Data Visualization with R
Workshop Day 2

Making maps

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Tuberculosis incidence

The TB data is from the WHO.

```
## # A tibble: 40,800 x 5
##    country      year age_group sex   count
##    <chr>       <dbl> <fct>     <chr> <dbl>
##  1 Afghanistan  1997 15-24     m        10
##  2 Afghanistan  1997 25-34     m         6
##  3 Afghanistan  1997 35-44     m         3
##  4 Afghanistan  1997 45-54     m         5
##  5 Afghanistan  1997 55-64     m         2
##  6 Afghanistan  1997 65-       m         0
##  7 Afghanistan  1997 15-24     f        38
##  8 Afghanistan  1997 25-34     f        36
##  9 Afghanistan  1997 35-44     f        14
## 10 Afghanistan  1997 45-54     f         8
## # … with 40,790 more rows
```

What is a choropleth map?
Why use a choropleth map?

How do we get a map?

A polygon map of the world can be extracted from the `maps` package.

```
world_map <- map_data("world")
world_map %>%
  filter(region %in% c("Australia", "New Zealand")) %>%
      DT::datatable(width=1150, height=100)
```

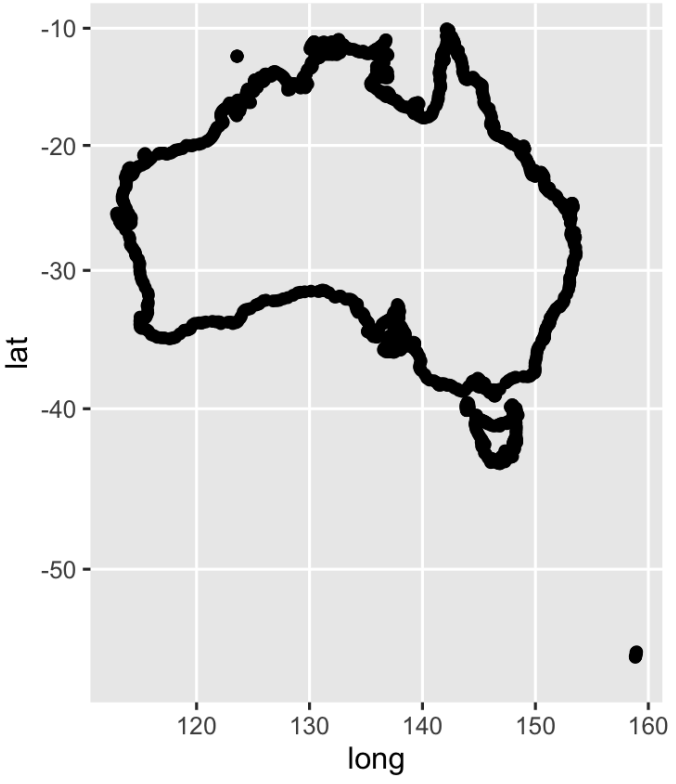
Show 10 entries Search:

	long	lat	group	order	region	subregion
1	123.594528198242	-12.4256830215454	133	7115	Australia	Ashmore and Cartier Islands
2	123.595207214355	-12.4359369277954	133	7116	Australia	Ashmore and Cartier Islands
3	123.573150634766	-12.4341802597046	133	7117	Australia	Ashmore and Cartier Islands
4	123.572463989258	-12.4239253997803	133	7118	Australia	Ashmore and Cartier Islands
5	123.594528198242	-12.4256830215454	133	7119	Australia	Ashmore and Cartier Islands
6	158.878799438477	-54.7097625732422	139	7267	Australia	Macquarie Island
7	158.84521484375	-54.7492179870605	139	7268	Australia	Macquarie Island

