

# **Analyse räumlicher Daten im ArcView/XGobi/XploRe Software Environment**

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## 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
- Available for UNIX platforms
- Interactive (dynamic) environment
- Close coupling through RPC's

# ArcView

ESRI™

- Desktop GIS with wide Range of Viewing and Data Manipulation Functions
  - Editing Features
  - Query Operations
  - Map Display
  - Interactive Interface
  - High Level Internal Scripting Language
- Support of Main GIS Themes:
  - Point Themes
  - Polygon Themes
  - Linear Themes

# XGobi

Swayne, Cook and Buja

- Interactive Environment for Exploring Multivariate Data
  - Linked Views allow “Linked Brushing”
  - Univariate, Bivariate and Multivariate Views of the Data
  - Grand Tour
  - Wide Variety of Methods
  - UNIX only

# XploRe

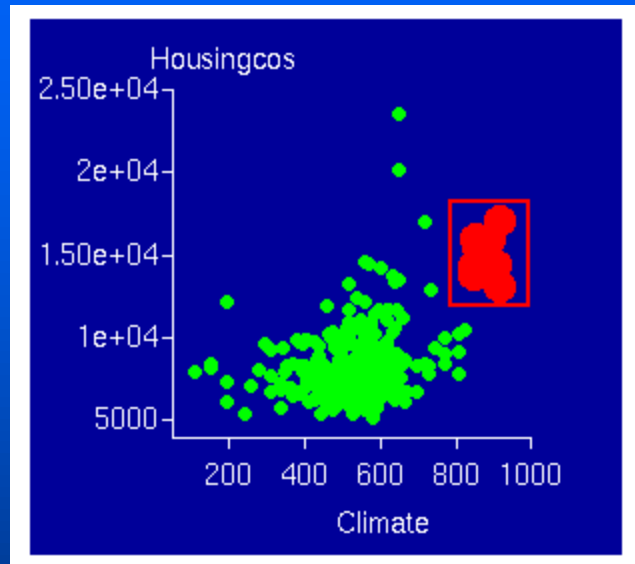
Härdle, et al.

- Statistical Computing Environment
  - Built-in Functionality
  - External Libraries (Quantlibs)
  - Web-based Help System
  - PC, Linux, UNIX

# Features of ArcView/XGobi Part

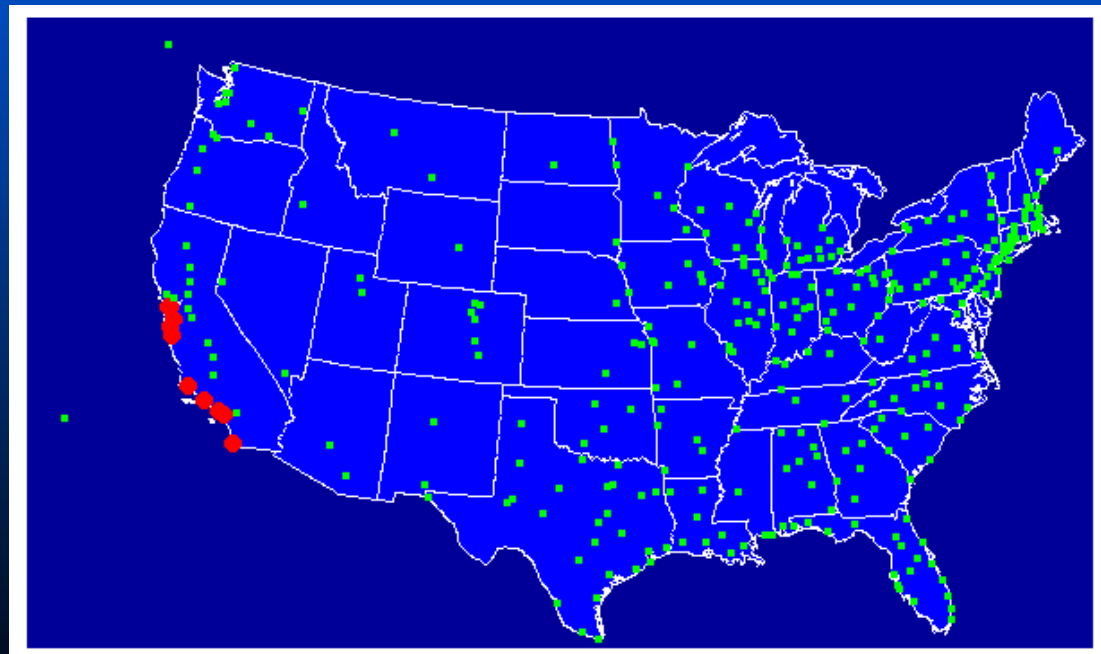
- Multivariate Link
- CDF Link
- Variogram-cloud Link
- Spatially Lagged Scatterplot Link
- Multivariate Variogram-Cloud Link

# Multivariate Link

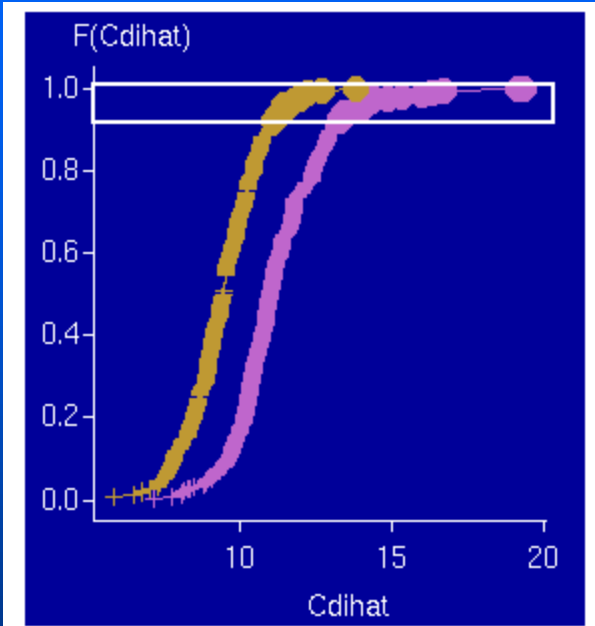


**XGobi**

**ArcView**

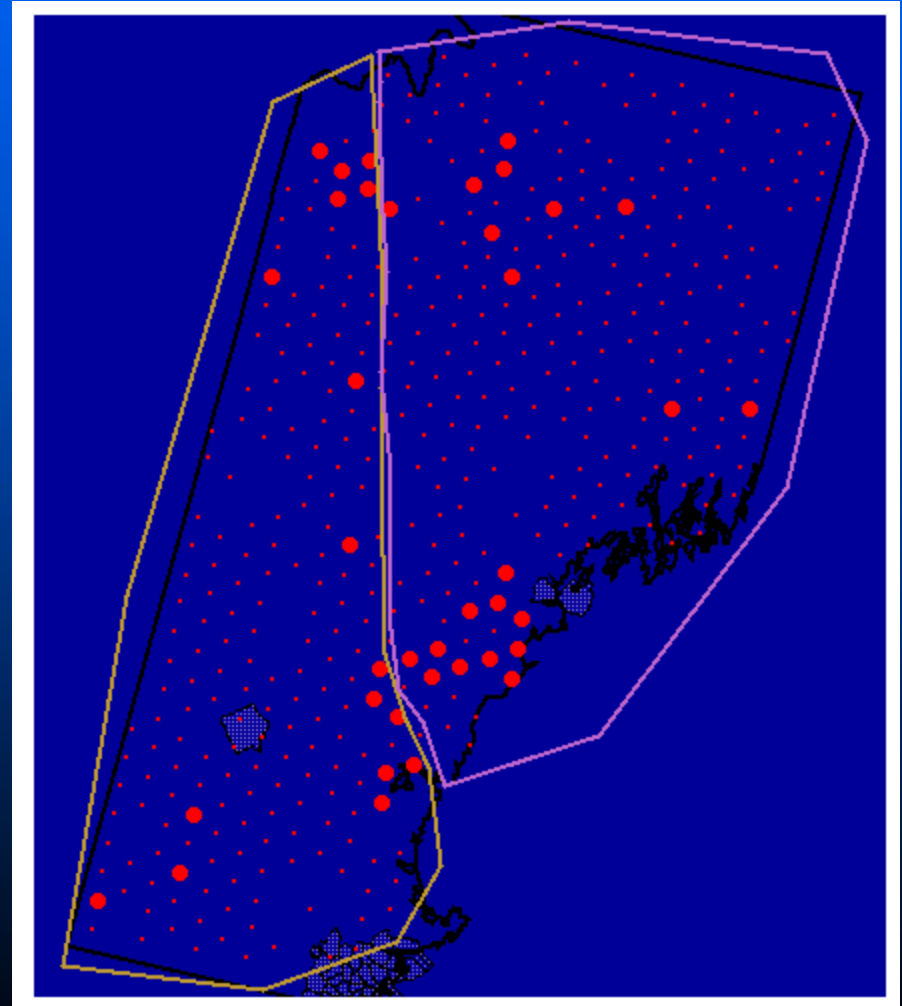


# CDF Link



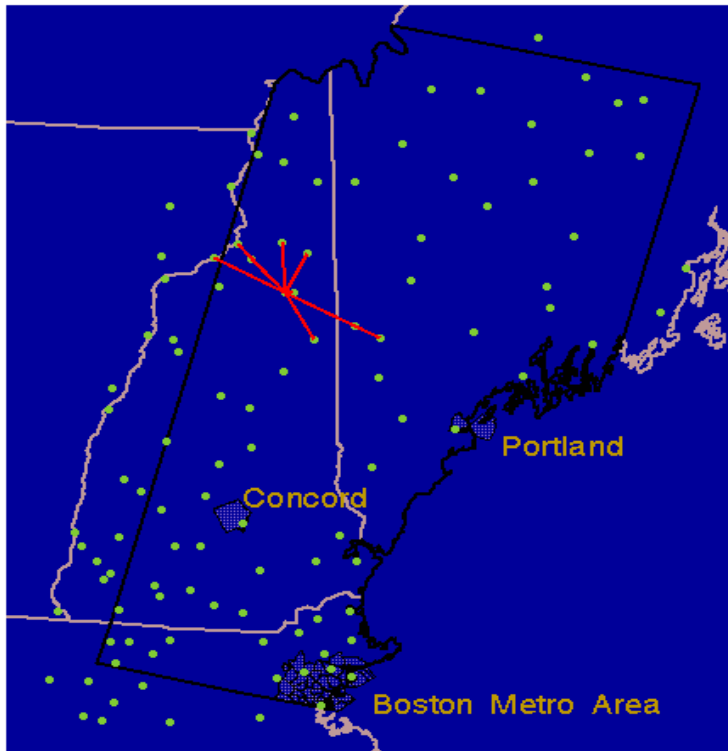
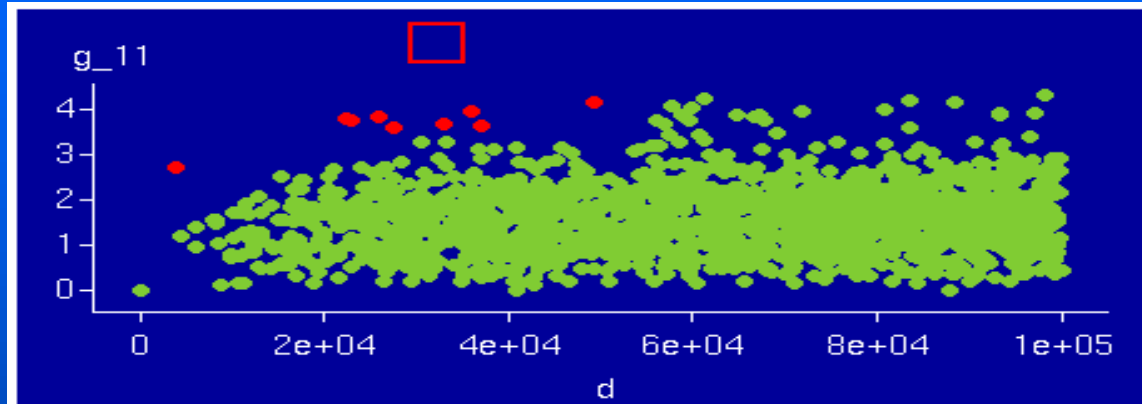
**XGobi**

