Fundamentals of GIS

Instructor: Professor Yuji Murayama
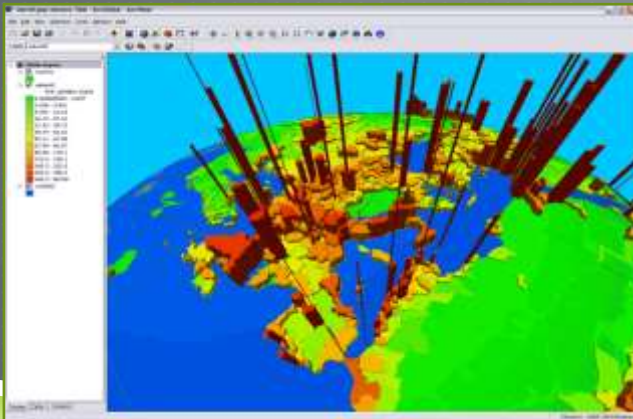
Teaching Assistant: Niloofar Haji Mirza Aghasi

WHAT IS GIS?

Geographical Information Systems (GIS) are a special class of information systems that keep track not only of events, activities, and things, but also of where these events, activities, and things happen or exist.
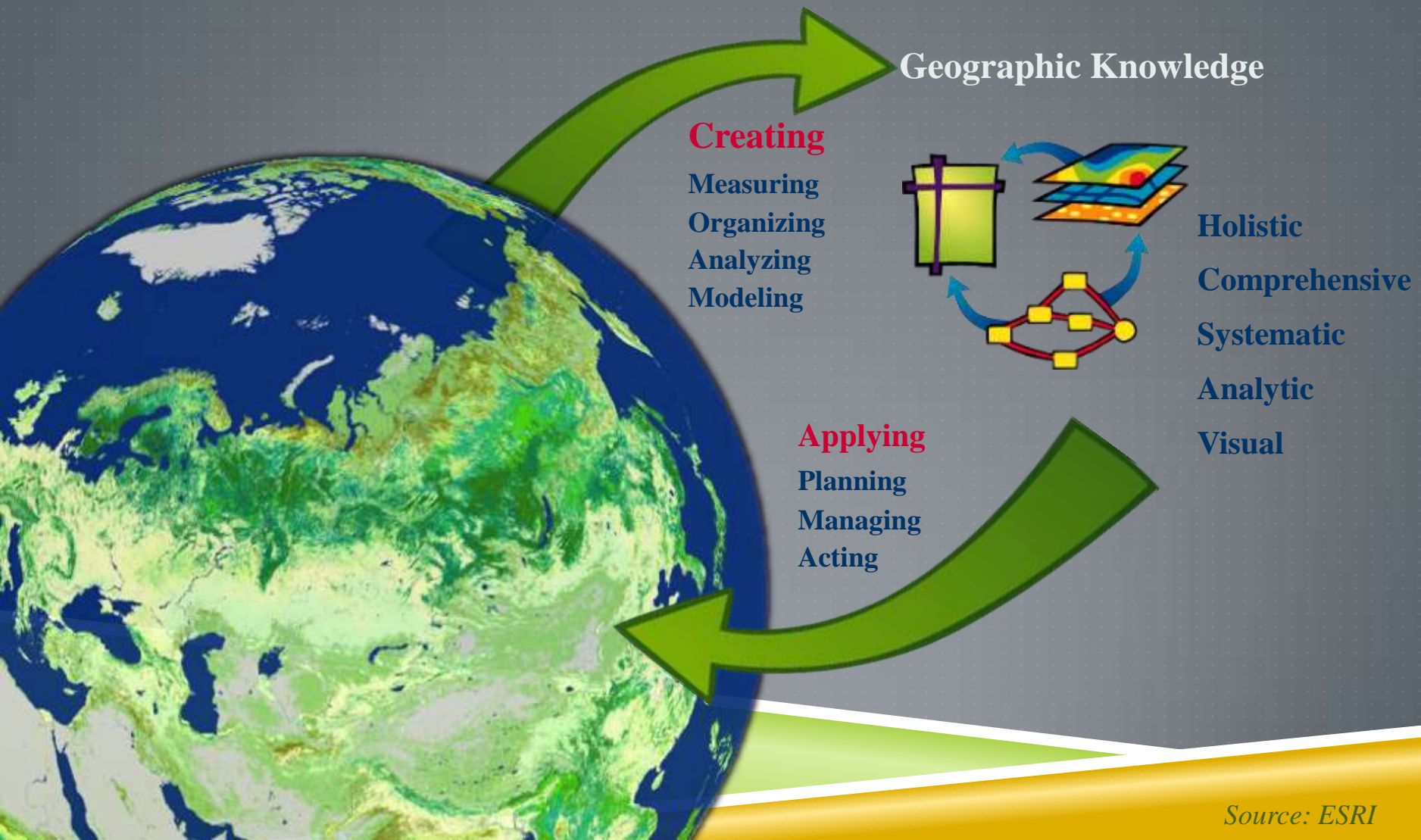
Source: Longley et al (2005) Geographic Information Systems and Science. 2nd Edition. John Wiley and Sons Ltd.

