

# Data Models

Introduce Common Models, Limits in “Sampling”

Basic Vector and Raster Structures

Geographic and Attribute components of features

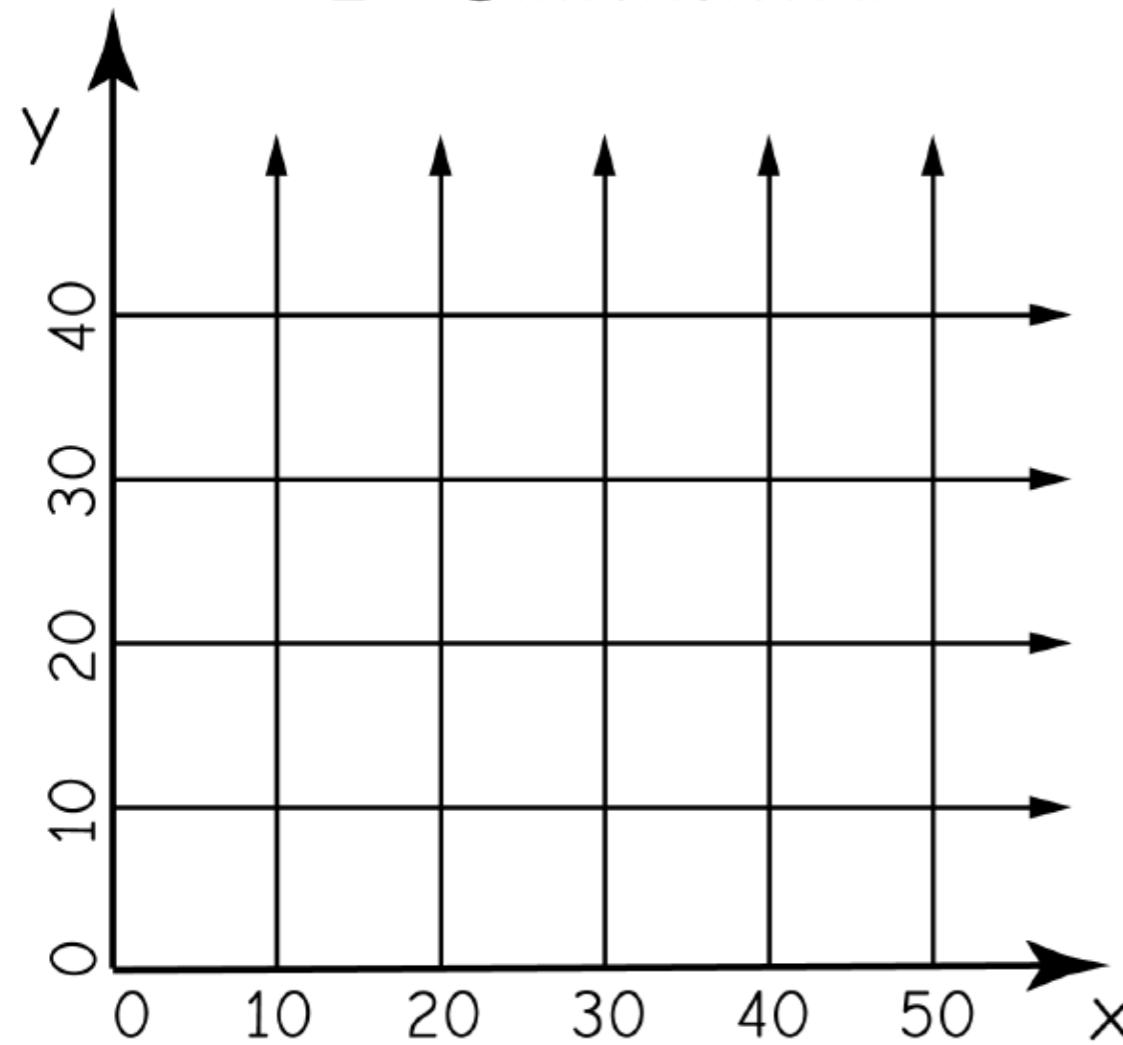
Tradeoffs in resolution, area, accuracy, and time - all data are a sampling of geographic reality

Attributes: Nominal, Ordinal, Interval/Ratio

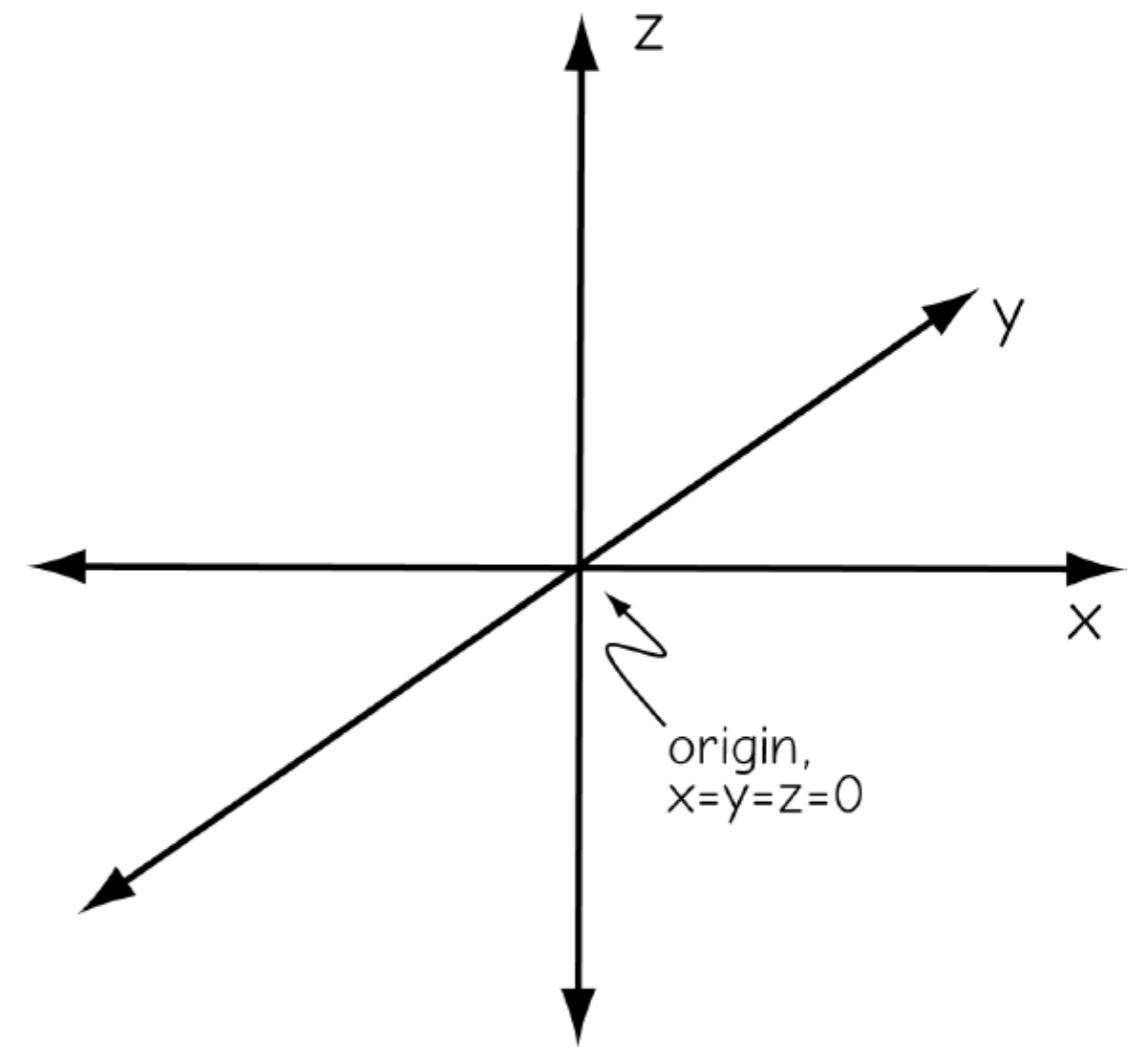
# Most of Our GIS Layers Stored, Manipulated in Cartesian Coordinate Systems