Maps are basically groups of connected dots

These are the points, defining the country boundary for Australia

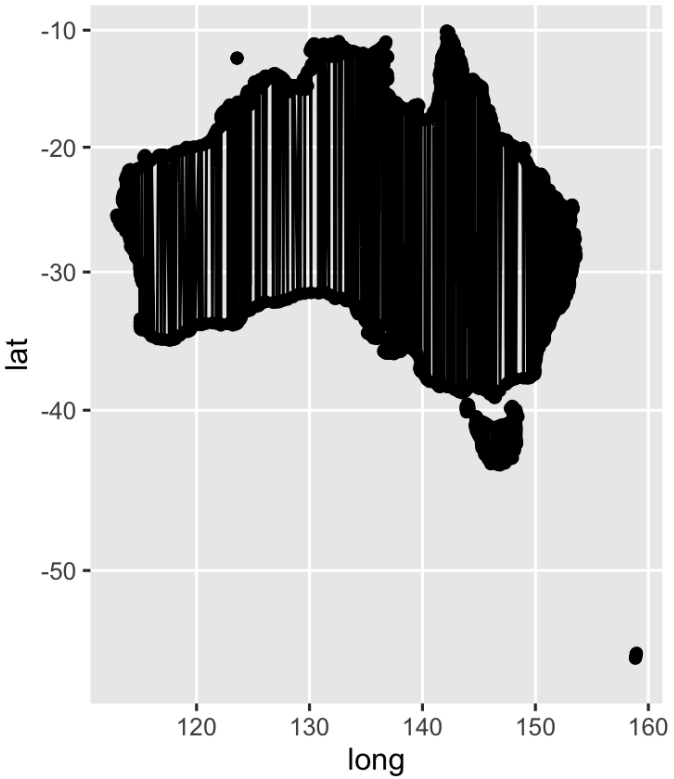
```
oz <- world_map %>%
  filter(region == "Australia")
ggplot(oz, aes(x = long, y = lat)) +
  geom_point() +
  coord_map()
```



Connect the dots

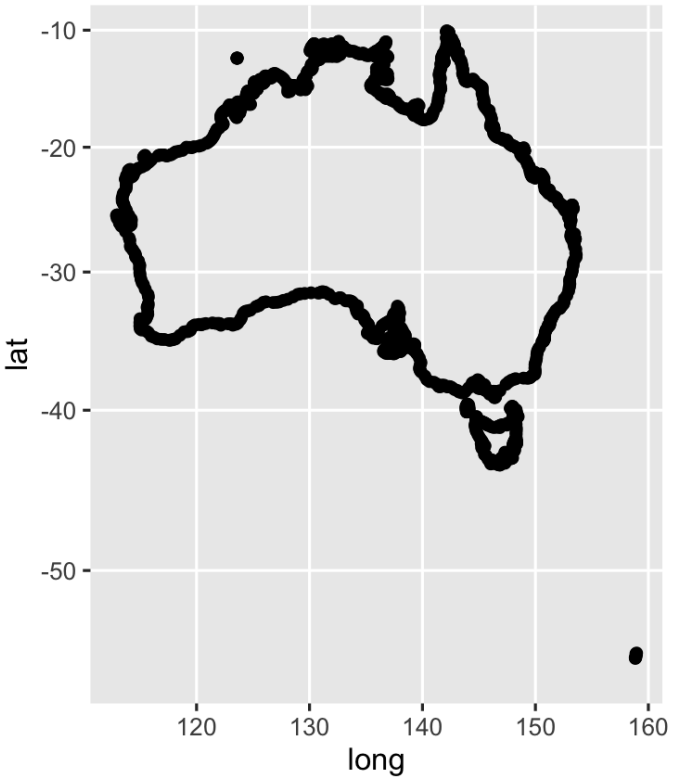
```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_point() +
  geom_line() +
  coord_map()
```

What happened?



