

# Spatial Analyst Tools

GIS III: GIS Analysis

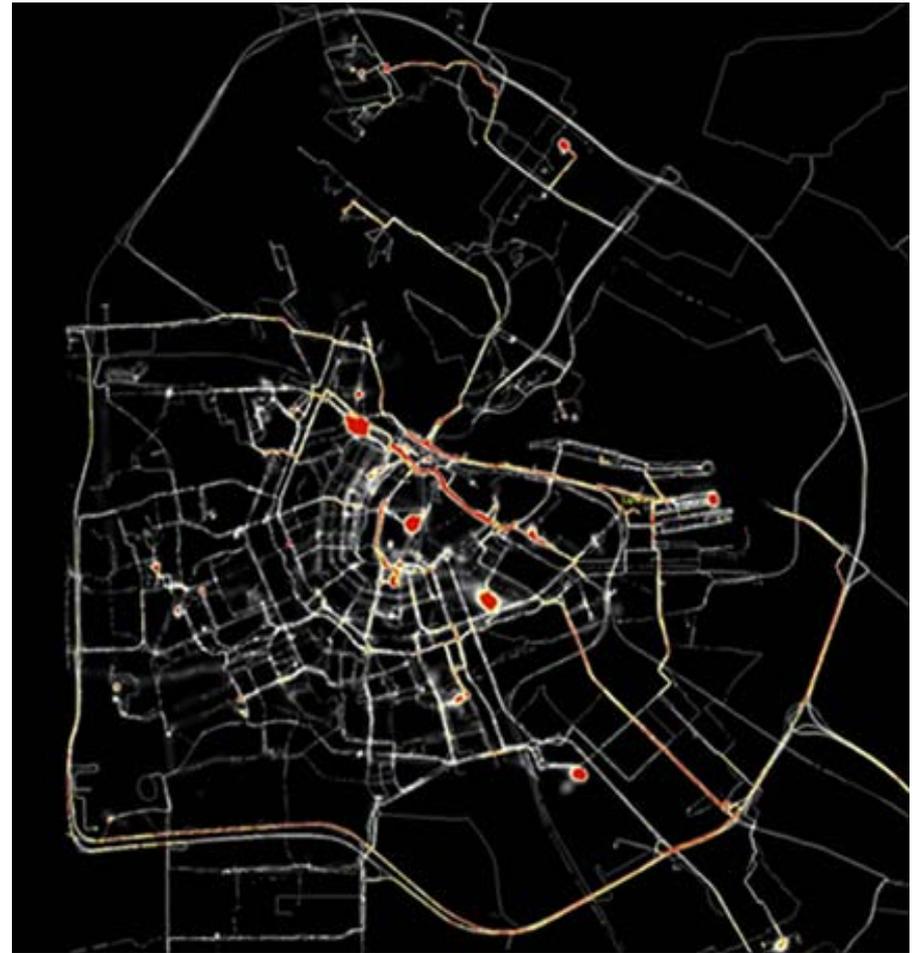


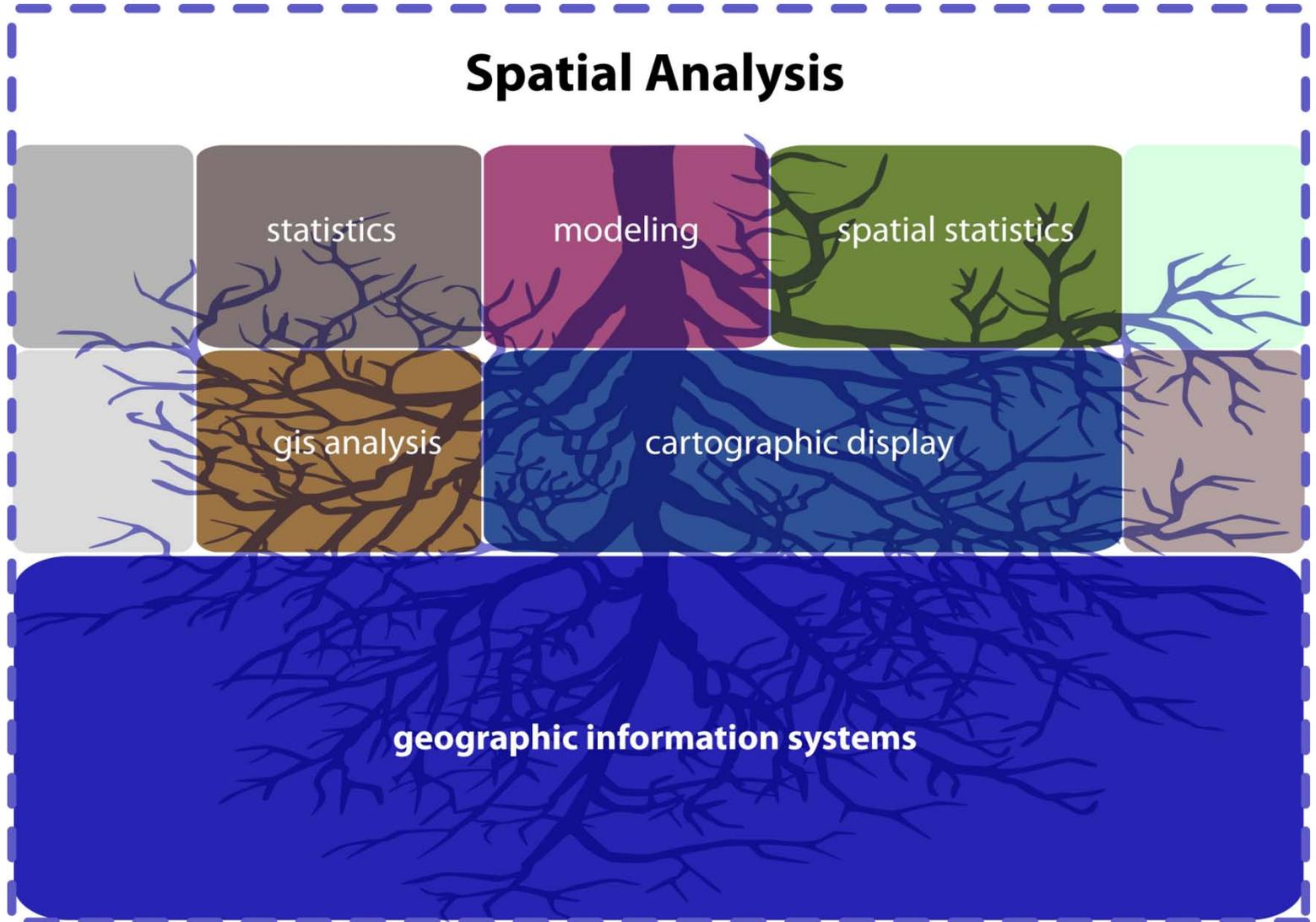
- **Spatial Analyst Toolbox**
  - **Density Tools**
  - **Interpolation Tools**
  - **Statistics Tools**



