# ArcGIS Platform Overview

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*Michigan GIS User Group 2022*

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# Agenda

- **10:30 AM-12:00 PM**
  - Effectively Utilizing the ArcGIS System
- **12:00 PM-1:00 PM**
  - Lunch
- **1:00-2:00 PM**
  - New Ways to Utilize ArcGIS

# ArcGIS Online & ArcGIS Enterprise

## Understanding the Relationship

# ArcGIS Enterprise & ArcGIS Online

## Understanding the Relationship

- **Two comprehensive products that allow for**
  - Organization-wide mapping
  - Analysis
  - Data Management
  - Sharing
  - Collaboration capabilities
- **Both ArcGIS Enterprise and ArcGIS Online are secure, scalable, and flexible**
- **Either or Both can be used**
  - Common for organizations to use both
  - Serve seperate purposes depending on business need

# ArcGIS Enterprise & ArcGIS Online

## Similarities

- **Both ArcGIS Enterprise and ArcGIS Online**
  - Operate around a central website where members can share maps, apps, and data with select groups, entire organization, or public
  - Allow access to templates and configurable apps to support office and mobile workflows
  - Allow access to ArcGIS Living Atlas of the World

# ArcGIS Enterprise & ArcGIS Online

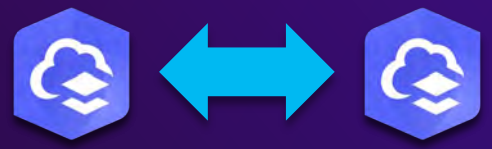
## Differences: Deployment

| ArcGIS Online | ArcGIS Enterprise |
| --- | --- |
| • **Software as a Service (SaaS) offering**<br>  • Hosted on Esri servers<br>  • Esri controls update schedule<br>  • Typically, 4x per year<br>  • No need to manually update patches<br>  • As your usage and data needs scale, ArcGIS Online dynamically scales to support | • **Software that is installed on infrastructure you control**<br>  • Cloud, on-prem, virtual machines<br>  • Highly customizable<br>  • Design your own deployment strategy |
| • **Automatic versions and updates**<br>  • No need for you to provision additional servers or infrastructure<br>  • Additional data stores are available to you if required. | • **Manage versions and updates**<br>  • Typically, one to two releases per year<br>  • Most AGO features available within the ArcGIS Enterprise portal in the next few ArcGIS Enterprise releases following an AGO update |

** Esri also provides Esri Managed Cloud Services to run ArcGIS Enterprise on behalf of your organization.*

# ArcGIS Enterprise & ArcGIS Online

## Differences: Features and Capabilities

| ArcGIS Online | ArcGIS Enterprise |
| --- | --- |
| • Extending ArcGIS Online<br>  • Support for ArcGIS Image for ArcGIS Online, ArcGIS Velocity, ArcGIS Notebooks | • Extending ArcGIS Enterprise<br>  • Extend through use of GIS Server, Image Server, Mission Server, GeoAnalytics Server, Knowledge Server |
| • Sharing Data<br>• Partnered Collaboration  | • Sharing Data<br>• Distributed Collaboration  |

# ArcGIS Enterprise & ArcGIS Online

## Differences: Features and Capabilities

| ArcGIS Online | ArcGIS Enterprise |
| --- | --- |
| • All data is hosted in ArcGIS Online system<br>• Data must either be:<br>  • Copied to ArcGIS Online<br>  • Used via distributed collaboration to share data from ArcGIS Enterprise to ArcGIS Online | • Connects to user-managed data stores<br>  • Cloud storage, folders, databases<br>  • Publishers can reference data from within these resources when publishing datasets<br>• Allows integration between user storage and ArcGIS storage (ArcGIS Data Store)<br>• Ability to publish geoprocessing services |
| • Supports organization specific logins via SAML and OpenID Connect<br>• Supports multi-factor authentication | • Supports organization specific logins via SAML and OpenID Connect<br>• Supports multi-factor authentication<br>• Provides additional security and authentication options<br>  • Web-tier authentication & Active Directory |

# ArcGIS Enterprise & ArcGIS Online

## Using Both Together

- Within ArcGIS Enterprise, you can use ArcGIS Online services such as elevation, geocoding, geoenrichment, and more.
- You can also access and incorporate ArcGIS Living Atlas content curated by Esri such as basemaps, imagery, demographics, infrastructure, and environmental data.
  - To use this content, your ArcGIS Enterprise deployment must have access to the internet.
- Many organizations use ArcGIS Enterprise and ArcGIS Online together by implementing distributed collaboration.
  - Enables the sharing of layers, maps, and other data from one system to the other.
  - This workflow makes data more accessible across an entire organization and allows for workflows such as managing data in ArcGIS Enterprise and sharing it with the public through ArcGIS Online.
- Both products support organization-specific logins via SAML and OpenID Connect so you can streamline authentication between systems.

# ArcGIS Enterprise & ArcGIS Online

## Things to Consider

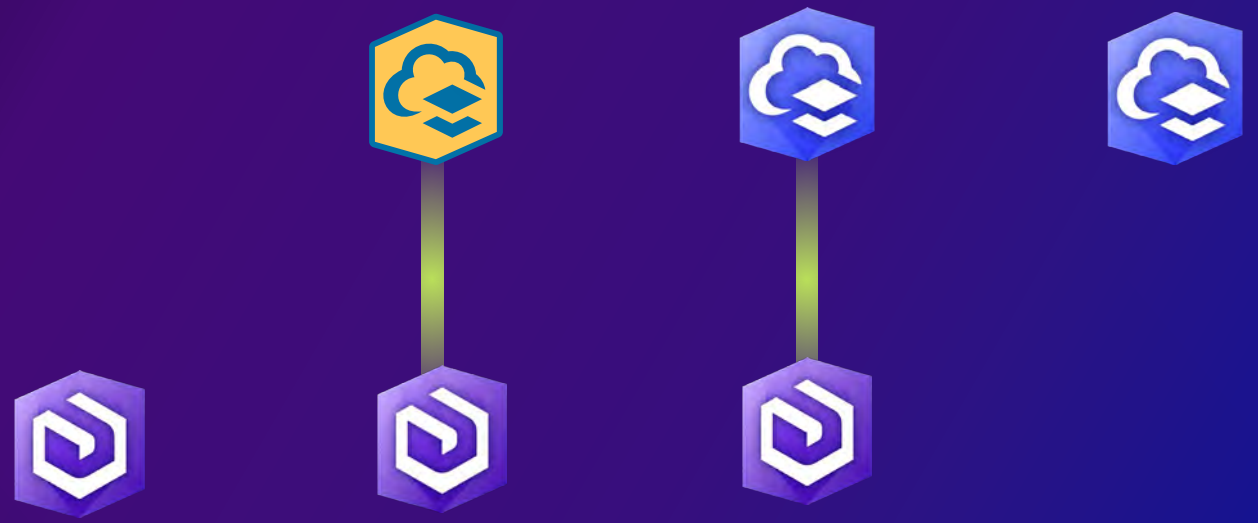
- Organizations often implement ArcGIS Enterprise
  - When they require full control over the hardware running the system or when data is prohibited from being physically stored off-site or on infrastructure not controlled by the organization
  - When servers, computers, and devices in the organization are not connected to the internet or have an unreliable internet connection
  - When advanced analytical capabilities and distributed processing power are needed
- When choosing how to use ArcGIS Online and ArcGIS Enterprise, organizations typically consider the following:
  - Do you need to deploy on infrastructure you control or infrastructure Esri controls?
  - What are your service level agreements and expectations?
  - Who will need access to your system and where will they be accessing it?
  - What of analysis will your organization perform and where do you want the analysis to run?
  - Do you need to integrate with your own data stores or would you prefer that Esri hosts your data?

# Collaboration Workflows in ArcGIS

A Brief Overview

# Collaboration Workflows in ArcGIS

## Implementation Patterns



ArcGIS Enterprise

ArcGIS Enterprise + Content/Services from ArcGIS Online

ArcGIS Enterprise + ArcGIS Online

ArcGIS Online only

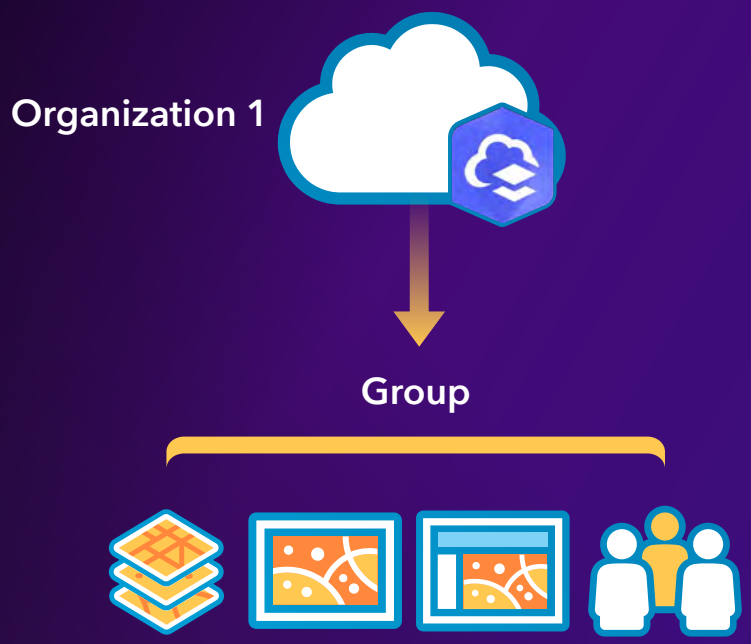
# Collaboration Workflows in ArcGIS

## Types

- **ArcGIS Online**
  - Group Sharing
  - Partner Collaboration
- **ArcGIS Enterprise**
  - Distributed Collaboration

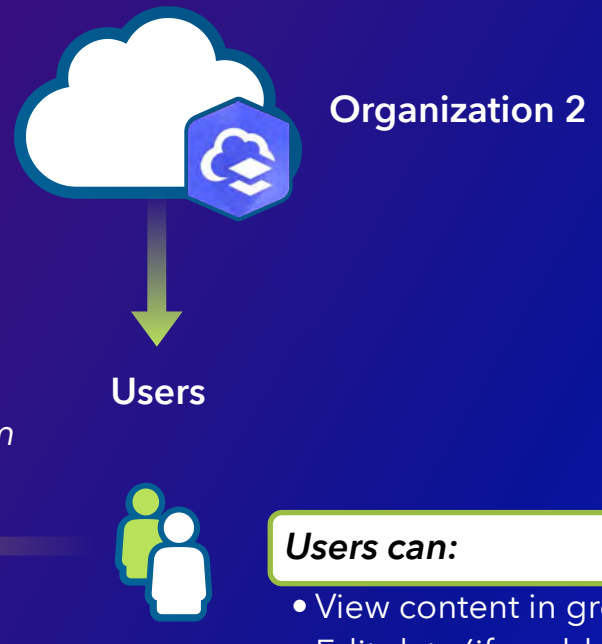
# ArcGIS Online Group Sharing

## How it works




*Org 1 adds members from Org 2 to their group*

*Capabilities of users are based on group settings*




***Users can:***

- View content in group
- Edit data (if enabled) in app or map
- Use content in their own items

**Users cannot:**

- Edit items (maps, apps)

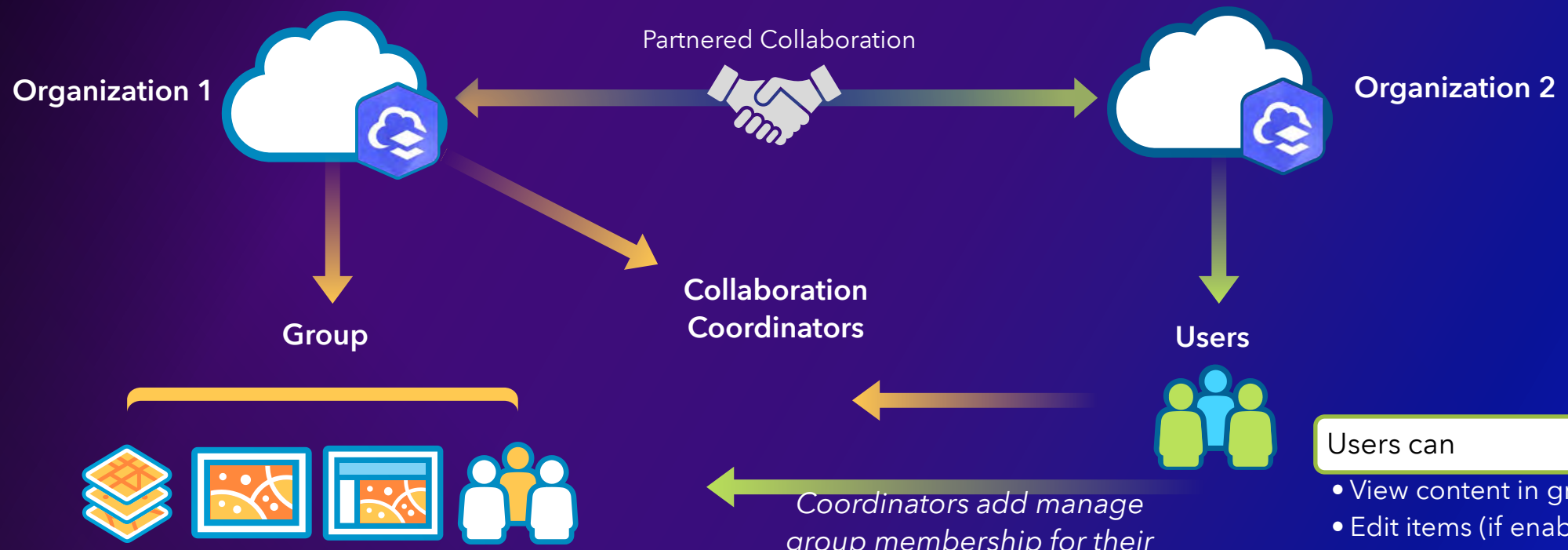
# ArcGIS Online Group Sharing

## Use Cases

- **Secure Data Sharing**
  - Invite users from another organization into a group to view data
  - Users can use data in their own maps and applications
- **Application Review**
  - Securely share apps for review before public release
- **Emergency Management Damage Assessment**
  - Invite users from another organization into a group to collect data
  - County agencies access statewide damage assessment tools

# ArcGIS Online Partnered Collaboration

## How it works




**Users can**

- View content in group
- Edit items (if enabled)
- Edit data (if enabled) in app or map
- Share content to group (if enabled)

