Introducción a datos espaciales con R

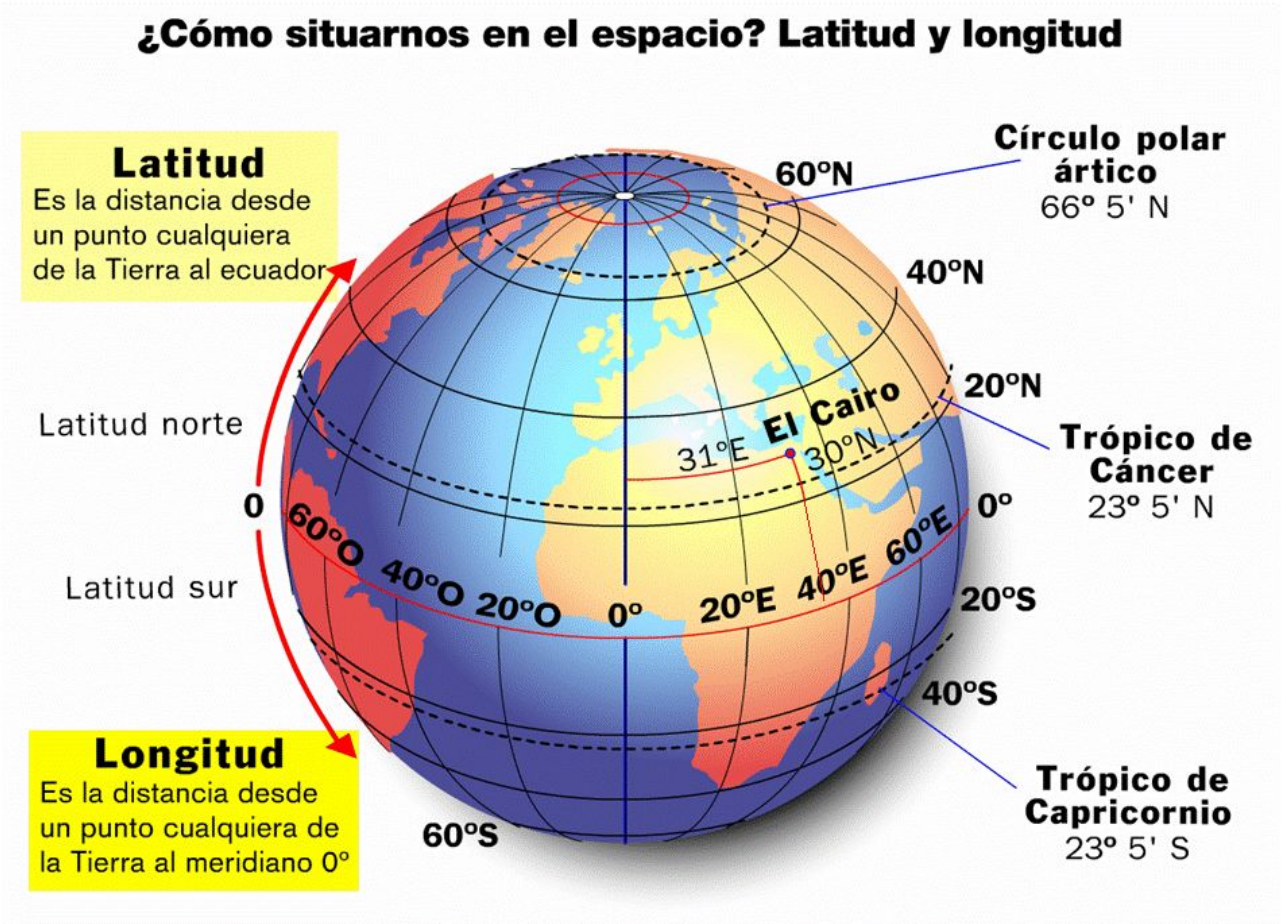
David Montero Loaiza - Frank David Montenegro Hurtado

MEETUP - R USERS (Cali) - 19 de agosto 2017

DATOS ESPACIALES

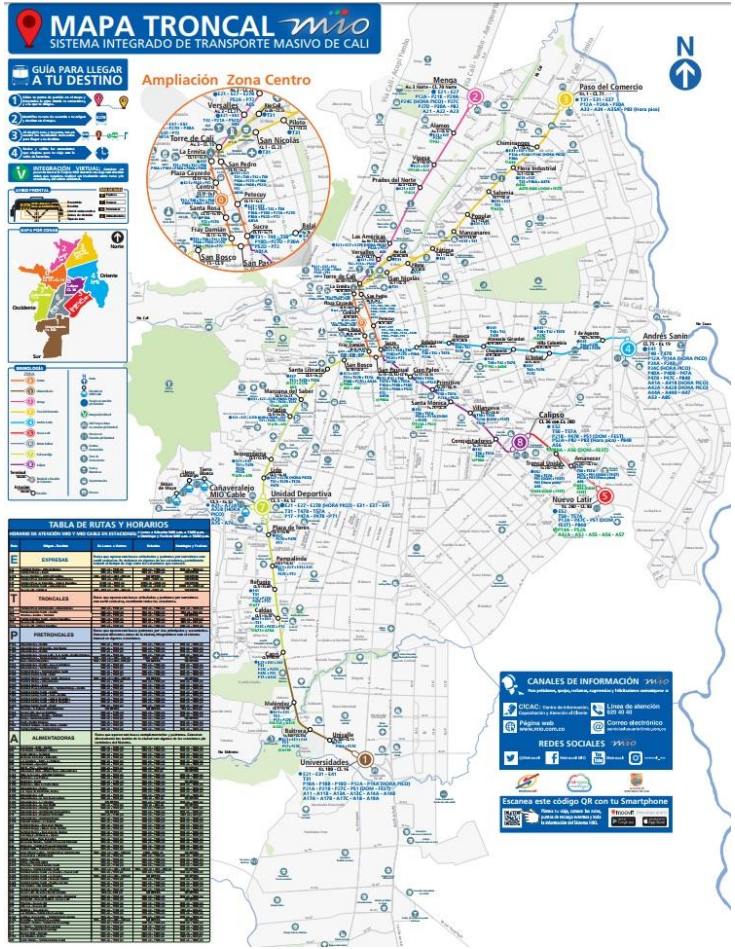
¿Qué son los datos espaciales?

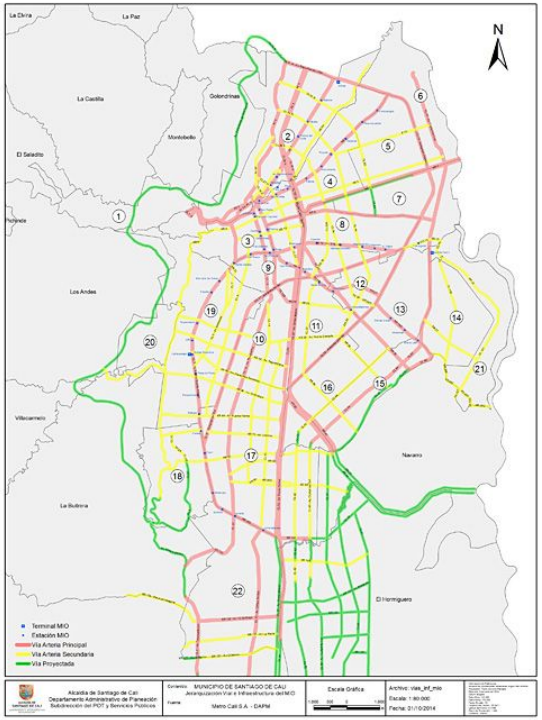
Todo puede ubicarse en un punto o en un conjunto de estos sobre el espacio...

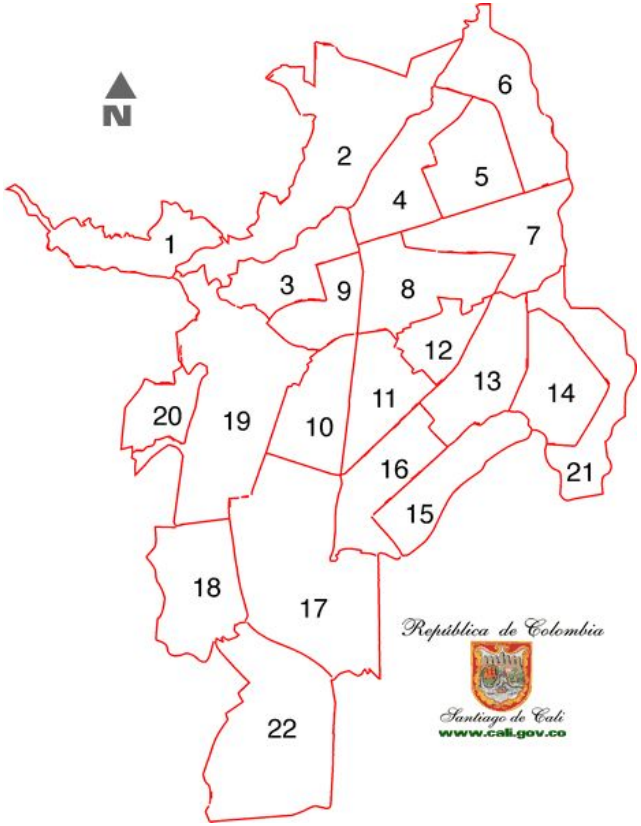


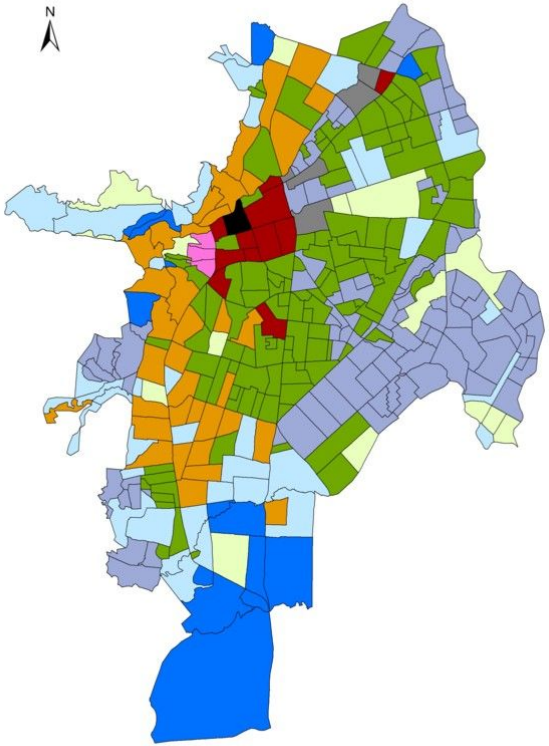
Datos e información asociada explícita o implícitamente a una localización en la tierra

