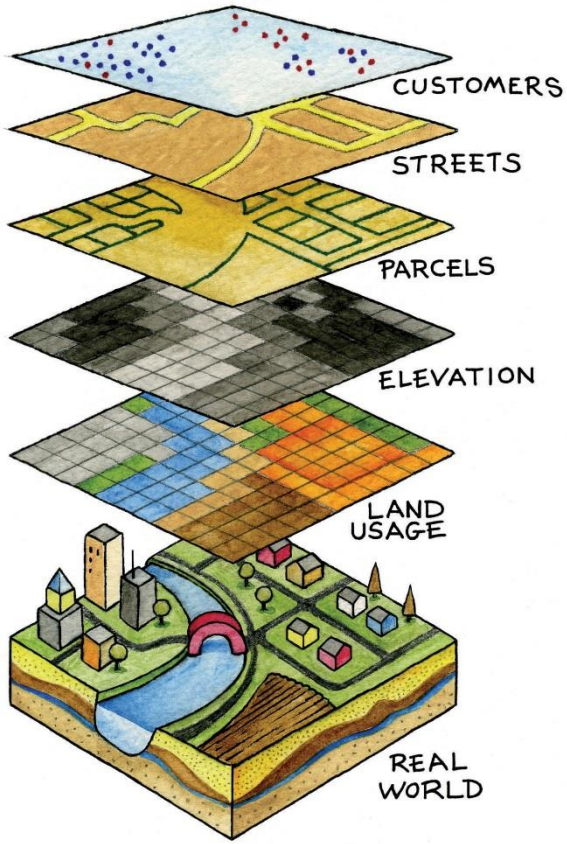
Introduction to GIS



Dr Nicholas Gould

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www.ondemandmapping.org.uk/igis

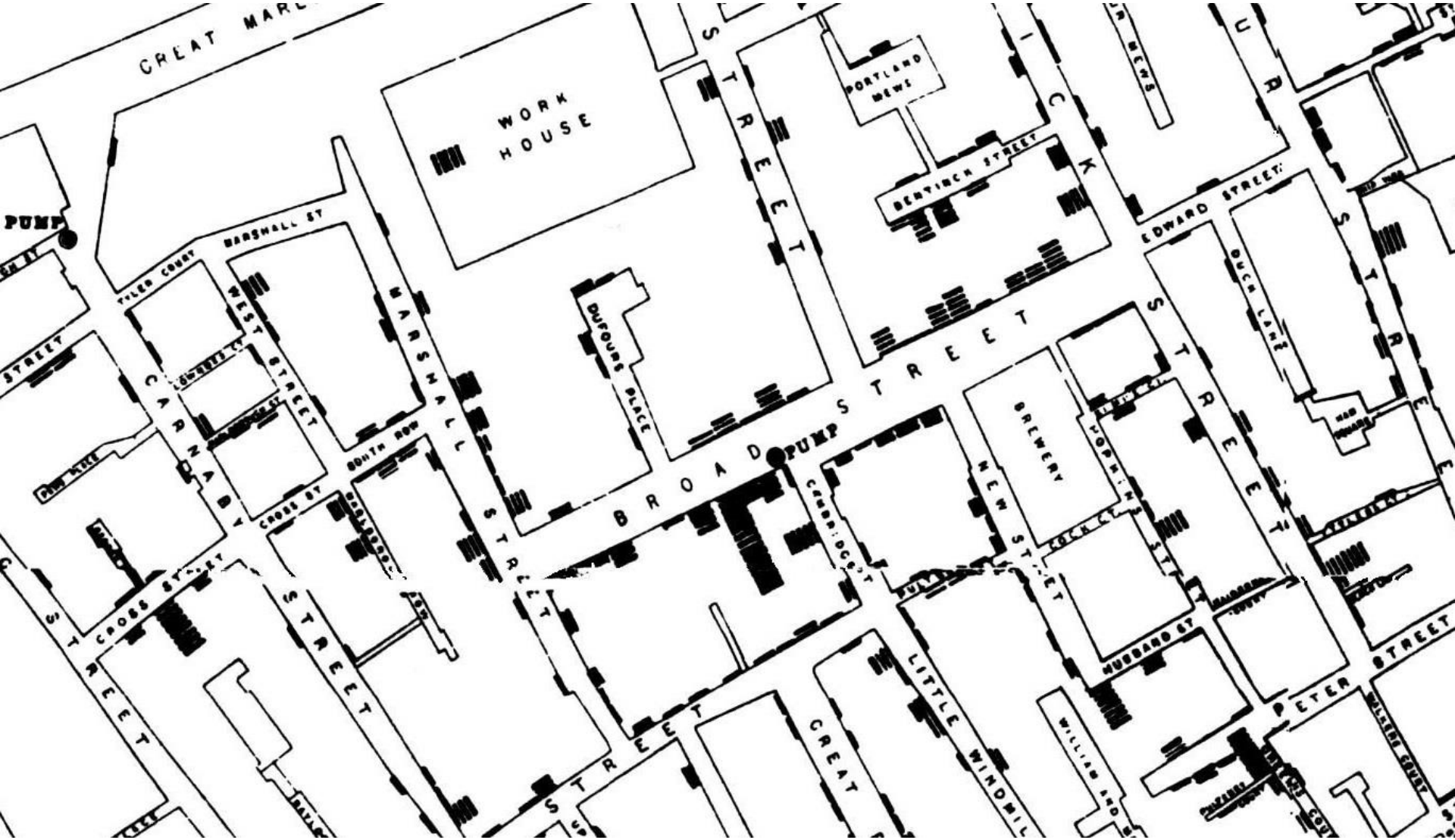
December 2019

Overview

- Introduction to GIS – Presentation (30mins)
- Introduction to GIS with QGIS - Practical session (3 hours)
- Spatial analysis without a GIS - Presentation (30 minutes)

My background

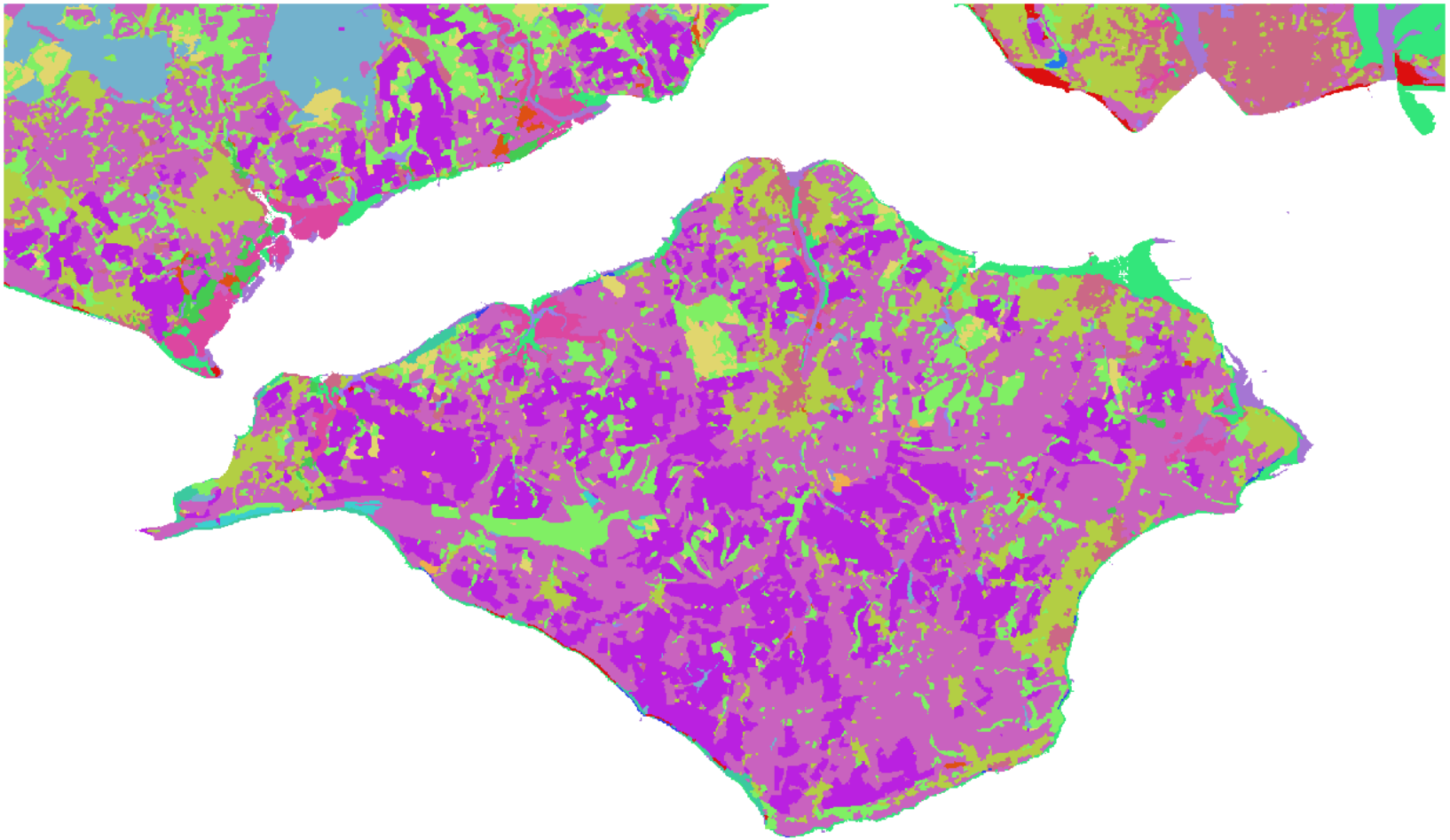
- GIS in transport
  - 5 years with Greater Manchester Transportation Unit, 6 months with Transport for the North
- Academia
  - Teach GIS up to Master's level – ArcGIS, QGIS, Python
  - Research
- Specialism – GI technologies
    - Spatial databases
    - Spatial programming
    - Web mapping


WORK HOUSE
PUMP
BROAD STREET
PUMP
DUFOURS PLACE
MARSHALL STREET
MARSHALL ST
TYLER COURT
WEST STREET
CROSS ST
SOUTH ROW
CROSS STREET
STREET
PORTLAND MEWS
BENTINCK STREET
EDWARD STREET
DUCK LANE
BREWERY
NEW STREET
HUBBARD ST
PETER
STREET
GREAT
LITTLE WINDMILL
WILLIAM AND

Geographic Information Systems

- A tool to manage, visualise, and analyse spatial data
- General purpose GIS
  - ESRI ArcGIS
  - QGIS
- Specialised
  - GeoDa

