TRƯỜNG ĐẠI HỌC MỞ TP. HCM
Cơ hội học tập cho mọi người

Applications of GIS in some branches within the social sciences

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Objectives

- Promote use of GIS as a tool to support research (increased visualisation, improved planning,…) and decision making.
- Acquire GIS as an additional skill to improve work quality and efficiency.

Outline of presentation

1. Introduction
   - Geographic information (GI) technologies
   - Current applications
   - Branches of social sciences applicable to GIS
2. Applications of GIS in some branches within the social sciences, and crossed disciplines e.g. program evaluation
3. GIS softwares, benefits of GIS, implementation conditions

1. Introduction

- GI technologies
- Current applications
- Branches of social sciences applicable to GIS

GI technologies

- **Global Positioning System (GPS)**
  - A system of satellites which can provide precise (X,Y) location on the earth's surface
- **Remote Sensing (RS)**
  - Use of satellites or aircraft to capture information (land cover) about the earth's surface
- **Geographic Information System (GIS)**
  - Systems with capability for input, storage, manipulation/analysis and display of spatial information

✓ ***GPS and RS are sources of input data for a GIS.***

Current areas of GIS applications (Yuan, 2008)

- Cartography
- Urban and regional planning
- Health
- Land & natural resource management
- Conservation e.g. sea turtle conservation
- Environmental modelling and management
- Safety e.g. transport
- Military services e.g. remote sensing
- Crisis management
- Trip navigation and routing
- Climate change
- Crime analysis and tracking
- …

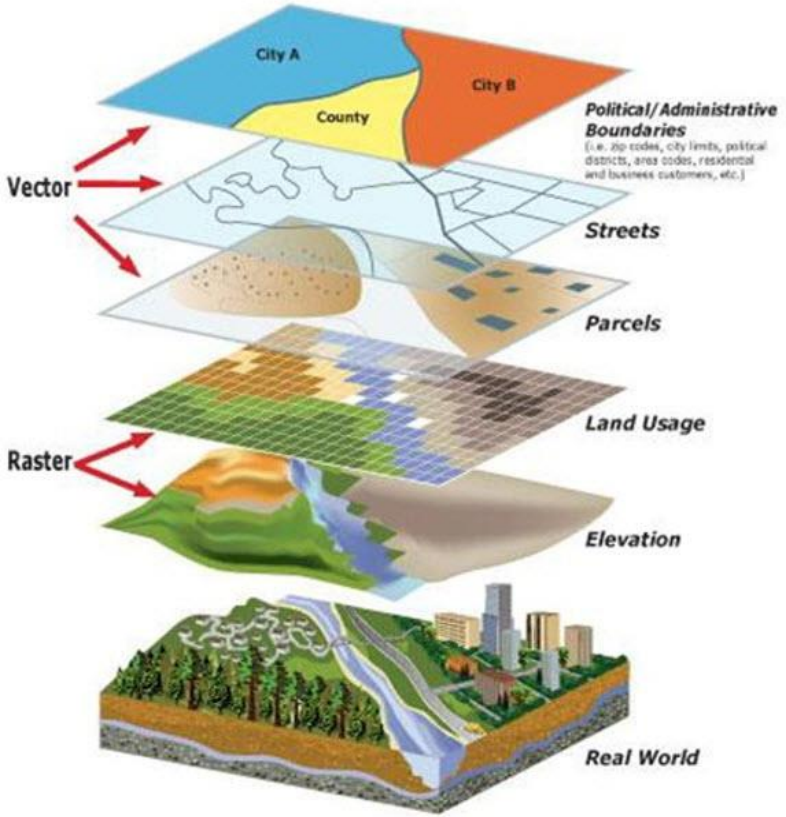
Some branches within the social sciences that are applicable to GIS

- Business studies
- Economics
- Sociology (incl. criminology, social movements, social change, social mobility, gender, stratification, …)
- Social work (incl. poverty, social planning, social policy, child welfare, community development,…)
- Demography
- Development studies (incl. community development, public health, social policy, …)
- Environmental studies

Source: Wikipedia

What is geographic information system (GIS)?

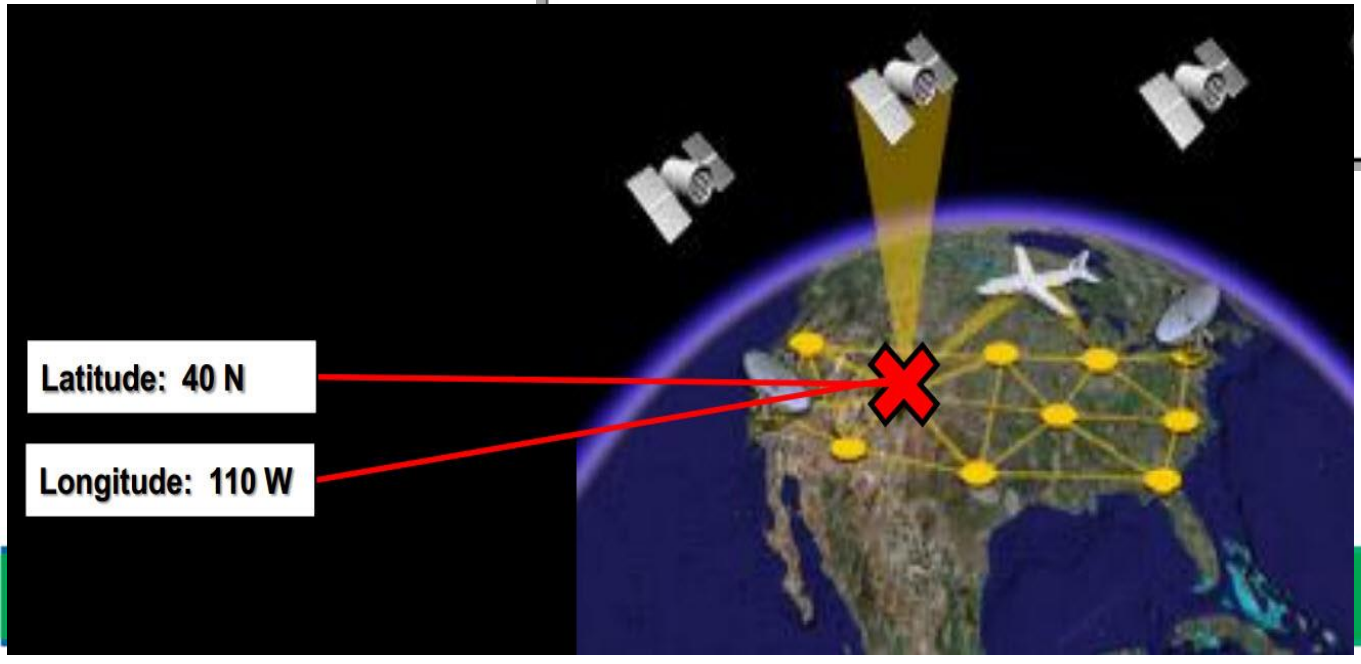
- **GIS** is a system designed to **capture, store, manipulate, analyze, manage**, and **present** all types of spatial or geographical data
- GIS allows us to **view, understand, question, interpret, and visualize** data in many ways that reveal spatial relationships, patterns & trends in the form of digital maps, globes, reports and charts.



GIS helps answer basic questions:

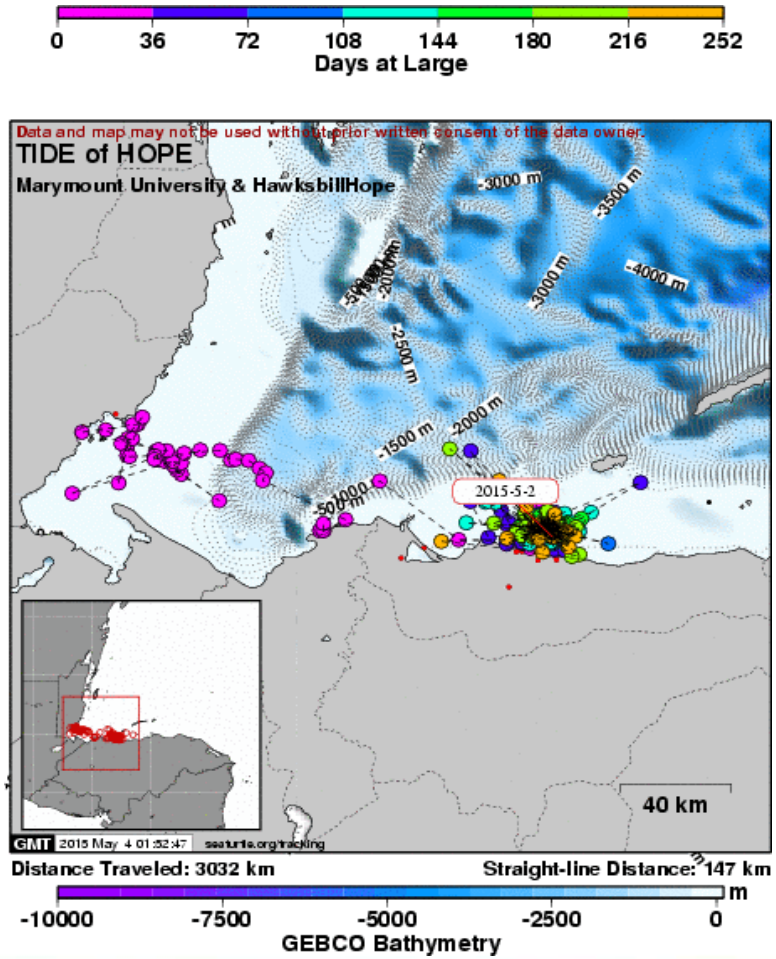
- Where is it?
- What else is nearby?
- Where is the highest concentration of ‘X’?
- Where can I find things with characteristic ‘Y’?
- Where is the closest ‘Z’ to my location?

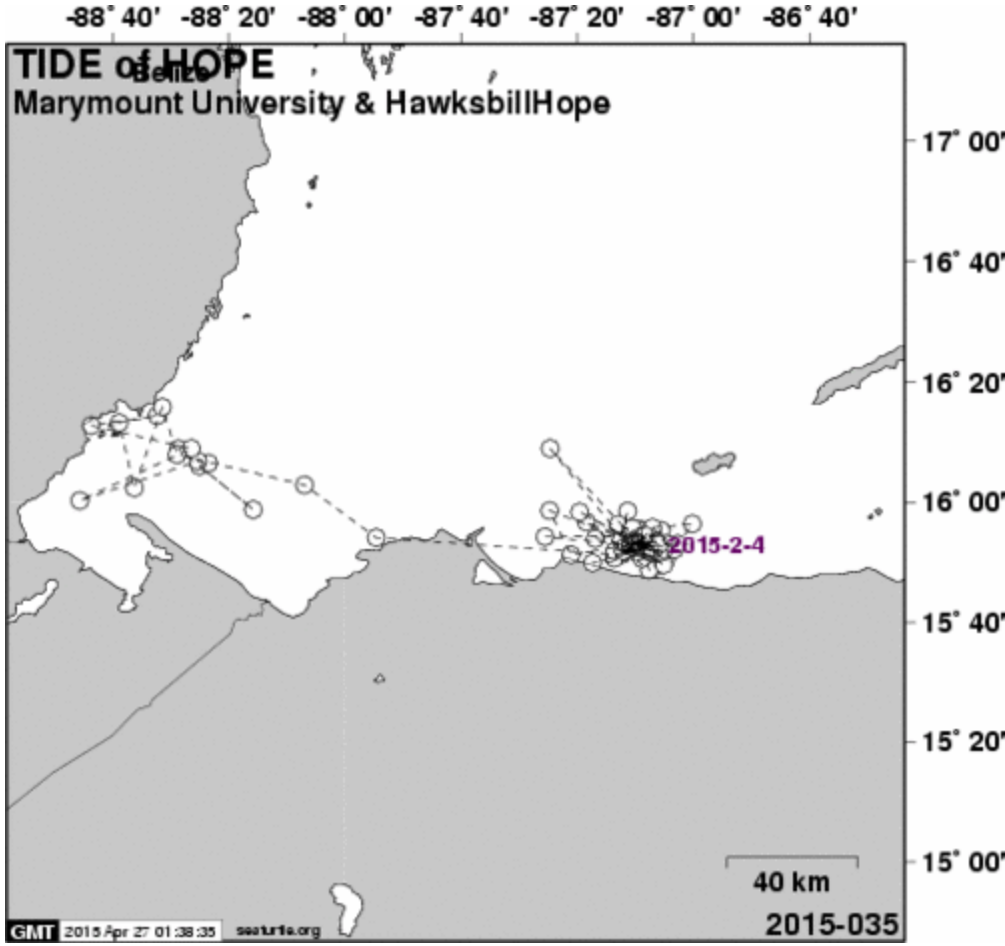
GPS- **G**lobal **P**ositioning **S**ystem



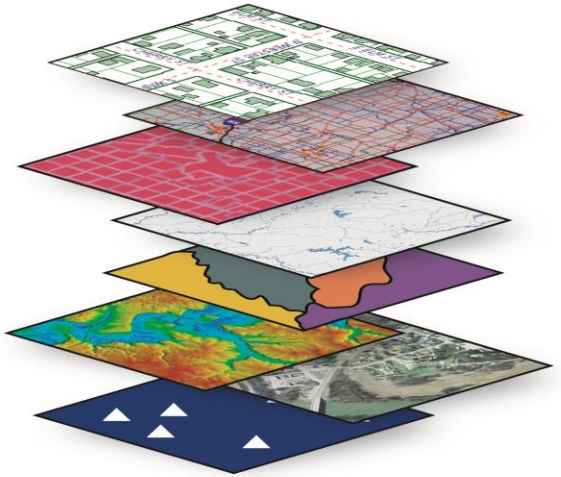
Satellite tracking

Satellite tracking

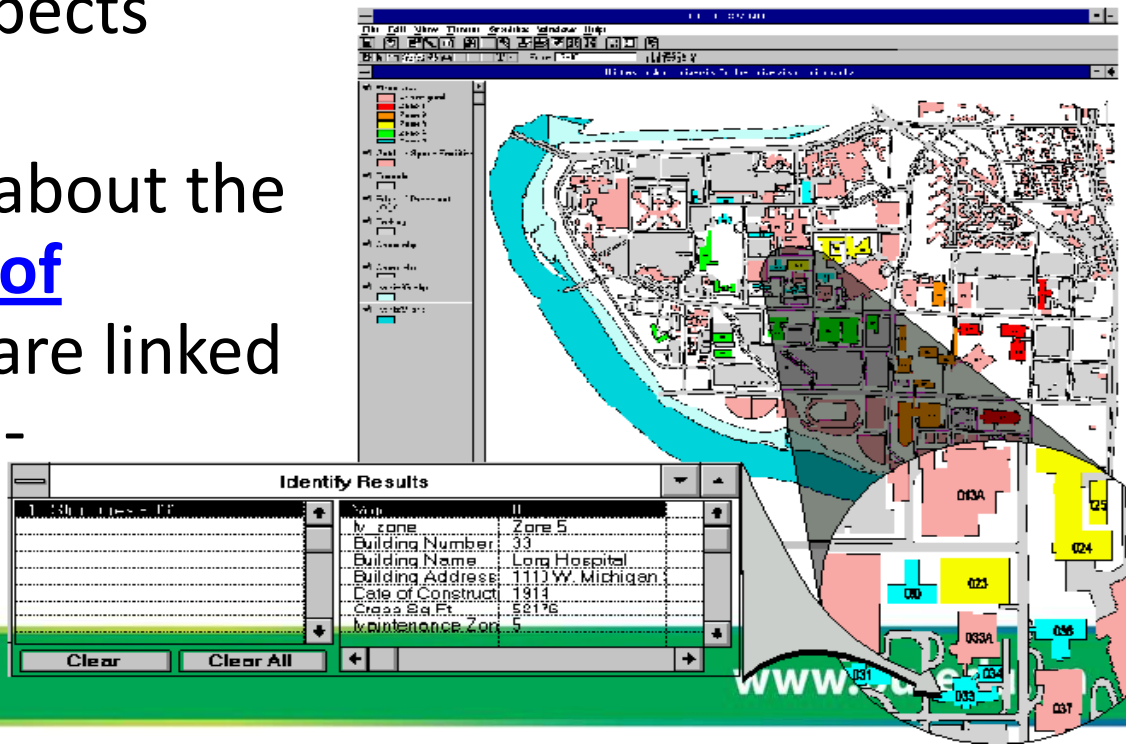




Why GIS is unique?

