Health and Economic Consequences of Storms: 1950 - 2011

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Contents

0.0.1 Synopsis

This report explores the NOAA Strom Database and shows the types of Events that are most harmful to population health and that cause the most property and crop damage.

0.0.2 Data Processing

```
strUrl <-"https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"
strFilename <-"stormdata.bz2"
strDataDir <-""
```

- If needed, download compressed data file.

```
strPathFilename <-file.path(getwd(), strDataDir, strFilename, fsep = "/")
strPathFilename <-sub(pattern = "/{2,}", replacement = "/", x = strPathFilename)
if (!file.exists(strPathFilename))
{
    download.file(url = strUrl, destfile = strPathFilename, mode = "wb")
}
```

- Read select columns into data frame `df`.

```
df <-read.csv(file = strPathFilename, stringsAsFactors = FALSE,
              colClasses = c(rep("NULL",7),"character",rep("NULL",14),
                             rep("numeric",3),"character","numeric","character",
                             rep("NULL",9)))
summary(df)
```

```
##     EVTYPE            FATALITIES          INJURIES
##  Length:902297      Min.   :  0.0000   Min.   :   0.0000
##  Class :character   1st Qu.:  0.0000   1st Qu.:   0.0000
##  Mode  :character   Median :  0.0000   Median :   0.0000
##                     Mean   :  0.0168   Mean   :   0.1557
##                     3rd Qu.:  0.0000   3rd Qu.:   0.0000
##                     Max.   :583.0000   Max.   :1700.0000
##     PROPDMG         PROPDMGEXP           CROPDMG         CROPDMGEXP
##  Min.   :   0.00   Length:902297      Min.   :  0.000   Length:902297
##  1st Qu.:   0.00   Class :character   1st Qu.:  0.000   Class :character
##  Median :   0.00   Mode  :character   Median :  0.000   Mode  :character
##  Mean   :  12.06                      Mean   :  1.527
##  3rd Qu.:   0.50                      3rd Qu.:  0.000
##  Max.   :5000.00                      Max.   :990.000
```

- Calculate A New Event Group Variable `(df$EVTGROUP)` to summarize the 985 event types.

```
df$EVTGROUP <-NA
#
df[grep("^astro|^blow-out tide|^high tides",df$EVTYPE,ignore.case = TRUE),
     "EVTGROUP"] <-"Tides"
df[grep("^aval",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Avalanche"
df[grep("^blizz",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Blizzard"
df[grep("^coastal flood",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Coastal Flood"
df[grep("wind chill",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Wind Chill"
df[grep("debris flow",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Debris Flow"
df[grep("dense fog",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Dense Fog"
df[grep("smoke",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Dense Smoke"
df[grep("drought",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Drought"
df[grep("dust devil",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Dust Devil"
df[grep("^dust storm",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Dust Storm"
df[grep("^excessive heat|record/excessive heat",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Excessive Heat"
df[grep("extreme cold",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Extreme Cold/Wind Chill"
df[grep("^flood|flooding$",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Flood"
df[grep("^flash flood",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Flash Flood"
df[grep("frost",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Forst/Freeze"
df[grep("funnel",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Funnel Cloud"
df[grep("freezing fog",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Freezing Fog"
df[grep("hail",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Hail"
df[grep("^excessive heat|^extreme heat|^record heat", df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Heat"
df[grep("^heat|excessive heat$", df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Heat"
df[grep("^heavy rain",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Heavy Rain"
df[grep("^heavy snow|snow and heavy snow|snow/heavy snow",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Heavy Snow"
df[grep("^high surf",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"High Surf"
df[grep("^high wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"High Wind"
df[grep("^hurricane|^typhoon",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Hurricane Typhoon"
df[grep("^ice storm|glaze/ice storm|sleet/ice storm", df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Ice Storm"
df[grep("snow and ice storm|snow/ice storm", df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Ice Storm"
```

```
df[grep("lake-effect snow",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Lake-Effect Snow"
df[grep("lakeshore flood",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Lakeshore Flood"
df[grep("^lightning",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Lightning"
df[grep("marine hail",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Marine Hail"
df[grep("marine high wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Marine High Wind"
df[grep("marine strong wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Marine Strong Wind"
df[grep("marine thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Marine Thunderstorm Wind"
df[grep("rip current",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Rip Current"
df[grep("seiche",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Seiche"
df[grep("sleet|^freezing drizzle|^freezing rain",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Sleet"
df[grep("storm surge",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Storm Surge"
df[grep("^strong wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Strong Wind"
df[grep("gusty thunderstorm wind|^severe thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Thunderstorm Wind"
df[grep("^thunderstorm wind",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Thunderstorm Wind"
df[grep("tornado",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Tornado"
df[grep("tropical depression",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Tropical Depression"
df[grep("tropical storm",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Tropical Storm"
df[grep("tsunami",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Tsunami"
df[grep("volcanic",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Volcanic Ash"
df[grep("^waterspout",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Waterspout"
df[grep("wildfire",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Wildfire"
df[grep("^winter storm",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"WinterStorm"
df[grep("winter weather",df$EVTYPE, ignore.case = TRUE),
     "EVTGROUP"] <-"Winter Weather"
```

