GIS in Action

Getting Started With GIS
Chapter 10

Nature (453, 2,1 May 2008)

A place for everything

More researchers must record the latitude and longitude of their data.

Who, what, where and when? Among the basic elements of scientific record-keeping, too often the 'where?' gets neglected. Now advances in satellite-positioning technology, online databases and geographical information systems offer opportunities to make good that neglect, and to add a much-needed spatial dimension to many types of biological research. Location data are essential for those modelling species' responses to climate change, or the spread of viruses, for example. Failure to include spatial information from the get-go may close off potentially highly productive routes to analysis — including those not yet foreseen. But those data are frequently inadequate or absent.

Many museums and herbaria are trying to make good this problem as best they can, geo-referencing their collections and putting them

Understanding GIS by Case Study

- Use of GIS is best understood by examining case studies.
- Case studies in 4ed chapter cover rural, suburban, urban, and coastal GIS applications.
- Case studies in 5th edition use examples from the "glossy" literature

Application issues

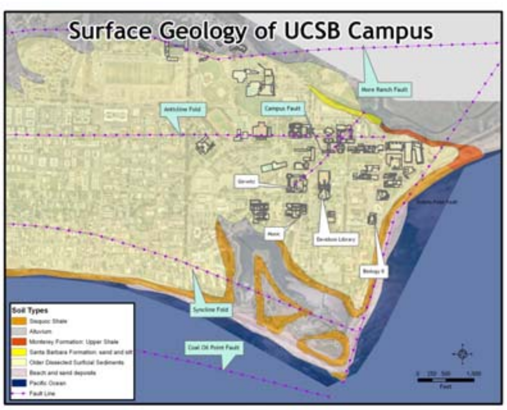
- What problem was being addressed?
- What data were acquired?
- How were the data integrated?
- What methods were used?
- How successful was the application?
- Are the methods general or specific?
- How well did the software perform?

UCSB EARTHQUAKE RISK ASSESSMENT

STEPHANIE COX, JENNY DOUTHETT, AND KELSEY SMITH

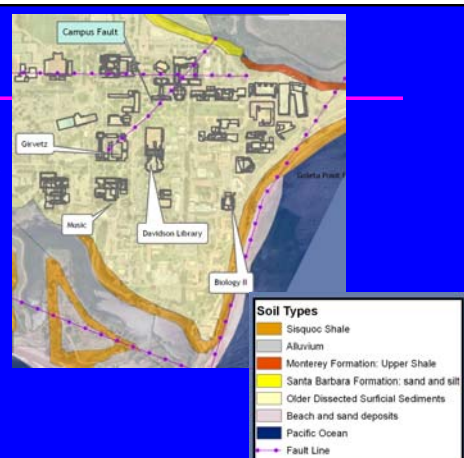
Santa Barbara County Earthquake History

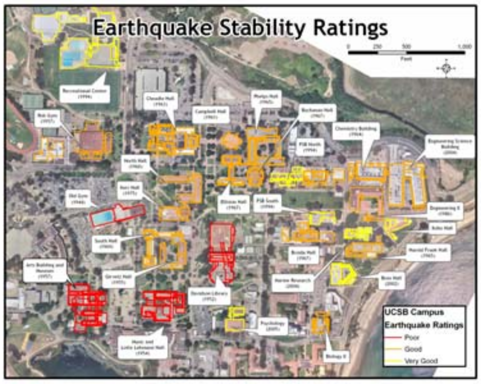
- 1812-Santa Barbara Earthquake
  - Magnitude 7.0
- 1925-Santa Barbara Earthquake
  - Magnitude 6.3
- 1927- Lompoc Earthquake
  - Magnitude 7.1
- 1978- Santa Barbara Earthquake (pictured)
  - Magnitude 5.1



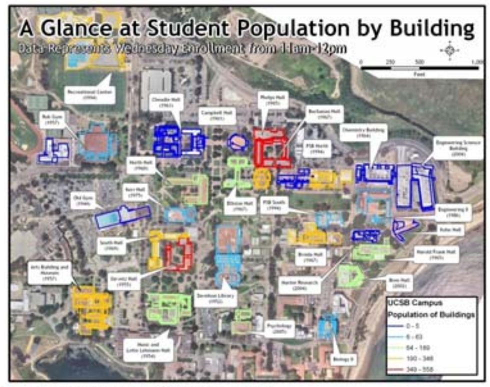
Data Source: Thomas W. Dibblee Jr., 1987
UCSB Map & Imagery Laboratory

- Located on older dissected surficial sediments.
- Composed of alluvial deposits of silt, sand, and gravel.
- Highly susceptible to soil liquefaction.
- Earthquake faults border campus on three sides.
- Campus fault runs directly through Phelps and Girvetz Hall.

