



# Exploring Data Visualization and Analytics with ArcGIS

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A stylized graphic in the bottom right corner featuring a stack of vertical bars in various colors like blue, red, and green. Overlaid on this are several thin, light-colored contour lines representing topographic or elevation data. A small orange rectangular box contains the text.

**GIS**  
**INSPIRING**  
**WHAT'S**  
**NEXT**

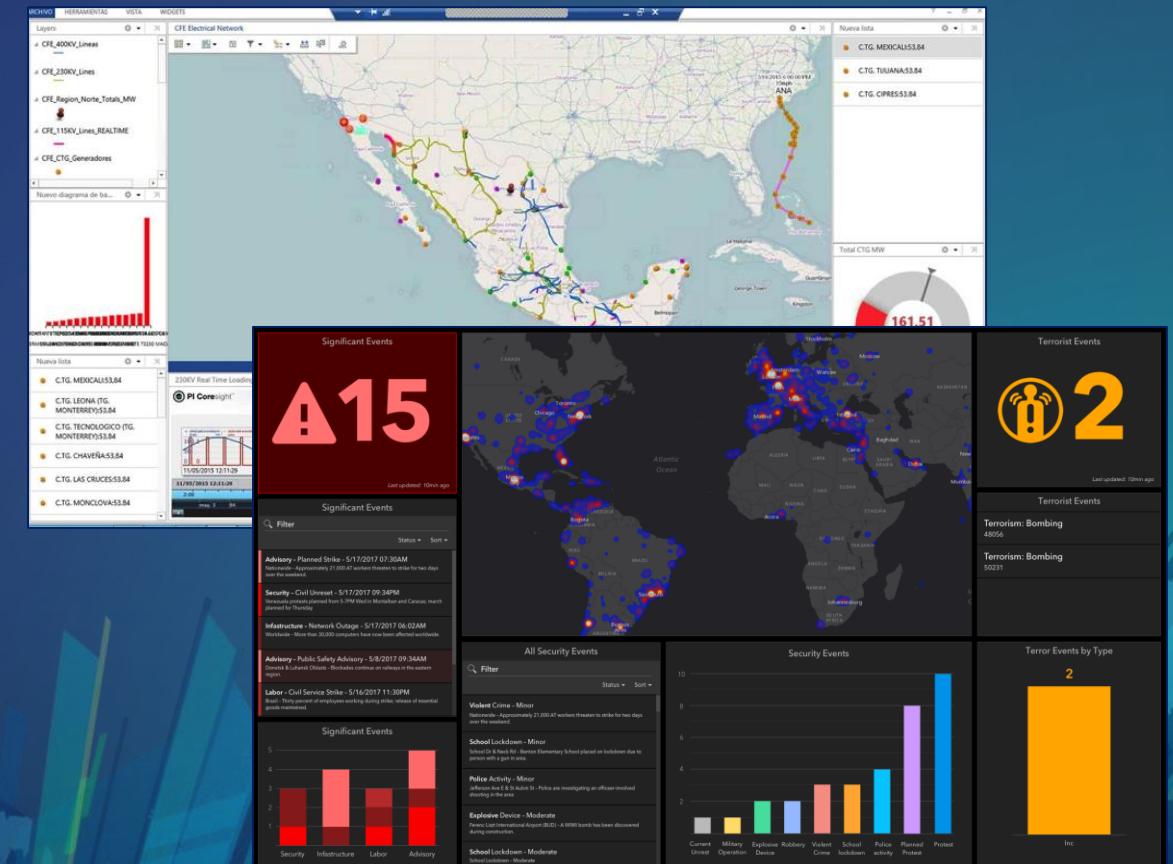
Hello!



# Operations Dashboard for ArcGIS



Monitor real-time operations



Key performance indicators (KPIs)

