Winter 2023

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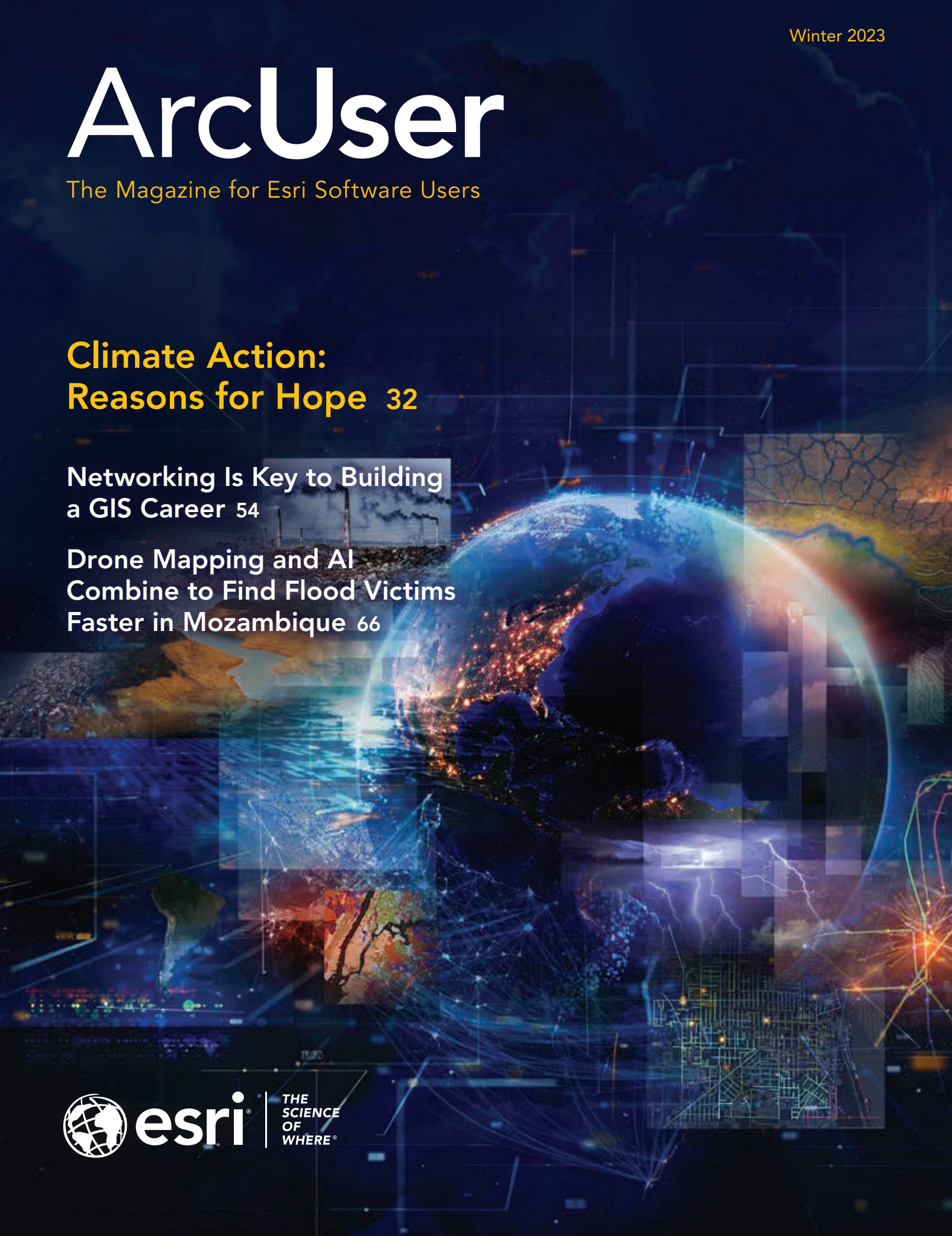

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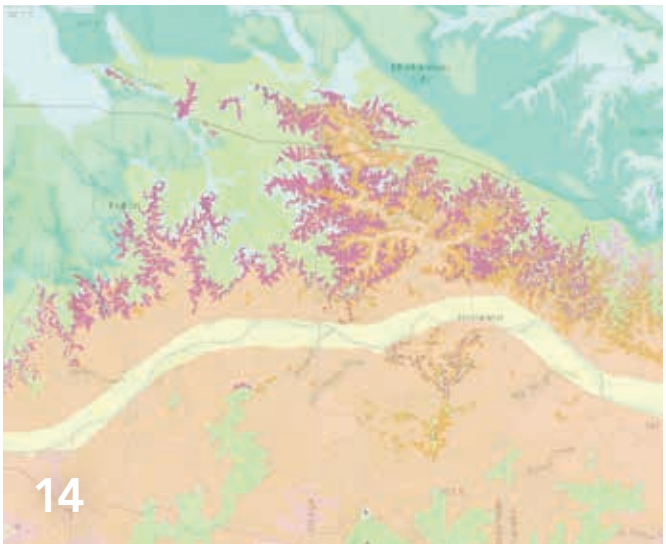

Focus

Special Section

End Notes

Providing Insight, Enabling Action

The increase in the number of extreme weather events in 2022 has brought home the reality of climate change.

From May through September, heat waves blistered communities across the United States. In Europe, the worst drought in 500 years and a heat wave that broke high temperature records exacerbated wildfires that blazed in France, Spain, and Portugal. Hurricane Ian, which hammered Florida and South Carolina, caused the second-largest insured loss on record.

These are just a few examples of weather patterns that have become more extreme, devastating, and—unfortunately—more common. As extreme weather events become more pervasive, the need to deal with them becomes increasingly urgent.

In "Climate Action: Reasons for Hope," Esri chief scientist Dawn Wright highlighted some of the ways the geographic approach and GIS are helping reveal the causes of climate change, focus mitigation efforts, and evaluate and integrate all available resources to build a more resilient and sustainable world.

Articles in this issue demonstrate the numerous ways GIS is being used to address aspects of climate change. For example, GIS played a vital role in responding to epic flooding in Mozambique. Using drone-captured imagery and artificial intelligence, people trapped by floodwaters were more quickly found and rescued.

GIS also has a vital role before disasters to identify mitigation strategies that will lessen the impact of these events. After disasters, GIS can assist in not only responding to events, but also in coordinating the work of building back communities so that they are more resilient. Through building digital twins in GIS, all communities can access tools to better understand threats, marshal resources, and model scenarios for building communities that are equitable, attractive, and sustainable.

The tangle of challenges the world faces now are the product of decisions that were made in isolation, bereft of the context that would illuminate their far-reaching effects. We need to think about these challenges in new ways. The geographic approach, implemented through GIS, provides new ways to see and think about the world's problems, collaborate, and devise solutions. The constantly expanding capabilities of ArcGIS to integrate, analyze, visualize, and model data are enabling insight into complex phenomena such as weather and ocean systems. This understanding is vital to meeting the current and future challenges of climate change.

Monica Pratt
ArcUser Editor

ArcUser

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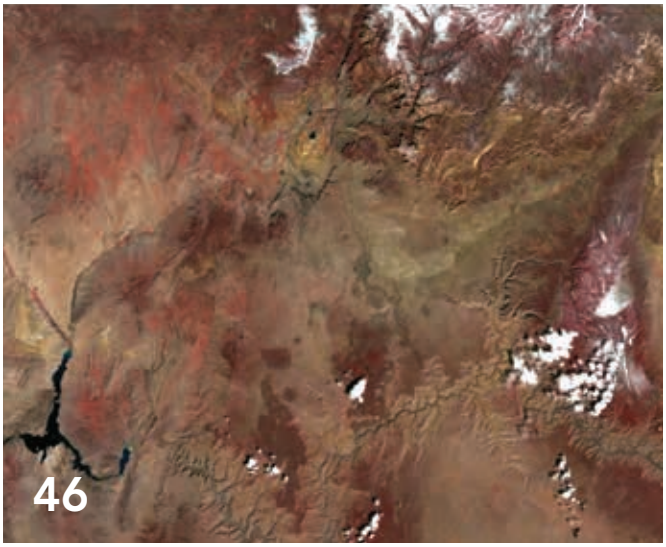


Briefly Noted

→ Esri Named Leader in Understanding Climate Risk

Independent research firm Forrester recognized Esri as a leader in offering advanced data processing and visualization to help decision-makers tackle climate risks in its report, *The Forrester New Wave: Climate Risk Analytics, Q4 2022*. Esri received a differentiated rating—the highest score possible—in 9 out of 10 criteria, including advanced data processing, visualization, and threat modeling. The report notes, "If you have physical assets that could be threatened by climate, Esri can bring the data and processes to bear to target operational resiliency opportunities."

→ Scalable Geospatial Analysis in a Data Science Workflow

ArcGIS GeoAnalytics Engine can be plugged into Databricks architecture to extend cloud-based geospatial capabilities for organizations that need big data spatial solutions at speed and scale. This engine is a plug-in for Apache Spark that extends data frames with very fast spatial processing and analytics and is ready to run in Databricks. ArcGIS GeoAnalytics Engine allows data scientists, engineers, and analysts to analyze geospatial data within their existing big data analysis environments. To read more about these use cases, see https://bit.ly/3BxySkG.

→ *World Terrestrial Ecosystems Map* Released

In partnership with Esri and The Nature Conservancy, the US Geological Survey (USGS) launched the *World Terrestrial Ecosystems Map*, which breaks up the globe not by political boundaries but instead by areas of similar climate, landform, and land cover. "Ecosystems give us goods and services like food, water, *[and]* fuel…so we need to take care of them," said Dr. Roger Sayre, senior scientist for ecosystems at USGS and the lead on the project. "A requirement for managing ecosystems is first knowing what they are and where they are on the planet. That's why we classify and map ecosystems." The map—which is available in ArcGIS Living Atlas of the World and as an explorer tool at rmgsc.cr.usgs.gov/wtee—can be used for conservation planning, analyzing ecosystem health and resilience, formulating how to make progress toward achieving the United Nations Sustainable Development Goals (SDGs), and more.

↓ The *World Terrestrial Ecosystems Map*, available through ArcGIS Living Atlas of the World, breaks up landmass by areas of similar climate, landform, and land cover.

→ GeoAI Helps Develop Sustainable Agriculture in Africa

↑ Combining GeoAI capabilities and satellite imagery with Microsoft's infrastructure and AI devices will help build a deeper understanding of the current agricultural landscape in Africa and improve agricultural yields.

To aid government and nonprofit organizations in Africa in addressing acute challenges related to climate change, including low agricultural yields and heavily degraded soils, Esri is collaborating with Microsoft to develop GIS-based crop mapping and land management technology. The tools combine Esri's geospatial artificial intelligence (GeoAI) capabilities with satellite imagery and Microsoft's infrastructure and AI devices to provide deeper understanding of the agricultural landscape across the continent.

There is a great need to improve agricultural productivity in Africa. Combining Esri's GeoAI capabilities and satellite imagery, as well as Microsoft's infrastructure and AI devices, will help build a deeper understanding of the current agricultural landscape, enable closer monitoring of crop conditions throughout the growing season, and suppport the mitigation of climate change impacts. This will contribute to better production and food security. To learn more about how location intelligence can power global land monitoring, visit https://bit.ly/3VUlM95.

→ Esri Extends Its Collaboration with Geneva Demining Center

Removing land mines and other explosive ordnance from former war zones is an inherently geographic problem. Humanitarian organizations that perform demining are relying increasingly on digital technology, especially GIS, to support these endeavors. Esri and the Geneva International Centre for Humanitarian Demining (GICHD) have renewed and expanded their partnership through a memorandum of understanding (MOU).

Humanitarian organizations, which have been using GIS for more than two decades, will continue using Esri's technology to map explosive ordnance to more precisely clear it and ultimately help people return to their homes and use their land safely. Esri will support modernization of the Information Management System for Mine Action (IMSMA), the GICHD flagship platform, used by more than 80 percent of national and United Nations mine action programs globally.

Built using Esri's GIS software, the platform serves a critical purpose in the demining process by providing information access to a wide range of stakeholders, as well as real-time visualization and reports on the extent of contamination in specific locations. To learn more about how GIS tools can help humanitarian organizations, visit esri.com/en-us/industries/humanitarian/overview.

Improved Location Accuracy Enables Hydraulic Modeling

By Christa Campbell

A water district in Kentucky increased the locational accuracy of assets in its GIS using mobile mapping so that its engineering team could use the data for hydraulic modeling. GIS also helps the district streamline operations and improve customer service.

Warren County Water District (WCWD), based in south central Kentucky, offers water and wastewater services over a 530 square mile area between Nashville and Louisville. Every day, the utility delivers more than 8.1 million gallons of drinking water across 1,194 miles of water lines, while its wastewater system transports 2 million gallons of wastewater across 218 miles of sewer line.

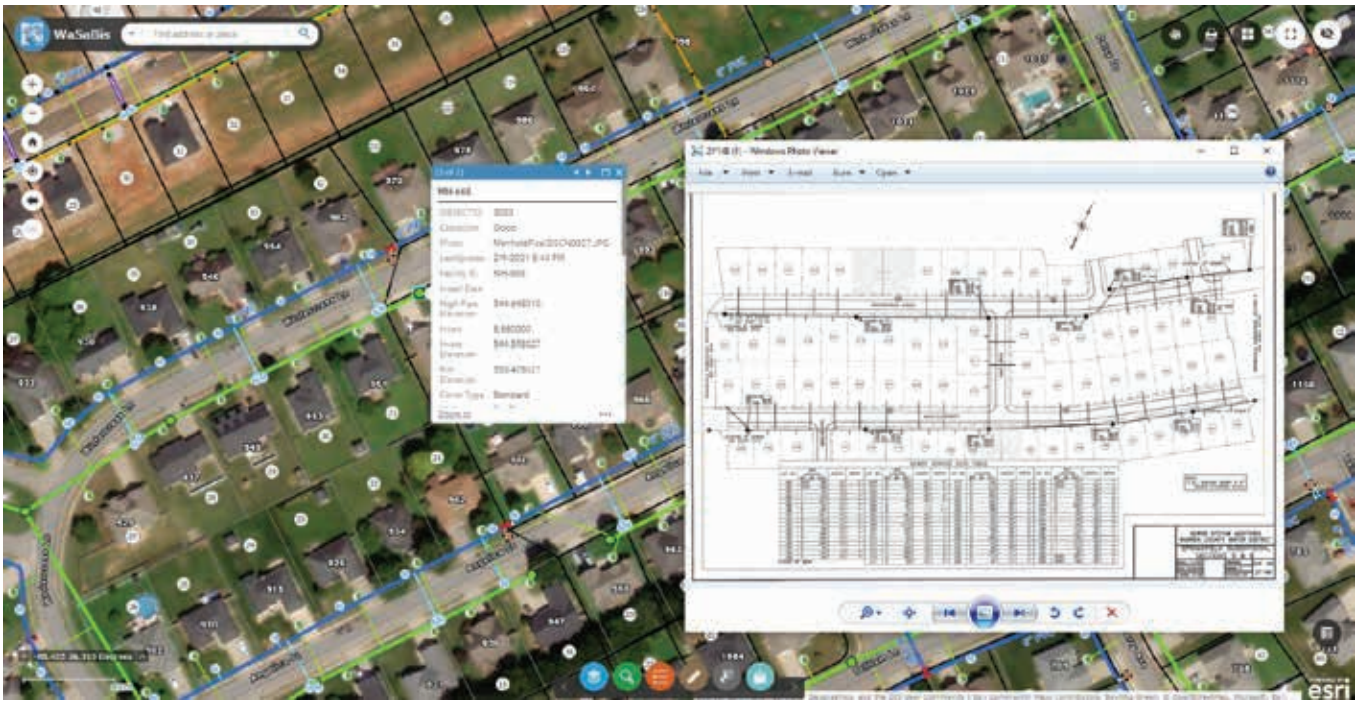
In addition to this system, WCWD manages the water systems for Simpson County Water District and Butler County Water System through a joint operations agreement that brings the total length of water main to just over 2,100 miles across 1,200 square miles. Each of the three utilities has a separate board of directors, but their operations are streamlined through GIS and one customer information system (CIS).

When moving from paper map books to web maps, WCWD digitized its original as-built drawings. Now engineers can access the drawings by selecting an asset to open its pop-up and then clicking a hyperlink from the attributes. The hyperlink launches an internal web mapping application where historical data can be viewed.

The Original Move to GIS

In the past, WCWD used to equip its field crews with 75-pound paper map books

↓ WCWD digitized its original as-built drawings, which can be accessed via a hyperlink that launches an internal web mapping application containing historical data.



to navigate to service order work sites. Although the map books got the job done, they were cumbersome and time-consuming to use—especially for new employees.

In 2006, WCWD decided to modernize its operations and hired its first full-time GIS employee along with a contractor to kick-start digital mapping. First, WCWD digitized thousands of paper as-built drawings and georeferenced them to GIS features. The contractor then went to the field to map all the aboveground assets, using subfoot-grade mapping equipment.

Once the locations were postprocessed, WCWD IT and GIS manager B. J. Malone uploaded them into the GIS and snapped features to the new accurate locations. Malone and the contractor mapped the WCWD system. Subsequently, Malone brought field mapping in-house to map the Simpson County and Butler County systems.

"At that point, we had all of our aboveground assets—every valve, meter, pump station, hydrant, and maintenance hole—mapped with subfoot accuracy," Malone said.

Hydraulic Modeling for Wastewater Assets

Subfoot asset accuracy was acceptable for mobile workers, but it was not good enough for the engineering team to use in hydraulic modeling. Hydraulic modeling relies on extremely accurate elevation values that would require centimeter-level accuracy in the GIS.

Extracting elevation values from paper as-builts was time-consuming and sometimes frustrating for WCWD's engineers. The drawings often contained inaccurate slope measurements. Malone realized that WCWD could benefit from improving the accuracy of its GIS data even further.

To test the idea, Malone hired another contractor to remap the utility's wastewater assets with centimeter-grade accuracy. In this pilot project, the collected data had to be postprocessed to obtain the desired accuracy, before being imported to update the GIS. When these tasks were completed, Malone had the information at a level of quality that his engineers could use. His next challenge was to find a simpler way to maintain this level of accuracy in-house—and potentially expand it to all assets.

Additionally, in 2009 WCWD had begun utilizing GIS data in the field with a Windows-based mapping application on laptops. While the laptops were a great tool, mobility in the field was limited to the truck. Malone believed the new in-house mobile mapping solution could overcome both remaining challenges.

Real-Time, Accurate Mobile Data Collection with ArcGIS

Around this time, Malone noticed Esri's mobile data-collection apps were becoming not only very popular but also incredibly robust. Originally, Collector for ArcGIS and later ArcGIS Field Maps, combined with ArcGIS Survey123, could enable GPS-supported data collection directly into the GIS, in real time and with the data already in GIS format.

"We already had Esri software, so migrating to Esri mobile apps made sense to us," Malone said. "Everything was native to the GIS format, and it enabled us to give our *[staff]* in the field something with GPS capabilities on a device they were comfortable using." The utility gave its field crews both iOS and Android tablets—based on user preference—running Esri apps.

The last remaining component was a compatible, centimeter-grade Global Navigation Satellite System (GNSS) receiver that worked with the ArcGIS apps. After consulting with a nearby water district, Malone chose the Arrow Series GNSS receivers made by Esri partner Eos Positioning Systems. The Arrow Gold receiver provides real-time, centimeter-grade locations through a combination of GNSS positioning and real-time kinematic (RTK) differential correction processing. It could be used with the Kentucky Real Time Reference Network, the local free RTK network. Going this route would eliminate both postprocessing and manual data uploads to the GIS.

"When Eos came along and made that marriage with Esri so that everything works natively in Esri apps, that became a huge time-saver for us with both data collection and postprocessing," WCWD GIS analyst Josh Smith said. "It streamlined both office and *[mobile]* workflows by keeping everything in one place and eliminating the need to pass data through multiple applications."

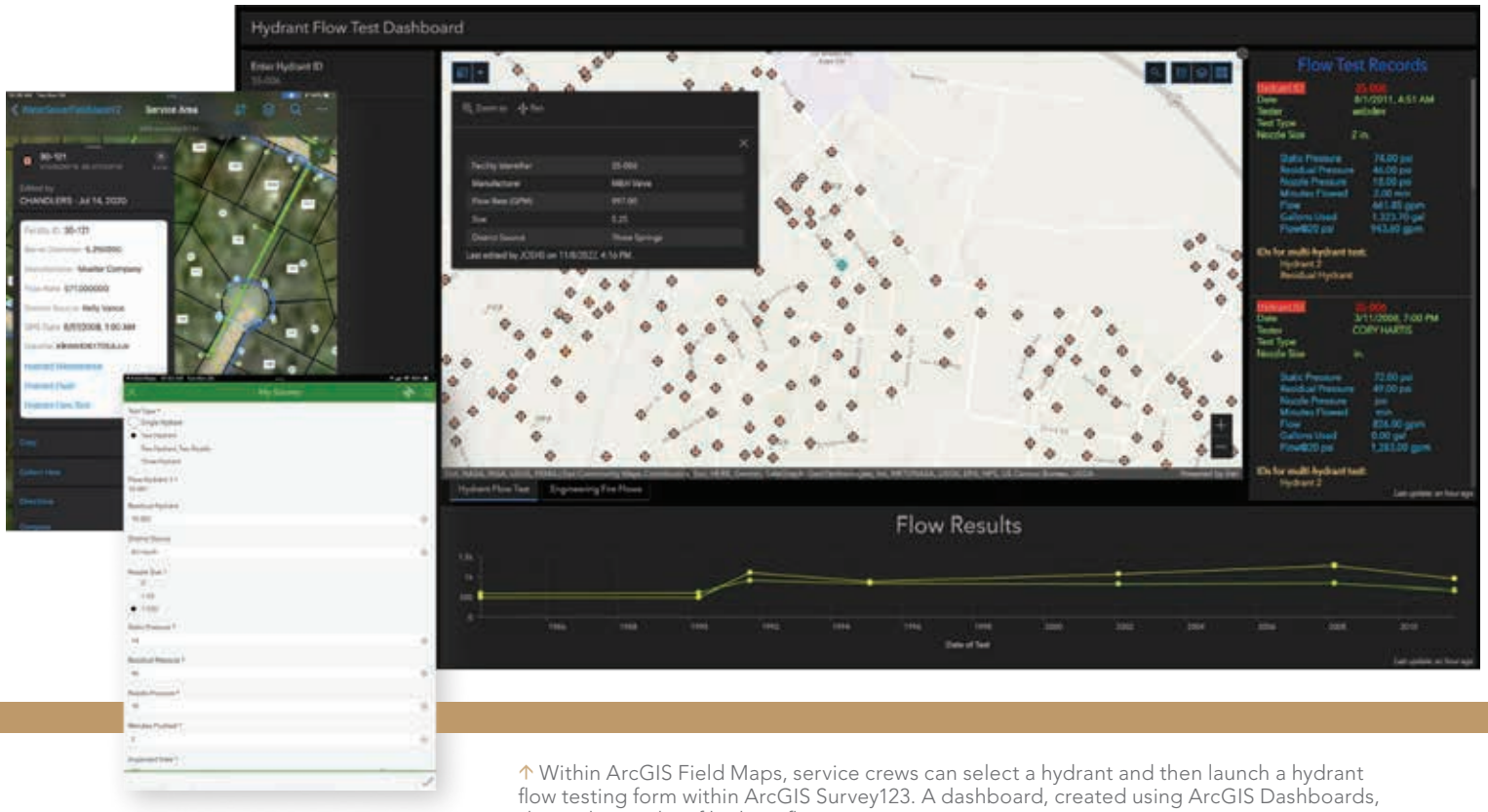
↑ Before WCWD switched to high-accuracy digital maps running on mobile devices, field crews used these 75-pound map books for navigation during service calls and routine work.

The Arrow Gold receiver also offered a feature for maintaining survey-grade accuracy in remote areas where internet service via the cellular network was spotty.

"We went to some of the most remote areas of our system to test out the Arrow GNSS receiver, and it just worked," Malone said.

Streamlined Data for Hydraulic Modeling

Today, WCWD has mapped its wastewater assets with centimeter-grade accuracy, and its aboveground assets—for all three



↑ Within ArcGIS Field Maps, service crews can select a hydrant and then launch a hydrant flow testing form within ArcGIS Survey123. A dashboard, created using ArcGIS Dashboards, shows the results of hydrant flow tests.

systems—with subfoot accuracy. This year WCWD staff have deployed RTK data collection for all newly constructed assets. Meanwhile, engineers have engaged a consultant who will now use RTK elevations to develop a wastewater hydraulic model. The engineers are already using the data for other workflows, such as system-modification planning and historic leak tracking.

> "We really try to be GIS-centric, to build the workflows and applications that enable us to make smarter decisions."
>
> B. J. Malone
> IT and GIS Manager
> WCWD

The field team members have also started to realize gains from having accurate, digital maps with them at all times. They are able to find things faster and can access what they need on one device. It has eased everybody's mind.

WCWD has since hired one more full-time GIS employee to support Malone. The district estimates that of the 74 employees at the utility, 65 to 70 use GIS regularly. The meter-reading team members use the maps to navigate to existing meters and aid the installation of 41,000 new smart meters by WCWD. Meter data is stored with locations in the GIS and integrated in the CIS. Customer service representatives (CSRs) use the data to respond faster to customer inquiries, generate service orders for field crews, and respond to contractor requests for asset information in specific areas. "We save a ton of time for our CSRs," Malone said.

Maps Help WCWD Keep Up with Requests to Locate Assets

The aboveground data has proved so valuable that WCWD has started to also map its underground assets. Today, developers and inspectors are equipped with ArcGIS Field Maps and Arrow Gold receivers to map assets in new subdivisions before they are buried.

For call-before-you-dig requests to locate existing assets, WCWD equipped its asset-locating teams with the same technology. The teams now use the maps of aboveground assets (e.g., valves, meters) to more quickly find buried water mains. In places where underground assets are already mapped, the teams navigate right to these assets. Although teams still perform traditional field validation, the time savings using the new system have been huge. Malone estimates that demand for fiber-optic cable installation has caused locate calls to approximately quadruple in the past year alone.

"With the increased number of locate requests that we currently have, I don't think we would have been able to keep up the pace without these maps," Malone said. "It has really streamlined that process and helped us locate assets more quickly."

So far, WCWD has mapped more than

68,000 underground points across 51 miles of pipe. The utility has also purchased two ground-penetrating radar (GPR) devices and equipped them with ArcGIS Field Maps on Android and an Arrow Gold receiver.

According to WCWD operations supervisor Travis Watt, having the RTK capabilities of the Arrow Gold along with the GPR devices and Field Maps has been amazing.

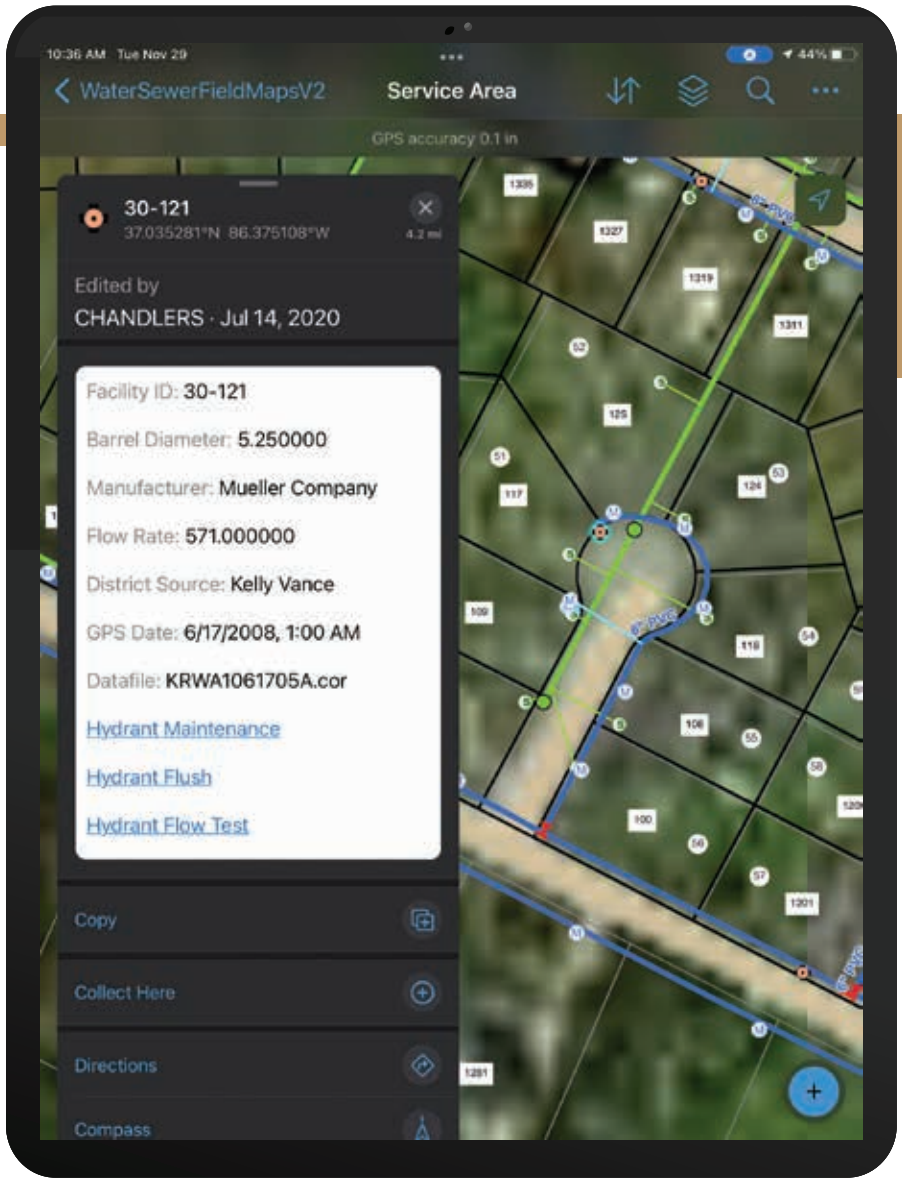
"It provides my team with two methods to locate underground assets," Watt said. "At times, *[the team]* can navigate nearly down the exact center of buried water mains."