- Calculate New Damage Amount Variables (`df$PROPDMGAMT & df$CROPDMGAMT`) for each event type.

```
df$PROPDMGAMT <- NA
#
df[grep("[0-9]", df$PROPDMGEXP), "PROPDMGAMT"] <- (10^as.numeric(df[grep("[0-9]",
    df$PROPDMGEXP, ), "PROPDMGEXP"])) * df[grep("[0-9]", df$PROPDMGEXP, ), "PROPDMG"]
df[grep("B", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grep("B",
    df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1e+09
df[grep("M", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grep("M",
    df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1e+06
df[grep("K", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grep("K",
```

```
    df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 1000
df[grep("H", df$PROPDMGEXP, ignore.case = TRUE), "PROPDMGAMT"] <- df[grep("H",
    df$PROPDMGEXP, ignore.case = TRUE), "PROPDMG"] * 100
#
df$CROPDMGAMT <- NA
#
df[grep("[0-9]", df$CROPDMGEXP), "CROPDMGAMT"] <- (10^as.numeric(df[grep("[0-9]",
    df$CROPDMGEXP, ), "CROPDMGEXP"])) * df[grep("[0-9]", df$CROPDMGEXP, ), "CROPDMG"]
df[grep("B", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("B",
    df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1e+09
df[grep("M", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("M",
    df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1e+06
df[grep("K", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("K",
    df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 1000
df[grep("H", df$CROPDMGEXP, ignore.case = TRUE), "CROPDMGAMT"] <- df[grep("H",
    df$CROPDMGEXP, ignore.case = TRUE), "CROPDMG"] * 100
```

- Calculate New Total Vectors for Fatalities, Injuries, Property Damage and Crop Damage by Event Group (`df$EVTGROUP`).

```
Fatalities <-tapply(X = df$FATALITIES, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
Injuries <-tapply(X = df$INJURIES, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
PropDmgAmt <-tapply(X = df$PROPDMGAMT, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
CropDmgAmt <-tapply(X = df$CROPDMGAMT, INDEX = df$EVTGROUP, FUN = sum, na.rm = TRUE)
```

0.0.3 Results

- Ranking of Event Groups by Population Fatalities.

```
(Fatalities <-sort(x = Fatalities, decreasing = TRUE))
```

```
##                  Tornado                     Heat              Flash Flood
##                     5658                     3138                     1018
##                Lightning              Rip Current                    Flood
##                      817                      577                      501
##                High Wind  Extreme Cold/Wind Chill                Avalanche
##                      293                      287                      225
##              WinterStorm        Thunderstorm Wind        Hurricane Typhoon
##                      217                      199                      135
##               Heavy Snow             Strong Wind                High Surf
##                      129                      111                      104
##                 Blizzard              Heavy Rain                Wind Chill
##                      101                       98                       95
##                Ice Storm                 Wildfire           Tropical Storm
##                       89                       75                       66
##           Winter Weather                  Tsunami              Storm Surge
##                       61                       33                       24
##               Dust Storm                     Hail                 Dense Fog
##                       22                       20                       18
##       Marine Strong Wind                    Sleet Marine Thunderstorm Wind
##                       14                       12                       10
##               Waterspout            Coastal Flood                Dust Devil
##                        6                        3                        2
##             Forst/Freeze         Marine High Wind              Dense Smoke
##                        1                        1                        0
##                  Drought             Freezing Fog             Funnel Cloud
```

```
##                        0                        0                        0
##         Lake-Effect Snow          Lakeshore Flood              Marine Hail
##                        0                        0                        0
##                  Seiche                    Tides      Tropical Depression
##                        0                        0                        0
##             Volcanic Ash
##                        0
```

- Ranking of Event Groups by Population Injuries.

```
(Injuries <-sort(x = Injuries, decreasing = TRUE))
```

```
##                  Tornado                     Heat                    Flood
##                    91364                     9224                     6808
##                Lightning        Thunderstorm Wind                Ice Storm
##                     5232                     2402                     1992
##              Flash Flood                High Wind                     Hail
##                     1785                     1471                     1466
##              WinterStorm        Hurricane Typhoon              Heavy Snow
##                     1353                     1333                     1034
##                 Wildfire                Blizzard           Winter Weather
##                      911                      805                      538
##              Rip Current              Dust Storm           Tropical Storm
##                      529                      440                      383
##                Dense Fog             Strong Wind  Extreme Cold/Wind Chill
##                      342                      301                      255
##               Heavy Rain                Avalanche                High Surf
##                      255                      170                      156
##                  Tsunami               Waterspout               Dust Devil
##                      129                       72                       43
##              Storm Surge                    Sleet Marine Thunderstorm Wind
##                       43                       38                       26
##       Marine Strong Wind               Wind Chill            Coastal Flood
##                       22                       12                        7
##                  Drought             Forst/Freeze             Funnel Cloud
##                        4                        3                        3
##         Marine High Wind              Dense Smoke             Freezing Fog
##                        1                        0                        0
##         Lake-Effect Snow          Lakeshore Flood              Marine Hail
##                        0                        0                        0
##                  Seiche                    Tides      Tropical Depression
##                        0                        0                        0
##             Volcanic Ash
##                        0
```

- Plot Ranking of Event Groups by Fatalities and Injuries.

```
par(mfrow = c(2,1))
barplot(Fatalities[1:3], ylab = "Total Fatalities")
barplot(Injuries[1:3], ylab = "Total Injuries")
```

- Ranking of Event Groups by Property & Crop Damage.

```
(PropDmgAmt <-sort(x = PropDmgAmt, decreasing = TRUE))
```