**ArcView**

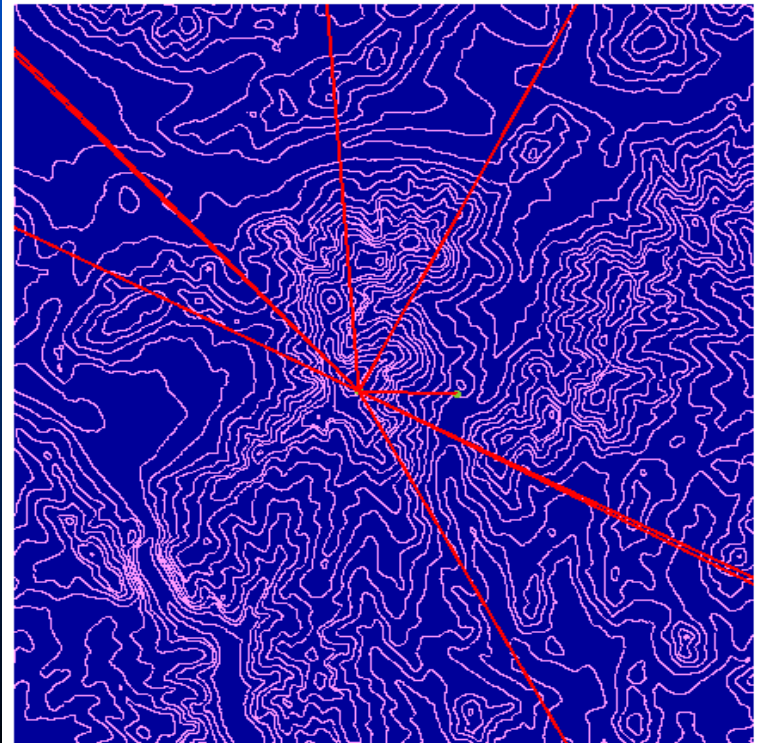


# Variogram-Cloud Link

**XGobi**

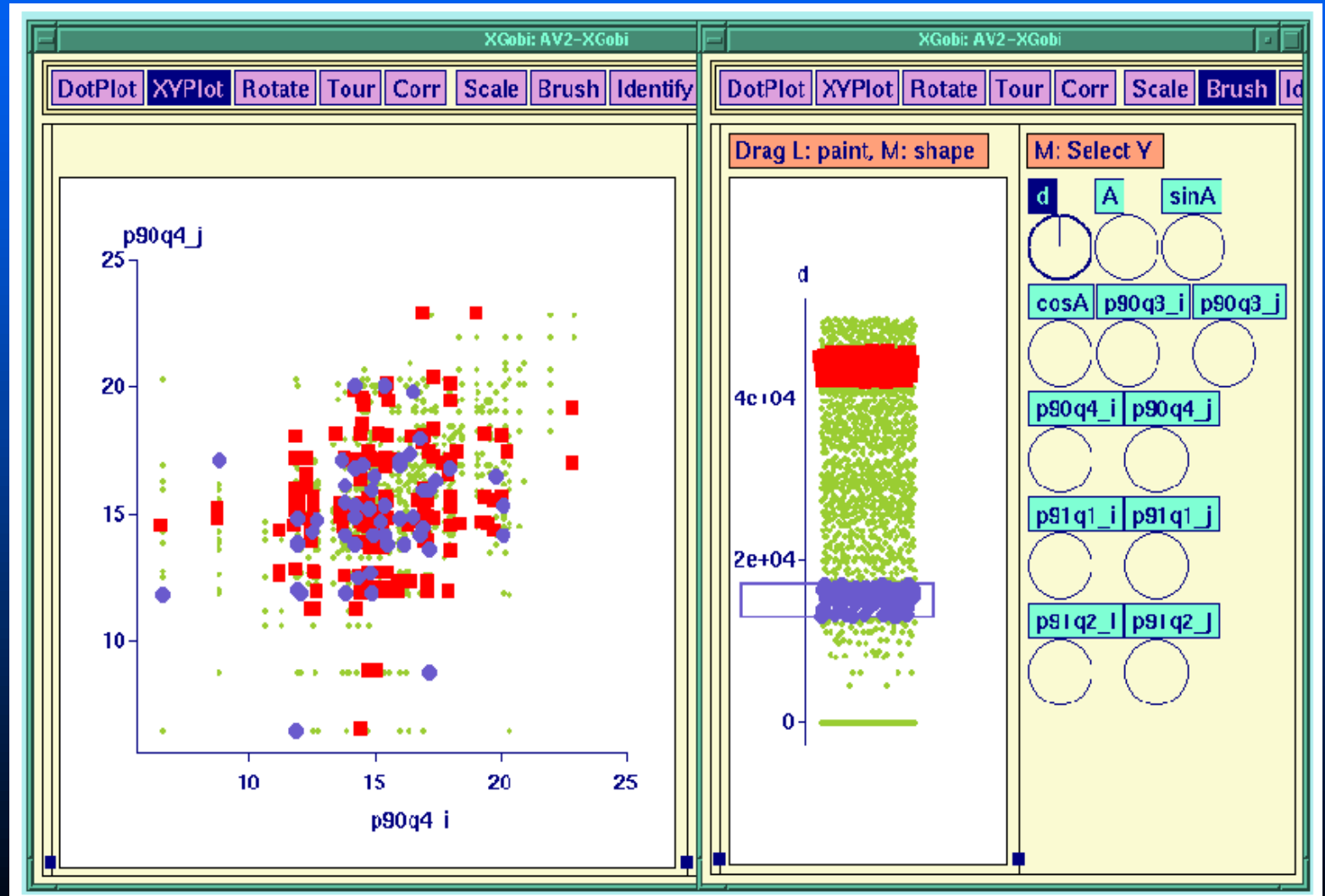


**ArcView**

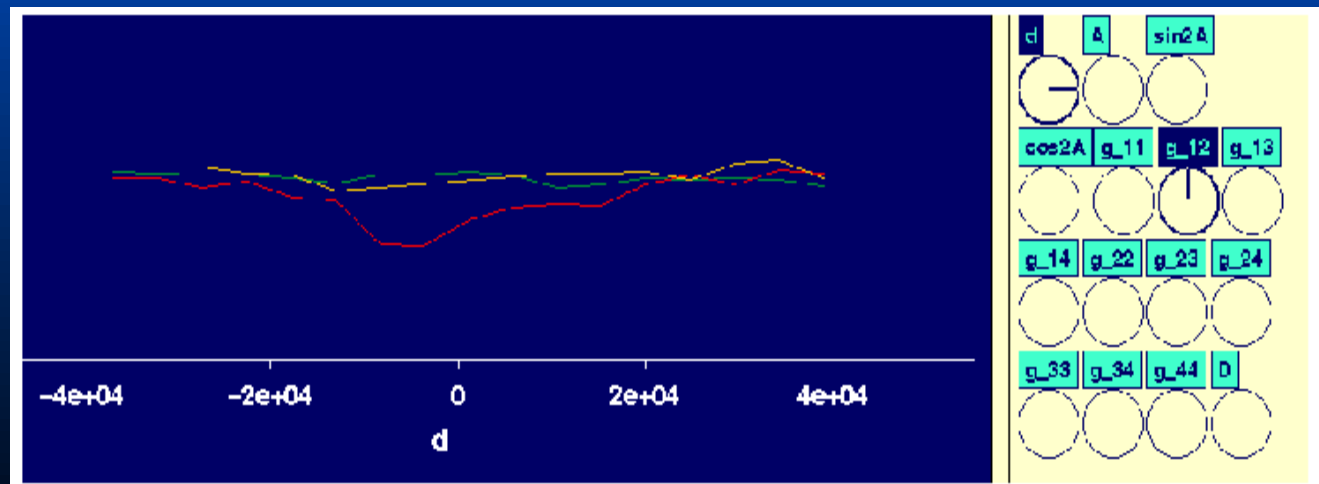
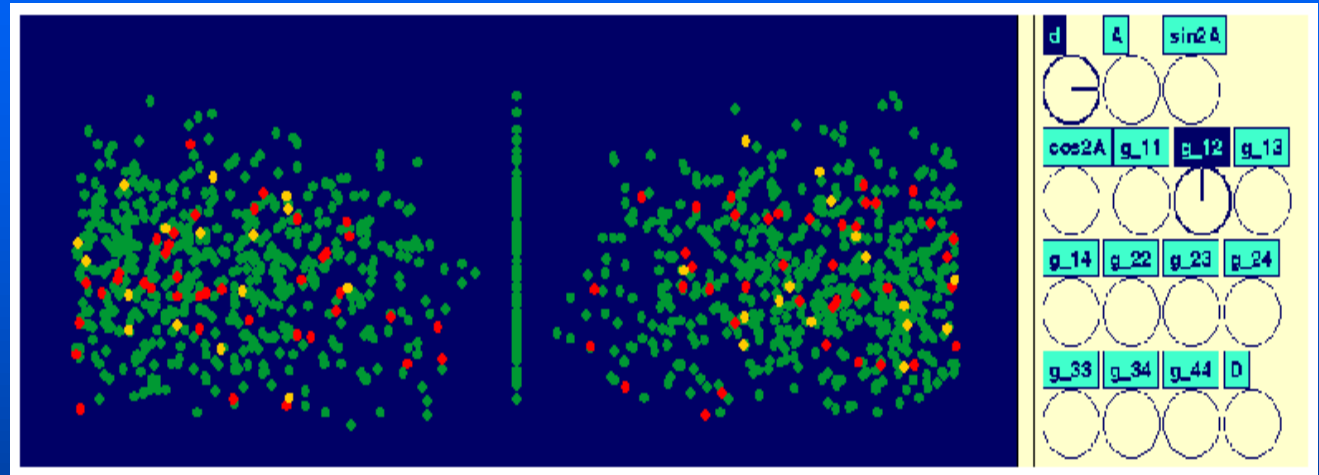
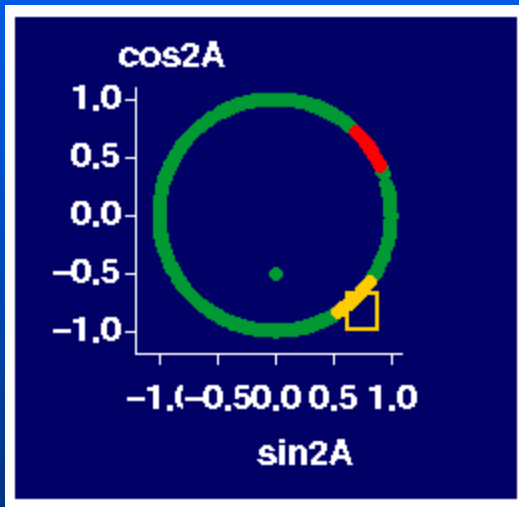


