Understanding the Basics: Introduction to the Language of Spatial Analysis

Miriam Schmidts

Nicholas M. Giner

Agenda

- What is the “Language of Spatial Analysis” and why is it important?
- Categories of spatial analysis
  - Understanding where
  - Measuring size, shape and distribution
  - Determining how places are related
  - Finding the best locations and paths
  - Detecting and quantifying patterns
  - Making predictions

Language of Spatial Analysis

- **Language:**
- The method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.

Language of Spatial Analysis

- **Language:**
- The method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.

•**Spatial analysis:**

•Pose questions and derive results using of analytical tools

•Pulling out information from data, turning data into information

•Unlock the data’s full potential

The Science of Where

- Illuminate the truth answer fundamental questions of where
  - Where is it
  - How do I get there?
  - Where am I?
  - Where is it changing?
  - Where is it suitable?

The Science of Where

- Illuminate the truth answer fundamental questions of where
  - Where is it
  - How do I get there?
  - Where am I?
  - Where is it changing?
  - Where is it suitable?

- Get away from using single geoprocessing tools – Think workflows!

THE LANGUAGE OF SPATIAL ANALYTICS

Using *The Science of Where* to understand our world—mapping where things are, how they relate, what it all means, and what actions to take.

Understanding where

1. Understanding where things are (location maps).
2. Understanding where the variations and patterns in values are (comparative maps).
3. Understanding where and when locations and values change.

Measuring size, shape, and distribution

4. Calculating individual feature geometries.
5. Calculating geometries and distributions of feature collections.

Determining how places are related

6. Determining what is nearby or coincident.
7. Determining and summarizing what is within an area(s).
8. Determining what is closest.
9. Determining what is visible from a given location(s).
10. Determining overlapping relationships in space and time.

Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria.
12. Finding the best allocation of resources to geographic areas.
13. Finding the best route, path, or flow along a network.
14. Finding the best route, path, or corridor across open terrain.
15. Finding the best supply locations given known demand and a travel network.

Detecting and quantifying patterns

16. Where are the significant hot spots, anomalies, and outliers?
17. What are the local, regional, and global spatial trends?
18. Which features/pixels are similar, and how can they be clustered, classified, and identified.
19. Are spatial patterns changing over time?

Making predictions

20. Given a success case, identifying, ranking, and predicting similar locations.
21. Finding the factors that explain observed spatial patterns and making predictions.
22. Interpolating a continuous surface and trends from discrete sample observations.
23. Predicting how and where objects spatially interact (attraction and decay).
24. Predicting how and where objects affect wave propagation.
25. Predicting where phenomena will move, flow, or spread.
26. Predicting what-if.

esri | THE SCIENCE OF WHERE™

Understanding where

1. Understanding where things are (location maps).
2. Understanding where the variations and patterns in values are (comparative maps).
3. Understanding where and when locations and values change.

Measuring size, shape, and distribution

4. Calculating individual feature geometries.
5. Calculating geometries and distributions of feature collections.

Determining how places are related

6. Determining what is nearby or coincident.
7. Determining and summarizing what is within an area(s).
8. Determining what is closest.
9. Determining what is visible from a given location(s).
10. Determining overlapping relationships in space and time.

Determining how places are related

6 Determining what is nearby or coincident.

7 Determining and summarizing what is within an area(s).

8 Determining what is closest.

9 Determining what is visible from a given location(s).

10 Determining overlapping relationships in space and time.

Finding the best locations and paths

11 Finding the best locations that satisfy a set of criteria.

12 Finding the best allocation of resources to geographic areas.

13 Finding the best route, path, or flow along a network.

14 Finding the best route, path, or corridor across open terrain.

15 Finding the best supply locations given known demand and a travel network.

Detecting and quantifying patterns

16 Where are the significant hot spots, anomalies, and outliers?

17 What are the local, regional, and global spatial trends?

18 Which features/pixels are similar, and how can they be clustered, classified, and identified.

19 Are spatial patterns changing over time?

Making predictions

20 Given a success case, identifying, ranking, and predicting similar locations.

21 Finding the factors that explain observed spatial patterns and making predictions.

22 Interpolating a continuous surface and trends from discrete sample observations.

23 Predicting how and where objects spatially interact (attraction and decay).

24 Predicting how and where objects affect wave propagation.

25 Predicting where phenomena will move, flow, or spread.

26 Predicting what-if.

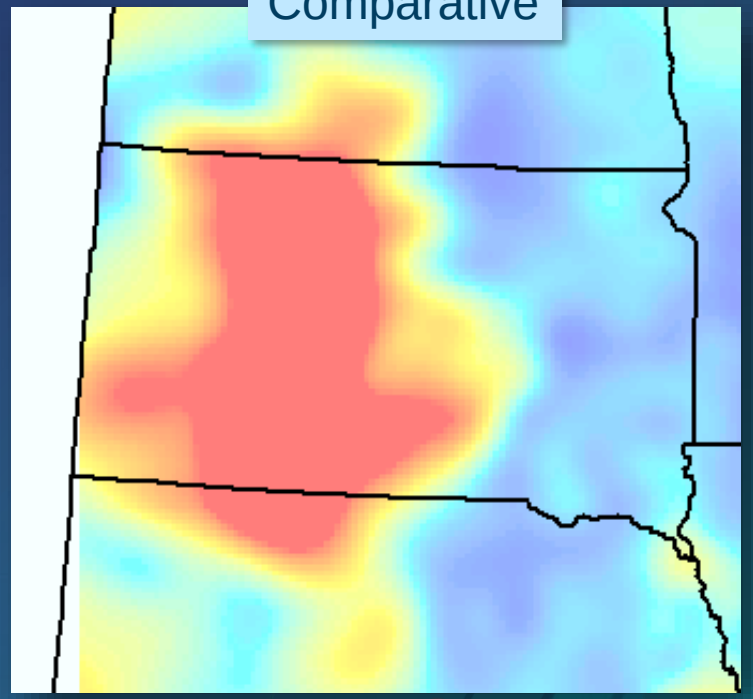
Examples: Understanding where

Location

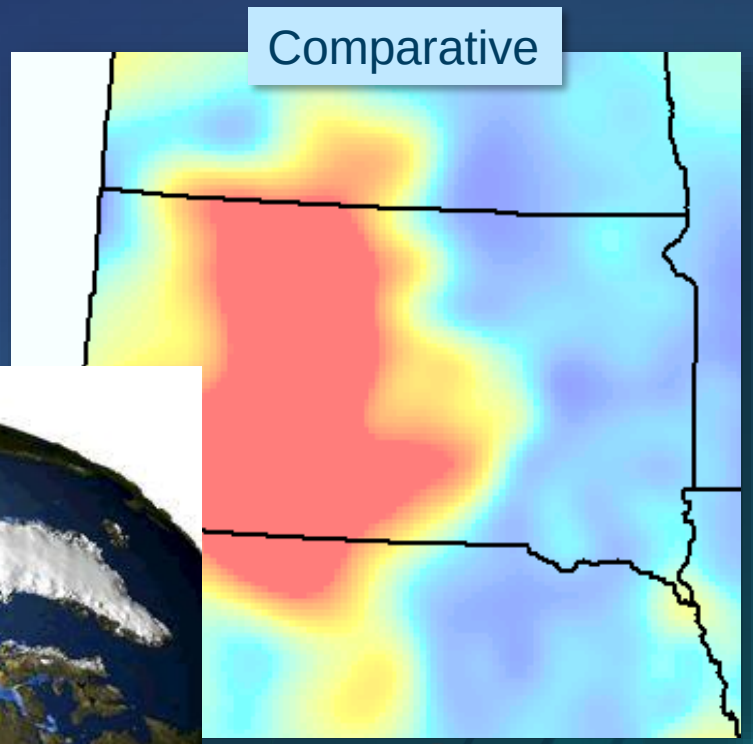
Examples: Understanding where

Location

Comparative



Examples: Understanding where



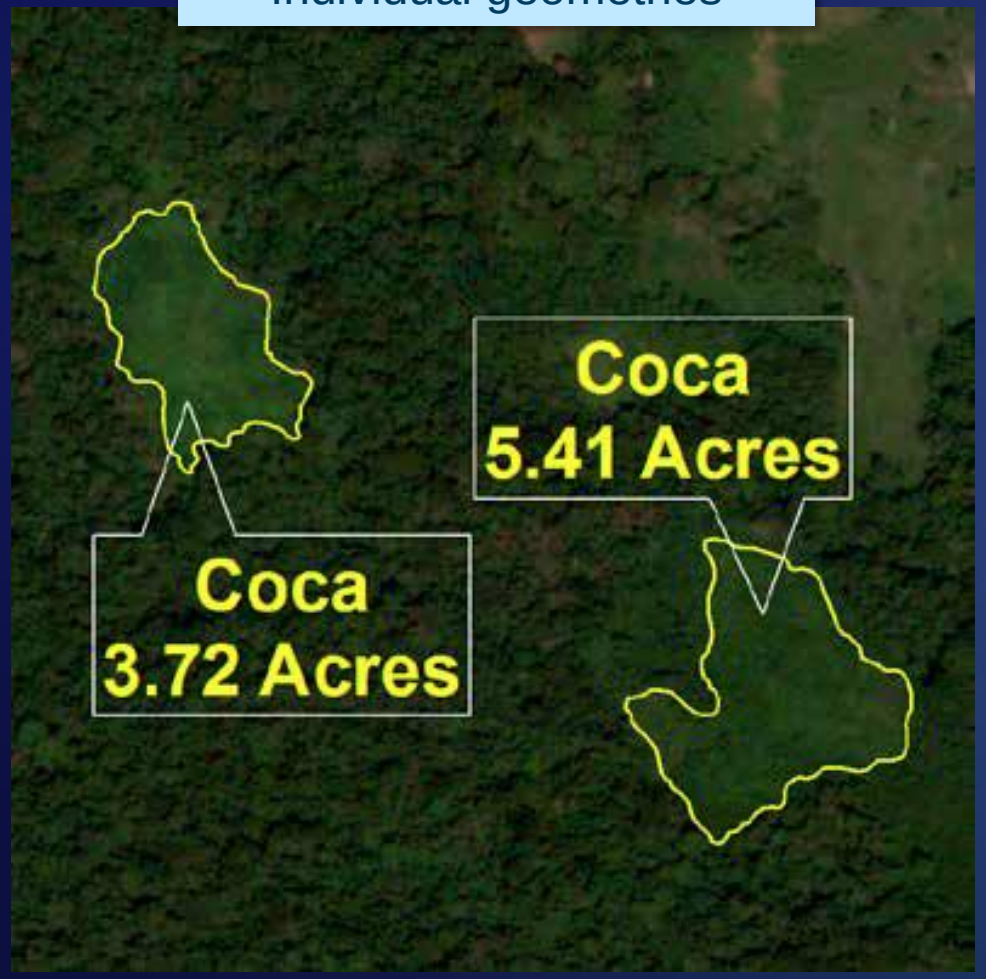
Examples: Calculating size, shape and distribution

Individual geometries

Feature Collections

Examples: Calculating size, shape and distribution

Individual geometries



Feature Collections

Examples: Calculating size, shape and distribution

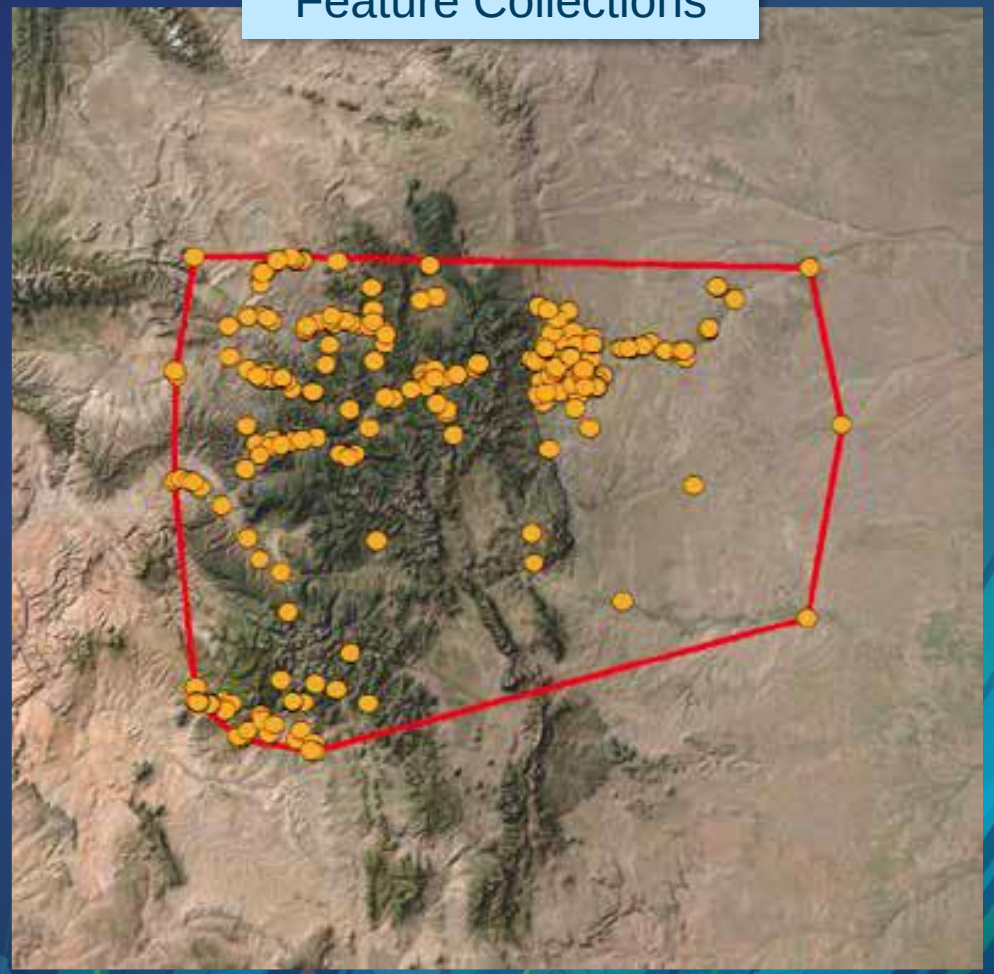
Individual geometries

Feature Collections

Examples: Calculating size, shape and distribution

Individual geometries

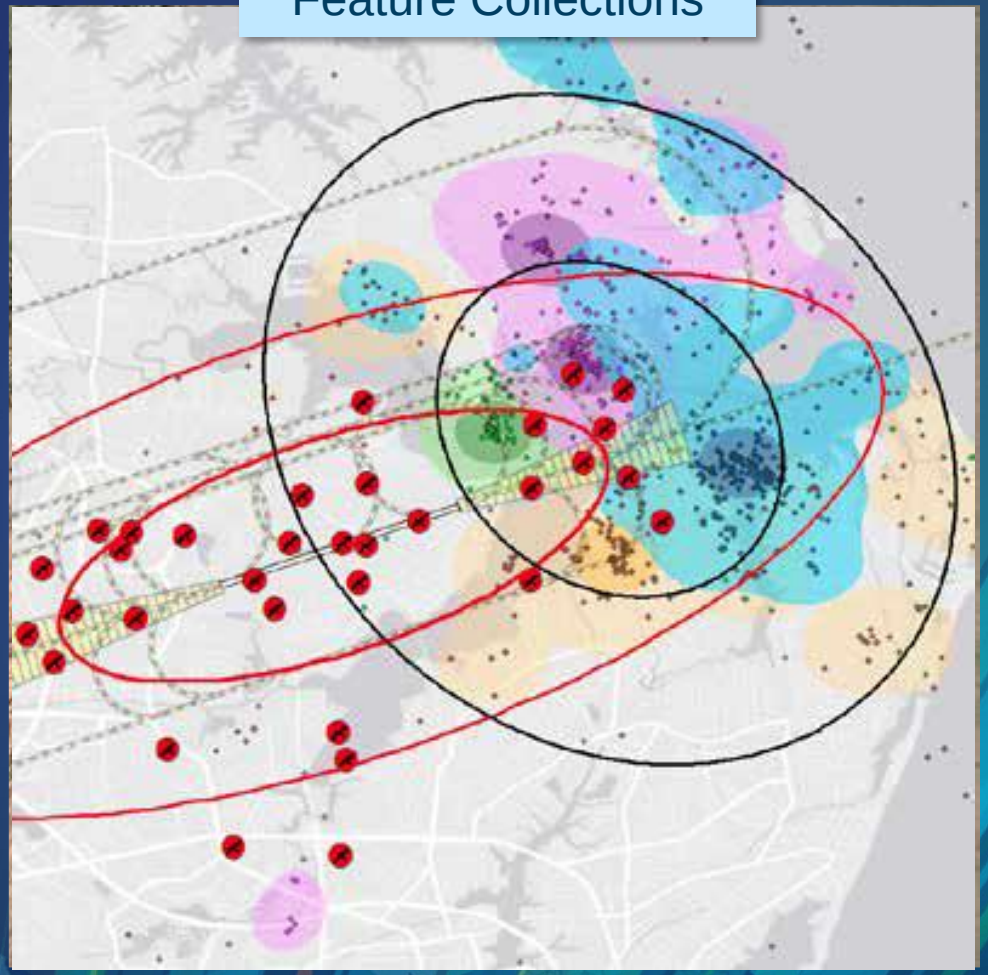
Feature Collections



Examples: Calculating size, shape and distribution

Individual geometries

Feature Collections

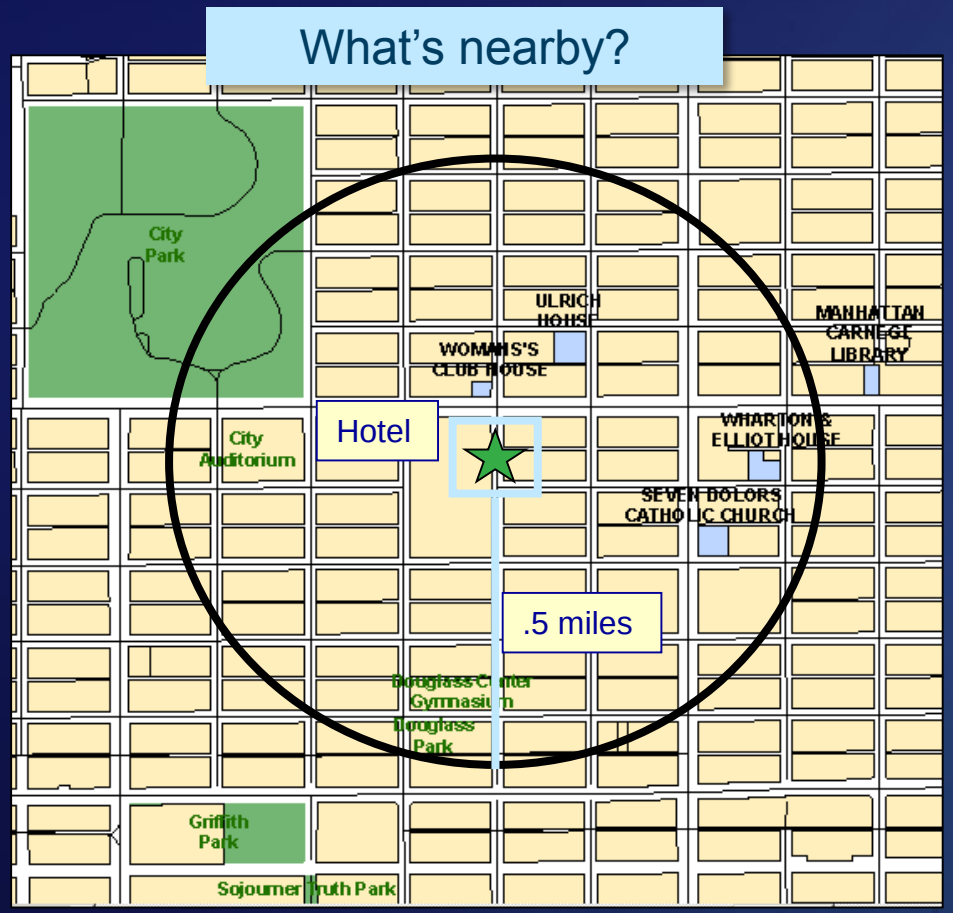


Demo:
Understanding where

Measuring size, shape, and distribution

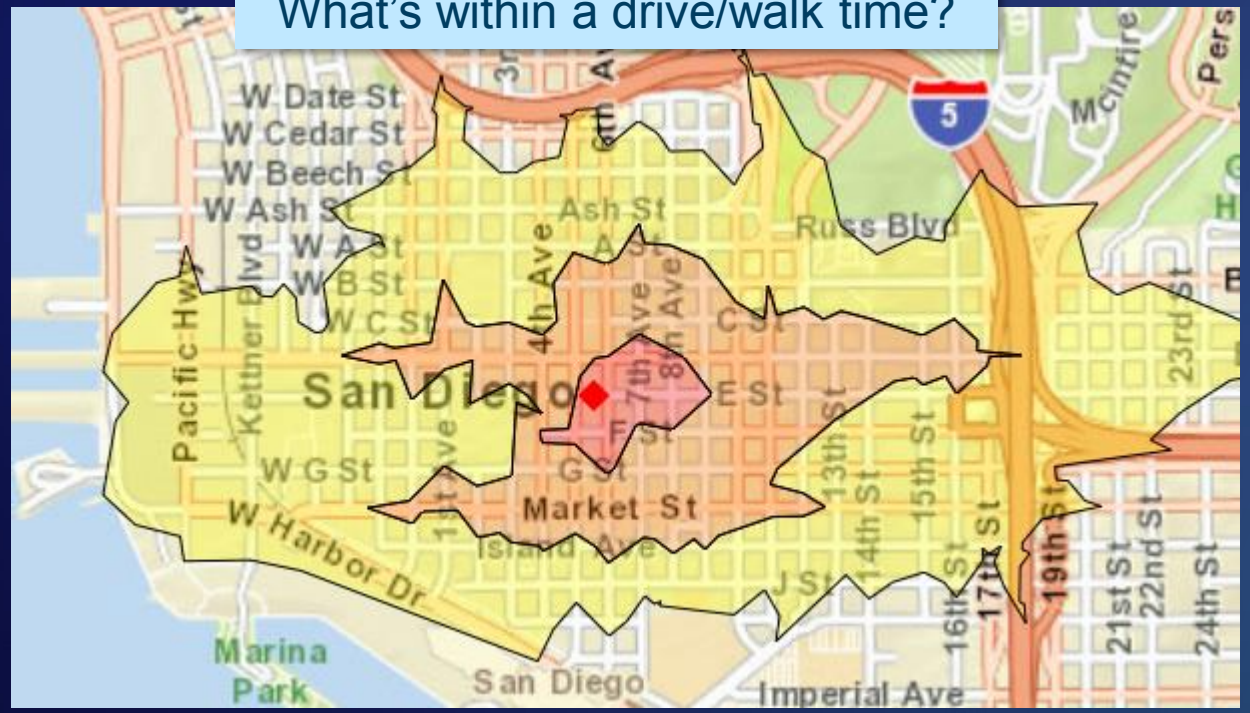
Determining how places are related - Distance

Determining how places are related - Distance

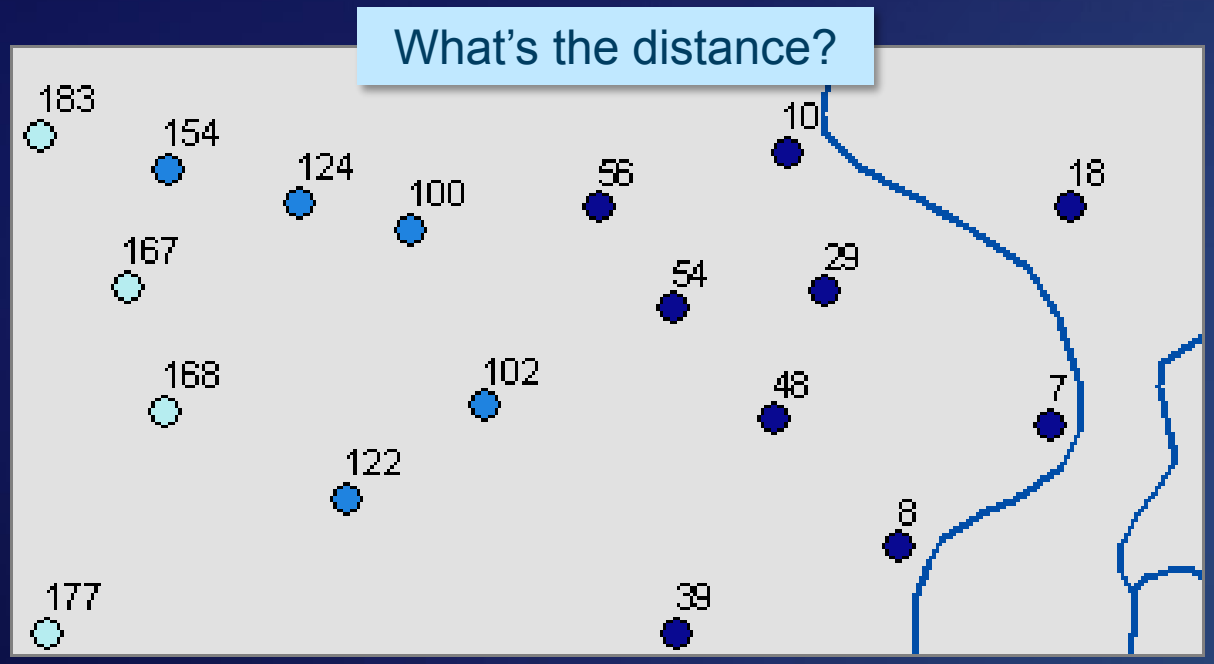


Determining how places are related - Distance

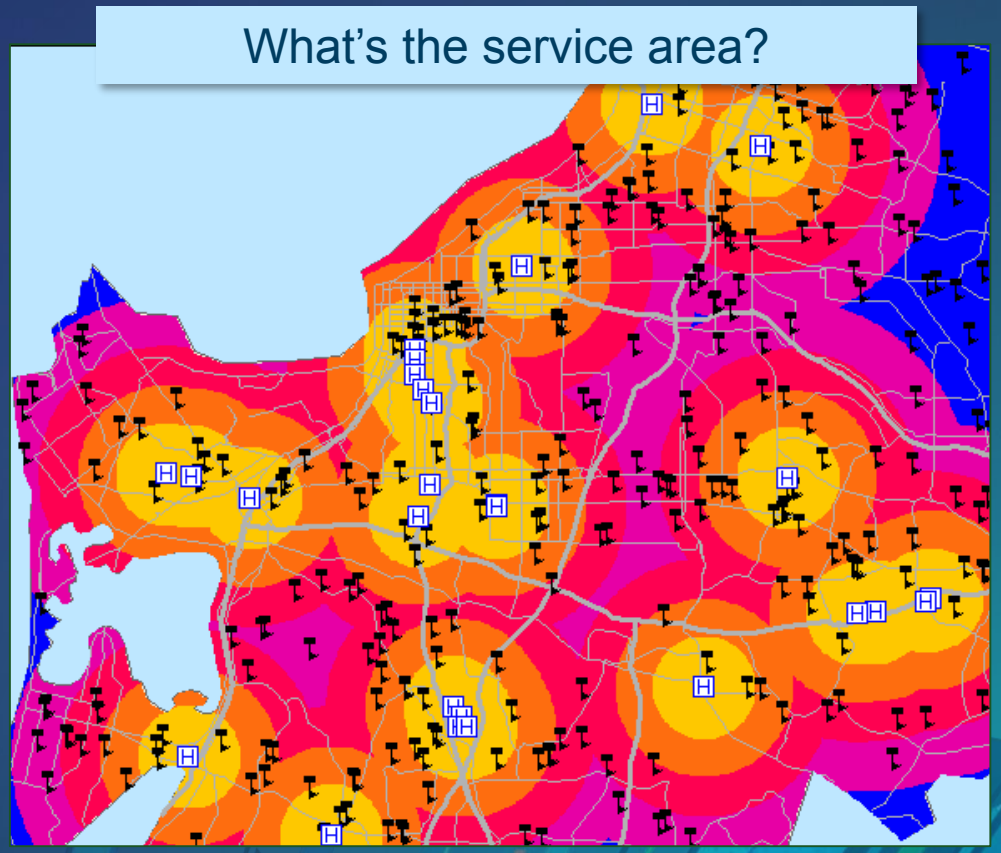
What's within a drive/walk time?



