Geographical Analysis

Introduction to Geographic Analysis and Visualization

Ira A. Fulton Schools of Engineering
Arizona State University

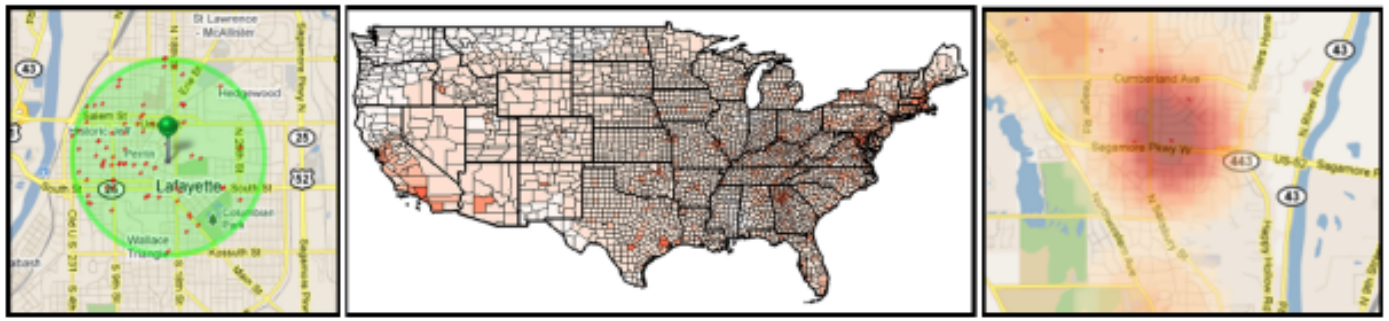
Objectives

Objective

Describe tools and techniques that are designed to support analyses that focus on datasets with a geographic component

Geovisualization

- Primarily denotes tools and techniques that are designed to support analyses that focus on datasets with a geographic component
- Visual representations are designed and built utilizing cartographic principles
- Look for trends over geographic regions



Geographic Visualization

Utilizes sophisticated, interactive maps to explore information

Recently, focuses on incorporating temporal components into analysis

Moving towards a combination of interactive maps and statistical analysis methods

Tobler's First Law of Geography

"Everything is related to everything else, but near things are more related than distant things"

Geographical Analysis

Thematic Maps

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

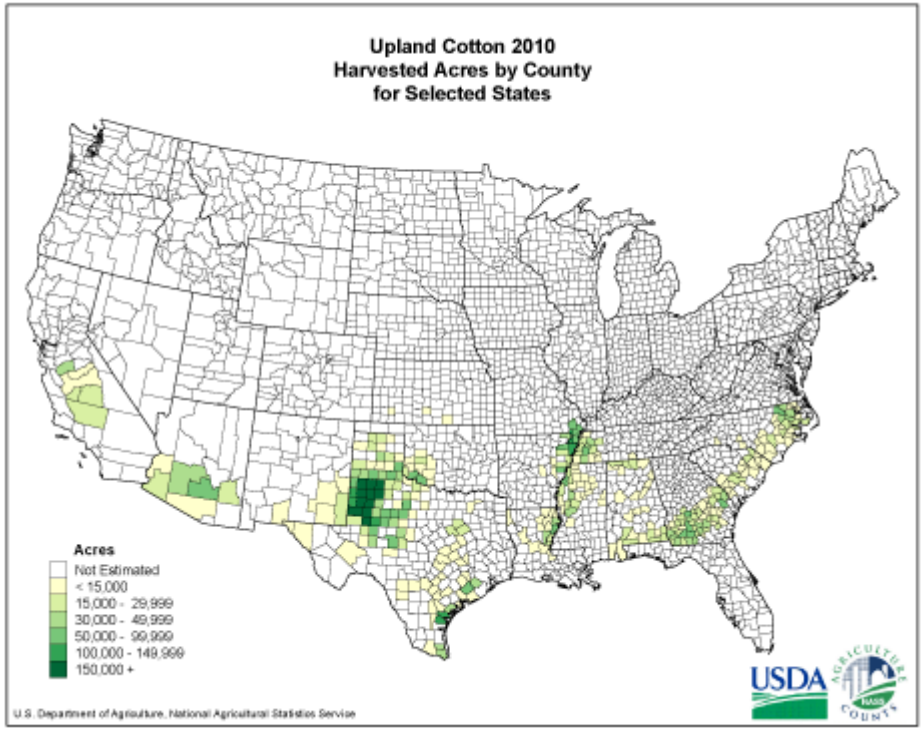
Objective

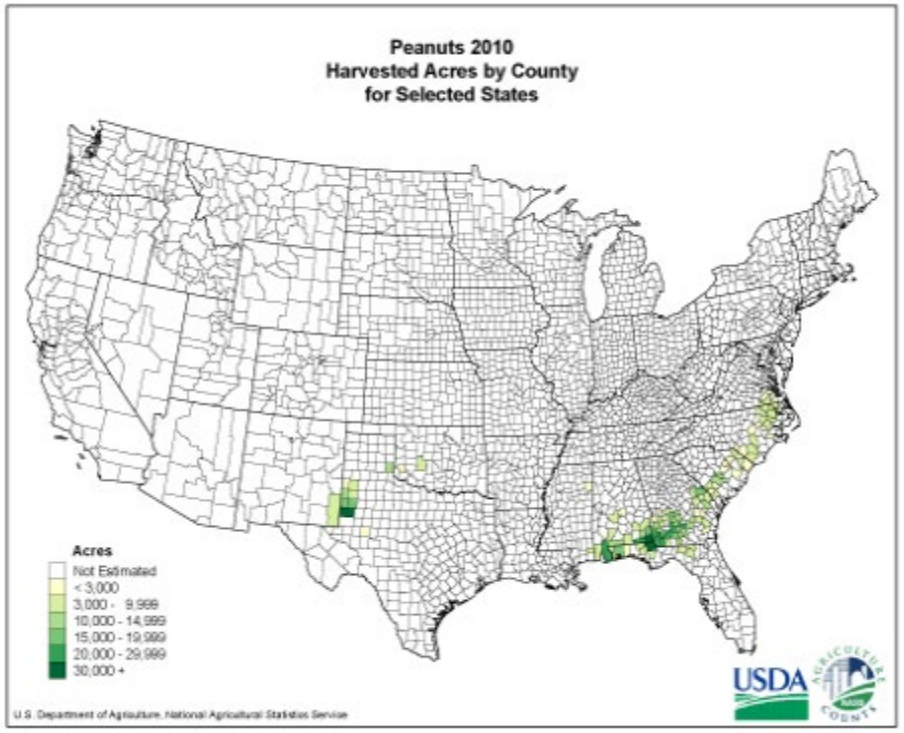
Describe tools and techniques that are designed to support analyses that focus on datasets with a geographic component

Thematic Maps

- A thematic map (or statistical map) is used to display the spatial pattern of a theme or attribute
- Focus is on spatial pattern as opposed to a general-reference map which focuses on location
- Goal of a thematic map is to emphasize spatial patterns of geographic attributes (e.g., population density)

Examples


Upland Cotton 2010
Harvested Acres by County
for Selected States
Acres
Not Estimated
< 15,000
15,000 - 29,999
30,000 - 49,999
50,000 - 99,999
100,000 - 149,999
150,000 +
U.S. Department of Agriculture, National Agricultural Statistics Service
USDA


Peanuts 2010
Harvested Acres by County
for Selected States
Acres
Not Estimated
< 3,000
3,000 - 9,999
10,000 - 14,999
15,000 - 19,999
20,000 - 29,999
30,000 +
U.S. Department of Agriculture, National Agricultural Statistics Service
USDA

How are Thematic Maps Used?

Locations	• To provide specific information about particular locations
Patterns	• To provide general information about spatial patterns
Comparisons	• To compare patterns on multiple maps

Geographical Analysis

Map Design: Coordinate System

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

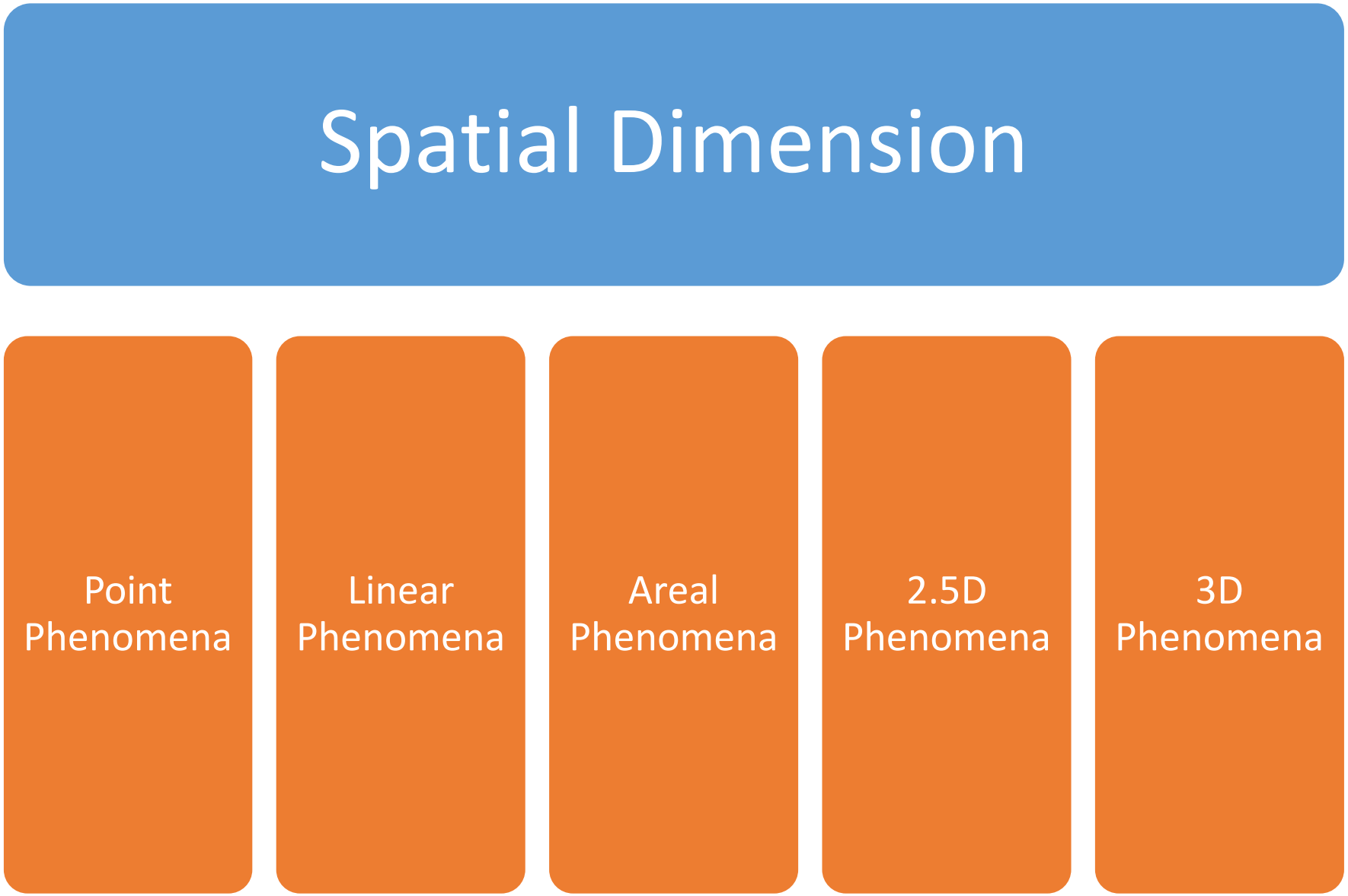
Objective

Describe tools and techniques that are designed to support analyses that focus on datasets with a geographic component

Basic Steps for Communicating Map Information

1. **Consider** what the **real-world distribution** of the phenomenon might look like
2. **Determine** the **purpose** of the map and the intended audience
3. **Collect data** appropriate for the map's purpose
4. **Design** and **construct** the map
5. **Determine** whether users find the map **useful/informative**

5 Types of Map Phenomena



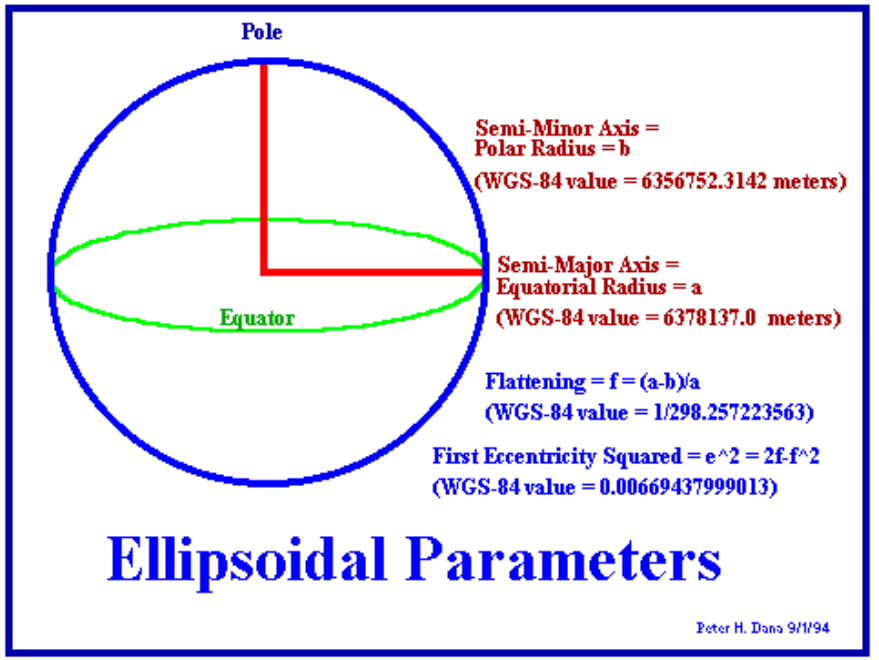
Coordinate Systems

Types of Map Coordinate Systems:

- Latitude/Longitude
- Universal Transverse Mercator
- State Plane
- Metes and bounds

Geodetic Datums

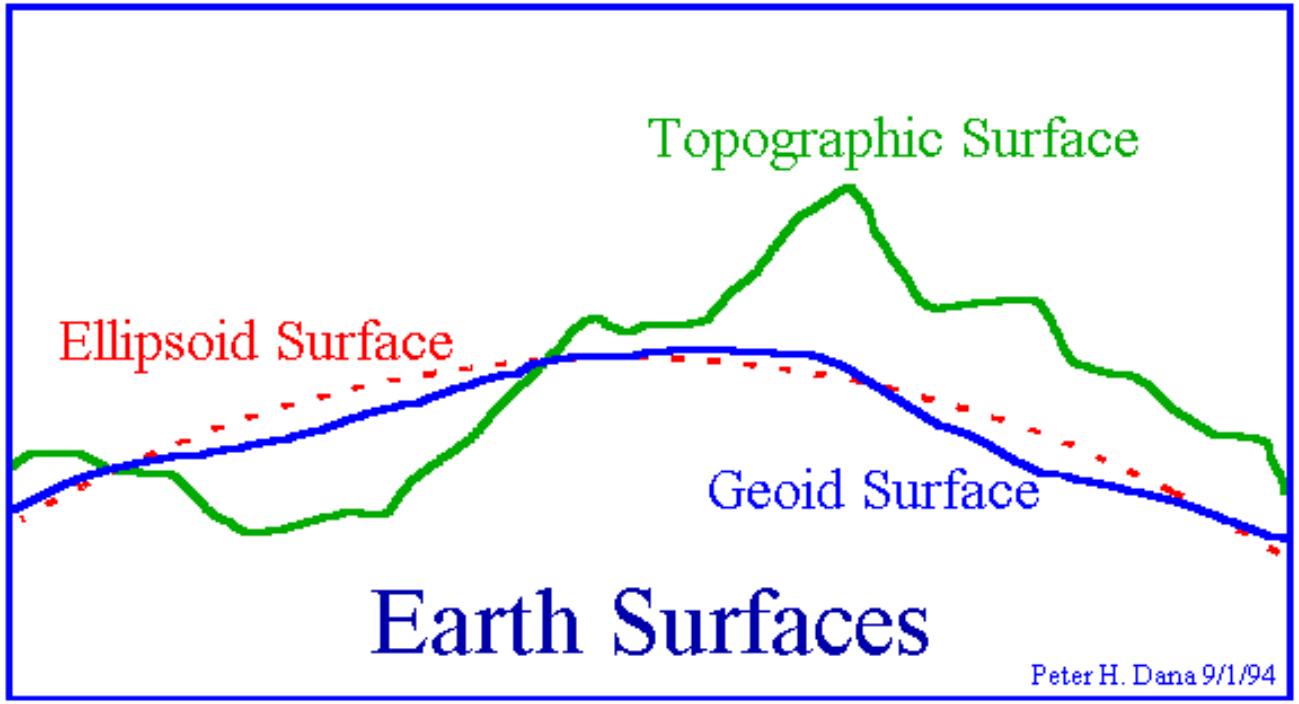
- Datums define the size and shape of the earth
- The initial point of the coordinate system is determined by the projection, ellipse model and datum



Common datums in the US:

- North American Datum 1927
- North American Datum 1983
- World Geodetic System

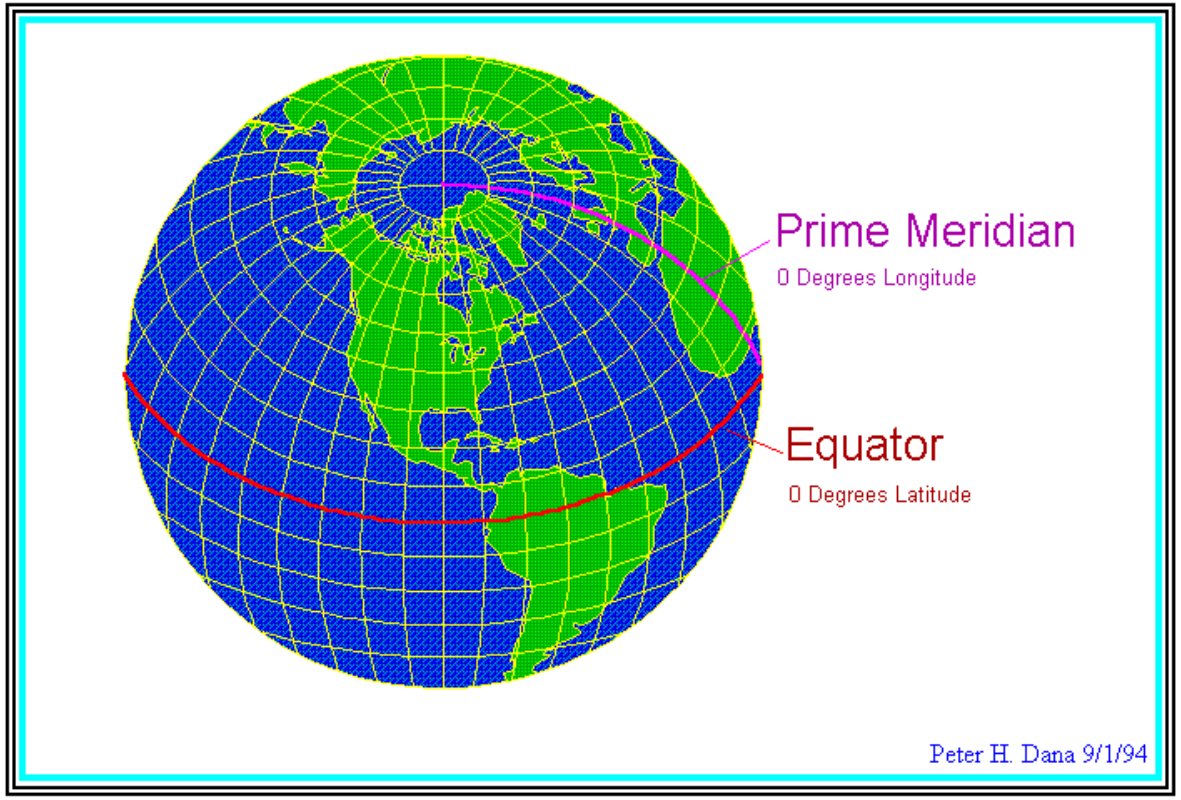
Types of Geodetic Datums



Topographical Surface Sea Level Gravity Models

Coordinate Systems: Latitude and Longitude

- Most commonly used coordinate system
- No transformations necessary between areas
- Scale, shape and direction distortion all increase with increasing area of interest



Geographical Analysis

Map Projections

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

Describe tools and techniques that are designed to support analyses that focus on datasets with a geographic component

Map Projections

Area/ Shape Distortion

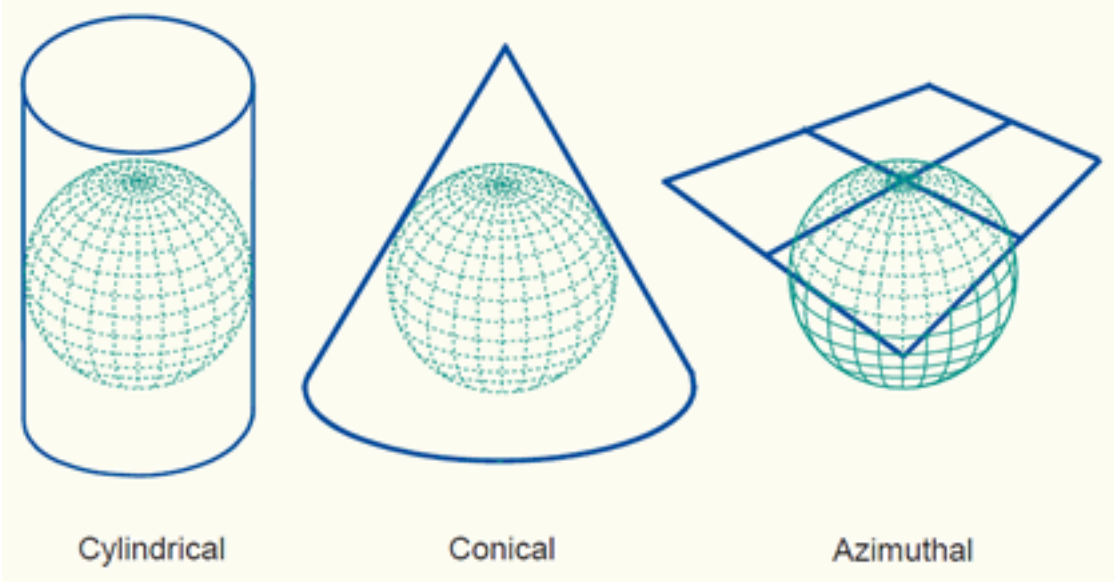
- **Equivalent** – Area is similar on globe and flat map, but shape is not
- **Conformal** – Shape is similar on globe and flat map, but the area is not

<do we have a pic to illustrate this? >

Map Projections

Shape of Projections

- **Cylindrical** – projection of sphere onto a cylinder
- **Conic** – projection of sphere onto a cone
- **Azimuthal** – projection of a sphere onto a plane
- **Miscellaneous**