Malone says he is grateful that the utility's employees and leadership see the value of GIS. "We really try to be GIS-centric, to build the workflows and applications that enable us to make smarter decisions. When we added accurate locations into the GIS, that's what really paid off for us. Now our field and office teams are realizing the efficiency gains, and we're making their lives a little easier. That's been a win."

About the Author

Christa Campbell is a water industry professional with 20 years of experience using and promoting technology to solve problems in the water industry. Campbell has been recognized for industry thought leadership, strategic thinking, and building success with organizations across the globe. She is a passionate GIS advocate, lifelong learner, and a collaborator who builds success jointly with teammates, peers, and customers. She is a certified GIS professional and holds a graduate degree in geography.

↓ Field team members have realized gains from having accurate, digital maps with them at all times so they can find things faster and access what they need on one device.



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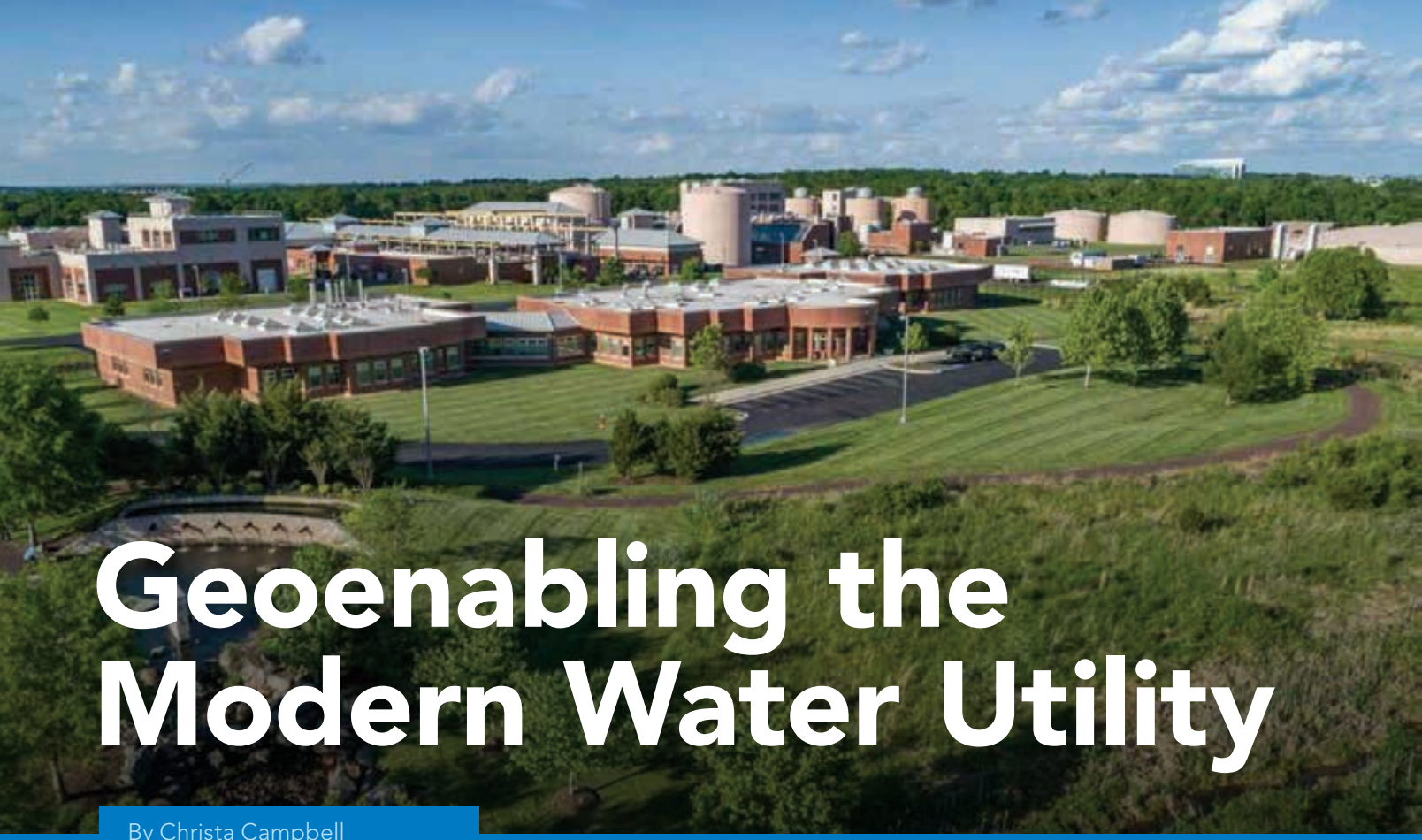

Geoenabling the Modern Water Utility

By Christa Campbell

↑ Loudoun Water Broad Run Water Reclamation Facility

Keeping data synchronized between a GIS and an asset management system is always challenging but of great value to business users. Loudoun Water implemented a cloud-based solution designed to simplify the challenges of Esri-SAP integration and optimized its operations.

Loudoun Water provides drinking water, wastewater, and reclaimed water services to over 80,000 homes and businesses in Loudoun County, Virginia, a Washington, DC, exurban area. For decades, Loudoun Water has used Esri GIS as the system of record for linear assets, such as pipes, maintenance holes, and hydrants, and synchronized them with an asset management solution to support maintenance, operations, and engineering activities.

In 2014, Loudoun Water implemented SAP software to run most aspects of the business including asset and maintenance management. At that time, only a handful of organizations in the world had achieved Esri-SAP technology integration in GEO.e. THe GEO.e solution ran inside SAP software and included both a map for visualizing/interacting with objects and a custom synchronization toolset that maintained the data integrity between the two systems.

Implementing GEO.e at Loudoun Water was a big success and added tremendous value to business users who wanted one version of reality, knowing that objects they saw in the GIS were the same objects they worked with in SAP and vice versa. With this success came additional requests to add other synchronized objects and attributes and improve the mapping capability.

However, making modifications to GEO.e proved to be difficult and costly with few technical resources to draw on. The complex code base also made routine incident management a challenge, and there were performance limitations when working with a large dataset. Furthermore, Loudoun Water plans to begin using SAP S/4HANA in the future. This required changing GEO.e, which presented a challenge to Loudoun Water, so alternatives were investigated.

Loudoun Water has a cloud-first policy for technology. The company moved its Esri and SAP solutions to separate Microsoft Azure cloud instances several years ago. Living with GEO.e emphasized that proven commercial off-the-shelf software was preferable to a custom one-off solution. Keeping this in mind, other water industry organizations were canvassed to identify a replacement for GEO.e.

Spatialitics LLC was identified by Loudoun Water as the perfect fit since it offered a cloud-based solution designed to simplify the Esri-SAP integration challenge. The solution comes in two parts: a map called Spatialitics Asset Mapper (SAM) and a robust synchronization framework called Unity Engine.

Spatialitics, a fully owned subsidiary of CyberTech, specializes in providing spatial analytics products and platforms using a cloud-based approach to digitalization. The company covers a wide range of industries, including health, public safety, and utilities.

After a thorough requirements-gathering phase, the project team from Loudoun Water and Spatialitics successfully constructed an architecture that securely connects the

Esri, SAP, and Spatialitics cloud environments. Cybersecurity is a top priority for Loudoun Water, and the Spatialitics solution was ready to be configured to unique and demanding specifications. Loudoun Water also has an Esri enterprise agreement, which meant that software licensing was not a factor as the team architected and tweaked the optimal design.

Spatialitics hosts configuration data (not the underlying business data) and enables real-time communication among the three environments. Because Unity Engine is SAP certified, Loudoun Water can be confident that the future move to S/4HANA won't be complicated by the Esri integration.

Each part of the solution meets a different business need. Front office end users employ SAM, and back office technologists, who are responsible for managing synchronization, use Unity Engine.

In the front office, daily users from across the business solve multiple problems. For example, the team responsible for managing meters has adopted SAM, as its mobile work order solution because it is real-time technology and easy to use to complete work orders.

The asset management team members like SAM because they can quickly access work order history while working directly in the map with many objects. Maintenance planners must use a map to create work orders. SAM includes functionality to do this individually or in bulk, which saves a lot of time. Customer service representatives can be talking with a customer while getting a real-time view of open work orders nearby, informing them of what's happening in this customer's neighborhood.

In the back office, the technologists responsible for managing the synchronization are thrilled with Unity Engine and have realized multiple benefits from its use. The easy-to-use interface makes it simple to manage the process and understand how objects and attributes in one system relate objects and attributes to the other system.

The synchronization can be scheduled or run on demand. All activities are logged for auditing of synchronization performance, and any problems are easy to spot. Unity Engine includes transformation capabilities that make it possible to automatically perform calculations each time synchronization runs. Since the solution is hosted by Spatialitics, which is responsible for routine operation and maintenance, Loudoun Water staff can focus on higher-value activities such as extending the synchronization and map functionality in the direction that the business leads.

"As the technology owner, I'm pleased that the Spatialitics solution meets our business needs, satisfies our strict cybersecurity requirements, is easy for us to operate, and is S/4HANA ready," said Mike Beardslee, managing director of technology services for Loudoun Water.

About the Author

Christa Campbell is a water industry professional with 20 years of experience using and promoting technology to solve problems in the water industry. Campbell has been recognized for industry thought leadership, strategic thinking, and building success with organizations across the globe. She is a passionate GIS advocate, lifelong learner, and a collaborator who builds success jointly with teammates, peers, and customers. She is a certified GIS professional and holds a graduate degree in geography.

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↗ Spatialitics Asset Mapper (SAM) uses a map interface to explore all the work orders from SAP for an asset so they can be examined and acted upon.

↘ The Unity Engine administration console lists synchronized objects along with the synchronization configuration. The synchronization schedule can be set to run automatically or on demand.

New Schema Shines for State Geological Agencies

By Sunny Fleming

Over the last few years, the methods used to gather, process, and display the nation's geological data have changed significantly. GIS is at the forefront of these developments, leading to a rethinking and reimagining of how state-level geological surveying agencies conduct their work

The major impetus for these changes is GeMS—or Geologic Mapping Schema—a standard developed by the US Geological Survey (USGS) National Cooperative Geologic Mapping Program (NCGMP). *[A schema is the formal definition of a dataset's structure, which includes feature types, permitted geometries, user-defined attributes, and other rules that define or restrict its content.]* USGS has been developing GeMS over the last two decades. GeMS is optimized for ArcGIS products "in order to adhere to USGS policy, and because this is the GIS most commonly used in the USGS, in the state geological surveys, and in the larger community," according to the agency's publication describing GeMS.

Precious GeMS

USGS now uses GeMS for nearly all the geologic mapping products it creates, and state geological surveys are also beginning to adopt it. "Across the board, all mapping is now being created in GeMS, or at least working toward it," said Jennifer Athey, a geologist with the Alaska Division of Geological & Geophysical Surveys, which provided input to USGS during the development of GeMS.

Vicki Voigt, a geologist with the Missouri Geological Survey, said that initial qualms about GeMS within the geologic mapping community were quickly allayed by how well it worked.

"USGS has implemented GeMS slowly, which has made the schema easier to adopt," she said. "After having a chance to acclimate to GeMS, we've realized that it's pretty straightforward and a practical approach to archiving geologic information."

Connecting the Dots

By making it easier to integrate data from state surveys, GeMS will help NCGMP fulfill a primary objective, the construction of a complete bedrock and surficial map of the United States.

At the same time, state geological surveys have adopted GeMS as a way to help complete their own state maps. Athey said that GeMS is helping her office make great progress in its "pie in the sky goal" of creating a 1:100,000-scale geologic map of Alaska. Voigt detailed how one of her colleagues at the agency has begun to implement the 1:500,000-scale geologic map of Missouri into GeMS using the new schema.

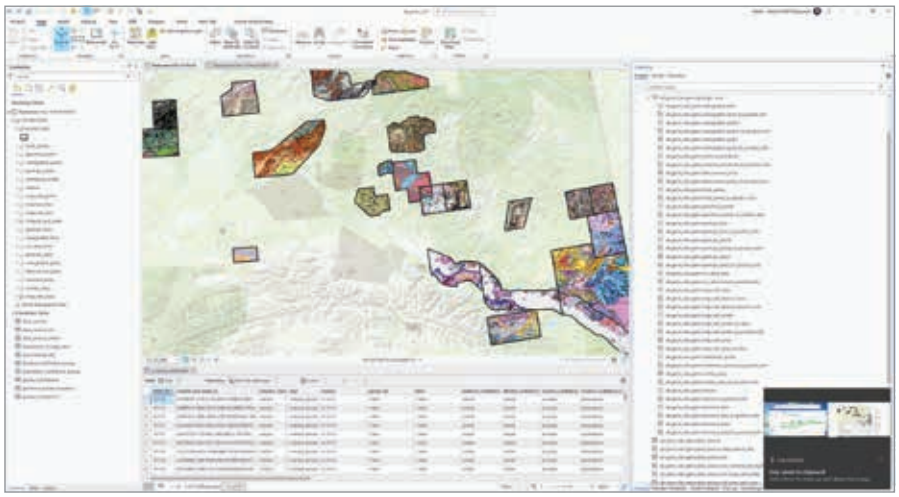
"It's an incredible effort," Voigt said. The map contains hundreds of bedrock unit polygons and polyline feature structures, and the GeMS schema is very particular, but Voigt has been able to complete it with very few headaches.

"The GeMS idea came around at the right time for us. We were inefficient and didn't have a standard of our own, so we were in a really good place to adopt it," said Athey. "Knowing we were going to be producing our deliverables for mapping in this new standard helped make us ready for it."

A Streamlined Process

Using a modified form of GeMS optimized for Alaska, the agency has developed a unified way to apply the standard to all the mapping products it produces from a variety of sources. These sources include old paper maps that require digitization, cartographic-centric data that requires conversion into GeMS, and products compiled from various data sources.

"Our basic process when we produce a product—and this



→ Alaska Division of Geological & Geophysical Surveys has increased productivity and now moves four times as much data through the process as it did previously.

← Missouri Geological Survey makes information previously captured in paper maps and locked away in filing cabinets widely available through its online Geologic Map Index.

includes conversion products—is that we go to the field to collect data and we use databases there, typically using *[ArcGIS]* Field Maps or *[ArcGIS]* Collector," said Michael Hendricks, a GIS analyst with the Alaskan agency. "We'll be in the field for three or more weeks with no internet access at all, so we actually stand up *[ArcGIS]* Enterprise portals on small devices and use them in the field offline, which is not for the faint of heart, let me tell you."

Back in the office, once a map is created, the data is reviewed using ArcGIS Data Reviewer, Python scripts, and models. With that completed, metadata is added. The data is also converted from the local GeMS to the main version, and the map is then packaged for publication and delivery to USGS.

Voigt said the Missouri agency is in the process of developing workflows that will allow raw data from the field to be incorporated directly into GeMS. It plans to have these workflows in place by the end of the year.

"It's a learning effort, but I think this process is going to be simple and straightforward," she said. "When you're archiving the geologic information of a small-scale 7 1/2-minute quadrangle, you're looking at maybe 12 bedrock polygons and few polylines, so it's simple to incorporate them into the *[GeMS]* database."

Improved Workflows

Retooling geological mapping procedures around GeMS creates a smoother internal workflow. As Voigt pointed out, GeMS databases are part of the deliverables for all products the office creates for USGS. "GeMS sets us up to automate our geologic mapping process from the beginning, so there's no back end anymore when putting the databases together," she explained. "It's almost like we're getting double the work done."

Alaska Division of Geological & Geophysical Surveys has also seen increased productivity. "I think we're moving four times as much data through the process as we used to," Athey said.

Hendricks agreed. "In the past, one of the big bottlenecks has always been metadata," he said. "And every database, even if it was in the same schema, people would implement it differently. What used to take a week, he added, can now be accomplished before lunch.

Internal and External Benefits

Streamlined workflows yield benefits both in and out of the office. For internal use, these standardized databases have the advantage of making information more findable and salvageable.

"We are a repository of so much information, and historically it's been taken down on paper and put in a filing cabinet somewhere," Voigt said. "It's been a huge effort to make sure all the information has been captured and remains usable. We have geologists who make very important decisions every day, and it's essential that they have all the information they need."

The advantages extend to everyone who requires solid geological maps and data. "What it really comes down to is, how are we helping the taxpayers by providing them with the best products in a timely manner?" said Jerry Prewett, deputy director of the Missouri Geological Survey. "This is standard information that a lot of people need."

Those who rely on authoritative Alaska geological mapping data range from people in industry and academia to "people who are building a house and want to know what's underneath it," according to Athey. "And now we can make this data available to them so much faster."

About the Author

Sunny Fleming is the industry lead for the domains of environment, conservation, and natural resources at Esri. Throughout her career, she has applied GIS concepts and technology to environmental policy, conservation, and natural resources, in efforts that range from monitoring species in the field to helping state parks manage assets and assess their economic impacts. She continues to pursue her passion for the environment by helping industry leaders streamline and improve their work with GIS technology, whether in the field or in the office, and whether setting policy or managing wildlife and resources.

Understanding Current Assets and Future Needs with Digital Twins

By Keith Cooke

What do a municipality in central Pennsylvania, a city ravaged by fire in Oregon, and a city struggling to improve its economic development outlook in Southern California have in common? More than you might think.

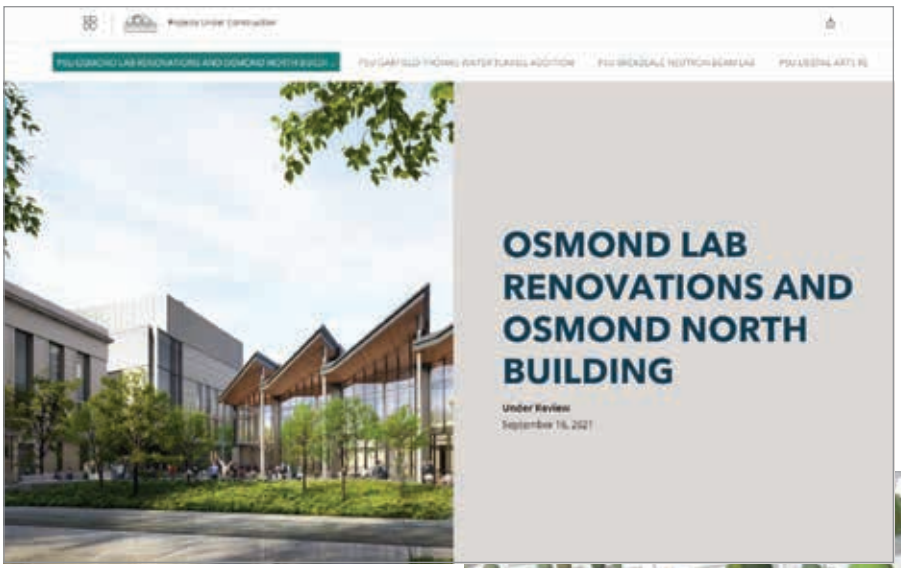
When it comes to planning, the tendency is to think that your community has a unique set of problems. No one else can really relate to them. Certainly not a community with a different socioeconomic structure.

Actually, the hurdles that communities are facing across the nation are familiar and similar. While the three communities previously mentioned have different backgrounds, stories, and even goals, all three embrace a modern, data-driven approach to planning so they can meet the evolving needs of their residents.

Designing for Rapid Growth

State College, Pennsylvania, has a modest population of 42,000, but the topography of the area constrains the city limits to less than five square miles. That means more dense and mixed-use development is a must to accommodate the growth the city is seeing.

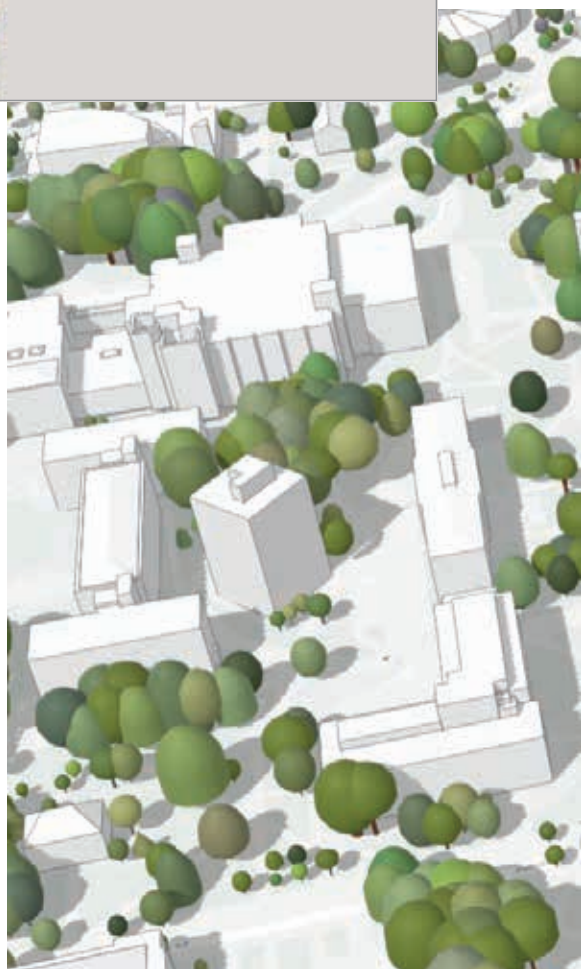
"We're seeing the biggest building boom since the 1970s, and we wanted to be in a better position to explain what's happening," said Ed LeClear, State College's director of planning and community development.

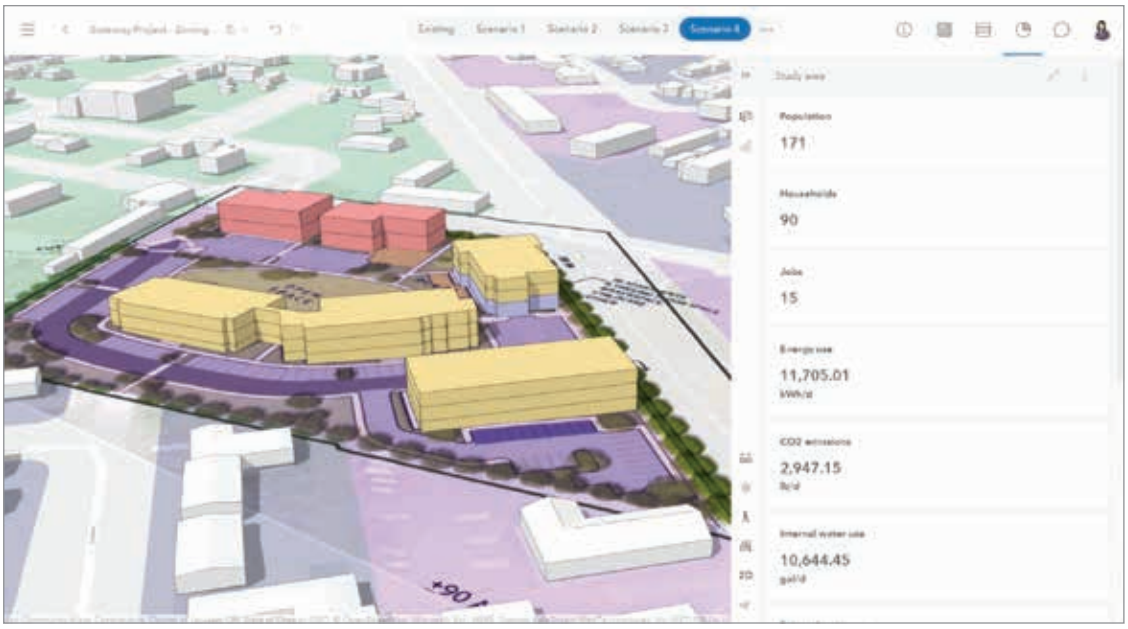


↑→ State College launched an immersive 3D website that lists all projects under review, approved, under construction, and completed to improve collaboration between planners and residents.

To track and share information about the rapid development, LeClear and his team are using ArcGIS to visualize changes and analyze impacts on residents and the local economy. LeClear teamed with colleagues Greg Garthe, a planner and zoning officer with a background in GIS, and Brian Fahringer, a GIS analyst who brings visualization skills from a prior job at an engineering firm.

Using ArcGIS Urban, the team created a digital twin, which combines a map and a 3D model of buildings and infrastructure. ArcGIS Urban is a web-based 3D application that supports scenario planning and impact assessment. The digital twin



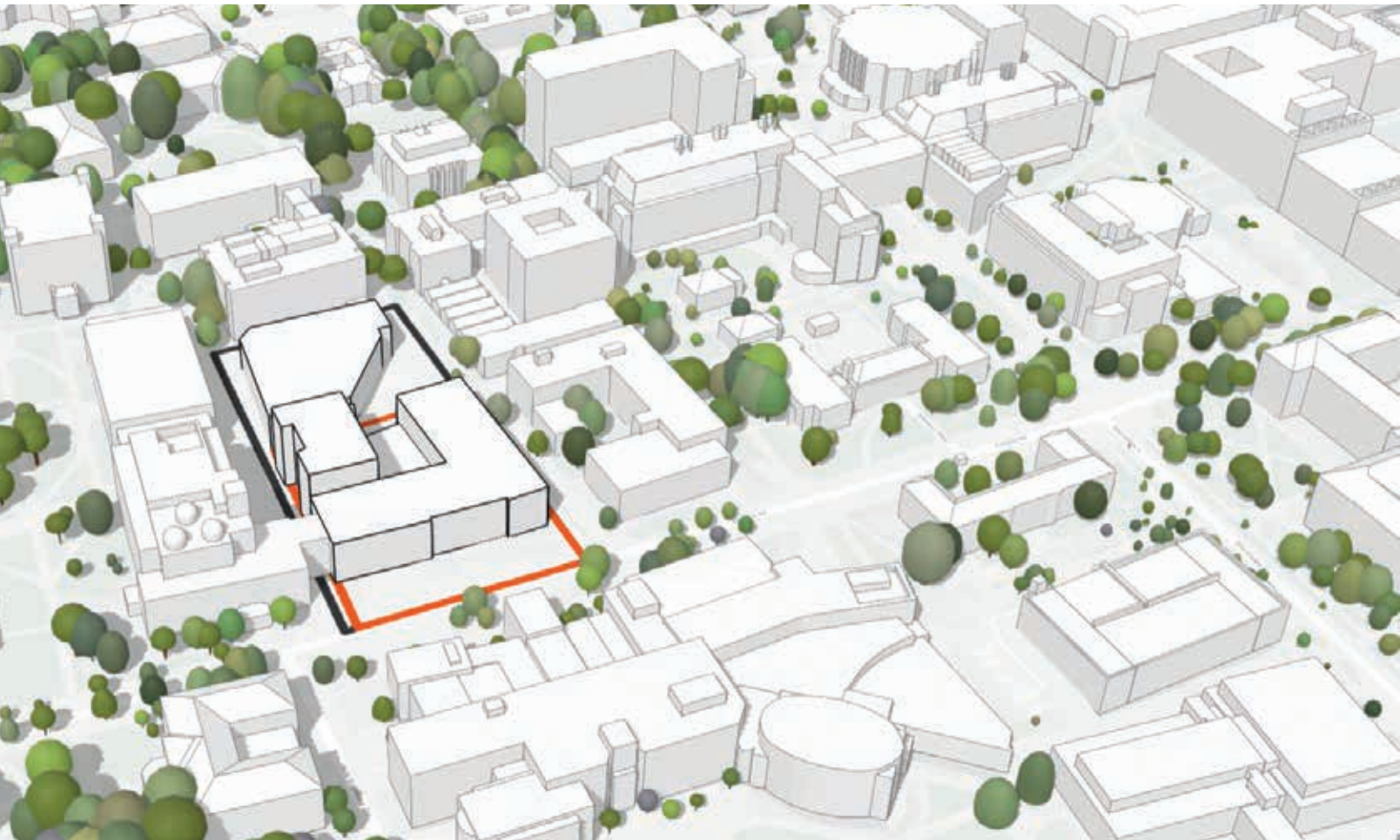


← A hub site communicates the vision for the Gateway Redevelopment Project in the city of Talent, Oregon.

enables the team to share and compare features, such as heights, setbacks, and floor area ratio (FAR), and see how streetscapes are changing.

For city planners, the look of downtown is important, but so is the economic mix that contributes to State College's vitality. Longtime residents of any city can be wary about significant changes in growth patterns. This means that transparency in these situations is more important than ever to create not only a dialogue, but also a partnership between residents and their planning department. To address this, State College launched an immersive 3D website (https://bit.ly/3DJ84iM) that lists all projects in the borough under review, approved, under construction, and completed.

