

SUNOIKISIS DC

DIGITAL APPROACHES TO CULTURAL HERITAGE

# SESSION 8: GEOGRAPHIC INFORMATION SYSTEMS

REBECCA SEIFRIED, UNIVERSITY OF MASSACHUSETTS AMHERST

SARAH C. MURRAY, UNIVERSITY OF TORONTO

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# SESSION 8: GEOGRAPHIC INFORMATION SYSTEMS

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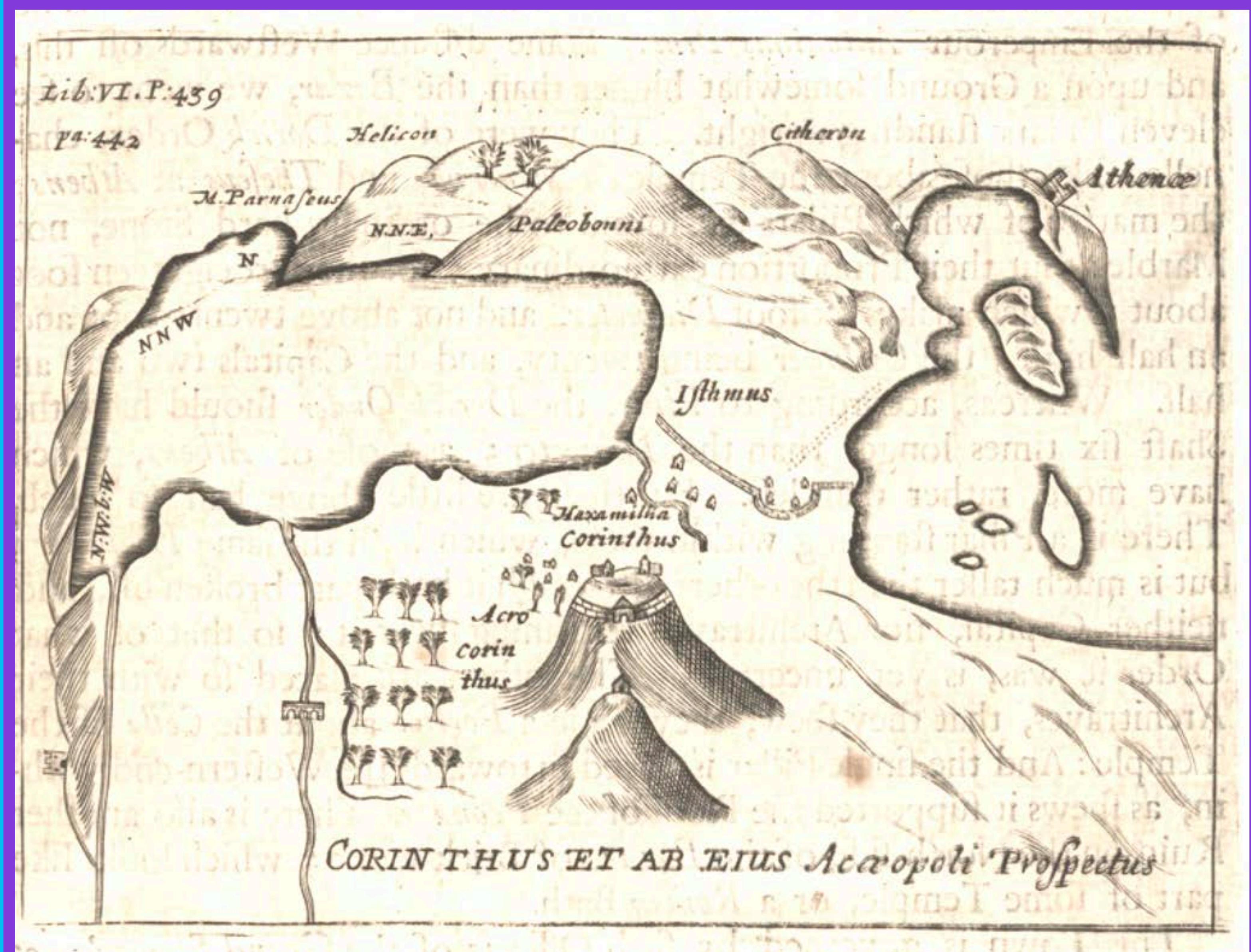
## WHAT WE WILL COVER:

1. Basic concepts of GIS
2. Demo: How to use QGIS to visualize geospatial data
3. Case Study: Visualizing spatial information in archaeological survey projects
4. Success stories (and pitfalls) of using GIS in Cultural Heritage applications

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

# BASICS OF GIS





# MAKING MAPS

- Some basic concepts  
(What you need to know before getting started with GIS)
- Contexts in which a proper GIS (not just looking at/using pre-generated maps, online or offline) might come in handy

# **BASIC CONCEPTS**

**GIS = Geographic Information Systems**

**A database, but organized**

**geographically (in space)**

**Used to: store, manage, analyze, and**

**display geospatial data**

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**MAPS: 3-DIMENSIONAL  
OBJECTS**



