

# **Improving the communication of geographic patterns of disease through computer-based tools**

**Linda Williams Pickle, Ph.D.**



Email: [PICKLEL@mail.nih.gov](mailto:PICKLEL@mail.nih.gov)

ASA meeting  
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# Outline

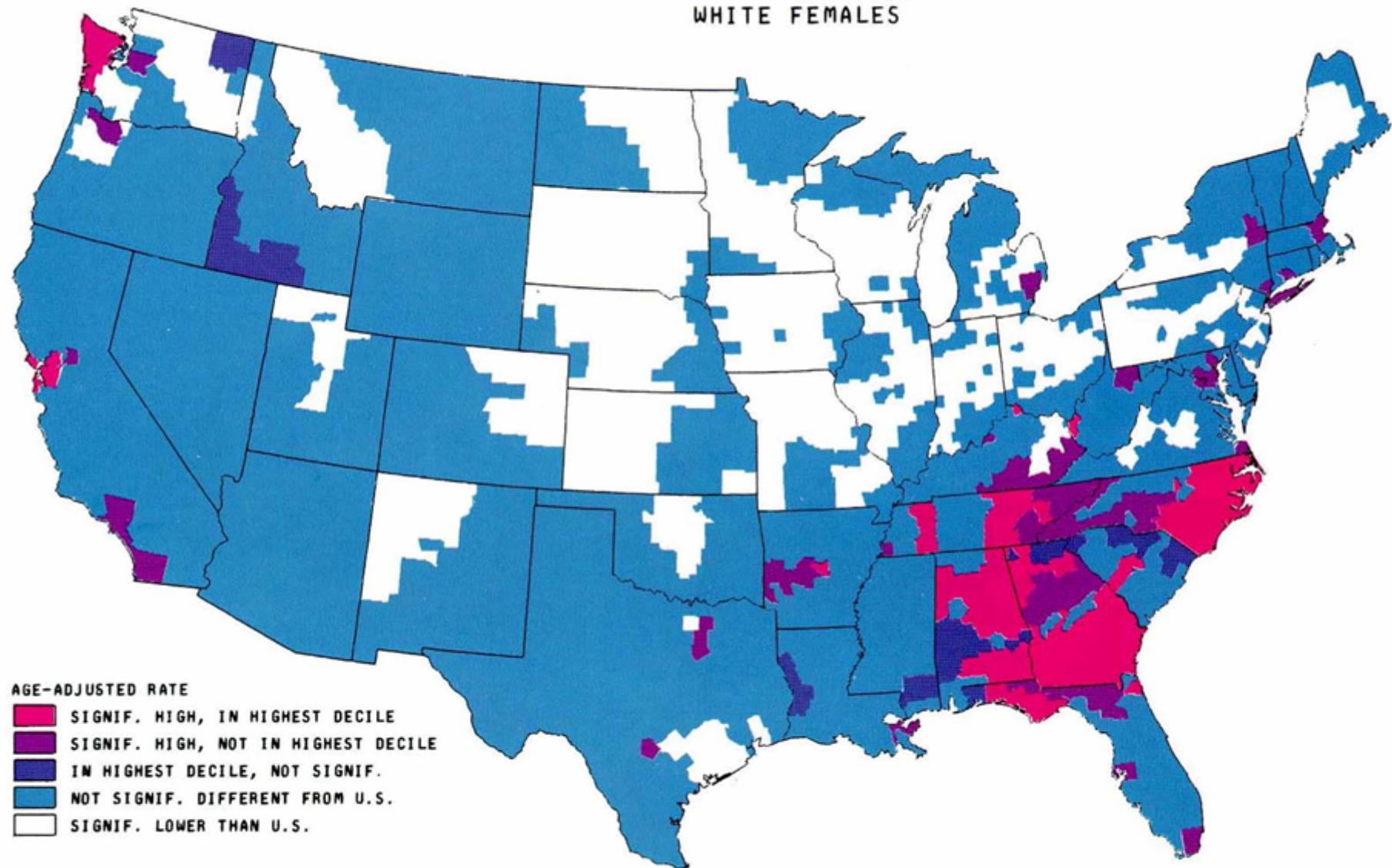
- Background
- Map design research at NCHS & NCI
  - Cognitive research methods
  - Basic map style
  - Legend design
  - Color choices
  - Indication of unreliable rates
  - Classification of rates into color categories
- Development of new graphical tools for communication
  - Smoothing
  - Cluster identification
  - Linked micromap plots
  - Exploratory Spatio-Temporal Analysis Tool (ESTAT)
- Communication over the web
  - NCI Cancer Atlas
  - Long Island Breast Cancer Study GIS
  - State Cancer Profiles

# Mortality data by county, sex, race & cancer: Published in tabular form in 1974 (700 p. !)

WHITE: MALIGNANT NEOPLASM OF TONGUE (ICD 141); FLOOR OF MOUTH (ICD 143); OTHER PARTS OF MOUTH AND MOUTH UNSPECIFIED (ICD 144); ORAL MESOPHARYNX (ICD 145); AND PHARYNX, UNSPECIFIED (ICD 148).													
ST-CO	MALE		FEMALE		ST-CO	MALE		FEMALE		ST-CO	MALE		
	#	RATE	#	RATE		#	RATE	#	RATE		#	RATE	
01001	2	1.9	2	1.7	01105	3	3.6	05049	1	.8	06003	5	3.7
01003	8	2.1	4	1.0	01107	4	3.2	05051	26	4.2	06005	5	3.7
01005	1	.9	2	1.3	01109	13	8.7	05053	1	.9	06007	51	5.0
01007	2	1.9	3	2.6	01111	1	.6	05055	8	2.9	06009	7	4.3
01009	5	2.0	1	.4	01113	9	4.7	05057	4	2.2	06011	7	4.7
01011	3	6.7			01115	3	1.4	05059	6	3.1	06013	117	4.4
01013	3	2.0	2	1.1	01117	9	3.8	05061	1	.9	06015	7	5.9
01015	17	3.2	9	1.4	01119	1	1.9	05063	5	2.0	06017	11	3.3
01017	10	4.5	7	2.4	01121	10	3.0	05065	2	2.0	06019	133	4.7
01019	1	.7	6	4.3	01123	5	2.2	05067	4	2.3	06021	17	9.0
01021	6	2.6	8	3.3	01125	17	2.5	05069	24	6.8	06023	35	4.3
01023	6	7.4	3	3.5	01127	14	2.9	05071	4	2.2	06025	20	3.6
01025	7	5.1	3	1.9	01129	2	2.6	05073	2	2.5	06027	10	7.2
01027	1	.7	3	1.8	01131	1	1.5	05075	7	3.7	06029	92	4.5
01029	1	.9	3	2.6	01133	4	2.6	05077	3	3.8	06031	12	3.0
01031	5	2.7	9	3.8	04001	1	1.2	05079	2	3.0	06033	7	2.6
01033	7	2.7	6	1.7	04003	11	3.1	05081	2	2.9	06035	4	2.8
01035	2	1.7	1	.7	04005	5	3.2	05083	5	2.0	06037	2277	4.7
01037	6	7.0	2	2.0	04007	7	3.5	05085	3	1.3	06039	15	4.2
01039	7	2.2	7	1.9	04009	2	1.8	05087	7	5.2	06041	59	5.0
01041	2	1.7	2	1.5	04011	1	2.6	05089	3	2.9	06043	1	1.1
01043	6	1.4	13	2.7	04013	168	3.3	05091	12	5.0	06045	19	3.5
01045	5	2.8	7	3.6	04015	5	3.8	05093	19	5.2	06047	21	3.5
01047	11	6.5	7	2.7	04017	5	4.3	05095	3	3.2	06049	2	2.1
01049	14	3.5	6	1.4	04019	42	2.1	05097	1	1.6	06053	61	4.8
01051	6	2.8	6	2.6	04021	6	1.7	05099	3	2.8	06055	40	4.7
01053	6	3.2	5	2.3	04023	4	4.6	05101	2	3.2	06057	8	2.5
01055	16	2.4	15	2.0	04025	9	2.2	05103	9	4.8	06059	146	3.0
01057	2	1.3	3	1.8	04027	16	5.4	05105	3	4.2	06061	26	4.0
01059	3	1.4	8	3.4	05001	8	4.3	05107	7	4.5	06063	5	3.8
01061	5	2.4	3	1.3	05003	5	3.7	05109	2	1.7	06065	109	3.6
01063	1	3.5	1	2.6	05005	5	3.0	05111	9	3.7	06067	174	4.9
01065	1	1.6			05007	10	2.0	05113	2	.9	06069	7	4.3
01067	6	6.8	5	4.4	05009	7	3.4	05115	8	3.3	06071	169	4.0
01069	11	3.5	6	1.6	05011	4	3.4	05117	2	1.8	06073	286	3.9
01071	8	2.6	8	2.4	05015	5	2.6	05119	78	5.0	06075	683	8.6
01073	189	5.8	76	1.8	05017	5	5.9	05121	2	1.3	06077	123	5.3
01075	5	3.5	1	.6	05019	6	3.6	05123	5	3.9	06079	37	4.2
01077	16	4.3	8	1.6	05021	6	2.4	05125	12	4.4	06081	153	4.9
01079	3	1.9	2	1.2	05023	1	.8	05127	1	.9	06083	67	4.7
01081	8	4.3	2	.9	05025	1	1.2	05129	1	.3	06085	161	3.8
01083	1	.4	3	1.2	05027	2	1.1	05131	23	3.7	06087	56	5.0
01085	1	3.1			05029	7	5.0	05133	6	4.5	06089	16	3.0
01087	2	4.9	3	5.2	05031	12	2.9	05135	2	1.8	06091	1	2.4
01089	16	2.9	5	.8	05033	6	2.4	05137	1	1.1	06093	18	4.8
01091	4	4.3	3	2.8	05035	7	5.9	05139	15	4.4	06095	34	3.6
01093	5	2.2	1	.4	05037	5	3.6	05141	3	2.9	06097	75	4.4
01095	9	2.2	9	2.0	05039	2	2.1	05143	14	2.4	06099	66	4.2
01097	85	6.2	21	1.2	05041	2	1.9	05145	10	2.5	06101	7	2.3
01099	7	6.7	6	4.6	05043	4	3.4	05147	2	2.0	06103	8	3.0
01101	47	6.7	13	1.4	05045	8	3.4	05149	3	1.8	06105	3	3.5
01103	15	3.7	8	1.6	05047	4	3.3	2	1.4	06107	41	2.7	
- 41 -													

Source: Mason & McKay, U.S. Cancer Mortality by County: 1950-1969, DHEW Publ. No.(NIH) 74-615, 1974.

CANCER MORTALITY, 1950-69, BY STATE ECONOMIC AREA  
OTHER MOUTH & THROAT  
WHITE FEMALES



# Cognitive Research Methods

- Focus groups
- Designed experiments
  - Focused on a single map element
  - Random order of maps seen
  - Subjects required to answer several types of questions about each map
  - Statistical analysis of % errors
- Think-aloud: “tell me what you are doing”

# Statistical map reading tasks

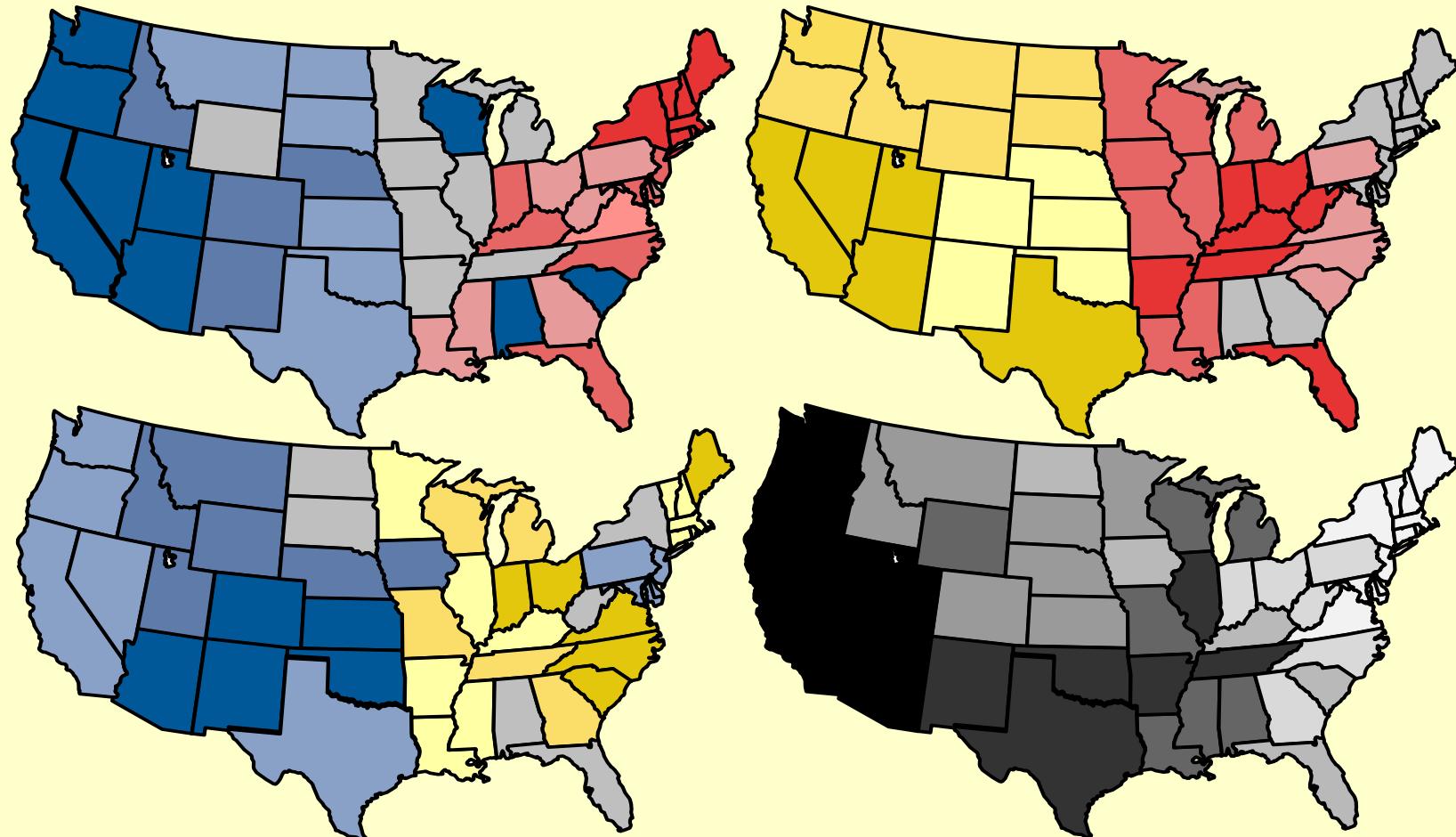
- Rate readout - what is approx. rate?
- Pattern recognition -clusters? outliers?  
-regional patterns?
- Pattern comparisons - compare maps