Enables at-a-glance decision making

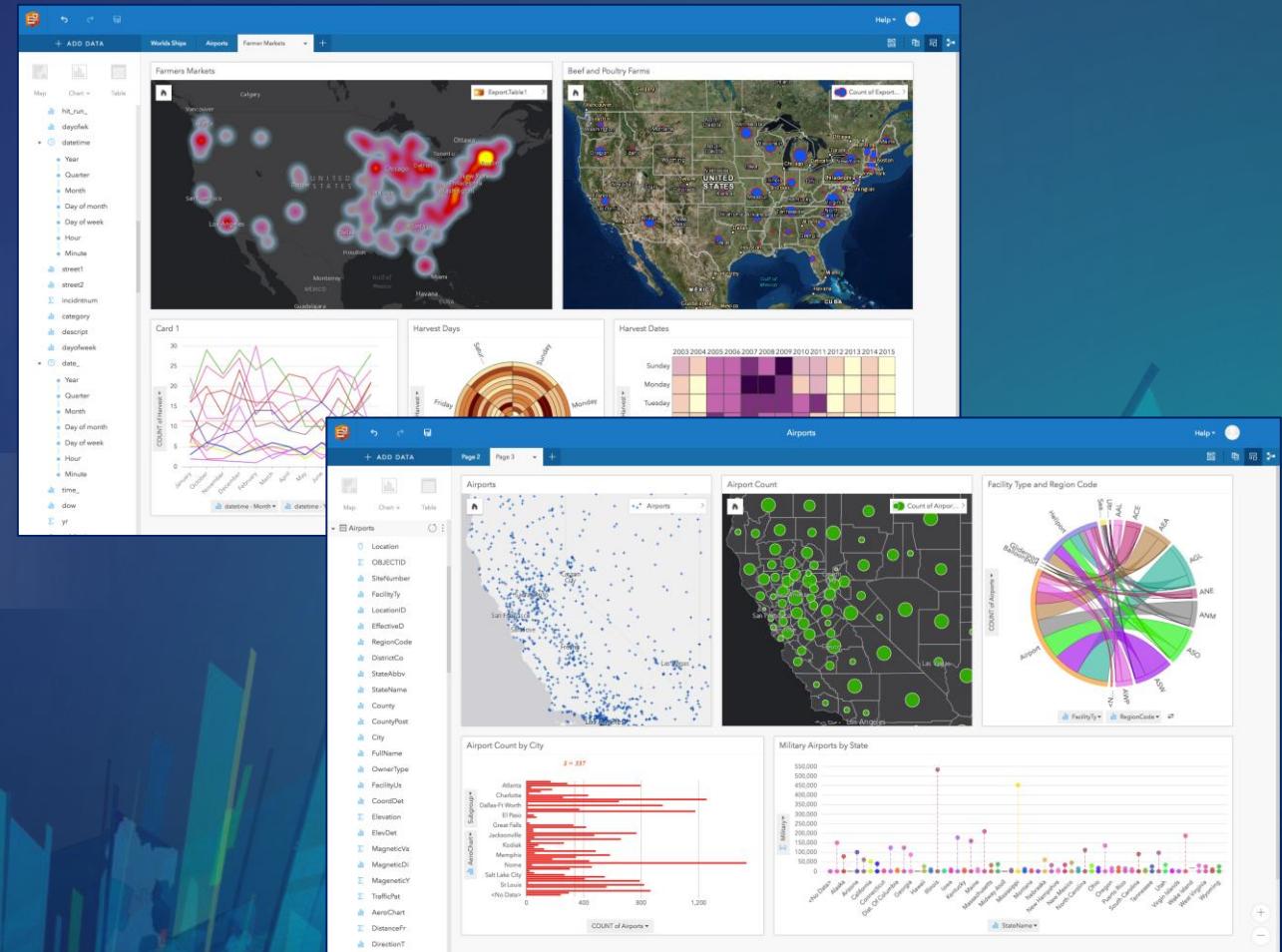
# Insights for ArcGIS



Exploratory spatial analytics

Visual, intuitive, dynamic

Fast data discovery



# Story Map Apps



Tell a narrative with text, maps, and media

8 different templates

“My Stories” app console



# ArcGIS Dashboards

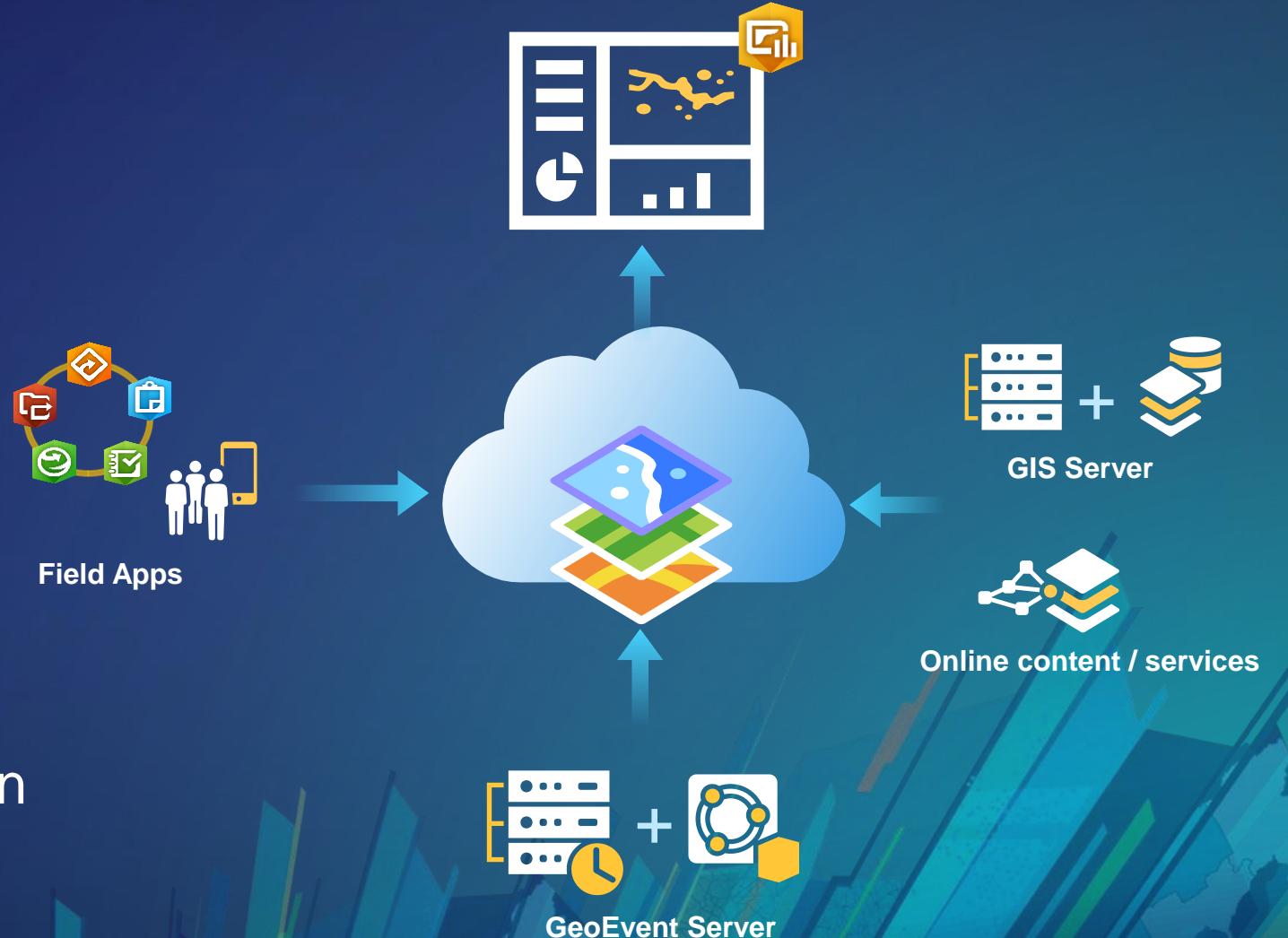
# Built-in functionality

- Ready to use data visualizations
  - Map, Legend
  - Serial chart, Pie chart
  - Indicator, Gauge
  - List, Details
  - Embedded content, Rich text
- Various tools and interactivity options
  - Tools that interact with the map (e.g. layer visibility, bookmarks, search)
  - Dashboard elements configured to communicate with each other (e.g. cross filter)



# Dashboards bring data together

- ArcGIS platform:
  - Real-time data
    - Coordination of work across an organization
    - Sensor data, social media, GPS locations, etc.
  - Other data
    - GIS Server
    - Online content and services
- Dashboards present the data in intuitive/compelling ways



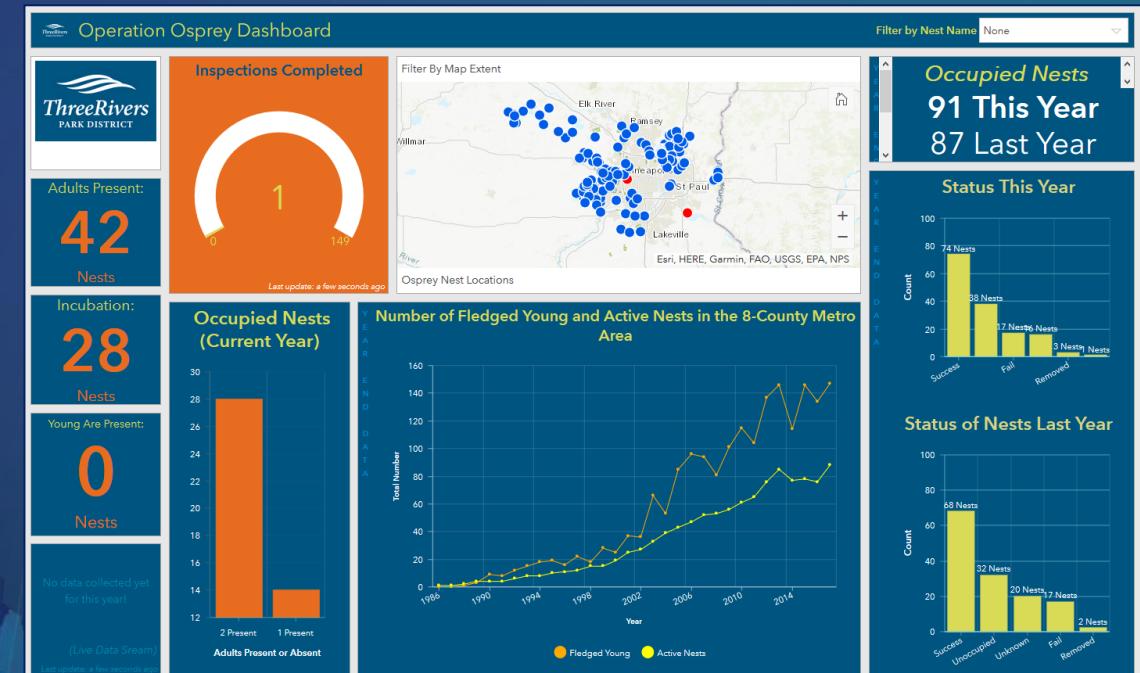
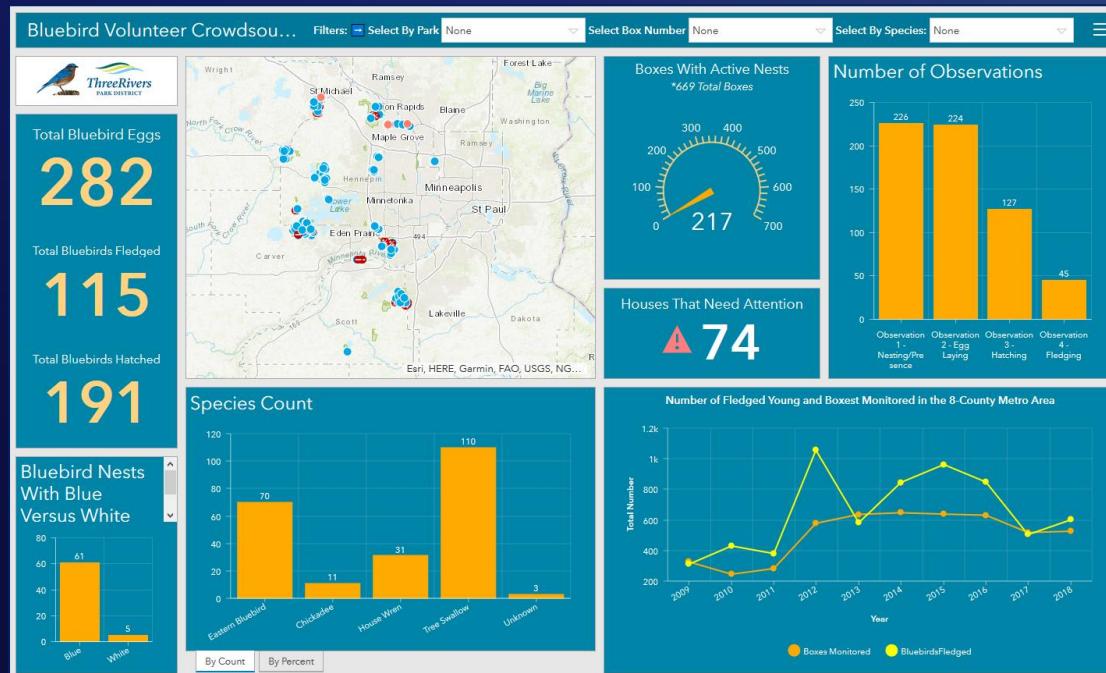
# Dashboards - Patterns of Use

- Monitor and manage operations/assets
  - IoT (e.g. sensor feeds)
  - Provide common operational picture
- Event Management
  - Situational awareness, emergency management
  - Visualize assets, personnel, activities, weather
- Summaries/Performance
  - Visualize and compare
  - Guided data insights
- Many, many others ...



# Three Rivers Park District, MN

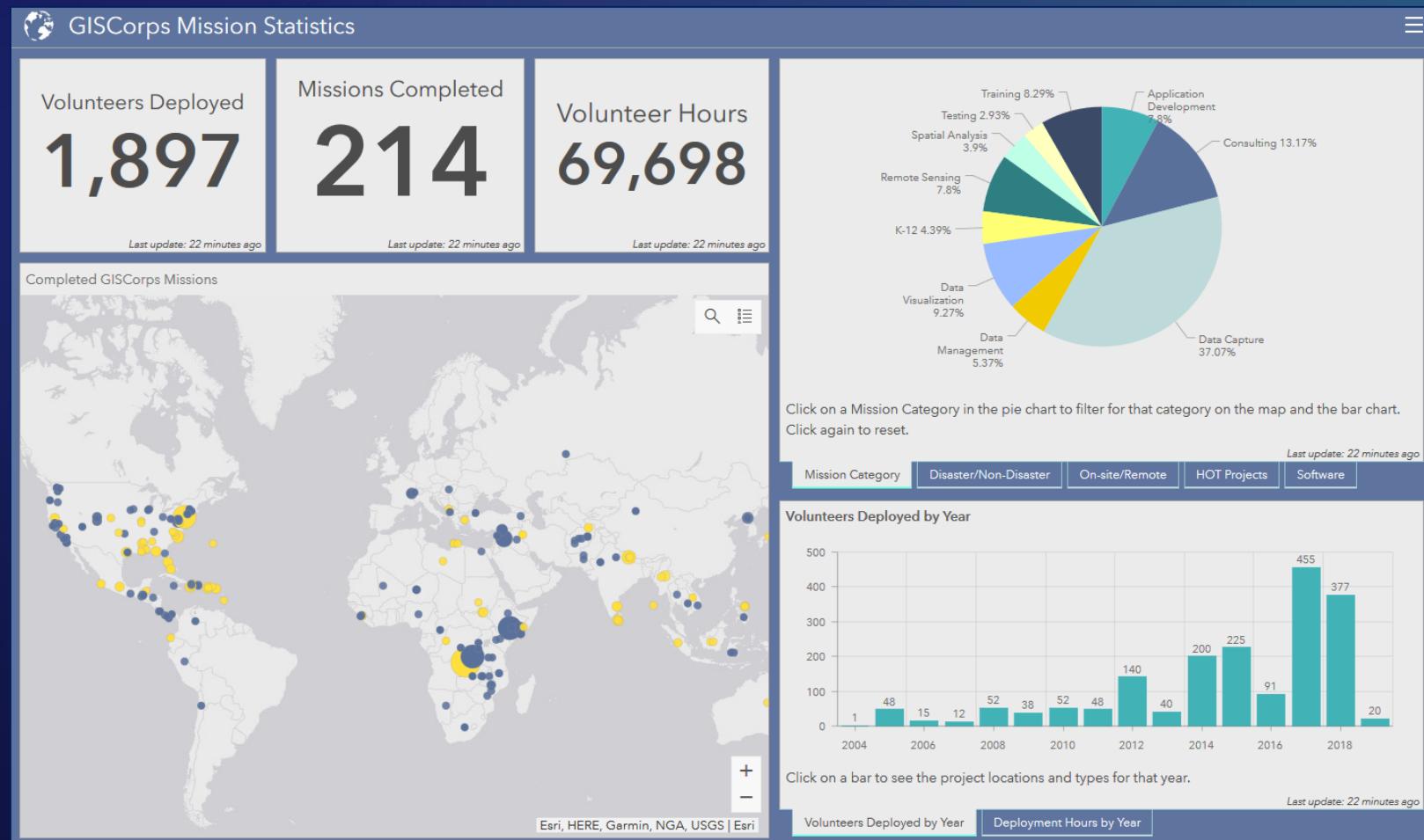
- Bird Count Dashboards
  - Bluebird Volunteer Crowdsource: <https://bit.ly/2JzSjvT>
  - Operation Osprey: <https://bit.ly/2sQf5cF>



