Geographical Maps with ggplot2

```
# load dplyr package
library(dplyr)
```

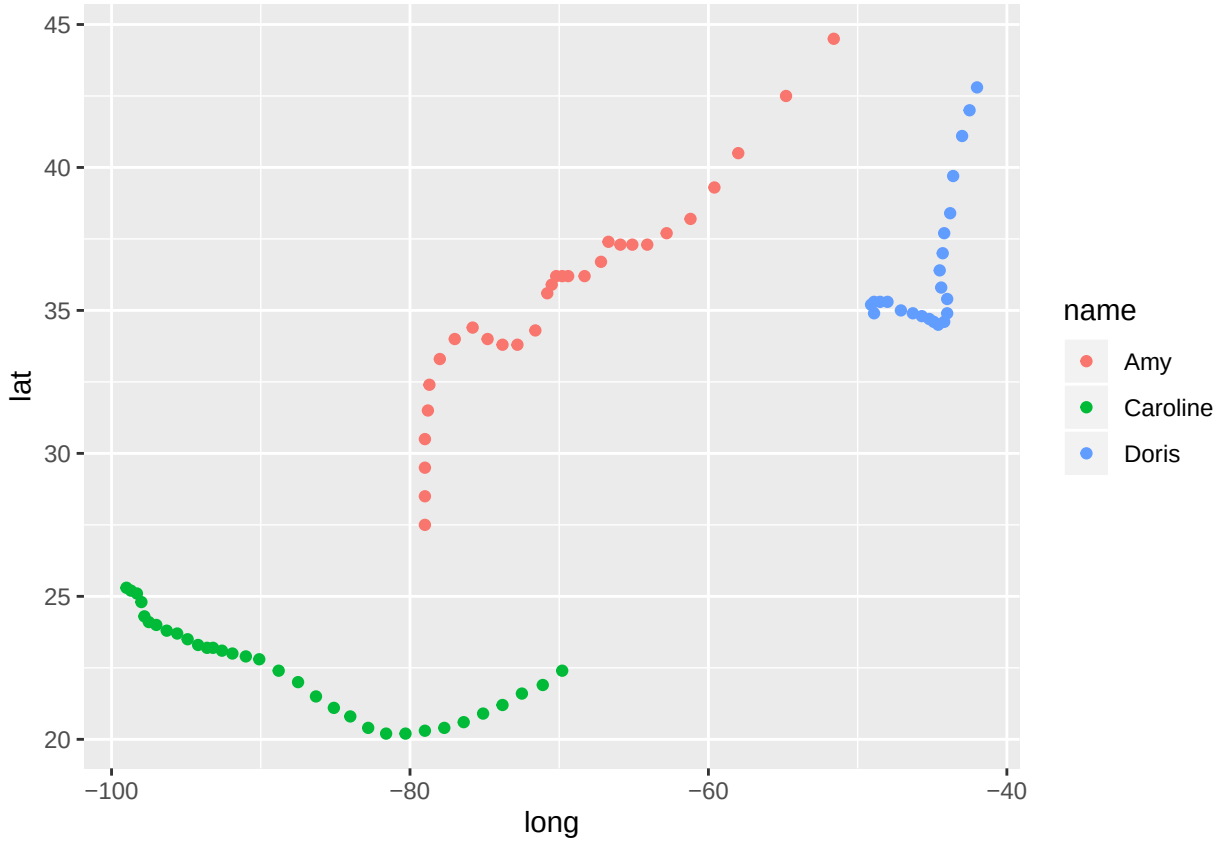
```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
```

```
storms75 <- filter(storms, year == 1975)
head(storms75)
```

```
## # A tibble: 6 x 13
##   name   year month   day  hour   lat  long status category  wind pressure
##   <chr> <dbl> <dbl> <int> <dbl> <dbl> <dbl> <chr>  <ord>    <int>    <int>
## 1 Amy    1975     6    27     0  27.5 -79   tropi~ -1          25     1013
## 2 Amy    1975     6    27     6  28.5 -79   tropi~ -1          25     1013
## 3 Amy    1975     6    27    12  29.5 -79   tropi~ -1          25     1013
## 4 Amy    1975     6    27    18  30.5 -79   tropi~ -1          25     1013
## 5 Amy    1975     6    28     0  31.5 -78.8 tropi~ -1          25     1012
## 6 Amy    1975     6    28     6  32.4 -78.7 tropi~ -1          25     1012
## # ... with 2 more variables: ts_diameter <dbl>, hu_diameter <dbl>
```

```
ggplot(storms75, aes(x = long, y = lat)) + geom_point(aes(color = name))
```




```
# alternative ways to write equivalent commands
# ggplot(data = storms75) +  geom_point(aes(x = long, y = lat, color = name))
# ggplot() +  geom_point(data = storms75, aes(x = long, y = lat, color = name))
```

