

1. Systems, Science, and Study

Geographic Information Systems and Science

SECOND EDITION

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Outline

- What is geographic information?
- Definition of data, information, knowledge and wisdom
- Kinds of decisions that use geographic information
- What is geographic information science?
- How do scientists use GIS?



Why GIS Matters

- Almost everything happens somewhere
- Knowing where some things happen is critically important
 - ❑ Position of country boundaries
 - ❑ Location of hospitals
 - ❑ Routing delivery vehicles
 - ❑ Management of forest stands
 - ❑ Allocation of funds for sea defenses



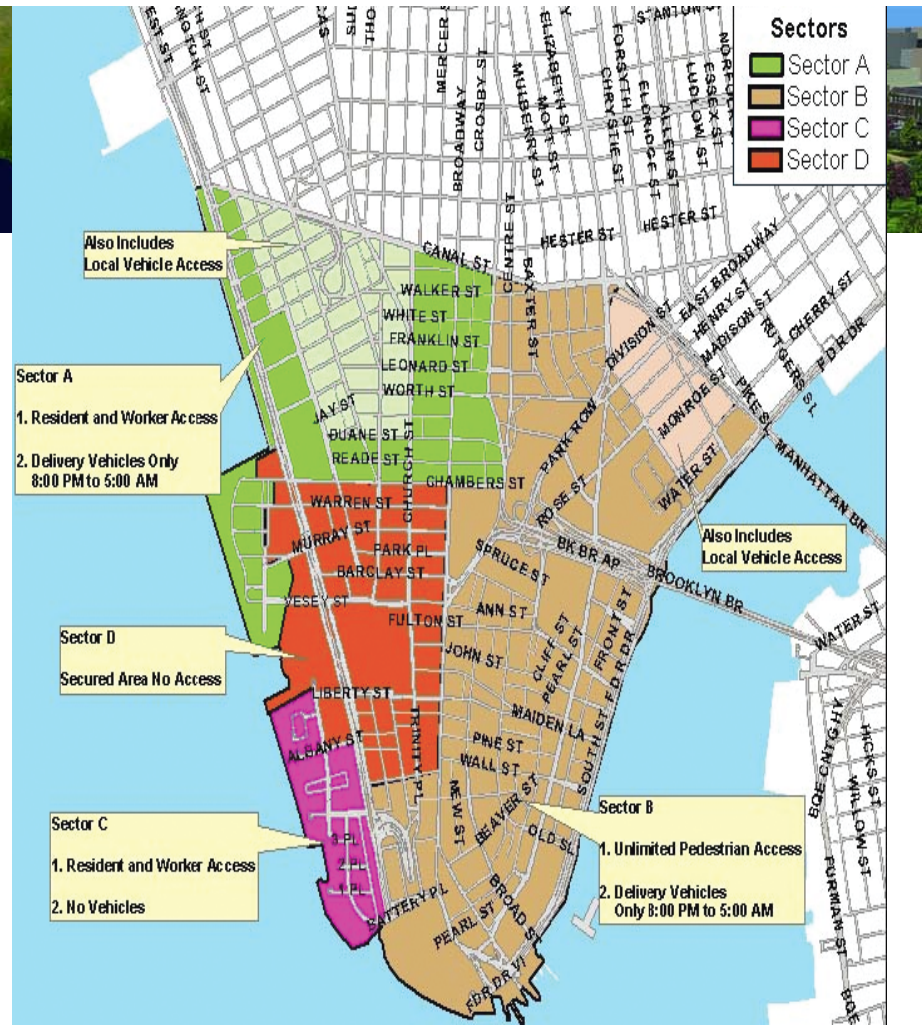
Subway Service and Station Closures
Effective as of 12:00 AM Sept. 24th
Lower Manhattan
(Subject to Revisions)



