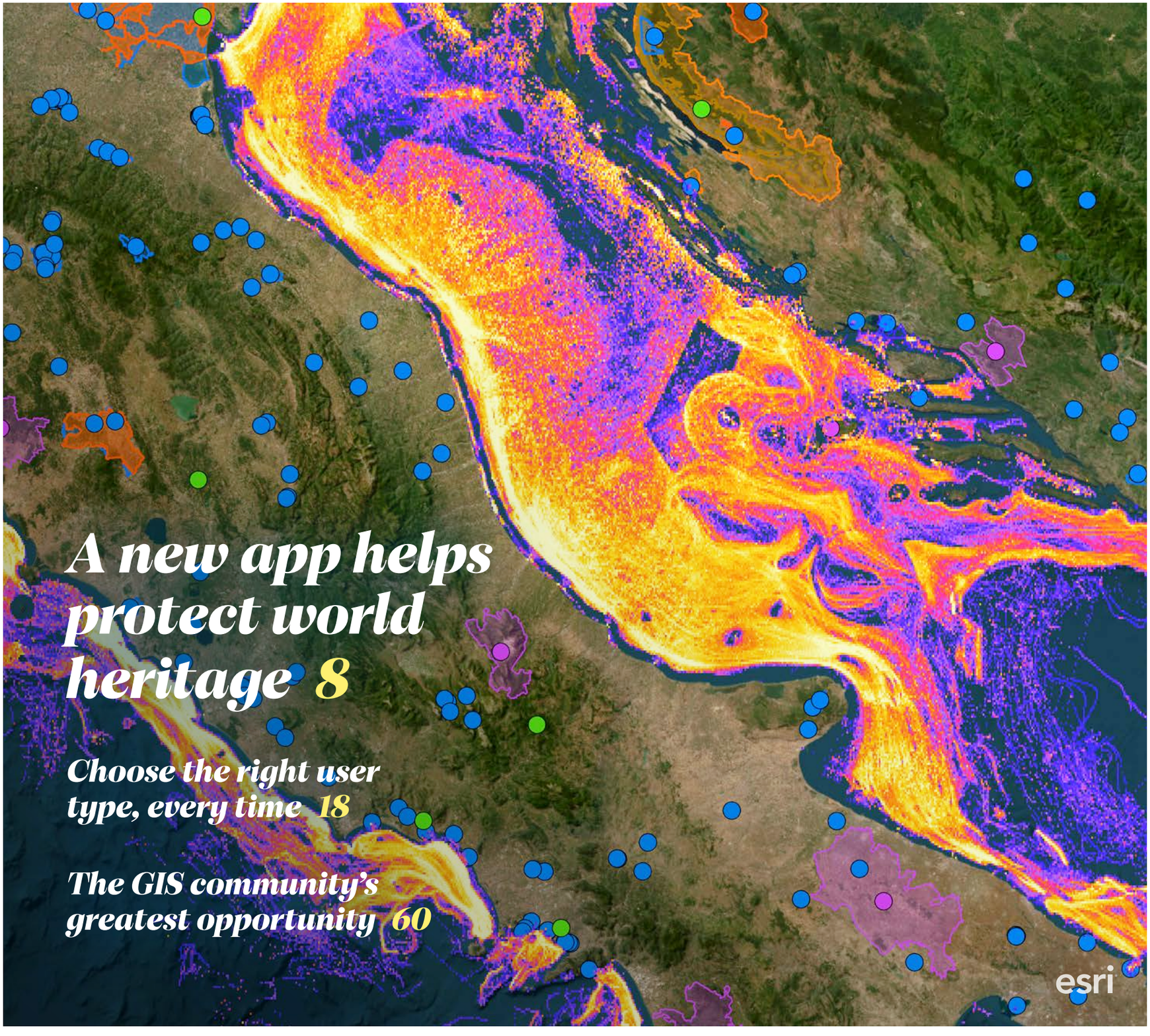
ArcNews

NOV 2026

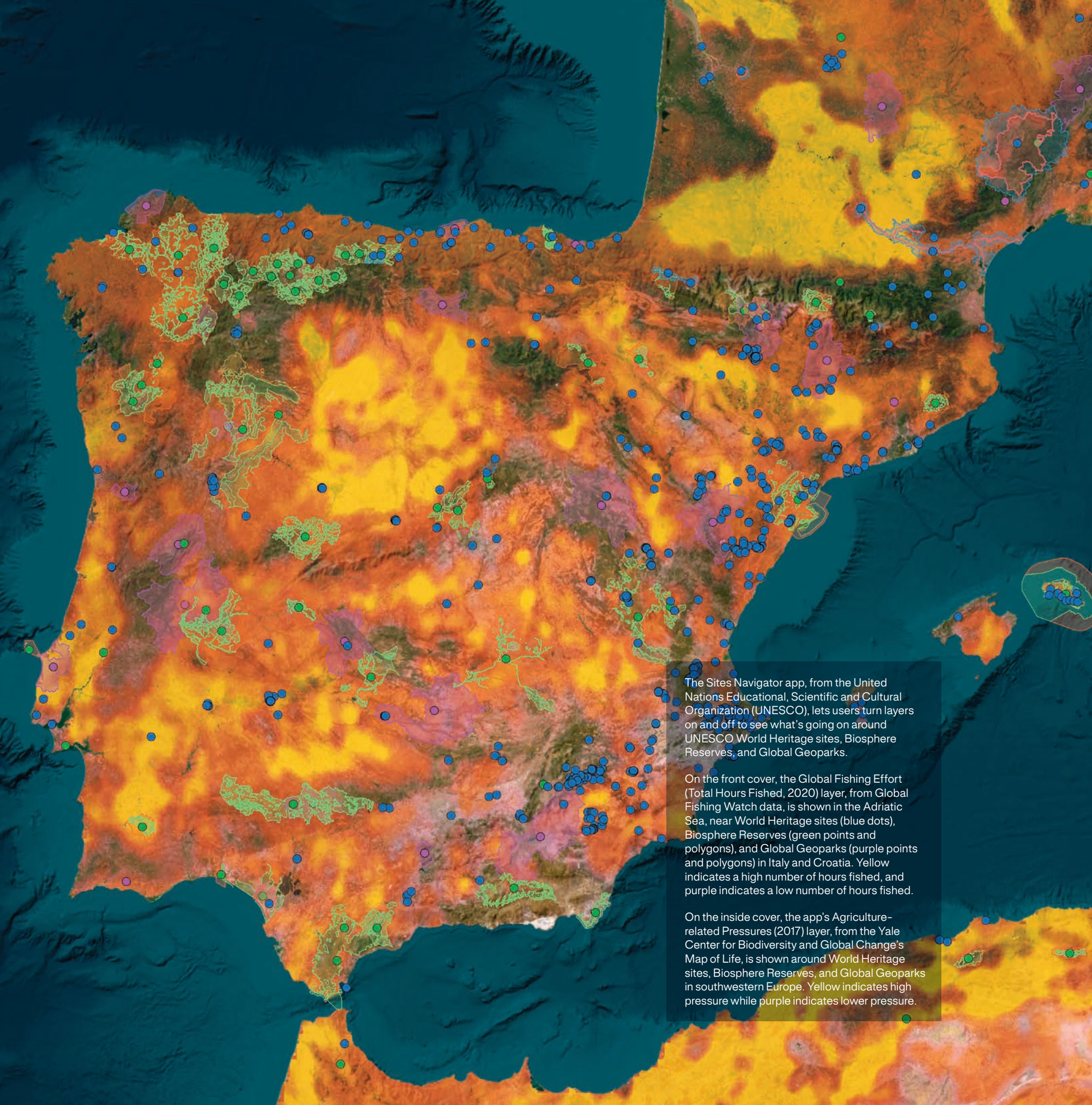


A new app helps protect world heritage 8

Choose the right user type, every time 18

The GIS community's greatest opportunity 60

esri



The Sites Navigator app, from the United Nations Educational, Scientific and Cultural Organization (UNESCO), lets users turn layers on and off to see what's going on around UNESCO World Heritage sites, Biosphere Reserves, and Global Geoparks.

On the front cover, the Global Fishing Effort (Total Hours Fished, 2020) layer, from Global Fishing Watch data, is shown in the Adriatic Sea, near World Heritage sites (blue dots), Biosphere Reserves (green points and polygons), and Global Geoparks (purple points and polygons) in Italy and Croatia. Yellow indicates a high number of hours fished, and purple indicates a low number of hours fished.

On the inside cover, the app's Agriculture-related Pressures (2017) layer, from the Yale Center for Biodiversity and Global Change's Map of Life, is shown around World Heritage sites, Biosphere Reserves, and Global Geoparks in southwestern Europe. Yellow indicates high pressure while purple indicates lower pressure.

ArcNews

Esri | November 2026 | Vol. 48, No. 4

Subscribe to *ArcNews*

Residents of the United States can subscribe to the print edition of *ArcNews* at links.esri.com/subscribe.

Manage Your *ArcNews* Subscription

Make changes to your subscription information at links.esri.com/manage-subscriptions. Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address.

Become a Contributor

Read the publication's submission guidelines at links.esri.com/submit.

Editorial Inquiries

Citabria Stevens, *ArcNews* Editor-in-Chief
Ben Van Voorhis, *ArcNews* Managing Editor
arcnews_editor@esri.com

Advertise in *ArcNews*

For information regarding placing an advertisement in *ArcNews* magazine, contact the advertising coordinator at ads@esri.com.

ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA.

Copyright © 2026 Esri.
All rights reserved.
Printed in the United States of America.

The information contained in this document is the exclusive property of Esri or its licensors. This work is protected under United States copyright law and other international copyright treaties and conventions. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, except as expressly permitted in writing by Esri. All requests should be sent to Attention: Director, Contracts and Legal Department, Esri, 380 New York Street, Redlands, CA 92373-8100 USA.

The information contained in this document is subject to change without notice.

Esri products or services referenced in this publication are trademarks, service marks, or registered marks of Esri in the United States, the European Union, or certain other jurisdictions. To learn more about Esri marks, go to links.esri.com/product-naming-guide.

Other companies and products or services mentioned herein may be trademarks, service marks, or registered marks of their respective mark owners.

Esri Resources

Esri Store
esri.com/store

Esri Technical Support
esri.com/support

Esri Developers
developers.arcgis.com

Customer Care Portal
my.esri.com

Contact Us
esri.com/contact

Editorial

Editor-in-Chief
Citabria Stevens

Managing Editor
Ben Van Voorhis

Contributors
Matt Ball, Brian Cooke, Jeanne Flores, Lance Owen, Sneha Suresh, Emily Swenson

Copy Editor
Joy Thompson

Design

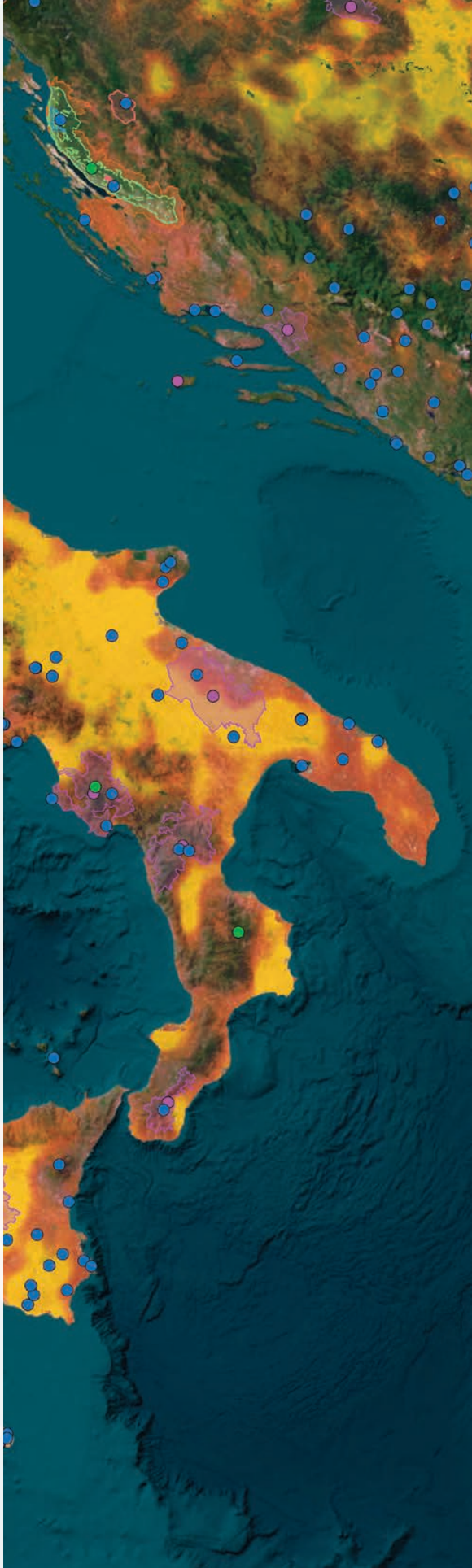
Creative Director
James Hitchcock

Management
Suzanne Hoyt, Tammy Johnson

Designers
Daniel Gill, Tyson Hubley, Doug Huibregtse, Takeshi Kanemura, David Lauruhn, Aldo Lopez, Jay Merryweather

Cartographer
Karie Krocker

Print Coordinator
Dervin Spradley



Contents

NEWS

5

Briefly Noted



6

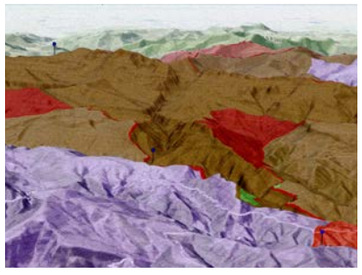
GIS at a Glance

Check out these stories from around the world of Esri, including *Esri Blog*, *ArcWatch*, and *Esri & the Science of Where* podcast.

8

From Blind Spots to Actionable Maps

For decades, UNESCO has worked to protect World Heritage sites, Biosphere Reserves, and Global Geoparks from climate impacts, conflicts, and other threats. With a new app, thousands of sites that were once managed separately can be visualized in one geospatial platform, making it easier to monitor and protect the world's cultural and natural heritage.



14

One Map to Put Together the World's Land-Use Plans



TOOLBOX

18

How Do I Choose the Right User Type?

The six ArcGIS user type licenses align with specific workflows and privileges, but it's not always obvious which one is best for your situation. Here's how to make sure everyone in your organization has the right user type.



20

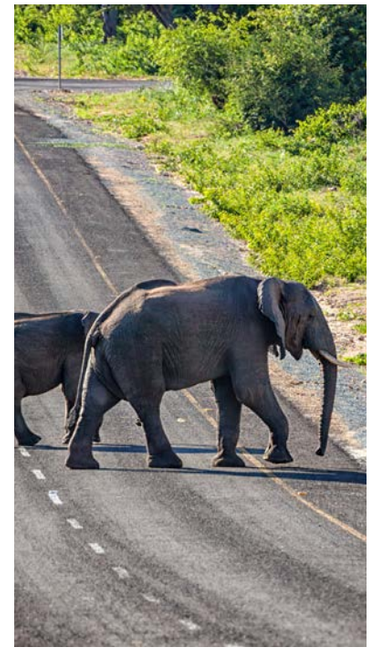
10 Tools for Geospatial Automation

YOUR WORK

24

From Conflict to Coexistence: Mapping Wildlife Encounters Across Borders

Human-wildlife conflict is one of the most persistent challenges facing conservationists in southern Africa. Consistent, reliable data about these incidents is crucial for helping humans and wildlife live together peacefully.



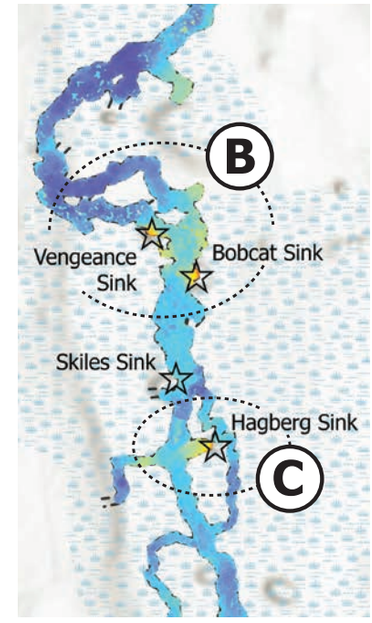
28

GIS Breathes Life into the Historical Census

32

Robot Maps an Underwater World

Mapping and monitoring the cave systems that channel Florida's groundwater is costly and dangerous. The solution? A specialized underwater robot.



DEVELOPER'S CORNER

34

How Can AI Unlock New Geographic Insights?

36

JavaScript Maps SDK 101

Whether you use developer tools every day or don't have much coding experience, ArcGIS Maps SDK for JavaScript can bring flexibility, scalability, and power to your mapping apps.

GIS PEOPLE

40

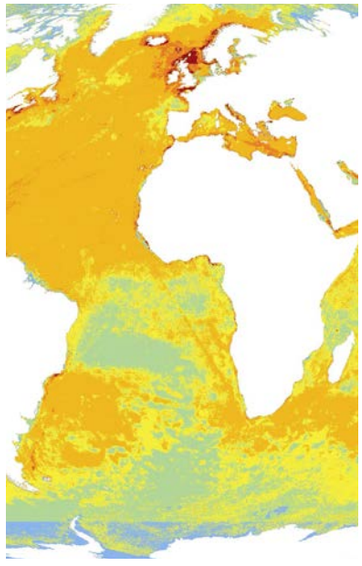
A Digital Twin of Nature to Test Ideas for the Future



44

Conservation Science Must Take Risks

Conservation science has long been risk-averse. Instead, it must embrace bigger ideas. The National Center for Ecological Analysis and Synthesis aims to make that possible.



46

Māori Scholar Maps a More Resilient Future



48

How Does Your Map Sound?

At first glance, maps and music appear to have little in common. But comparing the two reveals something fundamental about how maps work—and how your maps can work better.



50

Human Judgment: The Essential Element of Responsible Geospatial AI

52

Carrying Forward a Lifetime of Service

Shoreh Elhami, the founder of GISCorps, has spent decades asking the GIS community to show up for the world. Now, GISCorps needs someone to show up for it.



MANAGER'S HANDBOOK

54

The Future of GIS Depends on Who Leads It

56

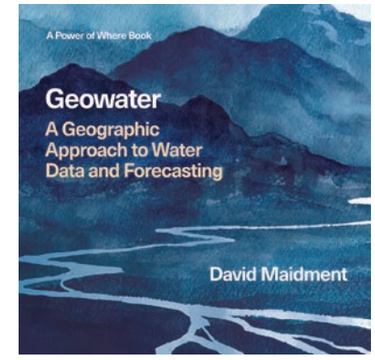
What AI Skills Do GIS Managers Need?

Agentic AI in GIS comes with challenges and demands that didn't exist even two years ago. To run and grow a GIS program in this new era, every manager must have and hone new skills. Here's what it takes to make your organization AI-ready.

ESRI ATLAS

58

What's New from Esri Press



60

GIS and the Coevolution of Civilization

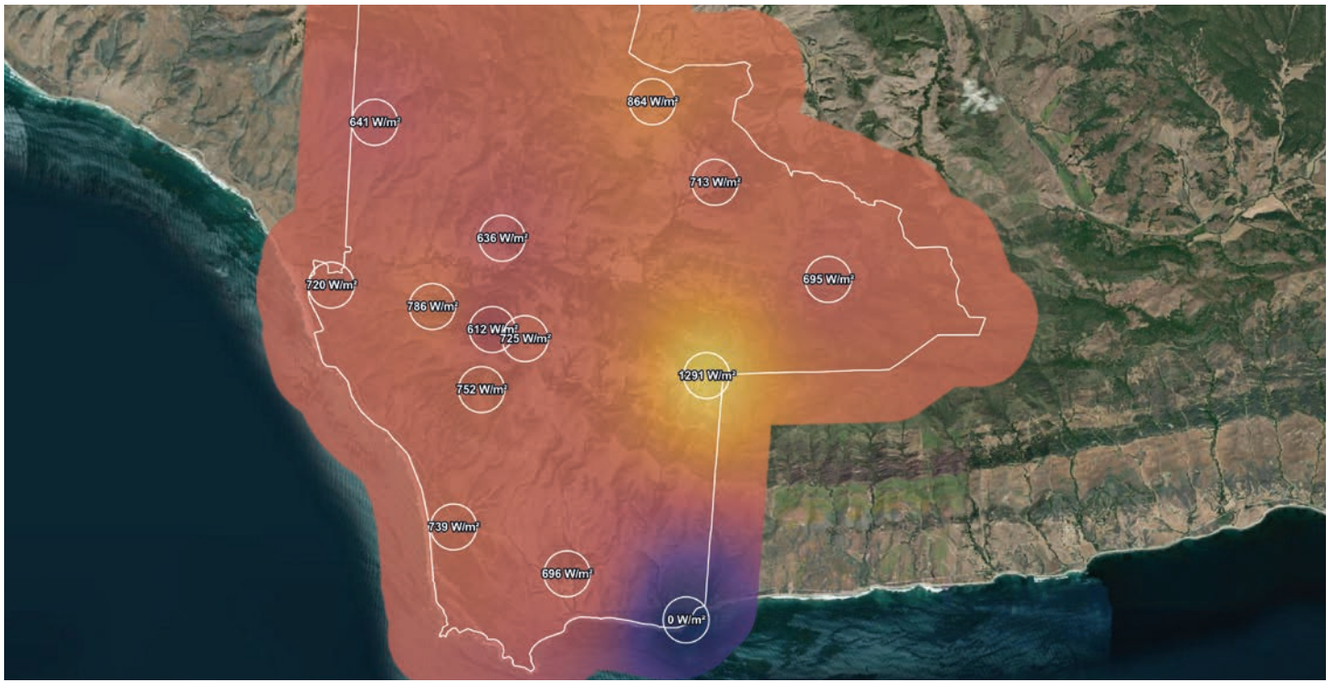
Geospatial professionals have always brought together data, science, technology, and human experience to address real-world problems. They must create a collective intelligence for a sustainable future.



68

Esri Training Courses and Certifications

ArcNews Is for You, the GIS Community



One of the first living digital twins of nature shows live solar radiation at the Jack and Laura Dangermond Preserve.

Welcome to the new *ArcNews*. This isn't the tabloid-sized magazine you're probably used to, but it's the same quarterly publication, just with a new look and new stories for a wider GIS audience.

For 28 years, Esri published two magazines for distinct groups within the geospatial community: *ArcNews*, for GIS users of all experience levels; and *ArcUser*, for GIS power users, managers, and developers. As GIS has evolved from a niche technology into an enterprise necessity, the line between these audiences has blurred.

ArcNews now aims to speak to this broader readership, keeping the entire GIS community connected, informed, driven, and inspired throughout each year.

The magazine's core remains the same. The News, Your Work, and GIS People sections contain stories about innovative uses of GIS technology and articles from prominent industry voices. Four additional sections allow *ArcNews* to fulfill its expanded mission. Toolbox is where you'll find product announcements and tutorials. Developer's Corner highlights developer-centric news, capabilities, and ideas. Manager's Handbook speaks directly to GIS managers—about how to promote geospatial technology to decision-makers and lead GIS teams. And Esri Atlas includes information about Esri events, new training opportunities, books from Esri Press, and more.

This issue is full of ideas that unify people, places, data, and systems. You'll get to explore the Sites Navigator app from the United Nations Educational, Scientific and Cultural Organization (UNESCO) that shows World Heritage sites, Biosphere Reserves, and Global Geoparks together, in one interactive view that reveals both opportunities and vulnerabilities. You'll be among the first to hear about OpenPlanMap, which will weave together planning data from around the world to encourage balance and coordination; the Luna Initiative, which incentivizes environmental scientists to explore riskier ideas; and a new digital twin of the Jack and Laura Dangermond Preserve that allows conservationists to test solutions before deploying them in the real world. You'll also meet University of Auckland PhD researcher Haukapuanui Vercoe, who grounds his engineering work not just in geography but also in Māori history and culture.

Several articles can help you hone the work you already do. Find out how to choose the right user types for your organization, automate specific workflows and tasks, and use AI to convert previously inaccessible information into geographic insight. Finally, put your work into context by reading Esri president Jack Dangermond's message to you—the geospatial professionals who give him hope for the future.

From everyone who worked on this issue, we hope you find these articles useful and thought-provoking. We're glad to be part of the same community.

Citabria Stevens

Citabria Stevens
ArcNews Editor-in-Chief

Briefly Noted



New Web Services Show Flood Impact for the First Time

Until now, it has never been possible to see—quickly and through widely available maps—how floods might play out across the United States. In collaboration with Esri, the National Water Center, part of the National Oceanic and Atmospheric Administration (NOAA), has released a series of web services via ArcGIS Living Atlas with detailed maps of flood inundation for the entire country. This information will be available several days ahead of major weather events.



Esri Introduces ArcGIS for ServiceNow

A new integration between ArcGIS and ServiceNow lets users incorporate location intelligence directly into everyday business workflows. ArcGIS for ServiceNow allows users to visualize and analyze operational data—including incidents, permitting, facilities, and work orders—in ArcGIS maps and apps, as well as within ServiceNow via maps powered by ArcGIS. Users can share data across both platforms without duplication and take action within their existing systems.



New High-Resolution Imagery for 2,000 Cities

Esri signed new agreements with Vantor, Airbus, and Nearmap to enhance the World Imagery basemap, the most widely used map service in ArcGIS. Vantor continues to provide the global imagery foundation for World Imagery, including refreshes for hundreds of cities and upgrades to 15-centimeter high-definition imagery in select major urban areas. Airbus is delivering 30-centimeter imagery with more current and detailed visual context to ArcGIS users worldwide. Nearmap's 20-centimeter vertical imagery will be integrated and regularly updated across 200 metropolitan areas in the United States, Canada, Australia, and New Zealand. **AN**

GIS at a Glance

1
About Time
Time zones are necessary in the modern world. But sometimes they subvert our understanding of time itself. Explore the geography of time in this ArcGIS StoryMaps story.

2
For the Largest Sporting Events on Earth, Public Health Goes Live
Facing back-to-back global events—the 2026 FIFA World Cup and the 2028 Olympic and Paralympic Games—Los Angeles County's Department of Public Health replaced static reports with live maps of public health data.

3
One Security Leader's Journey from the Air Force to Amazon
Michelle Riter has used GIS to detect threats to the US armed forces—and to Amazon's supply chain. Get an inside look at the world of operations security.



4
Visualize the Most Dangerous US Intersections
Some intersections see more fatal crashes than others. This animated 3D map uses data from the Fatality Analysis Reporting System to highlight the 15 deadliest intersections in the United States between 2019 and 2023.

5
Splats Bring a Stadium to Life
What happens when 70,000 drone images meet Gaussian splatting? Facilities staff and students at Clemson University get a photorealistic digital twin of its famed football stadium.



6
Animals on the Move
Migratory species face new obstacles in a rapidly changing world. Blue whales travel thousands of miles between their cold-water feeding grounds and warm-water breeding areas—but shipping traffic now poses a threat to their remarkable migration.

7
How NATO Developed a Spatial Thinking Culture
At the North Atlantic Treaty Organization's headquarters, one leader's determination to elevate GIS to a mission-critical capability reshaped how the alliance of 32 nations understands its world.





8
Where Music Meets Geography
Experience each curve and current of Czechia's Vltava River through Czech composer Bedřich Smetana's song *Vltava* (or *The Moldau*). Composed in 1874, the piece tracks the river's flow from the Bohemian countryside to Prague—and this ArcGIS StoryMaps story puts the masterpiece in its historical and geographic context.

9
How to House and Care for 1 Million Displaced People
As successive emergencies unfolded—each one bigger than the last—Lebanese organizations banded together to build a unified displacement-tracking platform. When conflict displaced over a million people, the platform showed where shelter, medical teams, and supplies were needed first.

10
Be Bold in Pursuit of Better
The 2026 ArcGIS StoryMaps Competition is open through December 11. Show how you use GIS to see what others miss, prepare your community for what's next, and ignite change. Learn how Azah Yamin, last year's winner in the People category, composes stories that flow, and get inspiration from a 2025 competition finalist by scrolling through *Grevy's Zebra Trust: Healthy Rangelands Program*.

11
Where a Digital Twin Makes Waves
Vietnam, a growing hub for manufacturing, wants to double its cargo capacity by 2030. To do this, Portcoast is reimagining operations with help from a digital twin.

12
Cloud-Native GIS Takes the Wheel
When rain pounded New Zealand in 2023, costing 11 lives and billions in damage, NZ Transport Agency Waka Kotahi's cloud-native GIS delivered. Within hours, the agency stood up a central geospatial capability with ArcGIS Enterprise on Kubernetes to capture data and provide situational awareness. Today, the platform is a single system of engagement for spatial data. **AN**

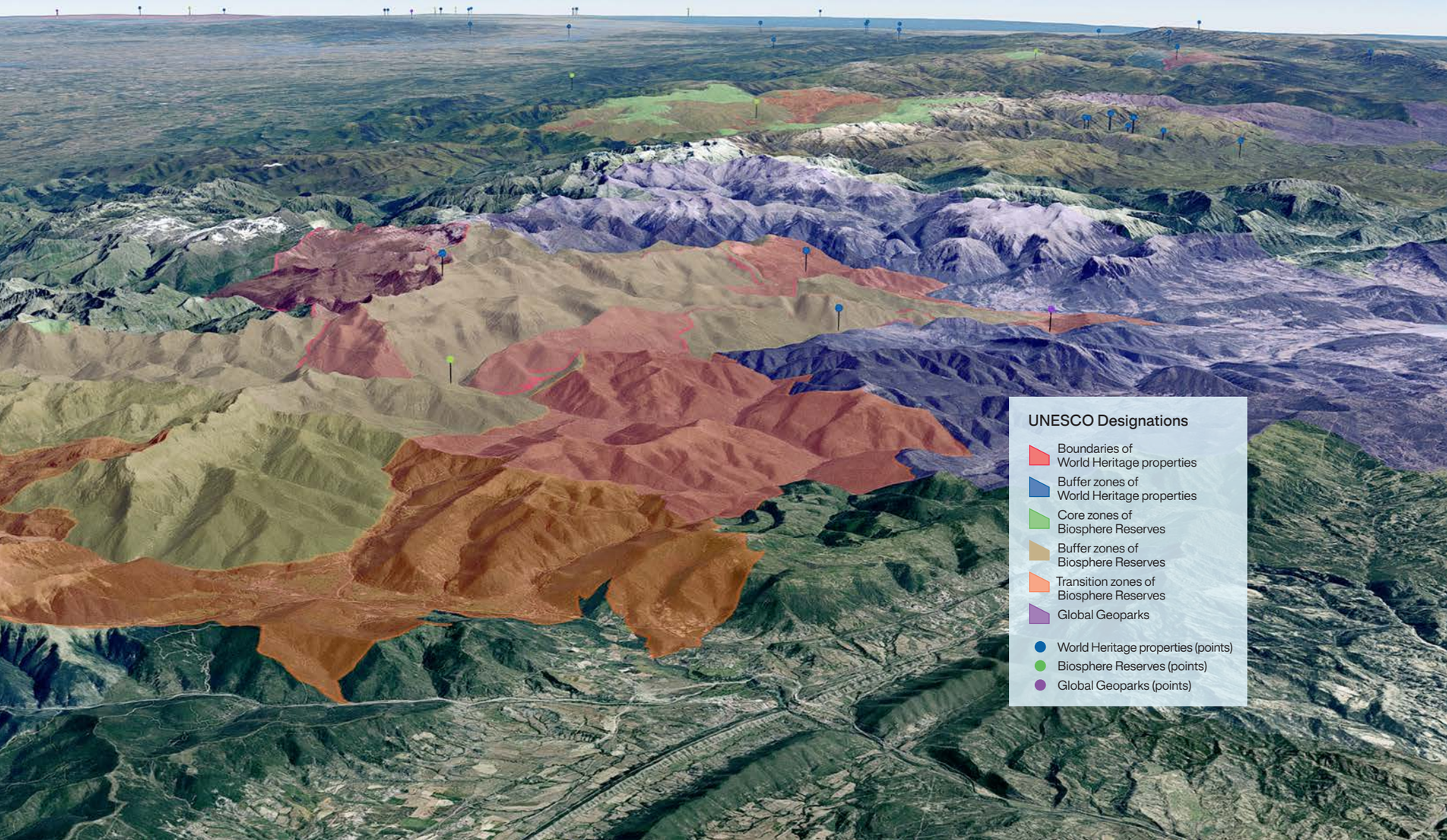




Scan the QR code to read all these stories at link.esri.com/gis-glance/nov26.

