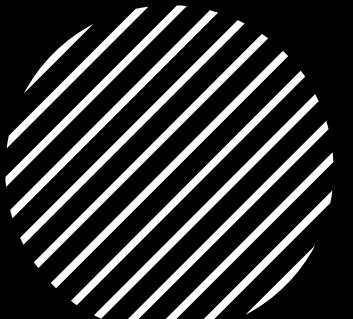




Preparation



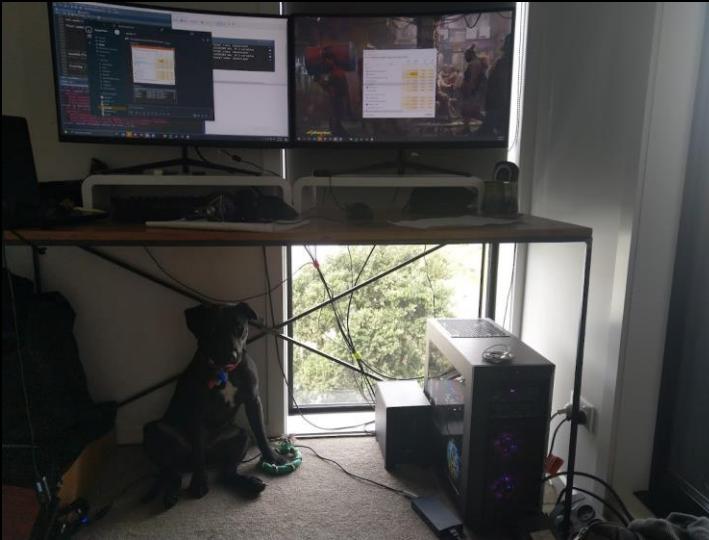
- R/Rstudio installed
 - `terra`, `rastervis` and `dplyr`,
`ggplot`, `ggspatial` installed
(`rgdal` - and `gdal` for MAC users?)
 - Workshop downloaded and unzipped
-
- **Workshop assumptions:**
 - Familiar with the basics of R (Intro to R will cover these?)
 - Assignment, Functions/Arguments, Loading basic data, directories and relative/absolute file paths (projects).

Geospatial Data in R

Manipulation and Mapping

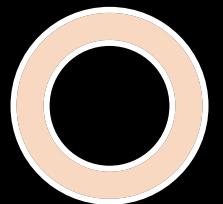
André Bellvé

Pronouns: he, him | @AndreMBellve





“Hello world”



- Laura Duntsch

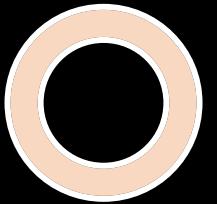


- Javiera Benavente



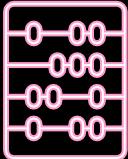
- Quinn Asena





How the workshop will run

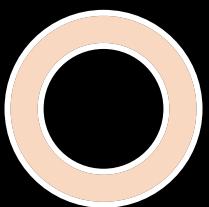


- Slides
- Live-coding A small icon of a code editor window showing four lines of code: '0-00', '000', '00-0', and '0-00'.
- Exercises
(`resBazGeospatialWorkshop_empty.rmd`)
- Workflows





Overview



- House-keeping
- Applications
- Simple features
 - Introduction
 - Reading
 - Mapping
 - Manipulating
- Rasters
 - Introduction
 - Reading
 - Plotting
 - Manipulations
- Combining sf and terra
 - Data extraction
 - Visualisation



What discipline(s) are you coming from?



What stage are you at?



Are you prepared?

0



There was
prep?

0



I have R and
RStudio
installed

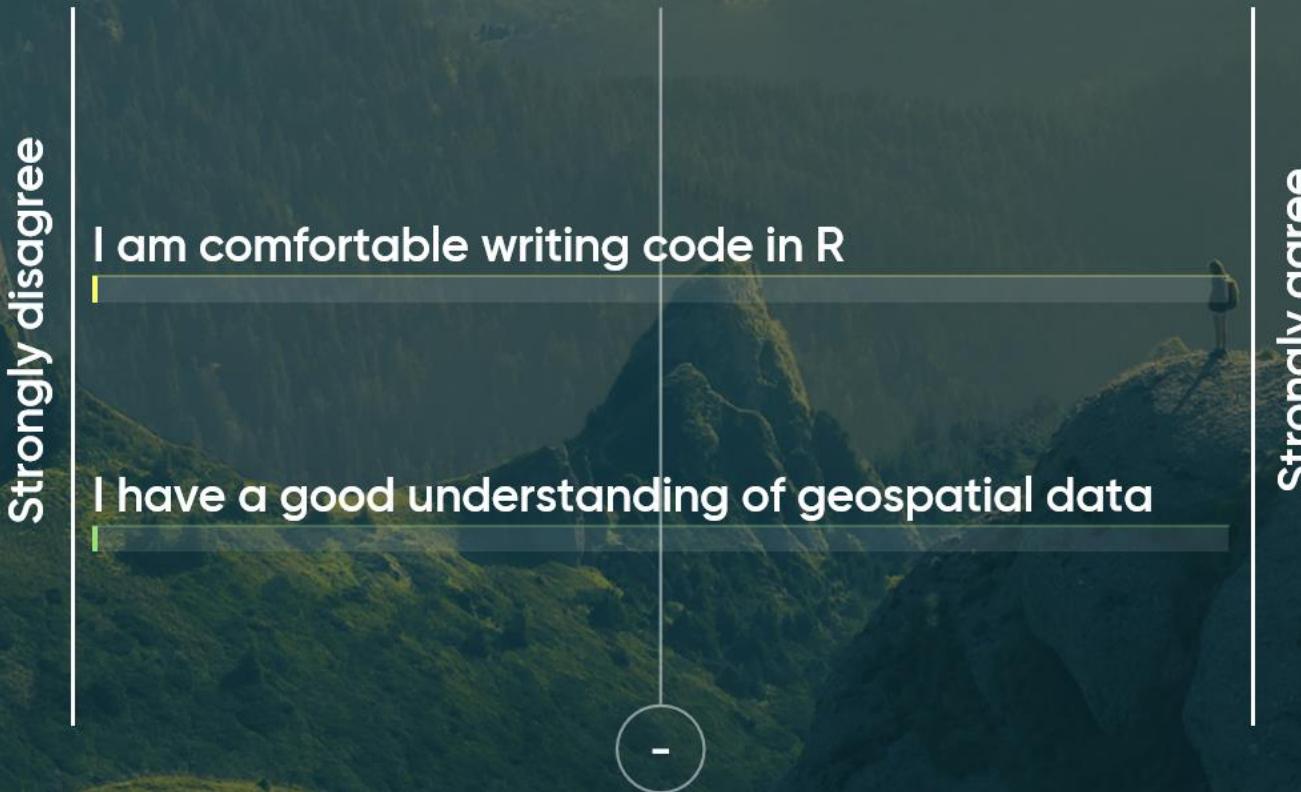
0



I have all the
packages
installed too;
scouts are
always
prepared!



How much experience do you have with geospatial data and/or R?



How familiar are you with ggplot2 syntax?

```
1 ggplot(mydata, aes(x = time, y = count)) +  
2   geom_point() +  
3   theme_classic()
```



gg-what?



I vaguely understand what that code means



ggplot2 for lyfe



I am a gg-wizard

Press S to show image





House Keeping

- Unzip and open up Rstudio project:

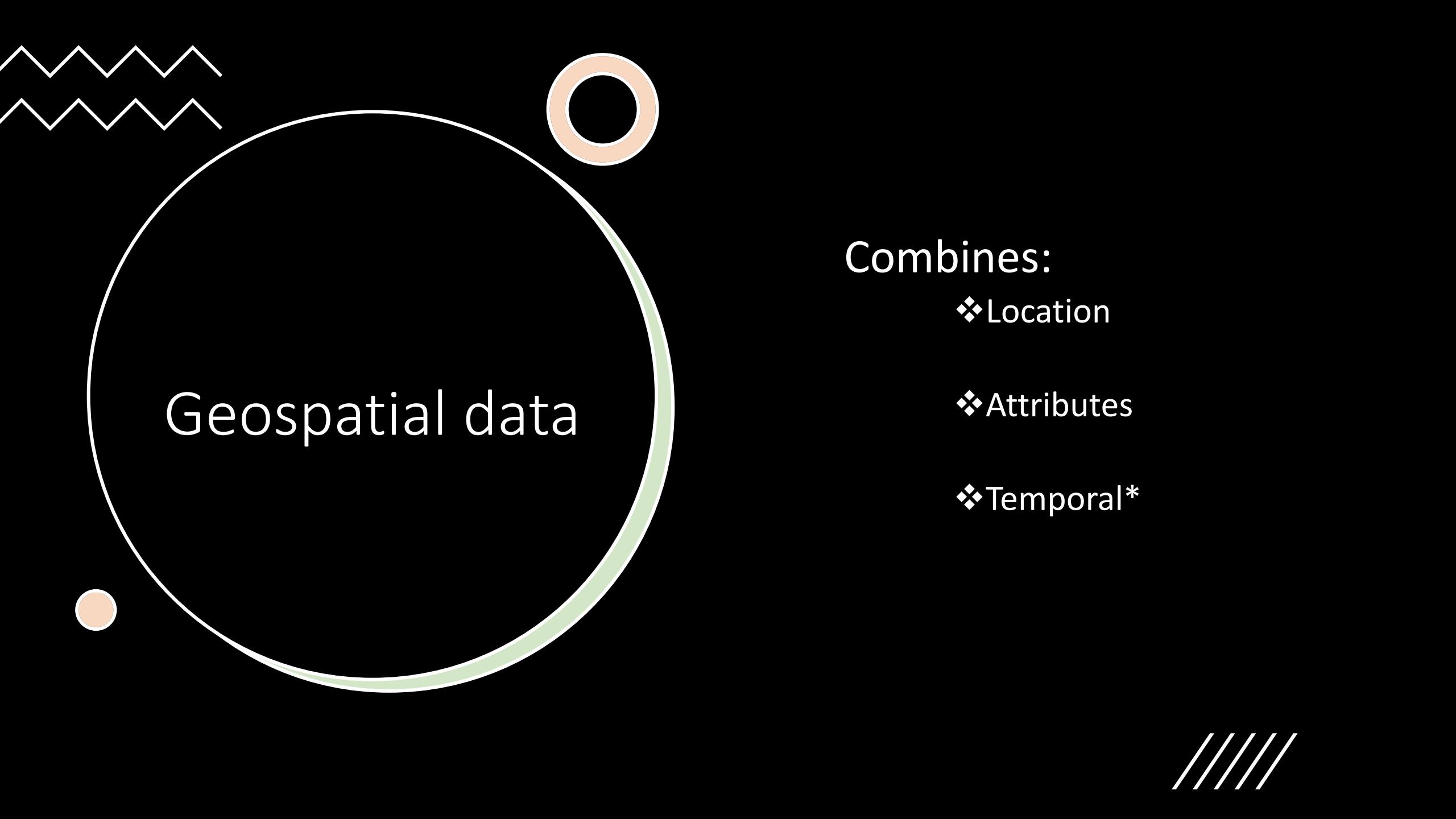
complete	24/11/2021 10:08 AM	File folder
data	11/11/2021 11:14 AM	File folder
extras	16/11/2021 6:31 PM	File folder
graphs	24/11/2021 10:01 AM	File folder
geospatialResBaz	24/11/2021 8:21 AM	R Project 1 KB
README	23/11/2021 5:23 PM	File 4 KB
resBazGeospatialWorkshop_empty	16/11/2021 6:42 PM	R File 3 KB
resBazGeospatialWorkshop_md_empty	24/11/2021 9:51 AM	RMD File 5 KB

- .Rmd chunk / R script

- Google Doc

- Mute when you aren't talking

- Be respectful!



