RR: Assessing Health and Economic Impact Of Weather Events

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Synopsis of Study Results

This study 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 when and where they occur, as well as estimates of any fatalities, injuries, and property damage.

Wind events, which include tornadoes and hurricanes, are by the far the most harmful in aggregate, causing over 100,000 injuries and 90 deaths over the course of this study. Though less frequent, severe heat events have the highest incidence of deaths and injuries per event. This study finds that severe rain and wind events are by far the most costly in terms of dollars spent to replace property and crop damage.

Questions this study considers

1. Across the United States, which types of events (as indicated in the EVTYPE variable) are most harmful with respect to population health?
2. Across the United States, which types of events have the greatest economic consequences?

Notes about the environment used

This study was done using the following tools, including OS and Programming language versions

The study was conducted on a 32-bit Windows 7 machine with 2 cores.

R language was R version 3.5.2 (2018-12-20)

For publishing to `rpubs.com`, I used RStudio version 1.1.463

The full project may be found on Github at `https://github.com/djolas/05-reproducible-research-assignment-2`

Data Processing

There will be categorization of event type that may be subjective. Not to mention the data collection of the weather events will be categorized on the field manually and hence subjected to human input errors.

```
setwd ("C:/Users/djolas/My Documents/data")
```

```
url <-
"https://d396qusza40orc.cloudfront.net/repdata%2Fdata%2FStormData.csv.bz2"
destfile <- "repdata%2Fdata%2FStormData.csv.bz2"
download.file(url,destfile,mode="wb")
url2 <-
"https://d396qusza40orc.cloudfront.net/repdata%2Fpeer2_doc%2Fpd01016005curr.p
df"
destfile2 <- "repdata%2Fpeer2_doc%2Fpd01016005curr.pdf"
download.file(url2,destfile2,mode="wb")

StormData<- read.csv(bzfile(destfile), stringsAsFactors = FALSE)
names(StormData)

##  [1] "STATE__"    "BGN_DATE"   "BGN_TIME"   "TIME_ZONE"  "COUNTY"
##  [6] "COUNTYNAME" "STATE"      "EVTYPE"     "BGN_RANGE"  "BGN_AZI"
## [11] "BGN_LOCATI" "END_DATE"   "END_TIME"   "COUNTY_END" "COUNTYENDN"
## [16] "END_RANGE"  "END_AZI"    "END_LOCATI" "LENGTH"     "WIDTH"
## [21] "F"          "MAG"        "FATALITIES" "INJURIES"   "PROPDMG"
## [26] "PROPDMGEXP" "CROPDMG"    "CROPDMGEXP" "WFO"        "STATEOFFIC"
## [31] "ZONENAMES"  "LATITUDE"   "LONGITUDE"  "LATITUDE_E" "LONGITUDE_"
## [36] "REMARKS"    "REFNUM"

summary(StormData$FATALITIES)

##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
##   0.0000   0.0000   0.0000   0.0168   0.0000 583.0000

summary(StormData$INJURIES)

##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
##    0.0000    0.0000    0.0000    0.1557    0.0000 1700.0000
```

It seems that there are 985 unique types of events, I will endeavor to decrease this list a lot more I will also create a list for Question 1 for most harmful and Question 2 for damages PROPDMGEXP,CROPDMGEXP Also, I will only need certain columns FATALITIES INJURIES PROPDMG CROPDMG PROPDMGEXP CROPDMGEXP

```
KeepCol <-
c("EVTYPE","FATALITIES","INJURIES","PROPDMG","CROPDMG","PROPDMGEXP","CROPDMGE
XP")
StormDataKeep <- subset(StormData, select = KeepCol)
names(StormDataKeep)

## [1] "EVTYPE"     "FATALITIES" "INJURIES"   "PROPDMG"    "CROPDMG"
## [6] "PROPDMGEXP" "CROPDMGEXP"

StormDataKeepNZ <- subset(StormDataKeep, FATALITIES > 0 | INJURIES > 0 |
PROPDMG > 0 | CROPDMG > 0)

StormDataKeepNZ$EVENT <- StormDataKeepNZ$EVTYPE
StormDataKeepNZ$EVENT[grep("flood",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"FLOOD"
```

```
StormDataKeepNZ$EVENT[grep("warm",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"HEAT"
StormDataKeepNZ$EVENT[grep("freeze",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"COLD"
StormDataKeepNZ$EVENT[grep("avala",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"AVALANCHE"
StormDataKeepNZ$EVENT[grep("ice",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"COLD"
StormDataKeepNZ$EVENT[grep("bitter",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"COLD"
StormDataKeepNZ$EVENT[grep("BELOW NORMAL
PRECIPITATION",StormDataKeepNZ$EVENT, ignore.case = T)] <-"DROUGHT"
StormDataKeepNZ$EVENT[grep("BLIZZARD",StormDataKeepNZ$EVENT, ignore.case =
T)] <-"SNOW"
StormDataKeepNZ$EVENT[grep("SNOW",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"SNOW"
StormDataKeepNZ$EVENT[grep("dry",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"DROUGHT"
StormDataKeepNZ$EVENT[grep("BEACH",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"BEACH EROSION"
StormDataKeepNZ$EVENT[grep("FIRE",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"FIRE"
StormDataKeepNZ$EVENT[grep("COLD",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"COLD"
StormDataKeepNZ$EVENT[grep("RAIN",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"RAIN"
StormDataKeepNZ$EVENT[grep("CHILL",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"COLD"
StormDataKeepNZ$EVENT[grep("wet",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"FLOOD"
StormDataKeepNZ$EVENT[grep("frost",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"COLD"
StormDataKeepNZ$EVENT[grep("freez",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"COLD"
StormDataKeepNZ$EVENT[grep("gust",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"WIND"
StormDataKeepNZ$EVENT[grep("hail",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"HAIL"
StormDataKeepNZ$EVENT[grep("heat",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"HEAT"
StormDataKeepNZ$EVENT[grep("hurricane",StormDataKeepNZ$EVENT, ignore.case =
T)] <-"HURRICANE"
StormDataKeepNZ$EVENT[grep("typhoon",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"HURRICANE"
StormDataKeepNZ$EVENT[grep("ice",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"COLD"
StormDataKeepNZ$EVENT[grep("icy",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"COLD"
StormDataKeepNZ$EVENT[grep("LANDSLIDE",StormDataKeepNZ$EVENT, ignore.case =
T)] <-"LANDSLIDES"
```

```
StormDataKeepNZ$EVENT[grep("mud",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"MUDSLIDES"
StormDataKeepNZ$EVENT[grep("high temp",StormDataKeepNZ$EVENT, ignore.case =
T)] <-"HEAT"
StormDataKeepNZ$EVENT[grep("TROPICAL STORM",StormDataKeepNZ$EVENT,
ignore.case = T)] <-"TROPICAL STORM"
StormDataKeepNZ$EVENT[grep("light",StormDataKeepNZ$EVENT, ignore.case = T)]
<-"THUNDERSTORM"
StormDataKeepNZ$EVENT[grep("tstm",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"THUNDERSTORM"
StormDataKeepNZ$EVENT[grep("torn",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"TORNADO"
StormDataKeepNZ$EVENT[grep("tide",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"FLOOD"
StormDataKeepNZ$EVENT[grep("tsu",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"FLOOD"
StormDataKeepNZ$EVENT[grep("thun",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"THUNDERSTORM"
StormDataKeepNZ$EVENT[grep("tsu",StormDataKeepNZ$EVENT, ignore.case = T)] <-
"FLOOD"
StormDataKeepNZ$PropertyDamageAmt <- StormDataKeepNZ$PROPDMG
MultLookup <- c(M = 10^6, m = 10^6, K = 10^3, k = 10^3, B = 10^9, b = 10^9)
StormDataKeepNZ$PropertyDamageAmt <- StormDataKeepNZ$PROPDMG * MultLookup
[as.character(StormDataKeepNZ$PROPDMGEXP)]
StormDataKeepNZ$CropDamageAmt     <- StormDataKeepNZ$CROPDMG * MultLookup
[as.character(StormDataKeepNZ$CROPDMGEXP)]
StormDataKeepNZ$TotDamageAmt   <- StormDataKeepNZ$PropertyDamageAmt +
StormDataKeepNZ$CropDamageAmt
```

