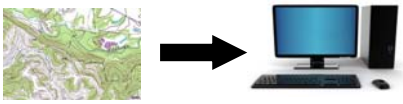


Getting the Map into the Computer

Getting Started with
Geographic Information Systems
Chapter 4

Getting the Map into the Computer

- 4.1 Analog-to-Digital Maps
- 4.2 Finding Existing Map Data
- 4.3 Digitizing and Scanning
- 4.4 Field and Image Data
- 4.5 Data Entry
- 4.6 Editing and Validation

GIS maps are digital not analog

1100010101110100111

- Maps have a communications function but...
- A map has a storage function for spatial data
- Somehow, the visually “stored” data must get digital
- Real and Virtual maps

GIS Data Conversion

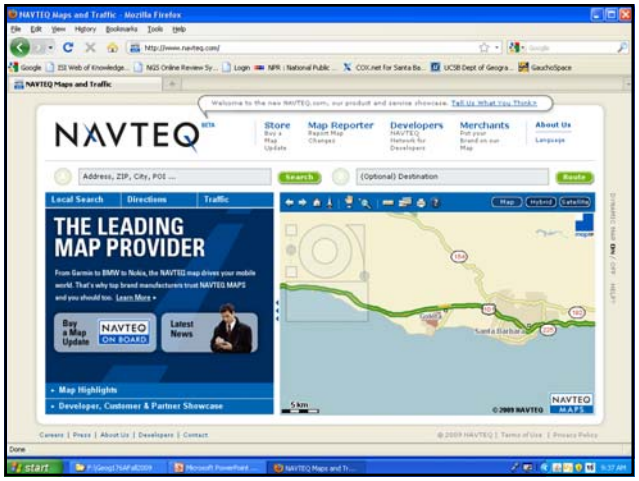
- Traditionally most of the cost of a GIS project
- One time cost
- Depends on reuse
- Requires maintenance
- Often done a whole collection at a time

Data or service?

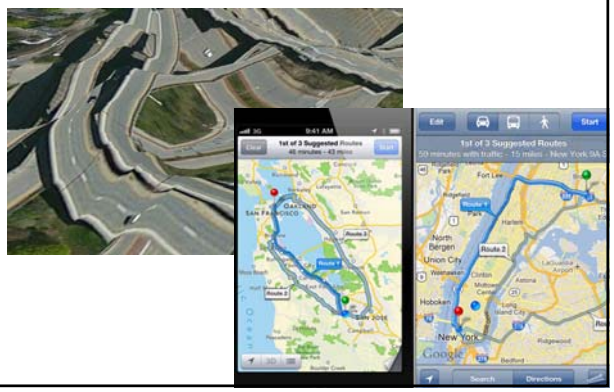
- Initially, GIS users wanted raw data for use in GIS, one project at a time
- Data reuse makes a great deal of sense!
- Next came clearinghouses and web portals: facilitating search and **discovery**
- Now the Internet offers web services
  - Solutions not data
  - But, queries can be tracked
- What next?

Finding Existing Map Data

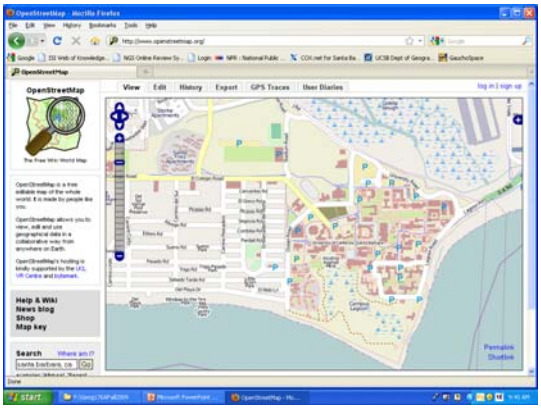
- Map libraries
- Reference sources e.g. data.gov
- State and local agencies
- Federal agencies
- Commercial data suppliers e.g. Rand McNally, Thompson, maps.com
- Teleatlas (TomTom), Navteq (Nokia)