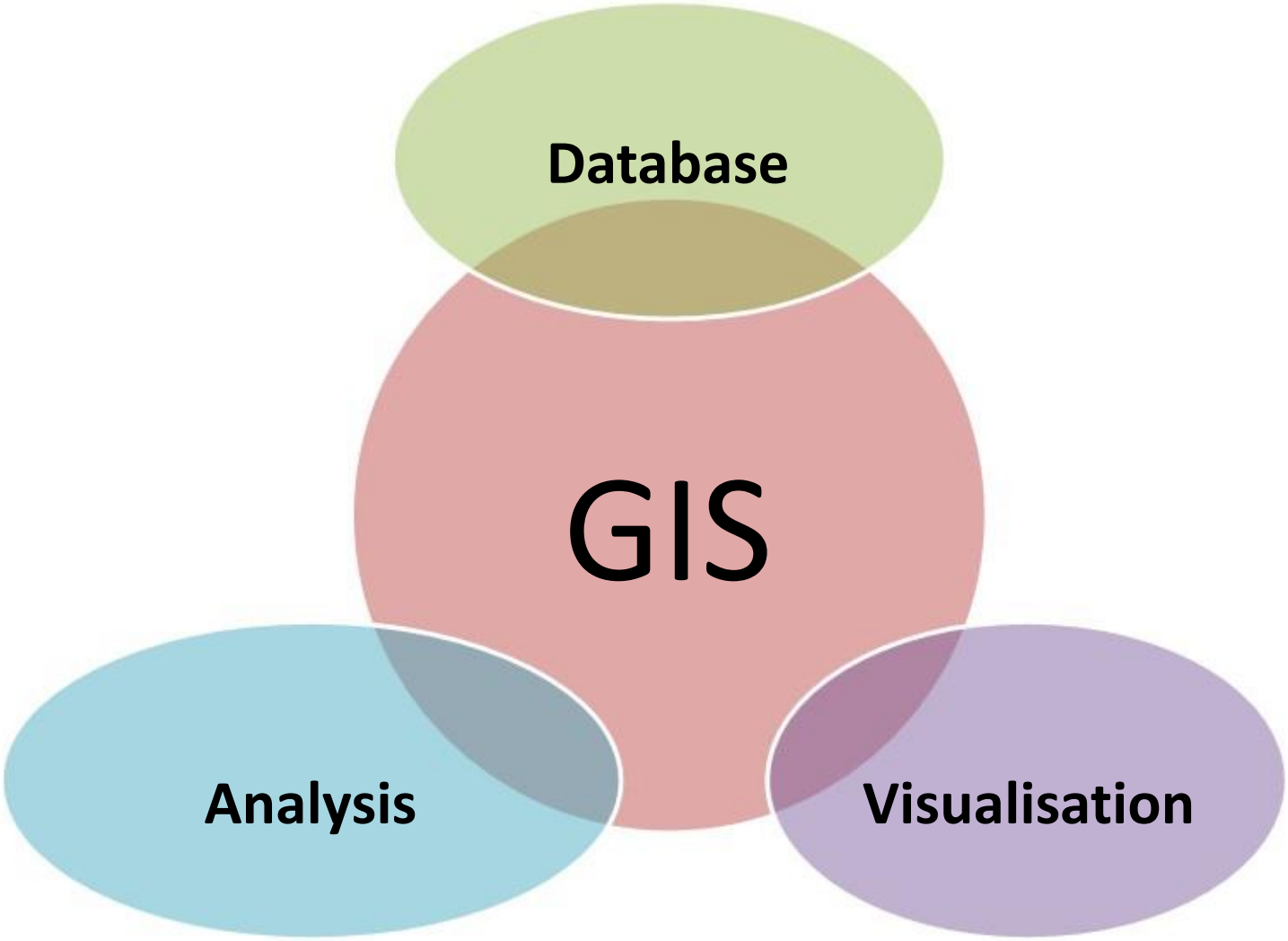


- GIS integrates **Spatial (map data)** and their **non-spatial** (**attribute information**) into one "system" that allows the user to **interact** with both aspects simultaneously.
- It stores information about the world as a **collection of thematic layers** that are linked together through geo-referencing



2. Applications of GIS in some branches within the social sciences

Three views of GIS



1. GIS as GEOdatabase
Before GIS: scattered geographic information

Descriptive attributes

Map

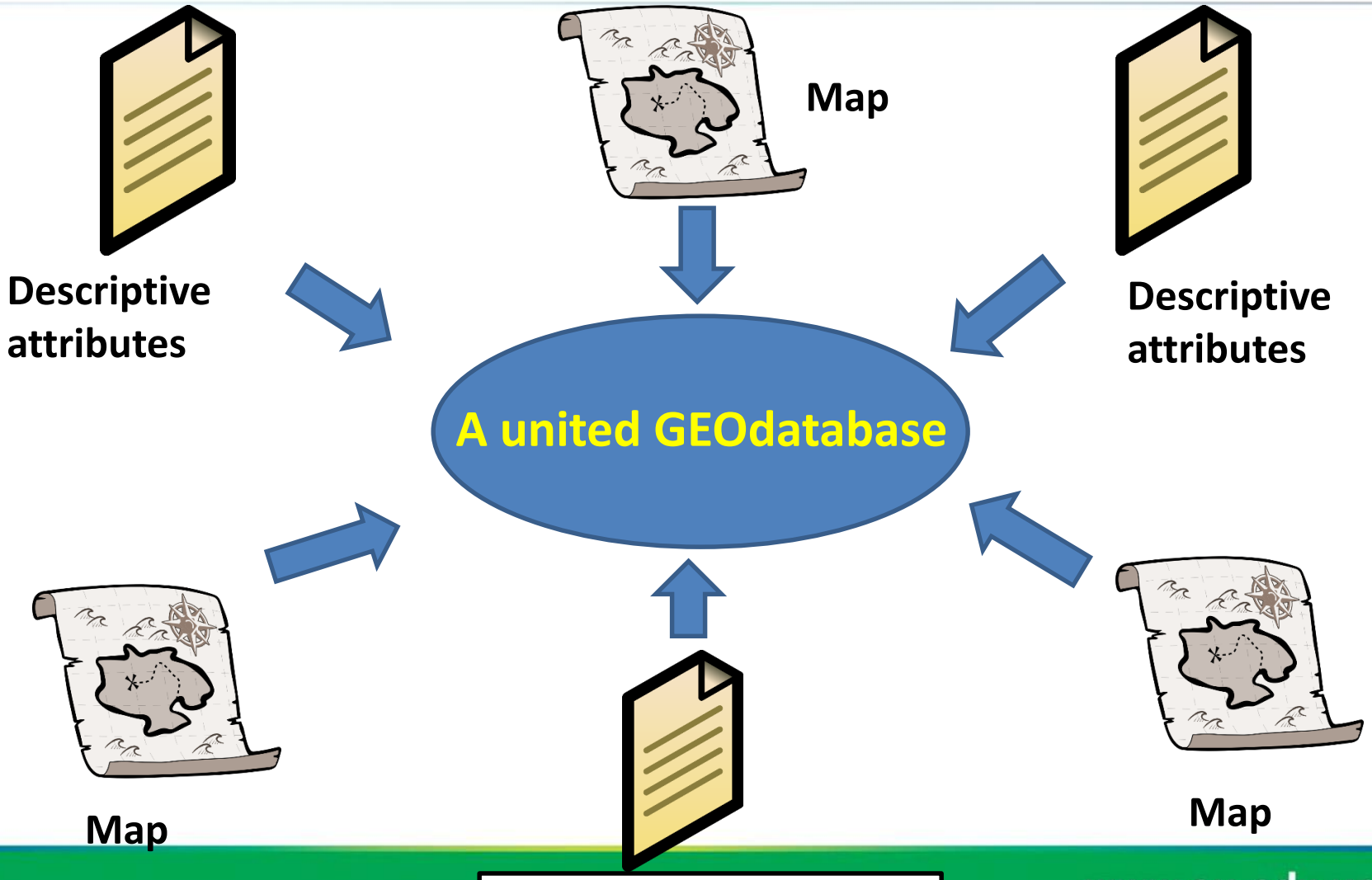
Descriptive attributes

Map

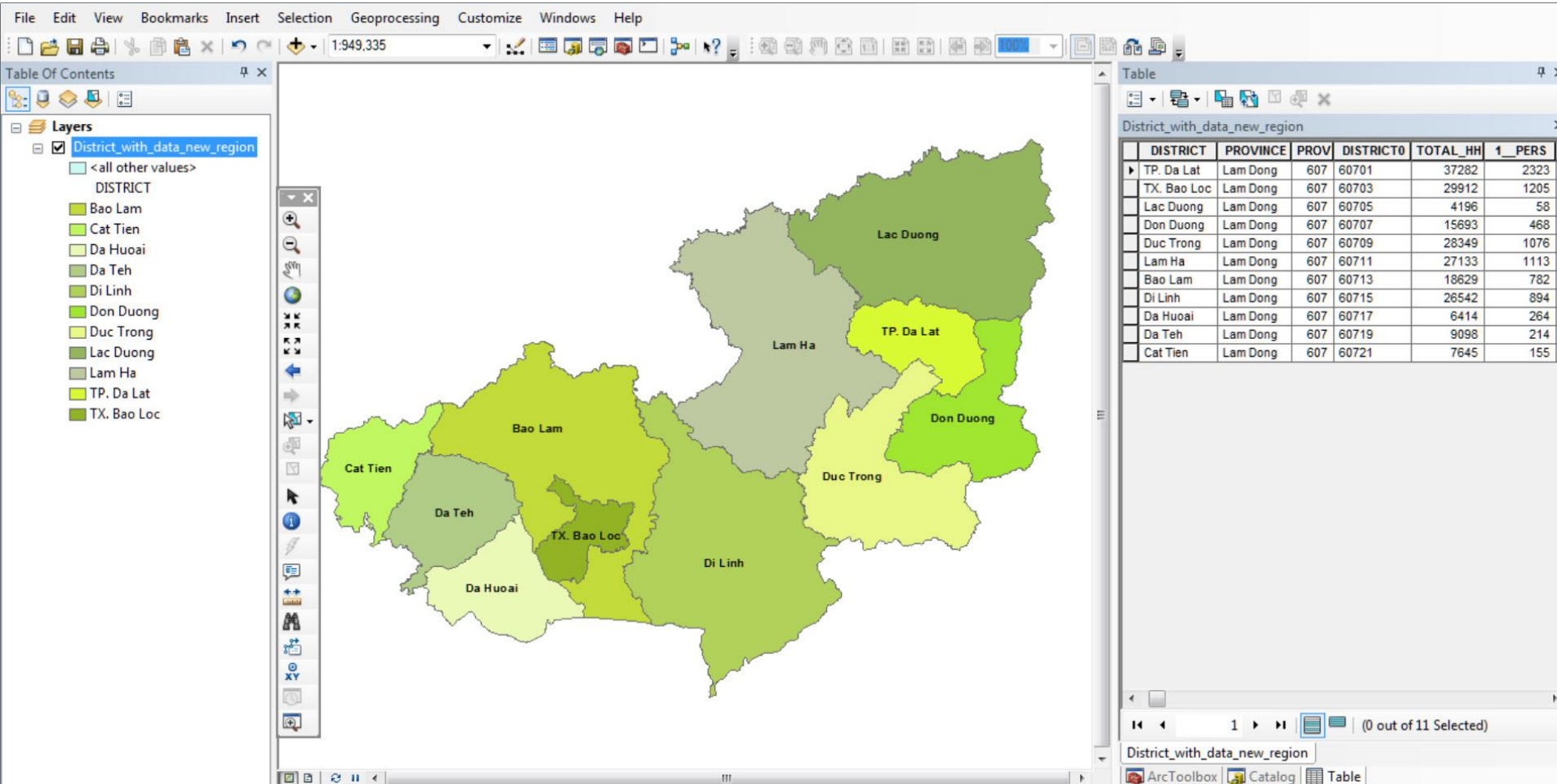
Descriptive attributes

Map

After GIS: a united geographic information

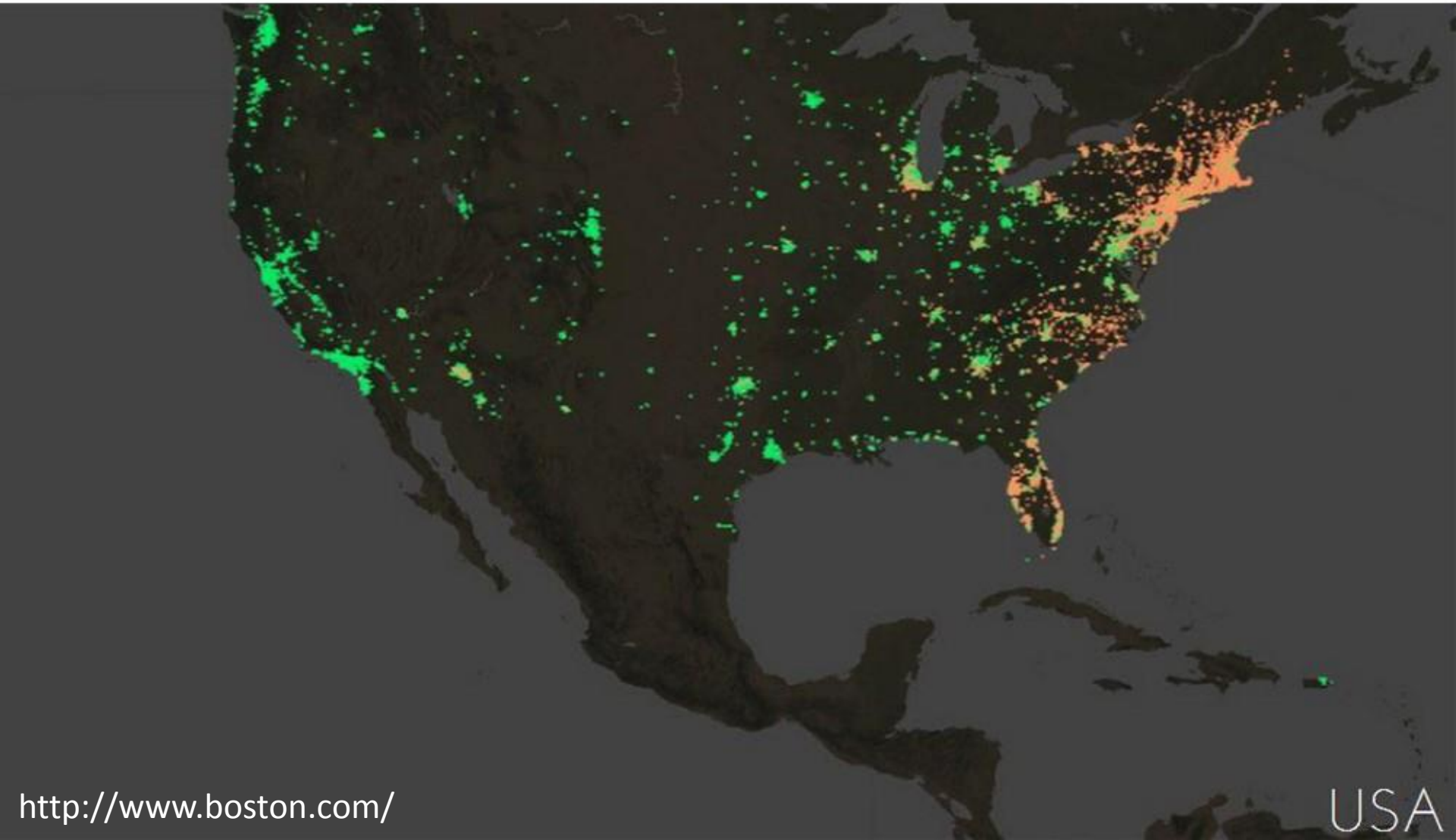


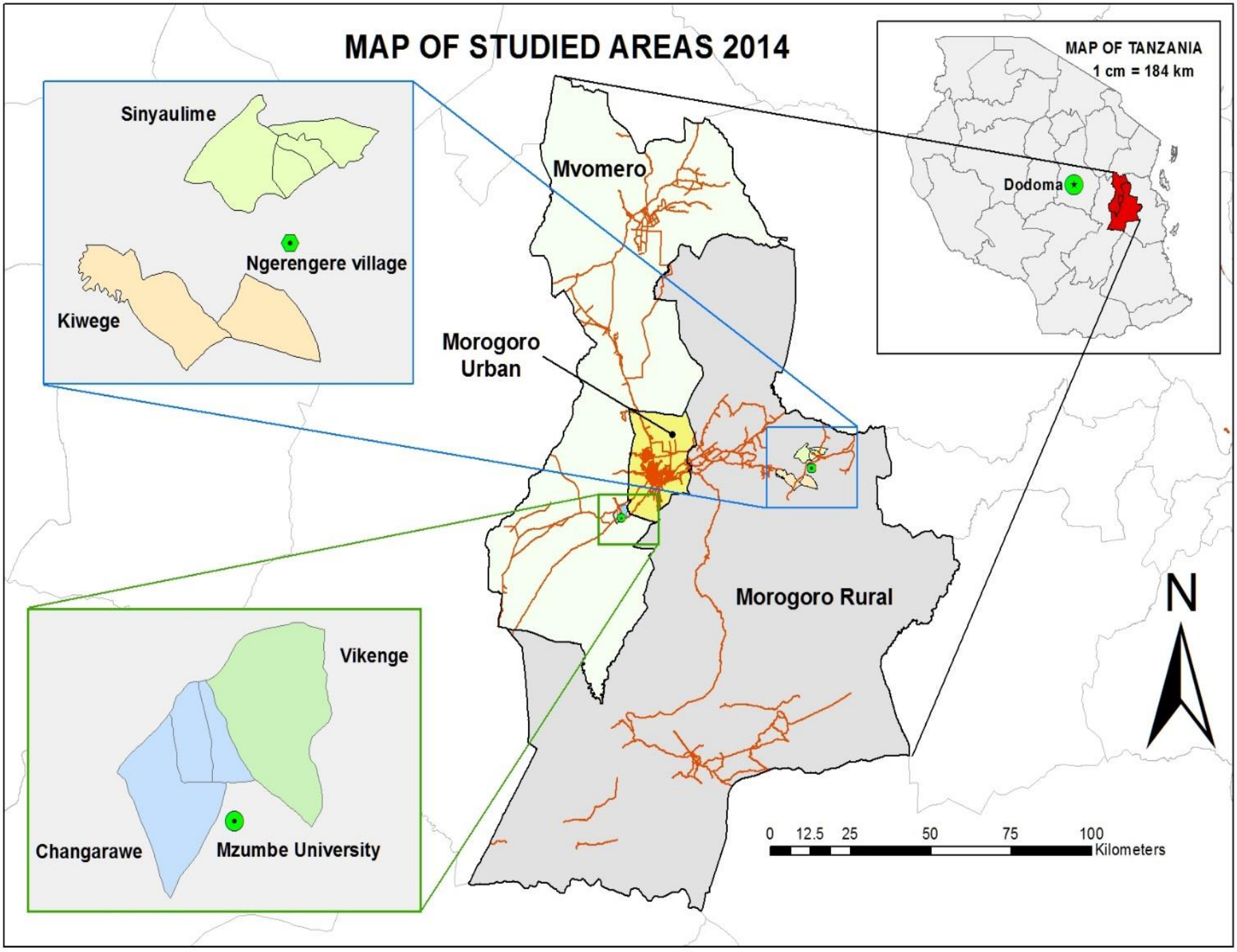
- **Geodatabase:** a spatial database containing data that associate with geographic information



