Analysis of Natural Catastrophies on Life and Economy from: (1950 - November 2011)

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Synopsis

Natural Catastrophies such as Storms, Tornadoes Fires, etc cause major disruptions in the areas where they occur.

This document presents and analysis of the effects of such catastrophies which have been labeled as "Events" for the purpose of analysis.

It seeks to answer the following questions:

1. Across the United States, which types of events are most harmful with respect to population health?
2. Across the United States, which types of events have the greatest economic consequences?

The document is broken into the following sections: 1. Data Processing 2. Results

1. Data Processing

Data processing is broken down into 2 steps: 1.1 Loading the data 1.2 Cleaning up the data

1.1 Loading the data

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
library(colorspace)
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##     combine
```

```
#====== Begin by loading the data=====
datatoanalyze <- read.csv("repdata-data-StormData.csv.bz2", header = TRUE, sep = ",")
```

Code breakdown:

- *Line 1- 4: load required packages.*
- *Line 5: unzips the bz2 file and reads contents into the datatoanalyze dataframe.*

```
#== Analyze the structure of the dataset
str(datatoanalyze)
```

```
## 'data.frame':    902297 obs. of  37 variables:
##  $ STATE__   : num  1 1 1 1 1 1 1 1 1 1 ...
##  $ BGN_DATE  : Factor w/ 16335 levels "1/1/1966 0:00:00",..: 6523 6523 4242 11116 2224 2224 2260 383
##  $ BGN_TIME  : Factor w/ 3608 levels "00:00:00 AM",..: 272 287 2705 1683 2584 3186 242 1683 3186 318
##  $ TIME_ZONE : Factor w/ 22 levels "ADT","AKS","AST",..: 7 7 7 7 7 7 7 7 7 7 ...
##  $ COUNTY    : num  97 3 57 89 43 77 9 123 125 57 ...
##  $ COUNTYNAME: Factor w/ 29601 levels "","5NM E OF MACKINAC BRIDGE TO PRESQUE ISLE LT MI",..: 13513 1
##  $ STATE     : Factor w/ 72 levels "AK","AL","AM",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ EVTYPE    : Factor w/ 985 levels "   HIGH SURF ADVISORY",..: 834 834 834 834 834 834 834 834 834 8
##  $ BGN_RANGE : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ BGN_AZI   : Factor w/ 35 levels "","  N"," NW",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ BGN_LOCATI: Factor w/ 54429 levels "","  Christiansburg",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ END_DATE  : Factor w/ 6663 levels "","1/1/1993 0:00:00",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ END_TIME  : Factor w/ 3647 levels "","  0900CST",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ COUNTY_END: num  0 0 0 0 0 0 0 0 0 0 ...
##  $ COUNTYENDN: logi  NA NA NA NA NA NA ...
##  $ END_RANGE : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ END_AZI   : Factor w/ 24 levels "","E","ENE","ESE",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ END_LOCATI: Factor w/ 34506 levels "","  CANTON","  TULIA",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ LENGTH    : num  14 2 0.1 0 0 1.5 1.5 0 3.3 2.3 ...
##  $ WIDTH     : num  100 150 123 100 150 177 33 33 100 100 ...
##  $ F         : int  3 2 2 2 2 2 2 1 3 3 ...
##  $ MAG       : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ FATALITIES: num  0 0 0 0 0 0 0 0 1 0 ...
##  $ INJURIES  : num  15 0 2 2 2 6 1 0 14 0 ...
##  $ PROPDMG   : num  25 2.5 25 2.5 2.5 2.5 2.5 2.5 25 25 ...
##  $ PROPDMGEXP: Factor w/ 19 levels "","-","?","+",..: 17 17 17 17 17 17 17 17 17 17 ...
##  $ CROPDMG   : num  0 0 0 0 0 0 0 0 0 0 ...
##  $ CROPDMGEXP: Factor w/ 9 levels "","?","0","2",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ WFO       : Factor w/ 542 levels "","  CI","%SD",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ STATEOFFIC: Factor w/ 250 levels "","ALABAMA, Central",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ ZONENAMES : Factor w/ 25112 levels "","
##  $ LATITUDE  : num  3040 3042 3340 3458 3412 ...
##  $ LONGITUDE : num  8812 8755 8742 8626 8642 ...
```

```
##  $ LATITUDE_E: num  3051 0 0 0 0 ...
##  $ LONGITUDE_: num  8806 0 0 0 0 ...
##  $ REMARKS   : Factor w/ 436781 levels "","\t","\t\t",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ REFNUM    : num  1 2 3 4 5 6 7 8 9 10 ...
```

```
datatoanalyze$EVTYPE <- as.character(datatoanalyze$EVTYPE)
length(unique(datatoanalyze$EVTYPE))
```

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

The basic structure of the dataframe has been printed out for analysis, It has the following:

- 902297 rows and 37 columns
- **EVTYPE:** The name of the "Event" (Natural Catastrophe)
- **FATALATIES:** Number of deaths due to "Event"
- **INJURIES:** Number of injuries due to "Event"
- **PROPDMG:** property damages cost due to "Event"
- **CROPDMG:** crops damages cost due to "Event"
- **PROPDMGEXP:** Property damage in powers of 10
- **CROPDMGEXP:** Crop damage in powers of 10

1.2 Cleaning up the data

Part 1: Removing the aliases for the event names, and associating them with the NOAA list of approvent events

We begin by viewing the table of all events:

```
#sort(table(datatoanalyze$EVTYPE))
unique(datatoanalyze$EVTYPE)
```

```
##   [1] "TORNADO"                         "TSTM WIND"
##   [3] "HAIL"                            "FREEZING RAIN"
##   [5] "SNOW"                            "ICE STORM/FLASH FLOOD"
##   [7] "SNOW/ICE"                        "WINTER STORM"
##   [9] "HURRICANE OPAL/HIGH WINDS"       "THUNDERSTORM WINDS"
##  [11] "RECORD COLD"                     "HURRICANE ERIN"
##  [13] "HURRICANE OPAL"                  "HEAVY RAIN"
##  [15] "LIGHTNING"                       "THUNDERSTORM WIND"
##  [17] "DENSE FOG"                       "RIP CURRENT"
##  [19] "THUNDERSTORM WINS"               "FLASH FLOOD"
##  [21] "FLASH FLOODING"                  "HIGH WINDS"
##  [23] "FUNNEL CLOUD"                    "TORNADO F0"
##  [25] "THUNDERSTORM WINDS LIGHTNING"    "THUNDERSTORM WINDS/HAIL"
##  [27] "HEAT"                            "WIND"
##  [29] "LIGHTING"                        "HEAVY RAINS"
##  [31] "LIGHTNING AND HEAVY RAIN"        "FUNNEL"
##  [33] "WALL CLOUD"                      "FLOODING"
##  [35] "THUNDERSTORM WINDS HAIL"         "FLOOD"
##  [37] "COLD"                            "HEAVY RAIN/LIGHTNING"
##  [39] "FLASH FLOODING/THUNDERSTORM WI"  "WALL CLOUD/FUNNEL CLOUD"
```