Target audience: Epidemiologists,  
public health professionals

# Results of early studies

- Choropleth (area-shaded) maps preferred & used most accurately by epidemiologists
- Legend: standard vertical fixed-box style
- Colors:
  - Very distinct colors best for rate readout (Hastie 1995)
  - Color gradient best for pattern recognition (Lewandowsky 1995)
  - Double-ended (diverging) scale combines gradients of 2 distinct hues; further tested for both types of questions
  - Color conventions (expectations) matter: darker or warmer color used for higher rates

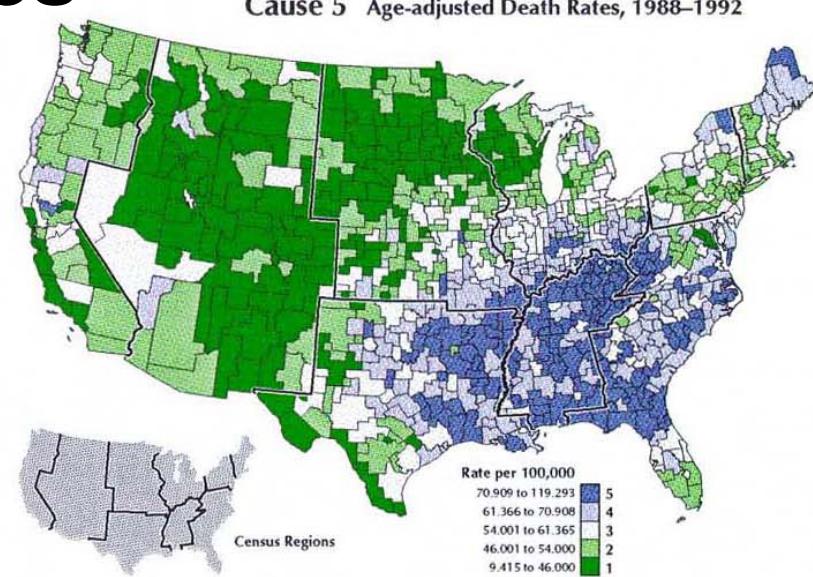
# What do you expect? Do color conventions matter?



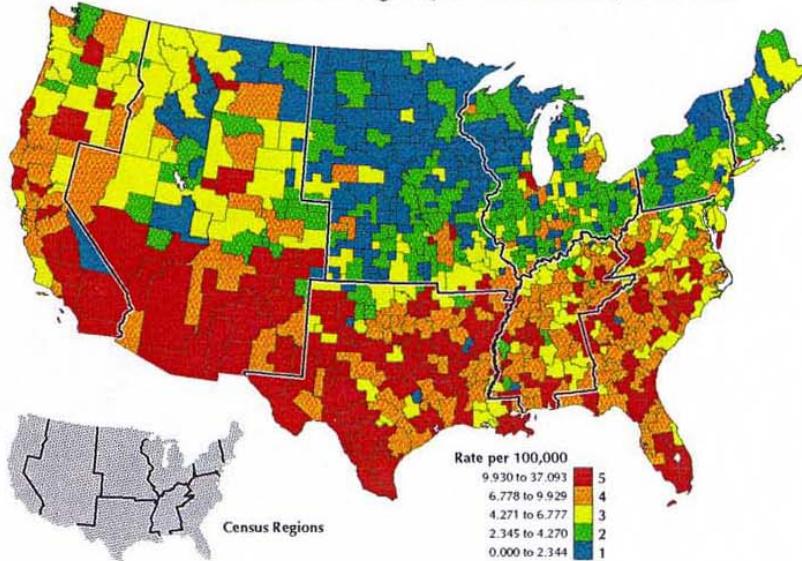
# Evaluating color schemes - Sample test maps

Figure 3. Example Quarter-Scale Test Maps

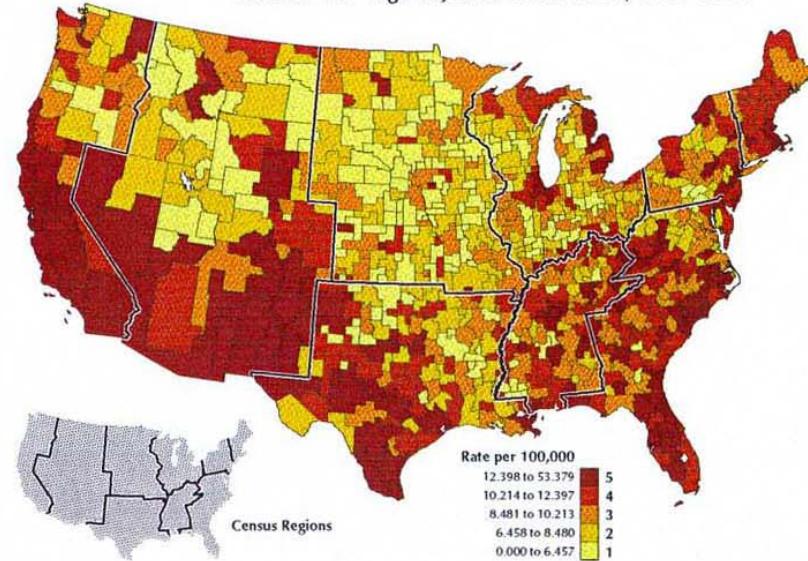
Mapped variables 5, 16, and 18 are shown with the five-class Purple/Green diverging, Spectral, and Red-Yellow sequential schemes.



Cause 16 Age-adjusted Death Rates, 1988–1992

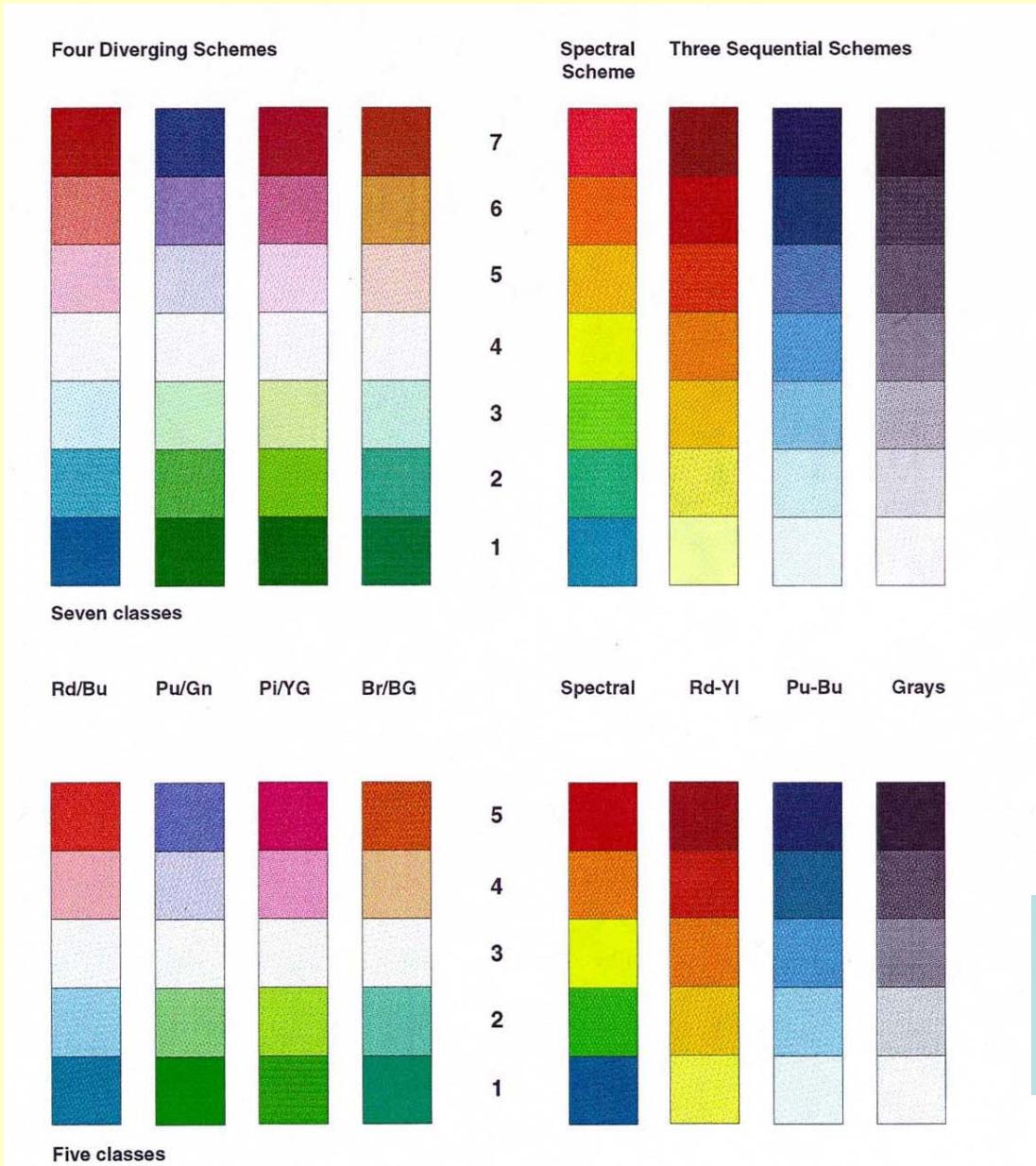


Cause 18 Age-adjusted Death Rates, 1988–1992



Source: Brewer et al., Annals of the Assoc of Amer Geographers, 1997.

# Color schemes tested

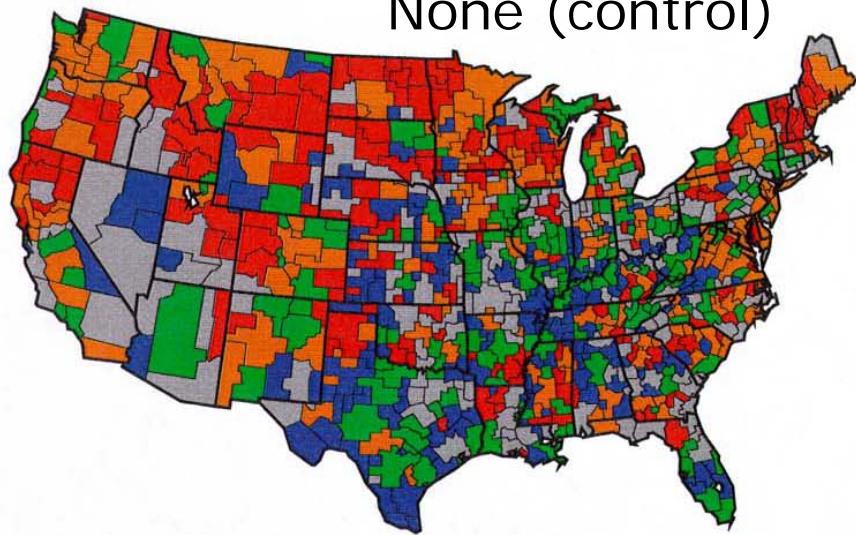


Source: Brewer et al., Annals of the Assoc of Amer Geographers, 1997.