Representing spatial data: raster

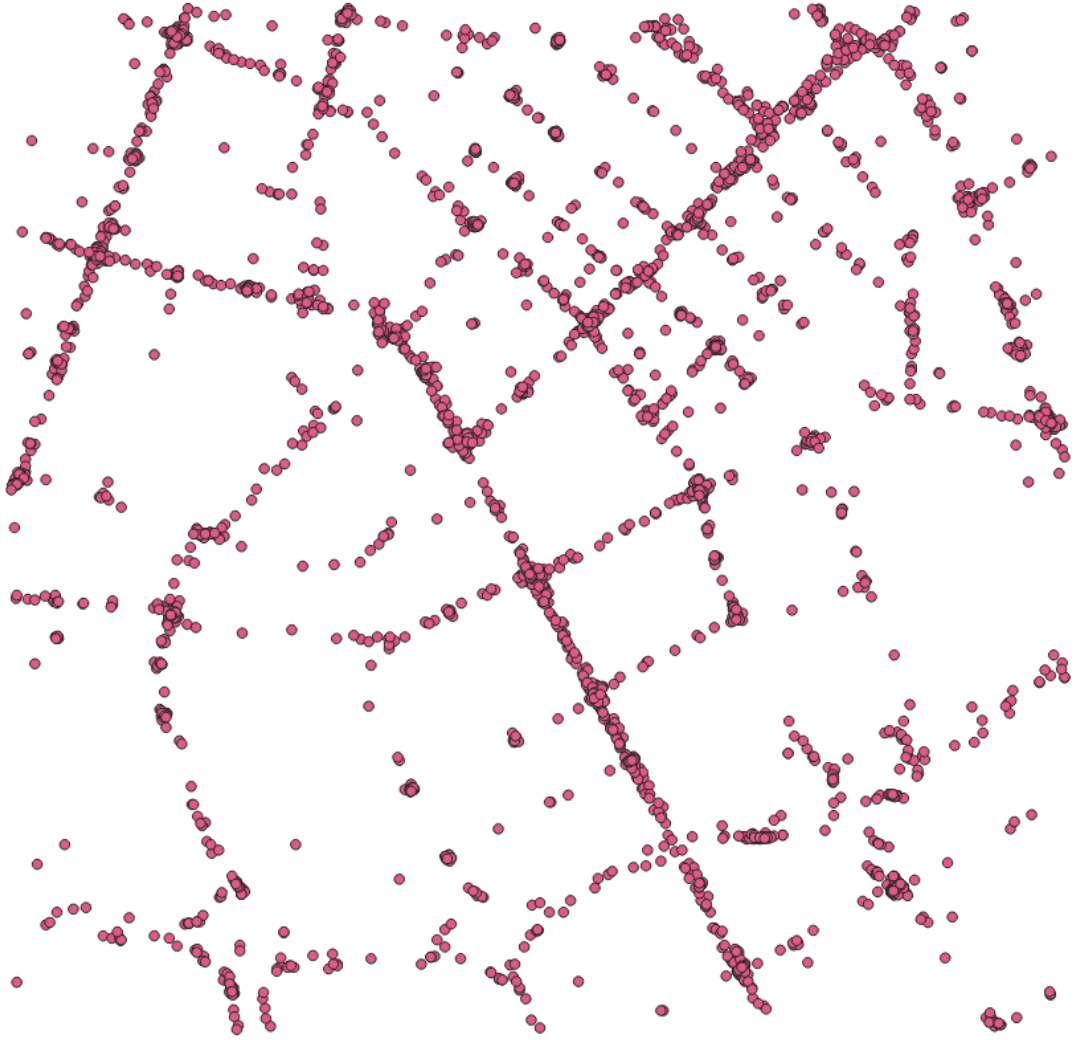


Land cover – scale 1:140000

Representing spatial data: raster

Land cover – scale 1:4000

Representing spatial data: vector

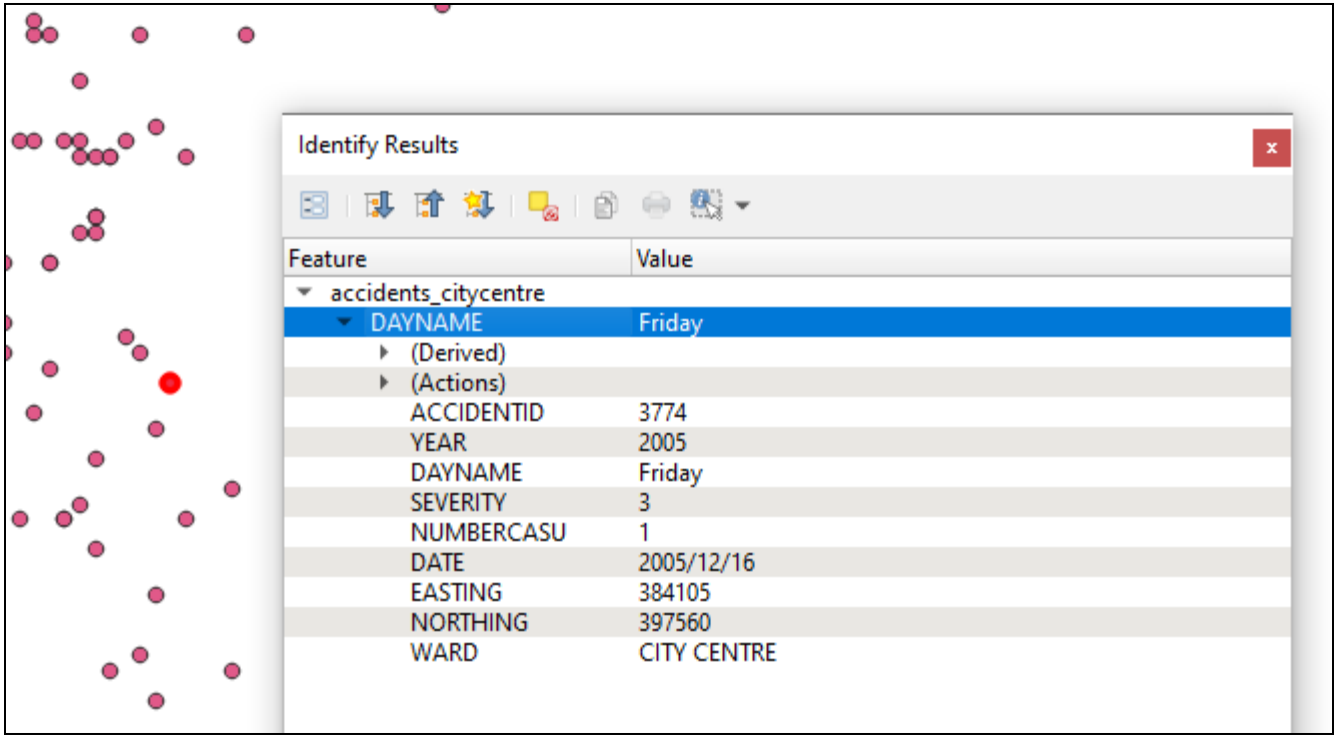


scale 1:6000

Representing spatial data: vector

scale 1:600

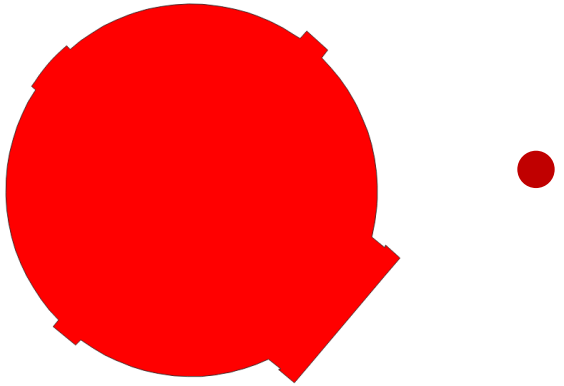
Representing spatial data: vector



Vector features can have multiple attributes

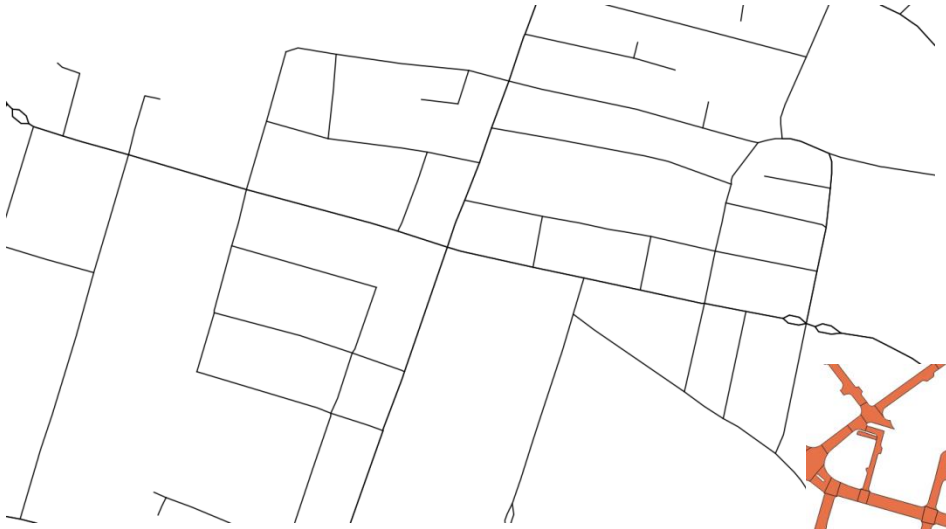
Representing spatial data: vector

Building as polygon and point

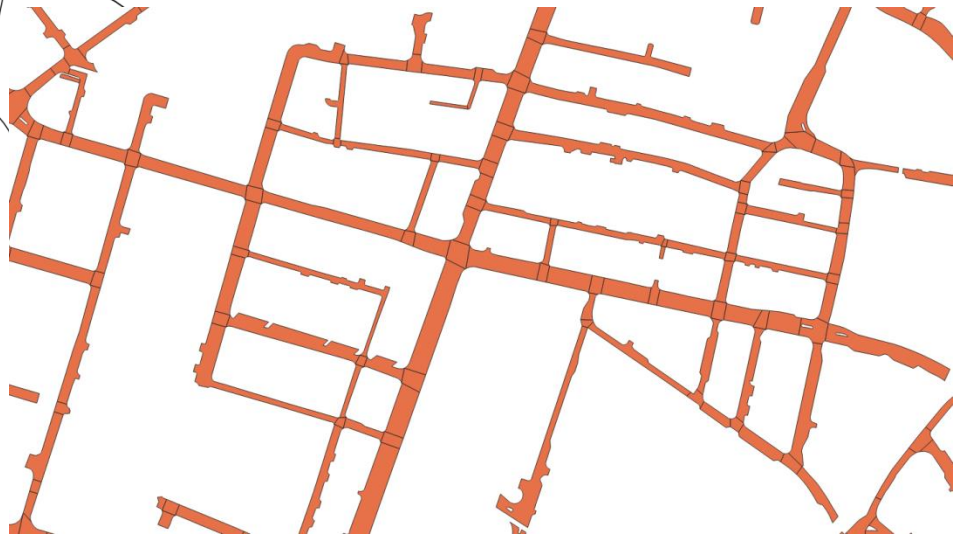


The same feature can be represented by multiple geometries

Representing spatial data: vector



Roads as polygons and polylines

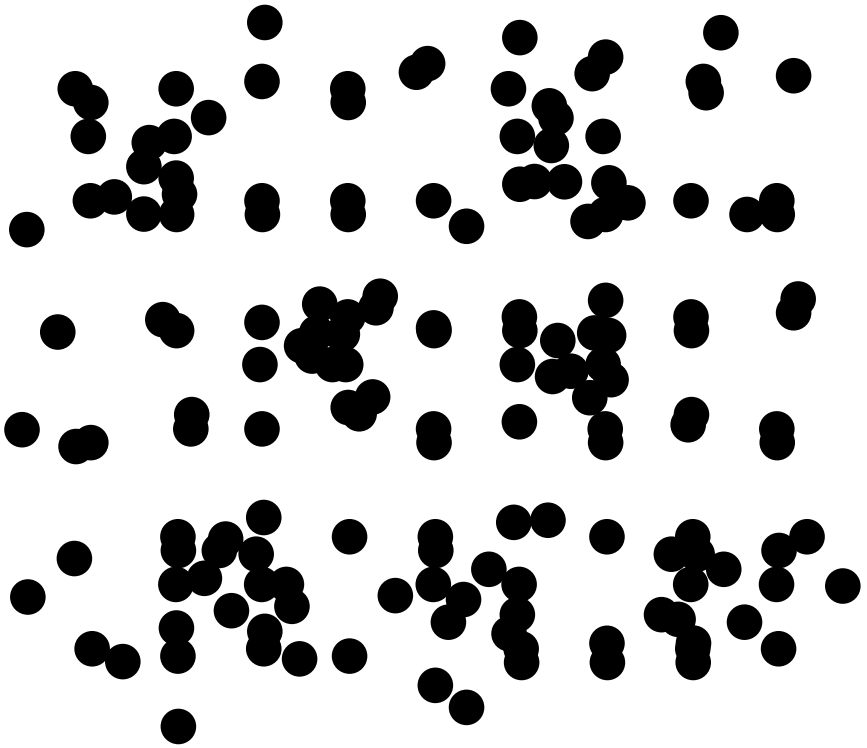


