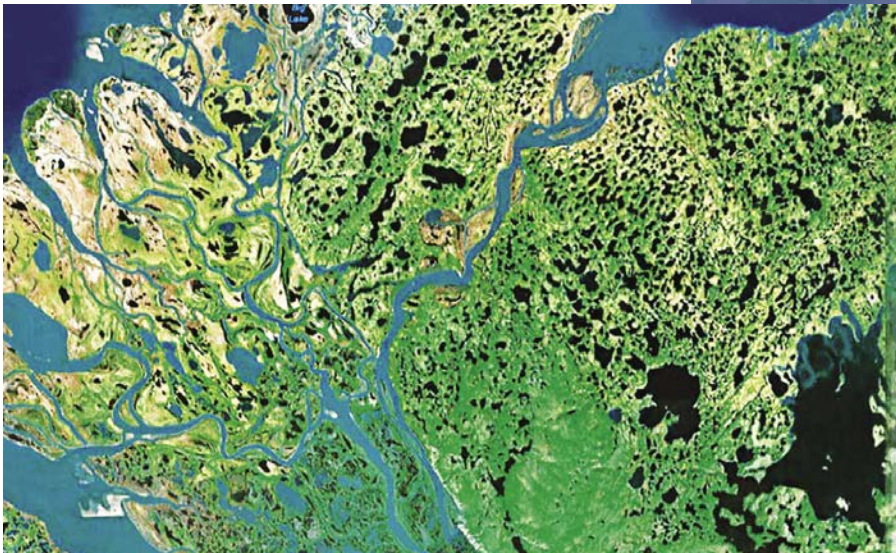
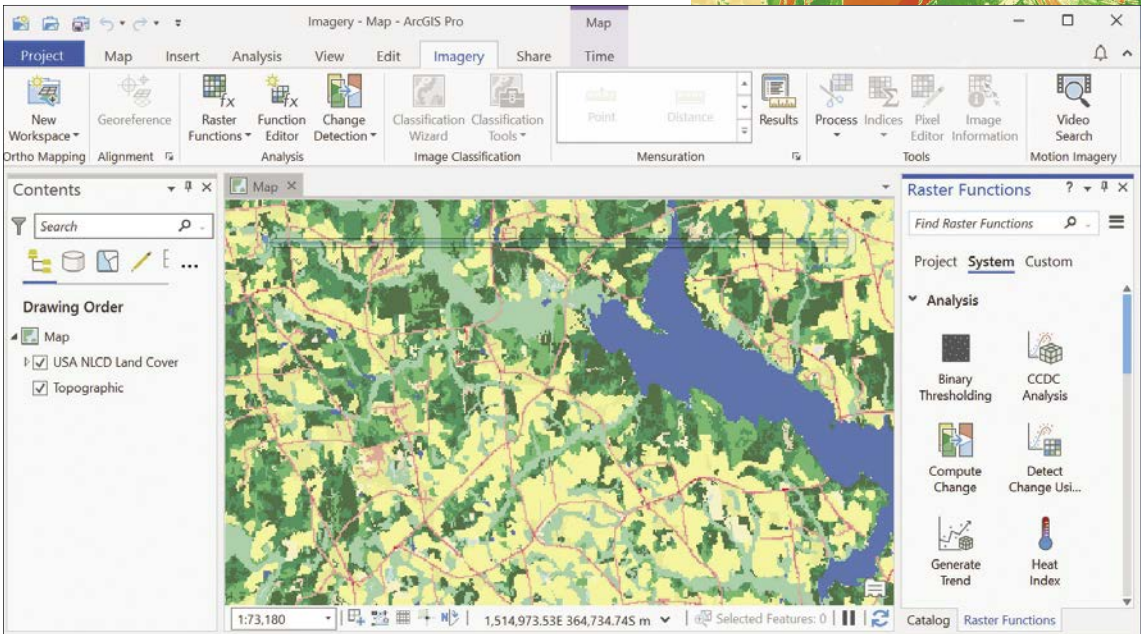
Imagery has become an increasingly valuable source for daily decision-making across various industries, including all levels of government; commercial retail and financial services; utilities; natural resource organizations; and architecture, engineering, and construction firms. As organizations of all types and sizes are challenged by disruptions like climate change; geopolitical and social unrest; and, of course, the global COVID-19 pandemic, they need quick access to reliable information. Imagery offers that, given that it is widely available and fast to procure using unmanned aerial vehicles (UAVs), satellites, and other sensors. And ArcGIS provides robust tools to swiftly ingest, process, visualize, analyze, and share imagery products that are key to maintaining situational awareness, monitoring change, and mitigating risks.

The Imagery in Action MOOC showcases cutting-edge apps and image analysis tools that can help organizations better understand and solve the complex issues they face. Participants will explore the rich repository of high-quality imagery available from ArcGIS Living Atlas of the World and work with ArcGIS Pro, ArcGIS Online, and other ArcGIS software to process, visualize, analyze, and share imagery.

All Esri MOOCs include video lectures by experts on the topic; guided, hands-on software exercises; quizzes; polls; and discussion forums. A new section opens every week that a course is in session, and attendees can study at their own pace when it's convenient for them. All the software needed to do course exercises is provided. Participants who complete the course content receive a certificate.

Imagery in Action is for anyone who wants to learn—or learn more—about the many uses and types of imagery and the rapidly growing integration of imagery with GIS. The course is especially relevant for GIS professionals, imagery analysts, geospatial intelligence analysts, researchers, and image and data scientists. Experience with GIS or ArcGIS software is helpful but not required.

View complete course details for Imagery in Action, which runs August 11–September 22, and register at go.esri.com/imagery-mooc.



↑ Course attendees will work with ArcGIS Pro to visualize, process, and analyze imagery.

← High-resolution imagery has myriad applications, including monitoring change over time.



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ArcGIS Pro Add-In Makes Outdoor Airflow Analysis More Accessible

spaces. In the past, this kind of fluid simulation required enormous computing resources. But now it can be done on general-use personal computers using GIS, meaning this technology is more accessible than ever and can help facility managers plan ventilation effectively.

Complex Methodologies for Measuring Ventilation Are Now Easier to Employ

The use of computational fluid dynamics (CFD) simulations is essential for evaluating ventilation performance in outdoor and semioutdoor spaces. Wind that passes through a stadium, for example, is turbulent and more complex than humans can imagine. CFD can predict convoluted airflows in places like that by solving the equations that govern fluid motion.

For most urban planners, CFD simulations are too complicated and time-consuming to put into practice. That's where Airflow Analyst comes in. It is the first CFD software that runs in ArcGIS Pro, and it uses terrain and building data organized in GIS to predict a variety of wind-related phenomena, including ventilation performance.

Airflow Analyst lets users apply commonly available GIS data—including 3D urban models, topography, and building information modeling (BIM) data—to wind analysis. The calculation algorithm is set up specifically for doing outdoor-airflow analysis, so users without any technical knowledge of how CFD works can put together a simulation. The software performs all the operations needed for a wind simulation exercise, from setting up the calculations to visualizing the results on a map. Thus, users who are familiar with ArcGIS technology can learn how to do a wind simulation in a short amount of time.

The turbulence model that Airflow Analyst applies is called the Large Eddy Simulation (LES), and its precision at predicting airflow has been verified by wind tunnel experiments. While LES typically requires a lot of computational time and power, Airflow Analyst uses multicore central processing units (CPUs)

or graphics processing units (GPUs) to produce results in a reasonable amount of time—several hours—on personal computers. This opens up this kind of important analysis to a whole host of new users who need to do things like plan human traffic in public spaces, visualize strong urban winds, or predict the extent of toxic gas diffusion due to potential chemical accidents.

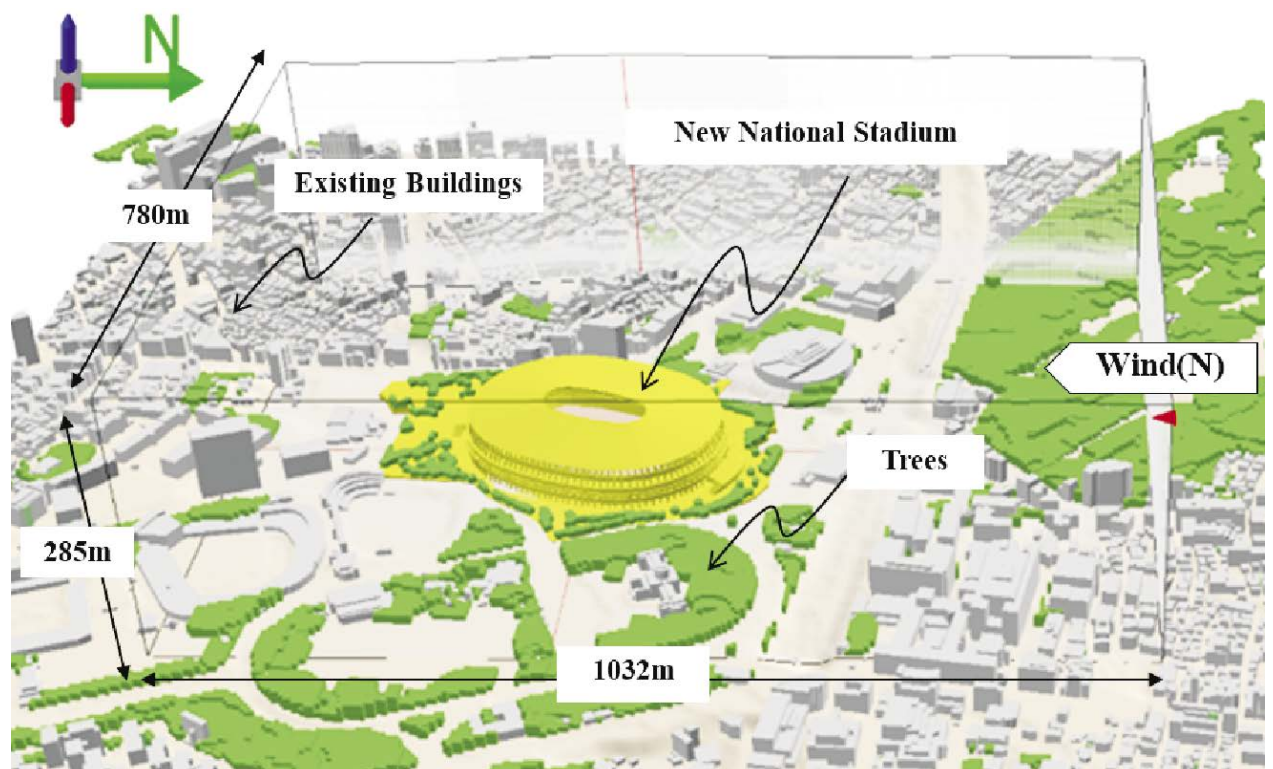
A Case Study for Measuring and Predicting Ventilation

As of press time, the 2020 Olympics in Tokyo, Japan, which were postponed to 2021, will be the first major international event to take place since the outbreak of COVID-19. The main venue, Japan's new National Stadium, has good ventilation, thanks to a gap between the stands and the roof that draws airflow into the stadium from outside. The architects who designed the stadium introduced this

feature to mitigate the summer's hot and humid thermal environment. But is it enough to prevent the spread of COVID-19?

To explore this, we used Airflow Analyst to simulate wind conditions inside the stadium so that we could see how much ventilation it would get from the natural wind that flows through Tokyo. Using AW3D—commercially available 3D map data—we reproduced the buildings and trees throughout the city. To replicate National Stadium's complex shape, we created a 3D CAD model based on drawings of the stadium and made it a multi-patch feature in ArcGIS Pro.

Next, we set a calculation area of about 1.3 square kilometers that centered on the stadium. We then set the grid spacing around the stadium to within 1 meter to reproduce the structure's shape in even more detail. The total number of computational



→ The software was used to analyze the natural airflow inside Tokyo's National Stadium, based on the wind that blows around it.

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grid points was about 11.1 million, making this a relatively large-scale wind simulation.

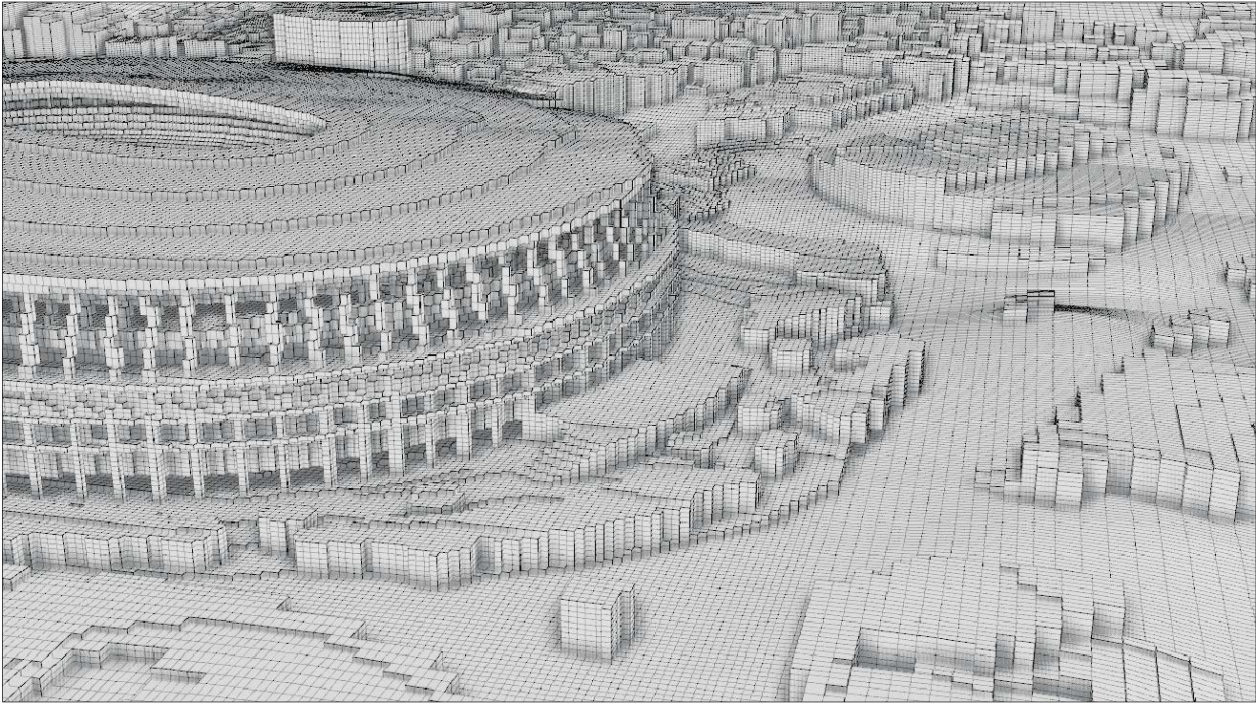
We were able to simulate and visualize the wind that flows in and out of the stadium via its eaves and holes in the ceiling. It turns out that wind takes a tangled path through the interior of the stadium. To ensure that we were capturing data on how aerosols—like those that emanate from people’s mouths—fill space, spread out, and then disappear, we placed a virtual tracer gas inside the stadium model as well to observe its concentration over time.

This simulation found that all the air inside the stadium is replaced in about 13 minutes when a northerly wind with an annual average wind speed of 3 meters per second—which is common in Tokyo—blows outside the stadium. This means that the stadium gets new air approximately 4.6 times per hour. Hence, the structure benefits from a decent amount of ventilation that occurs naturally. Of course, whether this amount of ventilation is sufficient to prevent the spread of COVID-19 needs to be evaluated based on the number of people and types of activities happening in the stadium.

This case study is based solely on a northerly wind, but wind direction and speed change constantly throughout the day. So the results for only one wind direction are not adequate for evaluating National Stadium’s full natural ventilation. To get a more complete picture of its ventilation capabilities and even estimate natural ventilation conditions in real time, it would be useful to combine the results of simulations done for 16 wind directions with real-time wind observation data or weather forecast data. This information would help facility managers come up with a comprehensive plan for ensuring proper ventilation in National Stadium during the Olympics and for any other events that take place there.

New Ways to Create Safety and Comfort in Urban Spaces

In cities around the world, detailed 3D digital maps are yielding digital twins of urban areas that can help immensely with city and event planning—especially as communities begin to emerge from the COVID-19 pandemic and enter a new normal. What’s more, integrating geospatial infrastructure with Internet



↑ The number of grid points in the analysis, shown here around the stadium, totaled about 11.1 million, making this a relatively large-scale simulation.

of Things (IoT) sensors, which measure everything from temperature to wind speed, can foster deeper understanding and better management of built environments.

By combining urban data with wind simulation technology specifically, urban planners can help create safety and comfort in densely populated areas in multiple ways including the following:

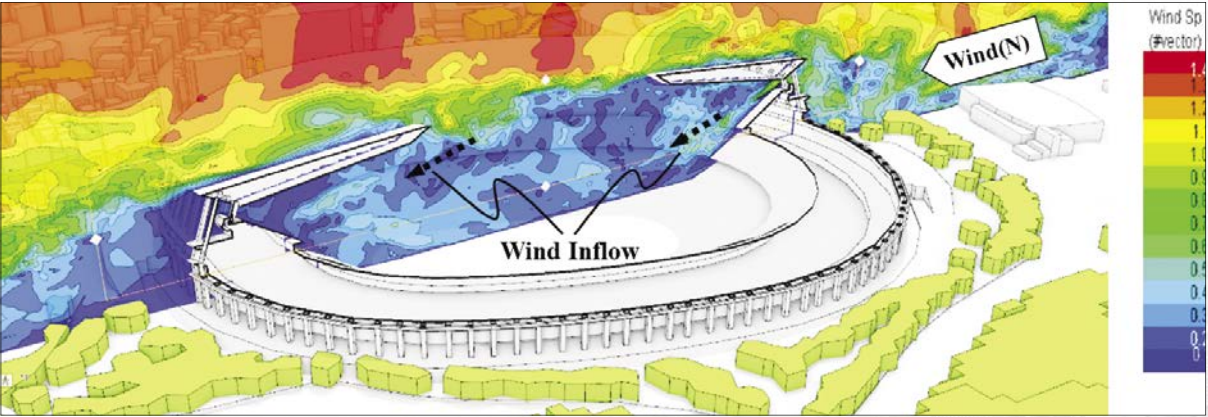
- Bringing fresh air into a city to reduce heat islands
- Making the pedestrian experience easier by analyzing how strong winds whip around high-rise buildings
- Evaluating the wind loads that structures can handle during heavy storms
- Introducing efficient natural ventilation in and around buildings

In this digital transformation that is moving through the world, being able to decipher the wind environment in various areas will provide valuable solutions for urban planning.

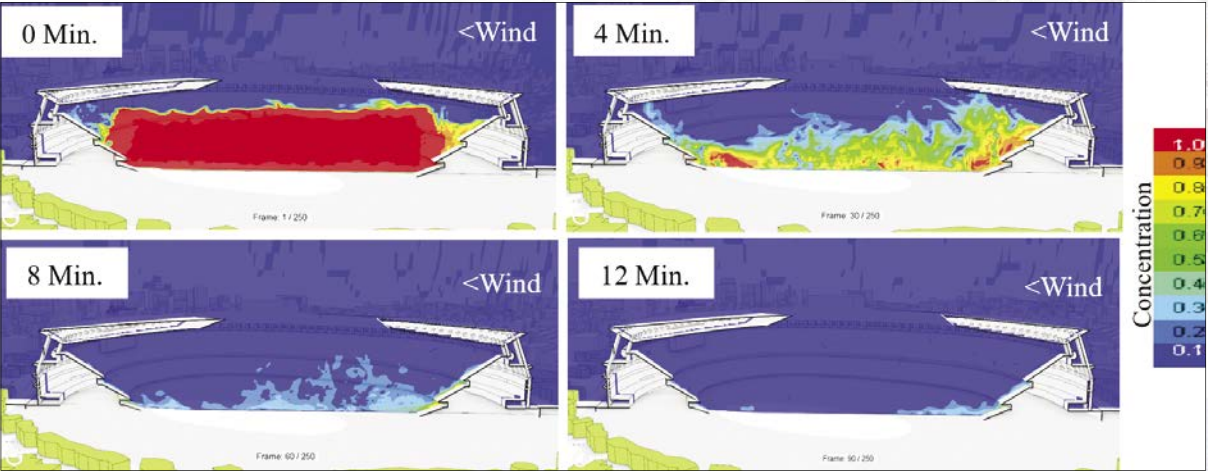
A trial version of Airflow Analyst is available in the ArcGIS Marketplace. Go to ow.ly/9bAN50ELwxS to try it out.

About the Authors

Ryo Araya is the president of Esri partner Environmental GIS Laboratory Co., a software development and consulting company based in Fukuoka City, Japan. Takanori Uchida is an associate professor at the Research Institute for Applied Mechanics at Japan’s Kyushu University.



↑ Wind takes a convoluted path through the interior of the stadium. (Note: The roof of the stadium in this rendition is not visible.)



↑ The simulation found that when a northerly wind with an annual average wind speed of 3 meters per second blows outside the stadium, the air in the stadium gets replaced every 13 minutes.



Esri Establishes Closer Ties with the Developer Community

Technology Showcased at the Esri Developer Summit Aims to Inspire Software Developers

GIS technology is quickly advancing in new directions, benefiting developers in many ways that will impact their work. That was evident from the news that came out of the 2021 Esri Developer Summit (DevSummit), held virtually in April.

For example, Esri announced the release of ArcGIS Enterprise on Kubernetes, which gives organizations a new way to deliver GIS using microservices. Esri also released ArcGIS Platform, a platform as a service (PaaS) product that provides software developers with mapping and location capabilities to integrate into their apps. Geospatial artificial intelligence (GeoAI) capabilities are becoming highly sophisticated, and new 3D GIS capabilities in ArcGIS API for JavaScript give developers the ability to provide more contextual awareness for locations and even create and visualize 3D scenes on Mars. Additionally, Esri has opened up the Calcite Design System to developers, allowing them to give their apps a consistent look and feel.

More than 5,500 developers from over 60 countries gathered for the three-day virtual event. Attendees received updates on Esri software and developer technologies during a series of plenary and technical sessions. The virtual Ask Our Experts Showcase also gave app developers the opportunity to get their technical questions answered by Esri staff.

While Esri wants to bring DevSummit back to its usual venue of Palm Springs, California, in 2022, the mission remains the same, whether people meet in person or online.

"This event is by developers, for developers," Jim McKinney, chief technology officer for desktop development at Esri, said in welcoming attendees. "DevSummit is the largest gathering of geospatial developers on the planet, and you are a significant part of that. We are not only hoping to educate you but inspire you."

Esri president Jack Dangermond joined McKinney for a few minutes to talk to the audience about the strong connection between Esri and the developer community, especially as Esri continues to redesign the developer experience. The aim is to bring the power of mapping and location intelligence to all developers by making capabilities more accessible.

"The developer community...has been foundational to our success, and I appreciate very much the work that you do—this year particularly," Dangermond said.

In 2021 and beyond, Esri plans to build on that foundation and establish closer ties with app developers.

"This is the year of opening up GIS to developers in a more amplified way," Dangermond announced.

He said he sees the important work that developers are doing in areas such as public health, climate change, racial equity, and biodiversity. He noted one prominent example: the work done by a team at Johns Hopkins University using ArcGIS technology to create a dashboard that mapped COVID-19 cases and deaths globally.

"That whole gamut [of work] is so important, whether it's putting a map in an app or whether it's building rich, science-modeling tools that are looking at the future of our world and how to make it a better place," Dangermond said. "Especially [important are] you, the GIS developers who bring the maps and the language of our world to life in various ways."

Esri Introduces ArcGIS Enterprise on Kubernetes

A major announcement made at the DevSummit this year was the release of ArcGIS Enterprise on Kubernetes.

Increasingly, apps are being built using containers or microservices to increase efficiency, scalability, and stability. Kubernetes is open-source software (originally designed by Google but now maintained by the Cloud Native Computing Foundation) that deploys, manages, and scales these types of containers or microservices.

"ArcGIS Enterprise on Kubernetes delivers GIS technology using cloud-native architecture," Sud Menon, director of software product development at Esri, told the developer community during his DevSummit Plenary Session presentation.

In brief, ArcGIS Enterprise on Kubernetes is a new deployment option based on a microservices architecture for scalability and resilience, containers for delivering software, and Kubernetes for orchestrating the containers.

"Each independent capability, such as hosted feature services or spatial analysis services, is delivered as its own, independently scalable microservice," said Menon.

The main benefits of ArcGIS Enterprise on Kubernetes, he pointed out, are streamlined installation, dynamic scaling, easy upgrades that minimize downtime, higher resilience, and easy IT integration.

Initially, ArcGIS Enterprise for Kubernetes is available for Red Hat OpenShift (an on-premises deployment option),

Microsoft Azure Kubernetes Service (AKS), and Amazon Elastic Kubernetes Service (Amazon EKS). Menon said that later in 2021, ArcGIS Enterprise on Kubernetes will be available for the Google Cloud Platform Google Kubernetes Engine (GKE).

ArcGIS Platform: A PaaS for Developers

While current ArcGIS software users can already access location content, services, and capabilities using ArcGIS Enterprise, ArcGIS Pro, and ArcGIS Online, Esri released ArcGIS Platform to reach the wider software developer community.

A PaaS offering, ArcGIS Platform is for software developers who want to integrate location capabilities into their apps, products, and business systems.

"It's designed to bring powerful mapping and location capabilities as a set of independent services to you in the form that you are expecting," said David Cardella, product manager for ArcGIS Platform. "These services have been powering ArcGIS for many years, but now we've opened them up in ways we haven't before, and we are making them available to the global developer community."



↑ With ArcGIS Platform, developers can integrate location capabilities into their apps, products, and business systems.

ArcGIS Platform offers three main elements:

- An excellent developer experience with mapping APIs, open-source mapping libraries, and developer resources
- Location services that deliver extensive geographic content and capabilities
- A consumption-based business model that is simple, transparent, and easy to understand

Developers get access to the mapping library of their choice. ArcGIS Platform comes with ArcGIS API for JavaScript for creating web apps; a set of APIs for developing mobile and desktop apps; scripting APIs for automating mapping and analysis; and support for popular open-source mapping libraries, including Leaflet, OpenLayers, and Mapbox GL JS.

"With the work we've done to enhance our back-end services, you will be able to use these libraries to access our location services in just a couple of lines of code," Cardella said. "The choice of mapping libraries is yours. But regardless of the one you choose, you will be able to use location services from ArcGIS Platform."

Cardella said that the location services available in ArcGIS Platform—basemaps, data hosting, data visualization, routing and directions, spatial analytics, geocoding and search, image analysis, and more—are now easier to access and integrate into solutions.



↑ Jack Dangermond (left) joined Jim McKinney (right) to talk about the strong connection between Esri and the developer community.

→ Sud Menon explained ArcGIS Enterprise on Kubernetes, a new deployment option based on a microservices architecture.





Julie Powell demonstrated Esri's new Calcite Design System, which developers can use in their web apps.

The business model is transparent and easy to understand, he added, stating that developers will only pay for the services they use, regardless of the API or authentication method they use.

Esri offers a free account to developers to help them get started using ArcGIS Platform.

"You will receive a generous free tier to kick-start your development that includes two million map tiles and thousands of other service transactions, [such as] searching, routing, or geocoding," Cardella said.

