Mapping Assignment

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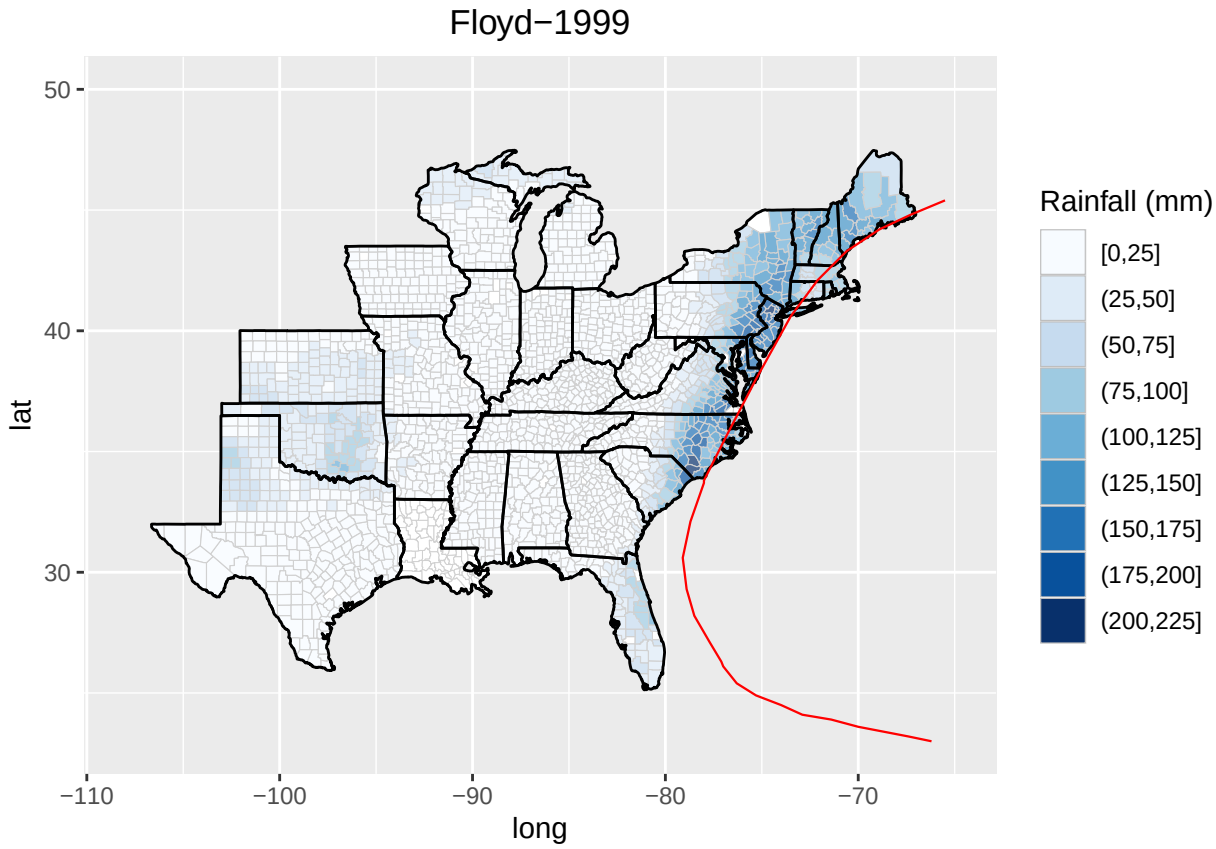
The first map for Floyd-1999 made with ggplot2

```
## load data
data("hurr_tracks")
data("rain")
data(county.fips)

MainStates <- map_data("state")
AllCounty <- map_data("county")
counties34 <- 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")
my_states <- subset(MainStates, region %in% counties34)
my_counties <- subset(AllCounty, region %in% counties34)

## get the track data of storm Floyd-1999
Floyd <- hurr_tracks[which(hurr_tracks$storm_id == "Floyd-1999"),]

## get the rain data of storm Floyd-1999
Floyd_rain <- rain %>% filter(storm_id == "Floyd-1999")
sum_precip <- Floyd_rain %>% group_by(fips) %>% dplyr::summarise(Rainfall = sum(precip))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
rain_county <- fips_info(sum_precip$fips)
Floyd_rain <- merge(sum_precip, rain_county, by = 'fips')
Floyd_rain$county %<>% str_replace(" County","")
Floyd_rain$full %<>% tolower()
Floyd_rain$county %<>% tolower()
Floyd_rain %<>% dplyr::rename(region=full, subregion=county)
a <- subset(Floyd_rain, region %in% counties34)
rainmap <- left_join(a, my_counties, by = c("region", "subregion"))

rainmap <- rainmap %>% mutate('Rainfall (mm)' = cut(rainmap$Rainfall,
                                                    breaks = c(0, 25, 50, 75, 100, 125, 150, 175, 200, 2
                                                    include.lowest = TRUE))


ggplot() +
  geom_polygon(data=my_counties, aes(x=long, y=lat, group=group),
               color="gray", fill="white", size = .1 ) +
```

```
  geom_polygon(data = rainmap, aes(x = long, y = lat, group = group,
                                   fill = `Rainfall (mm)`),
               color = "grey", size = 0.2, alpha = 1.6) +
  geom_polygon(data=my_states, aes(x=long, y=lat, group=group),
               color="black", fill="white",  size = .5, alpha = .3) +
  geom_path(aes(x = Floyd$longitude, y = Floyd$latitude), color = "red", size=0.4) +
  scale_fill_brewer(palette = "Blues") +
  xlim(-108, -65) +
  ylim(23, 50) +
  ggtitle("Floyd-1999") +
  theme(plot.title = element_text(hjust = 0.5))
```



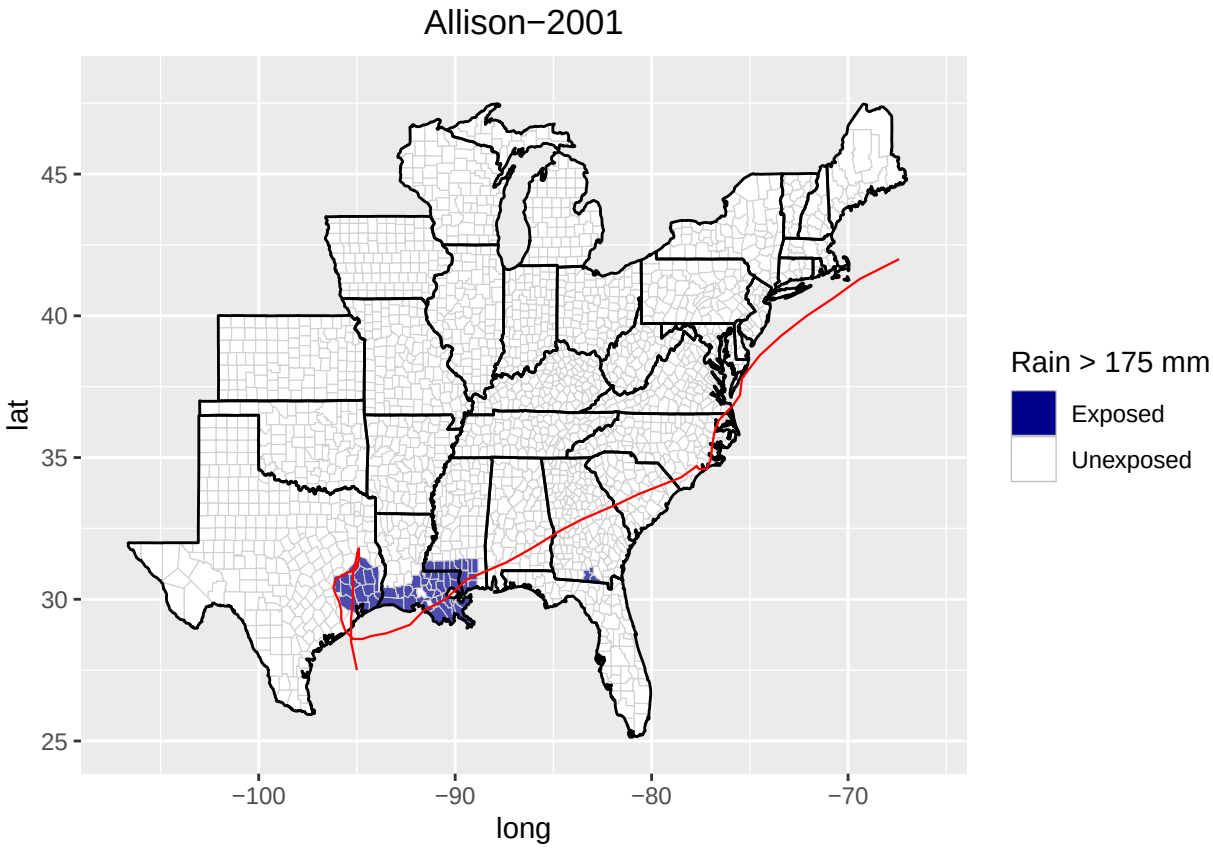
The second map for Allison-2001 made with ggplot2

```
## get the track data of storm Allison-2001
Allison <- hurr_tracks[which(hurr_tracks$storm_id == "Allison-2001"),]

## get the rain data of storm Floyd-1999
Allison_rain <- rain %>% filter(storm_id == "Allison-2001")
sum_precip <- Allison_rain %>% group_by(fips) %>% dplyr::summarise(Rainfall = sum(precip))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
sum_precip$fips %<>% as.numeric()
Allison_rain <- left_join(sum_precip, county.fips, by = 'fips')
Allison_rain %<>% separate(polyname, c("region", "subregion"), sep=",")
rainmap <- left_join(my_counties, Allison_rain, by = c("region", "subregion"))
```

```
rainmap %<>% mutate('Rain > 175 mm' = ifelse(rainmap$Rainfall < 175, "Unexposed", "Exposed"))
rainmap <- na.omit(rainmap)

ggplot() +
  geom_polygon(data=my_counties, aes(x=long, y=lat, group=group),
               color="gray", fill="white", size = .1 ) +
  geom_polygon(data = rainmap, aes(x = long, y = lat, group = group,
                                   fill = `Rain > 175 mm`),
               color = "grey", size = 0.2, alpha = 1.6) +
  geom_polygon(data=my_states, aes(x=long, y=lat, group=group),
               color="black", fill="white",  size = 0.5, alpha = .3) +
  geom_path(aes(x = Allison$longitude, y = Allison$latitude), color = "red", size=0.4) +
  scale_fill_manual(values = c("darkblue", "white")) +
  xlim(-107, -66) +
  ylim(25, 48) +
  ggtitle("Allison-2001") +
  theme(plot.title = element_text(hjust = 0.5))
```



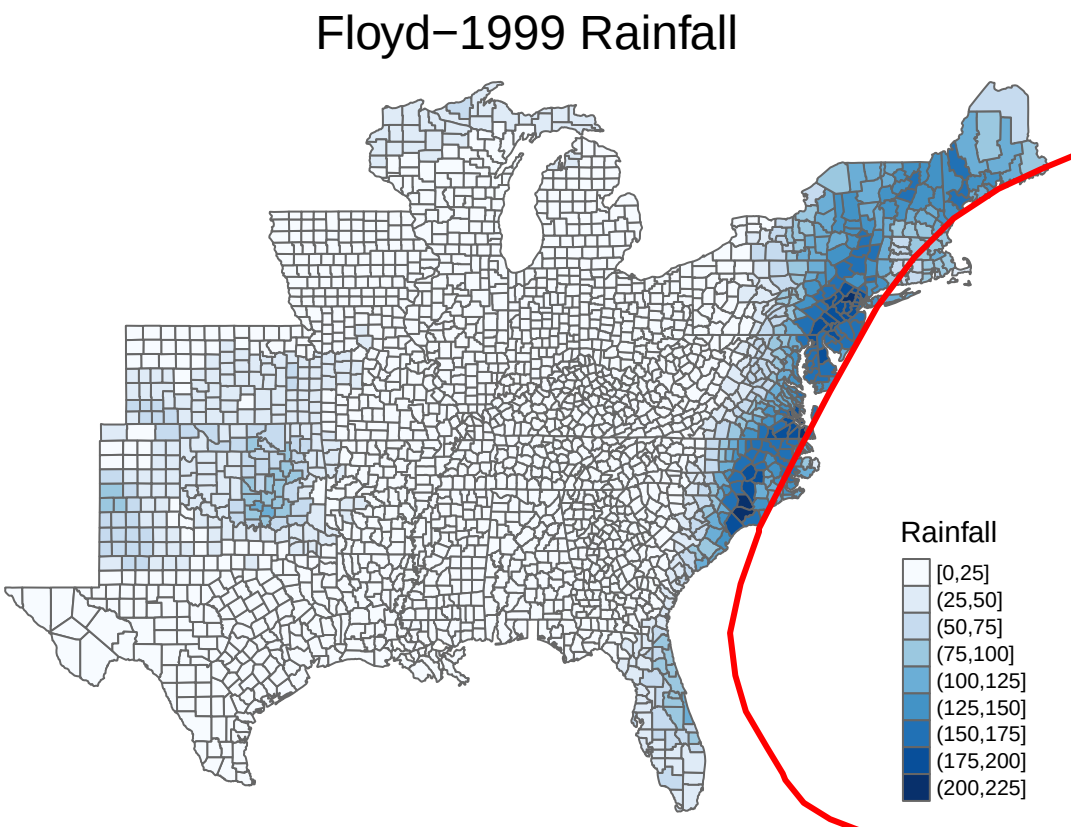
The third map for Floyd-1999 made with tmap

```
#fips match location
uscounty=st_as_sf(map('county',plot=F,fill=T))
colnames(county.fips)[2]=colnames(uscounty)[1]
uscounty=left_join(uscounty,county.fips,by='ID')

#floyd rain
```

```