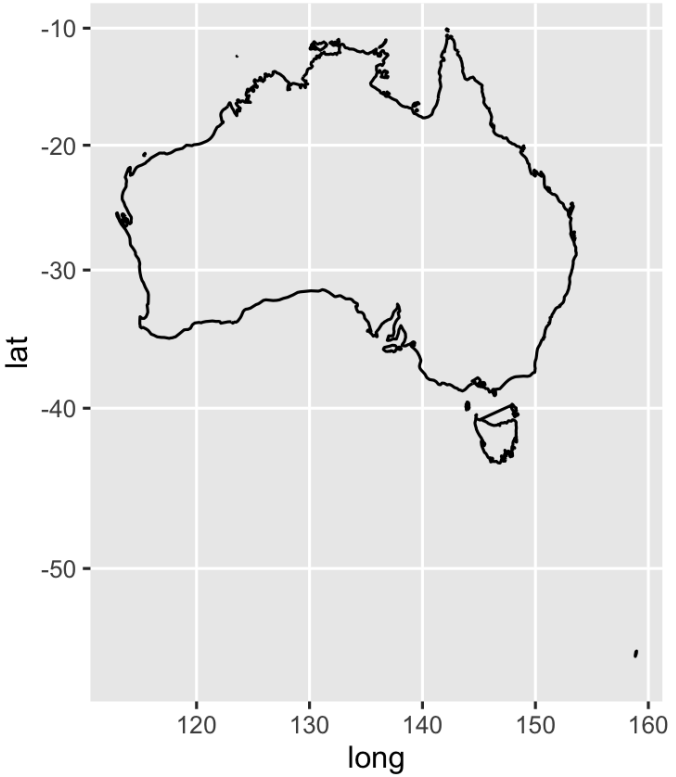
Connect the dots

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_point() +
  geom_path() +
  coord_map()
```



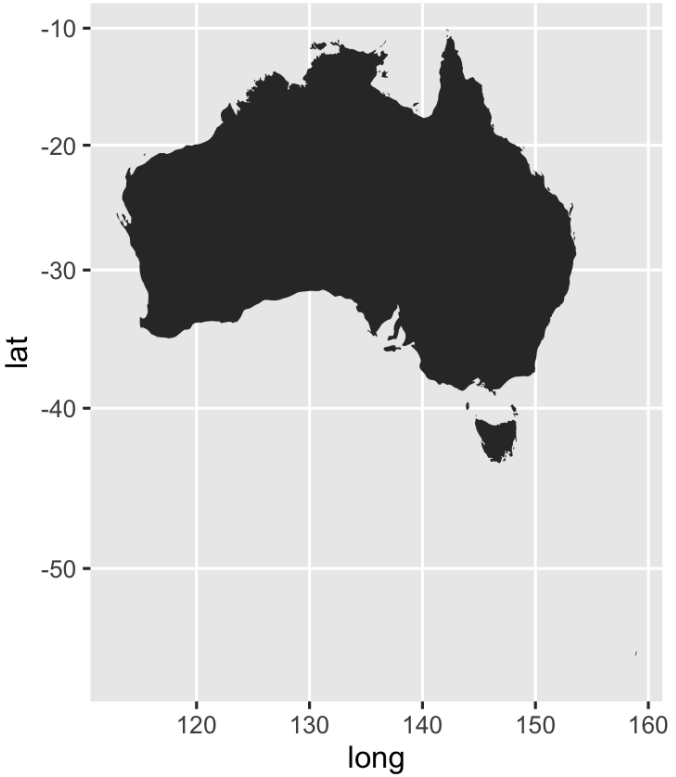
This map doesn't have states and territory connections.

```
ggplot(oz, aes(x = long, y = lat,
               group = subregion)) +
  geom_path() +
  coord_map()
```



We can also plot the map using `geom_polygon`, and fill with colour.

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_polygon() +
  coord_map()
```



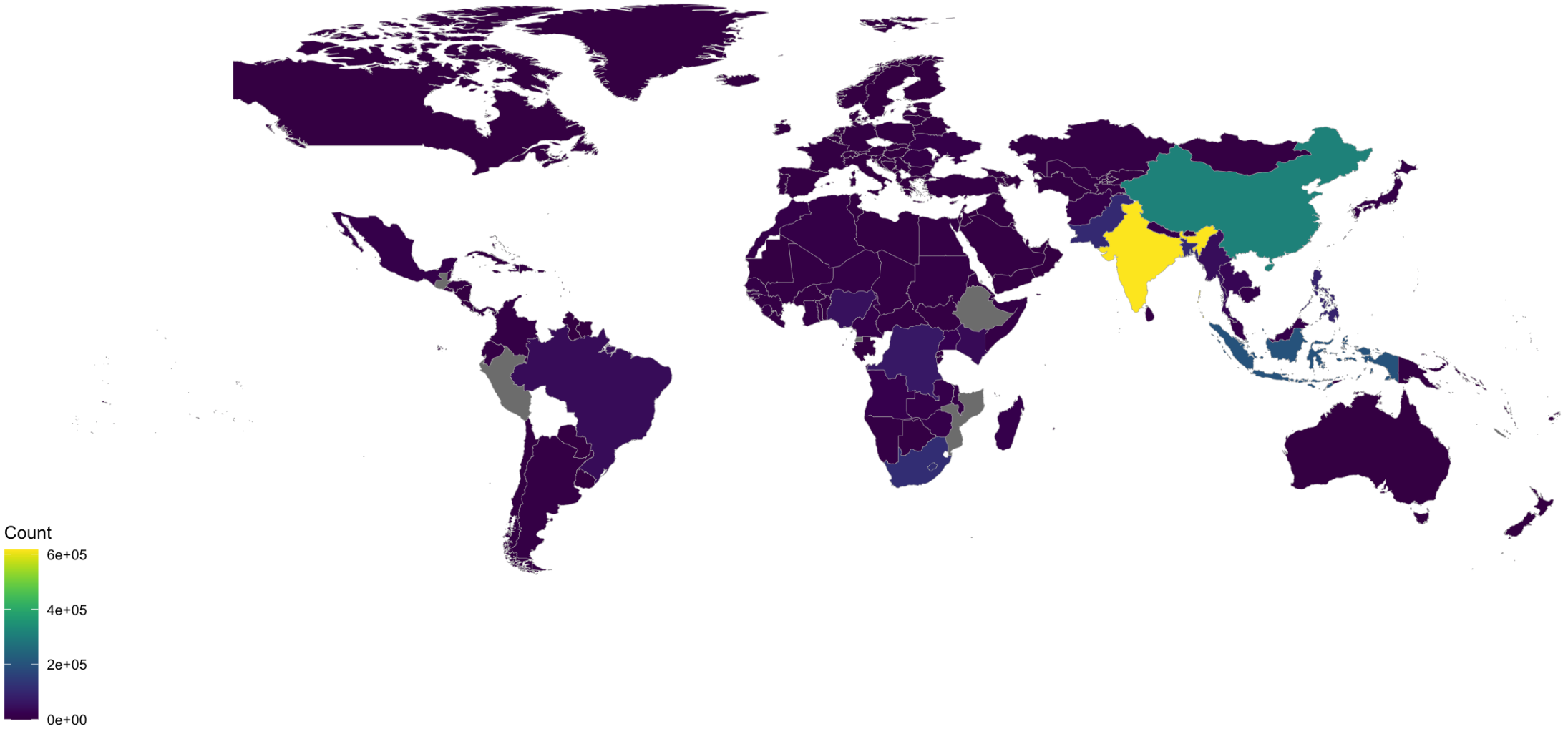
Using a map theme makes the result look more map like

```
ggplot(oz, aes(x = long, y = lat,
               group = group)) +
  geom_polygon() +
  coord_map() +
  theme_map()
```

