Dynamic and Interactive Statistical Graphics for Spatially Referenced Data

Jürgen Symanzik

George Mason University, Fairfax, VA

***e-mail: symanzik@galaxy.gmu.edu**

WWW: http://www.galaxy.gmu.edu/~symanzik

Contents

- The ArcView/XGobi/XploRe Environment
- EPA's Cumulative Exposure Web Page

ArcView/XGobi/XploRe: Collaborators

- Di Cook, Nicholas Lewin-Koh, Jim Majure: Iowa State University, Ames, IA
- Sigbert Klinke, Swetlana Schmelzer, Thomas Koetter: Humboldt University, Berlin, Germany
- http://www.public.iastate.edu/~arcview-xgobi/homepage.html

ArcView/XGobi/XploRe: Main Idea

- Link three kinds of software packages:
  - ArcView: Geographic Information System (GIS)
  - XGobi: dynamic statistical graphics program
  - XploRe: statistical computing environment

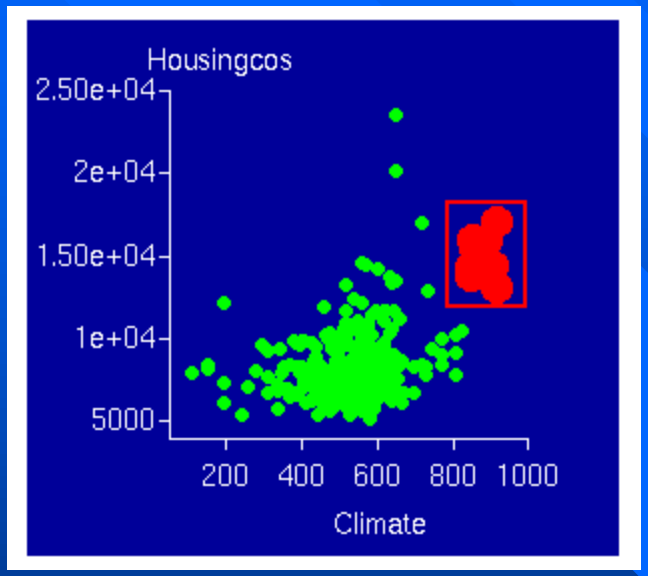
Implementation

- Remote Procedure Calls (RPCs):
  - Process on the local system (client) invokes a procedure on a remote system (server)
  - Request = client's desire to execute a particular remote procedure
  - Response = result produced by the remote procedure
- ArcView, XGobi, XploRe: server & client

Features of ArcView/XGobi-Link

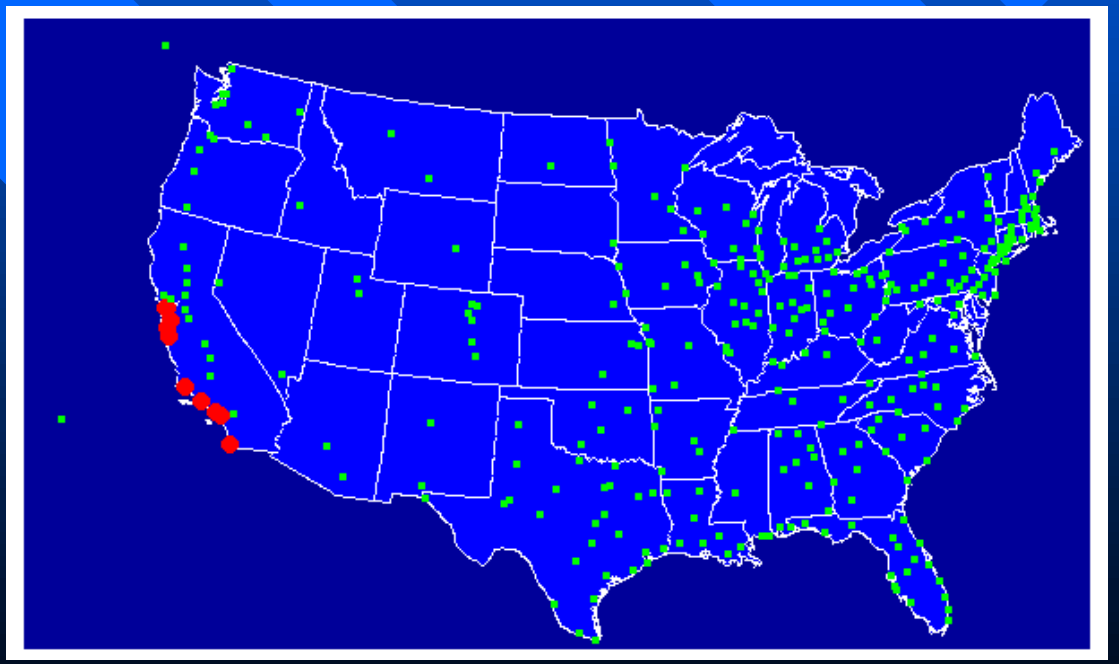
- Multivariate Link
- CDF Link
- Variogram-cloud Link
- Spatially Lagged Scatterplot Link
- Multivariate Variogram-Cloud Link

