United Nations Statistical Division

Workshop on Census Mapping with GIS

ESRI Experience in the Use of GIS for Census Mapping Applications

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And

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ESRI

- Founded in 1969 (38 Years)
- Privately Owned
- Zero Debt
- Focused Strictly on Geographic Information Systems (GIS)
- Modern evolving technology (i.e. ArcGIS)
- Ranked as one of the Top Software Companies in the World
- Sustained 20%+ annual growth
- 220 000+ Clients of ESRI software
- 130+ countries use ESRI software
- Over 1 Million Users Globally

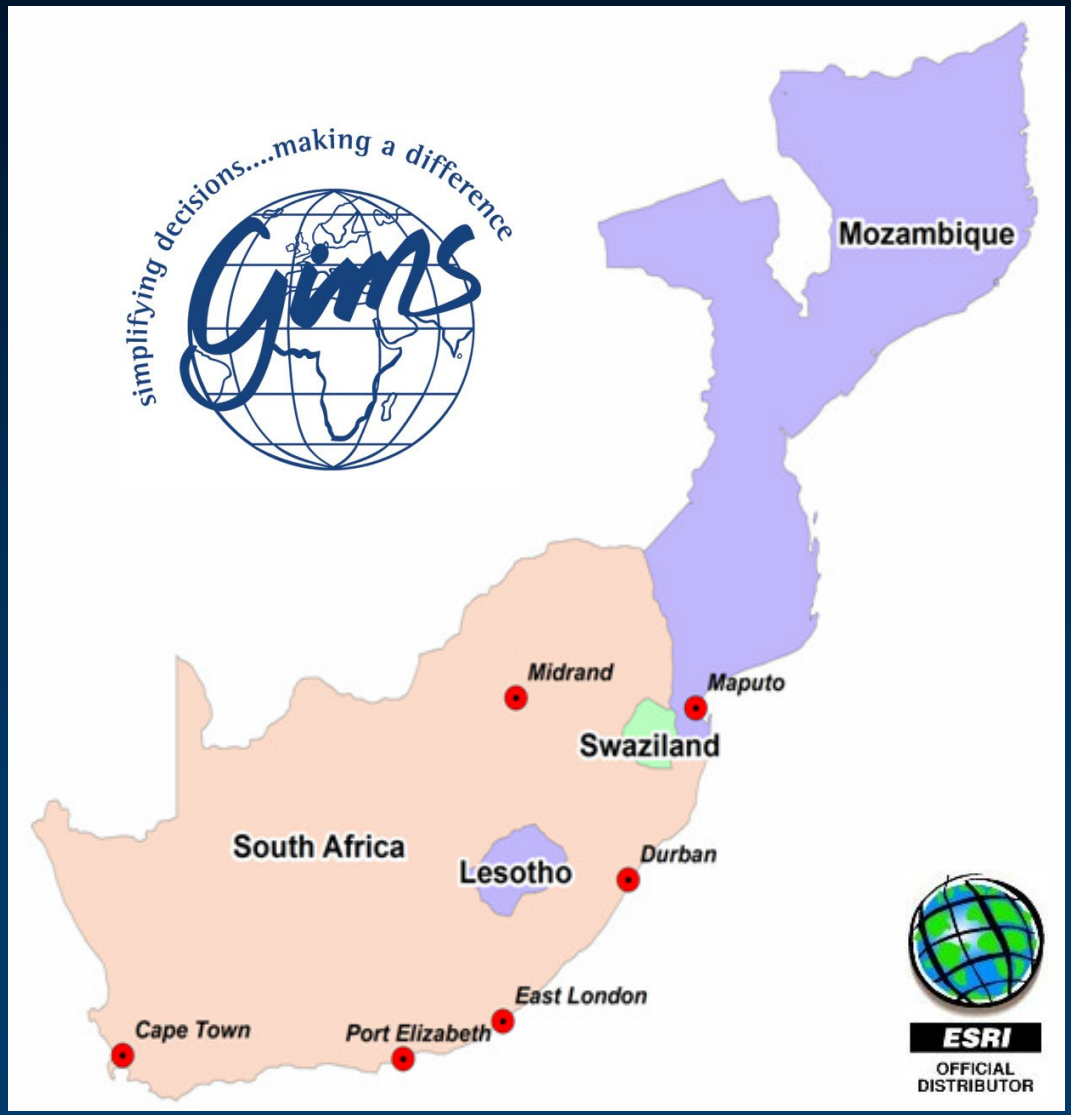
ESRI Distribution Network

- 50+ Distributor
- More than 1200 Sub-Distributors/ Business Partners

GIMS (Pty) Ltd

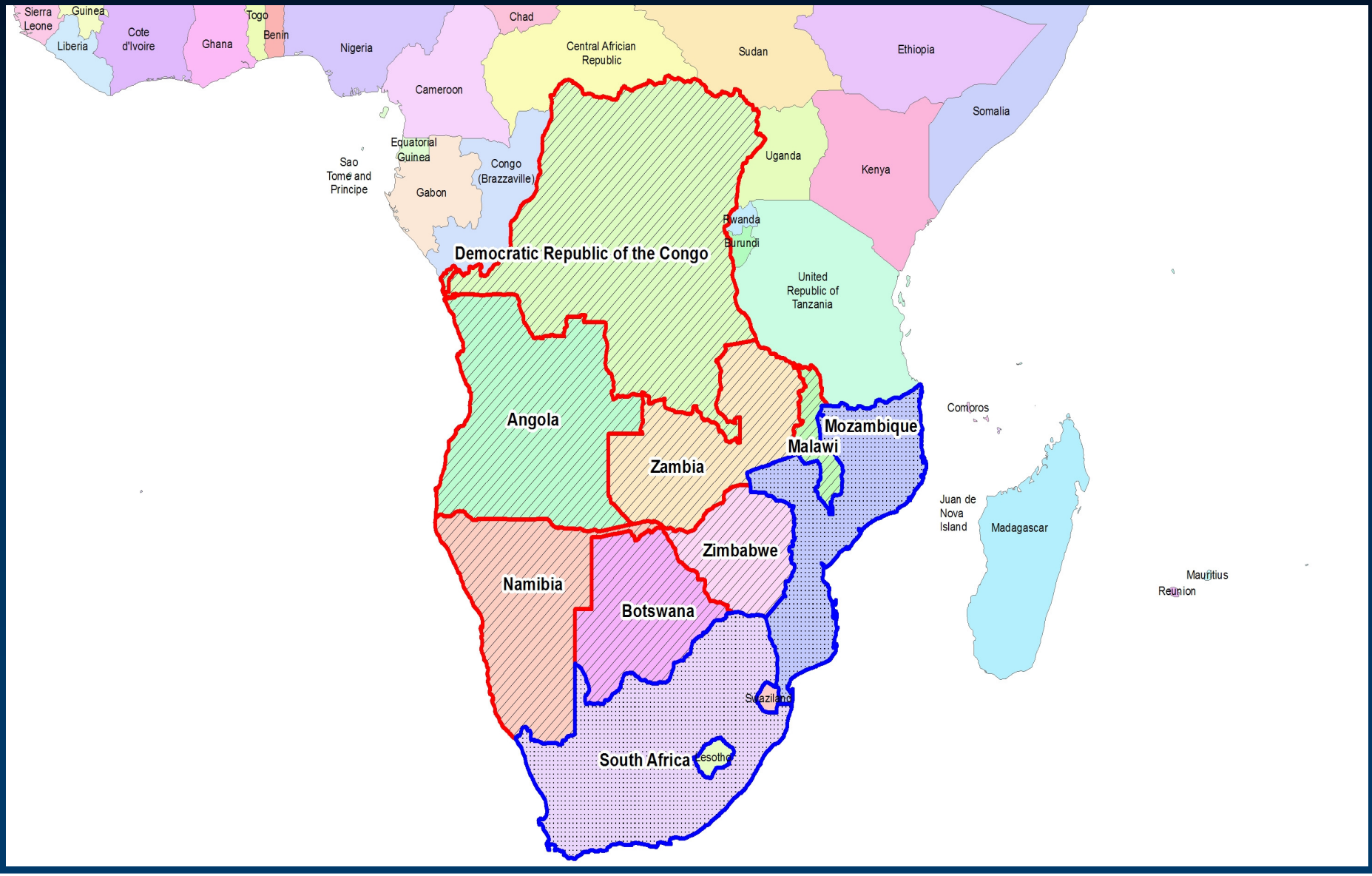
ESRI Southern Africa Distributor

- Company Formed 1989
- Authorised Distributor
  - ESRI
  - ERDAS Imagine
  - Trimble (BP)
  - GARMIN
- Sales
  - Software
  - Hardware (Plotters, GPS, scanners, etc)
- Training (7 ESRI Accredited Trainers)
  - Instructor Led (11)
  - Virtual Campus
  - Mobile Training Center
- Application Support
- Professional Services
- 25% of Business in Africa

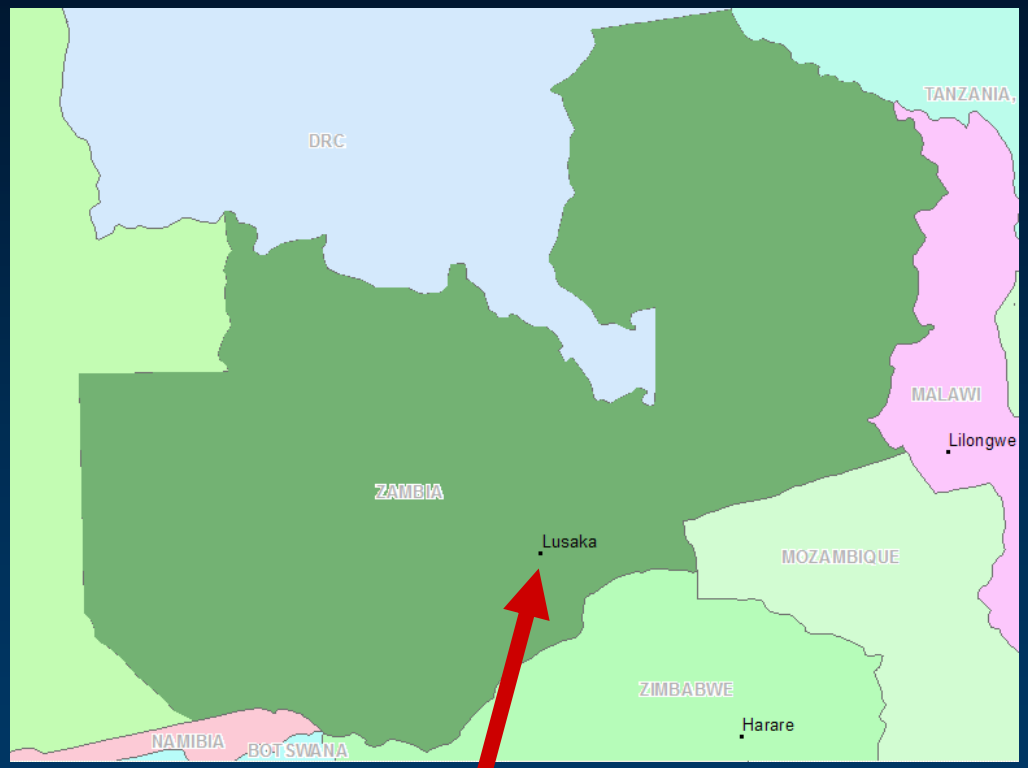


GIMS (Pty) Ltd

Sub-Distributors Distribution



Kelly & Kelly
Sub-Distributors



Kelly + Kelly

Management Consultancy and Training
Quality Systems

GIS Mapping and Analysis
ESRI Business Partner

- Company Formed 2000
- Authorised ESRI Sub-Distributors
- Sales
  - Software
  - Hardware (Plotters, GPS, scanners, etc)
  - Consultancy
- Training (ESRI Accredited Trainer)
  - Instructor Led
  - Virtual Campus
- Application Support
- Professional Services
- 30% of Business Outside Zambia