Determining how places are related - Distance



Determining how places are related - Distance

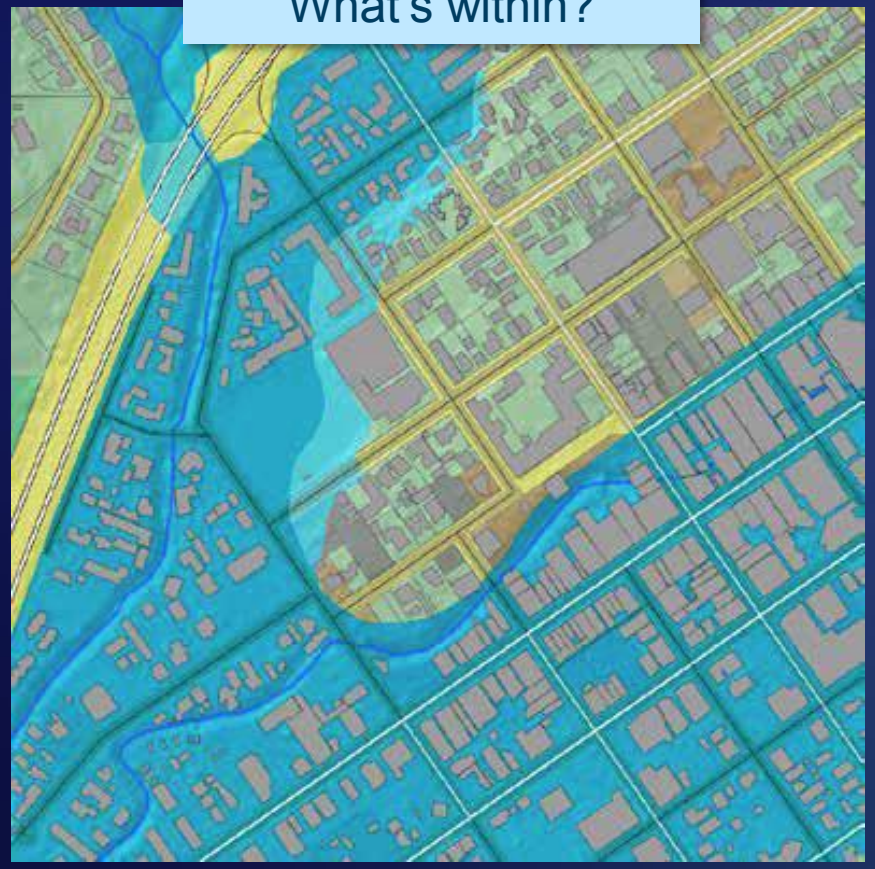


Determining how places are related - Distance

Determining how places are related – Coincidence and Containment

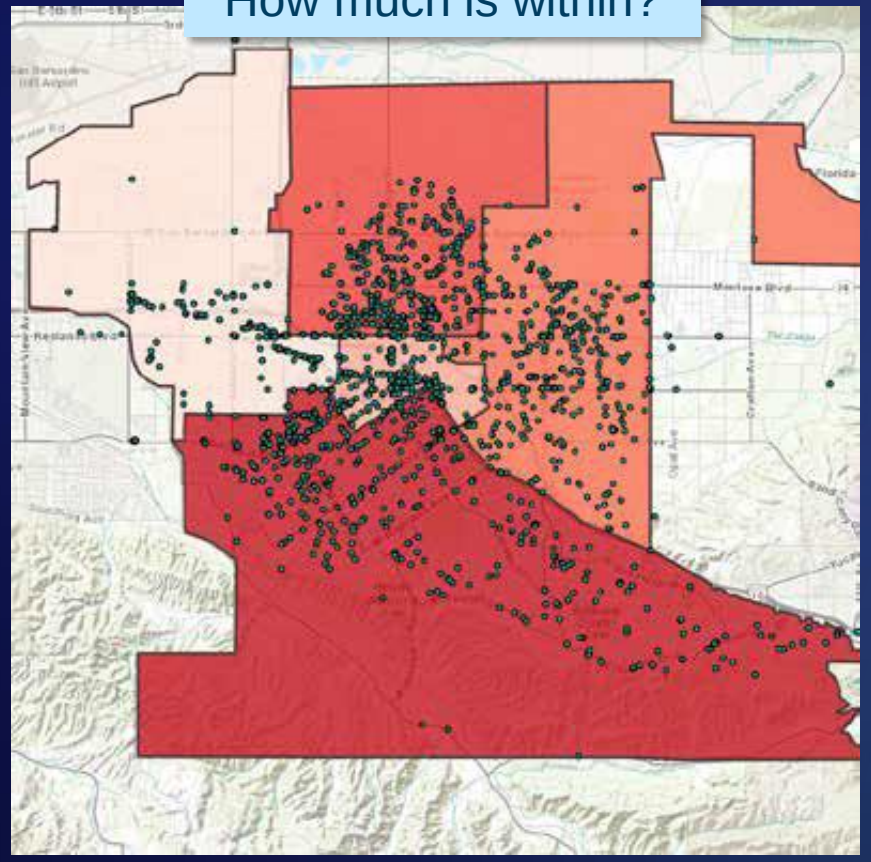
Determining how places are related – Coincidence and Containment

What’s within?



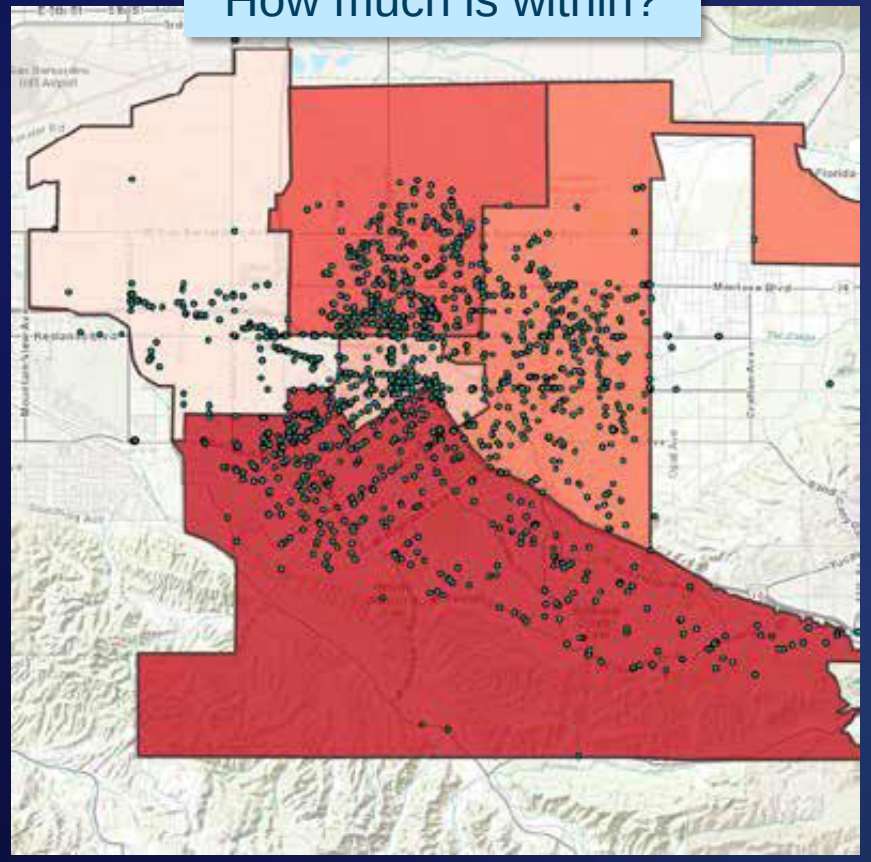
Determining how places are related – Coincidence and Containment

How much is within?

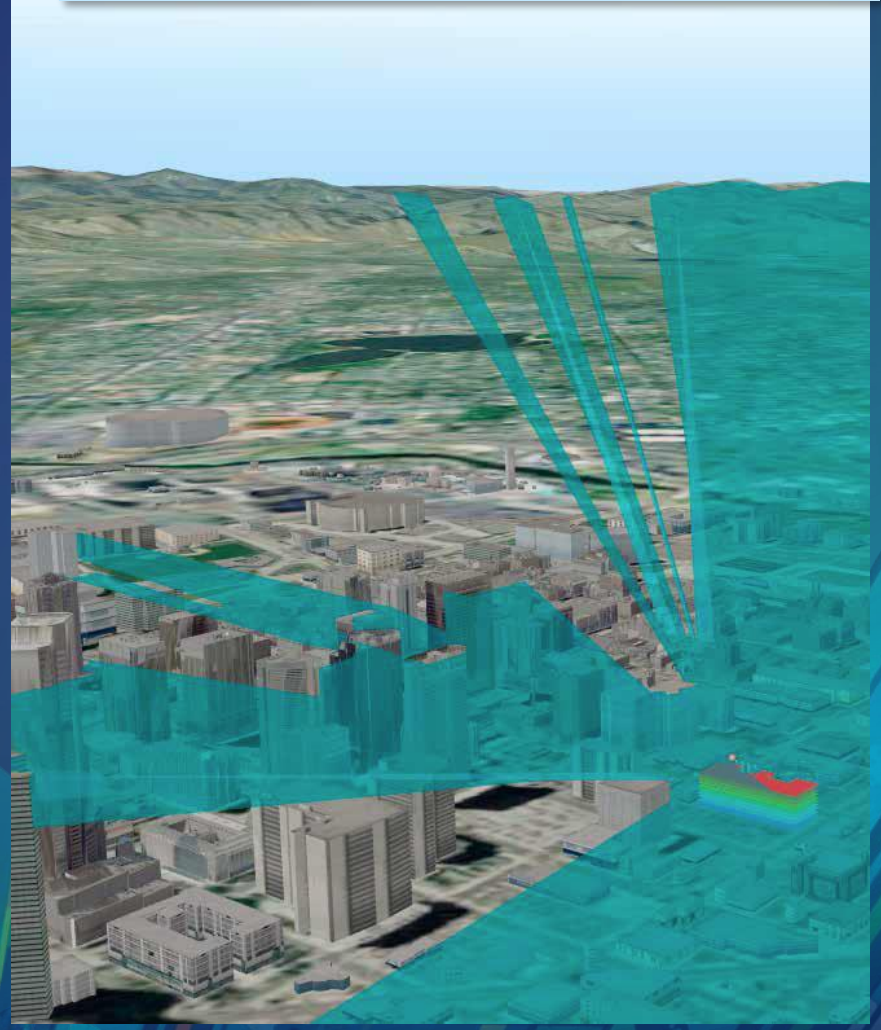


Determining how places are related – Coincidence and Containment

How much is within?

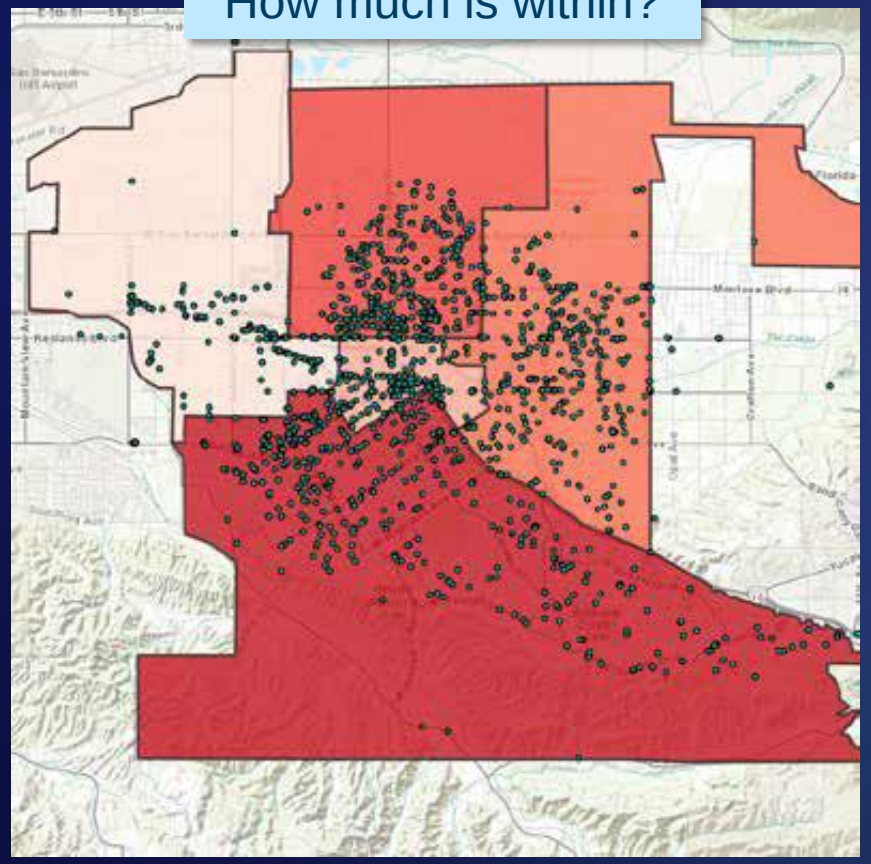


What's the visible area?

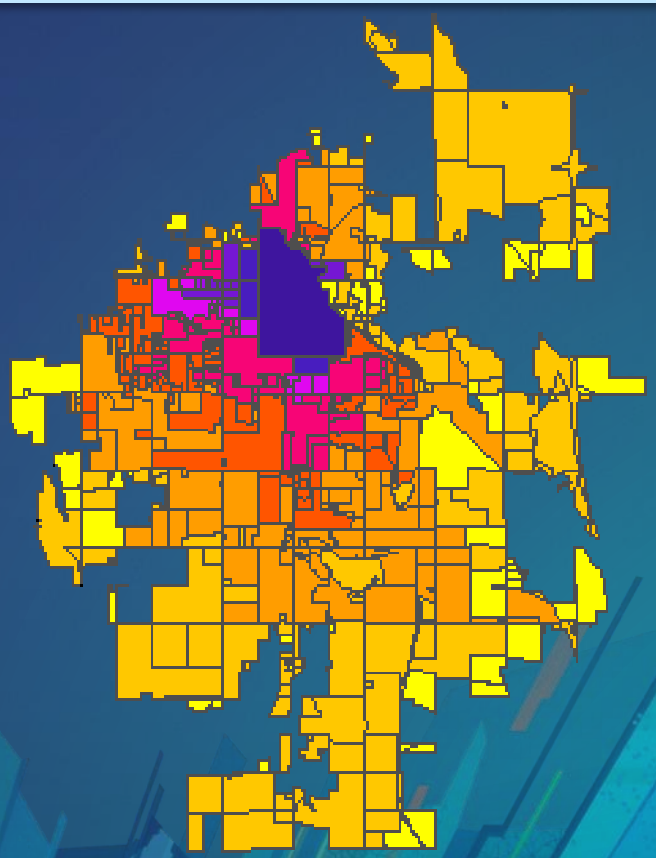


Determining how places are related – Coincidence and Containment

How much is within?

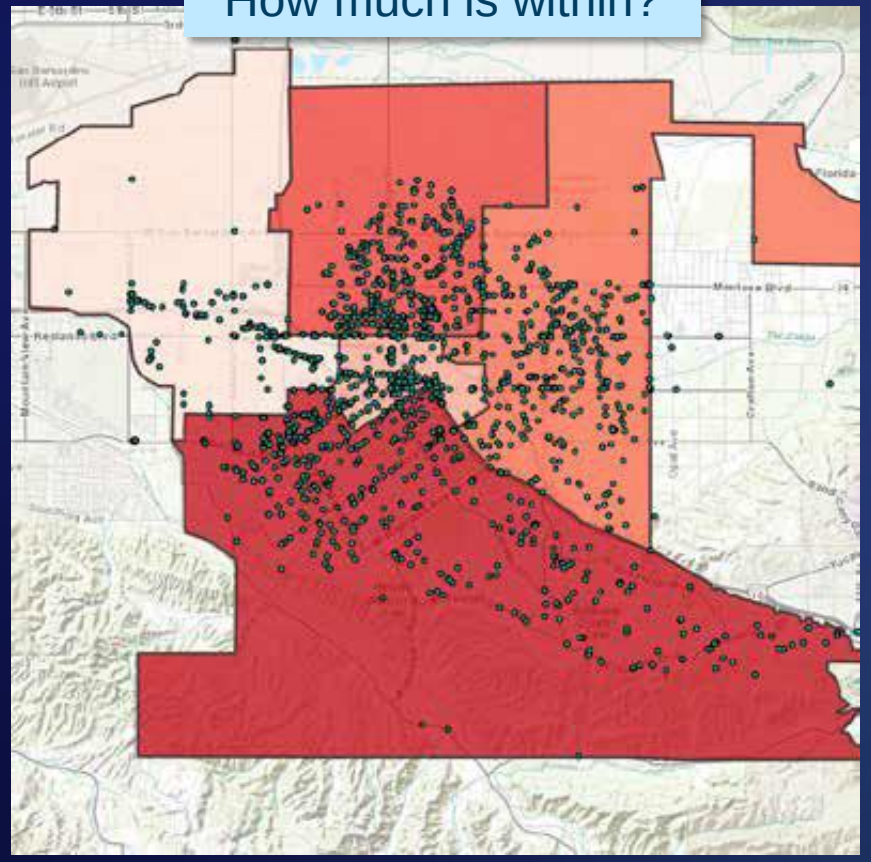


What's changing?

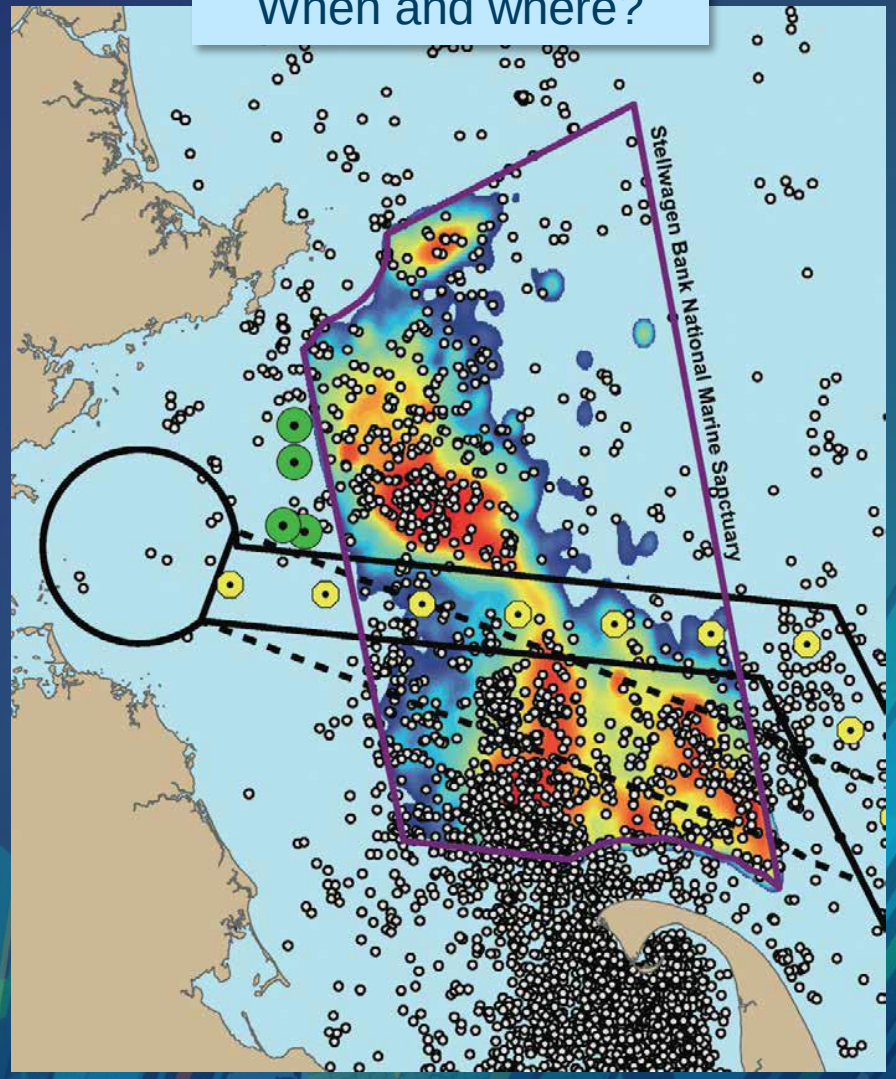


Determining how places are related – Coincidence and Containment

How much is within?



When and where?



Demo:
Determining how places are related

Finding the best locations and paths

Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria

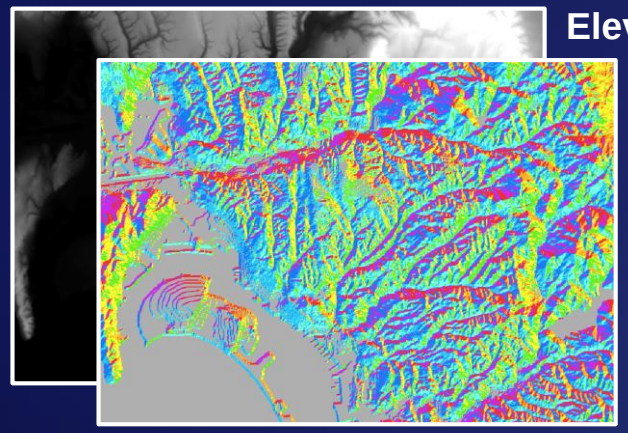
Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria

Elevation

Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria

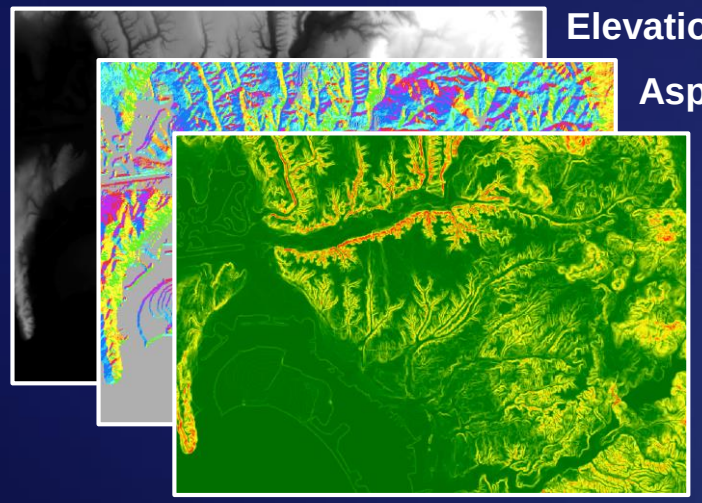


Elevation

Aspect

Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria



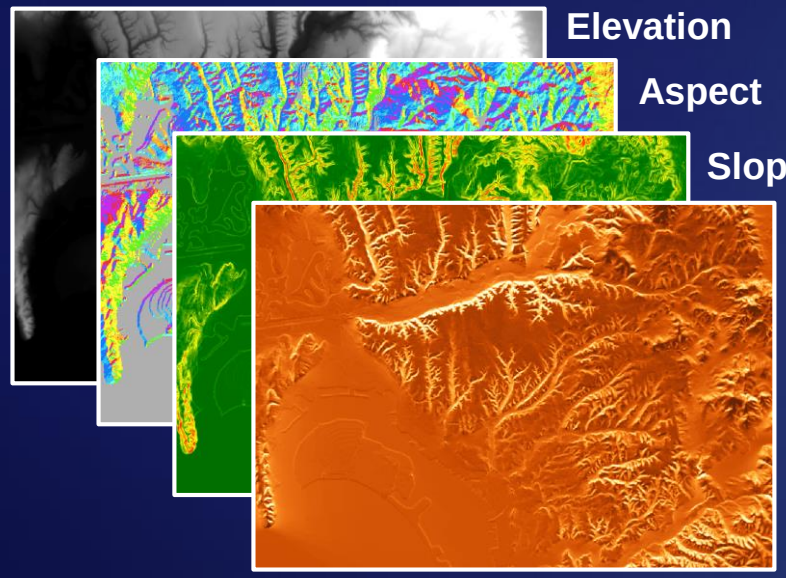
Elevation

Aspect

Slope

Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria



Elevation

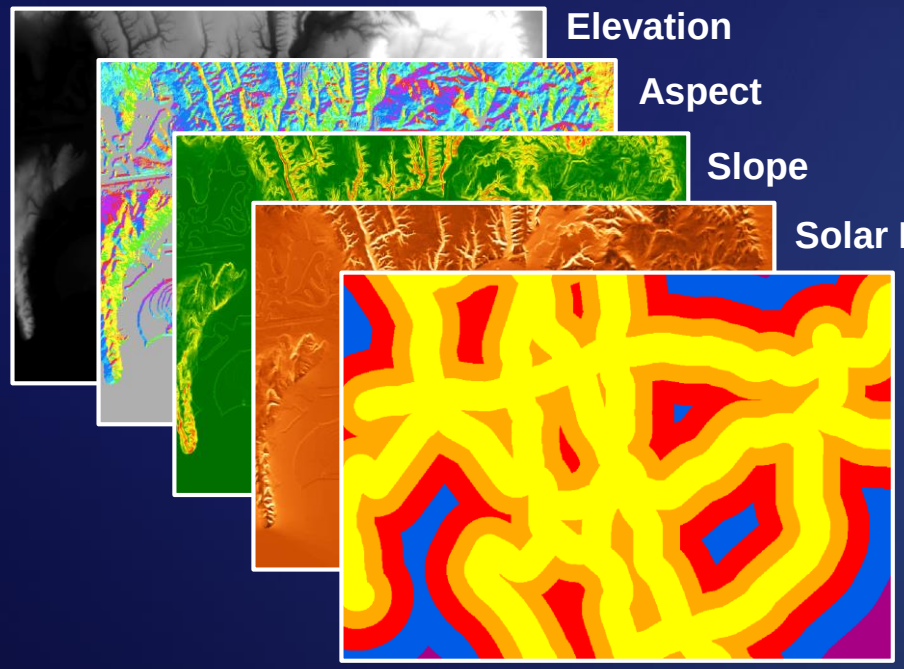
Aspect

Slope

Solar Radiation

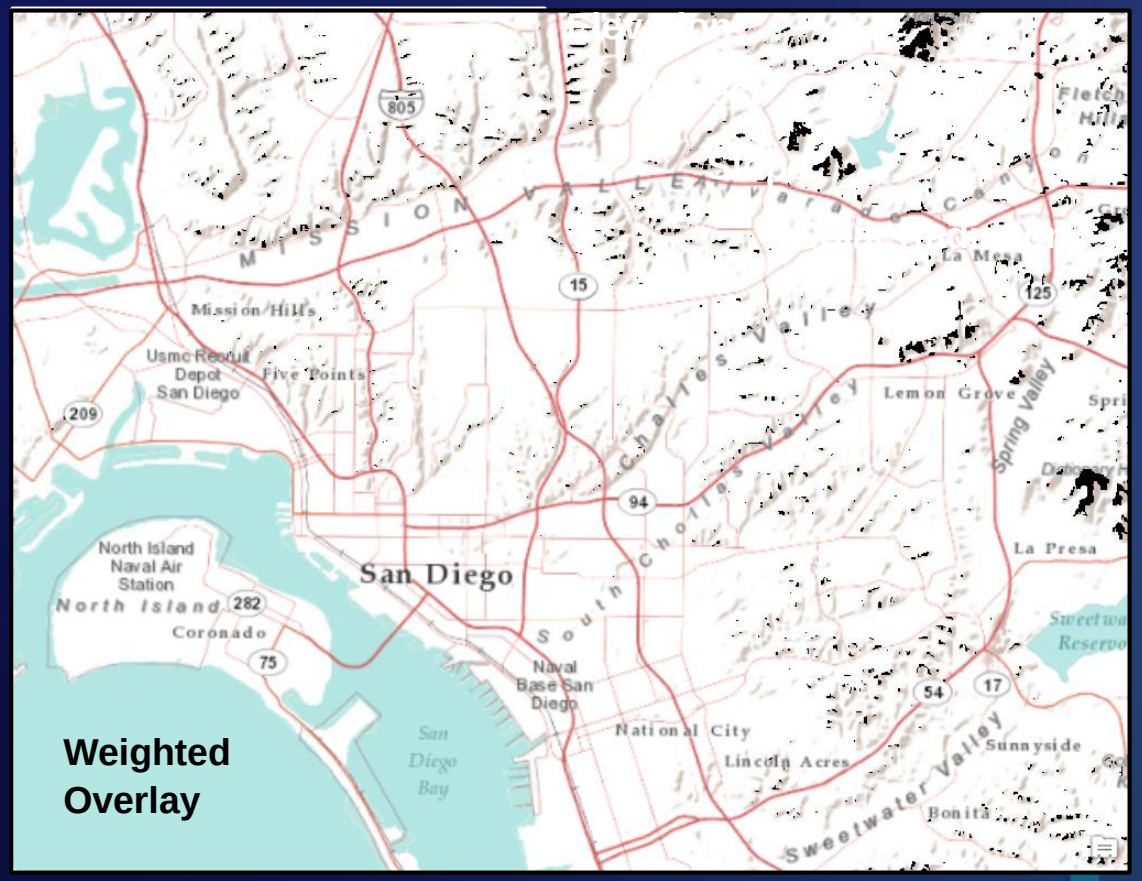
Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria



Finding the best locations and paths

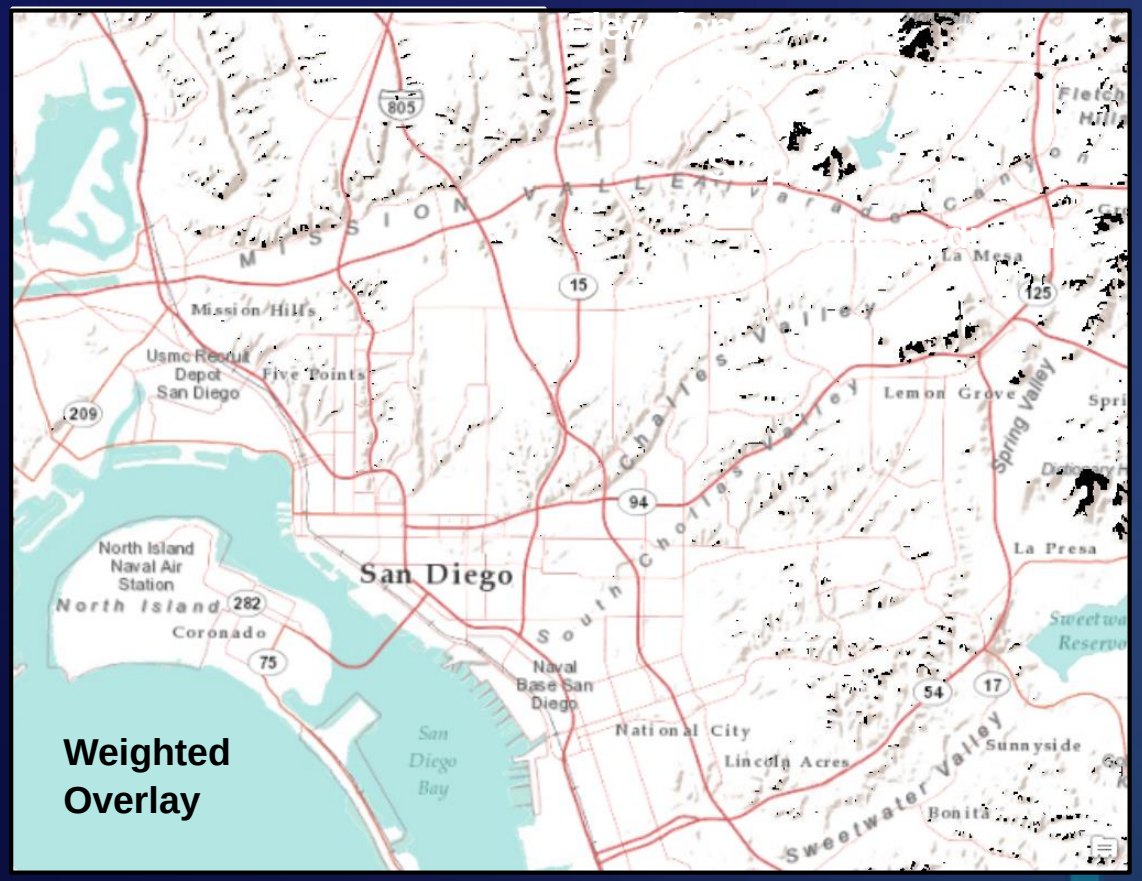
11. Finding the best locations that satisfy a set of criteria



