GIS in Action

Getting Started With GIS

Chapter 9

Dursun Z. ºeker

9 GIS in Action

- **9.1 Introducing GIS in Action**
- **9.2 Case Study 1: GIS Fights the Gypsy Moth**
- **9.3 Case Study 2: GIS and Road Accidents in Connecticut**
- **9.4 Case Study 3: GIS Helps Environmental Assessment in Brooklyn**
- **9.5 Case Study 4: Channel Island GIS**
- **9.5 Case Study 5: GIS and GPS to Map Sliding Rocks**

Understanding GIS by Case Study

- Use of GIS is best understood by examining case studies.
- Case studies in this chapter cover rural, suburban, urban, and coastal GIS applications.
- Rural: Gyspy Moth in Michigan
- Suburban: Road Accidents in Connecticut
- Urban: Environmental Decision Making: Brooklyn, NY
- Coastal: Channel Islands of California
- Wildlands: Sliding Rocks in Death Valley

Case Study #1:
Use of GIS to Understand Population Dynamics of the Gypsy Moth in Michigan

Contributors: Bryan C. Pijanowski and Stuart H. Gage, Dept. of Entomology, Michigan State University.

The Spread of the Gypsy Moth

- GIS has been used by Michigan State University to monitor the spread of gypsy moth.
- The gypsy moth has spread over the state from the north and east, and defoliates trees.

The Problem

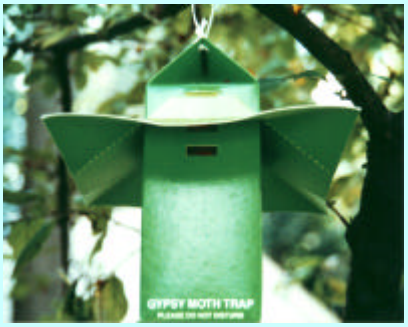
- First discovered in the state 40 years ago.
- Gypsy moth defoliated 280,000 ha in 1992
- Up from 2,800 in 1984.
- Insect is spreading across state.
- Impacts mostly oak and aspen.
- Agriculture, DNR, USDA involved.

The Gypsy Moth

The Monitoring Program

- Information from the monitoring program, via a GIS in Arc/Info and IDRISI, is used to direct spraying trees with Bt.
- A statewide monitoring program uses milk carton traps in trees dispersed over a spatial grid. (3000)
- A small pestiside strip in placed at a bottom of this trap to kill the moths once they have.
- Several agencies such as Agriculture, DNR (Department of Natural Research) and USDA (Forest Service) have been involved in yhis effort.

A gypsy moth trap

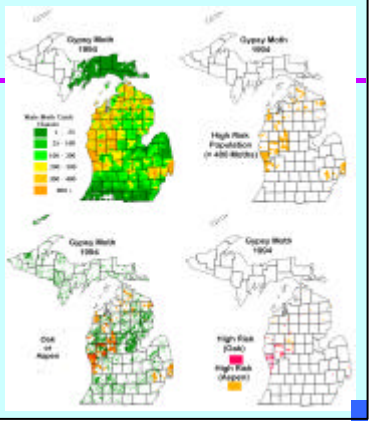


Locations of Traps for Gypsy moths in Michigan

Data Processing

- ✓ Data are aggregated annually in a central GIS, forms are entered and locations geocoded.
- ✓ Statewide gypsy moth infestation are interpolated using inverse distance squared weighting and mapped.
- ✓ An overlay of tree species data is then used to map the trees at risk of defoliation and therefore to be sprayed.

Risk to trees in Michigan from Gypsy Moth



Spraying with Bt biological pesticide

Software Used

- Arc/Info
- IDRISI
- Also use: ER-Mapper, ERDAS, Atlas*GIS
- - Results of spatial analyses are generally easy to interpret and are thus powerful tools for use in resource management and policy development.
- - Furthermore, because the results can be displayed as a colourful map, posting the maps and associated text on the World Wide Web has become a very effective communication device as well.

Case Study #2: GIS and Road Accidents in CT

Contributor: Ellen K. Cromley,
Medical Geographer,
University of Connecticut.

The Problem

- National need to quantify the benefits of automotive protection systems like seat belts and bicycle helmets.
- Connecticut had 72,672 crashes involving 190,143 people in 1995, and 78,407 crashes involving 202,792 people in 1996.

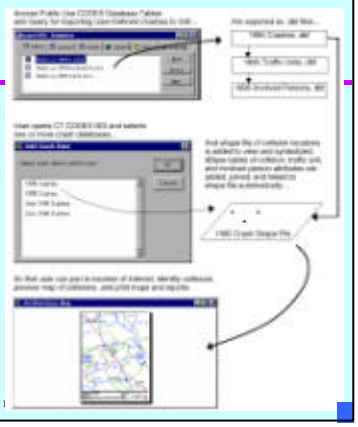
Crash Outcome Data Evaluation System

- National Highway Traffic Safety Administration funds 20 states through the CODES (Crash Outcome Data Evaluation System) Project.
- The Connecticut CODES Project uses GIS to link motor vehicle crash data with medical outcome data to develop a better picture of accidents and the effectiveness of protection systems.
- The purpose is to create a viewing environment for the linked crash records so that users can explore the locations and attributes of crashes.

