

---

# GIS

## Digital Humanities Boot Camp Series



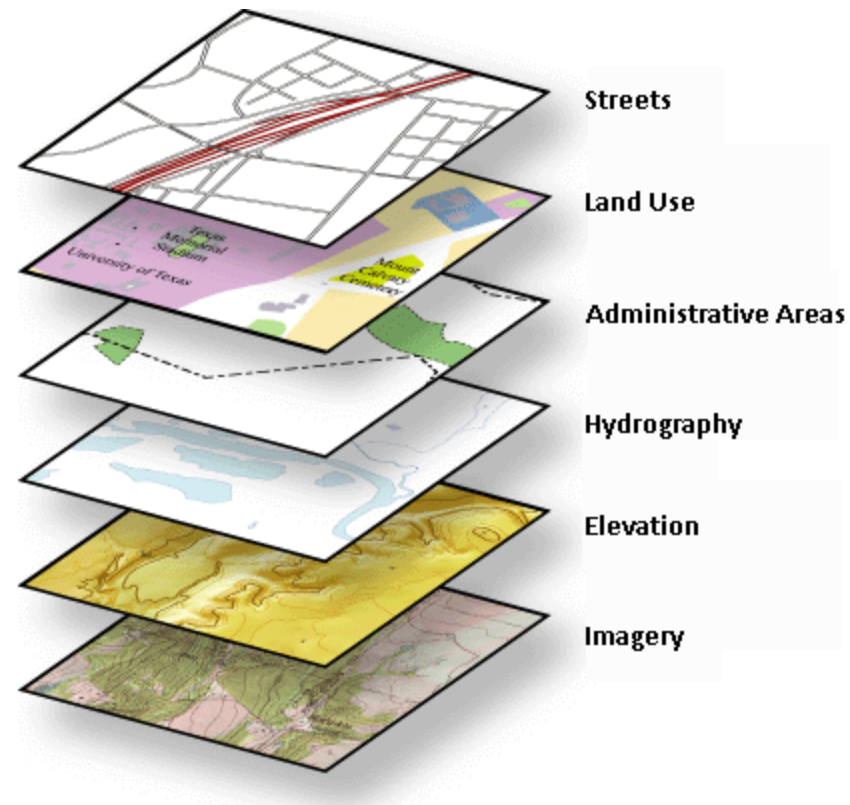
RICE

**Fondren Library**  
GIS/Data Center

# GIS Fundamentals

# Definition of GIS

A geographic information system (GIS) is used to describe and characterize spatial data for the purpose of visualizing and analyzing geographically referenced information.



# Components of GIS

---

## Software

- Esri, ERDAS, MapInfo, GRASS GIS, Cartographica

## Hardware

- Servers, Desktops, Smartphones, GPS devices

## Data

- Publically available, Purchased, Created

## People

- Data providers, GIS technicians, Audiences

## Methods

- Different methods provide different results

# Functions of GIS

---

## Visualization

- Getting information by looking at a map

## Geodata Management

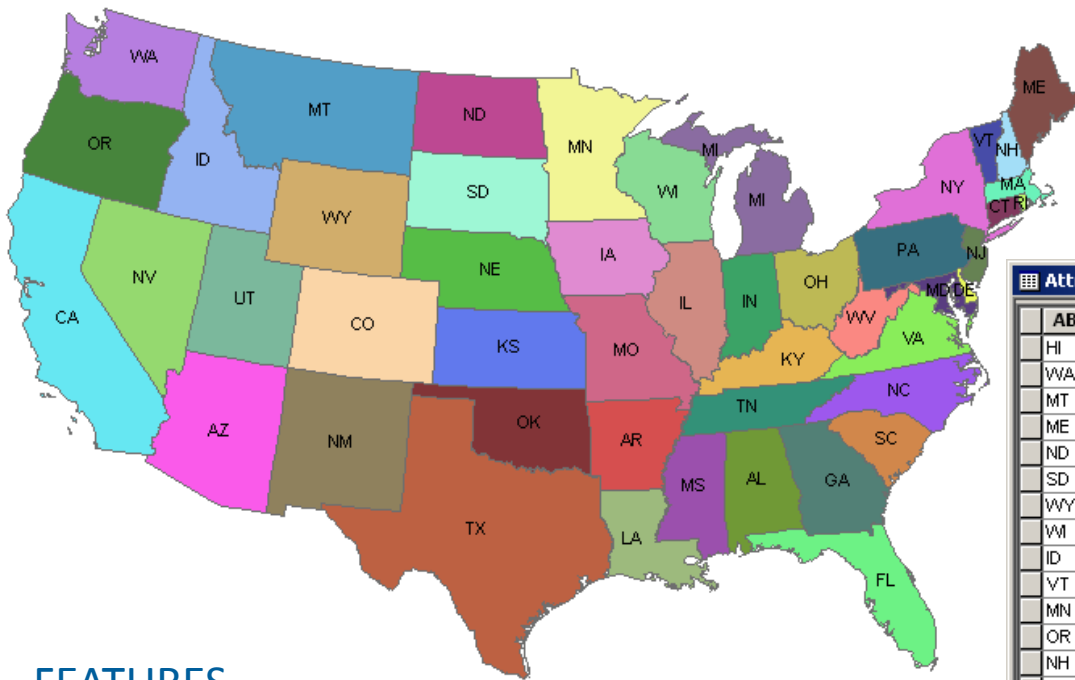
- Organizing and updating geographic data

## Geospatial Analysis

- Performing detailed analysis regarding the spatial relationships between datasets

# GIS Data

# GIS Data Components



## FEATURES

Graphic spatial representation of real-world physical features

## ATTRIBUTES

Non-spatial data describing the features

ABBR	NAME	AREA	SUB_REGI_1	POP1990	POP2000_1
HI	Hawaii	6428.217	Pacific	1108229	1184688
WA	Washington	67566.127	Pacific	4866692	5835089
MT	Montana	147043.116	Mtn	799065	885795
ME	Maine	32495.312	N Eng	1227928	1257219
ND	North Dakota	70700.125	W N Cen	638800	631032
SD	South Dakota	77116.662	W N Cen	696004	734993
WY	Wyoming	97813.807	Mtn	453588	479673
WI	Wisconsin	56050.459	E N Cen	4891769	5277833
ID	Idaho	83570.06	Mtn	1006749	1273309
VT	Vermont	9614.299	N Eng	562758	596714
MN	Minnesota	84383.092	W N Cen	4375099	4820250
OR	Oregon	96954.726	Pacific	2842321	3356108
NH	New Hampshire	9265.998	N Eng	1109252	1215100
IA	Iowa	56271.701	W N Cen	2776755	2877060
MA	Massachusetts	8118.475	N Eng	6016425	6206482
NE	Nebraska	77353.859	W N Cen	1578385	1672199
NY	New York	48623.646	Mid Atl	17990455	18223519
PA	Pennsylvania	45301.263	Mid Atl	11881643	11986139
CT	Connecticut	4975.458	N Eng	3287116	3289062
RI	Rhode Island	1088.882	N Eng	1003464	992011
NJ	New Jersey	7545.009	Mid Atl	7730188	8192386
IN	Indiana	36183.344	E N Cen	5544450	5970344

# Selecting Data by Attributes



(Sub-Region = South Atlantic)

ABBR	NAME	AREA	Sub Region	POP1990	POP2000
IL	Illinois	56339.384	E N Cen	11430602	12187552
DC	District of Columbia	68.342	S Atl	606900	513618
DE	Delaware	2012.514	S Atl	666168	762227
WV	West Virginia	24229.8	S Atl	1793477	1804812
MD	Maryland	9996.506	S Atl	4781468	5212902
CO	Colorado	104091.253	Mtn	3294394	4139027
KY	Kentucky	40409.048	E S Cen	3685296	3988695
KS	Kansas	82276.988	W N Cen	2477574	2672387
VA	Virginia	39978.562	S Atl	6187358	6945067
MO	Missouri	69704.423	W N Cen	5117073	5502243
AZ	Arizona	114000.36	Mtn	3665228	4894006
OK	Oklahoma	69898.272	W S Cen	3145585	3383158
NC	North Carolina	49364.622	S Atl	6628637	7762819
TN	Tennessee	42143.33	E S Cen	4877185	5539577
TX	Texas	264710.982	W S Cen	16986510	20398490
NM	New Mexico	121591.701	Mtn	1515089	1750921
AL	Alabama	51655.693	E S Cen	4040587	4395481
MS	Mississippi	47664.922	E S Cen	2573216	2788415
GA	Georgia	58830.269	S Atl	6478216	7950119
SC	South Carolina	30950.951	S Atl	3486703	3935123
AR	Arkansas	53178.652	W S Cen	2350725	2566938
LA	Louisiana	46738.807	W S Cen	4219973	4386033
FL	Florida	56616.254	S Atl	12937926	15341185

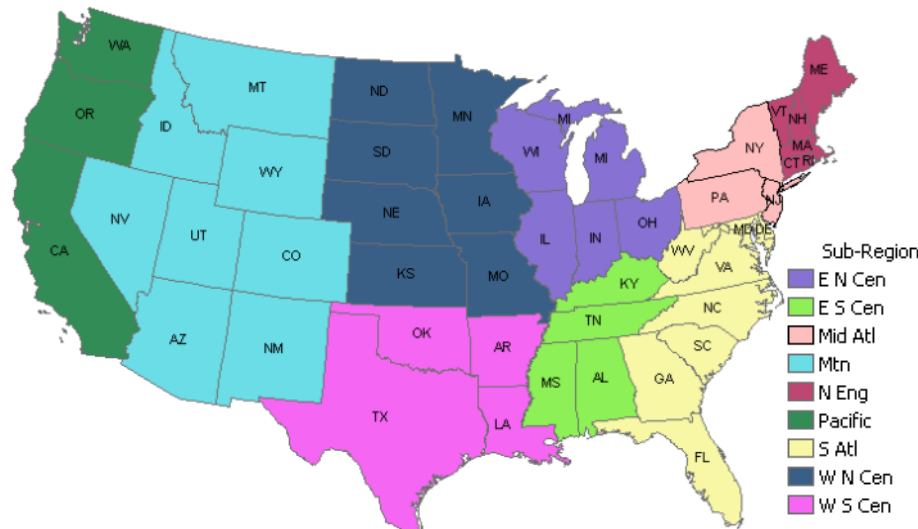
Record: 0 Show: All Selected Records (9 out of 51)