From Blind Spots to Actionable Maps

How UNESCO's World Heritage Mapping App Helps Monitor Risk and Respond to Threats



For decades, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has worked to protect places of outstanding cultural and natural value. These efforts are coordinated across multiple programs and have multiple designations; the organization's well-known World Heritage sites share importance with Biosphere Reserves and Global Geoparks. These different designations reflect unique mandates, but the pressures that affect these sites—from climate impacts to conflicts to tourism pressures—do not recognize those distinctions.

To confront this reality, UNESCO partnered with Esri to develop the UNESCO Sites Navigator, which brings the organization's various designations together in a single interactive geospatial platform. The result is a unified view of thousands of sites that were once visualized and managed through parallel systems and uncoordinated PDFs. Now, World Heritage sites, Biosphere Reserves, and Global Geoparks appear superimposed so end users can see their interrelationships, risks, and potential impacts.

For Fernando Avakian, the Navigator's project lead, the ease of using Esri's tools was a key differentiator. "We're very happy that we have the technology today in our hands to do all this wonderful stuff without being, for example, a developer," he said. His team, while fluent in GIS analysis, is primarily focused on understanding and communicating the importance of cultural heritage, not writing code.

With Esri's out-of-the-box and low- and no-code tools, Avakian's team members created a solution that they can maintain themselves and that allows them to concentrate on the vital work of protecting the world's cultural and natural heritage.

Building at Global Scale, Inside the Platform

Once the Paris-based World Heritage Centre had the foundational elements of the Sites Navigator, it was critical to implement more advanced analytic and alert-oriented capabilities. The team collaborated with Mapular UG, a partner of Esri Germany, whose expertise helped integrate live data into the Navigator to generate alerts. This engagement added two new sections to the tool: an advanced data view consolidating alert-related layers, and an alert dashboard.

While UNESCO already had the foundational data—core site layers, alert concepts, and the scientific logic behind them—Mapular's challenge was to translate that structure into a system that could capture the global picture. Using ArcGIS Experience Builder, the team built an app integrating more than 50 layers, including external data sources on everything ranging from flood forecasts to active fires to tree loss. These disparate sources all had to be registered, hosted, and optimized for performance.

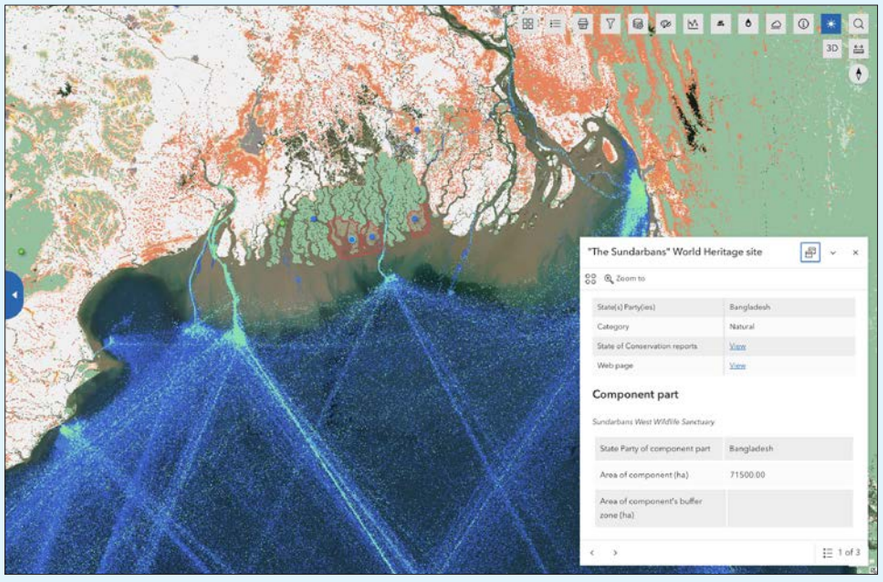
Many of the required layers were not native to ArcGIS. Ensuring that these layers could be accurately visualized and continuously refreshed was one of the project's main challenges.

One early structural decision proved especially valuable. Heritage sites vary enormously in geometric complexity. Some are extensive polygons spanning hundreds of miles; others are a single point. To handle that variability consistently across a daily automated process, Mapular developed a harmonized layer defining the geometry around each site.

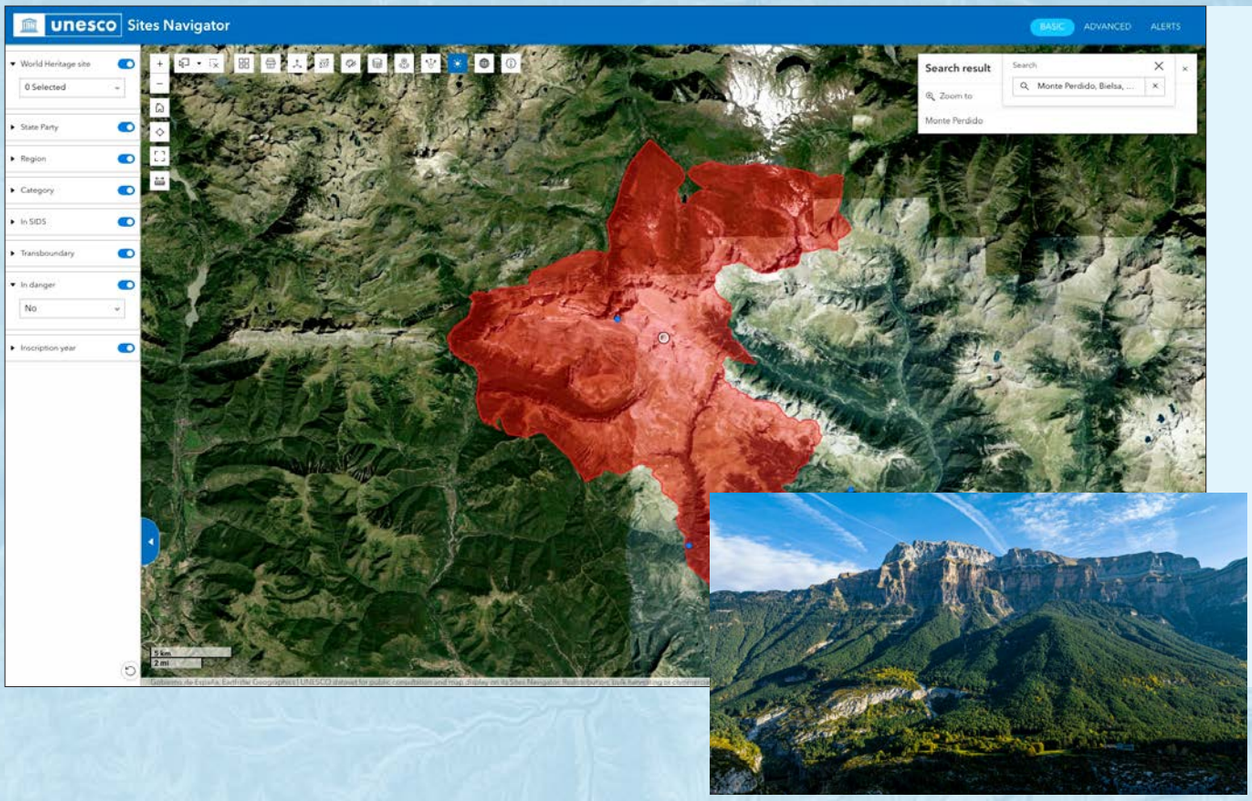
"This harmonized layer let us simplify the process and be more accurate during the analysis while also keeping performance management, since these processes run every day across many sites," said Nisleida Morales, a geospatial developer at Mapular who worked intensively on the project.

UNESCO also made it clear that everything needed to be built using out-of-the-box capabilities.

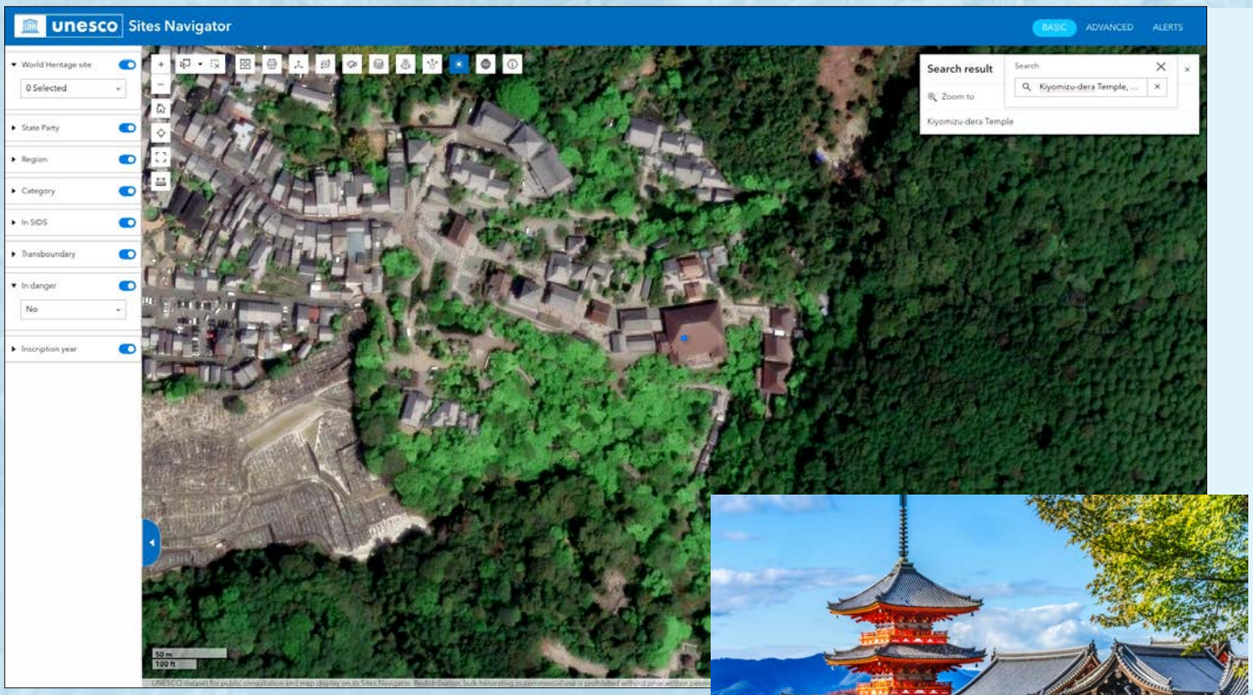
"One of the main things they communicated was that they wanted to be able to maintain all these apps independently," Morales explained. "We needed to build everything natively—out of the box—using whatever Experience Builder provided."



The Sundarbans World Heritage site in Bangladesh is shown with Global Wildland-Urban Interface data and Global Ship Density, 2015–2021.



Where France meets Spain, Mont Perdu in the Pyrenees holds a rare triple designation: World Heritage site, Biosphere Reserve, and UNESCO Global Geopark—all tracked together in the Sites Navigator.



World Heritage sites like Kiyomizu-dera Temple in Kyoto, Japan, are no longer just dots on a list. The Sites Navigator gives each a precise spatial footprint, enabling real-time monitoring of the conditions around them.

> *Everything displayed in the dashboard is an alert. Every alert is well-studied—the methodology, the buffer distances.*

Nisleida Morales
GEOSPATIAL DEVELOPER, MAPULAR

Automating the Science

While the Sites Navigator offers a smooth and interactive user experience, a lot of complex automation is happening behind the scenes. UNESCO had already defined, for instance, what constitutes a meaningful alert—which is important because overalerting erodes credibility with stakeholders. Variables like wildfire are not always a threat and can be normal in environments such as Boreal forests.

As a result, UNESCO's deep domain expertise drove the articulation of alert thresholds, buffer distances, and data sources suitable for the app. Mapular's key task was to wire these complex parameters into the platform. Using ArcGIS Notebooks, Morales translated UNESCO's alert logic into automated analyses that run on a regular schedule, pulling in authoritative data sources.

For Mapular's broader team—developers accustomed to writing their own scripts outside the Esri platform—ArcGIS Notebooks was a revelation.

"The capabilities were really impressive," Morales noted, "particularly that you can schedule their execution and see the impact directly in the output layers."

All the sources the domain experts provided are official. For wildfire monitoring, the system draws from NASA FIRMS, the National Aeronautics and Space Administration's Fire Information for Resource Management System. For tsunamis and floods, it relies on the Global Disaster Awareness Coordination System. For coral bleaching, it pulls from the National Oceanic and Atmospheric Administration (NOAA) Coral Reef Watch program.

Given that the Navigator is focused on near real-time data, each alert is recalculated daily. Users see the most recent available information in the dashboard. UNESCO and Mapular also made the design decision to avoid graduated alert levels or color-coded warnings.

"We chose not to apply yellow, orange, [and] red symbology," Morales explained, referencing UNESCO's rigorous alert guidelines. "Everything displayed in the dashboard is an alert. Every alert is well-studied—the methodology, the buffer distances."

The dashboard presented a distinct design challenge to make it immediately legible to users who might not know GIS.

"How do you let someone go deep and see the alerts quickly and intuitively?" asked Morales. "We used ArcGIS Dashboards features as tooltips and [added] a welcome message to provide users with complementary information about the alerts. We also used ArcGIS Arcade expressions to provide dynamic content in the pop-ups and alerts list."

The Operational Shift

Once UNESCO had the data mapped and georeferenced, it expanded what the organization could see, monitor, and protect.

The Sites Navigator signals not just a technical innovation but also an operational shift at UNESCO, enabled by heightened visibility. Lesser-known sites—those outside well-trodden tourism locales or far from media attention—now appear alongside the better-known sites, with the same analytical scrutiny applied to all. (The World Heritage list alone comprises nearly 1,200 individual sites.) This change highlights risks that might otherwise go unnoticed.

"We started discovering that things were happening at sites from which we'd received no information," Avakian said.

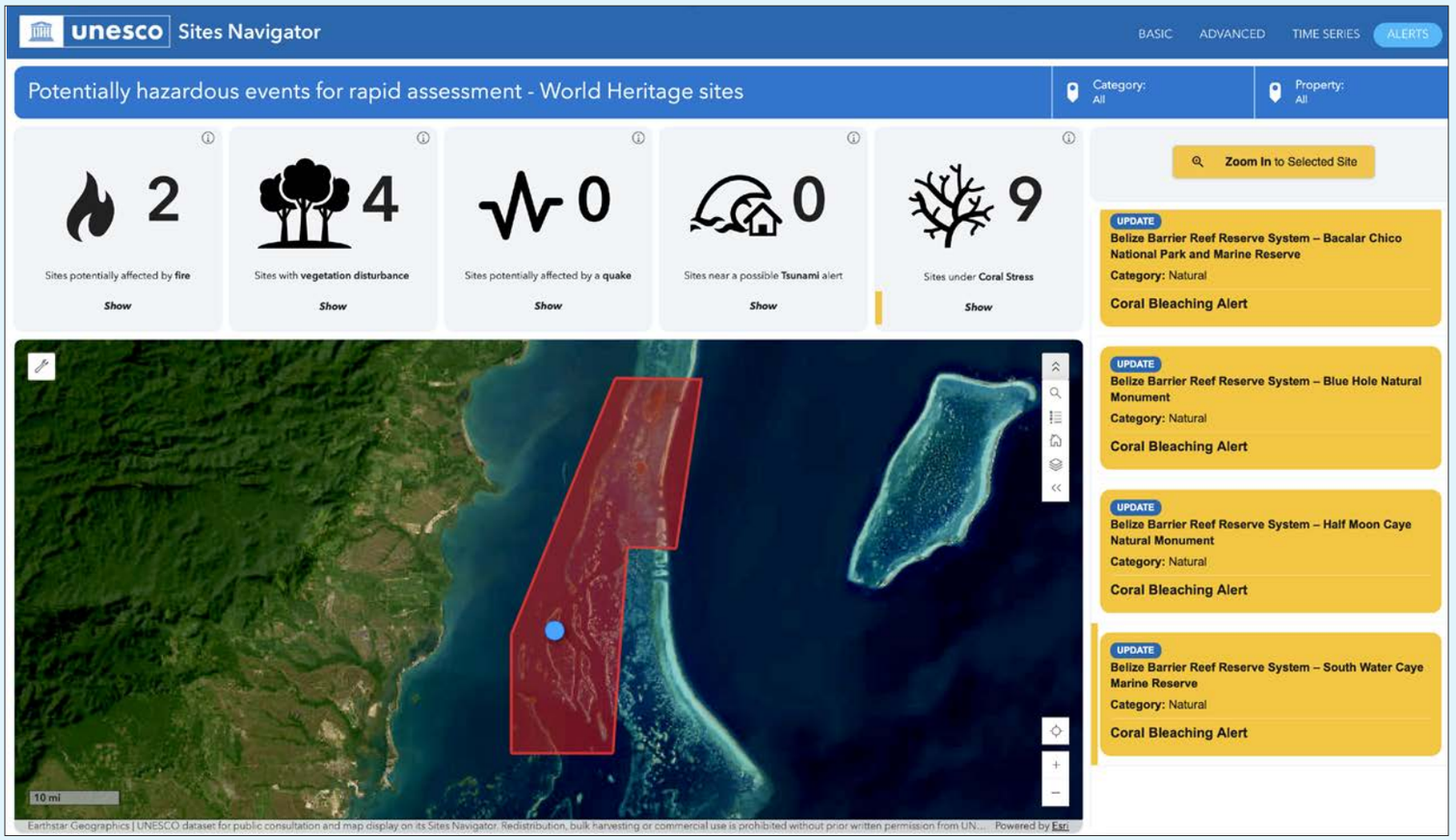
In practical terms, the platform helps UNESCO focus and prioritize action. It indicates where staff should look more closely and what type of response might be appropriate. Responses range from formal correspondence to field mission deployment—and in all cases, the decision is informed by shared, up-to-date spatial awareness.

The conflict dimension has proven equally significant. During recent conflicts in multiple regions, Avakian's team used the Navigator to cross-reference reported strike coordinates against World Heritage sites in near real time—the first time such tracking was possible at that speed and scale.

Since December 2025, when the Committee for the Protection of Cultural Property in the Event of Armed Conflict formally designated the Sites Navigator as an official notification method, its reach has extended further. The Navigator was the system of record used for media views showing sites in Lebanon, Iran, and Ukraine marked with a Blue Shield emblem, indicating they should not be targeted.

"I won't say that it stops attacks," said Avakian, "but we're conveying the data. We're doing our job."

The Sites Navigator also animated analysis of the relationship between climate change and UNESCO sites—the complexities of which have, at times, been elusive. The Navigator data formed the foundation of the recent *People and Nature in UNESCO-Designated Sites* report, a global assessment of all World Heritage sites, Biosphere Reserves, and Global Geoparks, which investigated not only the impacts of climate change but also how sites contribute to mitigating climate change and biodiversity loss. UNESCO seeks to highlight this interdependence—and the Sites Navigator helps make that more apparent.





Daily coral bleaching data from NOAA feeds into the Alerts dashboard. Waters around the Belize Barrier Reef Reserve System—shown with a protected area polygon—were under watch in August.

An Amplifier That Improves Action

Avakian sees the Navigator's ability to break down silos as equally important among different units within UNESCO—all of which are working toward a common goal. The World Heritage Centre's stature gave the Navigator immediate credibility, and Avakian says its launch triggered a cascade of internal requests for integration to capitalize on the work, bring together designations, and show interlinkages across natural and cultural assets.

The result is a more holistic reflection of UNESCO's diverse sites and mandates—something that can help expand public perception of the organization. For many people, UNESCO is synonymous with the World Heritage Centre and its highest-profile listings. But by showing the organization's full range of designated sites, the Sites Navigator reveals a more complete picture.

"When hearing about UNESCO, people immediately think cultural sites," Avakian said. "But UNESCO works not only on World Heritage—it's also intangible heritage, oceans, forested areas, and geodiversity."

Avakian makes clear that the Sites Navigator is an amplifier, a tool that, at its core, can improve action.

"UNESCO has a huge mandate," Avakian emphasized. And the Navigator lays the groundwork to bring the organization's expansive data, stakeholders, and users together. In doing so, it enables UNESCO to act earlier, more consistently, and across the full range of invaluable places it protects around the globe. **AN**



Salisbury
UNIVERSITY

MASTER OF SCIENCE
IN GIS MANAGEMENT

Henson School of Science & Technology



Advance Your Future in GIS Management

Salisbury University's Master of Science in GIS Management program – now approaching its 20th year – is designed specifically for the working GIS professional who seeks the management credentials needed for career advancement.

SPECIALIZED, VALUE-ADDED EDUCATION

- Management and technical proficiency often leads to salary increases
- Customized for those in government, business and non-profits
- Earn credits toward GISP® certification
- Third-party billing and flat tuition rate

CONVENIENT AND ACCESSIBLE

- 100% online and nationally ranked
- 2022 AAG Award - Program Excellence
- Earn degree in 13 months (full time) or 2 years (part time) on your schedule
- Begin classes summer, fall or spring
- Open to international students
- Flexible scheduling for U.S. military

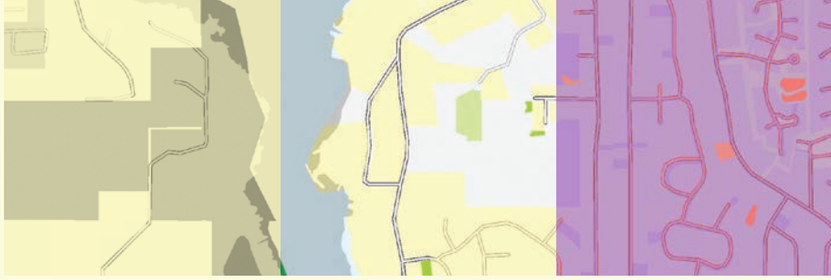
Salisbury University is an equal educational and employment opportunity institution.

APPLY NOW

GRE Waived for Current Year

MORE INFORMATION:

Lauren McDermott, Program Director
msgism@salisbury.edu
salisbury.edu/msgism



ONE MAP to Put Together the World's Land-Use Plans

Communities don't grow randomly. Land-use plans dictate how residential, downtown, and green spaces are designed and safeguard natural resources such as water, soil, and forests. They also prevent conflicts, like placing an industrial plant next to a quiet neighborhood, and support public infrastructure, including roads, transit, and utilities. In essence, a land-use plan foretells what an area will look like in the years and decades to come.

From municipality to municipality, however, land-use plans are largely disconnected. A city might not have easy, mapped-out access to the county's plan, and adjacent towns could be in the dark about one another's development objectives.

OpenPlanMap (OPM), the latest innovation from Esri's Community Maps Program, aims to change that. The initiative encourages planners from all over the world to share their planning documents via an Esri-managed online portal. The data—originally presented in different schemas and languages—is then standardized and shared via ArcGIS Living Atlas, an open data site, and a new app, where it will help reveal the collective impacts of how communities are designed, both now and in the future. This cloud-based system for community sharing and integration of land-use plans will use a crowdsourcing process to create a consistent and continuous digital map that consolidates local and regional plans from around the world. Public and private land-use planners will share, upload, and update their plans over time.

Today, nearly every local and regional government around the world creates and maintains land-use plans in different digital formats. While these plans are typically shared publicly as open data and web maps, they have never been consistently brought together to form continuous land-use plan maps and datasets for regions, states, or whole nations.

For the last several years, the International Geodesign Consortium has worked closely with Esri's ArcGIS Living Atlas team to create this system. This data will be maintained by Esri as a standard set of layers. It will also be available freely to anyone.

"The more communities that share their planning data, the faster it will start to mosaic," said Ryan Perkl, Esri's lead for geodesign and OPM. "Then we'll be able to build this big, patchwork quilt of land use across the globe."

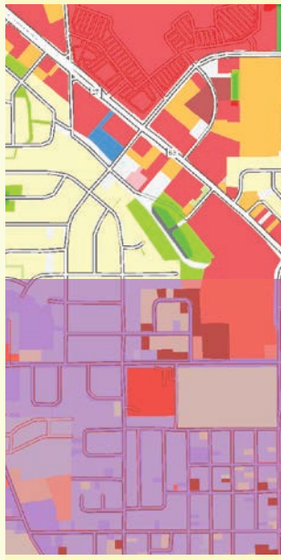
This goes beyond simply cataloging what exists today—a common trait of land-cover mapping, according to Perkl. Instead, OPM aims to share what the land's *intended use* is.

"A field in today's land-cover map might not remain a field. The area's land-use plan may show it becoming something else entirely—a neighborhood, a business center, or an industrial zone," Perkl said. "Maps depicting land use show what changes may be on the horizon—a critical step in planning for the future."

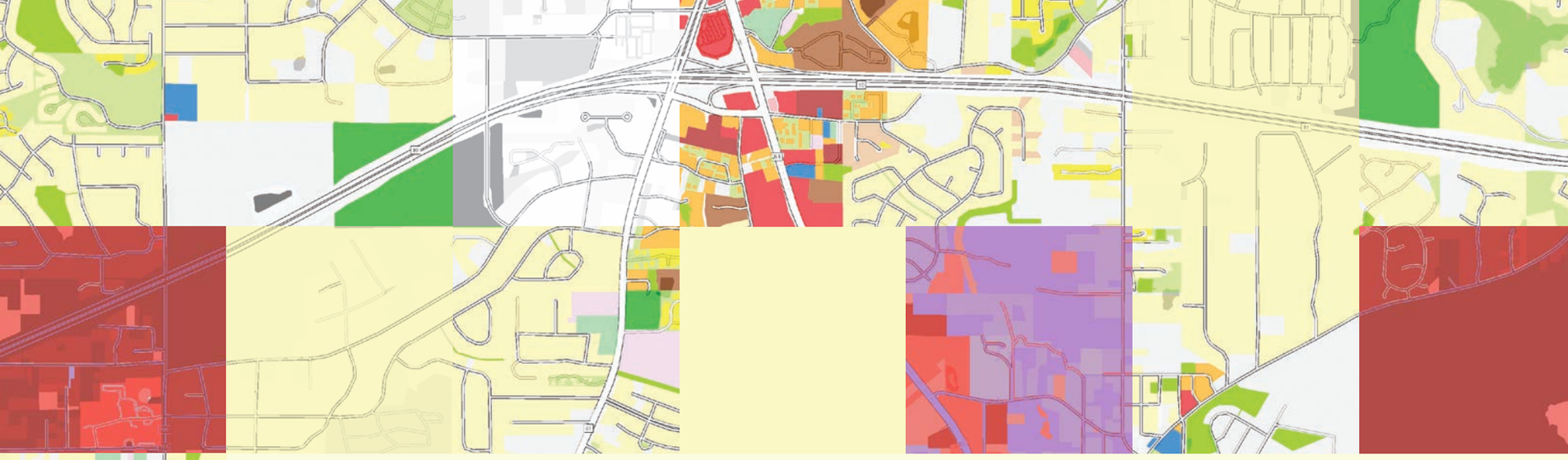
Planners who submit data to OPM also receive a map-based carbon assessment of their plan that reveals how much carbon dioxide it emits or sequesters. The hope is that their communities will use this to build accountability into their land-use plans and make adjustments that could have positive long-term effects.

But OPM's multidisciplinary team has more ambitious goals. One is to eventually unite different types of data from various sources: transportation and open space plans from cities and counties, conservation plans from other government agencies, and land management plans from businesses and nongovernmental agencies. With this data, users could map and evaluate how to improve connectivity between places and develop resilient green infrastructure. This would make genuine progress toward cutting carbon emissions to levels that keep global temperature increases in check.

"The idea is that we can actually spatialize climate actions," said Guoping Huang, an associate professor of spatial sciences at the University of Southern California, who helped develop one of the prototypes and serves as an advisory collaborator on the project. "That is the beauty of having a shared depository for all sorts of maps."







Bringing Planning Data into the Light

OPM launched in July 2026, and its immediate goal is straightforward: Get planners from all over the world to submit their planning data.

"Some cities with advanced GIS departments might have published, map-ready planning data, but currently, a lot of it is confined to 300-page planning documents—PDFs—and it doesn't see the light of day," said Perkl.

In much of the planning community, it is customary to share plans publicly once they're complete. But having the data all in one place, in a standardized format, opens an exciting new world.

Daniel Nairn, director of planning at the City of Bismarck, North Dakota, was not only open to submitting Bismarck's planning data—he was also energized by having one place to share and discover data like this.

"We can always go online and fish around on a website to find others' plans—we do that already . . . to make sure we're staying in line and following industry standards," he said. "But I think having one place with a standardized format will be helpful to draw those comparisons. If OPM grows to where we can actually see the region and how the cities and other communities that are directly adjacent to us are planning, it could become a regional planning tool."

That's what Tom Vo, the principal transportation planner at the Santa Barbara County Association of Governments (SBCAG) in California, hopes OPM becomes.

"OPM has the potential to support our data-driven and sustainable regional planning," said Vo, who was involved in testing OPM.

He explained that the local jurisdictions SBCAG works with maintain their planning data using different formats and update schedules.

"OPM provides a framework that can help organize and standardize those datasets, making regional analysis more efficient," he said. "By organizing planning information in a consistent format, OPM can improve our ability to understand regional growth patterns and evaluate how adopted local plans contribute to our regional transportation and sustainability objectives."

AI Streamlines the Submission Process

Submitting data to OPM isn't difficult, according to those who have done it.

"I uploaded Bismarck's comprehensive plan as a large PDF document and then tied in the feature service for our future land-use plan," said Darrel Nucech, a GIS developer for the City of Bismarck. "The portal actually had an AI assistant to interpret everything and then compile it all for us. So it wasn't much effort on my end at all."

To submit data to OPM, users must first register with the Esri Community Maps Program at links.esri.com/community-maps. There, the system allows organizations to upload their digital land-use plans. The system, which has been designed to accept multiple formats, automatically normalizes land-use plan classifications, different scales, and map projections before integrating the data into a continuous map layer and web map.

"We had more detail than what the OPM map layers incorporate—for example, we note 'neighborhood mixed use' areas, but OPM just groups that into 'residential,'" said Nucech. "It just broke out that classification, and I reviewed it and said, 'Yeah, that's fine, that would be residential.'"

Submitted plans feed into a hands-off processing pipeline where an extract, transform, and load (ETL) system completes the remaining steps of the workflow. From there, three primary data products are produced:

- **The original plan**—The plan's source data in its original format, projected into a common coordinate system for easier use.
- **The OpenPlanMap plan**—The transformed version of the plan, mapped in OPM's land-use language.
- **The global plan**—A curated collection of qualifying plans appended into a single view of what's happening around the world.

The data then appears in ArcGIS Living Atlas as authoritative data, on OPM's open data site (links.esri.com/OPMOpenDataSite), and in the OpenPlanMap Explorer app (links.esri.com/OPMExplorerApp). The app enables users to assess their plan's performance and see what others are doing in neighboring communities or similar bioclimates. This is also where a plan's carbon assessment report appears.

"Looking at carbon assessments is not something that's typically part of a planning agency's job," noted Huang. "Now, it's nicely generated on the web, as a map in ArcGIS Online, and will allow planners to understand the importance of their work and their shared responsibility for the future."

Perkl hopes that OPM's plan assessment can eventually expand beyond carbon emissions and include a myriad of other environmental, economic, and social metrics that are important to communities.

Mapping the Future, One Land-Use Plan at a Time

The technology is there. The challenge now is to get the planning community to submit their plans. This includes state, local, and tribal governments; regional planning organizations; universities and nonprofits; and anyone else tasked with planning for their communities.