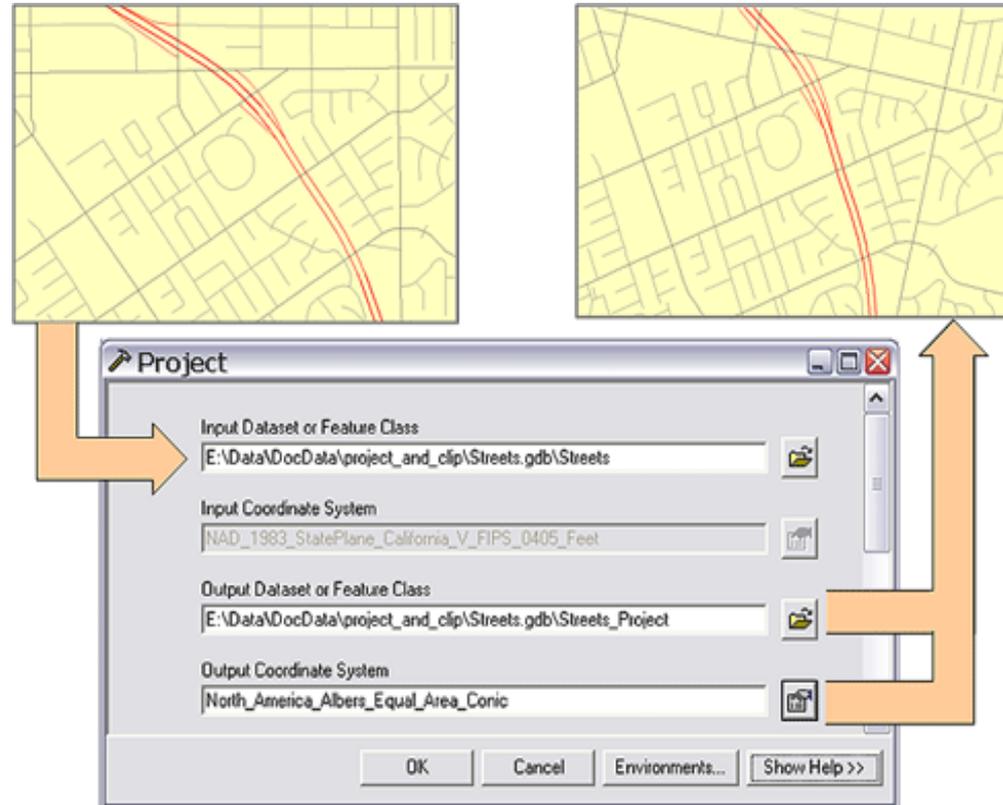
# What is GIS Analysis?

- **Mapped data shows you where objects are located but cannot explain why**
  - **GIS analysis searches for patterns and meaning in mapped data using GIS software**
  - **Allows you to link, query, collect and display your spatial data**



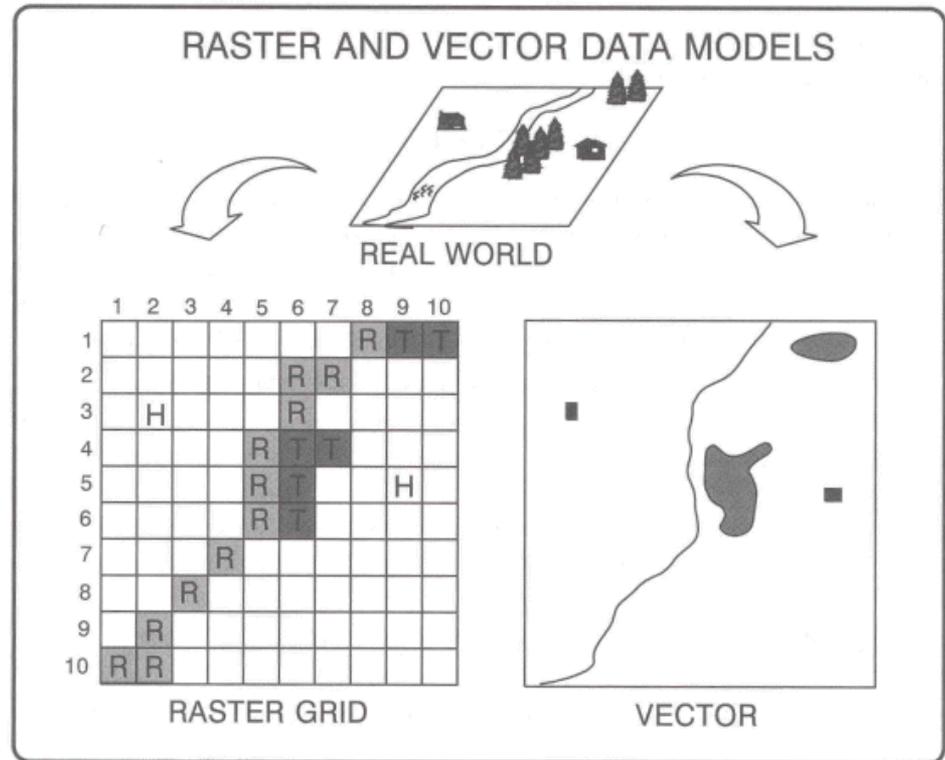


- **Geographic analysis and data management**
- **Performs an operation on an input dataset, resulting in a new output dataset**

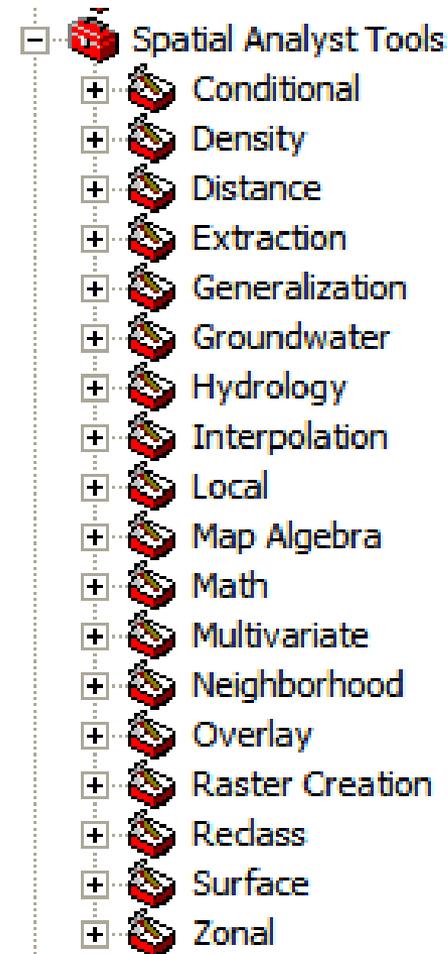
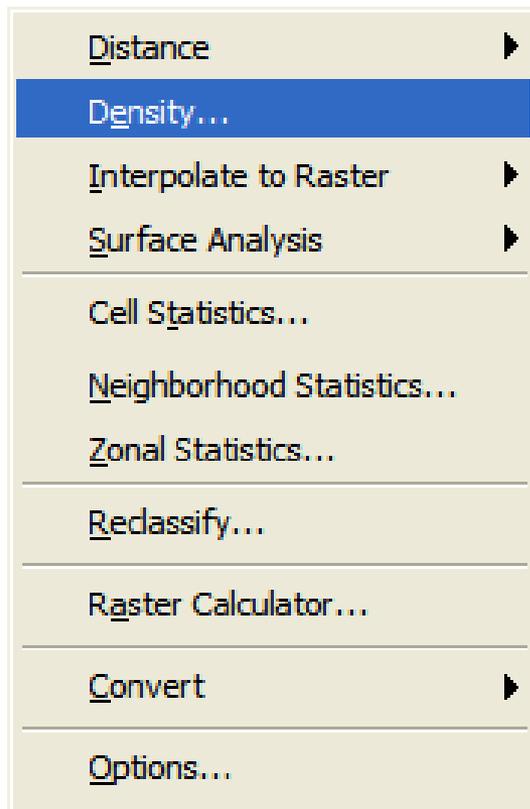


