GIS APPLICATIONS

EGE 2421 / EGS 2401

Applications of GIS

Lecture No. 01

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Wednesday, September 13, 2023

Content

- Course outline
- Introduction
- Review of GIS concepts
- Advantages/disadvantages of GIS
- Sample GIS applications

Course Structure

- **Objective**: At the end of this course unit, you should be able to:
  - Demonstrate a good understanding of GIS applications
  - Carry out a practical application of GIS
- **Course assessment:**
  - Assignment (many) – 25%
  - CAT(2) – 5%
    - Failure to submit = -10 marks
    - Copying from each other = -10 marks for each
  - Exam – 70%

References

- Aronoff S. (1989). *Geographic information systems: A Management perspective.* WDL Publications.
- Birkin M, Clarke G, Clarke M, and Wilson A.(1996). *Intelligent GIS: Location decisions and strategic planning.* Geoinformation International and Person Professional Ltd.
- Longley P.A., Goodchild M. F., Maguire D. J., Rhind D.W., (2005). *Geographic information system: Principles, techniques, management and applications.* Abridged edition, J Wiley, Hoboken.
- Longley P.A., Goodchild M. F., Maguire D. J., Rhind D.W., (1999). *Geographic information system, Volume I: Principles and Technical Issues, and Volume 2: Management Issues and Applications.* John Wiley & Sons.
- Maguire, D.; Goodchild, M. F. and Rhind, D.W. (eds.) (1998): *Geographic Information Systems, Principles and Applications, 2 Vol.* Longman Publishing, Cambridge.
- Mather P. M. (1996). *Geographic information handling – Research and applications.* John Wiley & Sons
- Internet sources: Journals in the field of GIS, remote sensing and photogrammetry, etc which have GIS application case studies

Objectives

- At the end of this course unit, the student should be able to:
  - Demonstrate a good understanding of GIS applications
  - Carry out a practical application of GIS in an area of their choice
  - Develop innovative solutions in mapping using GIS

Course Outline

- Overview of geospatial information system (GIS) applications.
- GIS data base development and analysis.
- Case studies in - Facilities and utility management; locating underground networks of pipes and cables, telecommunication and electric power transmission lines.
- Natural resources and environmental management, environmental impact analysis, site selection, route location,
- Networks: vehicle routing, planning and engineering, traffic engineering.
- Land use planning, Land information systems and management.
- Other contemporary GIS applications.

Lecture Plan

Week	Topic		Week	Topic	
1	Overview		8	Transportation – I *(concepts, network problems)*	
2	Review of GIS analysis Techniques		9	Transportation – II *(building networks, optimization)*	
3	GIS in Agriculture *(concepts, application areas, Crop Suitability Analysis)*		10	Transportation – III *(routing, tracking)*	
4	Natural resource Management – I *(concepts, application areas)*		11	Utility Management *(concepts, viewsheds,lineof sight)*	
5	Natural resource Management – II *(Groundwater, forestry)*		12	Health and Disease control *(concepts in epidemiology)*	
6	GIS in Business *(store location, consumer profiling)*		13	Governance *(crime, districting, LIS, census)*	
7	CAT I		14	CAT II	

Definitions

(a) A GIS is a computer application that stores, retrieves, manipulates, analyses, and displays geographically referenced information or geospatial data. Geographic referencing ties object to a known location on the ground and can relate this object to all other objects or features on the ground. Two basic types of data are managed by a GIS: geospatial data that dene the location of a feature or object on the ground, and attribute data that describe the characteristics of this feature (Landres et al., 2001).

(b) a system for capturing, storing, checking, manipulating, analysing and displaying data which are spatially referenced to the Earth. (Department of Environment, 1987)

(c) A powerful set of tools for collecting, storing, retrieving, transforming, and displaying spatial data from the real world. (Burroughs and McDonnel, 1998)

(d) A decision support system involving the integration of spatially referenced data in a problem solving environment(Cowen, 1988)

Advantages of GIS

- Can cope with larger amounts of data
- Can cover large study areas (the whole world if necessary)
- Can conveniently select any sub-study area
- Can cope with unlimited and frequent edits and changes
- More robust and resistant to damage
- Faster and more efficient
- Requires less man-time and money

Disadvantages of GIS

- Expensive
- Requires enormous amount of date: makes it prone for error
- Geographical error increases with larger scale
- Relative loss of resolution
- Violation of privacy

What can GIS do for you?

- **Perform geographic queries** : The ability of GIS to search databases and perform geographic queries has saved many companies literally millions of dollars.
  (a) Decrease the time taken to answer customer requests.
  (b) Find land suitable for development.
  (c) Search for relationships among crops, soils, and climate.
  (d) Locate the position of breaks in electrical circuits.
  (e) A Realtor could use a GIS to find the houses that have tiled roofs and five bedrooms, then list their characteristics.

What can GIS do for you?

- **Improve organizational integration** : Many organizations that have implemented GIS have found that one of the main benefits is improved management of their own organization and resources.
- Because GISs have the ability to link data sets together by geography, they facilitate interdepartmental information sharing and communication.
- By creating a shared database one department can benefit from the work of another{data can be collected once and used many times.

What can GIS do for you?

- **Making maps with GIS** : Maps have a special place in GIS. The process of making maps with GIS is much more flexible than traditional manual or automated cartography approaches. It begins with database creation.
- Existing paper maps can be digitized and computer-compatible information can be translated into the GIS. The GIS-based cartographic database can be both continuous and scale free.
- Map products can then be created centered on any location, at any scale, and showing selected information symbolized effectively to highlight specific characteristics

What can GIS do for you?

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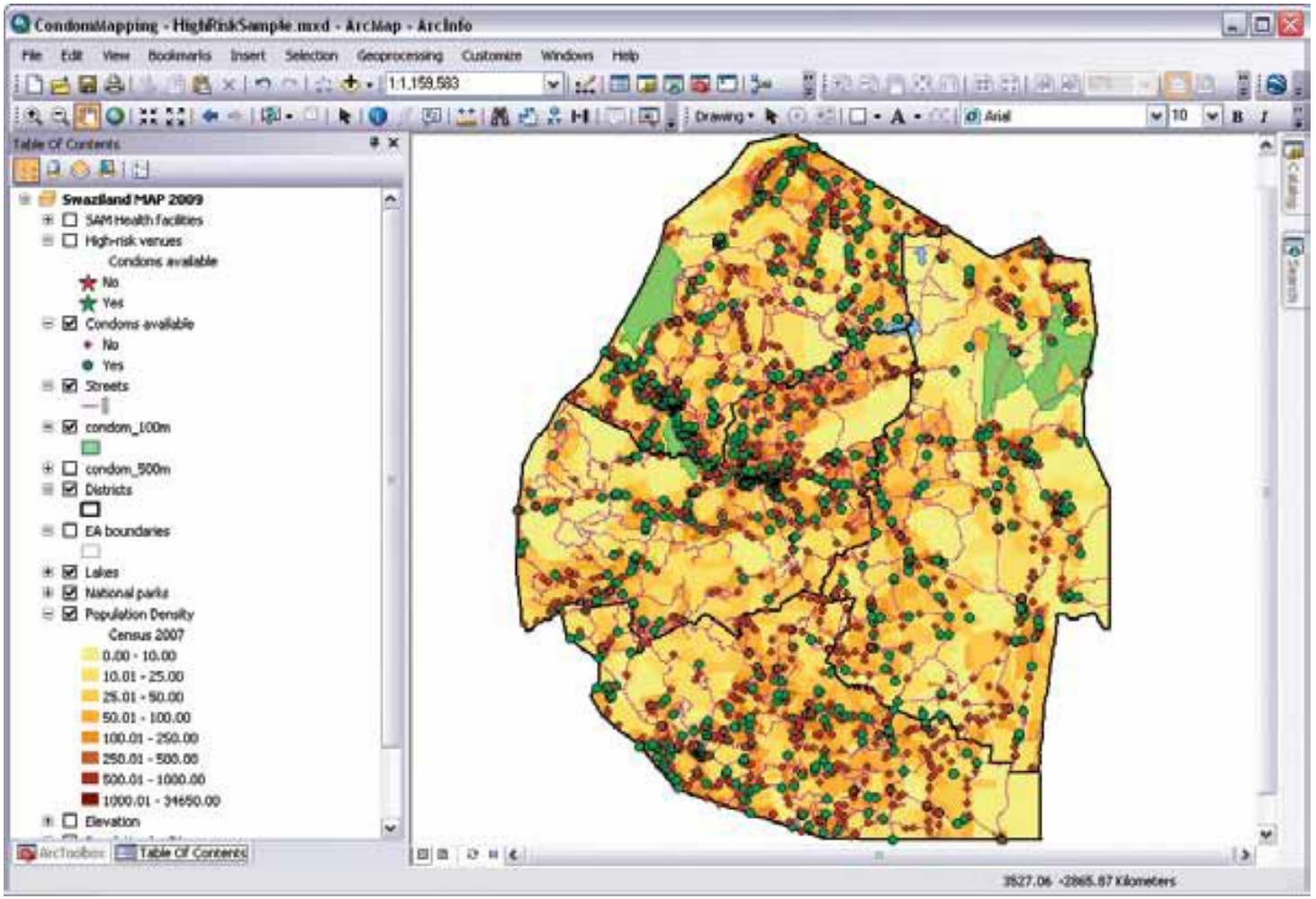
SAMPLE APPLICATIONS OF GIS

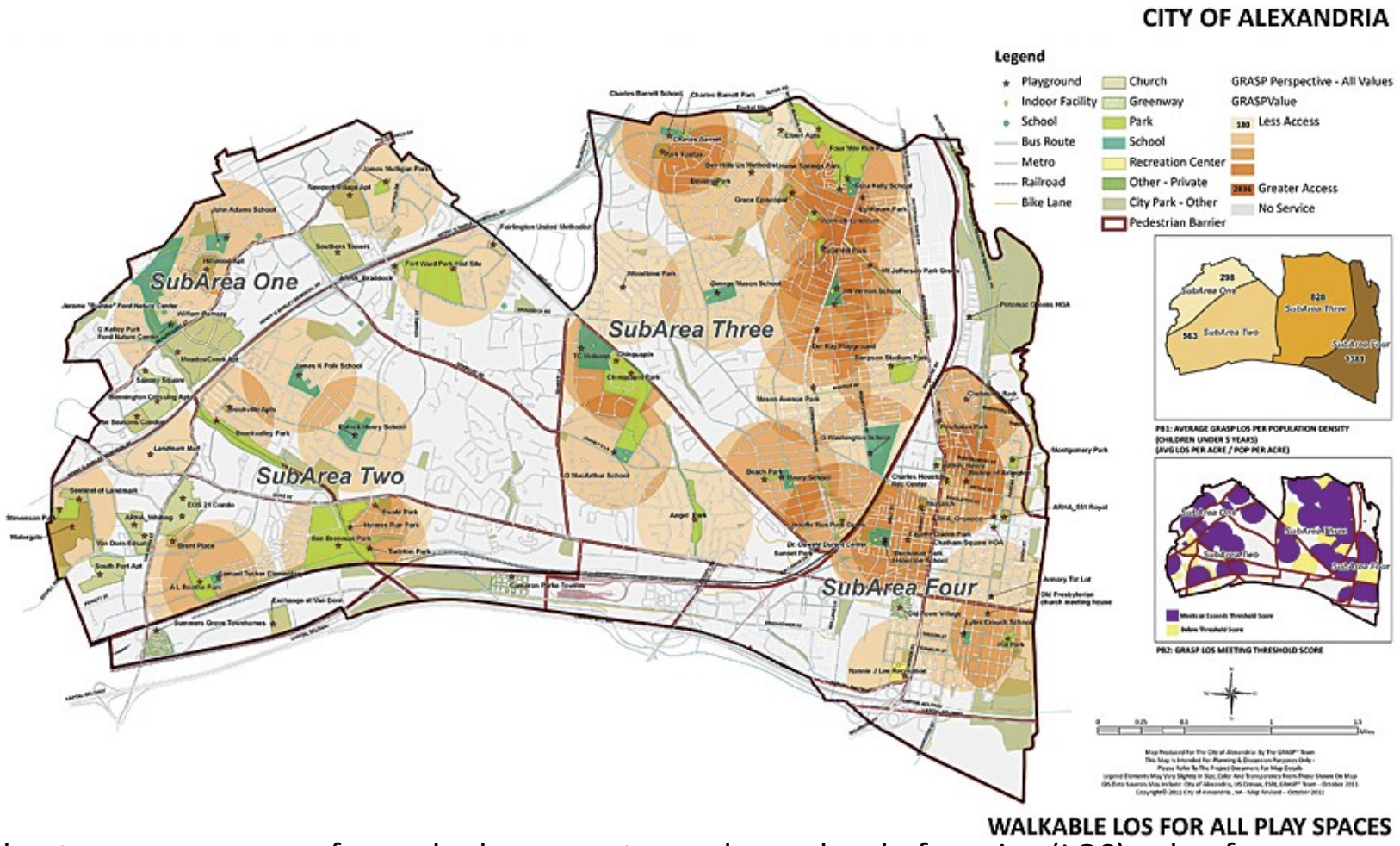
https://gisgeography.com/gis-applications-uses/

NGO Maps and Monitors Swaziland Efforts in Fight against HIV/AIDS



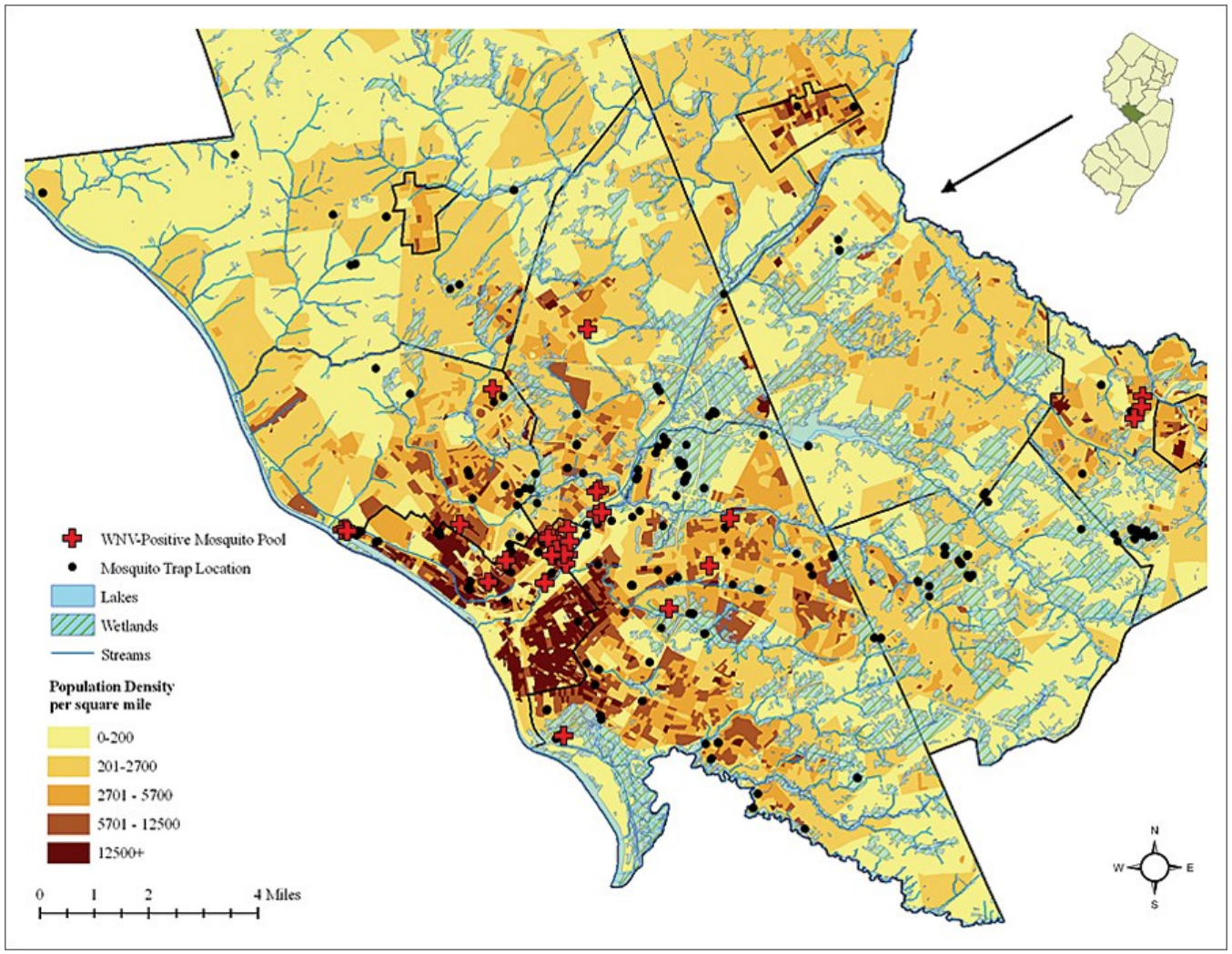
Health workers identify high-risk areas along with available resources, Swaziland

