Exploratory Analysis with Spatio-Temporal Data in ArcGIS

Tanu Hoque

SEE
WHAT
OTHERS
CAN'T

Dynamically aggregate data for spatio-temporal exploratory analysis

- **Aggregate data**
- **Dynamic**
- **Space**
- **Time**

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

Dynamically aggregate data for spatio-temporal exploratory analysis

- **Aggregate data**
- **Dynamic**
- **Space**
- **Time**

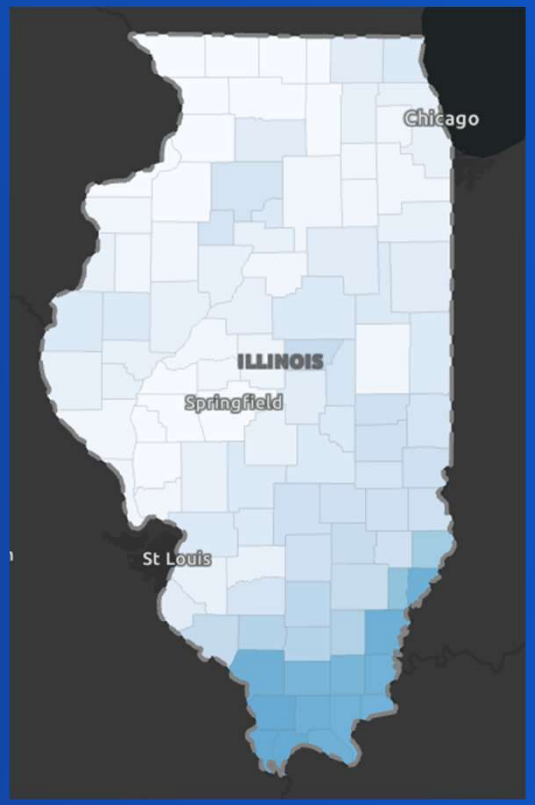
Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

1.37

2.97

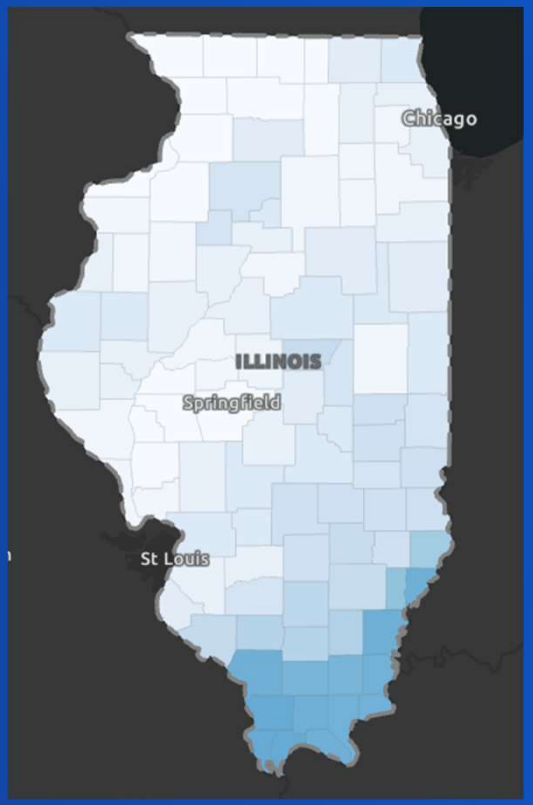
Dynamically aggregate data for spatio-temporal exploratory analysis

- Aggregate data
- Dynamic
- **Space**
- Time



Dynamically aggregate data for spatio-temporal exploratory analysis

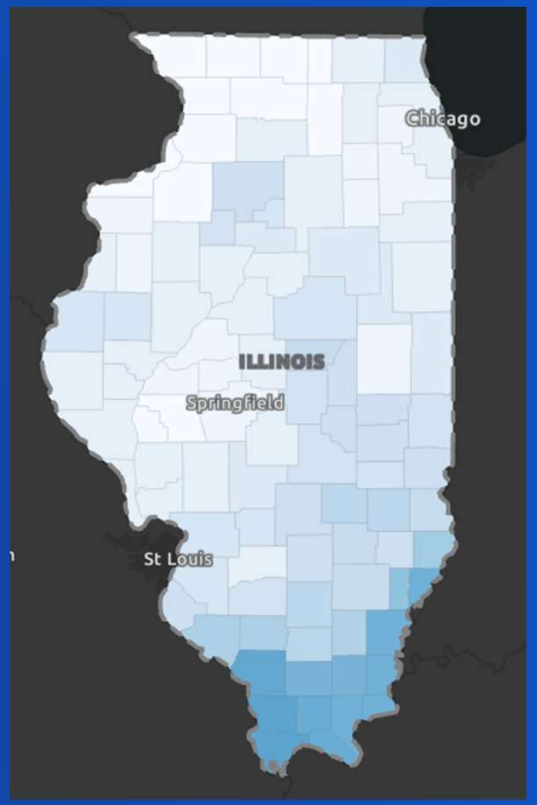
- Aggregate data
- Dynamic
- Space
- Time



Feb 16th – 23rd

Dynamically aggregate data for spatio-temporal exploratory analysis

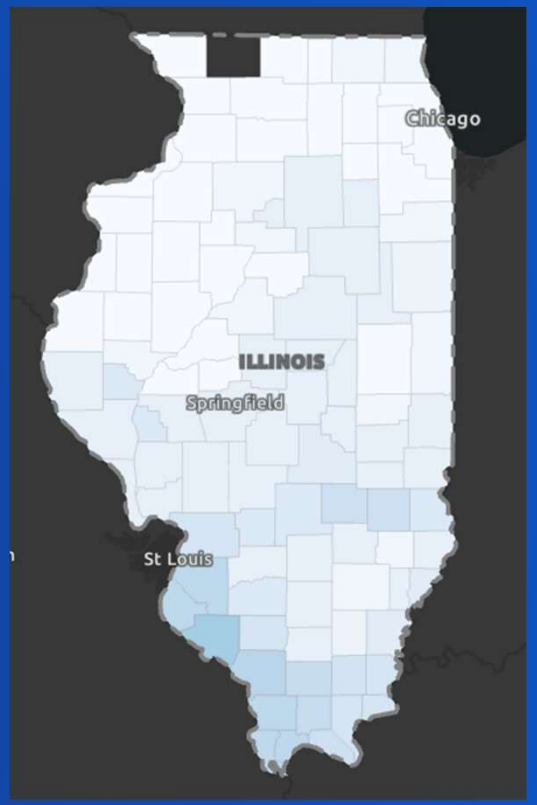
- Aggregate data
- Dynamic
- Space
- Time



Feb 17th – 24th

Dynamically aggregate data for spatio-temporal exploratory analysis

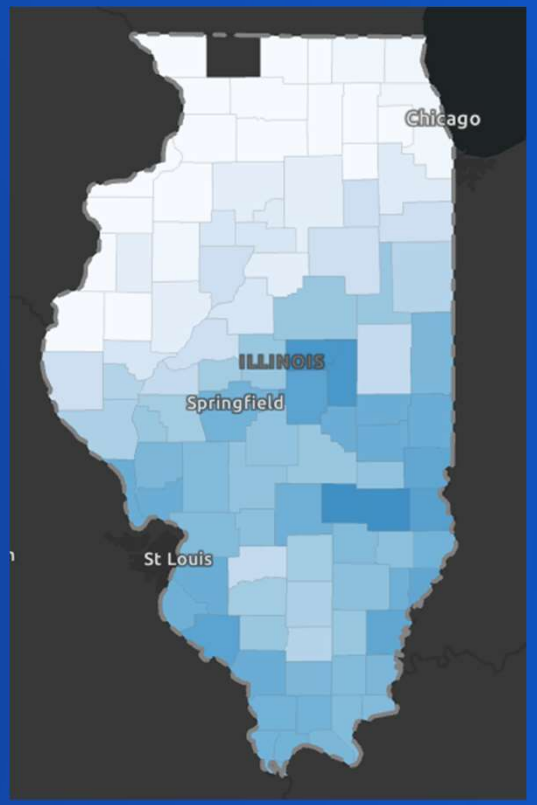
- Aggregate data
- Dynamic
- Space
- Time