Building Apps Using Services from ArcGIS Platform

Euan Cameron, chief technology officer of developer technology at Esri, said developers have many options to choose from when they use services from ArcGIS Platform to build apps. These options include low- or no-code services, APIs to create web apps, native and embedded apps, and apps built using game engines.

"We even have a design system to help you build beautiful-looking apps," Cameron said.

This design system has Cascading Style Sheet (CSS) and JavaScript frameworks that include a set of web components that can be integrated into apps, an interactive help system with great examples and documentation, and design guidelines and graphic resources.

Julie Powell, principal product manager of web development technologies at Esri, said that the new design system from Esri creates a consistent look and experience among a suite of apps with its user interface (UI) components, colors, icons, and design patterns. And Esri is now sharing its design system with developers.

"It's called Calcite, and now we are making it available to all of you so you can use it in your web apps," Powell said. "All you have to do is go to the [ArcGIS] Developers website, create an account, and you can start using it."

The new Map Viewer in ArcGIS Online and ArcGIS Enterprise uses the Calcite Design System for the user experience.

In her presentation, Powell showed the audience the library of UI components in the design system, such as accordion, button, card, label, data picker, and alerts.

"Because they are web components, you can use them with any JavaScript framework," she said. "They are also flexible, so you can configure them for your particular use case. The part that I like the best is [that] because they are responsive, they are designed to work on any form factor, so you have confidence when you build your application that it will adapt well to any screen size."

The design system also comes with colors and themes. While the UI components default to the ArcGIS color palette, users can configure a color scheme that matches their organization's branding. It's also easy to switch from a light to a dark theme or vice versa by changing a single property. All the components then adjust accordingly to the theme.

"There are also 1,400 icons you can choose from," said Powell. "This helps tell more of a visual story and simplify the text in your apps."

Powell explained that the Calcite Design System can help developers create consistency in all their web apps.

"You can seamlessly integrate with the ArcGIS ecosystem and, at the same time, highlight your brand and style," she said.

New Map Viewer Debuts

Developers got to see the Calcite Design System components in action during a demonstration of the new Map Viewer, which came out of beta in April.

Jeremy Bartley, group manager of the ArcGIS API for JavaScript team, demonstrated the viewer, which is available in ArcGIS Online and ArcGIS Enterprise.

"Map Viewer is a good example of an application that's completely built [using] the underlying technology within Esri, from ArcGIS API for JavaScript to the Calcite components to hosted feature services," he said.

Bartley showed attendees around several of the new and improved analysis, thematic mapping, and sketching tools that are included with Map Viewer. It also comes with an improved and intuitive UI for creating web maps. In addition, there are better pop-up configurations and labeling options, scale-driven styling, more printing layouts, reverse geocoding, new smart mapping styles, and new color ramps—including ones that are color-blind accessible—to better express data.

3D GIS Is Out of This World

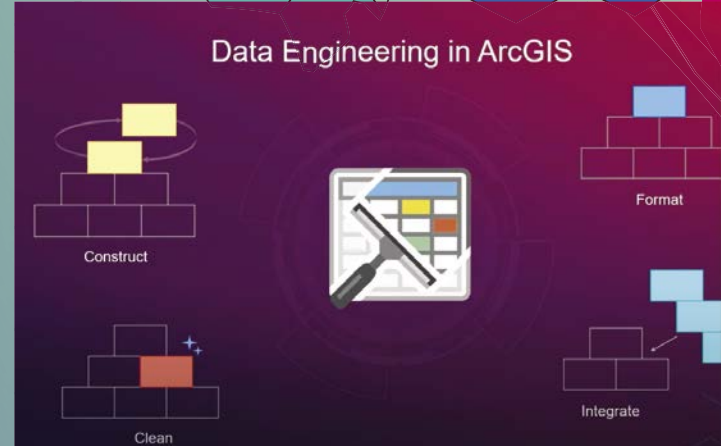
New 3D capabilities in ArcGIS API for JavaScript make many things possible, including creating 3D scenes of Mars.

Arno Fiva, an Esri 3D developer evangelist for ArcGIS API for JavaScript, showed the DevSummit audience an app built by Esri developers that supports two extraterrestrial coordinate systems. Other developers can use ArcGIS API for JavaScript in a similar way to create 3D scenes of the Martian landscape.

The Explore Mars app, available at explore-mars.esri.com, provides users with detailed elevation and imagery data for the whole planet. Fiva demonstrated how to use the app to zoom in to any location on Mars, including craters, valleys, and sites where various rovers have landed. The app comes with line, area, and elevation measurement tools and tools to compare areas on Mars with 3D models of Earth-based regions, including cities such as Zurich, Switzerland, and natural features like the Grand Canyon. For example, to see how much area Sudan would take up on Mars, users can click on the country on a globe and select Place it on Mars.



Map Viewer has new and improved tools for doing analysis, thematic mapping, and sketching.



New tools in ArcGIS Pro 2.8 make data engineering—the process of getting data ready for analysis by adding new fields or filling missing values—easier.

The New Data Engineering Experience

New tools in the May 2021 release of ArcGIS Pro 2.8 make data engineering—a highly time-consuming aspect of the spatial analysis process—much easier, according to Lauren Bennett, who leads the spatial analysis and data science software development team at Esri.

Data engineering—getting data ready for analysis by adding new fields or filling missing values—is crucial, she said.

"Our analysis is only ever as good as the data that we put into it," Bennett pointed out.

The release of ArcGIS Pro 2.8 introduced a data engineering experience that makes it easier to explore and visualize data. Tools that are in the ArcGIS system are brought together to construct, clean, format, and integrate data to prepare it for analysis, Bennett said. Esri solution engineer Lakeisha Coleman demonstrated this new capability using data from the Supplemental Nutrition Assistance Program (SNAP) and demographic and unemployment data.

As McKinney said during the Plenary Session, the hope is to educate and inspire.

"You have a great set of tools and developer technologies for yourself, your customers, or your enterprise," he said.

He then encouraged developers to stay connected through the Esri Community at community.esri.com.

"We look forward to hearing from you!" he added.

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NEW DASHBOARD TECHNOLOGY NOW WIDELY AVAILABLE

Dashboards—with their interactive visual elements, including maps, charts, and gauges—fundamentally change the way we explore information. They make data consumption easy and convenient.

The last year and a half has seen an exponential increase in the number of dashboards being created and shared. An array of industries is putting dashboards to good use, from emergency organizations coordinating disaster responses to public safety agencies monitoring events.

When the COVID-19 pandemic hit in early 2020 and organizations, including local governments, universities, and national and international health agencies, were clamoring for dashboards, Esri introduced a version of ArcGIS Dashboards that was built on ArcGIS API 4.x for JavaScript. The underlying technology in Dashboards needed an upgrade to provide better performance for dashboards that had gone viral, enhanced features to fit growing use cases, and refreshed designs that could meet various new user requirements.

After extensive testing and feedback from beta users, the product is now out of beta and available for general use. This updated version of ArcGIS Dashboards, which has a number of new capabilities and enhancements for dashboard authors, is now the default experience for all organizational users when they access dashboards.

Better Performance and Improved Usability

The new Dashboards is robust, built on powerful technology that can support several workflows, including those for mission-critical projects. Maps can now load more features, and those features load faster. Additionally, Dashboards can incorporate maps that make use of many valuable capabilities in the new Map Viewer, such as dot density mapping, layer blending, and group layers. These features ensure that dashboards perform as expected and that maps are tailored to convey the most relevant information to particular audiences.

The new version of Dashboards also brings improved usability. Users can employ a wider range of data sources within a dashboard and its elements, including feature collections and CSV web layers. In addition, Dashboards now has summary statistics for percentiles within the Indicator, Gauge, and Serial Chart elements. This is crucial for supporting the specific metrics that disaster response and emergency management agencies require.

Other enhancements to Dashboards include the ability to use ArcGIS Arcade for advanced formatting. Dashboard authors can compose Arcade expressions to apply conditional formatting to both the List and Indicator elements in their dashboards. This new level of

customization alters how data points are rendered to fit a theme, workflow, or goal.

Additional Customization Options

Two additional capabilities—selection-based display and data expressions—enable dashboard authors to further customize how they present data to their audiences.

For dashboards that include a lot of data, it's sometimes difficult to ensure that users are getting the information they need. In these cases, dashboards need more context.

Over the years, dashboard authors have found creative ways of guiding users' interactions with their dashboards. To help authors fine-tune what their users see, the new ArcGIS Dashboards includes the ability to configure element displays so that they're based on a user's selections. This selection-based display allows authors to set conditions or dependencies for when and how data is presented on a dashboard. Having dashboard elements display data only when necessary makes dashboards easier to read and allows authors to create products that have a specific focus and only show relevant data.

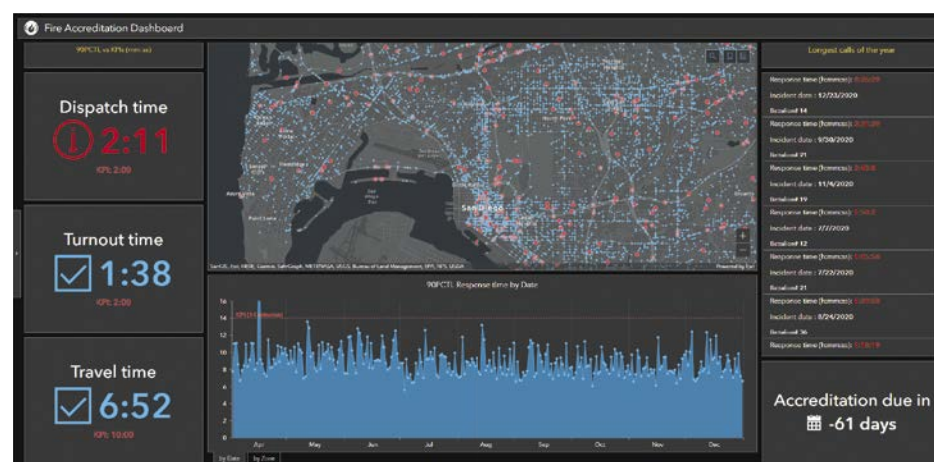
The new ArcGIS Dashboards also introduces data expressions—a way to structure data so it presents insightful visualizations to a targeted audience. With this capability, dashboard authors can leverage the data they have access to and return a feature set that powers one (or more) data-driven element and makes it interactive. For example, an organization collecting raw data on water quality across its state might want to show summary statistics to its audience, but what is being collected is many individual observations. A single data expression can bring these individual observations together, calculate a variety of statistics, and present insight about the data as a whole.

Data expressions are useful for a variety of purposes, such as when data needs restructuring, when a specific summary statistic is missing, or to calculate metrics from values across columns within one source or from multiple sources. Typically, it can be challenging for users to make such small data refinements, especially when they don't own the dataset. But using data expressions makes this easier, enabling dashboard authors to structure data in a way that can help communicate a story more effectively.

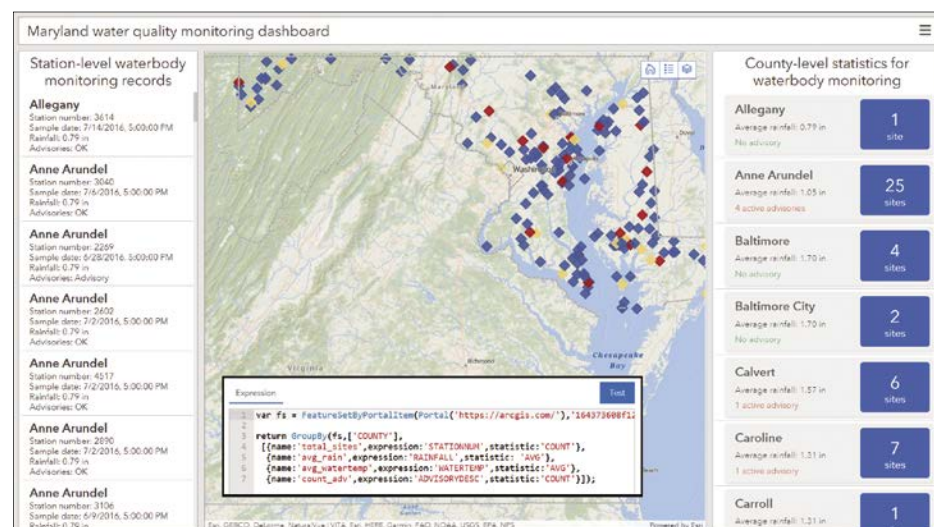
Try the New ArcGIS Dashboards

The new enhancements built into ArcGIS Dashboards make it easier to effectively convey information in an intuitive and interactive manner. Experienced dashboard authors will recognize a user interface similar to the one they were using before, and new users can get up and running quickly, thanks to the app's straightforward user experience.

There are numerous resources available to help anyone get started using ArcGIS Dashboards. Visit go.esri.com/arcgisdashboards for more information.



↑ This dashboard uses percentile statistics to compare 90th percentile response times to a standard key performance indicator. It also makes use of ArcGIS Arcade in the List and Indicator elements.



↑ While the list on the left side of this dashboard makes it difficult to see statistics at the county level, the list on the right—made using data expressions, Arcade, and some HTML edits—aggregates statistics across sites within a county.

Esri Provides Open Access to Key Federal Geospatial Data

state and local governments around the world has skyrocketed, with more than 11,000 powered by ArcGIS alone.

Recent legislation in the United States, including the GDA and the Open, Public, Electronic, and Necessary (OPEN) Government Data Act, is pushing this movement forward at the national level. It calls on all agencies that serve National Geospatial Data Assets (NGDA)—the priority national data layers—to expand standards-based open access. The overriding intent is to foster greater public and private sector use of federal data to encourage innovation and data-driven decision-making.

US federal agencies have excelled at creating and managing critical geospatial data to meet their own needs. Disseminating the data widely and making it available as accessible, usable services are more recent endeavors. Successful examples of open data providers at the national level do exist, though. For example, the Department of Homeland Security's Homeland Infrastructure Foundation-Level Data (HIFLD) program works with multiple federal agencies to curate and serve out geospatial data services. Demand for these web services is growing, with usage up 75 percent from 2019 to 2020. So the desire for open federal data is there.

But this is just the tip of the iceberg. Vast amounts of federal data exist, although many data owners have yet to modernize their data management and dissemination infrastructure. Increased collaboration among Esri and federal agencies will accelerate the pace at which more data is openly served.

Expanding access to federal data by making it public in ArcGIS Living Atlas empowers a wider audience to address challenges such as climate change, disaster relief, broadband access, and racial equity. Furthermore, offering that data as services makes it readily usable by not only GIS professionals but also web-savvy developers, scientific audiences, and even citizen scientists and app developers.

This is the only way to satisfy the data demands of today and tomorrow and increase the value of the investments made in geospatial data.

New Levels of Inclusiveness and Interoperability

To help address current data access and use challenges, Esri is working collaboratively with federal agencies to amplify their good work by increasing the visibility of their data and delivering it in app-ready formats.

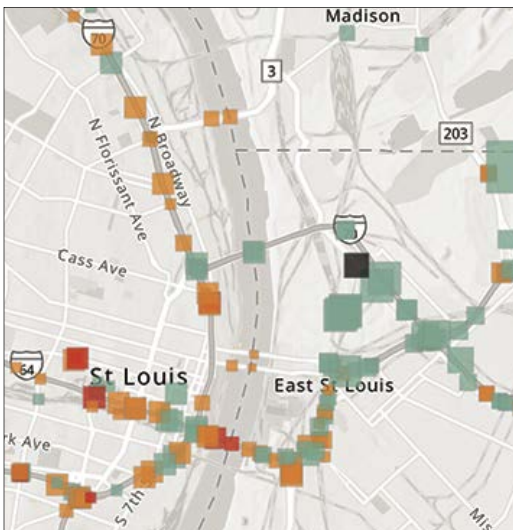
A new collection of federal maps and apps is now available in a curated, Esri-managed group in ArcGIS Online called the US Federal Maps and Apps organization. To government users, this collection of data is known as A-16. To everyone else, this is a fantastic collection of nearly 100 national geospatial datasets on things like dams, bridges, federal public lands, runways, and rail nodes. The collection serves the Esri and broader geospatial user communities as well as the open-source and web developer communities.

To enable enhanced open access to this collection, Esri is changing both the terms of use and the technical parameters of the data. The collection is now available under the Creative Commons Attribution 4.0 International (CC BY 4.0) license, meaning anyone can use, share, and adapt the data with proper attribution. This considerable policy update removes a historic barrier to access.

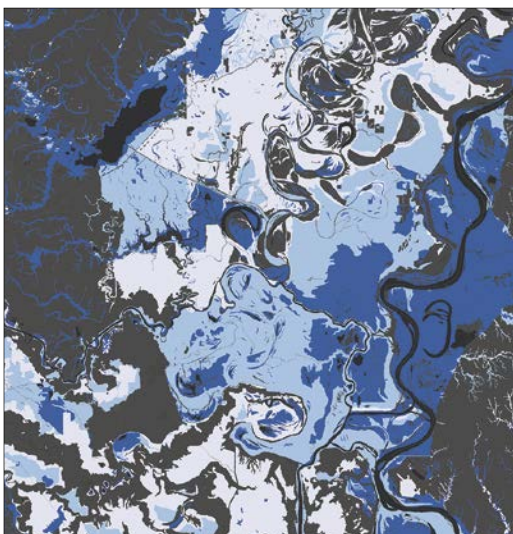
On the technical side, Esri is making cached and direct connections to public services within the federal government. The layers can be exported to multiple open formats, such as shapefile, CSV, KML, and GeoJSON, to perform further analysis. They are also accessible as OGC-compliant standards, like Web Map Tile Service (WMTS) and Web Feature Service (WFS), as well as Esri formats to support interactive exploration, visualization, and analysis. The geospatial layers are updated regularly and reference the federal agencies' metadata.

These advancements in open access to federal data demonstrate a new level of inclusiveness and interoperability across the geospatial community. Nadine Alameh, the OGC's chief executive officer, welcomed this development.

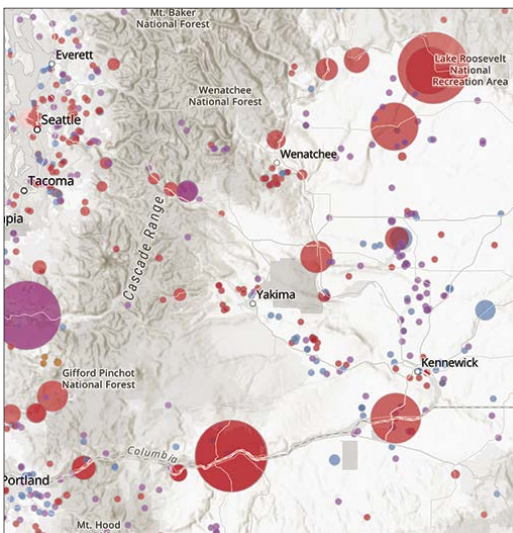
"I'm happy to see a practical, operational example of how open standards and services can advance the GDA objectives," she said. "Thank you, Esri, for making this government data available not only



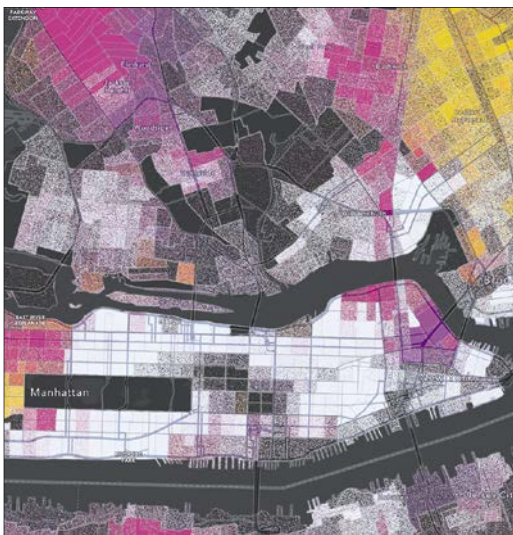
↑ A-16 geospatial data layers cover topics such as bridge conditions, shown here for St. Louis, Missouri.



↑ The Soil Survey Geographic Database (SSURGO) is available through ArcGIS Living Atlas of the World and can be used to see the effects of long-term flooding.



↑ The National Inventory of Dams (NID) database is another high-priority national dataset, used here to map dams in parts of Washington and Oregon.



to its vast geospatial community but also anyone through open OGC services, enabling further interoperability and innovation."

Benefits That Cut Across Governments and Sectors

This collaborative effort implements a "create once, use many times" philosophy.

Because the federal government produces and manages key data, the pressure is reduced on other organizations to engage in these time-consuming and cost-intensive tasks. Once that data is created and shared, it is thus advantageous for users to have many pathways for finding it. While federal agencies can publish their data on their own websites, put it on thematic or regional portals, and post it to the Federal Geographic Data Committee's (FGDC) GeoPlatform, making the data available through Esri technology just amplifies its exposure and increases the likelihood that it will be discovered and used.

According to Ivan B. DeLoatch, executive director of the FGDC, developing public-private partnerships is critical to advancing the United States' National Spatial Data Infrastructure.

"The exploration of a public partnership [between] Esri and the FGDC community will be an exciting opportunity to support the ongoing development of our National Geospatial Data Assets, or A-16 datasets," DeLoatch said. "This will encourage the use of open data and standards, as well as data sharing initiatives with stakeholders, to address national challenges and priorities."

For example, the data needs of state and local governments do not stop at their borders. They often rely on federal data to add broader perspectives to local projects and initiatives. The National States Geographic Information Council (NSGIC) has long advocated for the federal government and organizations across the country to provide openly accessible and interoperable geospatial services. And Frank Winters, current president of the NSGIC and executive director of the New York State Geospatial Advisory Council, commended this effort for advancing that vision.

"We need to maximize the reach of geospatial data, and that means we should think of everyone as a decision-maker," said Winters. "When our data reaches thousands or millions of people—to help them decide where to live, buy property, go to school, or start a business—our impact can scale to a point where it moves the dial of our economy. Removing barriers to high-quality spatial data, time and again, results in people using data in ways I could never predict, making interesting and meaningful contributions to their communities."

In the commercial sector, for instance, large companies with assets and interests spread throughout the United States need data that cuts across cities, states, and regions. Having high-quality national datasets on a variety of topics that are easy to access and available as services benefits countless businesses, from national retailers and insurance companies to railroads and utilities. It saves them the time and money required to gather and process the data themselves and enables them to carry out important operations more quickly and cost effectively, such as conducting risk assessments, doing environmental screenings to evaluate the feasibility of getting a project permitted, and analyzing growth opportunities.

Continuing to Elevate Federal Data

Geospatial data is critical to understanding and meeting the challenges that continually crop up all over the world. Esri is committed to collaborating with federal government organizations and agencies to make their spatial data easy to access and use so that it can better serve the geospatial community; developers; scientists; and, ultimately, people.

It is Esri's goal to build on the great content that federal agencies already collect and bring it to life through well-documented, open, and interoperable services and downloads. This cooperative effort will elevate the value of that data through increased usage, fuel the development of problem-solving apps across all sectors, and spur new innovations.

← Expanding access to federal data empowers more people to address challenges like racial equity—for example, by building dot density maps that highlight different racial and ethnicity groups.

Grow Your Open Data Ecosystem

By Andrew Turner, Esri



↑ Andrew Turner

As the world has become digitized, sheafs of paper and file drawers have transformed into ephemeral, infinite, and globally accessible databases. The data recorded in information systems—whether generated to comply with regulatory requirements or for specific tasks—has a nominal life cycle of birth; growth; and, finally, obsolescence. While the data never truly dies, it often atrophies in old, unmaintained systems. It is archived and stored for potential reuse later—if anyone remembers where the data is or how the old systems work.

When data is instead accessible, reusable, and open for continuous improvement, it is often of higher quality and has a greater impact on communities. We've seen this happen with software over the decades: at first, it was stored on fragile punch cards, and now it is being freely and rapidly shared for reuse and collaboration. This has resulted in undeniably more rapid, complex, and high-quality software innovation.

As Eric Raymond stated in *The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*, “given enough eyeballs, all bugs are shallow.” In other words, software code that can be read, used, and fixed by other software engineers will result in better software with fewer problems. And beyond fixing issues with software, making source code available for public access enables it to continually grow and be improved on—which is the

case for many key projects that now underpin computer systems around the world.

Open data is experiencing a transformation similar to that of software. Databases that were locked in silos of singular use are now made available and accessible to anyone. This means that people from other departments, municipalities, businesses, and community groups can immediately reuse the data in their own work, providing better context for evaluating complex relationships, making important decisions, and measuring program outcomes. It also means that journalists can use it when researching and reporting on specific issues or trends. And all consumers of the data can provide feedback on data quality issues, possible corrections that need to be made, and other potential improvements to the data.

The Benefits of Open Data

Organizations often face scrutiny of their policies to ensure that they are equitable, effective, efficient, and evolving. When organizations and programs openly share the data that fuels their decision-making—including data from other organizations that relates to the topic and geography of their work—it encourages independent evaluation. This, in turn, can dramatically improve organizational transparency and, thus, trust.

What's more, solving complex problems, such as disaster response or the need for affordable housing, depends on developing and maintaining partnerships. These types of relationships are strengthened when information is shared freely across groups. Data that is already

available and connected can produce opportunities for better collaboration and action.

All this requires an increased and ongoing investment in data maintenance and improvement—which can be done with already existing infrastructure, generating a multitude of benefits. For one, sharing data can reduce an organization's operating costs by making staff members more efficient at finding data for their work and encouraging interdepartmental collaboration earlier in a project. It can also improve the development and growth of markets by making it easier to compare business metrics with contextual trends and enhancing data-driven decision-making. By contrast, limiting data sharing due to cost-recovery policies, in which potential data users pay for access to public information, is demonstrably regressive.

Sharing data prioritizes the development of best practices that make it possible for other people to understand and appropriately use that data. To ensure that users always have the most up-to-date and accurate data available, for example, it's expedient to make data accessible through web hyperlinks so that it can easily be integrated into apps, websites, and software tools. It's also advisable to make sure that data can be downloaded in open-file formats that work in common tools like spreadsheets, dashboards, and developer APIs. Then, users can be automatically notified when the data gets updated so that they can quickly download new versions.

In addition, the metadata should be complete and readable, which improves discovery in search engines such as Google, the most

common way people look for and find information. Providing a data dictionary about attributes—such as the data's origin, usage, and relationships to other data—ensures that users know what the data means and how to best use it in analyses. Also, including contact information with data makes it possible for people to ask questions about the data and provide useful feedback that can, ultimately, improve it.