# Storing Abstracted Objects

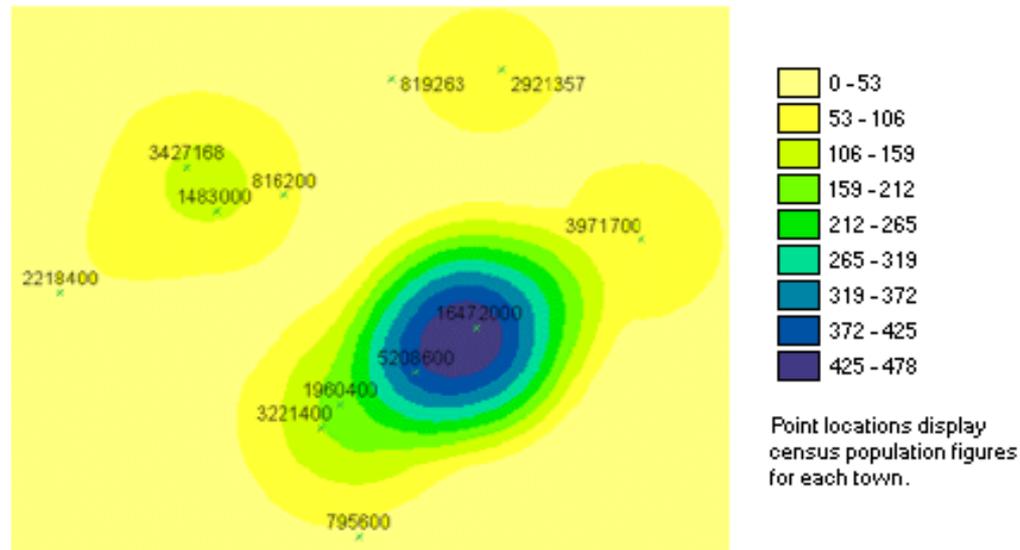
- **Two primary methods for digital storage**
  - **Vector formats discretely identify shape coordinates**
  - **Raster formats assign square cells to real world entities**



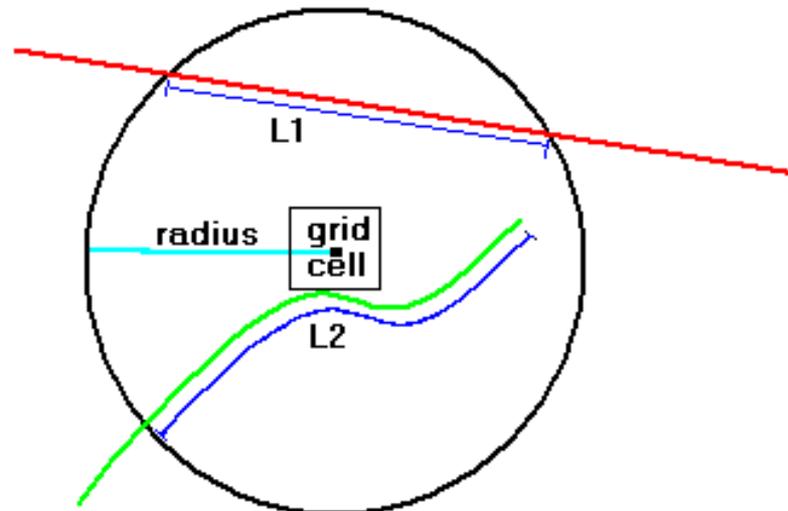
- Specialized tools for analysis
- Raster based



- Population per square mile
- Number of features per acre
- Uses
  - Produce a continuous surface from a point layer
  - Visualize overlapping points
  - Identify “hot spots”

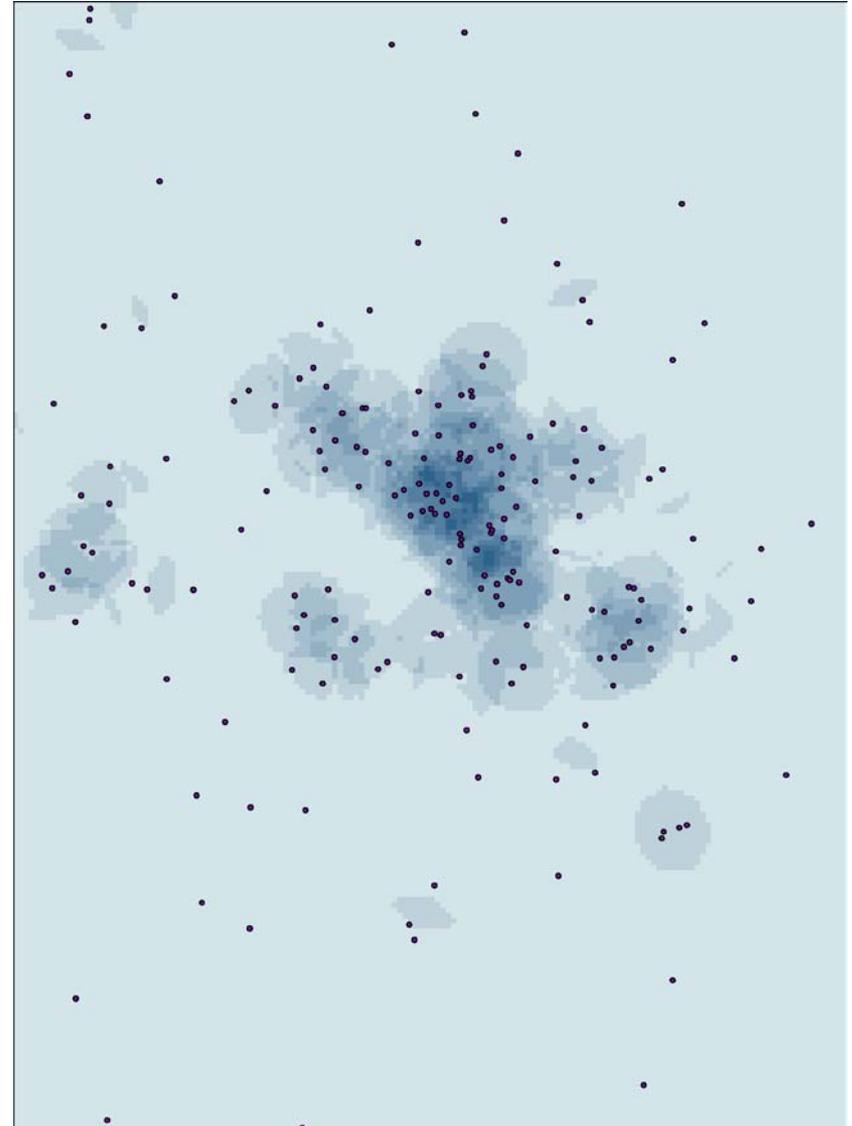
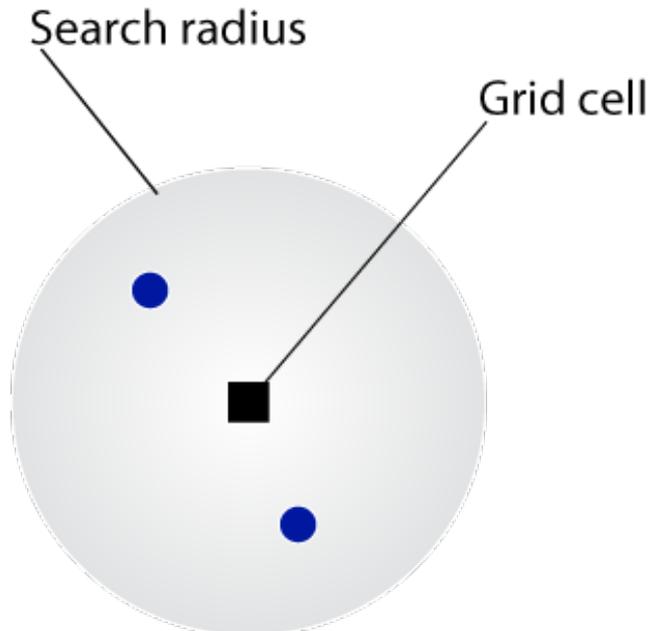