# Spatially Lagged Scatterplot Link

XGobi



# Multivariate Variogram-Cloud Link



**XGobi**

# Features of XGobi/XploRe Part

- Exchange of data and commands
- External smoother
- Dynamic linked brushing

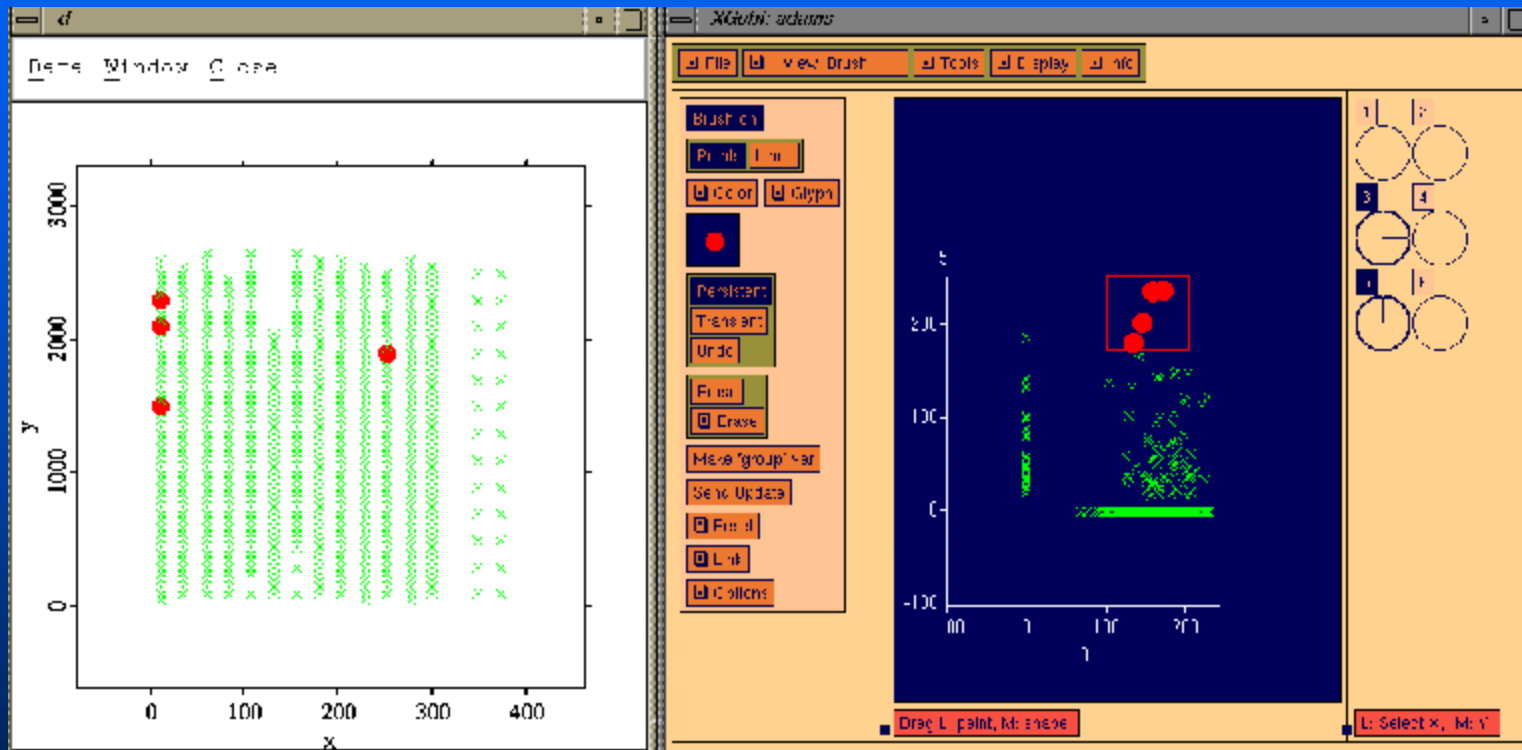
Clone XGobi  
Smooth ...  
Subset Data ...  
Jitter ...  
Parallel Coord Plot ...  
Variable List ...  
Case List ...  
**Start XploRe ...**  
Stop XploRe ...  
Launch Missing Data XGobi ...  
Impute Missing Values ...

Read ...  
Save (extend current file set) ...  
Save (create new file set) ...  
Print ...  
XploRe (pass variables) ...  
XploRe (pass projection) ...  
Quit (Q)

⊗ Mean  
Median  
Nadaraya-Watson  
Spline  
LINEAR  
SYMMETRIZED KNN  
KNN  
LOWESS  
LOCAL POLYNOMIAL  
NEURAL NETWORK  
ISOTONIC

## XGobi Menus

# Dynamic Linked Brushing



**XploRe**

**XGobi**

## Features of ArcView/XploRe Part

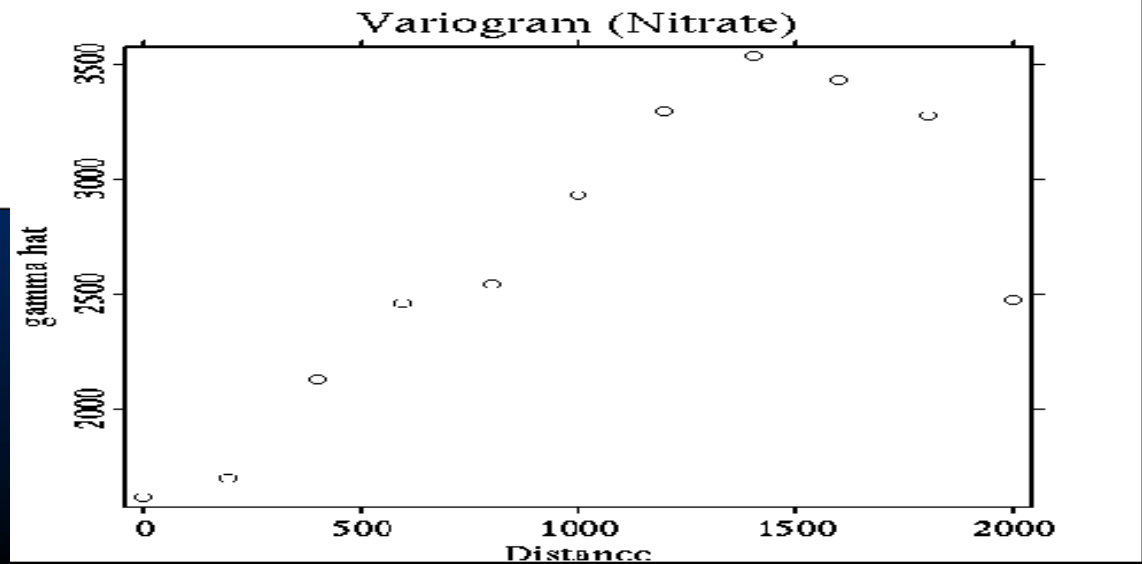
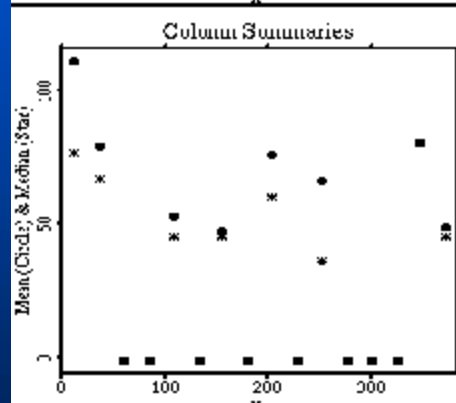
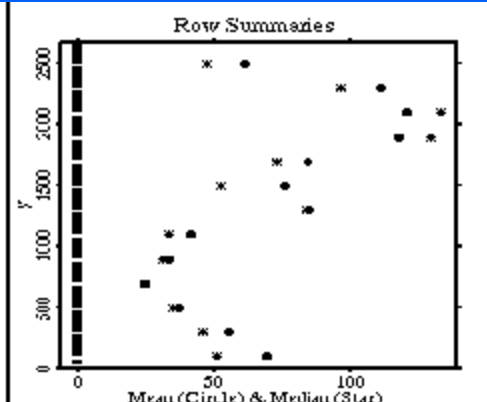
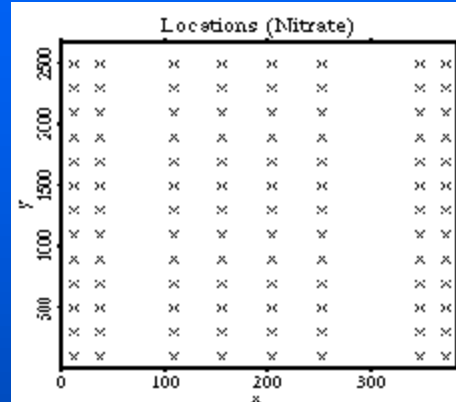
- Capabilities for spatial data analysis
- Weighted head-banging algorithm for the smoothing of maps

# Spatial Data Analysis in XploRe

Mean and Median Summaries

Variogram

XploRe



# Full Scenario

The screenshot displays the ArcView GIS Version 3.0 interface. The main window has a menu bar (File, Edit, View, Theme, Graphics, Window, Color, Glyph, Size, Help, JSU) and a toolbar. A command window titled 'XploRe' contains the following code:

```
d = createdisplay(1, 1)
e = createdisplay(1, 1)
;
show (d, 1, 1, XGobiData)
setgopt (d, 1, 1, "brushsize", 10 | 10)
setmode (d, 1, 1, 1)
rpclink (d, 1, 1, 0, "0x42000000")
;
```

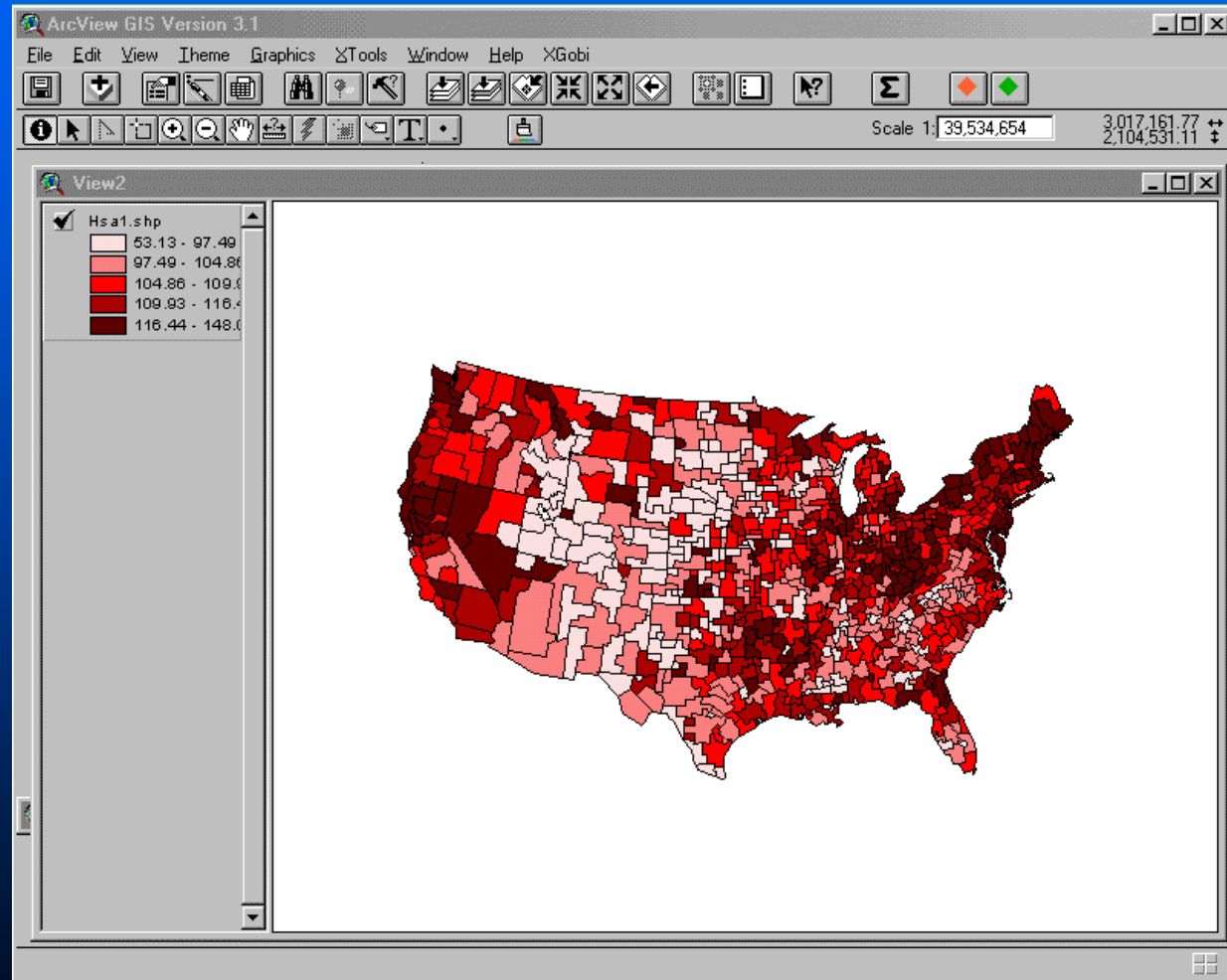
Below the code is a prompt: 'Please enter command:'. Two data windows are open: window 'e' shows a scatter plot of red, green, and blue points with axes ranging from -5 to 5; window 'd' shows a smaller version of the same data. A third window, 'XGobi: AV2-XGobi', features a control panel with buttons for 'Pause', 'Reinit', 'Link', 'Unlink', 'Send Tour Update', 'Manip', 'Radial', 'Path Len', 'Step', 'Go', 'Local Scan', 'Backtrck', '22', 'F', 'Hist On', 'Store', 'I/O', 'Interp', 'PC Basis', 'PC Axes', 'ProjPrst', 'Section', 'PP Indx', '2.26e-03', 'Optimz', 'Bitmap', 'TermsinExp: 1', and 'PP Index'. It also has a vertical column of 'PC' buttons (PC1 to PC6) and an 'L/M: Toggle (see' button. The main visualization area shows a 3D grid of colored cells (blue, green, yellow, red) with red dots scattered on top.

