

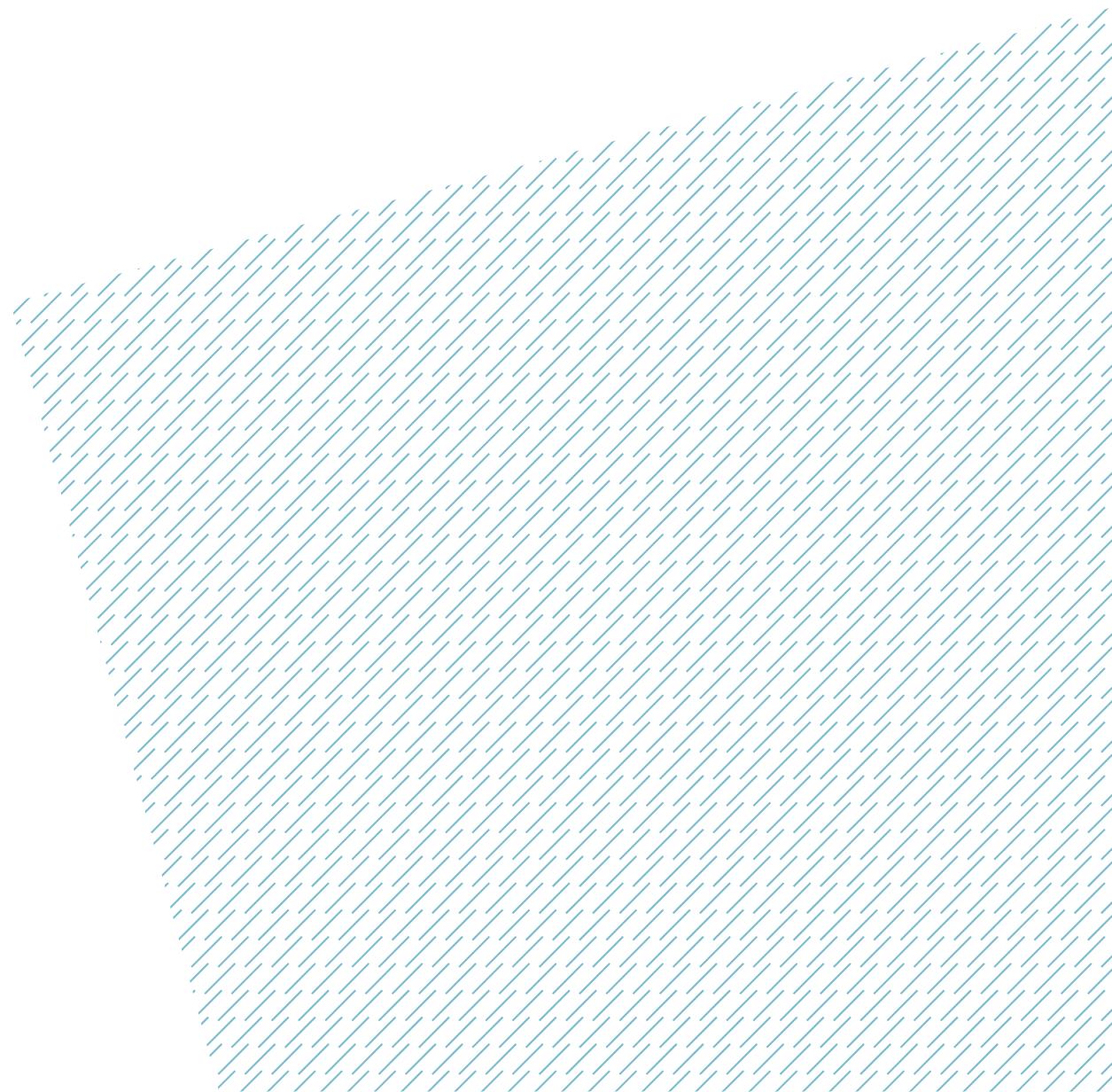


Putting your Data on the Map!

An introduction to Geospatial data and tools to use them!