# Symbolizing Data by Attributes

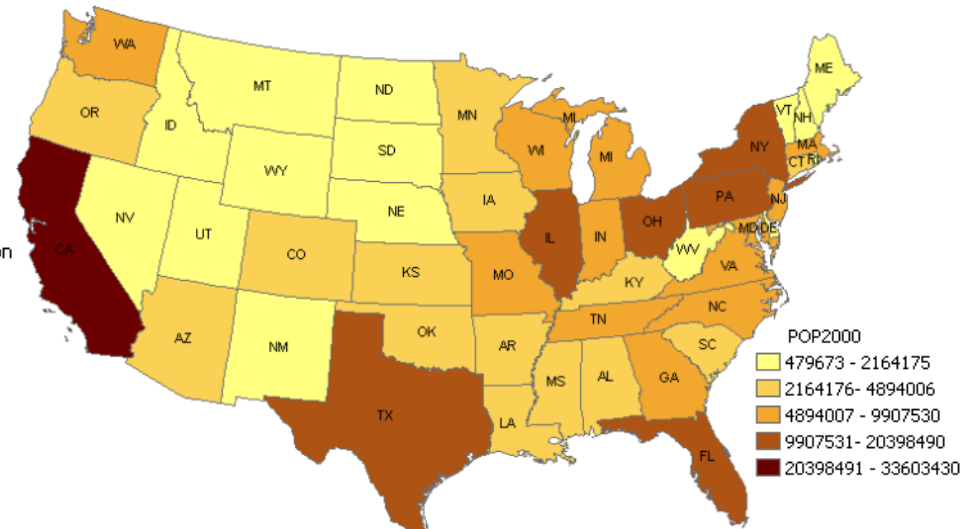
## Display categories (Sub-region)

ABBR	NAME	AREA	Sub Region	POP1990	POP2000
AL	Alabama	51655.693	E S Cen	4040587	4395481
AK	Alaska	579209.198	Pacific	550043	624523
AZ	Arizona	114000.36	Mtn	3665228	4894006
AR	Arkansas	53178.652	W S Cen	2350725	2566938
CA	California	158096.781	Pacific	29760021	33603430
CO	Colorado	104091.253	Mtn	3294394	4139027
CT	Connecticut	4975.458	N Eng	3287116	3289062
DE	Delaware	2012.514	S Atl	666168	762227
DC	District of Columbia	68.342	S Atl	606900	513618
FL	Florida	56616.254	S Atl	12937926	15341185
GA	Georgia	58830.269	S Atl	6478216	7950119
HI	Hawaii	6428.217	Pacific	1108229	1184688
ID	Idaho	83570.06	Mtn	1006749	1273309
IL	Illinois	56339.384	E N Cen	11430602	12187552
IN	Indiana	36182.311	E N Cen	5544159	5979311
IA	Iowa	56271.701	W N Cen	2776755	2877060



## Display quantities (Population)

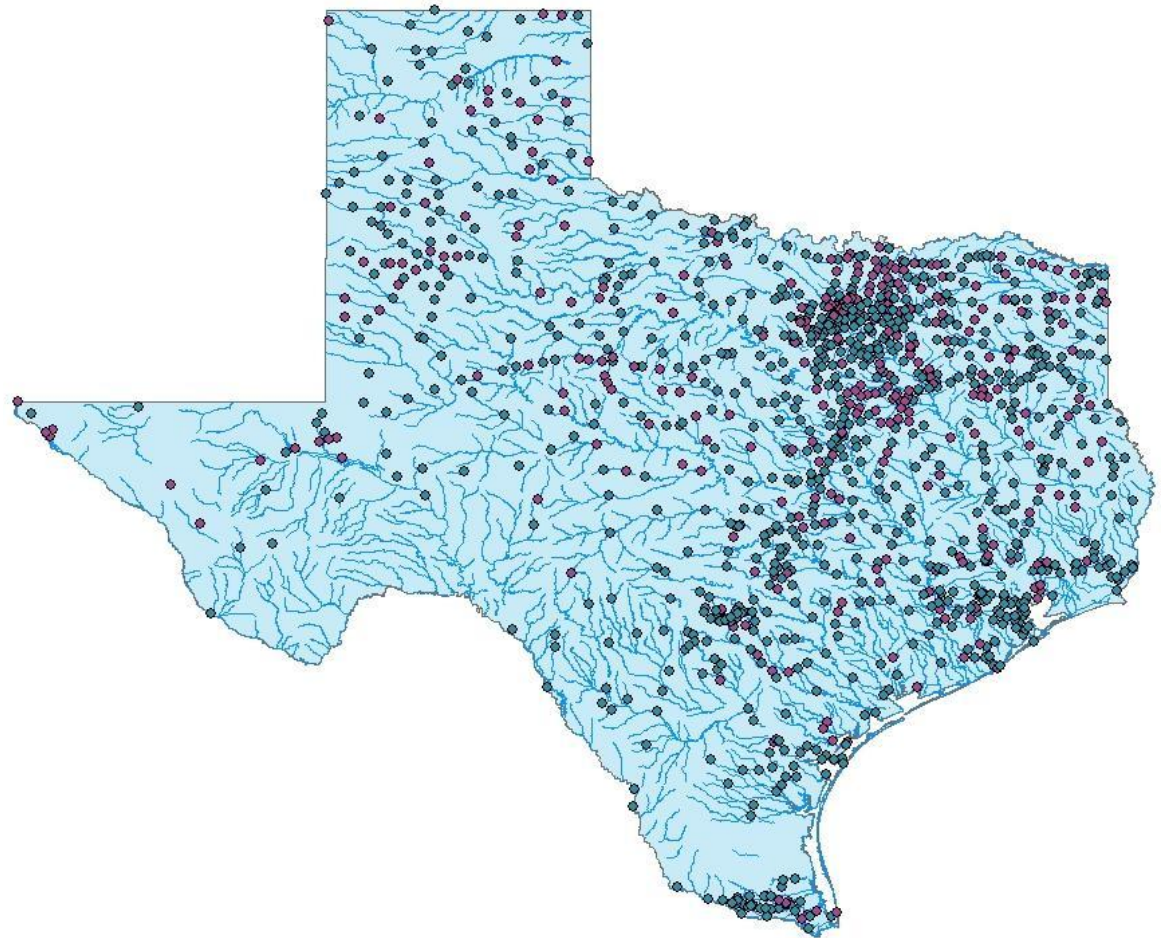
ABBR	NAME	AREA	Sub Region	POP1990	POP2000
HI	Hawaii	6428.217	Pacific	1108229	1184688
WA	Washington	67566.127	Pacific	4866692	5835089
MT	Montana	147043.116	Mtn	799065	885795
ME	Maine	32495.312	N Eng	1227928	1257219
ND	North Dakota	70700.125	W N Cen	638800	631032
SD	South Dakota	77116.662	W N Cen	696004	734993
WY	Wyoming	97813.807	Mtn	453588	479673
WI	Wisconsin	56050.459	E N Cen	4891769	5277833
ID	Idaho	83570.06	Mtn	1006749	1273309
VT	Vermont	9614.299	N Eng	562758	596714
MN	Minnesota	84383.092	W N Cen	4375099	4820250
OR	Oregon	96954.726	Pacific	2842321	3356108
NH	New Hampshire	9265.998	N Eng	1109252	1215100
IA	Iowa	56271.701	W N Cen	2776755	2877060
MA	Massachusetts	8118.475	N Eng	6016425	6206482
NE	Nebraska	77353.859	W N Cen	1578385	1672199