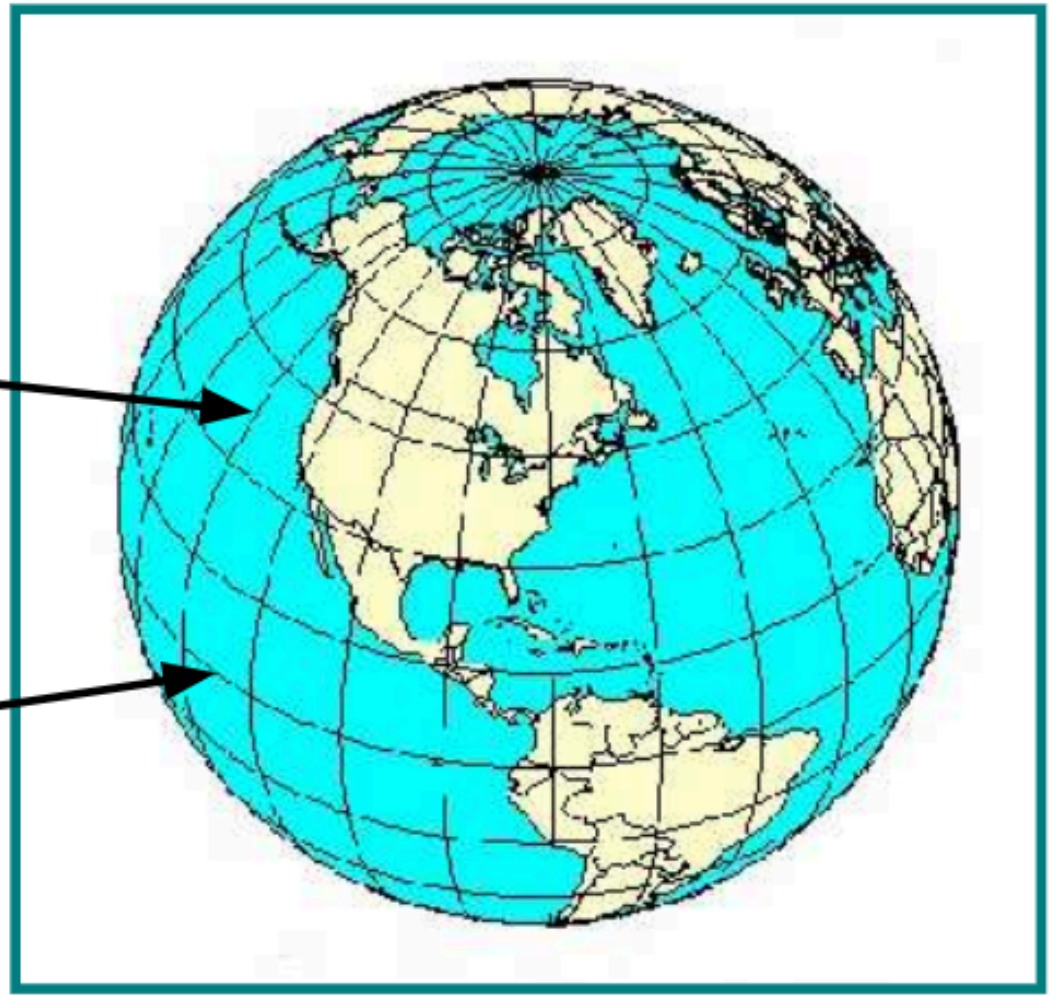
Map Projections

Meridians

North-South lines (such as Longitude)

Parallels

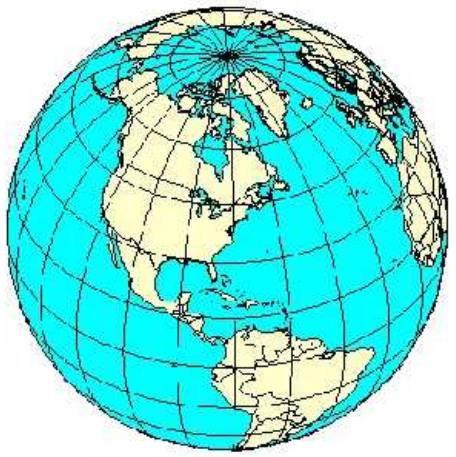
East-West lines (such as Latitude)



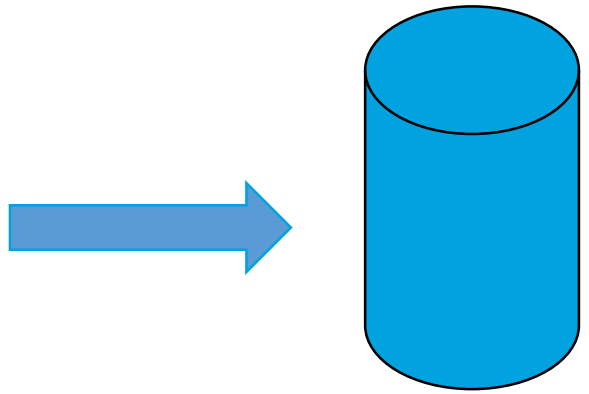
Cylindrical Projections

Characteristics:

- Straight meridians and parallels
- Meridians equally space
- Parallels unequally spaces

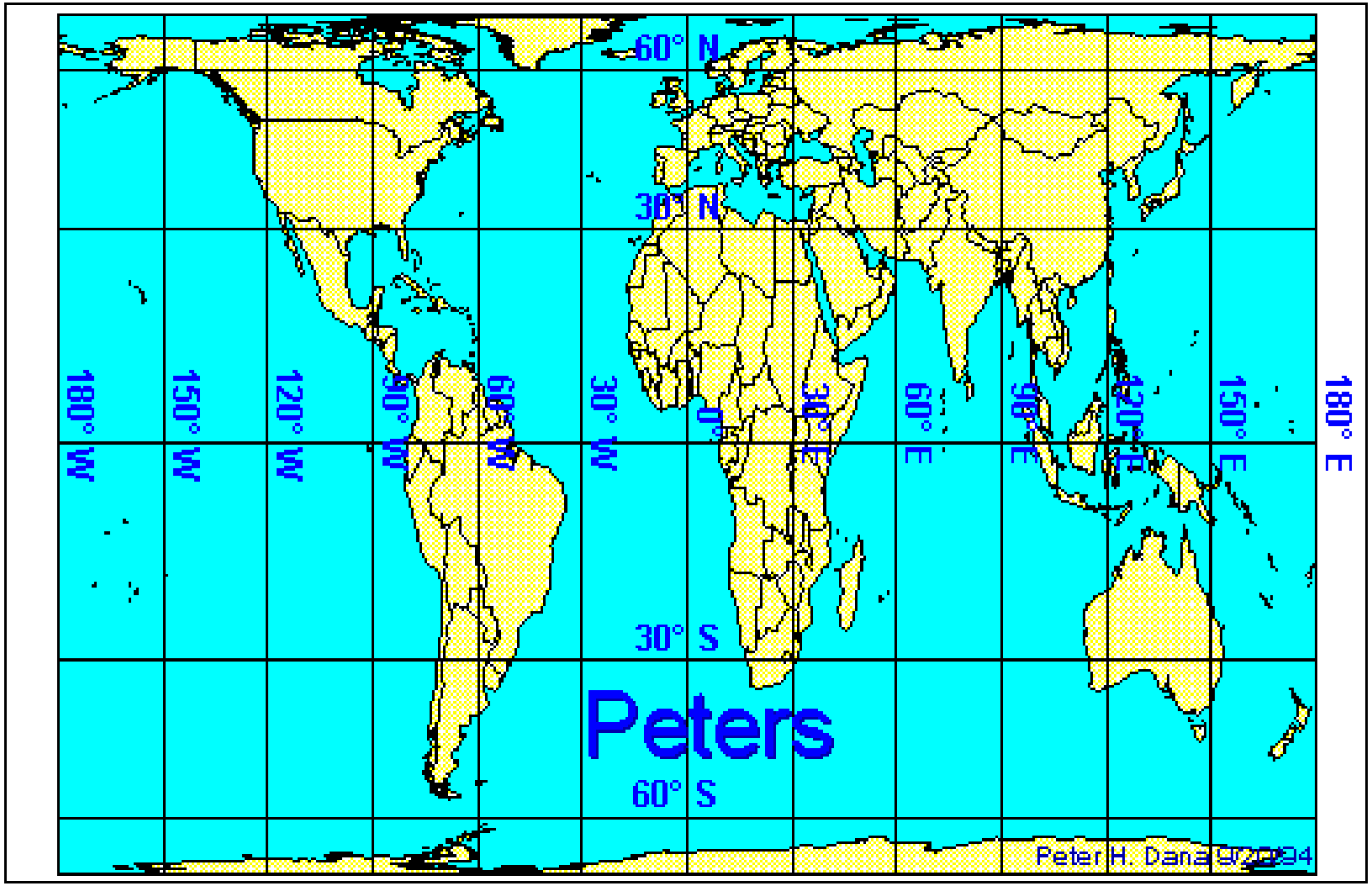


Mercator

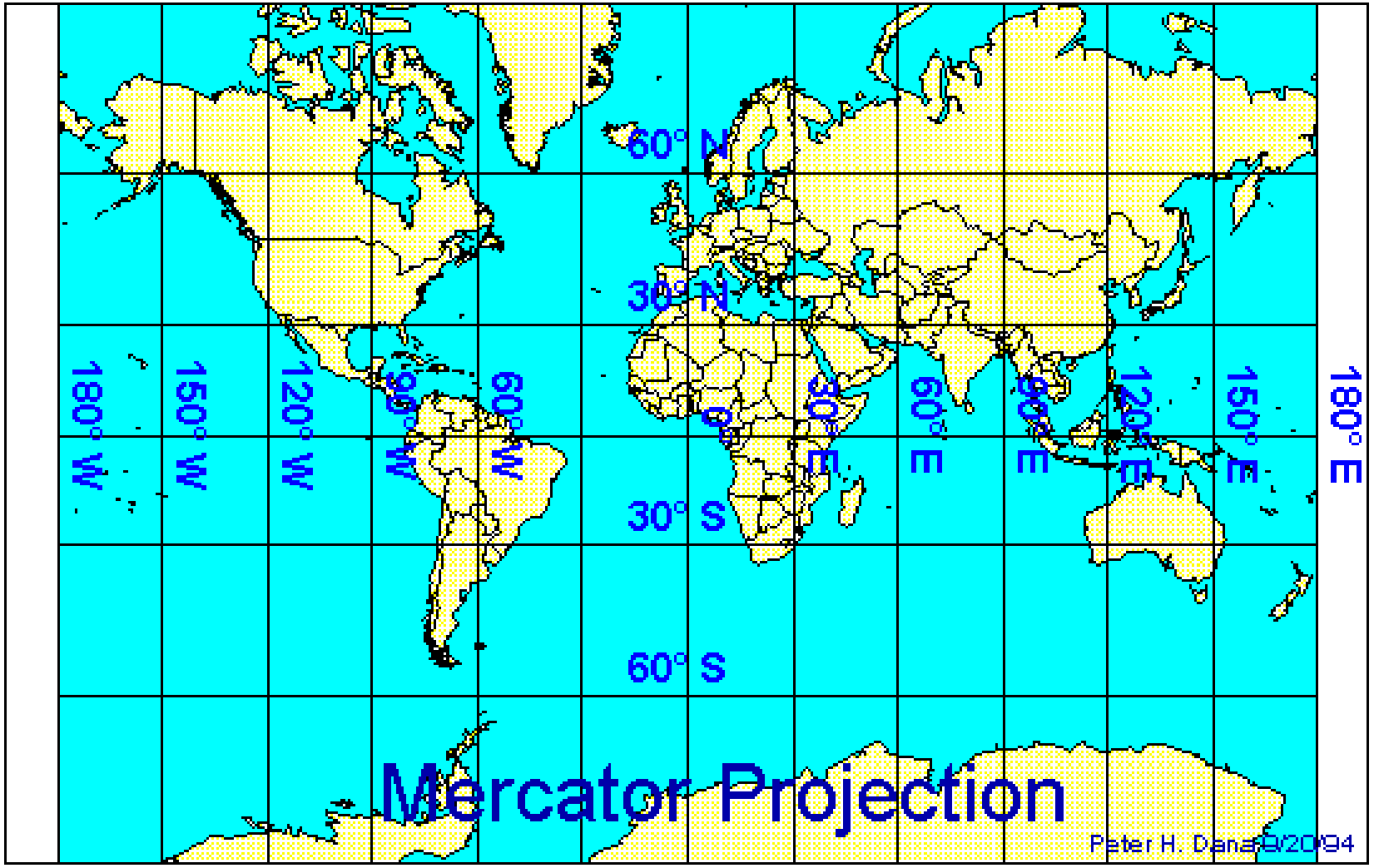


Universal Mercator

Cylindrical Projections - Peters



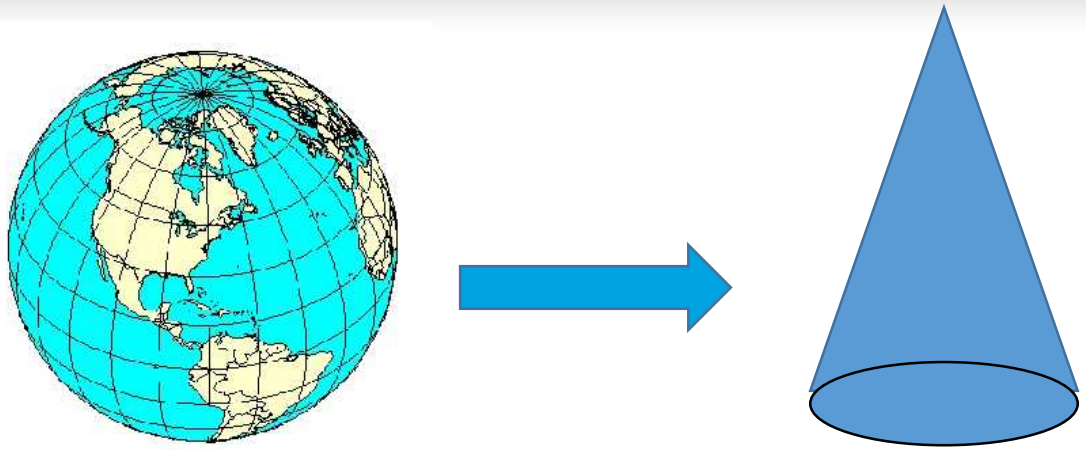
Cylindrical Projections - Mercator



Conic Projections

Characteristics:

- Straight meridians, curved parallels
- Meridians radiate from poles
- Parallels may be equally spaces

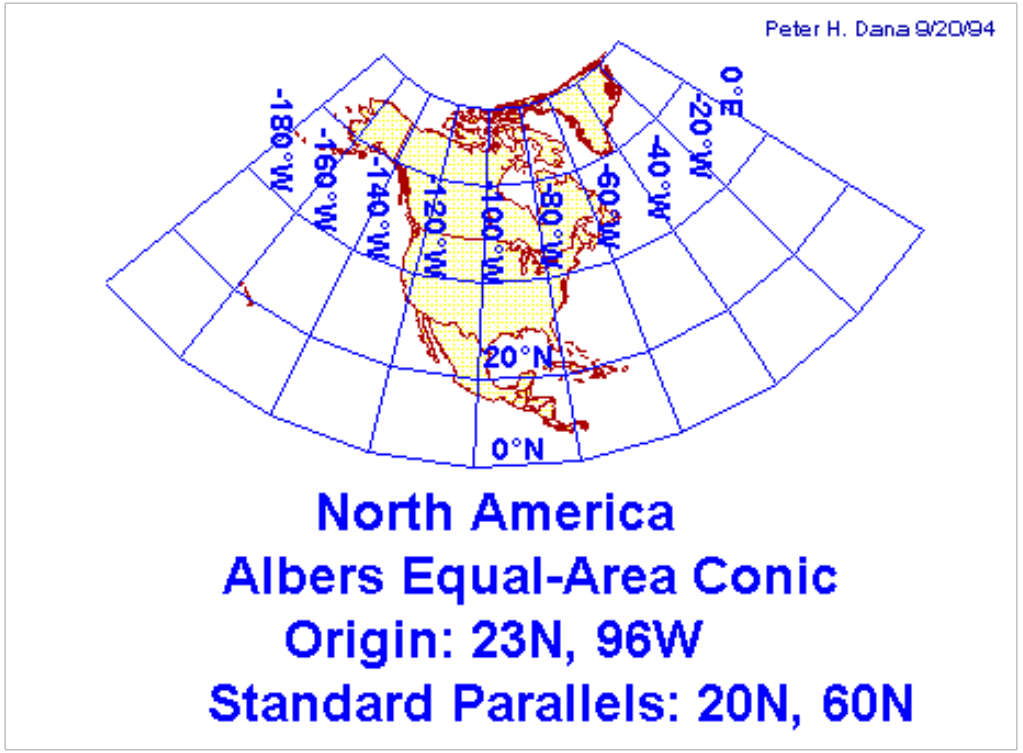


Common conic projections

- Albers
- Lambert
- Polyconic

Conic Projections – Albers Equal Area

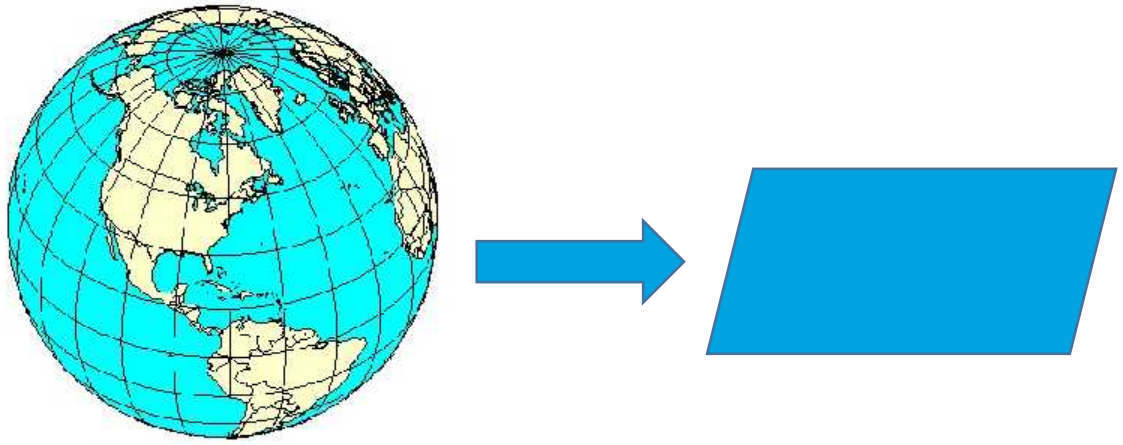
- Direction, area and shape are distorted away from the standard parallels
- Area and directions are true only in limited portions of a map



Azimuthal Projections

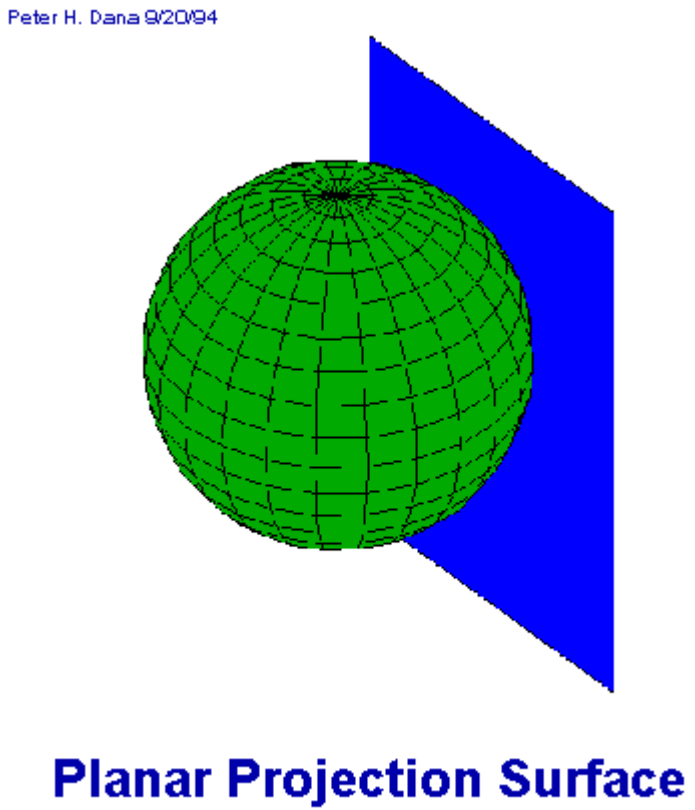
Characteristics:

- Straight or curved meridians, curved parallels
- Meridians radiate from poles
- Parallels may be equally spaced



Azimuthal Projections - Orthographic

- Simplest form is orthogonal projection
- Adequate only for very small areas
- Scale and area distortion increases as distance from the tangent center increases




NETHERLANDS
BELGIUM
PORTUGAL
SWITZERLAND
FRANCE
SPAIN
GERMANY
ITALY
EASTERN EUROPE
UNITED STATES
INDIA
INDIA PART 2
CHINA
CHINA PART 2
UK
JAPAN

Geographical Analysis

Map Design: Map Elements and Typography

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

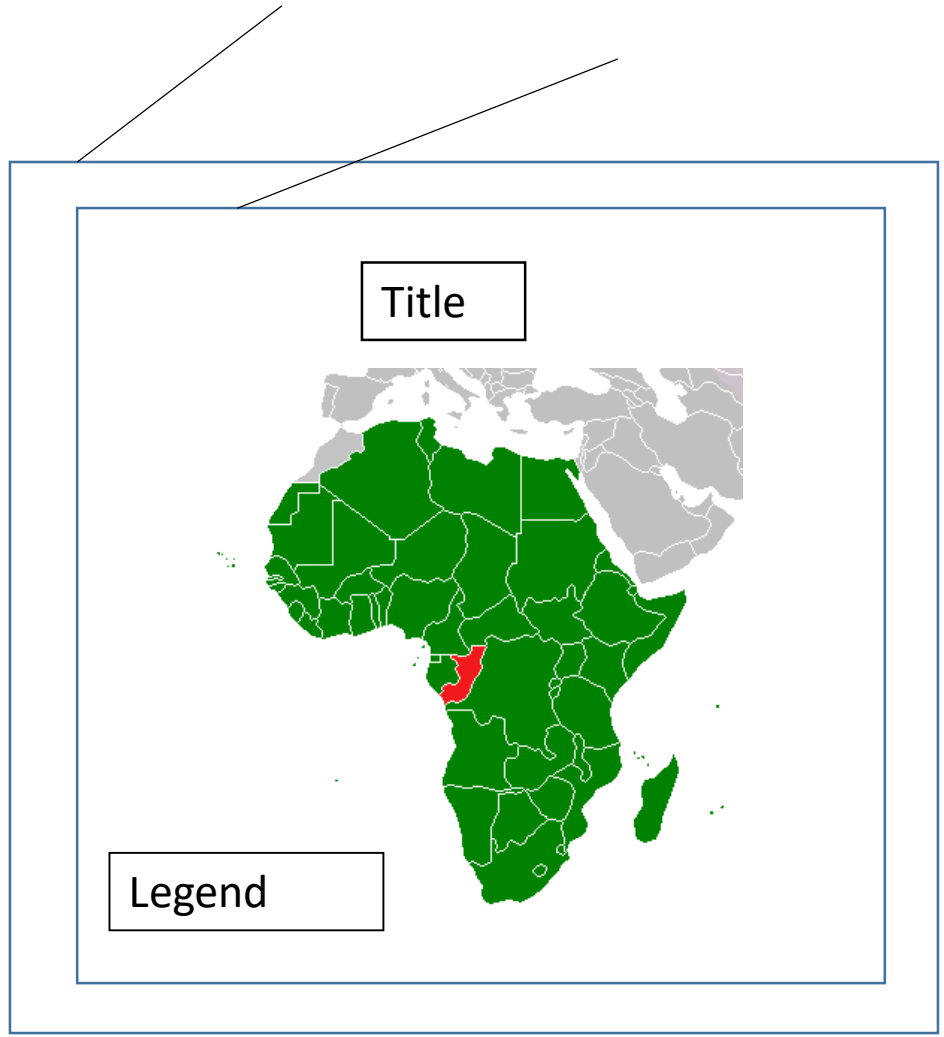
Objective

Describe tools and techniques that are designed to support analyses that focus on datasets with a geographic component

Map Elements and Typography

Map Elements

Frame line and neat line	Mapped area	Inset	Title and subtitle
Legend	Data source	Scale	Orientation


Title
Legend

Legend

- Map element that **defines all** of the thematic symbols of the map
- Symbols
  - if self explanatory or not directly related to the map's theme can be omitted
  - should be vertically centered with their definition
- Textual definitions should be horizontally centered
- Legend heading can be used to further explain the maps theme
- Scale is added to indicate the distances

Typography

Use

- Use bold and italic type sparingly
- A realistic lower limit for all type size
- Type size should correspond with the size or importance of map features

Do not use

- decorative type families
- Script, cursive and ornate style
- Two type families on a given map

Limited Use

- Reserve italics for water features or to identify the data source

Specific Guidelines for Map Elements

- Orient type horizontally
- Avoid overprinting
- Ensure type is placed so that it is clearly associated with the feature it is representing