Many new council members ran on a platform of creating affordable housing. As they take office, LeClear and his team plan



↑ The Almeda Drive Fire burned a path of destruction through southern Oregon, burning more than 2,600 structures.

to lean on their GIS maps and models to help developers and the city find a balance for residents. "This digital twin tool will be helpful to orient new local officials about the issues," LeClear said.

From Ashes to Affordable Housing

In 2020, the Almeda Drive Fire burned a path of destruction through southern Oregon. One of the cities that saw particularly harsh devastation was Talent, Oregon. The devastation was particularly harsh on many low-income first-generation immigrants who were working in the area. City officials and community leaders wanted to map a path to keep families who had called Talent home.

The Talent Urban Renewal Agency (TURA) purchased a four-acre plot of land between Route 99, the city's major thoroughfare, and Talent Avenue, the city's central street. The city had planned to develop this mostly vacant area into the Gateway Redevelopment Project. The project would combine residential development and local businesses to attract more traffic from the highway.

To reenvision the project to meet the housing needs of displaced residents, planners relied heavily on GIS. Nikki Hart-Brinkley, owner of land-use consultancy firm Greentop PDR, helped the city use existing lidar data to build a 3D basemap. That map provided a realistic interface for conducting scenario planning for the site. Planners could execute a proposal virtually, add structures to the GIS, and examine the results from all angles. This web-based

3D environment was built in ArcGIS Urban and allowed TURA to see how the project would mesh with existing zoning and land-use laws.

This work also provided insight into utility needs for the development. "You have to have water, sewer, and electricity for each and every unit," Hart-Brinkley said. "That stuff doesn't just happen to be there."

Because civic inclusion is a key component of this project, the city used ArcGIS Hub to create a hub site (https://bit.ly/3FsZGW6) to inform the public and provide transparency about the process.

With ArcGIS as a guide, Gateway's designers forged a four-phase development plan, beginning with 53 trailers of transitional housing. Over the next few years, permanent affordable housing will replace some of the trailers. This housing mix will evolve into a site with 90 affordable apartments.

"We knew when we purchased the property and started working with the community to create a vision here that it was a very special place," said Darby Ayers-Flood, Talent's mayor, during the groundbreaking ceremony. "We had no way of knowing how special this place would become."

Balancing Economic Development

The city of Colton, California, like many cities, lacks housing that fits the lifestyles of its changing and growing demographics. City leaders have decided to meet these needs and address economic development concerns with the creation of a downtown mixed-use marketplace called Hub City Centre. In 2014, the city had a 450-acre piece of land for the development. Instead of letting warehouses occupy the vacant space, Arthur Morgan, economic development manager for the City of Colton, wanted to use this area to transform Colton into a more livable, more appealing, and healthier city.

Like State College and Talent, Colton leveraged a digital twin created in ArcGIS to both plan and market the development of Hub City Centre. "We know what we want, we know what we're going after, and we can use GIS to tell the story to get businesses and developers to be a part of it," Morgan said.

When the city leaders asked the public what it wanted to see, it became clear that residents wanted to move away from traditional single-family residential lots to

↓ With ArcGIS as a guide, the Gateway Redevelopment Project has been designed as a four-phase development plan, beginning with 53 trailers of transitional housing.

↑ Instead of having warehouses occupy a 450-acre piece of land, Colton, California, is developing Hub City Centre, an area that will make Colton a more livable, more appealing, and healthier city.

→ Using ArcGIS Urban, Colton has built a 3D model of planned and existing development.

townhomes and other housing types. Using ArcGIS Urban, the city has built a 3D model of planned and existing development.

The 3D model made its debut at the International Council of Shopping Centers (ICSC) conference, where Morgan incorporated the immersive tool in his pitch to retailers. City leaders used the 3D model to show retailers how developers would blend into the community. Housing, restaurants, and hotels have been added to Hub City Centre over the past few years, with no signs of slowing down. Many local economies experienced significant loss during the pandemic, but Colton saw a $2 million revenue increase from sales and property tax.

Digital Twins Give Communities an Edge

These three cities are examples of a rapidly evolving trend taking place across the country. The implementation of a digital twin gives communities the tools they need to effectively understand current assets and resources, while also creating multiple scenarios for future development that meets the needs of all residents.

From a planning standpoint, digital twins and the tools used to model development provide a more efficient route to more sustainable and equitable developments. From an economic development standpoint, digital twins give communities a competitive edge, whether dealing with business recruitment or business retention and expansion.

Clearly, 3D is no longer a luxury. It's attainable and affordable—and importantly, it's how planners, economic developers, and the public think.

About the Author

Keith Cooke is the global industry manager for community development at Esri. A graduate of Auburn University, he has been a GIS professional since 1994 and has worked for planning and community development agencies at the regional and municipal levels in Alabama and North Carolina. Prior to this role, he was an account executive at Esri for 15 years working with more than 100 local governments.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Is Your Geospatial Strategy Aligned with the Rest of Your Business?

By Matthew Lewin

I'm frequently asked about the relationship between a geospatial strategy and the many other strategies that exist in most organizations. The question usually relates to alignment and how to ensure that the goals of your geospatial program and the systems you implement sync with the plans and priorities of other organizational functions. How do you advance your geospatial agenda while maintaining reasonable consistency with the rest of the business?

A simple test you can perform is to evaluate the design and desired outcomes of your geospatial strategy against the defining elements of other strategies. The idea is to see if your geospatial strategy is generally aligned or if you're setting yourself up for an unfortunate collision. Below I've compiled a table to help with the process.

The Best Geospatial Strategies Are the Best Aligned

An effective geospatial strategy syncs with strategies developed at other levels in the organization.

The accompanying table describes a set of common enterprise strategies. They range from the very top-level organization strategy to functional or departmental strategies. Most organizations will have some, if not all, of these strategies planned or operational at a given time. The trick is to design your geospatial strategy so that the critical decisions and actions that define your strategy gracefully intersect and integrate with these other strategies.

Keep in mind, you're not striving for 100 percent perfect alignment here. While I present two options—aligned or not aligned—the reality is that alignment exists along a spectrum. Your goal should be to optimize the degree of alignment by targeting a level that respects the core principles of the other strategies while advancing your overall geospatial vision. This is a balancing act where advancing your organization's overall mission should be the focus.

Organization Strategy

Your organization strategy is your topmost strategy. It's the defining "where-to-play/how-to-win" proposition for your entire business.

The purpose of every subordinate strategy, including a geospatial strategy, is to support and reinforce your organization's overall strategy. That means the systems and capabilities established under your geospatial strategy should conspire to help your organization compete and, ideally, win in its chosen markets.

How? Well, the core value proposition of geospatial technology is that it provides location-specific insights. It answers questions relating to spatial variation. Questions such as: In what regions are products selling the most? Why in one region versus another? How could this change in the future, given shifting consumer preferences in different regions? How should we tailor our marketing efforts to account for these changes?

A well-aligned geospatial strategy focuses on building systems and capabilities that help answer these questions. That includes relevant maps and information products, data acquisition processes, user-facing applications, user and analyst training programs, technology infrastructure, and management processes needed to sustain the capability for the long term.

IT Strategy

Geospatial technology is the collective set of information technologies that acquire, store, process, analyze, and visualize geographic information. That means your geospatial strategy, as an inherently information-based strategy, will be strongly influenced by your organization's IT strategy, which defines the overall complement of technologies, services, and human resources required to deliver on the business strategy.

Ideally, your geospatial strategy extends the IT strategy by defining technologies and processes specific to the geospatial discipline. To align, these technologies and processes should integrate well with the broader IT environment and respect established IT governance controls. That includes data security and privacy standards, cloud deployment practices, and buy versus build principles. If you stray too far from these principles, you'll likely experience pushback from your CIO and be forced to produce a strong exception case.

Business Unit Strategy

Most likely, your organization is divided into several departments or functions—we'll call these business units. Often, each business unit has its own strategy that (hopefully) cascades from the top-level organization strategy. The idea is that each business unit serves to advance the overall business strategy through a set of department-specific tactics and initiatives.

These tactics and initiatives often involve implementing a set of department-specific systems—some of them geospatial. From the business unit's perspective, if these systems advance the department's strategy, they are aligned. However, looking at strategy at an organizational level, optimizing locally can result in global inefficiencies. Decisions made at the business unit level without consideration for decisions or investments made at the organization level can lead to functional silos characterized by redundancies and the duplication of effort in areas ranging from system functionality to data management processes to support roles. It can hinder knowledge sharing between business units and exacerbate your organization's technical debt, where numerous siloed systems become increasingly expensive to maintain over time.

Strategy Type	How Aligned Is Your Geospatial Strategy?	
	☑ Aligned	☒ Not Aligned
Organization Strategy Defines the vision, competitive position, and strategic priorities of the organization	The chosen mix of geospatial technology, services, processes, and expertise forms a cohesive capability that reinforces the organization's strategy.	The geospatial strategy fails to support major strategic priorities or is disconnected from the organization's overall vision.
IT Strategy Defines the information-based technology, data services, and human resources deployed by an organization to support and enable the overall strategy	Geospatial technology investments integrate with the broader IT environment and respect the principles and standards set forth by the IT strategy.	Geospatial technology decisions conflict with established IT standards and principles, leading to integration risks and increased maintenance burden.
Business Unit Strategy The business unit strategy defines the scope and competitive approach for a specific department or line of business. Ideally it aligns with and aggregates up to the organization strategy level	Geospatial systems implemented at the business unit level support the business unit's needs while respecting broader platform and capability decisions made at the organization and IT levels for the purpose of scale benefits, knowledge sharing, and effective governance.	The geospatial strategy fails to support specific business unit priorities or fails to align with organization-wide geospatial principles and systems without sufficient business justification.
Data Strategy Defines the scope and approach to collecting, storing, managing, using, and sharing an organization's information assets	Practices for handling geospatial records, imagery, and maps respect principles defined under the organization's overall data strategy.	The geospatial strategy introduces practices or standards for geospatial data handling that conflict with defining tenets of the corporate data strategy.
Analytics Strategy Defines the scope and approach to deriving business insights from an organization's information assets to support better decision-making	Geospatial context is brought to bear on the full spectrum of descriptive, diagnostic, predictive, and prescriptive analytics questions posed by the organization.	The geospatial strategy fails to create adequate data or systems functionality to deliver the geospatial context required of key analytics workflows.
Digital Transformation Strategy Defines the approach to digitalizing an organization's products and services, customer experience, and core operations	Digital products, services, and experiences introduced through the transformation strategy are enhanced through geospatial context and intelligence.	The geospatial strategy fails to integrate with the organization's key digital initiatives, resulting in digital innovations that miss out on the value of spatial awareness.
Workforce Strategy Defines how an organization attracts, recruits, integrates, and retains people with the right mix of skills and competencies to deliver on an organization's mission and strategy	Gaps in geospatial literacy and skills requirements are identified and an approach to sourcing and developing geospatial talent is integrated with the overall workforce strategy.	The geospatial strategy fails to establish specific recruiting, staffing, and professional development practices needed to address geospatial literacy gaps.

A well-aligned geospatial strategy takes great pains to balance the needs of individual business units with the direction and constraints established at the whole-of-organization and related IT strategy levels.

Data Strategy

A data strategy is another common strategy found in modern organizations, especially those that recognize data as a core business asset. Most often, you'll see a data strategy focus on data handling, particularly the practices associated with collecting, storing, managing, using, and sharing corporate data. This is referred to as a defense-oriented data strategy. I'll talk about the other type of data strategy—the offense-oriented strategy—in the next section on analytics strategy.

Your geospatial strategy should focus on refining these practices in a way that respects the general data life cycle principles but defines rules and standards unique to handling geospatial data. This can include imagery acquisition practices, field data collection tools, data models and schemas for foundational data layers, and attribute-level data access standards. At the same time, core data standards or policies regarding records retention, data privacy and data dissemination should be adhered to as closely as possible by default. These areas are usually tightly governed, and only rare exceptions will be accommodated.

The geospatial strategy implements geospatial-specific data science technologies and learning models that support descriptive, diagnostic, predictive, and prescriptive data analysis.

Analytics Strategy

The complement to a data handling strategy is an analytics strategy that focuses on implementing data science technologies and models to enhance business decision-making.

For the most part, geospatial technology is an analytics technology—it's simply the extension of data-driven analysis into the geographic realm. That means that to align your geospatial strategy with the goals of your analytics strategy, you need to implement geospatial tools and capabilities that bring the necessary geospatial context to any analytics question that needs it.

Often this becomes a battle over tools. The analytics program wants to use its tools for analysis, while the geospatial team wants everyone to use theirs. Assuming the insights derived are the same, this is more a matter of philosophy and preference than anything. The key is whether you're accessing a common, authoritative data source. If not, a priority of your geospatial strategy should be to create a shared data source for spatial analysis purposes that's accessible by multiple systems.

Digital Transformation Strategy

A goal for many organizations is to leverage digital technology to not only improve how they do business but also fundamentally transform how the organization runs, engages customers, and delivers its products and services.

For your geospatial strategy to align, you need to bring the unique capabilities of geospatial technology to bear on these transformation efforts. That means connecting new digital workflows and experiences to geospatial data, analysis, and visualizations.

For example, imagine a utility company in the process of transforming the customer experience by delivering personalized mobile updates in the event of a power outage. The location of a customer's impacted properties is imperative to showing where the outage has occurred, affected areas, restored areas, and even estimated restoration time. This is where geospatial data and technology's unique value help drive the transformation effort. Your goal in aligning your geospatial strategy is to identify where geospatial technology can add value and build the capabilities necessary to deliver it.

In practice, you often see organizations tackle digital transformation through the creation of digital innovation programs. These are incubators for the research and development of new digital experiences. Programs like these can be an excellent vehicle for ensuring better geospatial integration. Work with these program owners to incorporate geospatial analysis and capabilities into the design and proof of concept process. That way, geospatial thinking will be front and center during digital ideation as opposed to an afterthought.

Workforce Strategy

A workforce strategy aims to ensure that people with the right skills and competencies are hired and developed through an ongoing set of human resource and professional development practices and programs. Resourcing and developing geospatial talent is no different. The goal for your geospatial strategy should be to identify gaps in geospatial literacy across the staff complement in your organization and then work to address them within the bounds of the programs.

To align your geospatial strategy, look at your organization's programs related to recruiting, skills training, professional development, job shadowing, succession planning, and performance management. Likely your organization already has some of these practices in place, so leverage them as best you can rather than duplicate effort.

As you consider strategic alignment, keep in mind that it's not about achieving flawless consistency. In fact, it isn't necessarily realistic in many cases—especially when considering the number and breadth of strategies operational in your organization. What's important is that you spend deliberate time reviewing your geospatial strategy for alignment and identifying where you might have significant disconnects. Work to alleviate these issues—within the confines of your geospatial strategy or potentially within the confines of the strategy it conflicts with—and adjust in favor of supporting your organization's long-term purpose.

About the Author

Matthew Lewin is the director of management consulting for Esri Canada. His efforts are focused on helping management teams optimize and transform their businesses through GIS and location-based strategies. As a seasoned consultant, Lewin has provided organizations in the public and private sectors with practical strategies that enable GIS as an enterprise business capability. His interests lie at the intersection of business and technology, and he thrives on helping organizations bridge the gap between the two to achieve their most challenging GIS ambitions.


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Introducing ArcGIS Maps SDKs

By Nick Furness, Rex Hansen, Mike Branscomb, and Julie Powell

At the Esri European Developer Summit in November 2022, Esri announced that client SDKs and APIs would be delivered under one name, as the ArcGIS Maps SDKs, beginning in December 2022.

This change reflects the common purpose and capabilities of these SDKs and will help bring them to a broader audience. They're same great SDKs. They just have-new names. The current and new names are listed in Table 1.

The Suite of ArcGIS Maps SDKs

ArcGIS Maps SDK for JavaScript 4.25
ArcGIS Maps SDK for .NET 200.0
ArcGIS Maps SDK for Java 200.0
ArcGIS Maps SDK for Qt 200.0
ArcGIS Maps SDK for Swift 200.0 (beta)
ArcGIS Maps SDK for Kotlin 200.0 (beta)
ArcGIS Maps SDK for Unity 1.1
ArcGIS Maps SDK for Unreal Engine 1.1

Note that the ArcGIS Runtime SDKs for iOS and Android are being superseded by the new ArcGIS Maps SDKs for Swift and Kotlin, respectively.

Common Capabilities

ArcGIS API for JavaScript, ArcGIS Runtime SDKs, and ArcGIS Maps SDKs for Game Engines have a great deal in common. Each is already a world-class SDK with conceptual guides, an API reference, tutorials, samples, and community forums. Each is backed by Esri Support. Combining these SDKs under one name better reflects these common underpinnings, which include:

- Sophisticated APIs for easy data access, visualization, and editing
- Support for multiple data formats and services
- High-performance, powerful visualization of geospatial data
- High-precision geospatial data support at global and local scale
- Support for multiple projections and coordinate systems
- Client-side geometry engine for in-memory analysis and processing of spatial data
- Support for place search, geocoding, and routing
- Seamless integration with the ArcGIS system: ArcGIS Platform, ArcGIS Online, ArcGIS Enterprise, and ArcGIS Pro
- Integration with the ArcGIS system's security model, including OAuth and API keys

Reaching a Broader Audience

Esri, which is proud to deliver some of the best SDKs available, wants to make it as easy as possible to discover them. Whether searching the web or exploring package managers, the hard truth is that *ArcGIS* and *Runtime* often don't mean much to a new audience. By including the word *Maps* in the SDK product name, Esri makes it much easier for developers to discover Esri's SDKs when they're searching for and evaluating location and mapping technologies for their projects.

One Suite of SDKs in Three Groups

Although the ArcGIS Maps SDKs share many capabilities, they do fall into three distinct groups, each of which is used to build specific kinds of solutions:

Web SDKs

ArcGIS Maps SDK for JavaScript is the only web SDK in the ArcGIS Maps SDK family. It is used for building apps that run in web browsers.

Native SDKs

ArcGIS Maps SDKs for Native Apps will be used as a convenient shorthand for the ArcGIS Maps SDKs for .NET, Java, Qt, Swift, and Kotlin. ArcGIS Maps SDKs for Native Apps are for building apps that run directly on mobile, desktop, and embedded devices, using .NET, Java, Qt, Swift, or Kotlin, either online or offline.

Game Engine SDKs

ArcGIS Maps SDKs for Game Engines will continue to be used as shorthand for the ArcGIS Maps SDKs for Unity and Unreal Engine. ArcGIS Maps SDKs are for building apps for augmented reality (AR), virtual reality (VR), mobile, and desktop devices using Unity or Unreal Engine that can work either online or offline.

What Will Change

This is a name change only. While you might see new names in package manager listings, documentation, or on the Esri Support site, the technology you work with won't be changing. Furthermore, names will change only for new releases of the SDKs.

What Won't Change

Although only the names will change, it's worth reiterating some of the things that won't change. Capabilities of the APIs/SDKs will remain the same. Namespaces, class names, methods, properties, and include statements will all stay the same. If you use a package manager, you'll continue

↓ Table 1

Current Name	New Name
ArcGIS API for JavaScript	**ArcGIS Maps SDK for JavaScript**
ArcGIS Runtime SDK for .NET	**ArcGIS Maps SDK for .NET**
ArcGIS Runtime SDK for Java	**ArcGIS Maps SDK for Java**
ArcGIS Runtime SDK for Qt	**ArcGIS Maps SDK for Qt**

Adopting New Name	Not Adopting New Name
ArcGIS API for JavaScript 4.25 and later **will** adopt the new name.	ArcGIS API for JavaScript 4.0–4.24 and all ArcGIS API for JavaScript 3.x releases **will *not*** adopt the name change.
ArcGIS Runtime SDKs beginning with the 200.0 release **will** adopt the ArcGIS Maps SDK name.	For ArcGIS Runtime SDKs, 100.0–100.15 releases of the ArcGIS Runtime SDKs **will *not*** adopt the new naming. This also includes any future patch releases of 100.x SDKs.
The new ArcGIS Maps SDK for Swift and ArcGIS Maps SDK for Kotlin **supersede** ArcGIS Runtime SDK for iOS and ArcGIS Runtime SDK for Android at version 200.0.	ArcGIS Runtime SDK for iOS and ArcGIS Runtime SDK for Android **will *not*** adopt the new names. The last release of these two SDKs was the 100.15 long-term support release.

↑ Table 2

to reference the same packages. If you're linking to ArcGIS Runtime SDK binaries, nothing will change.

In short, you won't need to change how you reference Esri APIs or SDKs. Coding patterns aren't changing, since the APIs aren't changing so the way you use them won't change either. Product support levels and product life cycles remain unchanged. Existing ArcGIS Runtime license strings will continue to be valid for ArcGIS Maps SDKs for Native Apps. Likewise, users of ArcGIS Online or ArcGIS Enterprise who have ArcGIS Runtime capabilities assigned to them will be able to use apps built with ArcGIS.

The 100.15 release of all ArcGIS Runtime SDKs will remain in General Availability status until August 2024 and won't retire until September 2027. Release frequency will remain unchanged.

*Note that if you are migrating your projects to the new Swift and Kotlin SDKs, that migration **will** involve code changes. See the blog post "ArcGIS Runtime in 2022 and Beyond" (https://bit.ly/3UWPObX) for more details on these SDKs.*

ArcGIS Maps SDKs for Native Apps

How does this affect versions of the APIs and SDKs that have already been released?

This is a forward-looking name change. Existing releases will not adopt the name change.

When Will These Changes Happen?

The ArcGIS Developers website was updated in December 2022 with the release of new versions of the ArcGIS Maps SDKs for Native Apps and ArcGIS Maps SDKs for Game Engines. The Esri Support, Esri Community, and other web pages; products; dashboards; and documentation will be updated to reflect the new name throughout 2023. As Esri rolls out the name changes, just continue building and deploying amazing apps.

About the Authors

Nick Furness is a technical product manager for the ArcGIS Runtime SDKs, who specialized in ArcGIS Runtime SDK for iOS. He has spent more than 20 years working in the GIS space, building projects ranging from small mom-and-pop solutions to enterprise utility and national government deployments. He presents at various Esri Developer Summits, the Esri User Conference, and many other events, most frequently speaking about the Runtime SDKs and occasionally JavaScript.

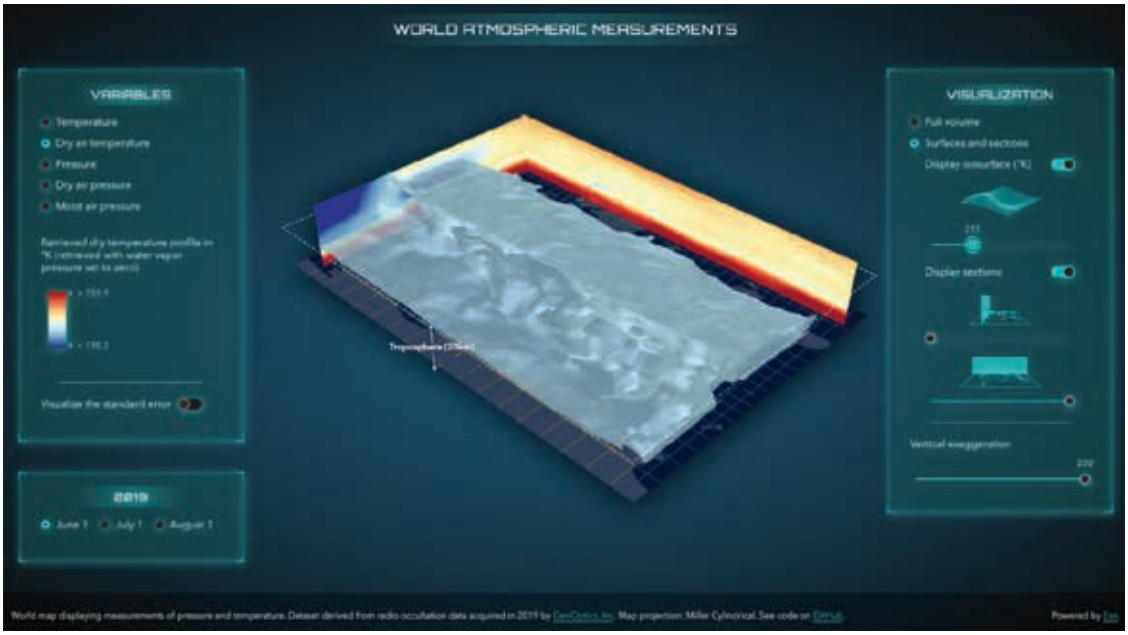
Rex Hansen is a product manager for the ArcGIS Runtime SDKs and ArcGIS Maps SDKs. He has more than 25 years of experience in GIS, spatial analytics, and computer mapping. Currently, he guides the development of native technologies in the GIS industry to use authoritative geospatial content and analysis in offline workflows; photo-realistic experiences; and immersive, extended reality solutions.

Mike Branscomb is a product manager for ArcGIS Runtime SDKs and ArcGIS Maps SDKs who specializes in ArcGIS Runtime SDK for .NET, ArcGIS Runtime Local Server, and 3D scene layers. He is also a Scrum Product Owner with more than 10 years of experience guiding teams through the product development life cycle.

Julie Powell is a principal product manager who focuses on Esri's web development technologies. She works to ensure that developers can be successful in building state-of-the-art, purposeful solutions using ArcGIS software. She brings 20 years of experience working with global leaders such as Hewlett-Packard and Esri, delivering a variety of software solutions for both the enterprise and consumer markets. Powell has worked on a wide range of projects and consulting endeavors, including serving as technical lead for web mapping solutions for strategic customers.

Visualizing Multidimensional Datasets with ArcGIS Maps SDK for JavaScript

By Raluca Nicola



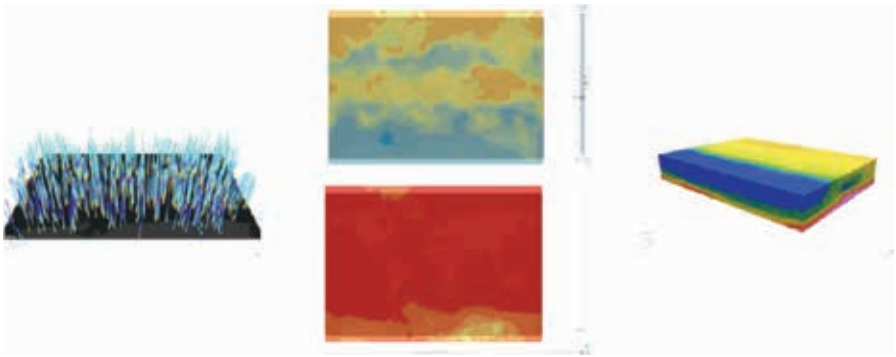
← This application visualizes a dataset representing atmospheric temperature and pressure measurements in a voxel layer.

Multidimensional datasets are complex and hard to understand without good visualization tools. This article visualizes a dataset representing atmospheric temperature and pressure measurements using an application built with ArcGIS Maps SDK for JavaScript. View the live application at https://bit.ly/3UUfLsw.

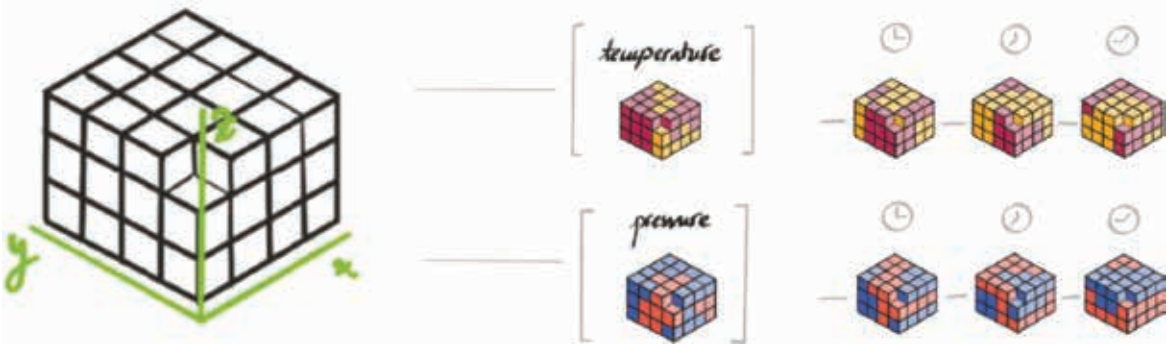
To better understand the application, some explanation is in order. Atmospheric pressure is the force exerted on a surface by the air above as gravity pulls it to Earth. The temperature at different levels of Earth's atmosphere is influenced by incoming solar radiation; humidity; and, of course, altitude.

How are temperature and pressure measured at such high altitudes? The technique involves a low Earth orbit satellite receiving a signal from a GPS satellite. When it passes through the atmosphere, the signal is refracted in a manner similar to the way light refracts when it passes through a lens. The magnitude of the refraction depends on the temperature, air pressure, and humidity. This technique, called radio occultation, produces highly accurate atmospheric measurements, which are used in weather forecasting systems.

The dataset used by the application is provided by GeoOptics, a company that specializes in radio occultations for weather forecasts. Each occultation event lasts less than a minute and produces a linear profile of between 350 and 400 observations from the top of the atmosphere to the bottom. The data acquires heights that range from an altitude of 30 kilometers to ground level. The initial dataset contained approximately 600 occultation profiles that were used to interpolate the measurements into a 3D surface. The geostatistical interpolation method used was empirical Bayesian kriging 3D. Using GA Layer 3D to netCDF in the Geostatistical Analyst



→ The initial dataset of approximately 600 occultation profiles were used to interpolate the measurements into a 3D surface using empirical Bayesian kriging 3D. The GA Layer 3D to netCDF tool in the Geostatistical Analyst toolbox in ArcGIS Pro was used to export a 3D surface to a netCDF file that can be viewed as a voxel layer.