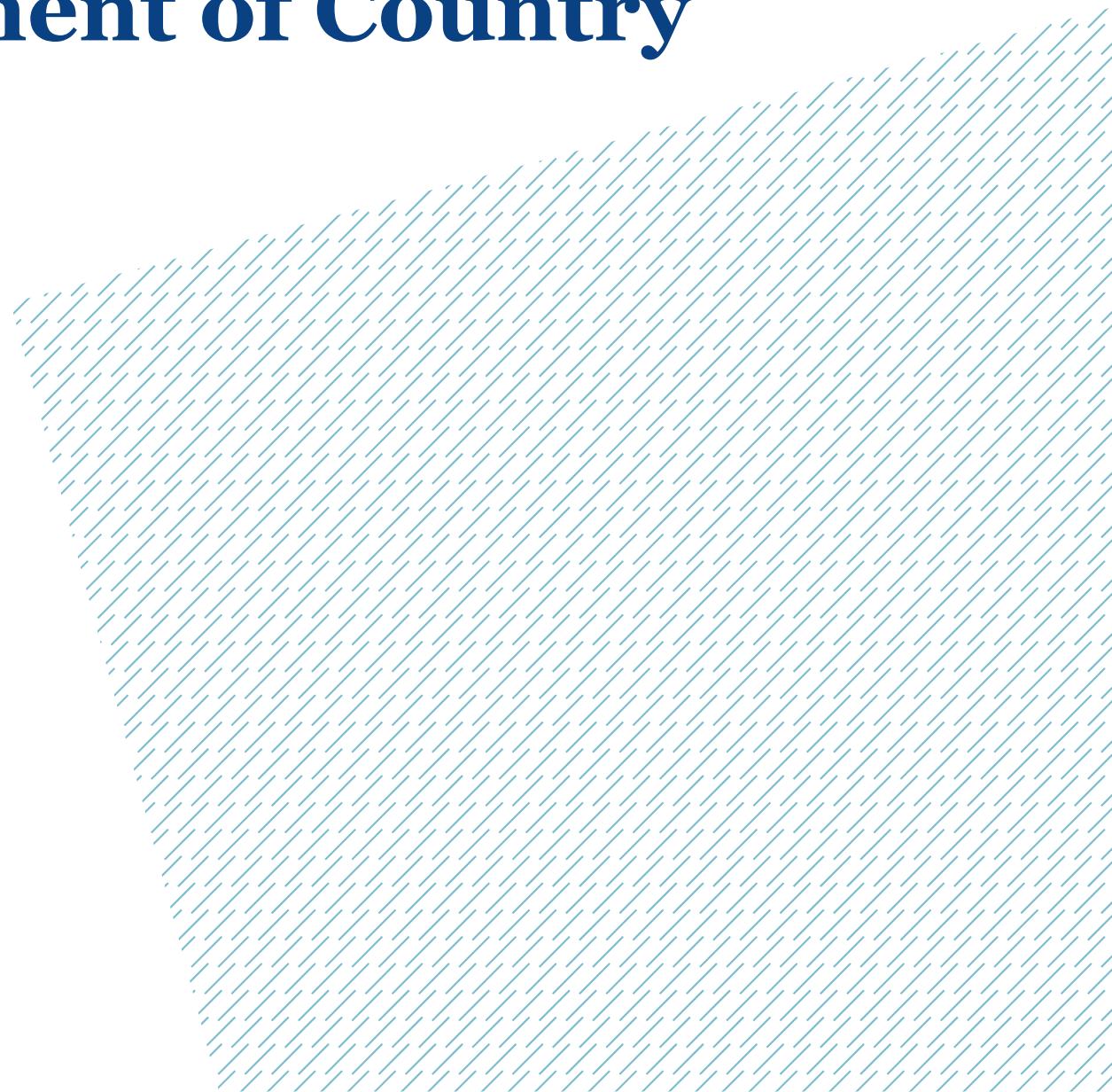
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Research Data Specialist, Melbourne Data Analytics Platform





Acknowledgement of Country



What does GIS stand for?

Spatial Data

- Any sort of data where it's important to know about where the data is located in relation to other data in real space

Geospatial data

- The above definition but you want to know where it is in relation to other real world locations on the globe

Geographic Information Systems

- A systematic way of dealing with the (Geo)spatial dimension of data, usually digitally



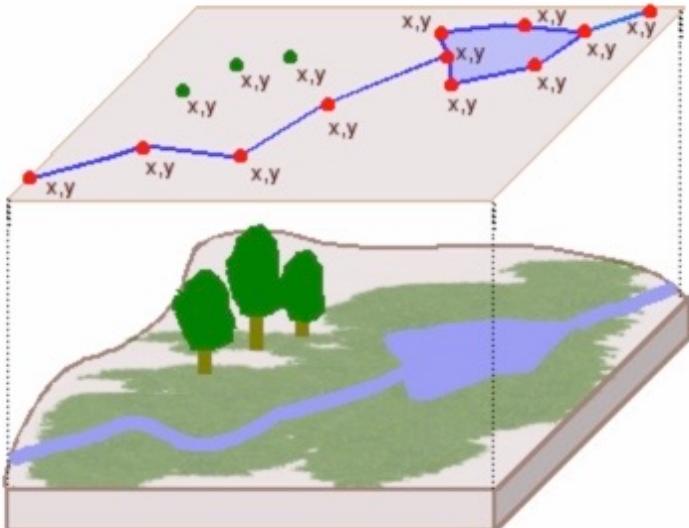


Vectors

Good for explicit objects

Essentially a group of:

- points
- Lines
- Or Shapes



<http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/03%20-%20Geographic%20data%20models.html>



Search by Country, Territory, or Area

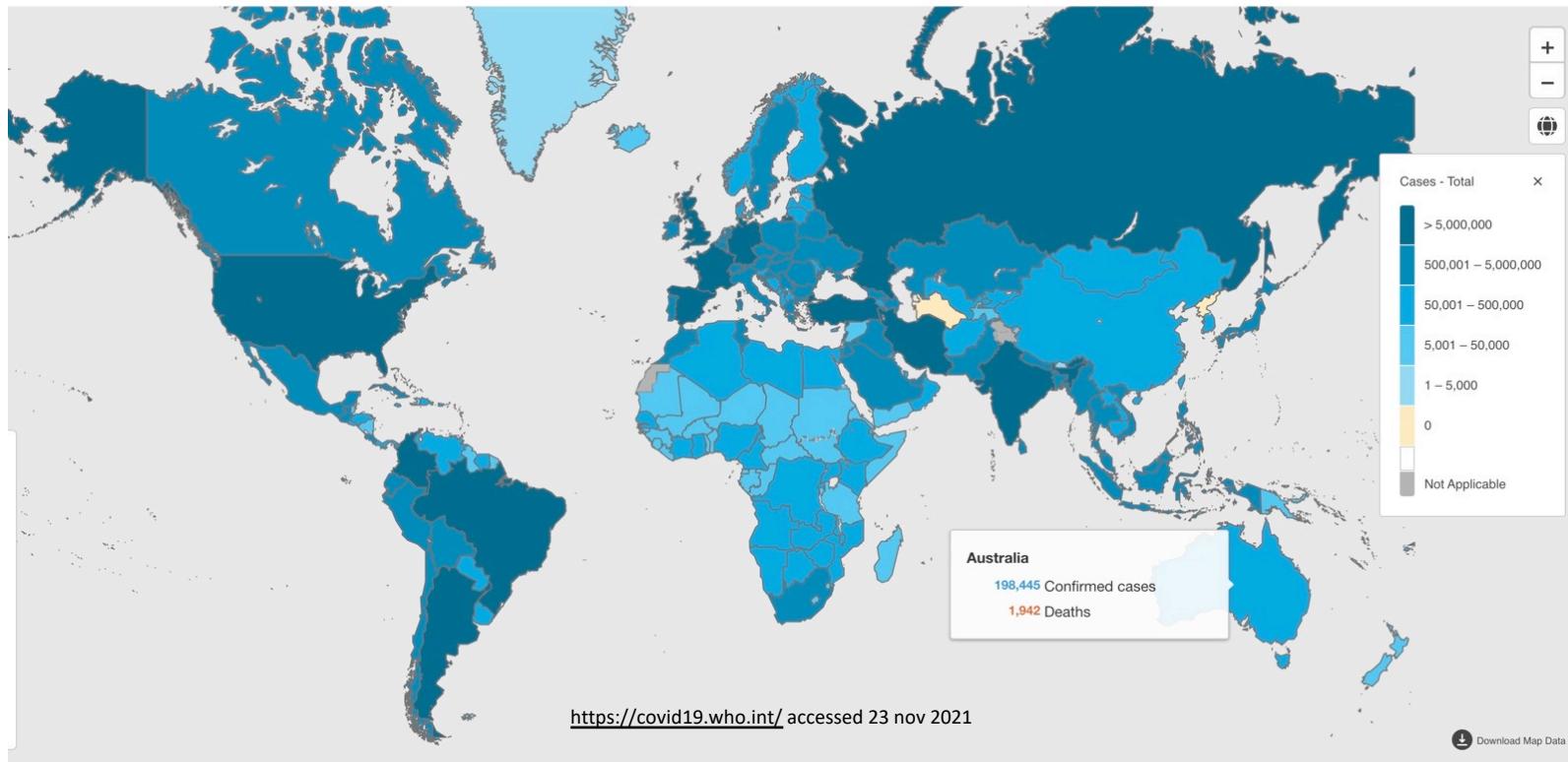
Covid-19 Response Fund



Donate

WHO Coronavirus (COVID-19) Dashboard

Overview Measures Data Table Explore



Connected to a table full of “other” data (usually)
i.e. columns of geography, and columns of numbers/text

What kind of data am I looking for?

Vector data:

- Shapefiles (.shp and riff raff)
- Geojson
- Geopackage
- Geodatabases (ESRI and PostGIS)

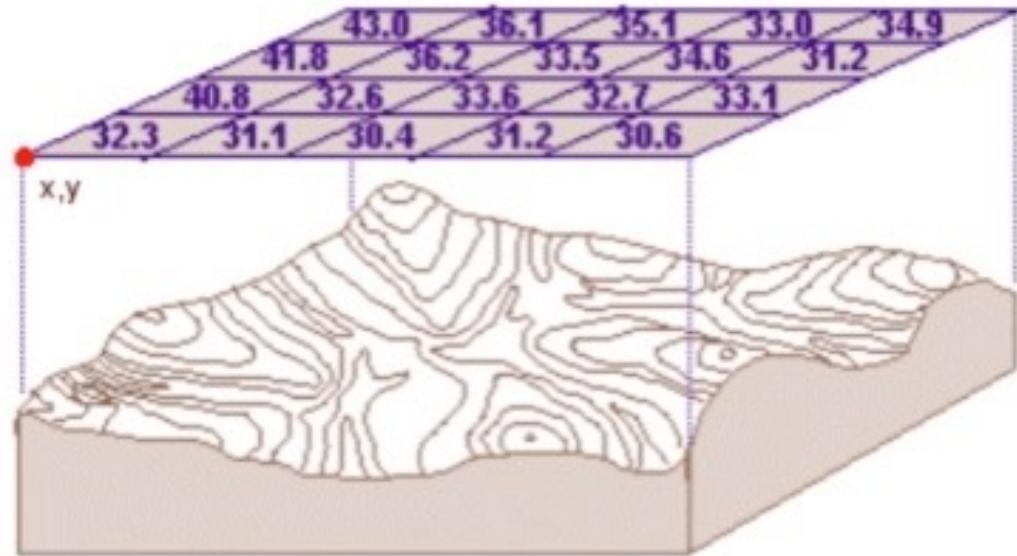
Rasters

Good for Spatially continuous data

A spatial grid with values associated with each cell on the grid

Data are an “image of some sort” associated with a location

- Can be actual imagery (each cell has a Red Green and Blue value)
- Or Pseudo imagery, where each cell denotes some other sort of value (I.E. the elevation at that Cell)
- These datasets must have the image and the following metadata:
 - The Position of one of the corners (usually bottom left)
 - The size of the cells (ie. 1 meter by 1 meter)
 - And the size of the image (x cells by ycells)
- And you have a Raster



<http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/03%20-Geographic%20data%20models.html>

Some Raster Datatypes:

- .ecw (Erdas style)
- Grid (ESRI style)
- Geotiff
- Geojpeg
- Ascii (text)

Other GIS types

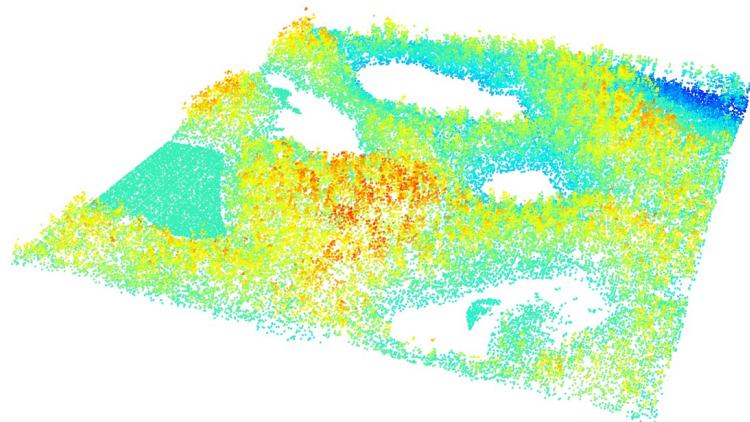
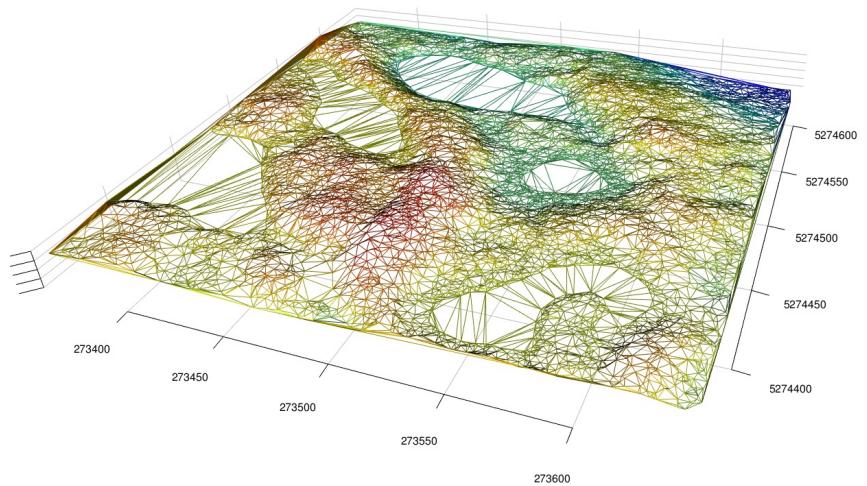
NetCDFs - (my favourite) – basically a stack of rasters

Basemaps – Streaming imagery that change with zoom (think google maps)

Point Clouds – 3D points describing the 3D morphology of the area, output of LiDAR and drone data

Meshes – 3D models of data built with edges of surfaces

Trajectories - like Vectors that have different positions through time



Deciding which is for you is a human decision

Most things can be represented by vector or Raster

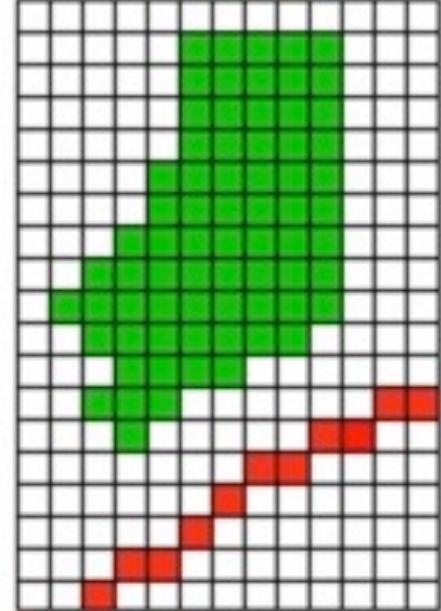
- Its up to us to decide which one to use
- And that will dictate what kinds of analyses we can do to it
- (however its easy go between, but converting comes with assumptions)



Real World



Vector



Raster

<http://www.geography.hunter.cuny.edu/~jochen/GTECH361/lectures/lecture05/concepts/03%20-%20Geographic%20data%20models.html>



Putting the “Geo” in Geospatial

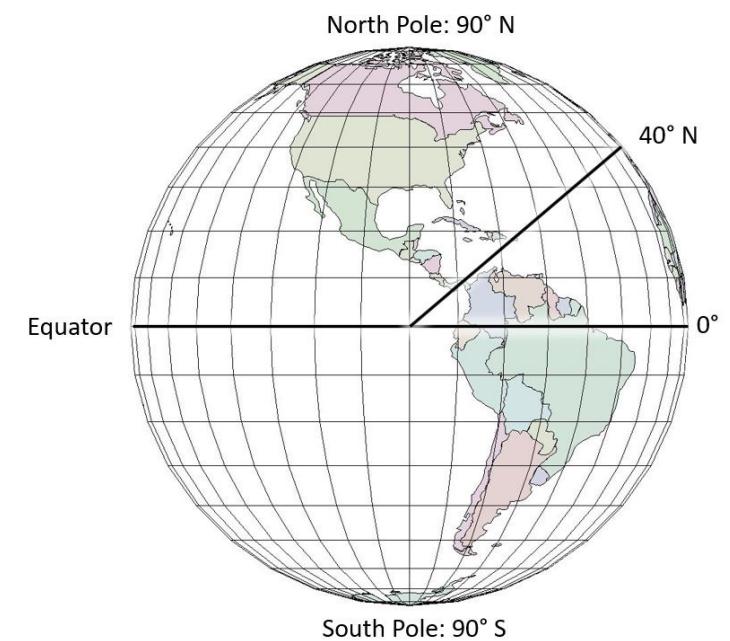
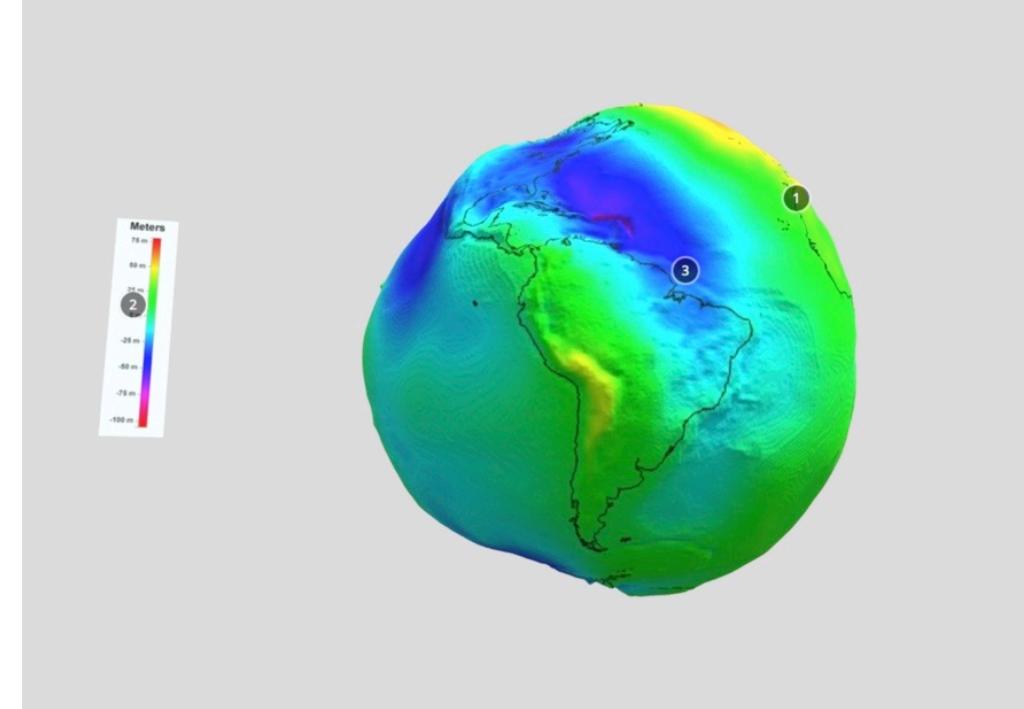
The Earth is spherical-ish

- Can be modelled as a geoid ([link](#))
- With a datum (point to reference to)

Geographic Coordinate Systems (GCS) put our data on the surface of a geoid using:

- Latitudes (90 S to 90 N) (North -South)
- Longitudes (180 E to 180 W) (East – West)

Warning: These are not straight line distances, so won't tell you how far you have run!





Which GCS, is your BFF?

Choose based on:

- Scope of the map (global vs regional)
- The region you are focusing on

Note: You can usually convert from one system to another using a GIS

GCS	Best for
Global	
- WGS 84	Works for most regions and globally
Local	
- Geographic Datum of Australia (GDA94) - GDA2020	Datum for Australia
- ETRS89 datum	Datum for Europe
- NAD83	Datum for North America
- African Geodetic Reference Frame (AFREF)	Datum for Africa
- South America Datum (SAD1969)	Datum for South America
- India Geodetic Datum	Datum for India
- datum GCJ-02	Geographic datum for China



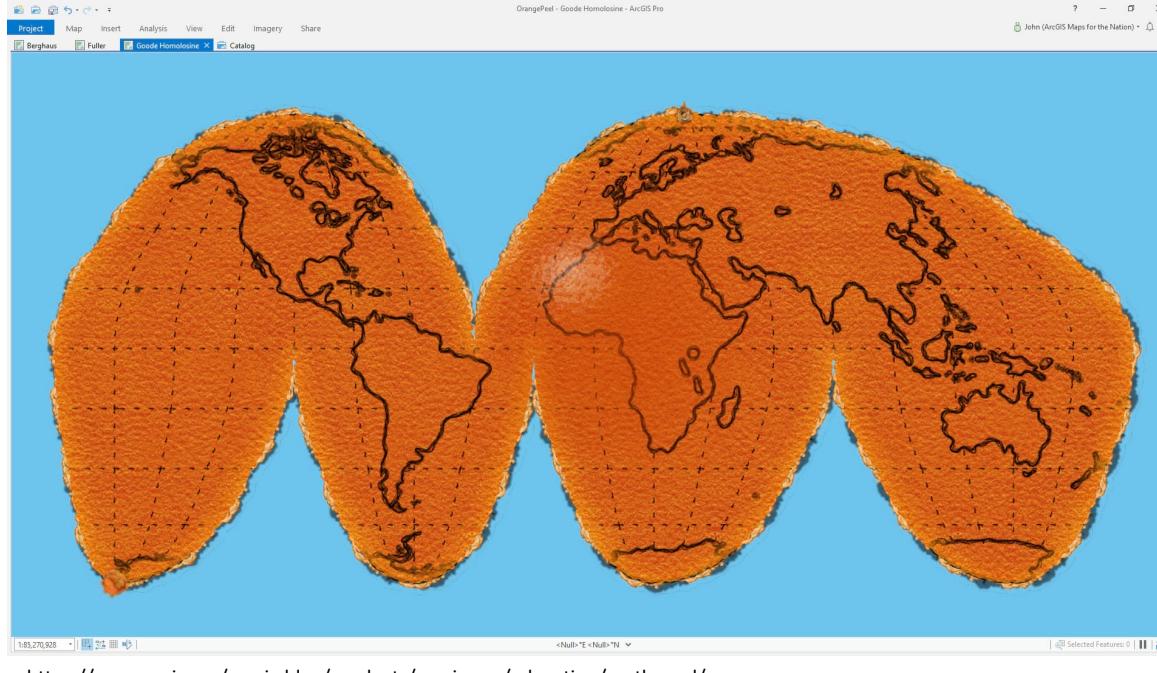
Flat Earthing: Projecting our geoid onto a map/screen

The earth can't be flattened onto a plane perfectly, it must be projected onto a plane using a “projected Coordinate System” (PCS)

No projection is perfect, you have to choose what to “preserve”:

- Compass directions between two places
- distances between two places
- Areas of polygons on the map
- Keeping the shapes on the map correct accurate

At best, you can “preserve” two to three of those



<https://www.esri.com/arcgis-blog/products/arcgis-pro/education/earth-peel/>

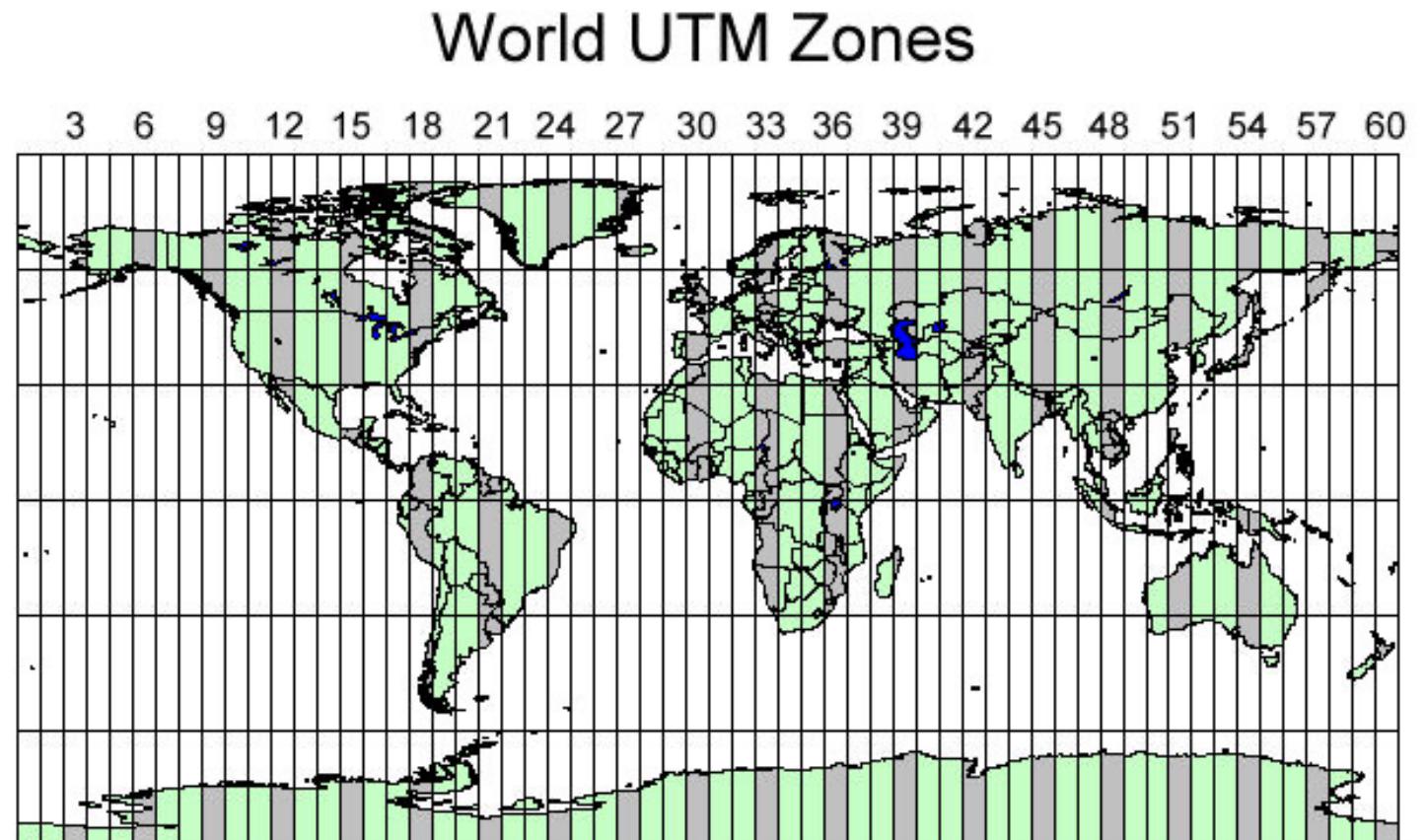
Best just to choose one and stick with it for each project!

- Choose based one that fits your analysis,
- and the story your map wants to tell!

Universal Transverse Mercator

Good for local stuff

- Focused maps (up to 100's of kilometers in extent)
- Preserves distance, direction, and area well
- Need to pick the right zone for your project

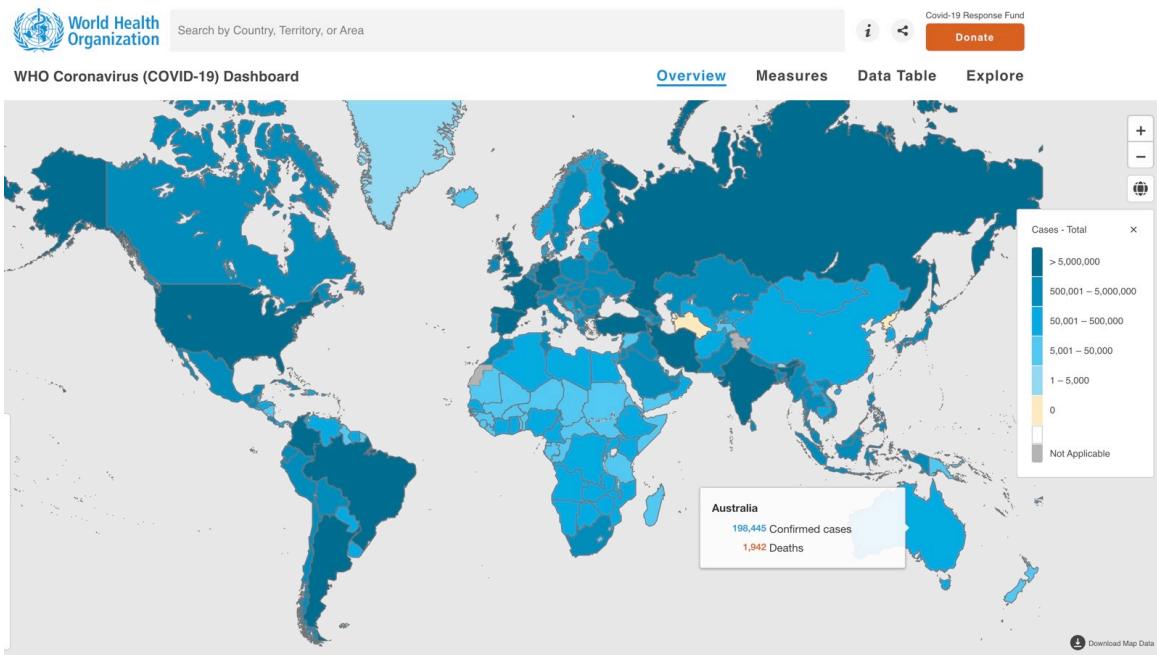


https://www.xmswiki.com/wiki/UTM_Coordinate_System

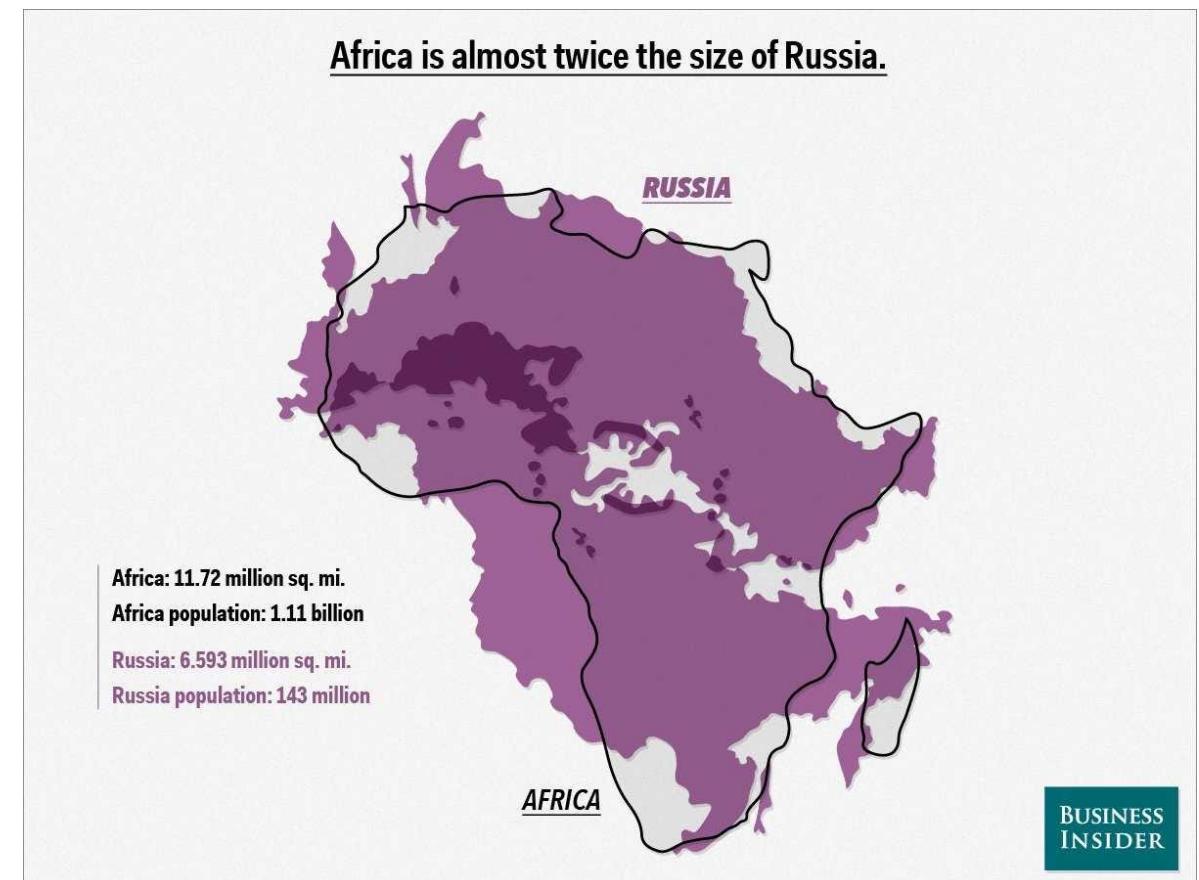


Maps can lie to you

Mercator makes the Northern Hemisphere look much bigger than it is, biasing our analysis away from the Equator!



Note: This isn't intentional, most zoomable world Maps online use "Web Mercator" because it is the simplest Projection to implement



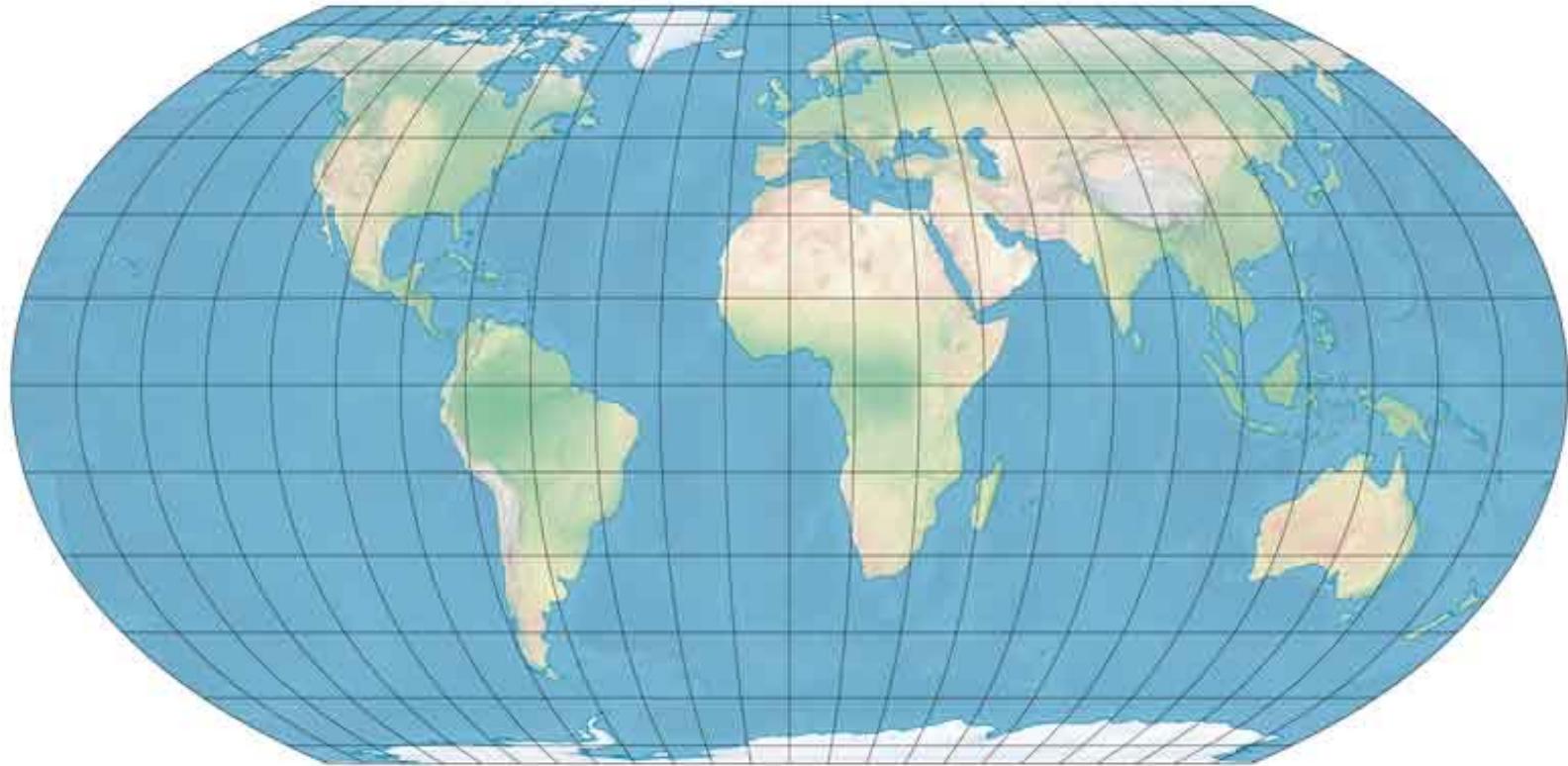
Equal Earth, the best new global all rounder

Equal Earth

- Without blank spots!
- This projection preserves the correct Areas for all shapes,
- With distance, direction and some shape distortion

This will be our little project!

- See here for more details (<https://epsg.io/8857>)



<https://www.esri.com/about/newsroom/arcuser/equal-earth/>



Now we have the fundamentals to do GeoSpecial research!

What type of GIS data Suits your Data?

- Vector, Raster

Which Geographic Coordinate System should I use?

- Based on the Scale of your Map (what part of the world you want to show) and where it is Centered

Which Projected Coordinate System should I use?

- Based on the analysis you need to do and the story you want to tell with a figure

Which tool should I use?



With So many tools to choose from!

Big paid software suites

- ESRI ArcGIS, and ArcPro (Arcpro Python API)
- ERDAS Imagine
- MapInfo
- Matlab spatial toolkits

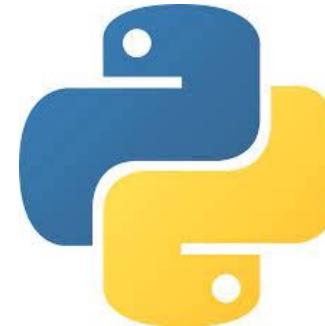


R packages

Vector Data: Sp, Sf

Raster Data: Raster

Interactive mapping: leaflet



OSGeo4

QGIS (GUI)

Command line tools (connected to QGIS):

OGR

GDAL

GRASS GIS

SAGA GIS

And much much more

Python Packages:

Vector Data: Geopandas, Shapely,

Pyshape, Ogr

Raster Data: RasterIO, Xarray, Rioxarray

Interactive Mapping: pydeck, folium



My Favorite GIS tools and resources

QGIS documentation: https://docs.qgis.org/testing/en/docs/user_manual/introduction/getting_started.html

GeoPandas documentation: <https://geopandas.org/>

RasterIO documentation: <https://rasterio.readthedocs.io/en/latest/>

Gdal documentation: <https://gdal.org/>

R Geospatial workshop from data carpentry: <https://datacarpentry.org/r-raster-vector-geospatial/>

ArcGIS blog: <https://www.esri.com/arcgis-blog/overview/>