# URISA GISCorps

[arcg.is/14v9Dj](http://arcg.is/14v9Dj)

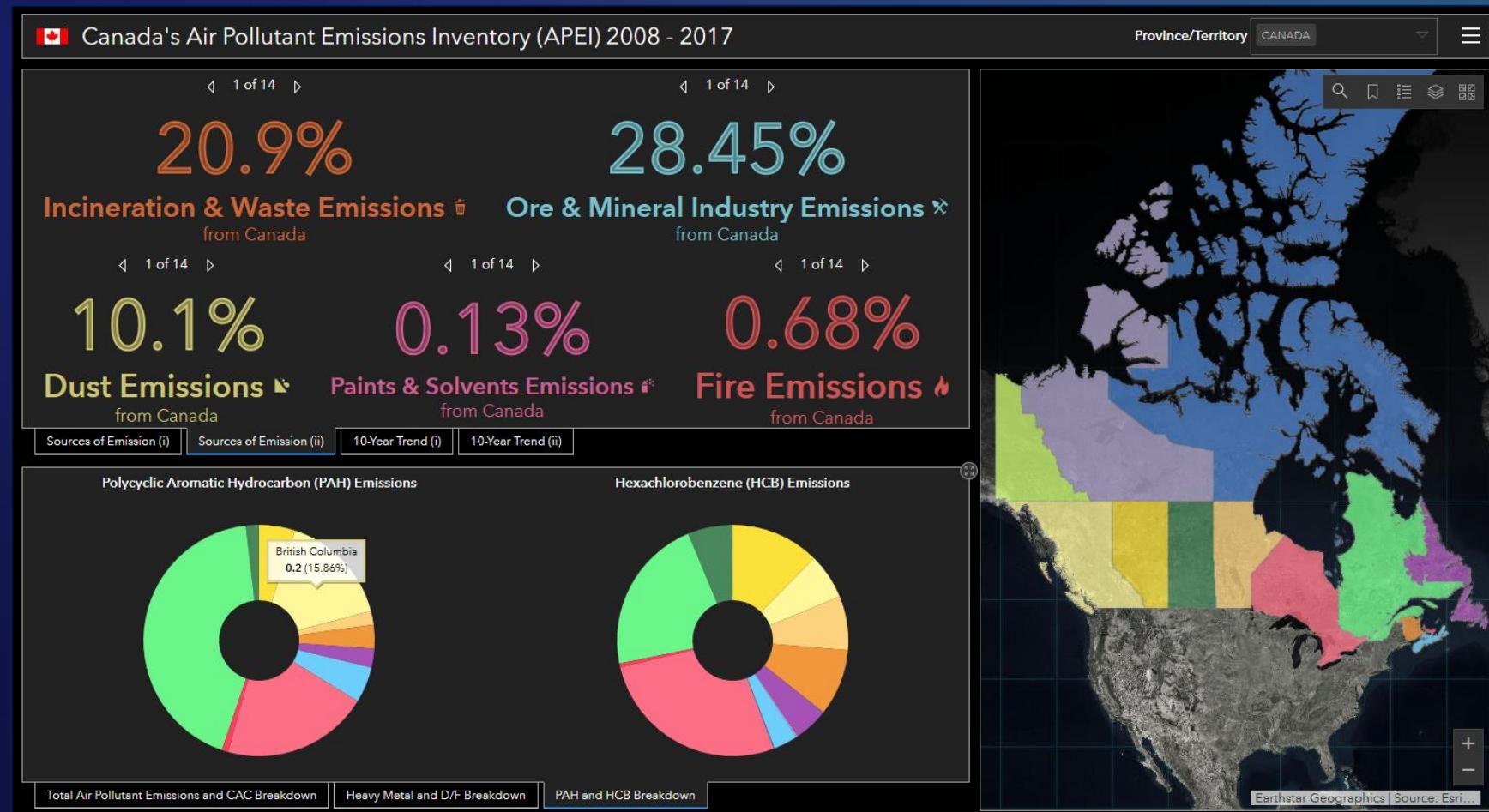
- GISCorps Mission Statistics Dashboard



# Natural Resources Canada

<http://arcg.is/045O4m>

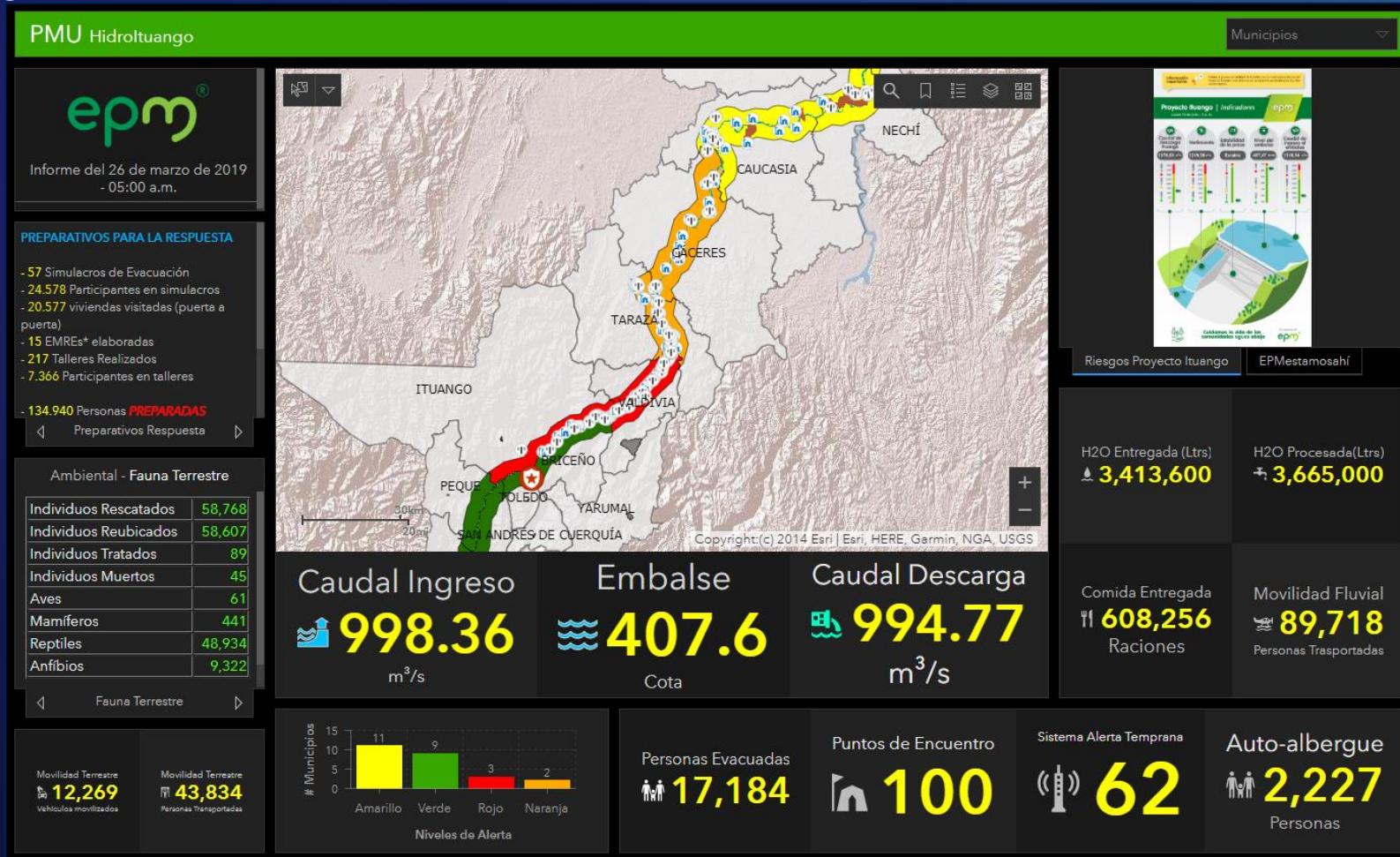
- Canadian Air Pollutant Emissions Inventory Dashboard



# Public Companies of Medellín

<https://bit.ly/2FPMn11>

- Hidroituango Dam Event Dashboard



# City of Vancouver Police, BC, Canada

[p.ctx.ly/r/90w8](https://p.ctx.ly/r/90w8)

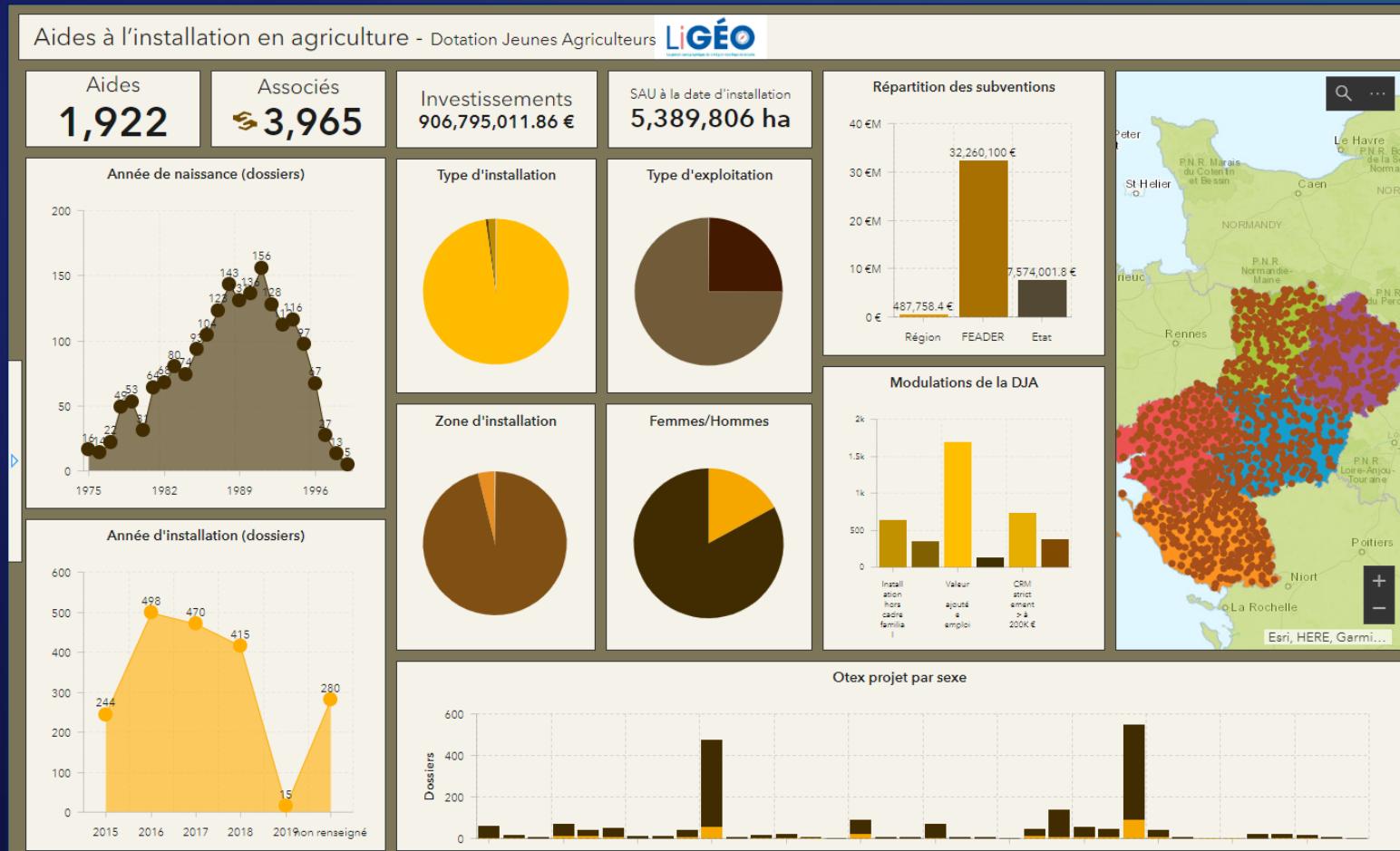
## • GeoDASH Crime Statistics Dashboard



# Region des Pays de la Loire

<http://bit.ly/2XWwjTb>

- Agriculture Aid Staffing Dashboard



# Arizona Dept of Emergency Management Agency

<https://bit.ly/2J1fP5j>

- Governor's Briefing Journal

AZ ESF/RSF Operations Dashboard

Governor's Briefing CBP Southwest Weather ESF 4 - Firefighting DFFM ESF 5 - Emergency Management DEMA ESF 6 – Mass Care DEMA ESF 7 - Logistics DEMA SERRP EMAP Accredited

**Twitter Updates AZ Fires**

**Arizona Fire News**  
A Twitter list by @EshreveAZ  
Arizona Fire News

BLM Arizona Fire Retweeted  
**Tonto NF** @TontoForest  
A community meeting for the #WoodburyFire will be held tomorrow, Tuesday, June 18 at 6:00 p.m. in Gold Canyon at the United Methodist Church.

**Woodbury Fire Information**  
OFFICIAL  
  
**COMMUNITY MEETING GOLD CANYON**  
Tuesday, June 18, 2019 6:00 p.m.

**WebEOC Fire Reporting**  
(Click icon to Zoom)

**Woodbury:** 6/17/2019, 1:38 PM Update Woodbury  
Fire - The fire is approximately 37,765 acres with 0% containment. Continued hot and dry conditions are providing very persistent burning conditions. Through today's shift, heat sources transition from flanking fire to head fire with robust short duration upslope runs in brush. Triple digit temps and single digit RHs will continue to support additional growth where heat sources are present. The fire continues to push to the north impacting a major transportation artery (Hwy 88), high voltage power lines, Horse Mesa Dam, private businesses, private residences.

**Initial Attacks (Click Point to Zoom)**  
**Prescribe Fires (Click Point to Zoom)**

**Sandy FA:**  
0.1 Acres 6/17/2019, 12:16 PM Discovery Date Mohave County

**CORRALS:**  
0.1 Acres 6/17/2019, 12:16 PM Discovery Date Mohave County

**Strip:**  
0.5 Acres 6/17/2019, Last update: a few seconds ago

**Type 1 Fires (National)**  
Woodbury: 36,490 Acres & 0% Contained

**Type 2 ICS Fires (National)**  
Elk: 1,819 Acres & 79% Contained

Last update: a few seconds ago

Map Predictive Services Drought Fire Weather Outlook Type 1 ICS Fires Type 2 Type 3

AZ ESF/RSF Operations Dashboard

Governor's Briefing CBP Southwest Weather ESF 4 - Firefighting DFFM ESF 5 - Emergency Management DEMA ESF 6 – Mass Care DEMA ESF 7 - Logistics DEMA SERRP EMAP Accredited

**EMAC Days Committed**

**EMAC Deployments 1**

**EMAC Missions Details**  
FEMA Link URL

**Incident:** AR-2019 May 21 and continuing - Arkansas River Flooding  
**Incident Identifier:** AR-1528-RR-8633  
**Name:** Joan Brown  
**Status:** At Incident (Assigned)  
**Resource:** Volunteer Agency Liaison  
**Location:** : Bldg 9501, Camp J T Robinson, North Little Rock, AR 72199  
**From Date:** 6/4/2019  
**End Date:** 7/3/2019  
**Days Left:** 16  
**Days Committed:** 29

**Job Description:** Provide expertise on available public and private resources and ways in which voluntary agencies may help disaster survivors. Coordinate with State and National VOAD to identify sources of disaster funding, skilled labor, donations and disaster case management, and other available services. Coordinate and integrate State Wide Voluntary/Community Agencies

**EMAC Total Cost** \*Costs are Estimated

Last update: a few seconds ago

Details Mission Status

**EMAC Missions (Click icon to filter list for Details)**

Incident: AR-2019 May 21 and continuing - Arkansas River Flooding  
At Incident (Assigned)  
Resource: Joan Brown  
Day Committed: 29

Incident: AK 2018 November Cook Inlet Earthquake  
Returned From Assignment  
Resource: Joan Brown  
Day Committed: 23

Incident: Severe Storms, flooding, mudslides  
Returned From Assignment  
Resource: Dave Heinert  
Day Committed: 95

Incident: Kilauea East Rift Zone Event (Volcano/Lava Flow)  
Returned From Assignment  
Resource: Dennis Erickson  
Day Committed: 81

Incident: Kilauea East Rift Zone Event (Volcano/Lava Flow)  
Returned From Assignment  
Resource: Dennis Erickson  
Day Committed: 81

Incident: Hurricane Michael  
Returned From Assignment  
Resource: Dennis Erickson  
Day Committed: 29

EMAC Days Committed

EMAC Member	Days Committed
John Caughlin	13
Daniel Hickey	13
Lurecita Hernandez	14
Rich Muner	33
Jim Hick	37
Joan Brown	66
Dan Porth	118
Dave Heinert	132
Dennis Erickson	187

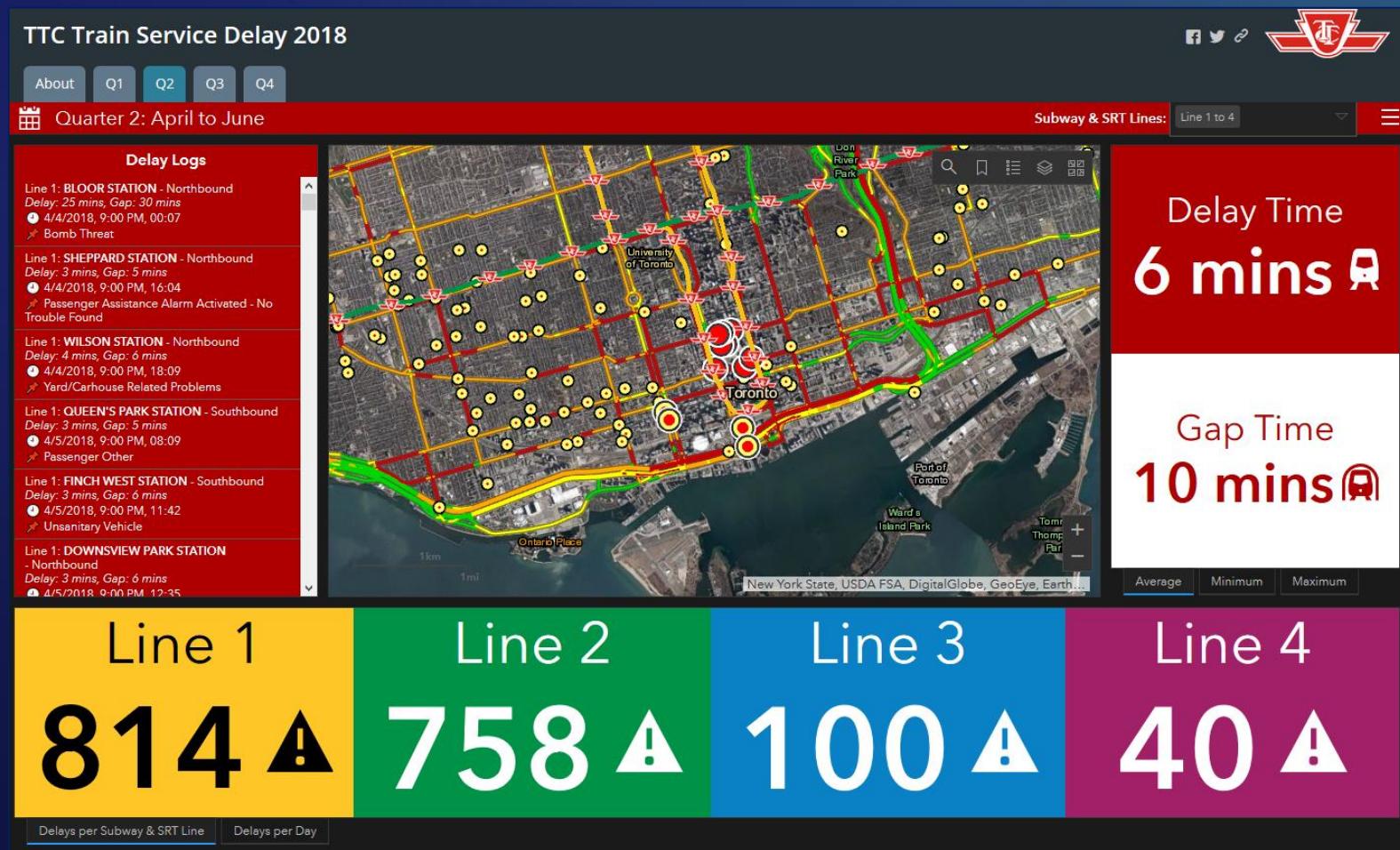
**EMAC Deployments 1**

EMAC Member	Deployments
John Caughlin	12.1k
Daniel Hickey	12.1k
Lurecita Hernandez	27.2k
Rich Muner	29.7k
Jim Hick	31.2k
Dave Heinert	40.1k
Dennis Erickson	55.3k
Joan Brown	60.8k
UH-60 (Blackhawk)	272.6k

# Toronto Transit Commission (TTC)

[arcg.is/0zbCi40](http://arcg.is/0zbCi40)

- TTC Subway and Train delays in 2018



# CTV News

<https://www.ctvnews.ca/business/real-estate>

- Vancouver and Toronto Housing Market Dashboards



# Resources

- Product Documentation: <https://arcg.is/2lVIC0R>
- GeoNet community: <https://arcg.is/2zamYzd>
- ArcGIS Solutions: <https://arcg.is/2lYHzNP>
- Esri training: <https://arcg.is/2nOdlwW>
  - Search for: “Operations Dashboard for ArcGIS” (include quotes)
- Blogs: <https://arcg.is/2ugxErp>
- YouTube videos: <https://arcg.is/3284V7w>

# Insights for ArcGIS



# Self-service location analytics



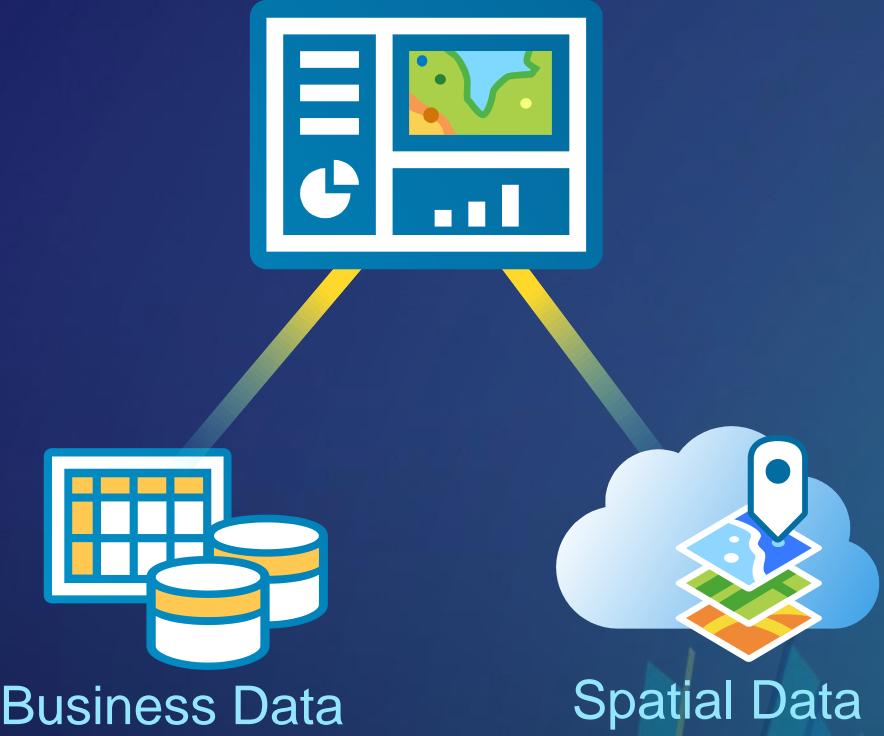
*Available as a SaaS, within your Enterprise, and locally on Windows or Mac*

# Powerful Analysis Made Simple

Usable Across Roles, Titles, and Skill Levels



# Business Data and Spatial Data Together in One Place





# Insights is analysis first, reporting second

- Analysis **finds answers**
- A process or procedure that **creates new information**
- Derivative **data available for re-use in other systems**
- Dashboards **present answers**
- A visualization or interaction that **communicates information**
- Data **remains within the visualization**

*Analysis creates new data and information, and finds answers..  
Dashboards present the answers to others.*

# Workbook

Page View

Analysis View

Page 1

Page 2

Page 3

Data Pane

Card 1

Card 2

Card 3

Widget 1

Widget 2

Widget 3

# Live Examples



Opioid Treatment Programs



Fishery Management



Population Change with Facebook data

# Data Preparation

# Use Data Where It Lives



Data Files



Enterprise GIS



Relational Databases



Python or R

# Working with your data

Data pane

Incidents

Shape → Location

Numeric → dc\_dist

Ratio → response rate

Categorical → dispatch\_date\_time

Date / time → dispatch\_date

Year

Quarter

Month

Day of month

Day of week

Hour

Minute

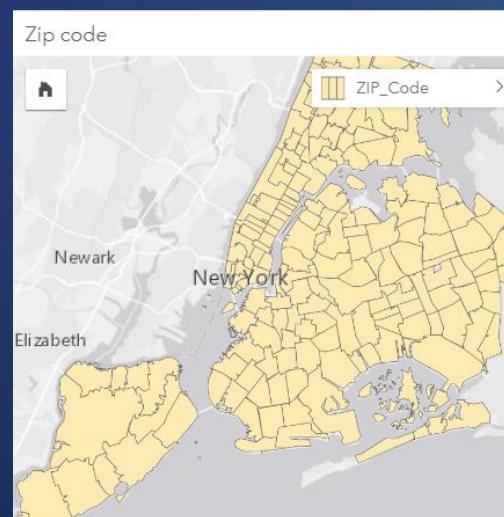
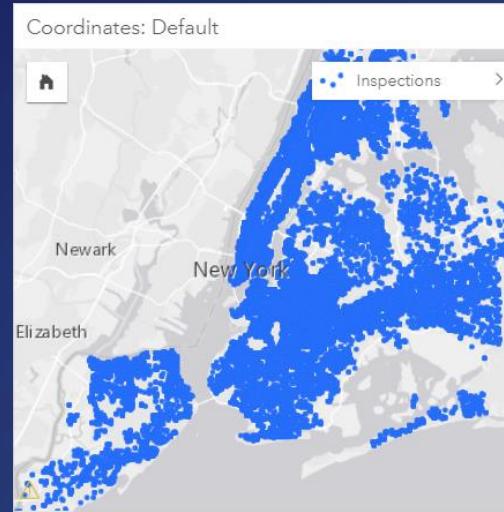
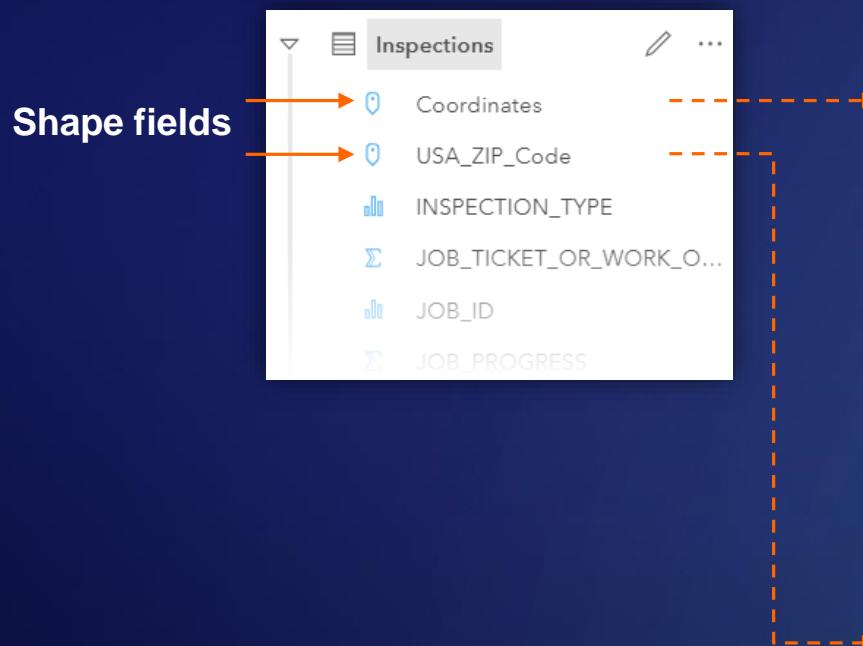
Σ crime\_id

address

**Date components** →

The screenshot shows the Data pane of a data visualization tool. On the left, there's a sidebar with categories: Shape, Numeric, Ratio, Categorical, Date / time, and Date components. Red arrows point from each category to specific fields in the main pane. The main pane lists fields under the 'Incidents' data source, including Location, dc\_dist, response rate, dispatch\_date\_time, dispatch\_date, Year, Quarter, Month, Day of month, Day of week, Hour, Minute, crime\_id, and address. A red vertical bar is positioned next to the Date components category, pointing to the same list of date/time components.

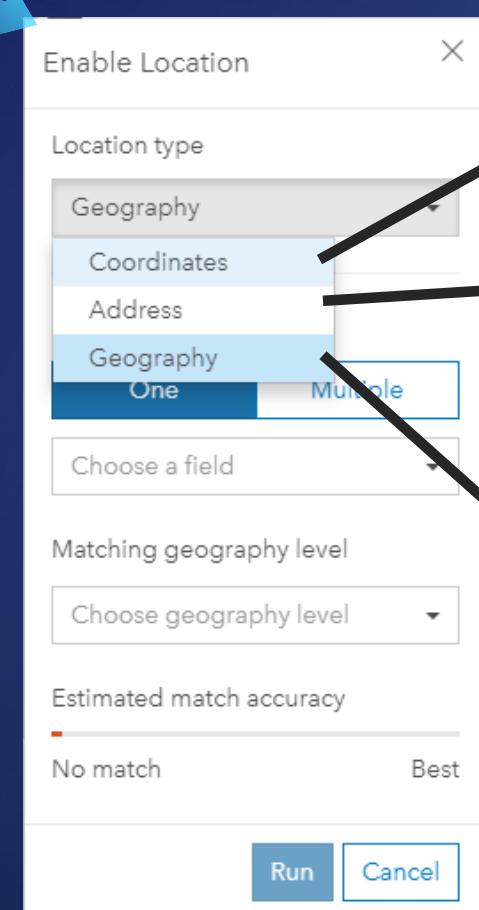
# Multiple spatial fields



# Enable Location

CA Accidents - Vehicles

- STATE NAME
- ST\_CASE
- DATE
- Year
- Quarter
- Month
- Day of month
- Day of week
- Hour
- Minute
- DR\_ZIP
- PRIOR INCIDENTS



## Latitude, Longitude Coordinates

- Custom spatial references supported

## Address geocoding

- Granularity down to point accuracy
- Points of interest
- Global
- One or multiple source address fields

## Geography

- Conflate spatial fields onto your data
  - point, line, or boundary
- Use boundaries that come with Insights
- Use your own custom boundaries

# Enrichment – thousands of data attributes for over 130 countries



+



Your Data

Enrich Variables



Your Data  
with Variables

# Create Relationships

Total strikes by year and location

INCIDENT_DATE - Year↓↑	AIRPORT_ID↓↑	COUNT of WILDLIFE STRIKES↓↑
1990	CYYZ	4
	D09	1
	FDDF	1

Sum of operations by year and location

DATE - Year↓↑	AIRPORT_ID↓↑	TOTAL_OPERATIONS↓↑ SUM↓↑
1989	KABQ	56,569
	KADW	34,542
	KATL	189,901
		46,038
		63,299
		110,748
		75,122
		64,254
		111,311
		68,302
		46,838
		11,616,307,833

My Data

- Strike by year and airport
- Operations by year and location
- AIRPORTS
- WILDLIFE STRIKES
- OPERATIONS

Strike by year and airport

AIRPORT\_ID

Create Relationships

Edit Relationship

Choose Relationship Type

Relationship type determines the way data is combined.

Inner      All      Left      Right

Choose Fields

Choose the fields you want to base the relationship on.

AIRPORT\_ID

Select Field

AIRPORT\_ID

Select Field

+

# Mapping & Charting

# Charts



*Bar & column chart*



*Key performance indicator*



*Combo chart*



*Treemap*



*Scatterplot*



*Stacked bar & column chart*



*Bubble chart*



*Scatterplot matrix*



*Histogram*



*Heat chart*



*Link chart*



*Box plot*



*Chord diagram*



*Data clock*



*Donut chart*



*Line graph*



*Time series graph*

# Maps



*Location*



*Flow*



*Choropleth*



*Aggregation*



*Heat*



*Density*



*Binned*



*Proportional symbol*



*Spider lines*



*Unique value*

# Visualization Options



## Insights for ArcGIS®

Data type: Qualitative Quantitative Temporal

**Measure:** ascertain the size, amount, or degree of (something)

A bar graph uses either horizontal or vertical bars to show comparisons among categories. They are valuable to identify broad differences between categories at a glance.

A treemap shows both the hierarchical data as a proportion of a whole and, the structure of data. The proportion of categories can easily be compared by their size.

Bubble charts represent numerical values of variables by area. With two variables (category and numeric), the circles placed so they are packed together.

A heat chart shows total frequency in a matrix. Values in each cell of the rectangular grid are symbolized into classes.

**Relationship:** a connection or similarity between two or more things or, the state of being related to something else

A choropleth map allows quantitative values to be mapped by area. They should show normalized values not counts collected over unequal areas or populations.

A chord diagram visualizes the inter-relationships between categories and allows comparison of similarities within a dataset or, between different groups of data.

Scatterplots allow you to look at relationships between two numeric variables with both scales showing quantitative variables. The level of correlation can also be quantified.

Link analysis is used to investigate relationships between entities where and an entity is an object, person, place or event. Links connect two or more entities.

Spider lines, also termed desire lines, show paths between origins and destinations. They show connections between places.

**Change:** process through which something becomes different, often over time

A bar graph uses either horizontal or vertical bars to show comparisons among categories. They are valuable to identify broad differences between categories at a glance.

A heat chart shows total frequency in a matrix. Using a temporal axis values, each cell of the rectangular grid are symbolized into classes over time.

Bubble charts with three numeric variables are multivariate charts that show the relationship between two values while a third value is shown by the circle area.

Graduated symbol maps show a quantitative difference between mapped features by varying symbol size. Data are classified with a symbol assigned to each range.

A Density/heat map calculates spatial concentrations of events or values enabling the distribution to be visualized as a continuous surface.

A Data clock creates a circular chart of temporal data, commonly used to see the number of events at different periods of time.

Line graphs visualize a sequence of continuous numeric values and are used primarily for trends over time. They show overall trends and changes from one value to the next.

A combo chart combines two graphs where they share common information on the x-axis. They allow relationships between two datasets to be shown.

**Interaction:** flow of information, products or goods between places

A chord diagram visualizes the inter-relationships between categories and allows comparison of similarities within a dataset or, between different groups of data.

Spider lines, also termed desire lines, show paths between origins and destinations. Flow maps show directional connections and flow between places.

**Distribution:** the arrangement of phenomena, could be numerically or spatially

Histograms show the distribution of a numeric variable. The bar represents the range of the class bin with the height showing the number of data points in the class bin.

A box plot displays data distribution showing the median, upper and lower quartiles, min and max values and, outliers. Distributions between many groups can be compared.

A choropleth map allows quantitative values to be mapped by area. They should show normalized values not counts collected over unequal areas or populations.

Graduated symbol maps show a quantitative difference between mapped features by varying symbol size. Data are classified with a symbol assigned to each range.

A Density/heat map calculates spatial concentrations of events or values enabling the distribution to be visualized as a continuous surface.

A unique symbol map (areas or points) allows descriptive (qualitative) information to be shown by location. Areas have different fills and points can be geometric or pictorial.

**Part-to-whole:** relative proportions or percentages of categories, showing the relationship between parts and whole

Donut charts are used to show the proportions of categorical data, with the size of each piece representing the proportion of each category.

A treemap shows both the hierarchical data as a proportion of a whole and, the structure of data. The proportion of categories can easily be compared by their size.

### Acknowledgement

Inspired by work by Jon Schwabish and Severino Ribecca, The Graphic Continuum, 2014 and, Alan Smith et al. Visual Vocabulary, The Financial Times, 2016



Linda Beale PhD, 2017

# Cross filters



# Tables (there are 2 types)

## Data Table

The screenshot shows a data table titled "My Big Dataset". The table has 14 rows and 9 columns. The columns are labeled: OBJ..., Date..., Date..., Date..., Date..., Date..., Date..., Date..., and Date... . The data includes various dates, months, and years. A tooltip at the bottom indicates "Selected Records: 0 Total Records: 1338".

OBJ...	Date...	Date...	Date...	Date...	Date...	Date...	Date...	Date...
1	1970	Q1	January	5	Monday	12 AM	00	1/5
2	1970	Q1	January	5	Monday	12 AM	00	1/5
3	1970	Q1	January	5	Monday	12 AM	00	1/5
4	1970	Q1	February	6	Friday	12 AM	00	2/6
5	1970	Q1	March	23	Monday	12 AM	00	3/2
6	1970	Q2	April	15	Wednesday	12 AM	00	4/1
7	1970	Q2	April	22	Wednesday	12 AM	00	4/2
8	1970	Q2	May	8	Friday	12 AM	00	5/6
9	1970	Q2	May	15	Friday	12 AM	00	5/1
10	1970	Q3	August	28	Friday	12 AM	00	8/2
11	1970	Q3	August	31	Monday	12 AM	00	8/3
12	1970	Q3	September	14	Monday	12 AM	00	9/1
13	1970	Q3	September	28	Monday	12 AM	00	9/2
14	1970	Q4	October	5	Monday	12 AM	00	10

- The entire dataset
- Calc new fields
- Not part of a shared page

## Summary Table

The screenshot shows a summary table with three main sections: "Shooter\_Gender", "Shooter\_Race", and "Wounded". The "Shooter\_Gender" section shows counts for F (Female) and M (Male). The "Shooter\_Race" section shows counts for Black, Some Other, Unknown, White, American Indian or Alaskan Native, Asian, and Native Hawaiian or Other. The "Wounded" section shows counts for Yes and No. Descriptive statistics like SUM, MIN, MAX, AVG, MEDIAN, and PERCENTILE are also provided. A tooltip at the bottom right indicates "Total 1,470" and "Total 18,542".