Líneas del MIO
Red vial
Red fluvial
Perímetros

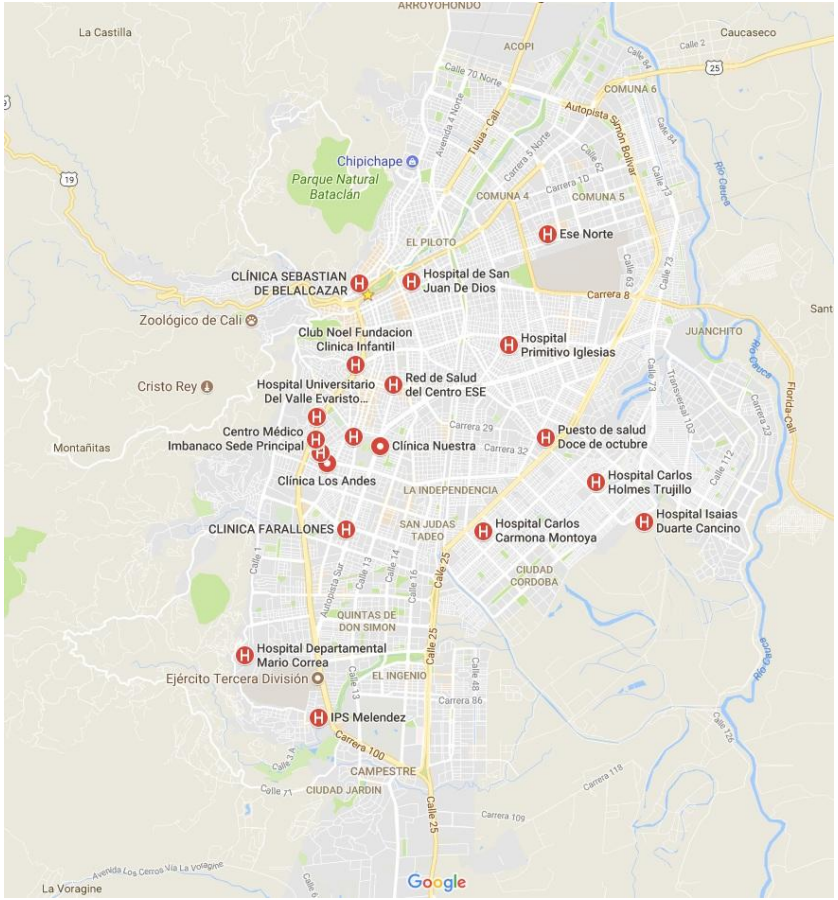


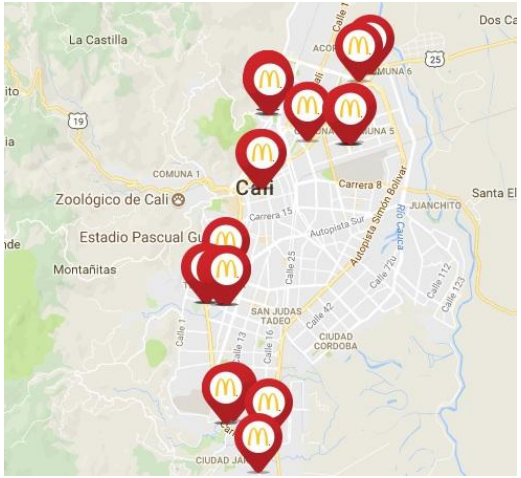




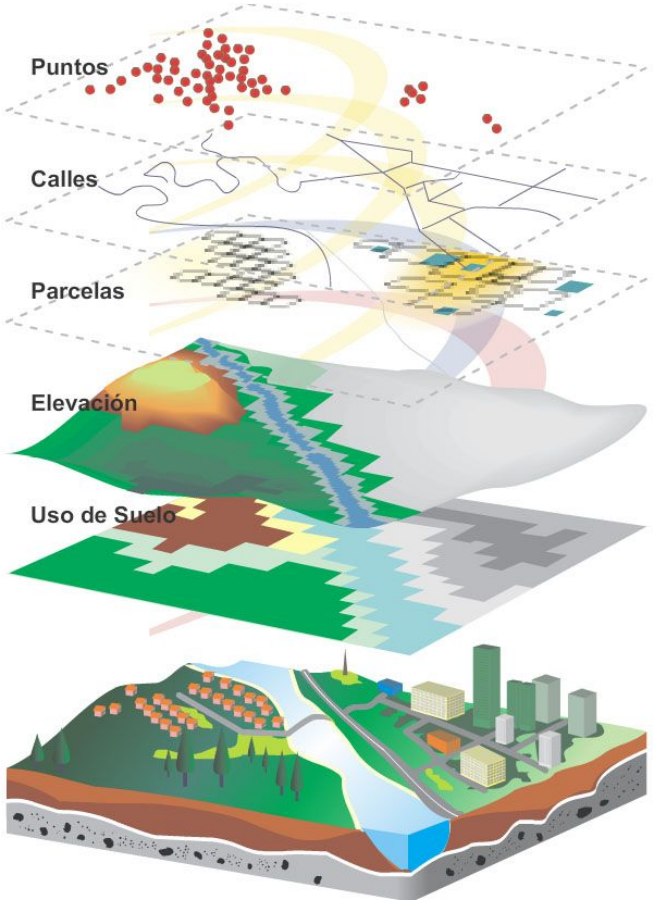


Ciudades
Comunas
Barrios
Predios
Áreas de interés





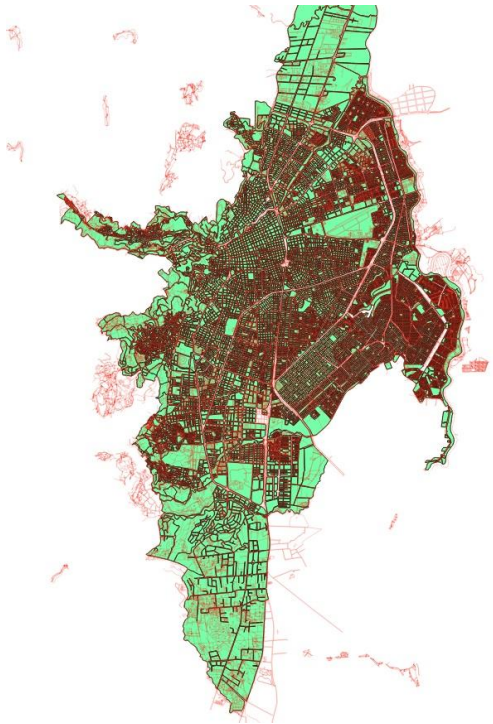
Hospitales
Escuelas
Puntos de atención
Sitios de interés

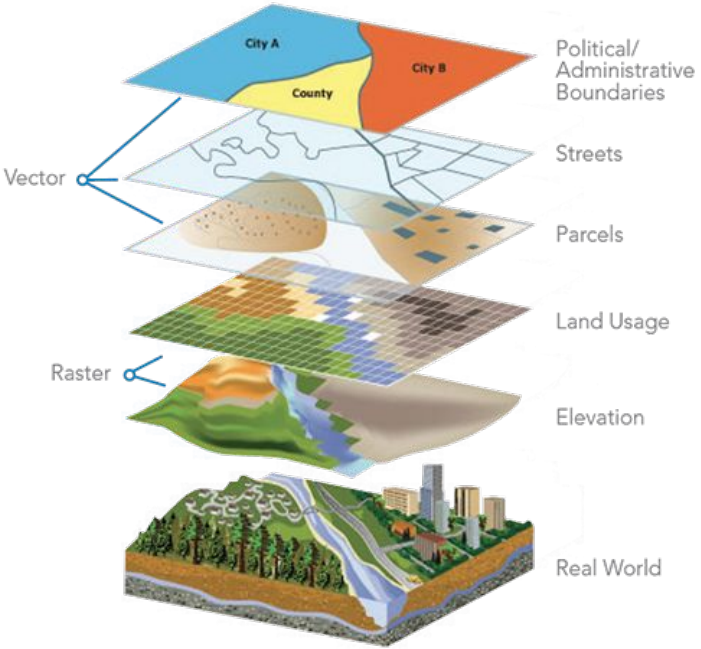


La información espacial es una representación del mundo real

TIPOS DE DATOS ESPACIALES

Vector | Ráster





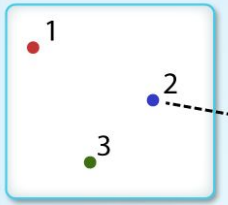
Vector

Puntos

Líneas

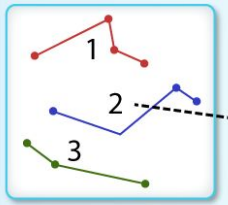
Polígonos

Example Attributes for Point Data



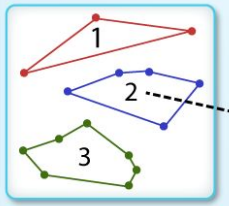
ID	Plot Size	Type	VegClass
1	40	Vegetation	Conifer
2	20	Vegetation	Deciduous
3	40	Vegetation	Conifer