Connecticut CODES GIS

Search and Query

- Users can perform detailed queries to select a set of collisions, and add them as a layer in the GIS.
- In the GIS, users can find where a collision occurred, or find out what kinds of collisions occurred in a place.



ArcView Quick Map

The user can pan to location of interest, identify collisions, preview map of collisions, and print maps and reports.

GIS Software Used

- CT CODES (Crash Outcome Data Evaluation System) GIS is an ESRI ArcView application modified with Avenue scripts to create a tailored GIS.
- Microsoft Access Database links motor vehicle crash data with medical outcome data.

Data Used in the Study

- Motor vehicle crash data from Police Accident reports for 1995 and 1996, coded by the Accident Records Section of ConnDOT.
- Trauma registry, emergency department, and inpatient records maintained by CHREF, an arm of the CT Hospital Association.
- Mortality records maintained by the Vital Records Section of the Health Dept.

Uses of CT CODES GIS

- Local child safety seat campaigns
- Evaluation of traffic calming devices by DOT
- Studies of elderly drivers in one CT county
- Research on fatal motor vehicle collisions in the state

Case Study #3: GIS Helps Environmental Assessment in Brooklyn

Contributors: Sean C. Ahearn
and Jeffrey P. Osleeb, Hunter College
City University of New York

Greenpoint/Williamsburg Brooklyn, NY

GIS Helps Environmental Assessment in Brooklyn

- In Brooklyn, New York, the industrialized Greenpoint/Williamsburg community decided to build a GIS to answer concerns it had over environmental contamination.
- At Hunter College, geographers assembled three different map base layers: parcels, a street map, and TIGER.

The Problem

- Greenpoint/Williamsburg heavily polluted
- 100,000 residents
- 19 sites on toxic release inventory
- 200 sites storing toxic materials
- How can public domain information get into the community's hands?

Data Use and Management

- The base layers were coregistered and used to geocode many text and other city databases with environmental, health, and demographic attributes.
- The link between the layers that the GIS provided allowed cross-referencing of information in ways that helped the community; for example, linking toxic storage facilities and citizens' complaints.

GIS land parcel reference base

Facilities storing hazardous materials within 1/10 mile of schools.

GIS Software used

- Arc/Info
- Caliper's GIS+
- TIGER Census
- SARA right to know data: EPA
- Local map base from NYC

Number of Odor Complaints

Results

The GIS has been placed in the community and is used to empower residents with knowledge about their own local environmental concerns.

Case Study 4: Channel Islands GIS

- Effective Resource Management for California's Coastal Islands

Contributor: Leal Mertes,
Dept. of Geography UCSB and grad/ undergraduate students.

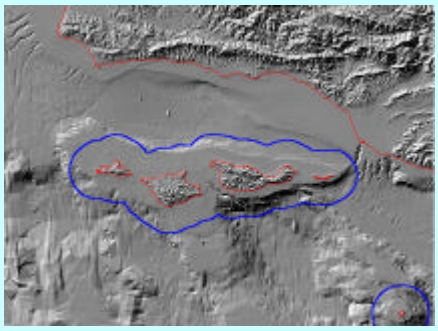
Channel Islands GIS

- Collaborative GIS
- Many contributors and developers
- Public domain and mission-specific data
  - UCSB
  - NOAA Channel Islands National Marine Sanctuary
  - Channel Islands National Park
  - Santa Cruz Island Reserve
  - UC Natural Reserve System
  - State of California Fish and Game (Oil Spill Prevention & Response)

Data layers

- Bathymetry
- Topography
- Flora and Fauna
- Archeological sites
- Sea caves
- Shipping lanes
- Oil platforms
- Geology
- Vegetation
- Soils

DEM and Bathymetry

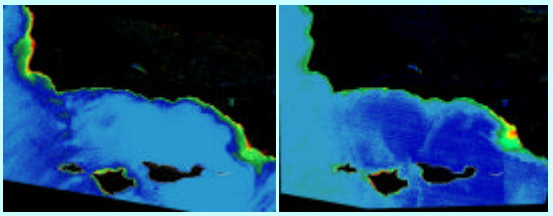


Data suite

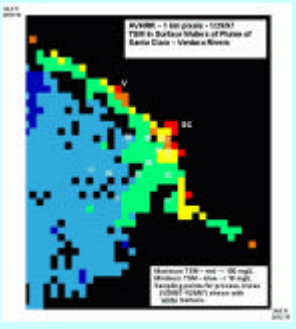
- Master DB is Arc/Info and ArcView
- Ongoing maintenance
- Use on workstations, PCs and on boats
- Plumes and blooms project
- Inclusion in a new class on Watershed Analysis

Plumes and Blooms Project

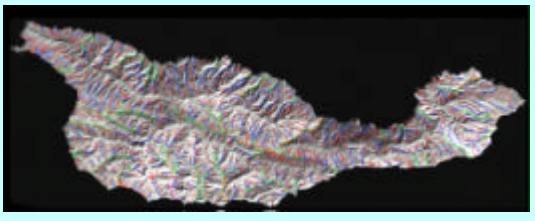
~El Nino Plume response



AVHRR Sediment Plume
Santa Clara/Ventura Rivers



Santa Cruz Island: Watersheds



Outcomes

- ✓ Data set constructed and used for better environmental management
- ✓ Highlighted significance of high magnitude rainfall events on water quality and ecosystems
- ✓ Integrated research, teaching and internships activities
- ✓ Led to Conception Coast project

Case Study 5: Sliding Rocks

Contributor: Paula Messina, Department of Geology, San Jose State University, California.