Geographical Analysis

Introduction to Choropleth Maps and Color Schemes

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

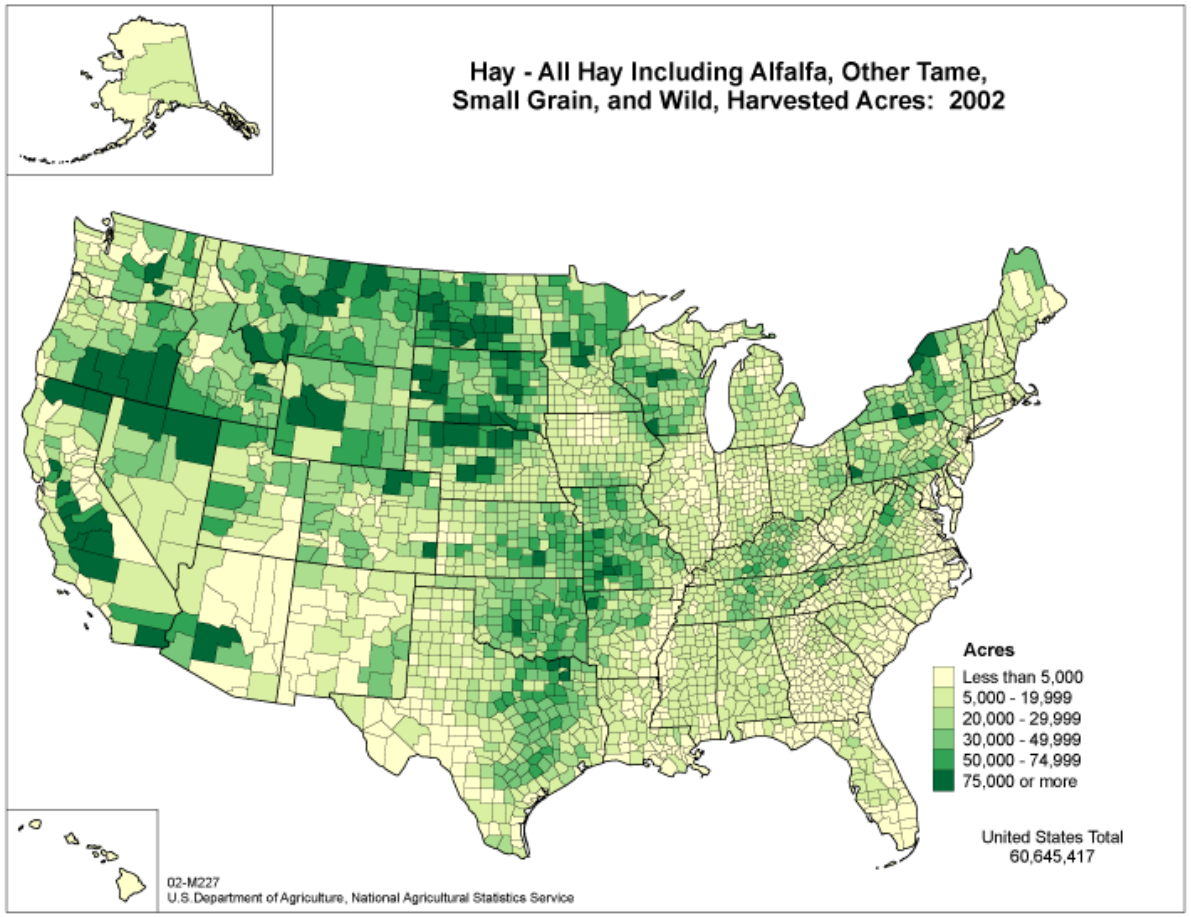
Differentiate types of geographic visualizations

Introduction to Choropleth Maps

- Earliest known choropleth map was created in 1826 by Baron Pierre Charles Dupin
- Term choropleth map was coined in 1938 by John Kirtland Wright
- Choropleth maps are based on statistical data aggregated over defined geographical regions

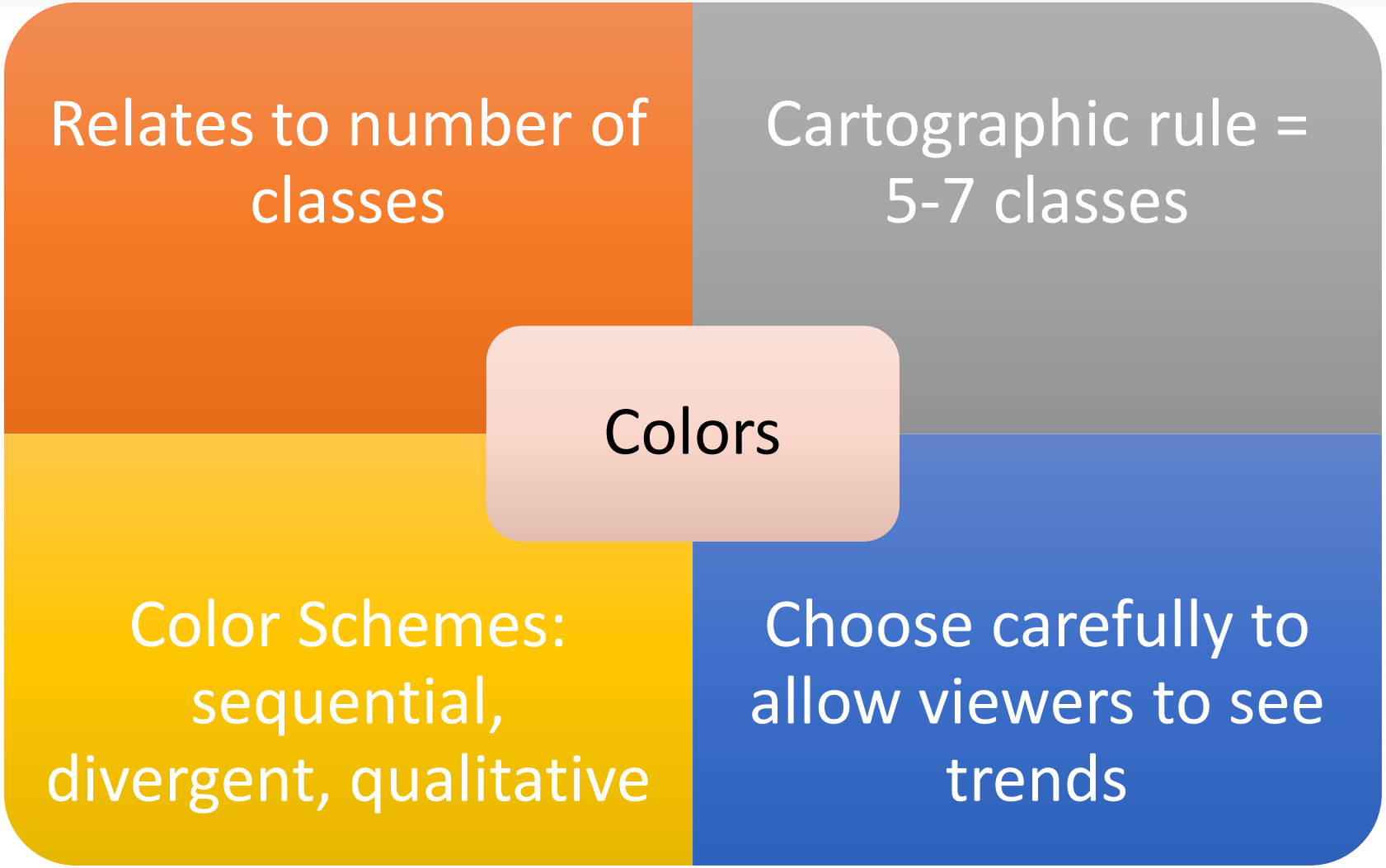
Choropleth Maps

- Areas of the map are shaded in proportion to a measured variable
- Coloring is based on a classification (histogram binning) of the distribution of the measured variable

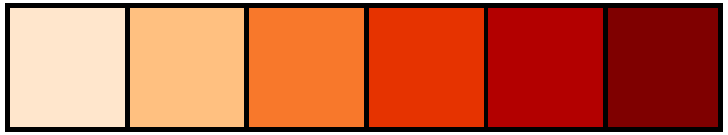


http://www.nass.usda.gov

Coloring Choropleth Maps

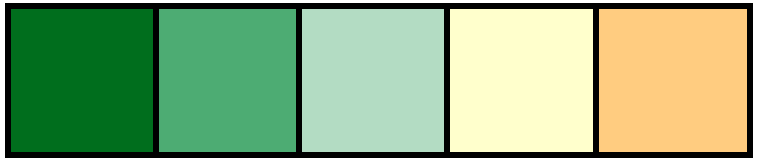


Color Schemes: Sequential



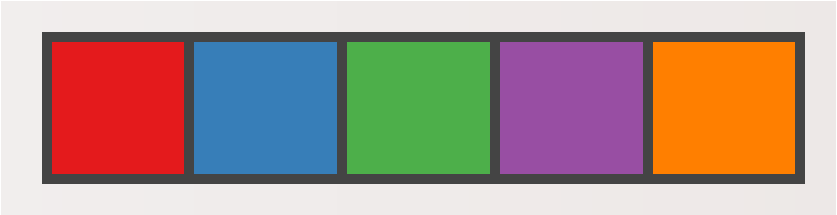
- Suited for ordered data
- Lightness steps dominate the look of the scheme
- Light values are low data values, dark are high
- Good for Ordinal, interval and ratio data types

Color Schemes: Diverging



- Puts an emphasis on critical midrange values
- Color change represents deviation from a meaningful midrange critical value
- Good for ratio data types where looking at data above and below a ‘zero’ point

Color Schemes: Qualitative



- Does not imply magnitude difference
- Used to show differences between classes
- Good for Nominal data types

Geographical Analysis

Data Classifications

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

Differentiate types of geographic visualizations

Class Interval Selection

- Choices for optimizing the class interval selection are highly dependent on the underlying data distribution
- Similar to the concept of histogram binning
- Popular choices for class interval selection include
  - Equal interval selection
  - Jenks' Natural Breaks
  - Minimum boundary error

Equal Interval

- Classifies data such that each case occupies an equal interval along the number line

- Advantage
  - Easy to compute

- Disadvantage
  - Fails to consider how data are distributed

$$\frac{range}{NumClasses} = \frac{High - Low}{NumClasses}$$

Quantiles

The number of color bins (classes) will determine the number of quantiles

Advantages

- Easy to compute
- Percentage of observations in each class will be the same
- Class assignment is based on rank order

Disadvantages

- Fails to consider data distribution
- Dissimilar data can be placed into same class

$$Number\ In\ Class = \frac{TotalSamples}{NumClasses}$$

Mean-Standard Deviation

- Classes are formed by adding or subtracting some number of standard deviations from the mean

- Advantages:
  - If data are normally (or near normally) distributed, the mean serves as a useful dividing point
  - Legend will contain no gaps

- Disadvantage:
  - Only works well only with data that are normally distributed

Maximum Breaks

- Goal is to consider individual data values and group those that are similar
  - Order data for low to high and differences between adjacent values are computed
  - The largest differences (“breaks”) are used for the class divisions

- Advantages:
  - Easy to compute
- Disadvantage:
  - May miss natural clusters

Natural Breaks

- Data values are examined visually to determine logical breaks within the data
- Goal is to **minimize** differences between data values in the same class and **maximize** differences between different classes

- Advantage:
  - Tries to take into account natural underlying structure of the data
- Disadvantage:
  - Subjective, different mapmakers may choose other values

Optimal Classification

- Same as natural breaks, but minimizes an objective function
- Goal is to place values into groups
- Measure an “error” – common is to use the sum of absolute deviations about class medians
- Calculate each class median and then add the resulting sums of absolute deviations
- Many computer based algorithms have been developed to do this:
  - Jenks-Caspall
  - Fisher-Jenks

Optimal Classification

Advantages

- Good empirical method for grouping data
- Can assist in determining appropriate number of classes

Disadvantages

- Hard to explain to novice users
- May leave gaps in the map legend

Utilizing Spatial Context

Optimal Map (with spatial constraint)

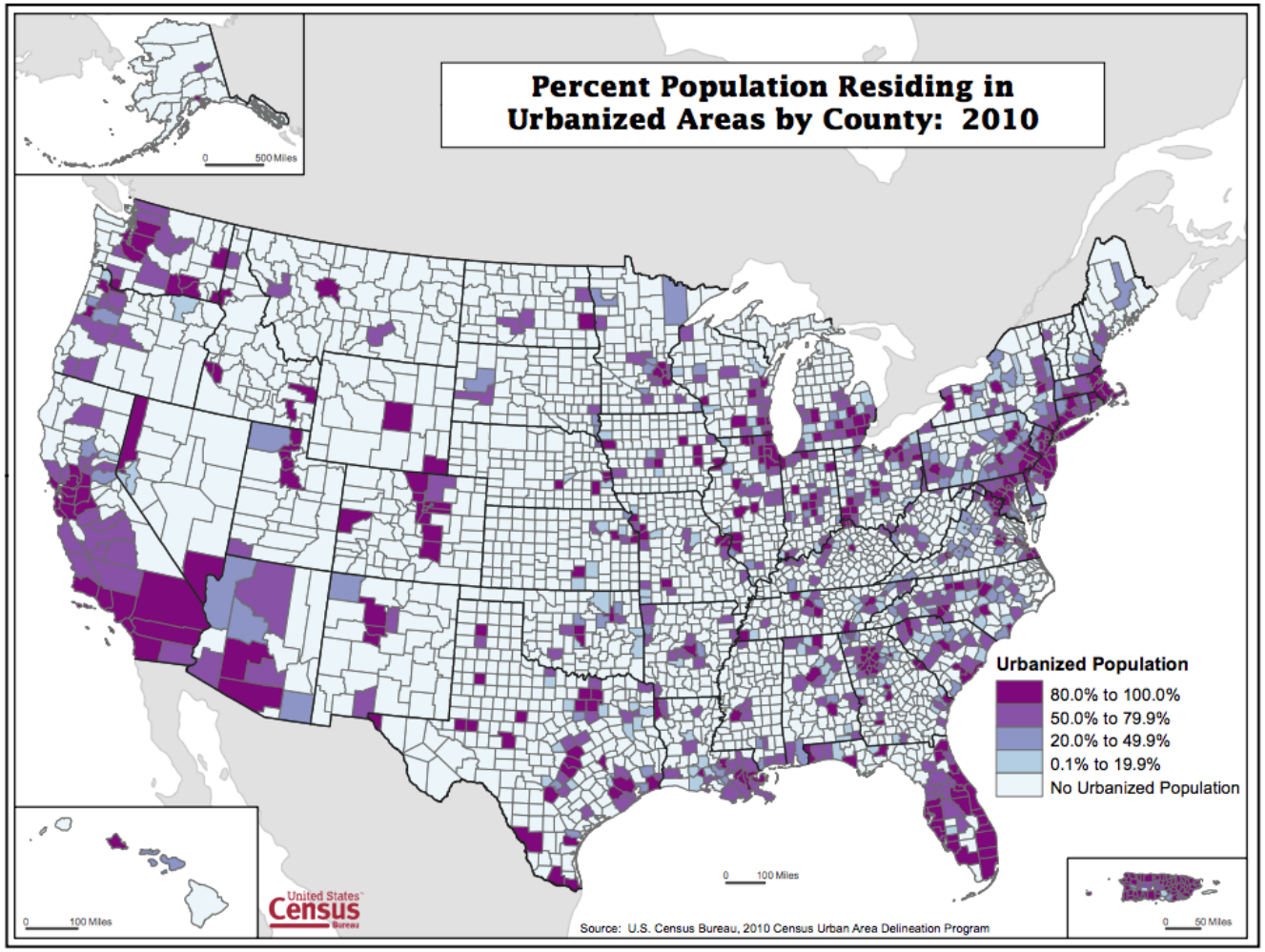
Raw Data
1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20

1	9	5	6
20	3	16	12
19	4	13	11
18	10	17	2

GADF = 0.70
$C_F = 6/16 = 0.38$

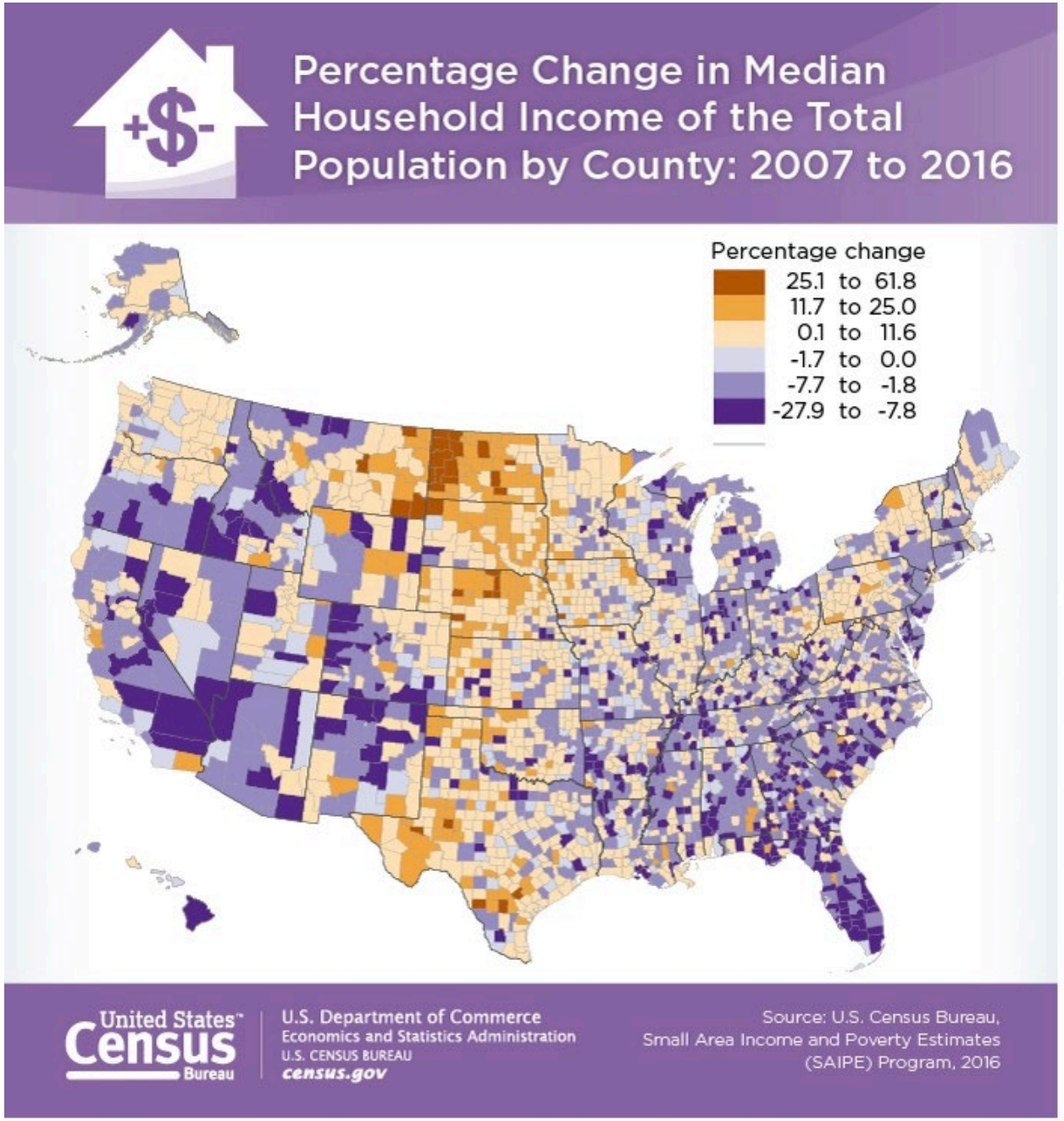
Choropleth Maps

- Need to standardize the statistics
  - Divide by population
  - Divide by area
- Modifiable areal unit problem – source of statistical bias occurring when data is aggregated into districts



Ecological Fallacy

- Inferences about individuals are based solely upon aggregate statistics collected for the group to which those individuals belong
  - Assumes that individual members of a group have the average characteristics of the group at large
  - Group characteristics do not necessarily apply to individuals within that group



Geographical Analysis

Spatial Statistics

Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

Explain spatial statistics

Tobler's First Law of Geography

"Everything is related to everything else, but near things are more related than distant things"

Spatial Statistics

- Spatial dependency is the co-variation of properties within a geo-space

- If correlation exists (either positively or negatively), there are at least three possible explanations:
  - There is a simple spatial correlation relationship
  - Spatial causality
  - Spatial interaction

Covariance

$$Cov(x, y) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

Covariance: The pattern of common variation observed in collection of two (or more) datasets, or partitions of a single dataset

Pearson's Correlation Coefficient

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - y)}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

Pearson's Correlation Coefficient: A measure of similarity between two or more paired datasets

Entropy

$$I = -\sum_{i=1}^{k} p_i \log(p_i)$$

Entropy: A measure of the amount of pattern, disorder, or information in a set $\{x_i\}$ where p_i is the proportion of events or values occurring in the i^{th} class or range.

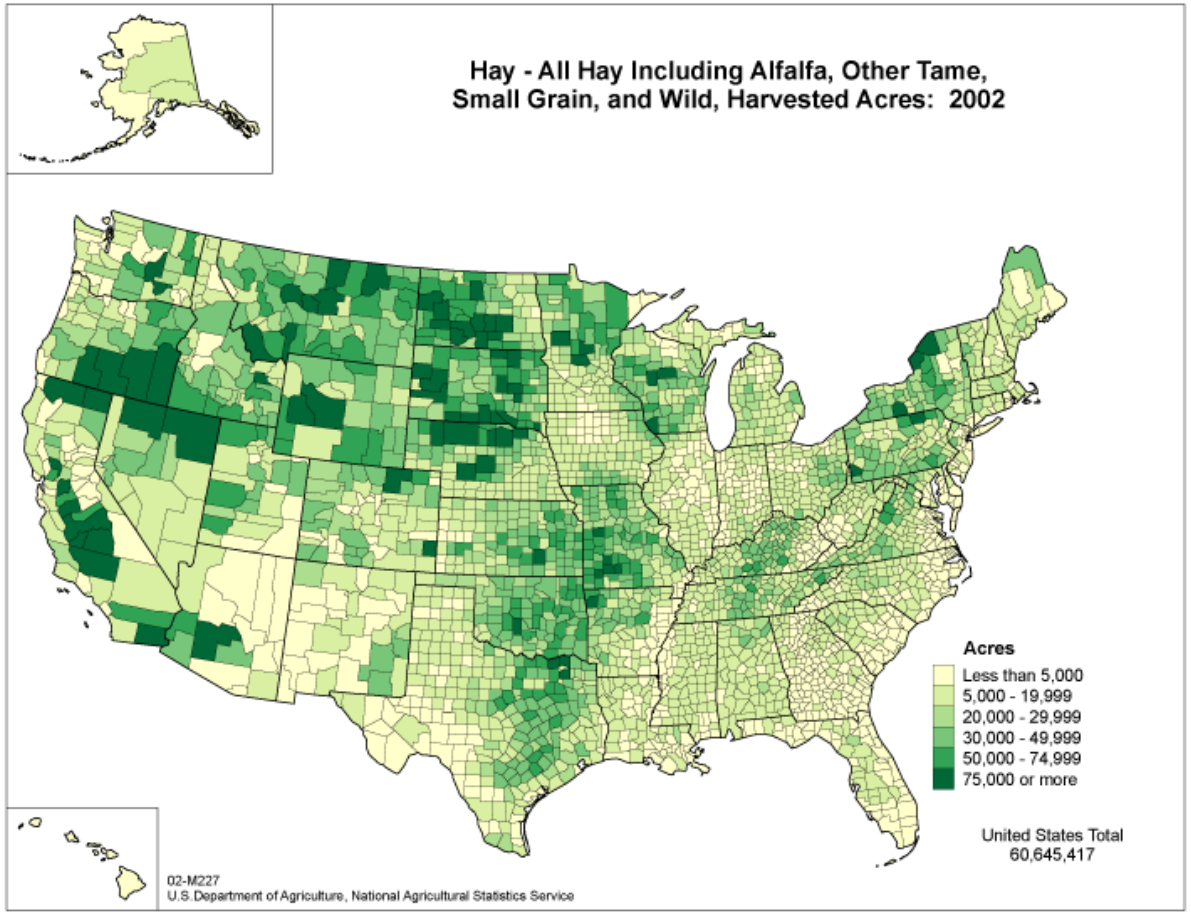
Diversity

$$Div = \frac{-\sum_{i=1}^{k} p_i \log(p_i)}{\log(k)}$$

Diversity: entropy standardized by the number of classes, k

Spatial Statistics

- For spatial data, we want to find related regions
- Can do analysis prior to the visualization to find areas that are statistically correlated and focus the visual representation on these areas
- One method of doing this is using spatial autocorrelation



Issues in Spatial Statistics

- Scaling
- Sampling
- Logical Fallacy
- Ecological Fallacy

Distance and Direction

- Knowledge of location also allows the analyst to determine the distance and direction between objects

- Many types of spatial analysis require the calculation of a table expressing the relative proximity of pairs of places

Elements of Matrix W

Elements of Matrix W:

- **1** if the places share a common boundary, else **0**
- The length of any common boundary between places, else **0**
- A decreasing function of the distance between the places, or between their representative points

Geographical Analysis

Spatial Autocorrelation

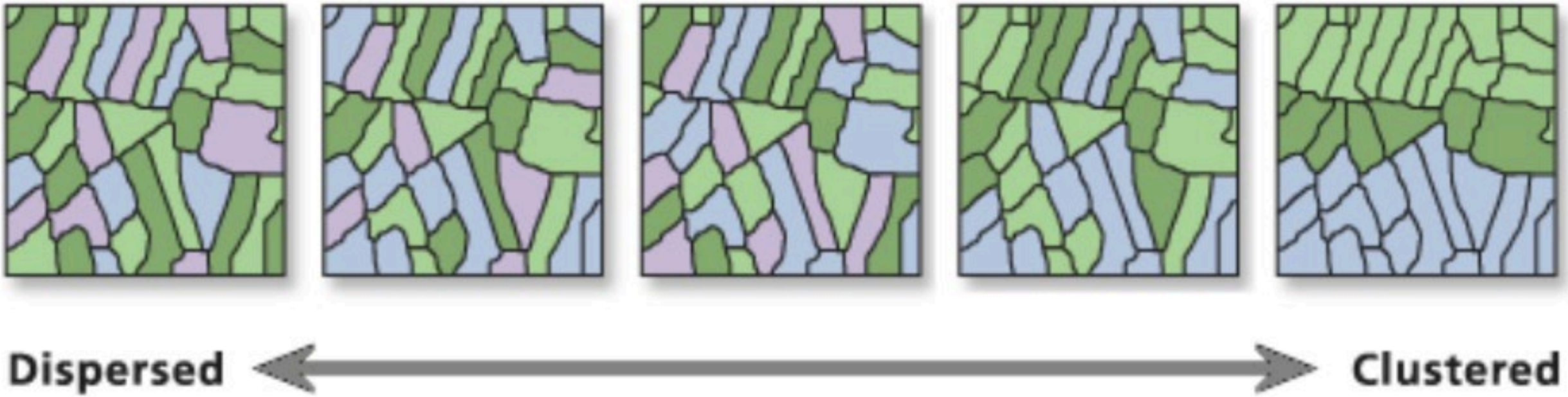
Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

Explain spatial statistics

Spatial Autocorrelation



Moran's I

$$I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij}(X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2}$$

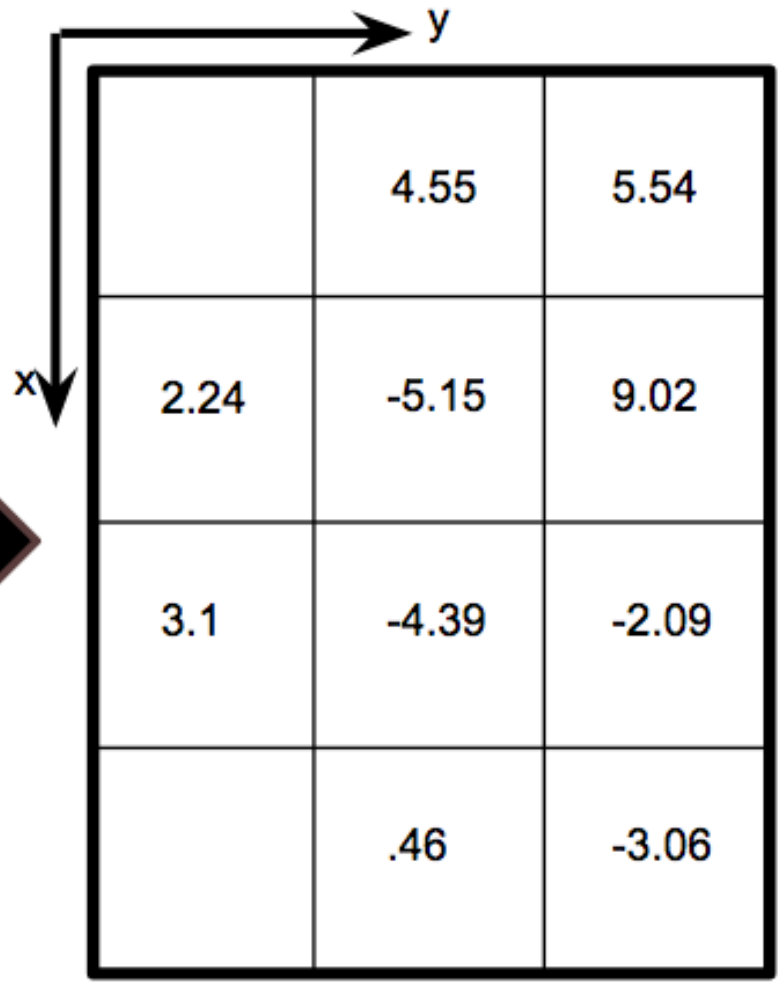
- Given a set of features and an associated attribute, Global Moran's I evaluates whether the pattern expressed is clustered, dispersed or random
- Values near +1.0 indicate clustering while values near -1.0 indicate dispersion
- Global Moran's I function also calculates a Z score value that indicates whether we can reject the null hypothesis of "there is no spatial clustering"

What is a Z Score?

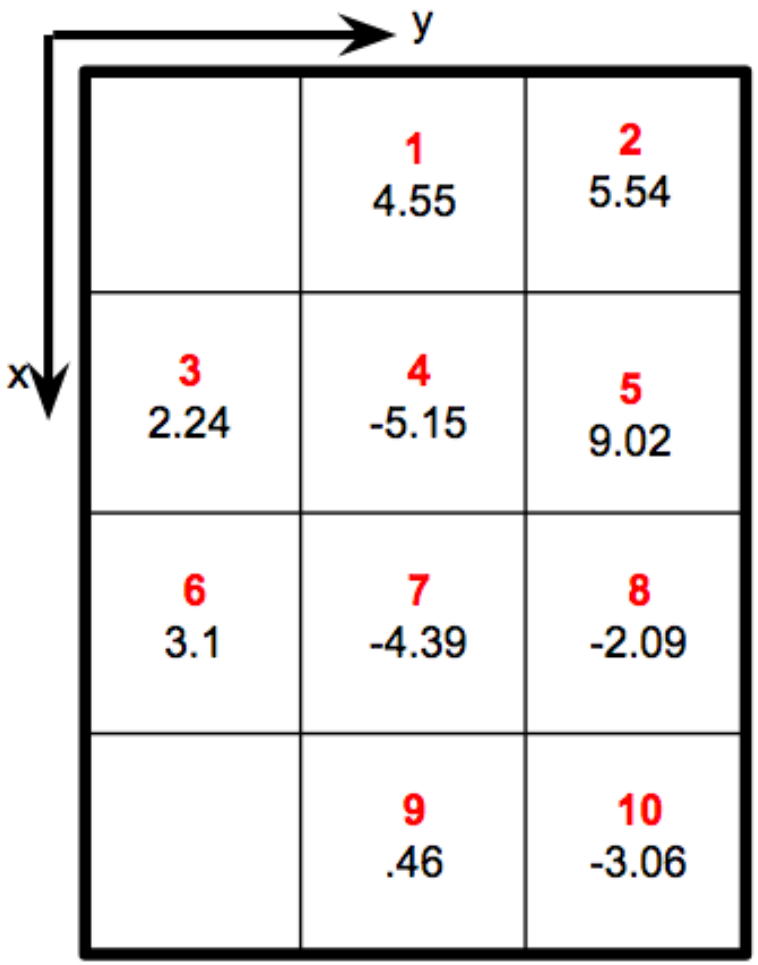
- Most statistical tests begin by identifying a null hypothesis
- The Z score is a measure of **standard deviations**
- The Z score is associated with a **normal distribution**
- Critical Z score values when using a 95% confidence level are **-1.96 and +1.96 standard deviations**.

Calculating Moran's I

X	Y	Z
1	2	4.55
1	3	5.54
2	1	2.24
2	2	-5.15
2	3	9.02
3	1	3.1
3	2	-4.39
3	3	-2.09
4	2	.46
4	3	-3.06



Adjacency Matrix



	1	2	3	4	5	6	7	8	9	10
1	0	1	0	1	0	0	0	0	0	0
2	1	0	0	0	1	0	0	0	0	0
3	0	0	0	1	0	1	0	0	0	0
4	1	0	1	0	1	0	1	0	0	0
5	0	1	0	1	0	0	0	1	0	0
6	0	0	1	0	0	0	1	0	0	0
7	0	0	0	1	0	1	0	1	1	0
8	0	0	0	0	1	0	1	0	0	1
9	0	0	0	0	0	0	1	0	0	1
10	0	0	0	0	0	0	0	1	1	0

Geary's C

$$C = \frac{(N-1)\sum_i \sum_j w_{ij}(X_i - X_j)^2}{2W\sum_i (X_i - \bar{X})^2}$$

- Value of Geary's C lies between 0 and 2
  - Values of 1 means no spatial autocorrelation
  - Smaller than one means positive spatial autocorrelation
  - Larger than one means negative spatial autocorrelation
- Geary's C is more sensitive to local spatial autocorrelation

Local Indicators of Spatial Association

- Moran's I is a **global** measure of correlation
- The individual components can be mapped and tested for significance to provide an indication of clustering patterns within the study region

Getis-Ord Statistic

$$G_i^* = \frac{\sum_{j=1}^{N} w_{ij}x_j - \bar{x}\sum_{j=1}^{N} w_{ij}}{S\sqrt{\frac{\left[N\sum_{j=1}^{N} w_{ij}^2 - \left(\sum_{j=1}^{N} w_{ij}\right)^2\right]}{N-1}}}$$

- Unlike Moran's I, the Getis and Ord statistic identifies the degree to which high or low values cluster together

Significance Tests for Autocorrelation Indices

- Autocorrelation coefficients can be tested for statistical significance under two different model assumptions.
  - Classical statistical assumption of Normality
  - Assume that values are independent and identically distributed drawings from a Normal distribution
  - Observed pattern of a set of values is assumed to be just one realization from all possible random permutations
  - Utilizes Monte Carlo testing

Geographical Analysis

Spatial Scan Statistics

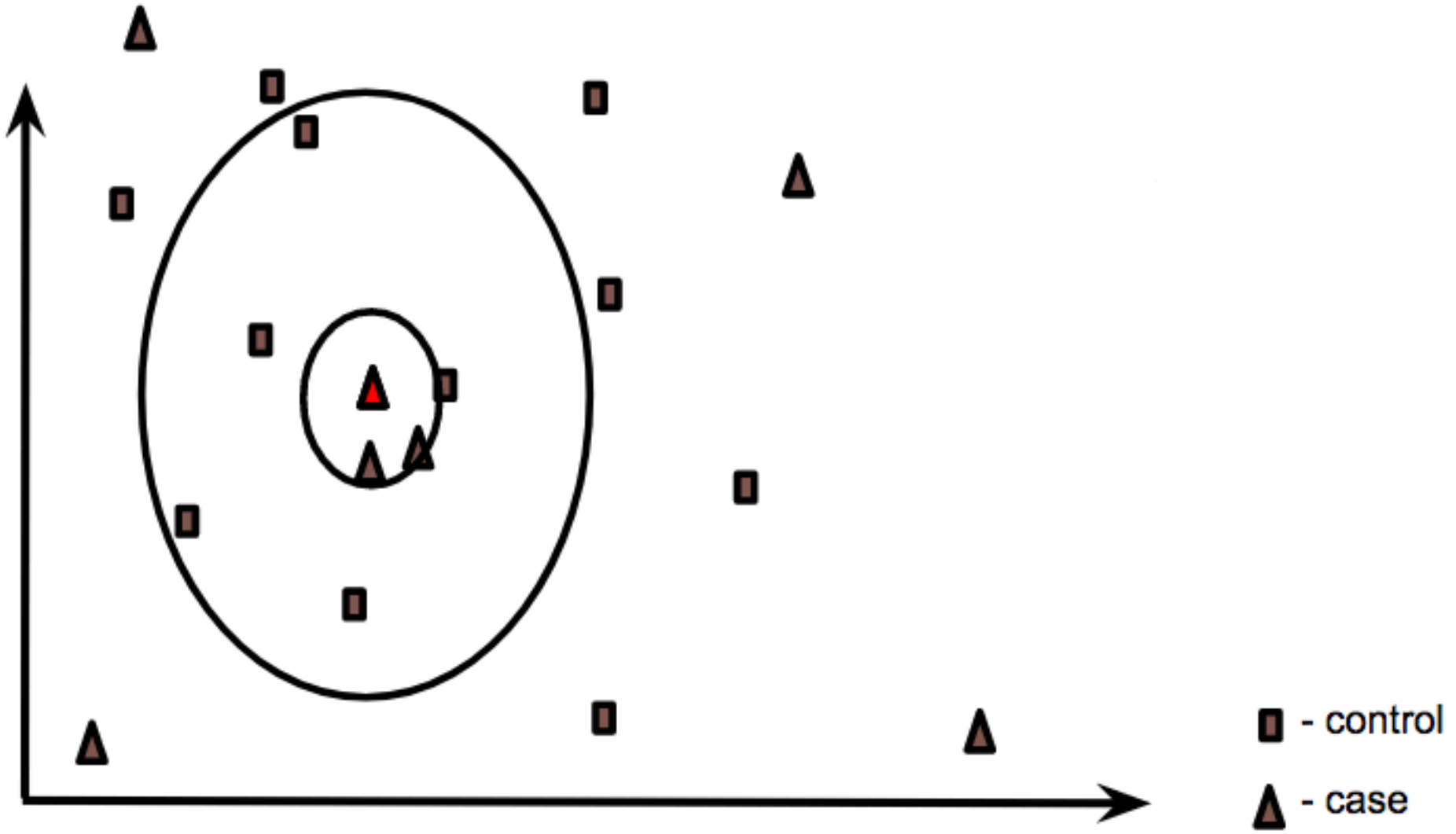
Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

Explain spatial statistics

Scan Statistics

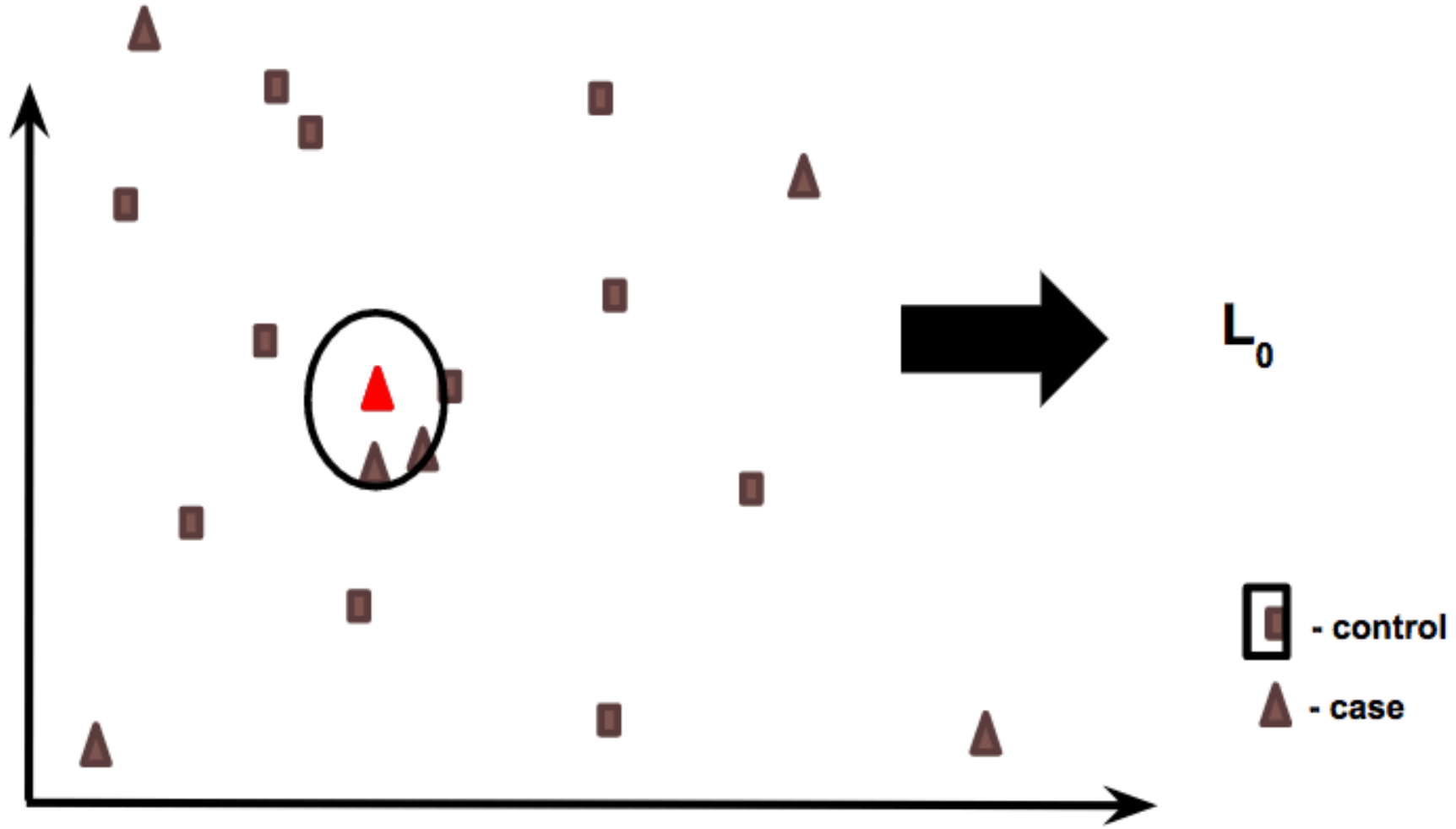


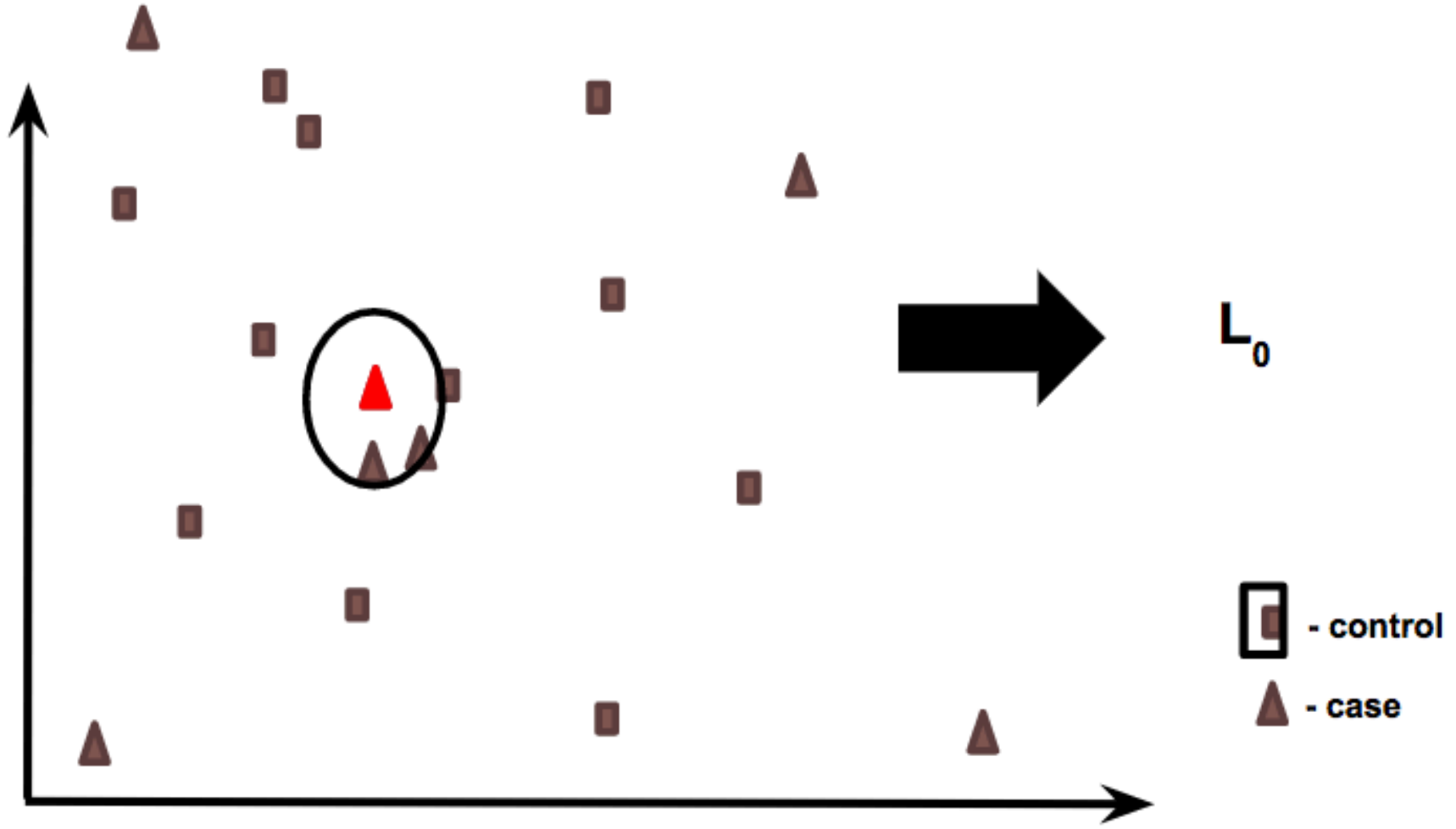
Scan Statistics

For each circle (window) compute the likelihood function

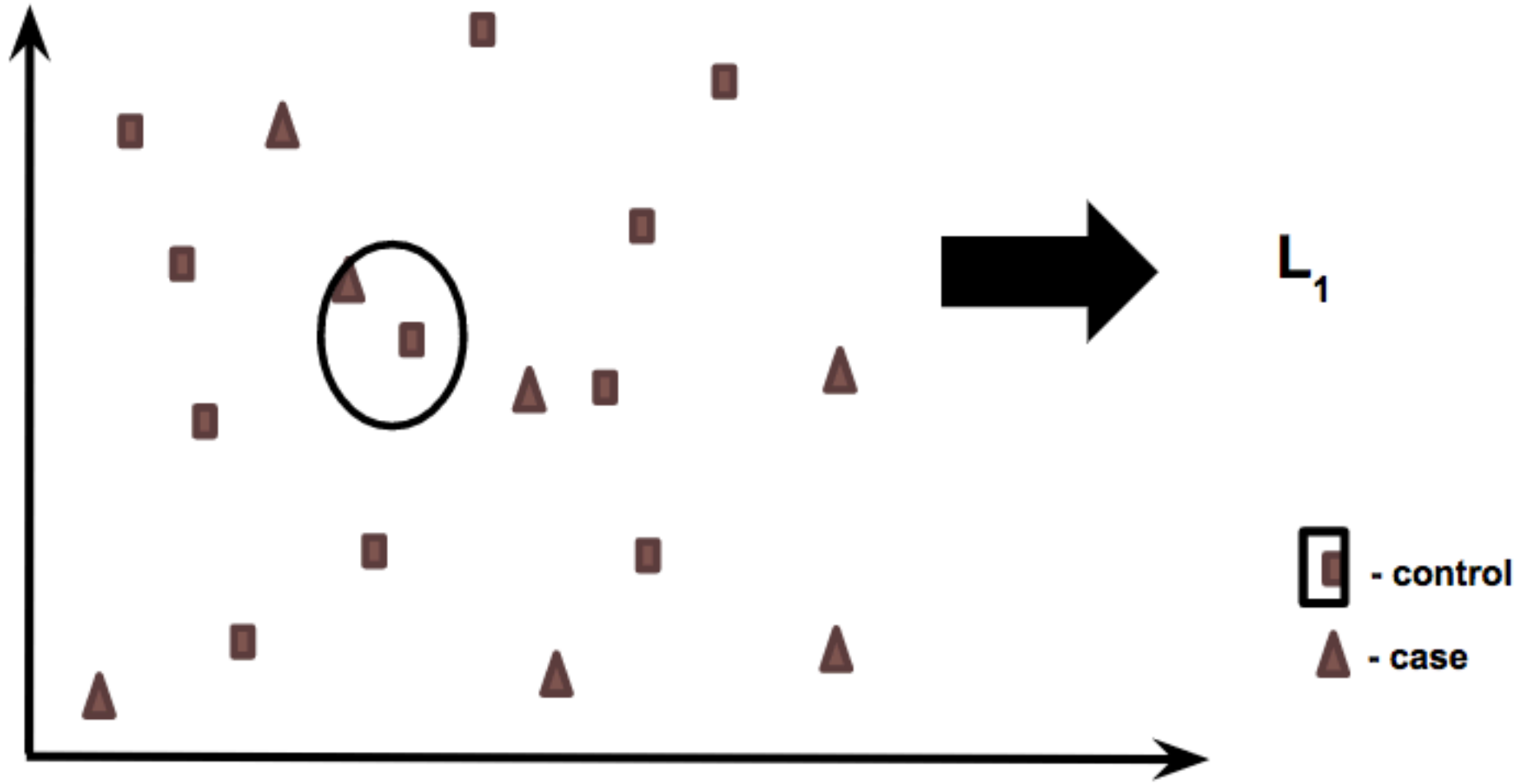
For Bernoulli distributions, the function is:

$$\left(\frac{c}{n}\right)^{c}\left(\frac{n-c}{n}\right)^{n-c}\left(\frac{C-c}{N-n}\right)^{C-c}\left(\frac{(N-n)-(C-c)}{N-n}\right)^{(N-n)-(C-c)} I()$$

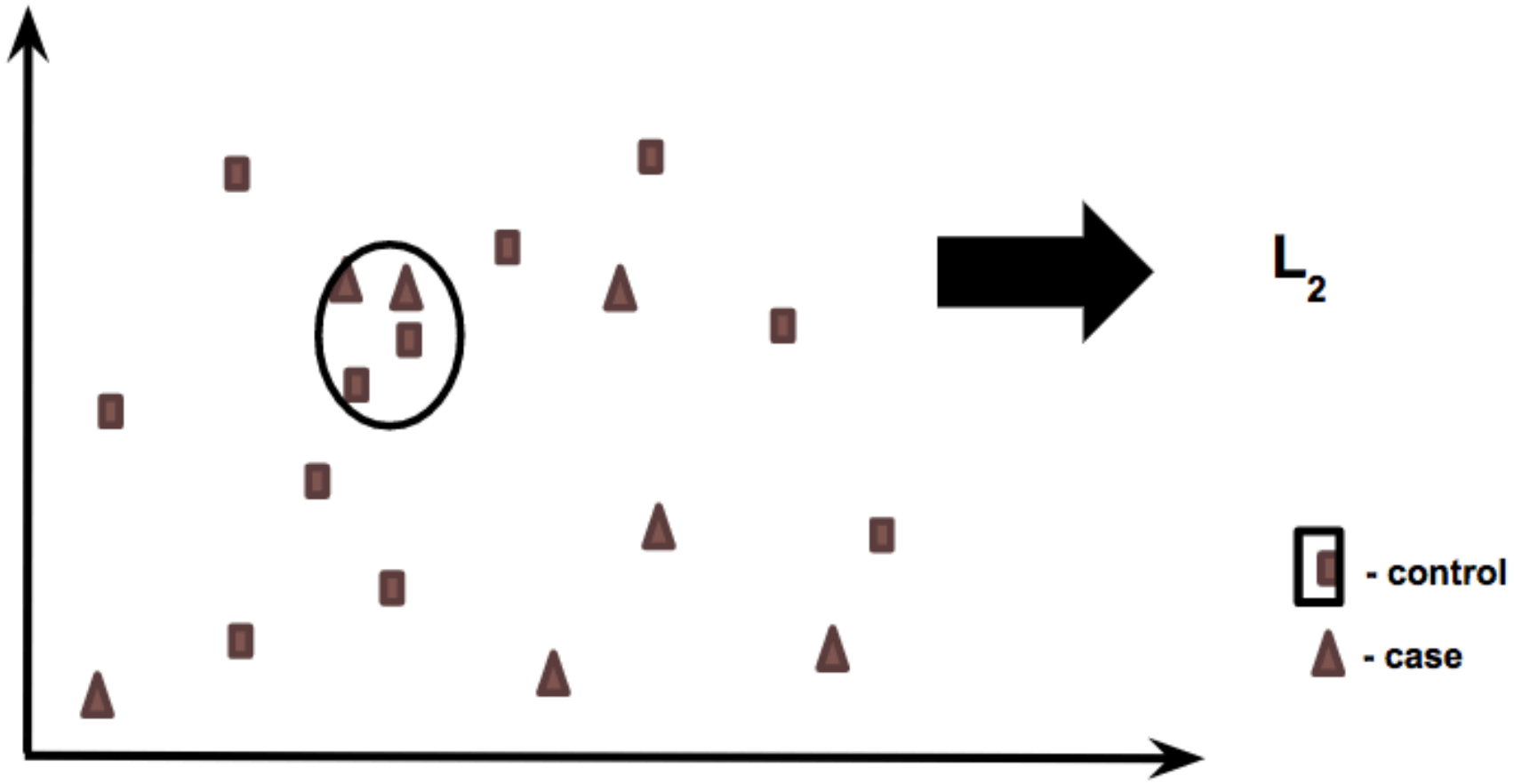

L_0
- control
- case


L_0
- control
- case

$[L_0]$



$[L_0, L_1]$

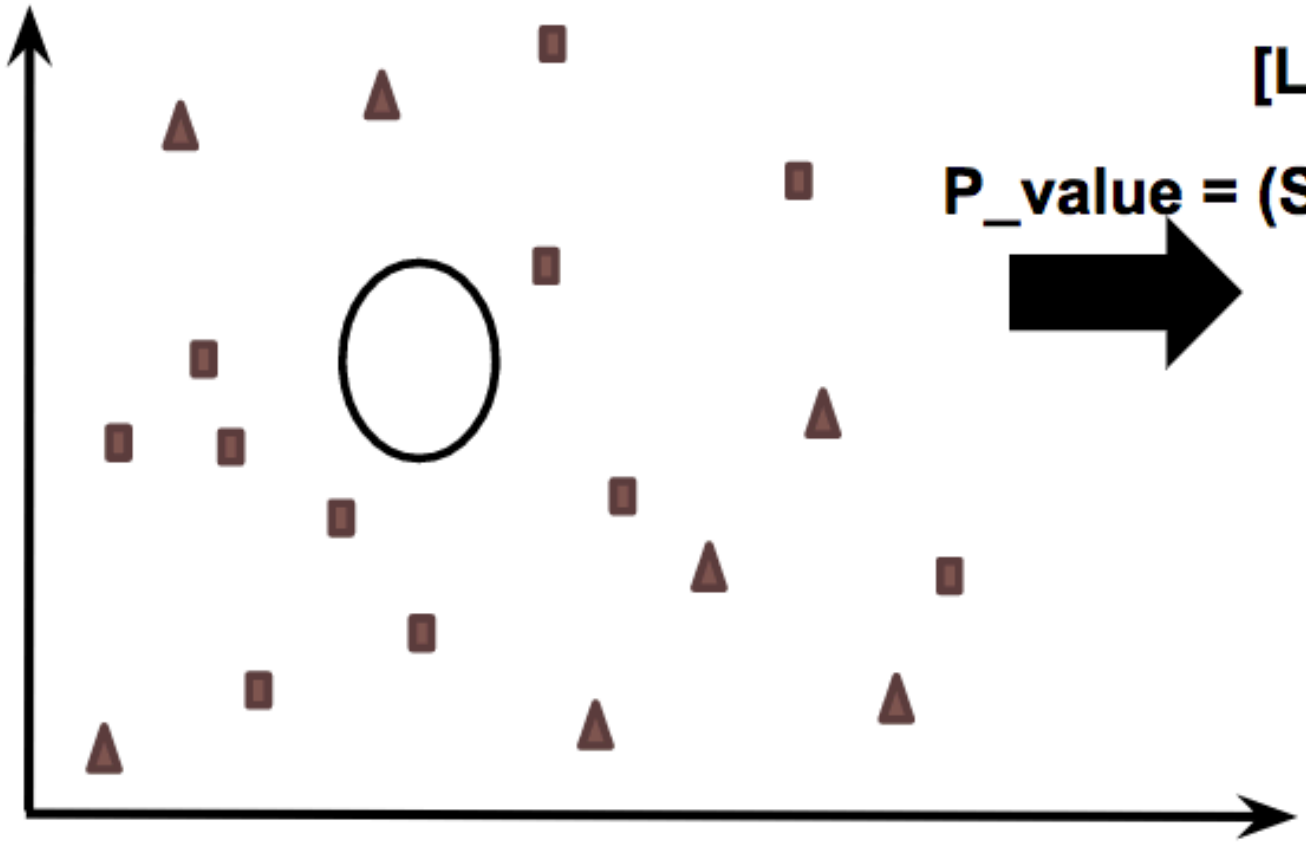


$[L_0, L_1, L_2, \ldots, L_{M-1}]$

$[L_5, L_2, L_{88}, L_0, \ldots, L_{M-22}]$

P_value = (Sorted position of L0 in list)/M

L_M



- control

- case

Geographical Analysis

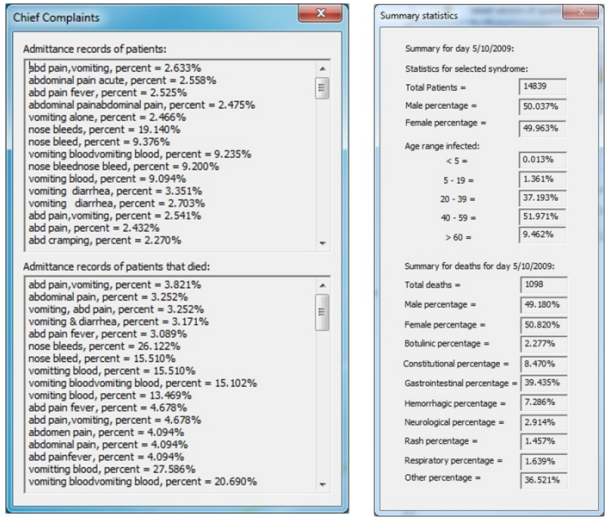
Geovisual Analytics Systems

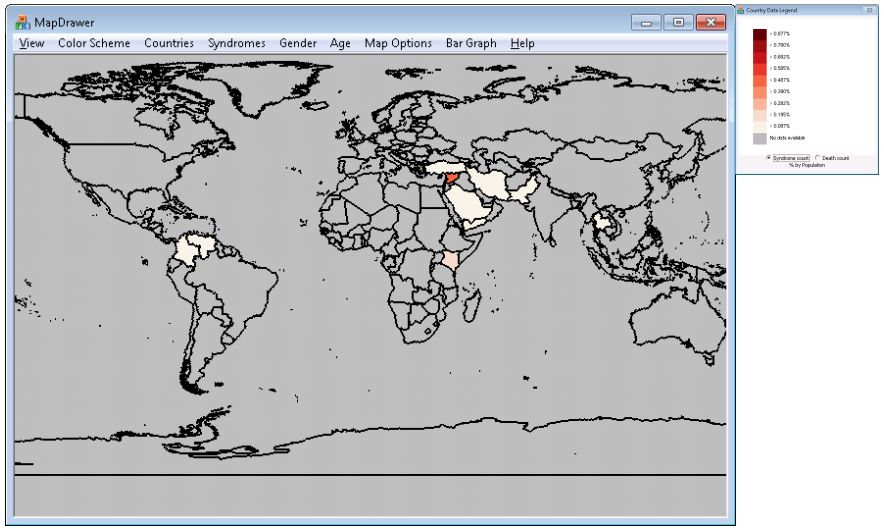
Ira A. Fulton Schools of Engineering
Arizona State University

Objectives

Objective

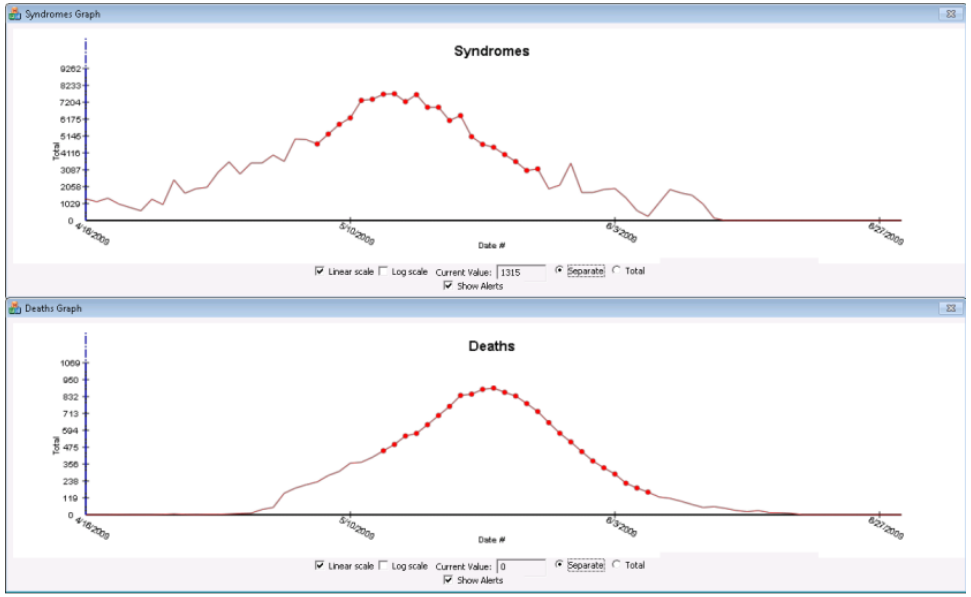
Apply methods of spatial analysis

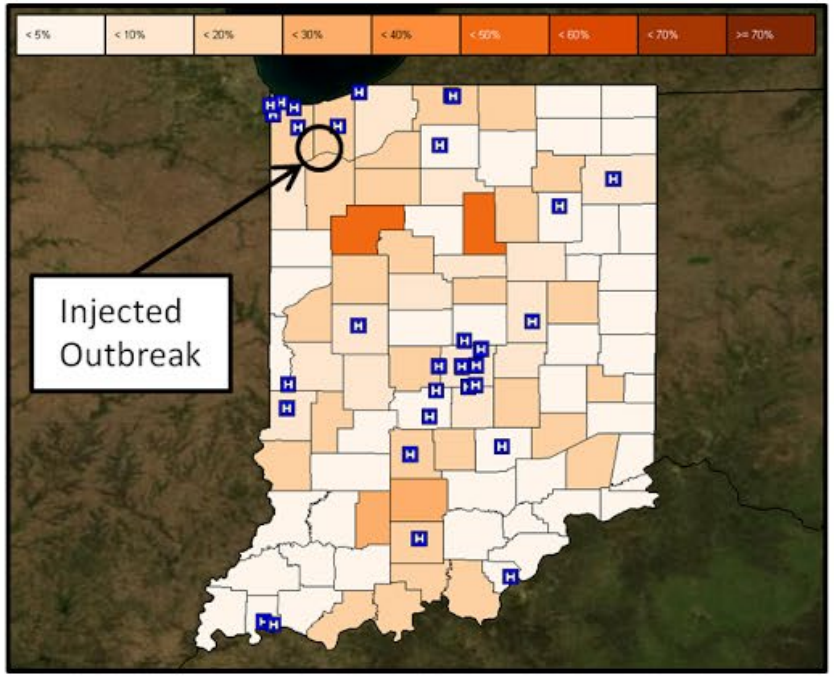


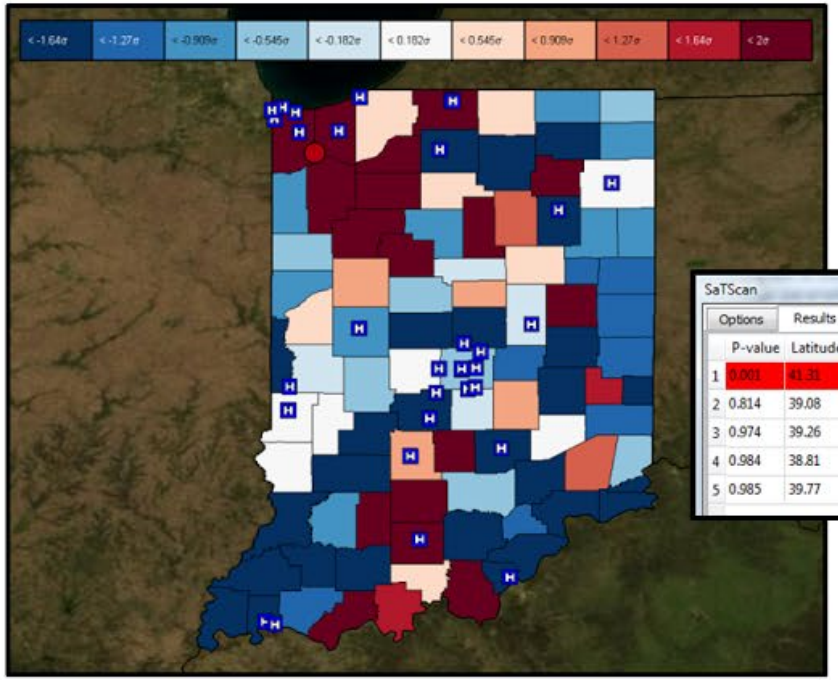


Patient ID	Date	Chief Complaints	Location
9398	4/16/09	Ear pain	Karachi
10816	4/16/09	Stuffy nose	Lebanon
1491	4/16/09	Fever	Allepo
16237	4/16/09	Head bleed	Yemen

CoCo Classifier



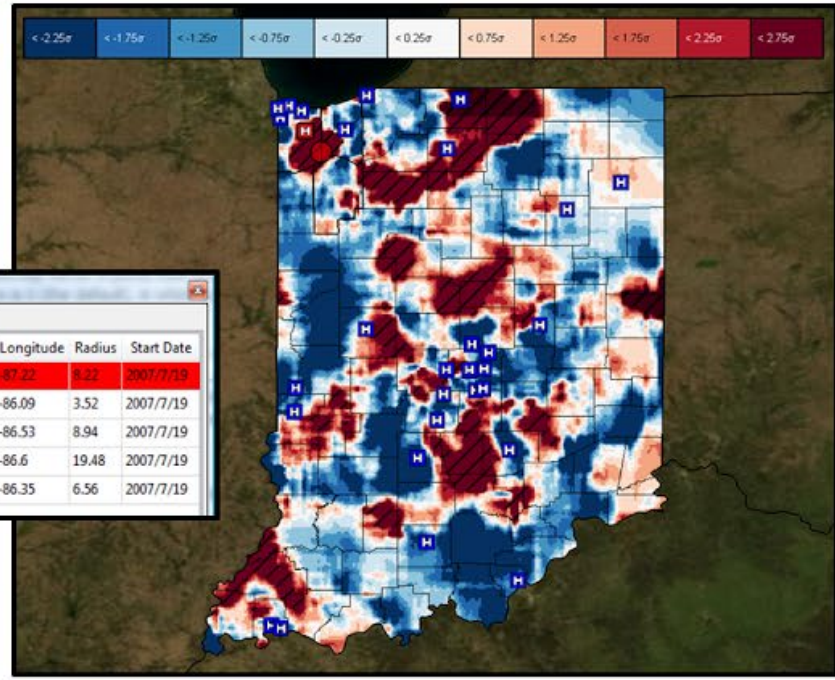


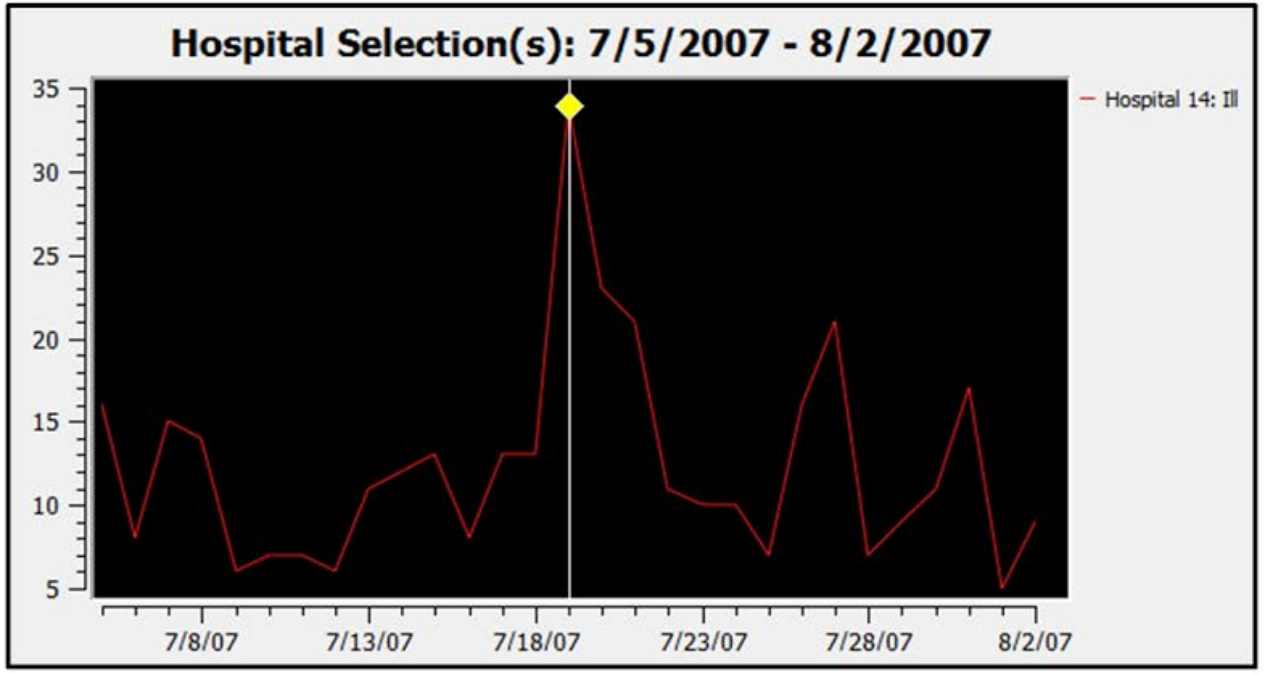


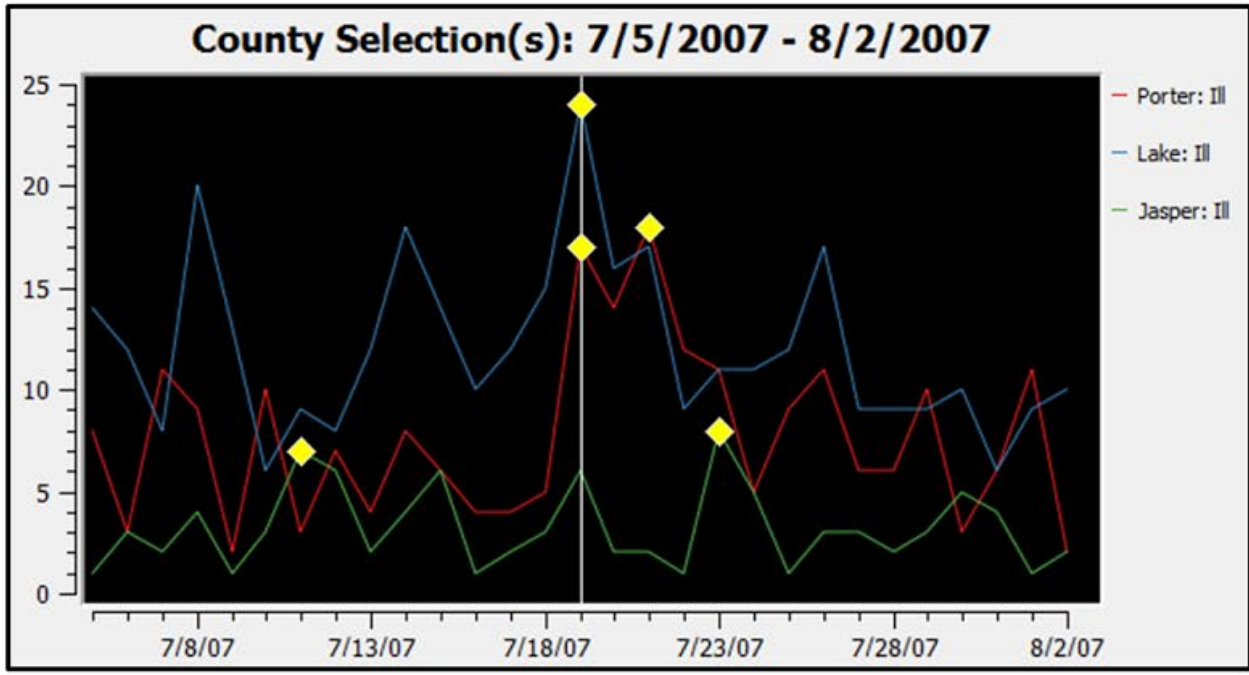
SaTScan

Options | Results

	P-value	Latitude	Longitude	Radius	Start Date
1	0.001	41.31	-87.22	8.22	2007/7/19
2	0.814	39.08	-86.09	3.52	2007/7/19
3	0.974	39.26	-86.53	8.94	2007/7/19
4	0.984	38.81	-86.6	19.48	2007/7/19
5	0.985	39.77	-86.35	6.56	2007/7/19



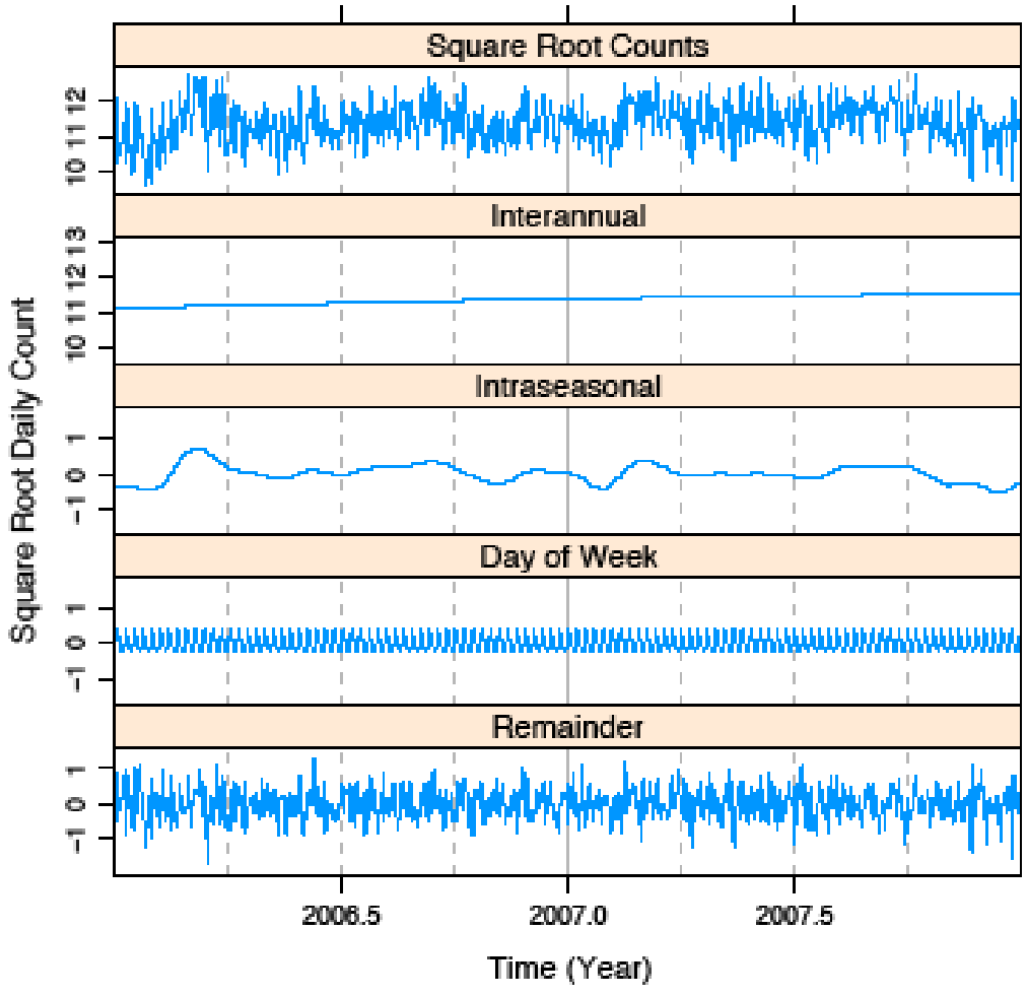




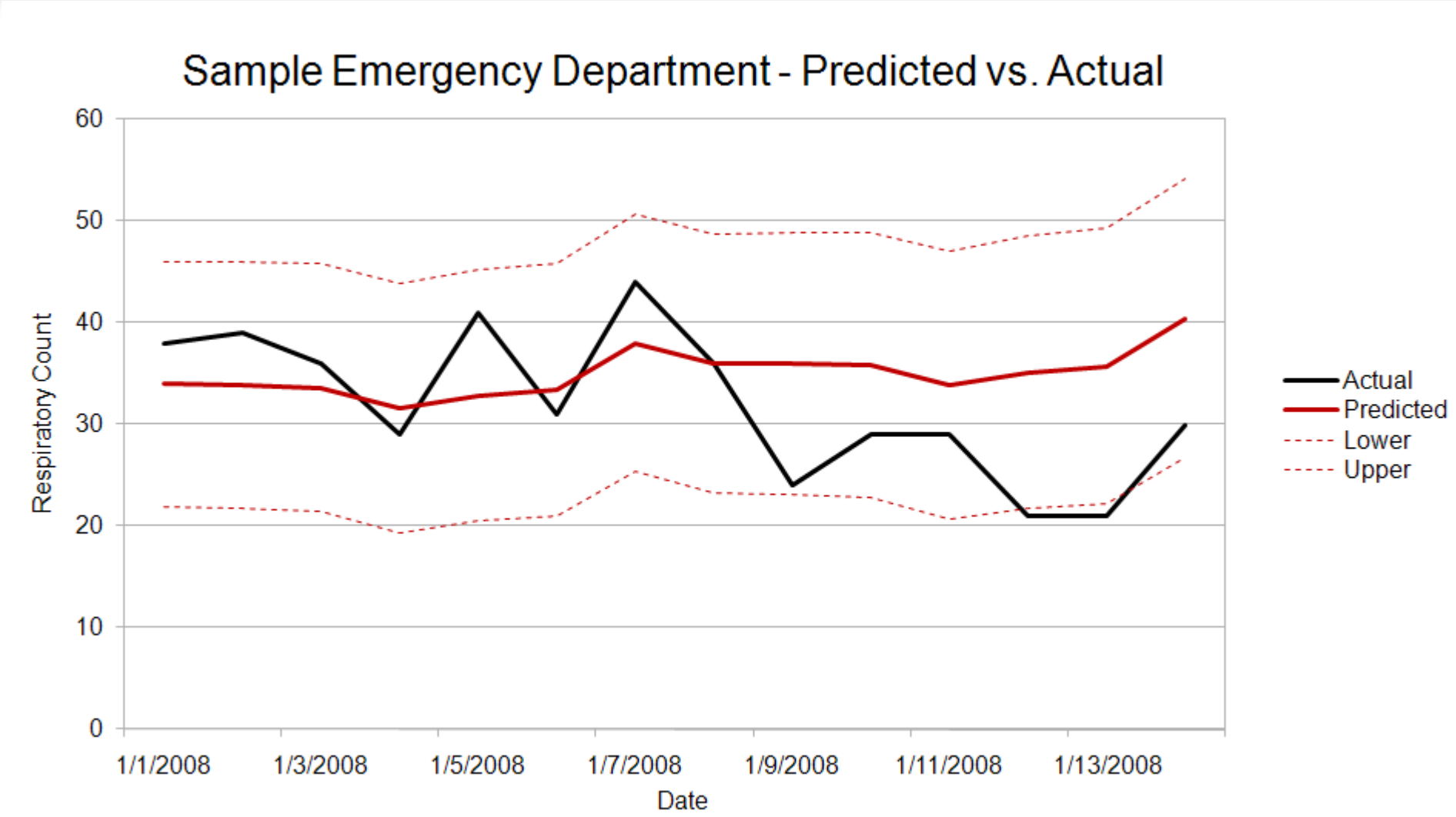
Time Series Modeling

Seasonal-Trend Decomposition Based on Loess

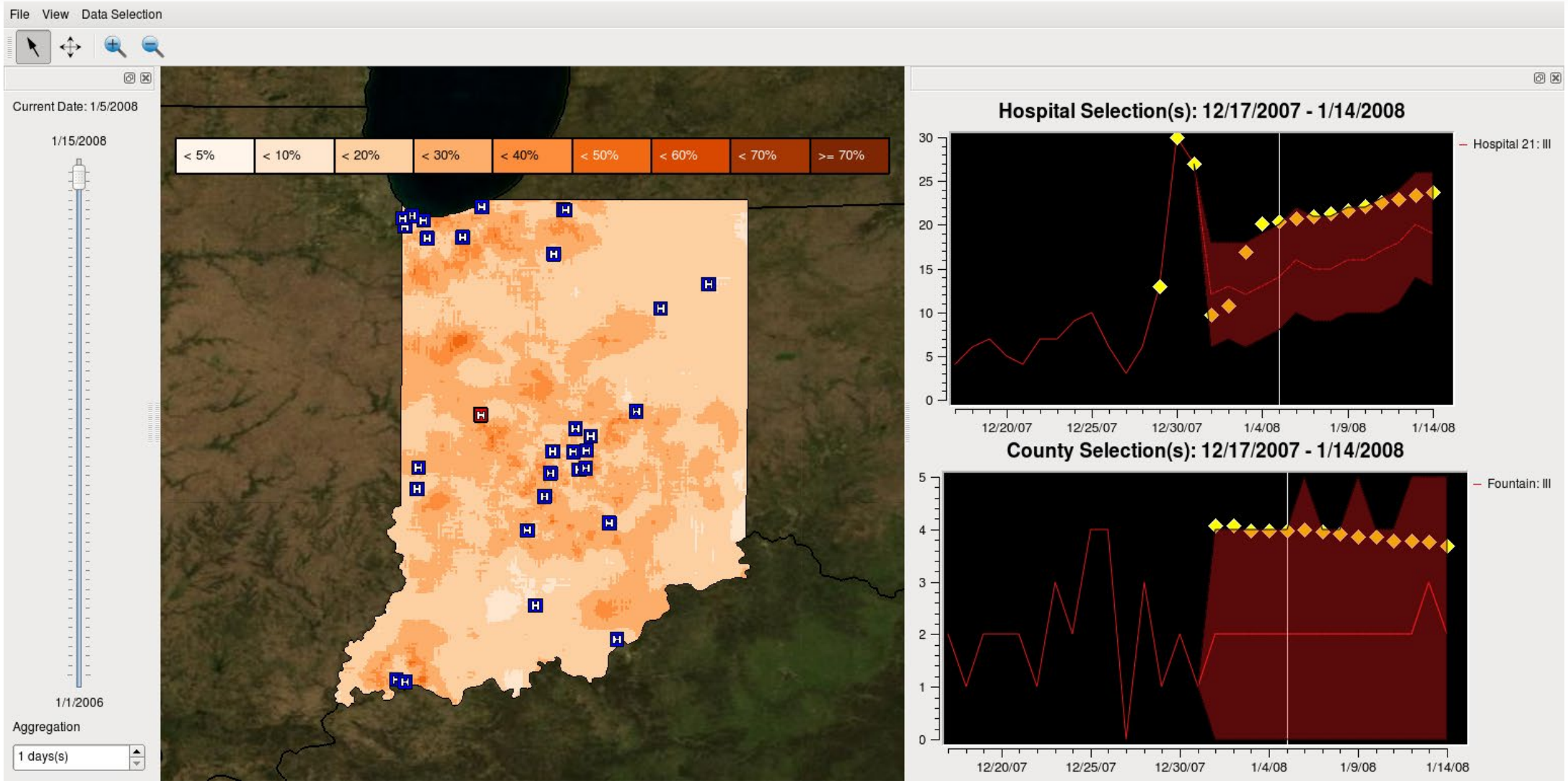
- Time series can be viewed as the sum of multiple trend components
- For each data signal, components are extracted
- Can then analyze correlation between components

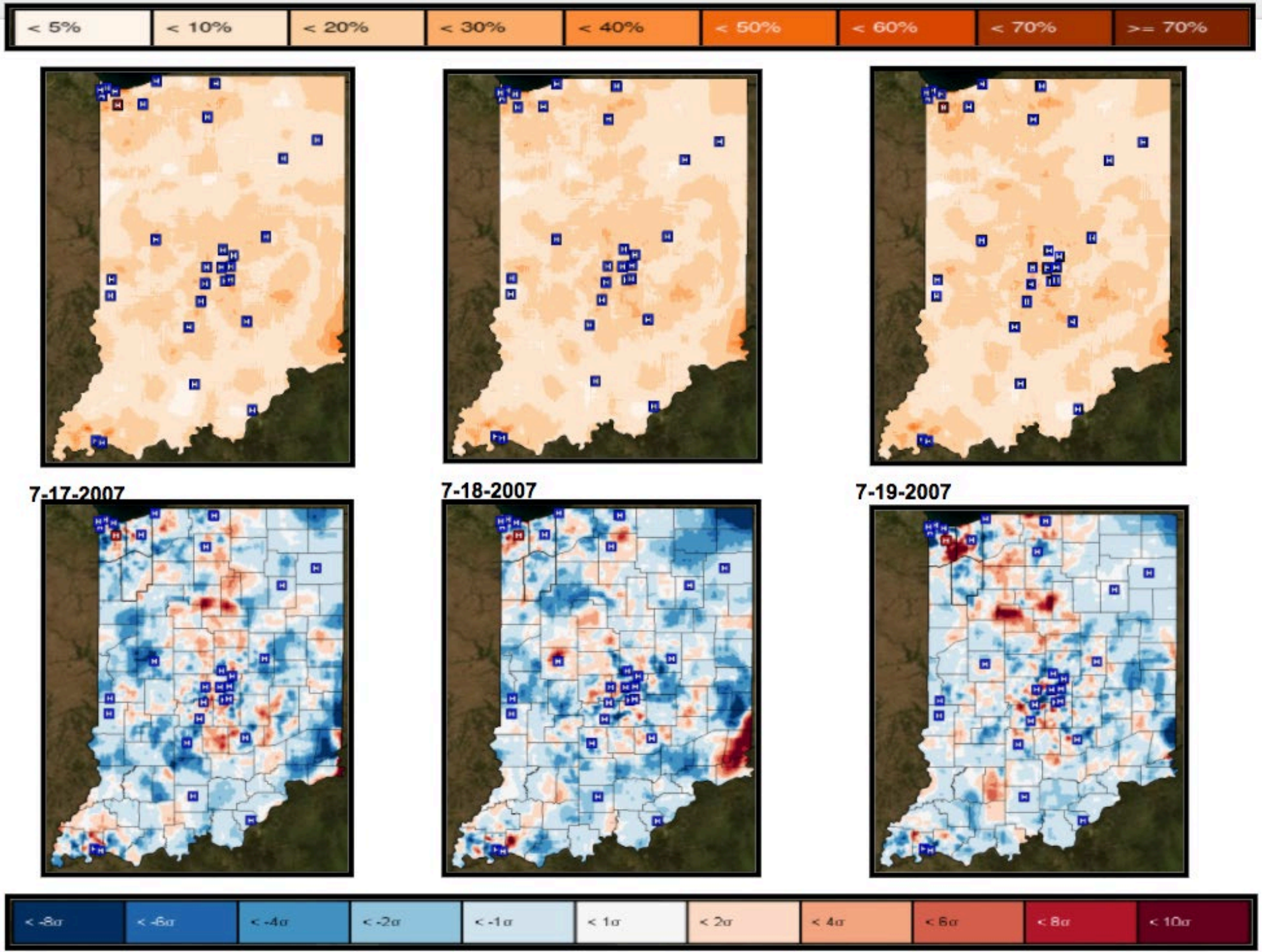


Predictive Visual Analytics



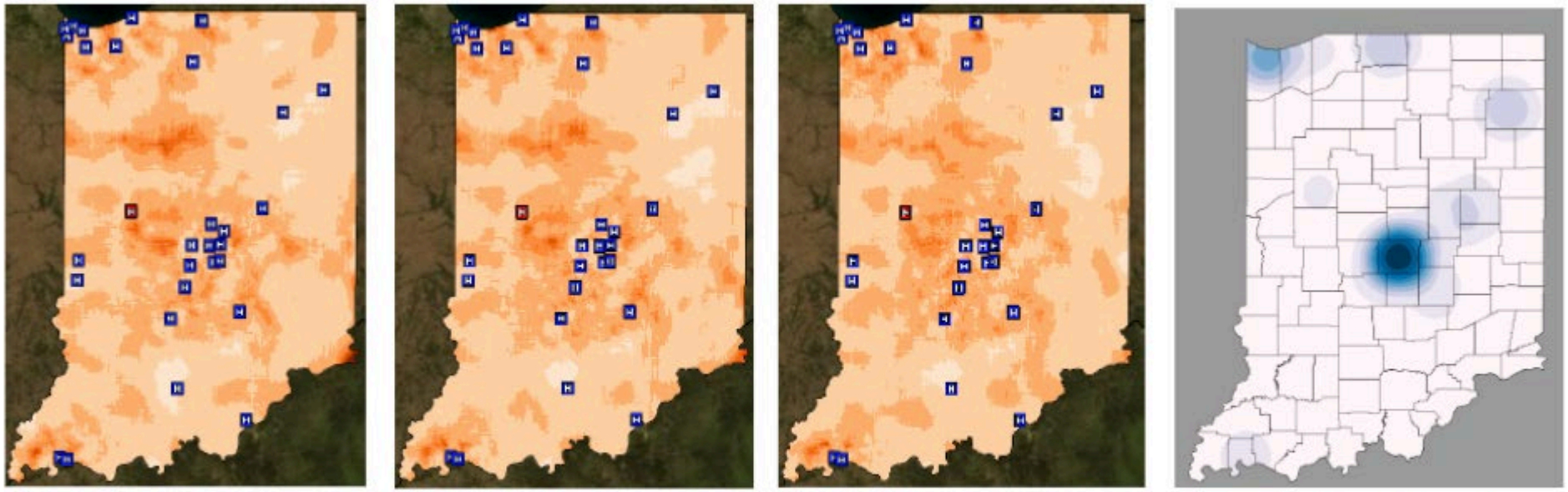
Predictive Visual Analytics

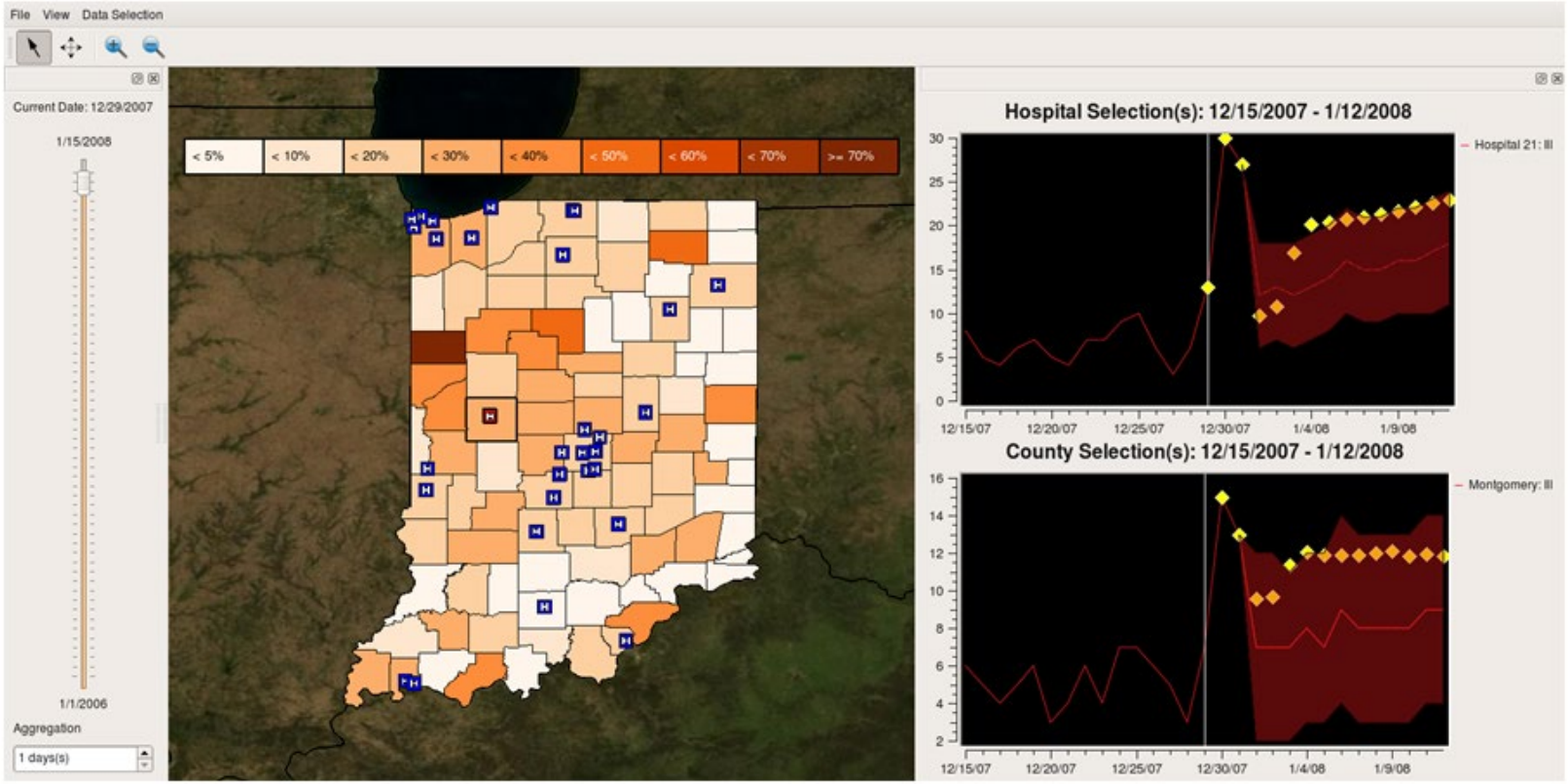


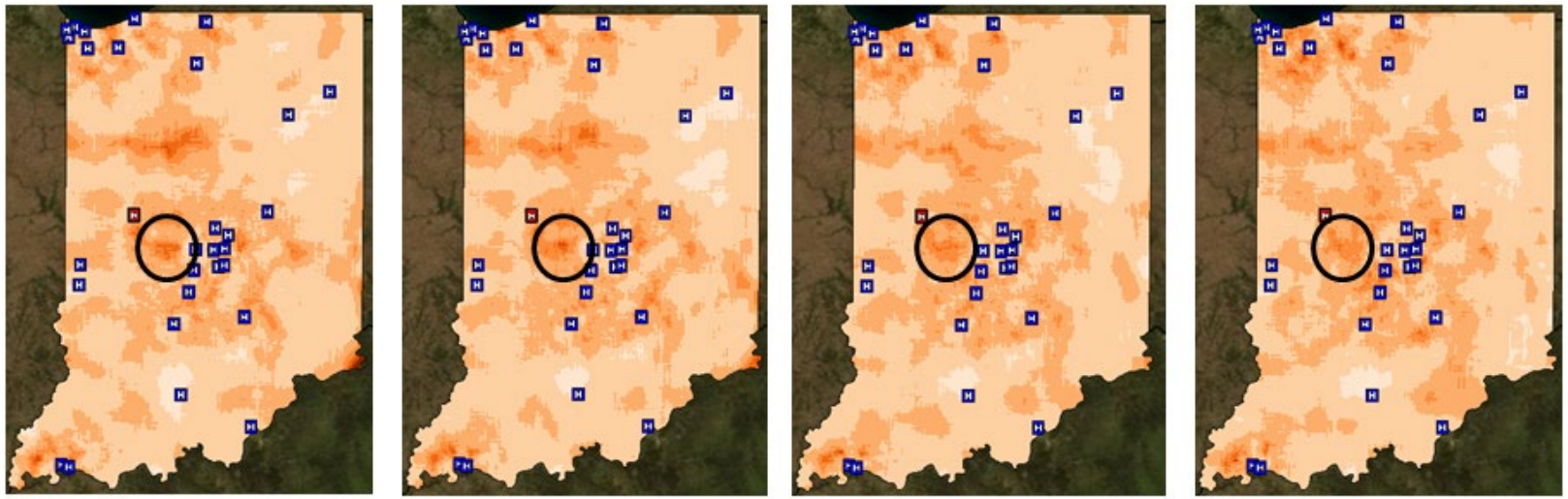

< 5%
< 10%
< 20%
< 30%
< 40%
< 50%
< 60%
< 70%
>= 70%
7-17-2007
7-18-2007
7-19-2007
< -8σ
< -6σ
< -4σ
< -2σ
< -1σ
< 1σ
< 2σ
< 4σ
< 6σ
< 8σ
< 10σ