Example Attributes for Line Data



ID	Type	Status	Maintenance
1	Road	Open	Year Round
2	Dirt Trail	Open	Summer
3	Road	Closed	Year Round

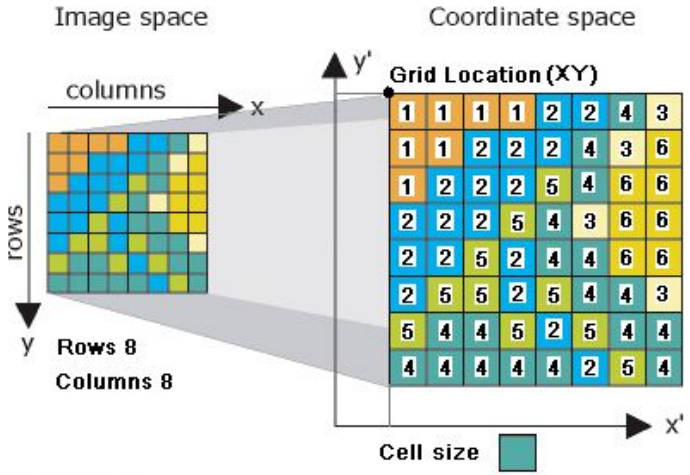
Example Attributes for Polygon Data



ID	Type	Class	Status
1	Herbaceous	Grassland	Protected
2	Herbaceous	Pasture	Open
3	Herbaceous / Woody	Grassland	Protected

neon

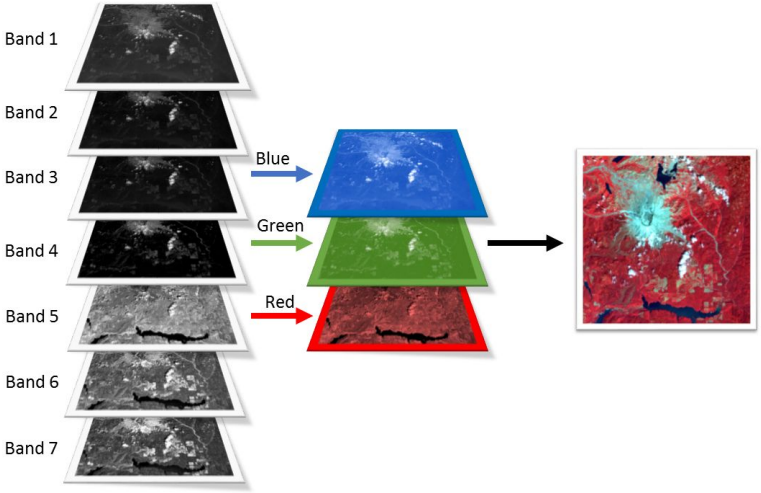
Ráster



List of cell values

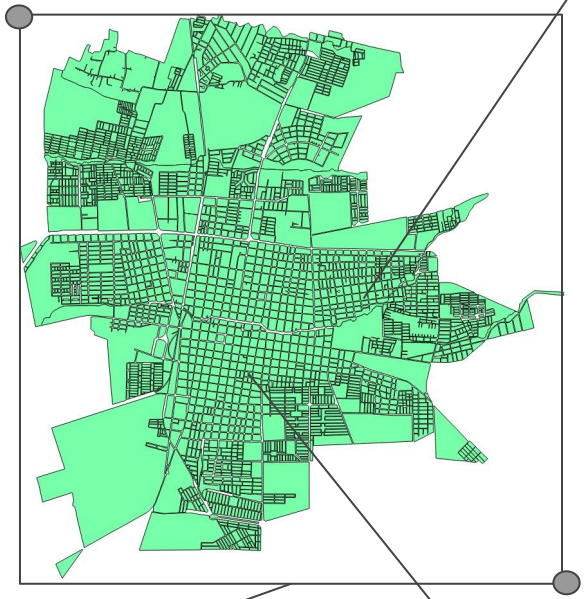
[1111224311222436122254662225436622524466255254435445254444444254]

Ráster Stack (Multibanda)

