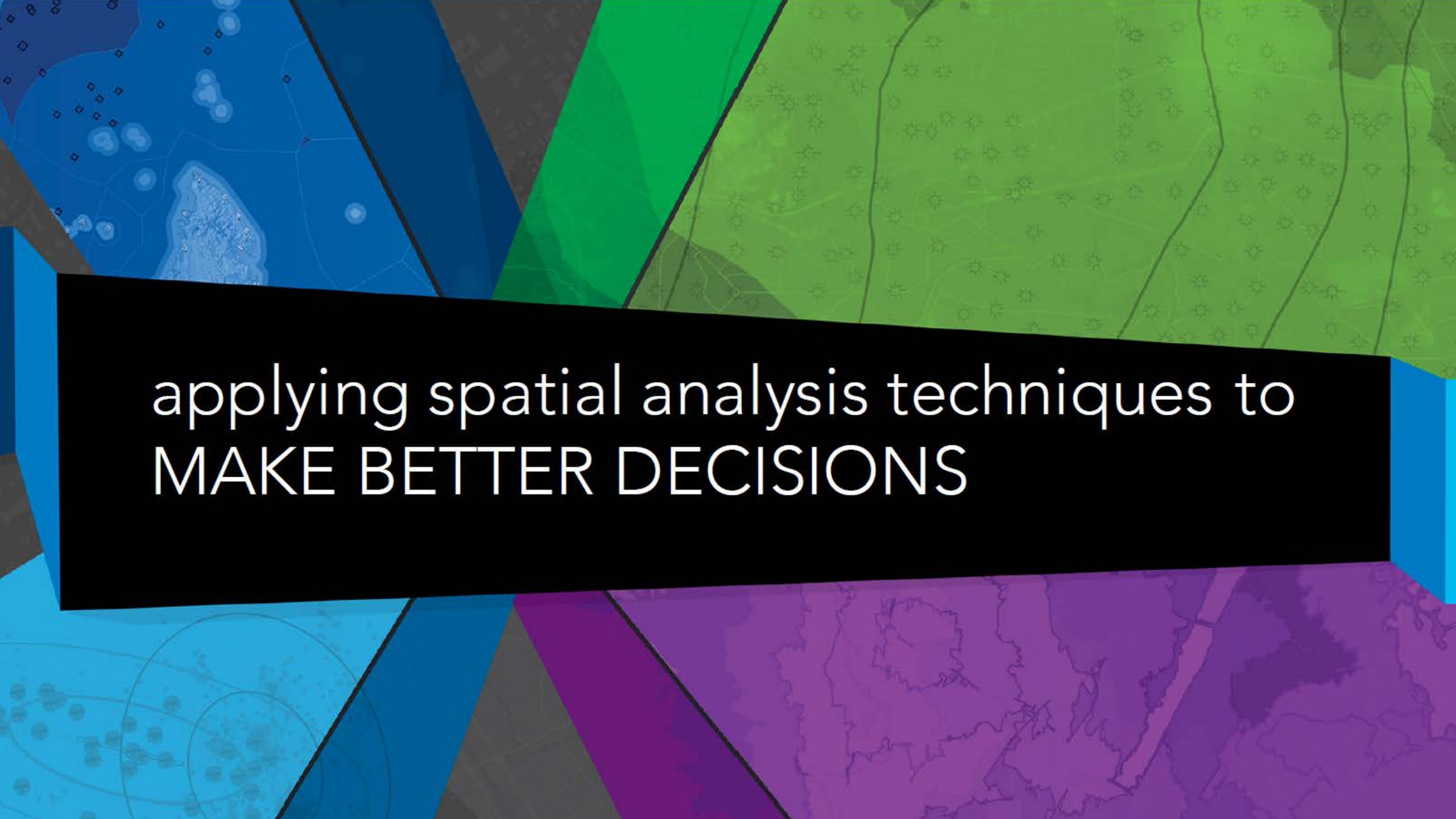

applying spatial analysis techniques to
MAKE BETTER DECISIONS

map

concept

ArcGIS spatial analysis

Geoprocessing

Spatial Analyst

categories

Understanding where

Measuring size, shape, and distribution

Determining how places are related

Finding the best locations and paths

Detecting and quantifying patterns

Making predictions

process

1. Ask questions
2. Explore the data
3. Analyze and model
4. Interpret the results
5. Repeat as necessary
6. Present the results
7. Make a decision

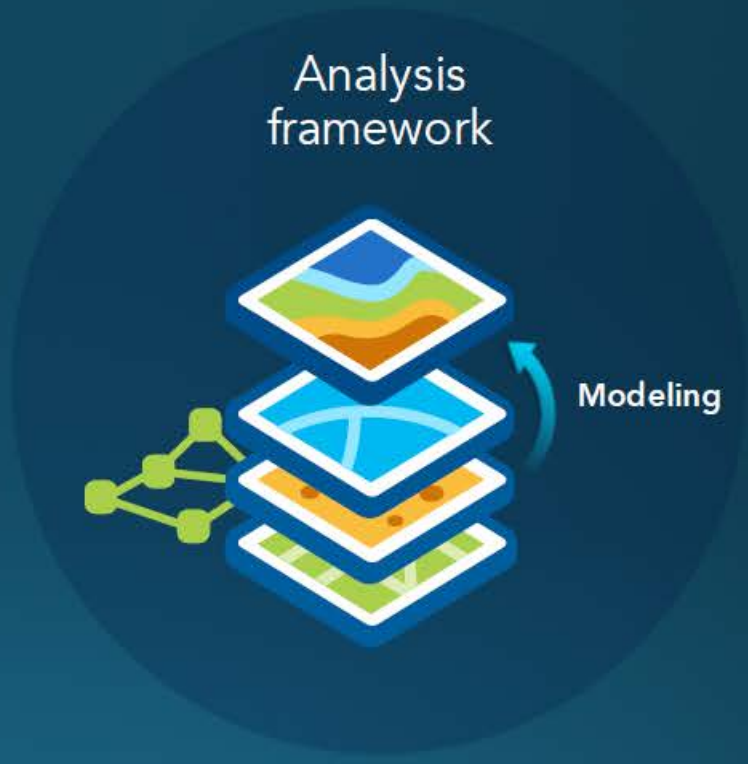
ArcGIS Spatial Analysis

Documentation and Resource center

applying arcgis spatial analysis techniques to make better decisions

In ArcGIS, geoprocessing is a *system* for managing and manipulating data

- Based on a framework of data transformation
- Solve real-world spatial problems
- Model processes and systems
- Ask questions; get results