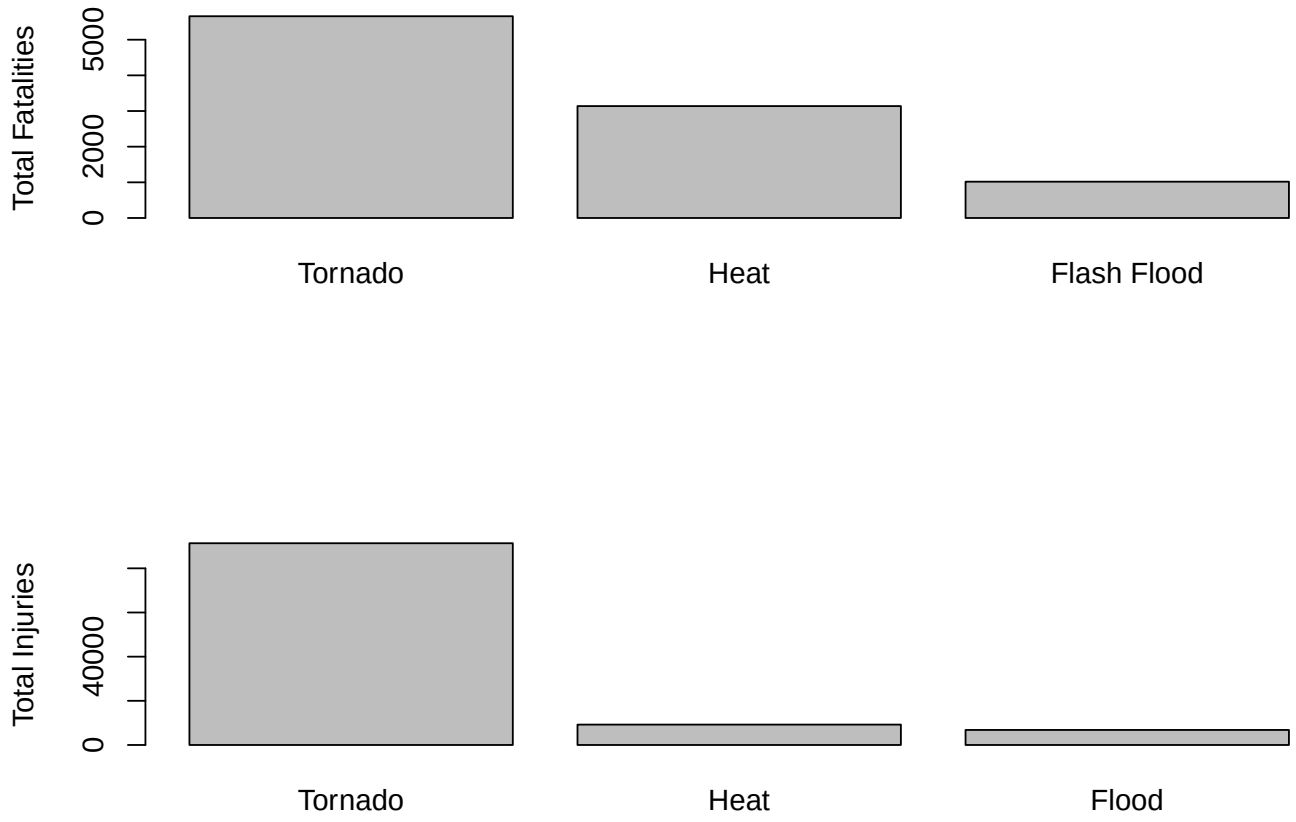
Total Fatalities
0
2000
5000
Tornado
Heat
Flash Flood
Total Injuries
0
40000
Tornado
Heat
Flood

Figure 1:

```
##                   Flood        Hurricane Typhoon                Tornado
##             145223640907              85356410010             58552151864
##              Storm Surge              Flash Flood                    Hail
##              47964724000              17414680872             16021900956
##           Tropical Storm              WinterStorm               High Wind
##               7714390550               6748997251              6003352990
##        Thunderstorm Wind                Wildfire               Ice Storm
##               5431305978               4865614000              3945527860
##               Heavy Rain                  Drought               Heavy Snow
##               3230998140               1046106000               953697140
##                Lightning                Blizzard           Coastal Flood
##                935452427                659713950               279600560
##              Strong Wind                  Tsunami               High Surf
##                177674240                144062000                89955000
##  Extreme Cold/Wind Chill               Waterspout         Lake-Effect Snow
##                 76385400                 60730200                40115000
##           Winter Weather                     Heat          Forst/Freeze
##                 27298000                 20325750                10995000
##                    Sleet                    Tides               Dense Fog
##                 10366500                 9745150                 9674000
##          Lakeshore Flood               Dust Storm               Avalanche
##                  7540000                  5599000                3721800
##             Freezing Fog               Wind Chill      Tropical Depression
##                  2182000                  2040000                1737000
##         Marine High Wind                   Seiche              Dust Devil
##                  1297010                   980000                 719130
##             Volcanic Ash Marine Thunderstorm Wind       Marine Strong Wind
##                   500000                   436400                 418330
##             Funnel Cloud              Rip Current              Dense Smoke
##                   194600                   163000                 100000
##              Marine Hail
##                     4000
```

```
(CropDmgAmt <-sort(x = CropDmgAmt, decreasing = TRUE))
```

```
##                  Drought                   Flood        Hurricane Typhoon
##              13972566000              5912155450              5516117800
##                Ice Storm                    Hail             Flash Flood
##               5022113500              3111633870              1437163150
##  Extreme Cold/Wind Chill           Forst/Freeze                    Heat
##               1313023000              1202186000               904469280
##               Heavy Rain         Tropical Storm               High Wind
##                795752800               694896000               686301900
##        Thunderstorm Wind                 Tornado                Wildfire
##                634694380               417461520               295972800
##               Heavy Snow                Blizzard             Strong Wind
##                134673100               112060000                69953500
##              WinterStorm          Winter Weather               Lightning
##                 32444000                15000000                12092090
##               Dust Storm             Storm Surge              Wind Chill
##                  3600000                  855000                  600000
## Marine Thunderstorm Wind                 Tsunami               Avalanche
##                    50000                   20000                       0
##             Coastal Flood               Dense Fog             Dense Smoke
##                        0                       0                       0
##               Dust Devil            Freezing Fog             Funnel Cloud
##                        0                       0                       0
##                High Surf         Lake-Effect Snow          Lakeshore Flood
```

```
##                    0                    0                    0
##          Marine Hail      Marine High Wind    Marine Strong Wind
##                    0                    0                    0
##          Rip Current               Seiche                Sleet
##                    0                    0                    0
##                Tides   Tropical Depression          Volcanic Ash
##                    0                    0                    0
##           Waterspout
##                    0
```

