Spatial Analysis

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4/10/2022

###Set up!

```
## [1] "C:/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject/R_
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
## Warning: package 'sf' was built under R version 4.1.3
```

```
## Linking to GEOS 3.9.1, GDAL 3.2.1, PROJ 7.2.1; sf_use_s2() is TRUE
```

```
## Warning: package 'leaflet' was built under R version 4.1.3
```

```
## Warning: package 'mapview' was built under R version 4.1.3
```

```
##
## Attaching package: 'lubridate'
```

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

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

```
##
## Attaching package: 'raster'
```

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

```
## Warning: package 'webshot' was built under R version 4.1.3
```

```
## function (new)
## {
##     old <- ggplot_global$theme_current
##     ggplot_global$theme_current <- new
##     invisible(old)
## }
## <bytecode: 0x000000002ed85338>
## <environment: namespace:ggplot2>
```

```
Africa <- st_read('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalP
```

```
## Reading layer `afr_g2014_2013_0' from data source
##   `C:\Users\Dell Laptop\Documents\GitHub\GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject\Data'
##   using driver `ESRI Shapefile'
## Simple feature collection with 59 features and 23 fields
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: -25.35875 ymin: -46.98138 xmax: 63.50265 ymax: 37.56095
## Geodetic CRS:  WGS 84
```

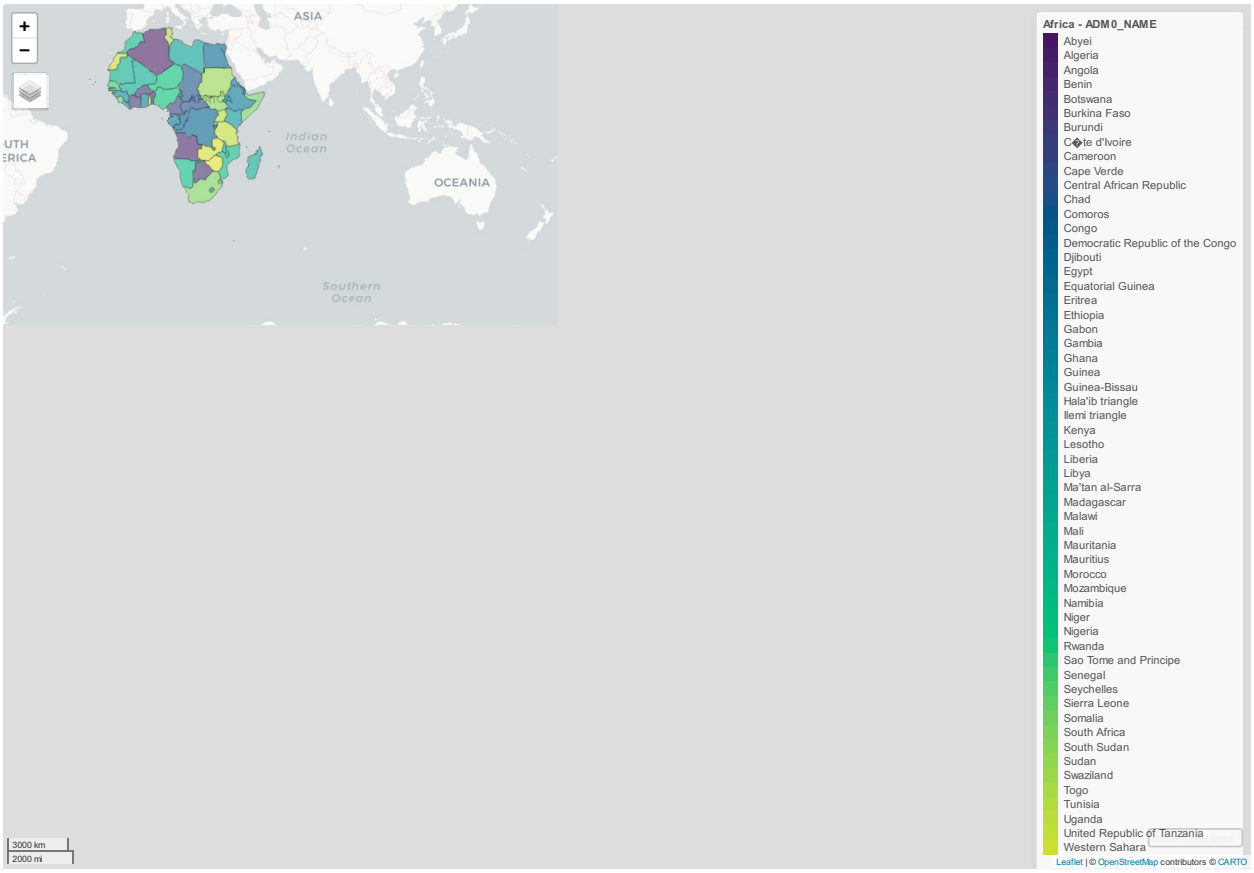
```
#Determine coordinate reference system & explore columns
st_crs(Africa)#WGS 84
```

```
## Coordinate Reference System:
##   User input: WGS 84
##   wkt:
## GEOGCRS["WGS 84",
##     DATUM["World Geodetic System 1984",
##         ELLIPSOID["WGS 84",6378137,298.257223563,
##             LENGTHUNIT["metre",1]],
##         ID["EPSG",6326]],
##     PRIMEM["Greenwich",0,
##         ANGLEUNIT["degree",0.0174532925199433],
##         ID["EPSG",8901]],
##     CS[ellipsoidal,2],
##         AXIS["geodetic longitude",east,
##             ORDER[1],
##             ANGLEUNIT["degree",0.0174532925199433]],
##         AXIS["geodetic latitude",north,
##             ORDER[2],
##             ANGLEUNIT["degree",0.0174532925199433]]]
```