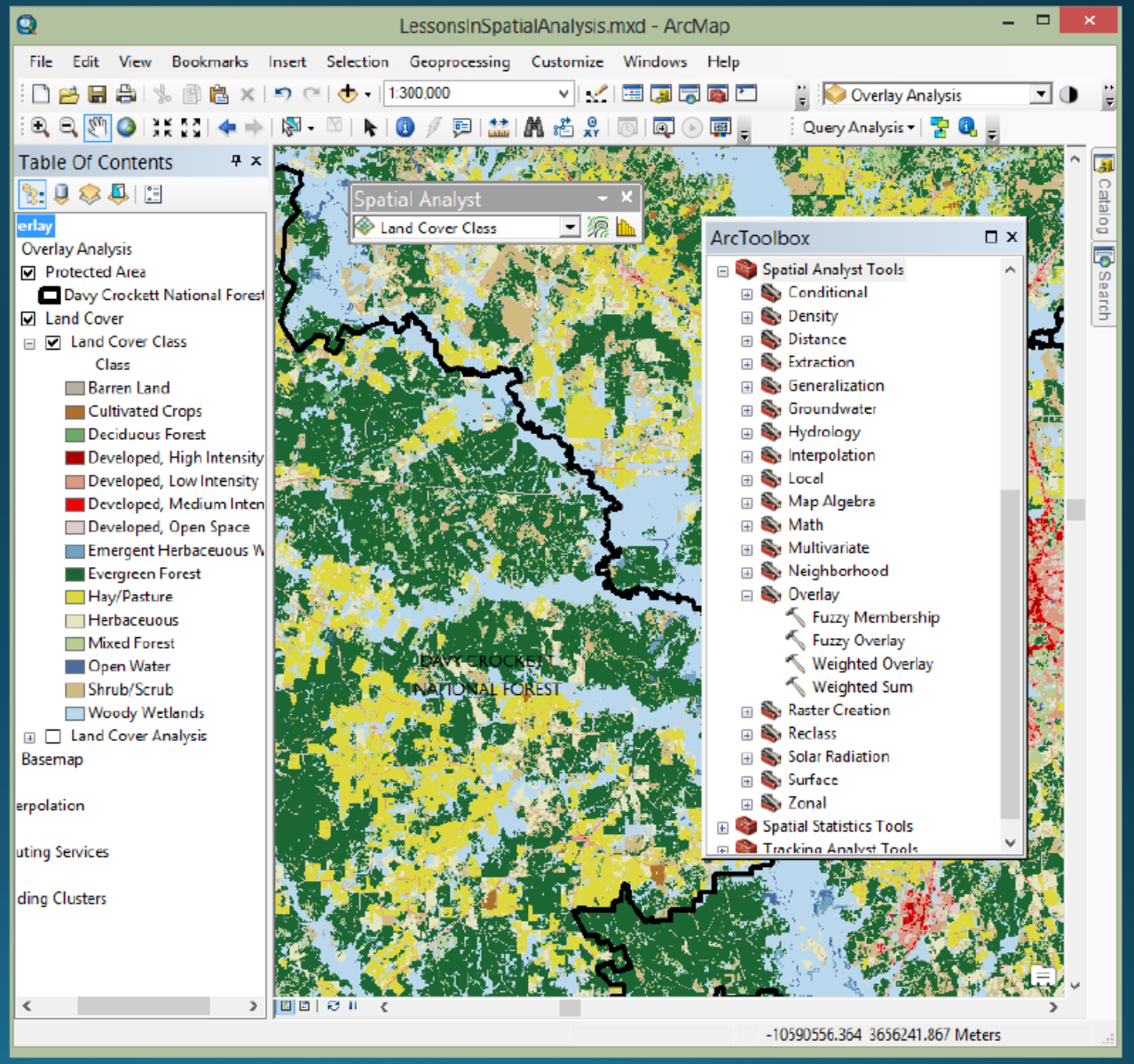
Spatial Analyst is an extension

With it's own Toolbox and tool bar

Integrated raster and vector spatial analysis tools

adds functionality to Desktop, Dev, and Server

Calculator with Map Algebra syntax



spatial analysis is about solving problems

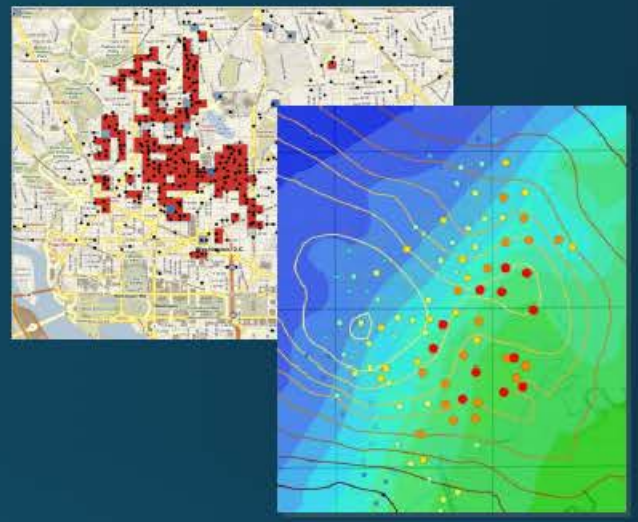
What is inside an area?

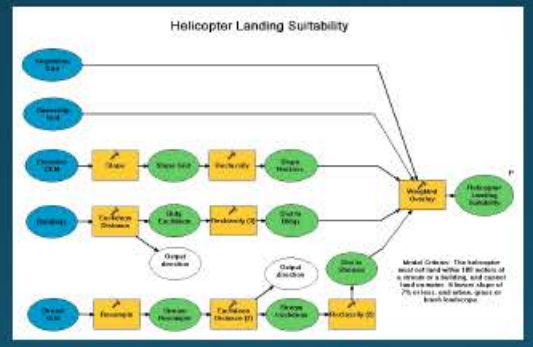
What is nearby?

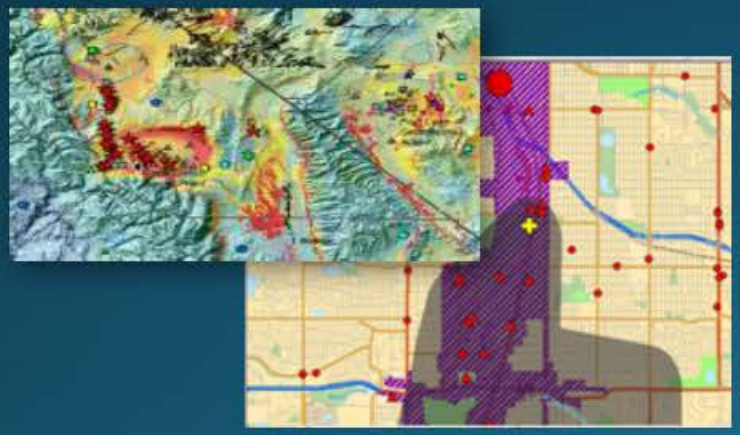
Where are the events concentrated?

Where do things move over time?

Why things occur where they do?