**Users Cannot**

- Change ownership of items

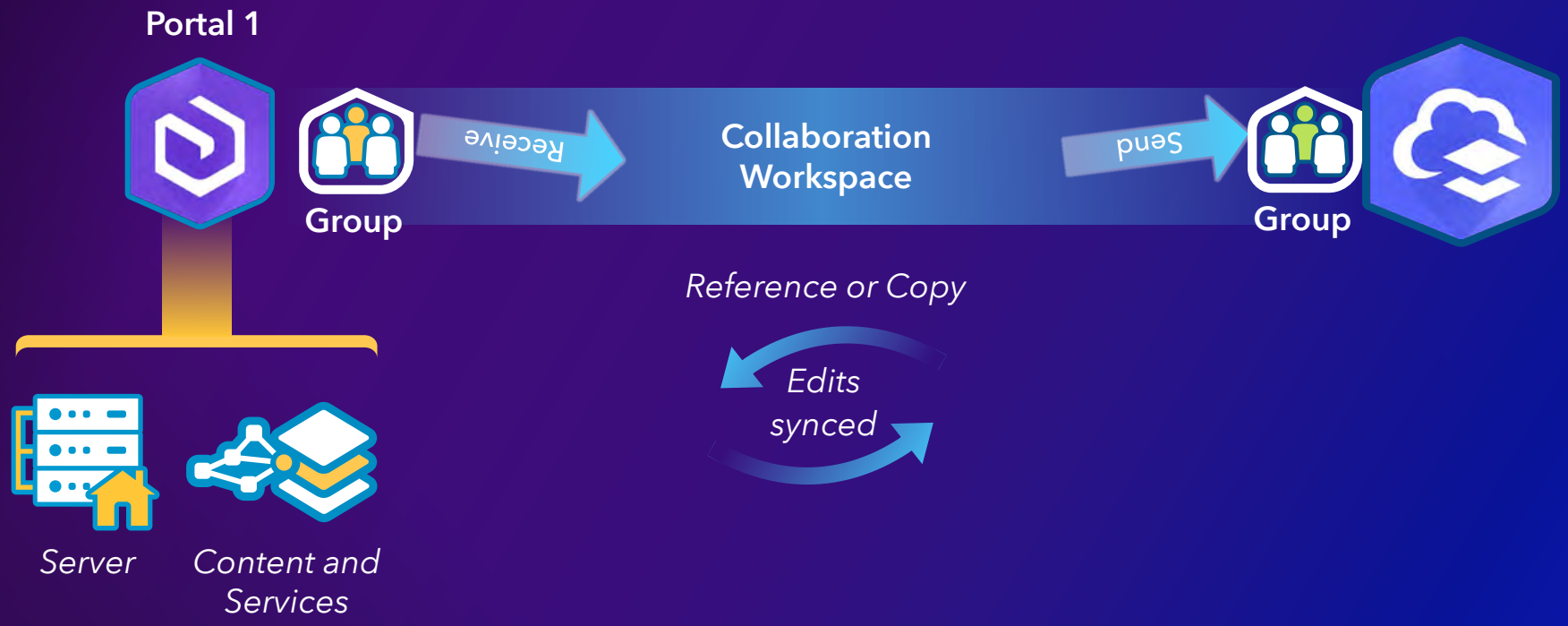
# ArcGIS Online Partnered Collaboration

## Use Cases

- Work more closely with other ArcGIS Online organizations
  - Work with another organization on a web application.
  - Work on secure projects with members from other organizations.
- Share, contribute, and update content using groups
- Designate collaboration coordinators to represent their organization in shared groups
- Add outside users to groups with share/update settings enabled

# ArcGIS Enterprise Distributed Collaboration

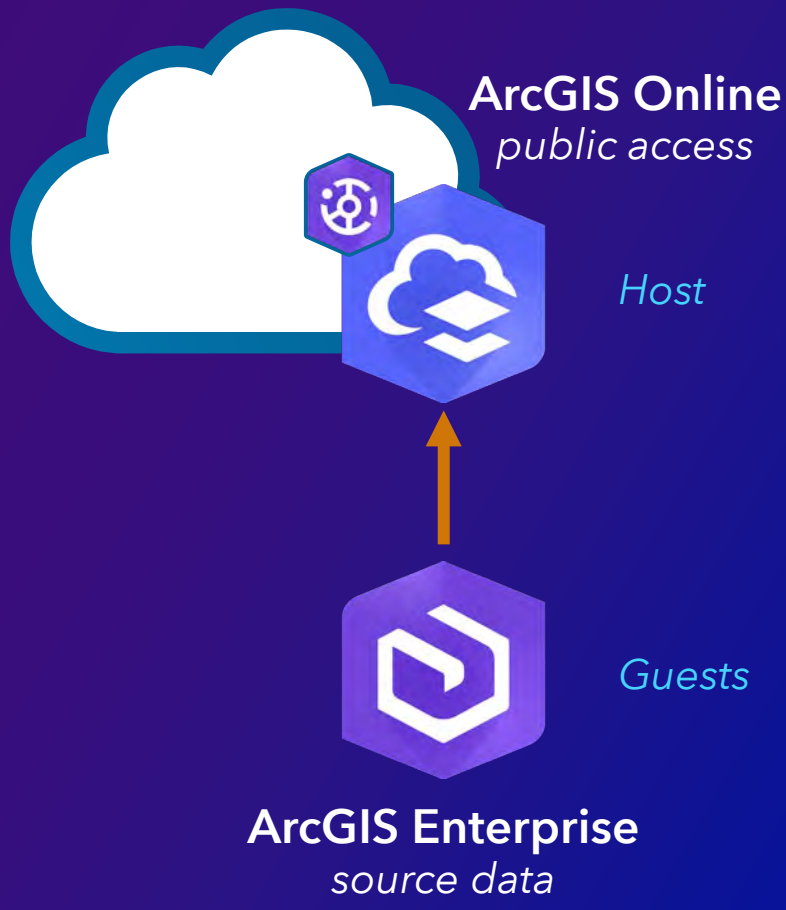
## How it works



# ArcGIS Enterprise Distributed Collaboration

## Use Cases

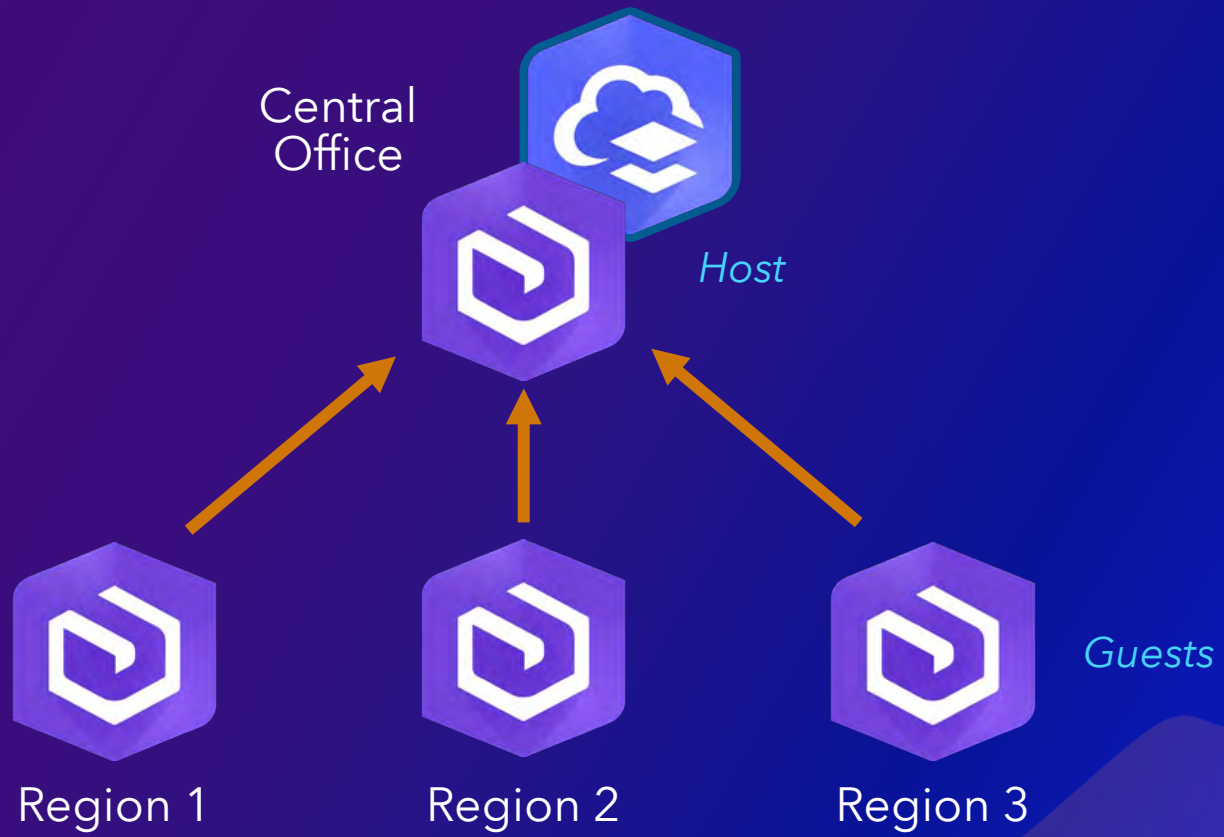
- Enable Open Data
- Manage data and items in ArcGIS Enterprise and shared to ArcGIS Online
- Benefit from the scalability of a SaaS environment
- Edits to data in ArcGIS Enterprise are synchronized to ArcGIS Online



# ArcGIS Enterprise Distributed Collaboration

## Use Cases

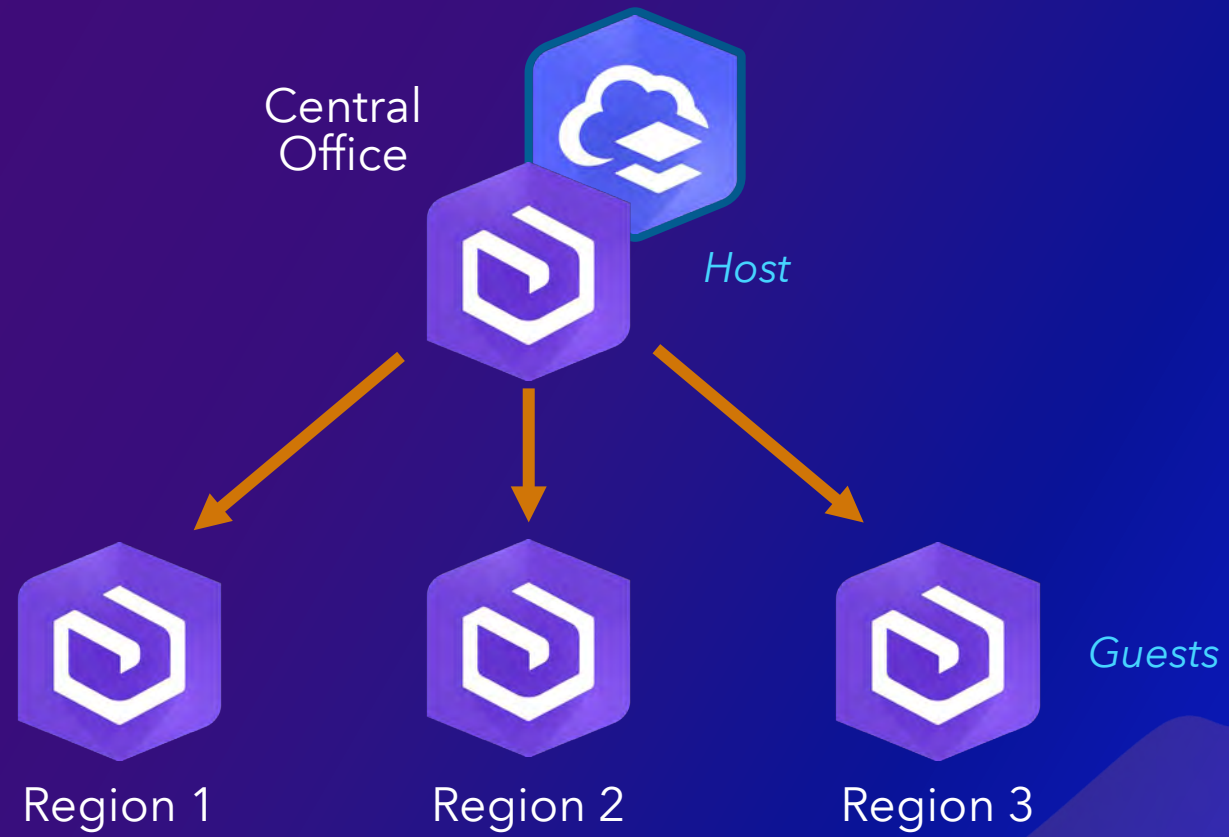
- Allows centralized visibility to an organizations data and content
- Data shared from organizations to a central organization
- Central organization could be ArcGIS Enterprise or ArcGIS Online



# ArcGIS Enterprise Distributed Collaboration

## Use Cases

- Share authoritative data and content from a central source
- Each guest can use the received data and content in their own maps and apps
- Central organization could be ArcGIS Enterprise or ArcGIS Online