## Example 1: NCHS Mortality Data

- Data for 798 health service areas (HSA's) in the contiguous US
- Variables:
  - Proportion of the hispanic population
  - Per capita income
  - Proportion of female heads of households
  - Proportion of unemployed
  - Cancer Mortality Rate (in deaths per 100,000)

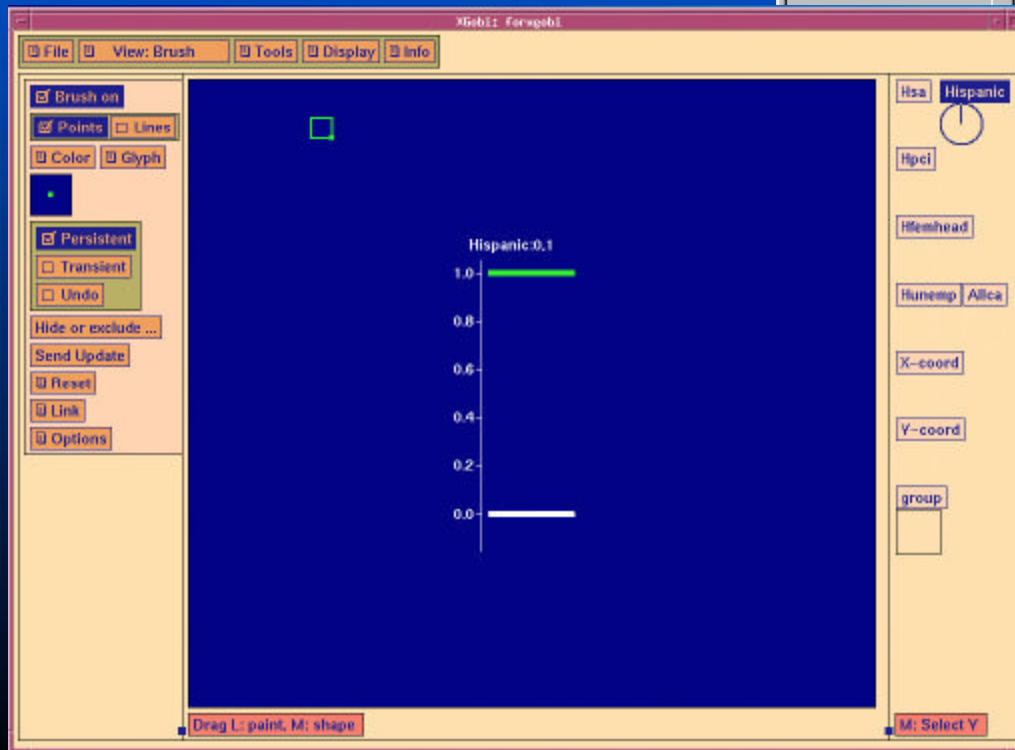
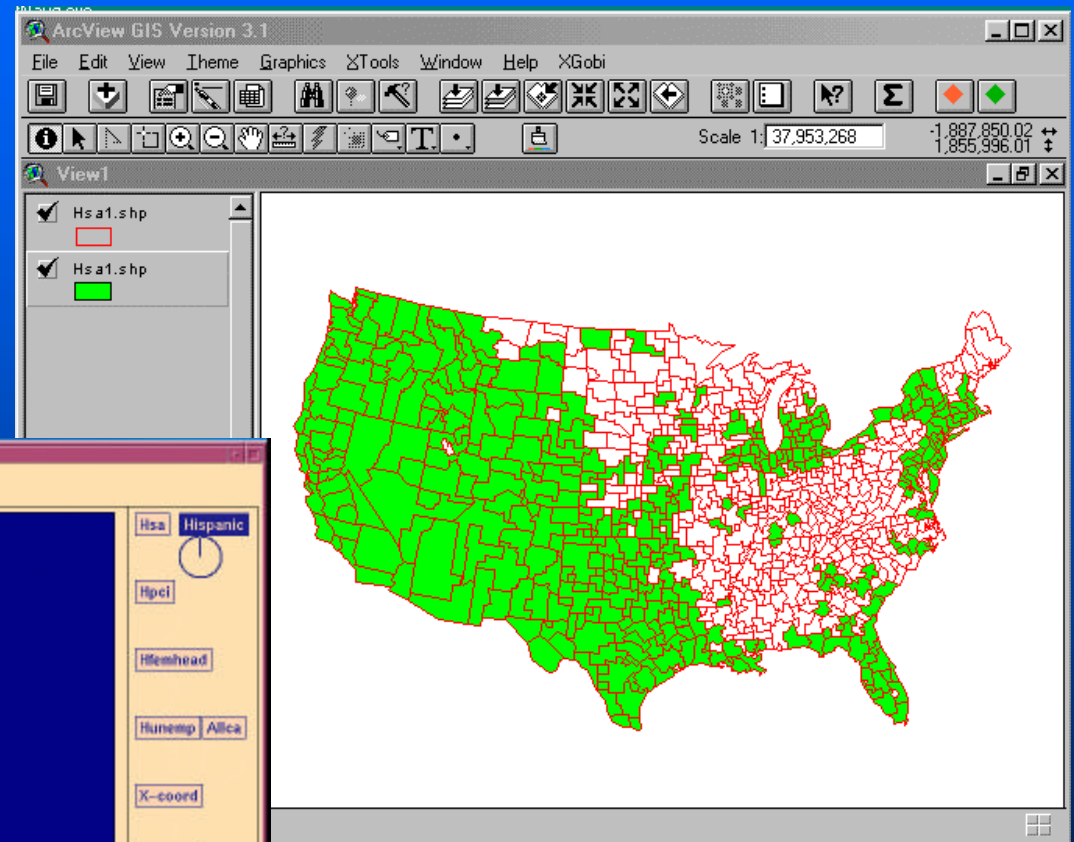
# Initial Choropleth Map of Cancer Mortality

ArcView



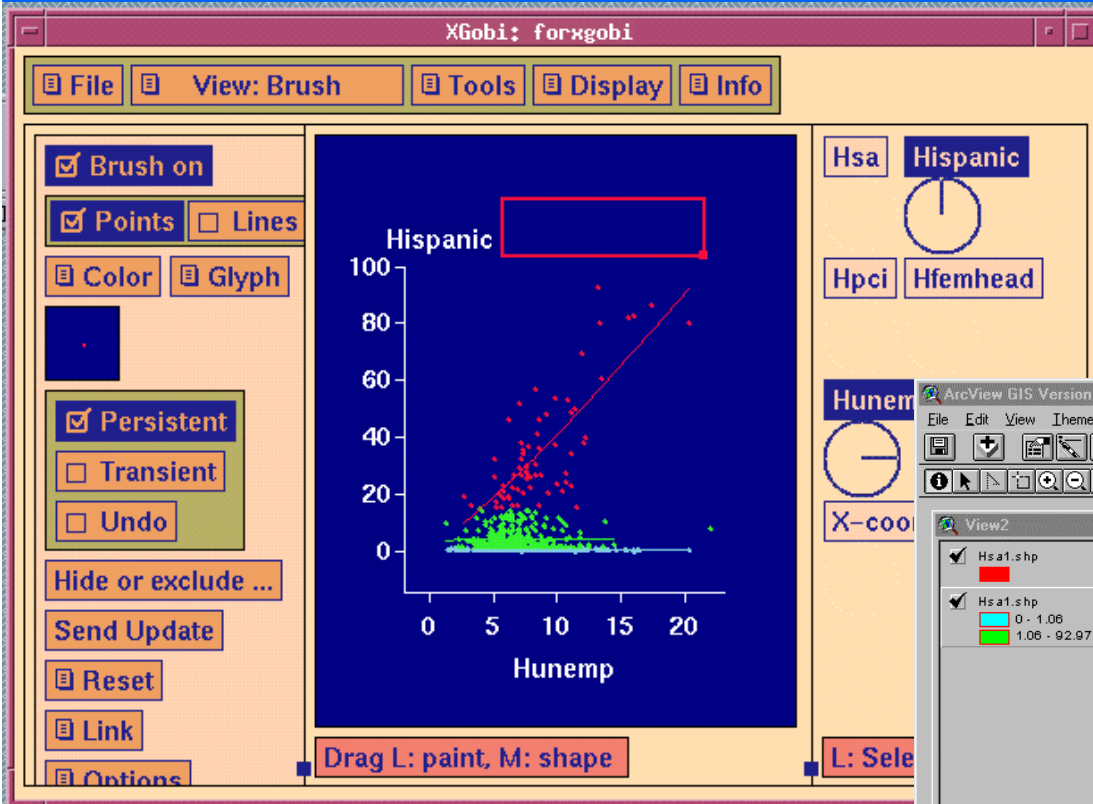
# After Brushing in XGobi

XGobi



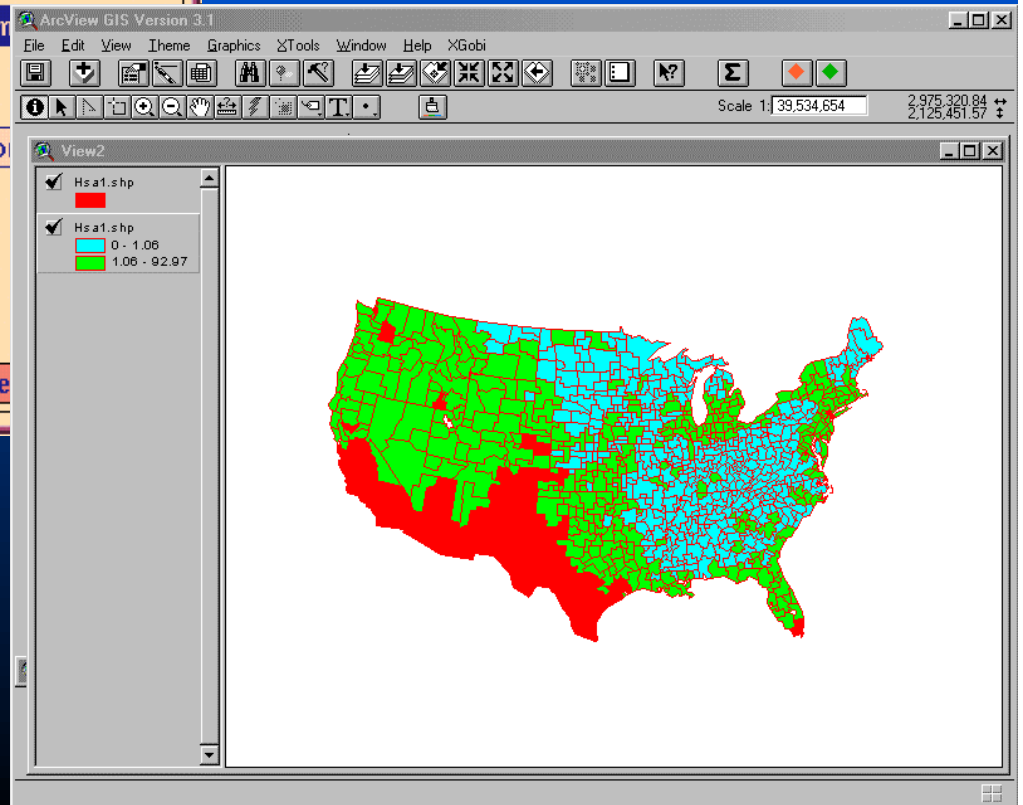
ArcView

# Further Data Exploration



XGobi

ArcView



## Other Applications

- Forest health data
- Precipitation data
- Remote sensing data

## Example 2: Remote Sensing Data

- Graphics & Remote Sensing
- Data & Definitions
- Geography
- Visual Exploration

# Stat Graphics & Remote Sensing

- Buja, McDonald, Michalak, Stuetzle (1991) & McDonald, Willis (1987): Confluence of 2 Rivers
- Klein, Moreira (1994): Agricultural Region in Brazil
- Scott (1986): Agricultural Scene on 5 Days
- Salch, Scott (1997): 3 Groups of Farm Crops
- Carr (1991): Nevada Test Site

# ArcView/XGobi/XploRe & Remote Sensing

- Symanzik, Majure, Cook (1996)
- Cook, Majure, Symanzik, Cressie (1996)
- Symanzik, Majure, Cook (1997)
- Symanzik, Cook, Klinke, Lewin (1998)
- Symanzik, Griffiths, Gillies (2000)