Feb 18th – 25th

Dynamically aggregate data for spatio-temporal exploratory analysis

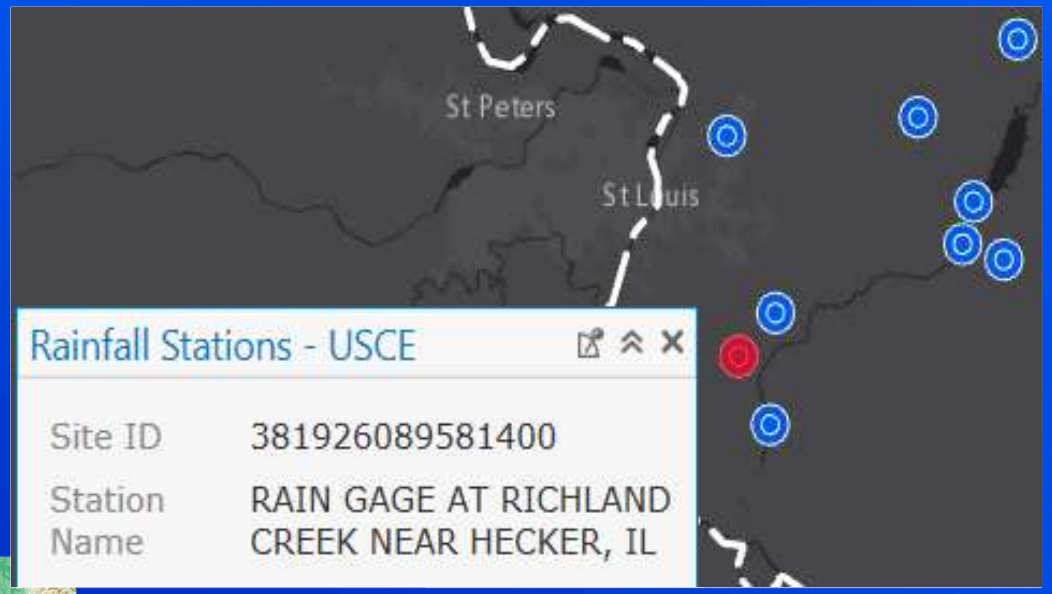
- Aggregate data
- Dynamic
- Space
- Time



Feb 19th – 26th

What is Exploratory Analysis?

- Summarize or aggregate raw data to
  - Identify
    - Outlier
    - Trends
    - Patterns
- Visualize them spatially
  - to tell its story
  - is useful in generating hypotheses



Aggregate non-spatial data

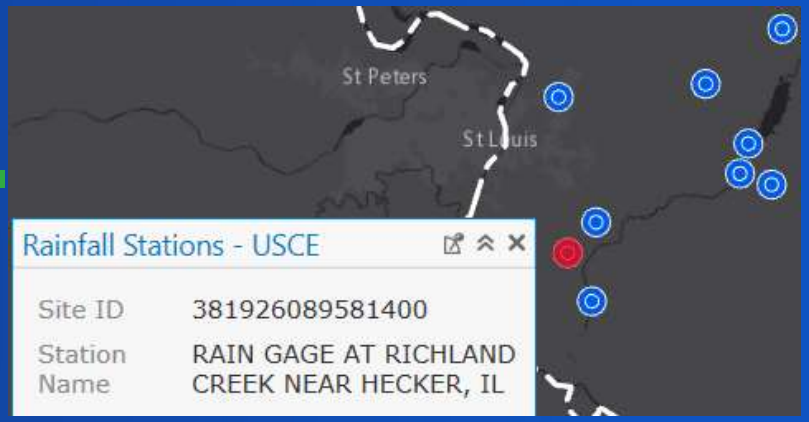
From a time series table

Observed Rainfall Data

Related to weather stations

Site ID	Date	Rainfall (inch)
381926089581400	1/12/2013 6:15:00 PM	0.02
381926089581400	1/12/2013 6:30:00 PM	0.02
381926089581400	1/12/2013 6:45:00 PM	0.04
381926089581400	1/12/2013 7:00:00 PM	0.06
381926089581400	1/12/2013 7:15:00 PM	0.09
381926089581400	1/12/2013 7:30:00 PM	0.08
381926089581400	1/12/2013 7:45:00 PM	0.07
381926089581400	1/12/2013 8:00:00 PM	0.07
381926089581400	1/12/2013 8:15:00 PM	0.08
381926089581400	1/12/2013 8:30:00 PM	0.07
381926089581400	1/12/2013 8:45:00 PM	0.08
381926089581400	1/12/2013 9:00:00 PM	0.05
381926089581400	1/12/2013 9:15:00 PM	0.05
381926089581400	1/12/2013 9:30:00 PM	0.03
381926089581400	1/12/2013 9:45:00 PM	0.03
381926089581400	1/12/2013 10:00:00 PM	0.03
381926089581400	1/12/2013 10:15:00 PM	0.05
381926089581400	1/12/2013 10:30:00 PM	0.03

Time Series Data



Station Locations

Dynamically Computed Total Rainfall for Any Time Window

Using SQL

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

```
SELECT
    SUM(rainfall_inch) AS Total_Rainfall
FROM USGS_Rainfall
GROUP BY site_no
```

Dynamically Computed Total Rainfall for Any Time Window

Using SQL

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

```
SELECT
    SUM(rainfall_inch) AS Total_Rainfall
FROM USGS_Rainfall
WHERE date_time >= '1/3/2013'
      and date_time <= '1/10/2013'
GROUP BY site_no
```

Dynamically Computed Total Rainfall for Any Time Window

Using SQL

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

```
SELECT
    SUM(rainfall_inch) AS Total_Rainfall
FROM USGS_Rainfall
WHERE date_time >= '1/4/2013'
      and date_time <= '1/12/2013'
GROUP BY site_no
```

Dynamically Computed Total Rainfall for Any Time Window

Using SQL and Range Parameter

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

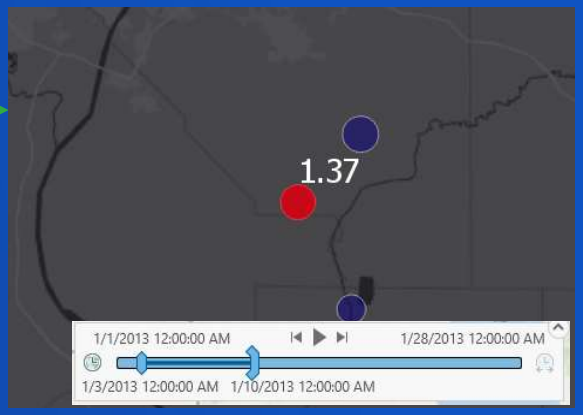
```
SELECT
    SUM(rainfall_inch) AS Total_Rainfall
FROM USGS_Rainfall
WHERE ::r:dateRange
GROUP BY site_no
```

help: http://esriurl.com/14540

Dynamically Computed Total Rainfall for Any Time Window

Draw them on map using query layer for the duration specified on the time slider

Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01



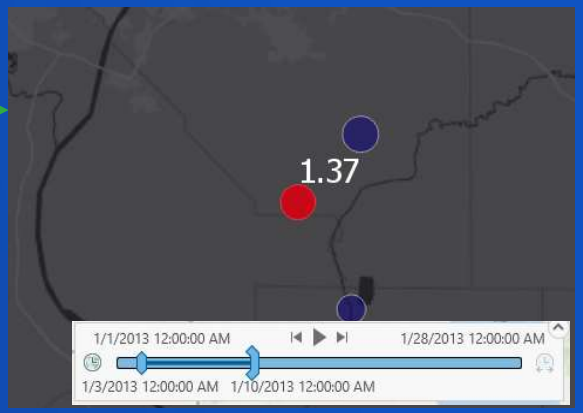

```
SELECT s.OID, s.shape, r.Total_Rainfall
    FROM USGS_Rainfall_Stations_IL s
INNER JOIN
    SELECT
        SUM(rainfall_inch) AS Total_Rainfall
    FROM USGS_Rainfall
    WHERE ::r:dateRange
    GROUP BY site_no) r
ON s.site_no = r.site_no
```

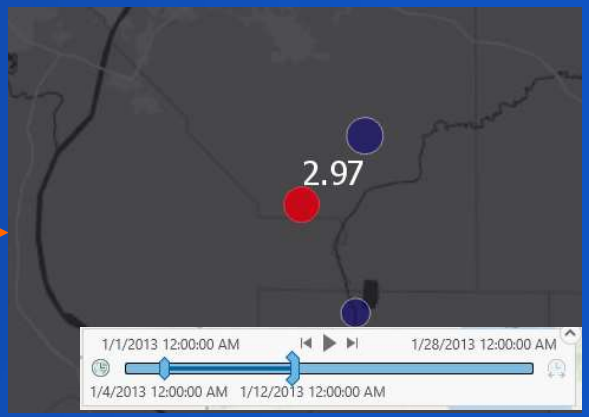
Dynamically Computed Total Rainfall for Any Time Window

Draw them on map using query layer for the duration specified on the time slider

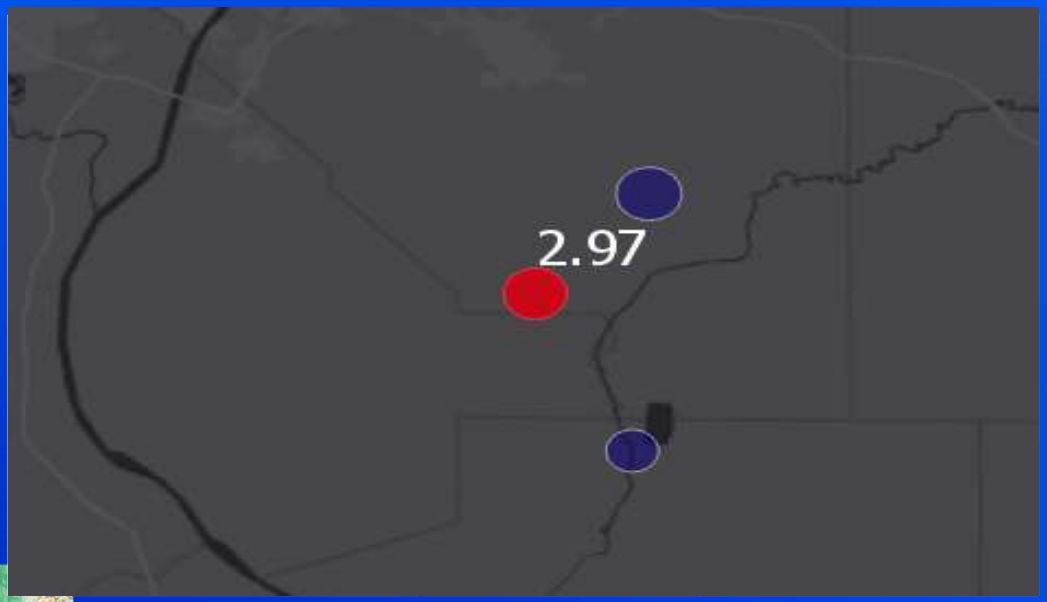
Site ID	Date	Daily Rainfall (inch)
381926089581400	1/3/2013	0.11
381926089581400	1/4/2013	0.01
381926089581400	1/9/2013	0.14
381926089581400	1/10/2013	1.11
381926089581400	1/12/2013	1.71
381926089581400	1/13/2013	0.01
381926089581400	1/14/2013	0.02
381926089581400	1/18/2013	0.01

```
SELECT s.OID, s.shape, r.Total_Rainfall
    FROM USGS_Rainfall_Stations_IL s
INNER JOIN
    SELECT
        SUM(rainfall_inch) AS Total_Rainfall
    FROM USGS_Rainfall
    WHERE ::r:dateRange
    GROUP BY site_no) r
ON s.site_no = r.site_no
```





blog: http://esriurl.com/15568



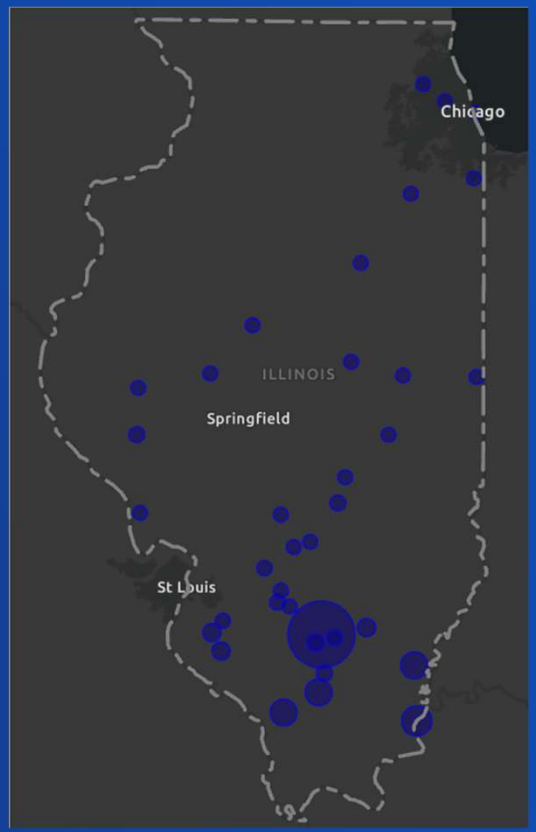
Aggregate spatial data

From table to point features to polygon features

Total Rainfall Per Areal Unit

Site ID	Date	Rainfall (inch)
381926089581400	1/12/2013 6:15:00 PM	0.02
381926089581400	1/12/2013 6:30:00 PM	0.02
381926089581400	1/12/2013 6:45:00 PM	0.04
381926089581400	1/12/2013 7:00:00 PM	0.06
381926089581400	1/12/2013 7:15:00 PM	0.09
381926089581400	1/12/2013 7:30:00 PM	0.08
381926089581400	1/12/2013 7:45:00 PM	0.07
381926089581400	1/12/2013 8:00:00 PM	0.07
381926089581400	1/12/2013 8:15:00 PM	0.08
381926089581400	1/12/2013 8:30:00 PM	0.07
381926089581400	1/12/2013 8:45:00 PM	0.08
381926089581400	1/12/2013 9:00:00 PM	0.05
381926089581400	1/12/2013 9:15:00 PM	0.05
381926089581400	1/12/2013 9:30:00 PM	0.03
381926089581400	1/12/2013 9:45:00 PM	0.03
381926089581400	1/12/2013 10:00:00 PM	0.03
381926089581400	1/12/2013 10:15:00 PM	0.05
381926089581400	1/12/2013 10:30:00 PM	0.03