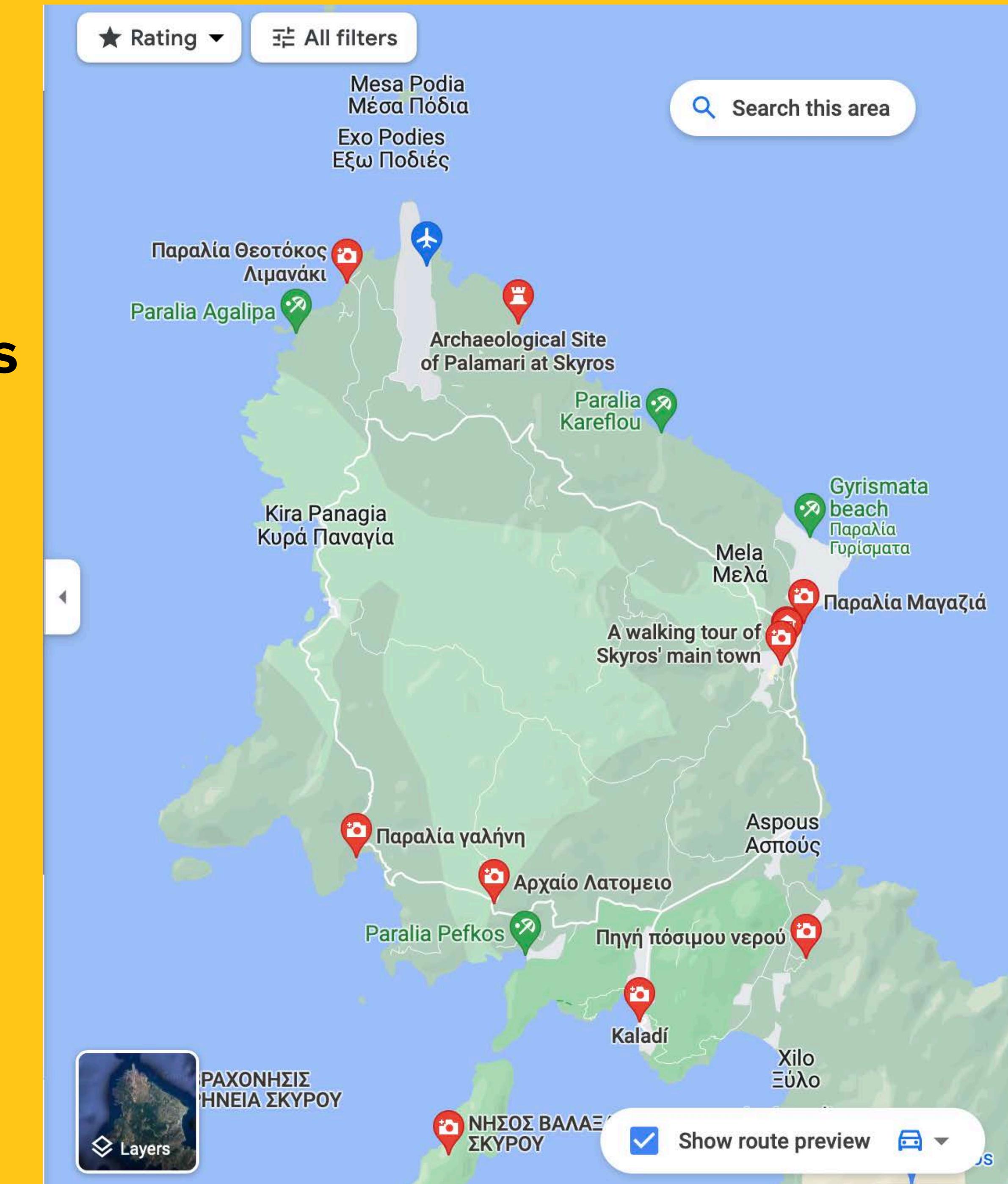
# BASIC CONCEPTS

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**MAPS: ON-LINE**

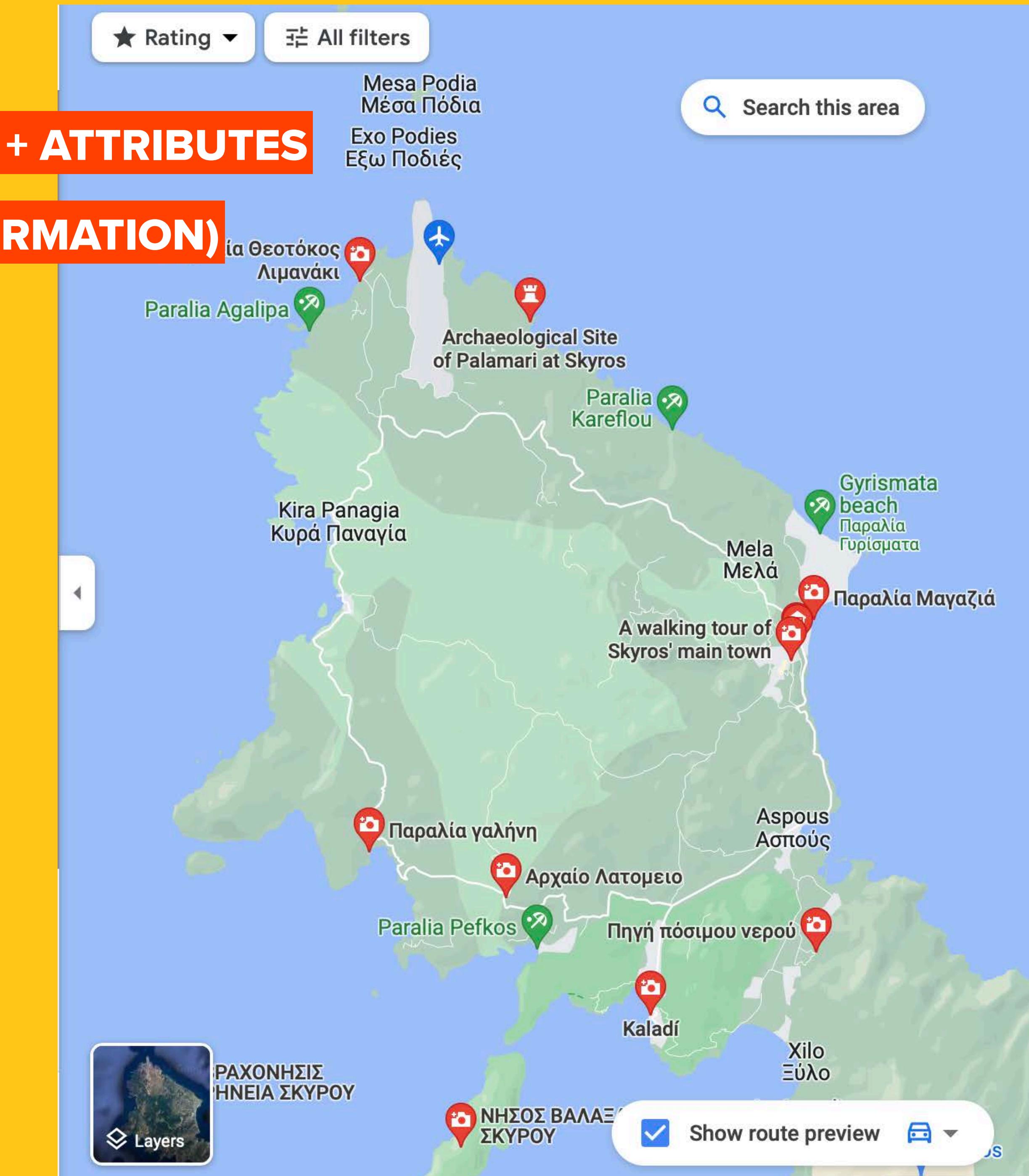




# SPATIAL DATA + ATTRIBUTES



## (OTHER INFORMATION)

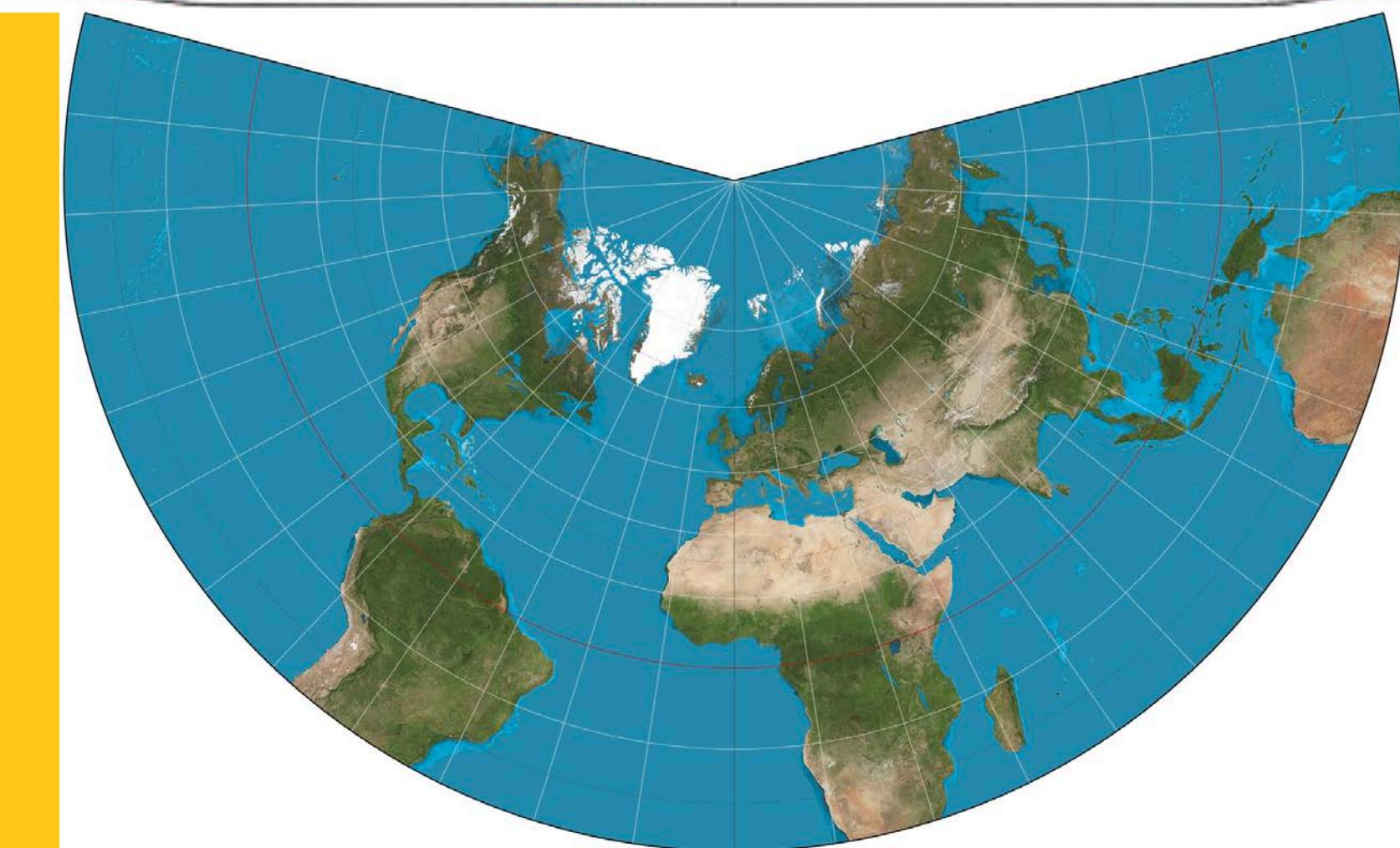
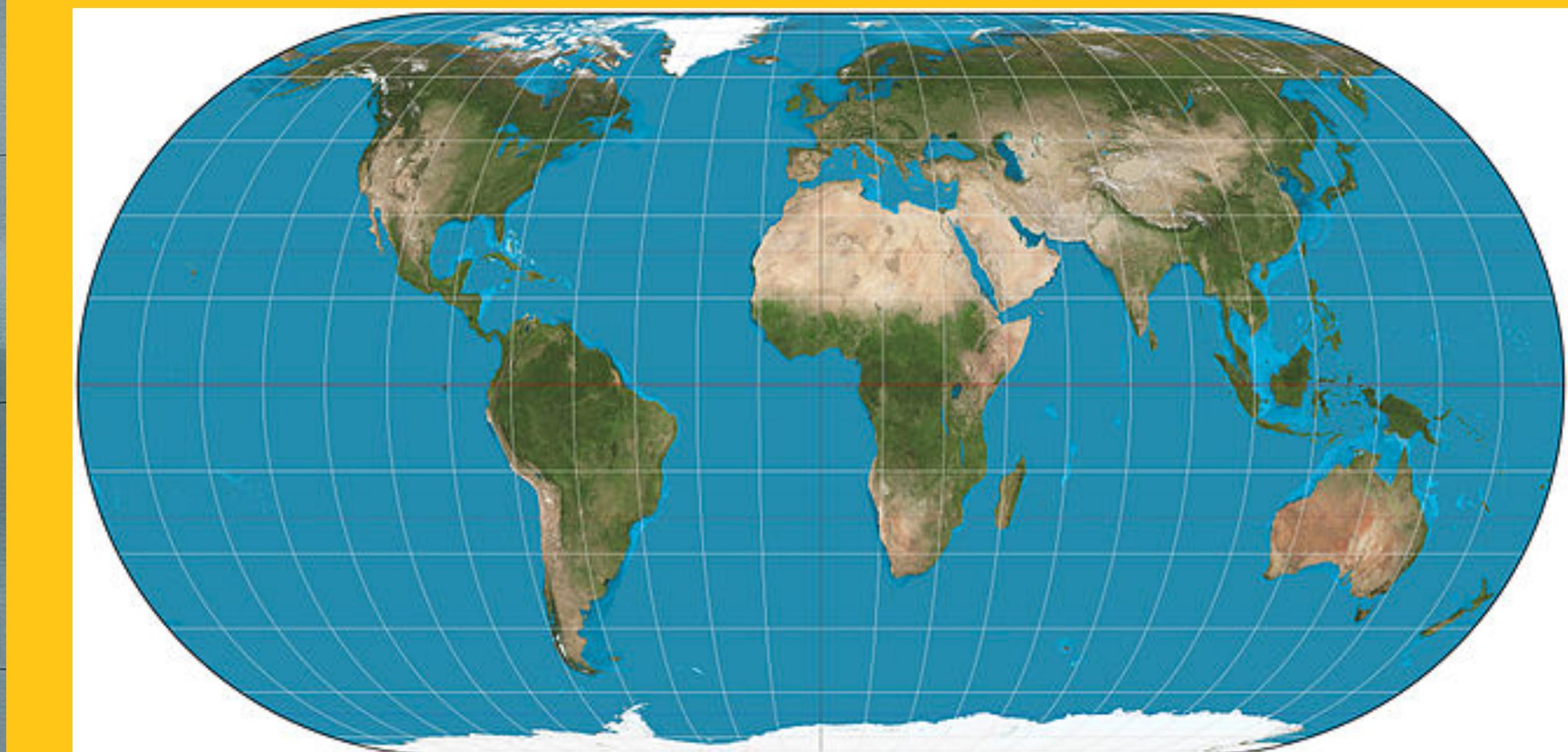