# The Data

- NOAA-14 Satellite (National Oceanic and Atmospheric Administration)
- AVHRR Sensor (Advanced Very High Resolution Radiometer):
  - Band 1: Red
  - Band 2: Near Infrared
  - Band 3: Mid Infrared
  - Band 4: Long Infrared
  - Band 5: (Very) Long Infrared
- Data from “NASA’s Project Atlanta”
- 18 Days from Jan 1997 to Dec 1997
- Resolution: 1 km x 1 km per Pixel
- Main Study Area: 70 km x 46 km

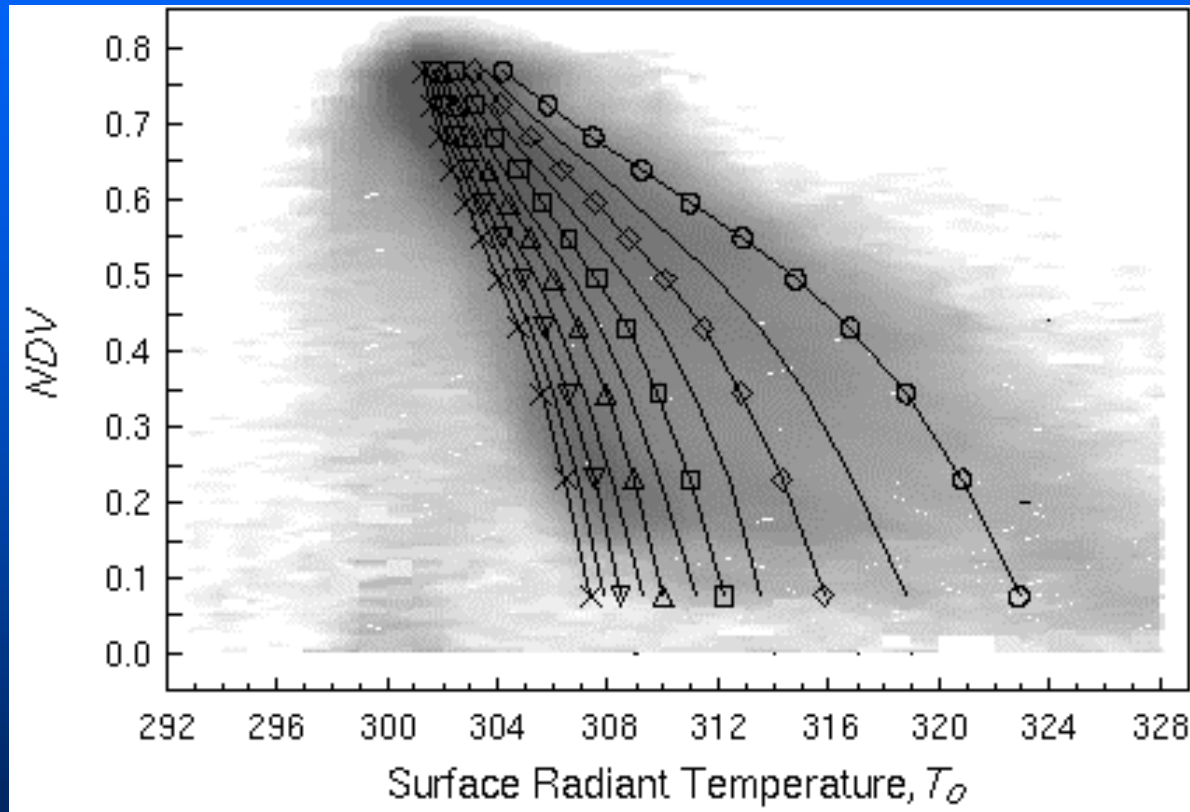
## Some Definitions

- Normalized Difference Vegetation Index:

$$NDVI = \frac{Band2 - Band1}{Band2 + Band1}$$

- $NDVI \sim 0.8$  for Highly Vegetated Surfaces
- $NDVI \sim 0.1$  for Bare Soil
- Surface Radiant Temperature  $T_0$ : Band 4
- Surface Moisture Availability  $M_0$

# An Example



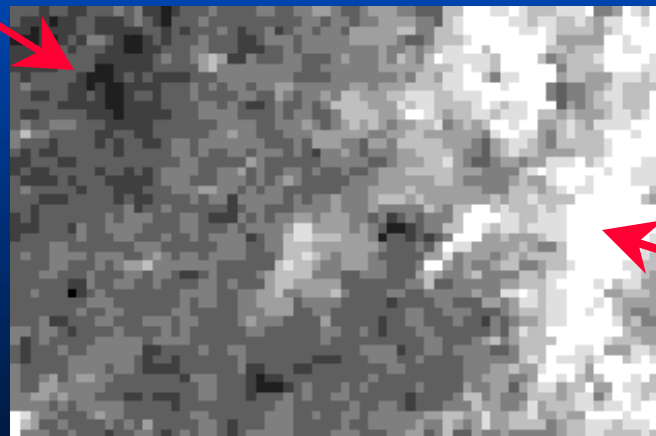
NS001-TMS derived  $T_o$ - $NDVI$  scatterplot (gray spectral scaling) at a 5 meter spatial resolution for a 7 x 3 km area of the Mahantango Watershed, Pennsylvania. 18 July 1990, 1145 LST. Isopleths representing moisture availability index,  $M_o$  are overlaid with the legend,  $o = 0.0$  ('warm' edge),  $\diamond = 0.2$ ,  $\square = 0.4$ ,  $\Delta = 0.6$ ,  $\nabla = 0.8$ , and  $\times = 1.0$  (cold edge).

## Goal of the Study

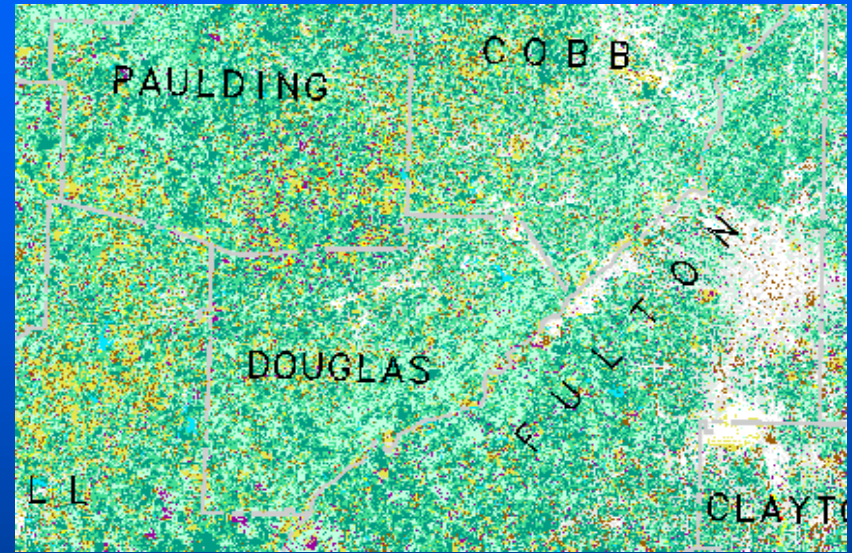
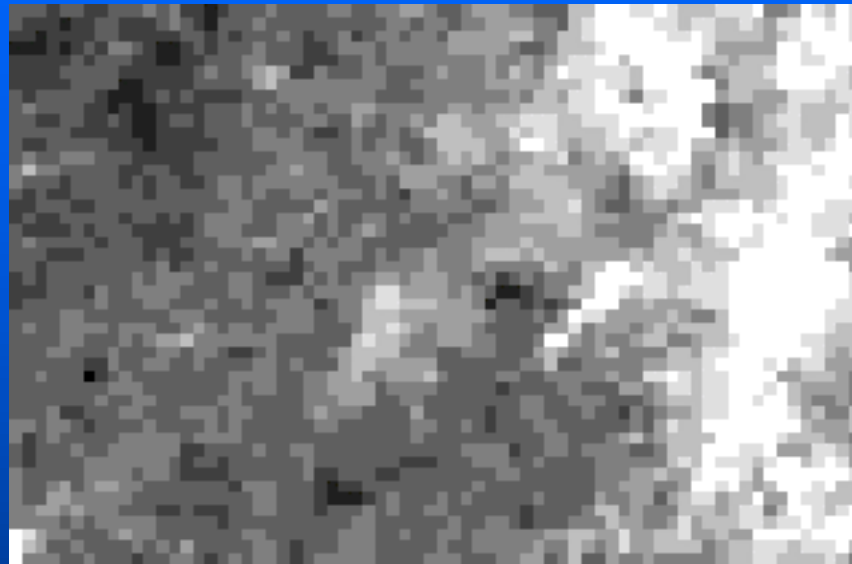
- Explore (and Model) Relationships between  $NDVI$ ,  $T_0$  and  $M_0$  for different Seasons
  - Specify Wide-Range Behavior (e.g., for City, Forest, Water)
  - Find Unusual Places





# The Main Study Area



# The Main Study Area - Landcover



## EXPLANATION

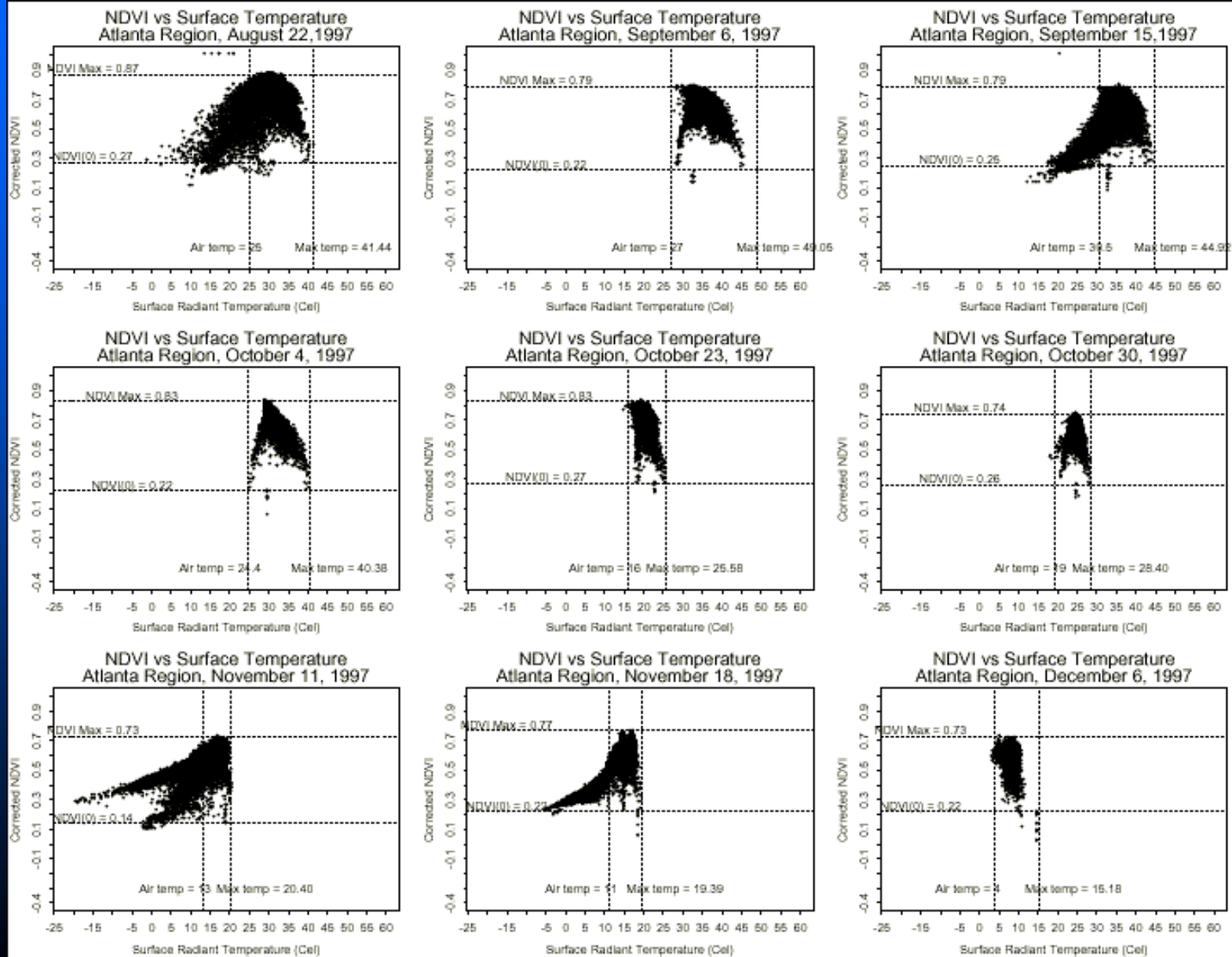
	Open Water		Forested Wetland
	Clear Cut / Young Pine		Coniferous Forest
	Pasture		Mixed Forest
	Cultivated / Exposed Earth		Hardwood Forest
	Low Density Urban		Salt Marsh
	High Density Urban		Brackish Marsh
	Emergent Wetland		Tidal Flats
	Scrub / Shrub Wetland		

Digital Landcover from Georgia Department of Natural Resources, Wildlife Resources Division, Natural Heritage Program, 200ft resolution.