rain_floyd=rain %>% filter(storm_id=='Floyd-1999')
total_rain_floyd = rain_floyd %>% group_by(fips) %>% summarise(storm_id=storm_id[1],precip=sum(precip))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
total_rain_floyd = total_rain_floyd %>% mutate(fips=as.numeric(fips))
total_rain_floyd <- total_rain_floyd %>%
mutate('Rainfall(mm)' = cut(total_rain_floyd$precip,
breaks = c(0, 25, 50, 75, 100, 125, 150, 175, 200, 225),
include.lowest = TRUE))
total_rain_floyd= right_join(uscounty,total_rain_floyd,'fips')


#floyd track line
hurr_floyd=hurr_tracks%>%filter(storm_id=="Floyd-1999")
track_floyd=cbind(longitude=hurr_floyd$longitude,latitude=hurr_floyd$latitude)
#the following codes refer to other's
track_floyd=SpatialLines(list(Lines(Line(track_floyd),ID='Floyd-1999')))


#plot
tm_shape(total_rain_floyd)+
  tm_polygons(col='Rainfall(mm)',title="Rainfall",palette = "Blues")+
tm_shape(track_floyd)+
  tm_lines(col = "red",lwd = 3)+
tm_layout(main.title="Floyd-1999 Rainfall",
            main.title.position="center",
             frame = FALSE)
```



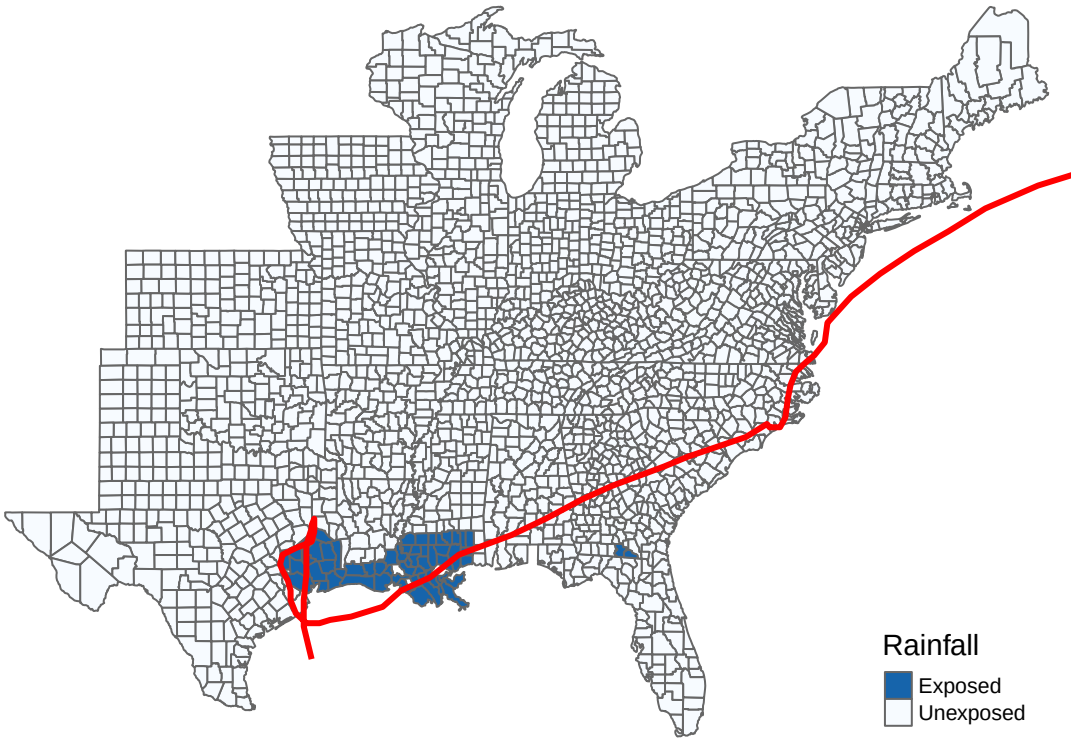
The fourth map for Allison-2001 made with tmap

We extract data from rain dataset and match fips with list format of longitude and latitude. Besides, we extract data from hurr_tracks dataset and process data into format that can be read with tmap packages.