The same feature can be represented by multiple geometries

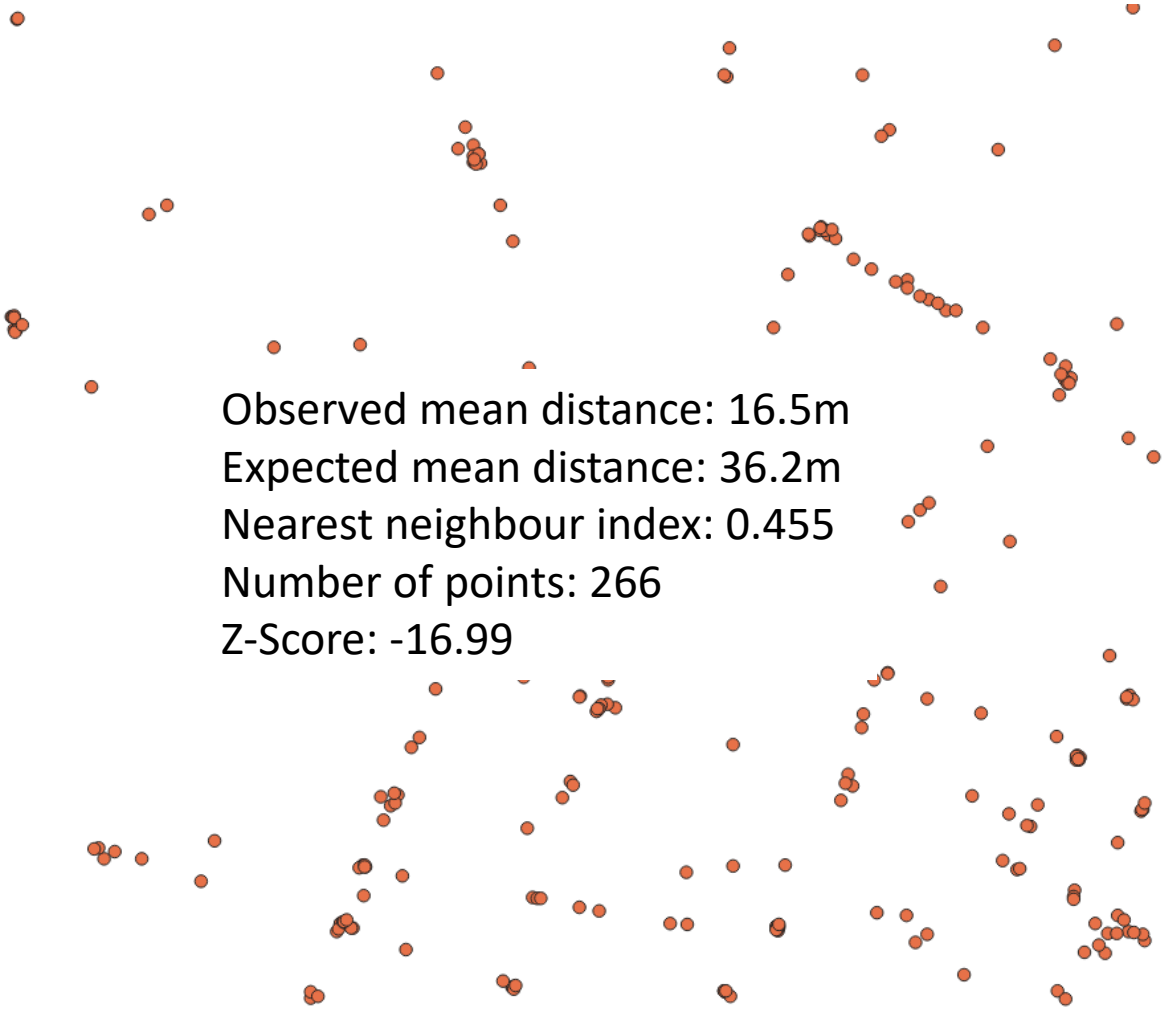
Representing spatial data: tools

- Vector
  - Select by attribute
  - Select by location
  - Count points in polygon
  - Nearest neighbour
  - K-means clustering
- Raster
  - Raster calculator
  - Aspect
  - Slope
  - Terrain profile

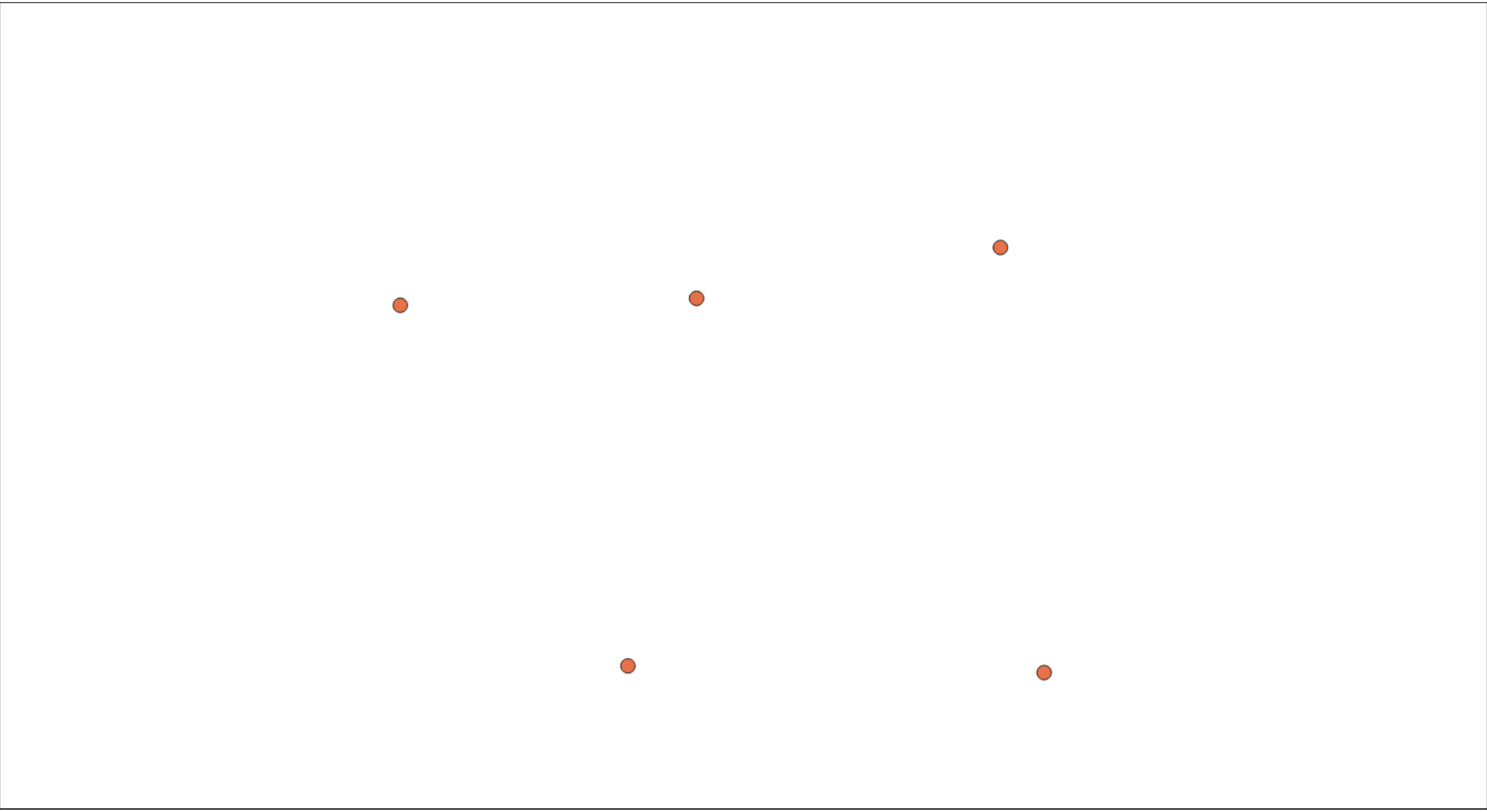
Point pattern analysis



Point pattern analysis: Nearest neighbour

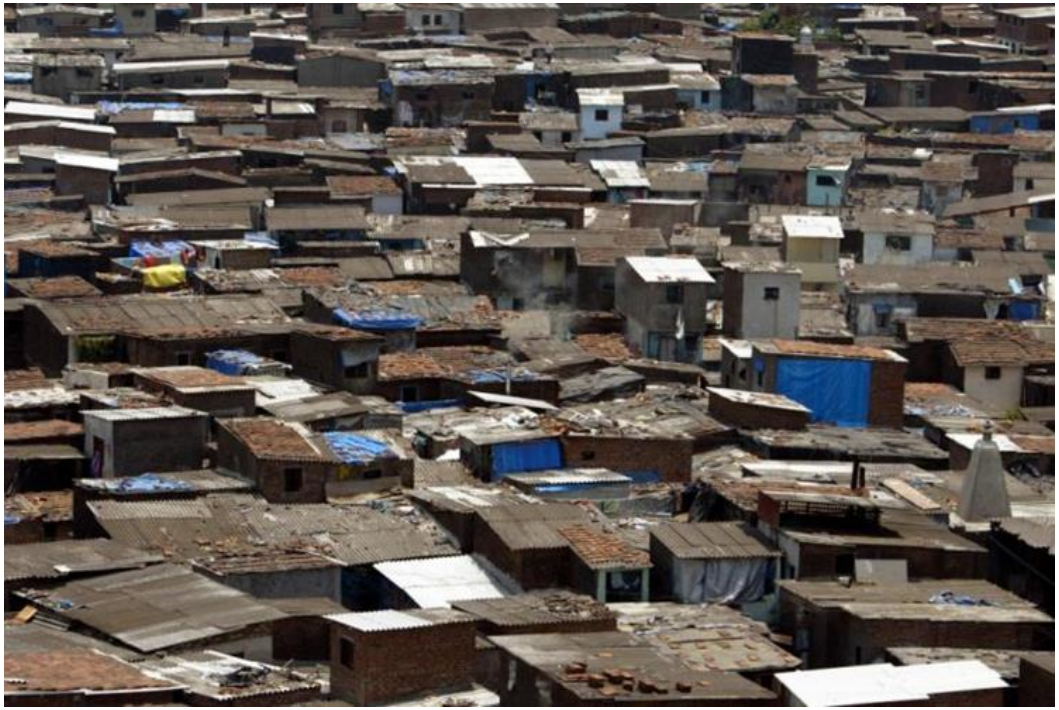


Point pattern analysis – K-means

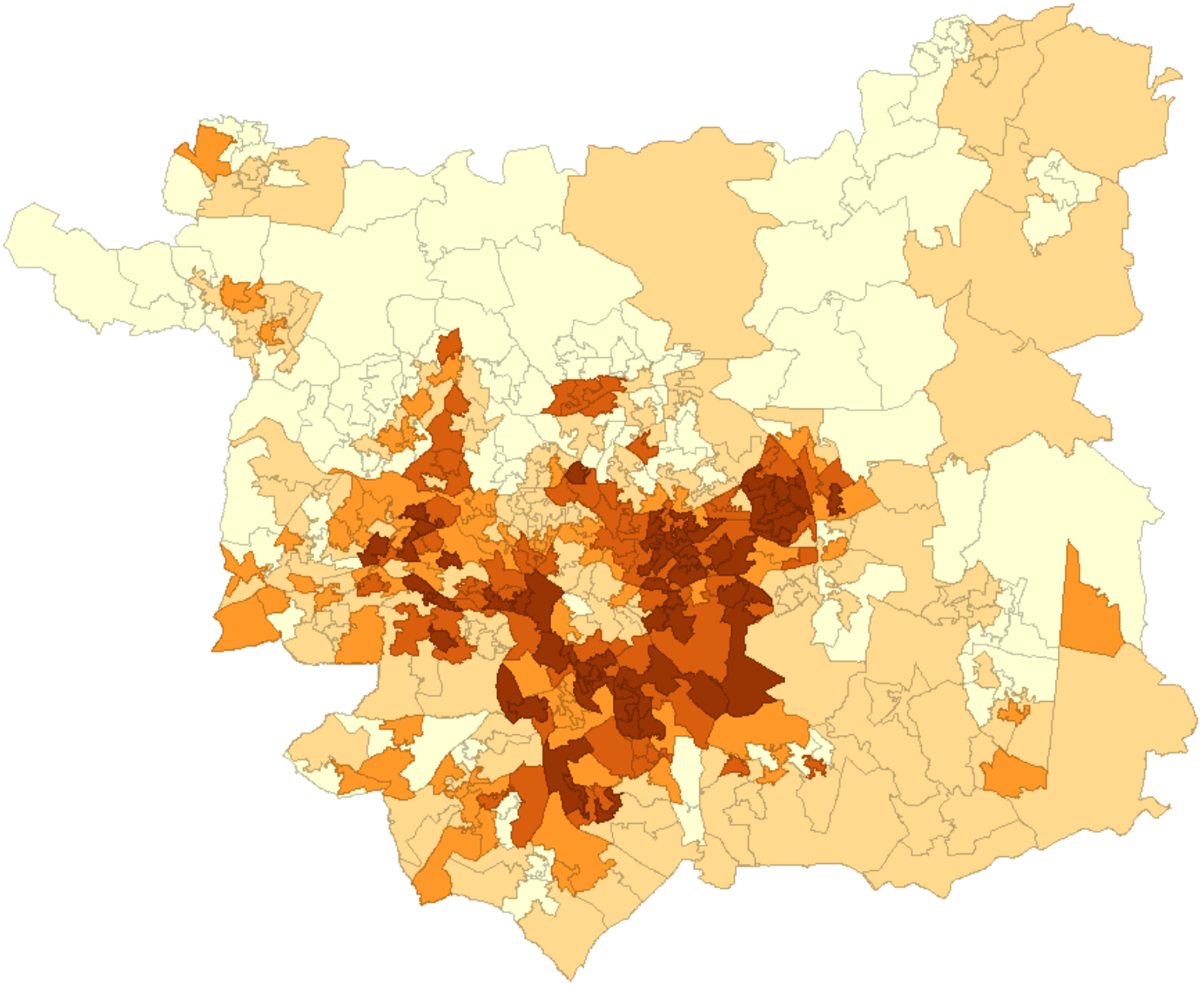


Polygon pattern analysis: Spatial autocorrelation

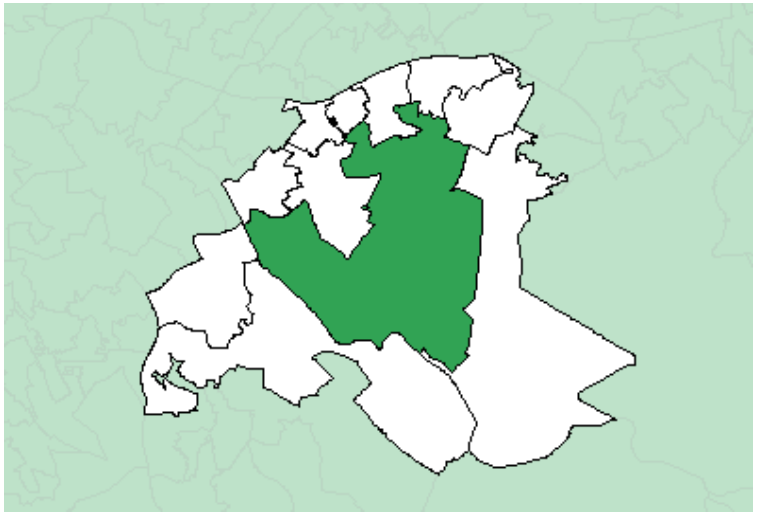
- Tobler's first law of geography
  - "*Everything is related to everything else, but near things are more related than distant things.*"