What GIS can do:

GIS can analysis different type of spatial and none-spatial data and display these analysis on maps.

GIS: A FRAMEWORK FOR UNDERSTANDING AND MANAGING OUR EARTH

Geographic Knowledge

Creating

Measuring
Organizing
Analyzing
Modeling

Holistic

Comprehensive

Systematic

Analytic

Visual

Applying

Planning
Managing
Acting

Source: ESRI

WHO USES GIS?

GIS usage are unlimited and GIS can use in:

▶ Transportation and road planning

   - Safety Transportation Management or Traffic Accidents

    - Logistics

    - Airport Facilities

    - Travel Demand Planning

    - Traffic Congestion Volume

    - Road, Highways… Planning

    - Public Transportation Management
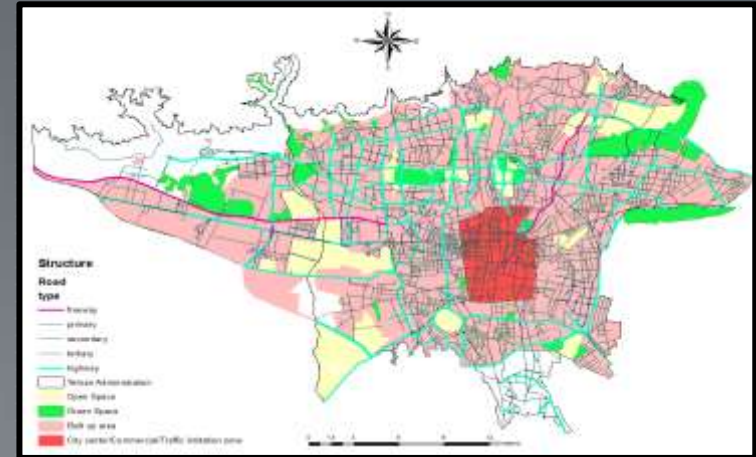

Tehran's Roads Network
Niloofar Haji Mirza Aghasi

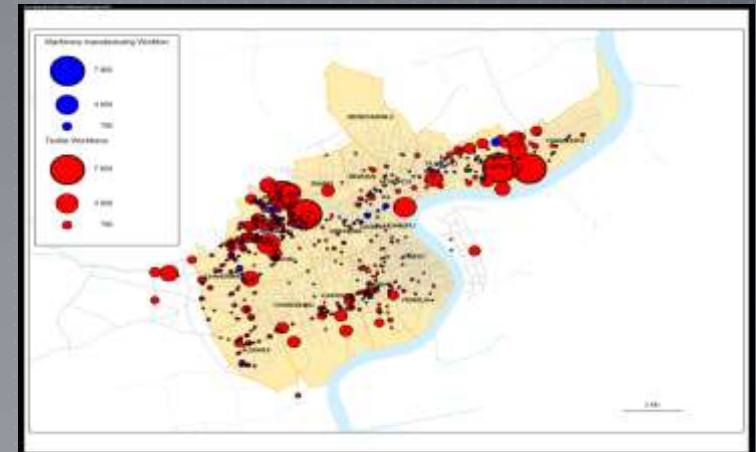**Spatial Distribution of Urban Accidents in Tehran**
Niloofar Haji Mirza Aghasi

▶Urban Planning

- Land use Changes

- Housing Planning

- Urban Development Control

- Plane Making

- Land use Control

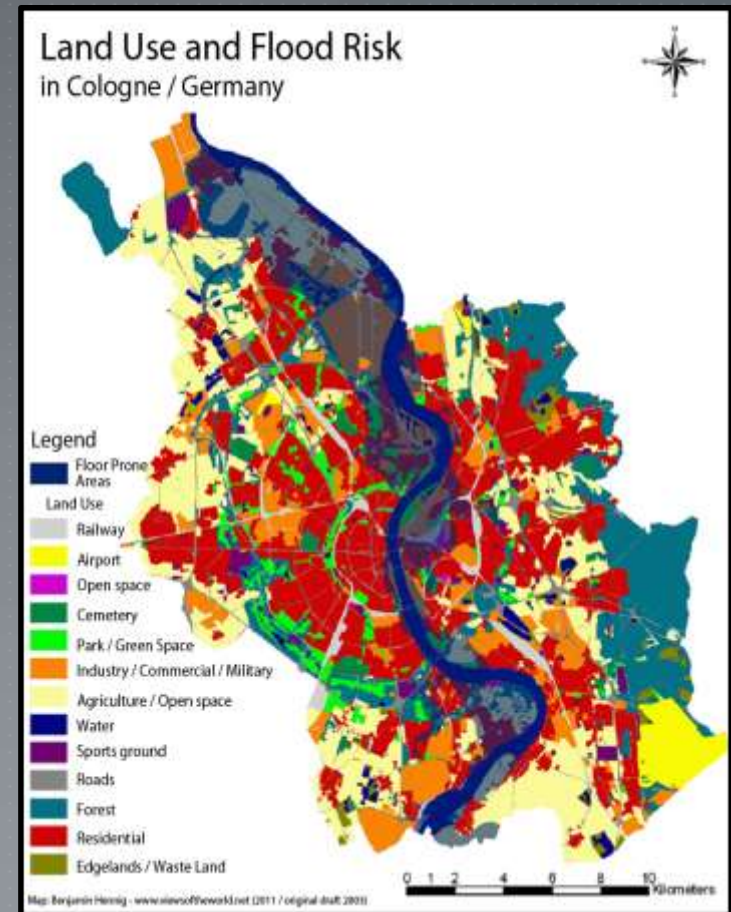- Industrial, commercial and Residential Records

Tehran's City Structure
Niloofar Haji Mirza Aghasi

Shanghai industries in the Civil War period
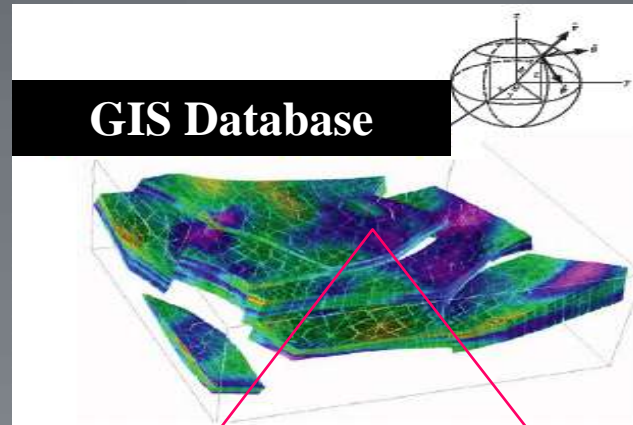Map Source: www.virtualshanghai.net