- **Three density tools in Spatial Analyst**
  - **Line density:** Calculates a magnitude per unit area from polyline features that fall within a radius around each cell
  - **Point density**
  - **Kernel density**
- **All density tools produce new raster datasets**



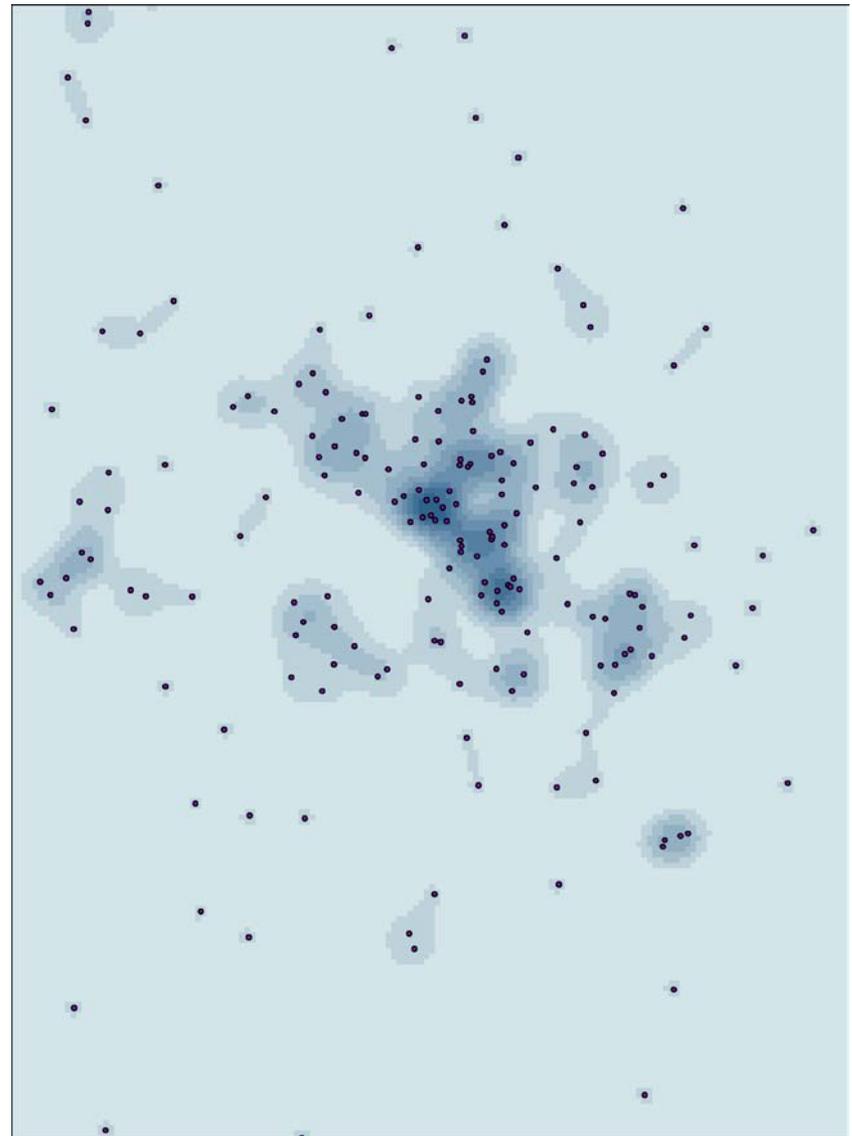
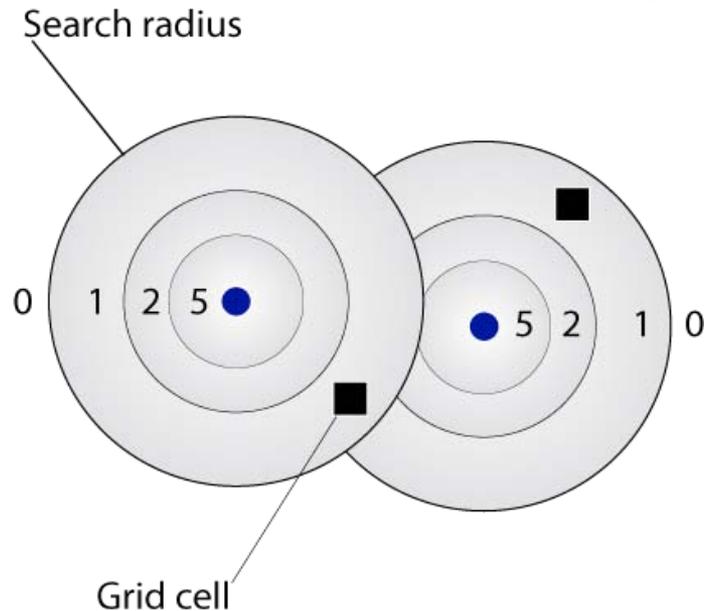
## Point Density

Calculates a magnitude per unit area from point features that fall within a neighborhood around each cell

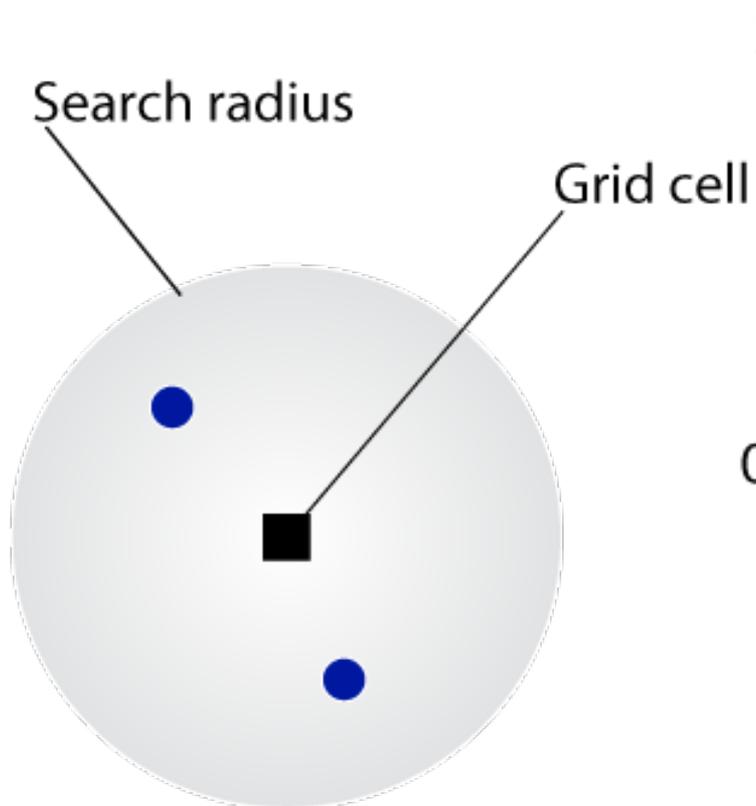


## Kernel Density

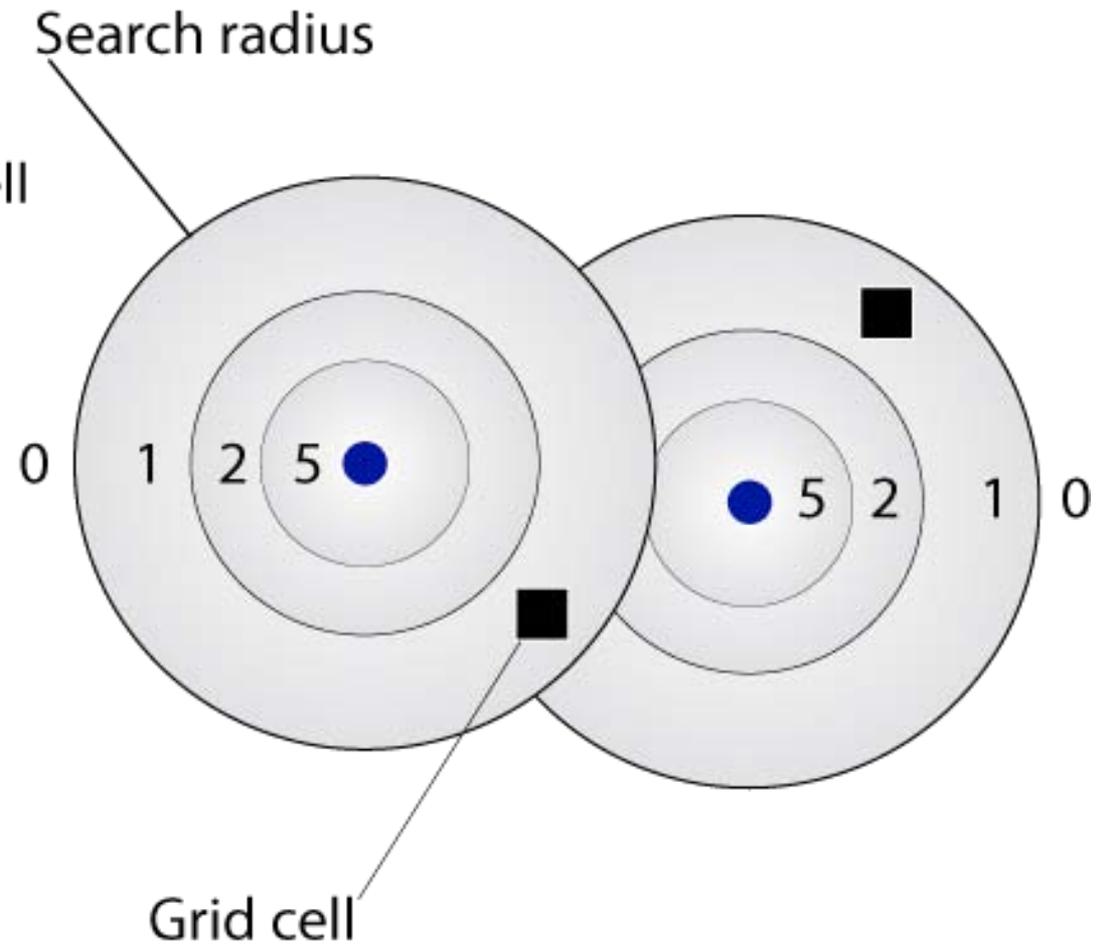
Calculates a magnitude per unit area from point or polyline features using a kernel function to fit a smoothly tapered surface to each point or polyline



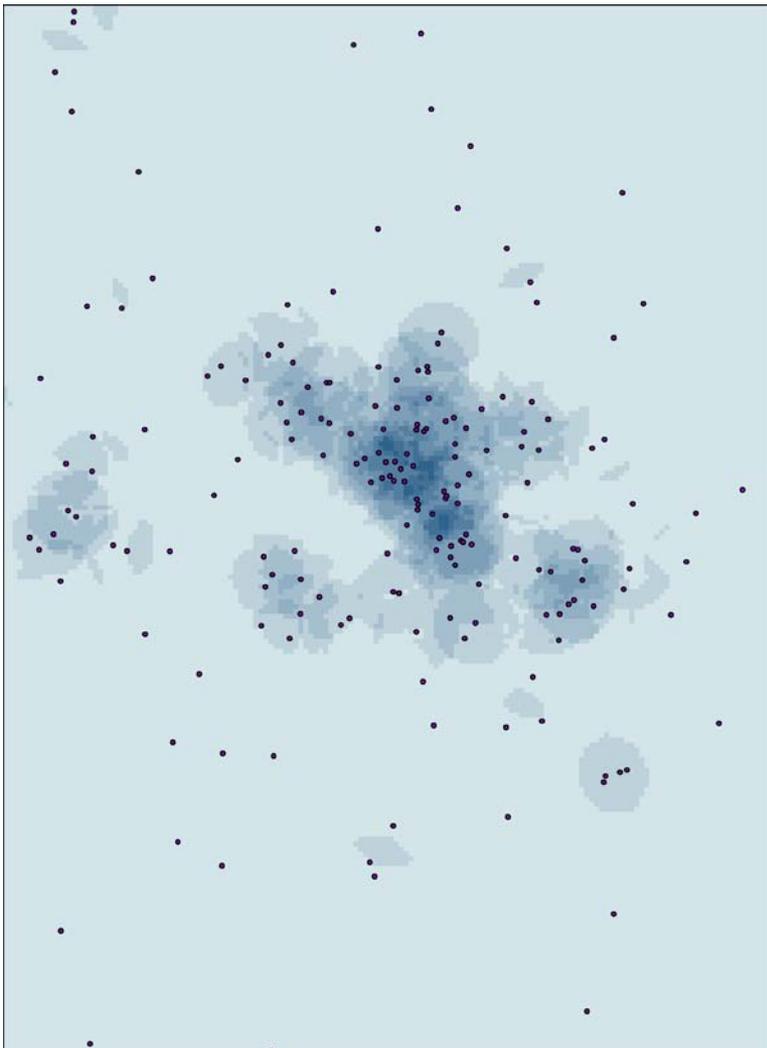
## Point Density



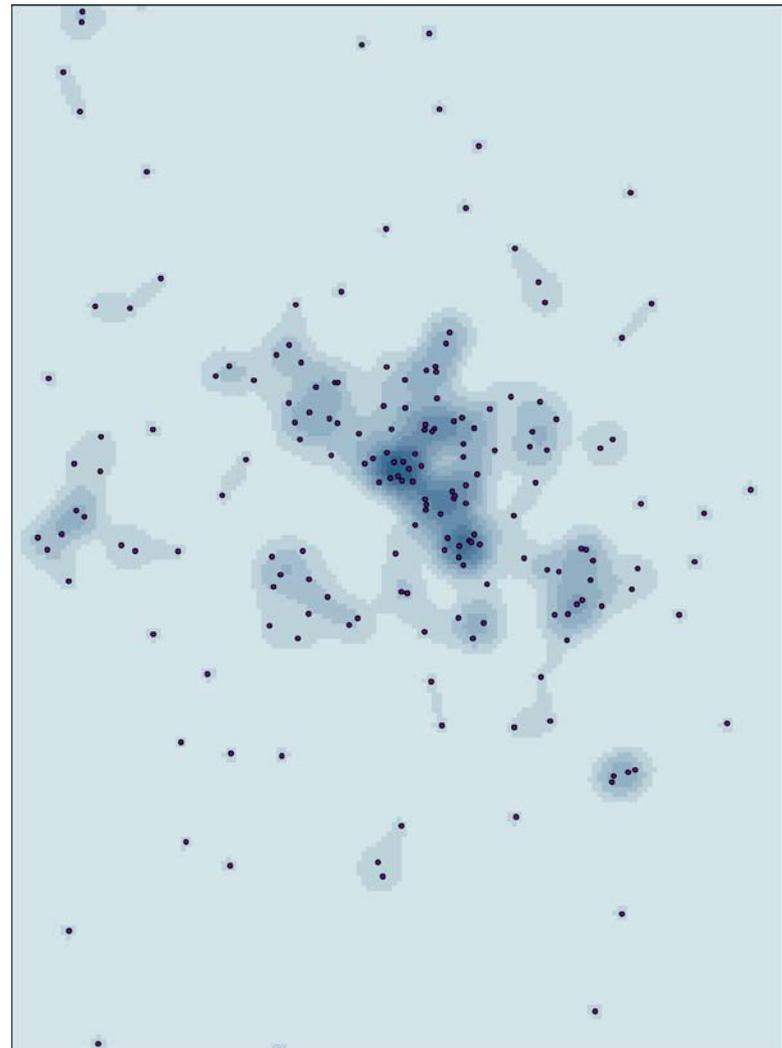
## Kernel Density



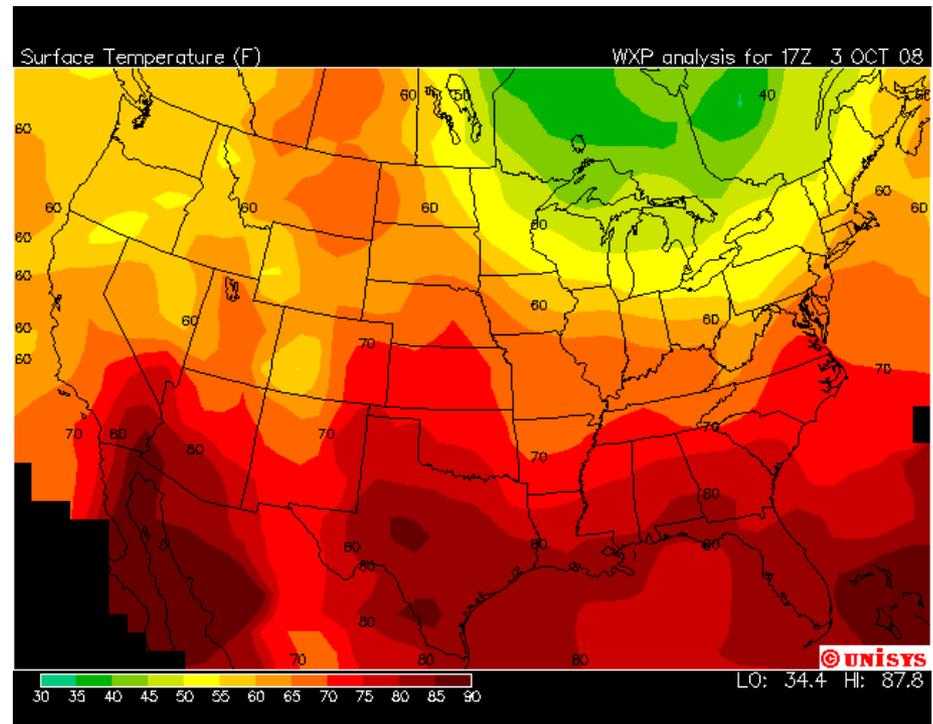
## Point Density



## Kernel Density

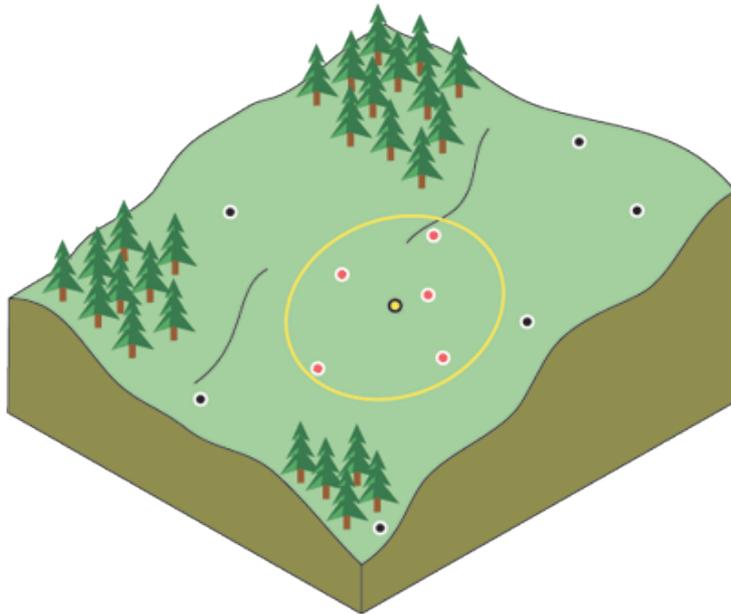


- Interpolation creates a continuous surface from individual point values
- Examples:
  - Elevation data
  - Temperature
- In ArcMap interpolation creates a new raster dataset



- **There are many different interpolation techniques**
- **Different methods produce different results**
- **Method parameters will also affect results**
- **Three common interpolation models**
  - **Inverse Distance Weighted**
  - **Spline**
  - **Kriging**

- **IDW determines values by weighting sample points**
- **Weight determines the influence of sampled points**
- **Use IDW for simple interpolation or in cases where closer points are thought to be similar**