# COORDINATE SYSTEMS



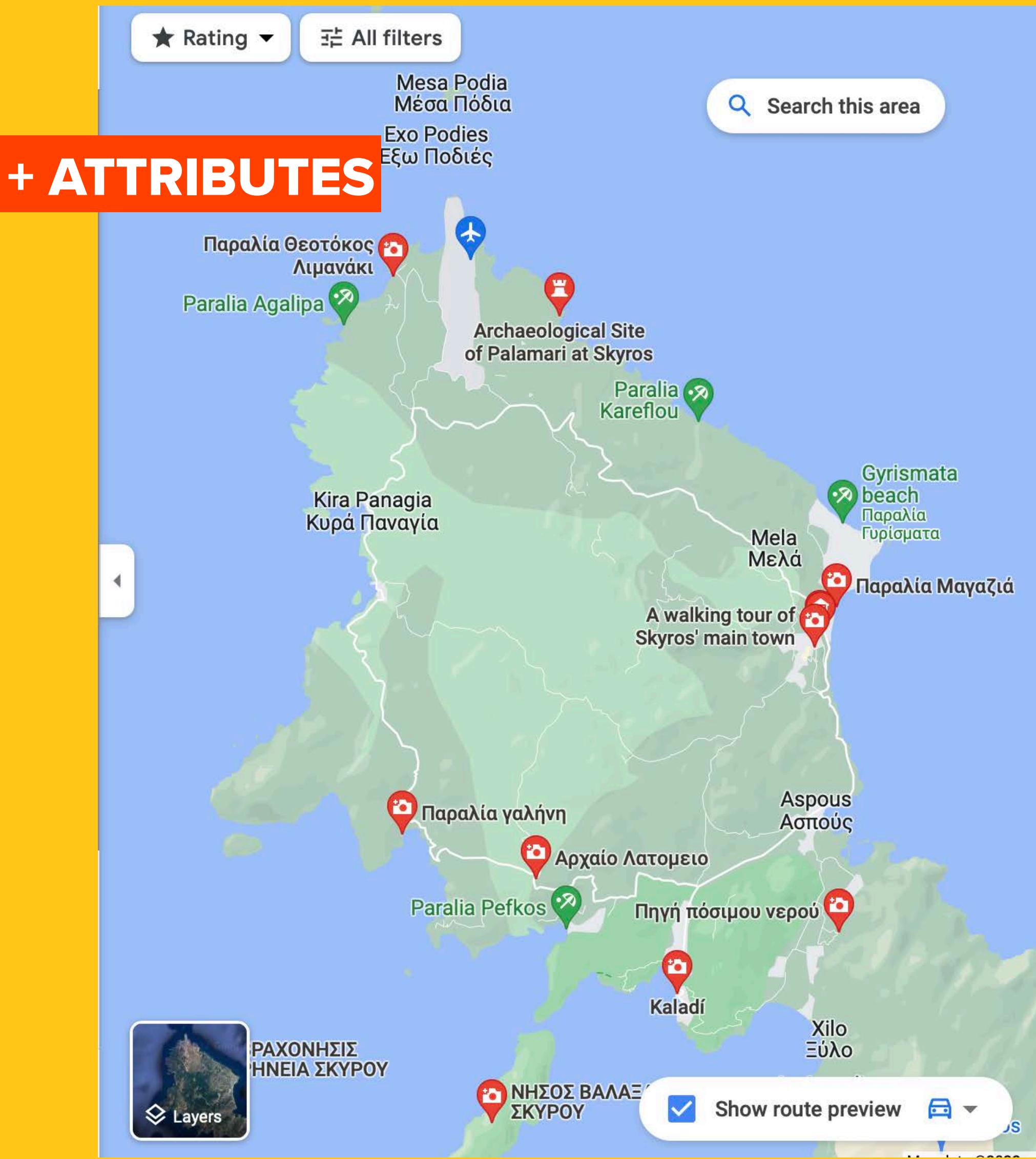
SPATIAL DATA + ATTRIBUTES

PROJECTED  
GEOGRAPHIC





## SPATIAL DATA + ATTRIBUTES

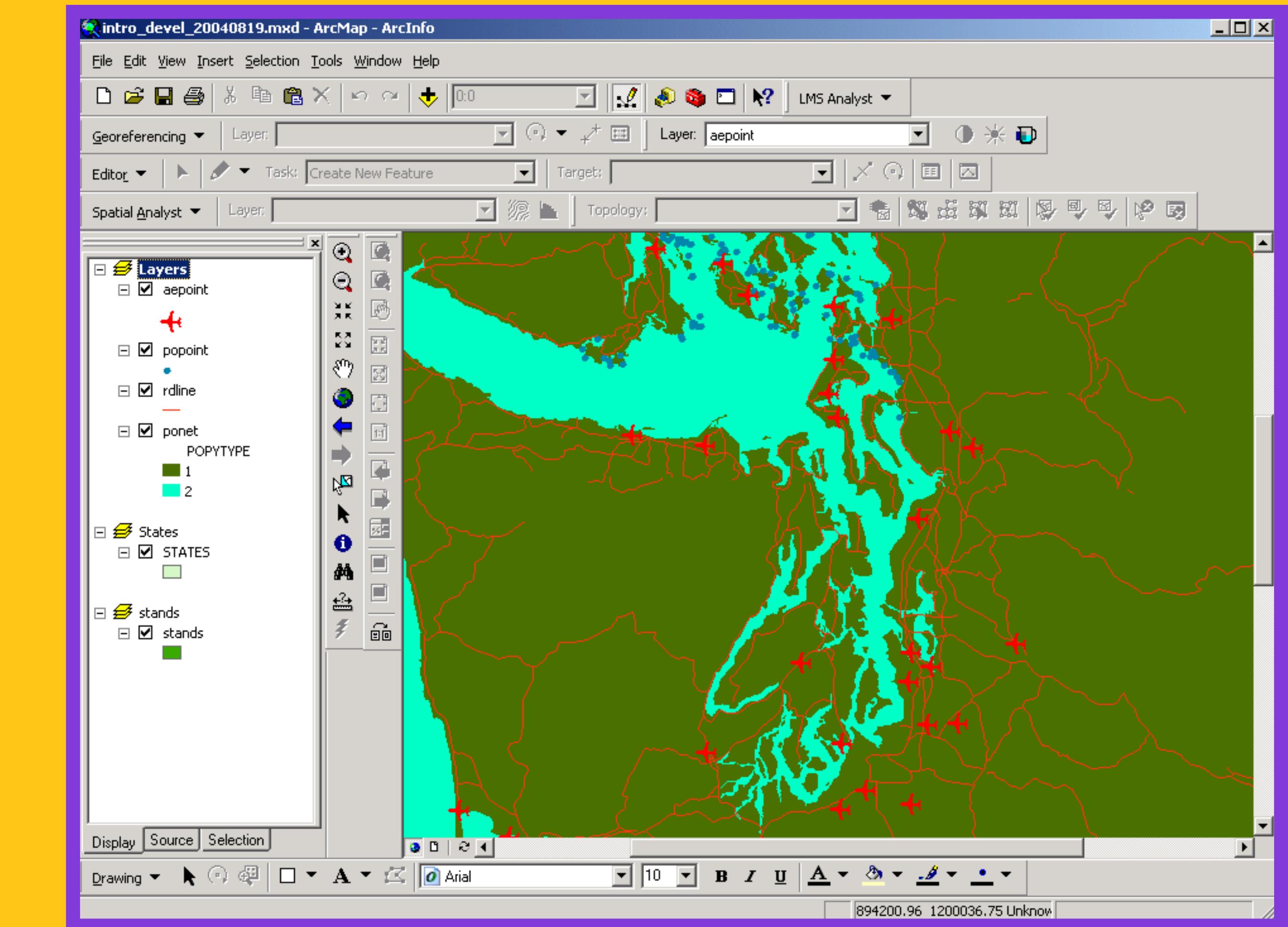


**THE GOOD OLD MAP:** used to store & display  
Geospatial data; not so interactive or analytical....

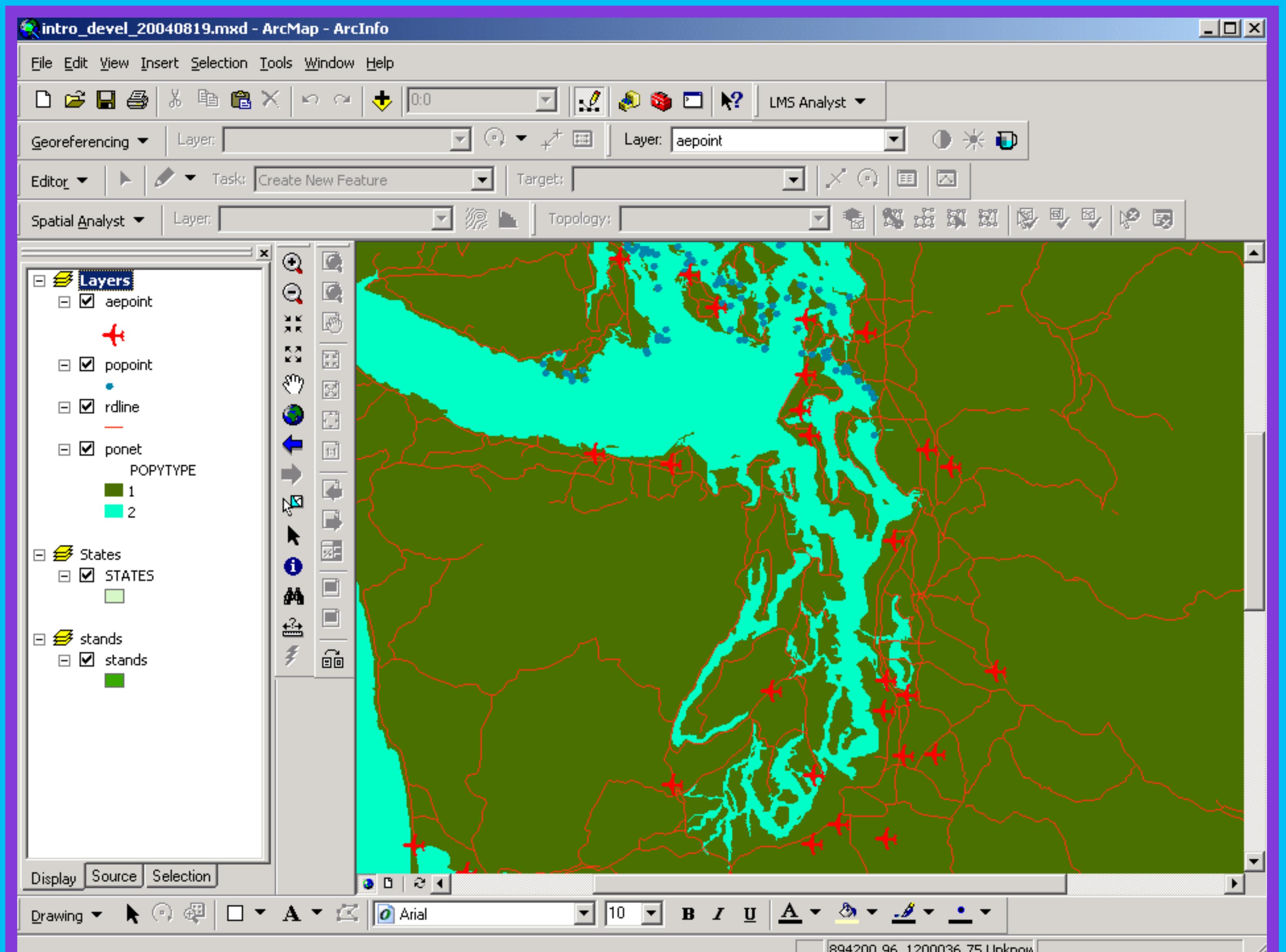
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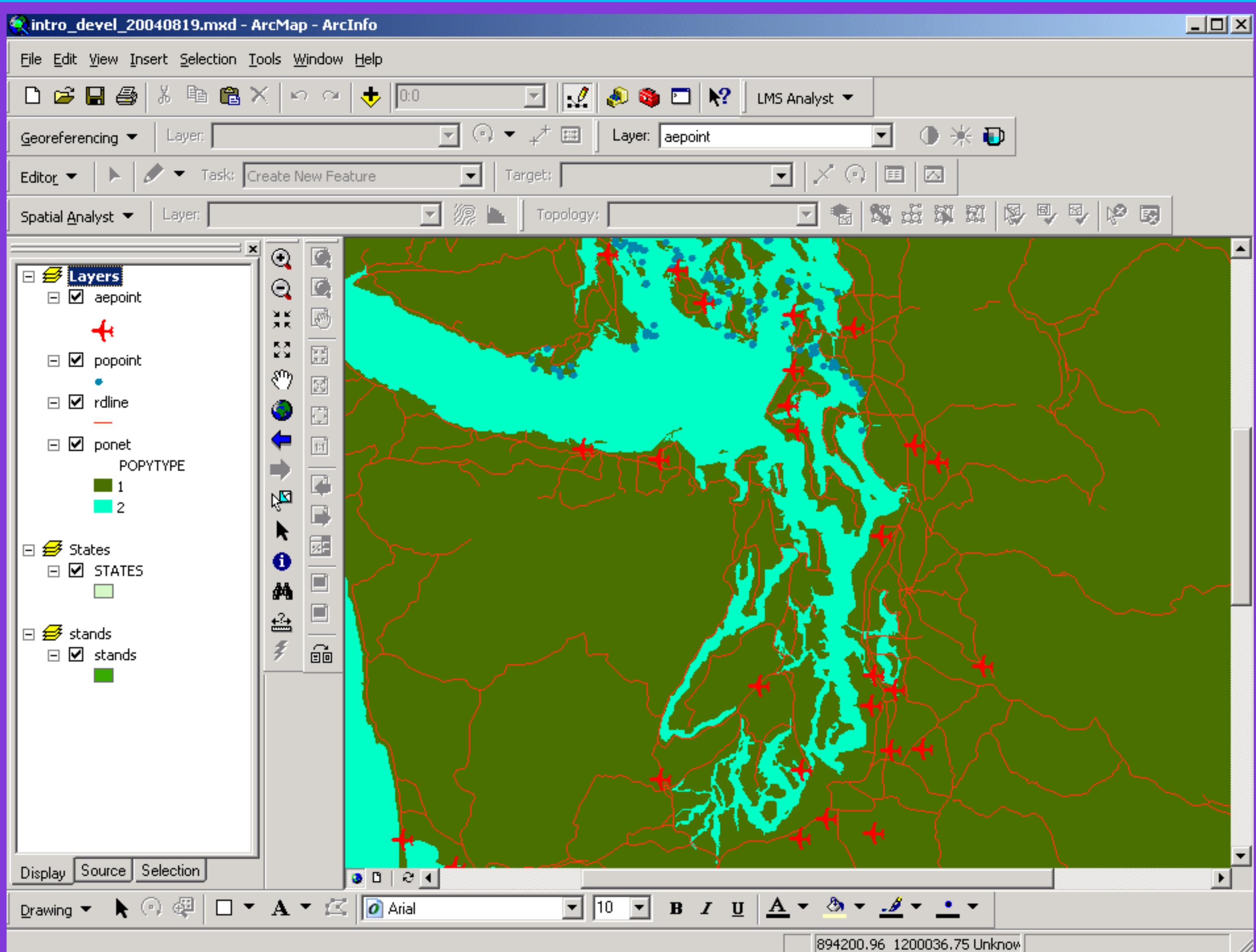
# MAKING MAPS

## GIS APPLICATIONS

- allow you to generate and manipulate maps & data

- Big One = ESRI ArcGIS

- Popular free option: QGIS



# GIS APPLICATIONS

## --key concepts

# MAKING MAPS

# MATH EQUATION

GIS APPLICATIONS

--key concepts

# VECTOR DATA

# GRID OF VALUES

# RASTER DATA

# MAKING MAPS

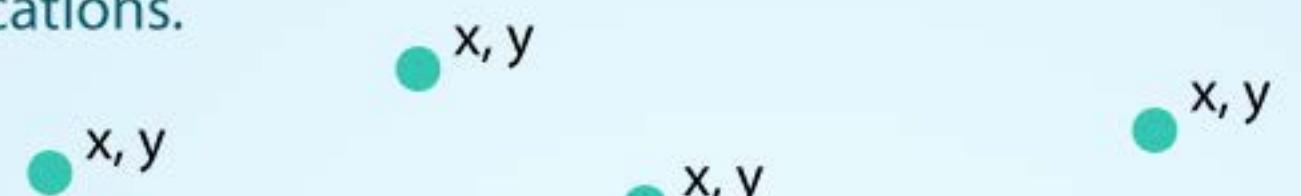
# GIS APPLICATIONS

--key concepts

## VECTOR DATA

**POINTS:** Individual **x, y** locations.

ex: Center point of plot locations, tower locations, sampling locations.