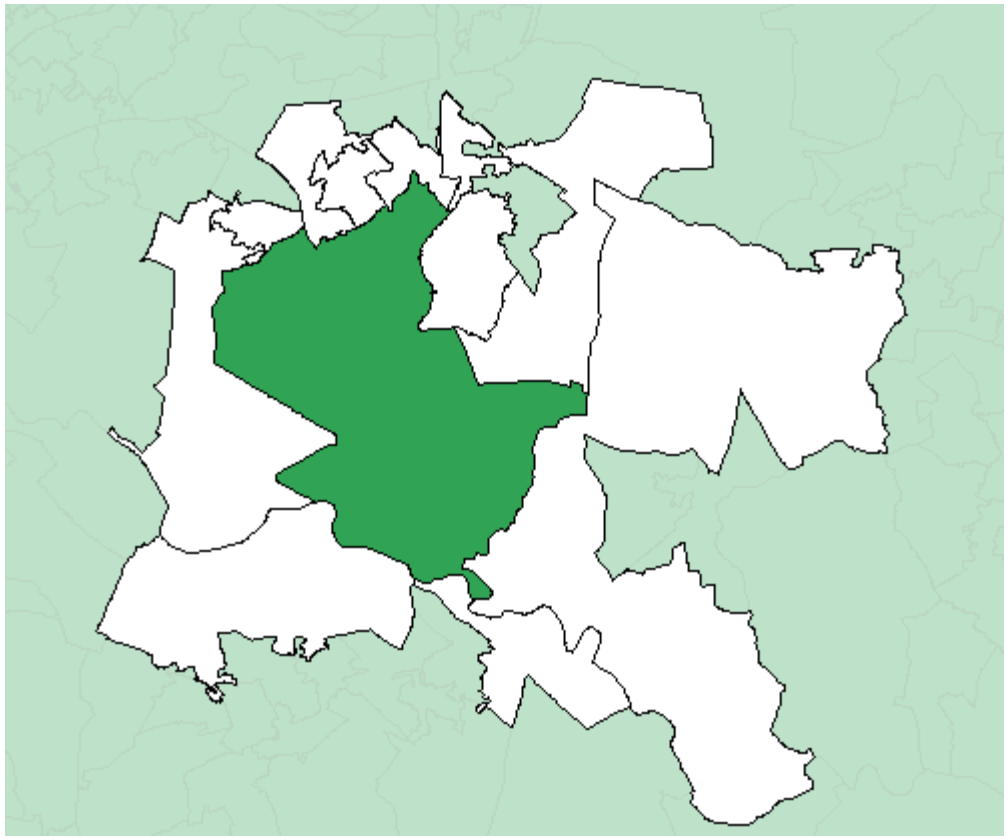


Polygon pattern analysis: Spatial autocorrelation



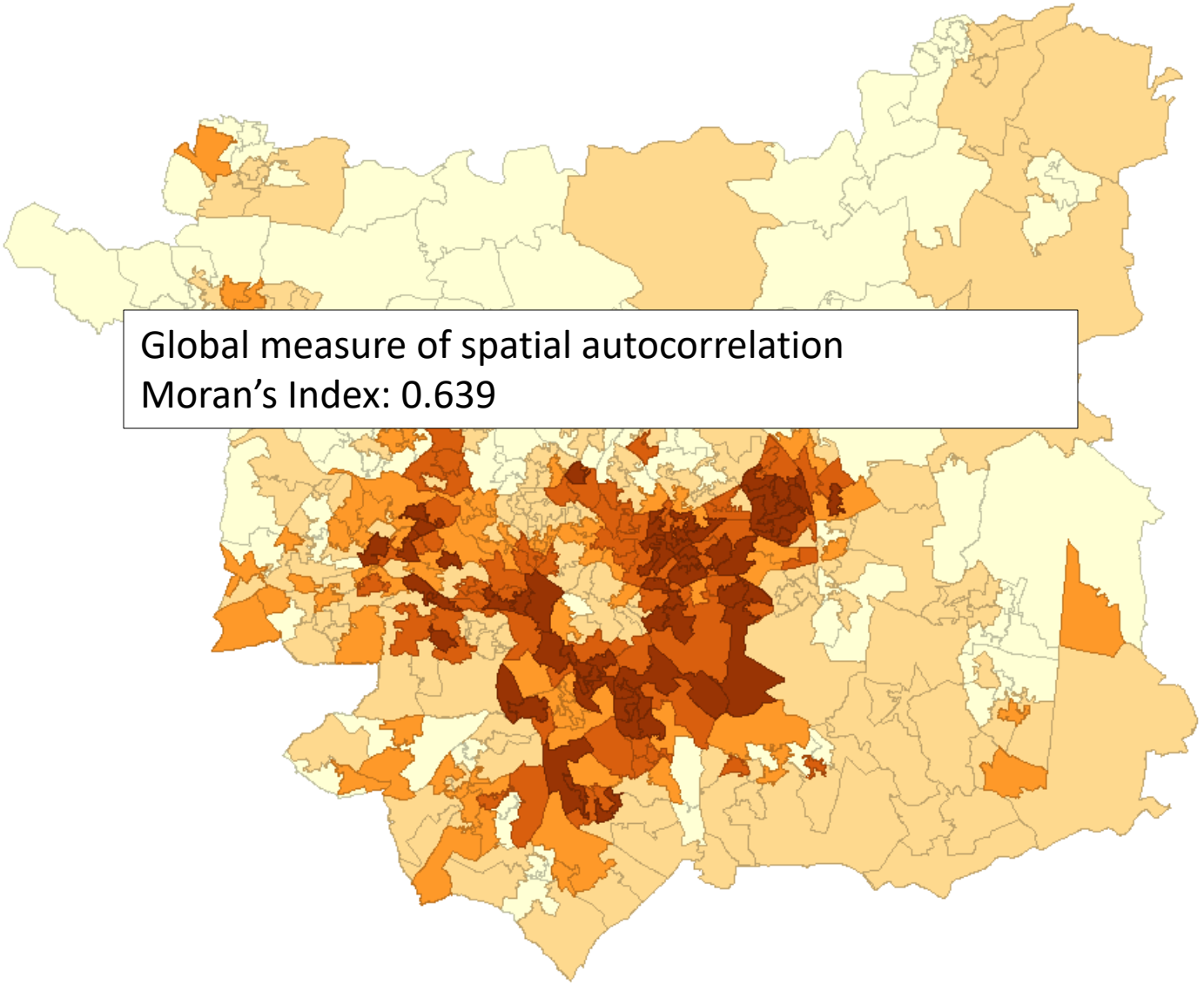
Polygon pattern analysis: Spatial autocorrelation



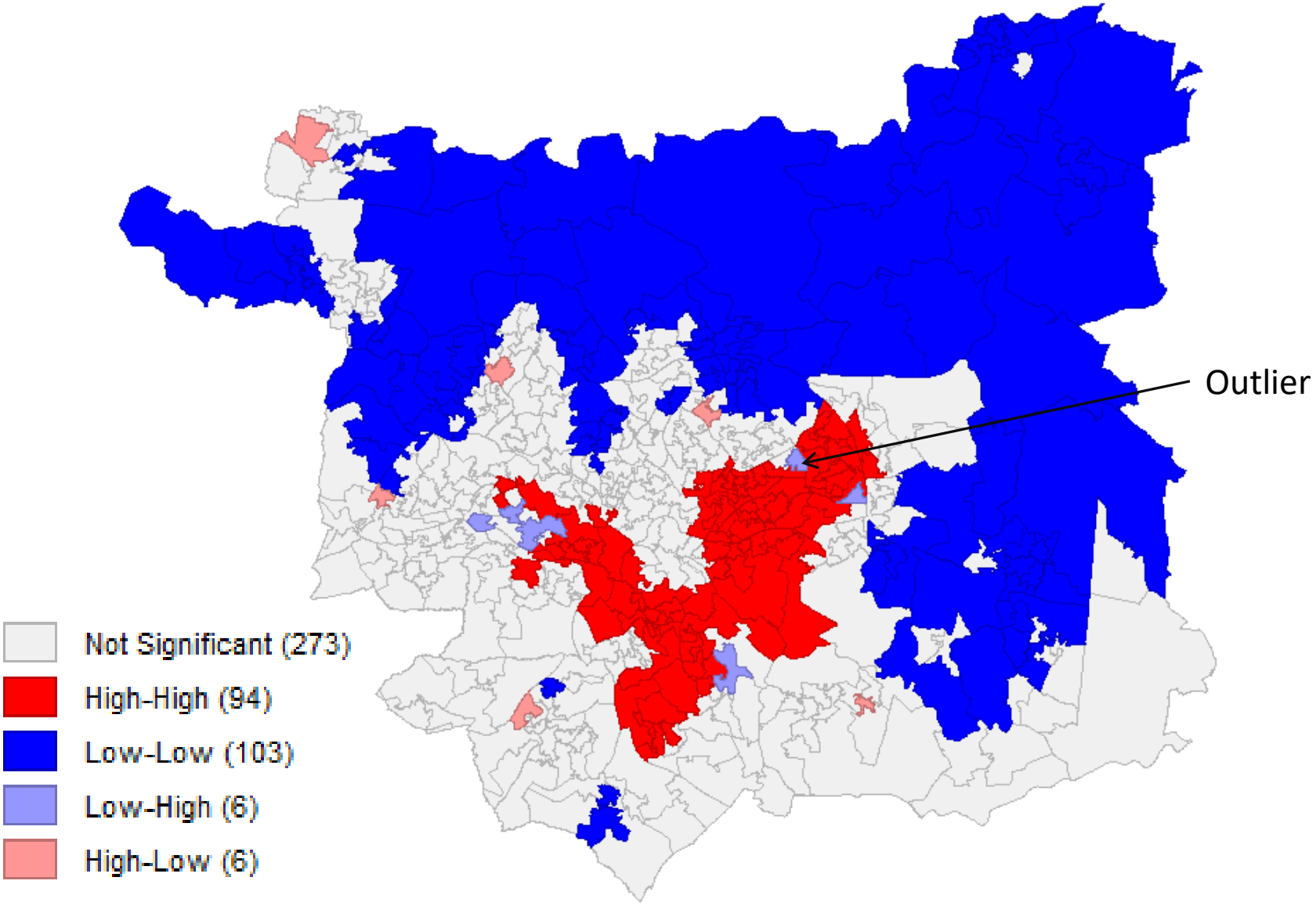


Defining “nearness” using neighbours

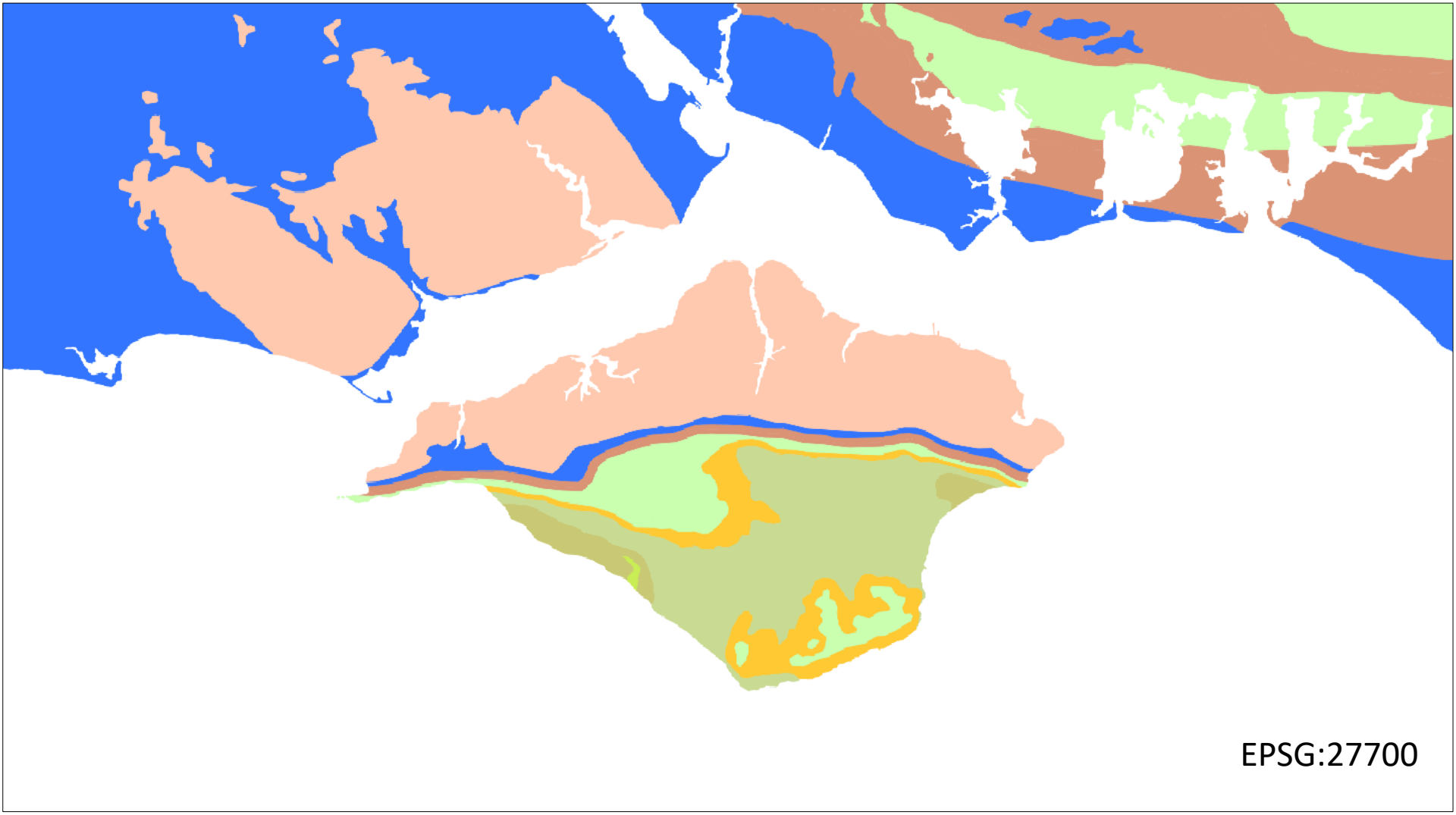
Polygon pattern analysis: Spatial autocorrelation



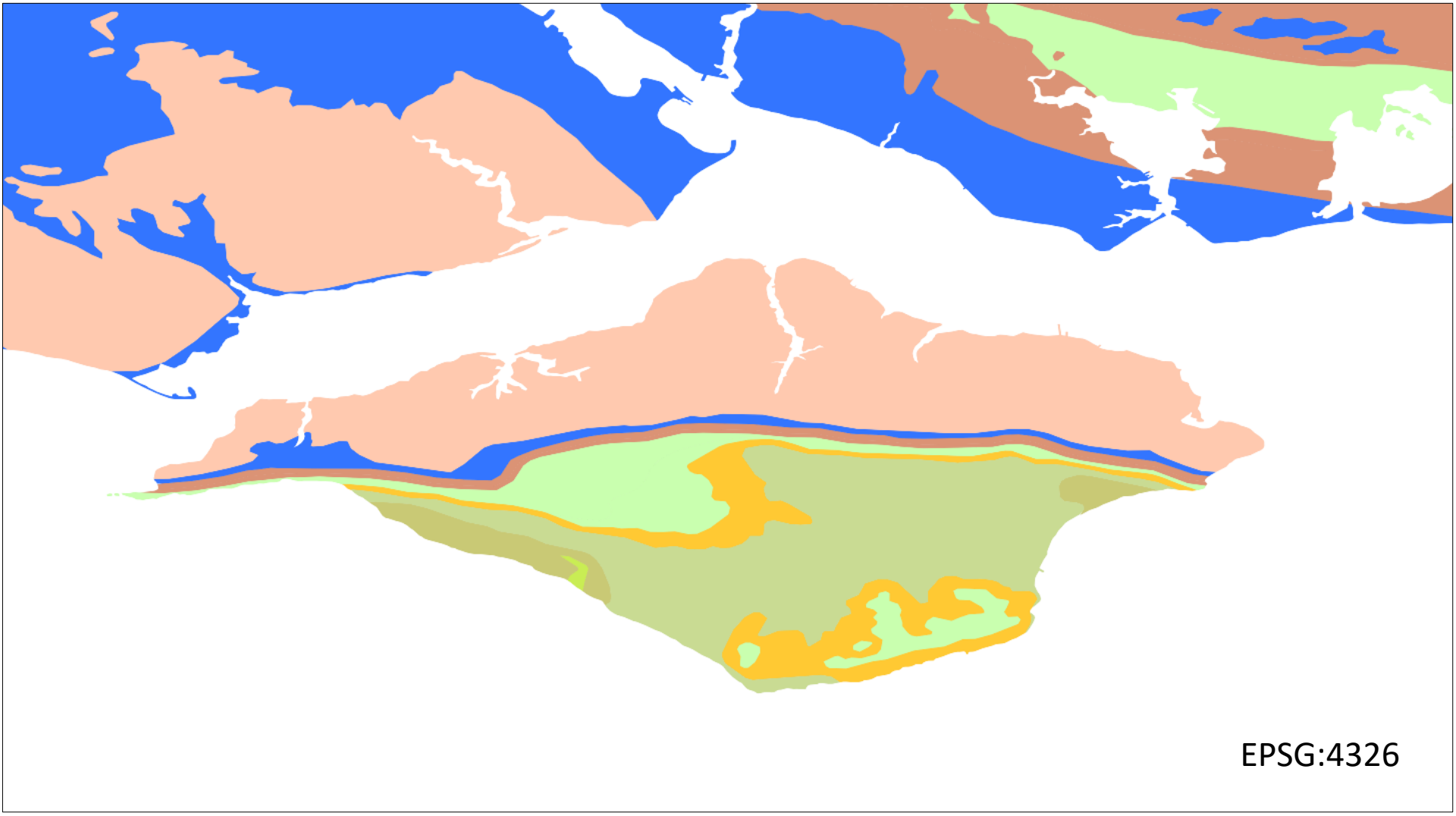
Polygon pattern analysis: Spatial autocorrelation - local