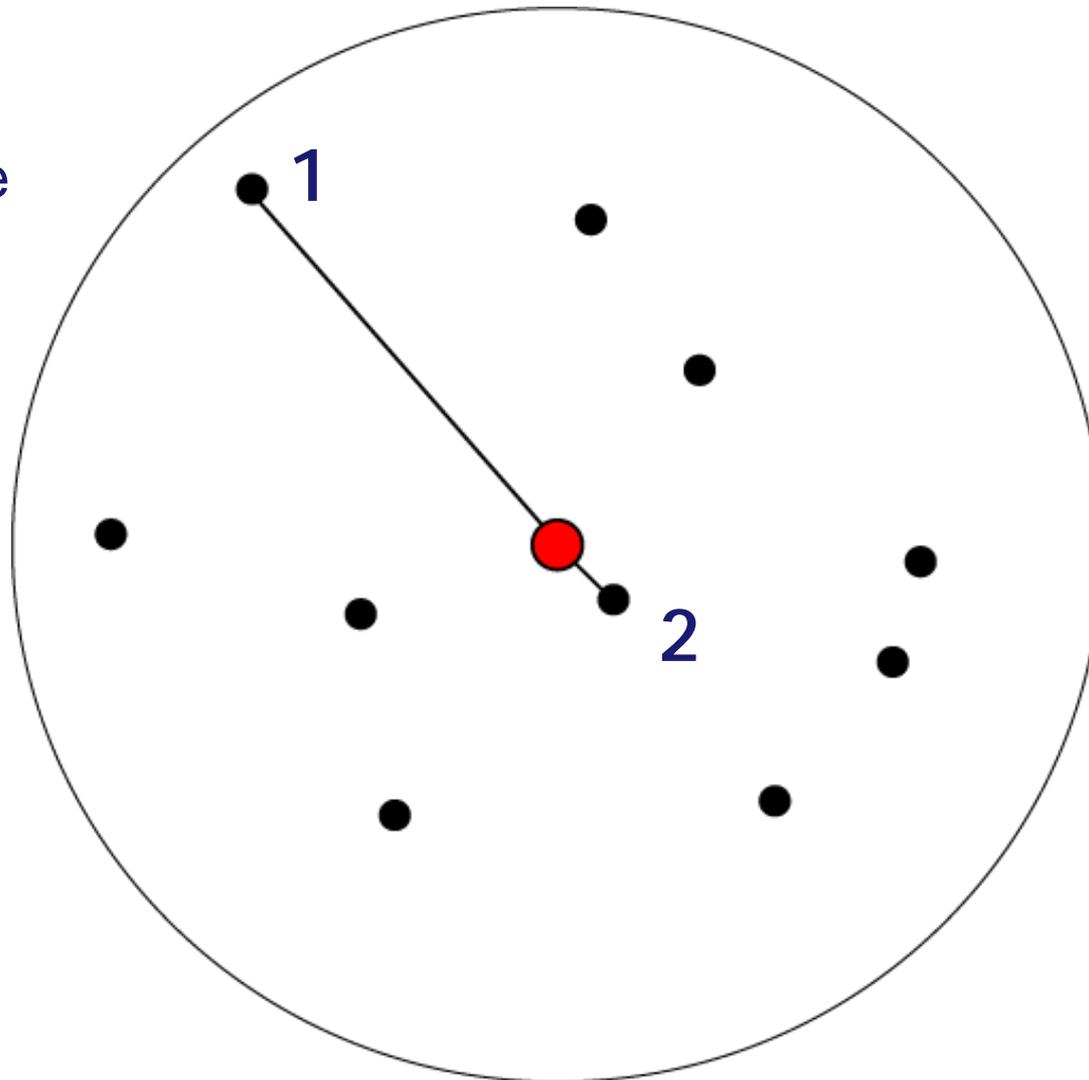


Examples:

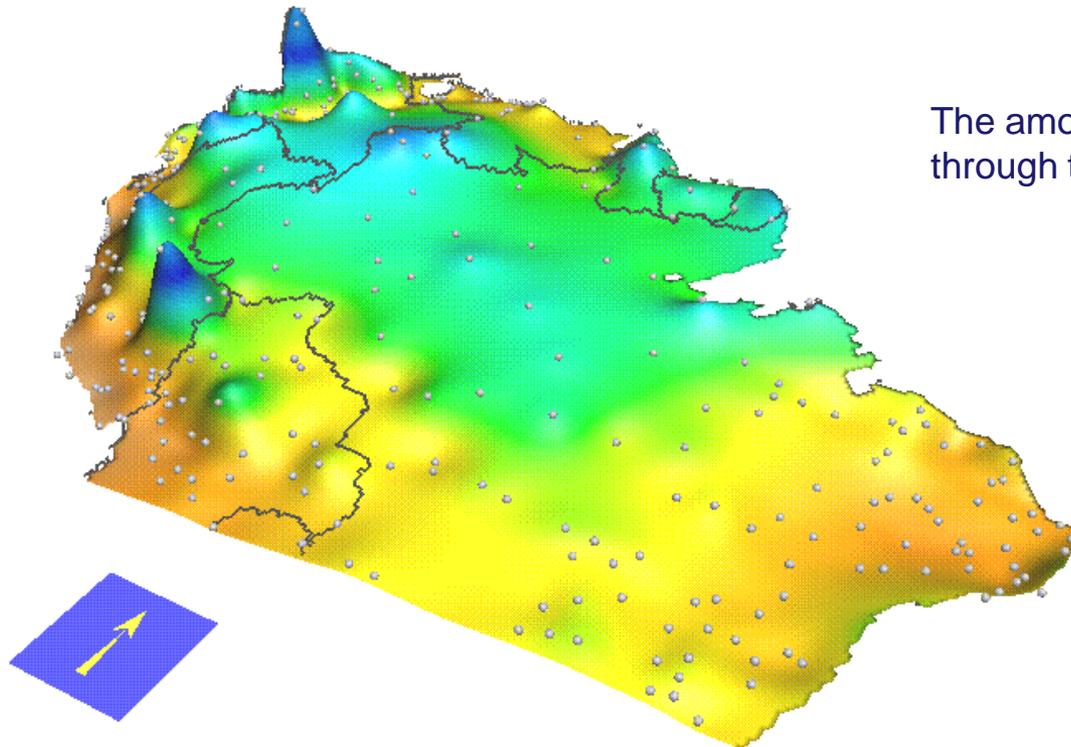
- Temperature
- Precipitation

## Example:

Point 1 has less influence than point 2



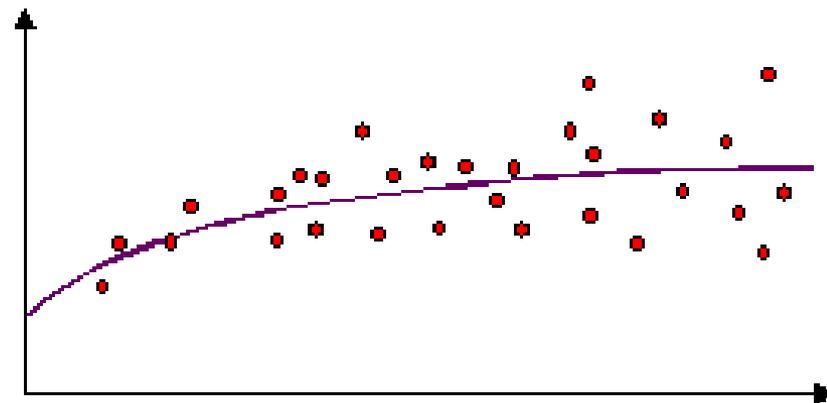
**The Spline method estimates values using a mathematical function that minimizes overall surface curvature, resulting in a smooth surface that passes exactly through the input points**



The amount of smoothing can be adjusted through the tension

- Based on the idea that closer points are more similar
- Kriging uses a statistical model to weight sample points
- Models based on the spatial autocorrelation between points
- The model produces an error surface