→ A voxel layer can store the spatial coordinates x,y and z and values for pressure and temperature variables over multiple days.

toolbox in ArcGIS Pro, the 3D surface was exported to a netCDF file, which can then be viewed as a voxel layer.

Exploring a Voxel Layer with ArcGIS Maps SDK for JavaScript

A voxel layer is a representation of multidimensional spatial and temporal information in a 3D volumetric visualization. This type of layer can be published to ArcGIS Online and visualized in a browser. View the voxel layer used in the application at https://bit.ly/3ExJYqw.

Variables

The voxel layer stores the spatial coordinates x,y and z and values for pressure and temperature variables over three days. Within ArcGIS Maps SDK for JavaScript, information about variables can be viewed by accessing the array voxelLayer.variables. For this layer, the temperature variable has the metadata shown in Listing 1.

```
{
  description: "temperature_Prediction",
  id: 10,
  name: "temperature",
  unit: "degree_K"
}
```

↑ Listing 1

Temperature can be visualized by setting the current variable ID on the layer using:

```
voxelLayer.currentVariableId = 10;
```

Change the time variable by setting the time extent on view.timeExtent. Visualizing different time periods allows the comparison of pressure and the temperature. The pressure changes almost linearly with altitude, whereas temperature fluctuates much more because it depends on not only altitude but also solar radiation and humidity.

Rendering

A voxel layer can be rendered as a volume or as surfaces. To switch between the two modes, set the voxelLayer.renderMode property to either volume or surfaces.

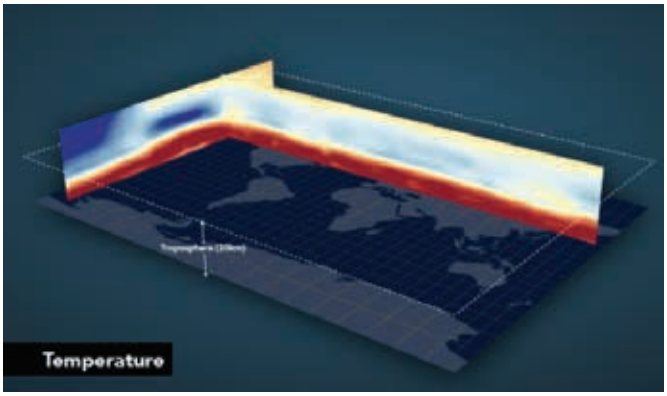
Depending on whether the variable is continuous or discrete, it can be rendered using stretch symbology or unique values. Each variable has its own symbology saved in voxelLayer.variableStyles. This example has only continuous values for temperature and pressure, so they should be rendered using the stretch symbology.

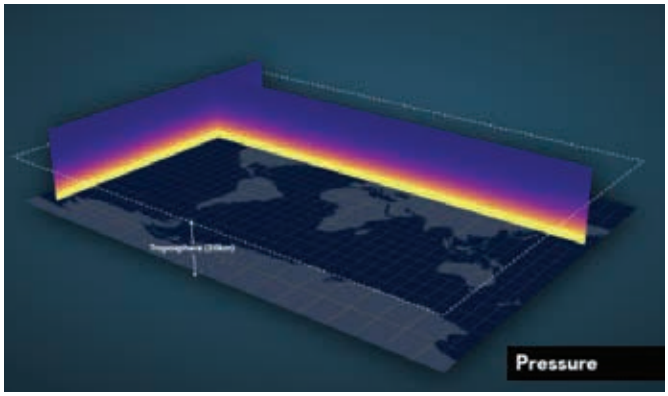
The variableStyle.transferFunction defines how the values are stretched between a minimum and maximum value that is associated with a color scheme. In case a variable has discrete values, the unique values are defined in variableStyle.uniqueValues.

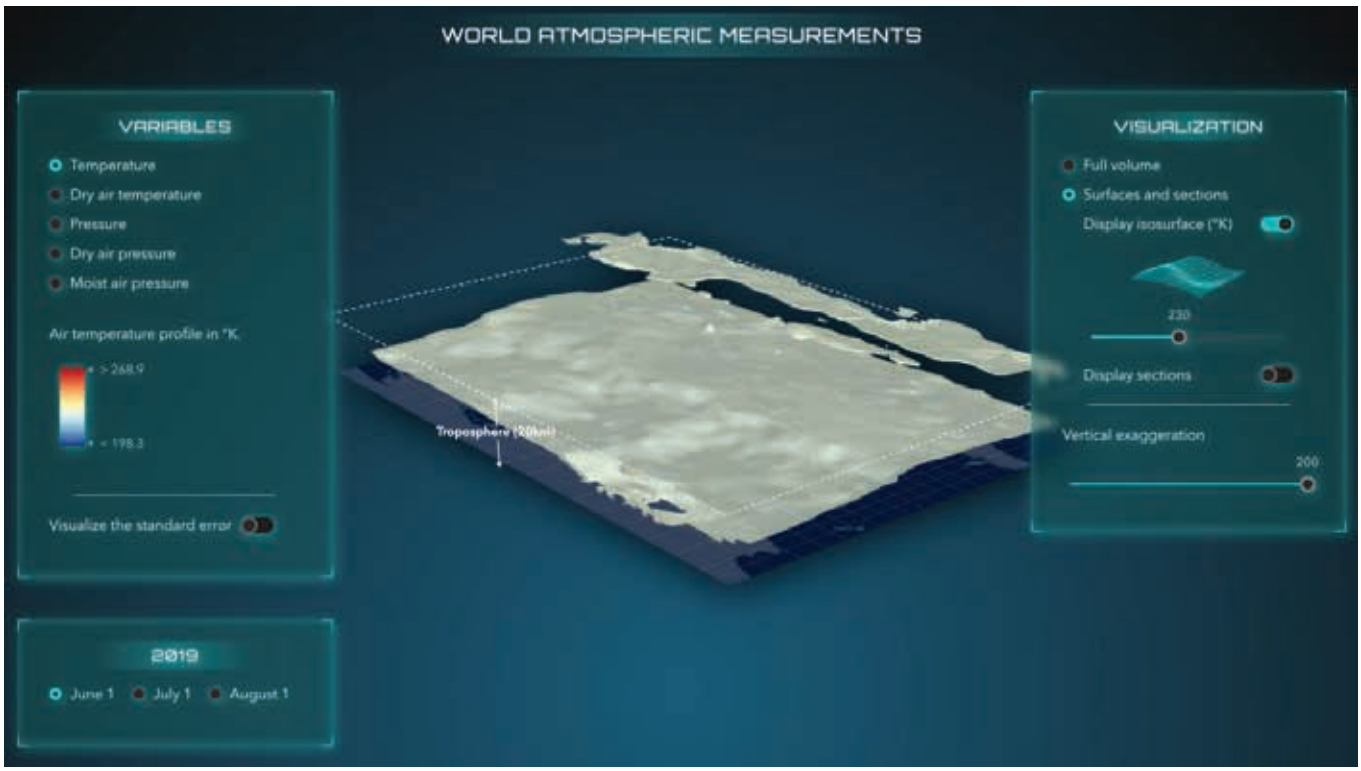
Isosurfaces

If the variable is continuous, isosurfaces—surfaces with the same variable value—can be created. In a voxel layer, up to four isosurfaces can be visualized at the same time. Isosurfaces are stored as part of the variable styles. For example, to get the isosurfaces for a selected variable, call voxelLayer.getVariableStyles(variableId).isosurfaces.

↓ Comparing pressure and temperature reveal that pressure changes almost linearly with altitude while temperature fluctuates much more because it is also affected by solar radiation and humidity.







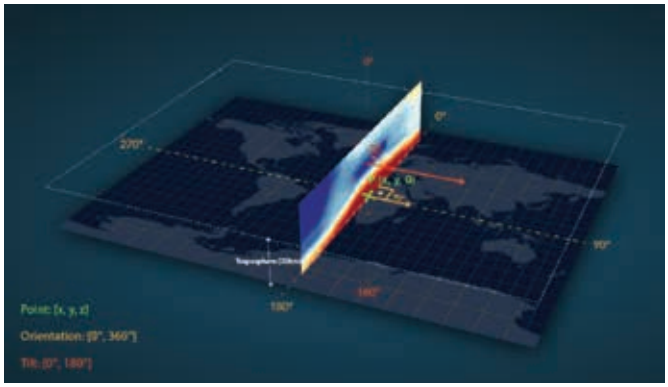
↑ A section is a two-sided vertical or horizontal plane cutting through a voxel layer.

→ Slices can be used to define areas of interest for both volume and surfaces visualizations.

In the demo application, surfaces are generated dynamically to explore the whole dataset. How does that work? When the variable is switched, the information about the range of values for that variable is available and the range is connected to a slider. As the user moves the slider, a single surface is created with the value of that slider, as shown in Listing 2.

```
const createIsosurface = value => {
  const style = layer.getVariableStyles(selectedVariable.
id);
  const color = layer.getColorForContinuousDataValue(sele
ctedVariable.id, value, false);
  if (style) {
    style.isosurfaces = [
      {
        value: value,
        enabled: true,
        color: {...color, a: 0.8},
        // if the color is not locked, we can override it
        colorLocked: false,
      },
    ];
  }
};
```

↑ Listing 2



Sections

A section is a two-sided vertical or horizontal plane cutting through a voxel layer. Creating sections allows analysis of profiles in the data. In ArcGIS Pro, a section can be locked so that it also displays when changing the variable so that several variables can be compared. ArcGIS Maps SDK for JavaScript can't create locked sections, but it can be used to visualize locked sections created in ArcGIS Pro.

In this application, dynamically generated sections allow exploration of vertical temperature profiles at any location. To define a dynamic section, set a point at which the plane should pass through, an orientation, and a tilt angle for the plane.

Because the point is defined in voxel space, the voxel dimensions will need to be retrieved using this code:

```
const dimensions = voxelLayer.getVolume().sizeInVoxels;
```

The code in Listing 3 generates a section that passes through the center of the voxel layer and is oriented from north to south .

```
layer.volumeStyles.getItemAt(0).dynamicSections = [
  {
    enabled: true,
    orientation: 90,
    tilt: 90,
    point: [Math.floor(dimensions[0] / 2), 0, 0],
  },
];
```

↑ Listing 3

Note that the y- and z-coordinates of the point can have any value within the voxel space; with the given orientation and tilt, x is the coordinate that sets the position of the plane.

Slice the Layer

Slices can be used to define areas of interest. Slices apply to both volume and surfaces visualizations. In our application we're slicing the layer not only vertically from east to west and south to north, but also horizontally from top to bottom. Similar to a section, a slice is also defined by a point, an orientation, and a tilt value as shown in Listing 4. Using the example of slicing from top to bottom, the slice can have any orientation so the tilt is 0, and the point's z-axis is important to give the height at which we want to slice the layer.

```
const getSlice = height => {
  return new VoxelSlice({
    tilt: 0,
    point: [0, 0, height],
  });
};
```

↑ Listing 4

Change the Vertical Exaggeration

This application needs vertical exaggeration to see the variation of the values on the z-axis. To change the exaggeration within ArcGIS Maps SDK for JavaScript, set it using volumeStyle.exaggeration.

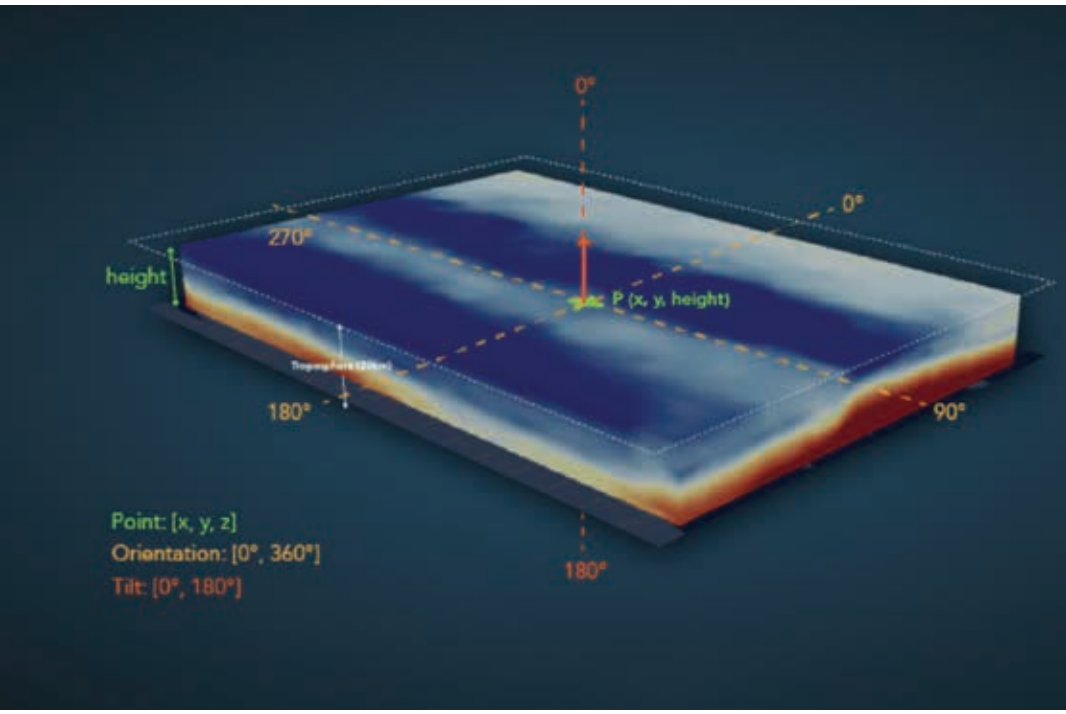
Learn More About Voxel Layers

This article showed just a few of the voxel layer capabilities on the web. Learn more about using voxel layers in the ArcGIS Developers documentation, which includes sample code and an API reference (https://bit.ly/3h0kyKt).

About the Author

Raluca Nicola works as a web cartographer with the Geo Experience Center team at Esri. She loves to play around with web technologies and visualization styles. If she's not in front of the computer, she's probably somewhere up in the mountains.

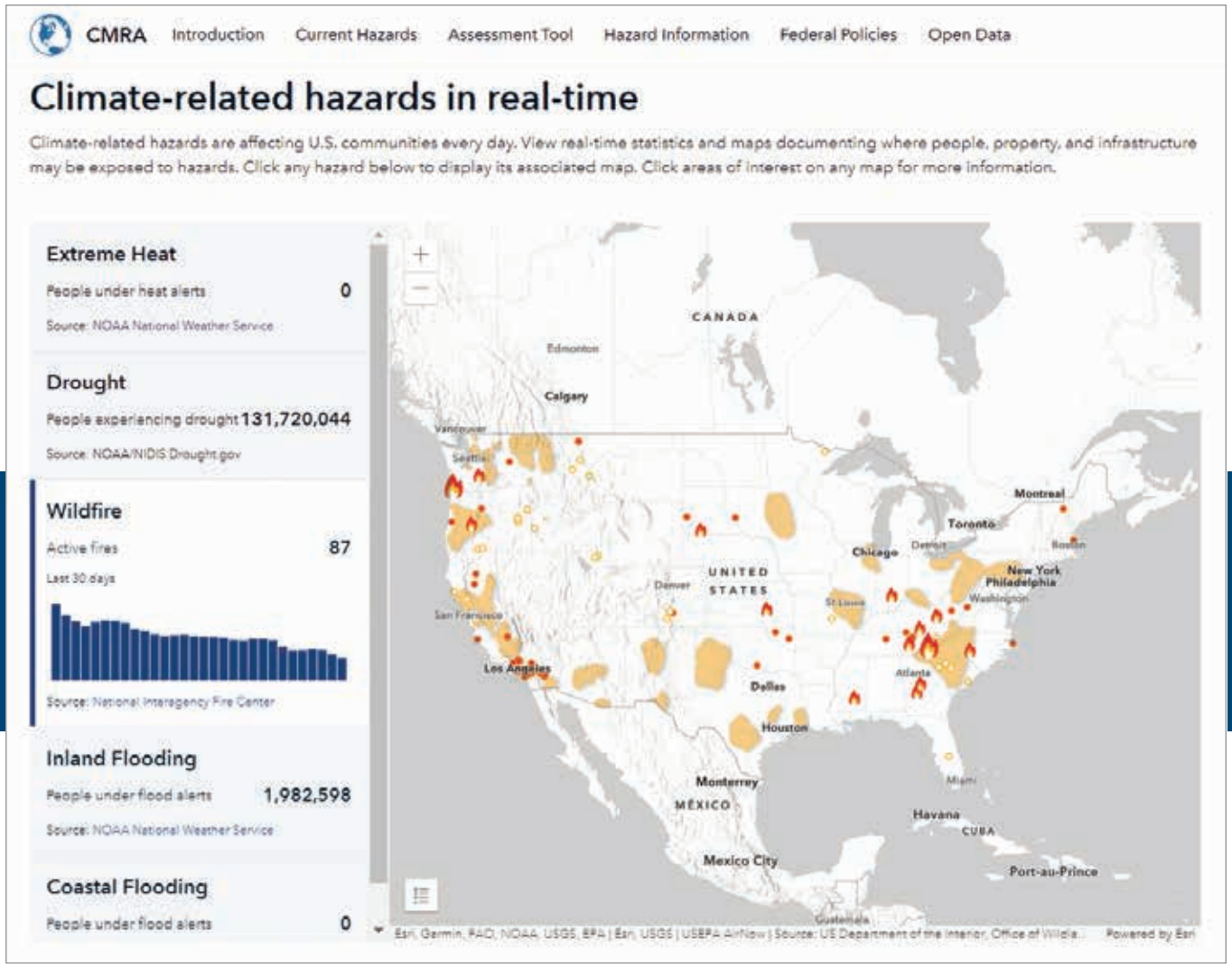
↓ Adding vertical exaggeration shows the variation of values on the z-axis.



CLIMATE ACTION: REASONS FOR HOPE

By Dawn Wright

Climate change, already a generational challenge, produces another problem that can feel insurmountable: hopelessness. Highlighting the climate action efforts and solutions that are underway—and showing progress—is a viable antidote and the focus of Atlas of Climate Action: Resilience and Reduction through a Geographic Approach, an event sponsored by Esri that was presented by the *Los Angeles Times* in September 2022.



↑ The White House's Climate Mapping for Resilience and Adaptation (CMRA) portal highlights climate-related risks in real time.

"The changes we're seeing are unprecedented in the history of human civilization on this planet. But there is so much good work going on," observed Katharine Hayhoe, who led a discussion into the steps being taken to tackle the effects of climate change including the use of GIS and data analysis. Hayhoe—my friend and an enduring source of hope—is the chief scientist of The Nature Conservancy.

Much of that good work is a result of the amount of location-based data that is being collected from satellites, sensors, and people on the ground, and gathered and analyzed with GIS. In GIS, users run models, display progress on dashboards, and make data and data products available to whoever may want it. Open data and open science are fueling a more inclusive and collaborative approach to meet the urgency of the moment.

Based on what we learned at the Atlas of Climate Action event, this article outlines what's already being done, what we can do in the future, and how we can make a difference on climate change and in people's lives both today and tomorrow.

Focusing Mitigation Efforts

We can better pinpoint where needs exist to have the greatest, most equitable impact on environmental mitigation. Governments are using location intelligence to determine where to dedicate funding.

California's CalEnviroScreen 4.0, a new version of the California Communities Environmental Health Screening Tool, identifies and displays communities that have been burdened by environmental harm. It combines 21 indicators of population and pollution characteristics, from poverty to pesticide use. Communities identified by the tool are then prioritized in the California Climate Investments program, which has already invested $11.4 billion in projects aimed at furthering environmental justice and mitigating climate effects.

"It's vital we understand data gaps and who might be left out because of them, as well as how to get feedback from those with the lived experience being mapped," said Yana Garcia, California's secretary for environmental protection. "Open government and open data must be constants," Garcia said.

Nationally, the White House's Climate Mapping for Resilience and Adaptation

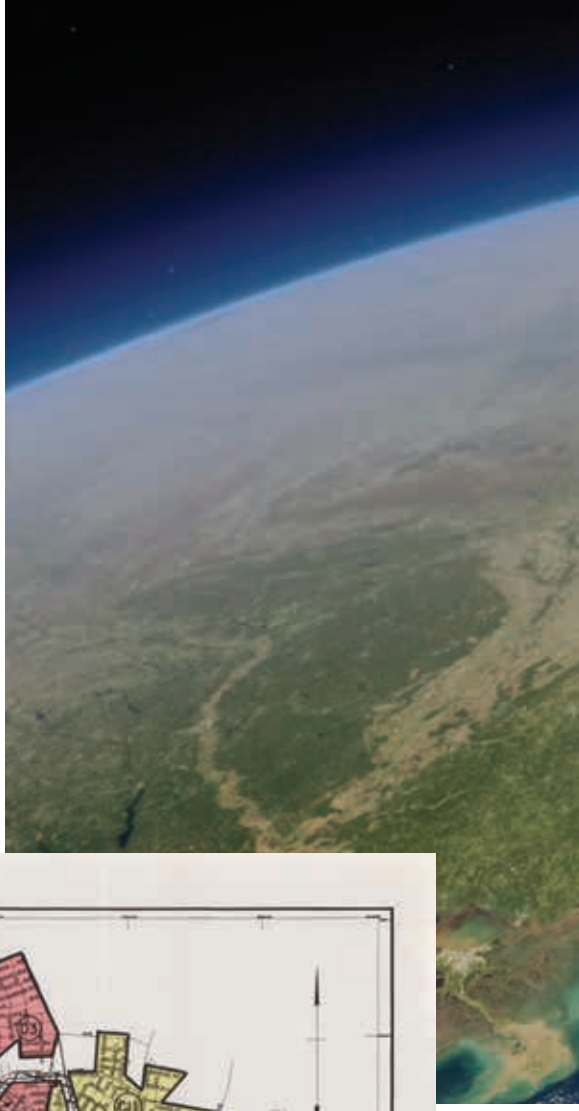
(CMRA) portal (resilience.climate.gov), produced in collaboration with Esri, explores current and projected climate conditions. This data highlights climate risks where we live and work, helping communities better prepare. And it elevates equity, an important metric that may make places eligible for government funding to build up resiliency. At an announcement for the portal, Phoenix mayor Kate Gallego noted that the city is spending tens of millions of dollars on climate resilience, "and this tool will help me understand where the most effective places are to put these dollars."

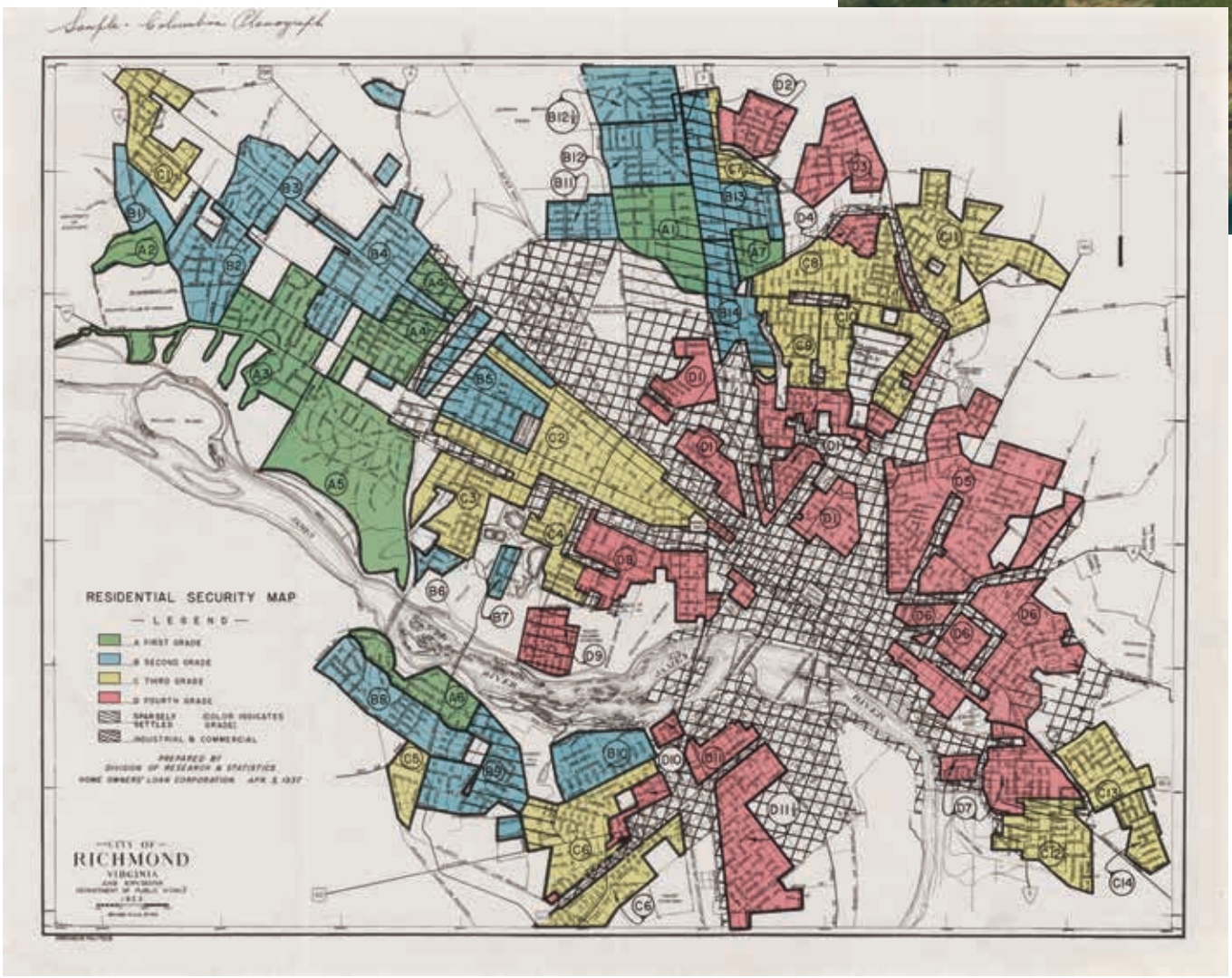
Adapting to Threats

We can see the risks cities are facing using sensor and satellite data to visualize vulnerability and build up resilience to threats. The City of Prague is studying which areas are most prone to extreme heat and using that information to decide where to plant trees and grass and install cooling surfaces.

Extreme heat is among the deadliest effects of climate change, and cities use GIS to examine heat islands and design mitigation measures to combat rising temperatures. Officials with the Prague Institute of Planning and Development are measuring and monitoring environmental changes (including temperature, humidity, and solar radiation in ambient air and the soil) and how adjustments to buildings and landscapes make a difference.

The analyses include visualizing the amount of chlorophyll plants that emit and studying the fluctuation of surface temperature with the aim of drawing down heat in





↑ For nearly 50 years, Landsat satellites, like Landsat 8 shown here, have been observing the Earth to better understand it and how it is changing.

← GIS helps identify communities that have been burdened by environmental harm, such as the lack of green infrastructure caused by historical redlining of neighborhoods.

densely populated areas of the city. All of this is helping Prague plan for worsening heat waves by designing adaptable future developments that better withstand environmental impacts.

Dealing with Extreme Weather

We are using location intelligence to prevent flooding by using smart sensors to divert runoff to where there's capacity. The company Xylem has been using sensors to monitor water levels and flow during storm surges, combining data from devices with machine learning to know which water storage facilities are full or which have the capacity to take in more runoff. The awareness is used in the moment, automating the opening and closing of valves to divert water to where it can fit during a storm.

Sensors can determine how much water is being used for crops during a drought. At a time of extreme drought in California, Land IQ, an agricultural and environmental consulting firm, monitors water use and crop acreage for both the agricultural industry and government regulators. It presents facts supported by science with data collected from satellites and on-the-ground measurements.

To find available public lands that might be ideal for holding solar panels, The Ray, an Atlanta-based nonprofit, uses maps to identify the best open rights-of-way along highways and freeways to position solar panels, making the most of unused public land by using an analytical map-based tool developed in partnership with Esri.

Observing the Earth

We are not only exploring space but also closely observing what's happening on the earth. A fleet of about 20 National Aeronautics and Space Administration (NASA) science missions has been orbiting the earth since the early 2000s. The sensors aboard these satellites record not only the ever-changing condition of ecosystems and agricultural land, but also the state of the cryosphere (the part of the earth's surface where water is in solid form) for sea level rise monitoring. The data provides continuous information for input into GIS models to track a wide range of climate variables, as well as biodiversity loss, from regional to global levels.

To bridge information gaps, satellites keep an eye on parts of the world that haven't been observed as closely before, said Carmen Blackwood, a scientist with NASA's Jet Propulsion Laboratory.

Planting Trees for Optimal Impact

We aren't simply planting more trees; we're planting trees where they'll benefit the most people and thrive. It's critical that trees be planted in the right forests, in the right urban locations, and at the right time, said Paul Cooper, chief information officer for the Arbor Day Foundation. That's where GIS outputs, including maps and dashboards, help inform people where heat islands exist or where there's a lack of shade. "Being able to pull up either your neighborhood or that forest that you're interested in and see where those impacts can be made most effectively—that's where we want to plant our trees," he said.

