



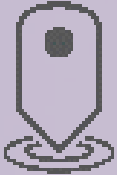
# Spatial Analysis: The Road Ahead

Jian Lange, Noah Slocum, Steve Kopp, Ashley Pengelly, Linda Beale

**GIS  
INSPIRING  
WHAT'S  
NEXT**

# Spatial Analysis

Gain value from location data to make better decisions



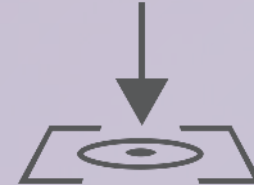
Understand  
where



Determine  
how things  
are related



Find the  
best  
locations  
and paths



Detect and  
quantify  
patterns



Make  
predictions

# Spatial Analysis

## Top Trends



# ArcGIS - Comprehensive Analytics Platform

## Analysis Experience for Everyone



Online Analytics



Fast Data Discovery & Analytics



Big Data Analytics



Professional  
Desktop Suite



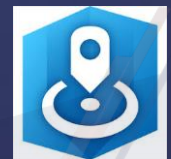
Real-time Analytics



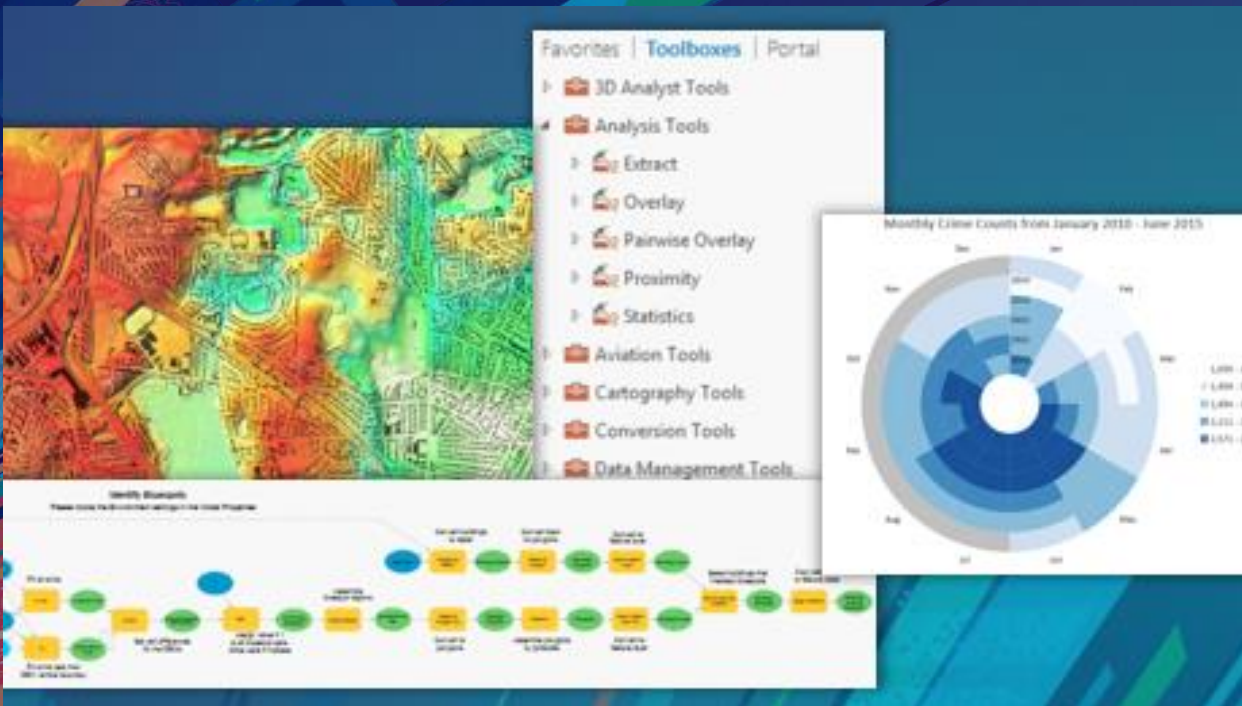
Python Notebooks & R  
Integration



Location-based  
Content & Services



Focused Analytical  
Solutions



# ArcGIS Pro

Analysis and Geoprocessing Road Ahead

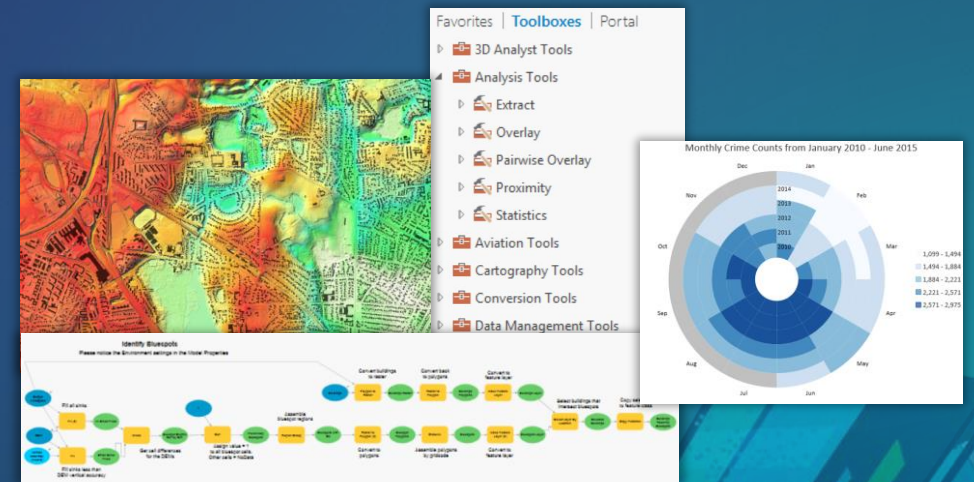
Jian Lange



# ArcGIS Pro: Analysis and Geoprocessing

*Provide a powerful framework and diverse set of tools for both interactive and automated spatial analysis and data management, enable users to share analytics with their organization or community, and leverage the analytics power of Web GIS*

- Geoprocessing tools and framework
- Charts and exploratory analysis
- ModelBuilder
- Python (ArcPy)
- Analytical extensions



# ArcGIS Pro Analysis & Geoprocessing Road Ahead



New Tools

Enhanced Workflows

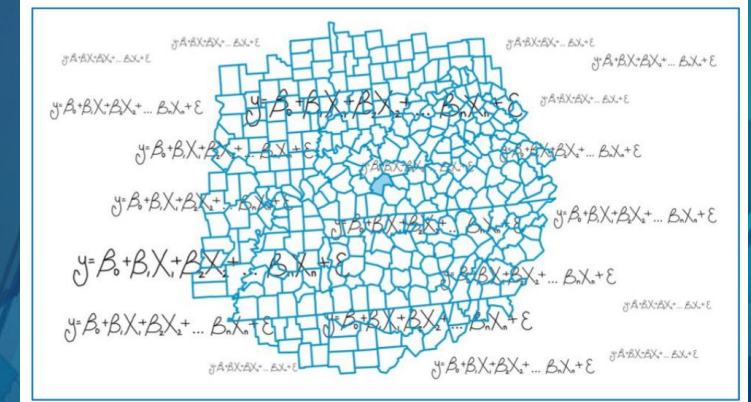
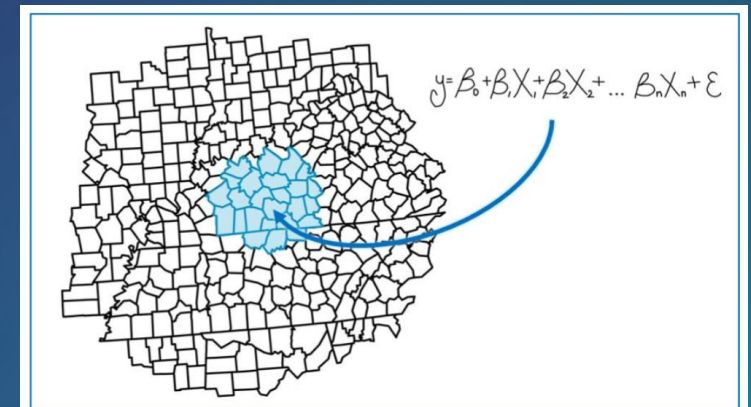
More Chart Types

Improving Performance

Support Python Notebooks

# New Tools

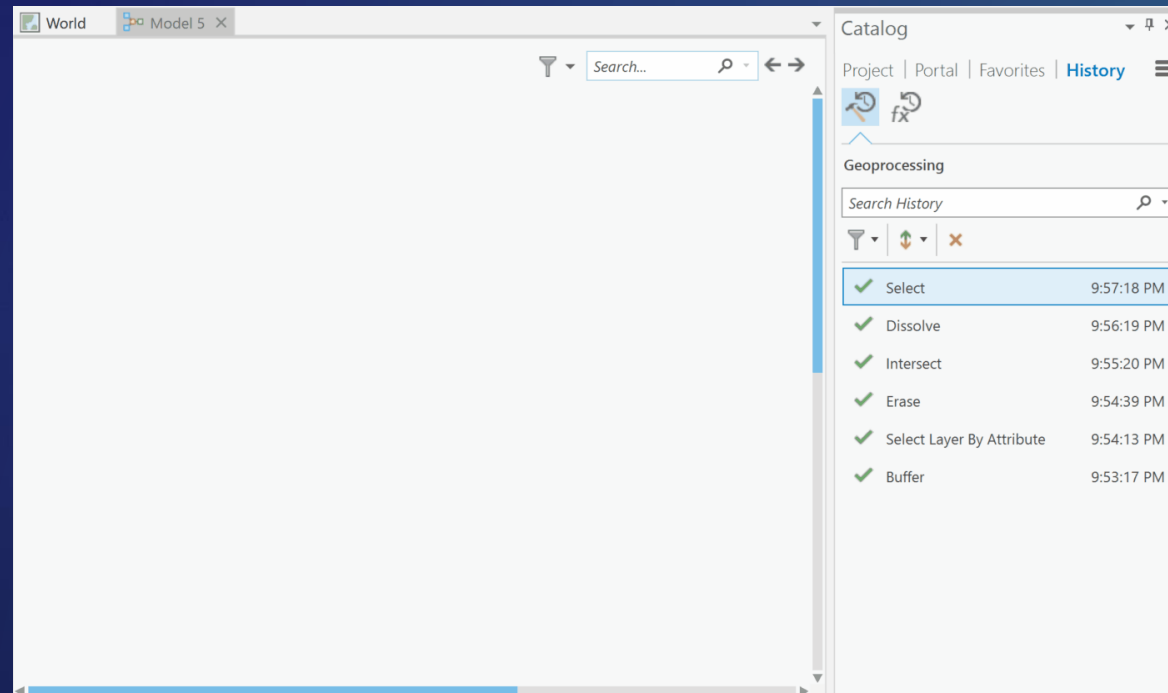
- Many new capabilities focusing on spatial machine learning techniques
  - Spatial Statistics
    - New Geographically Weighted Regression
    - General Linear Regression models
  - GPS Points to Road Network