Geospatial data

Combines:

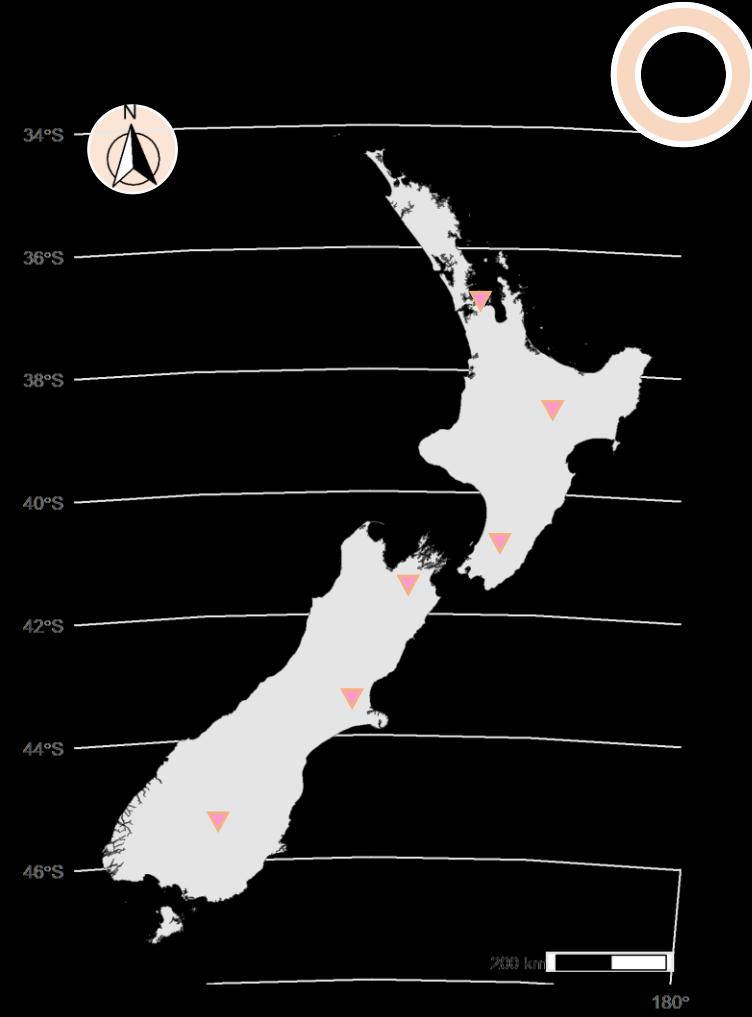
- ❖ Location

- ❖ Attributes

- ❖ Temporal*



Maps





Movement Data

- Visualise tracks through time and space
- Model behaviour
 - Animals?
 - Humans?
 - Non-living components?

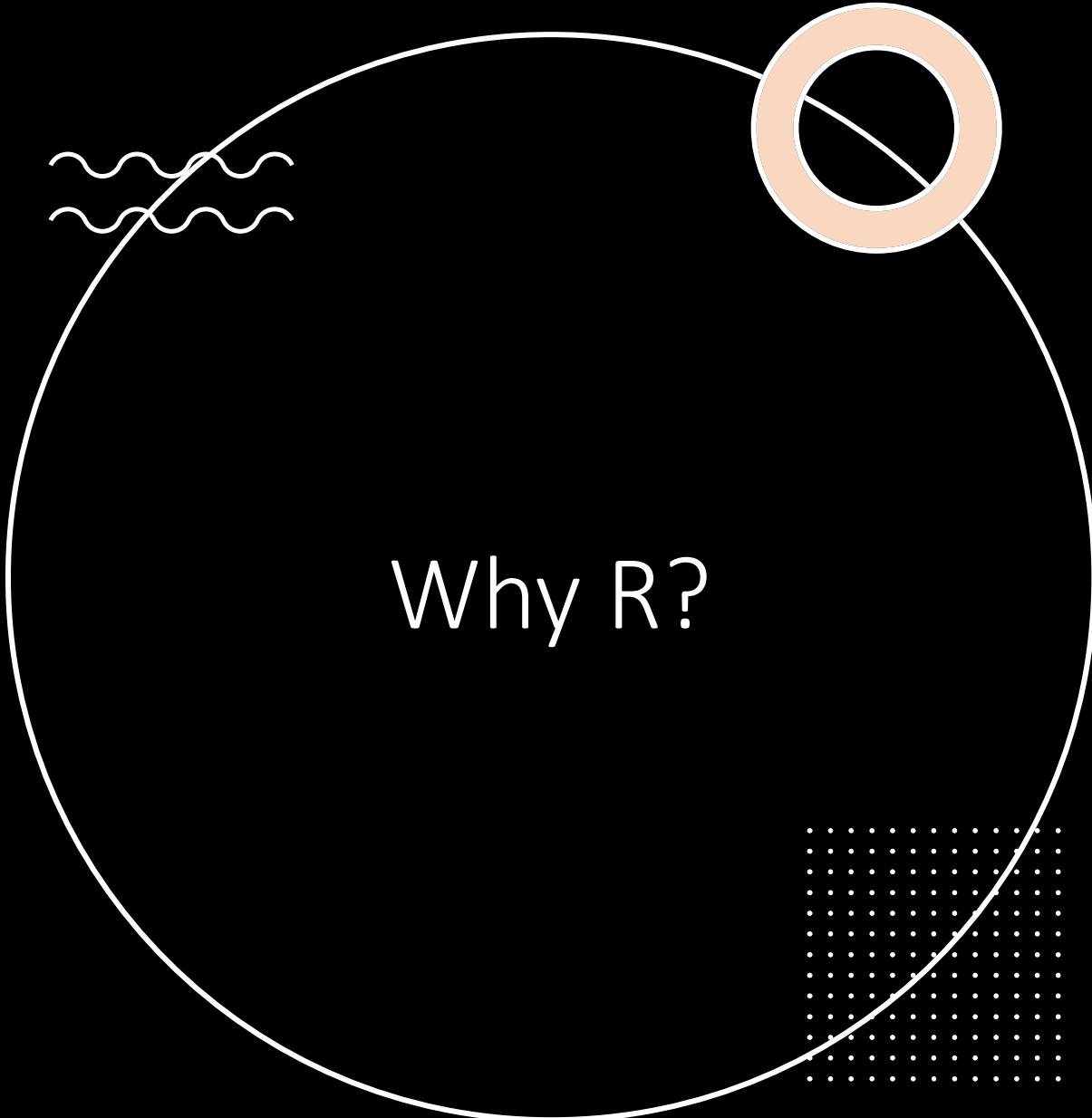


Modelling



- Estimate species ranges
- Differences between locations
- Spatial socio-economics
- Hazard modelling
- Predictions through space or time





- The one I know...
- Lots of packages for analysis
- Particularly geared towards ecology/biology
- Python is also good but the general workflow ideas will also apply there!



- sp → sf
(simple features)
- raster → terra
(gridded data)

Simple features (sf)

- Points
- Multi-points

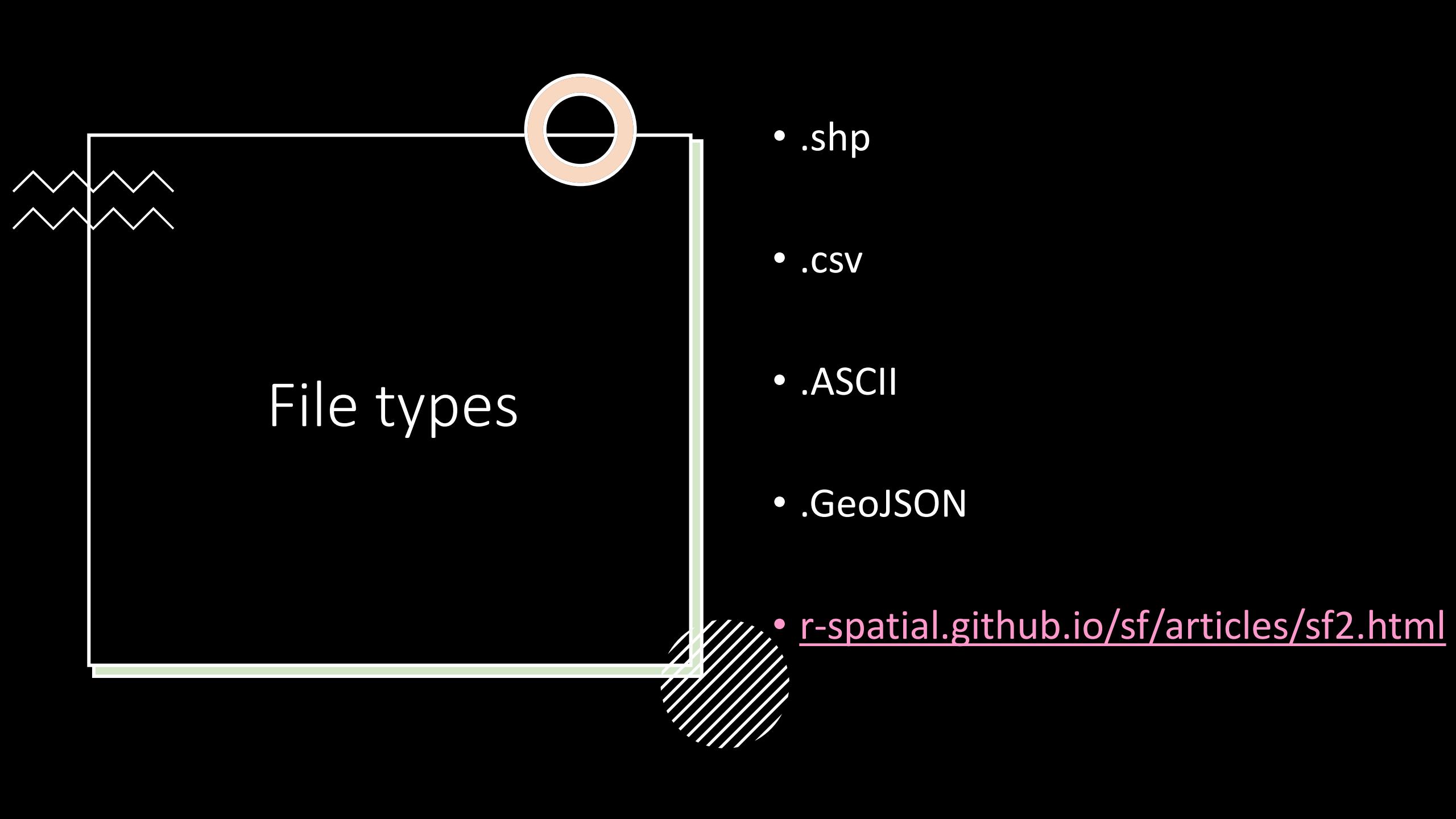


- Lines
- Multi-lines



- Polygons
- Multi-polygons





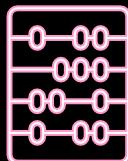
File types

- .shp
- .CSV
- .ASCII
- .GeoJSON
- r-spatial.github.io/sf/articles/sf2.html



Data sources

- [NASA](#)
- [ESRI Open datahub](#)
- [LRIS](#)
- [Koordinates](#)
- [NZEnvDS](#)
- [Many more...](#)



