MAP SPATIAL DATASETS IN R

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LOADING REQUIRED PACKAGES

```
#install.packages("ggplot2")

#install.packages("sf")

#install.packages("raster")

#install.packages("rgeos")

#install.packages("cowplot")

#install.packages("googleway")

#install.packages("ggrepel")

#install.packages("ggspatial")

library(ggplot2)
library(sf)
```

```
## Linking to GEOS 3.9.1, GDAL 3.4.0, PROJ 8.1.1; sf_use_s2() is TRUE
```

```
library(raster)
```

```
## Loading required package: sp
```

```
library(rgeos)
```

```
## rgeos version: 0.5-9, (SVN revision 684)
##  GEOS runtime version: 3.8.1-CAPI-1.13.3
##  Please note that rgeos will be retired by the end of 2023,
## plan transition to sf functions using GEOS at your earliest convenience.
##  Linking to sp version: 1.4-6
##  Polygon checking: TRUE
```

```
library(cowplot)
library(googleway)
library(ggrepel)
library(ggspatial)
library(ggsn)
```

```
## Loading required package: grid
```

```
##
## Attaching package: 'ggsn'
```

```
## The following object is masked from 'package:raster':
##
##     scalebar
```

LOADING DATASET AND VIEW DATA STRUCTURE

```
library(readr)
HARV_PlotLocations <- read_csv("~/Downloads/HARV_PlotLocations.csv")
```

```
## Rows: 21 Columns: 16
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (11): geodeticDa, utmZone, plotID, stateProvi, county, domainName, domai...
## dbl  (5): easting, northing, plotSize, elevation, plotdim_m
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
View(HARV_PlotLocations)
```

```
## Warning in system2("/usr/bin/otool", c("-L", shQuote(DSO)), stdout = TRUE):
## running command ''/usr/bin/otool' -L '/Library/Frameworks/R.framework/Resources/
## modules/R_de.so'' had status 1
```

```
##View of Data Structure
str(HARV_PlotLocations)
```

```
## spec_tbl_df [21 x 16] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ easting   : num [1:21] 731405 731934 731754 731724 732125 ...
##  $ northing  : num [1:21] 4713456 4713415 4713115 4713595 4713846 ...
##  $ geodeticDa: chr [1:21] "WGS84" "WGS84" "WGS84" "WGS84" ...
##  $ utmZone   : chr [1:21] "18N" "18N" "18N" "18N" ...
##  $ plotID    : chr [1:21] "HARV_015" "HARV_033" "HARV_034" "HARV_035" ...
##  $ stateProvi: chr [1:21] "MA" "MA" "MA" "MA" ...
##  $ county    : chr [1:21] "Worcester" "Worcester" "Worcester" "Worcester" ...
##  $ domainName: chr [1:21] "Northeast" "Northeast" "Northeast" "Northeast" ...
##  $ domainID  : chr [1:21] "D01" "D01" "D01" "D01" ...
##  $ siteID    : chr [1:21] "HARV" "HARV" "HARV" "HARV" ...
##  $ plotType  : chr [1:21] "distributed" "tower" "tower" "tower" ...
##  $ subtype   : chr [1:21] "basePlot" "basePlot" "basePlot" "basePlot" ...
##  $ plotSize  : num [1:21] 1600 1600 1600 1600 1600 1600 1600 1600 1600 1600 ...
##  $ elevation : num [1:21] 332 342 348 334 353 ...
##  $ soilTypeOr: chr [1:21] "Inceptisols" "Inceptisols" "Inceptisols" "Histosols" ...
##  $ plotdim_m : num [1:21] 40 40 40 40 40 40 40 40 40 40 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   easting = col_double(),
##   ..   northing = col_double(),
##   ..   geodeticDa = col_character(),
##   ..   utmZone = col_character(),
##   ..   plotID = col_character(),
##   ..   stateProvi = col_character(),
##   ..   county = col_character(),
##   ..   domainName = col_character(),
##   ..   domainID = col_character(),
##   ..   siteID = col_character(),
##   ..   plotType = col_character(),
```

```
##   ..   subtype = col_character(),
##   ..   plotSize = col_double(),
##   ..   elevation = col_double(),
##   ..   soilTypeOr = col_character(),
##   ..   plotdim_m = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

DATA DESCRIPTION

The dataframe contains 21 locations(rows) and 16 variables(attributes). The dataframe also contains columns with coordinate values namely; easting and northing (UTM coordinates) which can be demonstrated below,

COLUMN NAMES

```
names(HARV_PlotLocations)
```

```
##  [1] "easting"    "northing"   "geodeticDa" "utmZone"    "plotID"
##  [6] "stateProvi" "county"     "domainName" "domainID"   "siteID"
## [11] "plotType"   "subtype"    "plotSize"   "elevation"  "soilTypeOr"
## [16] "plotdim_m"
```

IDENTIFYING COORDINATE VALUES

The data frame contains several fields that are deem to contain spatial information , which includes the coordinate values. Below is a view of the first six rows of the coordinate values from the data frame.

