Impact of severe weather events on public health and economy in the United States

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Synopsis

Storms and other severe weather events can cause both public health and economic problems for communities and municipalities. Many severe events can result in fatalities, injuries, and property damage, and preventing such outcomes to the extent possible is a key concern.

This analysis explores the U.S. National Oceanic and Atmospheric Administration's (NOAA) storm database. This database tracks characteristics of major storms and weather events in the United States, including estimates of any fatalities, injuries, and property and crop damage.

This analysis found that between 1950 and November 2011, Tornados were the most impactful events with 5633 fatalities and 91346 injuries.

During the same period, Floods were responsible for 145B$ of property damages and Hurricanes for 800B$ of damages to crops.

Preparation of Environment and Packages

Data Processing

Load the data directly from original raw data file (..csv.bz2 file)

```
raw_data <- read.csv("StormData.csv.bz2",  stringsAsFactors = TRUE)
```

Question 1: Which types of events are most harmful to population health?

Process/transform the data

The strategy adopted extracts Event Types (EVTYPE), Fatalities (FATALITIES) and Injuries (INJURIES) from the dataset, group records by Event Type and sum Fatalities and Injuries by event Types. We sort summarised data by decreasing order of the number of Fatalities/Injuries occurences and keep only the 10 top most relevant.

```
# Analysis of Fatalities
dataFatalities <- select(raw_data, EVTYPE, FATALITIES) %>%
  group_by(EVTYPE) %>%
```

```
  summarize_all( sum ) %>%
  mutate(Percentage=paste0(round(FATALITIES/sum(FATALITIES)*100,2),"%")) %>%
  arrange(desc( FATALITIES )) %>%       #We keep only the most relevant events
  head( n = 10 )

# Analysis of Injuries
dataInjuries <- select(raw_data, EVTYPE, INJURIES) %>%
  group_by(EVTYPE) %>%
  summarize_all( sum ) %>%
  mutate(Percentage=paste0(round(INJURIES/sum(INJURIES)*100,2),"%")) %>%
  arrange(desc( INJURIES )) %>% #We keep only the most relevant events
  head( n = 10 )

# Sort Event Factors to generate a sorted bar chart.
dataFatalities$EVTYPE <- factor( dataFatalities$EVTYPE,
        levels = dataFatalities$EVTYPE[order(dataFatalities$FATALITIES, decreasing=TRUE)])
dataInjuries$EVTYPE <- factor( dataInjuries$EVTYPE,
        levels = dataInjuries$EVTYPE[order(dataInjuries$INJURIES, decreasing=TRUE)])
```

Results

As seen in the following tables, between 1950 and November 2011, Tornados were the most impactful events with 5633 fatalities, representing 37% of fatalities caused by severe weather events. In addition, Tornados are also responsible of 91346 injuries, representing 65% of injuries by severe weather events.

```
dataFatalities
```

```
## # A tibble: 10 x 3
##    EVTYPE         FATALITIES Percentage
##    <fct>               <dbl> <chr>
##  1 TORNADO              5633 37.19%
##  2 EXCESSIVE HEAT       1903 12.57%
##  3 FLASH FLOOD           978 6.46%
##  4 HEAT                  937 6.19%
##  5 LIGHTNING             816 5.39%
##  6 TSTM WIND             504 3.33%
##  7 FLOOD                 470 3.1%
##  8 RIP CURRENT           368 2.43%
##  9 HIGH WIND             248 1.64%
## 10 AVALANCHE             224 1.48%
```

```
dataInjuries
```

```
## # A tibble: 10 x 3
##    EVTYPE            INJURIES Percentage
##    <fct>                <dbl> <chr>
##  1 TORNADO              91346 65%
##  2 TSTM WIND             6957 4.95%
##  3 FLOOD                 6789 4.83%
##  4 EXCESSIVE HEAT        6525 4.64%
##  5 LIGHTNING             5230 3.72%
##  6 HEAT                  2100 1.49%
##  7 ICE STORM             1975 1.41%
##  8 FLASH FLOOD           1777 1.26%
```

```
##  9 THUNDERSTORM WIND      1488 1.06%
## 10 HAIL                   1361 0.97%
```