2. GIS as GeoVisualisation

Starbucks vs. Dunkin Donuts

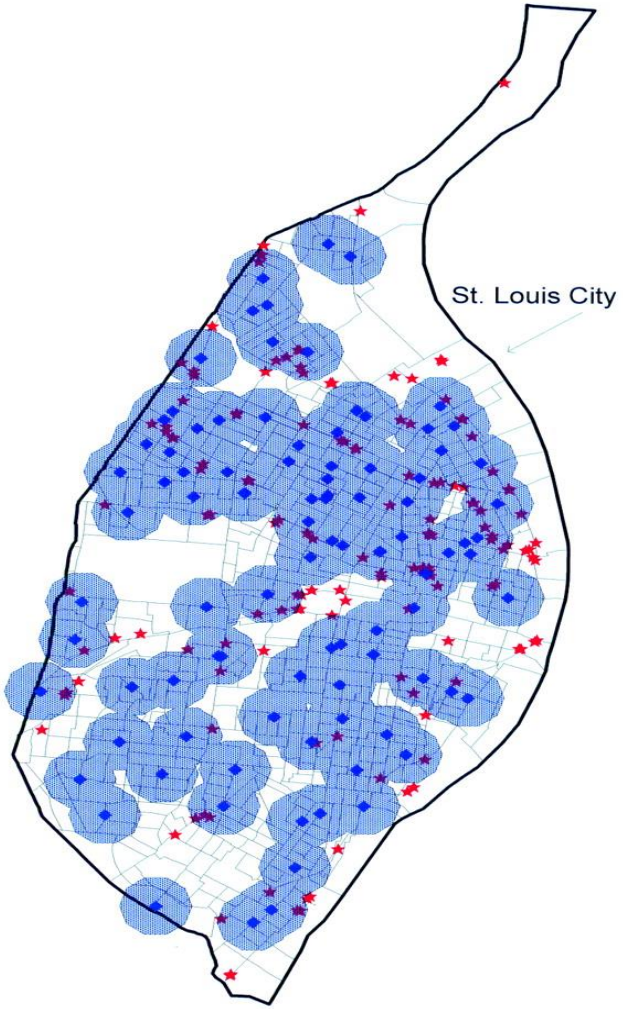



MAP OF STUDIED AREAS 2014
MAP OF TANZANIA
1 cm = 184 km
Dodoma
Sinyaulime
Ngerengere village
Kiwege
Mvomero
Morogoro Urban
Morogoro Rural
Vikenge
Changarawe
Mzumbe University
N
0 12.5 25 50 75 100
Kilometers

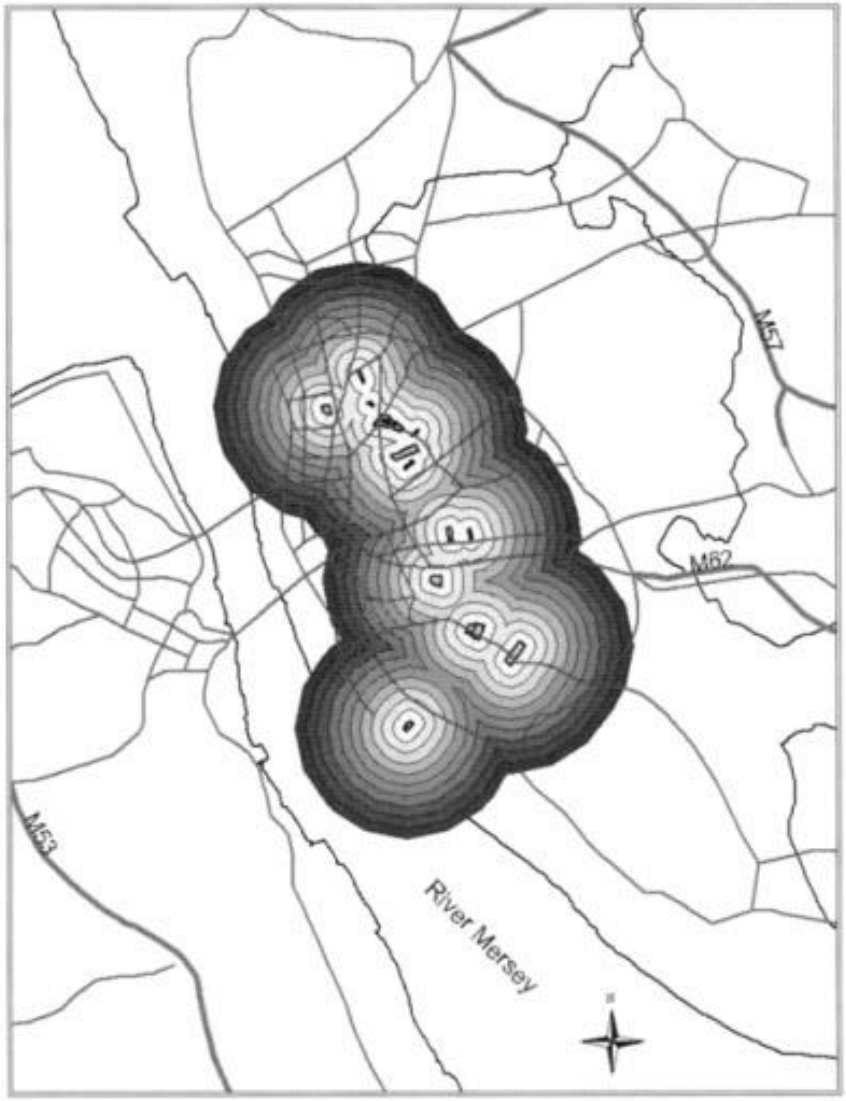
3. GIS as spatial analyst

- **Geoprocessing:** a set of tools take geographic information from existing data, apply spatial analysis functions to identify patterns or discover knowledge.

Locations of tobacco billboards and public schools in St Louis city-a buffer analysis (Luke et al., 2000)



Concentric ring buffer zones around Alleygated areas in Mersey side – buffer zone analysis



- Crime counts
- Property counts
- Burglary rate

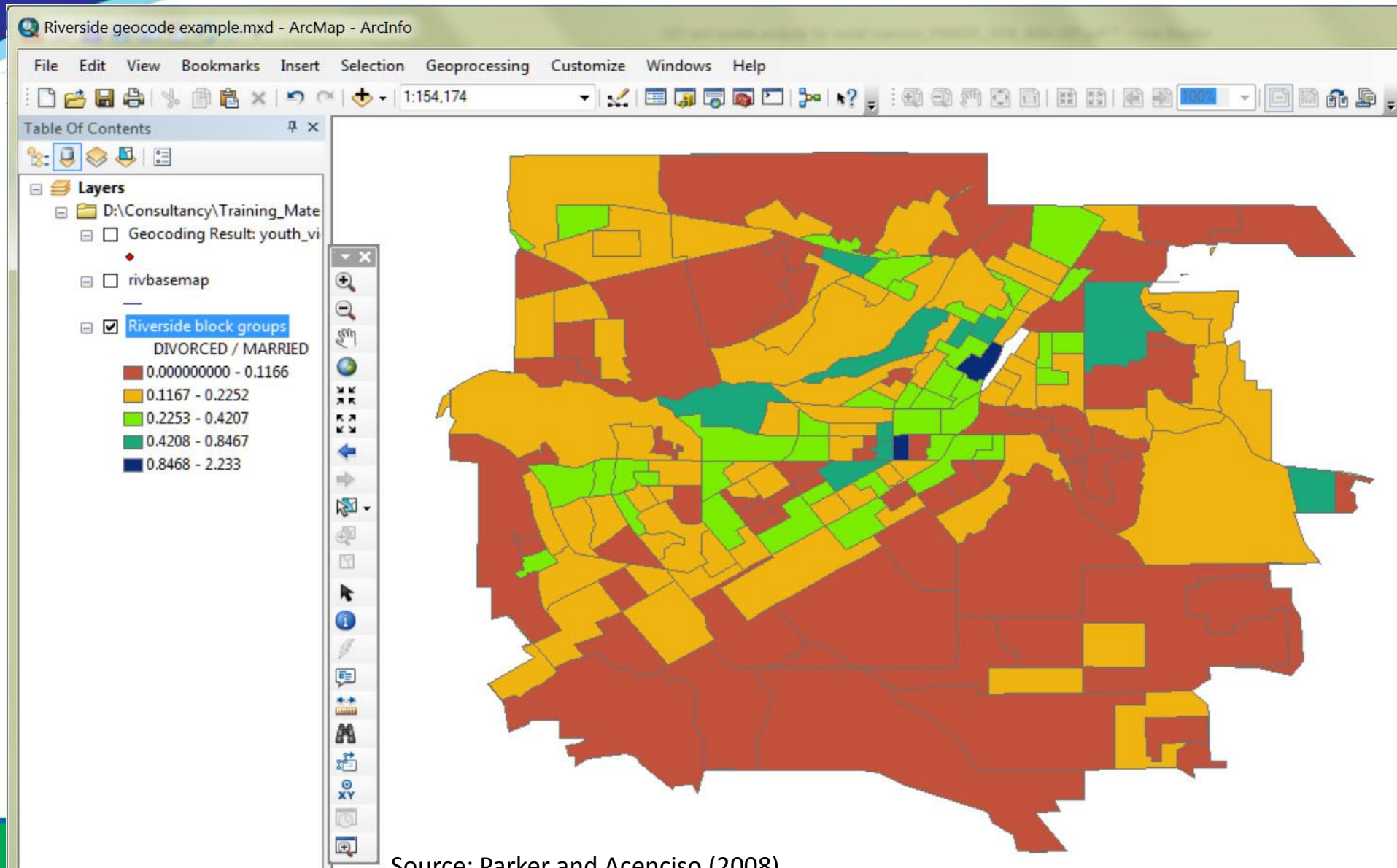
Source: Young et al. (2003).

Challenges/Limitations

- Availability, accessibility and appropriateness of GIS infrastructure (human resources, hardware, software, data, skills,…)
- Willing users

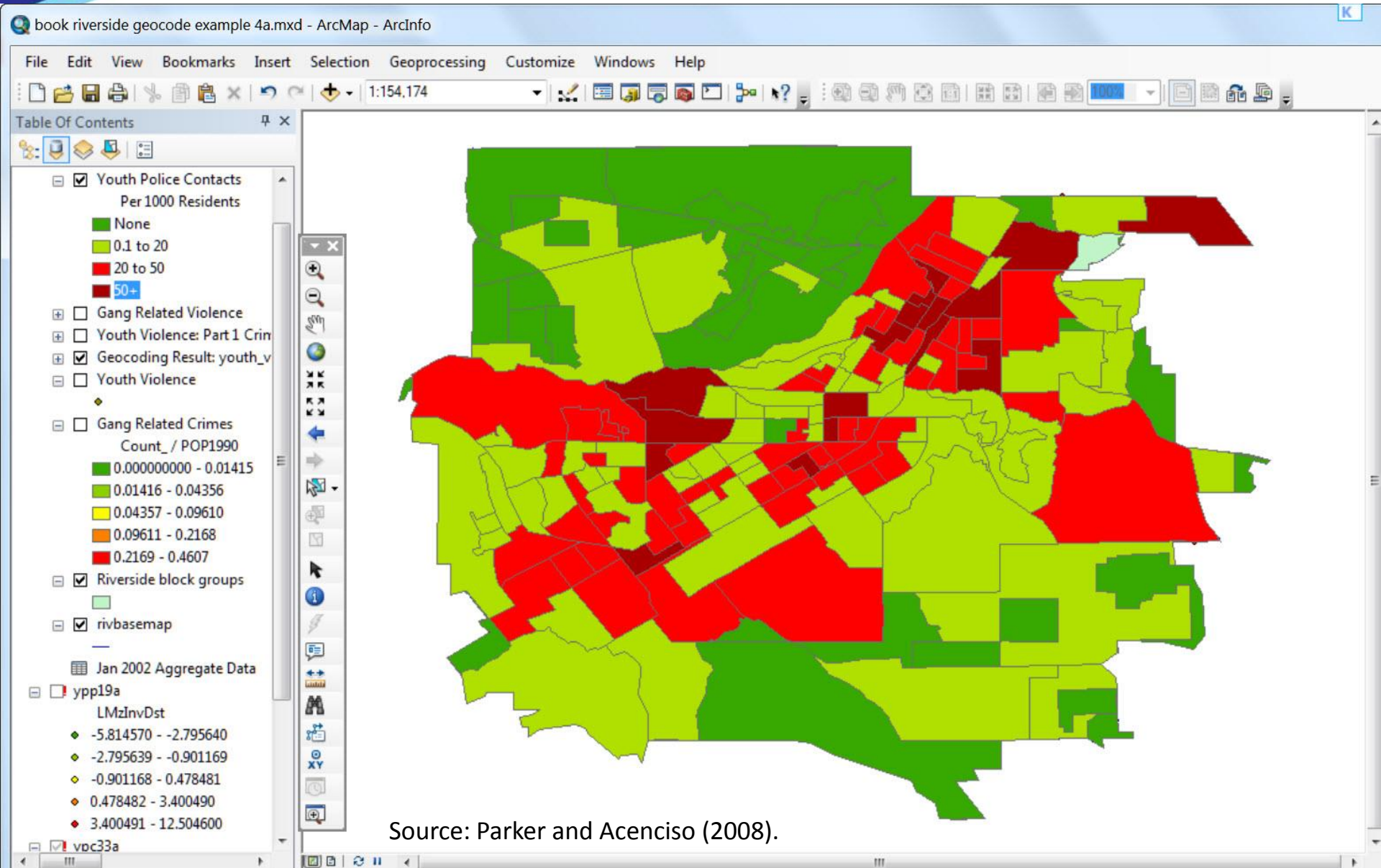
Mapping for Analysis, Policy & Decision Making

Mapping rates: divorced relative to married



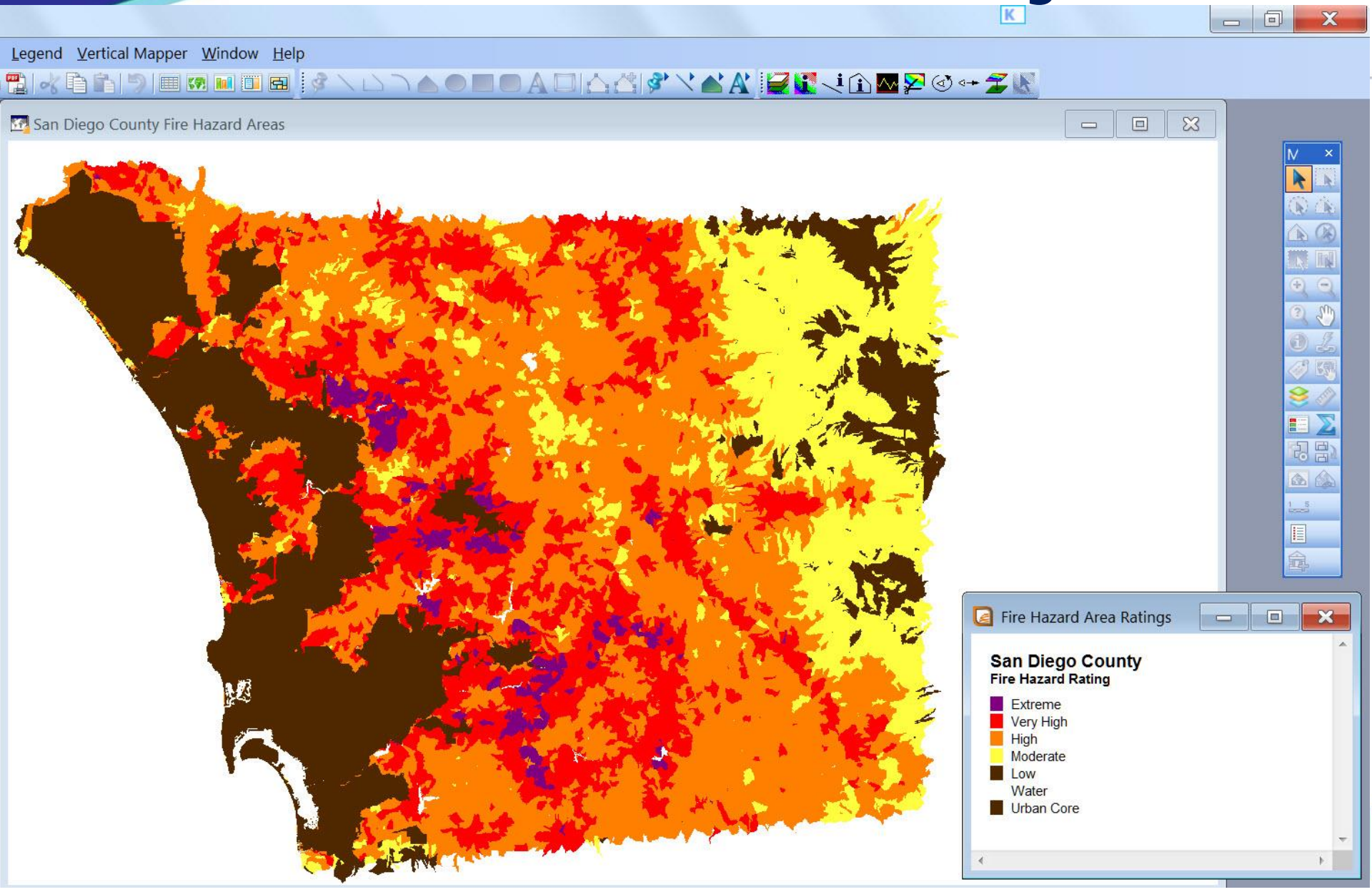
Source: Parker and Acenciso (2008).