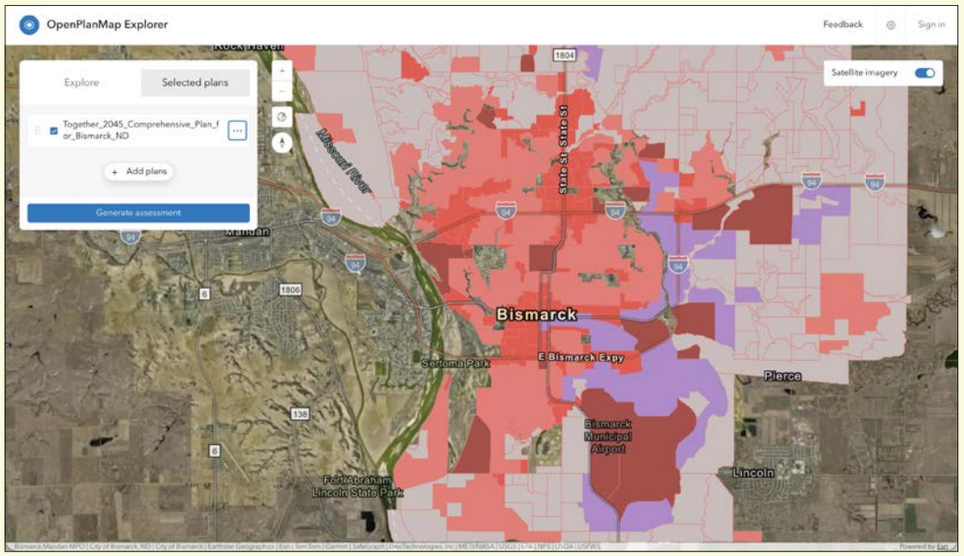
"I've talked to some colleagues in Europe, and they're planning to submit some data. I have also been talking to my colleagues in Asia who are working on a plan with a university, so maybe they will, too," said Huang. "We want submissions from every municipality all over the world, where it's possible . . . and I hope that, eventually, each city will have their own formal, spatialized climate action plan uploaded on OPM."

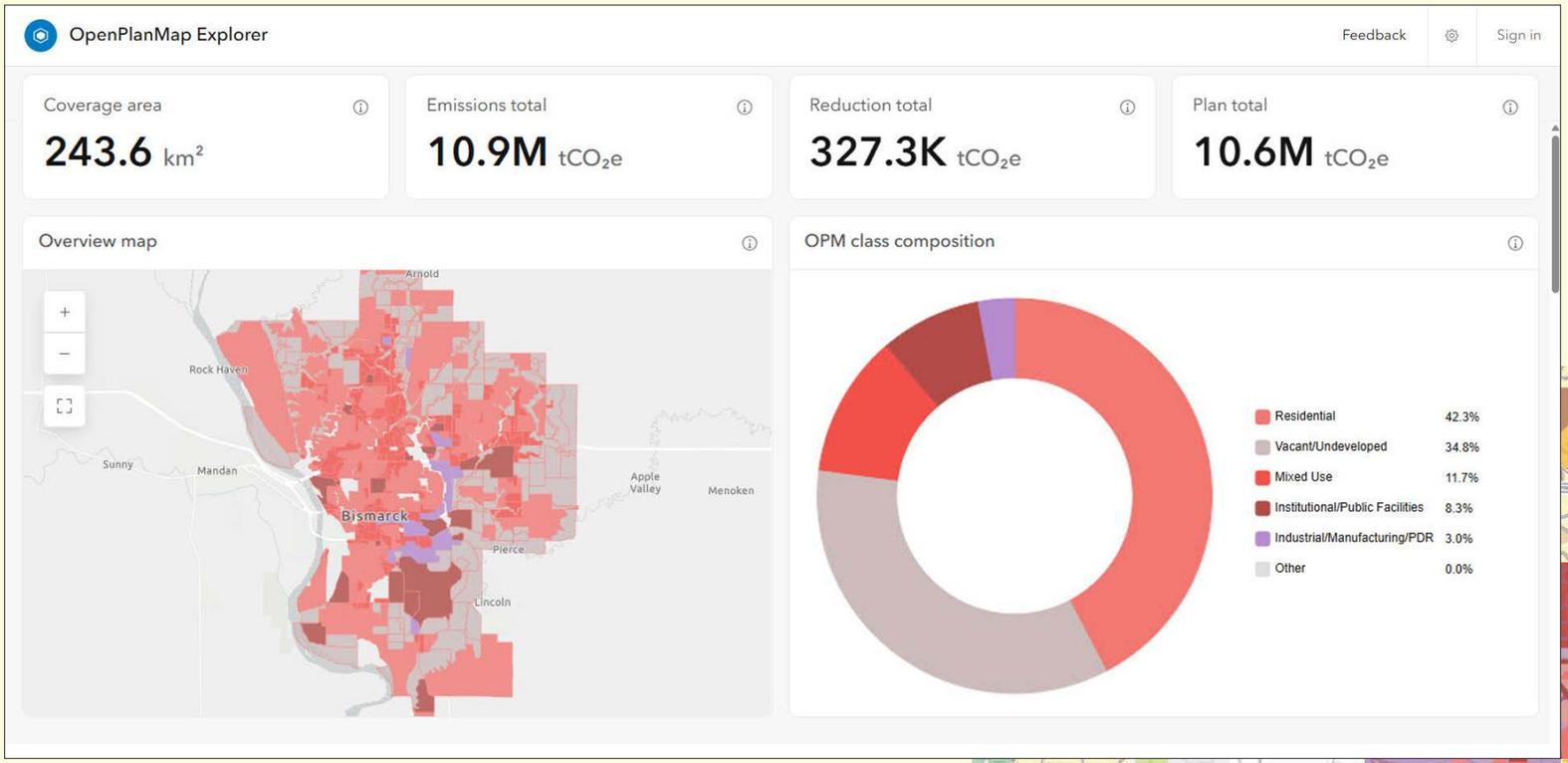
As Huang pointed out, most of the GIS data we have is either about the past or the present.

"People are so concerned about the future right now, but we don't really have a lot of data about it," he said. "This is a way to enrich spatial data on the web so people are able to see a future." AN

Top:
The City of Bismarck, North Dakota, was the first to submit data to OPM, and its comprehensive land-use plan is now available in the OpenPlanMap Explorer app.

Bottom:
Submitters receive a carbon assessment of their plan. Once more communities upload their plans to OPM, Bismarck's assessment can be put into context of neighboring communities and similar bioclimates.





A LEADER IN GIS EDUCATION

UNIVERSITY OF REDLANDS



4 ONLINE MASTERS

Master of Science in GIS*

Master of GIS*

Executive Master of GIS

MBA in GIS

5 ONLINE CERTIFICATES

Graduate Certificate in GIS

GIS for Public Safety**

Geospatial Data Science

GIS for Business

GIS Project Management

In-Person available
***Scholarships available for Jan 2027*

LEARN MORE

www.redlands.edu/GISprograms

UNIVERSITY OF Redlands

TOP 10 BEST VALUE IN THE WEST

U.S. News and World Report 2026

Located in Redlands, California—close neighbors and partners with geospatial leader, Esri—we offer academic programs that enable access to Esri technology, training, people, events, and internships, including classes taught by Esri employees.

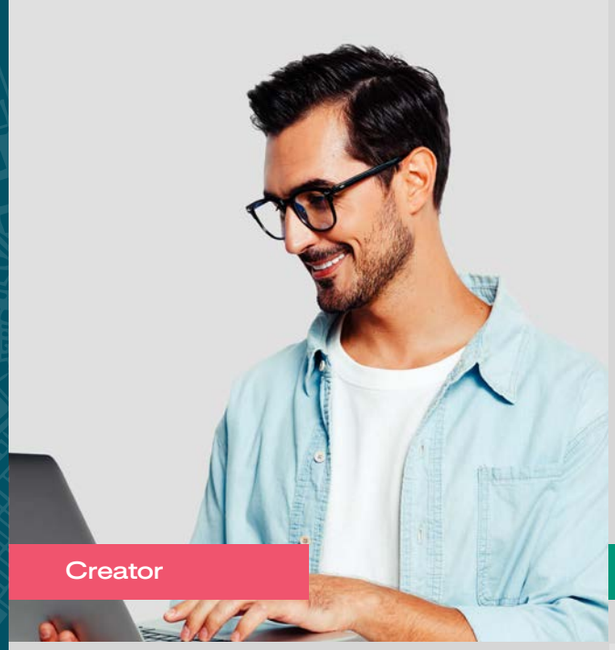
How Do I Choose the Right User Type?

ArcGIS apps and capabilities are primarily available through role-based user types, annual licenses that determine what privileges each member of an organization has (what they can or cannot do) and what apps they can access.

The six distinct user types align with various workflows and offer progressive privileges. But it's not always obvious which user type is best for which team member.

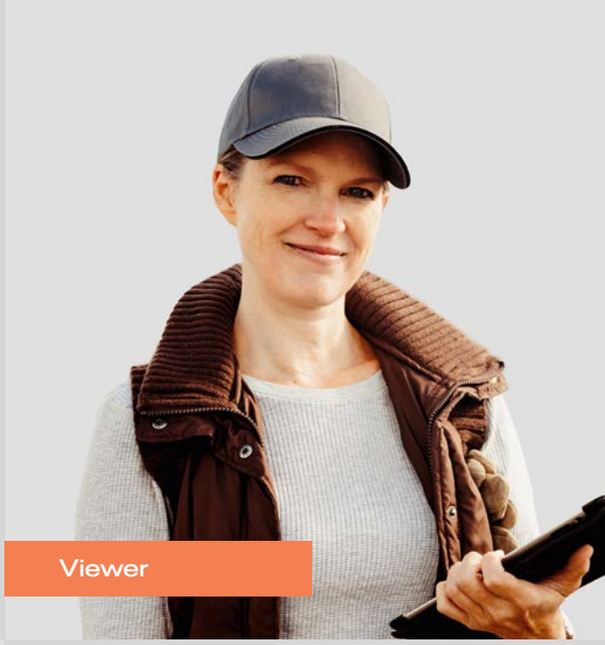
Choosing the most appropriate user type helps everyone—from mobile inspectors to executives—access the tools they need to contribute to the organization's goals.

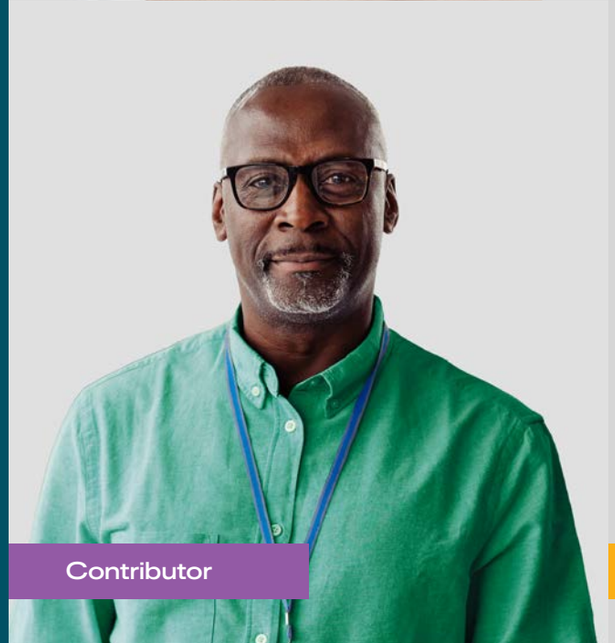
So how do you ensure each team member has the right user type? Consider this scenario-based approach: Picture a midsize city with a few common organizational roles. With the right user type for each role, city staff can function together as one cohesive geospatial organization.

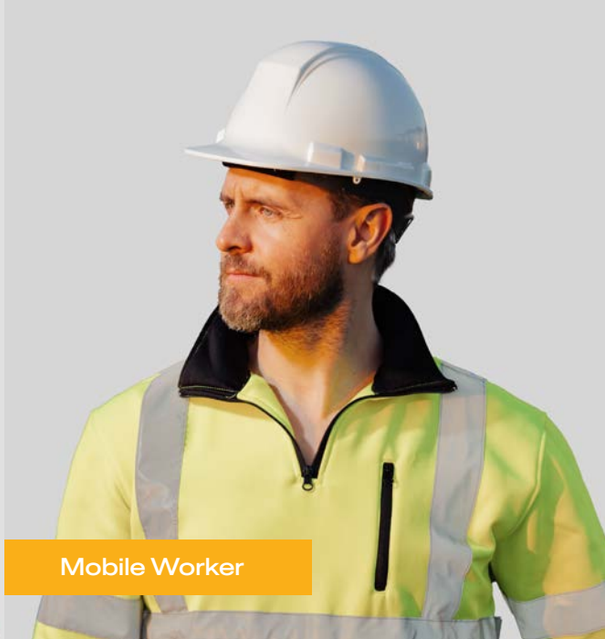












MAPMAKER

Scenario: A GIS analyst in the city planning department is creating a series of web maps and an ArcGIS StoryMaps narrative for a public hearing on a proposed zoning change. The analyst needs to combine data from various sources, such as parcel records, environmental overlays, and demographic data. They'll perform some basic analysis, such as creating buffers and selecting features, and then design a compelling, interactive map presentation for nontechnical stakeholders.

Recommended User Type: Creator
The essential building block for any ArcGIS implementation, this user type provides the foundational tools needed to create, manage, and share spatial content. Map Viewer access allows the analyst to build web maps, configure pop-ups, and set symbology. This user type also includes ArcGIS Pro Basic—perfect for data preparation and basic analysis tasks. With a Creator user type, the analyst can publish data as web layers and share maps and apps across the organization and with the public. (Note that any GIS administrator needs at least one Creator user type to manage users, content, and permissions.)

DATA MANAGER

Scenario: A civil engineer at the city airport manages authoritative computer-aided design (CAD) and GIS data for airfield assets such as runways, taxiways, and lighting systems. They ensure that the data is accurate, up to date, and integrated into the enterprise geodatabase, often working with data in different formats and performing advanced editing tasks such as maintaining topology and managing multiuser editing sessions.

Recommended User Type: Professional
This user type is designed for GIS professionals and data managers who require advanced data editing and management capabilities. It has everything in the Creator user type plus ArcGIS Pro Standard, including the tools necessary for managing complex datasets—such as ArcGIS Utility Network for modeling connected systems or ArcGIS Parcel Fabric for managing land records. This user type provides a robust toolset needed to maintain the integrity of critical infrastructure data and manage a versioned multiuser geodatabase.

GIS PROFESSIONAL

Scenario: A senior GIS analyst in the county's environmental protection department is conducting a habitat suitability study for an endangered species. This requires the analyst to work with a wide range of raster and vector data, perform complex geoprocessing tasks, and build predictive models using advanced statistical tools. The final output will be a series of high-quality cartographic products for a scientific journal and an interactive web app for internal planning.

Recommended User Type: Professional Plus
This user type is the ultimate package for the advanced GIS analyst, cartographer, or data scientist. It includes ArcGIS Pro Advanced and a comprehensive suite of extensions such as ArcGIS 3D Analyst, ArcGIS Geostatistical Analyst, and ArcGIS Spatial Analyst. It's best for sophisticated analysis, big data processing, and production-ready cartography. The analyst can leverage advanced modeling tools, automate complex workflows, and create visually attractive maps.

EXECUTIVE

Scenario: The director of emergency services needs to monitor storm response activities from the emergency operations center. The director doesn't create data or build maps, but needs a constant, high-level view of incoming data from various sources. Their primary need is to access a series of dashboards that display real-time field crew locations, incident reports, and resource allocation.

Recommended User Type: Viewer
A Viewer user type provides secure, view-only access to maps, dashboards, and apps created by others. It allows decision-makers to explore data, monitor key performance indicators, and achieve situational awareness without creating or analyzing data. The Viewer user type, which includes access to a wide range of apps such as ArcGIS Dashboards, ArcGIS Experience Builder, and Map Viewer, is the most cost-effective option for users whose primary interaction with GIS is consuming information.

SUPERVISOR

Scenario: A supervisor in the parks department is responsible for overseeing the maintenance of park assets. The supervisor doesn't perform complex GIS analysis but needs to mark up projects in ArcGIS GeoBIM, an Autodesk integration. They also sometimes add notes or photos to asset locations to provide context for the team.

Recommended User Type: Contributor
The Contributor user type includes all the capabilities of Viewer but adds the crucial ability to edit and contribute to existing data. This user type is perfect for stakeholders and supervisors who are part of a larger GIS workflow and need to perform simple data edits, quality checks, and updates via web or mobile apps. The supervisor can view ArcGIS Field Maps and edit ArcGIS Survey123 forms to interact with and enrich the organization's data, helping to ensure its accuracy and timeliness.

MOBILE OPERATOR

Scenario: A water utility crew member receives work assignments and logs updates from their truck. They also need to collect data on-site, sometimes in areas with no service.

Recommended User Type: Mobile Worker
Designed for field operations, the Mobile Worker user type allows ArcGIS users to view, collect, and edit data using ArcGIS field apps. They can also share their location and record location tracks, making this user type ideal for field technicians.

A COLLABORATIVE APPROACH

For the most effective licensing strategy, many GIS administrators adopt a collaborative, workflow-driven approach. This involves engaging directly with various departments to build a comprehensive understanding of their day-to-day needs before assigning user types.

GIS administrators or managers should facilitate discussions about work, not software. Teams from various departments can outline their specific tasks and challenges. For example, mobile crews might detail how they document asset maintenance, while planners describe their process for reviewing development proposals. Understanding these workflows will point GIS administrators to the right user type.

For more details on the capabilities included with each user type, visit links.esri.com/usertypes. AN

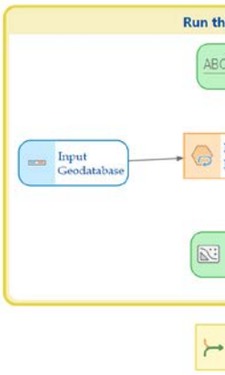
10 TOOLS FOR GEOSPATIAL AUTOMATION

By Mike Long and Stephanie Long, Spatialty

Many GIS departments are small teams expected to maintain data, respond to requests, build maps and dashboards, and support field crews. Because manual processes compete for limited hours in the day, GIS teams looking for breathing room often automate workflows. A well-automated workflow reduces errors, improves consistency, and frees up staff to focus on work that requires their expertise.

ArcGIS technology and its surrounding ecosystem offer a robust automation toolkit, even for those with no programming experience. Much of it is already available to organizations with an existing license.

Here are 10 of those tools—from no-code visual builders to real-time streaming platforms, including the type of automation each enables. If you're part of a GIS team looking to do more with what you already have, these tools are for you.



1. ModelBuilder

ModelBuilder has been a standard tool in ArcGIS Pro for over a decade and is often where geospatial professionals begin their automation journey. ModelBuilder is entirely visual and requires no coding knowledge, making it one of the most accessible entry points into automation. It allows geoprocessing tools to be dropped onto a canvas and chained together in a repeatable workflow. Once built, models can be scheduled, exported to Python, or published to ArcGIS Online or ArcGIS Enterprise.

EXECUTION TYPE:
Manual, Scheduled

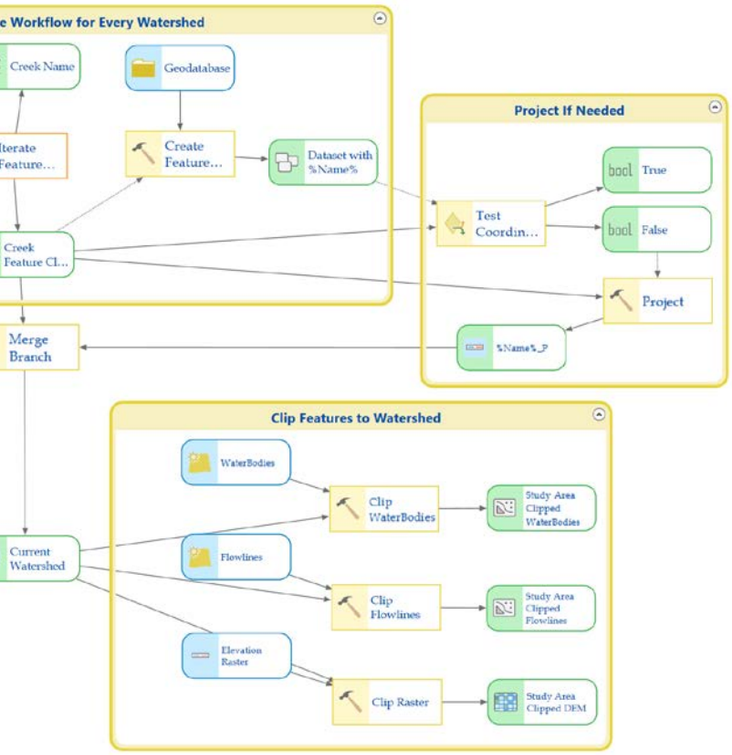
2. ArcGIS Data Pipelines

ArcGIS Data Pipelines is a web-based extract, transform, and load (ETL) tool designed to assist with processing data in ArcGIS Online and ArcGIS Enterprise. Like ModelBuilder, it offers a drag-and-drop interface, making it accessible for users newer to geospatial ETL. It allows data to be loaded from feature layers, cloud databases (Snowflake, BigQuery, Databricks), cloud storage (Amazon S3, Azure Storage), files, and URLs.

Data can be transformed and cleaned using common ETL operations such as field mapping, field calculation, and spatial functions like buffer and intersect. Once it is loaded into your organization, it is ready for consumption.

Creating workflows with ArcGIS Data Pipelines requires a Creator or Professional user type, or privileges available through a Publisher, Facilitator, Administrator, or similar custom role.

EXECUTION TYPE:
Manual, Scheduled



This ArcGIS Pro ModelBuilder workflow iterates on every watershed in a study area to create correctly projected and smartly clipped flowlines and water bodies, plus a digital elevation model.

3. Tasks

Tasks work within ArcGIS Pro and are designed to guide the user through a set of predetermined steps needed to complete a workflow. Tasks provide automation while keeping the human in the loop.

Geoprocessing steps can be configured as "click and run," reducing the chance of steps being skipped or executed out of order. That guided consistency is especially valuable when handing off a process to a colleague or onboarding someone new, ensuring the workflow runs the same way every time, regardless of who runs it.

The dynamic and event-driven aspects of tasks work differently than other automation tools. A task must be started manually, but once underway, individual steps can advance dynamically or respond to events occurring in the map, such as a selected feature or an edit, before continuing to the next step.

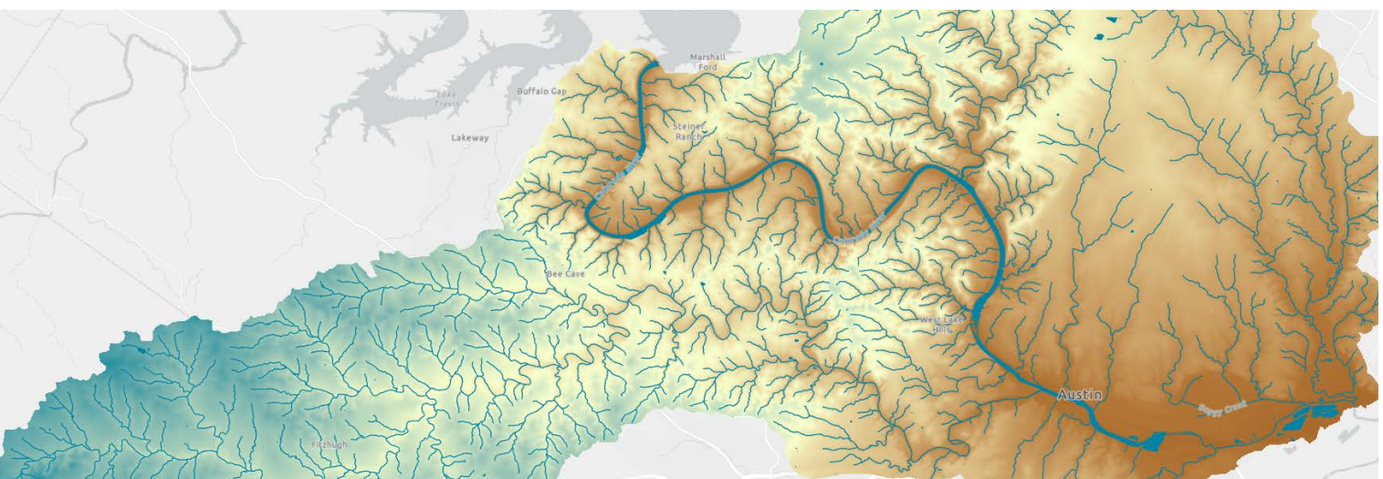
EXECUTION TYPE:
Manual, Dynamic, Event-Driven

4. Power Automate

ArcGIS includes connectors for Microsoft Power Automate that allow users to automate data processing based on different events. For example, when a feature layer is edited, a webhook can trigger Power Automate to send a notification email, update a record in another system, or calculate a field value. Workflows can also be triggered manually, making Power Automate a flexible option for both on-demand and event-driven automation.

For government teams, among others, Power Automate is worth a closer look for one practical reason: Many of these organizations already run Microsoft 365, which means Power Automate may already be available at no additional cost. That lowers the barrier to entry compared to other tools on this list and makes it a natural first step for teams looking to bridge their GIS workflows with other business systems like SharePoint, Teams, or Outlook.

EXECUTION TYPE:
Manual, Event-Driven



Automation isn't a one-size-fits-all solution. The right tool depends on when and how a process needs to run. By categorizing workflows into four execution types, you can match your limited time to the most efficient technology.

- **Manual**—Tools and scripts process data on demand, often requiring a manual update before execution.
- **Dynamic**—Results are calculated with an action such as panning the map or clicking a pop-up.
- **Scheduled**—Workflows run at regular intervals (hourly, nightly), processing and delivering results on a set timetable.
- **Event-driven**—Workflows run in response to a specific trigger (email, webhook, feature edit).

5. Artificial Intelligence

AI tools are now integrated into ArcGIS in several ways. For some time, GIS professionals have been able to use AI tools within the Python framework to analyze data—extracting building footprints from aerial imagery or finding power lines from lidar data. AI tools have also been integrated directly into ArcGIS Online and ArcGIS Enterprise to assist with item descriptions, titles, summaries, and tags.

AI capabilities within ArcGIS are rapidly evolving. Machine learning and deep learning workflows are available in ArcGIS Pro and ArcGIS Online through tools like the ArcGIS Image Analyst extension and the arcgis.learn module in ArcGIS API for Python. AI assistant features also help users find content, generate code, and navigate the platform. For small teams, the most practical entry points right now are the metadata and content generation tools already built into ArcGIS Online. These are low barrier, immediately useful, and a good way to get familiar with how AI is being woven into the platform before exploring deeper capabilities.

EXECUTION TYPE:
Manual, Event-Driven

6. Query Layers (SQL)

If you are using ArcGIS Pro or ArcGIS Server, you can build query layers and publish them in your maps. Query layers are created using standard SQL and are designed to work directly with your relational database management system (SQL Server, PostgreSQL, Oracle) or cloud data warehouses (Snowflake, BigQuery, Redshift).

Note that your data does not have to be in a geodatabase; it can be in any supported database, including other business systems like a permitting system, asset management platform, or financial database. Because the data lives directly in the source system and the map simply reflects it, there is no ETL step or scheduled refresh needed, making query layers one of the lowest maintenance automations available.

EXECUTION TYPE:
Dynamic

7. ArcGIS Arcade

ArcGIS Arcade is a scripting language, usable across multiple ArcGIS products, that allows automation to be executed when and where it is needed. While many GIS professionals first encounter Arcade through labeling and symbology, its capabilities run much deeper.

Arcade powers attribute rules that automatically calculate or validate field values when data is edited, execute calculations that guide field crews through data collection in ArcGIS Field Maps, and generate pop-up expressions that dynamically format and display information in maps and dashboards. None of this requires a full script or scheduled job. This makes Arcade one of the most flexible tools in the stack, capable of manual, dynamic, and event-driven automation.

EXECUTION TYPE:
Manual, Dynamic, Event-Driven

8. Python

When working in ArcGIS, you have access to two Python libraries that can automate data workflows: ArcPy and ArcGIS API for Python. Each is aimed at slightly different scenarios. ArcPy is designed for geoprocessing and analysis, while ArcGIS API for Python works with your web GIS. Both allow data loading and analysis to be automated in a scriptable fashion. Because these are standard Python libraries, you also have access to the hundreds of modules and libraries built into the base version of Python.

EXECUTION TYPE:
Manual, Scheduled

9. ArcGIS Velocity

ArcGIS Velocity enables real-time and near real-time processing of data sent to and received from vehicles, Internet of Things (IoT) sensors, and other streaming sources. It allows for common data processing such as field mapping and calculations, along with basic geospatial functions like intersect, proximity analysis, and pattern detection. More advanced calculations can be performed using Arcade, making ArcGIS Velocity a natural companion to those scripting capabilities. It runs as an add-on capability in ArcGIS Online and is built into ArcGIS Enterprise.

EXECUTION TYPE:
Dynamic, Scheduled, Event-Driven

10. Feature Manipulation Engine/ArcGIS Data Interoperability

Esri partner Safe Software's Feature Manipulation Engine (FME) is the Swiss Army Knife of geospatial automation. It can handle over 450 data formats, transforming them into the data you need and writing it directly into your enterprise geodatabase or hosted feature layer. It can also be used for spatial analysis and real-time and near real-time data processing. From sending and receiving emails to webhooks and event messages, FME can deal with everything you throw at it, making it the most versatile geospatial automation tool on this list.

Because FME is a third-party product, it requires a separate license outside the ArcGIS platform. However, if your team has access to it, FME is in a category of its own. Every automation type covered in this article (manual, dynamic, scheduled, and event-driven) is achievable within a single FME workflow, consolidating what might otherwise require multiple tools, languages, and skill sets. For a small team already stretched thin, that kind of versatility has real operational value.

If you can't get a full FME license, Esri offers the ArcGIS Data Interoperability extension for ArcGIS Pro and ArcGIS Enterprise. This extension is built on the FME engine but offers a slimmed-down version of its capabilities.

EXECUTION TYPE:
Manual, Dynamic, Scheduled, Event-Driven

Not every task is worth automating. If a manual process takes five minutes a week, the time spent building and maintaining an automated solution may never pay off. Automation can feel overwhelming when looking at the landscape of what's available, but you don't need to master every tool on this list. Just identify the right tool for the right problem.

A practical place to start is with the automation type that addresses your biggest pain point. If your maps always show stale data, you might be able to solve that today with a SQL query. If you repeat the same geoprocessing workflow every Monday morning, ModelBuilder or a scheduled Python script can take that off your plate. If your organization is running Microsoft 365, Power Automate may already be sitting there, waiting to be put to work. Meaningful automation is within reach, regardless of team size or technical background. The tools are there. The question is simply where to start. AN

About the Authors

Mike Long and Stephanie Long are the cofounders of Spatialty, a GIS consulting firm and Esri partner. Mike Long holds a master's degree in GIS and is certified as an ArcGIS Enterprise Administration Professional, FME Professional, and GISP. Stephanie Long holds a master's degree in GIS and is certified as a GISP.

TOOL	MANUAL	DYNAMIC	SCHEDULED	EVENT-DRIVEN
01 – ModelBuilder	●		●	
02 – Data Pipelines	●		●	
03 – Tasks	●	●		●
04 – Power Automate	●			●
05 – Artificial Intelligence	●			●
06 – Query Layers (SQL)		●		
07 – Arcade	●	●		●
08 – Python	●		●	
09 – Velocity		●	●	●
10 – FME/Data Interoperability	●	●	●	●

From Conflict to Coexistence

Mapping Wildlife Encounters Across Borders

By Craig Beech, cbio



Human-wildlife conflict is one of the most persistent challenges facing conservationists across southern Africa. In places where people, livestock, and wildlife coexist, incidents involving crop damage, livestock losses, property destruction, and threats to human safety undermine conservation outcomes and local livelihoods.

Nowhere is this challenge more evident than in the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA), a vast landscape spanning Angola, Botswana, Namibia, Zambia, and Zimbabwe. Here, conservation entities operate under diverse governance structures, land-use systems, and reporting requirements. Many organizations collect human-wildlife conflict data, but differences in survey design, terminology, spatial resolution, and reporting formats have historically made it difficult to compare incidents or aggregate data at a regional scale. This fragmentation limits people's ability to coordinate responses informed by shared evidence.

To address this, Ecoexist Trust in Botswana and Connected Conservation in Zimbabwe—both registered Esri Nonprofit Program organizations—collaborated with technology nonprofit cbio to adopt ArcGIS Survey123, ArcGIS Online, and ArcGIS Dashboards to standardize and scale data collection and sharing.