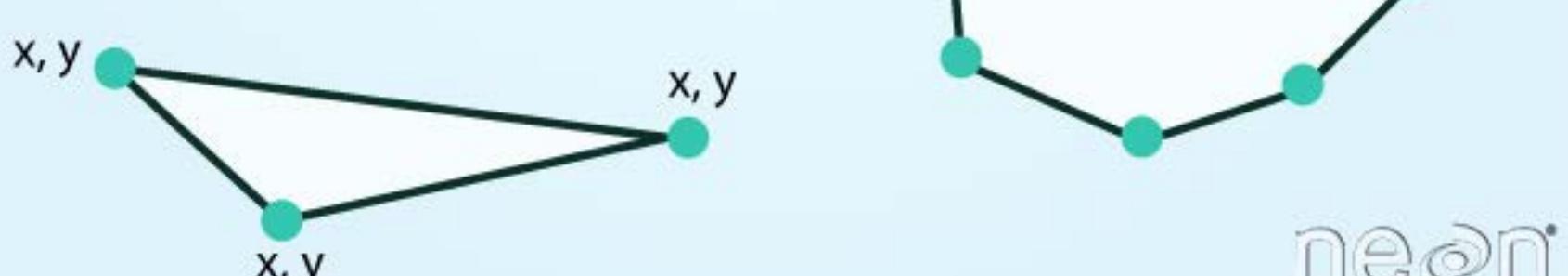
**LINES:** Composed of many (at least 2) vertices, or points, that are connected.

ex: Roads and streams.

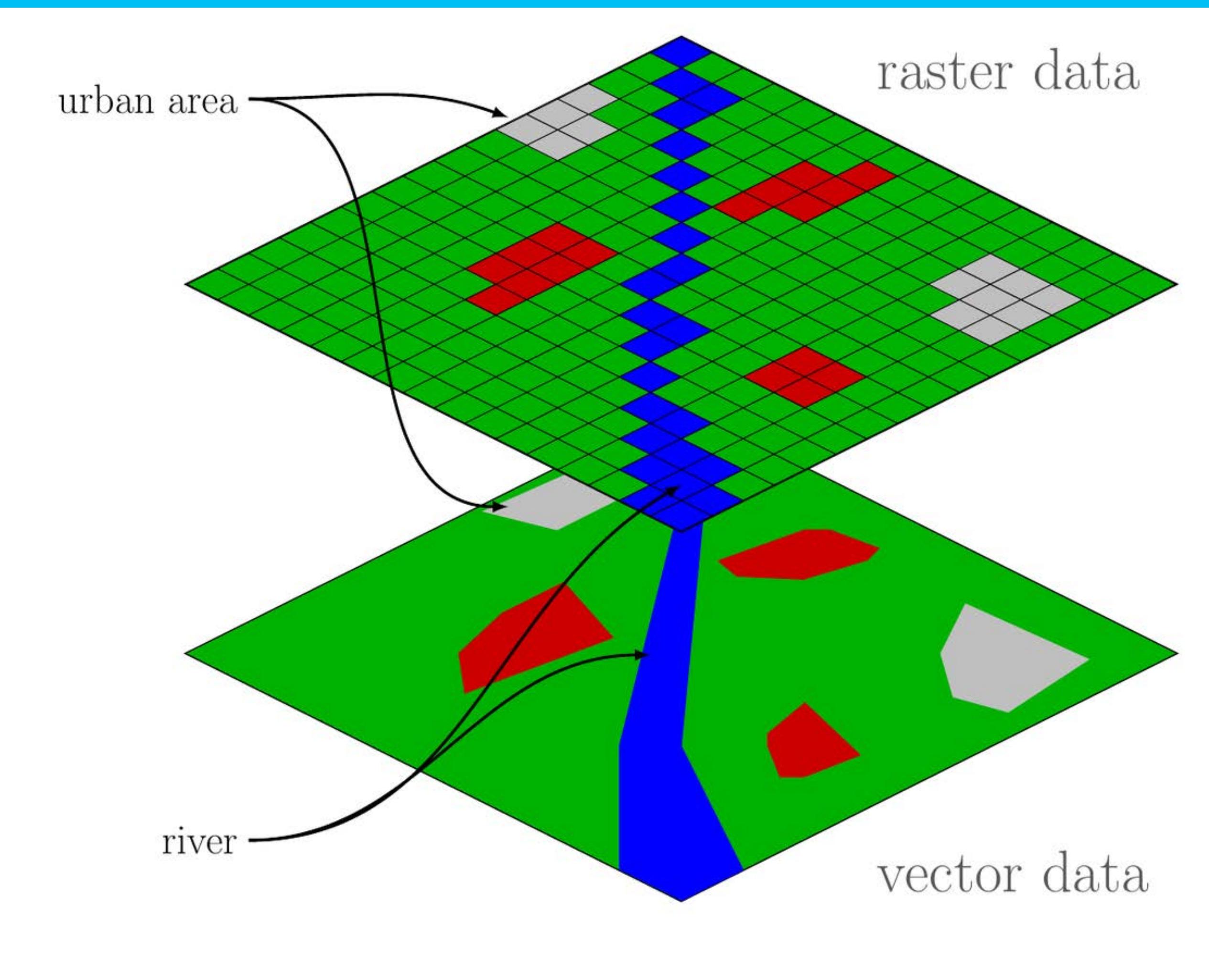


**POLYGONS:** 3 or more vertices that are connected and **closed**.

ex: Building boundaries and lakes.



# MAKING MAPS



## GIS APPLICATIONS

--key concepts

### RASTER DATA



# MAKING MAPS

10

# GIS APPLICATIONS

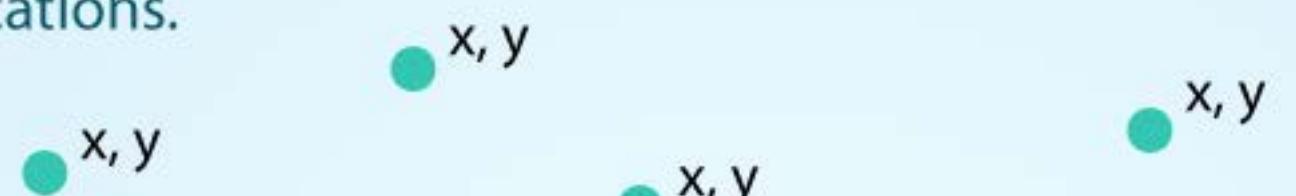
--key concepts

## VECTOR DATA

—usually we encode  
GIS data in vector  
format – points, lines  
and polygons

**POINTS:** Individual **x, y** locations.

ex: Center point of plot locations, tower locations, sampling locations.



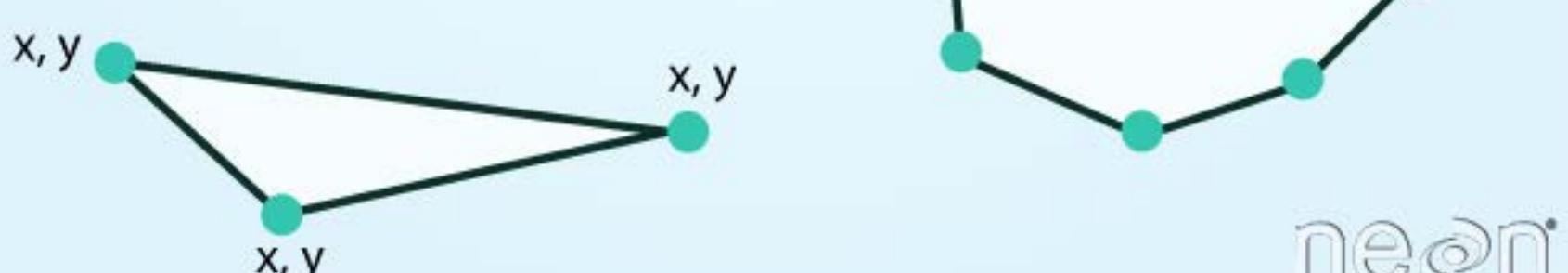
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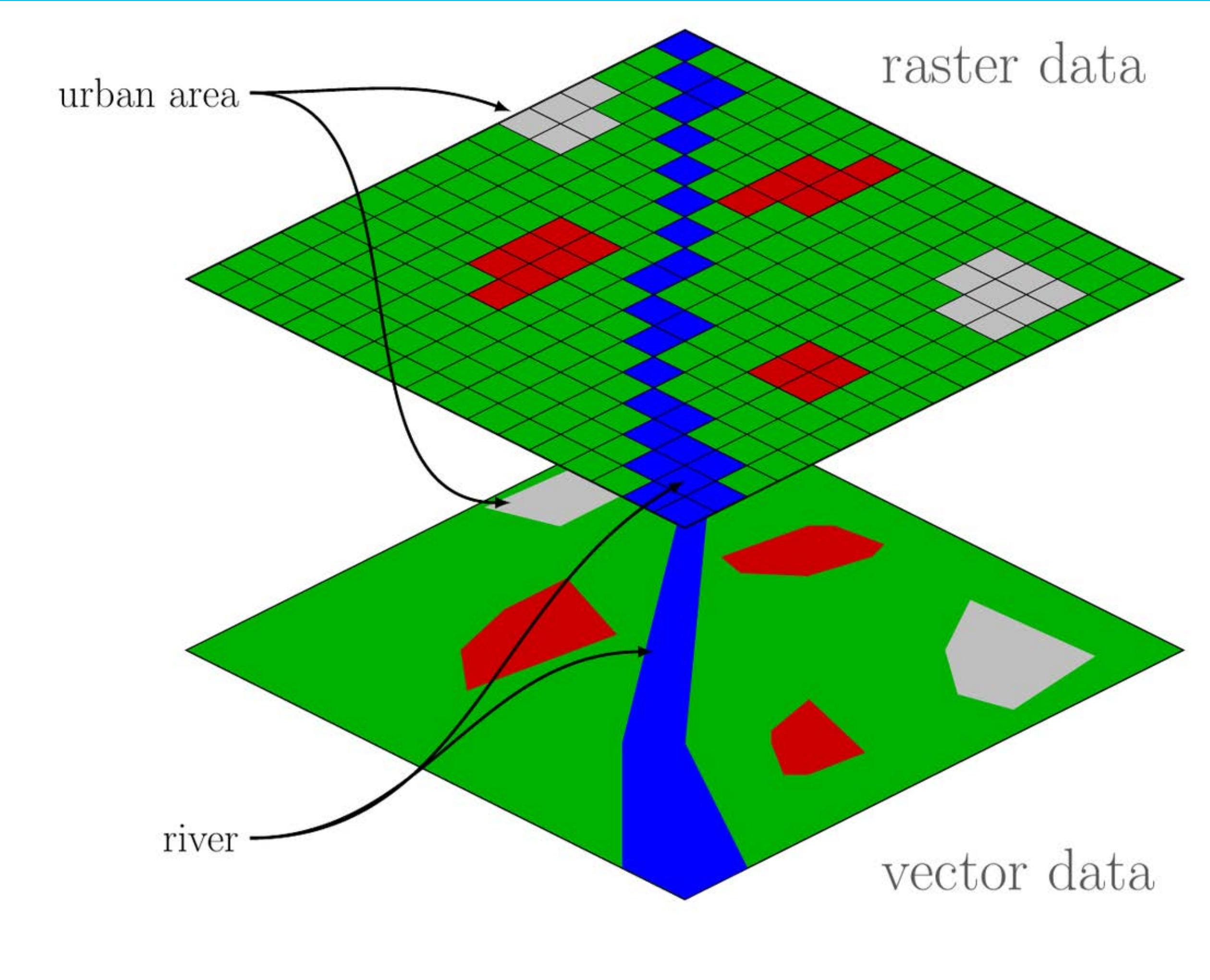