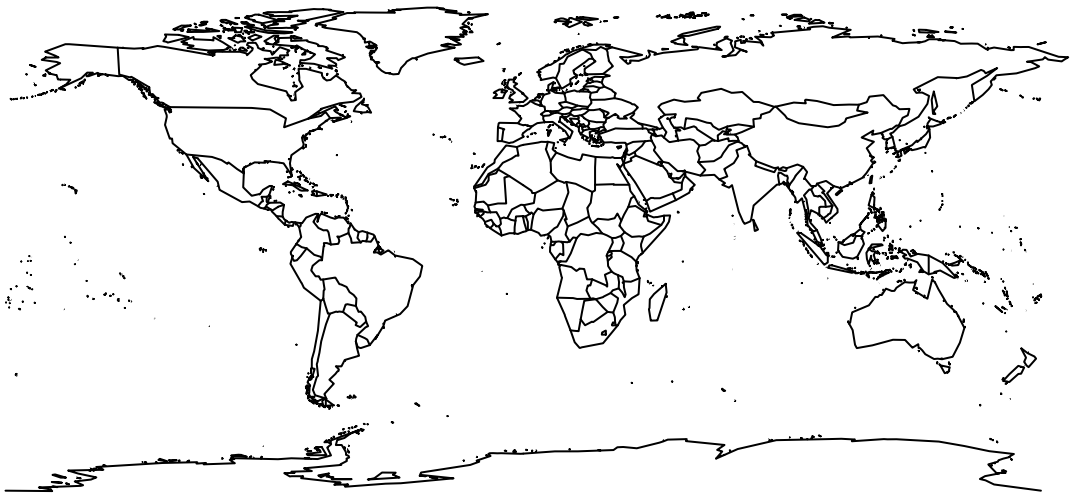
But where is it? We need an image of world map.

Using `maps` package

```
# install maps package
# install.packages("maps")

# load maps package
library(maps)
```

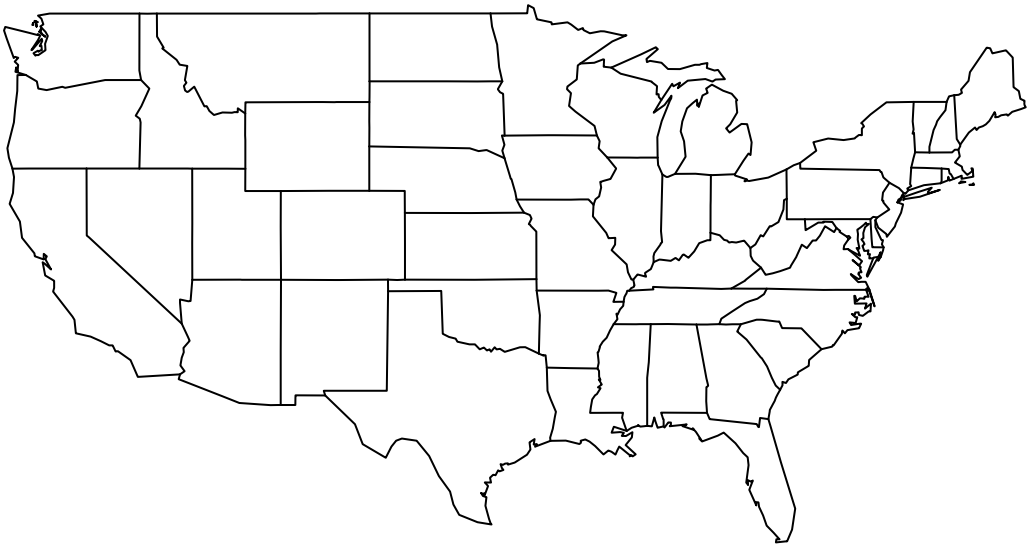
`map()` plots geographical maps.

```
# world map
map("world")
```

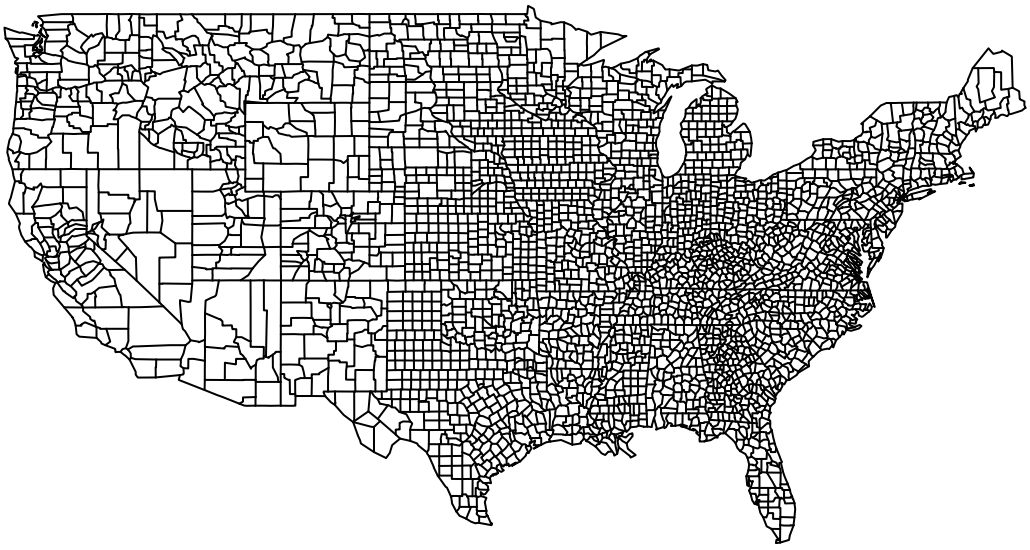


```
# usa map
map("usa")
```

```
# usa states
map("state")
```



```
# usa counties
map("county")
```



To use ggplot2 to map map objects, first we need to convert a map object to a dataframe object.

```
world_map <- map_data("world")
head(world_map)
```