# Vector Data - Points

## Vector Data

- Points



# Vector Data - Lines

---

## Vector Data

- Points
- Lines



# Vector Data - Polygons

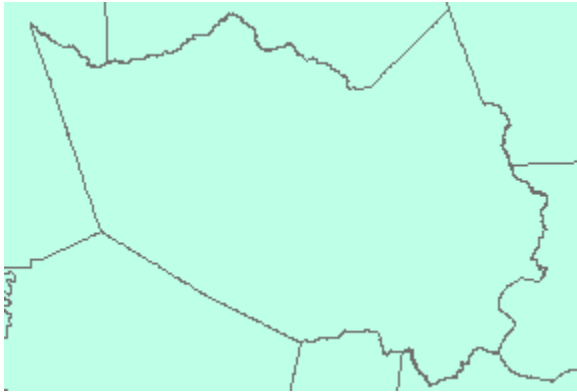
---

## Vector Data

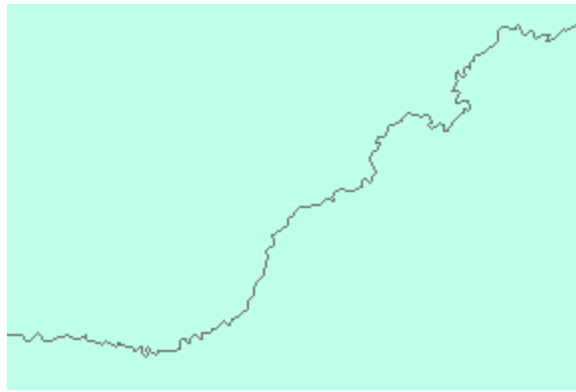
- Points
- Lines
- Polygons



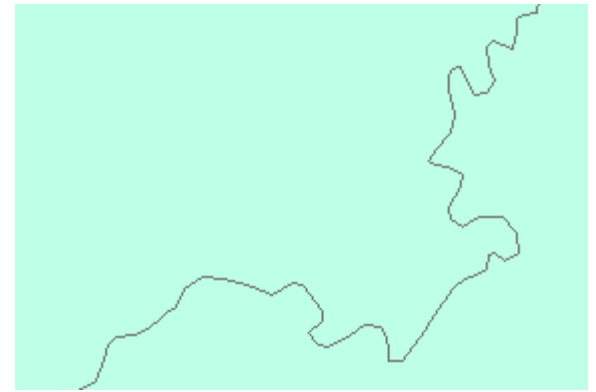
# Vector Data



1:1,500,000



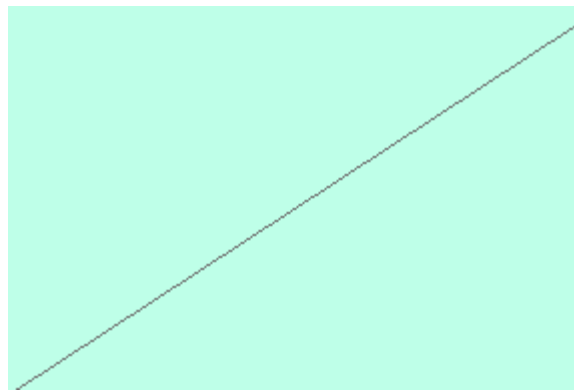
1:100,000



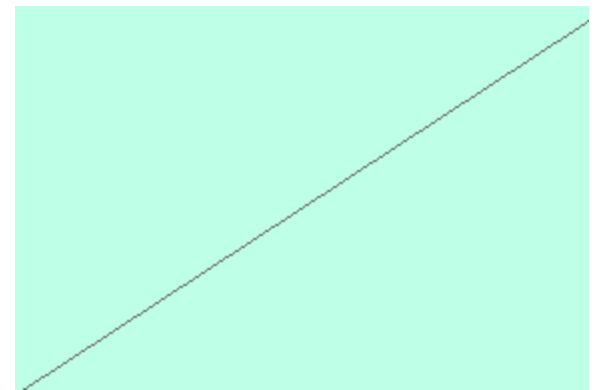
1:20,000



1:2,000



1:500



1:1

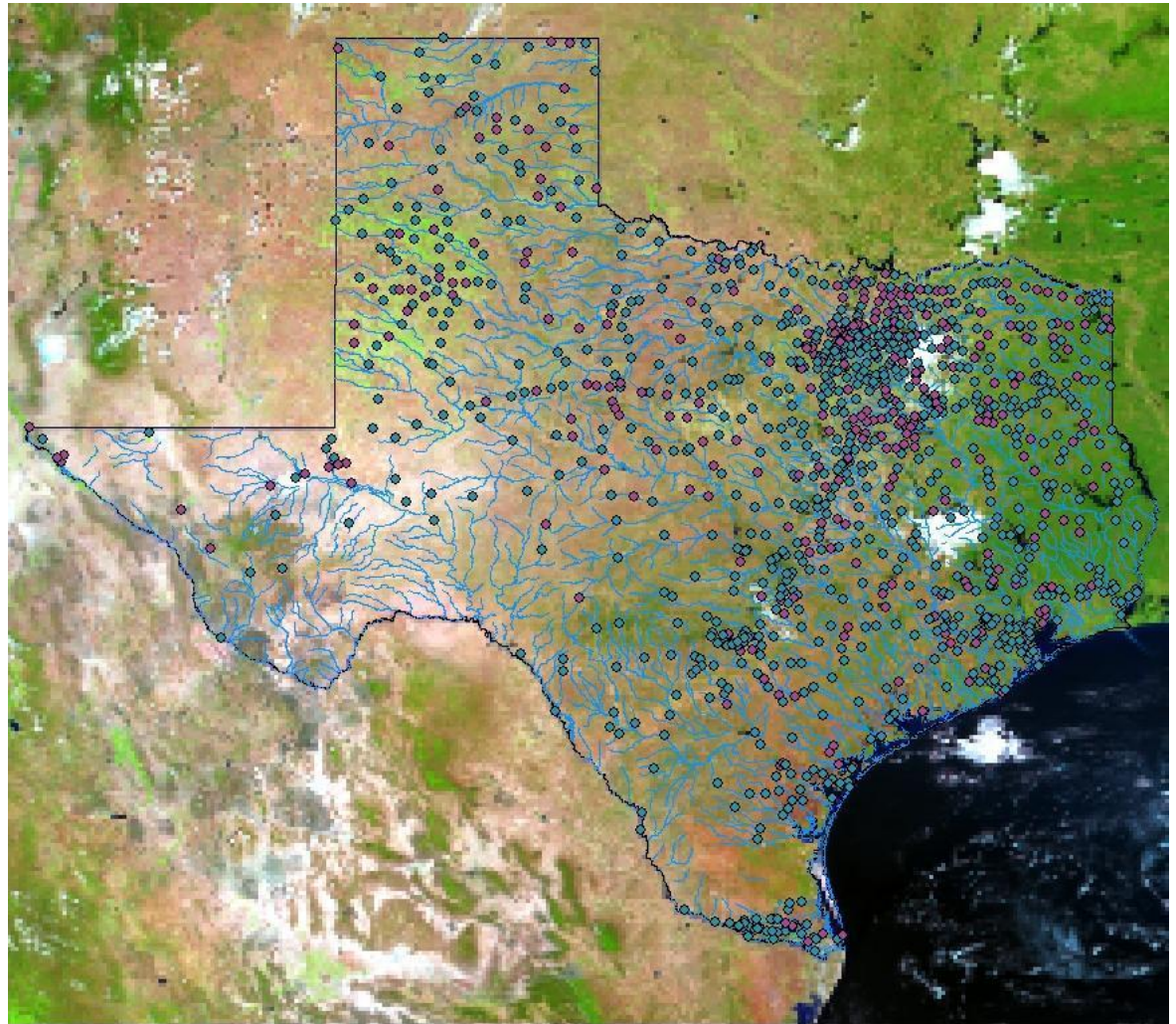
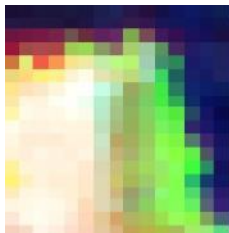


# Raster Data

## Vector Data

- Points
- Lines
- Polygons

## Raster Data

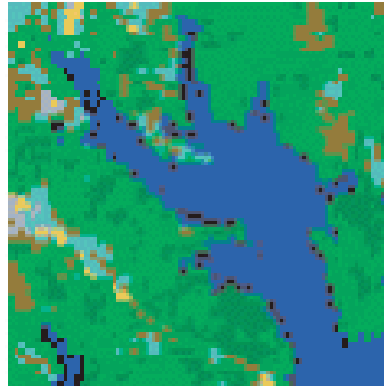


# Raster Data

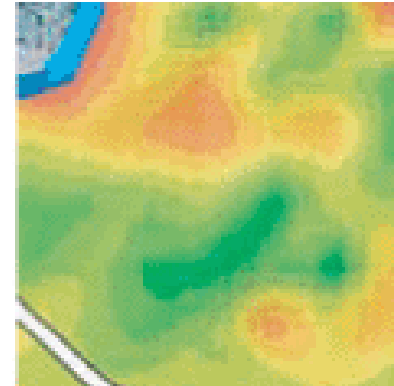
---



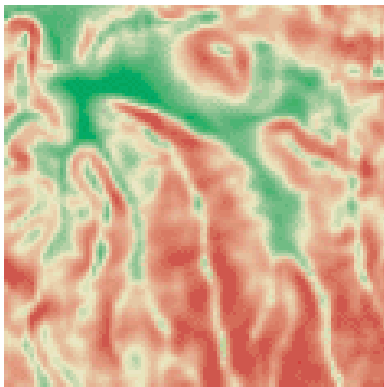
**Orthophoto**



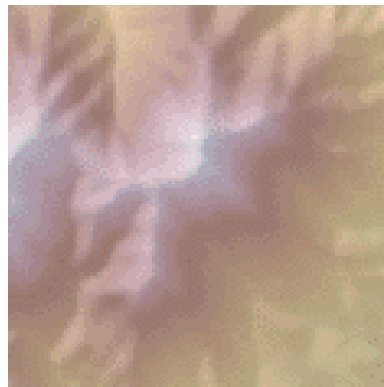
**Land Use**



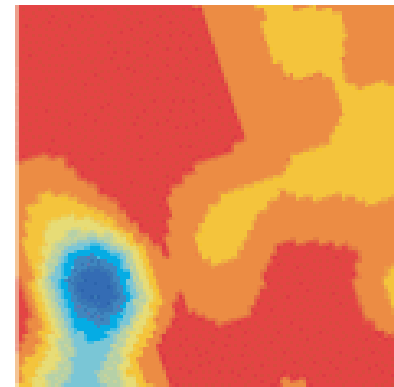
**Concentration**



**Slope**



**Elevation**

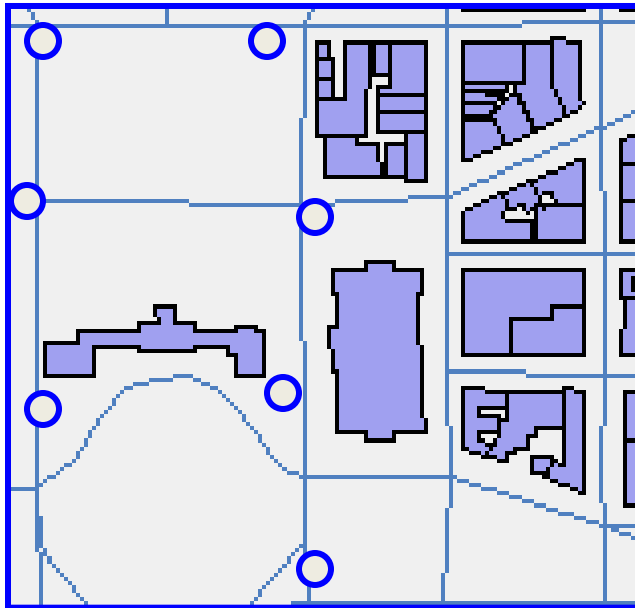


**Population**

# Vector Data vs. Raster Data

## Vector

Uses points, lines, and polygons to represent real features on the earth's surface, such as light poles, roads, and buildings. Ideal for discrete themes with definite boundaries.



## Raster

Is composed of a continuous grid of cells that represent a value for a portion of the earth's surface, such as elevation, and rainfall. Ideal for continuous themes of change.

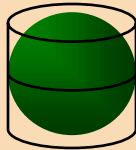




# Coordinate Systems and Projections

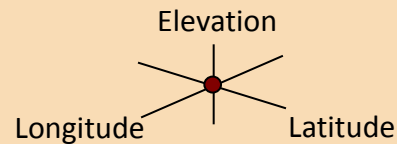
## PROJECTION

A method of representing the earth's three-dimensional surface as a flat two-dimensional surface.



## COORDINATE SYSTEM

A method of representing points in a space of given dimensions by coordinates.

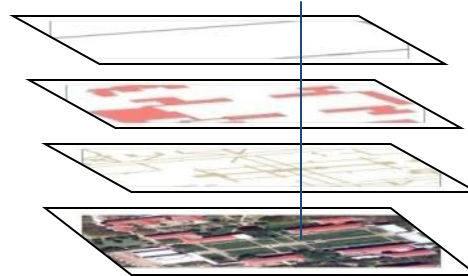


Streets

Buildings

Sidewalks

Aerial Photo



29° 43' 7.10 " N  
95° 23' 55.74" W  
GCS\_WGS\_1984



# ArcGIS Software

# ArcGIS Products

---

## Desktop GIS

- [ArcGIS for Desktop](#)

## Server GIS

- [ArcGIS for Server](#)

## Online GIS

- [ArcGIS Explorer Online](#)
- [ArcGIS Online](#)

## Mobile GIS

- [ArcGIS App for Smartphones and Tablets](#)
- [ArcPad](#)

# ArcGIS Software at Rice

---

## On Campus Access

- GIS/Data Center
- Fondren Library First-Floor Rice Computers
- Mudd Lab
- Residential College Labs
- Various Department Labs (ARCH, CEVE, ESCI)

# ArcGIS Software at Rice

---

## Rice Computer Access

- Log a ticket at <http://helpdesk.rice.edu/>  
or send an e-mail request to [helpdesk@rice.edu](mailto:helpdesk@rice.edu)
- Copy [gisdata@rice.edu](mailto:gisdata@rice.edu) on the ticket
- Request ArcGIS for Desktop 10.1 software
- Request an Advanced Single Use license
- Optionally, request Esri Data & Maps for ArcGIS 10
- Optionally, request ArcGIS Desktop Tutorial Data 10