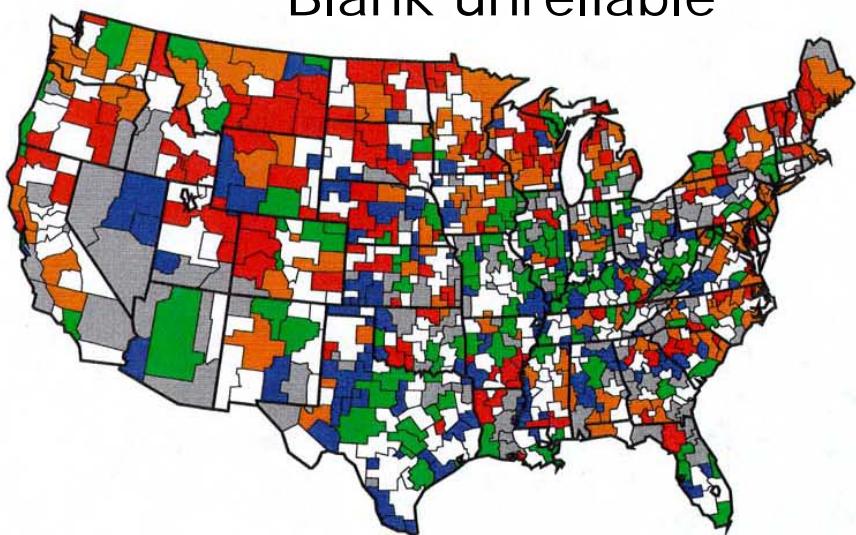
A new web tool for  
choosing colors:  
[colorbrewer.org](http://colorbrewer.org)

# Reliability Representation (study #1)

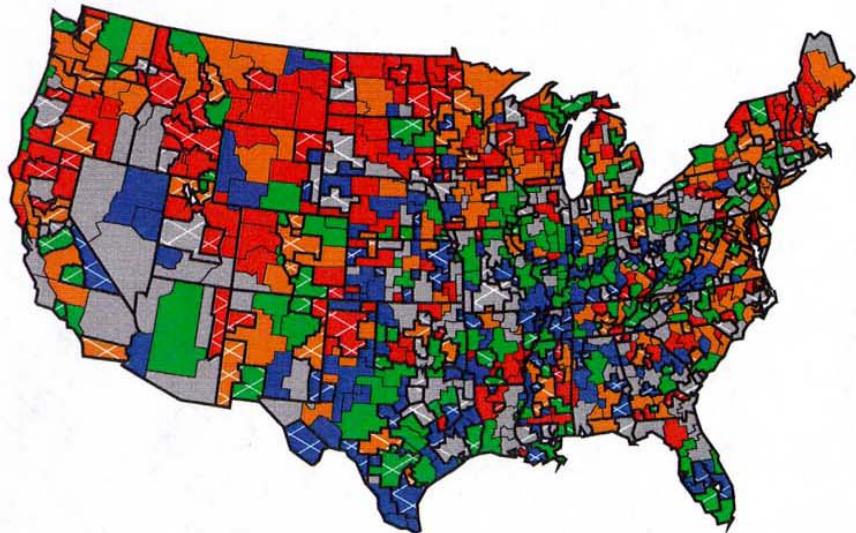
None (control)



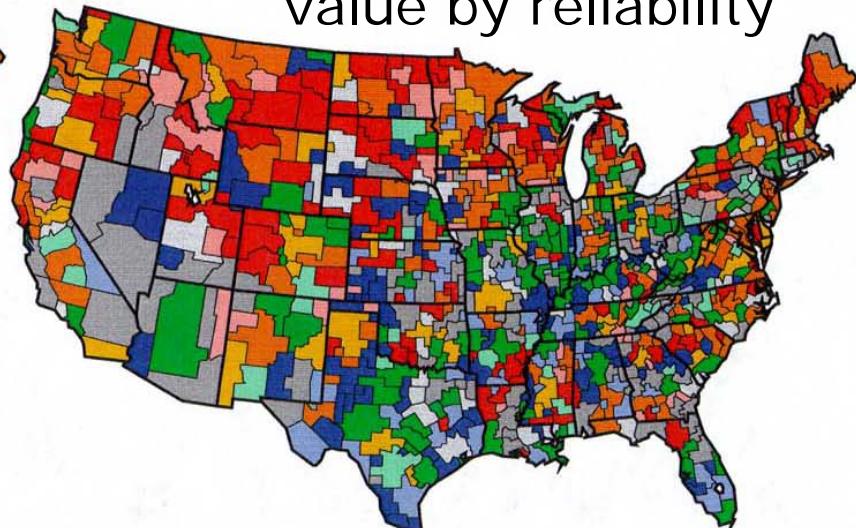
Blank unreliable



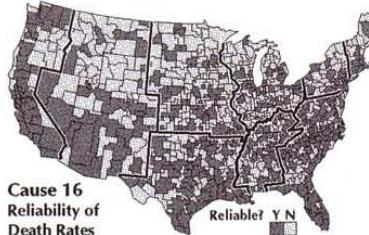
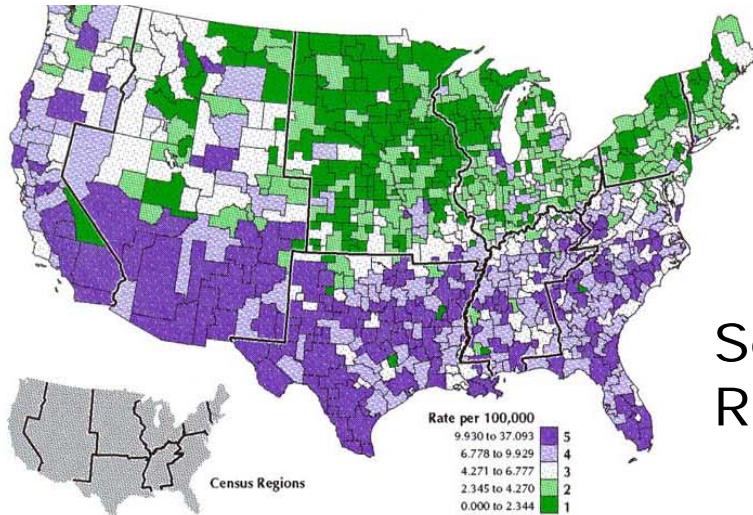
Hatch unreliable



Bivariate color scheme –  
value by reliability



# Reliability Representation (Study #2)

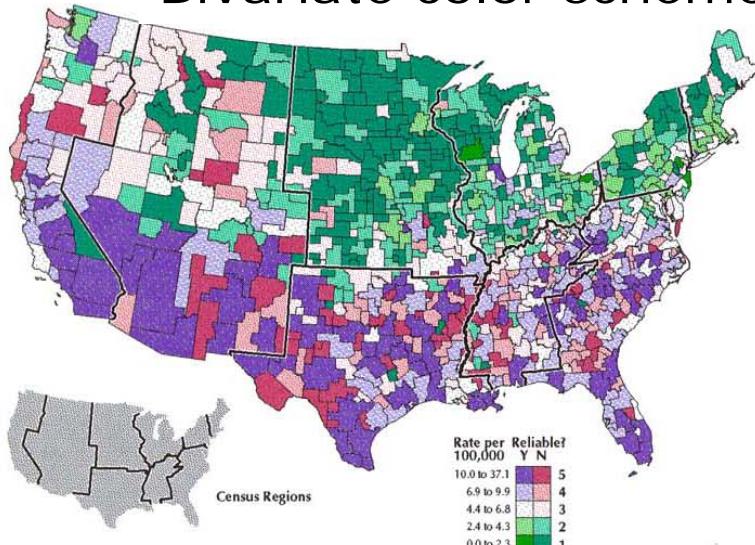


Sample Test Maps:

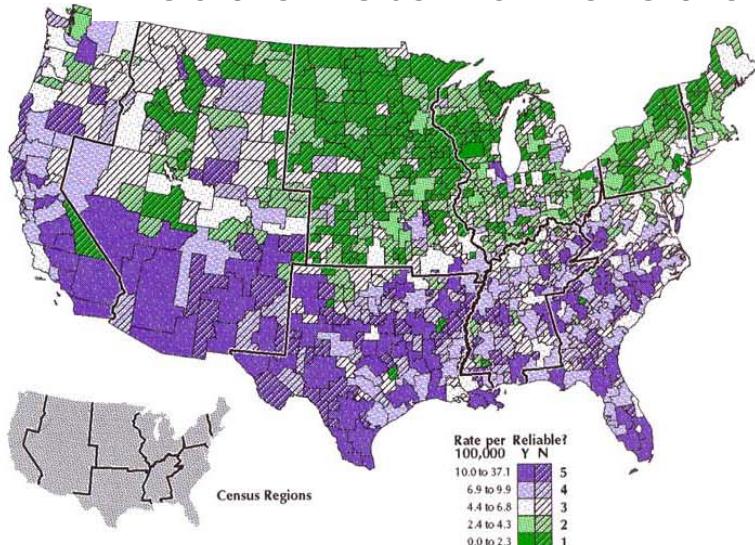
- cause: 16
- scale: quarter
- color scheme: purple-green
- reliability schemes:
  - map pairs
  - color change
  - texture overlay

Separate maps for  
Rate and reliability

Bivariate color scheme



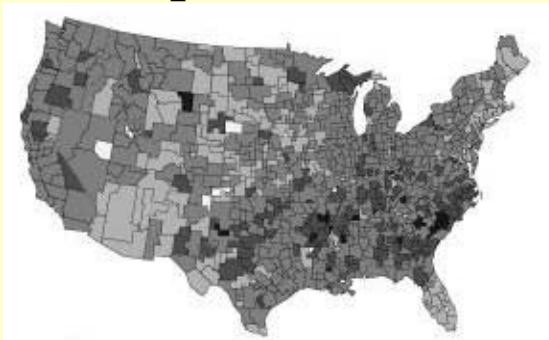
Double hatch unreliable



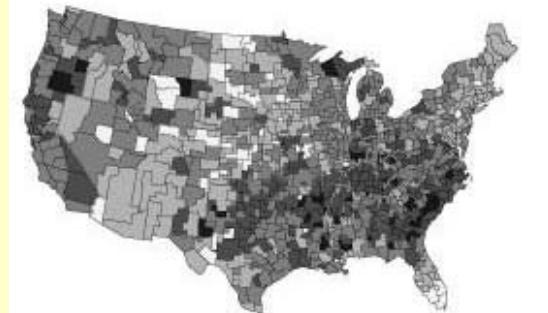
Source: MacEachren et al., Environment & Planning A, 1998.

# Cutpoint Methods Tested

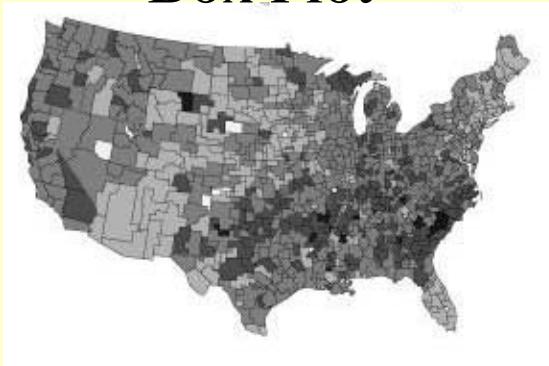
Equal Width



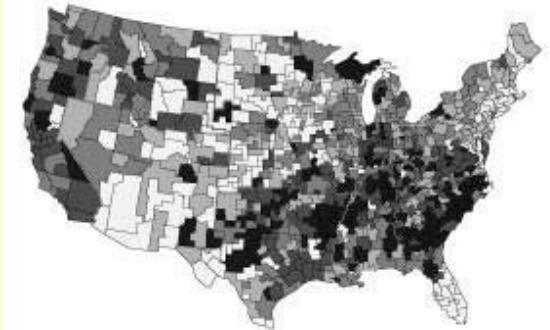
Natural Breaks (Jenks)



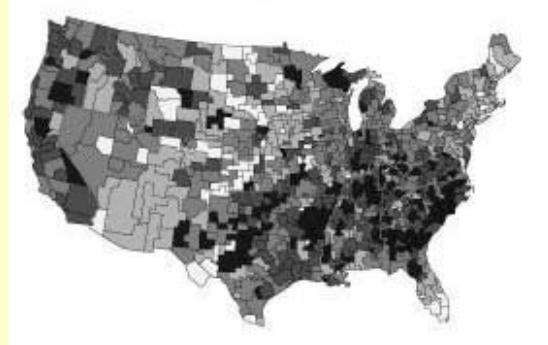
Box Plot



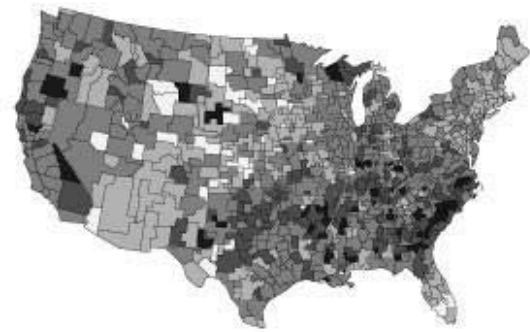
Quintile



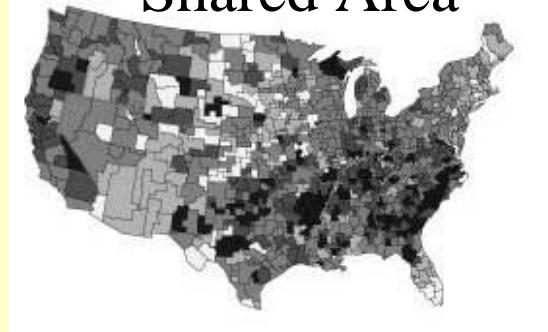
Minimum Boundary



Standard Deviation



Shared Area



# Recommendations for rate map design

- Design for particular audience and purpose & TEST PROPOSED DESIGNS FOR THESE
- Quantile-categorized choropleth map works well
- Use standard legend design
- Colors should be chosen for visually impaired and consistent with conventions
- Identify unreliable rates, don't blank out
- Accept that multiple maps are often needed
  - to address different questions,
  - to focus attention on different scales,
  - to compare modeled (smoothed) to observed...