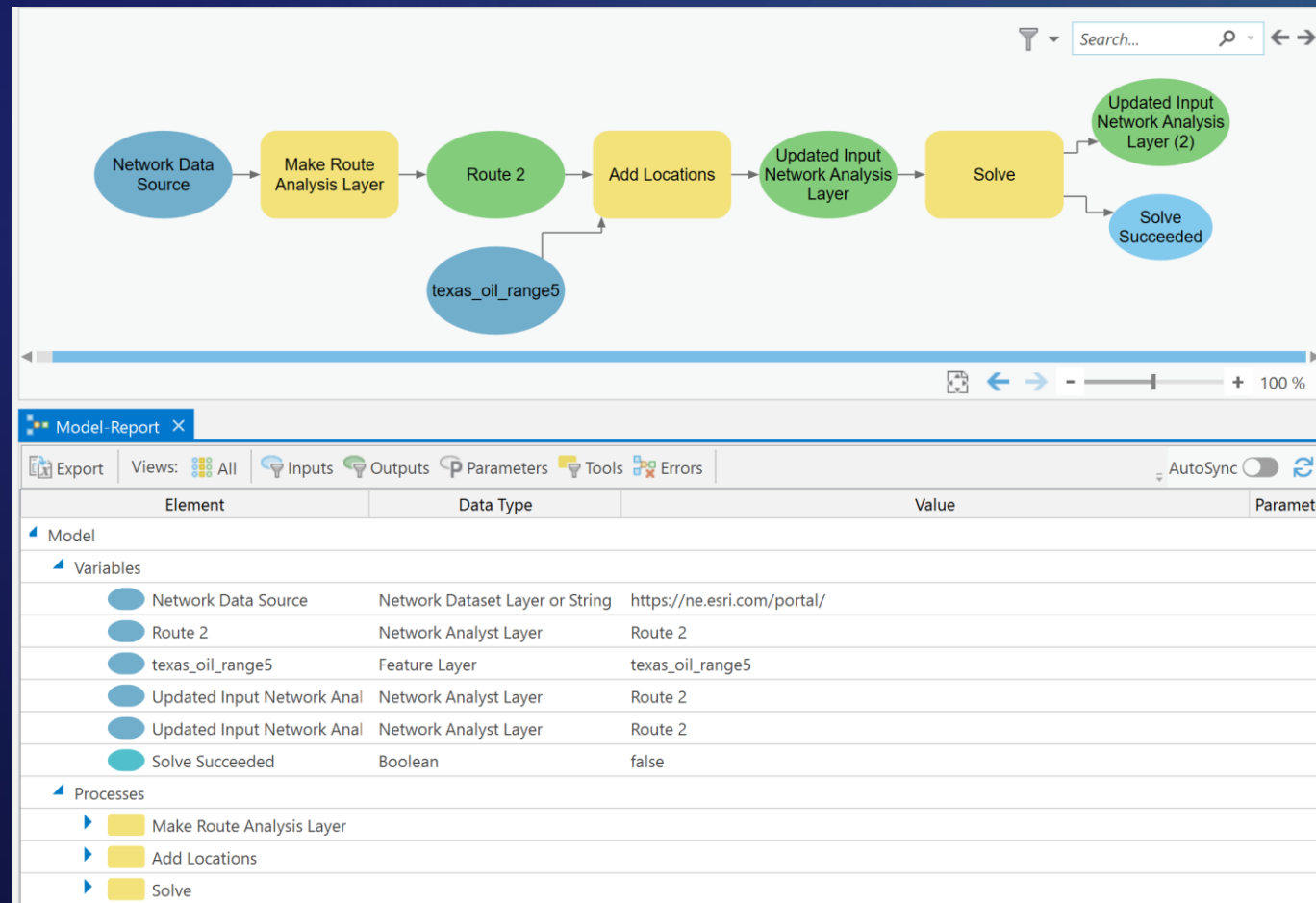
# Enhanced Workflows

- **ModelBuilder**
  - Automatically generate well formatted models from multiple sequentially run tools



# Enhanced Workflows

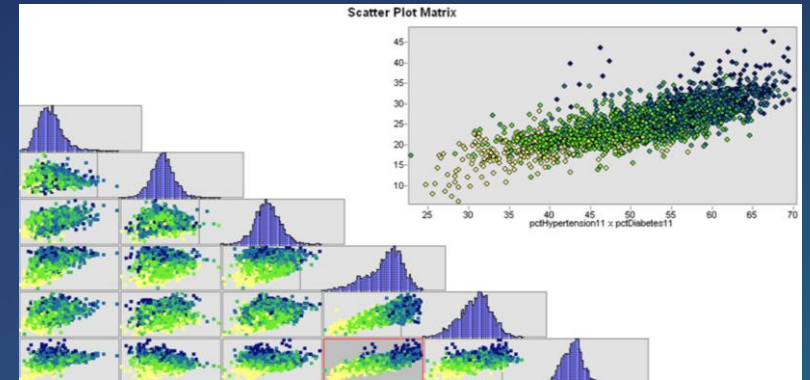
- **ModelBuilder**
  - support two-way editing of variable values and tool parameters



# More Chart Types

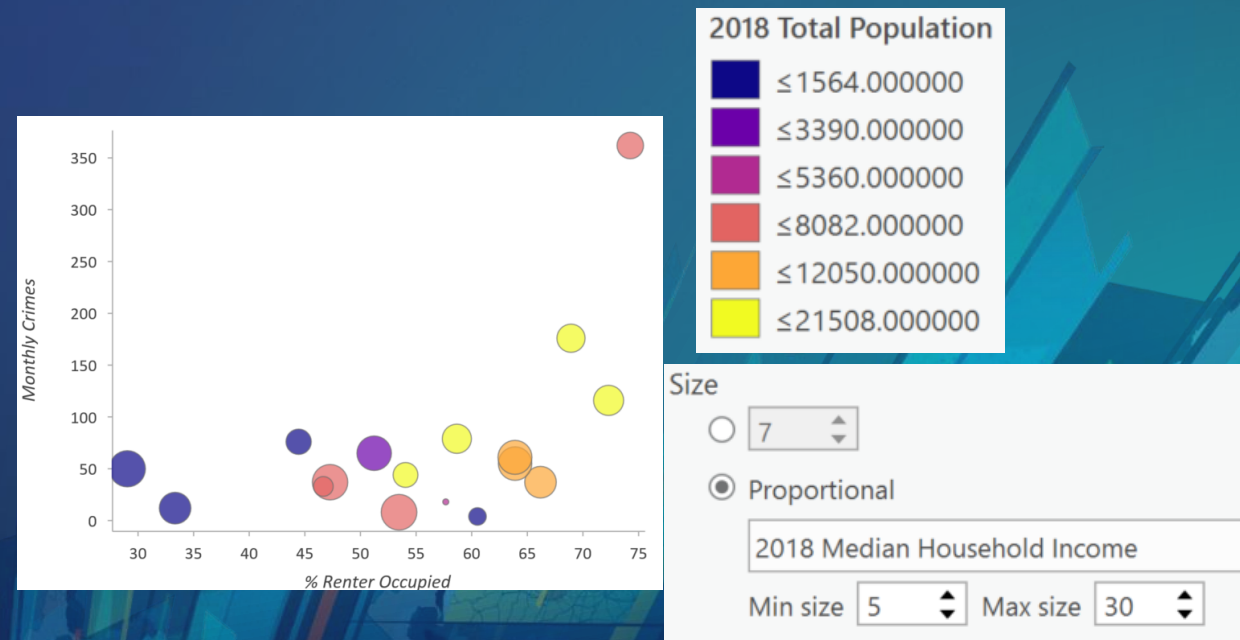
## Scatter Plot Matrix

Explore multiple relationships in one visualization



## Bubble Plot

Adding color and size to visualize more variables



# Improving Performance

**New parallelized geoprocessing tools for analyzing large desktop GIS data leveraging multi-core powerful desktop hardware**

**Leverage spatial capabilities in a number of databases to perform operations in the database instead of transferring data to client**



# Python Notebooks



**ArcGIS Desktop has had an interactive Python command line since ArcMap 10**

Useful for executing single lines or blocks of ArcPy or other Python code with syntax help and intellisense

Leverages the Desktop application to use layers and envs

**Next generation of interactive scripting interface is the Notebook**

Notebooks can be a local project item, or stored in the cloud

Similarly can be run on the Desktop or in the cloud

Empowered by both ArcPy and ArcGIS Python API, and united by data analysis with spatial data frames

Search



Drawing Order

- Map
- planning\_zones2\_pts
- Buffer\_Input\_Features\_Points
- addresses\_MinimumBoundingGeo
- addresses\_Buffer
- Output Feature Class
- area
- addresses
- Addresses\_ServiceAreas\_2mins\_Zone%Value%
- Addresses\_ServiceAreas\_2mins\_Zone%Value%
- planning\_zones2
- World Imagery



1:140,631 | 33.0653008°E 34.6246092°N | Selected Features: 7

Command Line | **NOTEBOOK**  
**jupyter** Cyprus Planning Zones Notebook Last Checkpoint: Yesterday at 11:00 AM (unsaved changes) Python 3 Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3



```
In [2]: arcpy.GetPortalInfo()

Out[2]: {'SSL_enabled': False,
         'organization': 'A&GP Enterprise Build 8320 Windows',
         'organization_type': '',
         'portal_version': 5.3,
         'role': 'org_admin'}
```

```
In [ ]: arcpy.Buffer_analysis("c:\\mydata\\data.gdb\\cities", "cities_buffers", "10 Miles")
```