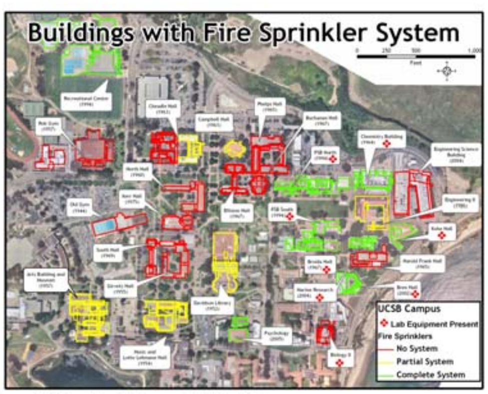




Data Source: University Policy on Seismic Safety, 2008



Data Source: UCSB Office of the Registrar, Spring 2008 Enrollment



Data Source: Jim White, Office of Environmental Health and Safety

High Risk Campus Buildings

Biology II

Seismic Stability Rating-GOOD
Chemicals: Present
Fire Sprinkler System: No system present

Girvetz Hall

Seismic Stability Rating-GOOD
Highly populated
Located directly on "Campus Fault"

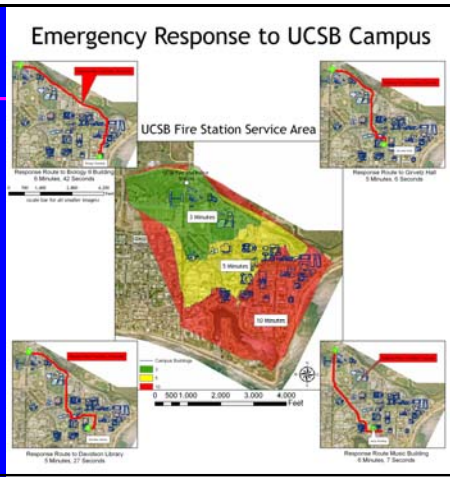
Music Building

Seismic Stability Rating-POOR
Seismic rehab work: Scheduled for 2012-13
Expected Year of Completion: 2016

Davidson Library

Seismic Stability Rating-POOR
Seismic rehab work: Began 2007
Expected Year of Completion: 2014-15

Other buildings for concern:
- Arts Building
- The Old Gym
- Phelps Hall
- Campbell Hall



Project Limitations

- A more thorough assessment of population would provide better preparation techniques.
- Geological data was simplified to provide overview.
- Seismic stability ratings are based on multivariate factors.
- There is a high level of uncertainty in earthquake management, and thus our project is based on presumptions.
- Earthquakes are rapid onset events, and thus preparation is complex.

Conclusions

- Constant development on campus creates a progressive problem.
- Campus safety organizations are aware of the risks and the main issue is time and funding.
- There are on-going developments in disaster preparedness such as the Great Southern California ShakeOut "to prevent disasters from becoming catastrophes." www.shakeout.org
- The "big one" is inevitable and we must be prepare ourselves through education.

The Great Southern California Shakeout Nov 14th Annually

USGS Ground Motion Simulation

Case Study 3:
GIS at the World Trade Center

- How GIS helped in the rescue and clean-up operations after the world's worst terrorist attack

Contributor: Sean C. Ahern
Hunter College - CUNY

September 11, 2001

- **"Get your staff together and start creating maps"**
- Hunter College's Center for the Analysis and Research of Spatial Information (CARSI) called in to help deal with the aftermath

GIS World Trade Center operations at Pier 92

- GIS support for firefighters, rescue workers, utility crews
- 24 hours a day / 7 days a week support for 2+ months
- 50+ GIS professionals

Data

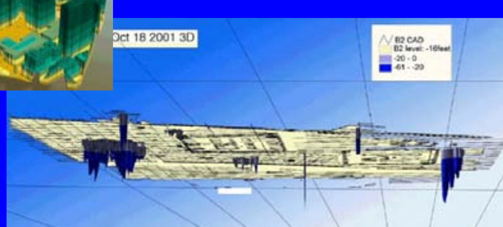
- NYCMap
  - Orthophotography
  - Planimetric maps
- Thermal imagery
- LIDAR imagery
- GPS data