Integrating Traditional Wisdom

We're taking a nature-based approach. The Karuk Tribe of Northern California has been utilizing geospatial technology as it revives its ancient traditional practices of prescribed fires and cultural burning to not just suppress potential fires but also clear dangers to homes and roads and improve stream flow—which can, in turn, cool temperatures.

Making Sustainable Choices

We're using maps to make more sustainable choices about appliances with heavy energy consumption. Space heating and domestic hot water use are responsible for much of the energy use and carbon emissions by the New York City Housing Authority's 400,000 residents. The agency has been using maps to identify areas that need improvements. It invests in new technologies that are not only efficient but also affordable and don't diminish residents' quality of life, such as heat pumps. It's one element of what the agency's senior vice president of sustainability, Vlada Kenniff, called its "geographic path to decarbonization."

Building Resilience

We're not just responding to disasters; we're equipping communities to better withstand them when they happen. Tools like the US Federal Emergency Management Agency's (FEMA) National Risk Index for natural hazards, an online mapping application, help the agency and public identify where risks may be disproportionately greater. The tool combines data on 18 potential natural hazards and helps communities consider social vulnerabilities. By knowing what the risks are, people can better plan how to make their communities more resilient. FEMA has also launched a national building code strategy to encourage the adoption of hazard-resistant building codes for new and existing structures. The standards are included in the White House's CMRA portal alongside metrics about the more extreme hazards we face.

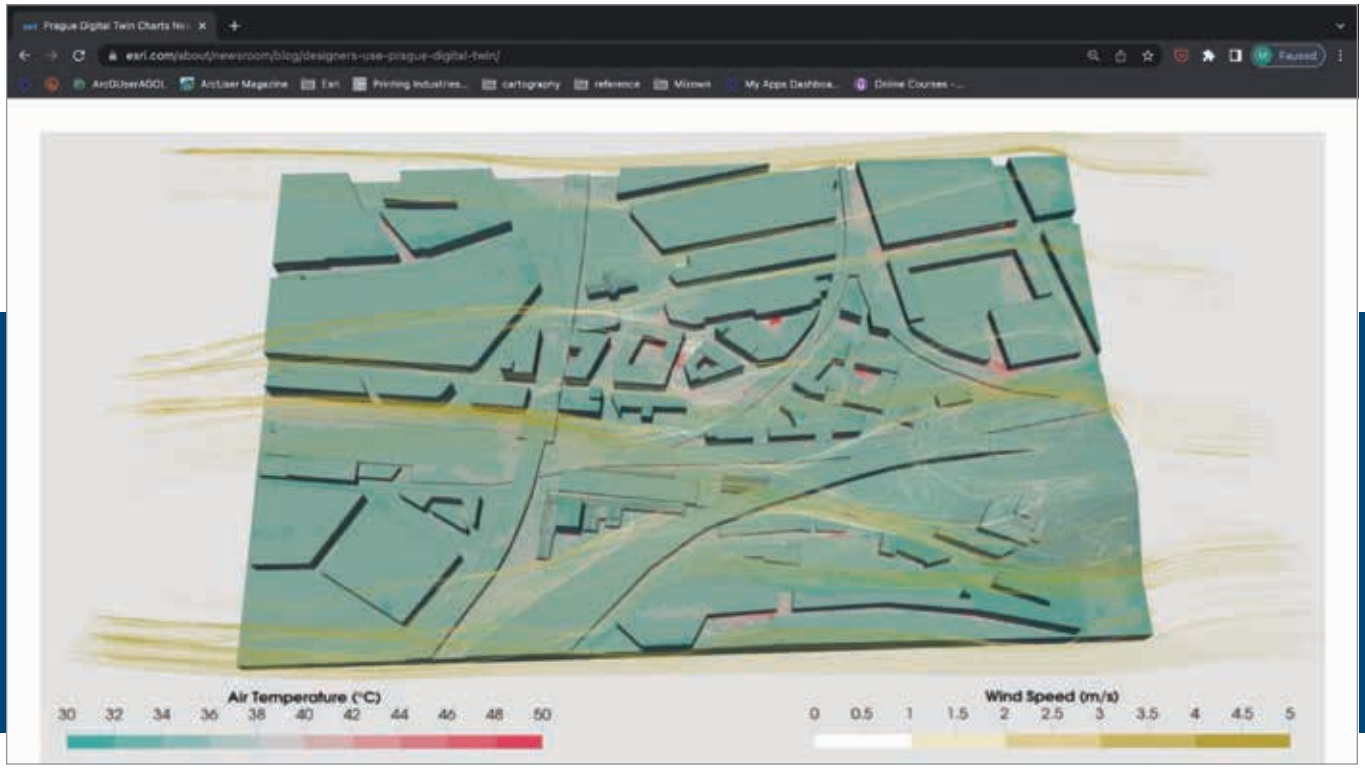
In each of these examples, climate action is benefiting from a growing amount of geographical data available at our fingertips like never before, and GIS is helping make sense of it.

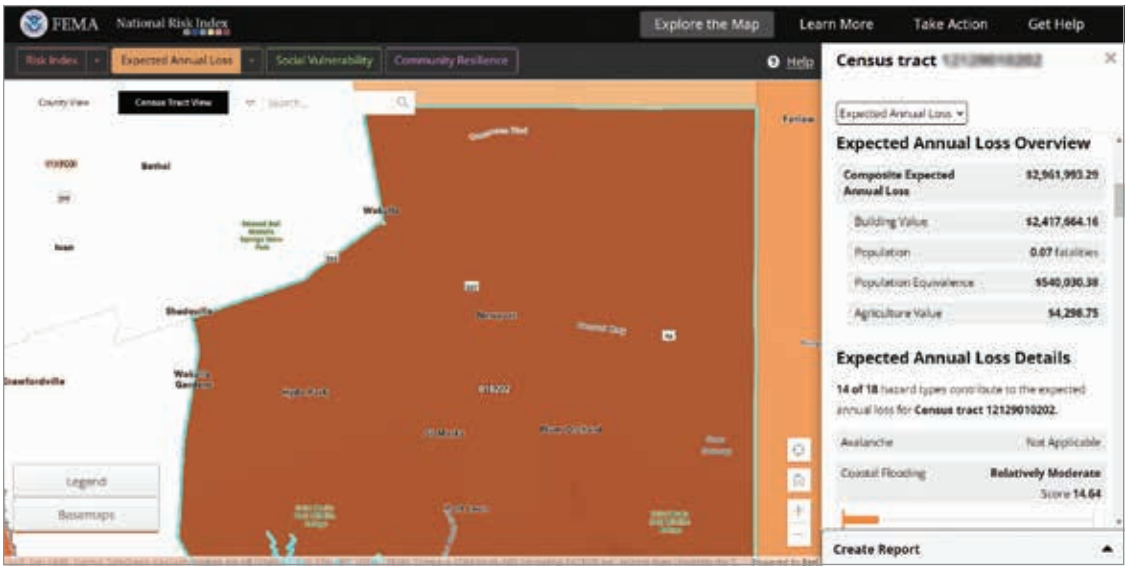
Or as Hayhoe so succinctly put it, "The more we know, the more decisions we can make that are informed by what's already happening and by what we expect to happen in the future."

About the Author

As the chief scientist of Esri, **Dr. Dawn Wright** helps strengthen the scientific foundation of Esri software and services,

↓ By modeling the microclimates in Prague neighborhoods, officials with the Prague Institute of Planning and Development can make adjustments to buildings and landscapes and make a difference in the city's livability.





← The US Federal Emergency Management Agency's (FEMA) National Risk Index for natural hazards, an online mapping application, helps the agency and public identify where risks may be disproportionately great.

while also representing Esri to the scientific community. A specialist in marine geology, she has authored and contributed to some of the most definitive literature on marine GIS. Wright is an elected member of the National Academy of Sciences and the American Academy of Arts & Sciences, as well as a fellow of the American Association of Geographers, the American Association for the Advancement of Science, the Geological Society of America, the California Academy of Sciences, and the Oceanography Society. She maintains an affiliated faculty appointment as professor of geography and oceanography in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University. Wright holds an interdisciplinary PhD in physical geography and marine geology from the University of California, Santa Barbara.

→ Watch a recording of the Atlas of Climate Action event (mediaspace.esri.com/media/t/1_4w42hakl).

→ Listen to this podcast (https://bit.ly/3VunJJ5), in which Katharine Hayhoe discusses how science is refining communication methods to better explain climatic data.

How Aggregation Resolves Reliability Concerns for American Community Survey Data

By Diana Lavery

Many GIS analysts work with American Community Survey (ACS) data from the US Census Bureau. This data is based on a sample of the population, therefore—like all survey data—it contains error due to sampling.

The census bureau publishes margins of error (MOE) along with every estimate it publishes, which is incredible. However, when users view the MOE for a specific measure on a specific tract, they can erroneously dismiss the entire ACS dataset. Even more unfortunately, users may not know that the typical geographic analysis of ACS data increases the reliability of the data by a noticeable amount.

[To learn more about MOEs, read "The Importance of Margins of Error and Mapping" (https://bit.ly/3O0fHFc) in the summer 2021 issue of ArcUser.*]*

The census bureau can publish estimates down to the census tract and even block group level by coarsening and aggregating data across years. Pooling together five years of data produces estimates at fine geographic levels. In addition to coarsening the data across time, data can also be coarsened across space.

While this may seem like heresy to many geographers, there are benefits to coarsening or aggregating data geographically. Many people need data disaggregated by race/ethnicity, gender, income, and other dimensions. Coarsening can make this data more reliable.

Some cities have gone through robust validation processes to create their own geographies that are coarser than census tracts. For example, New York City has its own Neighborhood Tabulation Areas, and Houston has its Super-Neighborhoods. You can use geography to test your own groups of tracts. You can call them anything you like, but I've been calling them super tracts.

The ACS Summarization App

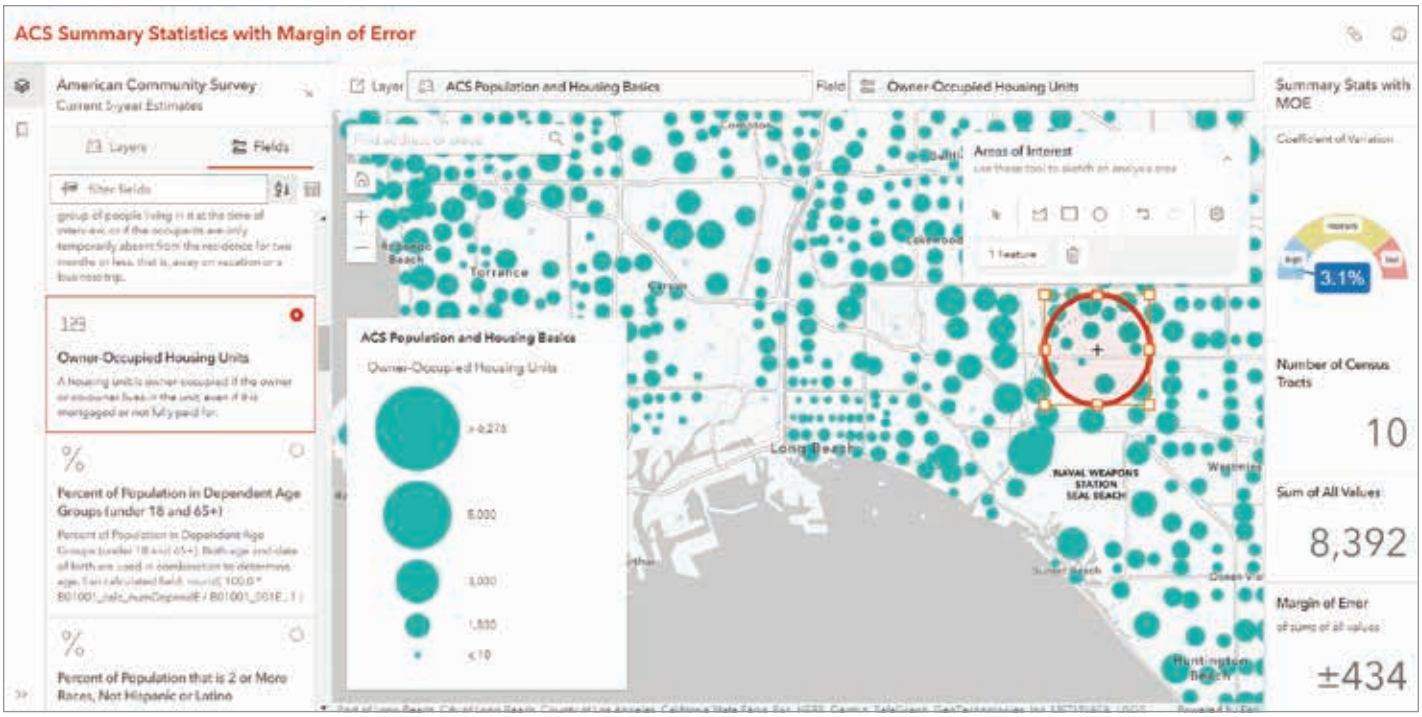
A lightweight app, ACS Summary Statistics with Margin of Error (https://bit.ly/3DWoO5a), is available at no charge to help you get a quick sense of how many tracts you'll need to aggregate to get an estimate that meets your desired level of reliability. The left panel of the app lets you search and select layers and attributes. If you select a count, the tract centroids will be symbolized by size. If you select percentage, the tract centroids will be symbolized by color.

Use the sketch tools on the top of the map to create your super tract. First, draw a shape around the neighborhood or district you know you want to analyze. Get the basic shape on the map to start.

The right panel of the app lets you see summary statistics for the chosen layers and attributes. The gauge shows the coefficient of variation (CV)

↓ Reliability for Coefficient of Variation (CV) Ranges

Coefficient of Variation	Reliability
CV <= 12	high
12 < CV <= 40	medium
40 < CV	low



↑ The ACS Summary Statistics with Margin of Error app helps you get a quick sense of how many tracts you'll need to aggregate to get an estimate that meets your desired level of reliability.

for the selection, which is calculated on the fly. *[CV is a measure of the relative spread of the values.]* Watch the gauge change as you modify your sketch. It characterizes the reliability of the CV as high, medium, or low. The lower the CV, the higher the reliability. Conversely, the higher the CV, the lower the reliability.

Best Practices for Tract Summarization

When aggregating tracts to improve reliability, try to

- Preserve patterns in the map.
- Be mindful of tracts with an estimate of zero.
- Use official estimates when available.

Preserve Patterns in the Map

Try to follow the patterns in the map when combining. For example, combine high values with other high values and lower values with other low values. The symbology in this app can help, but your own local on-the-ground knowledge is invaluable here. I realize this is hard when aggregating just a few tracts while balancing other considerations. However, combining areas with wildly differing characteristics will smooth out the numbers and become less informative.

Be Mindful of Tracts with an Estimate of Zero

Tracts with an estimate of zero are symbolized by the transparent teal symbols (for counts). These tracts are generally in places such as airports, cemeteries, and open land, but they can be anywhere. Even zero estimates have MOEs, which means there may be a few individuals in your population of interest in these tracts. They will not add anything to your estimate, but because they have a nonzero MOE, they could add slightly to your error.

Use Official Estimates when Available

In addition, this aggregation method will only give you an approximation for both the estimate and the MOE using the approximation formulas in *Understanding and Using American Community Survey Data* (https://bit.ly/3NUDvdx). The census bureau produces official estimates for school districts, incorporated places, county subdivisions, congressional districts, and many other areas. If you're aggregating up to get values for a defined census geography, such as a city boundary, check data.census.gov for an official estimate you can use. Not only does the official estimate use the true boundary, it will also have a lower MOE than you'd get from aggregating tracts, since it's not being approximated.

Reliability and the Nature of the Estimate

Adjust your reliability comfort level depending on the nature of the estimate. Ideally, you would like all estimates to have high reliability with a

Adjust your reliability comfort level depending on the nature of the estimate.

Geography can help you work with error, instead of being scared by it.

low coefficient of variation. However, this will be hard to achieve for very small populations, such as these:

- Children in the care of grandparents
- Female veterans
- Rental housing units that are mainly heated by solar energy

In cases like these, ask yourself if you could live with a medium level of reliability if that meant obtaining finer geographic detail. Also, neighboring tracts can have different levels of reliability for the same attribute. Sometimes tracts do have reliable estimates, so there's no need to aggregate unnecessarily and lose the geographic detail.

Start with the ACS Summarization App

The app is designed to give you a jumping-off point for creating aggregating tracts. It's designed to help you iterate quickly and dynamically, to get a quick sense of how much you'll have to aggregate up geographically to meet your reliability comfort level. Note that the final super tract does not persist outside of the app.

Create your final super tract using geoprocessing tools such as merge and dissolve. The app uses centroids for faster performance, but you might want to use the polygon versions of these layers that contain tract boundaries.

Estimates of medians are not included. Aggregating medians requires the full distribution of values, not just the medians of the various tracts. Therefore, estimates of medians are not in the app. Sometimes, entire layers are not included, such as Median Age, since all the attributes in this layer are medians.

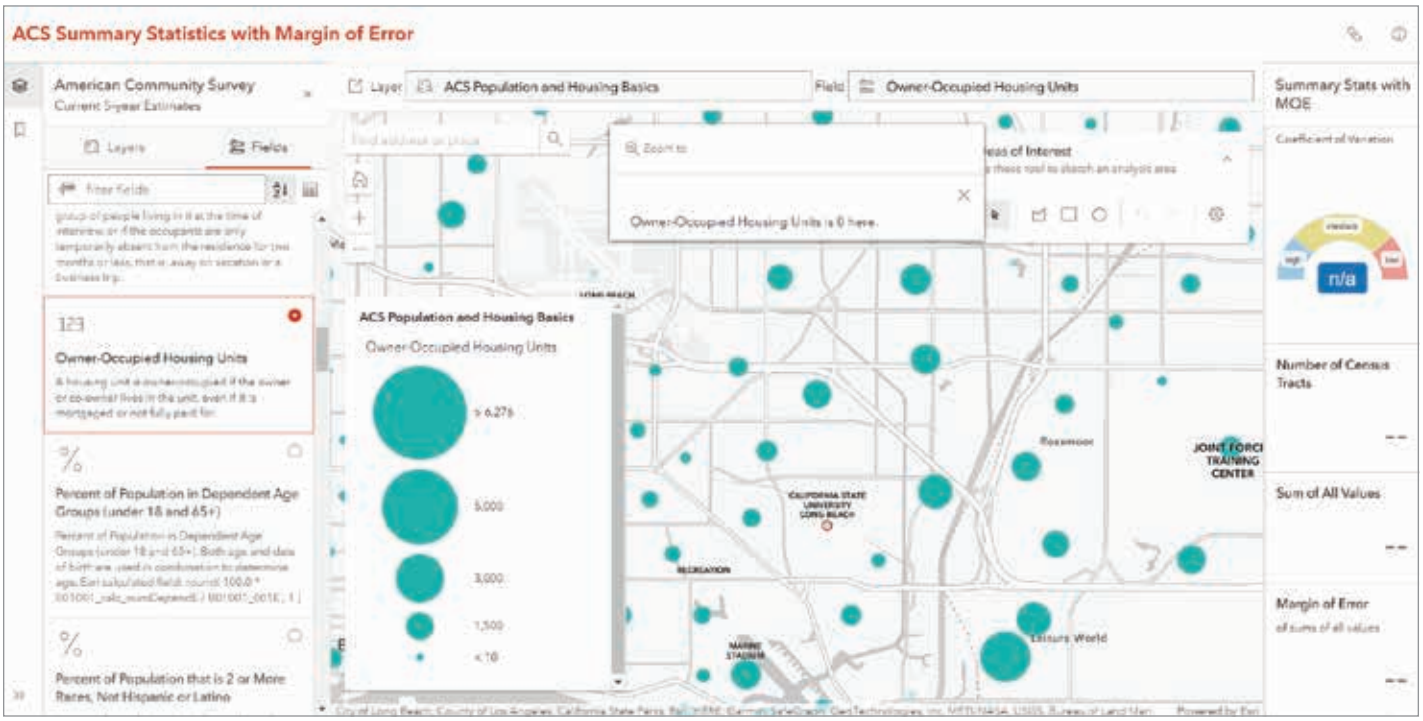
The estimates update every year with new values, since they use ArcGIS Living Atlas of the World layers that are updated annually. Remember that an aggregation that meets your reliability requirement now may not hold in future data releases.

Geography can help you work with error, instead of being scared by it.

About the Author

Diana Lavery (she/her/hers) loves working with data. She is a senior product engineer on ArcGIS Living Atlas of the World's policy maps team. She has over a decade of experience as a practitioner of demography, sociology, economics, policy analysis, and GIS. Lavery holds a bachelor's degree in quantitative economics and a master's degree in applied demography. She enjoys strong coffee and clean datasets, usually simultaneously.

↓ Tracts with an estimate of zero are symbolized by the transparent teal symbols (for counts). These tracts are generally in places such as airports, cemeteries, and open land, but they can be anywhere.

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Five Great Ways to Use Data Loading Tools

By Mindy Longoni, Joel Smith, and Alix Vezina

The Data Loading Tools, a free ArcGIS Pro toolbox, streamlines loading data from a source schema to a target dataset and allows you to perform in-process data transformation. This capability is especially useful for use cases such as migrating water utility assets into an ArcGIS Utility Network management system.

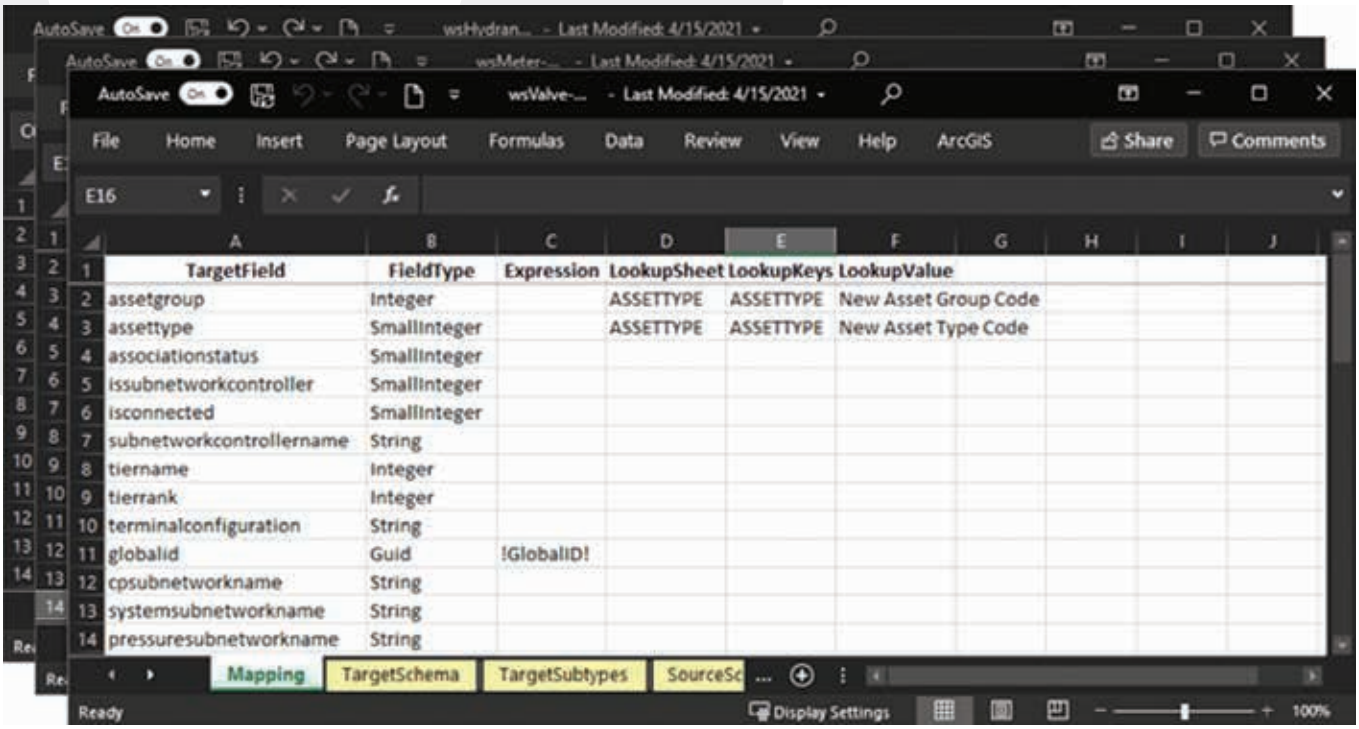
This toolbox creates a Data Loading Workspace that contains a collection of Microsoft Excel workbooks used to simplify field mapping and data loading. The Data Loading Tools toolbox requires ArcGIS Pro and Microsoft Excel 2016 or later.

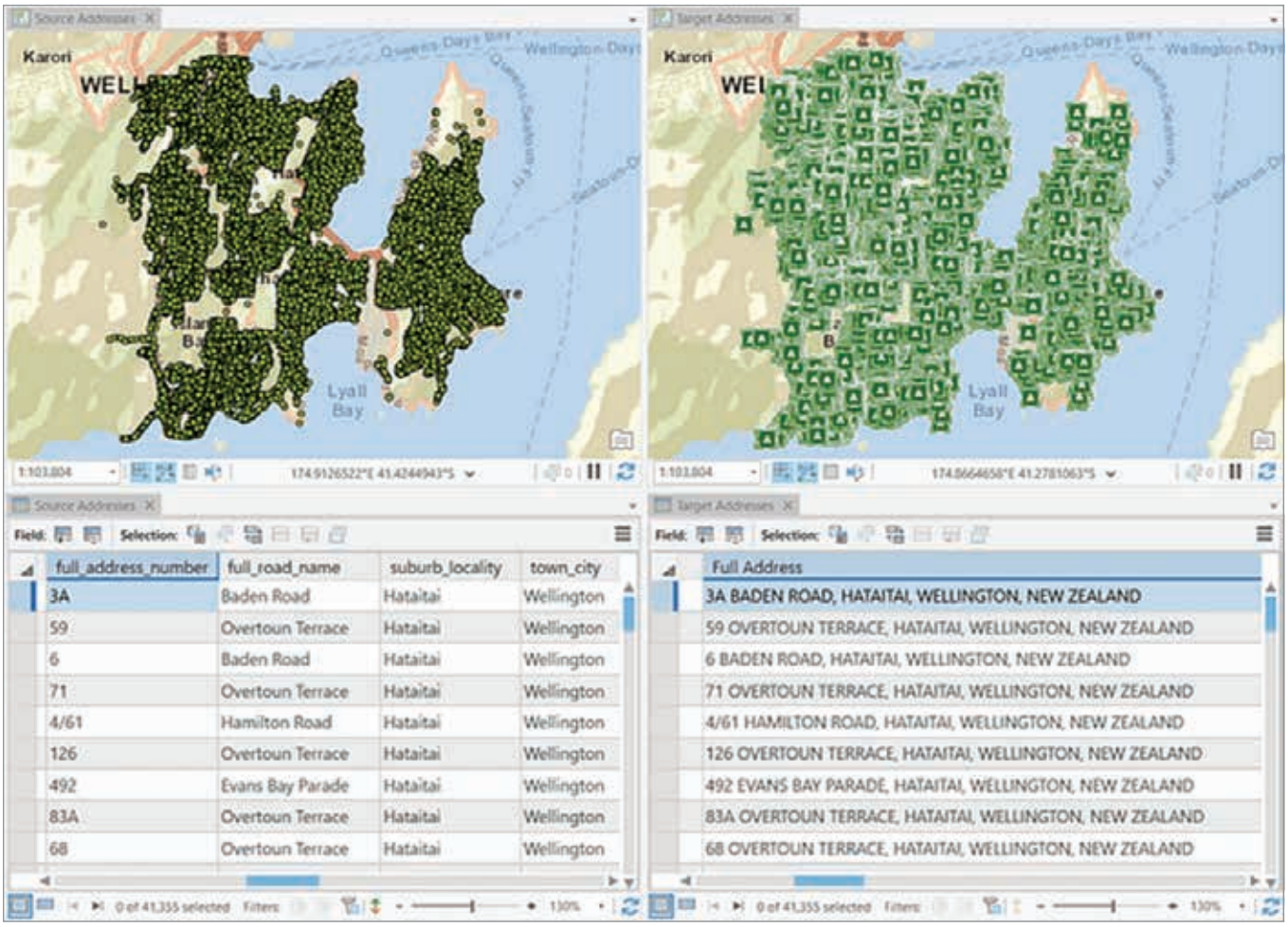
"I have loads of extra time!"

said no one—*ever.*

Seriously though, who couldn't use a little more time? In a nutshell, the Data Loading Tools, which are free with ArcGIS Pro, streamline the process of loading data from a source to a target dataset. These tools also allow you to transform your data at the same time. And best of all, the process is repeatable. You can transform your data once and reuse that logic again and again. Data Loading Tools can be used to migrate, consolidate, transform, clean, and archive data.

↓ Data Loading Tools helps you map data logically using a series of Microsoft Excel workbooks.





↑ Data Loading Tools can help you transform address data that you get from multiple suppliers into one format that works for you.

1 Migrate Data

Perhaps this has happened to you: A new data model or schema becomes available with improved features or functionality that your organization really needs. This is great. Then you realize that you will have to migrate your data to take advantage of that functionality. That is not so great. Data migration is famously time-consuming and difficult. That's where Data Loading Tools comes in.

Let's say that you're a utility GIS specialist responsible for moving data from a geometric network to a utility network. Data Loading Tools will allow you to map the data logically from source to target datasets using Microsoft Excel workbooks.