# ArcGIS Software for Individuals

---

## **Student Edition with Site License**

- ArcGIS for Desktop Advanced & Extensions, Free, 1-year

## **Student Personal License**

- ArcGIS for Desktop Advanced & Extensions, \$100, 1-year
- ArcGIS for Desktop Advanced, \$250, perpetual
- ArcGIS for Desktop Extensions, \$150 each, perpetual

## **ArcGIS for Home Use Program**

- ArcGIS for Desktop Basic & Extensions, \$100, 1-year

# ArcGIS Training

# ArcGIS Training

---

## Instructor-Led Training

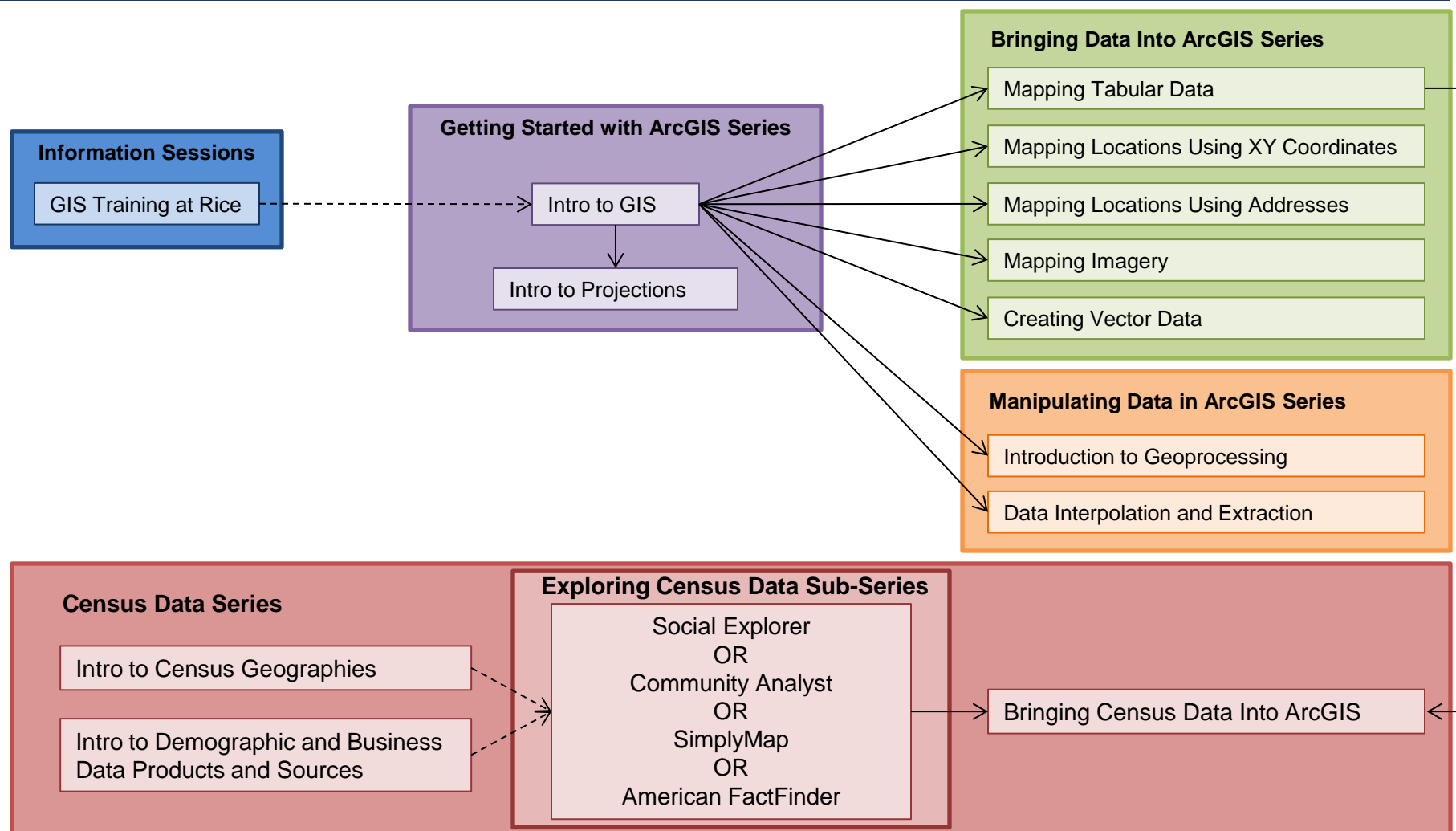
- GIS/Data Center Short Courses
- Commercial Instructor-Led Courses (Esri, TeachMeGIS)

## Self-Directed Training

- Esri Press Tutorial Books
- Esri Web Courses
- Esri Training Seminars
- ArcGIS Resource Center Tutorials



# GIS/Data Center Short Courses



# Bringing Data into ArcGIS Series

---

<b>GIS/Data Center Short Course Name</b>	<b>Non-Spatial Data Format</b>	<b>Required Supporting GIS Files</b>	<b>Procedure Name</b>
Mapping Tabular Data	Tabular numerical or categorical data	GIS data corresponding to tabular geographies	Joining
Mapping Locations Using XY Coordinates	Tabular XY coordinates	None	Adding XY data
Mapping Locations Using Addresses	Tabular addresses	Internet or GIS street network with address data	Geocoding
Mapping Imagery	Digital map images	Reference layers	Georeferencing
Creating Vector Data	None	Reference layers	Editing

# GIS Projects

# Typical GIS Project Process

---

## Project Planning

- Define research question
- Identify data needs

## Data Management

- Locate existing data
- Discover new data
- Organize data
- Determine if missing data can be created
- Convert non-geographic data into a geographic format

## Data Analysis

- Redefine project based on data availability and technical feasibility
- Process, analyze, and present data
- Integrate results of spatial analysis into larger research

# Types of Map Documents

---

## Reference Maps

- Orient readers to the area or the situation
- Contain a display of basic data layers, but do not present analysis
- Are not generally based on assumptions or subjective criteria

## Basic Analysis Maps

- Require selecting subsets of data or categorizing data based on certain criteria

## Advanced Analysis Maps

- Combine multiple facets of the data and often require the use of specialized ArcGIS extensions
- Focus on the spatial implications of the data

# Reference Maps

---

## Geographical Orientation

*Familiarize readers with the particular geographic area being studied by relating it to more familiar general geographic areas.*

- Where is Bolivia located within South America?
- Where is Harris County located within Texas within the United States?
- Where are the zip codes in this study located within Harris County?

## Data Orientation

*Display the locations of existing features in a particular data layer.*

- Where are the existing rail lines in the New York subway system?
- Where are the public libraries located within Montgomery County?
- What are the census tract boundaries within the City of Houston?

# Basic Analysis Maps

---

## Boolean Queries of Layer Attributes

*Select a subset of features from a layer based on a specific criterion for an attribute of that layer.*

- Which land parcels within the city limits are vacant?
- Which census tracts have a median income below the poverty level?
- Which counties have a population density over 3,000 people/mi<sup>2</sup>?

## Spatial Queries of Layer Features

*Select a subset of features from a layer based on the geographical relationship between features in that layer and features in another layer.*

- Which health clinics are within 1000 feet of a bus stop?
- Which households are not within a ½-mile radius of a public park?
- Which land parcels are within Harris County, but outside the City of Houston?

## Thematic Maps

*Symbolize layer attributes based on a numerical or categorical system to focus on the distribution of populations or resources.*

- What is the distribution of adults 65 and older in Alameda County?
- What is the distribution of land uses in the City of Pearland?

# Advanced Analysis Maps

---

## **Suitability Analysis – Spatial Analyst Extension**

Suitability analysis involves combining the results of several queries. A simple suitability analysis based exclusively on Boolean or spatial queries will result in a map of possible locations meeting all selected criteria. A more complex suitability analysis requires the use of the Spatial Analyst extension and will rank the suitability of each location based on the degree to which it meets the selected criteria.

## **3D Analysis – 3D Analyst Extension**

3D analysis involves visualizing and analyzing data in three dimensions. All 3D analysis requires the use of the 3D Analyst extension and work is often performed in ArcScene or ArcGlobe. Simple 3D analysis allows for the visualization of buildings or terrain. Advanced 3D analysis facilitates the calculation of line-of-sight visibility or cut/fill volumes and hydrologic downhill path problems.

## **Statistical Analysis – Geostatistical Analyst Extension**

Tabular data can be imported and exported with ArcGIS, so statistical analysis can be performed using programs such as SAS, SPSS, or STATA. However, advanced spatial statistical analysis can be performed within ArcGIS using the Geostatistical Analyst extension to calculate weighted means, medians, and central features; standard distances and directional distributions; linear directional means; spatial clustering and dispersion, high/low value clustering, autocorrelation, and hot-spots.

## **Network Analysis – Network Analyst Extension**

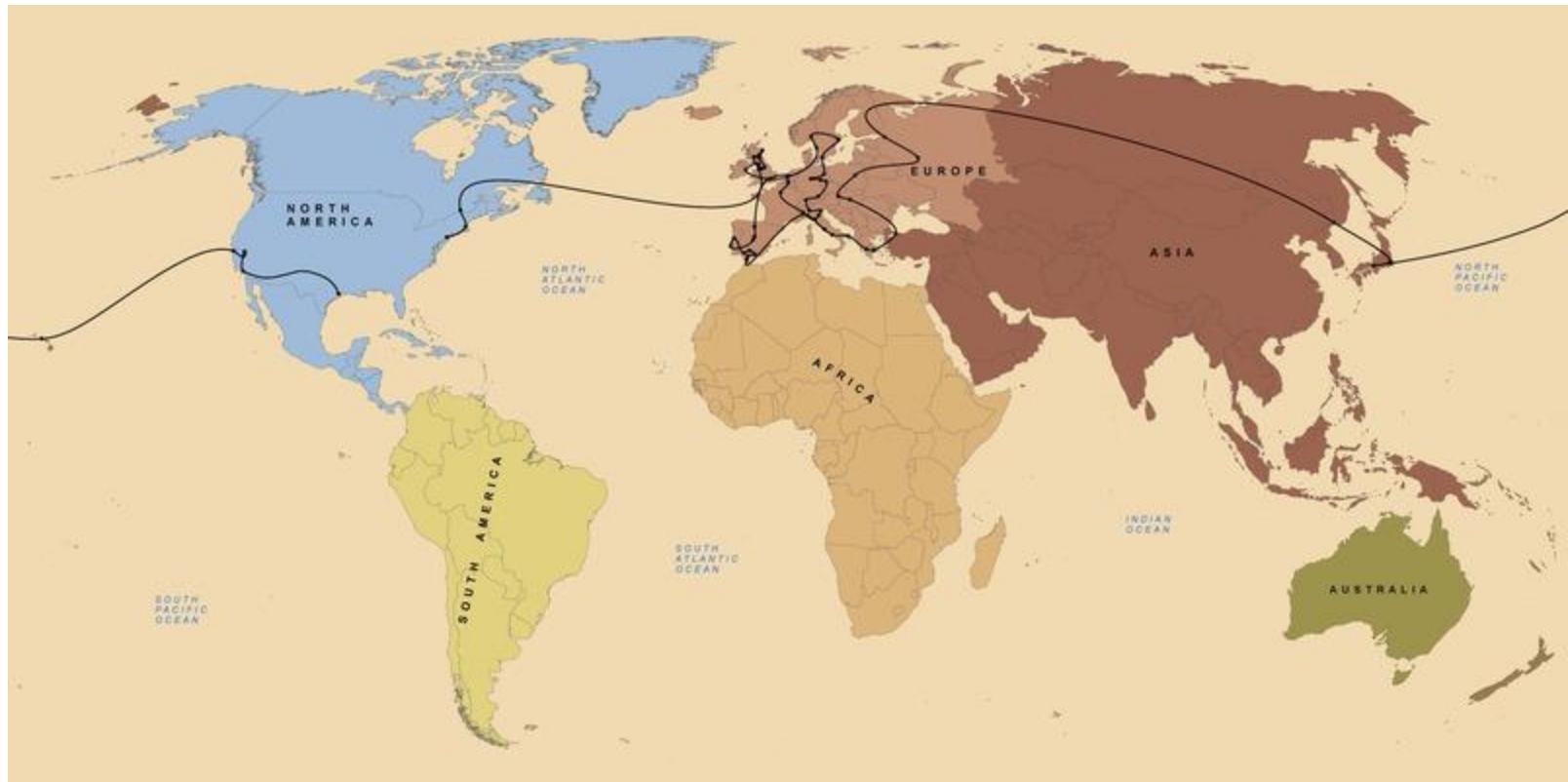
Network analysis involves analyzing spatial networks to calculate shortest paths, closest facilities, travel directions, and service areas.



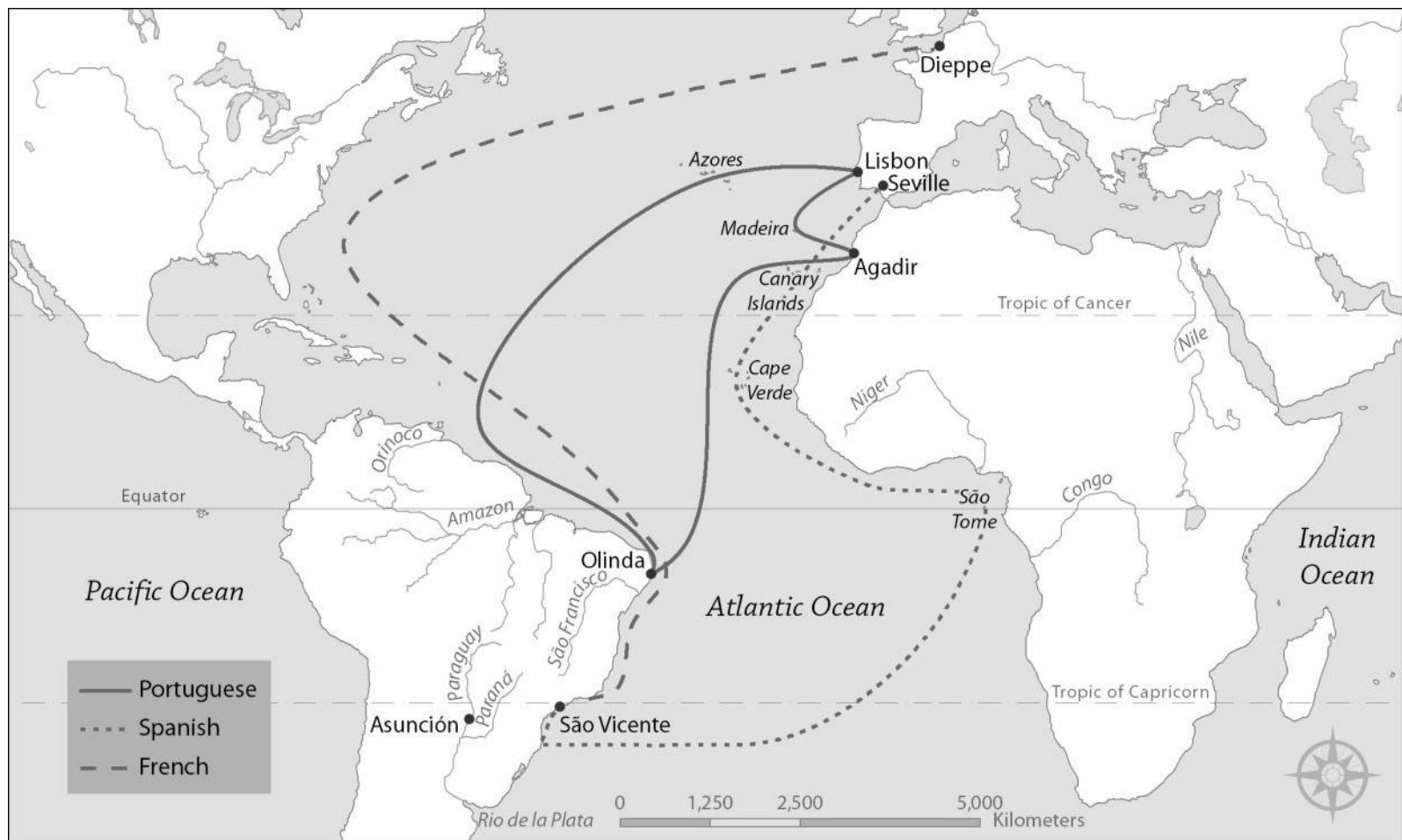
# GIS Projects

# Map of Edgar Odell Lovett's World Tour 1908-1909

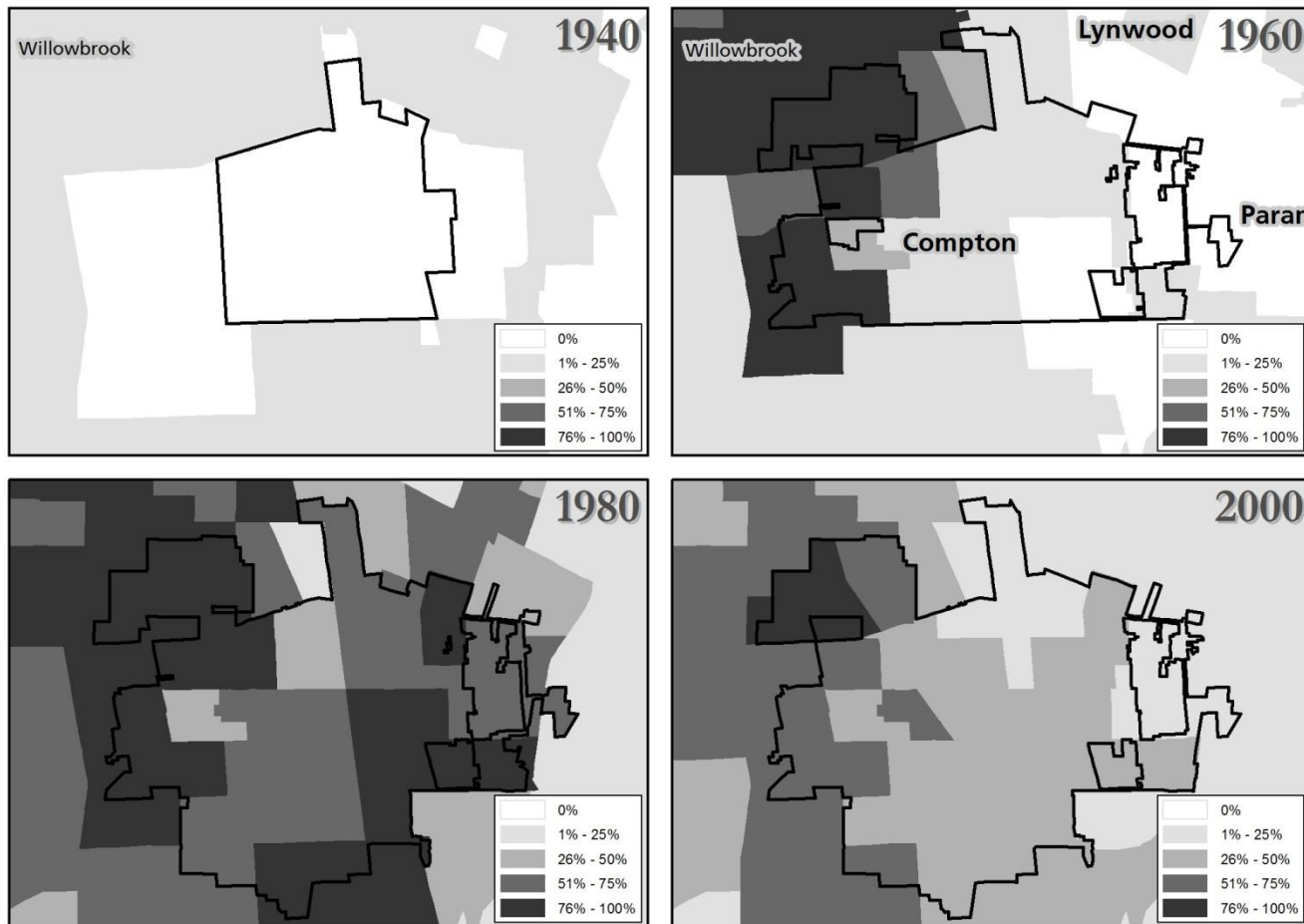
---



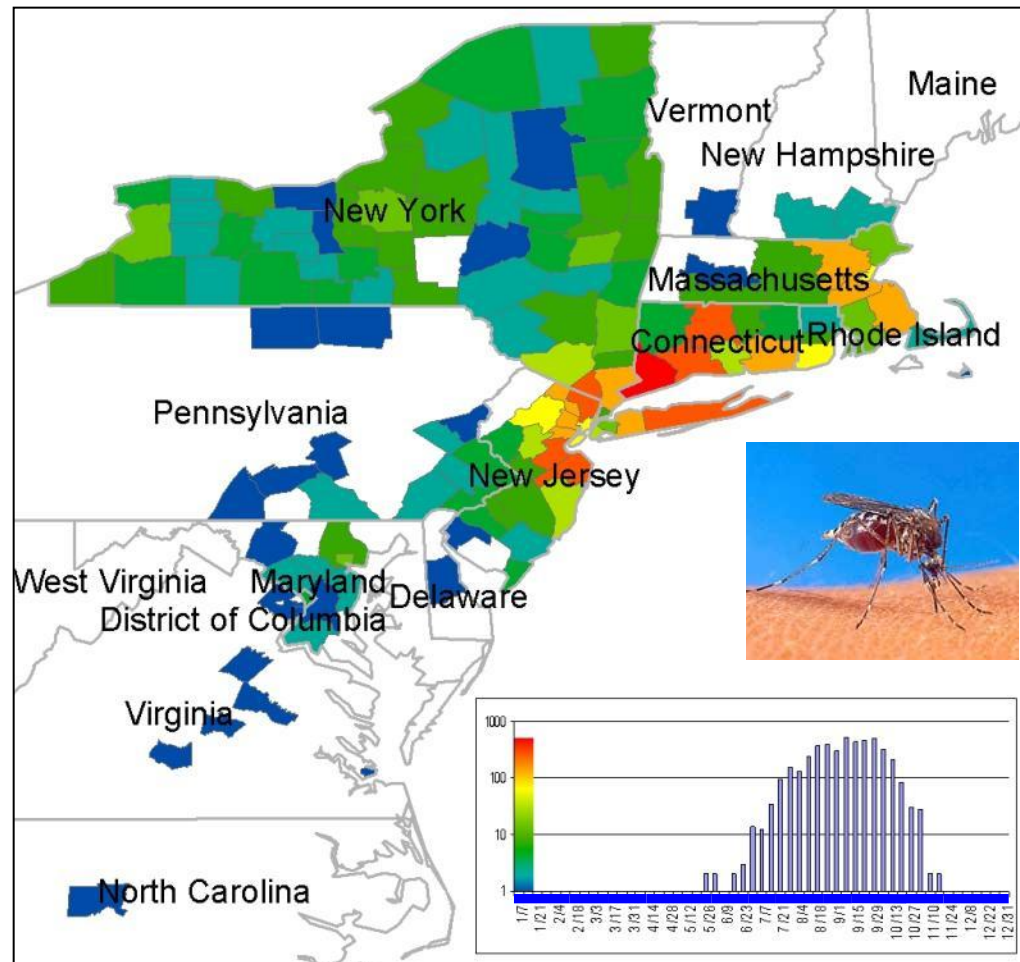
# The Return of Hans Staden



# Black Population in Compton, 1940-2000

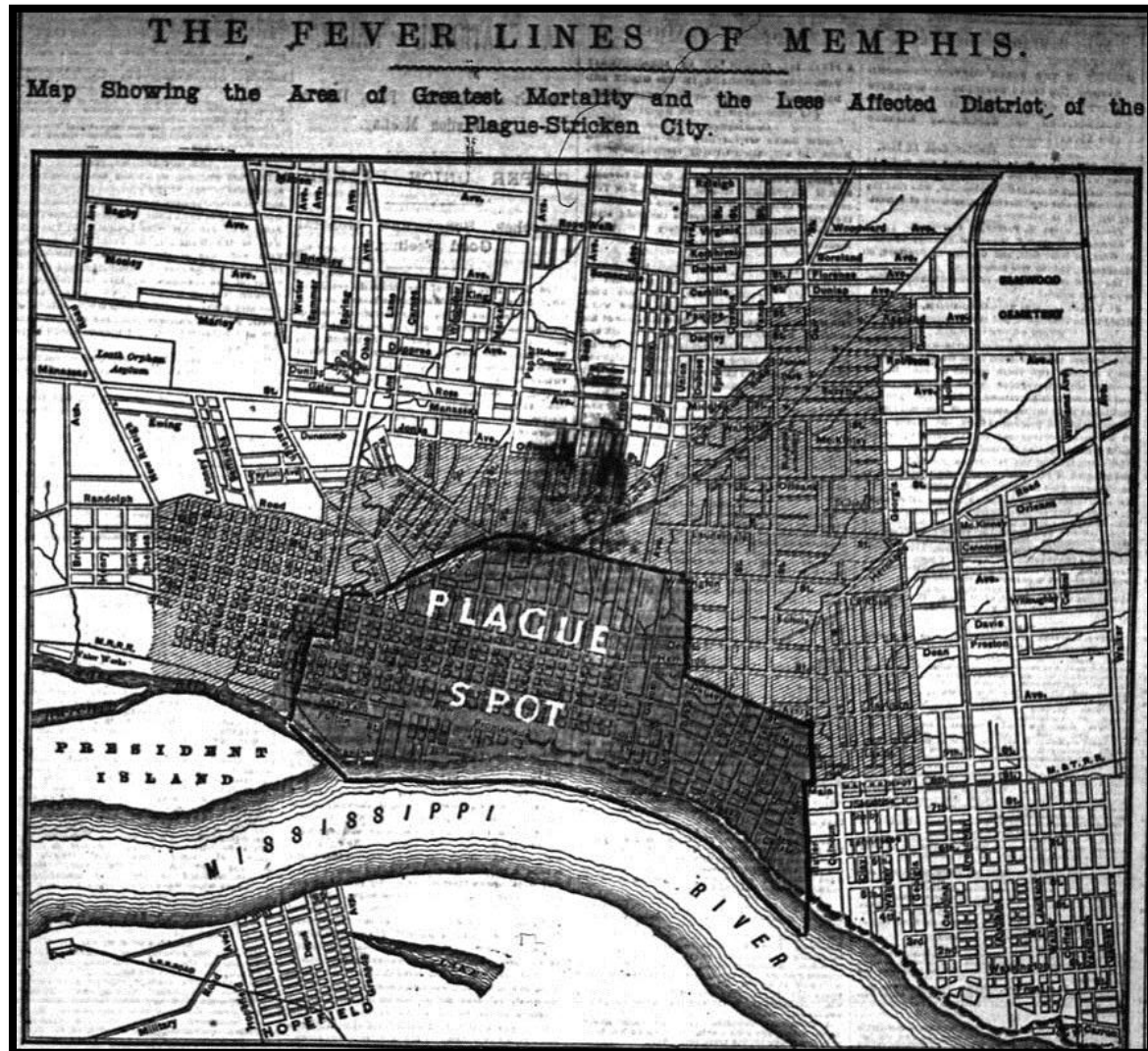


# West Nile Virus Cases in Wild Birds in 2000





# The Yellow Fever Epidemic in Memphis, TN



A HISTORY OF THE YELLOW FEVER.

A HISTORY OF THE YELLOW FEVER.

219

THE

# YELLOW FEVER EPIDEMIC

OF 1878.

IN MEMPHIS, TENN.

CONTAINING A COMPLETE LIST OF THE DEAD, THE PLACES OF THE SICKNESS AND  
