Mapping

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Set up:

```
library(tidyverse)
library(drat)
library(hurricaneexposuredata)
library(usmap)
library(ggplot2)
addRepo("geanders")
data("hurr_tracks")
data("rain")
```

For Floyd-1999

```
# Create a sub-dataset for the storm Floyd-1999 with hurricane data
Floyd_hurr <- hurr_tracks %>%
  filter(storm_id == "Floyd-1999")
```

```
# Create a sub-dataset for the storm Floyd-1999 with rain data
Floyd_rain <- rain %>%
  filter(storm_id == "Floyd-1999")
```

```
#head(Floyd_hurr)
head(Floyd_rain)
```

```
##    fips   storm_id usa_atcf_id lag precip precip_max
## 1 01001 Floyd-1999    AL081999  -5    0.3        0.5
## 2 01001 Floyd-1999    AL081999  -4    0.0        0.0
## 3 01001 Floyd-1999    AL081999  -3    0.0        0.0
## 4 01001 Floyd-1999    AL081999  -2    0.0        0.0
## 5 01001 Floyd-1999    AL081999  -1    0.0        0.0
## 6 01001 Floyd-1999    AL081999   0    0.0        0.0
```

```
library(maps)
# Since the rain data contains fips only, needs to convert this information into
# longitude and latitude information
head(county.fips)
```

```
##   fips        polyname
## 1 1001 alabama,autauga
## 2 1003 alabama,baldwin
## 3 1005 alabama,barbour
## 4 1007    alabama,bibb
## 5 1009  alabama,blount
```

```
## 6 1011 alabama,bullock
```

```
# The county.fips data contains information for fips, but fips are integers
Floyd_rain$fips <- as.integer(Floyd_rain$fips)
# head(Floyd_rain)
# Now, the fips in both tables are in a consistent format.
```

```
Floyd_rain <- Floyd_rain %>%
  group_by(fips) %>%
  summarize(precip = sum(precip), precip_max = sum(precip_max))
```

```
# Add the county information into our rain data set
Floyd_rain <- left_join(Floyd_rain, county.fips, by = "fips")
# A new row polyname is added at the end, needs to seperate into two columns
library(magrittr)
Floyd_rain %<>% separate(polyname, c("county1", "county2"), sep = ",")
# The Floyd_rain now contains the county information as well
```

```
# Check all counties showed in the rain data
# unique(Floyd_rain$county1)
counties_f <- c("alabama", "arkansas", "connecticut", "delaware", "district of columbia",
                "florida","georgia", "illinois", "indiana","iowa", "kansas", "kentucky",
                "louisiana","maine", "maryland","massachusetts", "michigan", "mississippi",
                "missouri","new hampshire", "new jersey", "new york", "north carolina",
                "ohio", "oklahoma", "pennsylvania", "rhode island", "south carolina",
                "tennessee", "texas","vermont","virginia", "west virginia", "wisconsin")
# The map_data function provides longitude and latitude information for conuties
# head(map_data("county"))
counties_floyd <- map_data("county", counties_f)
state_floyd <- map_data("state", counties_f)
```

```
# Rename the rain data set for consistency
Floyd_rain <-Floyd_rain %>%
  rename(region = county1, subregion = county2)
# Add the longitude and latitude information into our rain data set
Floyd_rain <- left_join(counties_floyd, Floyd_rain,
                        by = c("region", "subregion"))
```

```
# Create different range groups that will be showed on the map based on the
# precip level
Floyd_rain <- Floyd_rain %>%
  mutate(`Rainfall (mm)` = cut(Floyd_rain$precip,
                    breaks = c(0, 25, 50, 75, 100, 125, 150, 175, 200, 225),
                    include.lowest = TRUE))
Floyd_rain <- na.omit(Floyd_rain)
```

For Allison-2001:

```
# Similar steps for Allison-2001
Allison_hurr <- hurr_tracks %>%
  filter(storm_id == "Allison-2001")
Allison_rain <- rain %>%
  filter(storm_id == "Allison-2001")
```

```
Allison_rain$fips <- as.integer(Allison_rain$fips)
Allison_rain <- Allison_rain %>%
```

```
  group_by(fips) %>%
  summarize(precip = sum(precip), precip_max = sum(precip_max))
Allison_rain <- left_join(Allison_rain, county.fips, by = "fips")
Allison_rain %<>% separate(polyname, c("county1", "county2"), sep = ",")
```