```
##  [41] "THUNDERSTORM"                    "WATERSPOUT"
##  [43] "EXTREME COLD"                    "HAIL 1.75)"
##  [45] "LIGHTNING/HEAVY RAIN"            "HIGH WIND"
##  [47] "BLIZZARD"                        "BLIZZARD WEATHER"
##  [49] "WIND CHILL"                      "BREAKUP FLOODING"
##  [51] "HIGH WIND/BLIZZARD"              "RIVER FLOOD"
##  [53] "HEAVY SNOW"                      "FREEZE"
##  [55] "COASTAL FLOOD"                   "HIGH WIND AND HIGH TIDES"
##  [57] "HIGH WIND/BLIZZARD/FREEZING RA"  "HIGH TIDES"
##  [59] "HIGH WIND AND HEAVY SNOW"        "RECORD COLD AND HIGH WIND"
##  [61] "RECORD HIGH TEMPERATURE"         "RECORD HIGH"
##  [63] "HIGH WINDS HEAVY RAINS"          "HIGH WIND/ BLIZZARD"
##  [65] "ICE STORM"                       "BLIZZARD/HIGH WIND"
##  [67] "HIGH WIND/LOW WIND CHILL"        "HEAVY SNOW/HIGH"
##  [69] "RECORD LOW"                      "HIGH WINDS AND WIND CHILL"
##  [71] "HEAVY SNOW/HIGH WINDS/FREEZING"  "LOW TEMPERATURE RECORD"
##  [73] "AVALANCHE"                       "MARINE MISHAP"
##  [75] "WIND CHILL/HIGH WIND"            "HIGH WIND/WIND CHILL/BLIZZARD"
##  [77] "HIGH WIND/WIND CHILL"            "HIGH WIND/HEAVY SNOW"
##  [79] "HIGH TEMPERATURE RECORD"         "FLOOD WATCH/"
##  [81] "RECORD HIGH TEMPERATURES"        "HIGH WIND/SEAS"
##  [83] "HIGH WINDS/HEAVY RAIN"           "HIGH SEAS"
##  [85] "SEVERE TURBULENCE"               "RECORD RAINFALL"
##  [87] "RECORD SNOWFALL"                 "RECORD WARMTH"
##  [89] "HEAVY SNOW/WIND"                 "EXTREME HEAT"
##  [91] "WIND DAMAGE"                     "DUST STORM"
##  [93] "APACHE COUNTY"                   "SLEET"
##  [95] "HAIL STORM"                      "FUNNEL CLOUDS"
##  [97] "FLASH FLOODS"                    "DUST DEVIL"
##  [99] "EXCESSIVE HEAT"                  "THUNDERSTORM WINDS/FUNNEL CLOU"
## [101] "WINTER STORM/HIGH WIND"          "WINTER STORM/HIGH WINDS"
## [103] "GUSTY WINDS"                     "STRONG WINDS"
## [105] "FLOODING/HEAVY RAIN"             "SNOW AND WIND"
## [107] "HEAVY SURF COASTAL FLOODING"     "HEAVY SURF"
## [109] "HEAVY PRECIPATATION"             "URBAN FLOODING"
## [111] "HIGH SURF"                       "BLOWING DUST"
## [113] "URBAN/SMALL"                     "WILD FIRES"
## [115] "HIGH"                            "URBAN/SMALL FLOODING"
## [117] "WATER SPOUT"                     "HIGH WINDS DUST STORM"
## [119] "WINTER STORM HIGH WINDS"         "LOCAL FLOOD"
## [121] "WINTER STORMS"                   "MUDSLIDES"
## [123] "RAINSTORM"                       "SEVERE THUNDERSTORM"
## [125] "SEVERE THUNDERSTORMS"            "SEVERE THUNDERSTORM WINDS"
## [127] "THUNDERSTORMS WINDS"             "DRY MICROBURST"
## [129] "FLOOD/FLASH FLOOD"               "FLOOD/RAIN/WINDS"
## [131] "WINDS"                           "DRY MICROBURST 61"
## [133] "THUNDERSTORMS"                   "FLASH FLOOD WINDS"
## [135] "URBAN/SMALL STREAM FLOODING"     "MICROBURST"
## [137] "STRONG WIND"                     "HIGH WIND DAMAGE"
## [139] "STREAM FLOODING"                 "URBAN AND SMALL"
## [141] "HEAVY SNOWPACK"                  "ICE"
## [143] "FLASH FLOOD/"                    "DOWNBURST"
## [145] "GUSTNADO AND"                    "FLOOD/RAIN/WIND"
## [147] "WET MICROBURST"                  "DOWNBURST WINDS"
```

```
## [149] "DRY MICROBURST WINDS"           "DRY MIRCOBURST WINDS"
## [151] "DRY MICROBURST 53"              "SMALL STREAM URBAN FLOOD"
## [153] "MICROBURST WINDS"               "HIGH WINDS 57"
## [155] "DRY MICROBURST 50"              "HIGH WINDS 66"
## [157] "HIGH WINDS 76"                  "HIGH WINDS 63"
## [159] "HIGH WINDS 67"                  "BLIZZARD/HEAVY SNOW"
## [161] "HEAVY SNOW/HIGH WINDS"          "BLOWING SNOW"
## [163] "HIGH WINDS 82"                  "HIGH WINDS 80"
## [165] "HIGH WINDS 58"                  "FREEZING DRIZZLE"
## [167] "LIGHTNING THUNDERSTORM WINDSS"  "DRY MICROBURST 58"
## [169] "HAIL 75"                        "HIGH WINDS 73"
## [171] "HIGH WINDS 55"                  "LIGHT SNOW AND SLEET"
## [173] "URBAN FLOOD"                    "DRY MICROBURST 84"
## [175] "THUNDERSTORM WINDS 60"          "HEAVY RAIN/FLOODING"
## [177] "THUNDERSTORM WINDSS"            "TORNADOS"
## [179] "GLAZE"                          "RECORD HEAT"
## [181] "COASTAL FLOODING"               "HEAT WAVE"
## [183] "FIRST SNOW"                     "FREEZING RAIN AND SLEET"
## [185] "UNSEASONABLY DRY"               "UNSEASONABLY WET"
## [187] "WINTRY MIX"                     "WINTER WEATHER"
## [189] "UNSEASONABLY COLD"              "EXTREME/RECORD COLD"
## [191] "RIP CURRENTS HEAVY SURF"        "SLEET/RAIN/SNOW"
## [193] "UNSEASONABLY WARM"              "DROUGHT"
## [195] "NORMAL PRECIPITATION"           "HIGH WINDS/FLOODING"
## [197] "DRY"                            "RAIN/SNOW"
## [199] "SNOW/RAIN/SLEET"                "WATERSPOUT/TORNADO"
## [201] "WATERSPOUTS"                    "WATERSPOUT TORNADO"
## [203] "URBAN/SMALL STREAM FLOOD"       "STORM SURGE"
## [205] "WATERSPOUT-TORNADO"             "WATERSPOUT-"
## [207] "TORNADOES, TSTM WIND, HAIL"     "TROPICAL STORM ALBERTO"
## [209] "TROPICAL STORM"                 "TROPICAL STORM GORDON"
## [211] "TROPICAL STORM JERRY"           "LIGHTNING THUNDERSTORM WINDS"
## [213] "WAYTERSPOUT"                    "MINOR FLOODING"
## [215] "LIGHTNING INJURY"               "URBAN/SMALL STREAM  FLOOD"
## [217] "LIGHTNING AND THUNDERSTORM WIN" "THUNDERSTORM WINDS53"
## [219] "URBAN AND SMALL STREAM FLOOD"   "URBAN AND SMALL STREAM"
## [221] "WILDFIRE"                       "DAMAGING FREEZE"
## [223] "THUNDERSTORM WINDS 13"          "SMALL HAIL"
## [225] "HEAVY SNOW/HIGH WIND"           "HURRICANE"
## [227] "WILD/FOREST FIRE"               "SMALL STREAM FLOODING"
## [229] "MUD SLIDE"                      "LIGNTNING"
## [231] "FROST"                          "FREEZING RAIN/SNOW"
## [233] "HIGH WINDS/"                    "THUNDERSNOW"
## [235] "FLOODS"                         "EXTREME WIND CHILLS"
## [237] "COOL AND WET"                   "HEAVY RAIN/SNOW"
## [239] "SMALL STREAM AND URBAN FLOODIN" "SMALL STREAM/URBAN FLOOD"
## [241] "SNOW/SLEET/FREEZING RAIN"       "SEVERE COLD"
## [243] "GLAZE ICE"                      "COLD WAVE"
## [245] "EARLY SNOW"                     "SMALL STREAM AND URBAN FLOOD"
## [247] "HIGH  WINDS"                    "RURAL FLOOD"
## [249] "SMALL STREAM AND"               "MUD SLIDES"
## [251] "HAIL 80"                        "EXTREME WIND CHILL"
## [253] "COLD AND WET CONDITIONS"        "EXCESSIVE WETNESS"
## [255] "GRADIENT WINDS"                 "HEAVY SNOW/BLOWING SNOW"
```

```
## [257] "SLEET/ICE STORM"                "THUNDERSTORM WINDS URBAN FLOOD"
## [259] "THUNDERSTORM WINDS SMALL STREA" "ROTATING WALL CLOUD"
## [261] "LARGE WALL CLOUD"               "COLD AIR FUNNEL"
## [263] "GUSTNADO"                       "COLD AIR FUNNELS"
## [265] "BLOWING SNOW- EXTREME WIND CHI" "SNOW AND HEAVY SNOW"
## [267] "GROUND BLIZZARD"                "MAJOR FLOOD"
## [269] "SNOW/HEAVY SNOW"                "FREEZING RAIN/SLEET"
## [271] "ICE JAM FLOODING"               "SNOW- HIGH WIND- WIND CHILL"
## [273] "STREET FLOOD"                   "COLD AIR TORNADO"
## [275] "SMALL STREAM FLOOD"             "FOG"
## [277] "THUNDERSTORM WINDS 2"           "FUNNEL CLOUD/HAIL"
## [279] "ICE/SNOW"                       "TSTM WIND 51"
## [281] "TSTM WIND 50"                   "TSTM WIND 52"
## [283] "TSTM WIND 55"                   "HEAVY SNOW/BLIZZARD"
## [285] "THUNDERSTORM WINDS 61"          "HAIL 0.75"
## [287] "THUNDERSTORM DAMAGE"            "THUNDERTORM WINDS"
## [289] "HAIL 1.00"                      "HAIL/WINDS"
## [291] "SNOW AND ICE"                   "WIND STORM"
## [293] "SNOWSTORM"                      "GRASS FIRES"
## [295] "LAKE FLOOD"                     "PROLONG COLD"
## [297] "HAIL/WIND"                      "HAIL 1.75"
## [299] "THUNDERSTORMW 50"               "WIND/HAIL"
## [301] "SNOW AND ICE STORM"             "URBAN AND SMALL STREAM FLOODIN"
## [303] "THUNDERSTORMS WIND"             "THUNDERSTORM  WINDS"
## [305] "HEAVY SNOW/SLEET"               "AGRICULTURAL FREEZE"
## [307] "DROUGHT/EXCESSIVE HEAT"         "TUNDERSTORM WIND"
## [309] "TROPICAL STORM DEAN"            "THUNDERTSORM WIND"
## [311] "THUNDERSTORM WINDS/ HAIL"       "THUNDERSTORM WIND/LIGHTNING"
## [313] "HEAVY RAIN/SEVERE WEATHER"      "THUNDESTORM WINDS"
## [315] "WATERSPOUT/ TORNADO"            "LIGHTNING."
## [317] "WARM DRY CONDITIONS"            "HURRICANE-GENERATED SWELLS"
## [319] "HEAVY SNOW/ICE STORM"           "RIVER AND STREAM FLOOD"
## [321] "HIGH WIND 63"                   "COASTAL SURGE"
## [323] "HEAVY SNOW AND ICE STORM"       "MINOR FLOOD"
## [325] "HIGH WINDS/COASTAL FLOOD"       "RAIN"
## [327] "RIVER FLOODING"                 "SNOW/RAIN"
## [329] "ICE FLOES"                      "HIGH WAVES"
## [331] "SNOW SQUALLS"                   "SNOW SQUALL"
## [333] "THUNDERSTORM WIND G50"          "LIGHTNING FIRE"
## [335] "BLIZZARD/FREEZING RAIN"         "HEAVY LAKE SNOW"
## [337] "HEAVY SNOW/FREEZING RAIN"       "LAKE EFFECT SNOW"
## [339] "HEAVY WET SNOW"                 "DUST DEVIL WATERSPOUT"
## [341] "THUNDERSTORM WINDS/HEAVY RAIN"  "THUNDERSTROM WINDS"
## [343] "THUNDERSTORM WINDS      LE CEN" "HAIL 225"
## [345] "BLIZZARD AND HEAVY SNOW"        "HEAVY SNOW AND ICE"
## [347] "ICE STORM AND SNOW"             "HEAVY SNOW ANDBLOWING SNOW"
## [349] "HEAVY SNOW/ICE"                 "BLIZZARD AND EXTREME WIND CHIL"
## [351] "LOW WIND CHILL"                 "BLOWING SNOW & EXTREME WIND CH"
## [353] "WATERSPOUT/"                    "URBAN/SMALL STREAM"
## [355] "TORNADO F3"                     "FUNNEL CLOUD."
## [357] "TORNDAO"                        "HAIL 0.88"
## [359] "FLOOD/RIVER FLOOD"              "MUD SLIDES URBAN FLOODING"
## [361] "TORNADO F1"                     "THUNDERSTORM WINDS G"
## [363] "DEEP HAIL"                      "GLAZE/ICE STORM"
```

```
## [365] "HEAVY SNOW/WINTER STORM"        "AVALANCE"
## [367] "BLIZZARD/WINTER STORM"          "DUST STORM/HIGH WINDS"
## [369] "ICE JAM"                        "FOREST FIRES"
## [371] "THUNDERSTORM WIND G60"          "FROST\\FREEZE"
## [373] "THUNDERSTORM WINDS."            "HAIL 88"
## [375] "HAIL 175"                       "HVY RAIN"
## [377] "HAIL 100"                       "HAIL 150"
## [379] "HAIL 075"                       "THUNDERSTORM WIND G55"
## [381] "HAIL 125"                       "THUNDERSTORM WINDS G60"
## [383] "HARD FREEZE"                    "HAIL 200"
## [385] "THUNDERSTORM WINDS FUNNEL CLOU" "THUNDERSTORM WINDS 62"
## [387] "WILDFIRES"                      "RECORD HEAT WAVE"
## [389] "HEAVY SNOW AND HIGH WINDS"      "HEAVY SNOW/HIGH WINDS & FLOOD"
## [391] "HAIL FLOODING"                  "THUNDERSTORM WINDS/FLASH FLOOD"
## [393] "HIGH WIND 70"                   "WET SNOW"
## [395] "HEAVY RAIN AND FLOOD"           "LOCAL FLASH FLOOD"
## [397] "THUNDERSTORM WINDS 53"          "FLOOD/FLASH FLOODING"
## [399] "TORNADO/WATERSPOUT"             "RAIN AND WIND"
## [401] "THUNDERSTORM WIND 59"           "THUNDERSTORM WIND 52"
## [403] "COASTAL/TIDAL FLOOD"            "SNOW/ICE STORM"
## [405] "BELOW NORMAL PRECIPITATION"     "RIP CURRENTS/HEAVY SURF"
## [407] "FLASH FLOOD/FLOOD"              "EXCESSIVE RAIN"
## [409] "RECORD/EXCESSIVE HEAT"          "HEAT WAVES"
## [411] "LIGHT SNOW"                     "THUNDERSTORM WIND 69"
## [413] "HAIL DAMAGE"                    "LIGHTNING DAMAGE"
## [415] "RECORD TEMPERATURES"            "LIGHTNING AND WINDS"
## [417] "FOG AND COLD TEMPERATURES"      "OTHER"
## [419] "RECORD SNOW"                    "SNOW/COLD"
## [421] "FLASH FLOOD FROM ICE JAMS"      "TSTM WIND G58"
## [423] "MUDSLIDE"                       "HEAVY SNOW SQUALLS"
## [425] "HEAVY SNOW/SQUALLS"             "HEAVY SNOW-SQUALLS"
## [427] "ICY ROADS"                      "HEAVY MIX"
## [429] "SNOW FREEZING RAIN"             "LACK OF SNOW"
## [431] "SNOW/SLEET"                     "SNOW/FREEZING RAIN"
## [433] "SNOW DROUGHT"                   "THUNDERSTORMW WINDS"
## [435] "THUNDERSTORM WIND 60 MPH"       "THUNDERSTORM WIND 65MPH"
## [437] "THUNDERSTORM WIND/ TREES"       "THUNDERSTORM WIND/AWNING"
## [439] "THUNDERSTORM WIND 98 MPH"       "THUNDERSTORM WIND TREES"
## [441] "TORRENTIAL RAIN"                "TORNADO F2"
## [443] "RIP CURRENTS"                   "HURRICANE EMILY"
## [445] "HURRICANE GORDON"               "HURRICANE FELIX"
## [447] "THUNDERSTORM WIND 59 MPH"       "THUNDERSTORM WINDS 63 MPH"
## [449] "THUNDERSTORM WIND/ TREE"        "THUNDERSTORM DAMAGE TO"
## [451] "THUNDERSTORM WIND 65 MPH"       "FLASH FLOOD - HEAVY RAIN"
## [453] "THUNDERSTORM WIND."             "FLASH FLOOD/ STREET"
## [455] "THUNDERSTORM WIND 59 MPH."      "HEAVY SNOW   FREEZING RAIN"
## [457] "DAM FAILURE"                    "THUNDERSTORM HAIL"
## [459] "HAIL 088"                       "THUNDERSTORM WINDSHAIL"
## [461] "LIGHTNING  WAUSEON"             "THUDERSTORM WINDS"
## [463] "ICE AND SNOW"                   "RECORD COLD/FROST"
## [465] "STORM FORCE WINDS"              "FREEZING RAIN AND SNOW"
## [467] "FREEZING RAIN SLEET AND"        "SOUTHEAST"
## [469] "HEAVY SNOW & ICE"               "FREEZING DRIZZLE AND FREEZING"
## [471] "THUNDERSTORM WINDS AND"         "HAIL/ICY ROADS"
```