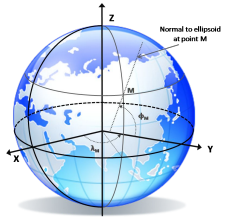


Geometría

X1,Y1



Información asociada

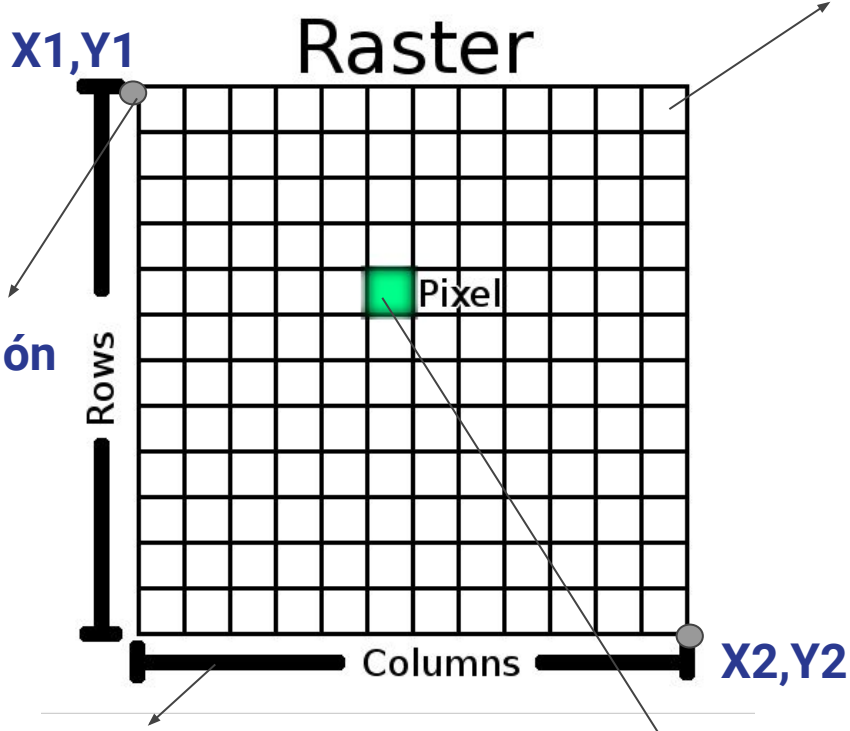


Sistema de referencia de coordenadas

X2,Y2

Extensión

Objetos espaciales



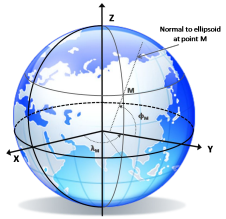
Resolución

Extensión

Dimensión

Objetos espaciales

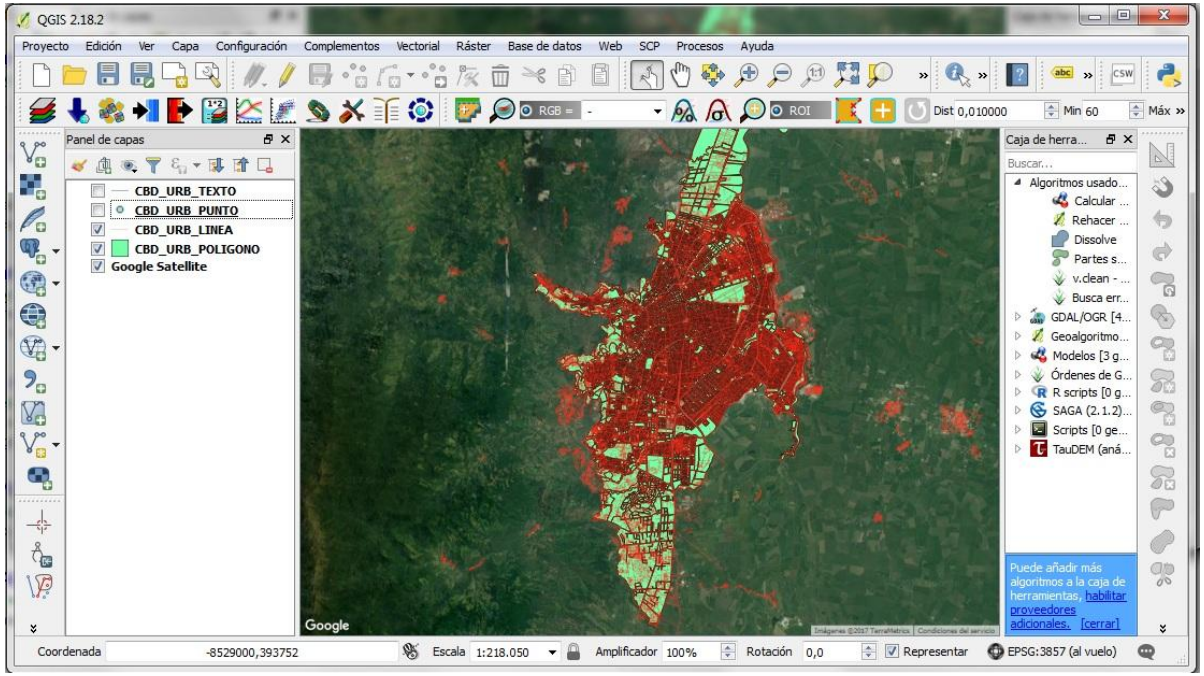
Información asociada



Sistema de referencia de coordenadas

HERRAMIENTAS SIG

Software de gestión SIG



QGIS

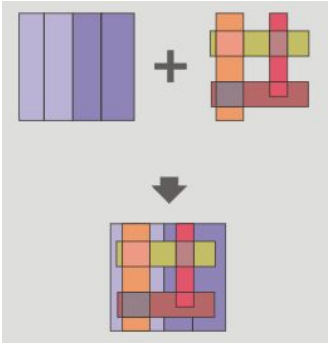
ArcGIS ESRI

gvSIG

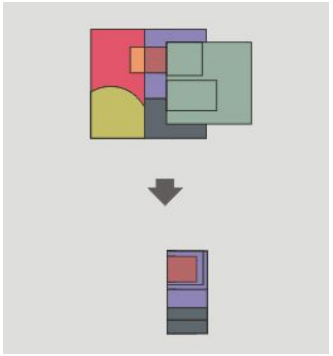
PostGIS
Spatial PostgreSQL

Geoprocesamiento de datos vectoriales

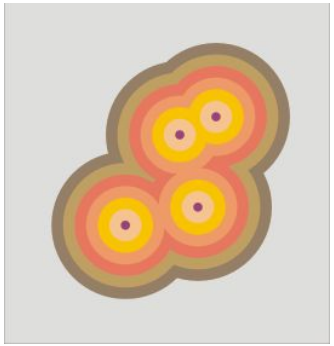
Union



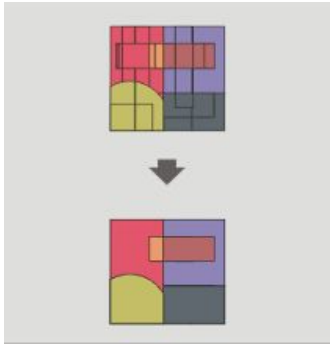
Interseccion



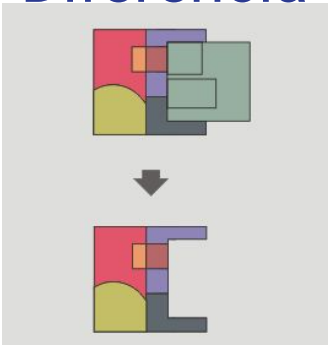
Buffer



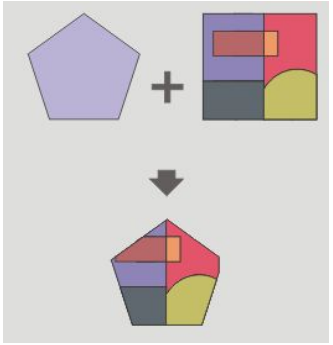
Disolver



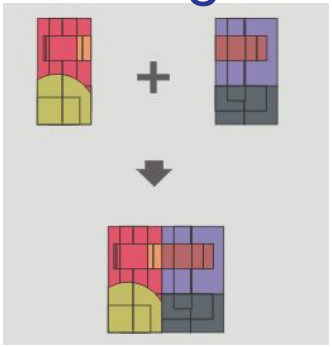
Diferencia



Cortar

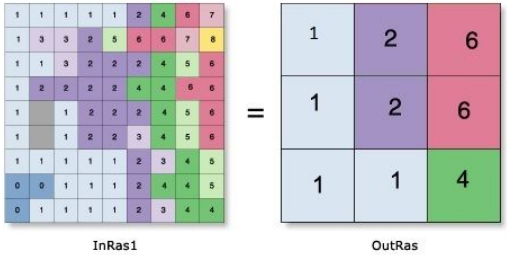


Margen

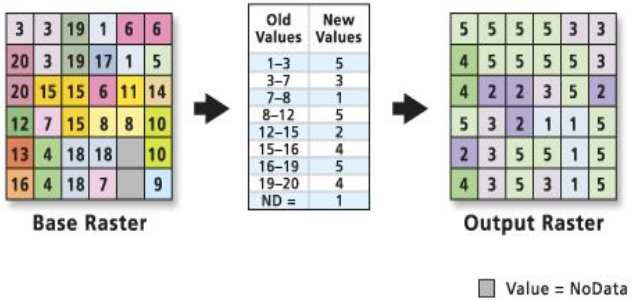


Geoprocesamiento de datos ráster

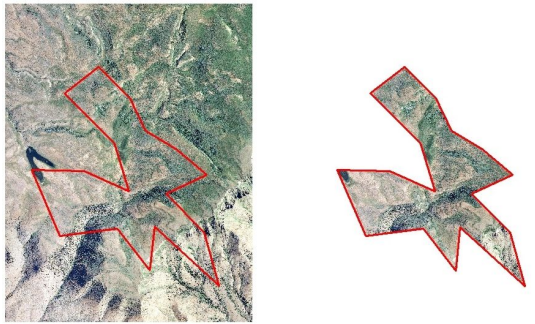
Resample



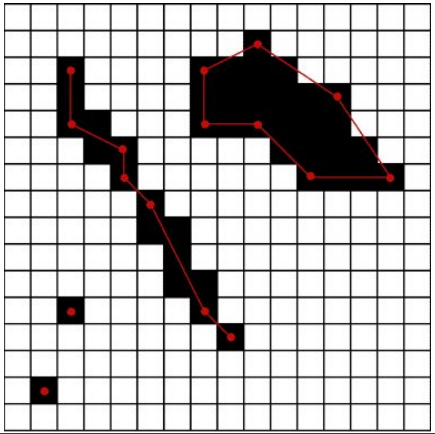
Reclasificación



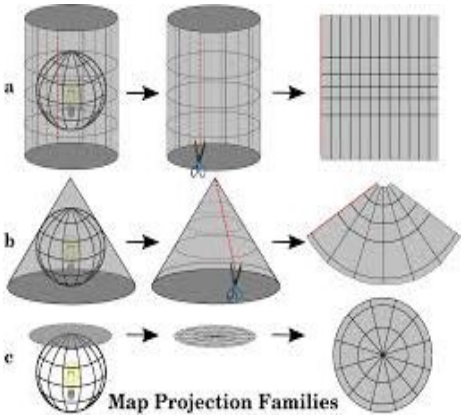
Máscara



Poligonizar



Reproyectar



GEOPROCESAMIENTO EN R

¿Por qué usar R?

- **R es gratis, potente y fácil de manejar, incluso para los nuevos useRs**
- **Procesamiento y visualización de datos espaciales**
- **Incremento de paquetes para datos espaciales**
- **Análisis de información espacial**
- **Fácil intercambio de objetos con formatos GIS**
- **Automatización de geoprocesos**
- **Integración con otros software de manipulación de datos espaciales como QGIS, ArcGIS, SAGA, GRASS, PostGIS, ect.**

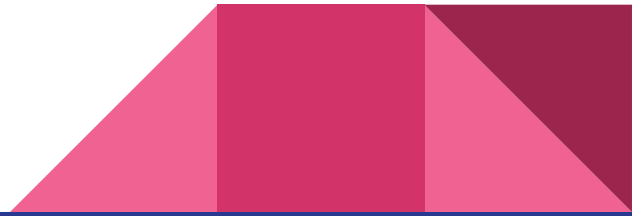
Objetos vectoriales en R

Sin atributos:

- SpatialPoints
- SpatialLines
- SpatialPolygons

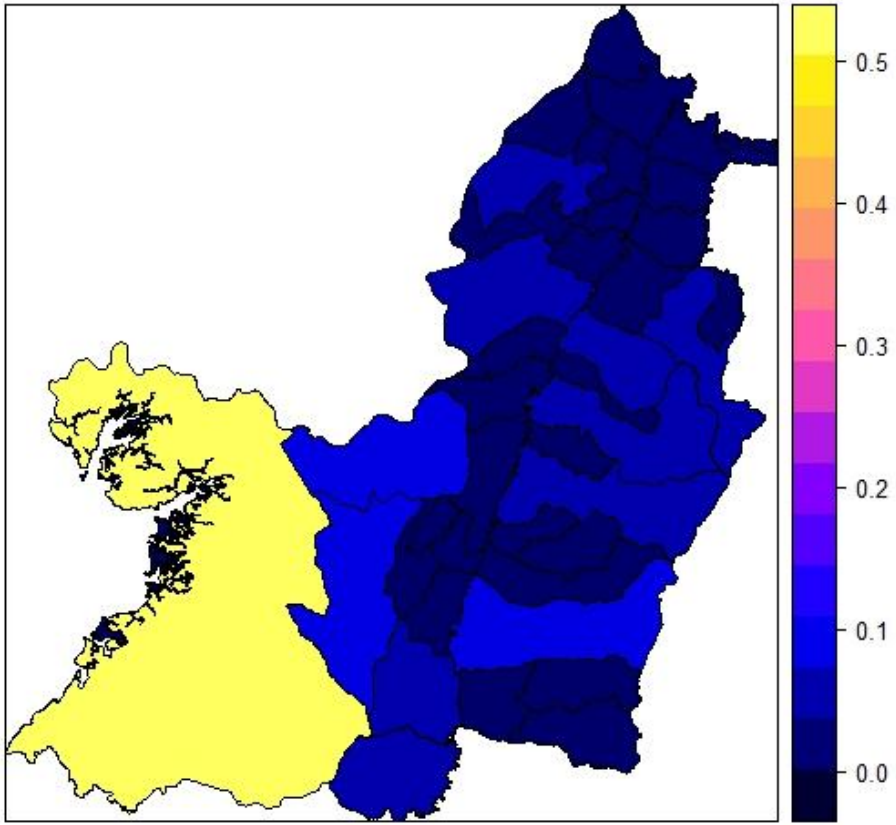
Con atributos:

- SpatialPointsDataFrame
- SpatialLinesDataFrame
- SpatialPolygonsDataFrame

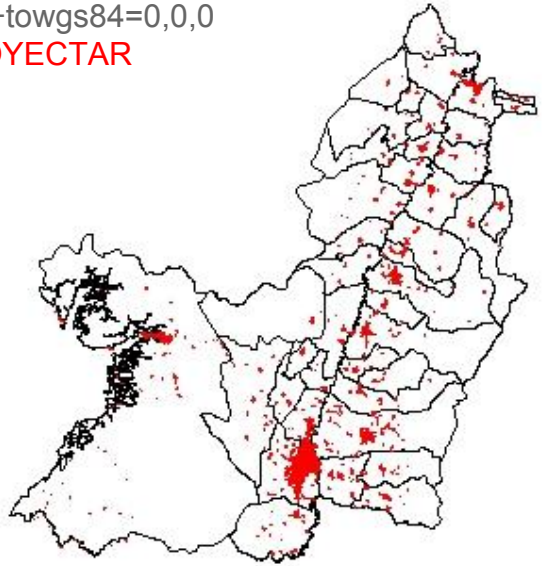


```
> require(raster)
> shpValle = shapefile("...dir/valle.shp") # LEER ARCHIVO SHAPEFILE
> shpValle
class       : SpatialPolygonsDataFrame
features    : 98
extent      : 948953.4, 1152268, 833922.6, 1048486  (xmin, xmax, ymin, ymax)
coord. ref. : +proj=tmerc +lat_0=4.599047222222222 +lon_0=-77.08091666666667 +k=1 +x_0=1000000 +y_0=1000000
+ellps=intl +units=m +no_defs
variables   : 8
names       :    AREA, PERIMETER, GEODIV_, GEODIV_ID, SIMBOLO, SYMBOL, COD_DANE, NOM_MUNI
min values  : 0.00001,   0.01243,    1000,  11538321,  CABECE,      0,       76,  ALCALÃ
max values  : 0.50352,  11.43106,     997,  11555635,  NO/APL,     25,       76,   ZARZAL
> plot(shpValle)
```

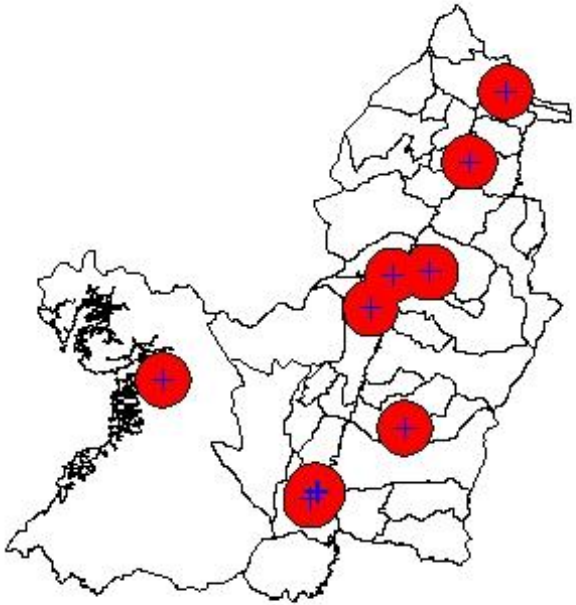
```
> require(sp)
> spplot(shpValle, zcol = “AREA”)
```



```
> require(sp)
> shpPoi = shapefile("...dir/CBD_URB_PUNTO.shp")
> compareCRS(shpValle,shpPoi) # COMPARAR SISTEMA DE REFERENCIA ENTRE 2 SHP
[1] FALSE
> crs(shpValle)
CRS arguments:
 +proj=tmerc +lat_0=4.599047222222222 +lon_0=-77.08091666666667 +k=1 +x_0=1000000 +y_0=1000000 +ellps=intl
+units=m +no_defs
> crs(shpPoi)
CRS arguments:
 +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
> shpValle = spTransform(shpValle,crs(shpPoi)) # REPROYECTAR
> compareCRS(shpValle,shpPoi)
[1] TRUE
> plot(shpValle)
> plot(shpPoi,add = T,col = "red",pch = ".")
```

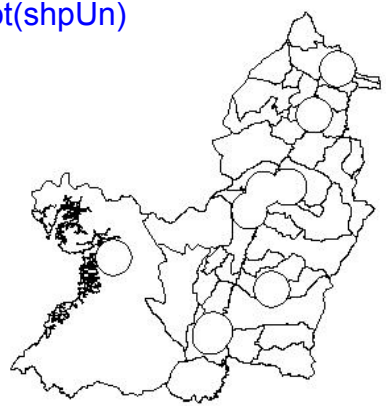


```
> require(rgeos)
> shpPoi2 = shpPoi[runif(10,1,length(shpPoi)),] # SELECCIONAR 10 OBJETOS ALEATORIOS
> shpPoi2 = spTransform(shpPoi2,CRS("+init=epsg:3115")) # REPROYECTAR A COORDENADAS PLANAS
> shpValle = spTransform(shpValle,CRS("+init=epsg:3115"))
> shpBuf = gBuffer(shpPoi2,width = 10000) # BUFFER A 10,000 m (10 km)
> plot(shpValle)
> plot(shpBuf,add = T,col = "red")
> plot(shpPoi2,add = T,col = "blue")
```



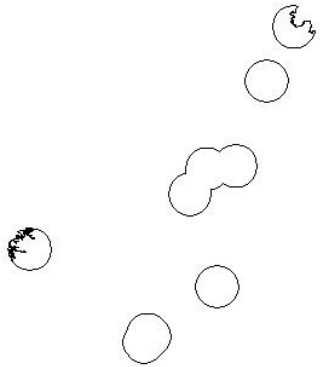
UNION

```
> shpUn = gUnion(shpValle,shpBuf,byid = T)
> plot(shpUn)
```



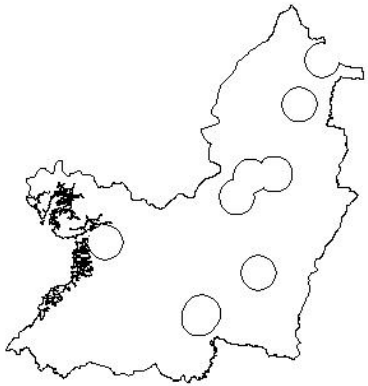
INTERSECCIÓN

```
> shpIn = gIntersection(shpValle,shpBuf)
> plot(shpIn)
```



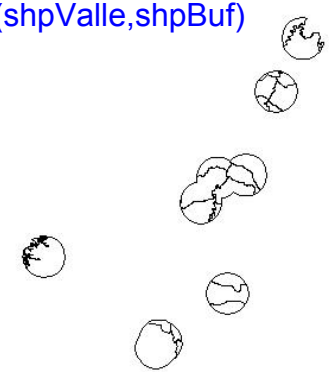
DIFERENCIA

```
> shpDif = gDifference(shpValle,shpBuf)
> plot(shpDif)
```



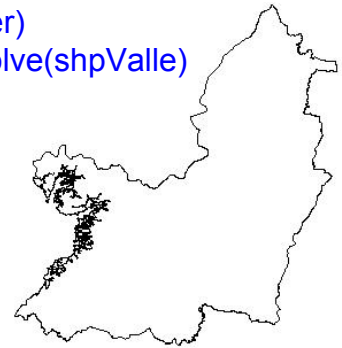
CORTE

```
> shpCor = crop(shpValle,shpBuf)
> plot(shpCor)
```



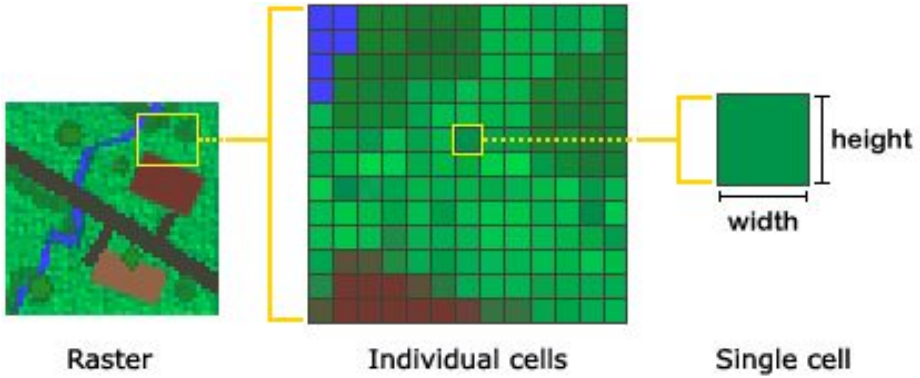
DISOLVER

```
> require(rmapshaper)
> shpDis = ms_dissolve(shpValle)
> plot(shpDis)
```