Let's make a choropleth map of tuberculosis

Aggregate counts across sex and age group for 2012

```
tb_2012 <- tb %>%
  filter(year == 2012) %>%
  rename(region = country) %>%
  group_by(region) %>%
  summarise(count = sum(count))
ggplot(tb_2012, aes(map_id = region)) +
    geom_map(aes(fill = count), map = world_map,
             color="grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long, y = world_map$lat) +
    scale_fill_viridis("Count") +
    theme_map()
```


Count
6e+05
4e+05
2e+05
0e+00

What happened to the USA? UK?

Check the name matching

```
wm_names <- world_map %>%
  select(region) %>%
  distinct()
tb_names <- tb %>%
  filter(year == 2012) %>%
  select(country) %>%
  distinct()
tb_miss_from_wm <- anti_join(tb_names, wm_names,
                             by=c("country" = "region"))
DT::datatable(tb_miss_from_wm, width = 1150, height = 100)
```

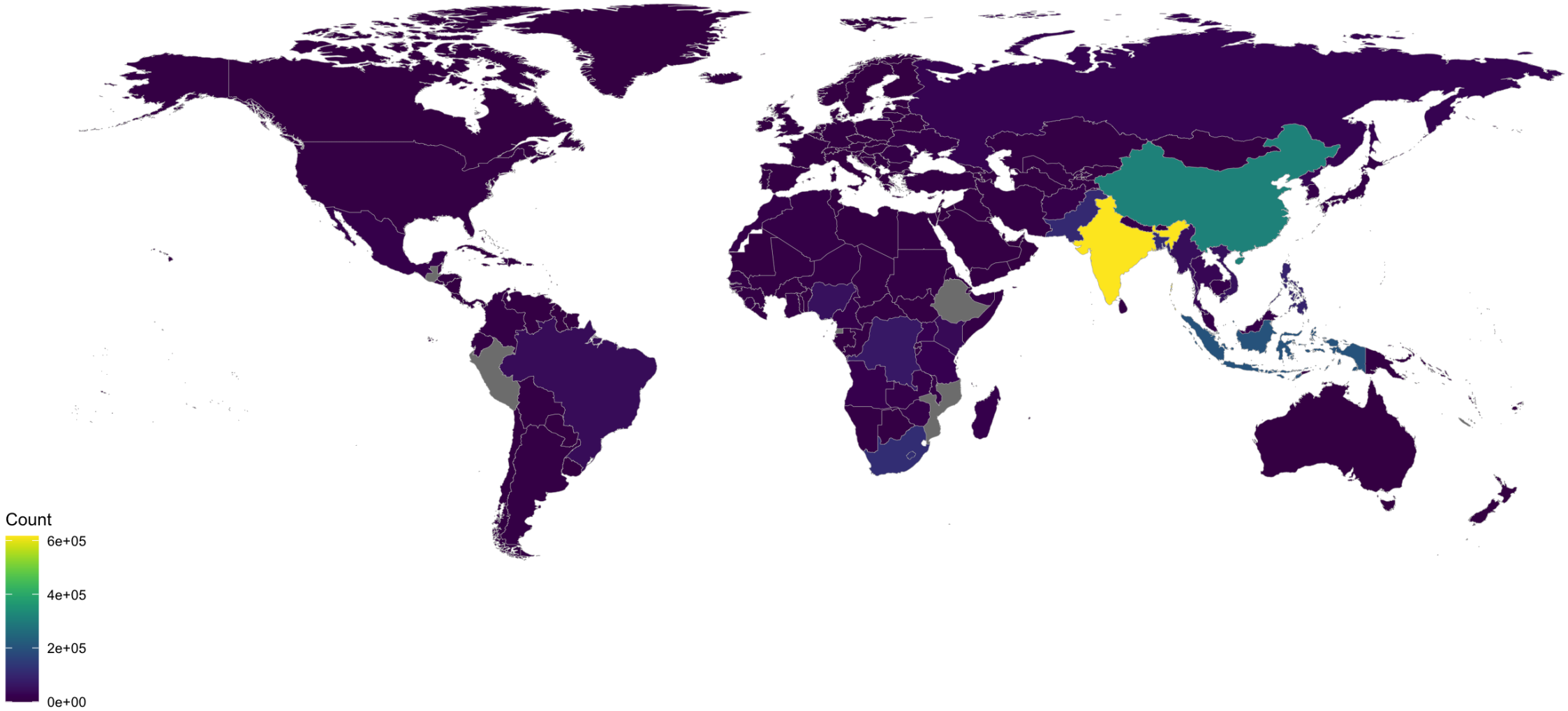
Show 10 entries Search:

	country
1	Antigua and Barbuda
2	Bolivia (Plurinational State of)
3	British Virgin Islands
4	Brunei Darussalam

```r
tb_fixed <- tb %>%
  mutate(region=recode(country,
                       "United States of America" = "USA",
                       "United Kingdom of Great Britain and Northern Ireland" = "
                       "Russian Federation" = "Russia",
                       "Viet Nam" = "Vietnam",
                       "Venezuela (Bolivarian Republic of)" = "Venezuela",
                       "Bolivia (Plurinational State of)" = "Bolivia",
                       "Czechia" = "Czech Republic",
                       "Iran (Islamic Republic of)" = "Iran",
                       "Iran (Islamic Republic of)" = "Laos",
                       "Democratic People's Republic of Korea" = "North Korea",
                       "Republic of Korea" = "South Korea",
                       "United Republic of Tanzania" = "Tanzania",
                       "Congo" = "Republic of Congo"))
```

😄 Try again!

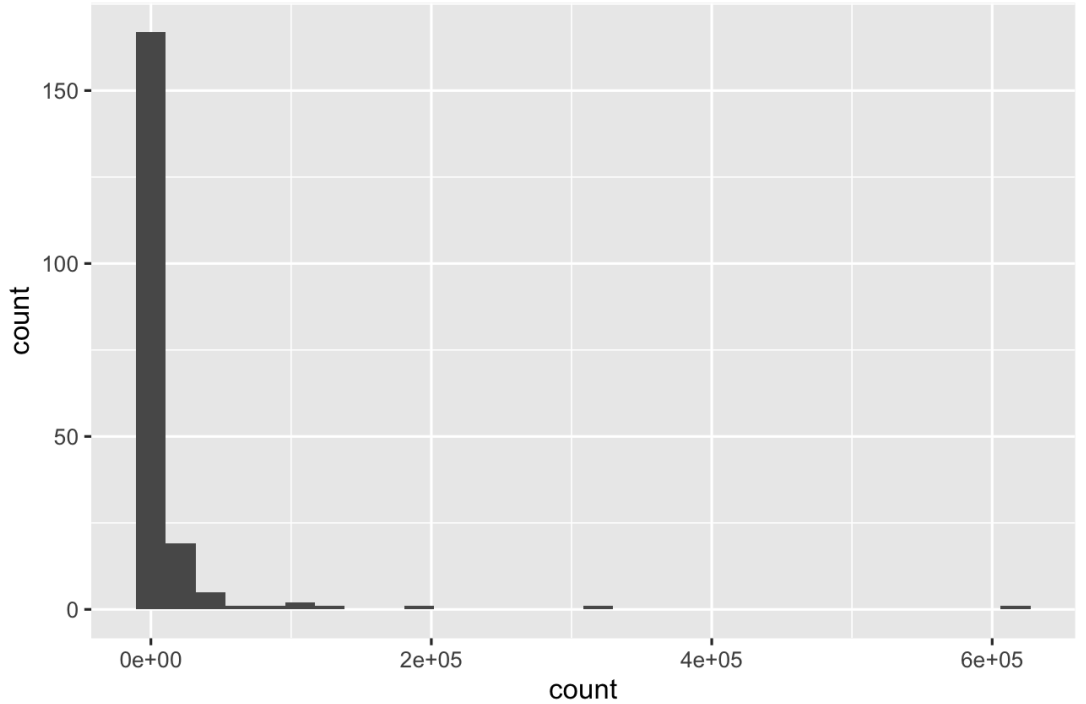
```
tb_2012 <- tb_fixed %>%
  filter(year == 2012) %>%
  group_by(region) %>%
  summarise(count = sum(count))
ggplot(tb_2012, aes(map_id = region)) +
    geom_map(aes(fill = count), map = world_map,
             color = "grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long, y = world_map$lat) +
    scale_fill_viridis("Count") +
    theme_map()
```