Because this mapping is saved in a series of Excel workbooks, you can migrate data in smaller chunks. You'll start with a pilot phase to confirm that the logic is appropriate for your migration, and then you'll use the toolbox to migrate data incrementally into the new data model or schema. You could even apply filters to perform quality assurance checks before you move completely into production or split data from a single source into different target datasets.

2 Consolidate Data

Another great benefit of Data Loading Tools is that you get the tools that you need to consolidate data from multiple data sources into one workspace. Say you're a data aggregator for your state. You regularly receive parcel data from each county that you must load into a statewide aggregated parcel layer. However, you may frequently receive data that is structured differently than your target workspace. With Data Loading Tools, you'll define how data should be loaded to your target database, which helps you produce a seamless statewide dataset.

Data Loading Tools will allow you to map the data logically from source to target datasets.

Address

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	address_type	full_address
1	Road	2/27 Abbott Street, Ngaio, Wellington
2	Road	5 Aitken St., Thorndon, Wellington
3	Road	70B Amapur Drive, Khandallah, Wellington
4	Road	53 Aurora Terrace, Kelburn, Wellington
5	Road	4 Baroda STREET, Khandallah, Wellington
6	Road	164B Broderick Road, Johnsonville, Wellington
7	Road	26 Doris Gordon Crescent, Crofton Downs, Wellington
8	Road	54A Fox Street, Ngaio, Wellington
9	Road	129 Grant Rd, Thorndon, Wellington

↑ Variety may be the so-called spice of life, but not when it comes to address suffixes. Let Data Loading Tools help you clean up your data.

3 Transform Data

One of the greatest Data Loading Tools superpowers is the ability to transform data. More specifically, if you get data from one supplier, you don't have to ask that supplier to modify the data to conform to your schema. Instead, you can use Data Loading Tools and an Excel workbook to conform the data on your end. The supplier formats the data as they like, you get what you need, and everyone wins.

Take address data, for example. If you've ever received address data from multiple suppliers, you know how messy it can be. One dataset may have the full address in a single field. A second dataset may separate the house number and street name from the rest of the address. A third dataset may store the house number and street name in one field, the city in a second field, the state or province in a third field, and the postal code in a fourth field.

To be usable, all datasets need to be transformed. The good news is that Data Loading Tools can help you define your data mapping using easy-to-configure Excel workbooks. You can even write calculation expressions to transform data, all within Excel.

4 Clean Up Data

Data is arguably the most important GIS component. Any analysis is only as good as the data that goes into it. However, clean and ready-to-use data is as elusive as a unicorn. With Data Loading Tools, cleaning up your data doesn't have to be tedious or time-consuming.

Remember the address data that Data Loading Tools helped you transform? Your address fields are now in great shape, but your street suffixes need a little help. Some of them are abbreviated, some are all caps, and some are abbreviated and all caps.

No worries! Data Loading Tools can help you turn any *st*, *St*, or *street* into consistent all-caps *STREET*, or whatever format you prefer.

Data is arguably the most important GIS component.

5 Archive Data

Archiving data can be complicated, but it is especially beneficial if you run analyses cyclically (for example, monthly, quarterly, or yearly). Fortunately, Data Loading Tools can help.

If you're a utility GIS analyst, you'll find this functionality useful for your yearly inspection cycle. You can use Data Loading Tools to define the mapping between your active workspace and your archive. The next time the analysis cycles back, you—or anyone else on your team—can clear the workspace and fill it with new, active data.

However, not all cycles are calendar based. If you're an emergency management professional, you know that disasters can occur at any time and that the data from one emergency offers valuable insight that is vital to preparing for the next. After the first emergency passes, you can use Data Loading Tools to archive the old data, and then clear the workspace for new incident data.

These five uses are only some of the repeatable and time-saving ways to put Data Loading Tools to work for you.

So, how are you going to use all that time you just saved?

Resources

For more information about Data Loading Tools, check out the following resources:

- ArcGIS Solutions help documentation: Data Loading Tools (https://bit.ly/3GFQ9LU)
- Esri Community: Data Loading Tools (https://bit.ly/3EWoZyW)
- Esri video series: Introducing the Data Loading Tools (https://bit.ly/3XpL8Nc)

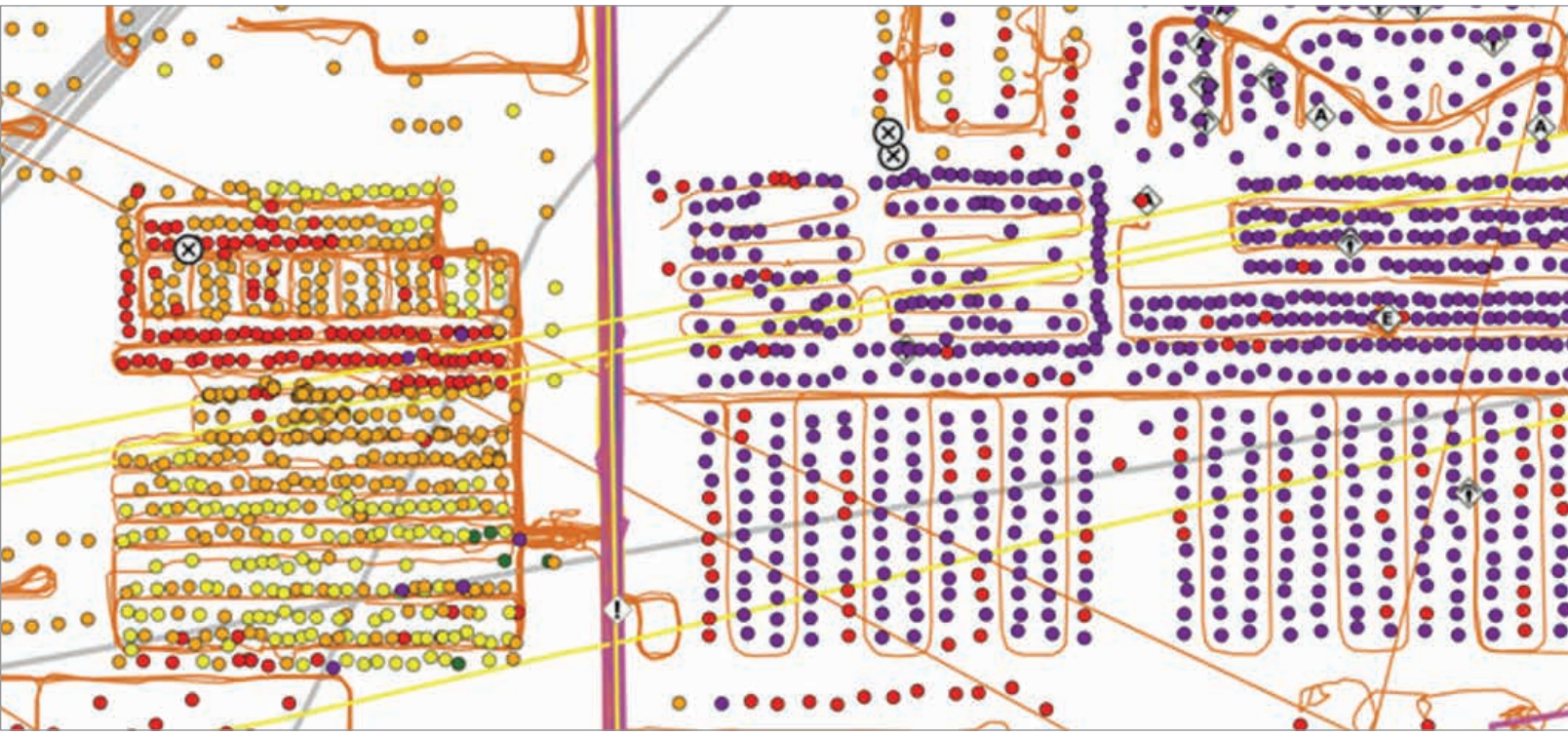
About the Authors

Mindy Longoni happily works as a technical writer on the ArcGIS Solutions team. When she isn't playing with maps, language, or language related to maps, she enjoys spending time with her family or pondering the meaning of life with her desert tortoise, Kevin.

Joel Smith is a solution engineer at Esri.

Alix Vezina works on the ArcGIS Utility Solutions team as a product engineer. She has been working to deliver tools for utilities in ArcGIS Web AppBuilder, ArcGIS Experience Builder, and ArcGIS Maps SDK for JavaScript since 2019. Prior to her work at Esri, she facilitated the digital GIS transformation of a property and land management organization in New Zealand and coauthored Esri Learn lessons for Public Safety. She has a degree in GIS from Université de Sherbrooke (Québec, Canada).

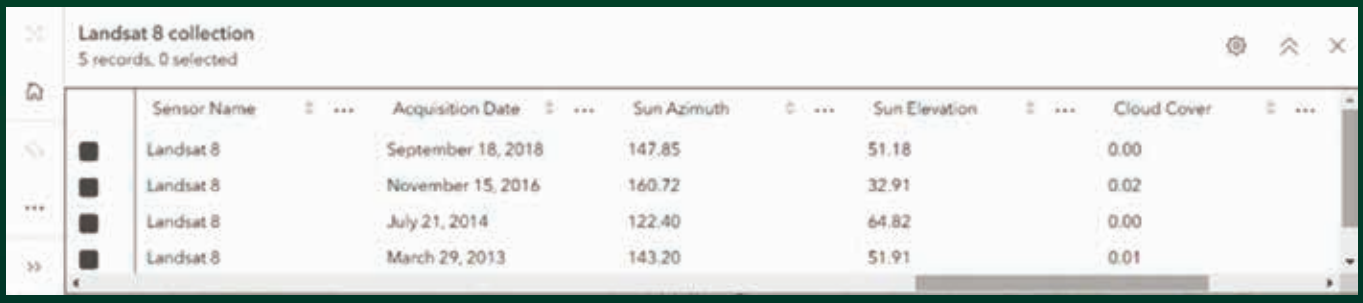
↓ Archiving data from an emergency ensures that you have access to that data the next time that a similar emergency occurs.

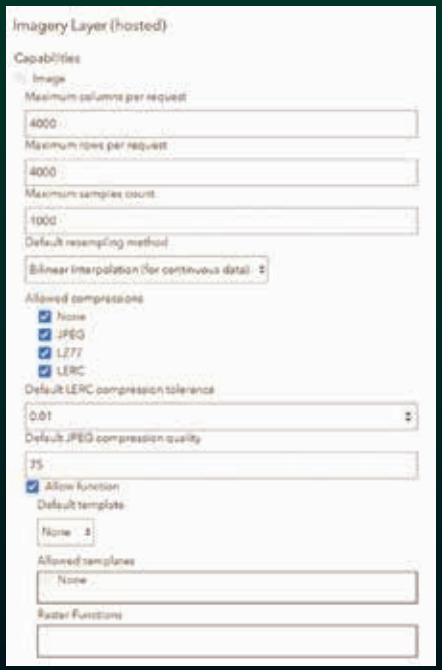


Control Imagery Visualization with *Dynamic Imagery Layers*

By Jeff Swain

ArcGIS Image for ArcGIS Online, an extension to ArcGIS Online, makes imagery more accessible and more easily managed. Because it is software as a service (SaaS), it eliminates the need for organizations to maintain infrastructure for imagery. Uploaded imagery and the results of analysis are saved as image services so that they can be shared and used in ArcGIS throughout an organization. This article describes how to control the display of dynamic imagery layers to optimize specific workflows.





Dynamic imagery layers give users control over the visualization of individual input images after creation to aid interpretation and visual analysis. For most imagery shared online, the visualization of those input images is set during creation.

Tile cache layers are created this way, with the visualization choices made prior to creation, indicating how to they will be displayed in the input imagery. For tiled imagery layers, there are options to alter the order of the raster bands, the stretch applied to the pixel values, and the image brightness.

↑ Dynamic imagery layers with the image collection layer configuration have attribute tables that can be visualized and used in the map.

← In the Item Details page of the dynamic imagery layer, you can modify additional properties to control the display.

Dynamic imagery layers from ArcGIS Image for ArcGIS Online have all the custom display options of the tiled imagery layers, but also provide additional control of the input images. Tiled and dynamic imagery layers have similar capabilities in terms of use in raster analysis, source pixel access, and custom visualization options. However, dynamic imagery layers have additional functionality that allows you further control over the display of the input imagery through processing templates, image display order, and filtering. Between the image display options and these additional control properties, dynamic imagery layers give you complete control over the visualization of the imagery layer.

What does a dynamic imagery layer allow you to do that a tiled imagery layer does not? The quick answer is, control over input images. Dynamic imagery layers are

controlled by a set of properties that allow for many visualization options that are not available for tiled imagery layers.

These properties are used as instructions for the application to use to display the individual input images. This allows you to control the order in which they display, which one will appear on top if there is overlap, and whether the input images display at all. Processing templates can also be added to dynamic imagery layers to provide preset visualization options for users. The creator of the dynamic imagery layer has control over many visualization settings when creating the layer and can stipulate which of those settings can be changed by the user.

Custom Visualization Using Processing Templates

Processing templates in ArcGIS Image for ArcGIS Online allow for preset custom visualizations. An image collection, a layer configuration, lets you maintain the metadata about input images. The attribute table included with the image collection allows you to maintain the metadata, which can be used to provide additional display and filtering options.

If a mosaic dataset was used to create the dynamic imagery layer, any field that you add to the attribute table using ArcGIS Pro will appear in the attribute table. The tables can be accessed in the map to view the attributes, or they can be used to modify the display of the dynamic imagery layer.

When the dynamic imagery layer is added to Map Viewer in ArcGIS Online, or to ArcGIS Pro, or to any other ArcGIS app, the results of those instructions will be visualized. When the dynamic imagery layer is created, default instructions control how it is displayed.

These properties can be changed at the creation of the layer for a specific default visualization. Dynamic imagery layers display according to these instructions on the server and are visualized on the user's machine. The user can modify those properties to customize the display if the creator of the imagery has allowed them to be modified.

Modifying the Image Layer

There are many options that control the display of the imagery layer. You can change them when the dynamic imagery layer is created. The first set of properties you can modify control include:

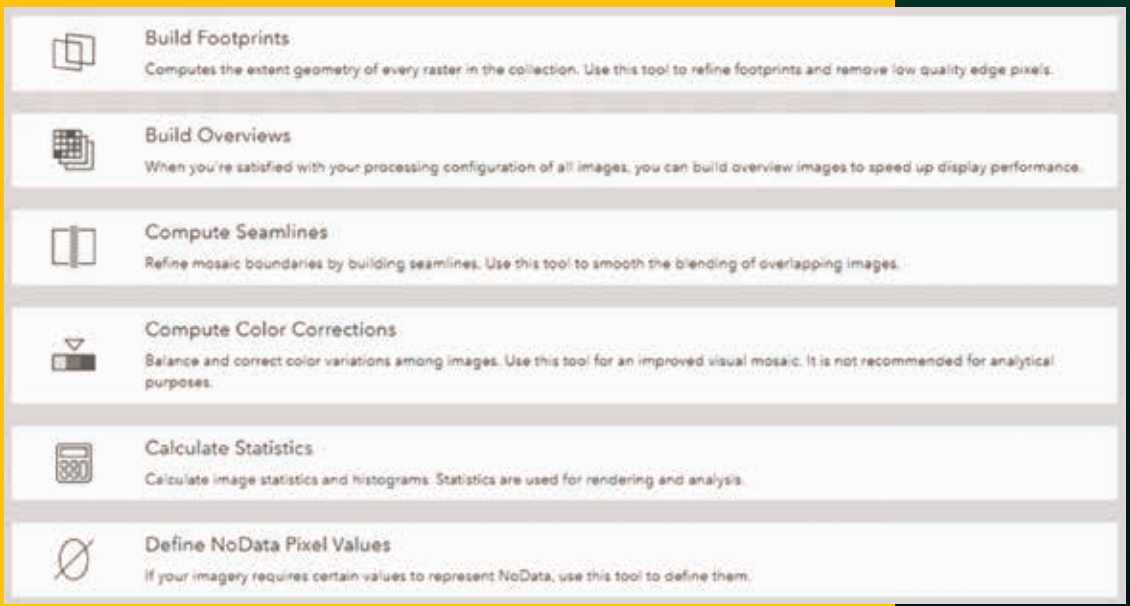
- Default resampling method
- Compression
- Default processing template
- Allowed fields (image collection)
- Allowed mosaic methods
- Allowed mensuration capabilities

These properties are in the Item Details page for the imagery layer where you can modify aspects of the dynamic imagery layer. These properties let a creator of the dynamic imagery layer ensure that it is used as desired by end users by changing the default look of the imagery layer.

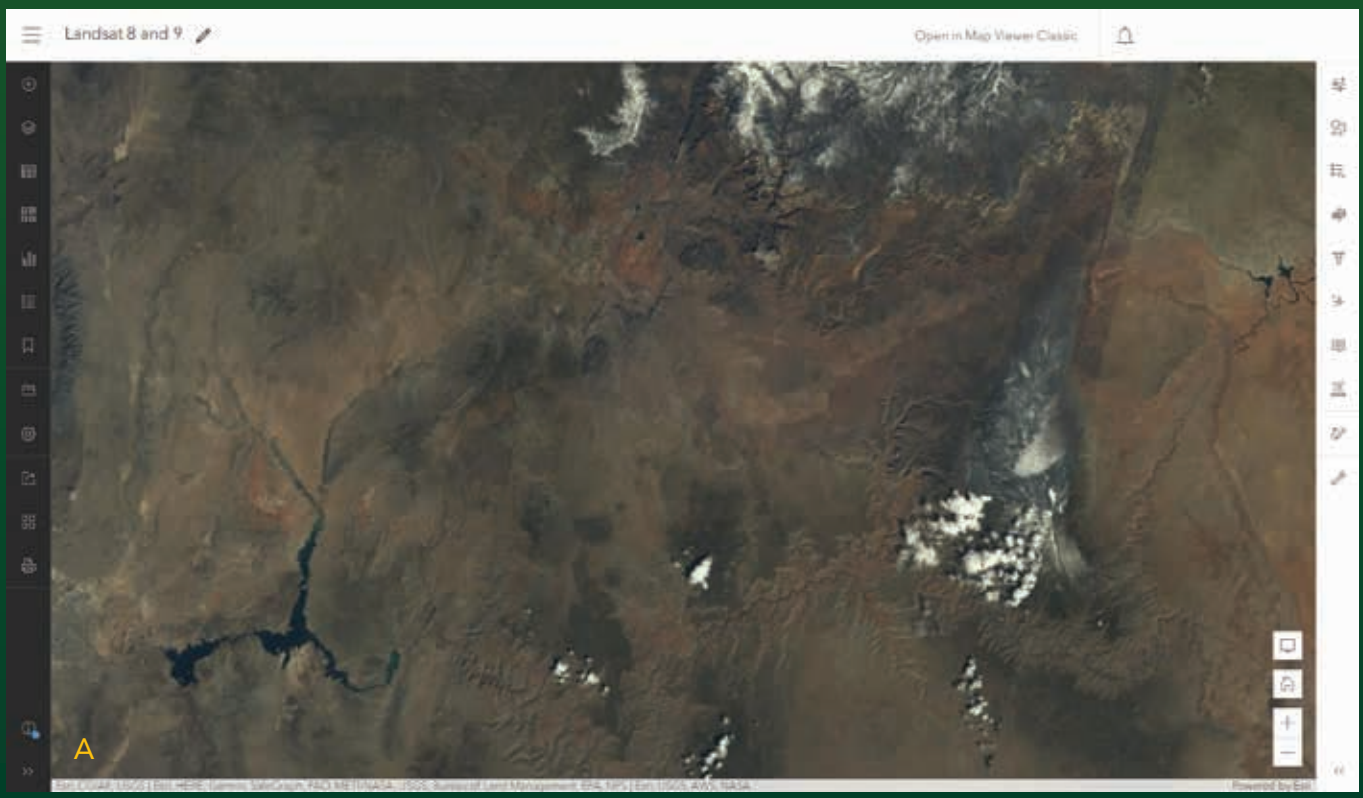
If the input imagery data is a mosaic dataset, you can even alter the default properties of the mosaic dataset to control the order of the input images, what metadata is included, or other mosaic dataset properties. Mosaic datasets can be used as input imagery in ArcGIS Pro with the Create Hosted Imagery wizard. This process also allows you to add more fields to the mosaic dataset that will appear in the dynamic imagery layer with the image collection configuration.

Dynamic imagery layers also allow you to perform image management tasks on the imagery layer. These tasks can be used to clean up the imagery layer by doing the following:

- Modifying visible areas
- Removing NoData areas
- Adding overviews to improve performance
- Correcting the color within the imagery layer
- Calculating statistics to improve the display



← You can use image management tools on dynamic imagery layers.



Controlling Display from the Map Viewer

You can control the display of a dynamic imagery layer by setting properties when the layer is created, from within its item details page, and also when the layer is displayed in Map Viewer. When the dynamic imagery layer is added to Map Viewer in ArcGIS Online, there are additional properties that can be modified. The properties available in Map Viewer can control the band combination, which processing template is chosen, or even which input image shows up on top.

When the dynamic imagery layer is selected, a few buttons will appear on the right side of Map Viewer. Visualization properties are controlled through four primary tabs located on the right side of Map Viewer: Styles, Processing Templates, Image Display Order, and Filter.

Styles

With this property, you can control the band combination, stretch type, and style. These capabilities are also enabled for tiled imagery layers. Processing templates based on raster function templates (RFTs) can be added as symbology options.

Processing Templates

This property allows adding RFTs to the dynamic imagery layer. For Map Viewer Classic, the Image Display property allows you to add RFTs, which can be used to change the visualization and create derived imagery layers from different analytical tools.

Image Display Order

Control the order of the input images with this property. For overlapping input images such as drone-collected images, you can set which image will appear on top as you pan and zoom within the map. If your input images share the same spatial extent but were collected over different time periods, you can set the order in which they display by default.

Filter

This property allows you to control which images are visible by creating a query that limits the images displayed to those that meet the criteria. You can use any property in the attribute table or in the metadata to control the display.

Workflows Enhanced by Dynamic Imagery Layer

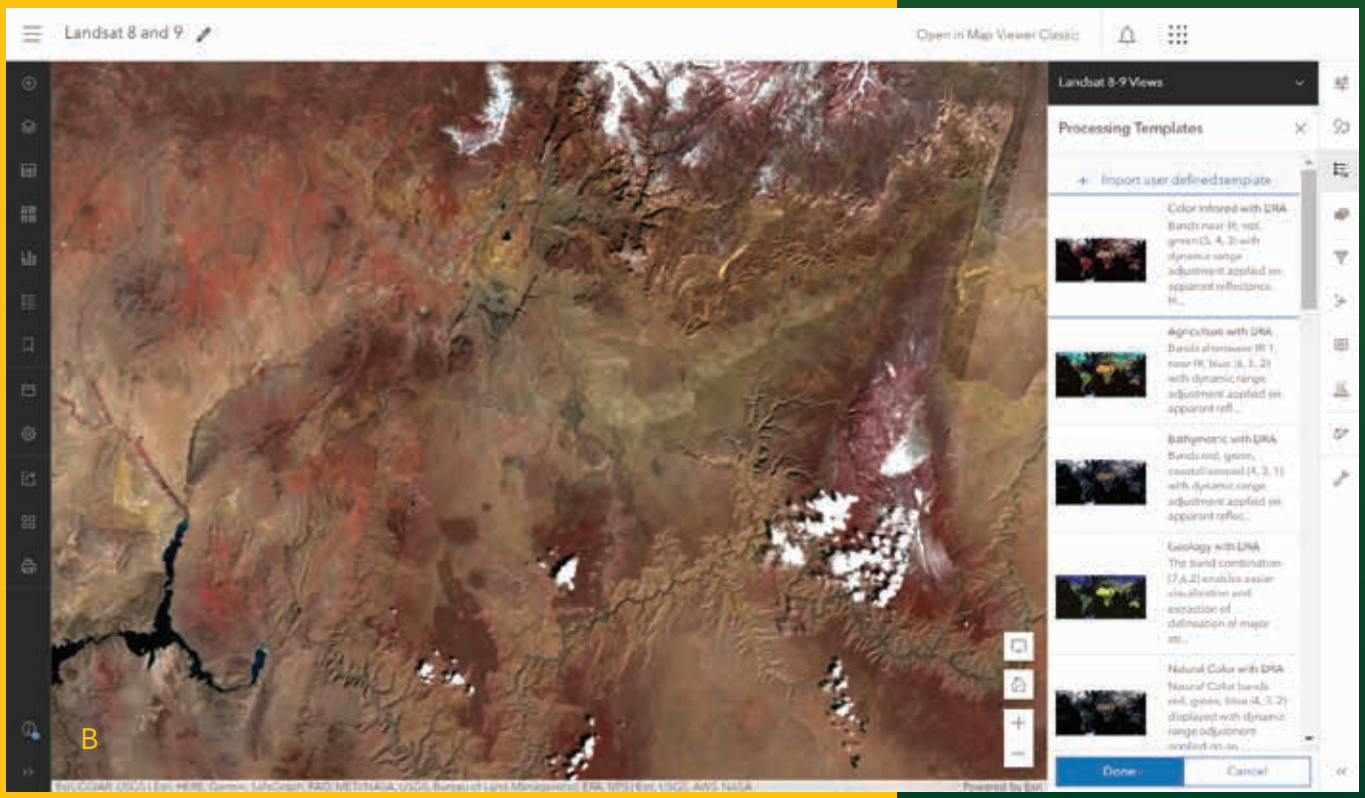
Some workflows are enhanced by using dynamic imagery layers, rather than tiled imagery layers.

Review of Drone Imagery

You can preserve the input imagery in a dynamic imagery layer and use the different dynamic display options such as Closest to center, By attribute display, or Closest to nadir. By viewing drone data in different ways, you can recognize features or look around overhanging features. Both ArcGIS Drone2Map and SiteScan for ArcGIS can be used to publish to ArcGIS Image for ArcGIS Online. For ArcGIS Drone2Map, there is also a mosaic dataset that can be published outside of the application as a dynamic imagery layer with the image collection layer configuration from ArcGIS Pro.

Time Series Analysis

You can review a specific area over a specific time period by adding input images that represent the same location from different capture dates into a dynamic image collection and adding a field in the attribute table or modifying a field in the attribute



←↑ Processing templates allows raster function templates (RFTs) to be applied to the dynamic imagery layer to change the visualization from natural color (A) to color infrared (B).

table. By filtering the imagery layer, changes over time can be visualized in the map.

Filtering Satellite Sensor Data

Creating a dynamic imagery layer (image collection) with satellite sensor data and choosing the raster type for that imagery layer allows the metadata for that input imagery to be added to the attribute table. Most satellite sensor data includes additional information about that input image. For example, Landsat 8 images, additional fields for cloud cover, and sun azimuth are added to the attribute table. Using the filter, you can dynamically remove images that have cloud cover over a certain threshold or images that were captured at a particular sun azimuth.

Conclusion

Both tiled imagery and dynamic imagery layers from ArcGIS Image Online have a lot of capabilities that you can use to enhance the use of imagery in your organization. Dynamic imagery layers give users control over the visualization of individual input images to create the desired visualization. Depending on the application of imagery, each type of imagery layer can be useful by providing context for a map, supplying input for analysis, or displaying the same imagery in multiple ways. These are just some of the uses for dynamic imagery layers. The visualization controls allow you to use the input imagery in any manner you desire.

About the Author

Jeff Swain is a product engineer on the raster team. He has been with Esri since 2009, working in various capacities including as an Esri support analyst and an author for Esri training services.

Read "A Guide to Sharing Imagery and Raster Data" (https://bit.ly/3OSv6aK) in the Winter 2022 issue of *ArcUser* to learn more about how to share imagery and raster data.

