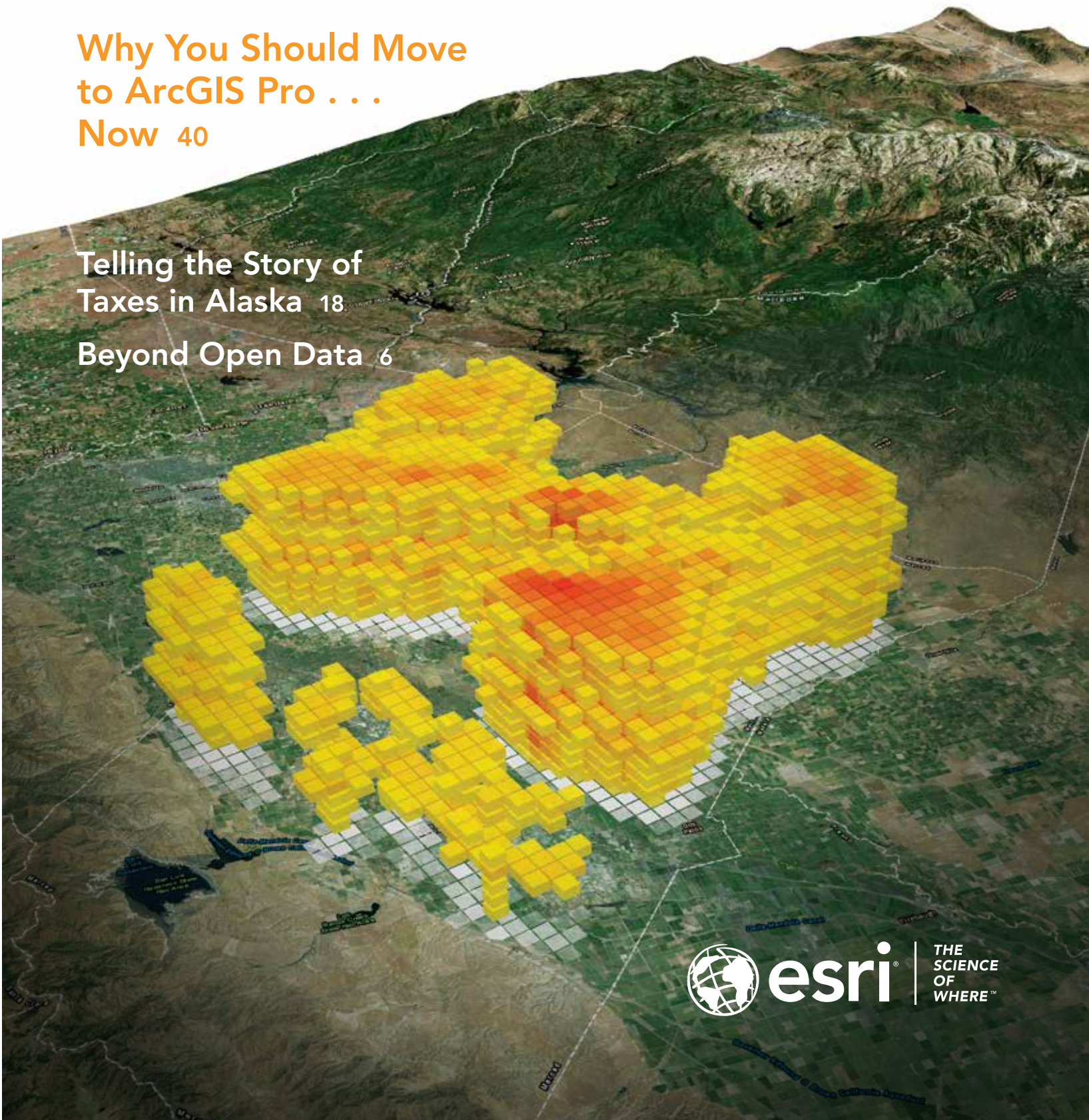
Summer 2017

ArcUser

The Magazine for Esri Software Users



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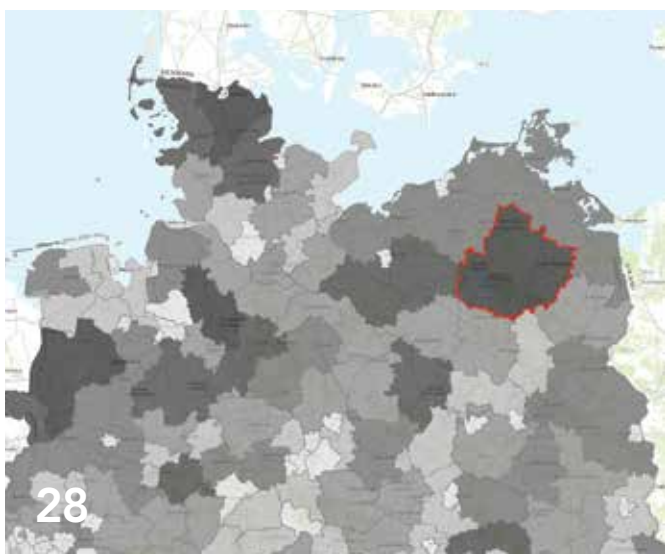

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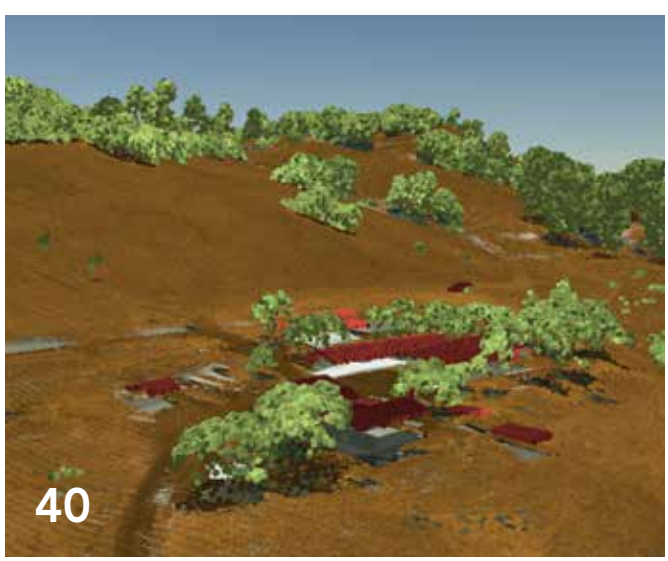

Special Section

On the Cover

Results of a 10-year water usage study in Merced County, California, visualized in ArcGIS Pro as a space-time cube. Each vertical stack represents a separate year, and the data can be filtered by space, time, and the level of water usage. It brings together irrigation averages, weather averages, and farm parcel and land-cover data. Read "Why You Should Move to ArcGIS Pro . . . Now" on page 40 for more information.

Familiar Concepts, New Tools

The work of a resourceful team at the Alaska Office of the State Assessor (OSA) is the subject of "Telling the Story of Taxes in Alaska" in this issue.

Each year the OSA must compile tax information for each of Alaska's 164 municipalities. Previously, this voluminous and detailed tax data was gathered, handled, and presented in tabular form and shared in a report known as Alaska Taxable. The knowledge of how to carry out this complex task was limited to just a couple of staff members who were nearing retirement. There was a real fear that this valuable knowledge might be lost.

Faced with the challenge of preserving institutional knowledge about how to produce an information product so vital to the functioning of Alaska's government and the prosperity of its citizens, the team formed to solve this problem decided to apply GIS. This team pioneered the use of Survey123 for ArcGIS to capture tax data and presented the information in an interactive and accessible manner using an Esri Story Maps app.

Not only did team members capture the knowledge needed to create this report, but they also optimized the process of gathering and assembling data. By elegantly and lucidly presenting this complex data as a story map called *Alaska Taxable 2016*, they made a treasure trove of information about revenue sources in Alaska accessible to many more people, both inside and outside state government.

Although innovative ArcGIS tools were used to accomplish their goals, the members of the OSA team were doing what people have been doing with GIS for more than 40 years. They applied the spatial framework of GIS to their work because it allowed them to solve problems, improve processes, realize cost savings, and accomplish things that would not have been possible in the absence of GIS.

The theme of this year's Esri User Conference, The Science of Where, celebrates the power of using this framework for applying science to almost everything so we can organize and integrate data, look at things holistically, and see relationships more clearly so we can meet the challenges we face at all levels—from local to global.

Monica Pratt
ArcUser Editor

ArcUser

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Editorial Inquiries

Monica Pratt, *ArcUser* Editor
380 New York Street
Redlands, CA 92373-8100 USA
arcuser_editor@esri.com

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Departments

Beyond Open Data

Getting Real with Civic Engagement

ArcGIS Hub takes GIS to the next step by answering the question,

"What makes a community smart?"

As Andrew Turner, director of the Esri R&D Center in Washington, DC, emphasized in his presentation during the 2017 Esri User Conference Plenary Session, "Citizens want to be empowered to make informed decisions to improve their neighborhoods."

The answer is more than just open data. ArcGIS Hub is a new framework for transforming open data into actionable information that enables collaboration between government and communities through community initiatives. Its goal is to help governments make civic engagement structured, repeatable, and targeted toward prioritized issues to support data-driven work on policy initiatives and measure the outcomes obtained.

Currently, community engagement tools and data are often disconnected from government operational and decision support systems. This is not sustainable in the long run.

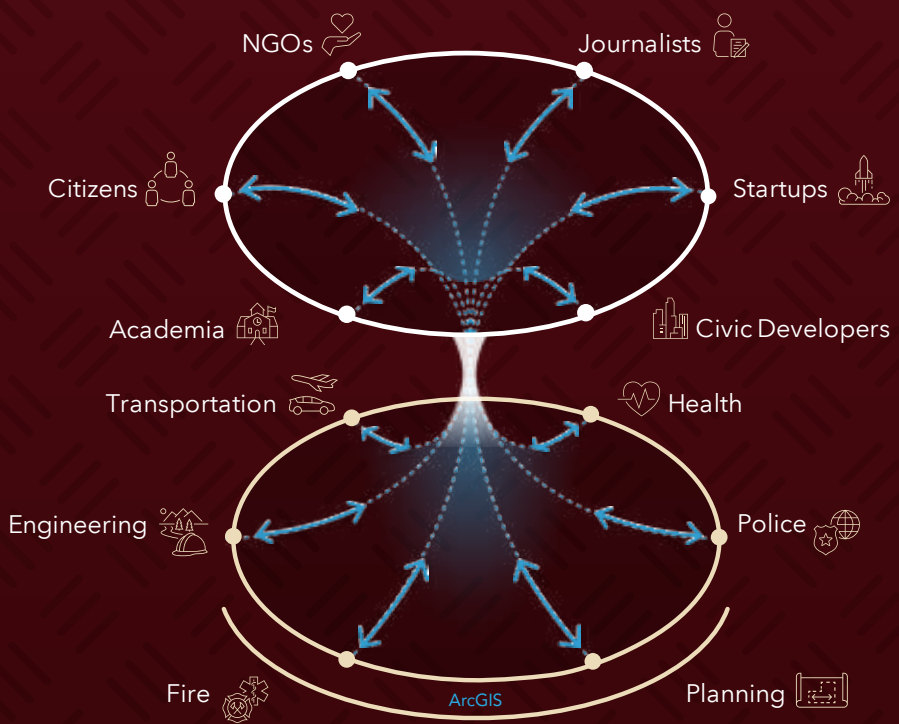
The hundreds of open data sites created by communities make it clear that citizens want more information on government. Since 2014, more than 8,000 organizations have started using ArcGIS Open Data, which lets anyone publish authoritative data using customized websites in a matter of minutes. This data is freely accessible by the public and easily explored using maps, charts, and tables. Data is downloadable in open formats and can be incorporated into apps built with developer APIs. Governments, universities, and other organizations have shared more than 70,000 datasets.

This open data movement, inspired by the desire for transparency in government and the need for innovation, created the foundation for ArcGIS Hub. Rather than a data repository, ArcGIS Hub is organized around policy initiatives that address community concerns and deliver data back to the public and across government in a way that is easy to consume, visualize, and analyze. Initiatives in ArcGIS Hub encapsulate a website, maps, apps, and reports that can be rolled out to the community. By bringing together data, visualization, analytics, and collaboration technology, ArcGIS Hub supports effective and open government that extends an organization's GIS to support the entire community.

Engagement occurs more readily when people can join forces around issues and initiatives they care about. Examples of these issues and initiatives include reducing pedestrian deaths, fighting the opioid addiction crisis, and attracting businesses to the community. To enlist the whole community in addressing initiatives, ArcGIS Hub not only provides ways to inform citizens but also ways to listen to them by providing a mechanism for feedback and the ability to monitor progress using dashboards. They can follow initiatives, contribute crowdsourced data, and provide feedback. This creates an ongoing two-way dialog between government policy makers and the community that makes citizens more fully engaged.

ArcGIS Hub makes it easy for citizens to learn about initiatives and participate with a fully hosted, scalable community organization. This part of ArcGIS Hub scales independently from the rest of the associated ArcGIS system but is fully connected to it so information can be gathered and communicated. It manages this process through monitoring and tracking citizen engagement.

The structured framework enabled by ArcGIS Hub uses GIS data residing in departmental systems of record to inform policy initiatives. Data and analyses contributed by the broader community can



ArcGIS Hub creates digital public spaces that connect citizens to their government.

improve operations and influence policy decisions. ArcGIS Hub brings together data, apps, narratives, events, key performance indicators, and engagement tools into initiative templates that address policy issues.

ArcGIS Hub comes with administrative tools for managing initiatives and a gallery of ready-to-use initiatives to make it easy to get started. Each initiative includes apps, maps, dashboards, and data already configured and comes with a complete toolset for creating initiatives that make an organization's policies actionable—supported by websites, maps, apps, and content.

The next incremental step in the evolution of the ArcGIS platform, ArcGIS Hub creates digital public spaces that connect citizens to their government. It takes community engagement to the next stage by helping initiate fact-based conversations around specific themes. This is a powerful way to extend and amplify existing GIS investments. Esri president Jack Dangermond sees it as the new way forward for GIS. "I always thought it was going to be GIS for society. No, it is going to be quite practically done by organizations that want to engage around real stuff and make things happen."

For more information, visit esri.com/hub.

Enhancements to the World Geocoding Service

↑ The World Geocoding Service supports address-level geocoding in 135 countries.

Improvements in matching logic, intersection geocoding, and reverse geocoding boost match rates for the ArcGIS Online World Geocoding Service, thanks to a major update in June. This update includes additional functionality as well as quality improvements.

The number of countries supported by the World Geocoding Service has expanded as well as the regular update of reference data for all countries. Enhanced coordinate search, previously available only in ArcGIS Desktop, can now be done in ArcGIS Online. Points of interest (POIs) can be included in batch geocoding operations.

Improved Matching Logic

Although geocoding in the United States consistently yields high match rates, address databases may contain questionable

Poorly Formed Address	Previous Match	Improved Match
7701 leadsville rd, Raleigh NC 27613	27613, Raleigh, NC	7701 Leesville Rd, Raleigh, NC 27613
6409 FORDBRICK, Cleveland OH 44130	44130, Cleveland, OH	6409 Fordwick Rd, Cleveland, OH 44130
Re: 30853 Loma Linda Rd (NA), Temecula, CA, 92592	Unmatched	30853 Loma Linda Rd, Temecula, CA 92592

↑ Table 1: Errors in addresses are highlighted in red. Improvements in matching logic produce better results with poorly formed addresses.

addresses that have misspellings or contain information that can't be geocoded such as the names of persons. Improvements in behind-the-scenes matching logic do a better job of handling poorly formed address searches (see examples in Table 1).

Better Intersection Geocoding

The World Geocoding Service can now locate the intersections of streets that are not physically connected such as a street ending in a cul-de-sac, a highway overpass elevated above the road beneath it, or streets entering a roundabout that intersect the roundabout but not another street.

New Methodology for Reverse Geocoding

Instead of using the previous process of converting x,y coordinates to an address or intersection to geocode them, ArcGIS Online now matches the location to be geocoded with the most relevant nearby feature when reverse geocoding.

Geocoding in More Countries

The list of countries supporting address-level geocoding has expanded from 109 to 135 countries. New authoritative address data sources have been added for Australia and Austria. Complete coverage information and a listing of the languages supported are available in the developer documentation. The World Geocoding Service is regularly updated with new reference data providing detailed global coverage using high-quality, authoritative datasets.

Enhanced Coordinate Search

Defense and intelligence community users will be able to search for MGRS (Military Grid Reference System) coordinates in ArcGIS Online as easily as they have always been able to in ArcGIS Desktop. ArcGIS Online also supports searches using postal codes, addresses, populated places, and POIs from a single endpoint with the World Geocoding Service as well as searches for latitude/longitude coordinates in different formats, such as degrees-minutes-seconds (DMS), and United States National Grid (USNG) coordinates.

Find POIs and Addresses in a Single Batch Operation

Users can batch geocode tables that contain addresses, postal codes, and POIs—in any combination—instead of having to deal with POIs separately. They can control which features are returned by using the new featureTypes parameter, available with the reverseGeocode operation through the service REST API.

Continually Improving

Additional improvements are planned for future releases. Send feedback on these enhancements and others that might be useful to GeocodeQA@esri.com.

Best Practices for Dealing with Missing Data

Using imputation intelligently

By Kevin A. Butler, Esri Spatial Statistics Product Engineer, and Aileen Buckley, Esri Research Cartographer

Missing data occurs in many spatial datasets. Data might be missing because a sensor is temporarily broken, a sampling site is inaccessible, or data values are intentionally suppressed to protect confidentiality.

If any variable for an observation is missing, a common way to deal with this situation is to delete that observation from the dataset. However, rather than throwing out valuable data that can impact analyses or result in "holes" in the map, missing data values can be "filled in" using other information from the dataset. In the case of spatial data, the values of neighboring features in space can be used to create an estimate for missing values. For spatiotemporal data, neighbors in time can be used to fill in the missing values.

We can feel confident doing this, in part, because of Waldo Tobler's first law of geography. It states that "everything is related to everything else, but near things are more related than distant things." *[Tobler is an American geographer who was a pioneer in the development of analytical cartography and computational geography and a leading contributor in the field of quantitative spatial analysis.]*

Tobler's law implies that the values of the missing data will be like the values of its neighbors in space and/or time. Therefore, we can use average, minimum, maximum, or median of the neighboring values to fill in the missing value. Statisticians call filling in missing values imputation or, in the case of spatial data, geoimputation.

While filling in missing values may seem harmless on the surface, it can potentially produce problematic or unwanted consequences. Statistical analyses with data that has been filled in can produce biased and misleading results. In statistical terms, imputation leads to narrower confidence intervals, underestimation of standard errors and, thus, overestimation of test statistics. Nonetheless, it is often necessary to fill in missing values so that we can produce an aesthetically pleasing map or perform a spatial analysis on the entire study area, but filling in missing values should be done with caution using best practices for imputation.

Some Cautionary Notes

Before you start filling in values, make sure you understand your data and determine which values are missing. The placeholder indicating a missing data value can vary from dataset to dataset. In a geodatabase feature class, missing values are stored as null values, written as <Null>, and thus clearly recognizable.

However, shapefiles cannot store null values. Tools or other procedures that create shapefiles may store or interpret a null value as zero. In some cases, null values in a shapefile are indicated by a very large positive or negative number.

A simple trick for discovering missing data values is sorting the field of interest from largest to smallest values and then from smallest to largest values. This will let you more easily see null values, zero values, or extremely large or small values. This may provide clues for identifying the placeholder used to indicate a missing value. Metadata sometimes indicates the placeholder for missing data.

Next, determine how many values are missing since you don't want to fill too many values. While there is no absolute cutoff for the number of missing data values you should attempt to fill in, a common rule of thumb is to fill in no more than 5 percent of the values in a dataset.

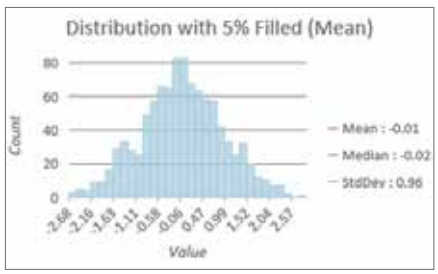
Finally, determine where the missing values are located. Map the attribute with missing data and explore its spatial patterns. Determine if missing data values are clustered or located on the periphery or in the core of your study area. See if the missing values appear to be in areas of primarily high or low values. Any of these situations suggest that there is a pattern to the location or values of missing data. Patterns can indicate that data is not missing at random. Filling in missing values works best when missing data is missing at random.

How Will You Fill in Missing Values?

When filling in missing values, you must decide on a fill method. Should you use the minimum, maximum, median, or average of neighboring values?

If you want to underestimate filled-in values, use the minimum of neighboring values. For example, you might want to underestimate if you are trying to fill in missing data on the number of students who receive free lunches.

If you don't want to underestimate the missing values, use the maximum. For



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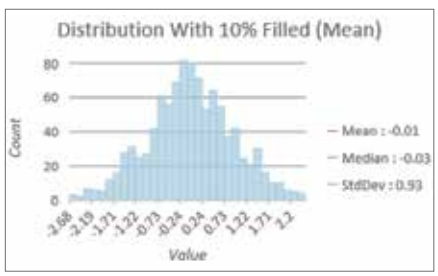

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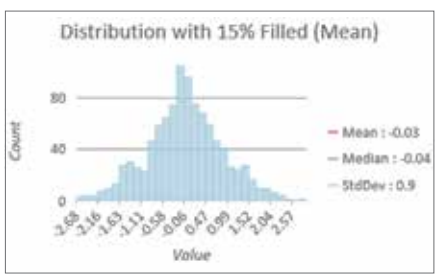

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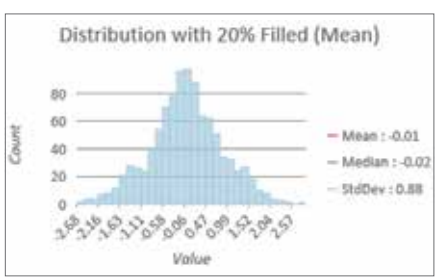


D

↑ Before imputation, this hypothetical dataset had a bell-shaped distribution. The data shows decreased variability as more values are filled in.

A Five percent of the data randomly removed then filled with the average of the eight nearest neighbors

B Ten percent of the data filled with the average of the eight nearest neighbors

C Fifteen percent of the data filled with the average of the eight nearest neighbors

D Twenty percent of the data filled with the average of the eight nearest neighbors

example, if you were filling in values in a dataset describing the number of people who have higher educational degrees.

If you suspect the presence of outlier high or low values locally, use the median. This might be most appropriate for data that often contains outliers.

If Tobler's first law seems to apply to the dataset, missing values will tend to be like neighbor values, so use the average.

You also must decide how to define the set of neighbors that will be used to calculate missing values. Neighbors can be defined based on a variety of spatial relationships. You can define a fixed number of neighbors, choose all neighbors within a fixed distance, or choose neighbors that are contiguous (i.e., share a border or have corners that touch).

Which fill method and which neighbors you use depend on how the filled data will ultimately be used. For example, a cartographer may want to fill polygons containing missing data to create an aesthetically pleasing map without holes. In this case, calculating the average of many spatial neighbors would be effective. A soil scientist who is filling in a missing soil moisture measurement resulting from a broken sensor will use neighbors within a fixed distance and calculate their median to avoid the influence of outliers.

When deciding how to define the neighborhood and choosing fill method, think carefully about which of the surrounding features legitimately influence the features with missing values. Choose the fill method that is least likely to bias the results of analysis.

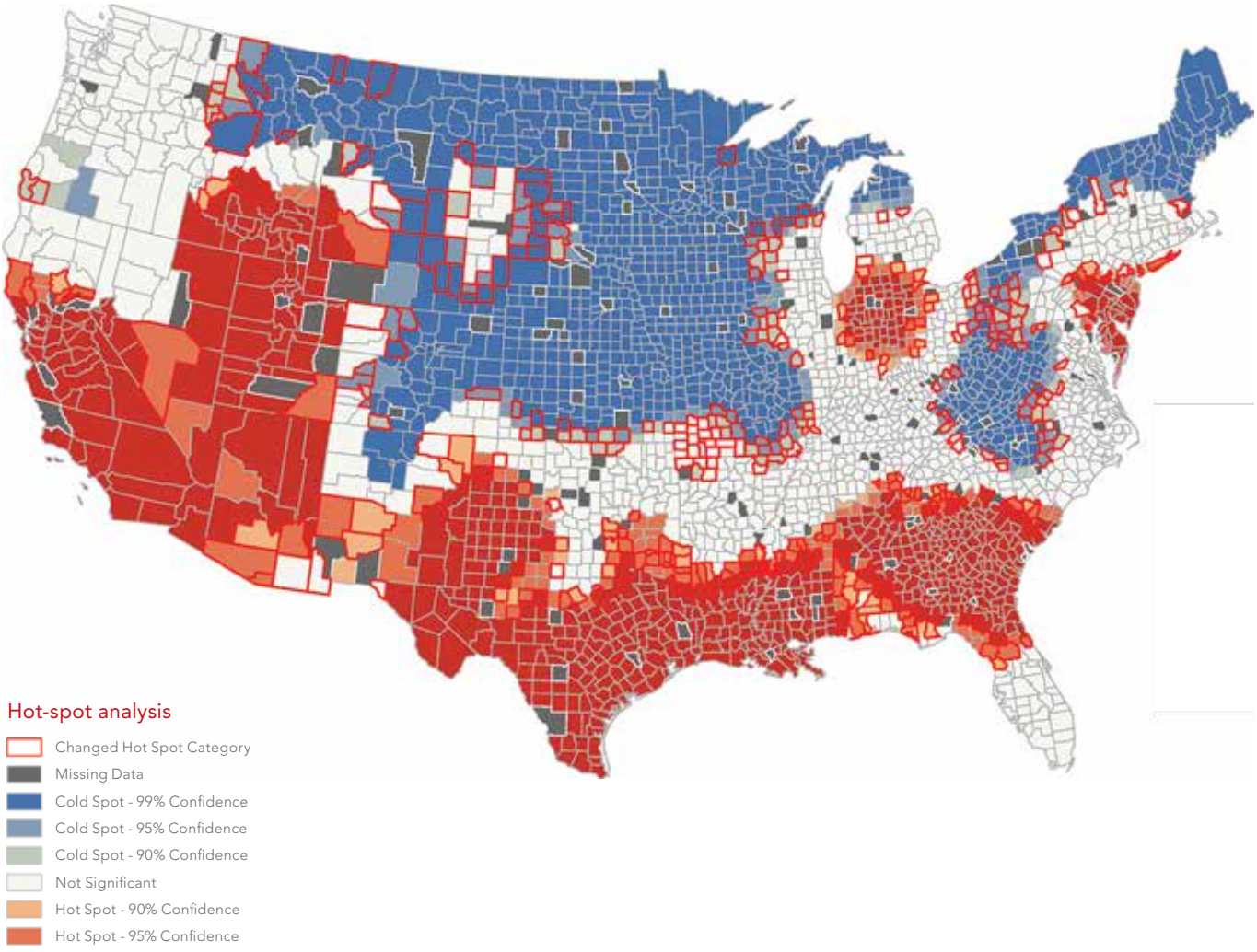
For example, a local public health analyst, who has childhood lead poisoning data at the census block group level, is missing data for a few block groups. That analyst might consider using the maximum values from neighboring block groups that share a border with the block group missing data to fill in the missing data. Using contiguous block groups can be justified because these locations will likely contain houses similar in age. Owing to changes in building practices over time, the age of houses is a known risk factor for lead exposure. While using the maximum value of the surrounding block groups to fill missing values might overestimate the true level of lead poisoning, when estimating risks to children's health, it is better to overestimate—rather than underestimate—the potential for lead poisoning.

Understanding the Impacts of Filling in Missing Values

All fill methods will likely change the distribution of the data. This is important when making statistical assumptions about data or mapping it. When using graduated colors in a choropleth map, a map of the original data may be different from a map that includes filled values because class breaks can change if the distribution changes. A bell-shaped (normal) distribution is required for some statistical tests. If the data will be used in a statistical analysis, filling missing values could result in a distribution that is skewed or has less variability. A best practice is to map and explore the distribution of the data before *and* after filling in missing values.

If the data has a bell-shaped distribution, filling in values with the average of neighbors will tend to increase the number of values around the mean and pull in the tails of the distribution, thus decreasing the variability in the data (that is, reducing the standard deviation). Filling in the values with the minimum value can produce a negative-skewed distribution (more low values), and filling in with the maximum can produce a positive-skewed distribution (more high values).

The impacts of filling in missing values on statistical analyses are more difficult to determine, particularly if the analyses involve calculating local statistics. For example, hot spot analysis (Getis-Ord GI*) compares a



local statistic to the global average. Filling in missing values can skew the distribution so that the mean of the dataset will be different once missing values are filled in. Since the impact of filling in missing values is difficult to predict, a best practice is to perform the statistical analysis before and after filling in missing values to compare the results.

Filling in Missing Values with ArcGIS Pro

With the release of ArcGIS Pro 2.0, the Space Time Pattern Mining toolbox contains a new tool for filling in missing values. The Fill Missing Values tool supports filling in missing values with the minimum, median, maximum, or average of neighbors. It also allows you to define the neighbors in a variety of ways: set number of nearest neighbors, neighbors within a fixed distance, contiguous neighbors, or neighbors defined by an input file.

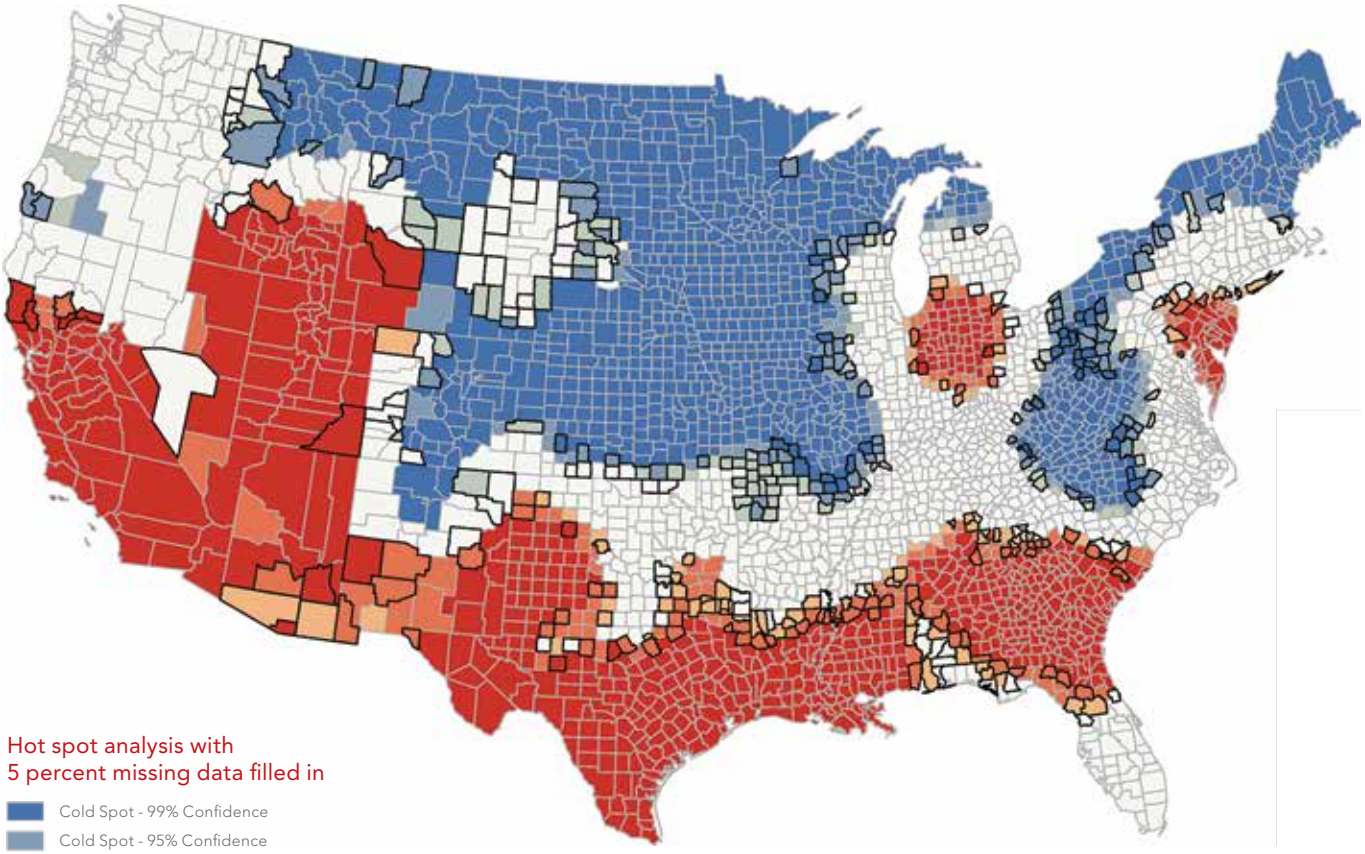
Additionally, the neighbors can be in both space and time. The temporal trend option fills in missing values using the time series at each location. Three types of input data are supported: a feature class with no associated temporal data, a feature class in which each feature is repeated for every time step, and a feature class with temporal data stored in a related table. The Fill Missing Values tool provides information about the distribution of the data before and after filling missing values as well as the total number and percentage of values filled. For help getting started with Fill Missing Values, see the ArcGIS Pro online help.

More Best Practices for Filling in Missing Values

There are several additional best practices to follow when filling in missing values. Check the number and percentage of values filled in to determine if any values are still missing. If they are, try changing the method used to fill the values. This might mean increasing the number of neighbors or size of the neighborhood. Be sure not to fill in missing values with values you already filled in. This is bad practice because you are essentially estimating values from estimates.

Examine the distribution of the data before and after filling in missing values by comparing descriptive statistics such as the mean and standard deviation and examining a histogram of the data to check for skewing, elevating, or flattening of the curve. An ideal solution would yield distributions that are similar in shape.

Look for local or regional applicability of the method used to fill in values. The method used to fill in values may have worked better in some areas than in others. For example, if you are filling using the average of neighboring values and the range of the reported standard deviations is wide, you might try varying the method by using a different type of neighborhood or a different fill method. Ideally, the standard deviation



↑ Both maps show hot spot analysis of 2010 average household size by US county. Counties with a bold outline indicate a change in hot spot category after filling in the missing values. While the overall spatial pattern did not change, many counties on the peripheries of hot and cold spots changed category.

would be about the same for all filled values, indicating that they all vary similarly from the neighbors used to fill in the values.

Think about how the data will be used once the values have been filled in. If the data will simply be mapped to create an aesthetically pleasing visualization without holes, minor variations in the filled values may be masked by the mapping method. Choropleth mapping typically classifies data into several classes, so variations within classes will not be apparent. On the other hand, if data will be used to generate official statistics, the impact of filling in missing values must be carefully examined and clearly understood.

Finally, communicate to your audience that you have filled in missing values. If you are writing a report, describe the method you used to fill the missing values and state any assumptions you made when choosing the method to fill in the values. If you are making a map, consider identifying the features for which the values have been filled in on a separate map. Cartographers have also identified polygonal features with filled in values using a hatched or stipple pattern or a unique feature outline. Be careful when using these methods as they can obscure the polygon fill or change the way the color of the fill is seen.

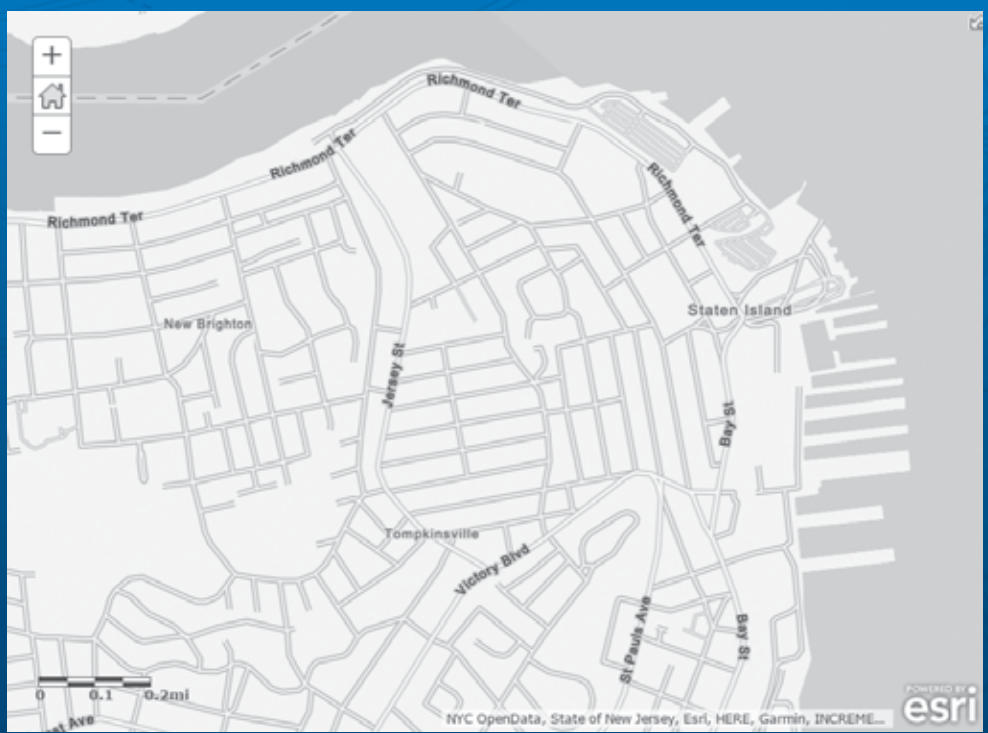
Following the guidelines described in this article thoughtfully when filling in missing values will help you avoid biased and misleading results in maps and analyses.

About the Authors

Kevin A. Butler is a product engineer on the Esri Spatial Statistics team and a member of Esri's Virtual Science team. He holds a doctorate in geography from Kent State University.

Aileen Buckley is a research cartographer and a member of Esri's virtual science team. She holds a doctorate in geography from Oregon State University.

Customizable Basemap
Supports Mapping Human Geography Data



↑ The Human Geography basemap consists of three customizable vector tile layers—base, detail, and label—that can be used together, as shown here, or separately.

↑ The Human Geography Detail layer shows larger water polygons, administrative boundaries, roads, and highways symbolized in dark gray.

The Human Geography Basemap, released by Esri in February 2017, is a detailed monochromatic vector basemap built to support the display data related to human geography such as demographics.

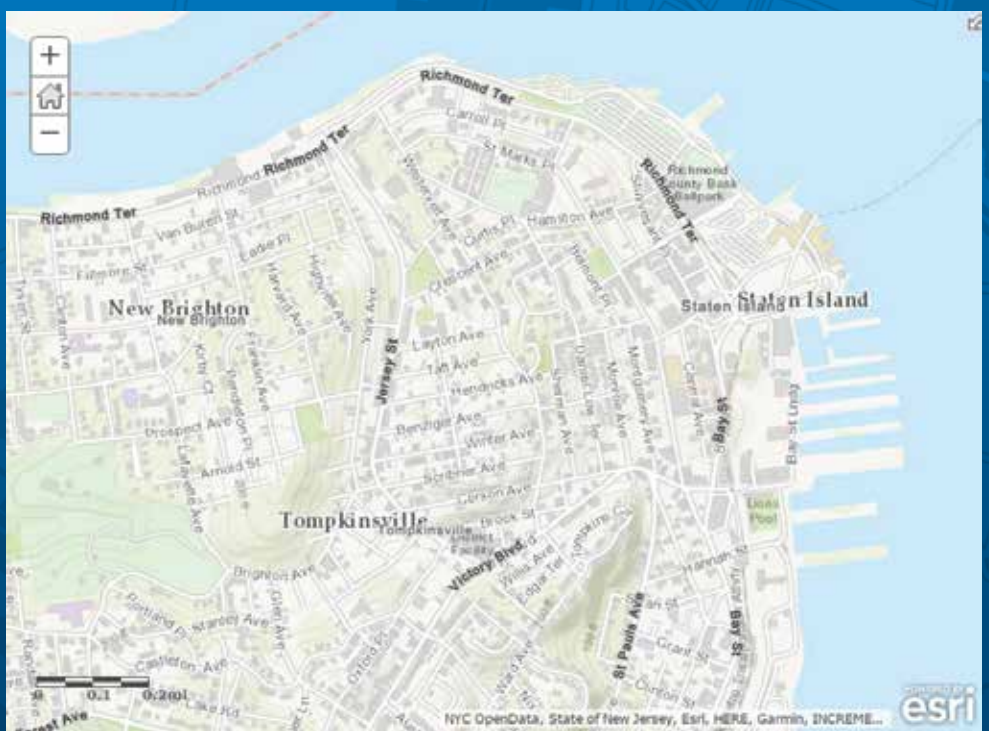
Because this map consists of vector tile layers that form the detailed basemap, it provides unique capabilities for customization, high-resolution display, and offline use by mobile devices.

The map consists of three separate gray-scale vector tile layers—base, label, and detail—that are designed to work together. The combination of these three layers provides strong contextual detail without upsetting the visual coherence of your data. However, these layers can be used separately.

The Human Geography Base layer is a blank canvas that displays land areas as gray to give the map some substance.

The Human Geography Label layer is a reference layer that includes labels for administrative areas, cities, towns, and neighborhoods—and at larger scales, street names. All labels have pale gray haloes to help them stand out without overpowering the other information. Because it is a vector tile layer, it can be customized by changing fonts and (in some areas) switching to an alternate local language.

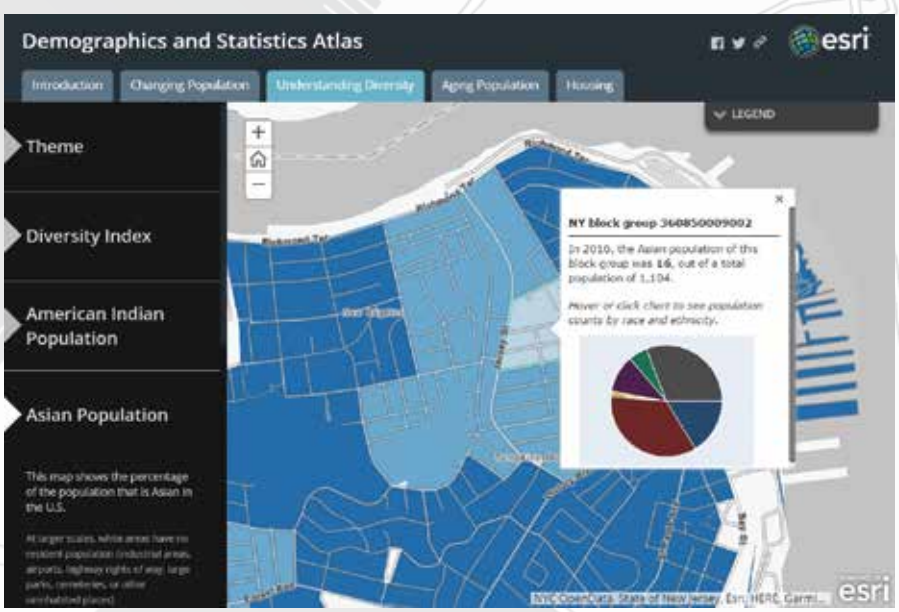
The Human Geography Detail layer is also a reference layer that includes all line and polygon features. This layer shows larger water polygons, administrative boundaries, roads, and highways symbolized in dark gray so that a significant amount of transparency can be applied to



↑ The Human Geography Label layer is a reference layer that includes labels for administrative areas, cities, towns, streets, and other features.

this layer. Transparency of 60 percent is assumed as the starting point, but this should be adjusted to suit a specific map.

Like all Esri vector basemaps, the layers in this map provide a starting point for you to customize them to suit the needs of your project.



→ The Demographics and Statistics Atlas shows how the Human Geography Basemap supports the display data related to human geography.

Briefly Noted

→ Esri Adds Airbus Global Elevation Data to Online Maps

Now the most accurate, detailed satellite-based elevation datasets for orthorectification are available to ArcGIS users and developers with the imminent inclusion of Airbus Defence and Space WorldDEM4Ortho elevation data in the ArcGIS Online Living Atlas of the World.

This is the most consistent and accurate elevation model that covers the entire land surface of the Earth. This data will be available for online end-user applications and developers creating apps with a specific need for elevation information. For example, navigation systems can use 3D road data to give drivers better estimates of fuel costs based on the terrain traveled or elevation data can be used in orthorectification workflows to ensure imagery is properly calibrated to geographic standards on a global scale.

The applications for these new elevation layers include analytics such as slope, aspect, rugosity, and visibility studies. The data will also be used extensively to improve basemap cartography with beautiful multidirectional hillshading and better 3D views.

The addition of this elevation data to the Living Atlas will enhance users' understanding of regional, national, continental, and global earth science. One important aspect of this new dataset is that it standardizes the scale of imagery, removing distortions from satellite photographs such as perspective and tilt. This improves accuracy in any kind of geographic measurement.

New Airbus data will be added to the more than 5,000 maps available to over four million users of the Esri platform worldwide and will be included in Esri's existing multiple elevation layers.

To learn more about Esri's elevation data and other content available online, visit go.esri.com/living-atlas.

↑ The inclusion of Airbus Defence and Space WorldDEM4Ortho elevation data in the ArcGIS Online Living Atlas of the World makes the most accurate, detailed satellite-based elevation datasets available to users and developers.

→ Subscription Simplifies Access to High-Quality Imagery in ArcGIS 10.5 Enterprise

DigitalGlobe has selected the ArcGIS 10.5 Enterprise architecture to deliver Imagery+Analytics, a new subscription product that enables organizations to subscribe to high-resolution imagery and analytics directly within the Esri environment.

The Imagery+Analytics subscription leverages ArcGIS Image Server to let customers search, access, and analyze vast amounts of DigitalGlobe high-resolution imagery. Once an area of interest is identified using the Imagery+Analytics application, ArcGIS Image Server displays the browse-level imagery and metadata so customers can add the imagery to their subscription.

The multispectral and temporal imagery then becomes accessible as dynamic image services running in the cloud so that it is available for both viewing and analysis in the ArcGIS applications. Users also have access to a wide range of cloud-based analyses using ArcGIS raster analytics as well as DigitalGlobe's GBDX Platform, which includes analysis capabilities powered by Harris Geospatial's Envi suite and deep learning-powered capabilities such as those offered by CrowdAI and other ecosystem partners. To learn more, visit go.esri.com/arcgis-enterprise.

→ Getting the Best Performance from Your Investment

Esri will soon offer ArcGIS Monitor, a tool for auditing the health of your enterprise GIS and IT infrastructure, including databases and network and GIS software that complement your existing monitoring ecosystem. Through the use of real-time dashboards, ArcGIS Monitor will provide timely alerts and notifications detecting potential and existing system infrastructure and operational problems that can aid in the rapid resolution of any issues. It will also generate reports that provide information about system usage and performance. These reports can improve communications among GIS and IT staff, senior management, and business owners. ArcGIS Monitor can maximize your GIS investment through more effective system operation and reduced administration costs. Learn more about ArcGIS Monitor at go.esri.com/monitor.

→ As Many or as Few Named Users as Needed

There is no longer a minimum number of Named Users required for an ArcGIS Online subscription. The only constraint is that there must be at least one Level 2 Named User to act as the administrator for the ArcGIS Online subscription. Beyond that, you can have as many (or as few) Named Users at Level 1 or Level 2 as you need to meet the business needs of your organization, no matter how large or small the organization may be. This is especially useful for very small organizations. If you just need one Named User to make maps for a website, you can simply buy a Level 2 Named User.

→ ArcGIS 10.5 Platform Receives More Than 30 OGC Compliance Certificates

More than 30 compliance certificates were awarded to the ArcGIS 10.5 platform by the Open Geospatial Consortium, Inc. (OGC), covering a wide variety of OGC implementation standards. The OGC standards Esri has implemented make sharing location-based data insight easier within an enterprise as well as with other organizations that use software and services that are certified OGC compliant. These standards allow customers, especially within the geospatial intelligence (GEOINT) community, to work more collaboratively.

Esri, a longtime and active member of the OGC, is committed to open standards compliance and pursues an open platform approach to meet the implementation goals of its customers. Recognizing the important role that standards play in fostering interoperability, Esri is a principal member of OGC and has participated in innumerable OGC-sponsored interoperability initiatives explicitly geared toward increasing interoperability among vendors' products.

ArcGIS 10.5 is next generation analytics technology for innovative organizations and arrives at a time when government and business are challenged to make sense of enterprise data, big data, and the Internet of Things. To learn more about Esri's commitment to open technology, visit go.esri.com/OpenSoftware2017.

Telling the Story of Taxes in Alaska

By Monica Pratt, *ArcUser* Editor

Although the State of Alaska does not levy sales or individual income taxes—depending instead primarily on petroleum revenues and federal subsidies to finance government operations and services—each of its 164 independent municipalities can levy their own sales and property taxes.

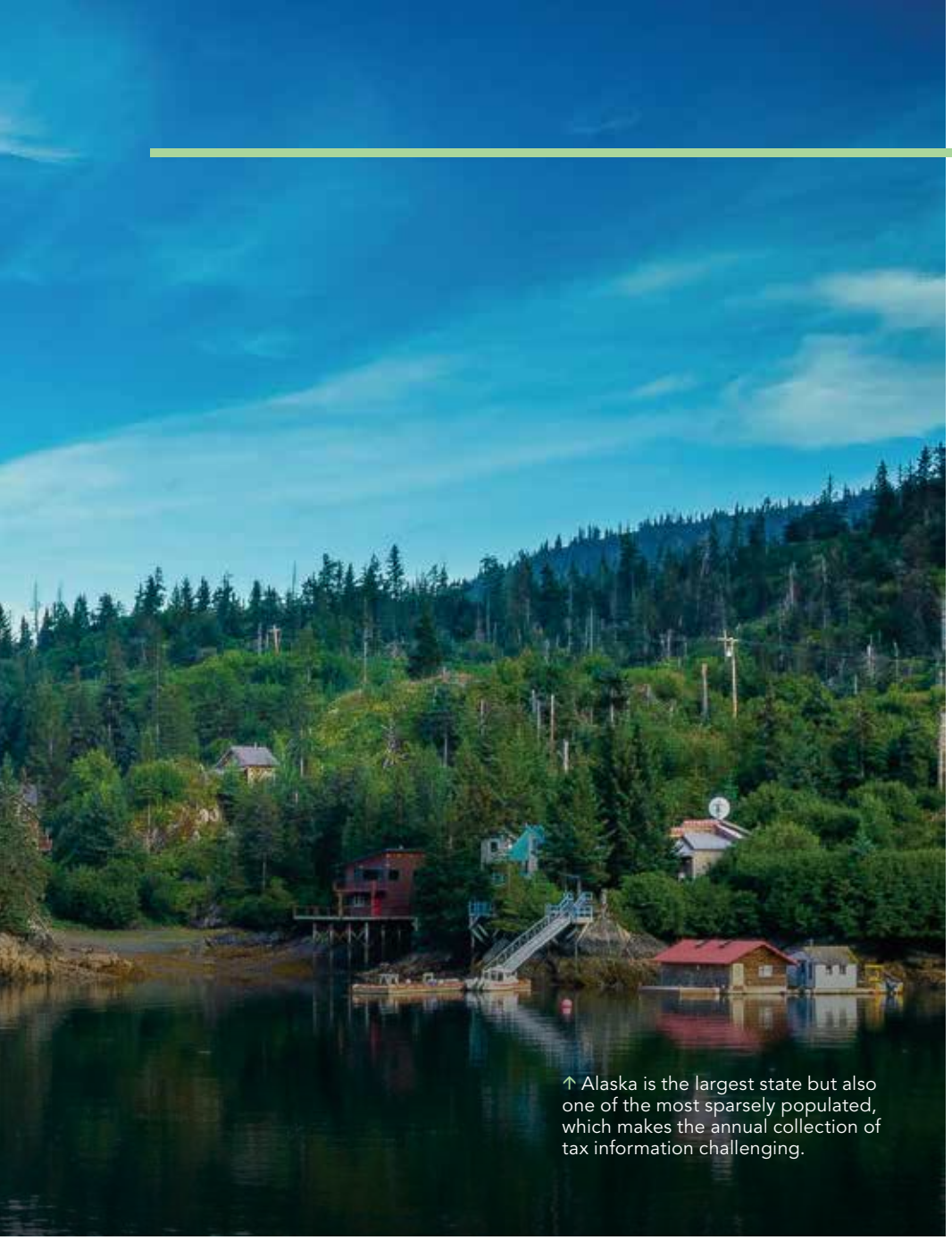
That makes the job of amassing municipal tax revenue data and creating an accessible, understandable document that communicates that information challenging for Alaska's Office of the State Assessor (OSA). Housed within the Municipal and Community Policy and Research Section of the Division of Community and Regional Affairs (DCRA) in the Alaska Department of Commerce, Community and Economic Development (DCCED), OSA is tasked with communicating the tax information and the nuances of each tax code in context for legislators, OSA staff, businesses, and the public. In addition to the variability and complexity of tax codes, Alaska is vast, and many of its communities are located in remote areas that are difficult to reach physically or contact via phone or the Internet.

OSA pioneered the use of Survey123 for ArcGIS to capture tax data and present the information in an interactive and accessible manner using an Esri Story Maps app called *Alaska Taxable 2016* (esri.com/AlaskaTaxable2016). The story map has made the work of OSA even more valuable. Using narrative, interactive maps and dashboards, it simplifies complex tax information and makes it highly consumable.

A Big Job

OSA is required by law to gather the taxation information for every municipality in the state and publish it each year. This is a formidable job. At 665,000 square miles, Alaska is the largest state in the United States and, at the same time, is one of the most sparsely populated. A portion of its citizens live in small, remote communities scattered across the state or hugging its rugged coast.

After the tax information is gathered, it is published and provided to state legislators and their staff as a printed document or a PDF file known as Alaska Taxable. In either case, the data is presented primarily



↑ Alaska is the largest state but also one of the most sparsely populated, which makes the annual collection of tax information challenging.

as pages of tables that contain the current taxes levied, rates, and revenue details for all municipalities.

For many years, municipal taxation information, including exemptions, rates, and revenue data, was compiled into a complex, massive Microsoft Excel workbook. "Depending on who was using it, the spreadsheet could be a masterpiece or a very confusing representation of taxation information," said Ron Brown, the assistant state assessor. The workbook, with its tangle of interdependencies, had become so complex over the years that only Brown and one other person could work with it successfully.

Clearly, OSA needed to figure out how to reduce its dependency on complicated processes, but it had an even more pressing problem. Brown is planning to retire in 2018, and there was a real danger that his detailed knowledge of Alaska Taxable might also depart. This highlights an issue faced by many organizations as increasing numbers of the baby boomer generation leave the workforce.

"We were facing a real problem of carrying forward the institutional knowledge of how this information came together," explained Brown. OSA needed to get it out of Excel and into something that was not so highly dependent on just a couple of people. Finding a new way to generate Alaska Taxable without relying so heavily on the complex processes associated with the workbook was needed sooner rather than later.

To simplify the creation of Alaska Taxable and retain the organizational knowledge associated with it, Manjula Boyina, research analyst with the Municipal and Community Policy and Research Section, and her small team composed of Grace Beaujean and Jade Bickmore (who were also research analysts within the section); Lorence Williams, a publications specialist; and George Plumley, a planner, and the only team member who had previous GIS experience, worked with Brown to implement an ArcGIS solution.

"Unlike past software projects where IT consultants were retained with a pretty fixed set of requirements, this new solution was an experiment in building capacity in-house," said Boyina.

Better Data Collection

The first part of the solution was finding a more efficient way of gathering tax data. The team decided to use Survey123 for ArcGIS, then in early beta, as part of its efforts to improve this task.

To collect data from the municipalities, OSA required municipalities to supply assessment information in an Excel form and the tax and debt information on two separate paper forms. These forms were sent out, returned, and checked for accuracy and completeness before the data was entered by OSA staff.

Checking data for consistency since the last report, verifying calculations, and correcting data entry errors are important steps because staffing at municipalities varies widely from experienced, dedicated staff to new or part-time employees who may not be familiar with the reports.

As the team considered the input process, it found ways to improve these forms. The short forms were combined into one survey to condense the data entry process. They also realized that the long form was convoluted and repetitive. "We collected the same data multiple times in multiple places. This made our output from the larger survey too long and unwieldy," said Beaujean.

into one feature class. Population, address, and supplemental data from other state agencies were also joined to the feature class. The data was further cleaned to remove redundant fields and add calculated fields, such as per-capita generated revenue, that were not part of the reports. The feature class was published as a feature service that provides almost all the data for the maps and apps for the *Alaska Taxable 2016* story map app.

"The agility of the process and platform was refreshing" said Boyina. "Requirements

Consequently, they condensed and reorganized the long form and will use that for the 2017 data collection.

In 2016, paper surveys were sent out. After the returned forms were checked, as usual, staff entered the data into two forms that had been created using Survey123 Connect. At that point, the Survey123 website was not yet available, and connectivity was an issue for some municipalities. By condensing and reorganizing the surveys, the team had already made the input process quicker, and further refinement will cut the output from the survey by half.

The survey building team of Bickmore and Williams pushed the capabilities of Survey123 for ArcGIS to balance the amount of data to be collected, add functionality to do calculations, and make survey interfaces user-friendly. Williams used HTML coding to address some of these challenges and stayed in constant contact with the Esri Survey123 team to find the best path forward. The survey forms the team developed have been included by Esri as samples for collecting municipal tax data. "Getting featured as a template within Survey123 is a testament to the alternate use of the application," said Williams with pride.

The data in the two Survey123 for ArcGIS forms was brought into ArcMap and joined

→ Alaska Taxable, published annually since 1962, presents current code and revenue details for the state's municipalities primarily as pages of tables.

Table 1
Per-Capita Tax Revenues

This table lists only those municipalities which levy a sales, severance, property or other type of local tax.

Municipality	Property Tax	Sales Tax	Other Tax (1)	Total Tax	Population	Tax Per Capita
North Slope Borough	$386,127,153	$0	$0	$386,127,153	10,420	$37,056
Valdez	$48,928,301	$0	$409,848	$49,338,149	4,011	$12,301
Municipality of Skagway	$1,821,411	$7,068,042	$120,267	$9,009,720	1,040	$8,663
Pilot Point	$0	$642,583	$0	$642,583	76	$8,455
Ergigik	$0	$0	$812,706	$812,706	104	$7,814
Bristol Bay Borough	$4,106,650	$0	$1,797,161	$5,903,811	887	$6,787
Whittier	$826,826	$597,365	$322,638	$1,806,429	283	$6,384
Saint Paul	$0	$376,326	$1,771,910	$2,148,236	427	$5,031
Unalaska	$5,929,241	$7,766,849	$9,212,284	$22,908,344	4,605	$4,975
City and Borough of Juneau	$47,205,860	$46,197,150	$4,880,853	$98,283,863	33,277	$2,954
Cordova	$2,305,133	$3,347,340	$130,833	$5,783,086	2,321	$2,492
City and Borough of Yakutat	$364,617	$924,232	$148,430	$1,437,279	613	$2,345
Seward	$1,807,672	$4,883,996	$498,669	$6,380,277	2,760	$2,311
Haines Borough	$2,825,493	$2,828,963	$109,808	$5,764,251	2,493	$2,312
Dillingham	$2,383,255	$2,620,237	$478,994	$5,482,486	2,386	$2,298
Akutan	$0	$0	$2,098,763	$2,098,763	933	$2,249
King Cove	$0	$854,550	$1,145,831	$2,000,381	900	$2,223
Nome	$3,051,603	$5,121,497	$151,997	$8,325,097	3,819	$2,180
Ketchikan	$5,488,642	$11,461,271	$486,838	$17,436,751	8,277	$2,107
Wasilla	$0	$17,504,642	$0	$17,504,642	8,468	$2,067
Homer	$3,101,669	$7,533,680	$0	$10,635,349	5,153	$2,064
Kodiak	$921,916	$11,512,936	$210,098	$12,644,950	6,288	$2,011
Sitka	$0	$1,550,134	$0	$1,550,134	783	$1,980
Denali Borough	$0	$0	$3,503,040	$3,503,040	1,781	$1,967
North Pole	$819,274	$2,845,666	$516,272	$4,181,012	2,138	$1,956
Petersburg Borough	$3,167,360	$3,050,191	$55,461	$6,273,012	3,199	$1,960
Municipality of Anchorage	$515,200,957	$0	$68,130,079	$583,391,036	298,908	$1,952
City and Borough of Sitka	$6,194,986	$10,014,174	$1,000,917	$17,210,077	8,929	$1,927
Craig	$602,456	$1,552,438	$0	$2,154,894	1,180	$1,826
City and Borough of Wrangell	$1,703,619	$2,642,785	$39,114	$4,385,518	2,442	$1,796
Sand Point	$0	$908,382	$688,317	$1,596,699	951	$1,679
Soldotna	$297,379	$6,920,246	$0	$7,207,625	4,319	$1,669
Seldovia	$181,892	$179,068	$0	$360,960	226	$1,597
Kenai Peninsula Borough	$62,078,842	$30,103,266	$0	$92,182,108	57,763	$1,596
Adak	$0	$331,940	$89,537	$421,477	276	$1,533
Palmer	$0	$28,735	$80,210	$108,945	72	$1,492
Kenai	$3,771,925	$6,781,037	$0	$10,552,962	7,229	$1,460
Aleutians East Borough	$0	$0	$4,268,884	$4,268,884	2,969	$1,438
Matanuska Susitna Borough	$119,269,340	$0	$9,474,899	$128,744,239	100,179	$1,285
Palmer	$1,316,111	$6,503,670	$0	$7,819,981	6,135	$1,275
Ketchikan Gateway Borough	$8,427,766	$8,452,798	$80,666	$16,931,229	13,778	$1,229
Kotzebue	$0	$3,711,382	$295,408	$4,006,790	3,267	$1,226
Kodiak Island Borough	$14,397,697	$0	$1,839,867	$16,237,564	13,819	$1,175
Bethel	$0	$5,720,309	$1,376,723	$7,097,032	6,205	$1,144
Fairbanks North Star Borough	$107,140,828	$0	$4,392,485	$111,533,313	98,645	$1,131
Chignik	$0	$0	$105,464	$105,464	95	$1,110
Nenana	$197,760	$161,723	$7,527	$366,998	380	$1,018

(1) Could include: bed, alcohol, car rental, raw fish, tobacco and other miscellaneous taxes

Average statewide per-capita revenue (Excludes North Slope) $1,855
Average statewide per-capita revenue (Including North Slope) $2,353

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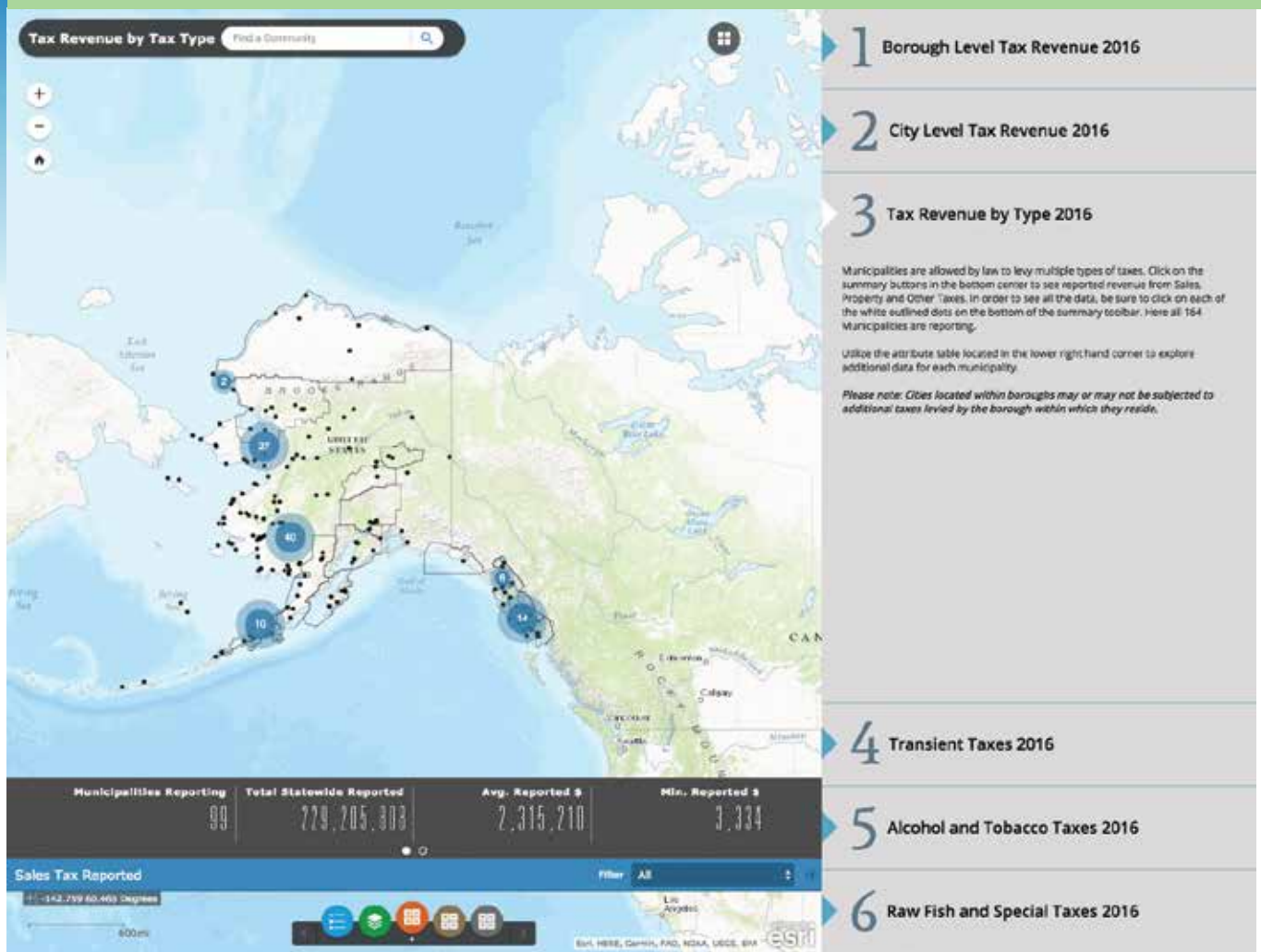


↑ The *Alaska Taxable* 2016 story map app is a short course in Alaska taxes as well as a compendium of tax code, revenue, and historic data.

constantly evolved based on back and forth with Ron Brown. The process of developing the workflow was extremely agile, and only the small team was designing and implementing the workflow with technical advise from Esri, so there was no issue with scope creep, as in a typical software project led by consultants."

Telling the Story

The second part of the solution involved coming up with a way to make this complex data interactively accessible and understandable in context.

"We knew we wanted something that was interactive," said Beaujean. "The Alaska Taxable report has been published since 1962, and it was a rather dry publication consisting of just tables without much explanation. To solve this problem, we decided to deliver something that provided a narrative. We wanted it to be visually appealing—something you could look at and easily understand."

Beaujean originally looked at web maps as a way to communicate the information. She tried mapping the different datasets, putting the map into apps, and combining them into one app, but "there was just way too much information."

Alaska Taxable had always been a publication, so it seemed natural to the team to use Esri Story Map Journal. "What we had here was a story. We had a story about local revenues, a story about tax capacity, a story about the types of exemptions you have in certain regions," said Beaujean. "If you looked at it holistically, you could see a story forming about how Alaska gets its revenue."

At the beginning of the project, team members were new to ArcGIS, Alaska Taxable, and creating story maps. They learned the basics of GIS on the fly. Plumley's experience with the ArcGIS platform offered the team an in-house consultant to resolve issues. By continually checking with Brown, they took advantage of his expertise in preparing tax data for decision-makers, incorporating that knowledge into the story map.

A New Level of Communication

The resultant map, *Alaska Taxable 2016*, tells the story of taxes in Alaska. It is a short course in Alaska taxes as well as a compendium of tax rates, revenue, and historic data. It tremendously simplifies the process of locating tax information.

By exploring its 12 pages, users learn about tax law, tax rates for each municipality, reported revenues, the breakdown for property tax revenue, tax exemptions both current and historic, the value for all real and personal property regardless of exemptions,

and historic real property values. An animation shows how the exemption amounts have changed over time. A dashboard shows the number of municipalities reporting, total revenue, average revenue, and minimum reported revenue.

Quick tips strategically placed throughout the map's pages help users locate information using the tools provided. Pop-ups make detailed information for each municipality easy to access by displaying charts of revenue breakdowns, historical real property values, and links to community fact sheets detailing municipal-specific taxation.

Getting Tax Information to More People

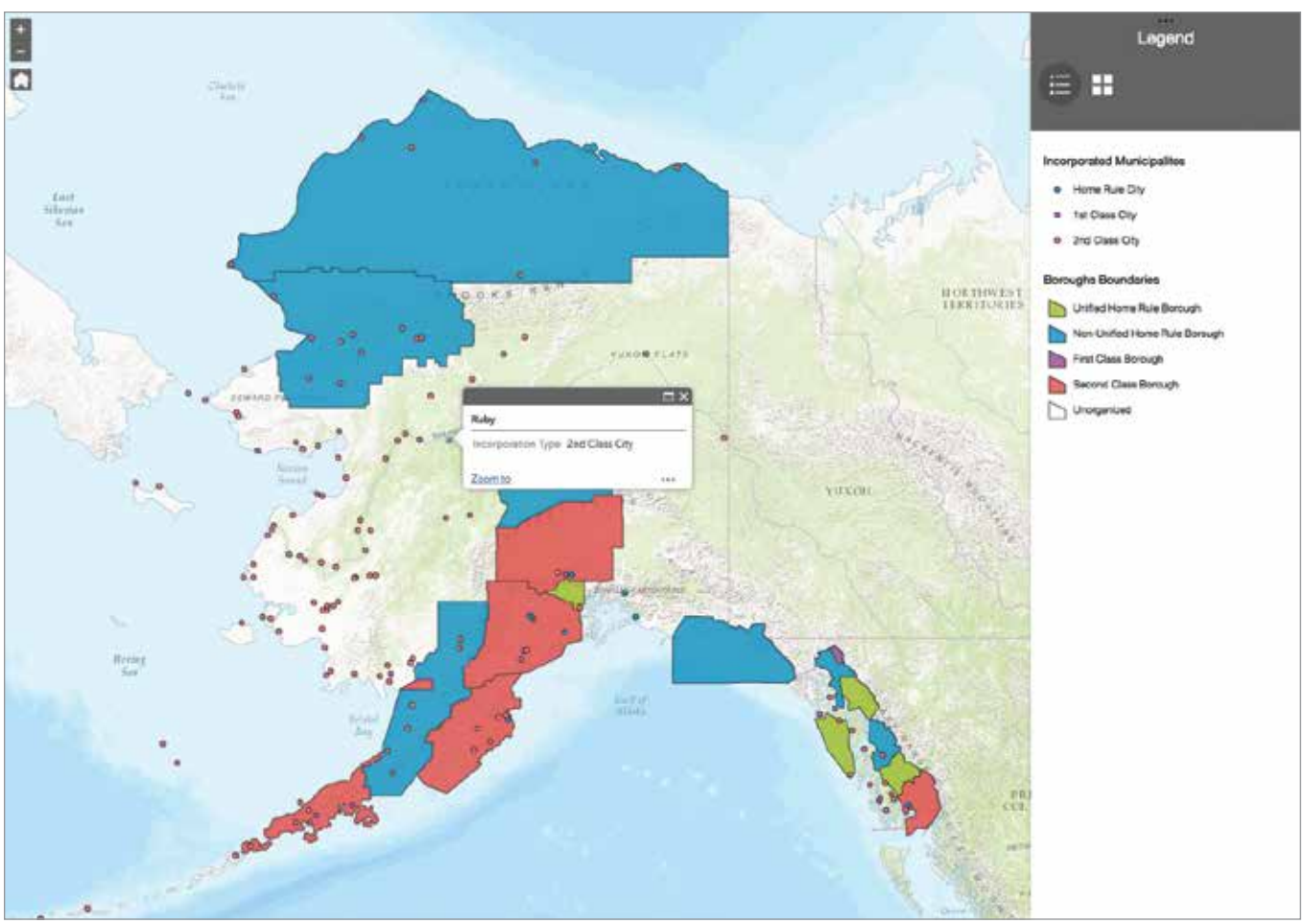
The traditional audience for Alaska Taxable has been the legislature. The information it contains is critical to carrying out its work. The *Alaska Taxable 2016* story map immediately captivated people both inside and outside of state government.

"Legislative staff, the Department of Health and Human Services, the Department of Natural Resources, and even out-of-state businesses thinking about locating in Alaska have found the story map extremely helpful. The story map is now an essential part of the Alaska Taxable publications we provide to the legislature every year before they go into session," said Brown.

Alaska Taxable in story map form is more readily used by state government staff, businesses, and the public. As Alaska enters its second year of recession, the topic of revenue generation has much broader interest. Local research groups like the Institute for Social and Economic Research have found the story map to be "an excellent resource" as they prepare reports examining the vulnerability of municipalities to reductions in state aid. Local government specialists use the map when discussing the possibility of tax rate increases with communities. Specialists can easily access OSA data and compare a community's current revenues with those of other communities of similar size. By showing how local governments fund themselves, Alaska Taxable can inform larger conversations.

Although the business community had used the printed version, they have been impressed with the story map version because it lets them look up municipal property taxes and sales taxes statewide easily. Tax codes for each community are unique, so

↓ *Alaska Taxable 2016* tremendously simplifies the process of locating tax information for state legislators, government staff, businesses, and the public.



↑ Starting from the back row going clockwise: George Plumley, Ron Brown, Paul Strickler (newest team member), Lorence Williams, Jade Bickmore, Grace Beaujean, and Manjula Boyina.

being able to look up the individual tax rates and exemptions for each of Alaska's municipalities is a huge benefit for businesses. It is also a great savings in time for OSA staff members who previously had to spend significant time marshalling tax information for business requests. For the same reason, the story map saves OSA time when fulfilling information requests from the public.

Improving the Process

The success of the *Alaska Taxable 2016* story map has guaranteed a version of it for 2017. The team continues to come up with new ways of streamlining the workflow used to produce it. As it becomes more widely known, its value as a decision-making tool should grow.

The adoption of Survey123 for ArcGIS to collect data and its publication as an Esri Story Maps app accomplished the team's goals of documenting and simplifying the process of generating Alaska Taxable each year. In the future, Excel will have a minor role in containing and maintaining tax data as all data—current and past—is migrated to a single file geodatabase that can be queried against other community-level data.

Although the primary role of that data will be the production of Alaska Taxable, it will also be used by the state assessor for other purposes. Because the data is available as a feature service, others in state government can use it for their research. Other departments are interested not only in the data but in using Esri Story Maps apps as an effective communication tool. The Department of Health and Human Service is interested in creating a story map for its directory of health care facilities.

"Certain accounting functions and regressive modeling that require tax data are performed by staff, and Excel will be the medium of choice for that. But in terms of storage and maintenance, Excel will no longer be the primary tool," said Beaujean.

As more functionality is introduced into Survey123 for ArcGIS to make the process more efficient, the team continues to refine the surveys. "Our hope is to one day have a complete and robust survey available for all municipalities to access online and filled by qualified staff," said Brown. This will eliminate the need for data entry by OSA. Providing functionality that gives municipalities access to previous years' survey data will give them a ready reference and eliminate the need for rummaging through old—often paper—files.

The team has an even more ambitious vision to get all future and past Alaska Taxable data into the geodatabase as well so that time series and predictive analyses can be performed.

In Summary

The team members appreciated what they were able to accomplish as novices and see great potential in how *Alaska Taxable 2016* can expand and benefit the state.

Boyina summarized the project by saying, "The experience of designing and developing the workflow exposed the team to how three different tools in the Esri platform can be seamlessly weaved together. ArcGIS Online hosted the Alaska tax story that was compiled using feature services published from data edited in ArcMap and captured in Survey123. Our experiment, carried out with the hard work, dedication and patience of the team, was a success!"

She was appreciative of the support of all on the management team by saying that "none of this would have been possible without the support of the DCRA management team and the DCCED Commissioner's Office."

Empowering Workers & Informing Customers

By Chad Cooper, Solutions Engineer, Geographic Information Services, Inc. (GISinc)

To meet the demands of a rapidly expanding customer base, a Florida utility realized it needed a variety of solutions that would empower its workforce and keep its customers informed. These solutions would begin at the data level and be expanded to web and mobile applications for data entry, analysis, service outages, water quality, service availability, and capital funds expenditures.

St. Johns County Utility Department (SJCUD) provides water, sanitary sewer, and reuse water services to 42,000 accounts and 100,000 residents in coastal northeast Florida. The utility's service area is experiencing strong demand caused by increased residential construction. In 2013, SJCUD initiated the development of an Integrated Water Resources Plan (IWRP) to implement water resources solutions through 2040. IWRP indicates that under medium-growth scenarios, by 2040 the SJCUD customer base will grow by 88,000 people.

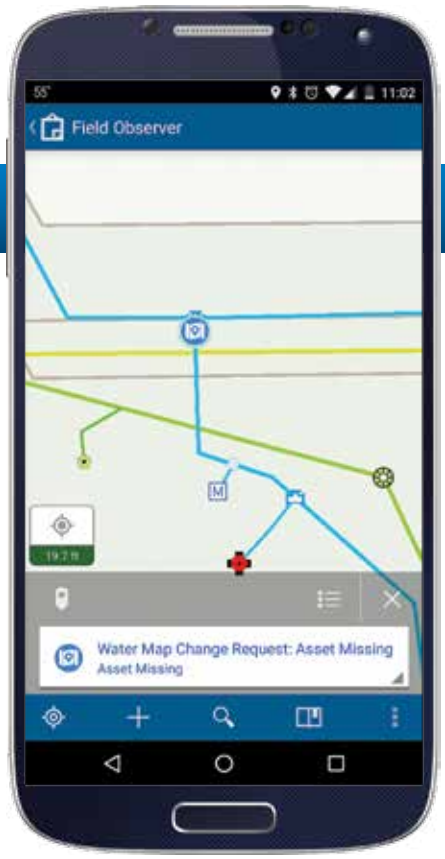
Current growth combined with this anticipated growth will bring challenges that include expanding capacity, replacing infrastructure, and meeting new regulations for water reuse and availability requirements. For years the utility has embraced the capabilities of its GIS. The value of GIS lies in its ability to truly empower users at all levels. The ArcGIS platform, used by SJCUD, provides the software, tools, and templates that allow it to create applications that empower its end users.

Secure but Accessible Data

Quality data is the lifeblood of any great application. To meet security requirements, SJCUD created geodatabases with both read/write feature access and read-only access. Read/Write feature service data is housed in an enterprise geodatabase separate from main production. For read-only data, a custom Python script utilizing the ArcPy module extracts data nightly from the main utility production enterprise geodatabase. To provide data to power applications for both in-house and external customer use, the script replicates it to a publication file geodatabase on the application server, and rebuilds the water distribution geometric network.

Keeping Up with Growing Infrastructure

Keeping up with new and expanding utility infrastructure in an area of rapid residential construction is difficult. Locating a particular piece of infrastructure in an area with so many new streets can be just as hard, so the utility built its own custom geolocator/geocoding service using the latest and greatest street data that is based on local



← Field Observer Collector map showing the location of a missing asset collected in the field.

knowledge and sources. Geolocators for address points and streets are frequently updated and combined into a composite locator, which is published to ArcGIS Server and consumed by a multitude of web applications. Using this service ensures that staff and end users can find even the newest of addresses in the service area.

Custom Tools

Water availability and quality are paramount for the utility. To help fulfill these directives, SJCUD implemented Esri's Utility Isolation Trace tool within two custom apps it created using Web AppBuilder for ArcGIS—Developer Edition. One app designed for field crews runs isolation traces during water main breaks. The other app is used by managers for further analyzing, maintaining, and disseminating isolation trace results as part of the outage information provided to the public.

The field crew app, referred to internally as Water Isolation Trace, is a Web AppBuilder for ArcGIS app that incorporates the Utility Isolation Trace widget and is configured against the utility's water distribution network, which resides in the publication file geodatabase, and ArcGIS Server feature services housed in the read/write enterprise geodatabase. Repair crews in the field access Water Isolation Trace over the Internet from their laptops and tablets. This allows them to conduct isolation traces while on-site and assess current conditions such as a main break. Isolation trace results can be saved to the enterprise geodatabase, which reduces the coordination with staff back at the office and saves time. Other applications can also consume isolation trace data and results.

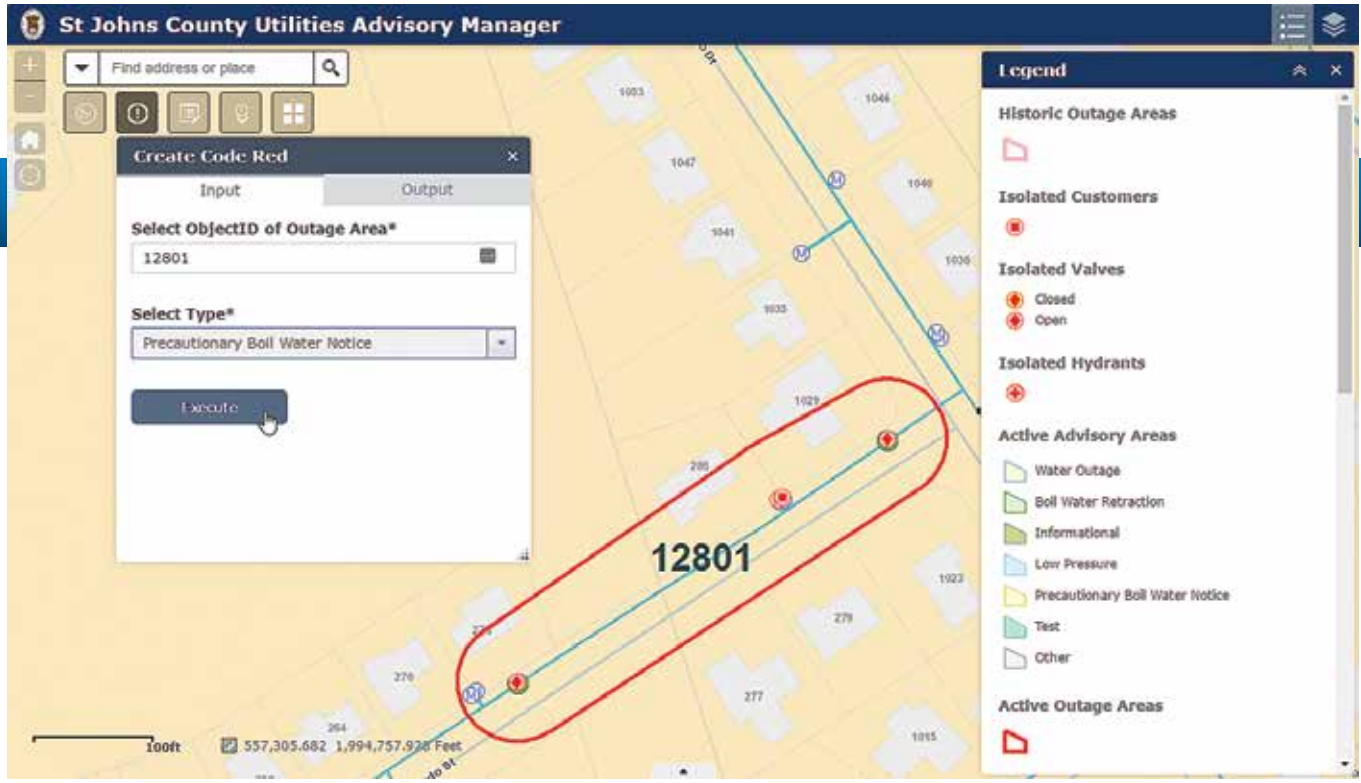
Powering these apps requires accurate and trustworthy data. To ensure data quality, the utility created an app that is a hybrid of two Esri solutions: Map Notes and Map Change Request. Both are configurations of ArcGIS that are accessed through Collector for ArcGIS on a mobile device.

This app, named Field Observer, is a one-stop shop that lets utility staff members enter utility infrastructure issues and data concerns that arise as part of ground truthing while in the field. Conditions such as a paved-over valve, vegetation issue, or evidence of a leak can be captured using the app as well as sewer, water, and reuse map data change requests. The app allows utility personnel to quickly and easily identify both infrastructure and data issues and get them into the system of record where further corrective actions can be taken.

Recently, Field Observer has been used to increase the accuracy of GIS data and streamline communication between field crews and the GIS team. Field crews verify the location of valves and use Field Observer to note changes to valve locations. In the past, these changes were communicated by capturing images and sending an email for each valve. Now, the information is added to the map so it is instantly visible to GIS staff. This reduces the volume of emails while increasing the flow of information.

← Water Isolation Trace is a Web AppBuilder app that incorporates the Utility Isolation Trace widget.

→ The Customer Services Summary application informs users of services available in their area and provides links to rate and water quality information.



↑ Advisory Manager application with Create Code Red tool set up to be run

Keeping Customers Informed

Advisory Manager, the other Web AppBuilder for ArcGIS app developed for managerial applications, is a clone of the Water Isolation Trace app. It incorporates the Web AppBuilder for ArcGIS Edit widget and two custom widgets (Create Code Red tool and Extract Code Red tool) that work with the utility's Code Red system, which is used to notify customers of outages and other potential water supply and quality issues.

The Create Code Red tool takes an outage area polygon from an isolation trace run and intersects it with parcel polygons to prepare a notification area. The Extract Code Red tool is a custom Web AppBuilder for ArcGIS widget powered by a slightly modified version of the Extract Data script tool from the Server Tools Toolbox. This tool allows a user to select a Code Red polygon to export from Advisory Manager as a shapefile that can be imported into the Code Red system. Code Red accepts the shapefile as an input, gathers all registered users in that area, and sends out notifications regarding the issue. This streamlines the customer notification process.

Advisory Manager is also used to manage the status of drinking water advisories. Following a recent water main break, SJCUD's environmental manager quickly created a Boil Water Notice for the affected customers and pushed that information out to the public. Once the lab tests determined that the water was safe for consumption, it was just as easy to issue a retraction of the Boil Water Notice. The process is so easy that in a recent case, the retraction was issued using Advisory Manager on a mobile phone from a tennis court. This anytime/anywhere application makes the flow of information from the utility to its customers smooth and virtually instantaneous.

Keeping the Community Informed

To notify customers of water quantity and/or quality issues, the ArcGIS for Water Utilities Drinking Water Advisory template was deployed. Boil water notices, boil water notice retractions, water outages, and low water pressure notices created through the Create Code Red tool are displayed here as Drinking Water Alerts and Advisories. The Alerts and Advisories layer is updated from within the Advisory Manager application.

To inform customers of services available in their area, the ArcGIS Information Lookup configurable web application was implemented as the Customer Services Summary application. Customers can click the map or search by address using the custom in-house geocoding service to get a list of services, contacts, and other information for that location such as water quality reports, irrigation regulations, and utility rates.

Keeping customers up-to-date on future projects and expenditures is important to any utility. To help with this, SJCUD created and Esri Story Maps app using the Story Map Tour template, customized with a tabbed layout for viewing reuse, sewer, and water capital improvement projects by category.

The utility had used CSV files and hosted feature services as data sources for its story maps in the past but wanted to be able to drive this story map dynamically using a feature service sourced to its enterprise geodatabase. With this setup, the utility's GIS staff can add content to the story map simply by adding new features and/or changing a status in the data. There is no need to touch the application or any items in its ArcGIS Online back end.

With this story map, the public can learn where capital investments are being made

↑ The capital improvement projects story map shows a variety of ongoing utility sewer projects.

in the county and what these investments can do for them. An internal-only ArcGIS Online web application was also created to keep utility staff informed of current and future capital improvement projects. Although a simple viewer, this internal app shows all capital improvement projects and provides full access to data attributes and full-resolution photographs.

Responding to Emergencies

After Hurricane Matthew hit the area in early October 2016, the utility was able to quickly deploy applications to aid in response and recovery. The Damage Assessment solution, a configuration for Collector for ArcGIS and Operations Dashboard for ArcGIS, was used to quickly assess damage to approximately 360 lift stations. Teams equipped with tablets began assessments. They completed the project ahead of schedule within a matter of days.

Lift station conditions were quickly recorded, including photographs of any damage. Information gathered with this tool was used for documentation for insurance evaluation and for Federal Emergency Management Agency (FEMA) reimbursement. Public water advisories were posted to the 100,000 customers without water. Sanitary sewer overflows were located, the public notified of their locations, and the sites inspected for water quality compliance.

In the aftermath of that natural disaster, GIS aided recovery efforts. The hurricane response and recovery tasks were tracked and reported using Cityworks and ArcGIS Server. To illustrate the volume of work completed during and after the hurricane, SJCUD created a web map app that demonstrated how rapidly the utility addressed and resolved issues in response to the emergency using a time line.

Conclusion

St. Johns County Utility Department uses the ArcGIS platform to enable its workforce and empower its customers with accurate and current data on the state of water, sanitary sewer, and reuse water services. By putting the right tools, maps, and apps into the hands of its field workforce, the utility can provide quality data, up-to-date information, and timely and accurate notifications to its customers despite the challenges of rapid growth in its service area. Although the utility has a mature GIS shop, it continues to discover new ways to utilize GIS and the ArcGIS platform to help gain efficiencies and save money.

For more information, contact Chad Cooper at chad.cooper@gisinc.com.

Acknowledgments

The author thanks Tom Tibbitts, Karri Thomas, and Bryan Bommersbach at St. Johns County Utility Department for partnering with GISinc and helping with this article. Michael Parma and Chris Blinn of GISinc were both instrumental in workflows and applications implemented for the utility by GISinc.

About the Author

Chad Cooper has worked in the geospatial industry over the last 15 years as a technician, analyst, and developer for state and local governments, oil and gas companies, and academia. For the last three years, Cooper has worked as a solutions engineer, consulting on the State and Local Government team with GISinc. At work, he couldn't be happier spending the day writing Python and helping clients such as St. Johns County Utility Department get the most out of their data through the use of the ArcGIS platform. At home, he enjoys hanging out with his gorgeous wife of 12 years and their three wonderful children. They enjoy hiking, fishing, and doing nothing on a nice beach.

Mapping the Potential of Bioenergy in Germany

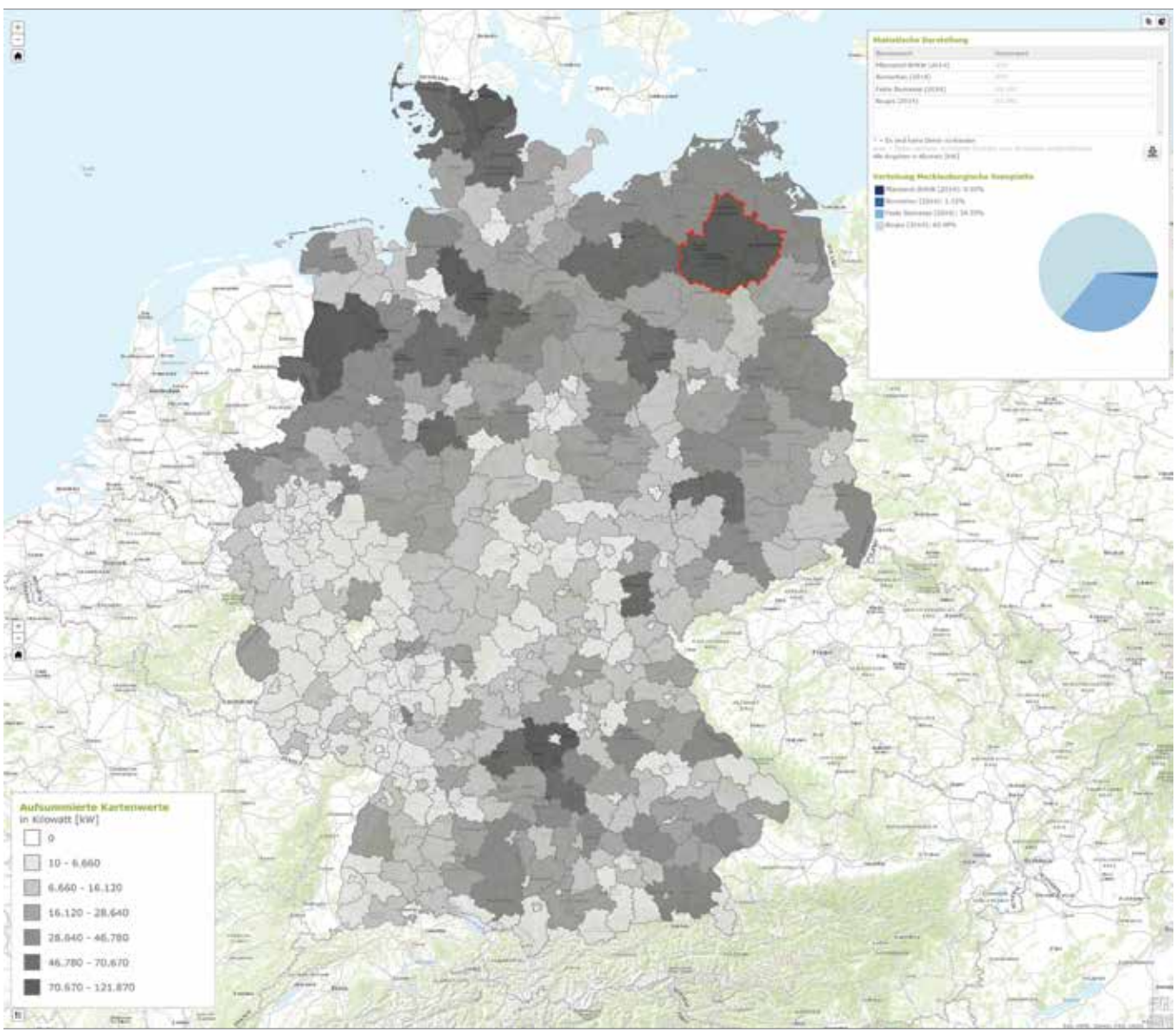
An interactive atlas available to the public lets researchers, investors, and other interested stakeholders quickly and easily visualize biomass potential on national and regional levels in Germany.

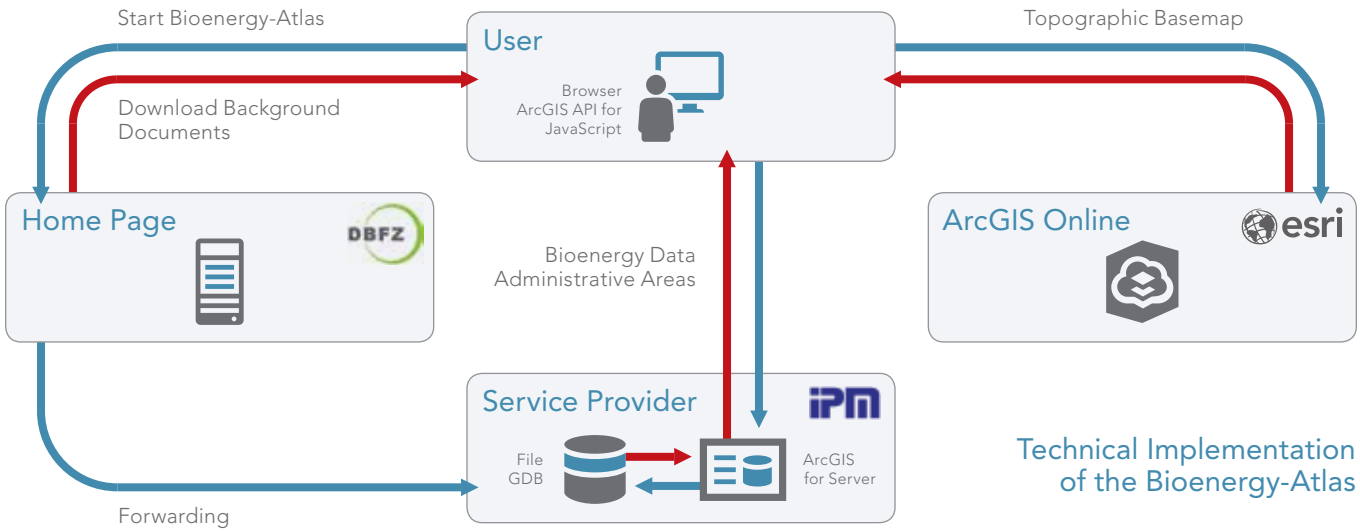
The Bioenergy-Atlas, developed by the German biomass research institute Deutsches Biomasseforschungszentrum gGmbH (DBFZ) and Esri partner Ingenieurbüro Peter Müller GmbH (IPM), also makes the underlying data available for download in Microsoft Excel format for further research. The Bioenergy-Atlas is publicly accessible at www.dbfz.de/biomassepotenziale at no charge.