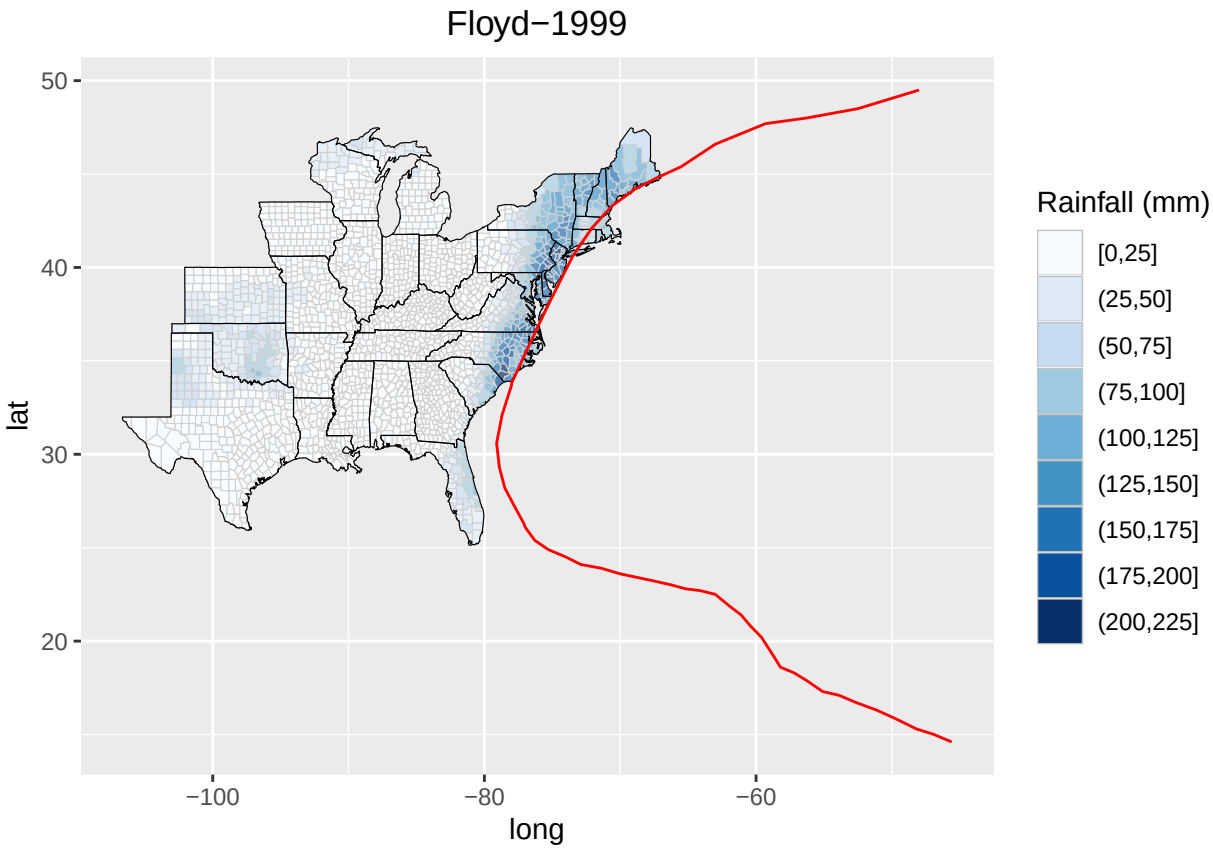
```
#unique(Allison_rain$county1)
counties_a <- c("alabama", "arkansas", "connecticut", "delaware", "district of columbia",
                "florida","georgia", "illinois", "indiana","iowa", "kansas", "kentucky",
                "louisiana","maine", "maryland","massachusetts", "michigan", "mississippi",
                "missouri","new hampshire", "new jersey", "new york", "north carolina",
                "ohio", "oklahoma", "pennsylvania", "rhode island", "south carolina",
                "tennessee", "texas","vermont","virginia", "west virginia", "wisconsin")
counties_allison <- map_data("county", counties_a)
state_allison <- map_data("state", counties_a)
```

```
Allison_rain <-Allison_rain %>%
  rename(region = county1, subregion = county2)
Allison_rain <- left_join(counties_allison, Allison_rain,
                          by = c("region", "subregion"))
```

```
# Create 2 different groups that will be showed on the map based on the precip level
Allison_rain <- Allison_rain %>%
  mutate(`Rain > 175 mm` = ifelse(Allison_rain$precip < 175, "Unexposed", "Exposed"))
Allison_rain <- na.omit(Allison_rain)
```

