

# Heath and Econmoic Consequences of Weather Events

## Synopsis

In this study we explore the data from the U.S. National Oceanic and Atmospheric Administration's (NOAA) storm database to understand the characteristics of major storms and weather events in the United States. This study includes when and where they occur, as well as estimates of any fatalities, injuries, and property damage. Detailed analysis of the given data proves that the tornadoes and hurricanes were the primary causes of deaths and injury to the populaton, compared to some of other factors in the events studied.

## Data Processing

Set the Global setting for command echo to be displayed, caching, etc

```
opts_chunk$set(echo = TRUE ,cache = TRUE, message=FALSE)
```

Loading the required R packages

```
library(scales)
library(ggplot2)
library(reshape2)
```

File Read and load in R

```
## Loading Raw Data File from .bz2 format
data <- read.csv("repdata-data-StormData.csv.bz2", stringsAsFactors = F)
```

Categorize the several event-types (column **EVTYPE**).

```
length(unique(data$EVTYPE)) ## Different event types
```

```
## [1] 985
```

There are numerous weather events depicted in the original data. For our analysis, we will create smaller number of groups for an easier analysis.

## Creating a category of the various types of weather

```
events <- as.factor(data$EVTYPE) ## Factorize the events column into a vector
events.backup <- events ## copy of the events themselves
```

Weather Events type grouped together so their affects can be demonstrated visually **Convection:** *Tornado; Lighting; Hail; Thunderstorm Wind* **Extreme:** *Temperature: Heat; Cold* **Flood:** *River Flood; Flash Flood* **Marine:** *Tsunami; Coastal Storm; Tropical Storm / Hurricane; Rip Current* **Winter:** *Avalanche; Ice; Winter Storm* **Other:** *Dust Storm; Drought; Rain; Dust Devil*

Cleanse dataset to convert the values to the event types as described in National Weather Service Storm Data documentation as provided in the URL below:[https://d396qusza40orc.cloudfront.net/repdata%2Fpeer2\\_doc%2Fpd01016005curr.pdf](https://d396qusza40orc.cloudfront.net/repdata%2Fpeer2_doc%2Fpd01016005curr.pdf)

### Convection

```
## Convection category included the following event types
levels(events)[c(4:6,8,64:66,214:220,225:228,231:272,347,358:395,463:476,491:494,524,605,607,615:617,675:680,748:750,7
```

```
## [1] " LIGHTNING" " TSTM WIND"
## [3] " TSTM WIND (G45)" " WIND"
## [5] "COASTALSTORM" "Cold"
## [7] "COLD" "FUNNEL"
## [9] "Funnel cloud" "FUNNEL CLOUD"
## [11] "FUNNEL CLOUD." "FUNNEL CLOUD/HAIL"
## [13] "FUNNEL CLOUDS" "FUNNELS"
## [15] "gradient wind" "Gradient wind"
## [17] "GRADIENT WIND" "GRADIENT WINDS"
## [19] "GUSTNADO" "GUSTNADO AND"
## [21] "GUSTY LAKE WIND" "GUSTY THUNDERSTORM WIND"
## [23] "GUSTY THUNDERSTORM WINDS" "Gusty Wind"
## [25] "GUSTY WIND" "GUSTY WIND/HAIL"
## [27] "GUSTY WIND/HVY RAIN" "Gusty wind/rain"
## [29] "Gusty winds" "Gusty Winds"
## [31] "GUSTY WINDS" "HAIL"
## [33] "HAIL 0.75" "HAIL 0.88"
## [35] "HAIL 075" "HAIL 088"
```

## [37]	"HAIL 1.00"	"HAIL 1.75"
## [39]	"HAIL 1.75)"	"HAIL 100"
## [41]	"HAIL 125"	"HAIL 150"
## [43]	"HAIL 175"	"HAIL 200"
## [45]	"HAIL 225"	"HAIL 275"
## [47]	"HAIL 450"	"HAIL 75"
## [49]	"HAIL 80"	"HAIL 88"
## [51]	"HAIL ALOFT"	"HAIL DAMAGE"
## [53]	"HAIL FLOODING"	"HAIL STORM"
## [55]	"Hail(0.75)"	"HAIL/ICY ROADS"
## [57]	"HAIL/WIND"	"HAIL/WINDS"
## [59]	"HAILSTORM"	"HAILSTORMS"
## [61]	"HIGH WINDS"	"High Wind"
## [63]	"HIGH WIND"	"HIGH WIND (G40)"
## [65]	"HIGH WIND 48"	"HIGH WIND 63"
## [67]	"HIGH WIND 70"	"HIGH WIND AND HEAVY SNOW"
## [69]	"HIGH WIND AND HIGH TIDES"	"HIGH WIND AND SEAS"
## [71]	"HIGH WIND DAMAGE"	"HIGH WIND/ BLIZZARD"
## [73]	"HIGH WIND/BLIZZARD"	"HIGH WIND/BLIZZARD/FREEZING RA"
## [75]	"HIGH WIND/HEAVY SNOW"	"HIGH WIND/LOW WIND CHILL"
## [77]	"HIGH WIND/SEAS"	"HIGH WIND/WIND CHILL"
## [79]	"HIGH WIND/WIND CHILL/BLIZZARD"	"HIGH WINDS"
## [81]	"HIGH WINDS 55"	"HIGH WINDS 57"
## [83]	"HIGH WINDS 58"	"HIGH WINDS 63"
## [85]	"HIGH WINDS 66"	"HIGH WINDS 67"
## [87]	"HIGH WINDS 73"	"HIGH WINDS 76"
## [89]	"HIGH WINDS 80"	"HIGH WINDS 82"
## [91]	"HIGH WINDS AND WIND CHILL"	"HIGH WINDS DUST STORM"
## [93]	"HIGH WINDS HEAVY RAINS"	"HIGH WINDS/"
## [95]	"HIGH WINDS/COASTAL FLOOD"	"HIGH WINDS/COLD"
## [97]	"HIGH WINDS/FLOODING"	"HIGH WINDS/HEAVY RAIN"
## [99]	"HIGH WINDS/SNOW"	"LIGHTNING"
## [101]	"LIGHTNING"	"LIGHTNING WAUSEON"
## [103]	"LIGHTNING AND HEAVY RAIN"	"LIGHTNING AND THUNDERSTORM WIN"
## [105]	"LIGHTNING AND WINDS"	"LIGHTNING DAMAGE"
## [107]	"LIGHTNING FIRE"	"LIGHTNING INJURY"
## [109]	"LIGHTNING THUNDERSTORM WINDS"	"LIGHTNING THUNDERSTORM WINDSS"
## [111]	"LIGHTNING."	"LIGHTNING/HEAVY RAIN"
## [113]	"LIGNTING"	"Metro Storm, May 26"
## [115]	"Microburst"	"MICROBURST"
## [117]	"MICROBURST WINDS"	"NON SEVERE HAIL"
## [119]	"SEVERE THUNDERSTORM WINDS"	"SEVERE TURBULENCE"
## [121]	"small hail"	"Small Hail"
## [123]	"SMALL HAIL"	"Strong Wind"
## [125]	"STRONG WIND"	"STRONG WIND GUST"
## [127]	"Strong winds"	"Strong Winds"
## [129]	"STRONG WINDS"	"THUDERSTORM WINDS"
## [131]	"THUNDEERSTORM WINDS"	"THUNDERESTORM WINDS"
## [133]	"THUNDERSTORM WINDS"	"THUNDERSTORM WINDS"
## [135]	"Thunderstorm wind"	"THUNDERSTORM WIND"
## [137]	"THUNDERSTORM WIND (G40)"	"THUNDERSTORM WIND 50"
## [139]	"THUNDERSTORM WIND 52"	"THUNDERSTORM WIND 56"
## [141]	"THUNDERSTORM WIND 59"	"THUNDERSTORM WIND 59 MPH"
## [143]	"THUNDERSTORM WIND 59 MPH."	"THUNDERSTORM WIND 60 MPH"
## [145]	"THUNDERSTORM WIND 65 MPH"	"THUNDERSTORM WIND 65MPH"
## [147]	"THUNDERSTORM WIND 69"	"THUNDERSTORM WIND 98 MPH"
## [149]	"THUNDERSTORM WIND G50"	"THUNDERSTORM WIND G51"
## [151]	"THUNDERSTORM WIND G52"	"THUNDERSTORM WIND G55"
## [153]	"THUNDERSTORM WIND G60"	"THUNDERSTORM WIND G61"
## [155]	"THUNDERSTORM WIND TREES"	"THUNDERSTORM WIND."
## [157]	"THUNDERSTORM WIND/ TREE"	"THUNDERSTORM WIND/ TREES"
## [159]	"THUNDERSTORM WIND/AWNING"	"THUNDERSTORM WIND/HAIL"
## [161]	"THUNDERSTORM WIND/LIGHTNING"	"THUNDERSTORM WINDS"
## [163]	"THUNDERSTORM WINDS LE CEN"	"THUNDERSTORM WINDS 13"
## [165]	"THUNDERSTORM WINDS 2"	"THUNDERSTORM WINDS 50"
## [167]	"THUNDERSTORM WINDS 52"	"THUNDERSTORM WINDS 53"
## [169]	"THUNDERSTORM WINDS 60"	"THUNDERSTORM WINDS 61"
## [171]	"THUNDERSTORM WINDS 62"	"THUNDERSTORM WINDS 63 MPH"
## [173]	"THUNDERSTORM WINDS AND"	"THUNDERSTORM WINDS FUNNEL CLOU"
## [175]	"THUNDERSTORM WINDS G"	"THUNDERSTORM WINDS G60"
## [177]	"THUNDERSTORM WINDS HAIL"	"THUNDERSTORM WINDS HEAVY RAIN"
## [179]	"THUNDERSTORM WINDS LIGHTNING"	"THUNDERSTORM WINDS SMALL STREA"
## [181]	"THUNDERSTORM WINDS URBAN FLOOD"	"THUNDERSTORM WINDS."
## [183]	"THUNDERSTORM WINDS/ FLOOD"	"THUNDERSTORM WINDS/ HAIL"
## [185]	"THUNDERSTORM WINDS/FLASH FLOOD"	"THUNDERSTORM WINDS/FLOODING"
## [187]	"THUNDERSTORM WINDS/FUNNEL CLOU"	"THUNDERSTORM WINDS/HAIL"
## [189]	"THUNDERSTORM WINDS/HEAVY RAIN"	"THUNDERSTORM WINDS53"
## [191]	"THUNDERSTORM WINDSHAIL"	"THUNDERSTORM WINDSS"
## [193]	"THUNDERSTORM WINS"	"THUNDERSTORMS"
## [195]	"THUNDERSTORMS WIND"	"THUNDERSTORMS WINDS"
## [197]	"THUNDERSTORMW"	"THUNDERSTORMW 50"
## [199]	"THUNDERSTORMW WINDS"	"THUNDERSTORMWINDS"
## [201]	"THUNDERSTROM WIND"	"THUNDERSTROM WINDS"
## [203]	"THUNDERTORM WINDS"	"THUNDERTSORM WIND"
## [205]	"THUNDESTORM WINDS"	"THUNERSTORM WINDS"
## [207]	"TORNADO"	"TORNADO DEBRIS"
## [209]	"TORNADO F0"	"TORNADO F1"
## [211]	"TORNADO F2"	"TORNADO F3"
## [213]	"TORNADO/WATERSPOUT"	"TORNADOES"
## [215]	"TORNADOES, TSTM WIND, HAIL"	"TORNADOS"
## [217]	"TORNDAO"	"Tstm Wind"

## [219]	"TSTM WIND"	"TSTM WIND (G45)"
## [221]	"TSTM WIND (41)"	"TSTM WIND (G35)"
## [223]	"TSTM WIND (G40)"	"TSTM WIND (G45)"
## [225]	"TSTM WIND 40"	"TSTM WIND 45"
## [227]	"TSTM WIND 50"	"TSTM WIND 51"
## [229]	"TSTM WIND 52"	"TSTM WIND 55"
## [231]	"TSTM WIND 65)"	"TSTM WIND AND LIGHTNING"
## [233]	"TSTM WIND DAMAGE"	"TSTM WIND G45"
## [235]	"TSTM WIND G58"	"TSTM WIND/HAIL"
## [237]	"TSTM WINDS"	"TSTM WND"
## [239]	"TSTMW"	"TUNDERSTORM WIND"
## [241]	"WAKE LOW WIND"	"WALL CLOUD"
## [243]	"WALL CLOUD/FUNNEL CLOUD"	"Whirlwind"
## [245]	"WHIRLWIND"	"wind"
## [247]	"WIND"	"WIND ADVISORY"
## [249]	"WIND AND WAVE"	"WIND CHILL"
## [251]	"WIND CHILL/HIGH WIND"	"wind Damage"
## [253]	"WIND DAMAGE"	"WIND GUSTS"
## [255]	"WIND STORM"	"WIND/HAIL"
## [257]	"WINDS"	"WND"

```
## Add to grouping
levels(events)[c(4:6,8,64:66,214:220,225:228,231:272,347,358:395,463:476,491:494,524,605,607,615:617,675:680,748:750,7
<- "Convection"
```

## Extreme Temperatures

```
## Extreme Temperatures category included the following event types
levels(events)[c(61:76,122:143,216:223,299:303,315:318,368:370,418:421,431:463,467,486,641:659,684,692)]
```

## [1]	"COLD AIR FUNNEL"	"COLD AIR FUNNELS"
## [3]	"COLD AIR TORNADO"	"Cold and Frost"
## [5]	"COLD AND FROST"	"COLD AND SNOW"
## [7]	"COLD AND WET CONDITIONS"	"Cold Temperature"
## [9]	"COLD TEMPERATURES"	"COLD WAVE"
## [11]	"COLD WEATHER"	"COLD WIND CHILL TEMPERATURES"
## [13]	"COLD/WIND CHILL"	"COLD/WINDS"
## [15]	"COOL AND WET"	"COOL SPELL"
## [17]	"EXCESSIVE"	"Excessive Cold"
## [19]	"EXCESSIVE HEAT"	"EXCESSIVE HEAT/DROUGHT"
## [21]	"EXCESSIVE PRECIPITATION"	"EXCESSIVE RAIN"
## [23]	"EXCESSIVE RAINFALL"	"EXCESSIVE SNOW"
## [25]	"EXCESSIVE WETNESS"	"EXCESSIVELY DRY"
## [27]	"Extended Cold"	"Extreme Cold"
## [29]	"EXTREME COLD"	"EXTREME COLD/WIND CHILL"
## [31]	"EXTREME HEAT"	"EXTREME WIND CHILL"
## [33]	"EXTREME WIND CHILL/BLOWING SNO"	"EXTREME WIND CHILLS"
## [35]	"EXTREME WINDCHILL"	"EXTREME WINDCHILL TEMPERATURES"
## [37]	"EXTREME/RECORD COLD"	"EXTREMELY WET"
## [39]	"HEAT"	"HEAT DROUGHT"
## [41]	"Heat Wave"	"HEAT WAVE"
## [43]	"HEAT WAVE DROUGHT"	"HEAT WAVES"
## [45]	"HEAT/DROUGHT"	"Heatburst"
## [47]	"Hot and Dry"	"HOT PATTERN"
## [49]	"HOT SPELL"	"HOT WEATHER"
## [51]	"HOT/DRY PATTERN"	"HYPERTHERMIA/EXPOSURE"
## [53]	"HYPOTHERMIA"	"Hypothermia/Exposure"
## [55]	"HYPOTHERMIA/EXPOSURE"	"LOW TEMPERATURE"
## [57]	"LOW TEMPERATURE RECORD"	"LOW WIND CHILL"
## [59]	"Prolong Cold"	"PROLONG COLD"
## [61]	"PROLONG COLD/SNOW"	"PROLONG WARMTH"
## [63]	"RECORD COLD"	"Record Cold"
## [65]	"RECORD COLD"	"RECORD COLD AND HIGH WIND"
## [67]	"RECORD COLD/FROST"	"RECORD COOL"
## [69]	"Record dry month"	"RECORD DRYNESS"
## [71]	"Record Heat"	"RECORD HEAT"
## [73]	"RECORD HEAT WAVE"	"Record High"
## [75]	"RECORD HIGH"	"RECORD HIGH TEMPERATURE"
## [77]	"RECORD HIGH TEMPERATURES"	"RECORD LOW"
## [79]	"RECORD LOW RAINFALL"	"Record May Snow"
## [81]	"RECORD PRECIPITATION"	"RECORD RAINFALL"
## [83]	"RECORD SNOW"	"RECORD SNOW/COLD"
## [85]	"RECORD SNOWFALL"	"Record temperature"
## [87]	"RECORD TEMPERATURE"	"Record Temperatures"
## [89]	"RECORD TEMPERATURES"	"RECORD WARM"
## [91]	"RECORD WARM TEMPS."	"Record Warmth"
## [93]	"RECORD WARMTH"	"Record Winter Snow"
## [95]	"RECORD/EXCESSIVE HEAT"	"REMNANTS OF FLOYD"
## [97]	"SEVERE COLD"	"Unseasonable Cold"
## [99]	"UNSEASONABLY COLD"	"UNSEASONABLY COOL"
## [101]	"UNSEASONABLY COOL & WET"	"UNSEASONABLY DRY"
## [103]	"UNSEASONABLY HOT"	"UNSEASONABLY WARM"
## [105]	"UNSEASONABLY WARM & WET"	"UNSEASONABLY WARM AND DRY"
## [107]	"UNSEASONABLY WARM YEAR"	"UNSEASONABLY WARM/WET"
## [109]	"UNSEASONABLY WET"	"UNSEASONAL LOW TEMP"
## [111]	"UNSEASONAL RAIN"	"UNUSUAL WARMTH"
## [113]	"UNUSUAL/RECORD WARMTH"	"UNUSUALLY COLD"

```
## [115] "UNUSUALLY LATE SNOW"          "UNUSUALLY WARM"
## [117] "VERY WARM"                    "WARM WEATHER"
```

```
## Add to grouping
levels(events)[c(61:76,122:143,216:223,299:303,315:318,368:370,418:421,431:463,467,486,641:659,684,692)] <-
"Extreme Temperatures"
```