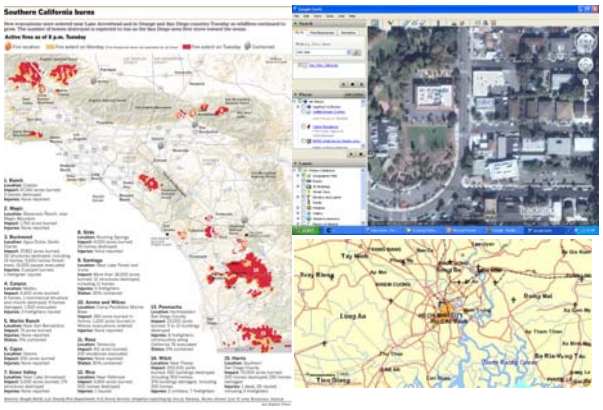
Apple Maps Ap



www.openstreetmap.org



Sources



Existing Map Data

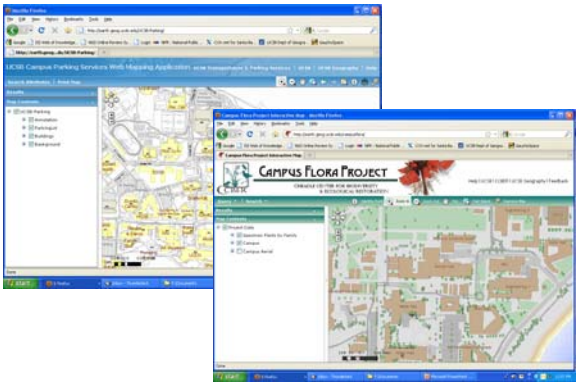
- Existing map data can be found through a map library, via network searches, or on media such as CD-ROM and disk
- Data providers make their data available via the Web, a network of file servers available over the Internet
- GIS vendors package data with products
- Web portals, search engines, clearing houses, “discovery”, the cloud

Commercial vendors




DeLorme: Eartha

Even USCB Geography is in on the act



Global data

- Concept of GSDI
- NGA: World data, e.g. VMAP0
- Global Map: ISCGM http://www.iscgm.org/cgi-bin/fswiki/wiki.cgi
- NASA Worldwind
- GDEM and SRTM
- United Nations: UNEP, UNICEF etc.
- Many clearing houses by topic, e.g. weather
- Continental data bases e.g. http://www.africover.org, CORINE

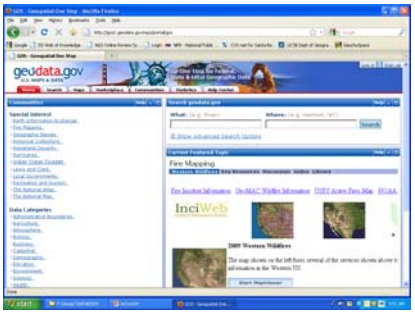
US Federal Data Agencies

- USGS
- NOAA
- Census Bureau
- NGA
- EPA
- FEMA
- many more...

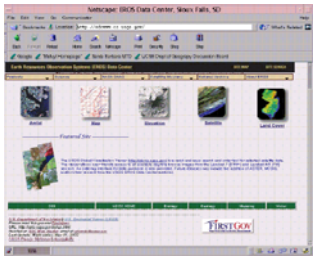
National Spatial Data Infrastructure

National Spatial Data Clearinghouse

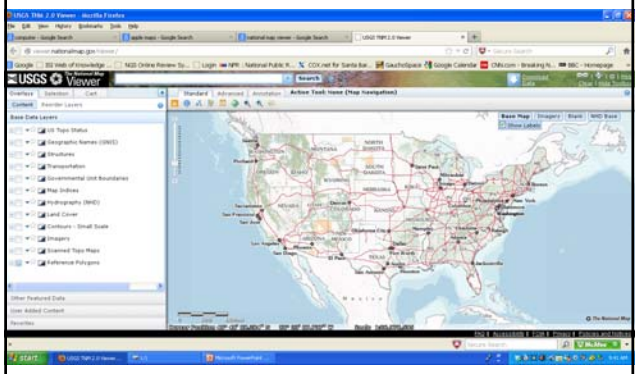
NSDI network
Includes geodata.gov
Geospatial onestop, eGov initiative from 2002