Outline

- GIS Technology for Census Mapping
  - Pre-Enumeration – Data Design, Collection, and Preparation
  - Enumeration – Conducting the Census
  - Post-Enumeration – Data Analysis, Dissemination
- Presented with examples from work around the globe
- Useful tools for Census Mapping with GIS

Benefits of using GIS for Census Activities

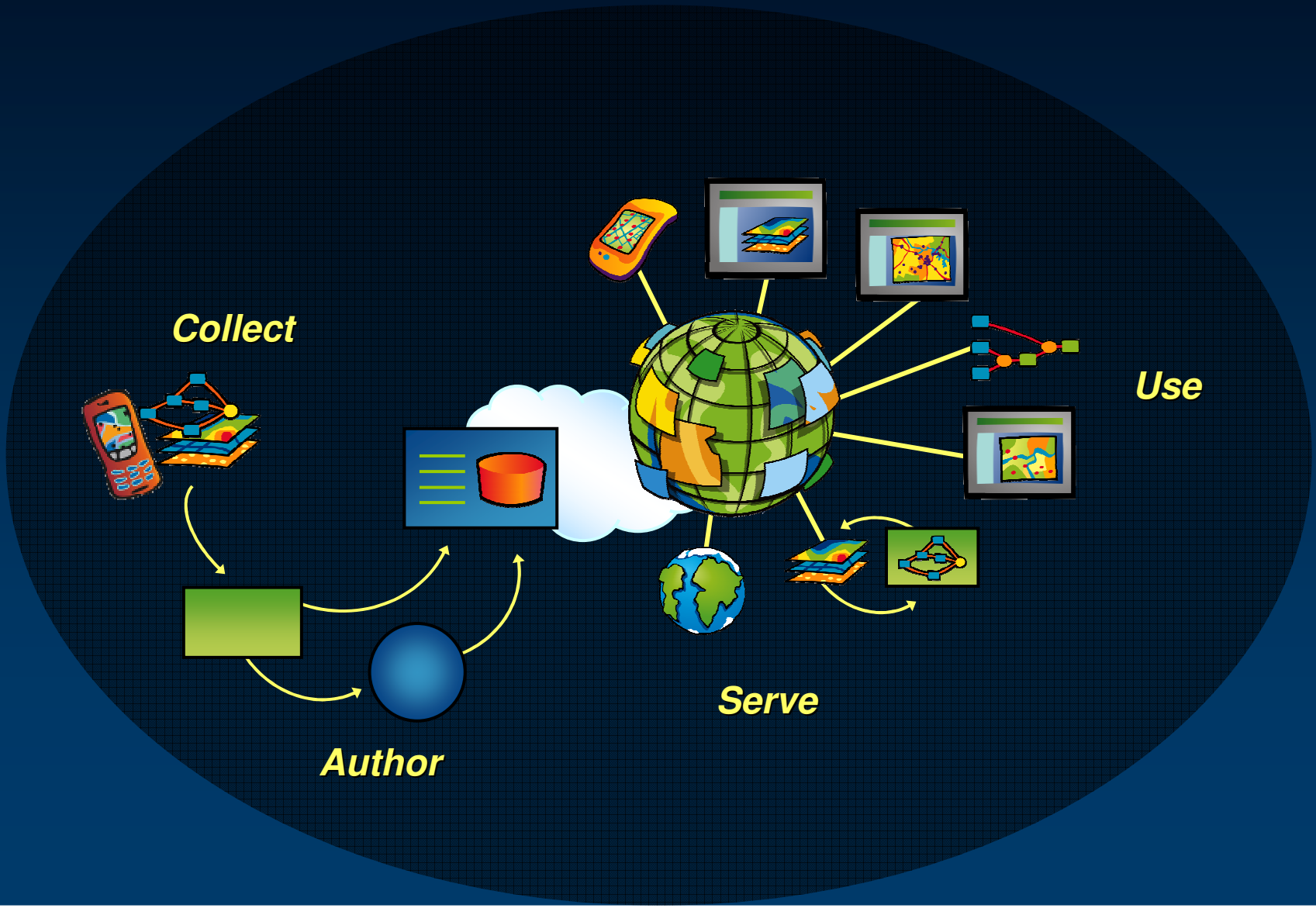
- Benefits in both effectiveness and efficiency for:
  - data creation/collection
  - geodatabase development
  - digital mapping
  - data analysis
  - web mapping
  - GIS web services

- These include:
  - productivity gain and time savings
  - cost savings/cost avoidance
  - greater credibility and authority of map products
  - better service
  - increased accuracy
  - improved consistency
  - income generation
  - improved analysis
  - improved policy-making
  - improved data sharing
  - improved outreach

Source: United Nations, DESA - Statistical Division,
Handbook on geographic information systems and digital mapping, 2000

Census Mapping

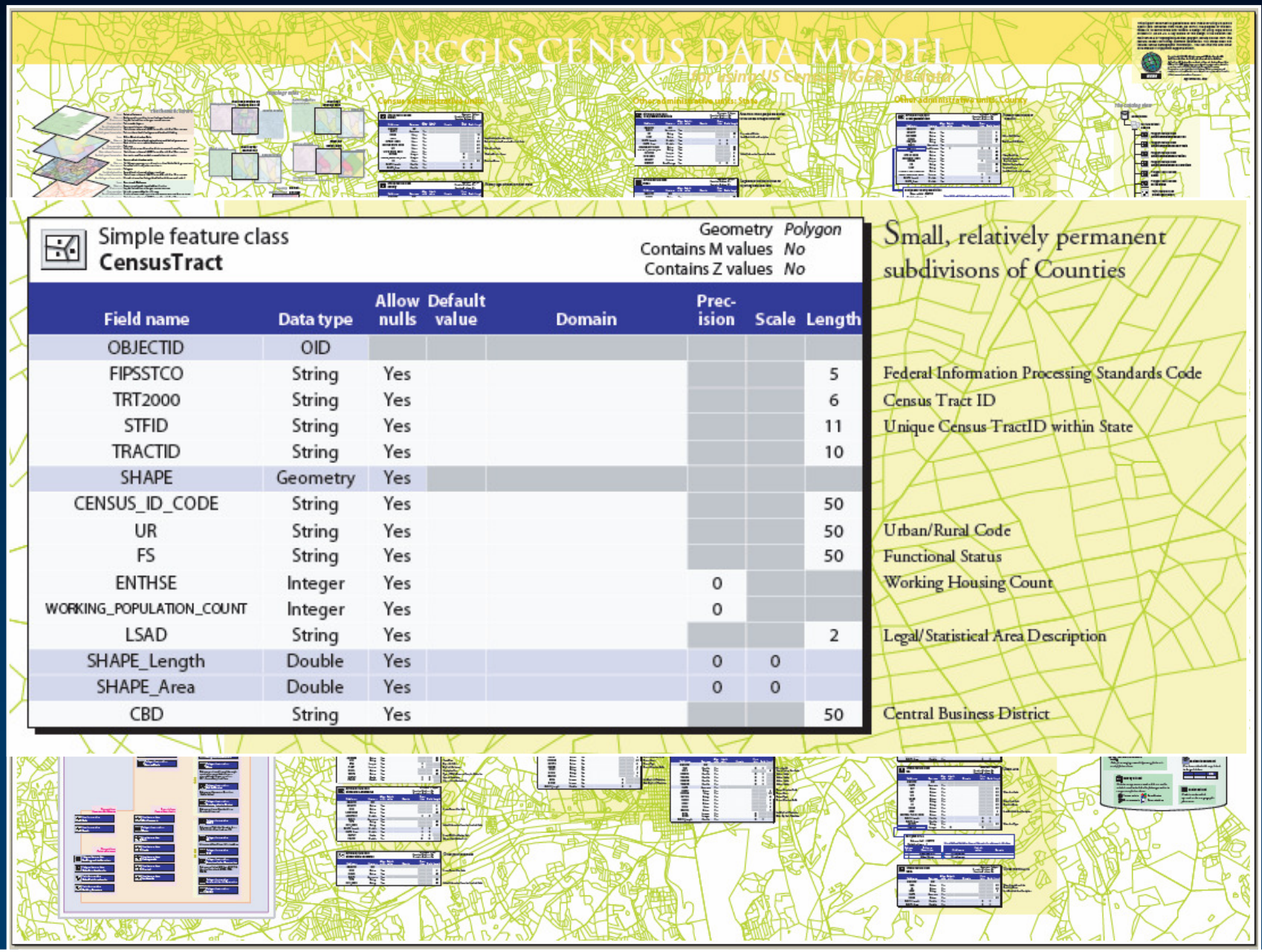
GIS is the platform



Pre-Enumeration
Data Design, Collection, and Preparation

- Data Design
  - Census Data Models
- Development of Census Geographies
  - Defining Enumeration Areas
  - Coding Schemes

Census Model from ESRI Support Center



Simple feature class
CensusTract

Geometry *Polygon*
Contains M values *No*
Contains Z values *No*

Field name	Data type	Allow nulls	Default value	Domain	Prec-ision	Scale	Length
OBJECTID	OID						
FIPSSTCO	String	Yes					5
TRT2000	String	Yes					6
STFID	String	Yes					11
TRACTID	String	Yes					10
SHAPE	Geometry	Yes					
CENSUS_ID_CODE	String	Yes					50
UR	String	Yes					50
FS	String	Yes					50
ENTHSE	Integer	Yes			0		
WORKING_POPULATION_COUNT	Integer	Yes			0		
LSAD	String	Yes					2
SHAPE_Length	Double	Yes			0	0	
SHAPE_Area	Double	Yes			0	0	
CBD	String	Yes					50

Small, relatively permanent subdivisons of Counties

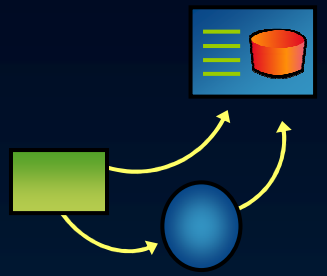
Federal Information Processing Standards Code
Census Tract ID
Unique Census TractID within State

Urban/Rural Code
Functional Status
Working Housing Count

Legal/Statistical Area Description

Central Business District

Geodatabase Development

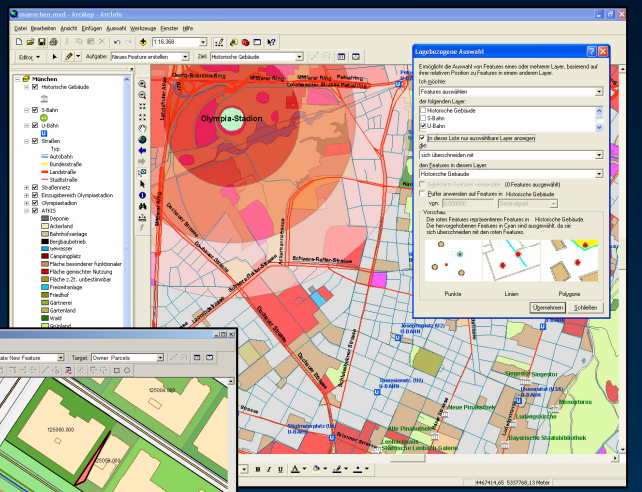


- Scanning, georeferencing, and vectorization of existing paper maps to develop digital datasets;
- Conversion of existing digital maps and datasets into the desired data structure;
- Updating of digital datasets since the last census activity to ensure that new settlements and roads are included and obsolete settlements are omitted from the enumeration activities; and/or
- Collection of aerial or satellite imagery followed by digital feature extraction and ground-truthing with GPS to ensure proper georeferencing of the images.

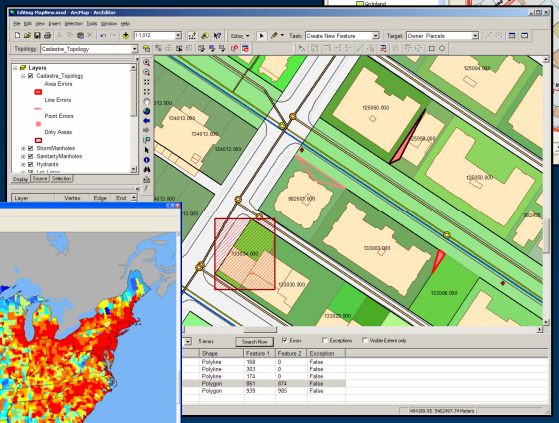
ArcGIS Desktop

Authoring and Using Geographic Knowledge

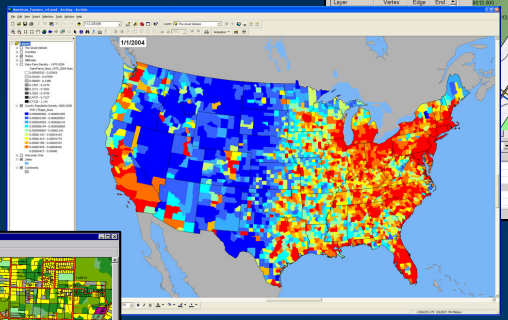
ArcInfo
(Geoprocessing/Analysis)



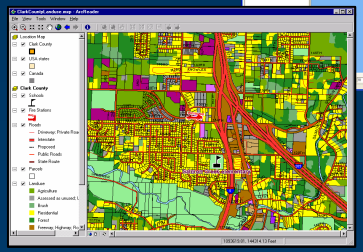
ArcEditor
(Create/Manage)



ArcView
(Use)



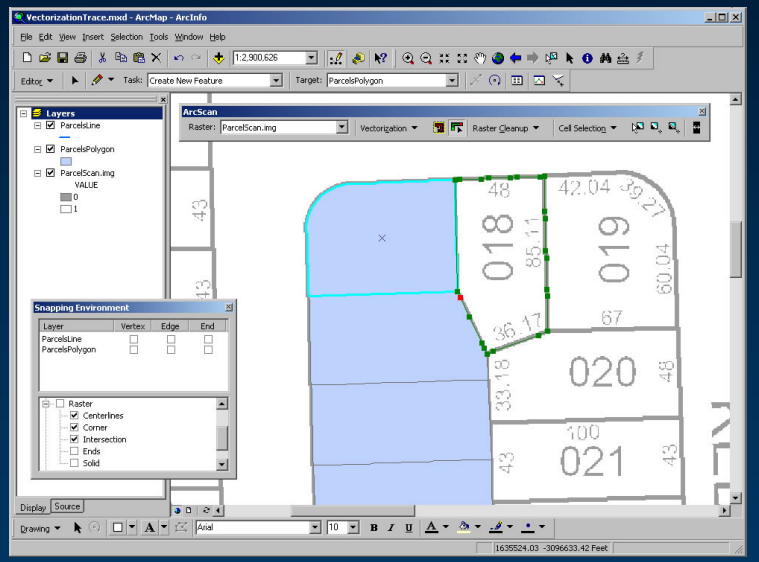
ArcReader
(View)



Common, Scalable Family of Products

ArcScan for ArcGIS

- Automate the conversion of scanned paper maps to vector form
- Reduce the time and expense in creating GIS data
- Eliminate the tedious need to digitize the data by hand
- Easily clean up scanned maps



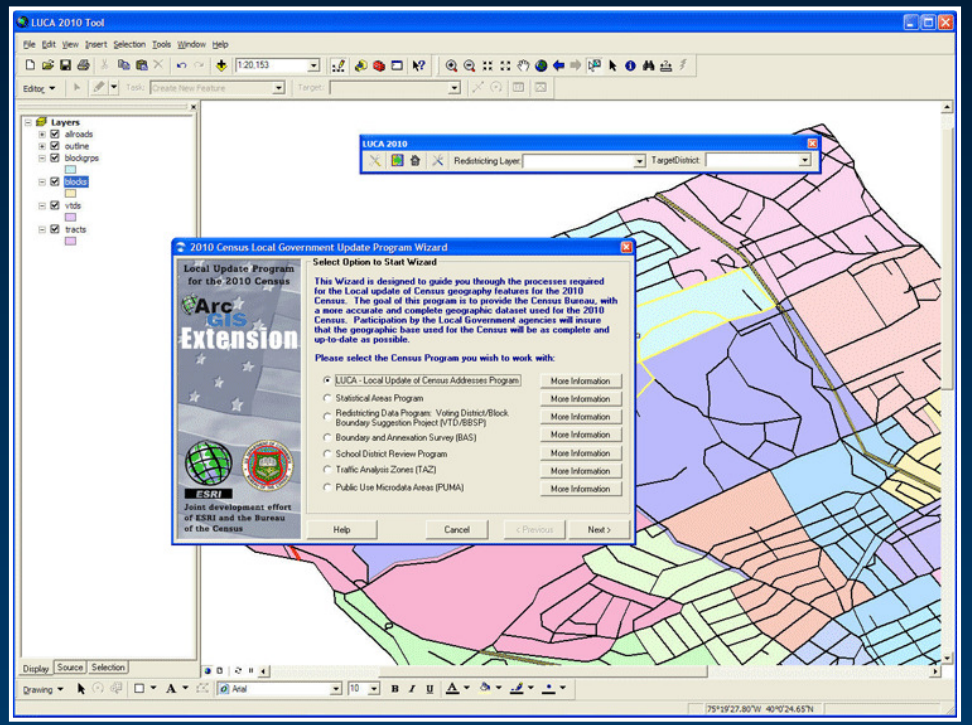
Districting for ArcGIS

- Updated for Version 9.2 of ArcGIS Desktop
- Create defined groupings of geographic data
  - census tracts, districts, ZIP codes, and precincts
  - by creating a districting plan
- Functionality
  - Redraw political boundaries
  - Set up sales territories
  - Define voting, school, and fire districts
  - Analyze population densities, housing breakdowns, income and race statistics

Local Update of Census Addresses (LUCA)

- **A new extension for ArcGIS**
- Built with CityGate GIS
- Part of the US Census Bureau's LUCA program

- Replicates the task and technical functionality of the census Master Address File/Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Partnership Software (MTPS)
-
- To be delivered later this year to 40,000 US local governments

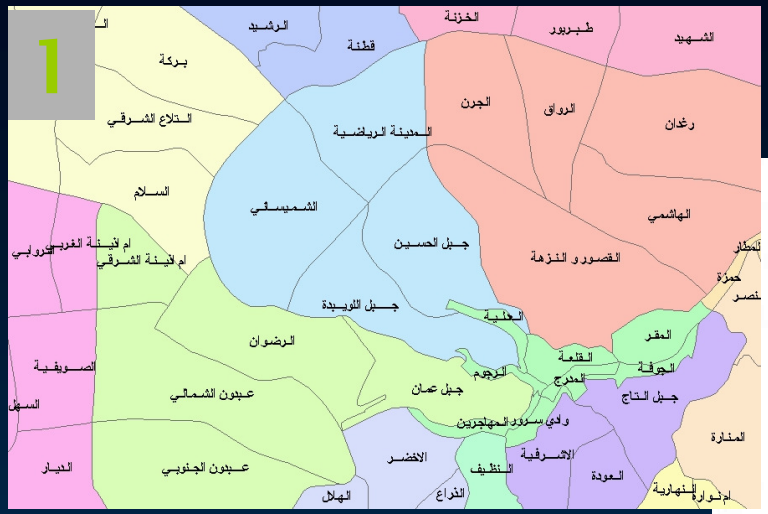


The Hashemite Kingdom of Jordan – Department of Statistics (DOS)

Images courtesy of David Rain, Ph.D., GWU

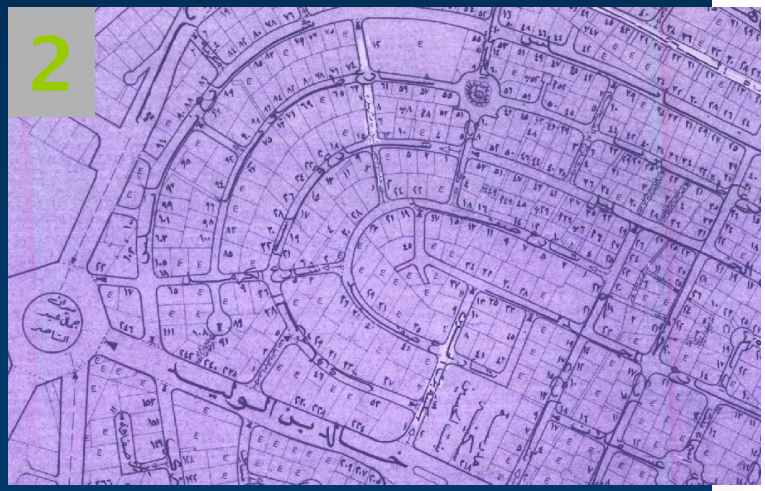
Department of Statistics, Royal Hashemite Kingdom of Jordan, with cooperation from USAID Amman, ESRI, and InfoGraph - a Jordanian GIS firm

1



District boundaries of part of Amman city are converted to digital form using center lines on cadastral maps from the Jordan Land & Survey Department

2



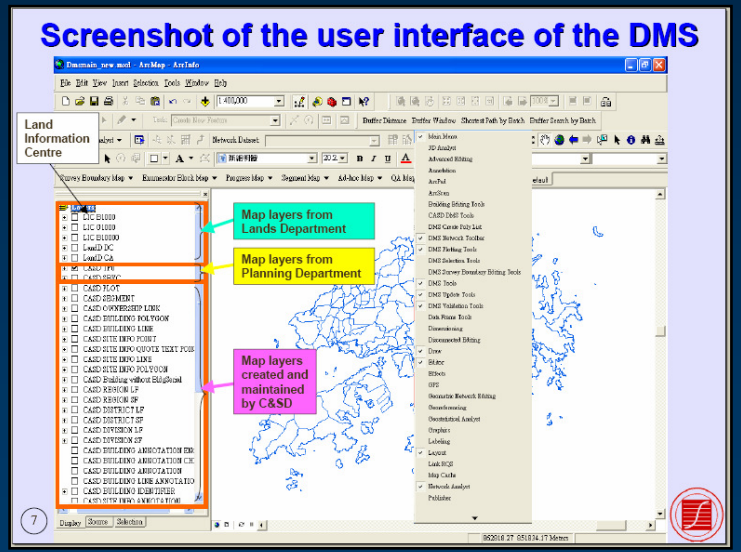
Building numbers and land parcels from municipal government

3

Source of street names

Hong Kong - Census and Statistical Department (CASD) Government of the Hong Kong Special Administrative Region of the People's Republic of China

- Digital Mapping System (DMS)
  - Updating the sampling frame
    - linking the spatial data and textual records of buildings/structures to facilitate the updating process and delineating boundary segments,
  - Allocation of assignments
  - Itinerary planning
  - Production of tailor-made and up-to-date maps of good quality to support fieldwork operation
  - Data compilation from several agencies:
    - Lands Department
    - Planning Department
    - and the Census and Statistics Department



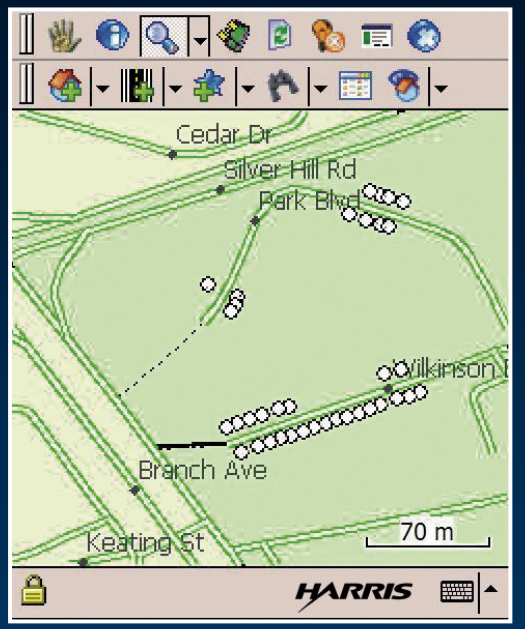
Enumeration
Conducting the Census

- Perhaps the biggest new opportunity for census work in 2010…

  Enumerators enabled with Mobile Computing Devices that include GIS and GPS

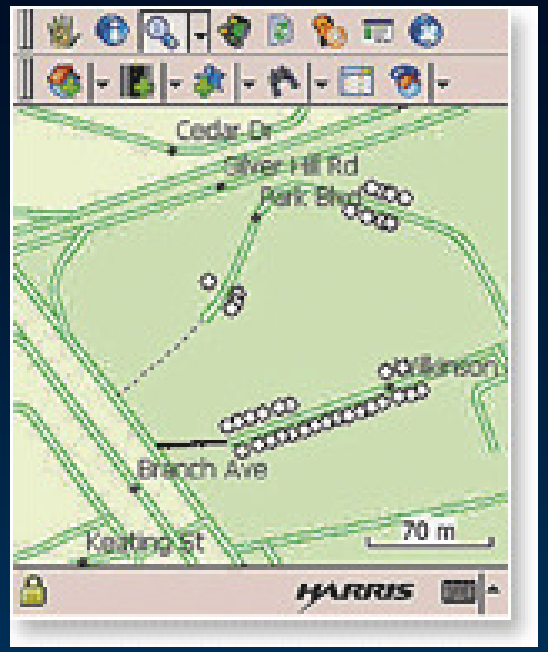
US Bureau of the Census

- Using ArcPad mobile GIS platform
- Field Data Collection Automation (FDCA) project for the 2010 Decennial Census
- Harris Corporation selected by the U.S. Census Bureau
- FDCA program supports census field enumerators
  - GPS-enabled mobile devices
  - ESRI's ArcPad software selected
    - performance, productivity, enterprise GIS integration, and customization options



ArcPad

- Perform reliable, accurate, and validated field data collection
- Integrate GPS, rangefinders, and digital cameras into GIS data collection
- Share enterprise data with field-workers for updating and decision making
- Improve the productivity of GIS data collection
- Improve the accuracy of the GIS database and make it more up to date



US - Census Bureau - Preparing for 2010 Census
A paperless census?

MCDs in the 2010 Census

- The Census Bureau plans to use a small, hand-held computer for field data collection in the 2010 Census.

- This will allow for:
  - Paper Reduction
  - Processing efficiency
  - GPS Coordinate Capture

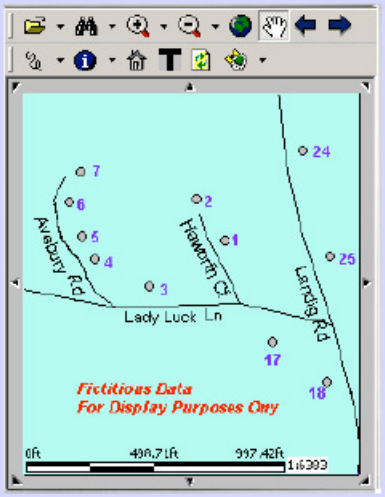
USCENSUSBUREAU

Helping You Make Informed Decisions

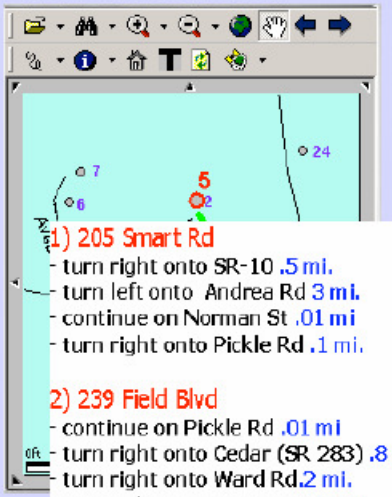
US - Census Bureau - Preparing for 2010 Census
Mobile Computing Devices (MCDs) with GPS and ArcPad

ArcPad Maps From Sussex Co Test

Base Map



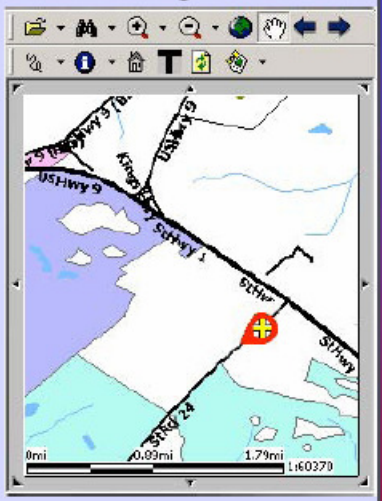
Base Map w/Route and Directions



1) 205 Smart Rd
- turn right onto SR-10 .5 mi.
- turn left onto Andrea Rd 3 mi.
- continue on Norman St .01 mi
- turn right onto Pickle Rd .1 mi.

2) 239 Field Blvd
- continue on Pickle Rd .01 mi
- turn right onto Cedar (SR 283) .8
- turn right onto Ward Rd.2 mi.
- turn right onto Gracie Ln .1 mi.
- turn right onto Field Blvd .01 mi.

Base Map w/ GPS



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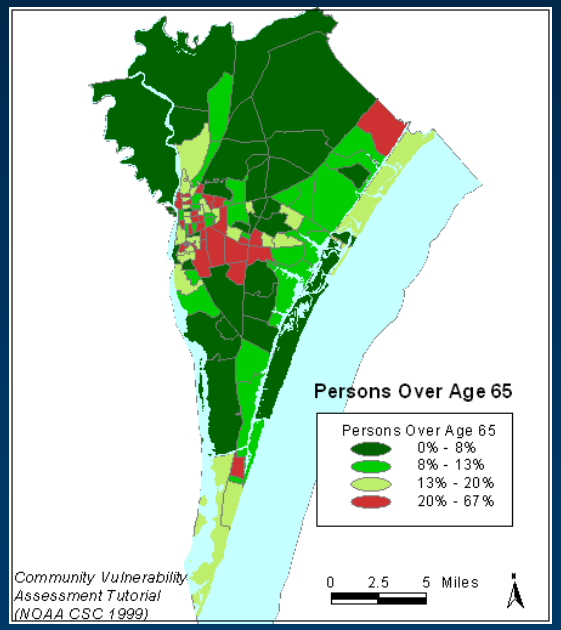
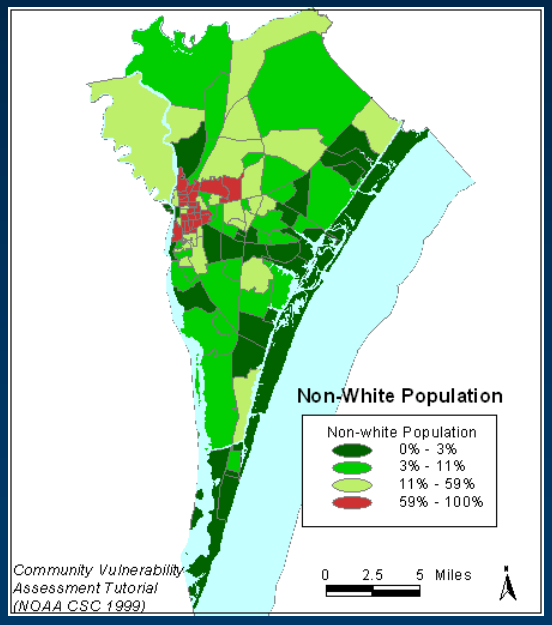
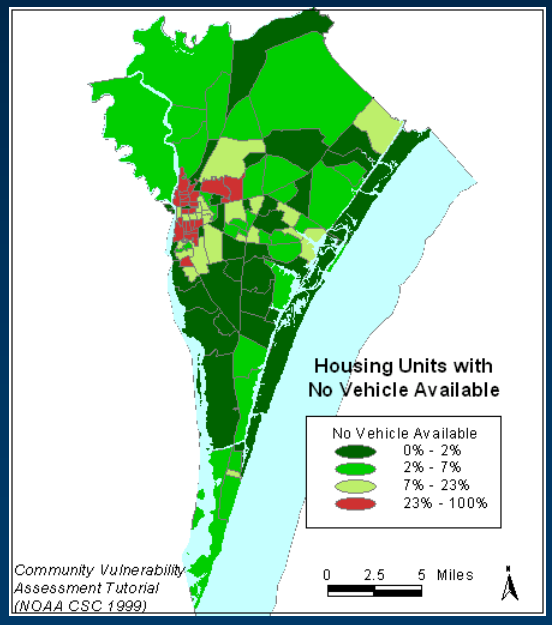
Helping You Make Informed Decisions

Post-Enumeration
Data Analysis

- Analysis of the results with Desktop GIS, such as ArcGIS Desktop products
- Development of maps for dissemination to the public







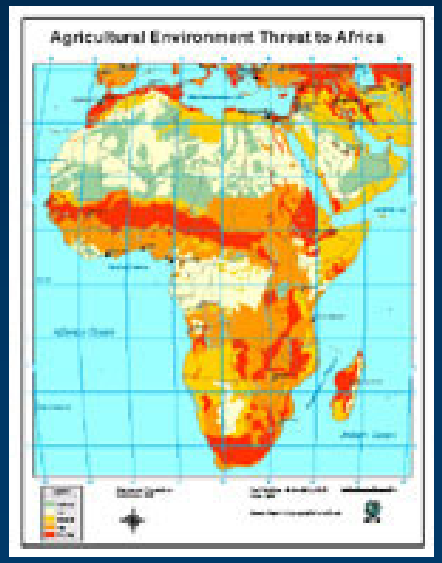
Source: NOAA Coastal Services Center – Community Vulnerability Assessment

Post-Enumeration
Data Dissemination

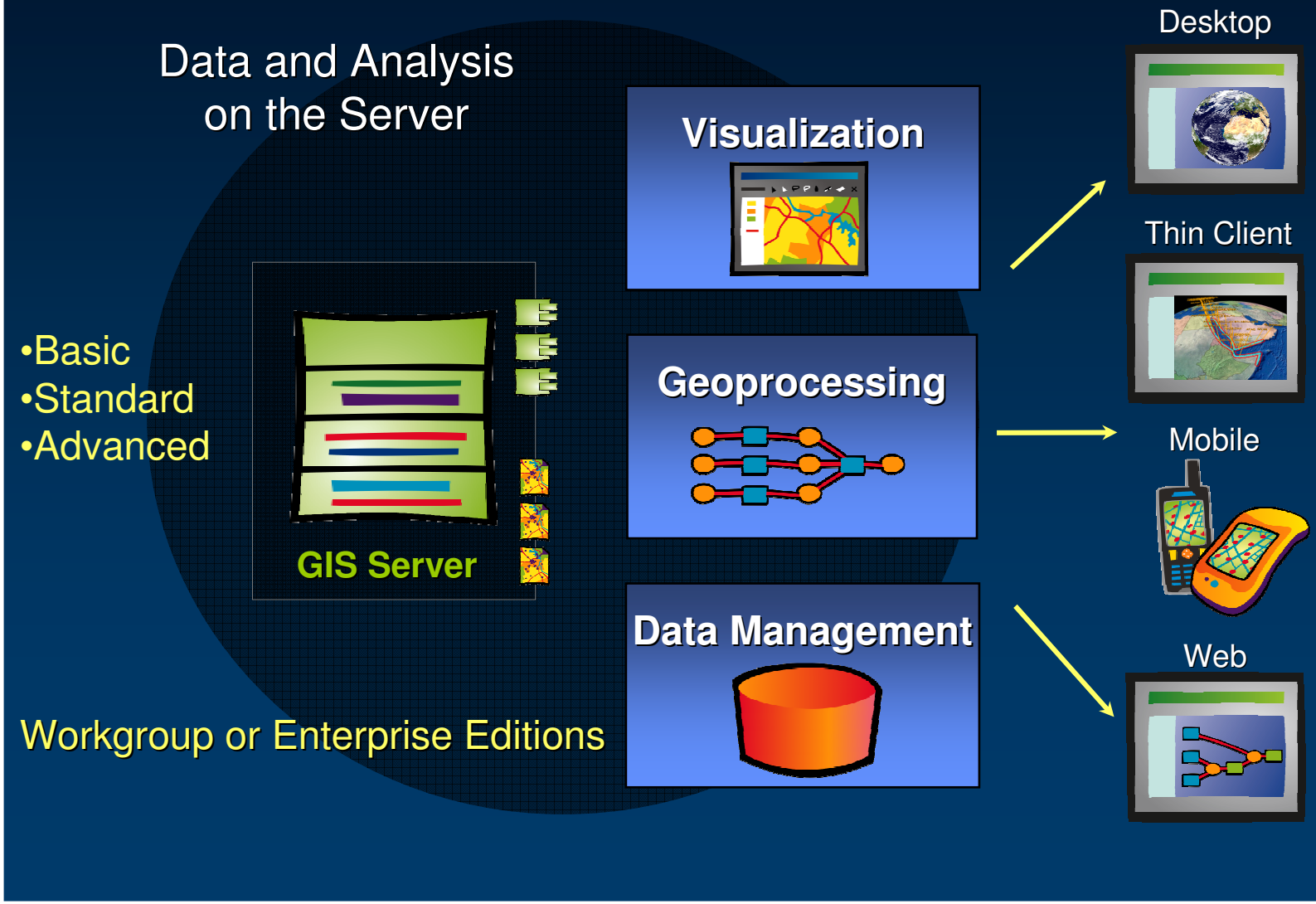
- Web Mapping and GIS Services
  - Web browsers
  - Geovisualization applications
- Database and Mapping Application on CD
  - Free, embeddable mapping application
  - Free data viewer

ArcReader

- Free and Easy-to-use
- Using ArcReader, anyone can view high-quality maps created using the ArcGIS Publisher extension
- Key features:
  - GIS Deployment
  - Map Viewing and Navigation
  - Data Query and Exploration
  - Map Printing
  - Configurable and Customizable

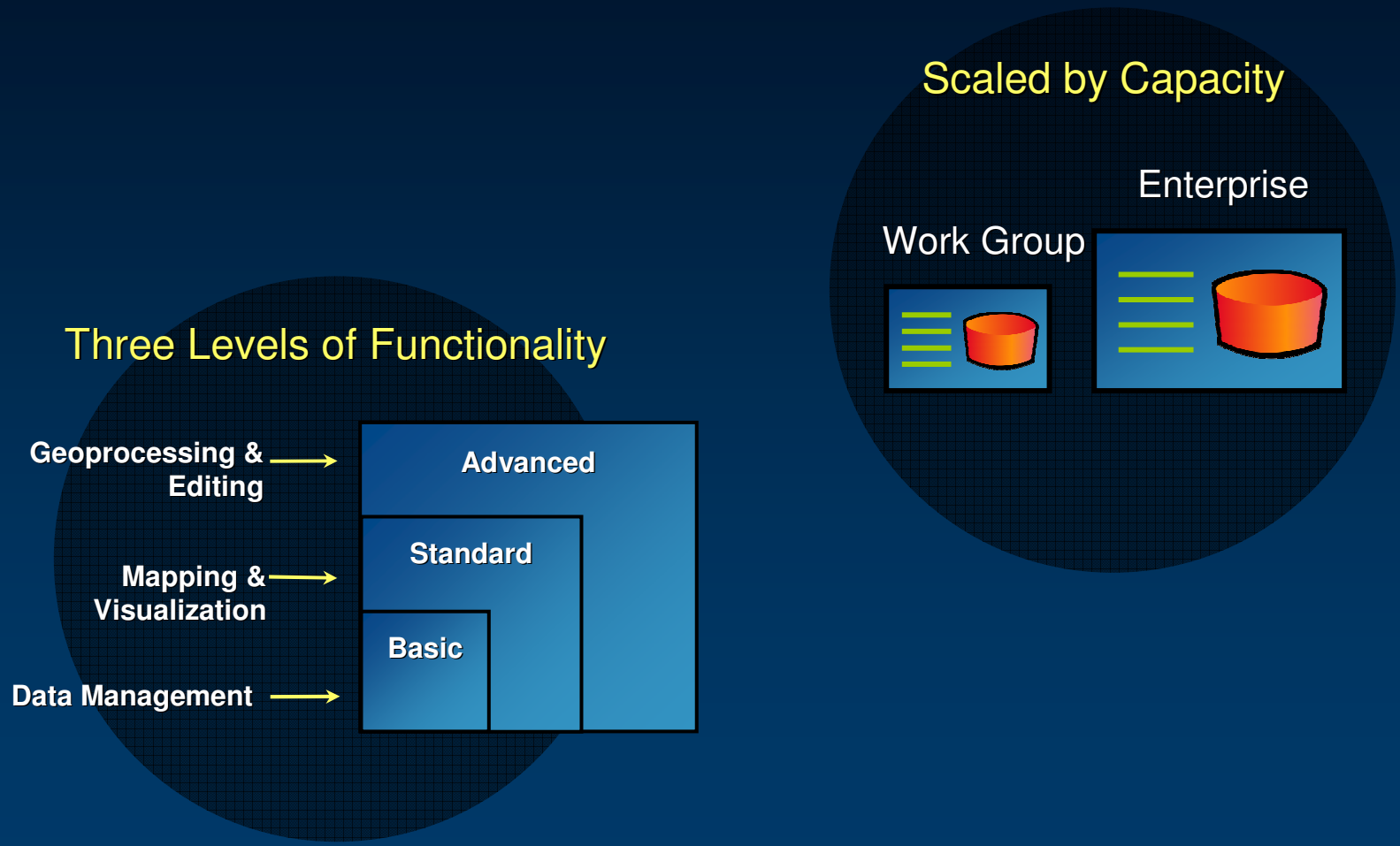


ArcGIS Server
Deploying GIS for Integration



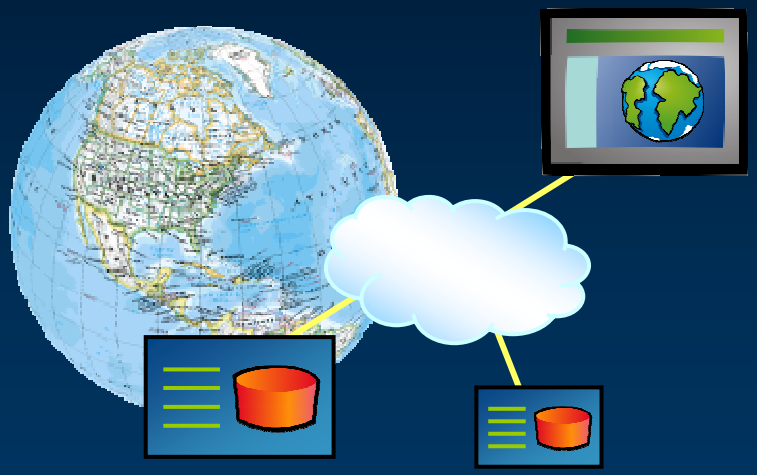
ArcGIS Server –
Licensed by Functionality and Capacity

More Affordable And Flexible



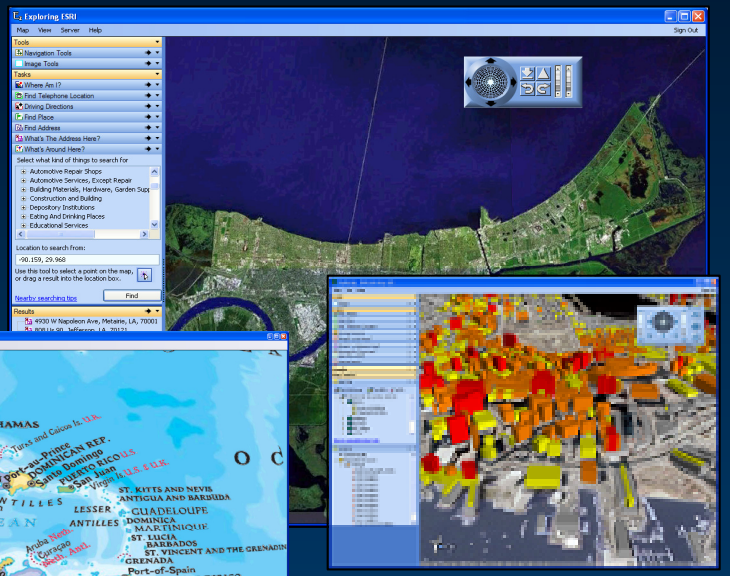
ArcGIS Explorer

GeoBrowser for Geographic Information



Integrates Multiple Services

Visualization

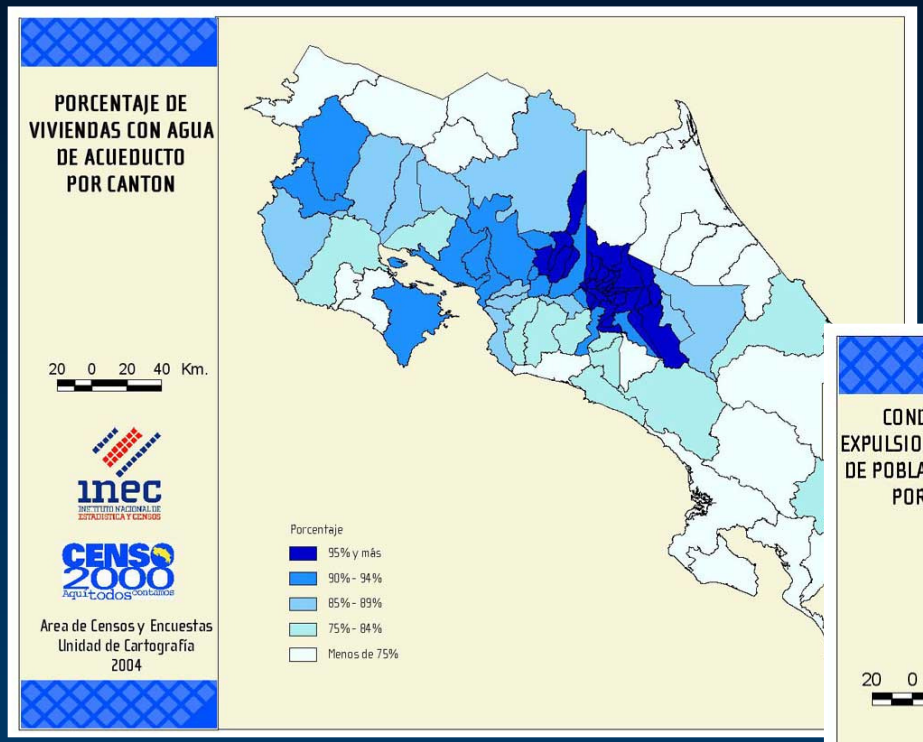


Mapping

Analysis Tasks

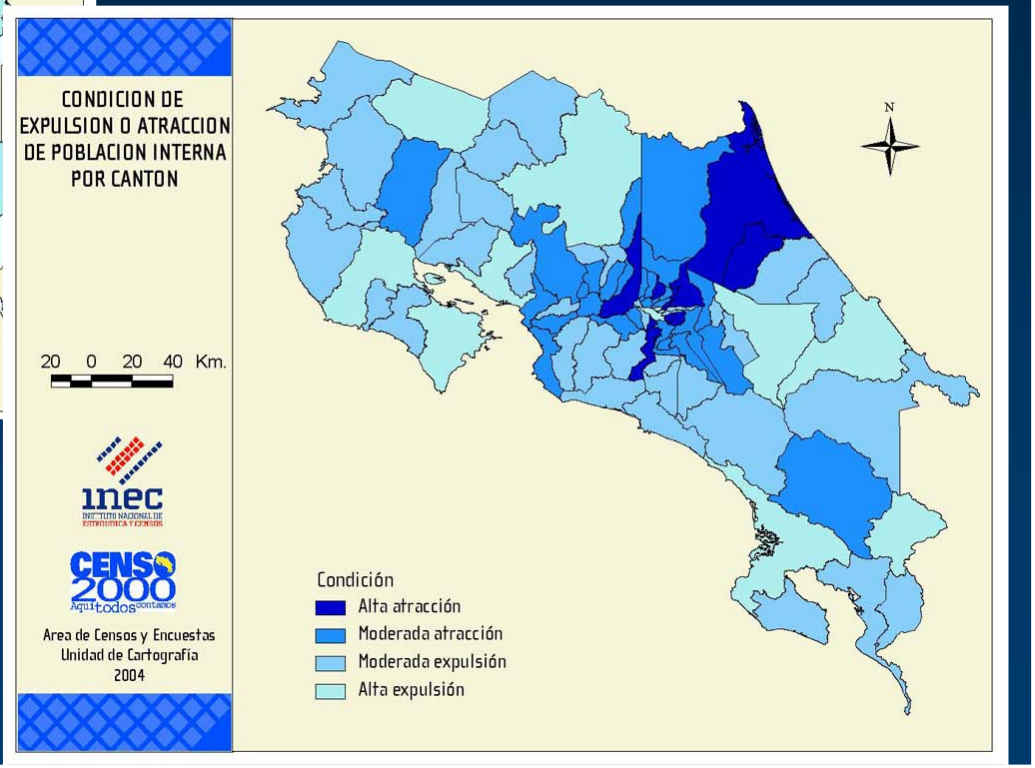
Costa Rica – INEC

- Map Distribution from Website

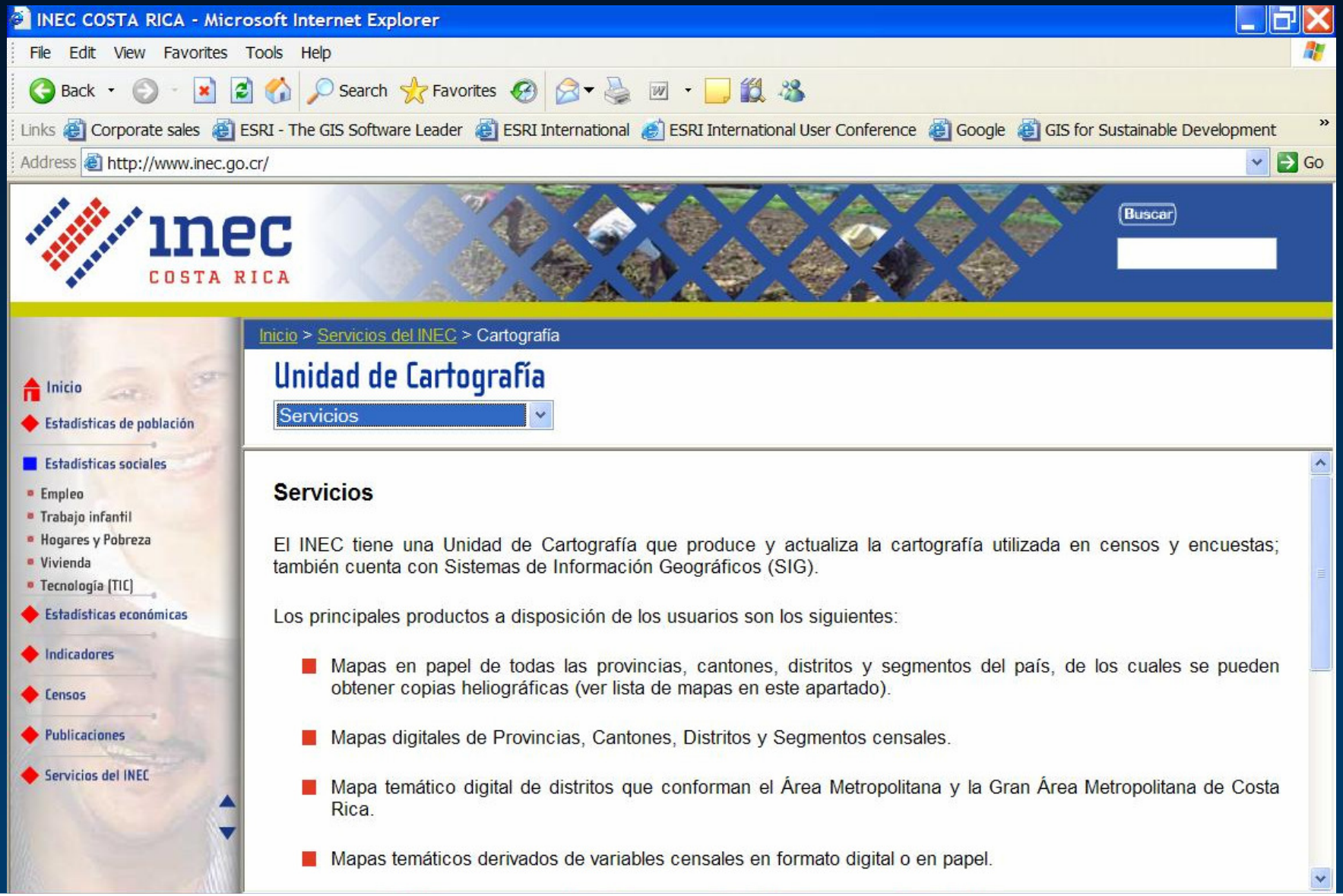


Percentage of Population with clean water

Internal Migration of Population



Costa Rica – National Office for Census and Statistics (INEC) www.inec.go.cr



US - Census Bureau

Address http://www.census.gov/geo/www/maps/

U.S. Census Bureau

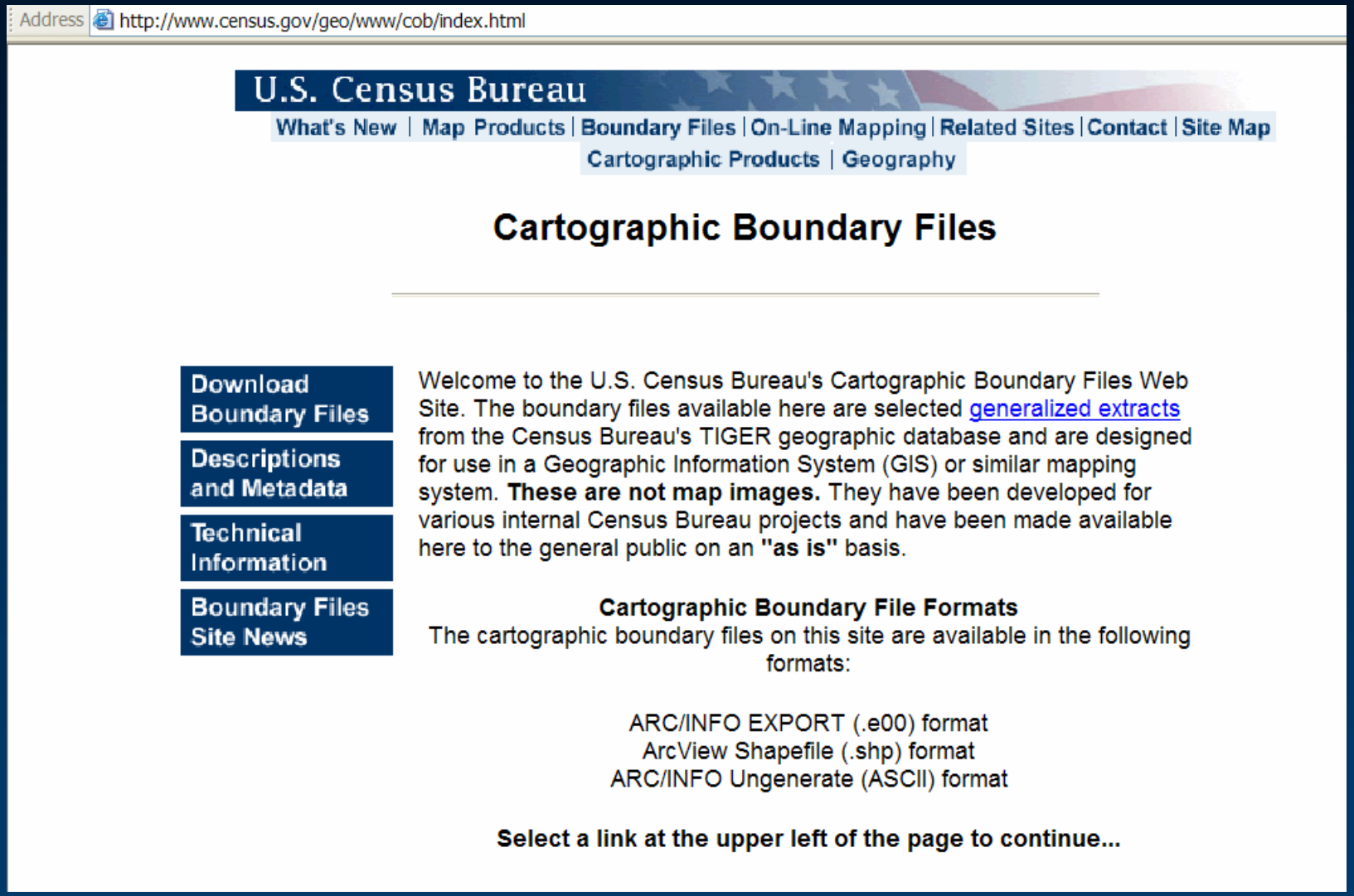
Cartographic Products | Geography

U.S. Census Bureau Maps and Cartographic Resources

- WHAT'S NEW - Lists the most recent products or services.
- MAP PRODUCTS - Links to publicly available printed maps and free, downloadable maps in Portable Document Format [PDF]. Ordering information for printed maps and PDF maps on CD-ROM and DVD is also provided.
- BOUNDARY FILES - Provides access to generalized, digital files suitable for use with a Geographic Information System (G.I.S.) as a base for medium to small-scale thematic mapping.
- ON-LINE MAPPING - Links to two mapping applications derived from Census Bureau base map data - American FactFinder, State & County QuickFacts, and the TIGER Map Server.
- RELATED SITES - Lists other resources on the Bureau's Web site.
- CONTACT - Send us questions and/or comments. Answers to Frequently Asked Questions (FAQs).
- SITE MAP - Site layout in text-only form.

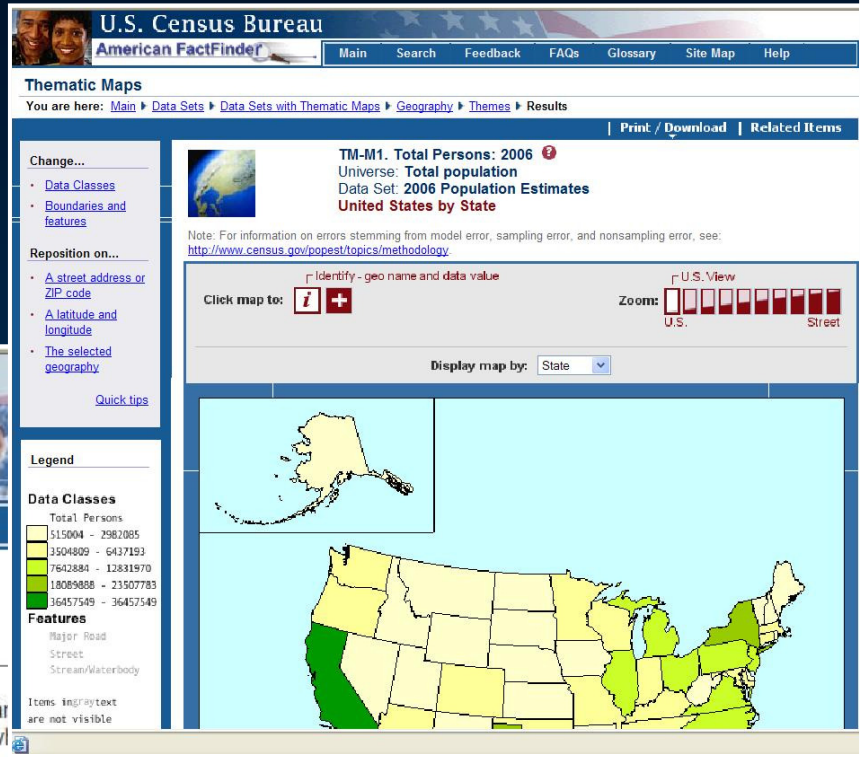
Source: U.S. Census Bureau
Geography Division
Cartographic Products Management Branch
Created: September 12, 2001

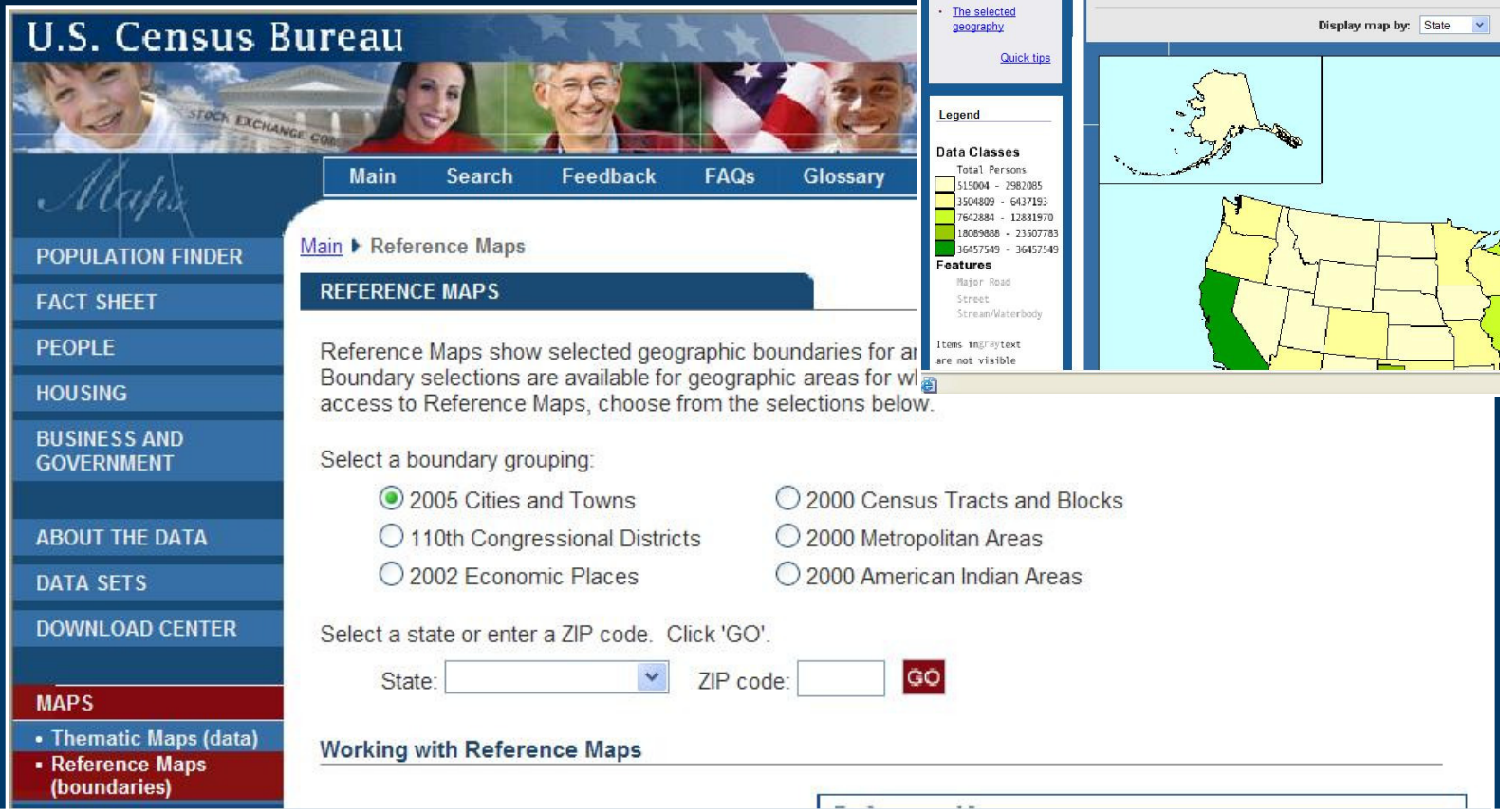
US - Census Bureau
Cartographic Boundary Files



US - Census Bureau
American Fact Finder

- Thematic Maps (Data)
- Reference Maps (Boundaries)

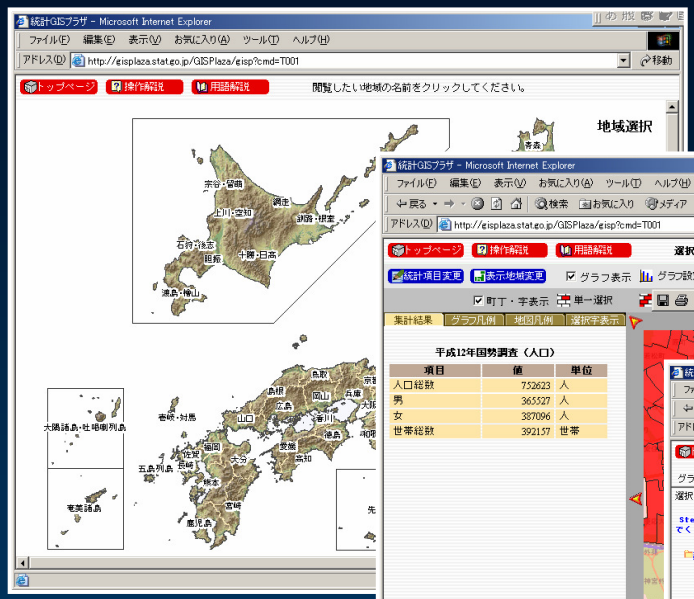




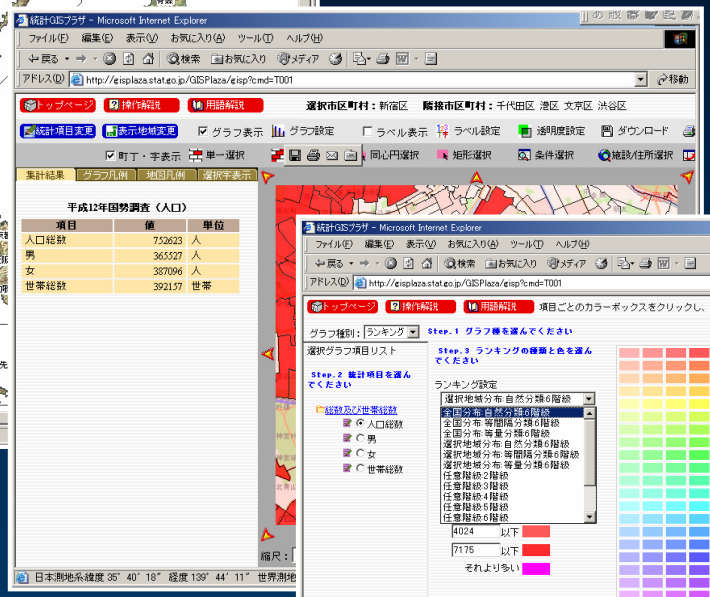
Japan - Statistics Bureau, Ministry of Internal Affairs and Communications