```
head(HARV_PlotLocations$easting)
```

```
## [1] 731405.3 731934.3 731754.3 731724.3 732125.3 731634.3
```

```
head(HARV_PlotLocations$northing)
```

```
## [1] 4713456 4713415 4713115 4713595 4713846 4713295
```

Also further exploration of the data frame suggest that there are column in the dataframe that provide information regarding Coordinate Reference System(CRS). The columns can be illustrated as follows;

```
head(HARV_PlotLocations$geodeticDa)
```

```
## [1] "WGS84" "WGS84" "WGS84" "WGS84" "WGS84" "WGS84"
```

```
head(HARV_PlotLocations$utmZone)
```

```
## [1] "18N" "18N" "18N" "18N" "18N" "18N"
```

RASTER FILE DETAILS

With the use of the raster package in R , there is a possible conversion of the raster file to a data frame for visualization

```
HARV_1 <- raster("/Users/carlkwamesarfo/Downloads/HARV_chmCrop.tif")

HARV_1
```

```
## class      : RasterLayer
## dimensions : 1367, 1697, 2319799  (nrow, ncol, ncell)
## resolution : 1, 1  (x, y)
## extent     : 731453, 733150, 4712471, 4713838  (xmin, xmax, ymin, ymax)
## crs        : +proj=utm +zone=18 +datum=WGS84 +units=m +no_defs
## source     : HARV_chmCrop.tif
## names      : HARV_chmCrop
```

```
## values     : 0, 38.17  (min, max)
```

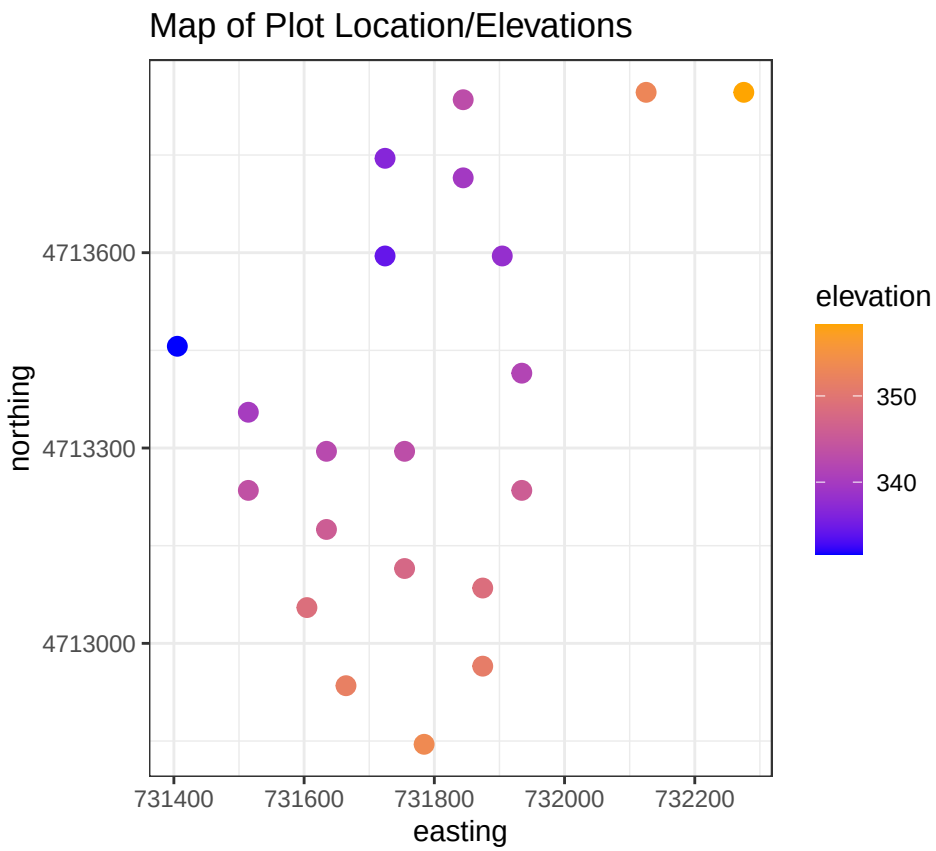
```
Summary(HARV_1)
```

```
## Warning in Summary(HARV_1): Nothing to summarize if you provide a single
## RasterLayer; see cellStats
```