NYCMap

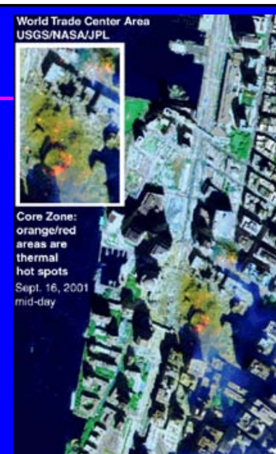
Planimetric map - absolute spatial accuracy of half a meter

30 cm resolution orthophotography

LIDAR



Thermal imaging



Thermal remote sensing data collected at the WTC on September 16.

Source: Roger Clark, USGS, Open File report 01-0429

GPS

Problems

- Maintaining building status database
- Unique identifiers for the buildings?
- Data consistency
- Data integrity
- TIME!

Lessons learned

- NYC GIS infrastructure was critical
- Cities should connect their spatial data to its attributes!
- Need for cartographic standards
- Need mobile access to GIS
- Version management for multi-user environment

Land use and land cover change on the South Coast

Jeffrey Hemphill

Problem

- How has land use and land cover changed on the South Coast given the rapid urbanization since about 1950?
- Are there patterns of LULC change that fit a general model or urban growth?
- Diffusion and coalescence cycle model


1967


1975


1986

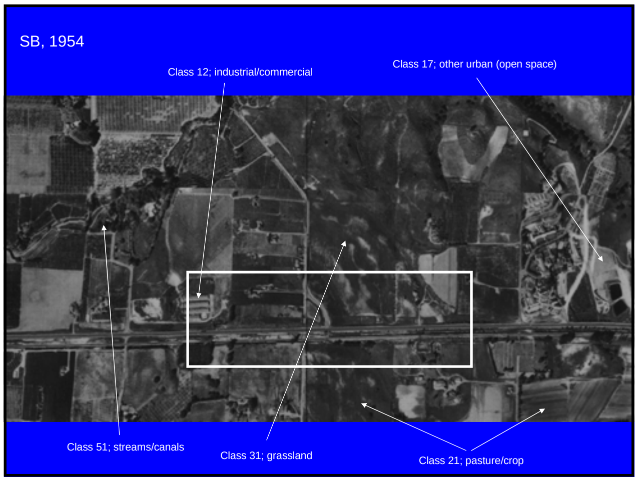

1998

Detail

- Fairview & Hollister intersection

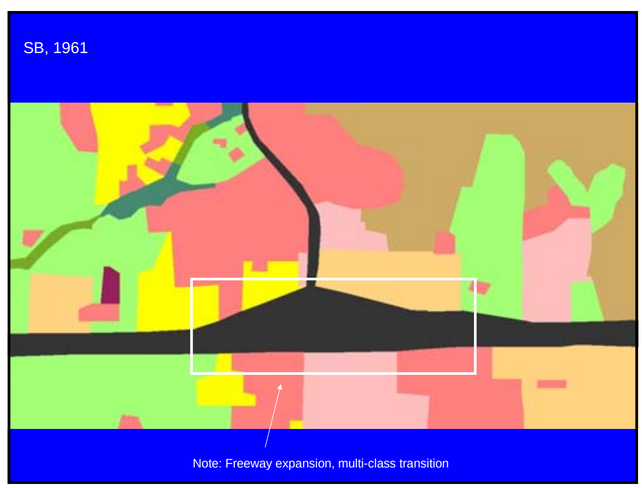
Anderson et al. LULC Classification System