- Plot Ranking of Event Groups by Property & Crop Damage.

```
par(mfrow = c(1,1))
barplot(PropDmgAmt[1:3]/1000000000, ylab = "Total Property Damage - $Billons")
```

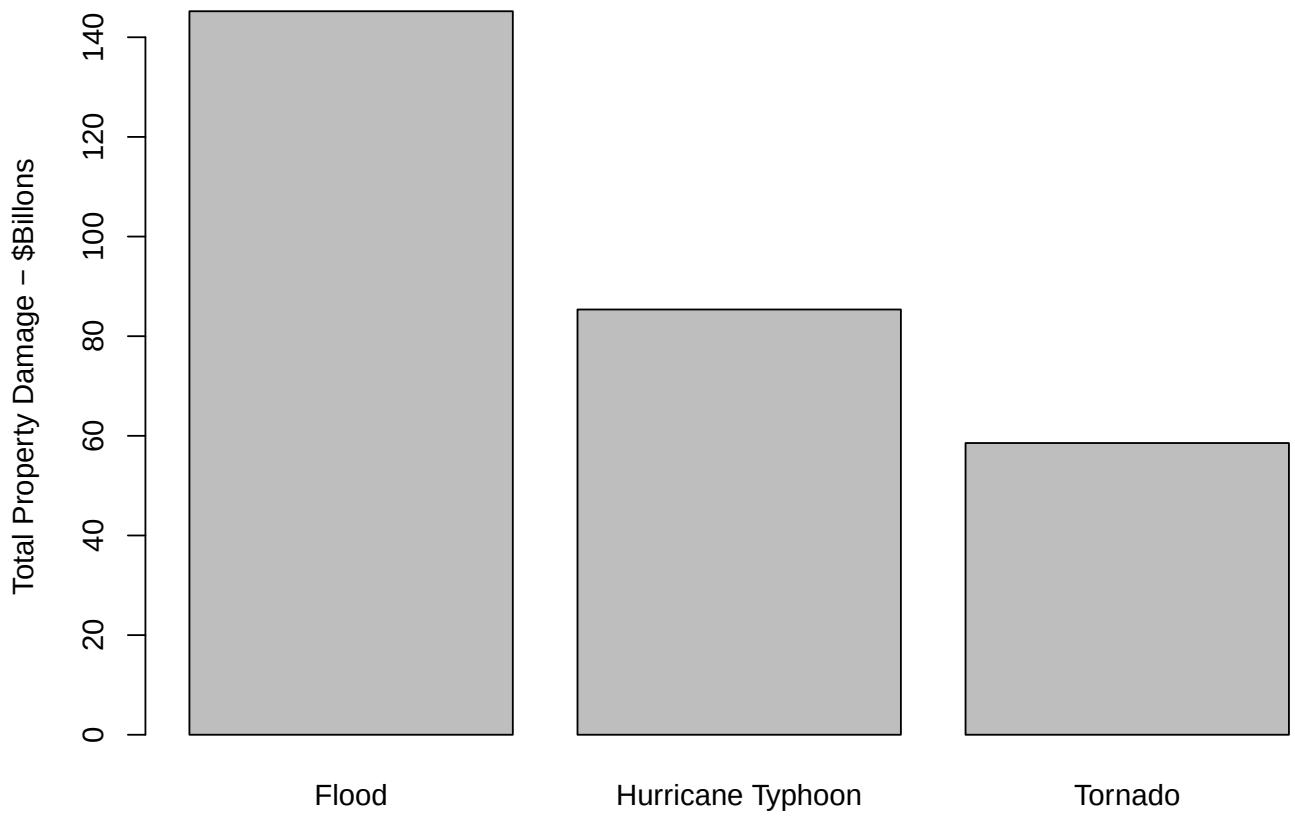

Figure 2:

```
barplot(CropDmgAmt[1:3]/1000000000, ylab = "Total Crop Damage - $Billions")
```