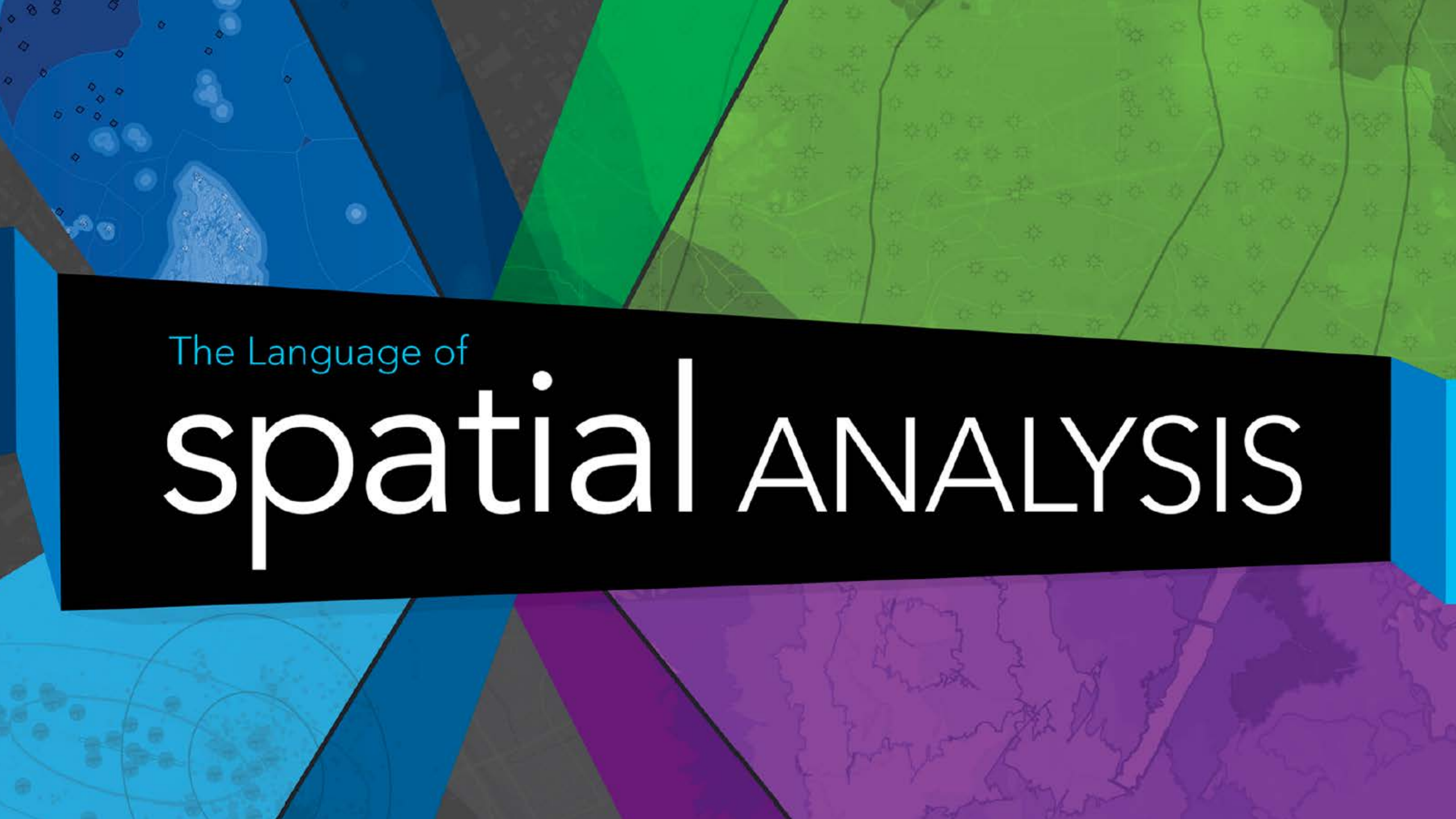


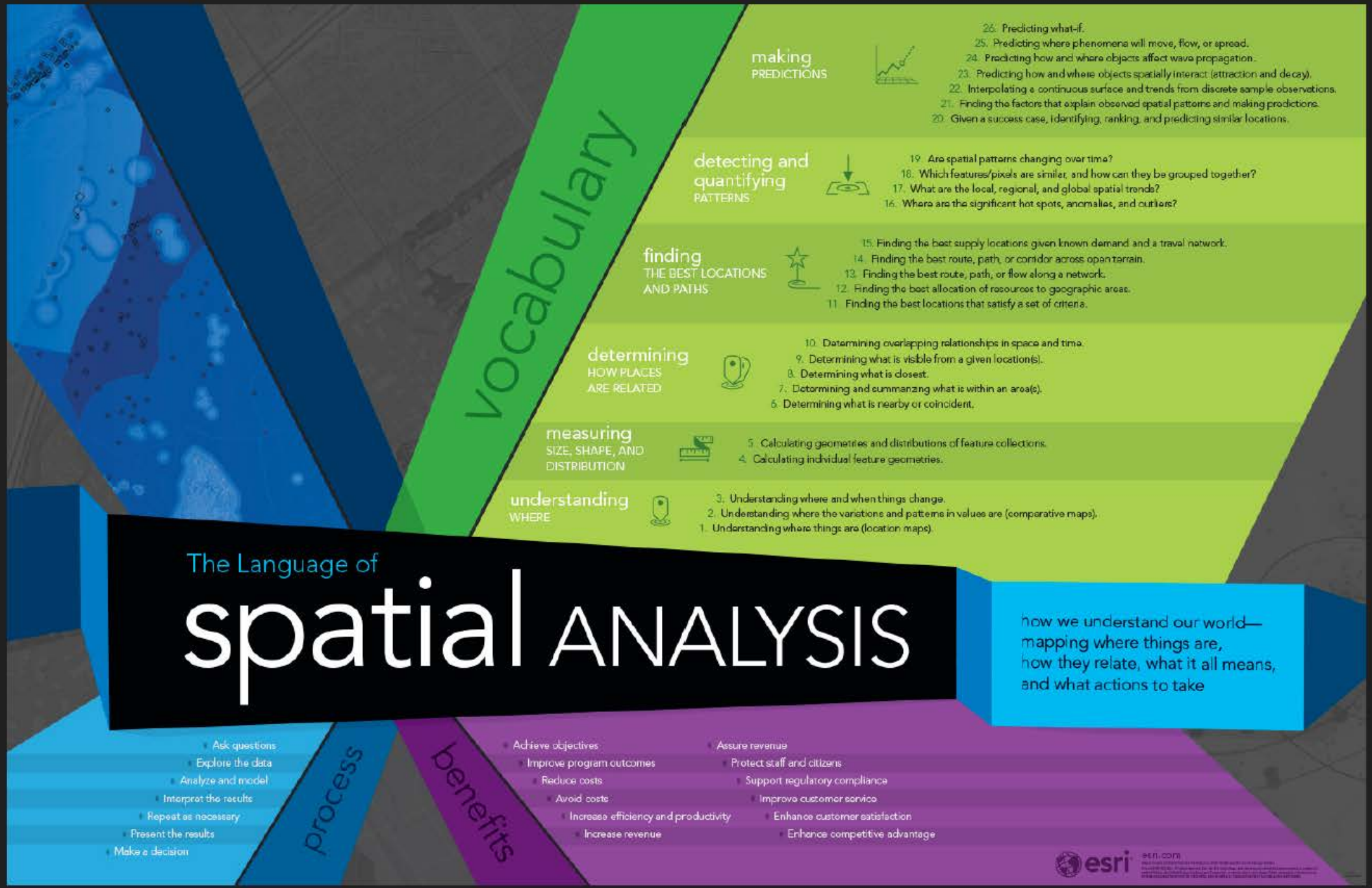
How can we estimate values for a whole area?

What is a suitable location for …?

to understand spatial analysis we need to learn the language

Whenever we look at a map, we inherently start turning that map into information by finding patterns, assessing trends, or making decisions. This is spatial analysis, and it's what our minds do naturally whenever we look at a map.


The Language of
spatial ANALYSIS


vocabulary
making
PREDICTIONS
26. Predicting what-if.
25. Predicting where phenomena will move, flow, or spread.
24. Predicting how and where objects affect wave propagation.
23. Predicting how and where objects spatially interact (attraction and decay).
22. Interpolating a continuous surface and trends from discrete sample observations.
21. Finding the factors that explain observed spatial patterns and making predictions.
20. Given a success case, identifying, ranking, and predicting similar locations.
detecting and quantifying
PATTERNS
19. Are spatial patterns changing over time?
18. Which features/pixels are similar, and how can they be grouped together?
17. What are the local, regional, and global spatial trends?
16. Where are the significant hot spots, anomalies, and outliers?
finding
THE BEST LOCATIONS AND PATHS
15. Finding the best supply locations given known demand and a travel network.
14. Finding the best route, path, or corridor across open terrain.
13. Finding the best route, path, or flow along a network.
12. Finding the best allocation of resources to geographic areas.
11. Finding the best locations that satisfy a set of criteria.
determining
HOW PLACES ARE RELATED
10. Determining overlapping relationships in space and time.
9. Determining what is visible from a given location(s).
8. Determining what is closest.
7. Determining and summarizing what is within an area(s).
6. Determining what is nearby or coincident.
measuring
SIZE, SHAPE, AND DISTRIBUTION
5. Calculating geometries and distributions of feature collections.
4. Calculating individual feature geometries.
understanding
WHERE
3. Understanding where and when things change.
2. Understanding where the variations and patterns in values are (comparative maps).
1. Understanding where things are (location maps).
The Language of
spatial ANALYSIS
how we understand our world—
mapping where things are,
how they relate, what it all means,
and what actions to take
process
Ask questions
Explore the data
Analyze and model
Interpret the results
Repeat as necessary
Present the results
Make a decision
benefits
Achieve objectives
Improve program outcomes
Reduce costs
Avoid costs
Increase efficiency and productivity
Increase revenue
Assure revenue
Protect staff and citizens
Support regulatory compliance
Improve customer service
Enhance customer satisfaction
Enhance competitive advantage
esri
esri.com

how we understand our world—
mapping where things are,
how they relate, what it all means,
and what actions to take

vocabulary

making
PREDICTIONS

detecting and quantifying
PATTERNS

finding
THE BEST LOCATIONS AND PATHS

determining
HOW PLACES ARE RELATED

measuring
SIZE, SHAPE, AND DISTRIBUTION

understanding
WHERE

six 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

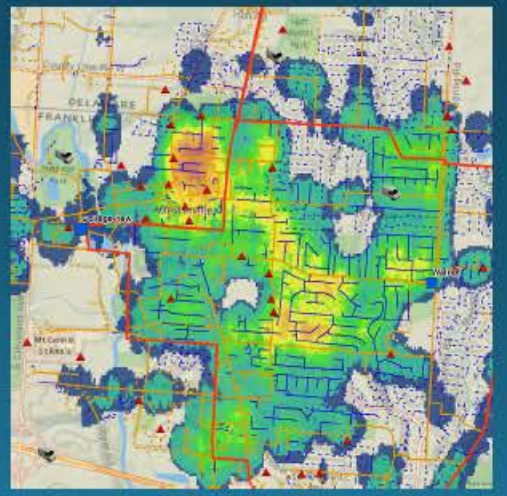
Making predictions

understanding WHERE

Where things are (Location maps

Where things vary and are there patterns (Comparative maps)

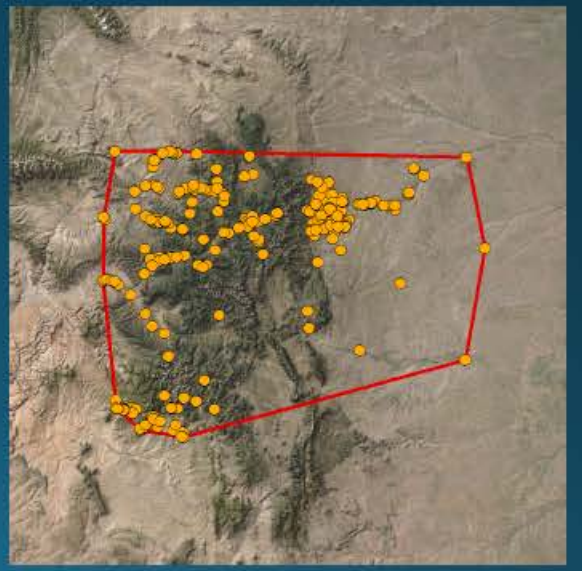
Where and when things change



measuring SIZE, SHAPE AND DISTRIBUTION

Calculating individual feature geometry

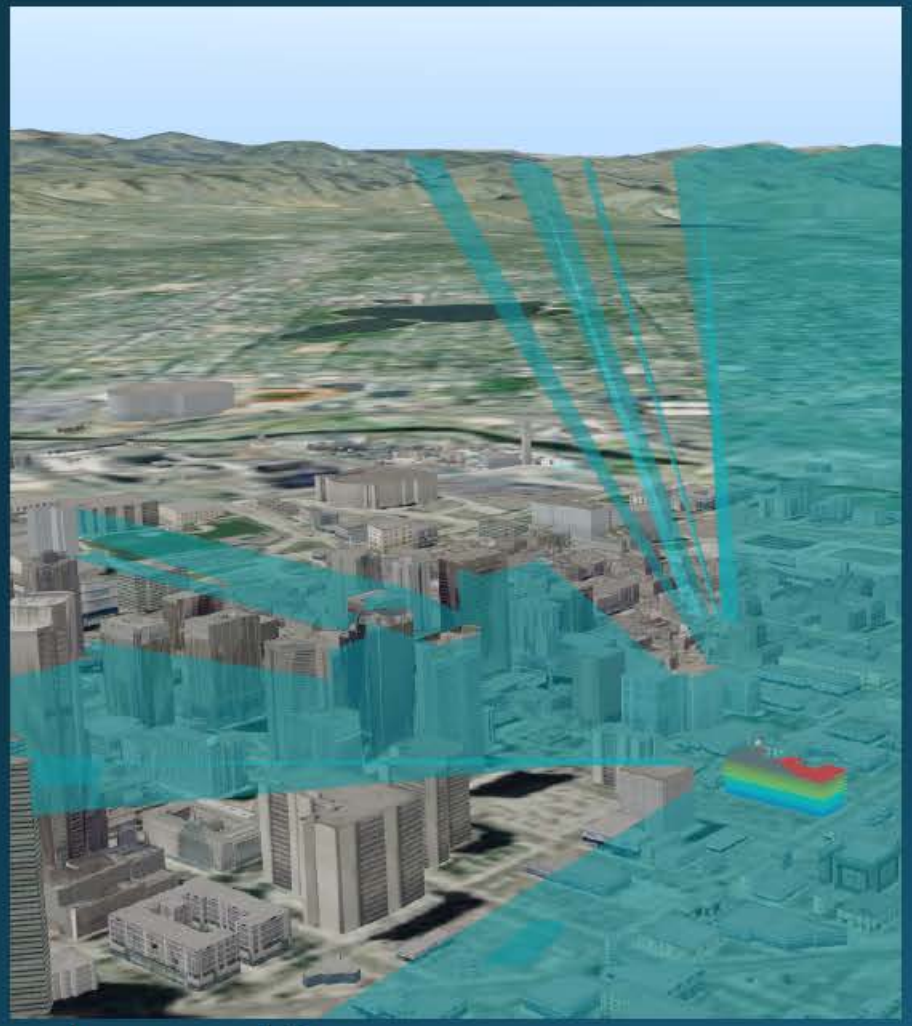
Calculating geometries and distributions of feature collections