Exercise One

1. Read in nz_coastlines shapefile data
2. Plot these data

Datums / Projections

Coordinate Reference Systems

<http://bl.ocks.org/vlandham/raw/9216751/>

ESPG

WGS84 (4326)

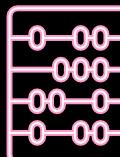
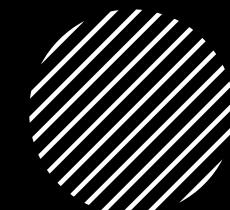
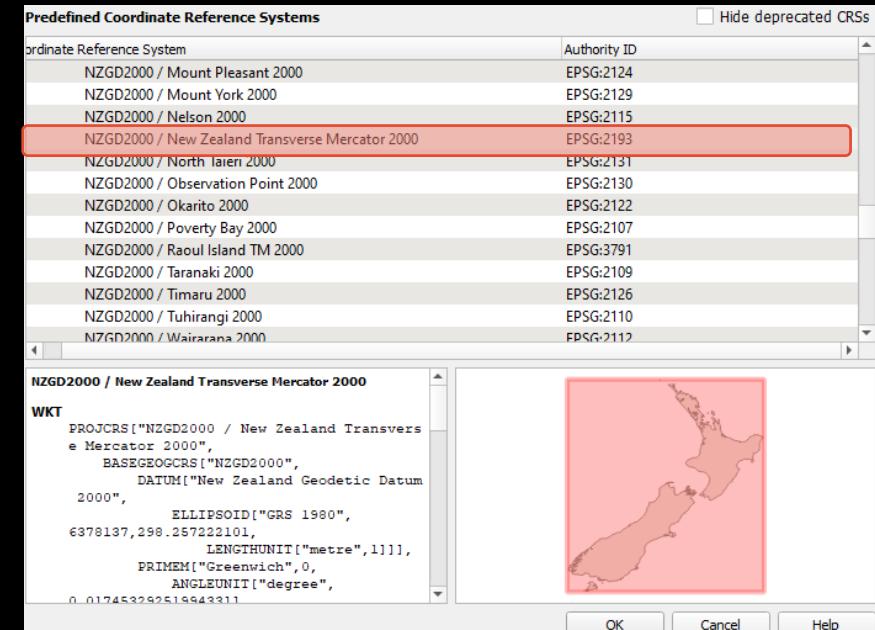
- Classic Lat/Long

NZGD2000 (2193)

- Snippets of the world
- Measured in metres

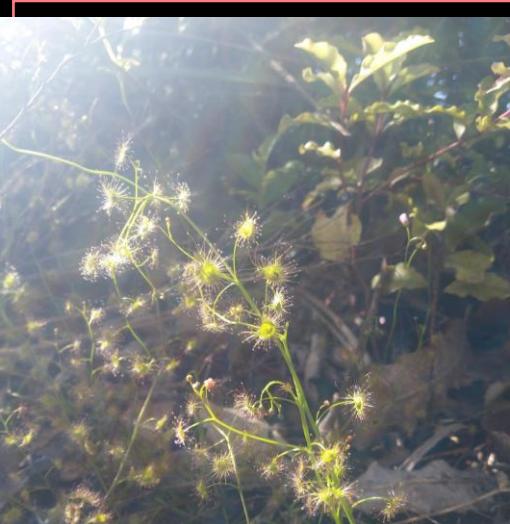
NZGD49 (27200)

- Deprecated

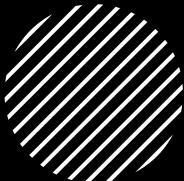




Sundews



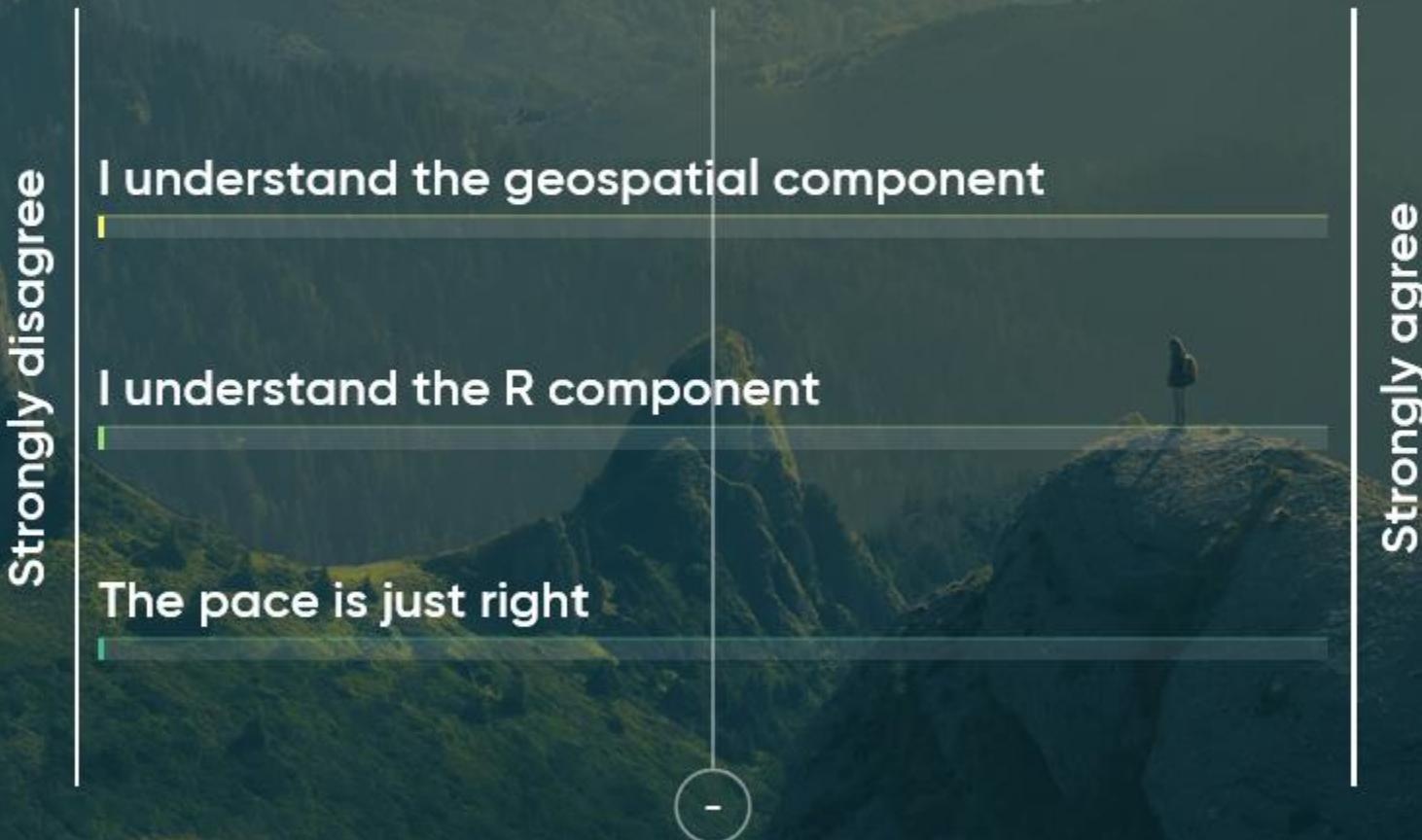
- *Drosera* spp.
- Carnivorous
- Many natives!



Exercise Two

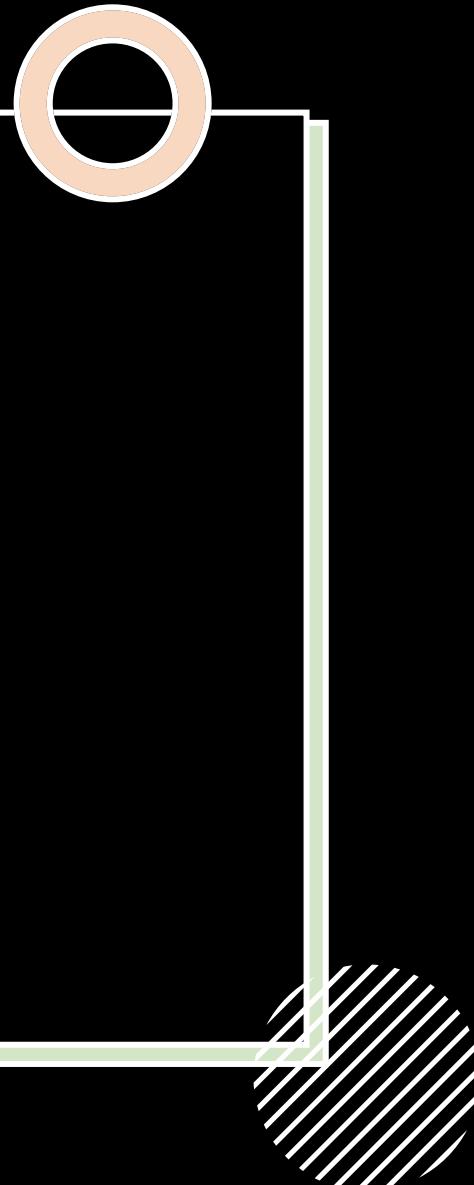
1. Read in drosera.shp point data
2. Transform these to NZGD2000
3. Plot points (colour by species)
and outline of NZ

Scales





ggspatial

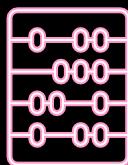


- Annotating maps

❖ Arrows



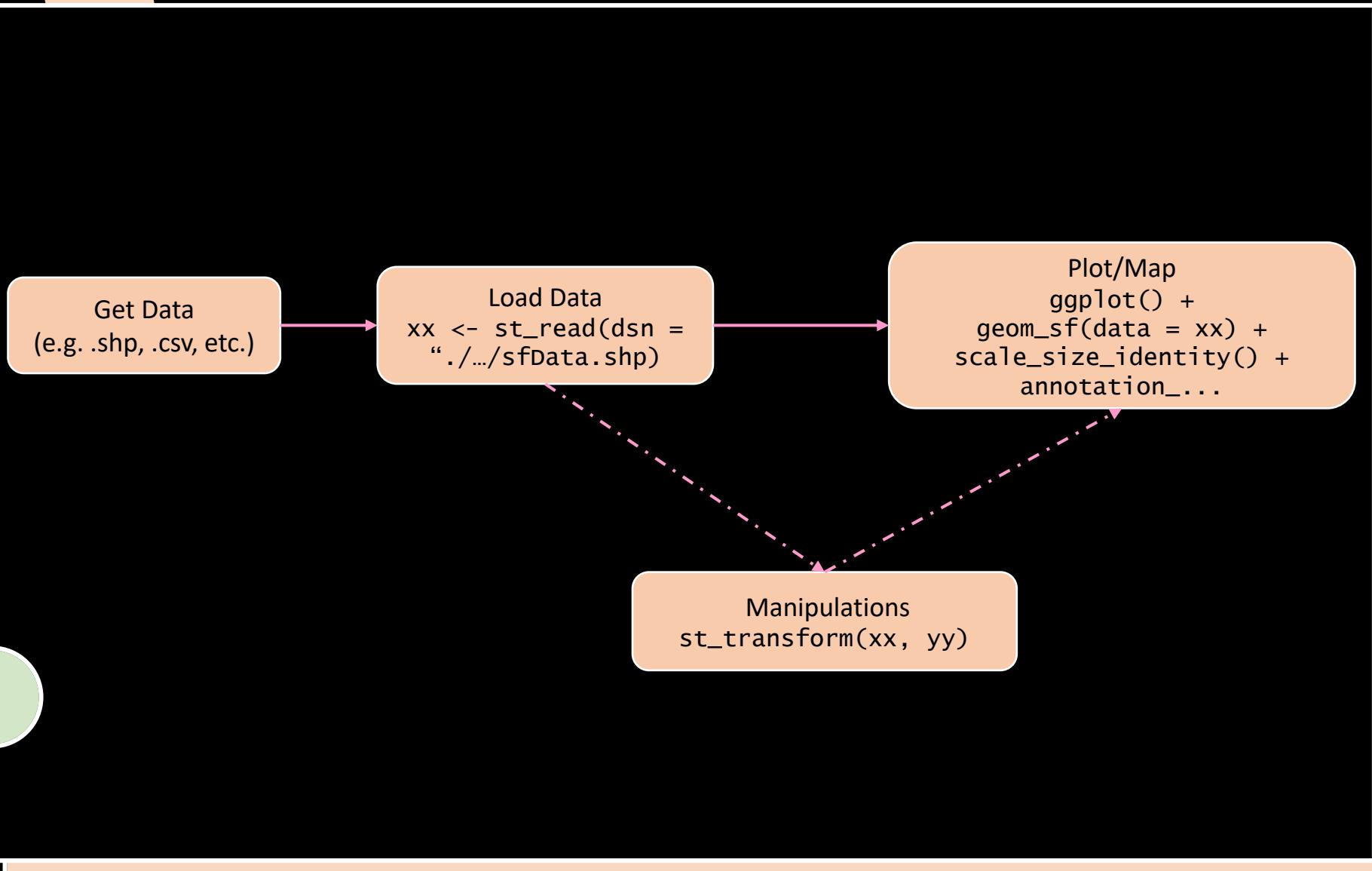
❖ Scales



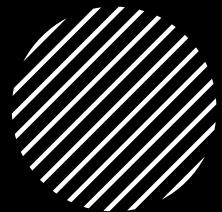
Exercise Three

1. Add to your map:
 - Scale bar
 - North arrow
2. Save your map

Workflow



Manipulations



- Cropping



- Masking



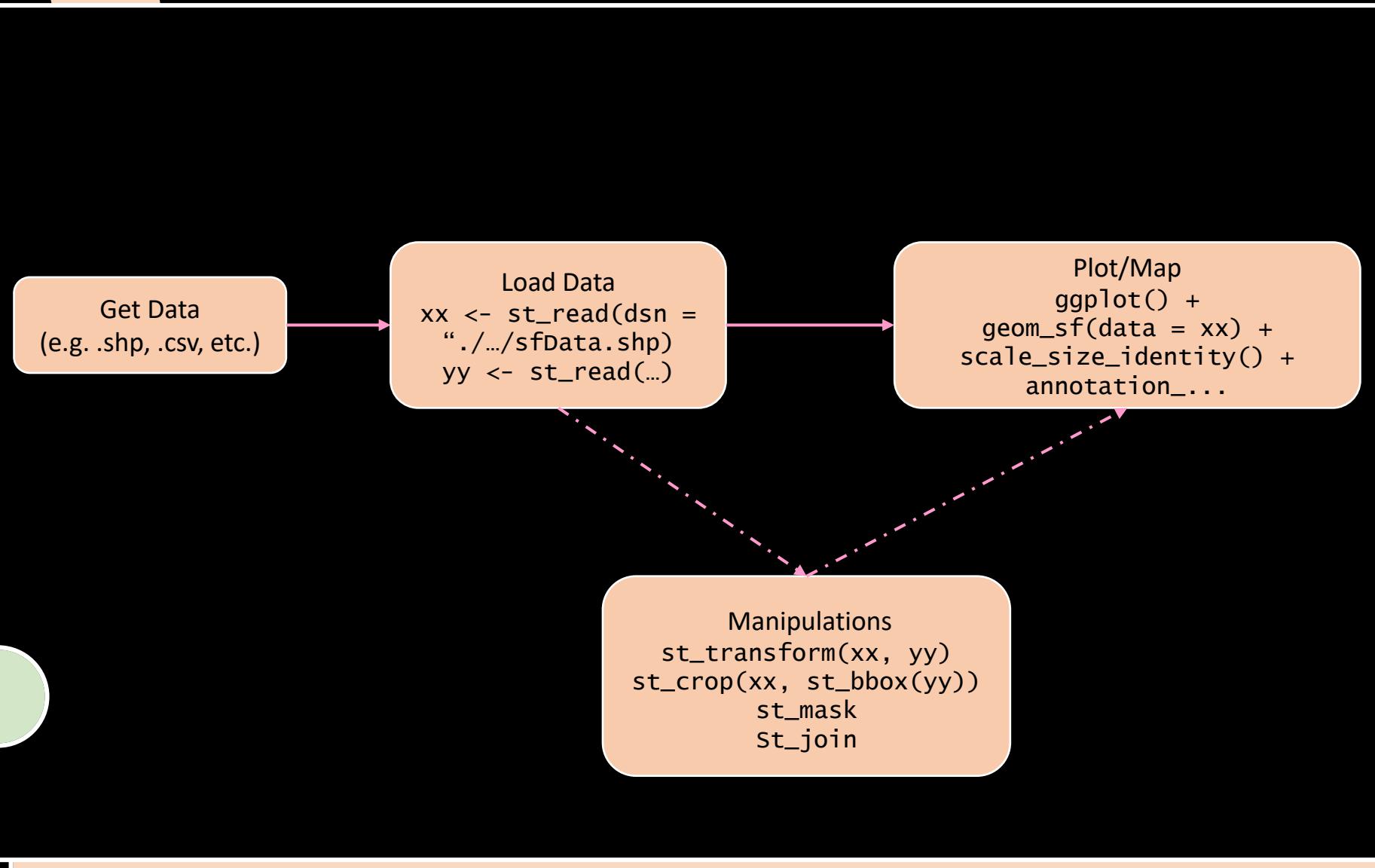
- Joins

0	-00
0	000
0	00-
0	-00

Exercise Four

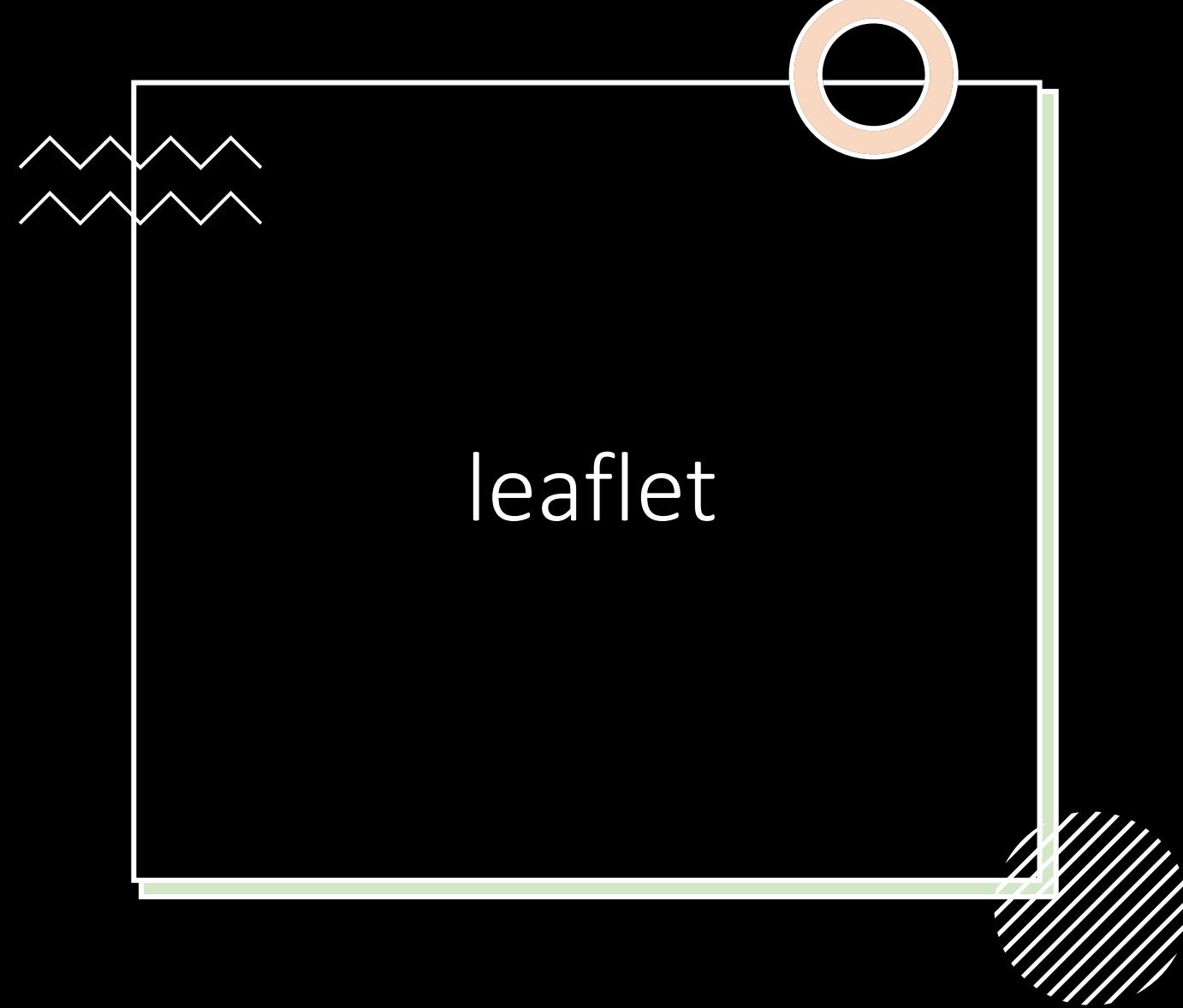
1. Use the stew.bbox to crop NZ coastline and drosera data layer to match
2. Plot the cropped sf objects

Workflow

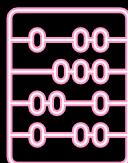


Scales





- Interactive geospatial data in R
- Add maps from a variety of sources
- Point data can have popups
- Does not work readily with *sf* objects



Exercise Five

1. Read in the `drosera.csv` file
(`read.csv`)
2. Convert df to a leaflet object
3. Make the species as a pop-up value
4. Open the viewer



Further reading

- Lovelace et al. *Geocomputation with R*
- sf cheatsheet:
[geospatialResBaz/extras/sf.pdf](#)
- leaflet for interactive maps

Go to www.menti.com and use the code 9639 7923

 Mentimeter

What was the trickiest part so far?



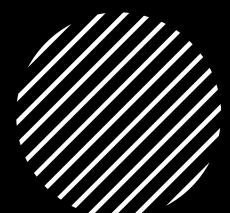
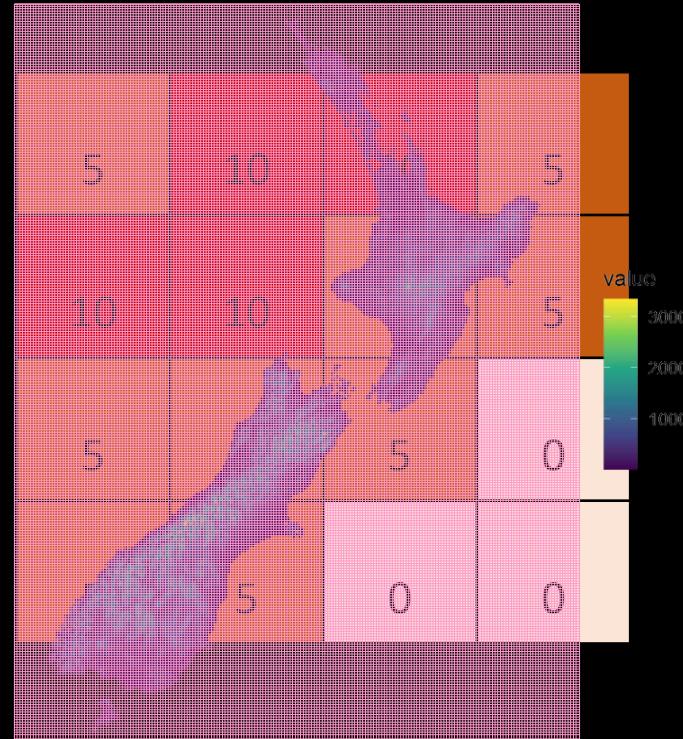
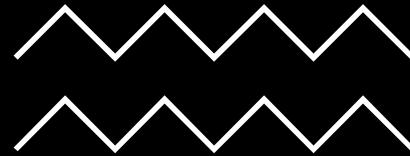
Rasters

Gridded data (a.k.a. matrix)

File formats

E.g. tif, GeoTiff, SAGA, ENVI, etc.

- Types
 - Numerical
 - Categorical
 - Logical
- Min? Max? Mean? Factor?

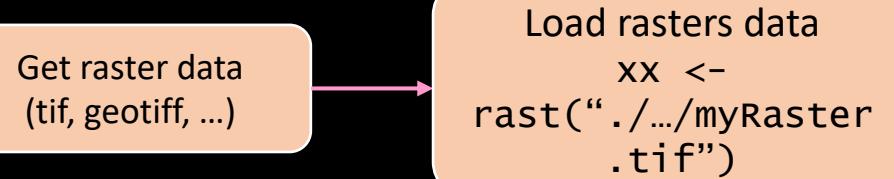


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0	00
00	0
0	00

Exercise Six

1. Load the “precip_warmQtr.tif” file assign it to the name **precip**
2. Load the “temp_meanColdQtr.tif” and assign it to **temp_cold**
3. Plot these raster data

Workflow





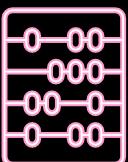
Extents and Resolutions

Extent :

The size of the page (same as sf)

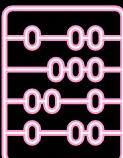
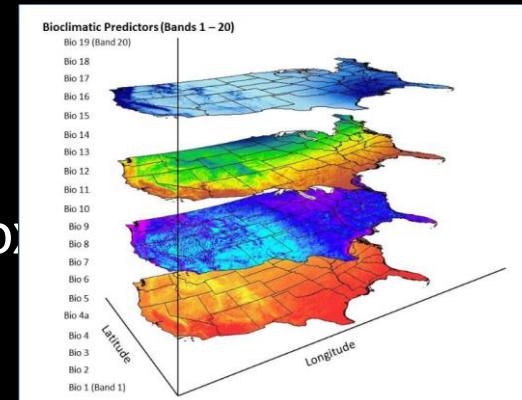
Resolution:

How large each square cell is on the page



Raster Stacks

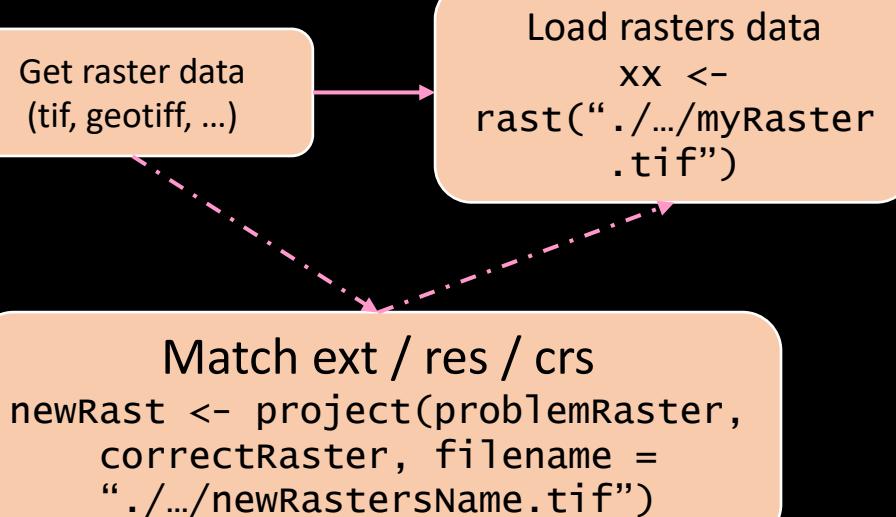
- Multiple rast can be simultaneously loaded or rast can be combined into a stack using c()
- Must have same:
 - Extent (bounding box)
 - Resolution
 - Dimensions
 - CRS
- Can be accessed like a list e.g.
`rastStack[[1]]`
`rastStack[["name"]]`



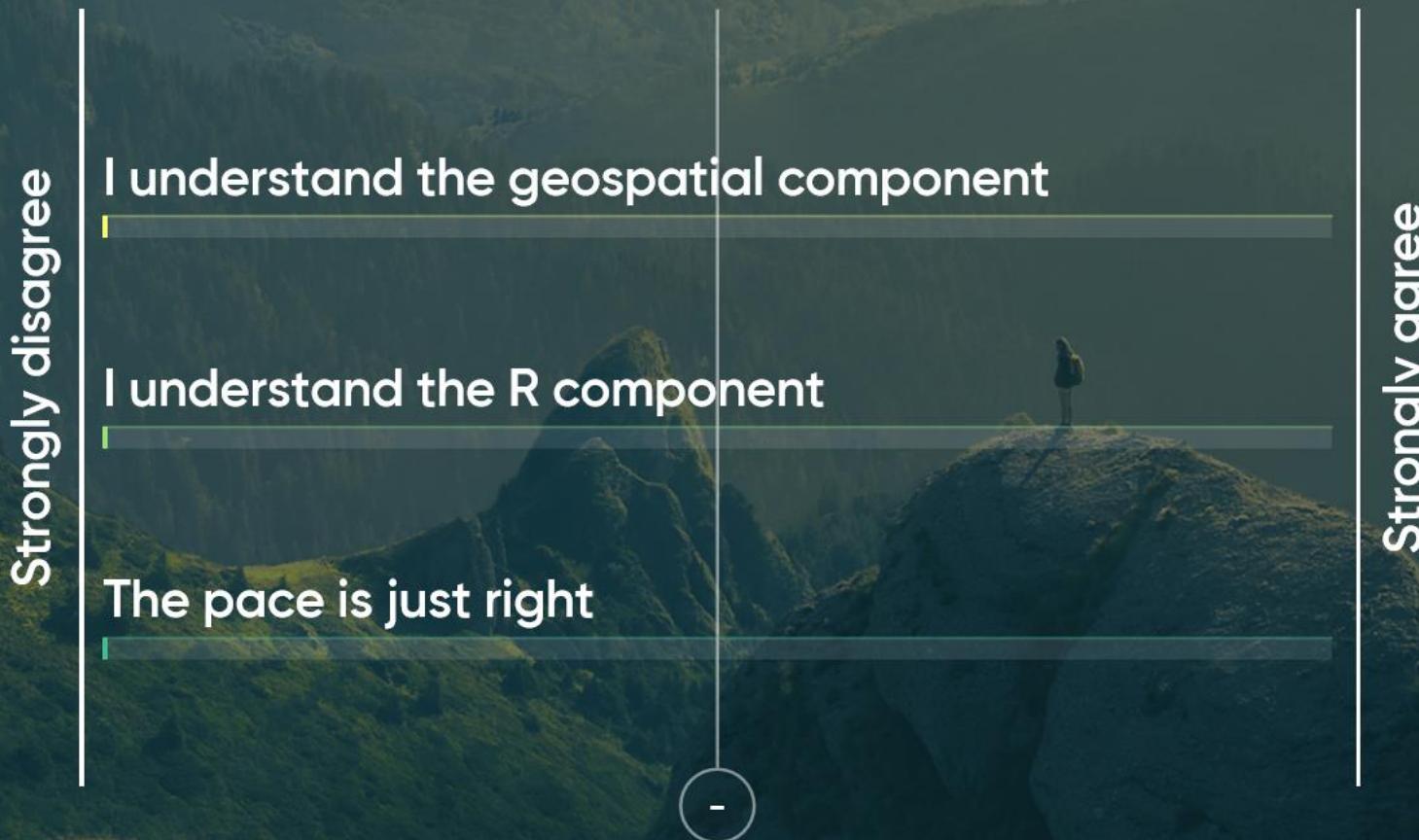
Exercise Seven

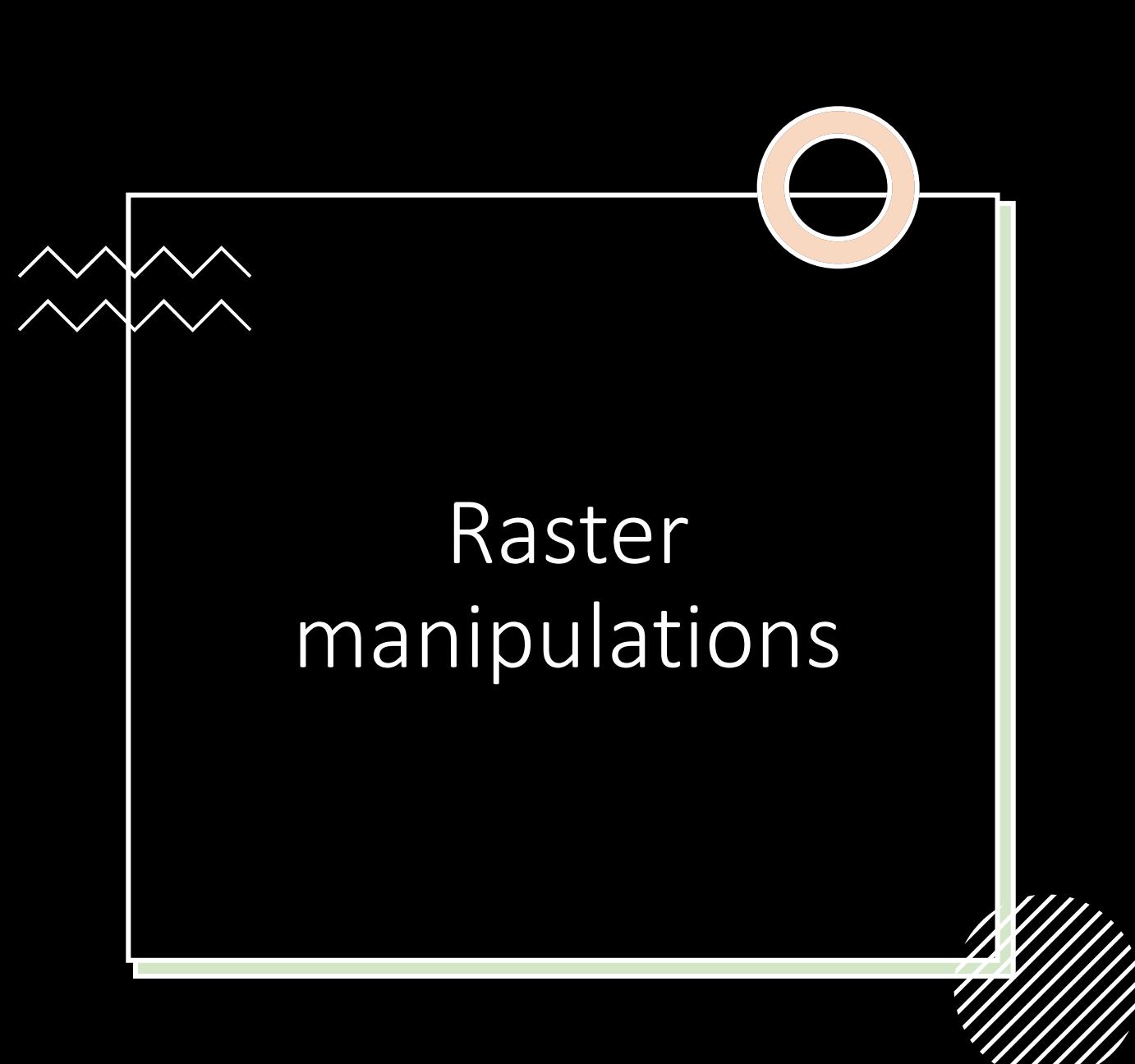
1. Combine the precip and temp_cold objects into a single object named rastStack
2. Load “elevation_49.tif” (*not* elevation.tif!) and assign the name elev49
3. Try to add the elev49 object to rastStack

Workflow



Scales





Raster manipulations

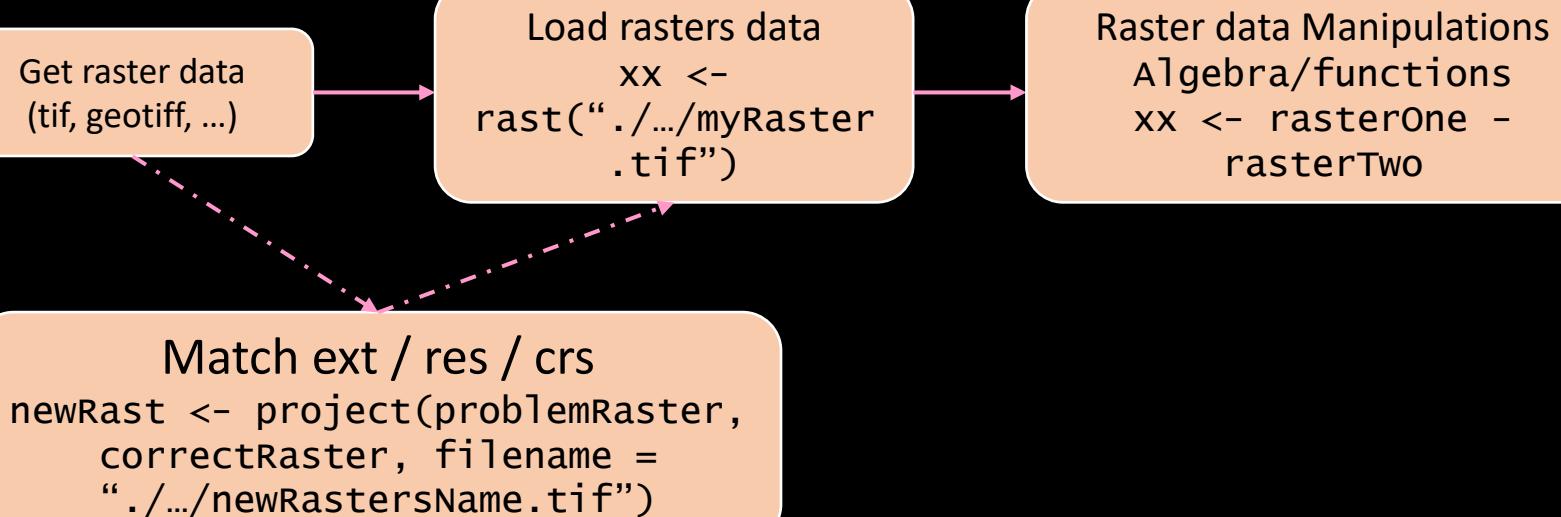
- Raster Algebra
 - BEDMAS / Logical
 - Occurs cell-by-cell
- Mask
- Crop