## Flood

```
## Flood category included the following event types
levels(events)[c(1:3,21,45,48,50,51,52,53,54,55,59,60,63,64,106,110:144,187,197,199,202,253,289,290,291,292,293,294,31
```

```
## [1] "HIGH SURF ADVISORY"          "COASTAL FLOOD"
## [3] "FLASH FLOOD"                "BEACH FLOOD"
## [5] "BREAKUP FLOODING"           "COASTAL FLOODING/EROSION"
## [7] "Coastal Flood"              "COASTAL FLOOD"
## [9] "coastal flooding"           "Coastal Flooding"
## [11] "COASTAL FLOODING"           "COASTAL FLOODING/EROSION"
## [13] "COASTAL/TIDAL FLOOD"        "COASTALFLOOD"
## [15] "DAM BREAK"                  "DAM FAILURE"
## [17] "Erosion/Cstl Flood"         "FLASH FLOOD"
## [19] "FLASH FLOOD - HEAVY RAIN"    "FLASH FLOOD FROM ICE JAMS"
## [21] "FLASH FLOOD LANDSLIDES"     "FLASH FLOOD WINDS"
## [23] "FLASH FLOOD/"               "FLASH FLOOD/ FLOOD"
## [25] "FLASH FLOOD/ STREET"        "FLASH FLOOD/FLOOD"
## [27] "FLASH FLOOD/HEAVY RAIN"     "FLASH FLOOD/LANDSLIDE"
## [29] "FLASH FLOODING"             "FLASH FLOODING/FLOOD"
## [31] "FLASH FLOODING/THUNDERSTORM WI" "FLASH FLOODS"
## [33] "FLASH FLOODING"             "Flood"
## [35] "FLOOD"                      "FLOOD & HEAVY RAIN"
## [37] "FLOOD FLASH"                "FLOOD FLOOD/FLASH"
## [39] "FLOOD WATCH/"              "FLOOD/FLASH"
## [41] "Flood/Flash Flood"          "FLOOD/FLASH FLOOD"
## [43] "FLOOD/FLASH FLOODING"       "FLOOD/FLASH/FLOOD"
## [45] "FLOOD/FLASHFLOOD"           "FLOOD/RAIN/WIND"
## [47] "FLOOD/RAIN/WINDS"           "FLOOD/RIVER FLOOD"
## [49] "Flood/Strong wind"          "FLOODING"
## [51] "FLOODING/HEAVY RAIN"        "FLOODS"
## [53] "HEAVY RAIN AND FLOOD"       "HEAVY RAIN/SNOW"
## [55] "HEAVY RAIN/WIND"            "HEAVY RAINS/FLOODING"
## [57] "HIGHWAY FLOODING"           "LAKESHORE FLOOD"
## [59] "LANDSLIDE"                  "LANDSLIDE/URBAN FLOOD"
## [61] "LANDSLIDES"                 "Landslump"
## [63] "LANDSLUMP"                  "LOCAL FLASH FLOOD"
## [65] "LOCAL FLOOD"                "LOCALLY HEAVY RAIN"
## [67] "MAJOR FLOOD"                "MINOR FLOOD"
## [69] "Minor Flooding"             "MINOR FLOODING"
## [71] "MUD SLIDE"                  "MUD SLIDES"
## [73] "MUD SLIDES URBAN FLOODING"   "MUD/ROCK SLIDE"
## [75] "Mudslide"                   "MUDSLIDE"
## [77] "MUDSLIDE/LANDSLIDE"         "Mudslides"
## [79] "MUDSLIDES"                  "RIVER AND STREAM FLOOD"
## [81] "RIVER FLOOD"                "River Flooding"
## [83] "RIVER FLOODING"             "ROCK SLIDE"
## [85] "RURAL FLOOD"                "SMALL STREAM"
## [87] "SMALL STREAM AND"           "SMALL STREAM AND URBAN FLOOD"
## [89] "SMALL STREAM AND URBAN FLOODIN" "SMALL STREAM FLOOD"
## [91] "SMALL STREAM FLOODING"       "SMALL STREAM URBAN FLOOD"
## [93] "SMALL STREAM/URBAN FLOOD"    "Sm1 Stream Fld"
## [95] "STREAM FLOODING"            "STREET FLOOD"
## [97] "STREET FLOODING"            "TIDAL FLOOD"
## [99] "Tidal Flooding"             "TIDAL FLOODING"
## [101] "URBAN AND SMALL"            "URBAN AND SMALL STREAM"
## [103] "URBAN AND SMALL STREAM FLOOD" "URBAN AND SMALL STREAM FLOODIN"
## [105] "Urban flood"                 "Urban Flood"
## [107] "URBAN FLOOD"                "URBAN FLOOD LANDSLIDE"
## [109] "Urban Flooding"              "URBAN FLOODING"
## [111] "URBAN FLOODS"               "URBAN SMALL"
## [113] "URBAN SMALL STREAM FLOOD"    "URBAN/SMALL"
## [115] "URBAN/SMALL FLOODING"        "URBAN/SMALL STREAM"
## [117] "URBAN/SMALL STREAM FLOOD"    "URBAN/SMALL STREAM FLOOD"
## [119] "URBAN/SMALL STREAM FLOODING" "URBAN/SMALL STRM FLDG"
## [121] "URBAN/SML STREAM FLD"        "URBAN/SML STREAM FLDG"
## [123] "URBAN/STREET FLOODING"
```

```
## Add to grouping
levels(events)[c(1:3,21,45,48,50,51,52,53,54,55,59,60,63,64,106,110:144,187,197,199,202,253,289,290,291,292,293,294,31
<- "Flood"
```

## Marine & Tropical Cyclones

```
## Marine category included the following event types
levels(events)[c(11,12,15,16,17,18,19,33,34,44,45,46,47,49,179:184,186:207,249:255,291,293,294,295,296,297,298,299,301
```

##	[1]	"ASTRONOMICAL HIGH TIDE"	"ASTRONOMICAL LOW TIDE"
##	[3]	"BEACH EROSION"	"Beach Erosion"
##	[5]	"BEACH EROSION"	"BEACH EROSION/COASTAL FLOOD"
##	[7]	"BELOW NORMAL PRECIPITATION"	"BLOW-OUT TIDE"
##	[9]	"BLOW-OUT TIDES"	"COASTAL EROSION"
##	[11]	"Coastal Storm"	"COASTAL STORM"
##	[13]	"COASTAL SURGE"	"CSTL FLOODING/EROSION"
##	[15]	"Heavy Surf"	"HEAVY SURF"
##	[17]	"Heavy surf and wind"	"HEAVY SURF COASTAL FLOODING"
##	[19]	"HEAVY SURF/HIGH SURF"	"HEAVY SWELLS"
##	[21]	"HIGH"	"HIGH SWELLS"
##	[23]	"HIGH SEAS"	"High Surf"
##	[25]	"HIGH SURF"	"HIGH SURF ADVISORIES"
##	[27]	"HIGH SURF ADVISORY"	"HIGH SWELLS"
##	[29]	"HIGH TEMPERATURE RECORD"	"HIGH TIDES"
##	[31]	"HIGH WATER"	"HIGH WAVES"
##	[33]	"HURRICANE"	"Hurricane Edouard"
##	[35]	"HURRICANE EMILY"	"HURRICANE ERIN"
##	[37]	"HURRICANE FELIX"	"HURRICANE GORDON"
##	[39]	"HURRICANE OPAL"	"HURRICANE OPAL/HIGH WINDS"
##	[41]	"HURRICANE-GENERATED SWELLS"	"HURRICANE/TYPHOON"
##	[43]	"Marine Accident"	"MARINE HAIL"
##	[45]	"MARINE HIGH WIND"	"MARINE MISHAP"
##	[47]	"MARINE STRONG WIND"	"MARINE THUNDERSTORM WIND"
##	[49]	"MARINE TSTM WIND"	"RAPIDLY RISING WATER"
##	[51]	"RED FLAG CRITERIA"	"RED FLAG FIRE WX"
##	[53]	"RIP CURRENT"	"RIP CURRENTS"
##	[55]	"RIP CURRENTS HEAVY SURF"	"RIP CURRENTS/HEAVY SURF"
##	[57]	"ROGUE WAVE"	"ROUGH SEAS"
##	[59]	"ROUGH SURF"	"STORM FORCE WINDS"
##	[61]	"STORM SURGE"	"STORM SURGE/TIDE"
##	[63]	"TROPICAL DEPRESSION"	"TROPICAL STORM"
##	[65]	"TROPICAL STORM ALBERTO"	"TROPICAL STORM DEAN"
##	[67]	"TROPICAL STORM GORDON"	"TROPICAL STORM JERRY"
##	[69]	"TSTM"	"TSTM HEAVY RAIN"
##	[71]	"TSUNAMI"	"TYPHOON"

```
## Add to grouping
levels(events)[c(11,12,15,16,17,18,19,33,34,44,45,46,47,49,179:184,186:207,249:255,291,293,294,295,296,297,298,299,301
<- "Marine"
```