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RESULTS

Now we will aggregate the results and output the top 10 events graphically. This will answer the 2 questions

```
library(plyr)
SFatal <- ddply(StormDataKeepNZ, .(EVENT), summarize, DEATHS =
sum(FATALITIES, na.rm = TRUE))
SInjury <- ddply(StormDataKeepNZ, .(EVENT), summarize, INJURED =
sum(INJURIES, na.rm = TRUE))
SPropDam <- ddply(StormDataKeepNZ, .(EVENT), summarize, PROPERTYCOST =
sum(PropertyDamageAmt, na.rm = TRUE))
SCropDam <- ddply(StormDataKeepNZ, .(EVENT), summarize, CROPCOST =
sum(CropDamageAmt, na.rm = TRUE))
STotDam <- ddply(StormDataKeepNZ, .(EVENT), summarize, TOTALCOST =
sum(TotDamageAmt, na.rm = TRUE))
SDEATH10 <- head(SFatal[order(-SFatal$DEATHS),],10)
SINJURED10 <- head(SInjury [order(-SInjury$INJURED),],10)
```

```
SPropDam10 <- head(SPropDam[order(-SPropDam$PROPERTYCOST),],10)
SCropDam10 <- head(SCropDam[order(-SCropDam$CROPCOST),],10)
STotDam10 <- head(STotDam[order(-STotDam$TOTALCOST),],10)
SDEATH10
```

```
##            EVENT DEATHS
## 106      TORNADO   5636
## 35          HEAT   3178
## 25         FLOOD   1569
## 105 THUNDERSTORM   1542
## 12          COLD    566
## 87   RIP CURRENT    368
## 97          SNOW    264
## 53     HIGH WIND    248
## 4      AVALANCHE    225
## 126 WINTER STORM    206
```

```
SINJURED10
```

```
##            EVENT INJURED
## 106      TORNADO   91407
## 105 THUNDERSTORM   14679
## 35          HEAT    9243
## 25         FLOOD    8738
## 12          COLD    2538
## 97          SNOW    1958
## 24          FIRE    1608
## 33          HAIL    1467
## 61     HURRICANE    1333
## 126 WINTER STORM    1321
```

```
SPropDam10
```

```
##              EVENT PROPERTYCOST
## 25           FLOOD 172324770320
## 61       HURRICANE  85356410010
## 106        TORNADO  56993098180
## 99     STORM SURGE  43323536000
## 33            HAIL  17619970720
## 105   THUNDERSTORM  11859474310
## 24             FIRE   8501628500
## 108 TROPICAL STORM   7714390550
## 126   WINTER STORM   6688497250
## 53       HIGH WIND   5270046260
```

```
SCropDam10
```

```
##              EVENT    CROPCOST
## 17         DROUGHT 13972581000
## 25           FLOOD 12527979100
## 12            COLD  8452940850
```

```
## 61       HURRICANE  5516117800
## 33            HAIL  3114212850
## 105   THUNDERSTORM  1218945740
## 35            HEAT   904479280
## 85            RAIN   806162800
## 108 TROPICAL STORM   694896000
## 53       HIGH WIND   638571300

STotDam10

##              EVENT    TOTALCOST
## 25           FLOOD 162549350740
## 61       HURRICANE  44330000800
## 106        TORNADO  16520165550
## 33            HAIL  11653045140
## 12            COLD   7002475700
## 105   THUNDERSTORM   5805209380
## 24            FIRE   3838549570
## 53       HIGH WIND   3057666640
## 17         DROUGHT   1886540000
## 108 TROPICAL STORM   1530352350
```

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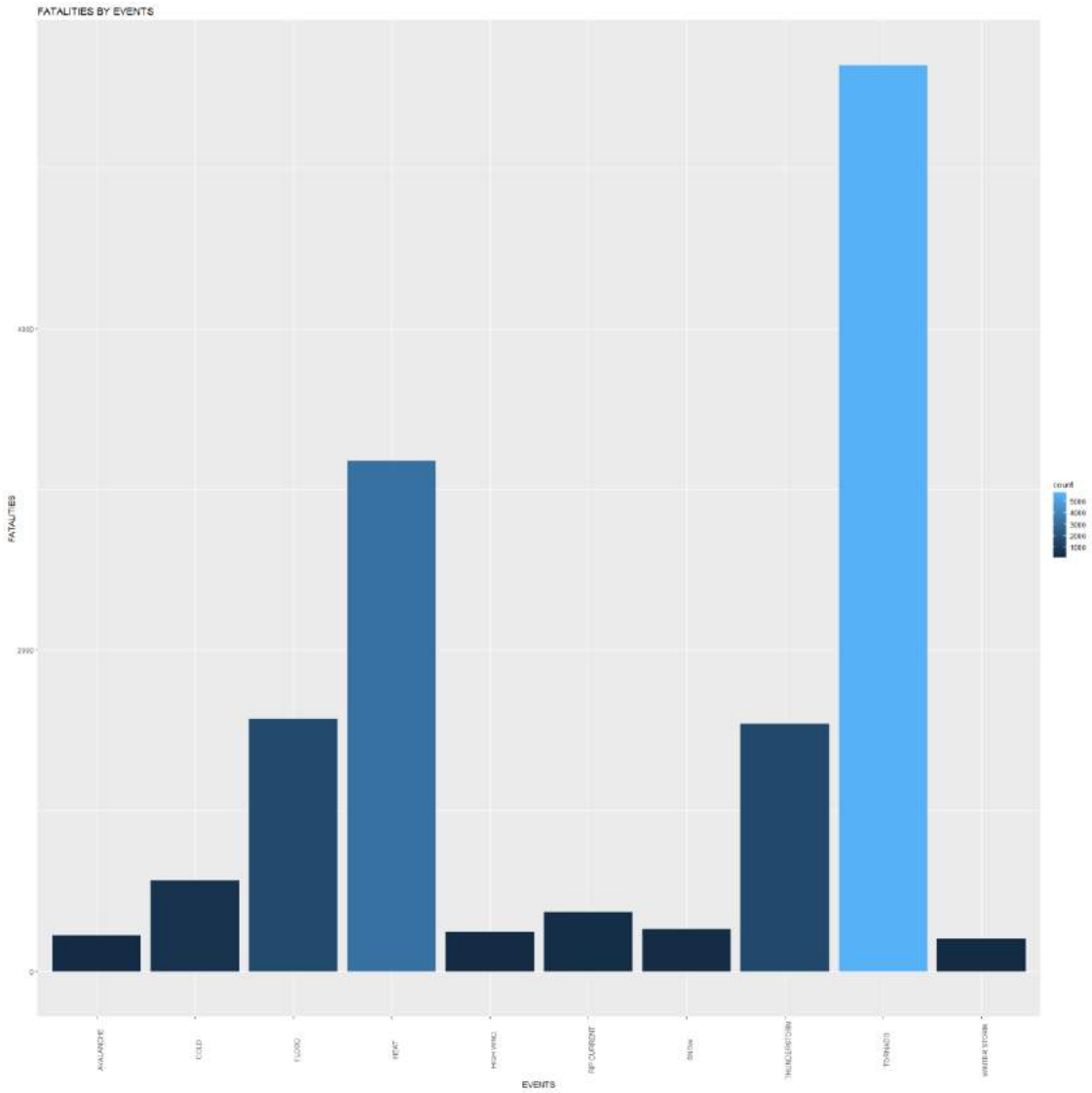