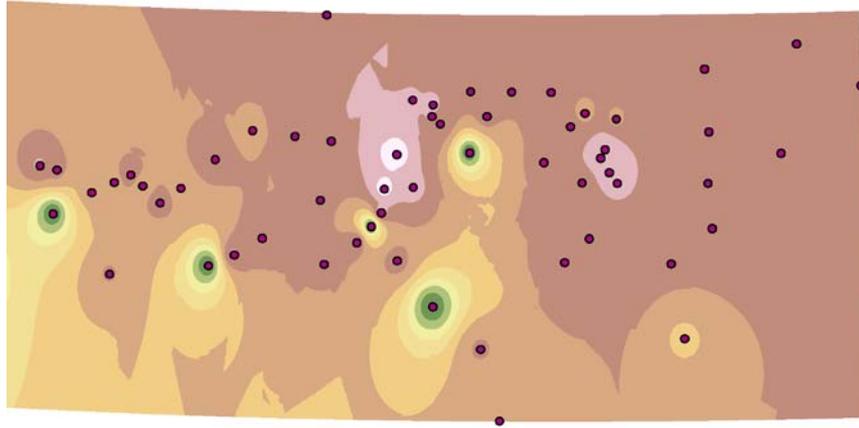
Semivariance



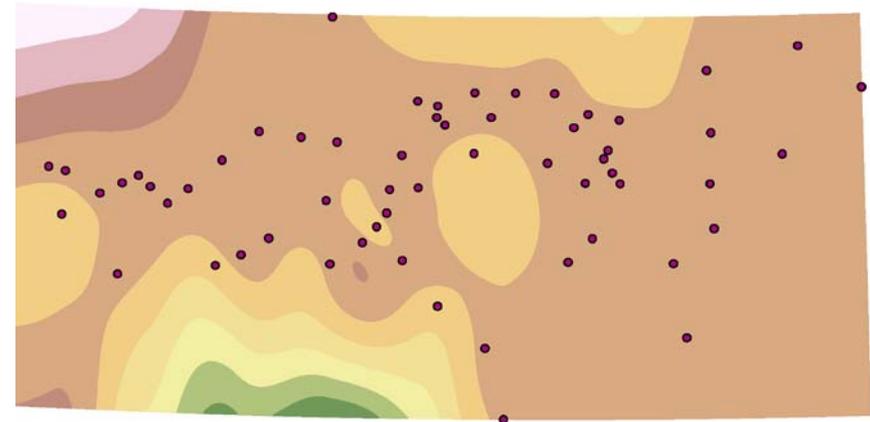
Distance

# Comparison

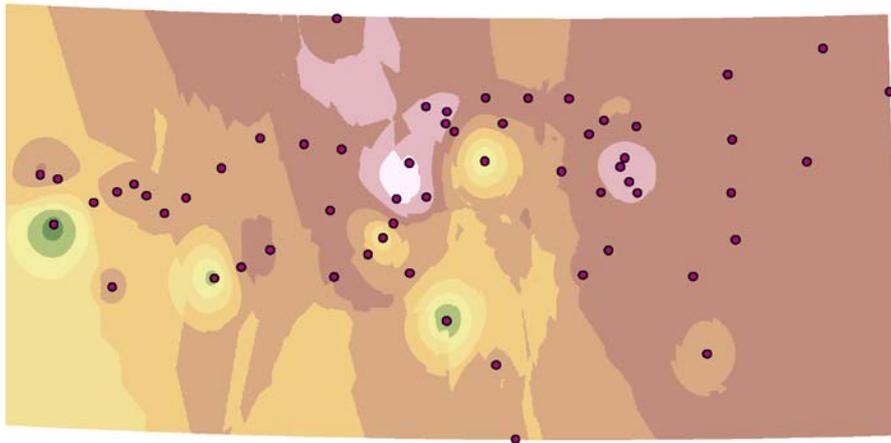
**IDW**



**Spline**

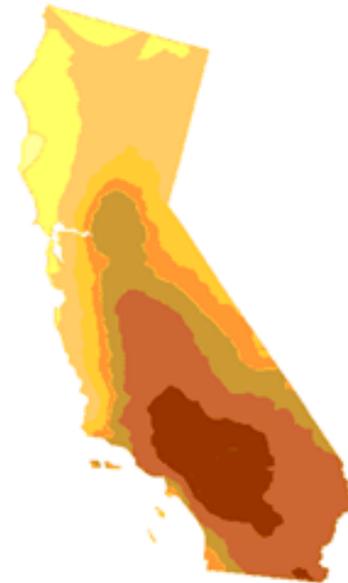


**Krig**

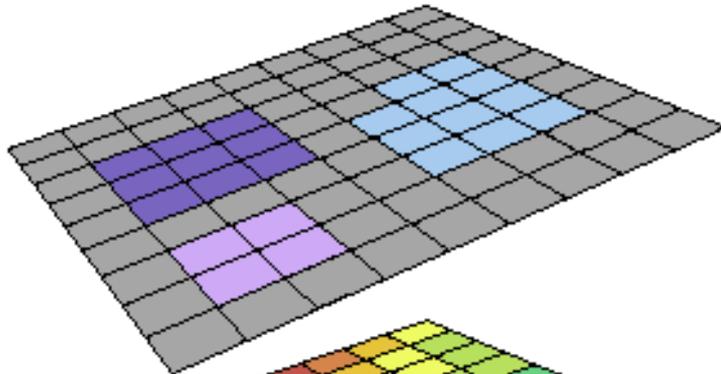


# Why Use Interpolation?

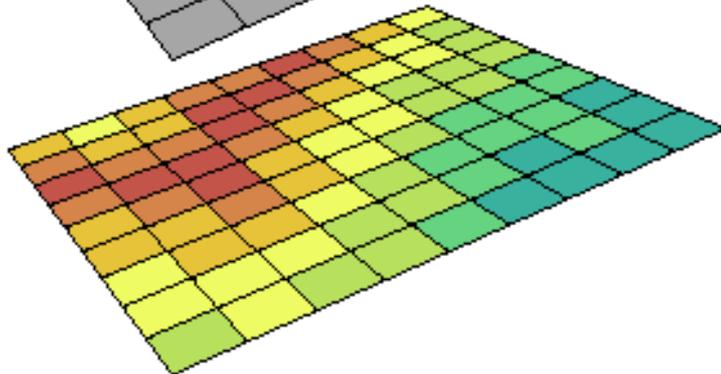
- **To estimate values where there is no data**
- **Visualization of complex point data**
- **Analysis of trends over space and time**
- **Creation of discrete boundaries between values**



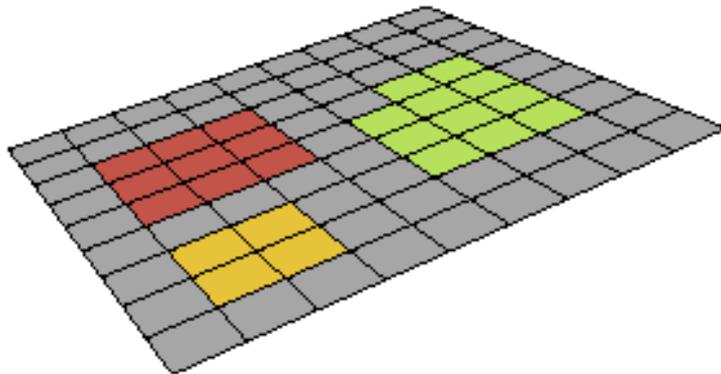
# Zonal Statistics



Zone layer  
Defines the zones  
(shapes, values and locations).



Value layer  
Contains the input values  
used in calculating the output  
for each zone.



Output  
The result of the statistic  
applied to the value input  
(Maximum in this example).

Can calculate:

- Majority
- Maximum
- Mean
- Median
- Minimum
- Minority
- Range
- Standard Deviation
- Sum
- Variety

- **Extraction – Subset raster datasets by values or locations**
- **Map Algebra – Run any algebraic operation on two rasters**
- **Overlay – Combine multiple rasters into one layer, applying weights to the input datasets**
- **Reclass – Change the values of rasters**