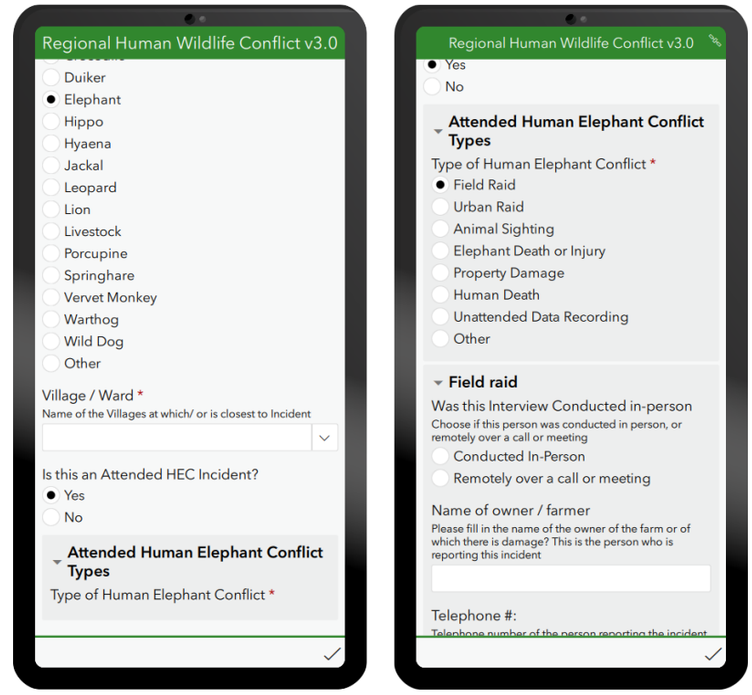
Since this work began in 2023, both organizations have digitally recorded hundreds of detailed human-wildlife conflicts across Botswana and Zimbabwe. Transitioning from paper-based reporting to digital records has reduced the time it takes to collect and clean data—from days or even weeks to a few minutes. This allows teams to spend more time focusing on field operations, community engagement, and mitigation efforts.

"Having consistent and reliable data is fundamental to understanding whether our interventions are actually making a difference," said Graham McCulloch, director of Ecoexist. "Survey123 allows us to bring field data together in near real time, helping us track trends, evaluate our progress against organizational objectives, and communicate our impact much more clearly to communities, governments, partners, and donors."



Where humans and wildlife coexist, crops must be protected from damage by animals such as elephants.

A joint steering committee develops the survey questions to ensure that they reflect the needs of both organizations.



A Shared Problem, a Flexible Solution

Both Ecoexist and Connected Conservation manage long-term human-wildlife conflict monitoring programs that rely on field teams operating in remote environments. These teams require data collection tools that function offline, capture accurate spatial information, and are simple enough that rangers and community liaison officers can use them consistently.

Working together, teams from both nonprofits designed a core survey schema with a shared set of required fields, including incident type, date and time, location, species involved, and severity. Each organization was then able to extend the form with additional questions based on their local contexts. For instance, stakeholders in one location may only need to record the primary crop type affected during an incident, while in a different location, it may be necessary to record all crop types that were damaged.

This approach ensures that information about human-wildlife conflict remains consistent across borders while accommodating differences in national reporting requirements, land tenure systems, and mitigation strategies. The surveys also align with metrics used in government data collection to promote consistency across datasets.

Cloud-Based Collaboration with ArcGIS Online

Once data is gathered in the field, records are synchronized as feature services in ArcGIS Online, where they are immediately available for visualization and analysis. To support collaboration, layers from each nonprofit's ArcGIS Online organization are shared within a dedicated group, enabling secure access to data across institutional boundaries.

Ecoexist and Connected Conservation each maintain their own dashboards, made with ArcGIS Dashboards, tailored to their specific audiences. Visualizations may differ, but the underlying data structure remains aligned thanks to the shared Survey123 schema—ensuring that regional analyses are conducted without extensive post-processing. The dashboards, which have reporting workflows for donors and government partners, bolster operational decision-making and community engagement.

"The dashboards have helped close the gap between collecting data in the field and actually using it, allowing us to visualize emerging [human-elephant conflict] patterns and communicate results without repeatedly having to manually collate and analyze spreadsheets," said McCulloch. "This makes reporting considerably faster and, importantly, gives our teams and partners a much clearer, near real-time picture of where conflict is occurring and whether our interventions are contributing to measurable change."

Over time, the project team intends to develop a set of standardized regional dashboards on human-wildlife conflict that draw from the shared data pool. These dashboards will serve multiple audiences, including field managers, policymakers, and transboundary coordination bodies, providing timely insight into conflict patterns and response priorities across the KAZA TFCA.

The shared system also supports broader transfrontier conservation efforts. By collecting and reporting incidents using the same set of standards, partner organizations and government agencies can better understand how human-wildlife conflict happens and is dealt with across national boundaries. This strengthens coordination between countries and provides robust evidence for regional conservation planning.

Managing Scale Through Standards and Version Control

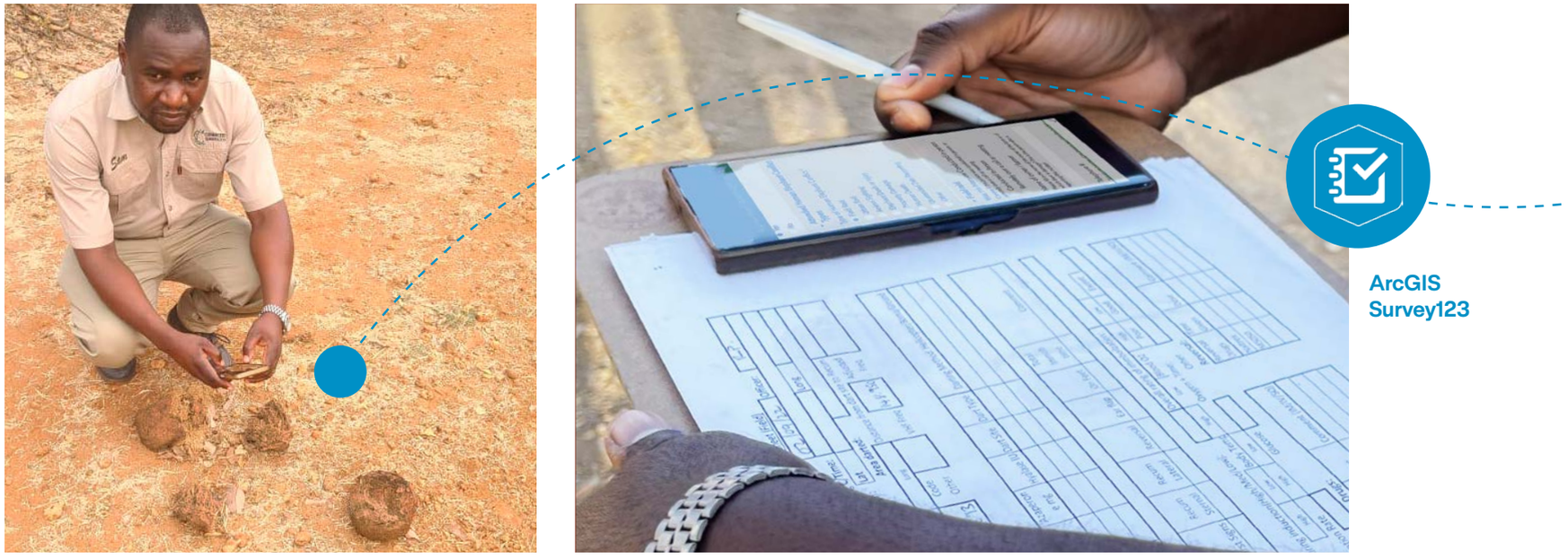
Work on the shared reporting standards has evolved over the last three years—and continues to do so.

To guide the shared-reporting process, Ecoexist and Connected Conservation established a joint steering committee. Representatives from both organizations meet regularly to review feedback from the field, refine survey questions, and ensure the framework reflects operational realities in both countries. These discussions have been instrumental in developing a practical tool that reflects best practices from both organizations.

As interest in the human-wildlife conflict framework grows, additional stakeholders within the KAZA TFCA have expressed interest in adopting this GIS-based, digital approach to data collection and reporting. Scaling the system requires technical consistency and clear governance to ensure that any changes to the schema, field definitions, and reporting standards are made collectively, managed transparently, and implemented by everyone.

The joint steering committee provides a forum to review proposed changes and assess their effects on existing workflows. The cbio team supports this governance structure by maintaining version control of the Survey123 XLSForm and coordinating updates across organizations. The team also documents revisions, considers backward compatibility, and helps minimize disruptions to field operations.

Field teams from both organizations moved from recording data on paper to using Survey123 on their mobile devices.



Measurable Benefits That Extend Beyond the Field

Since implementing ArcGIS technology, Ecoexist and Connected Conservation have experienced several tangible benefits. Field teams now record incidents digitally using mobile devices, which reduces paperwork and eliminates time-consuming data entry tasks. And the hundreds of incidents that have already been captured by the system contribute to a growing dataset that supports analysis and adaptive management.

Most importantly, this approach strengthens the evidence needed to develop human-wildlife coexistence strategies. By improving the quality, consistency, and accessibility of human-wildlife conflict data, conservationists are better equipped to identify patterns, evaluate interventions, and engage constructively with affected communities.

"Having accessible data from a wide landscape gives our organization and the relevant authorities . . . the ability to lobby government or NGOs to support farmer livelihoods," said Loki Osborn, executive director of Connected Conservation. "We have learnt that collaboration equates with buy-in from the politicians and decision-makers."

Looking Ahead

As the KAZA TFCA continues to prioritize coordinated conservation across national boundaries, the importance of shared data standards becomes increasingly clear. And it goes beyond getting everyone to use the same technology. Partner organizations must be consistent in how they gather and report human-wildlife conflict data.

Esri technology is well-suited to this work because it supports offline data collection, cloud-based sharing, scalable spatial analysis, and real-time reporting. But the framework is adaptable and open to other data-collection or management tools operating within the KAZA TFCA landscape—provided they align with the agreed-upon data schema and reporting standards.

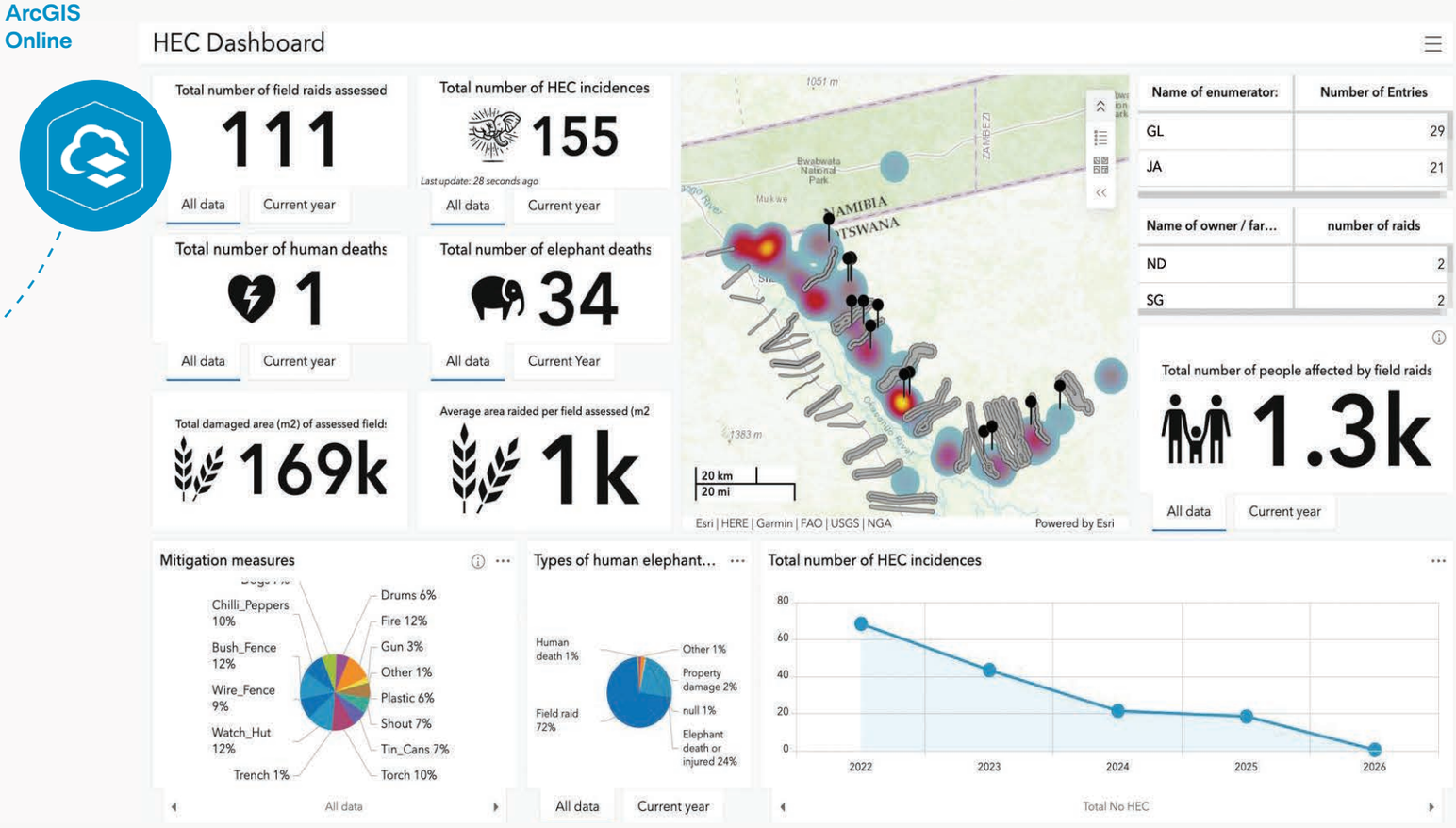
This standards-first approach allows innovation to continue at the organizational level while preserving the integrity of shared datasets. As additional conservation partners adopt and contribute to the framework, the initiative has the potential to become a regional model for human-wildlife conflict monitoring and reporting across the KAZA TFCA. **AN**

About the Author

Craig Beech is a conservation technologist who founded and co-owns ConservAxion Trust, operating as cbio. He has more than 25 years of experience applying GIS and spatial analysis to wildlife conservation across Africa.

This dashboard shows human-elephant conflicts in Botswana, recorded by Ecoexist Trust.

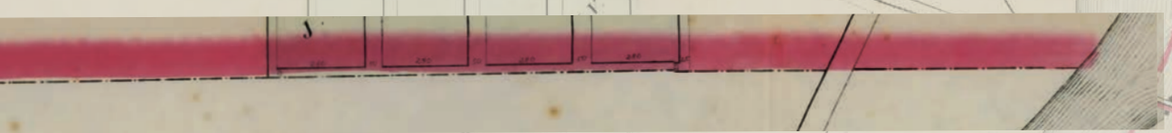
ArcGIS Online



Your Work

GIS Breathes Life into the Historical Census

By Douglas Miskowiak, Brad Casselberry, and Jarita Bavido, University of Wisconsin-Stevens Point





Historical census records are among the richest sources of information about communities, families, and patterns of human settlement. In the United States, decennial census records are released to the public by the National Archives and Records Administration in their entirety after 72 years. But the value they contain is often largely inaccessible, trapped in handwritten tables and stagnant archives.

At the University of Wisconsin–Stevens Point (UWSP), a collaborative effort has transformed these static records into dynamic, interactive geographic data.

The project's roots stretch back to the 1980s. Using historical census data from Stevens Point, Wisconsin, Japanese anthropologists Toshiyuki Sano and Mariko Fujita examined ethnicity, cultural identity, and perceptions of "authentic" American life in the Midwest. Their work, including compiled 1850–1930 census records, was later donated to the UWSP Archives.

Now, Archives staff have partnered with the UWSP GIS Center to transform these static records into geospatial data capable of being analyzed, visualized, and presented as a story of immigration and settlement.

By integrating archival research with tools such as ArcGIS Pro, ArcGIS Online, ArcGIS Experience Builder, and ArcGIS StoryMaps, UWSP researchers have been able to get a more comprehensive look at the records of the past, revealing new patterns and insights that breathe life into dormant geographical stories.

During the geocoding process, some geographic data points had to be estimated using historical maps—like this one of Stevens Point in 1895—or discarded.

Drawing Stories from Records

The task of bringing static archival records to life is no small feat. Between manually processing thousands of individual records, sifting through obsolete street names and addresses, and parsing out inconsistent spelling of surnames, the UWSP team had its work cut out.

So the team followed a structured, five-step process to turn census information into standardized geographical data. This included transcription, geocoding, geospatial analysis, cartographic visualization, and storytelling.

Transcription

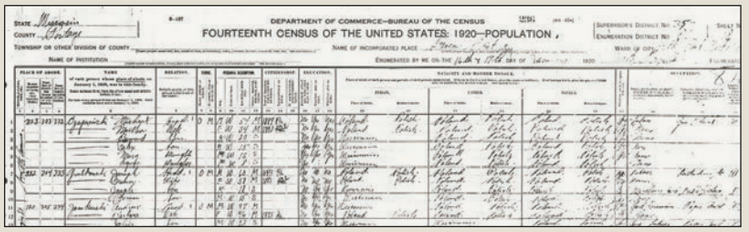
The first step was locating, verifying, and digitizing the historical census records.

US census data is released to the public with original street addresses. While some records were available through public genealogy platforms, the work often required manually transcribing an image or microfilm of original data into a digital table.

Other transcription complications arose. In some records, for instance, researchers noted a mysterious data artifact: respondents with Polish ancestry noted multiple places of birth. The reason proved elusive, until a look at the historical map revealed that Poland as a country, which had been there when those individuals were born, no longer existed during the decennial census when the question was posed.

To improve accuracy, the team cross-referenced census entries with city directories, newspapers, and obituaries, ensuring names were correctly interpreted and locations were set to present-day street addresses.

Before



After

Last Name	First Name	Relation	Street	Old House Number	New House Number	Dwelling Number	Place of Birth	Father's Place of Birth	Mother's Place of Birth	Language Spoken	Trade/Profession
Czapiewski/ Szapiewski/ Chapchefski/ CZAPIEWSKI	MICHAEL	HEAD	SIXTH AVE	323	441	288	POLAND	POLAND	POLAND	POLISH	
Czapiewski/ Szapiewski/ Chapchefski/ CZAPIEWSKI	MARTHA	WIFE	SIXTH AVE	323	441	288	POLAND	POLAND	POLAND	POLISH	
Czapiewski/ Szapiewski/ Chapchefski/ CZAPIEWSKI	ROSALIA	DAUGHTER	SIXTH AVE	323	441	288	WISCONSIN	POLAND	POLAND		

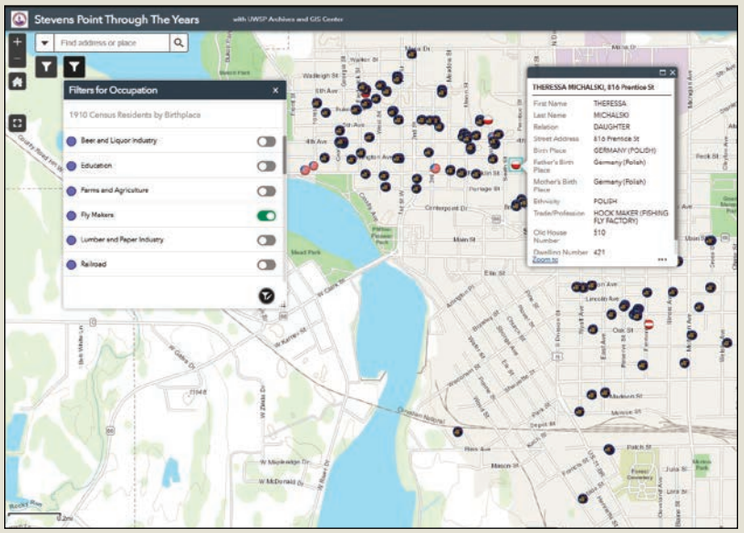
The 14th Census of the United States before and after the transcription process.



Carrie Frost, founder and operator of CJ Frost Fishing Tackle Manufacturing Company, employed many female factory workers in Stevens Point. (Photos courtesy of the Portage County Historical Society.)







Mapping the residences of CJ Frost Fishing Tackle Manufacturing Company employees reveals patterns that aren't apparent in census records.

A way to turn historical data into a tangible representation of lived experiences

Geocoding

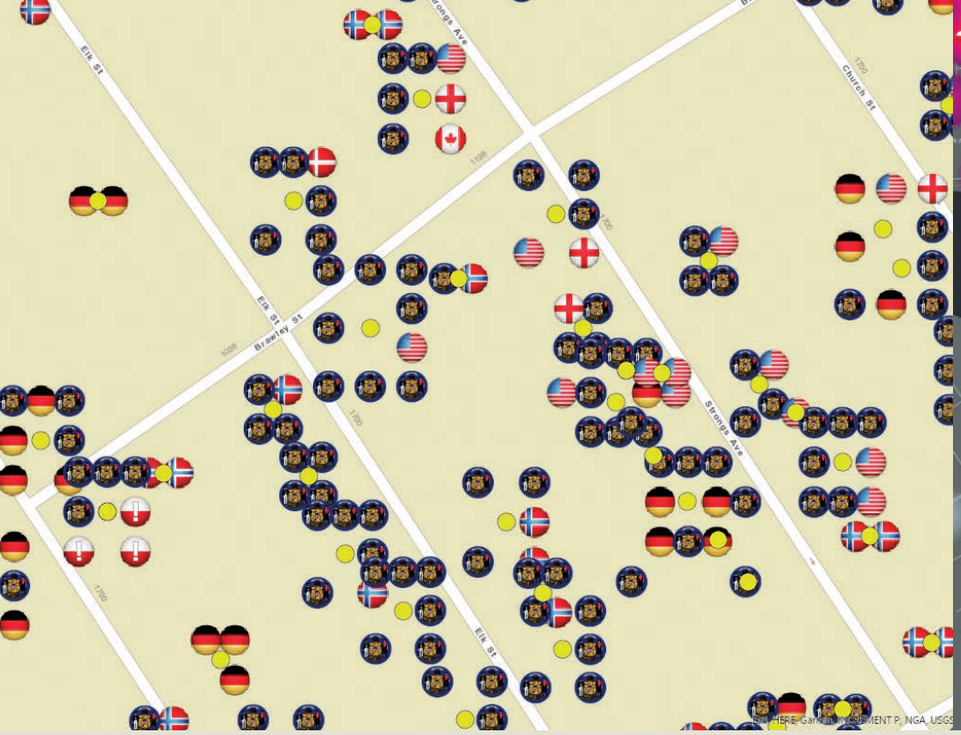
Once transcribed, validated street addresses were transformed into geographic coordinates. Geocoding allowed each census record to be placed on the present-day map, linking historical data to a current geospatial framework of street, city, state, and zip code. This was done using geocoding tools in ArcGIS Online and an address locator from the Portage County Planning and Zoning Department.

The geocoding process introduced new complexities. Some houses and addresses no longer existed. Some regions were converted from residential dwellings to other land uses, including parking lots. With no modern-day geographic placeholders for these records, these data points had to be estimated using historical maps or discarded.

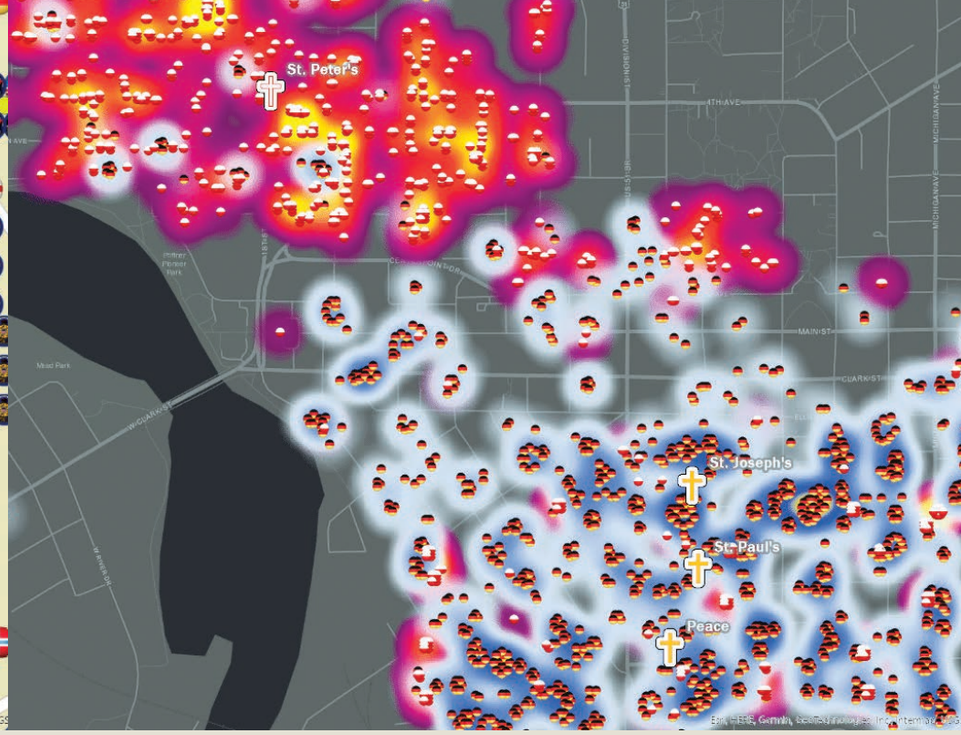
Geospatial Analysis

With the data geocoded, the team used ArcGIS Pro for advanced analysis. Researchers were able to answer new questions: Where did residents originate during that decennial census? How were immigrant communities distributed across the city? Which individuals migrated the greatest distances?

Geospatial analysis revealed patterns about population density, distribution of communities of various ethnicities, and other factors that were otherwise invisible without geographic context.



The Disperse Markers tool separated symbols for individuals living in the same household. A yellow point marks the central address, while custom-made flag symbols indicate individuals' birthplaces.



Human settlement and cultural landmarks in Stevens Point are assembled in a pattern associated with common ancestry. Poles (purple to red to yellow) settled on the north side of Stevens Point while Germans (blue to yellow) settled on the south side.

Cartographic Visualization

Using ArcGIS Pro and ArcGIS Online, the team designed maps that communicated this context. Census attributes such as place of birth were symbolized to create intuitive, visually engaging maps.

Here, the team had to figure out how to represent overlapping data points and diverse countries of birth. The Disperse Markers tool in ArcGIS Pro identified overlapping point symbols representing individuals at the same residence and separated them into a clear pattern centered on the associated household. Birthplace diversity was represented with custom picture markers based on country, and in some cases, city flags. This approach created unique, easily distinguishable markers for each represented birthplace.

Storytelling

Historical storytelling was the project's central ambition—a way to turn historical data into a tangible representation of lived experiences. The team used ArcGIS StoryMaps to weave spatial data and local history into human-centered insights.

For example, an industrial history emerges through mapped employment patterns, such as the female workers tied to Carrie Frost's fishing tackle company. The team also put together stories about the clustering of the Polish community on Stevens Point's north side and the German community on the south side, and the anchoring of community identity around religious and cultural landmarks, such as St. Peter's Catholic Church.

The historical census contains countless stories, yet the example narratives presented by the UWSP team are limited to their interests and interpretations. Using ArcGIS Experience Builder, the team also created interactive tools allowing visitors to explore and filter data to tell stories of their own. These tools bridge the gap between traditional archival research and modern spatial analysis.

Seeing the Past in a New Way

This project illustrates how GIS can transform static records into dynamic stories—a capability available to every community with access to historical census data. By linking peoples' stories with the places they lived and worked, GIS reveals patterns and culturally connected narratives that enrich our understanding of the past and make history accessible, engaging, and relevant.

Historical census data doesn't need to be confined to an archive. When it is mapped and shared, it comes alive. **AN**

About the Authors

Douglas Miskowiak is chair of geography and geology, program director of GIS professional graduate certificate programs, and instructional administrator of the GIS Center at UWSP. Brad Casselberry is the university's head of archives. Jarita Bavido is a recent graduate of UWSP, where she majored in history, international studies, and philosophy and earned a GIS certificate.





Robot Maps an Underwater World

SPOTLIGHT: ESRI STARTUP PROGRAM

Lafayette Blue Springs State Park in Mayo, Florida, is well-known for its recreational opportunities and natural scenic beauty. But its real importance lies deep beneath the surface, where a complex network of submerged caves channel Florida's groundwater.

These caves strongly influence regional water quality and safety, water supply, the fluctuating flow of the nearby Suwannee River, and the health of local ecosystems. But accessing this system means going where people often cannot.

It is difficult, costly, and dangerous to accurately map and monitor this environment. The Florida Department of Environmental Protection (FDEP) needed a safer, more reliable way to collect and update high-quality spatial and environmental data from this groundwater system. Esri startup partner Sunfish, Inc., had the answer: a specialized underwater robot.



The Sunfish AUV on a mapping mission in Lafayette Blue Springs.

Navigating the Unknown

This autonomous underwater vehicle (AUV) technology was originally designed by Stone Aerospace, using National Aeronautics and Space Administration (NASA) grants, to explore the deep, frigid oceans of Europa, one of Jupiter's moons. The AUV was later adapted to operate in a variety of underwater environments on Earth. In 2019, Sunfish was founded as a spin-off company focused on advanced underwater systems.

"We wanted to solve some of the world's biggest problems related to water resources and the ocean," said Alberto Lopez, CEO and cofounder of Sunfish. "Underwater caves are one of the most challenging environments in our field, so we knew if we could do that, we could probably work anywhere."

FDEP tasked the Sunfish team with collecting high-resolution spatial and environmental data from the underwater cave system of Lafayette Blue Springs. By combining autonomous robotics technology with ArcGIS, the team transformed fragmented data into a connected geospatial workflow for collecting, processing, analyzing, and sharing information.

"Cave passages can be narrow, unstable, and difficult to access," said Lopez. "Sunfish gave the project team another way to collect detailed, georeferenced information throughout the system while reducing the amount of work that had to be performed by divers."

Turning Hidden Waterways into Geographic Intelligence

To start, Sunfish deployed the AUV throughout the Lafayette Blue Springs system. Using multibeam sonar and water quality sensors, the AUV navigated submerged cave passages while collecting georeferenced nitrate, salinity, temperature, and depth measurements. During mapping operations, the AUV surfaced at sink locations—secondary entrances into the flooded cave system—to acquire GNSS position fixes, improving the accuracy of the final cave map. The vehicle mapped more than three miles of underwater passages while taking continuous environmental measurements.

> *One of the most valuable aspects of this project was that the data could move directly into ArcGIS workflows.*
>
> **Alberto Lopez**
> SUNFISH, INC., CEO AND COFOUNDER

The fieldwork was only the beginning. Once collected, the data moved into a GIS workflow centered on ArcGIS Pro and ArcGIS Online. Sunfish generated a series of spatial datasets, including georeferenced vehicle trajectories, water quality measurements, conduit geometry, point clouds, and surface models. These outputs provided the foundation for a comprehensive geospatial representation of the 3D cave network and the environmental conditions within it.

"One of the most valuable aspects of this project was that the data could move directly into ArcGIS workflows," said Lopez. "By integrating Sunfish data with ArcGIS, we could move from raw sensor measurements to a visual representation of the system that researchers and environmental managers could explore and analyze."

The project team used ArcGIS Pro to process and analyze underwater mapping data. Sonar and navigation information were transformed into bathymetric surfaces and 3D representations of the cave system, giving researchers a detailed view of the passage geometry. Analysts then examined Sunfish's spatially referenced nitrate, conductivity, and temperature measurements in relation to conduit structure, depth, and potential groundwater flow paths.

The high-resolution maps produced by Sunfish also informed the next phase of the project. Researchers from the University of South Florida used the georeferenced water quality data to identify locations where more detailed geochemical sampling would be most valuable. Scientific dive teams then collected additional water samples from selected areas of the cave system for laboratory analysis, helping investigators better understand pollution sources and factors influencing water quality variability.