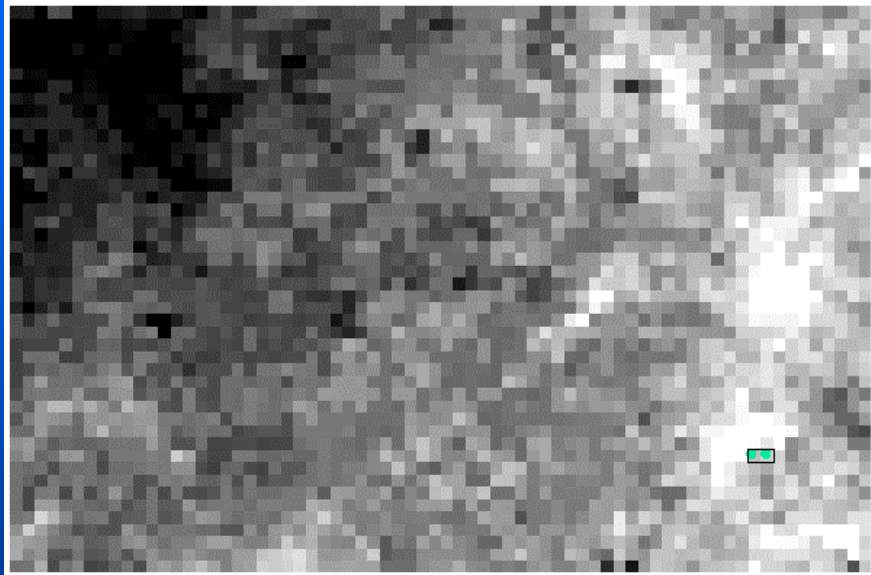
Digital state and county data compiled from US Census TIGER/line files 1:100,000.

Digital shoreline data compiled from NOAA vector shoreline of the US 1:70,000.

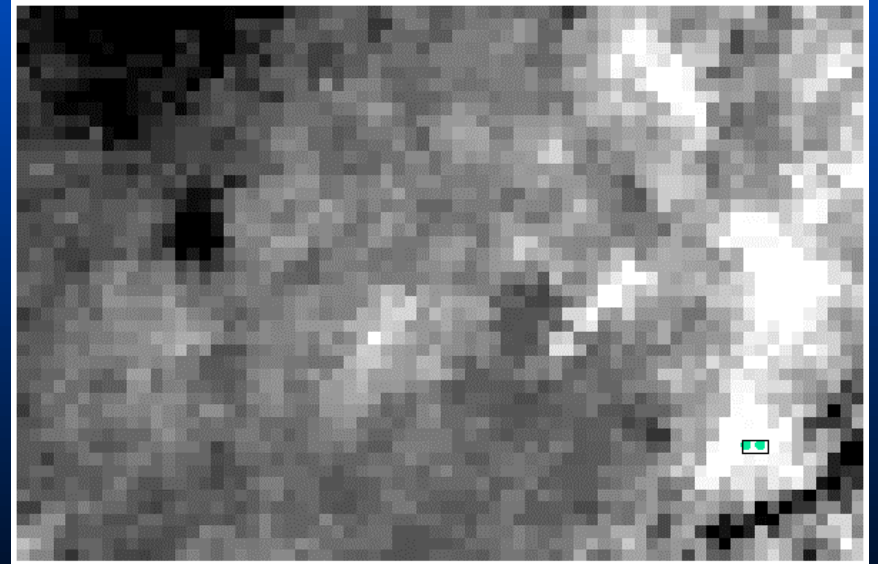
# NDVI vs Surface Temperature



# Two Months



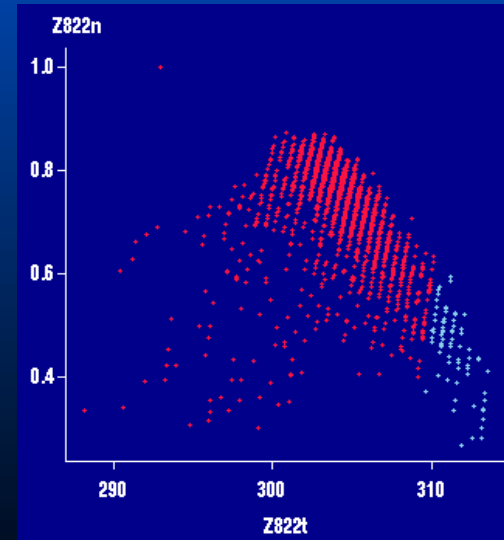
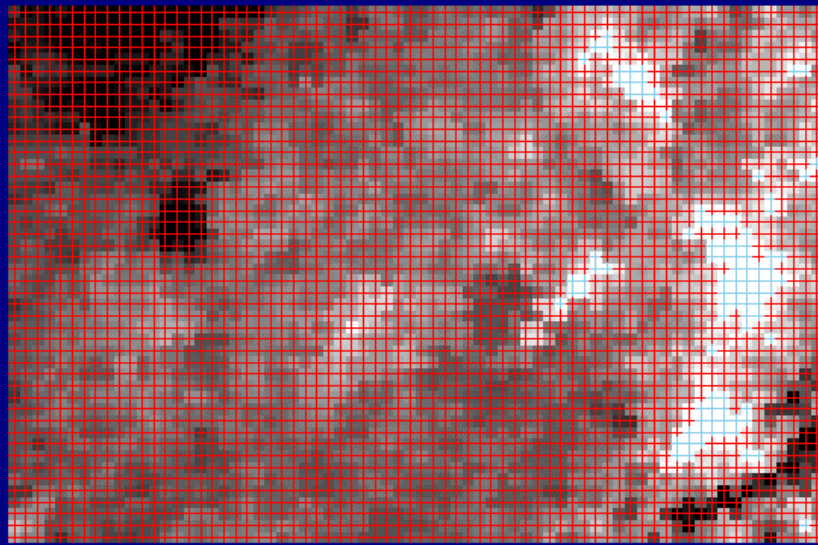
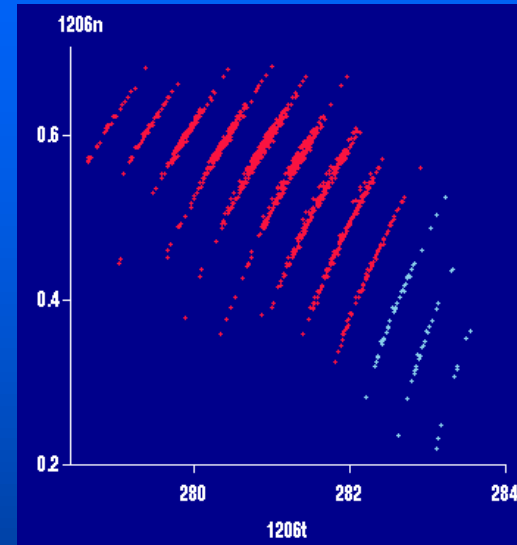
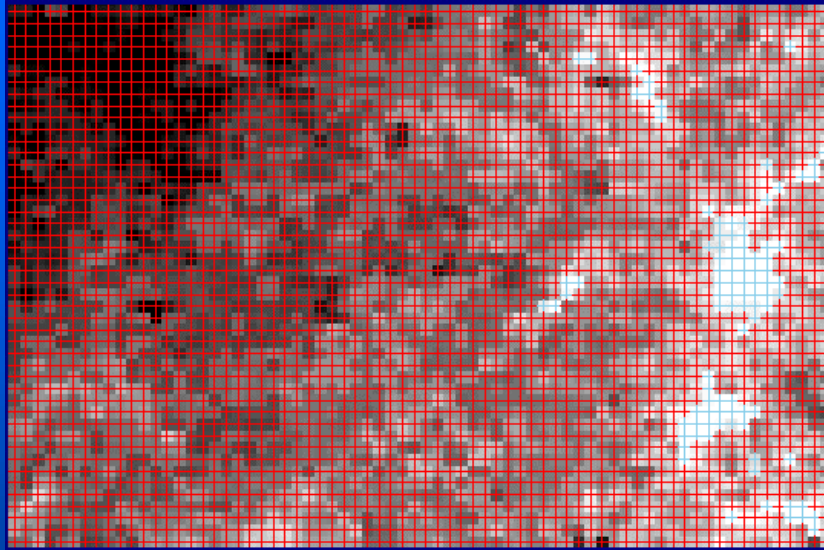
December



August

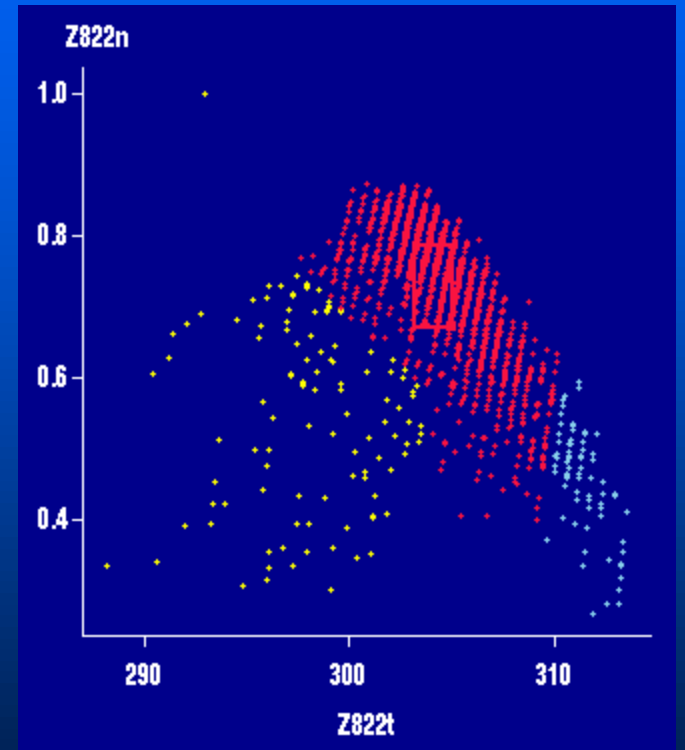
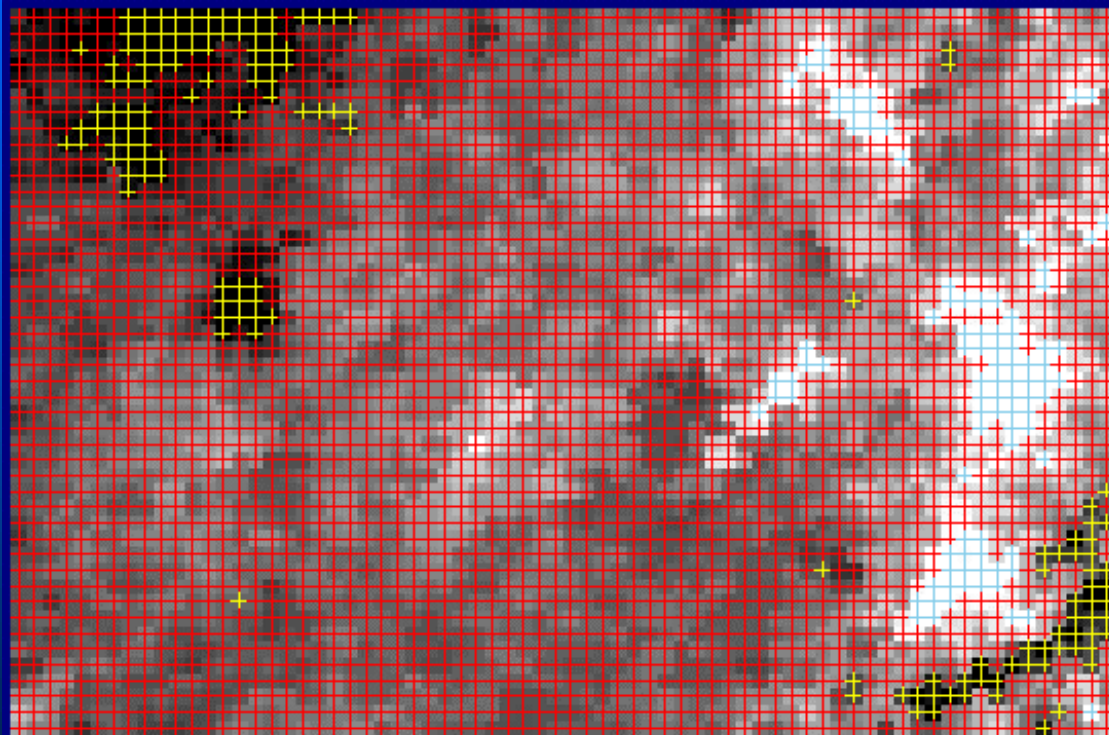
December

The City



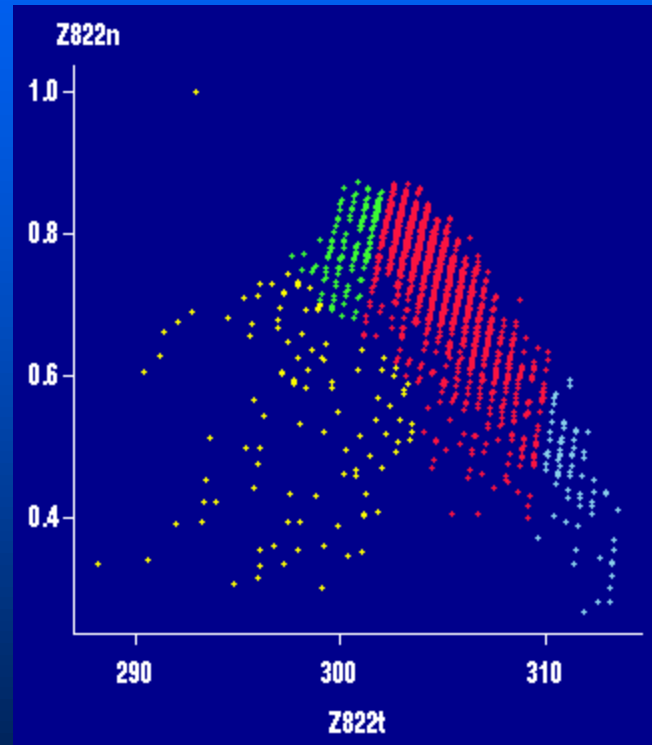
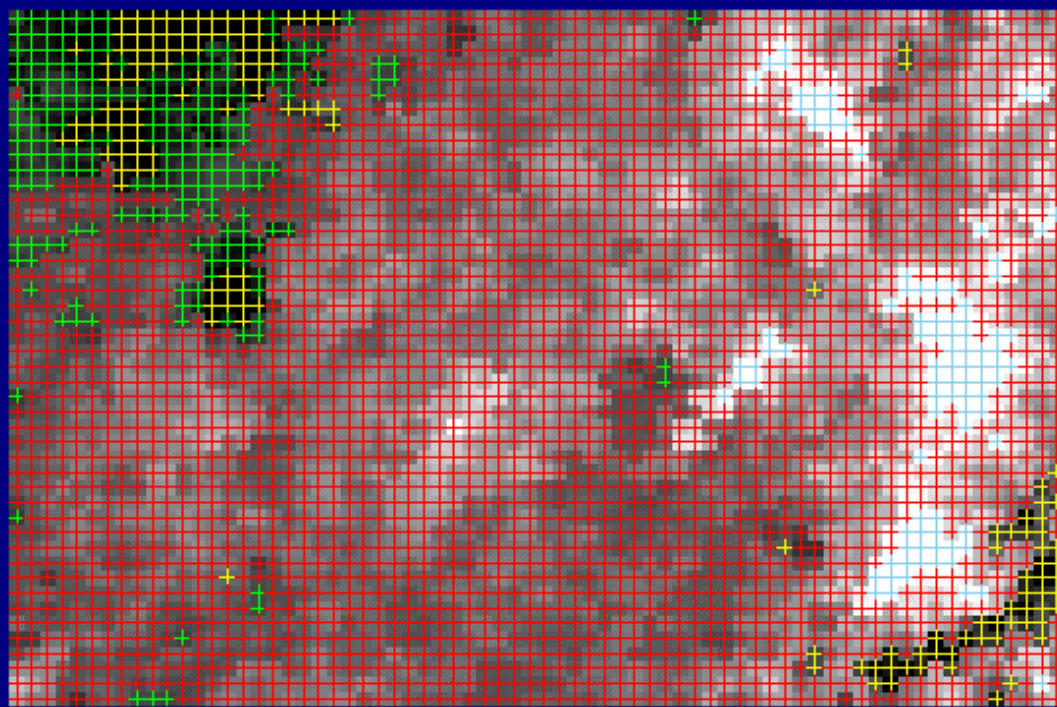
August

# Clouds in August



August

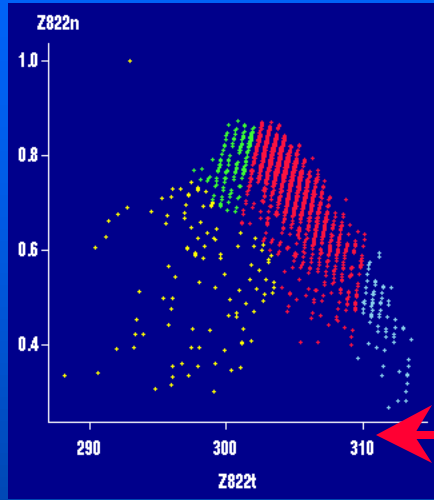
# Clouds and Forest in August



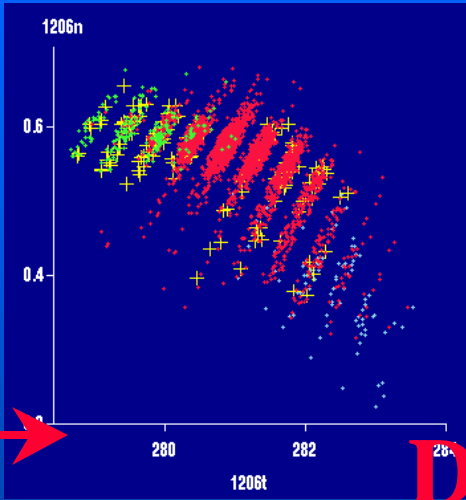
August

**August**

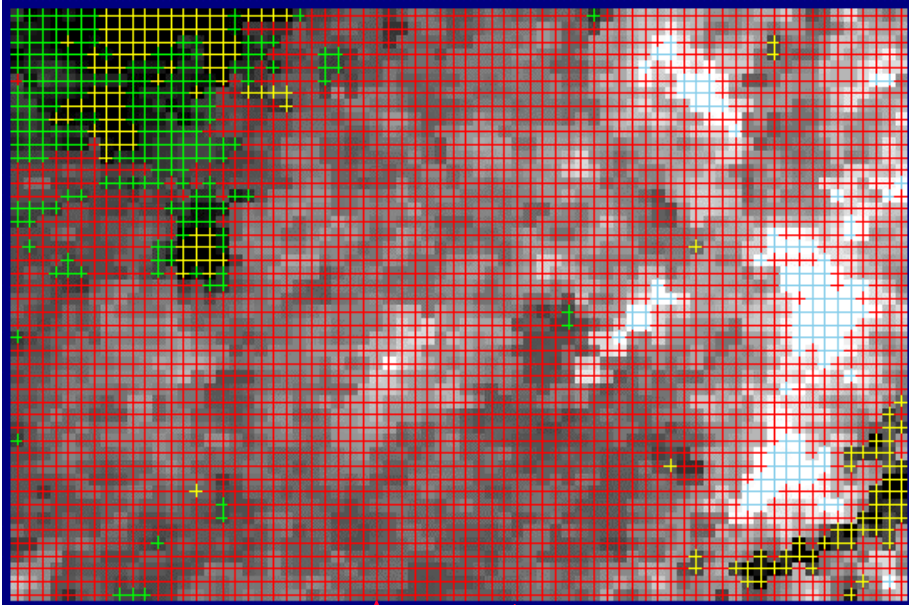
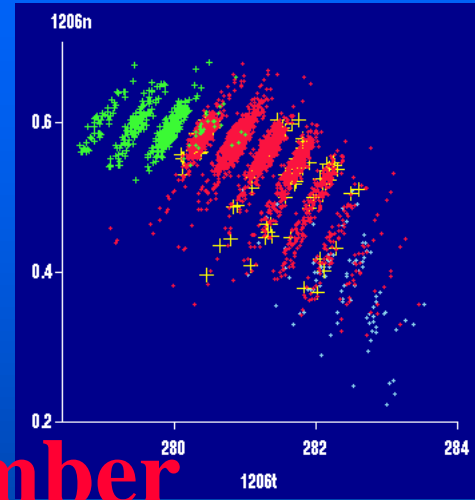
# Reclassifying Clouds