# Extensions of Map-based Research at NCI

- Extension of map research to computer-based maps, web-based data dissemination
- Development of new graphical tools for data exploration and communication
- Usability of interactive systems by the public
- Examples
  - **Visualization tools: Smoothing, Cluster identification**
  - Linking maps & graphs: Linked micromap plots, Exploratory Spatio-Temporal Analysis Tool (ESTAT)
  - Communication over the web
    - Cancer atlas
    - Long Island Breast Cancer GIS
    - State Cancer Profiles

# Map smoothing methods

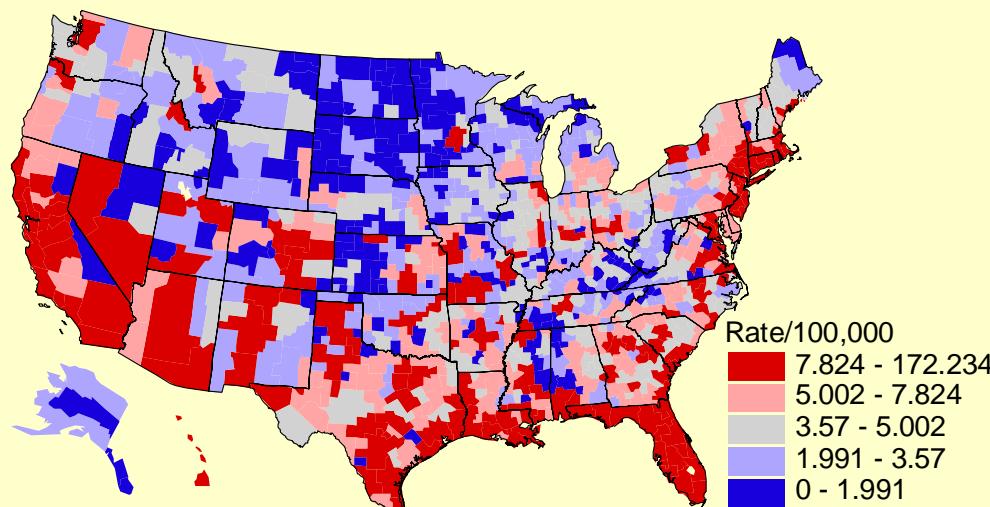
- 2D Smoothing is a method of removing some variability in a quantitative map
- Maps of cancer rates for small areas can be difficult to interpret because of background “noise”
- Previous methods ignored population differences
- Methods now can incorporate weights
  - very stable rates are smoothed less
  - more unstable rates (due to small populations) are smoothed more



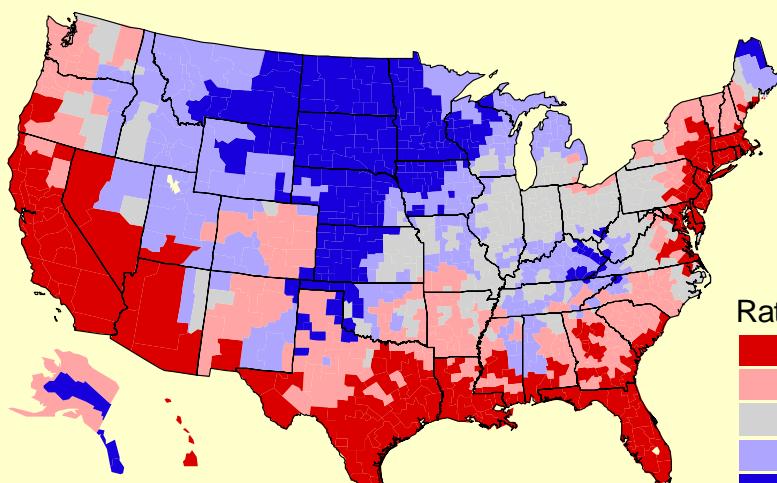
Source: Mungiole, Pickle, Simonson, *Statistics in Medicine*, 1999

# HIV mortality rates, 1988-92

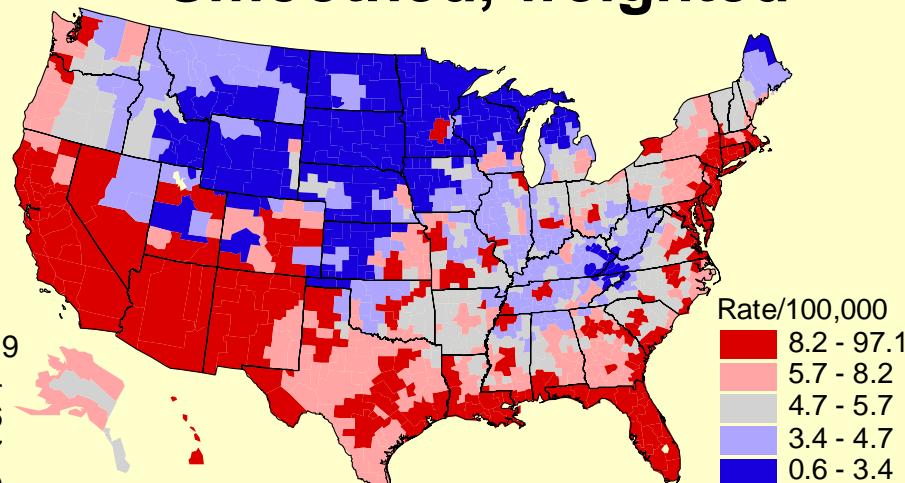
Original data:



Smoothed, unweighted



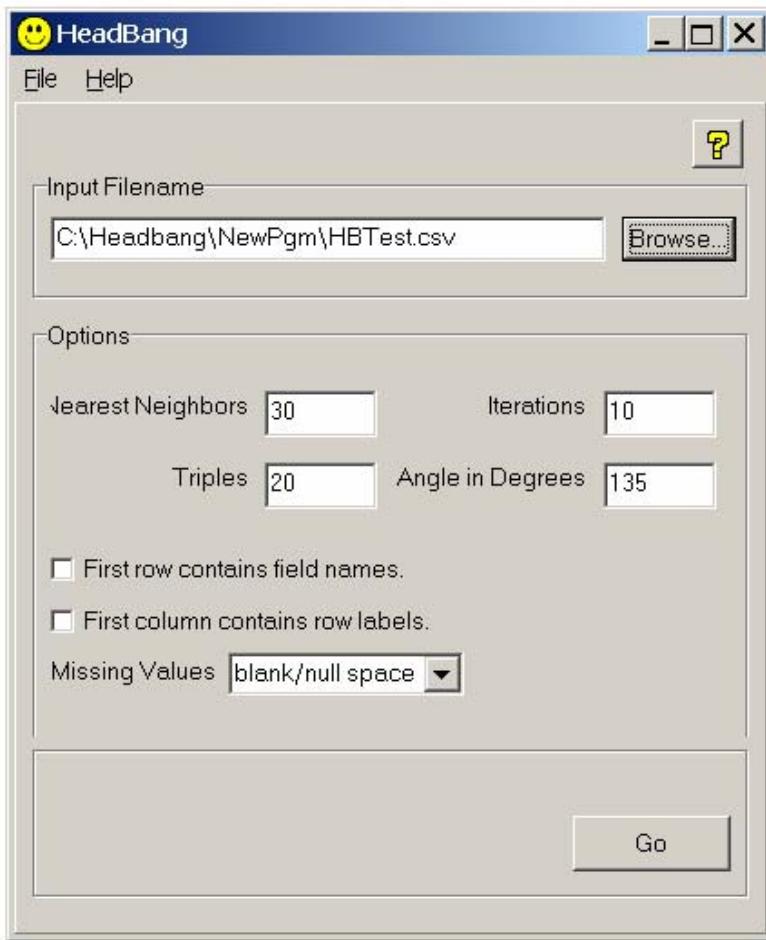
Smoothed, weighted



Source: Pickle et al., *Atlas of United States Mortality*, NCHS, 1996.

# Headbang software available from <http://srab.cancer.gov/headbang/>

GUI Interface



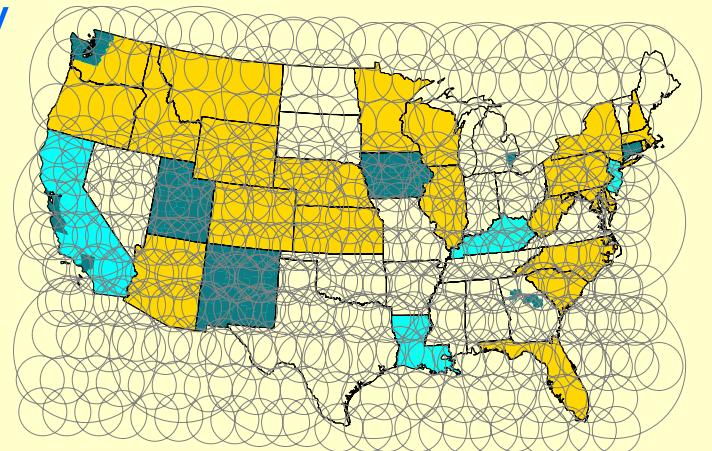
S+ call to C+ program

```
ResultNew<-dos(paste("headbang.exe",  
nn,ntrip,niter,thetastar),rbind(X,Y,rate,wgt))
```

Developers: Katherine Hansen Simonson  
and IMS, Inc. staff

# Cluster Identification

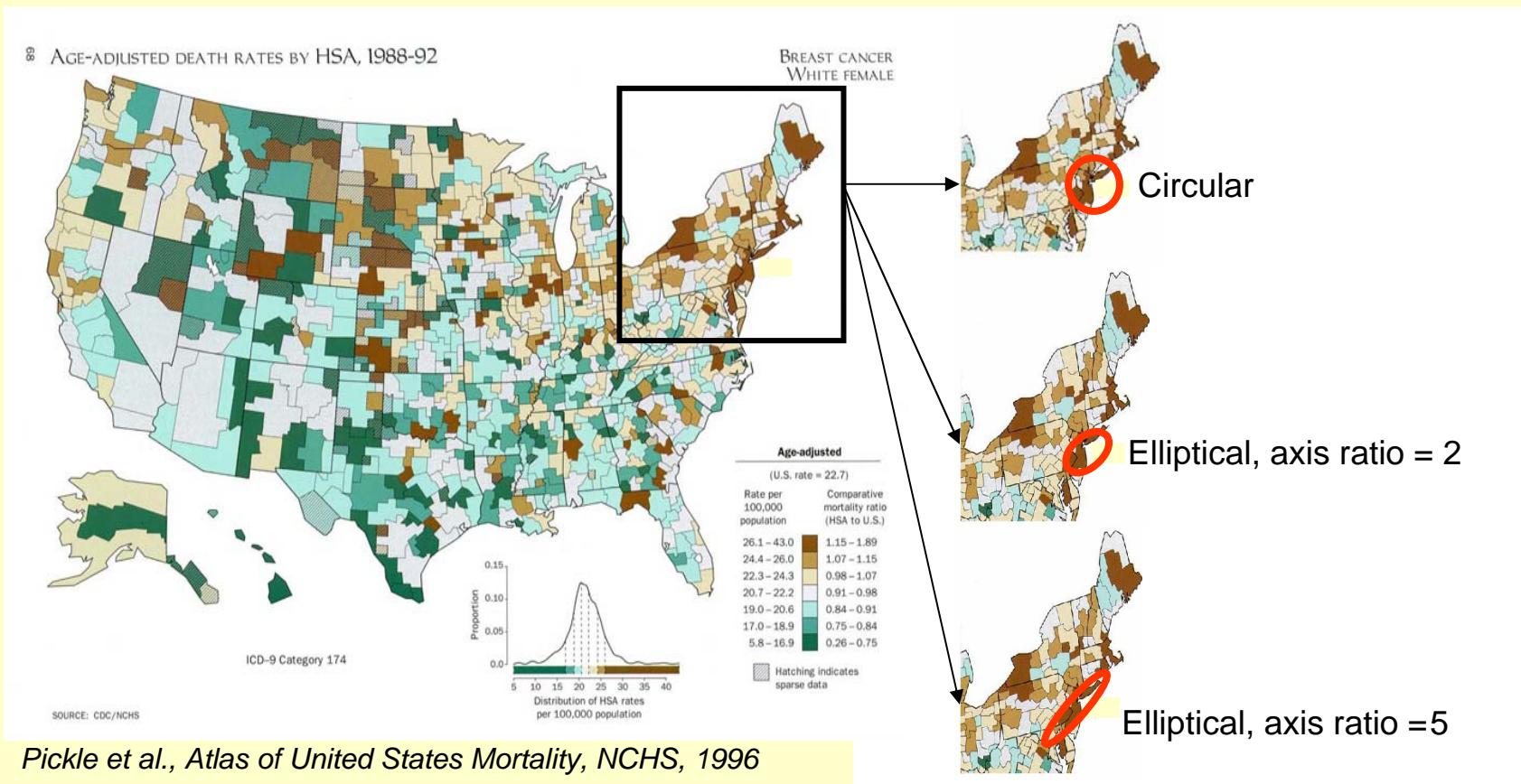
- SaTScan, a space and time scan statistic, was developed at NCI by Martin Kulldorff (see [srab.cancer.gov](http://srab.cancer.gov) and [www.satscan.org](http://www.satscan.org))
- Tests null hypothesis that disease risk is the same all over the map
- Creates a set of circles (new version includes ellipses) centered on each geographic unit
- Generates random replicas of the data under  $H_0$ , compares most likely clusters in real & random data sets to identify most likely cluster & its significance level



