R Notebook

This notebook will have some mappings o

The

```
if ("all_month.csv" %in% dir(".") == FALSE) {
  url <- "https://earthquake.usgs.gov/earthquakes/feed/v1.0/summary/all_month.csv"
  download.file(url = url, destfile = "all_month.csv")
}
quakes <- read.csv("all_month.csv", header=TRUE, sep=',', stringsAsFactors = FALSE)
```

How many lines are in our dataset?

```
  dim(quakes)
```

```
## [1] 16803    22
```

Increasing date ordering.

```
quakes = arrange(quakes, -row_number())
```

Lets have a look at the data.

```
head(quakes)
```

```
##                       time latitude longitude  depth  mag magType nst gap
## 1 2019-08-02T15:01:50.000Z 40.33733 -124.4283  17.68 1.60      md  14 260
## 2 2019-08-02T15:06:51.470Z 35.78450 -117.6205   8.31 2.45      ml  31  52
## 3 2019-08-02T15:08:34.631Z 60.47240 -152.7339   2.10 0.70      ml  NA  NA
## 4 2019-08-02T15:08:55.200Z 38.82383 -122.8003   1.70 0.79      md  12  71
## 5 2019-08-02T15:15:57.150Z 35.37950 -117.8457   3.89 0.99      ml  16 100
## 6 2019-08-02T15:17:22.727Z -6.15370  128.6222 323.51 4.40      mb  NA 125
##       dmin  rms net           id                  updated
## 1 0.081760 0.11  nc   nc73240836 2019-08-07T00:14:02.570Z
## 2 0.119800 0.17  ci   ci38684391 2019-08-02T15:17:56.890Z
## 3       NA 0.30  ak ak0199u5zjeh 2019-08-30T15:44:34.660Z
## 4 0.007623 0.03  nc   nc73240846 2019-08-02T15:47:03.564Z
## 5 0.111800 0.11  ci   ci38684399 2019-08-02T17:47:03.090Z
## 6 3.218000 0.91  us   us60004zm8 2019-08-19T14:05:10.040Z
##                                 place       type horizontalError depthError
## 1             12km W of Petrolia, CA earthquake            2.39       1.04
## 2         19km NNE of Ridgecrest, CA earthquake            0.23       0.94
## 3 1km SSE of Redoubt Volcano, Alaska earthquake              NA       0.30
## 4          6km NW of The Geysers, CA earthquake            0.32       0.58
## 5         19km W of Johannesburg, CA earthquake            0.27       0.90
## 6      273km S of Amahusu, Indonesia earthquake           11.50       8.90
##   magError magNst    status locationSource magSource
## 1    0.077      7  reviewed             nc        nc
## 2    0.161     25 automatic             ci        ci
## 3       NA     NA  reviewed             ak        ak
## 4    0.120      2 automatic             nc        nc
## 5    0.142     13  reviewed             ci        ci
## 6    0.120     20  reviewed             us        us
```

```
tail(quakes)
```

```
##                          time latitude longitude depth  mag magType nst
## 16798 2019-09-01T14:36:41.730Z 48.39133 -122.8217  3.84 2.02      md  32
## 16799 2019-09-01T14:40:58.300Z 35.59967 -117.5947  3.91 0.77      ml  13
## 16800 2019-09-01T14:42:43.630Z 35.59533 -117.3992  8.76 1.04      ml  20
## 16801 2019-09-01T14:46:24.560Z 33.32317 -116.4032  6.32 0.81      ml  34
## 16802 2019-09-01T14:47:47.980Z 33.21700 -116.3687  8.49 0.75      ml  29
## 16803 2019-09-01T14:57:58.654Z 65.22100 -148.7666 15.30 1.20      ml  NA
##       gap    dmin  rms net           id                 updated
## 16798  57      NA 0.17  uw   uw61547551 2019-09-01T14:43:07.500Z
## 16799  70 0.03053 0.25  ci   ci39032888 2019-09-01T14:44:34.299Z
## 16800 101 0.05213 0.21  ci   ci39032896 2019-09-01T14:46:28.294Z
## 16801  87 0.05606 0.18  ci   ci39032904 2019-09-01T14:50:08.255Z
## 16802  86 0.06526 0.24  ci   ci39032912 2019-09-01T14:51:29.324Z
## 16803  NA      NA 0.44  ak ak019b7rt3ax 2019-09-01T15:01:11.679Z
##                                    place       type horizontalError
## 16798 12km WNW of Ault Field, Washington earthquake            0.31
## 16799          8km ESE of Ridgecrest, CA earthquake            0.44
## 16800                19km S of Trona, CA earthquake            0.40
## 16801     8km NNW of Borrego Springs, CA earthquake            0.30
## 16802       4km S of Borrego Springs, CA earthquake            0.43
## 16803           54km NW of Ester, Alaska earthquake              NA
##       depthError magError magNst    status locationSource magSource
## 16798       2.03    0.250      5  reviewed            uw        uw
## 16799       0.84    0.250      9 automatic            ci        ci
## 16800       0.72    0.118     12 automatic            ci        ci
## 16801       0.62    0.148     21 automatic            ci        ci
## 16802       0.89    0.092     15 automatic            ci        ci
## 16803       0.30       NA     NA automatic            ak        ak
```

```
str(quakes)
```

```
## 'data.frame':    16803 obs. of  22 variables:
##  $ time           : chr  "2019-08-02T15:01:50.000Z" "2019-08-02T15:06:51.470Z" "2019-08-02T15:08:34.
##  $ latitude       : num  40.3 35.8 60.5 38.8 35.4 ...
##  $ longitude      : num  -124 -118 -153 -123 -118 ...
##  $ depth          : num  17.68 8.31 2.1 1.7 3.89 ...
##  $ mag            : num  1.6 2.45 0.7 0.79 0.99 4.4 3.34 1 1.75 1.11 ...
##  $ magType        : chr  "md" "ml" "ml" "md" ...
##  $ nst            : int  14 31 NA 12 16 NA 60 NA 26 12 ...
##  $ gap            : num  260 52 NA 71 100 125 29 NA 52 141 ...
##  $ dmin           : num  0.08176 0.1198 NA 0.00762 0.1118 ...
##  $ rms            : num  0.11 0.17 0.3 0.03 0.11 0.91 0.15 0.33 0.23 0.24 ...
##  $ net            : chr  "nc" "ci" "ak" "nc" ...
##  $ id             : chr  "nc73240836" "ci38684391" "ak0199u5zjeh" "nc73240846" ...
##  $ updated        : chr  "2019-08-07T00:14:02.570Z" "2019-08-02T15:17:56.890Z" "2019-08-30T15:44:34.
##  $ place          : chr  "12km W of Petrolia, CA" "19km NNE of Ridgecrest, CA" "1km SSE of Redoubt Vo
##  $ type           : chr  "earthquake" "earthquake" "earthquake" "earthquake" ...
##  $ horizontalError: num  2.39 0.23 NA 0.32 0.27 11.5 0.1 NA 0.26 0.59 ...
##  $ depthError     : num  1.04 0.94 0.3 0.58 0.9 8.9 0.17 0.5 0.58 0.5 ...
##  $ magError       : num  0.077 0.161 NA 0.12 0.142 0.12 0.135 NA 0.128 0.101 ...
##  $ magNst         : int  7 25 NA 2 13 20 113 NA 26 9 ...
##  $ status         : chr  "reviewed" "automatic" "reviewed" "automatic" ...
##  $ locationSource : chr  "nc" "ci" "ak" "nc" ...
##  $ magSource      : chr  "nc" "ci" "ak" "nc" ...
```