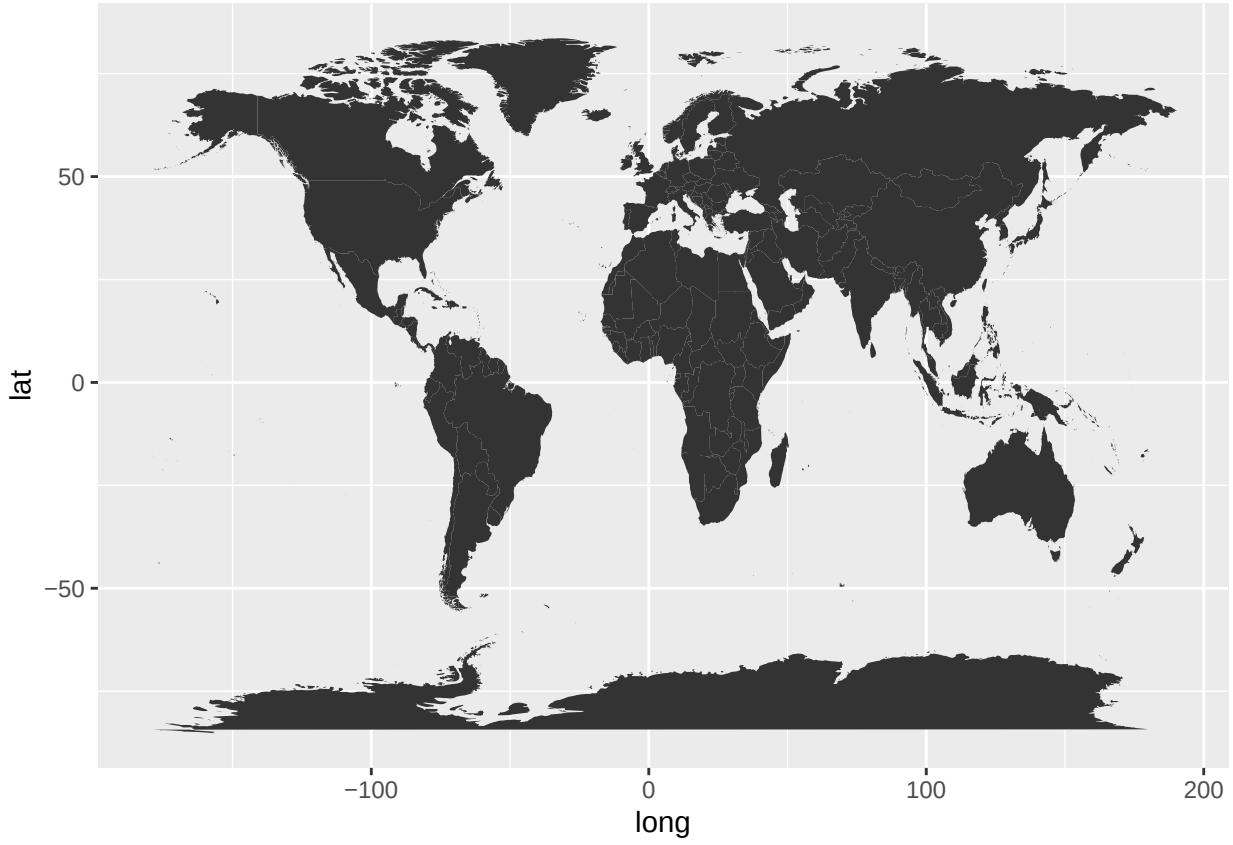
```
##        long      lat group order region subregion
## 1 -69.89912 12.45200     1     1  Aruba      <NA>
## 2 -69.89571 12.42300     1     2  Aruba      <NA>
## 3 -69.94219 12.43853     1     3  Aruba      <NA>
## 4 -70.00415 12.50049     1     4  Aruba      <NA>
## 5 -70.06612 12.54697     1     5  Aruba      <NA>
## 6 -70.05088 12.59707     1     6  Aruba      <NA>
```

```r
# check if world_map is really a dataframe object
class(world_map)
```