SAVE SMART & SAVE TIME

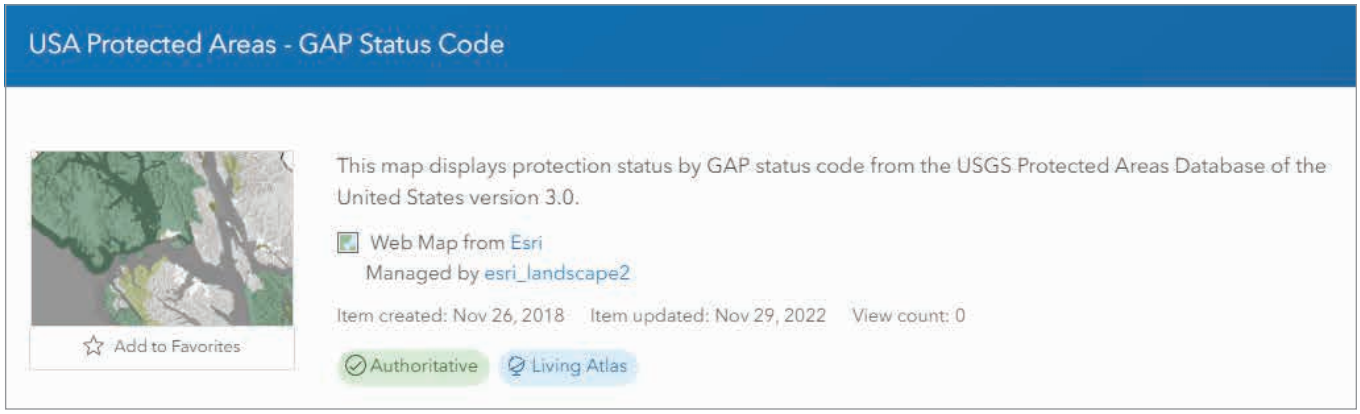
By Rich Nauman

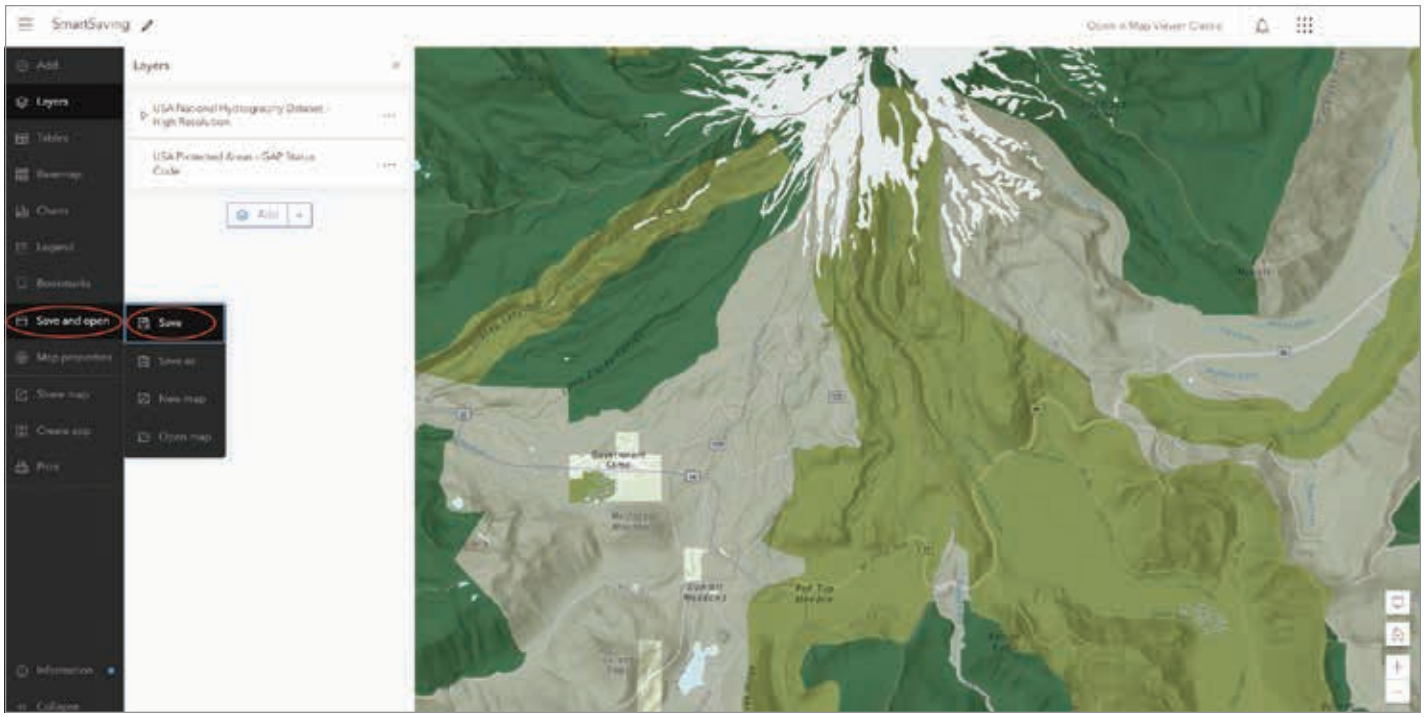
Understanding how to save a layer's symbology and other settings in ArcGIS Online will save you time as you build your Web GIS. While you can save both layers and maps, the controls for saving each are in different places and serve different purposes.

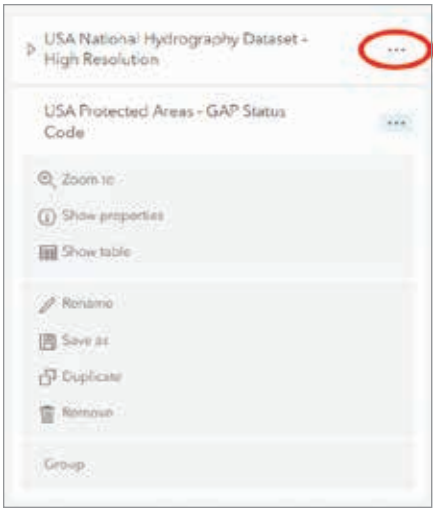
Layers and Maps

Layers are the building blocks of Web GIS. Feature layers, imagery layers, tile layers, and scene layers are all examples of layers. Each layer combines data with symbology, pop-up configurations, filters, and other properties and is an item in ArcGIS Online. A web map is also an item in ArcGIS Online. In the summary for each item, icons and text indicate whether an item is a layer or web map.

View layers by adding them to a web map in Map Viewer in ArcGIS Online. Web maps have a basemap and may have one or more additional layers. They can store many of the same properties as layers







↑↑ To save a web map in Map Viewer, click Save and Open > Save in the Contents toolbar on the left side of the map.

↑ Click the three dots for More Options under the layer, and then Save or Save As in the middle of the list to save all configurations with the layer. Note that you must be logged in as the layer's owner to see the save layer options.

← Layers and web maps are items in ArcGIS Online. Whether an item is a feature layer or a web map is indicated by the icon and text next to the thumbnail and below the summary on each item.

including symbology, pop-up configurations, and filters.

Understanding when these properties should be saved to a layer or a web map is key to successful Web GIS implementation.

Two Ways to Save

In Map Viewer, there are two places to save the contents of a web map: on the Contents toolbar on the left side of Map Viewer, under Save and open > Save, and via the options menu for the layers that you own in the map.

The Important Part

Saving the web map using the Contents toolbar on the left side of Map Viewer saves any changes made to the web map. If you close and reopen the map, you will see that any configurations you have made will be saved.

However, if you add a layer from that map to a new map, any settings changed in the saved web map will not be retained by the layer. Every time the layer is added to a web map, any symbolization, pop-up configurations, and other settings will need to be reapplied.

As a best practice, save a layer's configuration settings to the layer itself. Click the More Options button (the three dots under each layer in the table of contents) and choose Save Layer from the menu. Note that this option will only be available if you are logged in as the layer's owner.

Now when you add the layer to a map, it will be ready to use with no configuration needed for a neat, professional-looking map. Saving layers to preserve the properties you have set will save unnecessary work and go a long way to building an effective Web GIS.

About the Author

As a member of the ArcGIS Living Atlas of the World environment team, **Rich Nauman** works with a wide variety of natural resource datasets ranging from rare species and habitats to soils and hydrology. With nearly 30 years of experience in the field and office, he uses his skills to build a better understanding of the world. When he is not making maps, Nauman is using them to find new rivers to fish and places to visit. Contact him at rnauman@esri.com or livingatlas.ArcGIS.com.

GIS Bookshelf

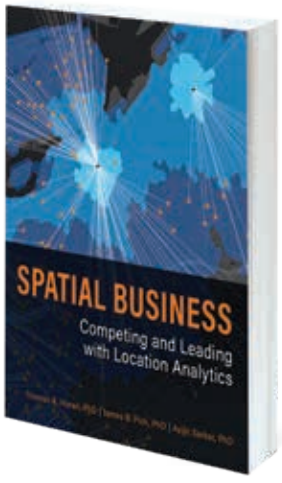
Creating a Smarter Campus: GIS for Education

Edited by Joseph Kerski and Matt Artz

GIS has a wide range of uses in the educational sphere. It provides educators with novel ways to teach problem-solving to tech-savvy learners. Researchers can employ GIS for data visualization and integration. IT professionals can use it to improve their cloud-based platform offerings. And administrators can wield the technology to visualize and manage everything from campus facilities to expansion opportunities. *Creating a Smarter Campus: GIS for Education* shows how educational institutions are actively integrating spatial reasoning and GIS technology into teaching, research, and management. Esri Press, 170 pp. Ebook ISBN: 9781589487383 and print ISBN: 9781589487376.

Spatial Business: Competing and Leading with Location Analytics

By Thomas A. Horan, James B. Pick, and Avijit Sarkar



In today's global economy, business leaders need to know where to source materials, where to operate, and where to grow their customer bases. *Spatial Business: Competing and Leading with Location Analytics* shows how real organizations have designed, deployed, and managed GIS solutions to improve decision-making and add value in both strategic and operational ways. Written by experts in spatial business, the book provides managers, professionals, and students with a road map for realizing the potential of geospatial data across the entire business value chain. Esri Press, 2022, 300 pp. Ebook ISBN: 9781589485341 and print ISBN: 9781589485334.

Preserving Our Planet: GIS for Conservation

By David Gadsden and Matt Artz

GIS is a comprehensive tool for conservation professionals. A modern GIS gives users a real-time look at data, locations, and relationships. When applied to conservation, GIS reveals dependencies and challenges across multiple environments. Through maps and apps, conservation professionals can analyze and organize data and collaborate with other organizations and the public to address threats and identify opportunities. *Preserving Our Planet: GIS for Conservation* is a collection of real-life stories about conservation organizations that are successfully using GIS to meet the challenges of preserving biodiversity. The book also includes ideas, strategies, and tools to help jump-start the use of GIS for conservation. Online resources that supplement this book include videos, downloadable tools, and additional content. Esri Press, 2022, 130 pp. Ebook ISBN: 9781589487222 and print ISBN: 9781589487215.

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[1]Based on IDC Quarterly Workstation Tracker, 2022Q3 (units)

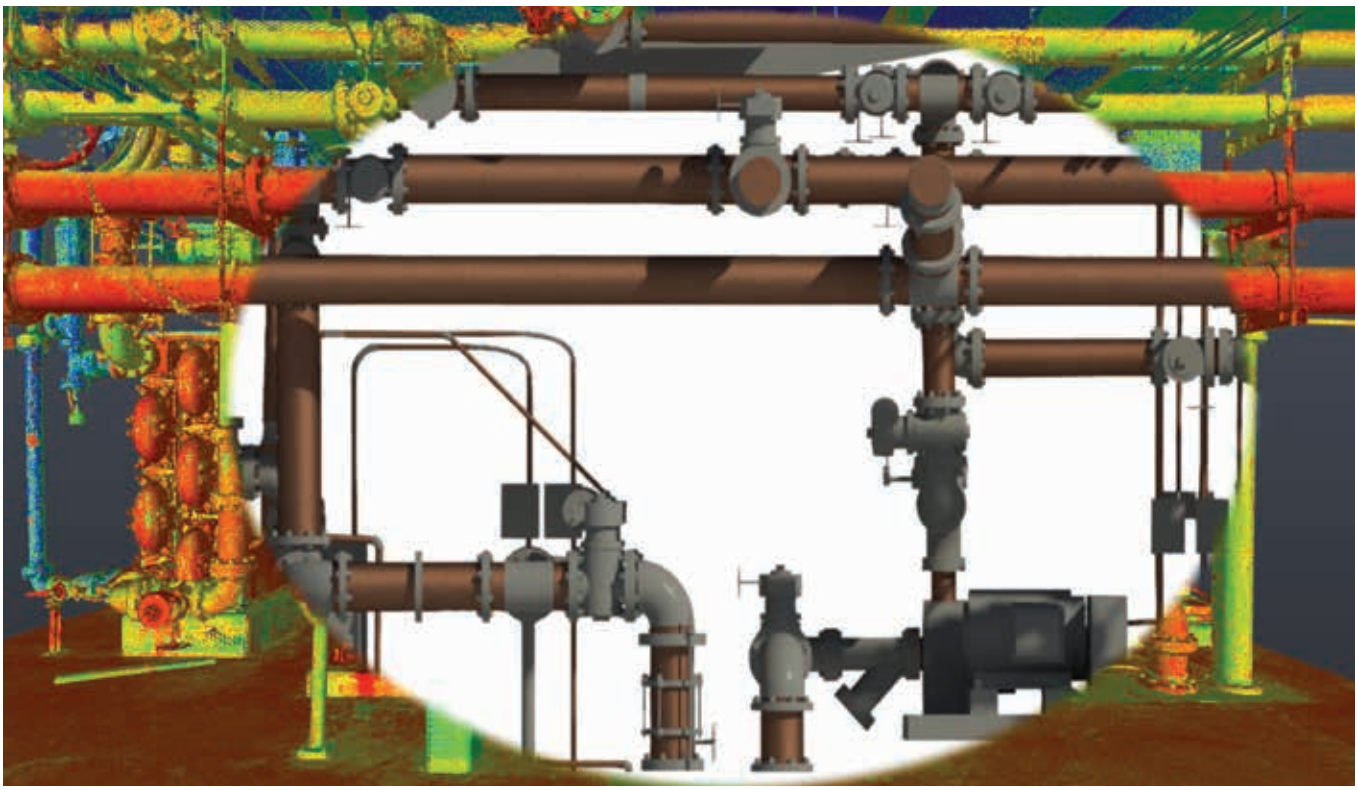
Networking Is Key to Building a GIS Career

By Rosemary Boone and Raquel Perez

Zach Jaffe is the GIS coordinator and project manager at LandTech Consultants Inc., a civil engineering and land surveying firm and Esri partner. He began his career working in surveying and GIS for water utility operations in Texas. Joining LandTech in 2018, he transitioned to a more specialized role in surveying and GIS, focusing on 3D data acquisition (lidar laser scanning), building information modeling (BIM), and GIS integration. Jaffe was a keynote speaker and presenter at the 2020 Esri Infrastructure Management and GIS Conference. His presentation highlighted his work with digital twins for facility and asset management. He is currently pursuing his professional land surveyor (PLS) and GISP certifications.

In this interview, Jaffe describes how and why he became interested in GIS and what has helped him build a successful GIS career.

→ Zach Jaffe, GIS coordinator for Esri partner LandTech Consultants, Inc., is responsible for all GIS and drone operations for his organization.



↓ This 3D model Jaffe created from a lidar survey/point cloud and building information modeling (BIM) data is integrated in the ArcGIS environment, primarily for asset and facility management.

↑ Many projects Jaffe has been working on focus on creating digital twins for facilities, such as water/wastewater treatment plants.

Q: What do you love about GIS?

A: Maps are awesome—plain and simple—and creating maps is even cooler. The majority of people don't know or even think about how the maps they look at and interact with are created. Most people still don't realize how just about any group, organization, or business can benefit from GIS and mapping. I love to learn about different industries and figure out how to best apply GIS to solve real-world problems.

Q: How did you get your start in GIS?

A: I got my GIS start studying geography in college. Taking a GIS course as a geography major is very standard, and so I took two GIS courses and liked it. GIS skills seemed very applicable in the real world. In college, I also did an internship that helped gauge what real-world projects are going on with using GIS. It helped me learn and realize what GIS really is in various professions.

Q: How are you using GIS in your current role?

A: I use GIS pretty much every day. We use an ArcGIS software-specific environment for our project *[goods and services]* in the infrastructure world. I focus on water, wastewater, and utilities as well as universities and campuses. I also use GIS to promote our various services as well as constantly using it for research and development to find new and cutting-edge technological solutions.

Maps are awesome—plain and simple—and creating maps is even cooler.

↑ Jaffe, shown here collecting wetland locations with GPS for an environmental impact study, occasionally gets time back out in the field.

Q: What are some GIS projects you are currently working on?

A: As of late, a lot of the projects I have been working on have been focusing on creating digital twins (or 3D models) for various facilities, including water/wastewater treatment plants. The models are created from a lidar survey/point cloud and BIM and integrated with the Esri ArcGIS environment primarily for asset and facility management. These projects are fun to work on because they involve so many different technologies and software solutions that all meet in the Esri environment for the final deliverable.

Q: What advice do you have for students and young pros?

A: My best advice for other young pros is to network, go to industry events, and put yourself out there. I have learned more at conferences just by speaking to people than I did in the majority of my college courses. When you meet people, you learn their thought process and point of view and take that into consideration when forming your own. Not only does it make you more aware, but building those connections is a huge part of being successful in business. Having a contact to call or team up with on a project has allowed me to grow in my position.

Q: What's the value in attending conferences?

A: For me, going to a conference was the biggest eye-opener because there is so much value in attending. At conferences, you hear from people in various industries and how they use GIS, and it helps me to think about how I can apply GIS in my own role.

When I started in my role, my company didn't have a GIS division, so I helped to implement GIS. This is where going to conferences is really helpful, because it helps me to grow GIS in my own company and probably is the best thing you can do for yourself to grow personally and professionally.

I'm fortunate in that my organization finds a lot of value in me attending conferences. I am able to justify attending conferences by making connections to bring back leads, being a presenter, and setting up follow-up meetings with people I've met, because this can all become a source of revenue.

Q: How did you handle starting the GIS division of your company?

A: It had its challenges, but I was lucky in my position to rely on my colleagues as subject matter experts, which helped guide me in what I should be doing in GIS. On the flip side, I didn't have someone I can troubleshoot with when it came to the GIS technology. So, when I ran into issues, I would post it to the Esri Community web page or directly contact people in my network. This is why I go to conferences. They help to build my network because I know—at some point—I will need to lean on other attendees for advice and have the opportunity to return the favor as well.

Q: What advice do you have for someone starting out in their GIS career?

A: Think about industry first, then GIS. For example, I knew I wanted to be in the water industry, and then I used GIS as a tool to get me into that industry. Go after the industry you like and want to work in and see how GIS is applied or how you can apply it. Reach out to other people in that industry through LinkedIn. Most people are responsive and want to help or answer your questions.

About the Authors

Rosemary Boone is a senior industry marketing manager for Esri. Her work is focused on executing marketing strategies for K–12 schools and higher education institutions. She holds a master's degree in education technology with an emphasis on multimedia. Prior to her career in marketing, she taught elementary school.

Raquel Perez is an industry marketing manager for Esri. She develops marketing strategies for conservation, climate change, earth sciences, and Esri's federal partners. She also manages Esri's Young Professionals Network. Perez holds a master's degree in management from the University of Redlands and a crime and intelligence analysis certificate from her previous career as a crime analyst.

Boost Your Career

Esri's Young Professionals Network (YPN) can help you discover strategies for career growth and greater professional success. This community for people just starting their GIS careers encourages the development of both leadership and technical skills. It will help members connect with peers and industry experts, expand their network of industry contacts, and raise their profiles within their organizations.

Visit https://bit.ly/3XGQIAr to learn about Esri Young Professionals Network and join. Check out these helpful resources for those entering geospatial technology careers:

- Esri Community—Young Professionals Network (https://bit.ly/3gGywRm)
- Esri YPN LinkedIn group (www.linkedin.com/groups/6972150/)
- Esri training courses (esri.com/training)
- Esri Technical Certification Program (https://bit.ly/2M8WK5s)
- Esri student programs (https://bit.ly/3XDdcgi)
- Esri recruiting events (www.esri.com/en-us/about/careers/recruiting-events)

30 Tips for Networking at Conferences and Other Events

By Alexa Vlahakis

For many people, attending conferences can be exciting or daunting, especially if you want to put yourself out there to network and meet other professionals in your field. If you are a natural introvert, you've probably struggled a time or two in adapting to professional environments. Being open to new experiences and meeting new people at a conference can be especially difficult for someone who has introverted tendencies or is new to attending professional conferences.

Try These Suggestions Before the Conference

1. Write your goals down ahead of time. What are the action items for you? What would you like to gain from attending the conference?
2. Plan to give yourself extra personal time. An extra 10 minutes can make a world of difference because you will have time to meditate, journal, or grab that quick coffee or breakfast item.
3. Prepare in advance—but not too much. Try to keep conversations casual and organic instead of scripted.
4. Practice your conversation starters on a vendor. They're paid to talk and have interesting stuff to talk about.
5. Schedule a meeting with a vendor or product rep. This is a low-risk environment to practice your technical conversation skills.
6. Begin with the end in mind. Knowing your end goal can help keep you on track and prevent your nerves from consuming you.

Use These Tips to Take a Proactive Approach

7. If you're asked a question and you do not know the answer, ask for the business card or contact information for the questioner and get back to them. Write the question you want to answer, perhaps on the back of the business card.
8. Dress professionally. First impressions are everything.
9. Force yourself to ask one question per session. Often people will approach you afterward if they are facing the same issue.
10. Write a question that you want to ask the presenter on the back of your business card. If you don't have business card, they're a great networking investment.
11. Pack a few go-to questions when meeting new people such as:
    - What's a fun project you've done in the last three months?
    - What's been your biggest struggle lately?
    - Which presentations have you liked so far?
    - Which presentation are you most looking forward to?
12. Charge up your introvert battery before going. Also, make sure to plan downtime during the conference so you can relax between sessions or networking events.
13. Be brave! GIS people are the best and you already have so much in common with other people attending the conference. Everyone is there for the same reason—to learn and grow professionally.
14. Look at the agenda ahead of time and schedule your sessions. Choose a mix of technical presentations, product updates, special interest groups, Expo hall events, and—most importantly—downtime.
15. Scan the room and sit next to someone who is sitting alone. Being in the same situation can lead to a conversation and could help you make a great connection.
16. Use social media, such as LinkedIn, Instagram, and TikTok, to connect to companies or individuals.

How to Go Above and Beyond

17 Gamify the event: turn the conference into a challenge where you need to meet one new person each day.

18 Approach a speaker of a session or workshop afterward to introduce yourself.

19 Follow your favorite organizations, such as URISA Vanguard Cabinet, and post social media content about the conference. Like, comment, or message them. This could lead to an in-person connection.

20 Attend a panel session. Take notes not only on the questions and answers but also on your observations on how panelists answer questions on the fly.

21 Say hello to other conference attendees and offer them a business card. Most professionals are interested in connecting and learning about the work that you do, no matter what your job title.

22 Sit down next to someone for lunch. Ask their name and what they do to get to know them better.

23 Try not to overthink things and go with the flow.

24 Take advantage of any socials, luncheons, or special interest group meetings. Those events can have smaller crowds and an informal format.

25 If you're interested in meeting someone but are nervous, ask a colleague to introduce you to them.

26 Try the buddy system. Being next to someone you already know can make you more confident.

Get Creative and Stand Out from the Crowd

27 Wear a badge that lists topics you are interested in. This will encourage people to approach you.

28 Make a list of people you have met virtually over the past three years who you know will be at the conference. Try to meet them in person at the conference. It's easier to talk to people you already know to some degree.

29 Connect virtually with attendees after the conference by sending them messages on LinkedIn. The next time you see any of those people at a conference, you'll be more comfortable talking to them.

30 If you are alone at your conference, approach a booth for an organization such as URISA or Esri YPN. Ask the people staffing the booth if they are attending any socials or grabbing dinner and ask if you can join them.

Still a little nervous? This probably has at least something to do with the fact that you represent your organization as well as yourself. That's OK. To help make conferences less intimidating, you can contact members the Esri Young Professionals Network (YPN) team at www.esri.com/en-us/about/ypn/overview. YPN, in partnership with URISA Vanguard Cabinet of Young GIS Professionals (www.urisa.org/vanguardcabinet), came up with these 30 tips for networking at conferences or other events. They can help you build your GIS career.

Stepping out of your comfort zone can be tricky. Conferences—large or small—can be incredibly intimidating. These tips and tricks can help you more easily make valuable connections that will help advance your career.

About the Author

Alexa Vlahakis, an associate industry marketing manager for Esri, supports the conservation and education teams. She holds a bachelor's degree in communication studies with minors in human relations and mass communication/journalism from the University of Iowa.

Arizona State University Expands Its Location Analytics

By Joseph Kerski

The location analytics program at the W. P. Carey School of Business at Arizona State University (ASU) is about to expand, now that it has been tested through its master's program in information systems management.

In spring 2021, Dr. Asish Satpathy offered a short course on location analytics for business executives. The course consisted of two weekends for one unit of credit. Due to the surge in demand, he offered an expanded version of the course in spring 2022 that spanned four weekends for two units of credit.

This course, entitled Location Analytics for Business Executives, explores the use of location data for business applications, introducing spatial data analysis as it applies to retail, insurance, marketing, real estate, and other areas of business. The course offers students an opportunity to gain hands-on experience with functionalities such as location analytics and visualization, using industry-standard business mapping software including ArcGIS Online, ArcGIS Business Analyst Web App, and ArcGIS Insights.

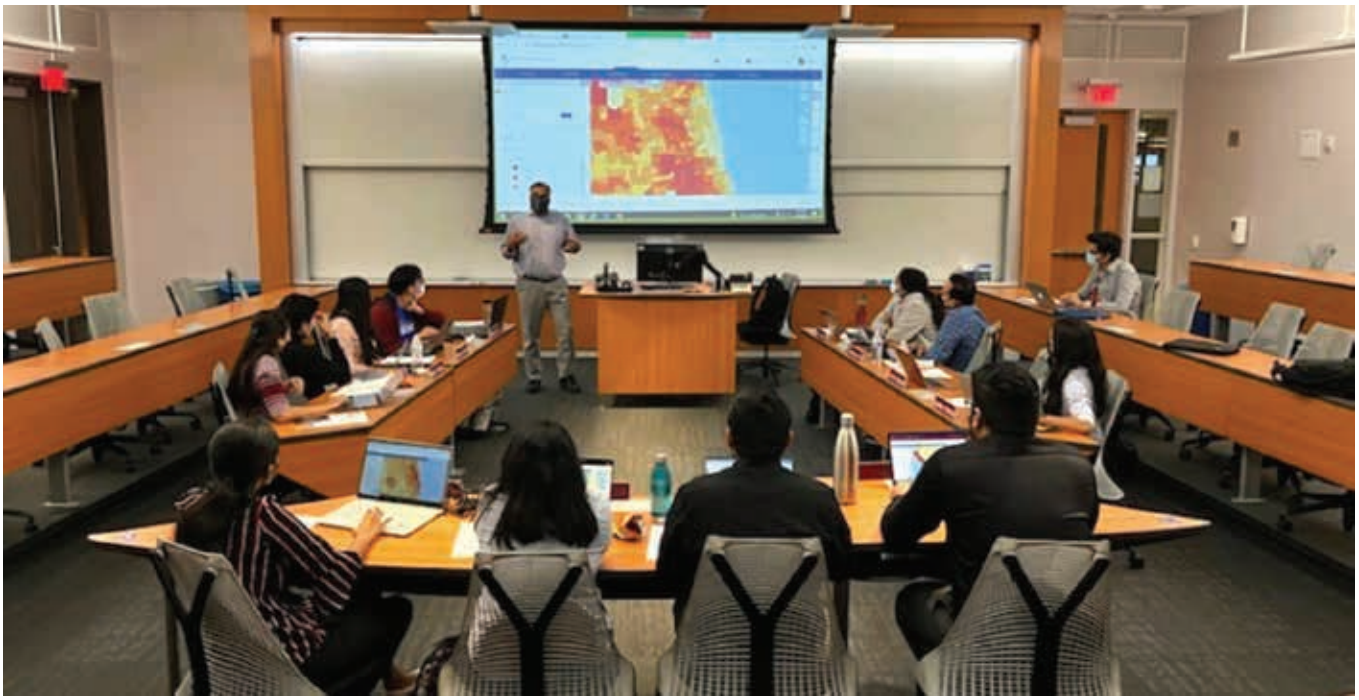
The new course addresses the overarching objectives of the school such as embracing the innovative curriculum at W. P. Carey School of Business, leading a new movement for skill enhancements in course offerings, and advancing ASU's aspiration of transcending academic disciplines through interdisciplinary collaboration.

The course objectives state that students will be able to do the following:

- Describe how location information can help business professionals question, analyze, interpret, and visualize spatial data, enabling more informed decisions.
- Explain the basic principles of GIS including coordinate systems, projections, maps, and geodatabases.
- Use industry-standard Esri GIS software such as ArcGIS Online, ArcGIS Business Analyst Web App, and ArcGIS Insights, and recognize open-source GIS software.
- Apply geospatial technology to various business functions, including market planning, site analysis, market research, and supply chain management.
- Examine case studies that demonstrate how location information is leveraged in specific industries to solve underlying business problems.
- Establish a collaborative relationship with peers to identify a real-world problem, gather information on the process to perform gap analysis, and produce a GIS-based solution.

The course fits in perfectly with the students' learning goals: critical thinking, communication, discipline-specific knowledge, ethical awareness and reasoning, and global awareness. Critical thinking is built

↓ Dr. Asish Satpathy discusses location analytics with students.



↑ Arizona State University students work through a location analytics activity.

around the recognition of the value of location data in relation to business goals and the best ways in which we can manipulate and transform this information to achieve those goals. Communication is inherent to the processes of interpreting location-based information and producing location-based visualizations to enhance decision-making. The specific knowledge of location analytics provides a whole new context in business intelligence that is simply not possible with tables and charts. Ethical awareness is required to use these skills and knowledge for the achievement of business goals respecting the fairness, inclusion, and social wellness principles ASU students abide by. Finally, the class materials used are thought to ensure exposure to diverse data from different contexts that promote global awareness among students.

The course contents include an introduction to GIS; discussion and work with coordinate systems and projections; a software introduction; characteristics of spatial data (vector and raster); geodatabase and table operations; principles of data visualization with maps; decision-making with spatial data; location data visualization; project introductions; and topics relating to marketing (customer analysis, business opportunity analysis, and product mix strategy), health care (the need for services), and the supply chain (route optimization). During the final class segment, students are asked to research and present an issue or problem by using location analytics.

Students have had very positive reactions to this course. In fact, most of the 31 students who completed this course in spring 2021 stated that they wanted to learn more about location analytics. Learn more about location analytics in business education with these resources for teaching and research (https://bit.ly/3AzTp7o).