Youth police contacts in Riverside



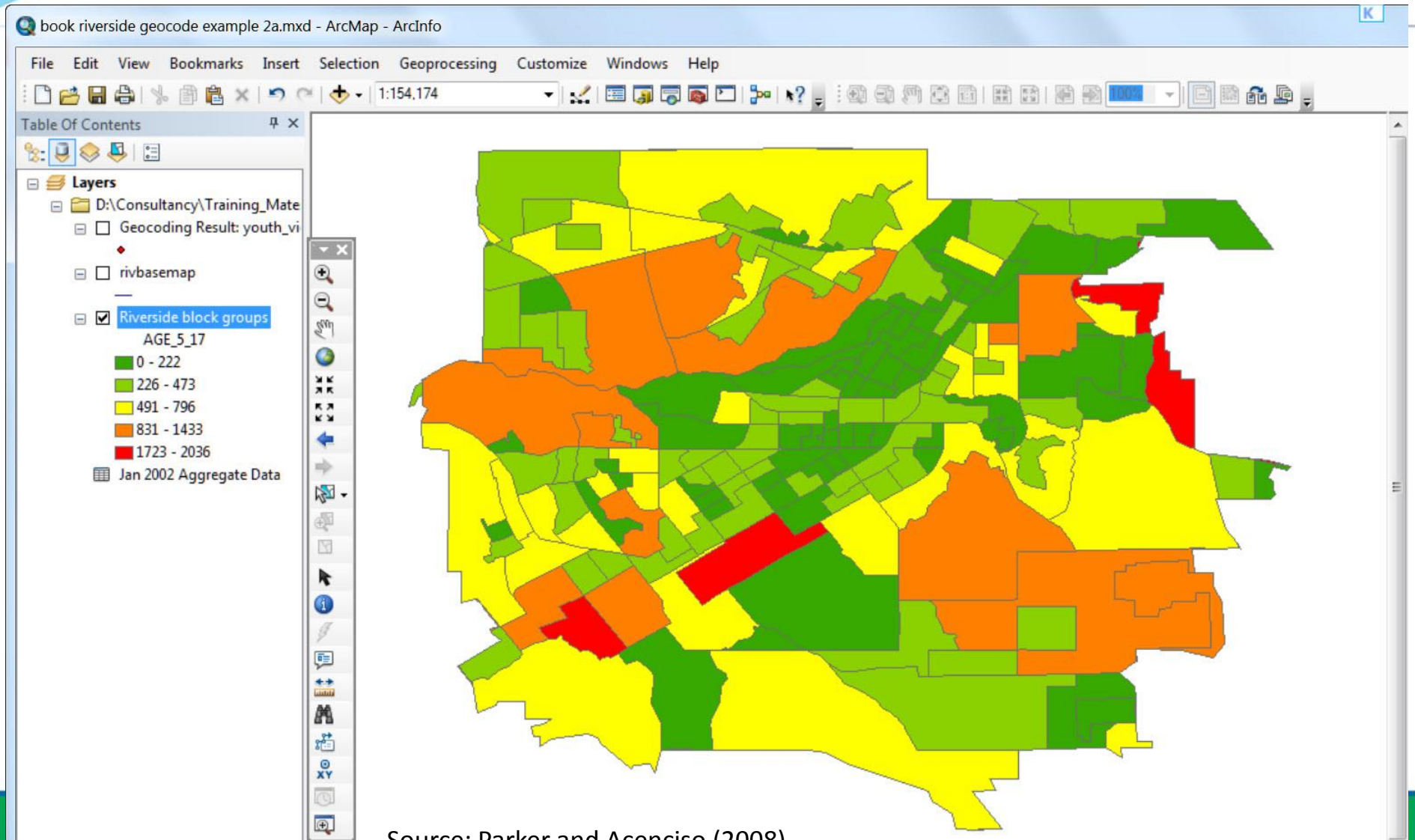
Source: Parker and Acenciso (2008).

Fire hazard rating



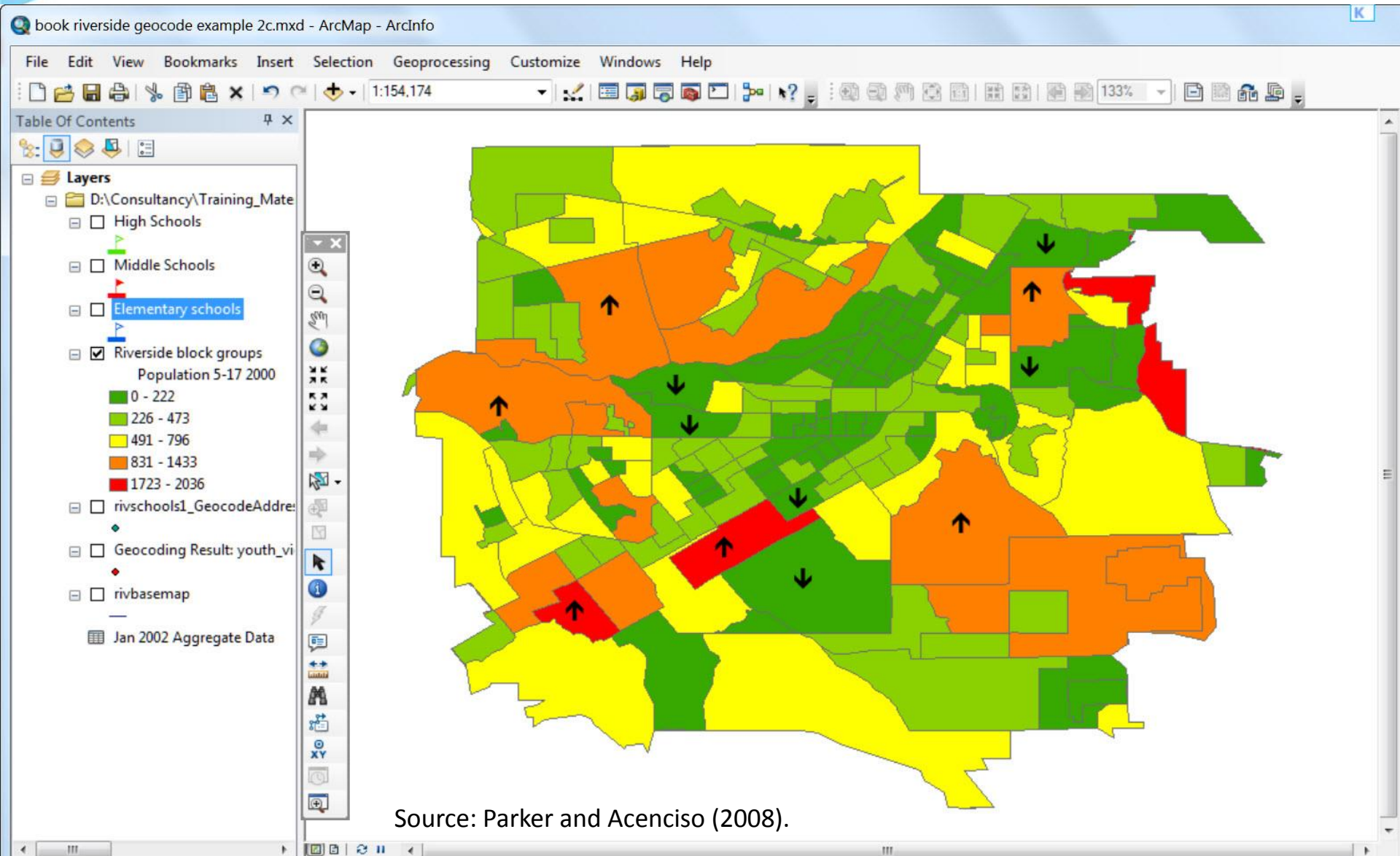
Planning and projections: multiple variable map for decision making

Maps for school planning: children aged 5-17 in Riverside, 2000; areas with large no of children



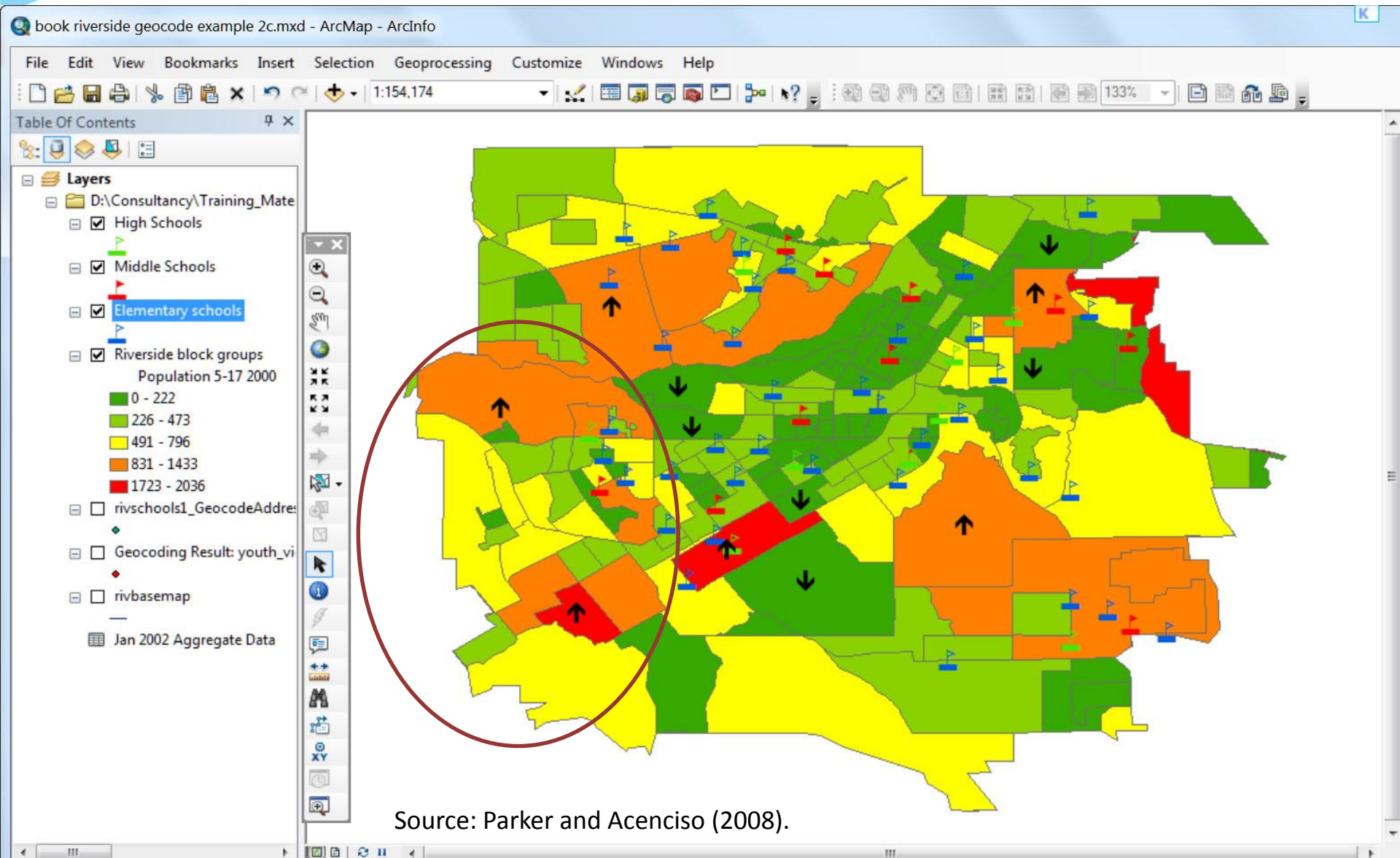
Source: Parker and Acenciso (2008).

Areas of growth (↑) or Decline (↓) in school age children (1990–2000) – a two-variable map



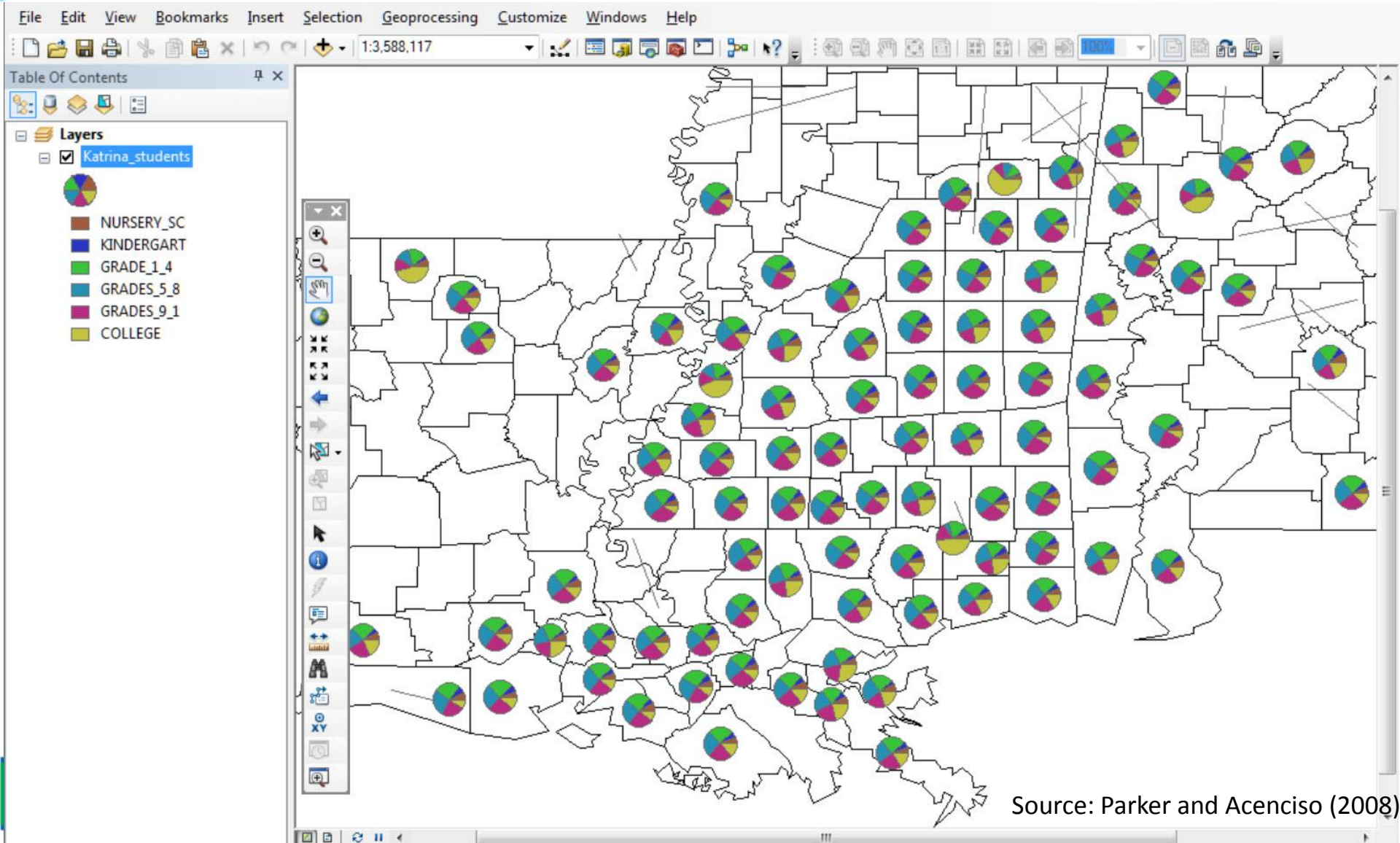
Source: Parker and Acenciso (2008).

Large populations of children, growth and few schools- a multi-variable map for planning/policy



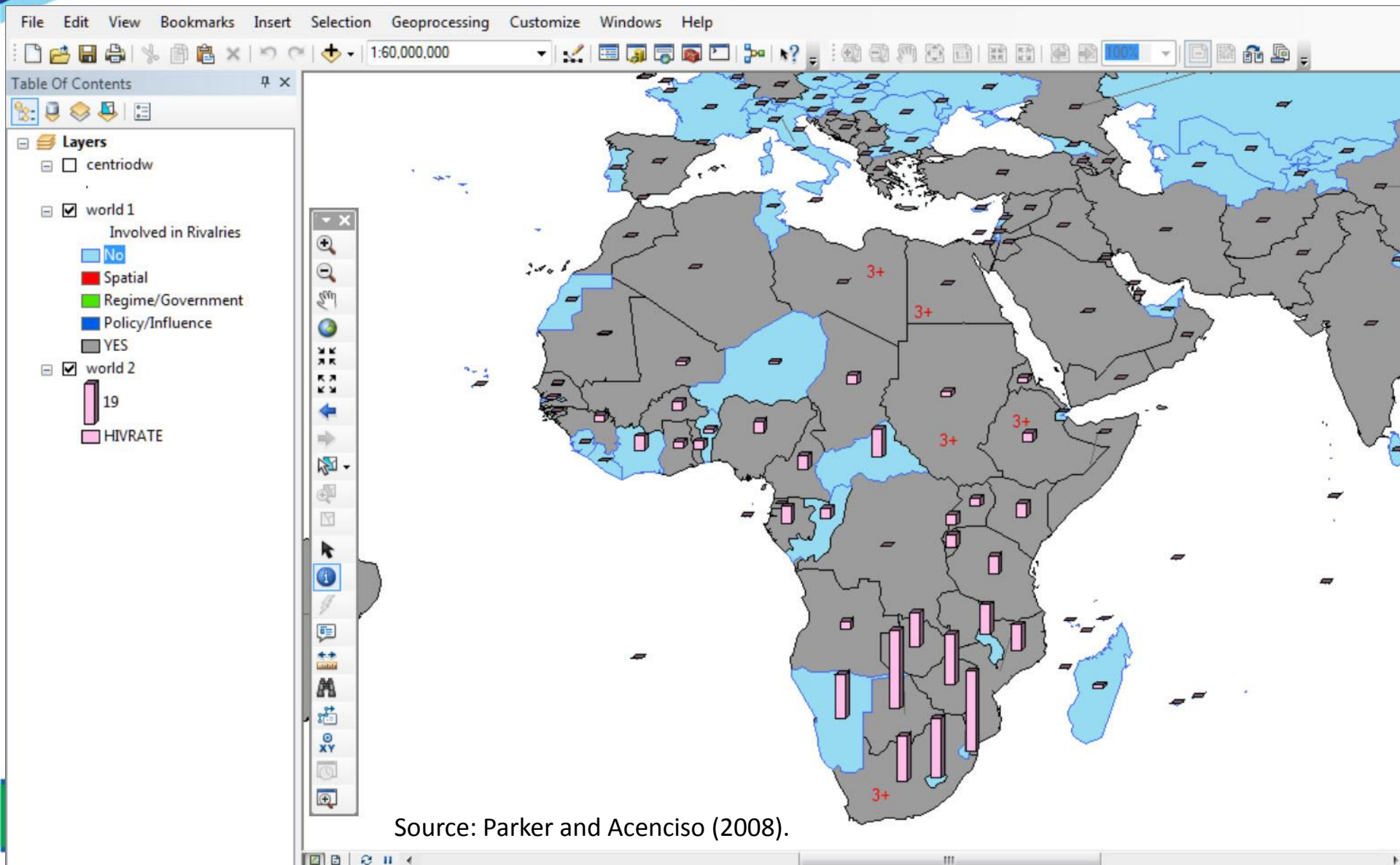
Source: Parker and Acenciso (2008).