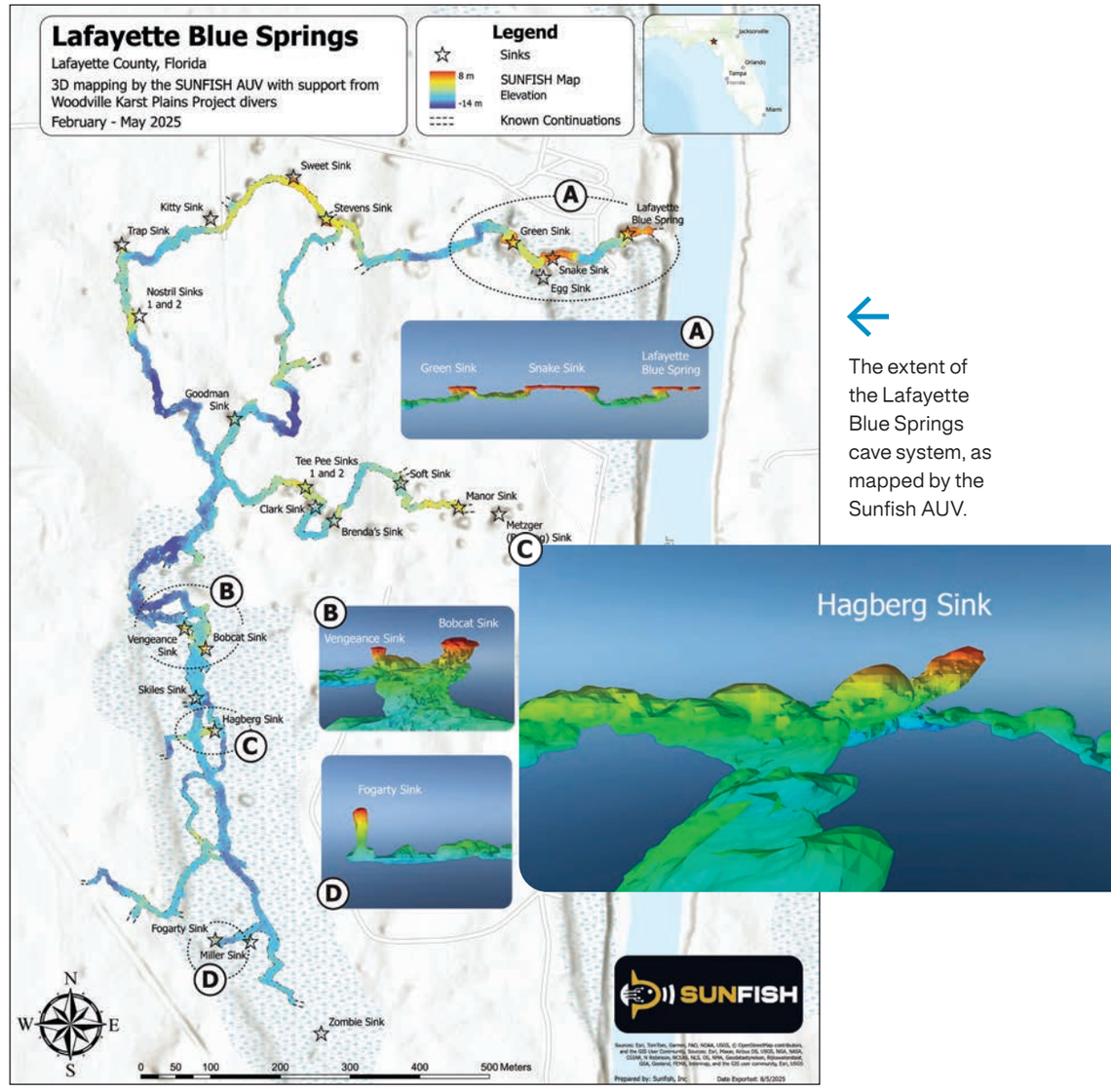
To support collaboration and communication among stakeholders, the team used ArcGIS Online to bring Sunfish sensor outputs, historical water quality records, and site observations into a unified geospatial environment. Interactive web maps and 3D scenes allowed researchers and environmental managers to explore the cave system, visualize water quality patterns, and share findings across organizations. Together, these tools carried the project from underwater data collection through analysis, scientific sampling, and communication with project stakeholders.

A Path Forward

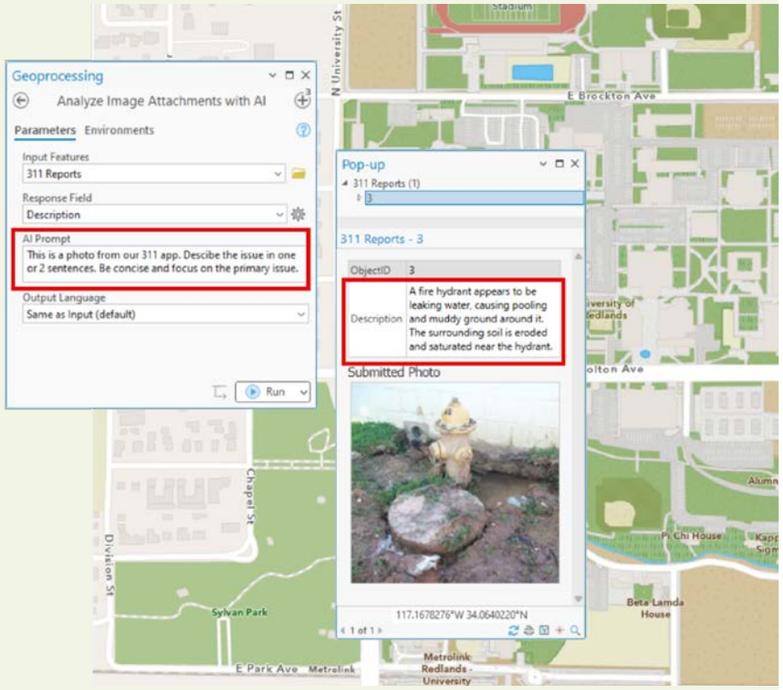
The project gave FDEP a detailed spatial record of the Lafayette Blue Springs cave network and its water quality conditions. These datasets now support groundwater modeling and improve understanding of how land use influences water quality.

Beyond the immediate mapping effort, the project established a repeatable approach for bringing AUV data into GIS, offering a model for studying difficult-to-access groundwater systems everywhere.

"Lafayette Blue Springs is just one of many cave systems in Florida. Looking beyond caves, we're able to inspect water pipelines and map ocean reef structures," said Lopez. "The ability to map complex underwater environments—and to effectively communicate that spatial data to land managers and asset managers—is the key that opens up many other venues for our technology." AN



The extent of the Lafayette Blue Springs cave system, as mapped by the Sunfish AUV.



How Can AI Unlock New Geographic Insights?

New Connections

By Nate Strout, Esri Geo Experience Center

GIS professionals have always looked for new ways to understand the world through data. In GIS, that data often manifests as points, lines, polygons, and the attributes associated with them. But some of the most valuable information organizations collect isn't stored in neatly structured attribute tables. It's found in photographs, inspection reports, maintenance logs, survey responses, and other forms that can be difficult to analyze at scale.

A photograph attached to a feature might reveal a damaged asset. An inspection narrative might describe multiple conditions requiring attention. A field report might contain valuable observations that never make their way into searchable GIS attributes.

The information is already there. The challenge is unlocking it.

Artificial intelligence is making that challenge easier. By bringing AI-powered image and text analysis into ArcGIS workflows, organizations can turn photographs, reports, and observations into structured geographic information that can be mapped, analyzed, and acted on. A photo collected during an inspection could be automatically summarized. A resident's service request could be categorized and standardized. Thousands of narrative reports could be transformed into consistent, searchable information ready for mapping and analysis.

This is where AI moves beyond productivity enhancement into something more transformative. It allows organizations to convert previously inaccessible information into geographic insight.

One powerful new AI tool that does this is the arcgis.ai module in ArcGIS API for Python. The module allows ArcGIS users to extract information from photographs, summarize reports, classify narrative content, and transform unstructured information into GIS-ready data with natural language prompts.

To help ArcGIS users explore this capability, the Esri Geo Experience Center (GeoXC) developed the AI Analysis Toolbox, a downloadable ArcGIS Pro toolbox that brings AI-powered image and text analysis directly into ArcGIS Pro. With this toolbox, users can select a layer, provide a prompt, and write AI-generated results back into their data. It can be used within ArcGIS Pro, while the included Python code can be explored, adapted, and extended for new workflows.

Visit esriurl.com/ai-toolbox to download the toolbox. Note that while this capability is in beta, ArcGIS Online credits won't be charged. After general release, running this tool will consume credits.

Extract Meaning from Images

The toolbox includes tools for analyzing photos stored as feature attachments or those referenced by URLs or file paths. Simply select the features to process, specify a destination field, and provide a natural language prompt describing what information you want extracted. The tool then analyzes each image and writes the results back into the dataset.

You might prompt the AI to do any of the following:

- Describe observable damage
- Identify maintenance issues
- Read text from a sign
- Extract asset numbers
- Classify photographs into categories
- Identify visible safety concerns

Rather than simply storing images as an attachment for a human to review, the tool generates a concise description of the observed condition and stores it as an attribute that can be searched, filtered, summarized, and analyzed.

The same workflow supports a wide range of applications. A utility company can examine pole inspection photos. Emergency managers can document storm damage. Parks departments can evaluate trail conditions. Environmental organizations can classify wildlife camera imagery. Photos that once served only as supporting documentation can become analytical inputs. Images become another source of geographic information.

Rather than creating a specialized tool for every scenario, organizations can adapt the analysis to the question they are trying to answer.

Make Text Mappable

But images are only part of the story. Many GIS datasets contain large volumes of narrative text in the form of inspection reports, incident descriptions, maintenance records, survey responses, and public feedback. While this information contains important context, it can be challenging to identify patterns across thousands of records.

AI-powered text analysis brings structure to this content. By supplying a prompt and a text field, analysts can generate summaries, extract key issues, categorize records, or identify recurring themes.

For example, a lengthy code-enforcement report describing overgrown vegetation, accumulated debris, and inoperable vehicles can be transformed into a concise list of issues to be filtered, grouped, and visualized geographically.

When narratives become structured information, they are easier to analyze. Patterns emerge that might otherwise remain hidden in paragraphs of text.

The Future of Geographic Analysis

GIS is changing the way we work with information. As AI becomes more deeply integrated into ArcGIS, information that has traditionally lived on the sidelines—in photographs, documents, reports, and notes—becomes part of everyday geographic analysis.

The arcgis.ai module and the AI Analysis Toolbox offer an early look at that future, helping organizations transform more of the information they already collect into actionable geographic insight.

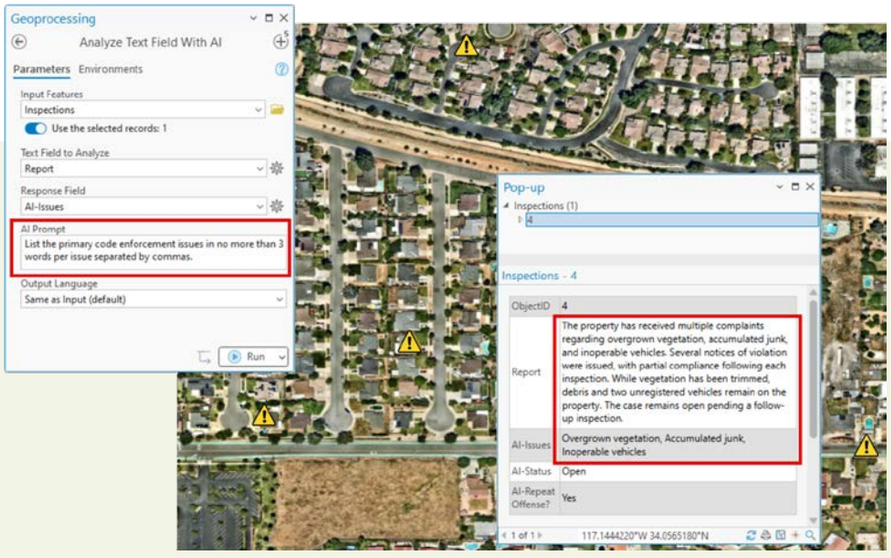
The future of GIS isn't just about collecting more data. It is about uncovering new insights from the information we already have. **AN**

About the Author

Nate Strout is a solution engineer for the GeoXC, where he leads a team that designs customer briefings, prototypes, and technology tours. He brings more than 25 years of experience with geospatial research, technical leadership, and GIS education.

About the Geo Experience Center

The Geo Experience Center is Esri's customer experience center and the home of the Executive Briefing Program. It provides a collaborative environment where customers, partners, and Esri experts engage in strategic discussions, technology demonstrations, and hands-on experiences.



The toolbox can convert an inspection narrative into a structured description of issues.

```python
from arcgis.gis import GIS
from arcgis.ai import analyze_image

gis = GIS("home")

response = analyze_image(
    image=image_url,
    prompt="Describe visible damage in one sentence.",
    to_language="en"
)

print(response.results[0].value
```

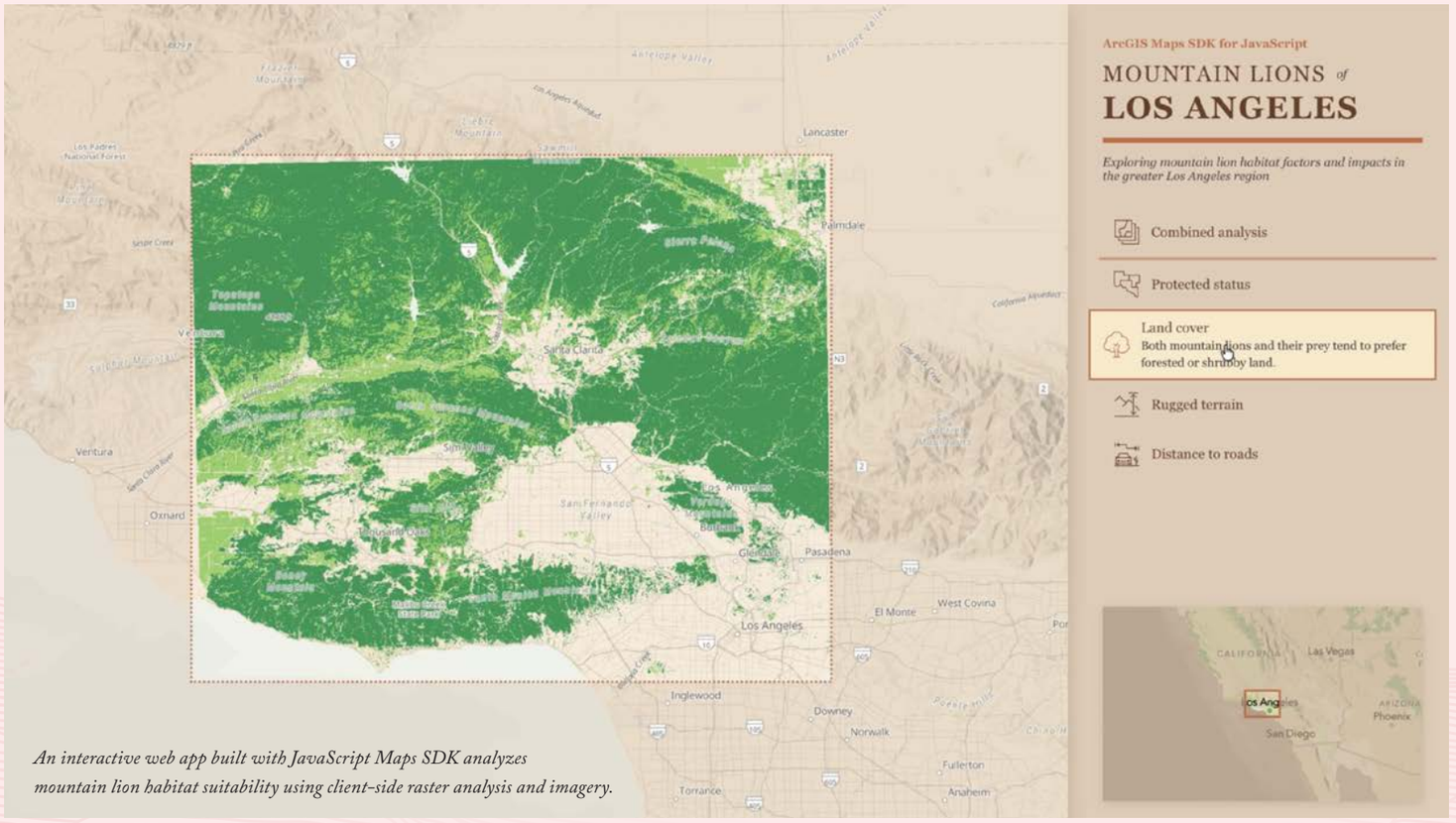
While the AI Analysis Toolbox provides a ready-to-use implementation, the underlying Python code offers a useful look at how you might extend these new AI image and text analysis features into your workflows.

JavaScript Maps SDK 101

Some GIS professionals use robust developer tools every day. Others work primarily with options that entail little to no coding and don't require experience with dedicated developer software. But tools like ArcGIS Maps SDK for JavaScript can bring extra flexibility, scalability, and power to your mapping apps.

ArcGIS Maps SDKs are a family of developer tools designed to build mapping and spatial analysis apps across platforms. Along with software development kits (SDKs) for web (JavaScript), the suite includes native apps (.NET, Flutter, Swift, Kotlin, and Qt) and game engines (Unity and Unreal Engine).

So what is JavaScript Maps SDK, and how can developers and organizations use it to build custom, location-aware apps?



An interactive web app built with JavaScript Maps SDK analyzes mountain lion habitat suitability using client-side raster analysis and imagery.

What Is JavaScript Maps SDK?

JavaScript Maps SDK is Esri's premium tool for building custom, interactive web mapping apps. It enables developers to create rich 2D and 3D experiences that visualize, analyze, and edit spatial data directly in a browser.

Esri uses it to build web apps such as ArcGIS Experience Builder, ArcGIS Instant Apps, and ArcGIS Dashboards. GIS practitioners also use it to create their own web-based apps.

The SDK is built around two complementary elements:

- **The core API**—This is the programmatic foundation for working with maps, layers, geometry, rendering, and analysis. It gives developers fine-grained control over app behavior through JavaScript classes, methods, events, and data models. The API enables highly customized workflows such as advanced visualization, client-side analysis, feature editing, and integration with other systems, making it ideal for developers who need flexibility and control.
- **Web components**—The SDK includes standards-based, reusable web components that can be used to incorporate maps, charts, UI elements, and AI into web mapping apps with minimal code. These components work with plain JavaScript as well as modern frameworks such as React, Angular, and Vue. Web components accelerate development by providing ready-to-use building blocks that follow accessibility and design best practices, allowing teams to focus more on solving problems and less on rebuilding common UI patterns.

Together, the core API and web components let developers choose between deep customization and rapid development or combine both approaches in the same app.

JavaScript Maps SDK is tightly integrated with Calcite Design System, Esri's framework-agnostic design system for building consistent, accessible, and responsive web apps. Calcite provides reusable layout components, UI patterns, and design tokens that handle app structure and styling, while ArcGIS map components focus on rendering and interacting with geospatial content. This clear separation helps developers build clean, maintainable apps faster; ensures visual consistency; and delivers built-in support for accessibility and theming, such as light and dark modes.

What Can JavaScript Maps SDK Do for Me?

The SDK offers several key benefits for GIS app developers:

- **2D and 3D visualization**—Create high-performance 2D and 3D maps that can handle large and complex datasets in a browser.
- **Fast client-side analysis**—Perform querying, filtering, measurement, and spatial analysis directly in the web app.
- **Developer resources**—Extensive documentation, tutorials, and samples help developers get started quickly and follow best practices.
- **Ecosystem integration**—Seamless connection to ArcGIS Online, ArcGIS Enterprise, and ArcGIS Location Platform ensures access to authoritative data and services.
- **Scalability and flexibility**—The SDK can be used for simple apps as well as enterprise solutions.

How Do I Use JavaScript Maps SDK?

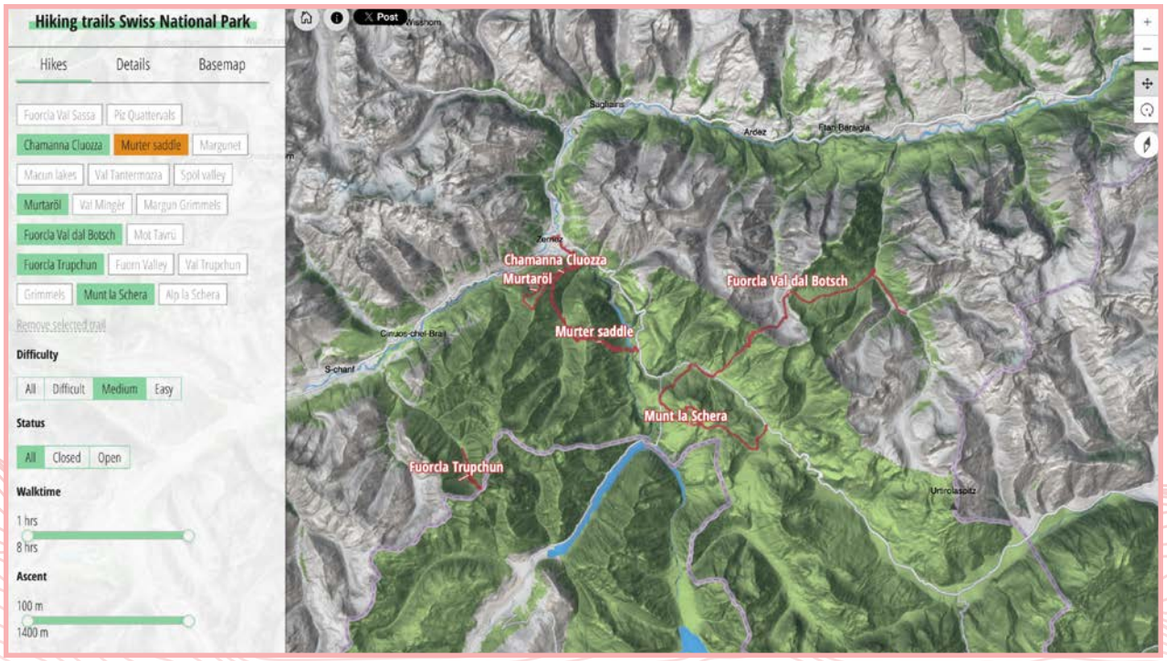
You can add JavaScript Maps SDK to your apps in two primary ways:

- **Content delivery network**—A content delivery network (CDN) hosts and delivers JavaScript files, libraries, and frameworks within a user's web browser, so you don't have to host these yourself. JavaScript Maps SDK can be loaded directly into an HTML page using <script> and <link> tags, adding the core API library, all component packages, and the CSS to your app. This approach is ideal for learning, developing quick prototypes, or creating lightweight apps where minimal setup is preferred.
- **npm**—Developers can install the SDK as a package in their project and integrate it with modern build tools and frameworks through npm, JavaScript's default package manager. This method is best suited for production apps that require structured code bases, version control, and optimized builds.

Both options deliver the same capabilities. The choice depends on workflow, not functionality.

While a CDN or npm determines how to access the SDK code, access to maps, data, and services is controlled by a foundational ArcGIS account. Apps built with JavaScript Maps SDK connect to ArcGIS through ArcGIS Online, ArcGIS Enterprise, and ArcGIS Location Platform, Esri's cloud-based platform as a service (PaaS) with a pay-as-you-go option for location services. Apps using Location Platform start with a free tier and incur usage-based charges as consumption scales.

Custom web apps built or deployed using JavaScript Maps SDK must be licensed through one of these options. For ArcGIS Online and ArcGIS Enterprise users, JavaScript Maps SDK is licensed via user types.



This interactive hiking map of Swiss National Park, built with JavaScript Maps SDK, highlights trails, terrain, and routes with filters for difficulty, status, and elevation.

When Should I Use JavaScript Maps SDK?

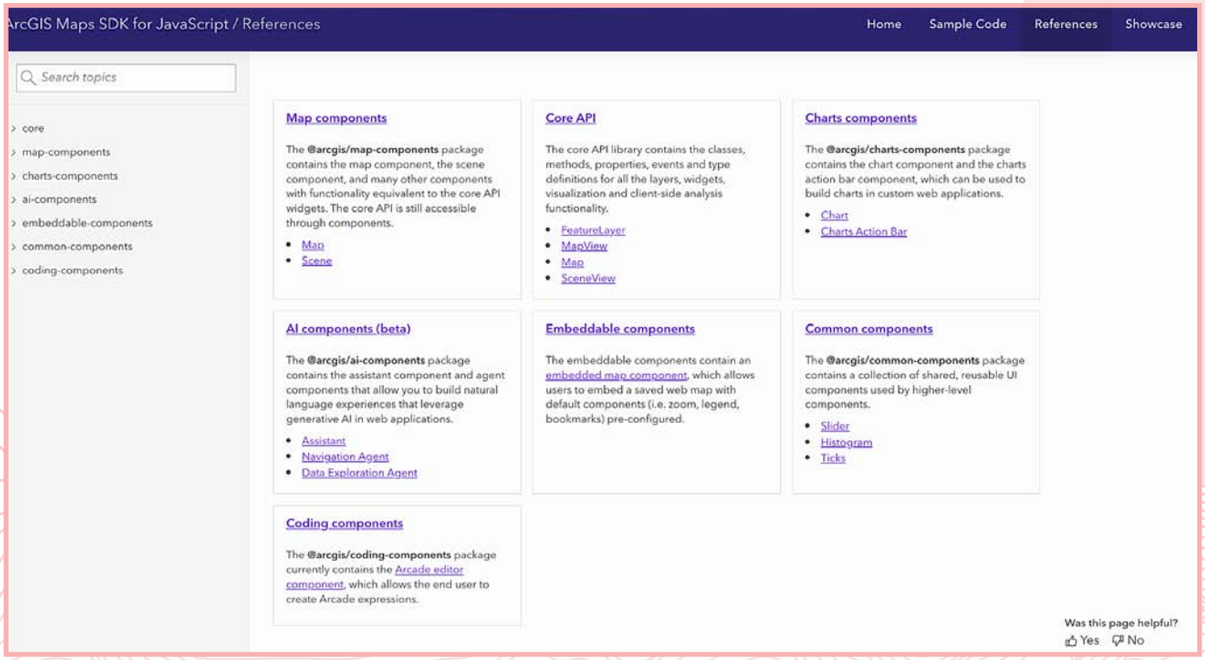
JavaScript Maps SDK works best for scenarios in which data and location drive decisions, meaning it can be instrumental in a wide range of environments. Building interactive parcel and zoning viewers; utility network and outage management apps; large-scale 2D and 3D city and infrastructure visualizations; real-time operational dashboards; situational awareness apps for planning and emergency response—all of these are perfect scenarios for the SDK's capabilities. Any organization that needs to visualize, analyze, or interact with location data on the web can take advantage of JavaScript Maps SDK.

JavaScript Maps SDK is an invaluable tool for bringing location intelligence to custom web apps. By enabling flexible, secure, and scalable web experiences, the SDK helps you transform location data into insight and impact. AN

Any organization that needs to visualize, analyze, or interact with location data on the web can take advantage of JavaScript Maps SDK.

JavaScript Maps SDK offers different ways to securely access ArcGIS services and private data hosted in ArcGIS. There are three types of authentication you can implement to get an access token for building apps that use secure ArcGIS resources and services:

- API key authentication—Uses a long-lived access token embedded directly into an app or console script. It's best suited for creating public-facing apps that use ArcGIS Location Services and secure items owned by an organization.
- User authentication—Uses an OAuth 2.0 protocol to generate an access token and let users sign in to access secure resources.
- App authentication—Uses an OAuth 2.0 credential to generate short-lived access tokens for public-facing apps with server-side components that need access to ArcGIS Location Services or secure content.



The JavaScript Maps SDK reference hub helps developers access APIs and web components for building interactive mapping and data-driven web apps.

A Digital Twin of Nature to Test Ideas for the Future

Spatial Foundations

By Amy Frazier, Trisalyn Nelson, Will Overbye-Thompson, and Dan Willett, University of California, Santa Barbara; and Sophia Leiker, Kelly Easterday, and Mark Reynolds, The Nature Conservancy's Point Conception Institute

What if you could rewind a forest fire, fast-forward a coral bleaching event, or test drive a species reintroduction? The most powerful tool in modern conservation is no longer a drone, a GPS tracing device, or a geofence—it's a digital twin. Digital twins give conservation scientists and practitioners a virtual mirror of the planet where they can experiment, fail, and fix things before reality catches up.

A digital twin is a dynamic, data-driven representation of a physical system. In GIS, most digital twins represent human systems like airports and cities. Around the world, these digital twins enable decision-makers to test solutions, get early warnings about problems, and prioritize where and when to invest resources.

But what about environmental systems that power the planet? These systems are under immense pressure from land use, rising sea levels, extreme weather, drought, floods, and more. Conserving nature and biodiversity requires bold, evidence-based decisions that benefit from accurate, real-time information about natural processes. This can aid understanding of how natural systems function and change and inform which interventions will be most effective for meeting conservation goals.

The Nature Conservancy's (TNC) Point Conception Institute and the Center for Spatial Science at the University of California, Santa Barbara (UCSB), have partnered with Esri to create one of the first digital twins of nature at the Jack and Laura Dangermond Preserve—a 24,364-acre property owned and managed by TNC.

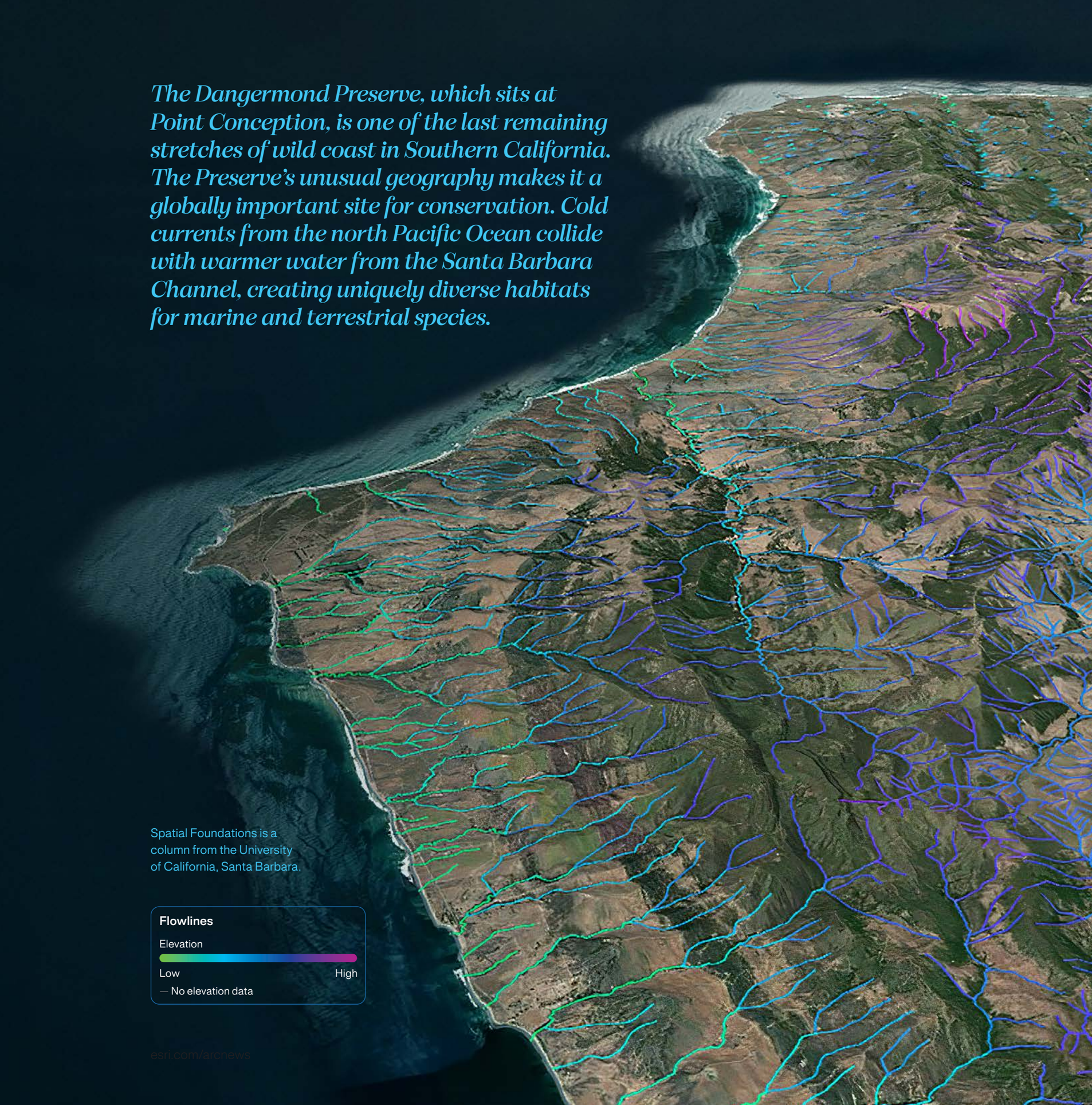
In April 2026, the Point Conception Institute held a symposium—Science for a Wild Coast—that brought together 70 researchers and practitioners from TNC, the University of California, Vandenberg Space Force Base, California State Parks, and other institutions to take a deep dive into coastal research findings. The group previewed the Dangermond Preserve Research and Discovery Digital Twin, which gets real-time data on water, climate, and species from scientific instruments placed throughout the landscape. The digital twin is supported by diverse data and experiences, plus a geospatial hub (links.esri.com/preserve-hub).

Now, this digital twin—with nearly 1,000 GIS data layers representing everything from hydrology and soils to wildlife, roads, and infrastructure—is available for anyone to access. It connects more than 120 research projects at 50 partner institutions focused on species recovery and managing healthy landscapes, seascapes, and watersheds.

The vision for the Dangermond Preserve Research and Discovery Digital Twin is to create a virtual environmental system that functions like a research lab, enabling data-driven decision-making in conservation based on spatial and temporal patterns. Similar to how molecular scientists use microscopes to see the unseeable, a digital twin of nature magnifies spatial processes to show the hidden architecture of ecosystems.

At the core of the Dangermond Preserve Research and Discovery Digital Twin is an automated data pipeline architecture that ingests continuous streams from Internet of Things (IoT) sensors, wildlife cameras, and third-party scientific APIs such as eBird and the Global Biodiversity Information Facility (GBIF). These pipelines transform incoming data and route it to a cloud-based, PostGIS-enabled database for storage and preprocessing. From there, datasets are published as feature layers, imagery layers, and Open Geospatial Consortium services within an ArcGIS Enterprise deployment. The team chose ArcGIS Enterprise to leverage its robust support for direct connections to cloud storage. Once published, these layers become discoverable alongside items from TNC's broader preserve operations through a shared catalog, creating a unified, queryable inventory of geospatial data for the preserve. This architecture is the backbone for the development of models and decision-making tools.

The Dangermond Preserve, which sits at Point Conception, is one of the last remaining stretches of wild coast in Southern California. The Preserve's unusual geography makes it a globally important site for conservation. Cold currents from the north Pacific Ocean collide with warmer water from the Santa Barbara Channel, creating uniquely diverse habitats for marine and terrestrial species.



Spatial Foundations is a column from the University of California, Santa Barbara.

Current technology makes real-time data discoverable and shareable. Data that was previously difficult to map—like a network of cameras that collect images of wildlife along movement corridors—is now easy to visualize against a 3D backdrop of terrain data. When a camera captures an image, computer vision AI tools automatically identify the species—and the image, along with the observation date, is summarized and made accessible to users.

Users can search the archive to find and download all images of a particular species, or they can identify all species that have been spotted at a particular camera. For example, they can see a photograph of a mountain lion captured by a camera near the coast in February 2025, along with the date and time the image was taken. Users can query all other locations where mountain lions have been identified, or explore what other wildlife species have been observed at that location.

The Dangermond Preserve Research and Discovery Digital Twin is a living example of open science in action. By making data and GIS tools easily accessible, people around the world can participate in activities at the preserve. Anyone, anywhere can explore and use rich GIS data for interdisciplinary research or to teach topics ranging from wildlife conservation to hydrology to GIS.

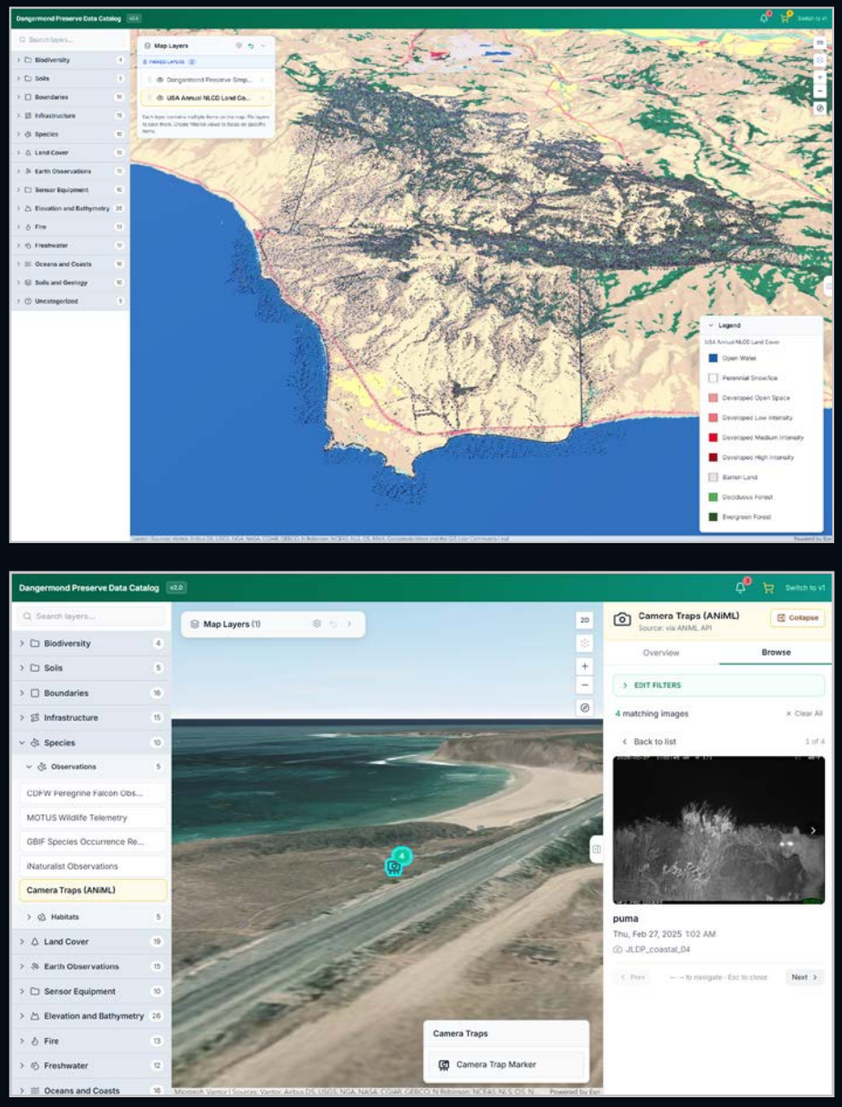
The next phase of development for the digital twin will focus on running real-time analytics through ArcGIS Velocity and building dynamic visualization tools that allow users to highlight changes in spatial patterns over time. Analyses and visualizations will flag unexpected patterns in observed data, compare observed and modeled data, and assess various modeled outputs. The Dangermond Preserve Research and Discovery Digital Twin will also include a suite of tools for users to develop and run their own scientific models, allowing predictive solutions to be tested and deployed virtually before implementing them in the real world.

The Jack and Laura Dangermond Preserve's wild coastline has supported a growing body of work on species recovery, translocations, and range shifts, highlighting the ecological implications of exploiting wildlife and coastal and marine resources. Now, paired with the Dangermond Preserve Research and Discovery Digital Twin, researchers and conservationists are prepared to accelerate the discovery and development of conservation solutions. AN

About the Authors

Amy Frazier is a professor and the Jack and Laura Dangermond Chair of Conservation at UCSB. Trisalyn Nelson is a professor and the Jack and Laura Dangermond Chair of Geography at UCSB, as well as the director of the university's Center for Spatial Science. Will Overbye-Thompson is a GIS researcher at UCSB and a GIS developer with the Center for Spatial Science. Dan Willett is a PhD student at UCSB and a GIS developer with the Center for Spatial Science. At TNC's Point Conception Institute, Sophia Leiker is the spatial data science associate, Kelly Easterday is the director of conservation technology, and Mark Reynolds is the director.

You are invited to join these efforts at the Jack and Laura Dangermond Preserve (dangermondpreserve.org), with open access to the Dangermond Preserve Research and Discovery Digital Twin (digitaltwinsofnature.org). GIS curriculum geared toward conservation is available to bolster use of the digital twin's data via the UCSB Guide to the Geographic Approach (theucsbguide.com).



Top: The Dangermond Preserve Research and Discovery Digital Twin provides open access to nearly 1,000 GIS datasets and includes tools for science and data exploration.

Bottom: Wildlife data collected by cameras installed at permanent locations is displayed alongside 3D landscape data and a time-stamped photo.

EOS
Positioning Systems

Transform Mapping Everywhere

High-Accuracy GNSS Receivers for ArcGIS® Apps on Any Device



Arrow Series®

Rugged. Flexible. Agnostic.



Skadi Series™

RTK In Your Hand™
Explore the Skadi Smart Handle™
& Skadi Tilt Compensation™

Contact us

www.eos-gnss.com

CONSERVATION SCIENCE MUST TAKE RISKS

A NEW INITIATIVE FUNDS BOLD IDEAS

By Ben Halpern and Courtney Scarborough,
National Center for Ecological Analysis and Synthesis



Conservation science has produced groundbreaking advances, from monitoring planetary change via satellites to detecting species from traces of DNA in water. These discoveries transpired because researchers pursued ideas that were uncertain, interdisciplinary, and often difficult to justify at the outset.

Today, however, conservation science is risk averse. This is evident when talking to seasoned scientists and graduate students, reading the latest scientific journals, and submitting grant applications. Bold ideas are shunned in favor of those with more certain outcomes.

There is a rationale for this. Funding agencies typically require evidence that an idea will work. They want to know it will build on pilot data or draw a clear line to existing knowledge. Furthermore, scientists get rewarded when they publish articles, papers, and books—yet ideas that don't pan out don't get written up. Bold ideas that carry real risk don't get funded or even explored.

As a result, research tends to focus on conservative, predictable topics that are more likely to grace the pages of a scientific journal. But this hampers innovation, especially the kind that enables transformative discovery and change.

Today, as ecosystems get reshaped faster than the conservation field can respond, the risk of incrementalism may be greater than that of trying something new. Conservation writ large must now—perhaps more than at any other time in history—embrace riskier and bigger ideas to accomplish its goals. A new initiative from the National Center for Ecological Analysis and Synthesis (NCEAS) seeks to make that possible.

Big Innovations Start as Long Shots

The past is teeming with risky ideas that led to transformative outcomes. The origins of GIS offer a powerful example.

When GIS pioneers began digitally integrating environmental data across landscapes, they advanced a new way of understanding environmental systems. It integrated ecology, geography, computation, and planning long before such interdisciplinary work was commonplace.

It soon became clear that GIS was more than a tool—it was a different way of viewing and comprehending the world. What began as an ambitious experiment in synthesis transformed conservation science and decision-making around the world.

Years later, that way of thinking inspired one of us—Ben Halpern—to ask another ambitious question: Could we map the cumulative impacts of human activities across the entire ocean? At the time, integrating dozens of disparate global datasets—from fishing and shipping to climate change and pollution—into a single spatial framework was technically difficult and methodologically uncertain. Yet advances in GIS and spatial synthesis suggested it was possible.

NCEAS, a research center at the University of California, Santa Barbara (UCSB), took a risk on the idea and supported an incubator team to flesh it out. This led to further funding, and the resultant cumulative human impact maps helped reshape marine spatial planning and ecosystem-based management. The maps gave scientists, governments, and conservation practitioners a shared framework for understanding how multiple stressors interact across ocean ecosystems. Today, cumulative impact mapping is widely used to inform marine protected area design, coastal planning, and ocean policy around the world.

These breakthroughs emerged because risk was met with support, curiosity, and a willingness to imagine what might be possible. The result was research that reshaped how environmental systems are understood and managed.

These stories raise a broader question: What would it look like to intentionally design research systems that cultivate ambitious environmental ideas from the start? Tech startups and venture capitalists have long embraced this approach, as have innovation hubs like the Defense Advanced Research Projects Agency (DARPA). These environments actively encourage high-risk, high-reward ideas. So how can this model be used in conservation science?

A New Way to Incorporate Risk into Science

NCEAS recently launched the Luna Initiative to do just that: incentivize and unleash the exploration of riskier ideas in environmental science.

Luna brings together small, interdisciplinary teams to investigate bold, untested ideas. The goal is to embrace ambitious exploration and discover moonshot ideas for the planet. Not all the ideas that get funded will work, but the ones that do have the potential to be transformative.

As a conservation science community, we need to reframe failure so it is not something to be feared but is, rather, a critical way to learn and filter ideas. Indeed, a key element of supporting risky ideas is to celebrate and learn from those that don't work. They are a vital part of innovation.

A different kind of research may emerge in this environment. Someone may develop a way to use AI to identify ecological tipping points before they occur. Or figure out how to fully automate biodiversity monitoring. Or discover a novel approach for measuring and understanding microbial ecology.

These ideas might not succeed exactly as imagined, but neither did many of the innovations we now take for granted. The challenge lies in creating enough space for transformative ideas to emerge. And creating this space may be one of the most important investments conservation science can make.

Urgency Changes the Equation

Today, factors including climate change, biodiversity loss, wildfire, drought, ocean warming, and rapid social change are reshaping ecosystems faster than scientific institutions can respond. To overcome institutional barriers, various components—including people with different perspectives and lived experiences, diverse datasets, and new methods—will need to come together in settings where unconventional connections can emerge and be tested.

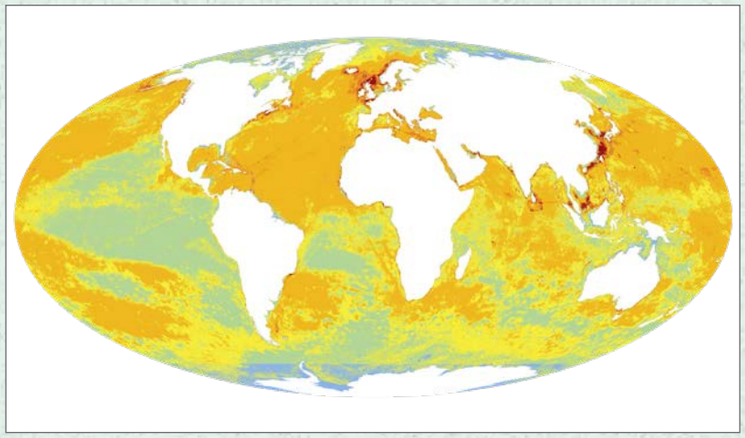
NCEAS has long served a central role in incubating this kind of synthesis. The Luna Initiative matches the urgency of the moment. We hope others will join us.

In a rapidly changing world, the greatest risk isn't in exploring bold ideas; it's in failing to pursue them at all.

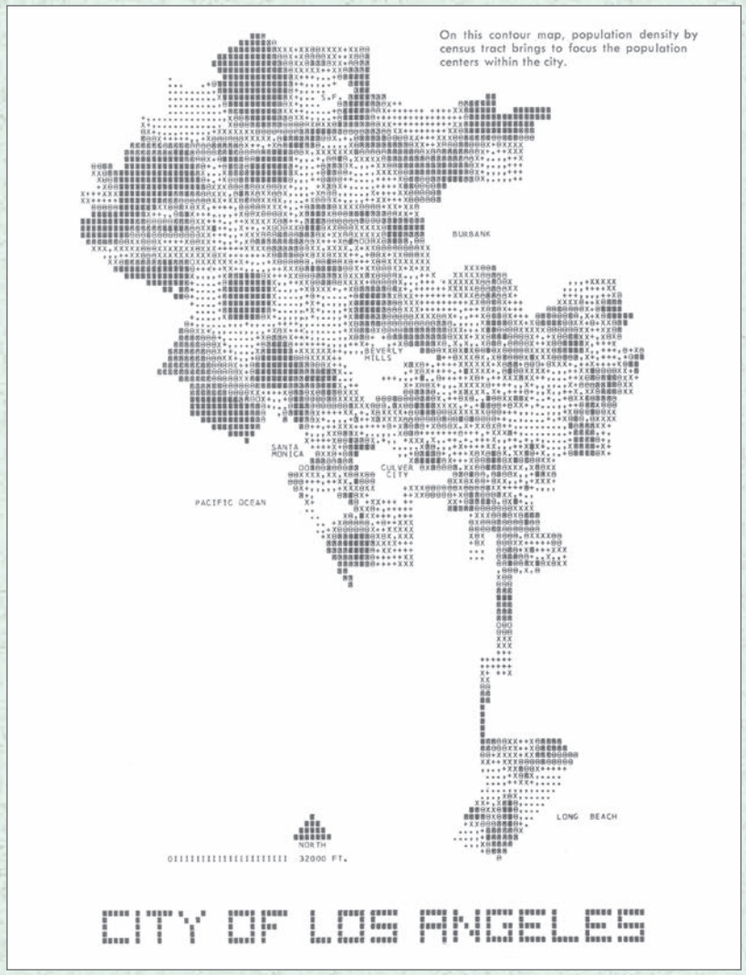
To learn more about Luna, its current areas of focus, and opportunities to participate, visit nceas.ucsb.edu/luna. **AN**

About the Authors

Ben Halpern is the executive director of NCEAS and a professor at UCSB. His research addresses the challenges, opportunities, and strategies for marine conservation around the world. Courtney Scarborough is the deputy director of NCEAS and a marine scientist who works to advance collaborative, solutions-focused environmental research.

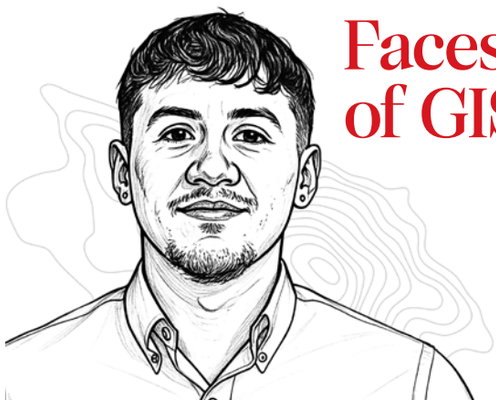


The original cumulative human impacts map from 2008.



This output from one of Esri's earliest products, Automap, rendered Los Angeles, California's early 1970s population density as dark areas on a contoured surface. (LA City Population, 1972, Esri.)

MĀORI SCHOLAR MAPS A MORE RESILIENT FUTURE



Faces of GIS

Haukapuanui Vercoe

Every map is shaped by the perspective of the person who makes it—who decides what story to tell and how to tell it. That perspective is its strength. For University of Auckland PhD researcher Haukapuanui Vercoe, Indigenous knowledge, engineering analysis, and ArcGIS technology come together in research aimed at protecting marae. These traditional meeting grounds are a vital component of cultural infrastructure for Māori, the Indigenous peoples of New Zealand.

Vercoe grew up at Pounamunui and Ōhākī, two historic marae near the New Zealand North Island town of Rotorua, and spent his schooling immersed in te reo Māori, the Māori language. His upbringing shaped his perspective on engineering—a perspective that places cultural, social, and environmental considerations alongside technical and economic ones.

In Māori culture, an individual's genealogy extends to the natural world: the land, forests, winds, and seas. Through that lens, it is vital that Māori look after the natural world.

About a century ago, construction of a power station displaced many of Vercoe's ancestors from their land, changing the trajectory of their identity.

"There's a Māori proverb that says, 'If the land is sick, the people are sick,'" he said.

That history and cultural grounding continues to influence how Vercoe approaches engineering today.

"Instead of developing a solution and consulting communities later, engagement and community input shapes the project from the beginning," Vercoe said. "My philosophy as an Indigenous engineer is to place relationships first, solutions second." In te ao Māori (the Māori worldview), this concept is called whakawhanaungatanga—the practice of building and maintaining relationships.

Vercoe also described the concept of "tea-towel-tanga," in which true leadership extends beyond talk and begins with humble service—by rolling up your sleeves and getting your hands soapy. In the wharekai (dining hall), doing dishes demonstrates a willingness to contribute and meaningfully connect with people. The most impactful communication may occur after a formal presentation, while people work together in the kitchen.

"That's where all the relationship building starts, where all the conversations are and where all the laughing happens," Vercoe said. "It's sometimes where we have the most important discussions, where we discuss whānau [family] matters."

Bringing Indigenous Knowledge to Engineering

Vercoe was always drawn to mathematics and physics and decided at 16 to pursue engineering. However, his school had limited access to teachers for subjects such as science and calculus. After his family met with a university dean, he studied science by correspondence and worked with an after-school tutor to complete the prerequisites he needed.

Vercoe described that schooling as a source of strength. Immersion in Māori culture gave him knowledge and perspectives uncommon in engineering and helped him see beyond technical calculations to the people affected by engineering decisions. The experience also helped his younger brother, Sonny, prepare for the same pathway.

The brothers pursued doctoral research in civil engineering at the same time. Haukapuanui studies the impacts of natural hazards on marae, while Sonny focuses on the seismic resilience of marae buildings. They conduct fieldwork together, often within their own communities. Rather than approaching a community as outside researchers with predetermined answers, they ask people what they need and then work toward possible solutions.

Mapping is a significant part of their research. For communities where oral and visual ways of sharing knowledge are important, a chart with technical data may be less effective than a map showing a familiar marae, its buildings, surrounding land, and nearby hazards.

Vercoe's national research examines and maps marae exposure to river and coastal flooding, earthquakes, landslides, soil liquefaction, and tsunamis. Using ArcGIS technology, Vercoe combines marae locations, land parcels, building outlines, and hazard datasets. Spatial joins help identify where hazards intersect parcels or buildings. He also considers critical infrastructure, such as access roads, because a marae that remains undamaged during a flood event, for example, can still become isolated.

His national assessment covers more than 800 marae and was recognized with the 2025 New Zealand Esri Young Scholar Award from Esri partner Eagle Technology. For Vercoe, scale matters, but communication—including with maps—matters just as much.

"A picture is worth a thousand words," he said, "but a map is worth ten thousand."



Asking, Not Answering

The maps are not intended to dictate what communities should do. Instead, they prompt questions. Should a building be raised or relocated? Is the current location acceptable? What adaptations might make the most sense technically and culturally?

"It's not about going in and saying that we've got all the answers," Vercoe said. "It's about providing the information to say, 'This is what the data suggests. How can this information be leveraged to make more informed decisions for Indigenous communities?'"

Recent analysis indicates that the need for those conversations is urgent. His results show that about half of all surveyed marae could be exposed to flooding. A similar percentage are at risk from earthquakes.

In the aftermath of natural disasters, marae provide food and shelter to hundreds of people with limited resources. Vercoe argued that public support structures should recognize the civil defense role marae already perform rather than leaving communities to finance that service themselves.

That idea is informed by direct experience. In his home region, Vercoe and Sonny worked with their aunt Mere Vercoe—who led Te Arawa Lakes Trust's emergency preparedness work—to develop marae-specific hazard maps supporting preparedness plans for 26 marae.

A Local Story Goes Global

As a 2025 Young Scholar Award winner, Vercoe attended the 2025 Esri User Conference in San Diego, California. Conversations there reinforced how local experiences can connect with global challenges. He recalled speaking with a Hawaiian attendee about similarities among Polynesian cultures and with other Young Scholars about climate-change adaptation, rising seas, relocation, and managed retreat.

Vercoe has since begun moving from academia into professional civil engineering while maintaining his connection to research.

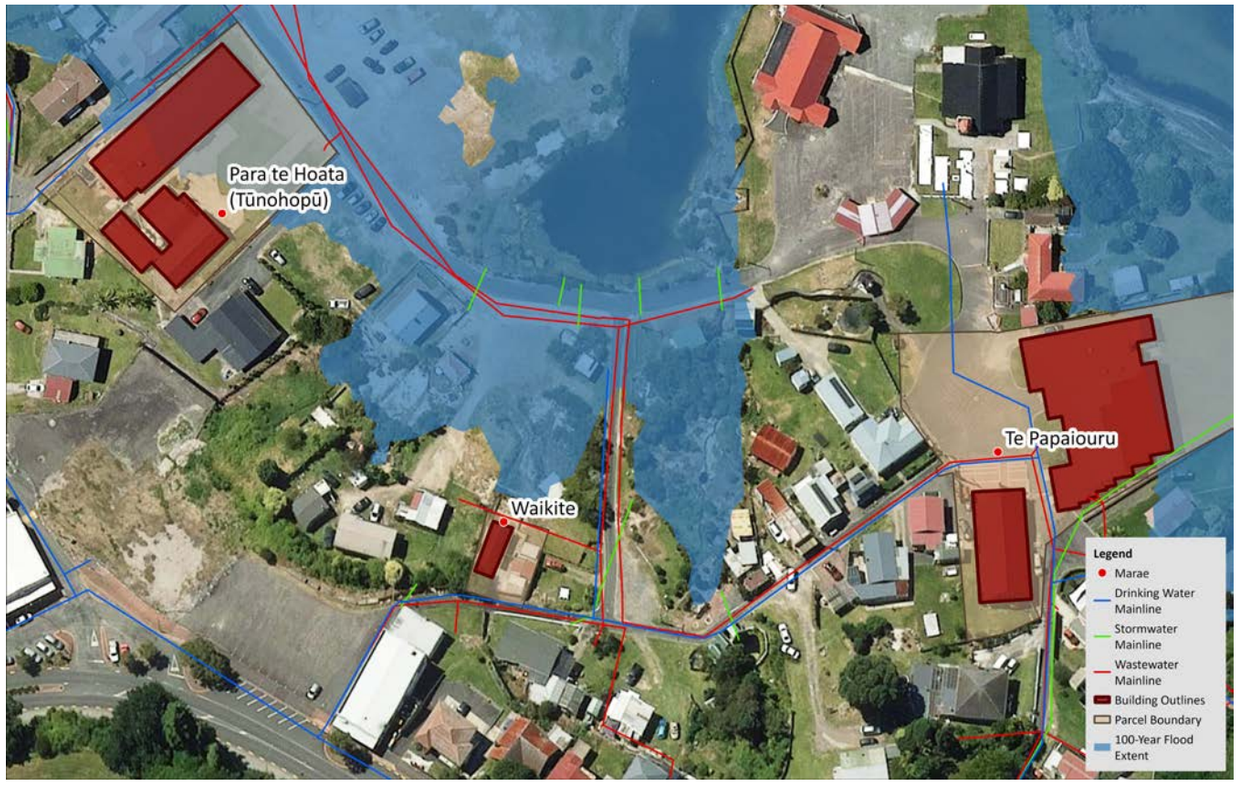
Looking further ahead, he hopes the example set by him and his brother brings more Māori into engineering and other STEM fields. The brothers regularly return to their school to speak with students about careers in engineering or other technical fields.

Vercoe's educational background gave him a perspective he now regards as a strength. Others see that quality as well.

"Haukapuanui is a great example of Māori leadership in engineering," said Te Rina Triponel, strategic communications partner at the University of Auckland, which is also known by its official Māori name, Waipapa Taumata Rau. "Vercoe's work has provided a valuable template for starting conversations about how we design, strengthen, and sustain marae infrastructure for the future." **AN**

"A picture is worth a thousand words, but a map is worth ten thousand."

Haukapuanui Vercoe



Opposite page:
Vercoe stands on the porch of a marae building in Aotearoa New Zealand. His research uses ArcGIS technology to help Māori communities better understand their exposure to natural hazards.

This page:
Vercoe created maps of hundreds of Māori cultural complexes around New Zealand, showing environmental risks such as 100-year flood areas (shaded blue) in relation to buildings, water lines, parcel boundaries, and more.

How Does Your Map Sound?

Perspectives on Cartography

By Georg Gartner, International Cartographic Association

Imagine walking into a concert hall. The orchestra is seated. The conductor raises the baton, and within seconds you can distinguish the melody from the harmony, the rhythm from the counterpoint. You do not consciously analyze each note; everything fits together. The music guides you. It tells you where to focus, when to expect change, when to relax, and when to be surprised.

Now imagine opening a map. At first glance, maps and music appear to have little in common. One speaks to our ears, the other, in many cases, to our eyes. One unfolds over time, the other seems frozen on paper or static on a screen. Yet perhaps they are more closely related than they seem. What if every map has its own soundtrack? What if the best maps are not only seen but also heard?

The comparison is more than a metaphor. It reveals something fundamental about how maps work.

Every piece of music begins with **rhythm**. Rhythm provides structure, repetition, and expectation. Without it, music is difficult to follow.

Maps have rhythm, too. Think of a city map. Streets repeat at regular intervals. Building blocks establish patterns. Contour lines create visual beats across a landscape. The spacing of labels guides the eye naturally across the page or screen. Good cartographers know that visual rhythm helps readers navigate almost subconsciously. Bad rhythm creates visual noise.

Then comes the **melody**. The melody is the part of a song we remember. It stands out from everything else.

Maps also have melodies. The route highlighted on a navigational map. The river winding through a valley. The migration path crossing continents. The thematic symbols revealing the spread of a disease or the distribution of renewable energy. Every successful map has a visual melody—the element that immediately attracts viewers' attention and tells the story.

Everything else supports the melody. In music, **harmony** enriches the melody without overwhelming it. Chords create depth and atmosphere, providing context.

The same happens in cartography. Background colors, terrain shading, subtle administrative boundaries, vegetation, and water bodies often remain in the background. They're rarely the focus of the map but help the central message make sense. Without harmony, the melody sounds empty. Without context, the map loses meaning.

Dynamics play another crucial role. Through crescendos and decrescendos, music constantly changes volume. Some passages whisper, others explode. These changes elicit emotion and direct listeners' attention.

Maps also use dynamics—visually rather than acoustically. Contrast, color intensity, line width, transparency, topography, and symbol size all determine what appears loud and what remains quiet. A bright red line demands immediate attention, while a pale gray road quietly supports orientation. Skilled cartographers compose these dynamics carefully. Not everything can be loud at the same time. If every instrument plays fortissimo, the audience hears only noise. If every map symbol is bright and bold, viewers see a mess.

Tempo offers another parallel. Music can be fast or slow, energetic or contemplative.

Maps control pace, too. A clean tourist map enables quick decision-making. An atlas encourages exploration. A historical map invites careful reading. Interactive digital maps let users control the tempo themselves by zooming, filtering, or revealing additional layers. Good cartography doesn't simply provide information; it controls the speed at which information is discovered.

One of the strongest parts of the analogy lies in **orchestration**. An orchestra consists of dozens, sometimes hundreds, of individual musicians. Each instrument has its own characteristics, strengths, and limitations. None is inherently more important than another. Success depends entirely on how they play together.

Maps are orchestrations of graphical elements. Points, lines, polygons, colors, labels, textures, diagrams, legends, and scale bars all perform different roles. A map where every element competes for attention resembles an orchestra where every musician insists on playing the solo. Technically impressive, perhaps, but impossible to enjoy.

Good cartography, like good music, requires restraint. **Silence** is important. The greatest composers understand that silence is not the absence of music—it is part of the composition. A pause allows listeners to breathe and creates anticipation.

Maps also need silence. White space is often misunderstood as unused space. In reality, it offers visual breathing room. Empty areas separate information, clarify structure, and reduce cognitive load. Many beginners try to fill every corner of a map with information. Experienced cartographers know that sometimes the most important part of design is deciding what to leave out.

Perhaps this is where cartography and music are most alike. Neither is simply about transmitting information. A musical score contains notes, but music emerges only when they are interpreted. A map contains geographic data, but spatial understanding emerges only when someone reads it.

Both require composition. Both require interpretation. Both depend on balancing complexity with simplicity.

Interestingly, neither discipline aims for perfect realism. A symphony does not reproduce every sound in nature. It selects, arranges, exaggerates, simplifies, and structures sound to create meaning.