Weighted Overlay

Finding the best locations and paths

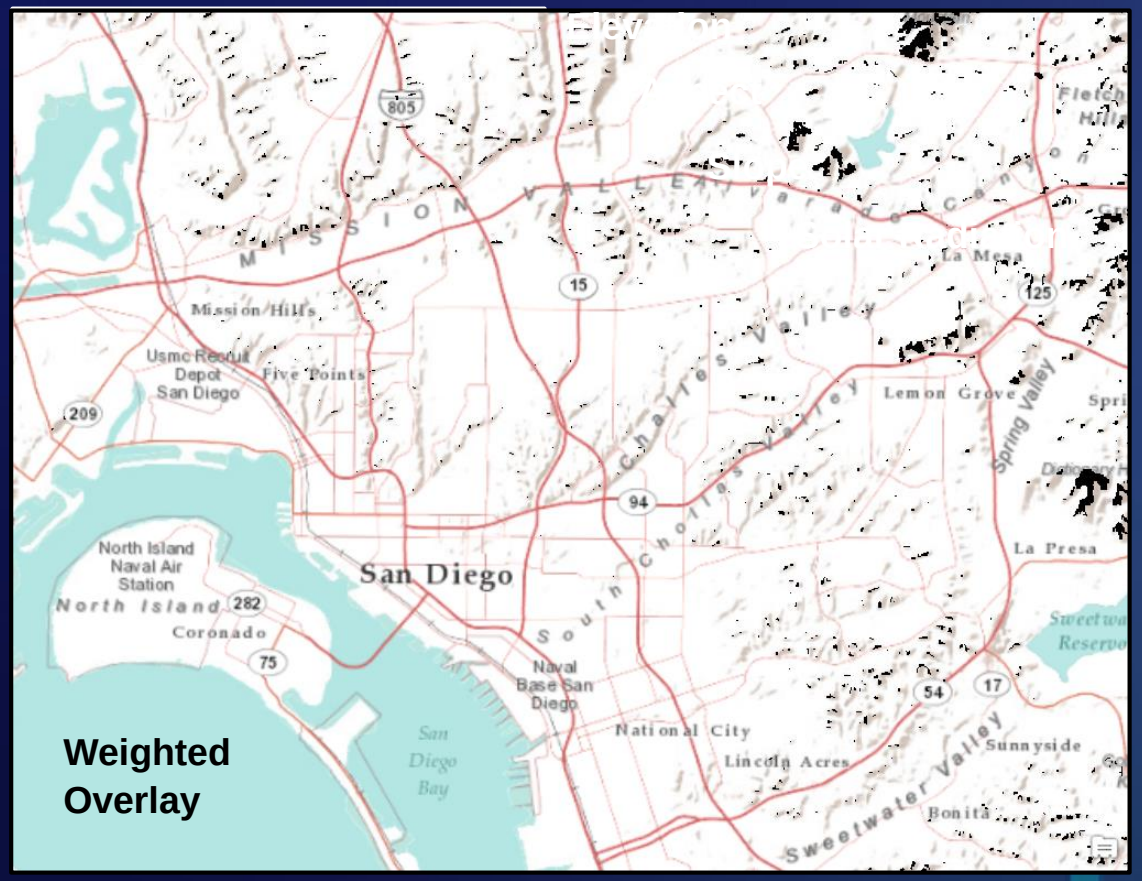
11. Finding the best locations that satisfy a set of criteria



12. Allocating resources to geographic areas

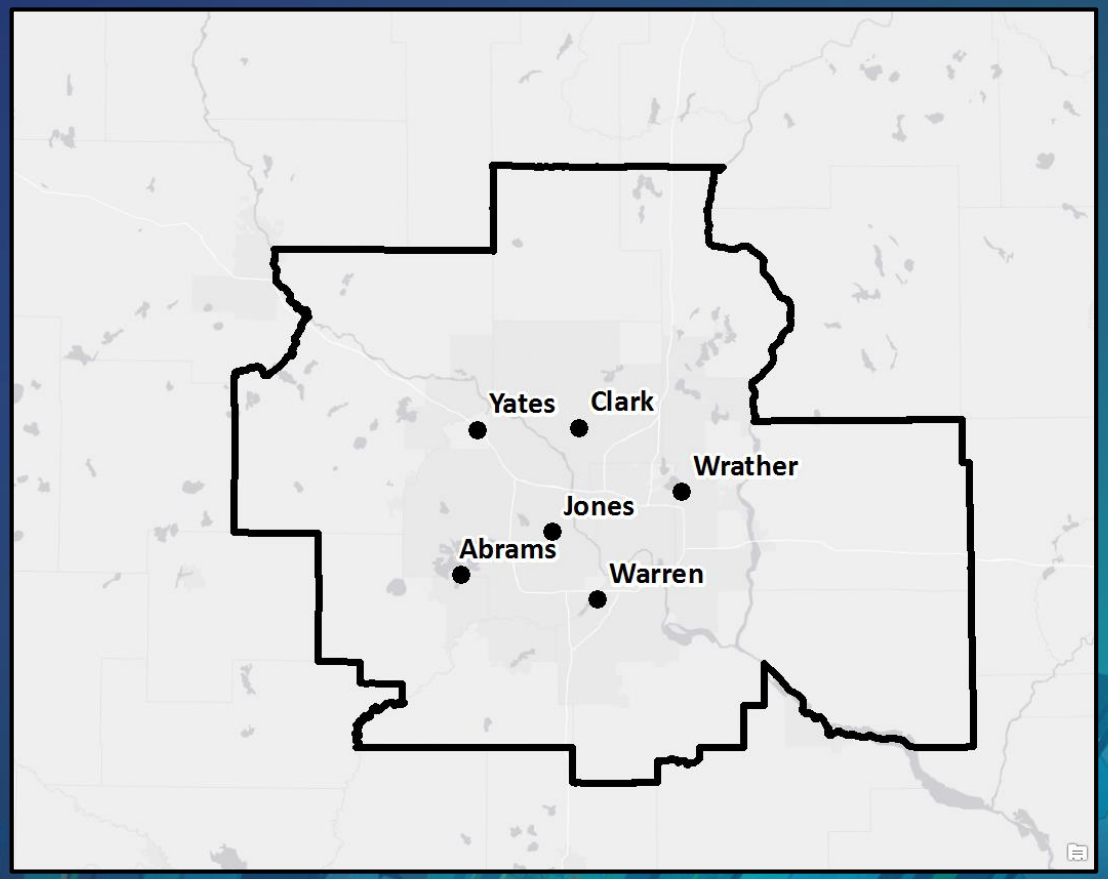
Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria



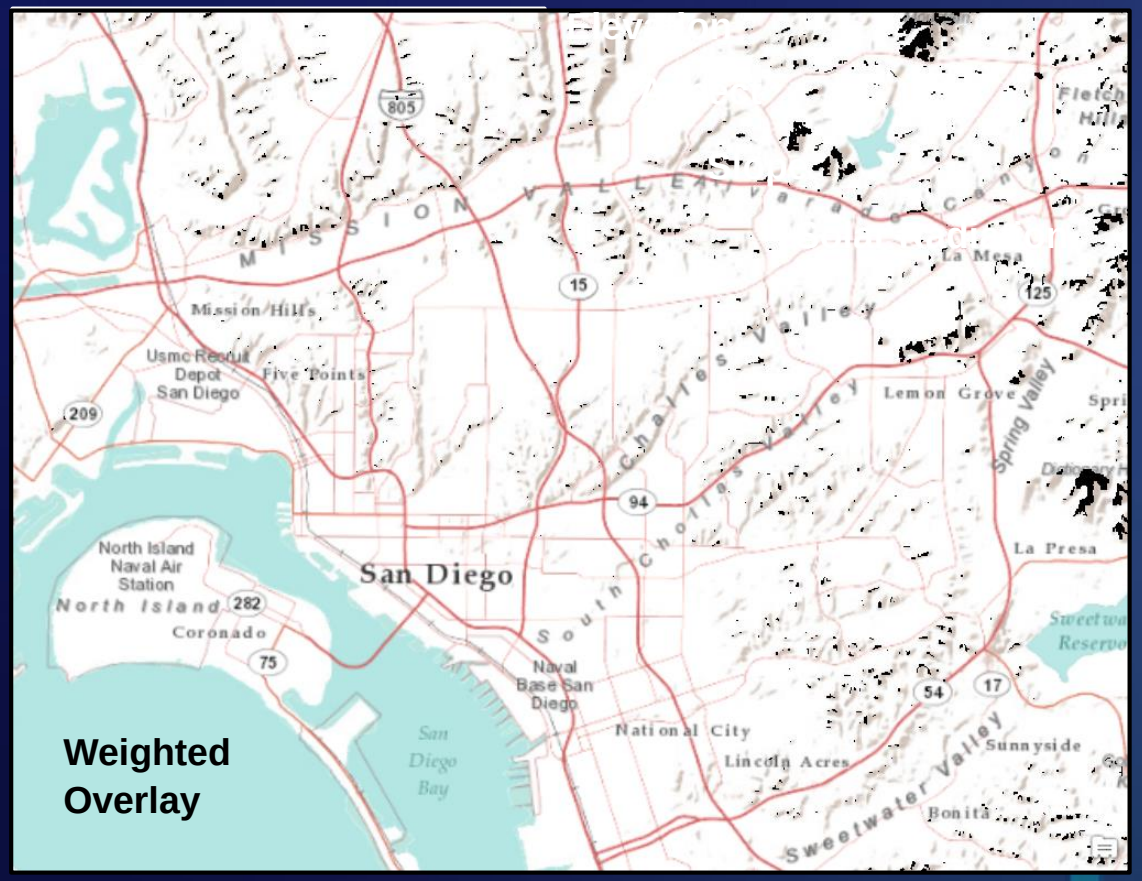
Weighted Overlay

12. Allocating resources to geographic areas

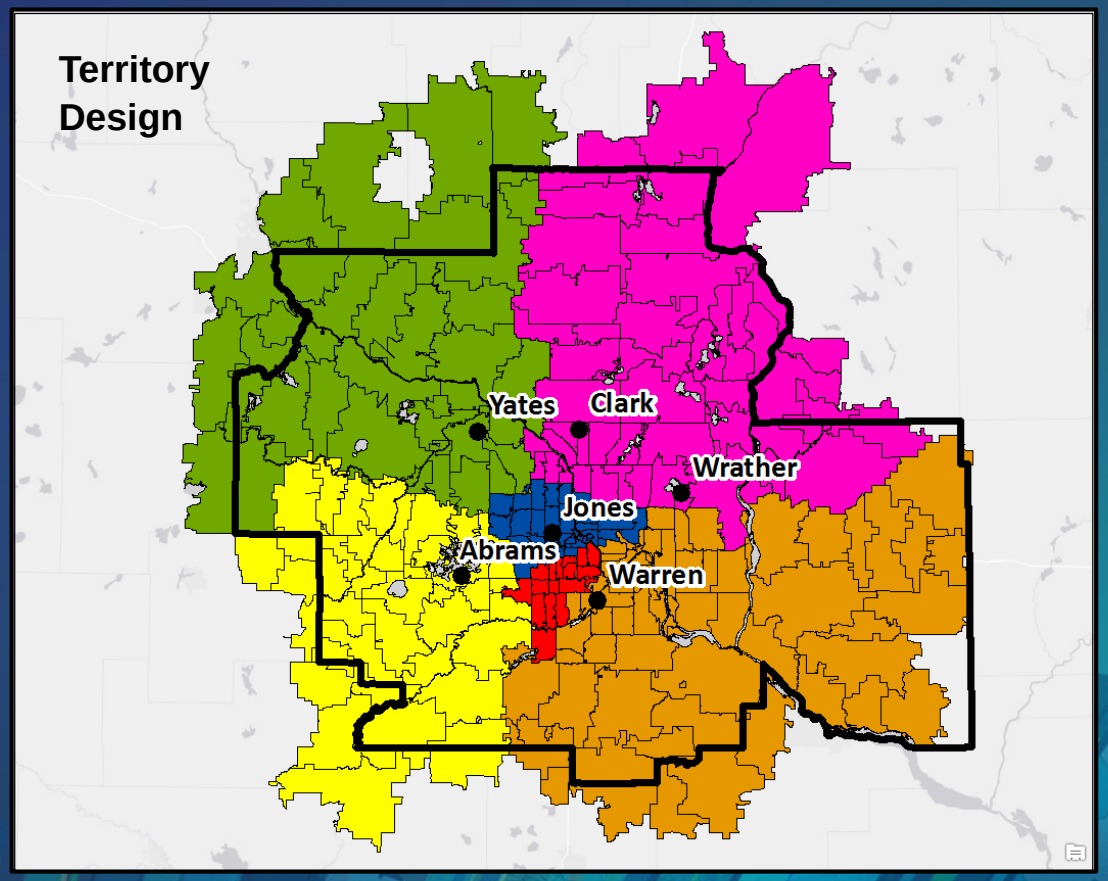


Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria

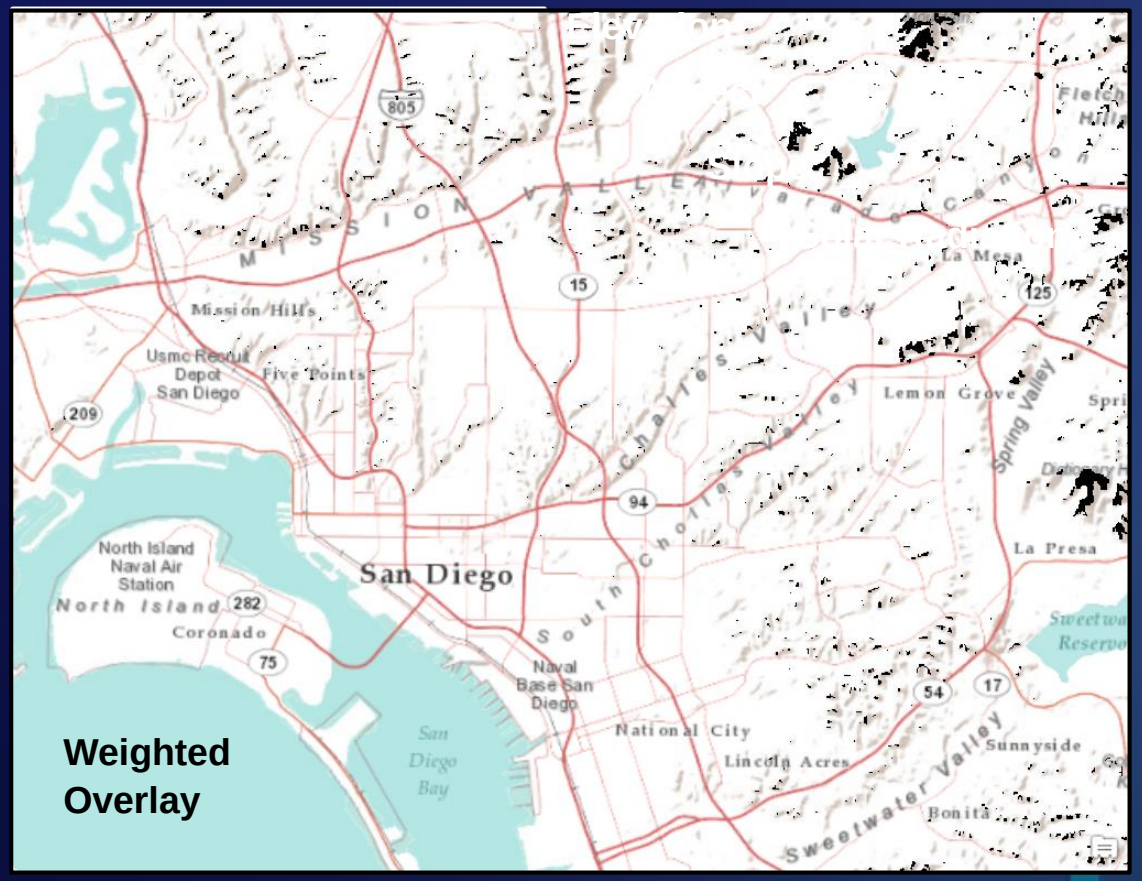


12. Allocating resources to geographic areas

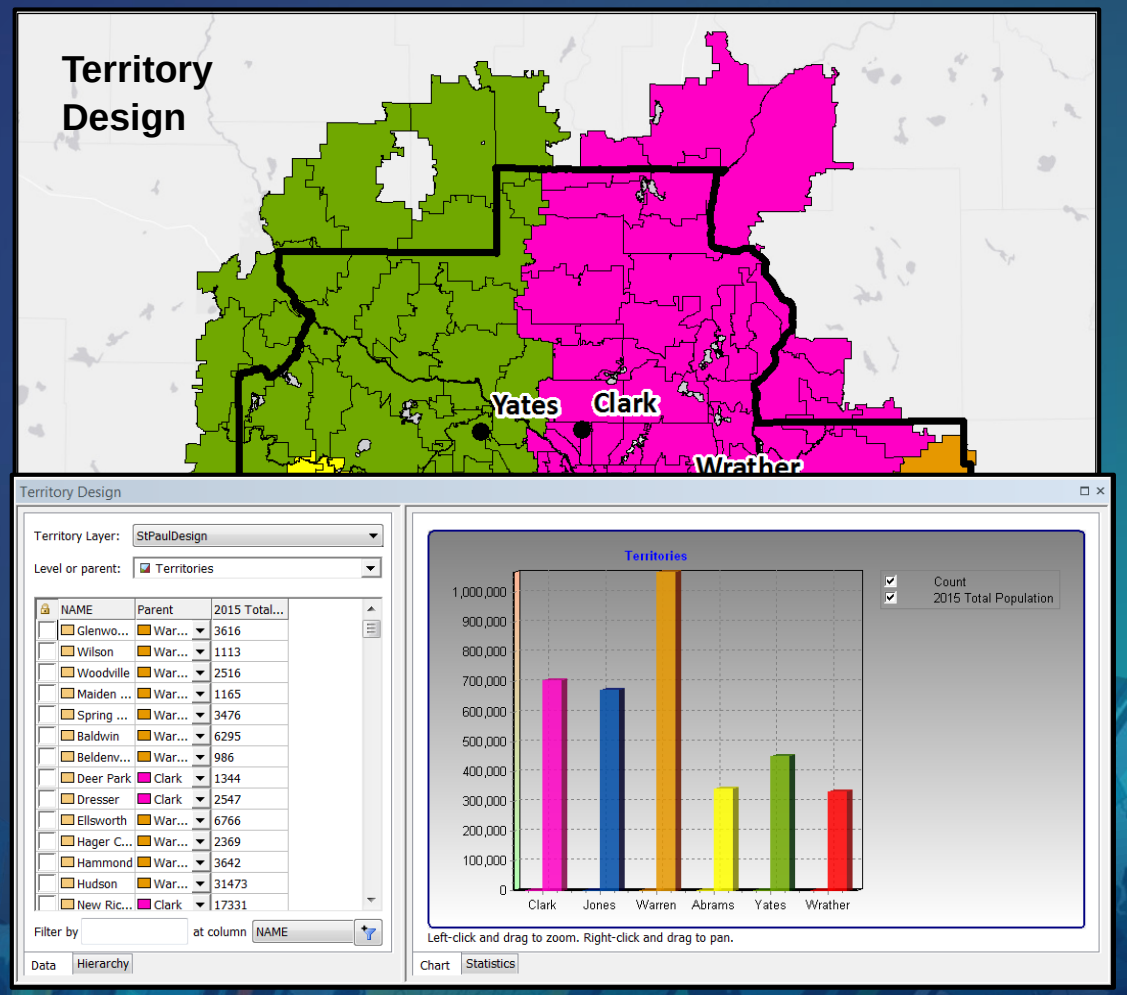


Finding the best locations and paths

11. Finding the best locations that satisfy a set of criteria



12. Allocating resources to geographic areas



Finding the best locations and paths

Finding the best locations and paths

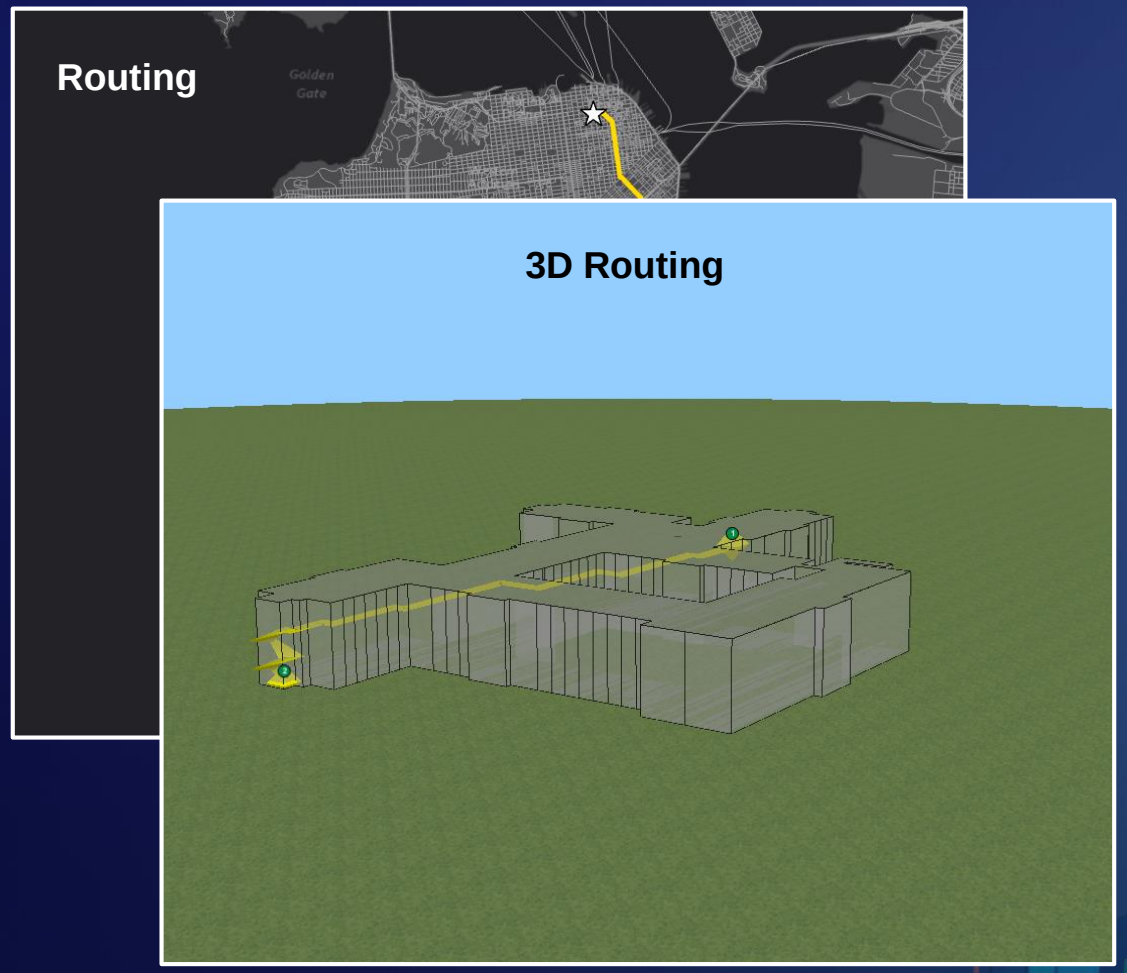
13. Finding the best route, path, or flow along a network

Finding the best locations and paths

13. Finding the best route, path, or flow along a network

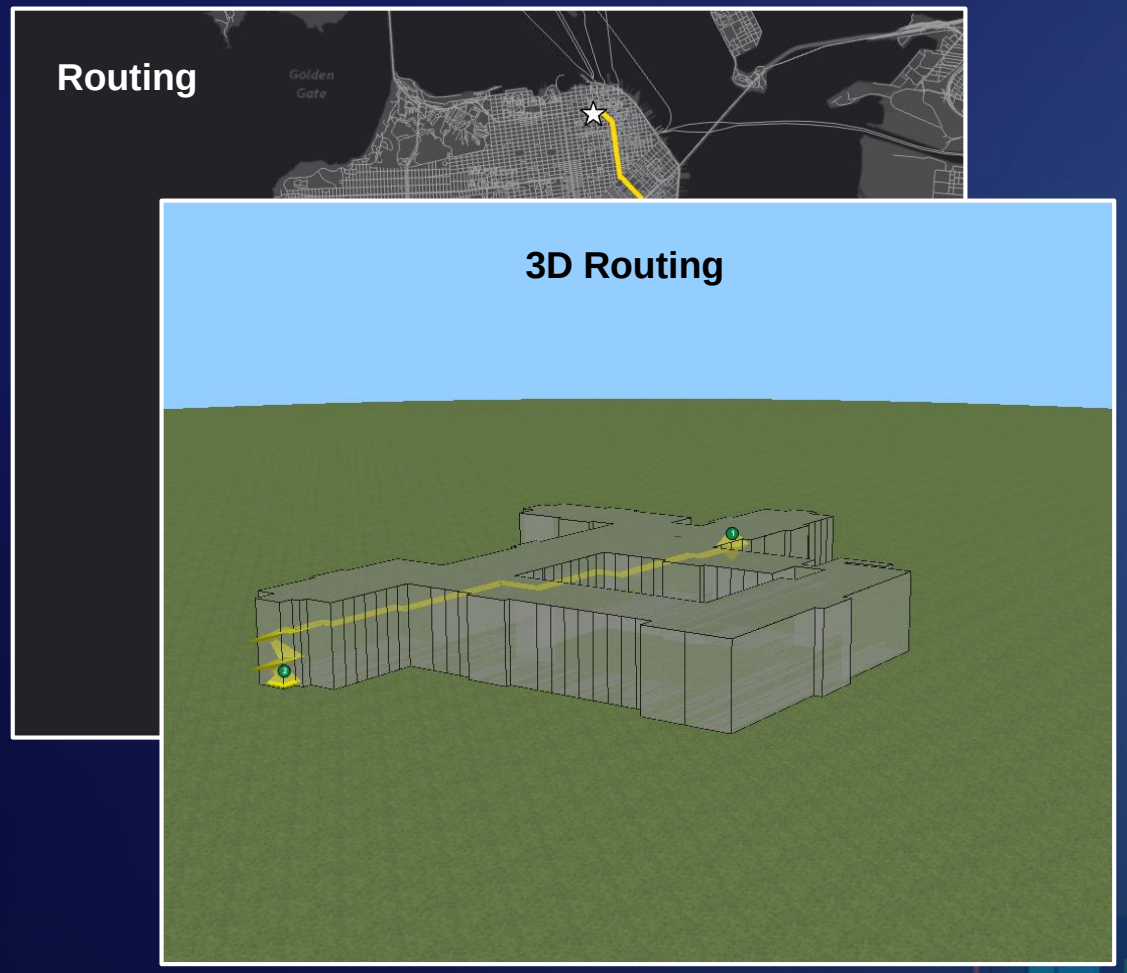
Finding the best locations and paths

13. Finding the best route, path, or flow along a network



Finding the best locations and paths

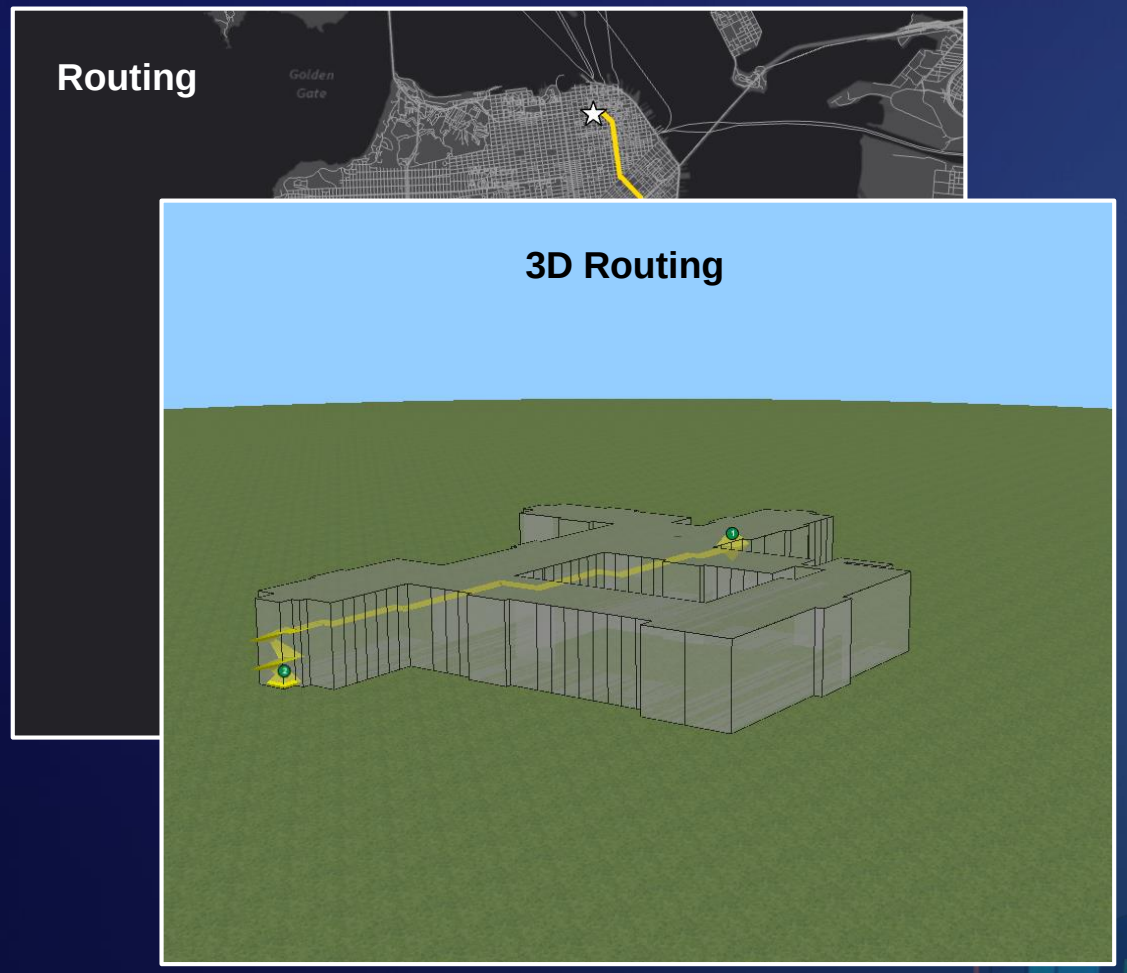
13. Finding the best route, path, or flow along a network



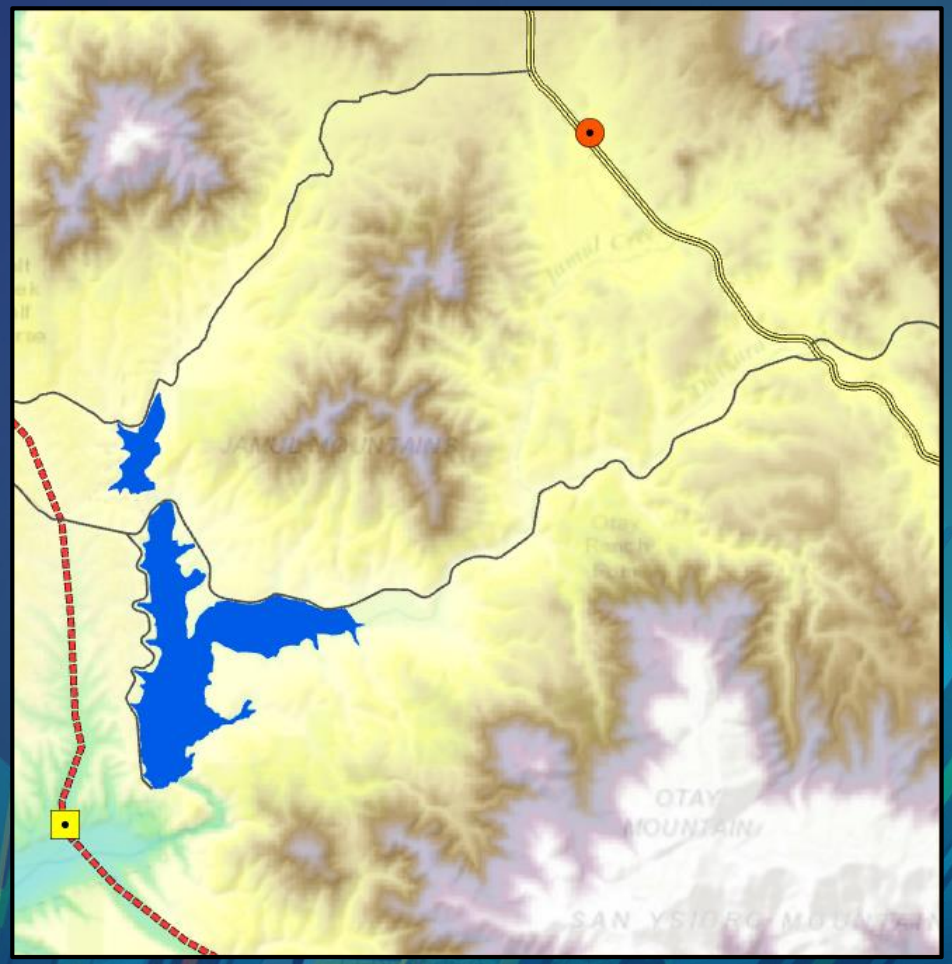
14. Finding the best route, path, or corridor over a terrain

Finding the best locations and paths

13. Finding the best route, path, or flow along a network

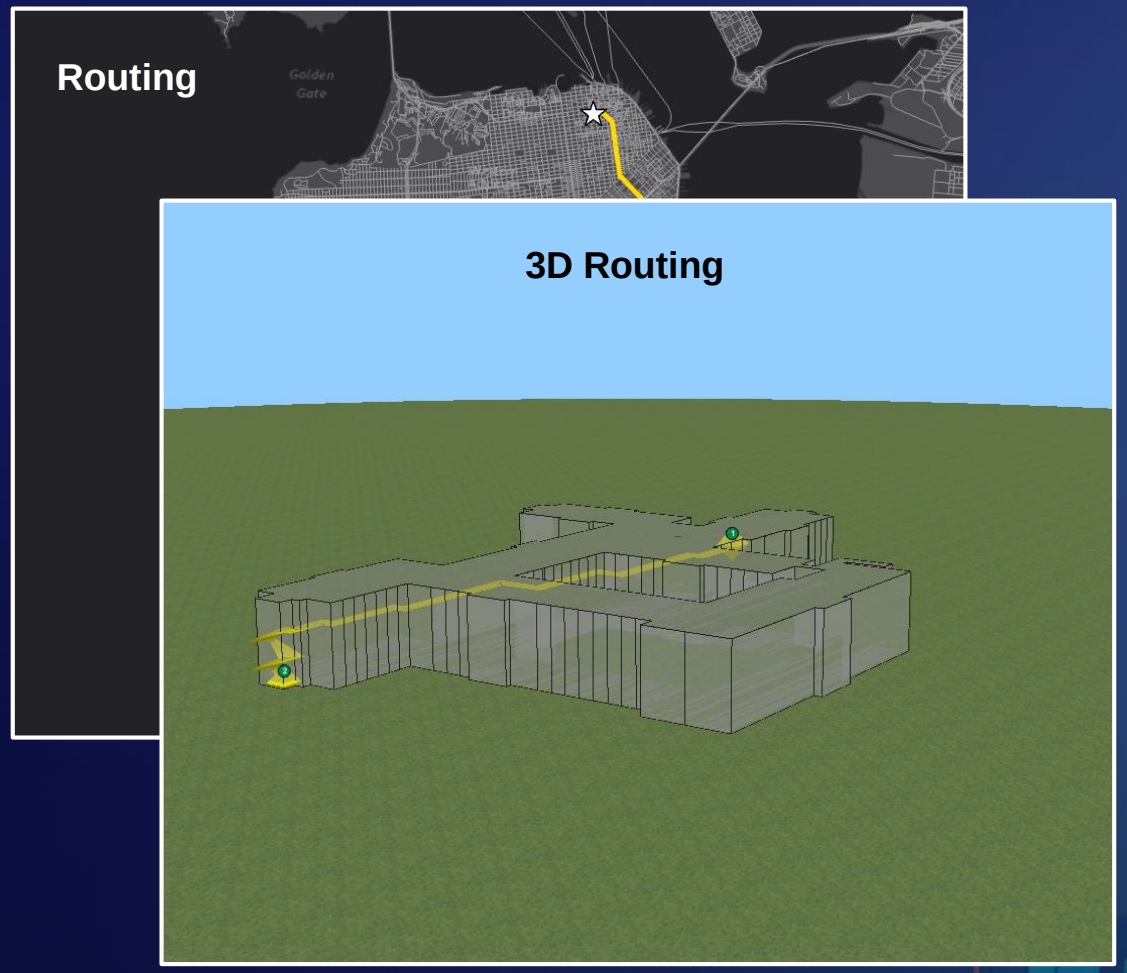


14. Finding the best route, path, or corridor over a terrain



Finding the best locations and paths

13. Finding the best route, path, or flow along a network



14. Finding the best route, path, or corridor over a terrain

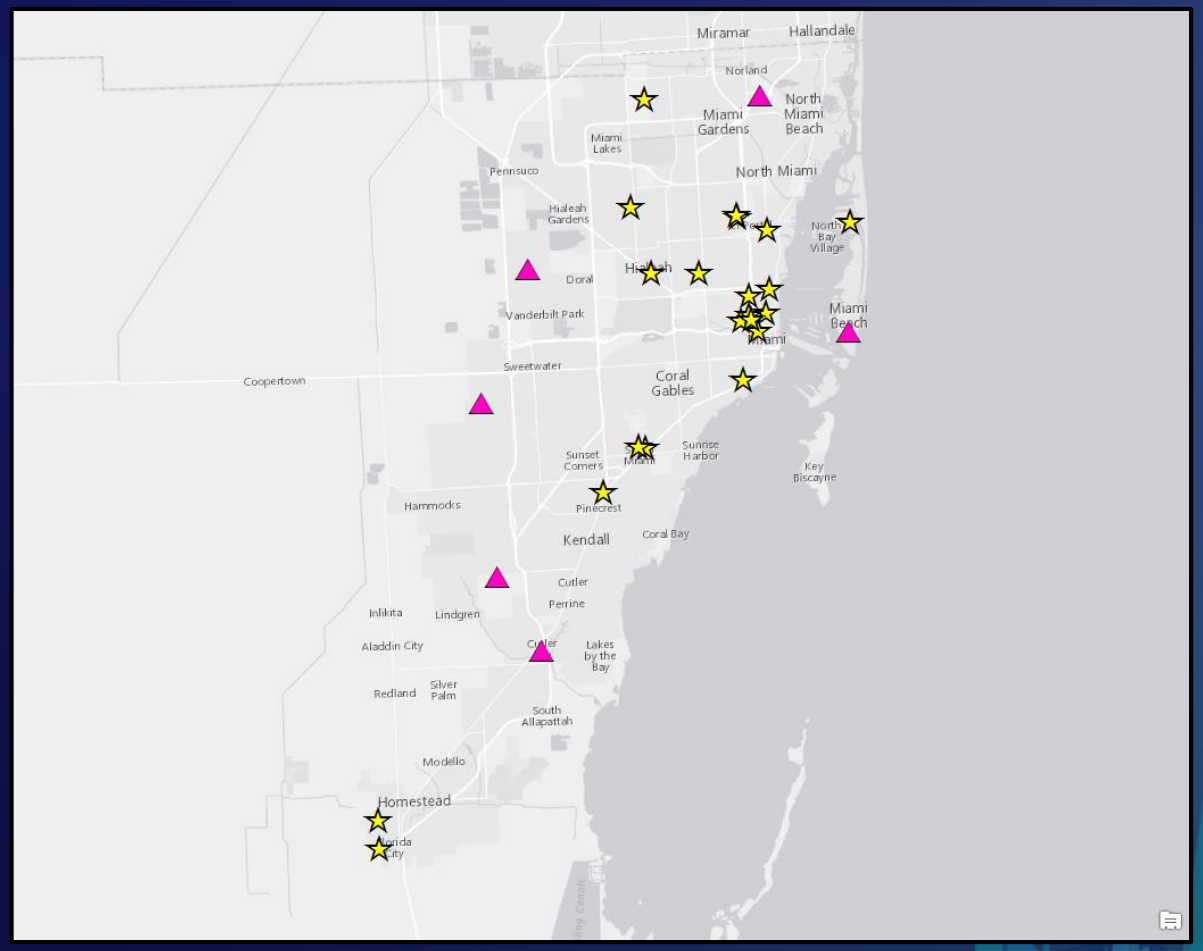
Finding the best locations and paths

Finding the best locations and paths

15. Finding the best supply locations given demand and travel network

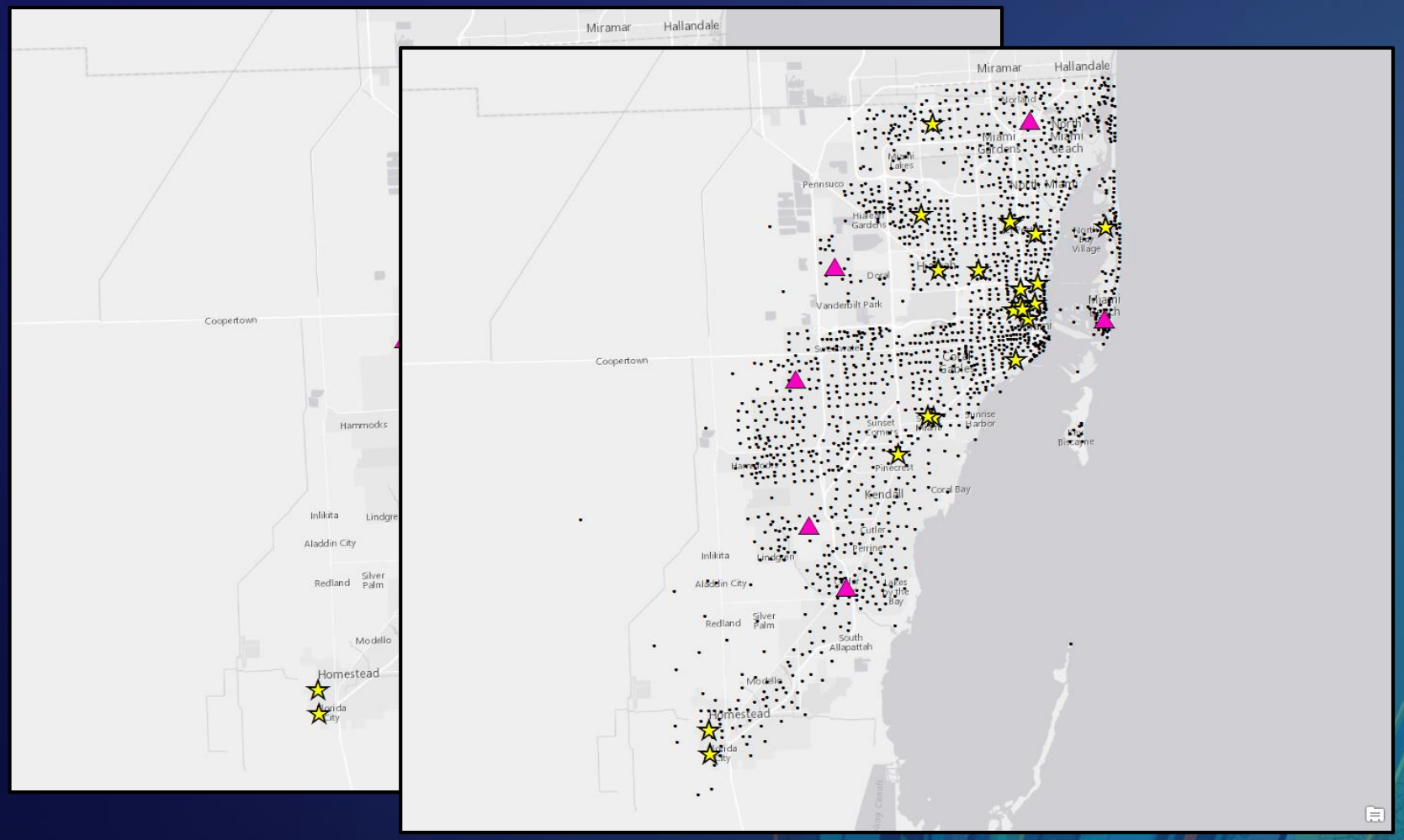
Finding the best locations and paths

15. Finding the best supply locations given demand and travel network



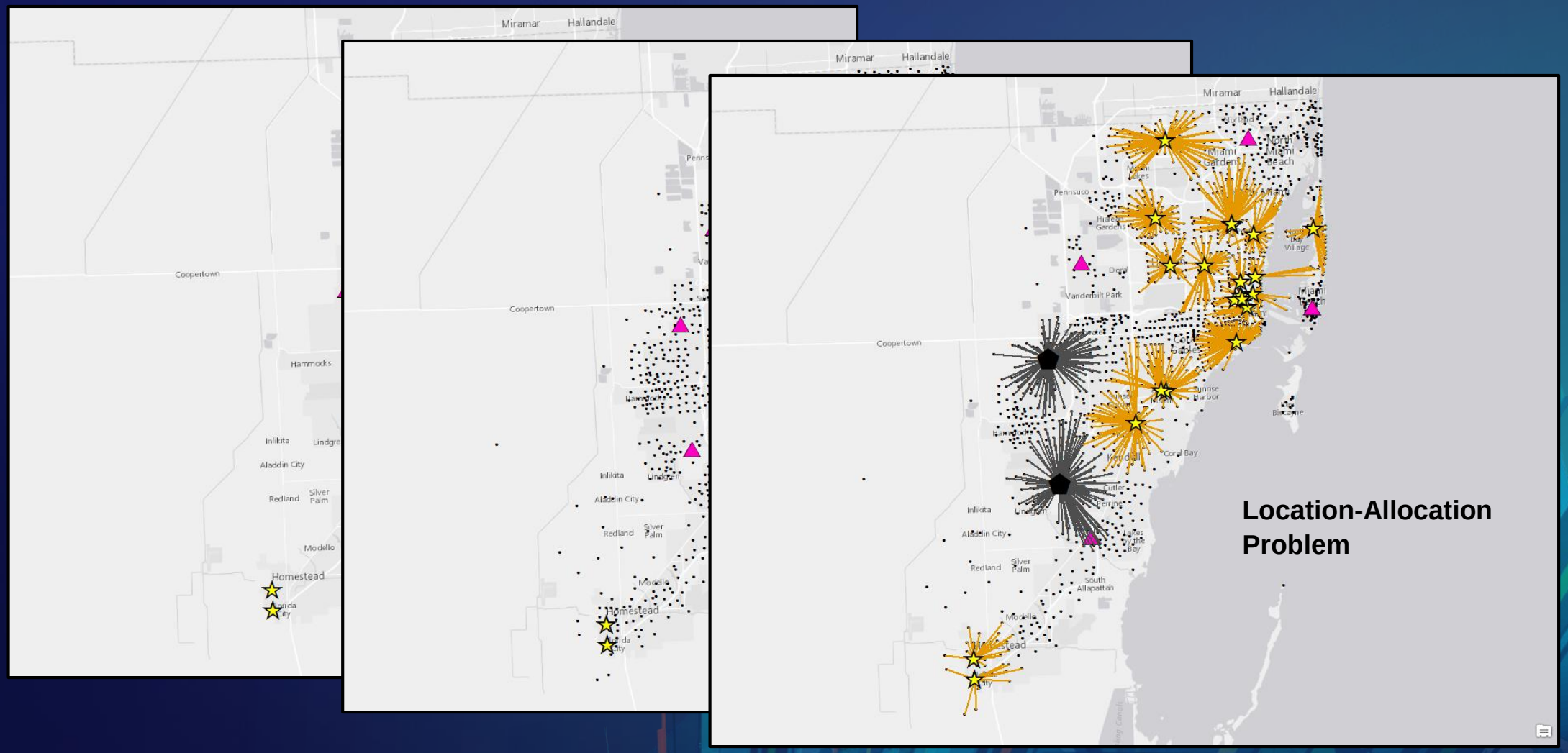
Finding the best locations and paths

15. Finding the best supply locations given demand and travel network



Finding the best locations and paths

15. Finding the best supply locations given demand and travel network



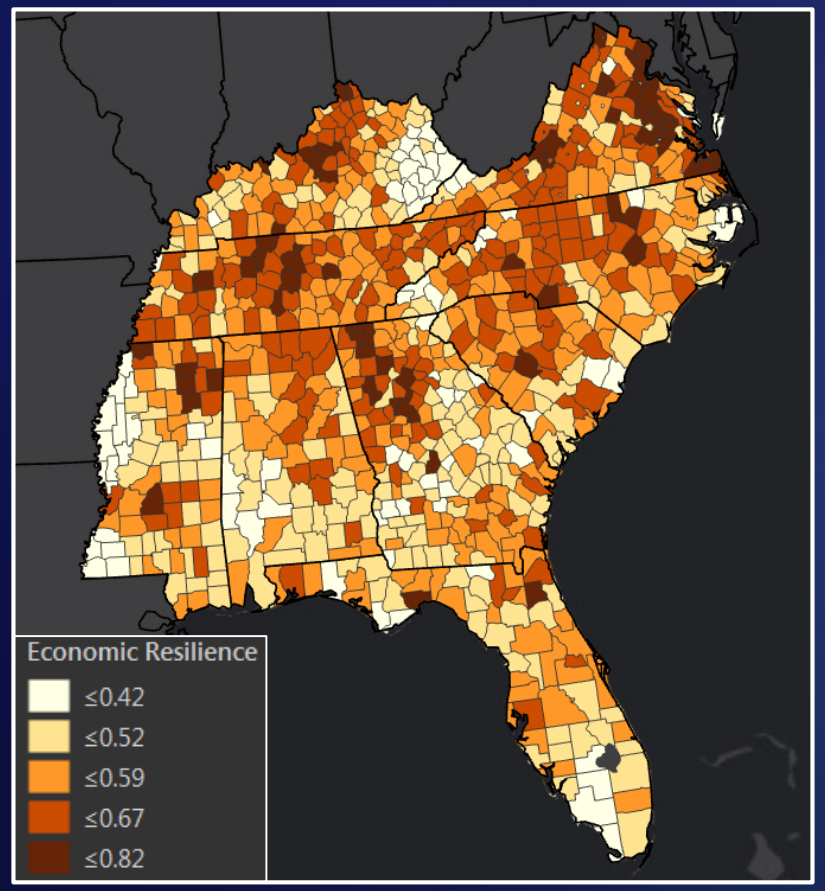
Detecting and quantifying patterns

Detecting and quantifying patterns

16. Where are the significant hot spots, anomalies, and outliers?

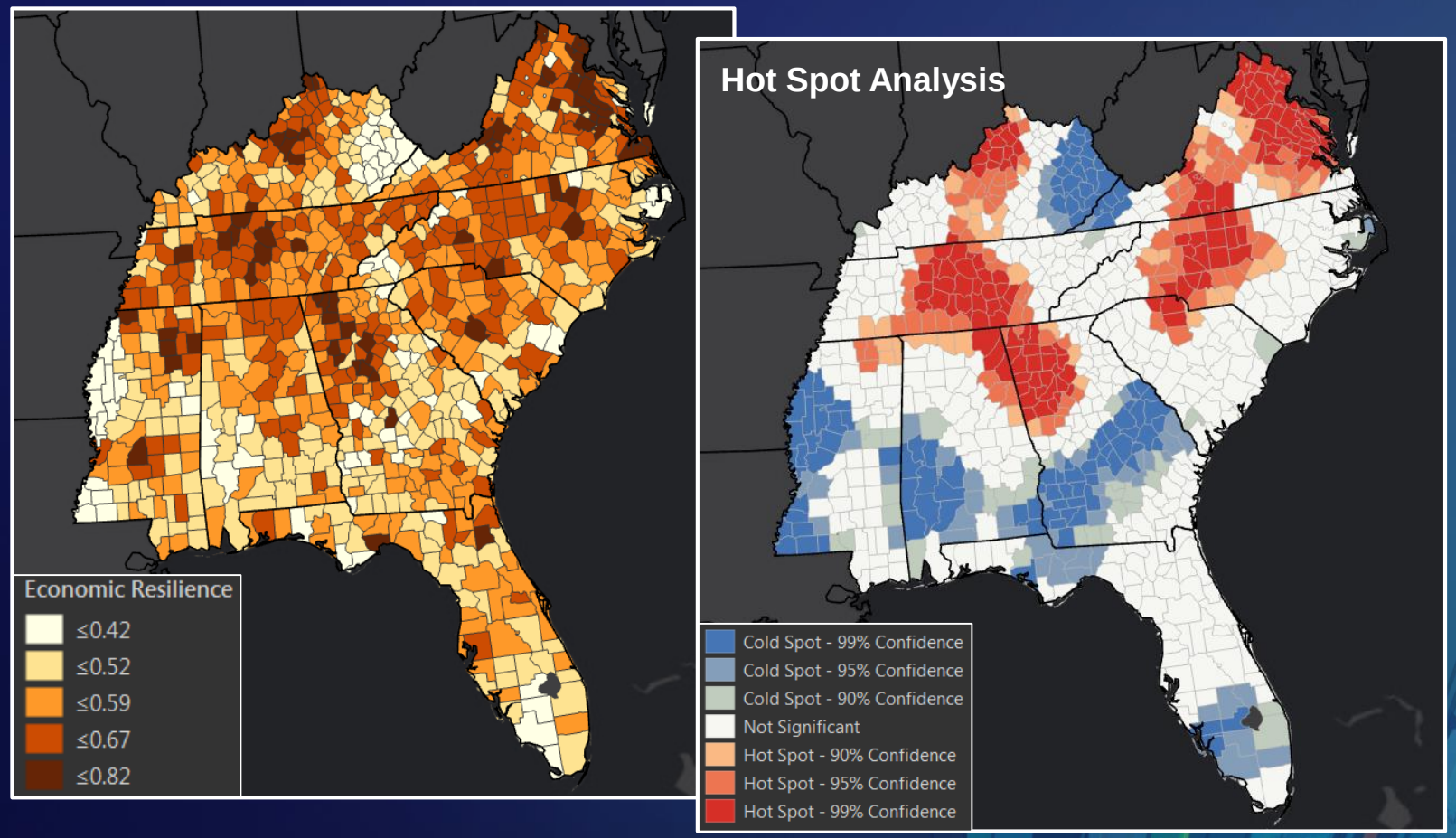
Detecting and quantifying patterns

16. Where are the significant hot spots, anomalies, and outliers?



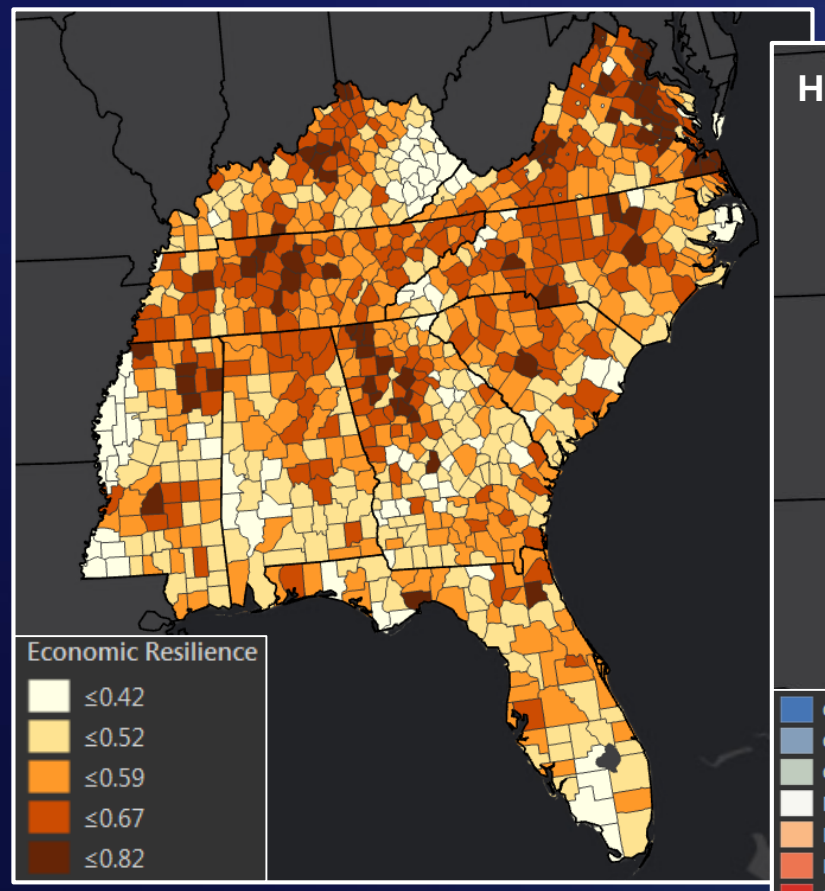
Detecting and quantifying patterns

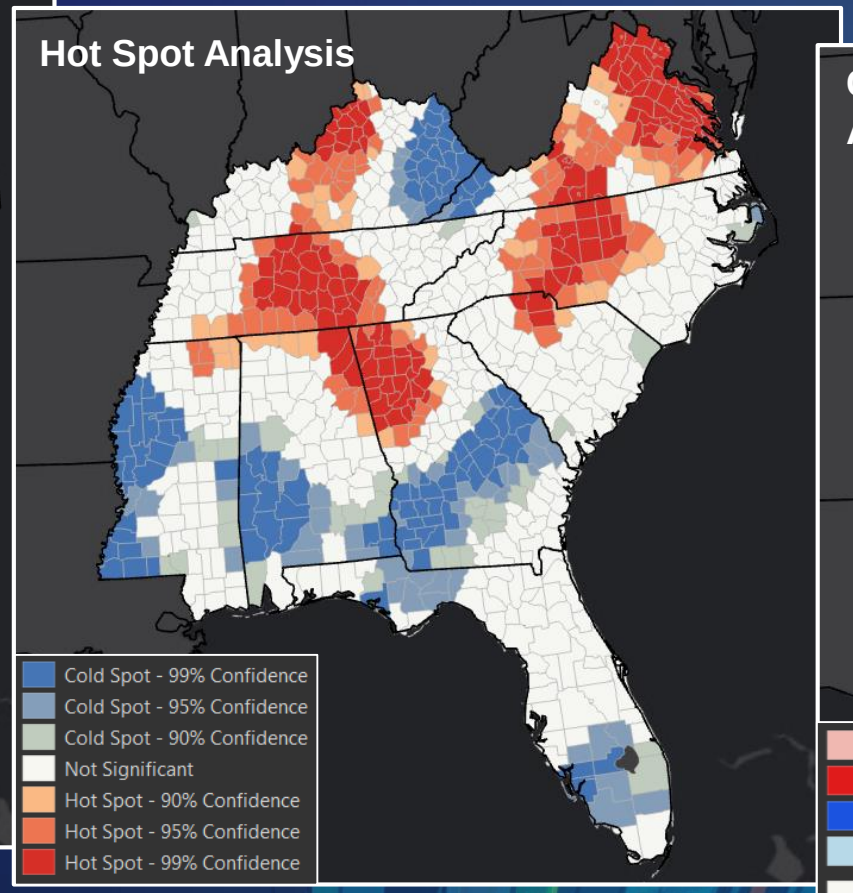
16. Where are the significant hot spots, anomalies, and outliers?

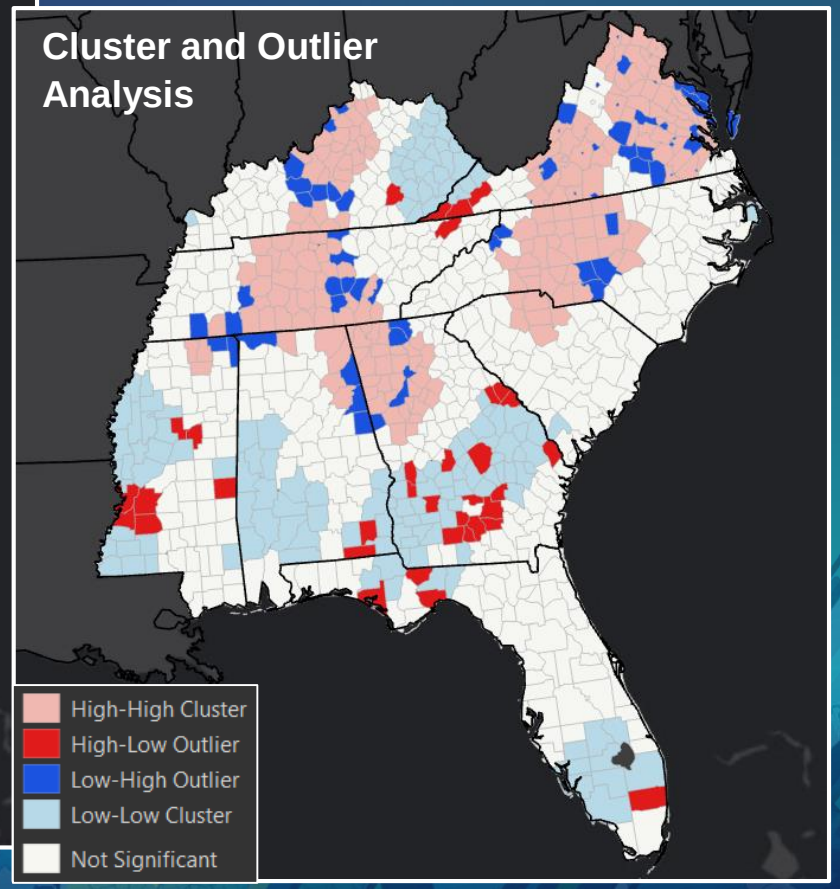


Detecting and quantifying patterns

16. Where are the significant hot spots, anomalies, and outliers?







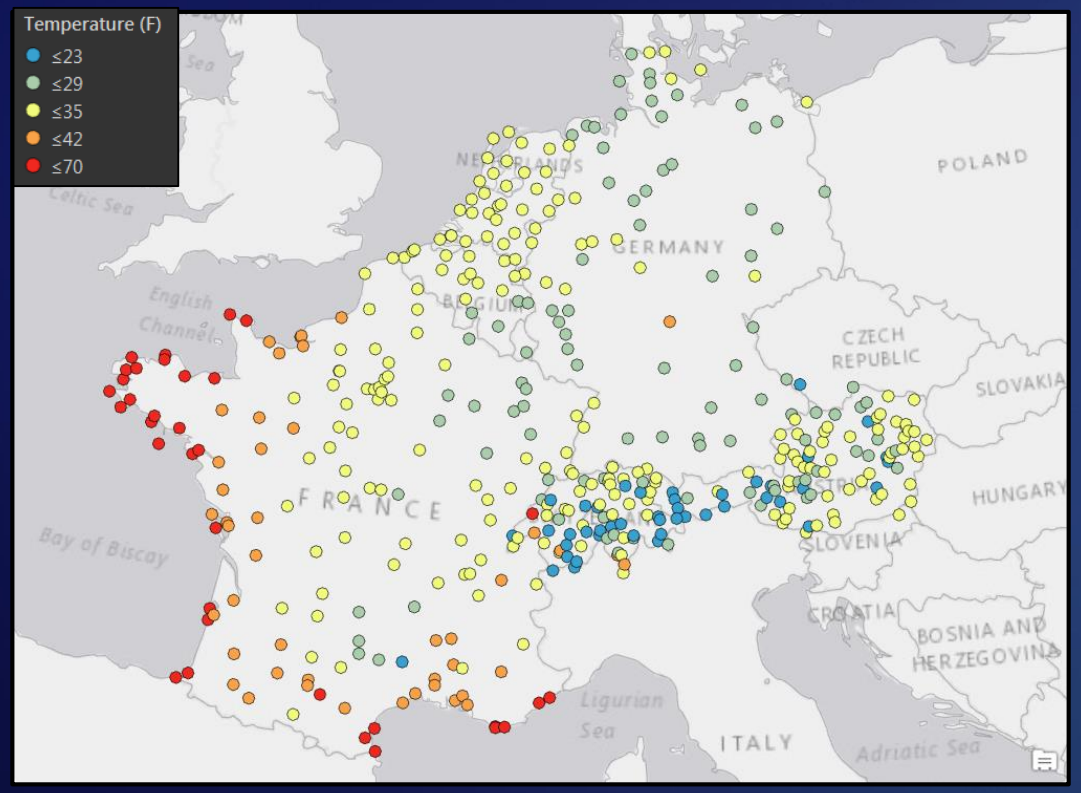
Detecting and quantifying patterns

Detecting and quantifying patterns

17. Where are the local, regional, and global trends?

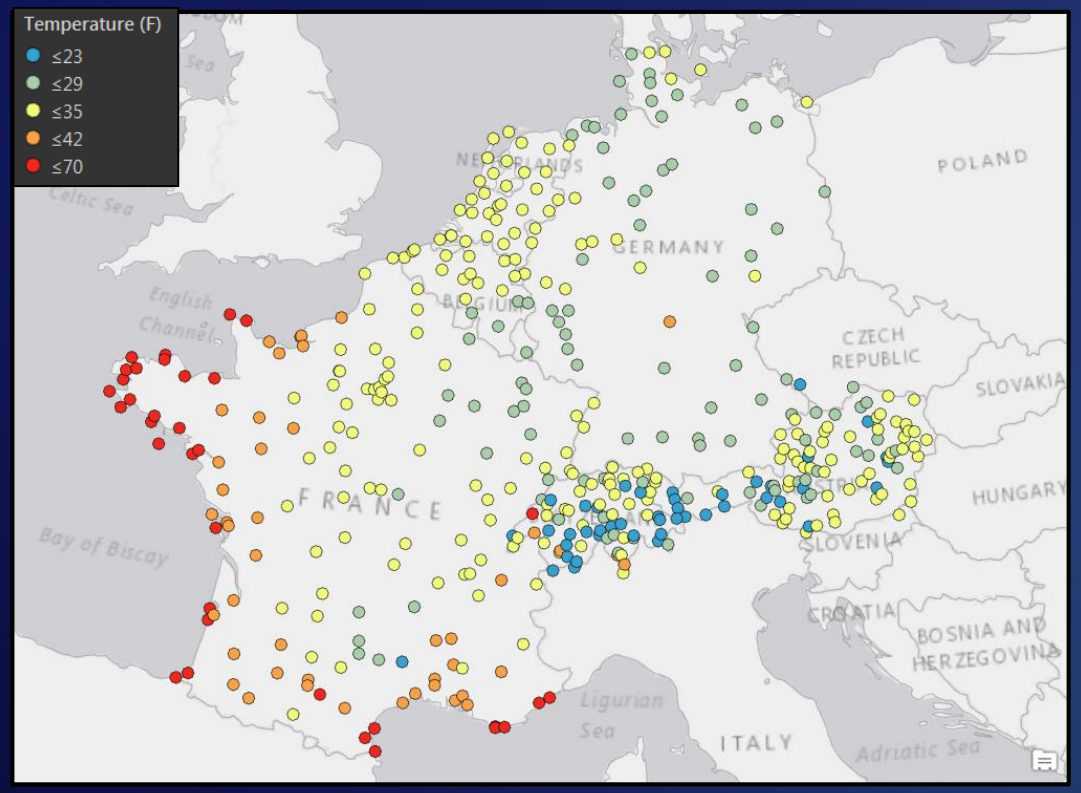
Detecting and quantifying patterns

17. Where are the local, regional, and global trends?

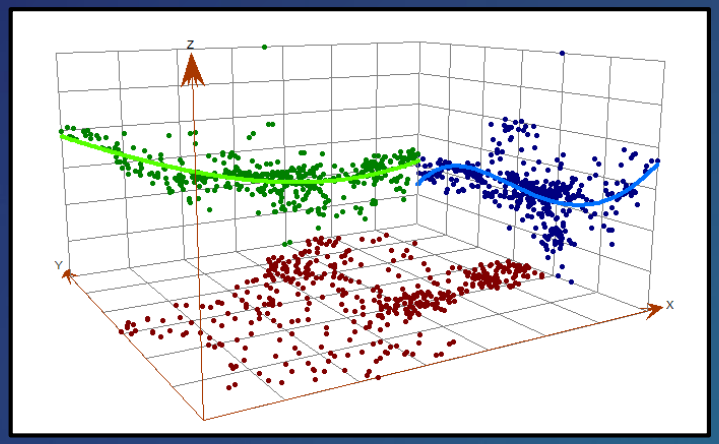


Detecting and quantifying patterns

17. Where are the local, regional, and global trends?

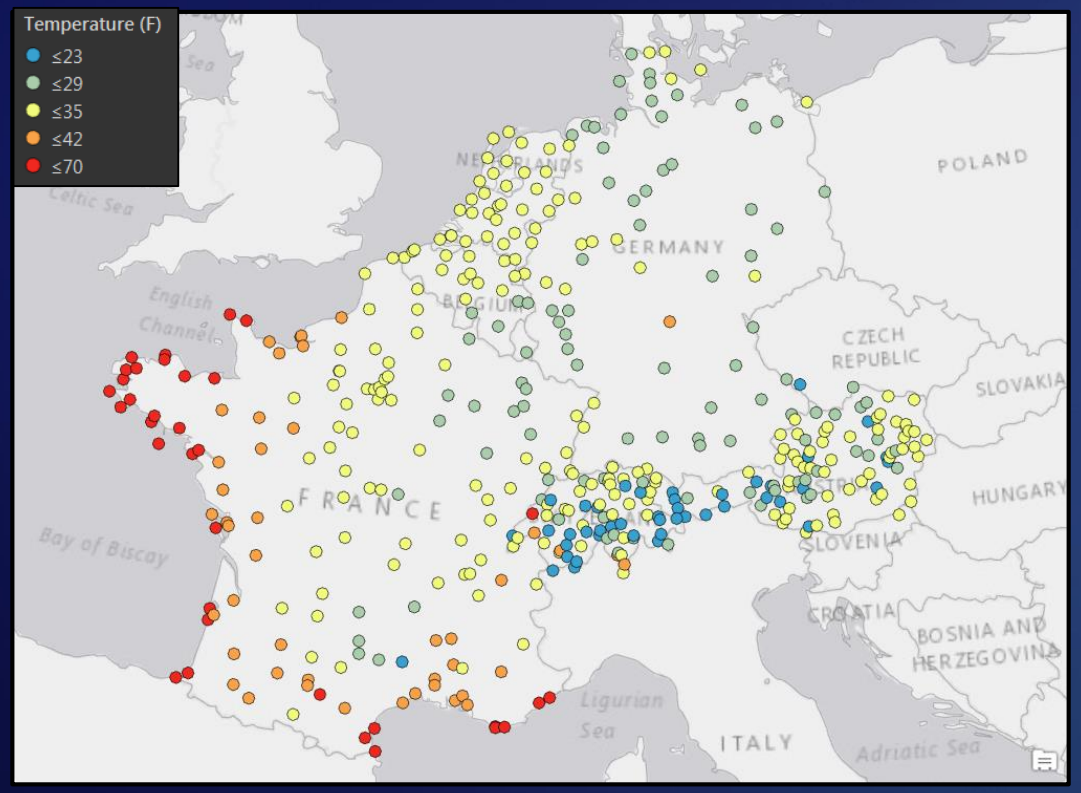


Global Trends

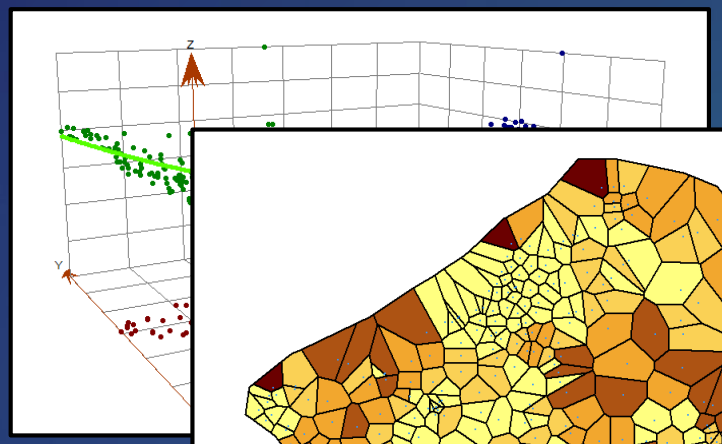


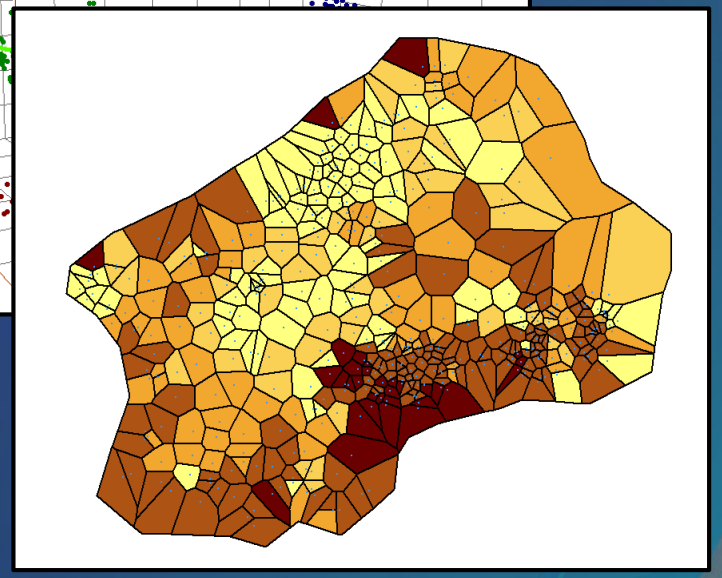
Detecting and quantifying patterns

17. Where are the local, regional, and global trends?



Global Trends

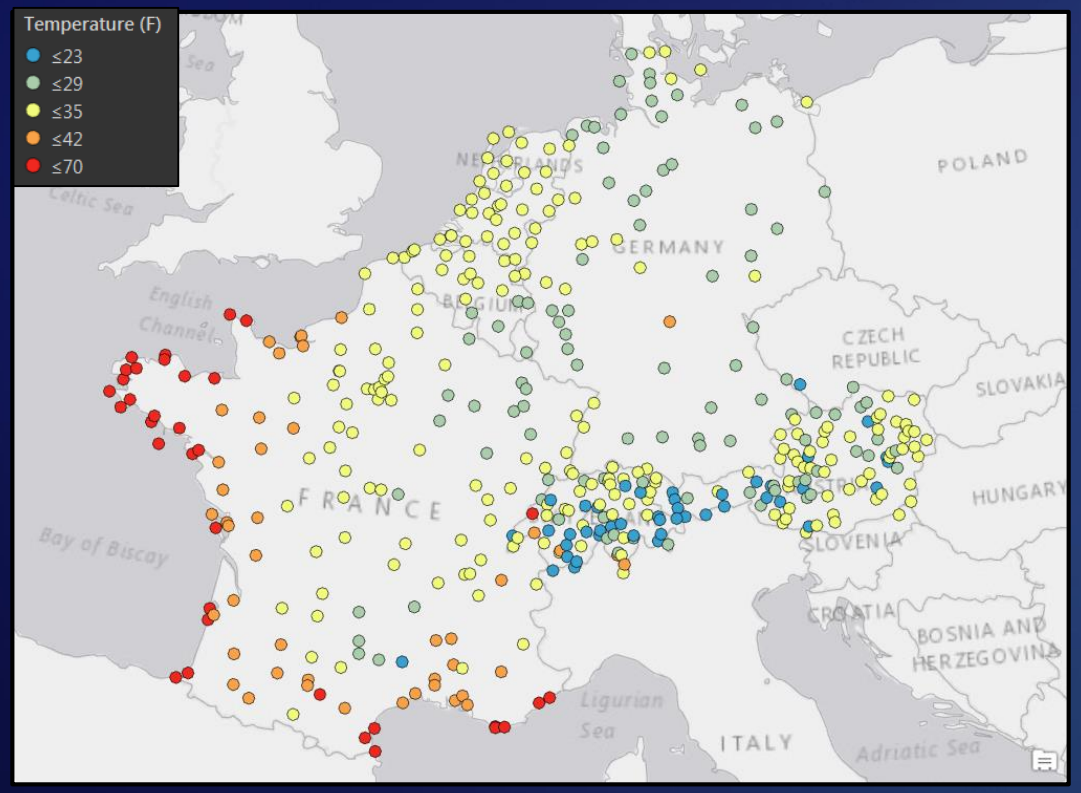




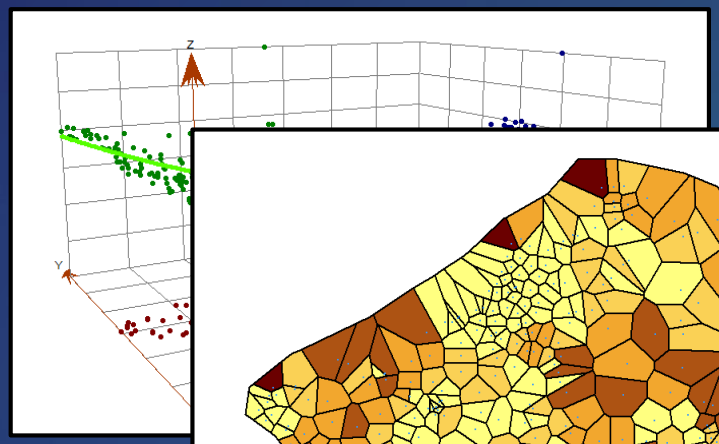
Local Trends

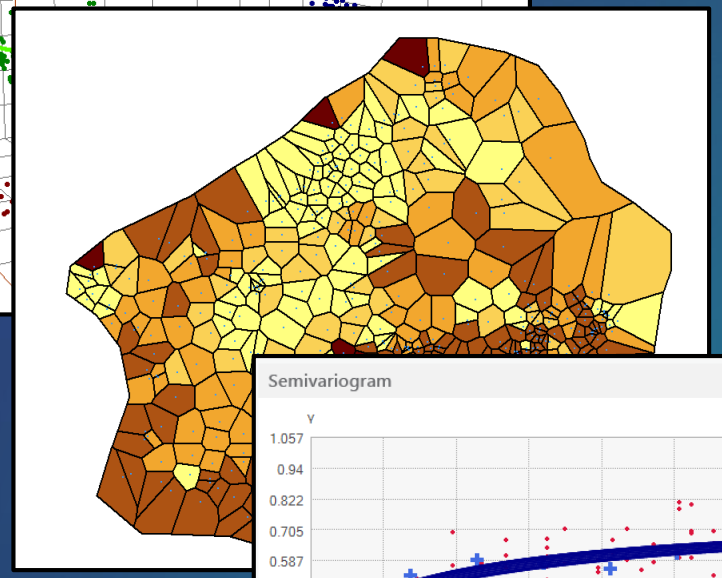
Detecting and quantifying patterns

17. Where are the local, regional, and global trends?

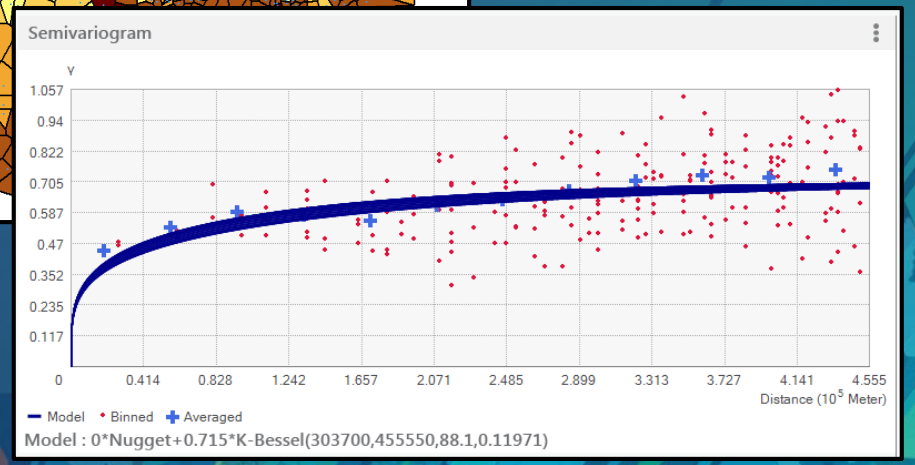


Global Trends





Local Trends



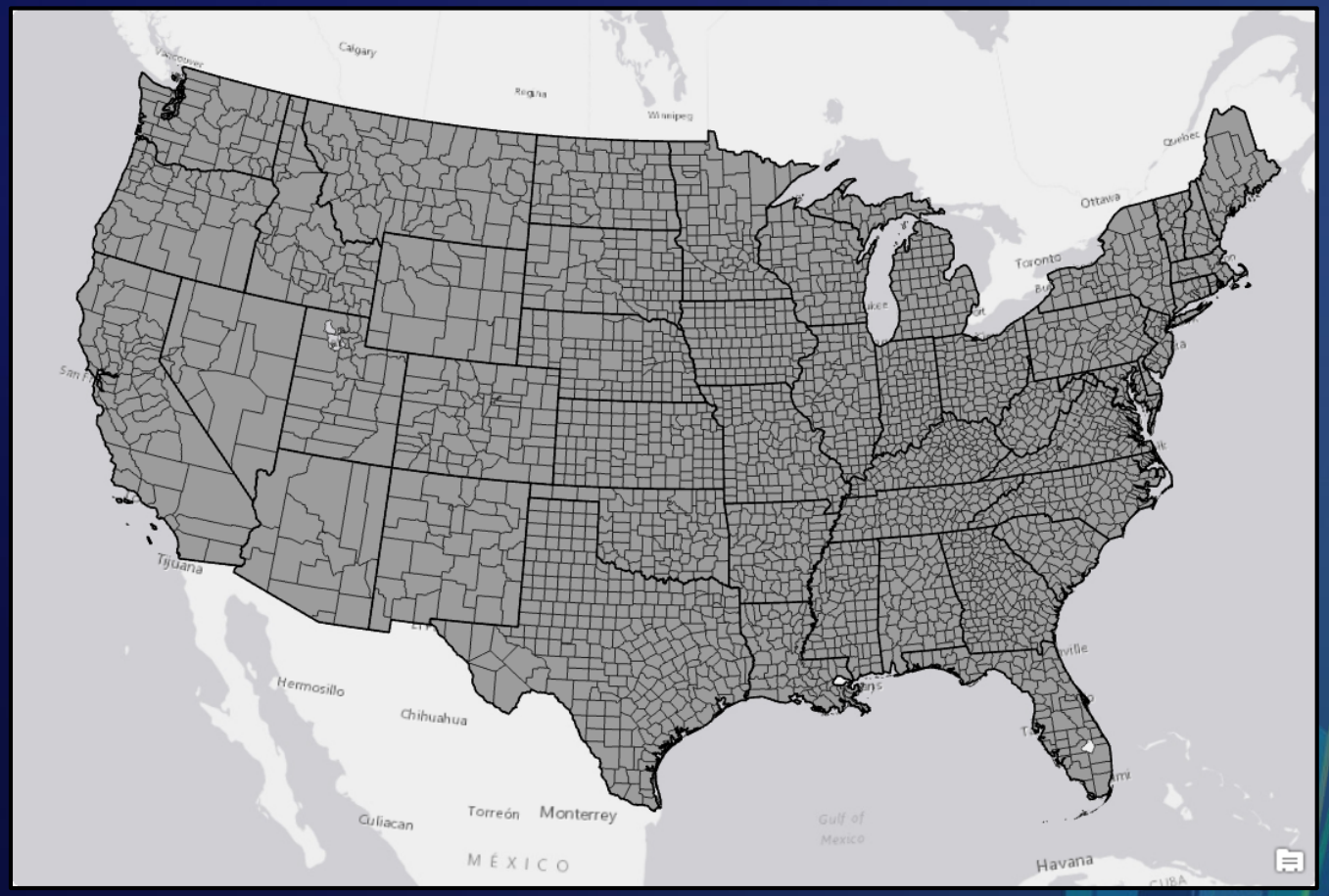
Detecting and quantifying patterns

Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?

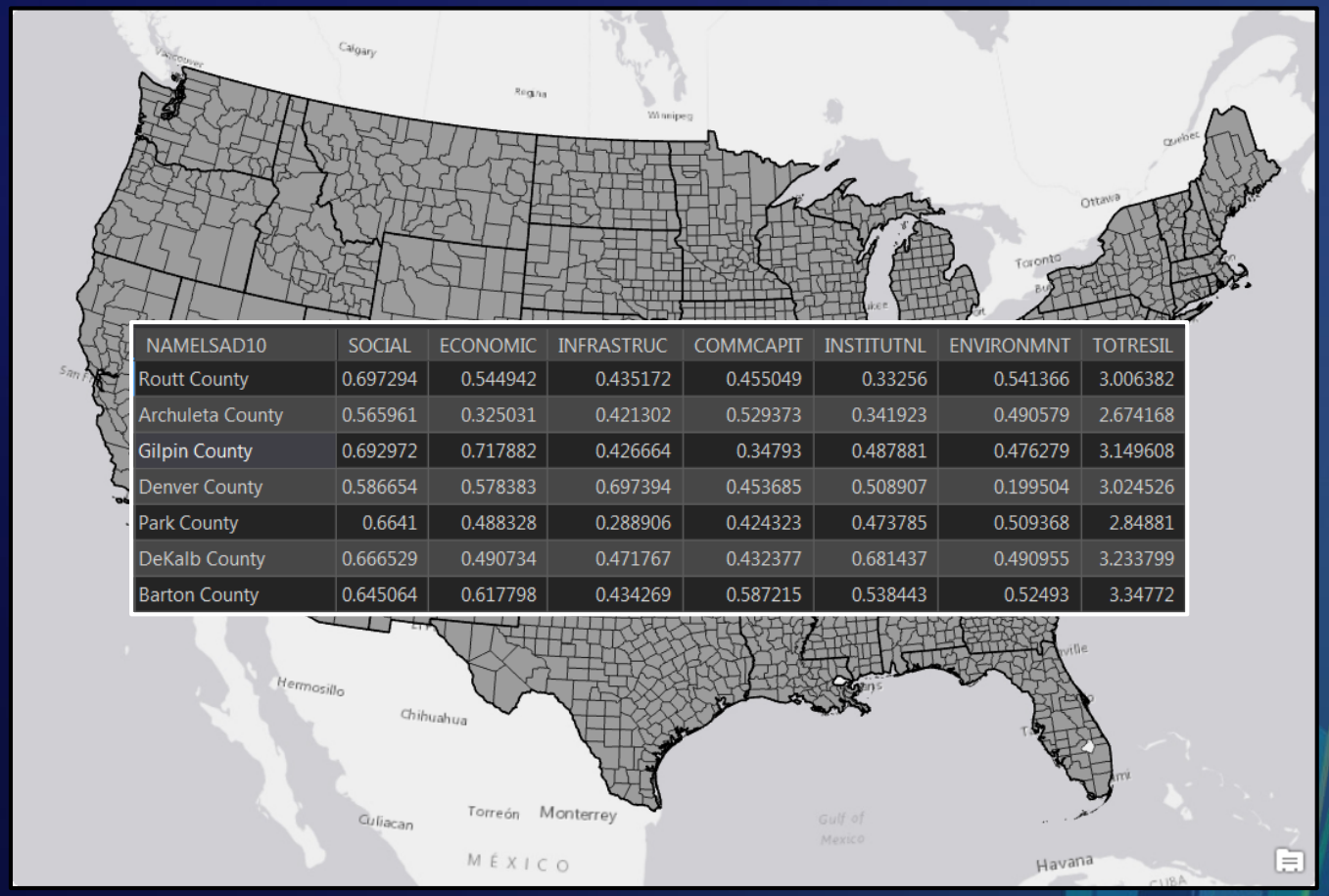
Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?



Detecting and quantifying patterns

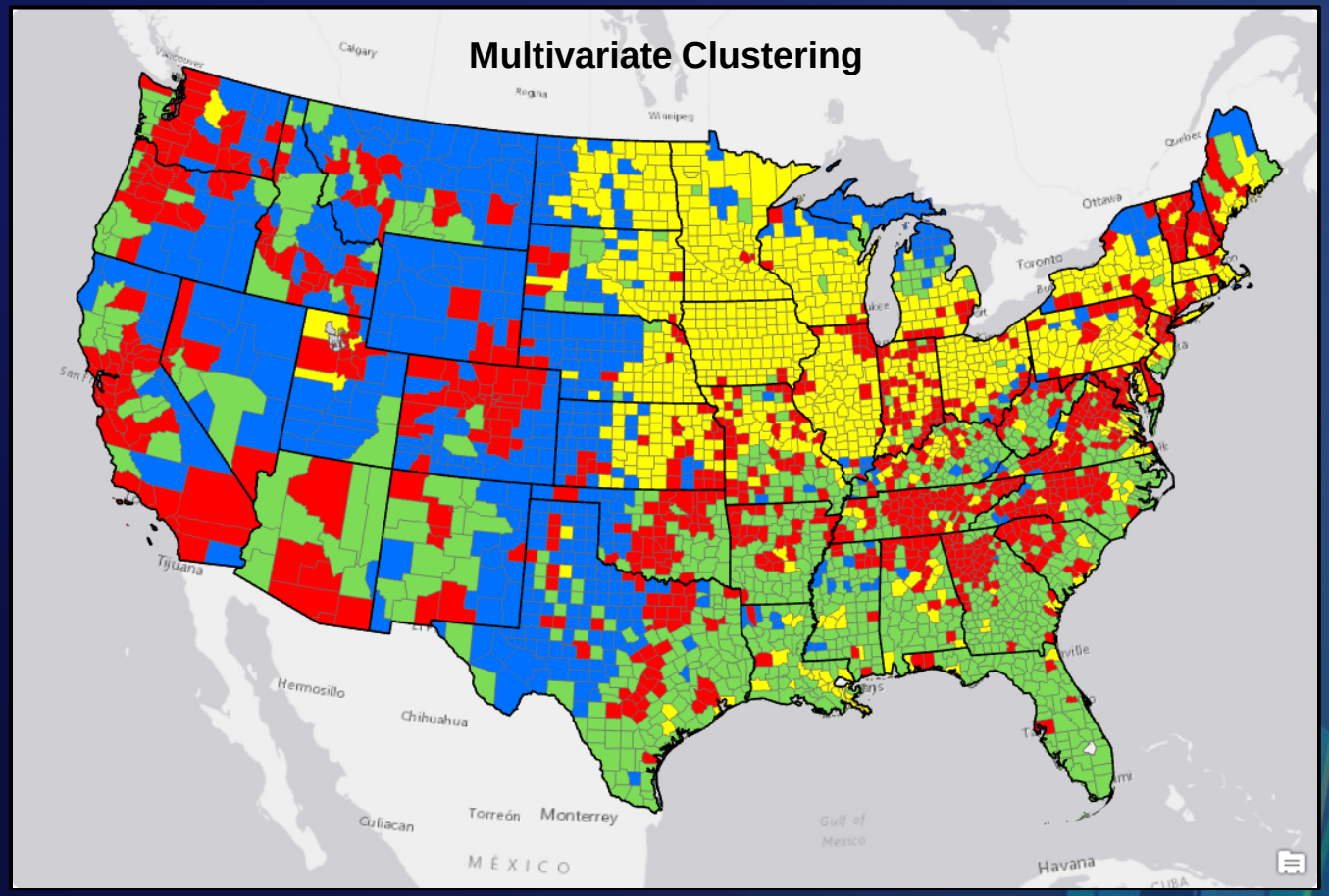
18. Which features are similar, and how can they be grouped together?



NAMELSAD10	SOCIAL	ECONOMIC	INFRASTRUC	COMMCAPIT	INSTITUTNL	ENVIRONMNT	TOTRESIL
Routt County	0.697294	0.544942	0.435172	0.455049	0.33256	0.541366	3.006382
Archuleta County	0.565961	0.325031	0.421302	0.529373	0.341923	0.490579	2.674168
Gilpin County	0.692972	0.717882	0.426664	0.34793	0.487881	0.476279	3.149608
Denver County	0.586654	0.578383	0.697394	0.453685	0.508907	0.199504	3.024526
Park County	0.6641	0.488328	0.288906	0.424323	0.473785	0.509368	2.84881
DeKalb County	0.666529	0.490734	0.471767	0.432377	0.681437	0.490955	3.233799
Barton County	0.645064	0.617798	0.434269	0.587215	0.538443	0.52493	3.34772

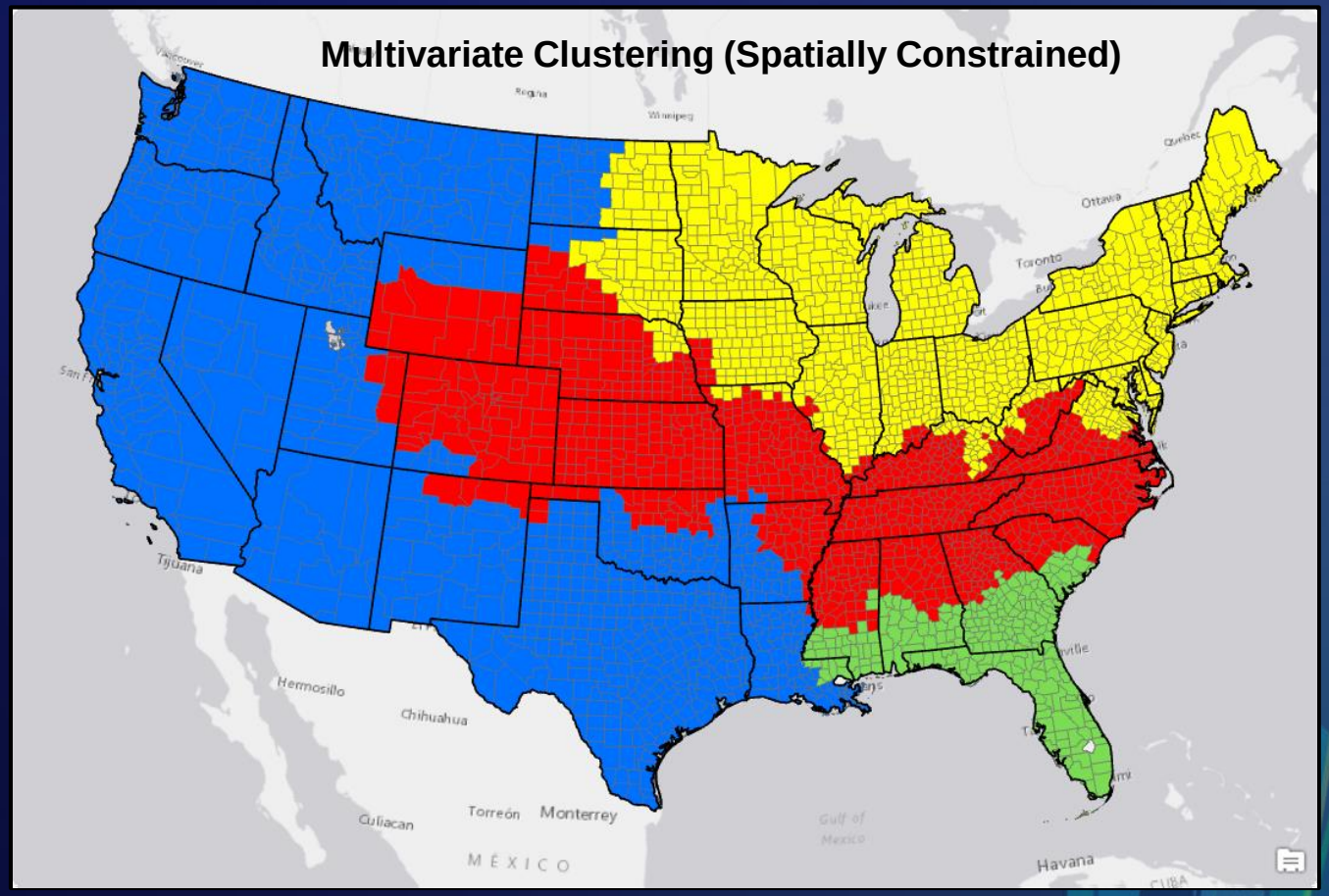
Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?



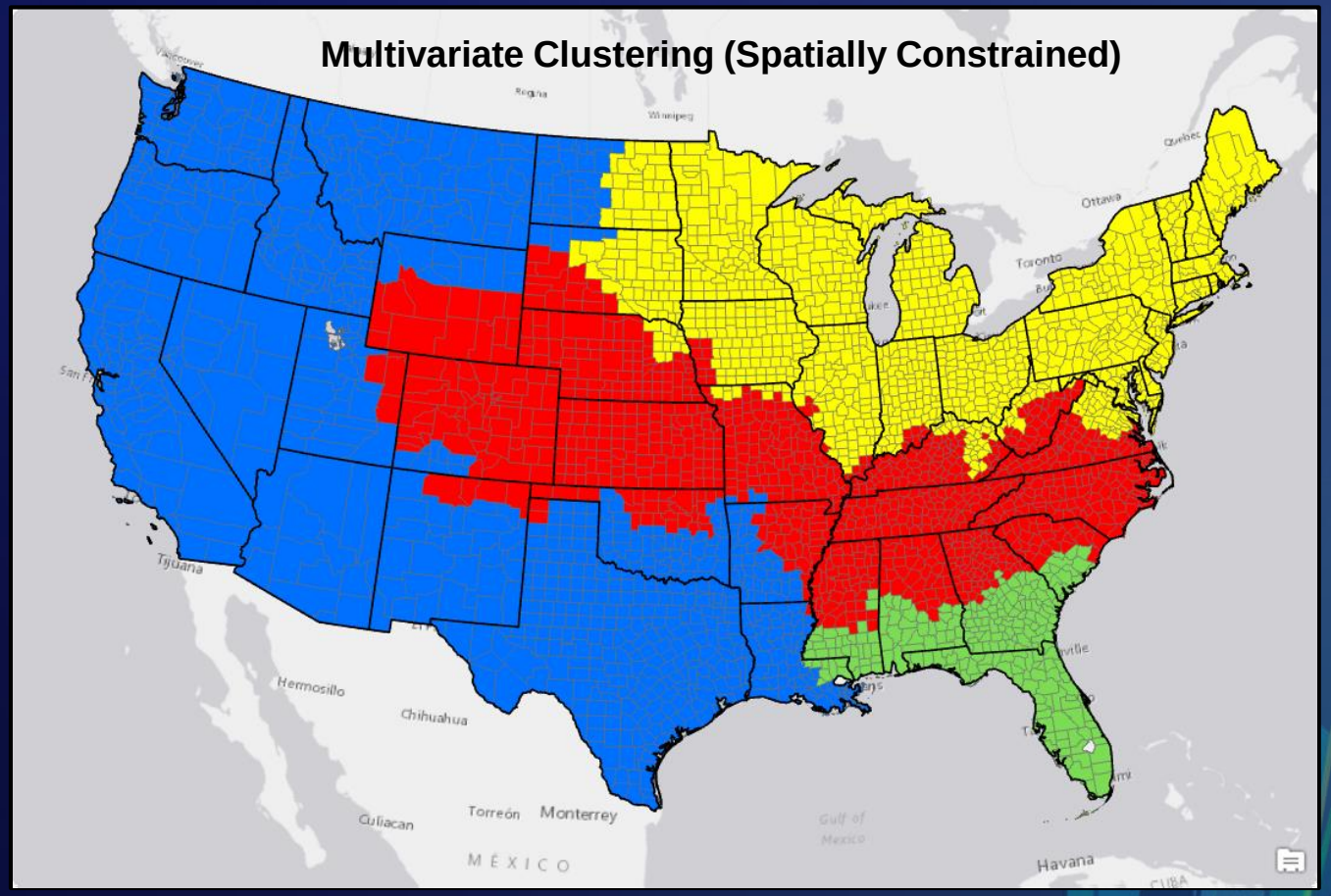
Detecting and quantifying patterns

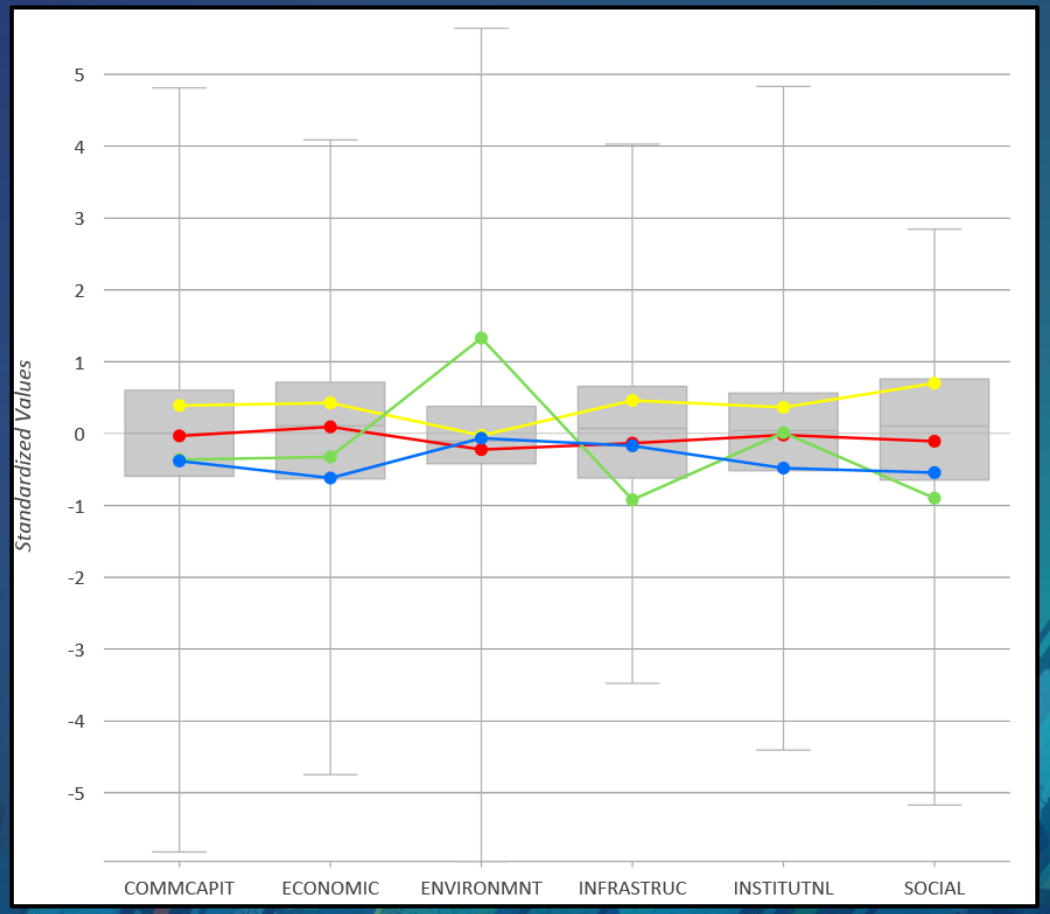
18. Which features are similar, and how can they be grouped together?



Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?





Detecting and quantifying patterns

Detecting and quantifying patterns

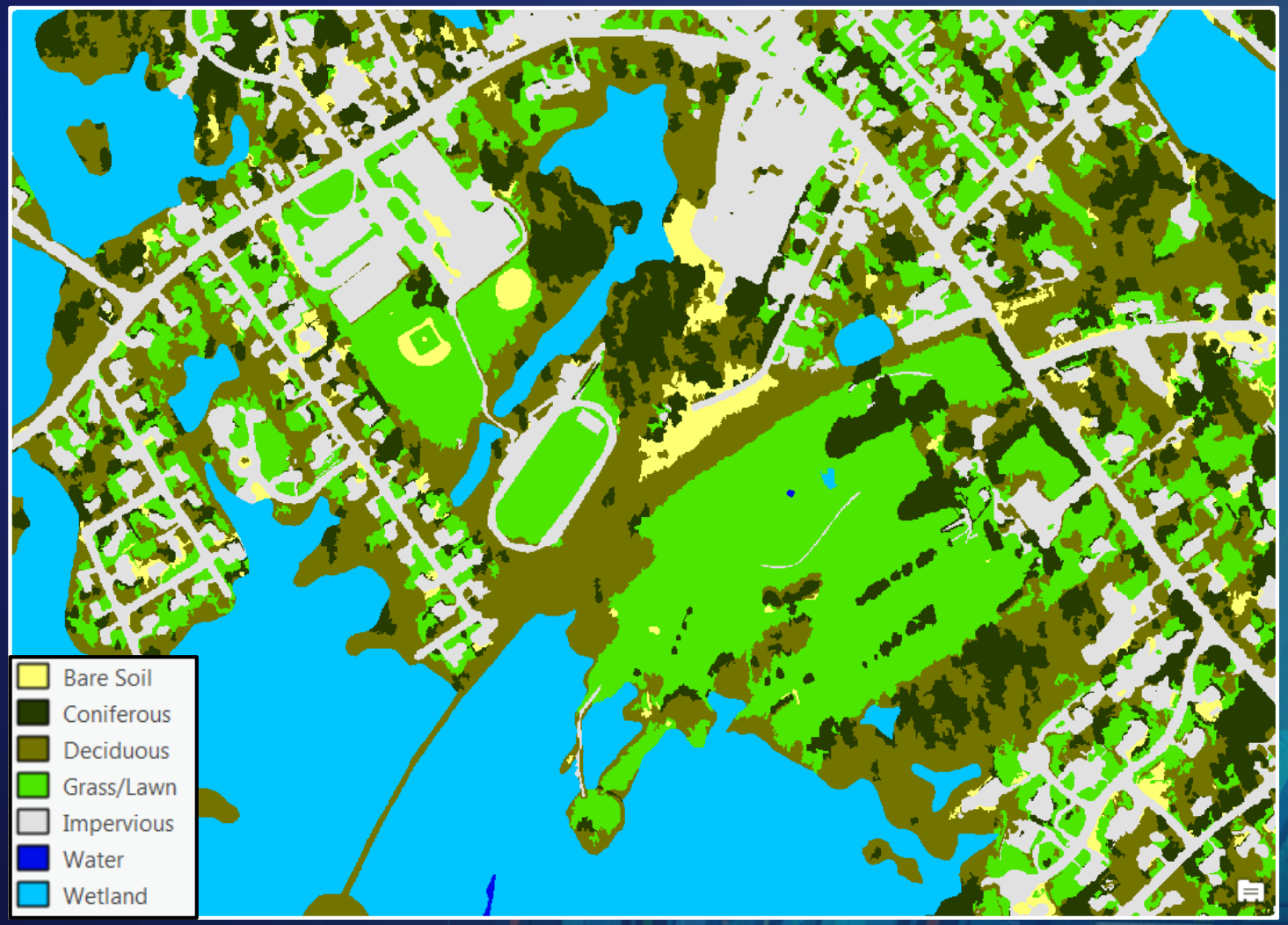
18. Which features are similar, and how can they be grouped together?

Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?

Detecting and quantifying patterns

18. Which features are similar, and how can they be grouped together?

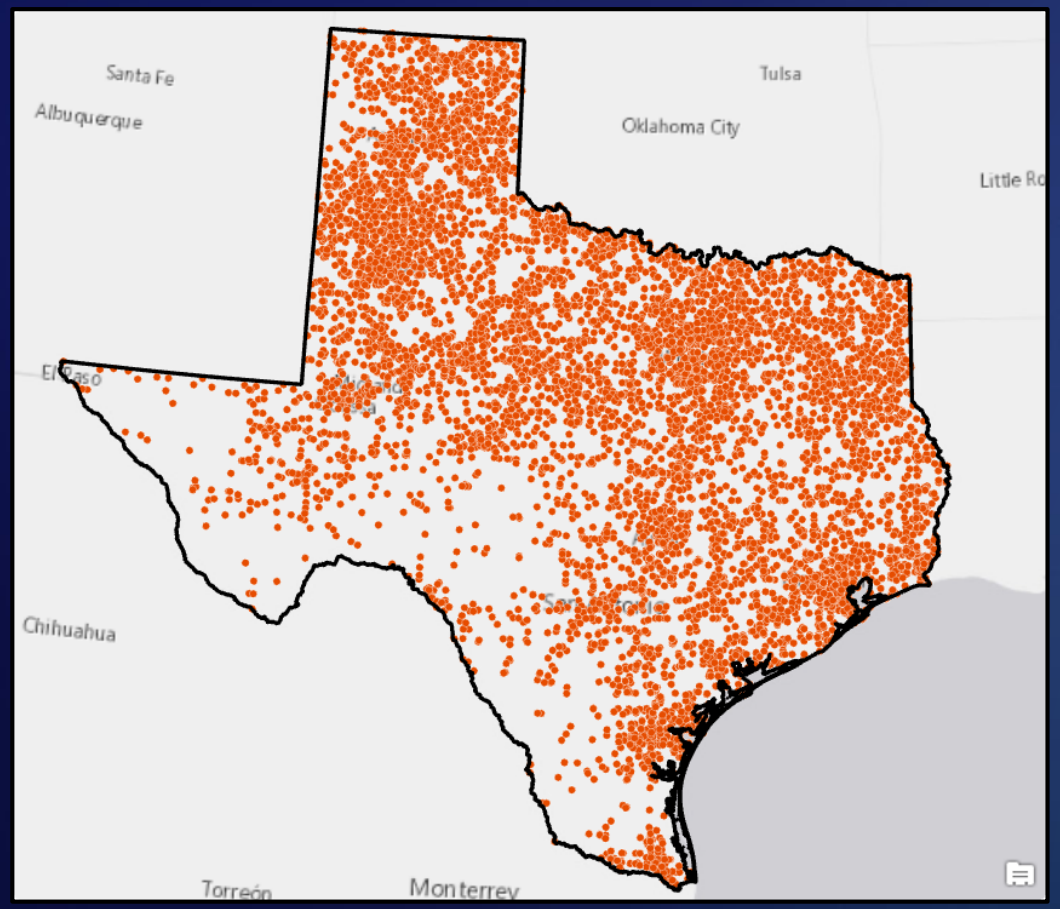


Detecting and quantifying patterns

19. Are spatial patterns changing over time?

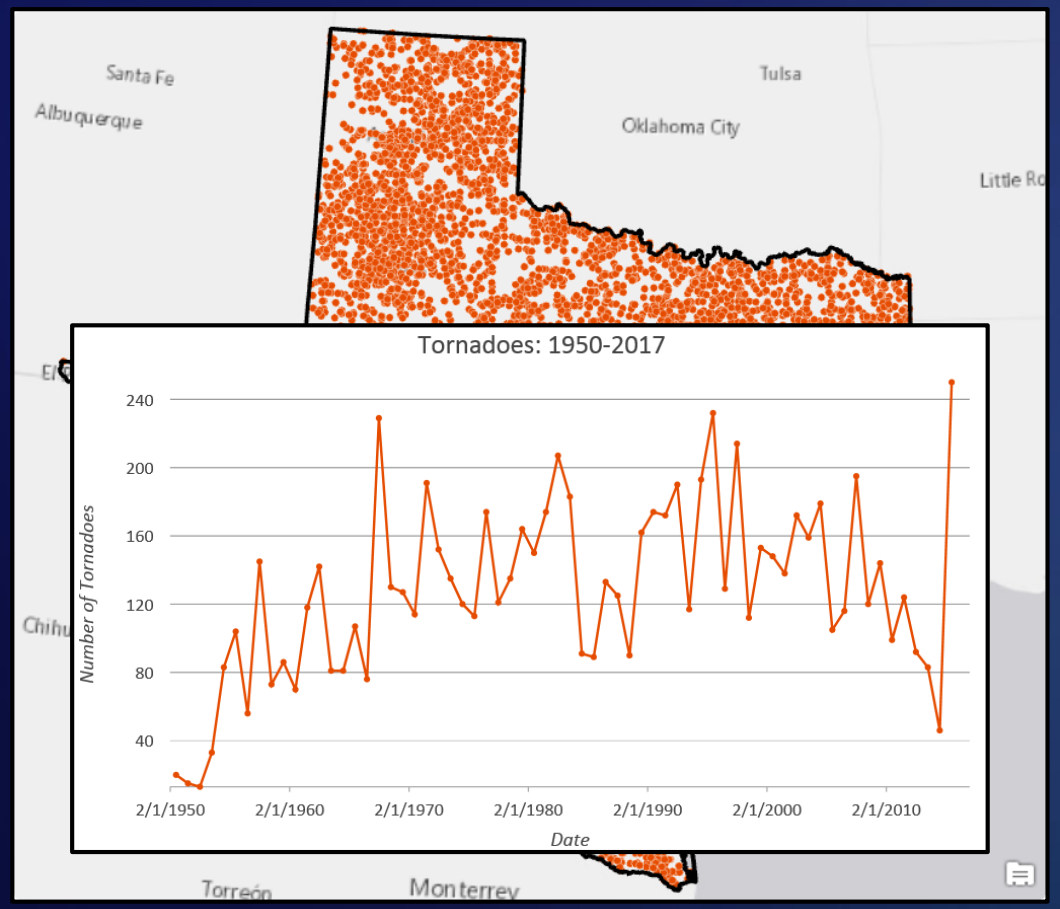
Detecting and quantifying patterns

19. Are spatial patterns changing over time?



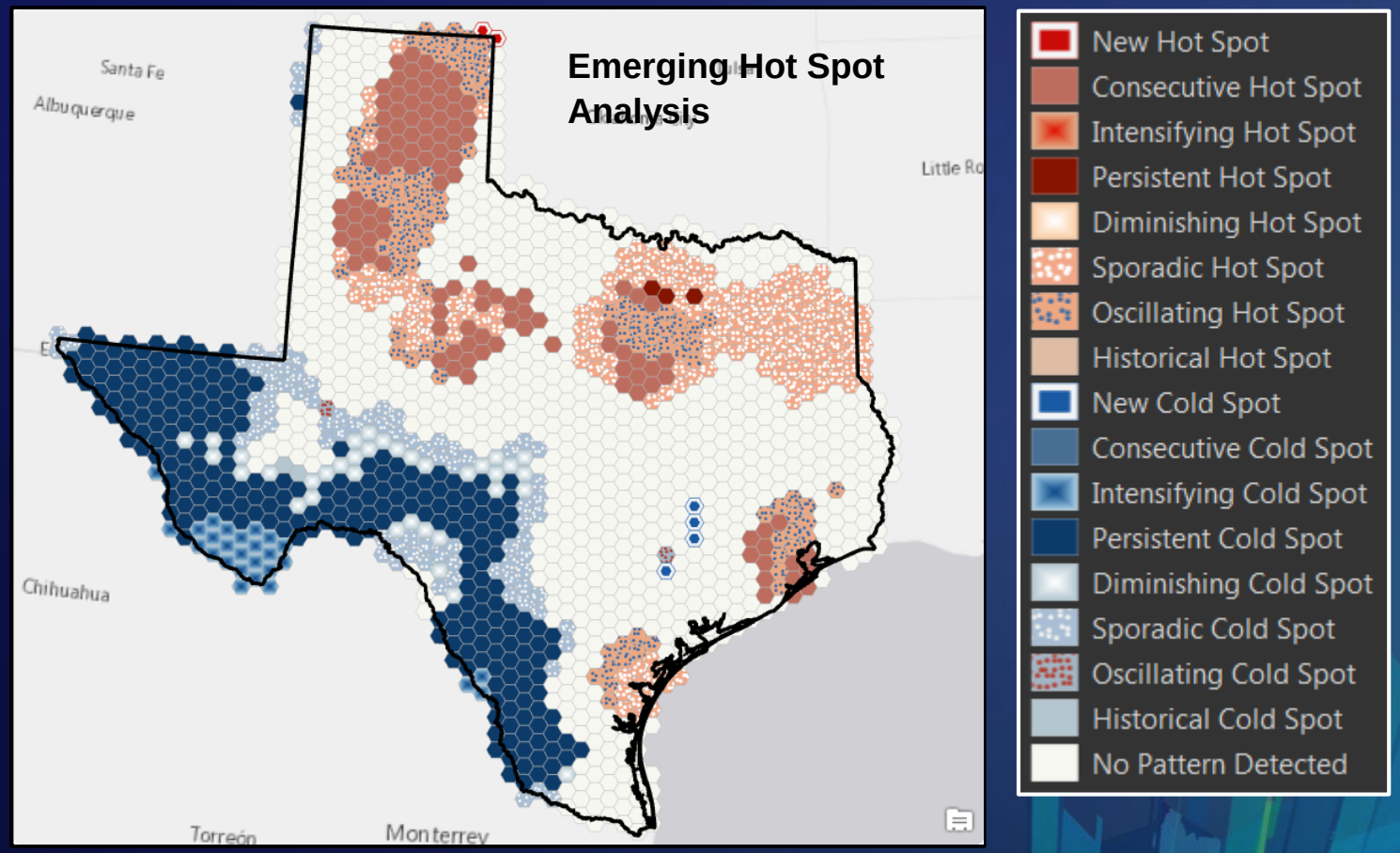
Detecting and quantifying patterns

19. Are spatial patterns changing over time?



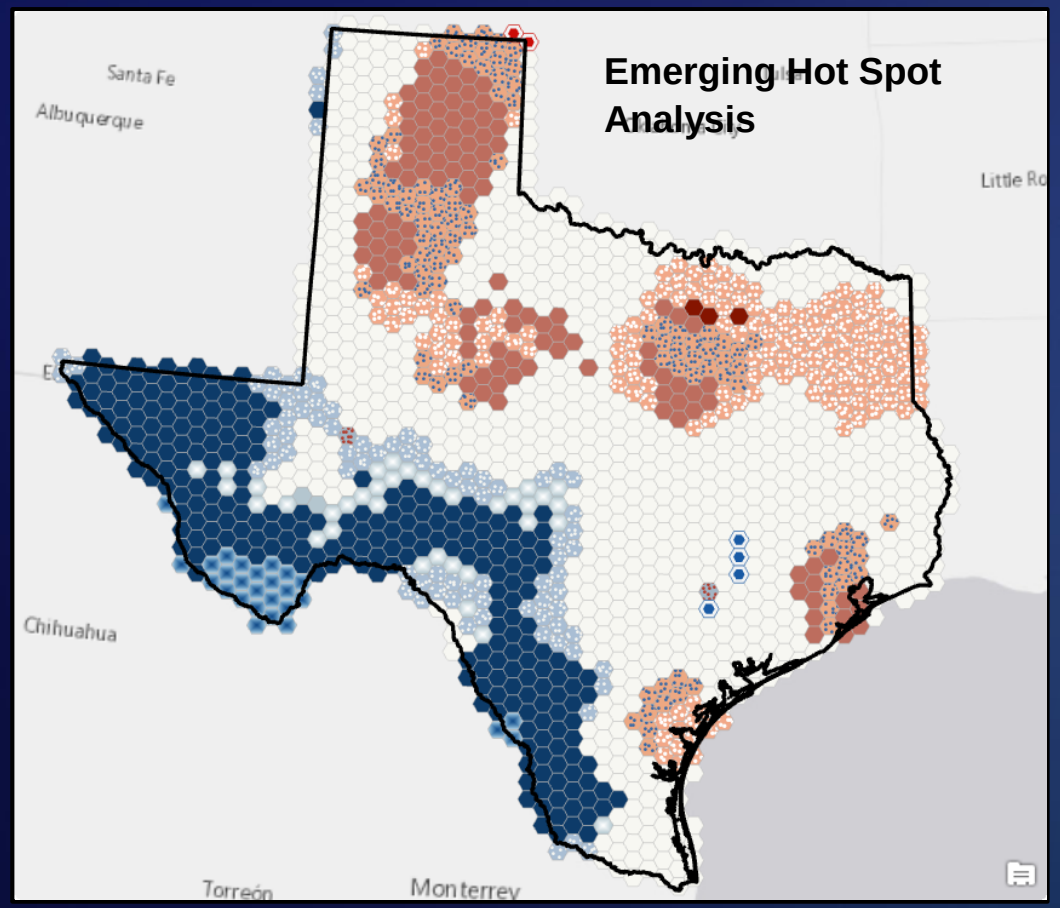
Detecting and quantifying patterns

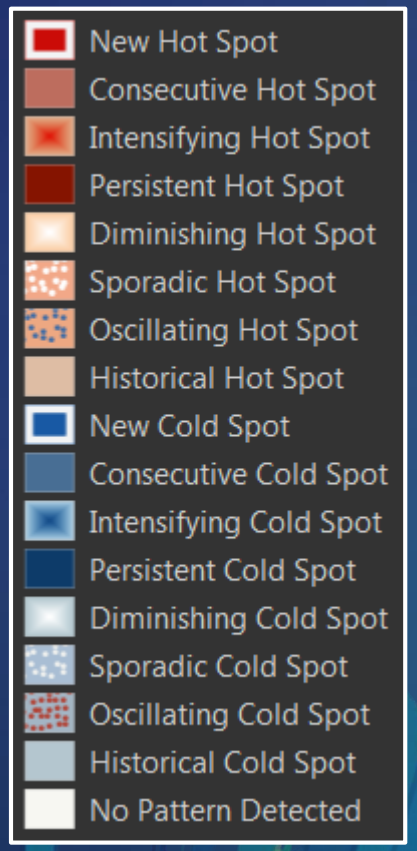
19. Are spatial patterns changing over time?

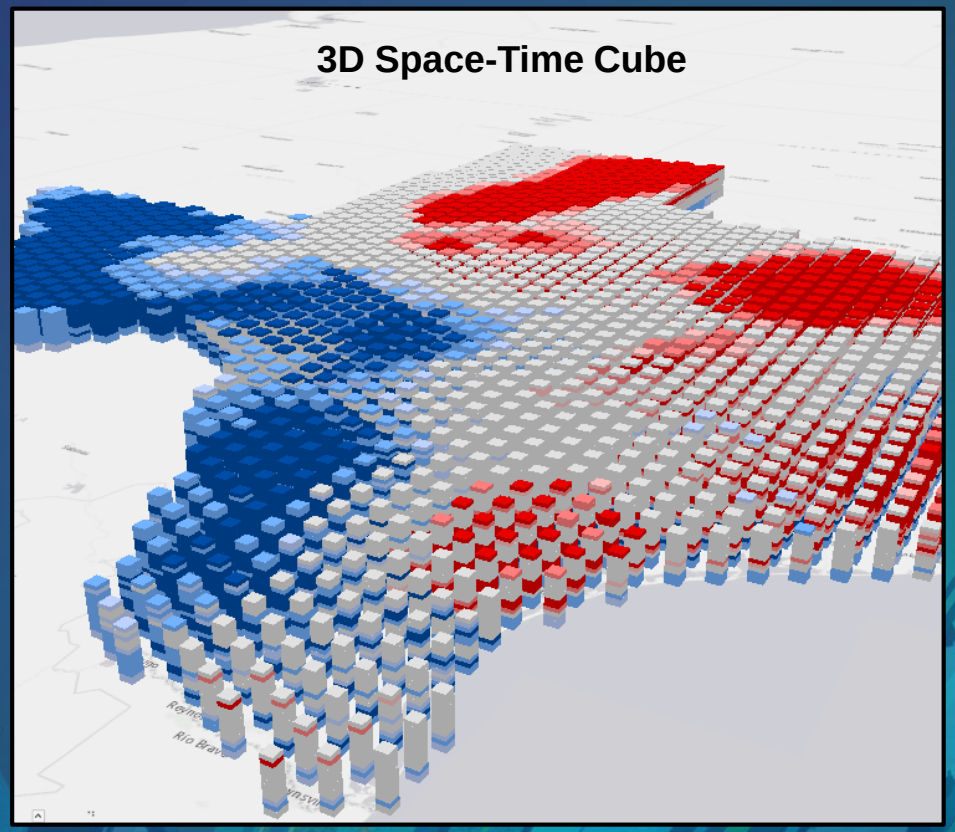


Detecting and quantifying patterns

19. Are spatial patterns changing over time?







Demo:
Detecting and quantifying patterns

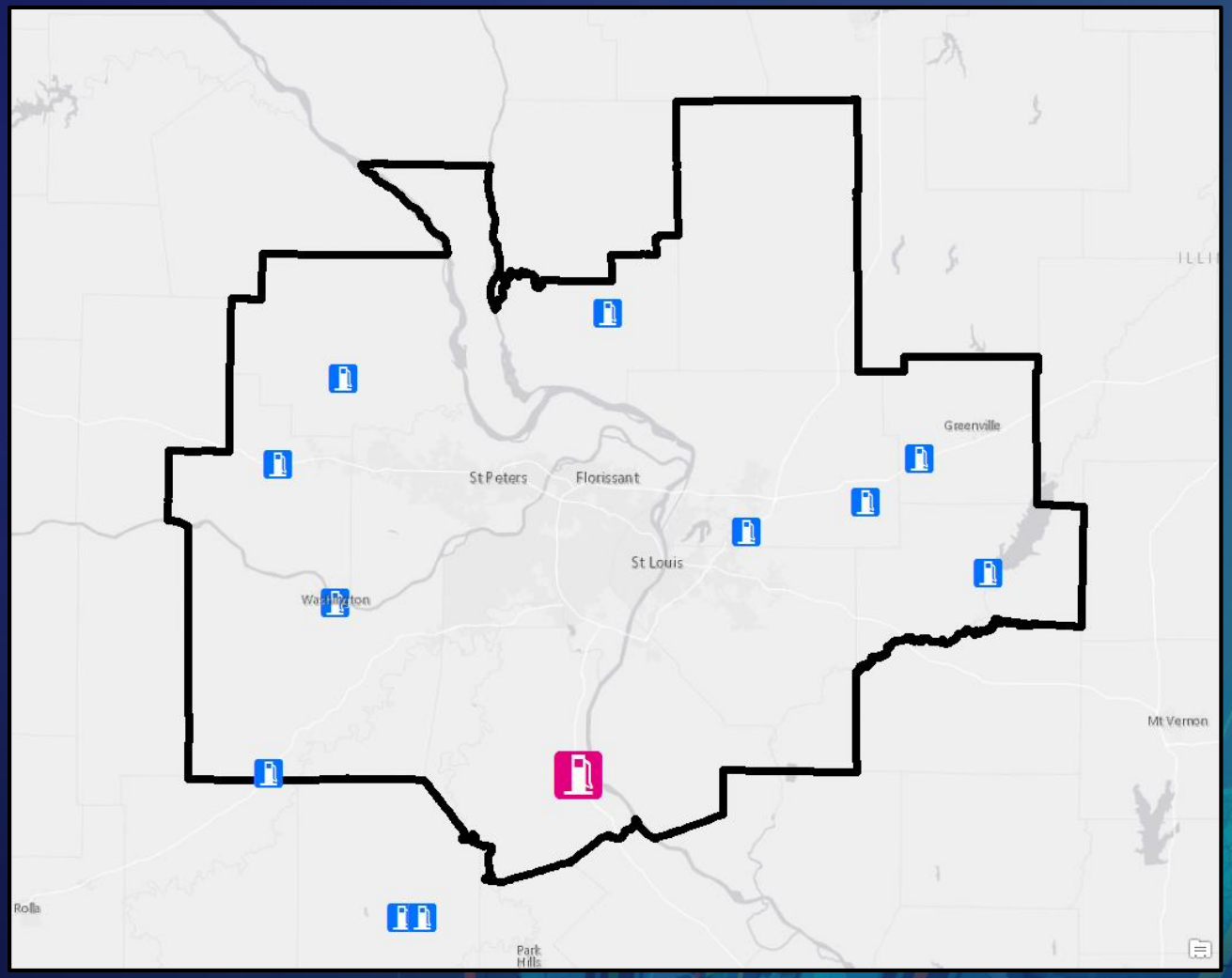
Making predictions

Making predictions

20. Identifying or ranking similar locations?

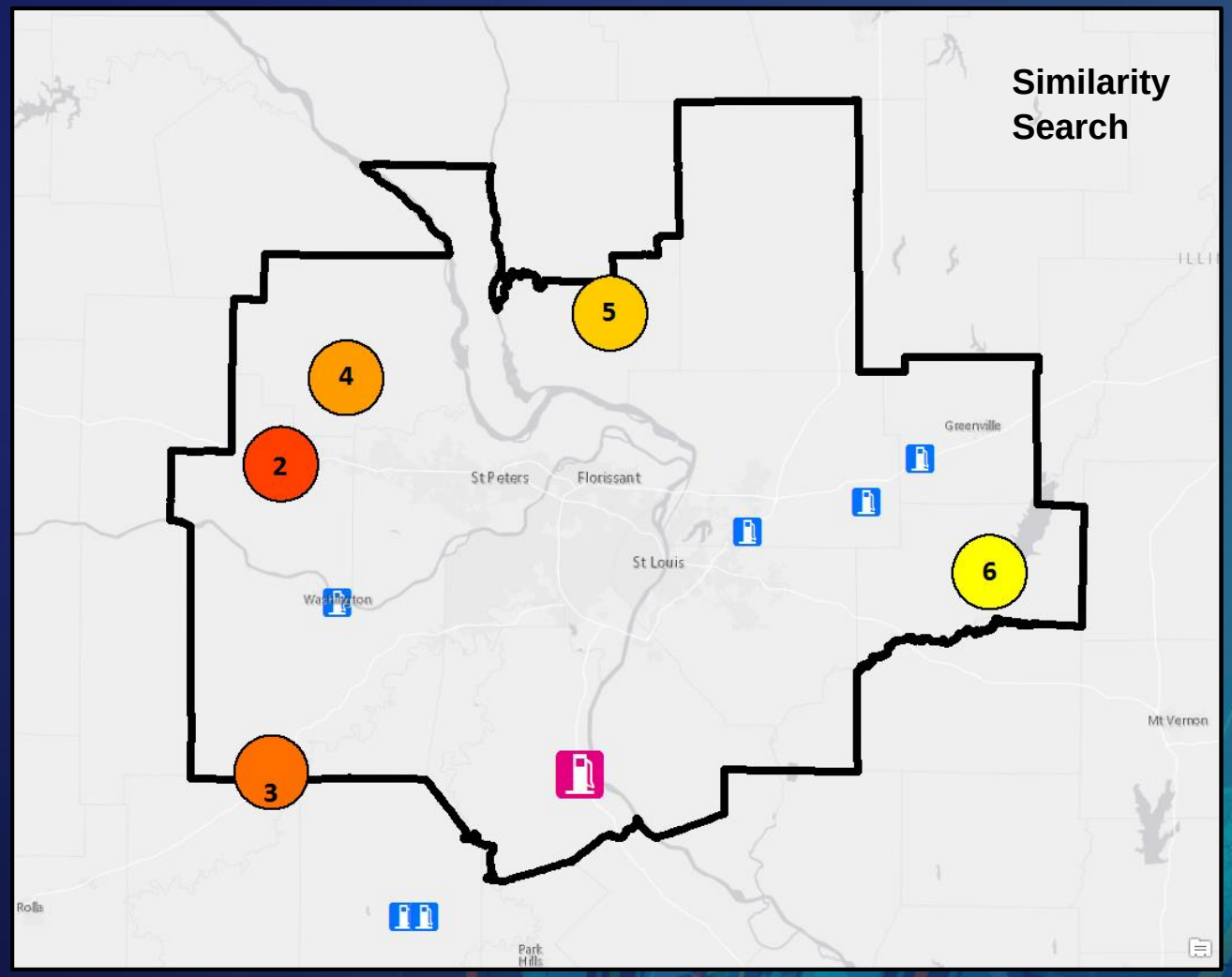
Making predictions

20. Identifying or ranking similar locations?



Making predictions

20. Identifying or ranking similar locations?

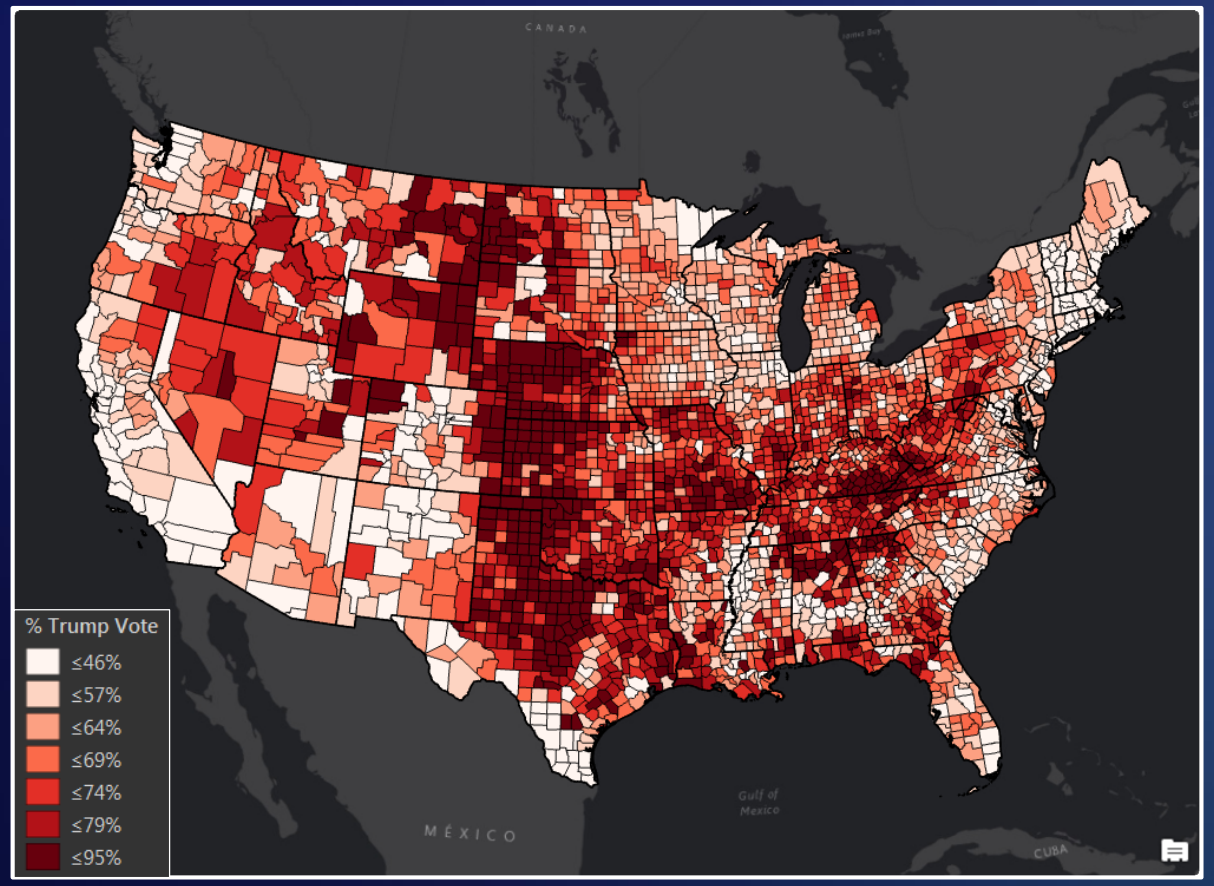


Making predictions

21. What explains or predicts patterns?

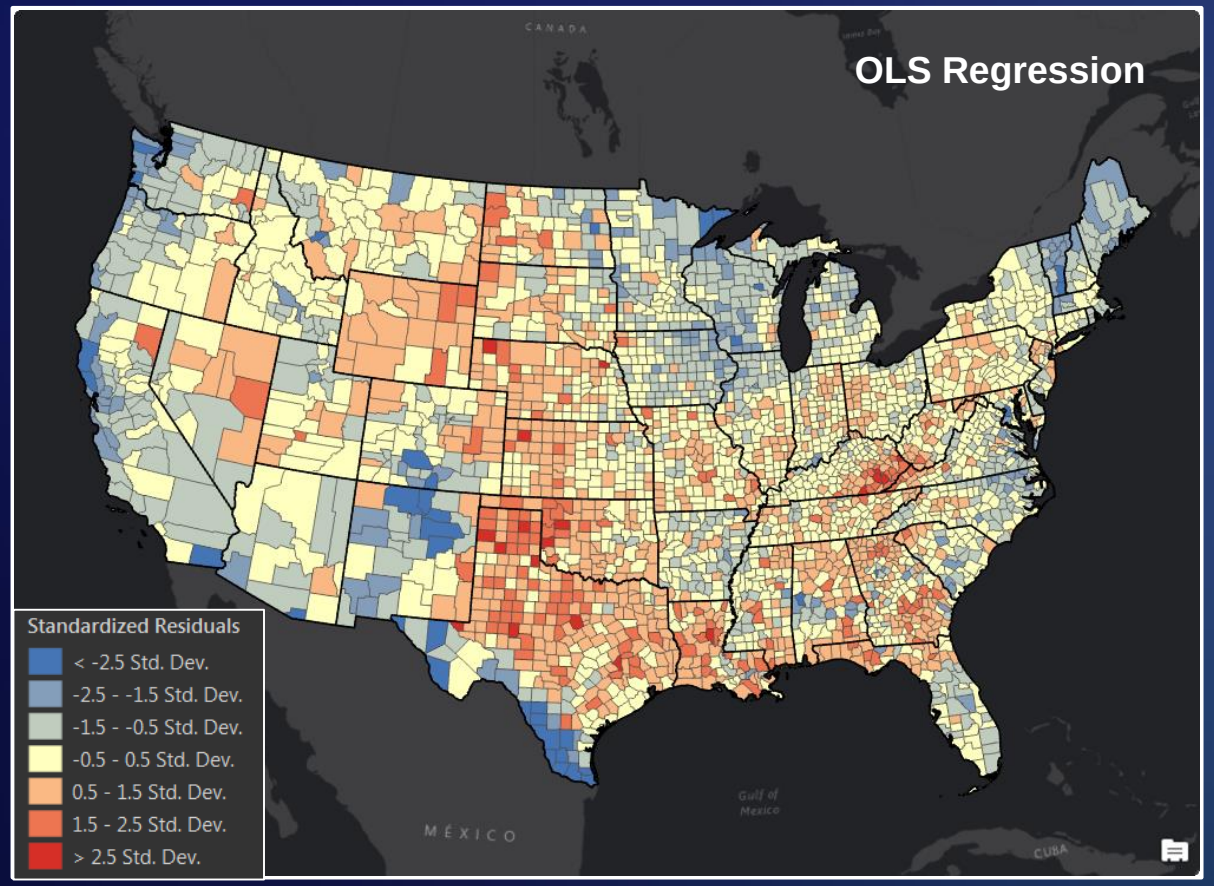
Making predictions

21. What explains or predicts patterns?



Making predictions

21. What explains or predicts patterns?

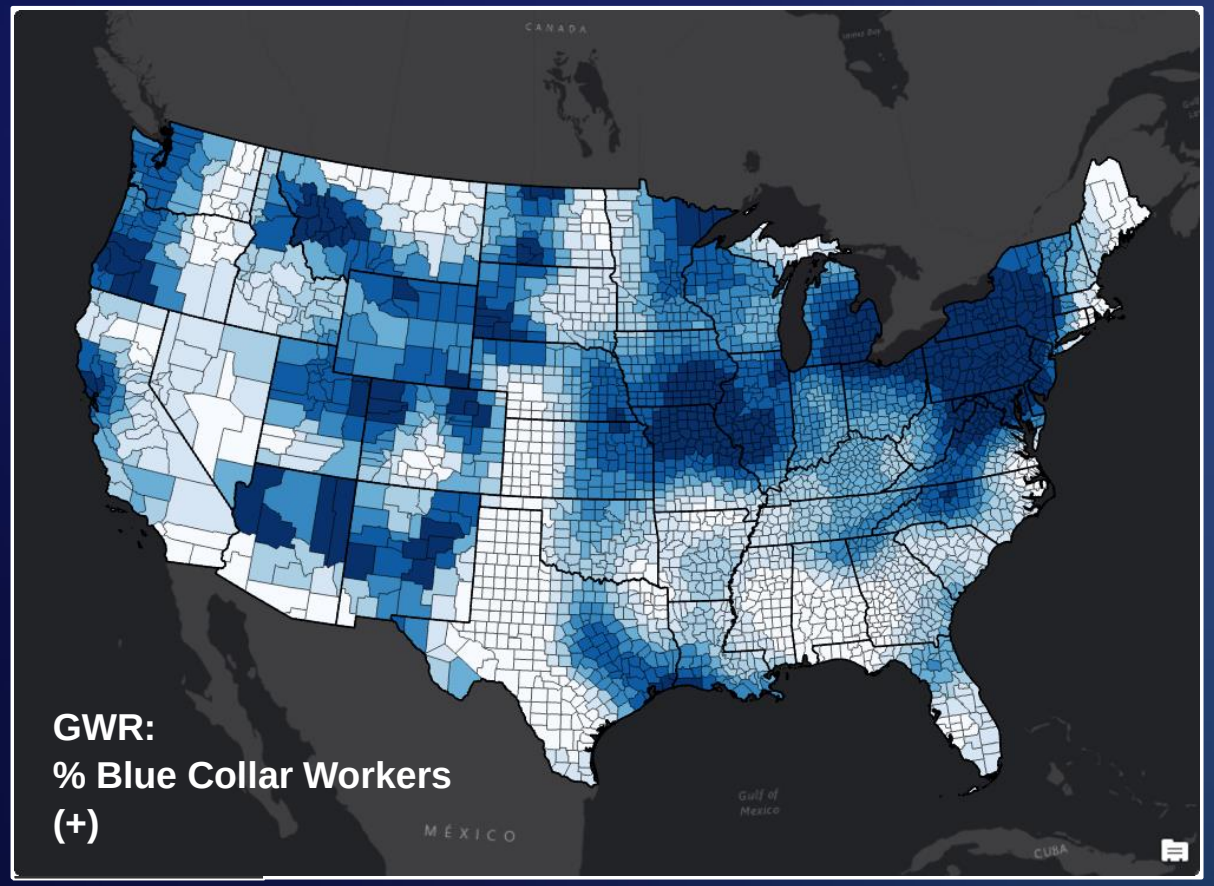


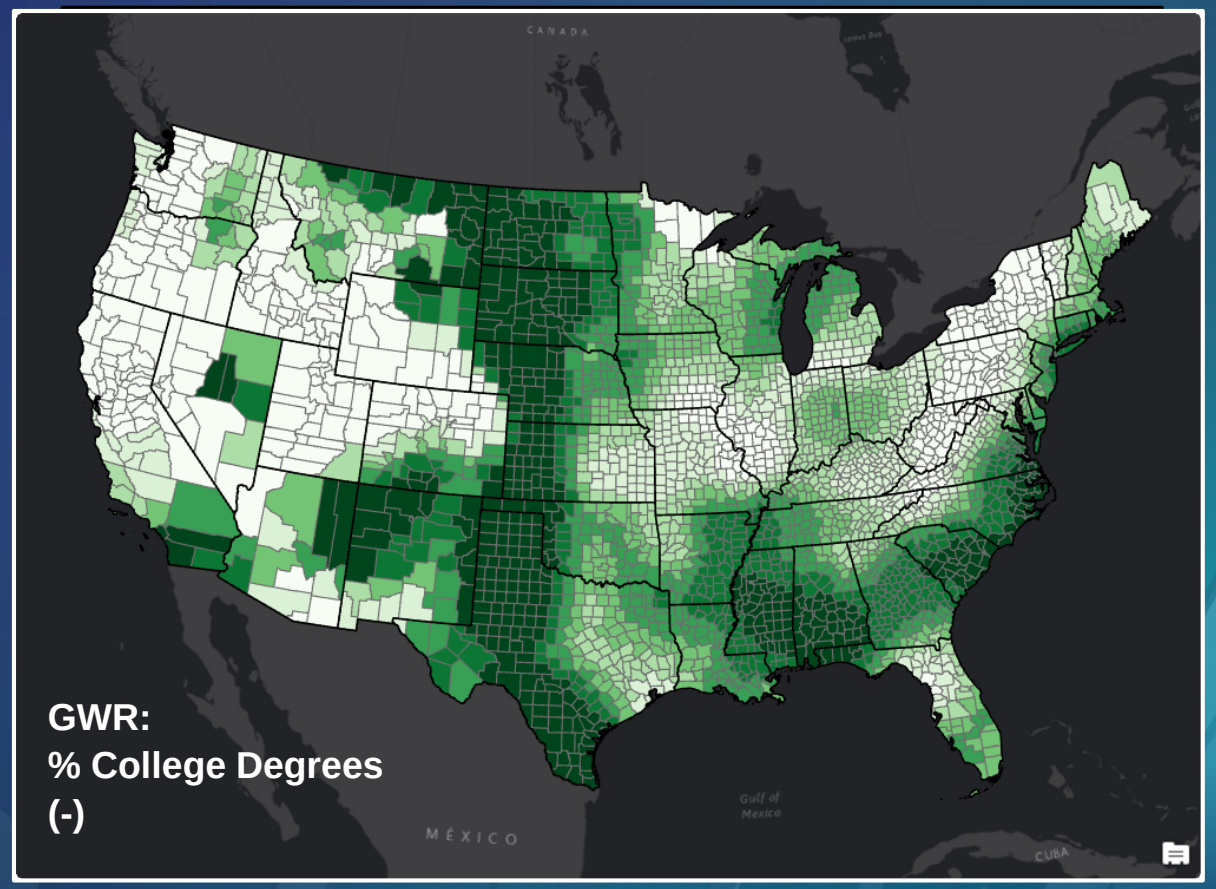
Summary of OLS Results - Model Variables

Variable	Coefficient [a]	StdError	t-Statistic	Probability [b]	Robust_SE	Robust_t	Robust_Pr [b]	VIF [c]
Intercept	0.531555	0.032871	16.171108	0.000000*	0.041840	12.704321	0.000000*	--------
AVEHHINC16	0.000000	0.000000	1.107253	0.268265	0.000000	0.949405	0.342474	2.881349
DIVERSITY16	-0.000283	0.000103	-2.747023	0.006049*	0.000115	-2.451987	0.014249*	1.490366
POPDENS_CY	-0.000002	0.000001	-1.882381	0.059877	0.000002	-1.190201	0.234059	1.128950
PREPPARTY	1.039640	0.055045	18.887196	0.000000*	0.074340	13.984954	0.000000*	1.838761
PBLUECOLLAR	0.224179	0.044049	5.089321	0.000001*	0.048664	4.606629	0.000006*	1.907710
PNEVERMARRIE	-0.775164	0.038753	-20.002541	0.000000*	0.049630	-15.618948	0.000000*	2.360260
PCOLLEGEDEG	-0.564060	0.036409	-15.492527	0.000000*	0.046444	-12.145031	0.000000*	3.593322