Time Series Data



Total Rainfall by Stations

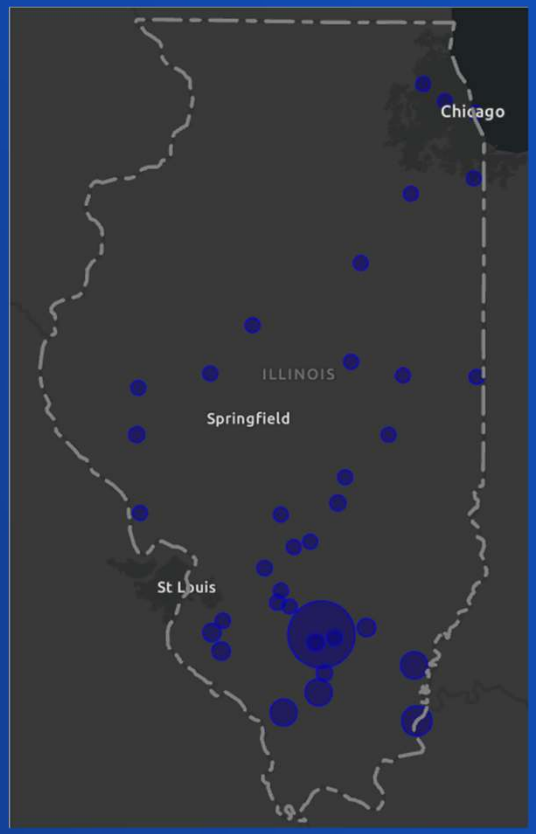
County Boundary

blog: http://esriurl.com/15569

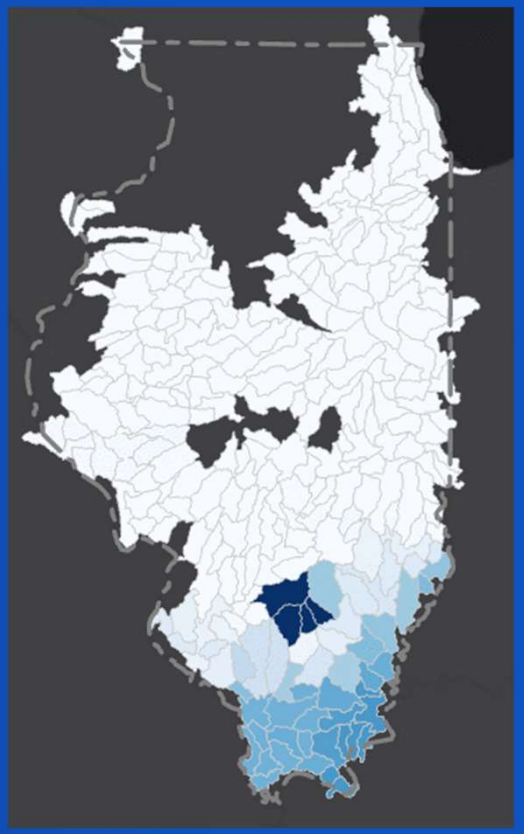
Total Rainfall Per Areal Unit

Site ID	Date	Rainfall (inch)
381926089581400	1/12/2013 6:15:00 PM	0.02
381926089581400	1/12/2013 6:30:00 PM	0.02
381926089581400	1/12/2013 6:45:00 PM	0.04
381926089581400	1/12/2013 7:00:00 PM	0.06
381926089581400	1/12/2013 7:15:00 PM	0.09
381926089581400	1/12/2013 7:30:00 PM	0.08
381926089581400	1/12/2013 7:45:00 PM	0.07
381926089581400	1/12/2013 8:00:00 PM	0.07
381926089581400	1/12/2013 8:15:00 PM	0.08
381926089581400	1/12/2013 8:30:00 PM	0.07
381926089581400	1/12/2013 8:45:00 PM	0.08
381926089581400	1/12/2013 9:00:00 PM	0.05
381926089581400	1/12/2013 9:15:00 PM	0.05
381926089581400	1/12/2013 9:30:00 PM	0.03
381926089581400	1/12/2013 9:45:00 PM	0.03
381926089581400	1/12/2013 10:00:00 PM	0.03
381926089581400	1/12/2013 10:15:00 PM	0.05
381926089581400	1/12/2013 10:30:00 PM	0.03

Time Series Data



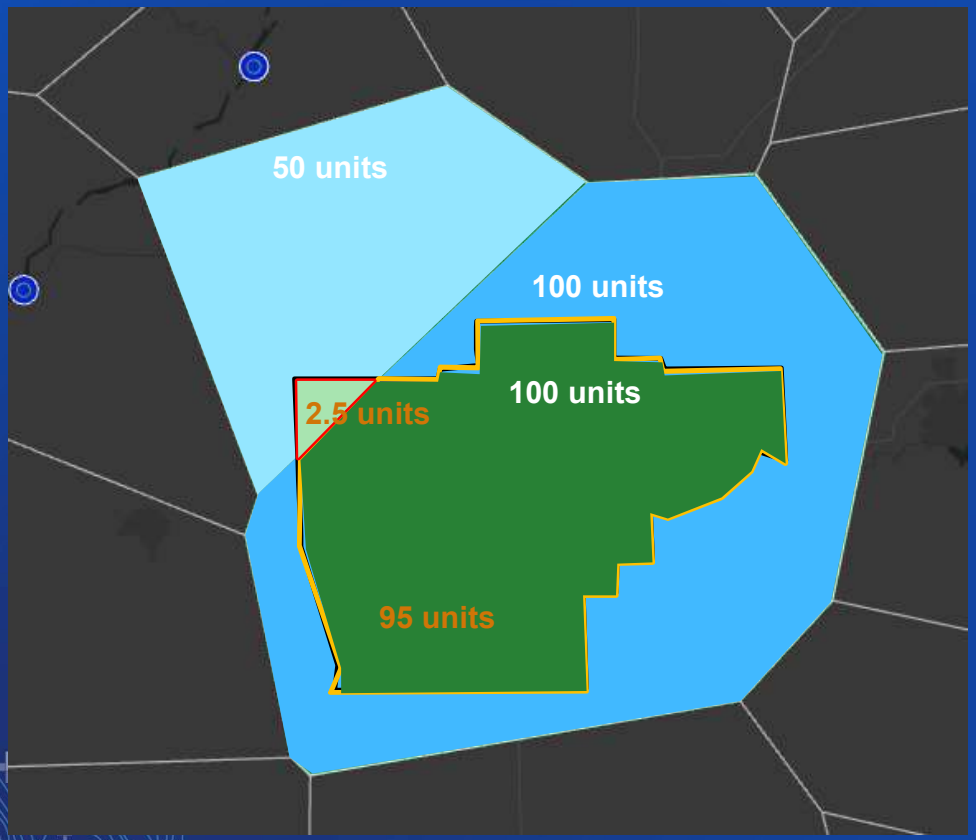
Total Rainfall by Stations

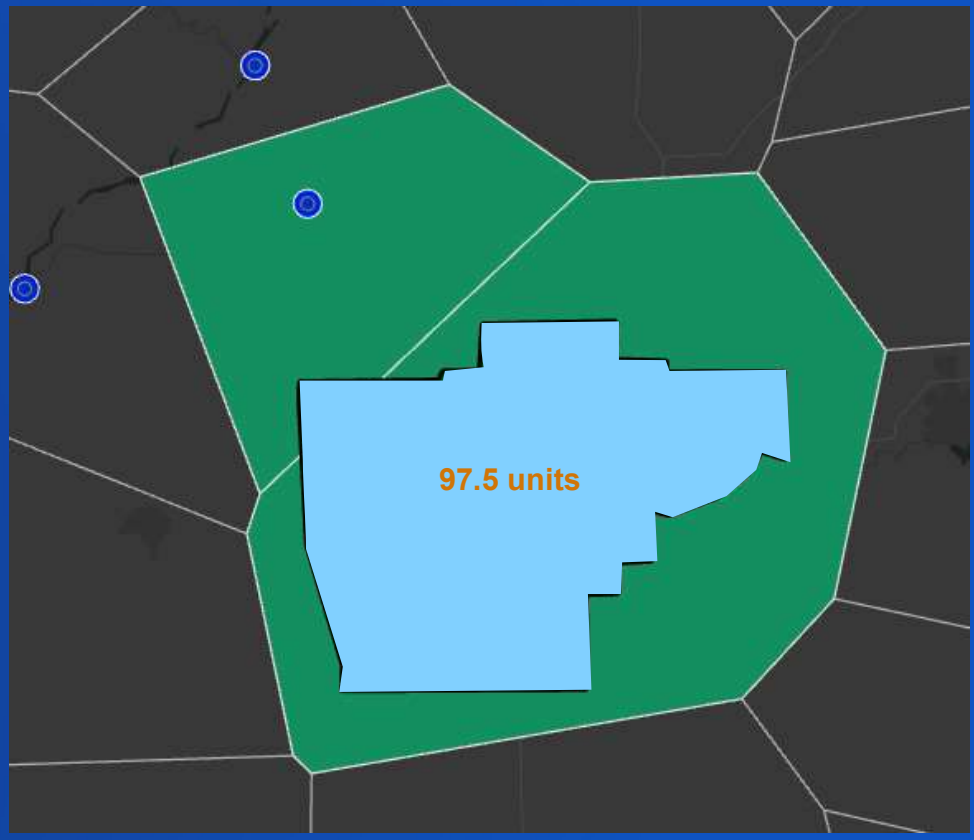


Watershed Boundary

blog: http://esriurl.com/15569

Computed Weighted Rainfall using Thiessen Polgyons





Total rainfall within the county

Exploratory Analysis Examples

Non-spatial and spatial data

Site ID	Date	Rainfall (inch)
381926089581400	1/12/2013 6:15:00 PM	0.02
381926089581400	1/12/2013 6:30:00 PM	0.02
381926089581400	1/12/2013 6:45:00 PM	0.04
381926089581400	1/12/2013 7:00:00 PM	0.06
381926089581400	1/12/2013 7:15:00 PM	0.09
381926089581400	1/12/2013 7:30:00 PM	0.08
381926089581400	1/12/2013 7:45:00 PM	0.07
381926089581400	1/12/2013 8:00:00 PM	0.07
381926089581400	1/12/2013 8:15:00 PM	0.08
381926089581400	1/12/2013 8:30:00 PM	0.07
381926089581400	1/12/2013 8:45:00 PM	0.08
381926089581400	1/12/2013 9:00:00 PM	0.05
381926089581400	1/12/2013 9:15:00 PM	0.05
381926089581400	1/12/2013 9:30:00 PM	0.03
381926089581400	1/12/2013 9:45:00 PM	0.03
381926089581400	1/12/2013 10:00:00 PM	0.03
381926089581400	1/12/2013 10:15:00 PM	0.05
381926089581400	1/12/2013 10:30:00 PM	0.03

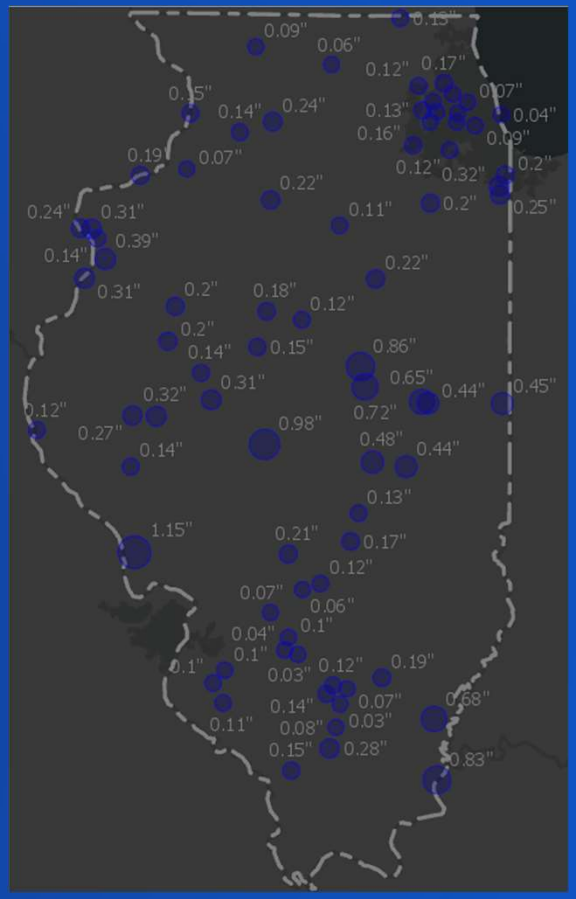
Observed rainfall @ 15 min interval

Crime locations

Observed Rainfall

Site ID	Date	Rainfall (inch)
381926089581400	1/12/2013 6:15:00 PM	0.02
381926089581400	1/12/2013 6:30:00 PM	0.02
381926089581400	1/12/2013 6:45:00 PM	0.04
381926089581400	1/12/2013 7:00:00 PM	0.06
381926089581400	1/12/2013 7:15:00 PM	0.09
381926089581400	1/12/2013 7:30:00 PM	0.08
381926089581400	1/12/2013 7:45:00 PM	0.07
381926089581400	1/12/2013 8:00:00 PM	0.07
381926089581400	1/12/2013 8:15:00 PM	0.08
381926089581400	1/12/2013 8:30:00 PM	0.07
381926089581400	1/12/2013 8:45:00 PM	0.08
381926089581400	1/12/2013 9:00:00 PM	0.05
381926089581400	1/12/2013 9:15:00 PM	0.05
381926089581400	1/12/2013 9:30:00 PM	0.03
381926089581400	1/12/2013 9:45:00 PM	0.03
381926089581400	1/12/2013 10:00:00 PM	0.03
381926089581400	1/12/2013 10:15:00 PM	0.05
381926089581400	1/12/2013 10:30:00 PM	0.03