Shooter_Gender	Shooter_Race	Wounded	SUM	Shooter_Age	SUM
F	<No Data>				
	Black				
	Some Other				
	Unknown				
	White				
M	<No Data>				
	American Indian or Alaskan Native				
	Asian				
	Black				
	Native Hawaiian or Other				
	Some Other				
			Total 1,470		Total 18,542

- Extracts significance from detailed dataset
- Pivot, and show descriptive statistics
- Interactive with chart and map cards
- Included with a shared page

# Analysis

# Powerful analysis made simple



Exploratory

Spatial

Statistical

- Find the right questions to ask
- Relate and overlay datasets
- Quantify and describe

# The Action Button



**Analytics** X

Find answers      Spatial analysis

---

How is it distributed?

---

How is it related?

---

What's nearby?

---

How has it changed?

**Analytics** X

Find answers      Spatial analysis



Create Buffer/  
Drive Times



Spatial  
Aggregation



Spatial Filter



Enrich Data

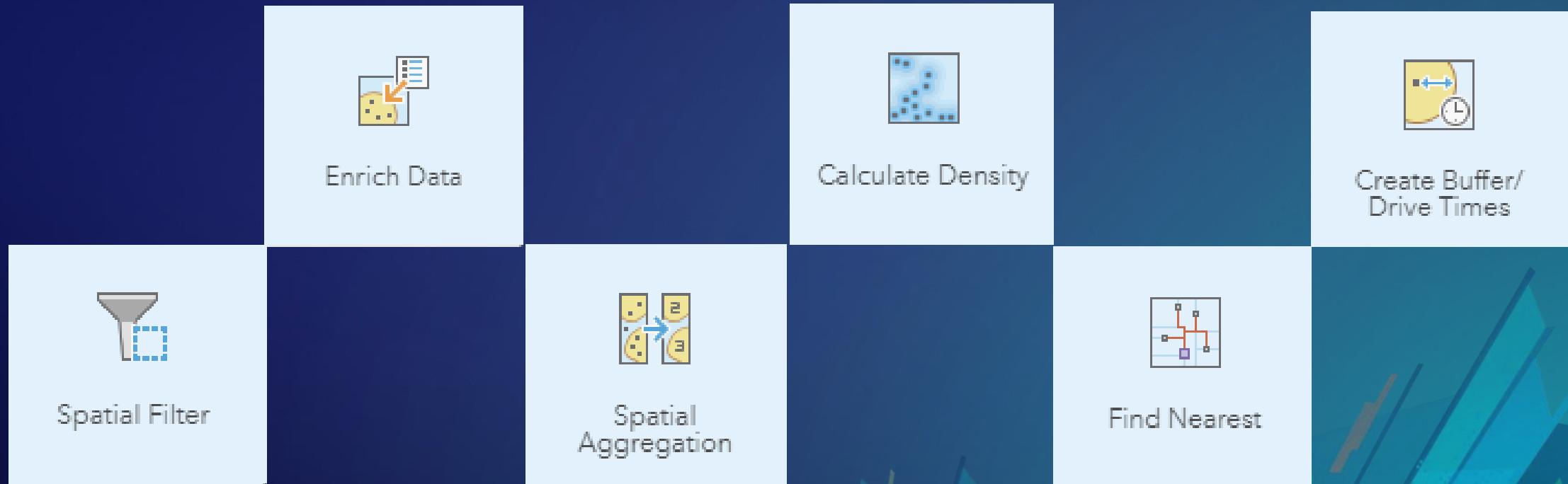


Calculate Density

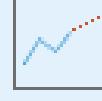
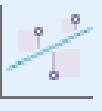


Find Nearest

# Spatial Analysis Techniques



# Statistical Analysis Techniques

 Calculate Ratio	 Predict Variable	 View Link Chart
 Calculate % Change	 Calculate Z-Score	 Create Regression Model

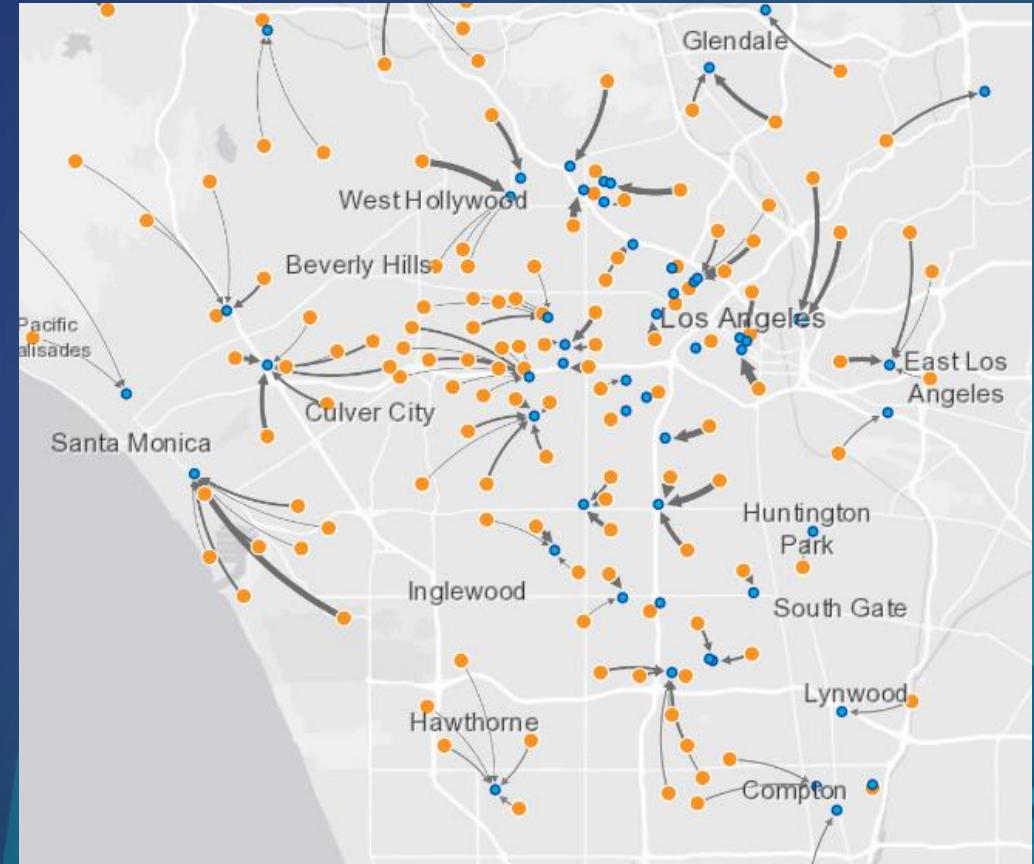
# Link maps (aka graph analysis)

- **Spider lines/Desire lines**

- A desire line map shows straight lines connecting the origins and the destinations
- Shows the shortest line between origin and destination

- **Flow maps**

- Shows movement of people, goods, transport etc.
- Displays direction of movement and can also show volume



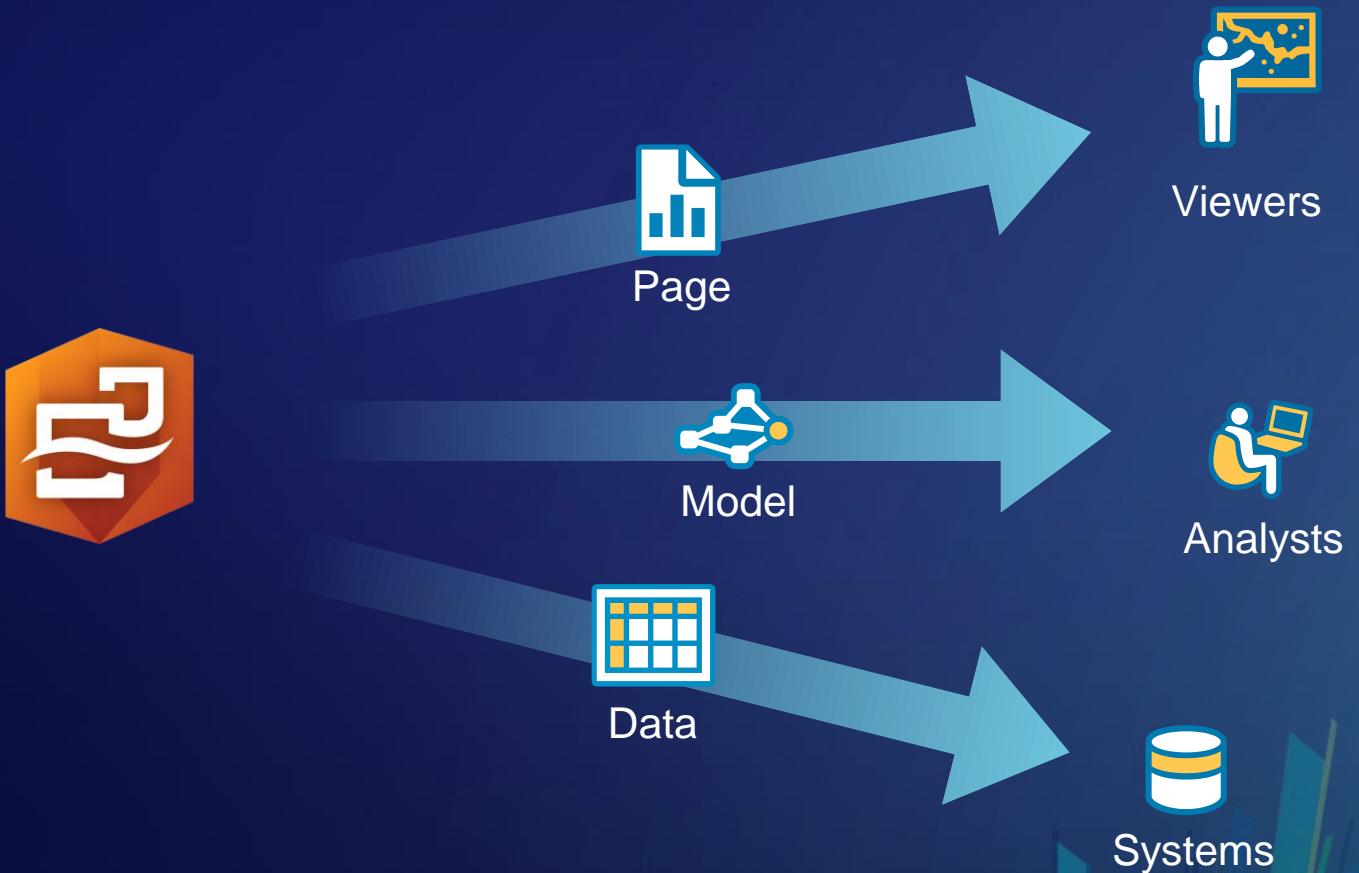
# Python & R Integration

- Connect to data
- Perform analysis with open data science tools
- Embed scripts into an Insights model