An energy source that utilizes the energy contained in organic material, bioenergy is a renewable resource that specifically excludes energy derived from fossil fuels. Biomass is the term applied to organic material that is the source of bioenergy.

Because bioenergy contributes approximately two thirds to the renewable energy system in Germany, it represents an essential option for balancing the very volatile renewable energy sources that contribute to the German power supply system. A variety of biomass sources, especially those from the residual and waste

↓ The interactive Bioenergy-Atlas enables the individual compilation of biomass potentials.





material sector, offer great potential for optimizing the integrated use of this material as an energy source.

The database for calculating various biomass potentials used data from several research projects conducted by different research facilities in Germany. Data was collected in different ways to meet the needs of these projects. The data was furnished in Microsoft Excel spreadsheets. An import tool was written by IPM to import the table data into the ArcGIS Server database.

The database initially created was inconsistent because the original data differed in the classification of the biomass type, graduation of the units, scale of measurement, and administrative boundaries.

As part of a meta-study and in collaboration with several German scientific partners (Helmholtz Centre for Environmental Research, State Institute of Agriculture of Thuringia, INFRO, Bremen University of Applied Sciences, Witzenhausen-Institute, and Fachagentur Nachwachsende Rohstoffe [FNR], data on biogenous residual and waste material was collected and harmonized to make biomass sources comparable for future scientific research. The resultant data has been collected and made available through this high-performance and intuitive web app.

For the first time, the Bioenergy-Atlas enables users to assemble biomass potential results of various biomass sources. This tool makes information about technical biomass potential in tons of dry substance (t TS) accessible as well as the installed electrical capacity of bioenergy plants in kilowatts (kWs).

The data is organized by biomass topics and regions. Currently, information on the potential of 15 biomass categories can be displayed in an interactive map up to the county level. The content will be extended step-by-step. The integration of additional topics and functionalities is planned.

The interactive tool is also embedded in a wide range of online services that provide further information on the topic of biomass potentials. The website offers a continuously growing amount of new data. Illustrations, maps, data sheets, publication, tools, and state profiles are also constantly added to the DBFZ website. To supplement research papers and other publications, interested parties or institutions can obtain direct access to research results. By providing an extensive range of information services, DBFZ is a central contact point for the information on biomass potentials.

The Bioenergy-Atlas quickly provides users with specific biomass information. Interested users can immerse themselves in the fundamentals of bioenergy and contact DBFZ to answer any questions and contact others in the field to discuss findings and improve results.

Developed by IPM on ArcGIS for Server using the ArcGIS API for JavaScript (version 3.17), the atlas, which uses cloud components from IPM and Esri, is integrated into DBFZ's home page. IPM hosts ArcGIS for Server and prepares the data on biomass potentials and the performance parameters of bioenergy plants in Germany. That data is delivered to the user's browser, where it is rendered.

This design fulfills the customer's requirement for a high-performance app that can work in low-bandwidth conditions. It is easy to use and does not require a manual. The Bioenergy-Atlas provides a high-quality visual representation of the data. It uses the *Esri World Topographic Map* from ArcGIS Online, so basemap content is automatically updated by Esri rather than requiring IPM to host and maintain the basemap.

ArcGIS for Server provides the atlas as a web service. The map shows administrative boundaries for country, state, and district. To accommodate differences in display quality and ensure results can be interpreted by users, color symbology has been optimized for interactive maps and charts.

For more information, please contact André Brosowski of Deutsches Biomasseforschungszentrum gGmbH (www.dbfz.de) at andre.brosowski@dbfz.de.

Adam-Ries-Straße 16
09456 Annaberg-Buchholz
Germany

Hubertus Kraus, CEO of Ingenieurbüro Peter Müller GmbH at kraus@ipm-gis.de.

Effective Managers Must Have PEOPLE SKILLS

By Gary Maguire, Department of the Premier and Cabinet, South Australia

Many of us toil away for years on our chosen academic path to make sure we have the skills and knowledge so that we are employable in a highly competitive job market. Our success is defined by securing a job in the industry area in which we can maximize our GIS skills. However, this success also depends on having the skills to communicate our way through an interview and fit into the values of the organization.

The education system prepares us with hard skills. These are skills that can be described from theory, tested in practice, and assessed using quantitative measurement. There is an equally important set of skills that are less tangible and not really taught in class beyond our adolescent years. These are soft skills.

Already I can hear many of you say, "I've got them." But do you really have them to be an effective manager?

Soft skills can be defined in so many ways. I personally like the description of people skills because this encapsulates the very essence of what is important in business—people. No matter how much technology, data, or revenue turnover we have, people make companies and organizations great. We deal with people in many ways every day in the workplace. How we interact with individuals has a dramatic impact on them, our business outcomes, and us.

The 2015 report *State of the American Manager*, by Gallup, stated that most managers are wrong for their roles. The study of employee engagement found that just 30 percent of US workers are engaged. This demonstrates a clear link between poor management and a nation of checked out employees. This statement doesn't point to any specific components of poor management, but there is clear evidence in the report that people skills are paramount for success in managing and leading people.

Why Are People Skills Important?

Think of people skills as a toolbox from which you can draw to resolve an issue or influence an outcome. Some of these skills include communication, emotional empathy, resilience, self-confidence, personal values, and the ability to mobilize your boss. People skills are not only important when engaging with customers and clients. They are equally—if not more—important when it comes to influencing executives and leading teams and employees. In today's complex workplace, individuals with good people skills are more likely to be able to influence up, sideways, and down with ease. The results of increasing business influence are better employee engagement, lower turnover of staff, and—at a personal level—more opportunities for career success.

Breaking the GIS Norm

Many people in our industry are introverts. They excel in using their hard skills in solitude. They have fewer people skills than others in the workplace. This makes it harder for them to rise above others who have better soft skills.

Daniel Tenner is a programmer and founder of GrantTree. The company works with a lot of technology companies to help them get government funding, and Tennet believes that people skills are important to success. In an article in *IDG Connect* from 2014, he is quoted as observing:

"Highly technical people tend to be more capable of being quiet and focused on what they're doing—because if you can't do that regularly, then you're not going to get very far with programming. So that rules out a number of extreme extroverts who feel de-energized immediately if they're not working with people. However, the general perception tends to be that geeks are all extremes in the other direction—socially maladapted and unable to handle human interactions."

Later in that same article, he added, "Failing to make a good first impression means missing out on good business deals and opportunities, and that hurts any kind of business." Apply this statement to yourself. Do you have the people skills to make a good impression, secure personal development opportunities, and be front and center for the next promotion in the organization?

Are You Speaking My Language?

Over the years, I have spoken with many individuals about the importance of people skills one-on-one or at meetings, such as the GIS Managers' Open Summit at the Esri User Conference. The most common questions are about communicating with and influencing others to act.

I believe communication is one of the foundational people skills. Communication comes in many forms: speech, writing, sign language, dance, storytelling, maps, pictures, and social media—the list goes on. We all understand that good communication is essential for our success.

What I have found over the years is that GIS professionals talk great geo jargon—and generally speak to the like-minded people in the room. Think about the last time you were at a conference and walked up to a stranger

and introduced yourself. For many people, especially introverts, that is a very difficult thing to do. This simple action requires you to use many skills, like self-confidence, emotional empathy, and resilience. Then there are formal meetings with a client or an executive. Often technology professionals default to acronyms and jargon to impress or sound knowledgeable. However, this often has the opposite effect.

Recently I was in a meeting with a group of executives in which a technology professional spoke on a very technical level. She was very enthusiastic and excited about her topic, schema design and databases. The executives were confused, but nobody wanted to interrupt her. The senior managers appreciated her professional enthusiasm and let her finish although they understood little of what she was talking about. After the meeting, one of the executives asked me, "What is a schema thing?" My response was to relate it to something familiar—an organizational chart. An organizational chart shows who and what is connected and in what way, which provided a general sense of what a schema is. It was not a complex answer but one that was easy to understand.

It is of utmost importance to consider the audience and structure the language and conversation at their level. You should go even further and speak musically. This means modulating sound, silence, and tempo to make each word count. Listen to other professionals. TED talks are a great resource. Practice communicating so your messaging will become engaging, consumable, and relevant to your audience. As a GIS professional, you need to speak many languages.

Mobilizing Your Boss

Is mobilizing your boss a people skill? Influencing is, and therefore mobilizing fits into the people skill toolbox. I have always liked this quote by Benjamin Franklin, "Tell me and I forget, teach me and I may remember, involve me and I learn." This is the essence of mobilization. You must involve the boss if your GIS is to succeed.

It is evident that organizational change is more frequent now than in the past. GIS teams may have established themselves over the years in an engineering section, information and communication technology division, or a scientific unit. GIS teams are now more often seen as enablers that can be established anywhere, moved anywhere, or even federated across an organization.

As a result, it is more relevant than ever before for GIS professionals and managers to utilize people skills to successfully mobilize the boss. The challenge is one of self-awareness: to know how and when to use the whole toolbox, which includes organizational awareness, adaptability, resilience, self-confidence, influence, empathy, and effective communication. Mobilizing the boss requires understanding what motivates and what irritates that boss. Most important, it requires an ability to build an environment of trust so that your advice about how GIS can best be utilized is acted upon.

In conclusion, in the words of CrossFit founder Greg Glassman, "Hiding from your weaknesses is a recipe for incapacity and error." Our greatest challenge is to do something that we do not practice every day. For many GIS professionals, this is reaching into that toolbox of soft skills often so you can become better with them through practice. You might just have to work harder at it than others.

About the Author

Gary Maguire is the senior geospatial intelligence officer for the Department of the Premier and Cabinet, South Australia. He has been involved in the spatial industry for 32 years and has led several major state government geospatial initiatives. He has held several executive positions including the president of the Surveying and Spatial Sciences Institute and a board member of the Centre for Spatial Law and Policy. In 2014, his team was recognized by Esri with a Special Achievement in GIS Award. He is a fellow of the Leadership Institute of South Australia.

ArcGIS Marketplace Offers Advantages for Consumers and Providers

If you are a GIS manager or professional, ArcGIS Marketplace is a great place to find apps, data, and additional capabilities that leverage and enhance what your organization can do with ArcGIS Online and the ArcGIS platform.

If you are a GIS developer, ArcGIS Marketplace provides direct engagement with the ArcGIS community and a mechanism for promoting, selling, and managing access to your apps and data.

ArcGIS Marketplace (marketplace.arcgis.com) is a central location for discovering and getting apps and data from qualified providers worldwide and making them available through any ArcGIS Online organization.

For GIS Professionals

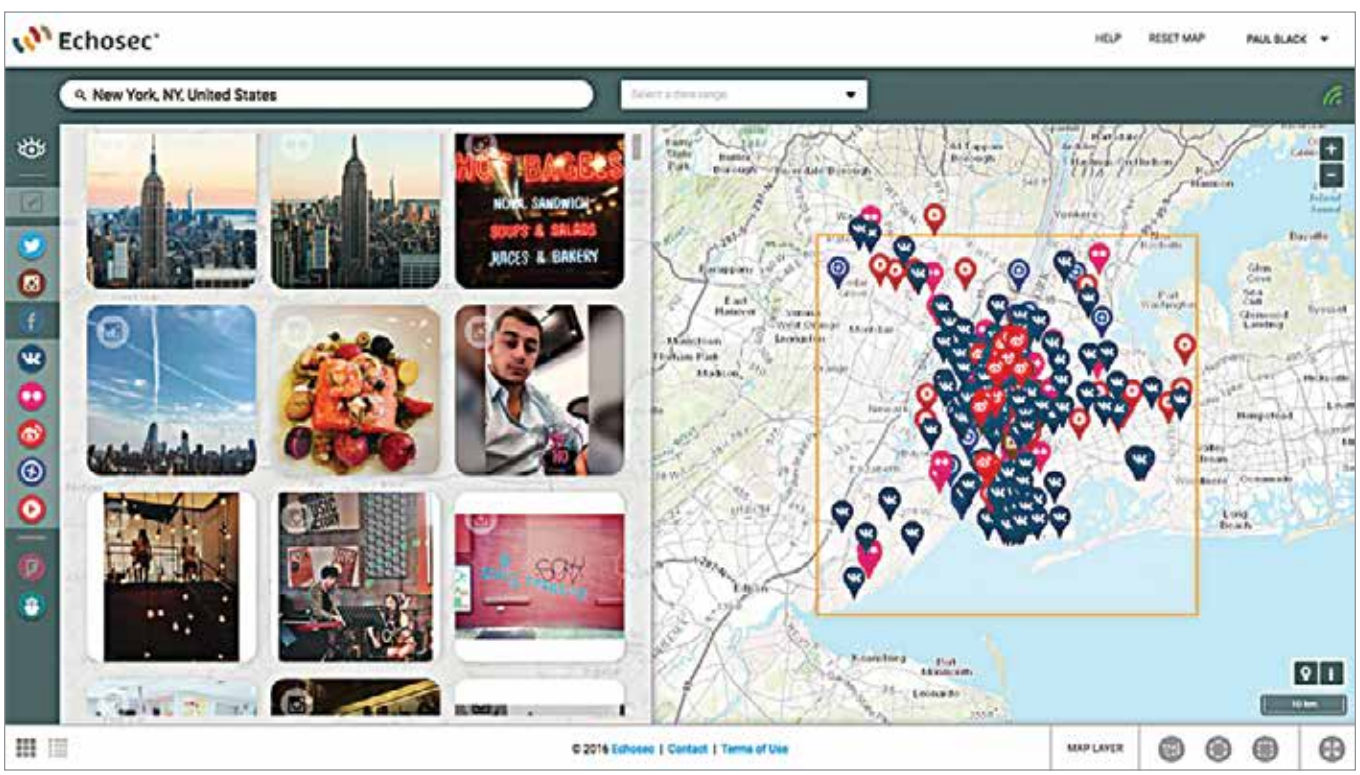
The marketplace includes both paid and free apps, and many include the ability to access free trials using your ArcGIS Online organization account. You can explore an array of solutions built by Esri and qualified Esri partners, international distributors, and startups. All Esri's premium apps—Drone2Map for ArcGIS, Navigator for ArcGIS, ArcGIS Business Analyst, ArcGIS Community Analyst, and GeoPlanner for ArcGIS—are available for trial and purchase online through ArcGIS Marketplace.

ArcGIS Marketplace makes it easy to discover, try, and gain immediate access to ready-to-use apps, content, and additional capabilities, especially offerings designed to tailor the functionality of ArcGIS to specific industries. ArcGIS Marketplace is built into ArcGIS Online so the benefit of apps, data, and capabilities can be realized in an integrated and seamless way. This integration streamlines the process of evaluating the trial versions of many offerings. ArcGIS Marketplace also offers apps, content, and services that are available at no cost. These items can be located using the Free filter.

For GIS Developers

As a provider for ArcGIS Marketplace, you keep 100 percent of the sales revenue from selling your ArcGIS Online supported apps and data while having access to tools that help you generate leads,

↓ Echosec Pro for ArcGIS filters social media for any geographic area stipulated by users.



→ Mapillary for ArcGIS is an ArcGIS Online web app for viewing, creating, and editing GIS data.

manage subscriptions, and seamlessly provide free trials.

You can take advantage of built-in marketing to the ArcGIS user community. Apps can be built with any ArcGIS Runtime SDK provided an ArcGIS Online subscription login is required to use the app. Members of the Esri Partner Network or Esri StartUp Program and qualified developers can apply to become a marketplace provider. Learn more about the program and apply at doc.arcgis.com/en/marketplace/provider/ to find offerings that can help you maximize the value of your organization's GIS.

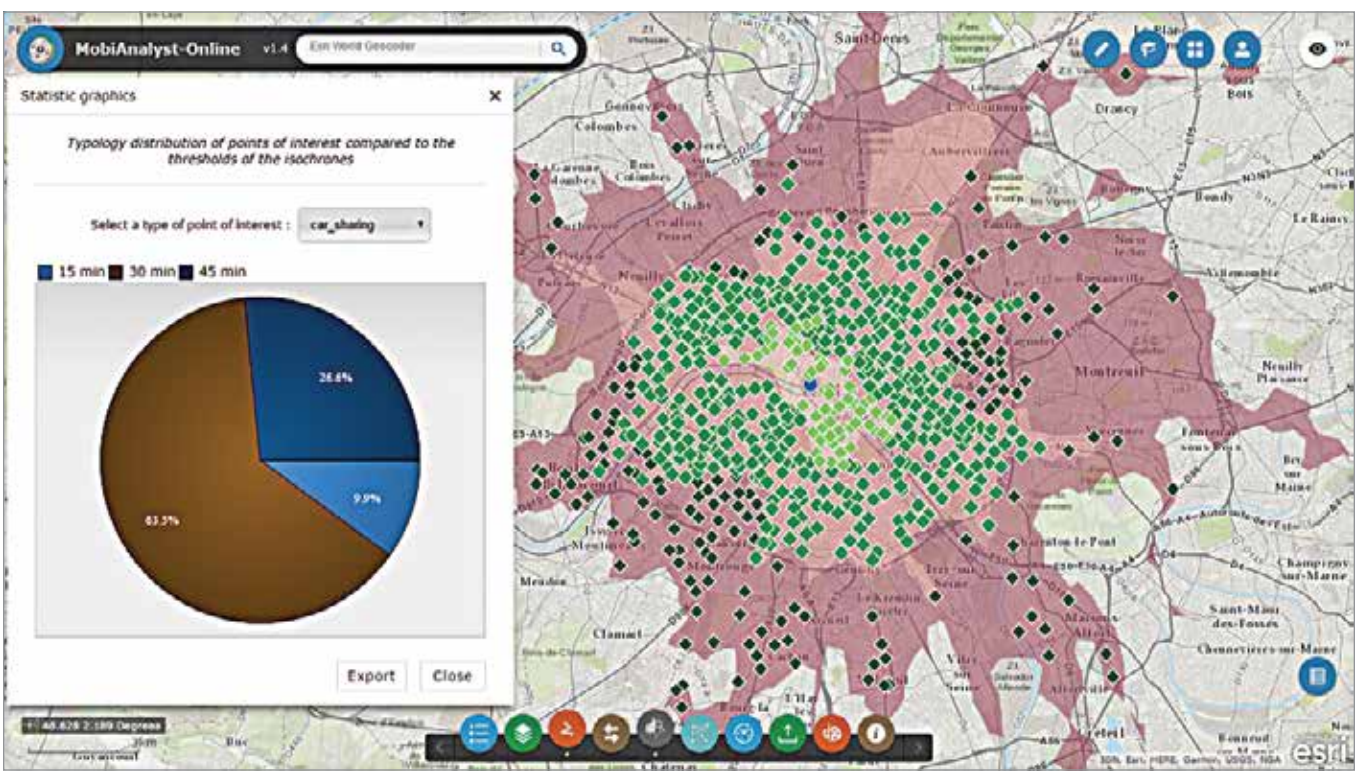
Coming Soon to ArcGIS Marketplace

ArcGIS Marketplace is constantly expanding. If you are looking for a specific app or type of content and can't find it, use the ArcGIS Ideas site on GeoNet to let Esri know what you need. Submit your ideas using the dedicated ArcGIS Marketplace section or add an Idea to the relevant section or category.

Among the new features planned for ArcGIS Marketplace are more ArcGIS Pro add-ins and configurations from Esri partners, distributors, and the startup community along with the ability to subscribe to more diverse types of data and content services. ArcGIS Marketplace will evolve to support apps, content, and additional capabilities that can be used with ArcGIS Enterprise.

Visit ArcGIS Marketplace at marketplace.arcgis.com to find out how you can benefit as a consumer or provider.

↓ Do multimodal network analysis and mobility flow pattern analysis with MobiAnalyst Online from MobiGIS.



Maximize the Benefit from E-Learning

If your organization has a qualifying Esri product and is current on maintenance, your users will have unlimited access to Esri's self-paced e-Learning resources. As a GIS manager, you can use these resources to keep the skills of your core ArcGIS users up-to-date so your organization can benefit from the constantly expanding analytical and visualization capabilities of ArcGIS.

You can also build expertise in your less experienced GIS staff members and make casual users more proficient. E-Learning is also a great way to generate excitement about the technology and expand awareness and appreciation of what can be done with GIS. To take full advantage of e-Learning in your organization, you need an enterprise-wide strategy that decides who will use e-Learning and how they will be managed.

Who Will Use E-Learning?

Everyone in your organization is eligible for e-Learning because access does not require an Esri product license or named user status. This means that anyone in your organization who might benefit from e-Learning can use it. In addition to continuing education for your core staff, you can include casual users, members of groups who are not direct users but who are interested in becoming more knowledgeable, and employees who would like to include GIS as part of their professional development.

How Will You Manage E-Learning Access?

Access can be managed through ArcGIS Online or through My Esri. The method you choose depends on the nature and number of your learners.

Using ArcGIS Online is easy because you or your administrator can grant access to e-Learning to all the named users in your organization at once. However, only named users will be able to use e-Learning. These members must use the same user name and password they use for ArcGIS Online. If they previously took training using an Esri public account, that training will not be associated with training completed using ArcGIS Online access. If these staff members are removed from the ArcGIS Online account, e-Learning terminates, and they will need to contact Esri Customer Service to transfer their training history to a public account. If e-Learning will be limited to a consistent number of ArcGIS Online named users, this may be a good option for you.

With My Esri, anyone connected to your My Esri organization has e-Learning automatically enabled. Make sure anyone who is not a member of ArcGIS Online for your organization is connected to your organization in My Esri. Administrators for My Esri can connect users using the email tool available at My Esri to invite as many as 1,000 people at a time to connect to My Esri. E-learning access can be limited by administrators to a specific time. If individuals have existing public accounts for e-Learning, they can continue to use them. Although administrators will see all connected users, filters in the Manage Users table can be used so only e-Learning users are displayed.

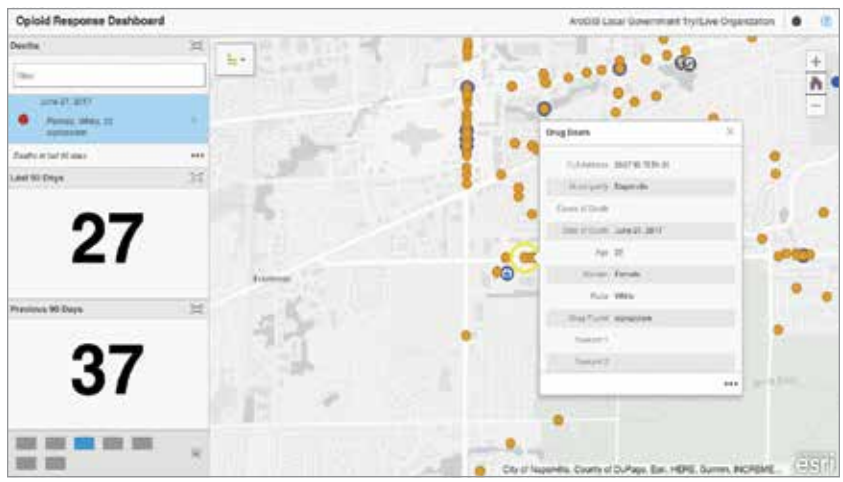
Whether you use ArcGIS Online or My Esri to manage e-Learning, determine if staff should request access to e-Learning or be automatically granted it. As staff are hired or leave, make adding or removing them from ArcGIS Online or My Esri part of your organization's standard procedures. Periodically revisit your management processes for e-Learning to evaluate how it is being used and if your organization would benefit from expanding access to it. Visit esri.com/training to learn more about this resource.

Location Intelligence for Executives

WhereNext, an online digital magazine targeted at business executives and decision-makers in government, looks at the role of location in trends such as the Internet of Things (IoT), digital transformation, big data analytics, and smart communities. Its articles describe how location intelligence relates to business assets, workers, demographic trends, and consumer behaviors. By giving context to technology trends, it can promote more effective decision-making. *WhereNext* underlines the value of seeing an organization spatially. The site will publish new content on a weekly basis. Subscribe to the magazine at go.esri.com/wherenext.

Tools to Tackle the Opioid Epidemic

Local governments that are dealing with the sharp increase in drug overdoses, driven by the recent rise in opioid addiction, have GIS tools to help them address this situation. These maps and apps can help both citizens and government staff. Maps can communicate to citizens the scope of the drug problem and inform them where to drop off unused prescription drugs or obtain treatment for addiction. Using a collection of apps, public health and safety staff can apply GIS to monitoring suspected drug activities and response efforts; tracking turned in prescription drugs and the use of naloxone; and inventorying drug treatment and alternative pain management programs. These maps and apps join a growing collection of ArcGIS for Local Government and other industry-specific solutions available at solutions.arcgis.com.



↑ The Opioid Response Dashboard is one of the solutions developed to help local governments cope with the opioid epidemic.

Designing Maps before Building Apps

By Allan Laframboise, Esri Geodeveloper

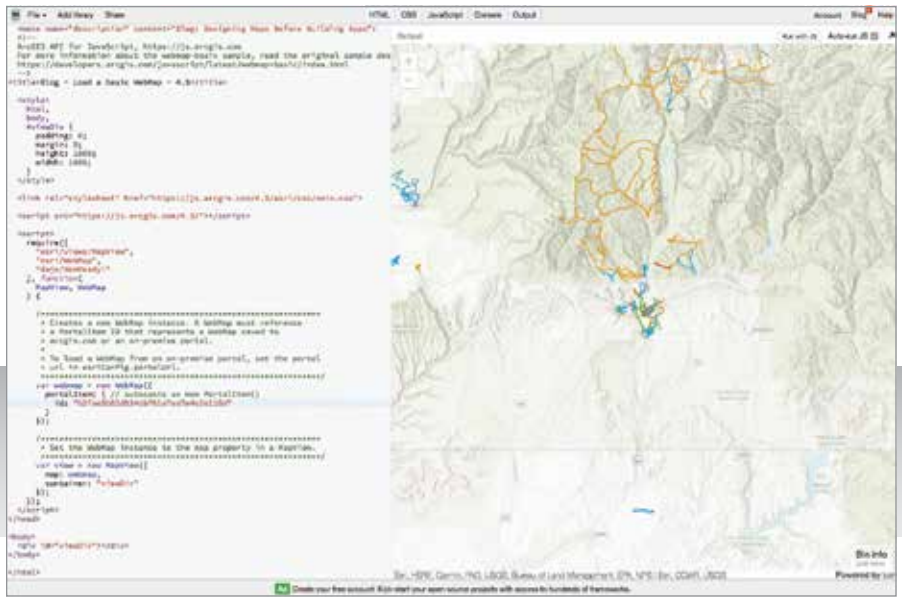
As a map app developer, one of the easiest ways to improve productivity before writing a line of code is to use ArcGIS platform tools such as Map Viewer or Scene Viewer. These viewers are online map editors that you can use to design maps and scenes interactively. Once created, maps can be consumed by your custom apps.

Designing maps with the viewers can save a significant amount of time during the application development process, especially when you are in the experimental and prototype phases. For example, it's a lot easier to change, apply, and visualize map settings interactively when you are selecting basemaps, deciding the best symbols and colors to use for layers, and trying to select the best fields and content to display in pop-ups.

The viewers also have built-in features, such as smart mapping, that help you make better styling decisions based on the type of data in your map. If you are new to ArcGIS and the viewers, you might want to check out the Data and Design tutorials available at Esri DevLabs (developers.arcgis.com/labs/) to learn how to create your own maps.

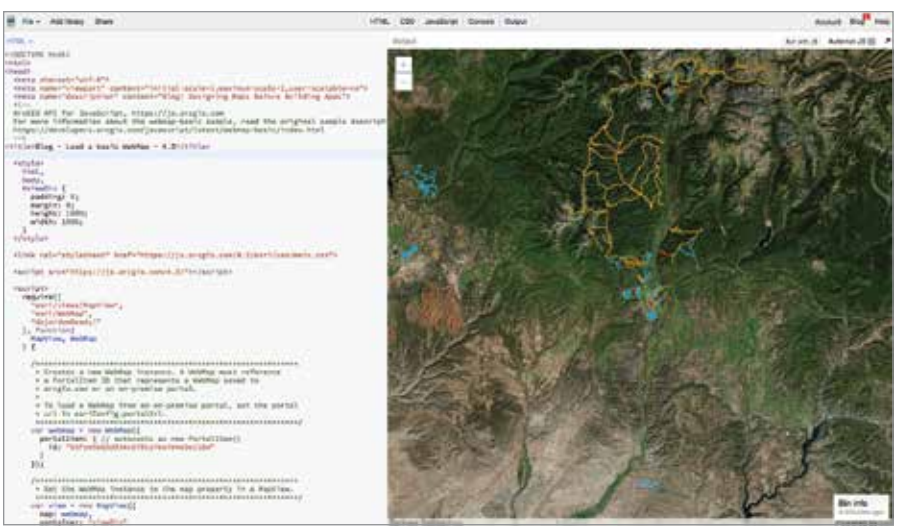
The best part of taking this "design a map first" approach is that once you are finished designing your map, you can save it in ArcGIS Online or ArcGIS Enterprise and then use one of the ArcGIS APIs to load the entire map (along with all its

↓ You can try this time-saving workflow by saving this sample map.



↖ Use one of the ArcGIS API for JavaScript samples with the ID from the sample map you saved to load the map.

↙ In Map Viewer, change the basemap to the *World Imagery* map, save it, and refresh the jsBin to see that the basemap has changed.



settings) in your app with just a few lines of code, saving you a ton of development time. Let's take a look at how to take advantage of this workflow.

Step 1
Get a Web Map ID

Web maps and web scenes are stored as items in ArcGIS Online and ArcGIS Enterprise. Each item has its own unique ID. To display a map in your app via code, you need the ID. If you don't have a map ID, you have three choices: search in the gallery for an existing map on ArcGIS Online (there are literally thousands to choose from); create a new map from scratch with Map Viewer or Scene Viewer and store it in ArcGIS Online; or use the sample map at http://arcg.is/0mXOvP and make your own copy of it.

The sample web map has been designed with the *World Vector Tile Topographic* basemap overlaid with the World Hillshade layer with transparency set at 50 percent. The trails layer is on top and has been classified by difficulty. Its pop-ups have been customized to display information as text as well as some field data.

Step 2
Load the Web Map

Now that you have a map ID, you can use the ArcGIS API of your choice to load and display the map. With the ID, the ArcGIS API knows how to access the item (PortalItem) on ArcGIS Online. The item is stored as a JSON structure based on the web map and web scene specification.

In this example, we'll just use one of the samples from the ArcGIS API for JavaScript and the map ID from the sample map saved to My Content to load the map. You should notice that the map has all the same settings and behavior as the map in the viewer. Feel free to copy the jsBin at https://jsbin.com/fohico/edit?html, output, add your own map ID, and give it a try.

Step 3
Update the Web Map (and App)

Now here's the best part. Since the app is referencing the item ID on ArcGIS Online, if you go back to the viewer and update the map, and then refresh your app, the changes will be automatically applied to your application as well—no code updates are required. This is a very powerful way to "remotely" edit the map in your app without actually changing any code.

In this example, we just changed the basemap in Map Viewer to *World Imagery*, saved it, and then reran the jsBin. Feel free to try to update and save your map and then refresh your web map.

Summary

If you are not already using the viewers to design your maps and scenes for your apps, be sure to give this technique a try. It's a lot easier to experiment with color and symbol changes in a viewer than it is through code. This is one of the most effective ways to optimize your development workflow with the ArcGIS platform.

Best Practices for Creating Bilingual Apps

By Beth Romero, Esri Software Product Release

Offering your web app in multiple languages can increase your audience and the app's overall impact. This article shows two examples of how to configure apps to support a bilingual audience.

Example 1

Configuring Two Apps

The first example uses the Basic Viewer template to showcase a map. For this project, the target audience has both French and English speakers. After the initial map and app were created, the map's pop-up is configured with custom attributes that explain the data.

Step 1: Identify the Data to Translate

Start by identifying what Esri translates as part of the localization process and what you will need to handle. Esri handles all application elements, such as search, element labels, and tooltips based on the browser locale or the ArcGIS organization locale. You must translate the web map content. In the example, the web map and data are in English and the browser locale was set to French.

Step 2: Translate Data and Create the Second Map

The pop-up, app title, and layer titles need to be updated in the French version. Create a second map and update all required data to fully translate your map and app into the language you need.

Step 3: Configure the Second App

While configuring your second app, you will be able to change the title, subtitles, and additional information to your language of choice. When finished, publish it.

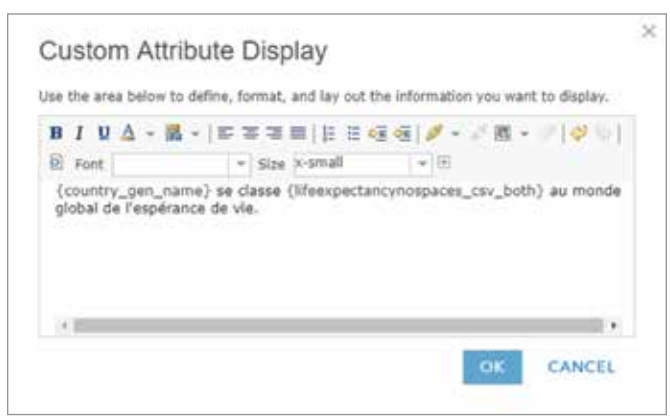
Optional Tips

To enable users to easily choose the appropriate language, I have added a splash screen to both apps. The splash screen linked to the version of the app that is in the other language.

In addition to the splash screen, a URL parameter can be set to force the locale to be in French. In the splash screen hyperlink, a URL parameter can be added to the application URL to force the locale to be set. In this example, "&locale=fr" was added to the end of the French application. For more information, visit the "Use URL parameters to modify maps" topic in the ArcGIS Online help.

Step 4: Share Your App

Review and test your app in both languages. Verify everything is correctly translated. Translations for this example were generated from Google Translate. You may want to have a fluent speaker verify your translations. Make any configuration or data adjustment and then share your app with your audience.



↑↑ Green boxes show what Esri translates, and red boxes highlight what is driven by web map content. In this example, the web map and data are in English and the browser locale is set to French.

↑ This custom attribute pop-up needed translation.

↑ The splash screen links to the version of the app that is in the other language.

→ You may need to update your data to support domain choices in two languages.

Example 2

Configuring One App to Support Two Languages

This example illustrates how to configure one app to support two languages. This project collects data from a community of both English and Spanish speakers but uses one application to collect all the information. This example uses the GeoForm, a configurable app template for form-based data editing of a feature service, available from Esri.

Step 1: Configure Data to Support Two Languages

In this example, four fields in the GeoForm app will be used to collect data. One field contains a domain to drive the drop-down options. The domain values appear in both Spanish and English. Having value choices in both Spanish and English will require a bit of planning or updating your data. These domains were created and published from ArcGIS Pro.

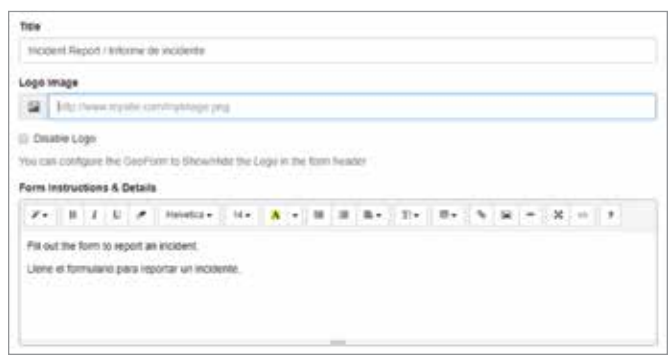
Step 2: Configure the application

During the configuration process, you can assign a title and short instructions in both languages. In most cases, you should adjust the layer names in the web map, but GeoForm allows you to change the field name labels in the builder. This is a simple way to add a second language to the field name.

Step 3: Share Your App

Test your app in both languages to ensure everything that needs to be supplied in two languages by you has been and the rest is localized. An easy way to test the app is to use the URL parameter discussed in the first example. Make any further refinements as needed and then share your app. If you are going to provide links to this app from a website, using the locale parameter to ensure that the app UI is in the correct language for your target audience is a good idea.

↓ GeoForm lets you change field names in the builder.



Why You Should Move to ArcGIS Pro . . . NOW.

Really.

This multiple-threaded 64-bit application is the professional, connected desktop GIS designed to help you work faster; visualize your data using 2D/3D, animations, and charts; and access resources and share your work easily.

Although ArcGIS Pro uses a new ribbon interface, it uses the same familiar basic concepts—maps, layers, and basemaps. ArcGIS Pro is included with the ArcGIS Desktop product. If you have ArcGIS Desktop and are current on maintenance, you have access to ArcGIS Pro and can download it from My Esri. You can license ArcGIS Pro any way that suits you—Named User, single user, or concurrent user.

Work Faster in ArcGIS Pro

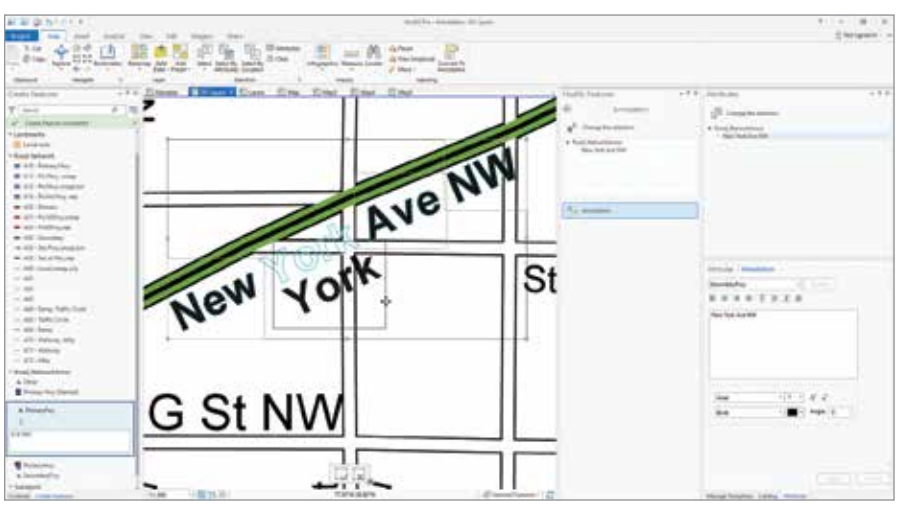
ArcGIS Pro is designed to help you work efficiently. The ribbon along the top of the ArcGIS Pro interface is contextual so it gives you the tools you need when you need them. This eliminates turning toolbars off and on and hunting for tools and provides a workflow-driven user experience.

Instead of dialog boxes that hide what you are working on, nonmodal panes on the sides of the workspace don't block what you are working on, allowing you to continue working while tool processes are executing. There is no need to start an editing session—editing is always on. ArcGIS Pro notes what type of data you are working on and invokes the appropriate tools.

Its project-centric approach keeps all your maps, layouts, tools, geodatabases, and connections in one place. ArcGIS Pro automatically creates a default geodatabase, which you can change if desired.

Work on multiple projects simultaneously

↓ At 2.0, ArcGIS Pro gives you full control over annotation.



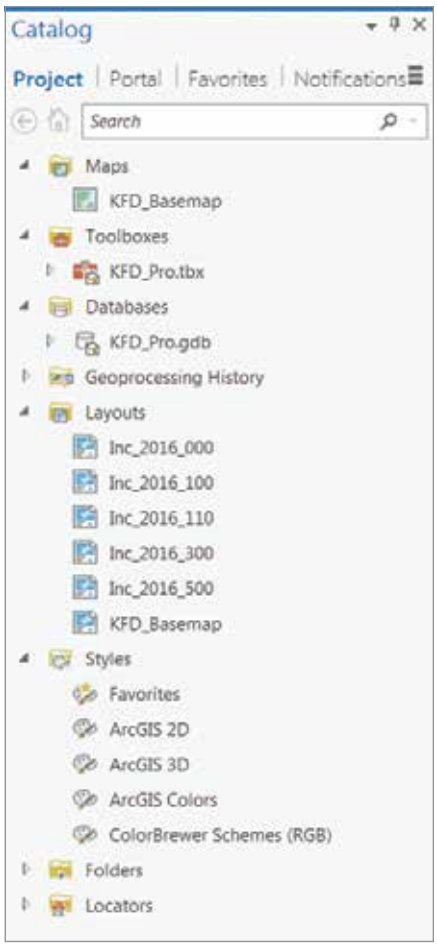
by opening and running multiple instances of ArcGIS Pro without closing the current project. You can work with a read-only project in the same manner as a writable project and use Save Project As to save it to a writable location. Continue to work in ArcGIS Pro while packaging operations complete in the background.

Use Project Favorites to save time if you often use the same folder, database, and server connections for many of your projects. Makes these items favorites and they will be available on the Favorites tab in the Catalog pane (previously known as the Project pane) and in Catalog view.

ArcGIS Pro lets you have many project templates that you can preconfigure for specific tasks such as editing or analysis. Project templates create preconfigured projects by saving interface modifications, toolboxes, and the connections needed for a specific task.

Take Advantage of Innovations and Integration

ArcGIS Pro features innovations that cannot be found in any other desktop GIS. New geoprocessing tools are available only in ArcGIS Pro. Work with views of 2D maps, 3D scenes, and tables at the same time and sync them so changes in one are reflected in the others.

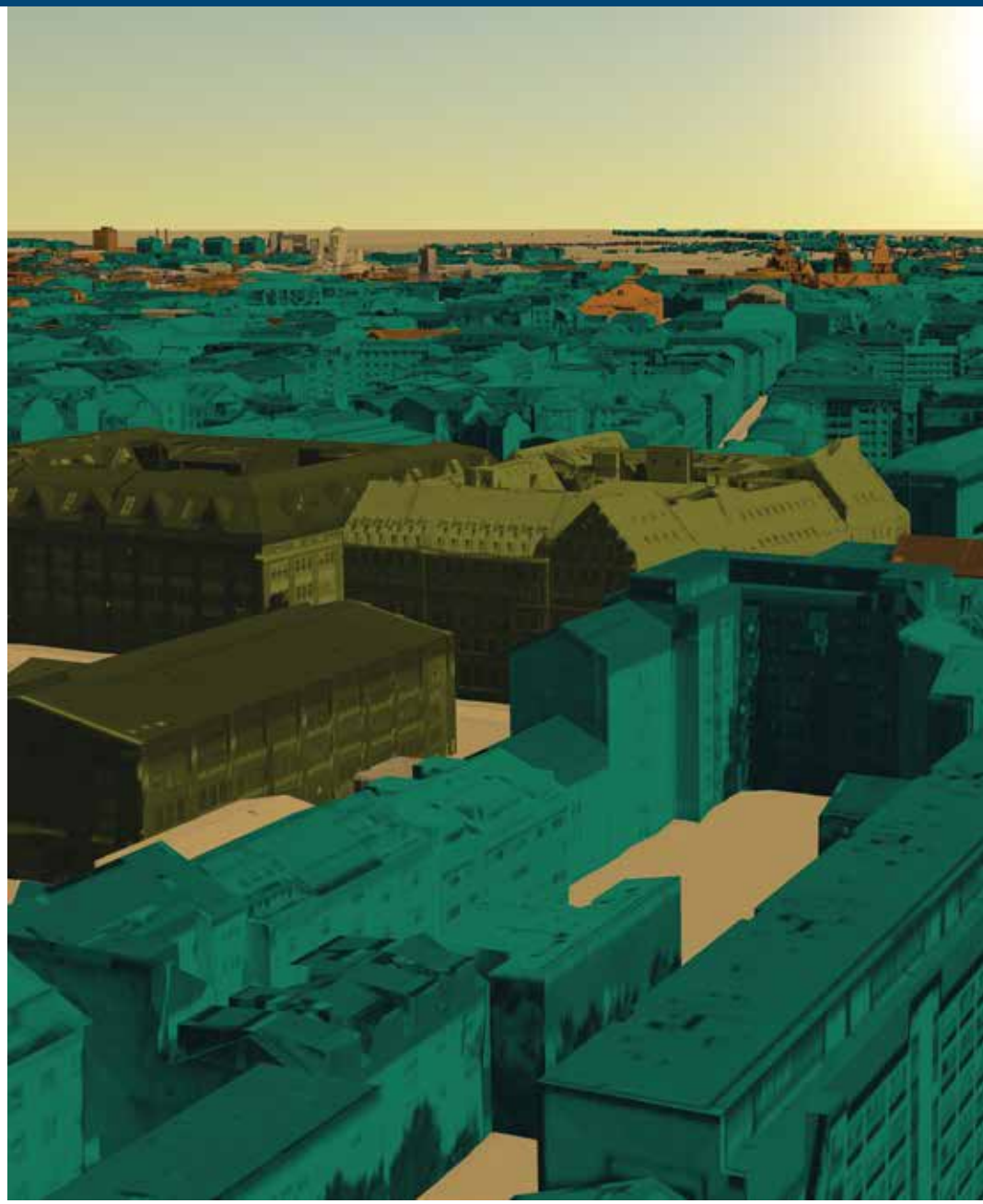


↑ ArcGIS Pro uses a project-centric approach that keeps all your maps, layouts, tools, geodatabases, and connections in one place.

← ArcGIS Pro supports lidar classification, feature extraction, and editing.

3D is the common visual and analytical experience for tomorrow's GIS that is fully supported by ArcGIS Pro. With 3D streaming for global and local scenes; spatial analysis for advanced 3D workflows; lidar classification, feature extraction, and editing; and support for the Industry Foundation Classes (IFC) data model and BIM (Building Information Modeling), ArcGIS Pro is the authoring tool for urban design.

ArcGIS Pro is the primary tool for authoring large web scenes and editing in 3D. It now supports storytelling in 3D with



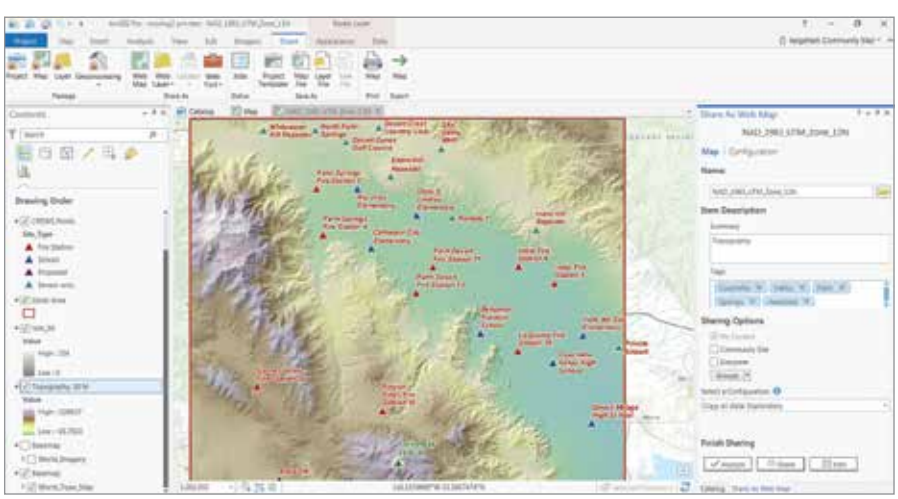
animation that can use range and time information. Improvements to 3D drawing include feature drawing by camera distance and enhanced lighting of 3D objects. Explore 3D landscapes using new navigation controls. Layouts are more useful and powerful with embeddable, interactive, customized charts. Visualizing data in charts helps uncover patterns, trends, relationships, and structure in data.

ArcGIS Pro is tightly integrated with ArcGIS Enterprise, ArcGIS Online, and the rest of the ArcGIS platform, making cross-platform workflows more powerful and providing easy access resources from ArcGIS Online or your portal.

Share your work as an item on ArcGIS Online or your portal or as a file. Sharing is built into the interface and available through the Sharing tab. Create a web map, publish a web layer, or share a project template directly from ArcGIS Pro and have it automatically added as an item in ArcGIS Online. Export maps to PDF and many other formats directly from ArcGIS Pro.

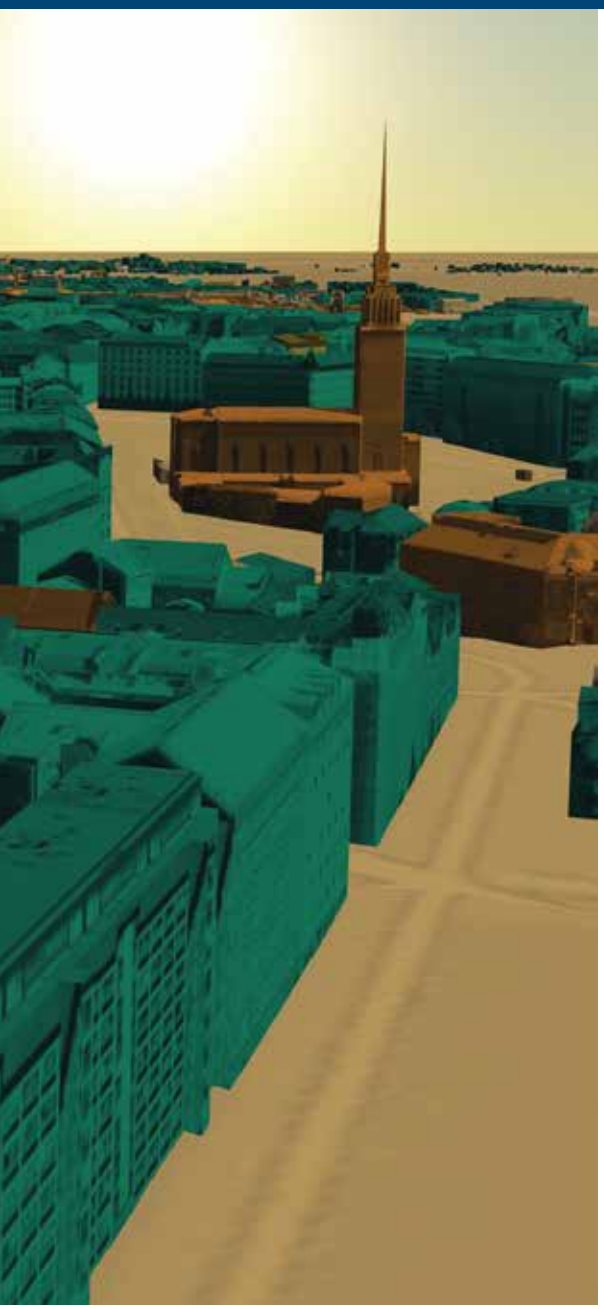
Migrate Your Work

Take existing maps directly into ArcGIS Pro. There is no need to re-create maps and layouts—simply import your map documents (.mxd), scenes (.sxd), and globes (.3DD) into ArcGIS Pro and save them as projects (.aprx). They will look just as they did in ArcMap with the same layouts and symbology. Actually, maps created in ArcMap may look even better after being imported because ArcGIS Pro uses anti-aliasing so lines and text are more crisp and clean. ArcGIS Pro uses the Maplex label engine for optimal placement, so if you did not use Maplex for the original map, labels may shift a bit.



ArcGIS can use the styles or style files you have already developed in ArcMap. By default, styles are not installed, but you can retrieve them from your ArcMap installation or get them from ArcGIS Online. Measured Grids (the lines, ticks, and labels used as a reference for projected

← Sharing is built into the interface and available through the Sharing tab.



coordinates on a map) can now be imported into ArcGIS Pro from a map document or inserted from a style.

ArcMap users have long requested multiple layout functionality, and ArcGIS Pro delivers this. Read "Managing Multiple Layouts in ArcGIS Pro" in the Spring 2017 issue of *ArcUser* to learn more about using multiple layouts.

ArcGIS Pro evaluates imported map documents and will tell you if any issues arise, so if you have created scripts or ModelBuilder models, it will check to see if they will work as originally written or if they need to be slightly modified. Minor syntax adjustments may be needed because ArcMap uses Python 2.7, while ArcGIS Pro uses Python 3.5.

Work Entirely in ArcGIS Pro

You can now perform more complete workflows, such as map creation and data management, entirely in ArcGIS Pro. You can modify topology properties directly in ArcGIS Pro. The enhanced traverse tool improves COGO workflows. In answer to user requests, the context menu options for importing and exporting data are included in the Catalog pane.

At 2.0, ArcGIS Pro gives you full control over annotation. You can create annotation feature classes, convert labels to annotation using a geoprocessing tool, and edit annotation features. Annotation is supported in core geoprocessing tools such as Copy Features, Append, and Feature Class to Feature Class.

Most of the geoprocessing tools and ArcGIS extensions will just work in ArcGIS Pro. Many of the time-saving features you used in ArcMap, such as Bookmarks, are in ArcGIS Pro but some may have a different name. For example, Data Driven Pages are now known as map series.

A New Generation of Desktop GIS

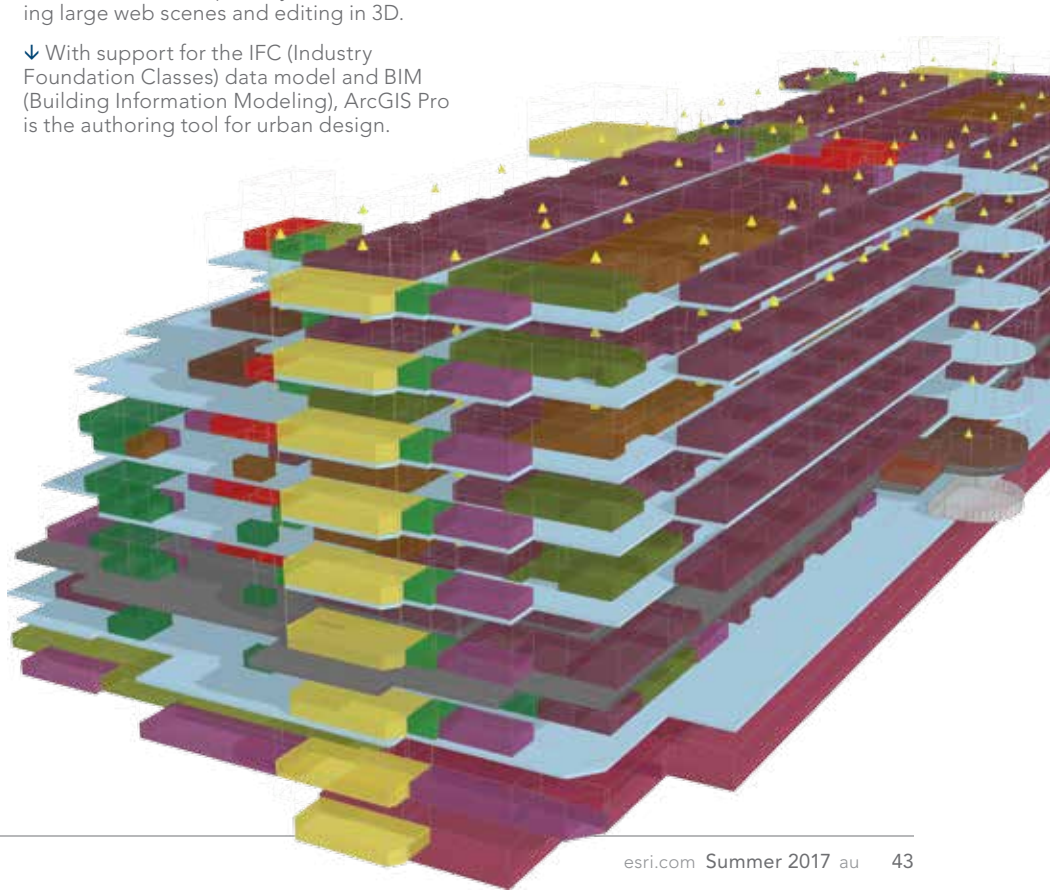
ArcGIS Pro, the new connected desktop, advances desktop GIS by providing a modern 2D/3D user experience not only for performing powerful analysis but also for creating beautiful maps. ArcGIS Pro is a premier client of the ArcGIS platform and an essential companion to ArcGIS Enterprise and ArcGIS Online. It is fully integrated into the Web GIS pattern of working with web layers, web maps, and web scenes.

Tasks previously executed in ArcMap can be automated in ArcGIS Pro simply by using Tasks or through the use of Python scripting. Extend ArcGIS Pro functionality by developing add-ins using the ArcGIS Pro SDK for the Microsoft .NET Framework.

Esri is working on new innovations in ArcGIS Pro that are only possible in the connected desktop and the services architecture. Each release of ArcGIS Pro incorporates the features and capabilities that you have requested. Take advantage of these capabilities by moving to ArcGIS Pro now.

← ArcGIS Pro is the primary tool for authoring large web scenes and editing in 3D.

↓ With support for the IFC (Industry Foundation Classes) data model and BIM (Building Information Modeling), ArcGIS Pro is the authoring tool for urban design.



Helping You Migrate to ArcGIS Pro

There are lots of resources in many formats to suit your learning style and schedule that will help you quickly become productive in ArcGIS Pro.

Guided Lessons Based on Real-World Problems

Learn ArcGIS (learn.arcgis.com) is an online resource that provides free lessons that walk you through a workflow based on a real-world scenario that focuses on using spatial tools to make more informed decisions. This new meaningful approach to learning has modules that teach you how to apply the analysis and visualization capabilities of ArcGIS Pro in concert with the rest of the ArcGIS platform.

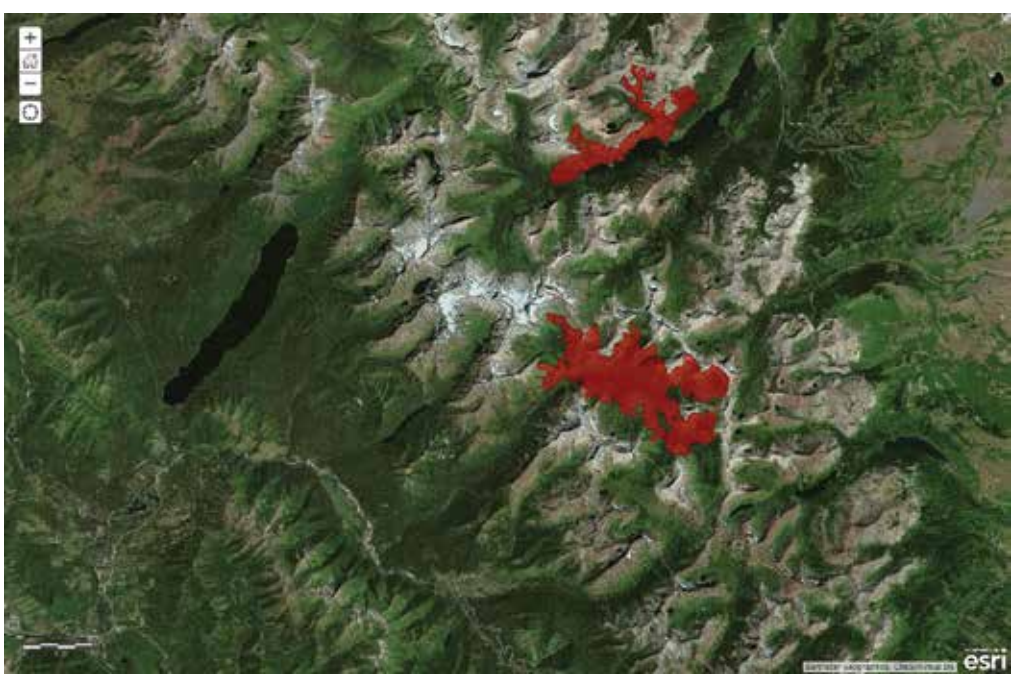
Current modules cover topics such as extracting realistic 3D roof forms from lidar data to guide municipal development, analyzing crime using statistics and the R-ArcGIS bridge, assessing burn scars with satellite imagery, classifying land cover to measure shrinking lakes, and building a model to connect mountain lion habitat. New lessons that focus on using ArcGIS Pro are constantly added.

Training That Suits Your Needs

Esri training (esri.com/training) offers great variety in its instructor-led classes and e-Learning options that will help you transition your workflows to ArcGIS Pro.

Instructor-led classes are offered throughout the United States and through the online classroom. Classes are focused on preparing students to immediately apply what they have learned. Teachers tailor class content to the audience, skill level, and professional interests of each class. Private classes and coaching sessions designed for your team and your workflows are available.

Unlimited, organization-wide access to Esri's collection of self-paced e-Learning resources is part of the Esri Maintenance Program. E-Learning options include web courses, training seminars, MOOCs (massive, open, online courses), videos, and tutorials. These options provide the flexibility and convenience of learning when and where you



→ In Learn ArcGIS lessons, you work through real-world scenarios such as this lesson on measuring the burn scars left by wildfires in Montana's Glacier National Park in 2015.

↑ The *ArcGIS Blog* keeps you informed of interesting, useful, or fun developments associated with ArcGIS Pro such as the firefly cartography basemap shown here.

- learn.arcgis.com
- esri.com/training
- geonet.esri.com
- blogs.esri.com/arcgis

want. Some of the web courses that can familiarize you with ArcGIS Pro capabilities such as Going Pro: ArcGIS Pro Essentials for ArcMap Users and Creating and Sharing Animation in ArcGIS Pro.

Learn Best Practices through *ArcUser* Articles

ArcUser has been running tutorials on how to accomplish modeling and analysis tasks in ArcGIS Pro. In this issue, "Modeling Incident Density with Contours in ArcGIS Pro" shows how to model fire department response data to create density rasters and contours to assess public needs and current capabilities. The Spring 2017 issue included "Managing Multiple Layouts in ArcGIS Pro" to help you take advantage of the ability to generate many layouts from a single project. "Efficient Geocoding with ArcGIS Pro" in the Winter 2017 issue shows how to simplify data by summarizing locations before geocoding them.

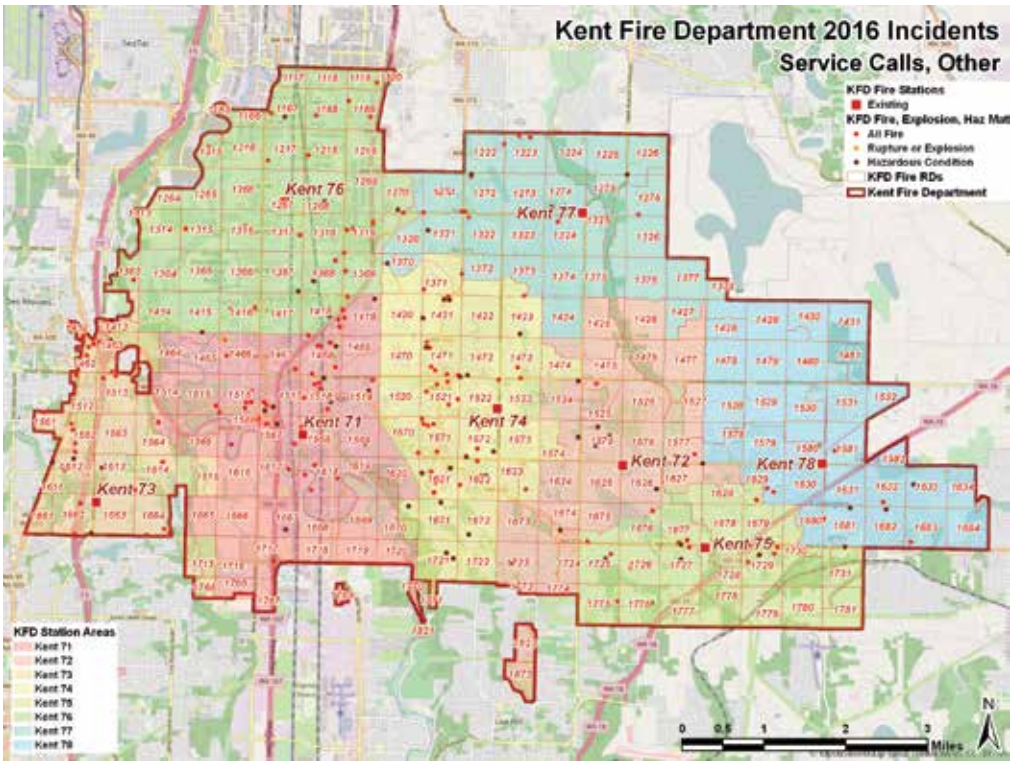
Get Your ArcGIS Pro Questions Answered on GeoNet

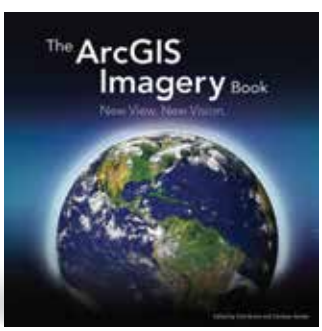
Launched in 2014 to extend the Esri User Conference learning/sharing experience all year long, GeoNet (geonet.esri.com) is where Esri customers, partners, staff, and others in the GIS and geospatial professional community connect, collaborate, and share experiences. The ArcGIS Pro space on Geonet is a great source for help on any aspect of ArcGIS Pro.

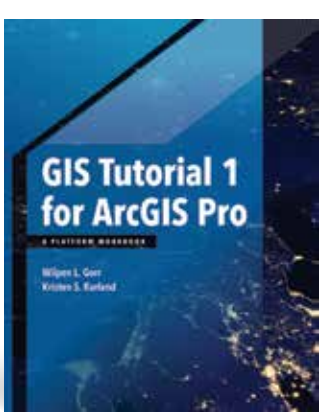
Stay Up-to-Date with Tips, Tricks, and Announcements

The ArcGIS Pro technical community regularly posts best practices, shortcuts, cool applications,

→ Tutorials in *ArcUser* teach best practices for optimizing your use of ArcGIS Pro, like this map from a recent exercise on how to use one ArcGIS Pro project for many layouts employing templates and styles.







and product announcements on the *ArcGIS Blog* (blogs.esri.com/arcgis). These posts keep you informed of interesting, useful, or fun developments associated with ArcGIS Pro.

Read All About It

Esri Press is turning out books to support your transition to ArcGIS Pro. In-depth exercises using ArcGIS Pro—as well as ArcGIS Online, and other ArcGIS apps—are in a forthcoming book, *GIS Tutorial 1 for ArcGIS Pro: A Platform Workbook* by Wilpen L. Gorr and Kristen S. Kurland. This text is designed primarily for classroom use.

Three additional books, *Making Spatial Decisions Using ArcGIS Pro; The ArcGIS Book: 10 Big Ideas About Applying The Science of Where*, second edition; and *The ArcGIS Imagery Book: New View. New Vision.*; show you how to apply ArcGIS Pro tools in the context of the ArcGIS platform.

[Making Spatial Decisions Using ArcGIS Pro is a new title described in the accompanying article, "Solving Geospatial Problems with ArcGIS Pro."]

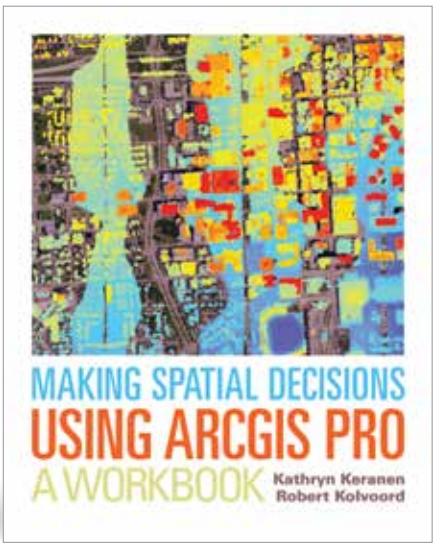
The ArcGIS Book: 10 Big Ideas About Applying The Science of Where, second edition, and its companion website (learn.arcgis.com/en/arcgis-book) explain how to use Esri's ArcGIS platform (and especially ArcGIS Pro) to manage, visualize, and analyze data and share the information thus created in maps and other visualizations. Chapters cover web mapping, ready-to-use apps, story maps, 3D GIS, spatial analysis, imagery, The Internet of Things (IoT), and curated content from the Living Atlas of the World.

With *The ArcGIS Imagery Book: New View. New Vision.* you will explore how imagery and remote sensing power modern GIS and the many tools ArcGIS Pro provides for using imagery in its pages and its companion website, thearcgisimagerybook.com. Both provide gorgeous, inspiring, and thought-provoking images.

Get Started Now

Pick the resources that suit your lifestyle and learning style and start taking advantage of the capabilities available in ArcGIS Pro.

Solving Geospatial Problems with ArcGIS Pro



Making Spatial Decisions Using ArcGIS Pro: A Workbook is a college-level text that is targeted at readers who are familiar with ArcGIS Pro and want to improve their skills in applying its powerful analysis capabilities to solve geospatial problems and produce information products that can be the basis of data-driven decisions.

It is the fourth in the *Making Spatial Decisions* series from Esri Press. The book presents activities that use different kinds of data—vector, remote sensing, and lidar—that is analyzed, interpreted, and applied to various scenarios to support policy makers and citizens in making meaningful decisions of the kind that affect the operations of an agency, community, or nation.

The scenarios include responding to hazardous spills, analyzing crime patterns, identifying assets that will be vulnerable to flooding; modeling storm surge; creating multispectral imagery for monitoring purposes; performing unsupervised and supervised imagery classification; and generating 3D scenes, suitability studies, and classified maps of canopy vegetation from lidar data. The projects focus on problem solving so they also improve critical-thinking skills.

Like the other books in this series, it uses the following real-world workflow process:

1. Define the problem or scenario.
2. Identify the deliverables needed to support decisions.
3. Document, set environments, and examine the data.
4. Perform analysis starting with a basemap.
5. Present or share your work.

Through this methodology, each module reinforces best practices for documenting analysis and evaluating processes and products. Exercises utilize other components of the ArcGIS platform and take advantage of the close integration of ArcGIS Pro with the platform.

The authors, Kathryn Keranen and Robert Kolvoord bring decades of teaching experience to this book. They chose scenarios from a wide range of disciplines. Keranen, a retired teacher, was instrumental in introducing GPS, GIS, and remote sensing into the geosystems curriculum in Fairfax County, Virginia. After retiring, she became a private consultant and an authorized K–12 Esri instructor. She has consulted for various universities and is an adjunct instructor at James Madison University and Towson University.

Kolvoord, a professor of integrated science and technology at James Madison University (JMU), has administered a variety of professional and curriculum development grants and workshops to help teachers bring these technologies to their classrooms. His main research interests are in the use of geospatial technologies in K–12 classrooms. Prior to coming to JMU, he worked at the University of Arizona, where he was a founder of the nonprofit Center for Image Processing in Education.

Modeling Incident Density with Contours in ArcGIS Pro

By Mike Price,
Entrada/San Juan, Inc.

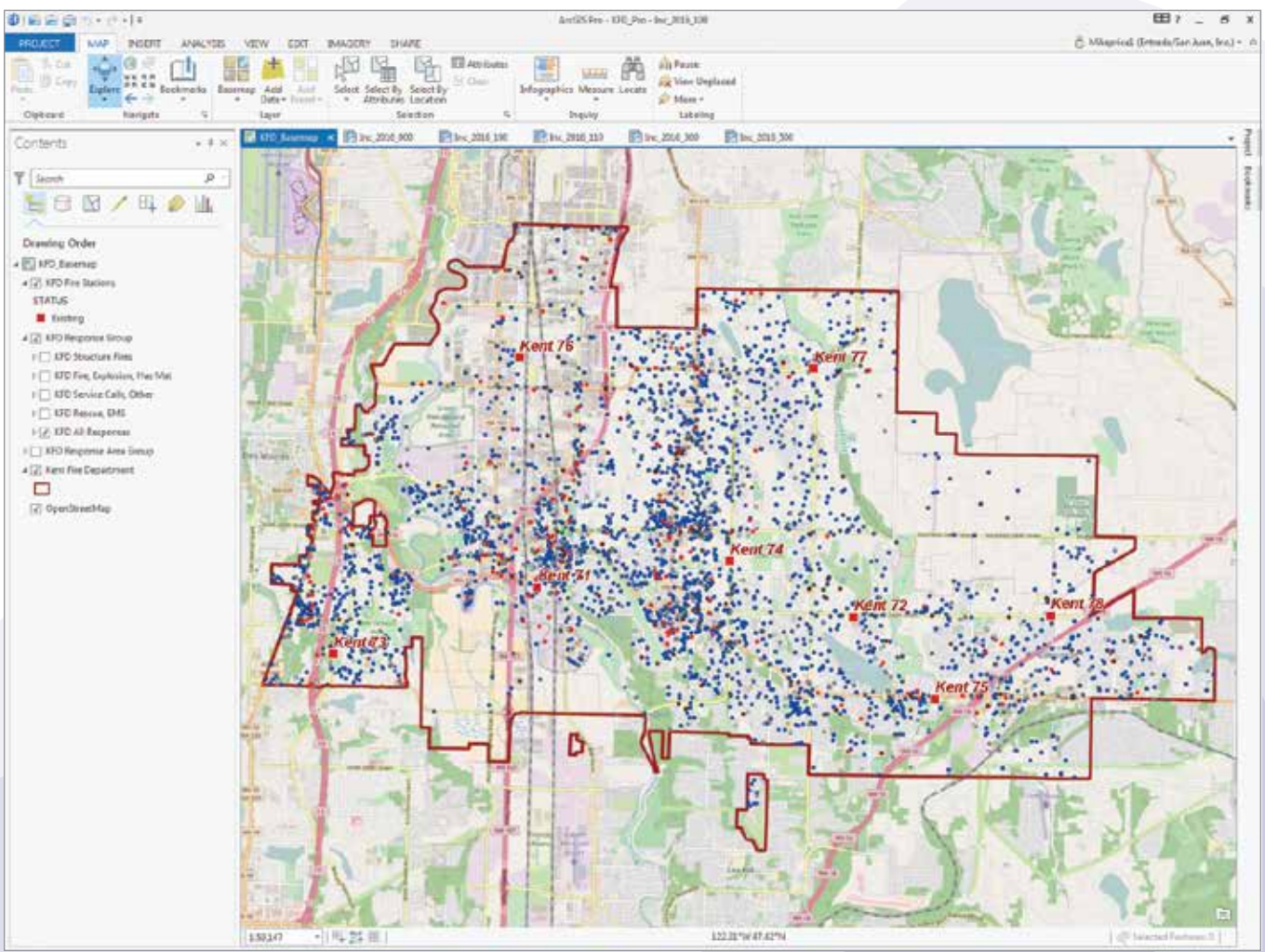
What you will need

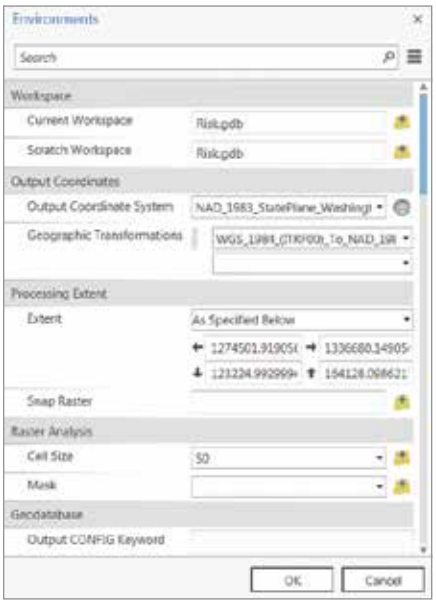
- ArcGIS Pro 1.4 license or later
- ArcGIS Spatial Analyst license
- ArcGIS Online for organizational account
- Sample dataset downloaded from *ArcUser* website
- Basic ArcMap and ArcGIS Pro skills

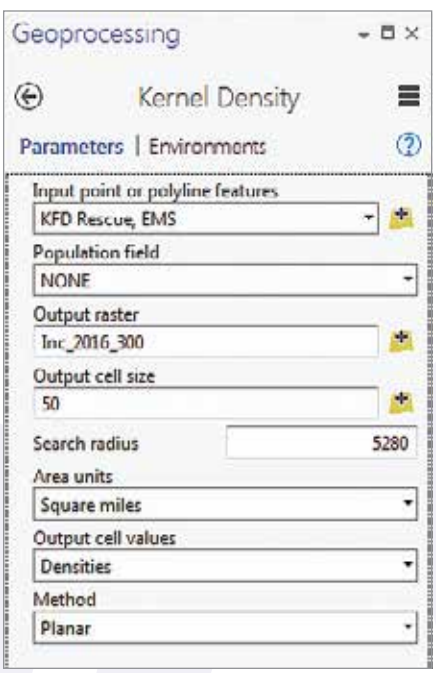
This tutorial demonstrates how ArcGIS Pro can generate multiple layouts from a single project and incorporate more sophisticated layer transparency. It uses individual response type layouts created in the spring 2017 issue of *ArcUser* and adds custom contour polyline datasets for each density raster. The updated layouts are exported as PDFs.

Fire and emergency medical service (EMS) providers carefully analyze emergency responses in time and space. To optimize resources and provide the best level of service, equipment and personnel are positioned to provide the best service possible. To understand the frequency and density of emergency and nonemergency responses, public safety GIS staff categorize and map incidents by incident type. Mapping incidents to understand historic demand for services is the best way to provide a reasonable estimate of future service requirements.

↓ The project contains a slightly synthetic subset of Kent Fire Department's emergency calls records for 2016.







↑ Set up the project environments before doing any geoprocessing.

↑↑ All parameters needed for creating the density raster for the KFD Rescue, EMS layer using the Kernel Density tool.

Exercise Overview

In the Spring issue of *ArcUser,* an existing ArcMap document containing 6,300 emergency response calls was imported into ArcGIS Pro for additional analysis. Incidents were coded based on the National Fire Incident Reporting System (NFIRS). Multiple layouts were created from the project and exported as PDF documents for printing and presentation.

Kent Fire Department (KFD) generously allowed the use of a slightly synthetic subset of its emergency calls records for current and previous exercises. The department protects a rapidly growing group of communities approximately 20 miles southeast of Seattle. The area is characterized by a mix of single family and multifamily residences, retail/commercial, industrial, warehousing, and other occupancies.

KFD is noted for developing and deploying many best practices in the fire service and has shared its knowledge with the GIS community. KFD is the cornerstone of a large fire and EMS protection group named the Puget Sound Regional Fire Authority (PSRFA). The PSRFA uses GIS extensively to map and understand public needs; plan for future growth; and manage its staff, apparatus, and other resources.

This exercise uses the ArcGIS Spatial Analyst Kernel Density geoprocessing tool to model all five risk sets created in the last tutorial from 2016 responses in the core KFD coverage area. This exercise will show how to generate custom contour polyline datasets for each density raster. The individual response type layouts created in the last exercise will be updated with this data and exported as PDFs.

Getting Started

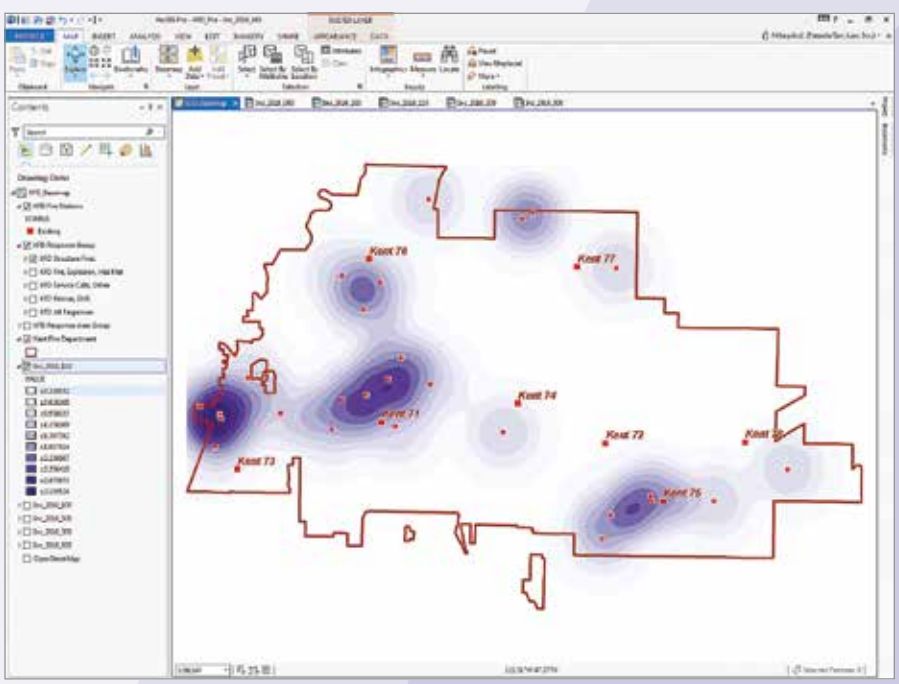
Begin by downloading the sample dataset from the *ArcUser* website. *Use this dataset* rather than the final version of the dataset from the previous exercise because several new layer files have been added and are needed for this exercise. Unzip the dataset and save it locally in a new folder so the previous exercise data is not overwritten.

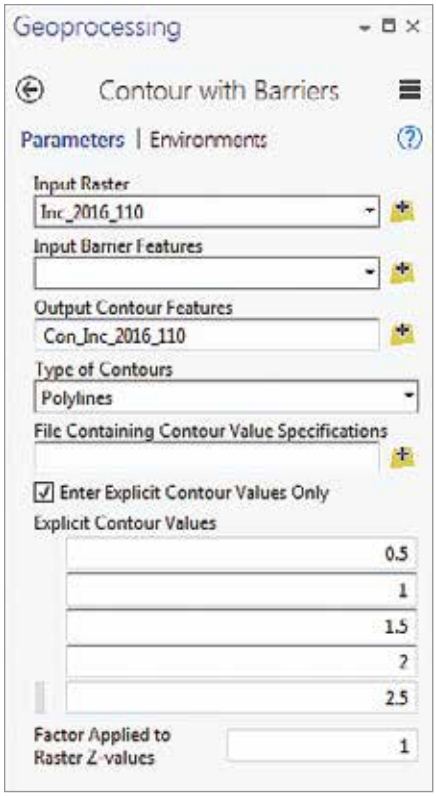
In Windows Explorer, browse to KFD\KFD_Pro\ and double-click KFD_Pro.aprx to open it. Inspect the project and note the layouts for five NFIRS incident groups. If necessary, repair any disconnected data links. Turn off the OpenStreetMap basemap and turn on KFD Fire Stations, KFD Response Group, and KFD All Responses.

Setting Up Geoprocessing in ArcGIS Pro

Click the Analysis tab in the ribbon and click Tools. The Geoprocessing pane should load on the right side of the workspace. Maximize its length if necessary. Click Toolboxes and scroll down to locate and expand the Spatial Analyst toolbox. These tools require an ArcGIS Spatial Analyst license. Notice that these tools are similar to ones made available when using the Spatial Analyst toolset in ArcMap.

↓ This is the output raster created by the Kernel Density tool.





↑ Use the Contour with Barriers tool to create contours using manually defined values that accommodate nonlinear, somewhat logarithmically distributed data.

Expand the Density group. Hover over the Kernel Density tool to read its description but do not open it. Collapse the Density tools and expand the Surface tools (also in the Spatial Analyst toolbox). The Surface set includes three contouring tools including Contour with Barriers. Hover the cursor over Contour with Barriers to read its description. This exercise will not use barriers but will use other advanced features of this contouring tool. Leave the Spatial Analyst toolbox open.

Click Environments in the ribbon on the Analysis tab. Before performing spatial analyses, several processing parameters and limits must be set. The parameters in this pane are similar to the Environment settings in ArcMap. Workspace, Output Coordinates, Processing Extent, and Raster Analysis must be specified before modeling the data.

In Environments, set the Current and Scratch Workspaces by navigating to \GDBFiles\WASP83NF and setting both parameters to Risk.gdb. Click the Output Coordinate System drop-down and select Kent Fire Department. The coordinate system is now Washington State Plane NAD83 North US Feet. This will be changed. To make sure that any data in World Geodetic System (WGS 1984) will be properly transformed, click the Transformations dropdown and select WGS_1984_(ITRF00)_To_Nad_1983, which is located near the bottom of a very long list.

Next, use the drop-down to set the Processing Extent to Kent Fire Department. For Cell Size, type 50. This will define a cell containing a call location equal in size to the width of a typical four-lane street. Click OK to save changes and close Environments. Save the project to preserve these settings.

Modeling and Contouring Incident Density

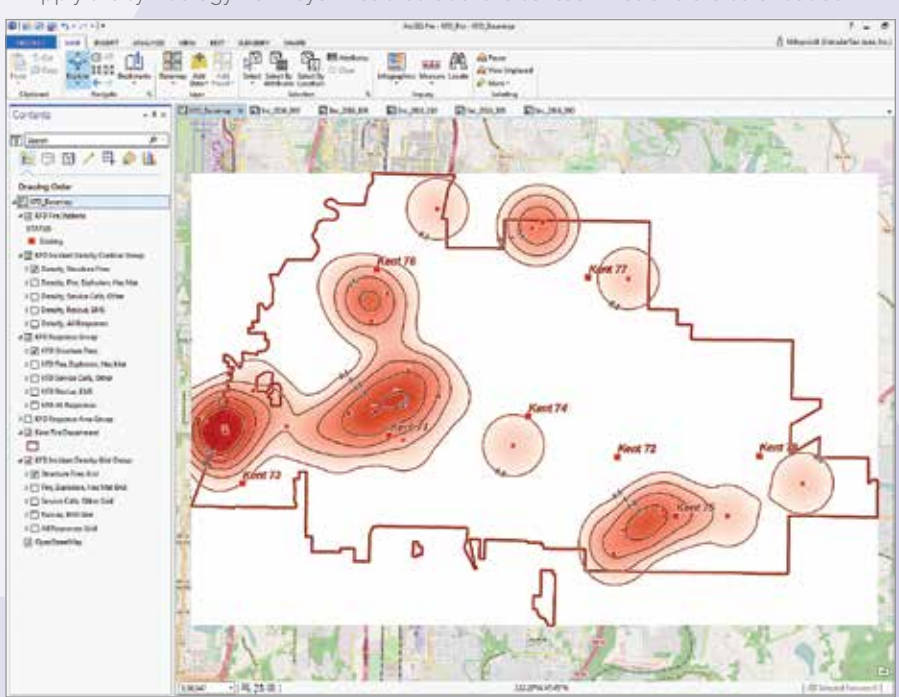
In the 2016 emergency response dataset, each point represents a unique response to an emergency or a service call. Responses are also captured at the apparatus level, so one incident may have two or more records that reflect each unit assigned to an incident. Mapping incident density typically models filtered data so that each point represents one emergency response or service call known as a master event. The dataset of master calls includes false calls and events cancelled in route and are categorized in a Service Calls, Other subset.

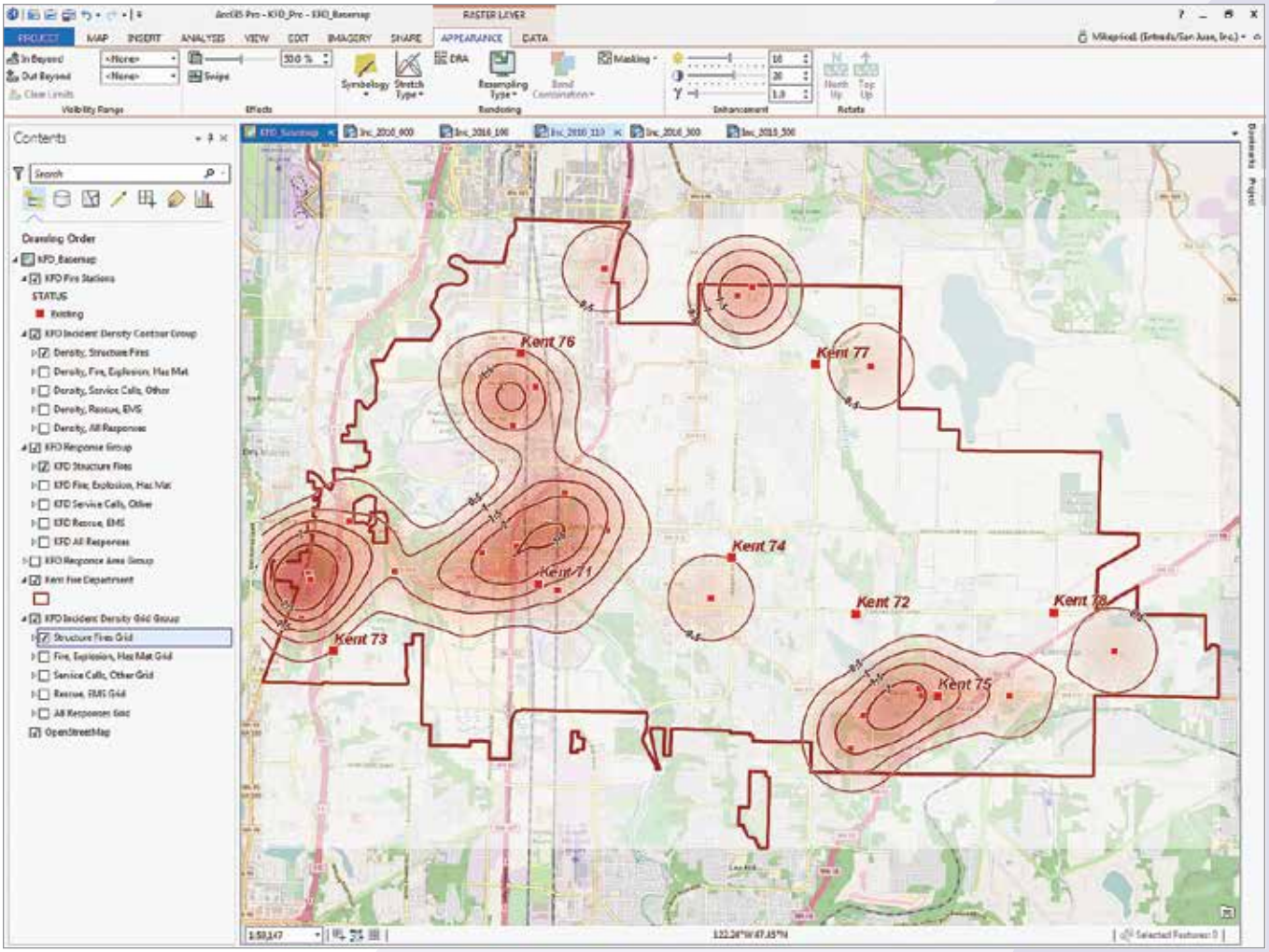
Return to the Geoprocessing pane, collapse Surface tools, and expand Density tools. Click Kernel Density. In the Kernel Density wizard, select KFD All Responses as Input features, leave the Population field as NONE, and name the Output raster Inc_2016_000. Make sure it is being saved to the Risk geodatabase as previously specified. The Output cell size should be 50 (so it will match the size set in Environments), set the Search radius to 5280 and Area units to square miles. Accept defaults for other parameters, click Run, and watch as the Kernel Density tool creates the Inc_2016_000 grid and loads it into the Contents pane. Save the project and return to the Geoprocessing pane.

Create four more density rasters using the Kernel Density tool and information in Table 1 to determine what to name the output incident density grids for each input feature class. After running the Density Kernel tool for each item, organize the output rasters as shown in the Stack Order column of Table 1 with 5 located at the bottom of the table of contents. Don't modify the symbology.

To check your work, turn on each raster and input set individually, and study the relationships between input points showing individual incidents and the density rasters

↓ Apply the symbology from layer files that label the contour lines and are color coded.





↑ Adjust the transparency so the basemap is visible.

generated from them. Open the Catalog pane (the Project pane in ArcGIS Pro 1.4) and expand Geoprocessing History to see five Kernel Density items. The most recent raster should be at the top of the list. Hover over each raster to verify its parameters. Save the project.

Creating Cool Contours

Now to model contours for all five rasters. Use the back arrow in the Geoprocessing pane to return to all the toolboxes and expand the Surface toolset. Select Contour with Barriers. This tool is the most advanced contouring tool in the toolbox. Although barriers won't be used, this tool is used to manually define discrete contour intervals.

Select Inc_2016_110 (which is the density raster for structure fires) as the Input Raster, name its output Con_Inc_2016_110, and make sure it will be saved to the Risk geodatabase. Check the box next to Enter Explicit

Input Feature Class	Stack Order	Output Incident Density Grid	Output Density Contour Polylines	Contour Interval
KFD All Responses	5	Inc_2016_000	Con_Inc_2016_000	20, 50, 100, 200, 500
KFD Rescue, EMS	4	Inc_2016_300	Con_Inc_2016_300	10, 20, 50, 100, 200
KFD Service Calls, Other	3	Inc_2016_500	Con_Inc_2016_500	2, 5, 10, 20, 50
KFD Fire, Explosion, Haz Mat	2	Inc_2016_100	Con_Inc_2016_100	1, 2, 5, 10, 20
KFD Structure Fires	1	Inc_2016_110	Con_Inc_2016_110	0.5, 1.0, 1.5, 2.0, 2.5

↑ Table 1: Naming conventions and recommended contour intervals for input and output datasets

Contour Values Only. Refer to the values listed under Contour Interval in Table 1 for the interval values. Type 0.5 in the first textbox below Enter Explicit Contour Values Only and press Enter to set that value and open a new textbox. Continue inputting the rest of the values under Contour Interval for KFD Structure Fires in Table 1. Make sure to click inside the new textbox each time to give it the focus, enter the interval value, and press Enter each time to create five intervals. Click Run.

After Con_Inc 2016_110 loads in the Contents pane, open its attribute table. Contour values range from 0.5 to 2.5. Type code 3 represents discrete user-defined intervals. If you need to add or remove an interval, you could return to the current Geoprocessing pane, make changes, and run the process again. Close the attribute table, turn off Con_Inc 2016_110, and save the project.

Use the Contour with Barriers tool to create contours for Inc_2016_100 (Fire, Explosion, Haz Mat) and make sure to rename the output as Con_Inc_2016_100. Change the explicit contour values to 1, 2, 5, 10, and 20 as specified in Table 1. These values accommodate nonlinear, somewhat logarithmically distributed data. Continue modeling the three remaining rasters, making sure to use the contour intervals from Table 1.

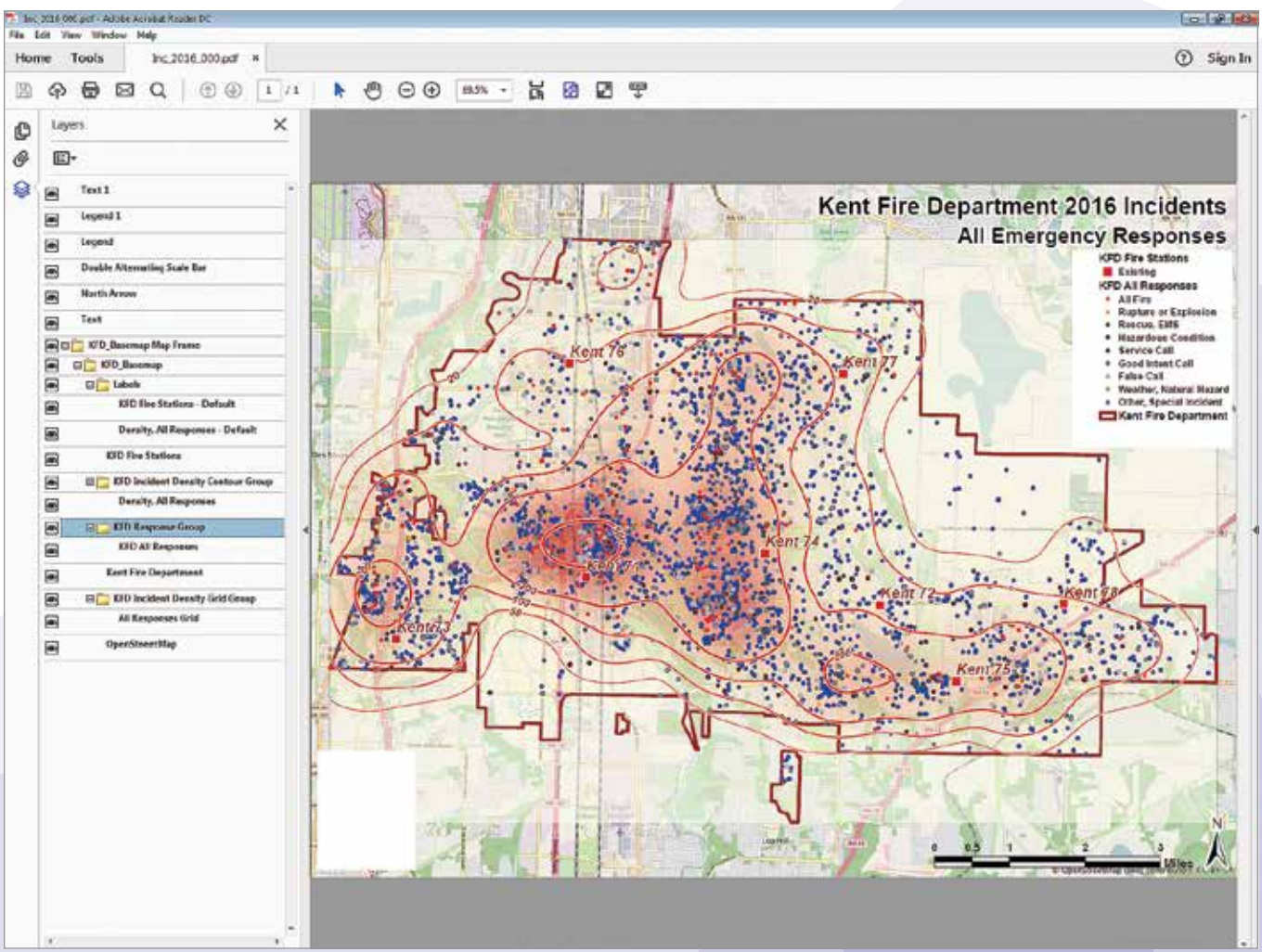
At the bottom of the Geoprocessing pane, click the Project tab to display the Catalog pane. In the folder list in the Catalog pane, expand the Geoprocessing History folder. Notice that the list includes five new Contour with Barriers events. Save the project.

Enhancing and Printing Incident Density Maps

The five density rasters and density contour sets could be manually symbolized. However, if Group Layer files have been created in ArcMap to preserve symbology, they could be used by loading them into the project and repairing any broken links.

Click the Map tab in the ribbon and choose Add Data > Data. Navigate to \GDBFiles\WASP83NF and locate KFD Incident Density Contour Group.lyr and KFD Incident Density Grid Group.lyr. Add these layer files using the map Contents pane. Move KFD Incident Density Contour Group to a spot just below the Con_Inc_ files. Move

↓ Adjust the layout templates to include the density and contour layers and export them as PDFs.



KFD Incident Density Grid Group to a spot just under the Inc_2016_ files. Expand both groups and notice that each group contains five layers and all have broken links.

Repair each layer in the KFD Incident Density Contour Group by right-clicking on it in the Contents pane; clicking Properties; and, in the dialog, clicking Source. Connect each layer in the KFD Incident Density Contour Group to the appropriate Con_Inc_2016 feature class just created and stored in \GBDFiles\WASP83NF\Risk.gdb. Once all the KFD Incident Density Contour Group data links have been repaired, make sure all Con_Inc_ files are turned off and turn on each KFD Incident Density Contour Group to make sure they are correctly linked. If they are, remove all Con_Inc files from the project.

Use the same methodology to repair the source data link for the layers in KFD Incident Density Grid Group by connecting them to the appropriate Inc_2016_ file geodatabase raster in the Risk.gdb, referring to Table 1. Turn each relinked layer off and on individually to make sure they are correctly linked and then remove the Inc_2016_ files from the project.

Study the color, symbology, and label for each line, which were imported from the layer file. Check all five layer file rasters and contour sets to ensure they have been correctly linked. Remove the temporary geoprocessing data (i.e., the density and contour files just linked to the layer files). Turn on the OpenStreetMap base and save the map. Notice that the raster transparency originally defined in the layer file imported from ArcMap is not respected.

Applying Raster Transparency (and an ArcGIS Pro Shortcut)

In ArcGIS Pro, raster and vector transparency is assigned through tools in the Appearance ribbon. To change a raster's appearance, select Structure Fires Grid from the KFD Incident Density Grid Group and click on the Appearance tab in the ribbon. In the Effects section, change transparency from 0 percent to 50 percent. Press the Enter key to set the percentage, and the transparency will update. The partially transparent raster enhances the appearance of the point density raster. The labeled contour lines suggest density even when the raster and points are not visible. Contours certainly enhance presentation maps for a mixed audience.

Instead of adjusting transparency for the remaining four density grids manually, use this shortcut. In the Contents pane, select all five density grids by holding Shift (to select a range of adjacent layers) or Ctrl (to select each layer individually). Return to the Effects tool on the Appearance ribbon to set transparency for all selected rasters to 50 and press Enter. Make sure all density grids are updated. Save the project again.

Exporting Multiple Layouts

In the previous tutorial, incident maps were exported from five separate layouts. Each layout was designed and titled for a specific incident type. This exercise uses the same layouts to export maps that include incident density grids and density contours. To do this, each layout will be individually activated and updated to make specific KFD Response Group items visible, including the density raster and contour layer, before being exported or printed.

To create a map showing density and contours for structure fires, make sure the Density, Structure Fires, KFD Structure Fires, and Structure Fires Grid layers are all visible. Right-click the Inc_2016_110 tab on top of the map canvas. Verify that the layout's subtitle is Structure Fires.

Open the Catalog pane by clicking the Project tab on the right size. Expand Layouts and right-click KFD_Inc_2016_110. Choose Export to File. In the Export Layout wizard, navigate to \KFD and create a new folder called Graphics. Set resolution to 200 dpi, verify that Embed Fonts is checked, and click Export. Use Windows Explorer to locate the file, and use Acrobat Reader or another program that can open PDF files to view the exported map.

To understand the power and function of ArcGIS Pro's updated PDF export, open one of the exported PDF maps. Notice that all visible layers are included in the PDF as individual elements that can be turned on and off independently rather than merged into a single PDF object titled Image when exported as a PDF in ArcMap.

For each of the four remaining layouts, update which layers are visible based on Table 1. Select the tab for the appropriate layout, right-click it, and choose Activate. Export each, accepting the name of each layout as the exported file's name. When finished exporting layouts, save the project. View the updated exported files by navigating to KFD\Graphics.

Summary

This ArcGIS Pro exercise builds on the previous one with additional modeling, contouring, and mapping of incident density. Imagine ways that these maps could be used to identify stations with the greatest number of EMS, fire, and other calls. These maps provide excellent performance measurement and operations planning tools.

Acknowledgments

Thanks once again to the Kent Fire Department for the use of its great data. This sample dataset represent only one-third of Kent's total responses for 2016 and should not be used to predict an actual response profile. Thanks also to Esri technical staff for their advice and support as I continue to investigate ArcGIS Pro.

Make Your Own Web Maps from 2010 Census Data

By Lisa Berry, Esri Cartographic Product Engineer

You can now easily map 2010 Census demographic data from the Living Atlas of the World, the foremost collection of global geographic information, curated by Esri and available through ArcGIS Online.

These services can be used to create multigeography demographic stories that help us understand the human population regionally and locally. The services use demographic attributes from the 2010 Census Demographic Profile. They are broken into four services by demographic theme:

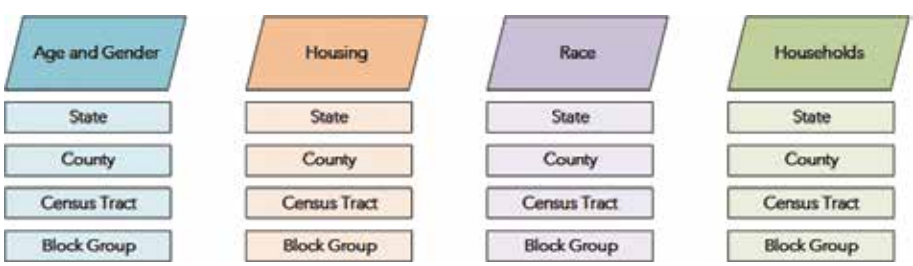
- Age and Gender
- Housing
- Race
- Households

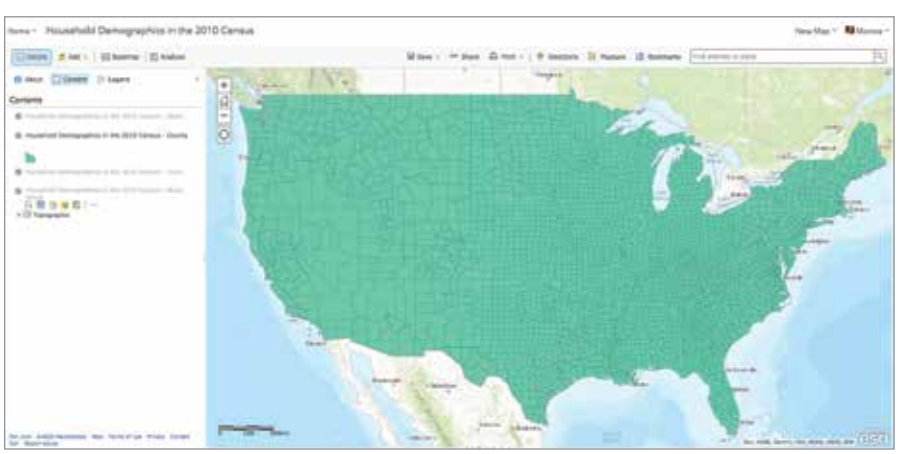
The services provide 2010 Census attributes for four different geographies: state, county, census tract, and census block group. The geography layers contain the same set of attributes in a single service.

Each service is configured so that as you zoom in to the map, you gain increasing geographic detail. When you are looking at the extent of the United States, you see states or counties. As you zoom closer to a city, the counties layer automatically turns off, and you will see a more detailed level of geography such as census tracts or block groups. If you want to customize the viewing scales, you can do so and save the service as a web map.

It's easy to make your own demographic map from these services. Once you have opened one of the services from the Living Atlas, you can save it to your My Content as a web map that calls the census service. Set the cartography and pop-ups for each layer and resave the finalized map. Now, this web map can be shared and used in your story maps and apps.

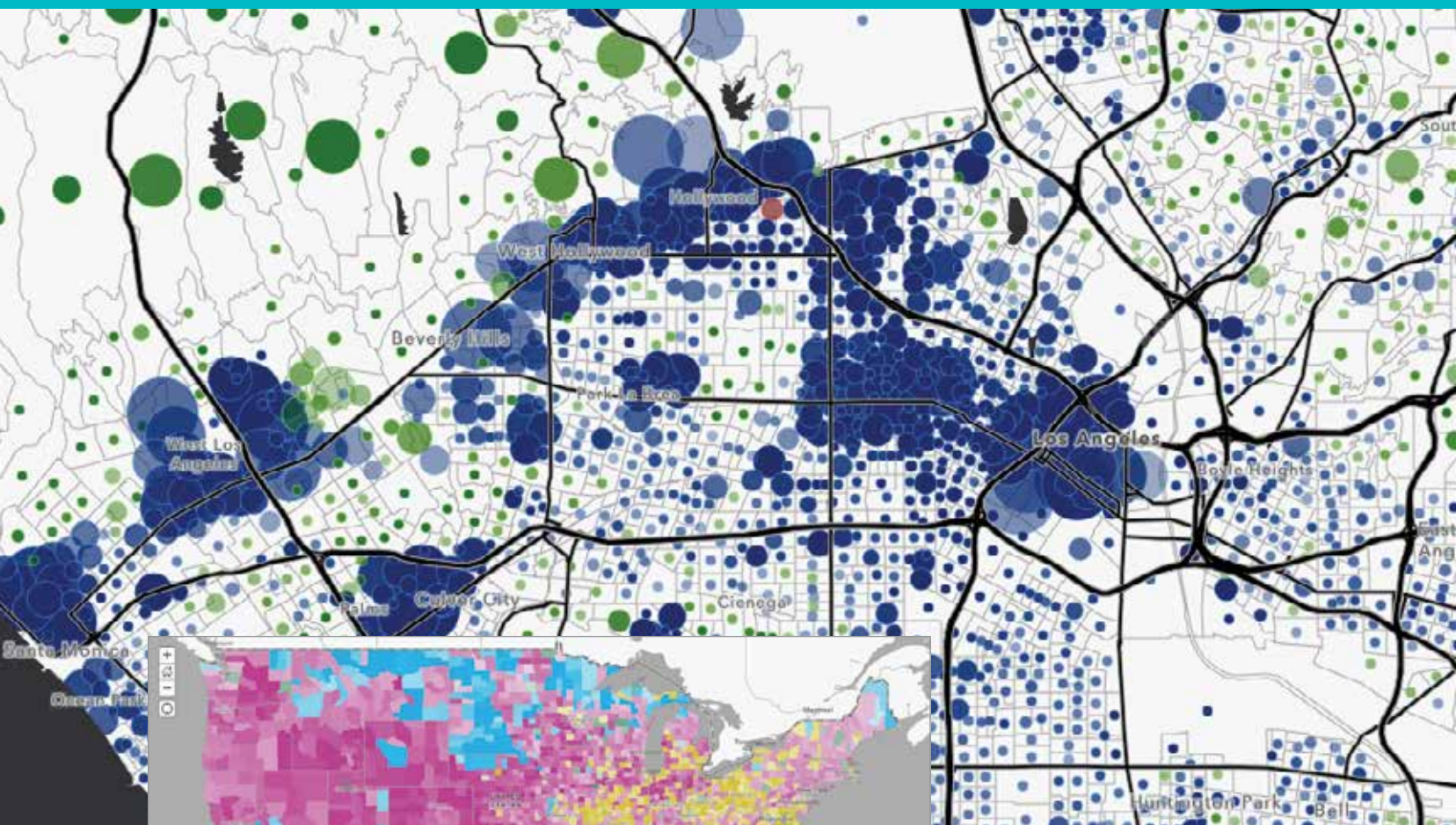
There is no limit to how many web maps you can create from these services. Find topics that interest you and create the maps you need using services from the Living Atlas of the World. The accompanying maps were made with these services.

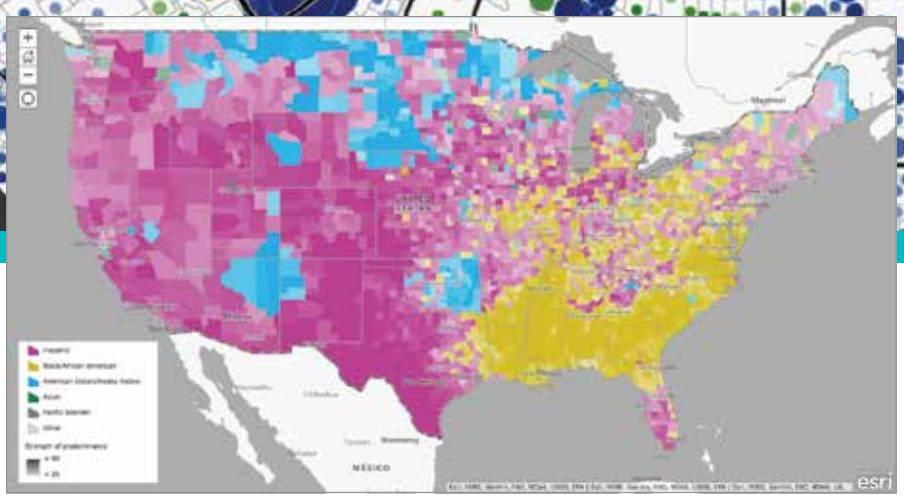


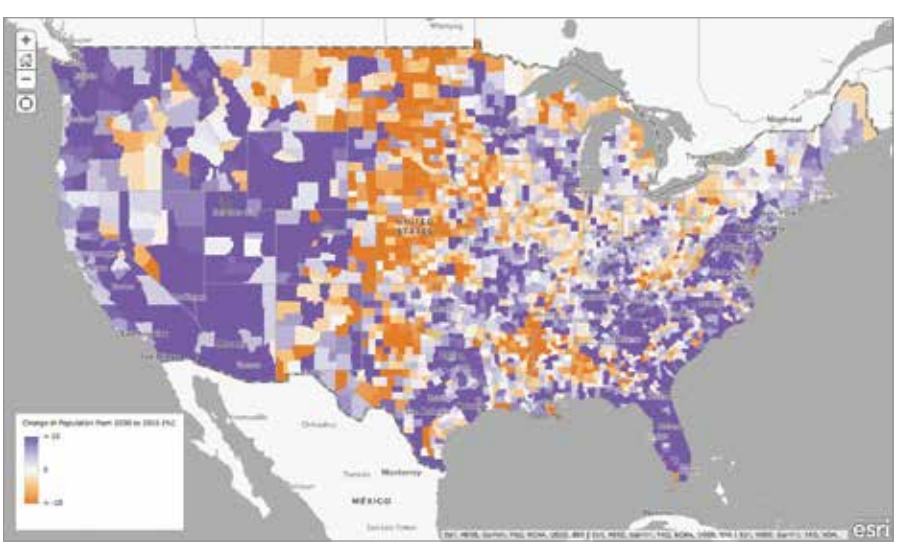


↖ 2010 demographic data services are broken into four demographic themes.

↙ Services for each theme are available at four geographies: state, county, census tract, and census block group.





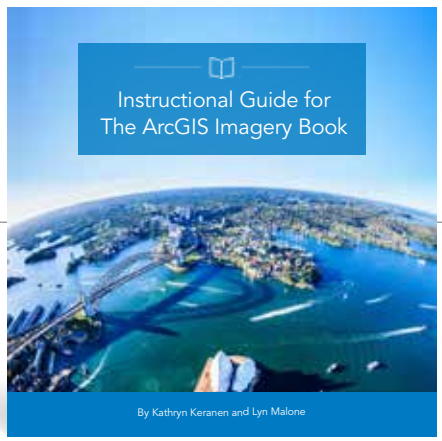


↑ Owner or Renter Occupied or Vacant Houses

↖ Non-White Predominant Population by Race

↙ 2000–2010 Population Change

Online Imagery Learning Guide for Students and Teachers



Instructional Guide for The ArcGIS Imagery Book, the companion workbook to *The ArcGIS Imagery Book: New View. New Vision.,* is a valuable resource for more than teachers. It is great for those who want to learn about imagery and its increasing integration with GIS, whether they are new to the topic or want a refresher course in this area. Teachers can use it as a lab manual to give students practice in basic skills or as a guide for teacher development.

Published by Esri, *Instructional Guide for The ArcGIS Imagery Book* is free and available online. Lessons use real-world examples that provide practical experience using imagery while learning ArcGIS concepts and how to use ArcGIS tools to get information from imagery. *Instructional Guide for The ArcGIS Imagery Book* teaches how to use ArcGIS to explore, analyze, and manage imagery using online maps, apps, and data to complete exercises. Lessons are enhanced with videos, activities, and sample questions. Chapters cover topics such as remote sensing, imagery analysis, 3D and 4D imagery, and big data management.

In these scenario-based lessons, students will use imagery to answer questions such as which agricultural fields are best for planting corn or what the extent of damage from a major wildfire is. They will learn how to work with Moderate-Resolution Imaging Spectroradiometer (MODIS) imagery to track a super typhoon. Lessons incorporate cloud computing in workflows, and some lessons and activities require Esri ArcGIS Online and Learn ArcGIS accounts.

Instructional Guide for The ArcGIS Imagery Book was written by GIS educators Lyn Malone and Kathryn Keranen. They have authored other Esri books including *Instructional Guide for The ArcGIS Book*. They will receive the Geographic Excellence in Media (GEM) Award from the National Council for Geographic Education (NCGE) later this summer.

GIS Bookshelf

The Second Edition of *The ArcGIS Book* Applies The Science of Where

The ArcGIS Book: 10 Big Ideas about Applying The Science of Where, second edition, and its companion website offer all the information and interactive educational resources needed to apply the "where factor" to get deeper insights from data. Readers can dive in and start using Web GIS to create maps, work with apps, create and use authoritative data, and do spatial analysis.

The new edition of *The ArcGIS Book* is geared toward three audiences: current ArcGIS users who want to do more work in the Web GIS realm using ArcGIS Online and ArcGIS Pro; web-savvy professionals who work in fields such as business, education, and science who are interested in analyzing and visualizing work-related data geographically; and people who understand the importance of geography and want to use Web GIS for projects.

The ArcGIS Book: 10 Big Ideas about Applying The Science of Where explains how to use Esri's ArcGIS platform to manage and analyze data and then visualize and share the information thus created in maps to get valuable location-based insights. Chapters cover web mapping, ready-to-use apps, story maps, 3D GIS, spatial analysis, imagery, the Internet of Things (IoT), and curated content from the Living Atlas of the World.

More than just a text, this book gives readers things to do. The printed version and the interactive PDF versions of the book work with the companion website that provides 10 Learn ArcGIS lessons and links to 250 online maps and apps from Esri as well as links to the worldwide ArcGIS user community, software downloads, videos, case studies, Esri Story Maps apps, e-books, open data sites, and The Living Atlas of the World. Visit the book website to start exploring and learning using a free Learn ArcGIS account and evaluation copies of software to create story maps, mobile apps, web maps, and 3D scenes.

The Learn ArcGIS lessons correspond with 10 big ideas about applying The Science of Where. They teach specific skills and concepts such as conducting demographic analysis, employing cartographic design techniques, and creating a 3D web scene. The lessons use scenarios to provide an understanding of how these ideas are applied in the real world. For example, the spatial analysis lesson teaches how to use ArcGIS Pro, the ArcGIS Spatial Analyst extension, and content from Living Atlas of the World to create a map of wildlife corridors for cougars trying to survive in urbanized Los Angeles metro area. Other lessons use spatial analysis to study traffic accidents or drought conditions in the American southwest or use 3D development scenarios in Portland, Oregon.

Thought leadership essays from authors, such as Lawrie Jordan, Esri director of Imagery and Remote Sensing, and Richard Saul Wurman, the architect and graphic designer who founded the TED conference, are included. Esri Press, 2017, 172 pp., ISBN: 9781589484870

NEW WAYS TO WORK SMARTER

Tim Witt, a 911 GIS analyst in Brevard County, Florida, continues to find new ways to work smarter while maintaining the accuracy of the GIS data that the county's public safety staff depends on.

Brevard County has had an active GIS program since 1988. Located on Florida's east coast, the county covers 1,557 square miles and has a population estimated at more than 544,000.

Witt began working as a 911 GIS analyst for the Board of County Commissioners in 2008. Previously, Witt had worked for the University of South Alabama, where he had also obtained a bachelor's degree in geography.

Witt initially thought he would be mostly concerned with the accuracy of addresses and street data. However, his perspective began evolving as his knowledge of GIS and its use in 911 systems grew.

"I learned that there was more to it," said Witt. "My data was used to route emergency vehicles, and it made sure that the right agency responded to a 911 call. With Next-Generation 911 shifting more towards GIS data, it was crucial that my data was close to perfect."

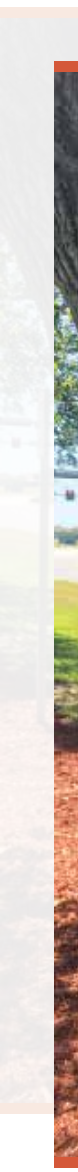
When reading GIS articles about Next-Generation 911 data, he kept encountering the word *topology*. He researched this term and learned that it is a collection of rules that work with ArcGIS software to more accurately model the geometric relationships of features and ensure data integrity. Although currently implemented for geodatabases, topology has long been a key GIS requirement for data management and analyzing spatial relationships. To maintain data integrity, topology must be validated after features have been edited.

For Witt, topology was more than an abstract concept—it had a real impact on his job. "In 911 terms, this meant to me, all your street segments need to be snapped, and your response zones can't have gaps or overlaps."

"The beauty of a Python add-in is that you can easily share it with everybody."

Doing It All by Hand

Armed with the knowledge of the importance of topology, he began building his first topology in ArcCatalog. "I was happy to see that Esri had a good help section that explained how to create a topology with my own data, how to add topology checks, and how to validate the topology. Even though this process was very time-consuming, it gave me the results I needed."



Witt fixed a lot of unsnapped street segments and made his response zones seamless, but he had to work to keep them that way. Witt's 911 data is updated every day with new streets or changes in response zones due to annexations. To stay on top of these changes, he planned to run topology checks once a week. However, performing these checks manually was time-consuming, and soon, Witt was looking for a way to automate and speed up the process.

Speeding It Up with ModelBuilder

He found that ModelBuilder was a good way to automate his topology validation processes. ModelBuilder is an application that works in ArcMap and ArcGIS Pro that lets users create, edit, and manage models. It functions as a visual programming language that replicates workflows and links geoprocessing tools so that outputs from one operation can be input into the next.

"I ended up using ModelBuilder to streamline my processes. This meant I needed to build a model for each of my layers, run each model, and eventually add the topologies to an MXD *[ArcMap document]* to fix found issues."

Creating a Python Add-In

Witt used the ModelBuilder models he had developed for a long time. Along the way, he decided to add Python programming to his GIS skill set. Python is the standard scripting language for ArcGIS, which is integrated with the platform, and can be used for automating tasks and extending functionality.

While he was learning Python, Witt came across an instructional video by Esri that showed how to create Python add-ins for ArcGIS Desktop. He realized that an add-in could streamline his topology checks even more. After about a week of programming, he shared a rough version of his add-in with GIS colleagues on the GeoNet forum. Members of this online Esri community tested his add-in and gave him feedback that led him to adjust the interface and improve the functionality. In return, he shared the finished add-in with the GeoNet community.

Witt's Topology Check Python Add-In checks polygon layers for gaps and overlaps and line layers for unsnapped and overlapping features. It will automatically add the errors to the MXD. "The beauty of a Python add-in is that you can easily share it with everybody. No programming skills are necessary to use it. The Python add-in can also be used with non-911 data. For example, if you want to check if your pipeline network has any unsnapped segments or if your ZIP code layer has gaps, there is now a tool for that."

To get Witt's add-in, go to geonet.esri.com/docs/DOC-9983-topology-check-python-addin. Contact him at tim.witt@brevardfl.gov.

GETTING TOGETHER

TO CHANGE THE WORLD

↓ Esri president Jack Dangermond explaining the conference theme, The Science of Where.

→ The 2017 Esri User Conference had the largest attendance in the event's history.

In July, 18,000 people from the United States, Canada, the United Arab Emirates, Germany, Ecuador, and dozens of other countries got together for the world's biggest GIS meeting in San Diego, California. For the 38th year, users of Esri technology have met face-to-face to learn, make friends, and have a little fun at the Esri User Conference.

During the Plenary Session, Esri president Jack Dangermond called attendees special people "because you hold inside of you the grains of a better future. You are the people who will come up with the solutions to the challenges we are facing as individuals and as organizations." Dangermond showed examples of the work of scores of users who are addressing challenges such as population increase, climate change, loss of nature, and social conflict.

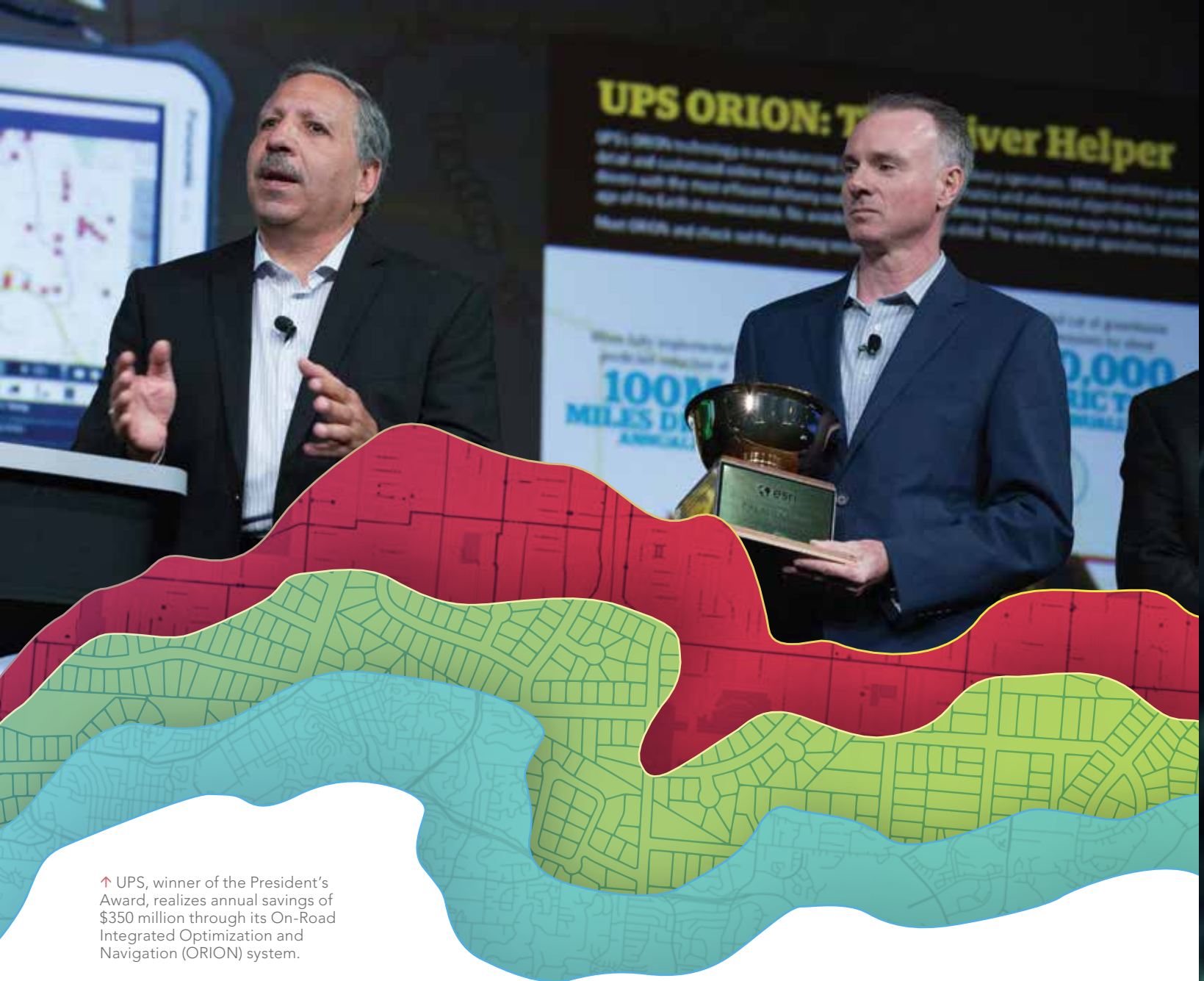
In his explanation of the conference theme—The Science of Where—Dangermond provided some historical context. From the beginning, GIS was applied to science, but it was not until 1993 when Dr. Michael Goodchild characterized geographic information science (GIScience) as an area of intellectual activity that addressed the fundamental issues raised by GIS that the world began to realize GIS is a science in its own right.

GIScience incorporates geography, data science, modeling, analytics, visualization, computer science, decision support science, and many others and integrates these into a kind of metascience.

What is The Science of Where? "Simply stated, it is the science of geography and the technology of GIS," said Dangermond. It is a framework for applying science to almost everything that lets us look at relationships and look at things as a whole so we can better solve problems and meet challenges. Using the power of *where* to integrate all kinds of data to foster better understanding and collaboration, it produces a system of insights.

The development of GIS technology has greatly enhanced the application of The Science of Where by taking advantage of new kinds of computing as well as faster computers. GIS now uses technologies such as augmented reality, statistical modeling, and crowdsourcing.

Web GIS, the modern GIS pattern, is leveraging web services to integrate organizations with shared knowledge. Now, working with all types of data is greatly simplified. Real-time information is making maps alive. Apps are bringing GIS to everyone on mobile devices and dashboards. Story maps are being created by thousands of people who are using GIS to tell their stories. The 3D capabilities in ArcGIS Pro and across the ArcGIS platform are integrating GIS into planning and design processes.



↑ UPS, winner of the President's Award, realizes annual savings of $350 million through its On-Road Integrated Optimization and Navigation (ORION) system.

Collaboration is the key to successfully applying The Science of Where to communities. ArcGIS Hub is a new product that takes GIS to the next level by enabling citizen engagement with government around policy initiatives. (Read "Beyond Open Data: Getting Real with Civic Engagement" in this issue.)

GIS is creating value from the wiring up of the world into the fabric of the Internet of Things (IoT). It is helping cities become smart communities that benefit from this massive digital transformation. Abu Dhabi, the federal capital of the United Arab Emirates, exemplifies this progressive development and was recognized with the inaugural GIS Digital Transformation Award. In presenting the award, Dangermond noted that Abu Dhabi took GIS "to a new frontier and pushed the limits" by integrating GIS into every government operation and making it accessible to every employee, so it deserved major acknowledgment for this achievement.

Another organization was honored for making geospatial information accessible. The National Geospatial-Intelligence Agency (NGA) received the Enterprise GIS Award. Not only does the NGA have the largest GIS database in the world, but it also maps the entire world and has implemented a portal that provides geospatial intelligence (GEOINT) services to thousands of users.

The winner of another award demonstrated how GIS can now be taken to scale. UPS was the winner of the President's Award. It has realized annual savings of $350 million through its On-Road Integrated Optimization and Navigation (ORION) system, which optimizes delivery routes for the 19 million packages UPS delivers every day.

Innovative work by these and other organizations implementing GIS is transforming how we think and how we carry our thinking into action to create a sustainable future, observed Dangermond. "From my perspective, this seems like the only technology that has a shot at being able to address those very challenges that you and I are facing."

The challenges may be great, but Dangermond says he's an optimist. "It's a high aspiration," he said. "Can we make a difference with our work and turn this around? My view is, yes, we can!"

Telling Stories That Inspire Action

"We are at an inflection point in the history of our species," said Dr. Jonathan Foley, the keynote speaker at the 2017 Esri Science Symposium. He noted that the magnitude of change has been greater in the last 50 years than in all previous history, making the need for scientists to shape humanity's response to this situation of vital importance.

Foley was speaking to more than 400 attendees at the second annual event held in conjunction with the Esri User Conference in San Diego, California. It is designed to bring together scientists from domains beyond geography and GIScience in this special venue to encourage networking and cross-disciplinary work.

The keynote speaker is the executive director of the California Academy of Sciences, where he is also the William R. and Gretchen B. Kimball Chair. An effective and prolific science communicator, he has presented on global environmental issues and written articles, op-ed pieces, and essays for mainstream media such as *National Geographic*, *Scientific American*, and *The Guardian*.

In her introduction of Foley, Esri chief scientist Dawn Wright underlined the dual nature of Esri's science mission: to support the science community with tools and technology to carry out its work and to establish Esri as a member of the scientific community through its scientific contributions.

The perception that the Earth is big and we are small has had a profound effect on our strategies for dealing with the Earth. The shortcomings of seeing the Earth as limitless were not as apparent for most of human history when the world's population was counted in hundreds of thousands instead of the billions of today.

"By 'mining the planet,' we are leaving a depleted and degraded legacy to future generations," cautioned Foley. "We are pushing the planet to its breaking point." However, Foley sees framing this situation as an environmental problem as missing the point, and he loathes the term "sustainability" for just that reason.

This is not an environmental problem—it's a civilization problem. "It is not just about polar bears but the world's people," Foley said. "It's not okay to knowingly leave behind a degraded world. The imperative has always been to leave the world a better place than you found it."

What can scientists do? Foley sees the development of big data, microsatellites, and citizen science as tools for making these changes. He cited the example of iNaturalist, a smartphone app for crowdsourcing biodiversity data sponsored by the California Academy of Sciences, that has collected millions of geocoded observations.

While gathering big data in areas such as biodiversity is undoubtedly valuable, what the world needs is not so much big data but big wisdom. Foley said we need to translate big data into "a sticky idea that changes the way we think."

But it won't be enough to just change the way we think, we need to change the way we act. What is stopping actions that will get us to a more viable future? It is a culture that disparages science. This factor must be addressed because it triggers a filter that causes half the people to tune out this important discussion.

Consequently, the role of scientists as communicators is more crucial than ever before. The lack of civil discourse around the value and role of science has led, in turn, to a loss of hope. Without hope, people will not act, and action is necessary.

To overcome this situation, scientists need to

1. Choose to hope.
2. Have a plan.
3. Tell stories that inspire action.

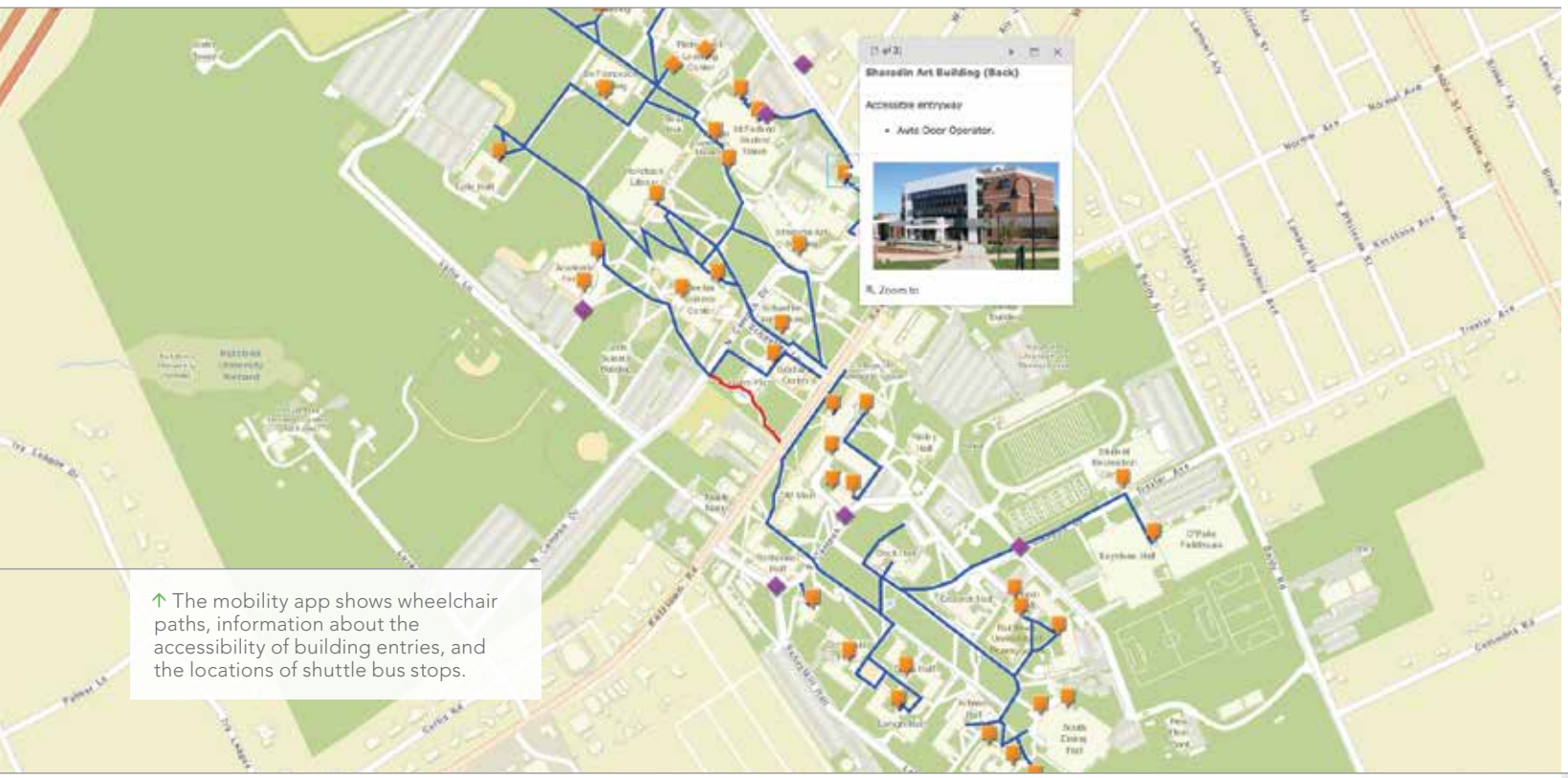
"Hope is the hardest but most necessary aspect because if we don't have hope, nothing else really matters," said Foley. Scientists need to help imagine a world in which people and nature are thriving together. Getting to that vision requires a plan. "As scientists, we need to work on solutions, not just pointing out problems." After embracing hope and coming up with solutions, scientists need to tell stories that communicate that vision and inspire action.

Following the keynote, Dr. Michael Goodchild, University of California, Santa Barbara, professor emeritus, led a panel discussion of topics raised by Foley. Panel participants were Shaowen Wang of the University of Illinois, Urbana-Champaign; Sheila Steinberg of Brandman University; Andre Skupin of San Diego State University; and Christina Boggs-Chavira of the California Department of Water Resources along with Foley. They spoke of the challenges of communicating science in a way that navigates cultural filters and is understandable and well received by a society in which science is increasingly a dirty word. A networking social followed the panel discussion.

To keep up with Esri's science work, visit esriurl.com/scicom and follow the science group on GeoNet.

A Better Way to Get to Class

By Olivia Harne



↑ The mobility app shows wheelchair paths, information about the accessibility of building entries, and the locations of shuttle bus stops.

The author, a student at Kutztown University of Pennsylvania as well as a GIS development intern for the Pennsylvania Department of Transportation, developed an app to help fellow students who use wheelchair pathways more easily travel across the campus.

For students with mobility issues, not knowing the best routes to class can cause delays that make them tardy.

My previous work for the library at Kutztown University creating maps for campus event attendees with low vision led to my interest in improving campus accessibility. I had learned there are many ways to create navigation systems that help different student populations. This is a problem I felt could be tackled on a smaller scale, working with the college's Disability Services Office. Using geospatial information to improve accessibility is often underutilized by colleges, but better accessibility is essential if educational institutions are going to accommodate the greater diversity of the modern student body.

I created a web map app that provides new and easily updated navigational information for students with mobility challenges. The app's development was triggered by a complaint that had been published in the student newspaper. This project was unfunded, and the work was done on a volunteer basis. It started in October 2016 and was completed by February 2017. I worked with the Disability Services Office's director on Americans with Disabilities (ADA) compliance.

My solution had three major components: a basemap, a web app, and a QR code. ADA-compliant pathways were obtained from the university. The app uses the ArcGIS Online World Streetmap basemap. This basemap was enhanced with wheelchair-accessible walkways highlighted by blue lines. Students with mobility issues can use blue-highlighted pathways to find routes that are the most convenient for their class schedules. Points designating entryways provide further information.

As I conducted my research for the app, I discovered that the accessibility of building entryways hadn't been evaluated and the university's standard accessibility map failed to identify details such as entryways in high foot traffic areas or whether entryways were close to elevators. For the

initial application, I completed all evaluations of entryways. However, to keep up with campus renovations, I take volunteer information submissions and incorporate that information.

Once the enhanced basemap had been completed and hosted on ArcGIS Online, I developed a separate web map app for presenting wheelchair pathways using Web AppBuilder for ArcGIS. I chose Web AppBuilder for its convenience and intuitive widget customization. Initially it was created for iOS, but an Android version was generated later. It took approximately four months to complete, mainly because I had to ensure that all ADA guidelines were met.

A QR code was created that could be scanned by students to quickly open the app. For this project's first wave of implementation, QR code signs were located at prominent locations with Internet access and were placed at the signage height recommended by the Americans with Disabilities Act Standards for Accessible Design.

As with any product, keeping the lines of communication open between the consumer and those responsible for its maintenance is crucial. I maintain the app. The Disability Services Office provides pamphlets that contain my email so students can contact me. I also talk to student groups on campus that promote accessibility awareness.

The response to the app has been positive. Students see it as a more convenient method of finding wheelchair pathways. The number of students using wheelchair pathways at Kutztown is not large, so the average number of users per month is about 10–20 students, though this total can increase depending on events that attract visitors to the campus.

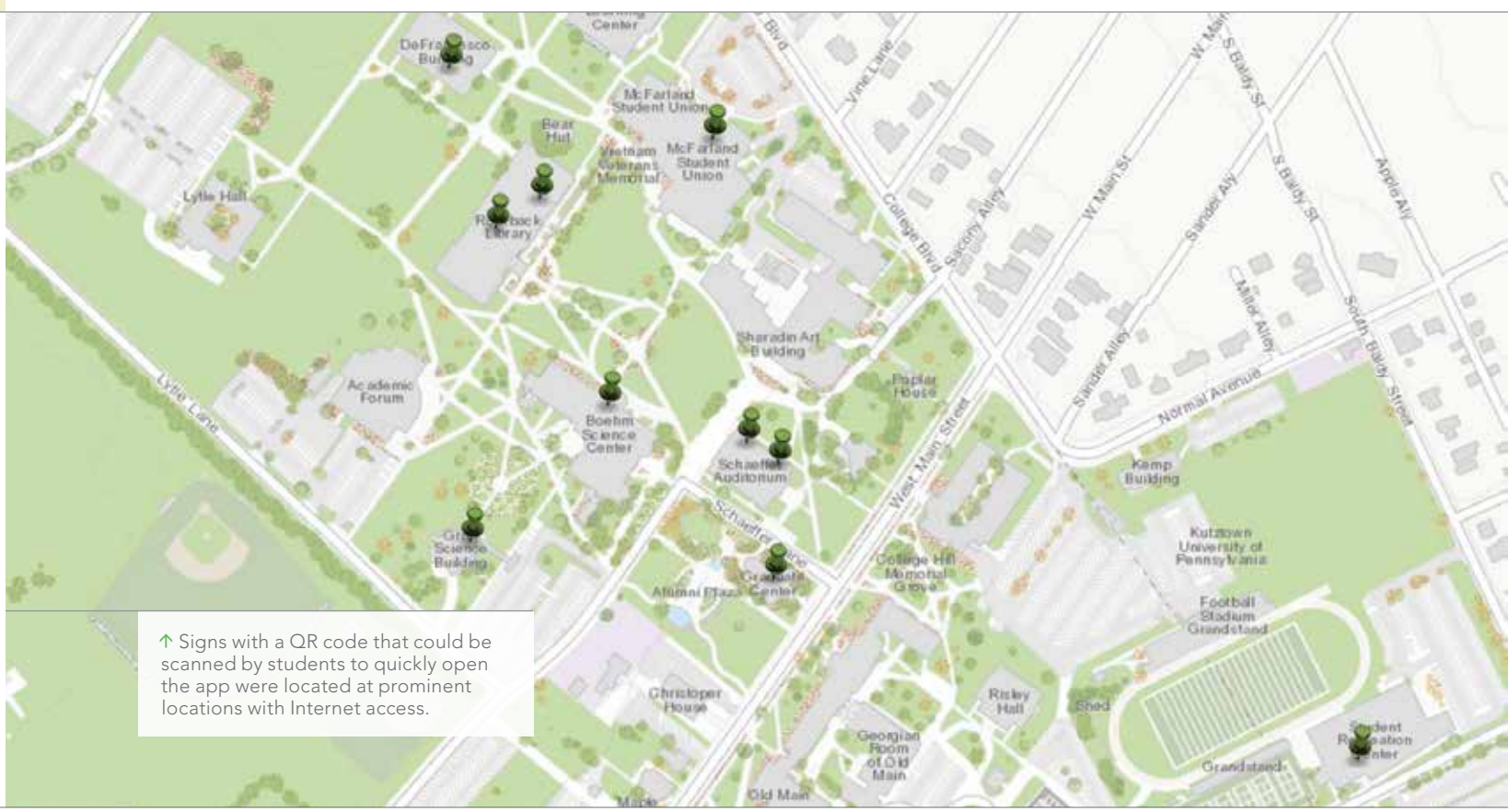
Although I currently update the app twice a year (fall and spring), I make small changes on a continuing basis. These changes are based on information about campus renovations and suggestions from users of the app. This new and relatively simple application for Kutztown University's Disability Services continually evolves.

I encourage other colleges to consider implementing a similar app to better assist students who have mobility issues and raise awareness of student diversity. Implementing GIS for mapping event routes could also be very useful for reducing travel time for those who need to more carefully plan how to reach destinations on campus.

For more information, contact Olivia Harne at oharn360@live.kutztown.edu.

About the Author

Olivia Harne is a GIS development intern for the Pennsylvania Department of Transportation (PennDOT). Currently, she is a student at Kutztown University, majoring in library science with minors in geography and computer science. She does freelance GIS work for Kutztown University, making accessible navigation tools for students.



↑ Signs with a QR code that could be scanned by students to quickly open the app were located at prominent locations with Internet access.

Opening Access to University Scholarship through Spatial Discovery

By Sara Lafia and Werner Kuhn
University of California, Santa Barbara's Center for Spatial Studies

The University of California, Santa Barbara (UCSB) Open Data site provides spatial views of scholarship that give the campus community new perspectives on research. The community now has a better understanding of where in the world research is happening and what that research is about.

UCSB, in partnership with the UCSB Library and Esri, launched the site to showcase campus research. For the first time, datasets and publications across campus departments—such as marine biology, archaeology, and political science—are geographically referenced, discoverable, and accessible through one platform.

Bridging Disciplines

In the 1990s, the University of California, Santa Barbara, advanced the vision for a spatially enabled digital library through the Alexandria Digital Library project. The goal was to provide access to diverse materials with functionality for spatiotemporal search.

Beginning in 2015, a team of academic researchers revived this vision by making their published datasets and papers spatially discoverable. This effort was supported by the UCSB Library, the Center for Spatial Studies, and the Spatial Discovery Fund. Research materials that range from imagery and scanned environmental impact reports to dynamic citizen science data are now available through one search interface.

Since the site's creation, more than 115 datasets have been exposed. These datasets include data about the campus, such as layers from the university's Interactive Campus Map, along with feature services, reports, and imagery used by campus researchers.

The UCSB Open Data site bridges disciplines. It identifies areas of the world for which research data is available, regardless of the discipline or data format. Research data is often organized by discipline (e.g., biology data portal) or theme (e.g., art catalog). Data is less likely to be described and organized spatially.

This is a missed opportunity. The spatial organization of campus research cuts across disciplines and formats and offers interdisciplinary views of campus scholarship that promote collaboration.

For example, campus researchers from several departments work in the Mesoamerican region, yet data about archaeological excavations, contested political borders, and land-cover type were not discoverable in one place until recently. Datasets that overlap in their geographic extents are now discoverable. This encourages data sharing and linking across disciplines. Relevant publications or other documents that reference the datasets are now also linked to the datasets. This additional context aids in discovery.

New Ways of Sharing

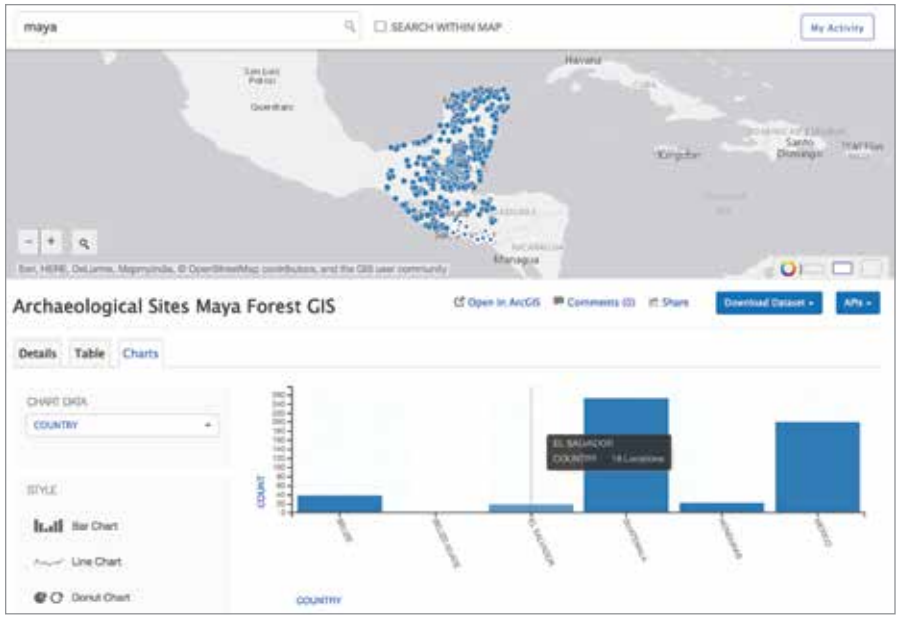
To support this effort, the authors developed a protocol that allows researchers to provide key metadata elements to geographically reference their resources, making observation locations explicit. In this way, diverse resources hosted across various university repositories can be made spatially discoverable.

ArcGIS Open Data supports a wide range of data formats, including URL links to externally hosted content and nongeographic formats, such as documents, images, and tables. Once described spatially, these datasets referenced in research papers are indexed and made discoverable alongside traditional spatial data. Because all formats contributed by researchers are supported by ArcGIS Open Data, they are also amenable to exploration and analysis in various web-based geographic information systems.

Access and contributions to the open data site are mediated by ArcGIS Online. Users do not need credentials to browse, download, or manipulate data from the site. To contribute, researchers from the campus community follow a simple and extensible workflow to describe and expose their research as data services.

This approach also offers a more dynamic

↓ The UCSB Open Data site provides geographic and thematic search.



↑ The resource view allows additional manipulation and faceting based on attributes.

means of sharing research products, allowing researchers to publish and maintain control of their original material through any means mandated by academic journals or grants while still sharing their research with a broader audience.

It also reduces demand for libraries to provide metadata curation and data hosting through repositories. Data shared through the ArcGIS Open Data site increases the visibility of campus scholarship. The UCSB Open Data site not only enables geographic views of research but also connects the data to publications about them, allowing users to learn more about the research data in context regardless of which department or repository hosts them.

Expanding the Use of Spatial Discovery

UCSB's Open Data site acts as a one-stop shop for browsing and accessing data. As the amount of research data available through UCSB Open Data continues to grow, discovery of campus research is also increasing across a broader community. Recent efforts to produce a self-organizing map of campus research based on the subject descriptions of dissertations have yielded interesting insights into clusters of research themes.

Expanding the notion of spatial discovery to such topic spaces offers another spatial view of data that is nongeographic. Coupling topic modeling with geographic views of research obtained from geoparsing text descriptions of research enables the spatial discovery of university scholarship through both geographic and topic spaces.

For more information, please visit UCSB Open Data (discovery-ucsb.opendata.arcgis.com) or contact Sara Lafia at slafia@geog.ucsb.edu.

About the Authors

Sara Lafia, a graduate student in the geography department at UCSB, works in partnership with the UCSB Library and the Center for Spatial Studies on improving the spatial discovery of research data and documents. Her research addresses the question of how to spatially enable discovery of connected data and publications in a setting that allows for mapping and GIS analysis. She is also interested in the application of spatialization frameworks to nonspatial data to gain new insights into contents. Her background is in urban and regional planning, and she has worked on projects with the Region 10 Environmental Planning Agency, the South Coast Air Quality Management District, and the Jet Propulsion Laboratory.

Werner Kuhn holds the Jack and Laura Dangermond Endowed Chair and is a professor in the department of geography at UCSB. He is also the director of the Center for Spatial Studies at UCSB. His main research and teaching goal is to enable transdisciplinary research through spatial information and computing. Before joining UCSB in 2013, Kuhn was a professor of geoinformatics at the University of Münster, Germany, where he led MUSIL, an interdisciplinary semantic interoperability research lab (musil.uni-muenster.de). He holds a doctorate from ETH Zurich in surveying engineering and was a postdoctoral researcher with the National Center for Geographic Information and Analysis (1989–1991) as well as with the Vienna University of Technology (1991–1996). He is a cofounder of the COSIT Conference Series (since 1993) and the Vespucci Initiative (vespucci.org) (since 2003).

↓ An Esri app showcases open access research theses and dissertations, organized in topic spaces.

→ Demolition experts removing the detonators from the 1.8-ton aerial bomb after the surrounding area had been evacuated. Photo courtesy of the City of Augsburg.

Massive Evacuation Orchestrated by GIS

By Wilfried Matzke, Director, Geodatenamt der Stadt Augsburg

By some estimates, half of the 2.7 million tons of bombs dropped on Europe during World War II landed in Germany. Each year, 2,000 tons of unexploded munitions are uncovered in Germany. Each time a bomb is discovered, the responsible municipal government must swiftly evacuate residents until the bomb is defused.

It wasn't how the residents of the City of Augsburg, Germany, had pictured their Christmas holidays in 2016.

A 1.8-ton aerial bomb, discovered during a construction project in December 2016—but originally dropped by the Royal Air Force (RAF) in February 1944—forced the evacuation of 54,000 residents on Christmas Day. Before the bomb could be defused, people living in a radius of 1.5 kilometers around the site had to be evacuated. This meant evacuating most of the residents in the city center and adjacent neighborhoods.

The city's use of geodata helped carry out the massive evacuation—the largest in postwar Germany—and return residents to their home by Dec. 26. Augsburg has been working with ArcGIS for more than nine years. The Office of Geodata (Geodatenamt), Augsburg's municipal surveying office, is responsible for the geodata infrastructure. Its geoportal is based on WebOffice, a web client developed using the ArcGIS API for JavaScript by Esri partner AED-SYNERGIS. It runs on the city's internal network, supplying geodata to all city departments and simplifying and improving the city's processes.

The municipal crisis team responded. Its 23 members are employees of the city council, the mayor, fire and police departments, medical services, municipal utilities,

and Agency for Technical Relief. The crisis team used ArcGIS to identify and document a 741-hectare area for evacuation. The location of roads, industrial development, and other characteristics of the area were considered. Approximately 32,000 households and 6,136 addresses were affected. The team used a map of the city showing the evacuation area and a Microsoft Excel spreadsheet listing the addresses to organize the evacuation.

One thing turned out to be highly useful: The geoportal manager at the Office of Geodata has specialized training in emergency situations and creating maps that provide a common operational picture. He works with the emergency management leadership group, an interagency group responsible for safety and security that coordinates response and ensures collaboration across departments.

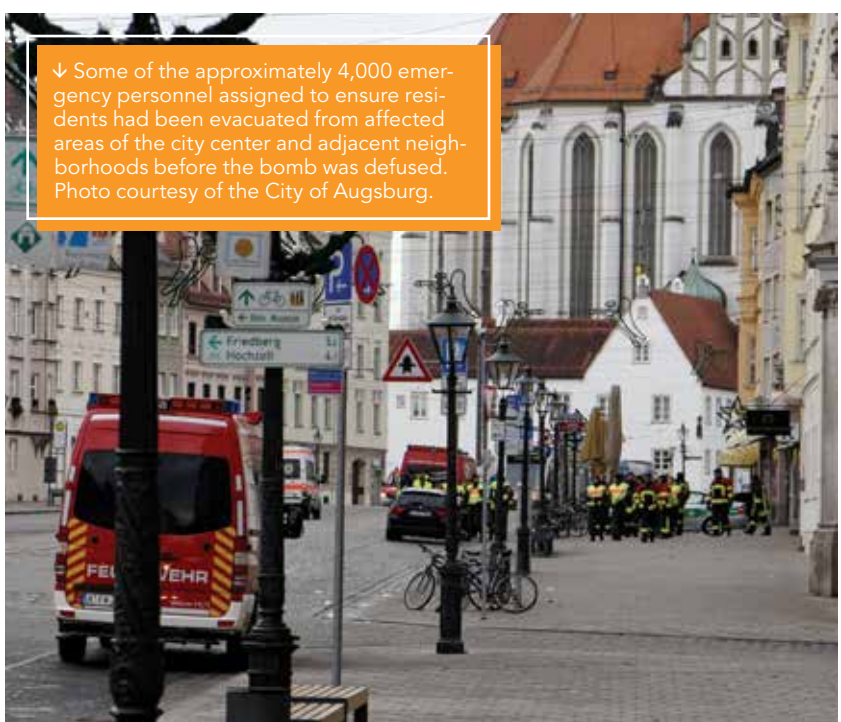
In addition, the Office of Geodata had also commissioned an experienced GIS professional who prepared a map of the city showing the 32 zones in the evacuation area that had been specified by the crisis team. He created detailed large-format (A3 or 11.7-inch by 16.5-inch) zone plans. By working two night shifts, the Office of Geodata Output Center staff generated printed copies of the zone plans and the other map materials that were needed.

These plans showed the routes that emergency personnel in each zone were to walk to ensure the complete evacuation of designated areas. Emergency personnel were organized into teams of 20 to 40 persons. In evacuating residents from designated areas, paper maps proved more useful than digital maps. The crisis team and the more than 4,000 emergency staff from the Agency for Technical Relief, fire and police departments, medical services, municipal utilities, and other groups were involved in the evacuation. Employees of the City of Augsburg and volunteers from other local governments in Bavaria relocated hospital patients and residents of retirement homes in the affected area. Printed maps of the city were especially useful for these volunteers.

Everything went smoothly. The bomb was discovered by a construction worker on December 20. The next day the situation was analyzed. A holiday, December 25, was chosen for the evacuation. The last of the residents who were evacuated from hospitals and nursing homes were returned on December 26.

For more information, contact Wilfried Matzke, director, Geodatenamt der Stadt Augsburg, at geodatenamt@augsburg.de.

↓ The 1944 aerial photo in the geoportal overlaid with current topography and an outline of the approved construction project where the bomb was discovered. Photo courtesy of the City of Augsburg.



↓ Some of the approximately 4,000 emergency personnel assigned to ensure residents had been evacuated from affected areas of the city center and adjacent neighborhoods before the bomb was defused. Photo courtesy of the City of Augsburg.

About the Author

For eight years, **Wilfried Matzke** has managed the municipal surveying authority in his hometown of Augsburg, the third-largest Bavarian city. In 2011, the authority was relaunched as Geodatenamt. With his staff of 43 employees, he works to advance the idea of the smart city. Before working for the city, he had a 12-year career as an artillery officer and worked in a Bavarian organization for rural reorganization. He studied geodesy at the Bundeswehr University in Munich.

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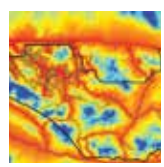


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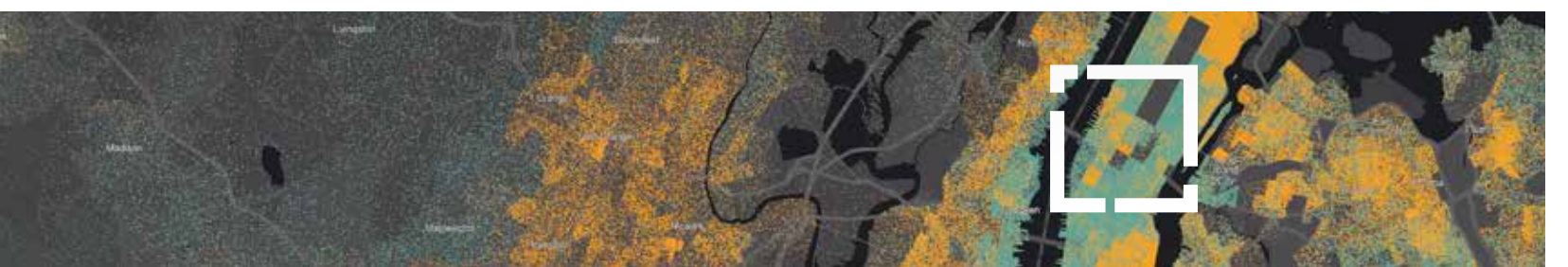

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