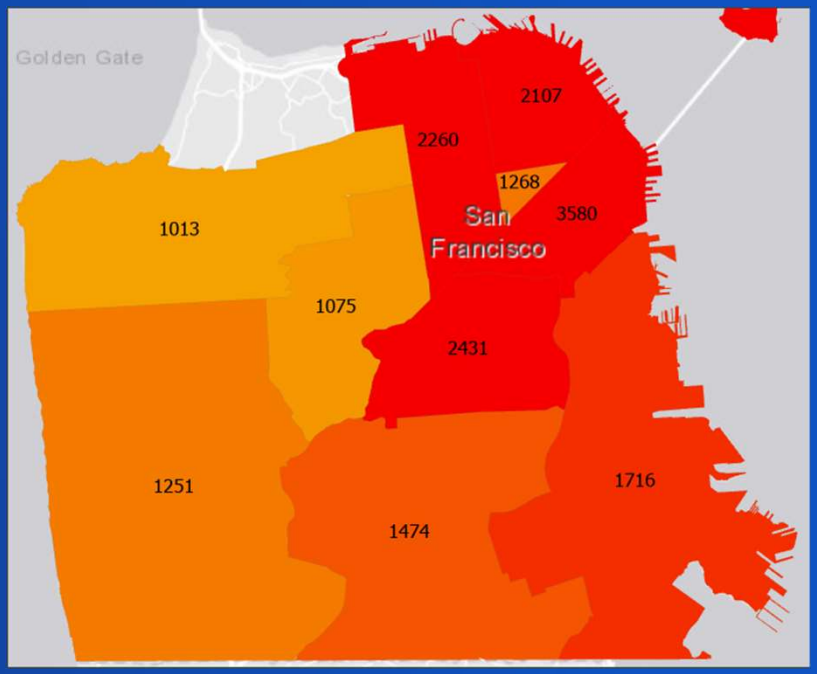
Observed rainfall @ 15 min interval



Weekly total rainfall

Crime Locations

All Crime locations

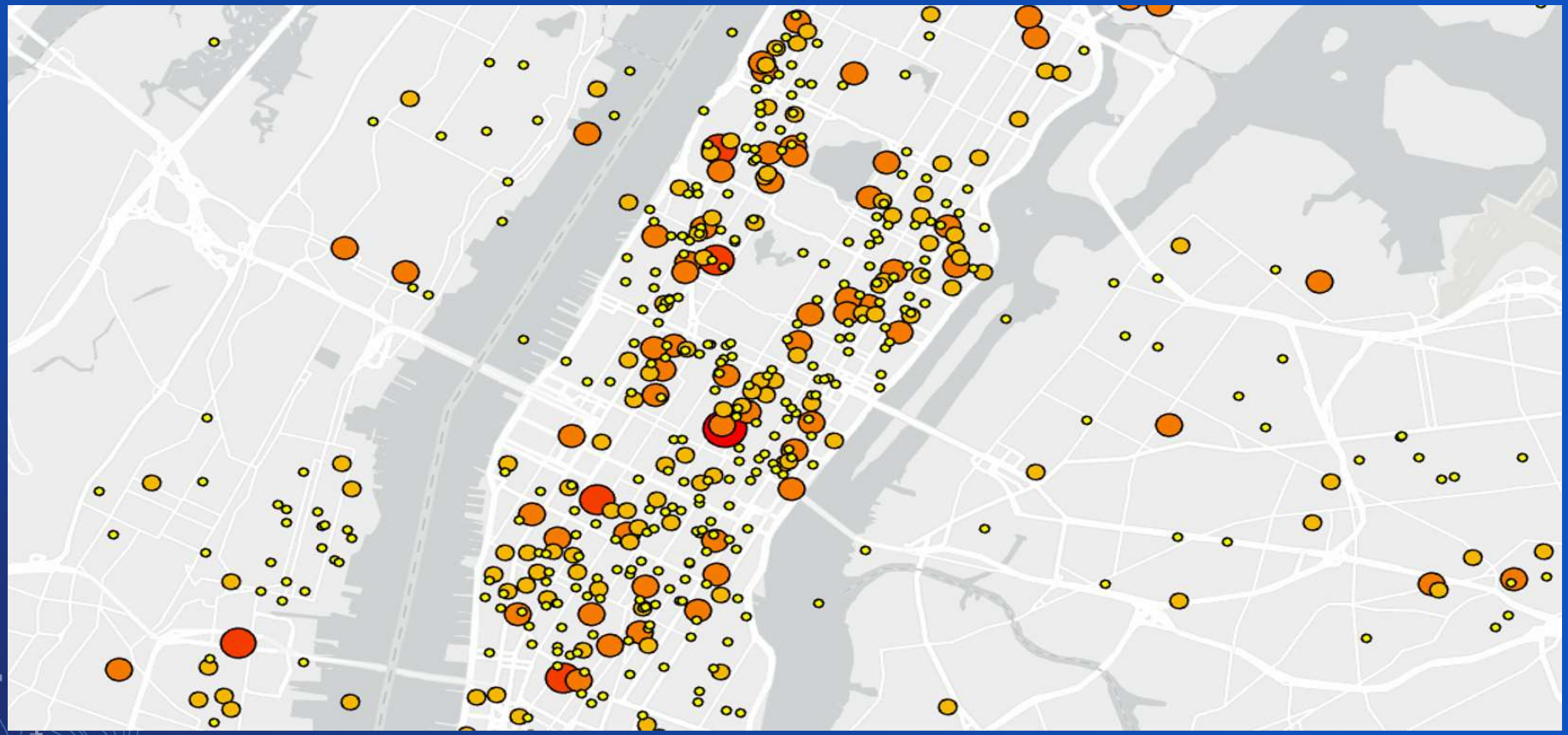


Crime totals by districts

blog: http://esriurl.com/15570

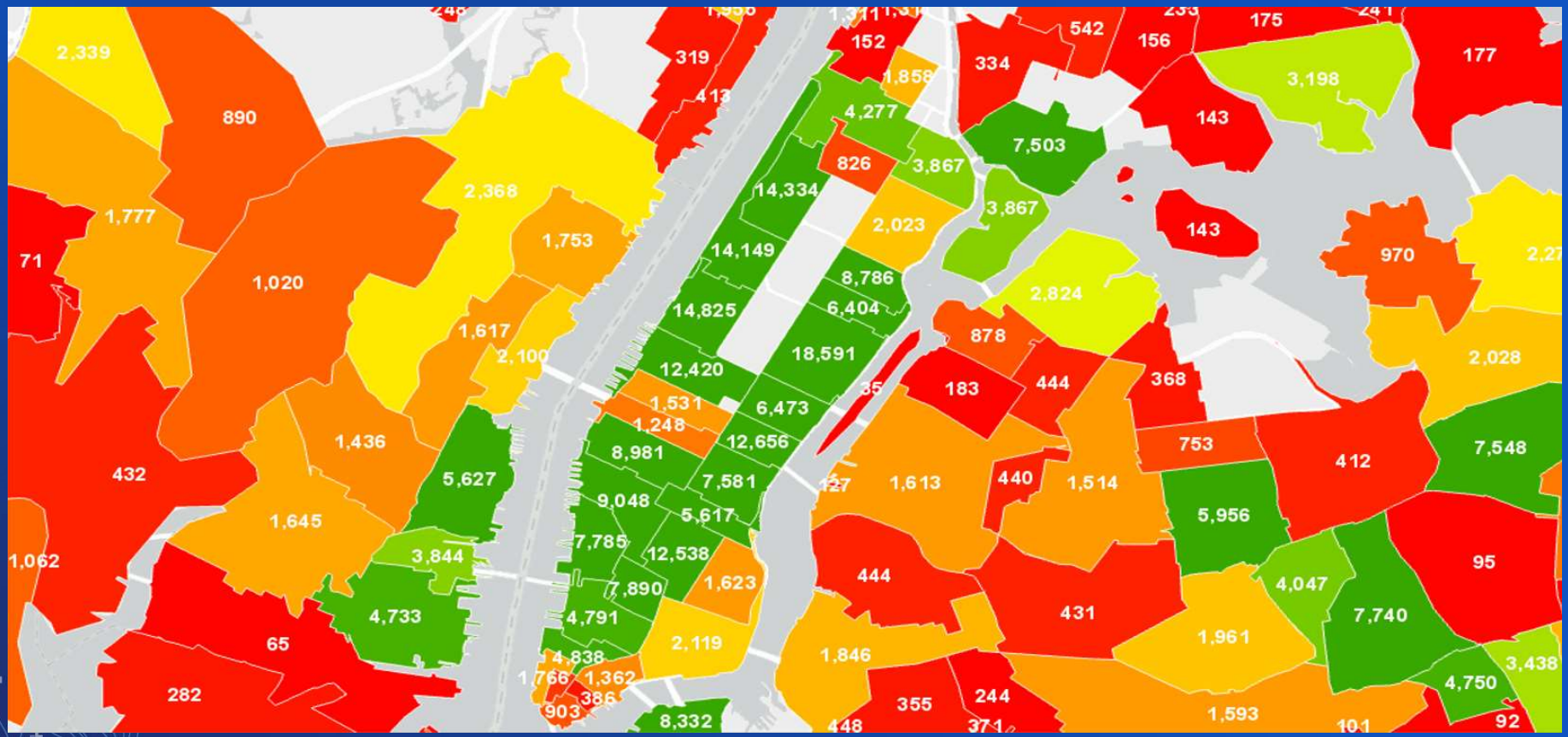
Sale Locations

Sales locations



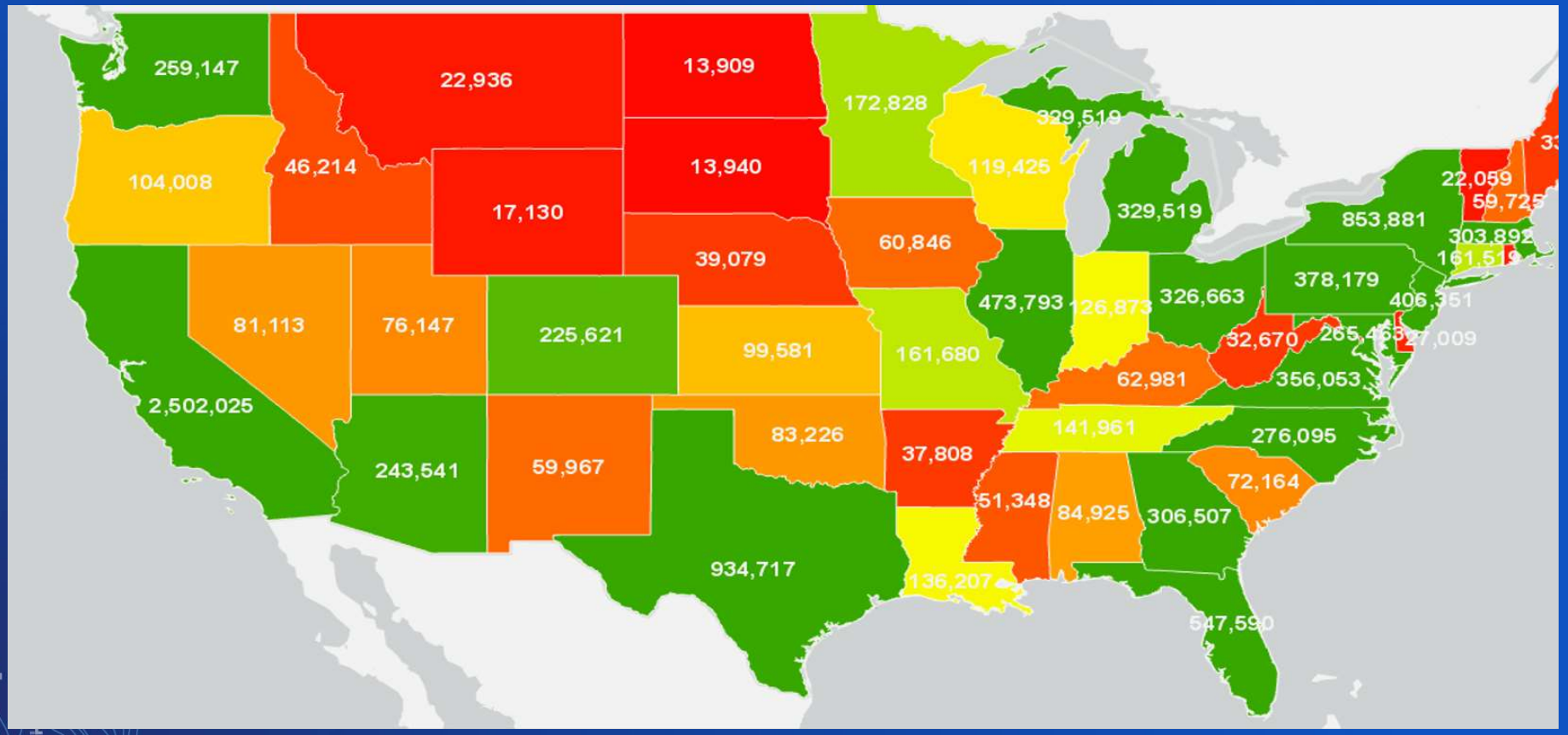
Aggregated Sales

Total sales by zipcodes

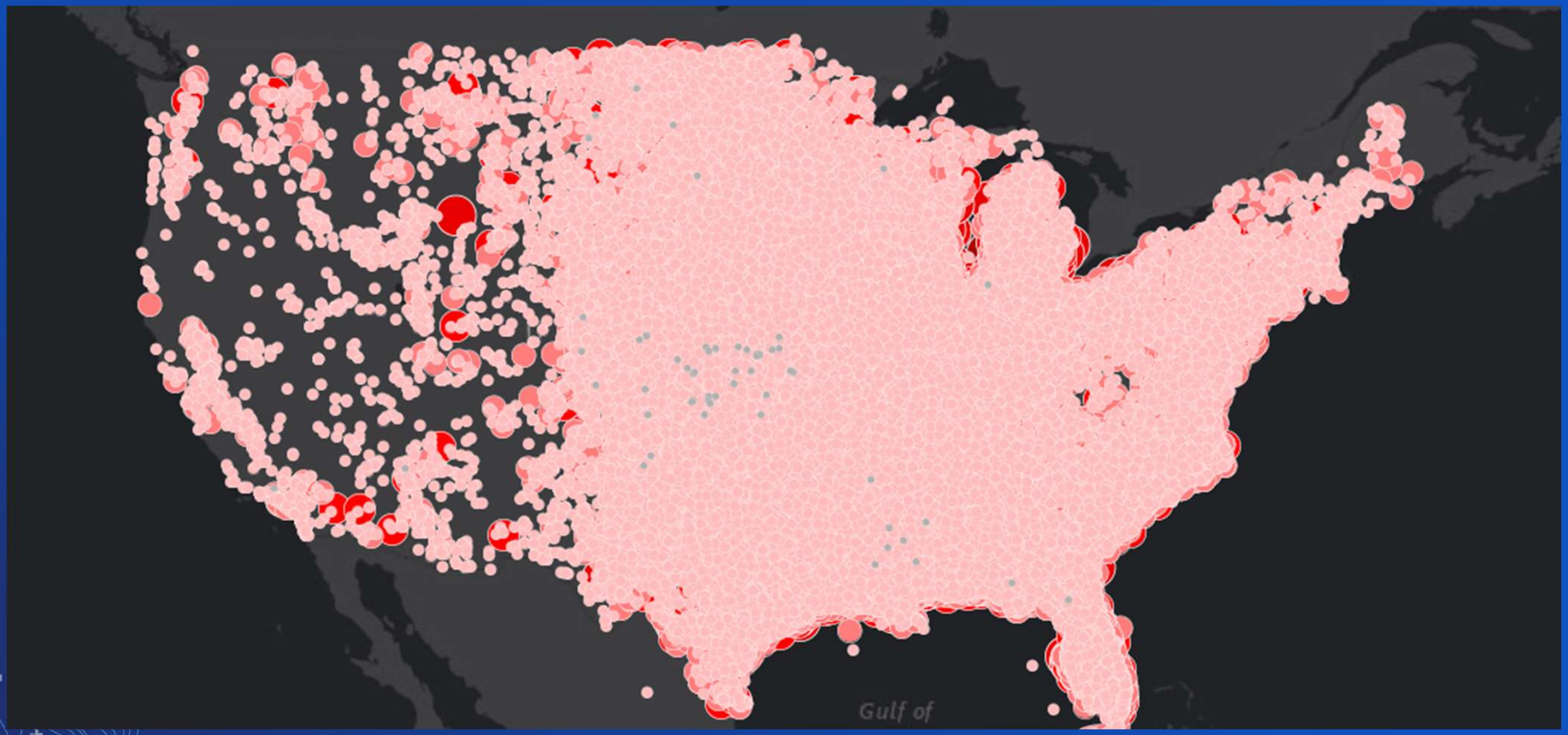


Aggregated Sales

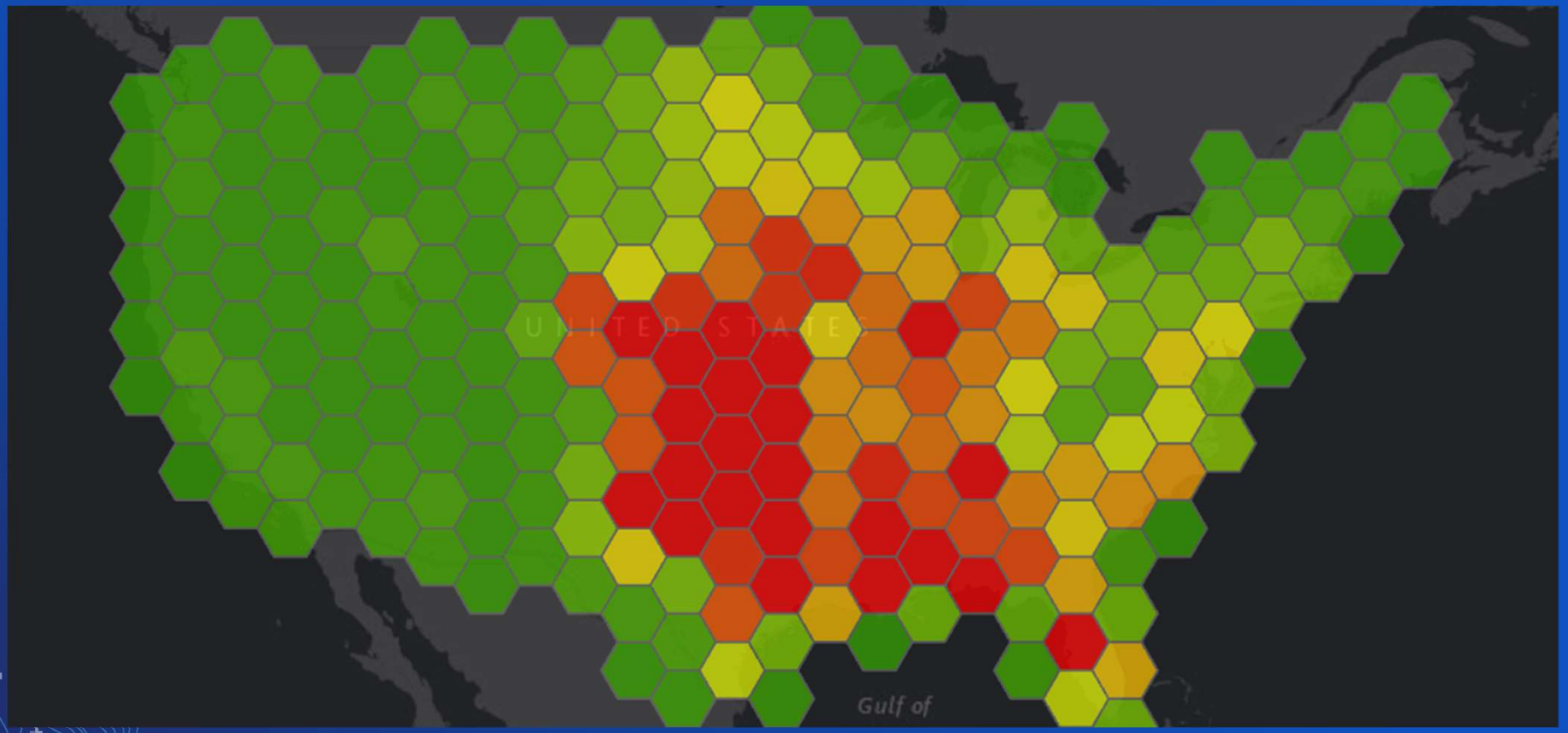
Total sales by States



Tornadoes Locations



Aggregated Tornadoes in Feature Bins



blog: http://esriurl.com/15551

Take away keywords

- Dynamic Aggregation/Summary
- Use Query Layer and binding parameters
  - New starting ArcGIS Pro 1.4

Helpful links

- Aggregate values into related features → http://esriurl.com/14539
- Define parameters in a query layer → http://esriurl.com/14540

Blog posts:

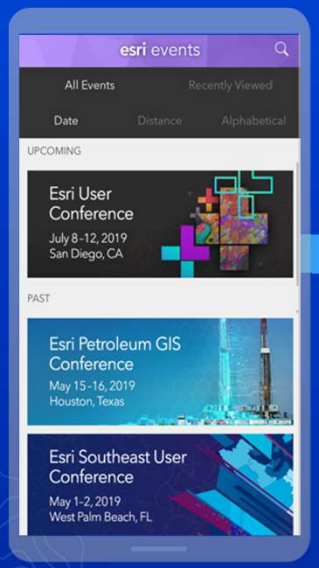
- Dynamic Spatiotemporal Exploratory Analysis with Aggregated Results Using Time Series Data in ArcGIS → http://esriurl.com/15568
- Transform Dynamically Aggregated Time Series Results into Polygons in ArcGIS → http://esriurl.com/15569
- Dynamic Aggregate Points within Polygon Features for Exploratory Analysis → http://esriurl.com/15570

Related sessions:

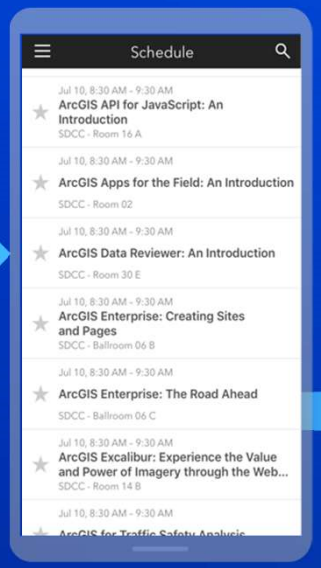
- Visualization & Exploration of Large Datasets Using Feature Binning
  Thursday @ 4:00 pm in - Room 16 B https://bit.ly/2xzYVpP

Please Share Your Feedback in the App

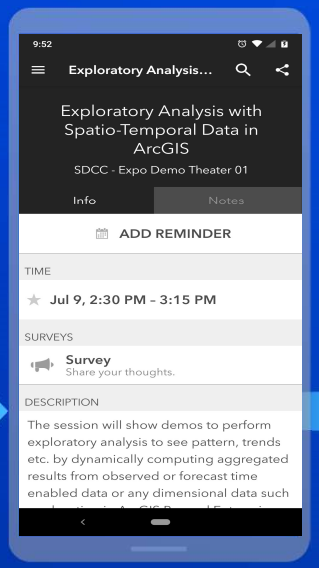
Download the Esri Events app and find your event



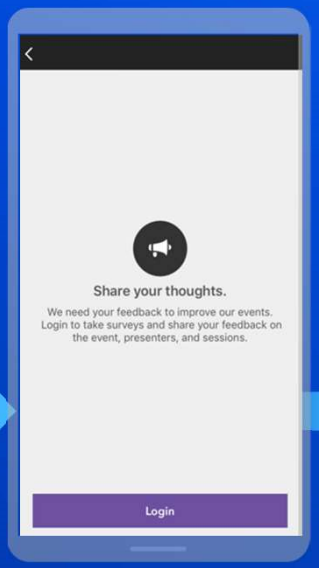
Select the session you attended



Scroll down to "Survey"



Log in to access the survey



Complete the survey and select "Submit"

Related sessions: https://bit.ly/2xzYVpP