Getting Started with Open Data

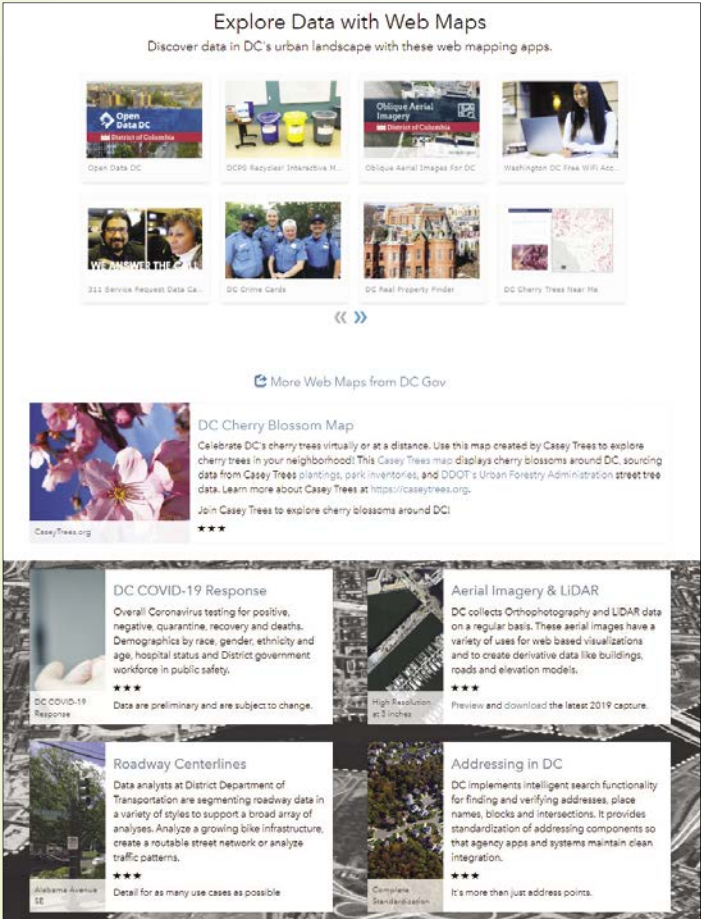
Achieving the ideals of data sharing can seem daunting. Many organizations face policy restrictions on data sharing or are unsure about how to start sharing data. Fortunately, over the past few decades, many successful pioneers have developed useful strategies for iteratively growing their own healthy open data programs.

For instance, the City of Washington, DC, has a spectrum of data—from open data to private and license-restricted data—and needed a comprehensive policy to cover a wide range of data sharing options. The city published a draft data policy that was available for anyone to read and comment on. Over several weeks, hundreds of respondents posted specific comments, recommendations, and requests to change various aspects of the policy. Based on that, the city created a structured taxonomy that goes from Level 0 data, which is completely open and can be reused by anyone, to Level 4 data, which is restricted and confidential. This simple structure provides city departments with clear guidance on open data and empowers them to make explicit and appropriate decisions about what data to share.

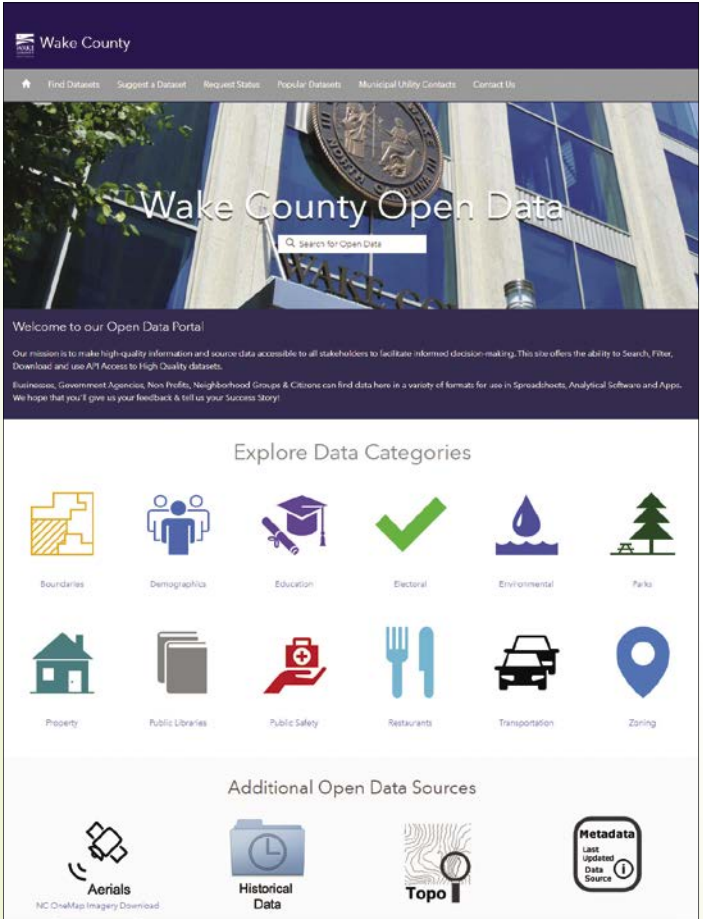
Many organizations are concerned about where to begin with open data. Wake County, North Carolina, started small by releasing a few datasets each month. This phased approach allowed employees at the county to focus their limited time on improving data quality and strengthening their data sharing processes. Each data release they put out had a focused story that highlighted the purpose of the data and opportunities for reusing it. This included integrating open data into popular consumer apps like Yelp and Waze. Sometimes the best place for open data is inside the apps people are already using.

Regional organizations that connect different government administrations are another healthy driver of open data. While data infrastructure and services are usually managed within specific administrative boundaries, the data necessarily intersects and requires coordinated action with nearby municipalities. Regional data sharing programs, like NC OneMap in North Carolina, define common data standards and priorities that support statewide local data sharing.

Open data has become a common and popular movement that continues to grow. National governments are leading the way with modern policies and programs that encourage local municipalities to share their data. Additionally, the commercial industry is sharing data that is accelerating health, energy, and transportation



↑ The City of Washington, DC, empowers city departments to make appropriate decisions regarding open data by providing clear guidance on what data they can share and what data should remain restricted.



↑ Wake County, North Carolina, started its open data program by releasing a few datasets at a time and highlighting various ways to reuse them, such as integrating the data into popular consumer apps.

New Ways to Explore ArcGIS Hub Content

innovation, and nonprofit organizations are sharing data that validates their important work and builds trust among their partners and donors. Together, all these organizations in various places around the world are developing a healthy ecosystem of data that overlaps and interconnects. But there are still significant gaps in available data. So regressive or restrictive policies need to evolve to provide open, free, and well-maintained data for all—a surefire way to better support local businesses and constituents.

It doesn't take much to share more data. Start small with focused open data releases that support specific priorities and issues. Find a champion in your organization who can provide leadership in this endeavor and demonstrate the effective outcomes of an open data program. Build partnerships with others, both within and outside your organization—including data providers, analysts, and users—to grow the reach and success of your program. And join the thriving open data ecosystem.

About the Author

Andrew Turner is the director and chief technology officer of Esri's Research and Development Center in Washington, DC, where he leads the development of ArcGIS Hub and supports Esri's strategies for open standards and open-source data. Turner joined Esri in 2012 from GeolQ and has been developing open data sharing systems for more than 20 years.

Smart cities recognize how important it is to provide local communities with the information they need to stay informed and take part in decision-making.

Since 2016, ArcGIS Hub has enabled organizations across government, business, and academia to create customized websites for sharing content related to local projects and initiatives. Hub sites have keyword searches and galleries that make it easy for users to discover data, maps, documents, and surveys. Additionally, each site includes a content library for building the website's search catalog, a group for collaborating with peers, and a dashboard for tracking community interest.

A key aspect of ArcGIS Hub is helping users share content that's clear, operational, and accessible to their audiences. Over the years, the ArcGIS Hub team has worked with users through the ArcGIS Hub User Lab to learn how they produce and employ digital content to communicate and engage with their communities. This research shows that organizations want to remove barriers to engagement

by creating thoughtful, easy-to-use tools for finding and working with their data.

That's why ArcGIS Hub recently launched a new approach to how it handles the content that users share through the software as a service. Now, it's easier for people to explore data within the context of hub sites.

When visitors go to a hub site, they can more easily preview data and other content prior to downloading or using a resource. Spatial data, including raster images and shapefiles, are featured on full-screen maps to encourage visitors to start exploring it straight away. The map's view can be switched to a full-screen view of its tabular data, and users can filter data in both views. Nonspatial tabular data and documents also now automatically open in full screen.

To symbolize attribute data in maps, users can employ new filter and styling options. Once the filters and styles are in place, the URL for the content preview page updates to reflect that, enabling users to share the patterns they've identified.

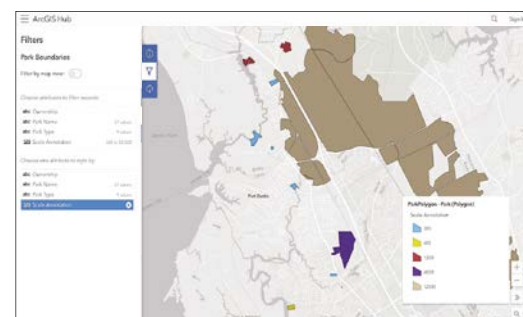
A collapsible side panel gives users the ability to access additional information about a piece of content via its full details page. The side panel also contains options to filter and download content. When downloading something, users can now select the format of their choice and track the status of their download. In addition, developers can access a dataset's API using the API explorer, available either on the side panel or in the item's full details page.

Any content that doesn't render in full screen opens as a full details page that features actions that users can take with that data, such as creating a web map or story. The full details page also contains metadata for the item, points users to related content, and has a link to the content's details page in ArcGIS Online.

To view these enhancements and learn more about what's new with ArcGIS Hub, check out the ArcGIS Hub content demo site at go.esri.com/content-views-demo and read the blog post "How ArcGIS Hub makes it simple to share engaging content" at go.esri.com/content-views-blog.



↑ Immersive displays, like this map, encourage visitors to immediately start exploring content.



↑ New filter and styling options allow users to quickly visualize trends and patterns.



→ A full details page provides in-depth information about an item.

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Scientific Currents

By Dawn Wright
Chief Scientist, Esri



THE MAP OF THE FUTURE

“The map of the future is an intelligent image” is one of my favorite sayings, coined a few years ago by Esri’s director of imagery and remote sensing, Lawrie Jordan.

Remotely sensed earth observation data—generally referred to as imagery—is the definitive visual reference at the heart of GIS. Moreover, the increasing availability of low-cost, high-temporal sources of data is making imagery foundational for a growing majority of geospatial workflows.

Imagery is a geographic Rosetta stone, of sorts, that unlocks the mysteries of how the planet operates. As Jordan has pointed out, although the technology powering this Rosetta stone is advanced, we can comprehend it in practice when we begin to understand the pictures.

It is indeed easier to understand something when we can see it. But the future lies in what goes on analytically, behind the scenes, to produce that picture.

As is the case with most technological innovation, the future is now. To get a glimpse of this present-future, let’s go behind the scenes and get technical.

What’s so different about this present-future I refer to? Two words: *cloud native*.

Cloud-native software is specifically designed to take advantage of cloud computing, including its considerable, on-demand resources such as storage and computing power. It is a software development approach in which scalable apps are built and run on services provided by Microsoft Azure; Amazon Web Services; and other dynamic, cloud-based environments.

For some time, Esri has been moving toward cloud-native solutions, including those with multiple types of imagery from

satellites, airplanes, ships, drones, and other sensors. This move is to ensure that GIS is scalable to nearly every kind of image and workflow. And it’s all brought together conveniently and efficiently in every kind of cloud—private, public, or a combination of the two—through server network architecture.

Similar to how real-time information lives in the cloud (think about COVID-19 outbreaks expressed as points), Esri now provides a much easier way for imagery to be incorporated into the ArcGIS environment. The ArcGIS Image product suite, composed of ArcGIS Image Server for ArcGIS Enterprise and ArcGIS Image Analyst for ArcGIS Pro, is now available both as an extension to ArcGIS Online and as a dedicated single-tenant cloud system wherein the server hosts just one user. ArcGIS Image for ArcGIS Online supports image management completely in the cloud and—more importantly for scientists—offers full support for highly scalable image processing and raster analytics.

In terms of image processing and management, ArcGIS Image Online will change for the better how some users handle their imagery, especially those who work at national, regional, and state government agencies and universities that acquire large stores of data. Rather than having to buy the infrastructure or set up their own instances of

data warehouses, these individuals and organizations can use ArcGIS Image Online as a service and achieve the same outcomes.

In ArcGIS Image Online, images can be streamed as static tiled imagery layers; intelligent tiled imagery, which maintains the performance benefits of tiling while being able to do pixel-level analysis; or dynamic imagery layers that support mosaicking and on-the-fly, server-side processing. By using drag-and-drop functionality for image files and their metadata, users can instantly host their imagery layers in ArcGIS Online. From the web interface, they can then select the layer configuration, choose the data type, and fill in additional information such as custom metadata types and processing templates.

In terms of raster analytics, ArcGIS Image is especially attractive to members of the scientific community who want to perform big data analytics on large imagery collections directly in the cloud. For example, instead of having to bring data into ArcGIS, scientists (or their organizations) can take analytics directly to their data. If they want to deploy raster analytics right next to existing big data stores or data lakes, that’s a perfect use case for ArcGIS Image Dedicated, a set of services offered to organizations that store imagery in their own clouds. For some scientists, it may make more sense to use ArcGIS Image Online to leverage the ready-to-use imagery



↑ ArcGIS Image for ArcGIS Online supports image management completely in the cloud.

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services and raster datasets that are stored in ArcGIS Living Atlas of the World, such as Landsat, Sentinel, the National Agriculture Imagery Program (NAIP), and the Moderate-Resolution Imaging Spectroradiometer (MODIS). ArcGIS gives users ready-to-use tools to perform powerful analytical functions, such as anomaly detection, predictive analysis, and artificial intelligence (AI) workflows, in addition to the out-of-the-box collaboration capabilities.

What's more, the raster function editor in ArcGIS Image provides access to more than 150 out-of-the-box raster functions that can be strung together to create custom image processing chains. Users can use and share these image processing chains as raster function templates in ArcGIS Online, ArcGIS Pro, and ArcGIS Enterprise deployments. Once a template is loaded in the Map Viewer or ArcGIS Pro, users can adjust the parameters and preview the processing results, then simply click Run Analysis to get persisted results.

Jupyter-style notebooks in ArcGIS Notebooks can also be deployed in the cloud to build automation, modeling, and machine learning tools right into basic scientific workflows, including an open-source ecosystem.

Esri is taking geospatial artificial intelligence (GeoAI) to the next level as well with ready-to-use models in ArcGIS Living Atlas ([ow.ly/RO2q50EoBhU](https://www.esri.com/arcgis/living-atlas)) that can be easily deployed with ArcGIS Image. These newly released models have been pretrained by Esri on huge volumes of data and can be used—with no training required—to automate the tedious tasks of digitizing and extracting geographic features from satellite imagery and point cloud datasets. Anyone with an ArcGIS Online subscription can access these at no additional cost.

So, for example, if you are conducting a burn severity analysis and need to discern how many building structures might be in a wild-fire's path, you can now leverage the deep-learning capabilities in ArcGIS Online to automate feature extraction and extract building footprints in your study area. By selecting Raster Analysis Tools in ArcGIS Image, you can select Deep Learning and invoke the Detect Objects Using Deep Learning tool. You can then specify your input imagery source—in this case, high-resolution imagery provided by Maxar—and choose the relevant model from a library of ready-to-use deep learning packages, including ones that perform road extraction; human settlement detection; land-cover classification; and, of course, building footprint extraction. In this case, you would choose the building footprint extraction model. Running the tool with these inputs extracts tens of thousands of building footprints in a matter of minutes—all thanks to the cloud.

GeoAI, Machine Learning, and Deep Learning

Providing New Opportunities for Innovation



↑ With new geospatial artificial intelligence (GeoAI), machine learning, and deep learning capabilities—all now provisioned in the cloud—ArcGIS offers many new opportunities for scientific innovation.

A final example comes courtesy of Esri's ongoing partnership with the US Forest Service and its Forest Inventory and Analysis (FIA) Program. First introduced to the Esri user community at the 2016 Esri Federal User Conference ([ow.ly/MJvZ50EoBkT](https://www.esri.com/arcgis/federal-user-conference)), the FIA Program has an extensive engagement portfolio with a profusion of resources, available at [ow.ly/nS2C50EoBn5](https://www.esri.com/arcgis/federal-user-conference). FIA researchers Charles H. "Hobie" Perry and Christopher M. Oswalt, along with their team, have been working with all the 30-meter Landsat imagery that's available for the continental United States over a five-year time series in what is essentially a multidimensional data cube. This imagery is frequently used in studies that examine the relative predictive power of land-cover models—in particular, those related to tree cover—using harmonic regression (HR) as a primary predictor variable. In successive single runs processing HR for the continental United States (with no tiling or mosaicking of multiple runs), Esri has reduced the processing time from 31 days to 33 hours. This means that 21.7 trillion pixels can be processed in 33 hours! Breaking that down even further, when an FIA researcher initiates a job, raster analytics is processing 15.8 trillion pixels per day, 657.6 billion pixels per hour, 10.96 billion pixels per minute, or 182.7 million pixels per second.

At the time of writing, FIA is using only four dedicated midtier, memory-optimized raster analytics machines, managed by Esri Managed Cloud Services, as part of this collaboration. FIA has no need for a massive cluster of high-end servers or supercomputers. For many, this is a clear example of the sheer power and elegance of Esri's raster analytics software.

Indeed, the map of the future is an intelligent image that is powered by raster analytics. As such, this is a map that can free scientists up to do their best science.

Since we generally understand things much better when we see them, go check out ArcGIS Image in action at [ow.ly/eZOq50EoBpZ](https://www.esri.com/arcgis/image).

About the Author

As chief scientist of Esri, Dr. Dawn Wright aids in strengthening the scientific foundation for Esri software and services while also representing Esri to the scientific community. A specialist in marine geology, Wright has authored and contributed to some of the most definitive literature on marine GIS.



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A Leader Who Embodies the Mission

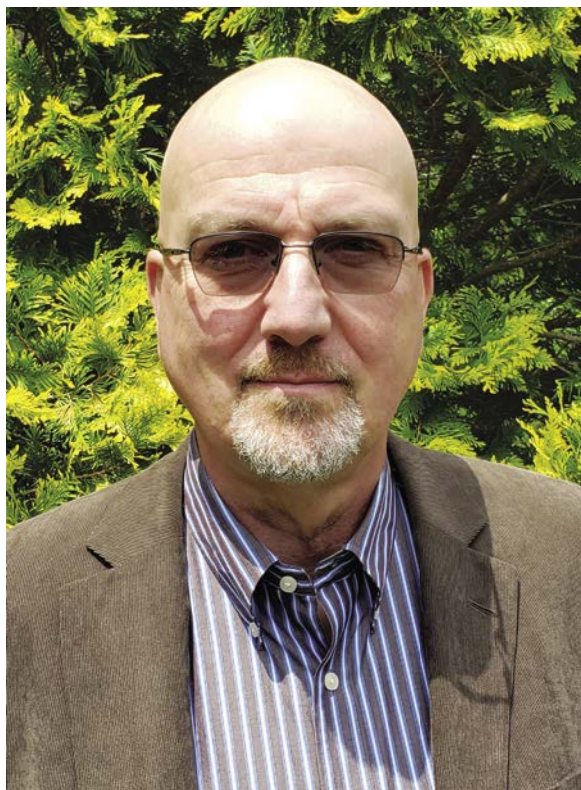
He led one of the largest international geospatial cooperatives in history. And his easygoing, unassuming nature is a big part of why it's been a resounding success.

Marzio Dellagnello, who recently retired as senior geospatial intelligence officer for international programs at the National Geospatial-Intelligence Agency (NGA), helped stand up and then managed the Multinational Geospatial Co-production Program (MGCP), a consortium of 32 nations that has created, updated, and maintained 5,300 one-by-one-degree cells of primarily 1:50,000-scale geographic data for key areas of interest around the world. That's roughly the equivalent of mapping 27 percent of land on the globe with enough detail to carry out tactical operations, from military campaigns to disaster relief.

"It's not easy to get 32 countries to work together. They all have their own national interests, their own data standards and standard operating procedures, and hundreds of military systems that need to be supported," said Mark Cygan, director of national mapping solutions at Esri. "To get them all to agree on this and then produce more than 5,000 cells—that's phenomenal. No one's ever accomplished that. And now, as allies, they can all work off the same map."

"There's something about [Dellagnello's] leadership style that just allowed him to get along with virtually everybody," said Jack Hild, a former executive at NGA who was also instrumental in the MGCP. "The fact that he spoke a number of languages certainly helped a lot. But he had a really unique combination of having the technical knowledge and simply the right personality and leadership style to interact with all the governments involved."

Born in Italy, Dellagnello moved to the United States when he was a teenager. He had always been interested in why human behavior happens in certain places, so he studied geography and cartography at the University of Kentucky.



↑ Marzio Dellagnello

"I was curious about population location, why cities are where they are," said Dellagnello. "For example, you can trace an old buffalo trail and how the Native Americans used that, and then you can see that a road was made there. So we have highways that follow ancient roads. That type of information—why we use the lines of transportation and communication that we do and why this population lived where they lived—has always intrigued me."

At a time when computers still required punch cards, Dellagnello was trained in manual cartography, "with scribes and all," he said. But when he got his first job out of college at a small firm that produced maps for Kentucky's coal mining industry, he did his work digitally.

"I really learned the whole process, from aerial photography and imagery to collecting features digitally," he said about that job.

When he made his next career move and started working at the Defense Mapping Agency (DMA) in Louisville, Kentucky, Dellagnello went back to mapping by hand, producing 1:50,000-scale topographical line maps and joint operation graphics at the 1:250,000 scale. So he really came of age in the mapping industry as it evolved from manual processes to mostly digital systems.

The DMA office where Dellagnello worked eventually shut down as part of the Base Realignment and Closure (BRAC) program, so he was moved to Washington, DC. There, he continued to work for the DMA, which became the National Imagery and Mapping Agency (NIMA) and, later, the NGA.

"That's where I started really doing GIS work," he said.

He was part of the VMap Co-production Working Group (VACWG), a partnership of 19 countries that produced medium-resolution vector data of areas around the globe. The VMap Group expanded on the work of earlier cooperative programs at the NGA. These included the Inter-American Geodetic Survey (IAGS), which from the 1940s to the 1980s surveyed unmapped areas of Central America and South America, and the Digital Land Mass System (DLMS), which in the 1980s linked eight countries in creating a digital cartographic product for Europe.

"At the beginning, I was just a worker bee collecting features," Dellagnello said about his time in the VMap Group. "Then I had the opportunity to engage with some European countries that were doing the same work, so I accepted a position in the international office."

Eventually, he became the chair of the VMap Group and saw it through to the end of its mandate. The MGCP, which came about after the September 11, 2001, terrorist attacks on the World Trade Center and the Pentagon, was built on lessons learned from the VMap Group. At the time, the NGA was tasked with furnishing geospatial readiness anywhere in the world that the fight against terrorism might take the United States or its allies. But doing that alone was beyond the NGA's mapping budget.

"The MGCP founders quickly brought 27 nations together to solve the organizational, resource, technical, sourcing, policy, and legal matters involved in producing and maintaining high-resolution geospatial data that's functional for all their needs," according to Cygan. "In less than two years, they went from having nothing to having a technical reference document in which they agreed on what all the features and attributes would be and what was needed to support defense forces in the field."

By convening in this coproduction program, the 27 countries that initially got involved, along with the 5 that have been added in the years since, have produced more than they ever could have individually. And Dellagnello, with his determination to get things done in a collaborative and inclusive manner, embodied the ethos of the mission.

"One of the things [*the NGA*] mostly unconsciously tried to do initially was to not act like the 600-pound gorilla. We did not want the US to try to dominate this group. We wanted it to be a real team effort," said Hild. "I believe, especially in retrospect, that the success of [*the MGCP*] was in taking that strategy. And Marzio was the heart and soul of all that."

According to Dellagnello, most of what he did was deconflict various members' interests to ensure that the data was produced according to certain specifications and delivered on time, when it was needed.

"We're all on the same side, but...every country has a different way of working, different responsibilities, and even different fiscal years," said Dellagnello. "Trying to get the funding in place for everybody to work and deliver the data was not all the same."

One of Dellagnello's main priorities was to ensure that each country was working on areas of interest that were valuable to it.

"For example, there are parts of the world where the United States may not have priorities but other countries do," he said. "It was important to make sure that we paired up the right countries with the right areas of responsibility so the data was delivered in a timely manner."

Since 97 percent of the MGCP's member countries use Esri software, it was also important that the group's data would work seamlessly with ArcGIS technology. Members of Esri's ArcGIS Defense Mapping team are typically present in the MGCP's technical meetings to ensure that the ArcGIS Defense Mapping solution fully supports the MGCP's data standard.

"We have a symbiotic relationship with the MGCP, the NGA, and geospatial intelligence defense mapping agencies around the world," said Cygan. "We support many different defense standards and models for data as well as for cartography, including the Topographic Data Store (TDS), the Topographic Map (TM), the MGCP Topographic Map (MTM), and others."

It's this kind of symbiosis, both within the MGCP and with outside partners, that has led many MGCP members to cooperate in other endeavors as well.

"When the Olympic Games were in Turin in 2006, I went to Italy, and I was able to work with Italian defense forces on the data and products that covered the area where the Winter Olympics happened," said Dellagnello. "There was no need for the NGA to produce any data for that, since Italy was well-covered by high-resolution data in that region, but it was a collaboration that was a big success."

And Dellagnello knows what makes a successful collaboration at the bilateral and multinational levels.

"You need to search for an equitable quid pro quo because you want everybody to participate," he said. "You need to standardize production. Relationships are critical. Don't be bound by convention. Look at the long-term focus rather than a very quick return. And remember that no single partner has all the answers."

He credits these principles, along with contributions from everyone on the NGA team, with keeping the MGCP on course and ensuring that it continues to be improved on and strengthened today.



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More Data Sharing and Collaboration in ArcGIS Enterprise

With the Q2 2021 release of ArcGIS in May, ArcGIS Enterprise gained several exciting and long-awaited features that provide users with needed updates and better tools for collaboration.

One of the most valuable updates to ArcGIS Enterprise is shared editing (two-way sync). This allows for distributed collaboration, enabling users to share data edits and sync content across ArcGIS Enterprise deployments and with ArcGIS Online. Additionally, ArcGIS Enterprise now supports hosted layers, branch

versioned layers, and nonversioned layers with archiving enabled.

Data management was also enhanced in ArcGIS Enterprise. For example, users can now append data—including CSV and Microsoft Excel files, shapefiles, and GeoJSON files—to hosted feature layers. They can also choose whether to add or update features in the existing layer or overwrite the layer.

A new home page editor for ArcGIS Enterprise is beneficial to users who want to customize

their home pages, choose different layouts, and incorporate more branding. With the editor, users can make their home pages responsive for desktop and mobile devices, display a full-screen cover image, rearrange the layout of the page, and adjust the tone to either light or dark. Edits can even be reviewed as they're being made.

New administrative reports now provide a helpful overview of content and member activity. For example, they let administrators see how many web maps their organizations have,

how many were created within a specific time frame, and which items need to be updated. The reports also allow administrators to export these ArcGIS Enterprise item and member inventories to CSV files.

In 2022, ArcMap software-based runtime components will be removed from ArcGIS Enterprise, affecting services that are published from and run in ArcMap. So this latest release of ArcGIS Enterprise incorporates migration tooling to help users prepare for the change. The UpdateArcMapServices tool is now included with ArcGIS Server, which enables users to do inventories or bulk migrations of service runtimes ahead of next year's removal. Users can also migrate services individually through the ArcGIS Server Manager. Any other services, however, will need to be migrated manually.