ENVIRONMENT

- Management of Water Resources
- Hydrologic Cycle
- Surface Water Management
- Ground Water Management
- Rainfall Analysis
- Forest Management and Analysis
- Deforestation Analysis
- Disaster Analysis
- Soil Management

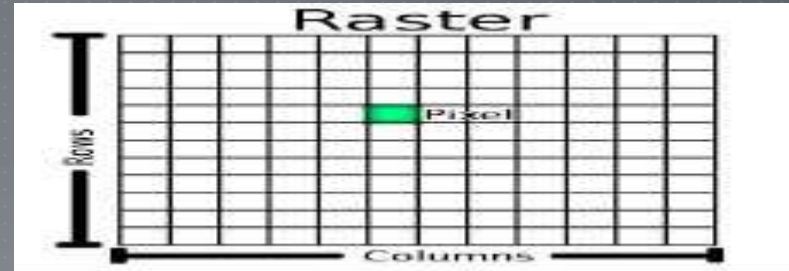Map Source: www.viewsoftheworld.net

GIS COMPONENTS

GIS Database

Computer hardware / Software tools

GIS
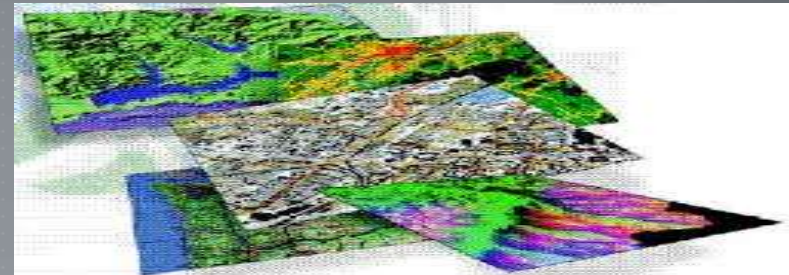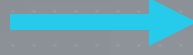
Specific applications

Natural Recourse Management
TRANSPORTATION
Urban Planning…

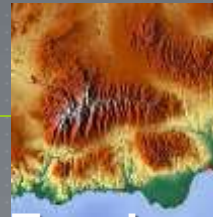# SPATIAL DATA MODELING

- RASTER

- VECTOR

- Real World

WHAT CAN YOU MANAGE WITH A GIS?

▶ The possibilities are virtually unlimited…

  ▶ Principles of environmental impact assessment

  ▶ Resource identification and management

  ▶ Land use planning considerations

  ▶ Tax Mapping

  ▶ Water and Sanitation Mapping

  ▶ Transportation routing

  ▶ And more...

DATA INTEGRATION WITH GIS

- Roads, highways, freeways,…
- Transportation Network
- Land Use, land planning
- Population, migrations, growth
- Facilities
- Land Mines,
- Hospitals, clinics …
- Schools, universities or
any other academic institution
- Movement, urban trip, person trip
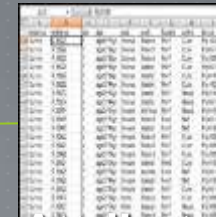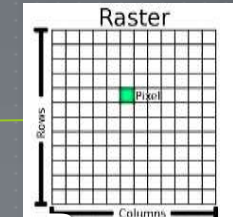- Images
- Natural source

Topology **Networks** **Vectors**

3D Objects **Attributes** **Raster**

Addresses **Images** **Points**

TYPES OF GIS

The following GIS types are not necessarily mutually exclusive and a GIS application can be always classified under more than one type (by Arul Prakash) :

- Four-dimensional GIS
- Multimedia/hypermedia GIS
- Web GIS
- Virtual Reality GIS

GIS DATA

1. Attribute data:
   ▶ Statistics, text, images, sound, etc.

2. Spatial data:
   ▶ Co-ordinate based
   ▶ Vector data: A series of x, y coordinates
      ▶ Points
      ▶ Lines
      ▶ Polygons
   ▶ Raster data:Grid and cells

GEO-REFERENCING DATA
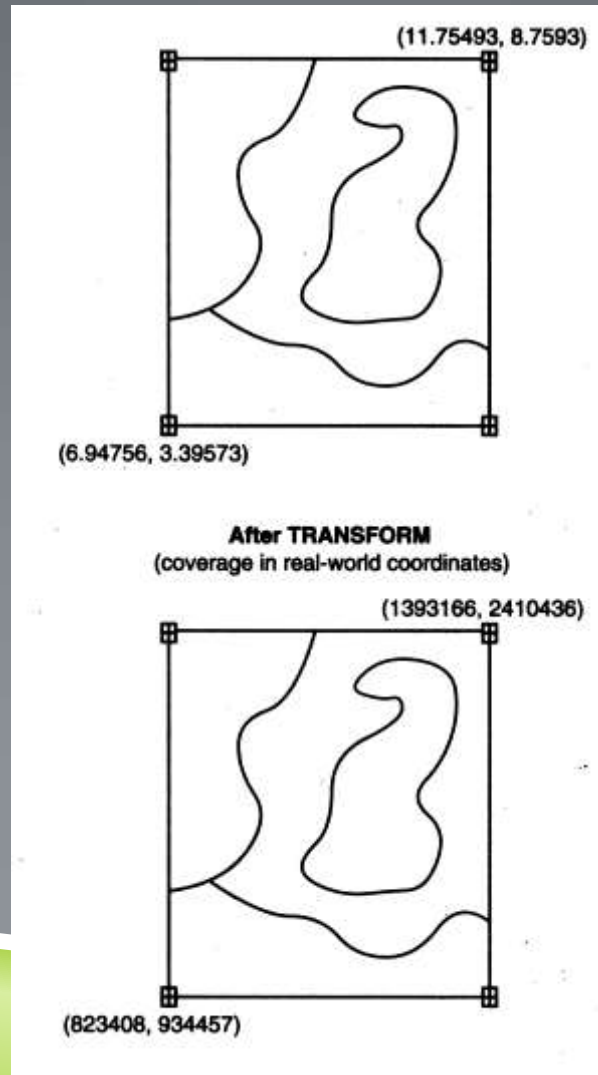
- Data capture
  - Scanning: all of the maps converted into raster data
  - Digitizing: individual features selected from the map as dots, lines or polygons
- Geo-referencing
  - Initial scanning, digitizing gives the coordinates in inches from bottom left corner of the digitizer / scanner
  - Real-world co-ordinates are set up for four-registration periods on the seized data
  - These are applied to convince the entire map onto a real-world coordinate system

EXAMPLE OF GEO-REFERENCING

LAYERS

- Data on different themes are stored in separate "layers"

- As each layer is Geo-referenced layers from different roots can easily be integrated using location

- This tin be applied to make up complex models of the real world from widely disparate sources

QUERYING GIS DATA

▶ Attribute query

   ▶ Use attribute data

   ▶ Attribute data can be mapped or shown in the separate database

▶ Spatial query

   ▶ Spatial query must be do with spatial information.

http://wiki.gis.com/

SOURCES OF GIS DATA

A wide variety of data sources exist for both spatial and attribute data. The most common general sources of spatial data are (by Arul Prakash) :