a short description of the variables

time: time of event latitude: decimal degrees latitude. Negative values for southern latitudes. Range is [-90.0,90.0] longitude: decimal degrees longitude. Negative values for western longitudes. [-180.0,180.0] depth: depth of the event in kilometers mag: magnitude for the event. Range [-1.0, 10.0] magType: method or algorithm used to calculate the preferred magnitude for the event nst: total number of seismic stations used to determine earthquake location gap: largest azimuthal gap between azimuthally adjacent stations (in degrees) dmin: horizontal distance from the epicenter to the nearest station (in degrees) rms: root-mean-square (RMS) travel time residual, in sec, using all weights net: ID of data contributor. Identifies the network considered to be the preferred source of information for this event id: unique identifier for the event. This is the current preferred id for the event, and may change over time updated: time when the event was most recently updated place: textual description of named geographic region near to the event. This may be a city name, or a Flinn-Engdahl Region name type: type of seismic event horizontalError: uncertainty of reported location of the event in kilometers depthError: uncertainty of reported depth of the event in kilometers magError: uncertainty of reported magnitude of the event magNst: total number of seismic stations used to calculate the magnitude status: indicates whether the event has been reviewed by a human locationSource: network that originally authored the reported location of this event magSource: network that originally authored the reported magnitude for this event

A sort exploratory analysis

```
(numeric_vars <- names(which(sapply(quakes, class) == "numeric")))
```

```
##  [1] "latitude"        "longitude"       "depth"
##  [4] "mag"             "gap"             "dmin"
##  [7] "rms"             "horizontalError" "depthError"
## [10] "magError"
```

```
(integer_vars <- names(which(sapply(quakes, class) == "ineger")))
```

```
## character(0)
```

```
(factor_vars <- names(which(sapply(quakes, class) == "factor")))
```

```
## character(0)
```

```
(character_vars <- names(which(sapply(quakes, class) == "character")))
```

```
##  [1] "time"           "magType"        "net"            "id"
##  [5] "updated"        "place"          "type"           "status"
##  [9] "locationSource" "magSource"
```

Map (static)

Because we have lattitude and logitude data we can make this a static map.

```
world <- map_data('world')

title <- paste("Earthquake map from ", paste(quakes$time[1], quakes$time[nrow(quakes)], sep = " to "))

p <- ggplot() + geom_map(data = world, map = world, aes(x = long, y=lat, group=group, map_id=region), fi
```

```
## Warning: Ignoring unknown aesthetics: x, y
```

```
p <- p + geom_point(data = quakes, aes(x=longitude, y = latitude, colour = mag)) + scale_colour_gradien
p
```