GIS and Data Themes
- A Brief Introduction -

Presented to
McCurtain Local Government Officials
October 26, 2009

Al Tongco
Research Specialist – GIS
Dept of Agricultural Economics
Oklahoma State University
al.tongco@okstate.edu
GIS – an acronym for . . .

• Geographic information system
• Geographical information system (British)
• Geospatial information system (GIS plus heavy usage of satellite and aerial photos)
  – Geographic information science or Geospatial information science
What is GIS?

• An information system
• Uses geographically-referenced data
  – Having latitude, longitude, and elevation
  – People, places, things on Earth
So what is GIS?

• An information system composed of
  – People
  – Hardware (computers/servers, wide-format printers & scanners, GPS eqpt)
  – Software (e.g. ArcGIS, Mapwindow, Manifold GIS, Quantum GIS)
  – Data (non-spatial and spatial data)
  – Methods (i.e. guidelines, specs, standards)

• Used to capture, manipulate, analyze, interpret, manage, store, retrieve, and display non-spatial and spatial (geographically-referenced) data
  – Tables, statistical results, graphs, charts
  – Maps (paper, digitized, scanned)
  – Raster (satellite, aerial, LIDAR)
What does GIS do with data?

• Captures / Collects
  – Spatial data (geographically-referenced data)
    • Digital vector maps (lines, points, and areas)
    • Raster maps (satellite and aerial photos, LIDAR)
    • GPS points
    • Survey data
  – Non-spatial data
    • Tables
    • Text
    • Hard-copy paper maps

• Manipulates / Analyzes / Interprets / Manages / Stores / Retrieves / Displays / Produces
  – Spatial data
    • Digital data
    • Digital maps
    • Image maps
  – Non-spatial data
    • Tables
    • Statistical results
    • Graphs
    • Charts

• Overlays produced spatial data to visualize and analyze trends and patterns
What can GIS do?

• Visualization and Mapping (2D, 3D)
What can GIS do?

• Database management
  – Stores and organizes spatial data
What can GIS do?

• Spatial analysis
  - Overlaying of data layers visualizes and analyzes relationships, interactions, connections, patterns, and trends
GIS Data Themes for Local Government

(Reference: GIS for the Nation Poster)

- Emergency operations
- Structures and critical infrastructures
- Local government units
- Utilities
- Addresses and names
- Transportation
- Cadastral
- Hydrography
- Environmental
- Land use, land cover
- Base map
- Elevation
- Imagery
- Geodetic control
Emergency Operations

- Damage locations, road closures, evacuation routes, shelters, contamination zones, fire boundaries
- Used for emergency response, Homeland Security, and national preparedness
Structures and Critical Infrastructures

- Structure locations, building footprints. Point locations for building centroids, entrances, and driveway entrances. Building complexes, often includes 3D.
- Used for tax assessment, planning, emergency response, critical infrastructure protection.
- High accuracy required for neighborhood and city level maps.
Governmental Units

- Administrative areas, census units, and management jurisdictions for local governments, states, federal agencies, and Native American organizations
- Used as administrative and legal boundaries
- High accuracy required. Units can span across a range of map scales from 1:10,000 or 1:25,000 in cities.
Utilities

• Key components of water, wastewater, electrical, telecommunications, and pipeline networks.
• Used as maps for transmission and distribution, emergency response, critical infrastructure protection
• Accurate relative to cadastral and transportation data. Typical data capture scales are from 1:2,500 to 1:6,000.
Addresses and Names

- Address ranges along street centerlines (DIME style addresses) and address point locations for building entrances. Includes place names for key landmarks, geographic zones, and locations.
- Used for geocoding, route planning
Transportation

• At the neighborhood level: curb-lines, street centerlines, rail, commuter lines, bus and other route lines; transportation ports and stations as polygons.
• At city and above: street centerlines, and public transportation routes as lines, transportation ports and stations as points.
• Used as basemaps for transportation planning and analysis, emergency route planning.
• Larger scale representations provide more detailed infrastructure and network characteristics.
Cadastral

• Tax parcels, ownership parcels and parcel corners. Includes key features that integrate into the land fabric such as zoning, rights, interests, and easements.

• Used as tax mapping, surface ownership maps, PLSS reference maps.

• Primarily collected at neighborhood scales using survey techniques.
Hydrography

• Hydro points, lines, and polygons. Watersheds, coastlines, and drainage areas. Connectivity and channel profiles for hydrological analysis. Integrates with high resolution (5-m) DEM.

• Used as maps for surface water features for moving, storing, and managing water. Base mapping. Includes support for hydrologic analysis.

• Local needs dictate better than 25k resolution, especially in flood prone areas.
Environmental

- Includes physical features and landform characteristics such as geology, soils, slope, aspect, vegetation, and floodplains as well as weather/climate. Also includes hazards and events (such as earthquakes, volcanic activities, and natural disasters). Also, environmental monitoring sensors and associated measurements (such as stream gauges, weather stations, and air quality monitoring sensors).
- Soil maps, geology maps, and maps for environmental monitoring, permitting, spatial modeling, and analysis.
- Collected at city levels or 1:25,000 map scales.
Land Use / Land Cover

- Areas that define the primary ways in which land is used (e.g., urban, rural, agricultural, range, forest, and so on)
- Used as land cover maps for planning, zoning
- Collected at city levels as attributes on parcels and administrative land
Base Map

- Includes the use of map sheets as scanned background maps such as scanned digital raster graphics (DRG) consistent with national maps, as well as for each state and for cities.
- Nationwide basemap products:
  - 1:25,000; 1:100,000; 1:250,000; 1:1,750,000 Cities and
  - Other Special Areas: 1:5,000 to engineering scales
Elevation

- Includes surface elevation and bathymetric observations (such as LiDAR point collections, hydrographic surveys, and other 3-D surveys) as well as derived digital elevation datasets for surface terrain, such as DEMs.
- Used for viewshed analysis, surface distance calculation, and resource flows. Environmental and water resources planning and analyses.
- Resolution to support 5-m DEM products for 2-foot contours. In low-lying, flat areas, finer resolution DEM’s supporting at least 1 foot contours should be used.
Imagery

- High resolution digital orthophotography coverage collected at periodic time intervals.
- Also, includes government generated products (such as USGS Digital scanned map sheets (ADRG’s), AVIRIS Hyper-spectral, LandSat, Spot Image; commercial satellite imagery (such as Space Imaging IKONOS, Digital Globe QuickBird, OrbImage OrbView); and specialized satellite/sensor applications (such as AVHRR, MODIS, POES, GOES)
- Used as reference data
- Orthoimagery should be collected for populated areas at 0.5-1 ft resolution every two years using the same control as the cadastral data.
Geodetic Control

- Survey control network for local, regional and national geo-referencing developed by National Geodetic Survey (NGS).
- For neighborhood and city level geographies, control can be represented by the cadastral framework which is part of the cadastral data theme.
- Common coordinate reference for all other geographic features
- Geodetic control provides the basic reference for other data according to NGS specifications for identification and capture.
Acronyms

- HAZUS – Hazards US (a FEMA risk assessment methodology)
- LIDAR – Light Detection and Ranging
- DEM – Digital Elevation Model
- NOAA – National Oceanic and Atmospheric Administration
- PLSS – Public Land Survey System
- TIN – Triangulated irregular network
- DIME – Dual Independent Map Encoding (developed by Census Bureau)
- PIN – Parcel Identification Number
- BLM – Bureau of Land Management
- FEMA – Federal Emergency Management Administration
- APA – American Planning Association
- NRCS – Natural Resources Conservation Service of the USDA
- ADRG – ARC (Arc-second raster chart/map) Digitized Raster Graphics
- TIGER - Topologically Integrated Geographic Encoding and Referencing system
- NAIP – National Agriculture Imagery Program
- PLSS – Public Land Survey System
Selected Data Sources

• Census Bureau – TIGER and American FactFinder Files
  – http://www.census.gov/
• USDA NRCS
  – http://datagateway.nrcs.usda.gov/
• National Atlas
  – http://nationalatlas.gov/
• Center for Spatial Analysis
  – http://csa.ou.edu/
• National Map Seamless Server
• Geospatial One Stop
  – http://gos2.geodata.gov/wps/portal/gos
• Oklahoma Center for Geospatial Information
  – http://www.seic.okstate.edu/
• USGS’s New “Digital Map – Beta” (A new generation of maps in geoPDF format)
The application of GIS is limited only by the imagination of those who use it.

Jack Dangermond
President & Founder
Environmental Systems Research, Inc. (ESRI)