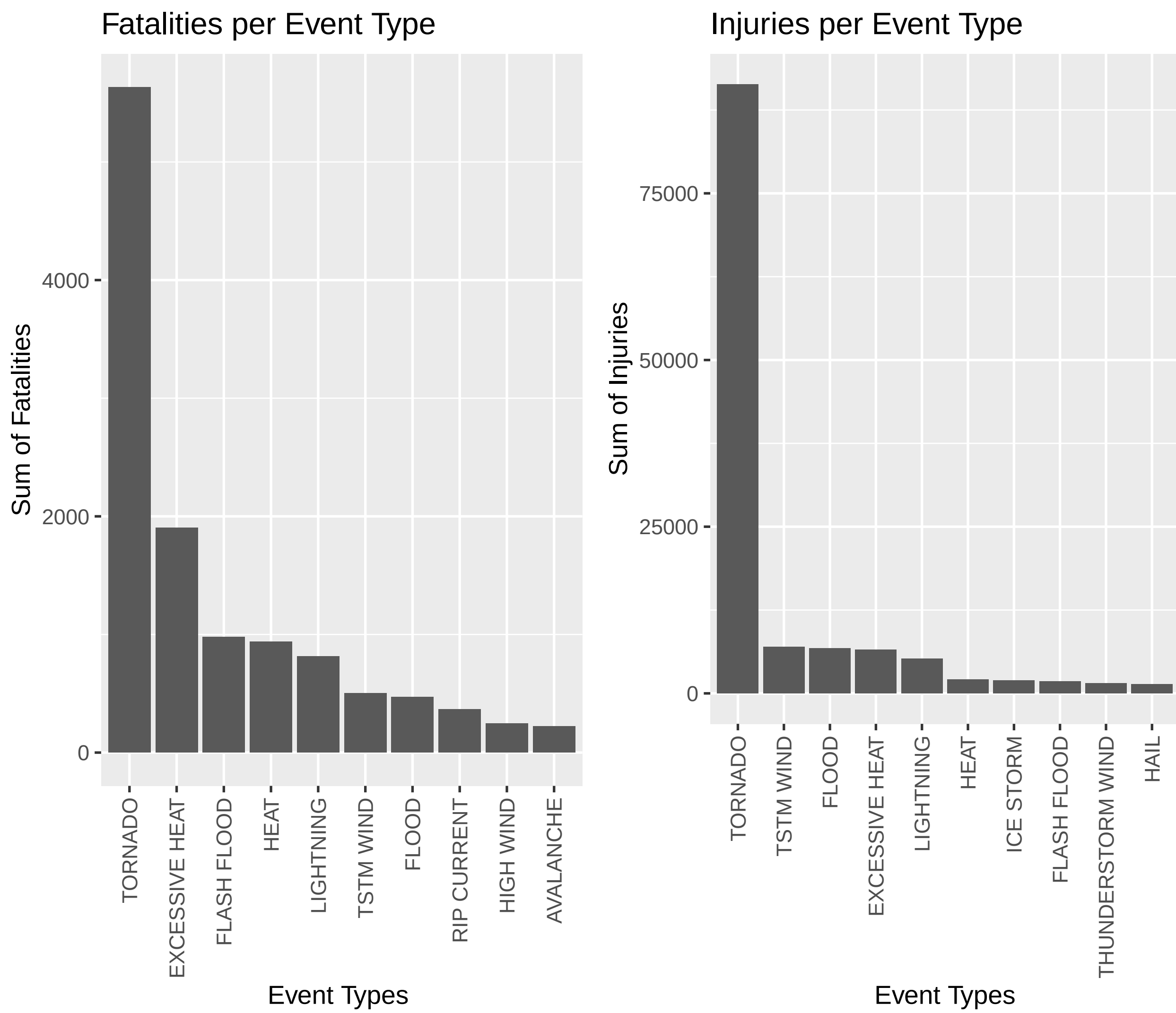

Figure 1: Cumulative fatalities and injuries caused by severe weather events in the US between 1950 and November 2011.

Question 2: Which types of events have the greatest economic consequences?