School children impacted by Hurricane Katrina in Louisiana, Alabama, and Mississippi



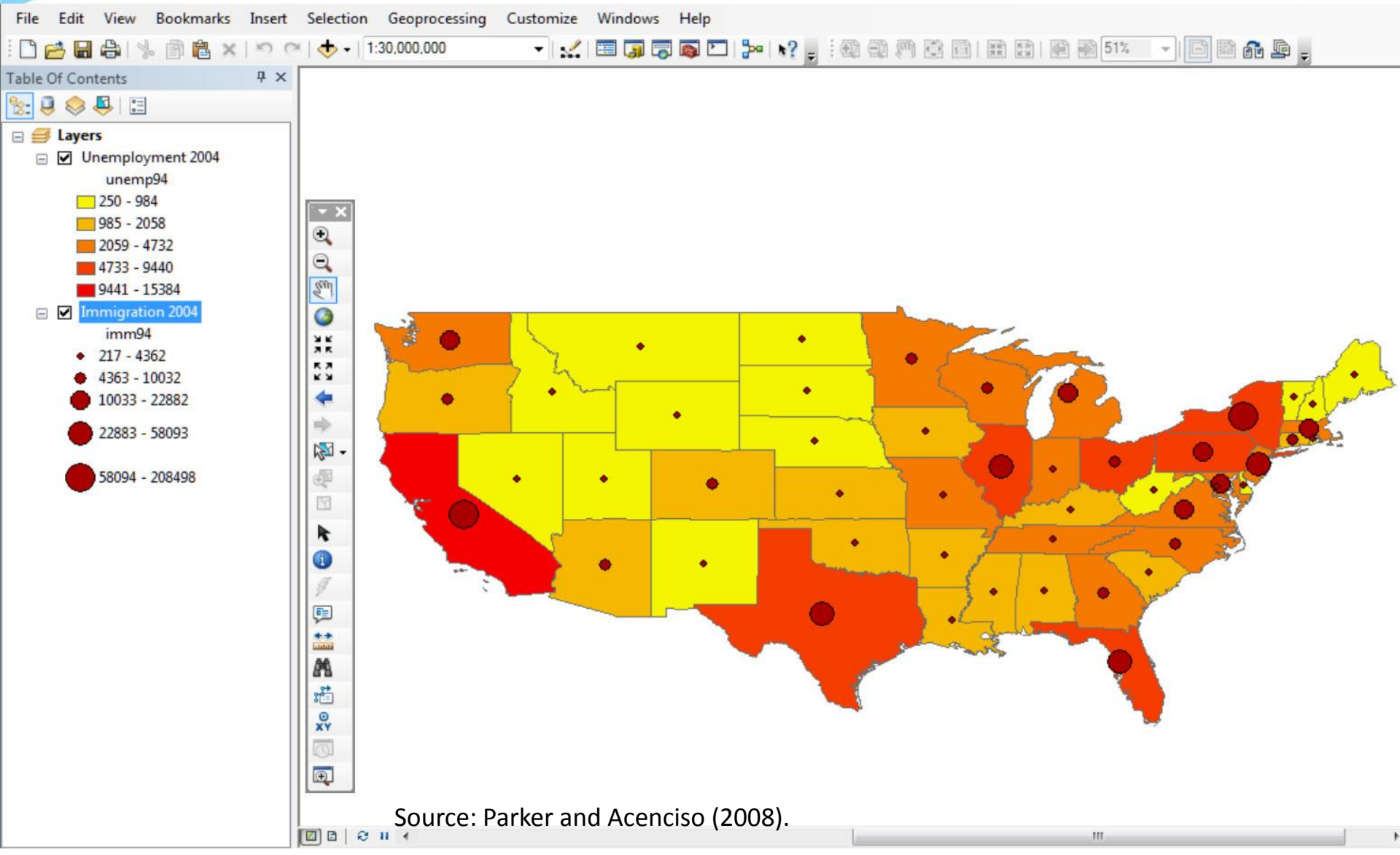
Source: Parker and Acenciso (2008)

HIV infected rate in Africa



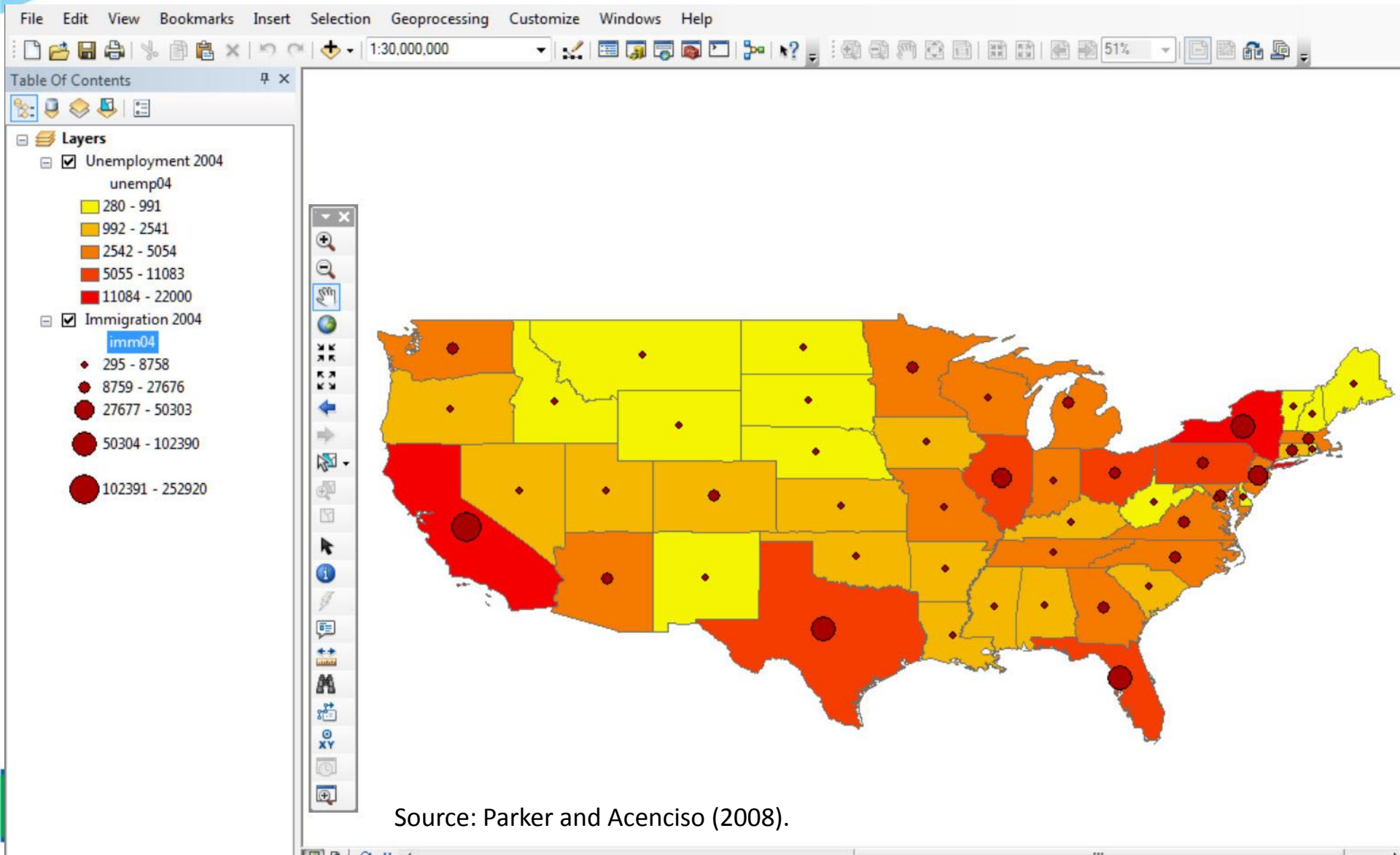
Source: Parker and Acenciso (2008).

Immigration and unemployment 1994 in the US



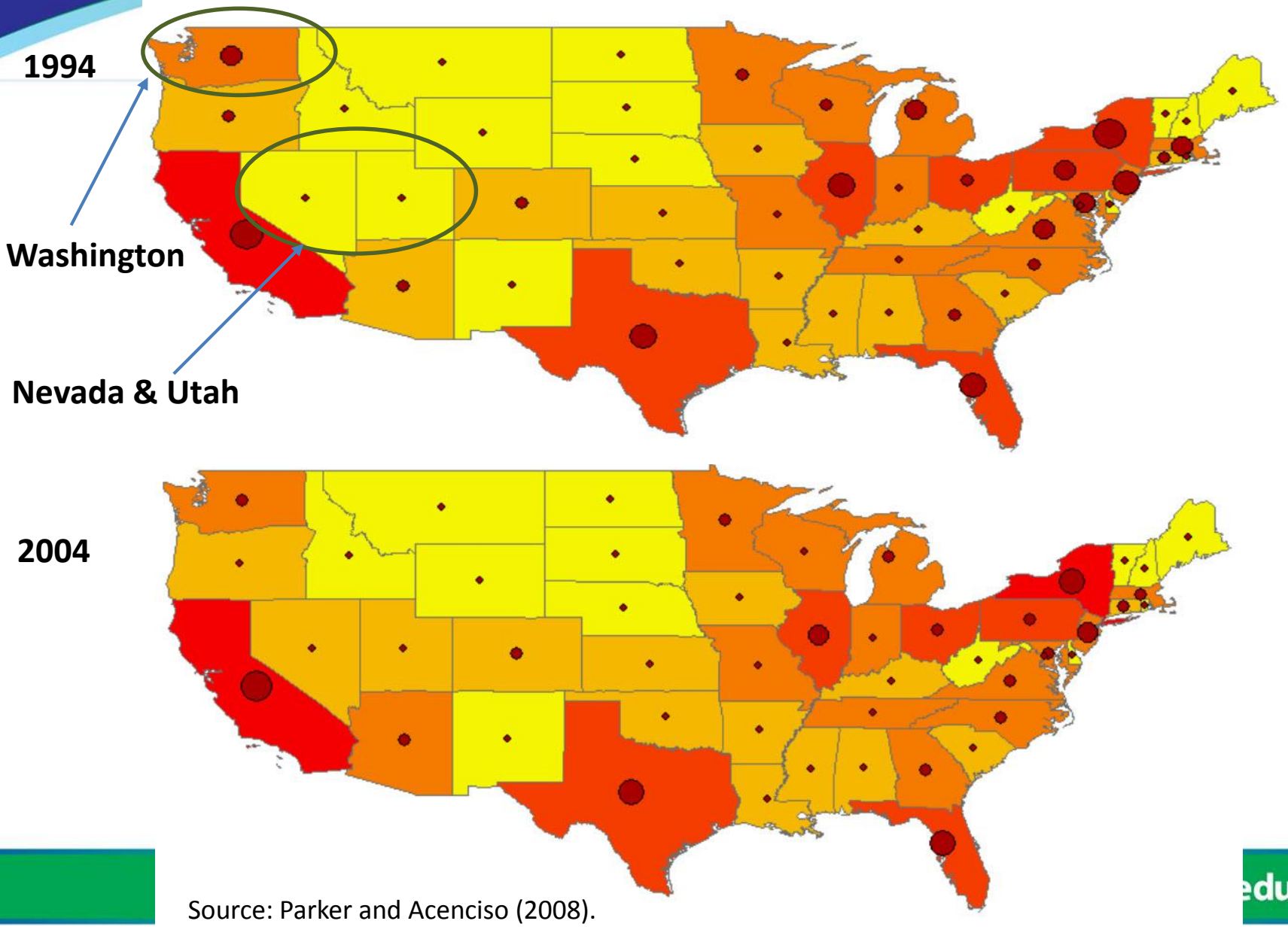
Source: Parker and Acenciso (2008).

Immigration and unemployment 2004 in the US



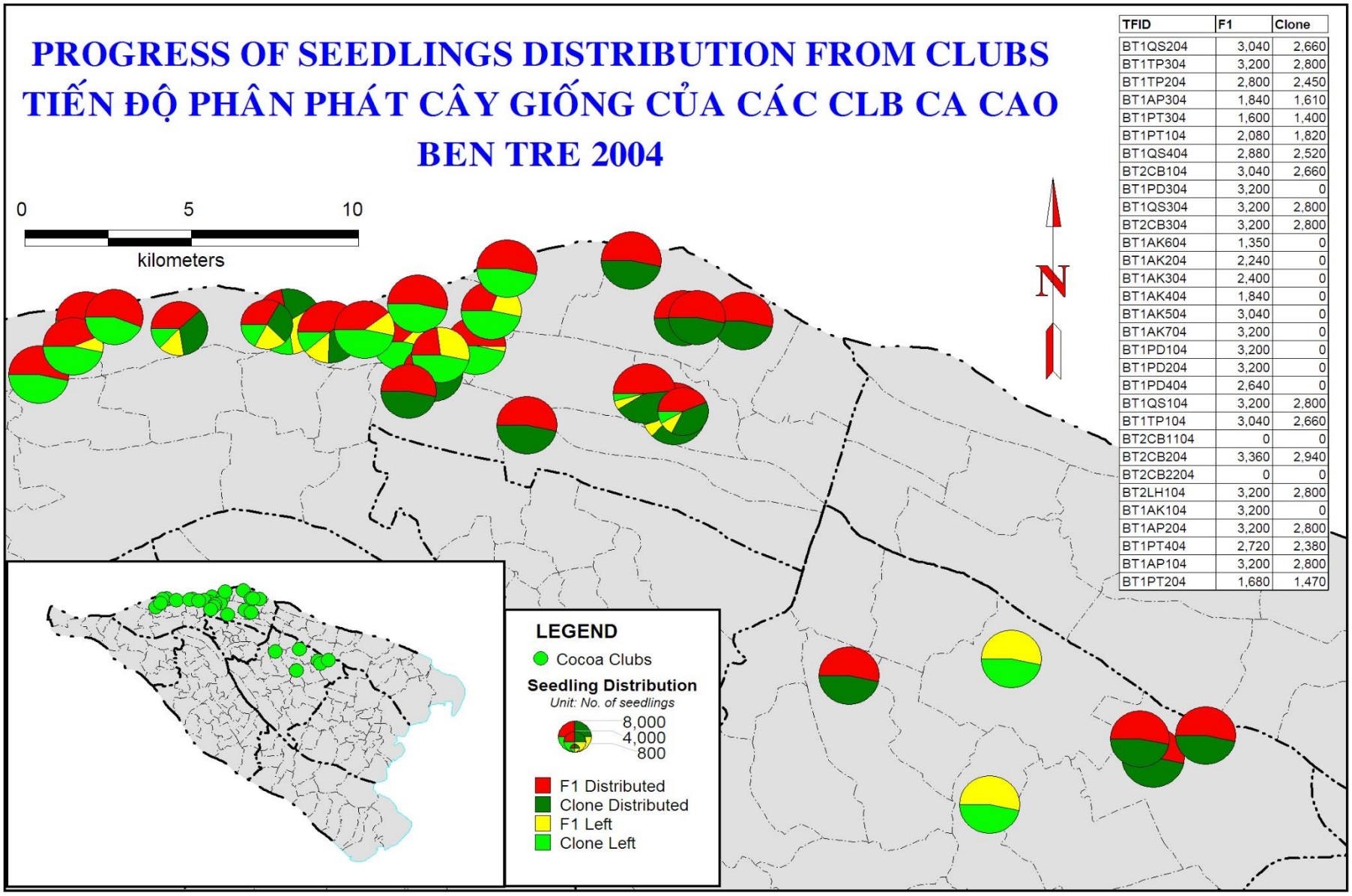
Source: Parker and Acenciso (2008).

Comparison 1994-2004

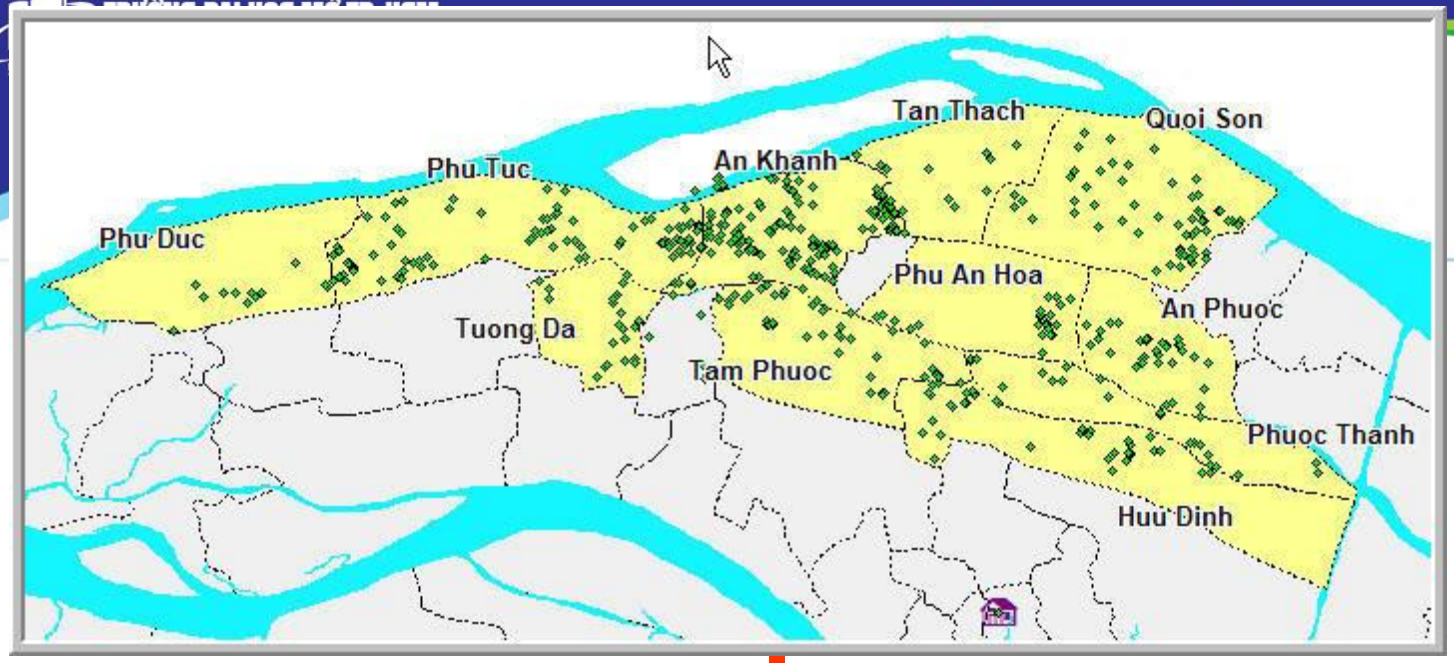


Source: Parker and Acenciso (2008).

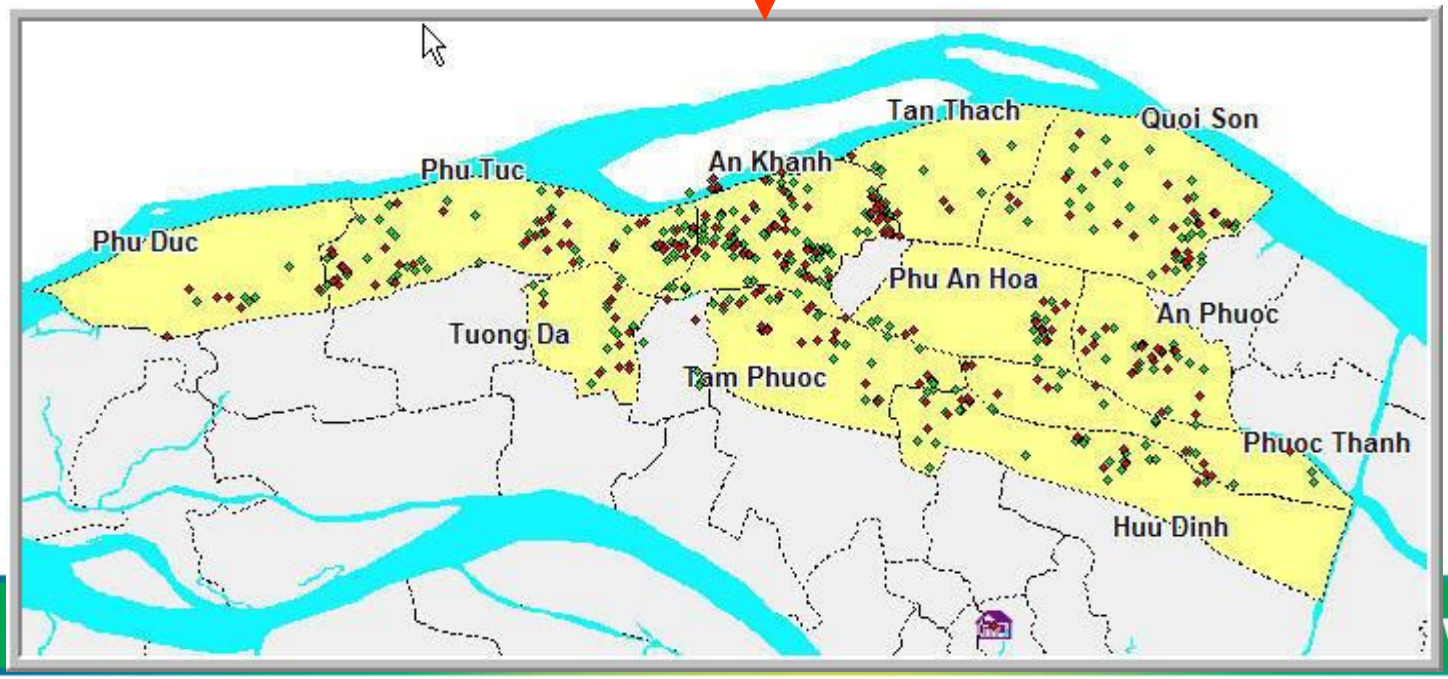
Progress monitoring



TFID	F1	Clone
BT1QS204	3,040	2,660
BT1TP304	3,200	2,800
BT1TP204	2,800	2,450
BT1AP304	1,840	1,610
BT1PT304	1,600	1,400
BT1PT104	2,080	1,820
BT1QS404	2,880	2,520
BT2CB104	3,040	2,660
BT1PD304	3,200	0
BT1QS304	3,200	2,800
BT2CB304	3,200	2,800
BT1AK604	1,350	0
BT1AK204	2,240	0
BT1AK304	2,400	0
BT1AK404	1,840	0
BT1AK504	3,040	0
BT1AK704	3,200	0
BT1PD104	3,200	0
BT1PD204	3,200	0
BT1PD404	2,640	0
BT1QS104	3,200	2,800
BT1TP104	3,040	2,660
BT2CB1104	0	0
BT2CB204	3,360	2,940
BT2CB2204	0	0
BT2LH104	3,200	2,800
BT1AK104	3,200	0
BT1AP204	3,200	2,800
BT1PT404	2,720	2,380
BT1AP104	3,200	2,800
BT1PT204	1,680	1,470

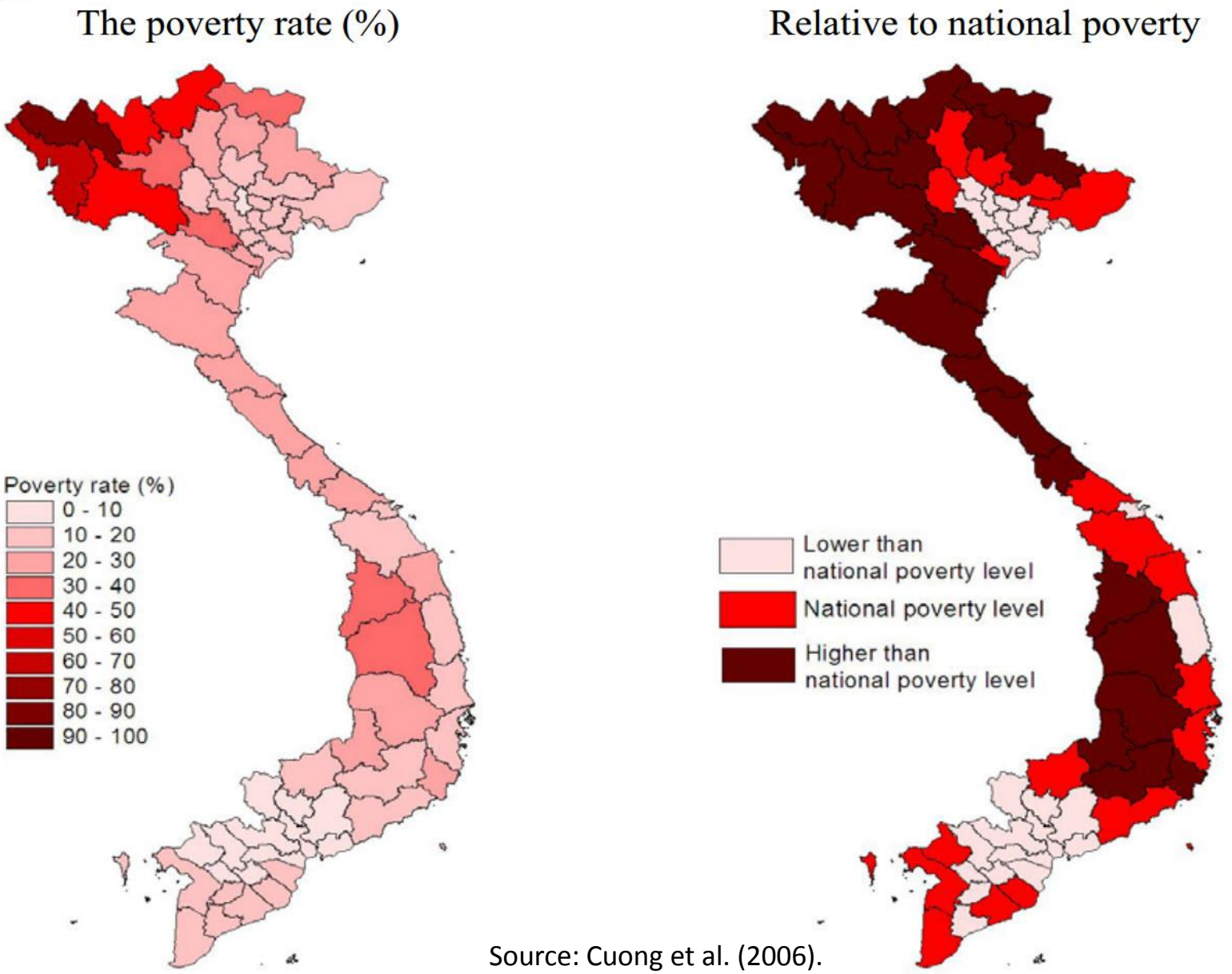


Total Potential Water Users Identified (using GPS)



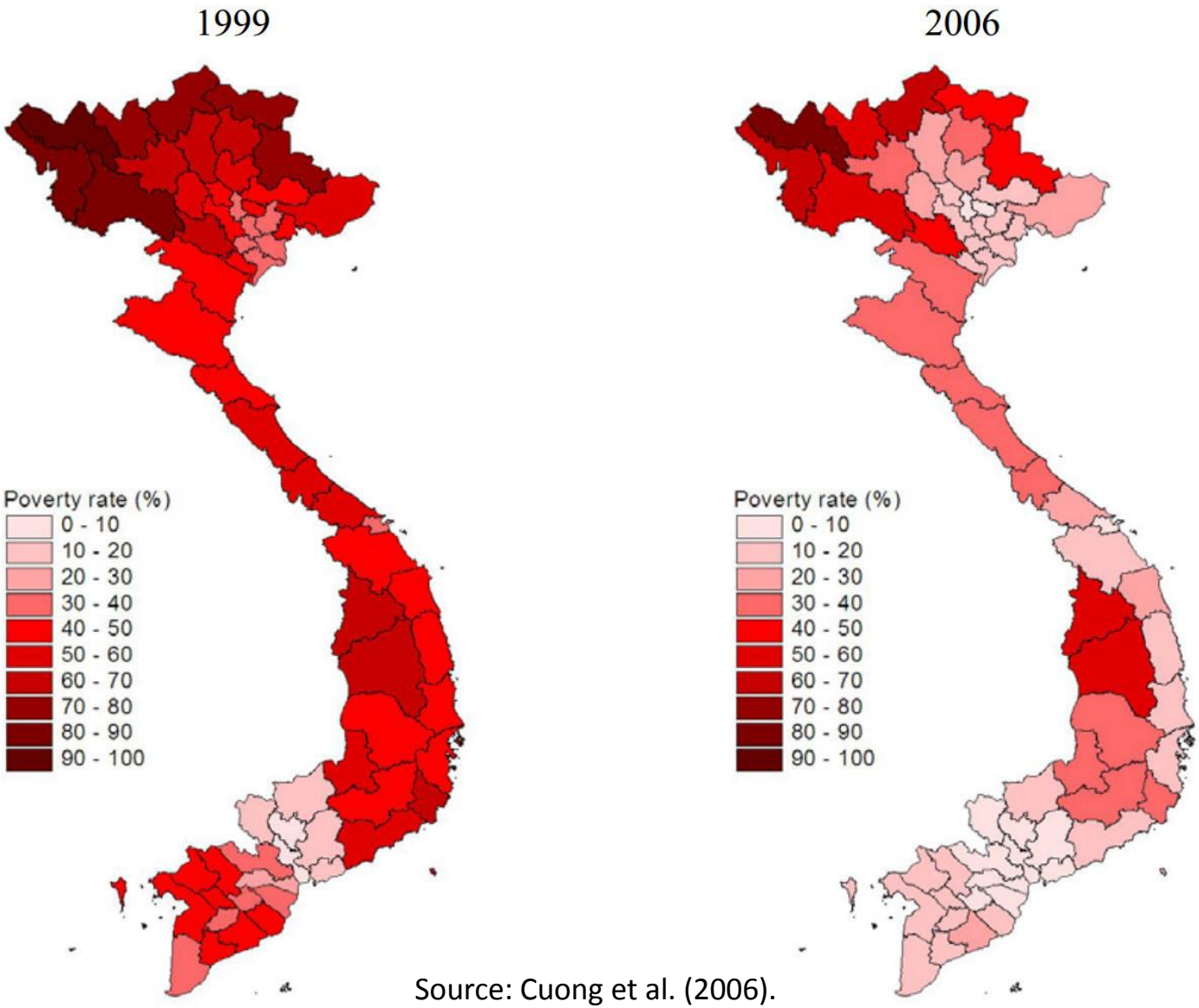
After 12 Months in relation to Total

Map of the provincial poverty rates



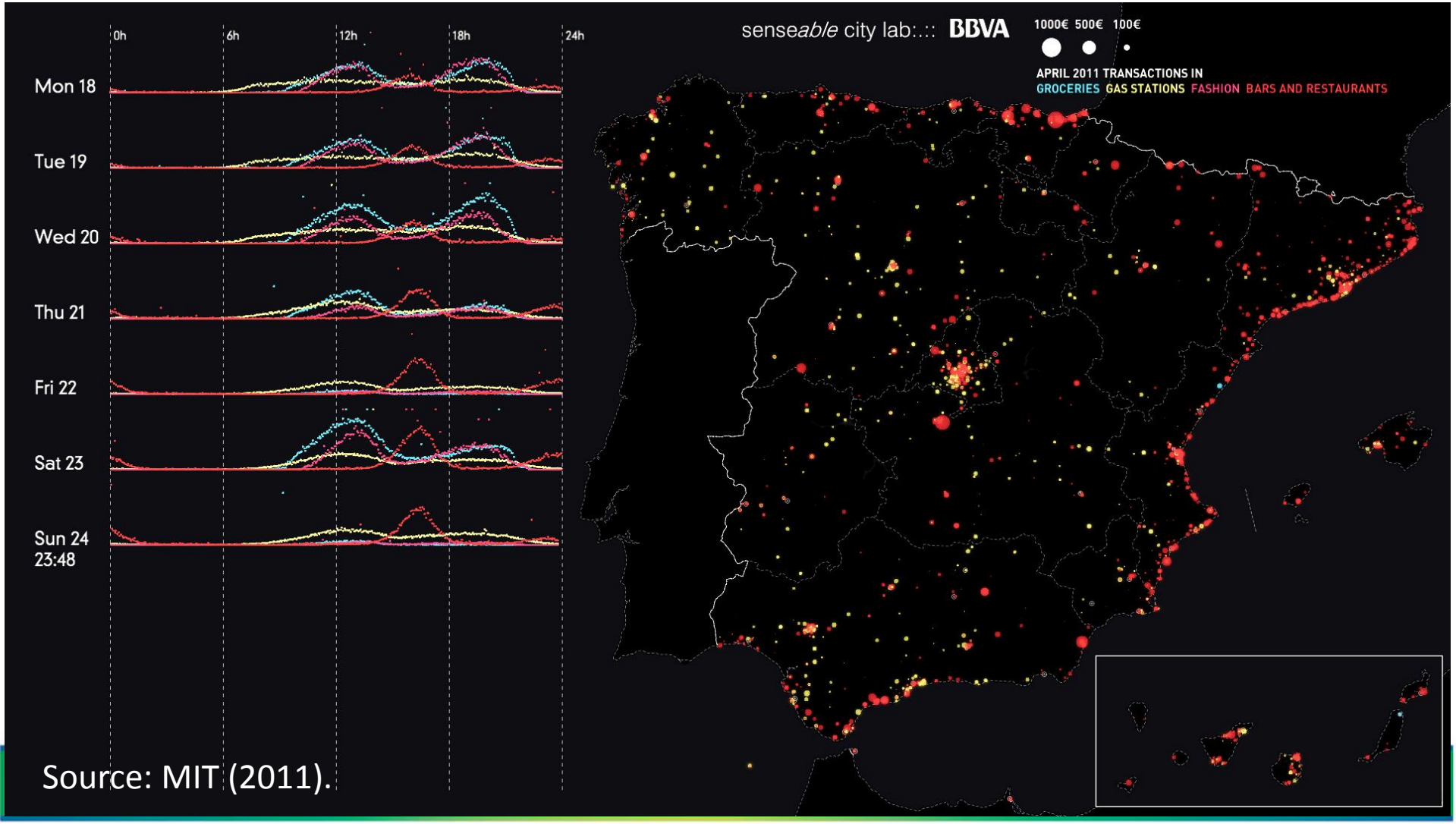
Source: Cuong et al. (2006).

