Analyse räumlicher Daten im ArcView/XGobi/XploRe Software Environment

Jürgen Symanzik
Utah State University, Logan, UT

*e-mail: symanzik@sunfs.math.usu.edu
WWW: http://www.math.usu.edu/~symanzik
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
• 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
• 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
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

XGobi Menus

- 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)

XploRe Menus

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

XploRe

Variogram
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

ArcView

XGobi
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

- 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 \( M_0 \)
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), $\hat{\diamond}$ = 0.2, □ = 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 Geographic Setting
The Main Study Area
The Main Study Area - Landcover

EXPLANATION

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

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

- NDVI vs Surface Temperature
  Atlanta Region, August 22, 1997
  Air temp = 85, Max temp = 41.44

- NDVI vs Surface Temperature
  Atlanta Region, September 6, 1997
  Air temp = 87, Max temp = 49.06

- NDVI vs Surface Temperature
  Atlanta Region, September 15, 1997
  Air temp = 87, Max temp = 44.99

- NDVI vs Surface Temperature
  Atlanta Region, October 4, 1997
  Air temp = 84.4, Max temp = 40.38

- NDVI vs Surface Temperature
  Atlanta Region, October 23, 1997
  Air temp = 86, Max temp = 25.58

- NDVI vs Surface Temperature
  Atlanta Region, October 30, 1997
  Air temp = 89, Max temp = 28.40

- NDVI vs Surface Temperature
  Atlanta Region, November 11, 1997
  Air temp = 85, Max temp = 20.40

- NDVI vs Surface Temperature
  Atlanta Region, November 18, 1997
  Air temp = 81, Max temp = 19.39

- NDVI vs Surface Temperature
  Atlanta Region, December 6, 1997
  Air temp = 85, Max temp = 15.18
Two Months

August

December
Clouds in August
Clouds and Forest in August

August
Reclassifying Clouds

August

Linked

December

August

December
Final Classification

December

Linked

December

August
2 Pixels of Interest
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