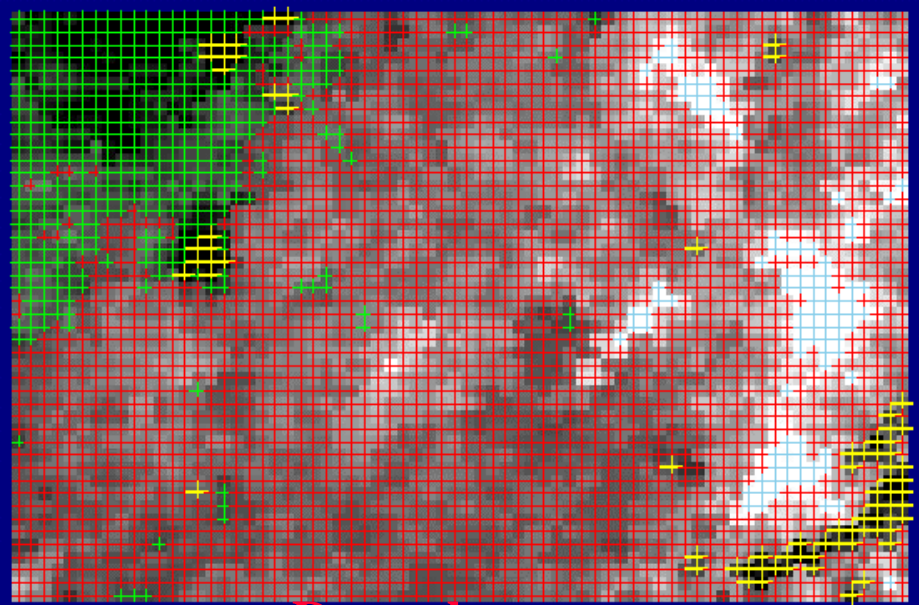
**Linked**



**December**

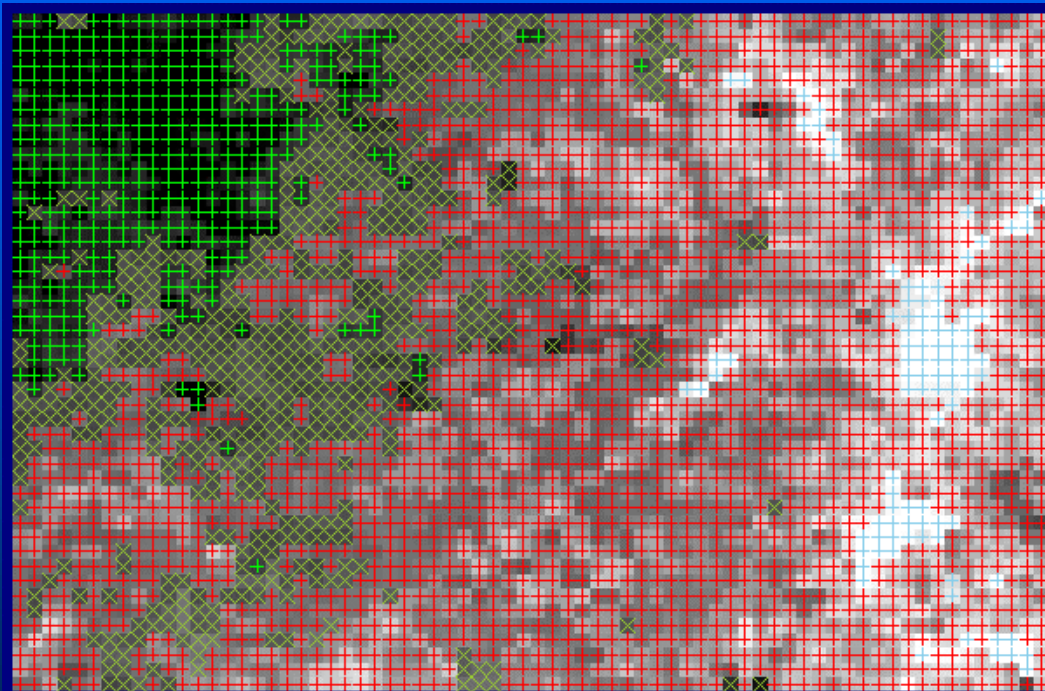


**August**

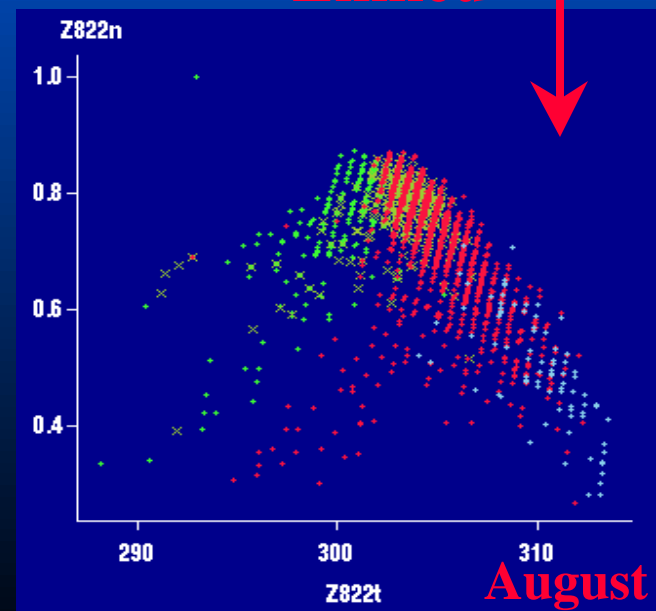
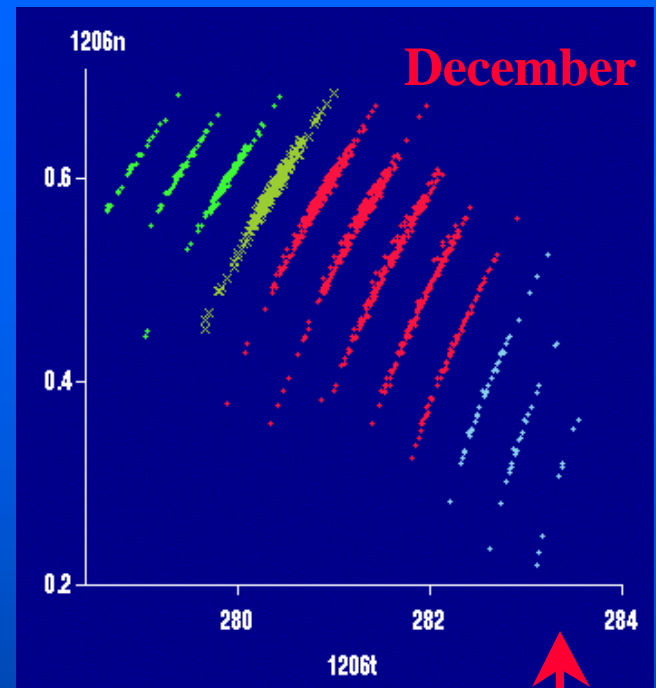


**December**

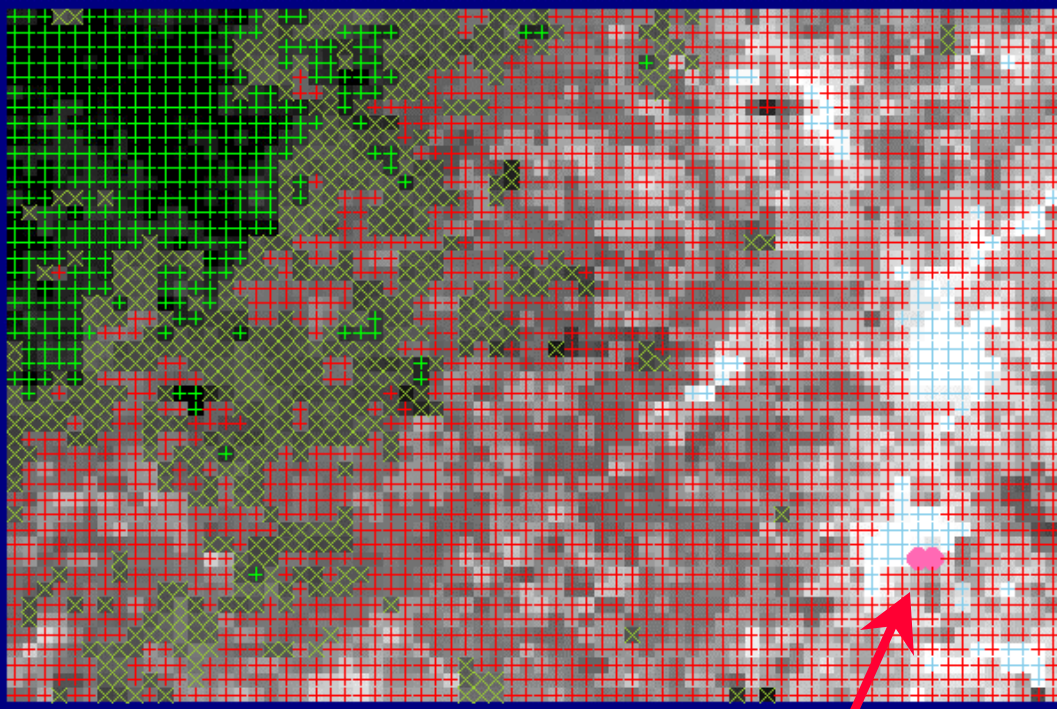
# Final Classification



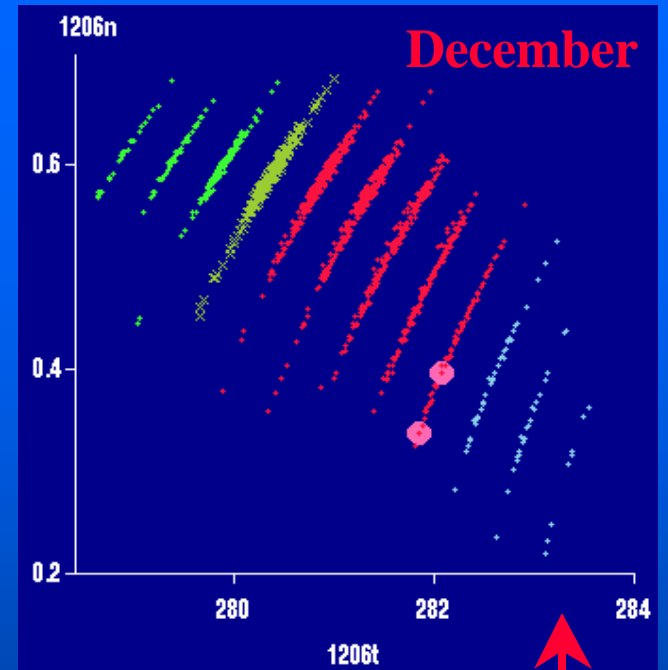
December



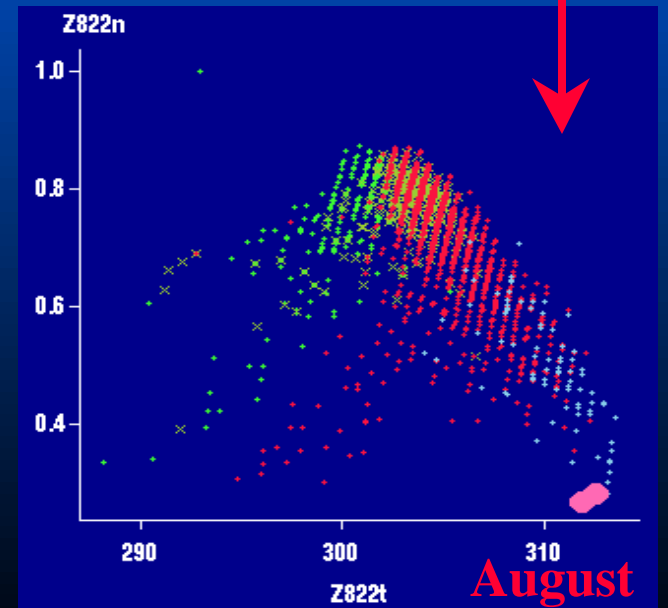
# 2 Pixels of Interest



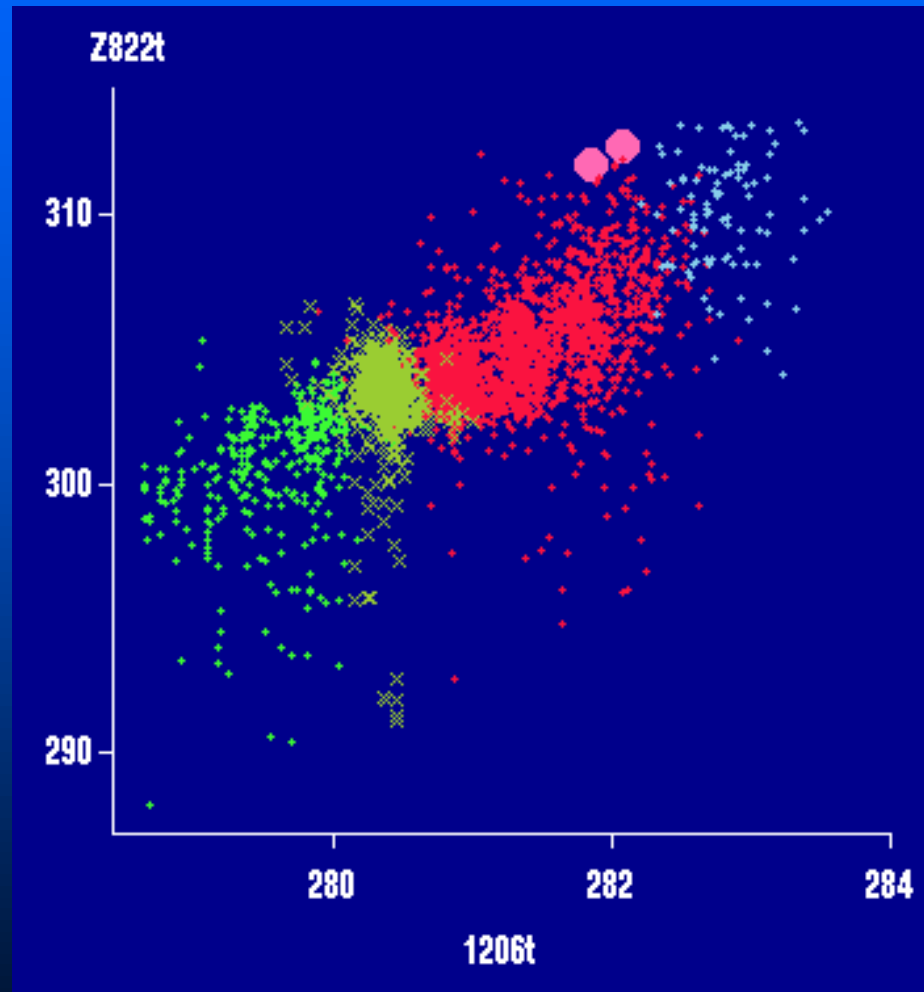
December



Linked



# Correlation of Temperatures



## Current Research

- Continuation ArcView <-> XploRe part
- Spatial statistics in XploRe
- Development of a PC version of XGobi

## Additional Information

- Articles on ArcView/XGobi/XploRe

- <http://www.math.usu.edu/~symanzik>

- Main Web page

- <http://www.public.iastate.edu/~arcview-xgobi/homepage.html>