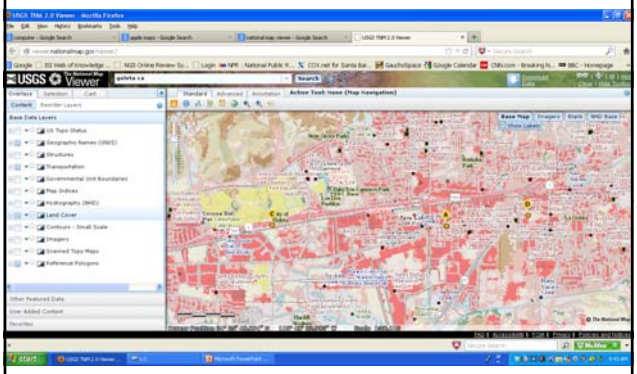
USGS: National Mapping



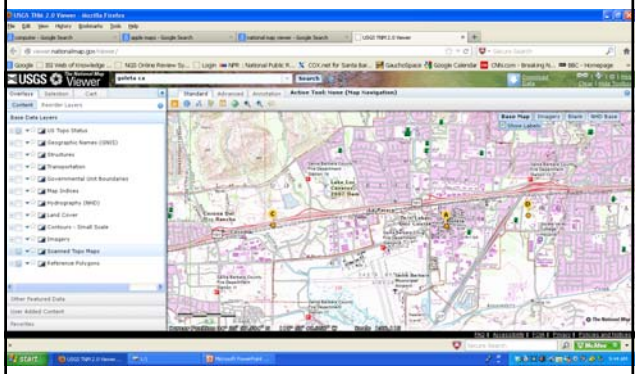
National Map Viewer



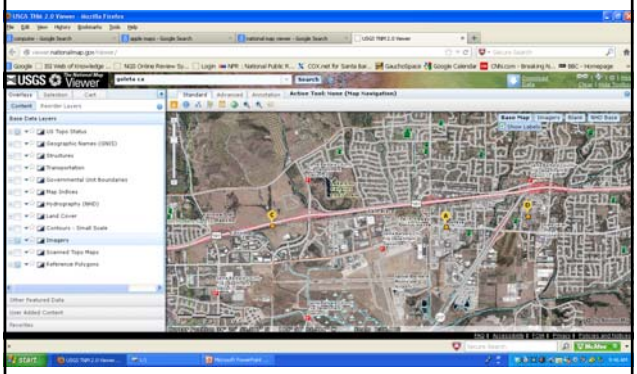
Land use, place names, transportation



DRG and USTopo



DOQQ



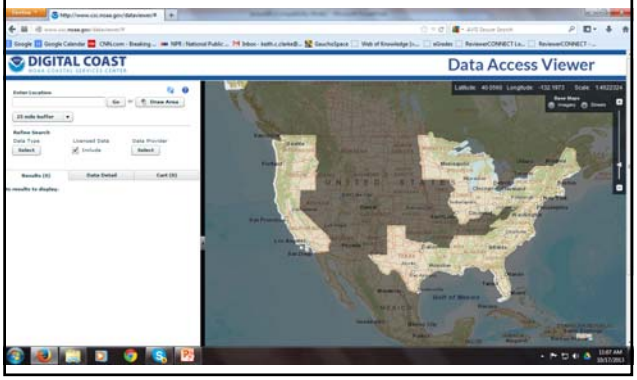
Seamless download

- Identify a point, quad, region (e.g. county), or polygon
- Server “cuts out” and mosaics data
- Sends an e-mail with limited time access to an ftp site
- Data are zipped and structured by layer
- Process is automated, but requests can get very large, very quickly!

GeoPDF and the “Map Store”