```
colnames(Africa)
```

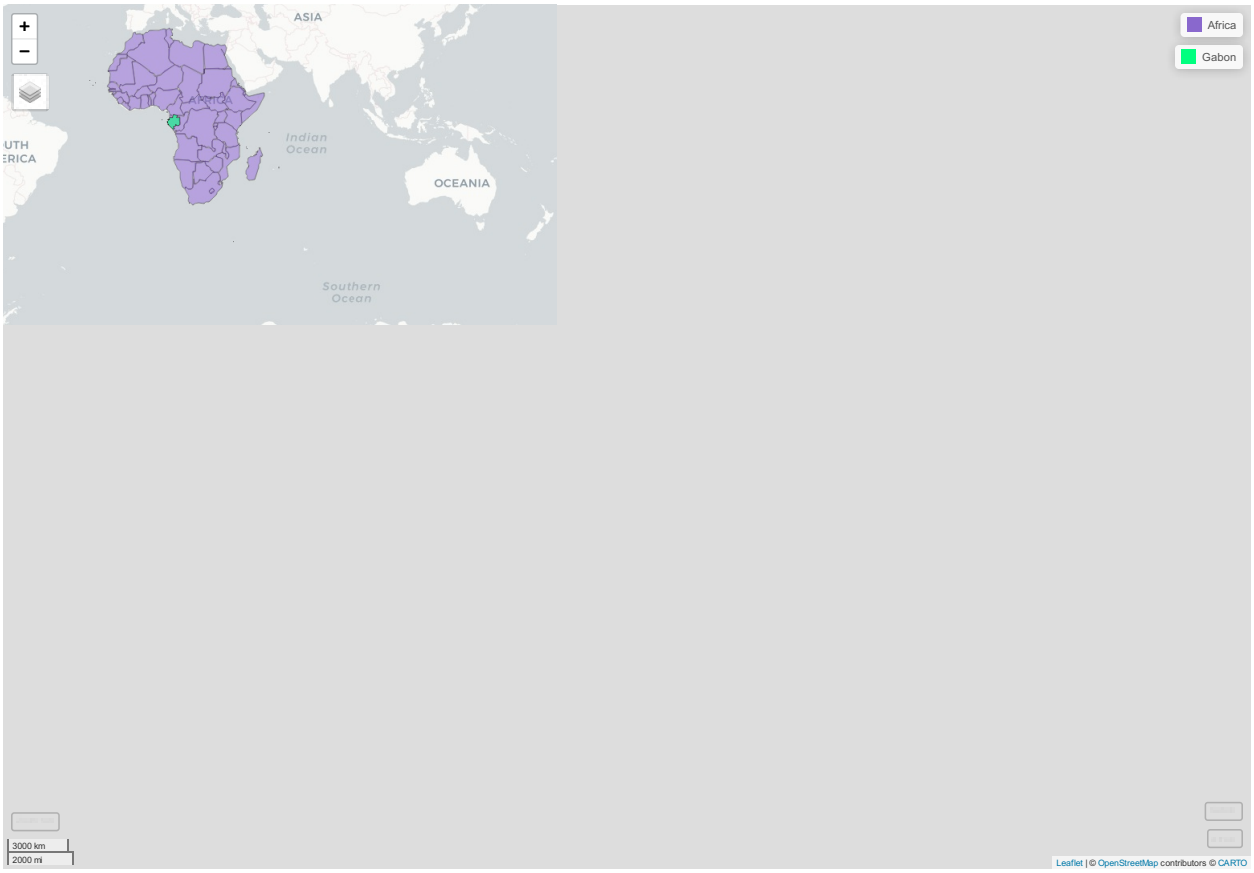
```
##  [1] "ADM0_CODE" "ADM0_NAME" "CONTINENT" "ISO3"      "ISO2"      "UNI"
##  [7] "UNDP"      "FAOSTAT"   "GAUL"      "RIC_ISO3"  "REC_ISO3"  "AFR"
## [13] "CEMAC"     "CILSS"     "CRA"       "ECOWAS"    "IGAD"      "IOC"
## [19] "SADC"      "CICOS"     "ICPAC"     "BDMS"      "MOI"       "geometry"
```

```
#Map of Africa
mapView(Africa,zcol = "ADM0_NAME")
```




```
#Making Gabon sf
Gabon <- Africa %>%
  filter(ADM0_NAME == 'Gabon')

#Maping Gabon
mapview(Africa, col.regions = "mediumpurple3")+
  mapview(Gabon, col.regions = "springgreen")
```




```
#Parks sf
Parks <- st_read('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalPr
```

```
## Reading layer 'NP_PresRes' from data source
##   'C:\Users\Dell Laptop\Documents\GitHub\GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject\Data'
##   using driver 'ESRI Shapefile'
## Simple feature collection with 14 features and 26 fields
## Geometry type: POLYGON
## Dimension:     XY
## Bounding box:  xmin: 177681.4 ymin: 145041.5 xmax: 755872.9 ymax: 752809.5
## Projected CRS: Gtm_Gabon
```

```
st_crs(Parks) #Gtm_Gabon
```

```
## Coordinate Reference System:
##   User input: Gtm_Gabon
##   wkt:
## PROJCRS["Gtm_Gabon",
##     BASEGEOGCRS["WGS 84",
##         DATUM["World Geodetic System 1984",
##             ELLIPSOID["WGS 84",6378137,298.257223563,
##                 LENGTHUNIT["metre",1]],
##             ID["EPSG",6326]],
##         PRIMEM["Greenwich",0,
##             ANGLEUNIT["Degree",0.0174532925199433]]],
```

```
##     CONVERSION["unnamed",
##         METHOD["Transverse Mercator",
##             ID["EPSG",9807]],
##         PARAMETER["Latitude of natural origin",0,
##             ANGLEUNIT["Degree",0.0174532925199433],
##             ID["EPSG",8801]],
##         PARAMETER["Longitude of natural origin",12,
##             ANGLEUNIT["Degree",0.0174532925199433],
##             ID["EPSG",8802]],
##         PARAMETER["Scale factor at natural origin",0.9996,
##             SCALEUNIT["unity",1],
##             ID["EPSG",8805]],
##         