## Winter

```
## Grouped into winter
levels(events)[c(8,9,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,28:33,37,38,39,45,73,71:73,75:80,84:110,113,112,138:
```

##	[1]	"ACCUMULATED SNOWFALL"	"AGRICULTURAL FREEZE"
##	[3]	"AVALANCE"	"AVALANCHE"
##	[5]	"BITTER WIND CHILL"	"BITTER WIND CHILL TEMPERATURES"
##	[7]	"Black Ice"	"BLACK ICE"
##	[9]	"BLIZZARD"	"BLIZZARD AND EXTREME WIND CHIL"
##	[11]	"BLIZZARD AND HEAVY SNOW"	"Blizzard Summary"
##	[13]	"BLIZZARD WEATHER"	"BLIZZARD/FREEZING RAIN"
##	[15]	"BLIZZARD/HEAVY SNOW"	"BLIZZARD/HIGH WIND"
##	[17]	"BLIZZARD/WINTER STORM"	"blowing snow"
##	[19]	"Blowing Snow"	"BLOWING SNOW"
##	[21]	"BLOWING SNOW & EXTREME WIND CH"	"BLOWING SNOW- EXTREME WIND CHI"
##	[23]	"BLOWING SNOW/EXTREME WIND CHIL"	"Damaging Freeze"
##	[25]	"DAMAGING FREEZE"	"DEEP HAIL"
##	[27]	"Drifting Snow"	"EARLY FROST"
##	[29]	"EARLY FREEZE"	"Early Frost"
##	[31]	"EARLY FROST"	"EARLY SNOW"
##	[33]	"Early snowfall"	"EARLY SNOWFALL"
##	[35]	"FALLING SNOW/ICE"	"FIRST FROST"
##	[37]	"FIRST SNOW"	"Freeze"
##	[39]	"FREEZE"	"Freezing drizzle"
##	[41]	"Freezing Drizzle"	"FREEZING DRIZZLE"
##	[43]	"FREEZING DRIZZLE AND FREEZING"	"Freezing Fog"
##	[45]	"FREEZING FOG"	"Freezing rain"
##	[47]	"Freezing Rain"	"FREEZING RAIN"
##	[49]	"FREEZING RAIN AND SLEET"	"FREEZING RAIN AND SNOW"
##	[51]	"FREEZING RAIN SLEET AND"	"FREEZING RAIN SLEET AND LIGHT"
##	[53]	"FREEZING RAIN/SLEET"	"FREEZING RAIN/SNOW"
##	[55]	"Freezing Spray"	"Frost"
##	[57]	"FROST"	"Frost/Freeze"
##	[59]	"FROST/FREEZE"	"FROST\FREEZE"
##	[61]	"Glaze"	"GLAZE"
##	[63]	"GLAZE ICE"	"GLAZE/ICE STORM"
##	[65]	"HARD FREEZE"	"GROUND BLIZZARD"
##	[67]	"HEAVY SNOW"	"HEAVY SNOW FREEZING RAIN"
##	[69]	"HEAVY SNOW & ICE"	"HEAVY SNOW AND"
##	[71]	"HEAVY SNOW AND HIGH WINDS"	"HEAVY SNOW AND ICE"
##	[73]	"HEAVY SNOW AND ICE STORM"	"HEAVY SNOW AND STRONG WINDS"