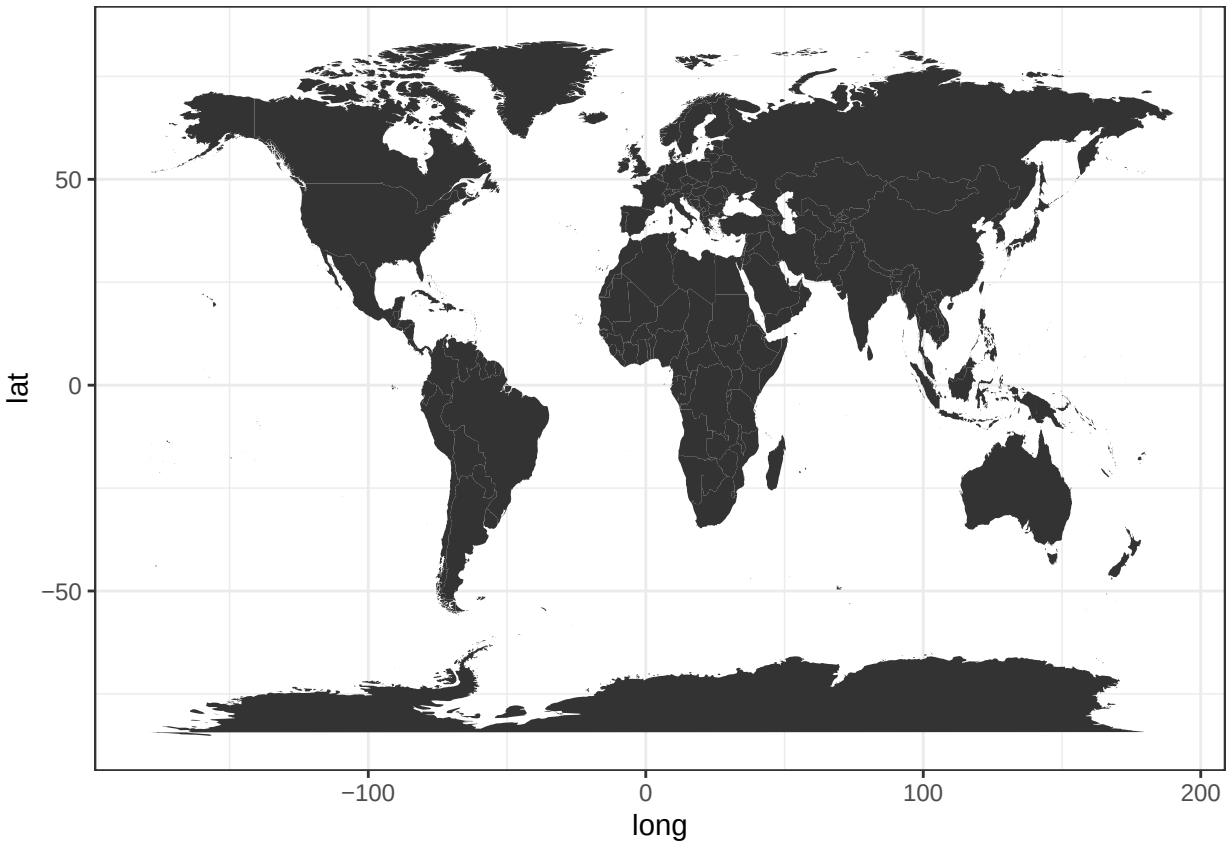
```
## [1] "data.frame"
```

Use `geom_polygon()` to draw a map. `theme_bw()` changes the map to black-white.

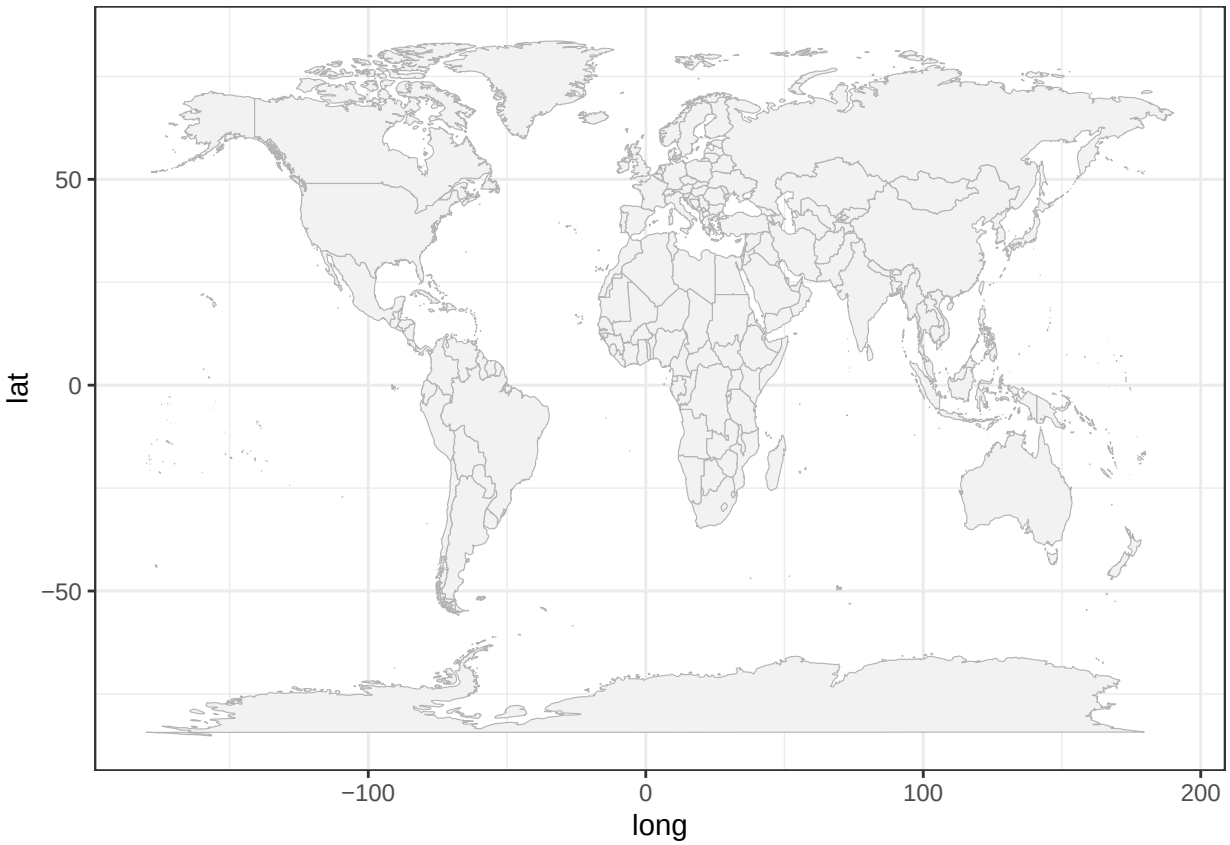
```r
ggplot() +
  geom_polygon(data = world_map, aes(x = long, y = lat, group = group))
```




```r
# use theme_bw()
# the background changes to white
ggplot() +
  geom_polygon(data = world_map, aes(x = long, y = lat, group = group)) +
  theme_bw()
```