Legend

Station Status

- ⊗ Closed
- Open
- No N-R Service
- No 1-9 Service



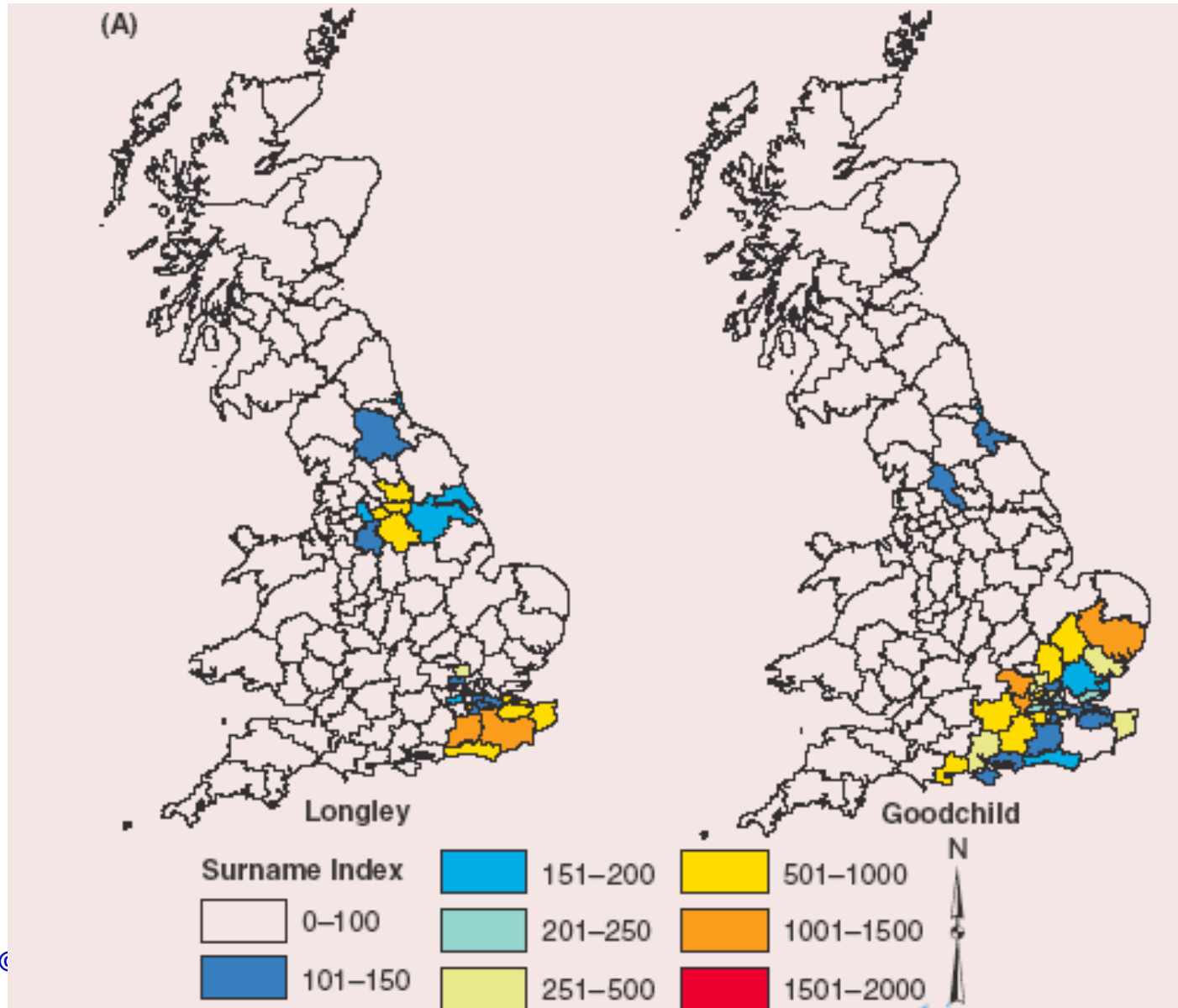
Sectors

- Sector A
- Sector B
- Sector C
- Sector D











Spatial is Special (Geographic is Great!)

- **Geographic** – Earth's surface and near-surface
- **Spatial** – any space (including geographic) e.g. medical imaging
- **Geospatial** – synonymous with geographic



GI is Special

- Multidimensional
- Voluminous
- Requires projection to flat surface
- Unique analysis methods
- Analyses require data integration
- Data updates are expensive and time consuming
- Map displays require fast data retrieval



Data, Information, Evidence, Wisdom and Knowledge

Decision-making Support Infrastructure	Ease of sharing
Wisdom	Impossible
Knowledge	Difficult
Evidence	Difficult
Information	Easy
Data	Easy



Information on the World

- How it looks – **Form**
- How it works – **Process**
- Knowledge about process more valuable than form, because can be used to **predict**
- GIS combine
 - ▣ General scientific knowledge in **software**
 - ▣ Specific information in **databases**



Forms of General Knowledge

- **Classifications** - e.g. what is a wetland?
(established rules)
- **Rule sets** - e.g. how can wetlands be used,
how wilderness defined
- **Laws** - e.g. Newton Laws of Motion predict
the way in which all matter (e.g. planets)
behave
- Geography laws are of much lower precision,
e.g. spatial interaction models



Problem Solving

Components and stages

- **Objective** or **goal** - often maximize or minimize (cost, distance)
- **Tangible** (well defined scale) vs **intangible** - e.g. quality of life, environmental impact
- **Multiple objectives** - e.g. cost and environmental impact
 - **Multi-criteria decision-making** techniques



Geographic Information Systems

- Software product
- Data sets / databases
- Community of people working with geographic information and tools
- Activity of advanced science and problem solving



Geographic Information System

- Container of maps
- Computerized tools for solving geographic problems
- Spatial decision support system
- Mechanized inventory of geographically distributed features and facilities
- Method for revealing patterns and processes in geographic information
- Tool to automate time-consuming tasks



Brief History of GIS

● 1960 – 70s Innovation

- ❑ First GIS – Canada Land Inventory
- ❑ DIME US Bureau of Census
- ❑ Harvard Laboratory for Computer Graphics
- ❑ Major vendors started (e.g. ESRI, Intergraph)
- ❑ Landsat satellite launched
- ❑ Key academic conferences (e.g. AutoCarto)



Brief History of GIS

● 1980s Commercialization

- ❑ Commercial GIS software (e.g. ArcInfo)
- ❑ First GIS textbooks
- ❑ First global data sets
- ❑ Clinton Executive Order

● 2000s Exploitation

- ❑ Internet becomes major deliver vehicle
- ❑ More than 1 million active users





Geographic Information System

● Organized collection of

- ❑ Hardware
- ❑ Software
- ❑ Network
- ❑ Data
- ❑ People
- ❑ Procedures





Routing

[Home](#) | [Low graphics search](#) | [Advertise here](#) | [About Yell](#) | [Contact us](#) | [Help](#)

<p>I AM LOOKING FOR</p> <input type="text" value="DENTAL SURGEONS"/> <p><small>(e.g. dentists, plumbers)</small></p>	<p>OR A COMPANY CALLED</p> <input type="text"/> <p><small>(e.g. Yell)</small></p>	<p>LOCATED IN</p> <input type="text" value="EC1"/> <p><small>(place name or postcode)</small></p>	<input type="button" value="SEARCH"/>
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(A) [Location map](#) [Back to search results](#)

The Dentist
 Vestry House, Greyfriars Passage London EC1A 7BA.
 Tel: **020 7600 1897**

Printer friendly map ?

ZOOM IN Scale 1:10000 **ZOOM OUT**

GET DIRECTIONS ?

From:
Please enter your postcode

Postcode:

OR

street name and town/city.

Street:

Town/city:

To:

The Dentist

I am walking
 I am driving

FIND THE NEAREST...

P CAR PARKS
Find nearest car parks.

(B) [Directions](#)

Your journey consists of 17 steps in total, and covers a distance of 1.61miles / 2.59km.



Individual

**GI
Science**

Computer

Society



GISystems, GIScience and GISudies

● GISystems

- ▣ Emphasis on technology and tools

● GIScience

- ▣ Fundamental issues raised by the use of GIS and related technologies (e.g.)
 - Spatial analysis
 - Map projections
 - Accuracy
 - Scientific visualization

● GISudies

- ▣ Systematic study of the use of geographic information



Social Implications of GIS

- Favors generalization, possibly at expense of minorities and individuals
- Use is not always neutral and can be applied to military and industrial surveillance
- Tendency to be technological rather than human need focused
- Maintains and extends the status quo of societal power structures
- Absence of GIS in critical research



Summary

- GIS is a science based on extensive technology application
- Unique perspective for examining patterns and processes on the Earth's surface
- From origins in 1960s now a multi-\$bn industry
- Widely studied in schools and universities as part of many discipline curricula