```
## class      : RasterLayer
## dimensions : 1367, 1697, 2319799  (nrow, ncol, ncell)
## resolution : 1, 1  (x, y)
## extent     : 731453, 733150, 4712471, 4713838  (xmin, xmax, ymin, ymax)
## crs        : +proj=utm +zone=18 +datum=WGS84 +units=m +no_defs
## source     : HARV_chmCrop.tif
## names      : HARV_chmCrop
## values     : 0, 38.17  (min, max)
```

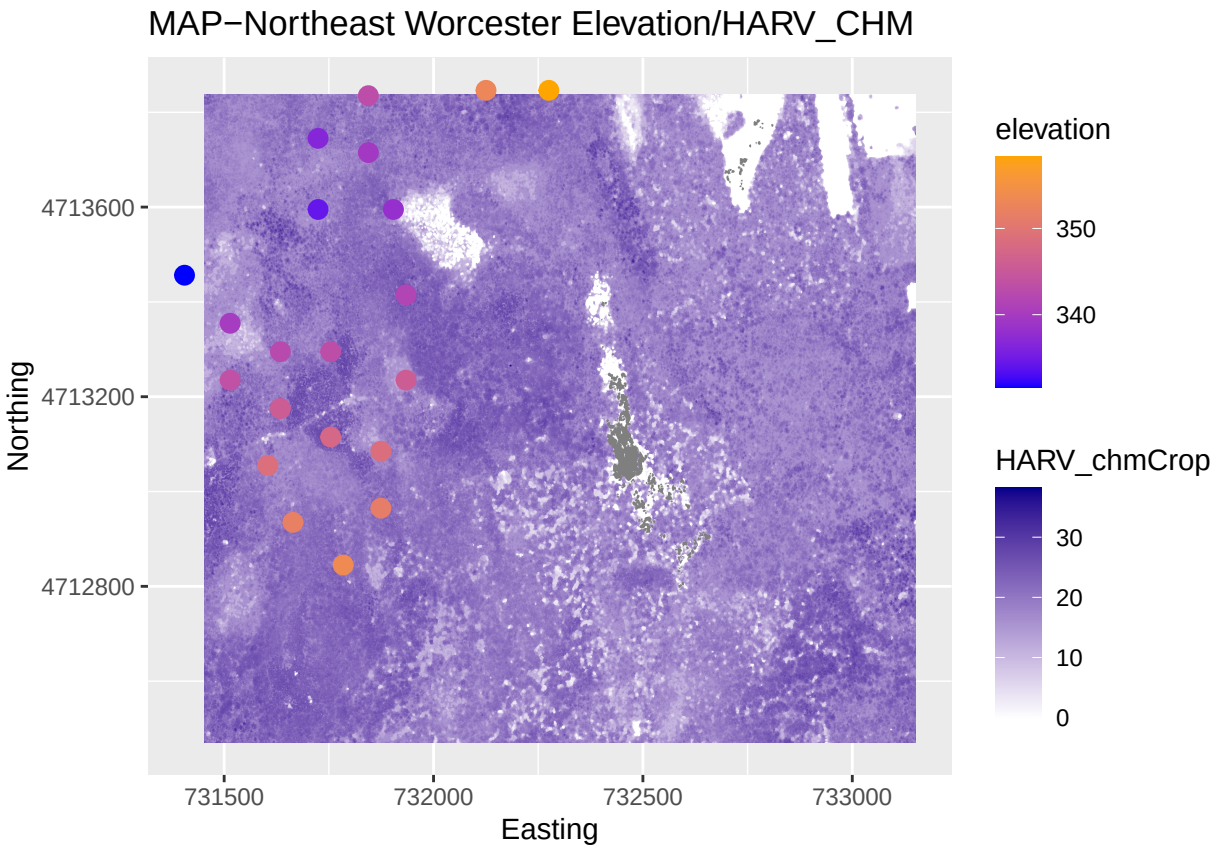
MAPPING POINTS AND RASTER IMAGE

```
#Call in point data, in this case a csv file with  coordinates
HARV_PlotLocations <- (read.csv("~/Downloads/HARV_PlotLocations.csv"))

#Make appropriate column headings
df <- data.frame(cbind(easting= HARV_PlotLocations$easting, northing= HARV_PlotLocations$northing, eleva

map <- raster("/Users/carlkwamesarfo/Downloads/HARV_chmCrop.tif")

#Reading points and ploting using ggplot
ggplot(df) +
geom_point(aes(easting, northing, color=elevation), size=3) +
coord_fixed(ratio= 1) +
scale_color_gradient(low= "blue", high="orange") +
theme_bw() +
  ggtitle("Map of Plot Location/Elevations")
```




```
## Reading the raster image and converting to a data frame
CHM_HARV <- raster("/Users/carlkwamesarfo/Downloads/HARV_chmCrop.tif")

CHM_HARV_df <- as.data.frame(CHM_HARV, xy=TRUE)
names(CHM_HARV_df)[1] <- 'Easting'
names(CHM_HARV_df)[2] <- 'Northing'
```

```
#Over lay the two data frames
ggplot(df)+
  geom_raster(data = CHM_HARV_df,aes(x=Easting,y=Northing,fill=HARV_chmCrop))+
  geom_point(aes(easting,northing,color=elevation),size=3)+
  scale_fill_gradient2(low= "blue", high="dark blue")+
  scale_color_gradient(low= "blue", high= "orange")+
  ggtitle("MAP-Northeast Worcester Elevation/HARV_CHM")
```


MAP−Northeast Worcester Elevation/HARV_CHM
Northing
4713600
4713200
4712800
731500
732000
732500
733000
Easting
elevation
350
340
HARV_chmCrop
30
20
10
0