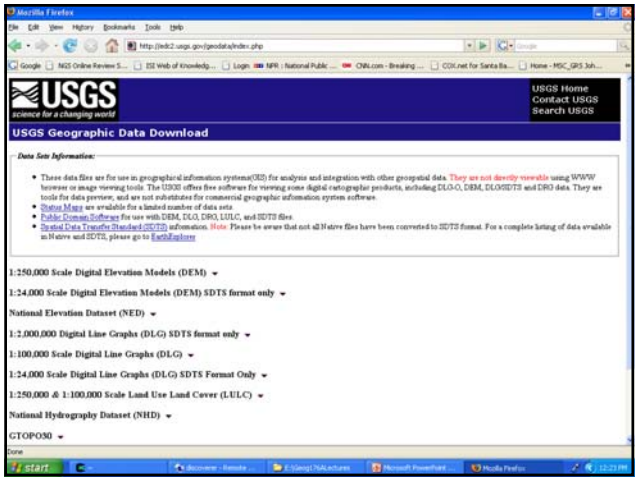
U.S. Bureau of the Census

NOAA: Digital Coast

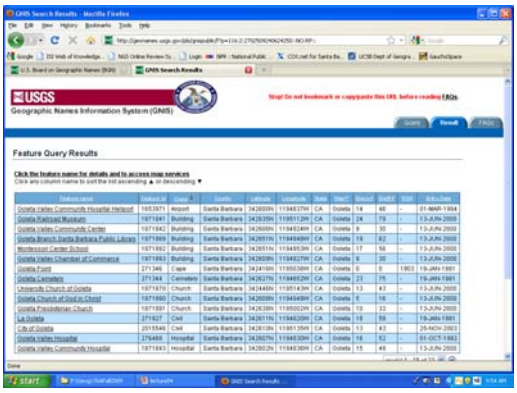


Eros Data Center

- Distributed active archive center
- Sioux Falls, SD
- Operated by USGS

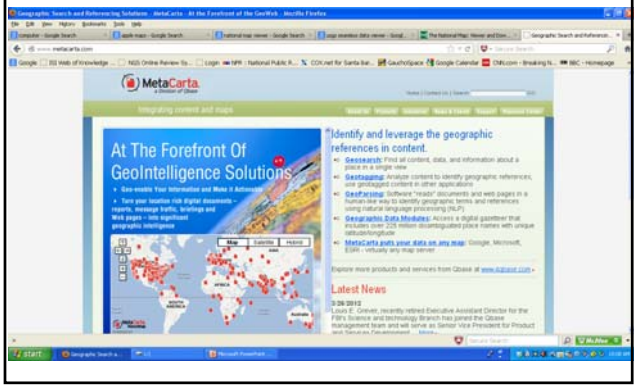


GNIS Feature locations

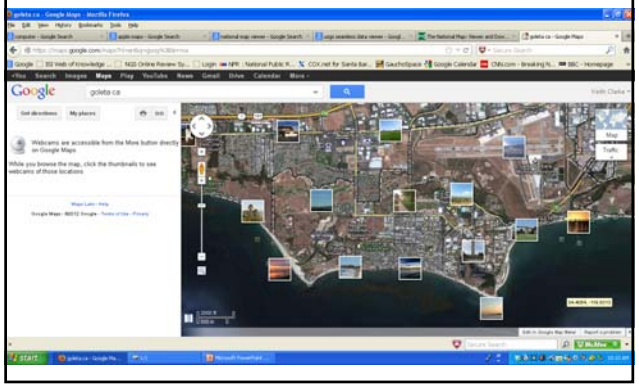


GeoNames server

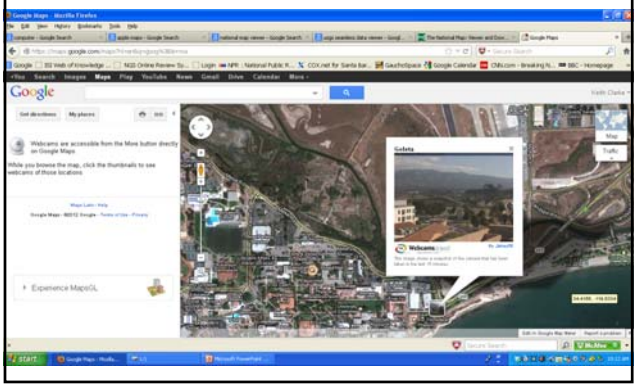
Metacarta.com



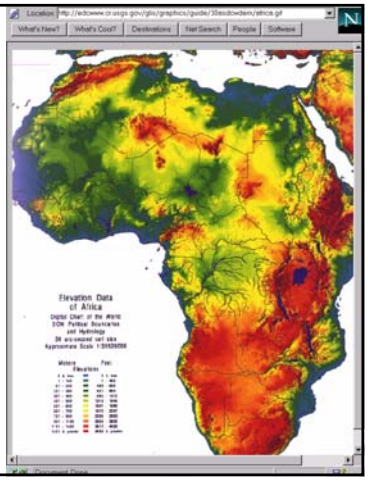
GeoTagged images, social media



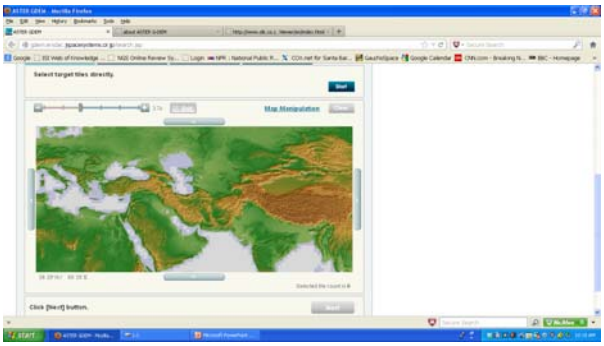
Geotagged Webcams



Terrain data
DEM
DLG
Contours
DCW
Contours
SRTM
GDEM



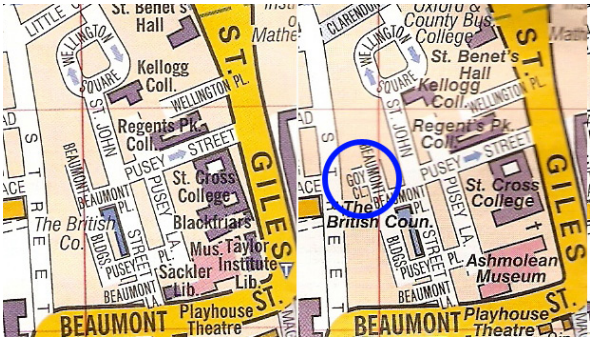
GDEM: search, tiles



Your Spatial Data "Rights"

- US Federal
  - FOIA
  - COFUR
- State (e.g. California, Teale Data Center)
- Local (e.g. Portland, OR Metro)
- Other countries
- Protection for security
- Steganography, watermarks, deliberate error
- Attributes vs. map data

Cartographic traps



“Goy Close”

A Cartographic Trap

Left: From A-Z streetmap of central Bristol (redrafted).
Above: Open Street Map

GeoPrivacy:Google Street View

GIGAOM

HOME APPLE CLEANTECH CLOUD DATA EUROPE MOBILE VIDEO

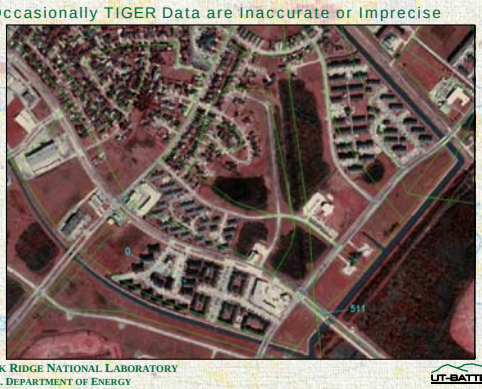
Aug 10, 2010 - 8:33AM PT

Google Street View Opt Out Goes Live in Germany While Spain Investigates

By Mathew Ingram

German citizens can now request that photos of their homes or businesses be blurred to prevent them being identified in Google's Street View photo service, which is about to launch. Meanwhile, Spain says it is investigating Google's collection of wireless data via its Street View cars.

Occasionally TIGER Data are Inaccurate or Imprecise

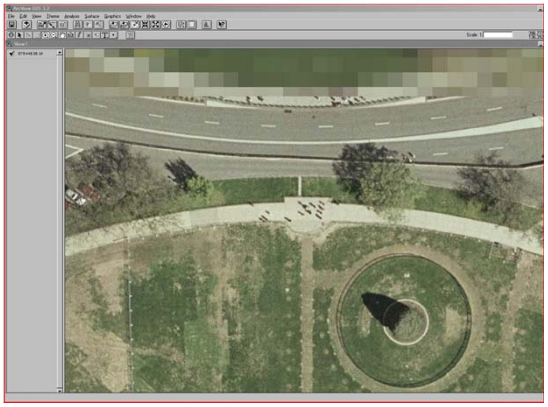


OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE

CORONA (KH Satellites)
Goleta, CA, 1967 Image

The White House in TNM



Post 9-11 2001: 2005 report

Mapping the Risks

Assessing the Homeland Security Implications of Publicly Available Geospatial Information

JOHN C. BAKER, BETH E. LACHMAN, DAVID R. FRELINGER, KEVIN M. O'CONNELL, ALEXANDER C. HOU, MICHAEL S. TSENG, DAVID ORLETSKY, CHARLES YOST

Prepared for the National Geospatial-Intelligence Agency

Approved for public release, distribution unlimited

RAND NATIONAL DEFENSE RESEARCH INSTITUTE

GIS data can be:

- Purchased
- Found from existing sources in digital form
- Captured from analog maps by GEOCODING

GEOCODING

- Geocoding is the conversion of spatial information into digital form
- Geocoding involves capturing the map, and sometimes also capturing the attributes
- Necessarily involves coordinates
- Often involves address matching

GEOCODING LEAVES A "STAMP" ON DATA

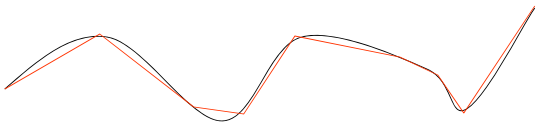
- The method of geocoding can influence the structure and error associated with the spatial information which results
- Examples: scanning (raster), digitizing (vector)

Geocoding methods for geospatial data

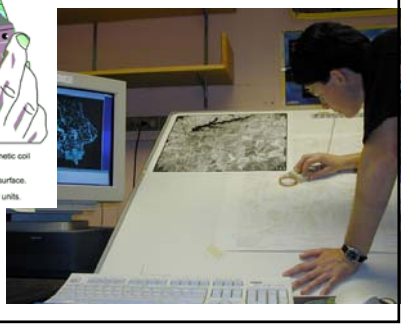
- Measure the map
  - –Digitizing
  - –Scanning
- Measure the earth
  - –Field data collection

Digitizing

- Captures map data by tracing lines from a map by hand
- Uses a cursor and an electronically-sensitive tablet
- Result is a string of points with (x, y) values



The Digitizing Tablet



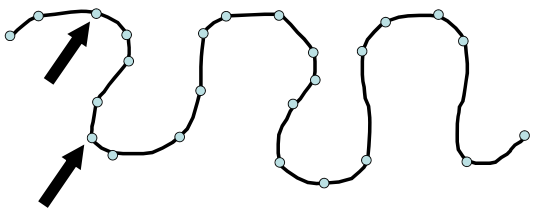
Digitizing

- Stable base map
- Fix to tablet
- Digitize control
- Determine coordinate transformation
- Trace features
- Proof plot
- Edit
- Clean and build

Digitizing

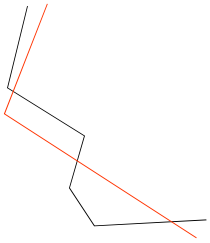
- Cursor data entry
- Secondary tablet (menu/template)
- Voice command entry
- Point select
- Stream mode
- Distance mode

Selecting points to digitize



Some common digitizing errors

- Slivers
- Duplicate lines
- Duplicate nodes
- Unended lines
- Gaps
- Zingers



Scanning

- Places a map on a glass plate, and passes a light beam over it
- Measures the reflected light intensity
- Result is a grid of pixels
- Image size and resolution are important
- Features can "drop out"

Scanning

- Flat bed
- Drum
- DPI
- File size

Scanning example

15 x 15 cm (3.6 x 3.6 km)

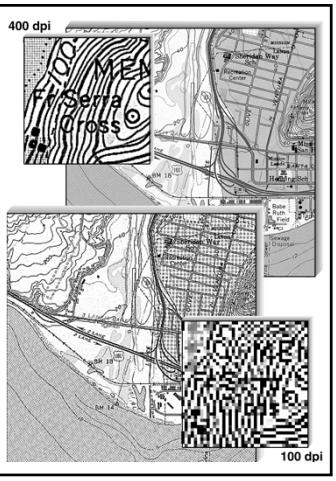
grid is 0.25 mm

ground equivalent is 6 m

600 x 600 pixels

one byte per color (0-255)

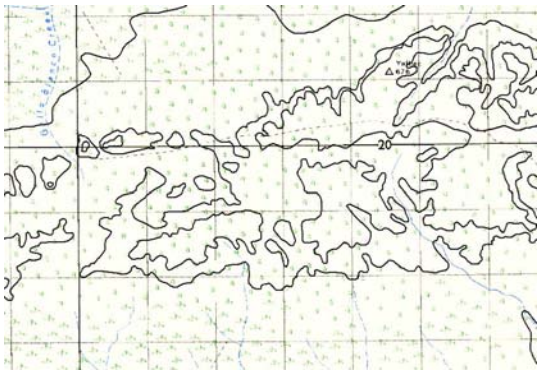
1.08 MB



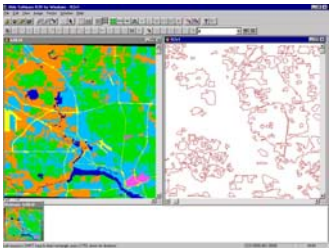
File size for raster images

- Header block: Usually contains name of format, metadata, nrows, ncols, cell size in bytes
- Data bloc: nrows x ncols x bytesize (x color bands)
- Some image formats e.g. PNG support a transparent layer
- Image format conversion often involves flattening

On-screen (heads up) digitizing

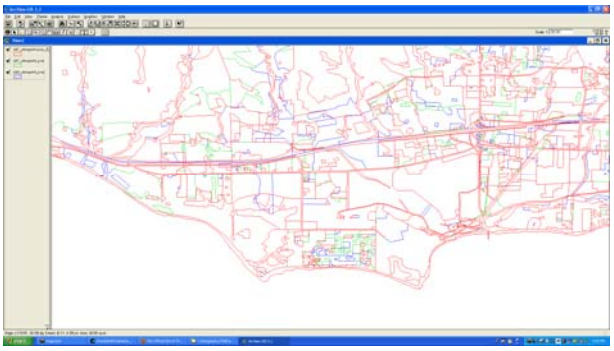


Select and trace vectors or updates



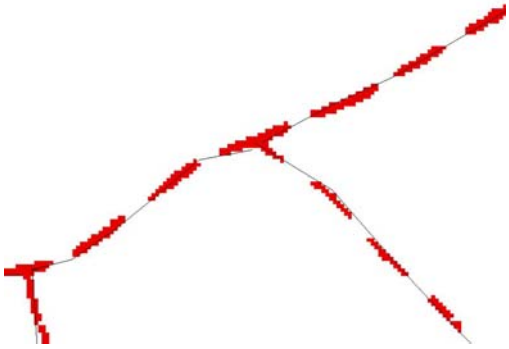
Add
Delete
Move
Split
Join

Capturing change

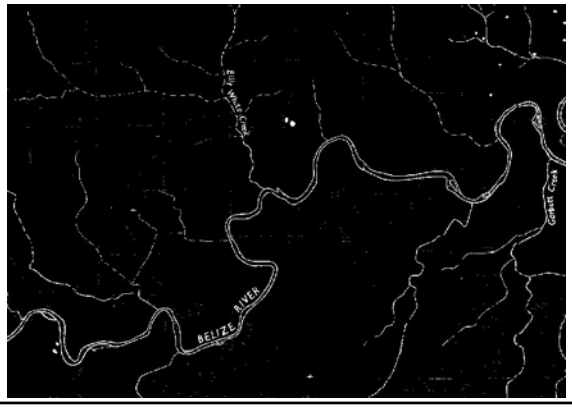


Isolate layer and capture

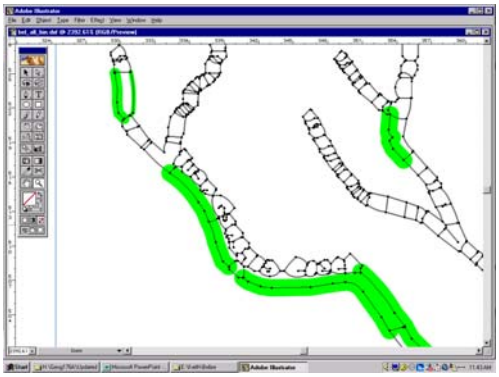
Resolve errors



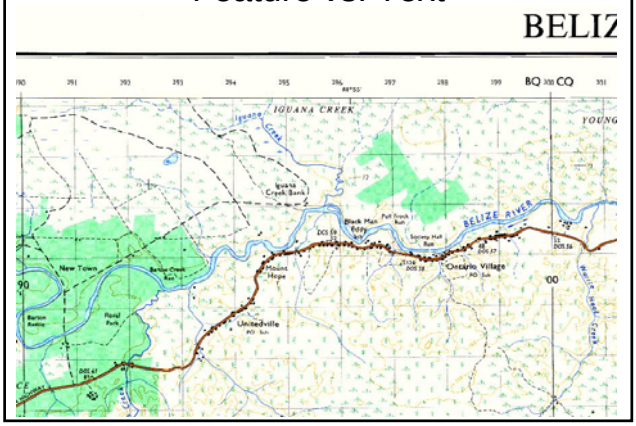
Automatic Raster-to-vector



Rasterization problems



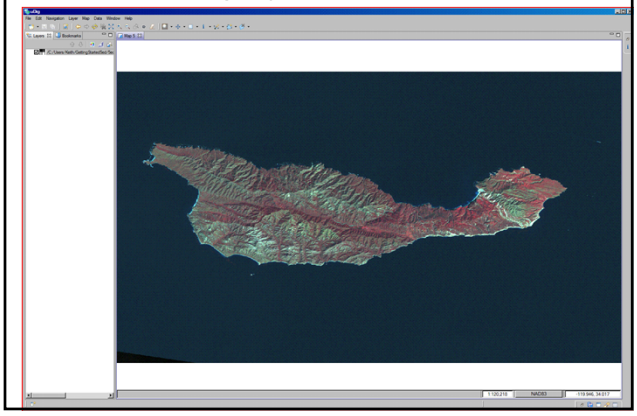
Feature vs. Text



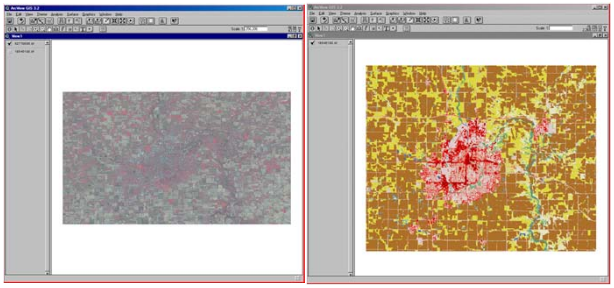
Field data collection

GPS navigation/tracks

Imagery source data



Derived data; e.g. LULC



Attribute data

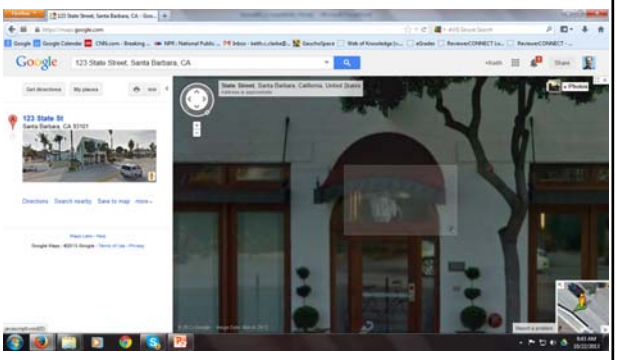
- Logically can be thought of as in a flat file
- Table with rows and columns
- Attributes by records
- Entries called values

Forms-based data entry

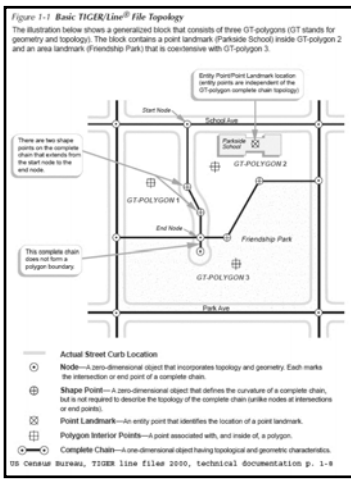
Address Matching

- Most GISs contain capability
- Start with 123 Main St, Santa Barbara, CA 93101
- End with Coordinates
- May need to interpolate along blocks
- Street number range, left and right side e.g. 101-199
- Example: 145 = 100 block + 45/99 left side

123 State Street, Santa Barbara



TIGER basis



Database Management Systems

- Data definition module sets constraints on the attribute values
- Data entry module to enter and correct values
- Data management system for storage and retrieval
- Legal data definitions can be listed as a data dictionary
- Database manager checks values with this dictionary, enforcing data validation

Database elements

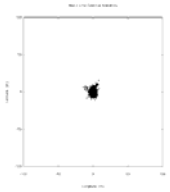
- Type of value
- Range
- Missing data
- Duplicate data
- Key

```
Attribute_labels = "ID #", "Feature",
"Name" , "Surface" , "Lanes", "Traffic" , "per hour"
"1",
"Road",
"US 11",
"tarmac",
"3",
"113"

"2",
"Road",
"I 81",
"concrete",
"4",
"432"

"3",
"Road",
"Lisk Bridge Road",
"tarmac",
"2",
"12",
"4"
```

The Role of Error

- Enforcement for map data is usually by using topology
- Map and attribute data errors are the data producer's responsibility, but the GIS user must understand error
- Accuracy and precision of map and attribute data in a GIS affect all other operations, especially when maps are compared across scales

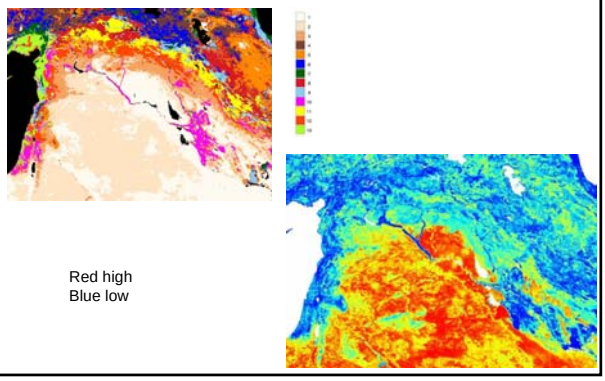
Types of error



- Omission and commission
- Additive and multiplicative
- Positional or attribute
- Systematic or random
- Measurement or process
- Dealing with uncertainty in mapping

Remote sensing example

http://www.yale.edu/ceo/Projects/swap/landcover/uncertainty.htm



Red high
Blue low

coming next…..

What is where?