Count
6e+05
4e+05
2e+05
0e+00

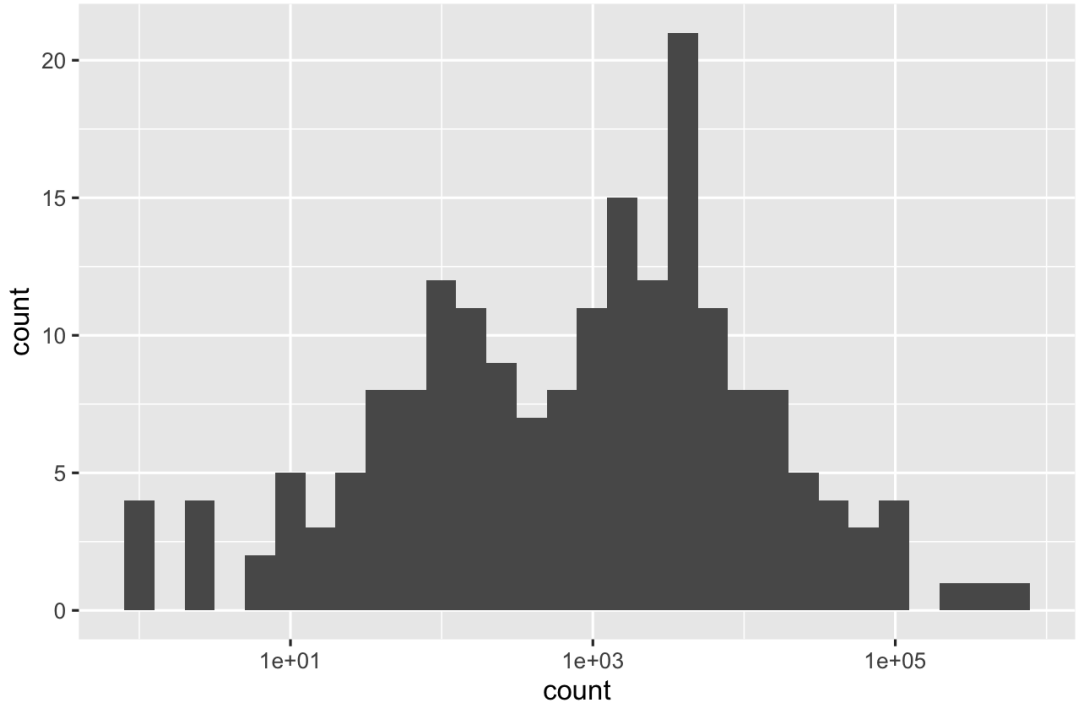
Counts are typically skewed

may be best to symmetrise

```
ggplot(tb_2012, aes(x = count)) +
  geom_histogram()
```

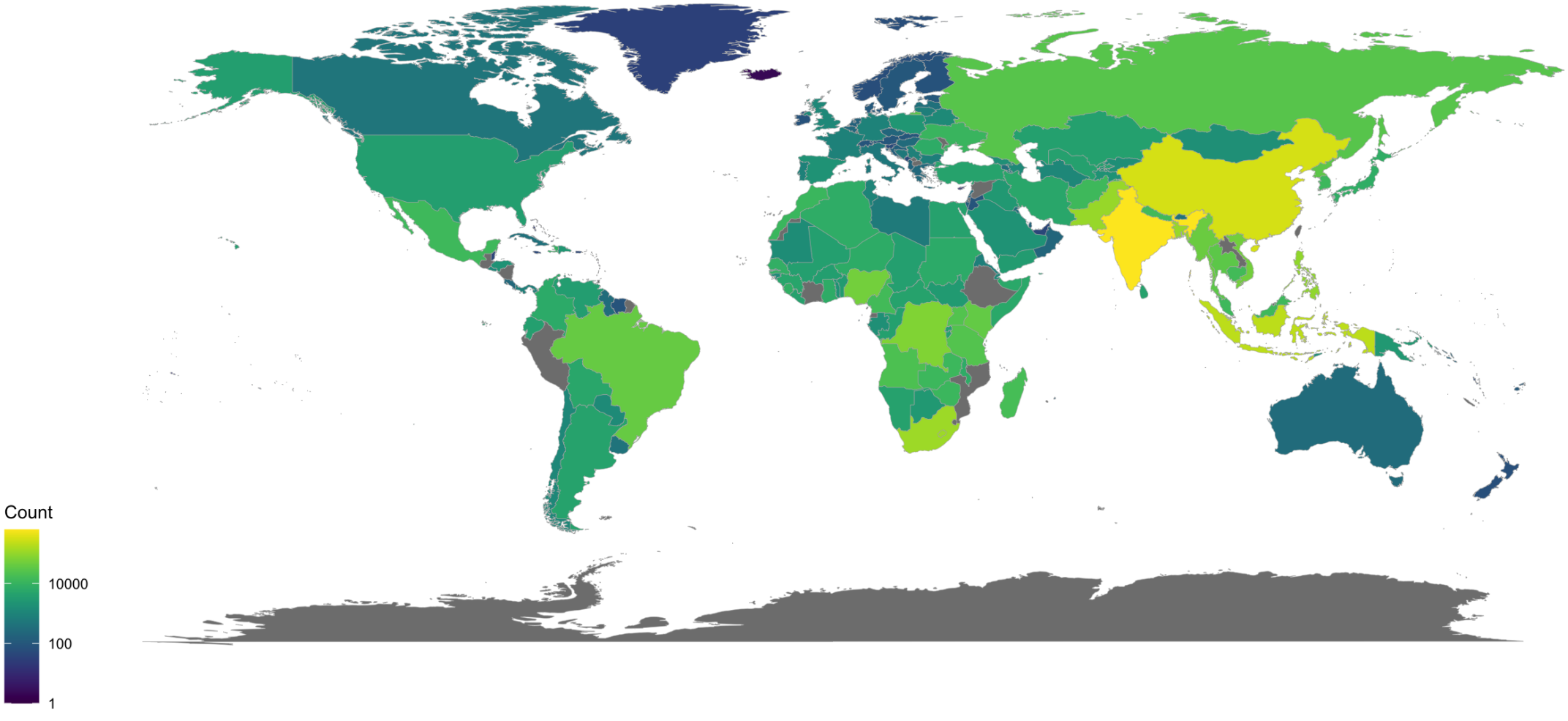


```
ggplot(tb_2012, aes(x = count)) +
  geom_histogram() +
  scale_x_log10()
```



`geom_polygon` can also be used

```
tb_2012_map <- world_map %>% left_join(tb_2012)
ggplot(tb_2012_map, aes(x = long, y = lat, group=group)) +
    geom_polygon(aes(fill = count),
                 color="grey70", size = 0.1, na.rm = TRUE) +
    expand_limits(x = world_map$long*1.1, y = world_map$lat*1.1) +
    scale_fill_viridis("Count", trans = "log10") +
    theme_map()
```


Count
10000
100
1

Resources

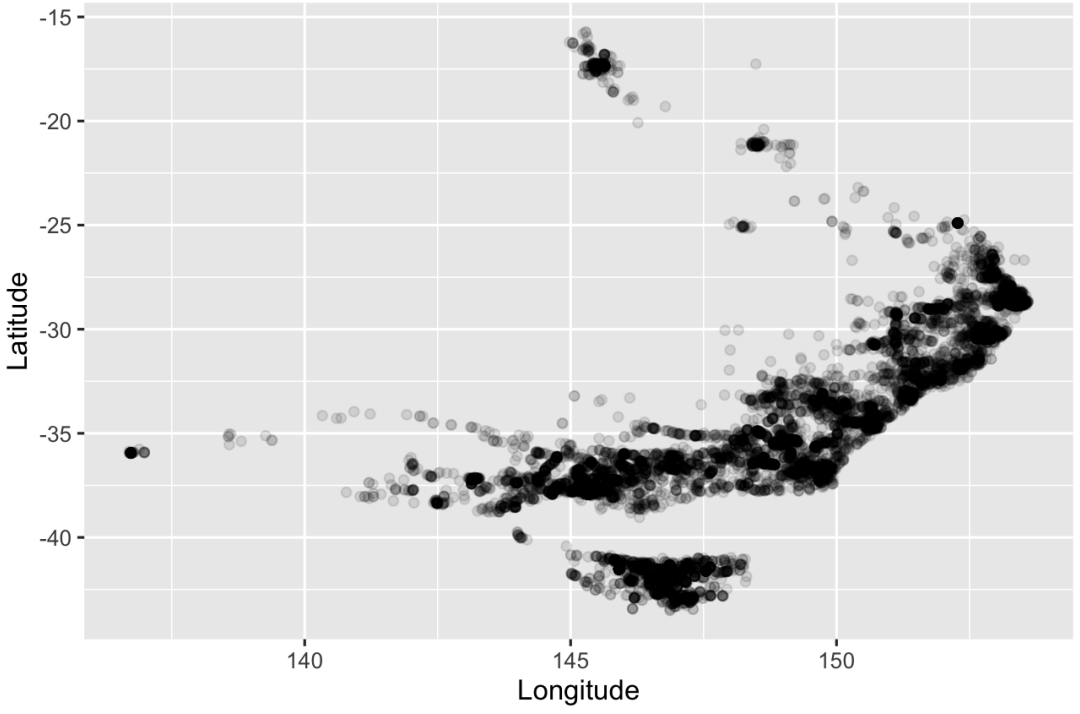
Where to go to get more help on maps

- `ozmaps` package: https://github.com/mdsumner/ozmaps, https://mdsumner.github.io/ozmaps/
- `eechidna` package https://docs.ropensci.org/eechidna/
- https://www.littlemissdata.com/blog/maps
- https://www.r-spatial.org/r/2018/10/25/ggplot2-sf.html
- https://www.paulamoraga.com/book-geospatial/sec-spatialdataandCRS.html

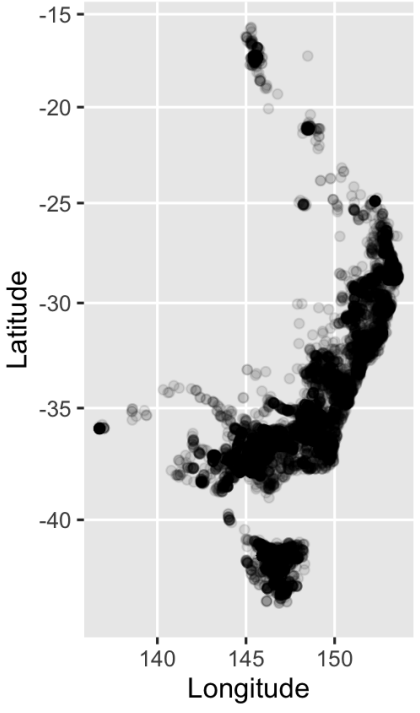
Note: The biggest change when converting spatial objects from a mapping software to a data analysis project is "thinning" the map to make it smaller and efficient to work with.

Reading google maps and overlaying data

```
load(here::here("data/platypus.rda"))
p <- ggplot(platypus) +
  geom_point(aes(x = Longitude, y = La
             alpha = 0.1)
p
```




```
p + coord_map()
```



Extract Open Street Map using ggmap

```
oz_bbox <- c(112.9, # min long
             -45, # min lat
             159, # max long
             -10) # max lat
oz_map <- get_map(location = oz_bbox, source = "osm")
save(oz_map, file=here::here("data/oz_map.rda"))
```

```
load(here::here("data/oz_map.rda"))
ggmap(oz_map) +
  geom_point(data = platypus,
             aes(x = Longitude, y = La
             alpha = 0.1, colour = "or
  theme_map()
```

</> Open `day2-exercise-02.Rmd`

15:00

Session Information

```
devtools::session_info()
```

```
## ─ Session info ─────────────────────────────────────────────────────────────
##  setting  value
##  version  R version 4.0.1 (2020-06-06)
##  os       macOS Catalina 10.15.6
##  system   x86_64, darwin17.0
##  ui       X11
##  language (EN)
##  collate  en_AU.UTF-8
##  ctype    en_AU.UTF-8
##  tz       Australia/Melbourne
##  date     2020-07-29
##
## ─ Packages ─────────────────────────────────────────────────────────────────
##  package     * version    date       lib source
```