Extent of bald eagle nests (Colorado Parks and Wildlife)

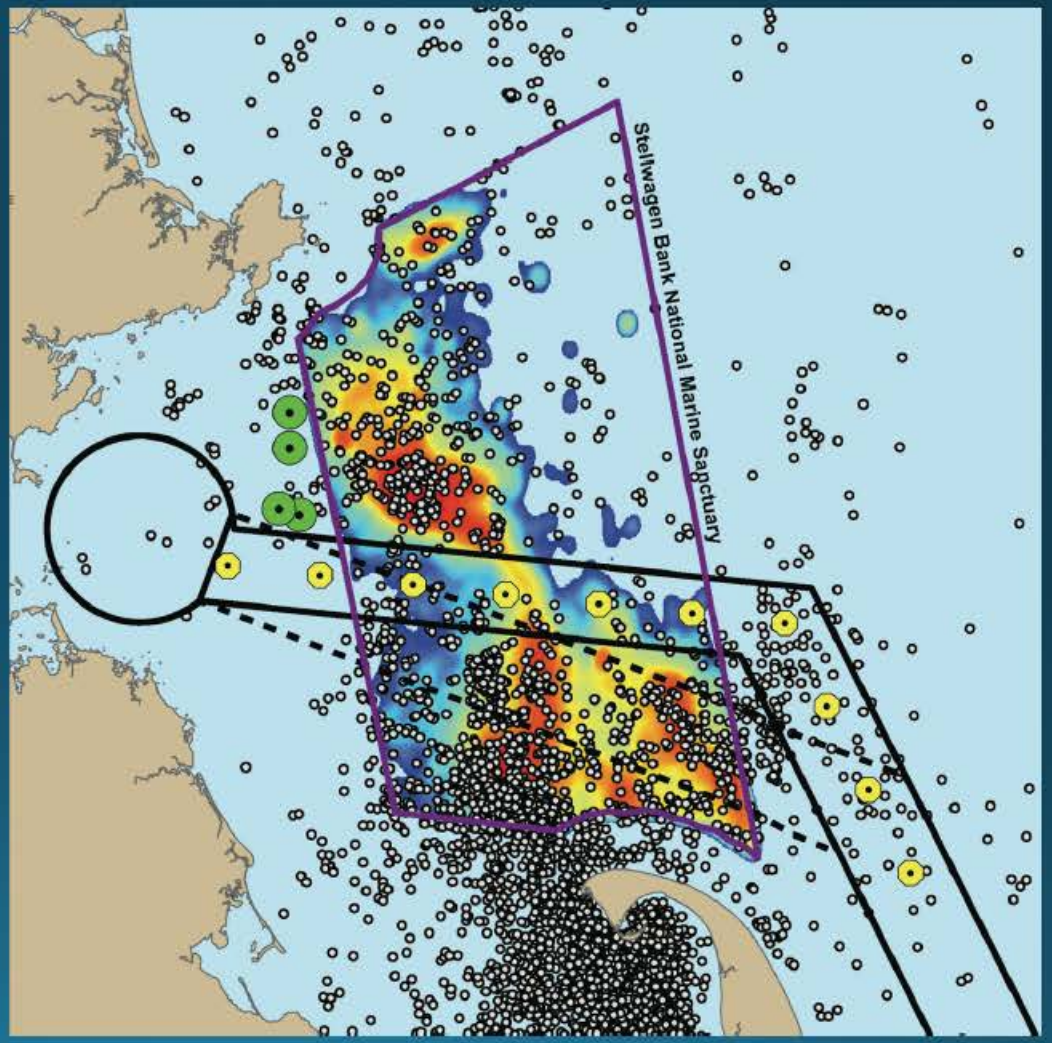
determining HOW PLACES ARE RELATED

- what is nearby or coincident
- summarizing what is within an area(s)
- what is closest
- what is visible from a given location(s)
- overlapping relationships in space and time



what is visible

overlapping relationships



finding the BEST LOCATION OR PATH

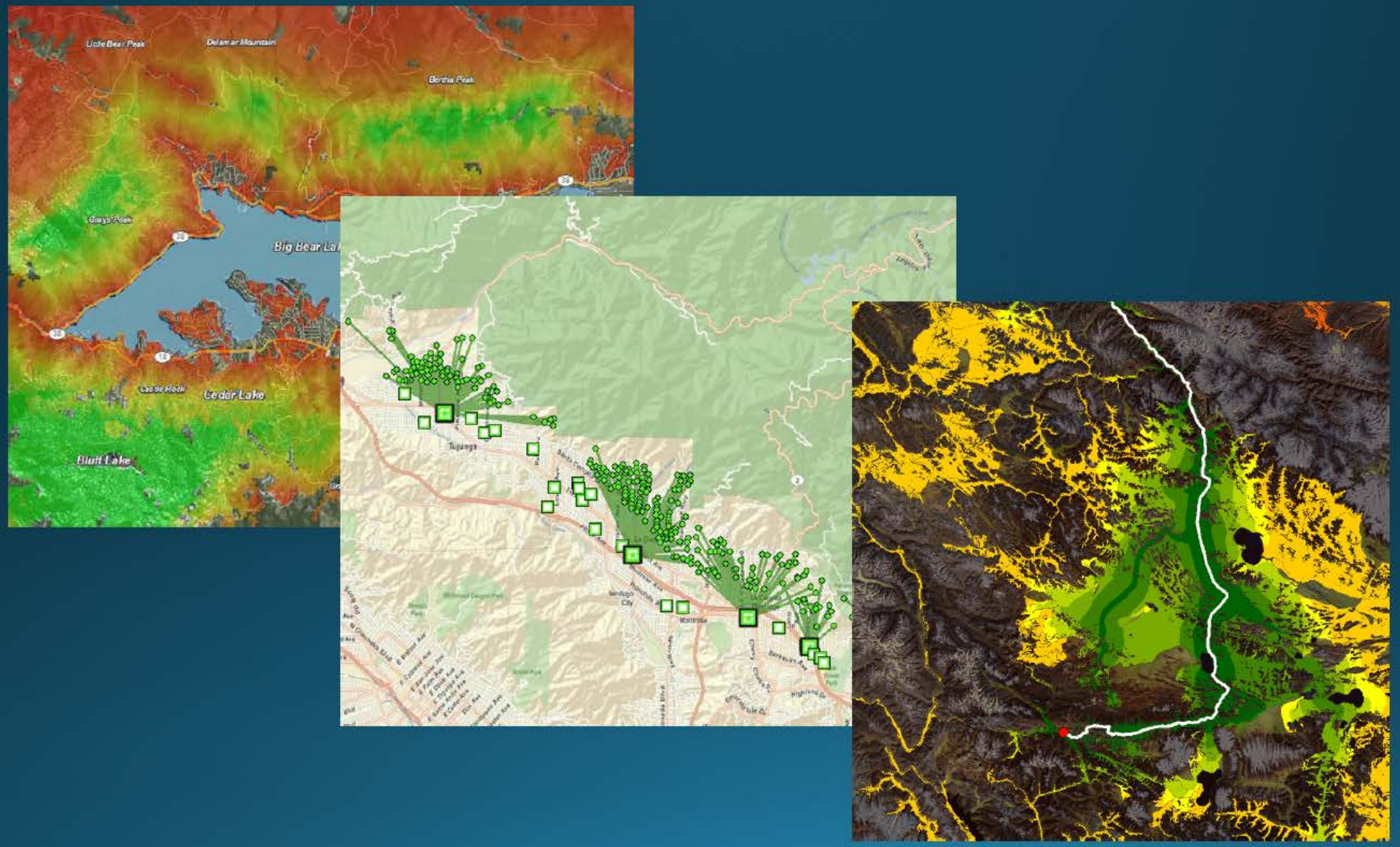
Finding the best locations that satisfy a set of criteria