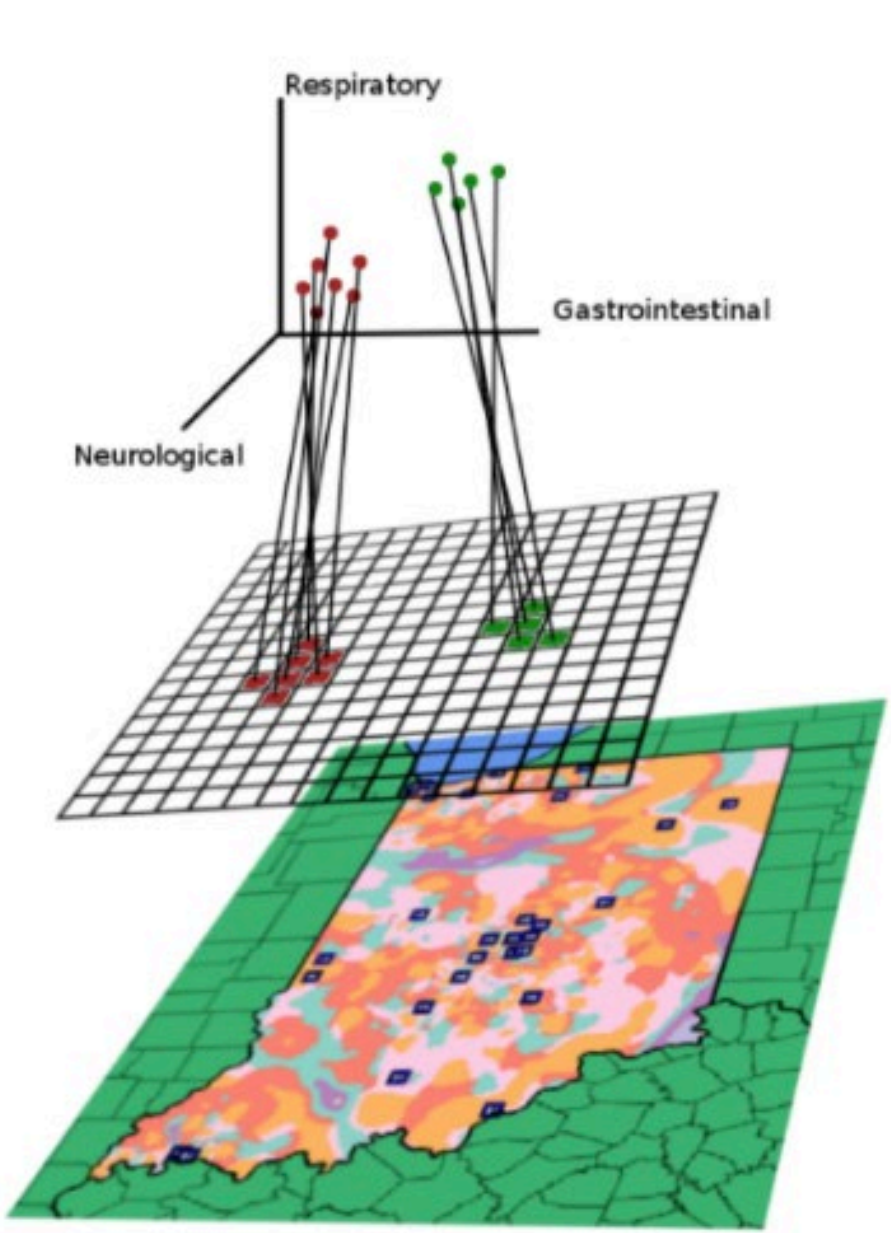
Spatiotemporal

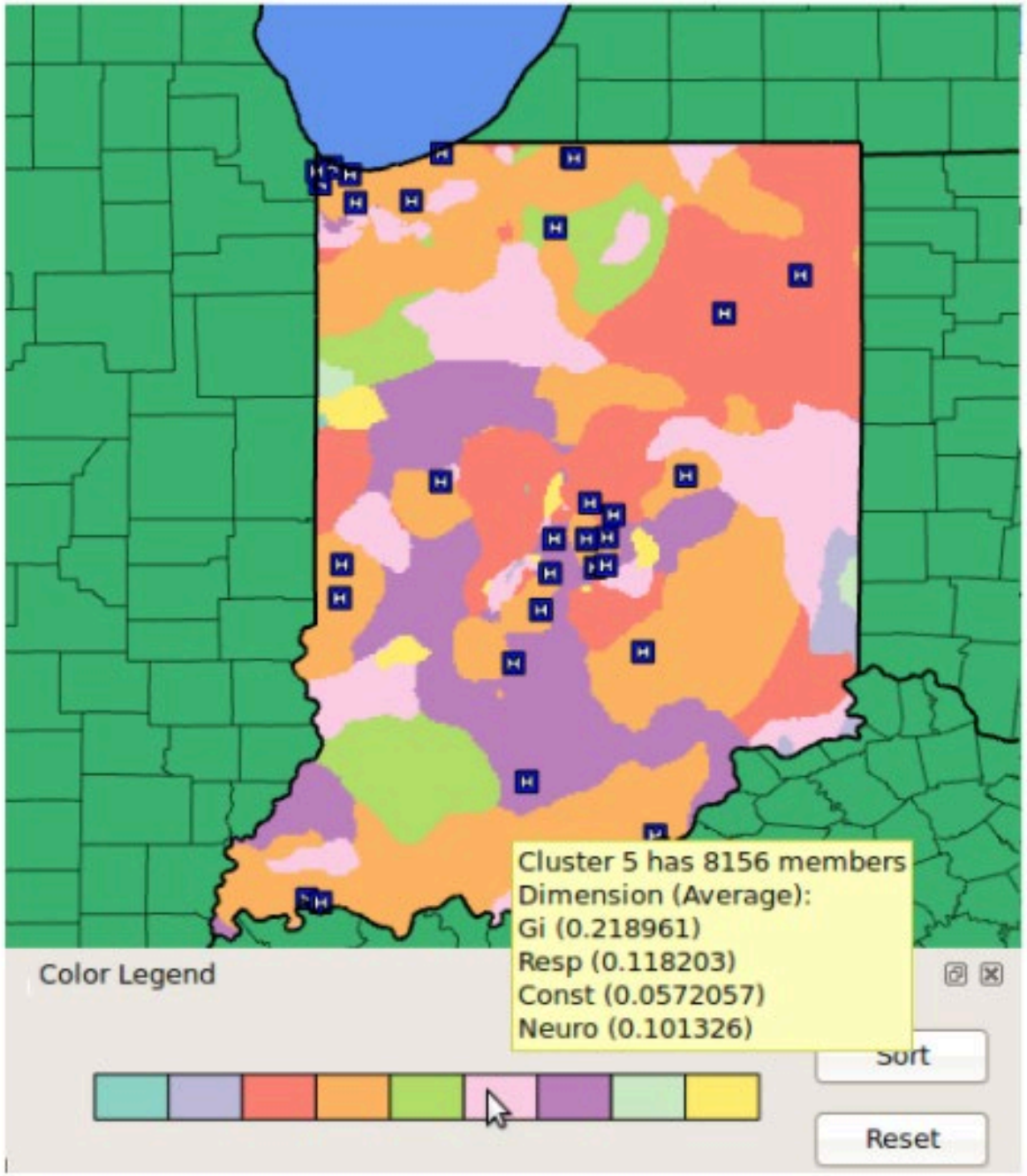
- The probability distribution of tomorrow can based on past probability distributions




File View Data Selection
Current Date: 12/29/2007
1/15/2008
1/1/2006
Aggregation
1 days(s)
< 5%
< 10%
< 20%
< 30%
< 40%
< 50%
< 60%
< 70%
>= 70%
Hospital Selection(s): 12/15/2007 - 1/12/2008
Hospital 21: III
12/15/07
12/20/07
12/25/07
12/30/07
1/4/08
1/9/08
County Selection(s): 12/15/2007 - 1/12/2008
Montgomery: III

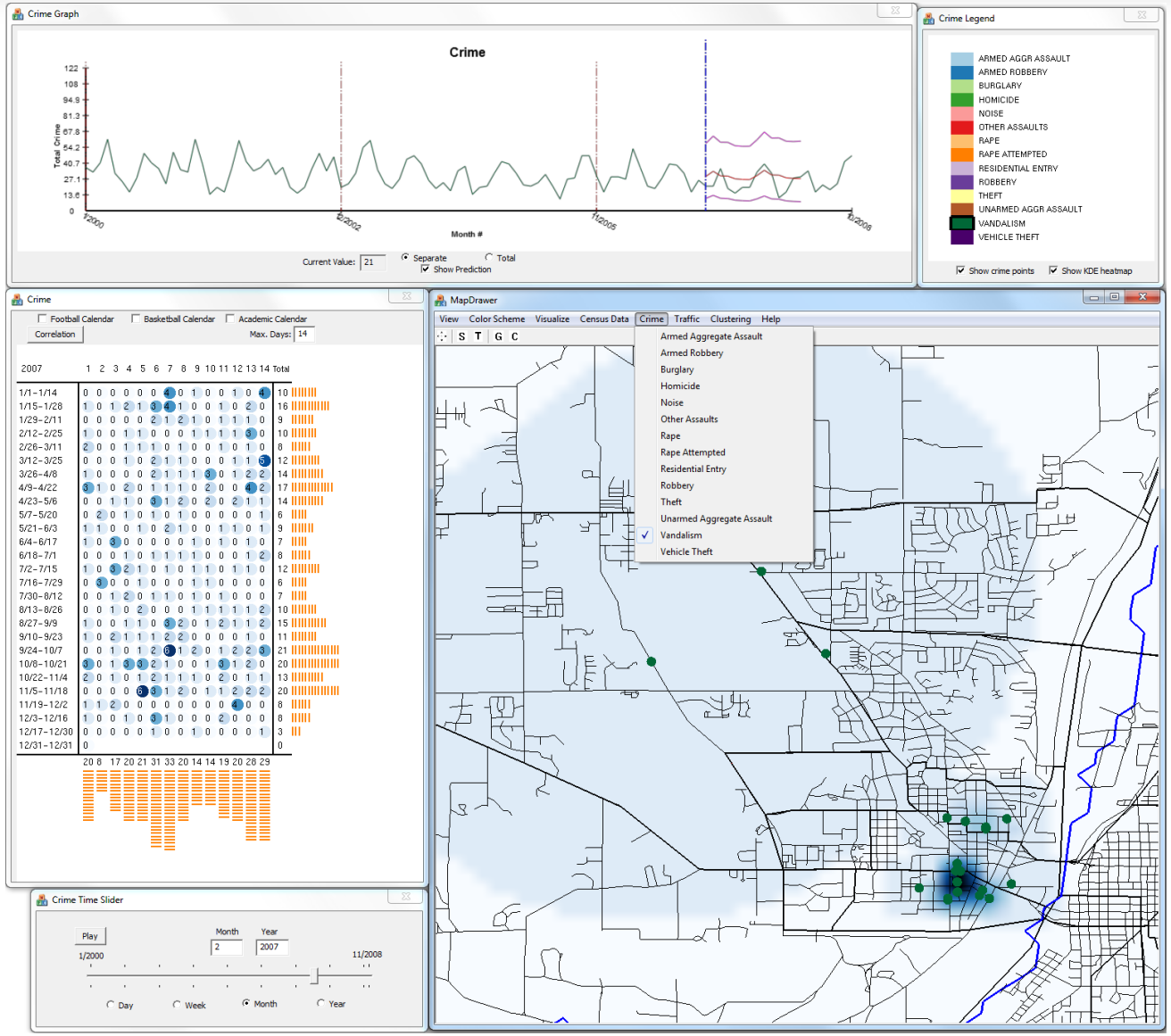

12-31-2007
1-1-2008
1-2-2008
1-3-2008

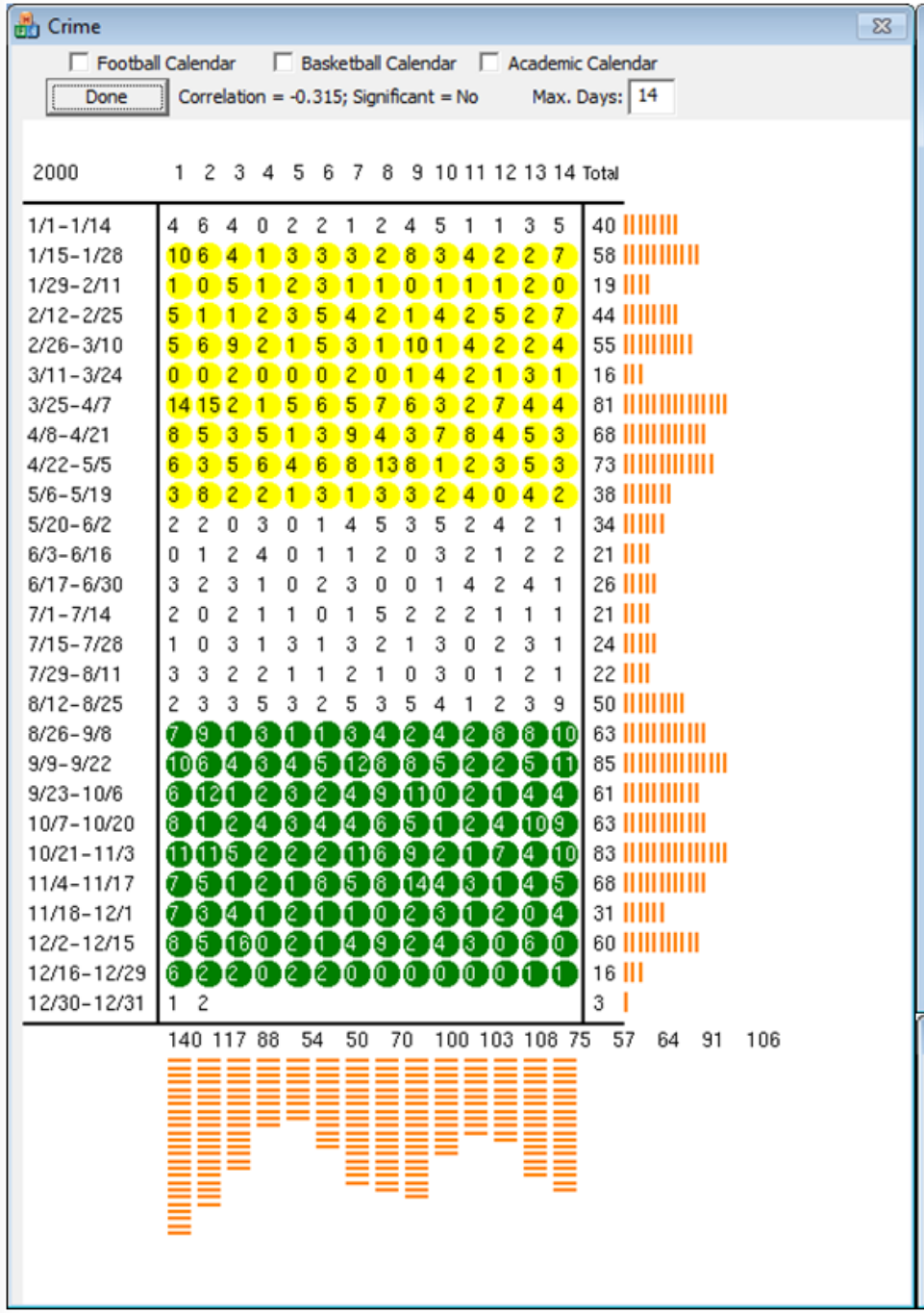

Respiratory
Gastrointestinal
Neurological

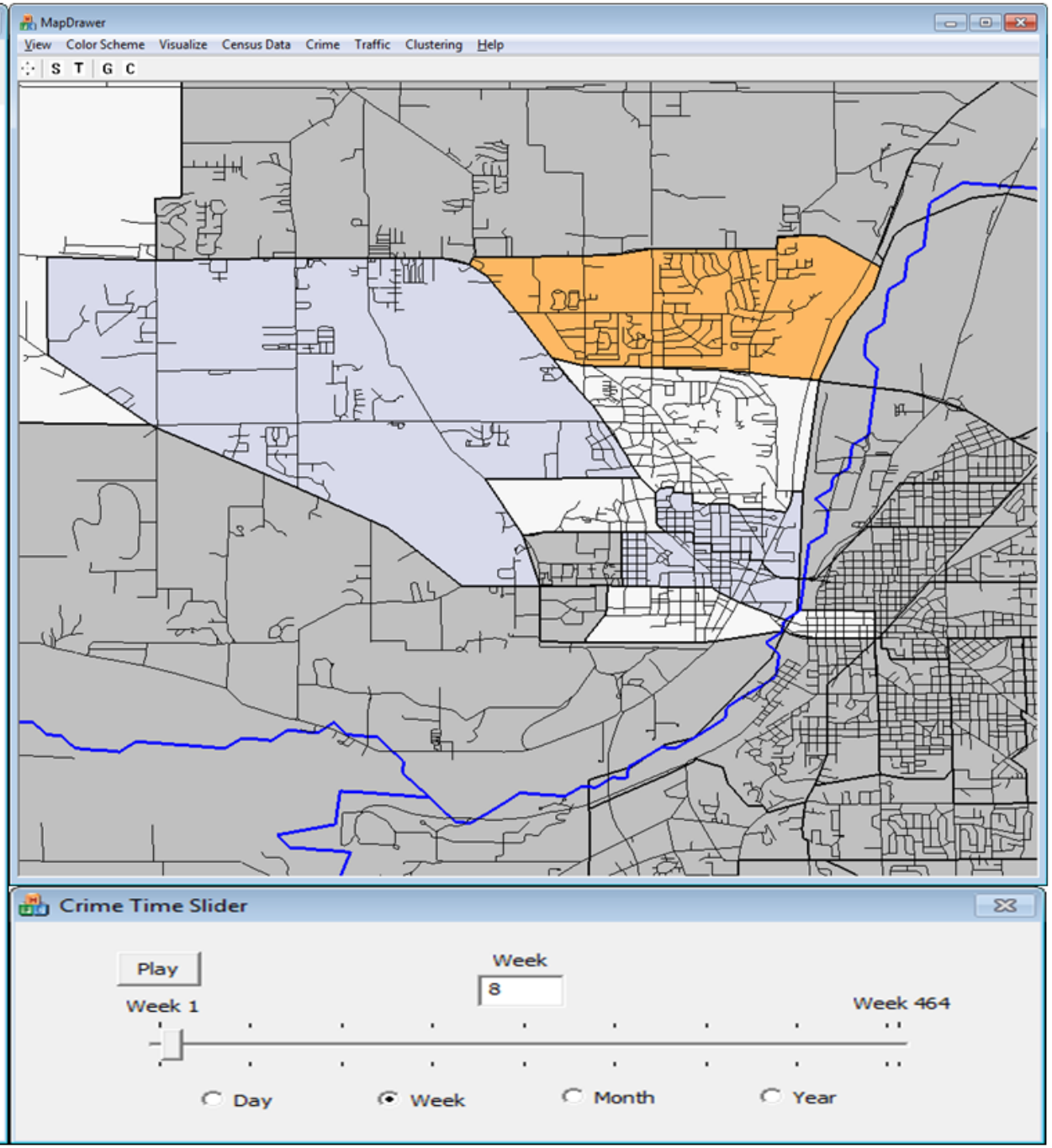

Cluster 5 has 8156 members
Dimension (Average):
Gi (0.218961)
Resp (0.118203)
Const (0.0572057)
Neuro (0.101326)
Color Legend
Sort
Reset

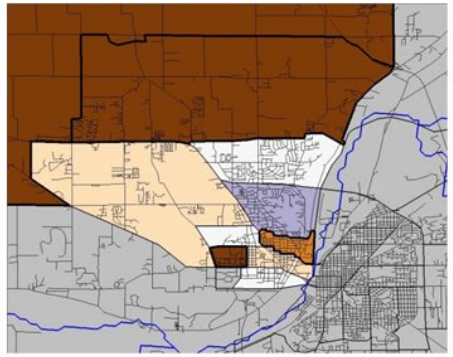
Crime Mapping

- The problem is analogous to syndromic surveillance
- Instead of patient addresses, now there is criminal incident reports
- More data (who, what, when, where, how)

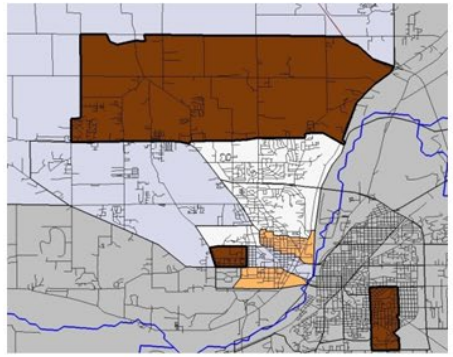



Crime
Football Calendar
Basketball Calendar
Academic Calendar
Done
Correlation = -0.315; Significant = No
Max. Days: 14
2000 1 2 3 4 5 6 7 8 9 10 11 12 13 14 Total
1/1-1/14 4 6 4 0 2 2 1 2 4 5 1 1 3 5 40
1/15-1/28 10 6 4 1 3 3 3 2 8 3 4 2 2 7 58
1/29-2/11 1 0 5 1 2 3 1 1 0 1 1 1 2 0 19
2/12-2/25 5 1 1 2 3 5 4 2 1 4 2 5 2 7 44
2/26-3/10 5 6 9 2 1 5 3 1 10 1 4 2 2 4 55
3/11-3/24 0 0 2 0 0 0 2 0 1 4 2 1 3 1 16
3/25-4/7 14 15 2 1 5 6 5 7 6 3 2 7 4 4 81
4/8-4/21 8 5 3 5 1 3 9 4 3 7 8 4 5 3 68
4/22-5/5 6 3 5 6 4 6 8 13 8 1 2 3 5 3 73
5/6-5/19 3 8 2 2 1 3 1 3 3 2 4 0 4 2 38
5/20-6/2 2 2 0 3 0 1 4 5 3 5 2 4 2 1 34
6/3-6/16 0 1 2 4 0 1 1 2 0 3 2 1 2 2 21
6/17-6/30 3 2 3 1 0 2 3 0 0 1 4 2 4 1 26
7/1-7/14 2 0 2 1 1 0 1 5 2 2 2 1 1 1 21
7/15-7/28 1 0 3 1 3 1 3 2 1 3 0 2 3 1 24
7/29-8/11 3 3 2 2 1 1 2 1 0 3 0 1 2 1 22
8/12-8/25 2 3 3 5 3 2 5 3 5 4 1 2 3 9 50
8/26-9/8 7 9 1 3 1 1 3 4 2 4 2 6 8 10 63
9/9-9/22 10 6 4 3 4 5 12 8 8 5 2 2 5 11 85
9/23-10/6 6 12 1 2 3 2 4 9 11 0 2 1 4 4 61
10/7-10/20 8 1 2 4 3 4 4 6 5 1 2 4 10 9 63
10/21-11/3 11 11 5 2 2 2 11 6 9 2 1 7 4 10 83
11/4-11/17 7 5 1 2 1 8 5 8 14 4 3 1 4 5 68
11/18-12/1 7 3 4 1 2 1 1 0 2 3 1 2 0 4 31
12/2-12/15 8 5 16 0 2 1 4 9 2 4 3 0 6 0 60
12/16-12/29 6 2 2 0 2 2 0 0 0 0 0 0 1 1 16
12/30-12/31 1 2 3
140 117 88 54 50 70 100 103 108 75 57 64 91 106

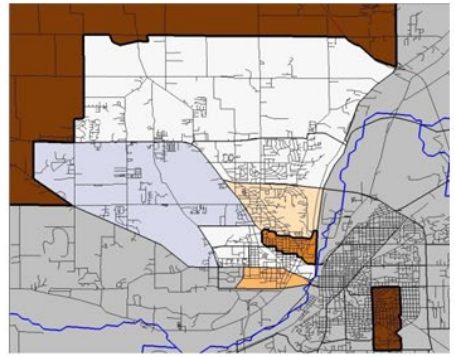

MapDrawer
View Color Scheme Visualize Census Data Crime Traffic Clustering Help
S T G C
Crime Time Slider
Play
Week
8
Week 1
Week 464
Day
Week
Month
Year
> 0.818
> 0.636
> 0.455
> 0.273
> 0.091
> -0.091
> -0.273
> -0.455
> -0.636
> -0.818
> -1.000



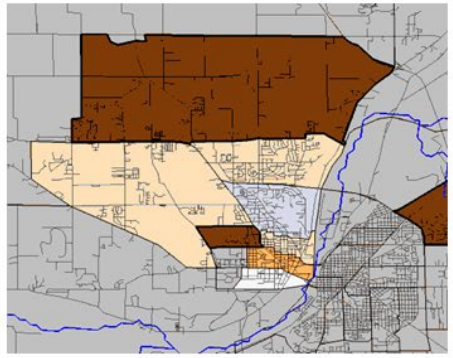
Fall 2004 vs. Fall 2005
Weekly Total Correlation = .062
Not significant



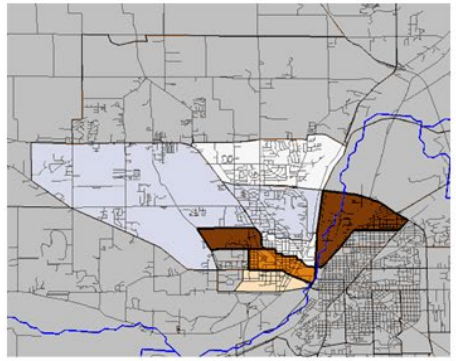
Fall 2004 vs. Fall 2006
Weekly Total Correlation = .321
Not significant