Maps do exactly the same thing. They are not mirrors of reality. They are carefully designed interpretations of reality. Every mapmaker decides what to include, omit, emphasize, and suppress. In that sense, every map is a composition.

Today, AI tools can generate maps in seconds. Algorithms can optimize layouts, classify imagery, and personalize visualizations for different users. Yet AI struggles with something musicians know instinctively: timing, balance, expression, and emotion.

A technically correct musical performance is not necessarily a beautiful one. The same is true for maps.

The future of cartography may resemble the role of a conductor rather than that of a drafter. Cartographers increasingly guide intelligent systems instead of drawing every line themselves. But their responsibility remains unchanged: ensuring that every visual element contributes to a coherent whole.

The next time you unfold a map—or design one yourself—try asking a new question. Not, "How does it look?" Rather, "How does it sound?"

Does your map have rhythm? Is there a clear melody? Are the supporting voices balanced? Does it whisper when it should and shout only when necessary? Does it leave enough silence between the notes?

Because the finest maps are like the finest music: They resonate long after we have stopped looking at them. **AN**

About the Author

Georg Gartner is a full professor of cartography at the Vienna University of Technology in Austria. He is currently serving his second term as president of the International Cartographic Association.

Perspectives on Cartography is a column from the International Cartographic Association (icaci.org).

HUMAN JUDGMENT: THE ESSENTIAL ELEMENT OF RESPONSIBLE GEOSPATIAL AI

From the Meridian

By Shaowen Wang, University of Illinois Urbana-Champaign

As geospatial AI grows more powerful, its future hinges on more than technological innovation. While AI tools can process vast amounts of data at remarkable speed, they cannot decide which questions matter most, which assumptions are sound, or which societal values should shape their use.

The Institute for Geospatial Understanding through an Integrative Discovery Environment (I-GUIDE)—a National Science Foundation-funded research institute led by the University of Illinois Urbana-Champaign—bases its AI work on a simple but critical vision: Responsible geospatial AI requires human judgment, expertise, and stewardship.

This vision fuels I-GUIDE AI, the institute's AI and data discovery tools that help researchers connect geospatial datasets, workflows, and other digital knowledge elements. It should also steer how other geospatial technology practitioners make use of AI.

Use of Geospatial AI Demands Responsibility

Geospatial intelligence—the ability to analyze, understand, and reason about phenomena across space and time—is foundational to tackling many of society's greatest problems. Disaster resilience, biodiversity conservation, public health, transportation, energy systems, agriculture, and urban planning all rely on geospatial intelligence to reveal how people, places, and processes interconnect. The emergence of geospatial AI, which integrates AI with geospatial data and geographic reasoning, offers transformative opportunities to enhance understanding of complex, real-world systems and accelerate scientific discovery.

Yet realizing geospatial AI's potential comes with significant responsibilities. Geospatial data represents real communities and environments. Decisions informed by geospatial AI can affect how resources are allocated, risks are evaluated, and policies are developed.

Geospatial AI's unprecedented ability to unearth patterns in large and complex datasets needs human guidance to ensure the results are accurate, transparent, ethical, and actionable. Humans must frame research questions, evaluate evidence, interpret results, identify bias, and determine whether the AI-generated insights are appropriate for a given context.

To Use AI Well, Abide by These Principles

I-GUIDE AI follows three core principles to support the conscientious use and development of AI.

- **Emphasize transparency, accountability, reproducibility, and trust in data-driven decision-making.** Users must be able to understand where knowledge originates, how conclusions are generated, and whether those conclusions can be independently validated.
- **Encourage critical spatial thinking so AI aids scientific inquiry without replacing human decision-making.** Understanding geographic processes demands more than identifying statistical relationships or detecting patterns in data. It requires grasping the underlying spatial context; asking informed questions; evaluating competing explanations; and interpreting evidence within broader environmental, social, and historical frameworks.
- **Democratize access to geospatial data and AI.** Historically, advanced computational resources, large datasets, and sophisticated analytical tools have only been available to well-resourced institutions and experts. I-GUIDE AI lowers these barriers by providing data resources and AI-enabled capabilities on an open, accessible platform. This empowers broad communities of researchers, educators, students, policymakers, and practitioners to discover, innovate, and solve problems.

These principles are realized through the I-GUIDE Platform (platform.i-guide.io), an AI-powered cyberinfrastructure ecosystem that connects data, computational resources, analytical methods, educational content, and domain expertise from across disciplines. Rather than treating data, models, and publications as isolated resources, I-GUIDE fosters an integrative environment in which various communities can share, connect, validate, and extend their knowledge.

From the Meridian is a column from the American Association of Geographers (aag.org).

Through multidisciplinary collaboration and community engagement, I-GUIDE encourages innovation via geospatial data science to address scientific and societal challenges.

How to Connect People and Ideas to Advance Knowledge

At the heart of I-GUIDE is convergence research—the integration of knowledge, data, and expertise from diverse disciplines to tackle complex challenges that no single field can solve alone. Realizing the full potential of such collaboration requires innovative approaches for connecting people, data, models, and ideas.

To guide this effort, the I-GUIDE AI research and development agenda centers on three fundamental questions:

- **What are the building blocks of a Convergence Knowledge Network (CKN)—the collaborative framework that links the people collectively working on a problem?** Traditional forms of scientific knowledge—including publications and reports—exist alongside new forms, such as datasets, computational notebooks, software code, workflows, machine learning models, and visualizations. Both types of knowledge are important. I-GUIDE AI recognizes that convergence research should leverage digital knowledge elements.
- **How can various research communities collaboratively construct and validate such a network?** Scientific knowledge production is inherently social. It advances through collaboration, peer review, evaluation, replication, and continual refinement. I-GUIDE relies on contributions from researchers, educators, and practitioners across many disciplines and institutions through streamlined workflows that support documentation, sharing, quality control, and validation. What results is an evolving and dynamic network of knowledge that encourages cross-pollination. Research papers reference datasets. Datasets are generated by computational workflows. Software tools analyze multiple datasets. Educational materials draw on published findings and analytical methods. These connections reveal not only individual pieces of knowledge but also the pathways through which knowledge is created, validated, and extended.
- **How can new knowledge be discovered by harnessing CKNs at scale?** As CKNs grow, AI systems can go beyond information retrieval. If an AI model recognizes relationships among datasets, methods, publications, and communities, it can help researchers identify relevant resources, uncover connections, recognize emerging trends, and generate new hypotheses.

The Bridge Between AI and Human Understanding

A distinctive aspect of I-GUIDE AI is its emphasis on spatial grounding: Whenever possible and appropriate, each digital knowledge element is associated with its geographic context. This grounding is essential because location often aids understanding of environmental processes, human activities, social dynamics, and infrastructure systems. Spatial grounding helps ensure that AI-generated insights remain connected to real-world places and conditions.

This commitment to spatial grounding enhances interpretability and trust. Researchers can more easily trace conclusions back to their underlying data, understand the geographic contexts in which observations were made, and evaluate whether findings are applicable to new locations or environments. Spatial grounding serves as a bridge between AI and human understanding.

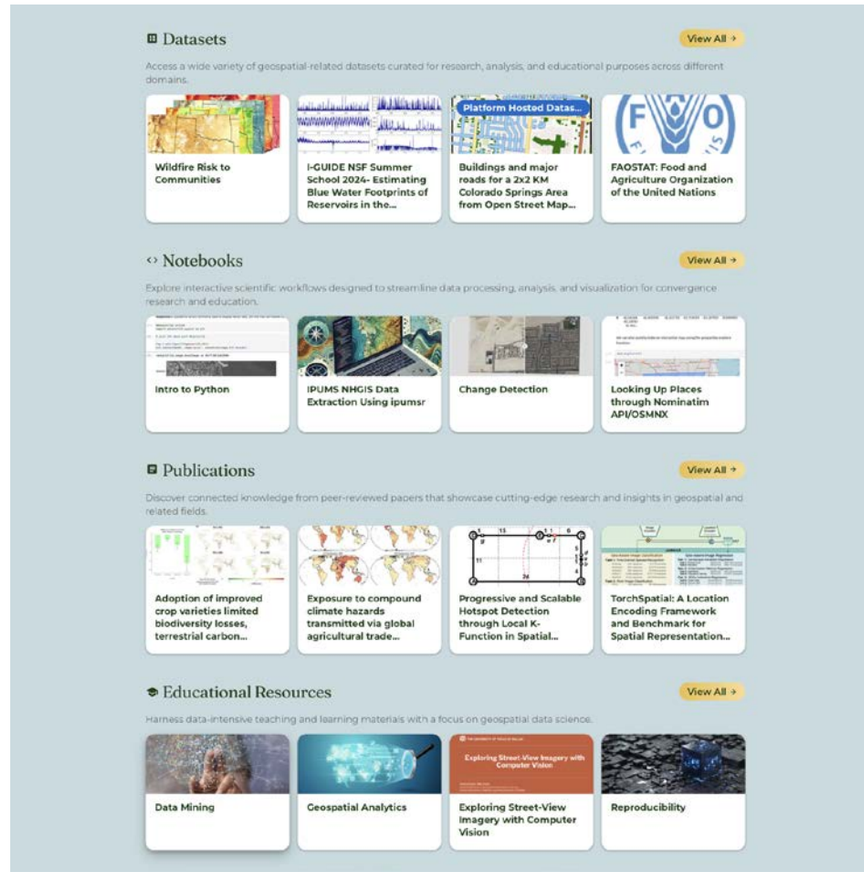
I-GUIDE AI is a vision for the future of geospatial AI—one in which human expertise and AI work together. Rather than replacing human judgment, AI should augment human capabilities by expanding access to knowledge, accelerating analysis, and revealing patterns. Human guidance ensures that these capabilities are used responsibly, ethically, and effectively.

In this vision, responsible geospatial AI is not merely a technical achievement. It is a collaborative endeavor that places critical spatial thinking and human understanding, accountability, and stewardship at the center of innovation. AN

About the Author

Shaowen Wang is the founding director of the CyberGIS Center for Advanced Digital and Spatial Studies at the University of Illinois Urbana-Champaign. He holds several faculty appointments at the university and leads I-GUIDE (funded by the National Science Foundation under award number 2118329).

Digital knowledge elements include datasets, computational notebooks, software code, workflows, machine learning models, and visualizations.



Carrying Forward a Lifetime of Service

Every year, floods, earthquakes, typhoons, and hurricanes cause unfathomable damage to communities all over the world. When they do, responders know whom to reach out to: GISCorps.

A program of the Geospatial Professional Network (GPN), GISCorps has attracted over 12,000 prospective volunteers from 162 countries and launched more than 380 missions worldwide since 2003.

But the organization does more than assist with disaster response. It also helps nonprofits develop maps and apps, review and collect datasets, conduct GIS training, and more. So far in 2026, more than 500 GISCorps volunteers have contributed their expertise to 14 completed disaster and non-disaster missions, with more in progress.

GISCorps is powered by the tireless work of volunteers. Yet its origins can be traced back to one person: Shoreh Elhami, who built the organization one spare evening at a time.

Giving Time

Elhami's path to founding GISCorps wasn't a straight line. Trained as an architect and urban planner in her native Iran, she eventually enrolled in a master's program in city and regional planning at The Ohio State University. As a research assistant, she got her first real taste of GIS and realized it could do in minutes what she had spent years doing by hand.



The Mission Statistics dashboard displays how many GISCorps missions have been launched, completed, and are in progress across the world.

GIS soon became the center of Elhami's career. She created one of the first GIS-driven county comprehensive plans as a GIS coordinator for the Delaware County Regional Planning Commission. She then joined the Delaware County Auditor's GIS division, where she and her team built the county's first land information system from the ground up. She taught GIS classes as an adjunct for 11 years. And in 2013, she was hired by the City of Columbus as a GIS manager, then promoted to an enterprise data architect to lead the city's data and analytics services program, supporting hundreds of datasets and dozens of apps.

Since Elhami first began developing the idea of GISCorps, she has spent part of nearly every weeknight and weekend reviewing mission requests, vetting volunteers, writing job descriptions, coordinating logistics, and staying personally involved with missions. Her participation has always been an unpaid commitment.

"It's what I do and love," she said. "Nothing makes me happier than helping someone whom I feel our expertise can help."

The Real GIS Heroes

Elhami has always insisted that the volunteers are the real story.

"There's nothing like meeting people who are like-minded, like-hearted," Elhami said of the GISCorps volunteer community.

The first volunteer requests arrived following the 2004 Indian Ocean tsunami and Hurricane Katrina the following year, when 40 volunteers stepped up to support disaster response. In the early years, most missions focused on GIS training in the United States and countries such as Afghanistan, as well as building apps and datasets for nonprofits.

As GIS technology advanced, more requests could be fulfilled virtually, although on-site missions continued. In 2014, for example, the World Health Organization (WHO) asked for volunteers to travel to four countries in West Africa to help map the Ebola response. In 2017, WHO turned to GISCorps again to support its polio eradication program, this time virtually. More than 270 volunteers from 20 countries contributed over 5,400 hours, placing more than 760,000 structure points in one of the largest GISCorps virtual missions.

That same year, GISCorps established a team called PhotoMappers, who have participated in more than 60 disaster response missions. This coincided with the start of another program, in partnership with Esri, called the GIS Service Pledge (GSP). Esri donates a one-year ArcGIS for Personal Use license to each GISCorps volunteer who commits to contributing their expertise to a worthwhile cause. Seventy GSP projects have been completed so far, and the program is growing.



GISCorps recruits thousands of volunteers, each with their own subject matter expertise, from hundreds of different countries.

The Search for an Executive Director

GISCorps faces a new challenge. Elhami has been diagnosed with a rare form of brain cancer. She has chosen to share this news with the GIS community because she wants GISCorps to be in strong, capable hands—and because *ArcNews* readers represent the community she and her team have spent two decades calling on to show up for others. Now, the organization needs someone to show up for it.

The organization has so far been sustained almost entirely by the unpaid efforts of its founder, core committee, advisory board, and volunteers. It is a model that has taken GISCorps further than anyone could have predicted.

That's changing. GISCorps is searching for its first paid executive director—someone who can continue to shape how the GIS community shows up for the world's most vulnerable people in their time of need, from earthquake zones to Ebola treatment centers.

And it could be you.

Given the limitless energy Elhami has poured into GISCorps, it's hard to imagine anyone stepping into her shoes. But the invitation is simple: If you're a skilled GIS professional, have mapped for GISCorps, or simply believe that GIS skills are worth volunteering when they matter most, this is the time to step up. The organization Elhami and her team built one late night at a time is ready for someone to carry it into its next chapter. **AN**



Shoreh Elhami has spent more than two decades building up GISCorps alongside her work as a GIS manager and teacher.

Role at a Glance:

GISCorps Executive Director, GIS and Humanitarian Programs

Time Commitment:
Part-time, approximately 10 hours per week (fully virtual)

Compensation: ~$50/hour

What You'll Do

- Provide GIS technical advice and strategic guidance to GISCorps leadership and volunteers
- Assess the feasibility of incoming project requests from partner organizations
- Join the monthly core committee meetings, plus roughly four to five partner-agency meetings a month
- Guide the program coordinator on processes and organizational matters
- Represent GISCorps at GIS and nonprofit events (one to two times a year)
- Help chart a sustainable fundraising path for GISCorps's staffing and technology needs

What You'll Bring

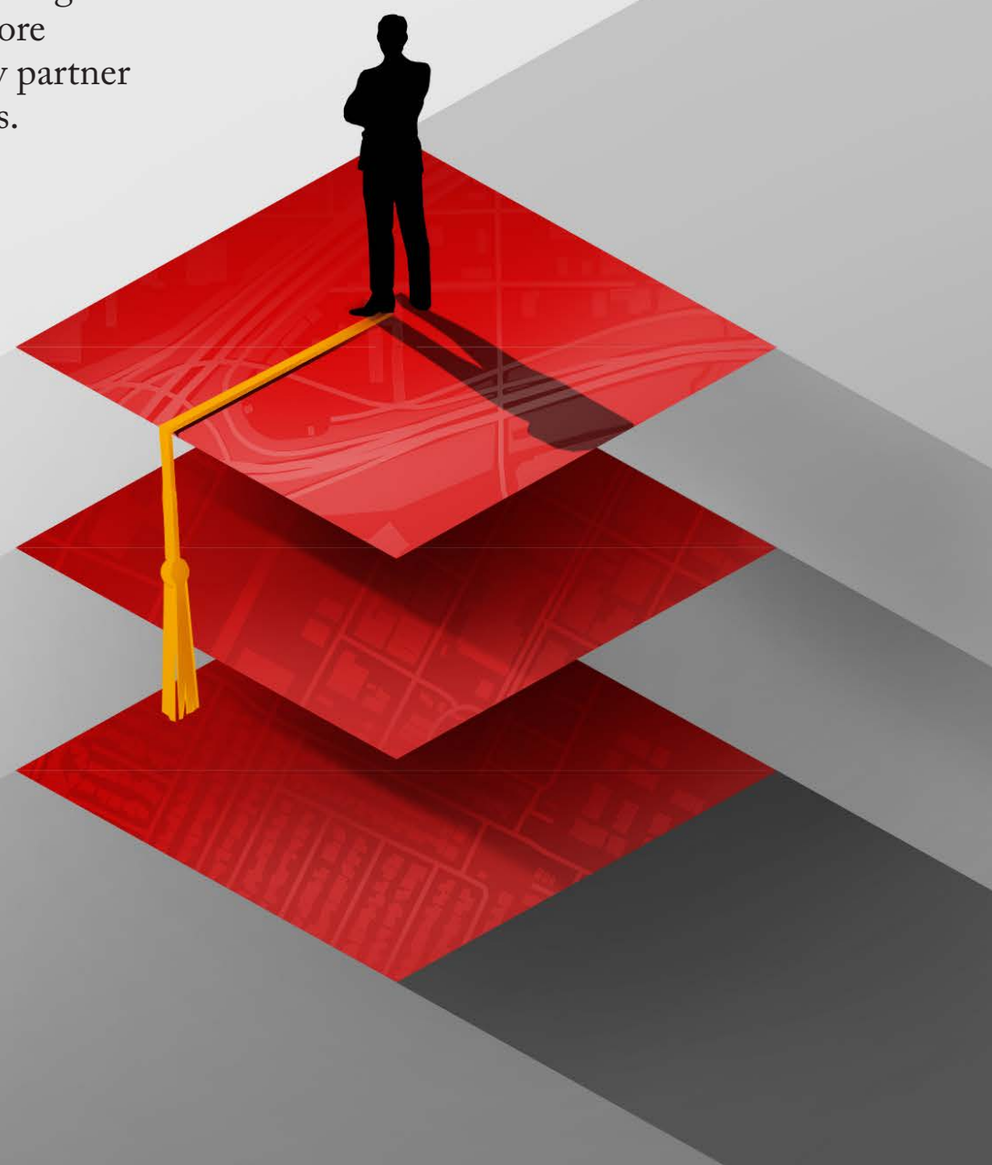
- 10+ years of professional GIS experience, including project or technical leadership
- Knowledge of GIS domains such as web GIS, spatial analysis, geospatial data management, remote sensing, and project management
- Nonprofit, humanitarian, volunteer-led, or government GIS leadership experience is highly desirable
- Strong communication and collaboration skills

To carry on the vital work that GISCorps does all over the world, submit a cover letter and résumé to advisoryboard@giscorps.org by November 9, 2026. More details can be found at links.esri.com/giscorpsjob.

The Future of GIS Depends on Who Leads It

By Lou Leonard, Clark University,
and John Wilson, University of Southern California

In recent decades, geospatial thinking has fundamentally changed how people see and understand the world. Today, the GIS industry is undergoing an era of profound change, and solutions grounded in geospatial thinking are needed to guide us in a complex future. It's more important than ever that universities and industry partner on a new approach to cultivate tomorrow's leaders.



Over the last year, Clark University and the University of Southern California (USC) have collaborated with the World Geospatial Industry Council (WGIC) to create a first-of-its-kind leadership credential: the Doctor of Geospatial Leadership (DGEO). This is not a typical research PhD. As with disciplines like medicine and law, this is a professionally focused terminal doctoral degree. The executive program prepares leaders with the technical understanding of a rapidly changing field and the business acumen to lead organizations in dynamic times.

Traditionally, the geospatial sector has largely been specialized, technical, and siloed. GIS professionals operated in their own corner of organizations. Rarely did they or their work have a place at the decision-making table.

GIS increasingly underpins decision-making across many fields like land-use planning, agriculture, architecture, engineering, construction, logistics, public health, emergency management, and insurance. This shift has been accelerated by innovations in remote sensing, digital twins, AI, cloud computing, and advanced analytics. New technologies and approaches have made spatial intelligence central to tackling some of the world's biggest challenges, such as climate resilience and public health. The sector's leadership needs are growing.

As leaders of two institutions with deep roots in spatial sciences and geospatial innovation, we see the GIS industry's rapid transformation as nothing short of extraordinary. It has grown from a discipline restricted to university labs and company basements to a living nervous system for global decision-making.

With these seismic changes, what organizations and businesses need from geospatial professionals and the programs that train them has also changed.

Research by the WGIC has identified a widening gap between the education currently available to geospatial professionals—including in university settings—and the capabilities employers need. This is particularly relevant at the management level and among mid-career professionals seeking to advance into leadership.

As educators, this research was sobering. It is also a call to action. To serve both the evolving geospatial discipline and society writ large, academia must move beyond merely training technical specialists. We need to train leaders. And we can only do this through deep partnerships within the industry itself.

Many mid-career GIS professionals have spent years developing deep technical expertise in a subspecialty of the sector, but not all of them have the business skills to manage teams and budgets, navigate organizational change, and develop strategies to adopt new technologies. As geospatial technology is embedded in organizations, and as that technology evolves, the people responsible for it must also acquire the leadership skills necessary to use it effectively. This is exactly what the new DGEO programs at Clark and USC will teach.

Designed in collaboration with WGIC and its more than 50 member organizations, including Esri, TomTom, Trimble, and Oracle, the programs will leverage the relationships cultivated by the Clark Center for Geospatial Analytics and the USC Spatial Sciences Institute. Participants will learn through real-world problem sets—often those they will bring from their current positions—and from current industry leaders.

DGEO programs are designed for mid- to senior-career professionals with some experience in geospatial roles and interest in advancing as organizational leaders. The program's low-residency, cohort-based format allows students to maintain their current roles while preparing to lead geospatial enterprises, innovation teams, and data-driven organizations at the highest level. Applications are now open and the first cohort begins summer 2027.

This new professional degree is vital for the geospatial industry, but also for the health of the wider world. Extreme weather and other natural and geopolitical threats are dominating headlines. Communities, businesses, and governments need adaptive, data-informed systems to understand what's happening and identify solutions they should implement. Spatially enabled precision agriculture platforms, for example, are needed to optimize crop yields and conserve water during severe droughts. Similarly, geospatial workflows allow emergency responders to model real-time wildfire behavior and deploy resources ahead of a blaze. Better-prepared geospatial leadership means more effective ways to build and operate infrastructure. It means determining whether initiatives support circular economies, stronger livelihoods, and climate resilience.

Investing in leadership today will guide how effectively rapidly advancing technologies can be translated into solutions that tackle future-defining challenges.

Technology doesn't drive progress on its own—people do. As AI, analytics, and other emerging technologies reshape the geospatial industry, the quality of its leadership will determine what those advances actually accomplish. Strong leaders can turn new capabilities into better decisions and greater public benefit and impact. At Clark University and USC, we want to play our part in enabling the geospatial industry to chart a course for a more sustainable and rewarding world. **AN**

About the Authors

Lou Leonard is the inaugural dean of the School of Climate, Environment, and Society at Clark University in Massachusetts. Previously, he was the dean of the Falk School of Sustainability and Environment at Chatham University and a visiting scholar at the Environmental Law Institute in Washington, DC. Leonard also served as senior vice president for climate and energy at the World Wildlife Fund for over a decade. John Wilson is a professor of spatial sciences and sociology in the Dornsife College of Letters, Arts and Sciences at USC, where he is the founding director of the Spatial Sciences Institute and a professor in the School of Architecture, the Viterbi School of Engineering, and the Keck School of Medicine.

Clark University and USC will be among the first institutions to offer a Doctor of Geospatial Leadership program.



What AI Skills Do GIS Managers Need?

By Matthew Lewin,
Esri Canada

Managing GIS

GIS managers have always needed unique skills to succeed in their role. But agentic AI in GIS comes with integration challenges, budgeting considerations, and team-building demands that didn't exist even two years ago. To run and grow a GIS program in this new era, every manager must have and hone five new skills.

1. Design GIS infrastructure for agent use

Agentic AI introduces a major design challenge for GIS infrastructure: Your system must accommodate agents in addition to people—and AI lacks the context to navigate the peculiarities of geospatial data and tools.

This architectural shift has practical implications across several areas:

- **Data readiness**—Not all datasets are ready for an agent. Some have quality issues, while others have informal caveats or context that only your team understands. You need a way to evaluate which datasets are agent-ready and provide instructions for appropriate use.
- **Metadata and documentation**—There's a difference between metadata written for a GIS analyst who understands conventions and metadata written so an AI model can decide whether a layer is appropriate for a given query. You must describe data and services to steer agent behavior rather than just inform human users.
- **Tool and service provisioning**—When an agent connects to your GIS environment, which geoprocessing tools does it have access to? Which data layers? Which services? This is like provisioning a new employee's toolbox, except that a person will ask for clarification; an agent will use whatever you give it.
- **Connectivity**—GIS managers must understand how agents connect to and interact with spatial infrastructure. That includes API exposure and the protocols through which large language models (LLMs) call spatial services. You don't need to build this yourself, but you need to know enough to make informed decisions. An agent that queries a published feature service, for instance, is different from one that has direct access to your geodatabase or geoprocessing tools. The scope of what it can read, write, and execute depends on how it's connected. If you don't understand those distinctions, you could inadvertently introduce usage and data access risk.

Consider a company whose operations team and environmental team each maintain spatial layers with the same field. For each team, the field means something different. A human analyst won't confuse these, but an agent lacks context to tell them apart without machine-readable documentation.

2. Decide what agents do and what people do

Five years ago, no GIS manager had to ask this: Which workflows stay human, which go to agents, and which are hybrids with human checkpoints along the way? Now, it's a daily conundrum!

Currently, LLMs and the agents they power are weak at performing certain spatial tasks. When it comes to precise coordinate math, topological reasoning, and map projections, agents confidently produce wrong answers if you let them. Knowing where agents are likely to fail is a new form of technical literacy.

The division of labor between humans and agents is an operational design question with real consequences. If you get it wrong in one direction, you've automated workflows that need human judgment—and potentially introduced a cascade of errors. Get it wrong in the other direction, and you risk inserting so many human checkpoints that you recreate the manual process with extra steps.

For each workflow, assess the cost of an error. How well can an agent handle the spatial reasoning involved? Where should a human review before the output goes further?

Say your team handles environmental impact assessments. A colleague suggests an agent could handle the initial screening phase, but you know that screening involves subtle spatial judgments, such as determining whether a wetland boundary is accurate or based on outdated imagery. How do you proceed? A pragmatic approach is to have the agent assemble the data package and run the analysis, then have a human analyst review the results before it reaches a stakeholder. That checkpoint still lets you capture most of the agent's efficiency while protecting against errors that could come back to bite you.

3. Consider the economics of agent-mediated work

Traditional GIS expenses are mostly predictable. They are based on licenses, full-time staff, and cloud-based consumption costs. But AI agents take consumption-based outlays to another level. Every query, analysis, and output carries a cost tied to compute cycles, API calls, and token-based AI services. Those costs can scale in hard-to-predict ways.

This creates three economic challenges that GIS managers must get comfortable with:

- **Take economics into account**—Find out what a single agent-driven analysis costs, and compare that to a human doing the same work.
- **Manage demand**—When spatial analysis takes two minutes instead of two hours, demand surges. Managing that is a new operational challenge.
- **Build the return-on-investment case**—What is it worth when an agent that costs $1,500 per month frees up 15 hours of analyst time for strategic work?

Say you roll out an agent that automatically generates vegetation management maps. It does in minutes what used to take hours. It's a hit, and you expand the pilot to all field operations. Six weeks later, your cloud compute charges have tripled. You failed to properly scope the volume of central processing unit (CPU) cycles and token generation required to scale to this level. A capable GIS manager understands these AI economics and establishes usage guardrails before the pilot expands.

4. Assure quality at agent scale

Because AI agents operate at unprecedented speeds, quality assurance (QA) can outpace your team's capacity. How do you avoid this without rubber-stamping tasks just to get them off your desk?

When a GIS team produces five maps or datasets each week, it's easy to keep up. But when an agent generates 500 outputs in the same period, QA becomes harder to handle.

GIS managers must design QA processes that work at agent speed and volume. One method is to shift from reviewing every output to defining error rates for different use cases, then randomly sampling outputs. Different use cases will naturally have distinct acceptable error rates.

This also means building audit trails. When an agent produces a spatial output, you need to be able to reconstruct what happened. What data did it consume? What operations did it perform? What data was the model trained on?

Previously, when something went wrong with a map or analysis, you could walk over to the analyst's desk and ask what happened. In an agent-driven workflow, observability and traceability should be built into the process. Otherwise, your agent-driven spatial work might not be trustworthy enough to use.

A residential zoning inquiry might tolerate a higher error rate than an infrastructure setback calculation that informs a construction permit. The latter is more spatially sensitive and requires high precision. But the process remains the same: Build automated checks that flag anomalies without requiring a human to review every result.

5. Govern agents and mitigate risk

With agentic AI, agents themselves must be governed alongside geospatial data. This means dealing with new risks.

Who in your organization can deploy an agent that consumes your spatial data and services? What approval process do they go through? What are agents permitted to do—perform read-only queries or publish outputs, modify data, and trigger workflows? These questions need clear answers. Yet in most organizations today, nobody has written the policies.

As a GIS manager, you're the best person to raise these questions because you understand what can go wrong with spatial data. While you'll need stakeholders to weigh in, you should kick-start the conversation around governance for geospatial agents.

When an agent produces an inaccurate spatial output, who owns that? Is it the GIS team because they published the underlying data, or is it the business unit that deployed the agent to serve a customer?

GIS managers must still understand GIS capabilities, articulate the technology's value, manage costs, know the latest integrations, build teams, govern data, and track the direction of the industry. Those skills haven't changed. But agentic AI adds new complexities that demand focus. If you build these skills now, you won't just keep up with change—you'll lead the way. AN

About the Author

Matthew Lewin is the director of management consulting for Esri Canada. He provides organizations in the public and private sectors with practical strategies that enable GIS as an enterprise business capability.

What's New from Esri Press

Geowater: A Geographic Approach to Water Data and Forecasting

By David Maidment

Geowater asks readers to rethink how we use data and technology to confront water scarcity, flooding, and environmental change. By linking global processes to local consequences, hydrologist David Maidment shows how applying the geographic approach to water is key to building a more resilient future. In this excerpt from the book, explore the challenges and powerful solutions at the heart of how we understand, model, and manage one of Earth's most vital resources.

The Geographic Approach to Water Forecasting

Forecasting water flow in streams and rivers today has become as ubiquitous as weather forecasting—available everywhere, all the time. It wasn't always that way, but in 2015 a new National Water Center opened on the Tuscaloosa campus of the University of Alabama. The National Weather Service established the center to provide a national focus for water forecasting in the United States. A year later, the release of the nation's first National Water Model allowed the National Weather Service to continually forecast water flows that eventually covered 3.2 million miles of streams and rivers in the continental United States.

Fast-forward to early April 2025: When rain-swollen floodwaters swept across swaths of the Midwest and South, the National Water Prediction Service published flood inundation maps on its website that went viral, with more than 20 million hits per day. With those maps, real-time flood information had entered the public consciousness.

Just three months later, on the Fourth of July, 2025, a devastating flood struck the Guadalupe River in central Texas as dawn approached. In 90 minutes, water levels rose more than 32 feet where the river runs through Kerrville in the Texas Hill Country, northwest of San Antonio. The flooding killed more than 130 people, including many children at a summer camp along the river. The tragedy showed that flood maps by themselves are not enough to save lives. People in the path of floods also must receive warnings and other information derived from these maps quickly so they can escape danger in time.

We still face many challenges when it comes to communicating flood forecasts in a timely and accurate way. However, the transformative story of how we forecast and model water flow would have been almost inconceivable a decade ago. How did these advances come about? What do they mean for the future? I was engaged from the beginning in these developments, so I'd like to describe what has happened, and what I see going forward.

The US National Water Model

The National Water Model is built on a foundation of geographic data to describe the connection between land and water systems as precipitation falls and becomes streamflow. Although large-scale floods are regional in extent, their consequences are local and personal. Homes are washed away, cars are swept downstream, lives are lost. The ability to relate cause and effect in such events requires us to connect information geographically across a wide range of spatial scales. In addition, web communication must inform the public about the current extent of flooding and what to expect in the near future.

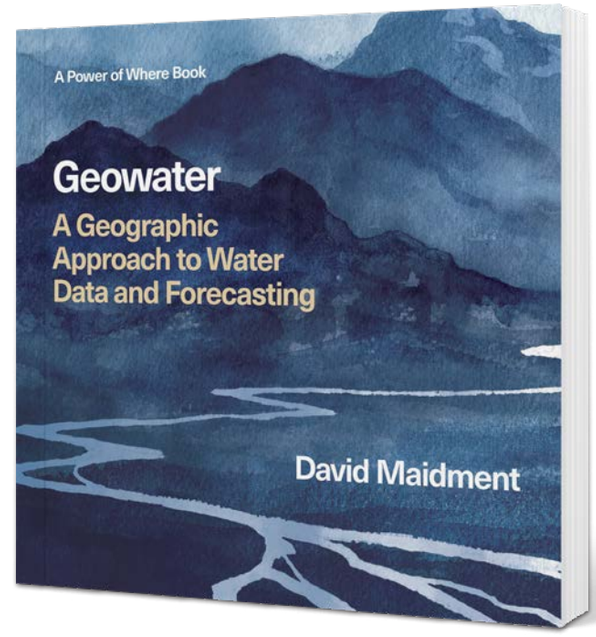
These tasks call for a geographic approach to water as described by Esri cofounder and president Jack Dangermond in his 2024 book, *The Power of Where*. As Jack explains, the geographic approach centers on the question of how to put the geographic factors that define Earth's systems into a computer so that we can see problems as relationships between phenomena. By visualizing and modeling these relationships, we can harness the computer and evolving technologies such as AI to compare vast amounts of data, make predictions, and reach new understandings to drive the smartest approaches to planning, design, and environmental protection.

GIS organizes and integrates all kinds of data and supports mapping and virtually all human activities with analysis, models, and maps full of information to transform how we address challenges and act responsibly. Within this context, water is a vast subject, vital to life, dynamic over the globe, and almost infinite in its scope and complexity.

Geowater does not attempt to tell the full story of all aspects of water but rather serves as a companion to *The Power of Where* and more specifically as a case study for the application of the geographic approach to water data and forecasting. AN

Geospatial data forms the foundation of the National Water Model, which simulates the water cycle with mathematical representations of the different processes of rainfall, evaporation, infiltration, streamflow—and how they fit together.

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



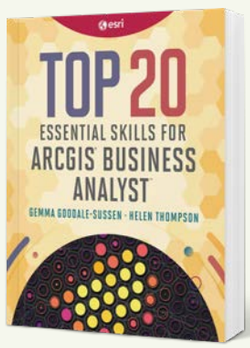


More from Esri Press

Top 20 Essential Skills for ArcGIS Business Analyst

By Helen Thompson and Gemma Goodale-Sussen

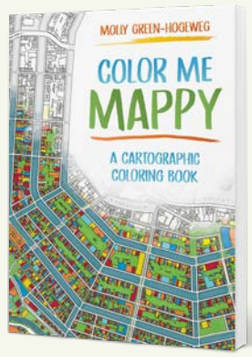
Learn how to use the world's premier data analysis software to make smarter decisions about site selection, gain insights into potential customers, easily visualize your location-based data, and more. September 2026, 268 pages.



Color Me Mappy: A Cartographic Coloring Book

By Molly Green-Hogeweg

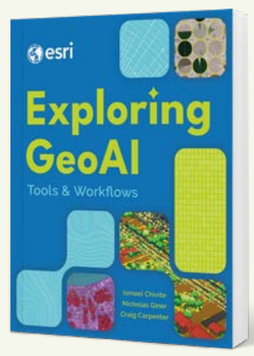
Color Me Mappy combines the beauty of cartographic detail with the joy of creative exploration, inviting you to interact with maps in a hands-on way. September 2026, 80 pages.



Exploring GeoAI: Tools and Workflows

By Ismael Chivite, Nicholas Giner, and Craig Carpenter

Learn the latest geospatial AI models and tools with *Exploring GeoAI*. This essential guide empowers readers with the practical skills to implement GeoAI and efficiently automate, predict, and optimize their work. August 2026, 168 pages.



Esri Atlas

GIS and the Coevolution of Civilization

Creating Collective Intelligence for a Sustainable Future

A Message to Geospatial Professionals



> *We need a global intelligence that matches our global impact. We are too smart for our own good, but not yet wise enough for our own survival.*

Carl Sagan
ASTRONOMER AND PLANETARY SCIENTIST

By Jack Dangermond, Esri

When I first encountered computer mapping as a graduate student at Harvard University, I was inspired by a simple idea: When we better understand geographic relationships, we make better decisions about land, natural resources, communities, and the environment. This idea has guided my life.

Introduction: **Why Now**

For nearly 60 years, I have watched GIS evolve from a little-known experimental technology into a global platform used by millions. I have had the privilege of working with early innovators and generations of geospatial professionals who have carried this field forward.

We can now observe the Earth with unprecedented clarity, integrate vast amounts of information, model complex systems, explore alternative futures, and share knowledge almost instantly.

Yet despite all this progress, I am more concerned about the future of our planet than at any other time in my life.

We have the knowledge and enabling capabilities to address many of our planet's most serious problems, but our collective response remains inadequate. The natural systems on which all life depends are rapidly deteriorating. Climate instability, biodiversity loss, deforestation, water scarcity, soil degradation, pollution, and resource depletion affect every part of the world. Some ecosystems are being damaged faster than they can recover. Others may soon be gone entirely. The cumulative human footprint has reached a scale that threatens the resilience of the planet itself.

This is not an abstract concern for me. I have spent much of my life observing, studying, mapping, and experiencing the extraordinary beauty and complexity of nature. At the same time, I have seen forests, rivers, habitats, species, and entire landscapes damaged or destroyed.

These are not simply beautiful places being lost. They are living systems that support human health, security, prosperity, and ultimately our survival.

We are living through an extraordinary paradox. Our knowledge and technological capabilities have never been greater, yet our ability to apply them collectively to the most serious challenges facing the planet remains inadequate. We possess enormous amounts of information, but we often lack a shared understanding of what is happening. We have powerful tools, but we do not always have the cooperation, coordination, or willingness needed to act at the necessary scale.

That is why I am writing this paper now.

Geospatial professionals are uniquely positioned to help society see the whole. This is now one of our profession's great opportunities and responsibilities.

I believe humanity has entered a critical period in its relationship with the Earth. The decisions we make in the coming years will influence the health of natural systems and the conditions of human life for generations. Addressing these challenges will require our best science, our most capable technologies, our creativity, and a much deeper commitment to collaboration.

I also believe the GIS and geospatial community has an essential role to play.

This paper is both a reflection and an invitation. It reflects on what I have learned from working in this field and witnessing the extraordinary contributions of the GIS community. It is also an invitation to geospatial professionals everywhere to see themselves as participants in something larger: the creation of a collective geospatial intelligence that can help humanity better understand, design, and steward its future.

GIS alone will not solve the challenges before us. No single technology or profession can. But geography gives us a way of seeing the whole. GIS gives us a framework for integrating knowledge. The Geographic Approach gives us a practical methodology for transforming that knowledge into action.

That is where you come in.

Every day, geospatial professionals bring together data, science, technology, and human experience to address real-world problems. You help people see patterns, understand relationships, evaluate consequences, and coordinate action. Your work supports nearly every type of human endeavor, including sustainable development, conservation, climate resilience, emergency response, public health, infrastructure, land management, and natural resource stewardship.

This is vital work, but the scale and urgency of today's challenges call us to do more. We must connect our individual efforts, share what we know, strengthen our institutions, and build a more comprehensive understanding of what is happening to our world and what we can do about it.

This is what collective geospatial intelligence is all about.

The decisions we make in the coming years will influence the health of natural systems and the conditions of human life for generations.



"The most important technology we are building may not be GIS or AI but our collective ability to understand and steward the Earth."





Civilization, Knowledge, and a Planet Under Pressure

Human civilization has advanced through successive revolutions in knowledge. Agriculture, science, industry, digital technology, and now artificial intelligence (AI) have steadily expanded humanity's ability to learn, innovate, and organize.

These advances have improved life for billions of people. At the same time, they have intensified humanity's impact on the Earth. Human activities now influence almost every aspect of our planet, including its climate, ecosystems, biodiversity, water systems, and landscapes.

As a result, the future of civilization and the future of the planet have become deeply connected.

In many ways, our ability to generate knowledge has advanced more quickly than our ability to apply it collectively and wisely. The challenge of the 21st century is no longer simply how to advance human progress. It is how to advance while sustaining the natural systems upon which life depends.

To understand this challenge, we must better understand the evolving relationship between humanity and nature.

"Geography gives us a way of seeing the whole."

The Coevolution of Humanity and Nature

Biologists Paul Ehrlich and Peter Raven helped popularize the concept of coevolution: the idea that living organisms evolve together through relationships of mutual influence. Plants and pollinators, predators and prey, forests and climate systems all shape one another through continuous interaction.

Today, humanity has become one of the most influential forces shaping life on Earth.

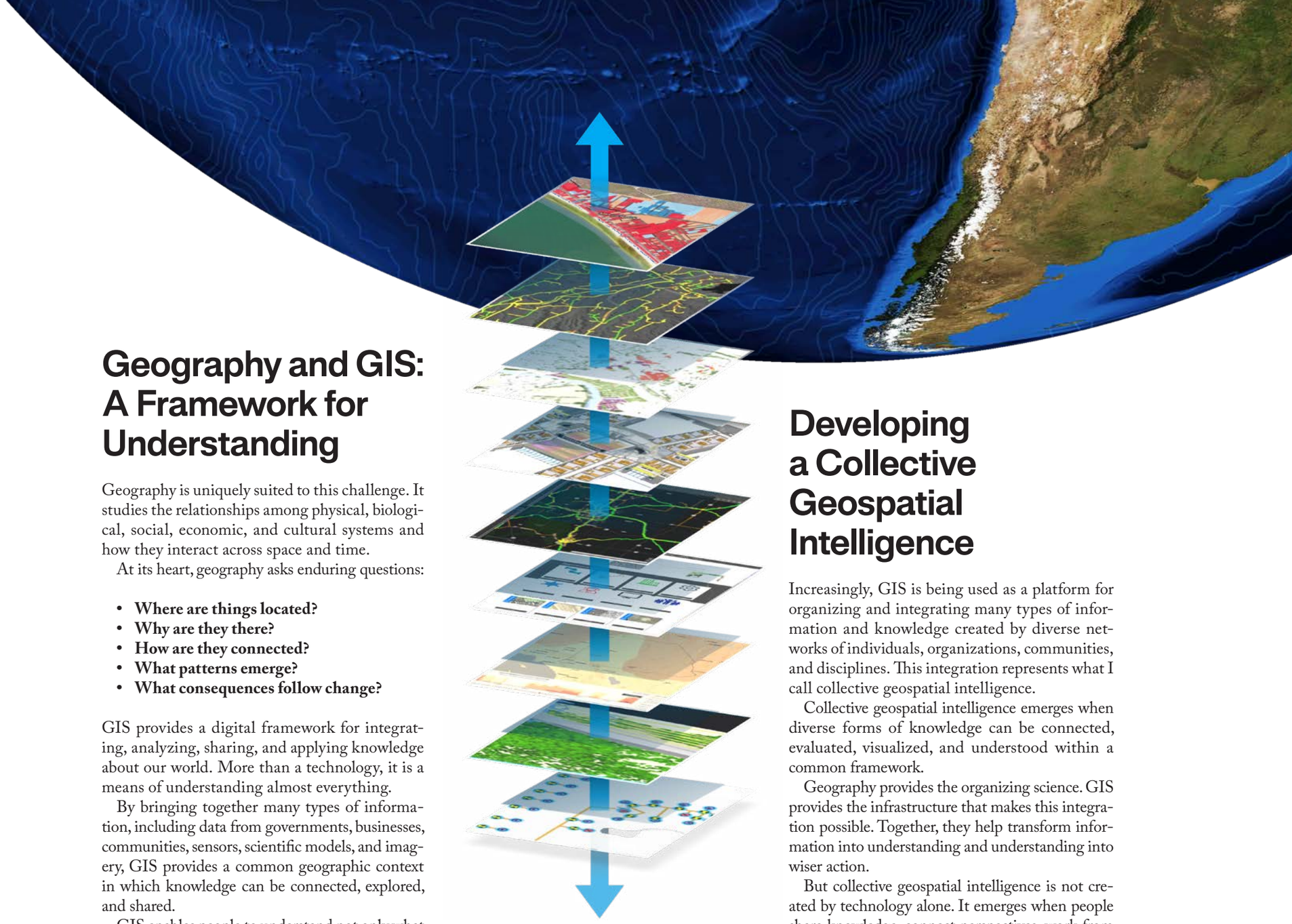
Human civilization, including our cities, economies, technologies, and population, is transforming global ecosystems, altering atmospheric conditions, reshaping landscapes, and influencing the future of countless species. At the same time, the health of natural systems profoundly affects our own prosperity, security, health, and resilience.

Droughts, wildfires, floods, food insecurity, biodiversity loss, and extreme weather remind us that our future is inseparable from the condition of the world around us.

The relationship is reciprocal. As we shape the Earth, the Earth shapes us.

Learning to understand and manage this relationship may be one of humanity's greatest intellectual and moral challenges. It invites us to move beyond the notion that human development and environmental stewardship are competing goals. Increasingly, they are inseparable.

This is fundamentally a geographic challenge because it involves understanding the relationships among natural and human systems across space and time.



Geography and GIS: A Framework for Understanding

Geography is uniquely suited to this challenge. It studies the relationships among physical, biological, social, economic, and cultural systems and how they interact across space and time.

At its heart, geography asks enduring questions:

- **Where are things located?**
- **Why are they there?**
- **How are they connected?**
- **What patterns emerge?**
- **What consequences follow change?**

GIS provides a digital framework for integrating, analyzing, sharing, and applying knowledge about our world. More than a technology, it is a means of understanding almost everything.

By bringing together many types of information, including data from governments, businesses, communities, sensors, scientific models, and imagery, GIS provides a common geographic context in which knowledge can be connected, explored, and shared.

GIS enables people to understand not only what is happening, but also where it is occurring, why it matters, who is affected, and what can be done about it.

Maps are central to this process. They illuminate relationships, reveal trends, and communicate complexity across disciplines, organizations, and cultures. In an interconnected world, maps are more than tools for navigation. They are instruments for building mutual awareness, shared understanding, and collaboration.

When geographic knowledge is connected and shared across many people and organizations, something larger begins to emerge.

"As we shape the Earth, the Earth shapes us."

Developing a Collective Geospatial Intelligence

Increasingly, GIS is being used as a platform for organizing and integrating many types of information and knowledge created by diverse networks of individuals, organizations, communities, and disciplines. This integration represents what I call collective geospatial intelligence.

Collective geospatial intelligence emerges when diverse forms of knowledge can be connected, evaluated, visualized, and understood within a common framework.

Geography provides the organizing science. GIS provides the infrastructure that makes this integration possible. Together, they help transform information into understanding and understanding into wiser action.

But collective geospatial intelligence is not created by technology alone. It emerges when people share knowledge, connect perspectives, work from trusted evidence, and collaborate across boundaries toward common goals.

Every organization, community, project, and individual can contribute to this shared understanding. Each adds information, experience, observations, models, maps, analysis, and ideas. When these contributions are connected, they become more valuable than they are in isolation.

Collective geospatial intelligence may become one of humanity's most important assets for creating a sustainable future.

The next challenge is turning this shared knowledge into practical action.

Transforming Knowledge into Action: The Geographic Approach

Early in my career, I realized that geography's greatest value was not simply in describing the world. Its real power was in helping people understand the world and make better decisions.

This idea is expressed in what we now call the Geographic Approach, a practical method for transforming geographic knowledge into action.

The process follows a continuous and iterative cycle:

Measure. Visualize. Analyze.
Design. Evaluate. Act.

We begin by observing our world. Satellites, drones, sensors, field surveys, community observations, and scientific research help us understand how natural and human systems are changing.

But data alone does not create understanding.

Maps and visualizations allow us to see patterns, relationships, and trends. Spatial analysis helps us understand how systems work, how they interact, and how they may change. We can study the movement of water through a watershed, model the effects of climate change, understand urban growth, assess ecosystem health, or identify communities at risk.

Understanding the present condition—what is—is only the beginning. We must also consider what could be and what should be.

Bringing geographic analysis into planning and design allows people to create and compare alternative futures before decisions are made. This is the practice of Geodesign.

Geodesign expands the questions we ask. We move from "What is happening?" to "What should happen?" and "What are the consequences if we choose one path instead of another?"

Communities are using Geodesign to address urban growth, transportation, conservation, housing, water management, climate resilience, and many other issues. Alternative plans can be evaluated for economic performance, environmental impact, social benefit, equity, resilience, and long-term sustainability.

These decisions should not be left to experts alone. Community members, scientists, planners, business leaders, and policymakers can use maps to explore alternatives together, understand trade-offs, and build shared solutions.

The next step is action. Plans become policies. Investments are made. Habitats are restored. Infrastructure is built. Communities adapt.

The results produce new information, and the cycle begins again.

We observe the world, understand its patterns, explore possible futures, evaluate their consequences, and act with greater awareness. Through this process, geographic knowledge becomes practical wisdom, helping communities make more informed decisions and create a more sustainable and resilient future.

> *Collective geospatial intelligence may become one of humanity's most important assets for creating a sustainable future.*



AI Can Enhance the Process

While I recognize that significant challenges remain with AI, my sense is that it can strengthen every stage of the Geographic Approach.

AI is already helping us extract information from imagery, lidar, sensors, and other data sources. It can identify patterns, automate analysis, support new forms of visualization, and make GIS more accessible through natural language and intelligent assistants.

Looking ahead, AI may become an increasingly valuable design partner. It can help people explore alternatives, evaluate trade-offs, anticipate possible consequences, and recognize relationships that might otherwise be missed.

AI can also help us monitor results. By comparing actual outcomes with what was expected, it can support adaptation, learning, and continuous improvement.

But AI should not replace human judgment, responsibility, or creativity. Its greatest value will come from augmenting what people do and helping them explore possible solutions.

Geography gives AI context. GIS connects it to places, relationships, and real-world conditions. Human values and judgment give it purpose and direction.

Together, geography, GIS, the Geographic Approach, and AI can help us better understand complexity and make more informed choices.

An Emerging Human Capability

While it is still early, decision-makers around the world are beginning to use the Geographic Approach to understand complex challenges that span environmental, social, and economic systems.

Urban planners are balancing growth with sustainability. Emergency managers are coordinating responses to natural disasters. Scientists are monitoring ecosystems and climate change. Businesses are improving efficiency while reducing environmental impacts. Conservation organizations are protecting biodiversity and restoring critical habitats.

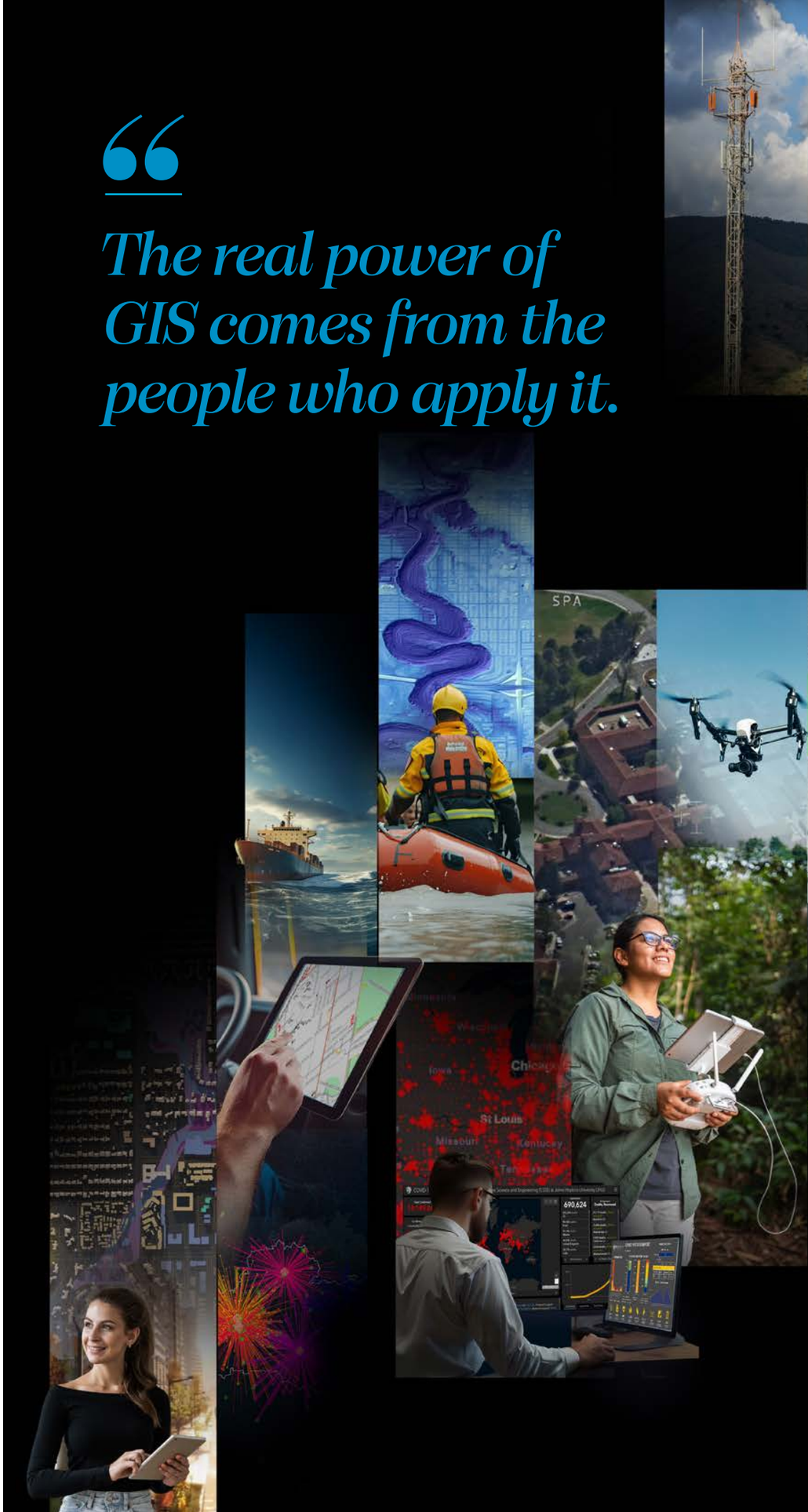
These efforts share a common pattern. They apply the Geographic Approach to transform information into shared understanding and shared understanding into coordinated action.

What is emerging is not simply a more advanced collection of technologies. It is a growing human capability to collaborate through a common geographic understanding of our world.

Each project matters. Each map, dataset, model, analysis, and application can contribute to a larger body of knowledge. When these efforts are connected across communities, institutions, and disciplines, they can strengthen our collective capacity to understand change and act more wisely.

This is the broader opportunity before our profession.

> *The real power of GIS comes from the people who apply it.*





Collective geospatial intelligence connects knowledge, human judgment, and shared action.

Conclusion:
A Call to the Geospatial Community

Humanity may be entering one of the most consequential periods in its history.

For centuries, progress has been measured largely through economic growth, scientific discovery, technological innovation, and improvements in human well-being. These achievements are real and important. But progress must now also be measured by our ability to sustain the natural systems that support life.

The question is whether we can learn to understand and manage our relationship with the Earth more wisely.

This is where the GIS and geospatial community has a unique opportunity and responsibility.

When geographic knowledge is connected across organizations and disciplines, people can learn from one another. When that knowledge is visualized and made accessible, it enables broader participation. When alternative futures are modeled and evaluated, communities can better understand their choices and make more informed decisions.

This is how collective geospatial intelligence begins to emerge.

GIS can provide an important infrastructure for creating a more sustainable future. But its real power comes from the people who apply it, helping others take a more holistic approach, consider the relevant facts, understand relationships, and create more sustainable solutions at every scale.

No single project will be sufficient. No single organization can succeed alone. But geospatial professionals, working within their communities and institutions, can contribute to a larger body of geographic knowledge and coordinated action.

Together, they can help create a more sustainable world.

Those of us who possess the knowledge and tools to see what is happening have an obligation to make that understanding useful. We must communicate what we know, identify what we do not yet understand, invite others to participate, and apply our work with humility, creativity, and purpose.

While I remain deeply concerned about the deterioration of our natural world, I also remain hopeful.

My hope comes from the GIS professionals, geographic scientists, conservationists, planners, educators, public servants, business leaders, and community members I see working every day to make a difference. Their efforts demonstrate that positive change is possible when knowledge is connected to action.

My invitation to the geospatial community is simple: Continue strengthening this culture of geographic understanding and collaboration. Bring together our best science, technology, creativity, and human judgment. Share what you know. Learn from one another. Help communities everywhere make more informed and sustainable choices.

The future will not be determined by technology alone. It will be shaped by what people choose to see, understand, value, and do together.

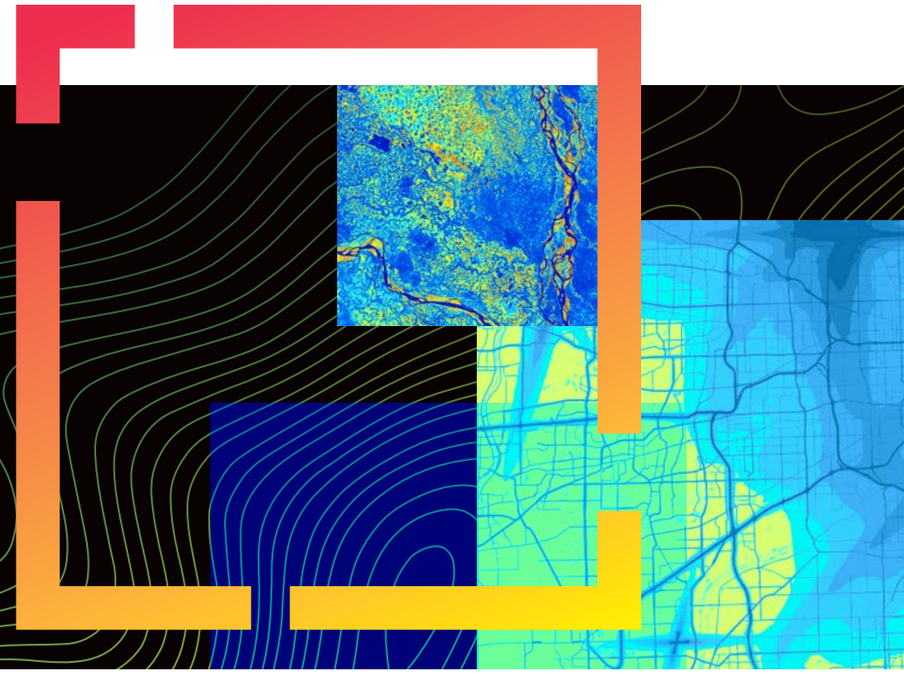
I believe geography, GIS, and the people who practice them can help humanity tip the balance toward a more sustainable future.

Our ability to grow this collective geospatial intelligence and translate it into positive action may be one of the greatest opportunities for our profession and one of the most important contributions our community can make. **AN**

About the Author

Jack Dangermond is the president and founder of Esri. Along with his wife, Laura, he founded Esri in 1969, based on the vision that geographic analysis and computer mapping could help design a better future.

Esri Training Courses and Certifications



Advance Your Field GIS Skills with Guided Learning

Whether you're just starting out or looking to deepen your expertise, Esri's instructor-led training courses are designed to meet you where you are and help you move forward with confidence. These courses blend expert instruction with exercises, ensuring you understand the concepts and can apply them to your daily work.

These courses are ideal for professionals who want to advance their skills and stay current with the latest ArcGIS capabilities for field operations:

- **AI Essentials: Assistants in ArcGIS**—In this four-hour course, participants gain practical experience using AI assistants in ArcGIS Field Maps, ArcGIS Survey123, ArcGIS StoryMaps, and ArcGIS Arcade. Learn to connect disparate tasks into a holistic field operations workflow that streamlines GIS data collection and sharing. Explore details and sign up at link.esri.com/ai-essentials-il.
- **Get Started with ArcGIS Field Apps**—Attend this two-day course to learn how to ensure accurate data collection in a variety of field conditions by choosing and configuring the right ArcGIS apps for different scenarios. Find out more and register at link.esri.com/field-apps-il.

Join a Live Training Seminar

Continuous learning is essential in an industry as dynamic as GIS. Live training seminars are focused, one-hour sessions led by Esri experts—at no cost. Session leaders demonstrate ArcGIS software in action while attendees learn tips to complete their GIS work more quickly and efficiently and connect with peers in the GIS community. Each seminar includes question and answer segments. View upcoming seminars at esri.com/lts.

Expand Your GIS Horizons in a MOOC

Esri's no-cost massive open online courses (MOOCs) combine flexibility with access to the latest ArcGIS software via step-by-step exercises that mimic real-world scenarios. Each course is a complete learning experience that includes videos, quizzes, discussion forums, and a certificate of completion. Gain valuable skills while exploring the newest advances in ArcGIS.

Register early to secure your spot in these 2027 courses:

- Opening January 27, 2027, **Going Places with Spatial Analysis** helps new GIS users build a foundation in spatial data and analysis. Over six weeks, you'll gain practice with ArcGIS Online tools that uncover patterns, relationships, and insights to support better decision-making.
- **Make an Impact with Modern Geo Apps** opens on February 17, 2027. Attend this four-week course that covers how to build and share engaging apps without writing code. Each week, you will explore a different ArcGIS app while learning best practices for delivering GIS insights that resonate with your audience.

Explore all MOOC topics and dates at link.esri.com/2027-moocs.

Enhance Your Professional Credibility with Esri Certification

Many GIS professionals achieve a technical certification to validate expertise with Esri technologies and advance professionally. New certification exams are available for anyone who wants to demonstrate their knowledge of core GIS concepts and ArcGIS best practices. If you're ready to take the next step in your career, explore these recently updated exams:

- **GIS Fundamentals Foundation 2026** is designed for candidates with three to six months of experience using ArcGIS Pro and ArcGIS Online to perform entry-level mapping, analysis, data management, and sharing workflows: link.esri.com/egff-2026
- **ArcGIS API for Python Associate 2026** is for candidates with two to four years of experience using ArcGIS API for Python for GIS administration, content management, visualization, and analysis: link.esri.com/epya-2026
- **ArcGIS Utility Network Associate 2026** is for candidates with two to four years of experience configuring, editing, analyzing, and managing ArcGIS Utility Network data: link.esri.com/euna-2026 AN

Go to esri.com/training for more information. Keep up with Esri Training news by subscribing to the newsletter at go.esri.com/training-news.

LASER TECH

ONE VANTAGE POINT. **MULTIPLE MEASUREMENTS.**



Reduce exposure in challenging or hazardous terrain by capturing everything you need from a single position. Instantly collect precise distance, height, and slope measurements while streamlining workflows, eliminating extra steps, minimizing risk, and reducing potential rework to keep projects moving efficiently.

Built for the field. Trusted by professionals.

LEARN MORE

www.lasertech.com/vantage

esri Partner Network Member

ArcGIS® Field Maps

esri
380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri

202113 8867865



ArcNews has a new look!

As the GIS community grows in reach and ambition, the magazine is evolving with you.

Welcome to the latest edition, where you'll find inspiring GIS stories, informed perspectives, practical insights, and more.

Look inside, and discover what's next.

esri

Copyright © 2026 Esri. All rights reserved.