Finding the best allocation of resources to geographic areas

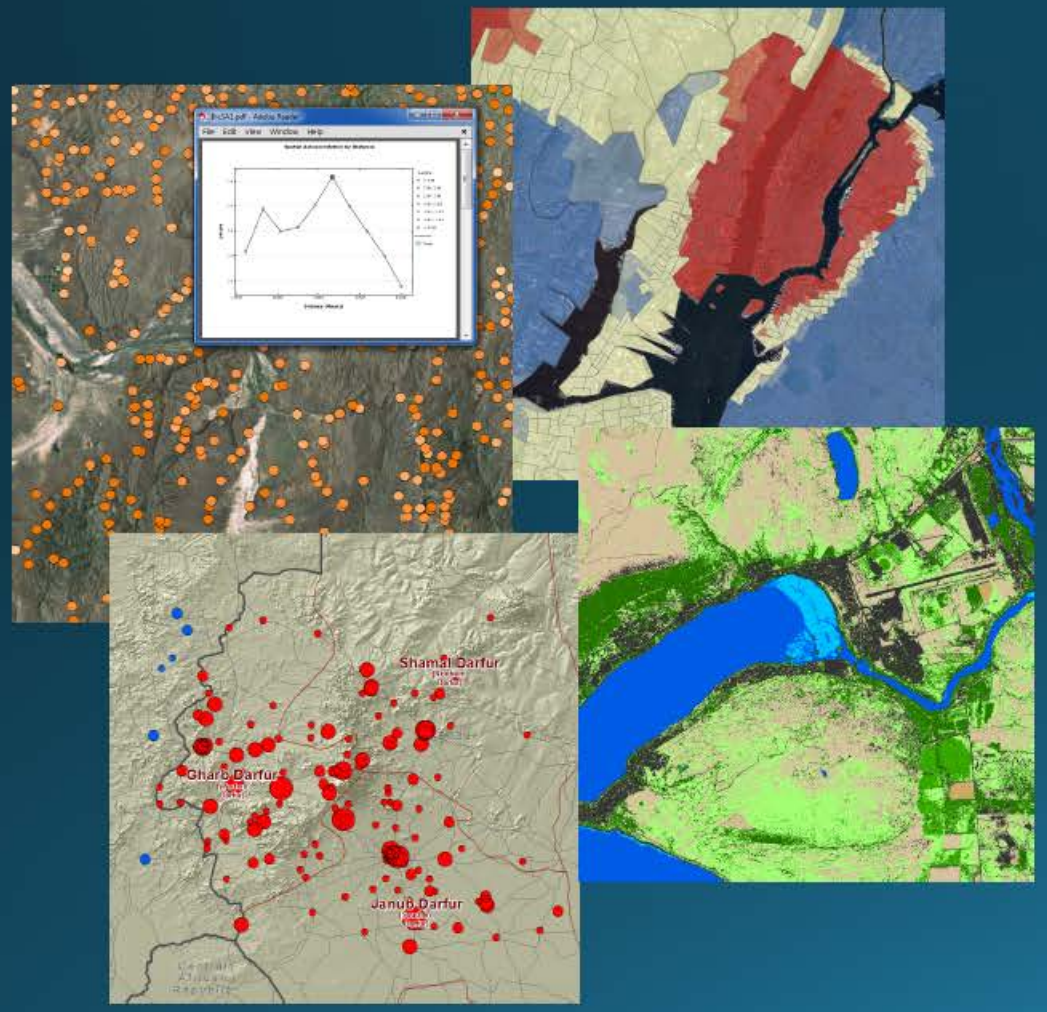
Finding the best route, path, or flow along a network

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

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


Little Bear Peak
Delamar Mountain
Bertha Peak
Grays Peak
Big Bear La
Cedar Lake
Bluff Lake
Tujunga

detecting and quantifying PATTERNS



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

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

Which features/pixels are similar, and how can they be grouped together?

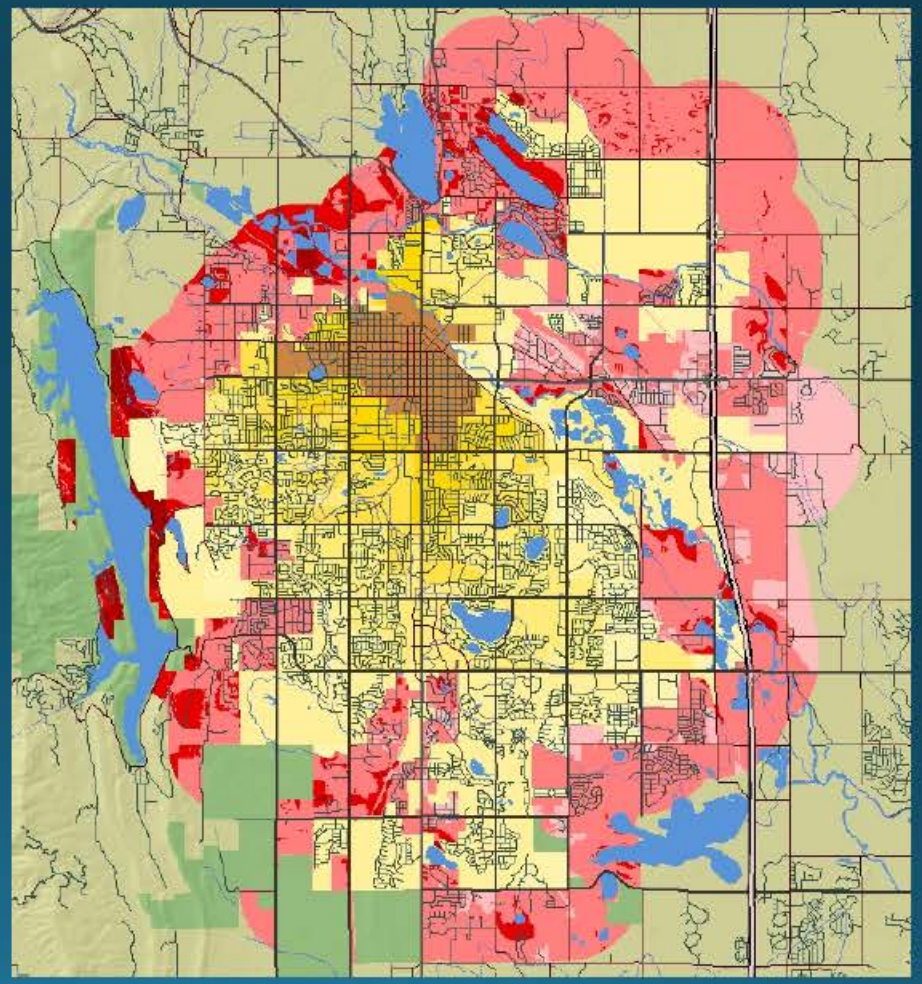
Are spatial patterns changing over time?

making PREDICTIONS

Predicting what-if

How will different urban development scenarios impact sprawl?
What if we create a new mixed-use town center?
What if we build a major sports complex?

Use modeling and prediction, applied repeatedly, to assess
different outcomes.