Multivariate Link

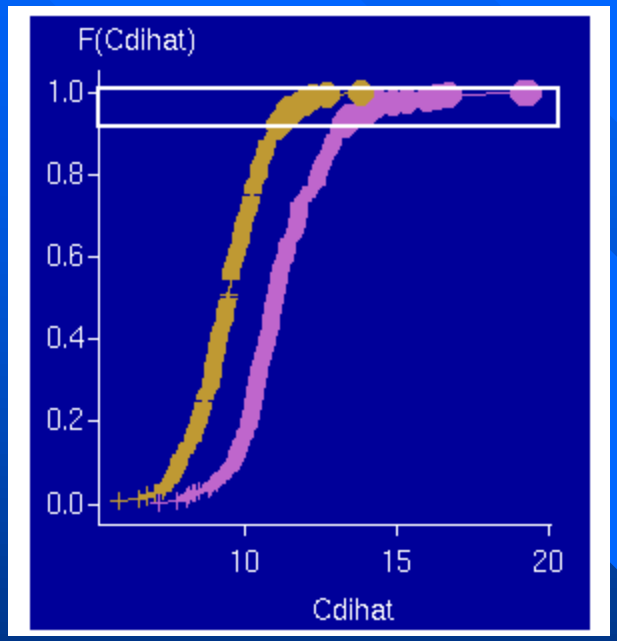


XGobi

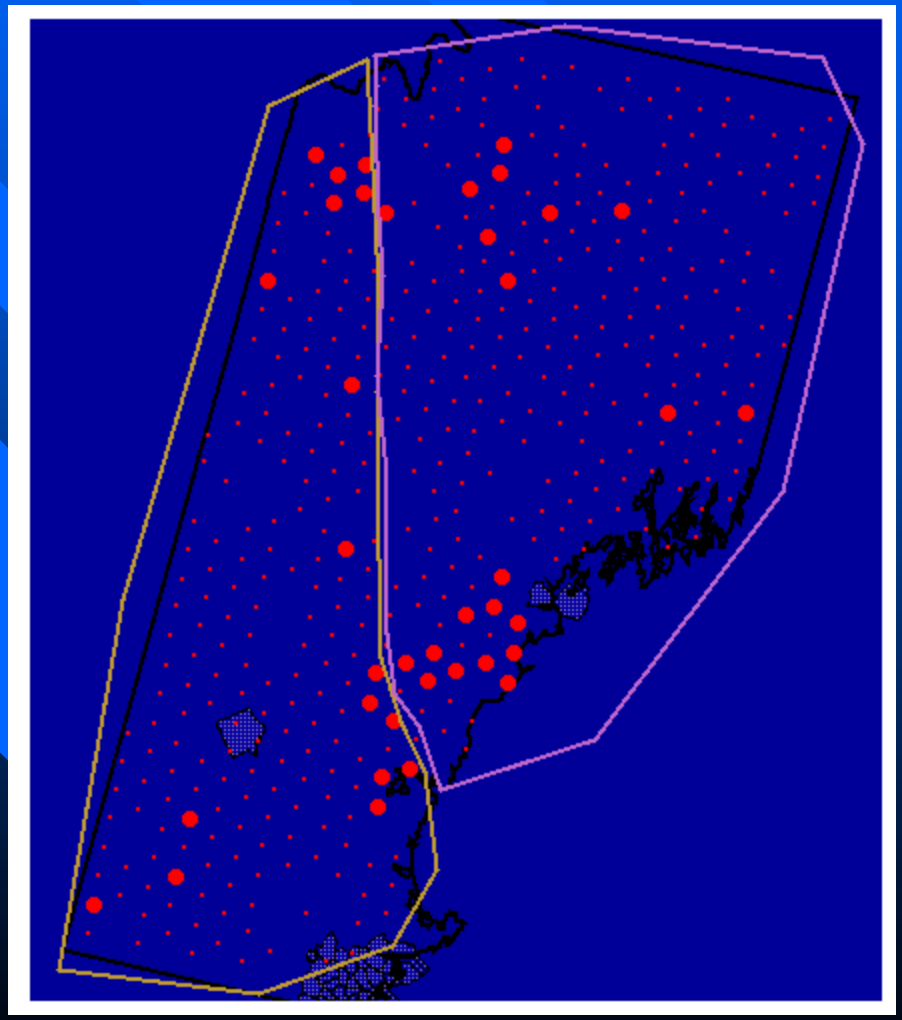
ArcView



CDF Link



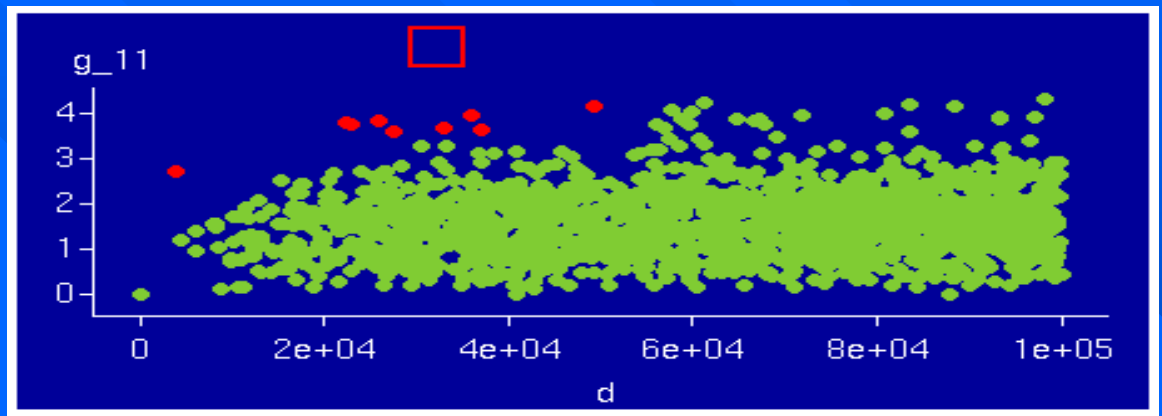
XGobi

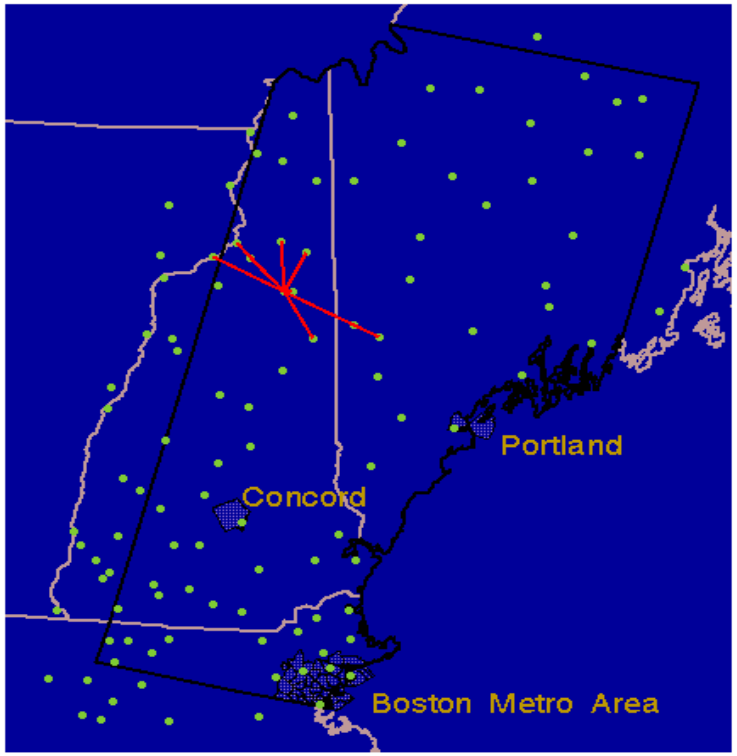


ArcView

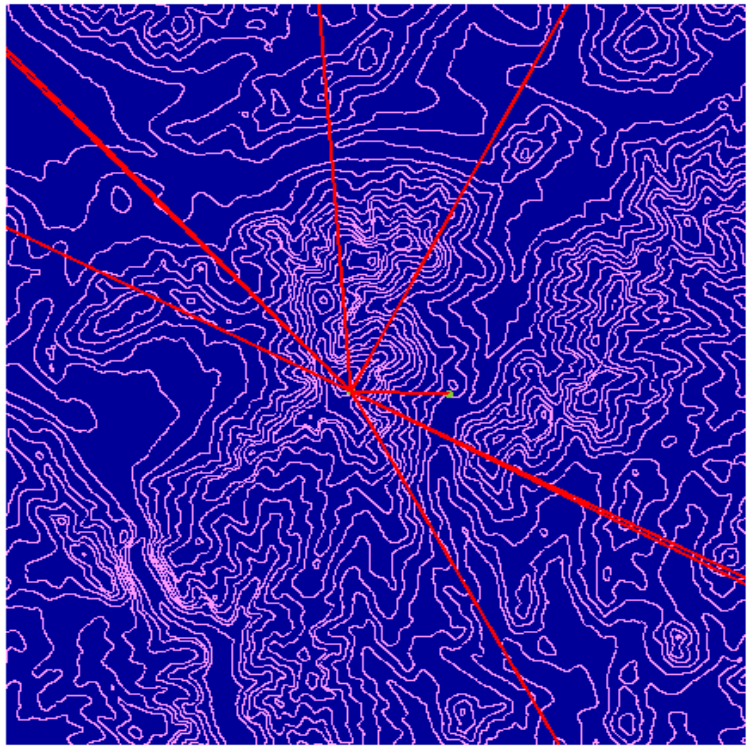
Variogram-Cloud Link

XGobi



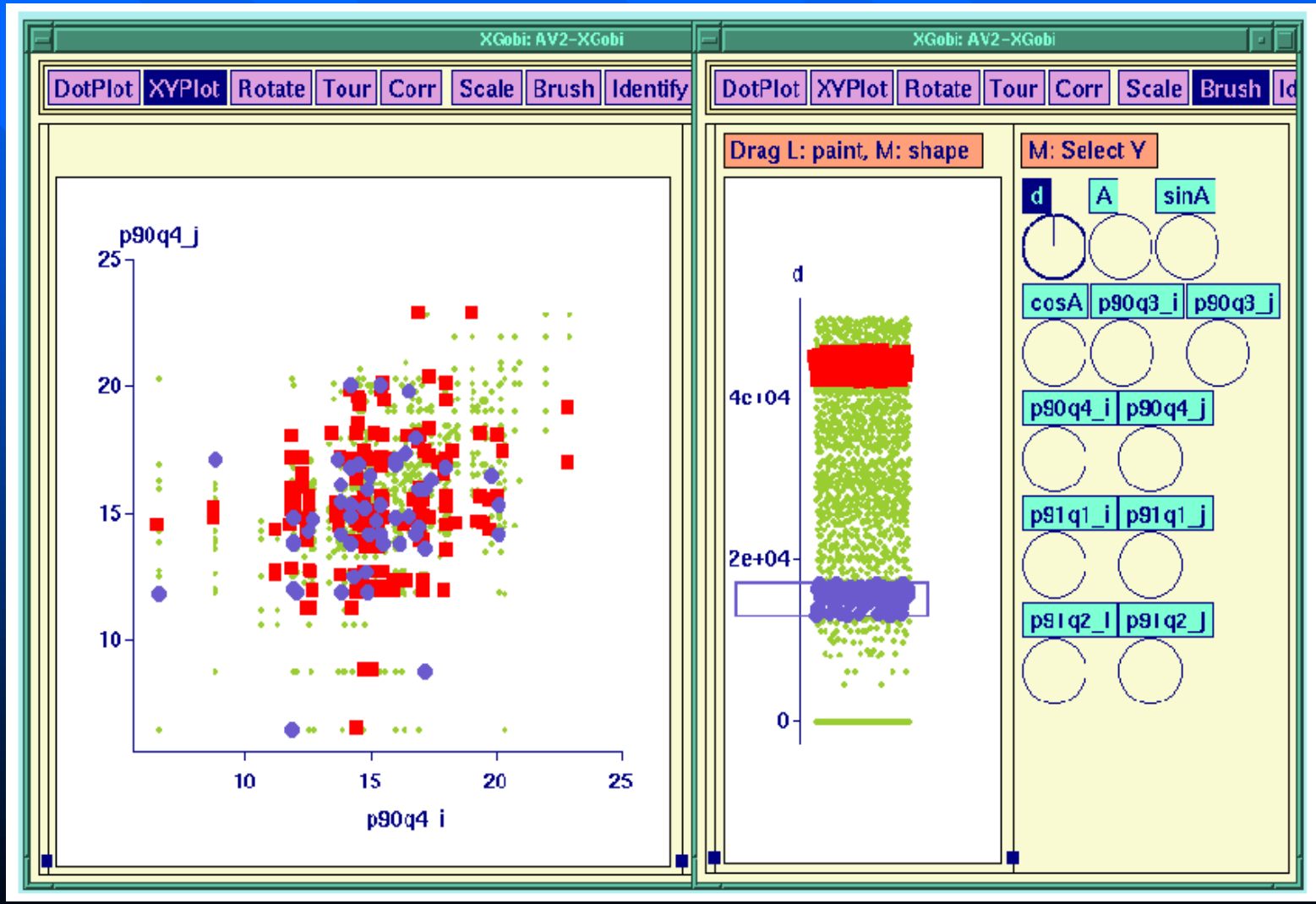


ArcView

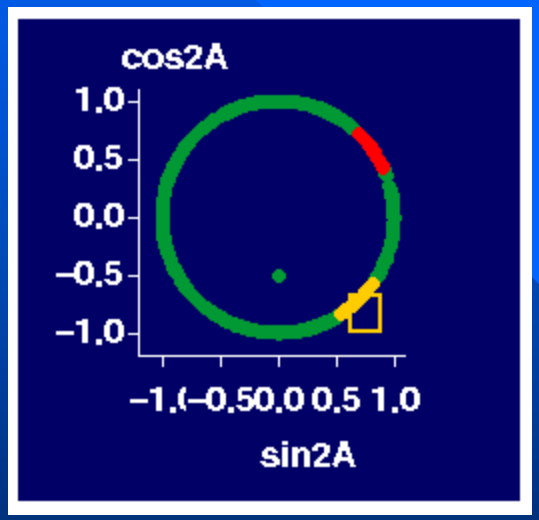


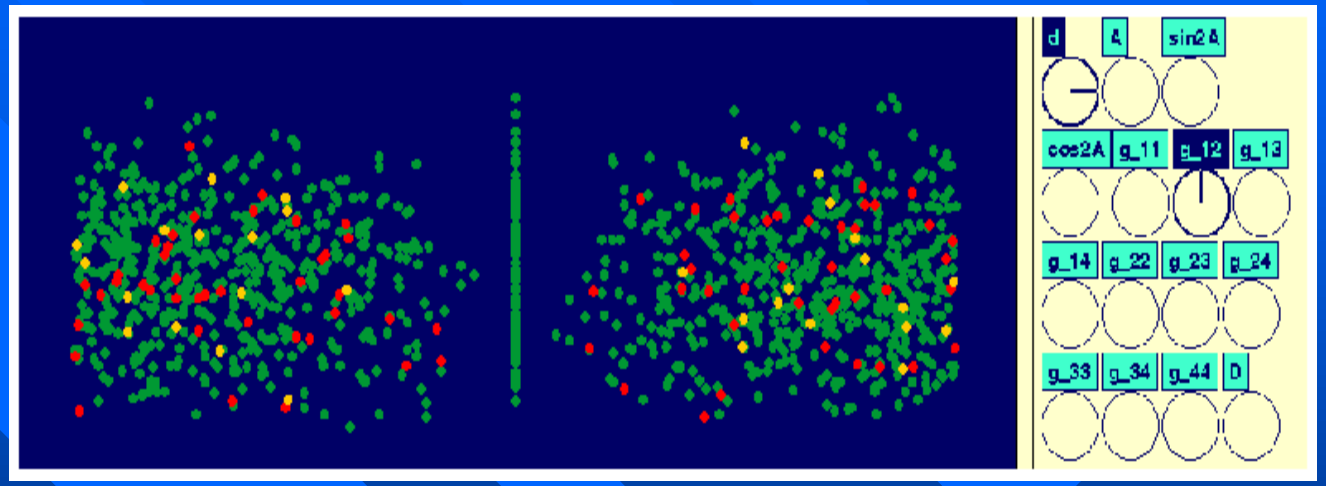
Spatially Lagged Scatterplot Link

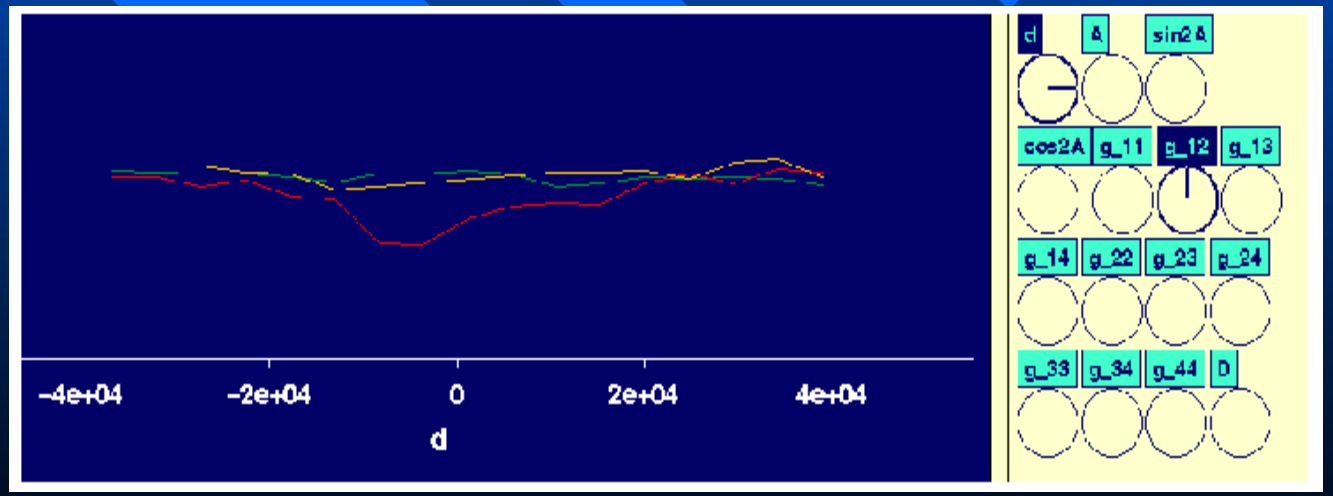
XGobi



Multivariate Variogram-Cloud Link



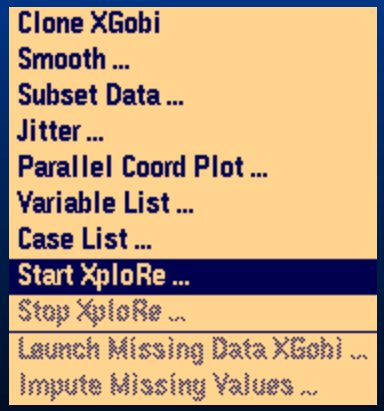


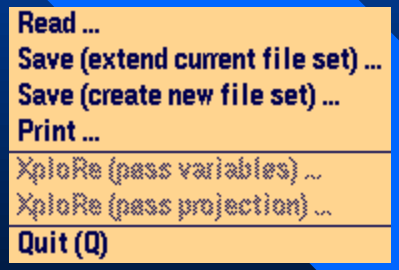


XGobi

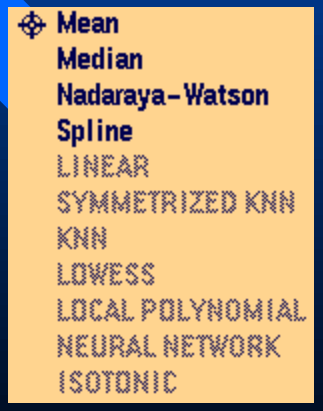
Addition of XploRe

- Exchange of Data and Commands
- External Smoother
- Dynamic Linked Brushing
- Capabilities for Spatial Data Analysis

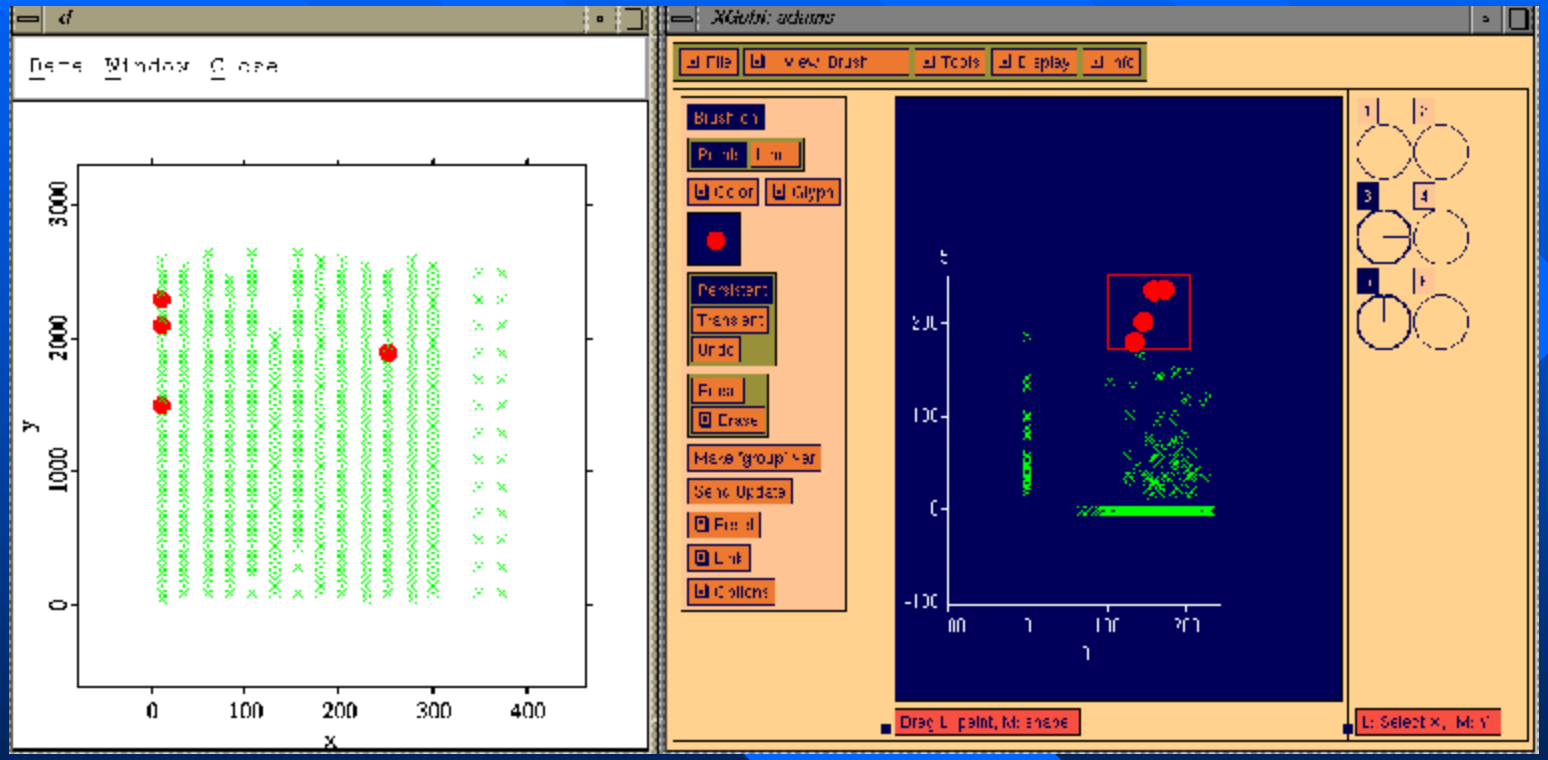




XGobi Menus



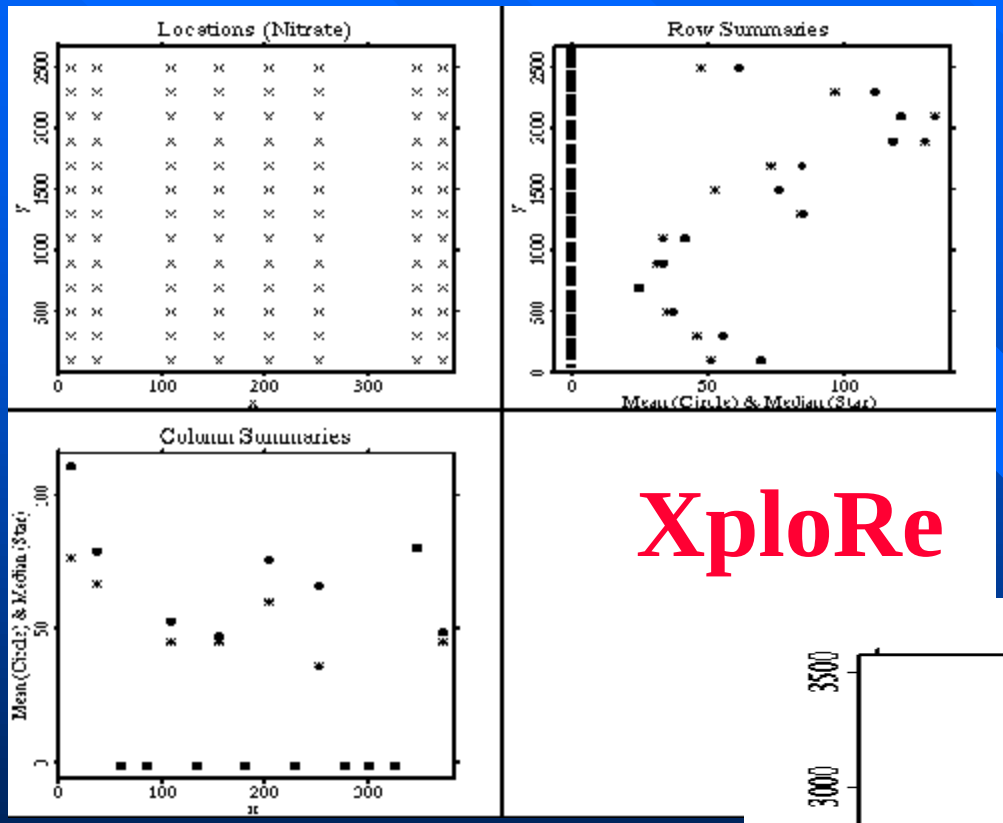
Dynamic Linked Brushing



XploRe

XGobi

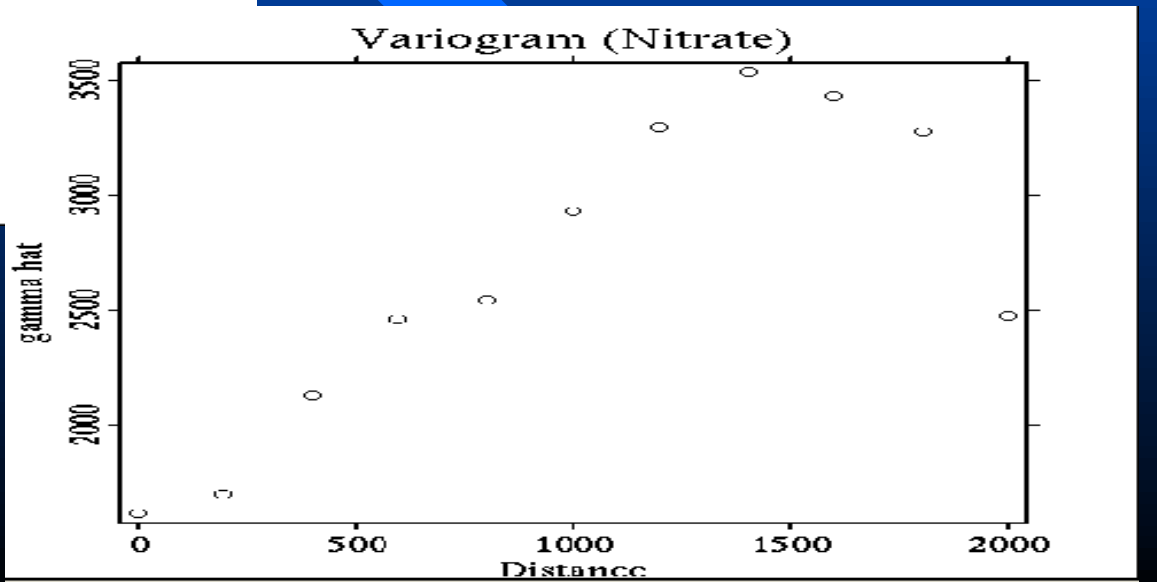
Spatial Data Analysis in XploRe



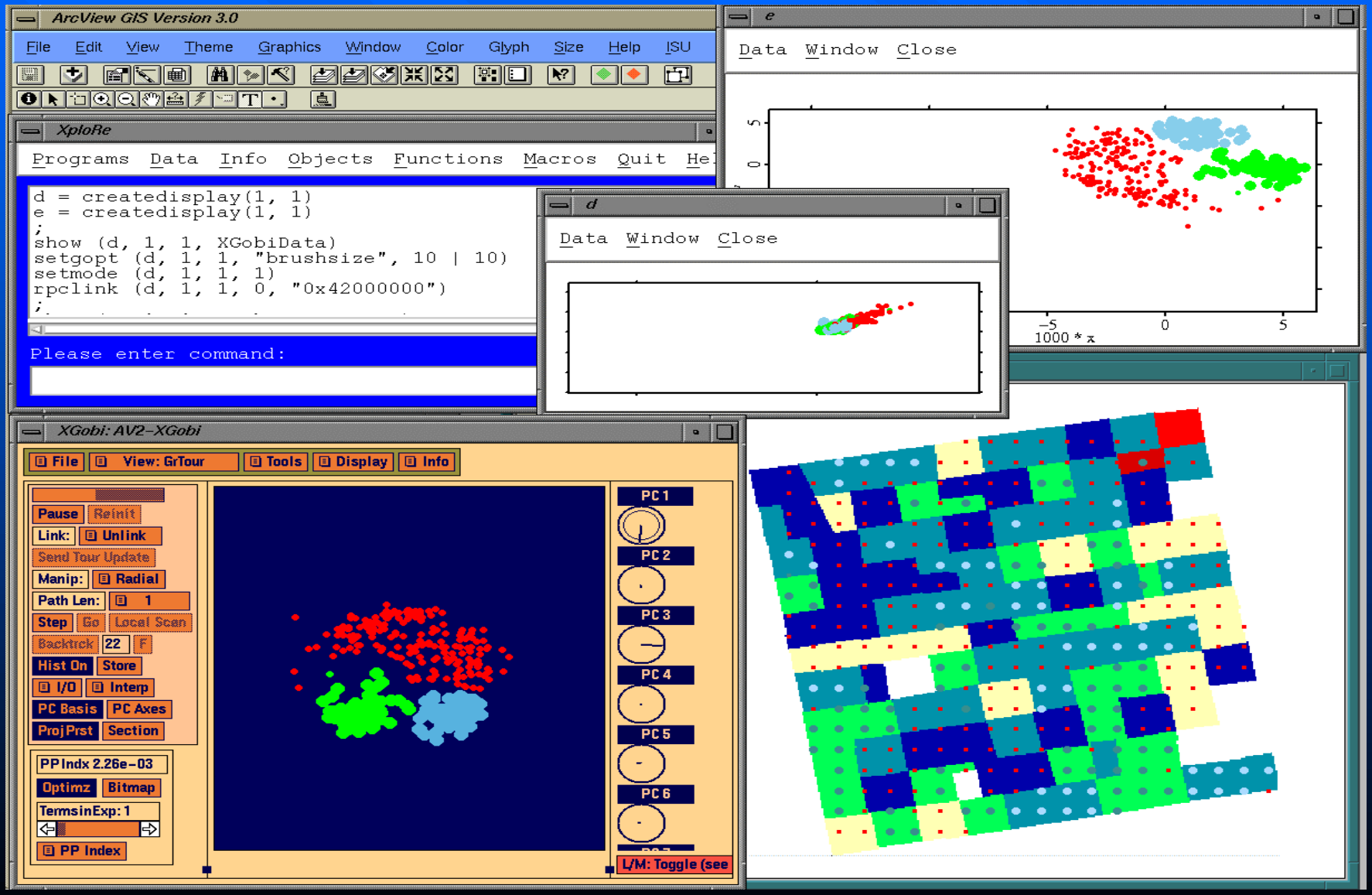
Mean and Mean Summaries

XploRe

Variogram



Full Scenario



Current Research

- Continuation ArcView <-> XploRe Link
- Spatial Statistics in XploRe
- Inclusion of the Virtual Reality GIS ViRGiS
- Point <-> Area Brushing

Cumulative Exposure Web Page: Collaborators

- David Wong, Dan Carr, Jingfang Wang: George Mason University, Fairfax, VA
- Dan Axelrad, Tracey Woodruff: EPA, Office of Policy, Washington, D.C.

- http://www.epa.gov/CumulativeExposure
- http://www.galaxy.gmu.edu/~symanzik/gpl/CEPstart

Cumulative Exposure Project: Idea

- Conducted by EPA's Office of Policy
- Collection of analyses, addressing multiple pollutants from multiple sites
- National analyses of
  - Air Toxics (Outdoor Concentrations)
  - Food Contaminants (Exposures)
  - Drinking Water Contaminants (Exposures)
- Pilot Community-level study: Greenpoint/Williamsburg, NYC

Air Toxics

- 188 Hazardous Air Pollutants (HAPs) in Clean Air Act
- Limited availability of air toxics monitoring data
- Atmospheric dispersion modeling provides understanding of concentrations of toxics in outdoor air

Scope of Modeling

- Modeled concentrations for each census tract in continental US (> 60,000)
- 148 HAPs modeled
- Includes stationary and mobile sources of air toxics emissions
- Uncertainty bounds derived from model-monitor comparisons

WWW-based Access of HAP Data

- Goals:
  - Concise display
  - Easy access
  - Understandable to nonstatistical audience
- Solution:
  - WWW
  - GPL
  - Micromaps

Graphics Production Library (GPL)

- Tool for creation and modification of statistical graphics on the WWW
- Follows guidelines of modern statistical graphics
- JAVA-based
- Works with Netscape and Internet Explorer

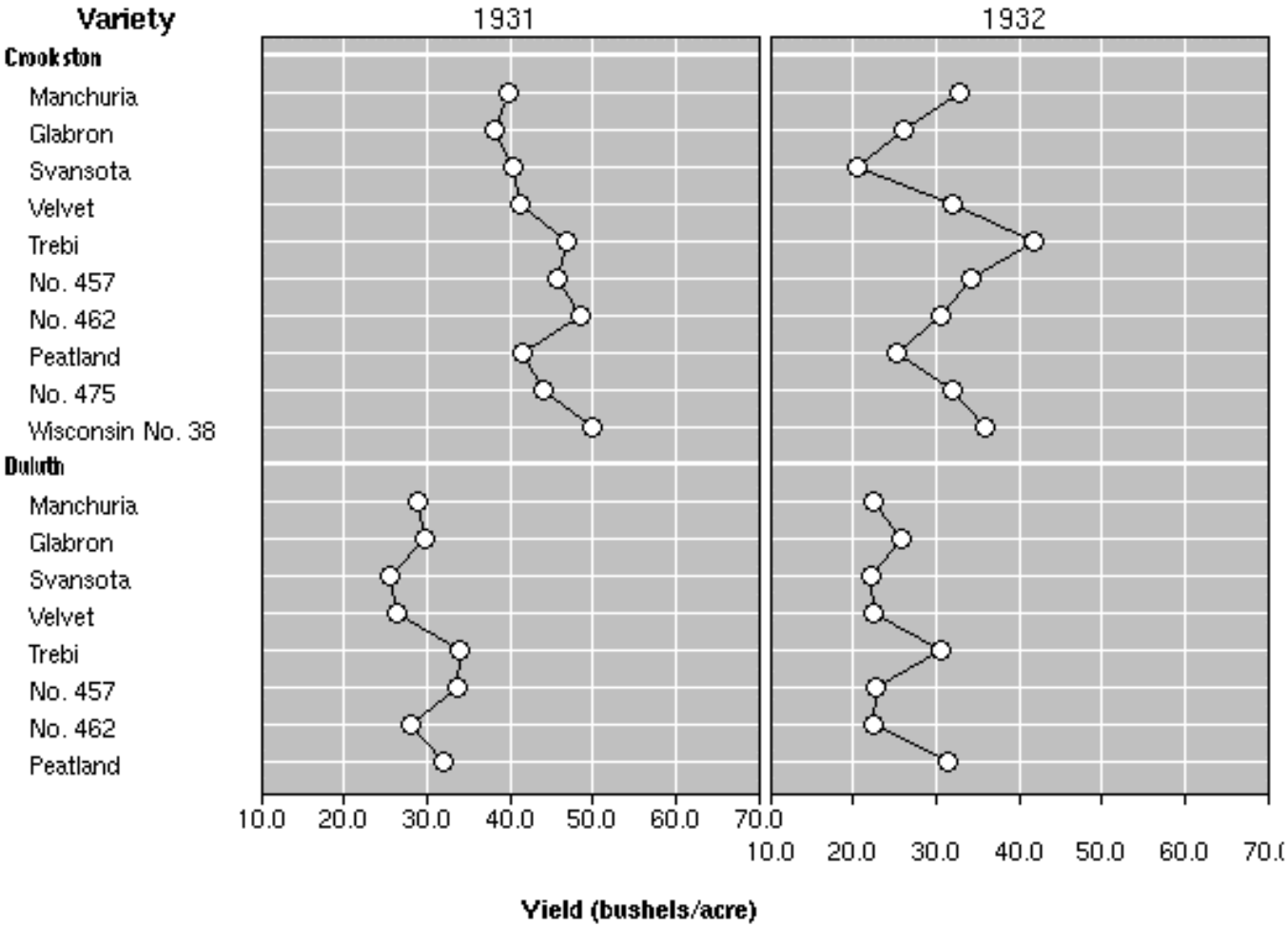
History of the GPL

- Main developer: Dan Rope
- Main reference: Carr, Valliant, Rope (1996): Plot Interpretation and Information Webs…, SCSG*, Vol. 7, No. 2
- New commercial product based on GPL currently developed by Dan Rope
- Upgrade and new features added to GPL through BLS and contractors

*Statistical Computing & Statistical Graphics Newsletter: http://cm.bell-labs.com/cm/ms/who/cocteau/newsletter/index.html

The Barley Data

From Visualizing Data by W.S. Cleveland



Show Data

Pan And Zoom

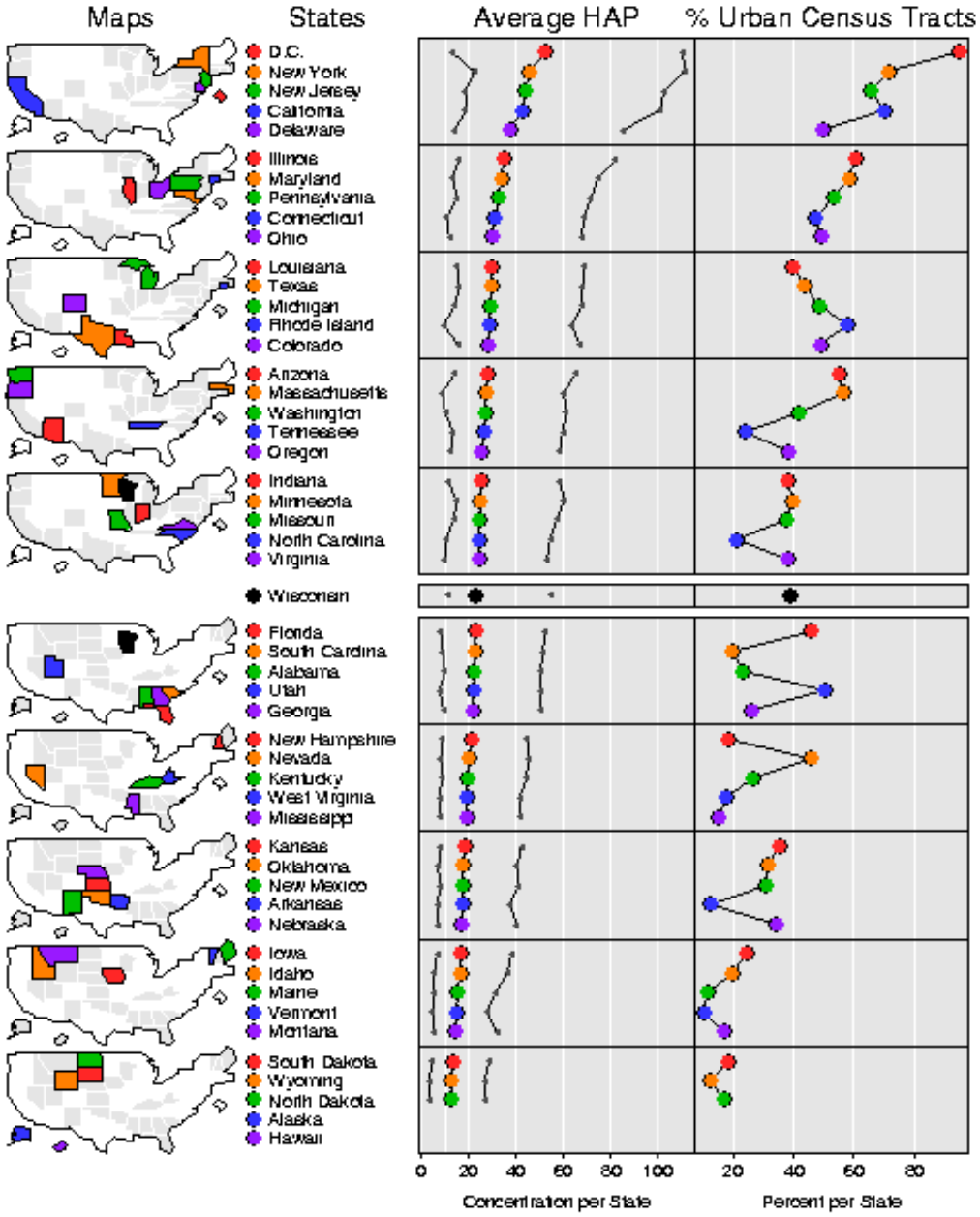
Micromaps

- Link of row-labeled univariate (or multivariate) statistical summaries to corresponding geographical region
- Focus on statistical display and not on maps
- S-Plus functions (available at ftp://galaxy.gmu.edu/pub/dcarr/newsletter/micromap/)

History of Micromaps

- First presented at 1995 American Statistical Association's annual meeting (Olsen, Carr, Courbois, Pierson)
- Main references:
  - Carr, Pierson (1996) Emphasizing Statistical Summaries … with Micromaps, SCSG, Vol. 7, No.3
  - Carr, Olsen, Courbois, Pierson, Carr (1998) Linked Micromap Plots …, SCSG, Vol. 9, No.1

Hazardous Air Pollutants (HAPs)
1990 Annual Average Per State

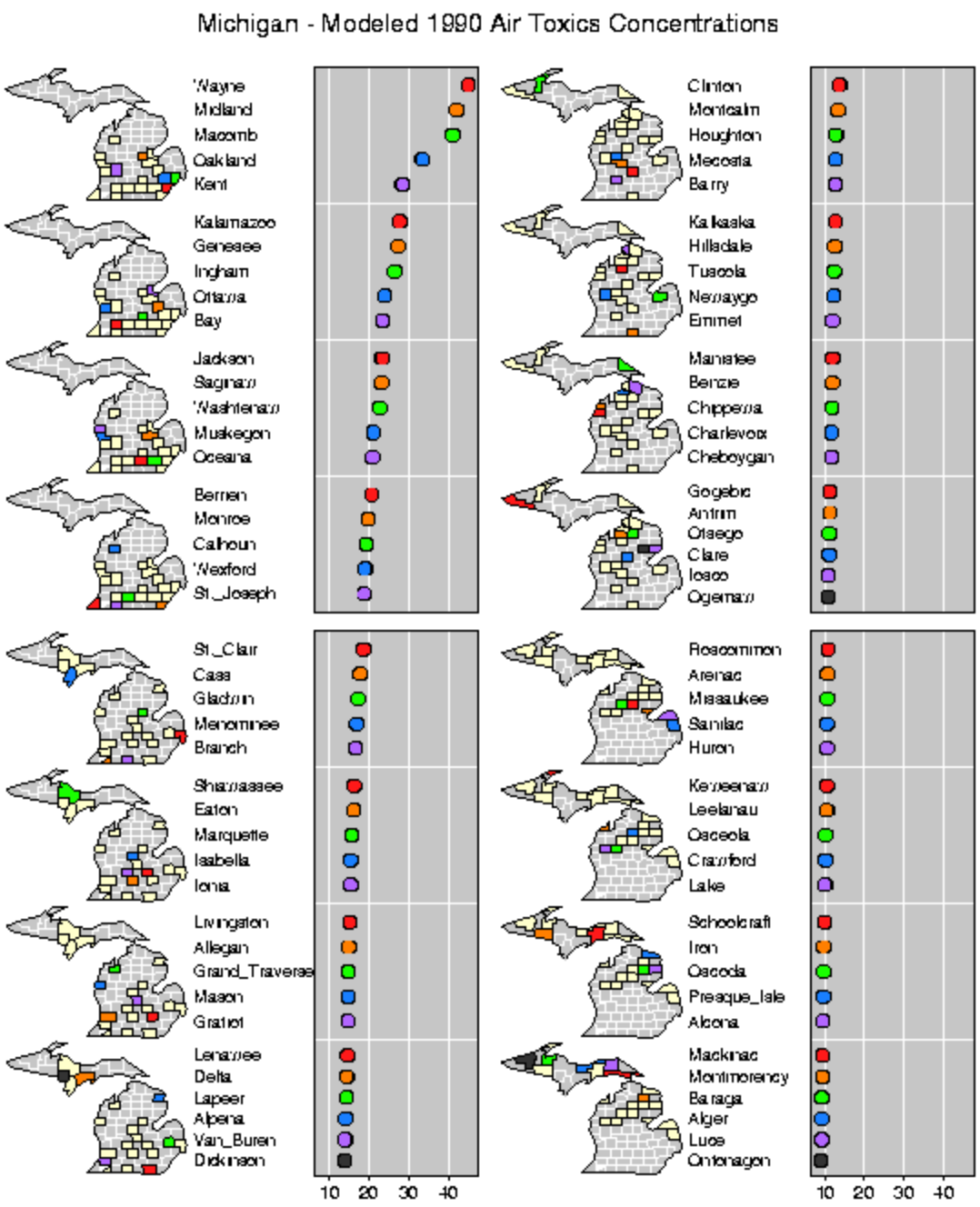


Bringing All Together

- **Hierarchical Clickable Micromaps in the GPL Environment for the Display of Hazardous Air Pollutants Data**
- GPL extended with micromaps
- Selection of HAPs
- Clickable maps
- Hierarchy of maps

Realization

- Automatic one-time creation of micromaps
- C code used to create follow-up data sets and Web pages
- Political vs. scientific design and layout
- Availability: hopefully February 1999


Michigan - Modeled 1990 Air Toxics Concentrations
Wayne
Midland
Macomb
Oakland
Kent
Kalamazoo
Genesee
Ingham
Ottawa
Bay
Jackson
Saginaw
Washtenaw
Muskegon
Oceana
Berrien
Monroe
Calhoun
Wexford
St_Joseph
St_Clair
Cass
Gladwin
Menominee
Branch
Shiawassee
Eaton
Marquette
Isabella
Ionia
Livingston
Allegan
Grand_Traverse
Mason
Gratiot
Lenawee
Delta
Lapeer
Alpena
Van_Buren
Dickinson
Clinton
Montcalm
Houghton
Mecosta
Barry
Kalkaska
Hillsdale
Tuscola
Newaygo
Emmet
Manistee
Benzie
Chippewa
Charlevoix
Cheboygan
Gogebic
Antrim
Otsego
Clare
Iosco
Ogemaw
Roscommon
Arenac
Missaukee
Sanilac
Huron
Kewaunee
Leelanau
Osceola
Crawford
Lake
Schoolcraft
Iron
Oscoda
Presque_Isle
Alcona
Mackinac
Montmorency
Baraga
Alger
Luce
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HOME
AIR
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DRINKING WATER
ABOUT THE PROJECT
WHAT'S NEW
RESOURCES
COMMUNITY-SPECIFIC STUDY
GREENPOINT/WILLIAMSBURG

EPA United States Environmental Protection Agency

CUMULATIVE EXPOSURE

P R O J E C T

EPA's Cumulative Exposure Project (CEP) is examining how much toxic contamination Americans are exposed to cumulatively through air, food,and drinking water. The study will estimate exposure levels for different communities and demographic groups nationwide, and identify which types of communities and demographic groups appear to have the highest exposures. The Cumulative Exposure Project is being conducted by EPA's Office of Policy.

About the Project

W H A T ' S N E W ?

Modeled 1990 air toxics concentrations are now available.

[Cumulative Exposure Project Home | EPA Home | Search | What's new]

http://www.epa.gov/CumulativeExposure/index.htm

last updated 12/3/98

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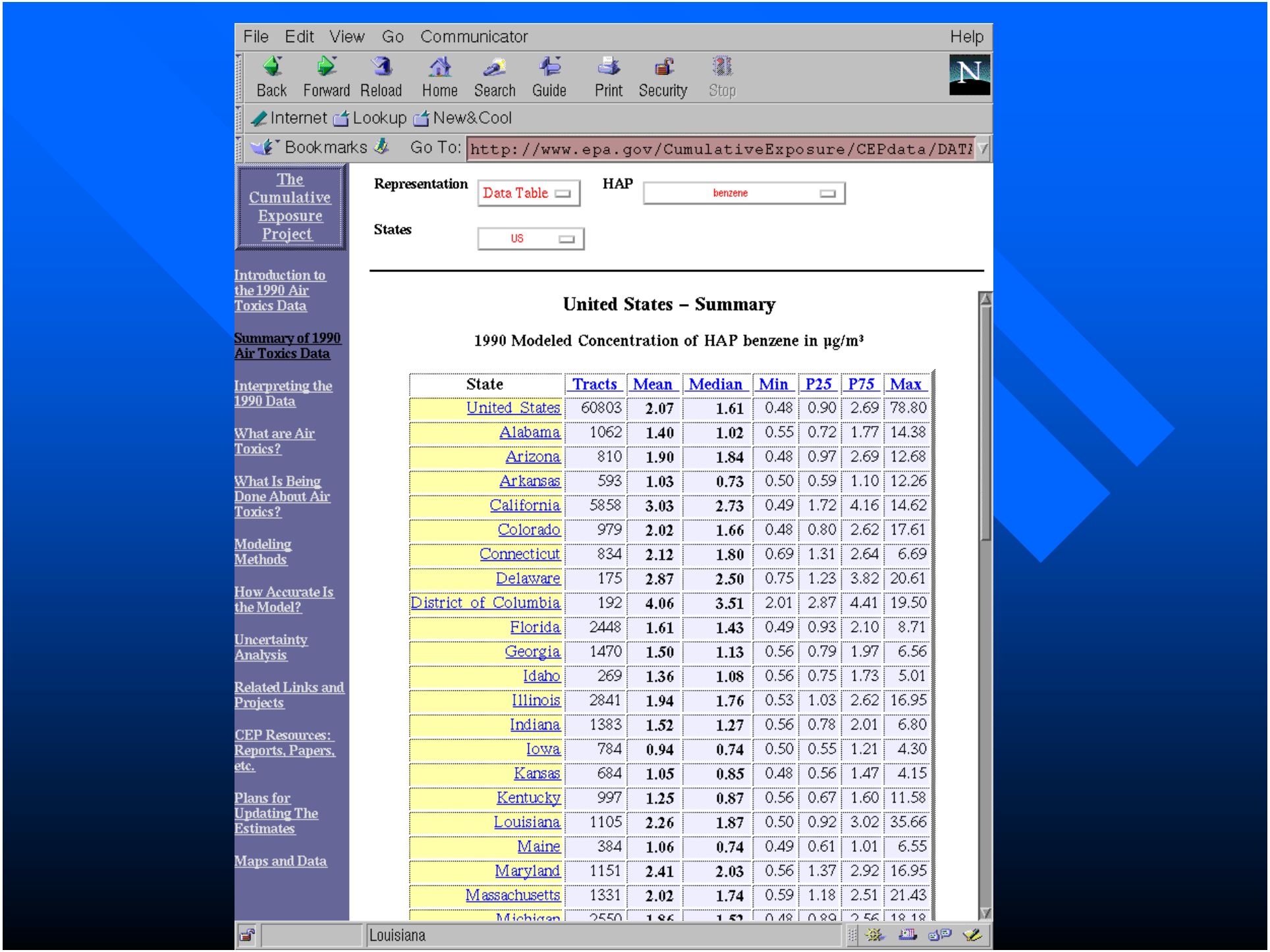
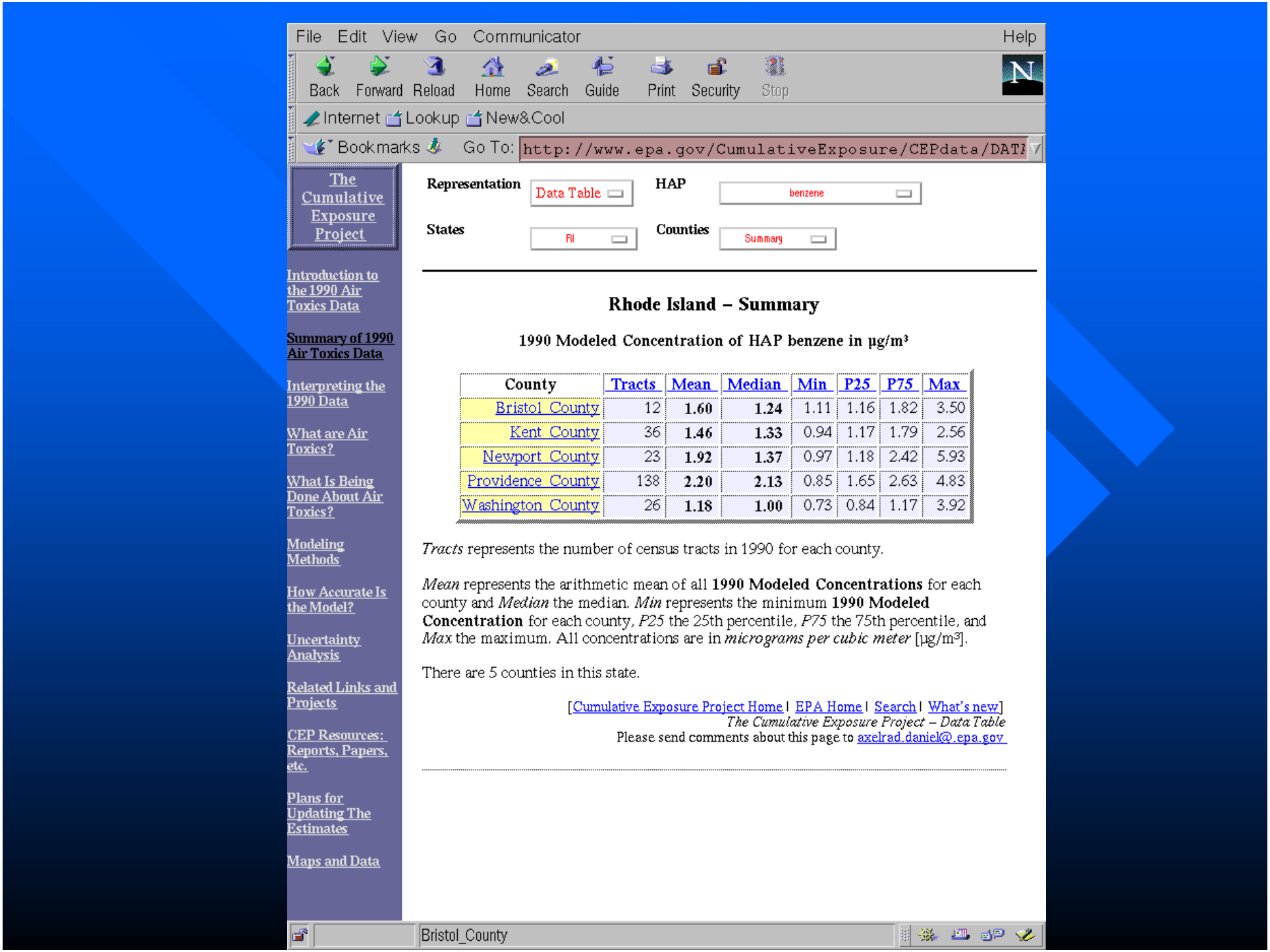


State	Tracts	Mean	Median	Min	P25	P75	Max
United States	60803	**2.07**	**1.61**	0.48	0.90	2.69	78.80
Alabama	1062	**1.40**	**1.02**	0.55	0.72	1.77	14.38
Arizona	810	**1.90**	**1.84**	0.48	0.97	2.69	12.68
Arkansas	593	**1.03**	**0.73**	0.50	0.59	1.10	12.26
California	5858	**3.03**	**2.73**	0.49	1.72	4.16	14.62
Colorado	979	**2.02**	**1.66**	0.48	0.80	2.62	17.61
Connecticut	834	**2.12**	**1.80**	0.69	1.31	2.64	6.69
Delaware	175	**2.87**	**2.50**	0.75	1.23	3.82	20.61
District of Columbia	192	**4.06**	**3.51**	2.01	2.87	4.41	19.50
Florida	2448	**1.61**	**1.43**	0.49	0.93	2.10	8.71
Georgia	1470	**1.50**	**1.13**	0.56	0.79	1.97	6.56
Idaho	269	**1.36**	**1.08**	0.56	0.75	1.73	5.01
Illinois	2841	**1.94**	**1.76**	0.53	1.03	2.62	16.95
Indiana	1383	**1.52**	**1.27**	0.56	0.78	2.01	6.80
Iowa	784	**0.94**	**0.74**	0.50	0.55	1.21	4.30
Kansas	684	**1.05**	**0.85**	0.48	0.56	1.47	4.15
Kentucky	997	**1.25**	**0.87**	0.56	0.67	1.60	11.58
Louisiana	1105	**2.26**	**1.87**	0.50	0.92	3.02	35.66
Maine	384	**1.06**	**0.74**	0.49	0.61	1.01	6.55
Maryland	1151	**2.41**	**2.03**	0.56	1.37	2.92	16.95
Massachusetts	1331	**2.02**	**1.74**	0.59	1.18	2.51	21.43
Michigan	2550	**1.86**	**1.52**	0.48	0.89	2.56	18.18


File Edit View Go Communicator Help
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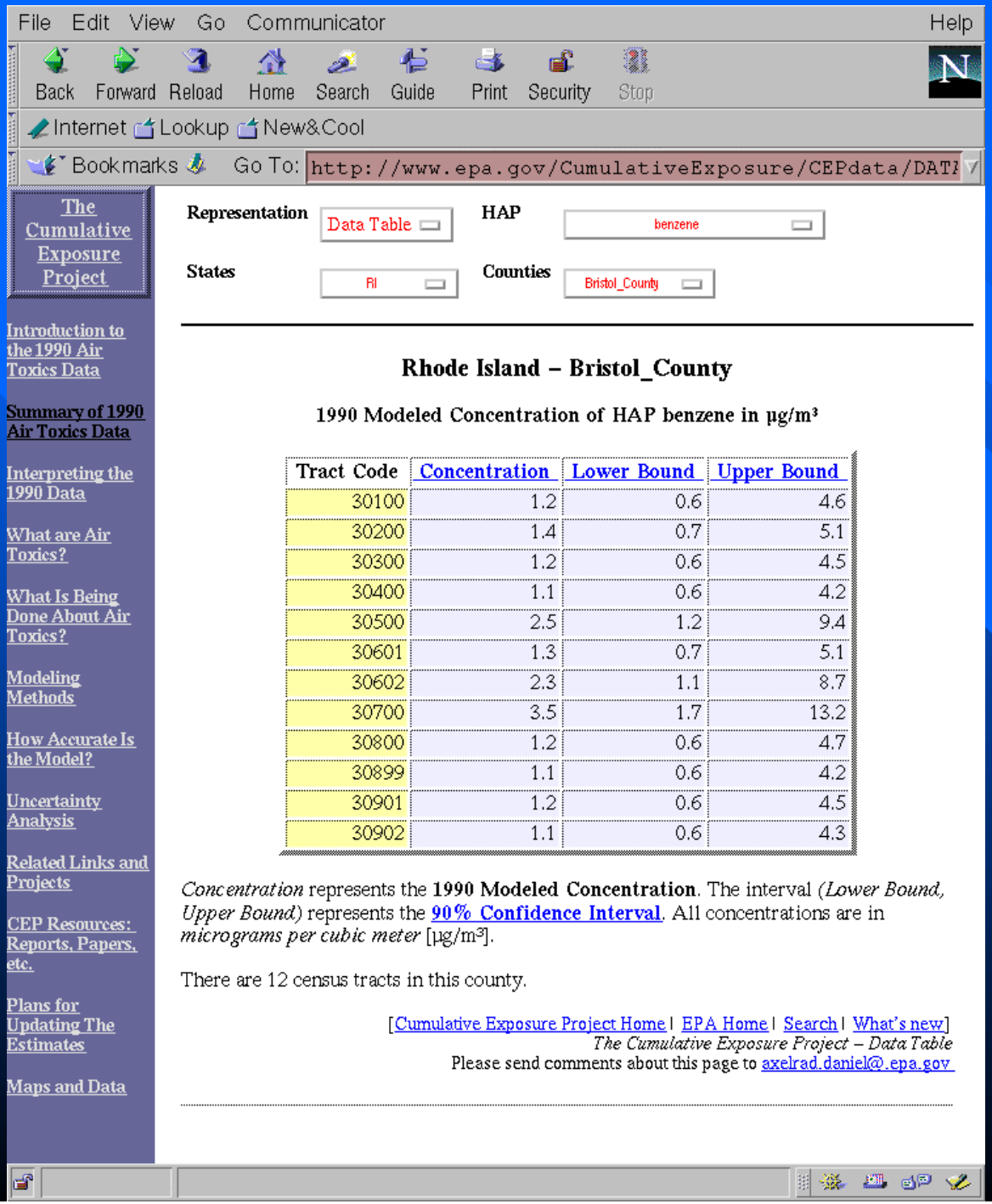
Internet Lookup New&Cool
Bookmarks Go To: http://www.epa.gov/CumulativeExposure/CEPdata/DATA
The Cumulative Exposure Project
Introduction to the 1990 Air Toxics Data
Summary of 1990 Air Toxics Data
Interpreting the 1990 Data
What are Air Toxics?
What Is Being Done About Air Toxics?
Modeling Methods
How Accurate Is the Model?
Uncertainty Analysis
Related Links and Projects
CEP Resources: Reports, Papers, etc.
Plans for Updating The Estimates
Maps and Data
Representation Data Table
HAP benzene
States RI
Counties Summary
Rhode Island – Summary
1990 Modeled Concentration of HAP benzene in µg/m³
County | Tracts | Mean | Median | Min | P25 | P75 | Max
Bristol_County | 12 | 1.60 | 1.24 | 1.11 | 1.16 | 1.82 | 3.50
Kent_County | 36 | 1.46 | 1.33 | 0.94 | 1.17 | 1.79 | 2.56
Newport_County | 23 | 1.92 | 1.37 | 0.97 | 1.18 | 2.42 | 5.93
Providence_County | 138 | 2.20 | 2.13 | 0.85 | 1.65 | 2.63 | 4.83
Washington_County | 26 | 1.18 | 1.00 | 0.73 | 0.84 | 1.17 | 3.92
Tracts represents the number of census tracts in 1990 for each county.
Mean represents the arithmetic mean of all 1990 Modeled Concentrations for each county and Median the median. Min represents the minimum 1990 Modeled Concentration for each county, P25 the 25th percentile, P75 the 75th percentile, and Max the maximum. All concentrations are in micrograms per cubic meter [µg/m³].
There are 5 counties in this state.
[Cumulative Exposure Project Home | EPA Home | Search | What's new]
The Cumulative Exposure Project – Data Table
Please send comments about this page to axelrad.daniel@.epa.gov
Bristol_County



Rhode Island – Bristol_County

1990 Modeled Concentration of HAP benzene in µg/m³

Tract Code	Concentration	Lower Bound	Upper Bound
30100	1.2	0.6	4.6
30200	1.4	0.7	5.1
30300	1.2	0.6	4.5
30400	1.1	0.6	4.2
30500	2.5	1.2	9.4
30601	1.3	0.7	5.1
30602	2.3	1.1	8.7
30700	3.5	1.7	13.2
30800	1.2	0.6	4.7
30899	1.1	0.6	4.2
30901	1.2	0.6	4.5
30902	1.1	0.6	4.3

Concentration represents the **1990 Modeled Concentration**. The interval *(Lower Bound, Upper Bound)* represents the 90% Confidence Interval. All concentrations are in *micrograms per cubic meter* [µg/m³].

There are 12 census tracts in this county.

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The Cumulative Exposure Project – Data Table
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