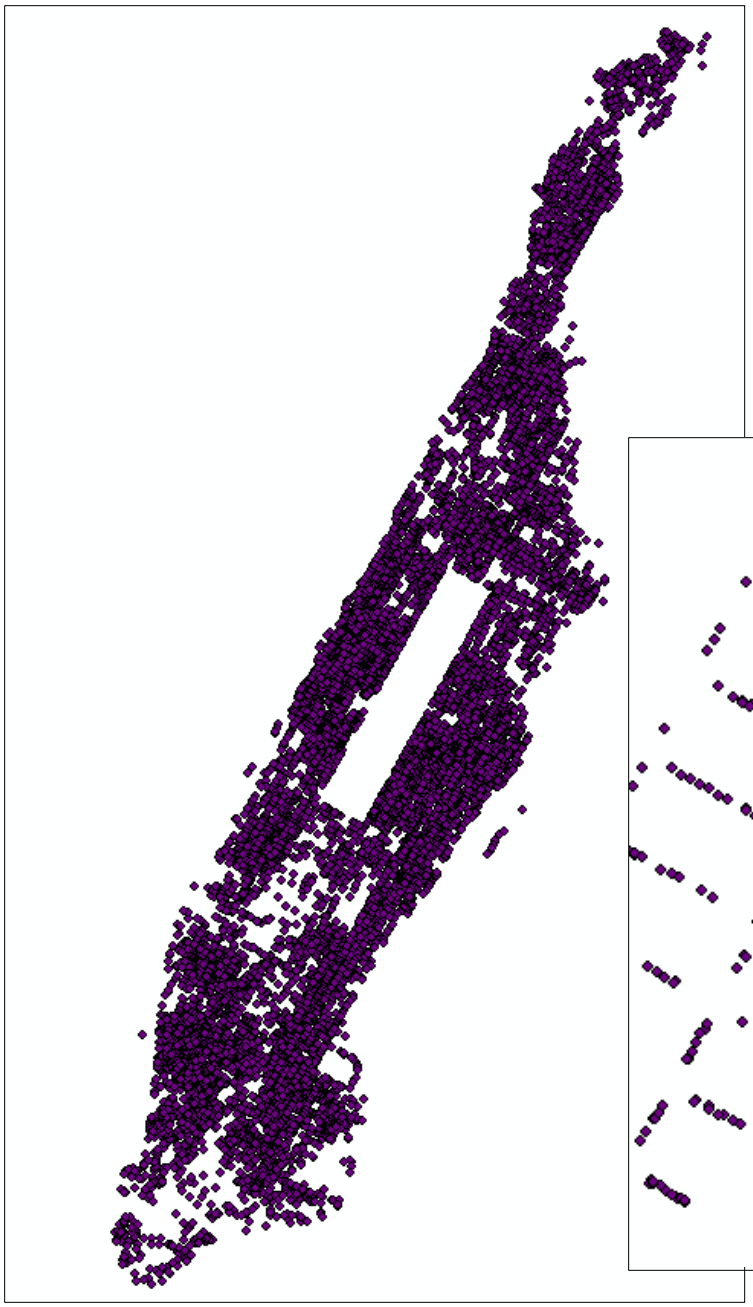
Projections

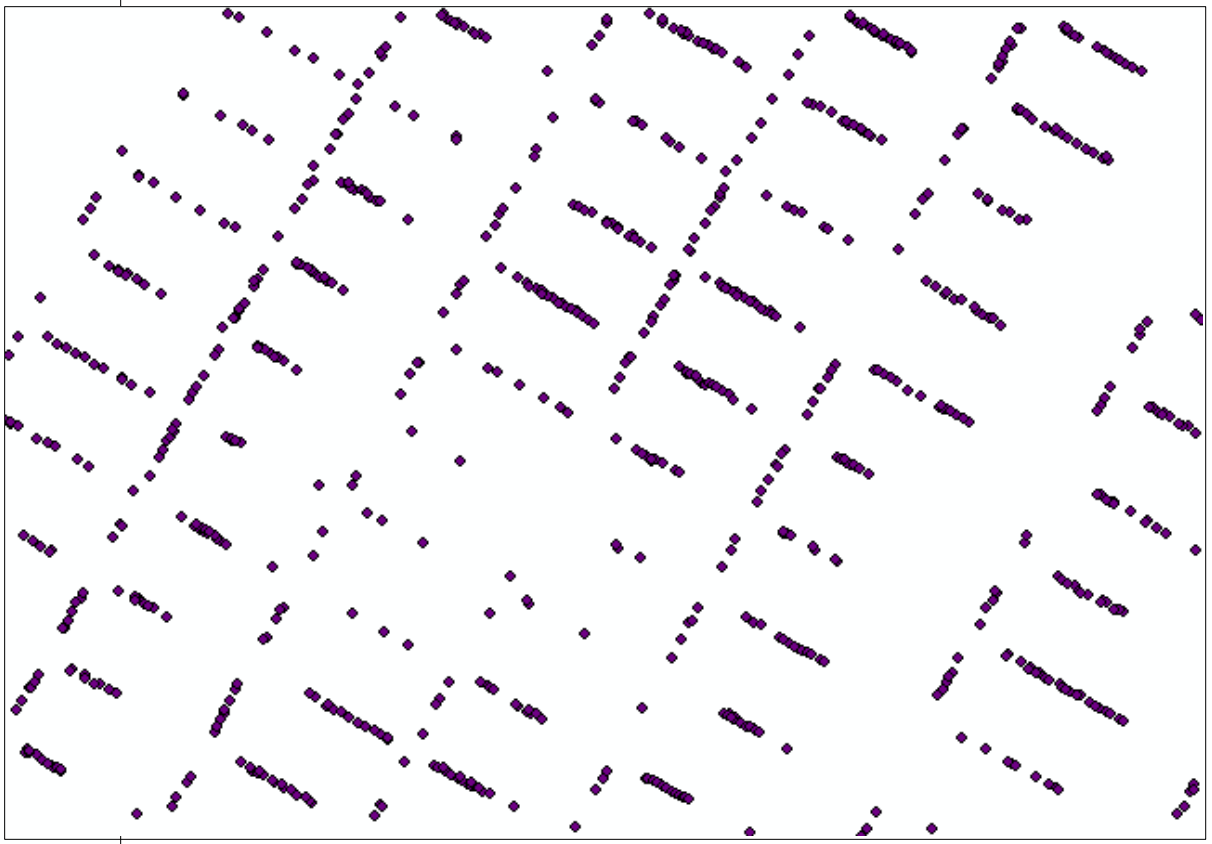


Projections



Data sources





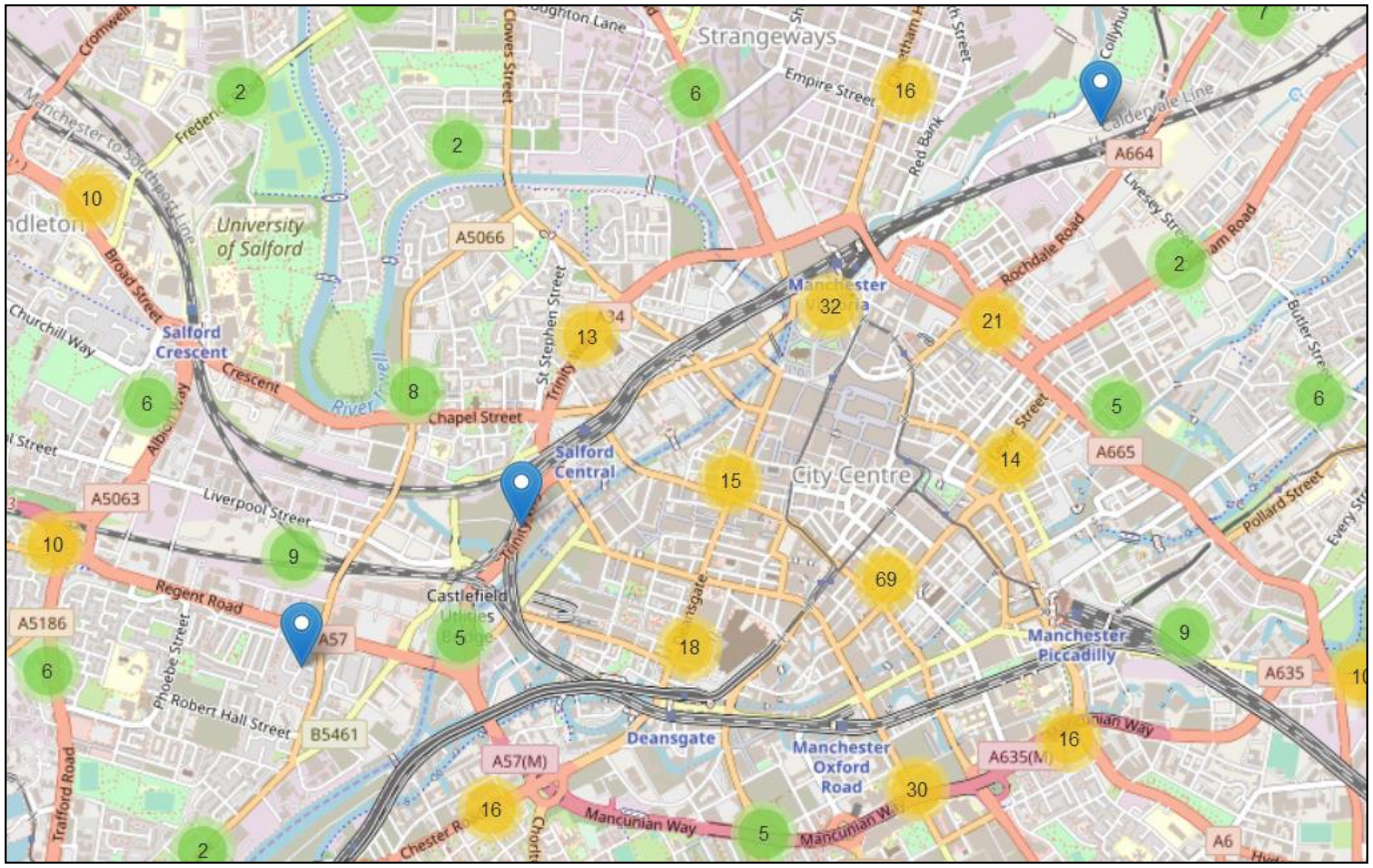
Data sources

- Ordnance Survey Open Data
  - Backdrop mapping (raster)
  - Vector data sources – green spaces, postcodes, roads, rivers
- Data.gov.uk
  - Boundaries, social data

Data formats

- File
  - Shapefile
  - Geodatabase
  - Geopackage
  - CSV
- Database tables
  - PostgreSQL/PostGIS, MS SQL, Oracle
- Web services
  - Geoserver