OTHER INTERESTING DETAILS OF ALL THE VARIOUS CONTRIBUTIONS OF MEN  
AND THE NAMES AND RESIDENCE OF THE SURVIVORS. TOGETHER WITH  
OTHER FACTS, AND LAWS OF THE GREAT SUBTROPIC.

By J. M. KEATING.

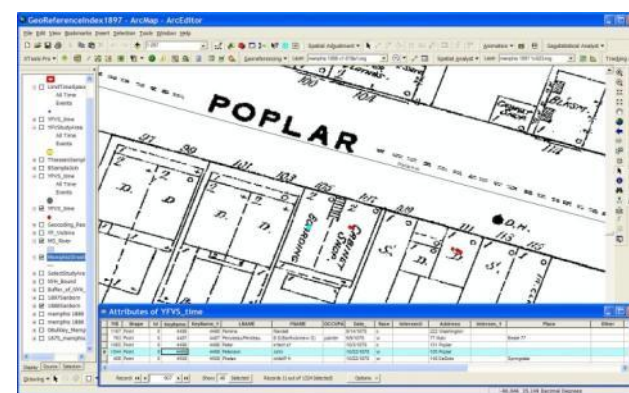
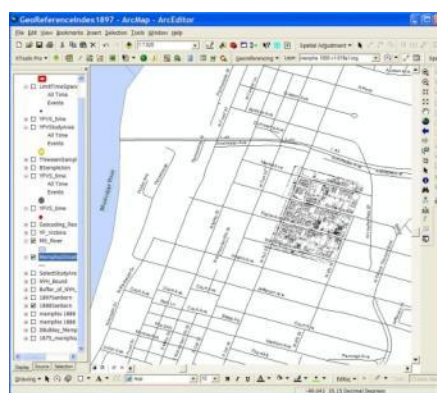
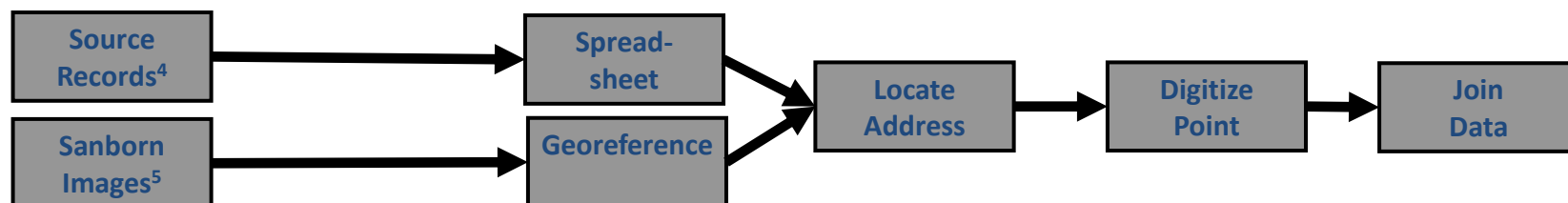
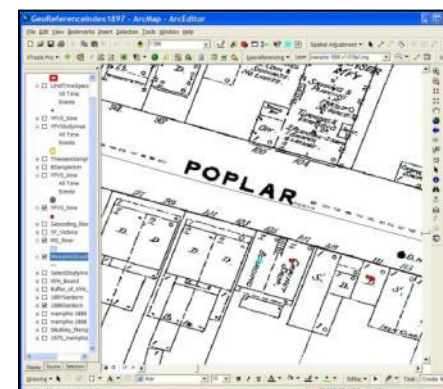
Printed and bound by the author, at the office of the publisher, at the corner of  
Main and Second Streets, in the city of Memphis, Tennessee.

MEMPHIS, TENN.

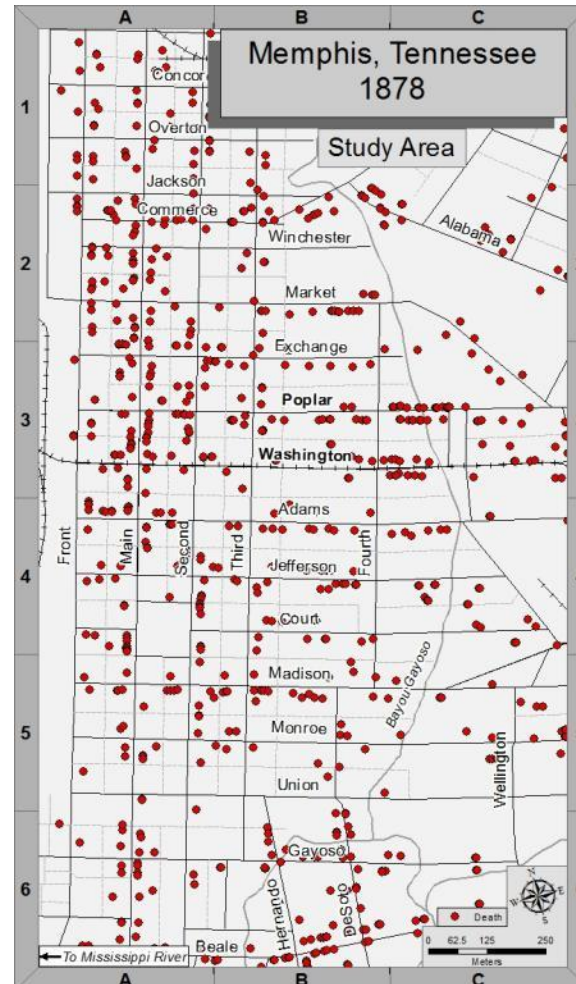
PRINTED FOR THE BOWMAN ASSOCIATION.