Python\_API\_network\_analysis x Guest

localhost:8888/notebooks/2017\_UC/screenshots/Python\_API\_network\_analysis.ipynb

Jupyter Python\_API\_network\_analysis Last Checkpoint: 10 minutes ago (autosaved) Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

```
In [1]: from arcgis.gis import *
        from arcgis.features.use_proximity import plan_routes

In [ ]: routes = plan_routes(relief_centers, 15, 15, start_time, nehru_stadium, stop_service_time=30)

In [ ]: routemap = gis.map("Chennai", zoomlevel = 12)
        routemap
```

# Python API Road Ahead

## Noah Slocum

# ArcGIS Python API

- **Python API to your Web GIS**
- **Support geocoding, spatial analysis, distributed vector and raster analysis, and network analysis**
- **Integrate spatial analysis with the scientific Python ecosystem**
- **Support Jupyter Notebook**



# Python API: Road Ahead

- Realtime GIS
  - Automate GeoEvent admin
- Machine learning
- Publishing imagery/raster functions
- File Geodatabase

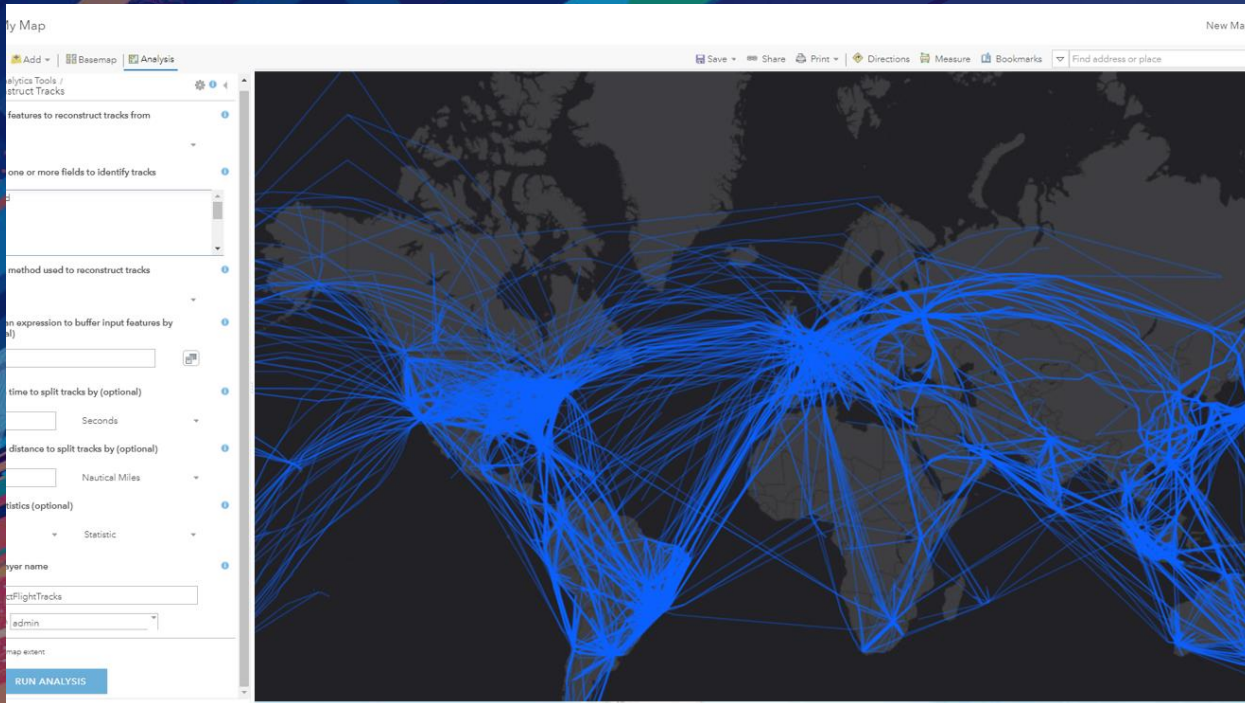
# Python API: Road Ahead

- Hosted notebooks
  - Enterprise and Online
  - Share, secure notebooks items
  - Schedule notebooks to run at future date or at periodic intervals

The image displays two overlapping screenshots of a web application interface. The top-left screenshot shows the 'Sample Notebook' detail page, including a thumbnail, description, and metadata. The top-right screenshot shows the 'Content' management page with a sidebar for folders and categories. The bottom screenshot shows a 'Content' page with a search bar and a table of items. A red box highlights the 'Schedule' button in the action bar above the table.

Content Management Page Details:

- Search: shreyasdevext
- 1 selected
- Buttons: Schedule, Move, Change Owner, Share, Delete
- Table Headers: Title, Modified
- Table Rows:
  - Creating and Managing.. Python Notebook Jun 21, 20...
  - Hosting Server Usage S... Python Notebook Jun 21, 20...
  - Usage Report Notebook Python Notebook Jun 21, 20...
  - Chennai Flood Analysis... Python Notebook Jun 21, 20...



# ArcGIS GeoAnalytics Road Ahead

## Noah Slocum



# ArcGIS GeoAnalytics Server

*Tools for processing **large vector and tabular data** with both **spatial (location) and temporal (time) components** using **distributed analytics and storage***

- ArcGIS Enterprise server role released at 10.5
- Run analysis in Pro, Portal, or the ArcGIS Python API
- Distributes analysis over multiple machines for faster processing time
- Supports reading directly from common data sources
  - File shares, HDFS, Hive, Amazon S3, Azure Data Lake
- Most tools support spatiotemporal analysis





# ArcGIS GeoAnalytics Server

## The Road Ahead:

- Expansion of basic data management capabilities:
  - *Clip, Merge, Dissolve*
- Expansion of spatial statistics and machine learning capabilities:
  - *Forest-based Classification and Regression, more in development*
- Developer story:
  - *Working on exposing GeoAnalytics functionality to developers*

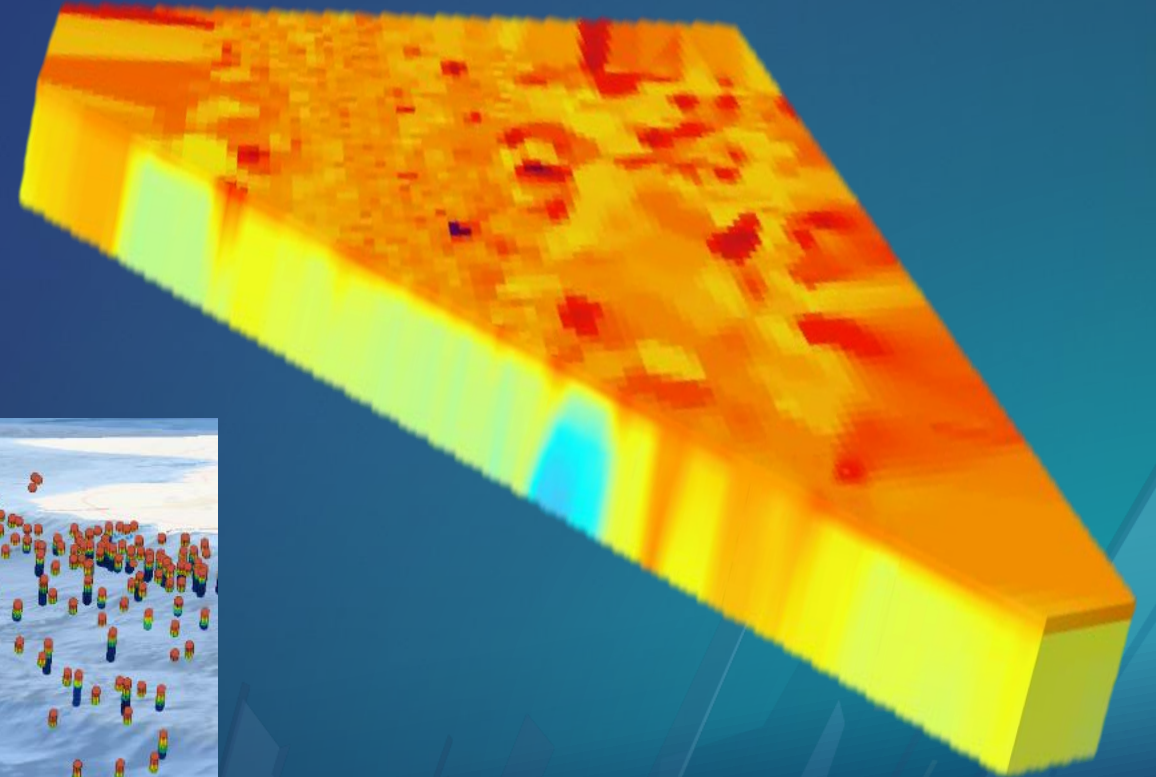
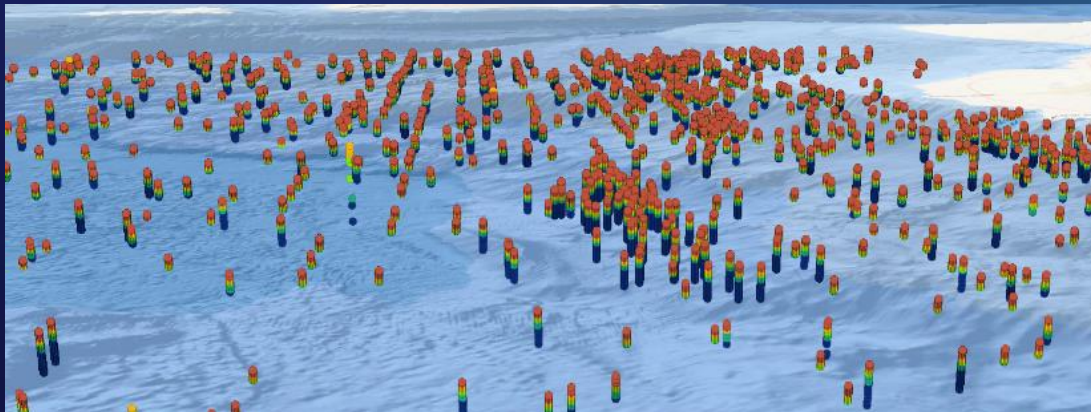