# Example: Breast cancer clusters

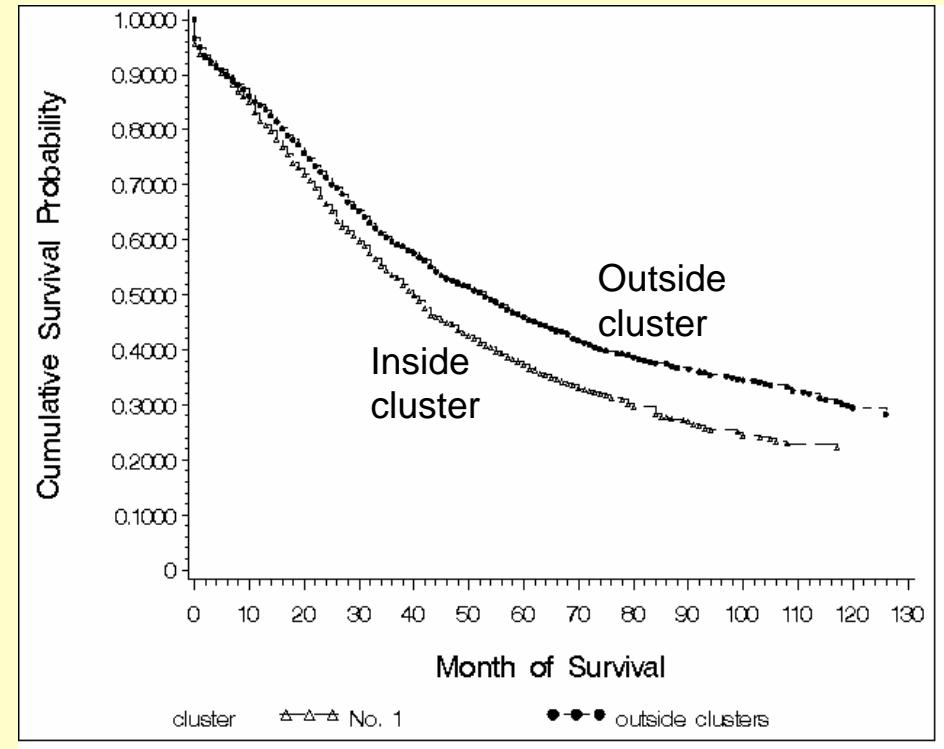
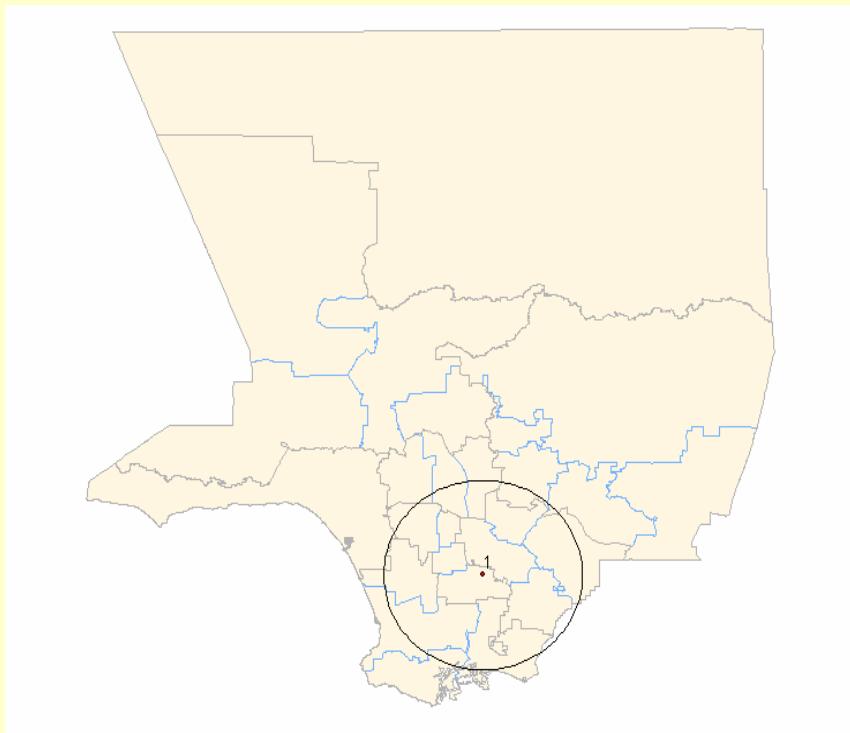
Breast cancer mortality rates

Most likely cluster



# Spatial clustering of survival for stage III colorectal cancer in Los Angeles, among male cases diagnosed 1988-2002

Significantly short survival,  $p=0.01$ , radius=17km



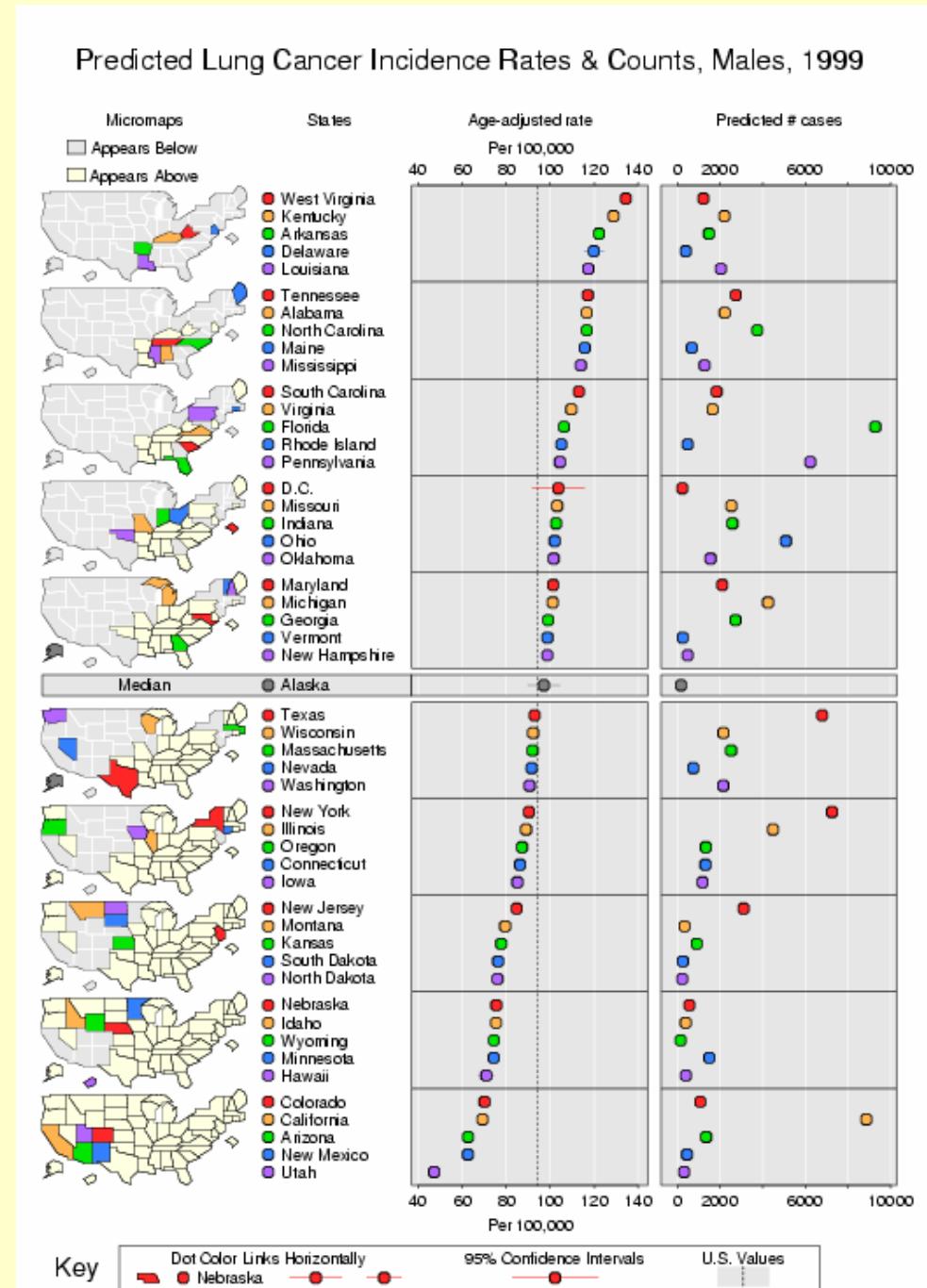
Source: Huang et al. (NCI), manuscript in preparation

# Extensions of Map-based Research at NCI

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- Development of new graphical tools for data exploration and communication
- Usability of interactive systems by the public
- Examples
  - Visualization tools: Smoothing, Cluster identification
  - **Linking maps & graphs:** Linked micromap plots, Exploratory Spatio-Temporal Analysis Tool (ESTAT)
  - Communication over the web
    - Cancer atlas
    - Long Island Breast Cancer GIS
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# Linked Micromap Plot

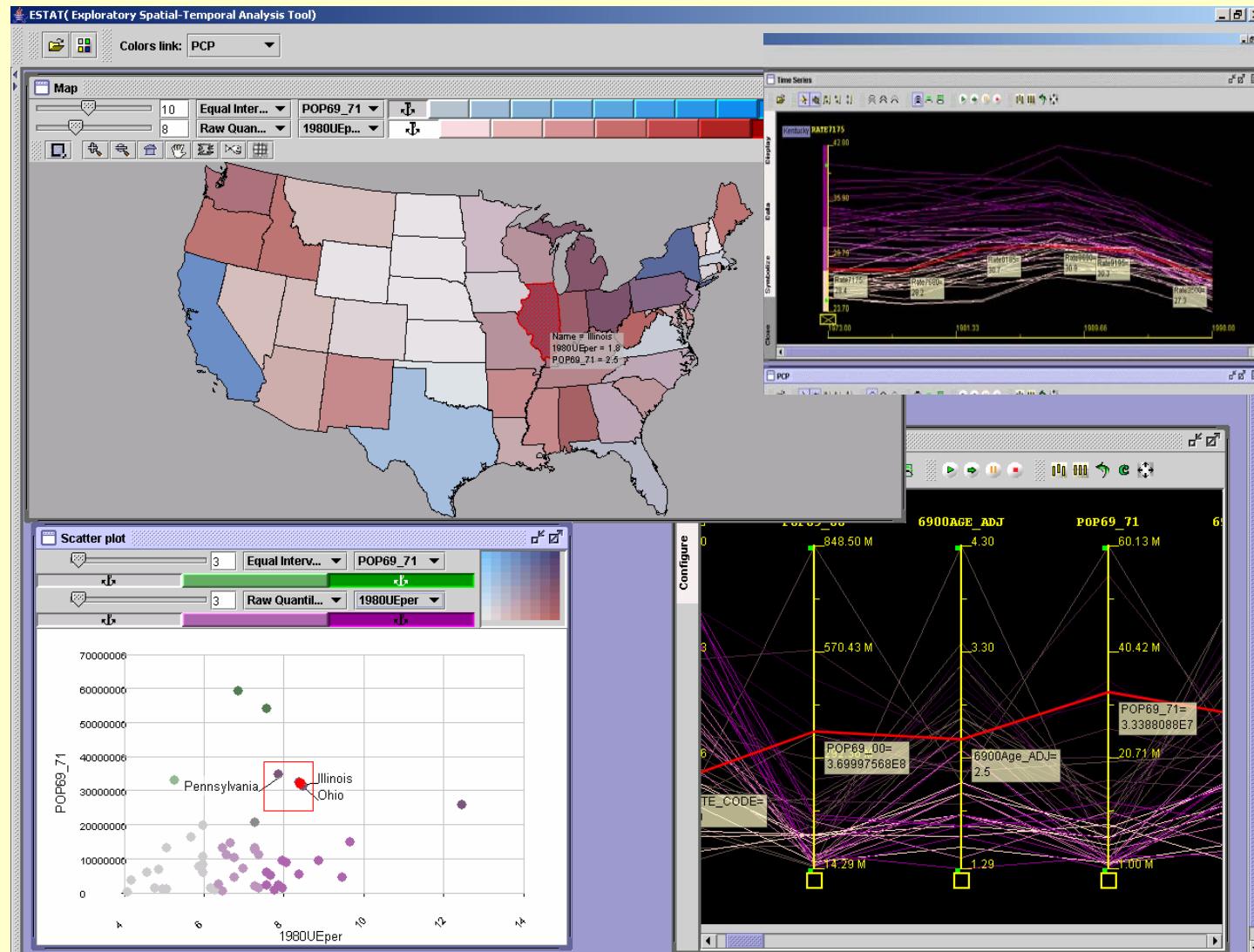
Linking geographic patterns with statistical detail