The provincial poverty incidence over 1999-2006



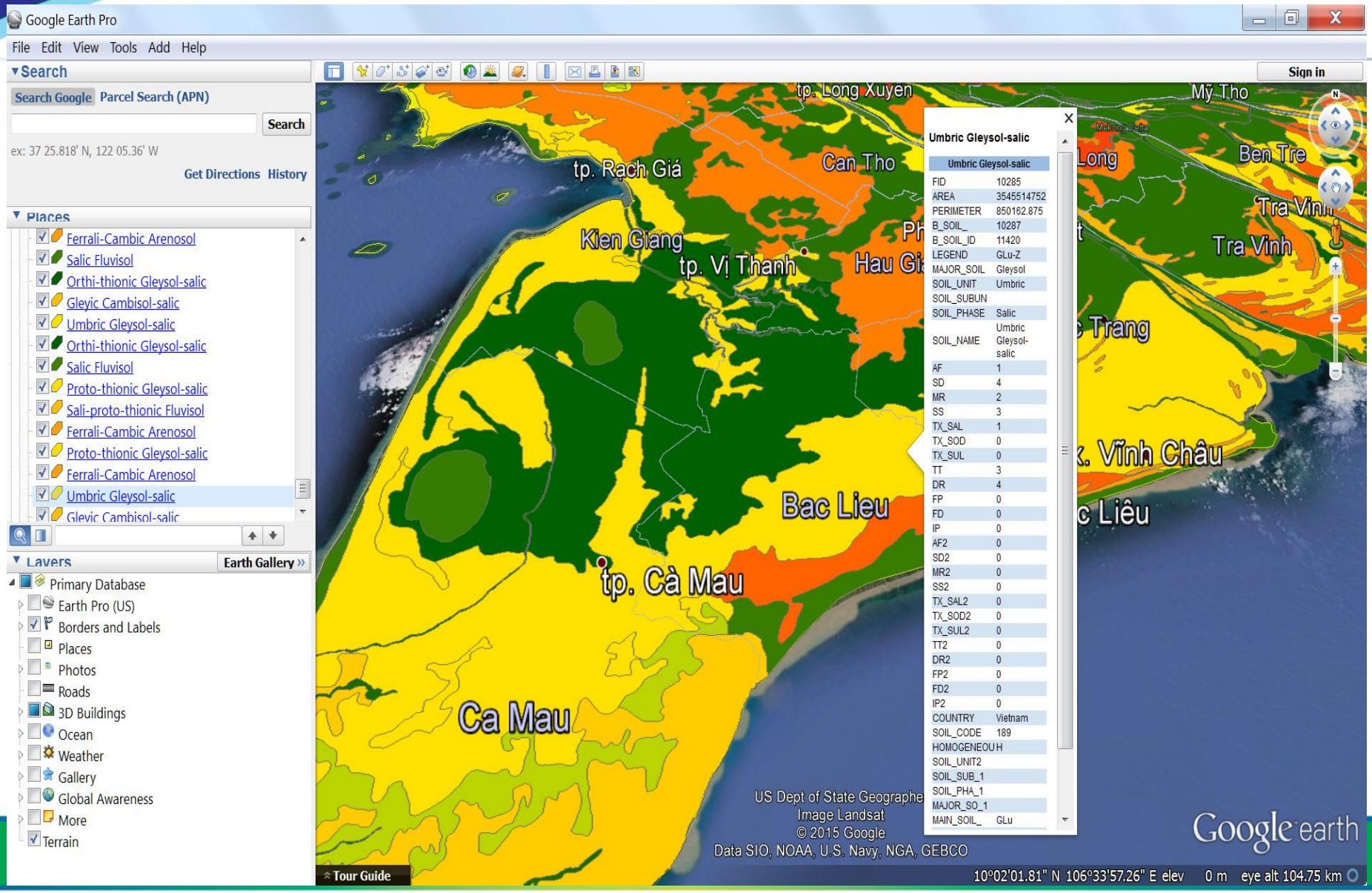
Source: Cuong et al. (2006).

Spending patterns in Spain during Easter 2011 in Spain (see video)

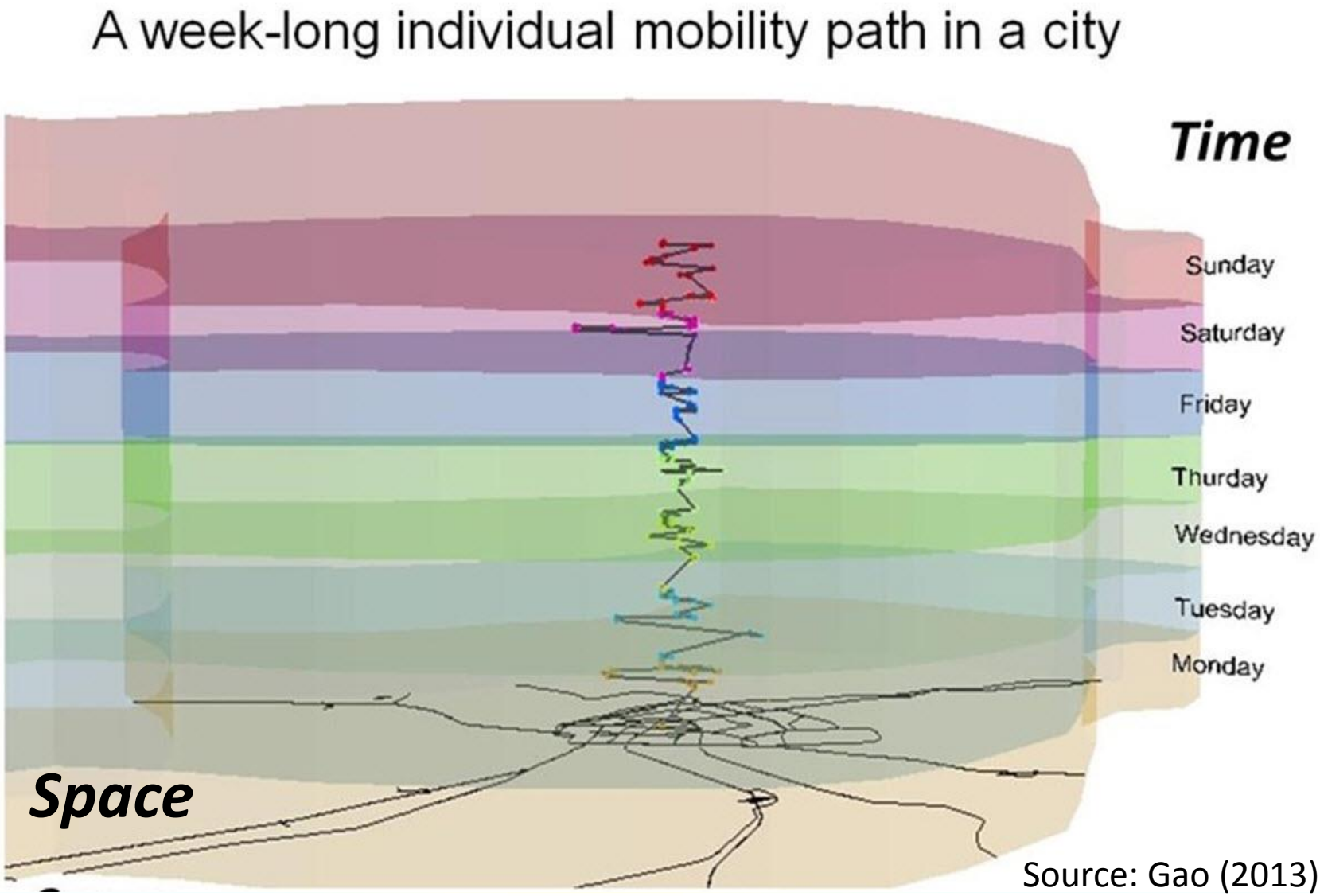


Source: MIT (2011).

Google earth and other maps e.g. soil map



Space – time GIS



Source: Gao (2013).

Spatial econometrics

- Developed from early 1970s
- A subarea of econometrics that offers an alternative approach where traditional methodologies are inappropriate
- A spatial econometrician may ask ***Why household income is higher in some regions of the country than others.***

Spatial regression (SR)– A spatial analysis technique

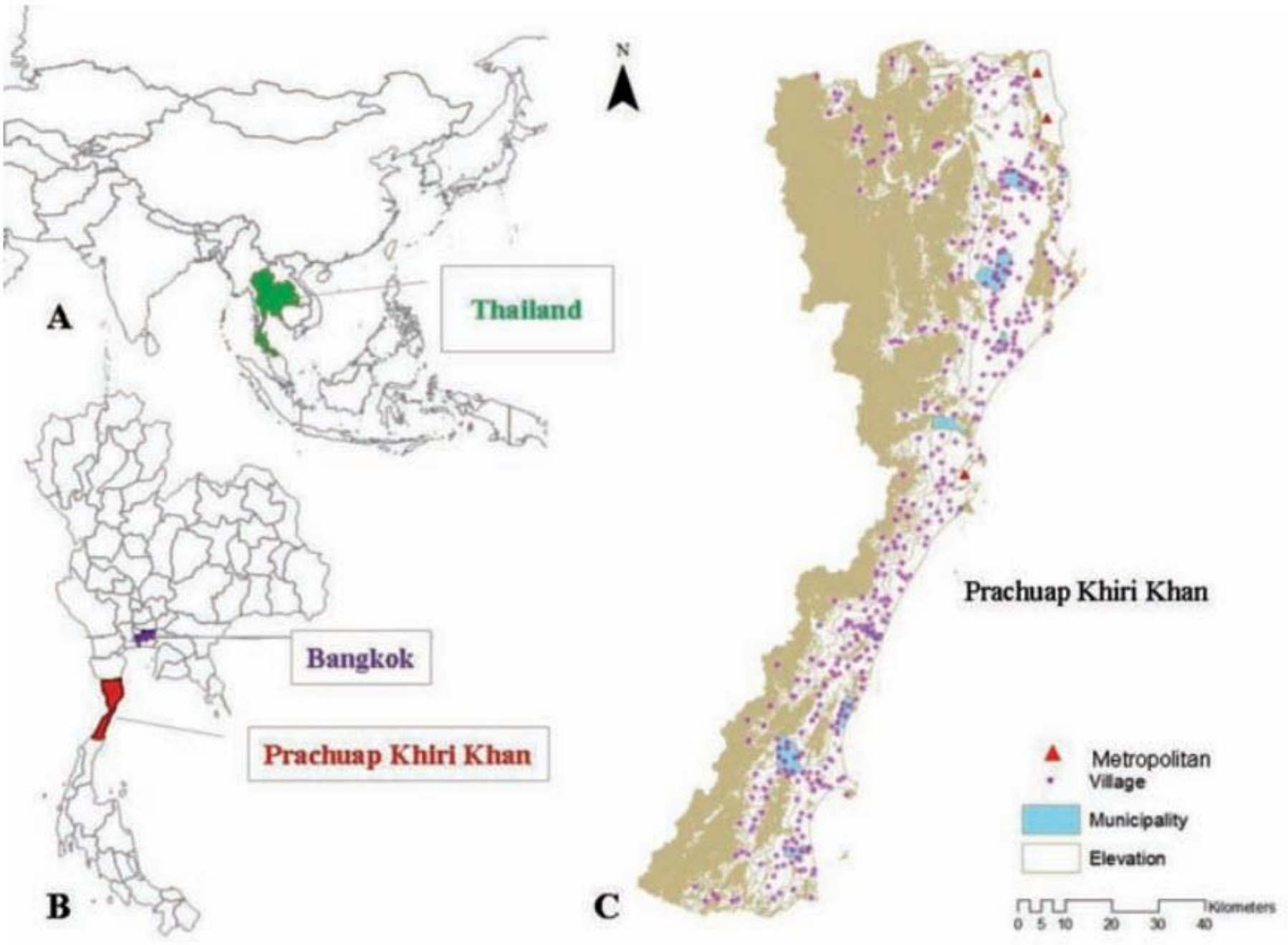
- Spatial regression (SR) is a global spatial modeling technique in which spatial autocorrelation among the regression parameters are taken into account (Duzgun and Kemec, 2008).
- Often spatial relationships are ignored ➔ weakens our ability to generate meaningful inferences about the processes being studied.
- Spatial data are often:
  - spatially autocorrelated (features near each other are more similar than those further away)
  - Non-stationary (features behave differently based on their location/regional variation)

Spatial regression (con't)

- Used in many areas, such as business, defense, education, health and human services, natural resources, and public safety, SR helps answer ***why*** questions.

Example 1 – Socio-geographical factors in vulnerability to dengue in Thai villages (Tipayamongkhogul & Lisakulruk, 2011)

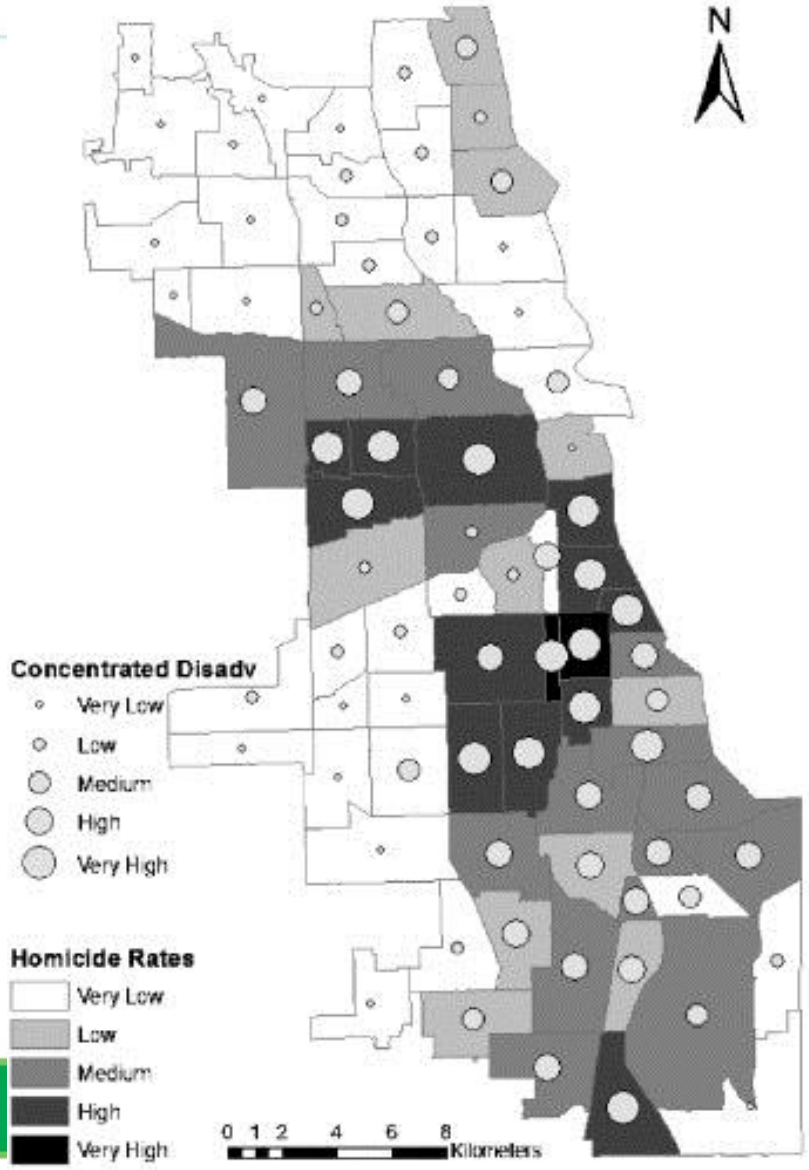
- Ordinary linear model used
- **DV**: cumulative degue incidence
- **IV**: **10 socio-geographic variables** e.g. average number of persons per house, number of houses in a village, distance from a village to the nearest urban area, number of factories, number of schools within a 5-km radius of a village, distance from a village to the nearest school, to the nearest health centre, to the nearest urban area, to the nearest well, to the nearest factory, and to the nearest road.
- **Results**: Average number of persons per house, and distance from a village to the nearest urban area are predictors of DV


N
A
Thailand
Bangkok
Prachuap Khiri Khan
B
C
Prachuap Khiri Khan
Metropolitan
Village
Municipality
Elevation
Kilometers
0 5 10 20 30 40

Example 2 – Income inequality, disadvantage and homicide (Wang & Arnold, 2008)

- Routine activity, strain and social disorganisation theories used
- **DV**: homicide rate in Chicago
- **IVs**: **11 variables** incl. black residents, families below the poverty line, families receiving public assistance, female-headed households with children under 18, unemployment, residents who moved in the last 5 years, renter-occupied homes, residents without high-school diplomas, households with an average of more than one person per room, Latino residents and localised income inequality index.
- Factor analysis was used to consolidate 11 IVs into 3 factors: *concentrated disadvantage, concentrated Latino immigration, and residential instability*.
- **Concentrated disadvantage** was found a strong predictor of homicide rates.

Homicide rates and concentrated disadvantage

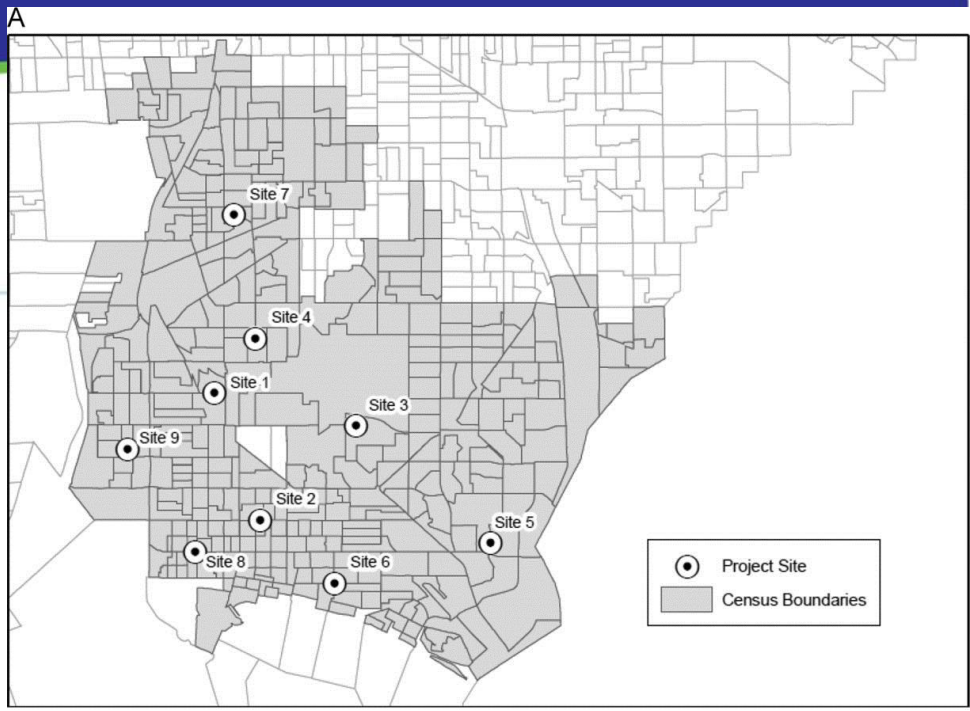


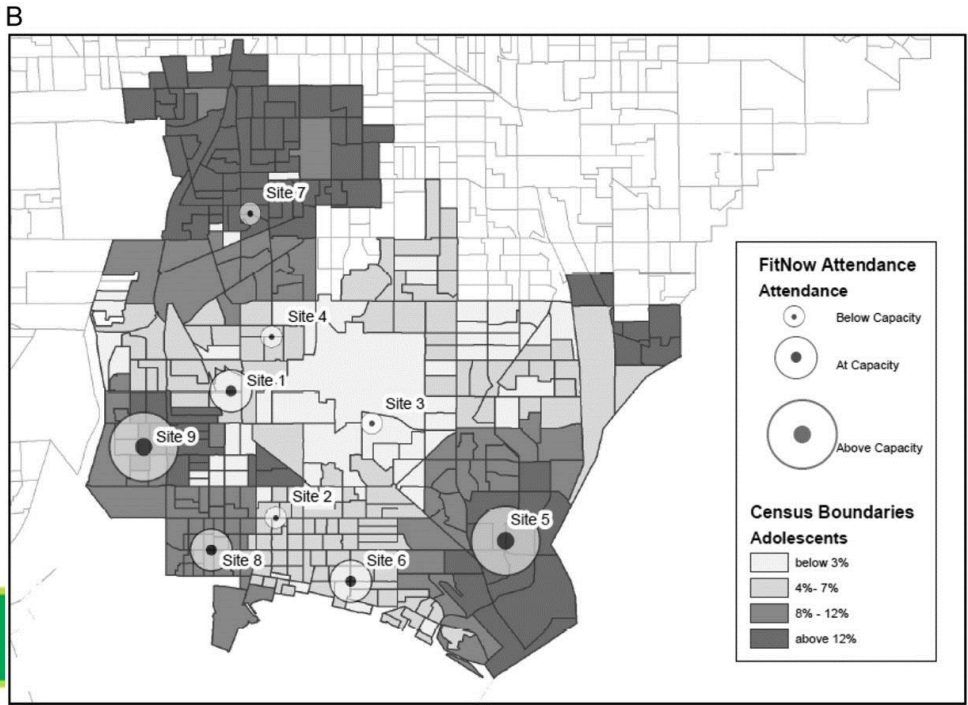
GIS in program evaluation

- Used to provide cross-sectional, snapshots of data
- Used to plot change over time, incl. impact and outcome data.

Example: FitNow program

- A: program sites
- B: Program capacity and adolescent concentration, per 2010 US Census

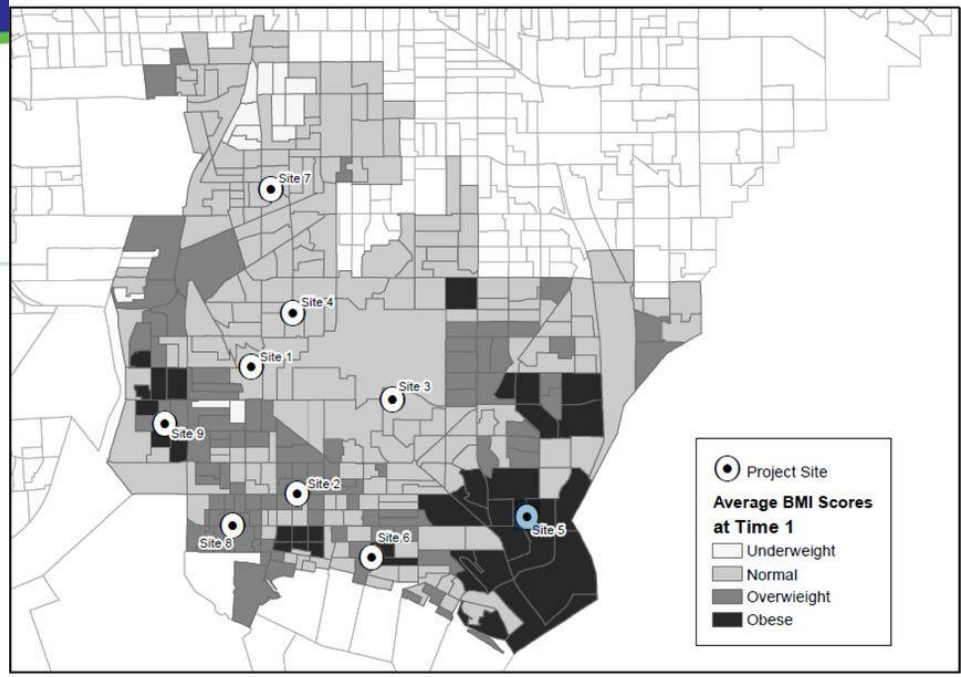




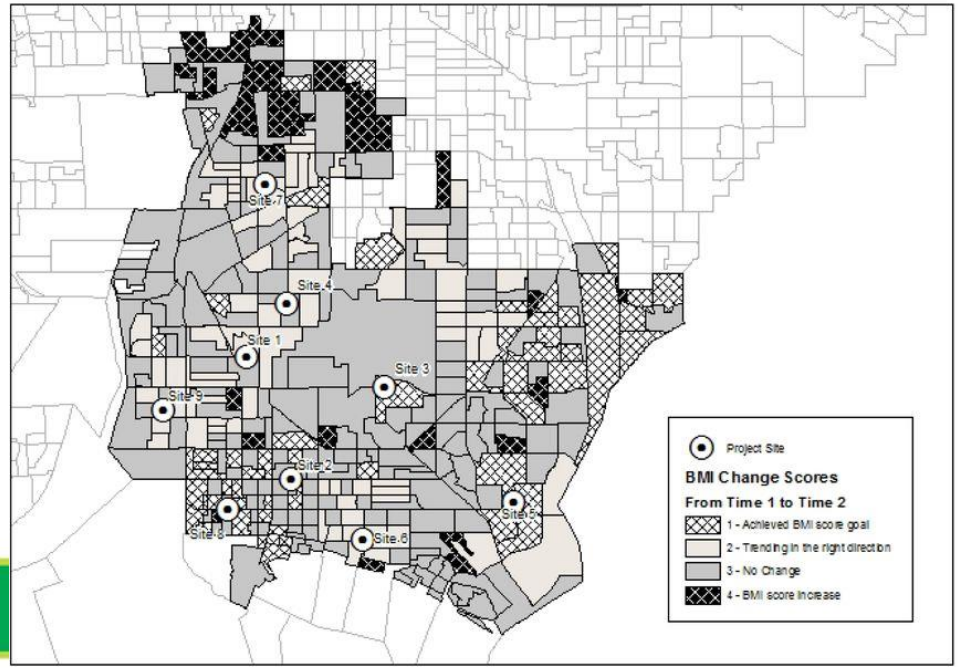
Source: Azzam and Robinson (2013).

- A, Baseline body mass index (BMI) scores.
- B, Change in BMI between Times 1 and 2

A

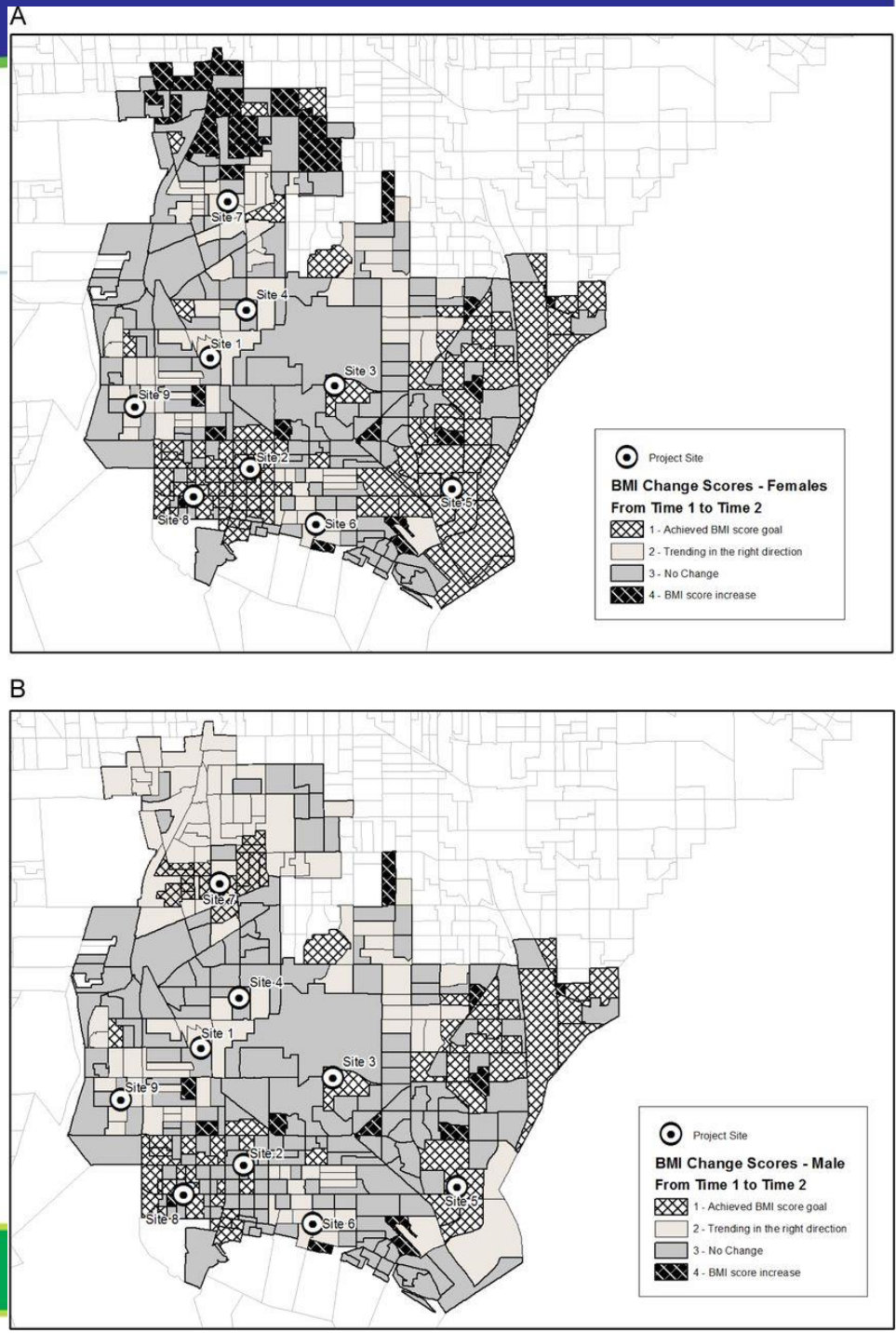


B



Source: Azzam and Robinson (2013).

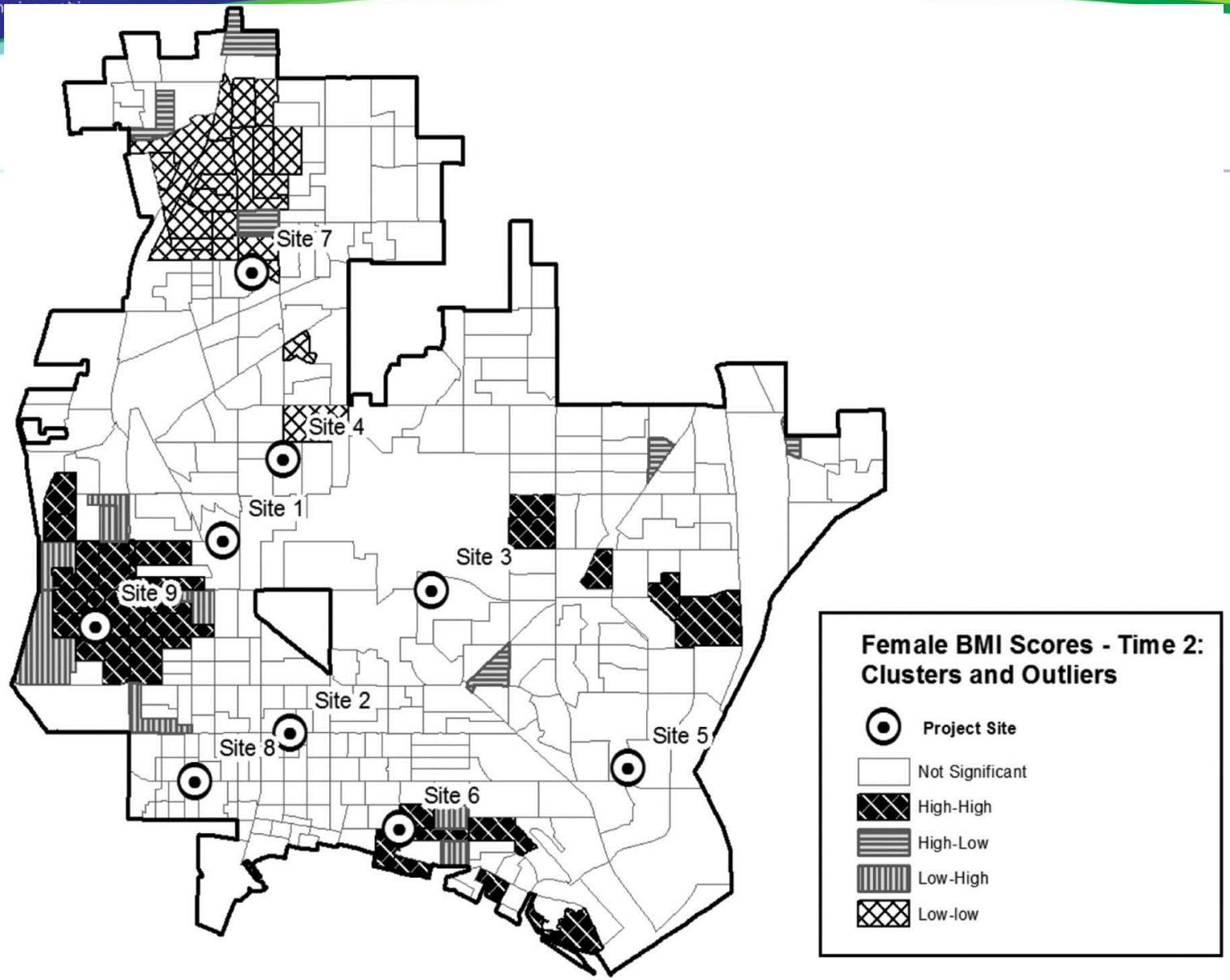
- A, Change in BMI scores for females.
- B, Change in BMI scores for males



Source: Azzam and Robinson (2013).

- **BMI**

Score clustering



Source: Azzam and Robinson (2013).

3. GIS softwares, benefits of GIS, implementation conditions

Top benefits of GIS

- Improved communication & intuitive tool – map & data visualisation (instead of reading & analysing **MANY** pages of text report)
- Better decision making – location (site selection, zoning, planning,…)
- Better geographic information recordkeeping e.g. land/area ownership, administrative boundaries,…
- Managing geographically e.g. land use, crime, distribution of resources, …

Các phần mềm GIS thương mại

- MapGuide
- Microstation
- ArcGIS
- MapInfo
- Intergraph
- ENVI
- …

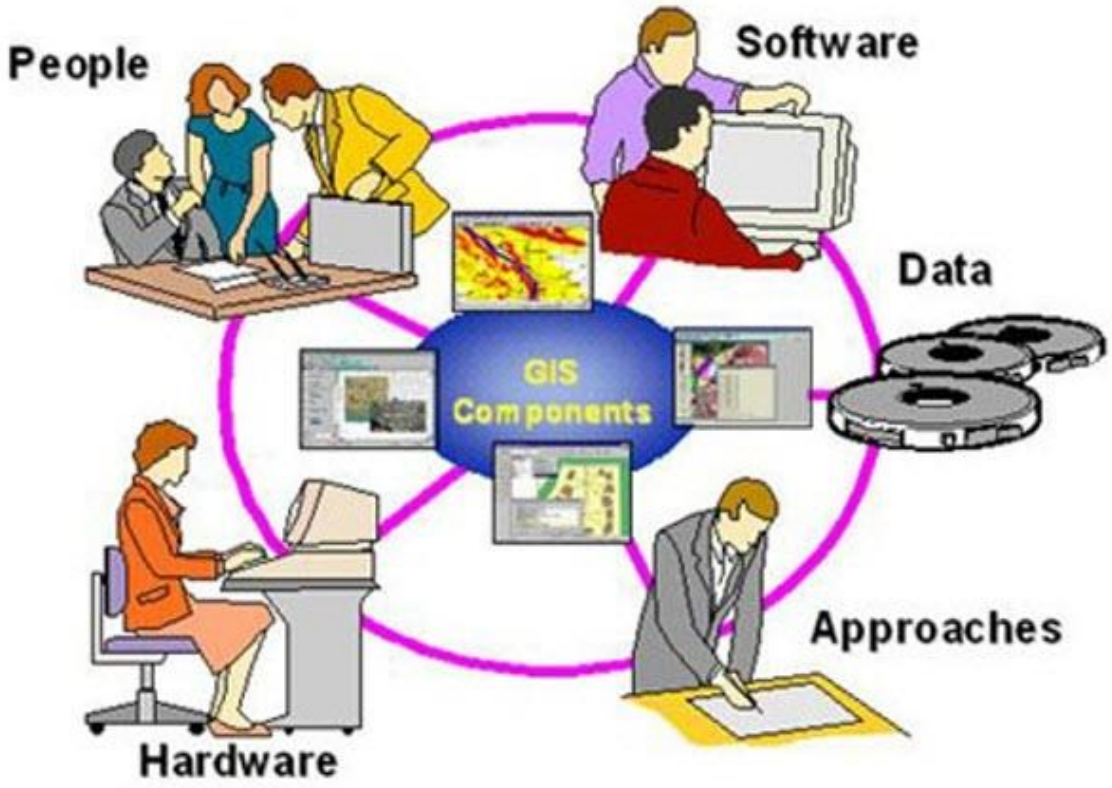
Các phần mềm GIS mã nguồn mở (freeware)

- GRASS
- JUMP GIS
- PostGIS
- …
- QGIS (version 1.6): cấu hình RAM = 1GB, Win XP hoặc mới hơn, 1.6GHz processor là đủ

Tại sao GIS cho sinh viên, nhà nghiên cứu, nhà quản lý?

- Hiểu biết và sử dụng được công nghệ GIS sẽ giúp tăng hiệu quả công việc của sinh viên, các nhà nghiên cứu, thực hành, quản lý, …
- Riêng đối với sinh viên, GIS giúp làm tăng giá trị gia tăng (value-add), và tính thực hành của sinh viên khi ra trường ➔ tăng tính cạnh tranh trong đào tạo (gồm tăng khả năng tìm việc làm của sinh viên).

Vậy các điều kiện để triển khai GIS?



- ✓ Con người
- ✓ Software
- ✓ Data
- ✓ Hardware
- ✓ Approaches

Thank you for your attention!