# Raster Analysis Road Ahead

Steve Kopp

## Geostatistical Analyst - 3D Interpolation

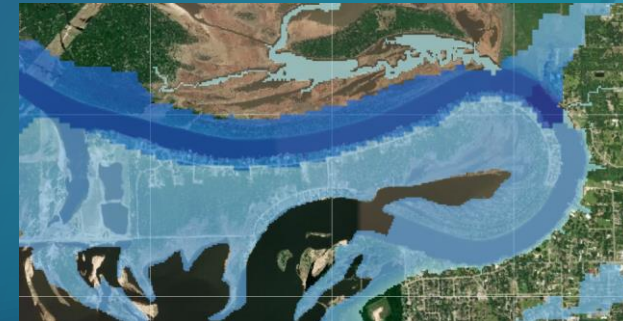
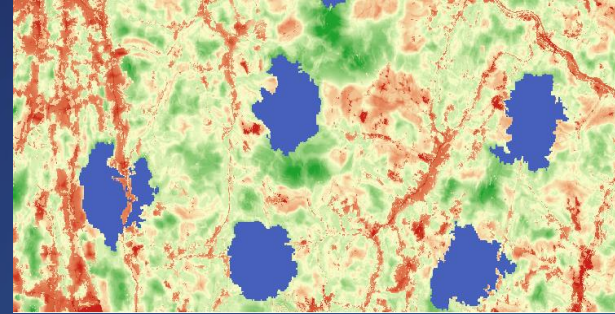
- Support requirements of ocean and atmosphere communities
- Extend geostatistical layer to 3D
- Leverage emerging Pro 3D scene layer capabilities





# Spatial Analyst

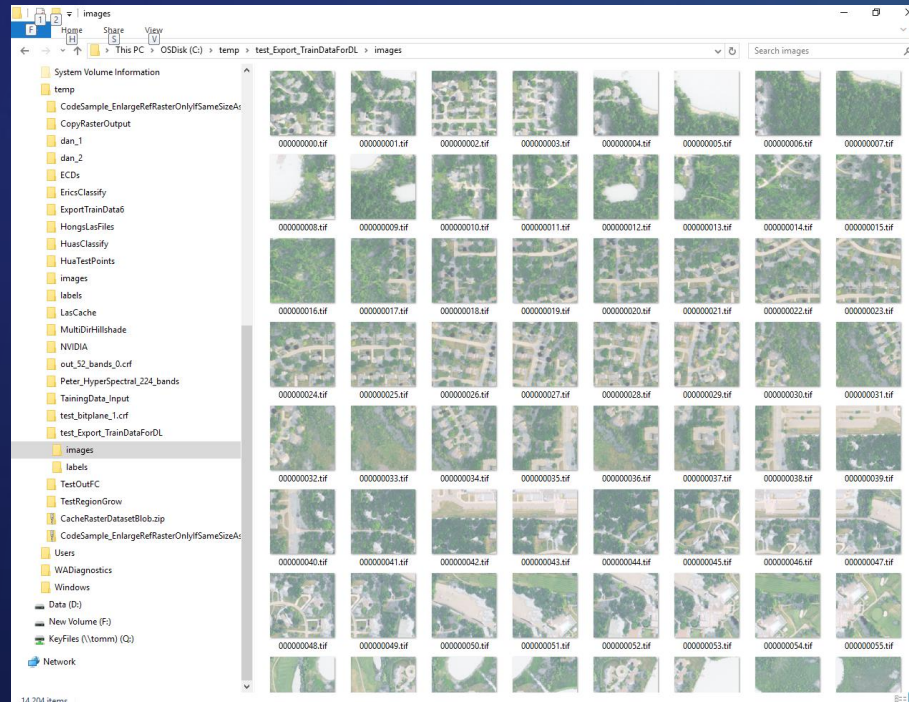
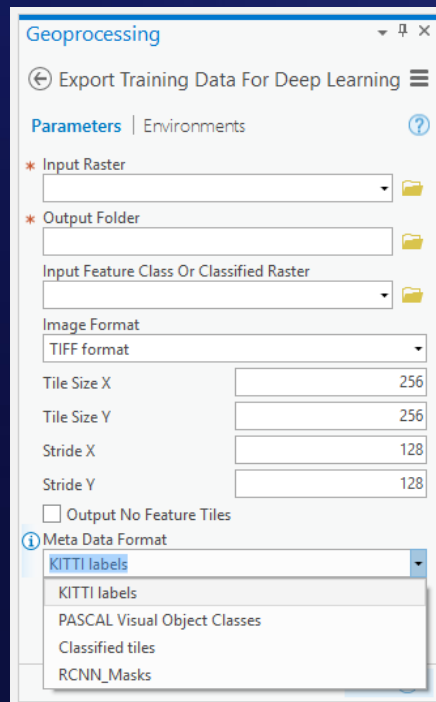
- Site selection / suitability modeling
  - New easier user experience
  - New analysis tools
- Distance analysis
  - Support cost geodesic distance, and true cost distance
- Hydrologic analysis
  - New elevation processing techniques for high resolution data
- *Optimize more key tools and expose in Image Server*





# Image Analyst – Deep Learning tools for Image Classification

- Leverage TensorFlow or CNTK as part of your ArcGIS imagery workflow
  - Export Training Data for Deep Learning
  - Detect Objects Using Deep Learning
  - Classify Pixels Using Deep Learning



## Enterprise Image Server *(big data raster analytics)*

- New suitability modeling dashboard web interface
- Function chain editor UI for building raster analytic workflows
- Continue to grow the collection of scalable distributed analytics tools
  - Path distance tools
  - Locate Regions
  - Neighborhood (focal) statistics tools
  - More new hydro tools





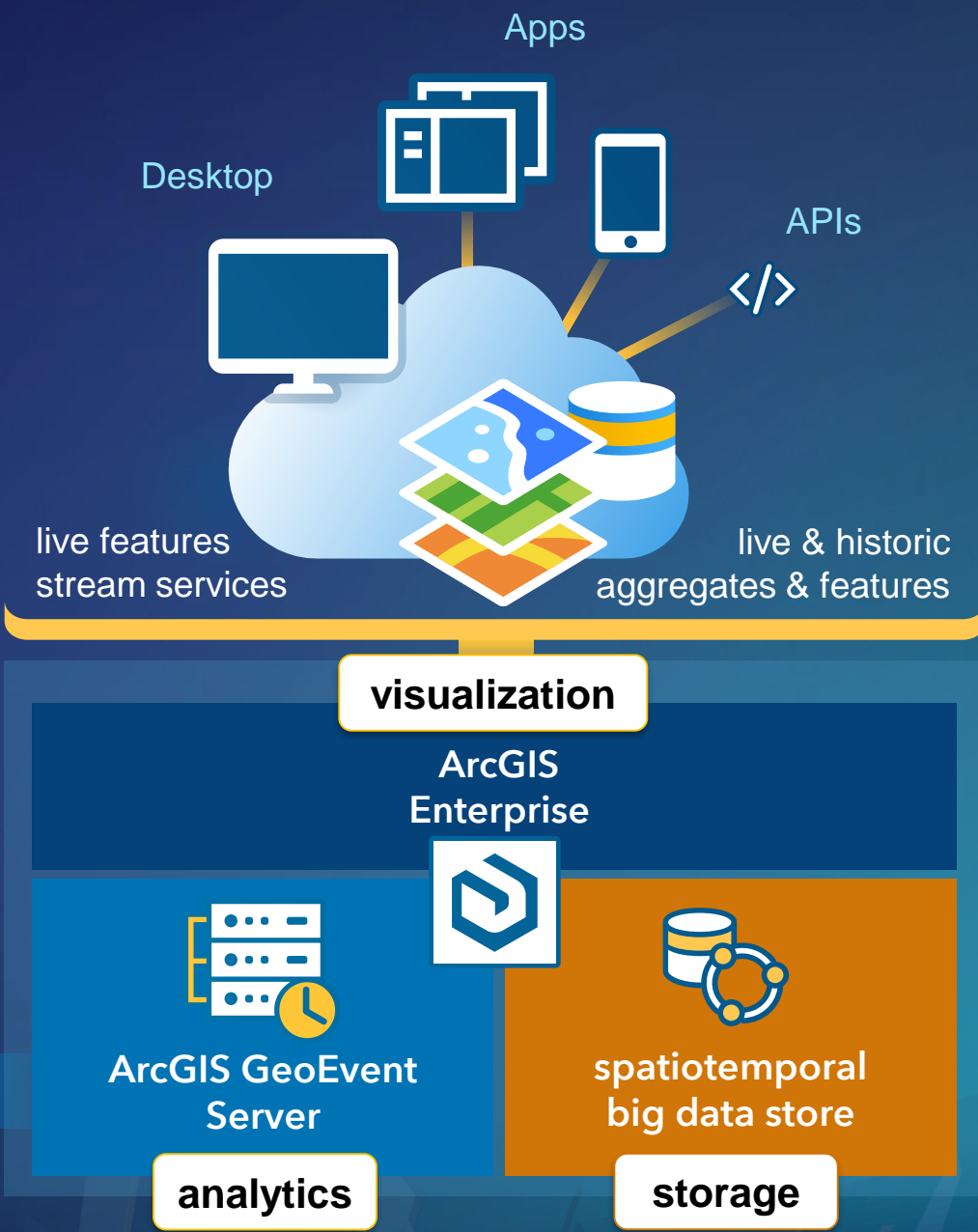
# Real-Time Analytics Road Ahead

Ashely Pengelly



# ArcGIS Enterprise

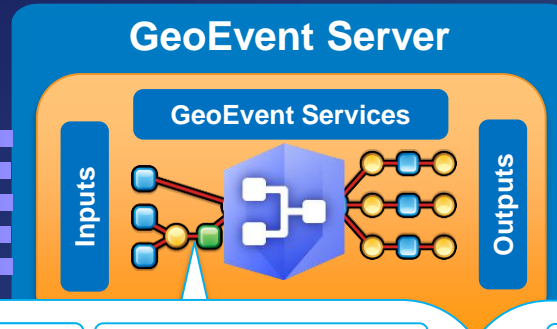
*with real-time capabilities*



## Road Ahead – Real Time Analysis

- **Real-Time Analytics and Big Data GIS as a service on ArcGIS Online**
- **Utilizing cloud computing and storage**
- **No need to host your own IoT infrastructure**

# Configurable Processors



you can create your own processors

**Out of the Box**

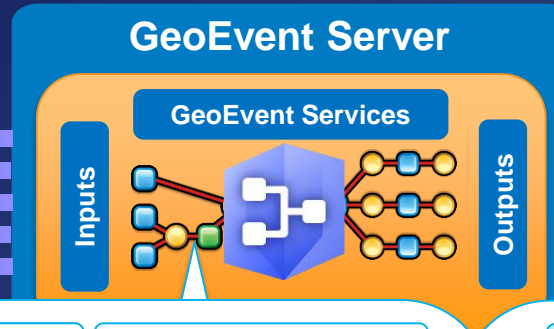
Buffer Creator	Geotagger
Convex Hull Creator	Incident Detector
Difference Creator	Intersector
Envelope Creator	Projector
Field Calculator	Simplifier
Field Enricher	Symmetric Difference
Field Mapper	Track Gap Detector
Field Reducer	Union Creator

**Esri Gallery**

Add XYZ	Range Fan
Bearing	Reverse Geocoder
Ellipse	Service Area Creator
Event Volume Control	Symbol Lookup
Extent Enricher	Track Idle Detector
Field Grouper	Unit Converter
GeoNames Lookup	Visibility
Motion Calculator	Query Report



# Configurable Processors



you can create your own processors

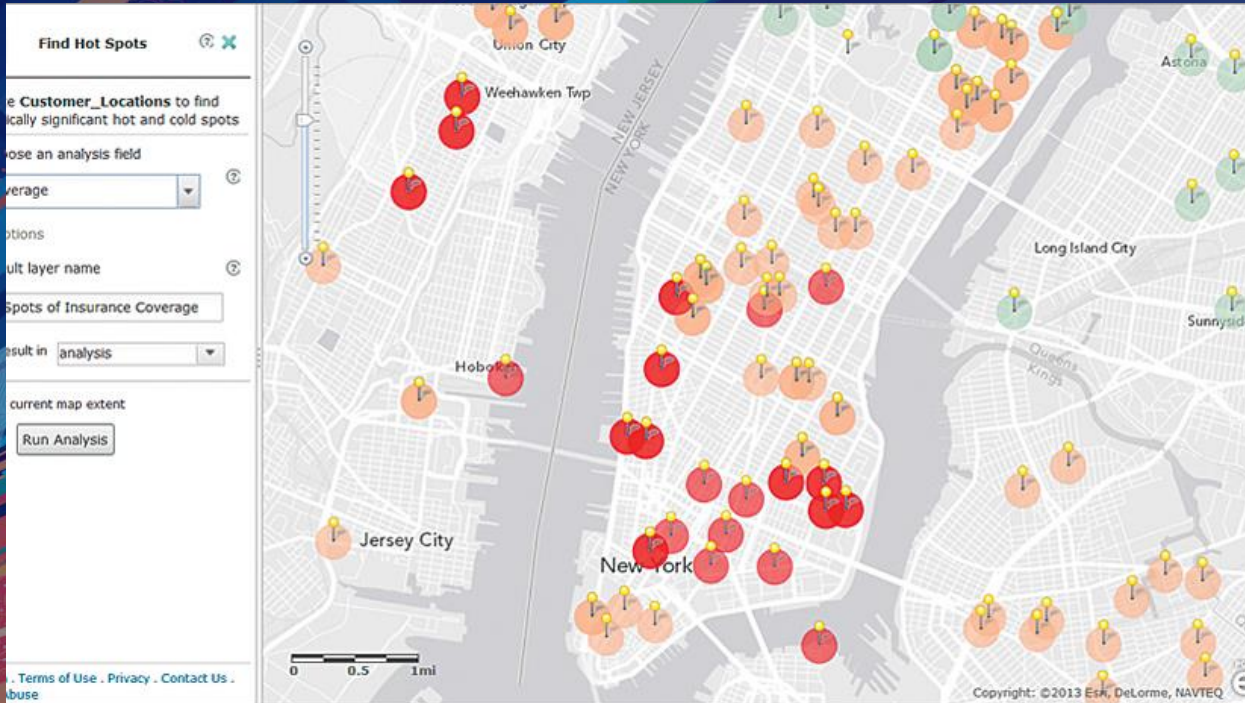
**Out of the Box**

Buffer Creator	Geotagger
Convex Hull Creator	Incident Detector
Difference Creator	Intersector
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**Esri Gallery**

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Field Grouper	Unit Converter
GeoNames Lookup	Visibility
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Several of the more common add-on processors available through the Esri Gallery and our GitHub Repositories are being targeted for inclusion into the core product with the 10.7 release.

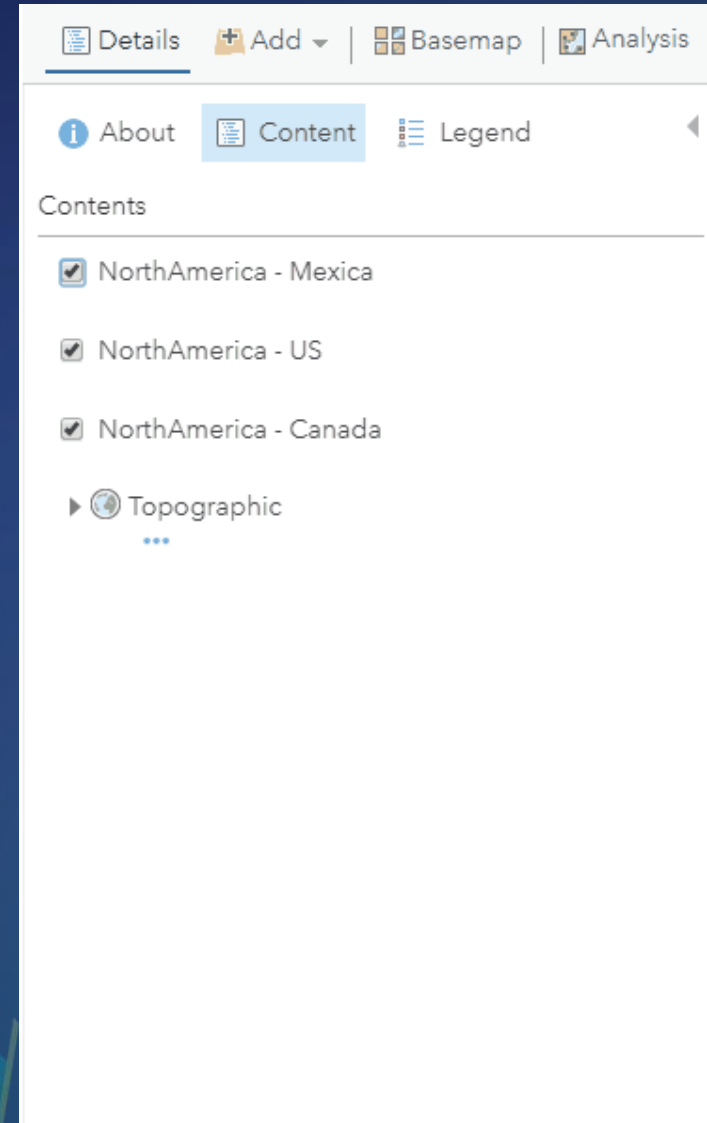


# Online Analysis Road Ahead

Ashely Pengelly

# Online Analytics

- Framework for running all “out of the box” analytic functionality
- Standard Tools
  - ArcGIS Online / Portal for ArcGIS
  - 29 tools
    - answer the most common spatial questions
  - Supported by:
    - Network analysis
    - Elevation
    - Hydrologic
    - GeoEnrichment services.

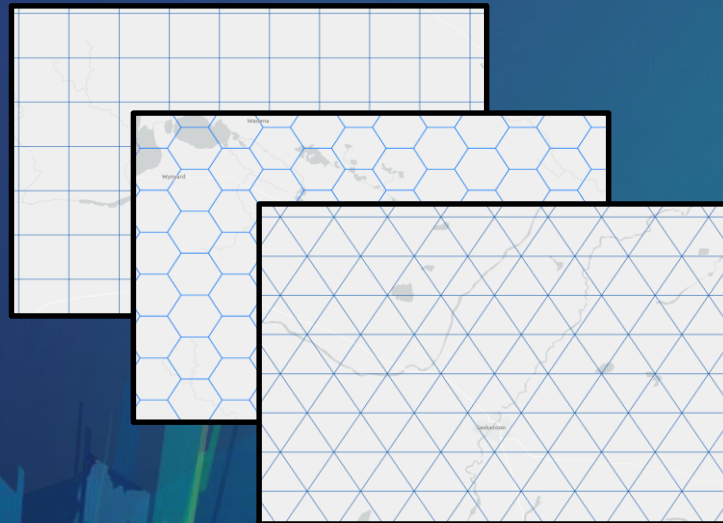




# Road Ahead – Analytics Online

- **New Tools**

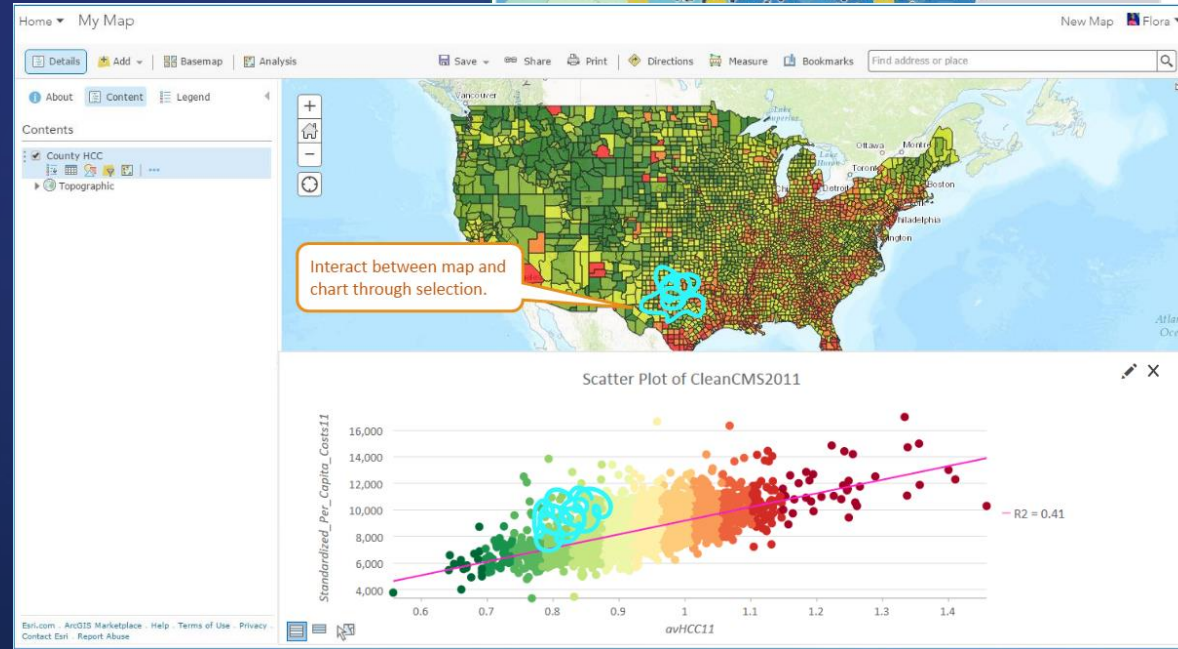
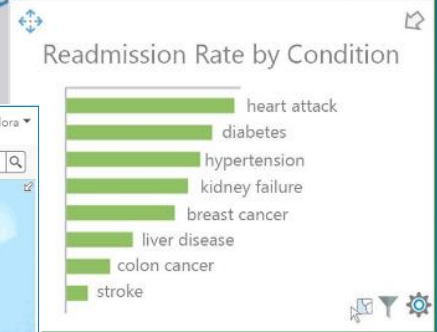
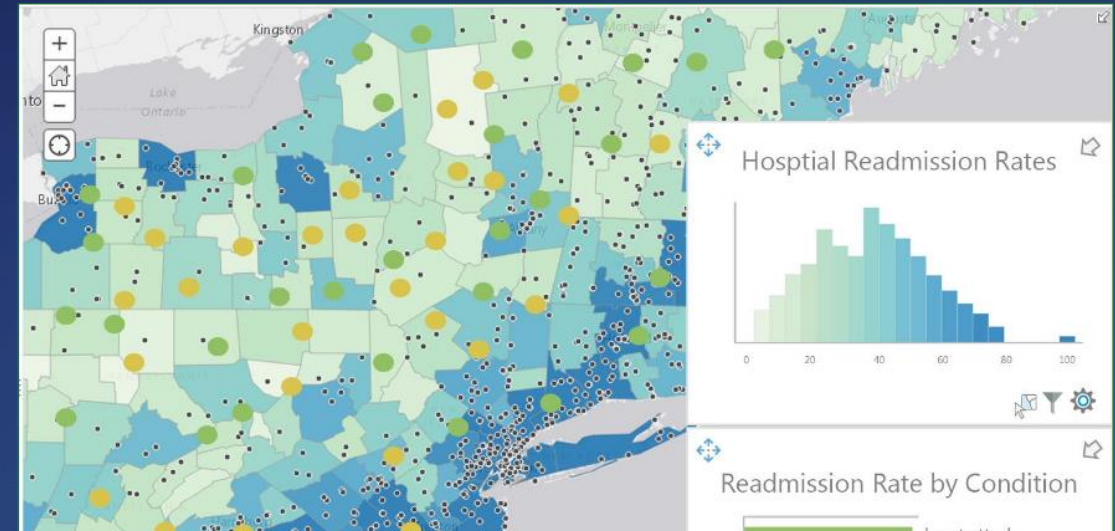
- New Machine Learning tools (TBD)
  - Find Point Clusters (10.6.1/6.3)
  - Forrest Based Classification & Regression
- Summarize Center and Dispersion (10.6.1/6.3)
- Generate Tessellations (TBD)



# Road Ahead – Analytics Online

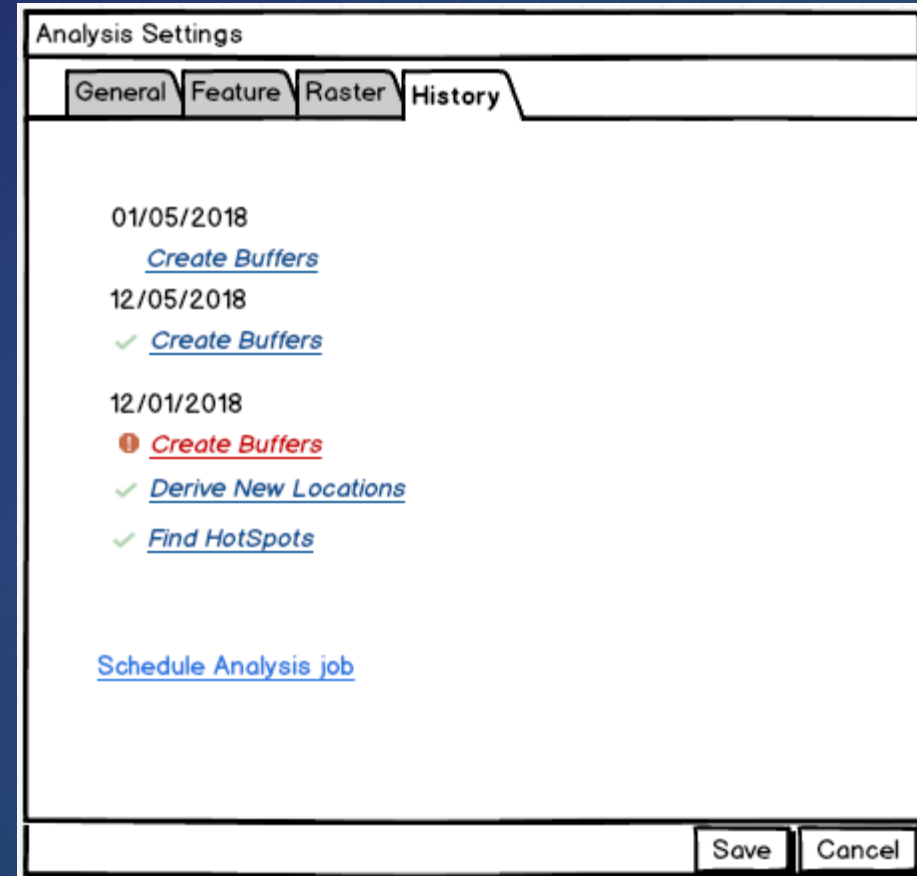
- Charting

- Support analysis workflows
- Visually explore and understand results



# Road Ahead – Analytics Online

- Tool history and job scheduling
  - Open
  - Run
  - View Details
  - Schedule
  - Delete





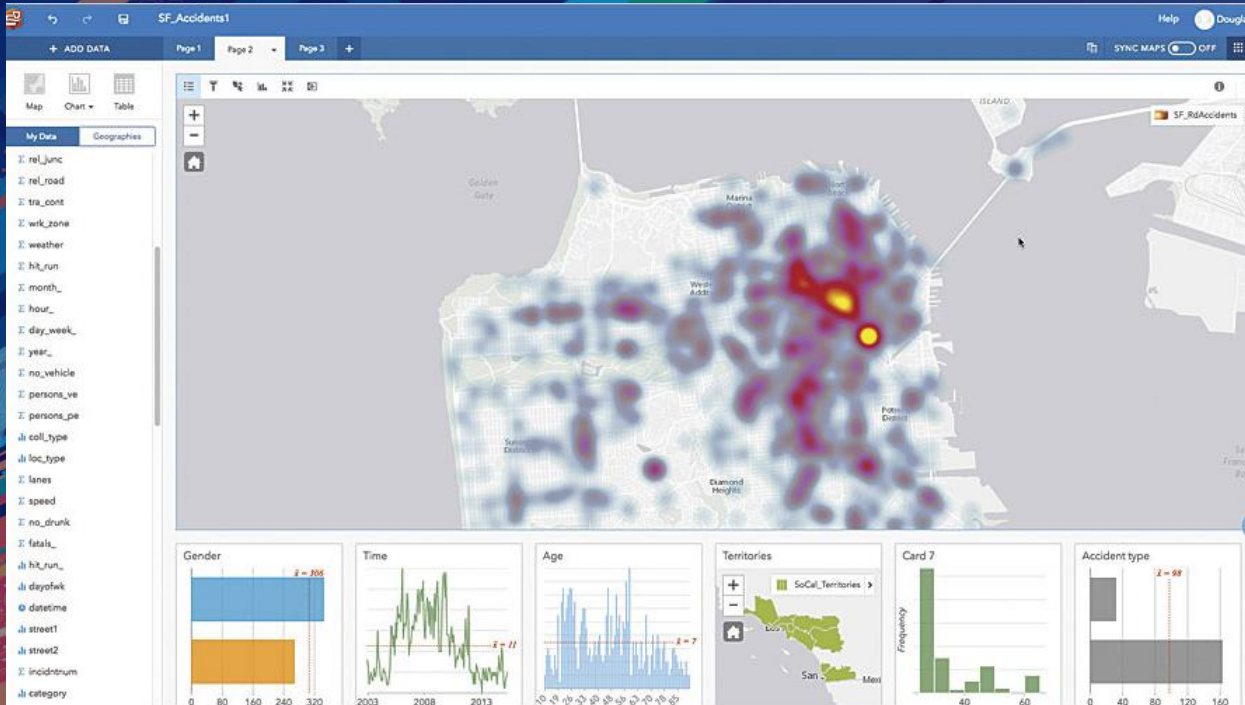
# Road Ahead – Analytics Online

- **Future Enhancements**

- Performance improvements
- Results as feature collections or feature services
- Overwrite result layers
- Filter input layers