0	00
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00	0
0	00

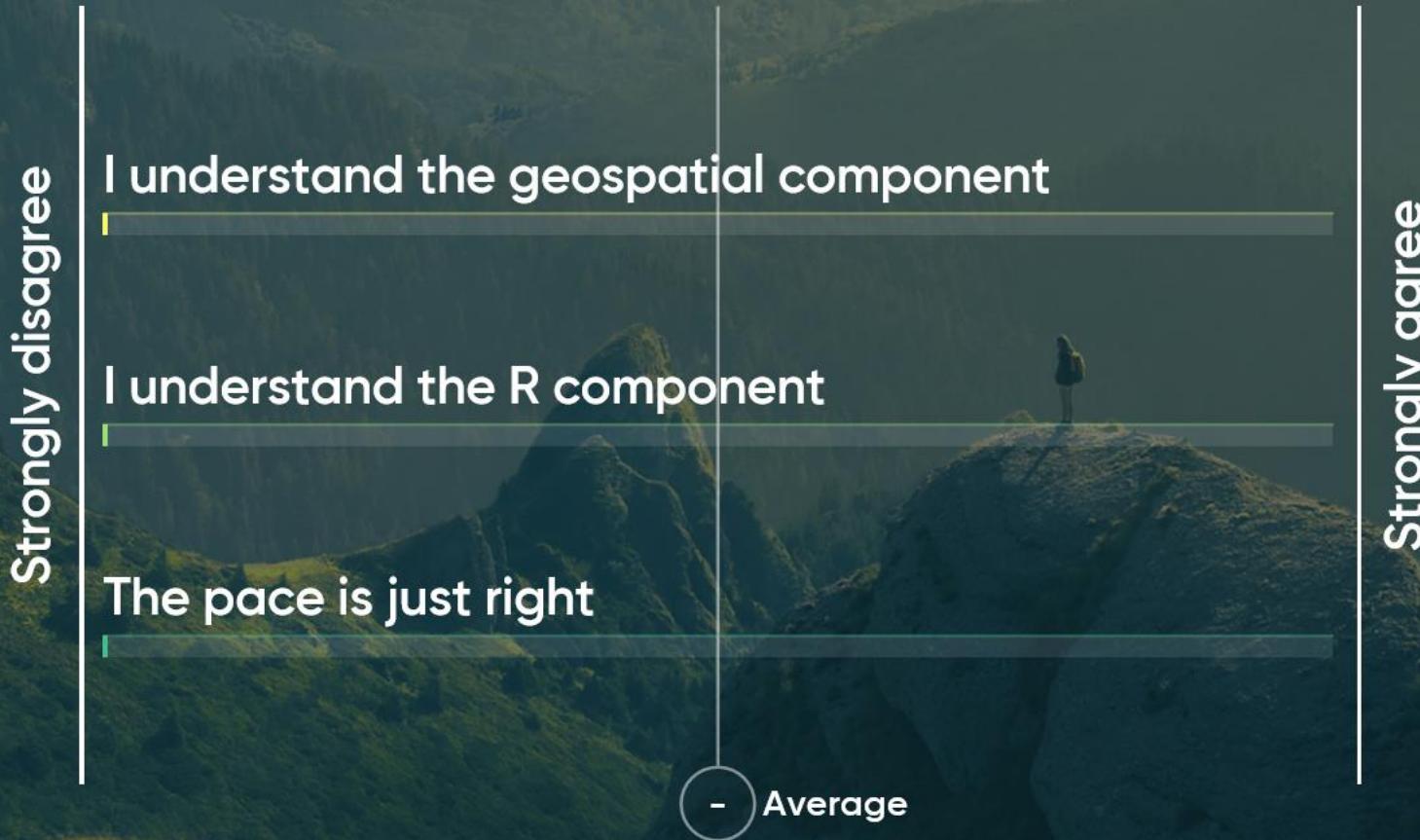
Exercise Eight

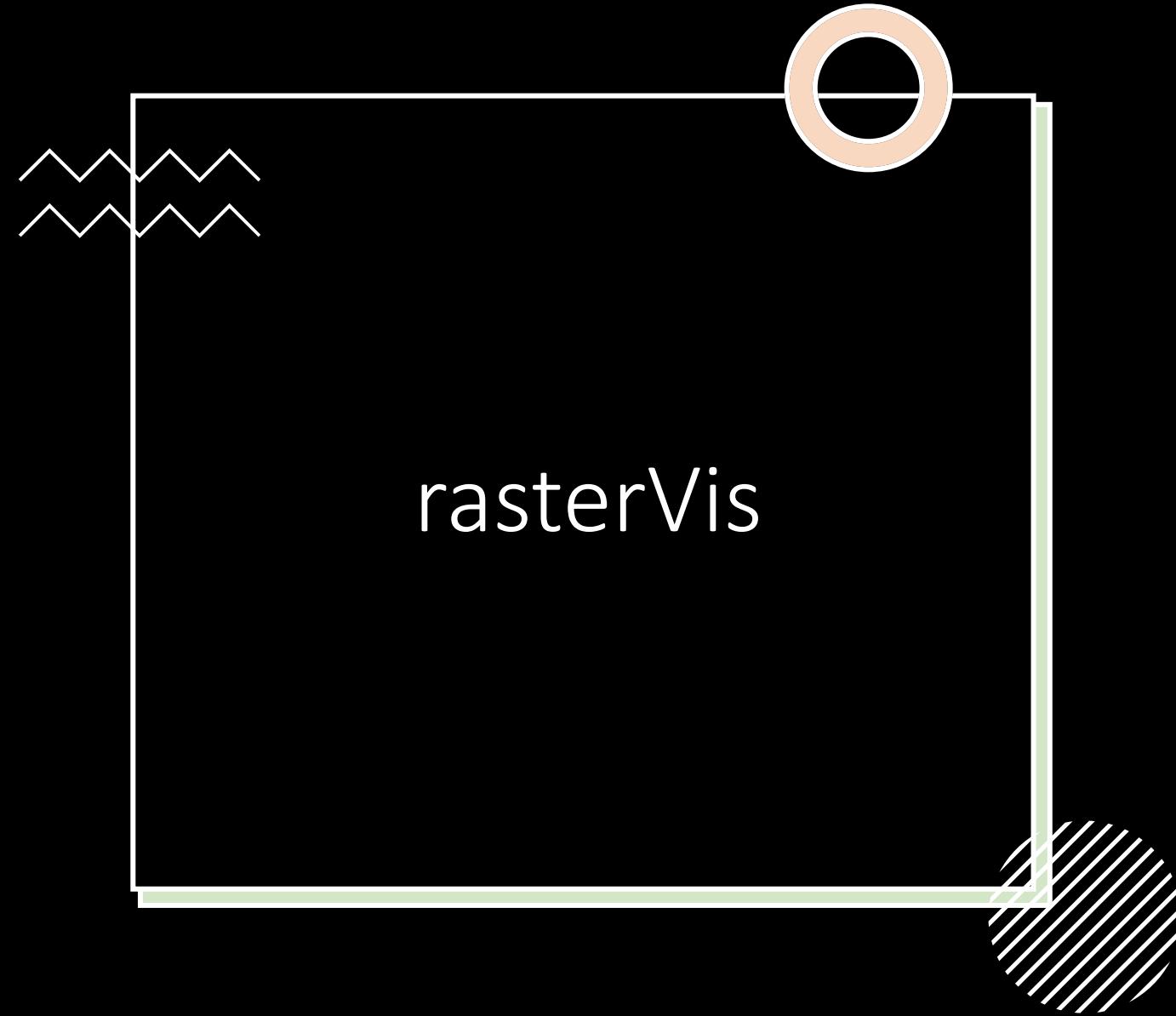
1. Load “temp_meanWarmQtr” and assign it to **temp_warm**
2. Create a raster of the difference between **temp_cold** & **temp_warm** and assign it to **temp_range**
3. Combine these into a single stack called temps

Workflow



Scales





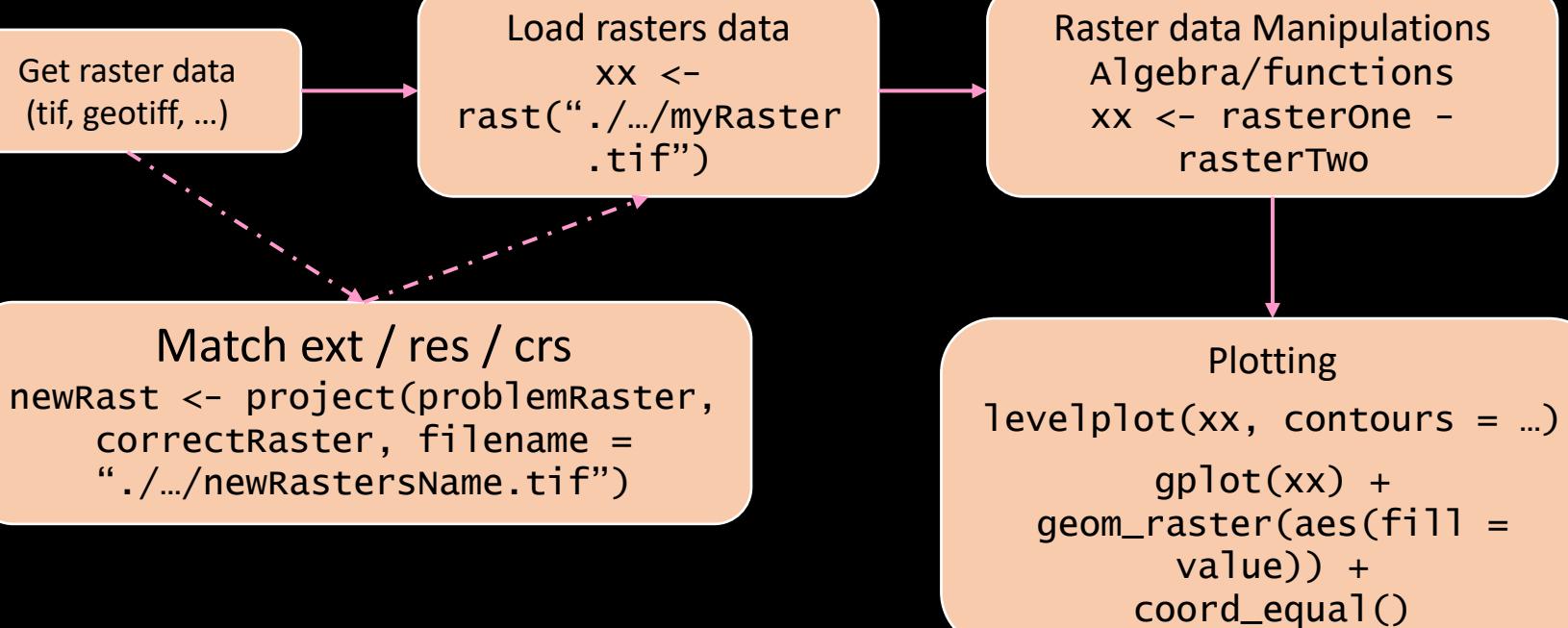
- rasterVis incorporates two of R's most widely used plotting systems
- lattice:
`levelplot(rasterName)`
- ggplot2:
Same syntax but with **ONE g**:
`gplot(rasterName) + geom_raster() + coord_equal()`

0	-00
	000
00	0
0	00

Exercise Nine

1. Use levelplot() to plot temp_range
2. Add contours to the map
3. Use gplot to plot a single layer

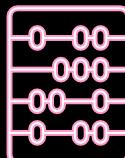
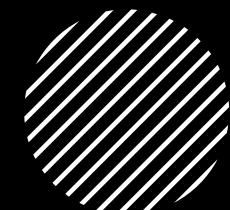
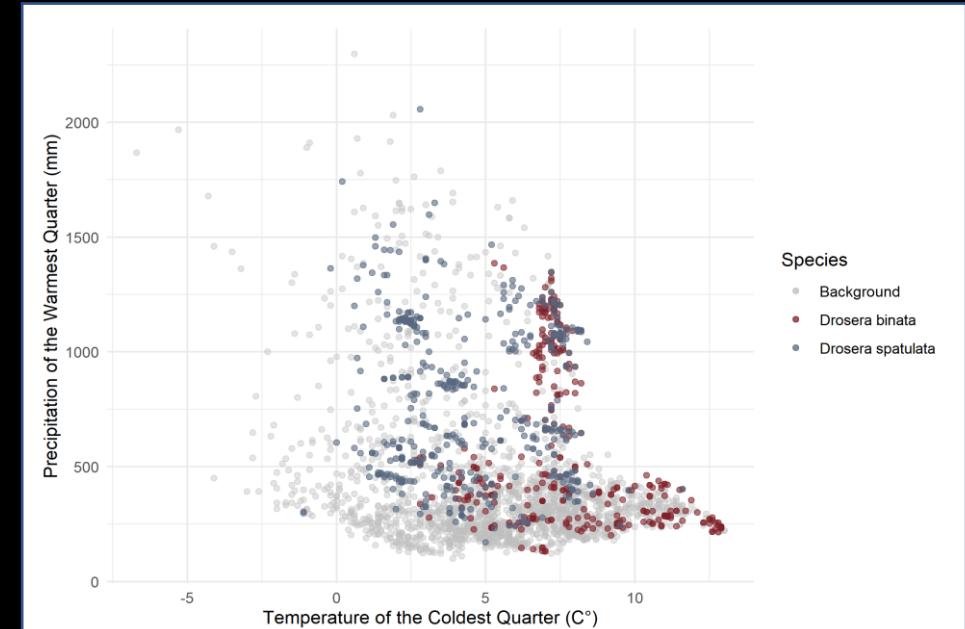
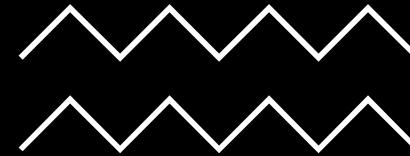
Workflow



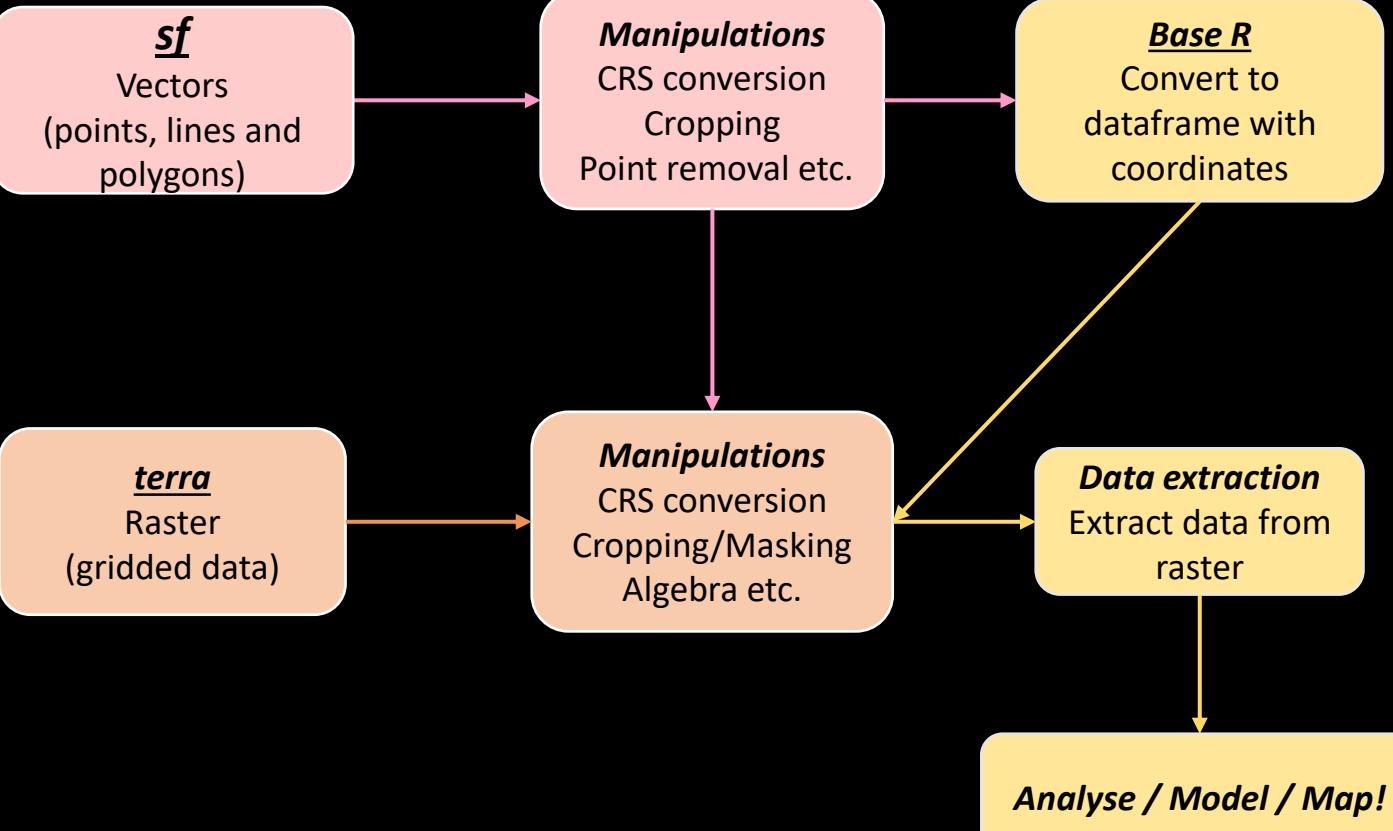
Combining sf and terra

Unfortunately, sf and raster won't use the objects from each other.

- sf for point and polygon manipulation (no rasters)
- terra can do some simple operations with vector objects (see `vect()`) but is the workhorse for rasters



Workflow

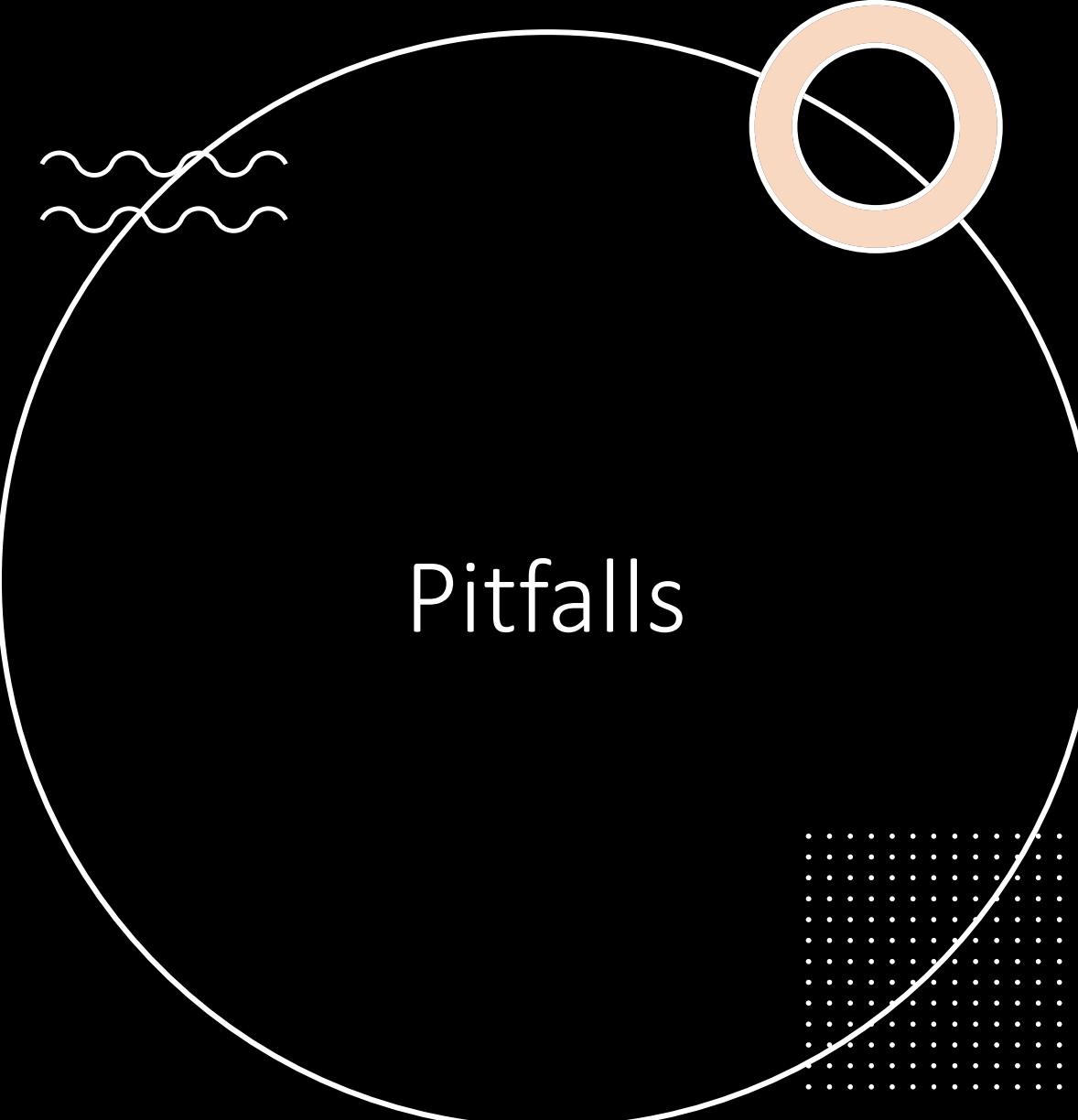


Example of Analysis

1. Combine temp_warm, temp_cold, temp_range into a single stack
2. Extract a random sample of 1000 background values from rastStack
3. Extract the values for the drosera species
4. Plot them!

Scales



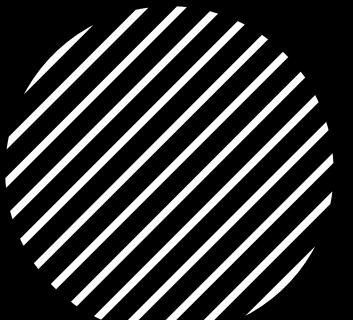


Pitfalls

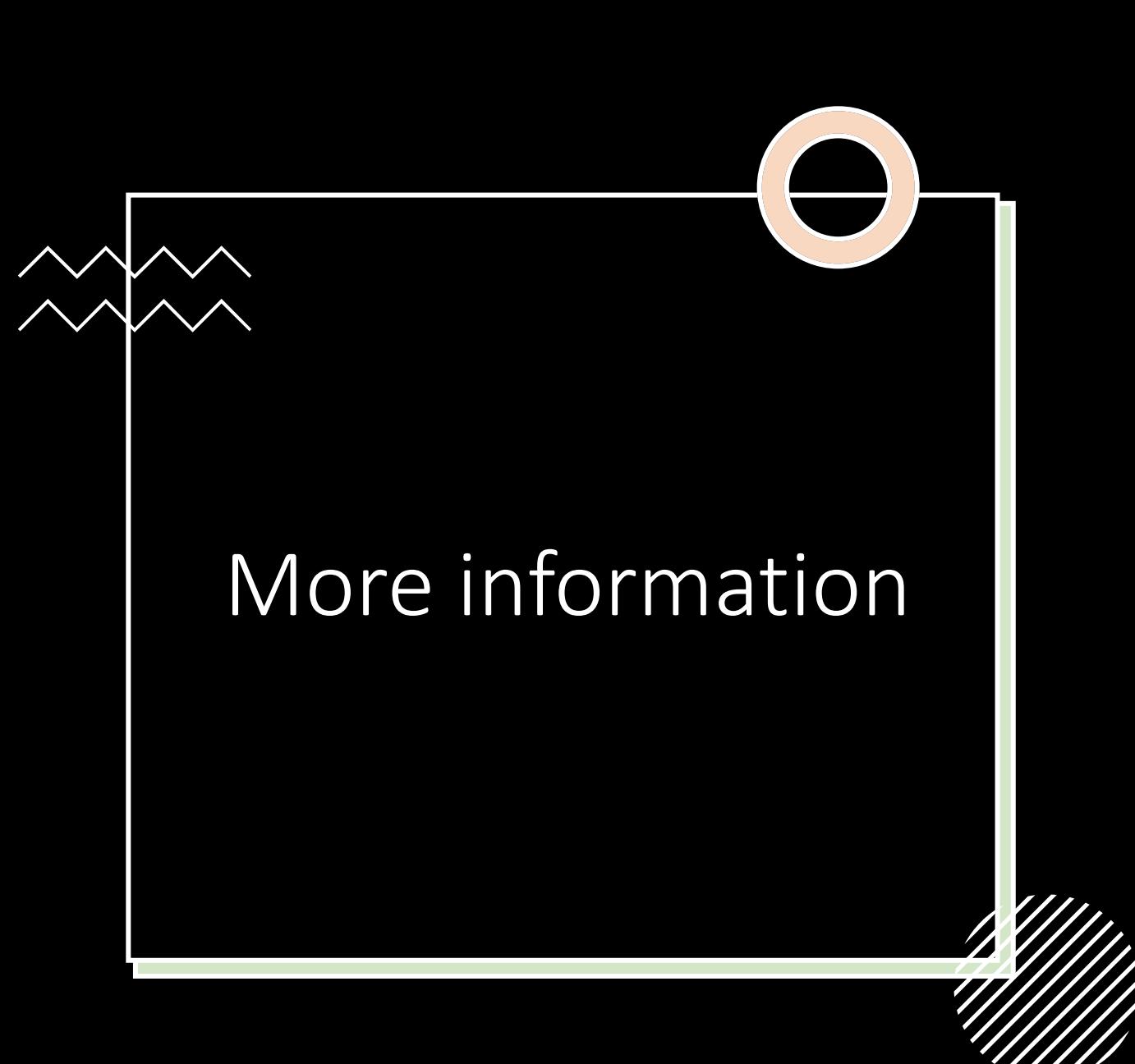
- Sampling biases
 - Spatial autocorrelation
 - For inferential statistics (multi)collinearity can cause issues
- Multiple layers to denote variations of a theme
- Artefacts from interpolation
- Analyses will easily produce results – but that doesn't mean they are right
- **Talk to an expert to begin with**



Key functions



- terra
 - rast/vect
 - c
 - ext/res
 - crs
 - project
 - -/+/mean
 - mask
 - crop
 - extract
 - spatSample
 - writeRaster
- sf/ggspatial
 - st_read
 - st_transform
 - st_bbox
 - st_crop
 - st_mask
 - st_coordinates
 - st_write
- rasterVis
 - levelplot(contours?)
 - gplot () +
geom_raster() +
coord_equal()
- ggspatial
 - annotation_scale
 - annotation_north_arrow



More information

- sf and stars
- terra
- HackyHour
- Check out Ben Collings Google Earth Engine Workshop!
- abel122@aucklanduni.ac.nz

Go to www.menti.com and use the code 9639 7923



One Up and One down