Cartesian Coordinate Systems

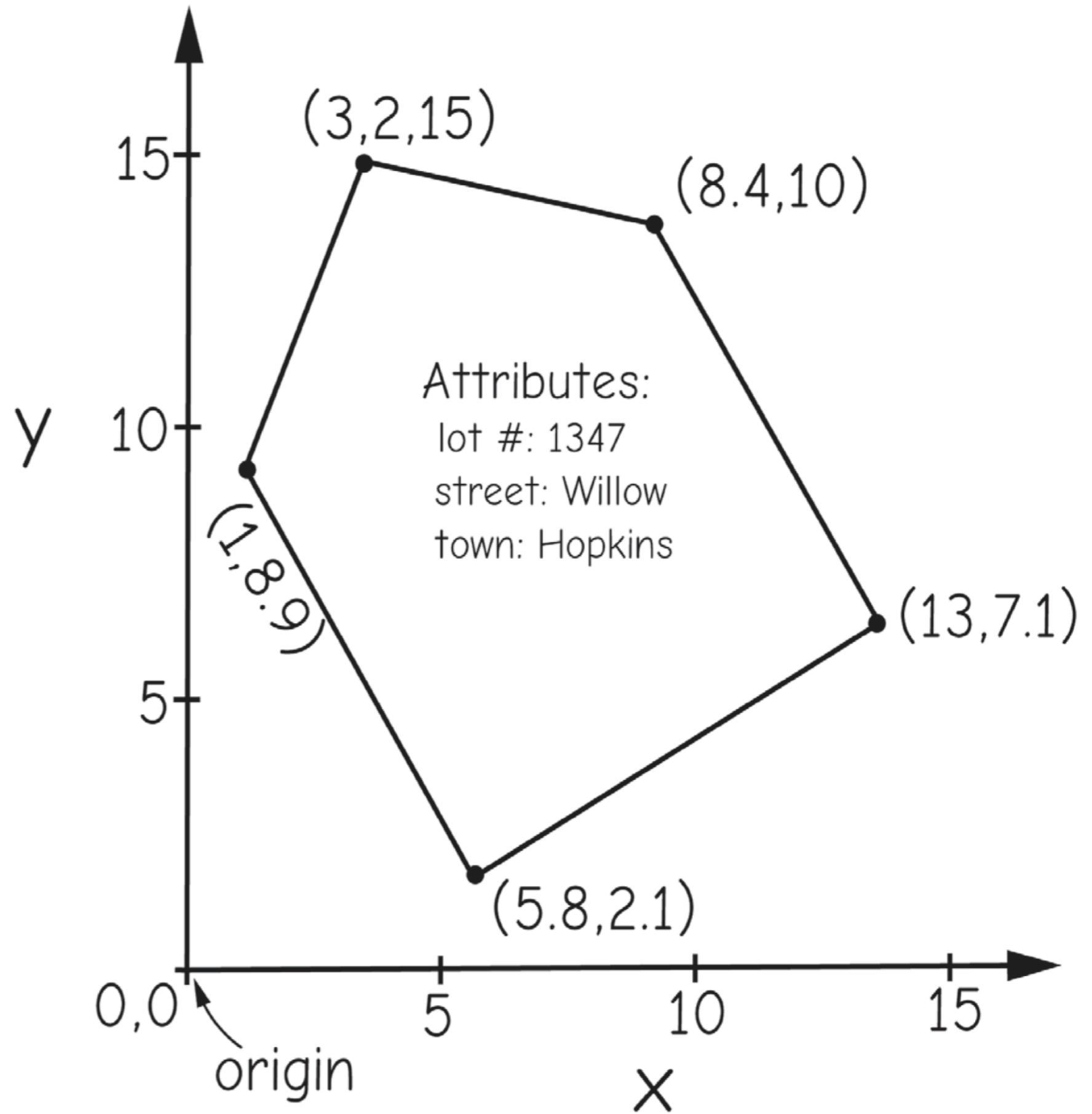
2 - Dimensional



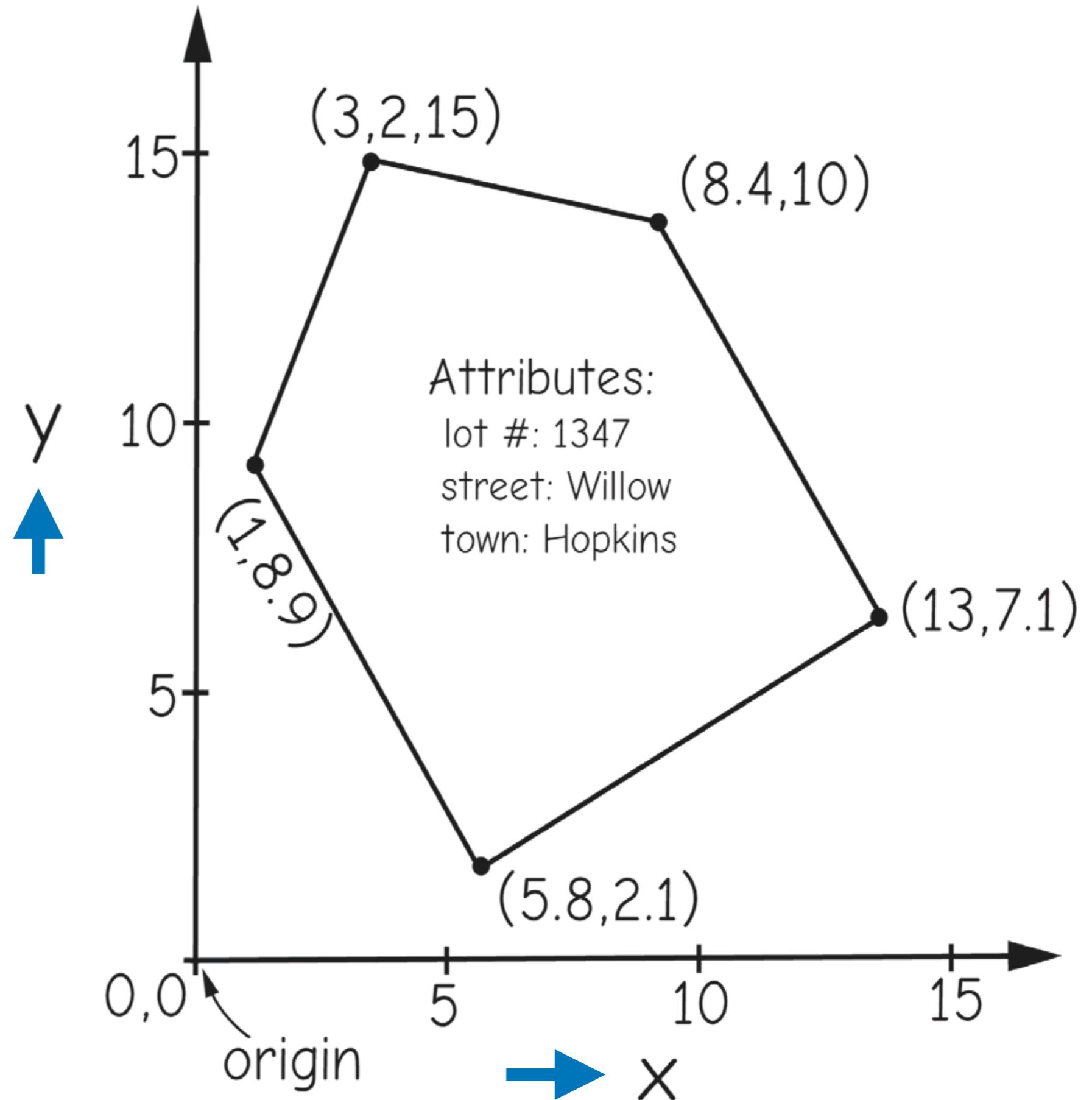
3 - Dimensional



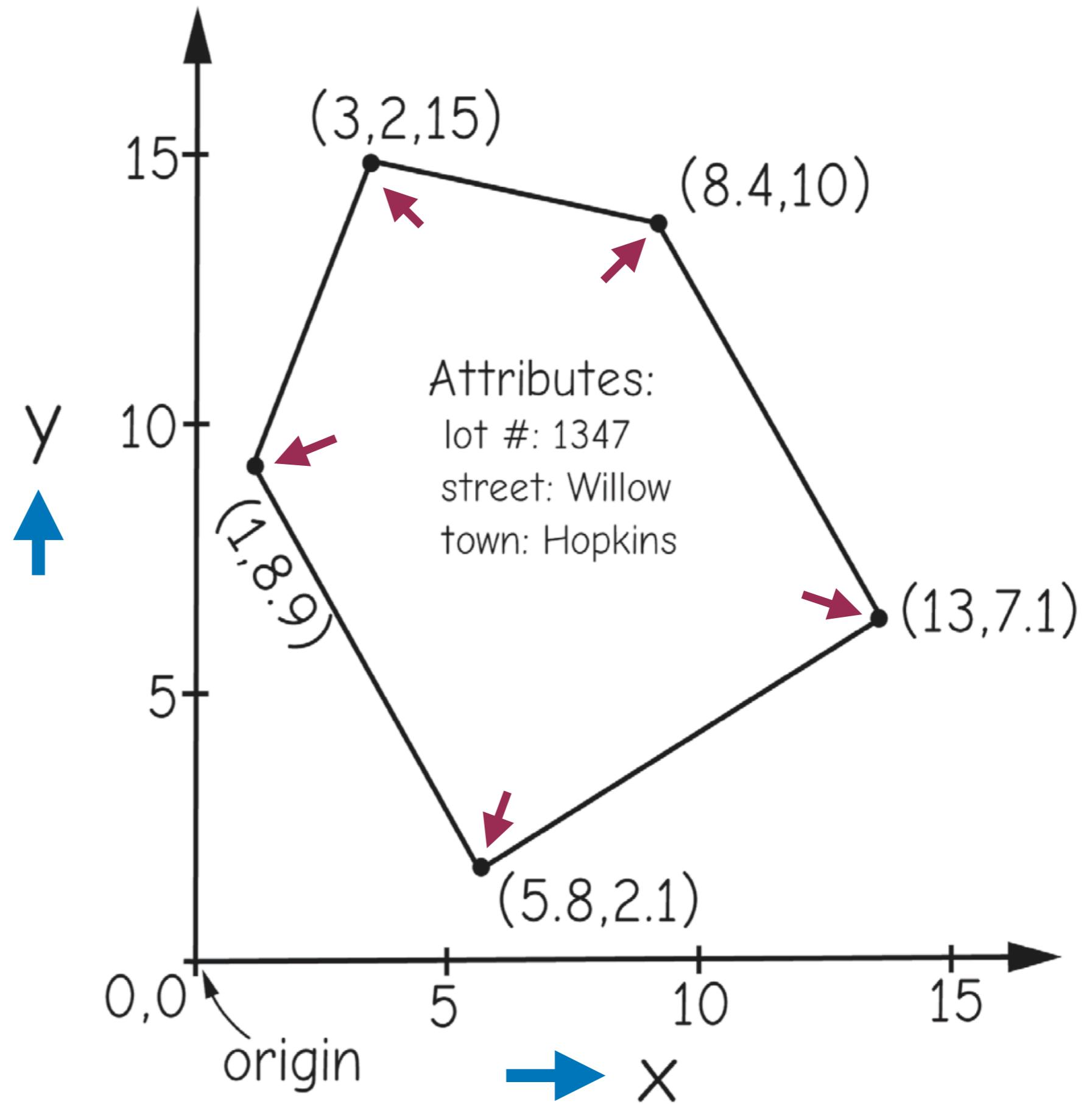
Two part  
data:  
Coordinates  
and  
Attributes



Two part  
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Coordinates  
and  
Attributes