Store analysis results as feature services



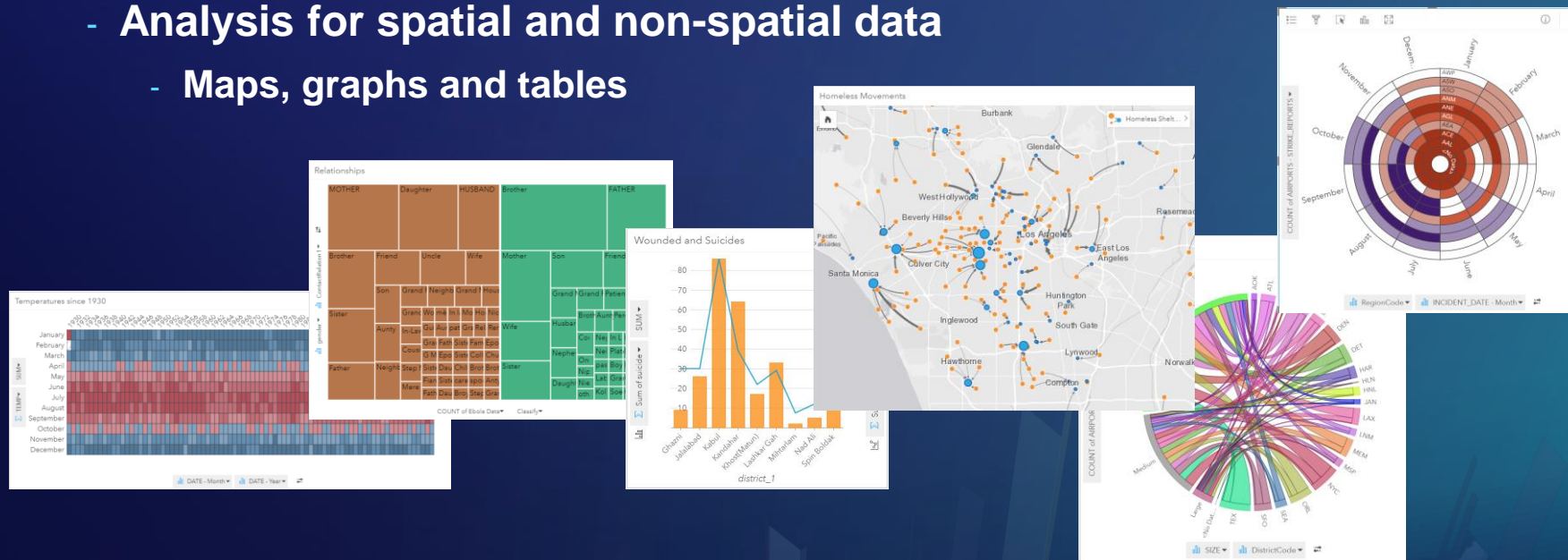


# Insights for ArcGIS Road Ahead

Linda Beale

# Insights for ArcGIS

- **Ease of accessibility to standard analytical approaches**
  - Send computation to the database
  - Connect to SQL, ORACLE, SAP-HANA
  - Can connect to GeoAnalytics
- **Analysis for spatial and non-spatial data**
  - Maps, graphs and tables





# Applicability of link analysis

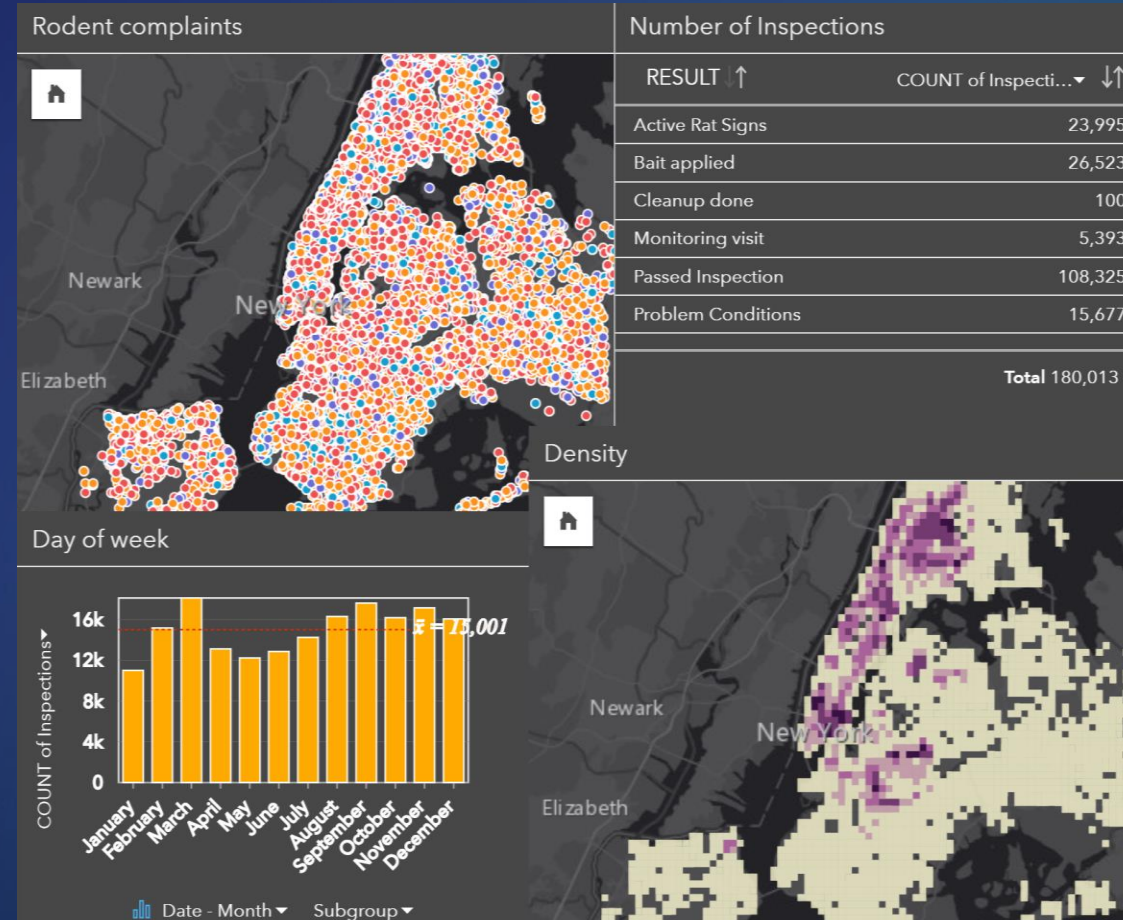
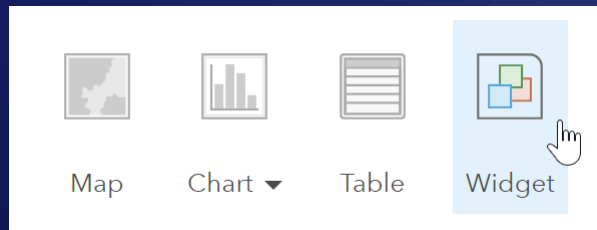


- **Which nodes are critical sections of a network?**
  - Lines of communication in business or crime networks
  - Electrical transmission or water towers, distribution transformers or water mains etc.
  - Road intersections or bridges
  - Servers that are likely to get the most load
  - Key distribution centers, finding catchment and service areas
  - Spread of epidemic diseases
  - Critical transport routes by affected people
  - Flow of information of goods between people or places



# Analytic Journals

- Page and card options
- Widgets
  - e.g. rich text card



# The coming year

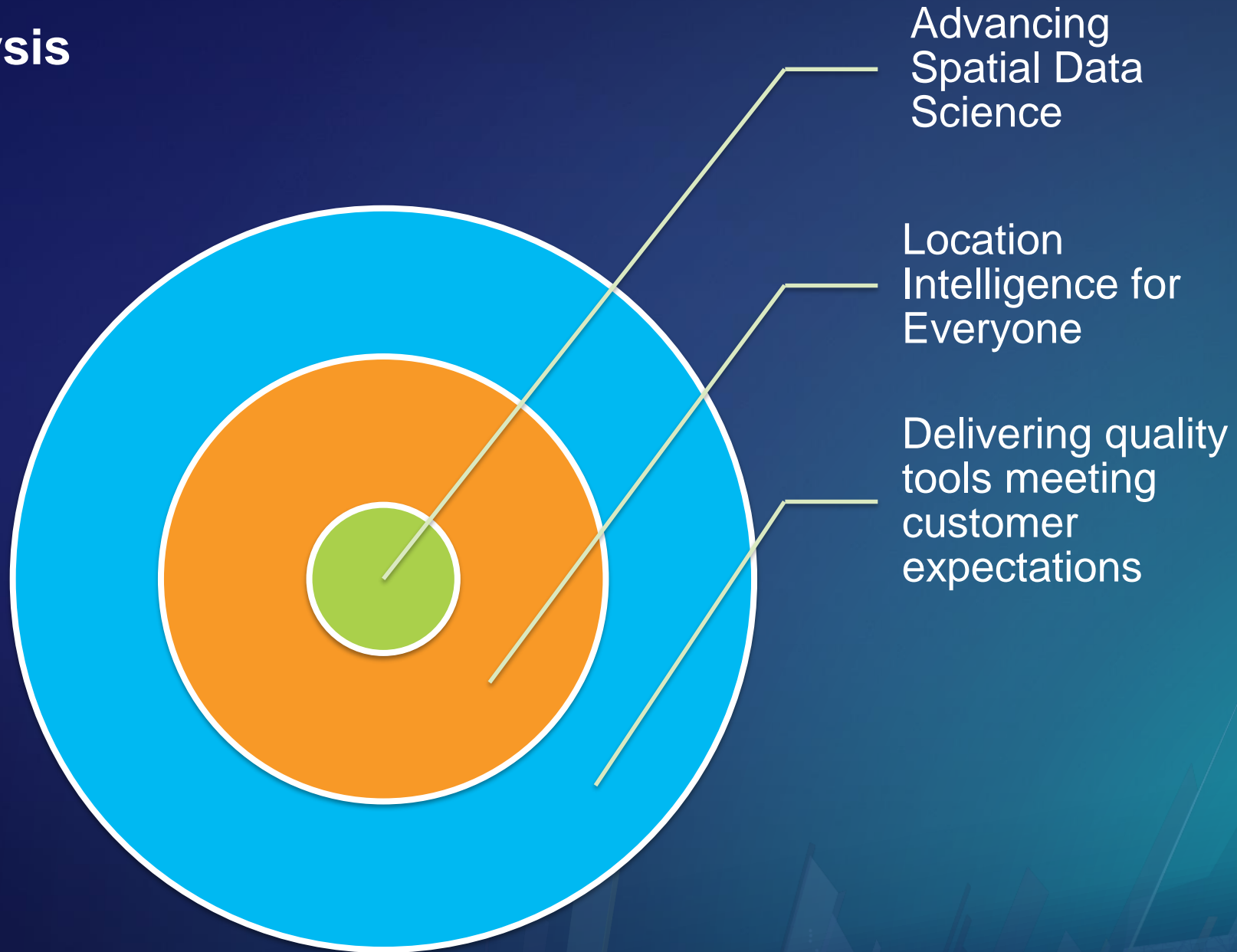
- **Ease of accessibility to standard analytical approaches**
- **Expanding analytical capabilities**
  - Trend analysis
  - Cluster analysis
  - More temporal analysis
- **Including access to Python Notebooks and R**
  - Providing ability to include customized analysis
- **Ease of data connection**
  - Continuing to extend our data connectors
  - Developing an API to allow developer extensibility