1878.

<p>1878</p> <p>1879</p> <p>1880</p> <p>1881</p> <p>1882</p> <p>1883</p> <p>1884</p> <p>1885</p> <p>1886</p> <p>1887</p> <p>1888</p> <p>1889</p> <p>1890</p> <p>1891</p> <p>1892</p> <p>1893</p> <p>1894</p> <p>1895</p> <p>1896</p> <p>1897</p> <p>1898</p> <p>1899</p> <p>1900</p> <p>1901</p> <p>1902</p> <p>1903</p> <p>1904</p> <p>1905</p> <p>1906</p> <p>1907</p> <p>1908</p> <p>1909</p> <p>1910</p> <p>1911</p> <p>1912</p> <p>1913</p> <p>1914</p> <p>1915</p> <p>1916</p> <p>1917</p> <p>1918</p> <p>1919</p> <p>1920</p> <p>1921</p> <p>1922</p> <p>1923</p> <p>1924</p> <p>1925</p> <p>1926</p> <p>1927</p> <p>1928</p> <p>1929</p> <p>1930</p> <p>1931</p> <p>1932</p> <p>1933</p> <p>1934</p> <p>1935</p> <p>1936</p> <p>1937</p> <p>1938</p> <p>1939</p> <p>1940</p> <p>1941</p> <p>1942</p> <p>1943</p> <p>1944</p> <p>1945</p> <p>1946</p> <p>1947</p> <p>1948</p> <p>1949</p> <p>1950</p> <p>1951</p> <p>1952</p> <p>1953</p> <p>1954</p> <p>1955</p> <p>1956</p> <p>1957</p> <p>1958</p> <p>1959</p> <p>1960</p> <p>1961</p> <p>1962</p> <p>1963</p> <p>1964</p> <p>1965</p> <p>1966</p> <p>1967</p> <p>1968</p> <p>1969</p> <p>1970</p> <p>1971</p> <p>1972</p> <p>1973</p> <p>1974</p> <p>1975</p> <p>1976</p> <p>1977</p> <p>1978</p> <p>1979</p> <p>1980</p> <p>1981</p> <p>1982</p> <p>1983</p> <p>1984</p> <p>1985</p> <p>1986</p> <p>1987</p> <p>1988</p> <p>1989</p> <p>1990</p> <p>1991</p> <p>1992</p> <p>1993</p> <p>1994</p> <p>1995</p> <p>1996</p> <p>1997</p> <p>1998</p> <p>1999</p> <p>2000</p> <p>2001</p> <p>2002</p> <p>2003</p> <p>2004</p> <p>2005</p> <p>2006</p> <p>2007</p> <p>2008</p> <p>2009</p> <p>2010</p> <p>2011</p> <p>2012</p> <p>2013</p> <p>2014</p> <p>2015</p> <p>2016</p> <p>2017</p> <p>2018</p> <p>2019</p> <p>2020</p> <p>2021</p> <p>2022</p> <p>2023</p> <p>2024</p> <p>2025</p> <p>2026</p> <p>2027</p> <p>2028</p> <p>2029</p> <p>2030</p> <p>2031</p> <p>2032</p> <p>2033</p> <p>2034</p> <p>2035</p> <p>2036</p> <p>2037</p> <p>2038</p> <p>2039</p> <p>2040</p> <p>2041</p> <p>2042</p> <p>2043</p> <p>2044</p> <p>2045</p> <p>2046</p> <p>2047</p> <p>2048</p> <p>2049</p> <p>2050</p> <p>2051</p> <p>2052</p> <p>2053</p> <p>2054</p> <p>2055</p> <p>2056</p> <p>2057</p> <p>2058</p> <p>2059</p> <p>2060</p> <p>2061</p> <p>2062</p> <p>2063</p> <p>2064</p> <p>2065</p> <p>2066</p> <p>2067</p> <p>2068</p> <p>2069</p> <p>2070</p> <p>2071</p> <p>2072</p> <p>2073</p> <p>2074</p> <p>2075</p> <p>2076</p> <p>2077</p> <p>2078</p> <p>2079</p> <p>2080</p> <p>2081</p> <p>2082</p> <p>2083</p> <p>2084</p> <p>2085</p> <p>2086</p> <p>2087</p> <p>2088</p> <p>2089</p> <p>2090</p> <p>2091</p> <p>2092</p> <p>2093</p> <p>2094</p> <p>2095</p> <p>2096</p> <p>2097</p> <p>2098</p> <p>2099</p> <p>2100</p> <p>2101</p> <p>2102</p> <p>2103</p> <p>2104</p> <p>2105</p> <p>2106</p> <p>2107</p> <p>2108</p> <p>2109</p> <p>2110</p> <p>2111</p> <p>2112</p> <p>2113</p> <p>2114</p> <p>2115</p> <p>2116</p> <p>2117</p> <p>2118</p> <p>2119</p> <p>2120</p> <p>2121</p> <p>2122</p> <p>2123</p> <p>2124</p> <p>2125</p> <p>2126</p> <p>2127</p> <p>2128</p> <p>2129</p> <p>2130</p> <p>2131</p> <p>2132</p> <p>2133</p> <p>2134</p> <p>2135</p> <p>2136</p> <p>2137</p> <p>2138</p> <p>2139</p> <p>2140</p> <p>2141</p> <p>2142</p> <p>2143</p> <p>2144</p> <p>2145</p> <p>2146</p> <p>2147</p> <p>2148</p> <p>2149</p> <p>2150</p> <p>2151</p> <p>2152</p> <p>2153</p> <p>2154</p> <p>2155</p> <p>2156</p> <p>2157</p> <p>2158</p> <p>2159</p> <p>2160</p> <p>2161</p> <p>2162</p> <p>2163</p> <p>2164</p> <p>2165</p> <p>2166</p> <p>2167</p> <p>2168</p> <p>2169</p> <p>2170</p> <p>2171</p> <p>2172</p> <p>2173</p> <p>2174</p> <p>2175</p> <p>2176</p> <p>2177</p> <p>2178</p> <p>2179</p> <p>2180</p> <p>2181</p> <p>2182</p> <p>2183</p> <p>2184</p> <p>2185</p> <p>2186</p> <p>2187</p> <p>2188</p> <p>2189</p> <p>2190</p> <p>2191</p> <p>2192</p> <p>2193</p> <p>2194</p> <p>2195</p> <p>2196</p> <p>2197</p> <p>2198</p> <p>2199</p> <p>2200</p> <p>2201</p> <p>2202</p> <p>2203</p> <p>2204</p> <p>2205</p> <p>2206</p> <p>2207</p>
---

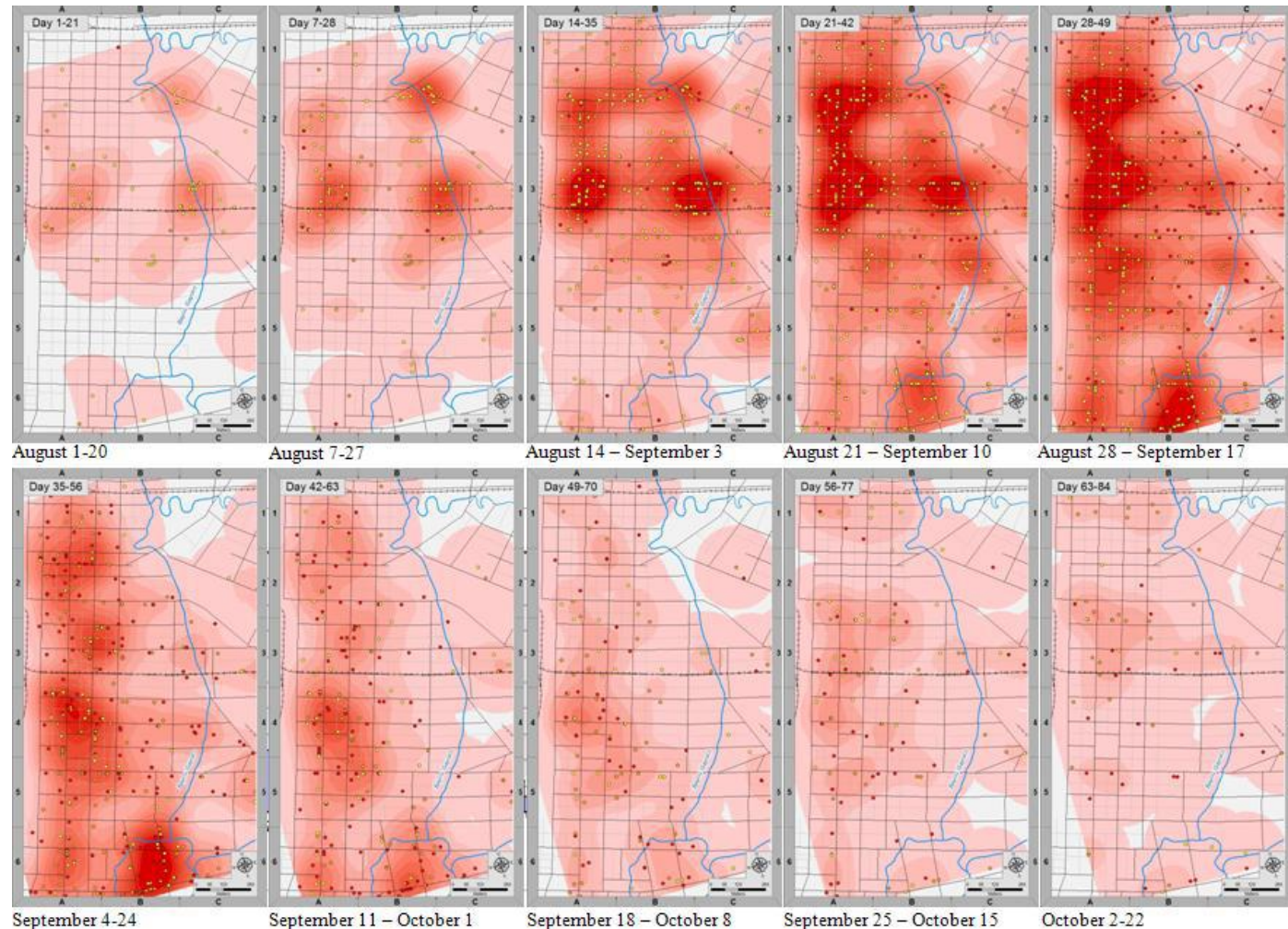
[illegible]