**POLYGONS:** 3 or more vertices that are connected and **closed**.

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# MAKING MAPS —



## GIS APPLICATIONS

--key concepts

### RASTER DATA

—raster data useful  
for rendering  
physical geography

# MAKING MAPS —

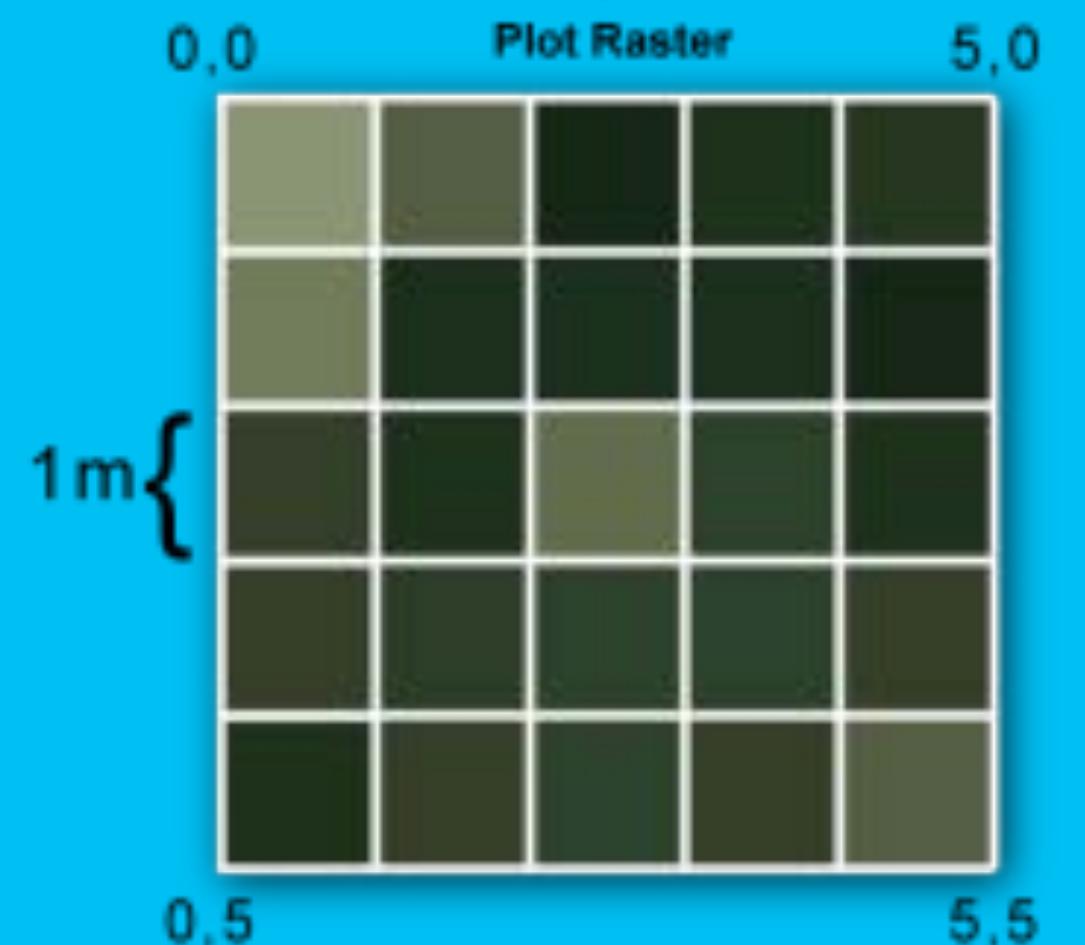
# GIS APPLICATIONS

--key concepts



1	3	9	7	7
2	8	7	7	8
6	7	3	5	7
7	6	5	5	6
8	6	5	6	4

Legend



SATELLITE IMAGES (PHOTOS) = RASTER DATA

GRID OF INDIVIDUAL VALUES —> PHOTO

## RASTER DATA

—raster data useful  
for rendering  
physical geography

# MAKING MAPS

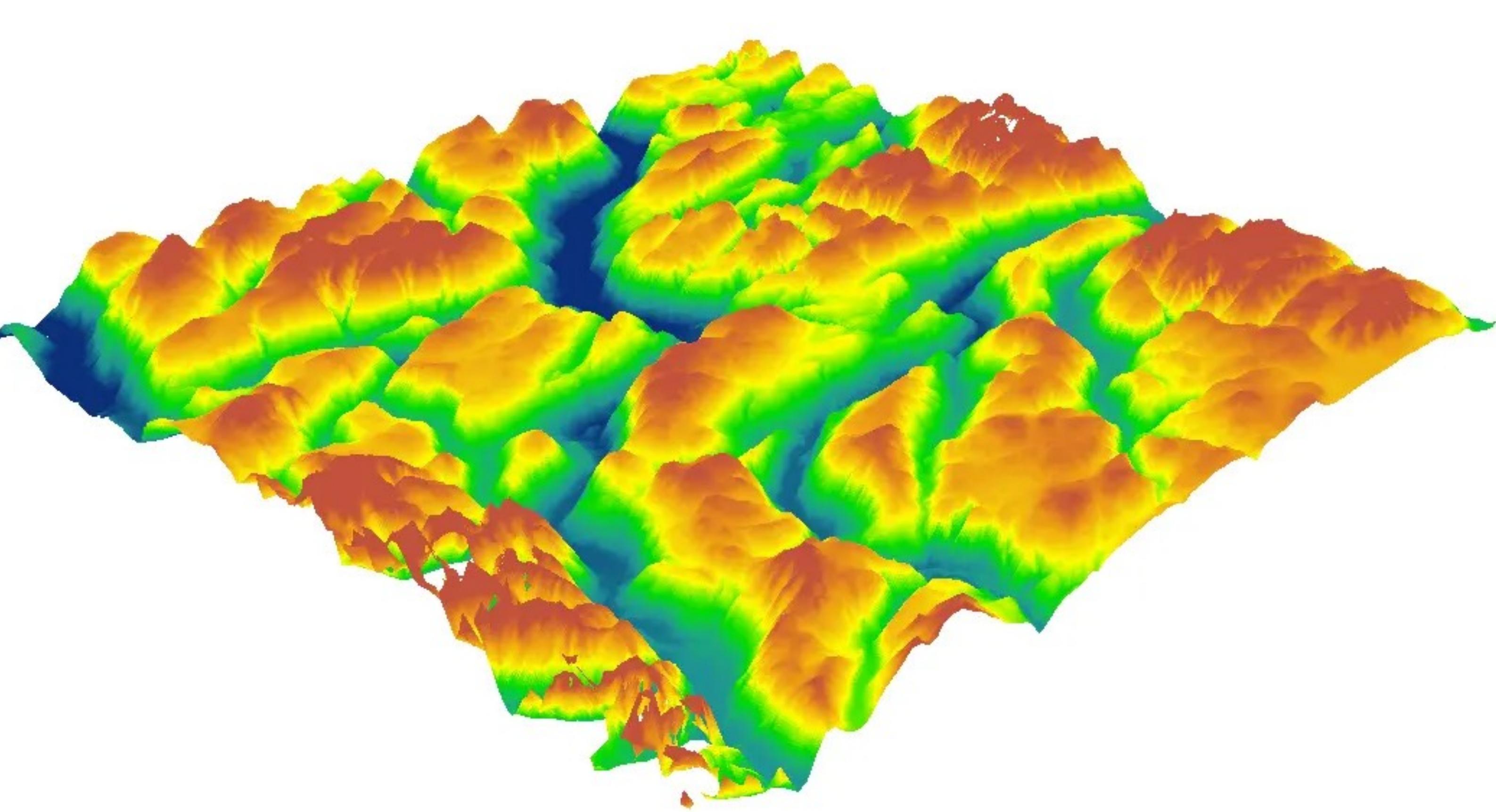
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## GIS APPLICATIONS

--key concepts

### RASTER DATA

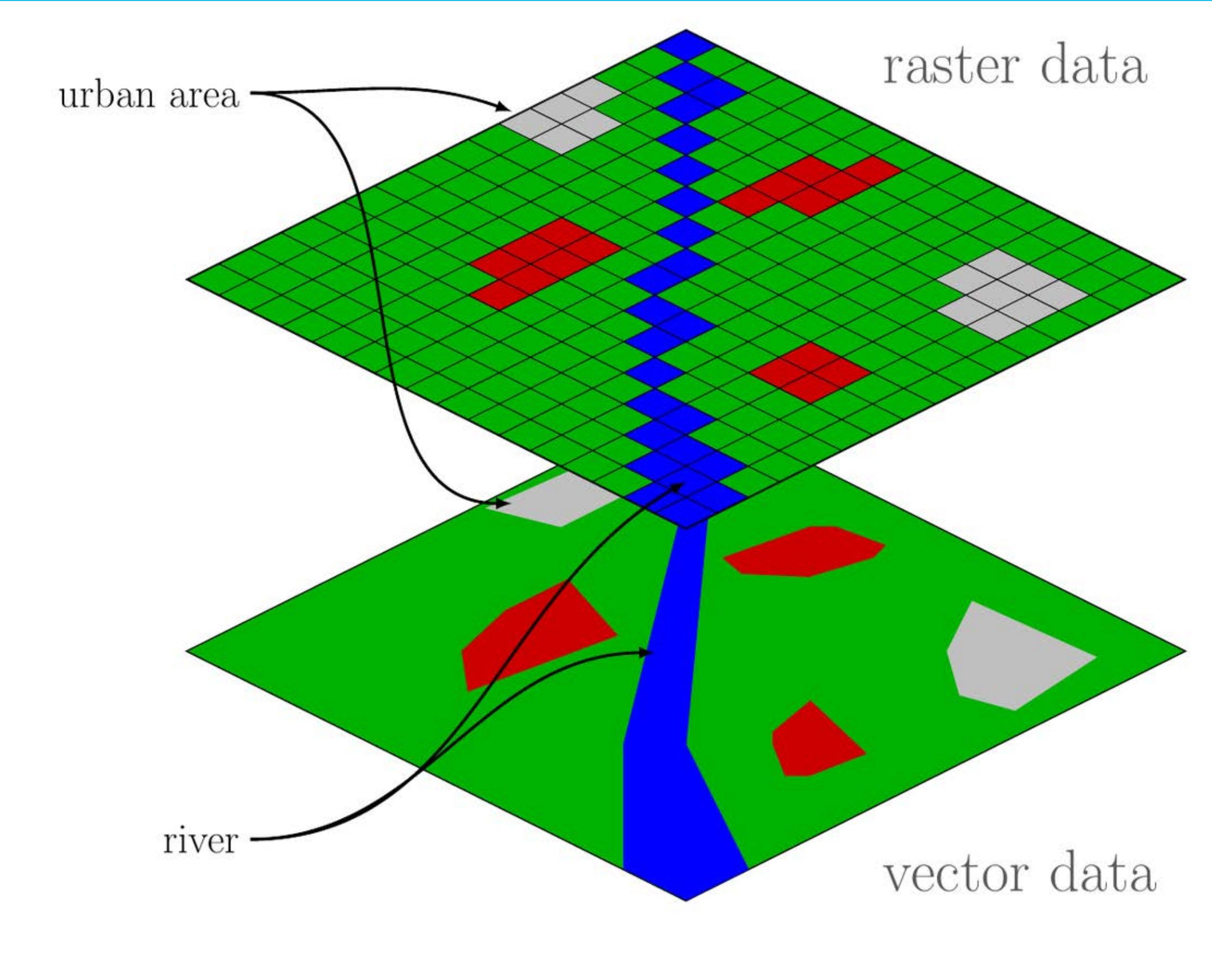
—raster data useful  
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physical geography