Alexandria, Virginia Gets Serious about Park and Play Space Improvements; *Optimizing Play, Creativity, Socialization, and Nature Appreciation*



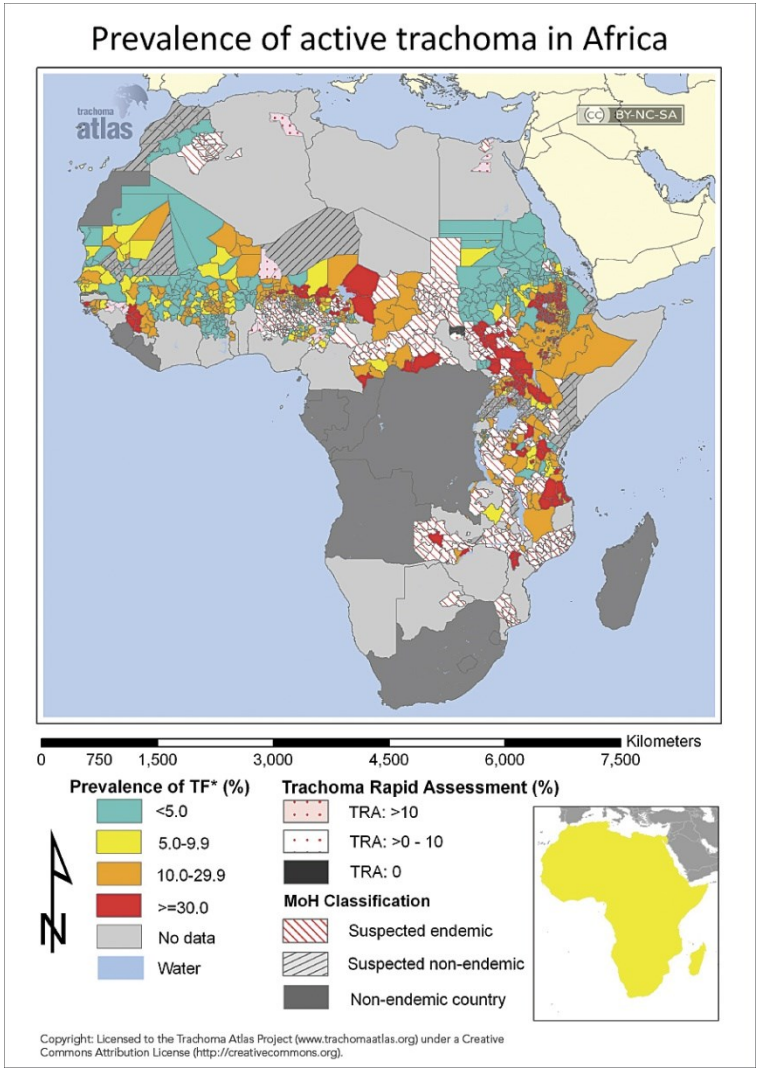
The heat map uses scores for each play space to produce a level of service (LOS) value for any location within the city

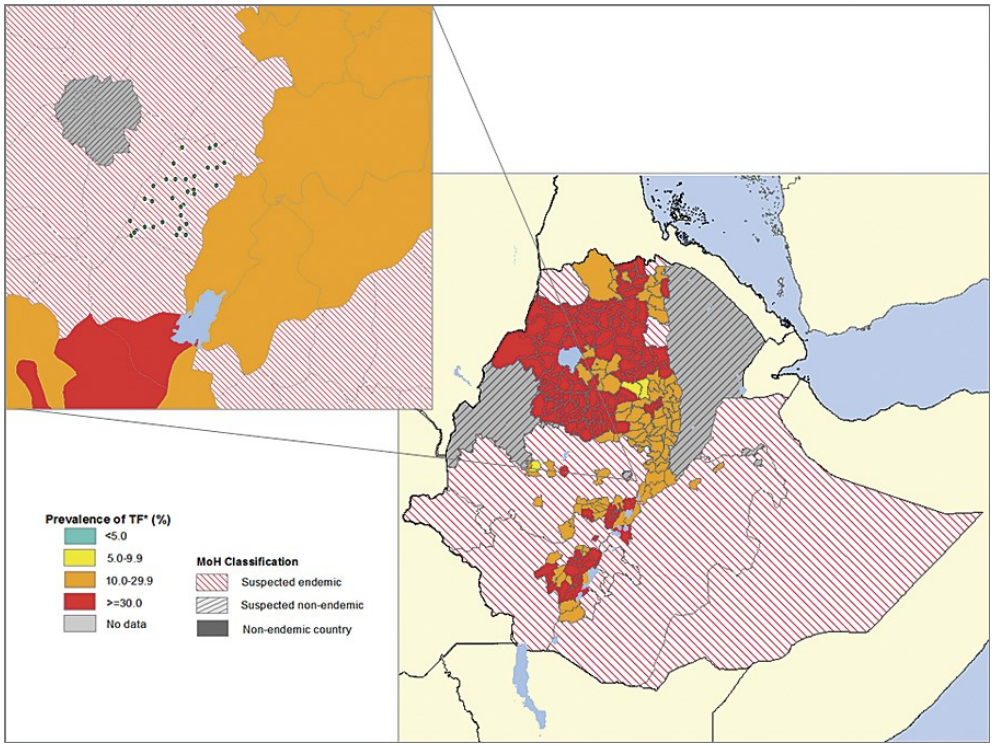
Monitoring the Asian Tiger Mosquito



Vector surveillance results collected during 2008 in Mercer County, New Jersey.

GIS Helps Fight World's Leading Cause of Preventable Blindness





This map of Africa from www.trachomaatlas.org illustrates the known distribution of trachoma and the data gaps across the continent.

Assignment 01

Each student is required to research on a GIS application of your choice. Required

1. Using Google Scholar search for a recent peer reviewed paper (2020-Now) with at least 5 citations
2. Outline the key **scientific** problem the paper is trying to solve. Max ½ page
3. Briefly describe the methodology followed in solving the problem. Max ½ page
4. Draw a flowchart of the study methodology. Be precise on the analytical techniques used. i.e. avoid general terms such as "analysis". Max ½ page
5. Briefly describe the key results and findings. Max ½ page
6. In your own interpretation outline the key gaps that remain to be researched on. Max ¼ page

Submission link

EGE 2421 : https://forms.gle/Y1tncSBsU2KXj4Ud9

EGS 2401 : https://forms.gle/5LThStQ885N5UQKEA

Deadline next week 7:00am

How to select research papers

Selecting published material

- There are many types of sources that you could use in your papers (journal articles, books, newspapers, interviews, etc.), but not all of them are good sources.
- **Good sources** give you reliable, accurate information based on real research. You can tell a good source by the following:
  - It is published in a scholarly (peer-reviewed) journal or by a scholarly publishing press (books)
  - It is recent, published within the past 5 years

Selecting published material

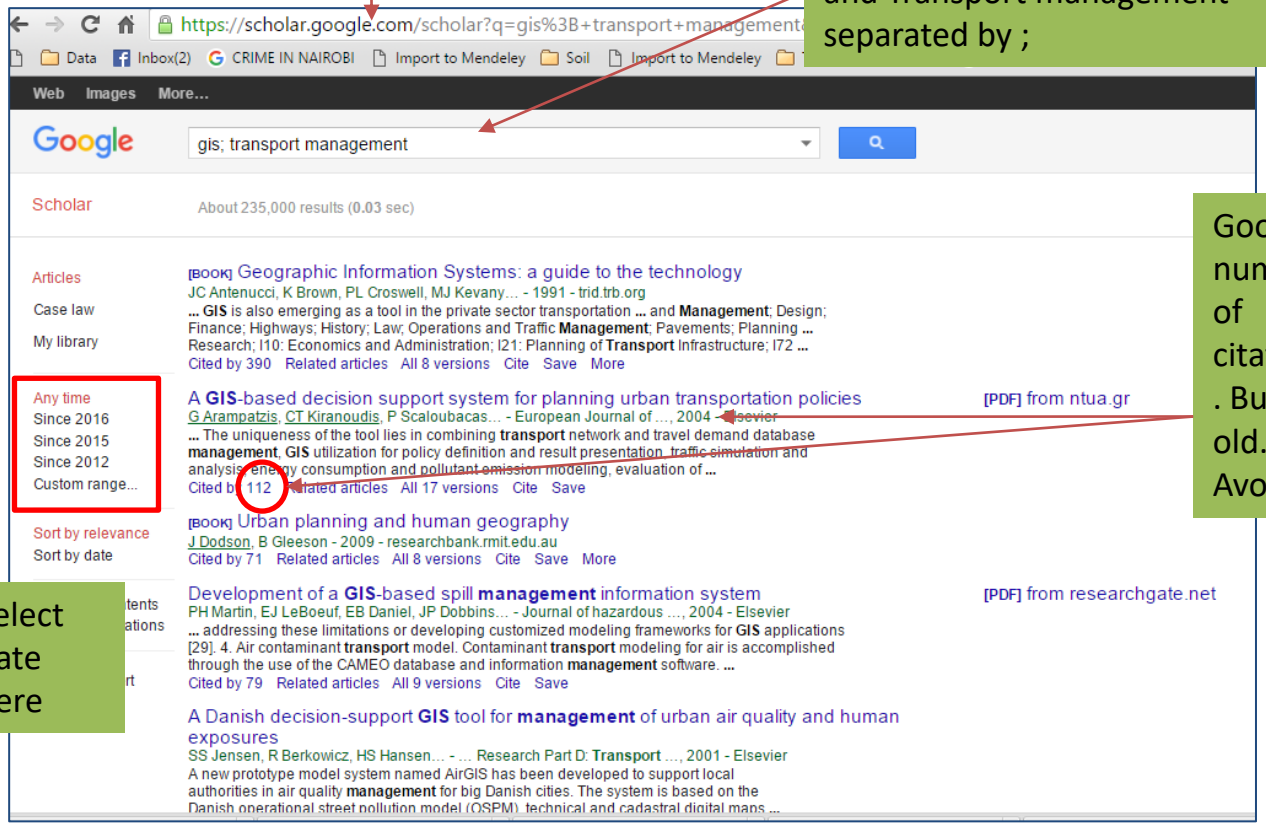
- **Bad sources** give you faulty, incomplete information that is often based on opinion or hearsay. You can tell a bad source by the following:
- It is not scholarly, such as:
  - Newspaper articles
  - Magazine articles
  - Journal articles NOT in peer-reviewed journals
  - Wikipedia
  - Books that are not research-based (popular books rather than academic)
  - Television, movies, or radio
  - Things that you have heard people say
- It is old, published more than 5 years ago

Finding a good source

- Do a library search using the library catalog (check the university Journal VPN)
- Use key words to search (try different variations)
- Browse to specific journals and go through recent publicaltions
- Only use acceptable books or peer-reviewed journals
- Choose articles from within the past 5 years
- Read titles to see what looks relevant
- Read the abstracts and only choose the most pertinent articles
- Use Scholarly search engines – e.g Google scholar
- Check for number of citations. The higher the better

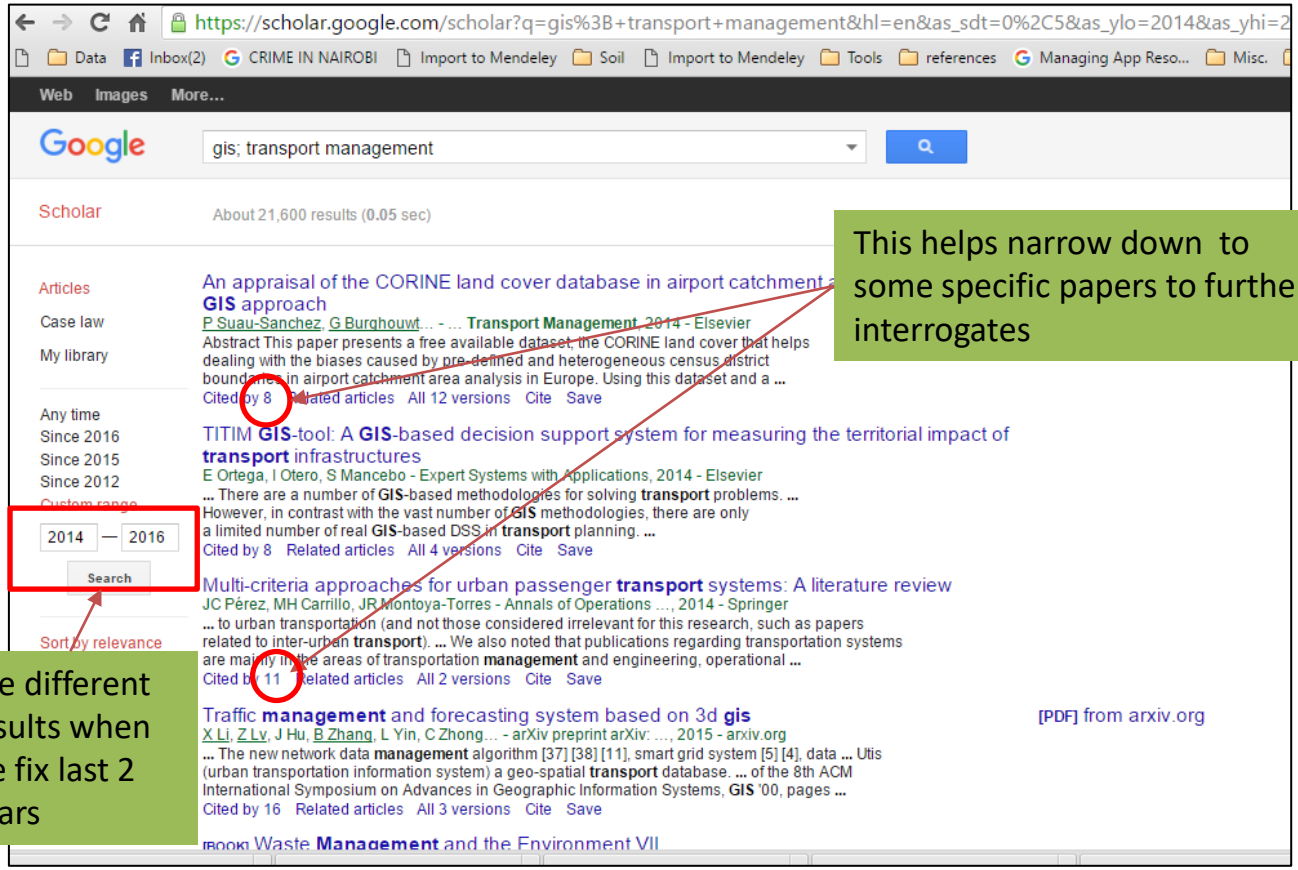
Note we are using scholarly search engine

Note the use of keywords : GIS and Transport management separated by ;



Good number of citations . But too old. Avoid

Select date here


https://scholar.google.com/scholar?q=gis%3B+transport+management&hl=en&as_sdt=0%2C5&as_ylo=2014&as_yhi=2
Data
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Import to Mendeley
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Scholar
About 21,600 results (0.05 sec)
Articles
Case law
My library
Any time
Since 2016
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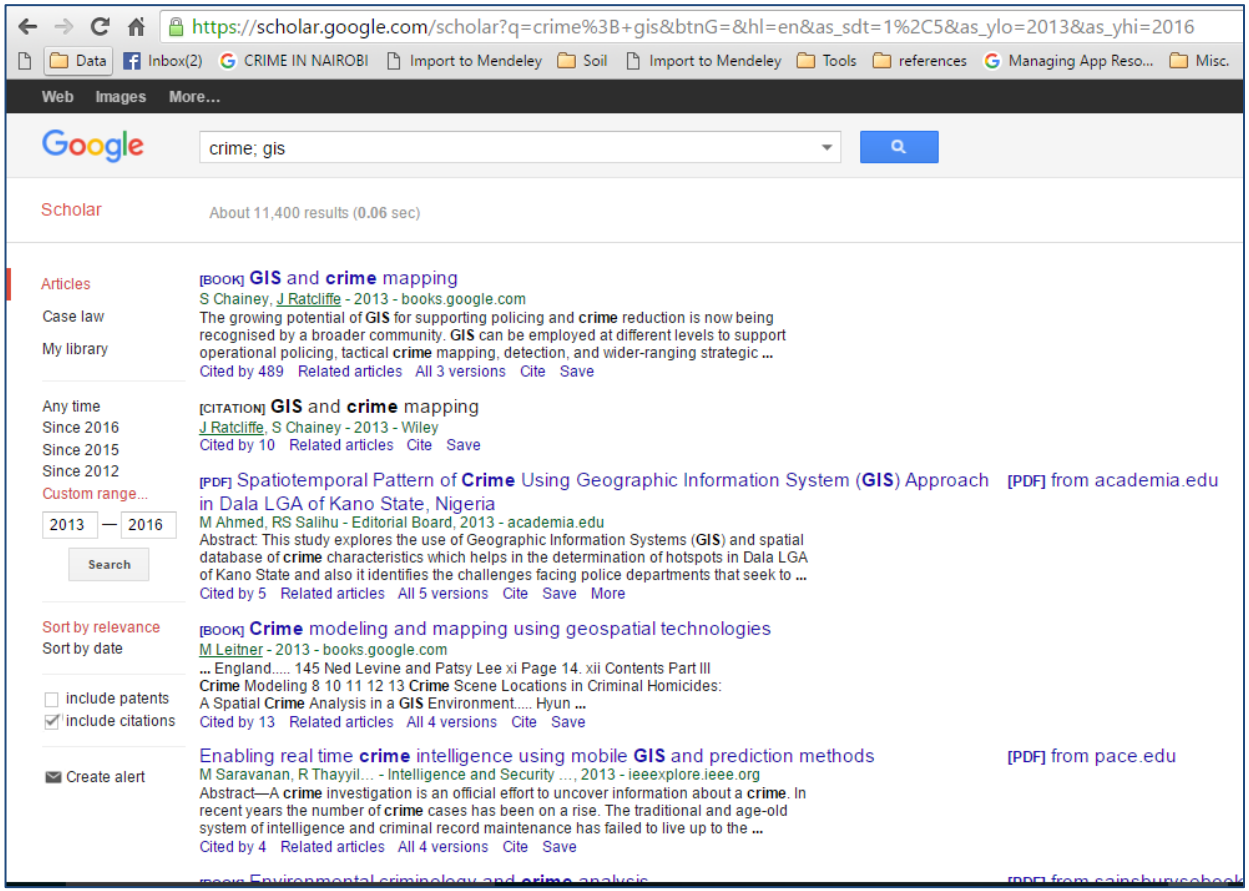
2014
2016
Search
Sort by relevance
An appraisal of the CORINE land cover database in airport catchment
GIS approach
P Suau-Sanchez, G Burghouwt... - ... Transport Management, 2014 - Elsevier
Abstract This paper presents a free available dataset, the CORINE land cover that helps dealing with the biases caused by pre-defined and heterogeneous census district boundaries in airport catchment area analysis in Europe. Using this dataset and a ...
Cited by 8 Related articles All 12 versions Cite Save
TITIM GIS-tool: A GIS-based decision support system for measuring the territorial impact of transport infrastructures
E Ortega, I Otero, S Mancebo - Expert Systems with Applications, 2014 - Elsevier
... There are a number of GIS-based methodologies for solving transport problems. ... However, in contrast with the vast number of GIS methodologies, there are only a limited number of real GIS-based DSS in transport planning. ...
Cited by 8 Related articles All 4 versions Cite Save
Multi-criteria approaches for urban passenger transport systems: A literature review
JC Pérez, MH Carrillo, JR Montoya-Torres - Annals of Operations ..., 2014 - Springer
... to urban transportation (and not those considered irrelevant for this research, such as papers related to inter-urban transport). ... We also noted that publications regarding transportation systems are mainly in the areas of transportation management and engineering, operational ...
Cited by 11 Related articles All 2 versions Cite Save
Traffic management and forecasting system based on 3d gis
[PDF] from arxiv.org
X Li, Z Lv, J Hu, B Zhang, L Yin, C Zhong... - arXiv preprint arXiv: ..., 2015 - arxiv.org
... The new network data management algorithm [37] [38] [11], smart grid system [5] [4], data ... Utis (urban transportation information system) a geo-spatial transport database. ... of the 8th ACM International Symposium on Advances in Geographic Information Systems, GIS '00, pages ...
Cited by 16 Related articles All 3 versions Cite Save
[BOOK] Waste Management and the Environment VII
This helps narrow down to some specific papers to further interrogates
See different results when we fix last 2 years


https://scholar.google.com/scholar?q=crime%3B+gis&btnG=&hl=en&as_sdt=1%2C5&as_ylo=2013&as_yhi=2016
Data
Inbox(2)
CRIME IN NAIROBI
Import to Mendeley
Soil
Import to Mendeley
Tools
references
Managing App Reso...
Misc.
Web
Images
More...
Google
crime; gis
Scholar
About 11,400 results (0.06 sec)
Articles
Case law
My library
Any time
Since 2016
Since 2015
Since 2012
Custom range...
2013 — 2016
Search
Sort by relevance
Sort by date
include patents
include citations
Create alert
[BOOK] GIS and crime mapping
S Chainey, J Ratcliffe - 2013 - books.google.com
The growing potential of GIS for supporting policing and crime reduction is now being recognised by a broader community. GIS can be employed at different levels to support operational policing, tactical crime mapping, detection, and wider-ranging strategic ...
Cited by 489 Related articles All 3 versions Cite Save
[CITATION] GIS and crime mapping
J Ratcliffe, S Chainey - 2013 - Wiley
Cited by 10 Related articles Cite Save
[PDF] Spatiotemporal Pattern of Crime Using Geographic Information System (GIS) Approach in Dala LGA of Kano State, Nigeria
[PDF] from academia.edu
M Ahmed, RS Salihu - Editorial Board, 2013 - academia.edu
Abstract: This study explores the use of Geographic Information Systems (GIS) and spatial database of crime characteristics which helps in the determination of hotspots in Dala LGA of Kano State and also it identifies the challenges facing police departments that seek to ...
Cited by 5 Related articles All 5 versions Cite Save More
[BOOK] Crime modeling and mapping using geospatial technologies
M Leitner - 2013 - books.google.com
... England..... 145 Ned Levine and Patsy Lee xi Page 14. xii Contents Part III Crime Modeling 8 10 11 12 13 Crime Scene Locations in Criminal Homicides: A Spatial Crime Analysis in a GIS Environment..... Hyun ...
Cited by 13 Related articles All 4 versions Cite Save
Enabling real time crime intelligence using mobile GIS and prediction methods
[PDF] from pace.edu
M Saravanan, R Thayyil... - Intelligence and Security ..., 2013 - ieeexplore.ieee.org
Abstract—A crime investigation is an official effort to uncover information about a crime. In recent years the number of crime cases has been on a rise. The traditional and age-old system of intelligence and criminal record maintenance has failed to live up to the ...
Cited by 4 Related articles All 4 versions Cite Save

Reading a primary research article

1. Begin by reading the introduction, not the abstract - *abstracts contain a succinct summary of the entire paper*

2. Identify the BIG QUESTION. - Not "What is this paper about", but "What problem is this entire field trying to solve? This *helps you focus on why this research is being done.*

- The Introduction section of the paper will provide the necessary background information to help you understand the goals of the study and why the study is important and interesting.
- It also will cite references to previous publications and other relevant work. The references within the text are often cited by author and year, but sometimes by a number

Reading a primary research article

3. Summarize the background in five sentences or less.

- Here are some questions to guide you:
  - What work has been done before in this field to answer the BIG QUESTION? What are the limitations of that work? What, according to the authors, needs to be done next?
- *The five sentences part is a little arbitrary, but it forces you to be concise and really think about the context of this research. You need to be able to explain why this research has been done in order to understand it.*

Reading a primary research article

4. **Identify the SPECIFIC QUESTION(S)**
   - What **exactly** are the authors trying to answer with their research? There may be multiple questions, or just one. Write them down. If it's the kind of research that tests one or more null hypotheses, identify it/them.
5. **Identify the approach**
   - What are the authors going to do to answer the SPECIFIC QUESTION(S)?

Reading a primary research article

6. Now read the methods section. Draw a diagram for each experiment, showing exactly what the authors did.

- I mean *literally* draw it. Include as much detail as you need to fully understand the work.

Reading a primary research article

7. Read the results section. Write one or more paragraphs to summarize the results for each experiment, each figure, and each table.

- Don't yet try to decide what the results mean, just write down what they are.
  - You'll find that, particularly in good papers, the majority of the results are summarized in the figures and tables. Pay careful attention to them!
  - You may also need to go to the Supplementary Online Information file to find some of the results.

Reading a primary research article

8. THINGS TO PAY ATTENTION TO IN THE RESULTS SECTION:

- Any time the words “significant” or “non-significant” are used. These have precise statistical meanings.
- If there are graphs, do they have error bars on them? For certain types of studies, a lack of confidence intervals is a major red flag.
- The sample size. Has the study been conducted on 10, or 10,000 people? (For some research purposes, a sample size of 30 is sufficient, but for most studies larger is better).

Reading a primary research article

9. Do the results answer the SPECIFIC QUESTION(S)? What do you think they mean?

- *Don't move on until you have thought about this. It's okay to change your mind in light of the authors' interpretation—in fact you probably will if you're still a beginner at this kind of analysis—but it's a really good habit to start forming your own interpretations before you read those of others.*

Reading a primary research article

10. Read the conclusion/discussion/Interpretation section.

- What do the authors <u>think</u> the results mean?
- Do you agree with them? Can you come up with any <u>alternative</u> way of interpreting them?
- Do the authors identify any weaknesses in their own study?
- Do you see any that the authors missed? (Don't assume they're infallible!)
- What do they propose to do as a next step? Do you agree with that?

Reading a primary research article

11. Now, go back to the beginning and read the abstract.

- Does it match what the authors said in the paper? Does it fit with your interpretation of the paper?

Reading a primary research article

12. FINAL STEP: *(Don't neglect doing this)* What do other researchers say about this paper?

- Who are the (acknowledged or self-proclaimed) experts in this particular field? Do they have criticisms of the study that you haven't thought of, or do they generally support it?
- *Here's a place where I do recommend you use google! But do it last, so you are better prepared to think critically about what other people say.*

Reading a primary research article

13. Literature cited

- go through the “Literature cited” section to see what other papers the authors cited.
- This allows you to better identify the important papers in a particular field, see if the authors cited your papers and find sources of useful ideas or techniques.)

THANK YOU