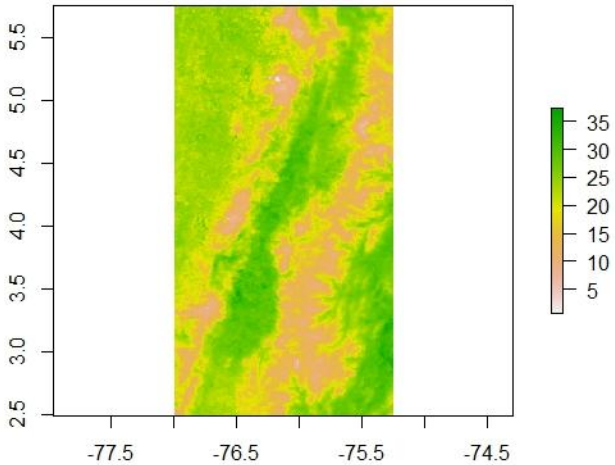


Objetos ráster en R

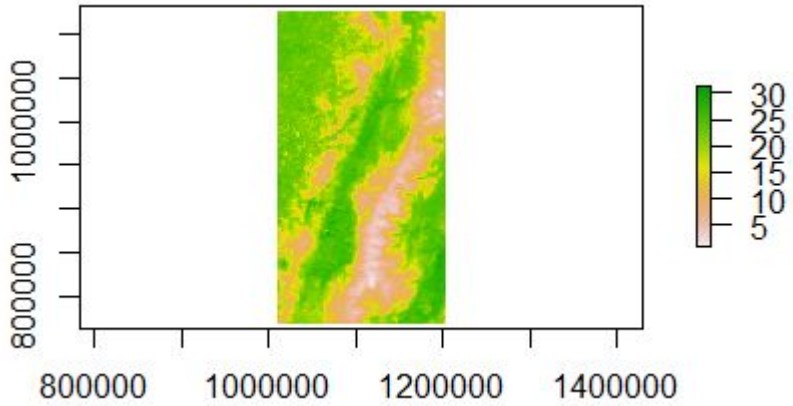
- SpatialGrid
- SpatialPixels
- SpatialPixelsDataFrame
- RasterLayer
- RasterStack
- RasterBrick



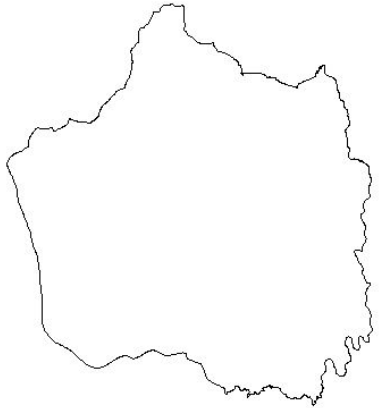
```
> require(raster)
> img = raster("...dir/2011_1_Filled.LST_Day_1km.tif")
> img
class       : RasterLayer
dimensions  : 361, 194, 70034  (nrow, ncol, ncell)
resolution  : 0.009023898, 0.009023898  (x, y)
extent      : -77.00192, -75.25128, 2.496628, 5.754255  (xmin, xmax, ymin, ymax)
coord. ref. : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
data source : ...dir\2011_1_Filled.LST_Day_1km.tif
names       : X2011_1_Filled.LST_Day_1km
values      : 0.75, 37.37  (min, max)
> plot(img)
```

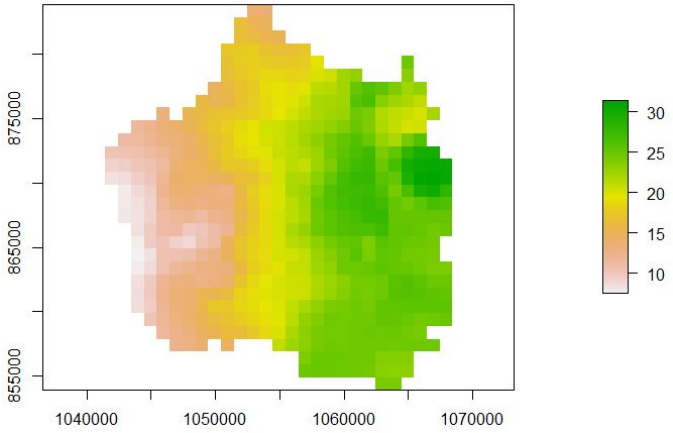


```
> projection(img)
[1] "+proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0"
> newproj <- CRS("+init=epsg:3115")
> newproj
CRS arguments:
 +init=epsg:3115 +proj=tmerc
+lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1
+x_0=1000000 +y_0=1000000 +ellps=GRS80
+towgs84=0,0,0,0,0,0,0 +units=m +no_defs
> img.reproject <- projectRaster(img, crs=newproj)
> plot(img.reproject)
> img.reproject
class       : RasterLayer
dimensions  : 371, 205, 76055  (nrow, ncol, ncell)
resolution  : 1000, 998  (x, y)
extent      : 1003372, 1208372, 763116.9, 1133375  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666 +lon_0=-77.07750791666666 +k=1 +x_0=1000000
+y_0=1000000 +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
data source : in memory
names       : X2013_12_Filled.LST_Mean_1km
values      : 0.755739, 31.33416  (min, max)
```

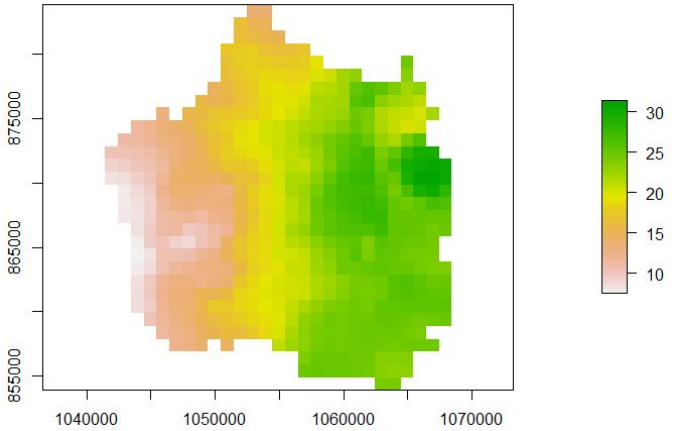


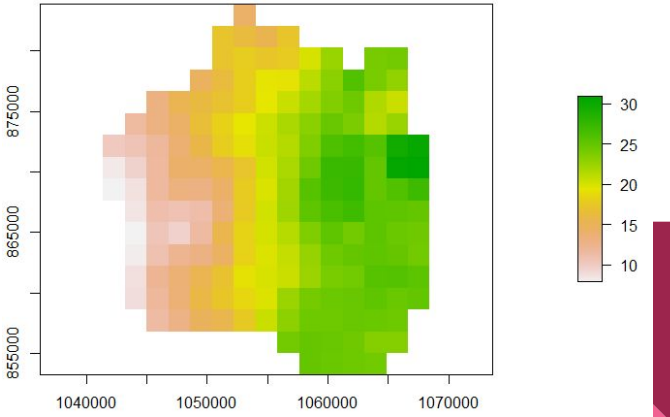
```
> cali
class       : SpatialPolygonsDataFrame
features    : 1
extent      : 1041119, 1068745,
853763.6, 884067.4  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1 +x_0=1000000 +y_0=1000000
+ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
variables   : 12
names       : OBJECTID, DPTO_DPTO_, MPIO_CCDGO, MPIO_CNMBR,
min values  :     1006,         76,        001,       CALI,
max values  :     1006,         76,        001,       CALI,
> img1.mask_cali=mask(crop(img.reproject,cali),cali)
> img1.mask_cali
class       : RasterLayer
dimensions  : 30, 27, 810  (nrow, ncol, ncell)
resolution  : 1000, 998  (x, y)
extent      : 1041372, 1068372,
853934.9, 883874.9  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1 +x_0=1000000 +y_0=1000000
+ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
data source : in memory
names       : valor_clase
values      : 7.458905, 31.33416  (min, max)
```



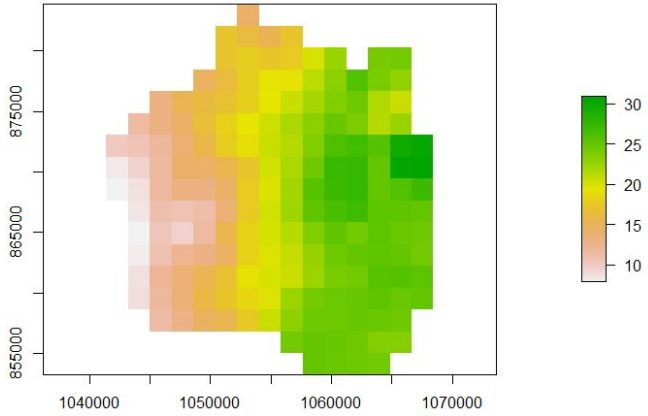


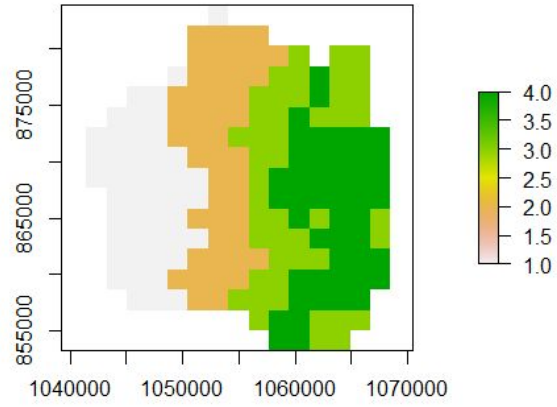
```
 > new.raster=raster(extent(img1.mask_cali))
> res(new.raster)=1800
> projection(new.raster)=newproj
> new.raster
class       : RasterLayer
dimensions  : 17, 15, 255  (nrow, ncol, ncell)
resolution  : 1800, 1800  (x, y)
extent      : 1041372, 1068372,
853274.9, 883874.9  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1 +x_0=1000000 +y_0=1000000
+ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
> img1.resample=resample(img1.mask_cali,new.raster,method='bilinear')
> img1.resample
class       : RasterLayer
dimensions  : 17, 15, 255  (nrow, ncol, ncell)
resolution  : 1800, 1800  (x, y)
extent      : 1041372, 1068372,
853274.9, 883874.9  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1 +x_0=1000000 +y_0=1000000
+ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
data source : in memory
names       : valor_clase
values      : 7.872405, 30.88012  (min, max)
```