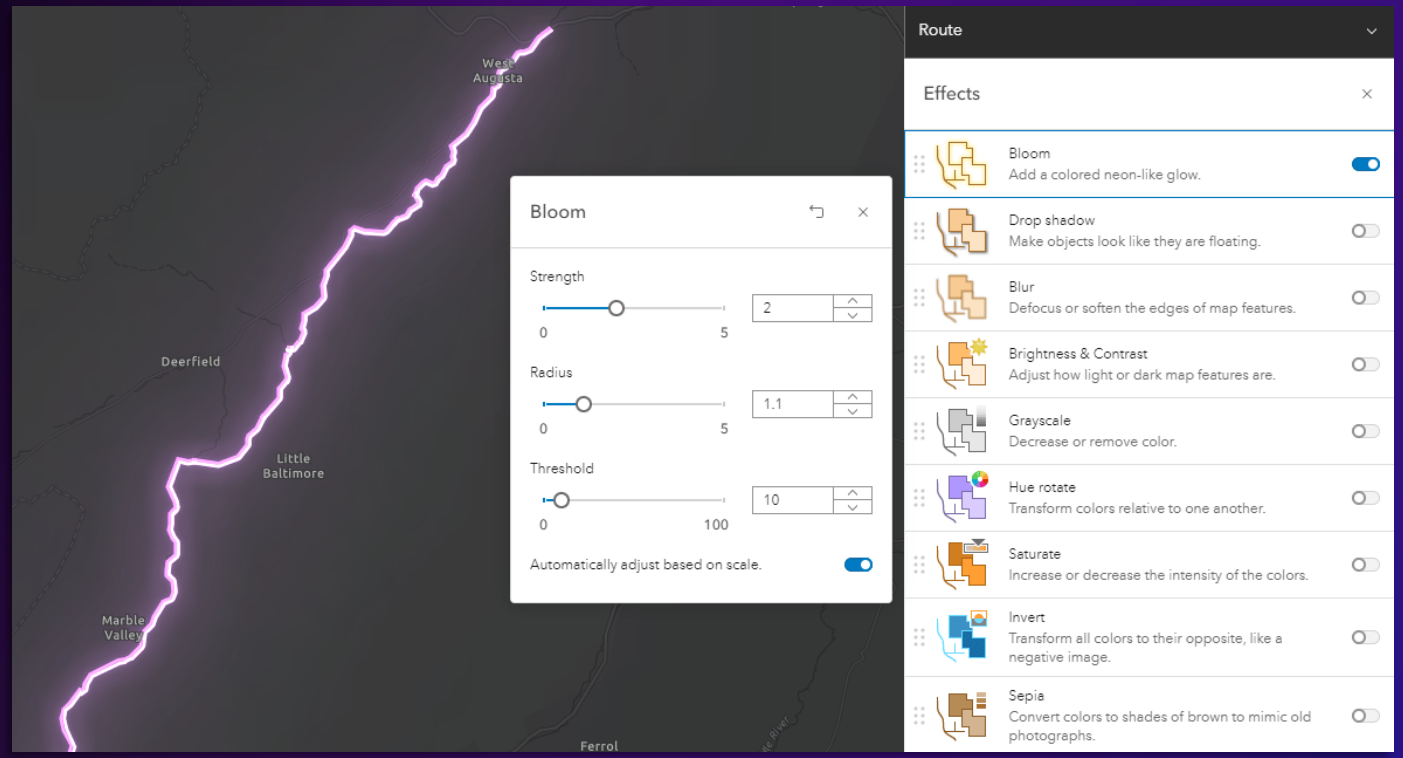


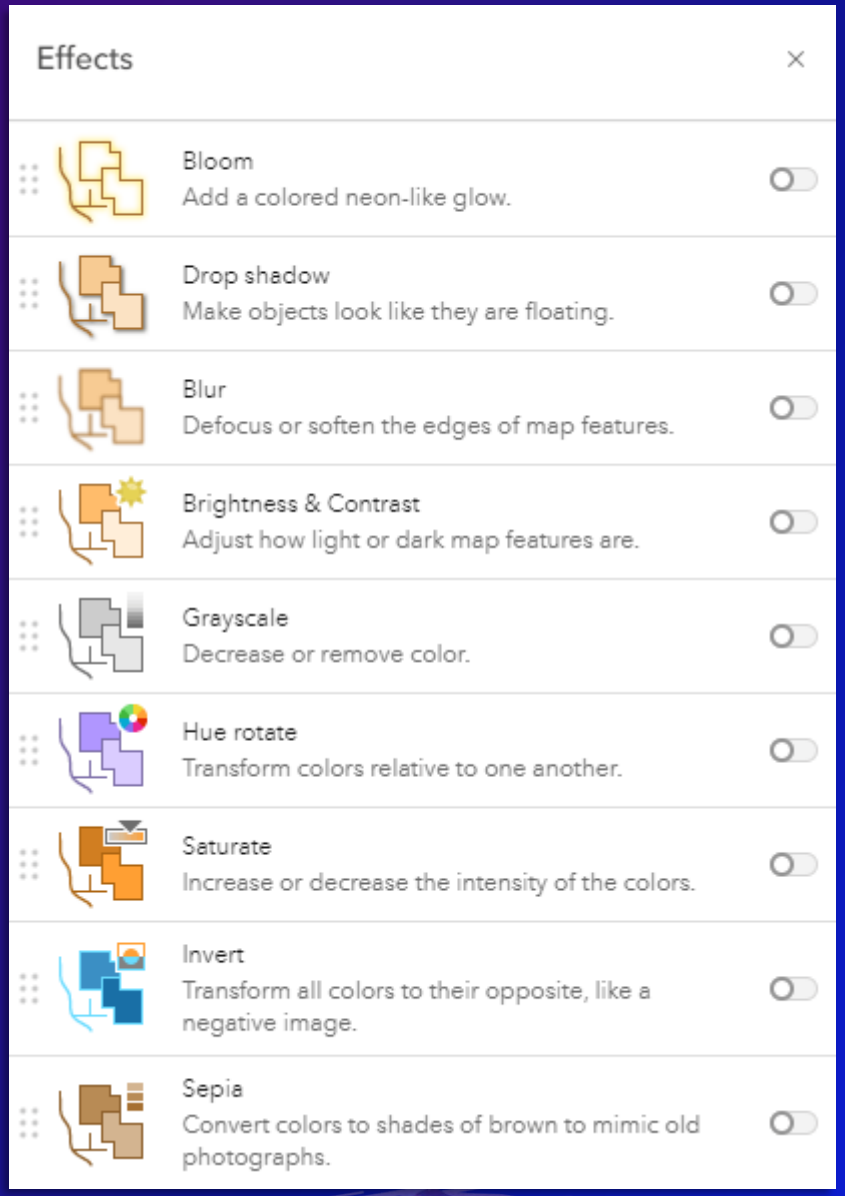
# ArcGIS Map Viewer

## Effects

# Effects in Map Viewer

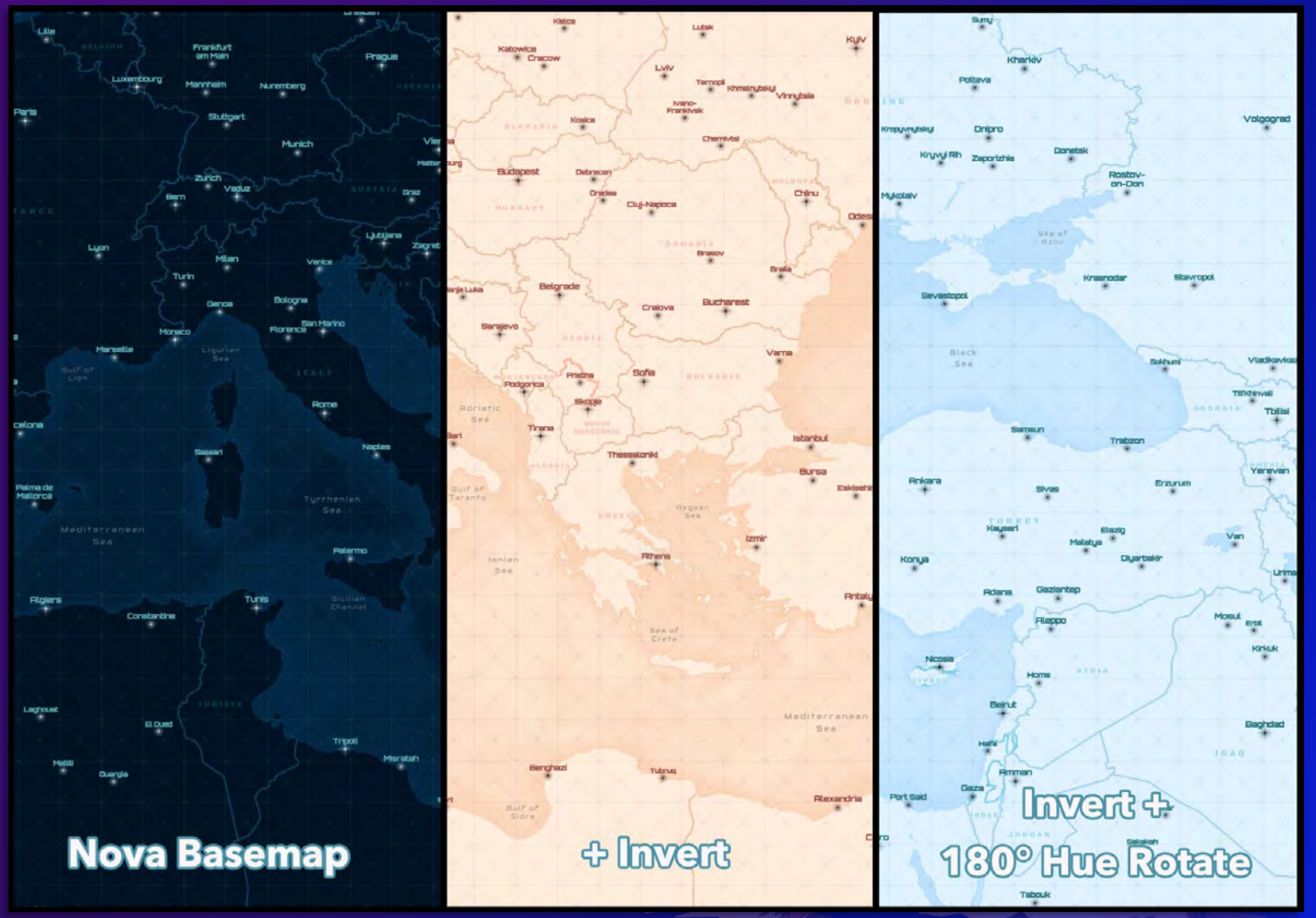
## ArcGIS is a comprehensive imagery platform



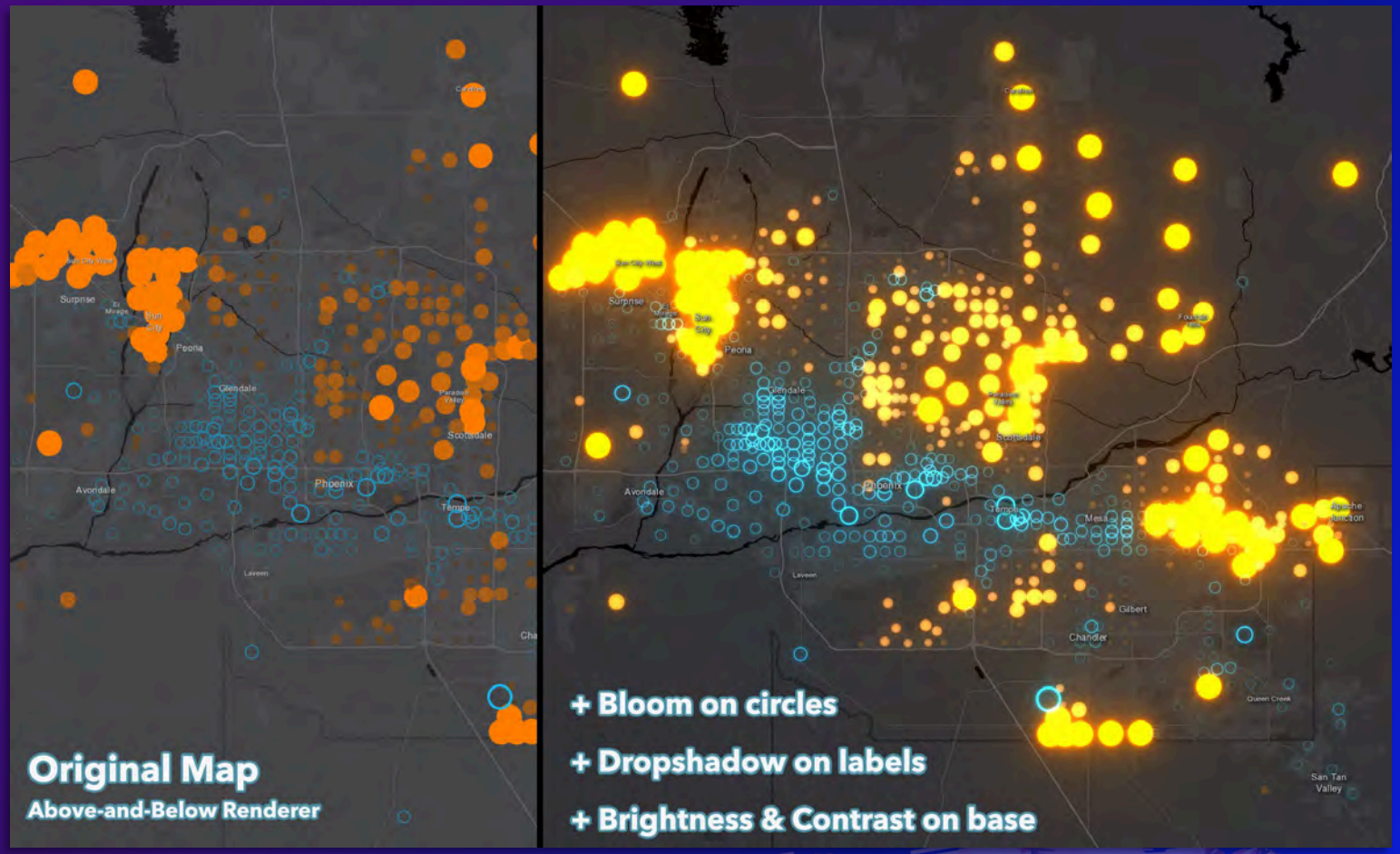
# Examples of Effects Available

## Invert + Hue Rotate



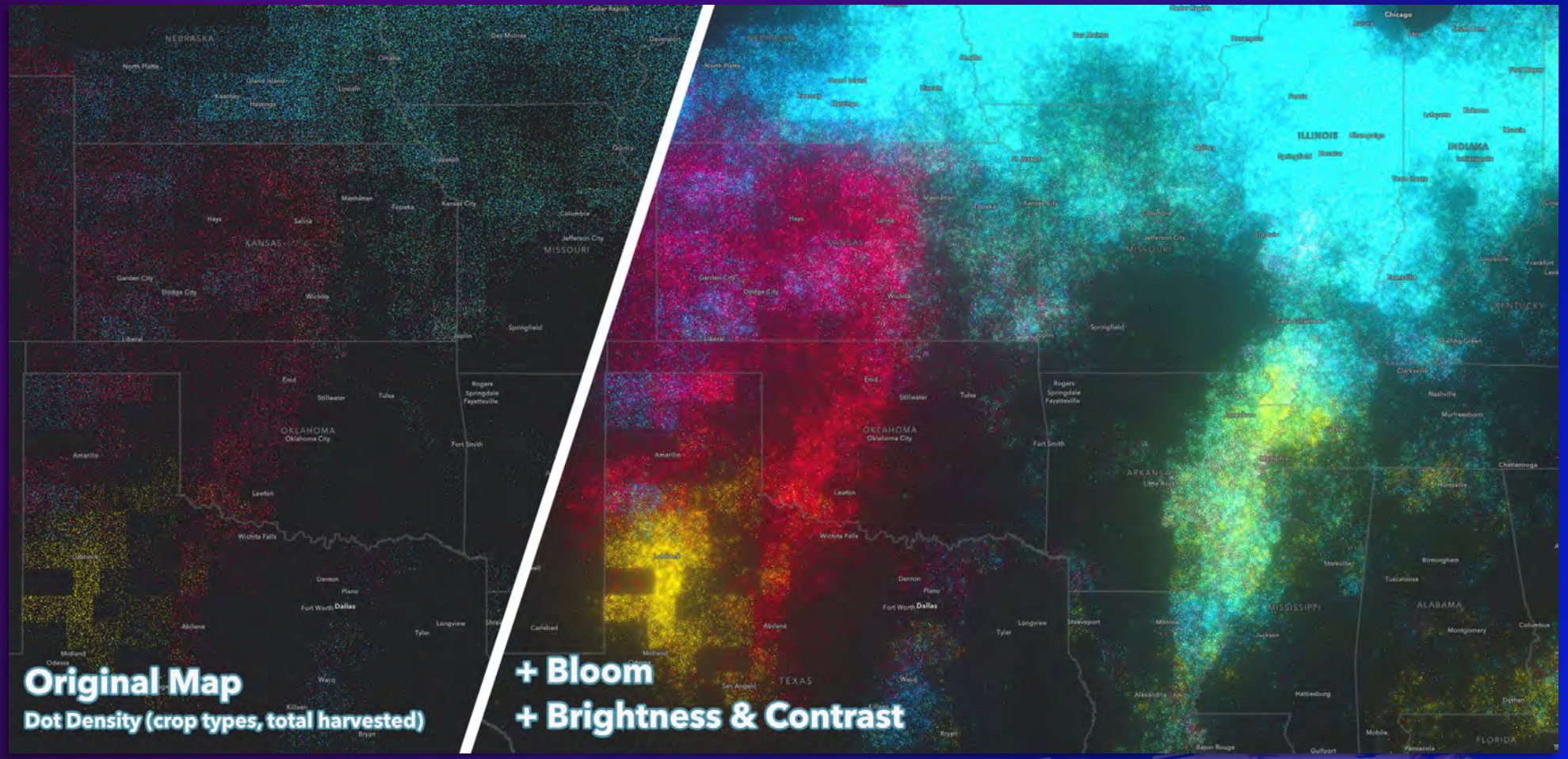
# Examples of Effects Available

## Bloom + Drop shadow + Brightness & Contrast



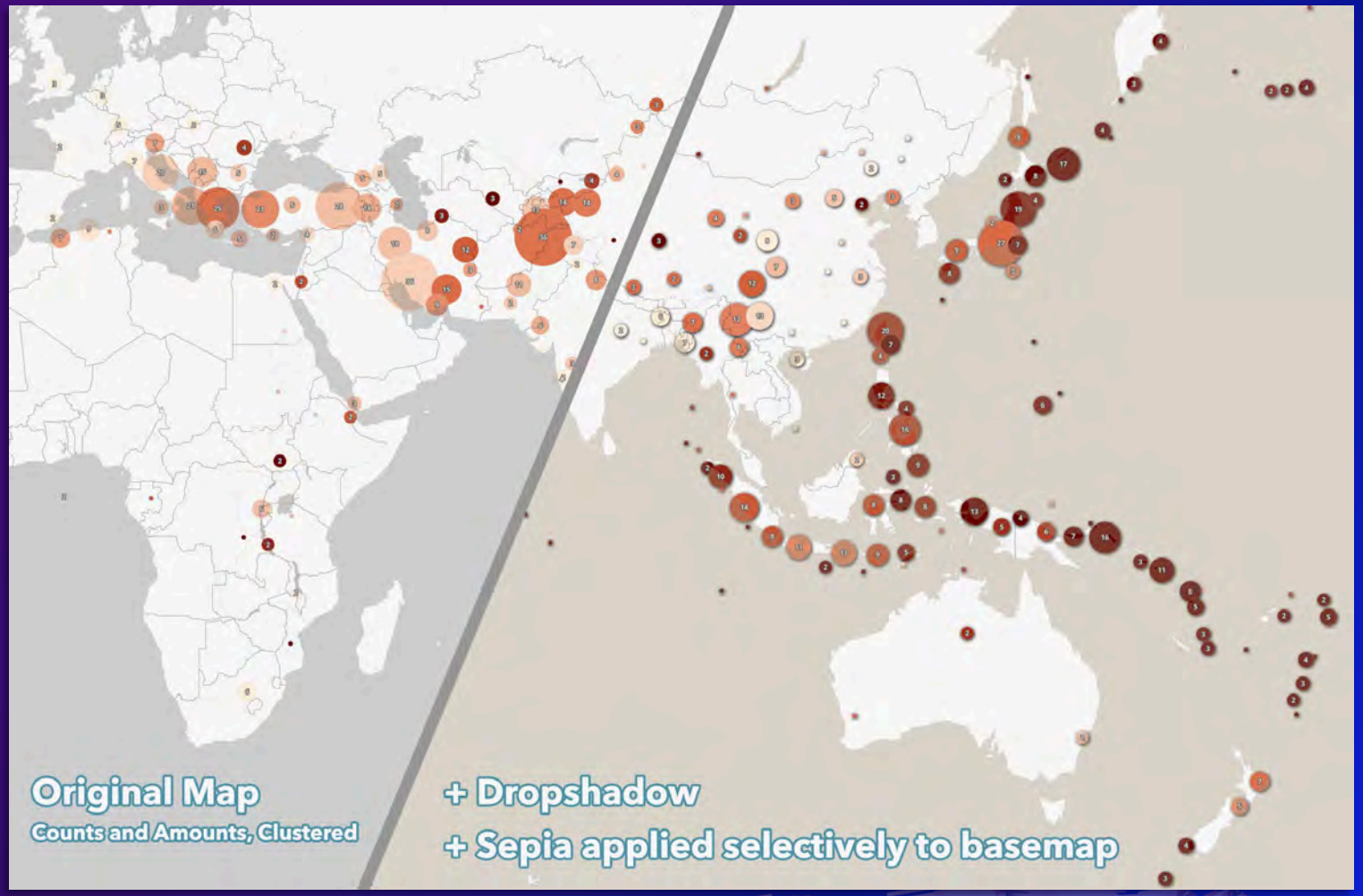
# Examples of Effects Available

## Bloom + Brightness & Contrast



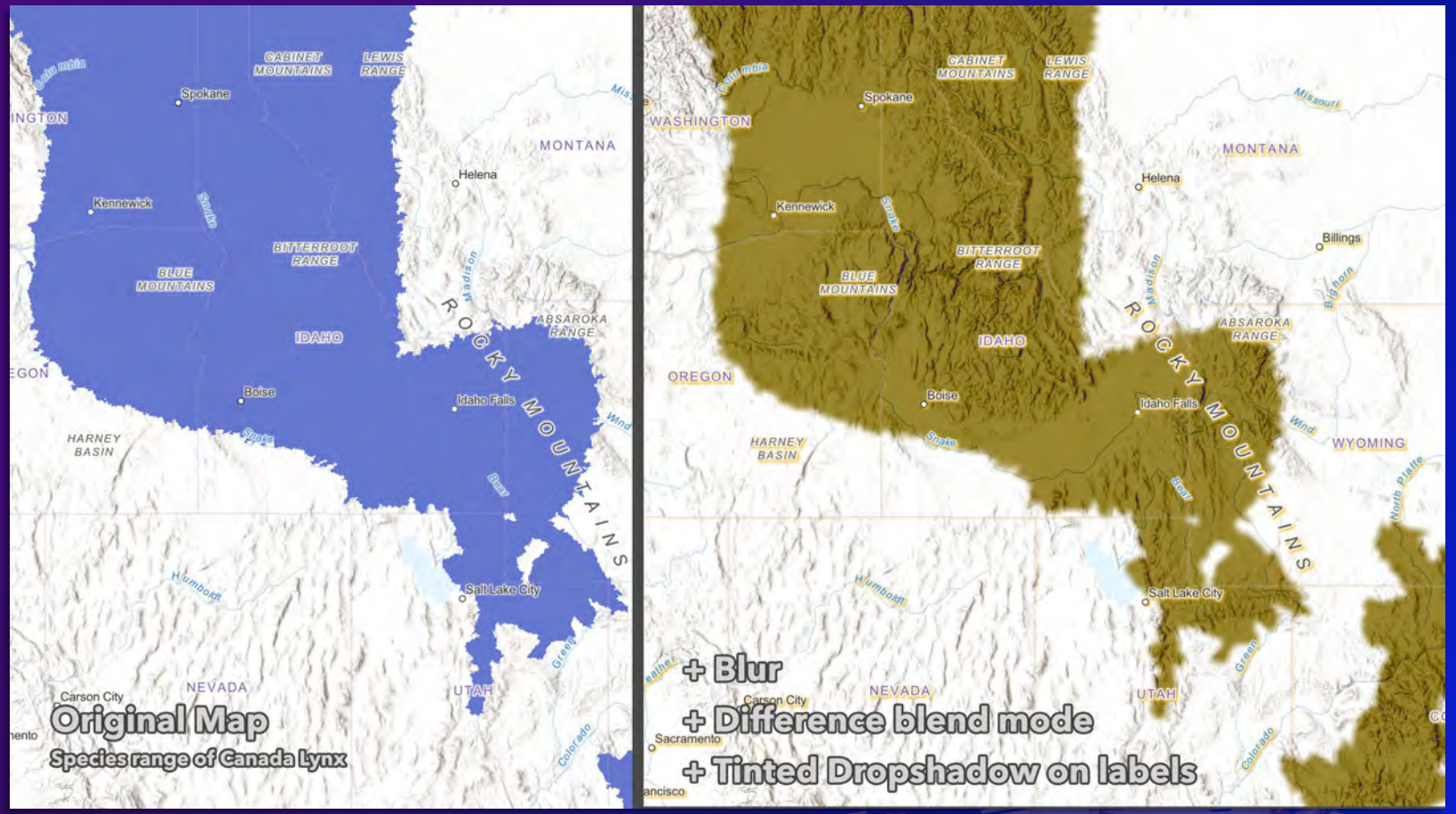
# Examples of Effects Available

## Drop shadow + Sepia



# Examples of Effects Available

## Blur + Blend Mode + Drop Shadow



# Examples of Effects Available

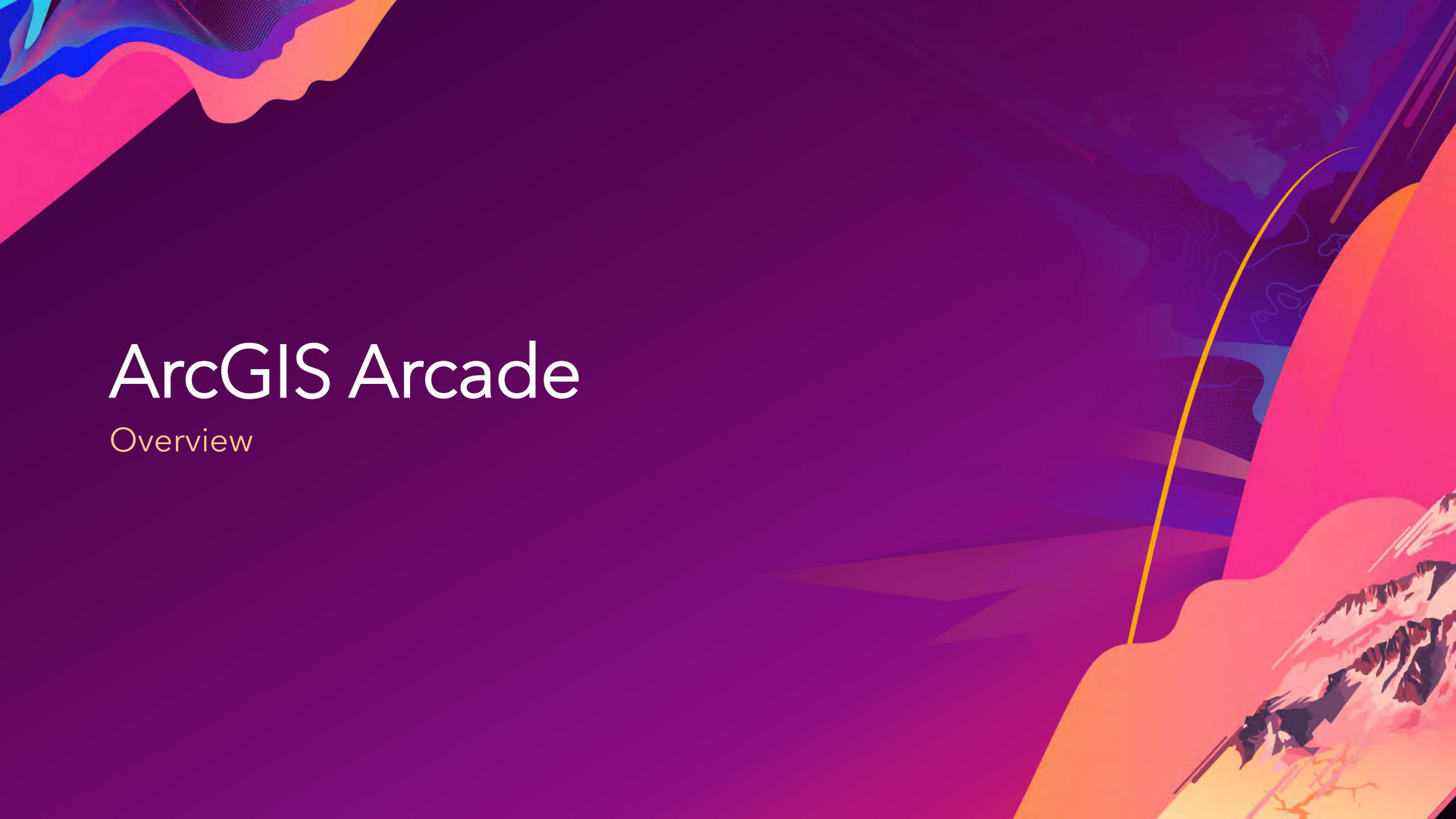
## Sepia + Bloom + Drop Shadow


# Map Viewer

## Effects

# ArcGIS Arcade

Overview



# ArcGIS Arcade

## Overview

- Lightweight expression language for working with your ArcGIS data
- Works across the ArcGIS platform
  - ArcGIS Pro
  - ArcGIS Online
  - Runtime SDKs
  - JavaScript API


# ArcGIS Arcade

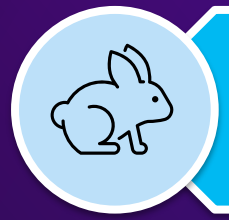
## Overview

### Portable

- expressions work across the platform

### Secure

- expressions do not compromise security



### Lightweight

- scripts and expressions execute quickly

### Geospatial

- treat geospatial data as first class members

# ArcGIS Arcade

## Why use it?

- Easy to get started
  - Forgot to add a field?
  - Used the wrong data type?
  - Don’t own the data?
- On-the-fly calculations
  - Map will stay up to date even if your data changes
- Expressions carry through to your downstream applications (portable)

# ArcGIS Arcade

## Examples

### Simple

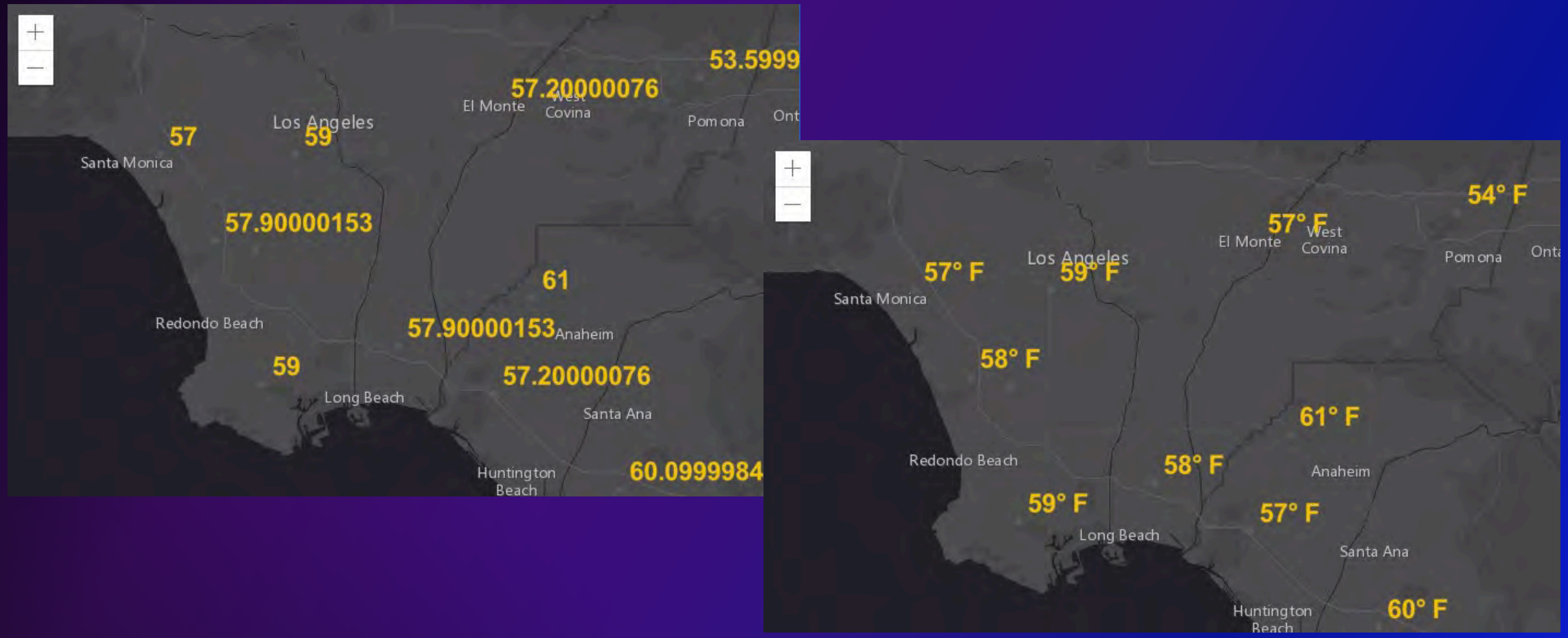
- Combine fields together
- Format existing fields
- Unit conversion
- Rotate symbols
- Improved text labeling

### Add Complexity

- Access related data in your popup
- Perform complex field calculations:
  - An unique index created from multiple fields
  - Render based on geographic relationships (field calculate)
  - Based on spatial relationships

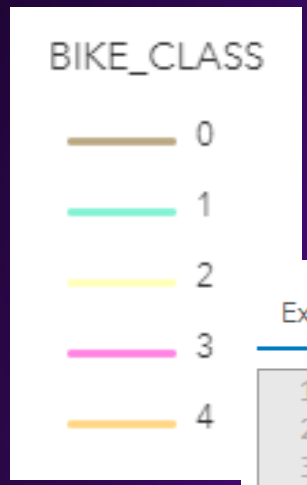
# ArcGIS Arcade

## Examples



# ArcGIS Arcade

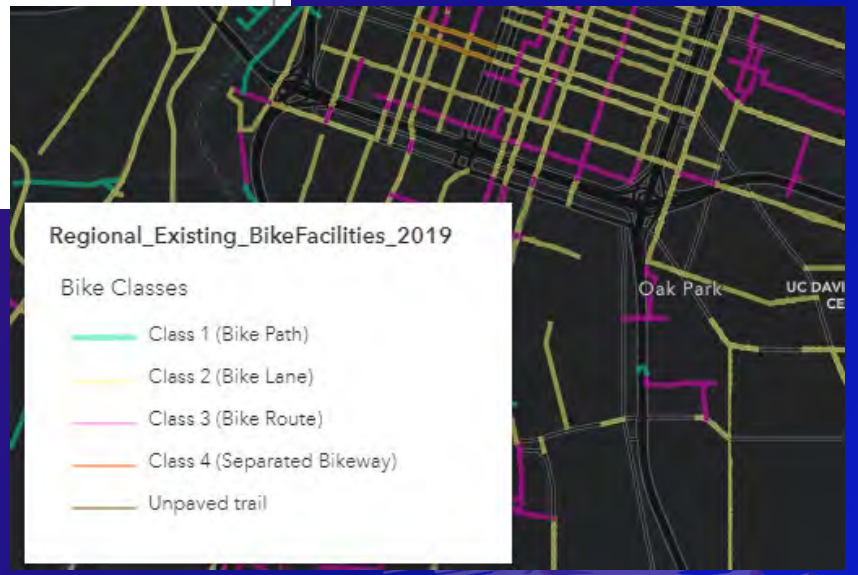
## Examples




Expression

Test

```
var bikeClass = $feature["BIKE_CLASS"]
When(bikeClass == 0, "Unpaved trail",
    bikeClass == 1, "Class 1 (Bike Path)",
    bikeClass == 2, "Class 2 (Bike Lane)",
    bikeClass == 3, "Class 3 (Bike Route)",
    bikeClass == 4, "Class 4 (Separated Bikeway)",
    null)
```



# Arcade

## Polish your app

# Real-time Support for ArcGIS Solutions for Winter Weather

ArcGIS Velocity

# ArcGIS Velocity

## Leverage sensor and IoT data for geospatial reasoning


- *…connects to industry leading cloud IoT platforms, data lakes, and sensor vendor APIs*

# ArcGIS Solutions

## Industry-Specific Maps and Apps

Preconfigured

Tools Workflows

Apps Comprehensive Systems

Maps Data Models

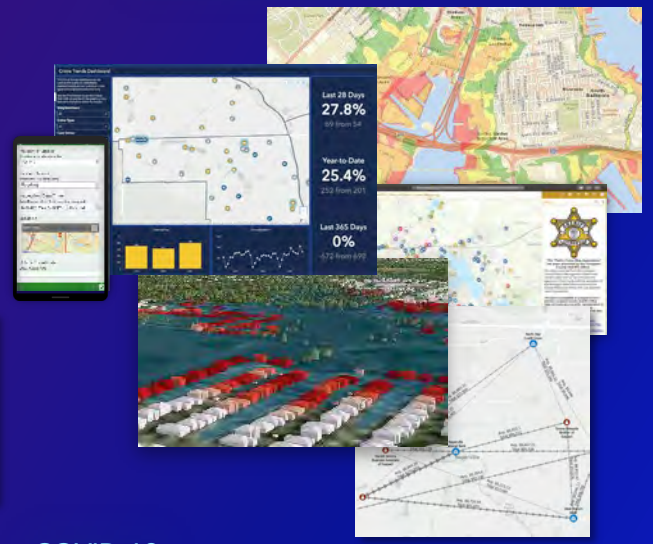
Initiatives

Dashboards

- Extensive (100+)
- Easy to Deploy
- Come with ArcGIS
- Fully Supported

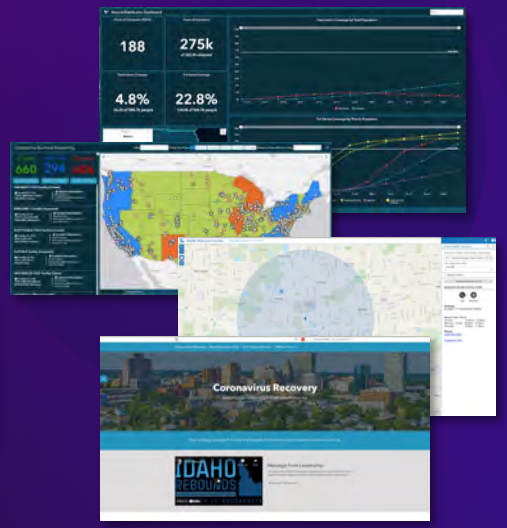
Local & State Government

Emergency Management & Public Safety

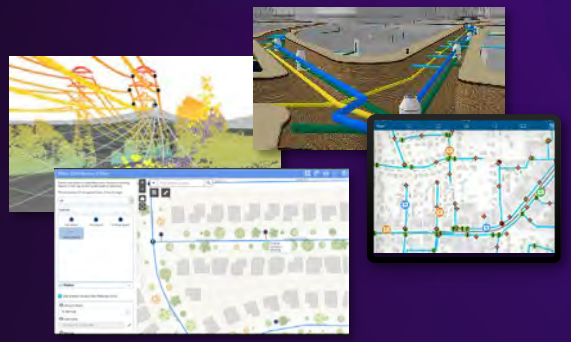


COVID-19

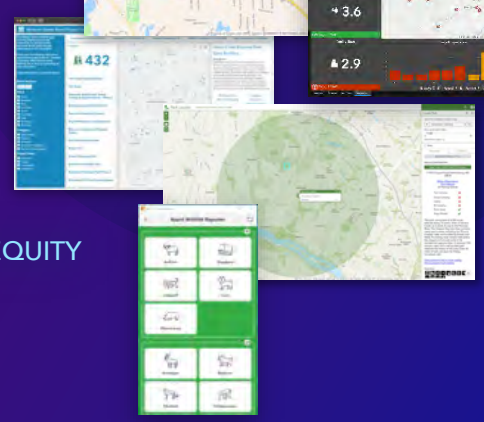
Health & Human Services



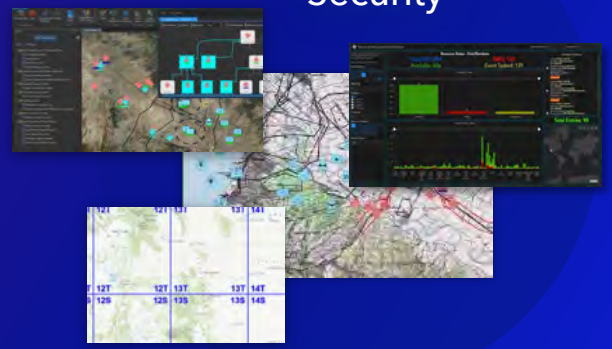

Utilities & Telecom



EQUITY



Defense & Security



*. . . Help Users Quickly Realize Value*


*Understanding where plows have traveled optimizes response activities and clearly communicates what roads have been serviced*

# Challenges

**Over seventy percent of the nation's roads are in snowy regions**

- Severe winter storms are happening more frequently
- Workforce reductions are driving increased use of contract resources
- Planning and response information is siloed
- Real-time information and transparency critical during winter weather response

# Winter Weather Solutions

- Improve winter weather planning
- Streamline winter weather operations
- **Increase transparency and public trust**

# ArcGIS Solutions for Winter Weather

## Focused Maps and Apps

### Winter Weather Operations

Focused workflows supporting operations personnel to improve winter weather planning and streamline operations

### Winter Weather Outreach

Constituent engagement maps and apps to help organizations increase transparency and build public trust

# ArcGIS Solutions for Winter Weather

**Focused Maps and Apps**


# Demo

## ArcGIS Solutions for Winter Weather

# ArcGIS Solutions for Winter Weather

## Recap

- Improve winter weather planning
  - Manage authoritative inventory of routes, restrictions and vehicles
  - Define winter weather events
- Streamline winter weather operations
  - Report materials used by each vehicle
  - Record current vehicle location and service status
  - Monitor snow operations and manage service requests
  - Review response activities and adapt response plans
- Increase transparency and public trust
  - Share winter weather plans, routes and restrictions
  - Communicate near real-time road status during winter weather events
  - Solicit winter weather service requests

# AI in ArcGIS

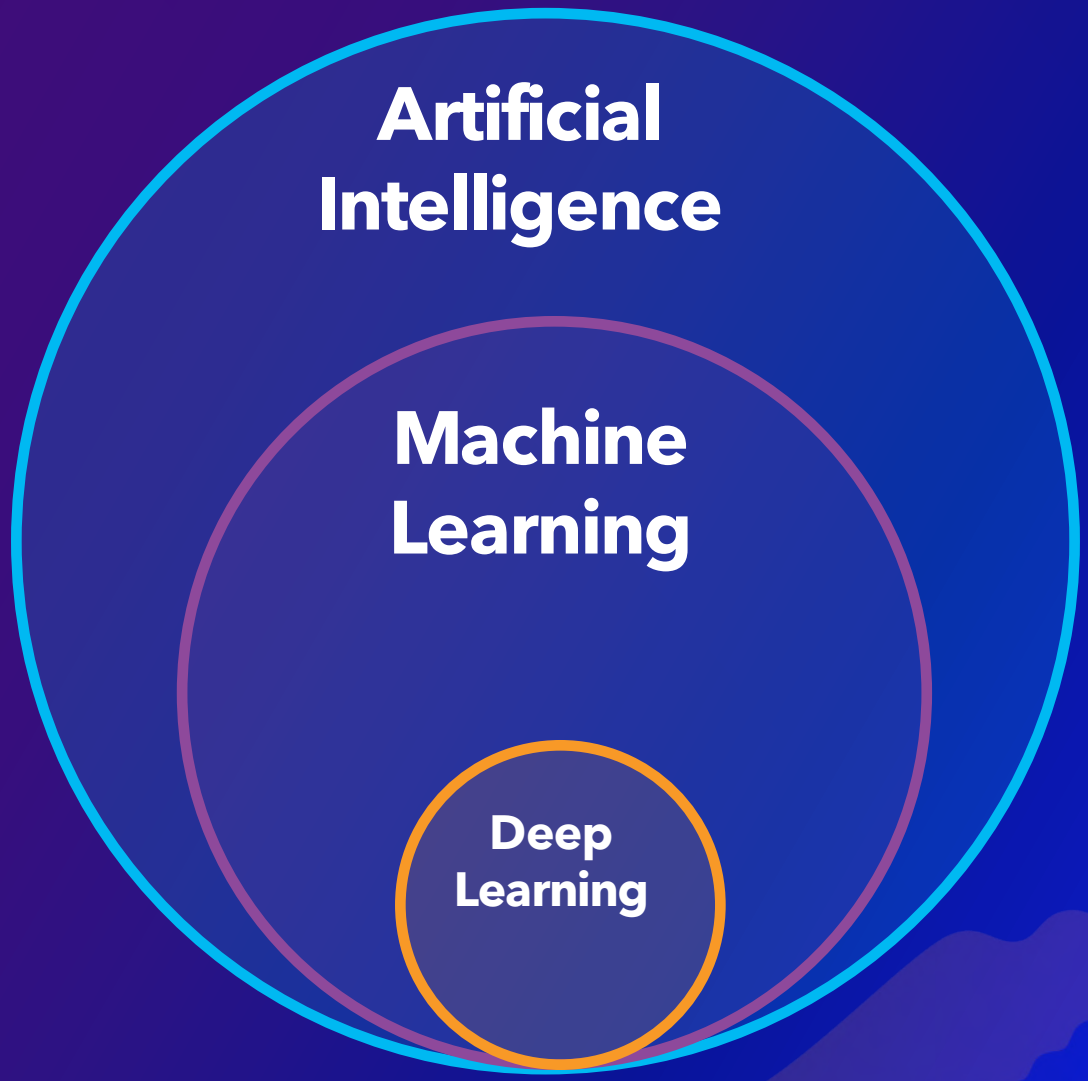
# What Is AI?

**Summary:**

Really, **machine learning (ML)**

**Machine learning** is about extracting patterns from data to derive rules, instead of these rules being explicitly programmed.

**Deep learning** is a type of ML using deep neural networks to find complex patterns especially in unstructured data (such as images, text, voice, and lidar).



AI is not one product. It spans ArcGIS.

Where we offer machine learning integration.

ArcGIS API for Python

ArcGIS Velocity

ArcGIS Notebooks

ArcGIS Pro

ArcGIS Online

ArcGIS Enterprise

ArcGIS Hub - Citizen Data Science

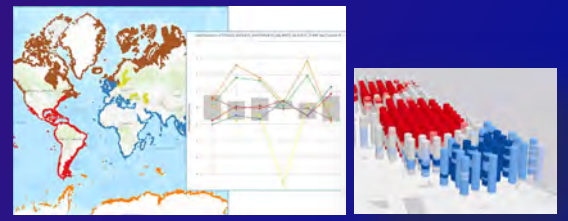
ArcGIS QuickCapture - Edge AI (in R&D)

ArcGIS Insights

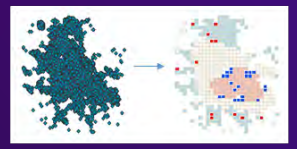
# What Can Machine Learning Do?

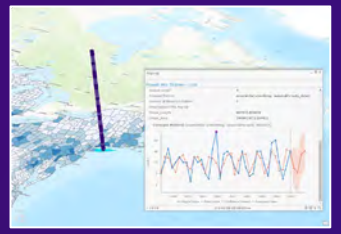
Extract features from imagery & lidar

Make predictions

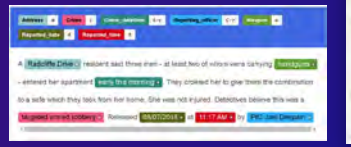


Find patterns & clusters



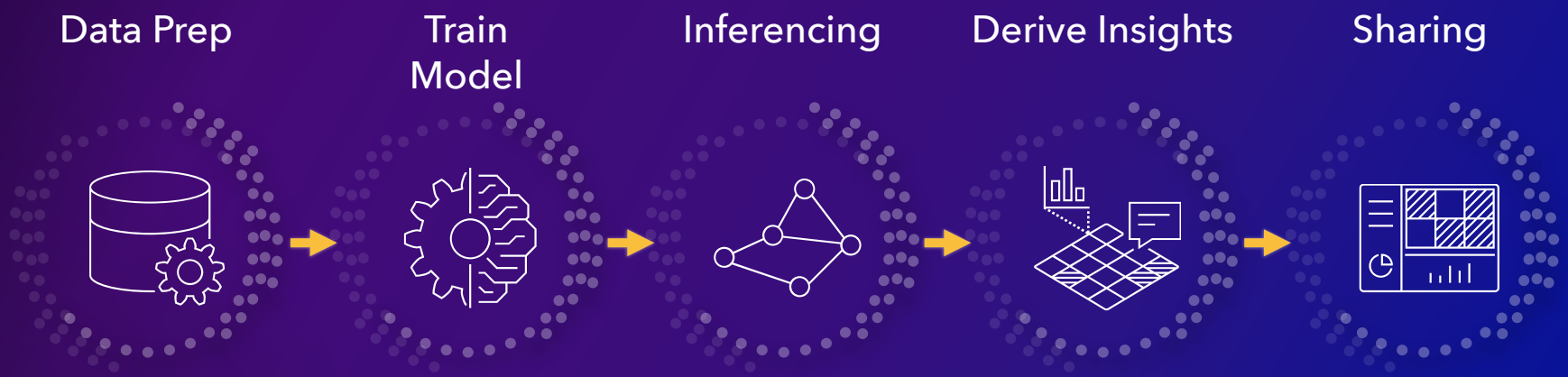


Detect anomalies



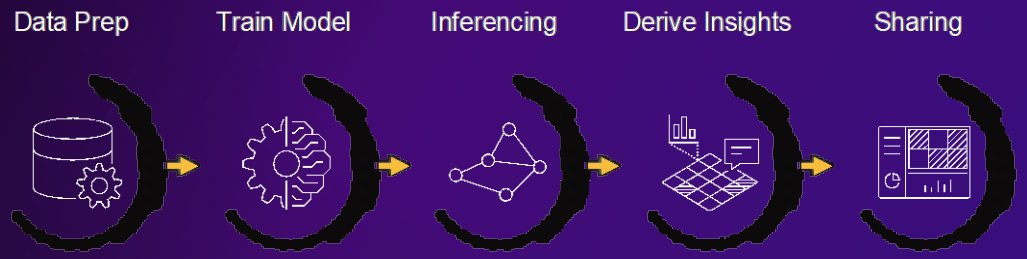
Extract insights from unstructured text

# Machine Learning Lifecycle



# Where Is AI in ArcGIS?

## 1. Tools for AI Workflows




### Code-less Experience

ArcGIS Pro

Spatial Analyst

Image Analyst

3D Analyst

### Code-first Experience

ArcGIS Notebooks

Python API

## 2. AI-Infused Capabilities

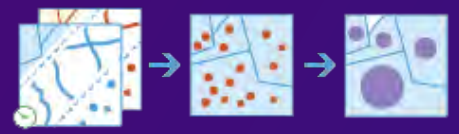

Tree extraction in 3D basemaps

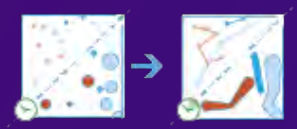
Offline inference in ArcGIS Survey123

# Machine Learning Tools in ArcGIS

## Classification

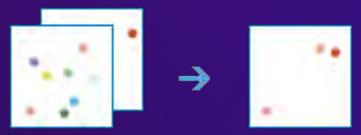
- Maximum Likelihood Classification
- Random Trees
- Support Vector Machine





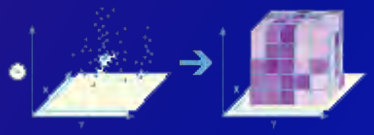
## Clustering

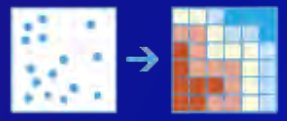
- Spatially Constrained Multivariate Clustering
- Multivariate Clustering
- Density-based Clustering
- Image Segmentation
- Hot Spot Analysis
- Cluster and Outlier Analysis
- Space Time Pattern Mining

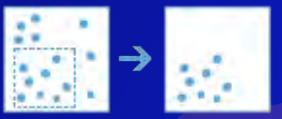


## Prediction

- Empirical Bayesian Kriging
- Areal Interpolation
- EBK Regression Prediction
- Ordinary Least Squares Regression and Exploratory Regression
- Geographically Weighted Regression
- Forest Based Prediction
- Time Series Forecasting





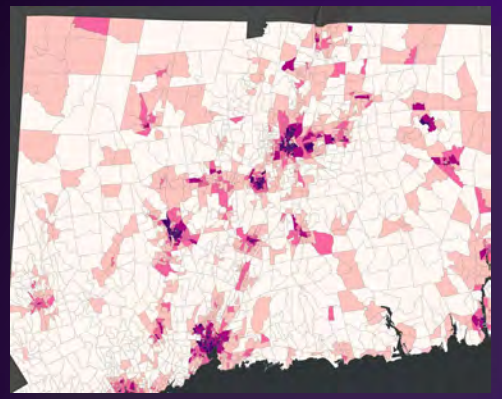


# What Workflows Can These Tools Enable?

# 1. Predictive Analytics

Prepare Data, Make Predictions, Find Correlations, Understand Top Variables, and More

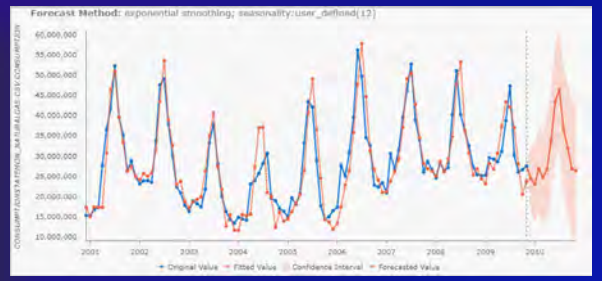
Predicting asthma rates



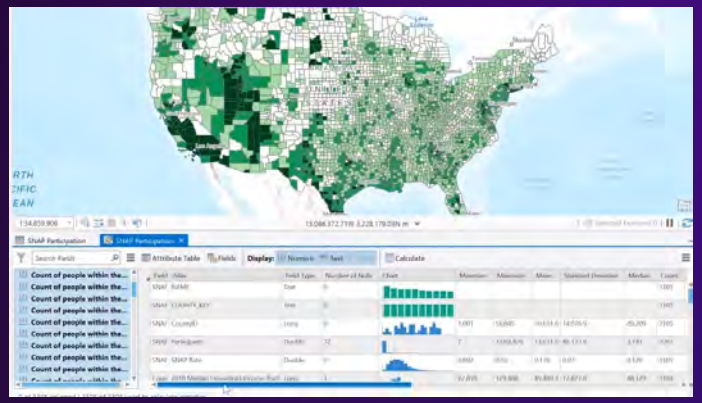
Predicting house pricing

Predicting sea habitat

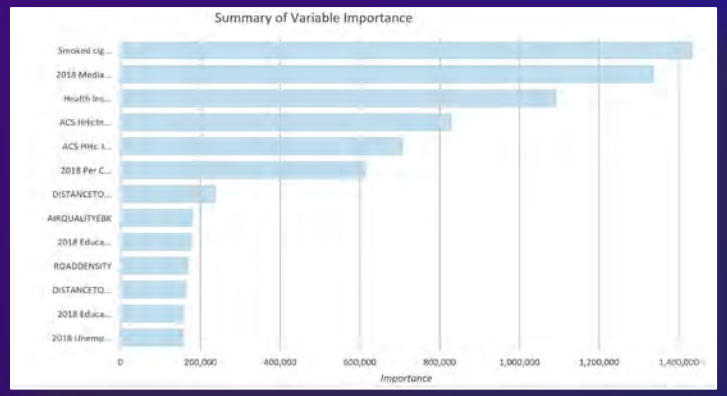

Time series forecasting



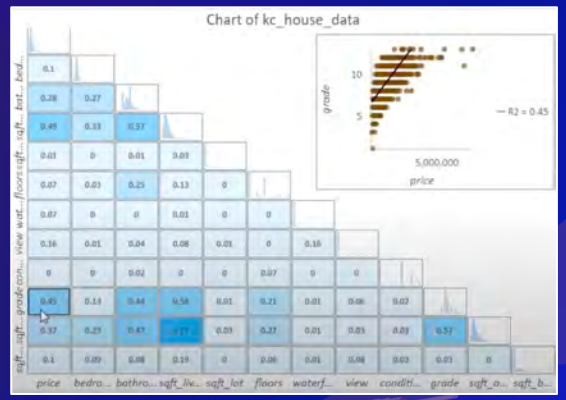
Data engineering



Variable importance

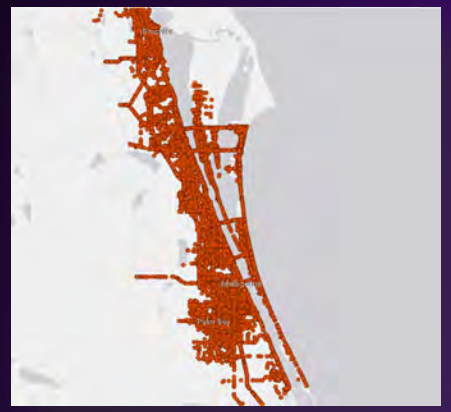


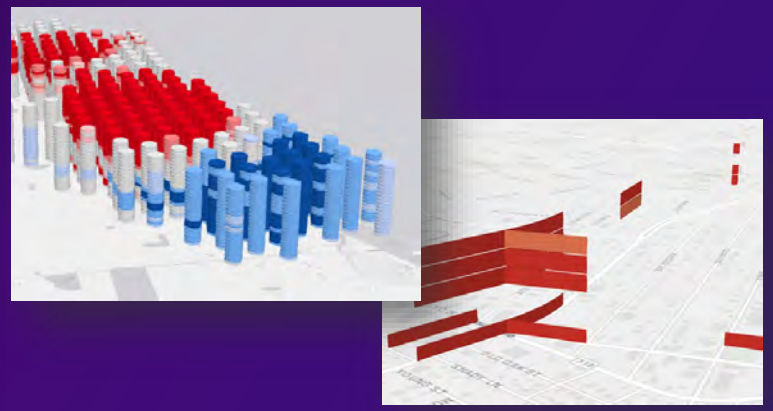

Variable correlation



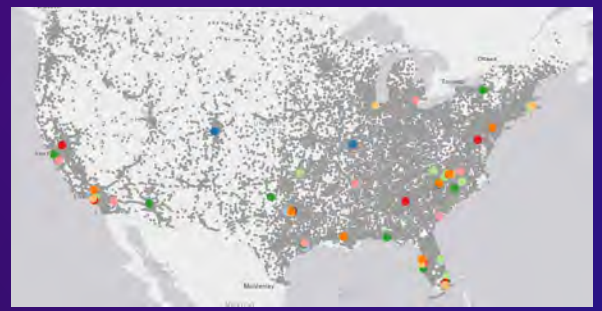
# 2. Pattern Mining and Clustering

## Understand Natural Groupings in Data That Are Statistically Significant

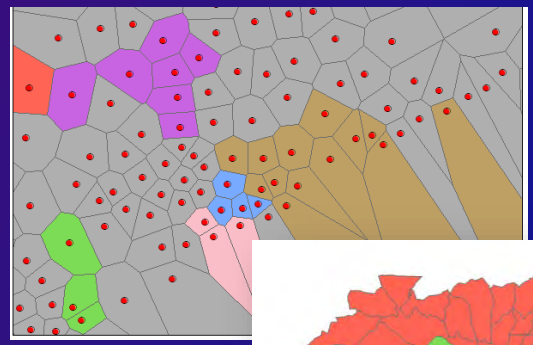


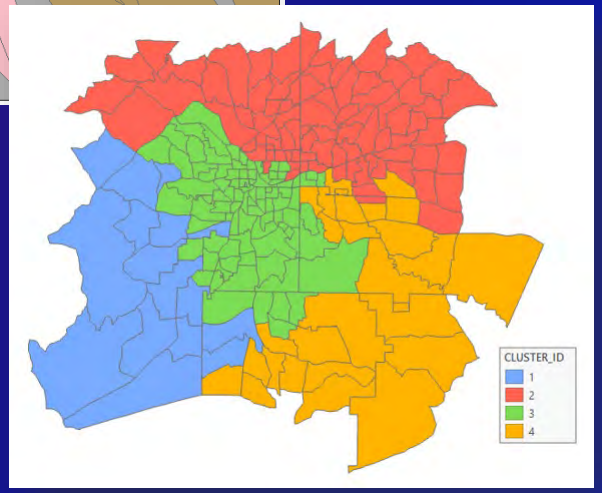


Emerging and fading hotspots for Crashes using **SpaceTime Pattern Mining Toolbox**



Most important fatal crashes clusters using **Density Based Clustering (DBScan)**



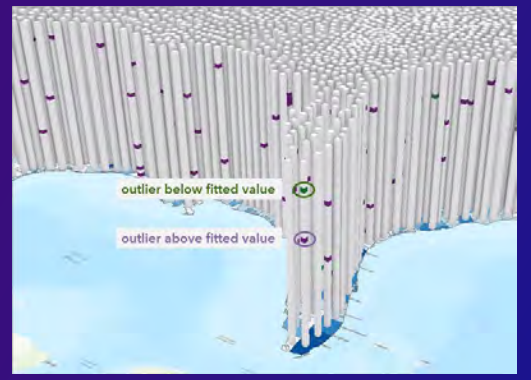



Find spatially contiguous clusters for animal territories using **Spatially Constrained Multivariate Clustering**

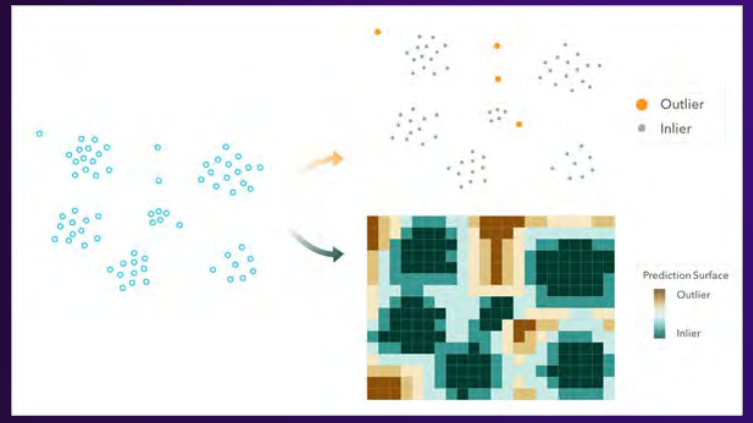
# 3. Anomaly Detection

## Spatial, Temporal, and Spatiotemporal Outliers

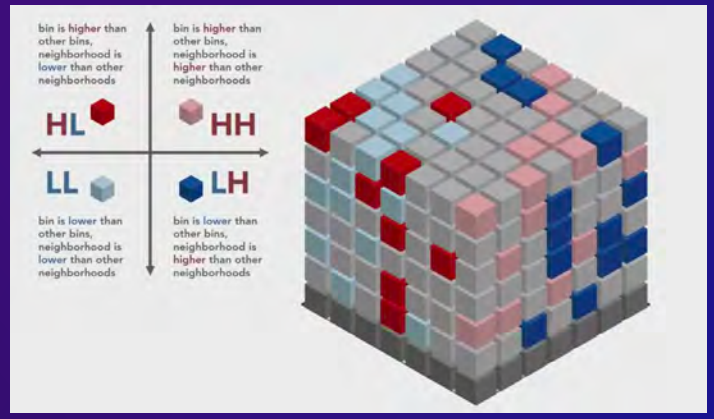
### Time series outliers (temporal)

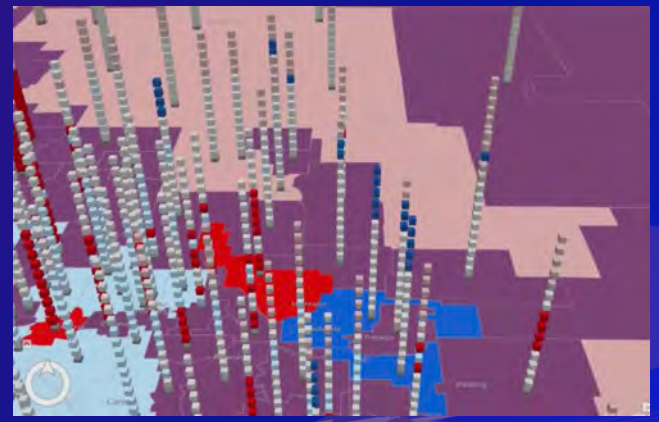




### Spatial outliers (spatial)




### Local outlier analysis (spatiotemporal)



# 4. Object Detection, Pixel Classification, Object Classification, Tracking, and More

Damaged structures

Building footprints

Land cover

Pipeline encroachment

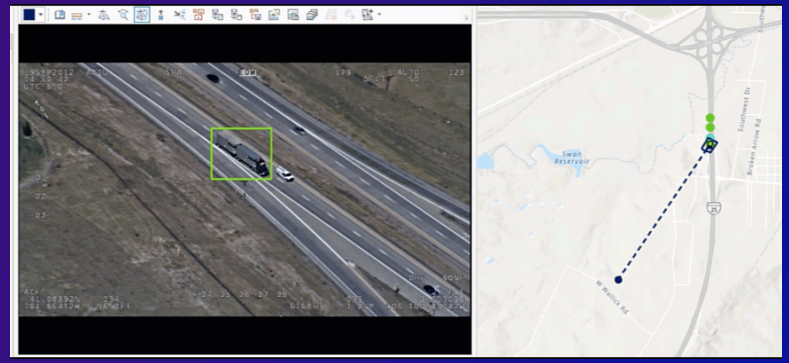
Palm trees

Roads

Oil pads

Road cracks

Tracking in FMV



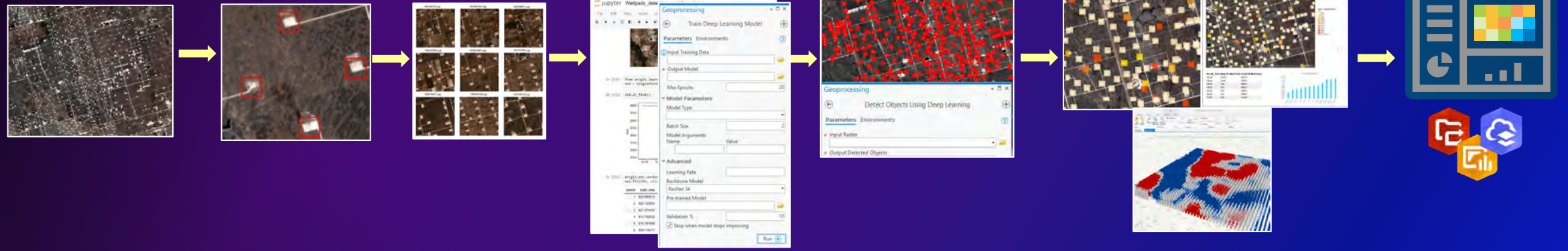
Swimming pools

Parcel (edge) detection

# Imagery AI: End-to-End Workflow

Extract Insights from Imagery at Scale, with High Speed and Accuracy

Image management → Labelling → Data prep → Model training → Inferencing → Analysis → Field mobility, monitoring




## For Wide Range of Data Types

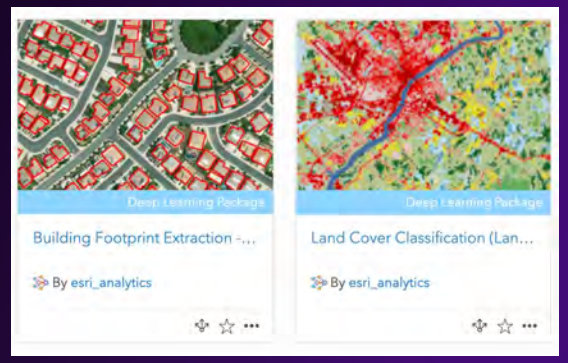
- Aerial
- Satellite
- Radar
- Lidar
- Motion imagery
- Bathymetry
- Point cloud
- Drone

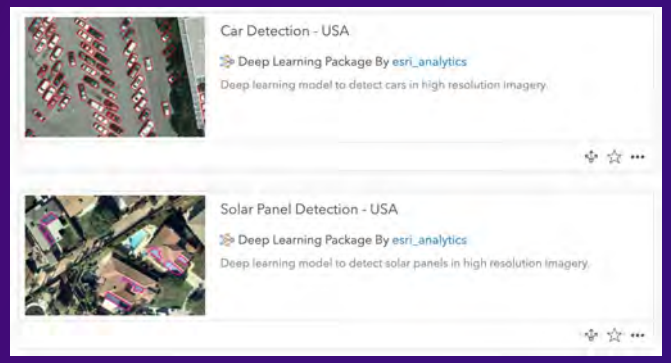
## Implementing Many Tasks

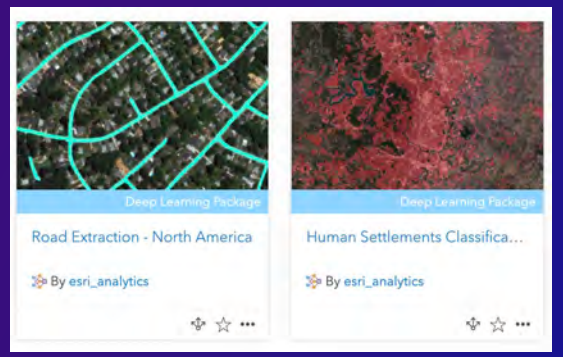
- Object classification
- Object detection
- Pixel classification
- Image translation
- Object tracking
- Scanned maps

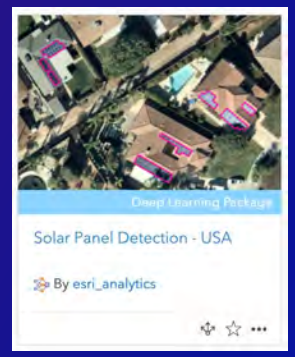
# Pre-trained Models on ArcGIS Living Atlas

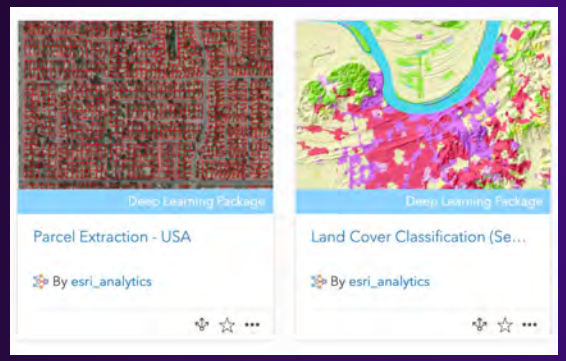
Plug-and-Play Models. No Training Needed. Easy Re-training Using Local Data.

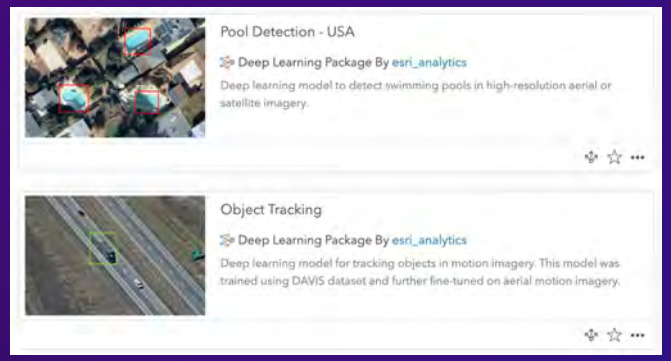



## Use Models Within

- ArcGIS Pro (+ Image Analyst Extension)
- ArcGIS Enterprise (+ Image Server)
- ArcGIS Online (+ ArcGIS Image)

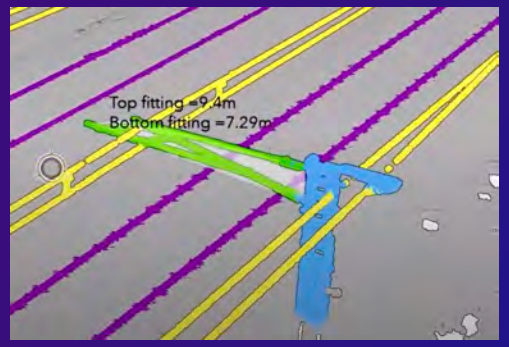
# Feature Extraction from Lidar

Data Pre-processing, Labelling, Training, and Inference

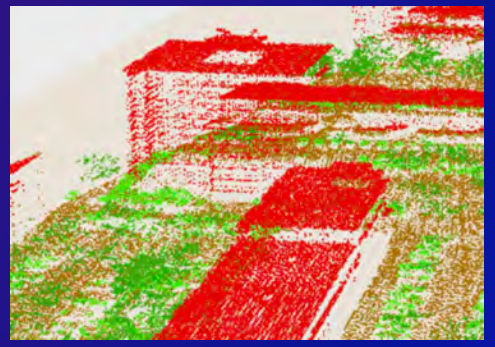
## Utility poles and lines

## Encroachments and trees

## Rail assets

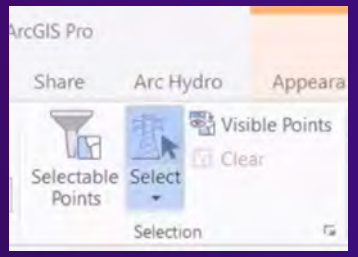



## Buildings

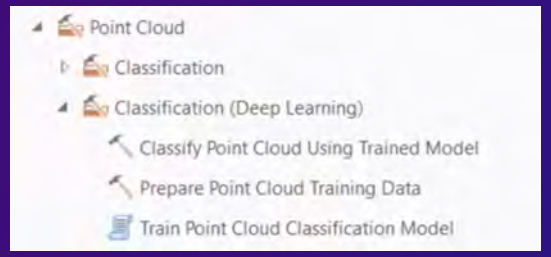


## Streetlights

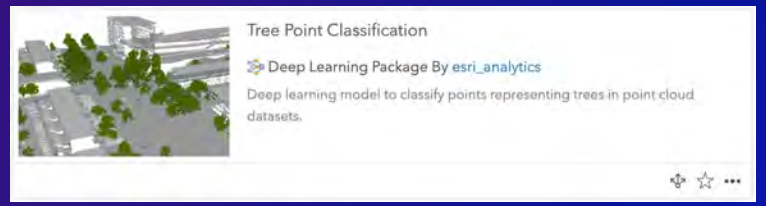
## Labelling tools

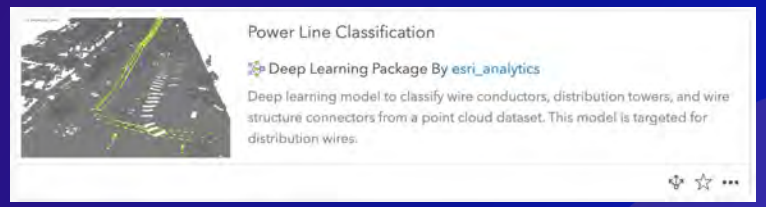



## Training and inference tools




## Pre-trained models (ArcGIS Living Atlas)



# ArcGIS.Learn

Python-first Approach for Machine Learning Workflows. Part of ArcGIS API for Python.


**Train SingleShotDetector Model**

```
from arcgis.learn import SingleShotDetector

ssd = SingleShotDetector(data, grids=[9], zooms=[1.0], ratios=[[1.0, 1.0]])
```

```
In [8]: ssd.fit(10, lr=slice(1e-3, 1e-2))
```

Total time: 15:56

| epoch | train_loss | valid_loss |
|---|---|---|
| 1 | 629.015869 | 250.982254 |
| 2 | 400.904327 | 181.745972 |
| 3 | 315.588318 | 163.946136 |
| 4 | 268.519928 | 155.258881 |
| 5 | 234.541077 | 133.495728 |
| 6 | 209.463257 | 116.552231 |
| 7 | 189.608063 | 104.452789 |
| 8 | 172.239929 | 98.530197 |
| 9 | 157.103226 | 91.969261 |
| 10 | 146.046310 | 91.620415 |

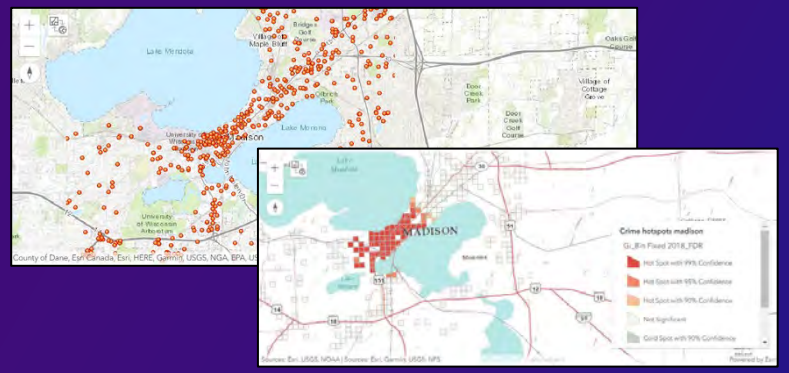
# 5. Extract Insights from Unstructured Text

Extract Entities, Classify Text, Translate StoryMaps, and More

## Extracting entities and relationships from text reports

Address a | Crime c | Crime_datetime c-c | Reporting_officer c-r | Weapon w | Reported_date d | Reported_time t

A Radcliffe Drive × resident said three men - at least two of whom were carrying handguns × - entered her apartment early this morning ×. They ordered her to give them the combination to a safe which they took from her home. She was not injured. Detectives believe this was a targeted armed robbery ×. Released 08/07/2018 × at 11:17 AM × by PIO Joel Despain ×




## Classifying country of incomplete addresses

| Address | Country |
|---|---|
| 40, Rue Eugene Delacroix, Seloncourt, 25230 | FR |
| 736, E AMOROSO PL, 90291 | US |
| 15127, CALLE EDGAR ALÁN POE, CHIHUAHUA, Chihuahua, Chihuahua | MX |
| 25376, COSTEAU ST, LAGUNA HILLS, CA | US |
| 1-6, 一乗寺堀ノ内町 | JP |
| 3701-1, 飯香浦町 | JP |
| 30, CL CARMEN AMAYA, 39011 | ES |
| NW21-17-23W | CA |
| 8140, avenue Belges | CA |
| 80, WURUNDJERI BOULEVARD, BERWICK, VIC, 3806 | AU |

## Translate StoryMaps


## Correct and normalize mistyped street addresses

| MISTYPED NON-STANDARD ADDRESS | NORMALIZED ADDRESS |
|---|---|
| 940, NORTH PENNSYLVANIA AVNEUE, MASON ICTY, IOWA 50401 | 940, N PENNSYLVANIA AVE, MASON CITY, IA 50401 |
| 220, SOYTH RHODEISLAND AVENUE, MASON CITY, IOWA 50401 | 220, S RHODE ISLAND AVE, MASON CITY, IA 50401 |

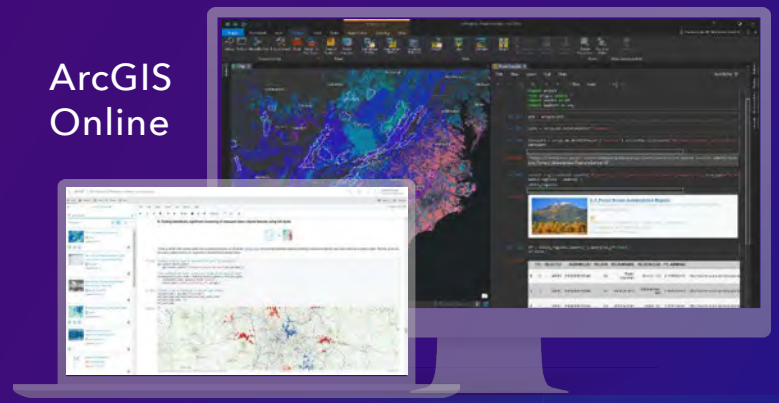
# ArcGIS Notebooks

Spatial Analysis Meets Open Data Science

ArcGIS Notebooks

ArcGIS Pro

ArcGIS Online



Enterprise

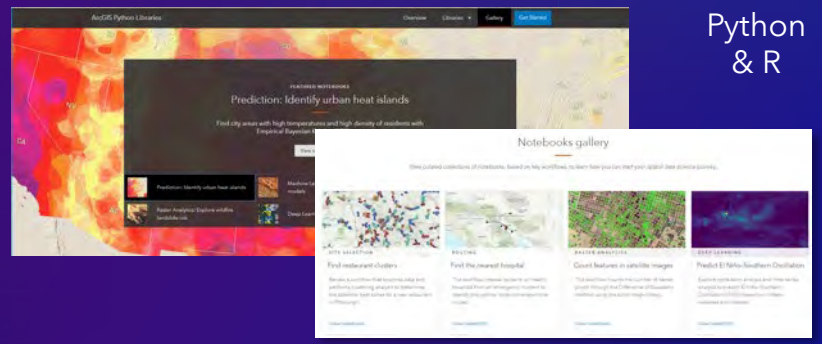
Specialized Server
Extensible

Pro

Integrated
Easy - No Setup

Online

Available as
an Extension




Python
& R


Open Source
Data Science Ecosystem

Includes ArcGIS Python Libraries and
100s of Open Science Libraries

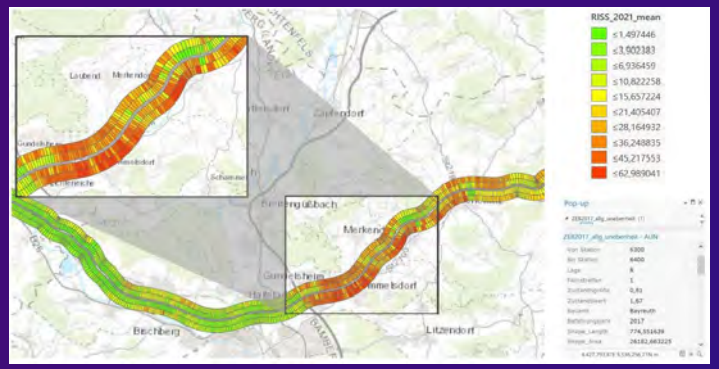
Notebook
Gallery

*Scripting Processes and Workflows*

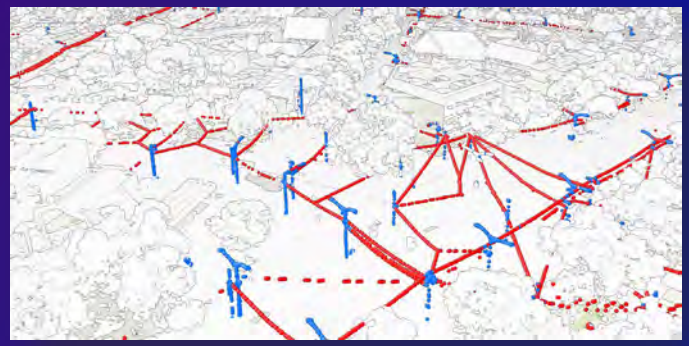
# Success Stories

Kuwait PACI Automates Country Map Production 17X Faster

Bavaria Forecasts Road Deterioration using Machine Learning

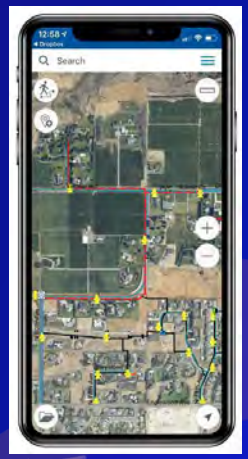



Australian Utility Saves 50,000 Man Hours by Automating Asset Extraction from Lidar



USAA Automates Damage Claims Processing using Imagery AI


Nob Hill Water Association Predicts Water Main Failures with Machine Learning



# Resources

**GeoAI Blog**

Medium.com/geoai

**GeoAI Demos**

landing-geoai.hub.arcgis.com/

**Sample Notebooks**

developers.arcgis.com/python/sample-notebooks/

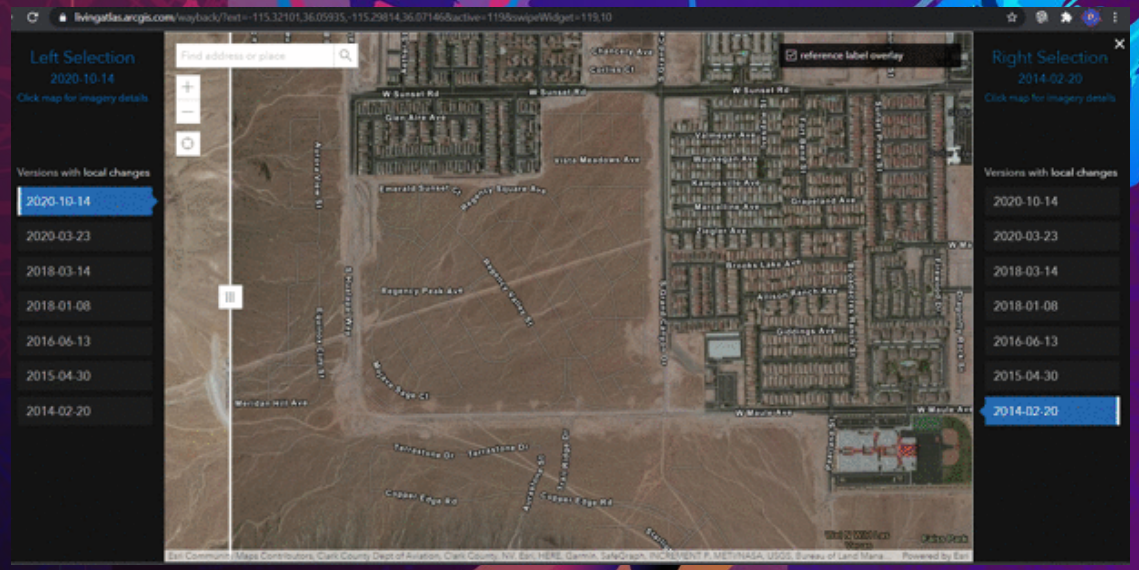
**Spatial Data Science MOOC**

bit.ly/3zUCOZy

**Spatial Statistics Page**

spatialstats.github.io/

***Got any questions?***
*Feel free to contact*
*Omar Maher (omaher@esri.com)*




# Demo

## Change Detection