Geocomputation

Welcome

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Geocomputation

Module Overview

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Module aims

Geocomputation provides you with an introduction to the principles of GIScience, spatial analysis, and the use of programming for spatial data analysis.

Over the next ten weeks, you will learn about the theory, methods and tools of spatial analysis using the R programming language within the RStudio software environment.

You will further learn how to find, clean, and manage demographic, socio-economic, and environmental datasets, and analyse them using core spatial analysis techniques.

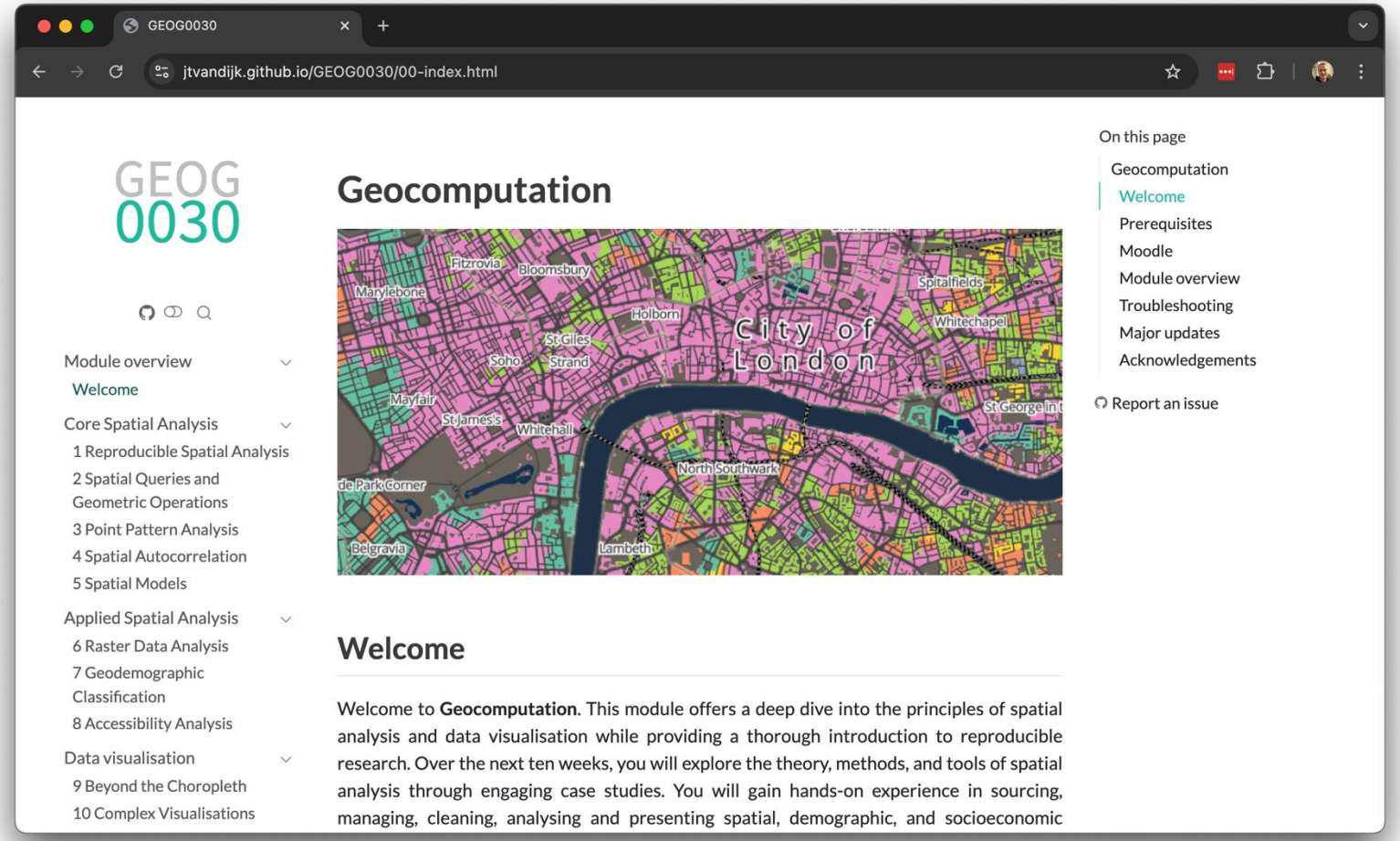
Module outline

W1	Reproducible Spatial Analysis	Core Spatial Analysis
W2	Spatial Queries and Geometric Operations	
W3	Point Pattern Analysis	
W4	Spatial Autocorrelation	
W5	Spatial Models	
W6	Raster Data Analysis	Applied Spatial Analysis
W7	Geodemographic Classification	
W8	Accessibility Analysis	
W9	Beyond the Choropleth	Data Visualisation
W10	Complex Visualisations	

Module structure

- This module consists of ten lectures (Monday morning) and ten supervised computer tutorials (Group A: Tuesday morning, Group B: Tuesday afternoon).
- Each week will have its own reading list. Reading lists and instructions for the computer tutorial are published on the dedicated GEOG0030 Geocomputation Workbook. The link to this workbook is available on Moodle.

Workbook


GEOG0030
jtvandijk.github.io/GEOG0030/00-index.html
GEOG
0030
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3 Point Pattern Analysis
4 Spatial Autocorrelation
5 Spatial Models
Applied Spatial Analysis
6 Raster Data Analysis
7 Geodemographic Classification
8 Accessibility Analysis
Data visualisation
9 Beyond the Choropleth
10 Complex Visualisations
Geocomputation
Fitzrovia
Bloomsbury
Marylebone
Holborn
Spitalfields
Whitechapel
City of London
St Giles
Soho
Strand
Mayfair
St James's
Whitehall
North Southwark
Belgravia
Lambeth
Welcome
Welcome to Geocomputation. This module offers a deep dive into the principles of spatial analysis and data visualisation while providing a thorough introduction to reproducible research. Over the next ten weeks, you will explore the theory, methods, and tools of spatial analysis through engaging case studies. You will gain hands-on experience in sourcing, managing, cleaning, analysing and presenting spatial, demographic, and socioeconomic
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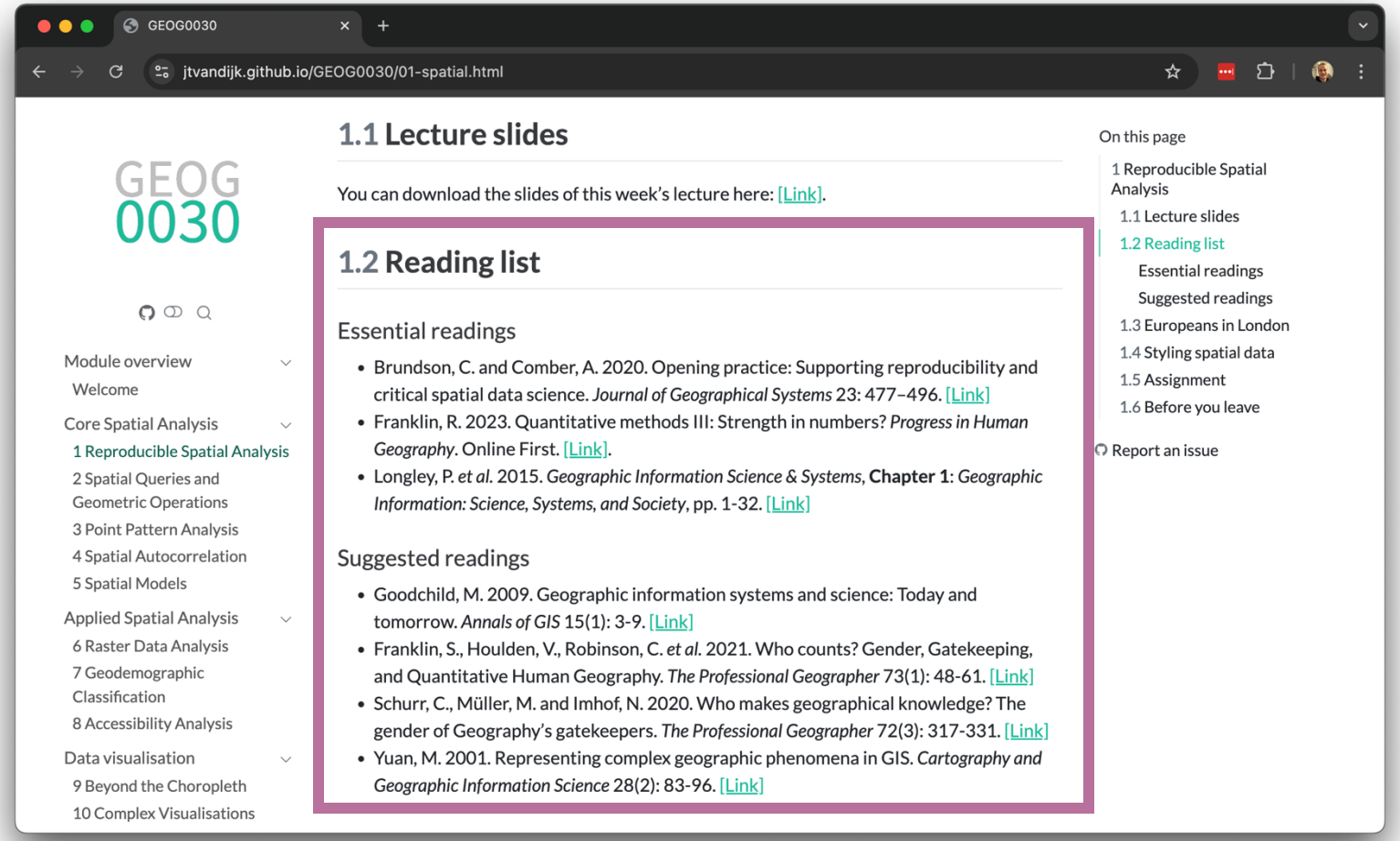
Workbook


GEOG0030
jtvandijk.github.io/GEOG0030/01-spatial.html
GEOG 0030
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8 Accessibility Analysis
Data visualisation
9 Beyond the Choropleth
10 Complex Visualisations
1.1 Lecture slides
You can download the slides of this week's lecture here: [Link].
1.2 Reading list
Essential readings
Brundson, C. and Comber, A. 2020. Opening practice: Supporting reproducibility and critical spatial data science. Journal of Geographical Systems 23: 477–496. [Link]
Franklin, R. 2023. Quantitative methods III: Strength in numbers? Progress in Human Geography. Online First. [Link].
Longley, P. et al. 2015. Geographic Information Science & Systems, Chapter 1: Geographic Information: Science, Systems, and Society, pp. 1-32. [Link]
Suggested readings
Goodchild, M. 2009. Geographic information systems and science: Today and tomorrow. Annals of GIS 15(1): 3-9. [Link]
Franklin, S., Houlden, V., Robinson, C. et al. 2021. Who counts? Gender, Gatekeeping, and Quantitative Human Geography. The Professional Geographer 73(1): 48-61. [Link]
Schurr, C., Müller, M. and Imhof, N. 2020. Who makes geographical knowledge? The gender of Geography's gatekeepers. The Professional Geographer 72(3): 317-331. [Link]
Yuan, M. 2001. Representing complex geographic phenomena in GIS. Cartography and Geographic Information Science 28(2): 83-96. [Link]
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1 Reproducible Spatial Analysis
1.1 Lecture slides
1.2 Reading list
Essential readings
Suggested readings
1.3 Europeans in London
1.4 Styling spatial data
1.5 Assignment
1.6 Before you leave
Report an issue

Practicalities

- Lecture slides will be made available on the GEOG0030 Geocomputation workbook webpage before each lecture. Lectures are recorded using Lecturecast.
- During the computer tutorials you are expected to work independently through the assignments in the workbook with the opportunity to ask questions.

Communication

- All important information will be communicated through Moodle.
- For specific questions on the module, my Academic Support and Feedback (ASF) Office Hours are scheduled on Monday 14h00-16h00 [in person] and Thursday 13h00-14h00 [online]. Slots can be booked through Microsoft Bookings: [Link]

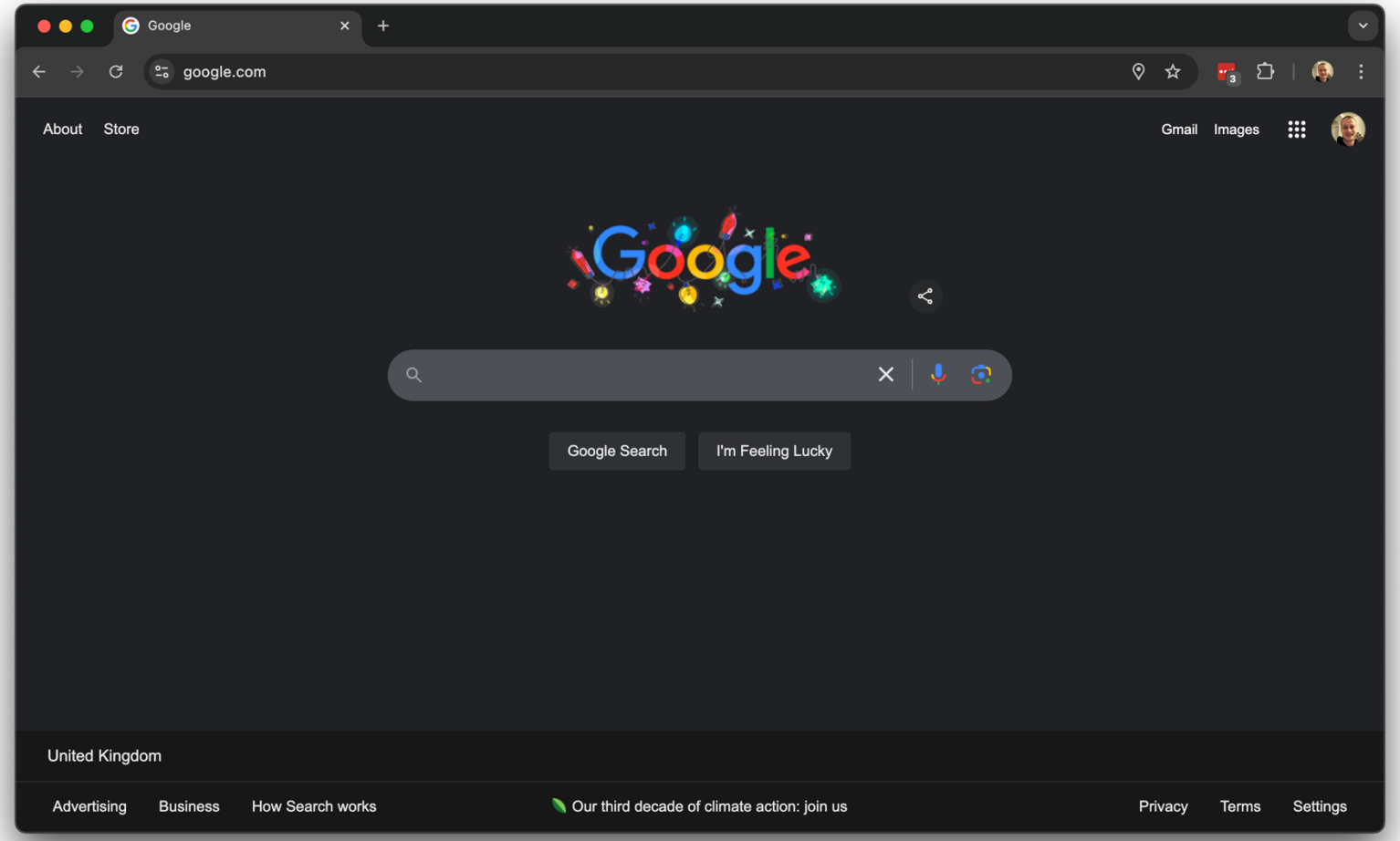
Assessment

- Social Atlas Coursework Assessment (60%): The first assessment will involve the completion of a spatial analysis project, based on the theory, concepts and application learnt during the module. For this coursework you are required to create a small *social atlas* on a topic or area that interests you. Deadline: April 28, 2025.
- Specific Coursework guidance on Moodle (including past examples with indicative grades), further attention to this in W05's Lecture.
- Exam Assessment (40%): The second assessment will take the form of a written two-hour Exam, further attention to this in W10's Lecture.

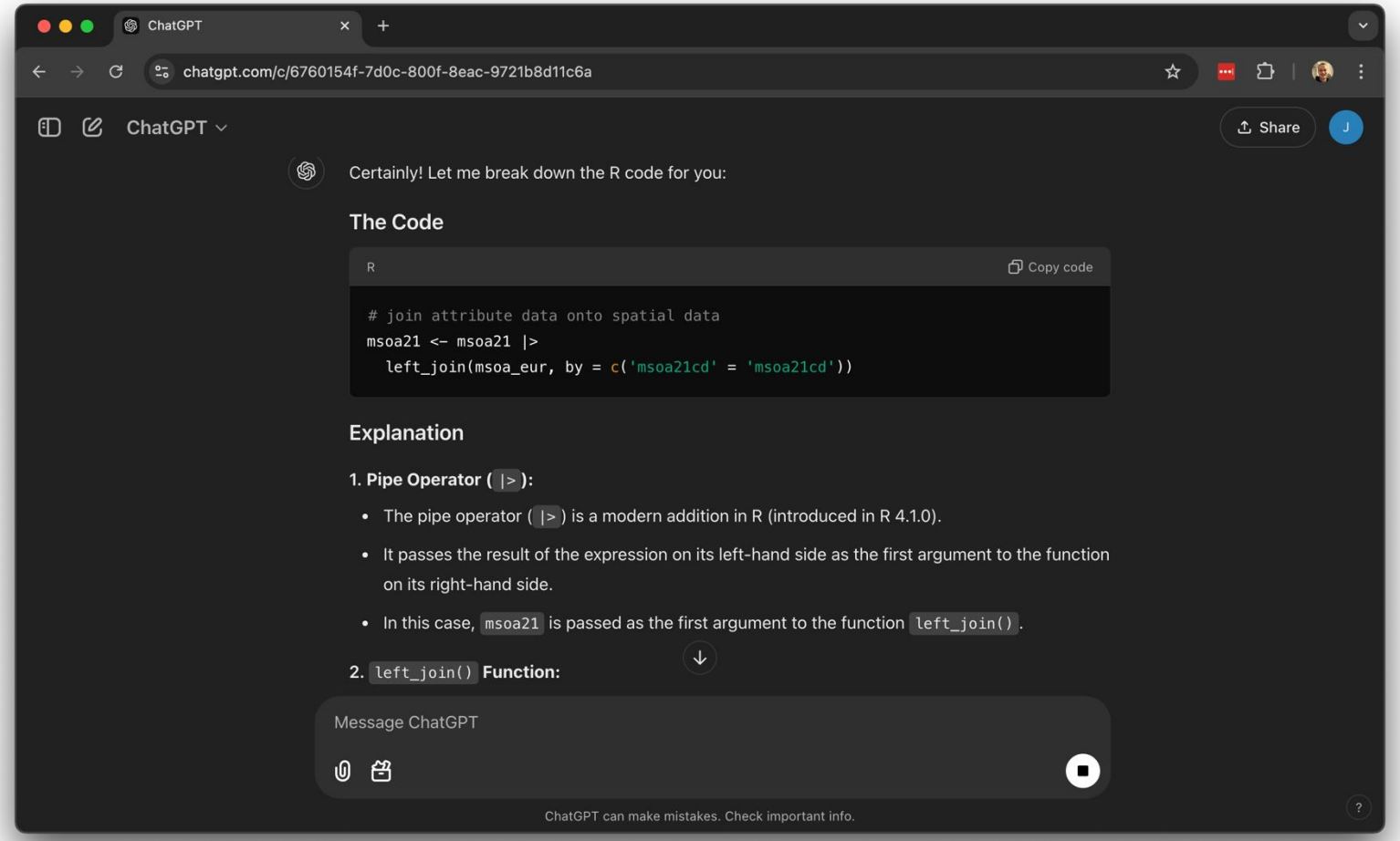
Troubleshooting

- Refresher GEOG0018 Methods in Human Geography.
- Ask a question at the end of a plenary lecture.
- Ask a question during a computer tutorial.
- Attend the optional bi-weekly BYOC Geocomputation Help sessions.

Troubleshooting



Troubleshooting



Questions

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Geocomputation

Reproducible Spatial Analysis

UCL

Module outline

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W10	Complex Visualisations

Core Spatial Analysis

Applied Spatial Analysis

Data Visualisation

This week

- What is GIScience?
- What is Geocomputation?

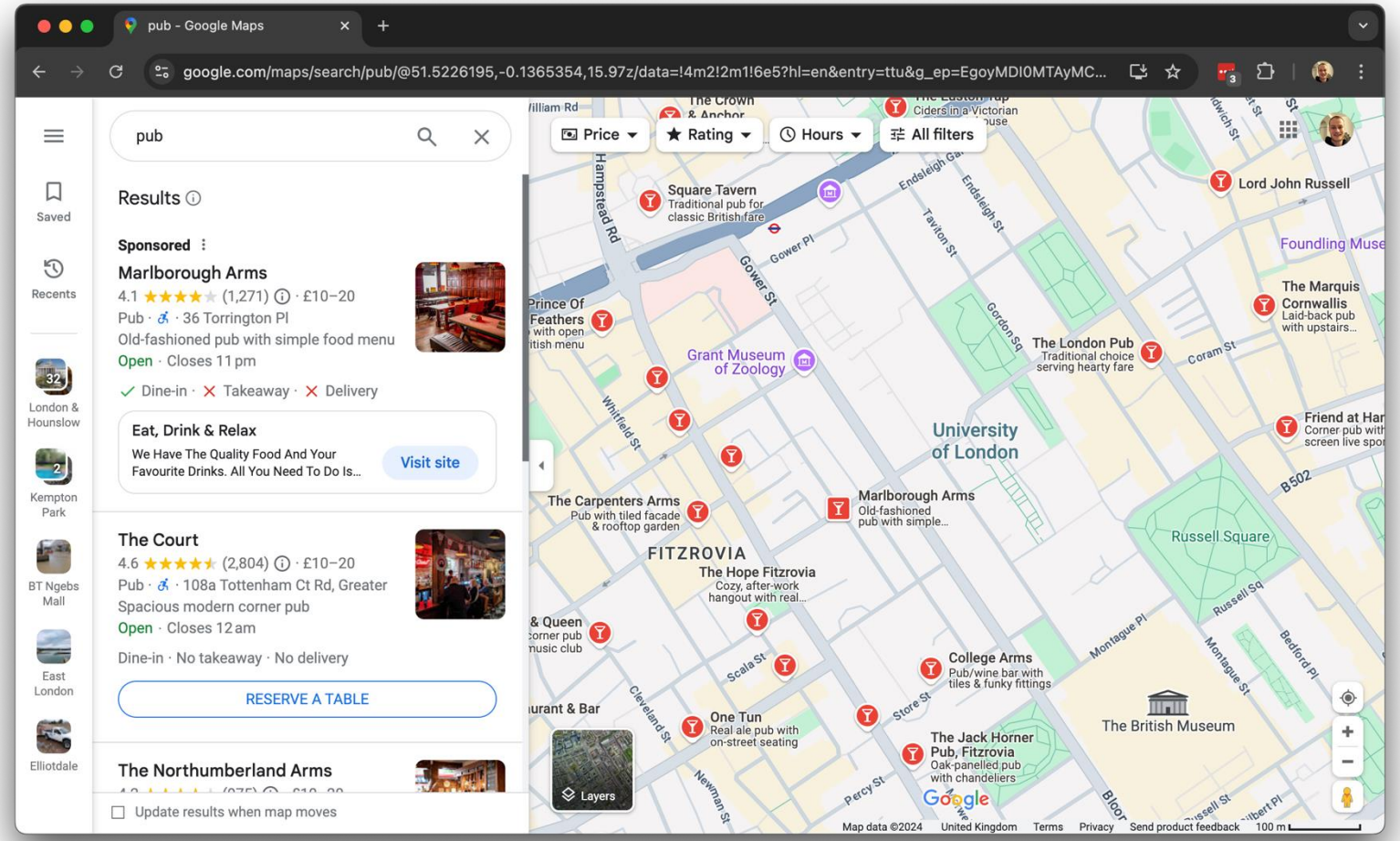
Before we start

- Go to www.menti.com
- Use code: 1457 2682

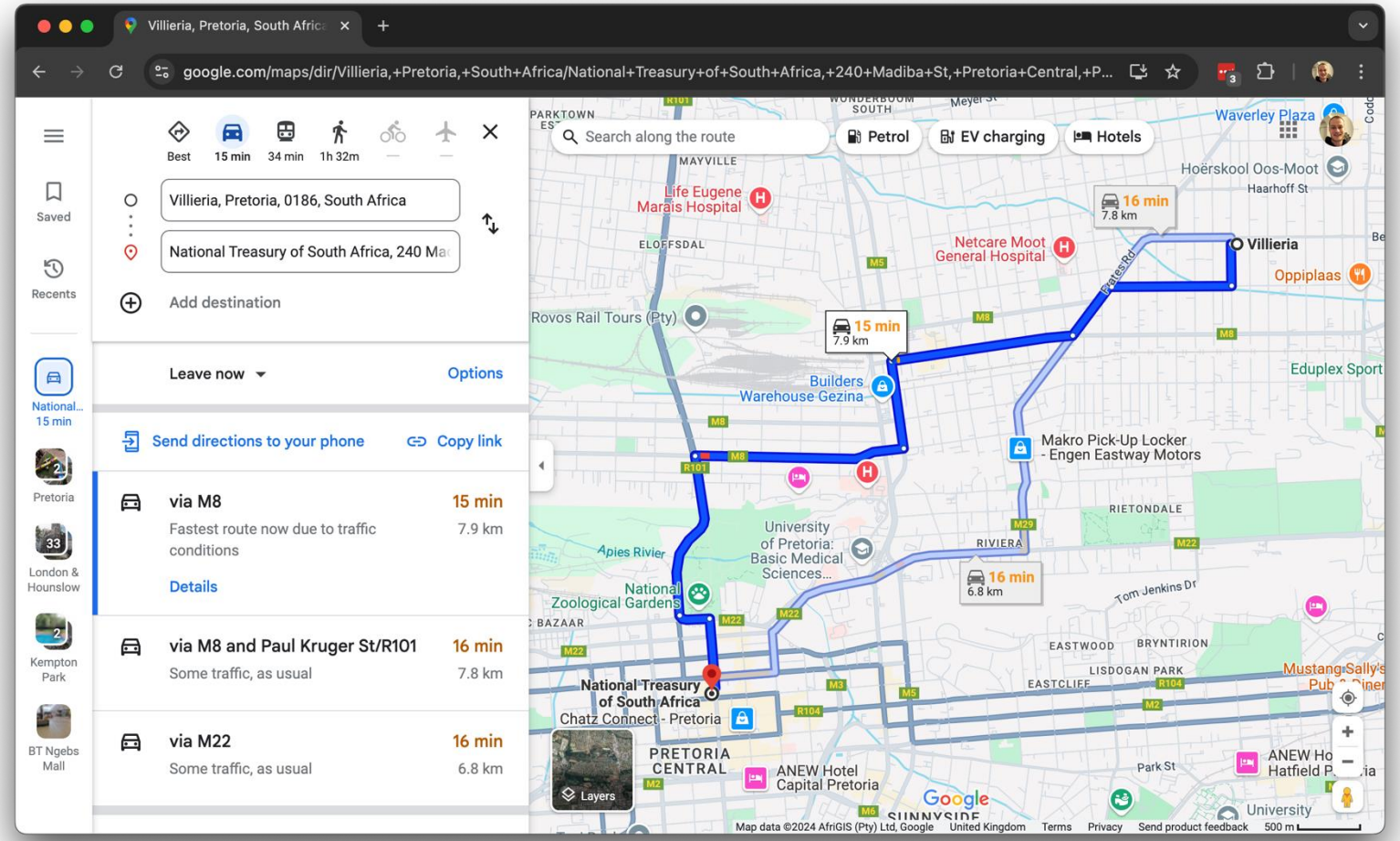
GIScience

- The Geocomputation module is designed to provide you with an introduction to the principles of GIS, spatial analysis and the use of programming for data analysis.
- GIS: Geographical Information System / Geographical Information Science
- Why do we need a science of Geographical Information?

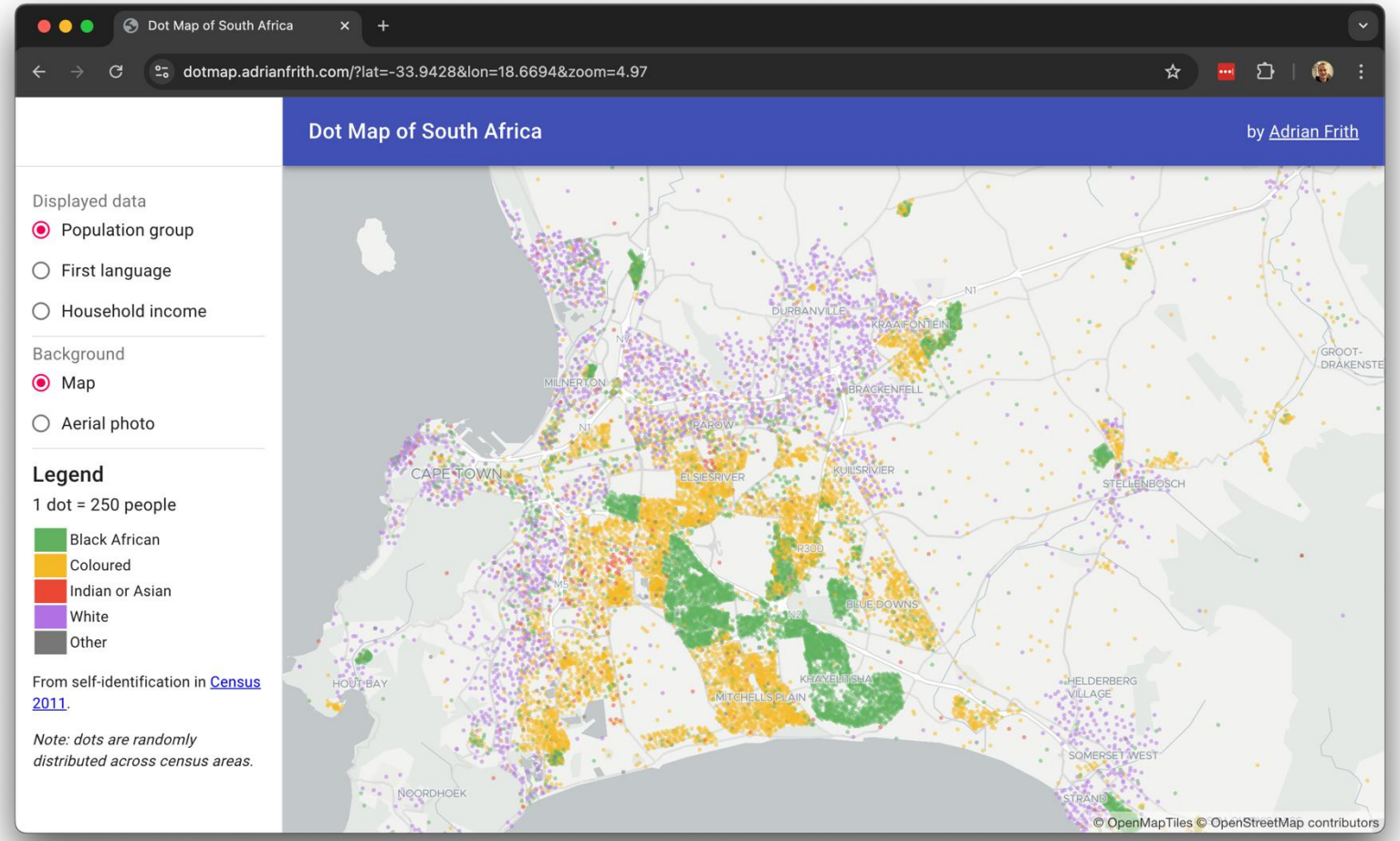
Pubs in Bloomsbury



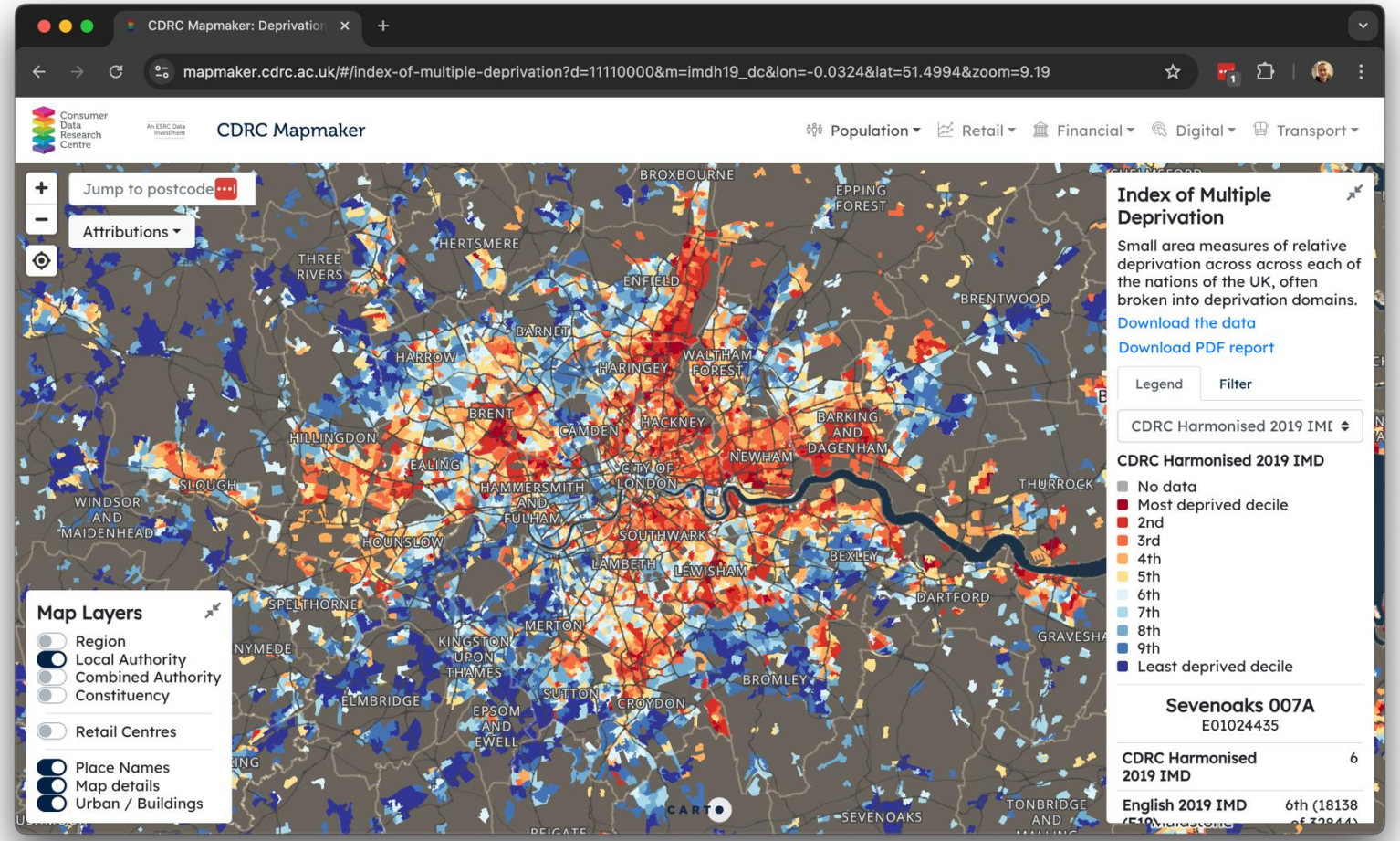
Finding your way abroad



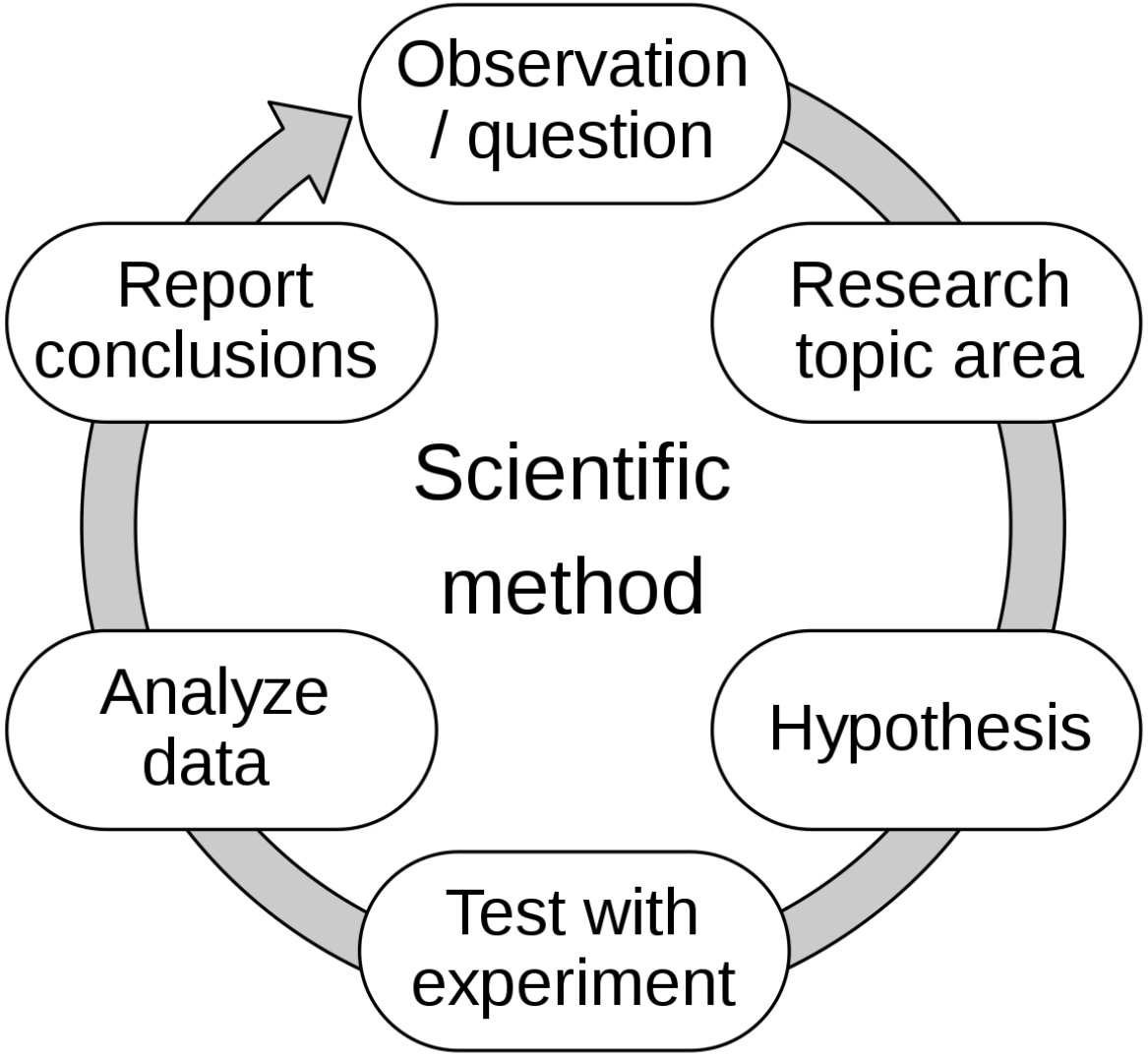
Segregation in Cape Town



Index of Multiple Deprivation in England



Foundations of GIScience



Foundations of GIScience

- Spatial information requires specialised methods and tools to handle its unique properties. To work effectively with spatial data, we need to:
  - Represent spatial data accurately in a digital format.
  - Store and organise spatial data for easy access and interaction.
  - Perform analyses to extract insights from spatial data.
  - Communicate results effectively
- Together they constitute the four pillars of GIScience.

Foundations of GIScience

(1) Spatial modelling and digital representation:

How to represent spatial phenomena digitally?

(2) Geographic Information Systems:

How to store, manage, retrieve, query, analyse and visualise these digital spatial phenomena.

Foundations of GIScience

(3) Spatial analysis:

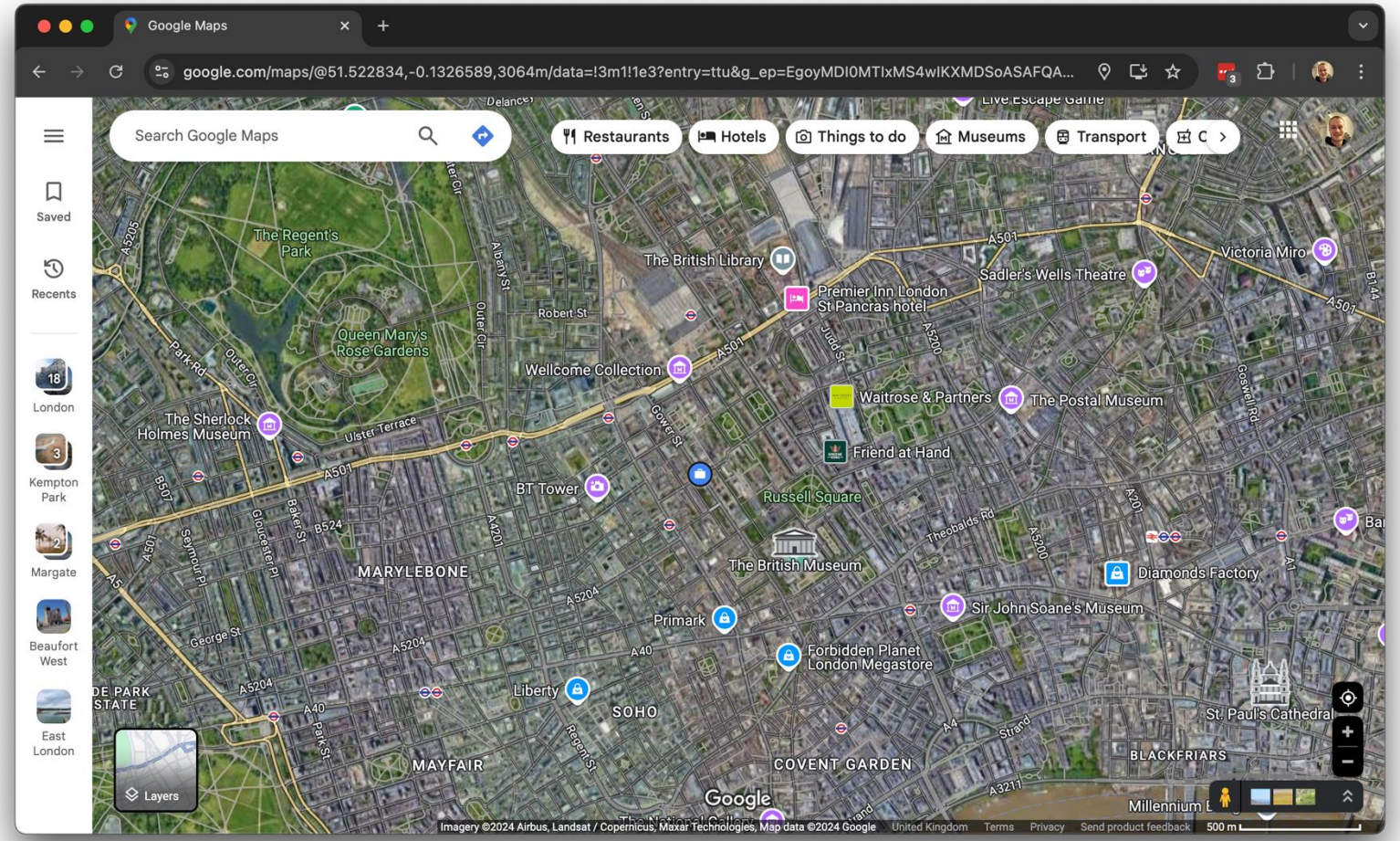
The theory, principles, and techniques that enable analysis of spatial data to look at spatial patterns, processes, and relationships.

(4) Cartography and visualisation:

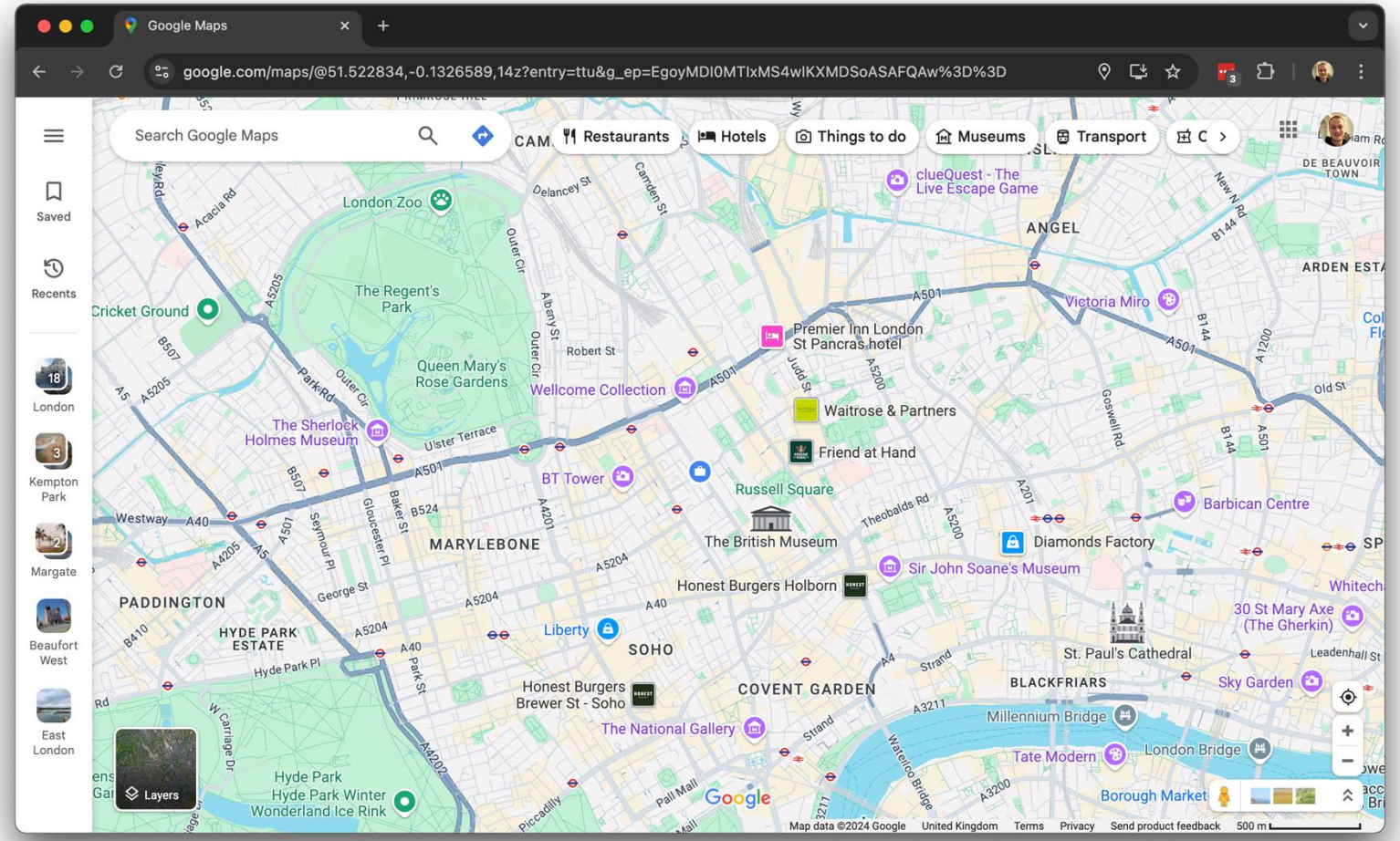
How to present spatial data and the results from spatial analysis to communicate results (including projections and map conventions).

Spatial modelling and digital representation

Spatial modelling and digital representation



Spatial modelling and digital representation

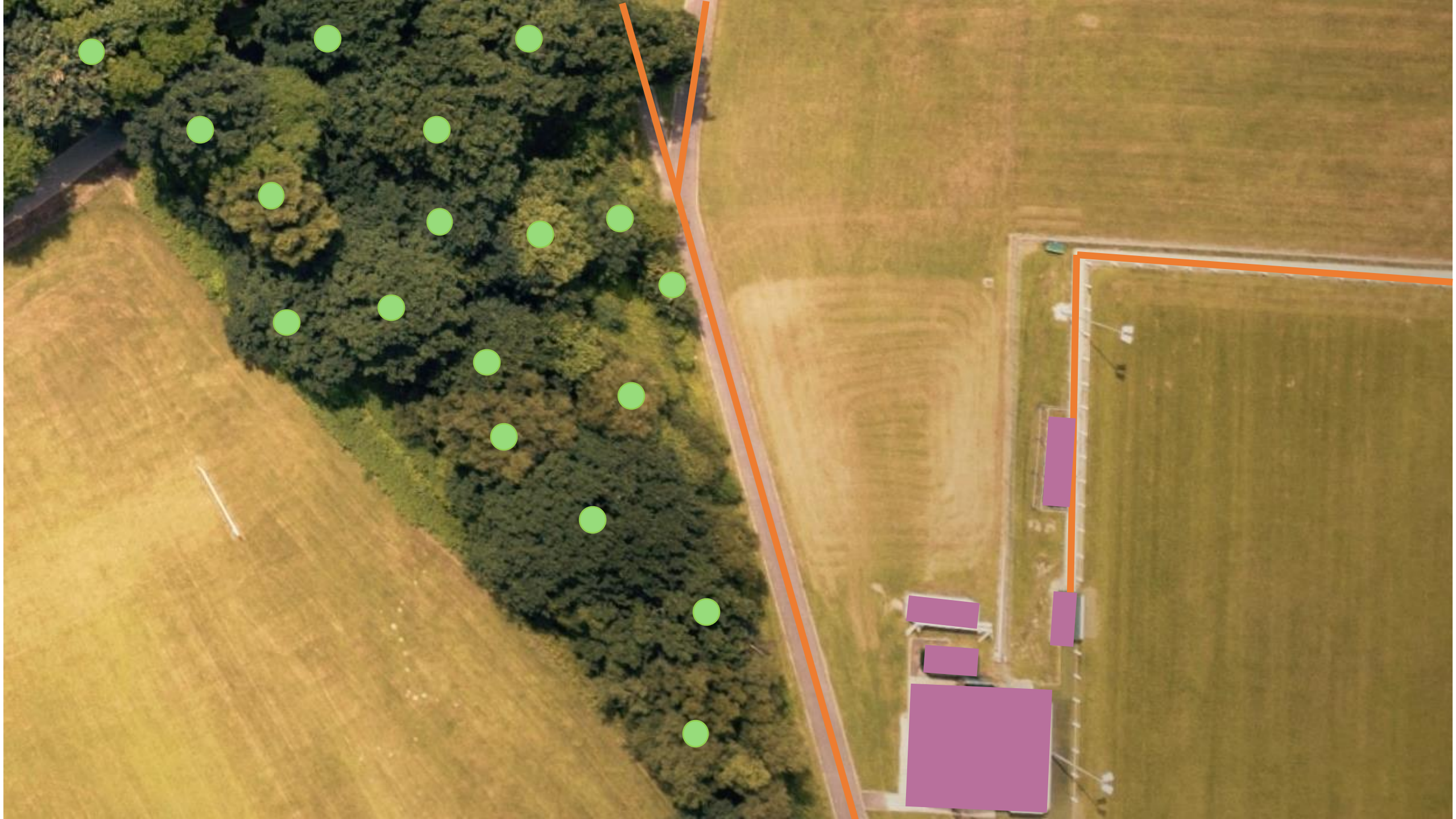


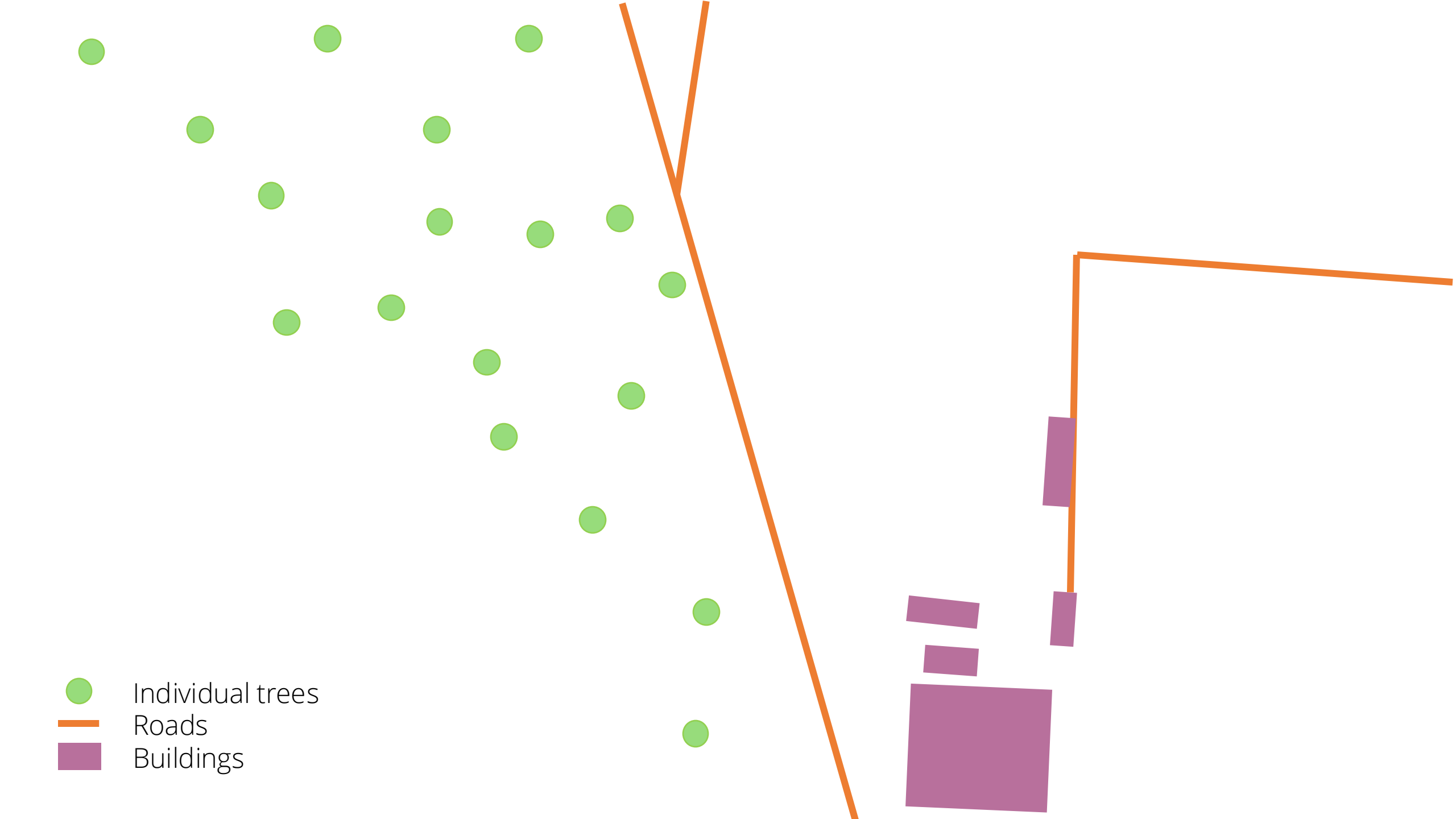
Spatial modelling and digital representation

- GIScience relies on representing spatial information in a digital format.
- Traditionally, geographic information is conveyed in two primary ways:

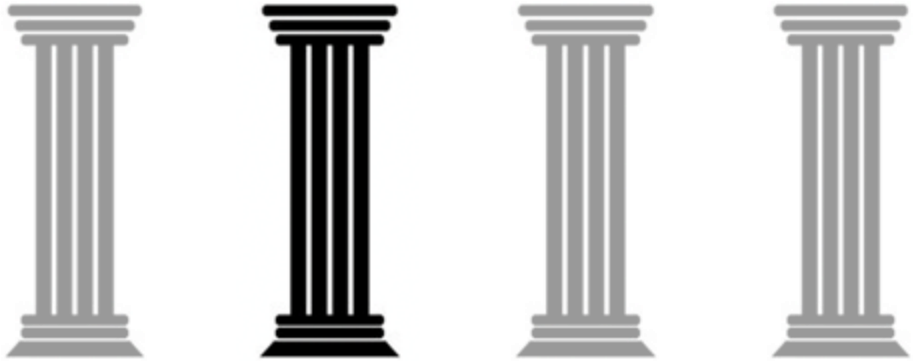
  Vector This method uses a finite set of discrete geometric objects, such as points, lines, and polygons, to represent spatial features.

  Raster This approach employs images or grids to represent surfaces, with each cell or pixel holding a value, often indicating attributes like colors or measurements.