About the Author

Joseph Kerski, a geographer with a focus on the use of GIS in education, holds three degrees in geography. He has been an education manager at Esri for 14 years. Before coming to Esri, he worked in the public sector for 21 years at the National Oceanic Atmospheric Administration (NOAA), the US Census Bureau, and the US Geological Survey (USGS). He has also worked at Penn State, Sinte Gleska University, University of Denver, and other institutions and nonprofit organizations, and served as president of the National Council for Geographic Education. Kerski is a prolific author of articles; book chapters; videos; lessons; blogs; and eight books, most recently *Spatial Thinking in Environmental Contexts*. But as a lifelong learner, he feels as though he's just getting started and thus actively seeks mentors, partnerships, and collaborators.

STUDENTS PROTECT THE UNHOUSED FROM WILDFIRES

By Tom Baker

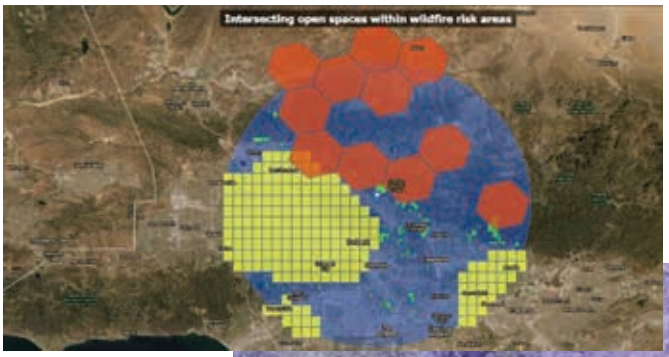
Students at a Los Angeles high school used web maps, GIS, and infrared technologies to identify the location of homeless encampments in high-risk fire areas. The completed map was shared with the Los Angeles Fire Department and will be used to help in future wildfire evacuations.

Knowing where unhoused populations are sheltering is vital during wildfire evacuations. The numbers of both wildfires and unhoused people have grown in California. The forests, fields, and hills in urban areas are full of dry brush due to drought. The results of the 2020 Greater Los Angeles Homeless Count showed that the number of residents experiencing homelessness grew 12.7 percent in 2020 to 66,426 people—many of them sheltering on the dry, open land.

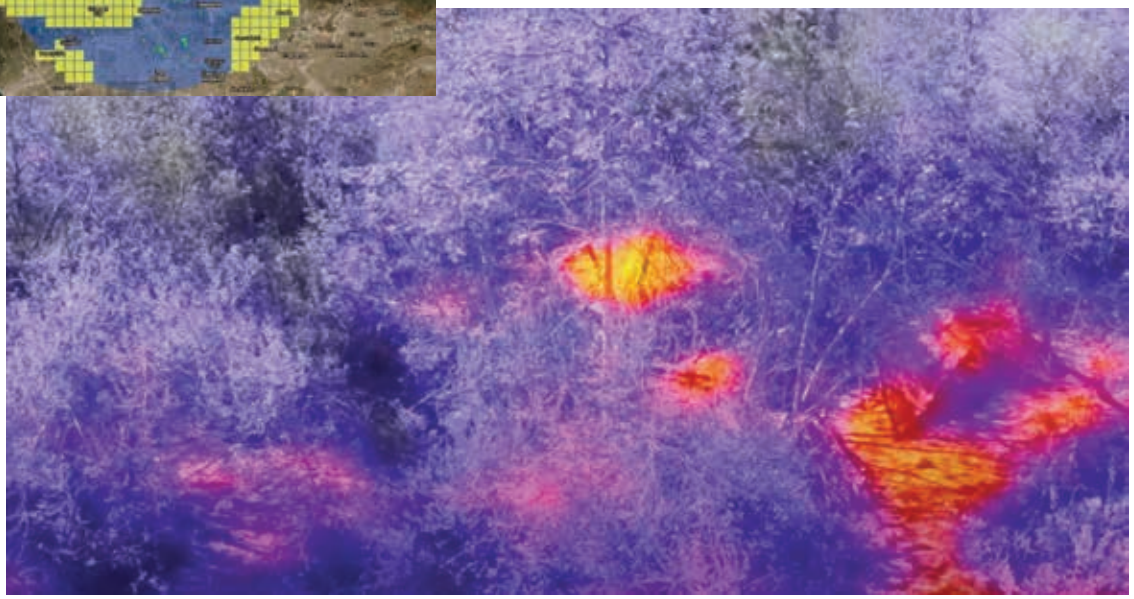
The students from Anderson W. Clark Magnet High School, whose school borders the Angeles National Forest in Glendale, set out to prove that infrared images analyzed with GIS technology could identify homeless encampments near areas at high risk of wildfire.

A Geographic Approach to Research

The curriculum at Anderson W. Clark Magnet High School integrates technology with core academics, including an honors course in GIS remote sensing. Spanning six weeks in 2021, 12 students enrolled in the course collaborated to build, program, and test what's known as a cube satellite, or CubeSat, prototype. These square miniature research satellites are used to collect data and take measurements. CubeSat prototypes are built with inexpensive materials and tested at low layers of Earth's atmosphere using balloons, drones, amateur rockets, or small aircraft.



↑ To find a test site, students performed a site suitability analysis within a 15-mile radius of their school that considered fire risk, land type, and FAA restrictions. The areas in green on the map indicate the intersection of all factors.



→ Students attached an infrared sensor to their CubeSat prototype to detect encampments in heavy vegetation.

← During the students' second flight at Hansen Dam,a small wildfire broke out, cutting short their data collection.

↓ Unhoused people often congregate in parks and open space, and may not know about the wildfire hazard.

The students' CubeSat project was part of the US Department of Education's CTE Mission: CubeSat challenge, which calls for designing, building, and testing a cube satellite prototype to tackle issues important to local communities.

To make the prototype, the students chose infrared sensors that could detect heat signatures, and a GPS receiver to map the locations of high-risk encampments. For the building phase, students were divided into two teams: one for the flight station and the other for the ground station.

Ensuring that each student had an opportunity to design a piece of the project, they self-assigned roles based on interest. Each student was also responsible for a secondary role such as managing documentation, writing the flight report, or determining the best location for the test. They learned to assemble and program their CubeSat prototype with instructional videos from their teacher as well as information on YouTube and online forums.

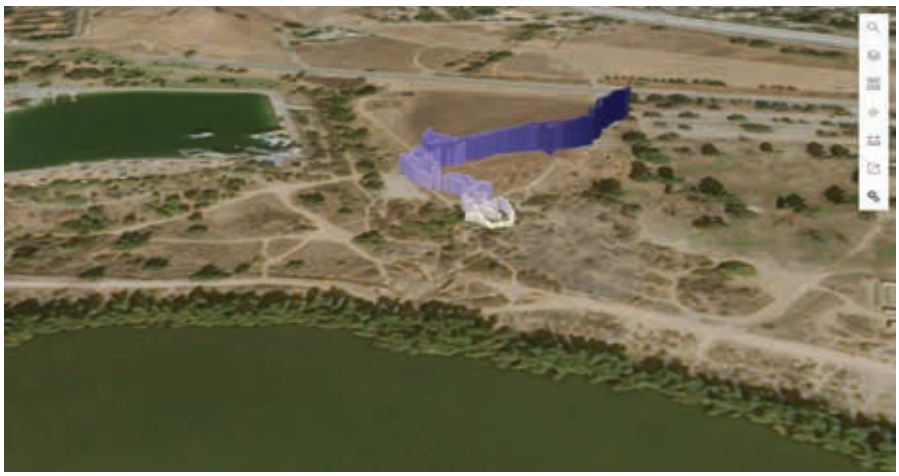
"Throughout the project, I consistently was on forums looking up how to make stuff work. CubeSats are not a widely used product, but there was so much information about them online," said Matthew Keshishian, one of the students who worked on the project.

Keshishian added that programming the prototype's onboard computer was personally challenging because he created three code variations. He conducted a test flight over the school to determine which code worked best with the sensors and camera. "We needed a code that was easy to use in most situations, since we weren't sure how we would import the data into a map at that point," Keshishian said.

After building the prototype, the students searched for a test site. They performed a site suitability analysis using factors such as land type, locations without drone flight restrictions, and fire risk based on Los Angeles County data. In GIS, they layered the data to identify a high-risk area within a 15-mile radius of their school.

They chose the Hansen Dam Recreation Area as the best place to test their technology. Because of Federal Aviation Administration (FAA) airspace restrictions, students attached their prototype to a tethered weather balloon instead of a drone.

"A wildfire broke out at Hansen Dam halfway through our second flight and proved our fire-risk data was right," said Keshishian.



→ The Hansen Dam Recreation Area met most of the requirements for the project.

A Positive Impact on Careers and Community

The students shared their Hansen Dam Recreation Area web map (https://bit.ly/3tOH2k5) and ArcGIS StoryMaps story (https://bit.ly/3VrL9ib) with Fire Captain Steven Marotta of the Los Angeles Fire Department. Marotta noted that dense vegetation makes evacuation efforts challenging and that the students' map would help emergency responders know where to search.

"This type of intelligence will help us to focus rescues and evacuations," Marotta said.

The team of students has since graduated, but their teacher Dominique Evans-Bye hopes to see the CTE Mission: CubeSat work continue in future class cohorts and to grow the project's impact. Evans-Bye said the project could one day include more geospatial technologies, drone imagery, and full motion video captures through a partnership with the Los Angeles Sheriff's Department and Los Angeles Fire Department.

Anderson W. Clark Magnet High School students received several accolades, including gold placement in the Industrial and Engineering Technology Cluster at the 55th annual SkillsUSA state conference and competition. Judges there noted the students' technical and workforce-ready skill sets, including hands-on engineering, programming, and mapping.

Evans-Bye agreed, "GIS impacts all industries. It is important to give students hands-on experiences like this where they can show off what they create while also impacting their community."

The students also had a unique opportunity to present their project to educators and professionals from around the world at the 2022 Esri Education Summit. "These experiences were a great opportunity for us to really revel in the work we'd done and celebrate our achievements," said student Gabriela Marcucci.

Knowing their work could make a difference made their task more important. "I didn't just look at textbooks," said Keshishian. "I can look back at my high school journey and, from this project, say I participated in something that gives back to the community and can save lives."

Learn more about how GIS helps children turn data into maps, stories, and knowledge (https://bit.ly/3OhKCNl) and how students can prepare for the workforce by using ArcGIS (https://bit.ly/3Olcj7J).

About the Author

Tom Baker is an education manager on the Esri education solutions team, strategizing effective use of GIS technology and solutions to meet instruction, administrative, and research challenges in schools, universities, and informal education. An instructional technologist and researcher by training, he now specializes in integrating classroom practice and technology with GIS. Most of his time at Esri is spent serving the nearly 5 million K–12 educators of the United States—and their 50 million students. Baker seeks to use his experience to enhance learning at all levels and subjects.

The US Department of Education Ed Prizes

Ed Prizes (www.edprizes.com) is a series of competitions managed by Luminary Labs under US Department of Education contracts. This collaboration with America's innovators is designed to increase equal career and technical education (CTE) through open national challenges that ask participants to develop initiatives customized to the needs of their communities.

This program provides opportunities for students to connect with employers and experts across industries. The past eight competitions have focused on specific outcomes, such as Rural Tech Project (www.ruraltechproject.com), which promotes advancing technology education in rural high schools. Another challenge, Reach Higher (www.reachhigherchallenge.com) is focused on app development and data education. In the EDSiM Challenge (www.edsimchallenge.com), students created simulated environments via augmented reality, virtual reality, and video game development. Yet another challenge, the CTE Makeover Challenge, inspired high school students to design makerspaces for creating, inventing, tweaking, and exploring hands-on projects. And the most recent competition, CTE Mission: CubeSat, invited high schools to bring space missions to students by designing and building CubeSat prototypes.

Since 2016, challenges developed by Ed Prizes have advanced student technological skills through hands-on learning to fill future talent pipelines and open pathways to rewarding careers.

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Drone Mapping and AI Combine to Find Flood Victims Faster in Mozambique

By Olivier Cottry

Between March and April 2019, two back-to-back cyclones battered Mozambique, destroying more than 800,000 hectares of farmland during harvest season. Cyclone Idai displaced hundreds of thousands of people in Mozambique. Six weeks later, Cyclone Kenneth brought powerful winds and heavy rains to the same, devastated area.

Cyclone Idai was an unusual storm that parked over land, dumped rain for days, and flooded an area spanning thousands of square kilometers. That period was also the first time in recorded history that two strong tropical cyclones hit the same country in the same season.

The cyclones devastated crops and livelihoods and left nearly two million people facing acute food insecurity. The United Nations (UN) World Food Programme (WFP) responded quickly, with two helicopters to ferry supplies and rescue stranded people. Given flooded roads, air support was crucial but not nearly sufficient to distribute food and find stranded people across such a wide area.

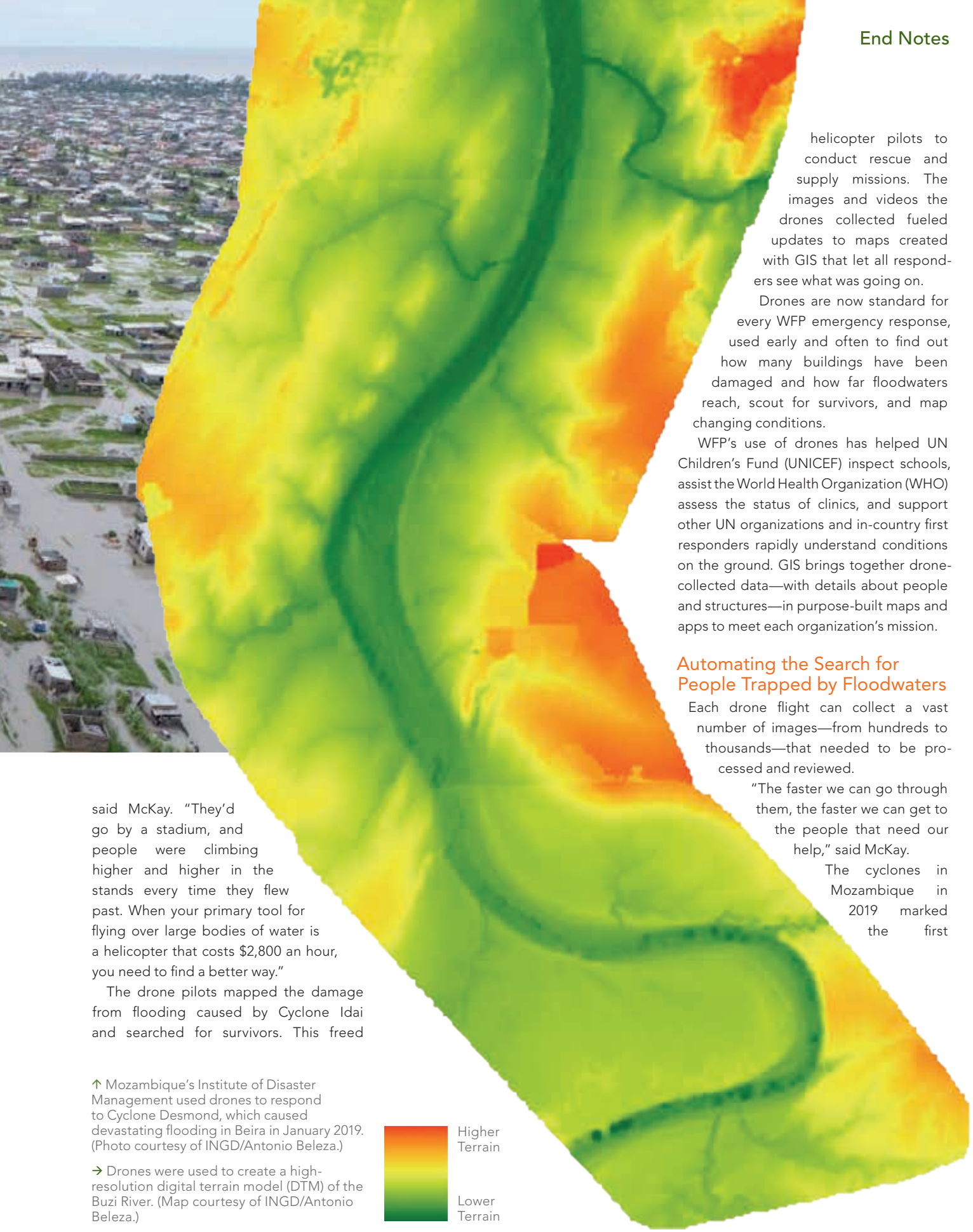
Using Drones in Mozambique

The world's largest humanitarian organization, WFP delivers food assistance in emergencies and works with communities to improve food security and nutrition. WFP is usually among the first organizations on the scene during disasters because it has offices in more than 120 countries and leads clusters of UN emergency telecommunications and logistics staff who need to go in and set up before other teams arrive.

The response to Cyclone Idai was the first time WFP used a coordinated fleet of drones for disaster response. The timing for this effort was right because WFP had been conducting drone training with Mozambique's National Institute for Disaster Management and Risk Reduction (INGD) to build in-country drone pilot capacity.

"Before, only the people with access to a helicopter could see the damage and do assessments," said Patrick McKay, drone data operations manager for WFP. "But now with drone pilots mapping in really high detail, down to two-centimeter resolution, we could share that information with everyone, and even do remote inspections."

"Each time the pilots came back, they told us the flooded area had gotten bigger,"



said McKay. "They'd go by a stadium, and people were climbing higher and higher in the stands every time they flew past. When your primary tool for flying over large bodies of water is a helicopter that costs $2,800 an hour, you need to find a better way."

The drone pilots mapped the damage from flooding caused by Cyclone Idai and searched for survivors. This freed helicopter pilots to conduct rescue and supply missions. The images and videos the drones collected fueled updates to maps created with GIS that let all responders see what was going on.

Drones are now standard for every WFP emergency response, used early and often to find out how many buildings have been damaged and how far floodwaters reach, scout for survivors, and map changing conditions.

WFP's use of drones has helped UN Children's Fund (UNICEF) inspect schools, assist the World Health Organization (WHO) assess the status of clinics, and support other UN organizations and in-country first responders rapidly understand conditions on the ground. GIS brings together drone-collected data—with details about people and structures—in purpose-built maps and apps to meet each organization's mission.

Automating the Search for People Trapped by Floodwaters

Each drone flight can collect a vast number of images—from hundreds to thousands—that needed to be processed and reviewed.

"The faster we can go through them, the faster we can get to the people that need our help," said McKay.

The cyclones in Mozambique in 2019 marked the first

↑ Mozambique's Institute of Disaster Management used drones to respond to Cyclone Desmond, which caused devastating flooding in Beira in January 2019. (Photo courtesy of INGD/Antonio Beleza.)

→ Drones were used to create a high-resolution digital terrain model (DTM) of the Buzi River. (Map courtesy of INGD/Antonio Beleza.)

↑ WFP conducted advanced drone training in Mozambique in September 2018. The in-country team members put this knowledge to work quickly and honed their skills repeatedly in subsequent disasters. (Photo courtesy of WFP/Katarzyna Chojnacka.)

time WFP used a model with AI machine learning algorithms to automatically find and classify damage to buildings, which removed the need for people to look at every image. Using traditional AI methods, it might take a team of 20 people more than six weeks to label the data and train the AI model before it can produce accurate results. This was not a workable solution given the time-critical nature of search and rescue in Mozambique.

WFP turned to Synthetaic, an Esri partner, to solve the more challenging problem of quickly finding stranded people surrounded by floodwaters using imagery. Synthetaic divides imagery into tiles and employs a product that doesn't require a pretrained AI model.

"That's where our product RAIC *[Rapid Automatic Image Categorization]* comes in," said Corey Jaskolski, president and founder of Synthetaic. "We can take completely unlabeled data, we don't need any humans to label it, and we can search for things in the dataset by a single example query."

With Synthetaic's workflow, WFP was able to achieve results that were useful in finding people in floodwaters in a few days. Aided by AI in this way, responders could quickly send a boat or helicopter if the algorithm found a person in a tree surrounded by floodwaters.

Mapping Efforts to Prepare and Respond

In responding to Cyclone Idai, WFP worked directly with Antonio Jose Beleza, deputy director of National Emergency Operations Center (CENOE) at INGD. Eight of the drone pilots came from the Mozambique government. With their local knowledge, they began mapping where they thought people still might be.

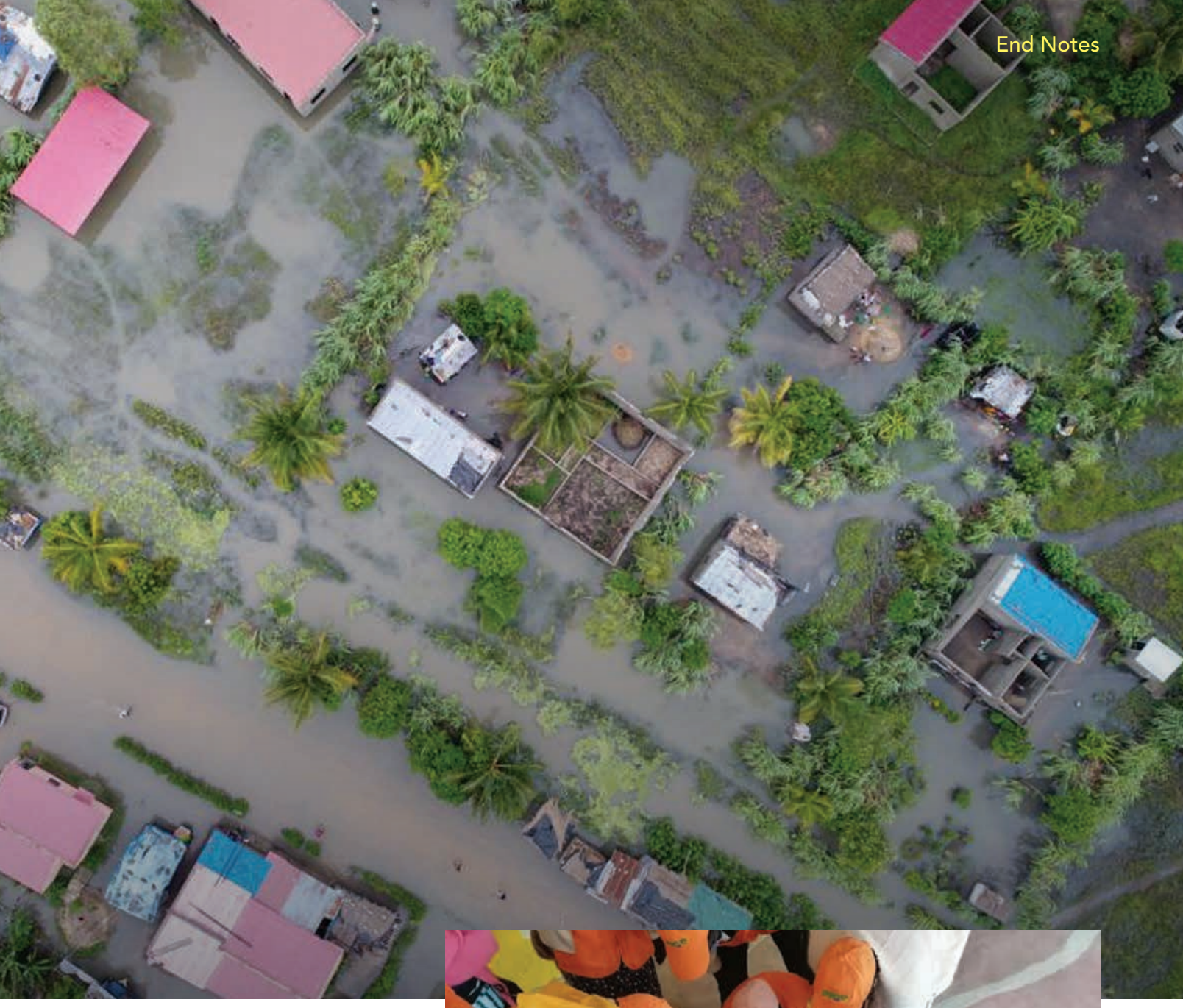
Every day, drone teams would meet in the morning, disperse, and meet in the evening to coordinate activities and process images to update maps. Evening meetings were for coordinating the next day's flights and the areas to cover. In the morning, the teams would assign people to ground vehicles, helicopters, and boats to reach flooded areas. The drone teams would check on villages, determine if they were flooded or clear, and document any people walking through floodwaters toward safety.

Flooding in Mozambique had started even earlier, with Tropical Depression Desmond, which dropped more than 400 millimeters (15¾ inches) of precipitation in less than 48 hours in Beira, the country's second-largest city, in January 2019.

The entire city was flooded, which led Beleza to try drones to assess the damage. "At that time, it was just me and my colleague Agnaldo Bila with two drones," he said. "We couldn't map very large areas, but we were able to cover critical areas and share the footage in real time. The images we collected on the ground were integrated in real time and for the very first time into the European Union's Copernicus Emergency Mapping Service, which was activated at the request of WFP to conduct rapid assessment of flooded areas."

The map helped establish accommodation centers in places that weren't flooded and showed others in the government the value of drones and mapping.

"Initially, we were focused on disaster response, but we wanted to be proactive," Beleza said. "Disasters will occur, and we want to be more prepared. We don't

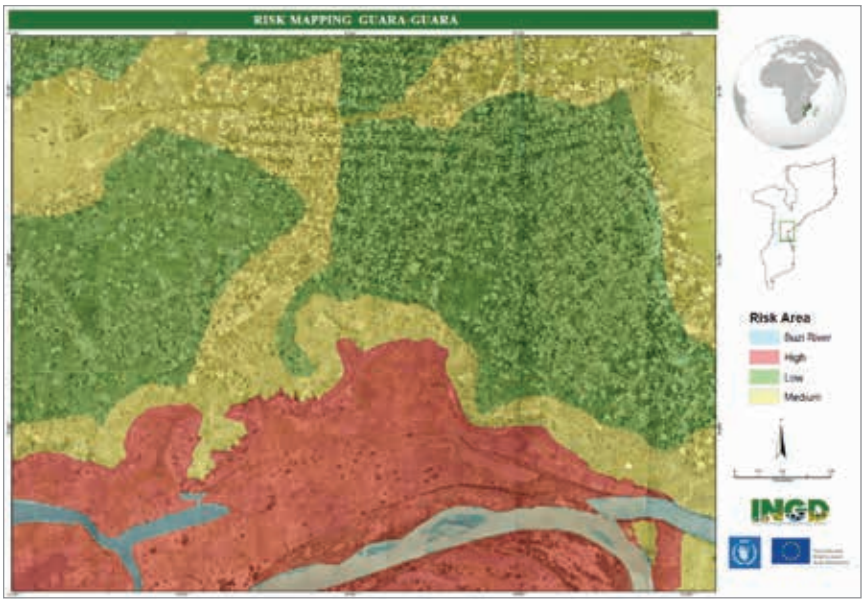


want extreme events to turn into disasters anymore."

Beleza and his team have been working with the Italian Centro Internazionale in Monitoraggio Ambientale (CIMA Foundation) on hazard mapping. The CIMA Foundation has created a hydrological model for the Buzi River watershed using

↑ Drones produce orthophoto outputs, a photographic map of uniform scale, that can be directly overlaid with other maps. (Photo courtesy of INGD/Antonio Beleza.)

→ The drone team looks at an orthophoto to prepare data capture missions along the Buzi River. (Photo courtesy of INGD/Antonio Beleza.)



↑ With a detailed DTM of the Buzi River, hazard maps were created to showing the areas that were most vulnerable to flooding. (Map courtesy of INGD/Antonio Beleza.)

satellite imagery, and recently drones were flown to improve the accuracy of the model.

"We flew the drones over 850 square kilometers of the Buzi River, then we processed the data and created a very high-resolution digital terrain model *[DTM]*," Beleza said. "When the rainy season comes, local governments can simulate floods and determine when and where the water will arrive downstream. We're sure that this will trigger community early actions and save lives."

GIS is used to look at different layers of data to model different flooding scenarios, design evacuation routes, and identify the safest places for accommodation centers.

"We combine science, technology, and local knowledge to prepare the communities and local governments in a participatory manner," Beleza said. "Every year we are seeing more frequent flooding. That has motivated us to go there and do something for these people."

WFP is greatly encouraged with how people in Mozambique continues to grow their skills. Mozambique now runs its own drone response team and uses drone imagery-derived maps to predict risks and hazards.

"They've got the expertise and drone equipment, so when the storms hit this year, they didn't call us because they knew exactly what needed to be done," McKay said.

For Beleza's team in Mozambique, the drones and AI analysis have been a game changer.

"We've been saving lives," Beleza said. "We are taking the opportunity to learn from the drone deployments we have made so far to improve the way we deal with this technology when it comes to disaster preparedness and response."

Learn more about how GIS helps organizations deliver effective humanitarian assistance (https://bit.ly/3TRFmAV).

About the Author

Olivier Cottray is director of humanitarian solutions at Esri, where he helps relief organizations get the most out of Esri solutions and develops best practices for the global humanitarian GIS community. Prior to joining Esri, Cottray led the Information Management Division of the Geneva International Center for Humanitarian Demining (GICHD), where he developed and implemented the Information Management System for Mine Action (IMSMA) and helped optimize and complement the logistics of cooperating agencies at the United Nations Joint Logistics Centre. He first applied GIS for humanitarian aid in 2002, when he helped found MapAction to provide rapid information management and GIS support following a crisis.

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