##	[75]	"HEAVY SNOW ANDBLOWING SNOW"	"Heavy snow shower"
##	[77]	"HEAVY SNOW SQUALLS"	"HEAVY SNOW-SQUALLS"
##	[79]	"HEAVY SNOW/BLIZZARD"	"HEAVY SNOW/BLIZZARD/AVALANCHE"
##	[81]	"HEAVY SNOW/BLOWING SNOW"	"HEAVY SNOW/FREEZING RAIN"
##	[83]	"HEAVY SNOW/HIGH"	"HEAVY SNOW/HIGH WIND"
##	[85]	"HEAVY SNOW/HIGH WINDS"	"HEAVY SNOW/HIGH WINDS & FLOOD"
##	[87]	"HEAVY SNOW/HIGH WINDS/FREEZING"	"HEAVY SNOW/ICE"
##	[89]	"HEAVY SNOW/ICE STORM"	"HEAVY SNOW/SLEET"
##	[91]	"HEAVY SNOW/SQUALLS"	"HEAVY SNOW/WIND"
##	[93]	"HEAVY SNOW/WINTER STORM"	"HEAVY SNOWPACK"
##	[95]	"HEAVY WET SNOW"	"ICE"
##	[97]	"ICE AND SNOW"	"ICE FLOES"
##	[99]	"Ice Fog"	"ICE JAM"
##	[101]	"Ice jam flood (minor)"	"ICE JAM FLOODING"
##	[103]	"ICE ON ROAD"	"ICE PELLETS"
##	[105]	"ICE ROADS"	"ICE STORM"
##	[107]	"ICE STORM AND SNOW"	"ICE STORM/FLASH FLOOD"
##	[109]	"Ice/Snow"	"ICE/SNOW"
##	[111]	"ICE/STRONG WINDS"	"Icestorm/Blizzard"
##	[113]	"Icy Roads"	"ICY ROADS"
##	[115]	"LACK OF SNOW"	"Lake Effect Snow"
##	[117]	"LAKE EFFECT SNOW"	"LAKE FLOOD"
##	[119]	"LATE FREEZE"	"LATE SEASON HAIL"
##	[121]	"LATE SEASON SNOW"	"Late Season Snowfall"
##	[123]	"LATE SNOW"	"Late-season Snowfall"
##	[125]	"LIGHT FREEZING RAIN"	"Light snow"
##	[127]	"Light Snow"	"LIGHT SNOW"
##	[129]	"LIGHT SNOW AND SLEET"	"Light Snow/Flurries"
##	[131]	"LIGHT SNOW/FREEZING PRECIP"	"Light Snowfall"
##	[133]	"MODERATE SNOW"	"MODERATE SNOWFALL"
##	[135]	"Monthly Snowfall"	"MONTHLY SNOWFALL"
##	[137]	"MONTHLY TEMPERATURE"	"Mountain Snows"
##	[139]	"NEAR RECORD SNOW"	"PROLONGED RAIN"
##	[141]	"SLEET"	"SLEET & FREEZING RAIN"
##	[143]	"SLEET STORM"	"SLEET/FREEZING RAIN"
##	[145]	"SLEET/ICE STORM"	"SLEET/RAIN/SNOW"
##	[147]	"SLEET/SNOW"	"Snow"
##	[149]	"SNOW"	"Snow Accumulation"
##	[151]	"SNOW ACCUMULATION"	"SNOW ADVISORY"
##	[153]	"SNOW AND COLD"	"SNOW AND HEAVY SNOW"
##	[155]	"Snow and Ice"	"SNOW AND ICE"
##	[157]	"SNOW AND ICE STORM"	"Snow and sleet"
##	[159]	"SNOW AND SLEET"	"SNOW AND WIND"
##	[161]	"SNOW DROUGHT"	"SNOW FREEZING RAIN"
##	[163]	"SNOW SHOWERS"	"SNOW SLEET"
##	[165]	"SNOW SQUALL"	"Snow squalls"
##	[167]	"Snow Squalls"	"SNOW SQUALLS"
##	[169]	"SNOW- HIGH WIND- WIND CHILL"	"SNOW/ BITTER COLD"
##	[171]	"SNOW/ ICE"	"SNOW/BLOWING SNOW"
##	[173]	"SNOW/COLD"	"SNOW/FREEZING RAIN"
##	[175]	"SNOW/HEAVY SNOW"	"SNOW/HIGH WINDS"
##	[177]	"SNOW/ICE"	"SNOW/ICE STORM"
##	[179]	"SNOW/RAIN"	"SNOW/RAIN/SLEET"
##	[181]	"SNOW/SLEET"	"SNOW/SLEET/FREEZING RAIN"
##	[183]	"SNOW/SLEET/RAIN"	"SNOW\\COLD"
##	[185]	"SNOWFALL RECORD"	"SNOWMELT FLOODING"
##	[187]	"SNOWSTORM"	"SOUTHEAST"
##	[189]	"WINTER MIX"	"WINTER STORM"
##	[191]	"WINTER STORM HIGH WINDS"	"WINTER STORM/HIGH WIND"
##	[193]	"WINTER STORM/HIGH WINDS"	"WINTER STORMS"
##	[195]	"Winter weather"	"WINTER WEATHER"
##	[197]	"WINTER WEATHER MIX"	"WINTER WEATHER/MIX"
##	[199]	"WINTERY MIX"	"Wintry mix"
##	[201]	"Wintry Mix"	"WINTRY MIX"

```
## Add to grouping
levels(events)[c(8,9,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,28:33,37,38,39,45,73,71:73,75:80,84:110,113,112,138:
<- "winter"
```

## Other

```
## other group included the rest
levels(events)[c(4,5,6,7,9,11,12,13,15,16,17,18,19,20,21,22,23,24:44,46,47,48,49,52:75,78:87,91,92,93,95,96,98:108,113
```

##	[1]	"?"	"ABNORMAL WARMTH"
##	[3]	"ABNORMALLY DRY"	"ABNORMALLY WET"
##	[5]	"APACHE COUNTY"	"BLOWING DUST"
##	[7]	"BRUSH FIRE"	"BRUSH FIRES"
##	[9]	"DENSE FOG"	"DENSE SMOKE"
##	[11]	"DOWNBURST"	"DOWNBURST WINDS"
##	[13]	"DRIEST MONTH"	"DROUGHT"
##	[15]	"DROUGHT/EXCESSIVE HEAT"	"DROWNING"
##	[17]	"DRY"	"DRY CONDITIONS"
##	[19]	"DRY HOT WEATHER"	"DRY MICROBURST"
##	[21]	"DRY MICROBURST 50"	"DRY MICROBURST 53"
##	[23]	"DRY MICROBURST 58"	"DRY MICROBURST 61"

## [25]	"DRY MICROBURST 84"	"DRY MICROBURST WINDS"
## [27]	"DRY MIRCOCURST WINDS"	"DRY PATTERN"
## [29]	"DRY SPELL"	"DRY WEATHER"
## [31]	"DRYNESS"	"DUST DEVEL"
## [33]	"Dust Devil"	"DUST DEVIL"
## [35]	"DUST DEVIL WATERSPOUT"	"DUST STORM"
## [37]	"DUST STORM/HIGH WINDS"	"DUSTSTORM"
## [39]	"FOG"	"FOG AND COLD TEMPERATURES"
## [41]	"FOREST FIRES"	"GRASS FIRES"
## [43]	"HEAVY MIX"	"HEAVY PRECIPITATION"
## [45]	"Heavy Precipitation"	"HEAVY PRECIPITATION"
## [47]	"Heavy rain"	"Heavy Rain"
## [49]	"HEAVY RAIN"	"Heavy Rain and Wind"
## [51]	"HEAVY RAIN EFFECTS"	"HEAVY RAIN; URBAN FLOOD WINDS;"
## [53]	"HEAVY RAIN/FLOODING"	"Heavy Rain/High Surf"
## [55]	"HEAVY RAIN/LIGHTNING"	"HEAVY RAIN/MUDSLIDES/FLOOD"
## [57]	"HEAVY RAIN/SEVERE WEATHER"	"HEAVY RAIN/SMALL STREAM URBAN"
## [59]	"HEAVY RAIN/URBAN FLOOD"	"HEAVY RAINFALL"
## [61]	"HEAVY RAINS"	"HEAVY SEAS"
## [63]	"HEAVY SHOWER"	"HEAVY SHOWERS"
## [65]	"Hvy RAIN"	"LAKE-EFFECT SNOW"
## [67]	"Mild and Dry Pattern"	"MILD PATTERN"
## [69]	"MILD/DRY PATTERN"	"MIXED PRECIP"
## [71]	"Mixed Precipitation"	"MIXED PRECIPITATION"
## [73]	"MONTHLY PRECIPITATION"	"Monthly Rainfall"
## [75]	"MONTHLY RAINFALL"	"No Severe Weather"
## [77]	"NONE"	"NORMAL PRECIPITATION"
## [79]	"NORTHERN LIGHTS"	"OTHER"
## [81]	"PATCHY DENSE FOG"	"RAIN"
## [83]	"RAIN (HEAVY)"	"RAIN AND WIND"
## [85]	"Rain Damage"	"RAIN/SNOW"
## [87]	"RAIN/WIND"	"RAINSTORM"
## [89]	"RECORD/EXCESSIVE RAINFALL"	"ROTATING WALL CLOUD"
## [91]	"Saharan Dust"	"SAHARAN DUST"
## [93]	"SMOKE"	"Summary August 10"
## [95]	"Summary August 11"	"Summary August 17"
## [97]	"Summary August 2-3"	"Summary August 21"
## [99]	"Summary August 28"	"Summary August 4"
## [101]	"Summary August 7"	"Summary August 9"
## [103]	"Summary Jan 17"	"Summary July 23-24"
## [105]	"Summary June 18-19"	"Summary June 5-6"
## [107]	"Summary June 6"	"Summary of April 12"
## [109]	"Summary of April 13"	"Summary of April 21"
## [111]	"Summary of April 27"	"Summary of April 3rd"
## [113]	"Summary of August 1"	"Summary of July 11"
## [115]	"Summary of July 2"	"Summary of July 22"
## [117]	"Summary of July 26"	"Summary of July 29"
## [119]	"Summary of July 3"	"Summary of June 10"
## [121]	"Summary of June 11"	"Summary of June 12"
## [123]	"Summary of June 13"	"Summary of June 15"
## [125]	"Summary of June 16"	"Summary of June 18"
## [127]	"Summary of June 23"	"Summary of June 24"
## [129]	"Summary of June 3"	"Summary of June 30"
## [131]	"Summary of June 4"	"Summary of June 6"
## [133]	"Summary of March 14"	"Summary of March 23"
## [135]	"Summary of March 24"	"SUMMARY OF MARCH 24-25"
## [137]	"SUMMARY OF MARCH 27"	"SUMMARY OF MARCH 29"
## [139]	"Summary of May 10"	"Summary of May 13"
## [141]	"Summary of May 14"	"Summary of May 22"
## [143]	"Summary of May 22 am"	"Summary of May 22 pm"
## [145]	"Summary of May 26 am"	"Summary of May 26 pm"
## [147]	"Summary of May 31 am"	"Summary of May 31 pm"
## [149]	"Summary of May 9-10"	"Summary Sept. 25-26"
## [151]	"Summary September 20"	"Summary September 23"
## [153]	"Summary September 3"	"Summary September 4"
## [155]	"Summary: Nov. 16"	"Summary: Nov. 6-7"
## [157]	"Summary: Oct. 20-21"	"Summary: October 31"
## [159]	"Summary: Sept. 18"	"Temperature record"
## [161]	"THUNDERSNOW"	"Thundersnow shower"
## [163]	"THUNDERSTORM"	"THUNDERSTORM DAMAGE"
## [165]	"THUNDERSTORM DAMAGE TO"	"THUNDERSTORM HAIL"
## [167]	"TORRENTIAL RAIN"	"Torrential Rainfall"
## [169]	"VERY DRY"	"VOG"
## [171]	"Volcanic Ash"	"VOLCANIC ASH"
## [173]	"Volcanic Ash Plume"	"VOLCANIC ASHFALL"
## [175]	"VOLCANIC ERUPTION"	"WARM DRY CONDITIONS"
## [177]	"Wet Month"	"WET WEATHER"
## [179]	"Wet year"	

```
## Add to grouping
levels(events)[c(4,5,6,7,9,11,12,13,15,16,17,18,19,20,21,22,23,24:44,46,47,48,49,52:75,78:87,91,92,93,95,96,98:108,113
<- "other"
```

#### The balance weather types

```
levels(events)[c(21:33)] <- "Convection";
levels(events)[c(3,8,11,12,13,14,15,19,20)] <- "Convection";
levels(events)[c(8,9,10,12)] <- "winter";
```

```
levels(events)[c(7:13)] <- "other"
```

## Raw data updated with the processed data by categories

```
data$EVTYPE <- events
length(unique(data$EVTYPE)) ## lesser number of groups make data management and visualization a lot efficient and easy
```

```
## [1] 6
```

**1. Across the United States, which types of events (EVTYPE variable) are most harmful with respect to population health?**

**2. Across the United States, which types of events have the greatest economic consequences?**

```
names(data)
```

```
## [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" "PROPDGM"
## [26] "PROPDMGEXP" "CROPDGM" "CROPDMGEXP" "WFO" "STATEOFFIC"
## [31] "ZONENAMES" "LATITUDE" "LONGITUDE" "LATITUDE_E" "LONGITUDE_"
## [36] "REMARKS" "REFNUM"
```

Here we need to understand the weather related types of events and their resultant effects on the health of the population and property costs due to possible damage

```
names(data)[c(2,8,23:28)]
```

```
## [1] "BGN_DATE" "EVTYPE" "FATALITIES" "INJURIES" "PROPDGM"
## [6] "PROPDMGEXP" "CROPDGM" "CROPDMGEXP"
```

## We chose Fatalities & Injuries columns because

These columns are related to the health of the population. The ultimate data frame will hold a combination of these values to get an understanding of all the incidents that are population health related.

## We chose columns PROPDGM, PROPDMGEXP, CROPDGM & CROPDMGEXP because

They are related to Property damage, Crop damage is included because it is considered agricultural property and both Crops and Property damage have negative economic effects. CROPDMGEXP and PROPDMGEXP signify the exponential value that needs to be applied relative to the values in CROPDGM and PROPDGM M = Million\$ = 1e6, K = Thousand\$ = 1e3, H = Hundred\$ = 1e2, etc  
These alphabetic notation will be converted to their number values, based on data from NOAA

## Subsetting the needed columns

```
subData <- data[,c(2,8,23:28)]
```

## Exponent Column Conversion

```
## Property Damage Exponents
subData$PROPDMGEXP <- as.factor(subData$PROPDMGEXP)
levels(subData$PROPDMGEXP)[c(1:5)] <- 1;
levels(subData$PROPDMGEXP)[c(6,13,14)] <- 1e6 ;
levels(subData$PROPDMGEXP)[c(7)] <- 1e7;
levels(subData$PROPDMGEXP)[c(2,10,11)] <- 1e2;
levels(subData$PROPDMGEXP)[c(3)] <- 1e3;
levels(subData$PROPDMGEXP)[c(4)] <- 1e4;
levels(subData$PROPDMGEXP)[c(5)] <- 1e5;
levels(subData$PROPDMGEXP)[c(8)] <- 1e8;
levels(subData$PROPDMGEXP)[c(9)] <- 1e9;
levels(subData$PROPDMGEXP)[c(10)] <- 1e3
## Crop Damage Exponents
subData$CROPDMGEXP <- as.factor(subData$CROPDMGEXP)
levels(subData$CROPDMGEXP)[c(1:3)] <- 1
levels(subData$CROPDMGEXP)[c(4,5)] <- 1e3
levels(subData$CROPDMGEXP)[c(2)] <- 1e2
levels(subData$CROPDMGEXP)[3] <- 1e9
levels(subData$CROPDMGEXP)[c(5,6)] <- 1e6
## All the exponents have been converted
levels(subData$CROPDMGEXP) ## Crop damage exponent
```



```
## [1] "1"      "100"     "1e+09"  "1000"   "1e+06"
```

```
levels(subData$PROPDGMGEXP) ## Property Damage exponent
```

```
## [1] "1"      "100"     "1000"   "10000"  "1e+05"  "1e+06"  "1e+07"  "1e+08"  "1e+09"
```

```
subData$PROPDGMGEXP <- as.numeric(as.character(subData$PROPDGMGEXP))  
subData$CROPDGMGEXP <- as.numeric(as.character(subData$CROPDGMGEXP))
```

### Combining of Value columns to their corresponding exponents

```
Total <- (subData$PROPDGMG*subData$PROPDGMGEXP) + (subData$CROPDGMG*subData$CROPDGMGEXP)
```

### Creating final data frame and columns

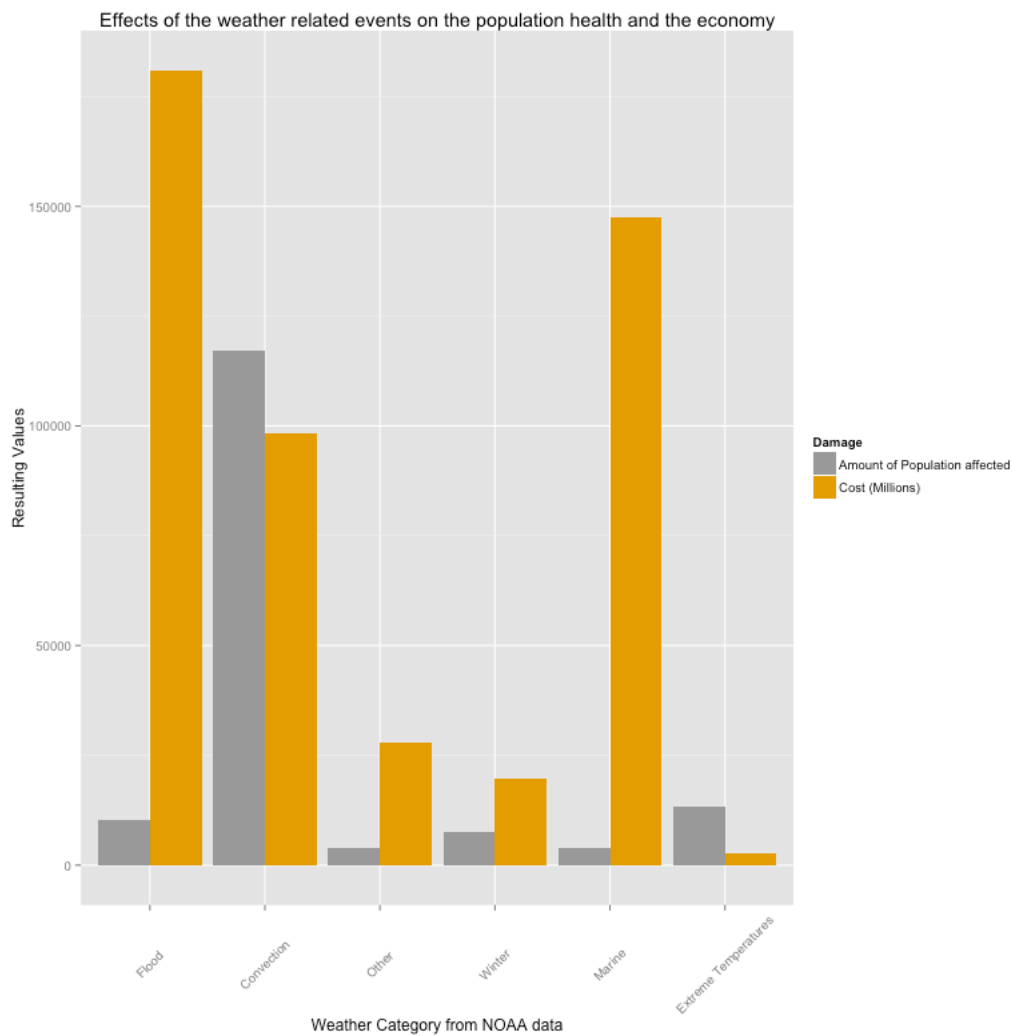
```
## Creating the Year vector  
Date <- as.Date(subData$BGN_DATE, format = "%m/%d/%Y %H:%M:%S")  
Year <- format(Date, format = "%Y")  
numeric <- as.numeric(Year)  
Year <- cbind(Year,numeric)  
Year <- data.frame(Year)  
  
## Resulting data  
resultData <- data.frame(Year, Category = subData$EVTYPE, Population.Harm = subData$FATALITIES +  
subData$INJURIES, Economic.Cost = Total)  
meltData <- melt(resultData[,3:5]) ## Add facets  
## Aggregates values sorted by weather category and Damage  
finalDat <- aggregate(meltData$value, list(Category = meltData$Category, Damage = meltData$variable), sum)  
finalDat$x[7:12] <- finalDat$x[7:12]/1000000 ## adjust cost scale to proportion for graphing purposes  
levels(finalDat$Damage) <- c("Amount of Population affected", "Cost (Millions)")
```

## Results

**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?**

```
q <- ggplot(finalDat, aes(Category, x, fill = Damage))  
q + geom_bar(position = "dodge", stat = "identity") + labs(title = "Effects of the weather related events on  
the population health and the economy") + theme(axis.text.x = element_text(angle = 45, vjust = 0.5)) +  
xlab("Weather Category from NOAA data") + ylab("Resulting Values") + scale_fill_manual(values=c("#999999",  
"#E69F00"))
```



## Yearly Data collection count

```
p <- ggplot(Year, aes(numeric, ..count..))
bin <- 60
p + geom_histogram(binwidth = bin, colour="white") + theme(axis.text.x = element_text(angle = 90, vjust = 0.5)) + xlab("Years") + ylab("Amount of Data Collected") + labs(title="Yearly Data Collection Count")
```