- Hard copy maps
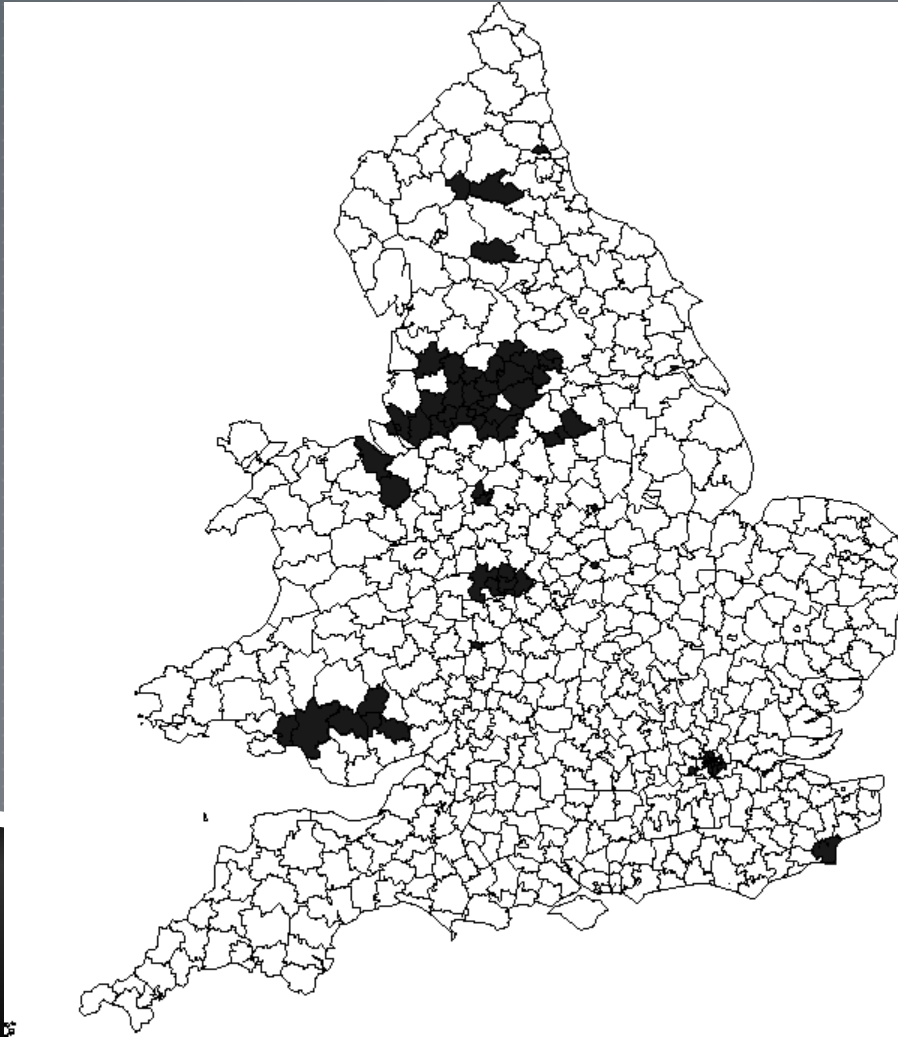- Aerial photographs
- Remotely-sensed imagery
- Point data samples from different source
- Existing digital data files

ATTRIBUTE QUERY: LUNG DISEASE IN THE 1860S
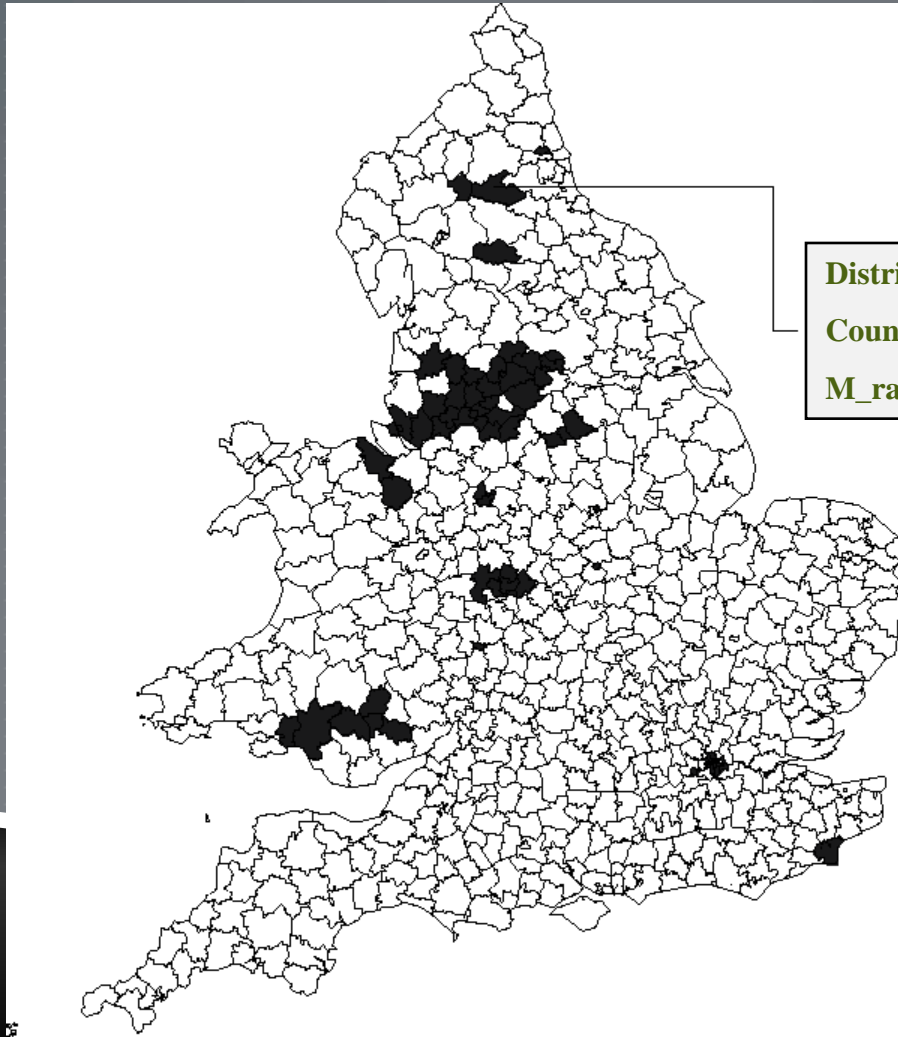

Spatial data: Registration Districts, 1/1/1870

Attribute data: Mortality rate per 1,000 from lung disease among men aged 45-64

Source: Registrar General's Decennial Supplement, 1871

Query: Select areas where mortality rate > 58.0

Dr. Ian Gregory

SPATIAL QUERY: LUNG DISEASE IN THE 1860S

District: Alston with Garrigill

County: Cumberland

M_rate: 68.4

MAIN GIS SOFTWARE

➢ ARCGIS (ARC View)
   ESIR is ARC View producer
➢ GRASS GIS (Geographic Resource Analysis Support System)
➢ Google Map
➢ Google Earth

REFERENCES

▶ *An Introduction to GIS, Angela Lee, ESRI Education Program*

▶ *Application of GIS for processing of soil data , Yeleuova Elmira*

▶ *EXAMPLES OF APPLICATIONS WITH REMOTE SENSING IMAGES, dr.ir. Jan Clevers, Centre for Geo-Information, Dept. Environmental Sciences, Wageningen UR*

▶ *Fundamentals of GIS: What is GIS? Dr. Ian Gregory, Department of Geography, University of Portsmouth*

▶ *Geo-referenced data and DLI aggregate data sources, Chuck Humphrey*

▶ *GIS Fundimentals, Dr. Ronald Briggs, The University of Texas at Dallas, Program in Geospatial Information Sciences*

▶ *Geographic Information Systems (GIS)History; Software Review; Data Capture, Reza Wahadj, University of California ,San Diego (UCSD)*

▶ *Introduction to Geographic Information Systems (GIS), Lesson 1. Amriddin Samiev, Ph.D.TSPU,*

▶ *RGS-IBG Online CPD course in GIS Introduction to GIS, Royal Geography Society with IBG.*