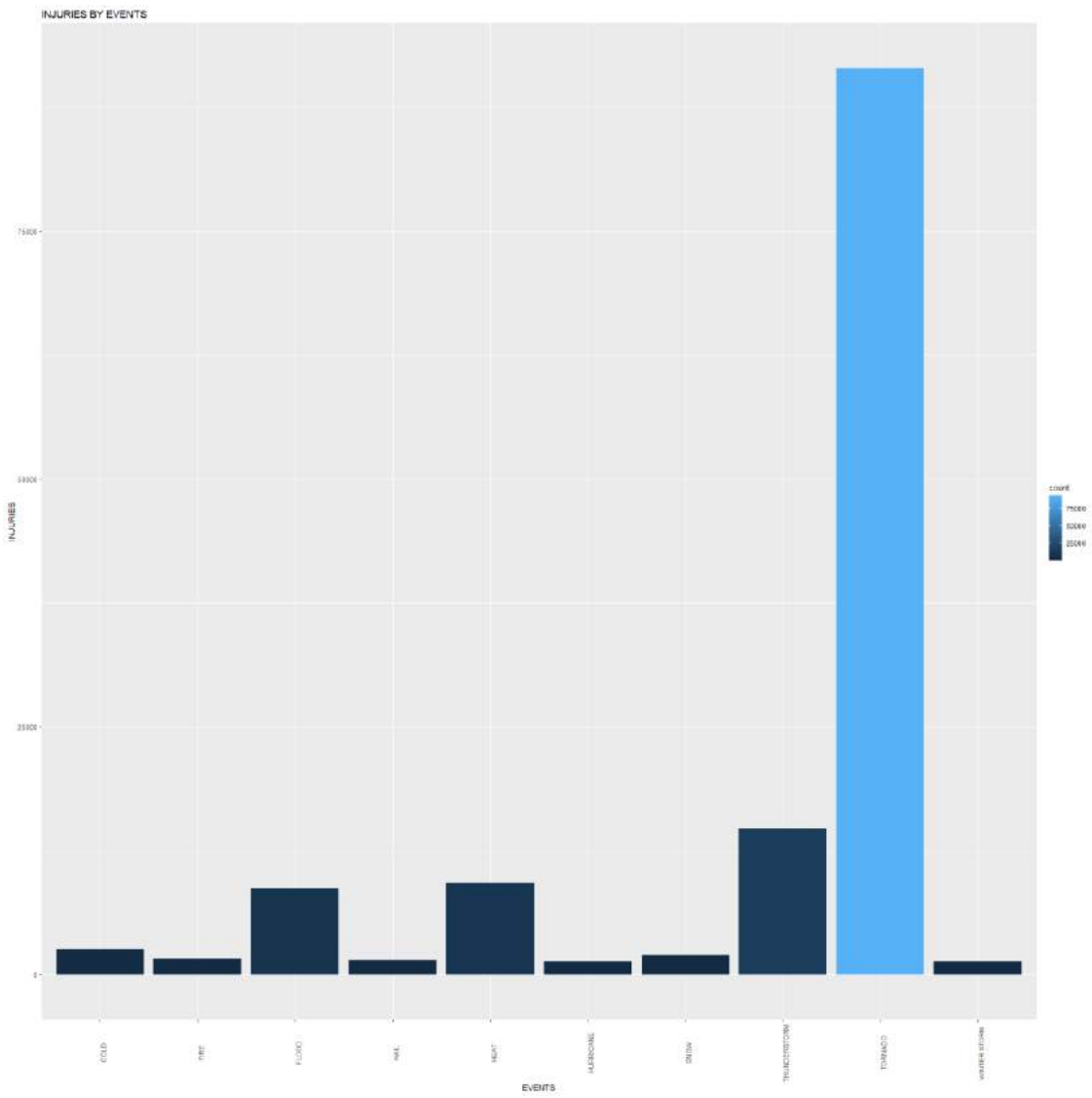
Graphing the results

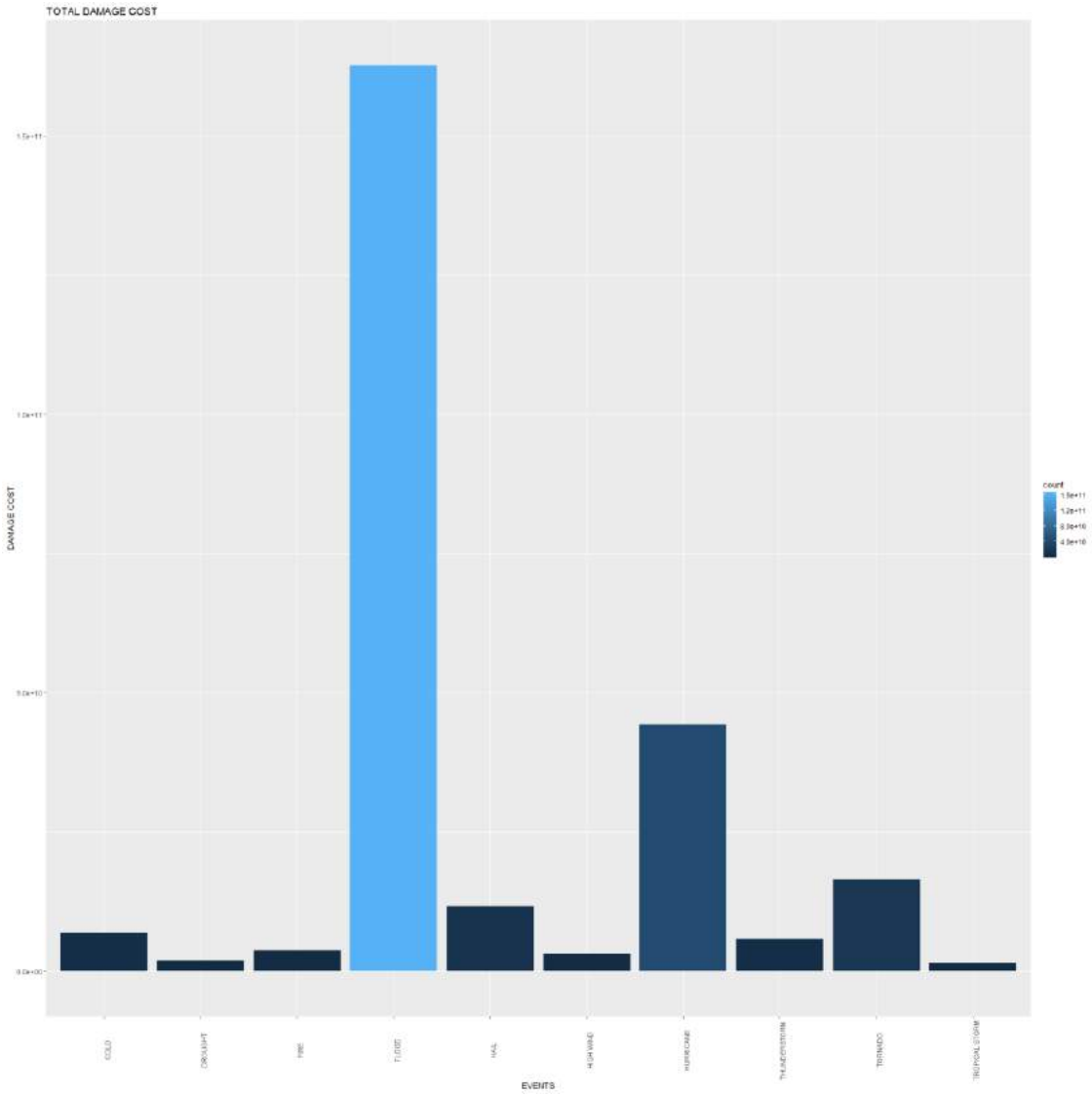
```
library (ggplot2)
ggplot(SDEATH10,aes(EVENT)) +
    geom_bar(aes(weight=DEATHS, fill =..count..)) +
    xlab("EVENTS") + theme(axis.text.x=element_text(angle = 90)) +
    ylab("FATALITIES") +
    ggtitle("FATALITIES BY EVENTS")
```




```
ggplot (SINJURED10,aes(EVENT)) +
    geom_bar(aes(weight=INJURED, fill =..count..),) +
    xlab("EVENTS") + theme(axis.text.x=element_text(angle = 90)) +
    ylab("INJURIES") +
    ggtitle("INJURIES BY EVENTS")
```




```
ggplot (STotDam10,aes(EVENT)) +
    geom_bar(aes(weight=TOTALCOST, fill =..count..)) +
    xlab("EVENTS") + theme(axis.text.x=element_text(angle = 90)) +
    ylab("DAMAGE COST") +
    ggtitle("TOTAL DAMAGE COST")
```



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SUMMARY

The main causes of property damage are floods, hurricanes and tornadoes Crop damages are generally caused by drought, flood, and cold

Fatalities are far and away caused by tornadoes and thunderstorms Injuries are also far and away caused by tornadoes, with heat, thunderstorms.