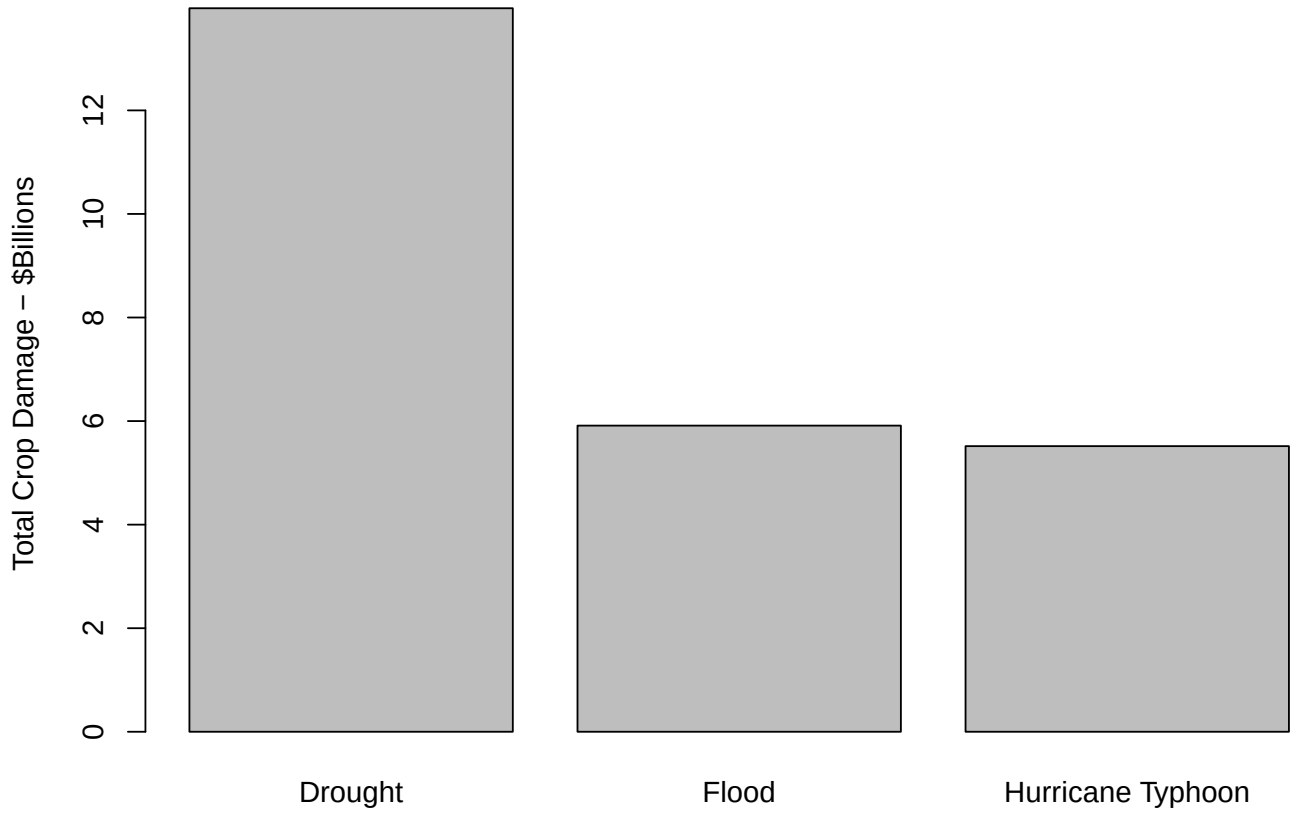
Total Crop Damage – $Billions
0
2
4
6
8
10
12
Drought
Flood
Hurricane Typhoon

Figure 3: