What is GIS?

2023 Research Methods e-Festival

Dr Nick Bearman

nick@nickbearman.com

Freelance GIS Trainer & Consultant | UCL Geography

November 9, 2023

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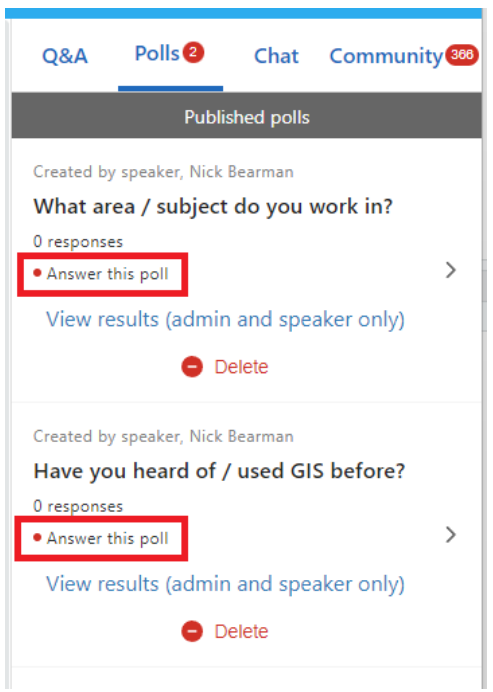
Please fill out the poll on Whova:
or type in on chat in Zoom



What is GIS?

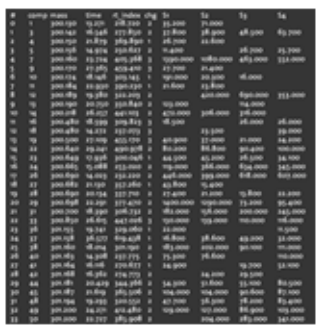
- Introduce GIS as a tool in your research
- Examples of GIS
- Strengths and weaknesses
- Where do we find data?
- Software & common issues
- Questions & case studies

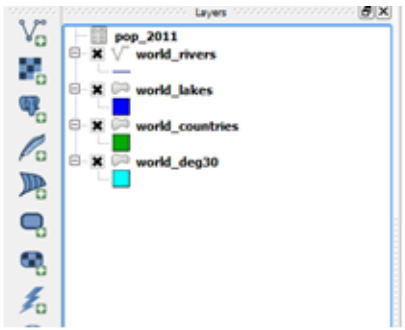
Intro Poll:

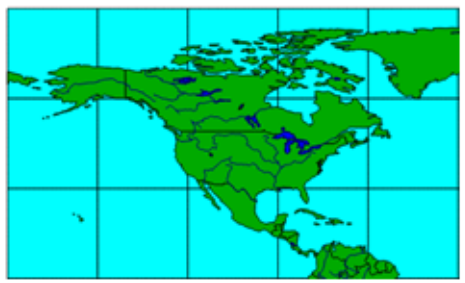
- What area / subject do you work in? (free text)
- Have you heard of / used GIS before?
  - → Not heard of GIS
  - → Heard of but not used GIS before?
  - → Used GIS before?

What is GIS?

- Geographical Information Systems
- Turning (spatial) data into information







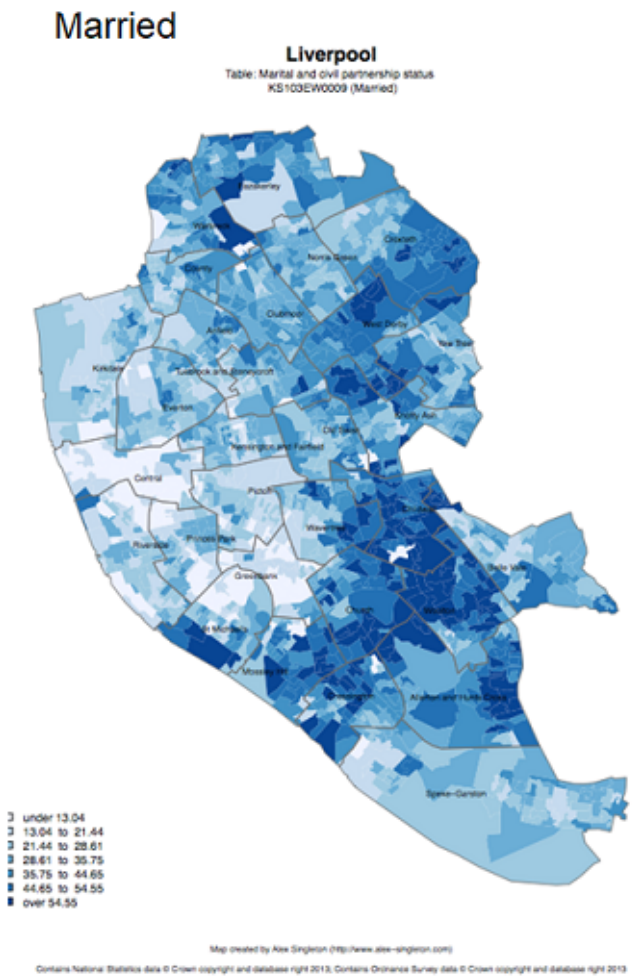
- Using this information to answer (research) questions

  → *"Where are groups of patients more likely to be suffering from obesity?"*

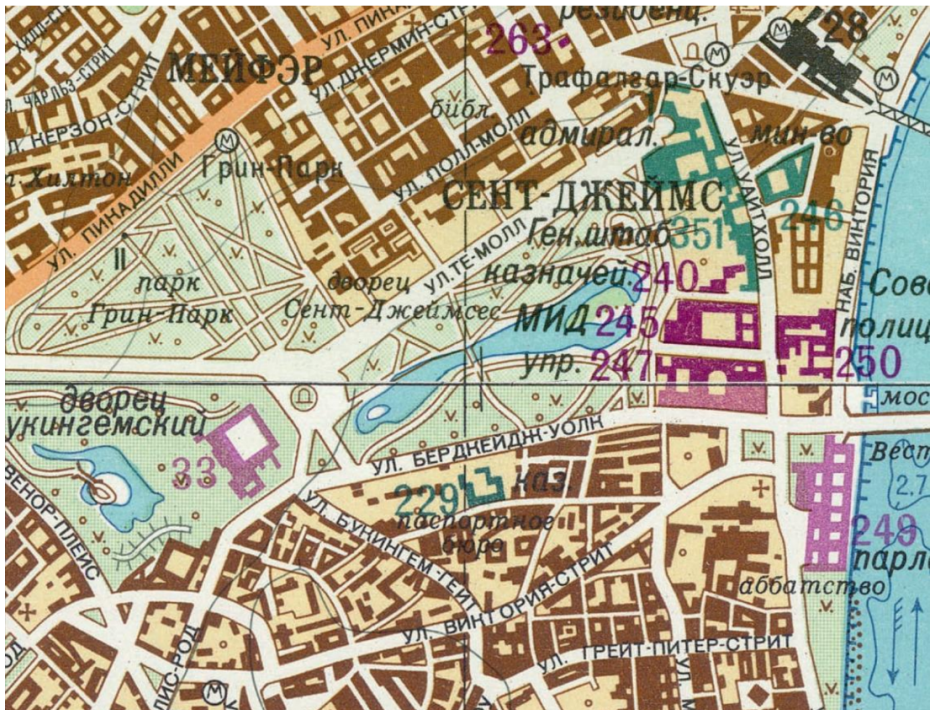
GIS

- Nearly all human activities & decisions involve geography
  - → the “**where?**”
- Working with geographic information is **different** to working with an **Excel** file
- This is why we need specialized **GIS** software to:
  - → **organize** and **store**
  - → **access** and **retrieve**
  - → **present** and **manage** spatial data
- And ultimately to apply to the solution of our **problem**

GIS can be used in almost any area



Census data

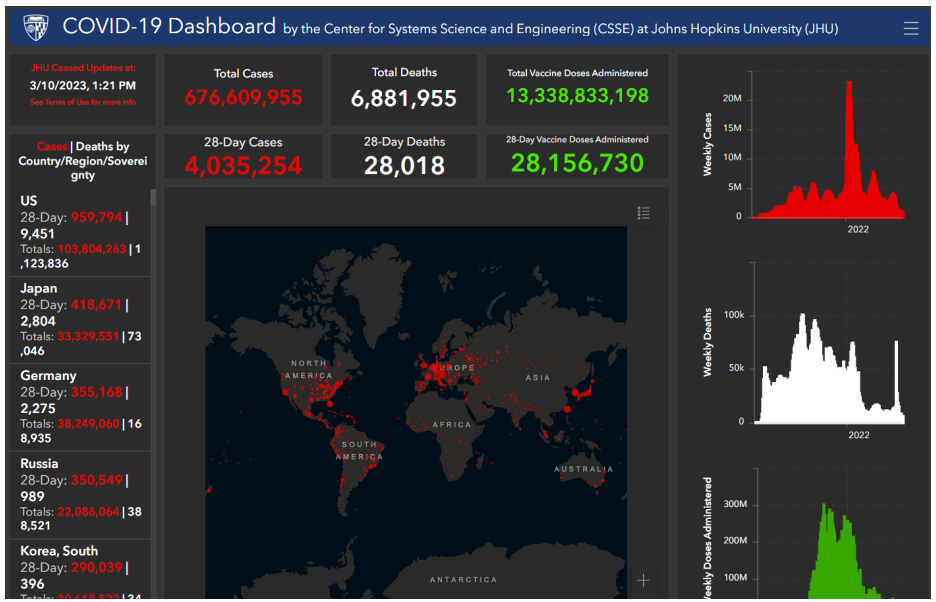


Military *How the Soviet Union Secretly Mapped the World*

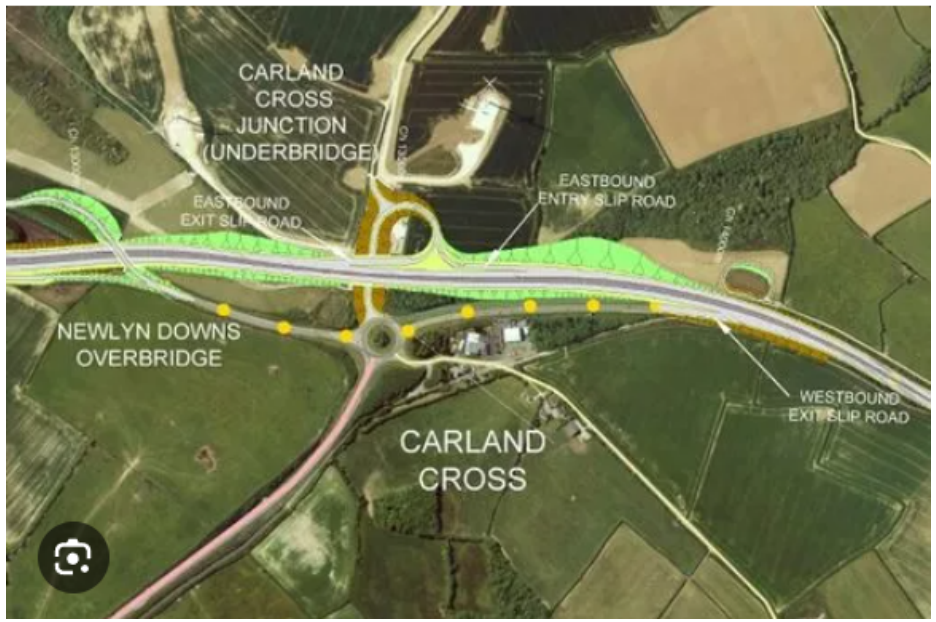
Buckingham Palace, London, UK

The Red Atlas, https://redatlasbook.com/

Public Health & Planning



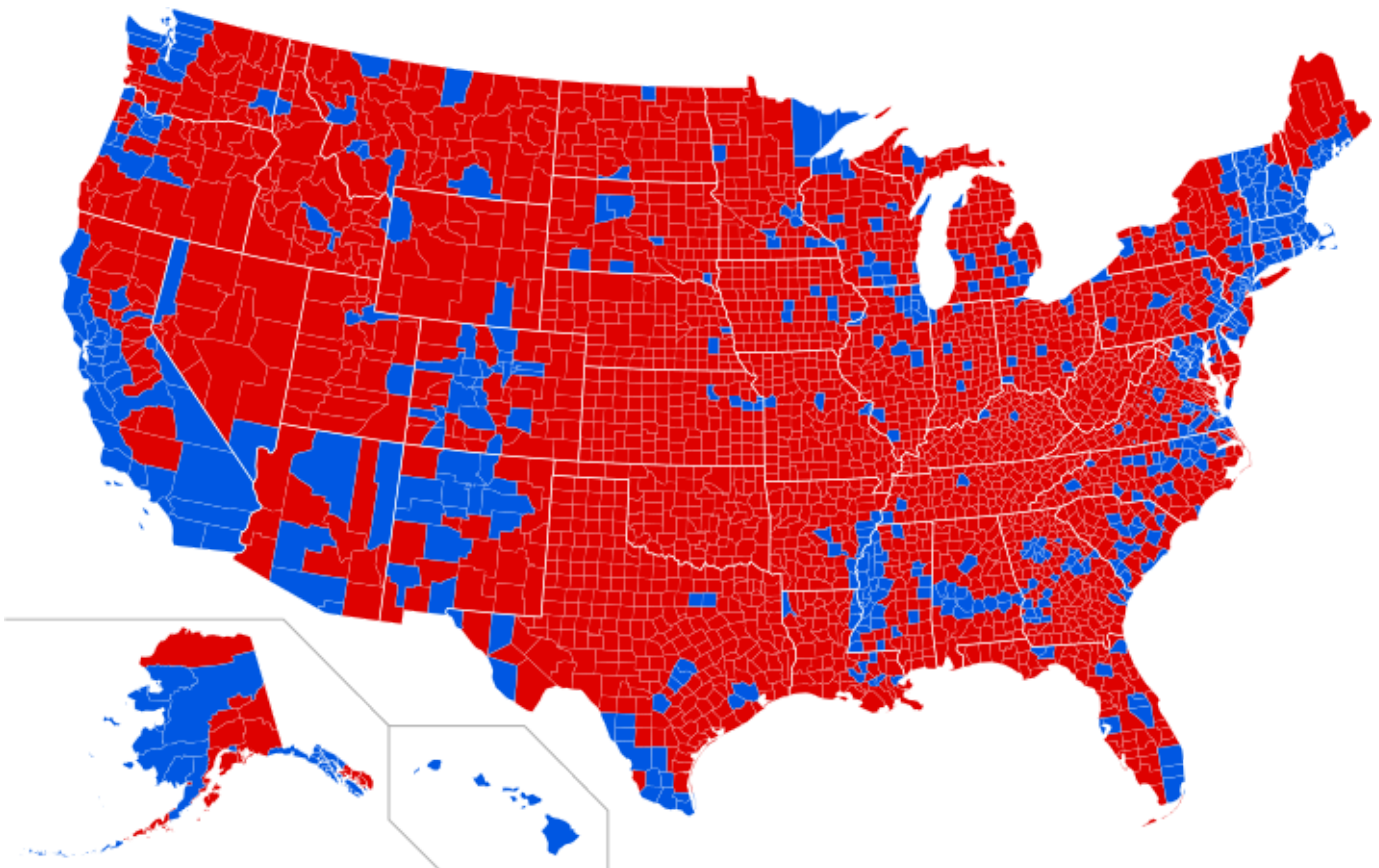
https://coronavirus.jhu.edu/map.html



https://www.cornwalllive.com/news/cornwall-news/first-chance-see-how-new-1089015

Politics - US Presidential Election 2020

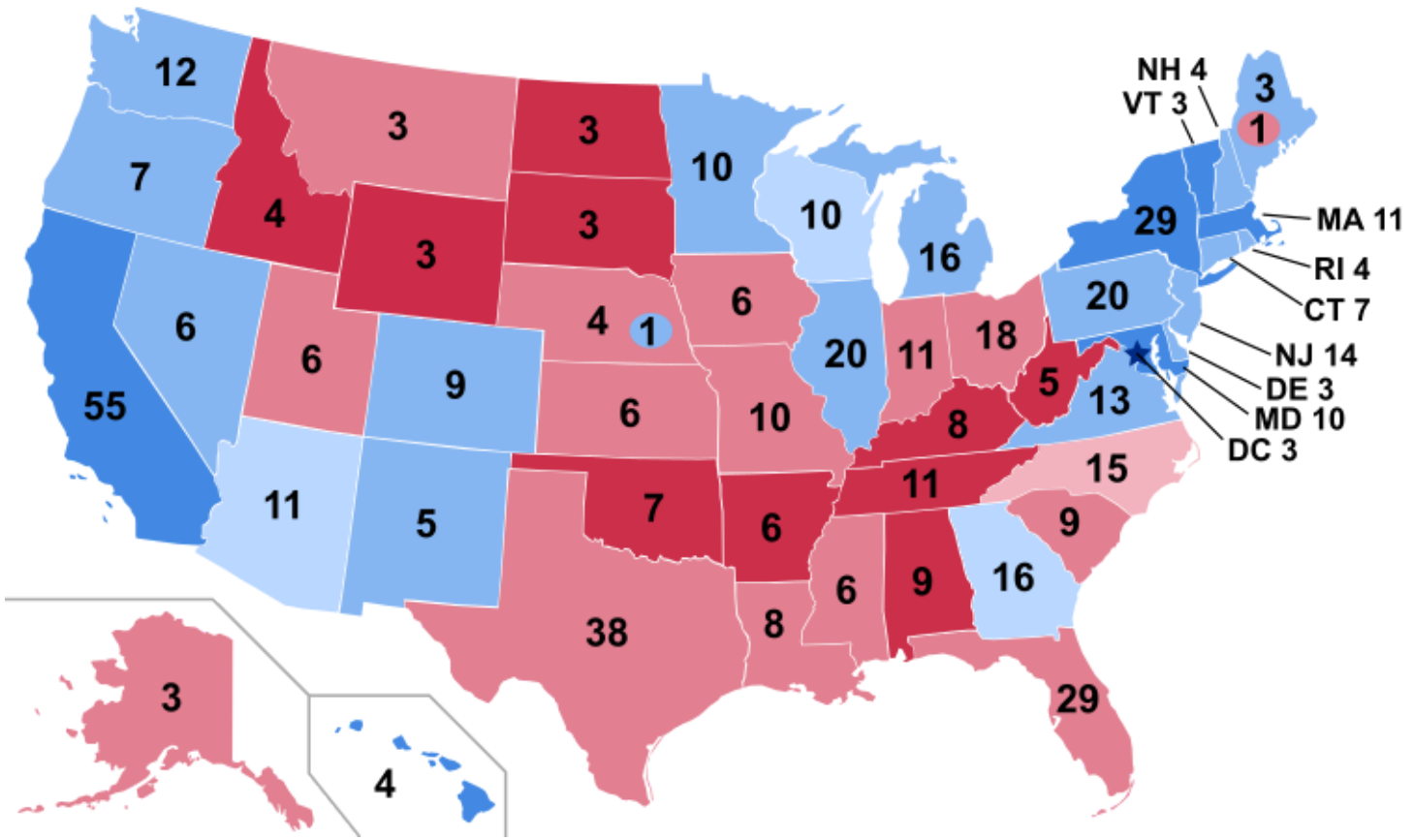
Biden (306) vs Trump (232)



By county

Politics - US Presidential Election 2020

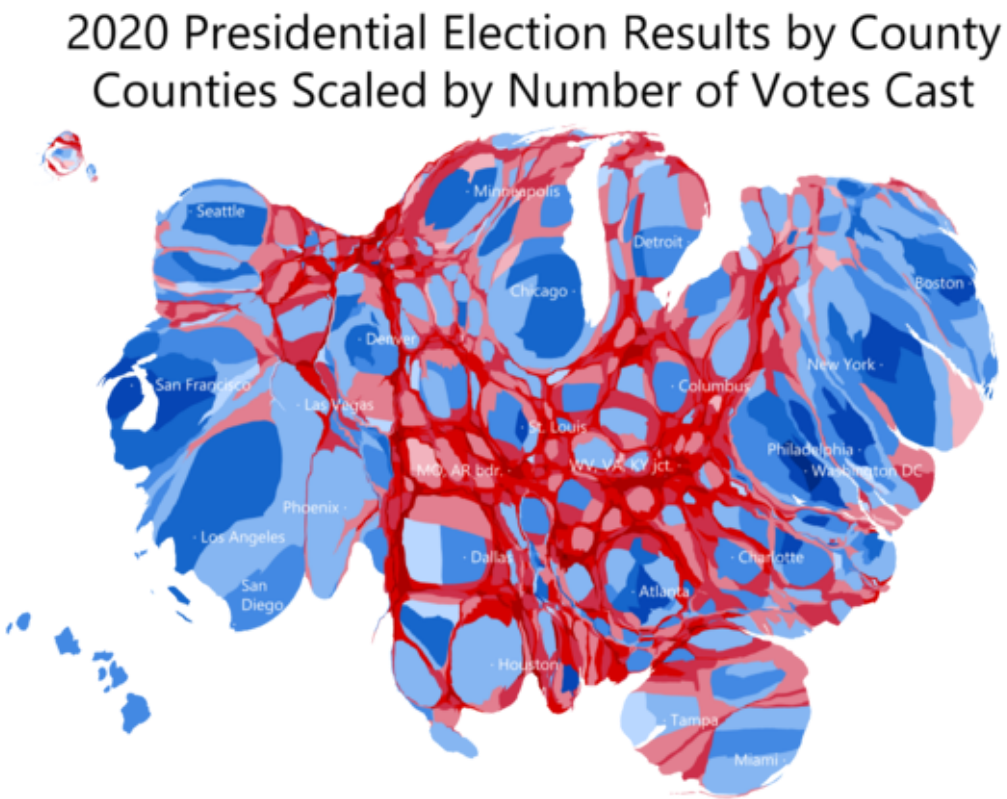
Biden (306) vs Trump (232)



By electoral college

Politics - US Presidential Election 2020

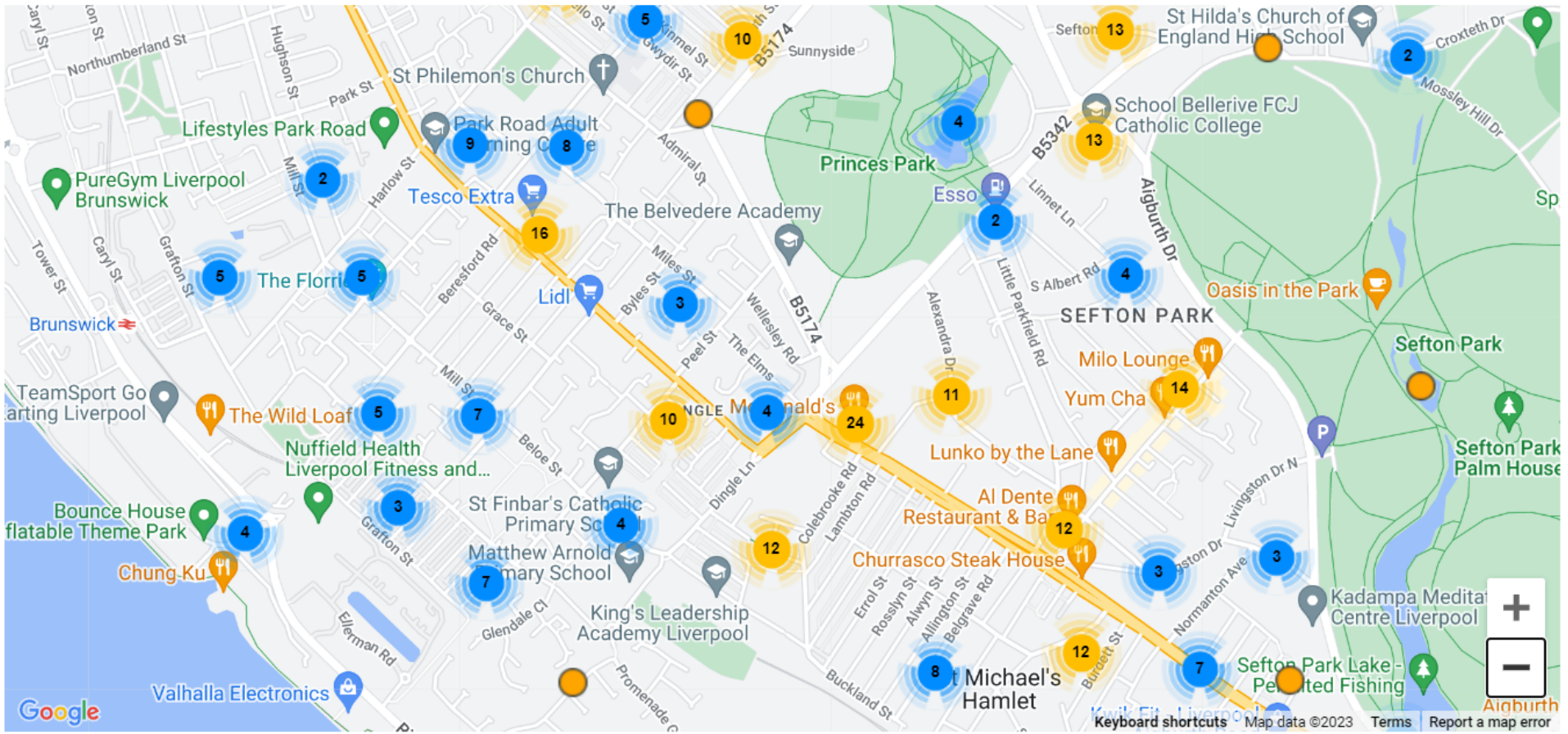
Biden (306) vs Trump (232)



Cartogram

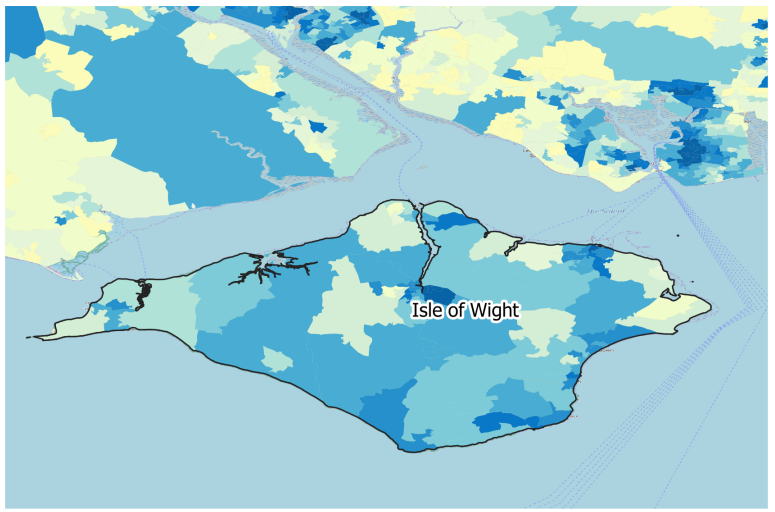
https://en.wikipedia.org/wiki/2020_United_States_presidential_election https://guides.libraries.indiana.edu/c.php?g=1024502&p=7421466

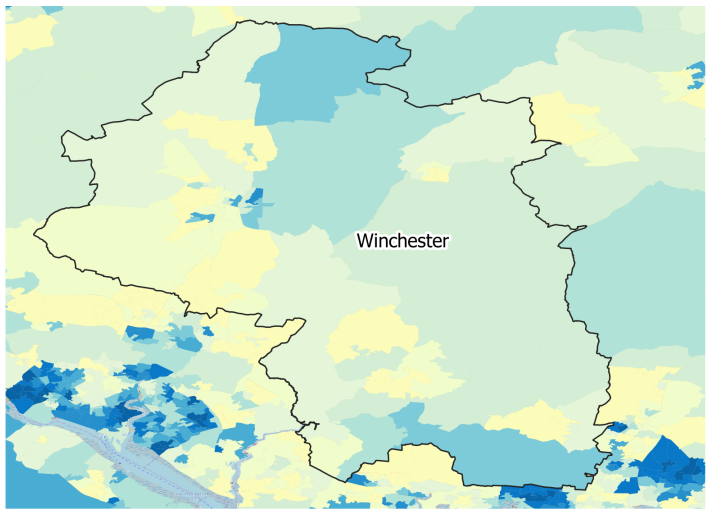
Crime

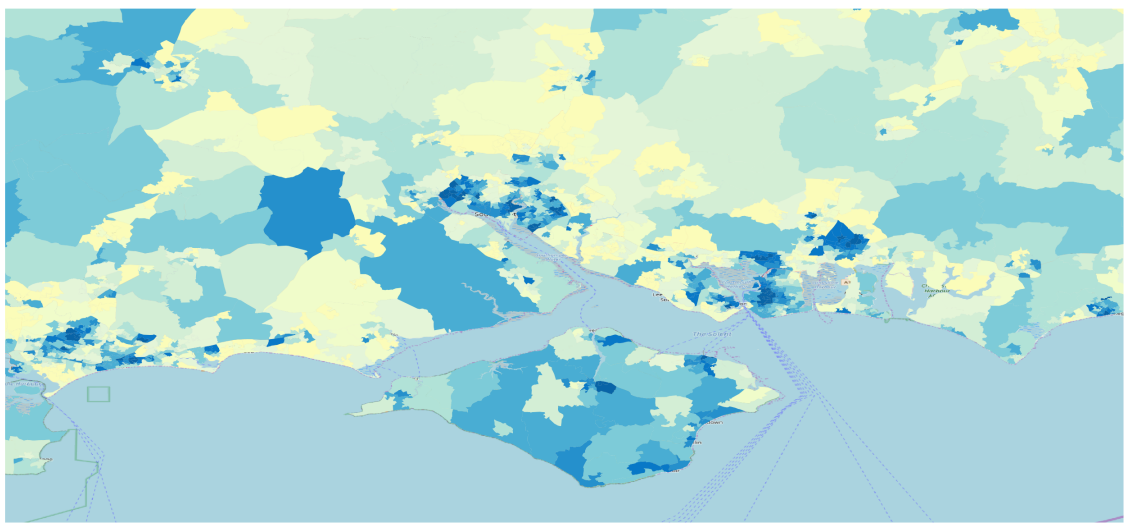


https://www.ourwatch.org.uk/crime-prevention/crime-prevention/crime-map?address=l17%207aq

Social Inequality - IMD





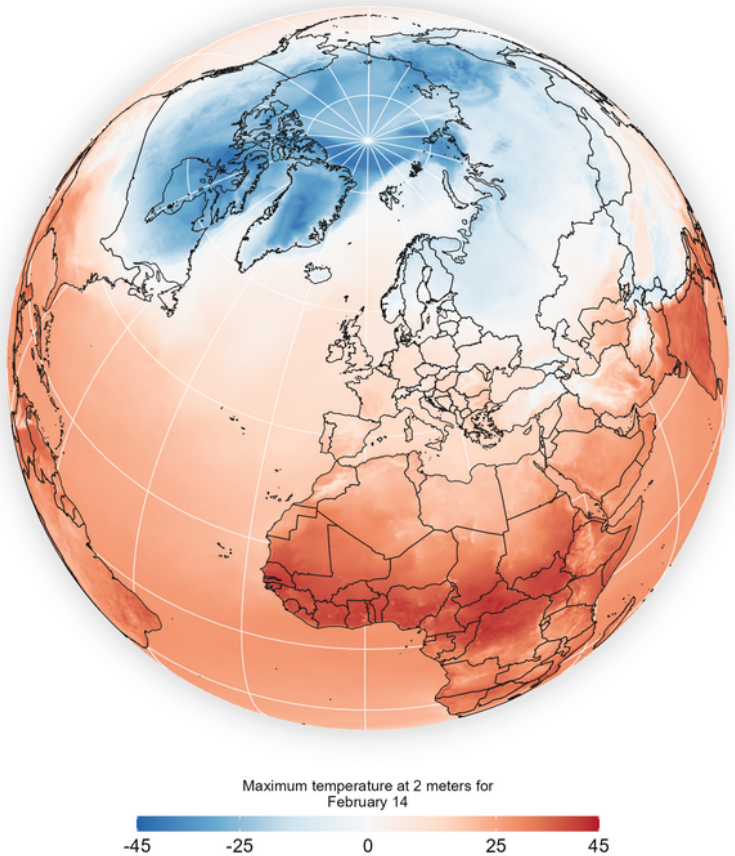


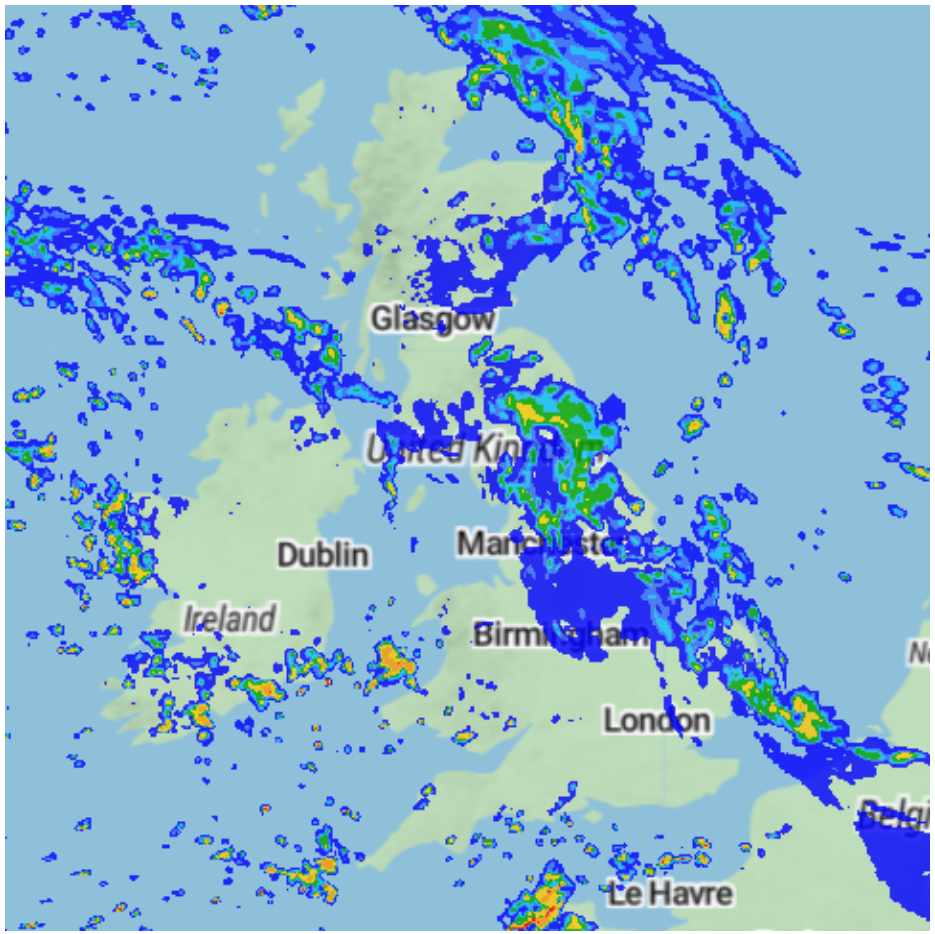
IMD Deprivation Decile
1 More deprived
2
3
4
5
6
7
8
9
10 Less deprived
Local Authority boundaries

0 5 10 15 20 25 km

MHCLD, 2019. Contains National Statistics data
© Crown copyright and database right 2020.

Weather





Weather map from Met Office, 26/10/2023

Tomorrows Weather - https://dominicroye.github.io/en/2023/tomorrows-weather/?

utm_source=puntofisso&utm_medium=email

Examples of using GIS

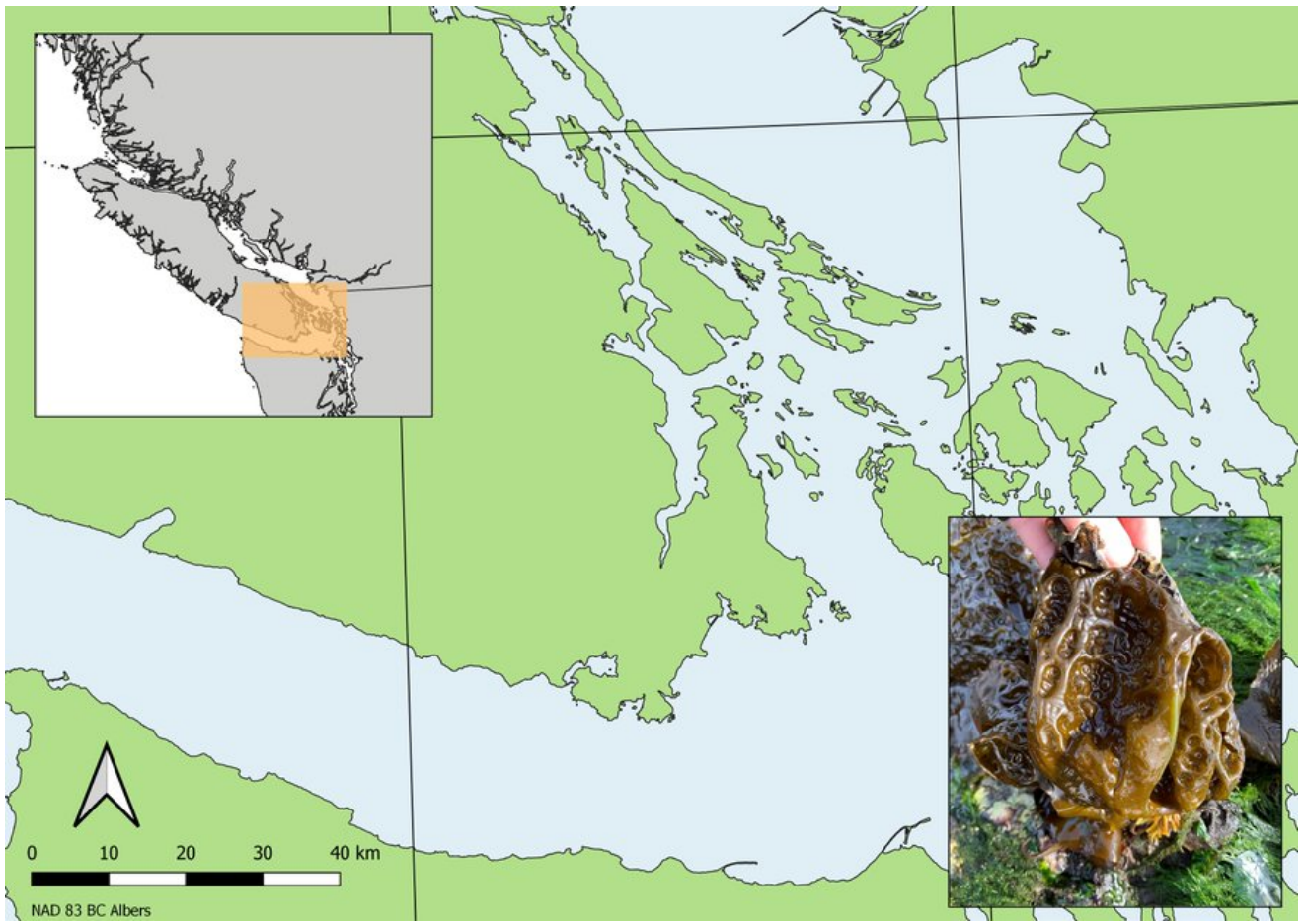
1 **making maps**

2 **showing data**

3 **spatial statistics**

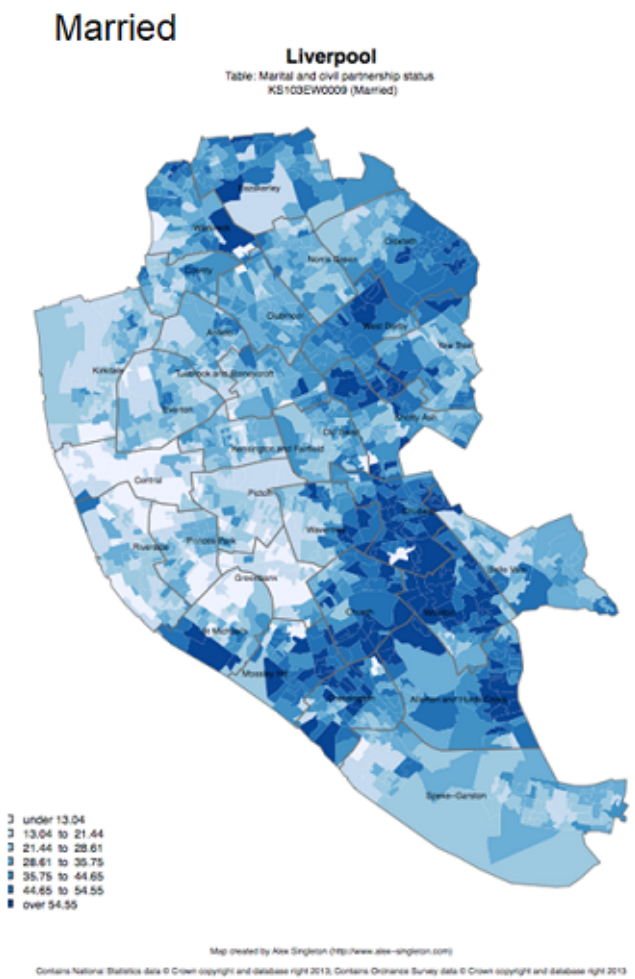
4 **spatial analysis**

Making Maps:



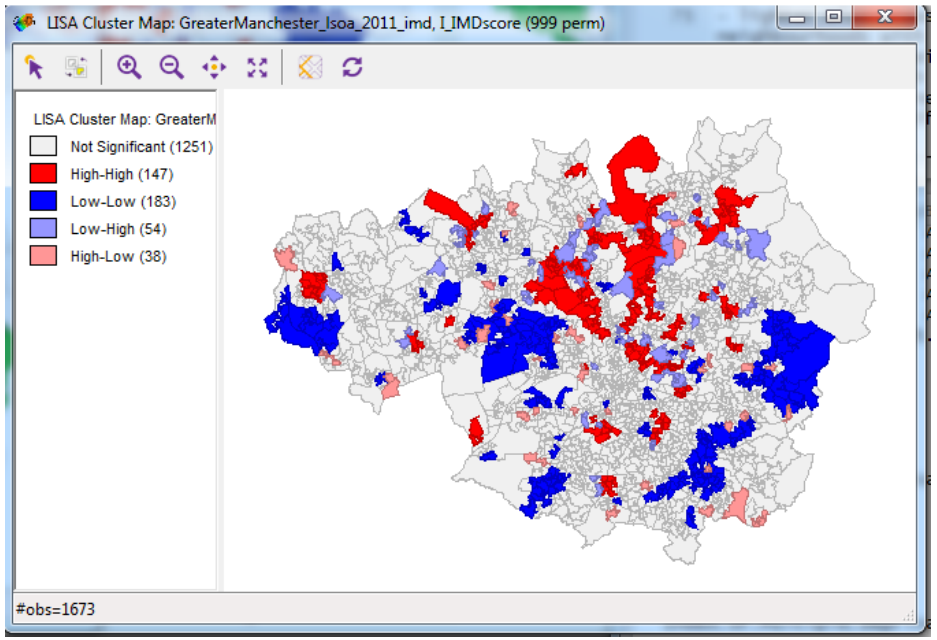
- Your study area
- *Getting excited for my first summer of fieldwork with a study site map I created during today's GIS workshop at #PEEC2022*
- Rebecca Hansen, Twitter

Showing Data:



- Choropleth maps
- Rates of disease
- % Married, Census data, 2011

Spatial Statistics:



Map of Greater Manchester, UK, showing clustering areas of high deprivation (red) and low deprivation (blue) (measured using IMD).

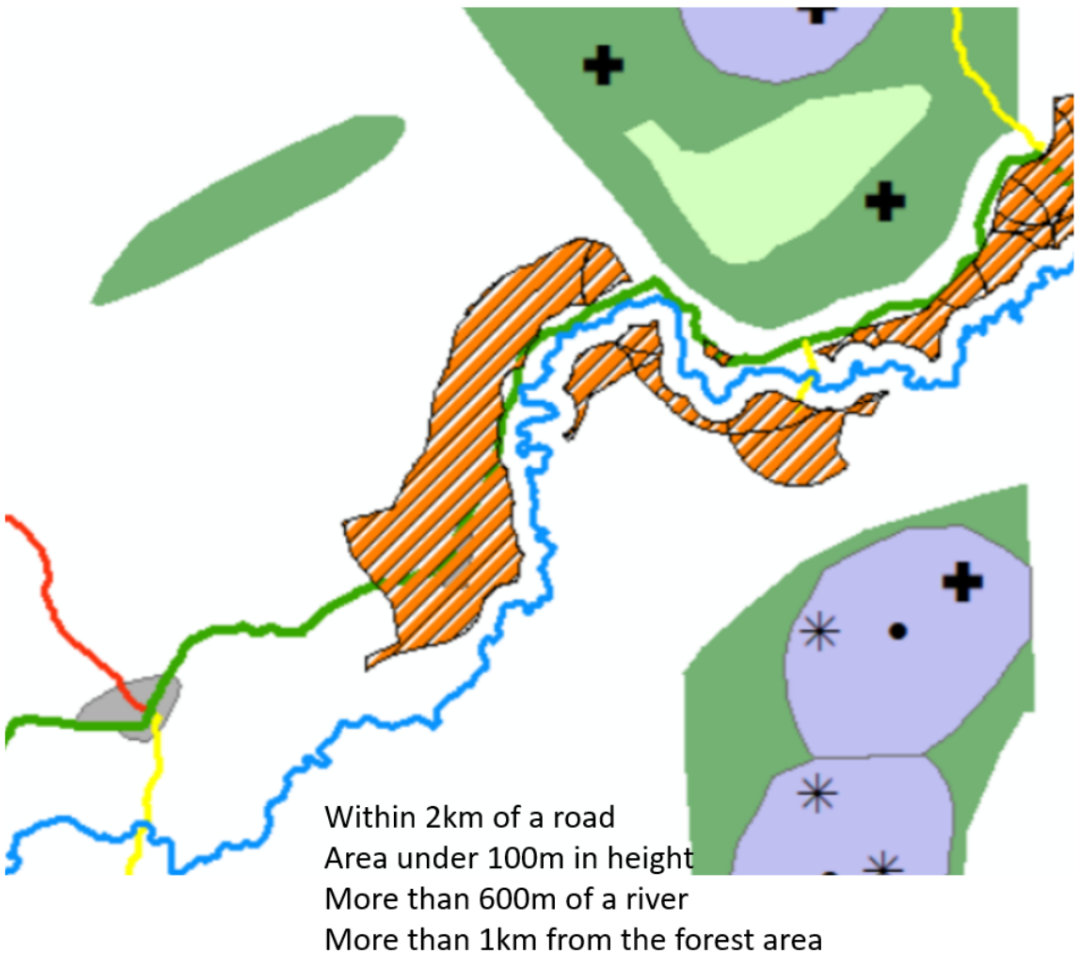
- Is space important? (Spatial autocorrelation / Moran's I)
- Clustering? (Local Moran's I)
- Regression? (What is driving these relationships?)

→ GWR - geographically weigthed regression

→ Full spatial regression

Spatial Analysis:

- **Where** meets x criteria?
- **Which site** meets criteria for a new hospital?
- How can **public transport** help address deprivation?
- Where should we **route** a water pipe?

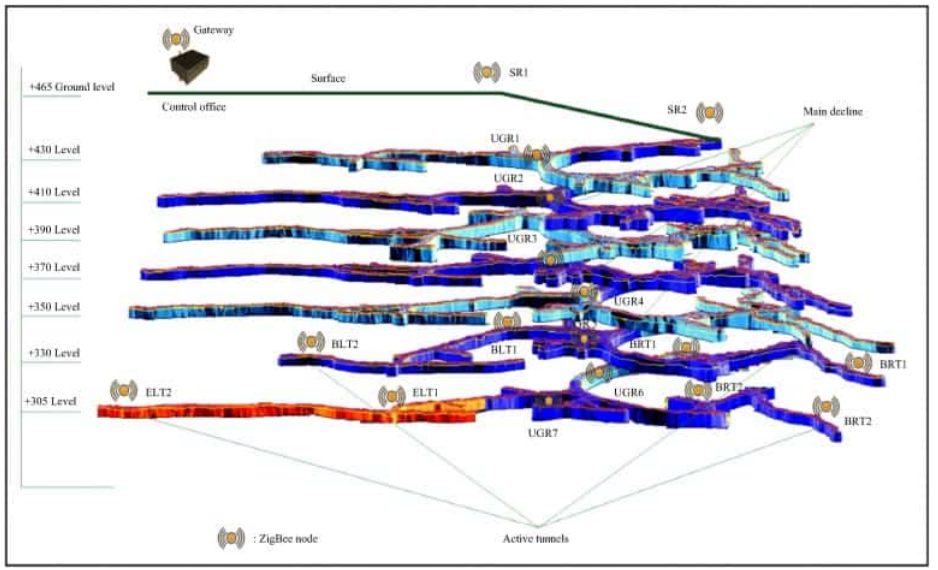


GIS can be used in almost any area

- Census
- Military
- Politics
- Health
- Crime
- Social inequality
- Weather

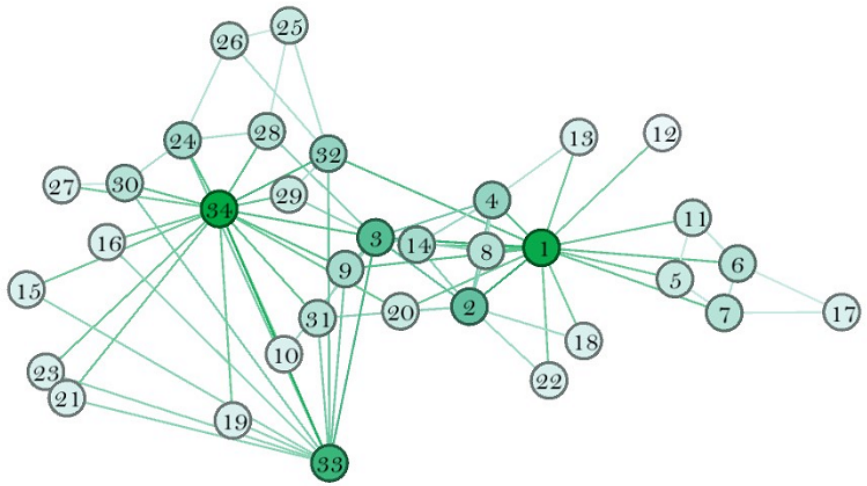
Including some you might not think of:

Mining



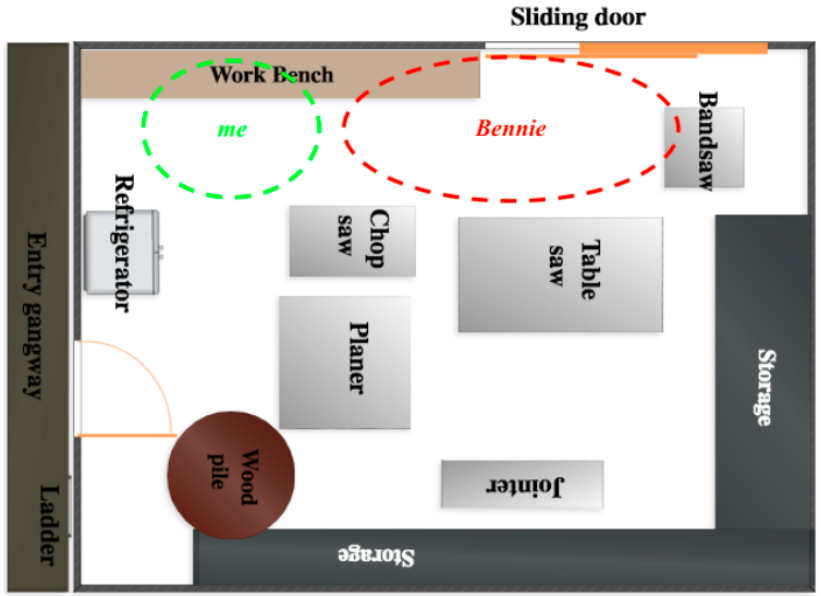
https://www.gislounge.com/gis-underground-mining/

Social Networks



https://gistbok.ucgis.org/bok-topics/2019-quarter-02/social-networks

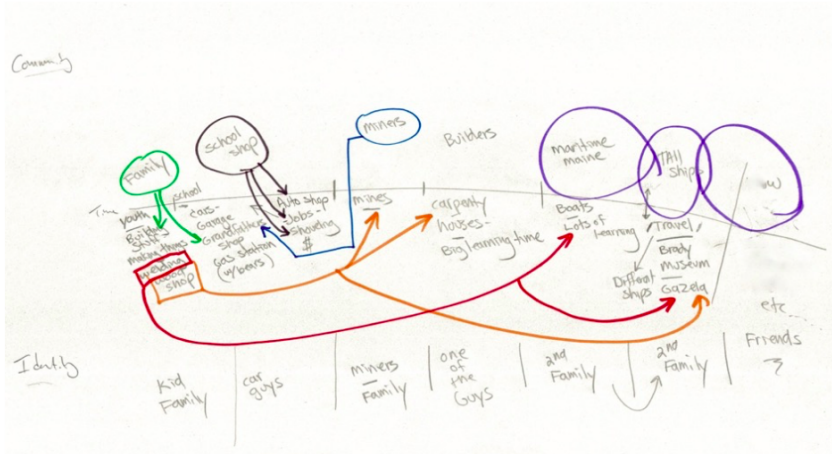
Ethnography



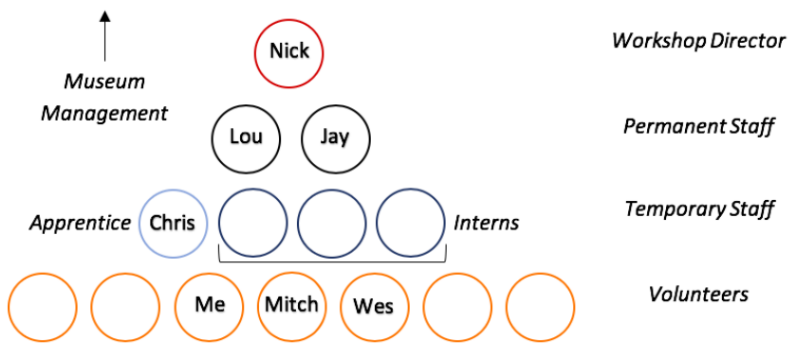
Working environment

https://cuny.manifoldapp.org/read/ethnography-made-simple-68f98a5d-5a01-

4233-b2dd-4c669d80ee81/section/3133b2c3-ac40-4c7c-bbdc-b5fcbd538925



Career journey



Organisational map

Poll - GIS

Have you worked with data with location? (address, POI, city name, country name, coordinates, etc.)

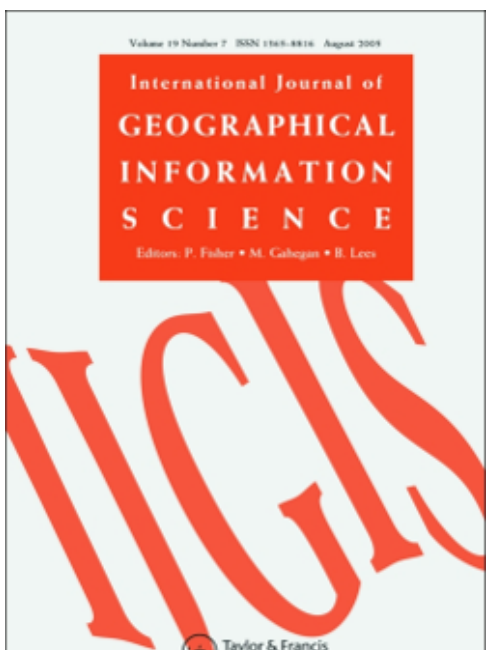
- Yes
- No

Did you know what GIS was before this session?

- Yes
- No

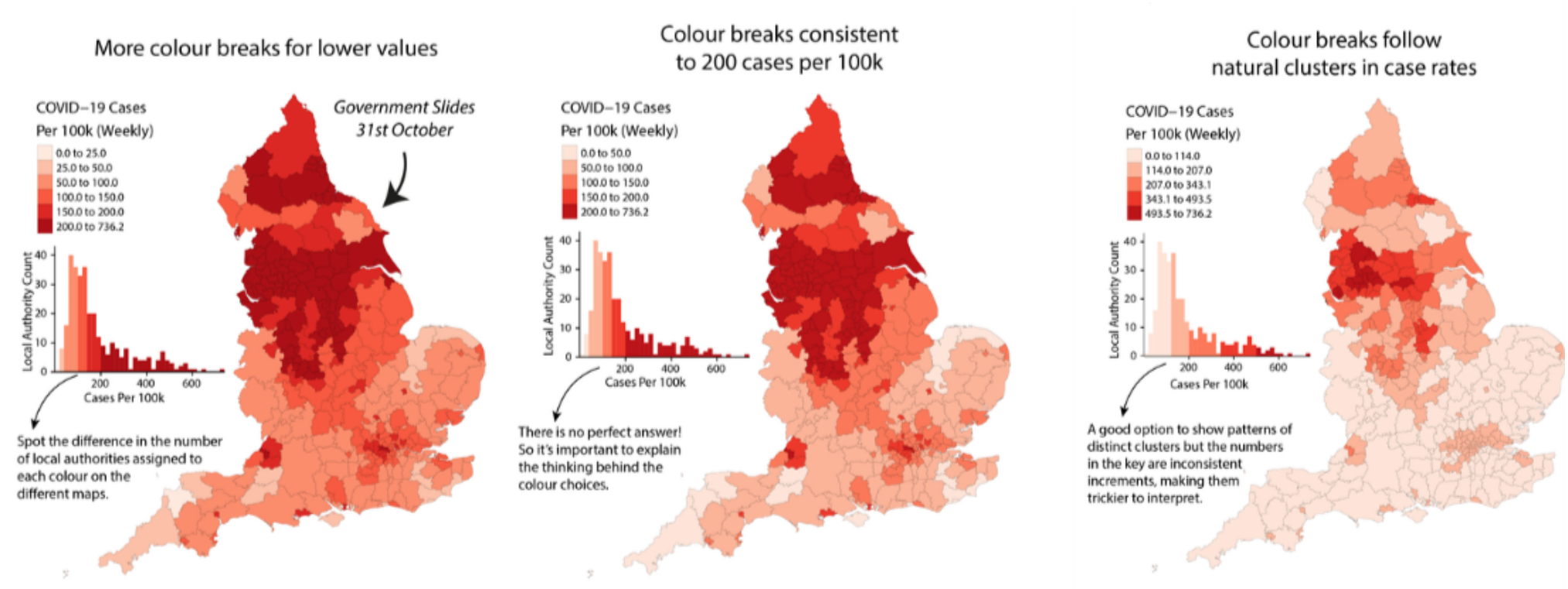
GIS: Systems and Science

- Geographical Information **Systems**
  - → The methods, process and technology we use
- Geographical Information **Science**
  - → The science behind the technology
  - → Including development of new technology, methods and processes
- Geographic*al* / Geographic
- Geographic Data Science



Things to remember!

- Like *"correlation <> causation!"*
- Be critical of maps - they are not what they seem



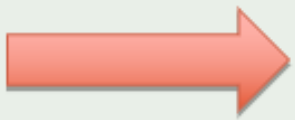
Things to know

Projections and Coordinate Systems

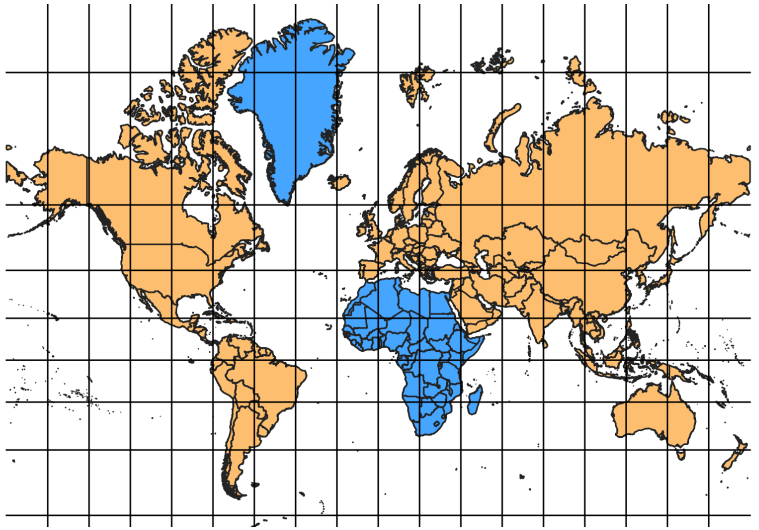
- How we show data
- Many many different types

Projections

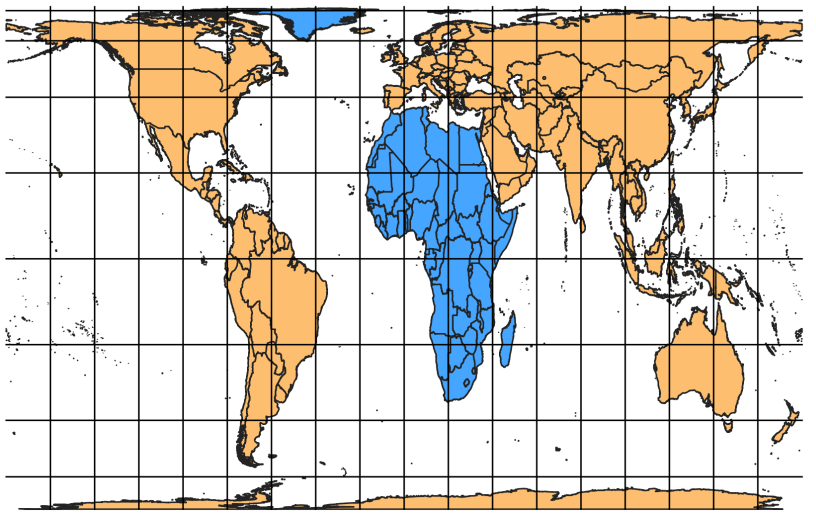
- Projection - going from a sphere to a flat surface



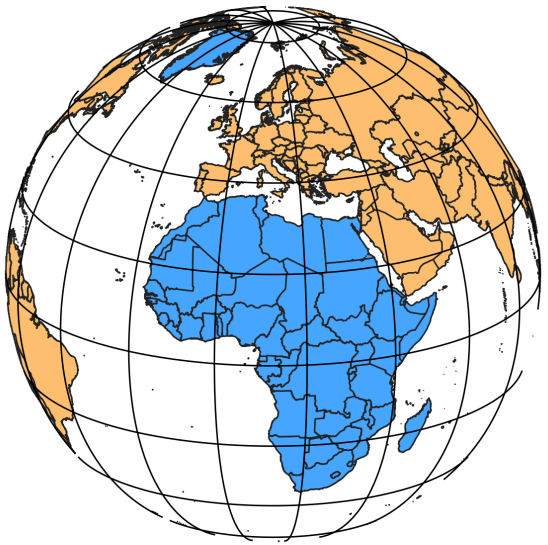
http://www.hdwallpapersos.com/orange-fruit-hd-wallpapers.html



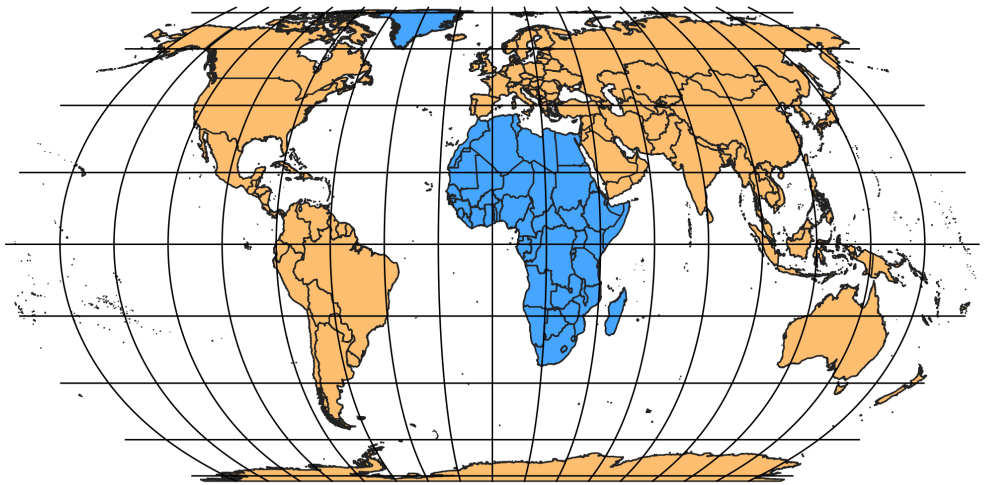
a) Mercator EPSG: 3395



b) Peters EPSG: SR-ORG:22



c) Adjusted version of The World From Space ESRI: 102038



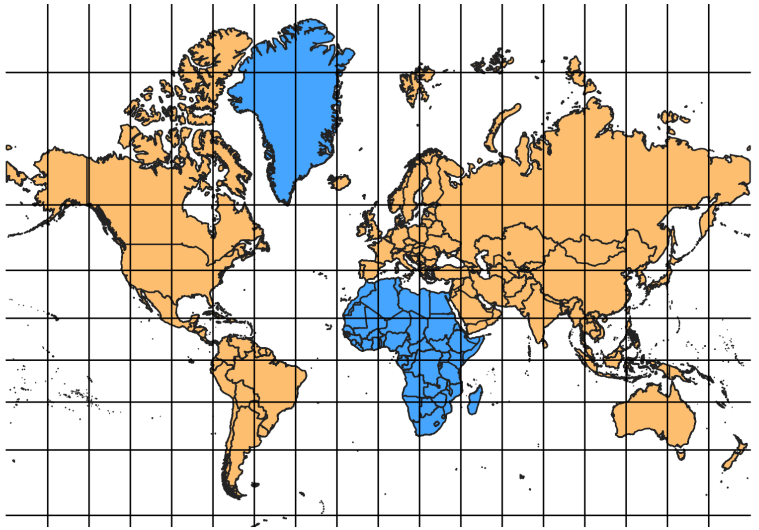
d) Equal Earth Greenwich EPSG: 8857

Mercator

Mercator

- *The son of a poor shoemaker near Antwerp, Belgium*
- *The Father of Modern Cartography*
- *By Mercator's Projection the navigators of the succeeding centuries sailed on their voyages of discovery*
- 1569

Sefton Park



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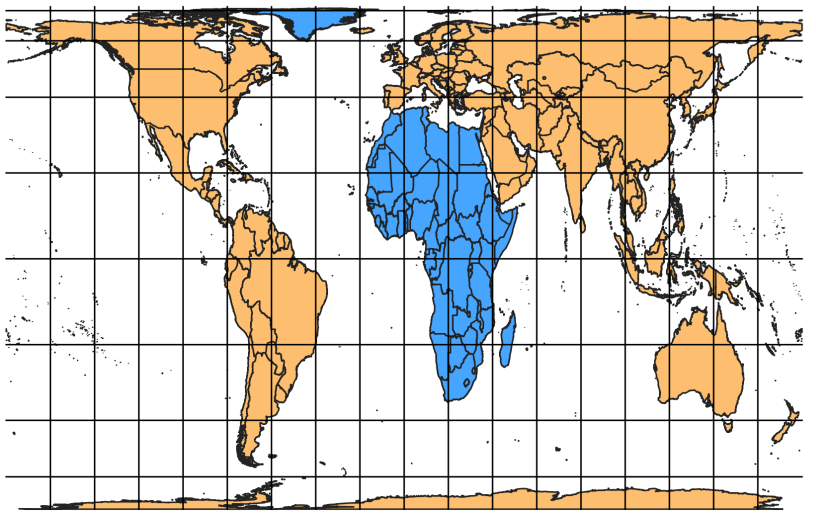

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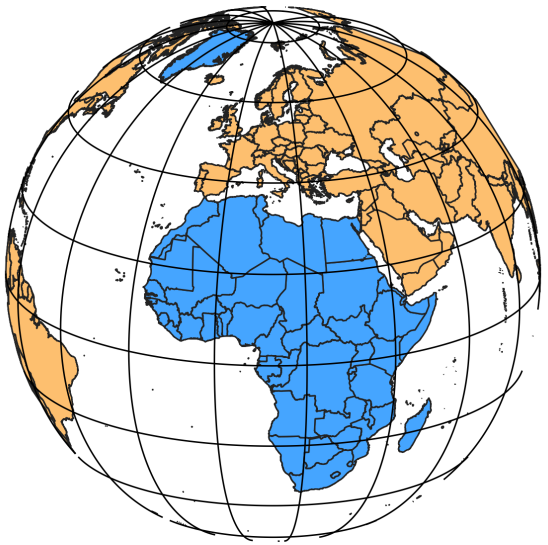

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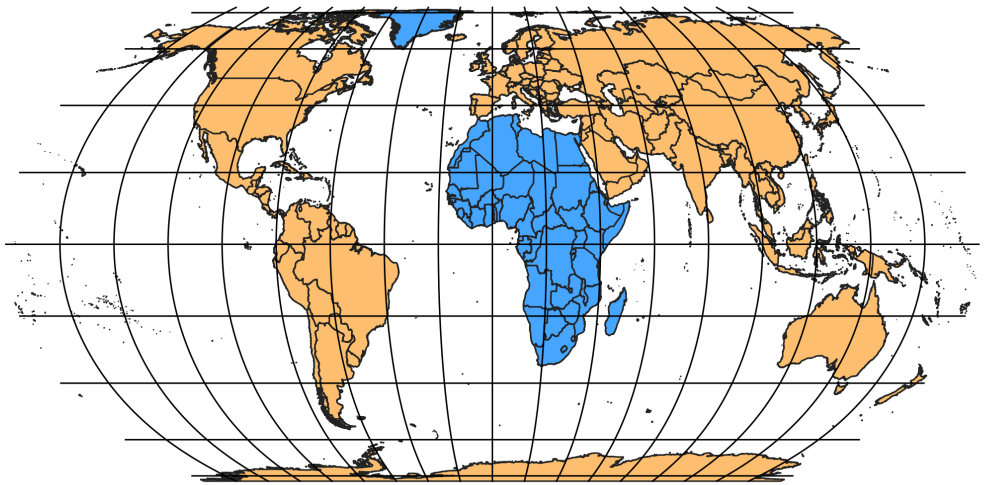
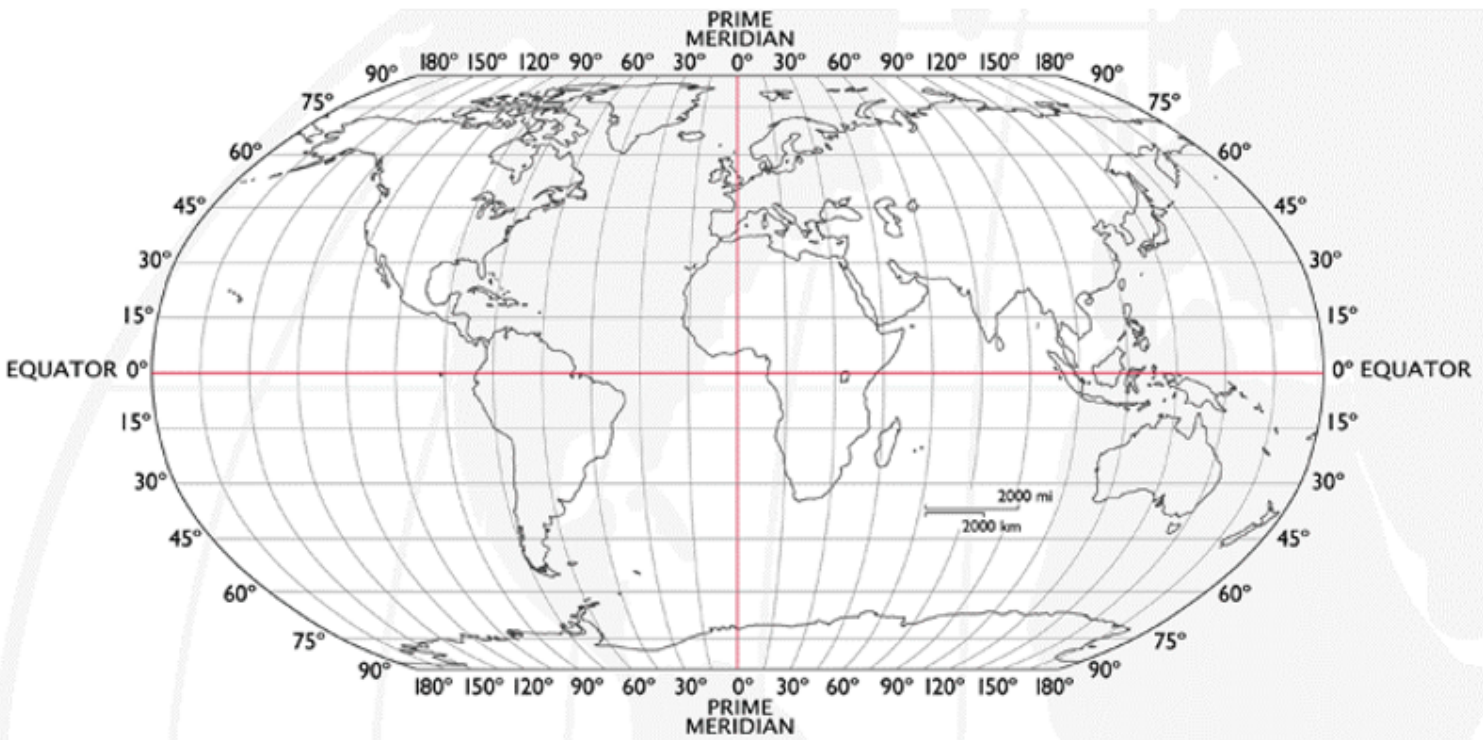


d) Equal Earth Greenwich EPSG: 8857

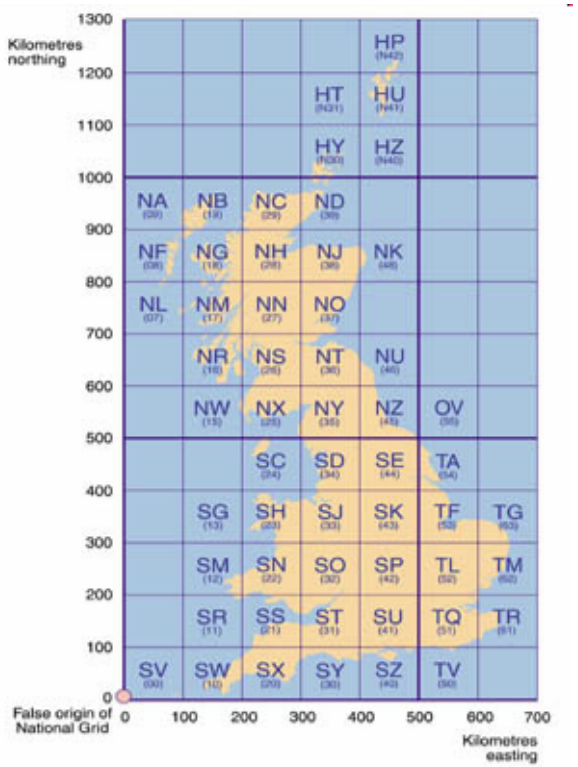
Coordinate Systems

How we specify location

- Latitude and Longitude (WGS 1984)
- *52°N 37’ 30.32” (52.6250) 1°E 14’ 2.05” (1.2339)*



Coordinate Systems



- British National Grid
- *Easting: 619301*
- *Northing: 307416*

Strengths and Weaknesses

- You need **data** to be able to do anything
- Availability of data is key
- As is quality of data, who collected it, bias, etc.
-
- Can be quite quantitative - not everything can be quantified!
- Some qualitative GIS, but very much the junior partner
- Participatory GIS an interesting area

Data

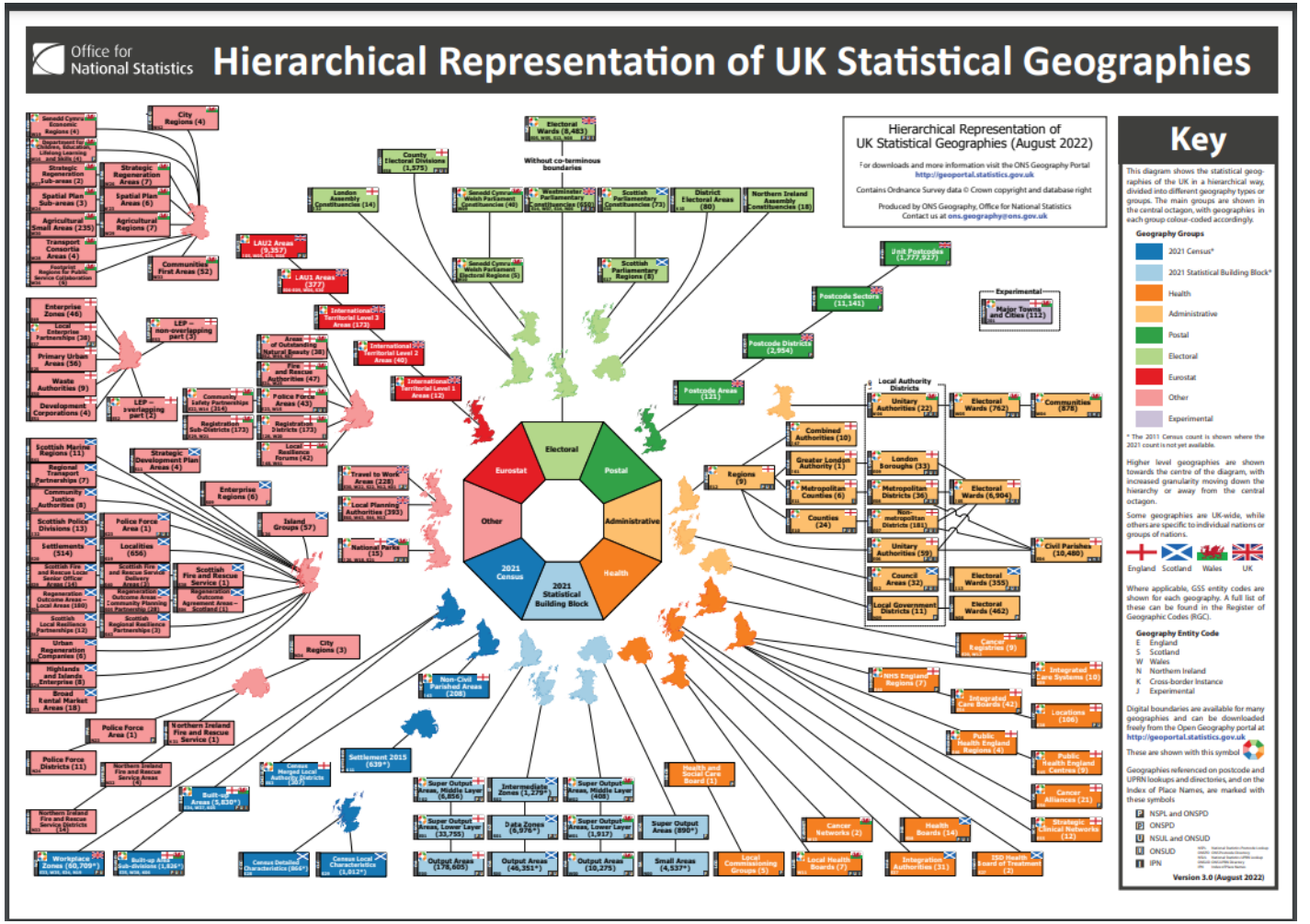
- where does it come from?
- **spatial** & **non-spatial** data
- **spatial** - the geographic areas
- **attribute data** - the spreadsheet

Data: sources

- Spatial data can come from various locations
- Ordnance Survey / OS Open Data
- Census & Census Boundary
  - → https://borders.ukdataservice.ac.uk/
- EuroStat
- Free GIS Data, Robert Wilson
  - → http://freegisdata.rtwilson.com/
- Geoboundaries.org
- OpenStreetMap.org
- Google Search – GIS data

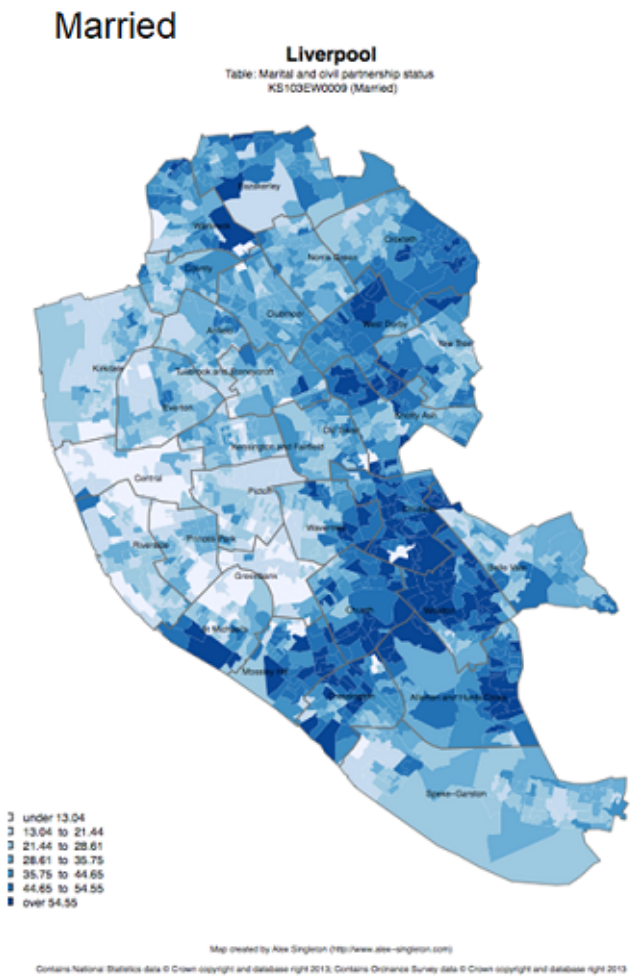
Data: Spatial Units

- Many many different spatial units
- Countries, counties
- Local authorities, GOR
- MSOA, LSOA, OA



Hierarchical Representation of UK Statistical Geographies (August 2022)

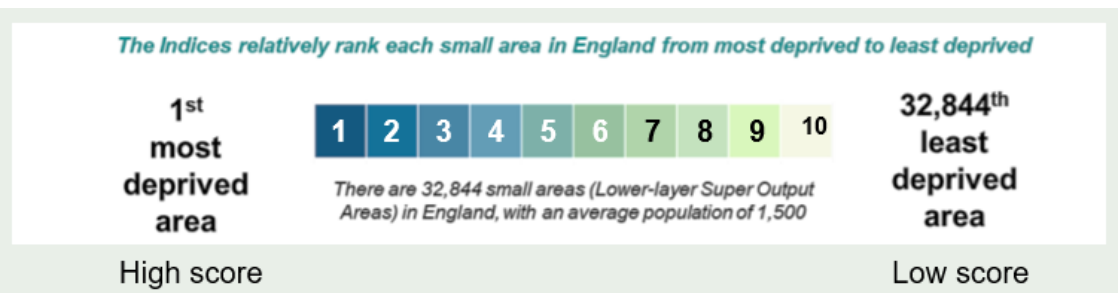
Data: Census Data



- Population
- Age groups
- Gender
- Marital status
- Ethnicity
- Health
- ….
- by OA, LSOA, MSOA, …

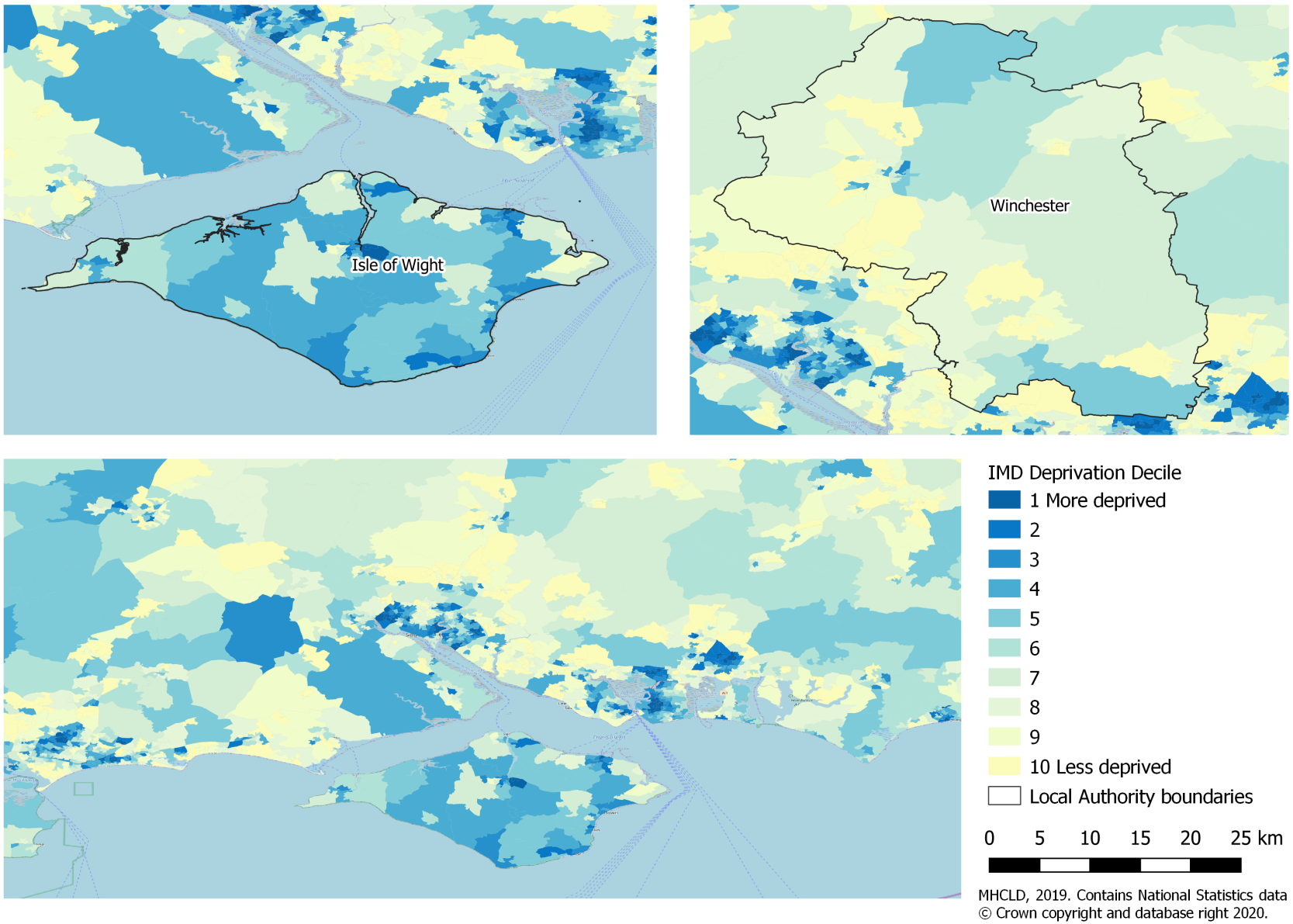
Data: IMD - Index of Multiple Deprivation

- A measure of deprivation
- 2019 (England)
- 2019 (Wales)
- 2020 (Scotland)
- Rank, score & decile



England: 7 domains

- Income
- Employment
- Health
- Education
- Access to Services & Housing
- Crime
- Living Environment


Isle of Wight
Winchester
IMD Deprivation Decile
1 More deprived
2
3
4
5
6
7
8
9
10 Less deprived
Local Authority boundaries
0 5 10 15 20 25 km
MHCLD, 2019. Contains National Statistics data
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Joining

Polygons

Area ID
1
2
3
4
5
14
7
8
11

Data

Joining

Polygons

Area ID
1
2
3
4
5
14
7
8
11

Data

Area ID	Deprivation
1	High
2	High
3	High
4	Average
5	Average
6	Average
7	Low
8	Low
9	Low
10	High
11	Low
12	High
13	High
14	Average
15	Average

Lookup

Joining

Polygons

Area ID
1
2
3
4
5
14
7
8
11

Data

Area ID	Deprivation
1	High
2	High
3	High
4	Average
5	Average
6	Average
7	Low
8	Low
9	Low
10	High
11	Low
12	High
13	High
14	Average
15	Average

Lookup

Area ID	Deprivation
1	High
2	High
3	High
4	Average
5	Average
14	Average
7	Low
8	Low
11	Low

High Deprivation

Average Deprivation

Low Deprivation

Poll - Software

Have you used any GIS software before (even just a bit)?

- ArcGIS / ArcMap / ArcGIS Pro
- QGIS
- R
- Python
- Something else (please put in chat)
- None at all

GIS Software

- **ArcGIS Pro** most popular commercial
- **QGIS** most popular open source
- **R / RStudio** open source, command line based
- **Python** also useful for spatial analysis of large data
- Reproducible analysis becoming more important

All can be useful

Common issues in GIS

- **Coordinate systems**

  → "9 out of 10 problems when using GIS results from using the wrong coordinate system"

- Finding (the right) **data**

  → "You can easily spend 50% of the time of your project looking for and bringing in data"

- **Postcodes** as geocoding

  → "WC1E 6BT" is a great way of asking people where they live, a residential postcode unit is about 10 - 15 houses

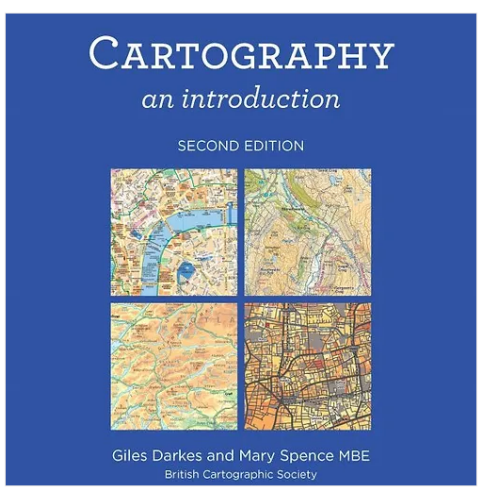
  → But (e.g. in Wales) this can vary from 0.6 ha (a football field) to 5404 ha (20 sq miles, ~ Ealing)

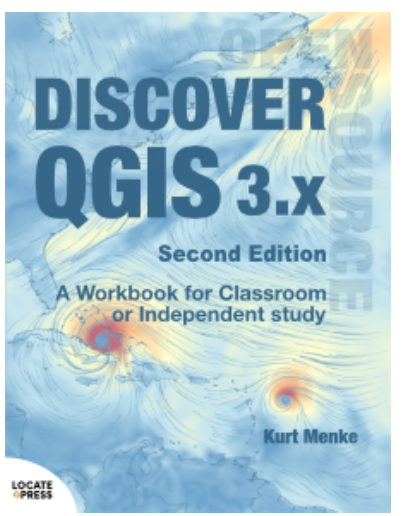
New developments

- **AI**
  - → Some automated interpreting of satellite data
  - → Houses / buildings / water / fields
- **LLM / ChatGPT / Bard**
  - → Clear learning / assessment challenges
  - → Also clear learning potential
  - → “How do I do GIS analysis…”
  - → “Where can I find data on…”
  - → Potentially really useful for writing code

Moving forward: Books

- GIS: Research Methods | *First chapter free*
- Cartography: An Introduction
- Discover QGIS 3.x
- Using R as a GIS | *first chapter free*





Moving forward

- Training courses | Feb *QGIS* | June *R* | July *Advanced R*
- Data | Free GIS Data | GeoBoundaries
- Looking at other people's maps

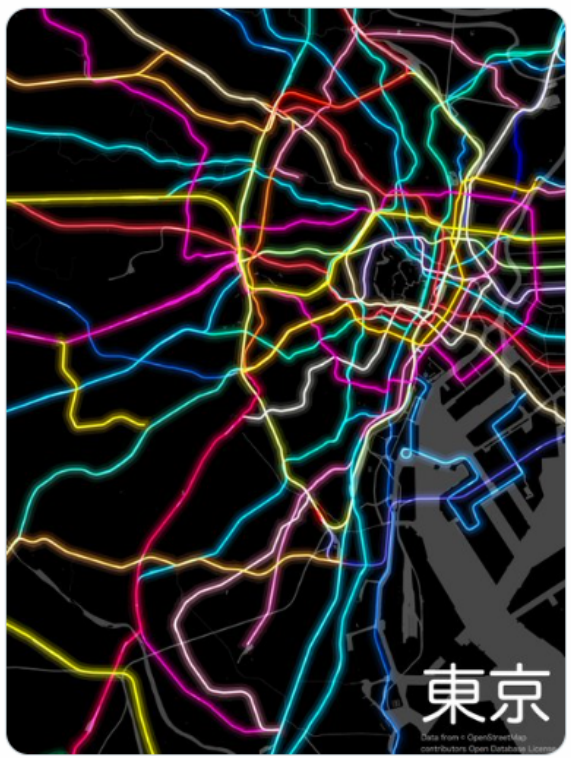
#30DayMapChallenge

Helen McKenzie @helenmakesmaps · 23h

Day 6 of the **#30daymapchallenge**: A neon map of Tokyo's metro [click to expand]

The great thing about this challenge is getting to create things that I can stick up on my empty walls!

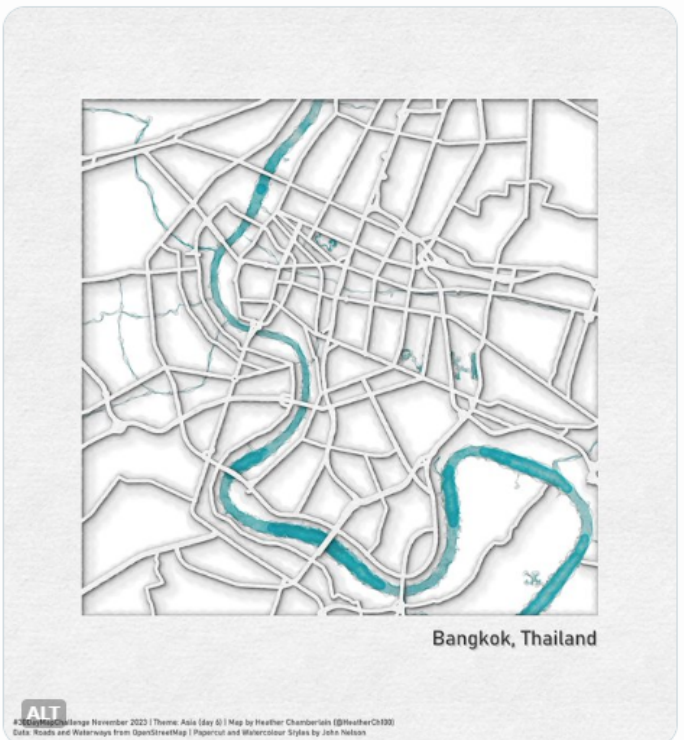
#qgis #openstreetmap



7 23 161 13K

Heather Chamberlain @HeatherCh100 · 5h

A late entry for yesterday's **#30DayMapChallenge** (day 6: Asia). I've revisited @John_M_Nelson's Papercut style again to create a paper cutout effect, with a map for Bangkok. I've only included major roads and then overlaid this with key waterways.



2 32 1.3K

Thank you :-)

- Case studies & questions

  →

  *“Participants are encouraged to bring questions along to the session and Nick will pick one or two **case studies** to talk through the process of how we might go about mapping or doing spatial analysis on these projects.”*

  →

  Raise your hand or type in the Zoom chat

Wrap-up

- Will be on **Whova** for the duration of the conference
- Any further questions welcome to post on Whova
- After that best to email nick@nickbearman.com
- Reminder: please rate my session!