Finally, for eligible customers seeking a containerized deployment option, ArcGIS Enterprise on Kubernetes is now available. To find out more about this new cloud-native offering, see "Esri Establishes Closer Ties with the Developer Community" on page 6. Users who are experienced in using Kubernetes can reach out to their Esri representatives to get more information.

Please note, this is a short-term support release that builds on previous releases of ArcGIS Enterprise and includes new features, apps, and improved functionality to the product. For more details on any of these topics, visit *ArcGIS Blog* at esri.com/arcgis-blog.



← A new home page editor lets users display a full-screen cover image, rearrange the layout of the page, incorporate more branding, and more.



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In ArcGIS Online, Extend and Multiply the Power of GIS

The April update to ArcGIS Online ushered in several important changes that not only make it easier to work within the cloud-based mapping and analysis software but also improve collaboration across organizations.

For starters, it is now easier for independent ArcGIS Online organizations to establish formal relationships with each other to share maps and data, multiplying the power of GIS. The new Map Viewer was released for general availability as well, and it is now possible to schedule ArcGIS Notebooks to run in ArcGIS Online. Administrators and those with specific privileges can create accessible custom color themes for their organization's home page. And a new gallery of focused app templates—complete with guidance for how to choose the one that best fits particular needs, plus an express setup option—is now available in ArcGIS Online.

Read on for more details about all these updates.

Improved Collaboration Among Multiple Organizations

Building and privately sharing maps across different organizations is a powerful capability of ArcGIS Online. A common use case is when various emergency response agencies work together during a crisis to protect people and lands. In the April update to ArcGIS Online, this kind of collaborative experience was improved and expanded.

It's called partnered collaboration, and it provides a way for two or more ArcGIS Online organizations to establish a formal relationship. Once a partnered collaboration is formed, the organizations in it can work with each other securely in groups to edit items and share content.

Managing groups in a partnered collaboration is simple. Organizations can make key people collaboration coordinators by assigning them the new facilitator role. Those people can then create and manage groups. They also become an established point of contact for other organizations and can be easily found and directly added to a group without an invite.

When collaboration coordinators are promoted to group managers, they can quickly get their team involved in a project by adding members from their organization to the group without having to send them an invitation. They can also find members in the partner organization by searching or filtering by organization affiliation (if this capability is enabled by the collaboration owner).

After a partnered collaboration is established and the shared update group is created, members from the collaborating organizations can build and edit maps and apps together. Whoever shares an item with the shared update group remains the owner of that item. Additionally, sharing content with a group can be limited to group owners and managers in different organizations who can ensure that the right content is curated and shared.

New Map Viewer Moves into General Availability

The new Map Viewer, recently out of beta, is now available for general use. This next generation mapmaking tool for ArcGIS Online and ArcGIS Enterprise provides new ways to visualize data and build compelling web maps.

New capabilities were also added to Map Viewer in the April update. Users can now draw features and place stamps anywhere on their maps using sketch layers. This is a fast way to add information and personality to a map.

The original Map Viewer is now called Map Viewer Classic. Administrators or individual users can make the new Map Viewer the primary viewer through their organization or user settings.

ArcGIS Notebooks in ArcGIS Online Supports Scheduling

In ArcGIS Online, ArcGIS Notebooks provides a Jupyter notebook experience that's optimized for spatial analysis. And now, users can automate routine tasks, run large or lengthy processes outside of work

hours, or regularly update datasets by scheduling ArcGIS Notebooks to run in ArcGIS Online at a set time or on a recurring basis. Users can also pass parameters into a notebook on a schedule to account for different analytical scenarios or for security purposes.

Specific examples in which scheduling notebooks to run would be helpful include inspecting all the items in an ArcGIS Online organization and reporting items that are missing required metadata, such as descriptions, terms of use, credits, or tags. Another example is training a deep-learning model overnight to save on computing resources during work hours. Scheduling a notebook to run after an online data source updates and then cleaning and engineering the data for use in an analysis workflow or a dashboard is an additional use pattern.

More Home Page Customization Options

For users who have wanted additional customization options for their organization's home page, they can now use preset or custom color themes that are available in the new home page editor. There are eight curated color themes, and users can create a custom theme as well.

To ensure that the text on the home page remains legible, ArcGIS Online checks the contrast ratio of the selected colors and informs users whether the colors pass accessibility standards. After selecting a theme, users can immediately apply different colors to each content block on the home page.

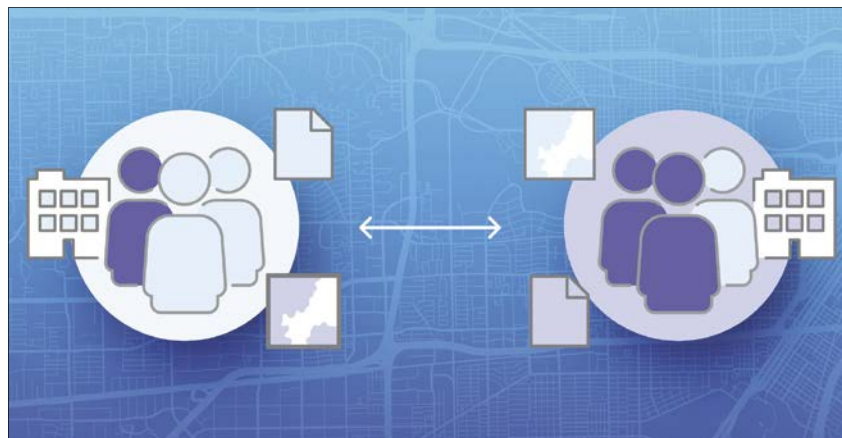
A New Way to Quickly Make Apps for Stakeholders

ArcGIS Instant Apps, which helps users quickly transform maps and data into apps, is now available in ArcGIS Online. Composed of a gallery of app templates, Instant Apps steers users to the ones that best fit their maps and data. It then offers two configuration experiences: express and full.

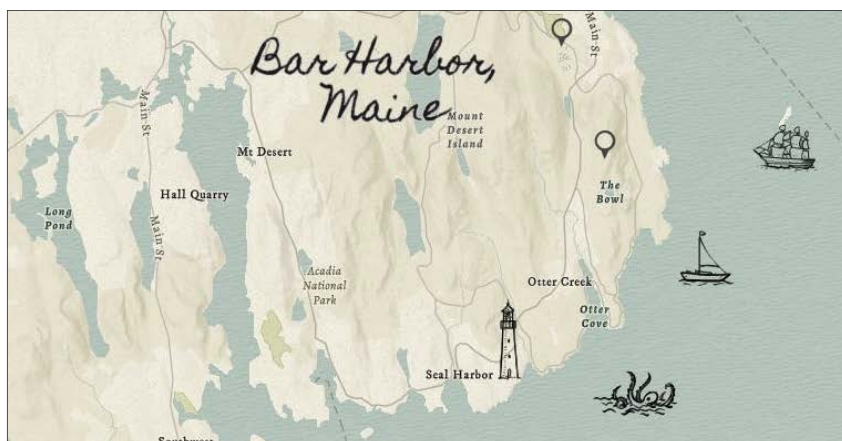
The gallery includes focused apps, each with a specific purpose—for example, viewing a map, comparing two things, getting directions, or finding something nearby. Instant Apps guides users through the selection process by suggesting the best app template for the maps and data being presented. It does this by analyzing map components, like pop-ups, symbolization, and attachments, and then recommending app templates with compatible capabilities.

After selecting their preferred app template, users can decide to do either a speedy setup with express configuration or a full one for more advanced customization. With the express setup, users can choose and configure an app within five minutes. The full setup is available when users need to configure additional capabilities.

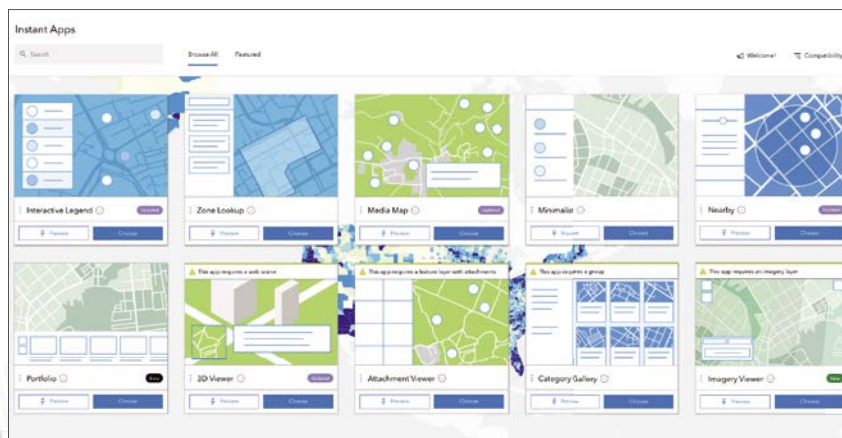
Instant Apps gives users confidence that they are creating an app that meets the needs of their audience. The apps in Instant Apps have a mobile-first design, meaning they can be used on any device. They are also localized to support many languages and accessible to people using assistive technologies.



← Partnered collaboration is an efficient way for two or more ArcGIS Online organizations to manage groups, edit items together, and share content.



← In Map Viewer, the sketch layers capability allows users to quickly draw features and place stamps anywhere on their maps.



← ArcGIS Instant Apps helps users select the best app template for the maps and data they need to present.

Enterprise Workflow Management System Streamlines Operations

Lots of organizations are looking for ways to improve their business processes and maximize the value of their GIS investments. But GIS professionals are often asked to do more without enough resources.

ArcGIS Workflow Manager can help. This scalable enterprise workflow management system enables employees to complete tasks and projects in a predictable, accurate, and timely manner.

While work management and productivity systems are not unique, Workflow Manager is different because it focuses on optimizing both GIS- and non-GIS-based processes to create seamless, end-to-end workflows that are synchronized across web, mobile, and desktop devices. Workflow Manager is also location aware, meaning it employs spatial analysis to report on work statuses and metrics.

Step-by-Step Workflows

Users of Workflow Manager benefit from its simple interface that takes them, step-by-step, through GIS workflow processes authored by their organizations. The steps are tightly integrated with Esri technology, allowing users to carry out actions such as the following:

- Creating a work order using ArcGIS Survey123
- Accessing web maps or apps in ArcGIS Enterprise
- Coordinating field crews with ArcGIS Workforce
- Performing editing and analysis in ArcGIS Pro

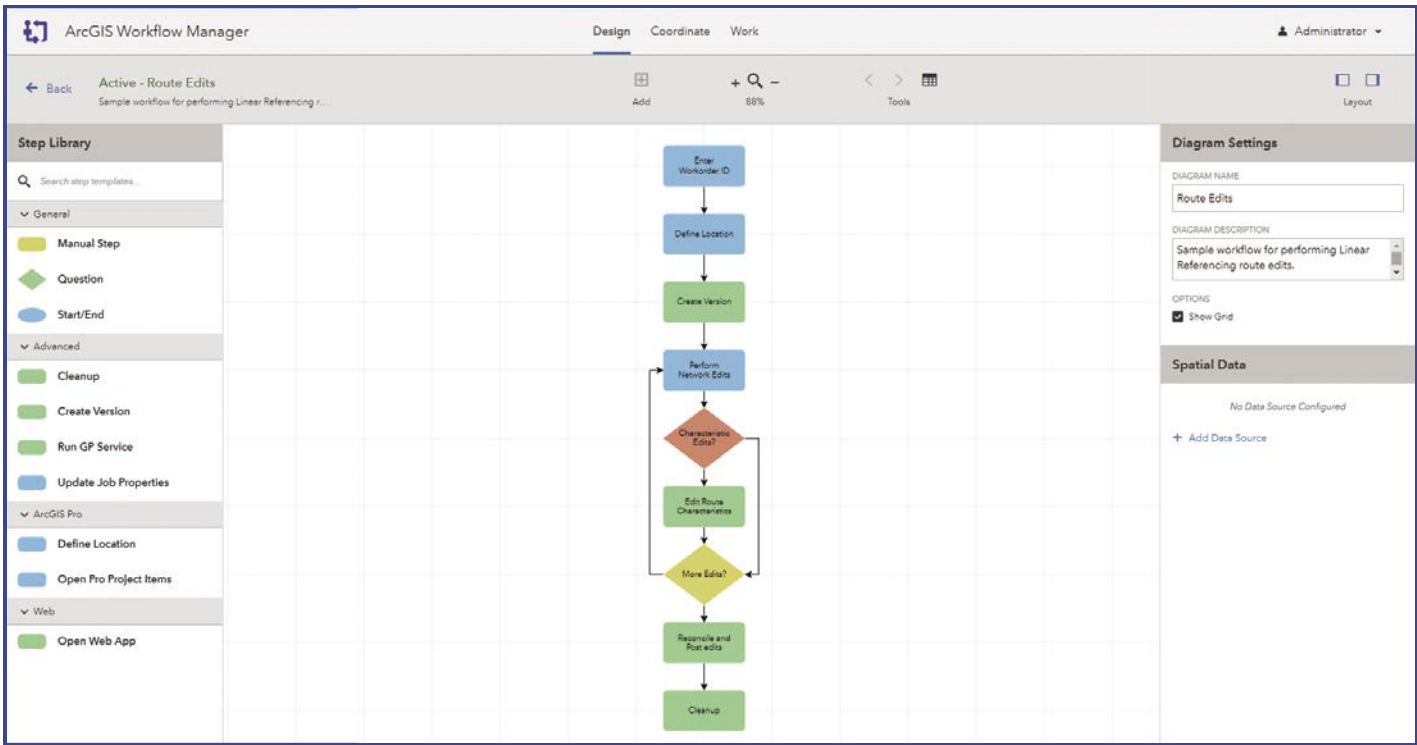
For example, to figure out if a proposed project is within 50 feet of a water boundary, Workflow Manager can guide users through the whole process. The person submitting the permit request does so using Workflow Manager, then the system determines whether the project's location meets specific permitting criteria. From there, Workflow Manager leads both the submitter and the person reviewing the project through any additional questions that need to be answered or forms that need to be filled out.

Workflow Manager lets users easily configure business processes like these in workflow diagrams that break operations down into digestible actions. Diagrams can include detailed steps directing users, for instance, to add an attachment or send an email. As an organization's processes evolve over time, employees can update their Workflow Manager systems to mature with them. So the program operates as a sort of living help system.

Based on a Four-Stage Process

Streamlining a GIS production process is not specific to certain industries or use cases. In fact, most standard workflows follow the same four-stage process: submit the work order, validate the quality of the submission, complete the resultant work, and deliver the results.

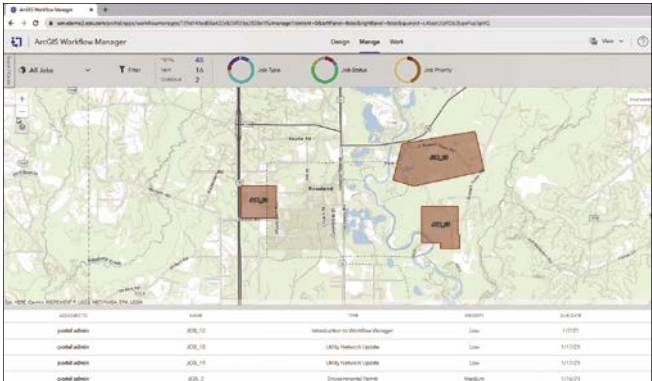
When someone submits a request to an organization, it is either validated as a request that can be handled, or it is invalidated and sent back to the submitter or canceled altogether. A valid request is pushed forward in the process, and work is done to complete the job. The final product of the request is then delivered to the stakeholder.



↑ ArcGIS Workflow Manager lets users easily configure business processes in workflow diagrams that break operations down into digestible actions.



↑ Most standard workflows follow the same process: submit the work order, validate the quality of the submission, complete the work, and deliver the results.



↑ Workflow Manager employs spatial analysis to report on work statuses and metrics.

Workflow Manager establishes the design and review process for requests and assists all project participants in completing their tasks efficiently. This works well for workflows that include doing inspections, allocating permits, soliciting or contributing data, managing incidents, and dealing with address changes.

An Automatic Production System

Some workflows—such as data aggregation, ingestion, and analysis—are becoming either fully automated or semiautomated, meaning that humans only need to intervene when necessary. Workflow Manager is evolving to act as the coordinator for heavily automated processes. By combining Esri technology and third-party systems, Workflow Manager is creating a powerful, streamlined, and scalable automatic production system.

Contributed data, for example, may not adhere to an organization's attribute or spatial data standards, so it might need to be reviewed, adjusted, or enriched before being added to the organization's larger data repository. Workflow Manager coordinates the steps the data needs to take from the point of being received through getting published. If the contributed data fails certain checks, it can be automatically rejected

or pushed to a more advanced automated or manual data correction process before reentering the normal data processing pipeline.

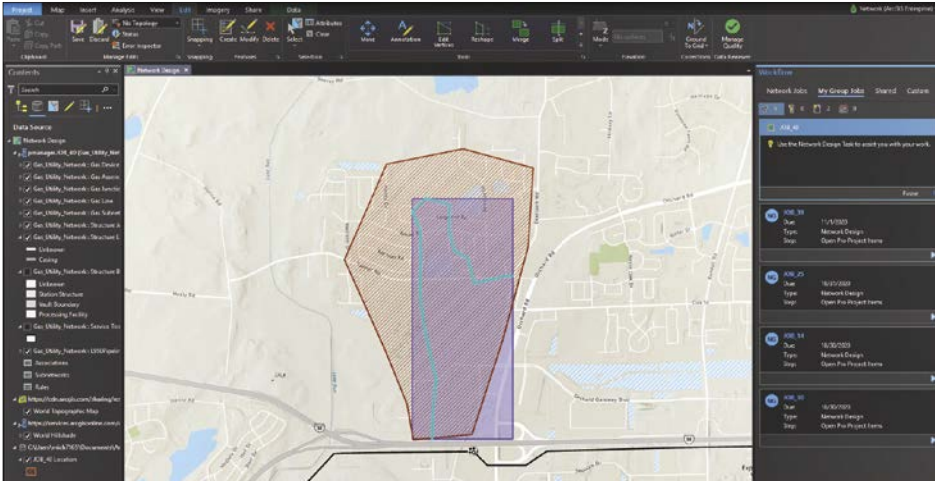
By running a largely automated process like this, organizations can save on time and labor while maintaining the integrity of their data.

Discover Integrated Workflows

Want to see a real example of a Workflow Manager workflow? Watch the video *Telecommunication*

Solution: Network Design Workflow Management at youtu.be/ZheS9-8zju8 to be guided through a workflow that helps a utility coordinate and track network designs. The workflow crosses from the web to ArcGIS Pro and shows how ArcGIS Workforce and web apps are integrated into a simple infrastructure design process.

Visit go.esri.com/ArcGISWorkflowManager for more information on ArcGIS Workflow Manager, or reach out to your Esri representative.



↑ Workflow Manager is tightly integrated with other Esri technology, such as ArcGIS Survey123, ArcGIS Enterprise, ArcGIS Workforce, and ArcGIS Pro.

Location-Based Simulations Aim to Increase COVID-19 Vaccine Uptake

City, state, and federal health officials are leading the effort to increase confidence in COVID-19 vaccines throughout the United States. Their goal is to get enough people vaccinated so that communities reach immunity levels that make it possible for people to safely get back to their prepandemic activities and ways of life. Achieving this objective requires developing tools that clearly communicate the benefits of the COVID-19 vaccines. Leaders across the country can then use those assets to encourage people in their communities to get vaccinated.

Esri startup partner Epistemix used a computational simulation to model future COVID-19 infections in Washington, DC, over a 15-week period based on how many people receive vaccines and whether they are partially or fully vaccinated. The results are easy to visualize and understand—and they're also convincing.

Challenges in Persuading People to Get Vaccinated

The messaging for encouraging people to get vaccinated against COVID-19 might seem straightforward: just tell people where and when to get their shots.

But public understanding of and confidence in the COVID-19 vaccines varies tremendously across cities, counties, and states. Moreover, individual communities have diverse demographic and cultural groups that interpret official guidance differently. Epidemiology is a complex topic that draws on a wide array of disciplines, from microbiology to sociology. So officials must balance all these factors as they endeavor to increase vaccination rates.

One powerful way to communicate the effectiveness of the vaccines is to show side-by-side scenarios of the spread of COVID-19 infections based on levels of population immunity. By comparing forecasts of how COVID-19 spreads at different levels of immunity over the same geographic area and time frame, officials can clearly present to community members the specific collective impacts of their vaccines.

It's a lot more compelling to see what getting the shot could do for your family, friends, and neighbors than to try to interpret abstract statistics.

Visualizing Disease Spread Around Washington, DC

Epistemix used its platform to build a model that simulates the impact of varying levels of COVID-19 immunity in Washington, DC. This platform has been employed to forecast both infectious and noninfectious diseases for groups such as the World Health Organization (WHO), the RAND Corporation, the Centers for Disease Control and Prevention (CDC), and the State of Indiana. The simulation incorporates the latest public health data, calibrates it to local conditions, represents every person and place in the area with statistical accuracy, and uses realistic social dynamics.

A team of epidemiological modelers at Epistemix ran the simulation for COVID-19 in Washington, DC, and then exported the data from Epistemix's platform to ArcGIS Online. This enabled them to visualize how the disease would spread around the city under various conditions.

The results revealed a stark difference between reaching 50 percent and 70 percent population immunity. In the figures below, every red dot represents an infected person, while every blue dot represents a person who has recovered from infection. The dramatic reduction in COVID-19 infections is clear if just 20 percent more of the population of Washington, DC, gets vaccinated. Fewer people get infected with the disease, which means fewer people end up hospitalized, and fewer people die. The city and the economy can open back up, and life can start getting back to normal.

But if people delay or refuse to get vaccinated and Washington, DC, stalls at 50 percent immunity, then successive waves of the disease will continually put residents at risk. This would likely lead to additional lockdowns and activity restrictions.

Grounded in the best epidemiological data available, these visualizations paint a precise and compelling picture of why residents of the US capital should get vaccinated as soon as they are eligible—and encourage others to do the same. People can see the direct impact of their vaccination decisions on the communities in which they live—what it means for their families, friends, neighbors, coworkers, schools, and local businesses.



By showing people how they can contribute to reopening instead of just telling them what to do, health officials invite those they serve to actively participate in the solution.

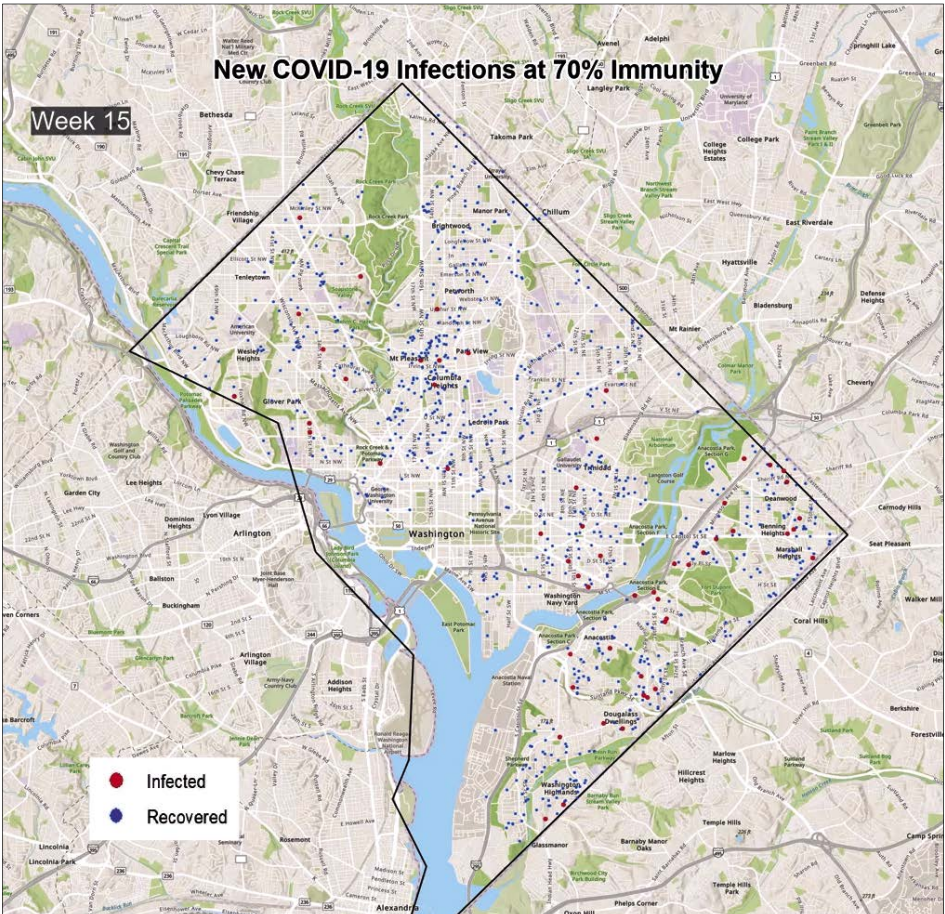
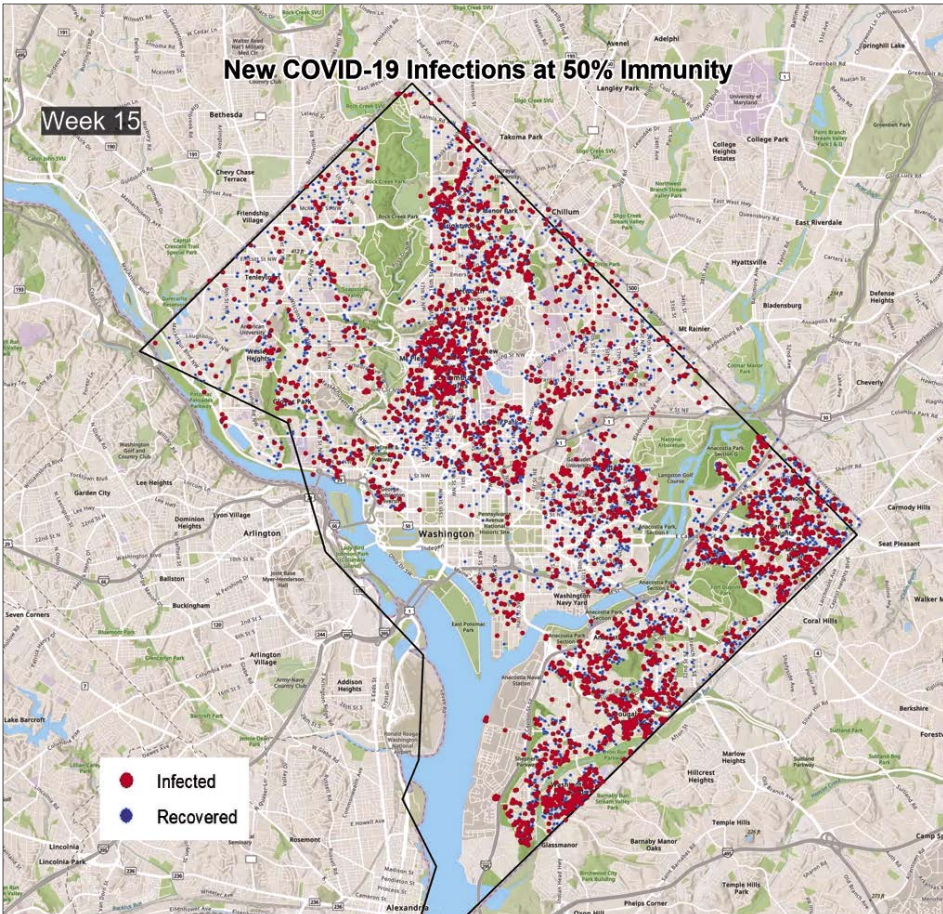
What It Takes to Get More Shots in Arms

Combining simulations with location intelligence to create powerful visuals that reveal real-world impacts can help officials, like those in Washington, DC, accelerate COVID-19 vaccine uptake in their areas.

Enabled by ArcGIS technology, Epistemix's tools synthesize detailed information—current vaccination levels, the effectiveness of vaccines, variant strains of the virus, vaccine hesitancy rates, evolving social distancing rules, and mobility considerations—into actionable visualizations that make sense to a diverse audience of stakeholders. This is what it takes to get shots in arms.

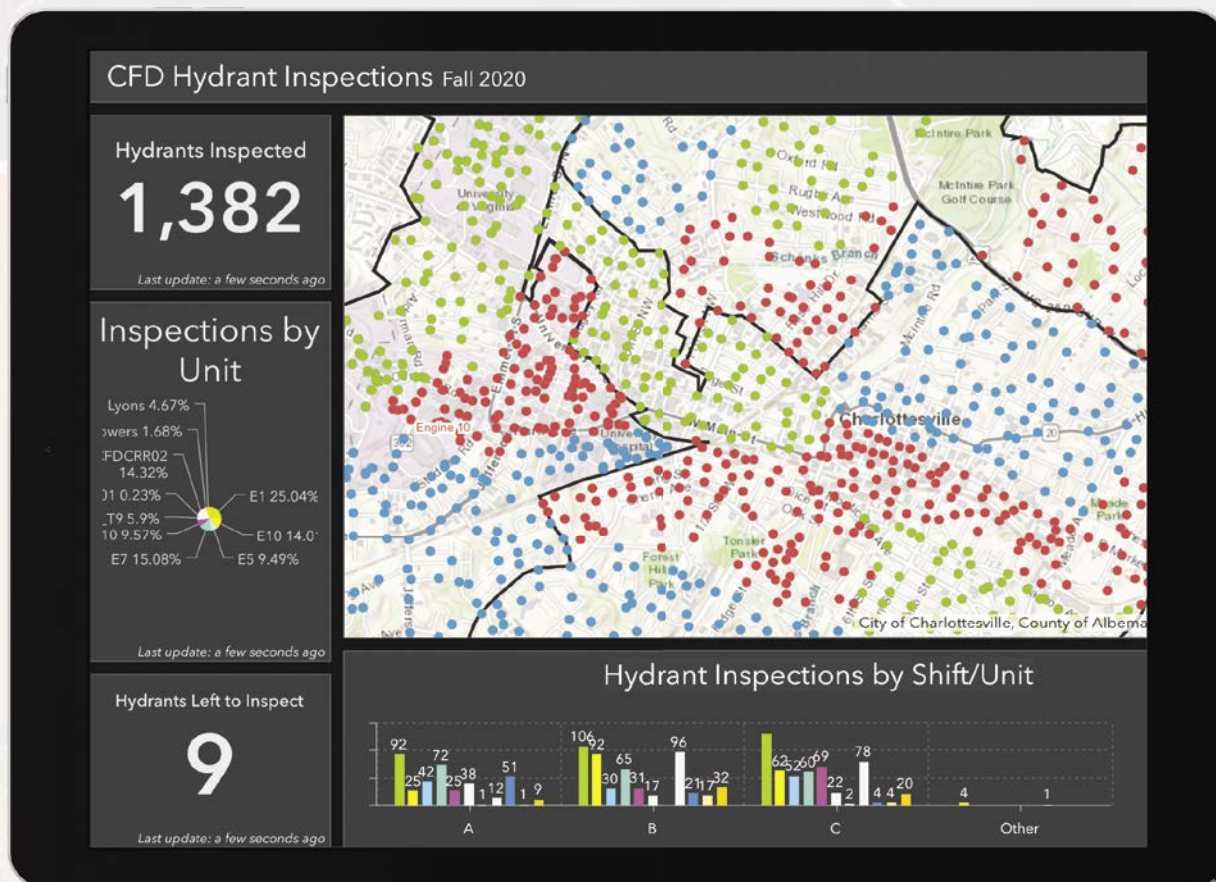
Epistemix's model for Washington, DC, is currently available in ArcGIS Marketplace and is already being replicated for other areas. The company has run similar simulations for cities including San Francisco and Miami, states such as Michigan and Indiana, and events like the Erie County Fair and the Chicago Marathon. Funding for this and other vaccine confidence data is available under the American Rescue Plan Act of 2021, section 2302.

Beyond COVID-19, location-based computational modeling can provide unique insights on health equity, chronic health conditions, and precision public health. And although health officials face historic challenges as the world combats the COVID-19 pandemic, they have better tools at their disposal than ever.

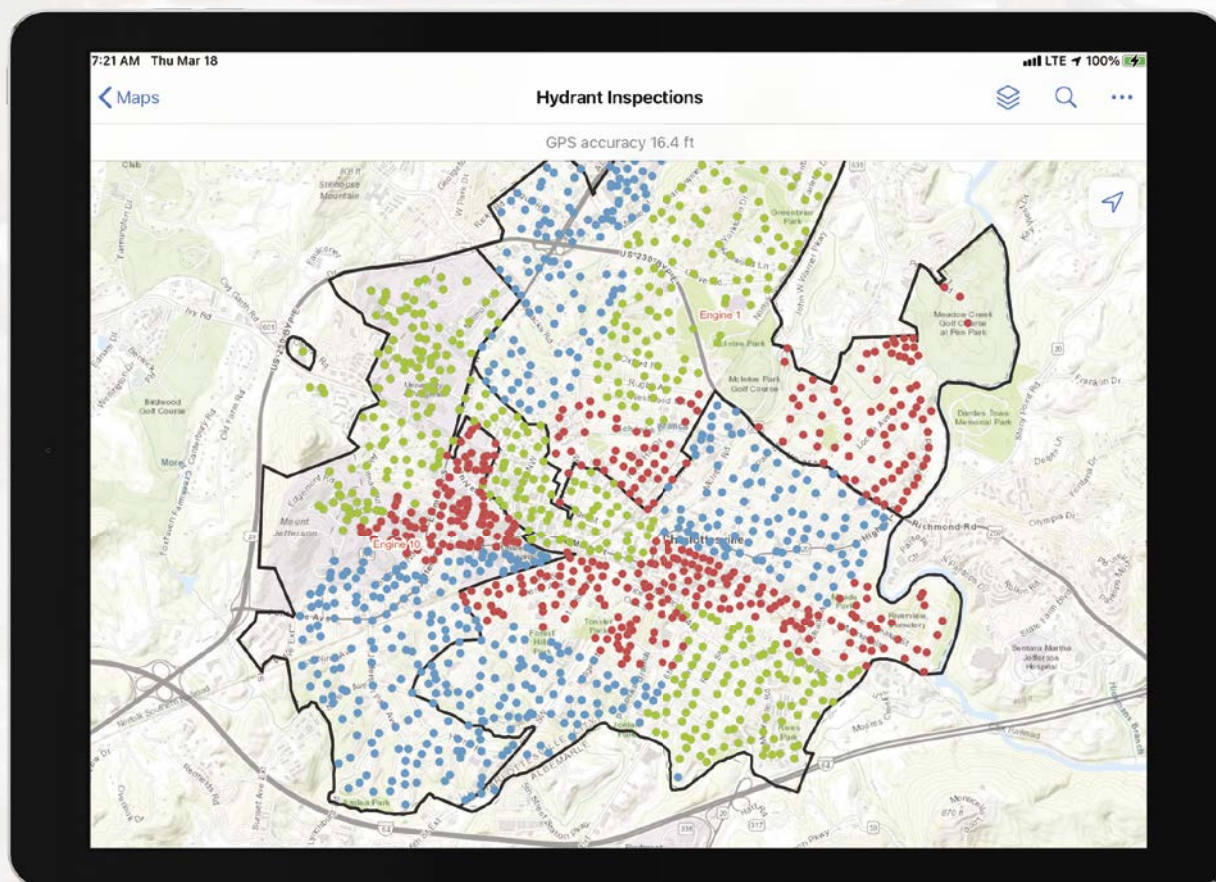


↑ If 50 percent of the population of Washington, DC, is vaccinated by the end of a 15-week period, there will be many more active cases of COVID-19 than if 70 percent of the population gets vaccinated within that time frame.

FIRE DEPARTMENT IMPROVES Hydrant Inspections with ArcGIS Field Maps



↑ ArcGIS Field Maps groups inspections by firefighting unit and shift, so administrators and crews can see how far along the inspection process is.



↑ Hydrant inspections are color coded. Green, for example, means that the hydrant has been inspected.

The Charlottesville Fire Department, which provides fire response, hazmat, and emergency medical services to residents of Charlottesville, Virginia, is a top-rated fire department. Accredited through the Commission on Fire Accreditation International, it has a Class 1 rating from the Insurance Services Office, meaning it is well-equipped to put out fires throughout the community.

One requirement for upholding this rating is that fire departments have to inspect all the fire hydrants in their jurisdictions. For Charlottesville, this means inspecting about 1,500 fire hydrants throughout the city and on the University of Virginia grounds.

For years, Charlottesville firefighters performed these inspections using a time-consuming paper-based workflow. To make this process more efficient, the Charlottesville Fire Department implemented ArcGIS Field Maps, a new all-in-one app from Esri that enables mobile workers to easily find assets and information, collect and edit data on the go, and report their real-time locations.

"We had the opportunity, through Field Maps, to refine our entire process and make it firefighter friendly," said Joe Powers, the deputy chief of community risk reduction for the City of Charlottesville.

INEFFICIENT INSPECTIONS

Prior to implementing a digital solution for fire hydrant inspections, Charlottesville firefighters had to slog through an inefficient manual process.

Using printed-out spreadsheets to locate each fire hydrant, the firefighters recorded their findings on pieces of paper. Back at the station, they transferred their notes to a form and emailed that to the Charlottesville Department of Public Works, which maintains the fire hydrants. If repairs were needed, the firefighters would follow up with a phone call to the department to ensure that a work order was created.

To move away from this, Lucas Lyons, a system performance analyst for the Charlottesville Fire Department, created a digital hydrant inspection process in 2018 using a mobile data collection app. The app had limitations, though.

"Users in the field were asking for developer-level requests," Lyons said. "I found we quickly hit walls, and I became somewhat frustrated by the [app's] limited features."

In addition, the City of Charlottesville organizes all the city's data in a spatial database, but, according to Lyons, it was largely inaccessible to the fire department.

"I had no ability to edit that, and neither did the firefighters," he said.

Lyons lobbied to get access to the database, but even then, it wasn't very open. In the end, it actually made collaboration difficult.

After two years of trying to make this digital process work, Powers began looking into more efficient ways to have firefighters inspect hydrants.



AN ALL-IN-ONE APP

Powers not only wanted to completely move away from a paper-based process, he also wanted each inspection to be tied to that hydrant's record. He and Lyons were cognizant that some users weren't familiar with GIS, so they needed the digital solution to be user-friendly as well. Field Maps—with its data collection and editing capabilities, digital maps, and ability to capture location tracks—ended up fitting the bill.

Using just a feature layer of the hydrants, Lyons created the fire department's Field Maps solution. The app groups inspections first by firefighting unit and then into three different shifts, which ensures that the work is divided up equitably and enables firefighters to see which inspections have been completed by people on other shifts. Additionally, Lyons color-coded the inspections (for example, a green dot means that the hydrant has already been inspected) to provide at-a-glance information.

"With Field Maps, you have a way to collect data without having to go through this whole process of [asking], Where should this data live? You just need to set up a feature layer, and you're good to go," said Lyons. "I like that."

After Powers and Lyons received some training on Field Maps from Esri, they created a three-minute training video to educate firefighters on how to use the new app. The video showed Lyons using Field Maps to do a hydrant inspection.

"We made a few little tweaks to [the app] once we were out on the street testing hydrants," said Lyons. "Then we deployed it to our firefighters."

Powers said the app was so straightforward that several firefighters went out with their iPads and other mobile devices the day it was released to inspect hydrants. And according to Lyons, the firefighters asked very few questions.

"I think [the app is] a game changer for the fire services," Powers said. "It allows firefighters to record information and collect data [using one app], and it's what the fire department needs to be successful in collecting data."

"I think we'll have more and better data in the future [by] having an application like this in users' hands," Lyons added.

QUICK AND COLLABORATIVE

Since implementing Field Maps in November 2020, the Charlottesville Fire Department has expediently completed two inspection cycles for its 1,500 fire hydrants. According to Powers, the new, streamlined process has helped decrease the workload while increasing productivity.

"From a staffing perspective, [firefighters] are not spending as much time on the street doing hydrant inspections because they're not writing it all down," said Powers. "They're doing it one time, and it's done."

Rather than having to write emails, make phone calls, and scan paper work related to hydrant inspections, Charlottesville's firefighters can complete other



→ Firefighters now inspect fire hydrants using ArcGIS Field Maps on iPads and other mobile devices.

tasks, such as taking hazmat or online training and keeping up their physical fitness—all of which is part of a firefighter's job, according to Powers.

Increased collaboration was also an important outcome of the Charlottesville Fire Department's Field Maps implementation. Being able to visualize all hydrant inspection data in real time and see who is doing what has eliminated a lot of duplicate work. And Lyons built the dashboard to track all this in an hour—something he attributes to having reliable data.

"In the past, administrators and the crews didn't have that kind of insight," Lyons said. "When the last hydrant was inspected and that form was turned in, then the whole process was done. But now we can track, in real time, how that's happening using dashboards."

The real-time updates from Field Maps have also improved the fire department's communication with Charlottesville Department of Public Works. Having the data and documentation for hydrant inspections as soon as it's ready allows staff members there to create work orders for repairs more quickly.

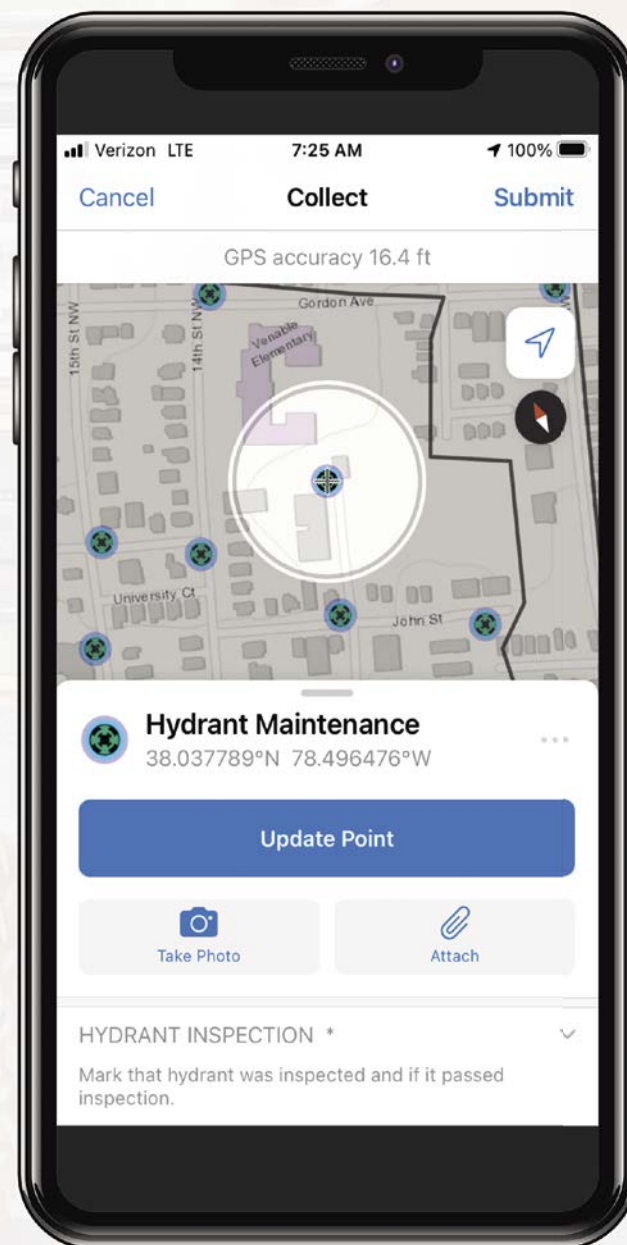
TECHNOLOGY THAT WORKS

Powers believes that, from an administrative perspective, team members have gained a huge amount of organizational equity because they seized an opportunity to improve an inefficient process.

"One of the big benefits is the goodwill of our workforce, who now believe in technology and see [that] it can work," said Powers. "Whenever we can show a win and show that life is easier with technology, that's good, because that hasn't always been the case."

Following such a favorable deployment of Field Maps, the Charlottesville Fire Department plans to use the app for hydrant inspections every year as well as broaden its use. One project will be to use the app to track the installation of free, city-provided smoke alarms.

"When you say, 'We're going to increase your productivity and save you time,' it's almost a pipe dream," said Powers. "But with Field Maps...that's exactly what we did."



↑ Field Maps makes it easy to collect and edit data on the go.

Spatial Analysis of Opioid Use Gets Lifesaving Medicine to the Right Places

According to the Centers for Disease Control and Prevention (CDC), nearly 71,000 overdose deaths in the United States in 2019 involved opioids. In addition, the economic burden of the opioid crisis—including health-care and treatment costs, lost productivity, and criminal justice involvement—totals \$78.5 billion per year.

Fortunately, overdose treatments are effective—particularly naloxone, a medication that quickly reverses the effects of opioids. Naloxone is easy to administer and has been used for many years as an immediate treatment for opioid overdoses. Distribution programs for naloxone, which train nonmedical persons to recognize opioid overdoses and administer the medication, have been around since the 1990s. And more recently, a widely adopted “leave behind” program expanded access to naloxone by having emergency medical services (EMS) personnel who respond to an opioid overdose leave behind a naloxone kit with friends or relatives in case the person overdoses again.

In Hamilton County, Tennessee, approximately 106 people died from overdoses and other drug-related issues in 2019, and that number increased by 50 percent in 2020 to about 160, according to the medical examiner (ME). Law enforcement agencies across the county responded to more than 700 overdose incidents in 2020, per the Tennessee Bureau of Investigation, and 90–95 percent of those calls likely involved opioids.

The rise in opioid overdoses prompted area health organizations to search for a way to get the state’s first leave behind program for naloxone up and running. Using GIS, a research team at the University of Tennessee at Chattanooga

(UTC) and its Interdisciplinary Geospatial Technology Lab (IGTLab) analyzed opioid overdose trends in Hamilton County and determined the most effective way to distribute naloxone kits among local EMS stations.

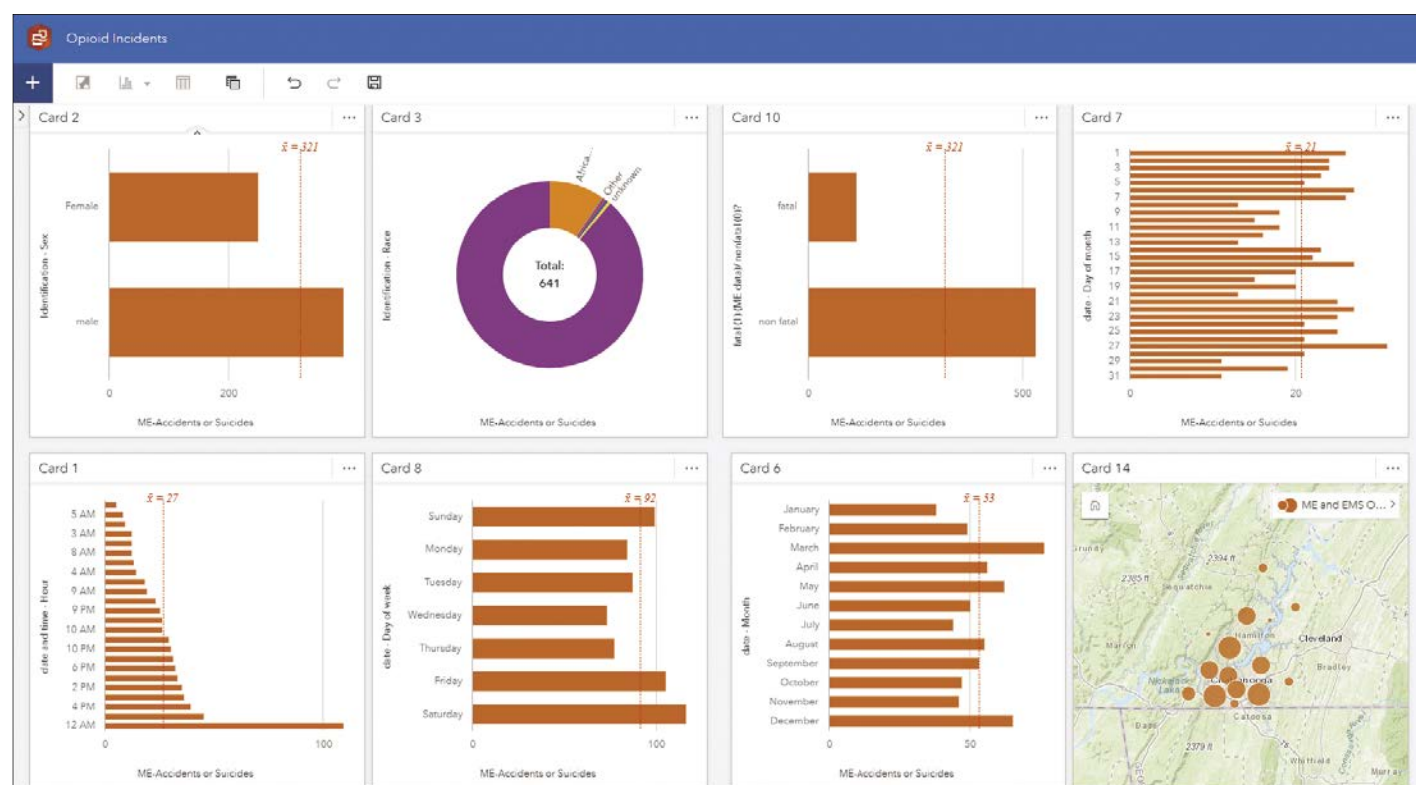
Identifying Clusters of Overdoses

The IGTLab, run by UTC GIS director Charlie Mix, provides spatial data analysis and

cartographic support to UTC faculty, staff, and students and the greater Chattanooga community. It also gives students unique learning opportunities that help them hone their GIS skills on real-world problems while supporting local nonprofits and other organizations.

“Over the years, the lab has provided GIS support in areas including conservation, outdoor recreation, and public health,” said Mix.

It was 2018 when the IGTLab was approached by a coalition composed of the University of Tennessee Health Science Center, Erlanger Health System, and the University of Tennessee at Chattanooga to help develop solutions to the area’s opioid problem. The group had a limited supply of naloxone kits and wanted to come up with spatially based criteria for allocating them.



Charts and graphics in ArcGIS Insights helped the team see the month, day, and time when opioid overdoses are most common and gain a better understanding of the victims’ demographics.

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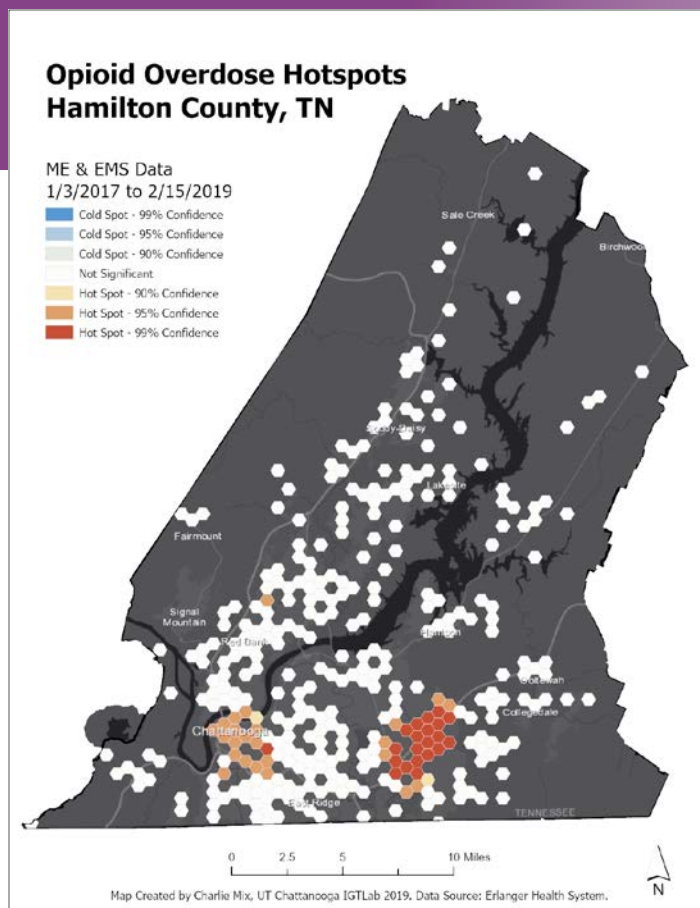
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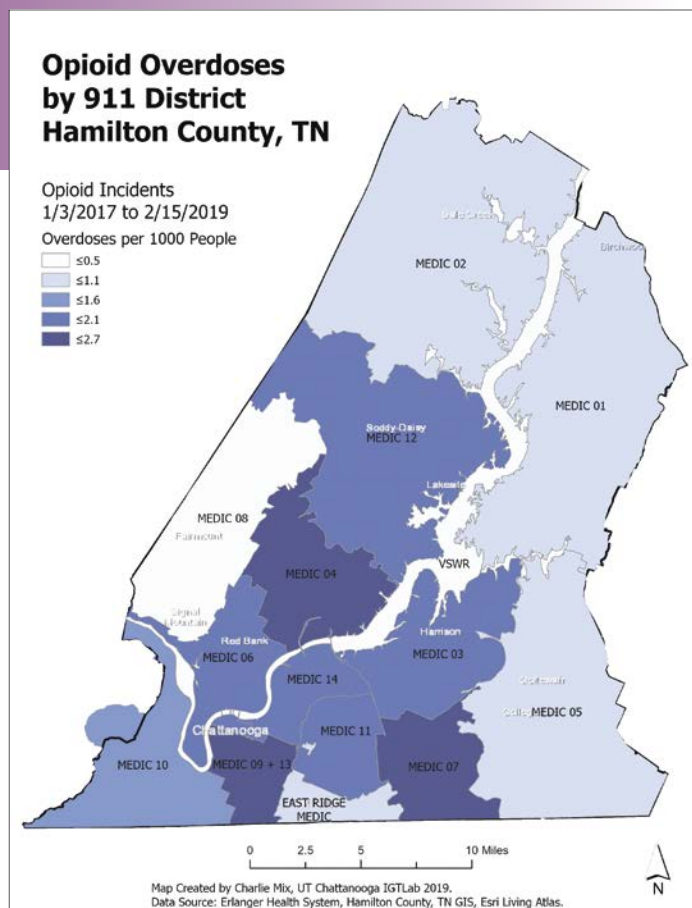
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↑ Identifying opioid overdose hot spots in Hamilton County, helped the research team determine where to target interventions.



↑ The team calculated the rate of overdose cases per emergency medical services (EMS) service area and created maps, like this one, that showed the normalized rate of overdoses by 911 response zone.



↑ When responding to an opioid overdose call, emergency personnel can leave behind naloxone, a medication that quickly reverses the effects of opioids.

Mix and UTC GIS analyst Nyssa Hunt used ArcGIS Pro, ArcGIS Online, and ArcGIS Insights to conduct the spatial analysis. They obtained two years of tabular EMS response and ME reports for opioid overdoses, which were scrubbed of personally identifiable information, from researchers in the coalition.

To geocode the data, team members used the ArcGIS World Geocoding Service. They did the EMS data separately from the ME data, since they were in different schemas. Duplicate records in the datasets were identified and removed.

The EMS data and the ME data were then combined in ArcGIS Pro using the Merge tool, and data schema differences were reconciled using the Field Map parameter. This workflow resulted in three separate opioid overdose point datasets that were suitable for analysis: EMS data, ME data, and EMS and ME data combined.

The team then used the geoprocessing tool Optimized Hot Spot Analysis in ArcGIS Pro to identify spatial clusters of opioid overdoses for all three datasets. These represented areas in the county with the most overdoses over the study period, which was two years.

“This allowed *[for]* the easy identification of areas in the county with the most overdoses reflected by the data,” said Mix.

Recognizing Patterns of Opioid-Related Deaths

To apportion the naloxone kits, the research team, along with the two doctors leading the study, decided to distribute them based on the number of opioid overdose calls each EMS station got. This would identify which EMS stations were likely to respond to the highest number of opioid overdoses and provide an opioid overdose map for EMS station coverage areas.

For this analysis, the team first needed to calculate the opioid overdose percentage for each EMS coverage area. This would be used to determine the proportion of the total number of naloxone kits to allocate to each EMS station.

To evaluate the total number of overdoses per 911 response zone in Hamilton County, team members performed a spatial join of the point data representing opioid overdoses and a shapefile of the 911 response zones served by the EMS stations. Then, using the Enrich tool in ArcGIS Pro, they determined the total estimated population for each 911 response zone and used that to calculate the rate of overdose cases per EMS service area. This allowed the team to create maps that displayed the normalized rate of overdoses by 911 zone.

“Visualizing the data in this way enabled us to recognize patterns of opioid-related deaths within the county,” said Dr. Rebecca Martin, an emergency medical physician with Erlanger Health System who was involved in the project. “Identifying opioid overdose hot spots within Hamilton County allowed us to better understand the local epidemic and where to target interventions.”

Additionally, because Erlanger Health System operates multiple regional hospitals

and emergency departments throughout the county, the data has “influenced administrative decisions within the health system regarding where to initiate programs aimed at combatting the opioid epidemic in order to benefit the most patients,” Martin added.

Gaining Deeper Understanding

In presenting their findings, team members from IGTLab also wanted stakeholders to be able to quickly understand other descriptive data contained in the EMS reports and ME records. So they used ArcGIS Insights to create and share graphs and other visuals that showed trends buried in the data, such as the age and racial characteristics of those who overdosed and the month, day, and time when these events occurred most frequently. It also gave researchers and medical planners the added benefit of interacting with the data and being able to perform their own analyses.

“The data has been used by administrators to reallocate EMS resources as well as emergency department resources to better serve the most vulnerable populations,” said Jessica Whittle, director of research in the Department of Emergency Medicine at UTC. “In addition, some of our medics have indicated that it gave them a sense of encouragement because they felt that the high rates of overdoses they were seeing were everywhere, when in fact they were working in an overdose hot spot. Now they view themselves more as specialists rather than people fighting an unwinnable war.”

Projects like this illustrate the power of maps and GIS as a collaborative tool for taking action and bringing about change, according to Mix.

“The UTC community is grateful for Esri’s support in helping respond *[to]* and solve these issues that our communities face,” he concluded.

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After Cyberattack, Transportation Organization Recovers Using Cloud-Based GIS

By Sean Burke and Chuck Harris, GeoDecisions

To protect data and systems from cyberattacks, organizations need to be in a position to quickly identify their IT vulnerabilities.

According to a 2020 Cybersecurity Ventures report, the costs associated with cybercrimes are estimated to grow globally by 15 percent year over year for the next five years. The report calculates cybercrime costs to include “damage and destruction of data, stolen money, lost productivity, theft of intellectual property, theft of personal and financial data, embezzlement, fraud, postattack disruption to the normal course of business, forensic investigation, restoration and deletion of hacked data and systems, and reputational harm.”

When the City of Durham, North Carolina, suffered a cyberattack in March 2020, it lost all access to its servers, resulting in major data loss. One of the departments affected by the cyberattack was the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), which manages regional transportation planning for the western area of North Carolina’s Research Triangle.

With the cyberattack came the loss of DCHC MPO’s Electronic Transportation Improvement Program (eTIP), a map-based app that allows staff to search projects and identify where planned improvements are to be located. In addition, the organization lost access to all its enterprise GIS data, including municipal data layers and data for the City and County of Durham, Chatham County, Orange County, and the North Carolina Department of Transportation.

These crippling casualties left DCHC MPO in search of a solution that would not only retrieve what was lost but also put in place a plan, processes, and support to ensure that this would never happen again. Moving its data to the cloud instead of maintaining an on-premises server environment seemed to be the best solution.

DCHC MPO teamed up with Esri partner GeoDecisions to regain access to its server data; increase security; and build more efficiency by leveraging technology that includes ArcGIS Enterprise, ArcGIS Pro, ArcGIS Online, and Microsoft Azure. The GeoDecisions team decided to tackle the project in a phased approach that included procuring

cloud services, setting up the cloud environment, migrating eTIP and GIS data, conducting trainings, and doing system maintenance.

The Road to Recovery

Jumping into action, the GeoDecisions team moved DCHC MPO’s GIS databases and eTIP app to the Microsoft Azure cloud computing service. During this phase, the team developed the work plan, provided project management and oversight, and met with DCHC MPO staff members and key stakeholders to discuss recommendations for cloud migration.

To move to Azure, the team needed to identify what data would move, how much RAM and bandwidth would be needed, and whether it should be a single- or multiserver configuration. One challenge that arose during this assessment was that almost 400 feature services would need to be moved while keeping the RAM costs within DCHC MPO’s budget. The organization decided to publish existing feature services using ArcGIS Pro, which can reduce RAM consumption by taking advantage of shared instances that pool central processing unit (CPU) resources for lightly used feature services. This ended up reducing DCHC MPO’s RAM consumption needs by at least 60 percent.

Setting up the cloud environment involved consolidating servers to create a single, Windows-based virtual machine (VM) that would act as a production application and database server for the eTIP app. This VM contains all the software required to run and maintain eTIP and its supporting functions. In addition, the VM hosts the GIS databases and provides the storage and networking resources the system needs.

GeoDecisions implemented system security measures as well, which included restricting remote desktop access to specific employees’ IP addresses and updating administrators’ user names and passwords. The team also put into place DCHC MPO’s full system backup strategy, which involved using Azure’s Recovery Services vault to store snapshots of the VMs. This enables instant recovery of the system in the event of a disaster.

Finally, to migrate and configure DCHC MPO’s apps, the team installed and configured the prerequisite software packages needed for eTIP, including Internet Information Services (IIS) for Windows Server, SQL Server, and ArcGIS Server. Once all the software was installed and operative, the team began migrating the eTIP app database and additional GIS databases.

ArcGIS Online Returns

To deal with DCHC MPO’s 400 feature services, the GeoDecisions team created a script to automate the publication of each feature service to the new ArcGIS Enterprise instance. This typically tedious and manual task was completed via background processing over the course of a couple afternoons.

When the feature services were republished, they maintained their nomenclature and link structure, so no additional configuration was required to remap existing ArcGIS Online apps or various links within DCHC MPO’s GIS web presence.

With the new server structure and ArcGIS Online up and running, Casey Chae, client manager at DCHC MPO, was pleased with the outcome.

“It gave us increased security and a renewed confidence in our disaster recovery,” said Chae. “We are now able to be more proactive than reactive in our efforts to manage and protect our data.”

System Maintenance, Visualization, and Ongoing Support

In addition to assisting DCHC MPO in recovering from its cyberattack, GeoDecisions now provides maintenance of the eTIP app and the server it runs on. This includes doing Windows updates, executing minor software patches, and performing virus definition updates. The project team developed a set of test plans for the app as well to ensure that it is functioning as expected.

The owners of the eTIP app can visualize system health and costs via a portal view provided by the Azure environment. And configurable dashboards allow for more proactive monitoring of critical metrics, meaning that DCHC MPO would immediately notice and be able to

respond to issues such as high RAM and CPU usage, low disk space, or a failed backup.

Throughout the project, the GeoDecisions team created system documentation to ensure that DCHC MPO stakeholders can perform any necessary tasks themselves if need be. GeoDecisions recommended that DCHC MPO implement a backup and recovery process, too, which the two organizations worked together to develop.

A Successful Outcome

After nearly nine months of not having access to its GIS data and eTIP app, DCHC MPO is up and running again, continuing to do its important work addressing the transportation needs of the communities it serves.

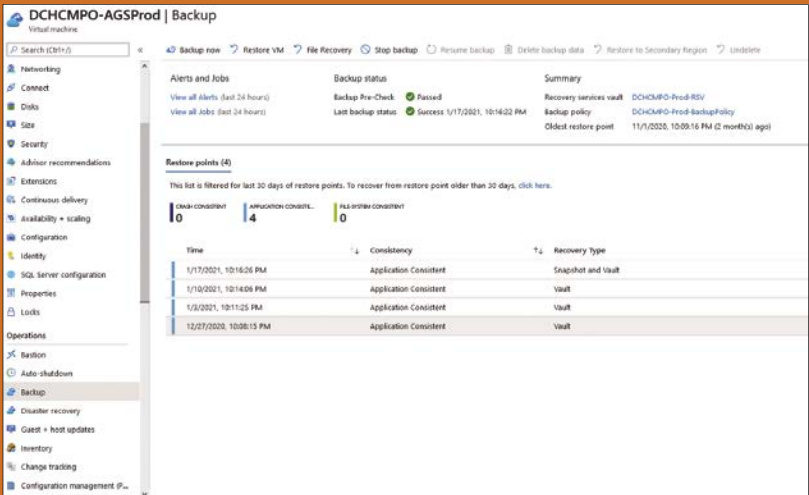
The migration to Azure provided DCHC MPO with greater security and maintenance capabilities for its data and apps. And the integration with ArcGIS Pro allowed the organization to conserve its valuable RAM budget, reducing consumption needs by 60 percent.

With the move to a more secure environment, proactive monitoring, and an improved backup and recovery process, DCHC MPO’s GIS data is now more secure and flexible than ever.

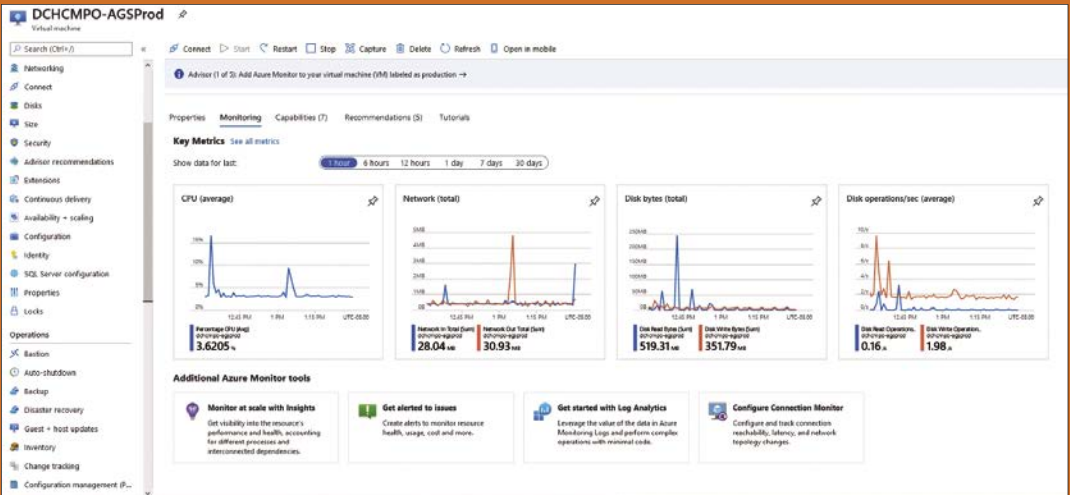
For more information, contact GeoDecisions GIS architect Chuck Harris at 804-767-1870, or visit the GeoDecisions website at geodecisions.com.

About the Authors

Sean Burke is a GIS architect at GeoDecisions and has a background in GIS database administration. He specializes in data integration and creating SQL and Python extract, transform, and load (ETL) procedures for app development. Chuck Harris is also a GIS architect at GeoDecisions. He has more than 25 years of experience in the industry and specializes in providing ongoing support and maintenance for ArcGIS Enterprise, enterprise geodatabases, and related systems.



↑ Microsoft Azure’s Recovery Services stores snapshots of virtual machines, enabling instant system recovery in the event of a disaster.



↑ Dashboards let stakeholders monitor critical metrics so that they can quickly respond to issues such as high RAM and CPU usage or low disk space.

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HOW MINNESOTA IS MAKING MAPS ACCESSIBLE

By Members of the Maps Community of Practice Team, State of Minnesota

“Make it accessible.” Gulp.

It was 2016, and the State of Minnesota was ramping up its digital accessibility efforts. Maps were on the list of products that needed an accessibility makeover, but just how to tackle this problem remained elusive. Standards such as Section 508—the US General Services Administration’s IT accessibility program—and the Web Content Accessibility Guidelines (WCAG) didn’t include detailed, map-specific information. Online resources were scarce, too. And any presentations about maps only had general solutions—for example, to use alt text for images.

So staff members did what any good government agency does when presented with a problem: they formed a committee. It started small but quickly grew into a statewide team of accessibility experts and mapping professionals who all came from diverse backgrounds. Called the Maps Community of Practice (MCOP), the team focused on creating practical guidance for making accessible maps.

The result was an online map accessibility resource center, available at ow.ly/nHCs50ELwKh. Launched in 2019, the website is filled with a growing number of guidance documents, quick tips, implementation tools, and additional web content to help anyone create an accessible map.

WHY ACCESSIBILITY?

Accessibility is crucial for making maps that everyone can use. It means taking proactive steps to remove potential barriers for people of varying abilities.

For example, high-contrast colors are important for those with color vision deficiency. Placing space around an object makes it easier for people with low vision to distinguish it. And alternative text, or alt text, helps people who use assistive technology, such as screen readers, to envisage photos, illustrations, maps, graphics, and other visuals.

The beauty of accessibility is that it assists people of all abilities. Who doesn’t appreciate a well-designed map with clear labels and a strong visual hierarchy?

WHAT MAKES A MAP ACCESSIBLE

Choosing the right design elements to make a map accessible can be challenging, especially when wading into this space for the first time. That’s why the MCOP came up with a series of top four tips for designing accessible maps.

For Map Design in General

Well-designed maps use fonts, colors, symbols, and more to help people navigate or share complex information in simple and easy-to-understand formats. Here’s how to make these choices more accessible:

- 1 Fonts**
The minimum font size for printed labels should be 6 point, and the minimum font size for explanatory text should be 12 point.
- 2 Colors**
Use a color checker, such as Color Oracle (colororacle.org), to confirm how accessible certain colors are to people with varied vision abilities. Select colors with high contrast to make important information stand out. The MCOP’s Map Design Guide, available at ow.ly/4Z9a50ELxgo, includes color palette options.
- 3 Symbology**
Use colors and symbols that people associate with what’s being represented. For example, blue should symbolize water, not land. Imitate the real world whenever possible.
- 4 Labels**
Labels should be consistent and easy to read. Make their orientation and placement uniform. Never let labels overlap.

Find more resources for designing accessible maps, including style downloads for Esri and Adobe software, at ow.ly/kmcS50ELxm0.

For Static Maps

Static digital maps are stand-alone graphics, such as JPGs or PDFs, that are not typically interactive. They serve as useful guides for visual and textual information. Here’s how these maps can be accessible to digital readers and visually impaired audiences:

- 1 Design for accessibility.**
Use descriptive text for the map’s title, captions, alt text, links, and body text to convey the map’s main messages. These elements should all work together to tell a story. Imagine you’re writing a report but don’t have the images yet and need to show a rough draft to stakeholders. What text would you use to fill in the gaps?
- 2 Enable human contact.**
Provide general contact information that is easy to find, and ensure that someone will be available to answer questions.
- 3 Export usable formats.**
Export flattened PDFs (without layers) with as few attributes as possible. Otherwise, items could disappear when adding accessibility tags to the PDF. Alternatively, export maps as images

→ Small changes in color, contrast, and label placement can increase readability for all map users.



and insert them in a document in a program like Microsoft Word or Adobe InDesign that allows users to apply accessibility elements such as headings, alt text, and metadata.

- 4 Tag maps.**
To aid assistive technology in reading and structuring static content, maps need to be tagged. Tag everything in a map as one figure or image. Add alt text to the map that complements other textual elements. Tag unique identifiers, like titles and captions, as text. For elements that are present only for visual appeal, tag them as background or artifacts.

The MCOP’s Accessibility Guide for Static Digital Maps, available at ow.ly/OSWT50ELxyM, has additional details about how to make static maps more accessible. Further information, such as how to tag maps using Adobe Acrobat, can be found at ow.ly/YATX50ELxyZ.

For Interactive Web Maps

Interactive web maps allow users to interact with maps using a mouse, keyboard, touch screen, voice commands, and other tools. Users can select areas of interest, enter coordinates, and toggle layers on and off. They can typically zoom in and out and pan around the map while data changes dynamically. Here’s how to simplify the accessibility requirements for this:

- 1 Define the map’s purpose.**
Focus on delivering key messages when designing an interactive web map. The content drives the accessibility requirements, so make the main points clear and simple.
- 2 Use native HTML.**
Where possible, use native HTML when coding elements. Only use Accessible Rich Internet Applications (ARIA) when needed, as it can complicate things unnecessarily. For example, when making a button, use `<button>` instead of `div role="button"`.
- 3 Ensure full keyboard control.**
Support a user interface (UI) that can be controlled using only the keyboard. This ensures that any user can access all the elements in a web map.
- 4 Test early and often.**
Perform both automated and manual accessibility tests to help evaluate how accessible a web map’s content is.



↑ Using certain colors can help people with color vision deficiencies—such as protanopia, tritanopia, and deuteranopia—see the details in a map.

↓ Quick cards are downloadable reference guides that summarize best practices for making accessible maps.



For additional information on making interactive web maps more accessible, see the MCOP's Accessibility Guide for Interactive Web Maps at ow.ly/ZjQw50ELxTf and visit the Interactive Web Maps web page at ow.ly/4yUr50ELxTu.

WHAT'S NEXT

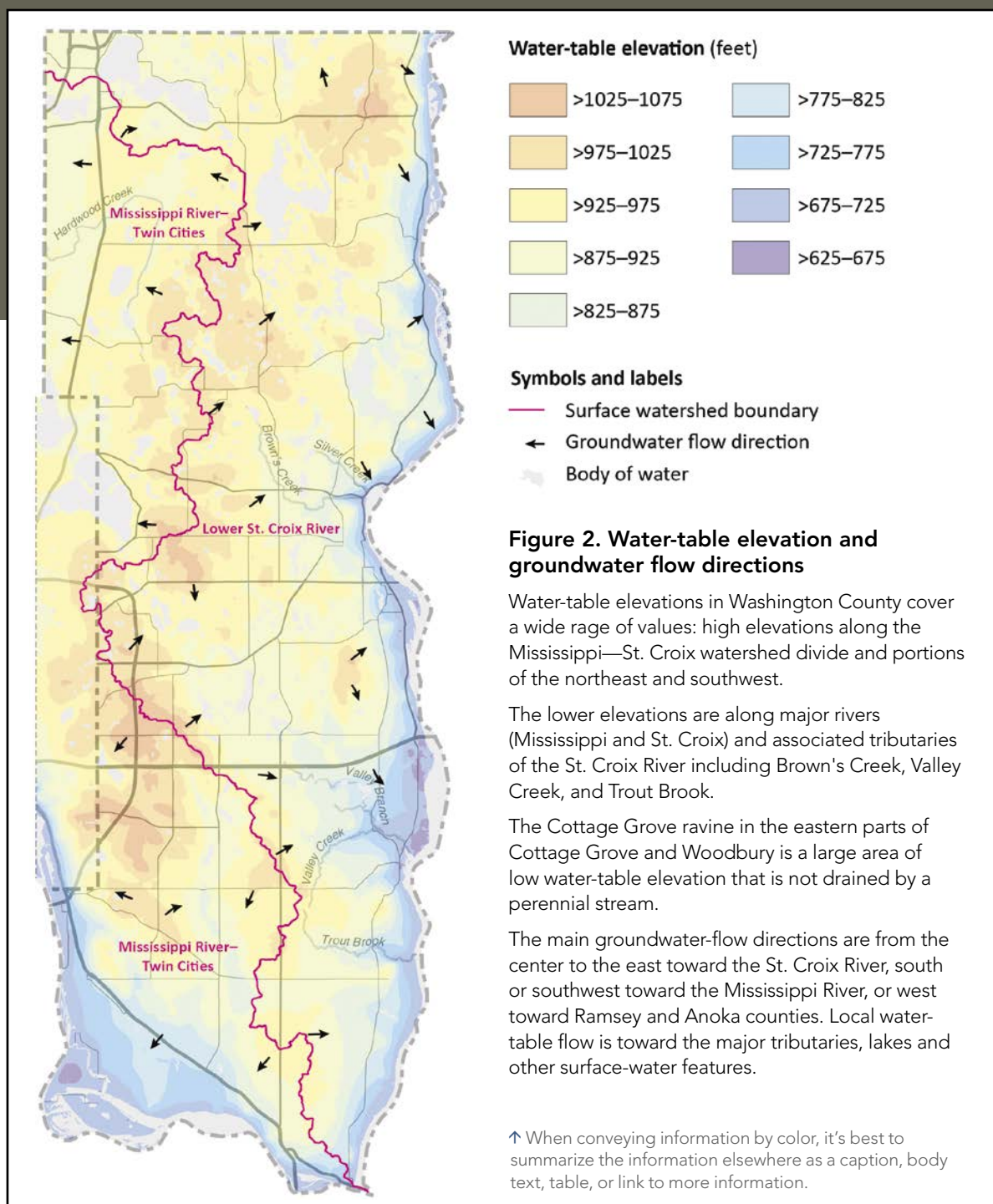
Going forward, the MCOP remains focused on providing easy-to-understand information and tools to help people make better, more readable maps. Some of its current and future projects include putting together guidance for building dashboards and interactive maps and working in ArcGIS Pro. The group also wants to continue coming up with new techniques and tools for changing technology, share more of its resources, and develop training videos.

Maps that are accessible ensure that whole audiences can fully utilize the products that mapmakers have taken so much time and care to create. Hopefully these free resources from the MCOP can help other people and organizations in their own journeys toward making accessible maps.

All information and tools produced by the MCOP are available on the Minnesota IT Services Map Accessibility web page at ow.ly/nHCs50ELwKh. For more information, email the Minnesota IT Services Office of Accessibility at MNITAccessibility@state.mn.us.

About the Authors

The State of Minnesota Maps Community of Practice team is composed of more than 60 staff members across 15 state agencies, educational and public organizations in Minnesota, and Esri employees. Team members have extensive professional experience in geography, cartography, accessibility, and web development.



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Answer the Call to Action for Equity and Social Justice

By Kathryn Brewer, Spatial Relationships, LLC

The last year and a half has been marked by the intersection of the COVID-19 pandemic, increased awareness of ongoing racism, and technological advances. The confluence of these powerful and transformative events has provided fertile ground for accomplishing real and lasting change. The opportunity to create a new, shared vision of a more equitable future is at a tipping point, and people's urge to take concrete action is palpable.

Race and place predict whether people have the opportunity to thrive, so geography matters. US president Joseph Biden recognized this when, on the day of his inauguration, he signed the Executive Order on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government. This order pinpoints the need to assess the *geographic* location of underrepresented or disadvantaged communities and to manage programs using technology.

The GIS profession is uniquely situated to lead the change that this executive order envisions. GIS practitioners are change agents that have brought new ways of doing business into organizations for the last several decades. Thus, it is no surprise that many GIS professionals are ready and eager to help make equity and social justice a reality.

The Urban and Regional Information Systems Association (URISA), with support from many key staff members at Esri, is answering that call to action by modeling how to institute organizational change and creating volunteer opportunities to do this transformative work. There are various ways to contribute that correspond to where GIS practitioners are in their own journeys regarding equity and social justice work, as well as to the level of commitment they can make.



↑ Many GIS professionals are ready and eager to help make equity and social justice a reality.

Begin with Individual Change

The first and most important step to take to confront racism and other systems of oppression that lead to inequities is at the individual level. Prosci, a leading change management organization, recognizes this in its article "5 Tenets of Change Management" (available at ow.ly/WKuJ50EMm3j), which states, "Organizational change requires individual change."

Challenging topics such as racism, equity, and social justice are often thought to be easier to work through in external settings, by participating in or donating to organizations doing work on institutional racism, for example. However, Dr. Tiffany Jana—CEO of

TMI Consulting Inc., cofounder of Loom Technology, and partner at Now Partners—reminds us that the core of what we can do to heal racism lies within ourselves.

"The minute that we are unkind to another human being, it doesn't matter what their identity is, necessarily. An act of unkindness, a thought of unkindness, or any action that makes one person feel excluded or a group of people feel excluded, these are the *[kinds]* of actions that reflect something back at us," Jana stated in a lecture they gave during the Inner MBA program for New York University's MindfulNYU program.

Most people are afraid of this unwanted reflection of themselves. Instead of lashing out because of fear, though, Jana went on to explain that "the minute that you find those experiences, or you know that you have not been kind, or you know that your thoughts were biased and a little bit skewed, it's important to identify those, to forgive yourself, and *[to]* have grace for yourself, understanding that this is a journey...and all of it is an opportunity to learn and grow."

GIS is a powerful tool for driving transformative change. It is imperative that each practitioner use the technology consciously and with clarity of character to create welcoming spaces that foster equity and belonging.

URISA Leads by Example

Just as it is important for individuals to confront racism, it is also crucial for organizations to reflect on their work and look for opportunities to modify policies, practices, and procedures that contribute to institutional racism.

Leading by example, URISA has formed the Pro-Equity Anti-Racism (PEAR) committee, which will review the organization's internal practices annually and inform its yearly work plans and budgets. The committee is led by pioneering professionals in the GIS field who have extensive experience doing this invaluable work at other organizations. PEAR worked with URISA's GISCorps to gain a valuable volunteer, Rylee Wrenner, to use ArcGIS Hub to create a hub site—scheduled to launch later this year—that supports community involvement in pro-equity and antiracism efforts. Anyone with experience in antioppression work, particularly in antiracism, is encouraged to reach out and lend their expertise to the process. Please email cochairs Nicole D. Franklin at customerservice@enhanced-interactions.com or Greg Babinski at greg.babinski@kingcounty.gov to learn more about PEAR.

URISA also established the GIS for Equity and Social Justice workgroup, which is poised to take external action against racism and social injustice as part of the Professional Education Committee. In partnership with PEAR, these groups authored URISA's *Anti-Racism Pro-Equity & Social Justice Statement* as well as An Open Letter to Acknowledge and Combat Anti-Asian Hate. Other areas of focus for this workgroup are GIS and redistricting, developing social justice indicators, hosting workshops, writing book reviews, and putting together informative articles to continue educating URISA members—and others—about these important topics. To learn more, reach out to the GIS for Equity and Social Justice workgroup chair, Judy Colby-George, at jcg@spatialalternatives.com.

If staying local is more enticing, connecting with local URISA chapters (listed at ow.ly/Lgt050EMm6o) is also a great way to get involved. The New England Chapter of URISA (NEURISA), for example, is in the process of organizing a new GIS for Social Justice subcommittee. To learn more about this initiative, email NEURISA chapter president Jodie Gosselin at neurisa@gmail.com.

Tools That Can Help Bring About Change

While the focus of this article has been on making personal and institutional change, it is also useful to talk about the tools that can help bring about these transformations. Esri has developed a framework, along with targeted geospatial solutions—all available at esri.com/racial-equity—to advance racial equity and social justice. Esri education manager Joseph Kerski also has a great blog, at ow.ly/PKAq50EMmqd, that highlights good resources for teaching about racial equity and social justice using GIS.

In addition, PEAR committee cochairs Franklin and Babinski developed a half-day workshop to introduce GIS professionals to doing racial equity and social justice work. Registration is open and available at ow.ly/e84950EMmqU. In 2019, Babinski was awarded the EthicalGEO Fellowship by the American Geographical Society to study how GIS is an effective tool for equity and social justice work. The resultant article, which contains best practices and is published on the EthicalGEO website at ow.ly/MK5n50EMmrY, has been peer reviewed by more than 50 GIS professionals and ethical and social justice practitioners.

What About Other Inequities?

Given that URISA and Esri have made antiracism a priority, this might spark curiosity about how other oppressed communities—including but not limited to women, immigrants, members of the LGBTQIA community, and people who identify as neurodivergent and differently abled—will be heard.

By examining where institutional racism exists in GIS, new practices will be put in place that ensure that other underserved groups gain a sense of belonging, too. In short, antioppression work that utilizes an equity lens for one underserved community helps lead the way for equitable change for all.

Now is the time to create lasting change for racial equity. Please join the effort at whatever level resonates with you, with whatever time commitment you can make. Let's also keep the conversation going on URISA Connect at connect.urisa.org.

To learn more about other URISA volunteer opportunities, visit ow.ly/CRRF50EMmuv. For more information, email Kathryn Brewer at kathrynb@spatial-relationships.com.



↑ Creating lasting change for racial equity will put in place new practices that ensure that other underserved groups gain a sense of belonging, too.

About the Author

Kathryn Brewer, GISP, is a partner at Spatial Relationships, LLC, and has more than 20 years of experience leading change in the geospatial technology field. She currently serves on the URISA Board of Directors and as board liaison to PEAR and the GIS for Equity and Social Justice workgroup. While working diligently in the geospatial technology field, Brewer is bridging her professional and personal lives by championing neurodiversity in many areas, including the workplace. Her goal is to lead—and be—the change needed to create workplaces where neurodivergent individuals are not only welcome but sought after as well for their expertise and unique perspectives.

Managing GIS

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

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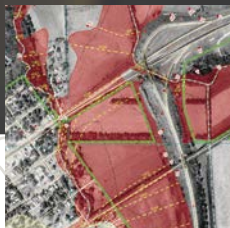
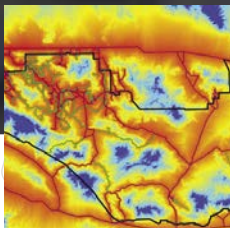
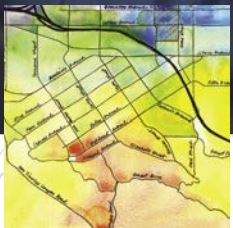


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From the Meridian

By Michael Goodchild
University of California, Santa Barbara



Geoethics in the Geospatial Community

Ethics has long been a topic of concern in the geospatial community. Since the earliest development of technologies that permitted remote and closeup surveillance, geographers have been concerned about the limits—or, more accurately, lack thereof—of what is possible with geospatial data collection.

Interest in geoethics has increased dramatically in recent years with the rise of social media and personal devices that serve up abundant user data, as well as the greater capacity of open mapping and voluntary data collection. Building on previous efforts over the past two decades, the American Geographical Society currently has its EthicalGEO project (ethicalgeo.org); the American Association of Geographers (AAG) and Open Geospatial Consortium, Inc. (OGC), have organized online meetings to discuss ethics; and the United Nations Global Geospatial Information Management group is focusing on teaching geospatial ethics.



Such interest may reflect a response to the growing power of geospatial technology and its potential for intrusion, surveillance, and misuse. This interest has been especially prominent during the COVID-19 pandemic, which has shown, more conspicuously than ever before, the potential of geospatial technology to trace individuals and their contacts. Perhaps the increased engagement with geoethics also reflects the consequences of the rapid research that had to be done to track the spread of COVID-19—consequences that may have included cutting security and privacy corners to produce helpful results.

This year, the AAG, in collaboration with Esri and the Center for Spatial Studies at the University of California, Santa Barbara (UCSB), began a multiyear conversation about ethical issues associated with location information and geospatial technologies. Currently, the project is taking the form of a webinar series. The first of these, on ethical spatial analytics, occurred on February 9. More gatherings are planned in the next few months with the intent of holding an international summit in late 2021 or early 2022.

The series seeks to bring together geospatial professionals from all sectors—academics, industry, and nongovernmental organizations—to create an action plan for directing greater attention to the ethical issues facing those of us who practice geography and GIS. The organizing committee, which I cochair along with AAG executive director Gary Langham, has been working for the past half year to put this programming together. Led by AAG director of geographic research Coline Dony, committee members include Mei-Po Kwan of the Chinese University of Hong Kong, Jeremy

Crampton of Newcastle University in the United Kingdom, Katina Michael of Arizona State University (ASU), Richard Appelbaum and Krzysztof Janowicz of UCSB, and William Herbert of Hunter College of the City University of New York.

Geoethics is a vast topic. Some of the ethical issues we face are common to all professions, although the expression of these issues is distinctly spatial. Diversity, equity, and inclusion are especially important, as many events from 2020 demonstrated, such as COVID-19's inequitable impacts in terms of race and income and the highlighted police violence that is part of larger, ongoing patterns in the United States. Other ethical issues arise more or less uniquely in the activities of geospatial professionals. The project has chosen to focus the majority of its efforts on these.

Organizers of the geoethics series developed four topic areas to address both the overarching issues and the specifically geographic concerns. These will form the initial emphasis of our conversation, although we fully expect to modify and augment the following topics as other matters are identified:

- **Surveillance:** The availability of technologies that do surveillance—tracking individuals, recognizing faces in closed-circuit television (CCTV) videos, building profiles of individuals based on their spatial behavior, and compiling information on people's social contacts—raises many ethical issues. What can be done to protect individuals' privacy while preserving individuals' freedom?
- **Labor and employment:** Surveillance is increasingly used in the workplace, much of it with a geospatial dimension. How can workers be protected? What regulations are needed? What are best practices in this area? And how should employers deal fairly with employees?
- **Governance:** What are alternative models for the ethical regulation of geospatial technologies? What ethical issues are raised by open data and software, data ownership, and the presence of both private and public agencies in the geospatial industry?
- **Geospatial analytics:** Analyzing geospatial data, as well as formulating predictions and drawing inferences from it, raises important ethical issues. Some of these are well known, such as the ecological fallacy and the effects of modifying areal units. New issues are coming to light with the growth of geospatial artificial intelligence (GeoAI), the ability to replicate and generalize inferences from geospatial analytics, and the ease with which anonymized data can be reidentified.

In its earliest stages in late 2019 and early 2020, this geoethics project was supposed to have launched at an in-person meeting

in Santa Barbara. But the arrival of COVID-19 postponed that, and the webinar program was introduced to build interest and momentum.

The first webinar in February was organized jointly with ASU as its 2021 Spatial Analysis Research Center (SPARC) workshop. It attracted more than 250 registrants. Peter Kedron and Amy Frazier of ASU moderated the webinar, and five speakers introduced four major topics on ethical spatial analytics:

- Mia Bennett from the University of Hong Kong and Luis Alvarez León from Dartmouth College discussed the ethical implications and property regimes of remote sensing, along with the importance of ethnography as a human-oriented source of ground truth.
- Peter Rogerson from the University at Buffalo presented ethical paradoxes that arise when attempting to make decisions based on inferences informed by doing spatial statistical analysis on sociodemographic data.
- Renee Sieber from McGill University discussed the ethical implications of GeoAI and locational big data, touching on the use of doorbell video cameras, biases in facial recognition technology, the internal workings of machine learning systems, and the ethical responsibilities the investigator has in using these tools.
- Jacqueline Vadjunec from Oklahoma State University focused on the ethical dimensions of spatial analyses based on data generated during citizen science projects, the ongoing need for mixed methods research, and the implications of both for reproducibility.

Video recordings of these presentations and the subsequent discussion are available at sgsup.asu.edu/sparc/ethics.

It has become abundantly clear from these and previous efforts that ethical issues emerge throughout geospatial practice. In my own teaching, I have addressed many of these under the rubric of critical spatial thinking—that is, the thought processes that experienced users of geospatial technologies go through. For example, what do I know about the origins and quality of this dataset, and what does it *not* tell me about real conditions on the ground? The data seems to support a particular inference, but what other inferences might also explain the data? What can I do to ensure that the results of this analysis are used appropriately and in the best interests of the public? Our students must be encouraged to think beyond the immediate operations of the GIS interface and about each project's broader ethical issues—and then carry those concerns with them into their careers.

Additional webinars in the series will be announced when details become available, so please check the website at ow.ly/LAu450Efa2L for updates. The organizing committee is hoping that the long-delayed face-to-face meeting will be possible in December.

We welcome any comments about and expressions of interest in the project, the webinars, the in-person meeting, and other activities. Please contact me (good@geog.ucsb.edu), Coline Dony (cdony@aag.org), or any other member of the organizing committee.

About the Author

Michael Goodchild is an emeritus professor of geography at UCSB. He holds positions at universities around the world, including distinguished chair professor at the Hong Kong Polytechnic University and research professor at ASU. Until his retirement in June 2012, Goodchild held the Jack and Laura Dangermond Endowed Chair in Geography and was the director of the UCSB Center for Spatial Studies.

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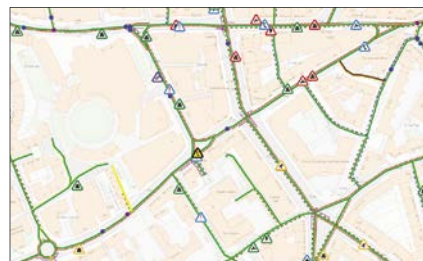
Geographic Business Solutions, Ltd. (GBS) | gbs.kiwi

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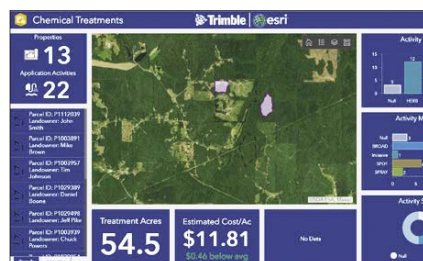
Symology | symology.co.uk

Symology's new integrated street works and asset management solution, Aurora, offers users a feature-rich experience along with real-world benefits. Built on ArcGIS Enterprise and ArcGIS API for JavaScript, Aurora dynamically connects clients with their information so they can efficiently manage assets and highway networks.



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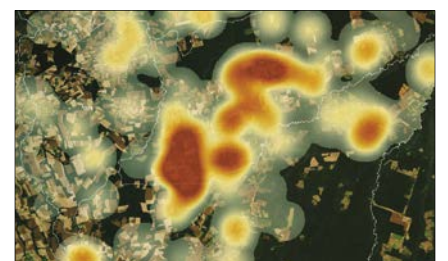
Timmons Group | timmons.com/gis

Timmons Group's technology practice has consistently employed Esri software to facilitate robust user engagement. Throughout the COVID-19 pandemic, the organization advanced this use to facilitate public meetings and interface with stakeholders in a richer way by incorporating ArcGIS Hub, ArcGIS StoryMaps, and ArcGIS Survey123.



VEGA Monitoramento | vegamonitoreamento.com.br

Brazilian company VEGA Monitoramento, which focuses on agribusiness and the environment, is committed to ensuring the origin and sustainability of products throughout the food chain. Incorporating ArcGIS technology into its data, monitoring, and spatial intelligence deliverables, VEGA supports decision-making at trade organizations, cooperatives, and suppliers.



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To help retailers, local governments, and real estate companies in Europe invest in the right retail locations, Locatus gathers its own data on shops and consumer-oriented service companies and makes this information accessible to clients through Locatus Online, an ArcGIS technology- and web-based platform.



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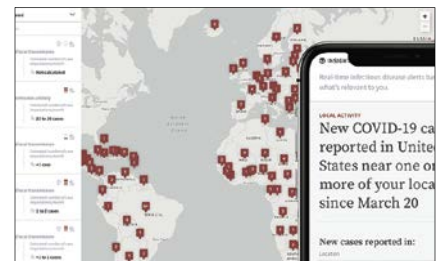
UM is a leading provider of human movement data for retail companies, restaurants, tourist organizations, city governments, and academic institutions. With datasets optimized for ArcGIS Pro and ArcGIS Online, organizations rely on UM to furnish timely, accurate, and efficient business intelligence on people and places.



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BlueDot | blue dot.global

BlueDot combines artificial intelligence (AI) with medical expertise to deliver comprehensive information on epidemics. The team anticipated the spread of Ebola and the Zika virus and published what it believes was the first paper on COVID-19. With ArcGIS Pro, BlueDot has empowered governments and businesses throughout the pandemic.



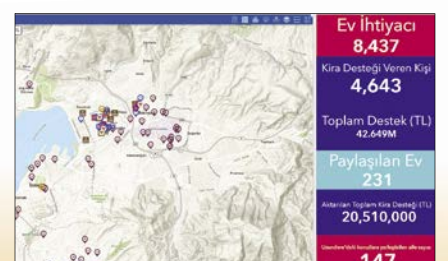
GeoAcuity | geoacuity.com

GeoAcuity provides geospatial insight, analytics, and mapping solutions to commercial and government sectors. During California's recent wildfires, it partnered with public safety unmanned aerial system (UAS) teams to leverage Site Scan for ArcGIS, ArcGIS Pro, and ArcGIS Online to deliver geospatial intelligence in record time.



IDEMA | idema.com.tr

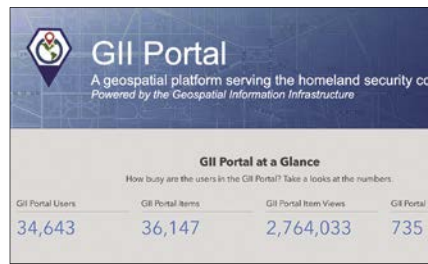
Turkish consultancy IDEMA generates innovative ideas and map-based solutions for national and international projects that revolve around socioeconomic development. Using real-time, location-based analytic data collection with software such as ArcGIS Survey123, IDEMA has helped clients improve their productivity and efficiency during crisis management situations.



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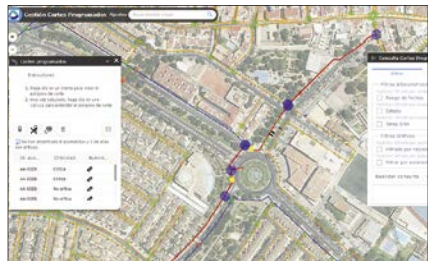
SSP Innovations | sspinnovations.com

SSP Innovations delivers ArcGIS Pro solutions to electric and gas utilities, telecommunications providers, and pipeline operators around the world. Its solutions are designed to help customers meet their unique business challenges through a combination of deep technology expertise and unmatched familiarity with industry best practices.



Tracasa | tracasa.es

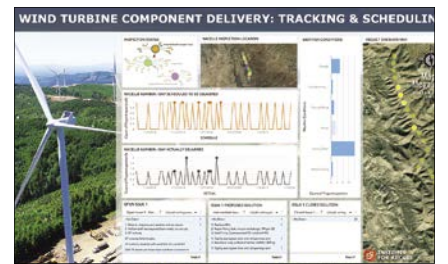
Based in Spain, Tracasa provides GIS services to water distribution organizations to help them improve how they manage resources. Employing the ArcGIS system ensures that clients use data and information efficiently. Currently, Tracasa works with 11 water companies in Spain, serving 4.5 million people.



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Aegean Energy Group | aegeanenergygroup.com

Aegean Energy Group's Maps to Megawatts solution helps wind and solar companies organize and manage the development, construction, and operation of renewable energy projects. A comprehensive, web-based mobile solution that leverages a suite of ArcGIS technology, Maps to Megawatts is technologically advanced, scalable, and secure.



Atos | atos.net

Atos is a global leader in providing secure and decarbonized digital transformation services and solutions. Using ArcGIS Enterprise, the company delivers hybrid and scalable cloud-based spatial solutions to diverse customers, such as Germany's Federal Office for Goods Transport (known by its German acronym, BAG).



1Spatial | 1spatial.com

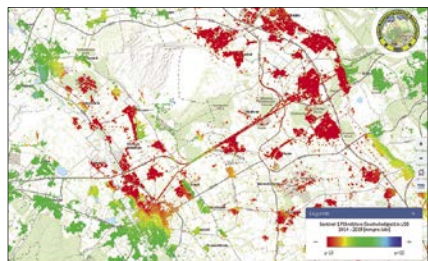
Working primarily with government, utility, and transportation organizations, 1Spatial is an international leader in offering software as a service (SaaS)-based solutions for managing geospatial data. Its 1Spatial Location Master Data Management (LMDM) platform delivers powerful business applications on premises, via mobile devices, and in the cloud.



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con terra | conterra.de

con terra transforms technological innovation into measurable success. When companies and organizations integrate con terra's ArcGIS technology-based GeoIT solutions into business operations, they make their data decisive. This puts geoinformation to profitable use—making processes more efficient, cost-effective, and transparent in the long term.



Swift Geospatial | swiftgeospatial.solutions

Swift Geospatial converts data into knowledge. For the forestry, agriculture, and mining sectors, the company provides advanced GIS analytics derived from remotely sensed data, including satellite imagery. Clients get ongoing decision support via Esri imagery services that are delivered through an online monitoring web app.



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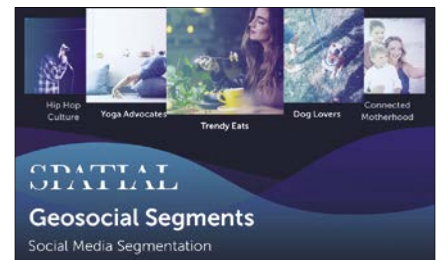
Geospark Analytics | geospark.io

With Geospark Analytics's AI engine, users can mitigate risk and capitalize on opportunities by identifying and forecasting emerging global events. The Federal Emergency Management Agency (FEMA), for example, integrates these AI models into ArcGIS Online apps to aid with disaster readiness and response.



Spatial.ai | spatial.ai

Spatial.ai's geosocial dataset, which works in ArcGIS Business Analyst and ArcGIS Pro, organizes public, geotagged social media posts into 72 segments. Companies like TSCG, Subway, and P&G use this data to predict sales by identifying specific social behaviors within proximity of potential retail sites.



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Equinox Geospatial partners with clients across the renewable energy sector to fully integrate their projects from development through construction and even into operations. Its specialties include implementing ArcGIS Enterprise and web-based mapping tools and building custom solutions for ArcGIS Survey123 and ArcGIS Field Maps.



SymGEO | symgeo.com

Located near Washington, DC, SymGEO provides digital community engagement platforms and innovative GIS solutions to government, commercial, and nonprofit organizations. Specializing in ArcGIS Hub, ArcGIS Online, data analytics, visual design, and focused messaging, SymGEO helps clients make well-informed decisions and communicate clearly with their audiences.



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Spatial Business Systems (SBS) | spatialbiz.com

SBS provides intelligent design solutions that help utility and telecommunications organizations leverage their investments in GIS, CAD, and enterprise systems. SBS utilizes ArcGIS Utility Network and other Esri technology to help its clients streamline workflows, improve design, and engage in building information modeling (BIM).



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Accurate addressing is crucial to the rhythms of modern life. Whether dispatching basic deliveries, ensuring that service providers perform the right work, or helping emergency responders save lives, there are times when it's critical that people be found.

But in an age when communities and industrial areas are continually changing or expanding, accurate addressing, in some ways, has never been more complicated to achieve. It can be difficult to locate the right address, especially in large multiunit developments such as apartment buildings, colleges, hospitals, and commercial complexes. And the time wasted trying to complete the last 100 feet of an address search can be costly.

That's why one innovative company, Esri startup partner One Hundred Feet (beans.ai), is using advanced geographic data to improve address accuracy at every step of the journey.

The Challenges of Complex-Level Address Data

In the United States, about a quarter of all recorded addresses contain multiple units. Those units sometimes have distinct spatial locations, making them hard for people to find once they arrive on-site.

With most complex-level address data, one location point represents many individual units that are spread over a considerable area—at times even in separate buildings. What's more, depending on what the adjacent road network looks like, some units aren't even accessible from the official address point.

This lack of accurate subaddress geocoding creates significant challenges. Delivery companies, for example, experience costly delays in the final 100 feet of distribution if their drivers have to search for the correct address. This kind of time wasted is particularly challenging for gig-economy delivery drivers, who depend on efficiency to ensure customer satisfaction and, ultimately, their ability to earn an income.

Inaccurate unit-level addressing also affects utility and internet companies that are looking to provide precise services. And when emergency responders need to reach people quickly, they can't afford to spend time searching large complexes for the correct unit.

Precise Location Data to Navigate Multiunit Developments

One Hundred Feet, a geospatial mapping company based in Palo Alto, California, is using precise location intelligence to create maps of addresses in complexes that include even structural features such as stairwells and entrances. The data that the company generates enables users to navigate to an exact destination in a housing, office, or industrial complex, eliminating the problems that tend to occur in the last 100 feet of an address search.

The startup built an adaptable framework that integrates address data drawn from diverse sources, including field operations and machine learning data models. Its in-house tools, combined with GIS software made accessible through the Esri Startup Program, have allowed One Hundred Feet to move quickly to create detailed address data for complexes across the United States.

"Becoming an Esri startup partner gave us access to a wide range of remarkable GIS tools and solutions," said Nitin Gupta, cofounder and CEO of One Hundred Feet. "It's really helping us tackle the toughest challenges in address mapping."

Employing massive field operations using apps such as ArcGIS Survey123 and ArcGIS Collector, together with machine learning models, One Hundred Feet is creating a wealth of data for apartments and multiunit dwellings at scale. Its data includes the following:

- Unit geocodes—accurate locations of units in apartment buildings and other types of complexes
- Semantic waypoints, such as the locations of entrances, elevators, and parking, to enrich unit context
- Points of interest, including swimming pools and community entrances
- Above ground level (AGL) and above sea level (ASL) elevation

By combining location and elevation data, One Hundred Feet's datasets can be used in augmented and virtual reality simulations of apartment units and other features. Additionally, the

company is working on accurately mapping indoor elements to enhance indoor navigation.

To accommodate the wide array of use cases for this subaddress-level data, One Hundred Feet provides its data in several formats, including a hosted geocoding service, hosted feature services (for units, entrances, points of interest, and more), reference tables, and an enterprise geodatabase. This range of offerings allows users to easily integrate the company's services into web apps, mobile apps, ArcGIS Pro, ArcGIS Online, and more.

A Positive Impact on Several Industries

One Hundred Feet has mapped more than eight million apartment units in the United States and now has what it believes to be the largest database of pinpoint multidwelling address locations in the country. With its unit locations presented as point features, the company has generated a granular network dataset of high-quality subaddress data that is already having an impact on several industries.

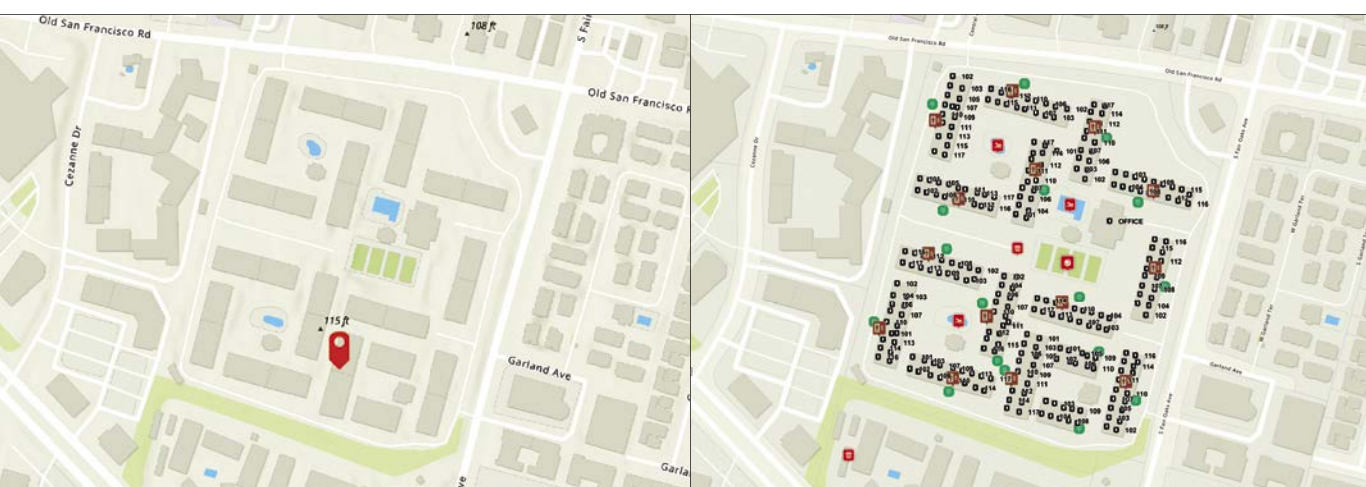
Delivery drivers, for instance, have reported reduced trip times of, on average, two to eight minutes per trip and a 40–50 percent decrease in failed deliveries. Both outcomes have a direct impact on logistics companies' bottom line.

Utility asset managers can now perform network tracing and modeling at the subaddress level. This helps them provide more accurate and timely services.

And public safety agencies that use One Hundred Feet's subaddress unit location data, along with maps that show key features such as entrances, parking locations, and stairwells, have reported reduced arrival times for emergency responders. According to the American Heart Association, when someone has a cardiac incident, every minute that passes without CPR decreases that person's chance of survival by 7–10 percent. So the faster that emergency responders can find people, the greater the number of lives that can be saved.

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

→ It can be difficult to locate the right address in large, multi-unit developments like apartment buildings and college campuses.