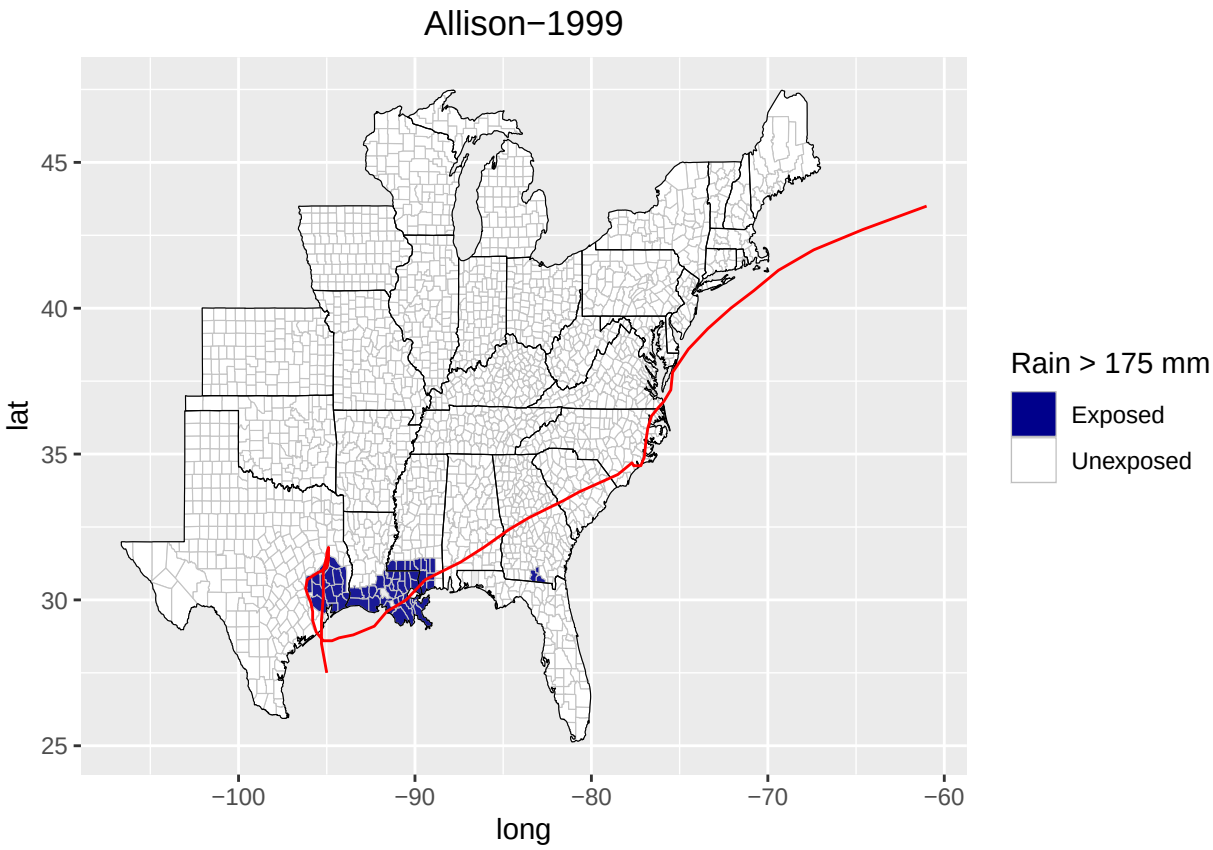
Floyd-1999 map with ggplot2:

```
ggplot() + geom_polygon(data = Floyd_rain, aes(x = long, y = lat, group = group,
                                               fill = `Rainfall (mm)`),
                        color = "grey", size = 0.2, alpha = 1.6) +
  geom_polygon(data = state_floyd, aes(x = long, y = lat, group = group),
                color="black", fill="white", size = 0.2, alpha = 0.3) +
  geom_path(aes(x = Floyd_hurr$longitude, y = Floyd_hurr$latitude), color = "red") +
      scale_fill_brewer(palette = "Blues") +
  ggtitle("Floyd-1999") +
  # Center the title
  theme(plot.title = element_text(hjust = 0.5))
```



Allison-2001 with ggplot2:

```
ggplot() + geom_polygon(data = Allison_rain, aes(x = long, y = lat, group = group,
                                                 fill = `Rain > 175 mm`),
                        color = "grey", size = 0.2, alpha = 1.6) +
geom_polygon(data = state_allison, aes(x = long, y = lat, group = group),
                color="black", fill="white", size = 0.2, alpha = 0.1) +
geom_path(aes(x = Allison_hurr$longitude, y = Allison_hurr$latitude), color = "red") +
scale_fill_manual(values = c("darkblue", "white"))+
ggtitle("Allison-1999") +
theme(plot.title = element_text(hjust = 0.5))
```



Floyd-1999 map with tmap:

Allison-2001 with tmap: