



# ArcGIS Pro: Advanced Analysis and Geoprocessing

Drew Flater and Jian Lange

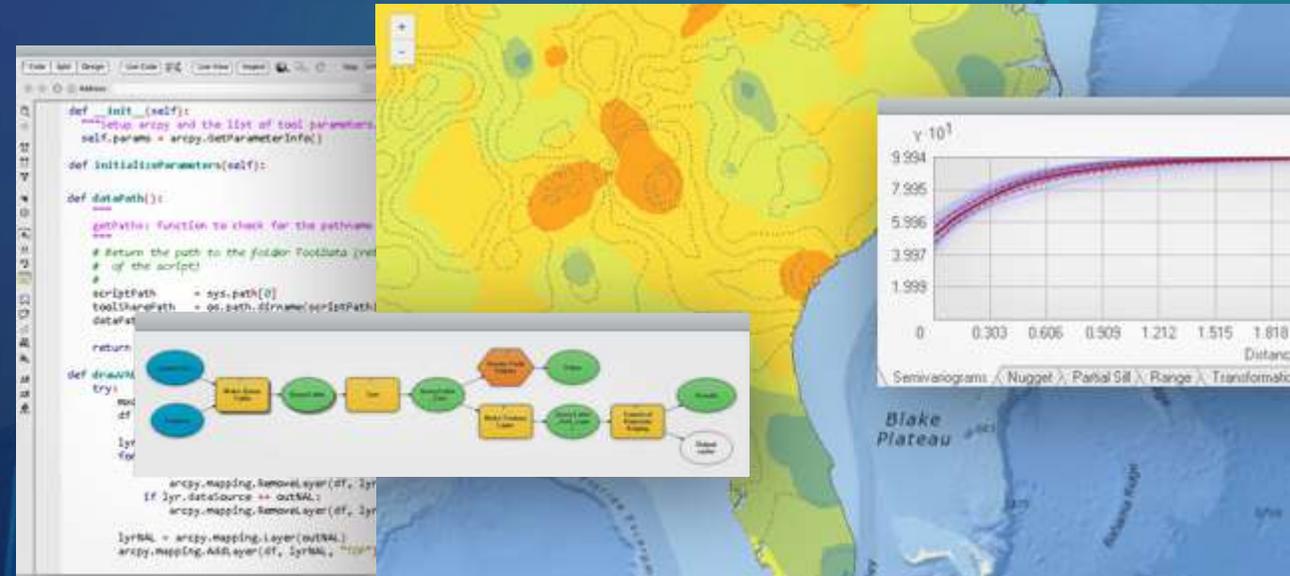
An abstract graphic on the right side of the slide features various geometric shapes in shades of blue, orange, and green. A prominent orange rectangular box contains the text 'GIS INSPIRING WHAT'S NEXT' in white, uppercase, sans-serif font. The background of the graphic includes a stylized topographic map with contour lines and a cluster of small orange dots.

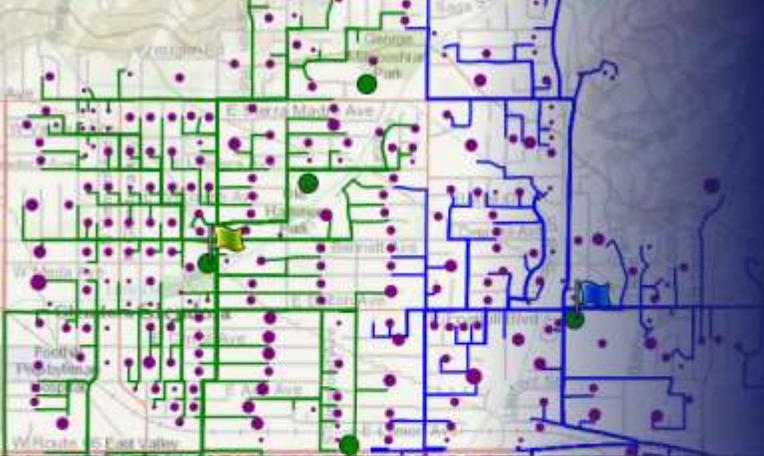
GIS  
INSPIRING  
WHAT'S  
NEXT

# What is analysis?

Analysis transforms raw data into information or knowledge

***Spatial analysis*** does this for geographic or spatial data





Who? What? **Where?** When? Why?

Spatial analysis is used to answer questions with a *where* component

Where is the most accessible location for a new community center?

Where is an area with statistically high crime rates?

Where has the landscape changed the most in the last 10 years?

# What is geoprocessing?

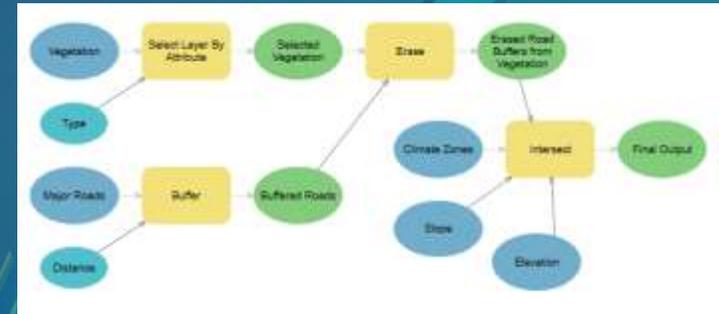
**Geoprocessing** is a rich suite of tools for **processing geographic data**  
Analysis + Data Management + Conversion + More

A typical geoprocessing tool processes input data and produces an output

For example, Buffer a map layer to create proximity areas around the layer's features



Geoprocessing is also a framework you can use to model and automate processes using ModelBuilder or Python scripts



# Analysis in ArcGIS Pro

ArcGIS Pro provides incredible analysis capabilities in 2D, 3D, and 4D (time)

Scalable 64-bit execution, non-blocking threading, 60 parallel tools, and improved viz

The *Analysis* ribbon tab provides access to

Gallery of commonly-used tools

Suite of all 1000+ geoprocessing tools

ArcGIS Enterprise and Online analysis tools

Geoprocessing History

Python command line

ModelBuilder

Network Analysis

Geostatistical modeling

Raster Functions

Data Interoperability Workbench



# Geoprocessing in ArcGIS Pro

Rich user experience driven through the Geoprocessing pane

Search for tools or explore Toolboxes

Open tools and set parameter and environment settings

Run the tool and track progress

View recently run tools and history

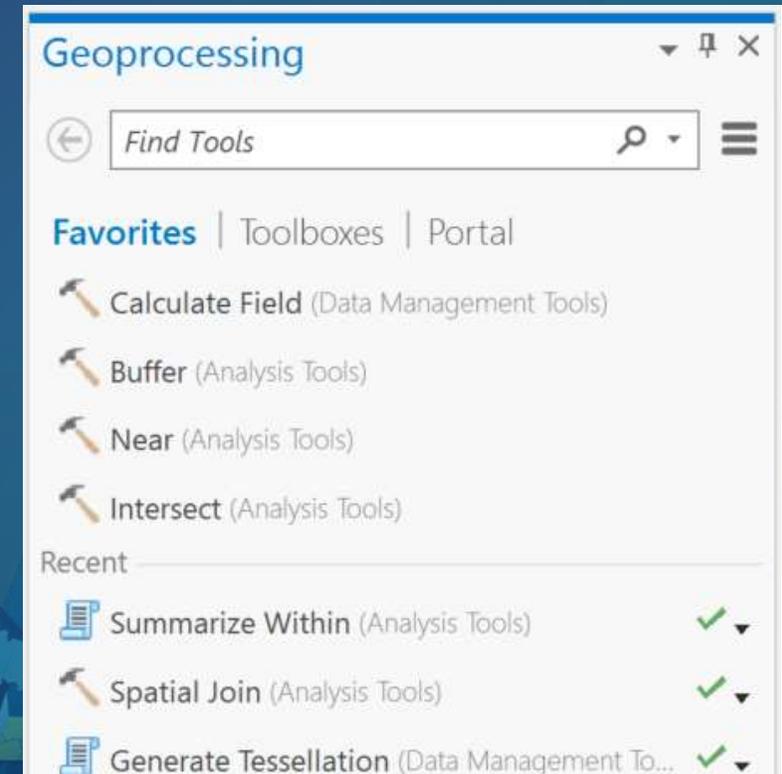
Supports most\* tools, models, and Python scripts that work in ArcMap; [esriurl.com/MissingTools](http://esriurl.com/MissingTools)

\*ArcObjects-based custom tools are not supported

Supports traditional feature and raster data sources as well as web layers

History provides a log of all tools you run

Share as a geoprocessing package or web tool

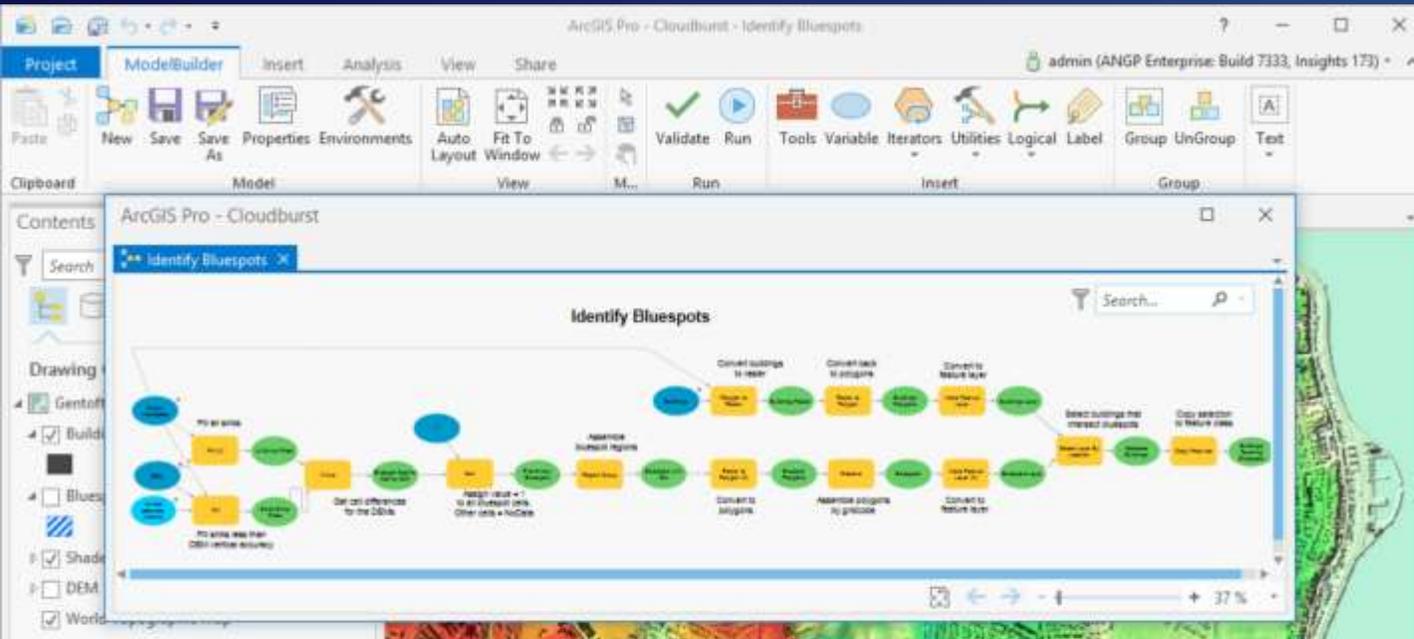
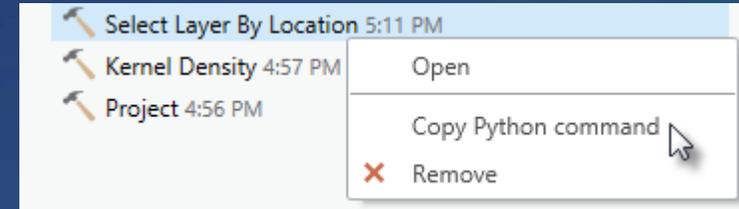


# Model or script a geoprocessing workflow

Automate geoprocessing in a Python script

To get started, run the tool in Pro, then  
*Copy Python command* and paste into script

```
arcpy.Buffer_analysis(input, output, "10 Miles")
```



Build a model of your workflow  
using ModelBuilder

Connect tools and data to  
make a diagram that  
represents your workflow

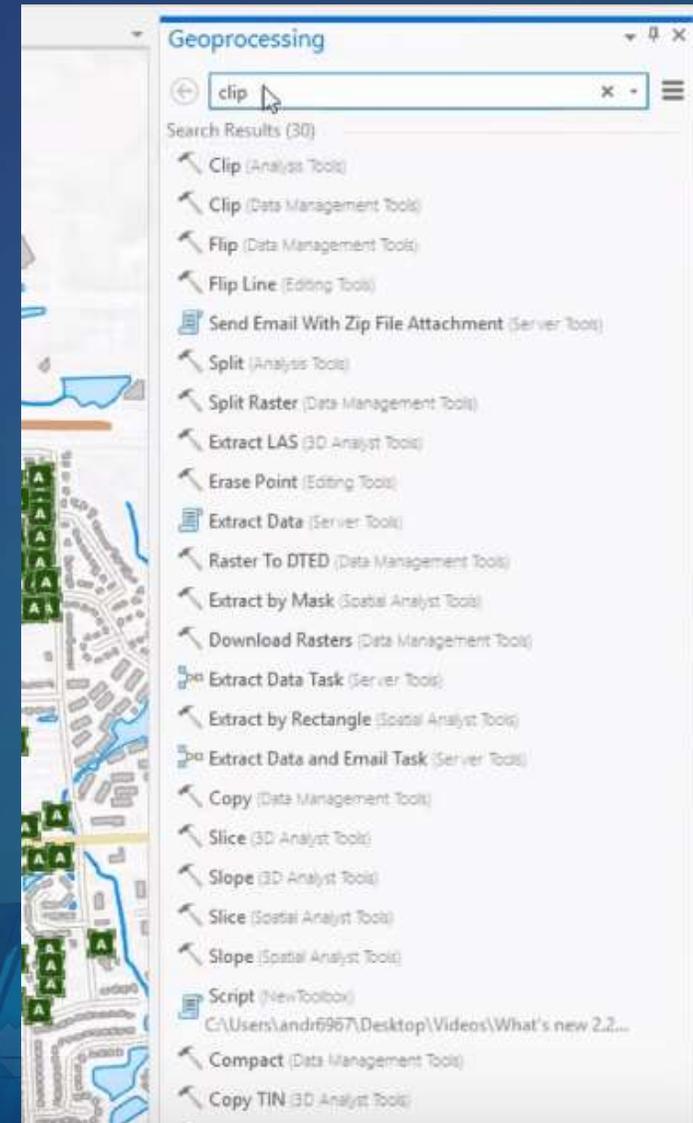
# Batch Geoprocessing

**Allows you to run the tool multiple times using many input datasets or different parameter settings**

Makes it possible to run a given tool as many times as needed with very little interaction

**For example, you can run the batch Clip tool to clip several layers to the same study area**

**Builds a model in the background so you can learn and extend your batch process**



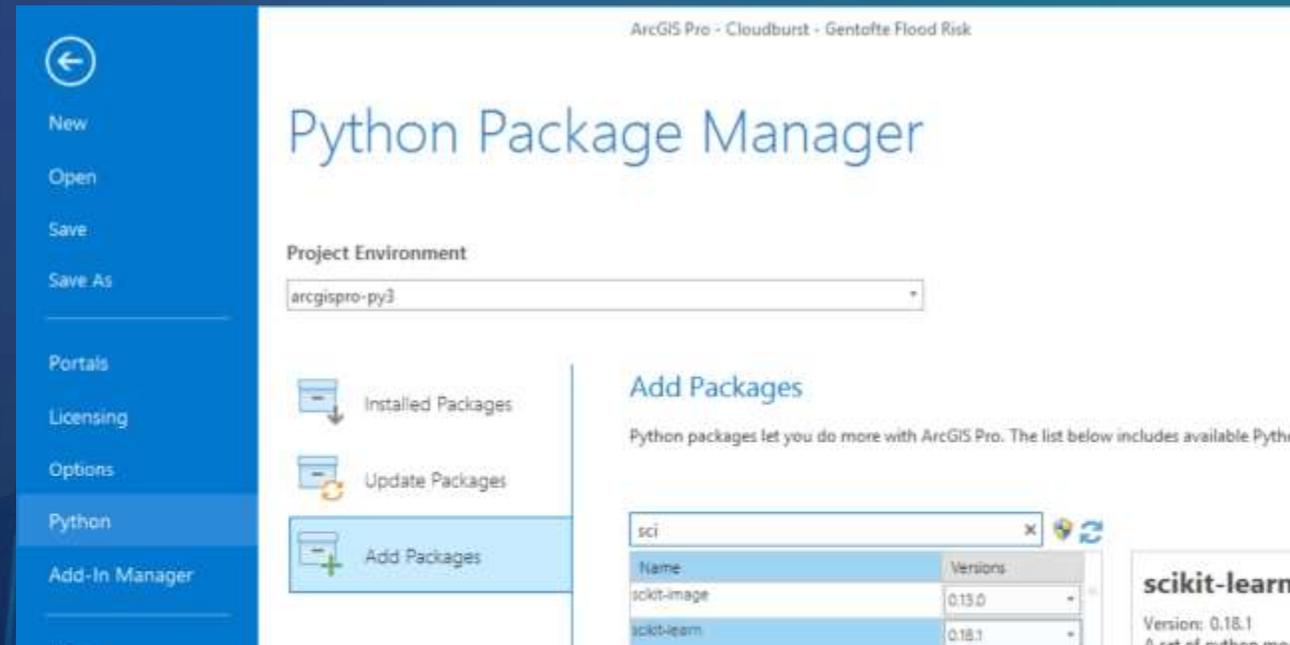
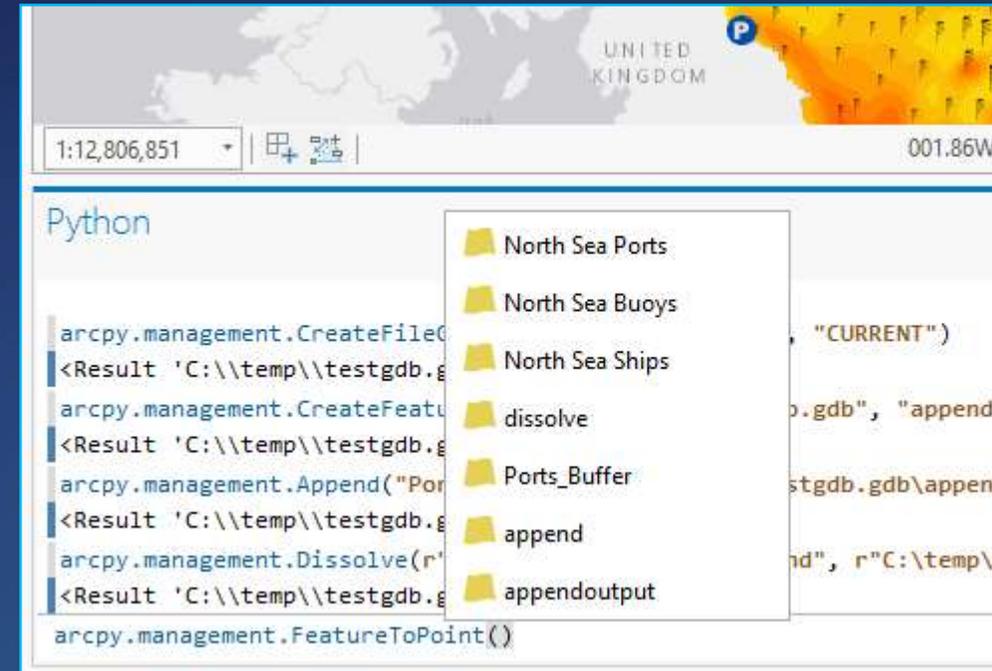
# Python in ArcGIS Pro

Command line with syntax help and intellisense

Uses Conda environment manager and enhanced with built-in Python Package Manager

Makes it easy to find and install additional libraries, including Python API for ArcGIS for scripting portal operations

Pro includes new data analysis libs  
Pandas, SciPy, and NetCDF4;  
ArcGIS API For Python







Demo

# Statistical Analysis

Spatial Statistics and R integration

# Spatial Statistics

Statistical tools for analyzing spatial distributions, patterns, processes and relationships

Summarize key characteristics of a spatial distribution

Identify significant clusters and outliers, hot and cold spots

Model and explore spatial relationship through regression

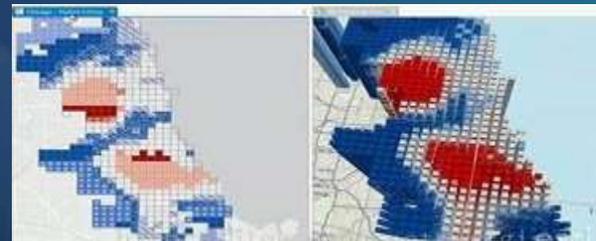
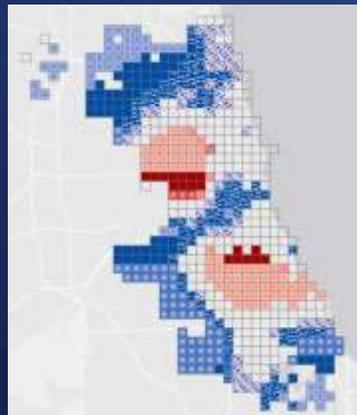


## Space-Time Pattern Mining

Aggregate data into cube data structure

Identifies hot and cold spot trends and outliers

Visualize the cube in 3D



# Spatial Statistics Advancements

Available only in ArcGIS Pro

Many new capabilities focusing on spatial machine learning

Clustering

Classification

Regression

# Clustering

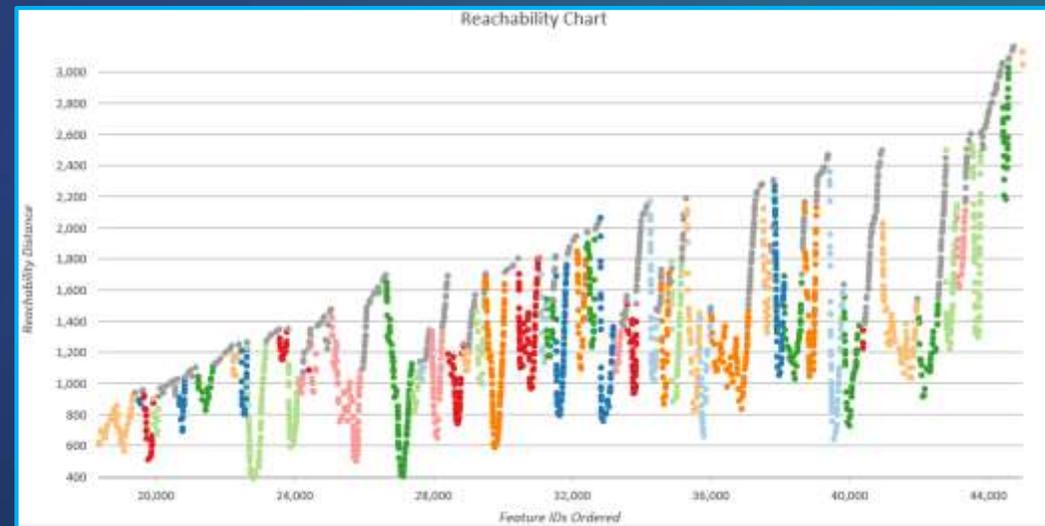
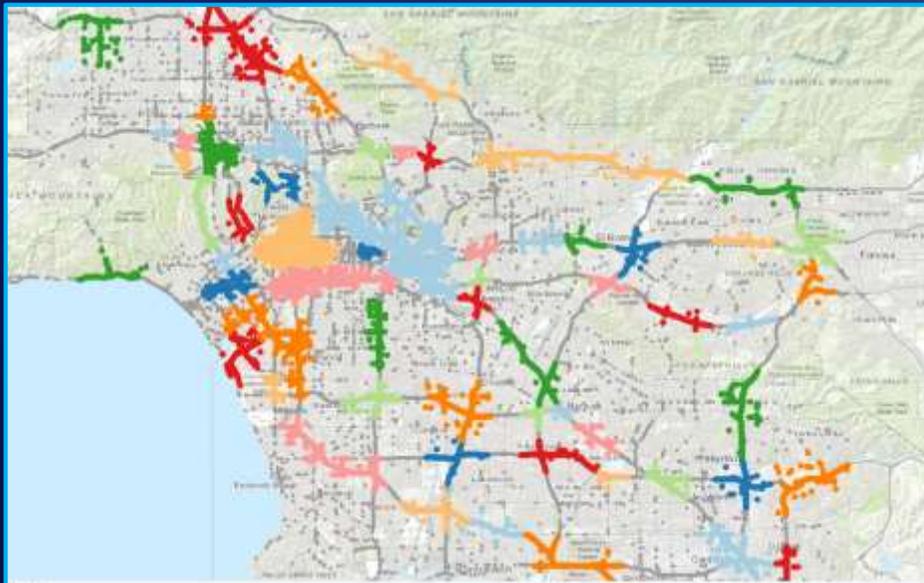
The grouping of observations based on similarities of values or locations

# Clustering

The grouping of observations based on similarities of values or locations

**New in ArcGIS Pro 2.1 - Density-based Clustering**

Use machine learning techniques to find clusters based purely on spatial location and a specified cluster size



# Clustering

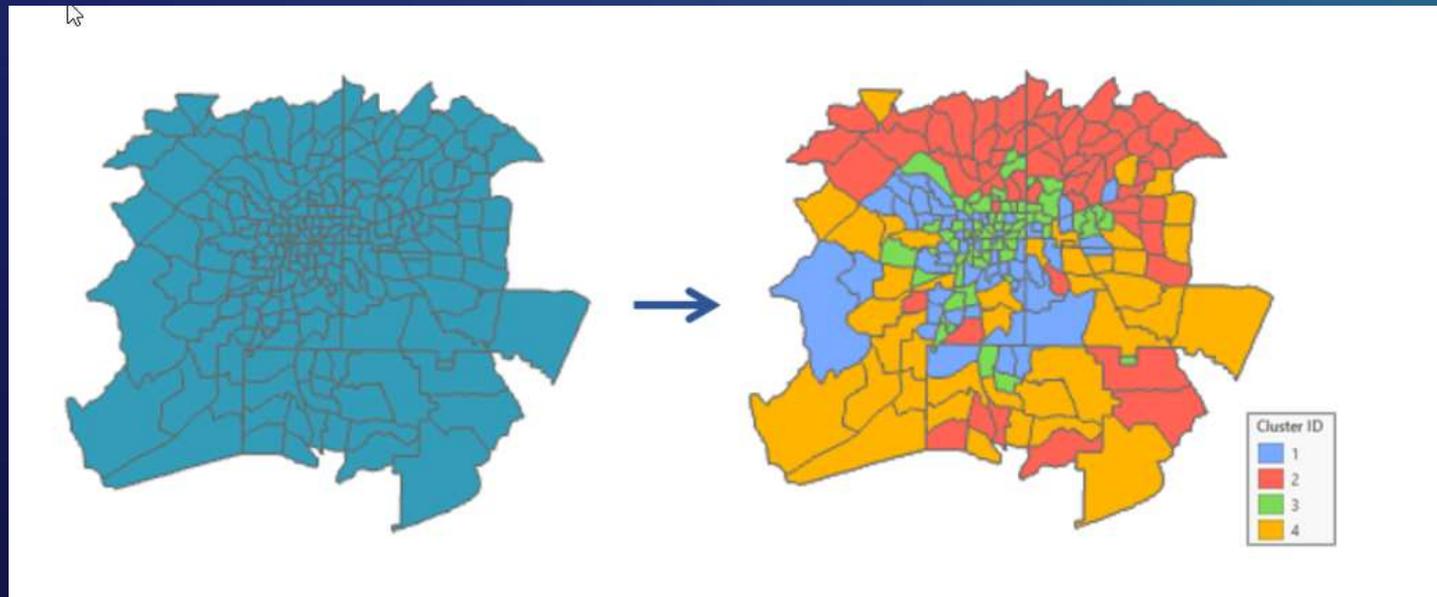
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New in ArcGIS Pro 2.1 - Density-based Clustering

Use machine learning techniques to find clusters based purely on spatial location and a specified cluster size

New in ArcGIS Pro 2.1 – Multivariate Clustering

Use machine learning techniques to find natural clusters of features based solely on feature attribute values



# Clustering

The grouping of observations based on similarities of values or locations

New in ArcGIS Pro 2.1 - Density-based Clustering

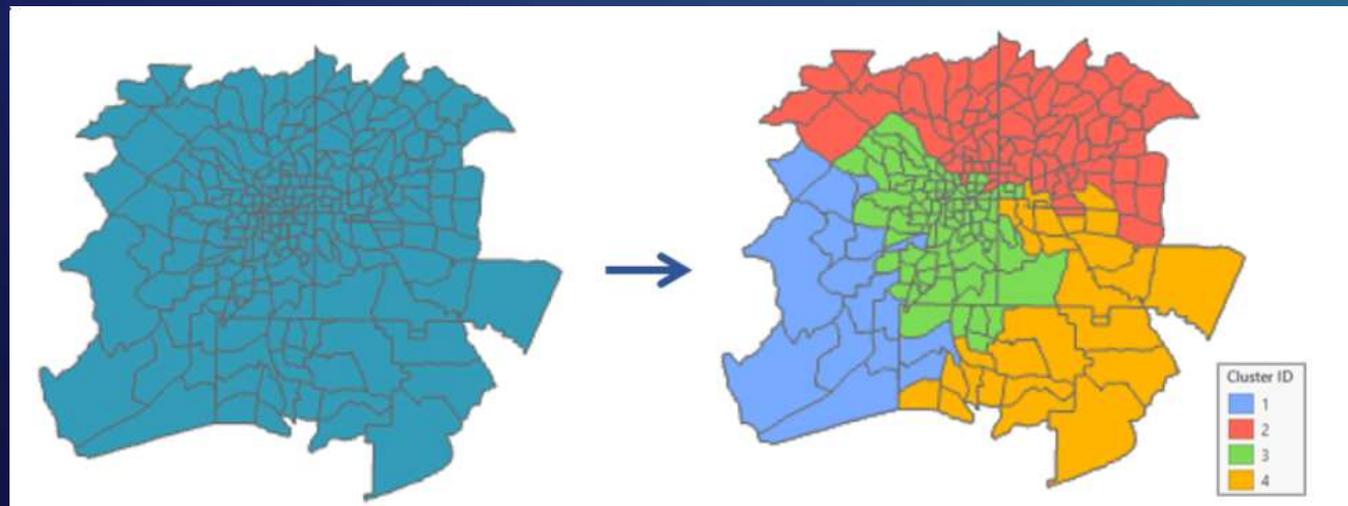
Use machine learning techniques to find clusters based purely on spatial location and a specified cluster size

New in ArcGIS Pro 2.1 – Multivariate Clustering

Use machine learning techniques to find natural clusters of features based solely on feature attribute values

**New in ArcGIS Pro 2.1 – Spatially Constrained Multivariate Clustering**

Use machine learning techniques to find spatially contiguous clusters of features based on a set of feature attribute values and optional cluster size limits

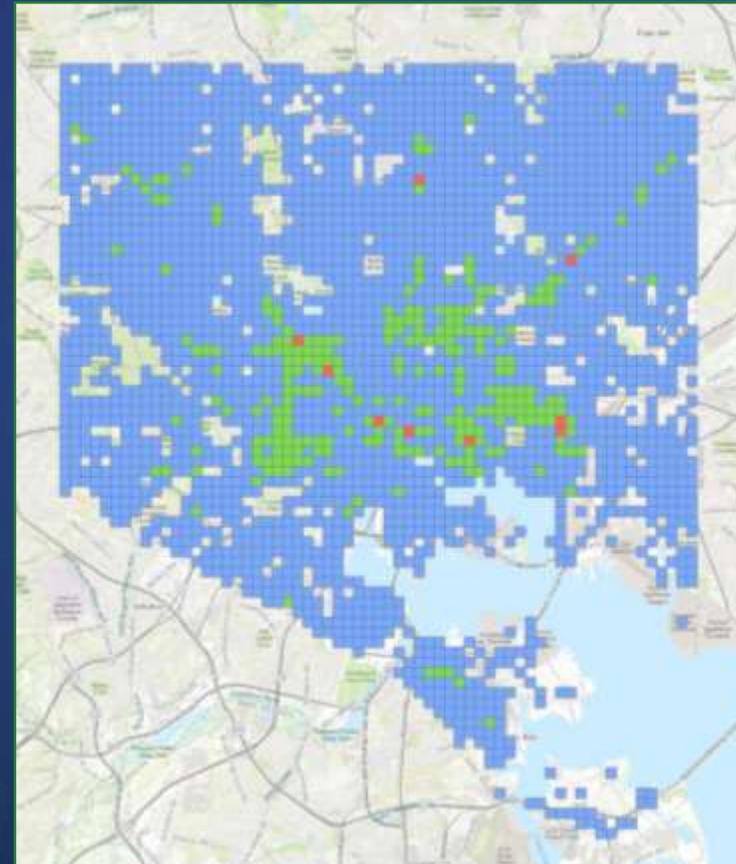


# Clustering

The grouping of observations based on similarities of values or locations

**New in ArcGIS Pro 2.2 – Time Series Clustering**

Use machine learning techniques to cluster features based on time series characteristics



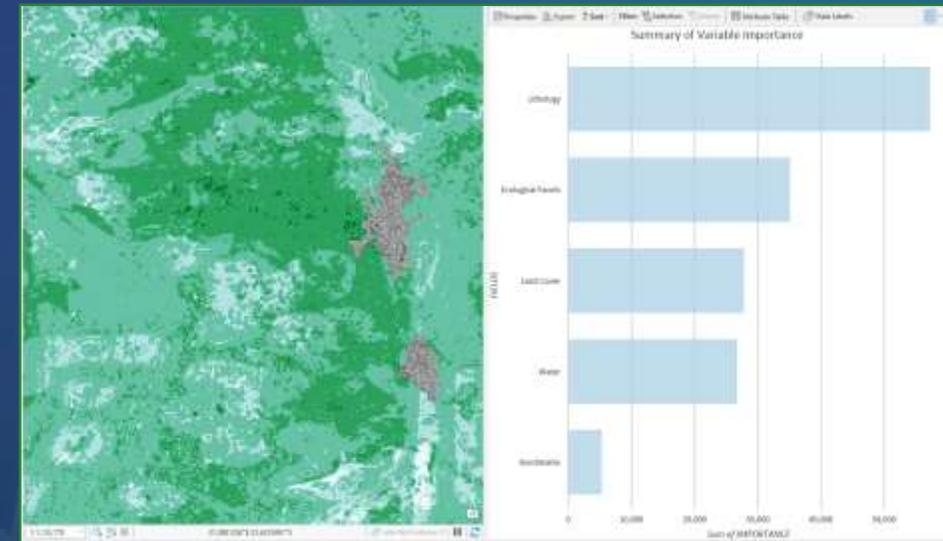
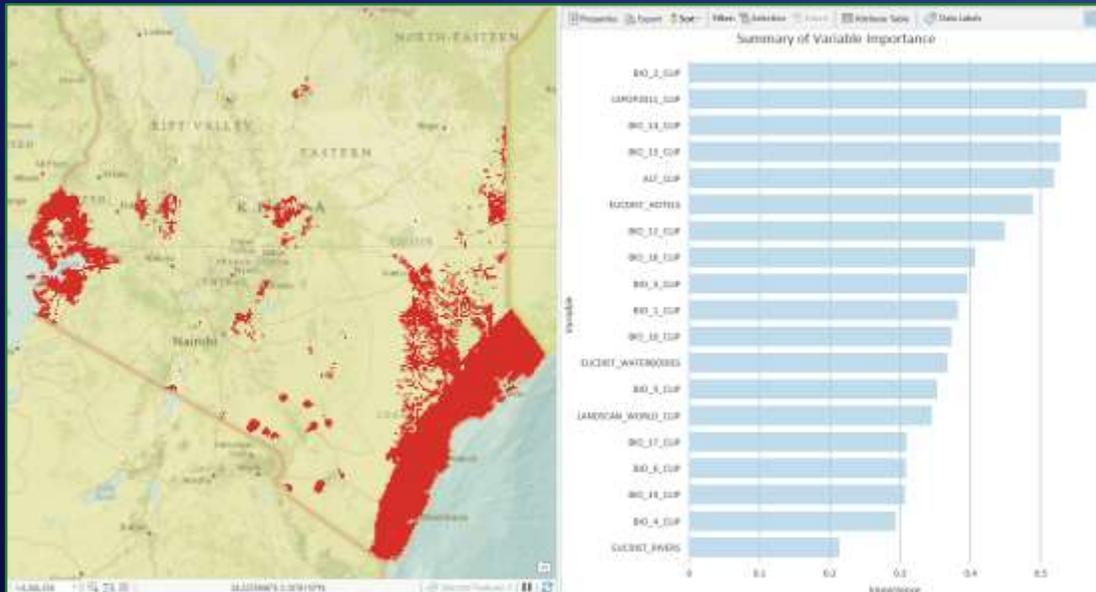
# Prediction and Classification

**Prediction:** Using the known to estimate the unknown

**Classification:** The process of deciding to which category an object should be assigned based on a training dataset

## New in ArcGIS Pro 2.2: Forest-based Classification and Regression

Use Random Forest machine learning algorithm for classification and regression



# R-ArcGIS Bridge



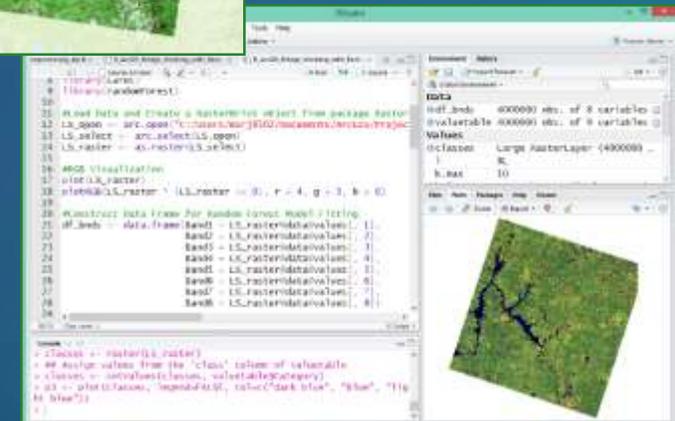
Leverage powerful statistical analysis in R with spatial methods in ArcGIS

Integration at every level

R scripts supported across ArcGIS

Accessible, reproducible science

Raster support (new)



Web Course

## Integrating R Scripts into ArcGIS Geoprocessing Tools

1 Hour Wish List

Available with a current maintenance subscription. [Sign In](#)

Use the R-ArcGIS bridge to discover the power of R from your ArcGIS toolbox. You will learn how to apply a workflow to create a geoprocessing script tool that leverages the capabilities of R.