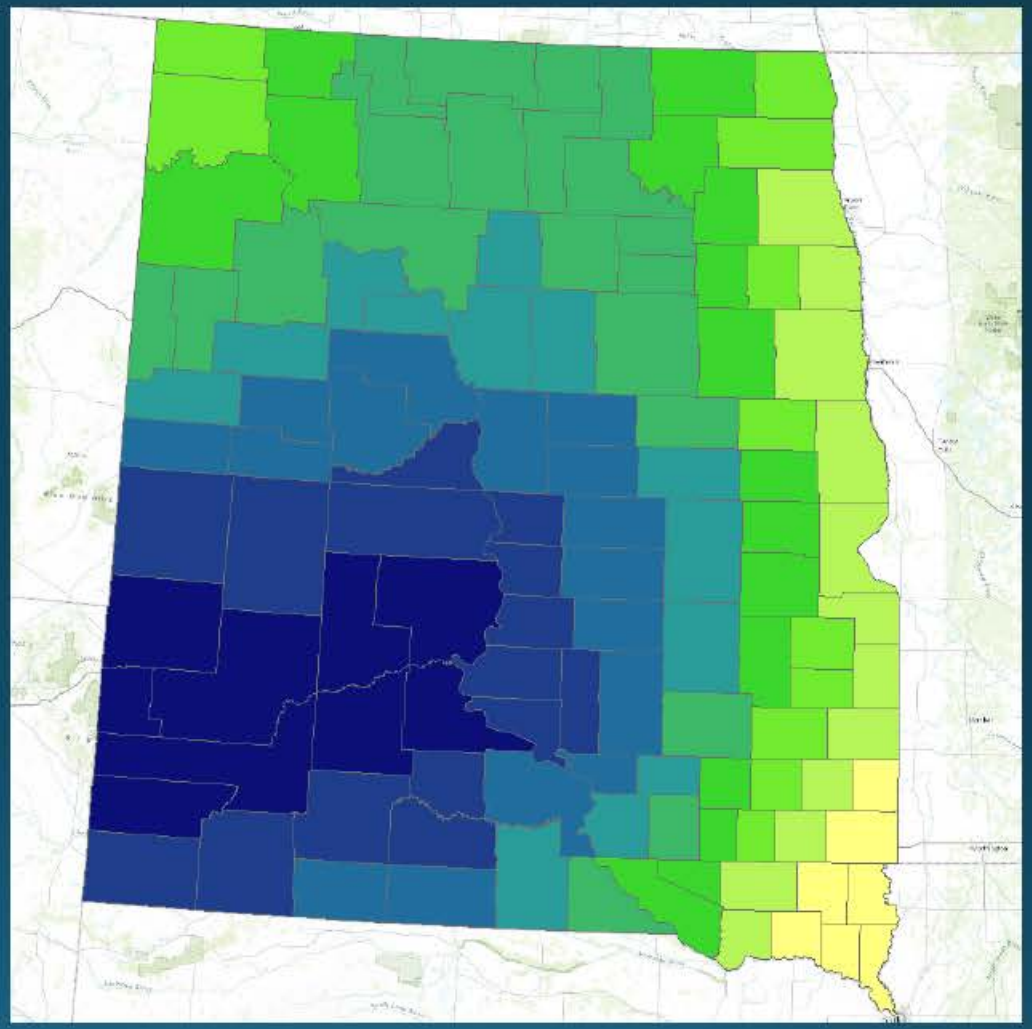


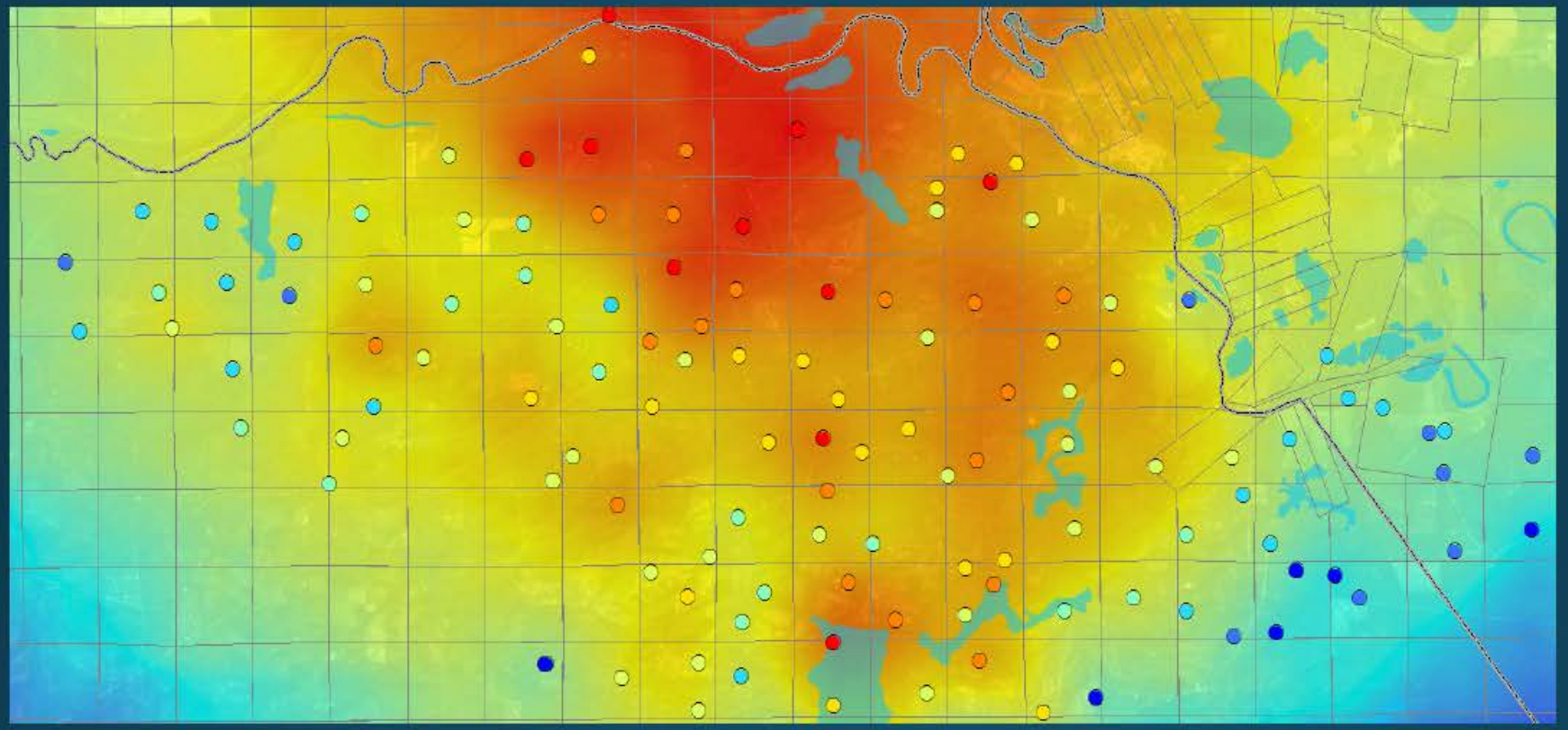
Given a success case, identifying, ranking, and predicting similar locations

Use a similarity search to look at multiple input variables of a success case and find other similar candidates where a successful outcome can be predicted.

Finding the factors that explain observed spatial patterns and making predictions

Use linear, geographically weighted, and exploratory regression approaches to identify relevant factors and make predictions

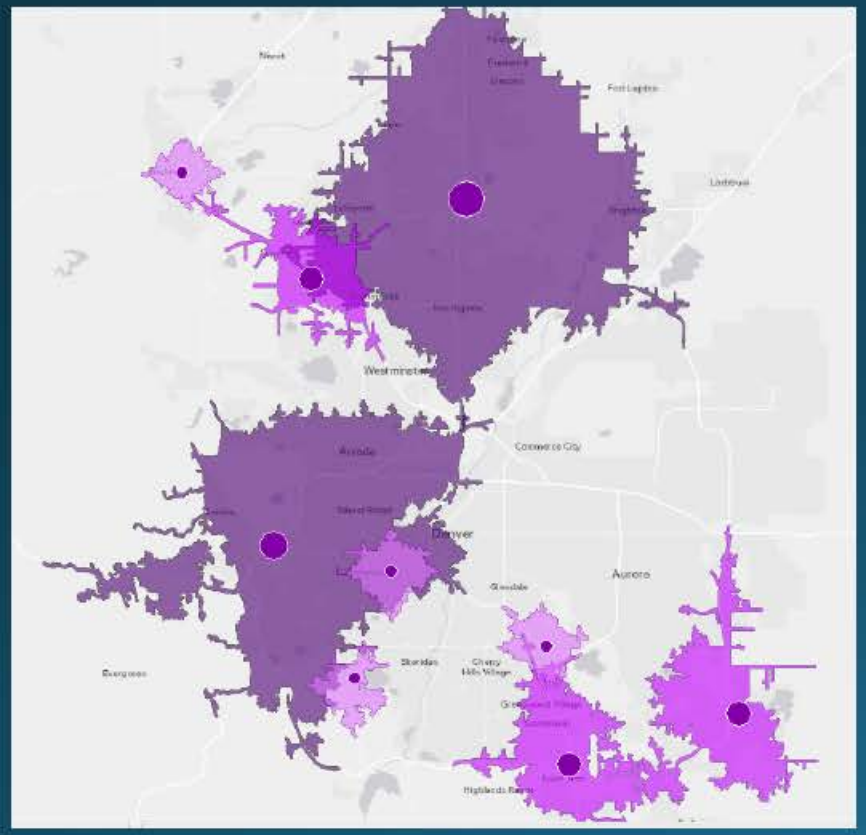




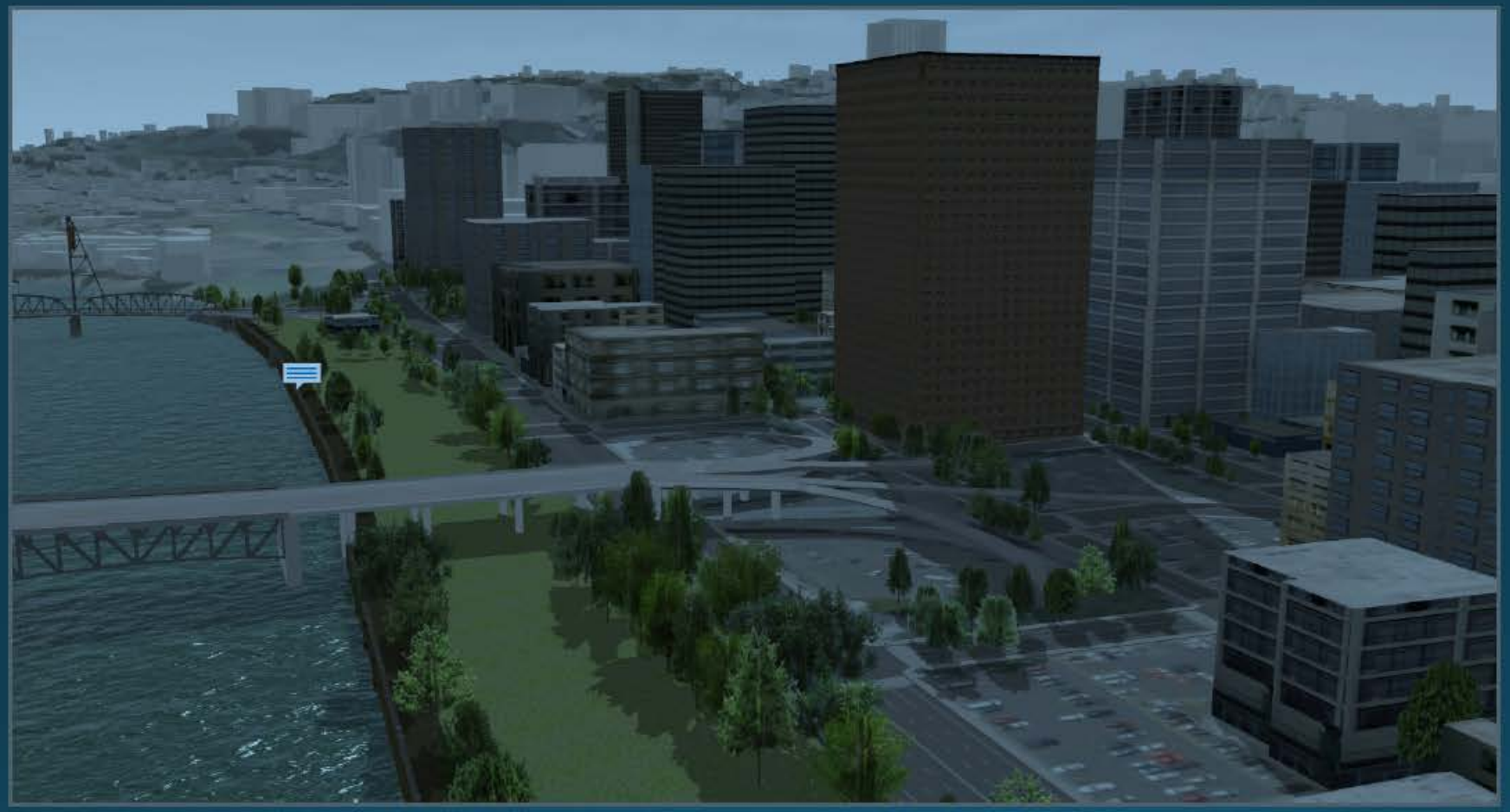
Interpolating a continuous surface and trends from discrete sample observations

Use kriging, spline, and inverse distance weighted methods to predict data values across a continuous surface from discrete sample points.

predicting how and where objects spatially interact (attraction and decay)



Use spatial interaction (gravity models), travel distances, and characteristics about the supply location to predict demand as well as cannibalization of other resources.