Making predictions

21. What explains or predicts patterns?





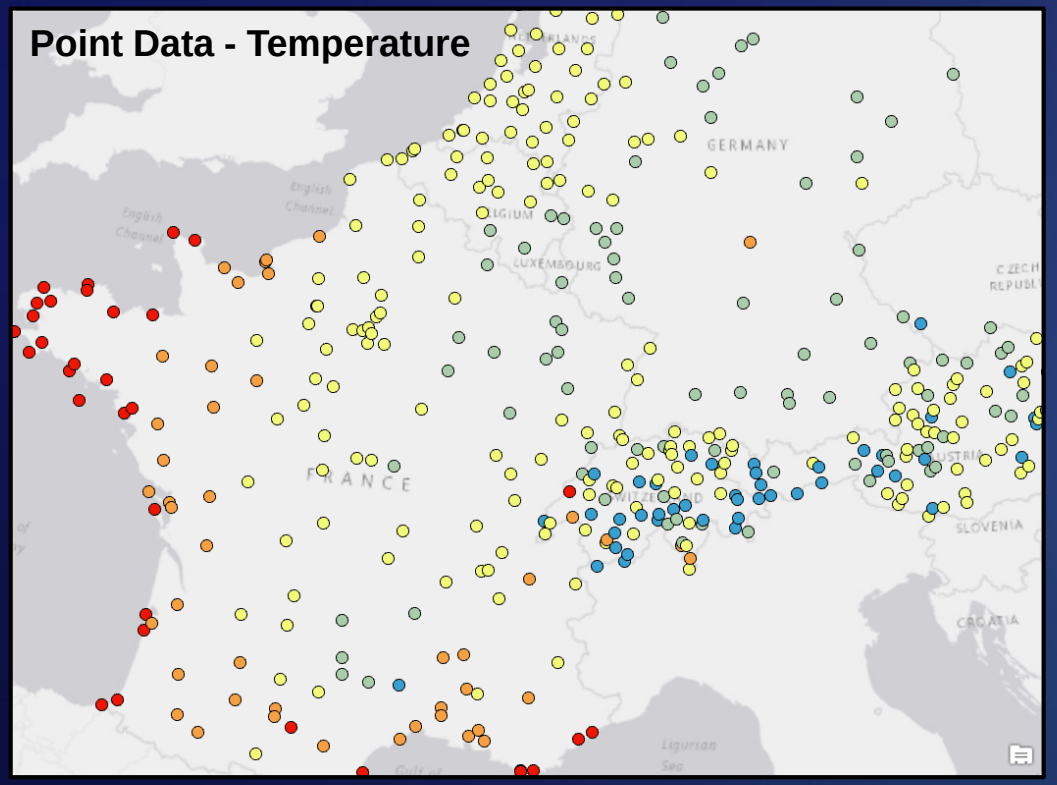
Making predictions

Making predictions

23. Interpolating a continuous surface from discrete sample locations

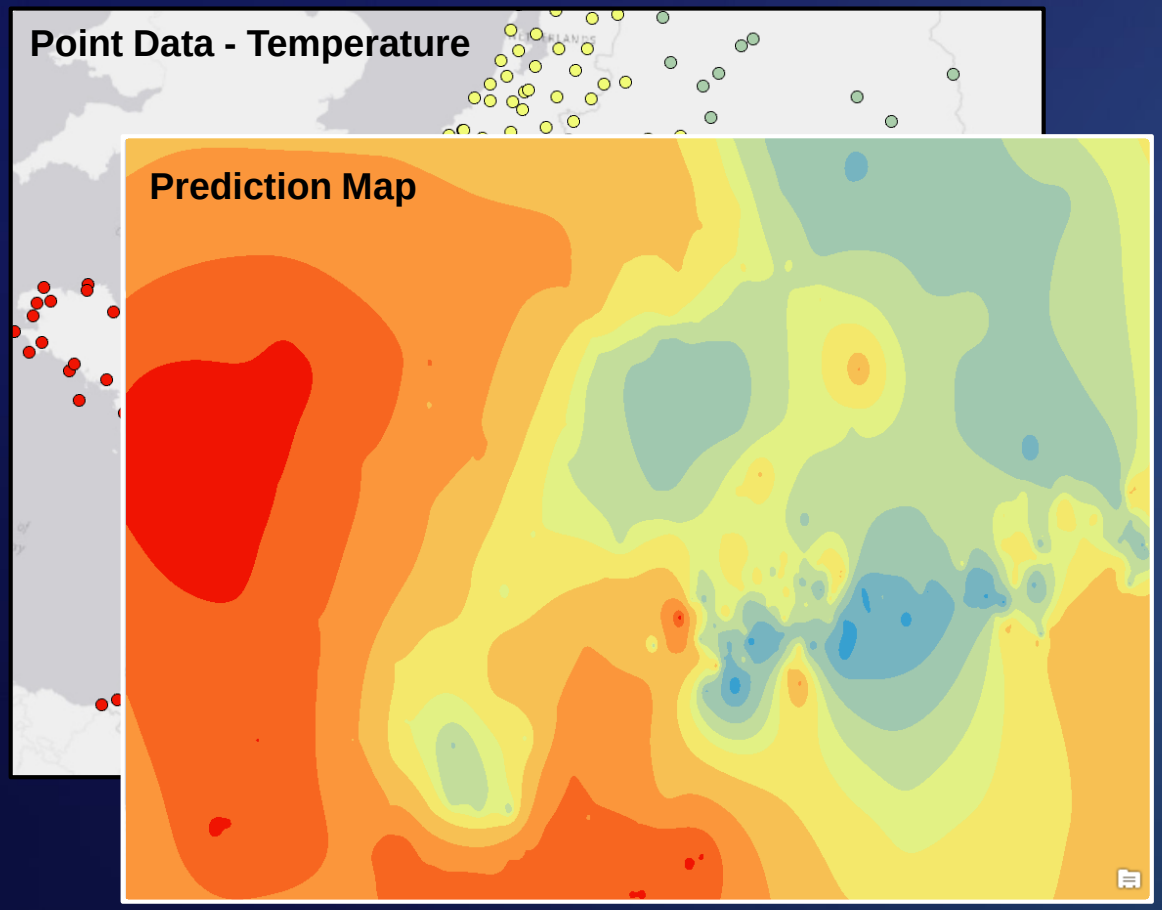
Making predictions

23. Interpolating a continuous surface from discrete sample locations



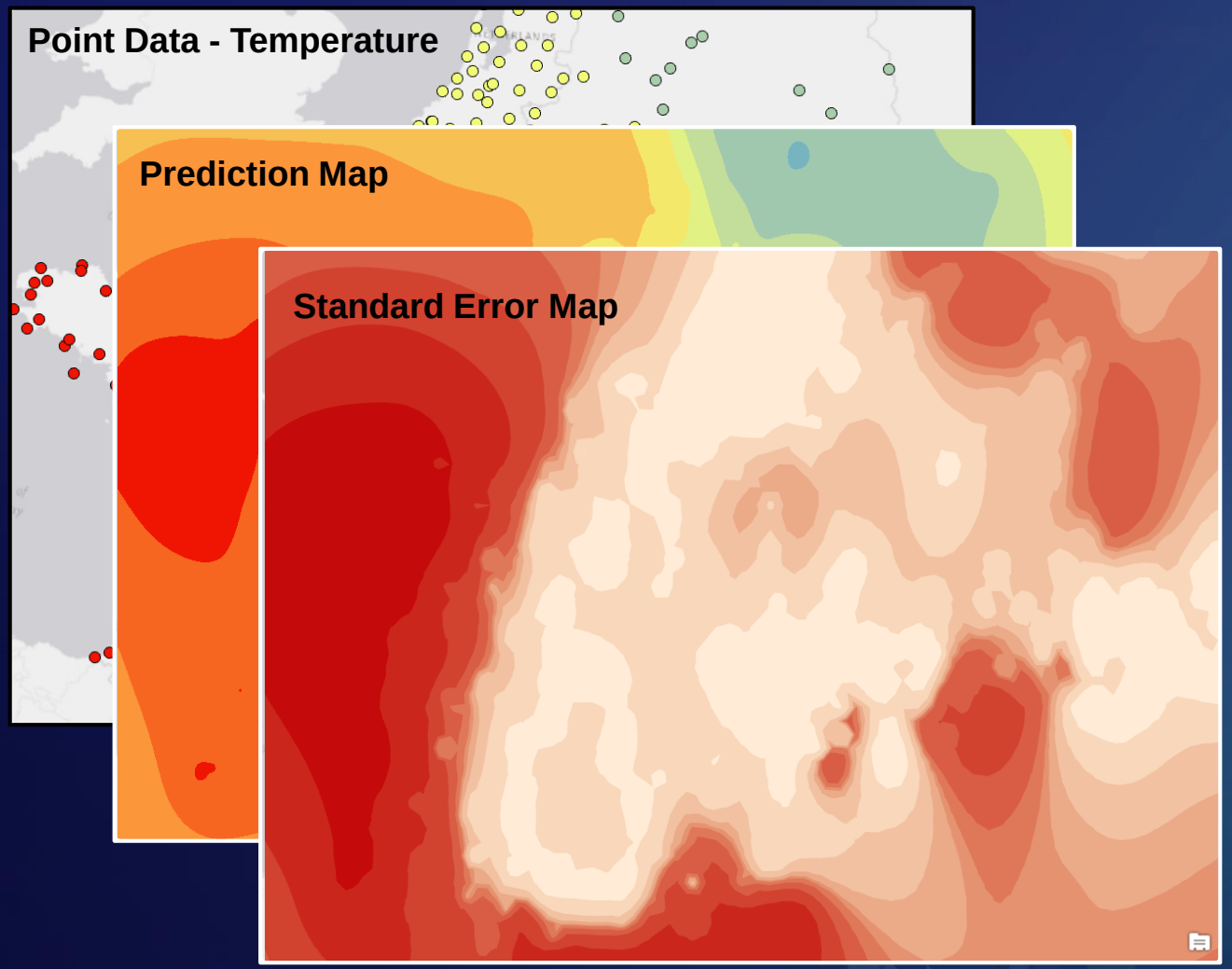
Making predictions

23. Interpolating a continuous surface from discrete sample locations



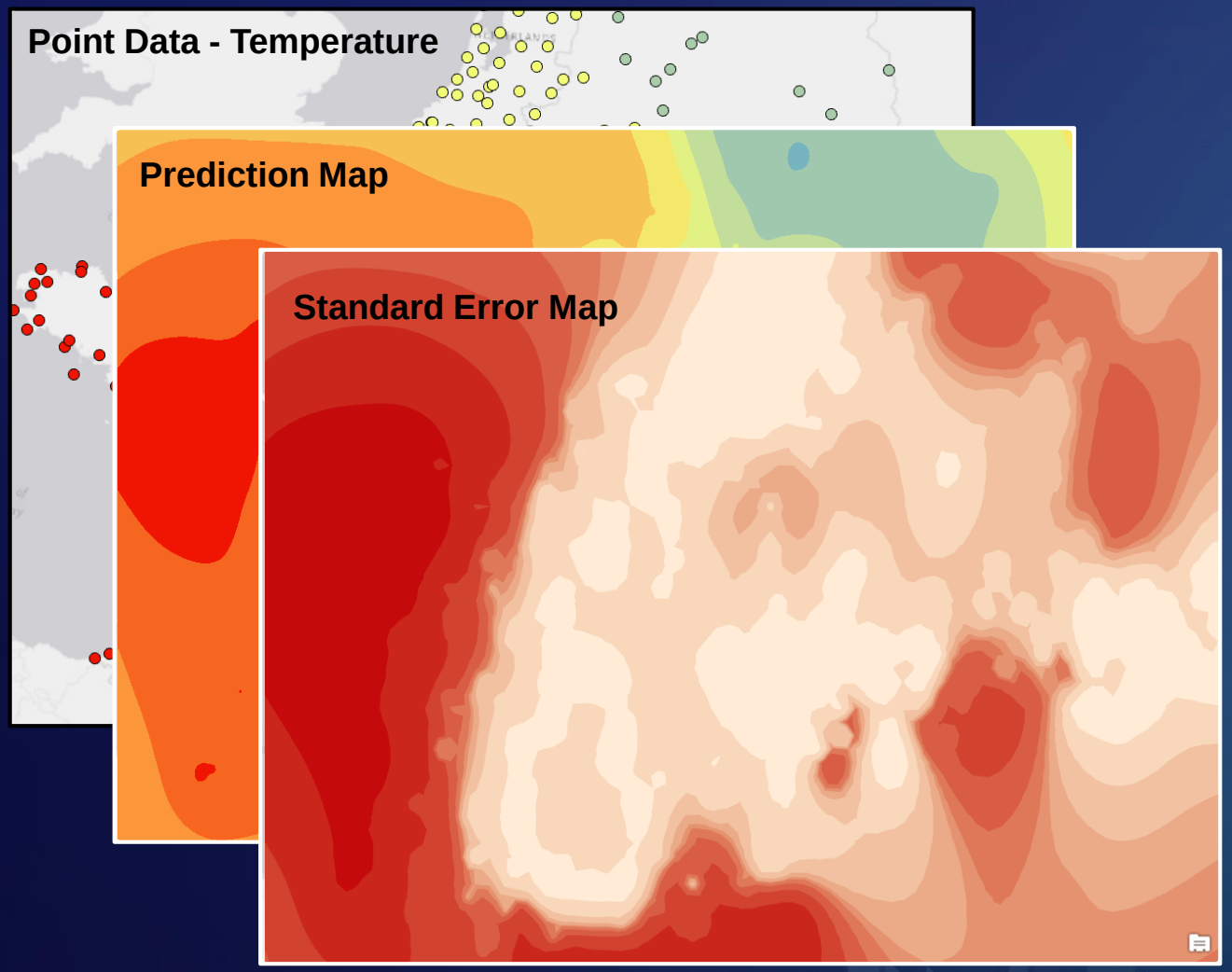
Making predictions

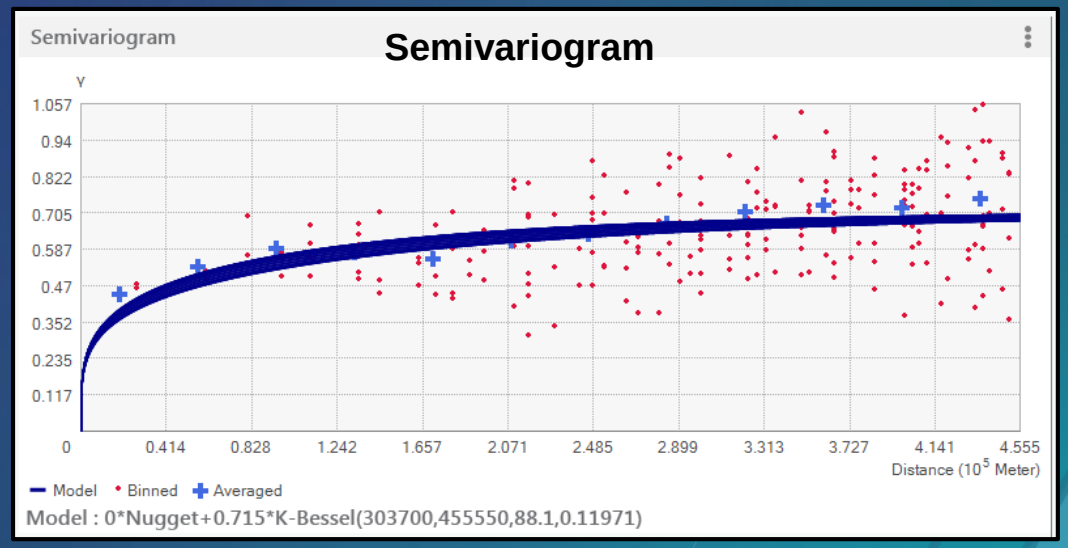
23. Interpolating a continuous surface from discrete sample locations



Making predictions

23. Interpolating a continuous surface from discrete sample locations





Making predictions

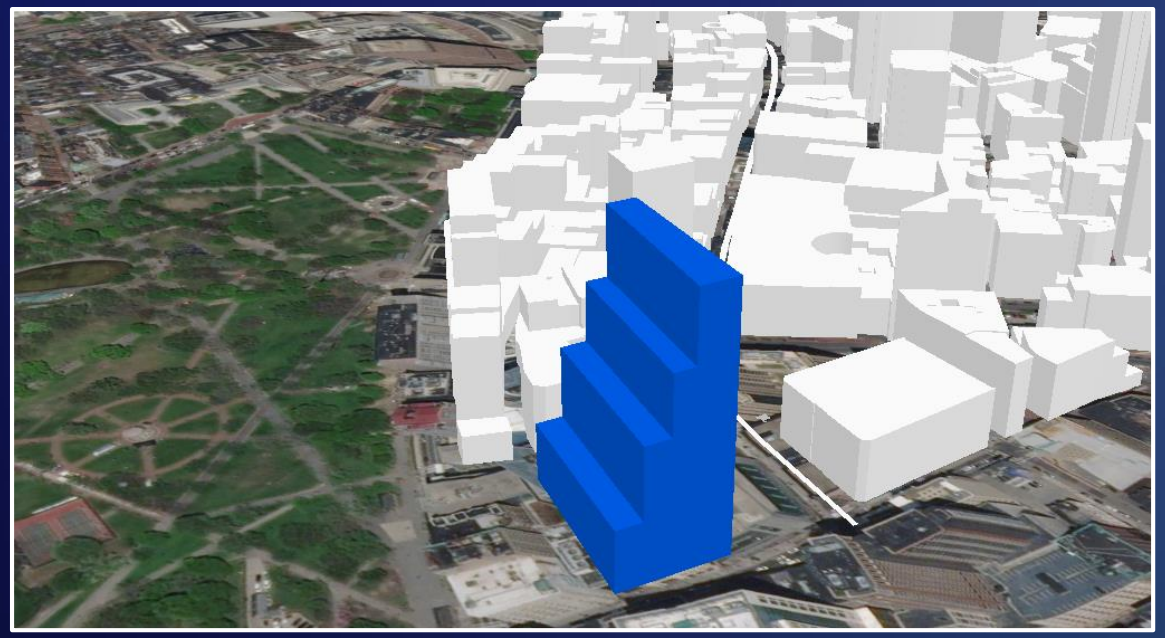
Making predictions

24. Predicting how and where objects affect wave propagation

Making predictions

24. Predicting how and where objects affect wave propagation

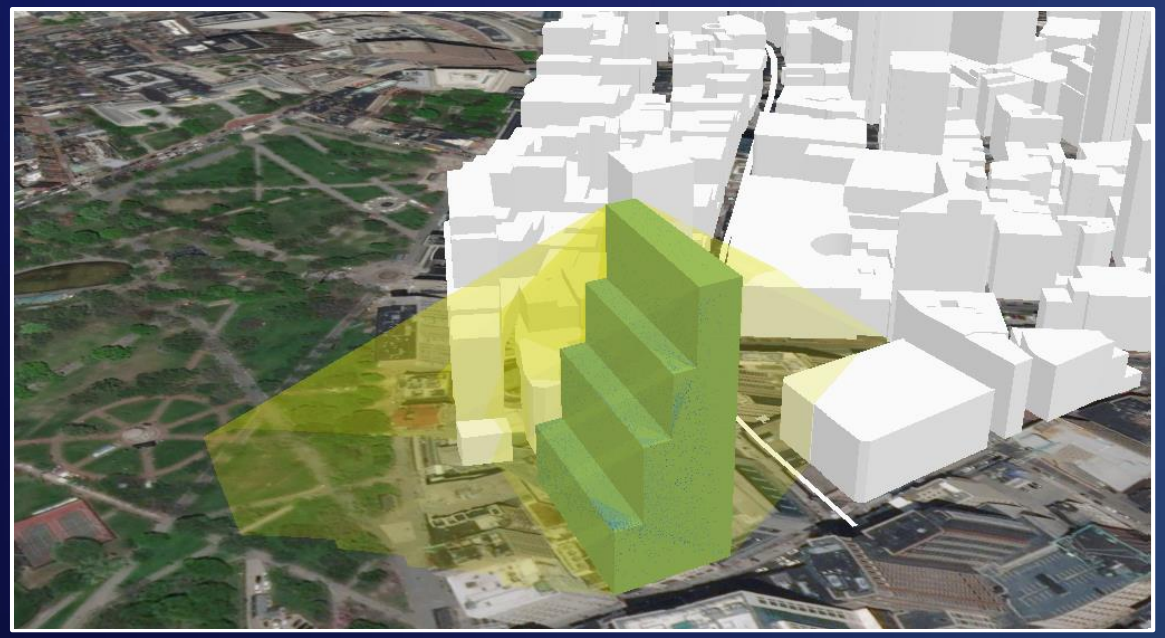
Sun Shadow Volume - Building Scenario #1



Making predictions

24. Predicting how and where objects affect wave propagation

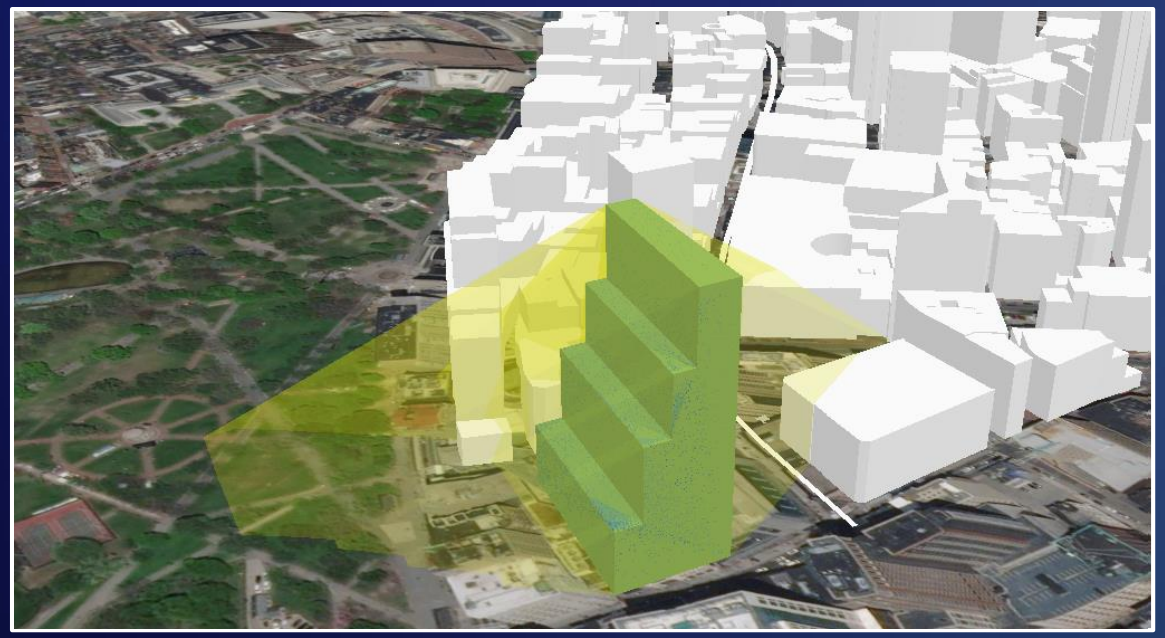
Sun Shadow Volume - Building Scenario #1



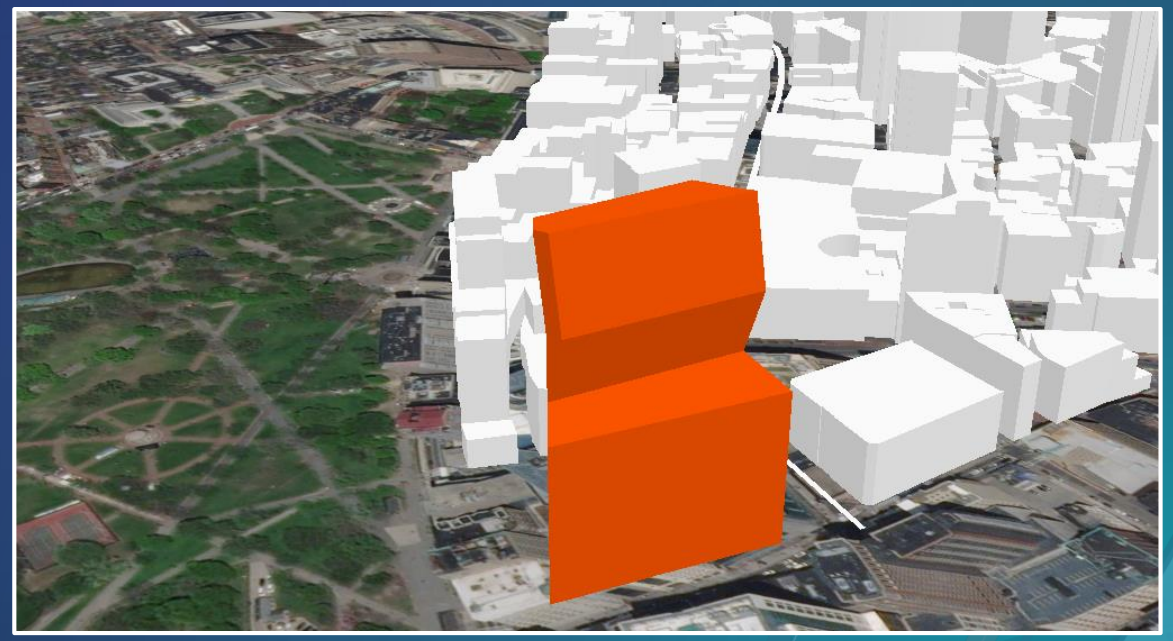
Making predictions

24. Predicting how and where objects affect wave propagation

Sun Shadow Volume - Building Scenario #1



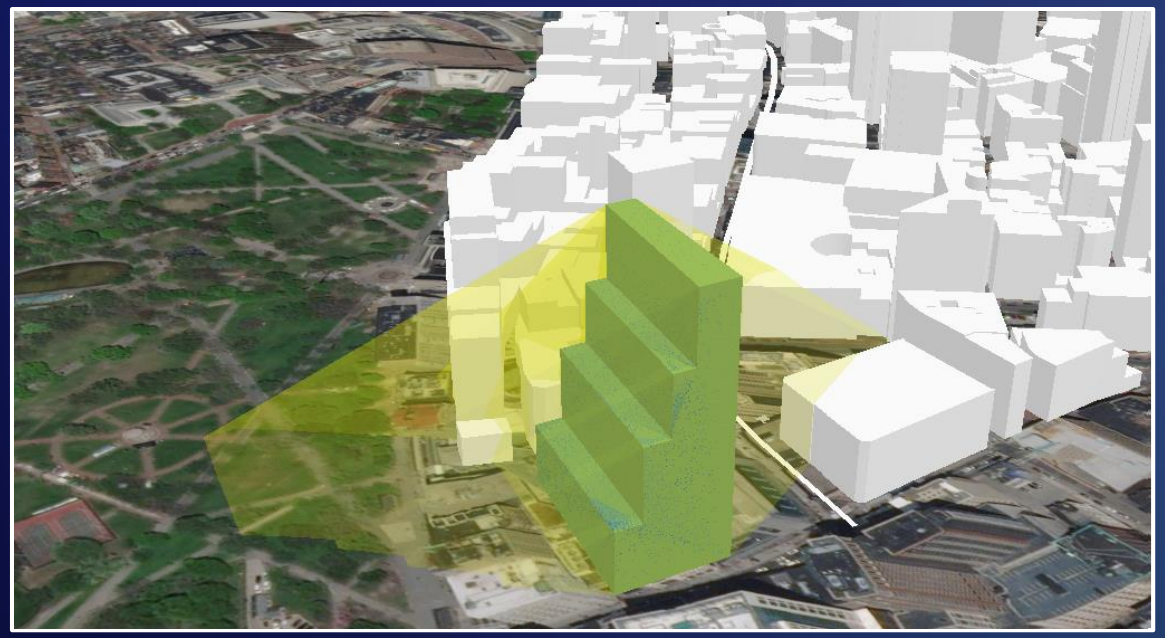
Sun Shadow Volume - Building Scenario #2



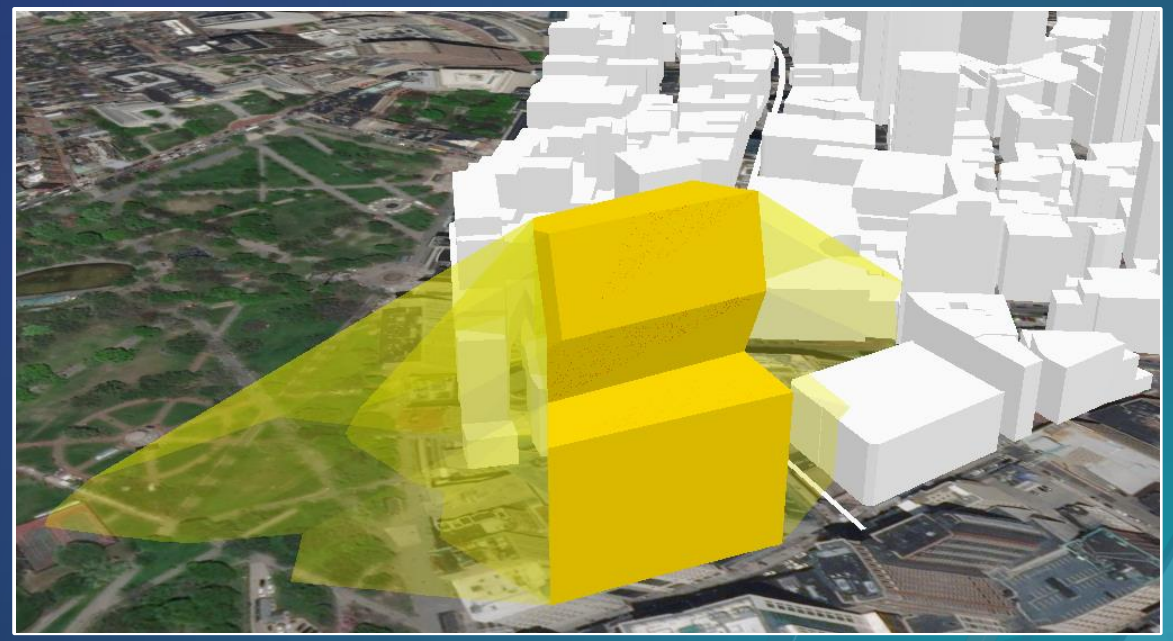
Making predictions

24. Predicting how and where objects affect wave propagation

Sun Shadow Volume - Building Scenario #1



Sun Shadow Volume - Building Scenario #2

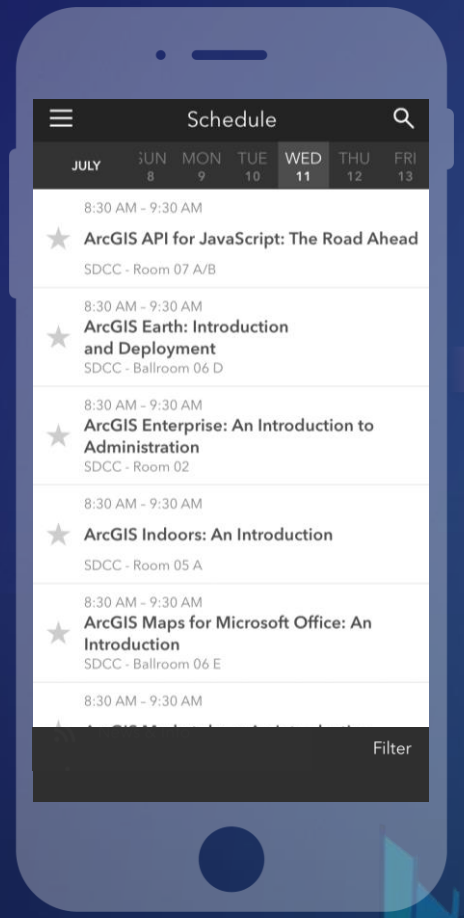


Demo:
Finding similar locations

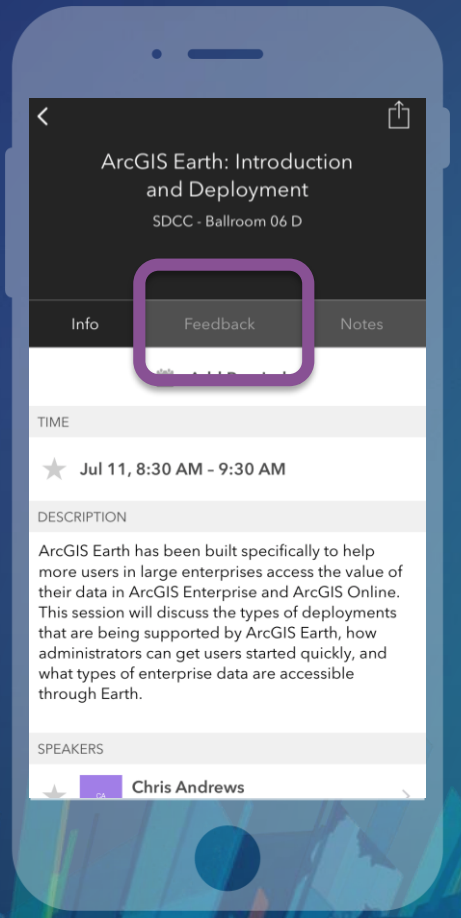
Please Take Our Survey on the App

Download the Esri Events app and find your event

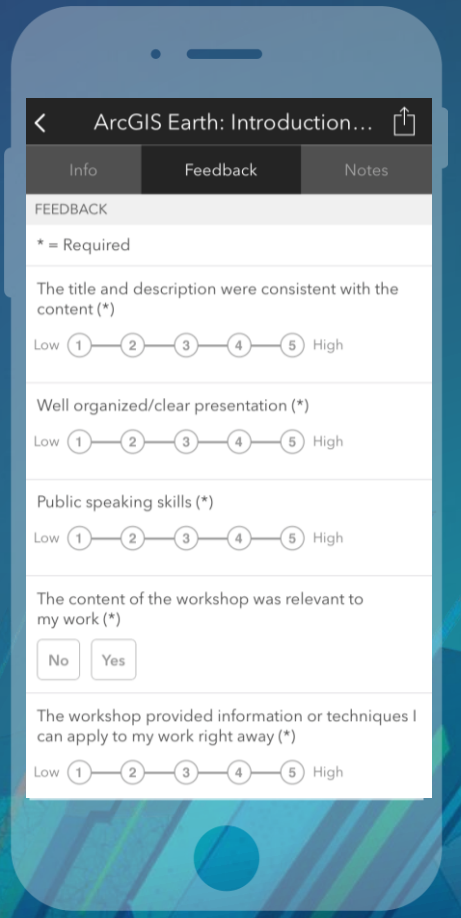
Select the session you attended



Select the Feedback tab



Complete answers and select “Submit”



esri | THE SCIENCE OF WHERE