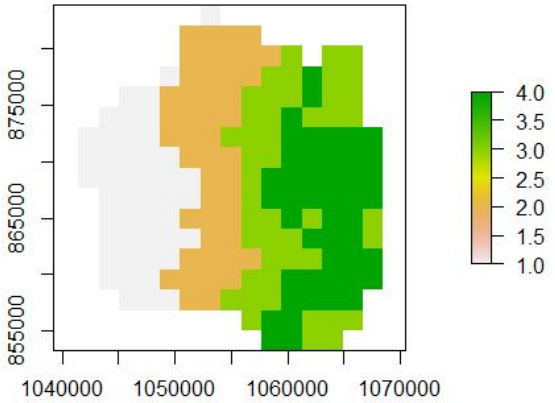


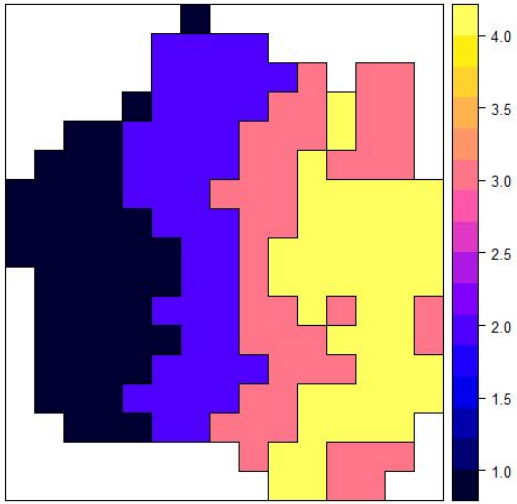
```
> summary(img1.resample)
      valor_clase
Min.      7.872405
1st Qu.  15.495912
Median   20.571836
3rd Qu.  24.654200
Max.     30.880123
NA's     70.000000
> img1.resample[img1.resample>=7.8 & img1.resample<15.49]=1
> img1.resample[img1.resample>=15.49 & img1.resample<20.57]=2
> img1.resample[img1.resample>=20.57 & img1.resample<24.65]=3
> img1.resample[img1.resample>=24.65 & img1.resample<=30.9]=4
> plot(img1.resample)
> summary(img1.resample)
      valor_clase
Min.      1
1st Qu.   2
Median    3
3rd Qu.   4
Max.      4
NA's     70
```





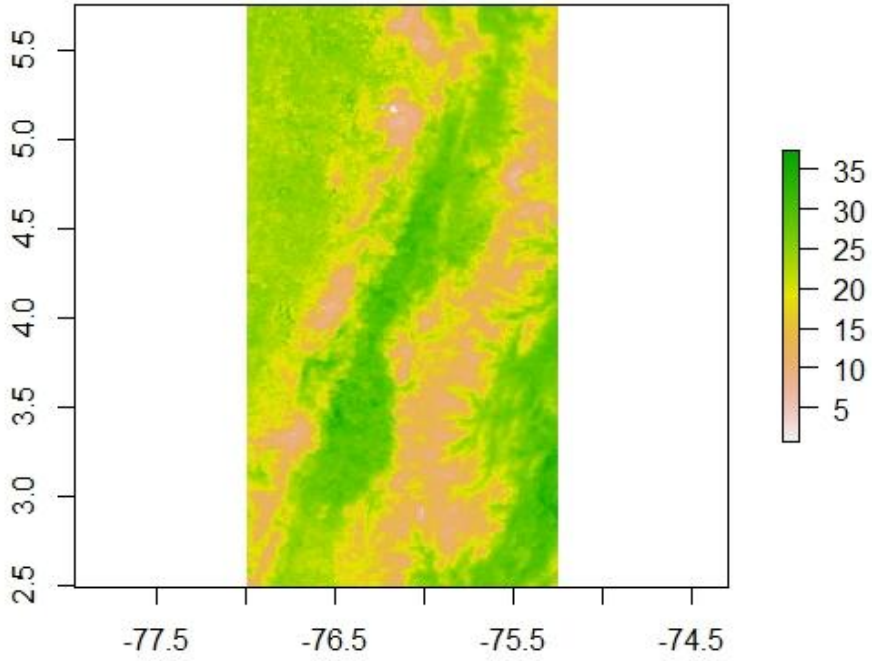
```
 > img1.vector=rasterToPolygons(img1.resample,dissolve = T)
> img1.vector
class       : SpatialPolygonsDataFrame
features    : 4
extent      : 1041372, 1068372,
 853274.9, 883874.9  (xmin, xmax, ymin, ymax)
coord. ref. : +init=epsg:3115 +proj=tmerc +lat_0=4.596200416666666
+lon_0=-77.07750791666666 +k=1 +x_0=1000000 +y_0=1000000
+ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +units=m +no_defs
variables   : 1
names       : valor_clase
min values  :           1
max values  :           4
> spplot(img1.vector,zcol="valor_clase")
```



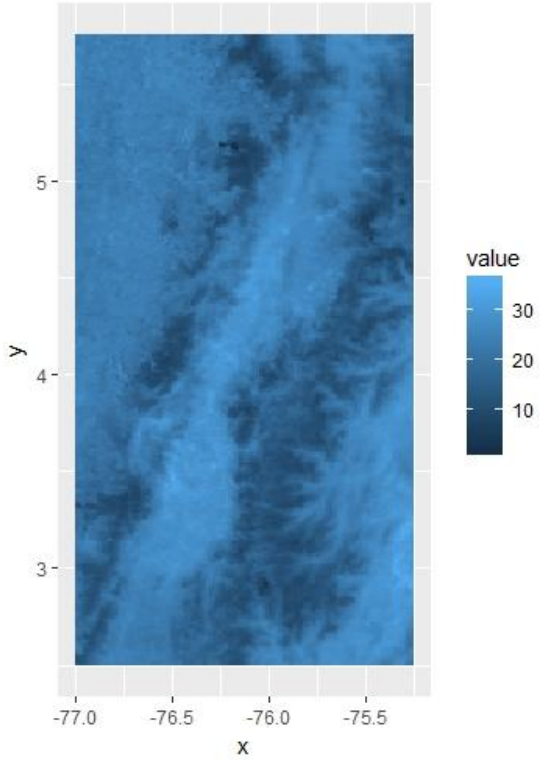


VISUALIZACIÓN

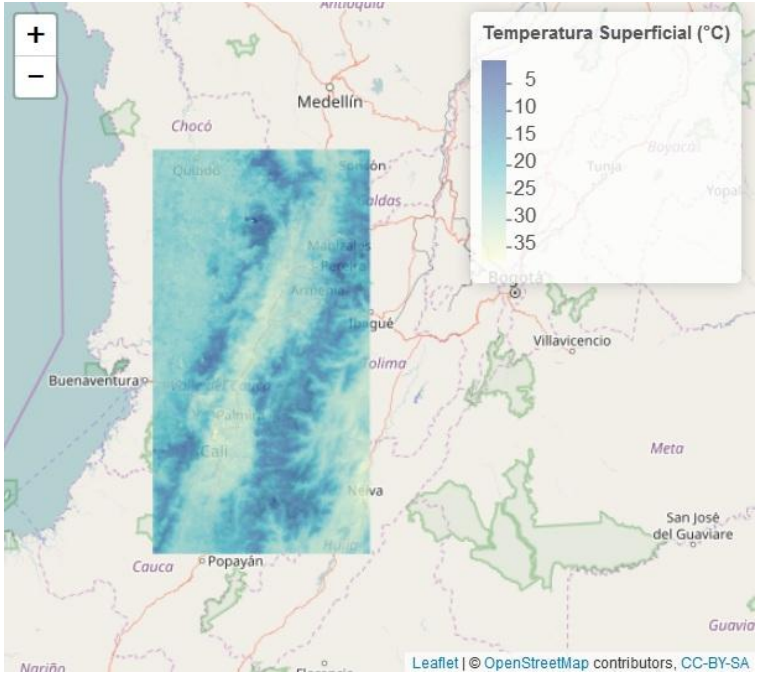
Visualización



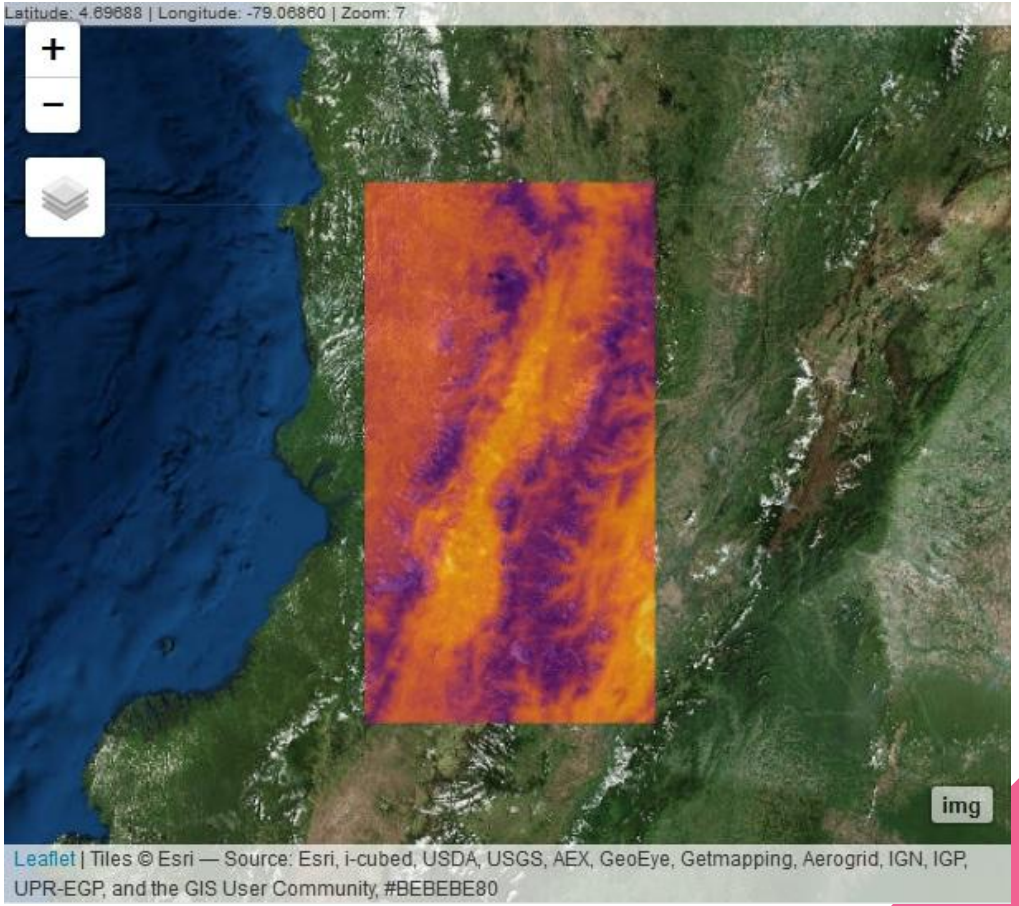
```
> require(rasterVis)
> require(ggplot2)
> gplot(img) + geom_tile(aes(fill = value)) + coord_equal()
```



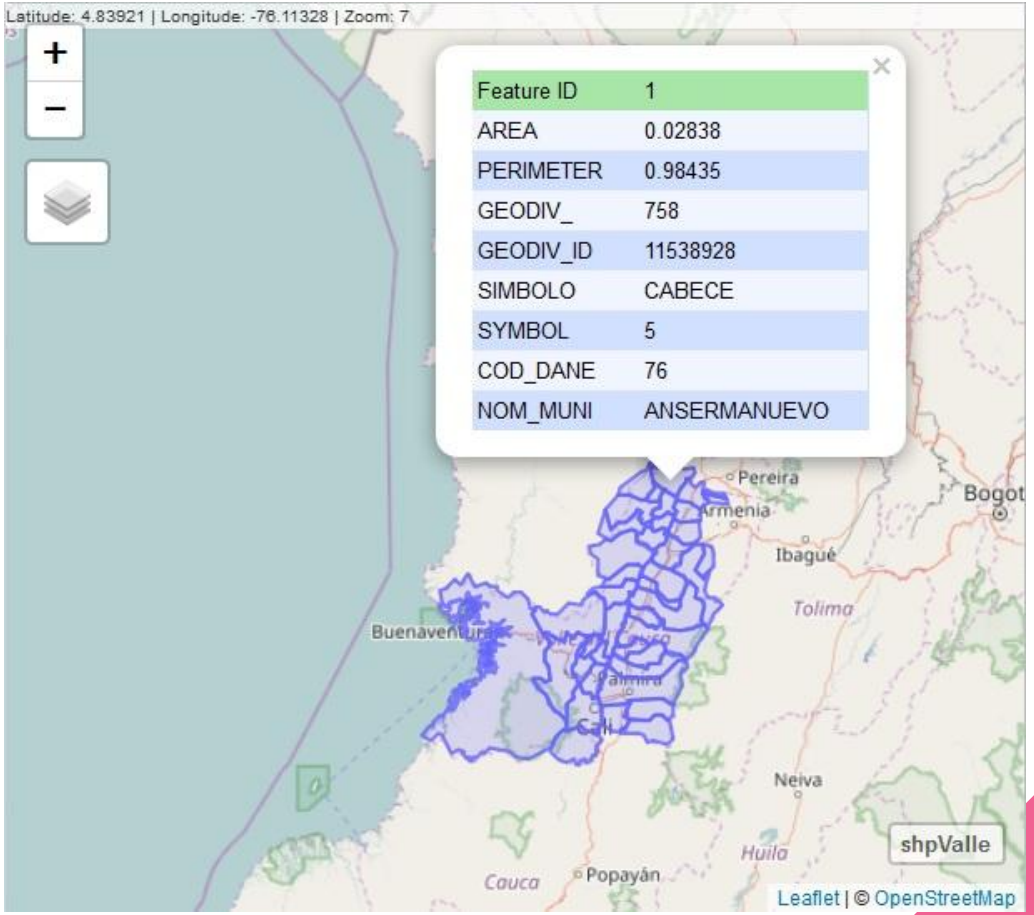
```
> require(leaflet)
> require(raster)
> img = raster("...dir/2011_1_Filled.LST_Day_1km.tif")
> pal <- colorNumeric(c("#0C2C84", "#41B6C4", "#FFFFCC"), values(img),na.color = "transparent")
> leaflet() %>% addTiles() %>%  addRasterImage(img, colors = pal, opacity = 0.8) %>%  addLegend(pal = pal, values = values(img),title = "Temperatura Superficial (°C)") # MAPA INTERACTIVO LEAFLET
```



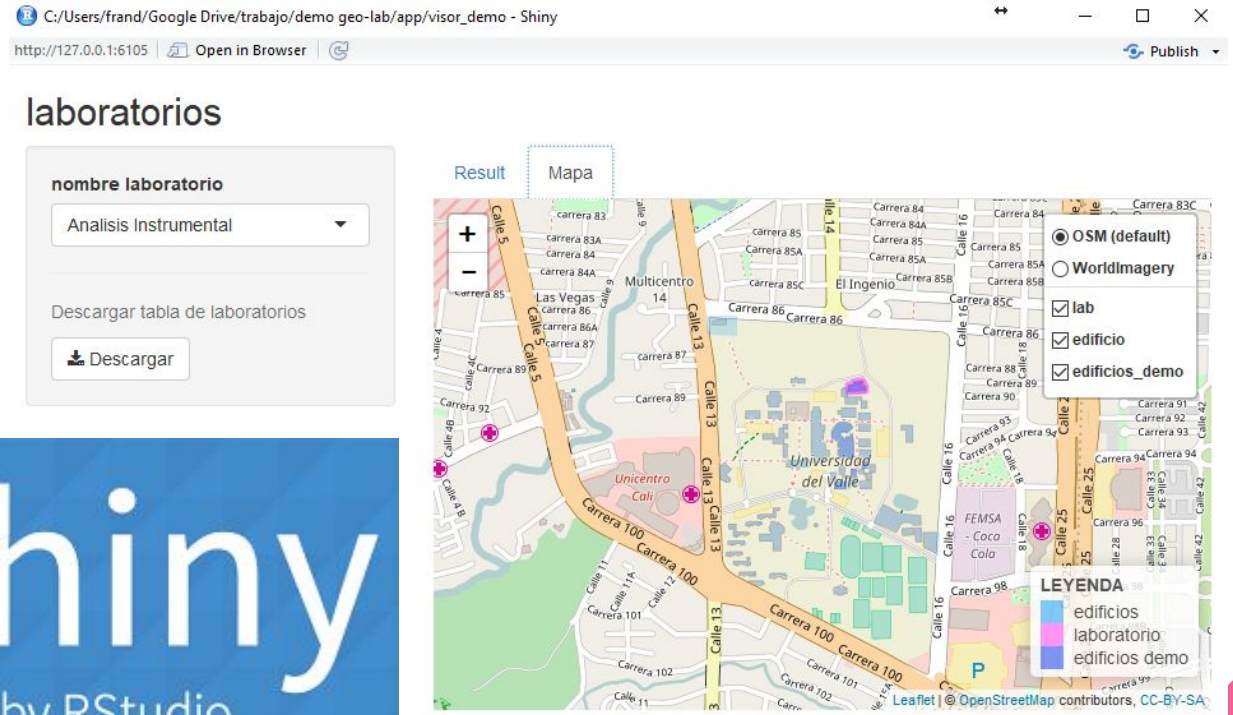
```
> require(mapview)
> mapview(img)
```



```
> require(mapview)
> mapview(shpValle)
```



WEB



Shiny

Shiny
by RStudio