```
## [473] "FLASH FLOOD/HEAVY RAIN"          "HEAVY RAIN; URBAN FLOOD WINDS;"
## [475] "HEAVY PRECIPITATION"             "TSTM WIND DAMAGE"
## [477] "HIGH WATER"                      "FLOOD FLASH"
## [479] "RAIN/WIND"                       "THUNDERSTORM WINDS 50"
## [481] "THUNDERSTORM WIND G52"           "FLOOD FLOOD/FLASH"
## [483] "THUNDERSTORM WINDS 52"           "SNOW SHOWERS"
## [485] "THUNDERSTORM WIND G51"           "HEAT WAVE DROUGHT"
## [487] "HEAVY SNOW/BLIZZARD/AVALANCHE"   "RECORD SNOW/COLD"
## [489] "WET WEATHER"                     "UNSEASONABLY WARM AND DRY"
## [491] "FREEZING RAIN SLEET AND LIGHT"   "RECORD/EXCESSIVE RAINFALL"
## [493] "TIDAL FLOOD"                     "BEACH EROSIN"
## [495] "THUNDERSTORM WIND G61"           "FLOOD/FLASH"
## [497] "LOW TEMPERATURE"                 "SLEET & FREEZING RAIN"
## [499] "HEAVY RAINS/FLOODING"            "THUNDERESTORM WINDS"
## [501] "THUNDERSTORM WINDS/FLOODING"     "THUNDEERSTORM WINDS"
## [503] "HIGHWAY FLOODING"                "THUNDERSTORM W INDS"
## [505] "HYPOTHERMIA"                     "FLASH FLOOD/ FLOOD"
## [507] "THUNDERSTORM WIND 50"            "THUNERSTORM WINDS"
## [509] "HEAVY RAIN/MUDSLIDES/FLOOD"      "MUD/ROCK SLIDE"
## [511] "HIGH WINDS/COLD"                 "BEACH EROSION/COASTAL FLOOD"
## [513] "COLD/WINDS"                      "SNOW/ BITTER COLD"
## [515] "THUNDERSTORM WIND 56"            "SNOW SLEET"
## [517] "DRY HOT WEATHER"                 "COLD WEATHER"
## [519] "RAPIDLY RISING WATER"            "HAIL ALOFT"
## [521] "EARLY FREEZE"                    "ICE/STRONG WINDS"
## [523] "EXTREME WIND CHILL/BLOWING SNO"  "SNOW/HIGH WINDS"
## [525] "HIGH WINDS/SNOW"                 "EARLY FROST"
## [527] "SNOWMELT FLOODING"               "HEAVY SNOW AND STRONG WINDS"
## [529] "SNOW ACCUMULATION"               "BLOWING SNOW/EXTREME WIND CHIL"
## [531] "SNOW/ ICE"                       "SNOW/BLOWING SNOW"
## [533] "TORNADOES"                       "THUNDERSTORM WIND/HAIL"
## [535] "FLASH FLOODING/FLOOD"            "HAIL 275"
## [537] "HAIL 450"                        "FLASH FLOOODING"
## [539] "EXCESSIVE RAINFALL"              "THUNDERSTORMW"
## [541] "HAILSTORM"                       "TSTM WINDS"
## [543] "BEACH FLOOD"                     "HAILSTORMS"
## [545] "TSTMW"                           "FUNNELS"
## [547] "TSTM WIND 65)"                   "THUNDERSTORM WINDS/ FLOOD"
## [549] "HEAVY RAINFALL"                  "HEAT/DROUGHT"
## [551] "HEAT DROUGHT"                    "NEAR RECORD SNOW"
## [553] "LANDSLIDE"                       "HIGH WIND AND SEAS"
## [555] "THUNDERSTORMWINDS"               "THUNDERSTORM WINDS HEAVY RAIN"
## [557] "SLEET/SNOW"                      "EXCESSIVE"
## [559] "SNOW/SLEET/RAIN"                 "WILD/FOREST FIRES"
## [561] "HEAVY SEAS"                      "DUSTSTORM"
## [563] "FLOOD & HEAVY RAIN"              "?"
## [565] "THUNDERSTROM WIND"               "FLOOD/FLASHFLOOD"
## [567] "SNOW AND COLD"                   "HOT PATTERN"
## [569] "PROLONG COLD/SNOW"               "BRUSH FIRES"
## [571] "SNOW\\COLD"                      "WINTER MIX"
## [573] "EXCESSIVE PRECIPITATION"         "SNOWFALL RECORD"
## [575] "HOT/DRY PATTERN"                 "DRY PATTERN"
## [577] "MILD/DRY PATTERN"                "MILD PATTERN"
## [579] "LANDSLIDES"                      "HEAVY SHOWERS"
```

```
## [581] "HEAVY SNOW AND"                 "HIGH WIND 48"
## [583] "LAKE-EFFECT SNOW"               "BRUSH FIRE"
## [585] "WATERSPOUT FUNNEL CLOUD"        "URBAN SMALL STREAM FLOOD"
## [587] "SAHARAN DUST"                   "HEAVY SHOWER"
## [589] "URBAN FLOOD LANDSLIDE"          "HEAVY SWELLS"
## [591] "URBAN SMALL"                    "URBAN FLOODS"
## [593] "SMALL STREAM"                   "HEAVY RAIN/URBAN FLOOD"
## [595] "FLASH FLOOD/LANDSLIDE"          "LANDSLIDE/URBAN FLOOD"
## [597] "HEAVY RAIN/SMALL STREAM URBAN"  "FLASH FLOOD LANDSLIDES"
## [599] "EXTREME WINDCHILL"              "URBAN/SML STREAM FLD"
## [601] "TSTM WIND/HAIL"                 "Other"
## [603] "Record dry month"               "Temperature record"
## [605] "Minor Flooding"                 "Ice jam flood (minor"
## [607] "High Wind"                      "Tstm Wind"
## [609] "ROUGH SURF"                     "Wind"
## [611] "Heavy Surf"                     "Dust Devil"
## [613] "Wind Damage"                    "Marine Accident"
## [615] "Snow"                           "Freeze"
## [617] "Snow Squalls"                   "Coastal Flooding"
## [619] "Heavy Rain"                     "Strong Wind"
## [621] "COASTAL STORM"                  "COASTALFLOOD"
## [623] "Erosion/Cstl Flood"             "Heavy Rain and Wind"
## [625] "Light Snow/Flurries"            "Wet Month"
## [627] "Wet Year"                       "Tidal Flooding"
## [629] "River Flooding"                 "Damaging Freeze"
## [631] "Beach Erosion"                  "Hot and Dry"
## [633] "Flood/Flash Flood"              "Icy Roads"
## [635] "High Surf"                      "Heavy Rain/High Surf"
## [637] "Thunderstorm Wind"              "Rain Damage"
## [639] "Unseasonable Cold"              "Early Frost"
## [641] "Wintry Mix"                     "blowing snow"
## [643] "STREET FLOODING"                "Record Cold"
## [645] "Extreme Cold"                   "Ice Fog"
## [647] "Excessive Cold"                 "Torrential Rainfall"
## [649] "Freezing Rain"                  "Landslump"
## [651] "Late-season Snowfall"           "Hurricane Edouard"
## [653] "Coastal Storm"                  "Flood"
## [655] "HEAVY RAIN/WIND"                "TIDAL FLOODING"
## [657] "Winter Weather"                 "Snow squalls"
## [659] "Strong Winds"                   "Strong winds"
## [661] "RECORD WARM TEMPS."             "Ice/Snow"
## [663] "Mudslide"                       "Glaze"
## [665] "Extended Cold"                  "Snow Accumulation"
## [667] "Freezing Fog"                   "Drifting Snow"
## [669] "Whirlwind"                      "Heavy snow shower"
## [671] "Heavy rain"                     "LATE SNOW"
## [673] "Record May Snow"                "Record Winter Snow"
## [675] "Heavy Precipitation"            " COASTAL FLOOD"
## [677] "Record temperature"             "Light snow"
## [679] "Late Season Snowfall"           "Gusty Wind"
## [681] "small hail"                     "Light Snow"
## [683] "MIXED PRECIP"                   "Black Ice"
## [685] "Mudslides"                      "Gradient wind"
## [687] "Snow and Ice"                   "Freezing Spray"
```