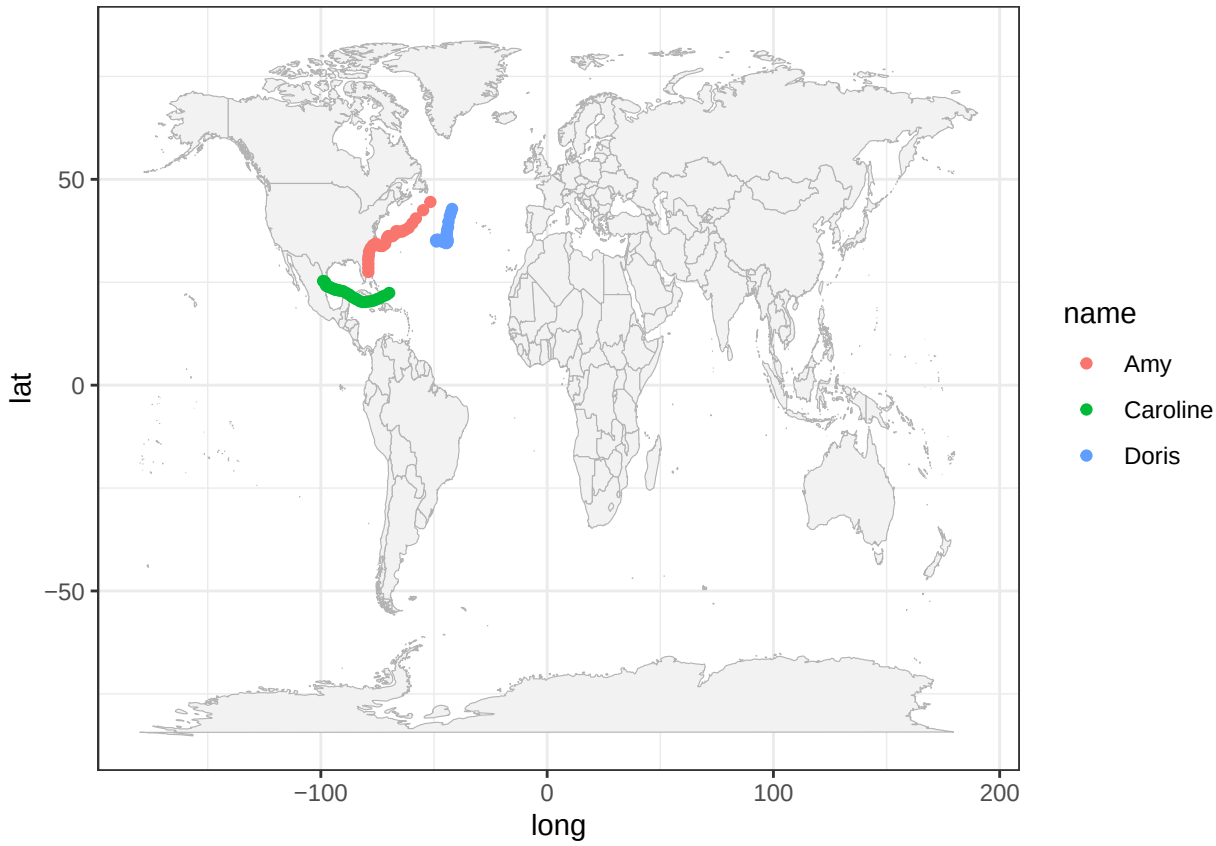



```
# store the ggplot to a variable
gg_world <- ggplot() +
  geom_polygon(data = world_map,
               aes(x = long, y = lat, group = group),
               fill = "gray95", colour = "gray70", size = 0.2) +
  theme_bw()

gg_world
```