Source: Carr, Wallin & Carr,  
Stat in Med 2000

# Exploratory Spatio-Temporal Analysis Tool (ESTAT)

Map

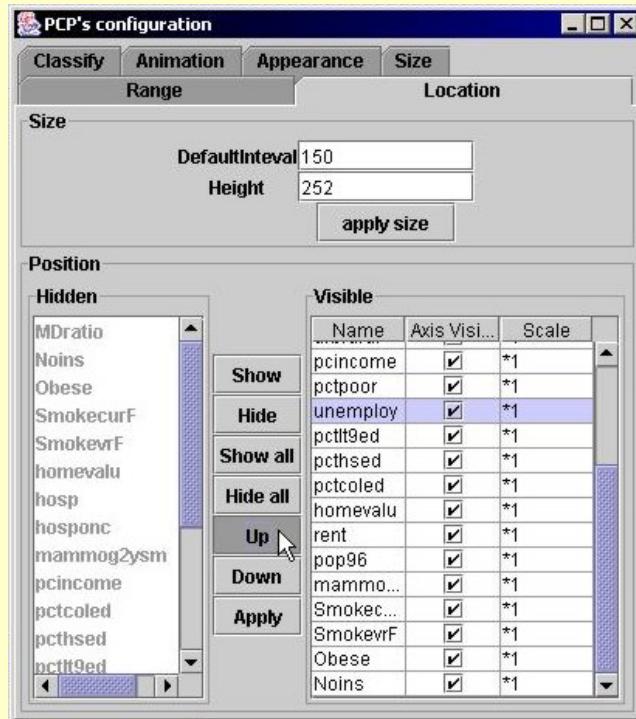


Rate  
Time  
Series  
Plot

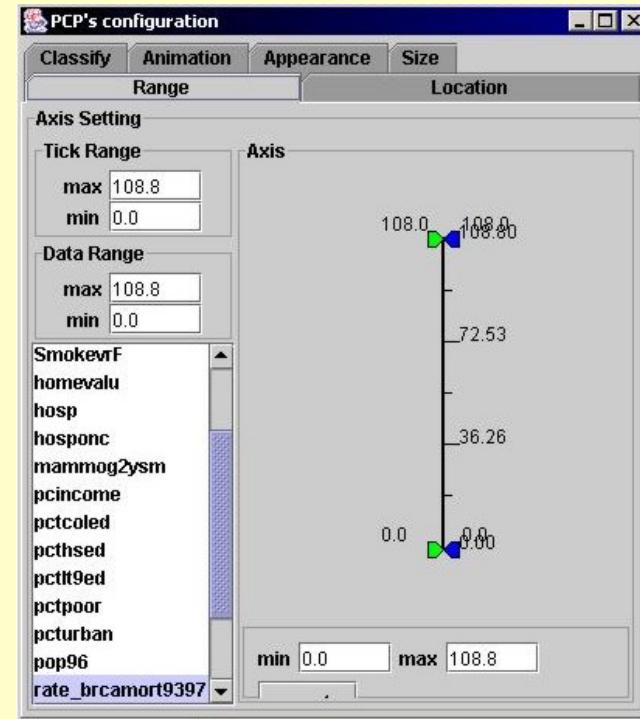
Covariate  
PCP plot

# Examples of ESTAT's extensive user controls

Select and order PCP variables



Restrict range of PCP axis



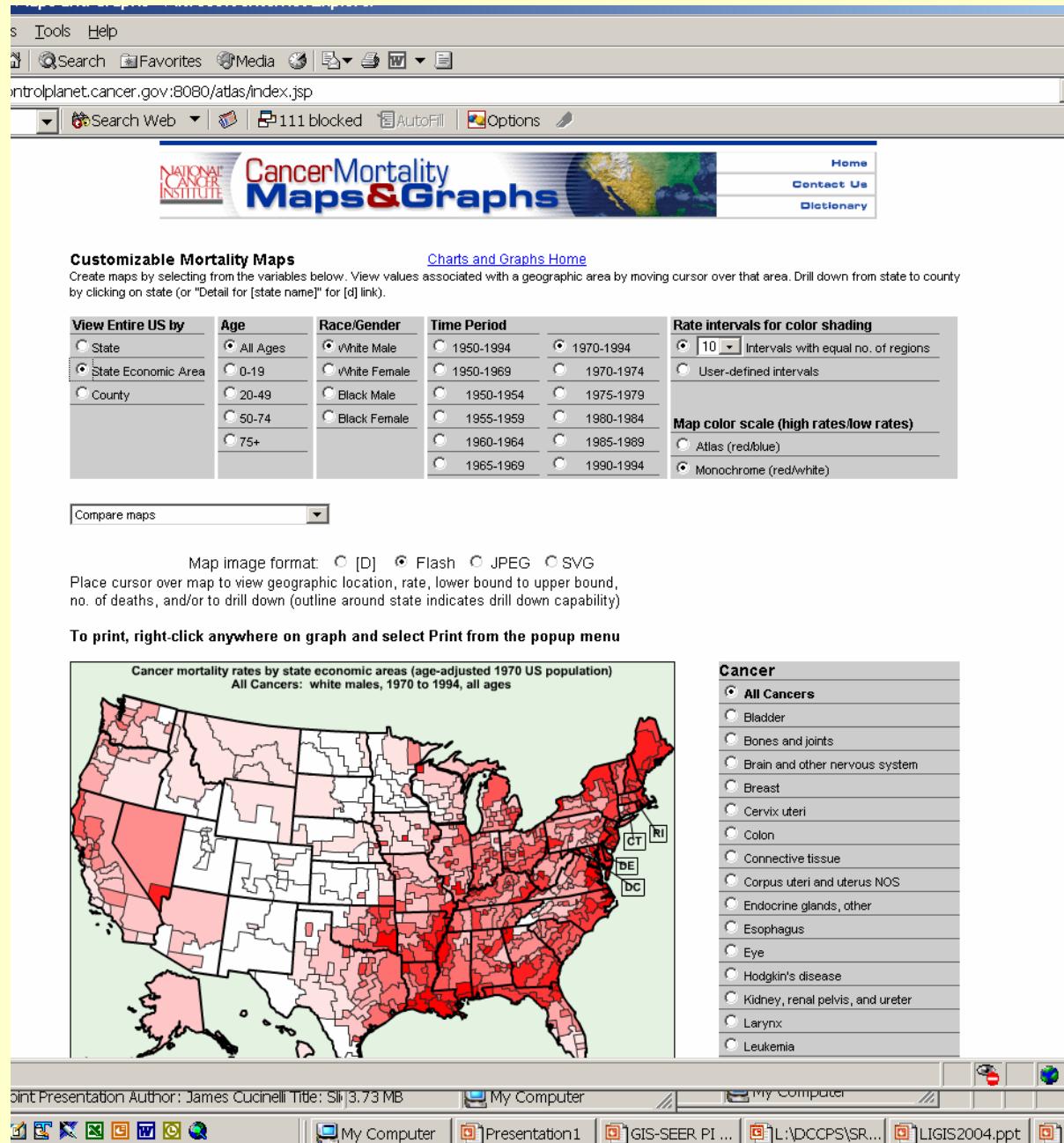
Also, dynamic linking & brushing, color specification, simple summary statistics, etc.

# Extensions of Map-based Research at NCI

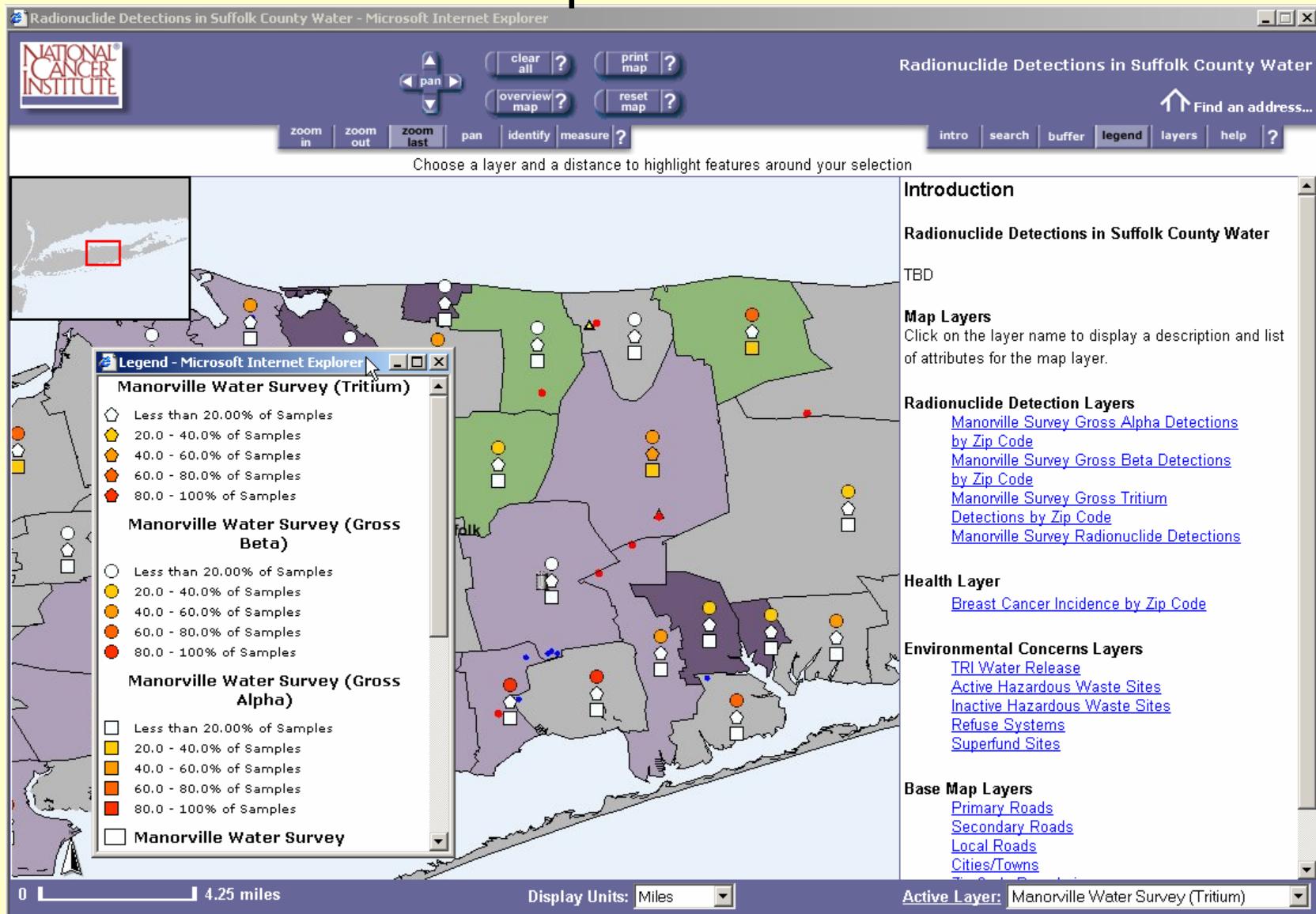
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# Web-based interactive cancer mortality maps

[www.cancer.gov/atlasplus](http://www.cancer.gov/atlasplus)



# Long Island Breast Cancer Study Project GIS: A more complex web-based tool



# Web-based Communication of Cancer Statistics: State Cancer Profiles Web Site

- Goal: provide a system to characterize the cancer burden in a standardized manner to:
  - Motivate action
  - Integrate surveillance into cancer control planning
  - Characterize areas & demographic groups
  - Expose health disparities
- Target audiences:
  - Health planners
  - Policy makers
  - Cancer information providers

# Extensive usability testing

- Tested at several professional meetings that members of target audience attended as well as in NCI Usability Lab
- Focus groups + hands-on testing conducted by a specialist in usability tests of web pages
- Tested on and/or approved by federal, state and local health department staff; cancer control professionals; policy makers
- Many iterations of prototypes
- Released to state health departments a week early so that they could verify their own data before general release

# URL: statecancerprofiles.cancer.gov



## State Cancer Profiles

Dynamic views of cancer statistics for prioritizing cancer control efforts in the nation, states, and counties

Help us improve!  
Contact us with  
feedback.



Profiles Home

### Quick Profiles

Area

Cancer

### Comparison Tables



#### Rate/Trend Comparisons

set higher priority for cancer control when rates are high or rising  
[learn more...](#)

- [by State/County](#) prioritize cancer sites
- [by Cancer](#) prioritize states or counties in a state



#### Death Rates

for states or for counties in a state  
[learn more...](#)



#### Incidence Rates

for states with high quality cancer registries  
[learn more...](#)

### Interactive Graphs and Maps



#### 5-Year Rate Changes

in cancer mortality or incidence for all major cancer sites by user selectable criteria  
[learn more...](#)



#### Historical Trends

compare trends in cancer mortality and incidence by user selectable criteria  
[learn more...](#)



#### Latest Rates, Percents, and Counts

explore relationships across geography of mortality, incidence, demographics, or risk factors  
[learn more...](#)



#### Interactive Maps

for states or for counties in a state  
[learn more...](#)

### Support Data



#### Screening and Risk Factors

prevalence percents by state from behavioral surveys  
[learn more...](#)



#### Peer Counties

identify counties that are comparable based on a user specified criteria  
[learn more...](#)



#### Age Distribution

male and female population sizes by age groups by user selectable criteria  
[learn more...](#)



[Cancer Control PLANET Home](#)

### New Releases

[2002 & 2003 BRFSS Survey Data](#)

[2001 USCS Incidence Data](#)

2002 SEER Incidence Data (also released in the [Cancer Statistics Review](#))

[2002 Mortality Data](#)

[Release Schedule](#)

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**Note:** This Web site is best viewed in [Internet Explorer](#) (version 5.0 or higher) or [Netscape](#) (version 7.0 or higher) at a [screen resolution](#) of 1024 by 768 or more.

### Links

[State Registry Contacts](#)

[US Cancer Statistics: 2001](#)

[Incidence](#)

[Resources for Cancer Control](#)

[Cancercontrolplanet.cancer.gov](#)

# Includes linked micromap plots...

statecancerprofiles.cancer.gov - Microsoft Internet Explorer

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Address http://www72.ims.nci.nih.gov/micromaps/ Go

cancer.gov

NATIONAL CANCER INSTITUTE

State Cancer Profiles

Dynamic views of cancer statistics for prioritizing cancer control efforts in the nation, states, and counties

CDC

CCPLANET

Profiles Home > Latest Rates, Percents, and Counts

Left Column Data

Area: US - state level

Data Group: Cancer Statistics

Cancer: Lung & Bronchus

Statistic: Mortality Rate

Race: White

Sex: Males

Age: All Ages

Right Column Data (optional)

Data Group: Risk Factors / Screen

Cancer:

Statistic: Current Smokers

Race: All Races

Sex: Males

Age: 18+

Draw Clear Overview Options

Lung & Bronchus Cancer

Year 1999

Death Rate

White

Males, All Ages

Deaths per 100,000

Rank 1=Lowest

Rank	Value and 95% Confidence Interval (CI)	Median value for sorted column
40	40	40
60	60	60
80	80	80
100	100	100

Year 2001

Current Smokers

All Races

Males, Age 18+

Percent

Rank 1=Lowest

Rank	Value and 95% Confidence Interval (CI)	Median value for sorted column
10	10	10
15	15	15
20	20	20
25	25	25
30	30	30
---	--- not available ---	
51	51	51
50	50	50
49	49	49
48	48	48
47	47	47
46	46	46
45	45	45
44	44	44
43	43	43
42	42	42
41	41	41
40	40	40
39	39	39
38	38	38
37	37	37
36	36	36
47	47	47

Micromaps

for sorted column

United States

Healthy People 2010 U.S. Target

Above current map

Below current map

Key

Value and 95% Confidence Interval (CI)

Median value for sorted column

See data table for source information

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# New interactive map feature

Area: US by state [About this Map](#)

Cancer: All Cancer Sites [Quick Reference Guide](#)

Race: All Races [Tutorial](#)

Sex: Both Sexes

Age: All Ages

Year(s): 1998 - 2002

Map Options

Interval Type: Quantiles (rankings) [Interval Type](#)

Number of Intervals: 6

Color Scheme: Red-Yellow-Blue (Div) [Color Scheme](#)

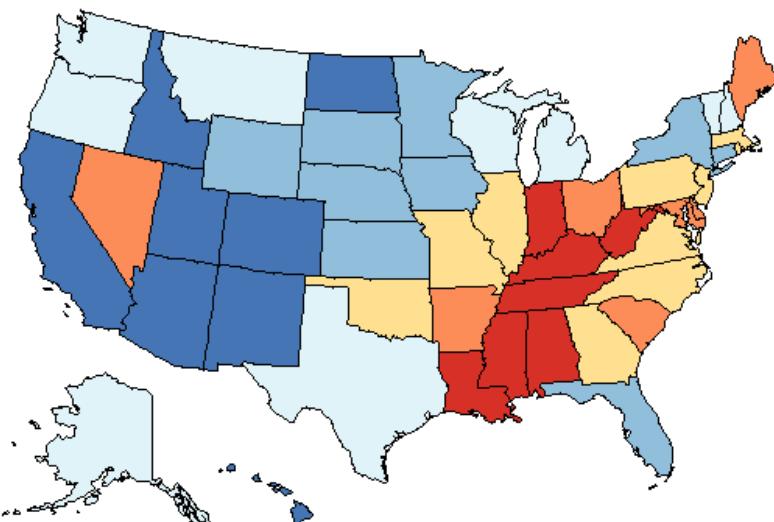
[Generate Map](#)

[Data Use Restrictions](#)

## Age-Adjusted Death Rates for United States, 1998 - 2002

### All Cancer Sites

### All Races, Both Sexes, All Ages



Age-Adjusted  
Annual Death Rate  
(Deaths per 100,000)  
[Quantile Interval](#)

- 211.8 to 238.7
- 207.2 to 211.7
- 202.5 to 207.1
- 190.8 to 202.4
- 183.3 to 190.7
- 150.6 to 183.2

United States  
Rate (95% C.I.)  
197.8 (197.6 - 198.1)

Healthy People 2010  
Goal 03-01  
159.9

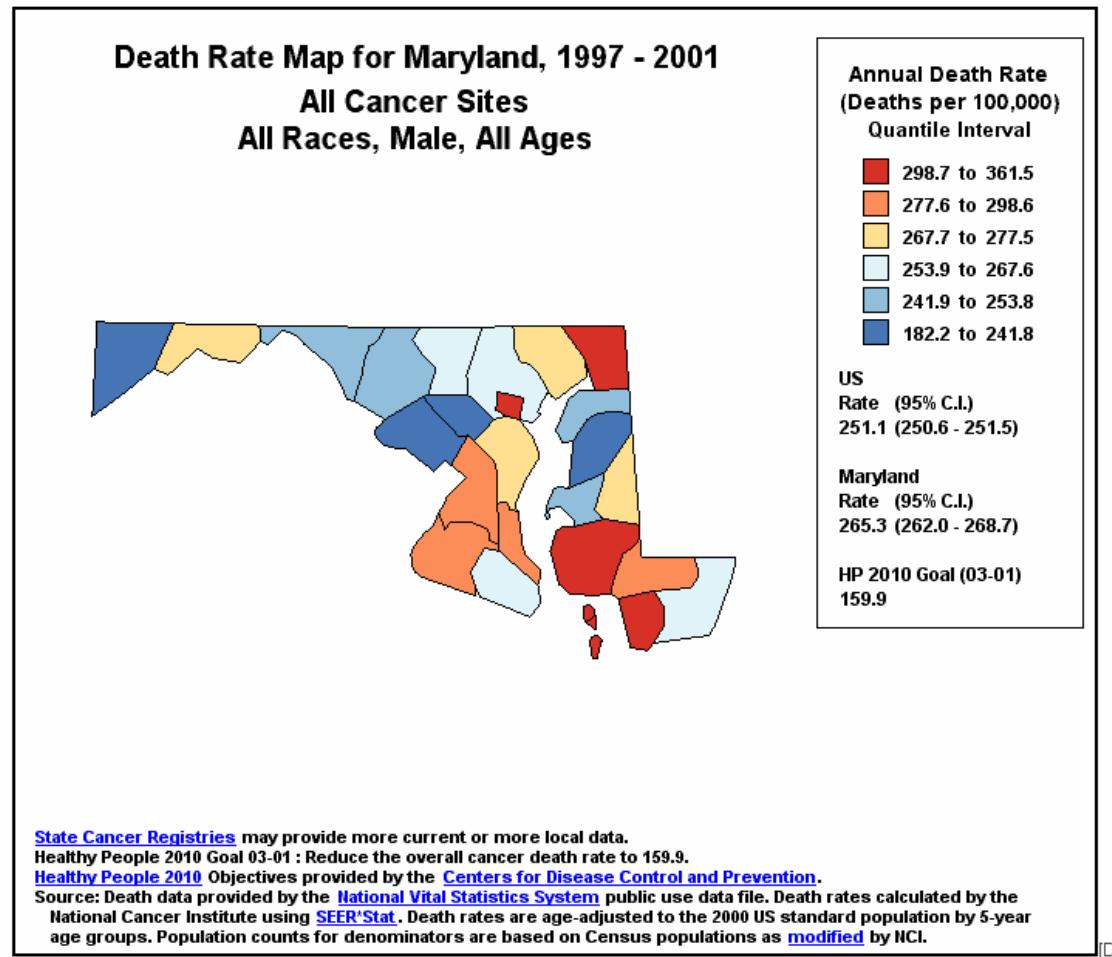
- [Save Map Image](#)
- [Data Table](#)
- [CSV](#) [Export Data](#)
- [Interpret](#)

[Printable View](#)

### Action Notes

- Rollover a state with your mouse to see the rate (and 95% C.I.)
- Click on a state to show the counties of that state
- Scroll to the top of the web page to change the parameters of the map

# Basic mapping functions for states or counties within state



Map of Maryland showing cancer death rates by county for 1997-2001. The map uses a color-coded legend to represent different quantile intervals. A legend box on the right shows the intervals: 298.7 to 361.5 (red), 277.6 to 298.6 (orange), 267.7 to 277.5 (yellow), 253.9 to 267.6 (light blue), 241.9 to 253.8 (medium blue), and 182.2 to 241.8 (dark blue). Data labels on the map indicate rates for the US, Maryland, and HP 2010 Goal (03-01).  
**All Cancer Sites**  
**All Races, Male, All Ages**

**County** **Rate** **Count** **Group Range** **Map Color**

County	Rate	Count	Group Range	Map Color
Maryland	265.3 (262.0 - 268.7)	26,108	N/A	N/A
United States	251.1 (250.6 - 251.5)	1,422,173	N/A	N/A
Baltimore City	361.5 (351.0 - 372.2)	4,660	298.7 - 361.5	Red
Dorchester	331.6 (293.3 - 374.5)	279	298.7 - 361.5	Red
Somerset	330.4 (283.2 - 384.2)	184	298.7 - 361.5	Red
Cecil	322.0 (291.6 - 355.3)	478	298.7 - 361.5	Red
Calvert	298.6 (266.0 - 335.0)	356	277.6 - 298.6	Orange
Charles	295.5 (267.5 - 326.4)	507	277.6 - 298.6	Orange
Wicomico	283.2 (257.8 - 311.0)	484	277.6 - 298.6	Orange
Prince Georges	283.1 (272.2 - 294.5)	3,107	277.6 - 298.6	Orange
Caroline	277.5 (238.5 - 321.8)	187	267.7 - 277.5	Yellow
Allegany	272.2 (249.4 - 296.8)	542	267.7 - 277.5	Yellow
Anne Arundel	272.1 (260.2 - 284.6)	2,298	267.7 - 277.5	Yellow
Harford	269.3 (251.2 - 288.7)	980	267.7 - 277.5	Yellow
Carroll	267.6 (247.6 - 289.0)	718	253.9 - 267.6	Light Blue
Baltimore	263.7 (255.9 - 271.7)	4,497	253.9 - 267.6	Light Blue
Worcester	259.0 (232.3 - 288.6)	381	253.9 - 267.6	Light Blue
St. Marys	256.7 (230.5 - 285.6)	381	253.9 - 267.6	Light Blue
Frederick	253.8 (236.0 - 272.9)	828	241.9 - 253.8	Medium Blue
Kent	253.1 (213.9 - 299.2)	150	241.9 - 253.8	Medium Blue
Washington	252.4 (234.2 - 271.8)	741	241.9 - 253.8	Medium Blue
Talbot	249.8 (220.4 - 283.1)	269	241.9 - 253.8	Medium Blue
Queen Annes	241.8 (210.1 - 277.8)	225	182.2 - 241.8	Dark Blue

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My Co... Present... GIS-SE... L:\DCC... F:\CII

# Where is there a problem?

## Color & position classify rates & trends

Death Rate/Trend Comparison by Cancer, death years through 2001 US States versus US			
Lung & Bronchus All Races, Both Sexes			
	Above US Rate	Similar to US Rate	
Rising Trend	Priority 1: rising ↑ and above ↑ <a href="#">Mississippi</a>	Priority 2: rising ↑ and similar = <a href="#">Montana</a> <a href="#">Vermont</a> <a href="#">Wyoming</a>	
	Priority 4: stable → and above ↑ <a href="#">Indiana</a> <a href="#">Kentucky</a> <a href="#">Oklahoma</a> <a href="#">Tennessee</a> <a href="#">West Virginia</a>	Priority 6: stable → and similar = <a href="#">Alabama</a> <a href="#">Iowa</a> <a href="#">Kansas</a> <a href="#">Minnesota</a> <a href="#">Missouri</a> <a href="#">Nebraska</a> <a href="#">North Carolina</a> <a href="#">North Dakota</a> <a href="#">South Carolina</a> <a href="#">South Dakota</a> <a href="#">Wisconsin</a>	Priority 3: rising ↑ and below ↓ [none]
Stable Trend	Priority 5: falling ↓ and above ↑ <a href="#">Arkansas</a> <a href="#">Delaware</a> <a href="#">Louisiana</a> <a href="#">Nevada</a>	Priority 8: falling ↓ and similar = <a href="#">Alaska</a> <a href="#">California</a> <a href="#">Connecticut</a> District of Columbia <a href="#">Florida</a> <a href="#">Georgia</a> <a href="#">Illinois</a> <a href="#">Maine</a> <a href="#">Maryland</a> <a href="#">Massachusetts</a> <a href="#">Michigan</a> <a href="#">New Hampshire</a> <a href="#">New Jersey</a>	Priority 7: stable → and below ↓ <a href="#">Idaho</a> <a href="#">Utah</a>
			Priority 9: falling ↓ and below ↓ <a href="#">Arizona</a> <a href="#">Colorado</a> Hawaii <a href="#">New Mexico</a>
Falling Trend			

# Experimental Rate/Trend Table with Maps

	Above US Rate	Similar to US Rate	Below US Rate
Rising Trend	Priority 1: rising ↑ and above ↑  <a href="#">Mississippi</a>	Priority 2: rising ↑ and similar =  <a href="#">Montana</a> <a href="#">Vermont</a> <a href="#">Wyoming</a>	Priority 3: rising ↑ and below ↓  [none]
Stable Trend	Priority 4: stable → and above ↑  <a href="#">Indiana</a> <a href="#">Kentucky</a> <a href="#">Oklahoma</a> <a href="#">Tennessee</a> <a href="#">West Virginia</a>	Priority 6: stable → and similar =  <a href="#">Alabama</a> <a href="#">Iowa</a> <a href="#">Kansas</a> <a href="#">Minnesota</a> <a href="#">Missouri</a> <a href="#">Nebraska</a> <a href="#">North Carolina</a> <a href="#">North Dakota</a> <a href="#">South Carolina</a> <a href="#">South Dakota</a> <a href="#">Wisconsin</a>	Priority 7: stable → and below ↓  <a href="#">Idaho</a> <a href="#">Utah</a>
Falling Trend	Priority 5: falling ↓ and above ↑  <a href="#">Arkansas</a> <a href="#">Delaware</a>	Priority 8: falling ↓ and similar =  <a href="#">Alaska</a> <a href="#">California</a>	Priority 9: falling ↓ and below ↓  <a href="#">Arizona</a> <a href="#">Colorado</a>

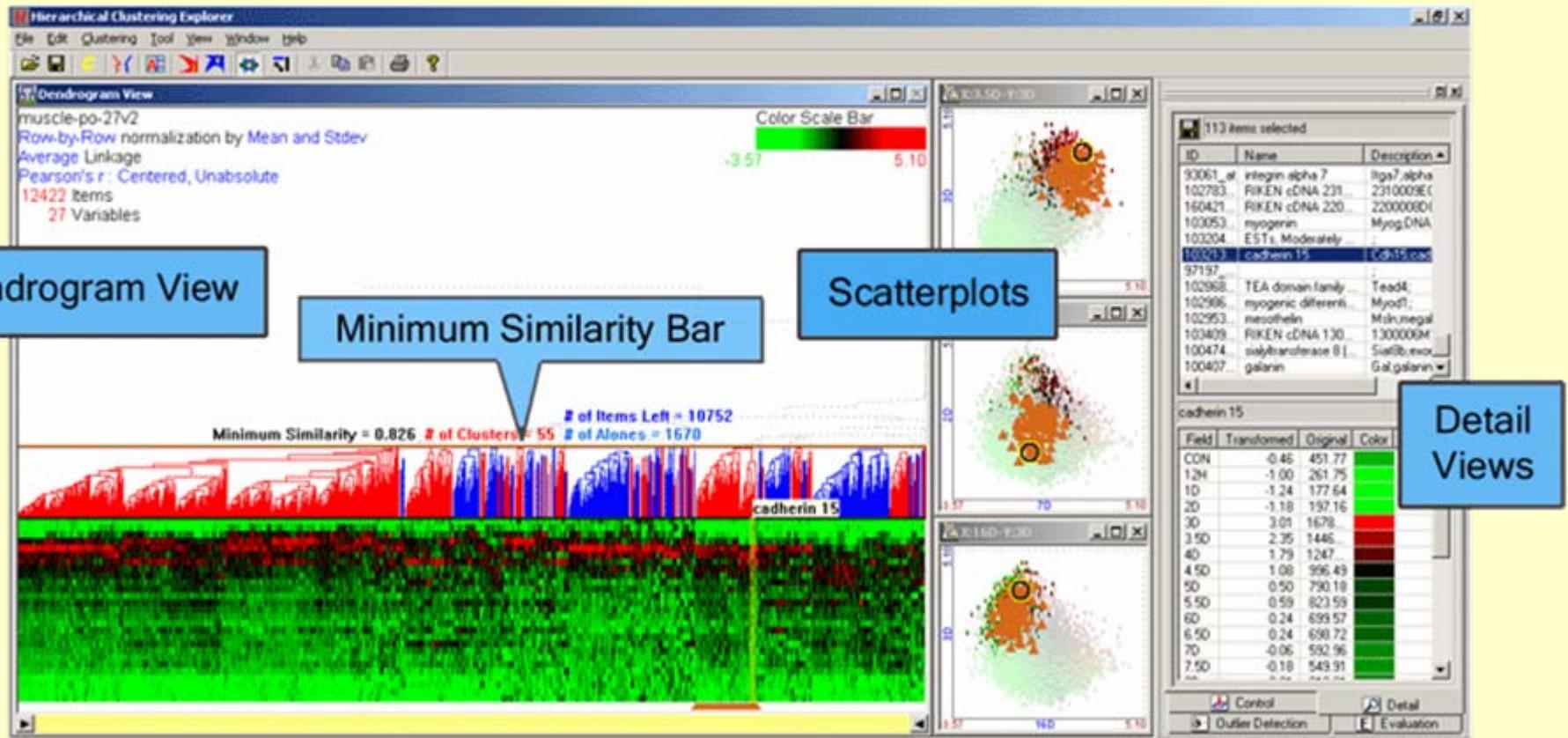
Cf. Conditioned Choropleth Maps: Carr, Wallin, & Carr, *Statistics in Medicine*, 2000

# Identification of Peer Counties in State Cancer Profiles system

- A common question: One county in my state has unusually high cancer rates compared to the rest of the state, but we know that county is different from the others, e.g., in terms of income, education, etc.  
How do the rates in this county compare with others in the US with a similar sociodemographic profile?
- How to identify “peer counties” for this comparison?

# Hierarchical Clustering Explorer

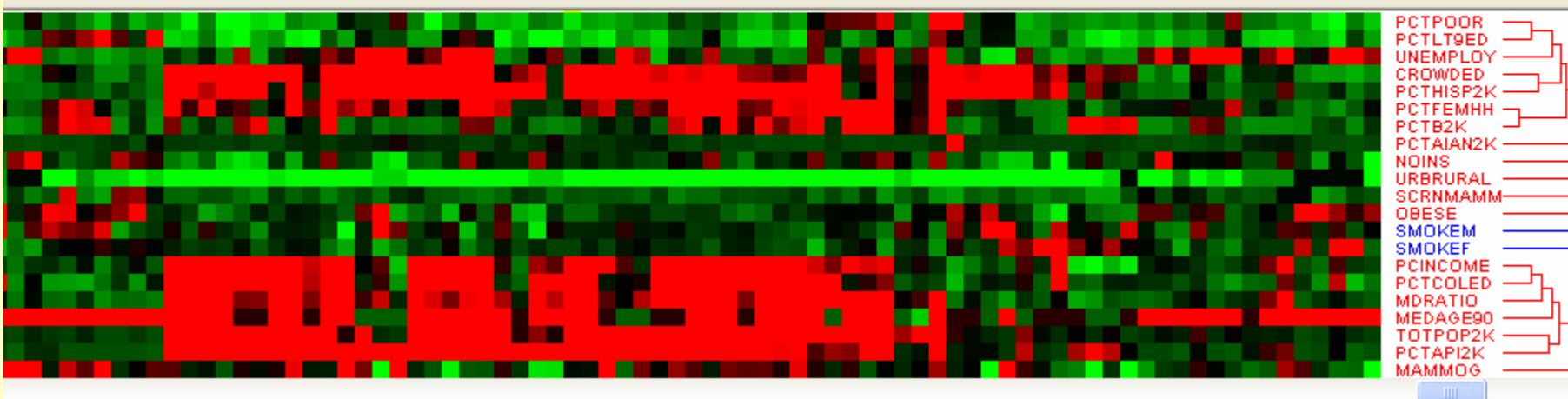
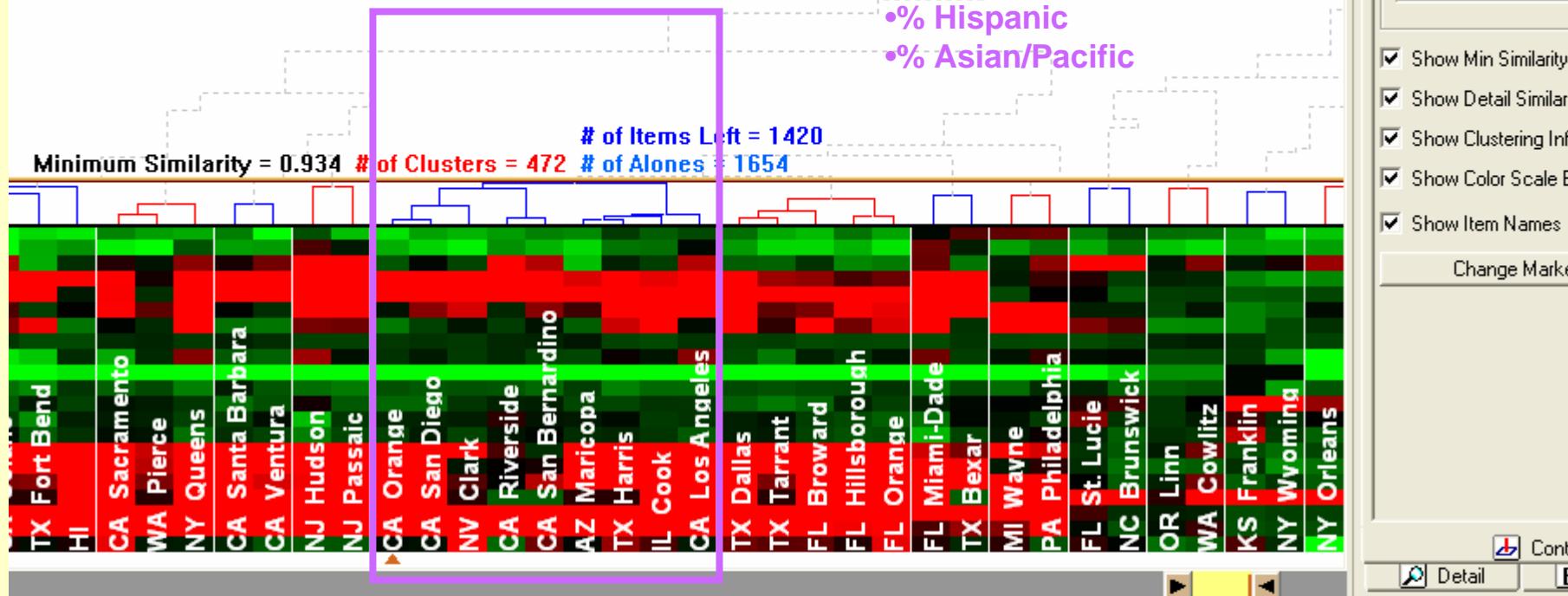
## for Interactive Exploration of Multidimensional Data



## Peers of Orange County, CA

Primary common factors:

- Crowding
- Urban/rural
- % Hispanic
- % Asian/Pacific



# Collaborators

- NCI was a partner in an NSF Digital Government Initiative grant to develop better visualization tools (web site: [diggov.org](http://diggov.org))
  - Dan Carr, George Mason University
  - Alan MacEachren, Penn State University
  - David Scott, Rice University
- NCI geographic information systems grant & contracts to develop ESTAT
  - Alan MacEachren, Penn State University
- NCI sabbatical
  - Dan Carr, George Mason University
- Web sites for more info:
  - [gis.cancer.gov](http://gis.cancer.gov) (for a poster on NCI research in GIS)
  - [srab.cancer.gov](http://srab.cancer.gov) (for headbang, SaTScan, etc)
  - [statecancerprofiles.cancer.gov](http://statecancerprofiles.cancer.gov)
- Email: [PICKLEL@MAIL.NIH.GOV](mailto:PICKLEL@MAIL.NIH.GOV)