# Online Analytics

Leverage ArcGIS Online and Enterprise

## Integration with Web GIS

**ArcGIS Pro is designed to be connected to ArcGIS Online and ArcGIS Enterprise**

**Access information and layers stored in your web GIS**

**Share custom analytics as web tools to ArcGIS Enterprise**

**Leverage the full analytic power of ArcGIS, including ArcGIS Online and ArcGIS Enterprise tools and services**



# Leverage ArcGIS Online and ArcGIS Enterprise Analysis Tools

Ready to use tool hosted in ArcGIS Online

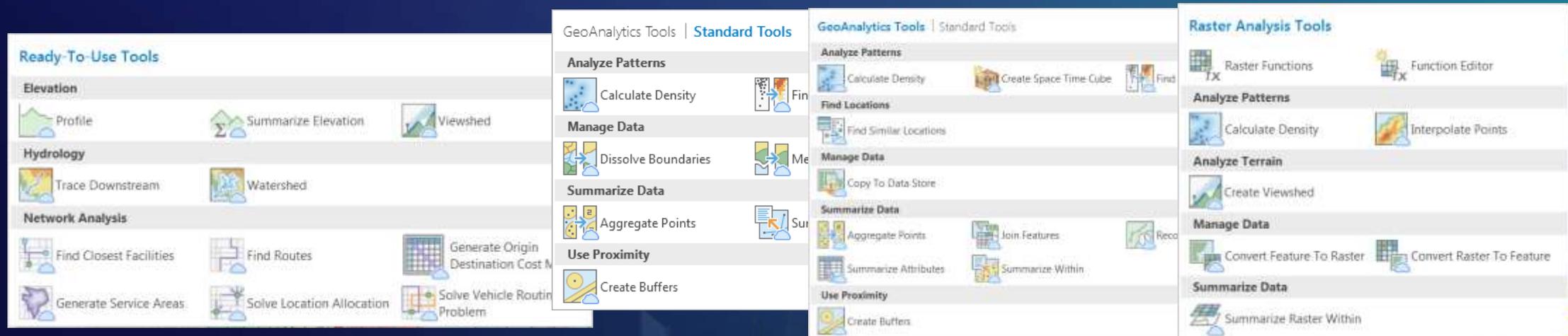
ArcGIS Enterprise Standard Feature tools

ArcGIS Enterprise GeoAnalytics Server

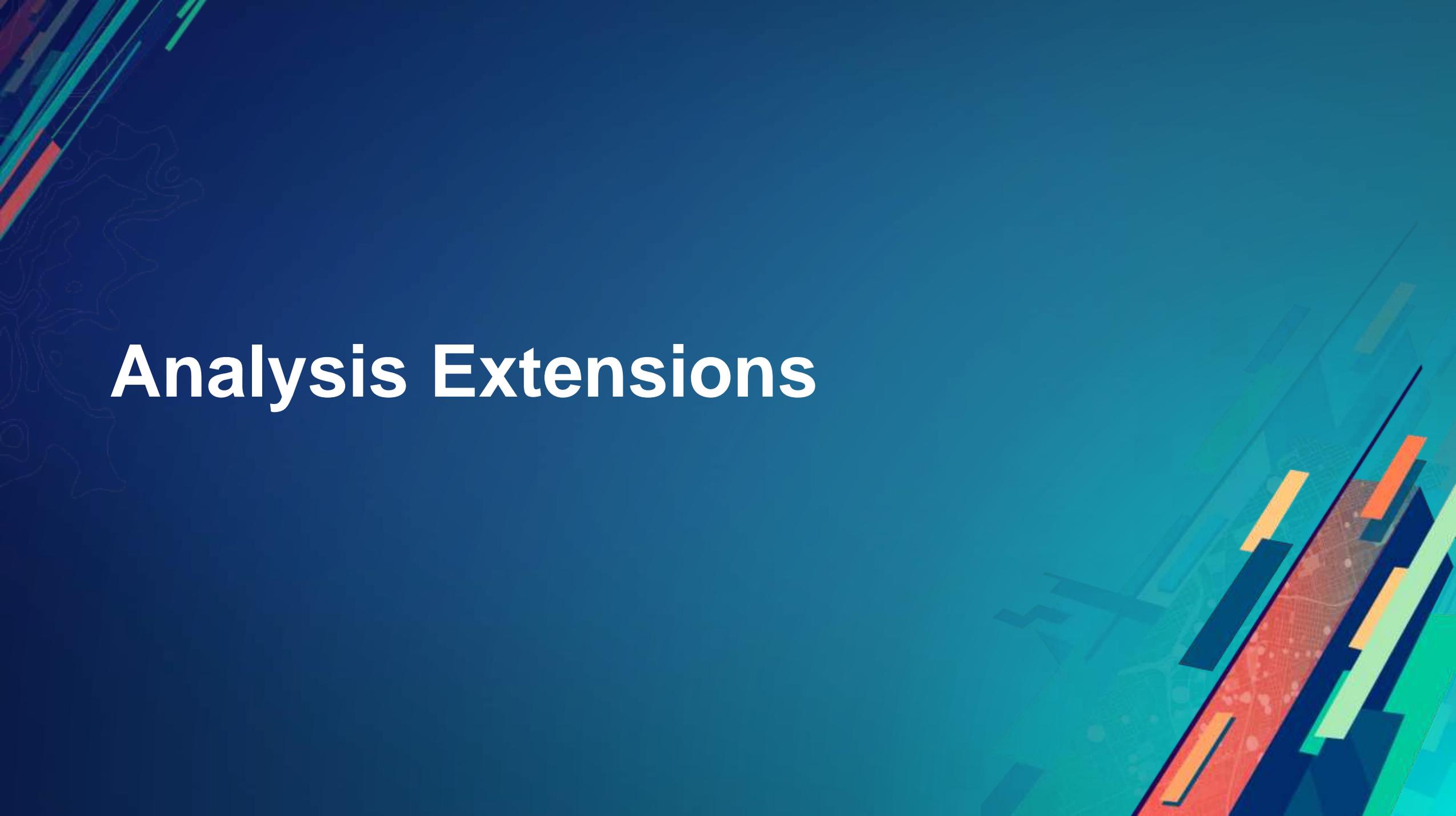
Process large feature data with both spatial and temporal components in distributed environment

ArcGIS Enterprise Image Server Raster Analytics

Enables distributed processing and analysis of imagery and raster data



# Analysis Extensions

The background features a dark teal gradient. On the left, there are several overlapping, semi-transparent geometric shapes in shades of teal, orange, and blue, creating a layered, abstract effect. On the right, a series of parallel, slanted lines in teal, orange, and blue extend towards the bottom right corner, suggesting a sense of depth and movement.

# Analysis Extensions

**Extensions build on the core analysis capabilities of ArcGIS Pro**

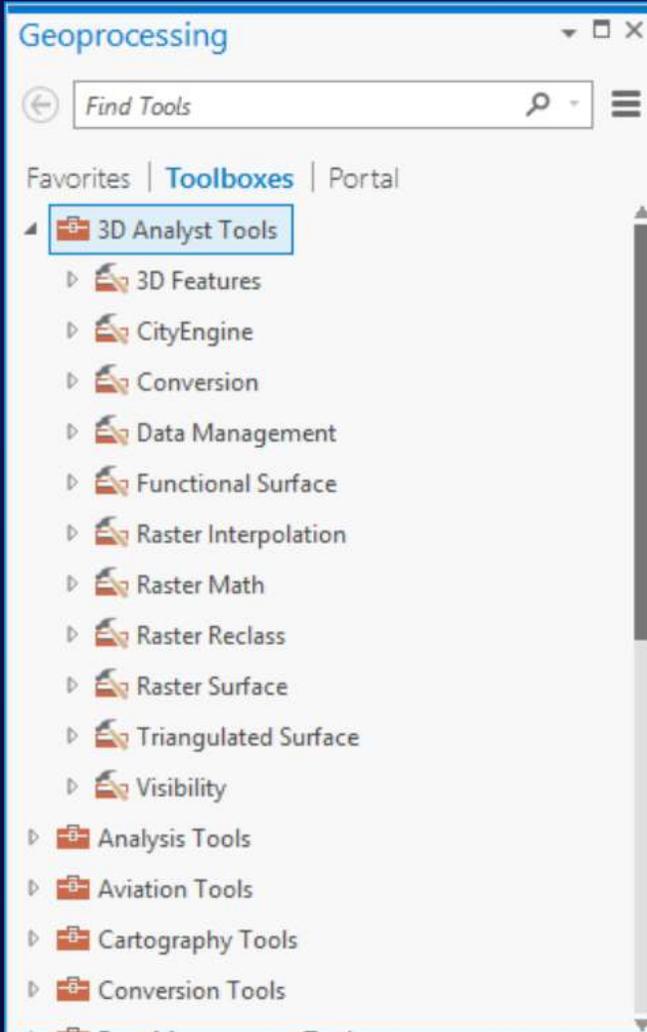
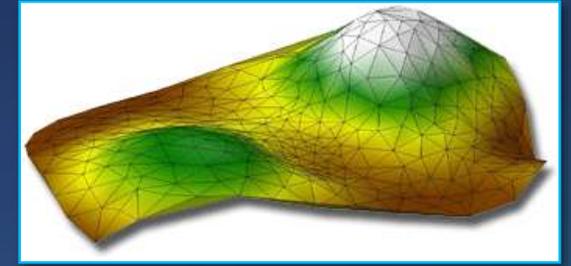
<b>3D Analyst</b>	<b>Business Analyst</b>	<b>Geostatistical Analyst</b>
<b>Image Analyst</b>	<b>Network Analyst</b>	<b>Spatial Analyst</b>

**Comprised of additional geoprocessing toolboxes and interactive capabilities**

**Extension licensing is consistent between ArcMap and ArcGIS Pro**

**Same licensing models for ArcGIS Pro are used for extensions  
(Named User, Single Use, Concurrent Use)**

# 3D Analyst

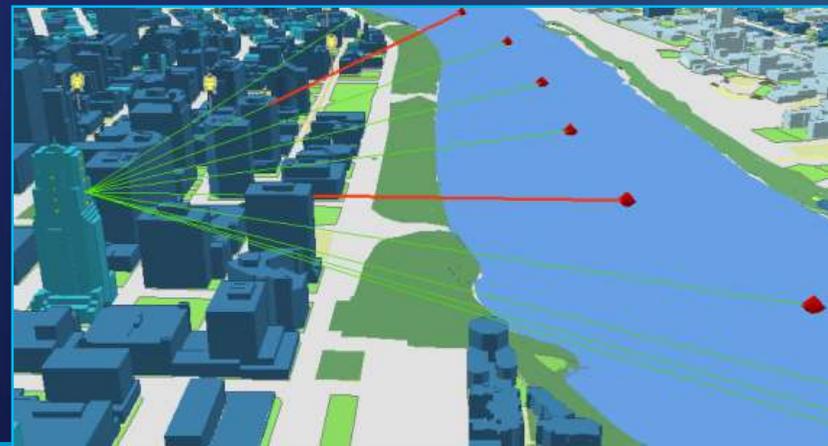


Elevation surface creation and analysis using 3D vector geometries, rasters, 3D TINs, terrains, and point clouds

Perform analysis, visualize, and classify Lidar and point-cloud data in the LAS dataset format

Measuring 3D distances and evaluating 3D spatial relationships

Volumetric and visibility analysis



**NOTE: 3D mapping and visualization does not require 3D Analyst extension**

# 3D Exploratory Analysis

Provides interactive exploration and visibility/field of view analysis capabilities in 3D

Line of Sight

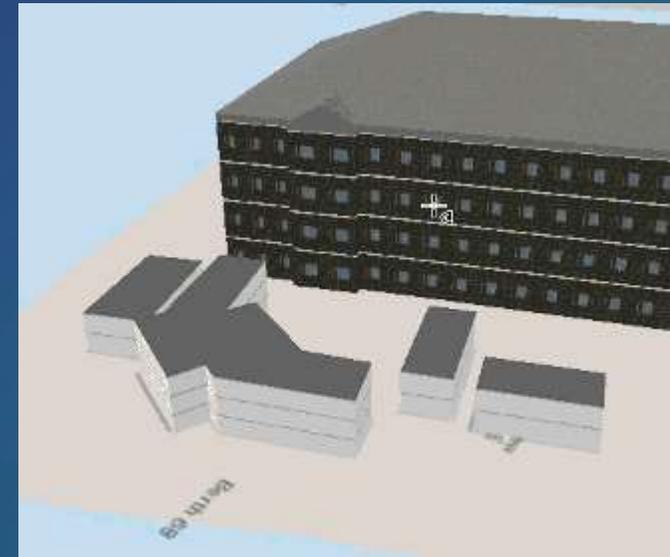
View Dome

Viewshed

Slice

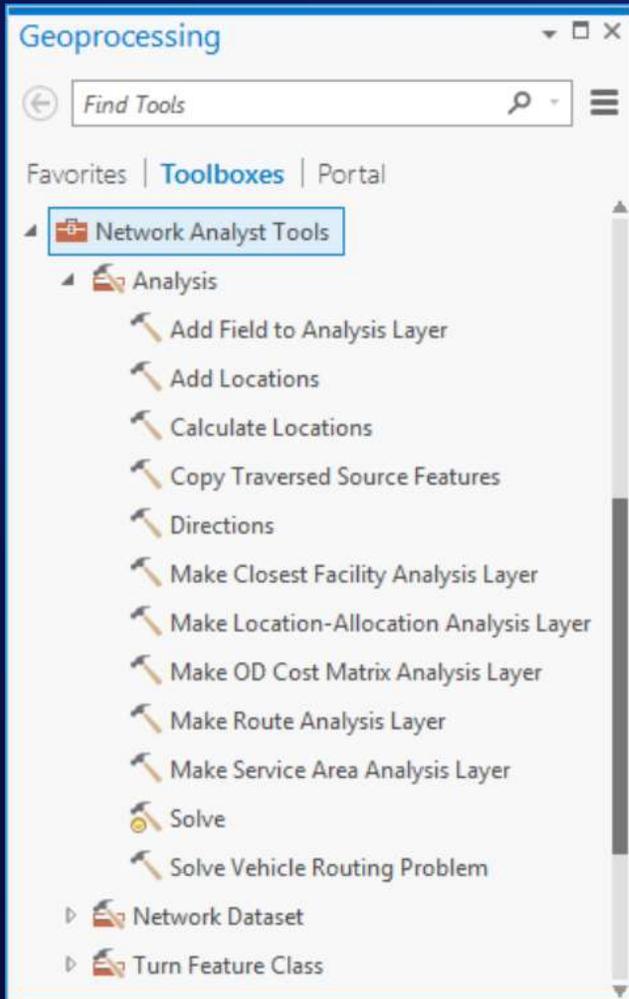
Analysis done on-the-fly using screen resolution, inputs and outputs are screen overlay graphics

For high-precision analysis and to persist or share results, use 3D Analyst geoprocessing tools



**NOTE: Does NOT  
require the 3D  
Analyst extension**

# Network Analyst



20+ geoprocessing tools that automate network analysis

Ribbon-based workflow makes it interactive and easy

Routing and Directions

Closest Facility

Location-Allocation

Drive Times and Service Areas

Vehicle Routing

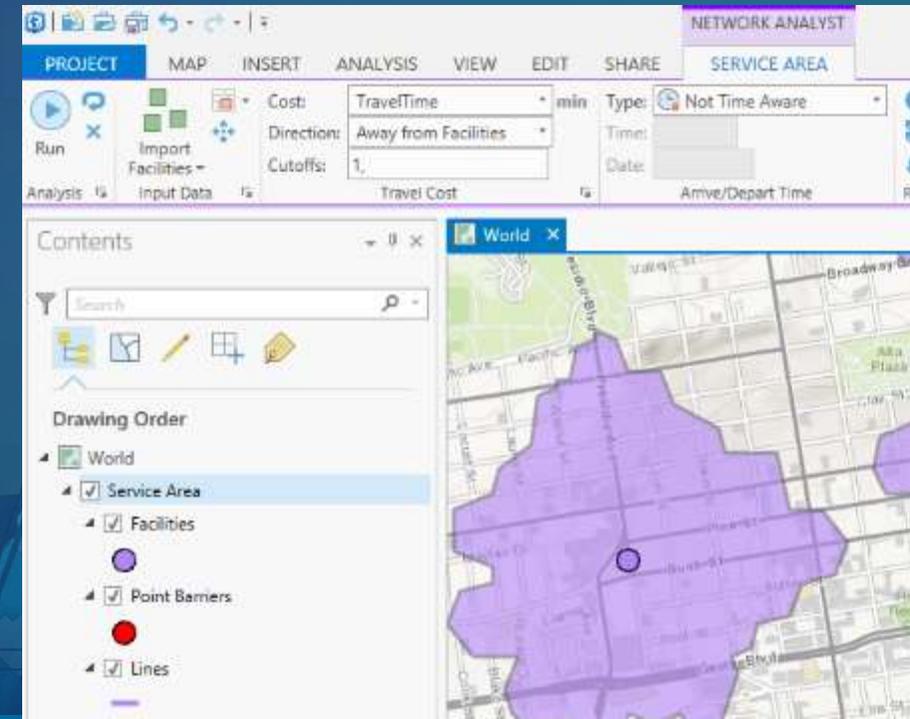
Origin-Destination Matrix

Workflow steps include

1. Create a network analysis layer
2. Add locations and set options
3. Solve

2D and 3D network analysis

Works with your network dataset or Online network service



# Business Analyst

- Business Analyst Tools
  - Analysis
    - Color Coded Layer
    - Enrich Layer
    - Generate Desire Lines
  - Reports
    - Summary Reports
  - Suitability Analysis
  - Trade Areas
- Territory Design Tools
  - Analysis
    - Add Level Variables
    - Set Balance Variables
    - Solve Territories
  - Territory Solution
    - Add Territory Level
    - Create Territory Solution
    - Import Territory Solution
    - Load Territory Records

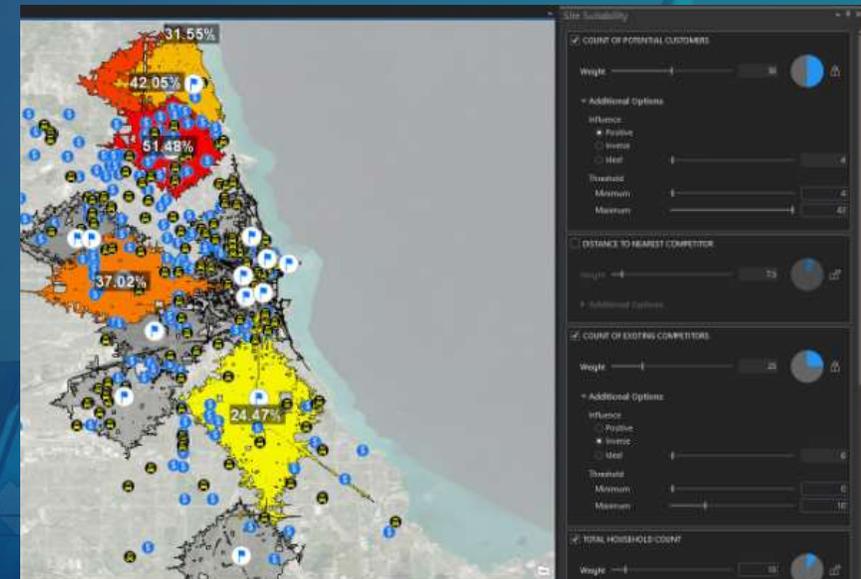
Analyze market trends, including customer and competitor analysis, site evaluation, and sales territory planning

Demographics and summary reports based on exhaustive Business Analyst datasets or ArcGIS services

Enrich your data with demographic, lifestyle, spending, or landscape attributes

Interactive site selection and suitability analysis

Not just for commercial or retail!



# Image Analyst

New in ArcGIS Pro 2.1

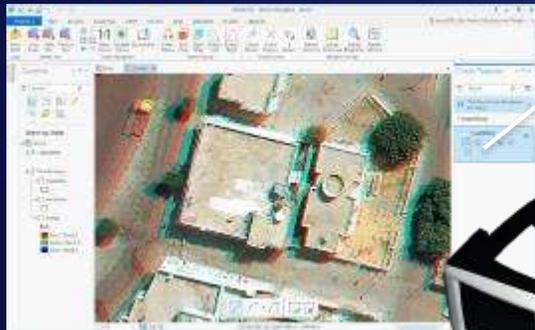
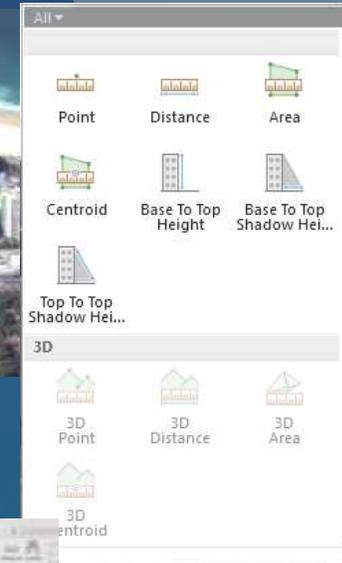
Provides capabilities for image analysts, photogrammetrists and geospatial analysts who focus on image processing, interpretation, analysis, and creation of information from imagery



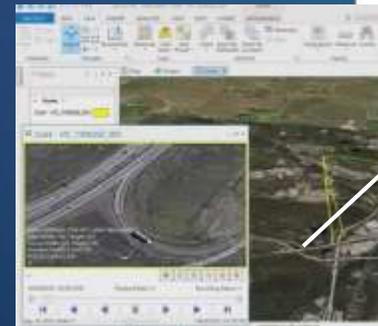
Image Classification



Image Space



Stereo Mapping



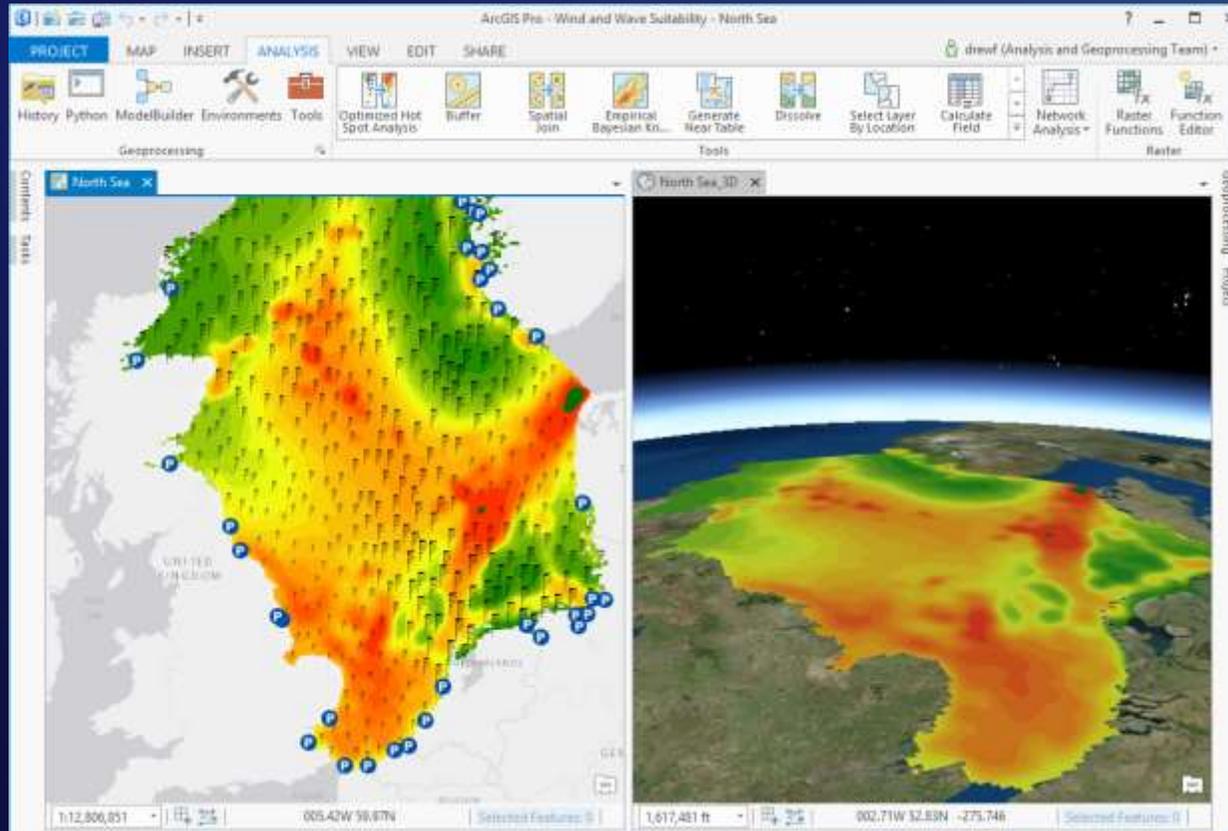
Full Motion Video

New in ArcGIS Pro 2.2

# Spatial Analyst

Extension available across the ArcGIS platform

Provide spatial modeling and analysis tools for raster data



Geoprocessing

Find Tools

Favorites | **Toolboxes** | Portal

- ▾ Spatial Analyst Tools
  - ▾ Conditional
  - ▾ Density
  - ▾ Distance
  - ▾ Extraction
  - ▾ Generalization
  - ▾ Groundwater
  - ▾ Hydrology
  - ▾ Interpolation
  - ▾ Local
  - ▾ Map Algebra
  - ▾ Math
  - ▾ Multivariate
  - ▾ Neighborhood
  - ▾ Overlay
  - ▾ Raster Creation
  - ▾ Reclass
  - ▾ Segmentation and Classification
  - ▾ Solar Radiation
  - ▾ Surface
  - ▾ Zonal

# Spatial Analyst key features

Suitability modeling

Density analysis

Distance and cost of travel analysis

Hydrologic analysis, watersheds

Powerful Map Algebra language & Raster Calculator

Leverage Image Server Raster Analytics for distributed spatial analyst workflows

Many Spatial Analyst workflows can also be achieved via raster functions



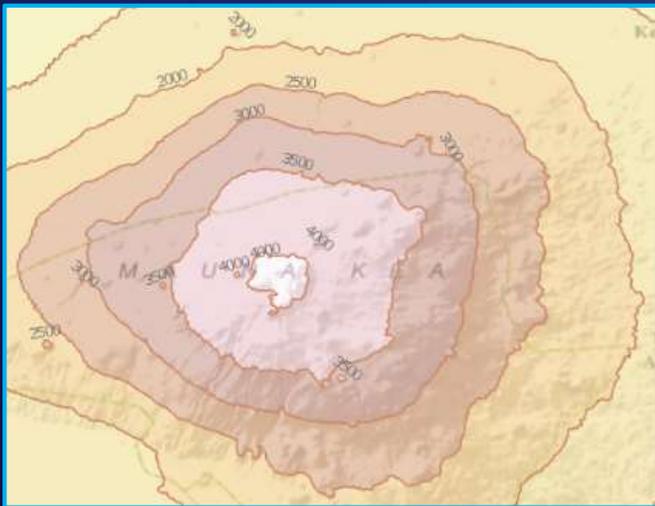
# Spatial Analyst

## New tools

Improved tool algorithms and parameters

More Spatial Analyst tools have been updated to support parallel processing

Improved hydrologic modeling scalability



**New Polygon Option in the Contour tool**



**New Cost Path as a Polyline tool**

# Predicting flood levels for hurricane Harvey

Using Spatial Analyst, Image Server, and ArcGIS Online  
National scale flood forecasting



# Geostatistical Analyst

## Statistical models and tools for spatial interpolation

Predict values at new locations based on measurements in known locations

Creates statistically valid prediction surfaces along with prediction uncertainty or error

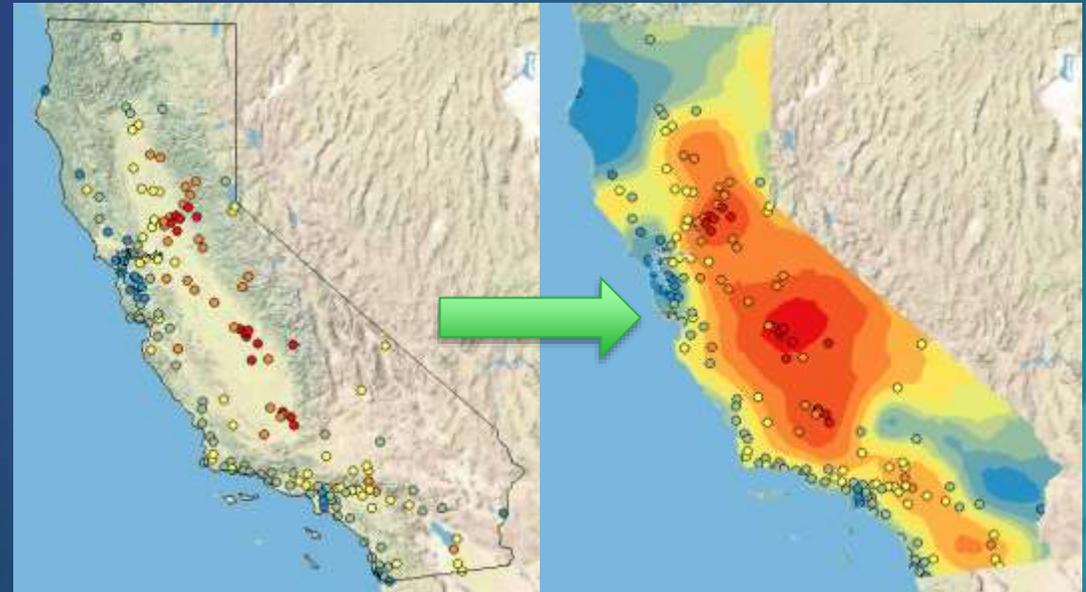
## Interactive Geostatistical Wizard

## Advanced geostatistical interpolation methods

Empirical Bayesian Kriging

Areal Interpolation

EBK regression prediction



# EBK Regression Prediction

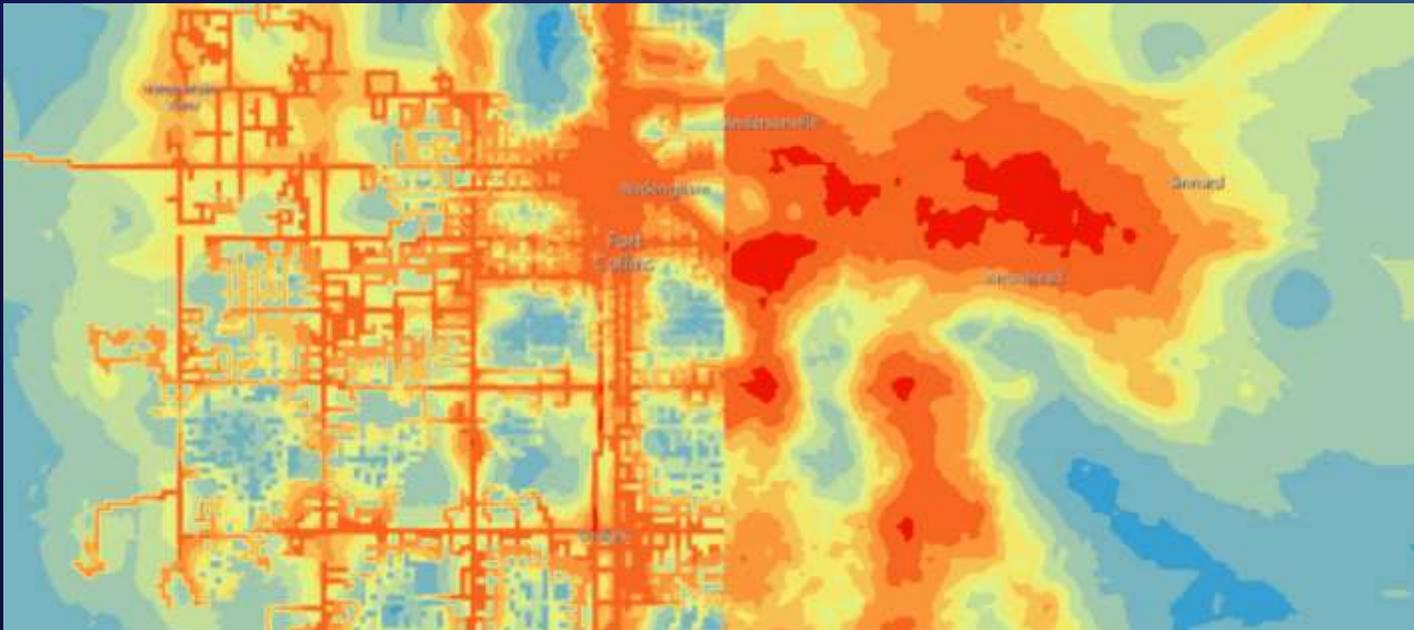
Available only in ArcGIS Pro

## A geostatistical multivariate prediction tool

Used to predict values of phenomena using secondary variables

Provide improved predictions at un-sampled locations

## Better results by combining regression and kriging



Geoprocessing

EBK Regression Prediction

Parameters | Environments

Input dependent variable features  
Noise\_samples

Dependent variable field  
decibel

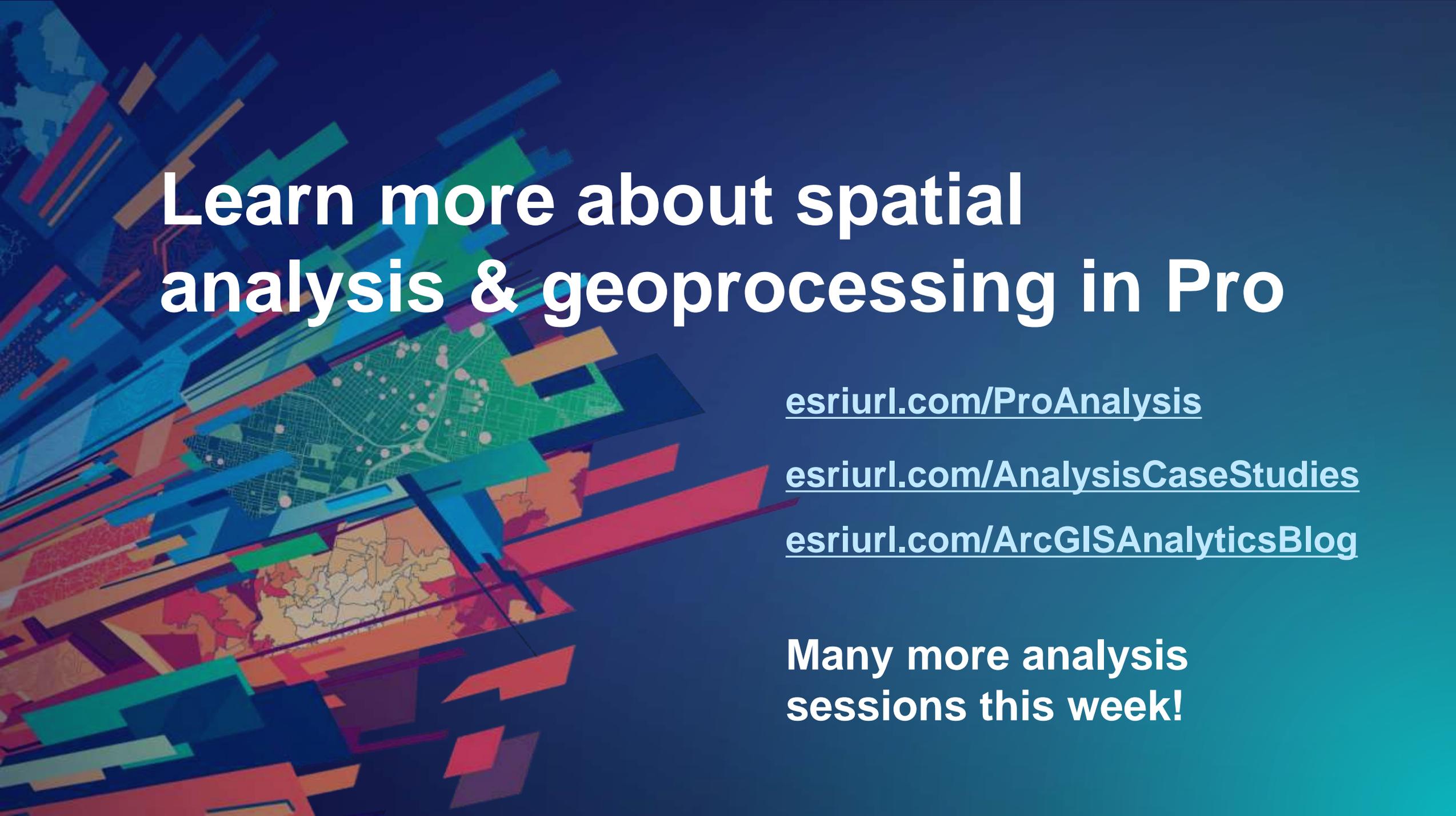
Dependent variable measurement error field

Input explanatory variable rasters

- Distance to Green Areas
- Distance to Interstate
- Road Density

Output geostatistical layer  
EBKRegressionPrediction1

Output prediction raster  
NoisePrediction

The background features a dark blue gradient with a complex, abstract pattern of overlapping, semi-transparent geometric shapes in various colors including teal, orange, red, and purple. A faint, stylized map of a city grid is visible in the center-left area, overlaid on the geometric pattern.

# Learn more about spatial analysis & geoprocessing in Pro

[esriurl.com/ProAnalysis](https://esriurl.com/ProAnalysis)

[esriurl.com/AnalysisCaseStudies](https://esriurl.com/AnalysisCaseStudies)

[esriurl.com/ArcGISAnalyticsBlog](https://esriurl.com/ArcGISAnalyticsBlog)

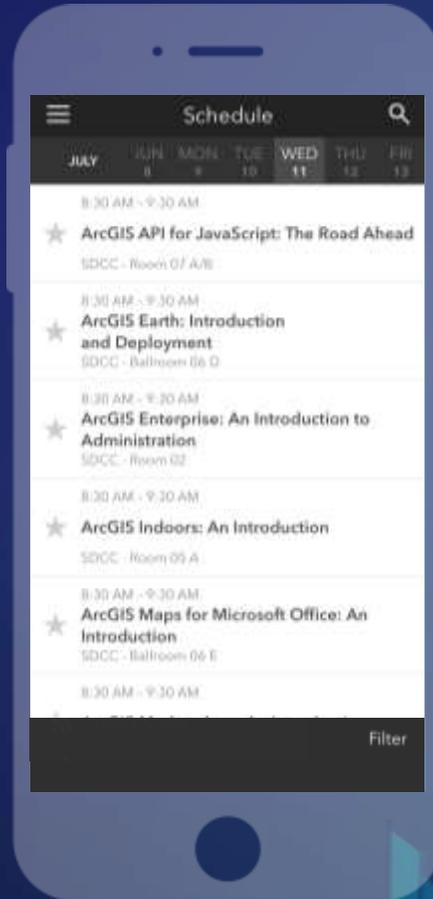
**Many more analysis sessions this week!**

# Please Take Our Survey on the App

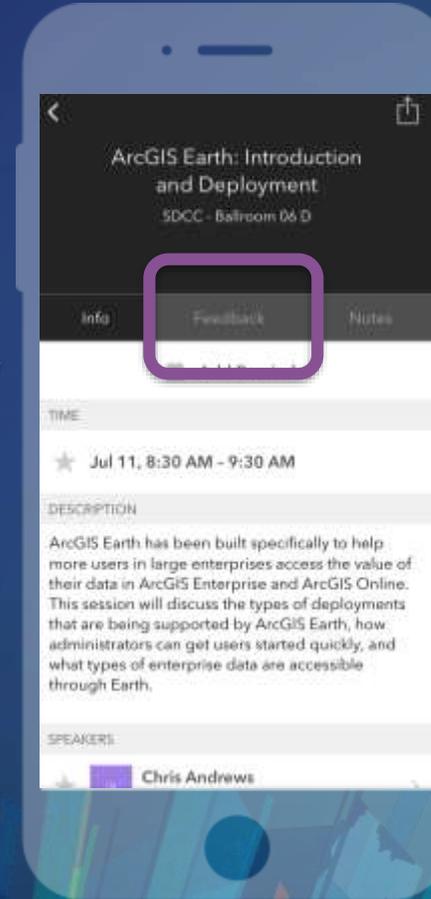
Download the Esri Events app and find your event



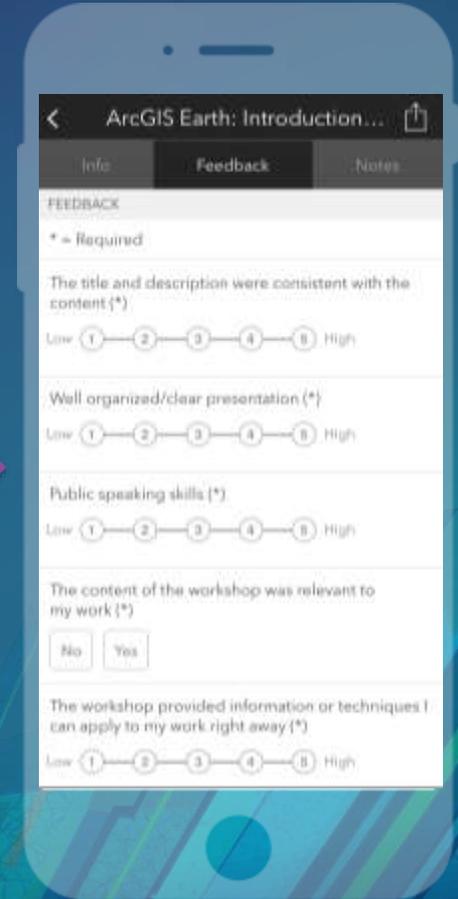
Select the session you attended



Scroll down to find the feedback section



Complete answers and select "Submit"





esri

THE  
SCIENCE  
OF  
WHERE