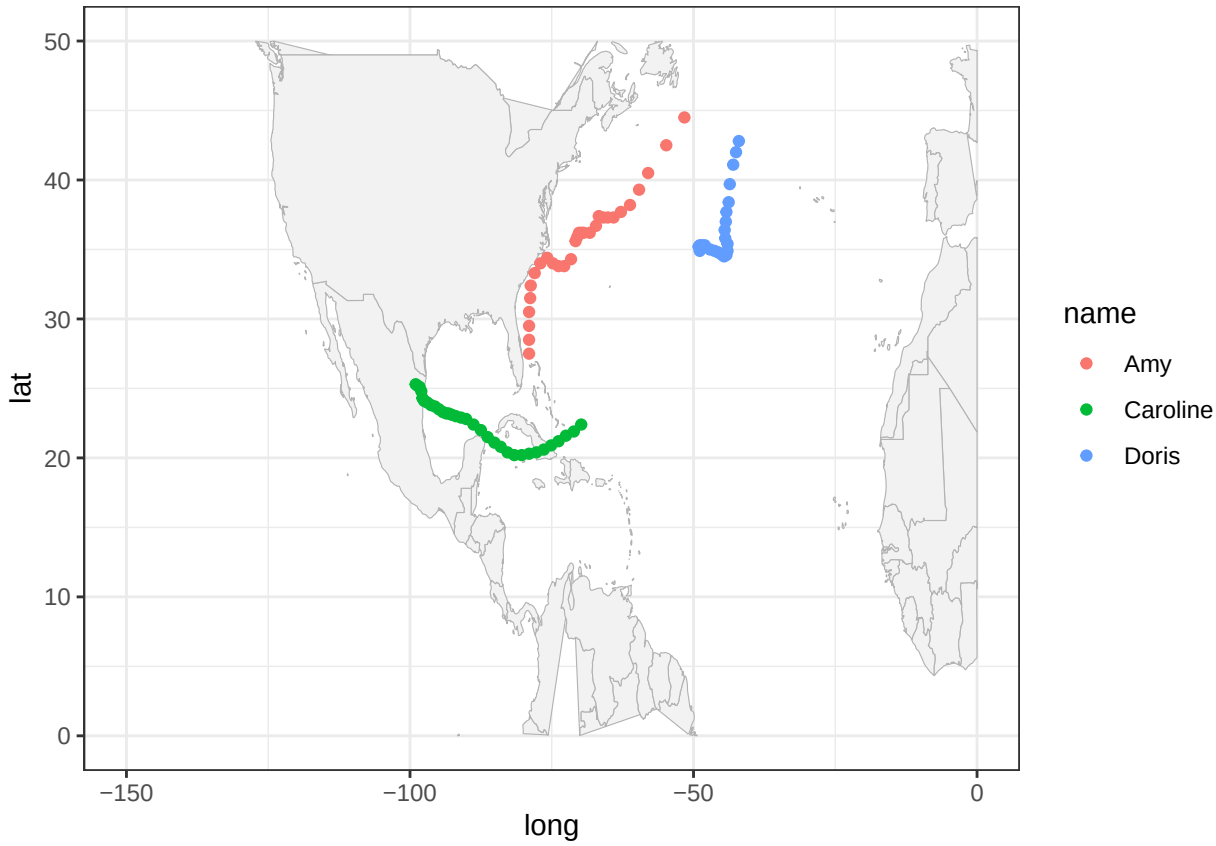


Let's add the points of the storm records. Use `xlim()` and `ylim()` to specify the range of longitude and latitude for zooming-in.

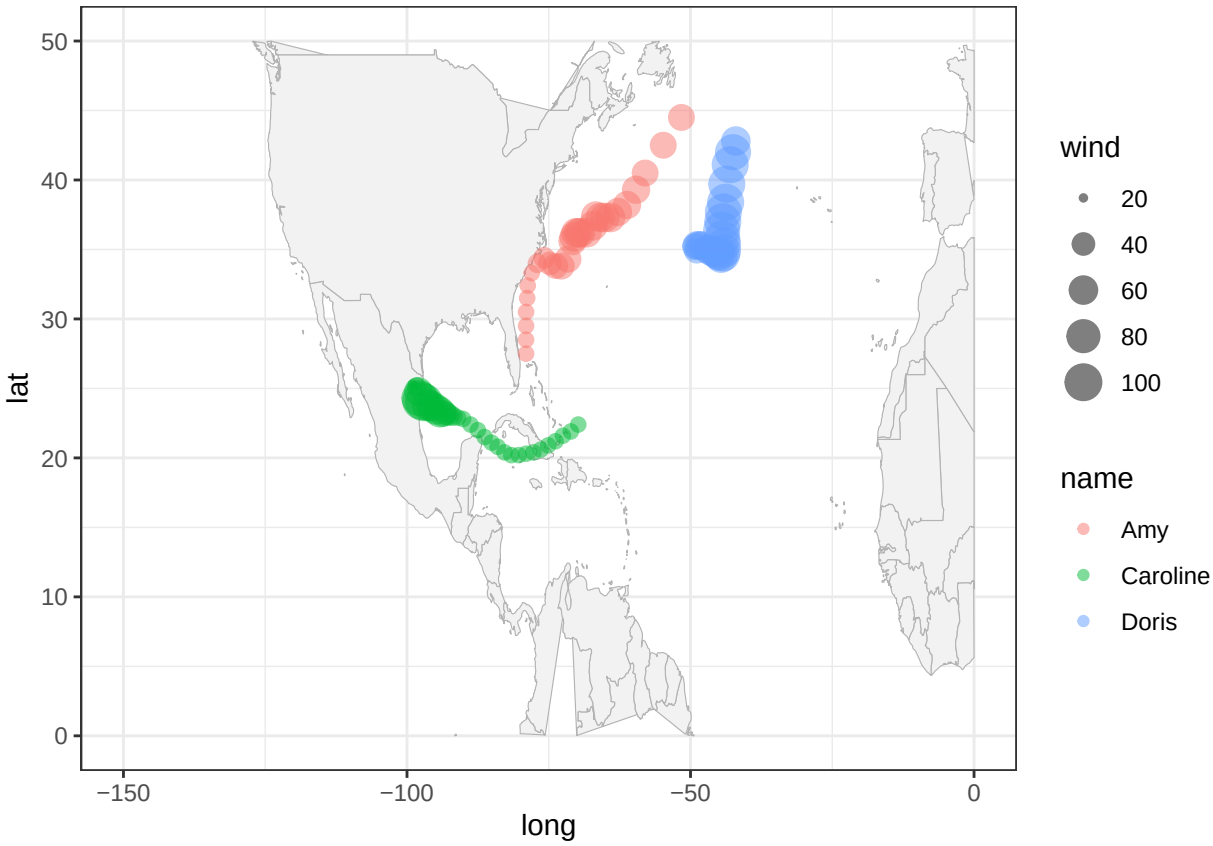
```
gg_world + geom_point(data = storms75, aes(x = long, y = lat, color = name))
```




```
# zoom-in
gg_world + geom_point(data = storms75, aes(x = long, y = lat, color = name)) +
  xlim(c(-150, 0)) +
  ylim(c(0, 50))
```

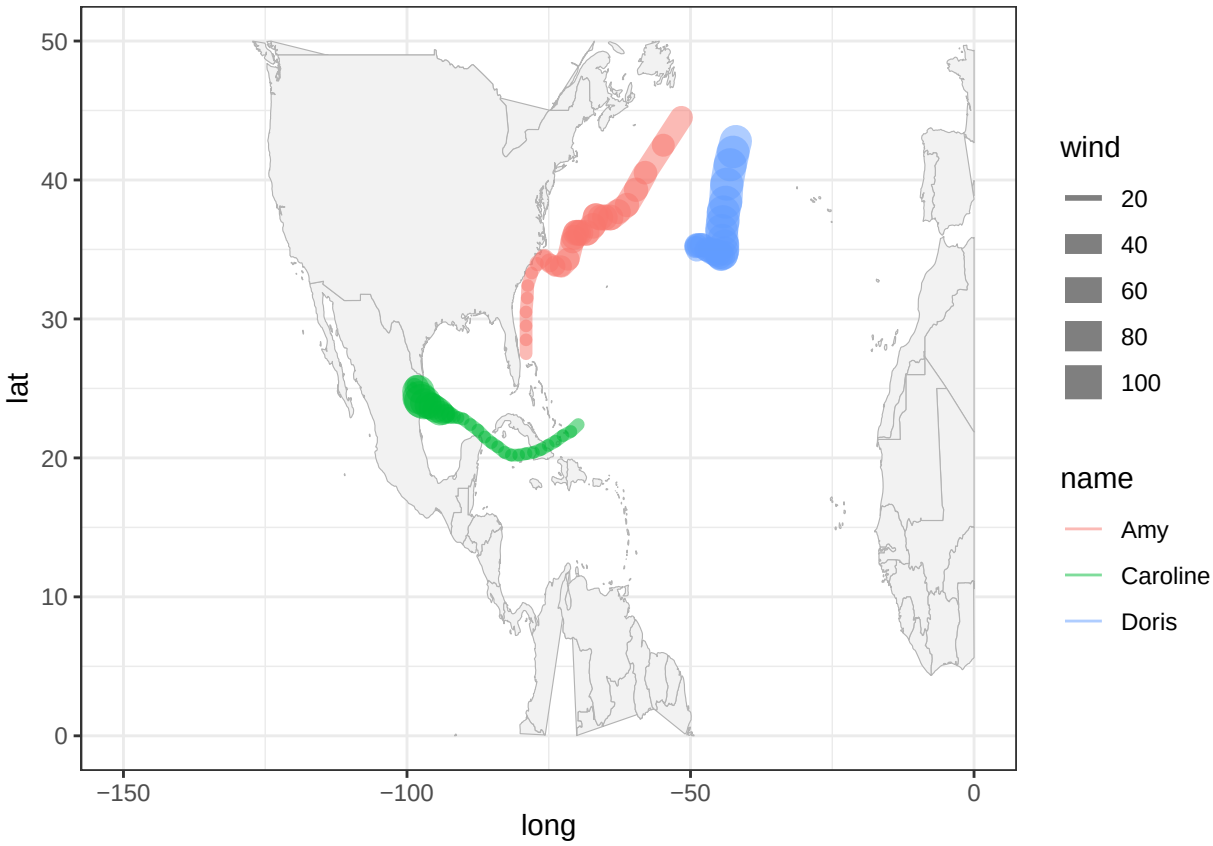



```
# add wind speed feature by setting size argument
gg_world +
  geom_point(data = storms75,
             aes(x = long, y = lat, color = name, size = wind), alpha = 0.5) +
  xlim(c(-150, 0)) +
  ylim(c(0, 50))
```



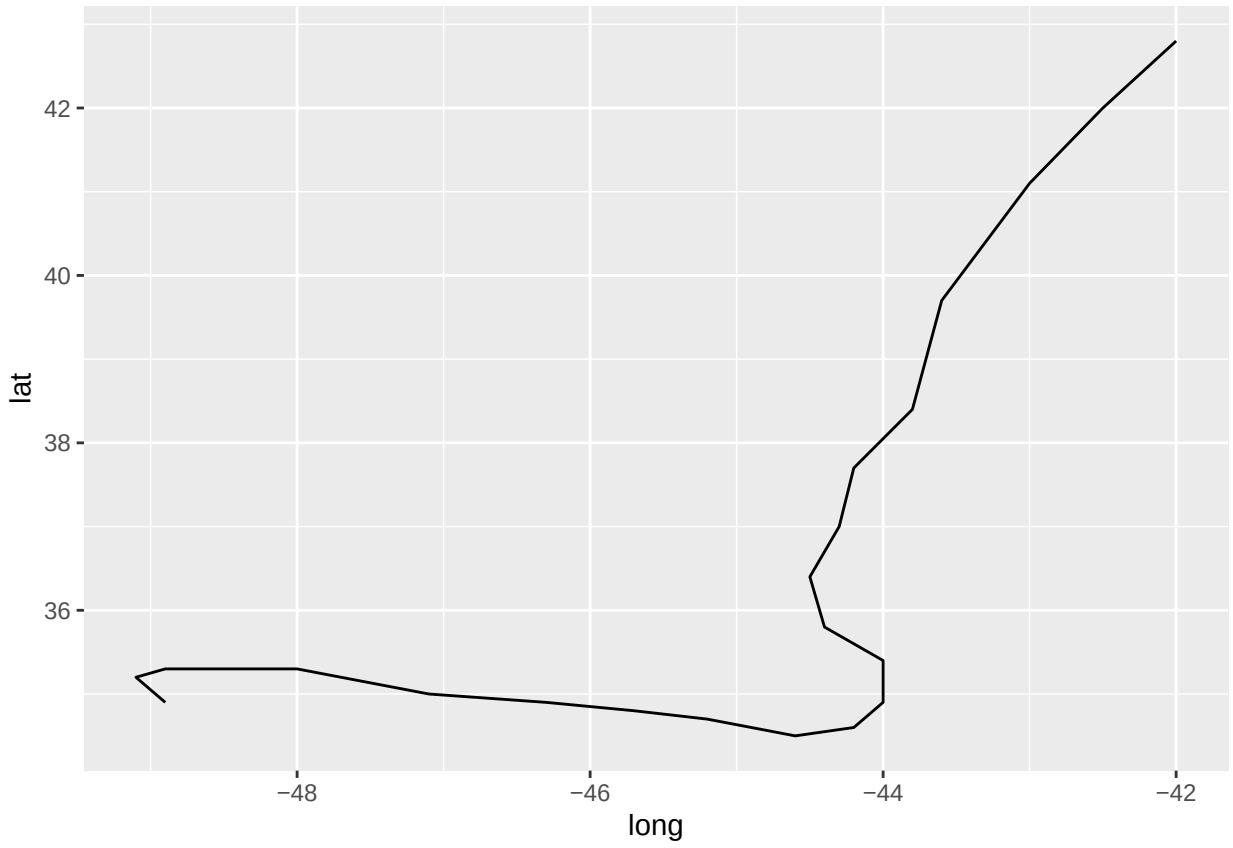
`geom_path()` acts like `geom_point()`. It connects points but it's more like a "path" of the points.

```
# similar result
gg_world +
  geom_path(data = storms75,
            aes(x = long, y = lat, color = name, size = wind),
            alpha = 0.5, lineend = "round") +
  xlim(c(-150, 0)) +
  ylim(c(0, 50))
```