- **Statistics GIS Plaza**
- http://gisplaza.stat.go.jp

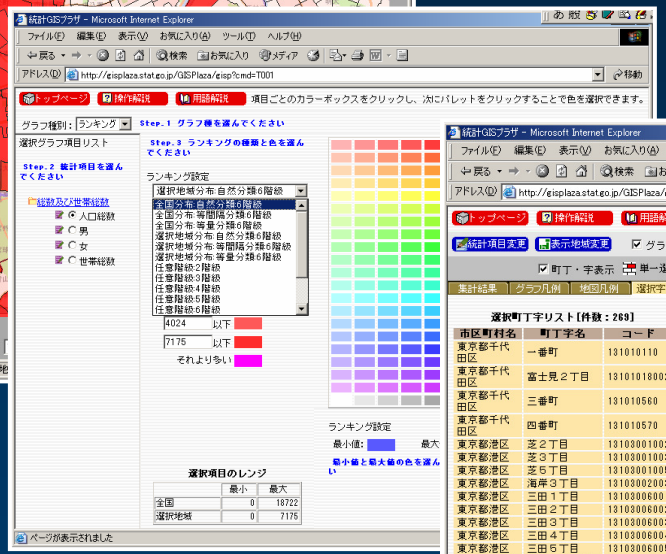
Japan - Statistics Bureau, Ministry of Internal Affairs and Communications



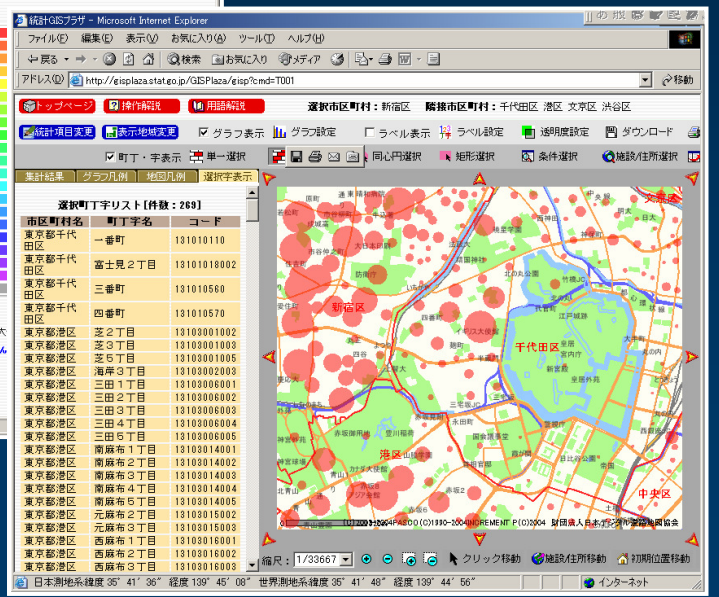
Area Selection



Cadastral Map

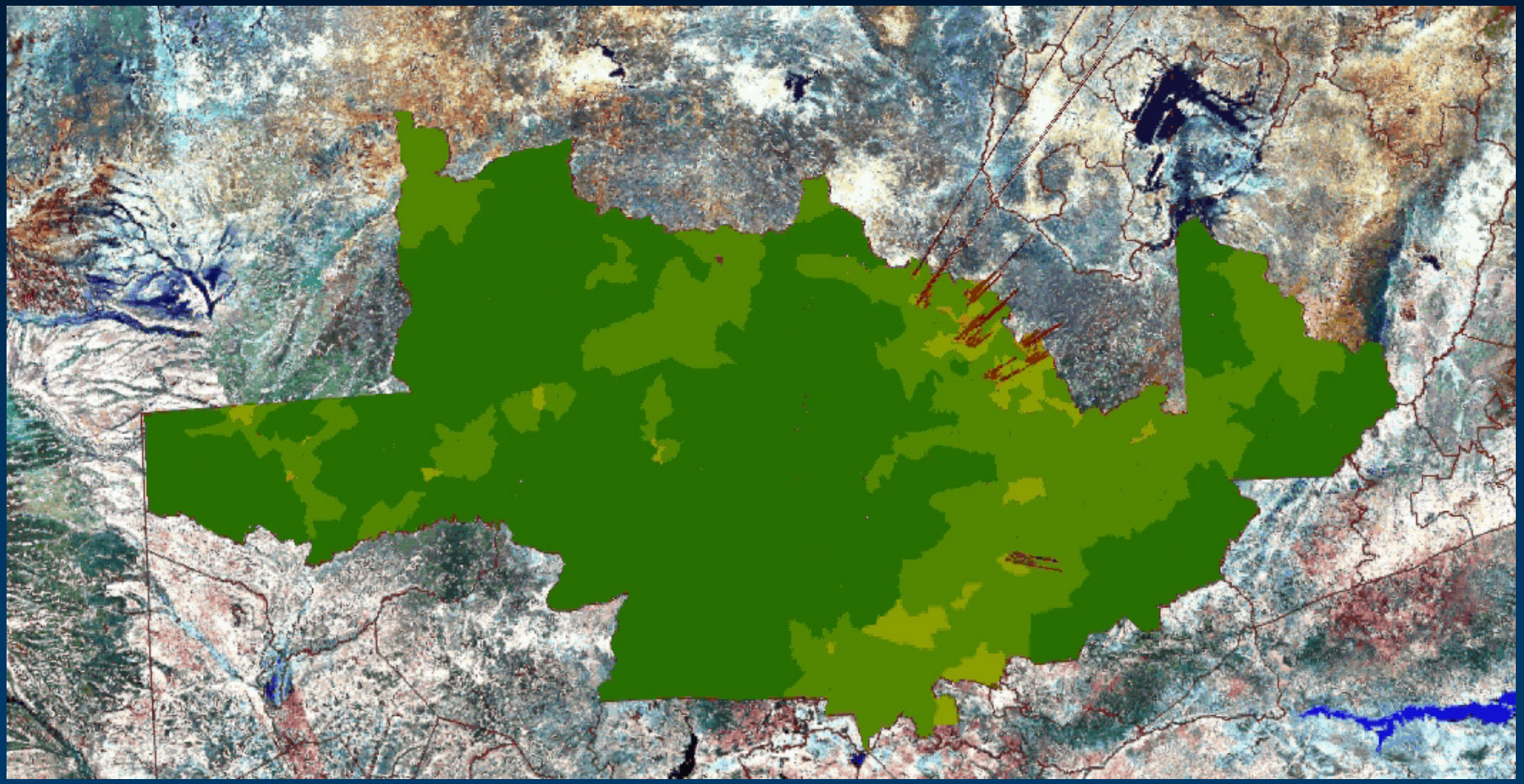


Graph Settings



Graph and Map

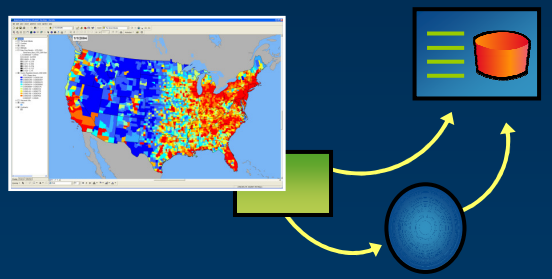
Zambia – Sensus data depicting the population density per area



Recommendations for the 2010 Round

- Consider appropriate GIS technology for each phase of the Census

- Mobile GIS
  - Integrates with GPS
  - Field data collection
    - Geographic location verification
    - Navigation
- Desktop GIS
  - Data collection and preparation
    - Automated raster-to-vector conversion
    - Imagery integration
    - Development of enumeration areas
    - Allocation of assignments
  - Data analysis
    - Strong cartographic tools
  - Data Dissemination with free data viewers
- Server GIS
  - Data dissemination
    - Web map publishing
    - GIS Services (geocoding, gazetteer, etc.)
    - GeoVisualization tools

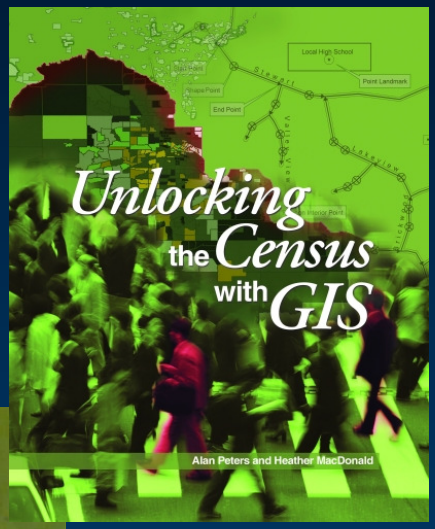


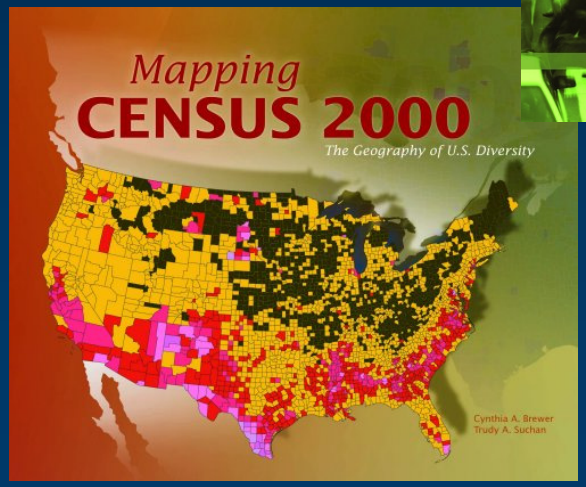
Recommendations for the 2010 Round

- Consider the benefits of using GIS and imagery in areas of complex geography
  - Rural areas
  - Informal settlements
- Adapt best practices to suit specific census requirements
- Partner with the private sector
  - Builds the geospatial component of your local, knowledge economy
  - Work jointly on coding efforts with telecom, postal service, etc.
  - Value added solutions – higher demand for census data

Literature related to Census Mapping

- ESRI Press:
  - *Unlocking the Census with GIS*
  - *Mapping the Census 2000*





Support GIS Day!

GIS Day: November 14, 2007

An Opportunity to Share Your Knowledge

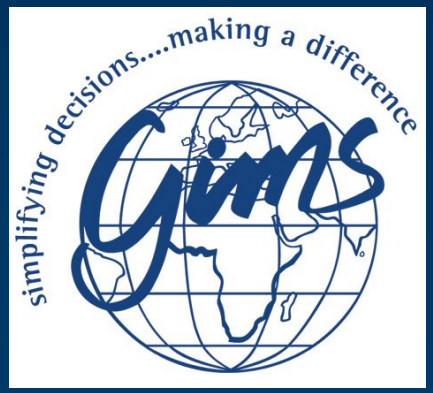
Let's make sure that everyone counts!
..and is counted!

Source: World Resources Institute

Source: Robert Ford, LLU

Thank you!

ESRI


simplifying decisions....making a difference
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