PARAMETER["False easting",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8806]],
##         PARAMETER["False northing",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8807]]],
##     CS[Cartesian,3],
##         AXIS["(E)",east,
##             ORDER[1],
##             LENGTHUNIT["metre",1,
##                 ID["EPSG",9001]]],
##         AXIS["(N)",north,
##             ORDER[2],
##             LENGTHUNIT["metre",1,
##                 ID["EPSG",9001]]],
##         AXIS["ellipsoidal height (h)",up,
##             ORDER[3],
##             LENGTHUNIT["metre",1,
##                 ID["EPSG",9001]]]]
```

```
colnames(Parks)
```

```
##  [1] "ID"         "NOM"        "POINTS"     "DISTANCE"   "LIM"
##  [6] "Aire_ha"    "AireDecret" "Texte_decr" "NUMNORM"    "TYPE"
## [11] "NUMérO"     "RESERVE"    "SURFACE"    "TITULAIRE"  "NAT_TEXTE"
## [16] "NUM_TEXTE"  "DATE_TEXTE" "Déb_EXPLO"  "ECHéaNCE"   "ZTAXE"
## [21] "TAUXTAXE"   "REDEVANCE"  "NR"         "REMARQUE"   "OBJGéo"
## [26] "Label"      "geometry"
```

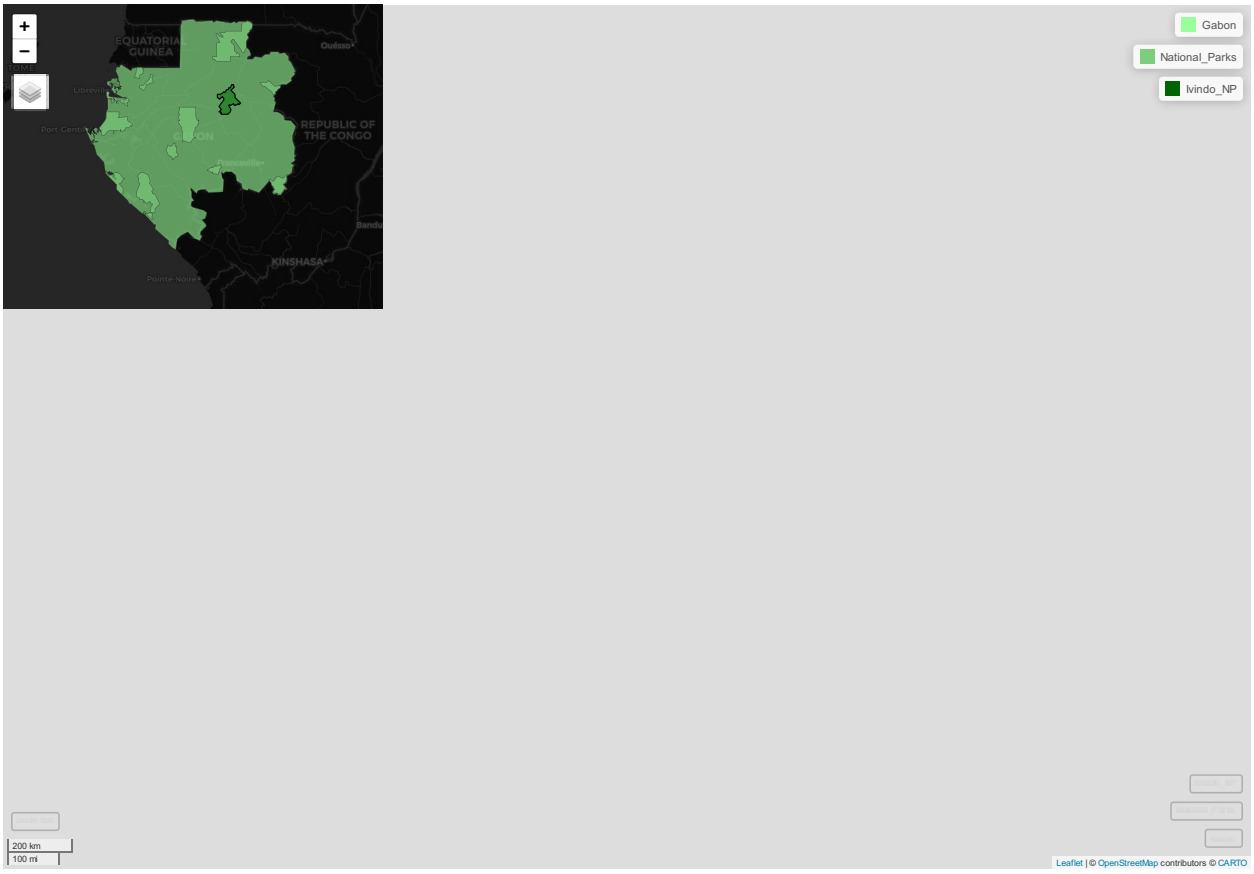
```
#change crs to WGS 84
National_Parks <- st_transform(Parks, "+proj=longlat +datum=WGS84")
st_crs(National_Parks)
```

```
## Coordinate Reference System:
##   User input: +proj=longlat +datum=WGS84
##   wkt:
## GEOGCRS["unknown",
##     DATUM["World Geodetic System 1984",
##         ELLIPSOID["WGS 84",6378137,298.257223563,
##             LENGTHUNIT["metre",1]],
##         ID["EPSG",6326]],
```

```
##     PRIMEM["Greenwich",0,
##         ANGLEUNIT["degree",0.0174532925199433],
##         ID["EPSG",8901]],
##     CS[ellipsoidal,2],
##         AXIS["longitude",east,
##             ORDER[1],
##             ANGLEUNIT["degree",0.0174532925199433,
##                 ID["EPSG",9122]]],
##         AXIS["latitude",north,
##             ORDER[2],
##             ANGLEUNIT["degree",0.0174532925199433,
##                 ID["EPSG",9122]]]]
```

```
#Getting Ivindo National Park by itself
Ivindo_NP <- National_Parks %>%
  filter(NOM == "IVINDO")

mapview(Gabon, col.regions = "palegreen1")+
  mapview(National_Parks, col.region = "palegreen3")+
  mapview(Ivindo_NP, col.region = "darkgreen", lwd = 1.5, color = "black")
```




```
#Rivers sf
Rivers <- st_read('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalPr
```

```
## Reading layer 'GAB_hydro_lineaire_principal_2013' from data source
```

```
##   'C:\Users\Dell Laptop\Documents\GitHub\GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject\Data'
##   using driver 'ESRI Shapefile'
## Simple feature collection with 6549 features and 5 fields
## Geometry type: LINESTRING
## Dimension:     XY
## Bounding box:  xmin: 134086.9 ymin: 63148.33 xmax: 780977.7 ymax: 756232.6
## Projected CRS: WGS 84 / Gabon TM
```

```
st_crs(Rivers)
```

```
## Coordinate Reference System:
##   User input: WGS 84 / Gabon TM
##   wkt:
## PROJCRS["WGS 84 / Gabon TM",
##     BASEGEOGCRS["WGS 84",
##         DATUM["World Geodetic System 1984",
##             ELLIPSOID["WGS 84",6378137,298.257223563,
##                 LENGTHUNIT["metre",1]]],
##         PRIMEM["Greenwich",0,
##             ANGLEUNIT["degree",0.0174532925199433]],
##         ID["EPSG",4326]],
##     CONVERSION["Gabon Transverse Mercator",
##         METHOD["Transverse Mercator",
##             ID["EPSG",9807]],
##         PARAMETER["Latitude of natural origin",0,
##             ANGLEUNIT["degree",0.0174532925199433],
##             ID["EPSG",8801]],
##         PARAMETER["Longitude of natural origin",12,
##             ANGLEUNIT["degree",0.0174532925199433],
##             ID["EPSG",8802]],
##         PARAMETER["Scale factor at natural origin",0.9996,
##             SCALEUNIT["unity",1],
##             ID["EPSG",8805]],
##         PARAMETER["False easting",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8806]],
##         PARAMETER["False northing",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8807]]],
##     CS[Cartesian,2],
##         AXIS["easting (X)",east,
##             ORDER[1],
##             LENGTHUNIT["metre",1]],
##         AXIS["northing (Y)",north,
##             ORDER[2],
##             LENGTHUNIT["metre",1]],
##     USAGE[
##         SCOPE["Forestry."],
##         AREA["Gabon - onshore."],
##         BBOX[-3.98,8.65,2.32,14.52]],
##     ID["EPSG",5223]]
```

```
#Roads sf
Roads <- st_read('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalPr
```

```
## Reading layer 'GAB_major_roads_2013' from data source
##   'C:\Users\Dell Laptop\Documents\GitHub\GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject\Data'
##   using driver 'ESRI Shapefile'
## Simple feature collection with 976 features and 12 fields
## Geometry type: LINESTRING
## Dimension:     XY
## Bounding box:  xmin: 202004.2 ymin: 118846.4 xmax: 762828.9 ymax: 753375.2
## Projected CRS: WGS_1984_Transverse_Mercator
```

```
st_crs(Roads)
```

```
## Coordinate Reference System:
##   User input: WGS_1984_Transverse_Mercator
##   wkt:
## PROJCRS["WGS_1984_Transverse_Mercator",
##     BASEGEOGCRS["WGS 84",
##         DATUM["World Geodetic System 1984",
##             ELLIPSOID["WGS 84",6378137,298.257223563,
##                 LENGTHUNIT["metre",1]],
##             ID["EPSG",6326]],
##         PRIMEM["Greenwich",0,
##             ANGLEUNIT["Degree",0.0174532925199433]]],
##     CONVERSION["unnamed",
##         METHOD["Transverse Mercator",
##             ID["EPSG",9807]],
##         PARAMETER["Latitude of natural origin",0,
##             ANGLEUNIT["Degree",0.0174532925199433],
##             ID["EPSG",8801]],
##         PARAMETER["Longitude of natural origin",12,
##             ANGLEUNIT["Degree",0.0174532925199433],
##             ID["EPSG",8802]],
##         PARAMETER["Scale factor at natural origin",0.9996,
##             SCALEUNIT["unity",1],
##             ID["EPSG",8805]],
##         PARAMETER["False easting",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8806]],
##         PARAMETER["False northing",500000,
##             LENGTHUNIT["metre",1],
##             ID["EPSG",8807]]],
##     CS[Cartesian,2],
##         AXIS["(E)",east,
##             ORDER[1],
##             LENGTHUNIT["metre",1,
##                 ID["EPSG",9001]]],
##         AXIS["(N)",north,
##             ORDER[2],
##             LENGTHUNIT["metre",1,
##                 ID["EPSG",9001]]]]
```

```
#Makokou village
Makokou <- read_csv('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_Final
  st_as_sf(coords = c('Longitude', 'Latitude'), crs = "+proj=longlat +datum=WGS84")
```

```
## Rows: 1 Columns: 3

## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (1): City
## dbl (2): Longitude, Latitude

##
## 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.
```

```
st_crs(Makokou)
```

```
## Coordinate Reference System:
##   User input: +proj=longlat +datum=WGS84
##   wkt:
## GEOGCRS["unknown",
##     DATUM["World Geodetic System 1984",
##         ELLIPSOID["WGS 84",6378137,298.257223563,
##             LENGTHUNIT["metre",1]],
##         ID["EPSG",6326]],
##     PRIMEM["Greenwich",0,
##         ANGLEUNIT["degree",0.0174532925199433],
##         ID["EPSG",8901]],
##     CS[ellipsoidal,2],
##         AXIS["longitude",east,
##             ORDER[1],
##             ANGLEUNIT["degree",0.0174532925199433,
##                 ID["EPSG",9122]]],
##         AXIS["latitude",north,
##             ORDER[2],
##             ANGLEUNIT["degree",0.0174532925199433,
##                 ID["EPSG",9122]]]]
```

```
Makokou_WGS84 <- st_transform(Makokou, "+proj=longlat +datum=WGS84")
```

```
#Plots sf
Plots <- st_read('/Users/Dell Laptop/Documents/GitHub/GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalPr
```

```
## Reading layer `plots_with_species' from data source
##   `C:\Users\Dell Laptop\Documents\GitHub\GoldenGriffithsKnierMalinowski_ENV872_EDA_FinalProject\Data'
##   using driver `ESRI Shapefile'
## Simple feature collection with 6 features and 4 fields
## Geometry type: POINT
## Dimension:     XY
## Bounding box:  xmin: 12.58091 ymin: 0.310917 xmax: 12.80674 ymax: 0.480954
## Geodetic CRS:  WGS 84
```

```r
#CRS
st_crs(Plots) #WGS 84
```

```
## Coordinate Reference System:
##   User input: WGS 84
##   wkt:
## GEOGCRS["WGS 84",
##     DATUM["World Geodetic System 1984",
##         ELLIPSOID["WGS 84",6378137,298.257223563,
##             LENGTHUNIT["metre",1]]],
##     PRIMEM["Greenwich",0,
##         ANGLEUNIT["degree",0.0174532925199433]],
##     CS[ellipsoidal,2],
##         AXIS["latitude",north,
##             ORDER[1],
##             ANGLEUNIT["degree",0.0174532925199433]],
##         AXIS["longitude",east,
##             ORDER[2],
##             ANGLEUNIT["degree",0.0174532925199433]],
##     ID["EPSG",4326]]
```

```r
colnames(Plots)
```

```
## [1] "Plot_Name" "xcoord"    "ycoord"    "Distance"  "geometry"
```

```r
#Map Gabon with Parks and Plots
mapviewPalette(name = "mapviewVectorColors")
```

```
## function (n)
## {
##     grDevices::hcl.colors(n, palette = "viridis")
## }
## <bytecode: 0x0000000036052b48>
## <environment: 0x000000003034ecf0>
```

```r
mapview(Ivindo_NP, col.region = "palegreen2", lwd = 1, color = "black", alpha.regions = 0.5)+
  mapview(Plots, zcol = "Plot_Name", col.region = c("orangered","magenta","red","gold","orange","yellow
  mapview(Makokou, col.region = "black", cex = 4, alpha.regions = 0.95)
```


Ivindo_NP
Plots - Plot_Name
DF 3B
DF 5A
DF 5B
DF 6A
DF 6B
IF 2A
Makokou
30 km
10 mi
Leaflet | © OpenStreetMap contributors © CARTO