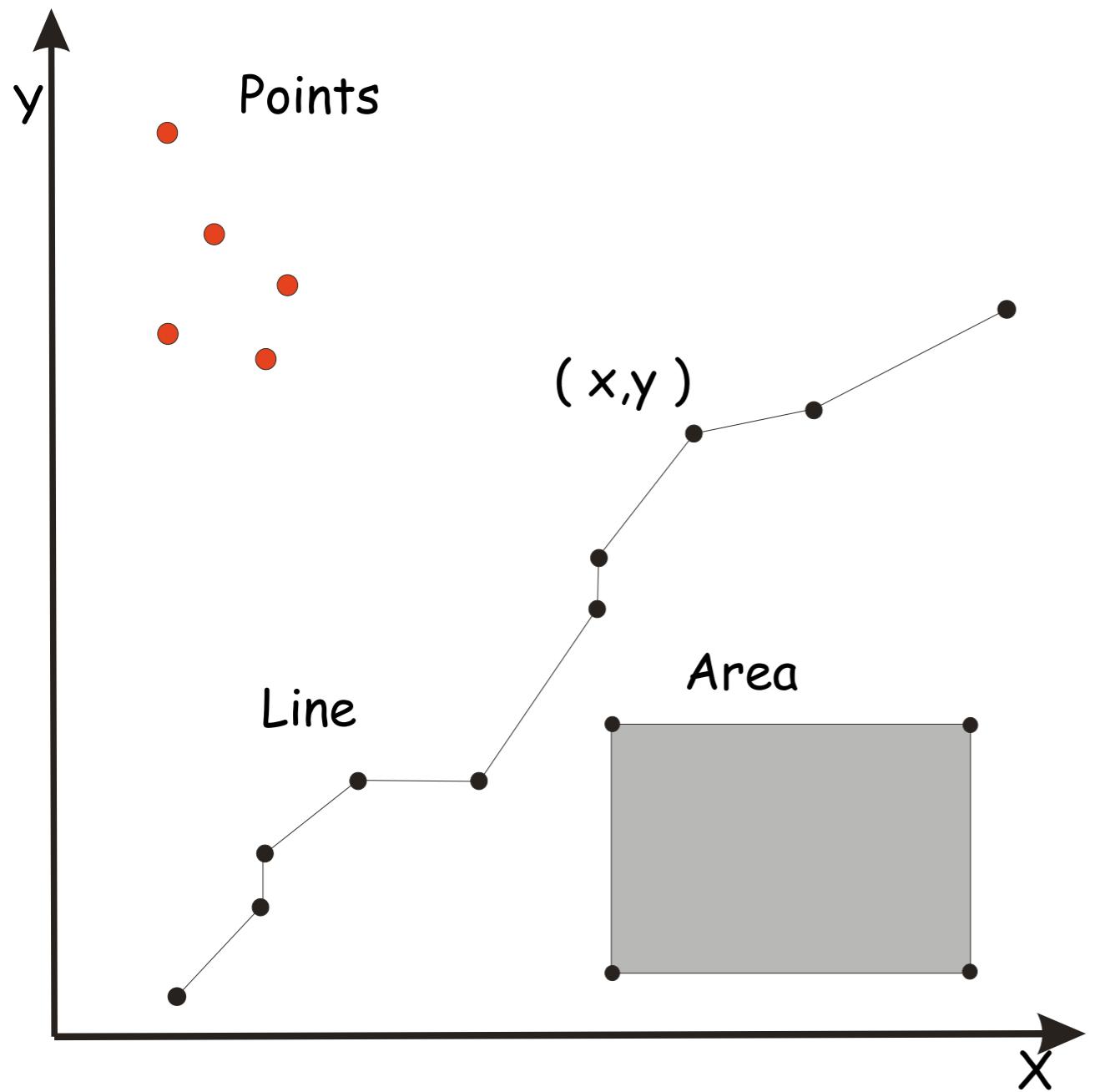


Two part  
data:  
Coordinates  
and  
Attributes

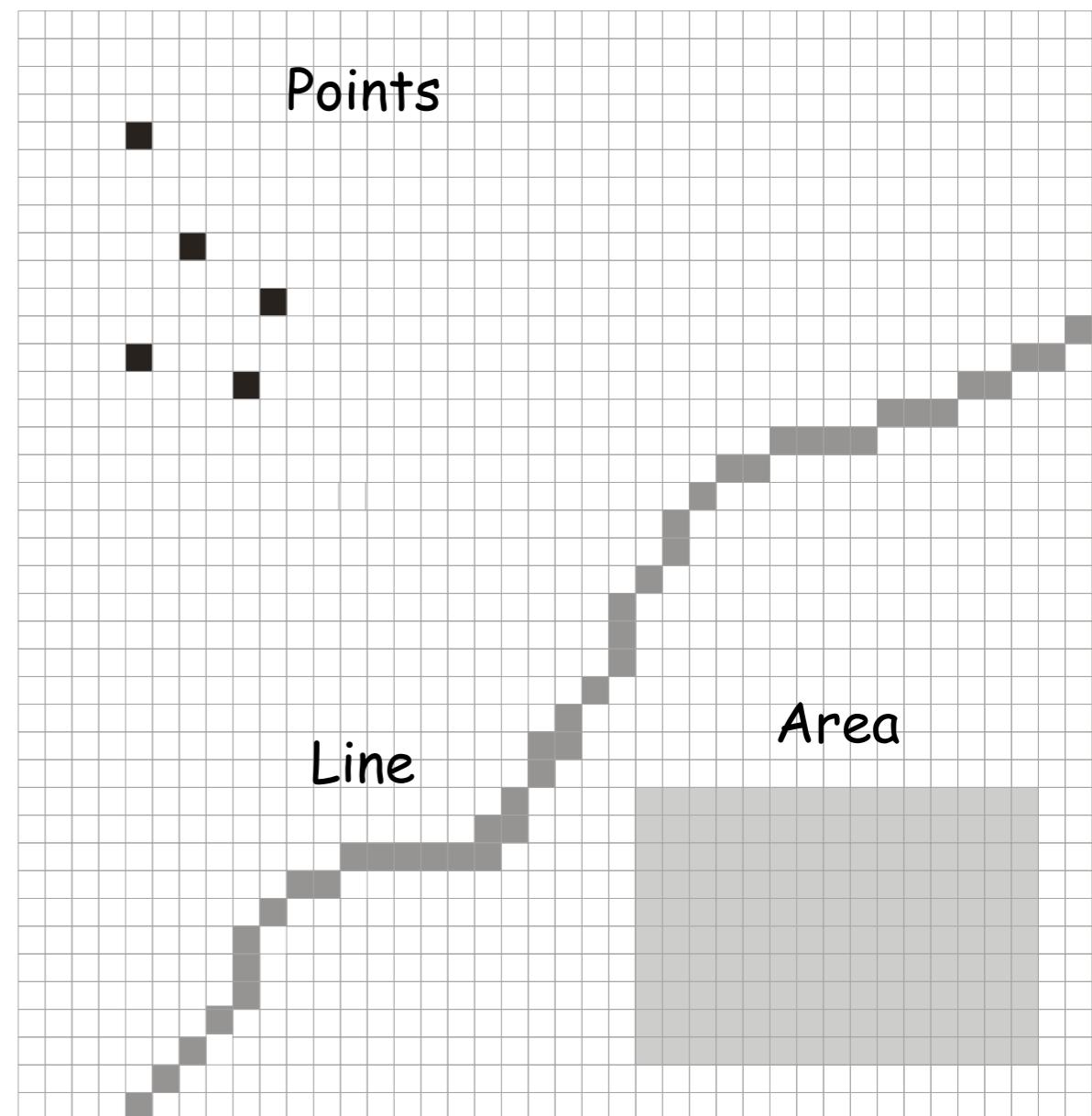


# Two Main Data Models

Vector



Raster



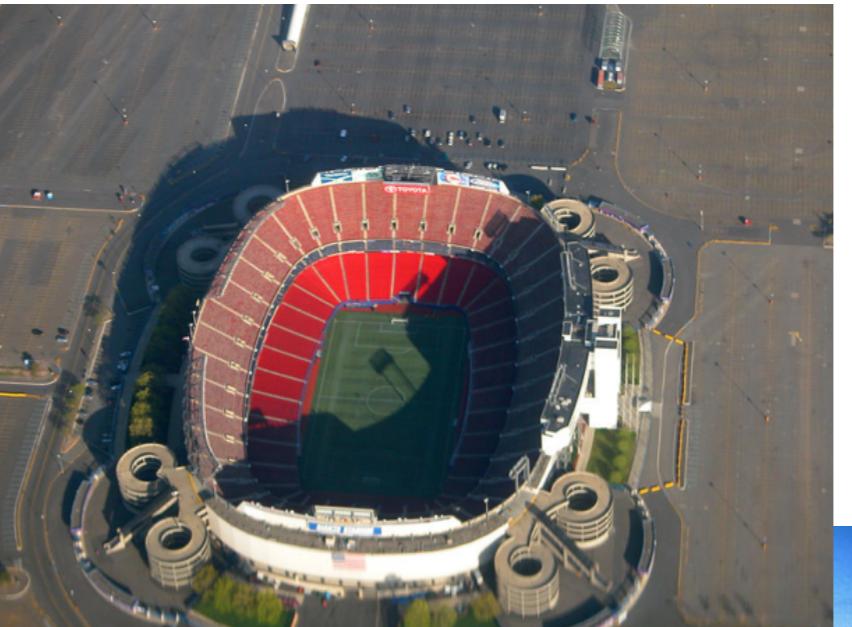
# Vector Features



Points

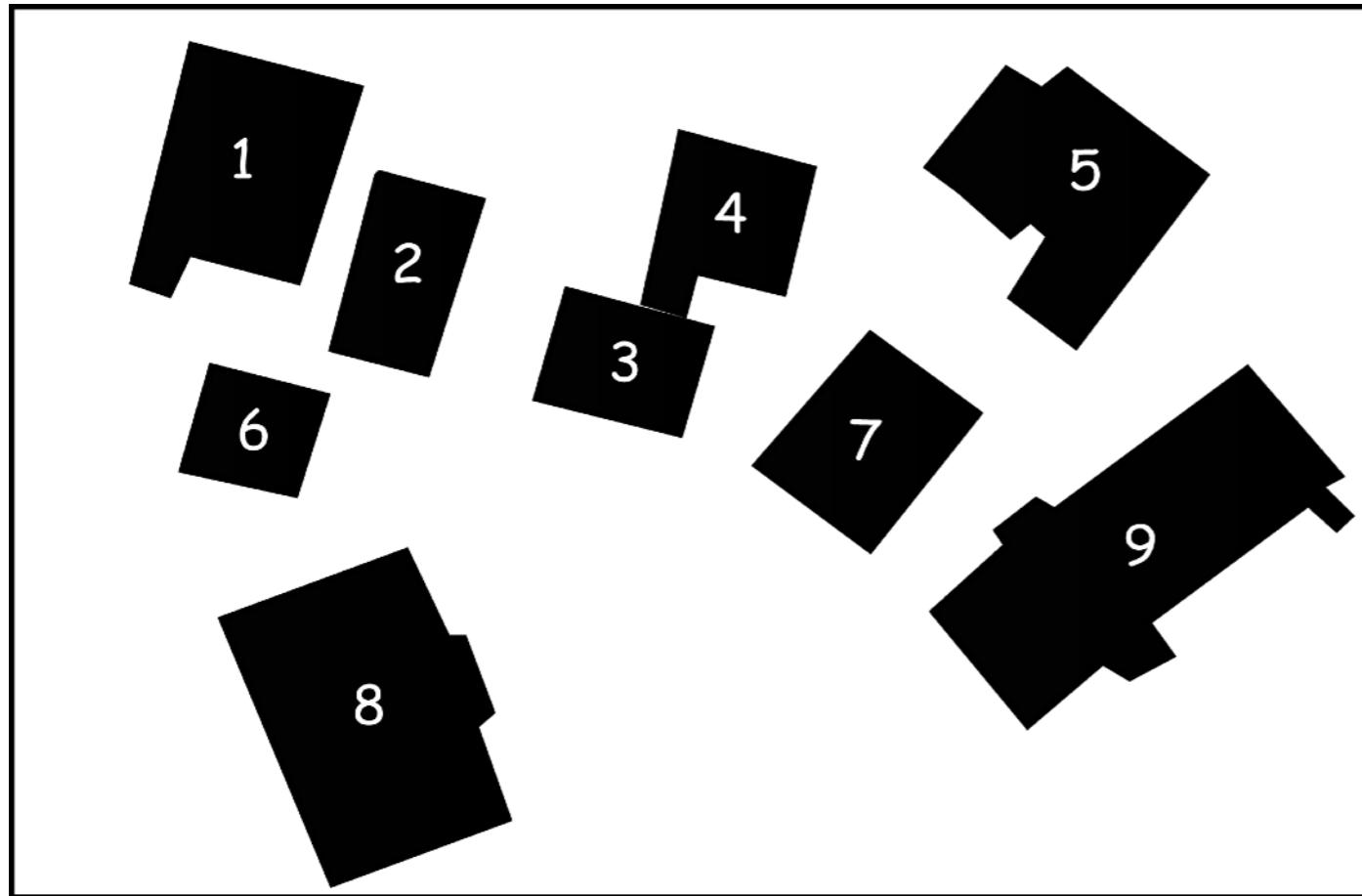


Lines



Areas

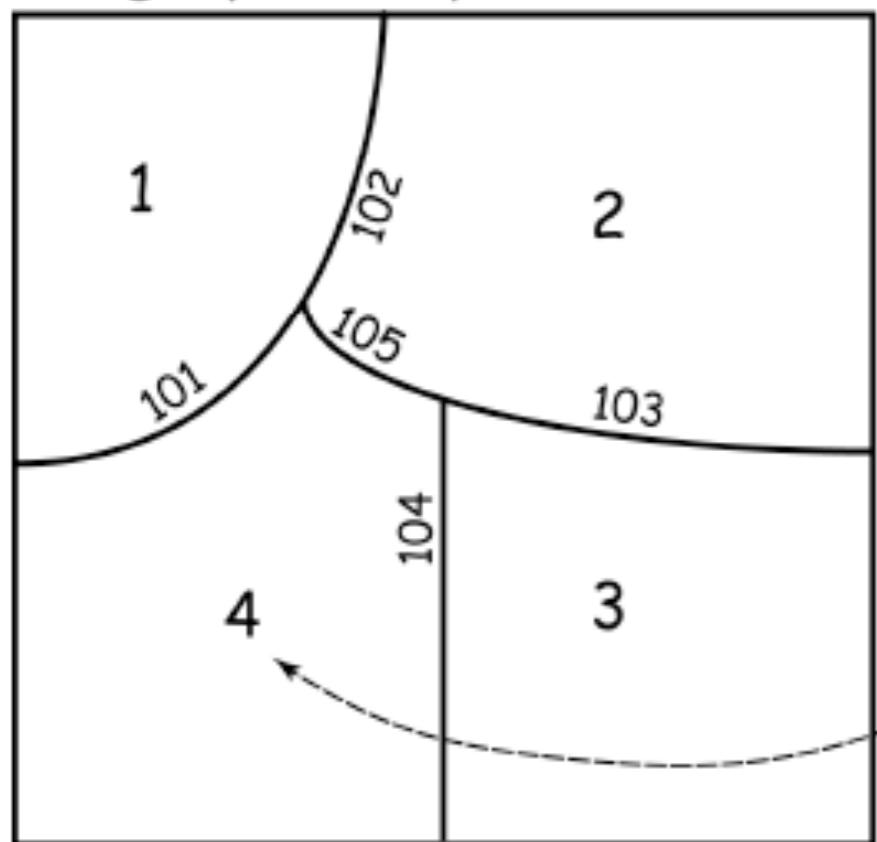




## Vector Polygons

ID	Building Name	Floors	Roof Type
1	Hodson Hall	6.0	flat, sealed tar
2	Borlaug Hall	5.5	pitched 9/12, tile
3	Guilford Technology Bldg.	4.0	flat, gasket
4	Shop Annex	2.5	flat, sealed tar
5	Animal Sciences Bldg.	1.0	pitched 12/12, tile
6	Administration Bldg.	14.0	pitched 6/12, metal
7	Climate Sciences Center	6.0	flat, sealed tar
8	Grantham Tower	1.0	pitched, 9/12, tile
9	Biological Sciences Bldg.	9.0	pitched 12/12, tile

## Geographic Depiction



## Attribute Table

ID	type	area
1	big	16.8
2	little	22.2
3	mid	18.4
4	tiny	20.7

Polygon	Lines
1	101, 102, ...
2	102, 103, ...
3	103, 104, ...
4	104, 101, ...