- 1 Urban or Built-Up Land
  - 11 Residential
  - 12 Commercial Services
  - 13 Industrial
  - 14 Transportation, Communications
  - 15 Industrial and Commercial
  - 16 Mixed Urban or Built-Up Land
  - 17 Other Urban or Built-Up Land
- 2 Agricultural Land
  - 21 Cropland and Pasture
  - 22 Orchards, Groves, Vineyards, Nurseries
  - 23 Confined Feeding Operations
  - 24 Other Agricultural Land
- 3 Rangeland
  - 31 Herbaceous Rangeland
  - 32 Shrub and Brush Rangeland
  - 33 Mixed Rangeland
- 4 Forest Land
  - 41 Deciduous Forest Land
  - 42 Evergreen Forest Land
  - 43 Mixed Forest Land
- 5 Water
  - 51 Streams and Canals
  - 52 Lakes
  - 53 Reservoirs
  - 54 Bays and Estuaries
- 6 Wetland
  - 61 Forested Wetlands
  - 62 Nonforested Wetlands
- 7 Barren Land
  - 71 Dry Salt Flats
  - 72 Beaches
  - 73 Sandy Areas Other than Beaches
  - 74 Bare Exposed Rock
  - 75 Strip Mines, Quarries, and Gravel Pits
  - 76 Transitional Areas
  - 77 Mixed Barren Land

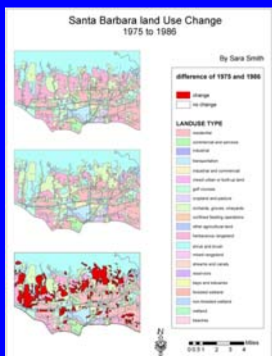

SB, 1954
Class 12; industrial/commercial
Class 17; other urban (open space)
Class 51; streams/canals
Class 31; grassland
Class 21; pasture/crop

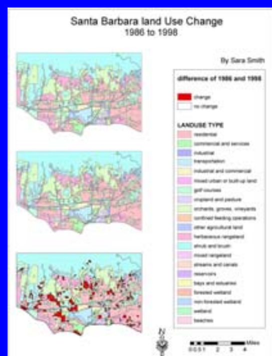

SB, 1954
Note: Freeway expansion, multi-class transition


SB, 1961
Note: Freeway expansion, multi-class transition


SB, 1961
Note: Freeway expansion, multi-class transition

Visualizing Change





Software

- ArcInfo Version 7
  - Register
  - ArcEdit
- Custom LU change software, written in C
- Requires GIF 8 bit image files
- Data will go into the SLEUTH LULCC model

Case Study 5: Sliding Rocks

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

Sliding rock phenomenon

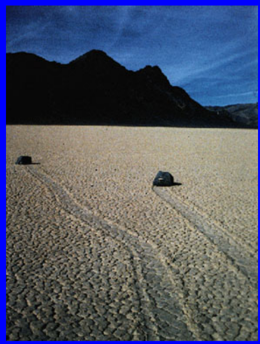
- Recessed trails in the playa sediments suggest that rocks and boulders glide across an almost perfectly flat lakebed at Racetrack Playa in Death Valley. No one has witnessed the rocks in motion.
- Trails are defined by lateral ridges, suggesting that the surface is saturated and pliant when the rocks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



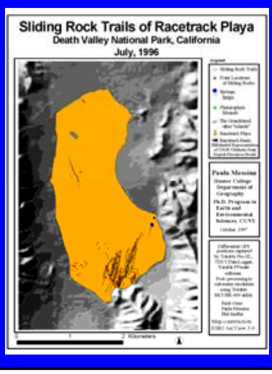
GIS, GPS and Terrain Analysis

- 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

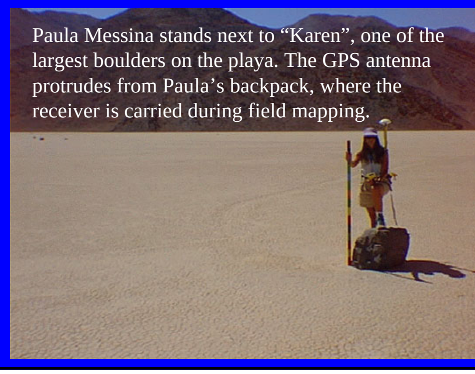
- Maps of a few selected trails showed significant parallelism, suggesting that rocks may move while imbedded in a cohesive wind-propelled ice sheet.
- While some trails are parallel, most are not. Does that impy that ice moves only some rocks?
- Robert P. Sharp concluded that the wind alone, acting 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.

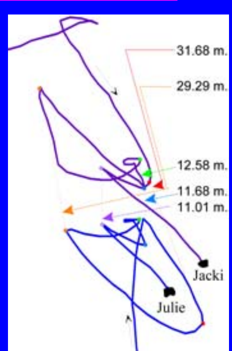
"Karen"



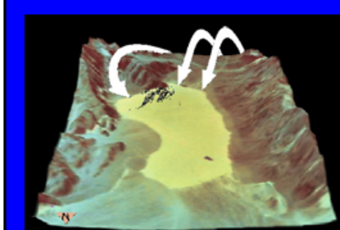
Paula Messina stands next to "Karen", one of the largest boulders on the playa. The GPS antenna protrudes from Paula's backpack, where the receiver is carried during field mapping.

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.

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.

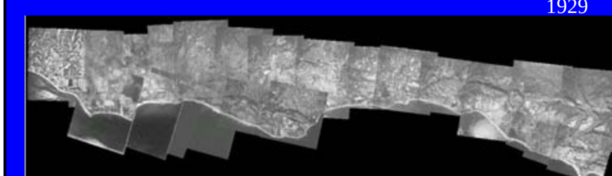
GIS Software and Data Used

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

The South Coast

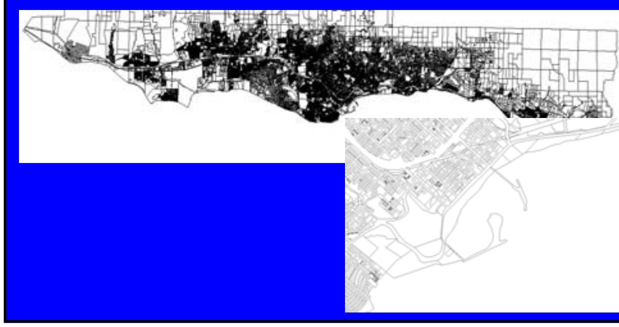
Aerial Photos

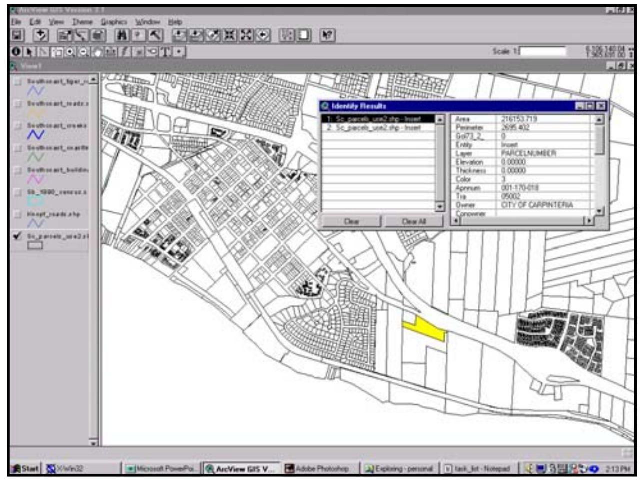
1929

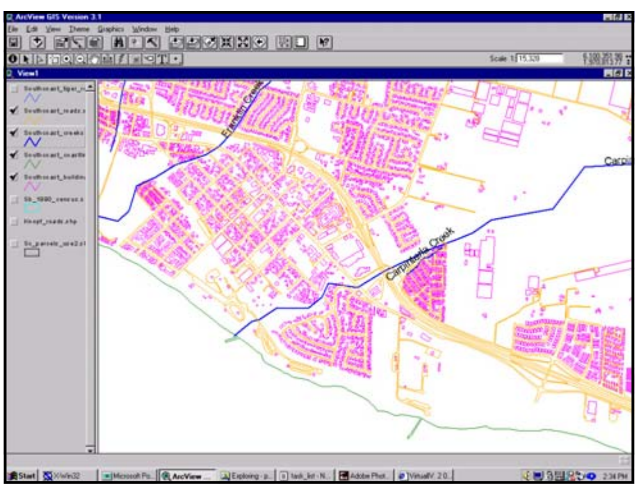


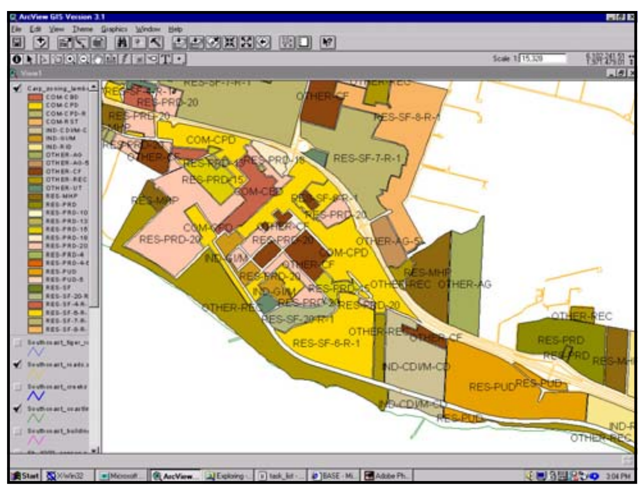
Years: 1929, 1943, 1954, 1967, 1986, 1997

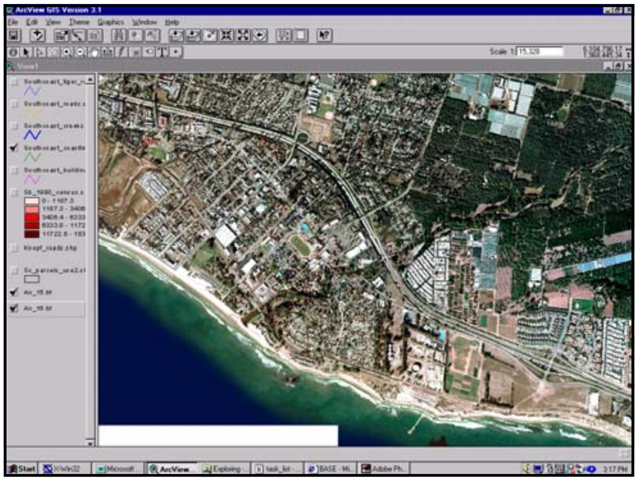
Assessors' Digital Parcel Map



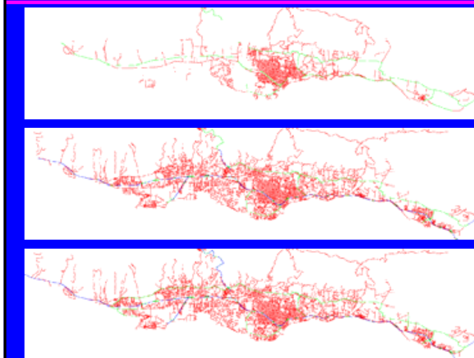






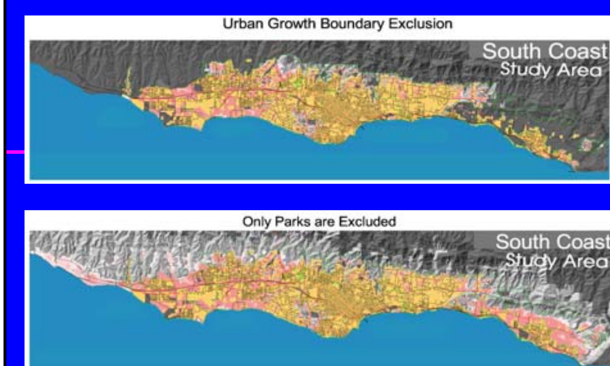


Roads input



Model simulation

2040 Scenarios

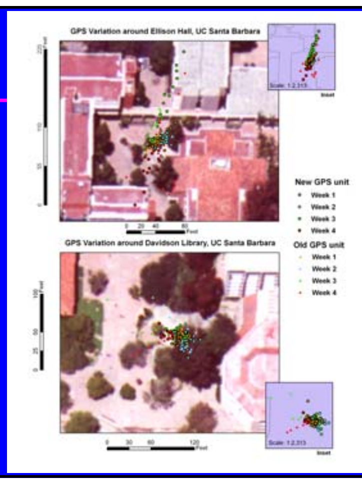


Adeline Dougherty's Honors Project

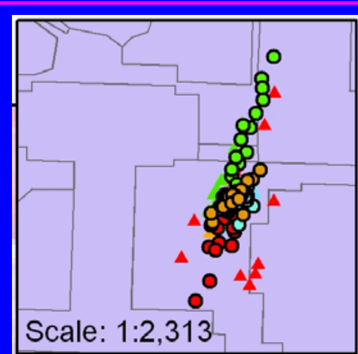
- Create a new test GPS data set for Chapter 6 of the text
- Find a spot where multipath error is likely to be high
- Make repeat measurements over the quarter
- Map them, and build a database so that new stats can be computed

The target (1 of 2)

The map



Lots of multipath error!



Coming next….

- The Future of GIS