Process/transform the data

The strategy adopted here is essentially to extract Event Types (EVTYPE), property damages (PROPDMG), property damage magnitude factor (PROPDMGEXP), crop damage (CROPDMG) , and crop damage magnitude factor (CROPDMGEXP). Property damages have to be calculated according to PROPDMGEXP (K, M, B) to end up with proper comparable values.

```r
# Analysis of property and crop damages
dataPropDMG <- select(raw_data, c(EVTYPE, contains("DMG")) ) %>%
  mutate( PROPDMG = case_when(
      str_detect(PROPDMGEXP, "K") ~ PROPDMG * 1000,
      str_detect(PROPDMGEXP, "M") ~ PROPDMG * 1000000,
      str_detect(PROPDMGEXP, "B") ~ PROPDMG * 1000000000
  )) %>%         # if K,M,B is missing, case_when returns NA
  filter( !is.na(PROPDMG) ) %>%
  group_by(EVTYPE) %>%
  summarize( PROPDMG = sum(PROPDMG) ) %>%
  mutate(Percentage=paste0(round(PROPDMG/sum(PROPDMG)*100,2),"%")) %>%
  arrange(desc( PROPDMG )) %>% #We keep only the most relevant events
  head( n = 12 )

dataCropDMG <- select(raw_data, c(EVTYPE, contains("DMG")) ) %>%
  mutate( CROPDMG = case_when(
      str_detect(PROPDMGEXP, "K") ~ CROPDMG * 1000,
      str_detect(PROPDMGEXP, "M") ~ CROPDMG * 1000000,
      str_detect(PROPDMGEXP, "B") ~ CROPDMG * 1000000000
  )) %>%         # if K,M,B is missing, case_when returns NA
  filter( !is.na(CROPDMG) ) %>%
  group_by(EVTYPE) %>%
  summarize( CROPDMG = sum(CROPDMG) ) %>%
  mutate(Percentage=paste0(round(CROPDMG/sum(CROPDMG)*100,2),"%")) %>%
  arrange(desc( CROPDMG )) %>% #We keep only the most relevant events
  head( n = 12 )

# ort Event Factors to generate a sorted charts.
dataPropDMG$EVTYPE <- factor( dataPropDMG$EVTYPE,
                              levels = dataPropDMG$EVTYPE[order(dataPropDMG$PROPDMG, decreasing=TRUE)]
dataCropDMG$EVTYPE <- factor( dataCropDMG$EVTYPE,
                              levels = dataCropDMG$EVTYPE[order(dataCropDMG$CROPDMG, decreasing=TRUE)]
```

Results As seen in the following tables, between 1950 and November 2011, hurricanes were the most impactful events with Property Damages of $145B. Similarly, Hurricanes are responsible of $800B of crop damages.

```
dataPropDMG
```

```
## # A tibble: 12 x 3
##    EVTYPE                 PROPDMG Percentage
##    <fct>                    <dbl> <chr>
##  1 FLOOD             144657709800 33.86%
##  2 HURRICANE/TYPHOON  69305840000 16.22%
##  3 TORNADO            56925660480 13.32%
##  4 STORM SURGE        43323536000 10.14%
##  5 FLASH FLOOD        16140811510 3.78%
##  6 HAIL               15727366720 3.68%
##  7 HURRICANE          11868319010 2.78%
##  8 TROPICAL STORM      7703890550 1.8%
##  9 WINTER STORM        6688497250 1.57%
## 10 HIGH WIND           5270046260 1.23%
## 11 RIVER FLOOD         5118945500 1.2%
## 12 WILDFIRE            4765114000 1.12%
```

```
dataCropDMG
```

```
## # A tibble: 12 x 3
##    EVTYPE                         CROPDMG Percentage
##    <fct>                            <dbl> <chr>
##  1 HURRICANE                 802881916000 45.23%
##  2 HURRICANE/TYPHOON         732768451330 41.28%
##  3 FLOOD                      87251972270 4.92%
##  4 FLASH FLOOD                38822136880 2.19%
##  5 TORNADO                    28269872180 1.59%
##  6 HAIL                       15314162250 0.86%
##  7 HURRICANE OPAL/HIGH WINDS  10000000000 0.56%
##  8 TSTM WIND                   7684639900 0.43%
##  9 HIGH WIND                   7174065610 0.4%
## 10 WILDFIRE                    7173808200 0.4%
## 11 RIVER FLOOD                 5571191000 0.31%
## 12 THUNDERSTORM WIND           5422692550 0.31%
```

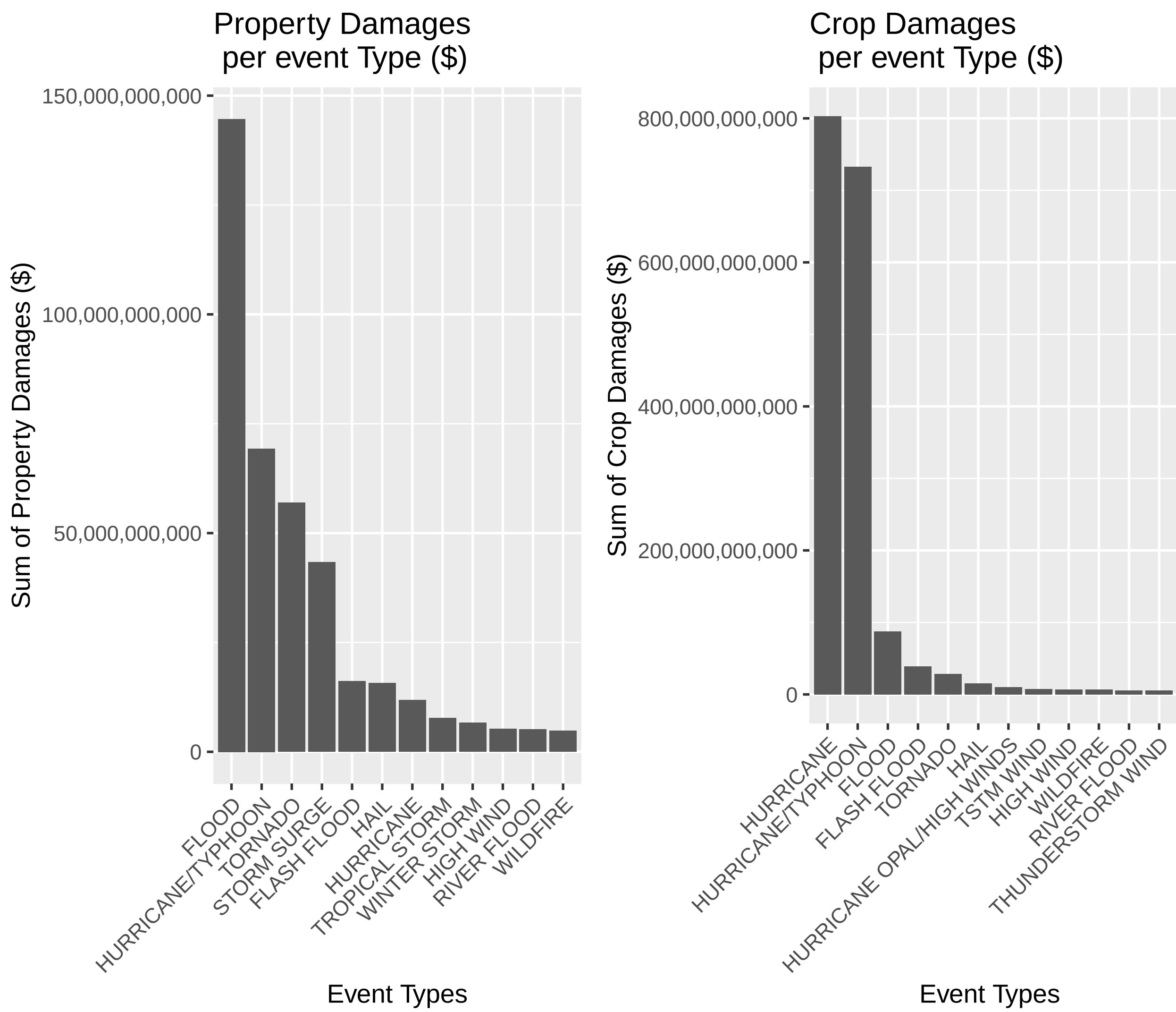

Figure 2: Cumulative Property Damages and Crop Damages caused by severe weather events in the US between 1950 and November 2011.