Topology &  
Coordinate  
Data

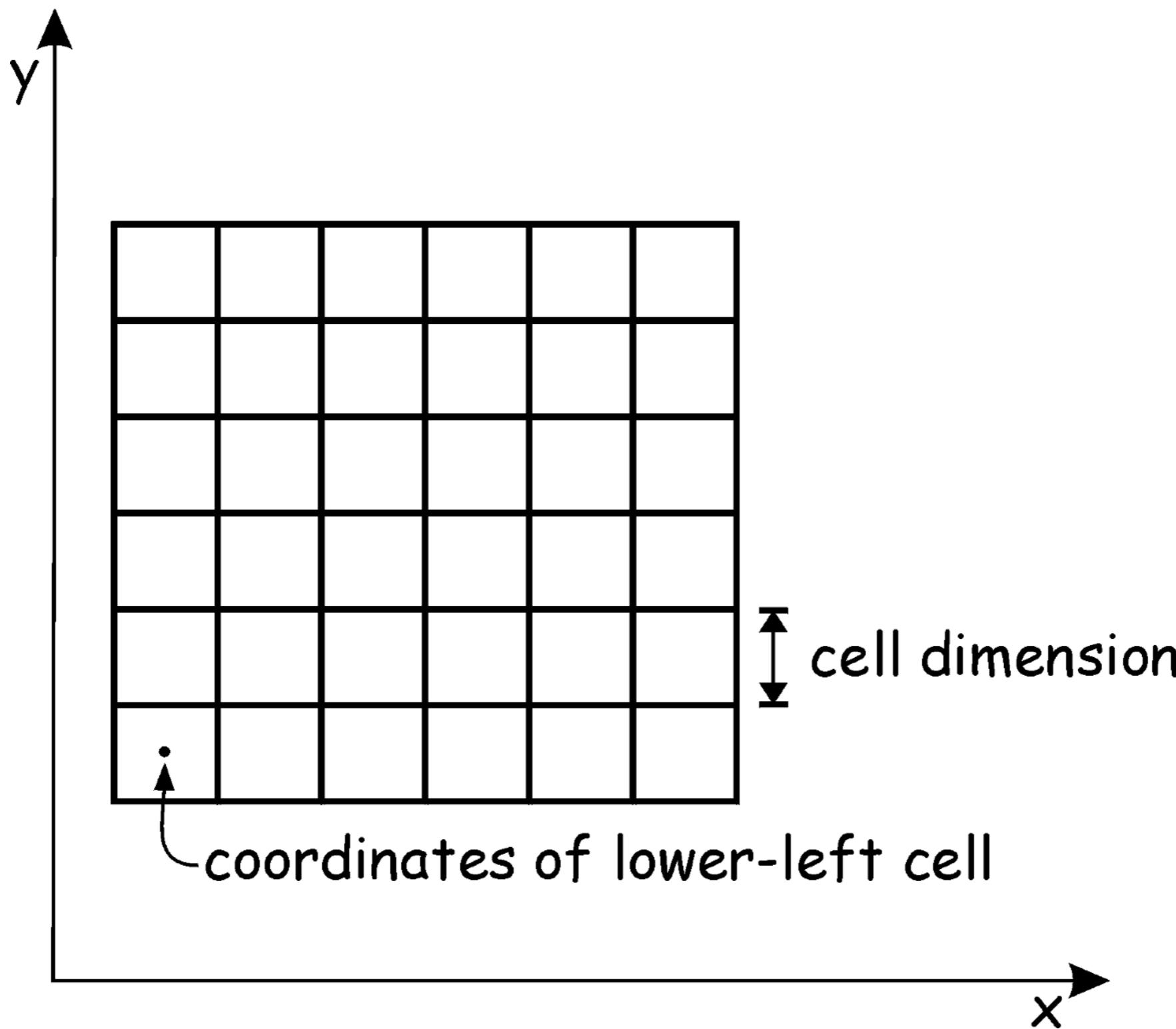
N & V	Type	X	Y
21	v	124.7	155.2
35	n	202.2	150.9
47	v	16.3	35.5
94	n	135.5	22.2
...	...	...	...

What you see

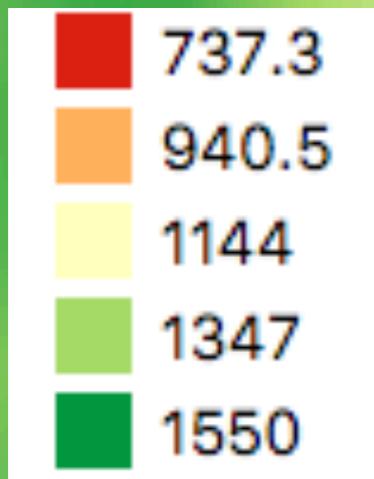
What you don't see

Line	Nodes & Vertices
101	58, 47, 48, 49, 50, ...
102	71, 72, 73, 74, 75, ...
103	35, 21, 22, 23, 24, ...
104	94, 79, 80, 81, 82, ...
...	...

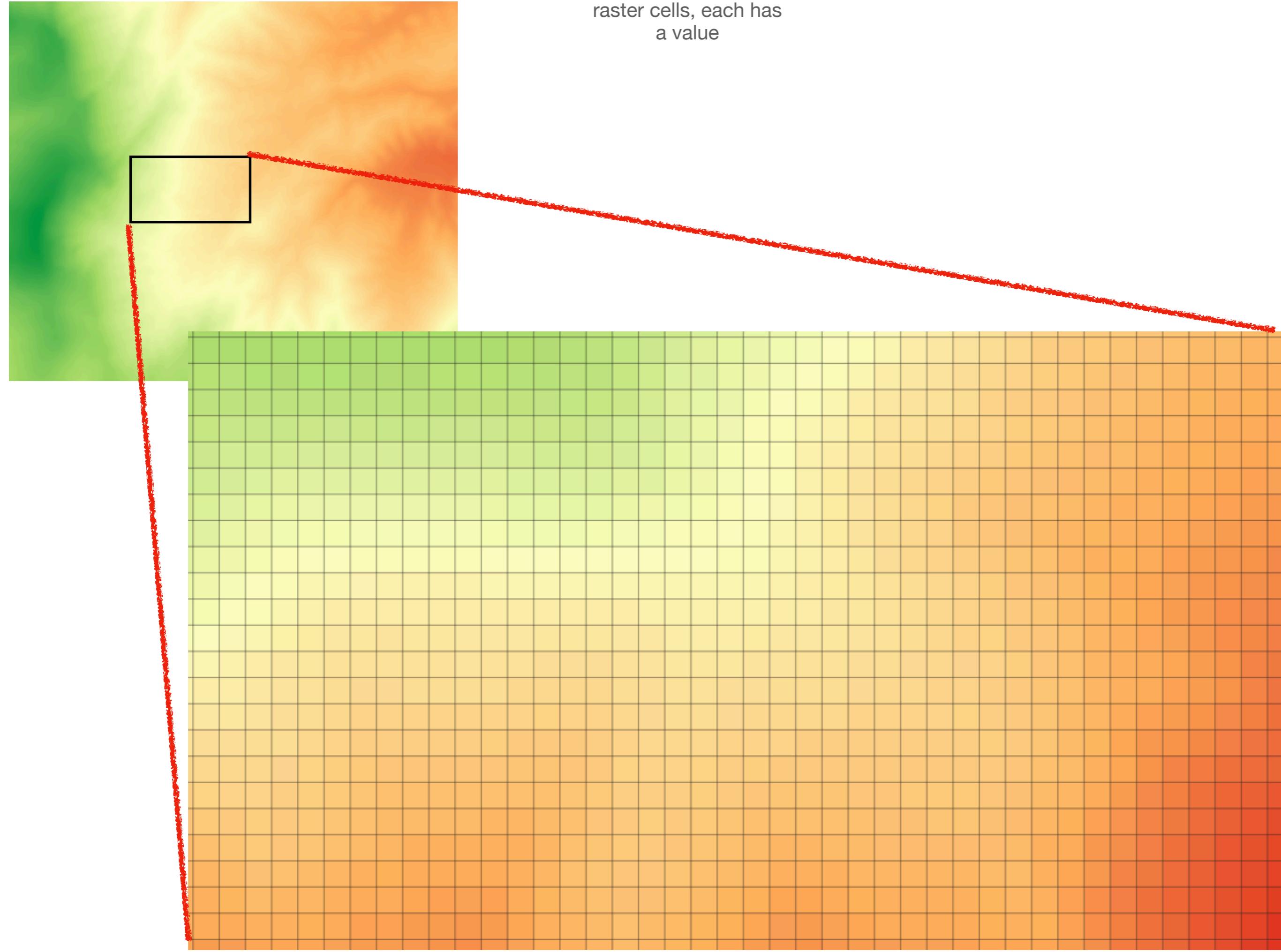
# Rasters – Fixed Cell Size, Grid Orientation

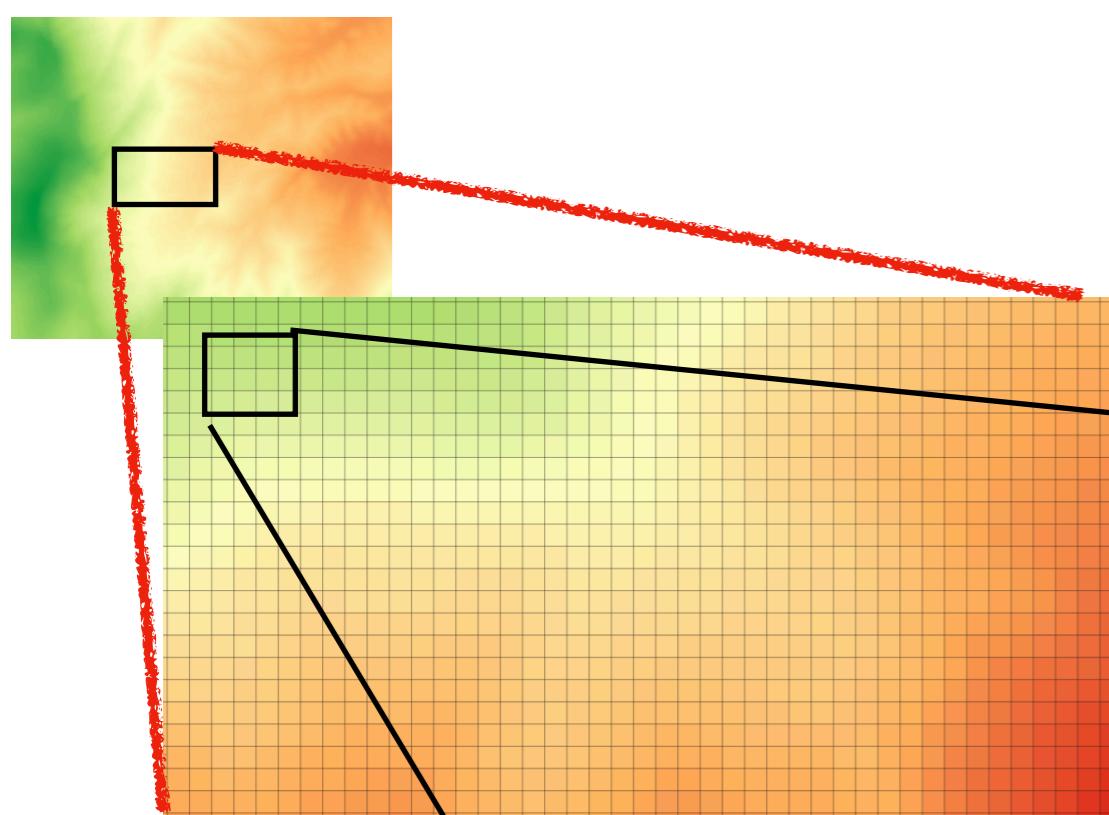


# Gradients



raster cells, each has  
a value





Raster cells, each has  
a value

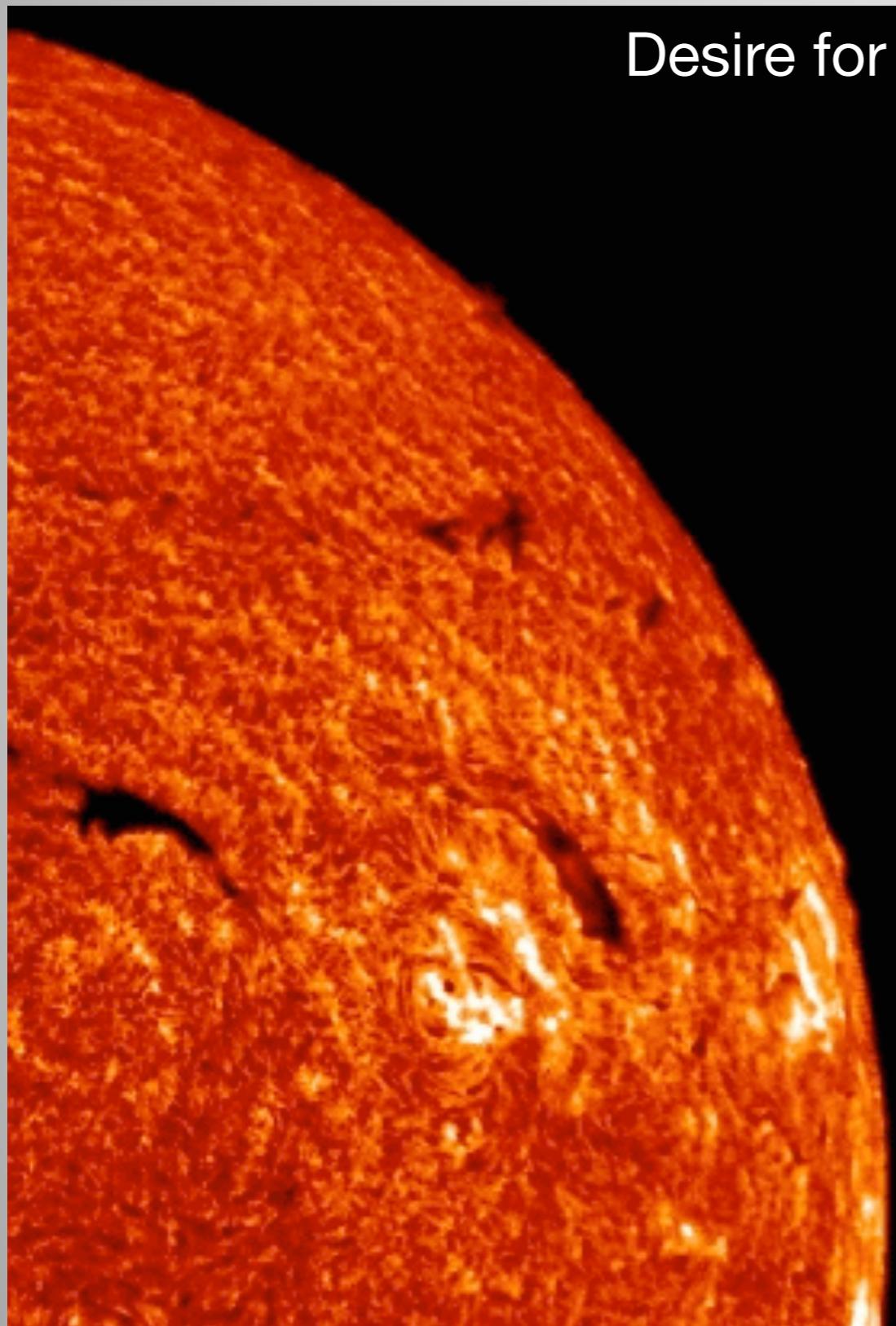
953.5	956.8	959.8	962.5	965.1	967.5
956.4	959.9	962.6	964.9	967.2	969.1
960.3	963.8	966.2	967.5	969.1	970.5
964.0	967.0	969.3	970.1	970.9	971.8
966.6	969.0	971.2	972.2	972.6	972.9
969.2	970.8	972.7	974.0	974.2	973.9



Two key questions:  
Grain size (smallest thing I want to resolve, and  
Extent (spatial scope of my analysis)

Life is often about managing expectations

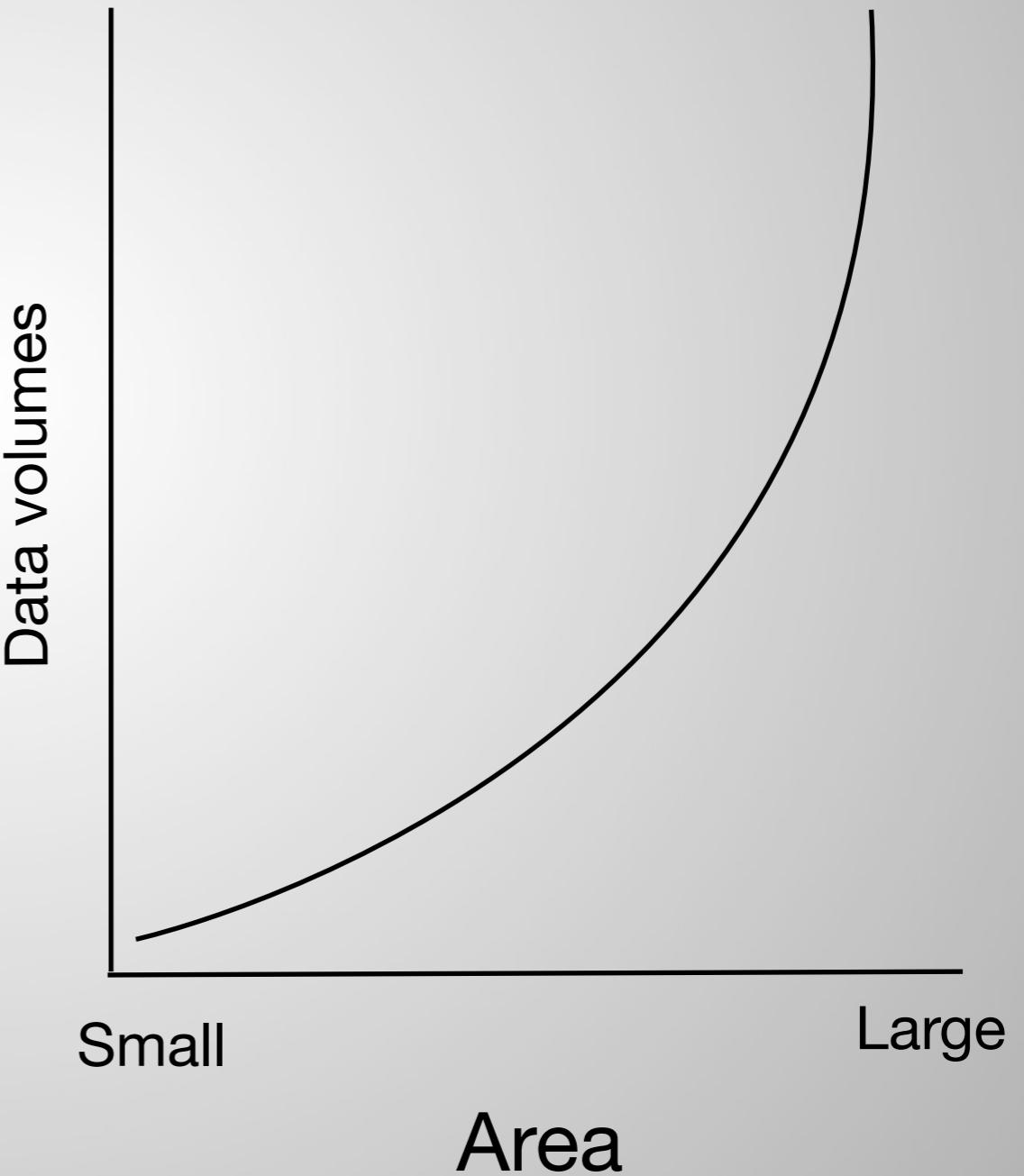
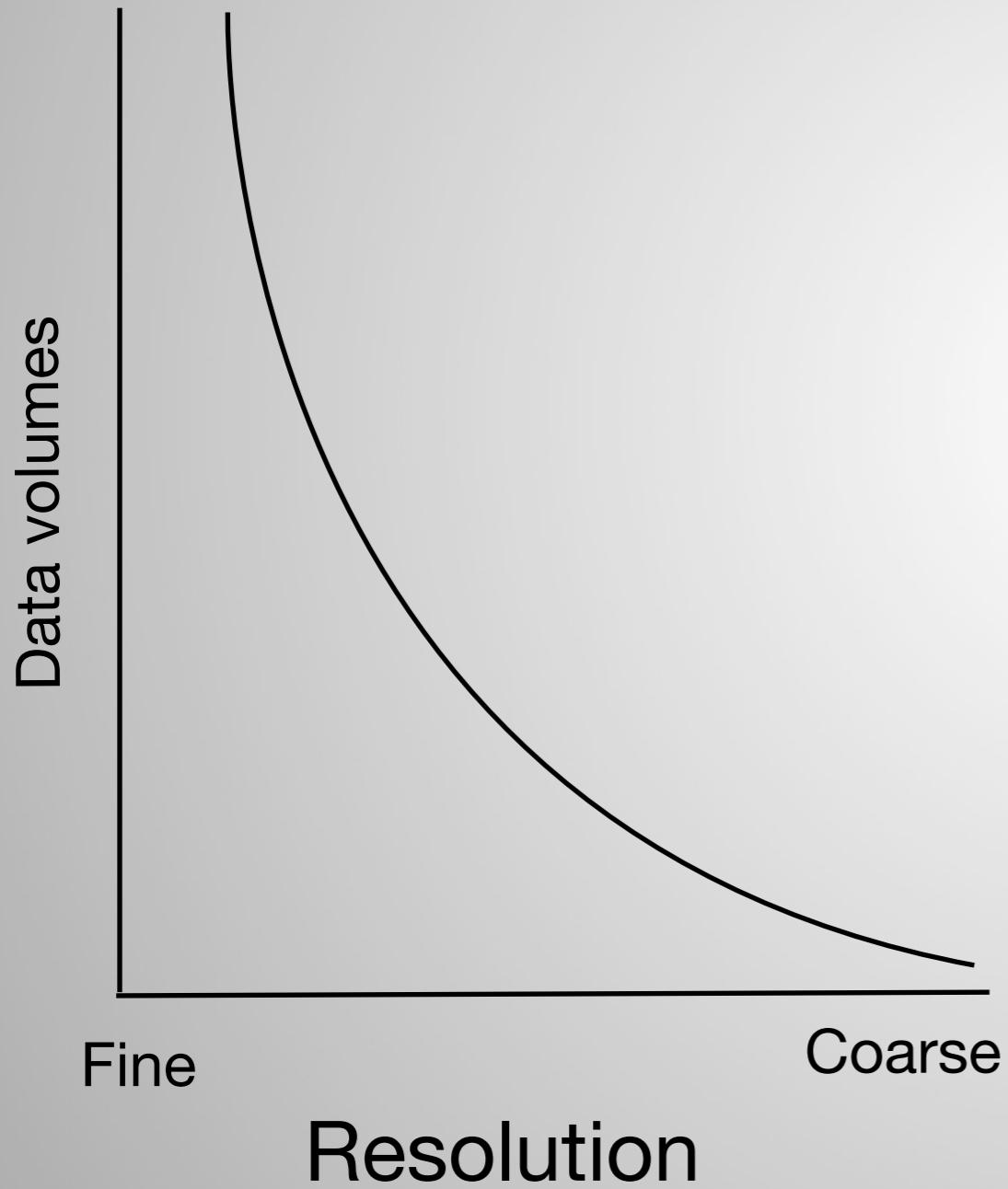
Desire for this extent....



....at this spatial grain

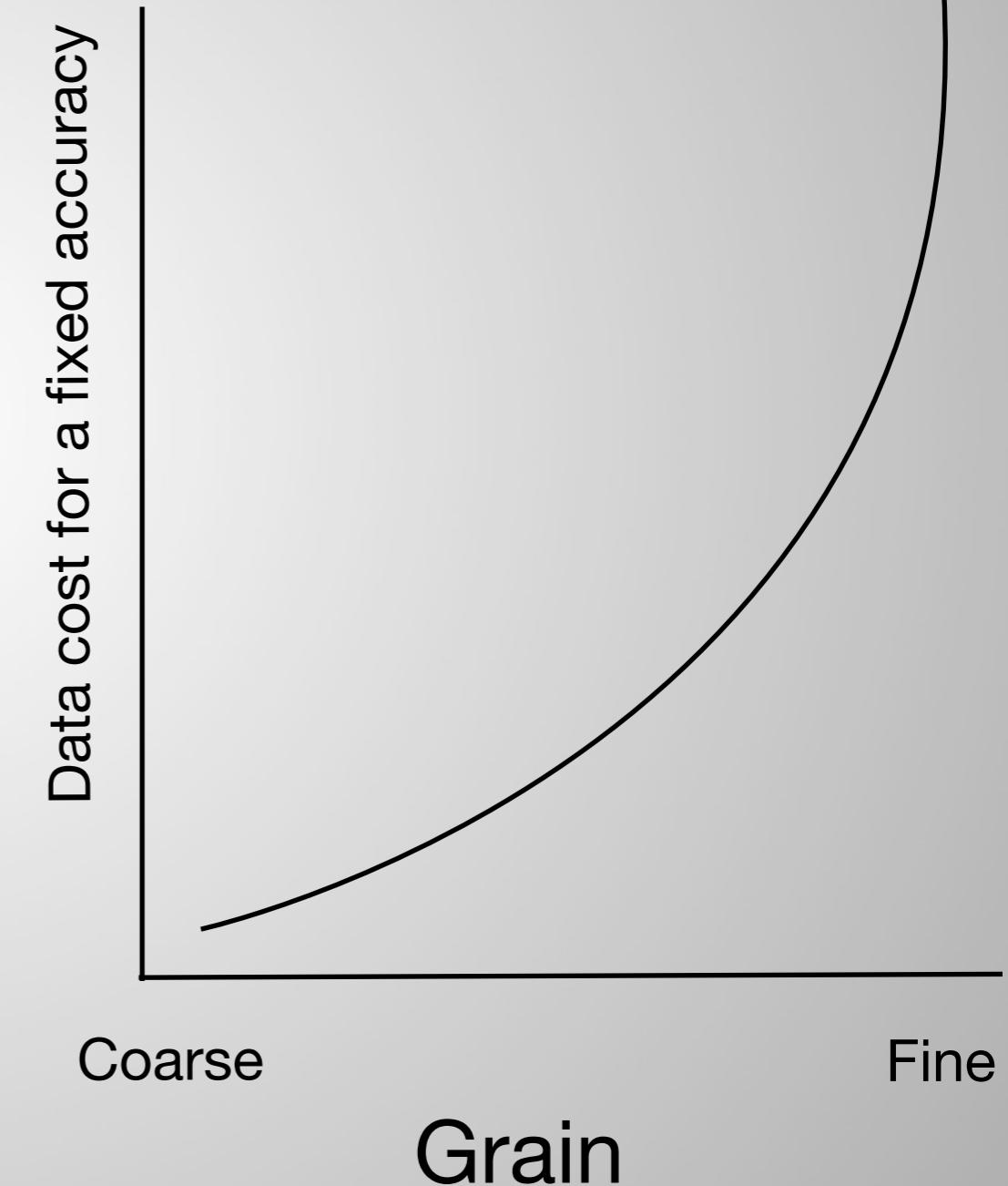
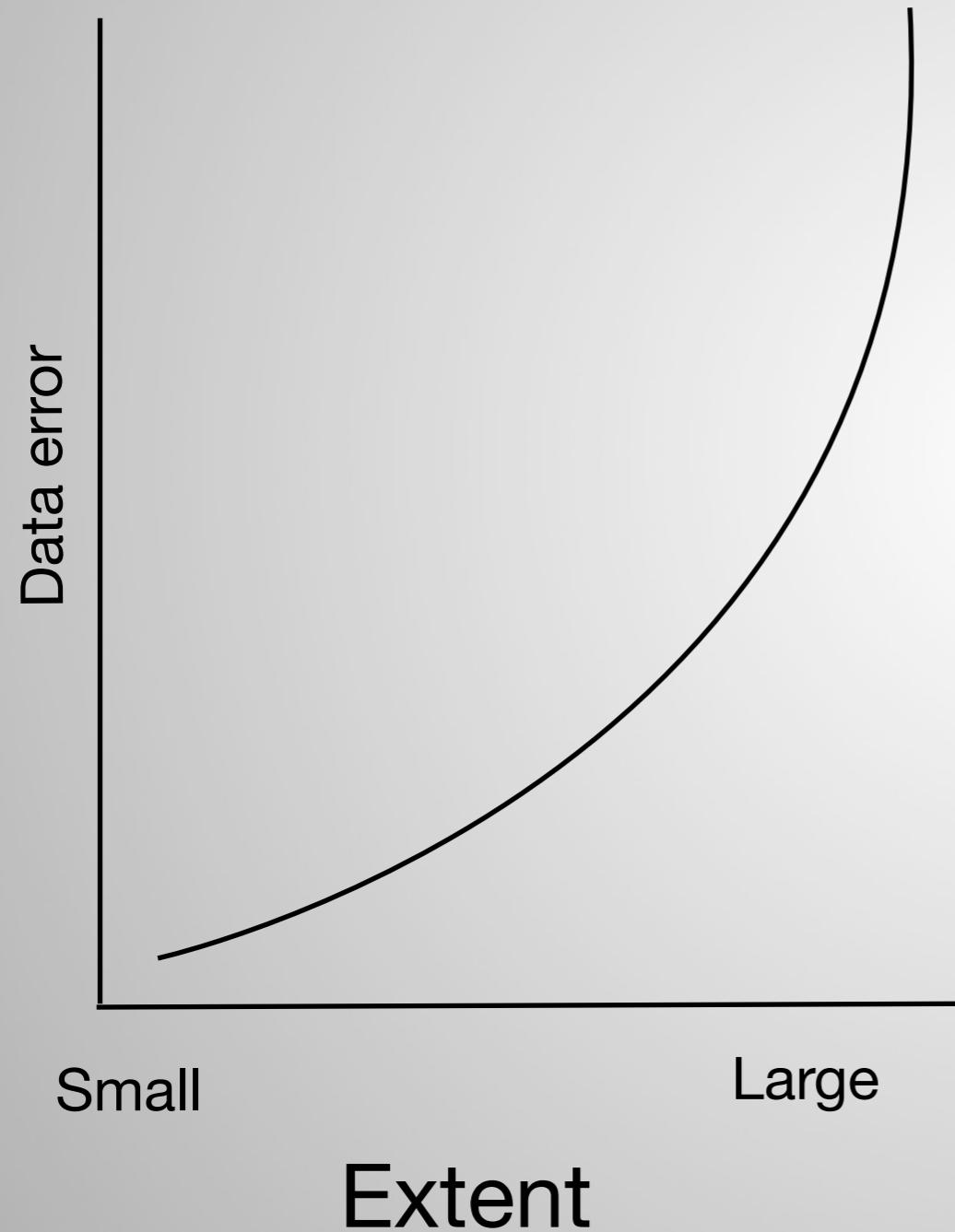


- What resolution (how fine scale)?
- How big an area?

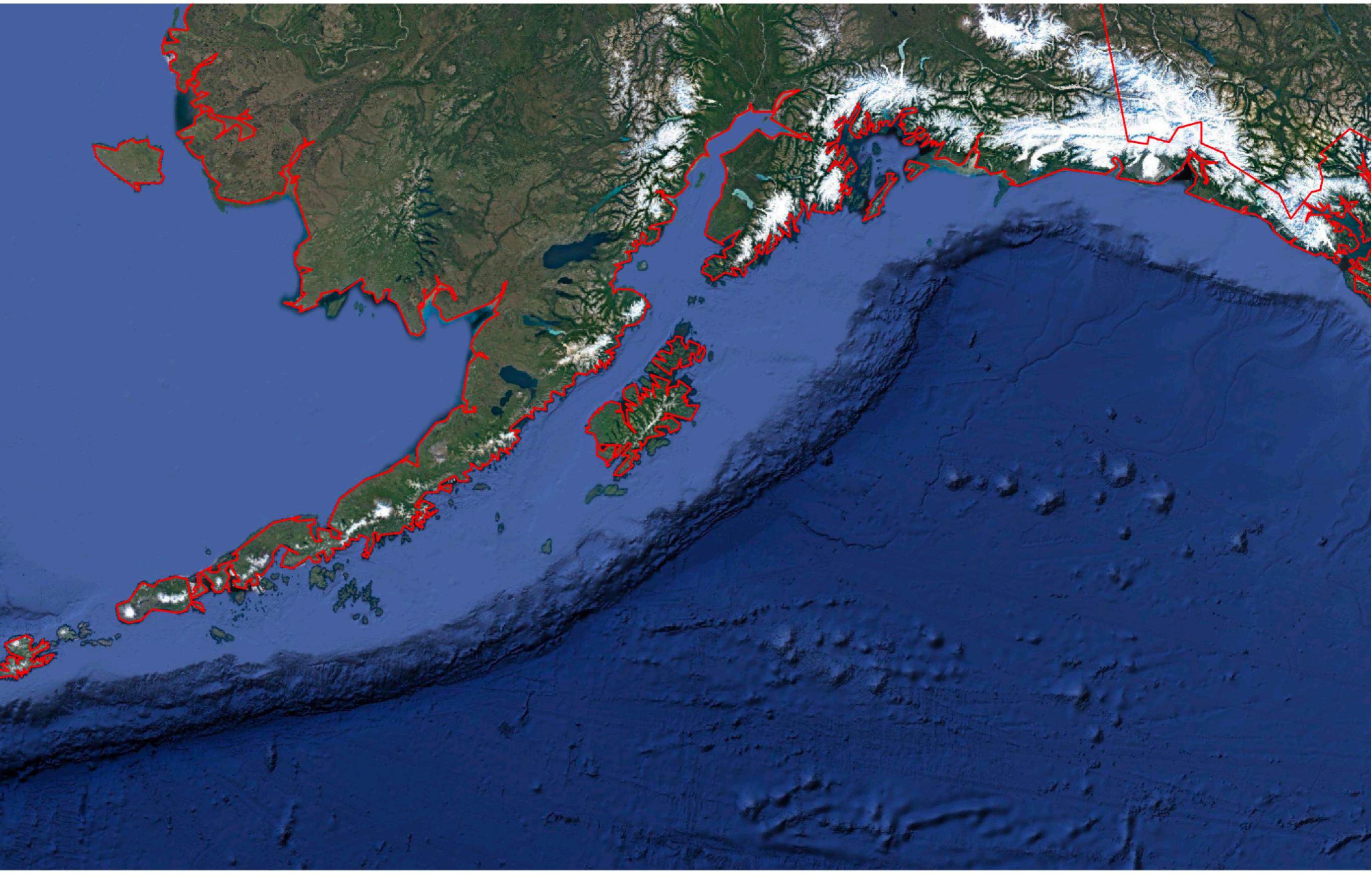


Third key question: how fine a grain size can I afford while meeting my accuracy targets?

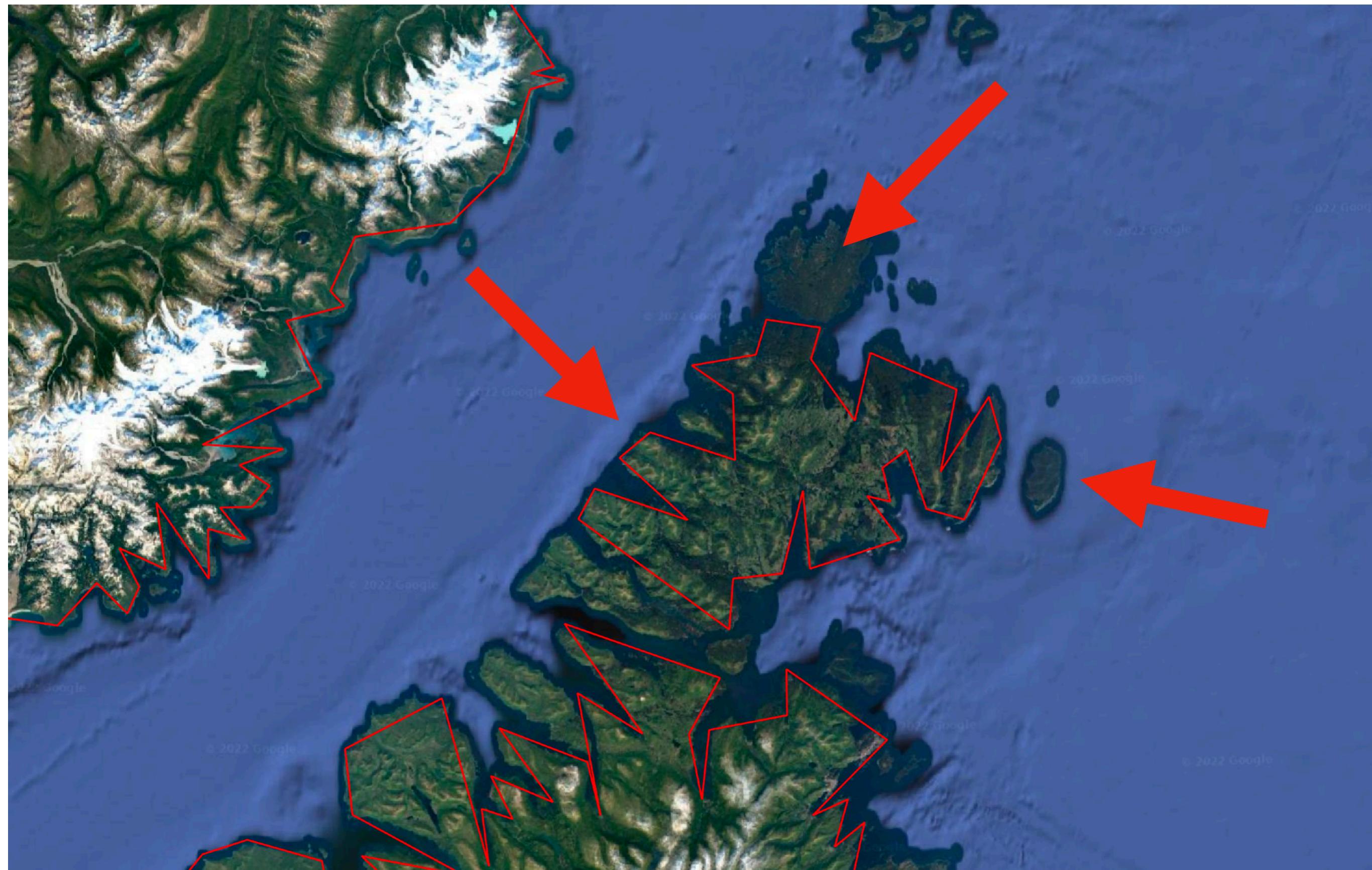
Errors Often Increase with Extent, Data Costs Increase as Grain Decreases.



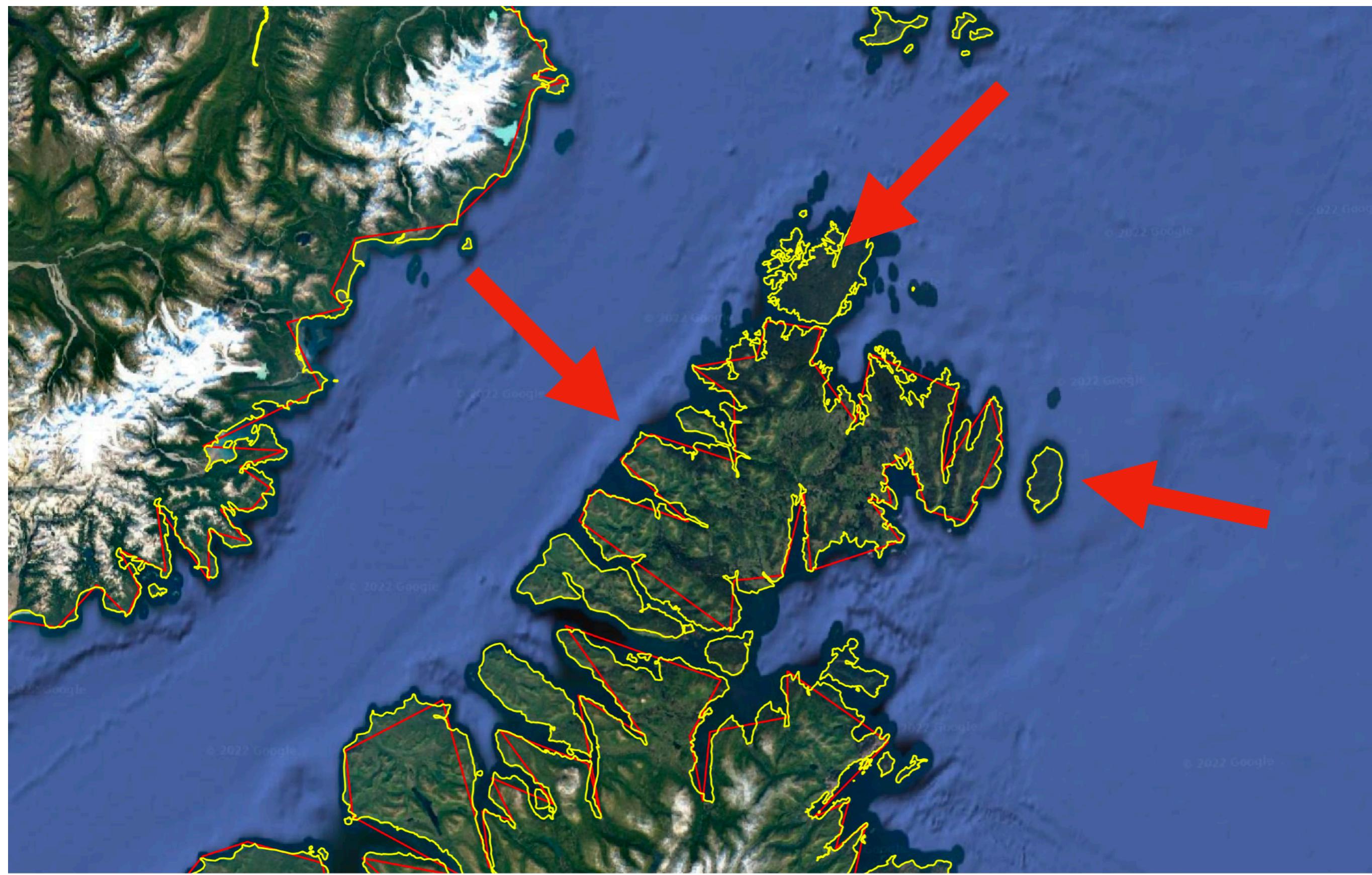
# Sampling (digitizing) Accuracy vs. Cost



# On Closer Inspection, Sampling Errors



# A more detailed (and expensive) sampling of vertices



But further magnification reveals (smaller) errors are still there



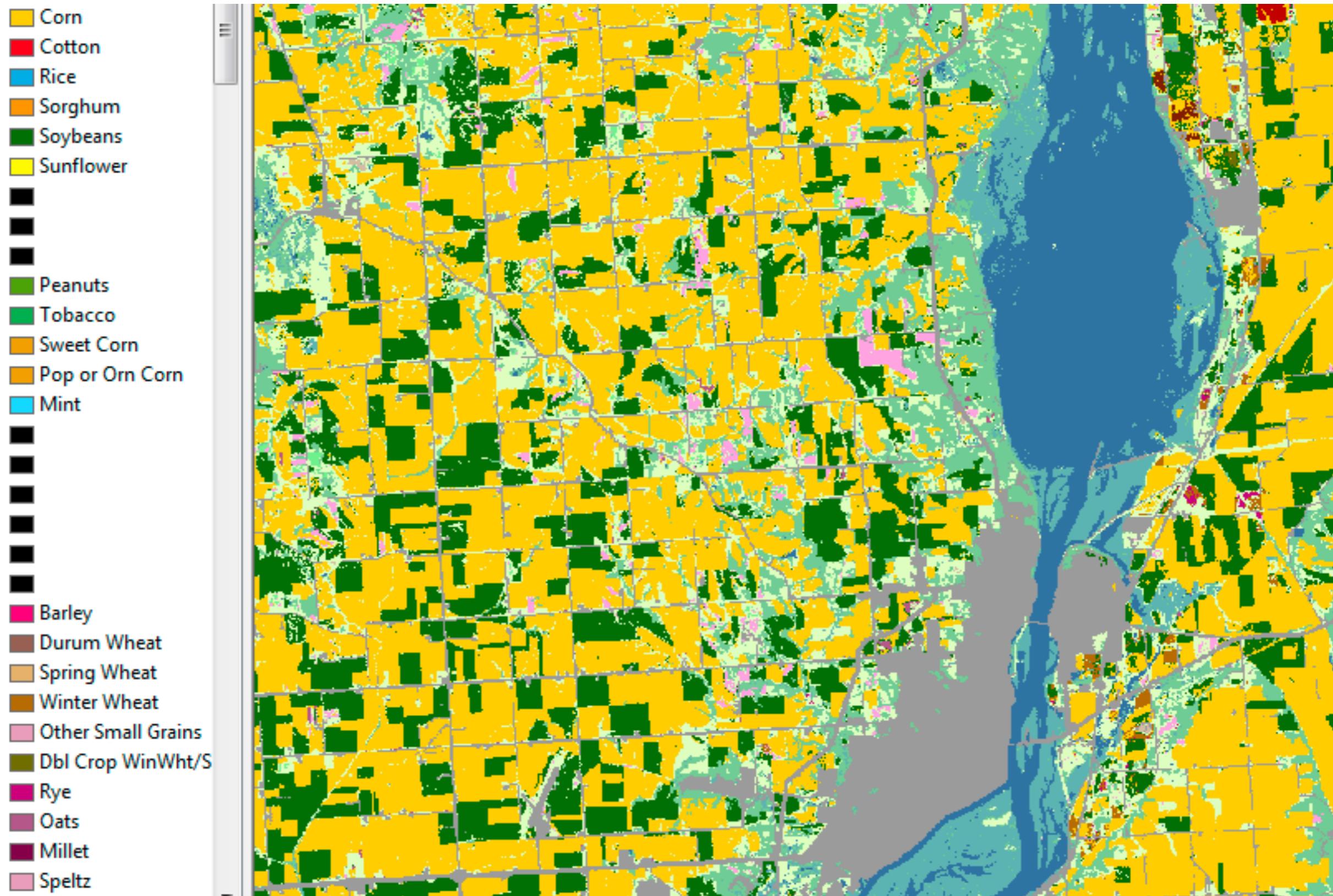
Remedy: realize all data have  
some sampling (resolution, grain)  
error, ensure it is below a spatial  
dimension that is important to you

# Common Attribute Types of Data, Both Raster and Vector

- Nominal - no implied rank or size, e.g., county or country name,
- Ordinal - identifies order, but not absolute difference, e.g., state rank by percent poverty
- Interval/ratio - both order and a linear scale, e.g., temperature, pop. density, elevation

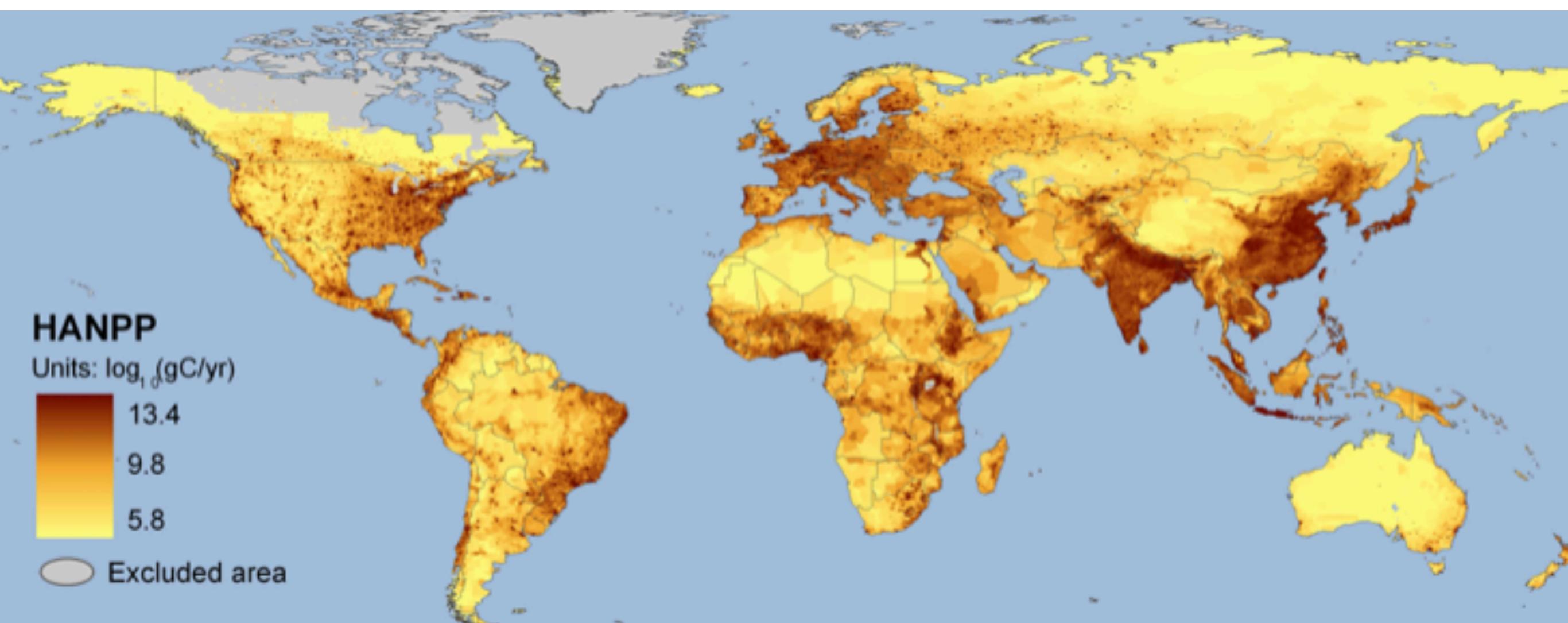
## Nominal

# Land Cover



Interval/Ratio

Human appropriation of net primary productivity - grams  
of carbon per unit area per year



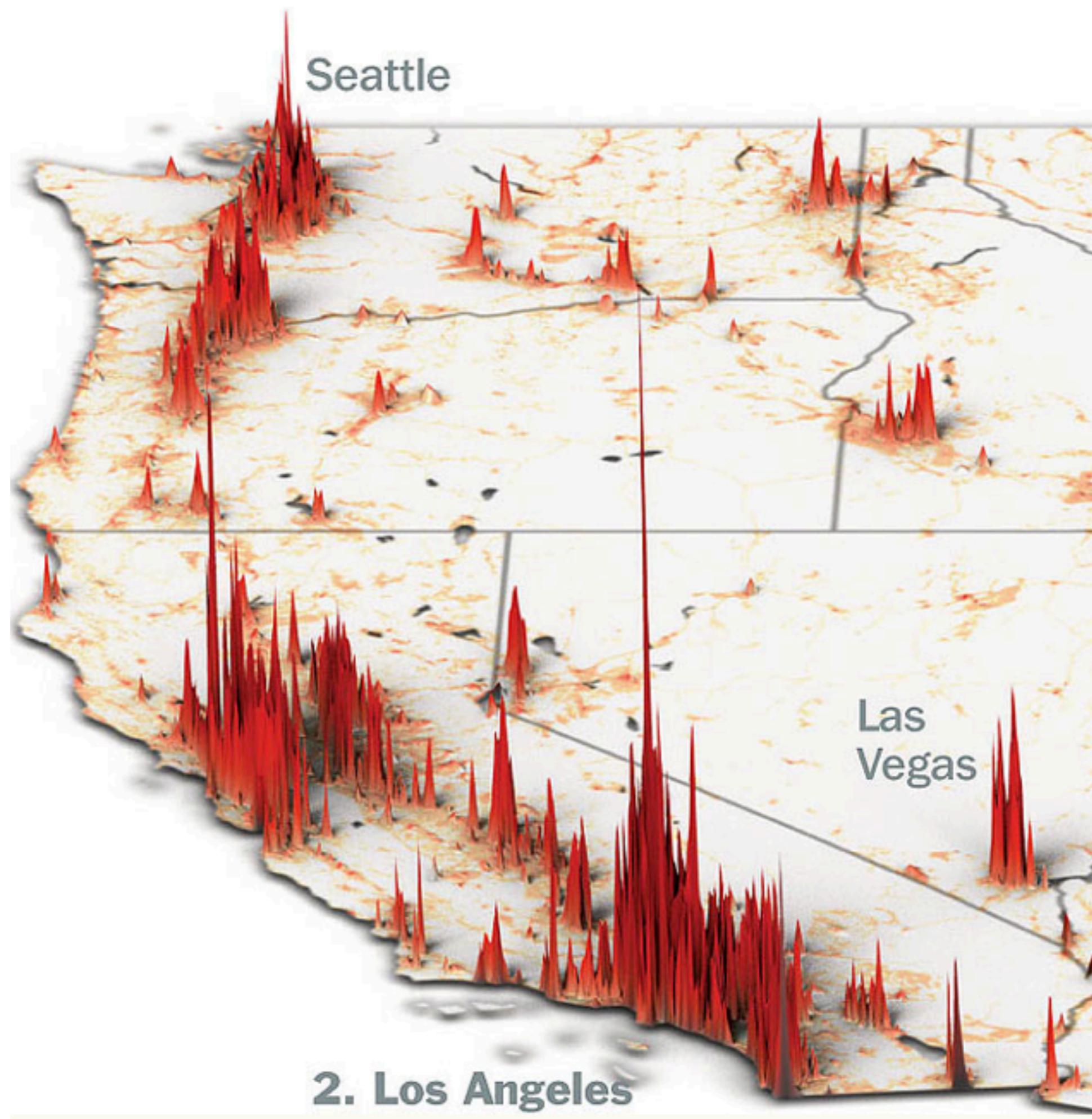
Population  
count,  
persons

Seattle

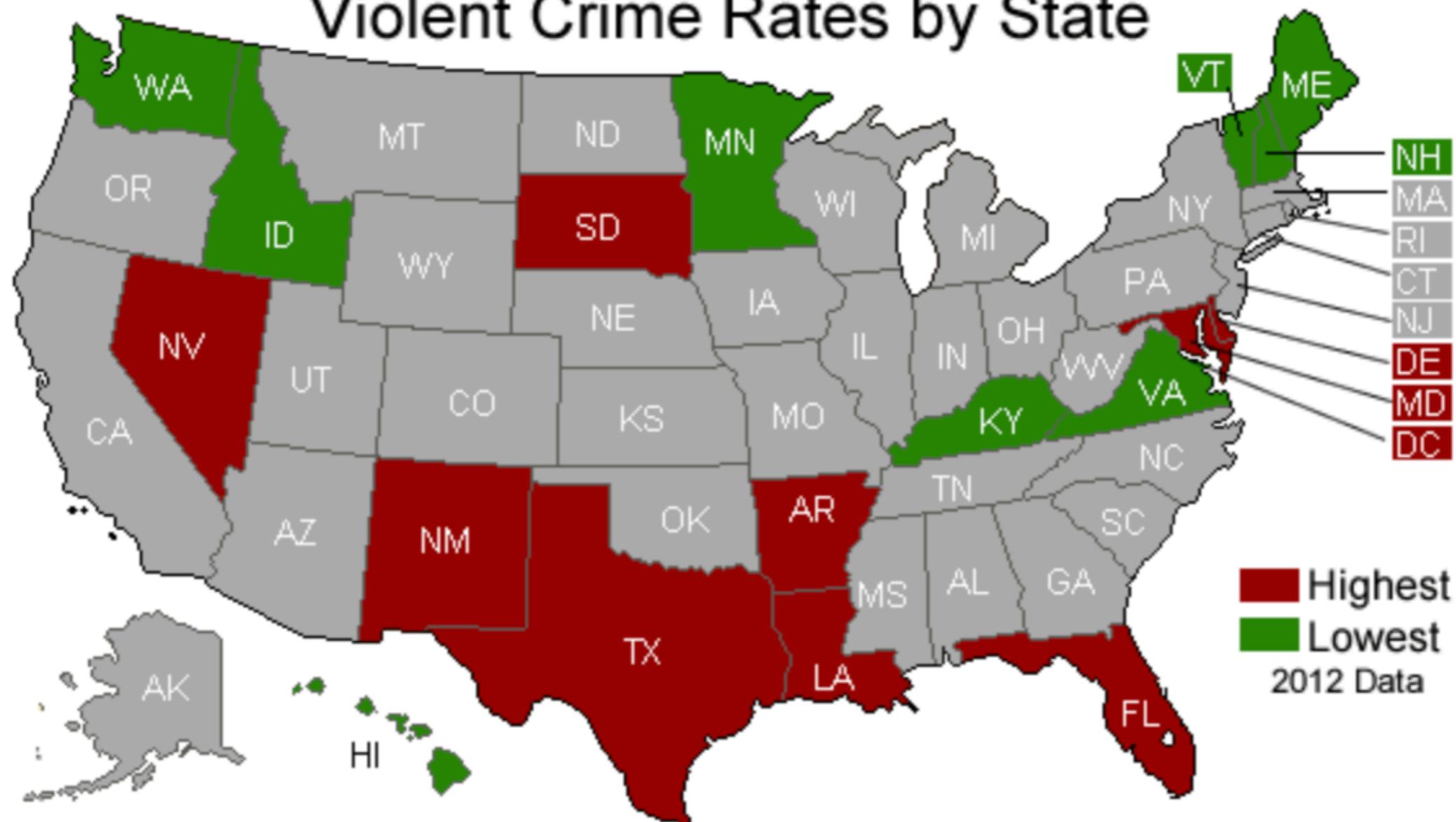
Las  
Vegas

2. Los Angeles

Interval/Ratio



# Violent Crime Rates by State



Ordinal

# Data Models

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Basic Vector and Raster Representation

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