# The Yellow Fever Epidemic in Memphis, TN

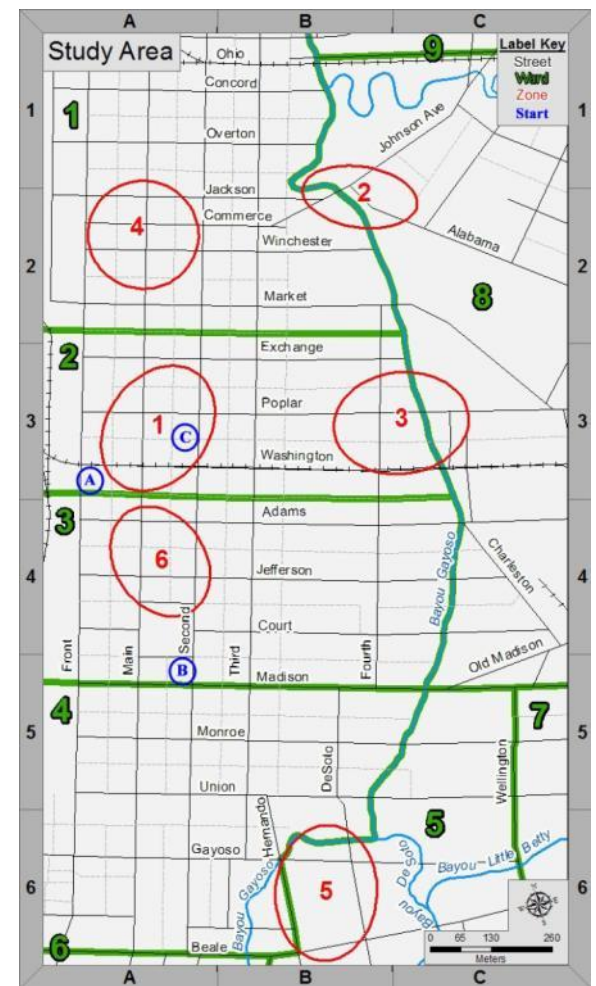
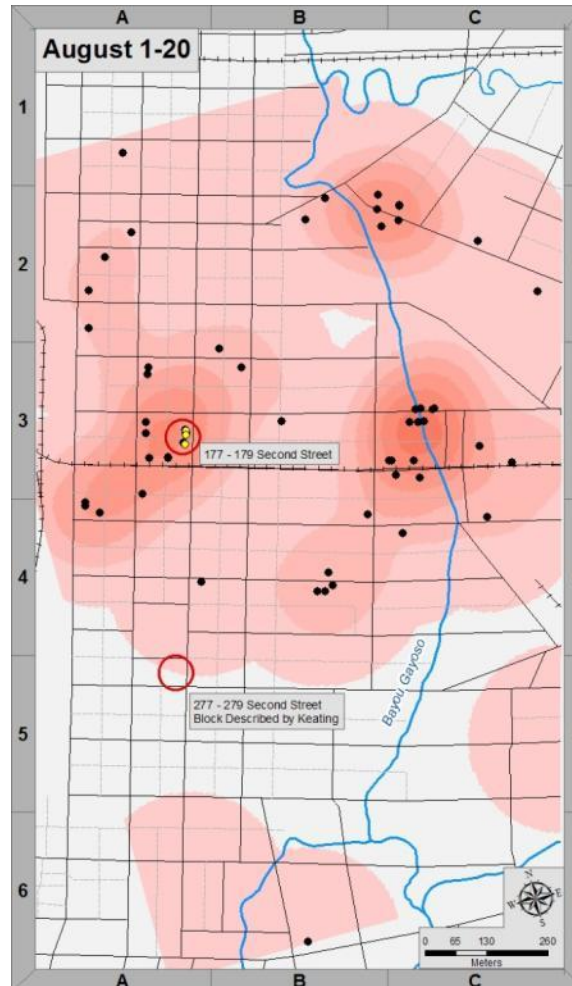
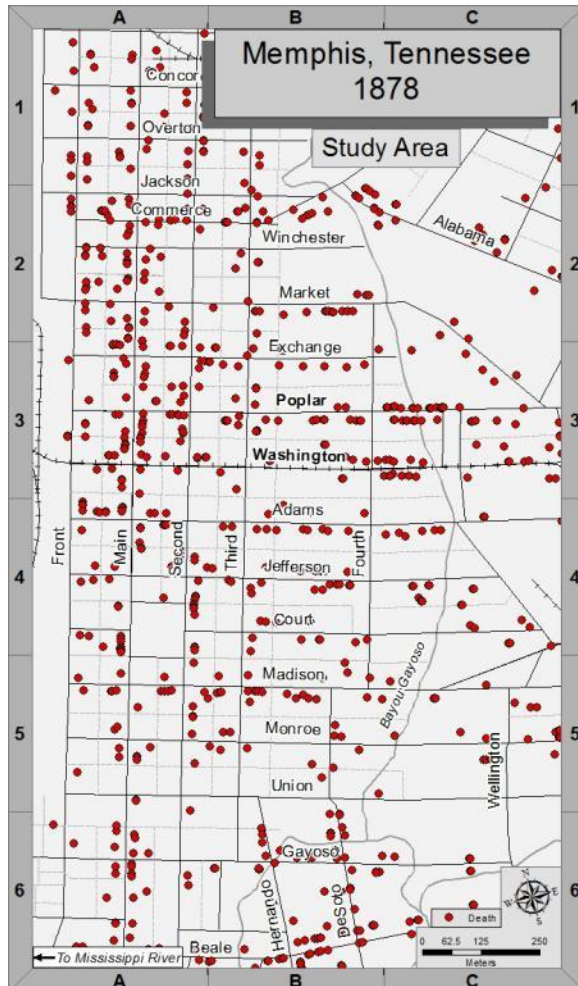




# The Yellow Fever Epidemic in Memphis, TN



# The Yellow Fever Epidemic in Memphis, TN





# The Yellow Fever Epidemic in Memphis, TN

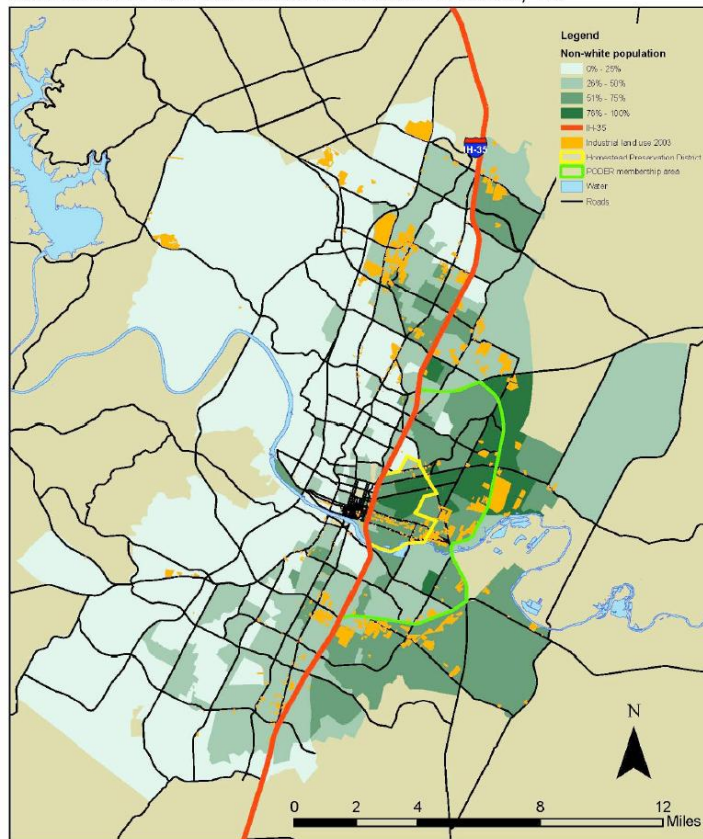
---





# East Austin Environmental Justice Project

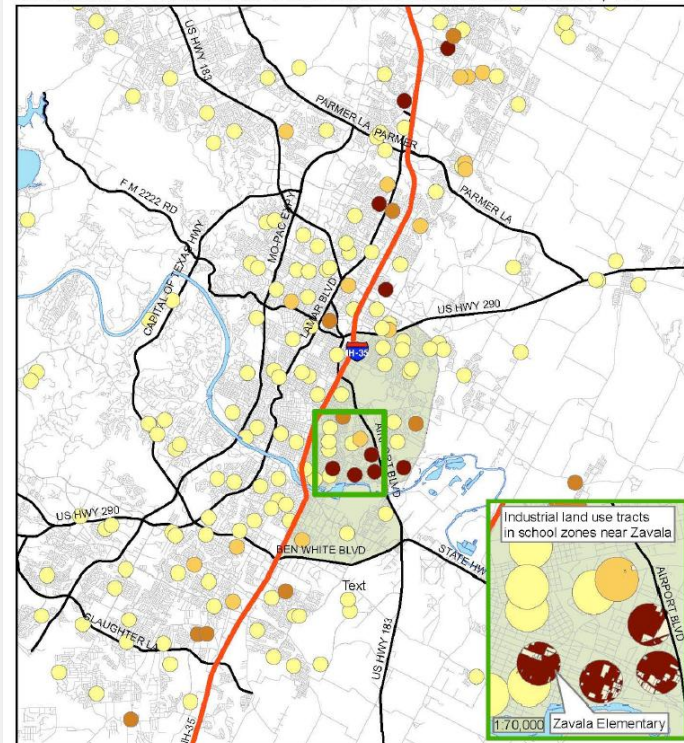
**East Austin Environmental Justice Project:**  
Distribution of race and industrial land use in Austin, TX



The East Austin Environmental Justice Project is a collaboration between the University of Texas at Austin, PODER, American Youth Works and Zavala Elementary. Data sources: City of Austin, U.S. Census 2000. Cartography/GIS: Scott Ford, Jasmin Moore, Jean Niswonger, Elizabeth Walsh. Project contacts: Susana Almanza, PODER, and Bjorn Sletto, UT-Austin. Spring 2007.



**East Austin Environmental Justice Project:**  
Distribution of industrial land use within school zones in Austin, TX



Percent industrial land use within school zones, 2003 (0.25 mile radius)

The green area east of IH-35 is served by PODER, Austin's primary environmental justice organization. It is also home to a disproportionate number of low-income and minority Austin residents.

The East Austin Environmental Justice Project is a collaboration between the University of Texas at Austin, PODER, American Youth Works and Zavala Elementary. Project contacts: Scott Ford, Jasmin Moore, Jean Niswonger, Elizabeth Walsh. Project contacts: Susana Almanza, PODER, and Bjorn Sletto, UT-Austin.

Scale: 0 to 4 Miles



# Impact of Support Housing on Property Values