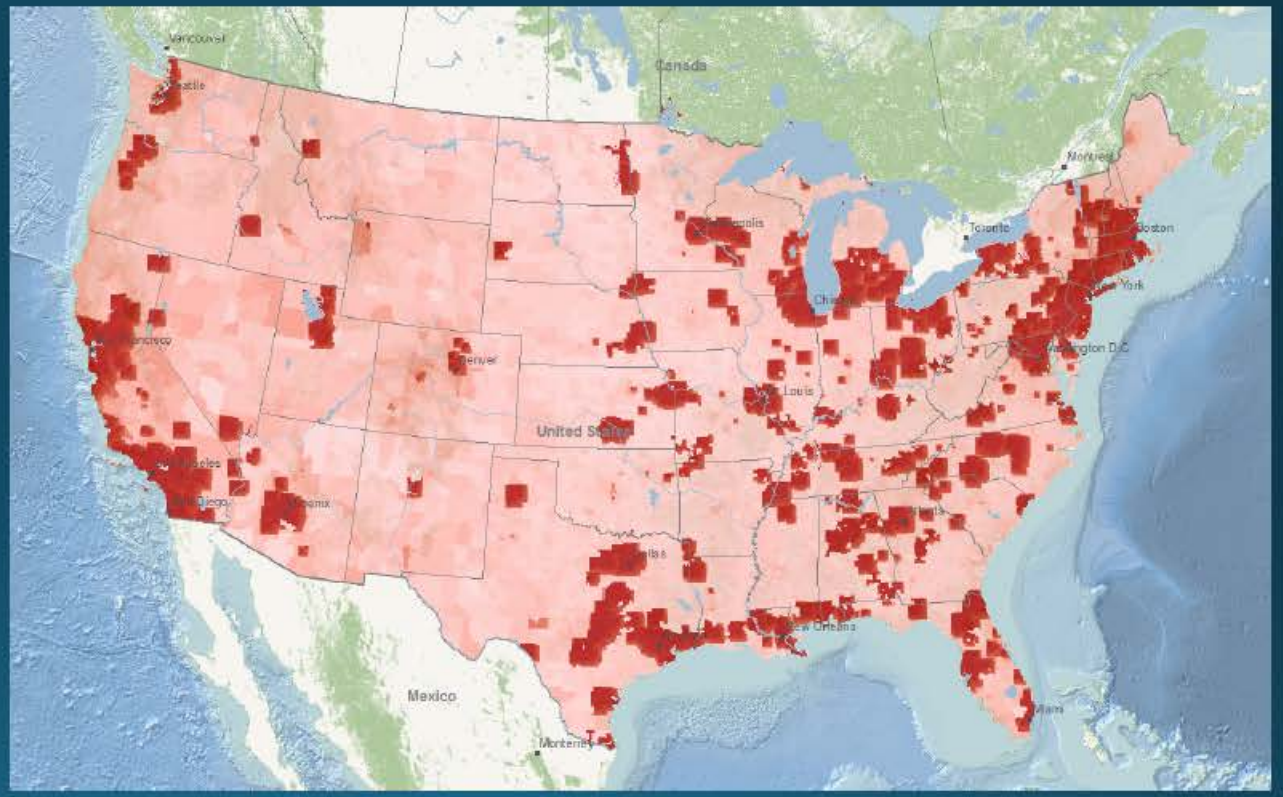


Predicting how and where objects affect wave propagation

Combine tools such as line of sight and shadow analysis with more complex modeling and simulation techniques to predict wave propagation.

predicting where phenomena will move, flow, or spread

Use dispersion modeling, flow direction, and cost surfaces to predict how phenomena change size, shape, and location.



process

- Ask questions
- Explore the data
- Analyze and model
- Interpret the results
- Repeat as necessary
- Present the results
- Make a decision

7 Steps for Spatial Analysis

1. Ask questions
2. Explore the data
3. Analyze and model
4. Interpret the results
5. Repeat as necessary
6. Present the results
7. Make a decision

craft your QUESTIONS

Formulate spatial questions and hypotheses
Tie them to the forms of spatial analysis.

How to travel from A to B?

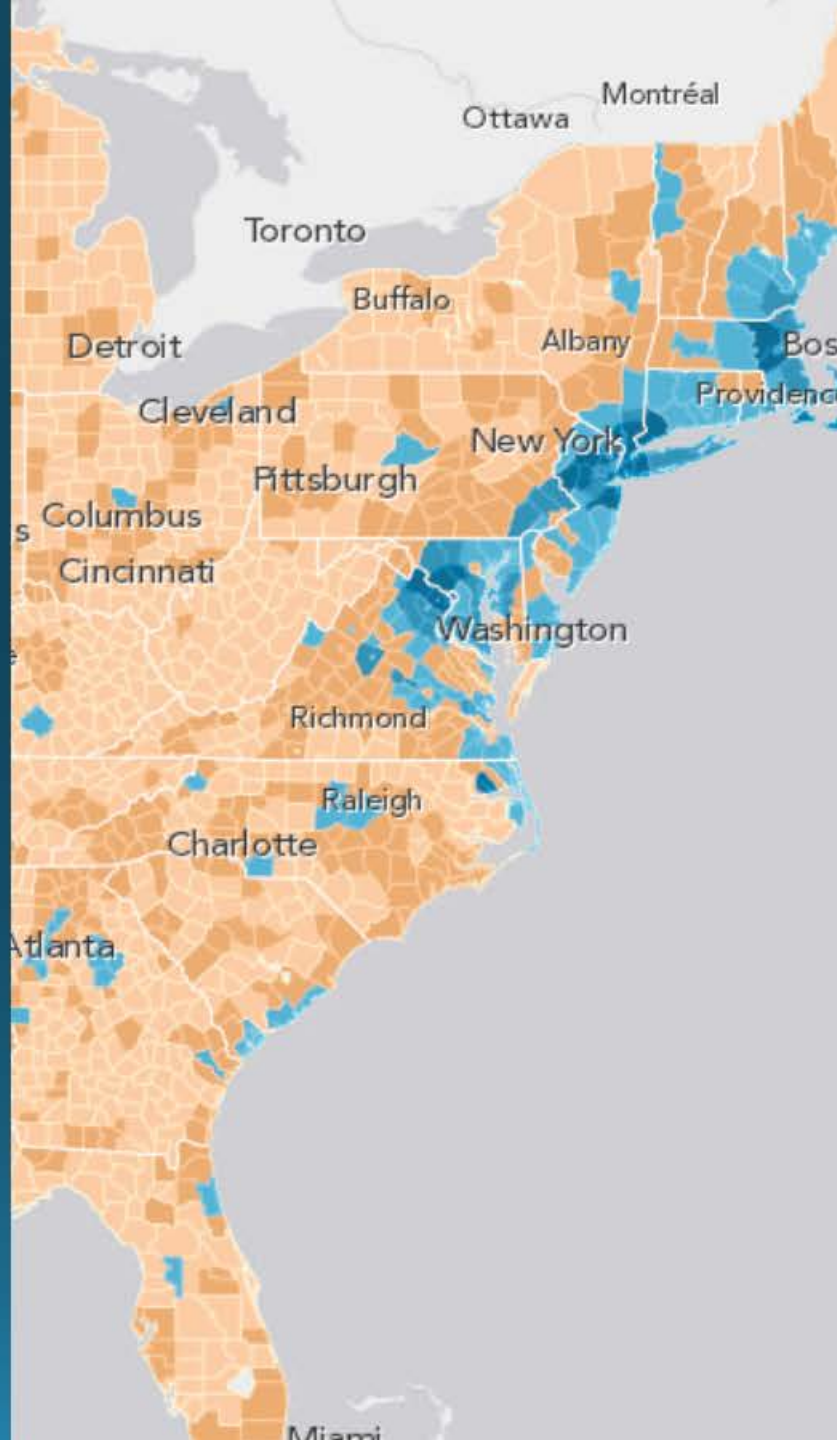
EXPLORE your data

Examine the data quality, completeness, and measurement limitations (scale and resolution) to determine the level of analysis and interpretation that can be supported.

Services

Imagery

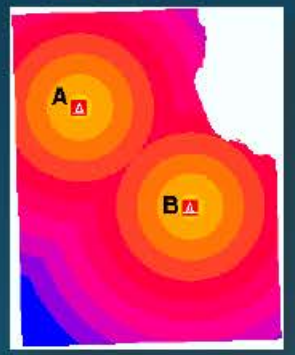
Maps



ANALYZE and model

Break the problem down into solvable components that can be modeled. Quantify and evaluate the spatial questions.

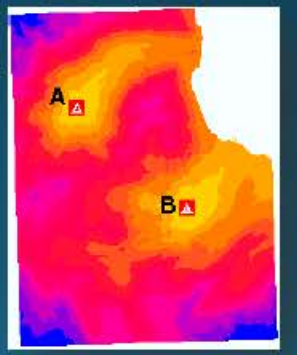
Straight Line Distance



Direction

Allocation

Cost Weighted Distance

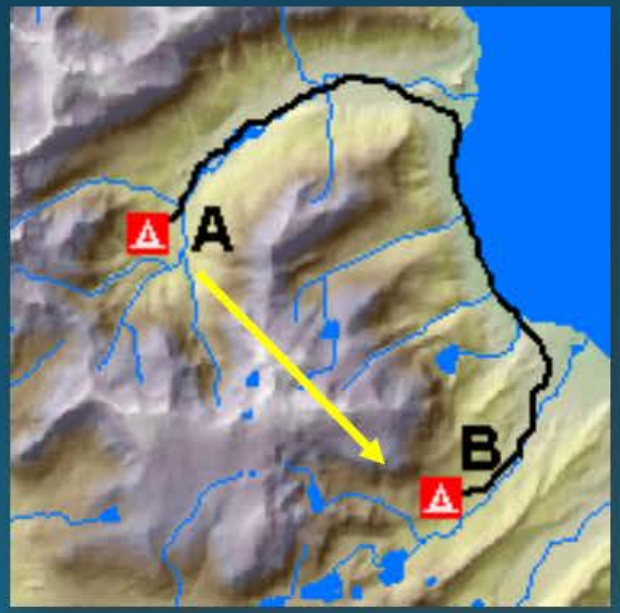


INTERPRET your results

Evaluate and analyze the results in the context of the question posed, data limitations, accuracy, and other implications.

Shortest Path

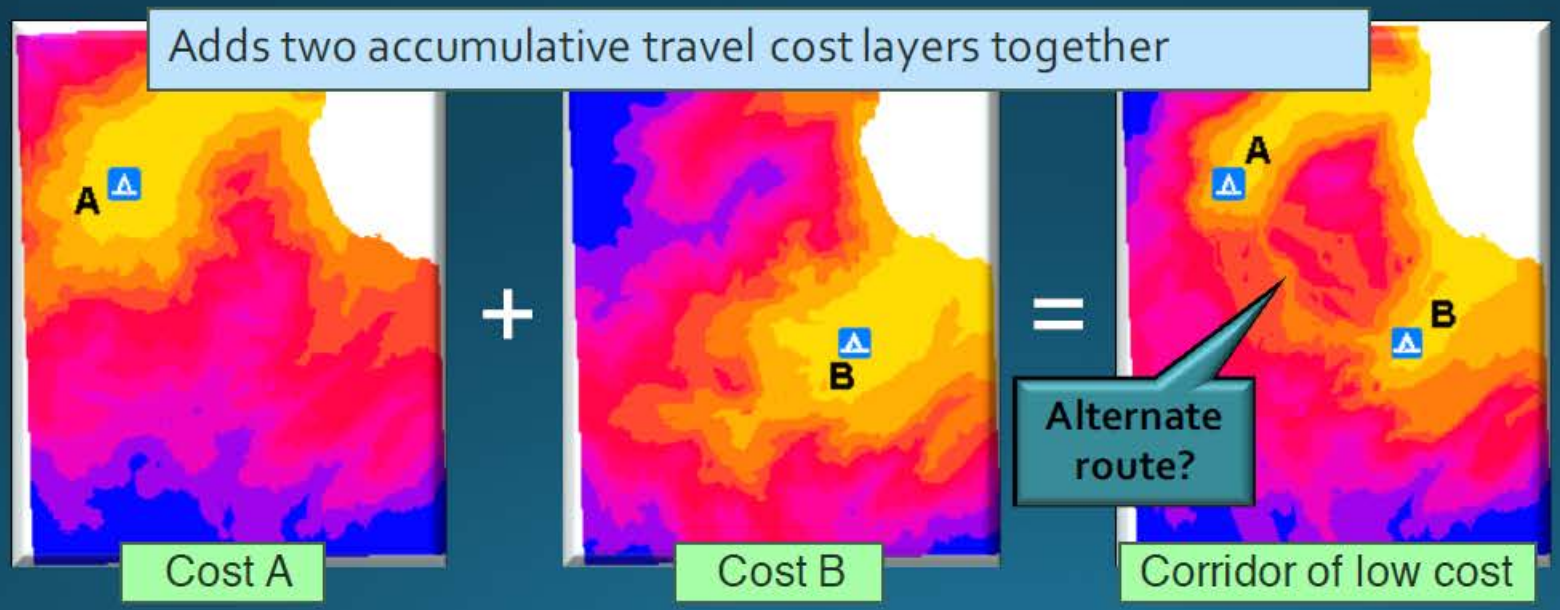
Ten Hours



Five Hours

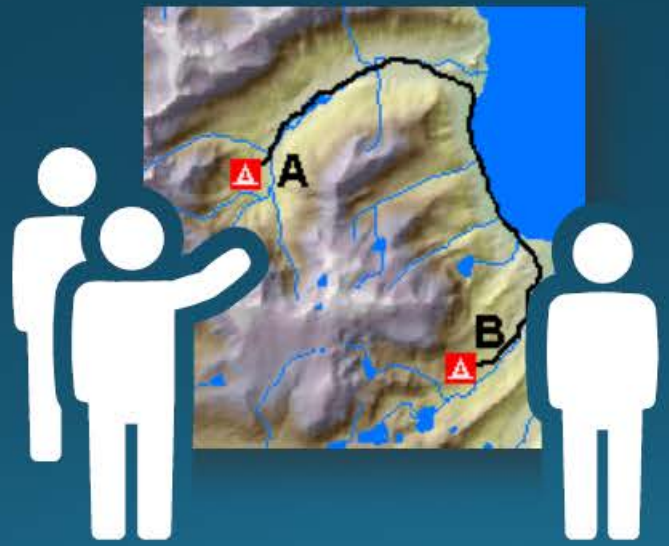
REPEAT as necessary

Spatial analysis is a continuous and iterative process that often leads to further questions and refinements.



PRESENT the results

The best information and analysis becomes increasingly valuable when it can be effectively presented and shared with a larger audience.



make a DECISION

Spatial analysis and GIS are used to support the decision-making process. A successful spatial analysis process often leads to the understanding necessary to drive decisions and action.

map

concept

ArcGIS spatial analysis

Geoprocessing

Spatial Analyst

categories

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process

1. Ask questions
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six categories of spatial analysis

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7 steps for spatial analysis

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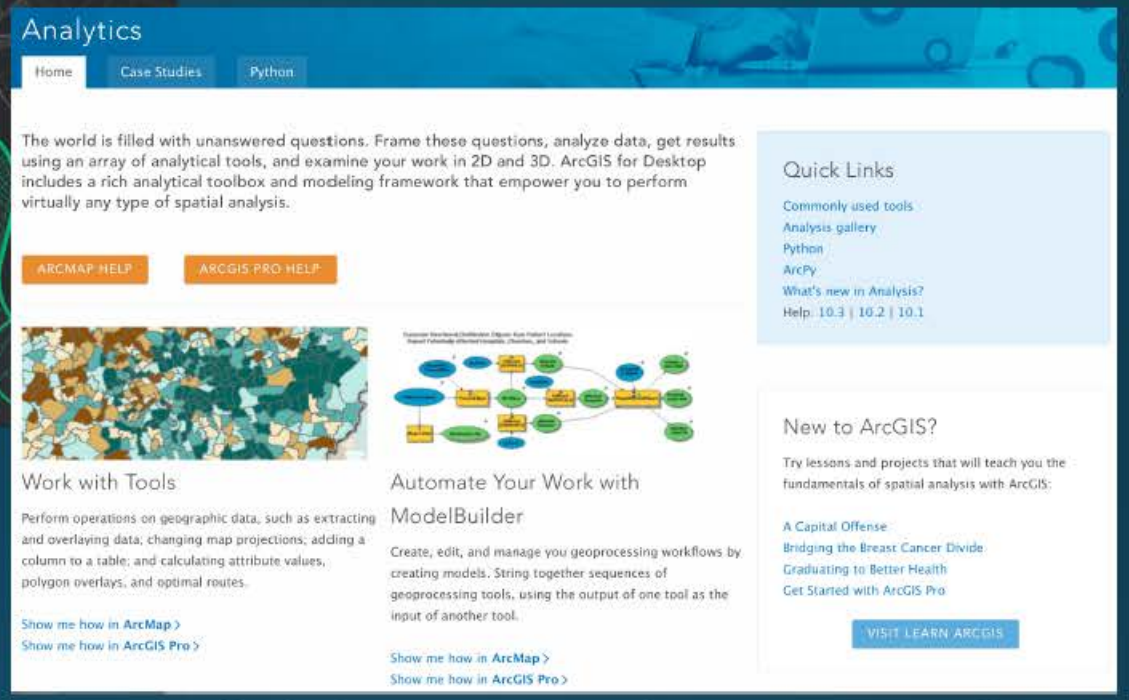

There are many resources available; providing templates, tutorial and documentation

http://www.arcgis.com/features/features-spatial-analysis.html

https://desktop.arcgis.com/en/analytics/

http://pro.arcgis.com/en/analysis/

http://learn.arcgis.com/en/arcgis-book/chapter5/

http://shar.es/1XSAyM