# Spatial Analysis

Our Goal



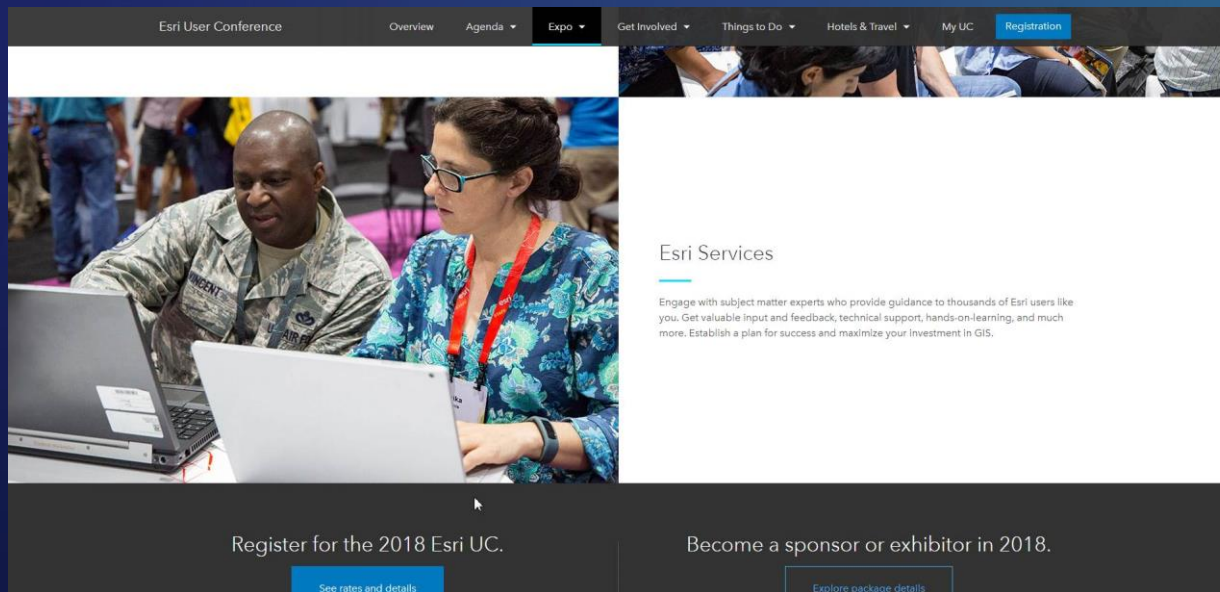
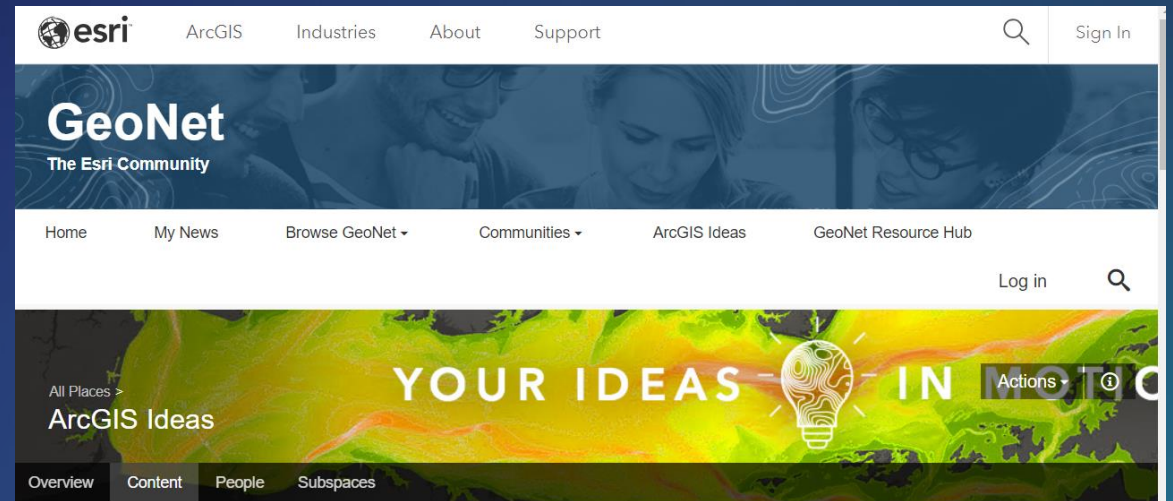
# We like to hear your feedback

- Ideas:

- Add to ideas website

<https://community.esri.com/community/arcgis-ideas/>

- Spatial analytics showcase

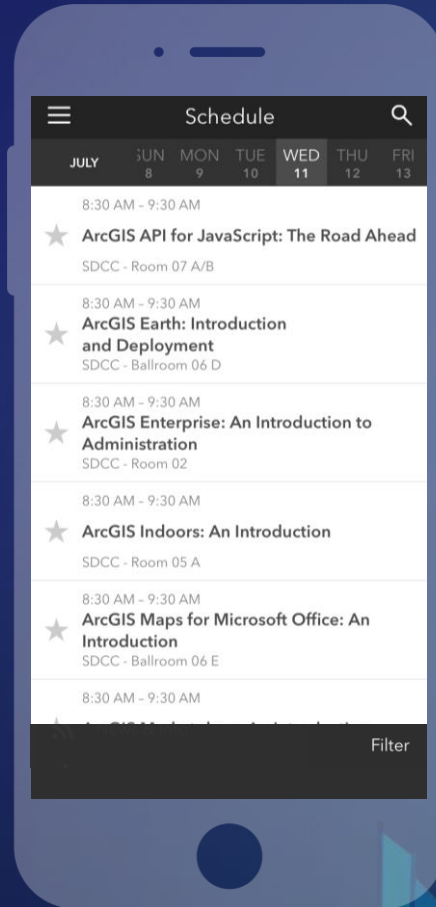


# Please Take Our Survey on the App

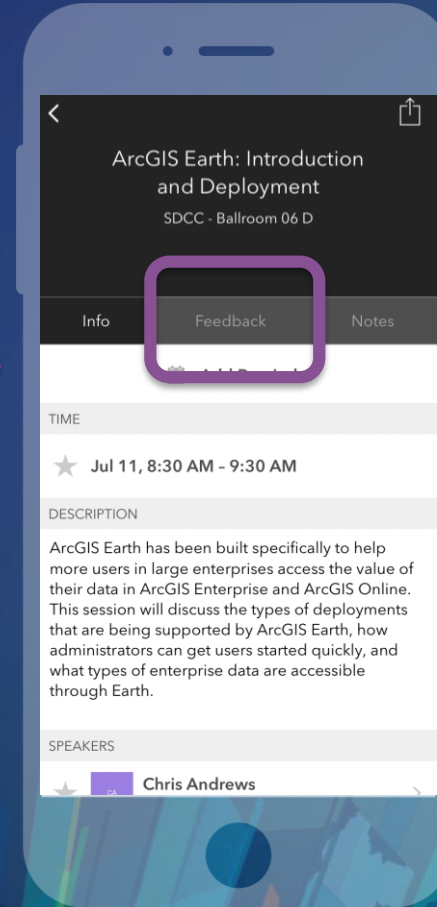
Download the Esri Events app and find your event



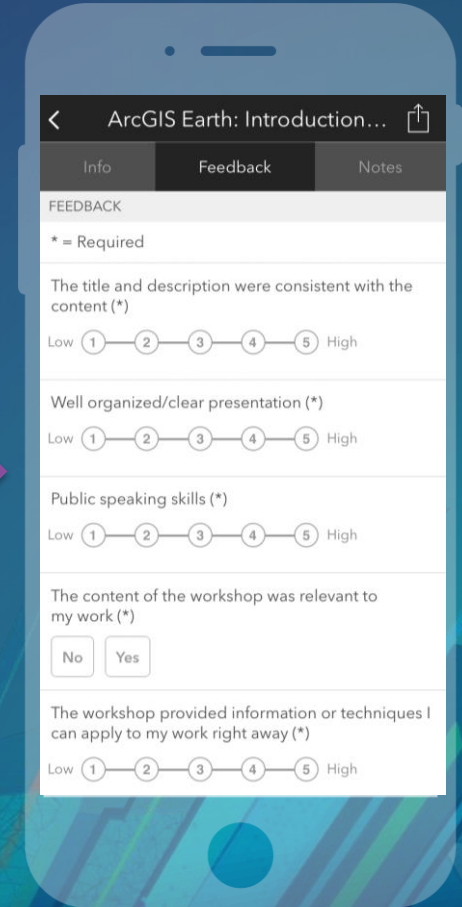
Select the session you attended



Select the Feedback tab



Complete answers and select "Submit"







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OF  
WHERE**