

Story_5

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INTRODUCTION

Historic data seems to indicate the average temperature on earth has been increasing over time. Further, it has been widely reported and believed that the increase in global temperature is responsible for the increased severity, intensity, and occurrence of cyclonic storms (Hurricanes, Typhoons, and Tornadoes). For this assignment I will utilize NYC average temperatures from The Climate Explorer 1950 through 2013. As well as count of Tornadoes occurrences from The National Centers for Environmental Information, the count of Hurricane occurrences from United States Environmental Protection Agency, Tornadoes intensity from NOAA National Weather Service, and Hurricane intensity from NOAA Hurricane Research Division. I will attempt to let the data tell the story if indeed the Global temperature has had an effect on occurrence and intensity of these storms.

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr      1.1.3      v readr      2.1.4
## v forcats    1.0.0      v stringr    1.5.0
## v ggplot2     3.4.3      v tibble     3.2.1
## v lubridate  1.9.2      v tidyr      1.3.0
## v purrr      1.0.2
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(ggplot2)
```

Reading in the data.

```
tornadoes <- read.csv("~/DATA_SCIENCE/DATA_608/Major Assignments/Assingment_5/DATA/tornadoes.csv")
tropical_cyclones <- read.csv("~/DATA_SCIENCE/DATA_608/Major Assignments/Assingment_5/DATA/tropical_cyclones.csv")
temp <- read.csv("~/DATA_SCIENCE/DATA_608/Major Assignments/Assingment_5/DATA/New_York_County-annual-historical-temperature.csv")
h_intensity <- read.csv("~/DATA_SCIENCE/DATA_608/Major Assignments/Assingment_5/DATA/hurricane_intensity.csv")
t_intensity <- read.csv("~/DATA_SCIENCE/DATA_608/Major Assignments/Assingment_5/DATA/1950-2022_tornadoes_intensity.csv")
```

Grouping the intensity of Hurricane and Tornadoes data by year, summarizing the intensity, and joining to create one intensity dataset.

```

h_intensity_summ <- h_intensity %>%
  group_by(Year) %>%
  summarise(Avg_SS_index = mean(Highest.Saffir.Simpson.US.Category), Hurricanes = n())
t_intensity_summ <- t_intensity %>%
  rename(Year = yr) %>%
  group_by(Year) %>%
  summarise(Avg_F_index = mean(mag, na.rm = TRUE), Tornadoes = n())
intensities <- h_intensity_summ %>%
  inner_join(t_intensity_summ, join_by(Year))

```

To merge the Hurricane and Tornado count datasets.

```

tornadoes <- tornadoes %>%
  rename(Year = Date)
merged <- tornadoes %>%
  inner_join(tropical_cyclones, join_by(Year))
temp <- temp %>%
  rename(Year = year)
merged2 <- merged %>%
  inner_join(temp, join_by(Year))

```

To pivot table longer for graphing.

```

data_long <- merged2 %>%
  select(Year, tmax, Tornadoes, Hurricanes.reaching.the.United.States) %>%
  pivot_longer(cols = !c(Year, tmax), names_to = "Storm", values_to = "count") %>%
  mutate(Storm = ifelse(Storm == "Tornadoes", "Tornadoes", "Hurricanes"))

```

Plotting the landfall frequency storms over time from 1950 through 2013.

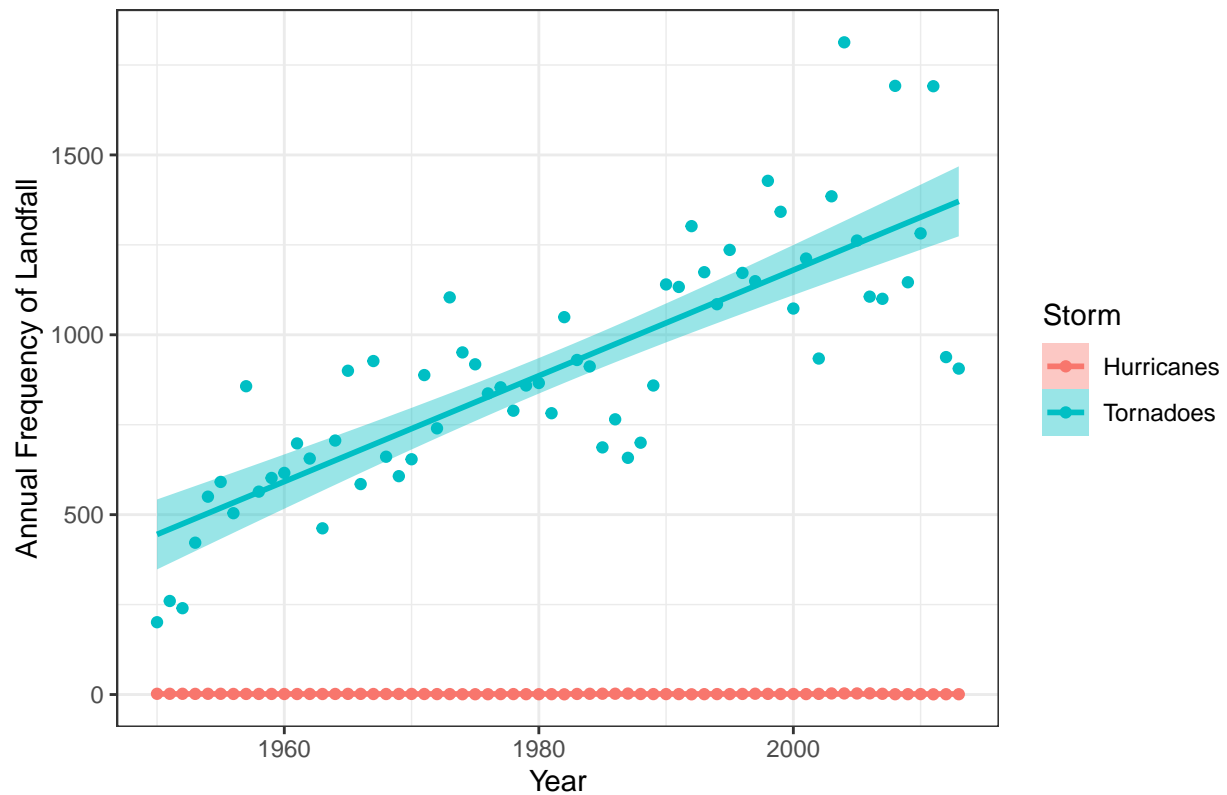
```

data_long %>%