↑ A map with typical addressing (left) has one location point that represents many individual units, whereas a map with subaddress-level data (right) identifies the various units.



The Relevance of Cartography

A Cartographer's Perspective

By Tim Trainor

President, International Cartographic Association



New Book Highlights Importance of Cartography in Achieving SDGs

Cartography is a highly effective tool for engaging with the Sustainable Development Goals (SDGs), the objectives set forth by the United Nations (UN) to ensure a more sustainable, equitable future. That's why the International Cartographic Association (ICA) partnered with the UN to produce a valuable book—*Mapping for a Sustainable World*—for anyone interested in how mapping can contribute to understanding the SDGs.

Recently released as an e-book (available at ow.ly/yQP950Eyex7), *Mapping for a Sustainable World* is a must read for those who are contributing to or acting on the SDGs. At one level, it is a basic cartography textbook centered on the singular theme of the SDGs. But on another level, it shows how the processes involved in making maps, including managing data, can pinpoint areas that need more attention and, ultimately, help achieve the SDGs.

A Big Topic Revolving Around One Theme

Mapping for a Sustainable World has myriad uses, from educating those who seek knowledge about the world to supporting experts in one of the many disciplines—cartography—that can be wielded to attain these goals.

As Kyoung-Soo Eom, chief of the UN's Geospatial Information Section, notes in the foreword to the book, "The United Nations Secretary-General called for making better use of data so that everyone, everywhere uses data for insight, impact, and integrity." Cartography does this, he continues, by enabling people to analyze large amounts of data and visualize the results.

According to the editors of *Mapping for a Sustainable World*, the book offers "guidelines for mapping geographic datasets related to the SDGs by introducing basic principles of map design and use, discussing established best practices and conventions, and explaining how different mapping techniques support understanding of the SDGs."

In a sense, then, this is a book about cartography, the various types of data used for mapping, and how one can create different maps—all using the SDGs as a common theme. This single-purpose approach to teaching the fundamentals of cartography enriches the value of the practice by also fostering increased knowledge about the SDGs.

An Extensive Survey of Cartography

Mapping for a Sustainable World is divided into four sections: SDGs & Geospatial Data, Map Design Considerations, Maps & Diagrams, and Map Use Environments.

The first section describes the SDGs and goes over the characteristics of many SDG indicators, introducing readers to some of the types of data required for each indicator. This section also examines the geospatial information that's needed to address the indicators' intrinsic complexities. General information, definitions, and numerous examples give readers context about different kinds of data—such as geospatial, attribute, and statistical data—in an easy-to-understand style. Descriptions of how data is organized and made available for the SDGs is beneficial for helping readers develop a fuller understanding about the nature of the data and how to apply it to cartographic applications. The value of cartography is made evident in a segment on visual style, which states that the "treatment of map design as an artistic process enables new ways to *humanize* the otherwise abstract statistical SDG indicator data." Helpful links to resources and current efforts coordinated by various UN expert and working groups provide up-to-date information for anyone interested in more detail.

The second section, on map design, introduces novice mapmakers to the assorted components, options, and decisions involved in creating an effective cartographic portrayal. As

the first line of this section affirms, "Designing a map is not a trivial task"—a point that is evident throughout the book as the authors demonstrate all the decisions cartographers must make, many of which are not perfect or preferred because of the nature of the data being mapped or other limitations. For example, how do cartographers proceed when data is either deficient or missing? Identifying when data elements need attention is just one of the many ways that cartographic processes can inform SDG-related data management efforts.

Different types of maps and diagrams are described in the third section, which emphasizes how choosing the best depiction depends on the final product's purpose and intended use. For instance, the authors point out that making thematic maps of indicator data is a requirement for meeting the SDGs. They then use sample datasets to put together thematic map designs—from choropleth maps to dot density maps—to show the visual variations of particular map displays.

The last section of the book focuses on map use environments, which involves looking at the characteristics of different audiences. Because the SDGs are critical to tackling the biggest challenges facing our world today, map content and design often need to speak to decision-makers, political leaders, and other influencers and champions of the varied topics within the 17 SDGs. A key focus of this section describes diverse user environments, which, due to technology, have opened up many new ways for users to make maps and for audiences to experience them. Anyone interested in learning more and seeing examples of mapping data associated with each SDG will find the various visualizations presented in this section useful.

The afterword closes the book with important summaries, observations, and lessons learned. As the authors explain, the data needed to achieve the SDGs is voluminous, complex, and disparate, yet the visualizations made possible through mapping offer compelling

options for seeing, informing, and ultimately understanding it all in a variety of ways, depending on one's needs, interests, and intended use. Put simply, maps aid in making complicated numbers and messages easier to understand.

An Unfinished, Ongoing Process

Mapping for a Sustainable World reveals, yet again, how maps and mapping are critical for solving real-world challenges. The strength of this single-themed cartography book, with its focus on the SDGs, is in its examples. They show readers how to use several techniques to map a variety of data and encourage practitioners to apply similar approaches to data at the subnational level. This, however, often presents challenges—albeit also unique solutions.

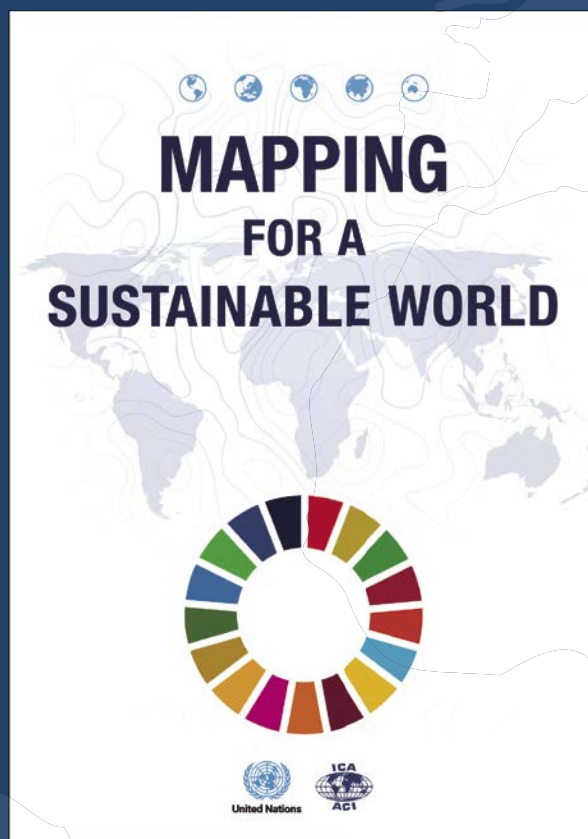
Cartographers are still limited by a lack of small-area statistics for many communities. Currently, most SDG mapping reflects national-level datasets. To facilitate real change, there needs to be an increased focus on collecting data at ever more local levels to facilitate small-area mapping. Imagine the value of being able to visualize community-level data as it relates to national- and global-scale SDG indicators—and then making relevant decisions based on that.

According to observations made by the book's contributors, it is clear that even though there is a plethora of data that supports the SDGs, this data is incomplete and/or inconsistent. Additionally, the availability of SDG data and associated mapping is not the end of the story, nor will that meet all the challenges presented by the SDGs. As the authors state,

"mapping the SDGs is much more of an ongoing process than a final product."

Efforts in working to achieve the SDGs have begun to expose topics that need to be explored at the global, national, and local levels to improve the world in which we live. In 2015, the 17 goals, targets, and indicators that were identified as the SDGs were classified as some of the most important global issues that need to be addressed. While their relevance has not lessened, other issues have come to the forefront—including racial disparity, social injustice, and climate change's even wider-reaching effects—that can benefit from similar attention.

So please, seek out, explore, and use *Mapping for a Sustainable World*. As mentioned in a section on open access, the SDG datasets and cartographic guidance in this book are openly available. That means that more people than ever before can make maps in support of an economically, environmentally, and socially sustainable future.



↑ *Mapping for a Sustainable World* is available as an e-book.

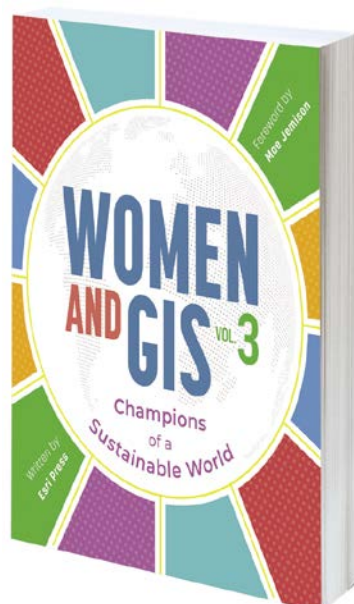
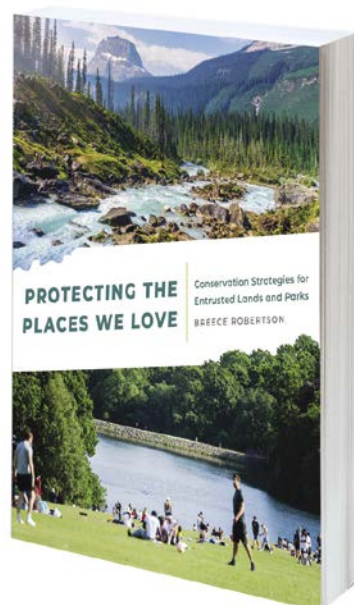
About the Author

Tim Trainor is a part-time consultant to the UN and is the former chief geospatial scientist for the US Census Bureau. He is a member of the US Federal Geographic Data Committee's National Geospatial Advisory Committee, has served as cochair for the UN Committee of Experts on Global Geospatial Information Management, and was the senior agency official for geospatial information for the US Department of Commerce.

Protecting the Places We Love: Conservation Strategies for Entrusted Lands and Parks

By Breece Robertson

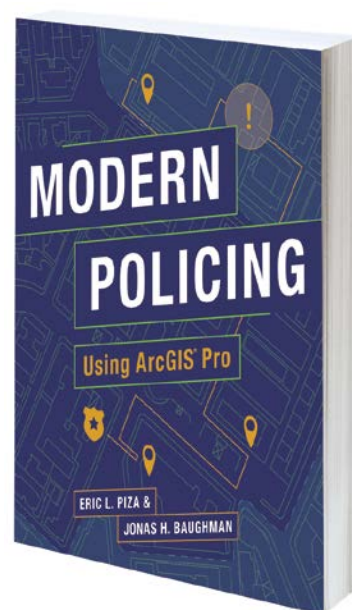
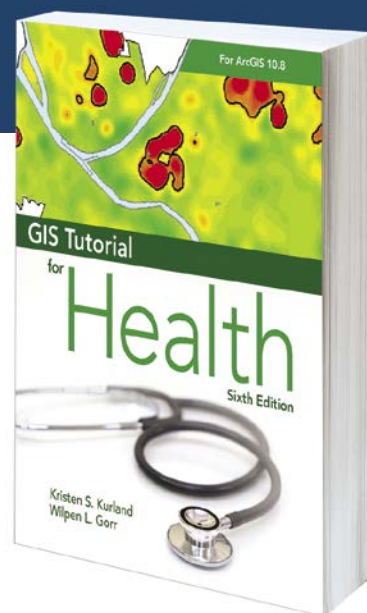
Bold conservation requires strategic action. In *Protecting the Places We Love: Conservation Strategies for Entrusted Lands and Parks*, veteran conservationist and geospatial designer Breece Robertson uses her experience and myriad resources to demonstrate how to act now for conservation and collaborate to achieve better results. Written for professionals and advocates at conservation organizations, park agencies, and small to midsize land trusts, *Protecting the Places We Love* includes strategies and methods for conservation, plus real-world examples from land protection organizations all over the globe. April/July 2021, 280 pp. E-book ISBN: 9781589486171 and paperback ISBN: 9781589486164.



Women and GIS, Volume 3: Champions of a Sustainable World

By Esri

The third volume of the popular *Women and GIS* series shows how 31 women and people of diverse genders in various science, technology, engineering, and mathematics (STEM) fields discovered their passions; broke down barriers; and used maps, analysis, imagery, and GIS to advance their work and improve the world. Sharing their experiences from childhood and throughout their careers, the people featured in the book reveal the obstacles they have overcome, the knowledge they have gained along the way, and how tenacity and determination have helped them succeed. May/June 2021, 320 pp. E-book ISBN: 9781589486386 and paperback ISBN: 9781589486379.



GIS Tutorial for Health for ArcGIS 10.8, Sixth Edition

By Kristen S. Kurland and Wilpen L. Gorr

Knowing how technology can improve health research and health-care management has never been more important. A workbook for learning the basics of ArcGIS within a health context, *GIS Tutorial for Health for ArcGIS 10.8*, Sixth Edition, shows readers how to prepare, visualize, and analyze health data using ArcGIS Desktop. Readers get hands-on tutorials, mostly in ArcMap, that revolve around concrete health-care scenarios. This edition also features an introduction to ArcGIS Online and examples that employ international health data. Suitable for health management students, health-care managers, IT specialists, and researchers either as a computer lab textbook or for self study, *GIS Tutorial for Health* incorporates proven teaching methods, Your Turn sections, and homework assignments. May/June 2021, 400 pp. E-book ISBN: 9781589486799 and paperback ISBN: 9781589486782.

Modern Policing Using ArcGIS Pro

By Eric L. Piza and Jonas H. Baughman

Crime mapping and spatial analysis play a key role in day-to-day police functions. For crime analysts, *Modern Policing Using ArcGIS Pro* offers an easy-to-use, hands-on guide to employing ArcGIS Pro for creating crime prevention strategies, measuring program implementation outputs, and conducting crime control evaluations. The book covers strategic and predictive analysis and workflow automation, making it an essential read for anyone looking to enhance their agency's operations. June/August 2021, 340 pp. E-book ISBN: 9781589485983 and paperback ISBN: 9781589485976.

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GIS for Science, Volume 3: Maps for Saving the Planet

Edited by Dawn J. Wright and Christian Harder

The natural world is on the line. More than ever, we need GIS-driven mapping to make scientifically informed decisions about the myriad forces affecting life on Earth. With a foreword by two-time Pulitzer Prize winner E. O. Wilson, *GIS for Science, Volume 3: Maps for Saving the Planet* highlights real-world examples of how scientists are creating the maps that are saving the planet. The stories in this volume, which center on biodiversity, are written for professional scientists and anyone interested in learning about how conservation and technology intersect. Contributors represent a cross section of scientists using ArcGIS software to bring to life the geographic data they gather via remote sensing and on-site technologies. The ideas presented in *GIS for Science* and its companion website—including collaboration, spatial analysis, and science communication—can be applied across many disciplines and will hopefully inspire readers to join in the effort to save planet Earth while there's still time. Fall 2021, 206 pp. E-book ISBN: 9781589486720 and paperback ISBN: 9781589486713.

GIS Jumpstart for Health Professionals

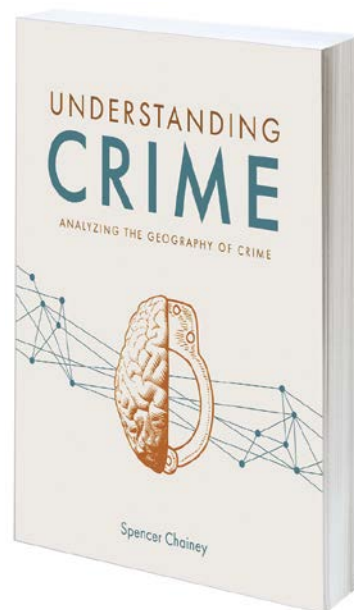
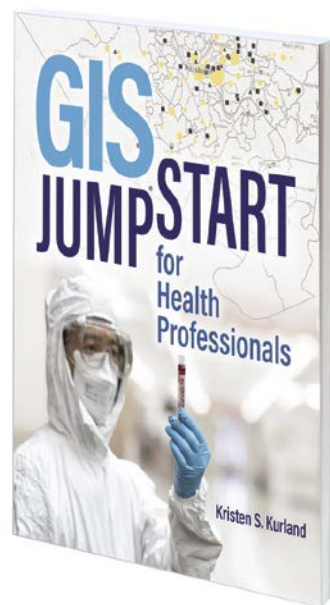
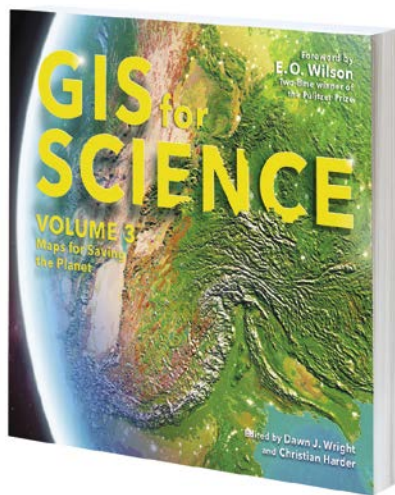
By Kristen S. Kurland

GIS Jumpstart for Health Professionals is a concise workbook that introduces location analytics and ArcGIS technology to health professionals; medical students, residents, fellows, and researchers; nursing students; and others interested in health IT and informatics, health-care administration, and health policy. Tutorials demonstrate how to use things like web-based data and storytelling apps, while short video lectures included with the book improve learning outcomes. Focused lessons get health professionals up and running with GIS quickly, so they can experience firsthand the value of location data, maps, and analytics. August/September 2021, 150 pp. E-book ISBN: 9781589486546 and paperback ISBN: 9781589486539.

Building a Smarter Community: GIS for State and Local Government

By Christopher Thomas and Keith Mann

Continual advancements in smart technologies mean that the use of location intelligence in state and local governments is no longer just for GIS specialists. In *Building a Smarter Community: GIS for State and Local Government*, readers can see how government leaders at the city, county, and state levels apply GIS to decision-making in planning, operations, and civic inclusion. Through web apps, hub sites, dashboards, and other GIS solutions, state and local government professionals can not only develop a deeper understanding of the communities they serve but also improve urban plans and designs, increase operational effectiveness, and find new ways to communicate with the public. May/June 2021, 120 pp. E-book ISBN: 9781589486850 and paperback ISBN: 9781589486843.



Understanding Crime: Analyzing the Geography of Crime

By Spencer Chainey

Understanding Crime: Analyzing the Geography of Crime is the first book to fully explain how to truly analyze the geography of crime. With comprehensive content that includes both new and old techniques, the book shows readers how to examine the spatial and temporal patterns of crime, analyze crime with other spatial data, and evaluate the impact of geographically targeted interventions. Topics covered in the book include the following:

- Hot spot analysis using microplace crime concentration and cluster analysis techniques
- Temporal analysis, including methods of examining the stability of crime patterns
- Analyses of troublesome places, repeat and near-repeat victimization, and persistent and emerging crime patterns
- The dispersion of crime concentration over time

Whether readers are new to analyzing the geographic patterns of crime or are experienced pros, they will benefit from learning the techniques presented in *Understanding Crime*. November 2020/January 2021, 304 pp. E-book ISBN: 9781589485853 and paperback ISBN: 9781589485846.

The Locators: Adventure in South America

By Kyle Bauer, Colleen Conner, and Wesley Jones

The Locators—a group of kids who solve problems using maps, technology, and spatial thinking—are determined to help those who need it. After crash-landing in the Amazon during their first mission, Lucy, Oliver, and Moe the Parrot embark on an exciting adventure to find and protect several endangered species in South America. Full of colorful illustrations; activities; and facts about endangered species, habitats, and more, *The Locators: Adventure in South America* keeps kids interested and makes learning easy. At the end of the story, readers can get their own Locator member ID number and become part of the team! July 2021, 120 pp. E-book ISBN: 9781589485839 and paperback ISBN: 9781589484986.

New Textbooks

Esri Press has several new textbooks for the classroom. Ideal for teachers of spatial analysis, cartographic design, human geography, and more, these books are written for a variety of learning levels. Recommended titles include the following:

- *Introduction to Human Geography Using ArcGIS Online*
- *The Esri Guide to GIS Analysis, Volume 2: Spatial Measurements and Statistics, Second Edition*
- *Understanding Crime: Analyzing the Geography of Crime*
- *Modern Policing Using ArcGIS Pro*
- *Mapping by Design: A Guide to ArcGIS Maps for Adobe Creative Cloud*
- *Resilient Communities Across Geographies*

Esri also offers reference copies of its textbooks to professors, instructors, and university faculty members. Educators can submit a request at ow.ly/XvE250ERULm.

For more information on all Esri Press publications, visit esri.com/esripress.



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New Training and Certification Offerings

Training

New Instructor-Led Courses

Esri's instructor-led courses are developed in-house by subject matter experts who have a deep understanding of ArcGIS best practices and recommended workflows. All instructors have Esri Technical Certifications and CompTIA CTT+ certification. Courses are currently offered online, in real time (in multiple time zones), and as private training events.

Do you need to ensure the accuracy of your authoritative GIS database? Are you looking to build the skills required to share actionable insight with decision-makers? If either of these scenarios speaks to you, check out the following courses:

- **Configuring Branch Versioning in ArcGIS**—For organizations that use ArcGIS Pro and ArcGIS Enterprise, branch versioning supports multiuser editing workflows. This one-day class provides GIS database managers with the knowledge they need to create and edit branch versions of geodatabase feature classes, configure user roles and privileges, resolve editing conflicts, and support online and offline editing workflows.
- **ArcGIS Enterprise: Analysis Workflows for Intelligence**—This course, which caters to analysts in the defense, intelligence, and public safety communities, goes over the mapping and analysis capabilities that are available through an organization's ArcGIS Enterprise portal. Participants learn how to make web maps, analyze data, and share intelligence using ArcGIS apps and app builders.

Take an Esri MOOC

Massive open online courses (MOOCs) are free and convenient and offer a great way to keep up-to-date with fast-changing technologies. Participants get access to ArcGIS software, and each course includes video lectures by Esri experts, hands-on software exercises, and interactive forums to engage with learners from around the world. Everyone who completes the course content receives a certificate of completion. View all the MOOCs Esri has available at esri.com/mooc. For a closer look at some upcoming courses, check out the following:

- **Imagery in Action**, August 11–September 22: This brand-new course is for anyone who wants to learn more about imagery. Participants get to explore cutting-edge imagery apps and the latest ArcGIS capabilities for working with imagery and remotely sensed data. Find out more about the course on page 3, and register at go.esri.com/imagery-mooc.
- **Going Places with Spatial Analysis**, September 22–November 3: This MOOC introduces spatial analysis concepts and workflows that are grounded in ArcGIS Online. Course exercises examine interesting, real-world examples in which conducting spatial analysis creates information that leads people to make better decisions. View course details and register at go.esri.com/going-places-mooc.
- **Spatial Data Science: The New Frontier in Analytics**, October 27–December 8: Explore how to apply spatial data science to uncover hidden patterns, gain deeper insight into data, and improve predictive modeling. Participants will work with powerful ArcGIS analytical tools, use machine learning and deep learning techniques, and discover how to integrate popular open data science packages into their analyses. Learn more and register at go.esri.com/sds-mooc.

Certification

Did you know that the Esri Technical Certification program offers specialty exams that measure users' knowledge and skills on focused topics, including ArcGIS API for Python and ArcGIS Online administration? These shorter exams are popular with those who are interested in showcasing their ongoing commitment to professional development and excellence.

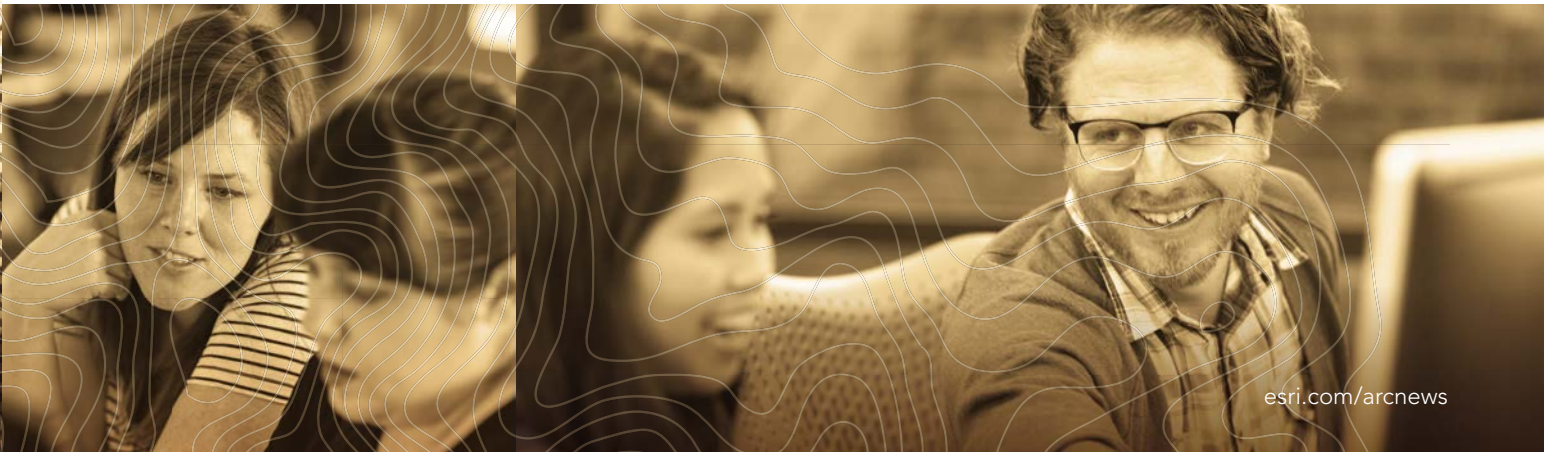
The steps to attain a specialty certification vary based on where you are in the eligibility framework.

- **Recently Certified:** Specialty exams are designed to stack on top of core desktop and enterprise exams. Together, these certifications showcase foundational ArcGIS skills and knowledge as well as focused expertise. If you currently hold a core certification at version 10.3 or higher (think 10.4, 10.5, and 19-001), then you are eligible to take a specialty exam right now. Simply determine which specialty topic applies to your skills and experience.
- **Certified, But Need to Update:** Do you currently hold a certification at a version older than 10.3? Although Esri Technical Certifications never expire, you will need to earn a later-version core certification before you can achieve a specialty certification. Finding the right core exam to support your specialty aspirations starts with choosing the one that best aligns with your ArcGIS knowledge and experience.
- **Not Yet Certified:** Are you ready to embark on your certification journey? Great! Start by reviewing the core exams to determine which one best matches your skills. Then use the information and resources provided to prepare for the exam. Getting core certified will solidify your foundational ArcGIS knowledge and put you just a step away from earning a specialty certification.

Understanding eligibility requirements is an important part of validating the specific ArcGIS skills you have honed on the job or in school. Whether you're just starting out or continuing your certification journey, engaging in the right planning and preparation is key to achieving your goals.

Get some inspiration for your GIS journey by viewing certification success stories at go.esri.com/certification-success. Also, explore the latest Esri Technical Certification exams at esri.com/training/certification, and join the Esri Technical Certification groups on LinkedIn and the Esri Community.

Go to esri.com/training for more information. Find courses at esri.com/training/catalog/search. Keep up with Esri training news by subscribing to the newsletter (go.esri.com/training-news), visiting the *Esri Training Matters* blog (go.esri.com/trainingblog), connecting with the Esri Training community on the Esri Community (go.esri.com/training-community), and following @EsriTraining on Twitter.



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