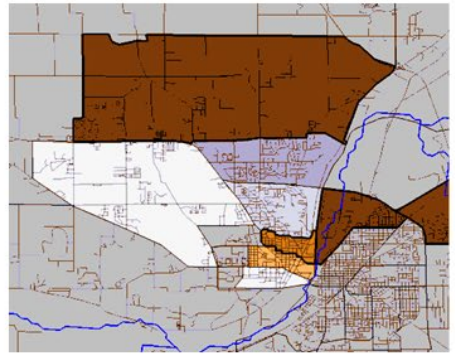
Fall 2005 vs. Fall 2006
Weekly Total Correlation = .224
Not significant



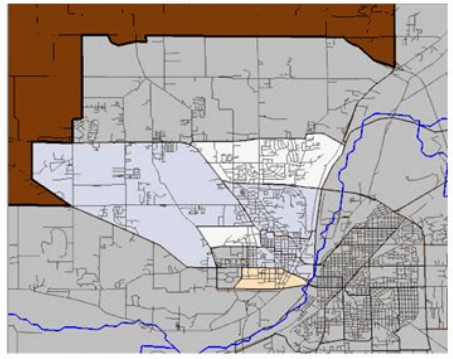
Spring 2004 vs. Spring 2005
Weekly Total Correlation = .536
Significant



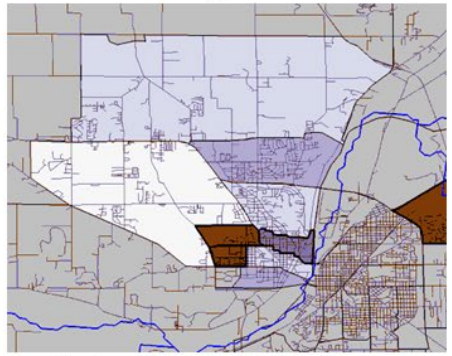
Spring 2004 vs. Spring 2006
Weekly Total Correlation = .389
Not Significant



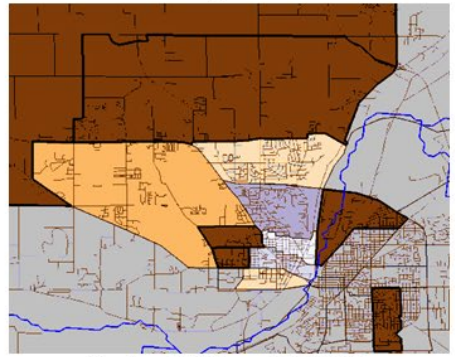
Spring 2005 vs. Spring 2006
Weekly Total Correlation = .210
Not Significant



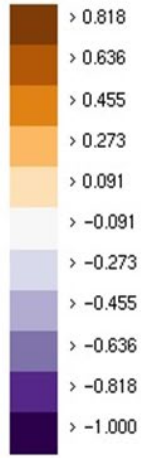
Spring 2004 vs. Fall 2004
Weekly Total Correlation = -.153
Not Significant

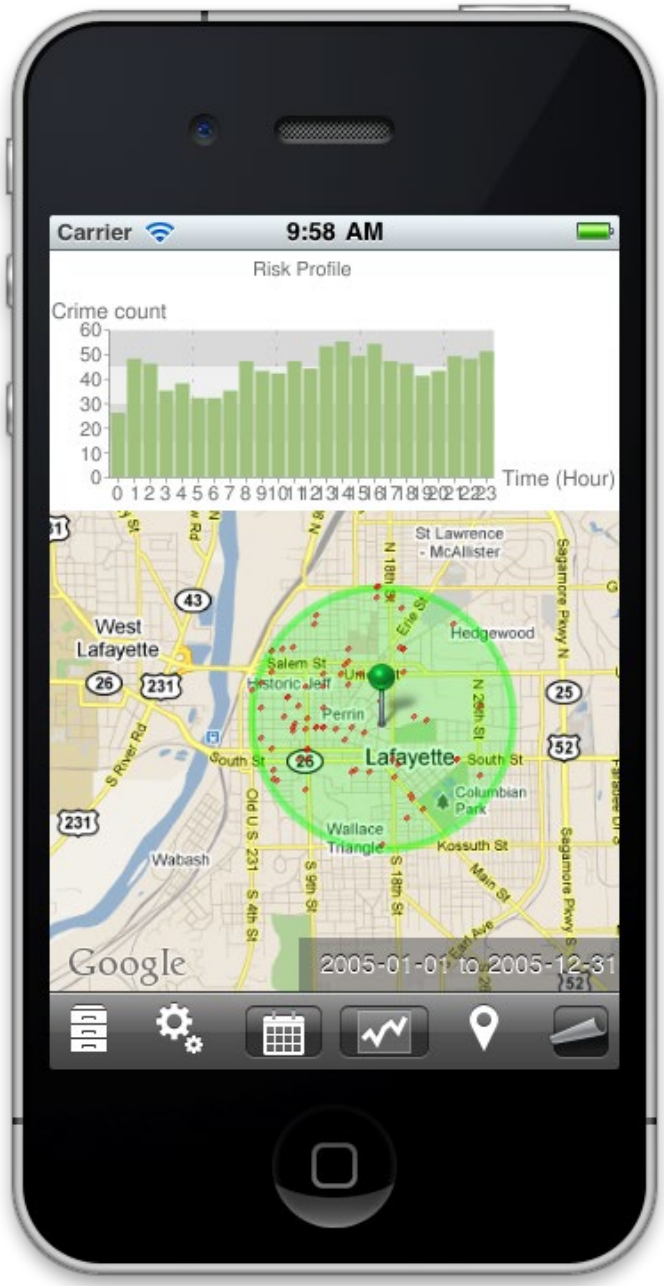


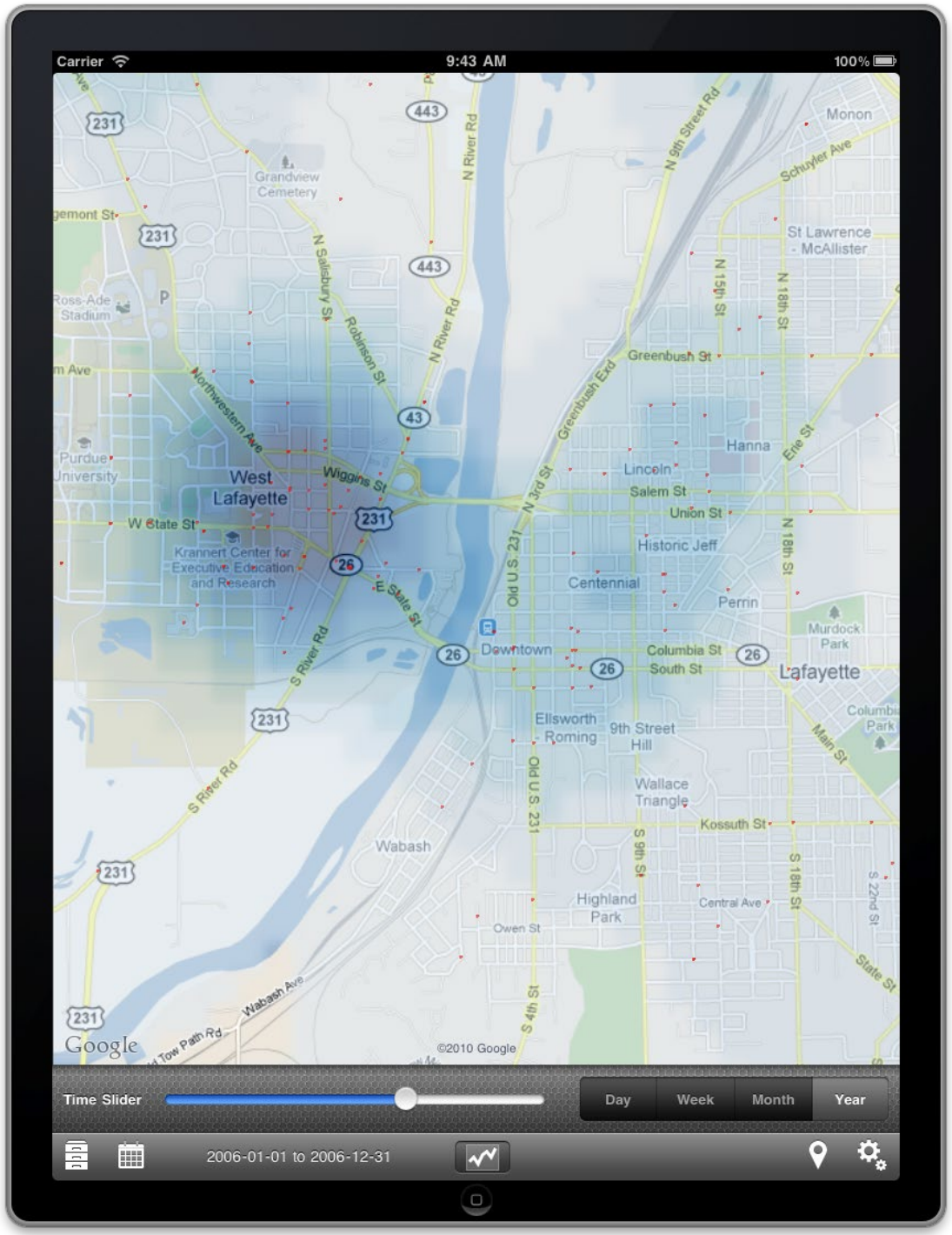
Spring 2005 vs. Fall 2005
Weekly Total Correlation = -.614
Significant



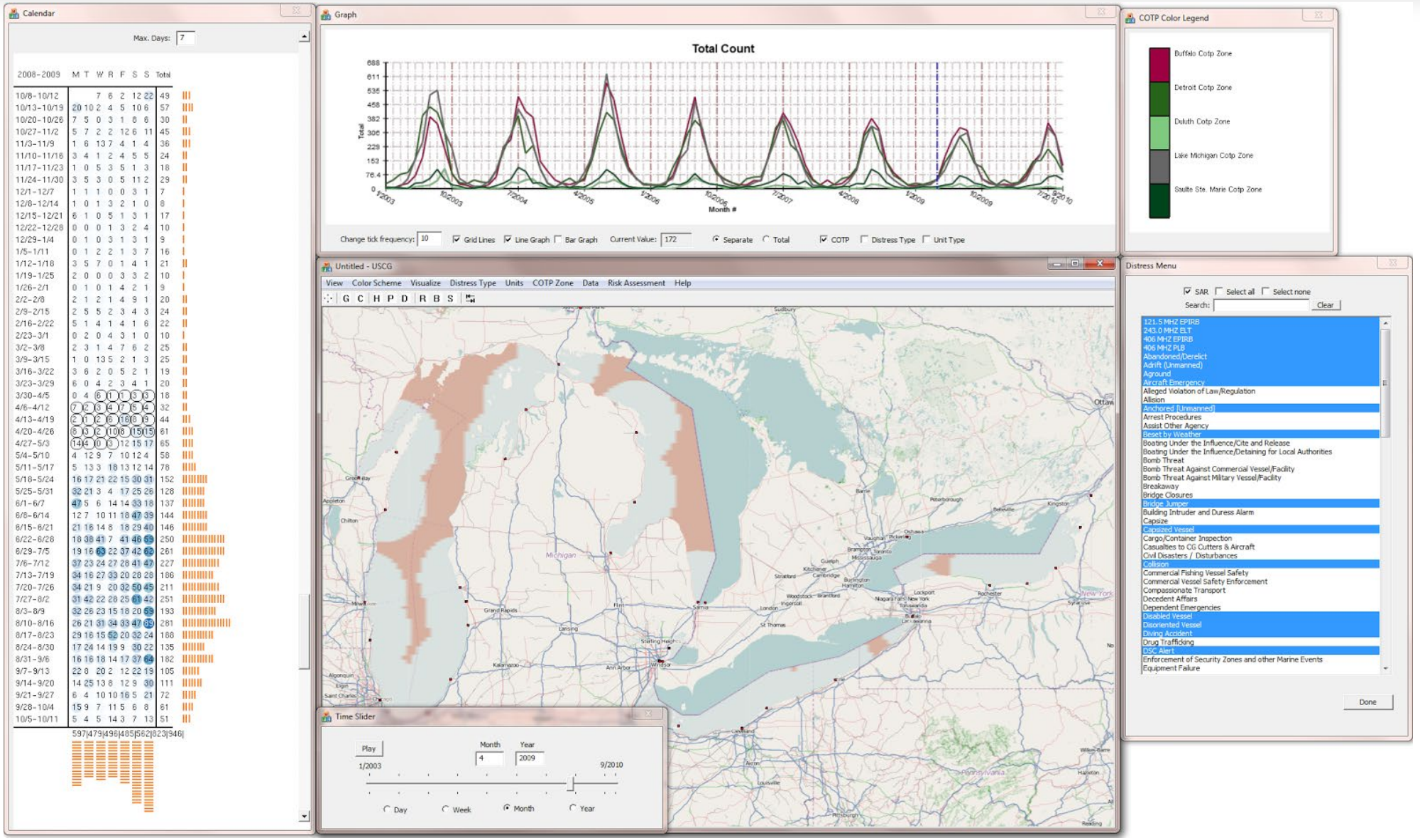
Spring 2006 vs. Fall 2006
Weekly Total Correlation = .096
Not Significant



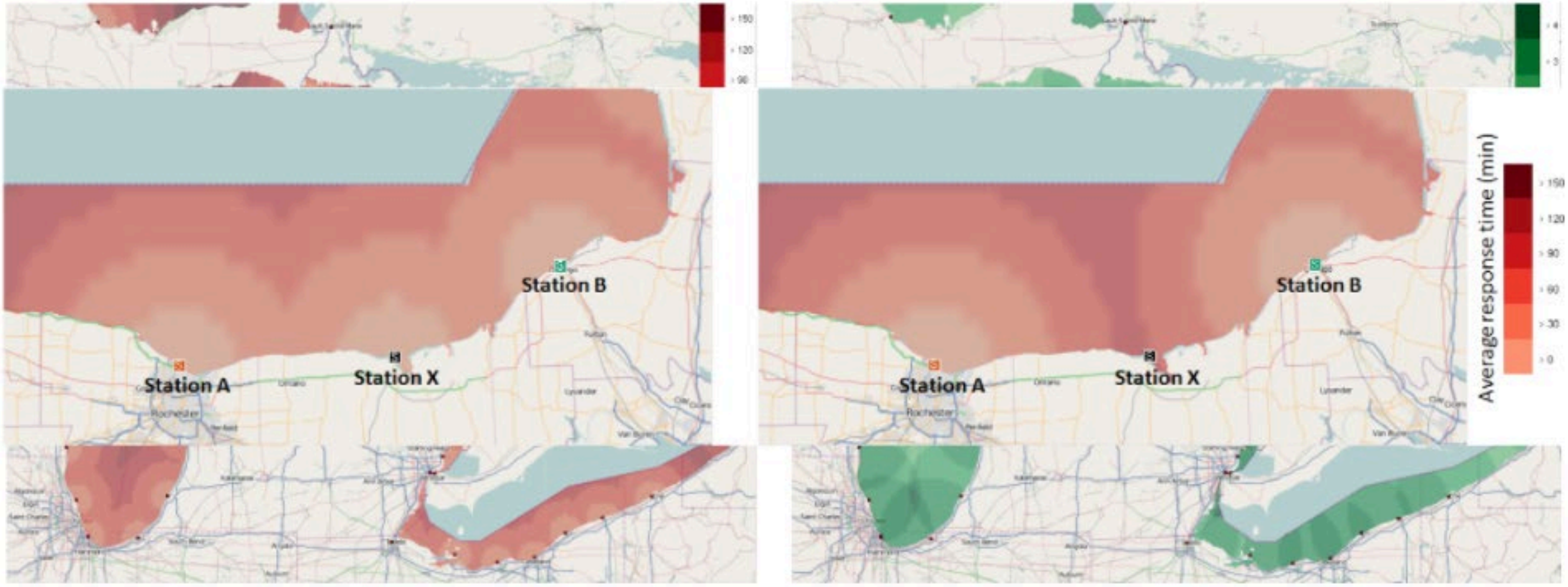

Carrier
9:58 AM
Risk Profile
Crime count
60
50
40
30
20
10
0
Time (Hour)
West Lafayette
Lafayette
Hedgewood
Perrin
Historic Jeff
Columbian Park
Wallace Triangle
Kossuth St
South St
Wabash
St Lawrence - McAllister
Google
2005-01-01 to 2005-12-31

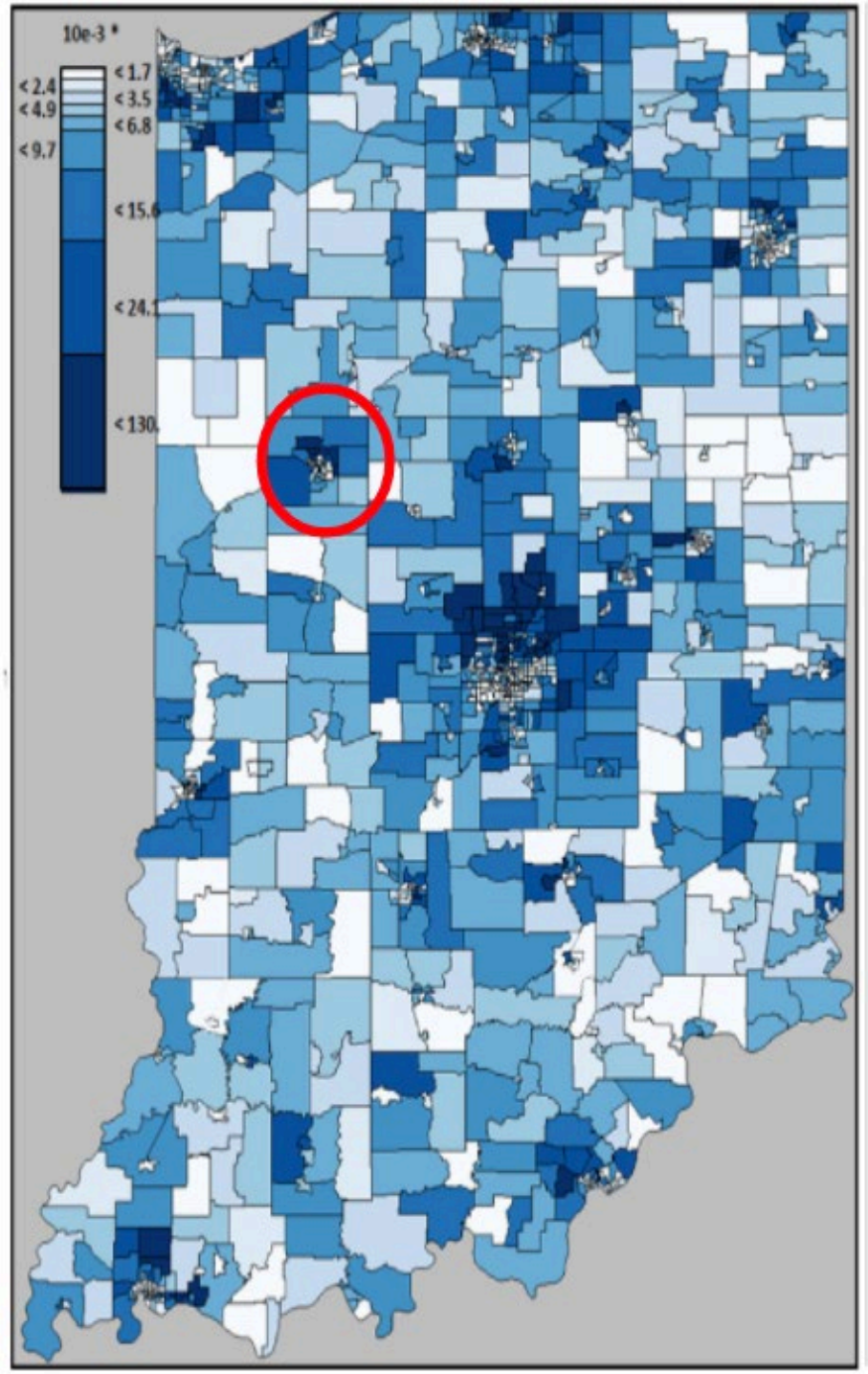

Carrier
9:43 AM
100%
West Lafayette
Purdue University
Krannert Center for Executive Education and Research
Grandview Cemetery
Ross-Ade Stadium
Downtown
Centennial
Perrin
Historic Jeff
Hanna
Lincoln
Salem St
Union St
Columbia St
South St
Lafayette
Ellsworth - Roming
9th Street Hill
Wallace Triangle
Kossuth St
Wabash
Highland Park
Owen St
Monon
St Lawrence - McAllister
Greenbush St
Wiggins St
W State St
E State St
Northwestern Ave
N River Rd
S River Rd
Old U.S. 231
Robinson St
N Salisbury St
Schuyler Ave
N 9th Street Rd
Greenbush Expd
N 3rd St
Erie St
N 15th St
N 18th St
S 9th St
S 18th St
S 22nd St
S 4th St
Central Ave
Main St
Columbia Park
Murdock Park
Wabash Ave
Tow Path Rd
Google
©2010 Google
Time Slider
Day
Week
Month
Year
2006-01-01 to 2006-12-31

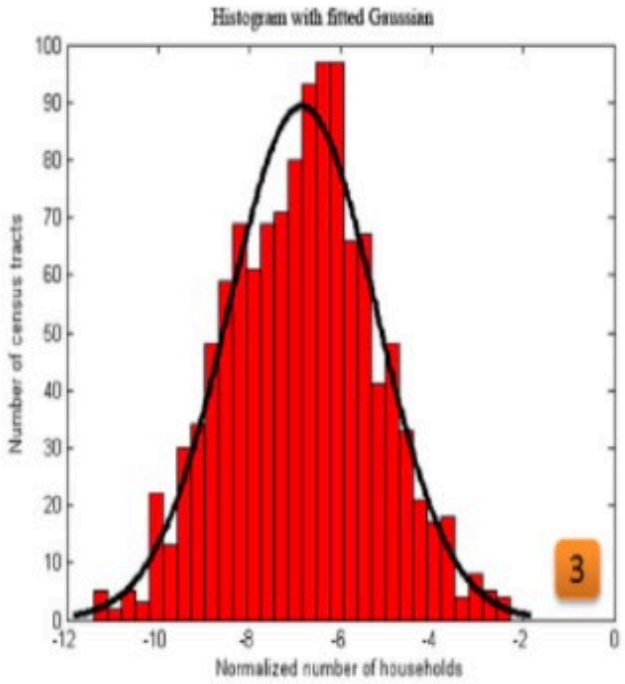
Coast Guard Search and Rescue Visual Analytics (CGSARVA)

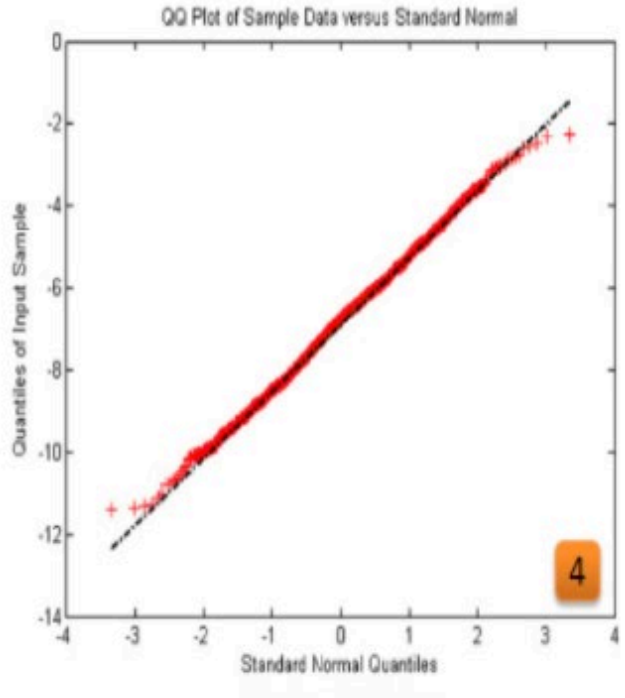


Assessing Risk in the Great Lakes




10e-3 *
< 1.7
< 2.4
< 3.5
< 4.9
< 6.8
< 9.7
< 15.6
< 24.1
< 130.


Histogram with fitted Gaussian
Number of census tracts
Normalized number of households
3


QQ Plot of Sample Data versus Standard Normal
Quantiles of Input Sample
Standard Normal Quantiles
4