Individual trees
Roads
Buildings

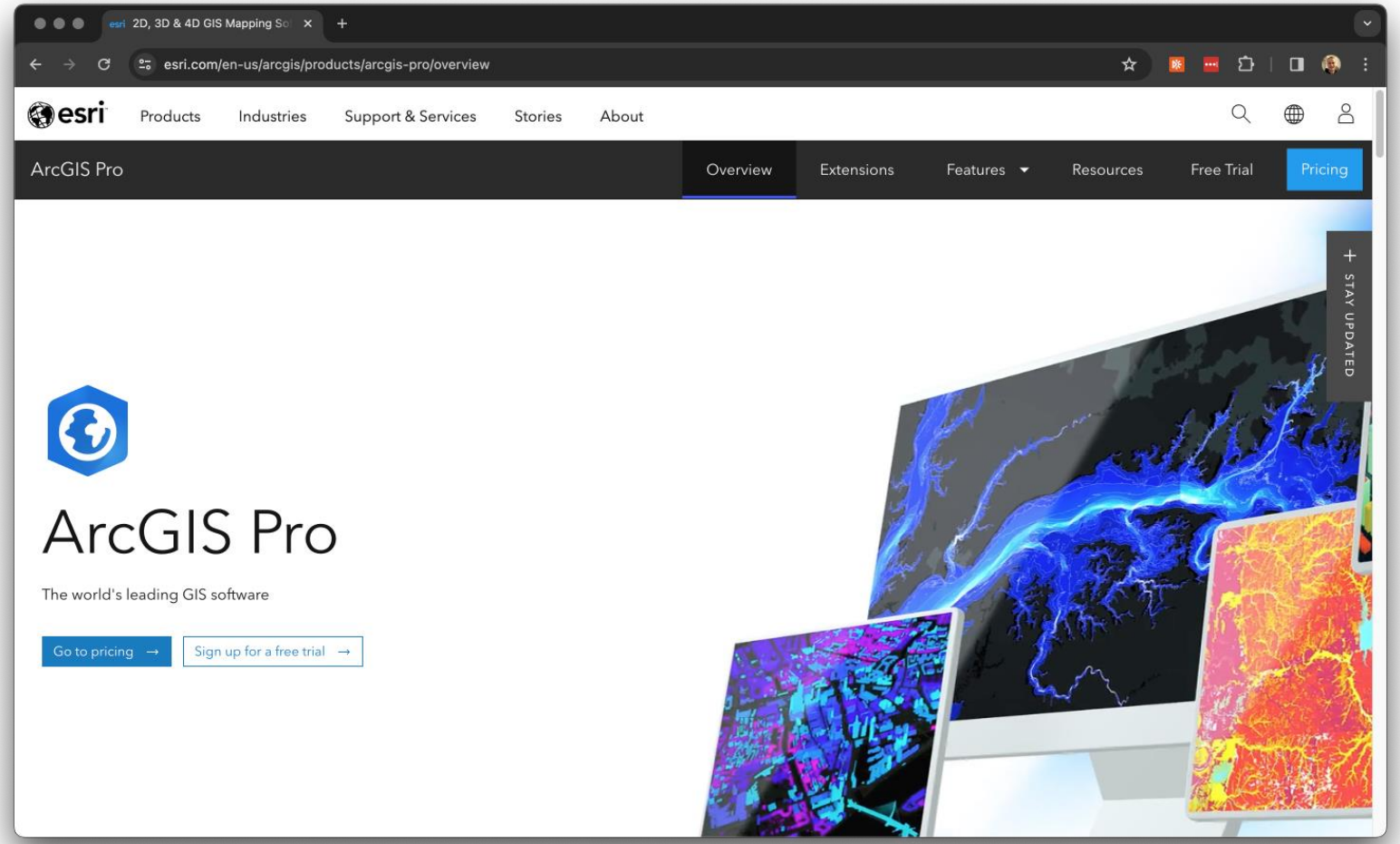
Geographic Information Systems



Geographic Information Systems

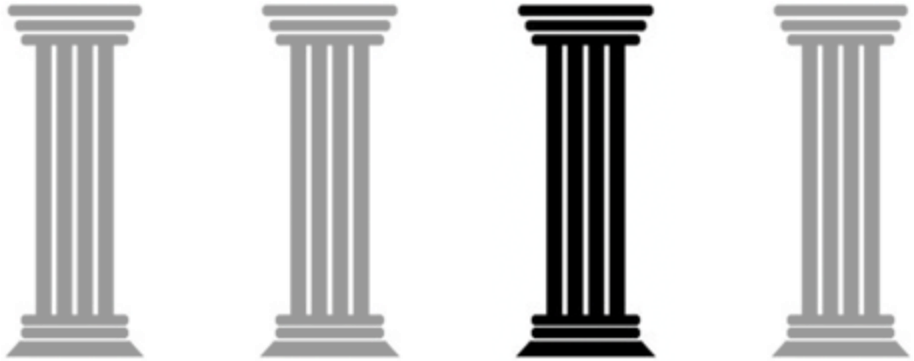
- GI systems help us to manage spatial data: organisation, storage, access and retrieval, and manipulation.
- Dedicated GIS software: ArcGIS Pro, QGIS, GeoDa
- Software that has GIS functionality: R, Python

Geographic Information Systems



Geographic Information Systems

Spatial analysis



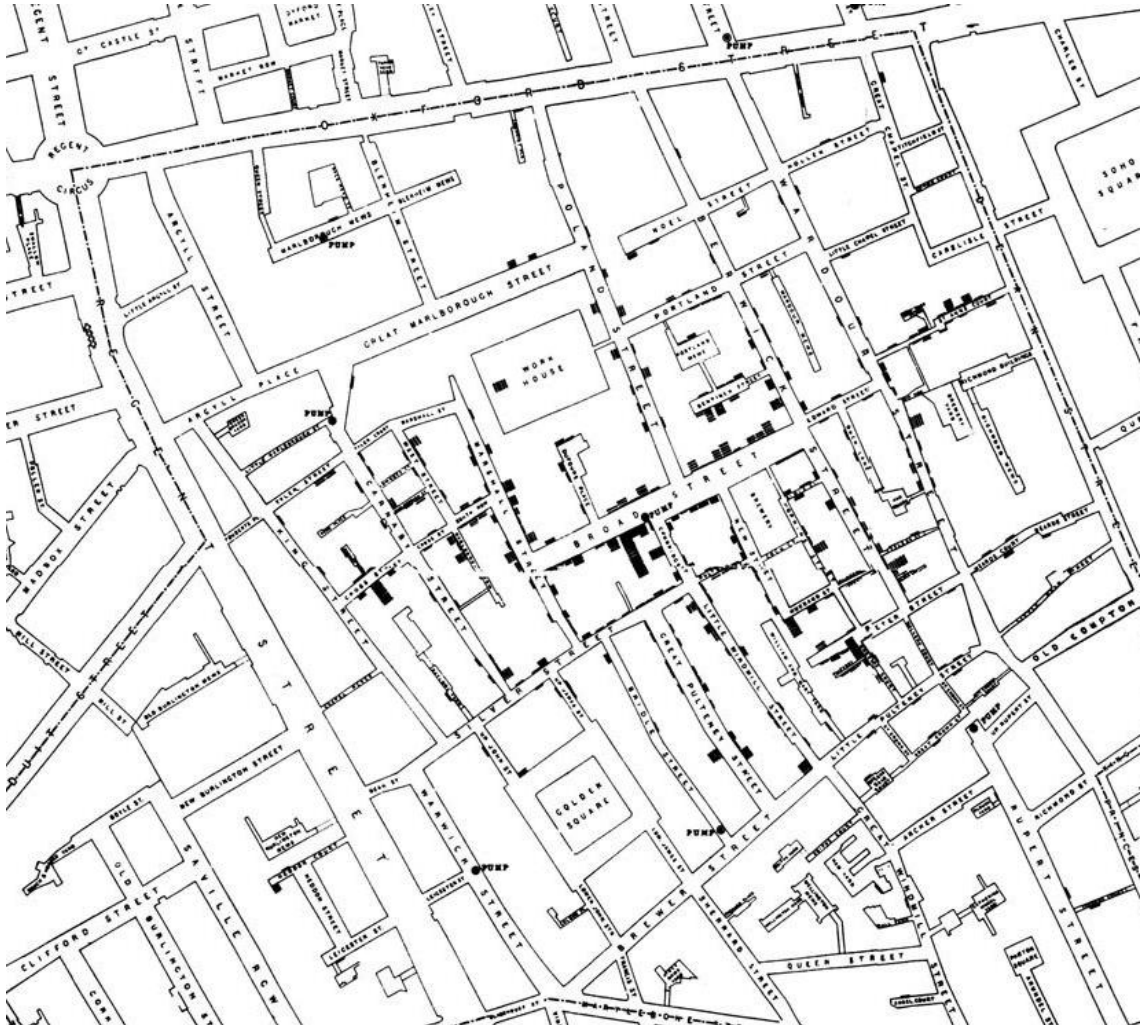
Spatial analysis

- The theory, principles, and techniques that enable analysis of spatial data to discover spatial patterns, processes and relationships.
- The application of formal techniques to analyse specific phenomena or entities, that are represented by spatial data, using their topological, geometric or geographic properties.

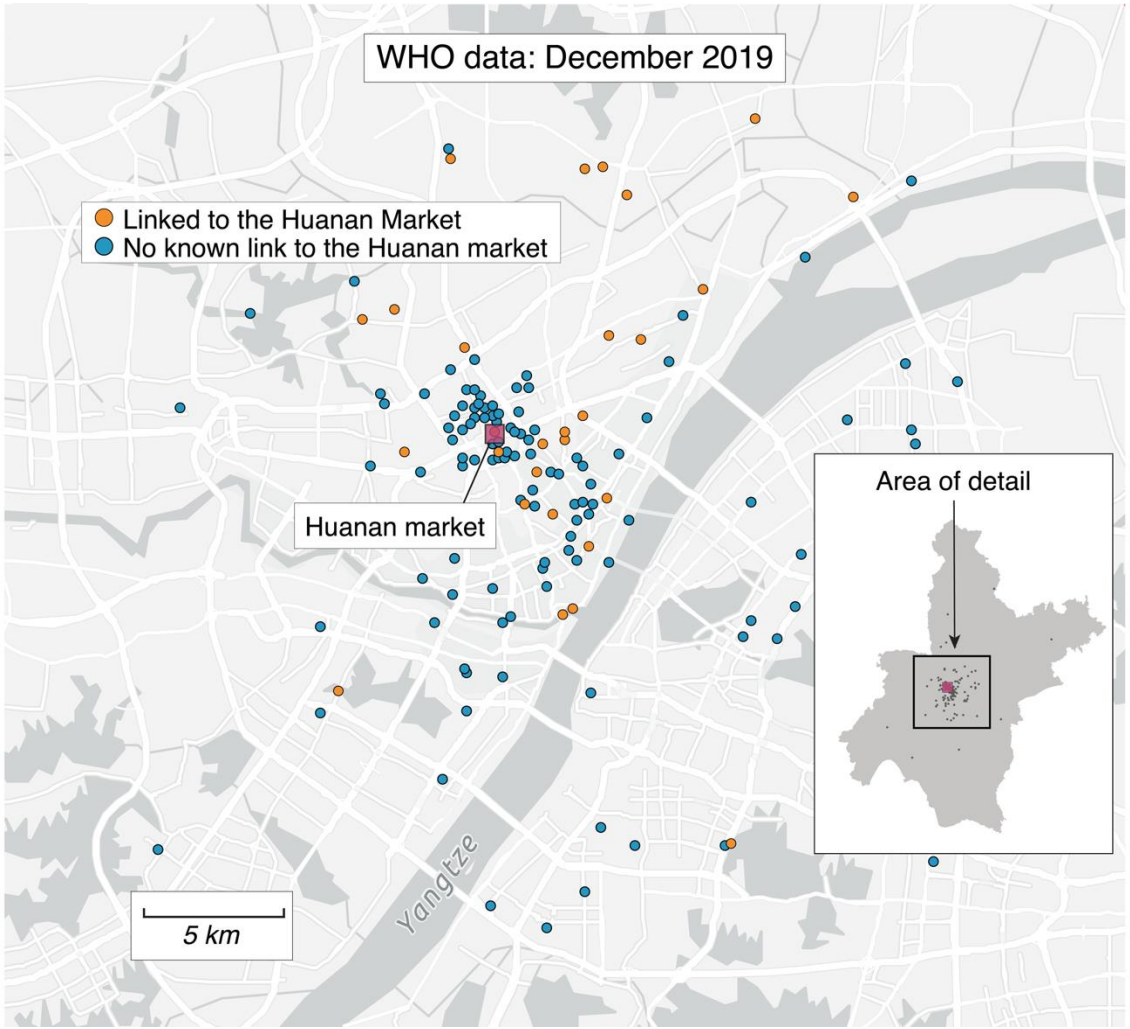
Spatial analysis

- Spatial analysis seeks to enhance our understanding of the world by transforming data into meaningful information, quantifying elements such as distributions and spatial processes.
- This quantification is made possible by a variety of techniques that are all underpinned by key laws of geography and spatial principles and properties.

Spatial analysis

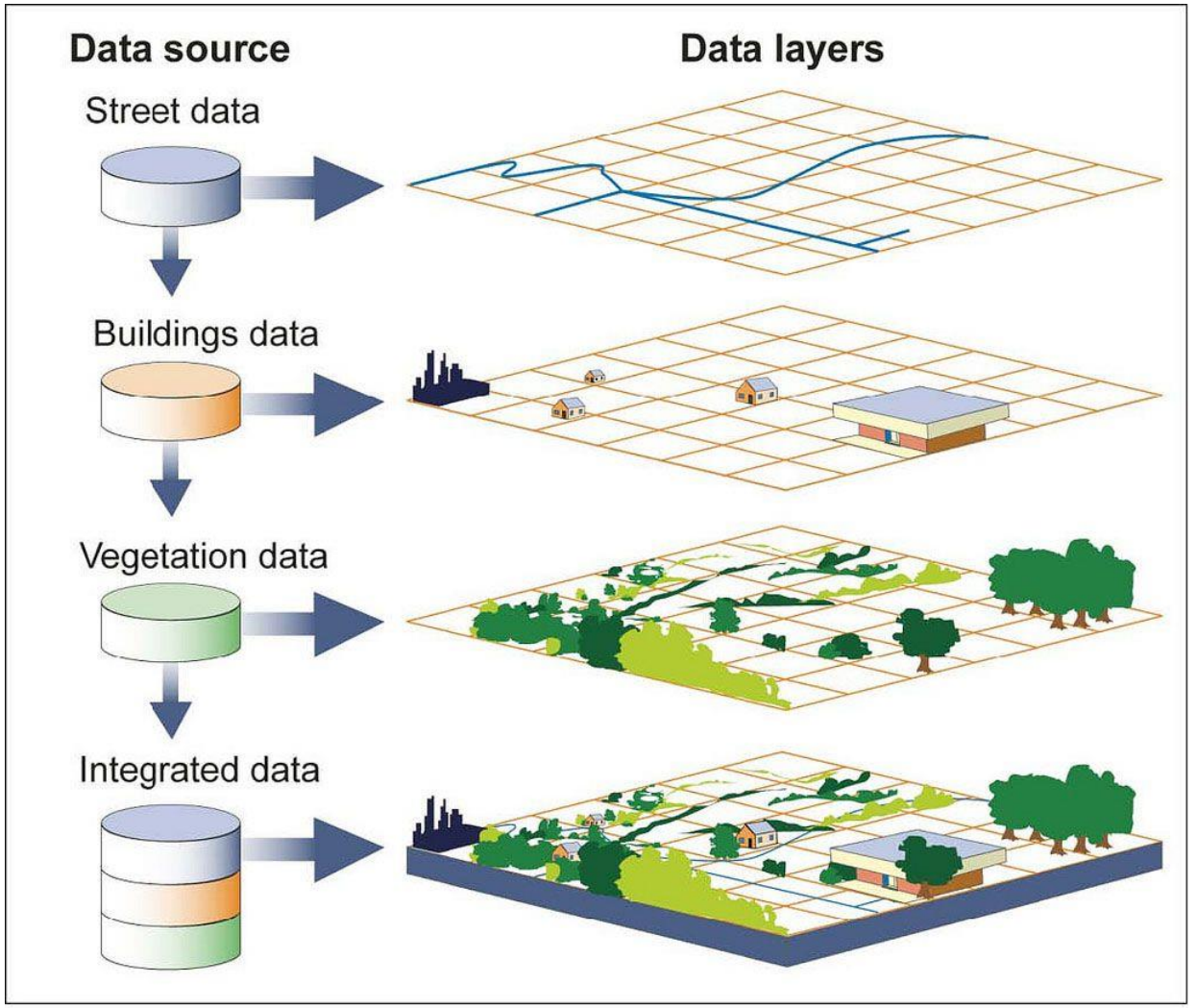


Spatial analysis



Worobey *et al*. 2022

Spatial analysis



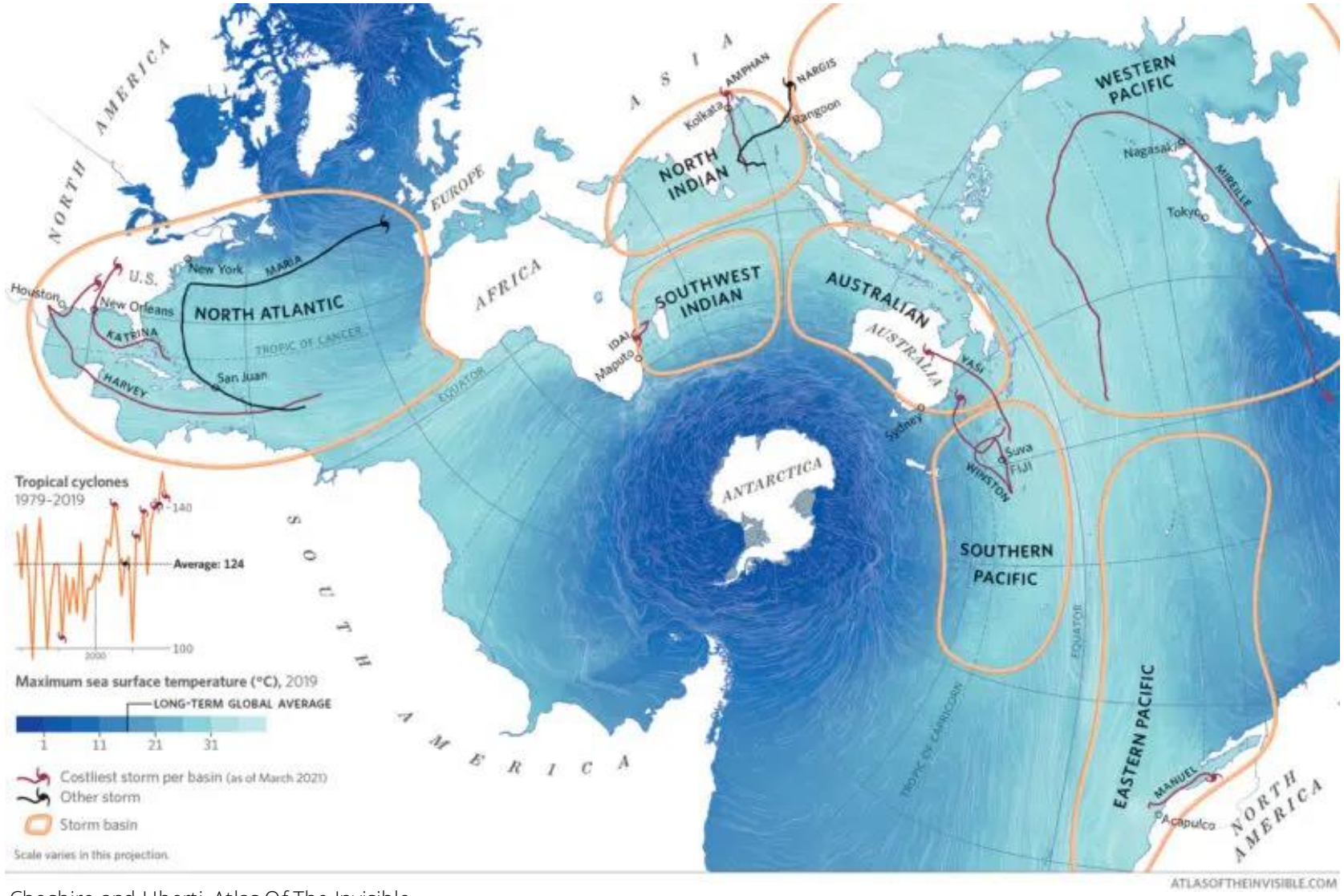
Source: GAO.

Cartography and visualisation

Cartography and visualisation

Cheshire and Uberti. Atlas Of The Invisible

Cartography and visualisation



Cheshire and Uberti. Atlas Of The Invisible

Geocomputation

Lots of pillars, but what then is this Geocomputation?

Geocomputation

“Spatial analysis is currently entering a period of rapid change leading to what is termed intelligent spatial analysis (sometimes referred to as Geocomputation). The driving forces are a combination of huge amounts of digital spatial data from the GIS data revolution (with 100,000 to millions of observations), the availability of attractive soft computing tools, the rapid growth in computational power, and the new emphasis on exploratory data analysis and modeling.”

Fischer 2001

Geocomputation

- Scientific research emphasises reproducibility, allowing others to verify results.
- Open-source and programmatic approaches to analysis are increasingly important, partially due to technological advances.
- Advances include access to larger datasets, improved information systems, data mining, AI, and enhanced visualisation techniques.
- Programming languages like R enable reproducible spatial analysis.

Geocomputation

Repeatability	The same methodology will produce the same (or nearly the same) outputs given the same inputs.
Reproducibility	Work can be easily redone or completed by someone else.
Collaboration	Easy to share work with others and collaborate, preferably in real-time, with others, alongside easy integration with version control.
Scalability	Basic: Re-run work easily, adjusting variables and parameters. Intermediate: Expand on work to include larger datasets. Advanced: Suitable for distributed computing.

Geocomputation

“Everyone does need to learn to code. It is no longer sufficient for a GI Scientists to just work with a standard GIS interface: menus, buttons and black boxes.”

Brunsdon and Comber 2021

Conclusion

- A science of Geographic Information is needed to help us create geographic data that can be analysed to turn it into information that can be used as evidence to provide knowledge and thus insight to our biggest – and smallest - geographic challenges and problems.
- Geocomputation emphasises working with geographic data through coding, reproducibility, and modular approaches to deliver robust and transparent analyses.

Questions

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