Sliding rock phenomenon

- Recessed trails in the playa sediments suggest that rocks and boulders glide across an almost perfectly flat lakebed at Racetrack Playa in Death Valley. No one has witnessed the rocks in motion.
- Trails are defined by lateral ridges, suggesting that the surface is saturated and pliant when the rocks move.

Sliding rock phenomenon, ctd.

- ❖ Some trails exhibit splash marks, wakes, and bow waves, indicating that the rocks are propelled at speeds of 2 meters per second or even more.
- ❖ The longest trail, over 800 meters, is fairly straight, but others record extremely chaotic activity.
- ❖ The largest boulders have masses up to 320 kilograms, and their trails are by no means the shortest.

"Ellen" and "Bessie"

Two rocks, "Ellen" and "Bessie", apparently slid to the northwest, imprinting trails as evidence of their unusual activity.

GIS, GPS and Terrain Analysis

- ✓ Dr. Messina, captivated by the sliding rocks of Racetrack Playa, used a variety of mapping and GIS tools to solve the mystery.
- ✓ GPS was used to map the positions of "sliding" rocks, and their trails.
- ✓ GIS was used to find spatial patterns in the movement of the rocks.
- ✓ She used hand-held anemometers to map wind vectors.
- ✓ Terrain analysis provided the elusive clue.

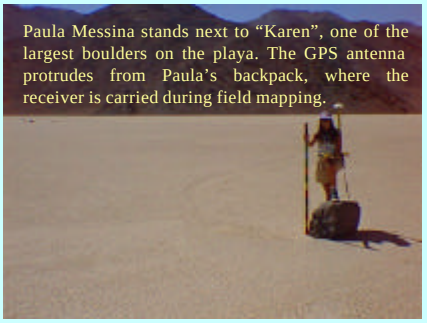
Ice vs. Wind

- Maps of a few selected trails showed significant parallelism, suggesting that rocks may move while imbedded in a cohesive wind-propelled ice sheet.
- While some trails are parallel, most are not. Does that imp ly that ice moves only some rocks?
- Robert P. Sharp concluded that the wind alone, acting over a surface “lubricated” with wet clay may provide enough force to set the rocks in motion.

GPS and GIS to the Rescue

The exact locations of all rocks and precise plans of all trails on the 667 hectare playa were captured by Global Positioning System (GPS), exported to ArcView GIS, and analyzed using a variety of spatial and statistical methods.

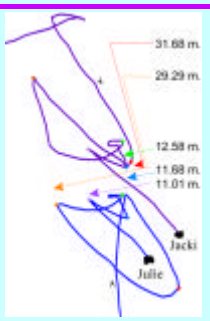
“Karen”



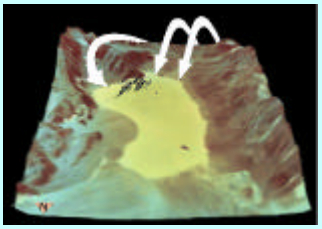
Paula Messina stands next to “Karen”, one of the largest boulders on the playa. The GPS antenna protrudes from Paula’s backpack, where the receiver is carried during field mapping.

Spatial Patterns

The trails of “Jacki” and “Julie” suggest a high degree of similar motion. However, although somewhat congruent, the rocks apparently converged during their calligraphic journeys. There appeared to be no correlation between the size, shape, or lithology of a rock, and the length or straightness of its trail.



Terrain Analysis



Analysis of the surrounding terrain, using the USGS Digital Elevation Model (DEM), provided the clue that had remained hitherto elusive. The slope and aspect of the basin directs airflow along very specific vectors. Direct measurements of the wind revealed that wind speeds up to six times faster, and up to 50 degrees deviant occurred at locations only 400 meters apart.

GIS Software and Data Used

- ArcView GIS
- ArcView Spatial Analyst Extension
- USGS Digital Elevation Model (DEM)
- Global Positioning System (GPS)
- Handheld anemometers

Results

The nature of a trail has more to do with the location of the rock that inscribed it than the physical characteristics of the rock itself. The Racetrack may be thought of as a mosaic of microclimates, with different wind regimes in adjacent locations. A few days after a rain, when fine, saturated clays coat the surface, a “near-Teflon” state supports mobilization of Racetrack Playa’s rocks by wind.

Coming next….

The Future of GIS