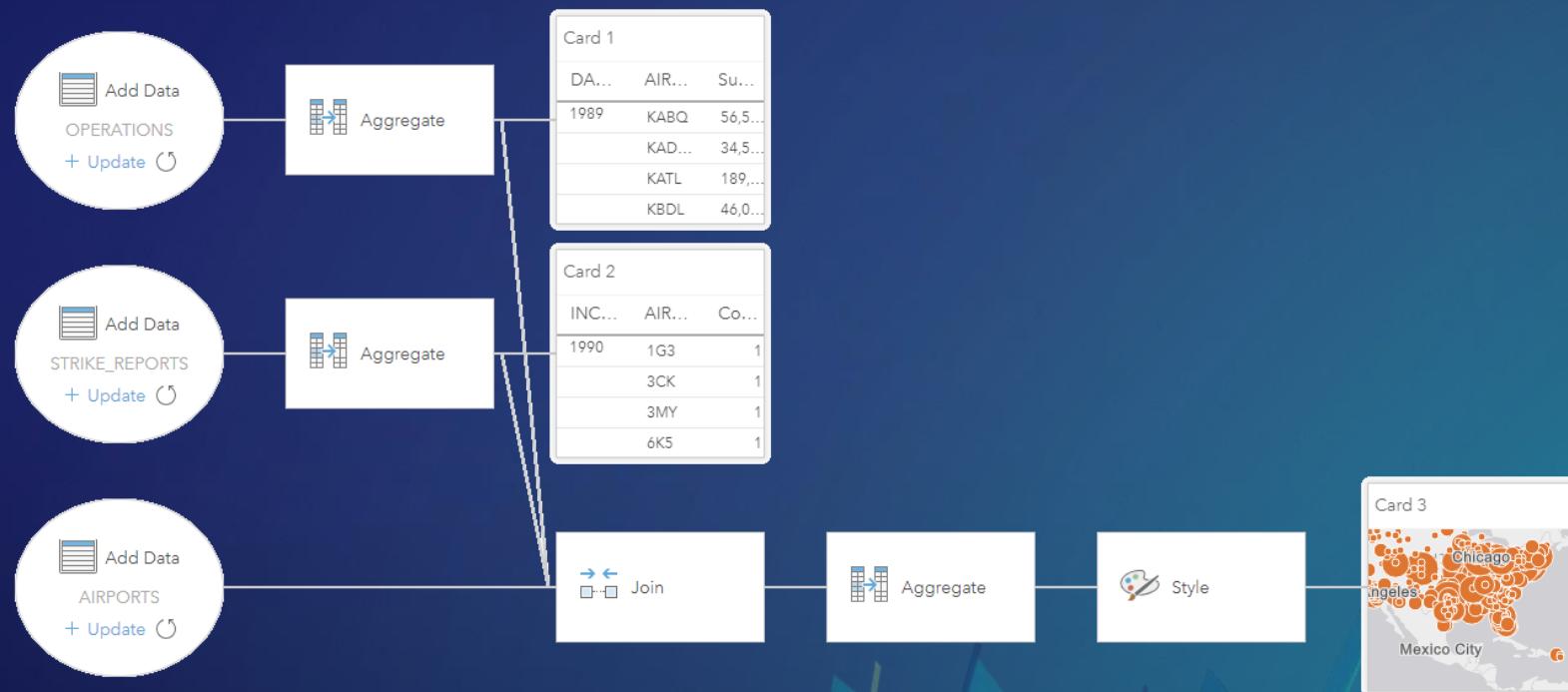
# Sharing Presentations & Models

# Maximizing Your Work With Others



- **Share results**
  - Interactive cards
  - Tell your story
  - Internal stakeholders or public
- **Repeat and understand analysis**
  - Share models to analysts
  - Document your methodology
  - Rerun with new data
- **Export resulting datasets**
  - Use in different systems

# Methodology – Documented and Repeatable



# Refined and finished information products

- Organization branding, theme, and logo
- References and site resources
- Context, story, and narrative



Authors: *L. Bird & M. Johnson*  
Data source: *World Wide Sports*

- Title
- Hyperlinks, videos, images
- Textual descriptions

# Resources & Next Steps

## Training



- Getting Started - <http://esriurl.com/GetStartedInsights>
- Analyze county development permits - <http://esriurl.com/CountyPermits>
- Investigate prescribed drugs - <http://esriurl.com/PerscriptionDrugs>
- Find a new home with Zillow data - <http://esriurl.com/ZillowData>

## Success Stories



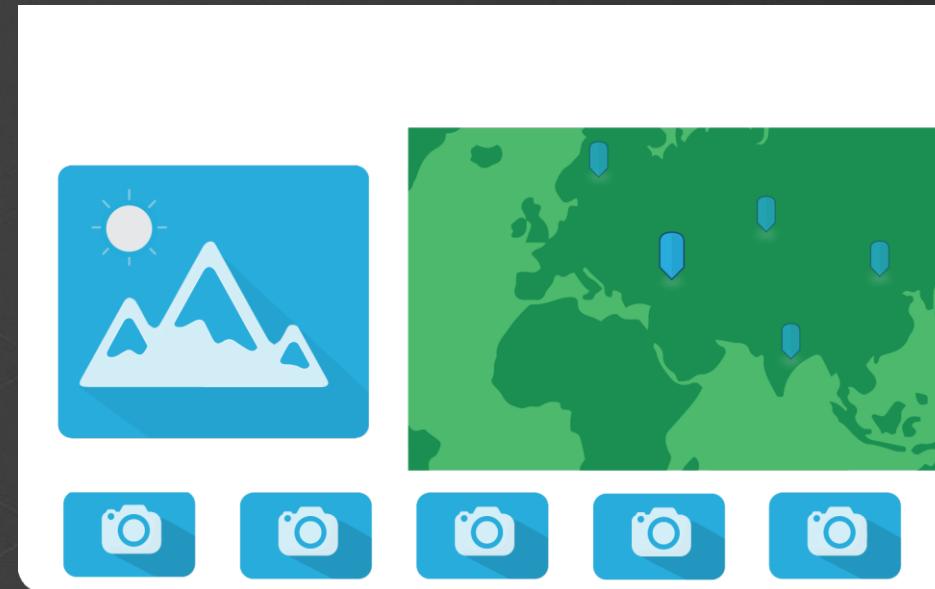
- Bavarian State Building Administration - <http://esriurl.com/BSBA>
- Opelika Water Utilities - <http://esriurl.com/Opelika>
- National Geospatial-Intelligence Agency - <http://esriurl.com/NGA>
- East Valley Water District - <http://esriurl.com/EVWD>

# Story Maps

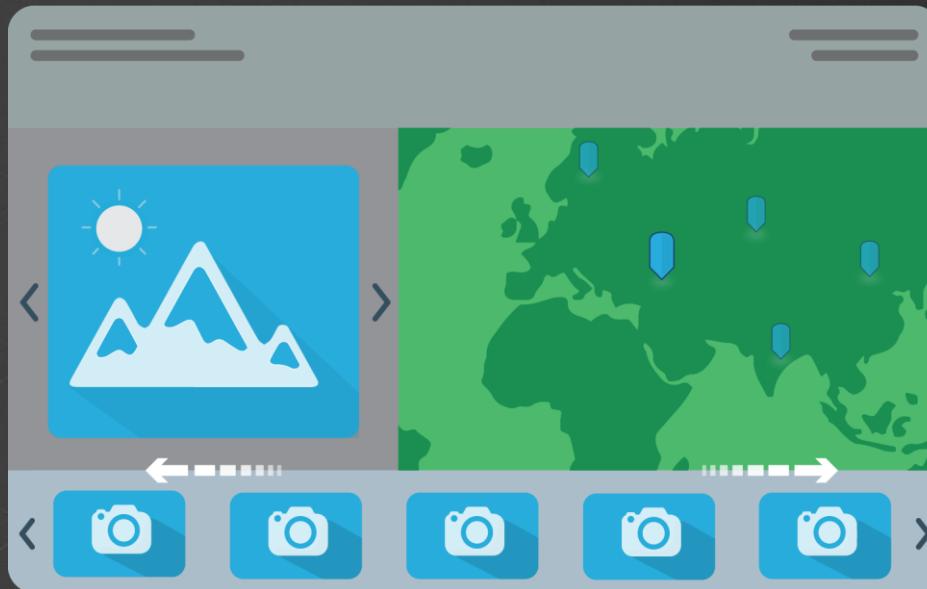
**Story Maps** are simple  
web apps that combine  
interactive maps,



**Story Maps** are simple  
web apps that combine  
interactive maps,  
multimedia content,



**Story Maps** are simple web apps that combine interactive maps, multimedia content, and user experiences



**Story Maps** are simple web apps that combine interactive maps, multimedia content, and user experiences to tell stories about the world.



**Story Maps** include an array of apps that provide different ways of interacting with maps.



**Story Maps are responsive and work on PCs, laptops, tablets, and smartphones.**



**Story Maps incorporate builder functions that enable you to build an engaging story with no GIS or web development skills.**



**Story Maps incorporate builder functions that enable you to build an engaging story with no GIS or web development skills, but...**



**Story Maps are open source.  
Developers are free to  
download and customize them.**



**Story Maps** are hosted by Esri in  
the cloud... or you can download  
and host them yourself.



# How can story maps be used?

- **Communication**
  - Analysis/data science
  - Annual reports
  - Marketing
- **Presentation / Teaching tools**
- **Tradeshows / Events / Operations Centers / Lobby Displays (autoplay)**
- **Fun!!**
  - Vacation photos/journal, wedding story, hobbies, ...

# Story Map Resources

- [Templated Story Maps Resources](#)
- [Templated Story Maps Gallery](#)
- [ArcGIS StoryMaps](#)
- [StoryMaps Resources](#)
- [Story Telling Tips and Resources](#)