```
## [689] "Summary Jan 17"              "Summary of March 14"
## [691] "Summary of March 23"         "Summary of March 24"
## [693] "Summary of April 3rd"        "Summary of April 12"
## [695] "Summary of April 13"         "Summary of April 21"
## [697] "Summary August 11"           "Summary of April 27"
## [699] "Summary of May 9-10"         "Summary of May 10"
## [701] "Summary of May 13"           "Summary of May 14"
## [703] "Summary of May 22 am"        "Summary of May 22 pm"
## [705] "Heatburst"                   "Summary of May 26 am"
## [707] "Summary of May 26 pm"        "Metro Storm, May 26"
## [709] "Summary of May 31 am"        "Summary of May 31 pm"
## [711] "Summary of June 3"           "Summary of June 4"
## [713] "Summary June 5-6"            "Summary June 6"
## [715] "Summary of June 11"          "Summary of June 12"
## [717] "Summary of June 13"          "Summary of June 15"
## [719] "Summary of June 16"          "Summary June 18-19"
## [721] "Summary of June 23"          "Summary of June 24"
## [723] "Summary of June 30"          "Summary of July 2"
## [725] "Summary of July 3"           "Summary of July 11"
## [727] "Summary of July 22"          "Summary July 23-24"
## [729] "Summary of July 26"          "Summary of July 29"
## [731] "Summary of August 1"         "Summary August 2-3"
## [733] "Summary August 7"            "Summary August 9"
## [735] "Summary August 10"           "Summary August 17"
## [737] "Summary August 21"           "Summary August 28"
## [739] "Summary September 4"         "Summary September 20"
## [741] "Summary September 23"        "Summary Sept. 25-26"
## [743] "Summary: Oct. 20-21"         "Summary: October 31"
## [745] "Summary: Nov. 6-7"           "Summary: Nov. 16"
## [747] "Microburst"                  "wet micoburst"
## [749] "Hail(0.75)"                  "Funnel Cloud"
## [751] "Urban Flooding"              "No Severe Weather"
## [753] "Urban flood"                 "Urban Flood"
## [755] "Cold"                        "Summary of May 22"
## [757] "Summary of June 6"           "Summary August 4"
## [759] "Summary of June 10"          "Summary of June 18"
## [761] "Summary September 3"         "Summary: Sept. 18"
## [763] "Coastal Flood"               "coastal flooding"
## [765] "Small Hail"                  "Record Temperatures"
## [767] "Light Snowfall"              "Freezing Drizzle"
## [769] "Gusty wind/rain"             "GUSTY WIND/HVY RAIN"
## [771] "Blowing Snow"                "Early snowfall"
## [773] "Monthly Snowfall"            "Record Heat"
## [775] "Seasonal Snowfall"           "Monthly Rainfall"
## [777] "Cold Temperature"            "Sml Stream Fld"
## [779] "Heat Wave"                   "MUDSLIDE/LANDSLIDE"
## [781] "Saharan Dust"                "Volcanic Ash"
## [783] "Volcanic Ash Plume"          "Thundersnow shower"
## [785] "NONE"                        "COLD AND SNOW"
## [787] "DAM BREAK"                   "TSTM WIND (G45)"
## [789] "SLEET/FREEZING RAIN"         "BLACK ICE"
## [791] "BLOW-OUT TIDES"              "UNSEASONABLY COOL"
## [793] "TSTM HEAVY RAIN"             "Gusty Winds"
## [795] "GUSTY WIND"                  "TSTM WIND 40"
```

```
## [797] "TSTM WIND 45"                    "TSTM WIND (41)"
## [799] "TSTM WIND (G40)"                 "TSTM WND"
## [801] "Wintry mix"                      " TSTM WIND"
## [803] "Frost"                           "Frost/Freeze"
## [805] "RAIN (HEAVY)"                    "Record Warmth"
## [807] "Prolong Cold"                    "Cold and Frost"
## [809] "URBAN/SML STREAM FLDG"           "STRONG WIND GUST"
## [811] "LATE FREEZE"                     "BLOW-OUT TIDE"
## [813] "Hypothermia/Exposure"            "HYPOTHERMIA/EXPOSURE"
## [815] "Lake Effect Snow"                "Mixed Precipitation"
## [817] "Record High"                     "COASTALSTORM"
## [819] "Snow and sleet"                  "Freezing rain"
## [821] "Gusty winds"                     "Blizzard Summary"
## [823] "SUMMARY OF MARCH 24-25"          "SUMMARY OF MARCH 27"
## [825] "SUMMARY OF MARCH 29"             "GRADIENT WIND"
## [827] "Icestorm/Blizzard"               "Flood/Strong Wind"
## [829] "TSTM WIND AND LIGHTNING"         "gradient wind"
## [831] "Freezing drizzle"                "Mountain Snows"
## [833] "URBAN/SMALL STRM FLDG"           "Heavy surf and wind"
## [835] "Mild and Dry Pattern"            "COLD AND FROST"
## [837] "TYPHOON"                         "HIGH SWELLS"
## [839] "HIGH  SWELLS"                    "VOLCANIC ASH"
## [841] "DRY SPELL"                       " LIGHTNING"
## [843] "BEACH EROSION"                   "UNSEASONAL RAIN"
## [845] "EARLY RAIN"                      "PROLONGED RAIN"
## [847] "WINTERY MIX"                     "COASTAL FLOODING/EROSION"
## [849] "HOT SPELL"                       "UNSEASONABLY HOT"
## [851] " TSTM WIND (G45)"                "TSTM WIND  (G45)"
## [853] "HIGH WIND (G40)"                 "TSTM WIND (G35)"
## [855] "DRY WEATHER"                     "ABNORMAL WARMTH"
## [857] "UNUSUAL WARMTH"                  "WAKE LOW WIND"
## [859] "MONTHLY RAINFALL"                "COLD TEMPERATURES"
## [861] "COLD WIND CHILL TEMPERATURES"    "MODERATE SNOW"
## [863] "MODERATE SNOWFALL"               "URBAN/STREET FLOODING"
## [865] "COASTAL EROSION"                 "UNUSUAL/RECORD WARMTH"
## [867] "BITTER WIND CHILL"               "BITTER WIND CHILL TEMPERATURES"
## [869] "SEICHE"                          "TSTM"
## [871] "COASTAL  FLOODING/EROSION"       "UNSEASONABLY WARM YEAR"
## [873] "HYPERTHERMIA/EXPOSURE"           "ROCK SLIDE"
## [875] "ICE PELLETS"                     "PATCHY DENSE FOG"
## [877] "RECORD COOL"                     "RECORD WARM"
## [879] "HOT WEATHER"                     "RECORD TEMPERATURE"
## [881] "TROPICAL DEPRESSION"             "VOLCANIC ERUPTION"
## [883] "COOL SPELL"                      "WIND ADVISORY"
## [885] "GUSTY WIND/HAIL"                 "RED FLAG FIRE WX"
## [887] "FIRST FROST"                     "EXCESSIVELY DRY"
## [889] "SNOW AND SLEET"                  "LIGHT SNOW/FREEZING PRECIP"
## [891] "VOG"                             "MONTHLY PRECIPITATION"
## [893] "MONTHLY TEMPERATURE"             "RECORD DRYNESS"
## [895] "EXTREME WINDCHILL TEMPERATURES" "MIXED PRECIPITATION"
## [897] "DRY CONDITIONS"                  "REMNANTS OF FLOYD"
## [899] "EARLY SNOWFALL"                  "FREEZING FOG"
## [901] "LANDSPOUT"                       "DRIEST MONTH"
## [903] "RECORD  COLD"                    "LATE SEASON HAIL"
```