Web mapping

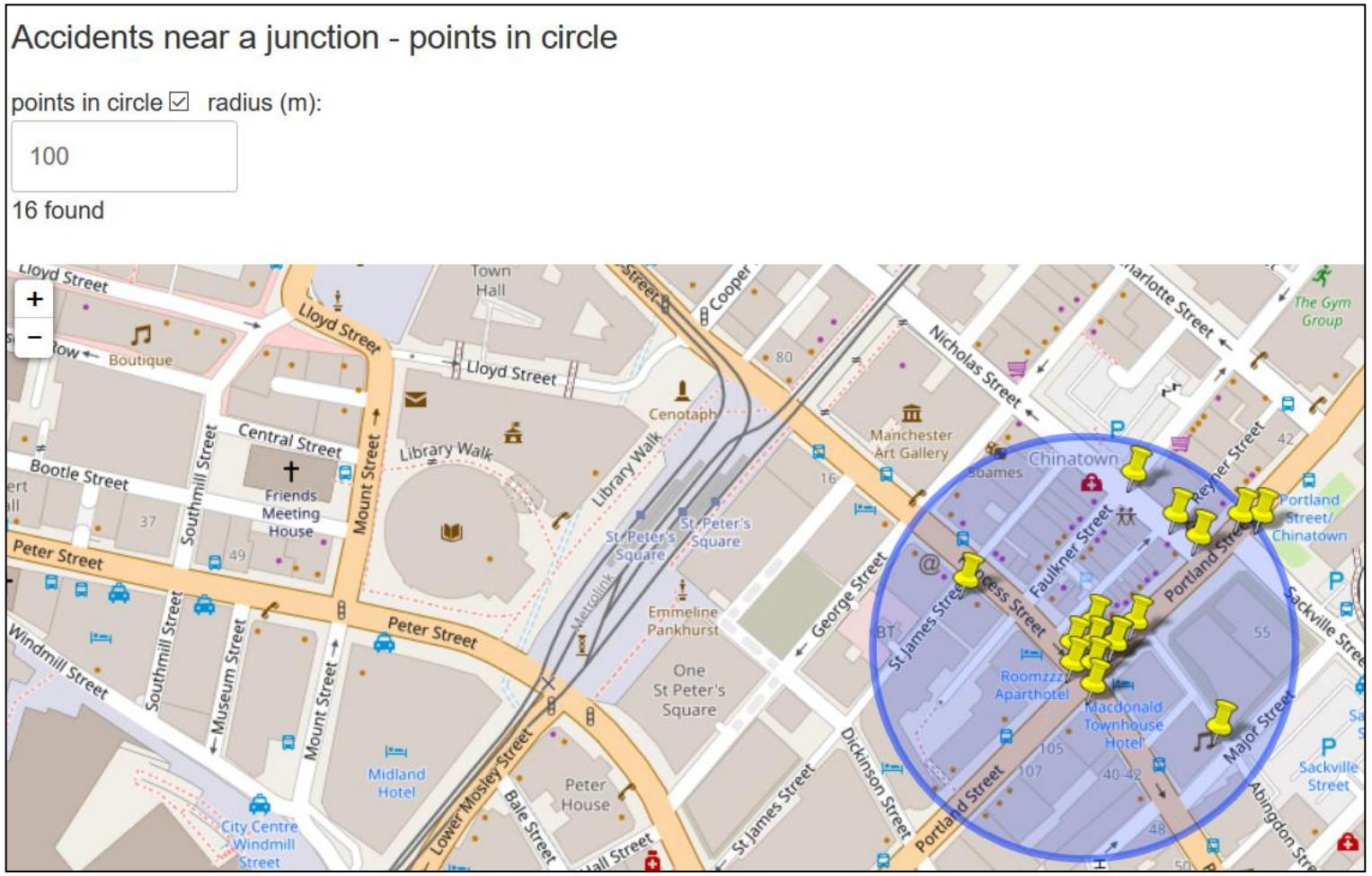


Clustering of road accidents

Web mapping

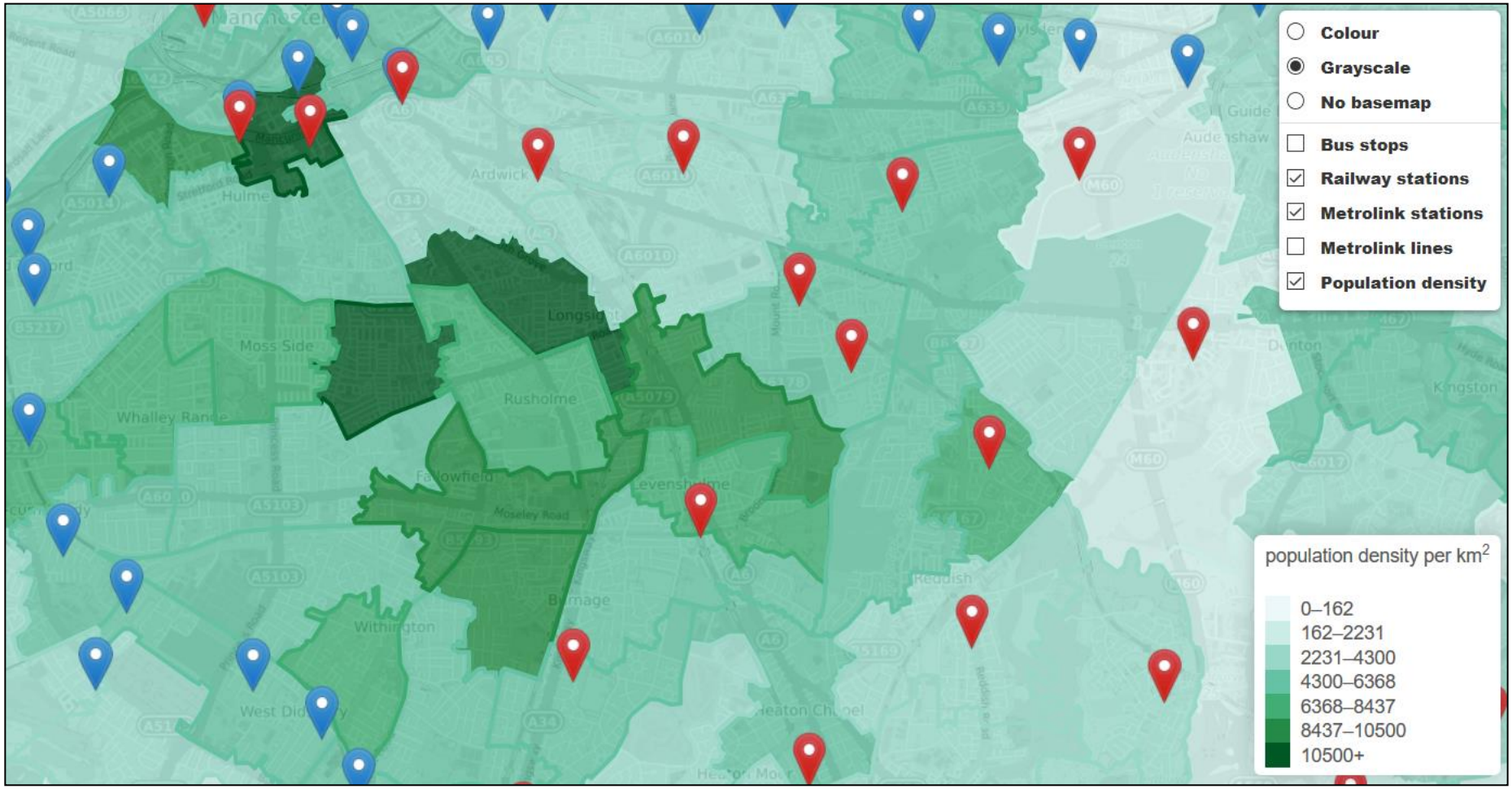
Heat map of road accidents

Web mapping



Point in polygon

Web mapping

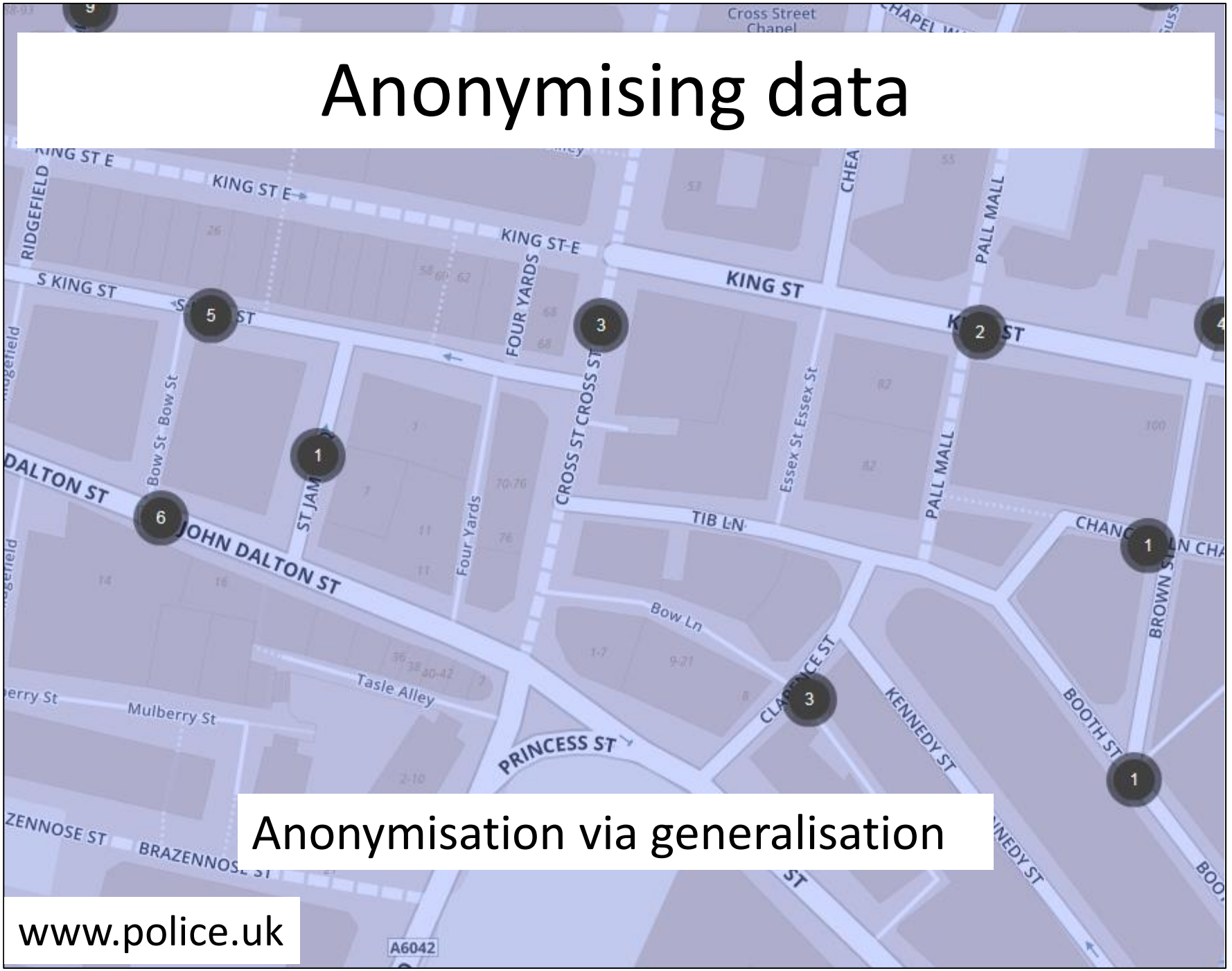


Multiple layers

Web mapping

- Google Maps
  - Free but not open source
  - Changing Terms and Conditions
- Open source libraries
  - Leaflet
  - Open Layers
- Data
  - GeoJSON files exported from Shapefile using QGIS

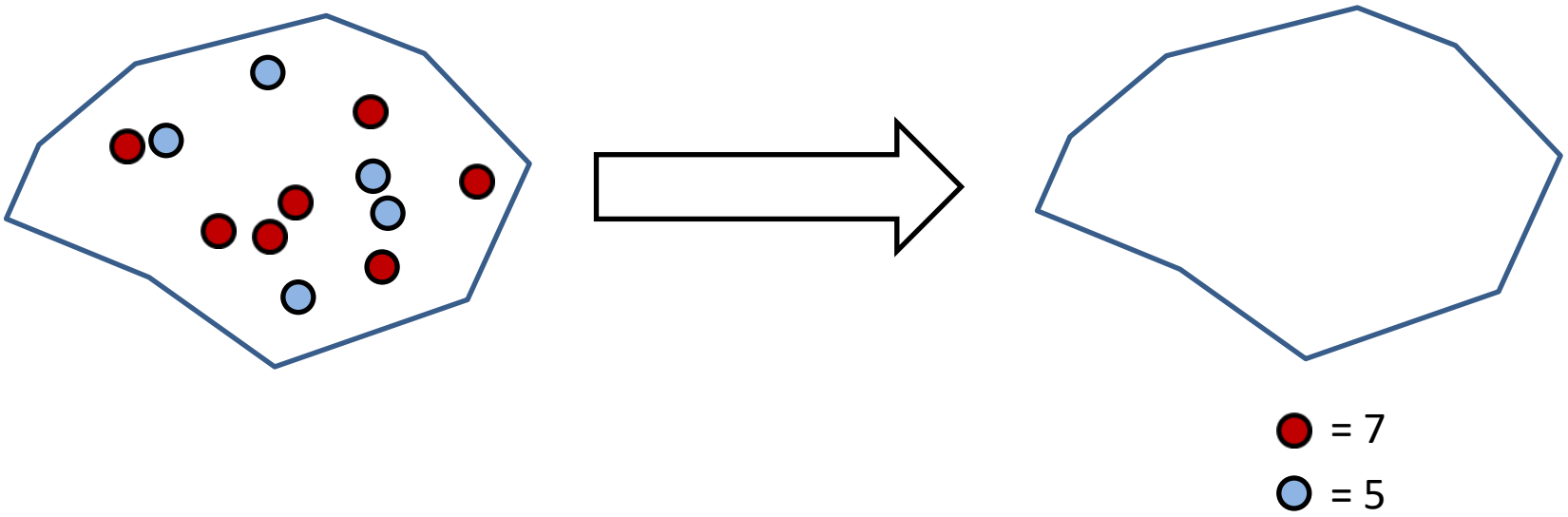
Anonymising data



Anonymisation via generalisation

www.police.uk

Anonymising data



Anonymisation via aggregation

The importance of scale

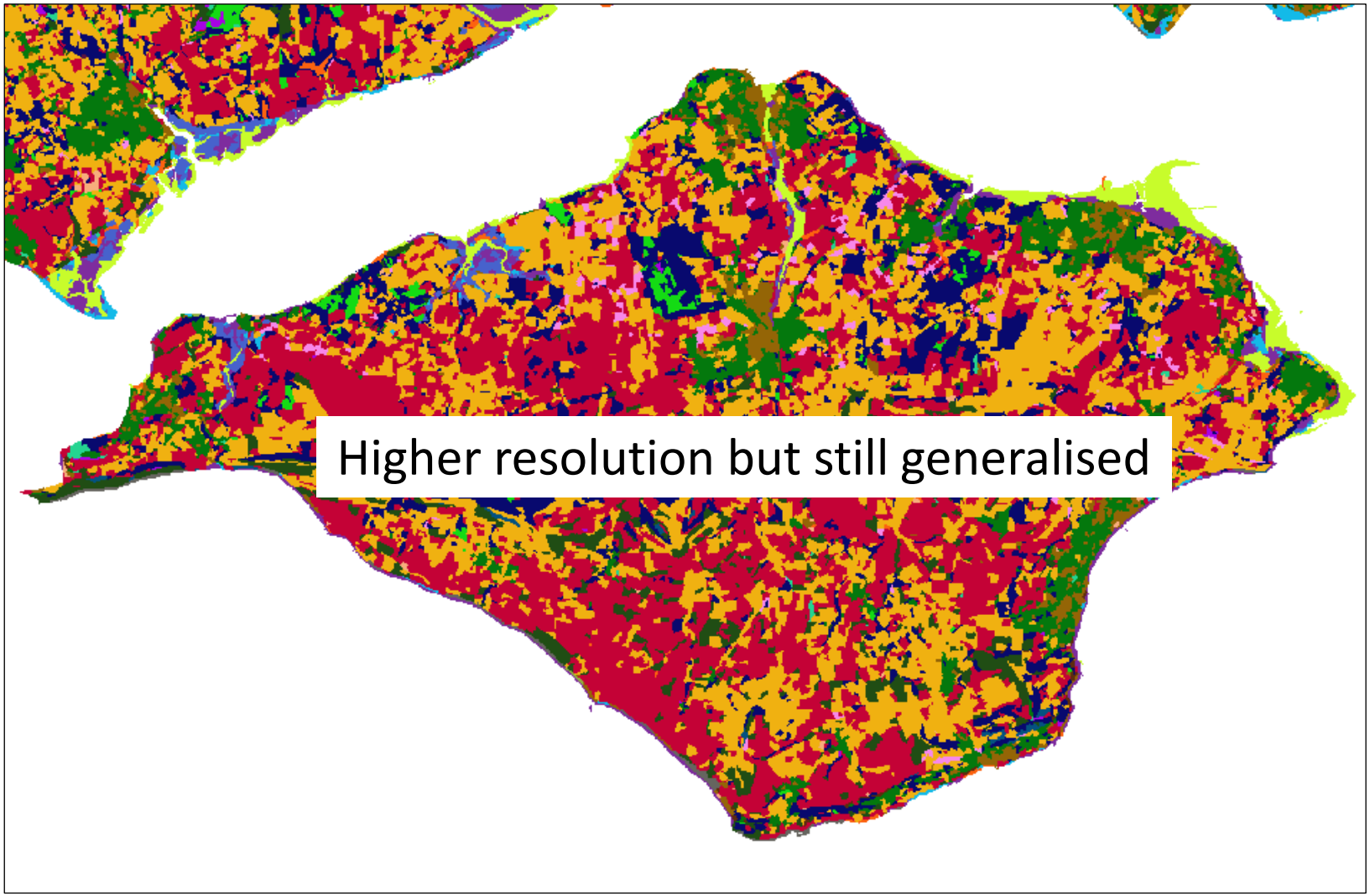
- “Scale or level of geographic detail is an essential property of any GIS project”

Longley, P.A., Goodchild, M.F., Maguire, D.J. and Rhind, D.W., 2005. *Geographic information systems and science*. John Wiley & Sons.

The importance of scale

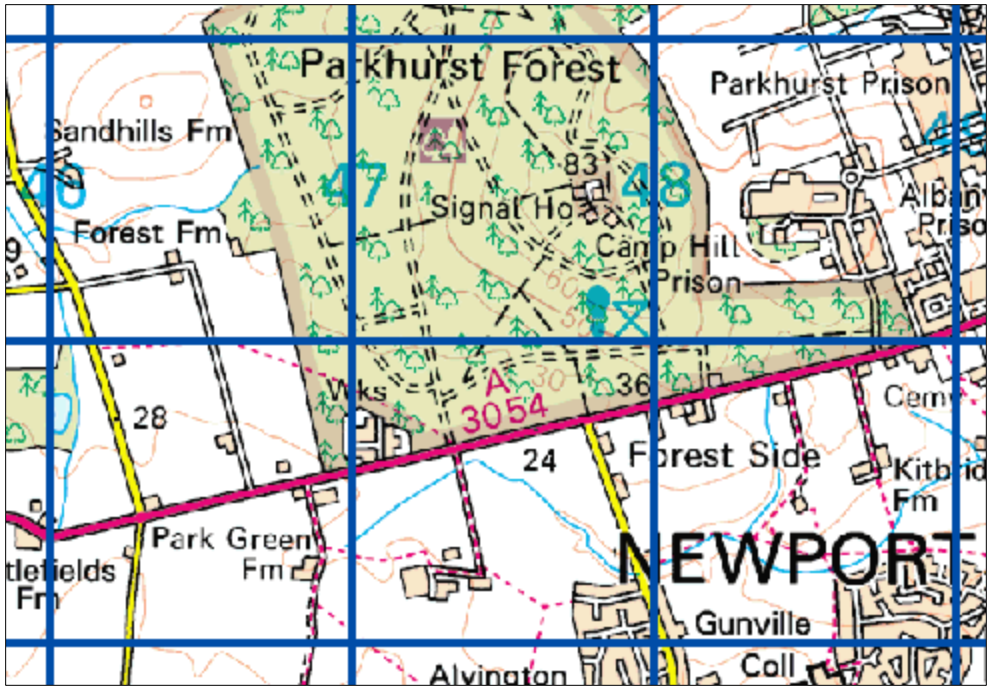
Land cover at 1km resolution

The importance of scale



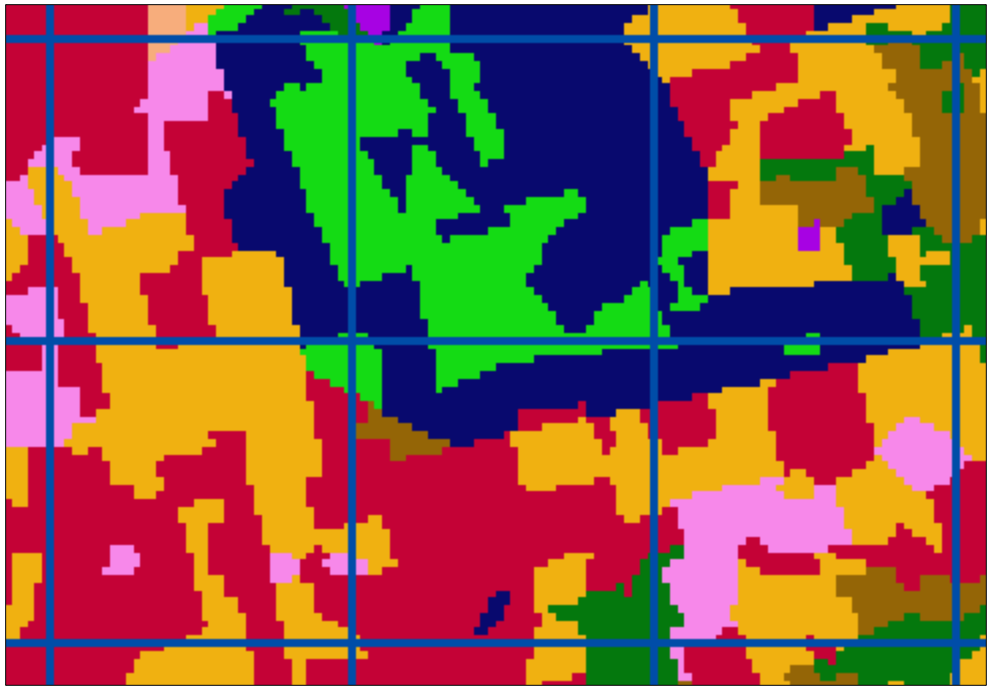
Land cover at 25m resolution

The importance of scale

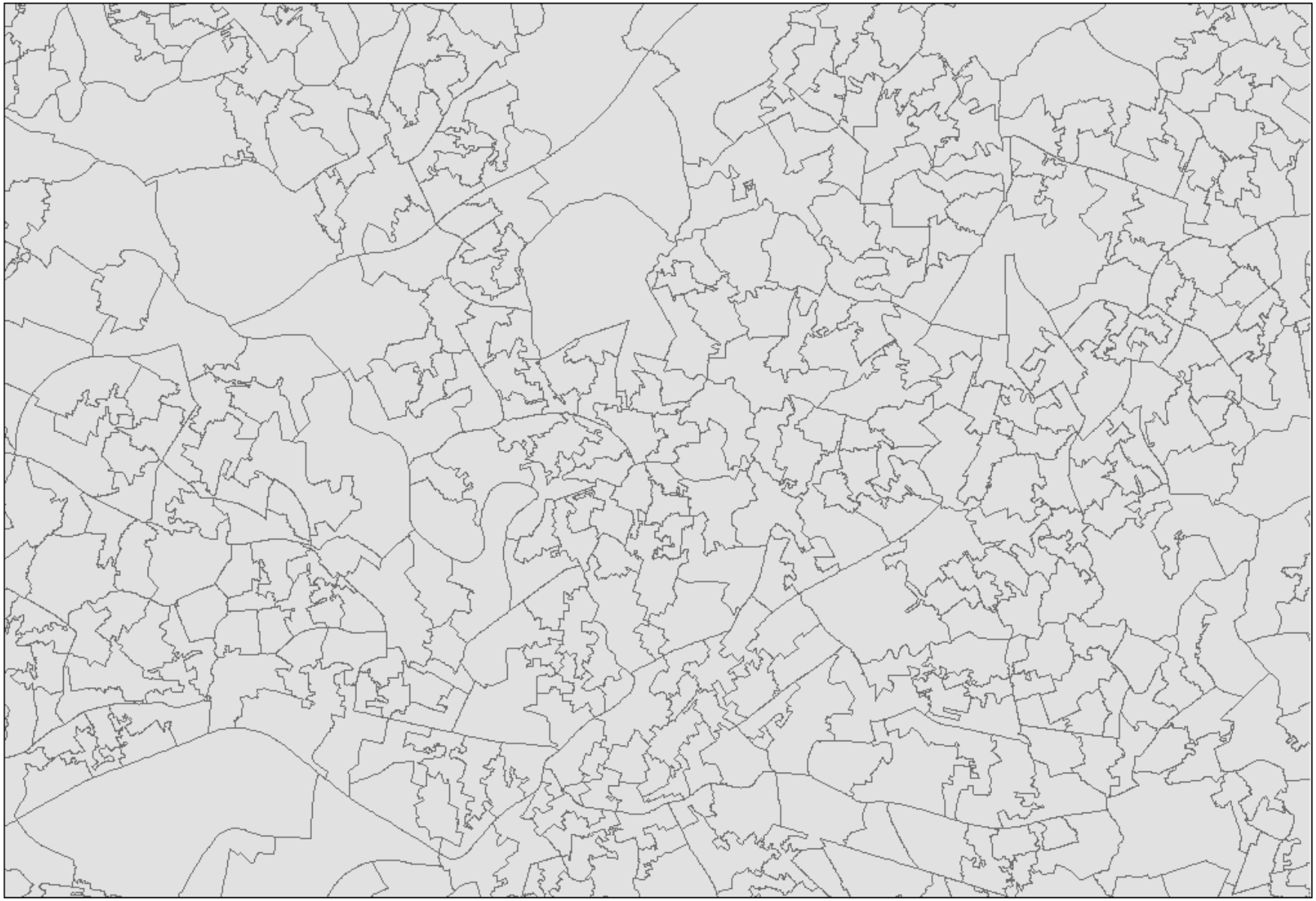


The importance of scale

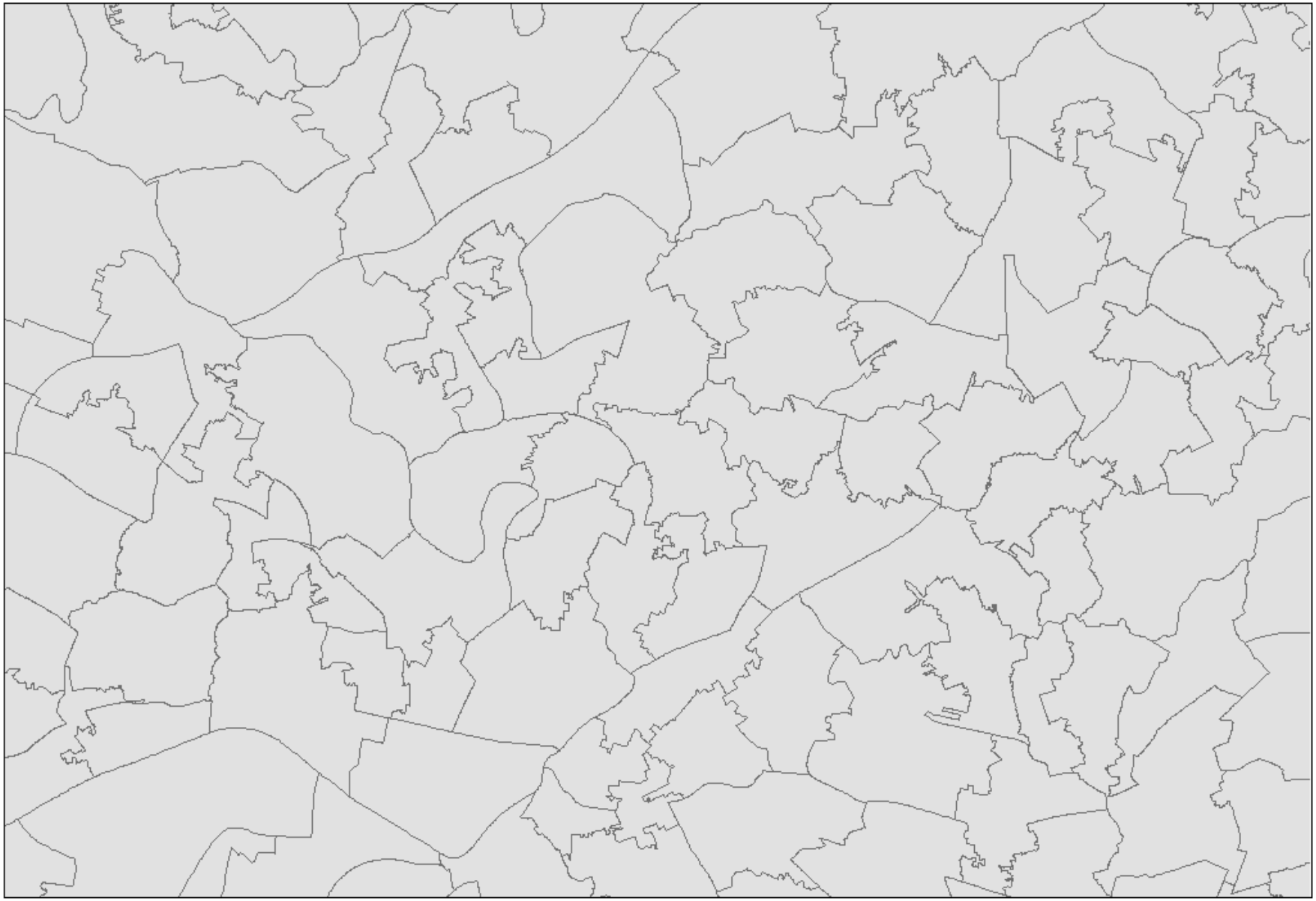
The importance of scale



Census *Output Area* - average population = 309

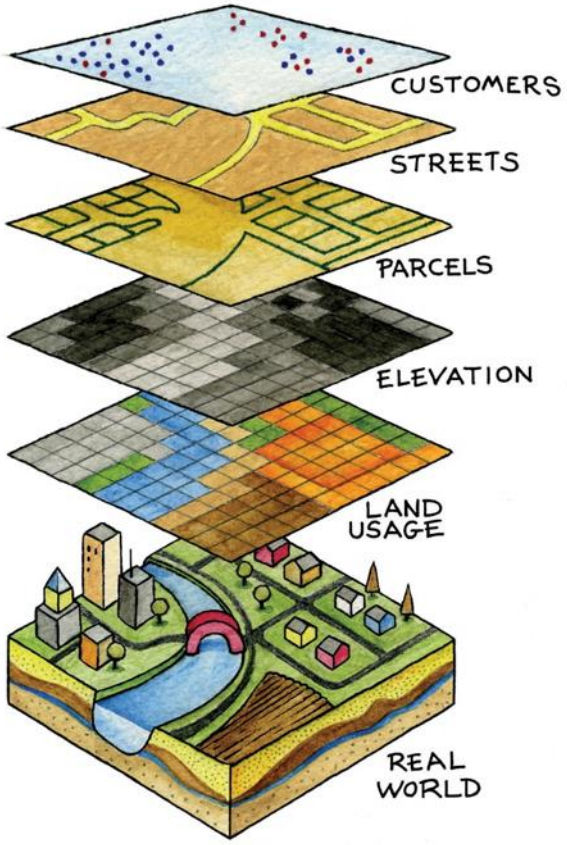


Census *Lower level Super Output Area* - average population = 1614



Census *Medium level Super Output Area* - average population = 7787

A GIS is just a model…



Source: www.cachecounty.org/gis/

"A message to mapmakers: highways are not painted red, rivers don't have county lines running down the middle, and you can't see contour lines on a mountain."

William Kent, Data and Reality (2000)

Introduction to the practical

- File formats
  - Shapefile – multiple files
- Projections
  - Coordinate Reference System
- Website
  - www.ondemandmapping.org.uk/igis/