GIS Tools and Information Sources

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Outline

• Introduction and objectives
• GIS: an overview and concepts
• Vector (vs.) raster data types: transportation network and elevation (examples)
• Data lineage: “metadata”, the door to data
• Software – desktop and Web based: ArcGIS and extensions
• Sources of geospatial data
• Kentucky Geography Network – KYGEONET
• Conclusions
• Q/A
Objectives

• Sources of geospatial data layers and information on the Web and internet, relevant to geohazards (i.e. location and nature of potential geohazards)

• Analysis/mapping tools: desktop GIS software (ESRI’s ArcGIS suite of desktop software products)

• Spatial layers and services published and maintained in various sites, with emphasis on the Kentucky Geography Network (KYGEONET)
What is GIS?

“An acronym for geographic information system: An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed”.

Feature classes:
- Point features = sinkhole centroids
- Line features = transportation, hydrography
- Polygon features = parcels, boundaries

Methods:
- On-screen digitizing
- GPS
- Scanning paper maps

File format:
- Shapefiles
- CAD

"PLANIMETRIC DATA" = GEOMETRY + GEOGRAPHY
Spatial resolution = pixel size

Spectral resolution = “bands”

Tessellation of space = picture elements (pixels)

Raster Data Model

August 05, 2009
For your elevation needs …

• The Kentucky Geography Network:

    • KY Single Zone State Plane Coordinate System?
    • UTM – USGS?
    • Slope? Hillshade?
(D)igital (E)levation (M)odels

- Required for visualization/virtualization
- FGDC – (USGS) format (.dem)
- Ingestible into ArcGIS
- Converted to: ESRI GRID, tiff, img, jpg
- x,y,z (elevation)
- 1-band “image” = raster
- Post-spacing (g.s.d. = ground sampling distance) → “pixel size”

- SPATIAL RESOLUTION
- ACCURACY
... but

LiDAR makes better DEMs!
Toyota
Georgetown, KY
“true” images (digital)

- Scanned documents (paper maps)
- D(igital) R(aster) G(raphics) (topographic maps)
- Aerial/satellite imagery (“maps”)
What is Remote Sensing?

"Remote sensing is the science (and to some extent, art) of acquiring information about the Earth’s surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information."

http://rst.gsfc.nasa.gov/
http://www.ccrs.nrcan.gc.ca/resource/tutor/fundam/chapter1/01_e.php
What Are Remote Sensing Systems?

Sensors on Aircraft

Sensors on Satellites
Geotechnical Remote Sensing…
(“mapping” implied – not always “geospatial”)

• Ground Penetrating Radar (GPR)
• Electromagnetic Induction (EMI)
• Side-looking (terrestrial) laser (LiDAR)
• Acoustic methods (SONAR)
• Optical methods (Hyperspectral)
• etc.
Deriving *information* from digital imagery

• We are all remote sensors
  – Visual *photo interpretation*
    • Tone
    • Shape
    • Size
    • Pattern
    • Texture
    • Shadow
    • Association
  – Tools that can be developed through photo-interpretation
Spatial Resolution
Kentucky’s Imagery
Varying Spatial Resolutions
For your high resolution imagery …

• The Kentucky Geography Network:
  
    • Temporal resolution (2006?, 2008?, 2004?, etc.)
    • Spatial resolution (1 meter, 2 meters, 2 feet?)
    • Spectral resolution (RGB, CIR?)
Input

GIS (geoprocessing)

Output

- Transportation Network
- Soils ("surficial geology")
- Geology
- Karst features
- Hydrology/hydrography
- Elevation (DEM, contour lines)
- RESOLUTIONS – ACCURACIES - SCALES

- Query/Selection
- Topological analysis
  - (containment, adjacency, connectivity)
- Proximity (buffer)
- Overlay (layer grouping, Boolean logic, map algebra)
- Geostatistics (e.g. kernel density, spatial correlation)
- Visualization/virtualization (3-D and pseudo 3D)
- RESOLUTIONS - SCALES

- Classification schemas
- Risk models
- Maps (hard/soft copy): thematic, choropleth, feature, density, dasymetric, etc.
- Text
- SCALE – RESOLUTION - ACCURACY
Downloading shapefiles from the KYGEONET...

A "shapefile" is made of several files (FILE based)...

**shapefile**
[ESRI software] A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.
“Metadata are data about data, of any sort in any media. An item of metadata may describe an individual datum, or content item, or a collection of data including multiple content items.”

http://en.wikipedia.org/wiki/Metadata
GIS AND “GIS” SOFTWARE

– Web-based “GIS”
  • Google Earth:
    – http://maps.google.com/
    – http://maps.google.com/
  • Microsoft Bing Maps: http://www.bing.com/maps/

– The Commonwealth Map:
  – http://kygeonet.ky.gov/tcm/viewer.htm
  – http://kygeonet.ky.gov/kyweather/

– Desktop-based GIS
SOURCES OF GEOSPATIAL DATA

• The Kentucky Geography Network: KYGEONET: http://kygeonet.ky.gov
• Kentucky Mine Mapping Information System: http://minemaps.ky.gov/
• Kentucky Geologic Map Information Service: http://kgsmmap.uky.edu/website/KGSGeology/viewer.asp
• etc.

• The National Map Seamless Data Distribution: http://seamless.usgs.gov
• USDA Data Gateway: http://datagateway.nrcs.usda.gov/
• Soil Data Mart: http://soildatamart.nrcs.usda.gov/
• etc.
ArcGIS Desktop extensions
(automate process of geospatial information layer extraction)

• Feature extraction (create delineations in automated fashion): Feature Analyst

• Structure/bare earth extraction from LiDAR data: LiDAR Analyst

• LiDAR (LAS file format) classification: LP360
  – http://www.qcoherent.com/

• Image classification: ERDAS Image Analysis

• Soil thematic layer creation: Soils Data Viewer
  – http://soildataviewer.nrcs.usda.gov/
Summary

- Geospatial data are accumulating… fast!
- Accuracies and resolution increasing … fast!
- Web/Internet based analysis services coming up… fast!
- Desk-palm-lap top analysis … still important
Contact Information

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Questions?