```
## [905] "EXCESSIVE SNOW"                "DRYNESS"
## [907] "FLOOD/FLASH/FLOOD"             "WIND AND WAVE"
## [909] "LIGHT FREEZING RAIN"           " WIND"
## [911] "MONTHLY SNOWFALL"              "RECORD PRECIPITATION"
## [913] "ICE ROADS"                     "ROUGH SEAS"
## [915] "UNSEASONABLY WARM/WET"         "UNSEASONABLY COOL & WET"
## [917] "UNUSUALLY WARM"                "TSTM WIND G45"
## [919] "NON SEVERE HAIL"               "NON-SEVERE WIND DAMAGE"
## [921] "UNUSUALLY COLD"                "WARM WEATHER"
## [923] "LANDSLUMP"                     "THUNDERSTORM WIND (G40)"
## [925] "UNSEASONABLY WARM & WET"       " FLASH FLOOD"
## [927] "LOCALLY HEAVY RAIN"            "WIND GUSTS"
## [929] "UNSEASONAL LOW TEMP"           "HIGH SURF ADVISORY"
## [931] "LATE SEASON SNOW"              "GUSTY LAKE WIND"
## [933] "ABNORMALLY DRY"                "WINTER WEATHER MIX"
## [935] "RED FLAG CRITERIA"             "WND"
## [937] "CSTL FLOODING/EROSION"         "SMOKE"
## [939] " WATERSPOUT"                   "SNOW ADVISORY"
## [941] "EXTREMELY WET"                 "UNUSUALLY LATE SNOW"
## [943] "VERY DRY"                      "RECORD LOW RAINFALL"
## [945] "ROGUE WAVE"                    "PROLONG WARMTH"
## [947] "ACCUMULATED SNOWFALL"          "FALLING SNOW/ICE"
## [949] "DUST DEVEL"                    "NON-TSTM WIND"
## [951] "NON TSTM WIND"                 "GUSTY THUNDERSTORM WINDS"
## [953] "PATCHY ICE"                    "HEAVY RAIN EFFECTS"
## [955] "EXCESSIVE HEAT/DROUGHT"        "NORTHERN LIGHTS"
## [957] "MARINE TSTM WIND"              "   HIGH SURF ADVISORY"
## [959] "HAZARDOUS SURF"                "FROST/FREEZE"
## [961] "WINTER WEATHER/MIX"            "ASTRONOMICAL HIGH TIDE"
## [963] "WHIRLWIND"                     "VERY WARM"
## [965] "ABNORMALLY WET"                "TORNADO DEBRIS"
## [967] "EXTREME COLD/WIND CHILL"       "ICE ON ROAD"
## [969] "DROWNING"                      "GUSTY THUNDERSTORM WIND"
## [971] "MARINE HAIL"                   "HIGH SURF ADVISORIES"
## [973] "HURRICANE/TYPHOON"             "HEAVY SURF/HIGH SURF"
## [975] "SLEET STORM"                   "STORM SURGE/TIDE"
## [977] "COLD/WIND CHILL"               "MARINE HIGH WIND"
## [979] "TSUNAMI"                       "DENSE SMOKE"
## [981] "LAKESHORE FLOOD"               "MARINE THUNDERSTORM WIND"
## [983] "MARINE STRONG WIND"            "ASTRONOMICAL LOW TIDE"
## [985] "VOLCANIC ASHFALL"
```

We see there are many events that are not part of the approved list of events from the NOAA database. We proceed to clean up the data by combining the **major ones** into valid event types.

Note: I've done most, but not all of the events , there has been a reduction 985 to 165

```
#=== Combine tose non-NOAA events into NOAA event types.
datatoanalyze[grep("(^TSTM)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Thunderstorm Wind"
datatoanalyze[grep("(^Thunder|thunderstorm)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Thund
datatoanalyze[grep("(^Thu)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Thunderstorm Wind"
datatoanalyze[grep("^hurr",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Hurricane/Typhoon"
datatoanalyze[grep("^typ",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Hurricane/Typhoon"
datatoanalyze[grep("(^heavy snow)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Heavy Snow"
```

```
datatoanalyze[grep("(^heavy rain)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Heavy Rain"
datatoanalyze[grep("(^hail|hail)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Hail"
datatoanalyze[grep("(^high wind)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "High Wind"
datatoanalyze[grep("(^tornado|^TORNDAO)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Tornado"
datatoanalyze[grep("(^rip)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Rip Current"
datatoanalyze[grep("(^wild)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Wildfire"
datatoanalyze[grep("(^summary)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Summary"
datatoanalyze[grep("(^lightn)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Lightning"
datatoanalyze[grep("(^winter weather)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Winter Weatl
datatoanalyze[grep("(^volcanic)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Volcanic Ash"
datatoanalyze[grep("(^winter stor|^snow)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Winter St
datatoanalyze[grep("(flood)",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Flood"
datatoanalyze[grep("^water",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Waterspout"
datatoanalyze[grep("mix$",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Sleet"
datatoanalyze[grep("wind",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Strong Wind"
datatoanalyze[grep("Ice|Icy",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Ice Storm"
datatoanalyze[grep("heat|warm|hot",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Heat"
datatoanalyze[grep("coast",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Coastal Flood"
datatoanalyze[grep("cold",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Extreme Cold/Wind Chill"
datatoanalyze[grep("tropical s",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Tropical Storm"
datatoanalyze[grep("tropical d",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Tropical Depressior
datatoanalyze[grep("snow",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Heavy Snow"
datatoanalyze[grep("rain|slide",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Heavy Rain"
datatoanalyze[grep("og$",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Dense Fog"
datatoanalyze[grep("smoke",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Dense Smoke"
datatoanalyze[grep("freez",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Frost/Freeze"
datatoanalyze[grep("surf",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "High Surf"
datatoanalyze[grep("surge",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Storm Surge/Tide"
datatoanalyze[grep("funnel",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Funnel Cloud"
datatoanalyze[grep("fld",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Flood"
datatoanalyze[grep("blizzard",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Blizzard"
datatoanalyze[grep("wind$|WND$",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Strong Wind"
datatoanalyze[grep("HYPERTHERMIA/EXPOSURE|hypothermia|RECORD LOW|RECORD COOL|RECORD PRECIPITATION",data
datatoanalyze[grep("DRY SPELL|DRY WEATHER|RECORD HIGH TEMPERATURE|RECORD HIGH|HIGH TEMPERATURE RECORD|R
datatoanalyze[grep("\\?",datatoanalyze$EVTYPE, ignore.case = T),"EVTYPE"] <- "Other"
```

We now look at the newly cleaned up set of events:

```
#=== Newly reduced list of events
#sort(table(datatoanalyze$EVTYPE))
unique(datatoanalyze$EVTYPE)
```

```
##   [1] "Tornado"                 "Strong Wind"
##   [3] "Hail"                    "Heavy Rain"
##   [5] "Winter Storm"            "Flood"
##   [7] "Hurricane/Typhoon"       "Extreme Cold/Wind Chill"
##   [9] "Lightning"               "Dense Fog"
##  [11] "Rip Current"             "Funnel Cloud"
##  [13] "Heat"                    "LIGHTING"
##  [15] "WALL CLOUD"              "Waterspout"
##  [17] "Blizzard"                "Heavy Snow"
##  [19] "Frost/Freeze"            "HIGH TIDES"
##  [21] "Excessive Heat"          "Ice Storm"
```

```
##  [23] "AVALANCHE"                  "MARINE MISHAP"
##  [25] "HIGH SEAS"                  "SEVERE TURBULENCE"
##  [27] "DUST STORM"                 "APACHE COUNTY"
##  [29] "SLEET"                      "DUST DEVIL"
##  [31] "High Surf"                  "HEAVY PRECIPATATION"
##  [33] "BLOWING DUST"               "URBAN/SMALL"
##  [35] "Wildfire"                   "HIGH"
##  [37] "DRY MICROBURST"             "DRY MICROBURST 61"
##  [39] "MICROBURST"                 "URBAN AND SMALL"
##  [41] "DOWNBURST"                  "GUSTNADO AND"
##  [43] "WET MICROBURST"             "DRY MICROBURST 53"
##  [45] "DRY MICROBURST 50"          "DRY MICROBURST 58"
##  [47] "DRY MICROBURST 84"          "GLAZE"
##  [49] "UNSEASONABLY DRY"           "UNSEASONABLY WET"
##  [51] "Sleet"                      "Winter Weather"
##  [53] "DROUGHT"                    "NORMAL PRECIPITATION"
##  [55] "DRY"                        "Storm Surge/Tide"
##  [57] "Tropical Storm"             "WAYTERSPOUT"
##  [59] "URBAN AND SMALL STREAM"     "LIGNTNING"
##  [61] "FROST"                      "COOL AND WET"
##  [63] "SMALL STREAM AND"           "EXCESSIVE WETNESS"
##  [65] "ROTATING WALL CLOUD"        "LARGE WALL CLOUD"
##  [67] "GUSTNADO"                   "GRASS FIRES"
##  [69] "Coastal Flood"              "HIGH WAVES"
##  [71] "DUST DEVIL WATERSPOUT"      "URBAN/SMALL STREAM"
##  [73] "AVALANCE"                   "FOREST FIRES"
##  [75] "BELOW NORMAL PRECIPITATION" "OTHER"
##  [77] "DAM FAILURE"                "SOUTHEAST"
##  [79] "HEAVY PRECIPITATION"        "HIGH WATER"
##  [81] "WET WEATHER"                "BEACH EROSIN"
##  [83] "LOW TEMPERATURE"            "RAPIDLY RISING WATER"
##  [85] "EARLY FROST"                "FLASH FLOOODING"
##  [87] "EXCESSIVE"                  "HEAVY SEAS"
##  [89] "DUSTSTORM"                  "Other"
##  [91] "BRUSH FIRES"                "EXCESSIVE PRECIPITATION"
##  [93] "DRY PATTERN"                "MILD/DRY PATTERN"
##  [95] "MILD PATTERN"               "HEAVY SHOWERS"
##  [97] "BRUSH FIRE"                 "SAHARAN DUST"
##  [99] "HEAVY SHOWER"               "HEAVY SWELLS"
## [101] "URBAN SMALL"                "SMALL STREAM"
## [103] "Dust Devil"                 "Marine Accident"
## [105] "Wet Month"                  "Wet Year"
## [107] "Beach Erosion"              "Early Frost"
## [109] "Landslump"                  "Glaze"
## [111] "Heavy Precipitation"        "MIXED PRECIP"
## [113] "Summary"                    "Metro Storm, May 26"
## [115] "Microburst"                 "wet micoburst"
## [117] "No Severe Weather"          "Saharan Dust"
## [119] "Volcanic Ash"               "NONE"
## [121] "DAM BREAK"                  "BLOW-OUT TIDES"
## [123] "UNSEASONABLY COOL"          "Frost"
## [125] "BLOW-OUT TIDE"              "Mixed Precipitation"
## [127] "Mild and Dry Pattern"       "HIGH SWELLS"
## [129] "HIGH  SWELLS"               " LIGHTNING"
```

```
## [131] "BEACH EROSION"              "SEICHE"
## [133] "Tropical Depression"        "COOL SPELL"
## [135] "RED FLAG FIRE WX"           "FIRST FROST"
## [137] "EXCESSIVELY DRY"            "MONTHLY PRECIPITATION"
## [139] "MONTHLY TEMPERATURE"        "MIXED PRECIPITATION"
## [141] "DRY CONDITIONS"             "REMNANTS OF FLOYD"
## [143] "LANDSPOUT"                  "DRIEST MONTH"
## [145] "DRYNESS"                    "ROUGH SEAS"
## [147] "UNSEASONABLY COOL & WET"    "LANDSLUMP"
## [149] "UNSEASONAL LOW TEMP"        "ABNORMALLY DRY"
## [151] "RED FLAG CRITERIA"          "Dense Smoke"
## [153] " WATERSPOUT"                "EXTREMELY WET"
## [155] "VERY DRY"                   "ROGUE WAVE"
## [157] "DUST DEVEL"                 "NORTHERN LIGHTS"
## [159] "ASTRONOMICAL HIGH TIDE"     "ABNORMALLY WET"
## [161] "DROWNING"                   "SLEET STORM"
## [163] "TSUNAMI"                    "ASTRONOMICAL LOW TIDE"
```

Part 2: Processing the Property and Crop Damages, by changing the EXP to their respective exponents.and then multiplying the exponents with the values to get the total values

First we prepare the data that needs to be cleaned, converting factors to characters

```
datatoanalyze$PROPDMGEXP <- as.character(datatoanalyze$PROPDMGEXP)
listofPROPDMGEXP <- unique(datatoanalyze$PROPDMGEXP)

datatoanalyze$CROPDMGEXP <- as.character(datatoanalyze$CROPDMGEXP)
listofCROPDMGEXP <- unique(datatoanalyze$CROPDMGEXP)
```

Then we create the respective multipliers for both the Crop and Property

```
#=== Creating Crop damage multiplier.
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == ""] <- 0
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "M"] <- 1000000
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "K"] <- 1000
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "m"] <- 1000000
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "B"] <- 1000000000
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "?"] <- 0
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "0"] <- 1
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "k"] <- 1000
datatoanalyze$CROPDMGMULTIPLIER[datatoanalyze$CROPDMGEXP == "2"] <- 100

#== creating Property Damage Multiplier
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP ==  "K"    ]  <-    1000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "M"     ]   <-  1000000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == ""      ]   <-  0
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "B"     ]   <-  1000000000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "m"     ]   <-  1000000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "+"     ]   <-  0
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "0"     ]   <-  1
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "5"     ]   <-  100000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "6"     ]   <-  1000000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "?"     ]   <-  0
```

```
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "4"     ]   <-  10000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "2"     ]   <-  100
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "3"     ]   <-  1000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "h"     ]   <-  100
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "7"     ]   <-  10000000
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "H"     ]   <-  100
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP == "-"     ]   <-  0
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP =="1"     ]   <-  10
datatoanalyze$PROPDMGMULTIPLIER[datatoanalyze$PROPDMGEXP =="8"     ]   <-  100000000
```

We then generate the Crop damage and Property damage amounts by : multiplying the numeric Crop/Property damage numbers against their respective Crop/Property damage multipliers:

The mathermatic code for that is given below:

```
datatoanalyze$PROPERTYDMGVAL <- datatoanalyze$PROPDMG * datatoanalyze$PROPDMGMULTIPLIER
datatoanalyze$CROPDMGVAL <- datatoanalyze$CROPDMG * datatoanalyze$CROPDMGMULTIPLIER
```

Results

We now proceed to use the data from Data Processing to answer the following questions:

Across the United States, which types of events are most harmful with respect to population health?

```
# == Plotting out the information for health toll
#== Check for NAs. in Injusties and Fatalities. There are none.
sum(as.integer(is.na(datatoanalyze$FATALITIES)))
```

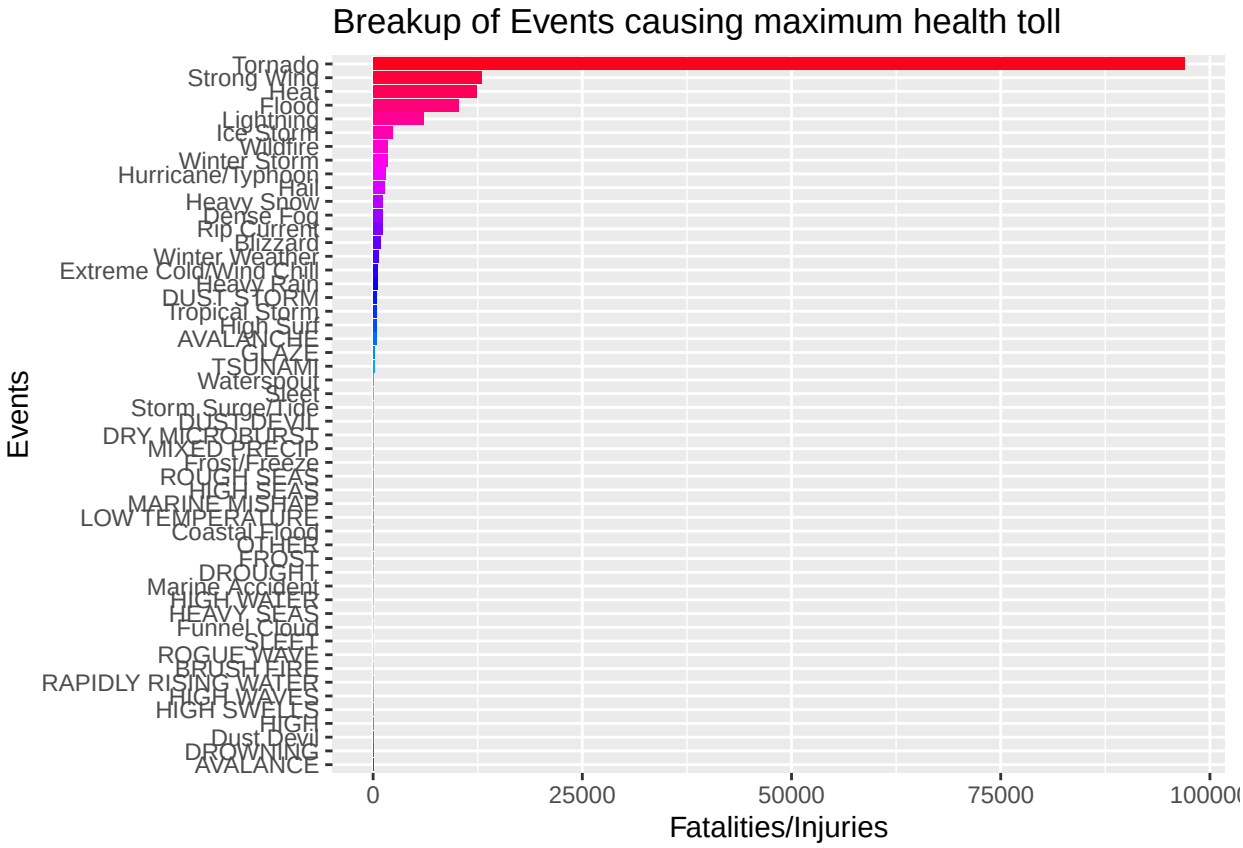
```
## [1] 0
```

```
sum(as.integer(is.na(datatoanalyze$INJURIES)))
```

```
## [1] 0
```

```
#=== we will combine the injuries and Fatalities into a common variable called healthToll
datatoanalyze$healthtoll <- datatoanalyze[,"FATALITIES"] + datatoanalyze[,"INJURIES"]

#== we wil look only at subset of rows with healthtoll(FATALITIES+INJURIES) with greather than 0 occure
OnlyDataWithhealthToll <- datatoanalyze[datatoanalyze$healthtoll > 0,]




##=== We now group the events and summarize

groupbyEVTYPE <- group_by(OnlyDataWithhealthToll,EVTYPE)
groupbyEVTYPE <- summarise_at(groupbyEVTYPE, .vars = c("healthtoll"),sum)%>%arrange(desc(healthtoll))
```

```
##==== Results:
# Log scale
ggplot(data = groupbyEVTYPE,aes(x=reorder(EVTYPE, (healthtoll)),y = healthtoll))+geom_bar(stat = "ident
```



Code breakdown:

- *Line 1: check the FATALITIES column for NAs.*
- *Line 2: check the INJURIES column for NAs .*
- *Line 3: combine the injuries and Fatalities into a common variable called healthToll.*
- *Line 4: look only at subset of rows with atleast healthtoll of 1 or more.*
- *Line 5: display table breakups of healhtoll.*
- *Line 6: group data by their Events.*
- *Line 7: summarise total healthtoll(INJURIES+FATALITIES) for each Event type.*
- *Line 8: Do a plot, see contributors.*

Inference:

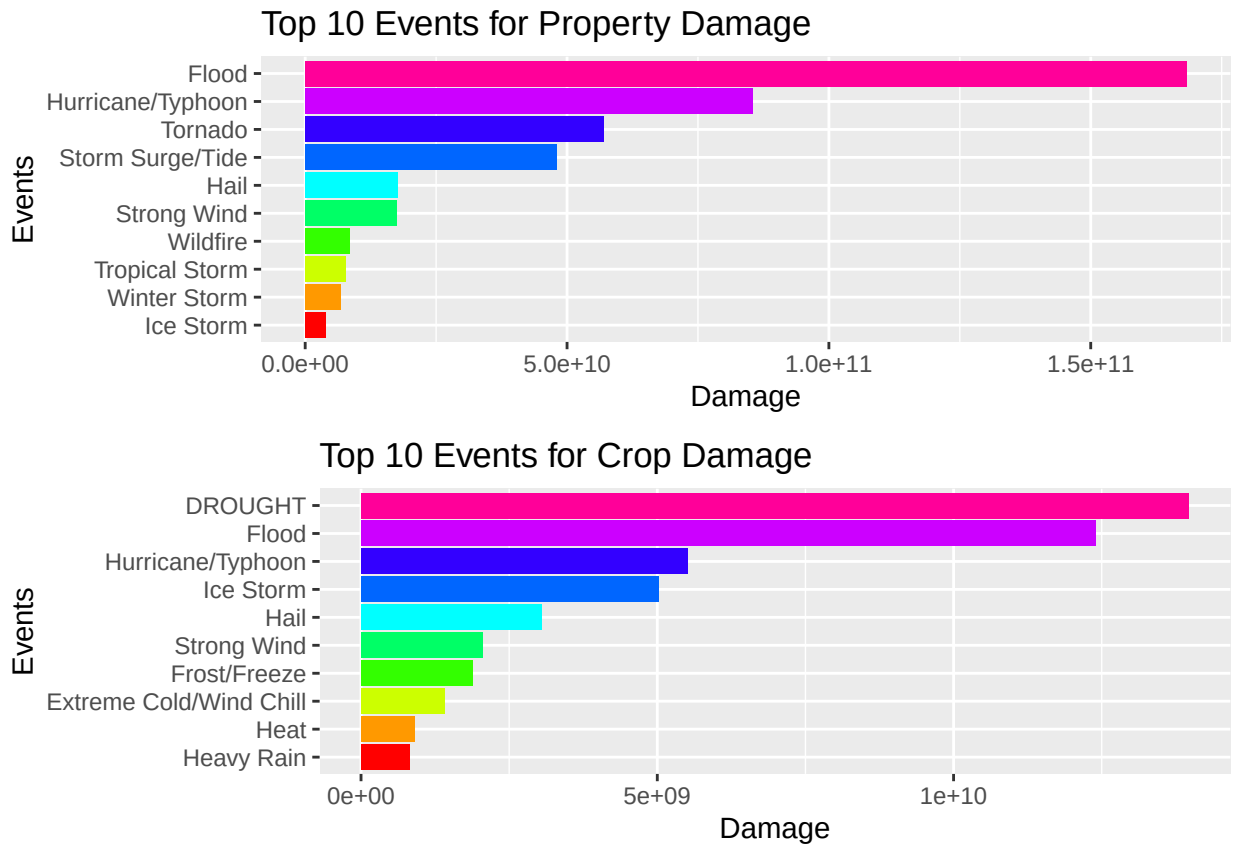
We infer the following:

- Tornados are the largest contributor to human suffering. They seem to cause the greatest human toll. Approaching 1000000.
- There is a huge difference in magnitude following which, Storm wind, heat etc occupy the next tier with 18000 human toll

- Everything else falls lower in damage to human beings.
- Conclusion: Tornados seem to be the biggest contributor to human suffering by a very large margin.

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

```
OnlyDataWithPropertydmg <- datatoanalyze[datatoanalyze$PROPDMG > 0,]
groupbyEVTYPE1 <- group_by(OnlyDataWithPropertydmg,EVTYPE)
groupbyEVTYPE1 <- summarise_at(groupbyEVTYPE1, .vars = c("PROPERTYDMGVAL"), sum)%>%arrange(desc(PROPERT

OnlyDataWithCropdmg <- datatoanalyze[datatoanalyze$CROPDMG > 0,]
groupbyEVTYPE2 <- group_by(OnlyDataWithCropdmg,EVTYPE)
groupbyEVTYPE2 <- summarise_at(groupbyEVTYPE2, .vars = c("CROPDMGVAL"), sum)%>%arrange(desc(CROPDMGVAL)


plot1 <- ggplot(data = groupbyEVTYPE1[1:10,],aes(x=reorder(EVTYPE, (PROPERTYDMGVAL)),y = PROPERTYDMGVAL
plot2 <- ggplot(data = groupbyEVTYPE2[1:10,],aes(x=reorder(EVTYPE, (CROPDMGVAL)),y = CROPDMGVAL))+geom_

grid.arrange(plot1,plot2, nrow = 2)
```



Code breakdown:

- *Line 1: look only at subset of rows with atleast Property damage of 1 or more.*
- *Line 2: group data by their Events.*
- *Line 3: summarise total Property damage for each Event type and sort from larges to smallest.*

- *Line 4: look only at subset of rows with atleast Crop damage of 1 or more.*
- *Line 5: group data by their Events.*
- *Line 6: summarise total Crop damage for each Event type and sort from larges to smallest.*
- *Line 7: generatate the plot for property damage.*
- *Line 8: generate the plot for crop damage.*
- *Line 9: print both plots in the same picture.*

Inference:

We infer the following:

- **CROP Damage:**
- Droughts cause the greatest damage to crops, followed by floods and typhoons.
- **PROPERTY Damage:**
- Floods and typhoons cause the greatest damage to property followed by Tornados.
- Hail equally affects both crops and property
- Icestorms have a greater impact on crops than they do on property.
- Tornados damage properties, they seem to have less of an impact on crops

Final Conclusion:

- Droughts are expensive in terms of Crop damage.
- Floods and typhoons are expensive in terms of Property damage.

Tornados are expensive in terms of Property damage (featuring at number3) as well as highly dangerous for human lives. Prioritize reducing the damaging effects of Tornados