DIGITAL ELEVATION MODEL

GRID OF INDIVIDUAL VALUES WITH 'Z' DATA ATTACHED TO EACH PIXEL —> DEM

# MAKING MAPS —



## GIS APPLICATIONS

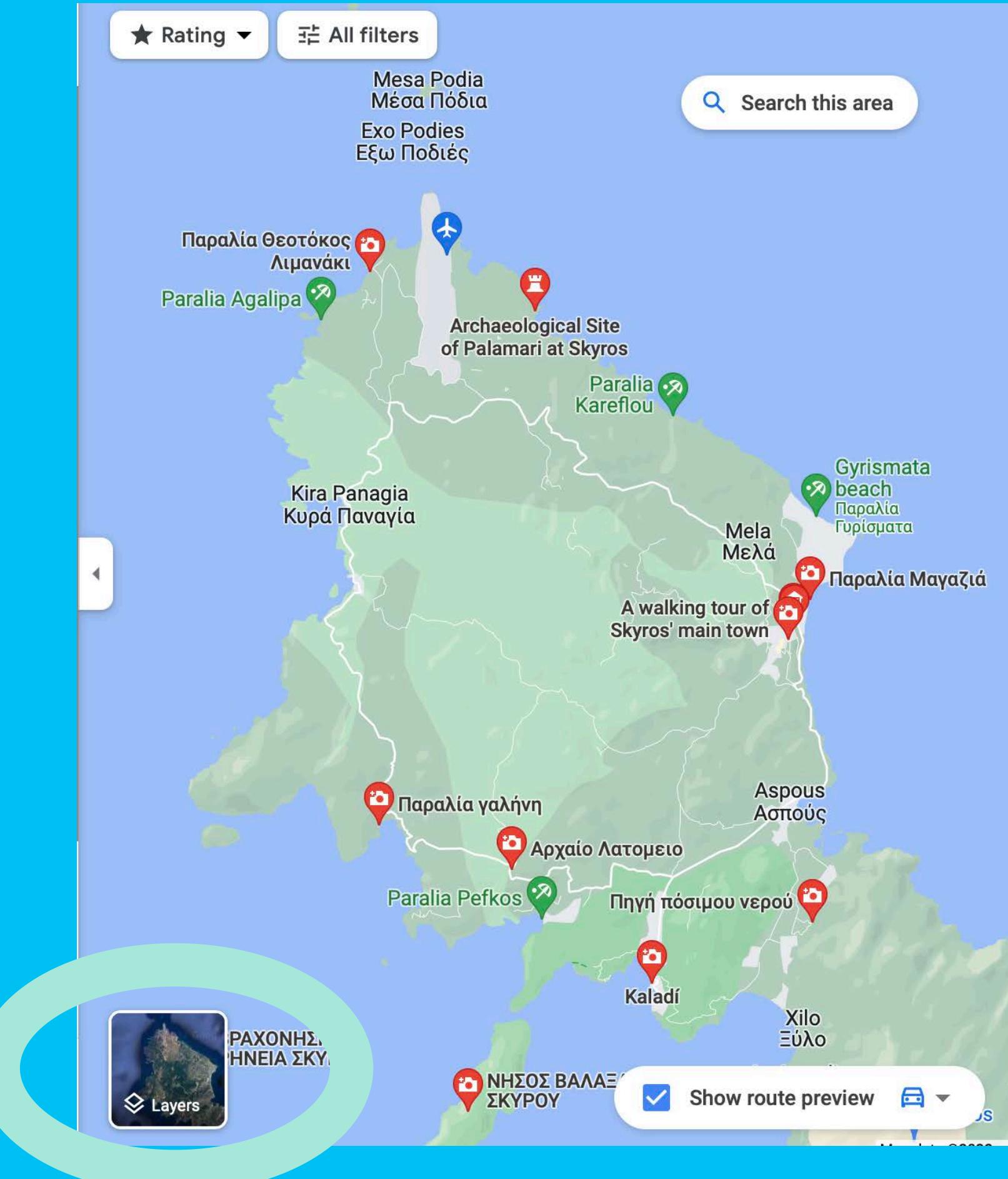
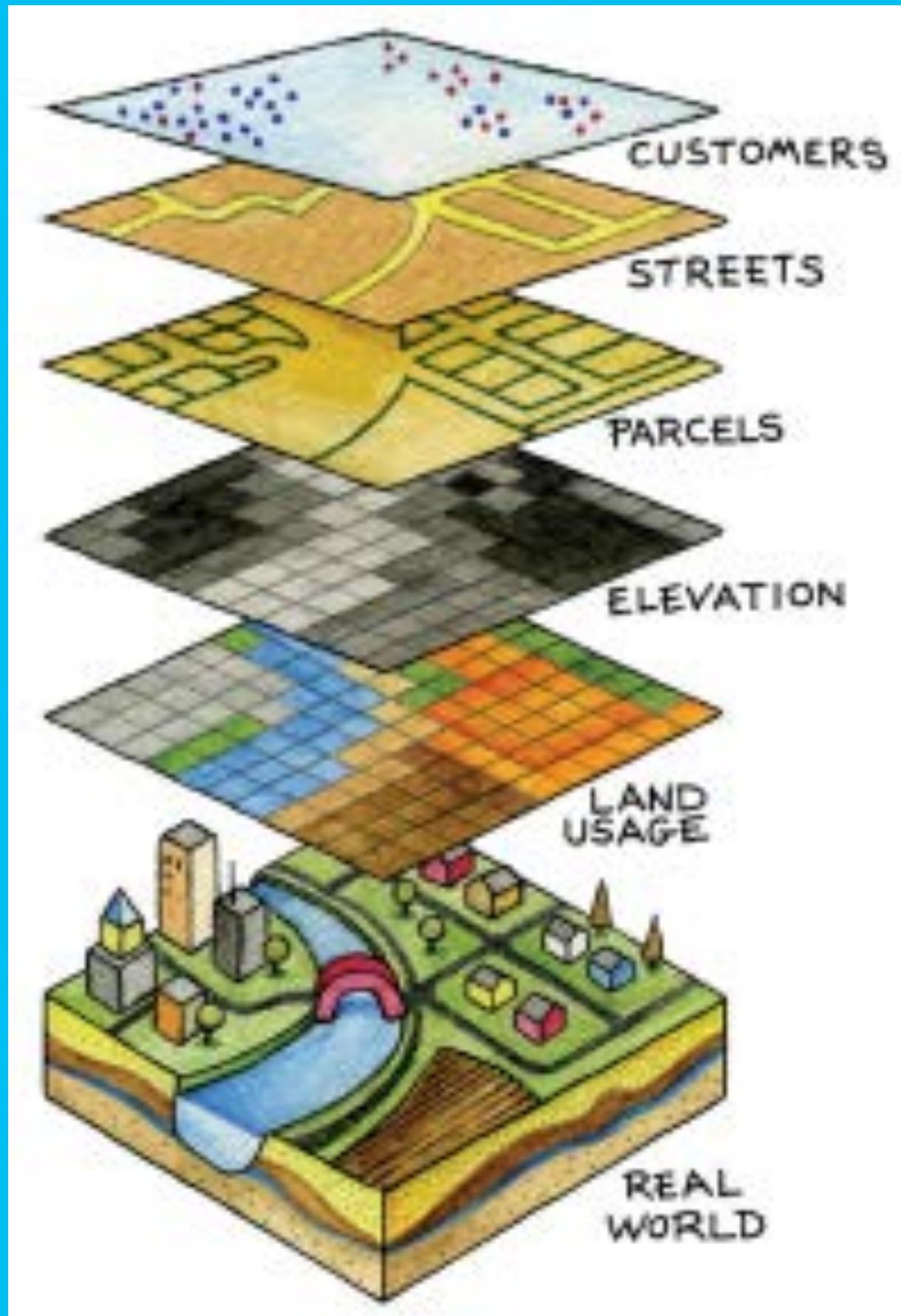
--key concepts

### RASTER DATA

—higher resolution  
BETTER (in general)  
but files can be big.