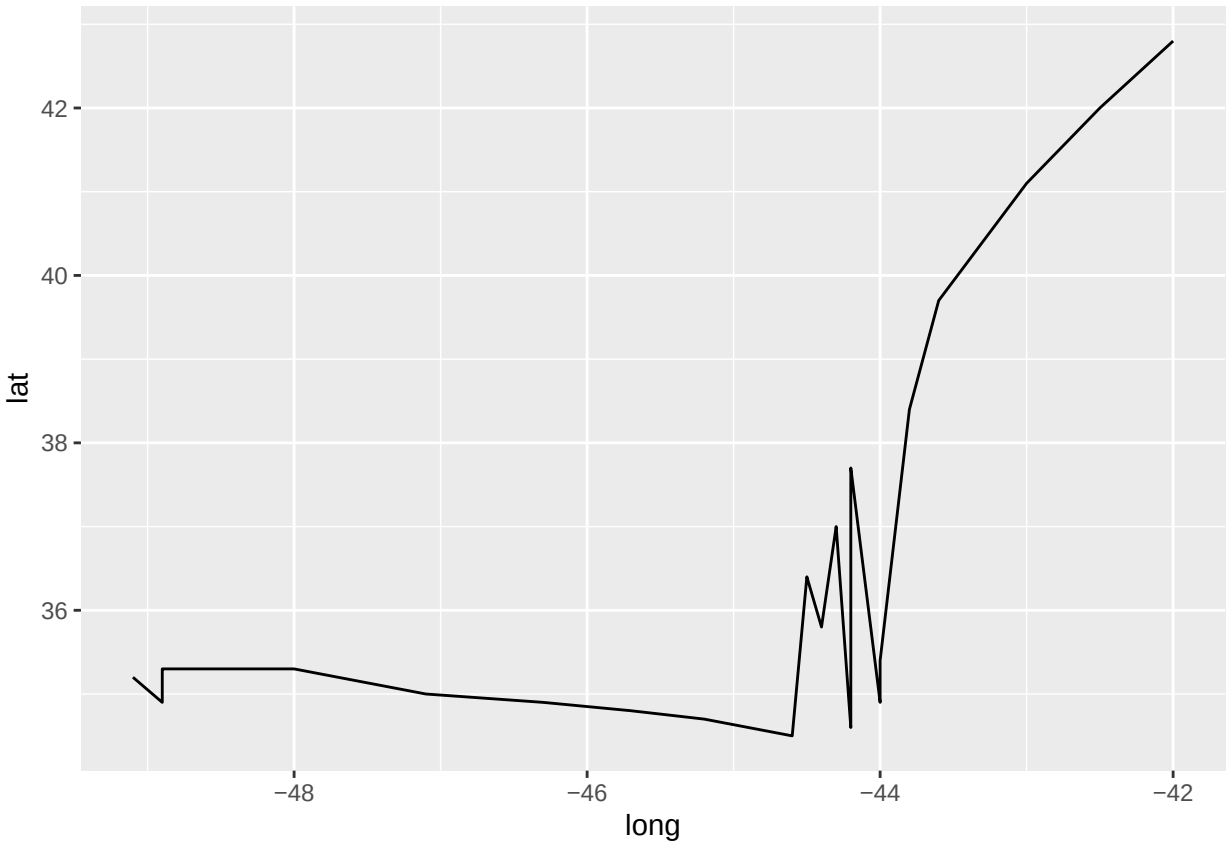


See the difference between `geom_line()` and `geom_path()` Both connects points but there's a big difference.

```
# just an example
doris75 <- filter(storms75, name == "Doris")

# geom_path()
ggplot(data = doris75, aes(x = long, y = lat)) + geom_path()
```




```
# geom_line()
ggplot(data = doris75, aes(x = long, y = lat)) + geom_line()
```



Using `rnaturalearth` package