```
#fips match location
uscounty=st_as_sf(map('county',plot=F,fill=T))
colnames(county.fips)[2]=colnames(uscounty)[1]
uscounty=left_join(uscounty,county.fips,by='ID')

#floyd rain
rain_allison=rain %>% filter(storm_id=='Allison-2001')
total_rain_allison = rain_allison %>% group_by(fips) %>% summarise(storm_id=storm_id[1],precip=sum(prec
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
total_rain_allison = total_rain_allison %>% mutate(fips=as.numeric(fips))
total_rain_allison <- total_rain_allison %>%
mutate('Rain > 175 mm' = ifelse(total_rain_allison$precip > 175, "Exposed", "Unexposed"))
total_rain_allison= right_join(uscounty,total_rain_allison,'fips')


#floyd track line
hurr_allison=hurr_tracks%>%filter(storm_id=="Allison-2001")
track_allison=cbind(longitude=hurr_allison$longitude,latitude=hurr_allison$latitude)
#the following codes refer to other's
track_allison=SpatialLines(list(Lines(Line(track_allison),ID='Allison-2001')))


#plot
tm_shape(total_rain_allison)+
  tm_polygons(col='Rain > 175 mm' ,title="Rainfall",palette = "Blues",contrast = c(0.8,0))+
tm_shape(track_allison)+
  tm_lines(col = "red",lwd = 3)+
tm_layout(main.title="Allison-1999 Rainfall",
            main.title.position="center",
             frame = FALSE)
```


Allison−1999 Rainfall
Rainfall
Exposed
Unexposed