# MAKING MAPS —

# LAYERS

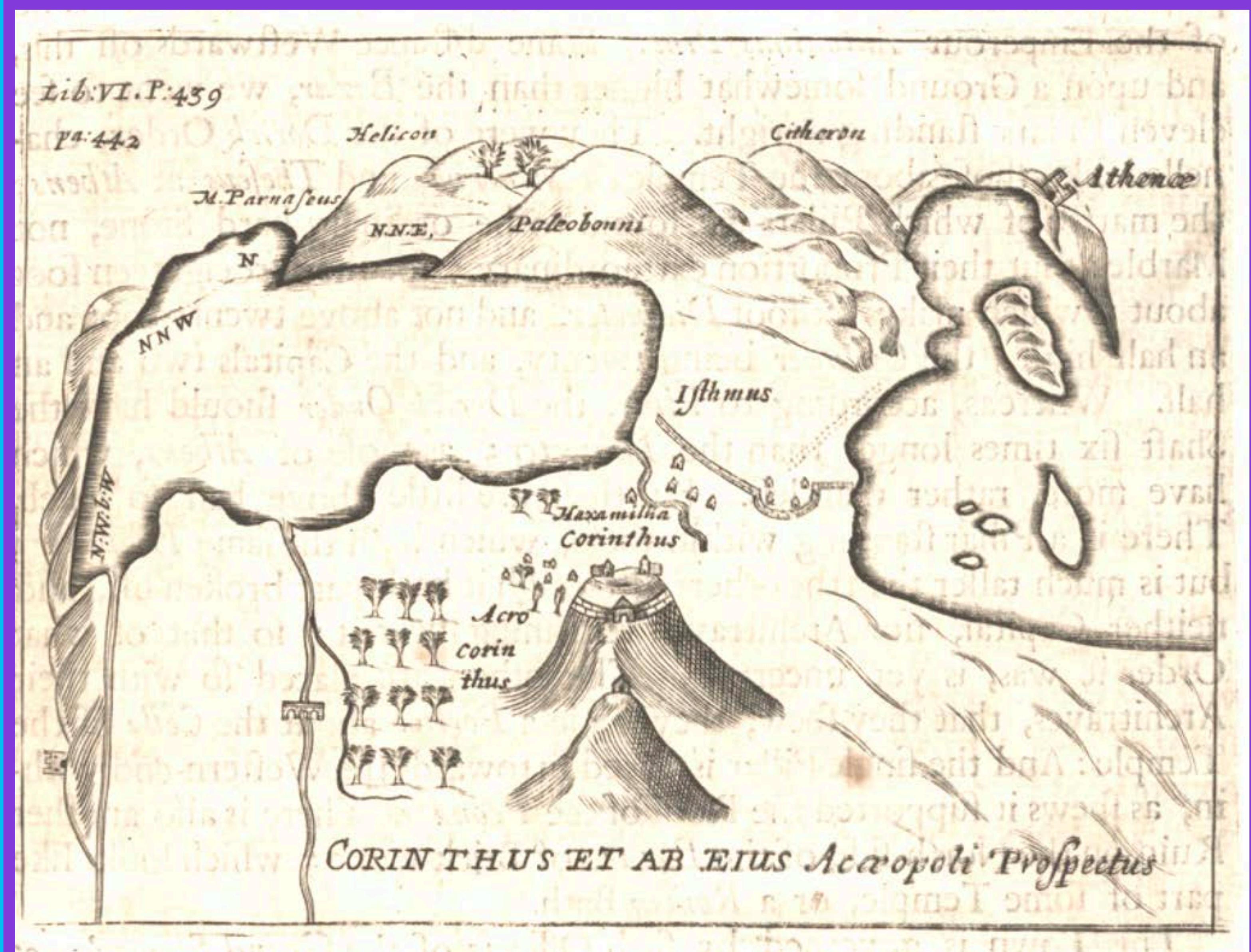


GIS APPLICATIONS  
--key concepts

**VECTOR DATA**

**RASTER DATA**

MAKING MAPS -

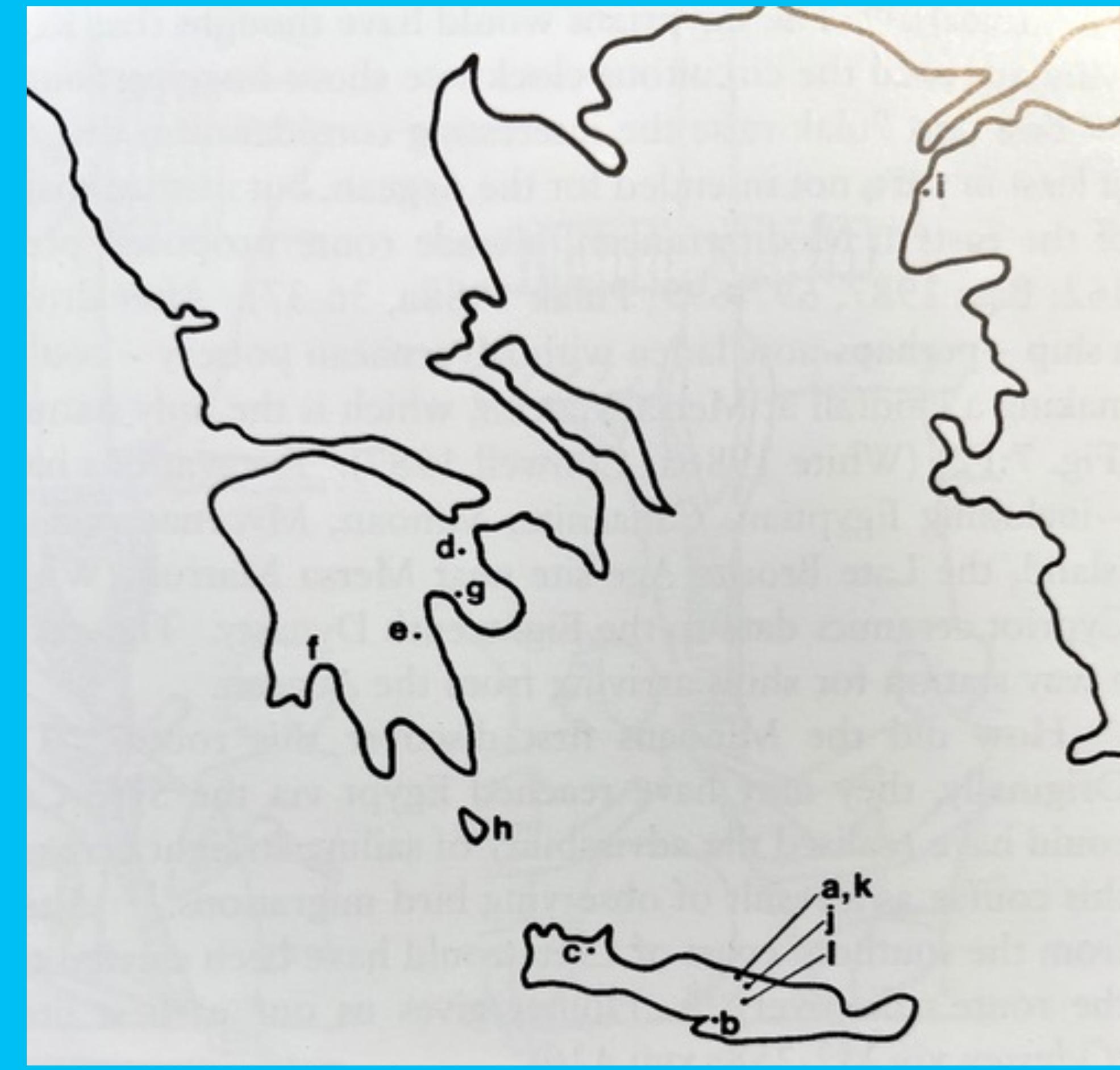


# MAKING MAPS

- Some basic concepts  
(What you need to know before getting started with GIS)
- Contexts in which a proper GIS (not just looking at/using pre-generated maps, online or offline) might come in handy

- make a database of information that is spatially organized for your research – it can help you see spatial patterns, understand relationships between different attributes and geospatial location, etc. It can also be just as simple as making a “regular” database.
  - use the GIS computational ‘engine’ to query various aspects of data – what points may be visible from a position in space, how to move through a landscape with least effort, etc.
  - You want a custom way to display data and generate maps for publications or to share with colleagues
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# MAKING MAPS —



generate maps for publications or to share with  
colleagues

**GUM BY MEDITERRANEAN!  
DON'T LESS THIS HAPPEN TO YOU**



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- Some basic concepts (What you need to know before getting started with GIS)
  - Contexts in which a proper GIS (not just looking at/using pre-generated maps, online or offline) might come in handy
  - LOADS OF OTHER APPLICATIONS INSIDE AND OUTSIDE OF ACADEMIC RESEARCH

# MAKING MAPS —

# Success stories (and pitfalls) of using GIS in Cultural Heritage applications

# Site Discovery

- Remote-sensing techniques can be used to document the location of archaeological and historical sites and identify standing features

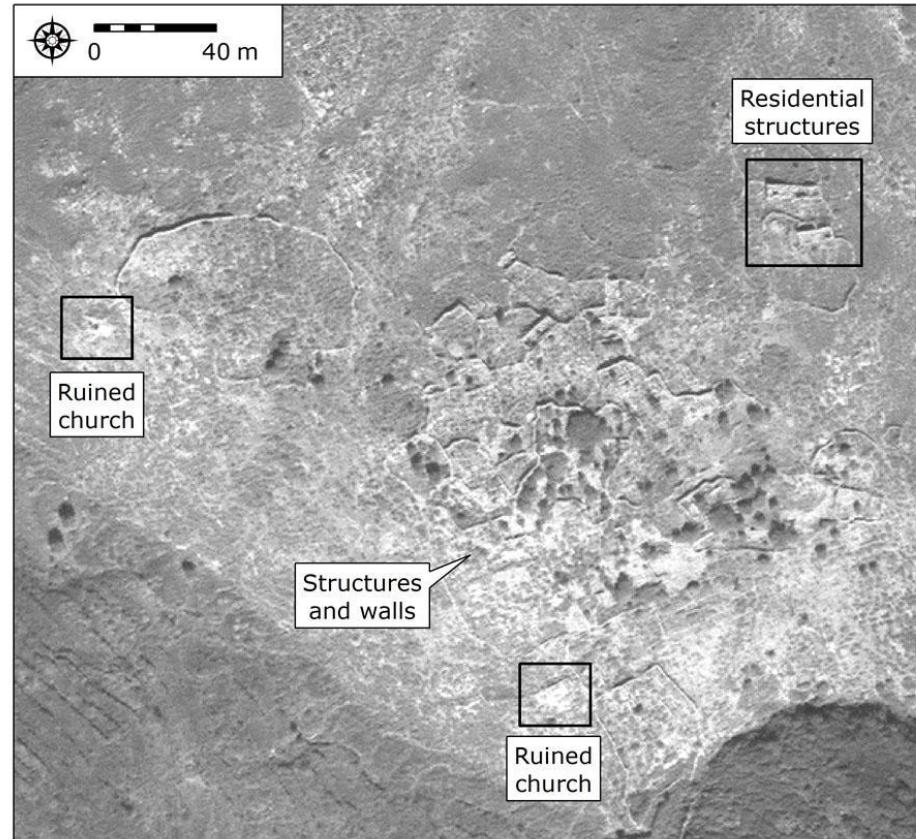
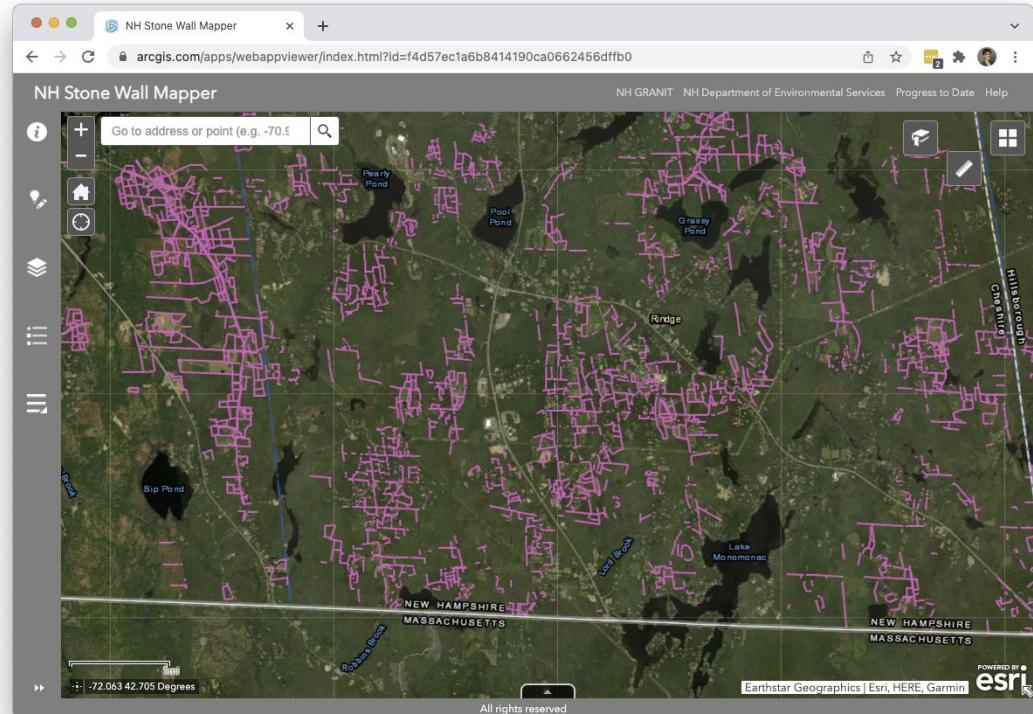


Figure 39. Site T360 (Proskephalia) identified in WorldView-2 satellite imagery.

# Site Discovery

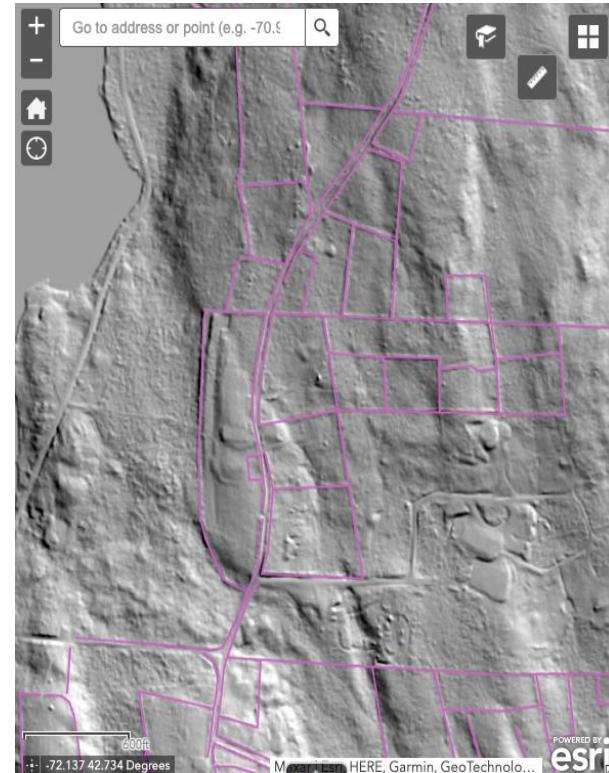
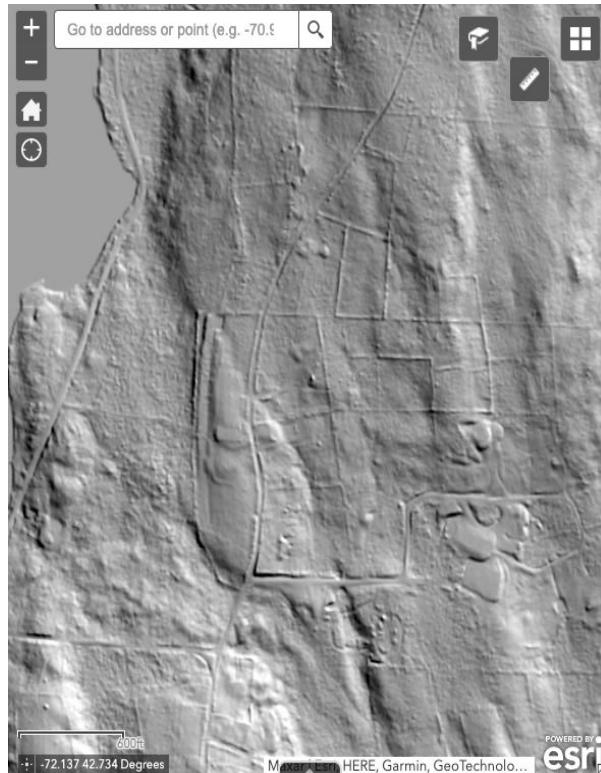
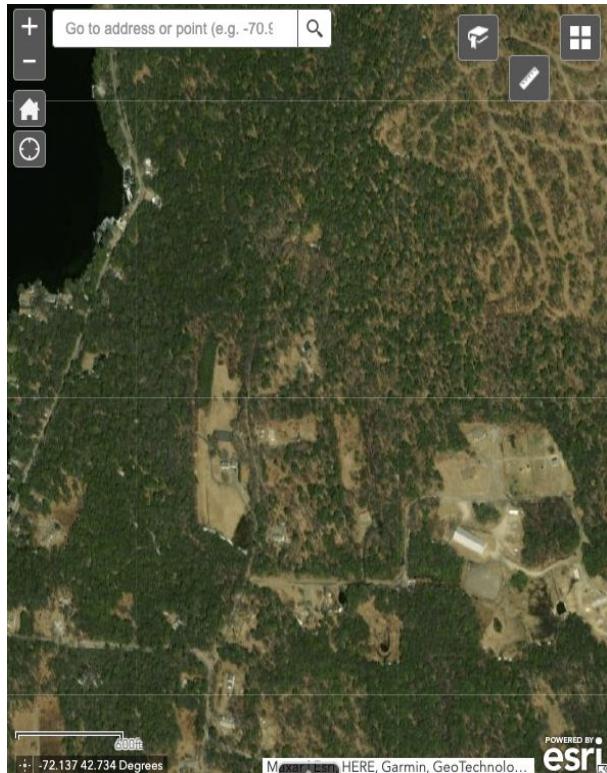
- Crowd-sourcing projects get the public involved in site detection without requiring lots of training
- Potential to cover huge areas of land quickly (particularly with automation / machine learning)

## New Hampshire Stone Wall Mapper



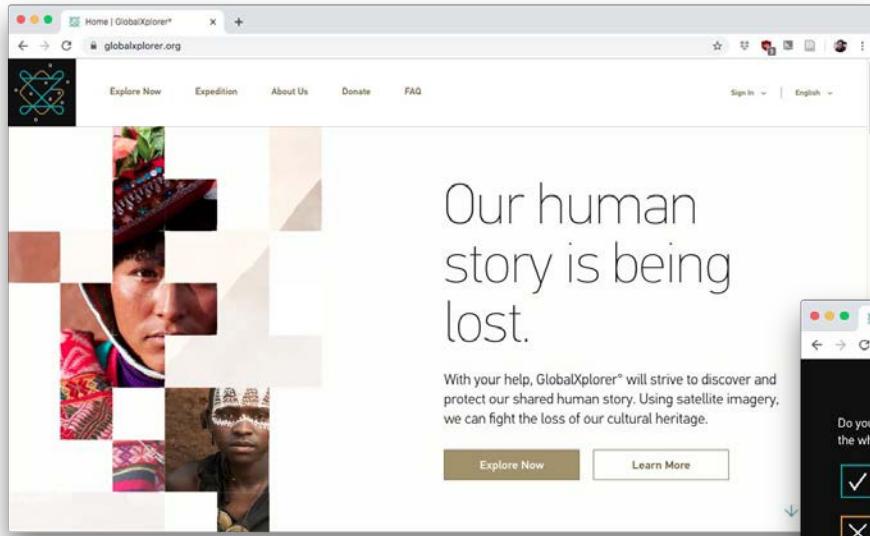
NH Stone Wall Mapper: <https://www.arcgis.com/apps/webappviewer/index.html?id=f4d57ec1a6b8414190ca0662456dffb0>

StoryMap about the project: <https://nhdes.maps.arcgis.com/apps/MapJournal/index.html?appid=8d0b2ac3e3ac40f4b12ab958402d7f36>



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A screenshot of the GlobalXplorer interface. At the top, it asks "Do you see evidence of looting pits in the white highlighted area?". Two options are shown: "Looting" (with a checked checkbox) and "No Looting" (with an unchecked checkbox). Below this is a "Revisit Tutorial" button. To the right is a satellite map of a terrain with a white rectangular highlight. The DigitalGlobe logo is in the top right corner of the map. At the bottom, there are user status indicators ("Guest"), campaign information ("CURRENT CAMPAIGN: LOOTING"), and statistics ("LOOTING TILES VIEWED: 1,000").

# GlobalXplorer

<https://www.globalxplorer.org/>

# Site Discovery

- Remote sensing techniques can also detect archaeological features buried beneath the surface or otherwise obscured by modern features

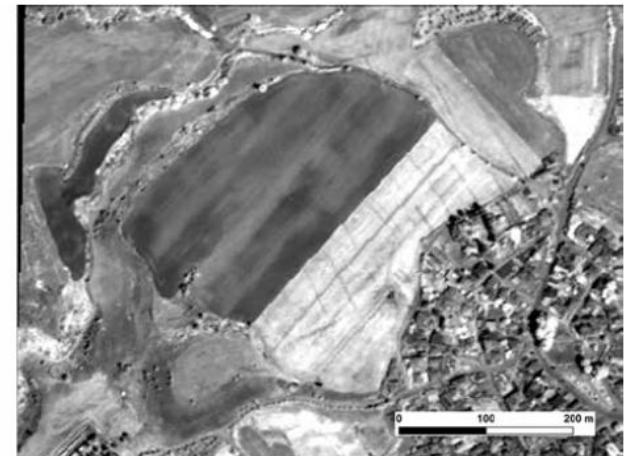


FIGURE 3. DECORRELATION STRETCH APPLIED TO QUICKBIRD, 15 JUNE 2009 (LEFT) AND MSR APPLIED TO GEOEYE-1, 4 MAY 2010 (RIGHT) SHOWING DIAGONAL SUBSURFACE STREETS AT PHERAI.

Donati, J. C. 2015. "Cities and Satellites: Discovering Ancient Urban Landscapes Through Remote Sensing Applications." In: Best Practices of Geoinformatic Technologies for the Mapping of Archaeolandscapes, edited by A. Sarris, 127–136. Oxford: Archaeopress.

# Tracking Damage to Archaeological Sites

- Remote sensing techniques can be used to identify different kinds of damage (e.g. looting, urban expansion, natural disasters, etc.) and track change to sites over time

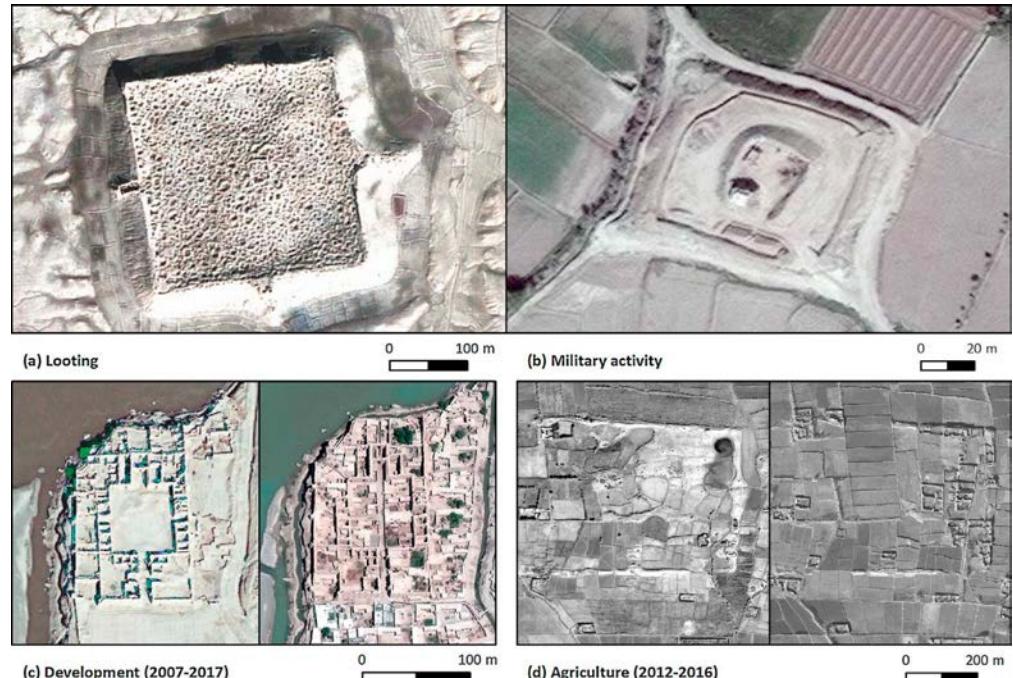


Fig. 4. Examples of each type of damage to archaeological sites as seen in DigitalGlobe imagery: a: looting at Abu Huraira in Balkh Province (Gazetteer site 8); b: military activity at Gur Tepe in Kunduz Province (Gazetteer site 400); c: development-related damage at Lashkari Bazar in Helmand Province (Gazetteer site 685); d: agricultural-related damage at Kafir Qal'a in Kunduz Province (Gazetteer site 487). Base imagery courtesy of DigitalGlobe.

# Tracking Damage to Archaeological Sites

- Ongoing projects are using GIS/RS to monitor cultural heritage remotely and compare with targeted assessments on the ground

EAMENA database v3.0: <https://database.eamena.org/>

ASOR-CHI: <http://www.asor.org/chi/about>

# EAMENA

Endangered Archaeology in the Middle East & North Africa



HOME SEARCH MAP VIEW