  ggplot(aes(x = Year, y = count, fill = Storm, color = Storm)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(x = "Year", y = "Annual Frequency of Landfall", title = "US Storm Frequency 1950 - 2013") +
  theme_bw()

```

```
## 'geom_smooth()' using formula = 'y ~ x'
```

US Storm Frequency 1950 – 2013

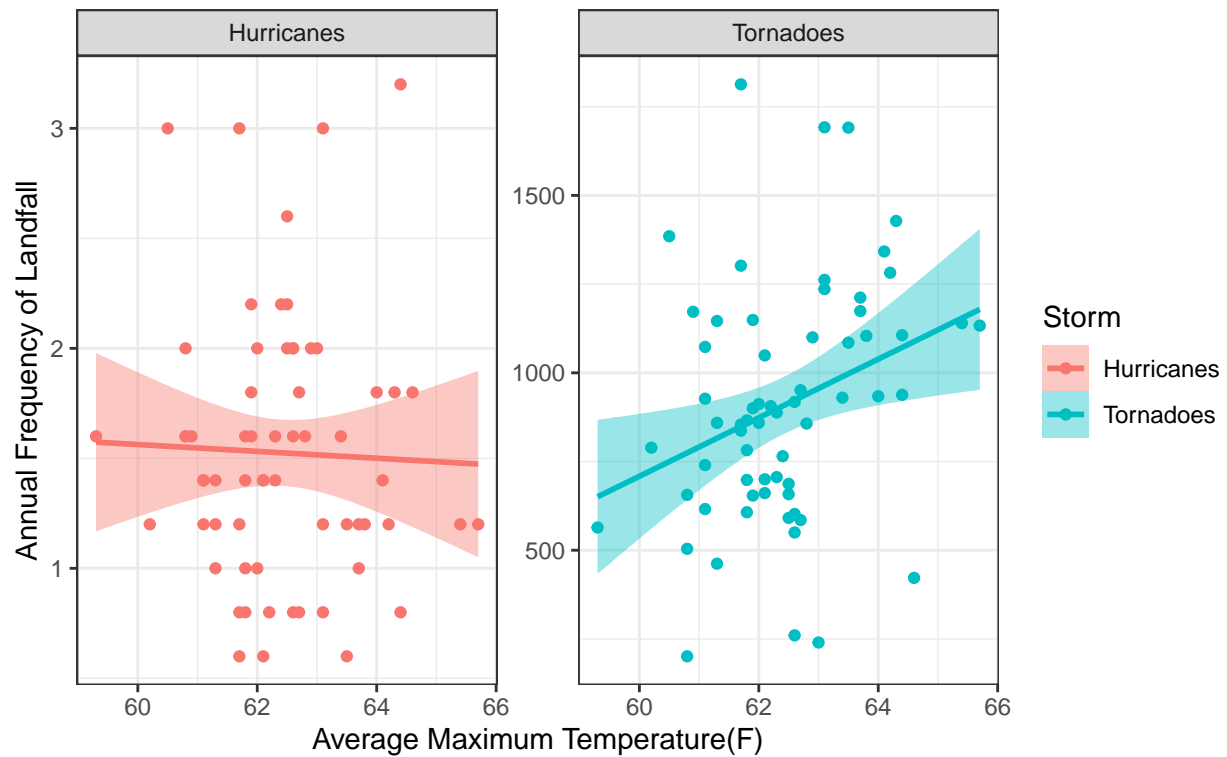


Plotting the landfall frequency of storms vs average global Average Maximum temperature from 1950 though 2013.

```
data_long %>%
  ggplot(aes(x = tmax, y = count, fill = Storm, color = Storm)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(x = "Average Maximum Temperature(F)", y = "Annual Frequency of Landfall", title = "US Storm Frequency 1950 – 2013") +
  theme_bw() +
  facet_wrap(~Storm, scales = "free")
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```

US Storm Frequency by Average Max Temperature New York City, NY

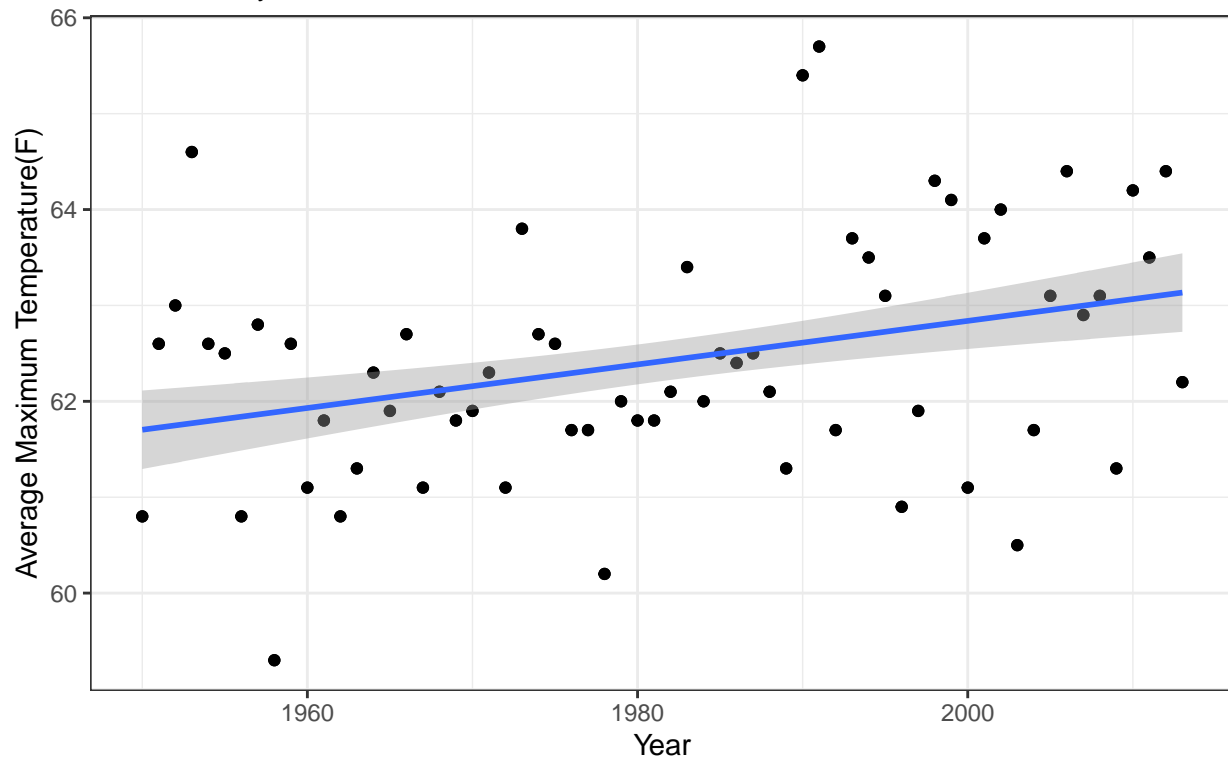


Plotting the average Maximum temperature over time from 1950 through 2013.

```
data_long %>%
  ggplot(aes(x = Year, y = tmax)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(x = "Year", y = "Average Maximum Temperature(F)", title = "Annularized Average Daily Max Temperature")
  theme_bw()
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```

Annularized Average Daily Max Temperature 1950 – 2013 New York City, NY

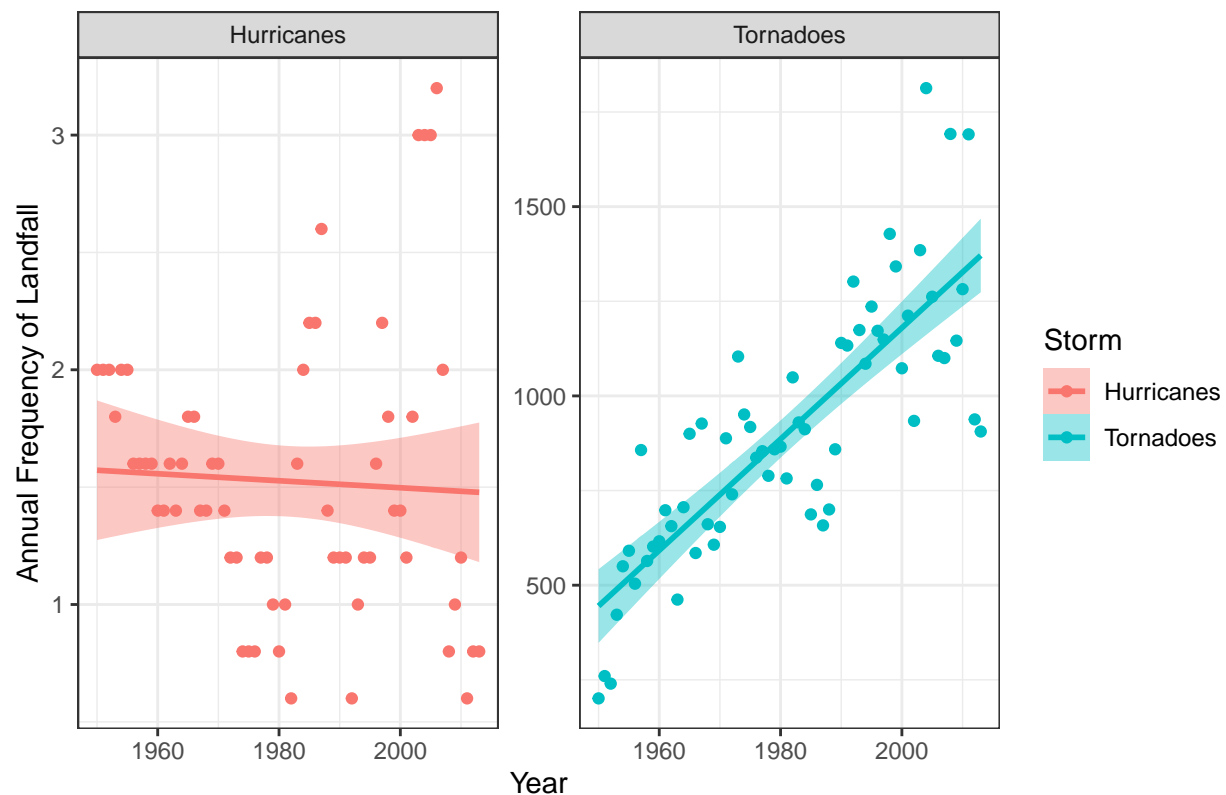


Plotting the landfall frequency of storms from 1950 through 2013.

```
data_long %>%
  ggplot(aes(x = Year, y = count, fill = Storm, color = Storm)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(x = "Year", y = "Annual Frequency of Landfall", title = "US Storm Frequency 1950 - 2013") +
  theme_bw() +
  facet_wrap(~Storm, scales = "free")
```

'geom_smooth()' using formula = 'y ~ x'

US Storm Frequency 1950 – 2013



Data wrangling for the combined intensities datasets into one.

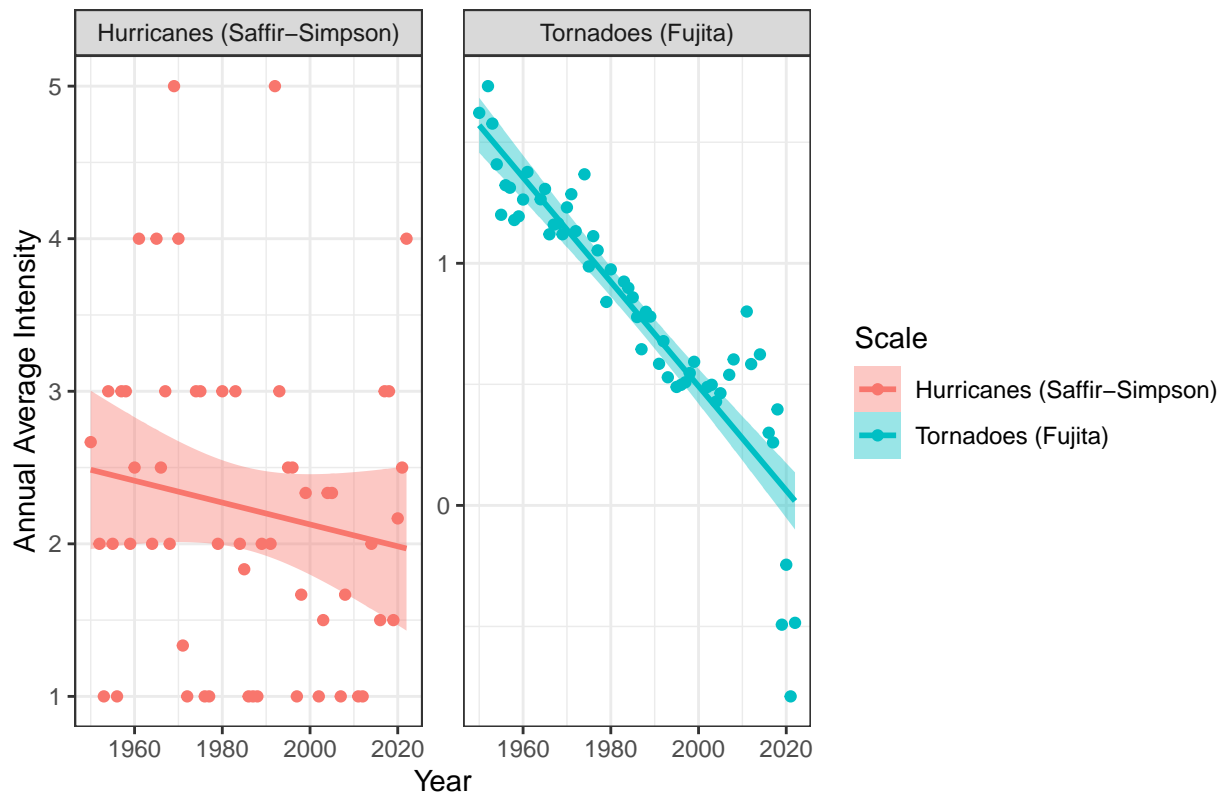
```
intensities_long <- intensities %>%
  pivot_longer(cols = !c(Year, Hurricanes, Tornadoes), names_to = "Scale", values_to = "Value") %>%
  mutate(Scale = ifelse(Scale == "Avg_F_index", "Tornadoes (Fujita)", "Hurricanes (Saffir-Simpson)"))
```

Plotting the US Storm intensity data from 1950 through 2022.

```
intensities_long %>%
  ggplot(aes(x = Year, y = Value, fill = Scale, color = Scale)) +
  geom_point() +
  geom_smooth(method = "lm") +
  labs(x = "Year", y = "Annual Average Intensity", title = "US Storm Intensity 1950 - 2022") +
  theme_bw() +
  facet_wrap(~Scale, scales = "free")
```

```
## 'geom_smooth()' using formula = 'y ~ x'
```

US Storm Intensity 1950 – 2022



CONCLUSION

The data has shown a clear pattern of global average maximum temperature increase from 1950 through 2013. Also, it appears there is a significant increase in the frequency of landfall for Tornadoes in the United States and marginal increase in the frequency of Hurricane landfall in the United States both over time and as the Global Average Maximum Temperature increase. However, the data clearly shows that while the frequency and count of occurrence of these storms have increase at the same time the severity of these storms have decrease. There is a very strong negative correlation of intensity for Tornadoes, and a mildly negative intensity correlation of Hurricanes for the years 1950 through 2022.

SOURCES Tornadoes Count <https://www.ncei.noaa.gov/access/monitoring/tornadoes/time-series/ytd/12?mean=true>

Hurricane Counts <https://www.epa.gov/climate-indicators/climate-change-indicators-tropical-cyclone-activity>

Tornado Intensity <https://www.spc.noaa.gov/wcm/>

Hurricane Intensity https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html

Average Maximum NYC Temp over time https://crt-climate-explorer.nemac.org/climate_graphs/?county=New+York+County&city=New+York%2C+NY&fips=36061&lat=40.7127753&lon=-74.0059728