Mi proyecto
Subtítulo
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Mi resumen

Keywords: palabra clave 1, palabra clave 2

1   Introducción

Cuál es la distribución espacial de los puntos de calor - Hot Spots para los incendios forestale

Para él o las áreas con mayor índice de influencia.

Qué relación existe entre este resultado y las elevaciones del área?
Qué relación existe entre este resultado y las pendientes del área?
Qué relación existe entre este resultado y la cobertura arbórea del área?
Qué relación existe entre este resultado y el uso de suelo del área?
Qué relación existe entre este resultado y la cobertura agrícola del área?

Data a usar
Para el desarrollo de este trabajo se estará usando la siguiente información

Incendios forestales "https://firms.modaps.eosdis.nasa.gov/download/create.php" (Información de
Variables climaticas "http://www.worldclim.org/" (10m)
    Temperatura Minima (C°)
    Temperatura Maxima (C°)
    Temperatura Promedio (C°)
    Precipitacion (mm)
    Radiación Solar (Kj m-2 day-1)
    Velocidad del viento (m s-1)
    Presion de Vapor de agua (KPa)

Es de resaltar que para las siguiente data se realizará una selección basada en los resultados
del análisis de hot-spots realizado.

Elevaciones "https://www.eorc.jaxa.jp/ALOS/en/aw3d30/index.htm"
Pendientes -> Se realizará un análisis de pendientes basado el modelo DEM (Digital Elevation Mod
Cobertura arbórea http://earthenginepartners.appspot.com/science-2013-global-forest
Uso de suelo http://due.esrin.esa.int/page_globcover.php
Cobertura agrícola "Por definir"

2 Metodología

...

3 Resultados

...

4 Discusión o Conclusiones

...

5 Información de soporte

...

6 *Script* reproducible

```r
library(sf)
```

```
## Linking to GEOS 3.7.1, GDAL 2.4.2, PROJ 5.2.0
```

```r
library(sp)
library(raster)
library(tidyverse)
```

```
## -- Attaching packages -------------------------------------------------------------

## v ggplot2 3.2.1      v purrr   0.3.3
## v tibble  2.1.3      v dplyr   0.8.3
## v tidyr   1.0.0      v stringr 1.4.0
## v readr   1.3.1      v forcats 0.4.0

## -- Conflicts ---------------------------------------------------------------------
## x tidyr::extract() masks raster::extract()
## x dplyr::filter()  masks stats::filter()
## x dplyr::lag()     masks stats::lag()
## x dplyr::select()  masks raster::select()
```

```r
library(tmap)
library(RColorBrewer)
library(lmtest)
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```r
library(spdep)
```

```
## Loading required package: spData

## To access larger datasets in this package, install the spDataLarge
## package with: 'install.packages('spDataLarge',
## repos='https://nowosad.github.io/drat/', type='source')'
```

```r
#carga de capas y transformación
incendios <- st_read(dsn = "data/Incendios/FiredataBuffer.shp")
```

```
## Reading layer 'FiredataBuffer' from data source '/home/ingdi/unidad-0-asignacion-99-mi-proyec
## Simple feature collection with 66803 features and 17 fields
## geometry type:  POINT
## dimension:      XY
## bbox:           xmin: -71.97234 ymin: 17.66494 xmax: -68.34374 ymax: 19.92763
## epsg (SRID):    4326
## proj4string:    +proj=longlat +datum=WGS84 +no_defs
```

```r
mun <- st_read(dsn = 'data/DivisionRD/divisionRD.gpkg', layer = 'MUNCENSO2010')
```

```
## Reading layer 'MUNCENSO2010' from data source '/home/ingdi/unidad-0-asignacion-99-mi-proyecto
## Simple feature collection with 155 features and 5 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: 182215.8 ymin: 1933532 xmax: 571365.3 ymax: 2205216
## epsg (SRID):    32619
## proj4string:    +proj=utm +zone=19 +datum=WGS84 +units=m +no_defs
```

```r
mun4326 <- st_transform(mun, crs = 4326)
usoSuelo <- raster('data/UsoSuelo/GLOBCOVER_RD.color.tif')

#extracción de datos raster
incUsoSuelo <- raster::extract(usoSuelo, incendios,sp=TRUE)
incForestales <- subset(incUsoSuelo,incUsoSuelo$GLOBCOVER_RD.color>20 & incUsoSuelo$GLOBCOVER_RD
incForestales.df <- data.frame(incForestales)
summary(incForestales.df[[18]])
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   30.00   30.00   30.00   37.91   40.00  120.00
```

```
colnames(incForestales.df)
```

```
##  [1] "LONGITUDE"          "LATITUDE"           "SYMBOL"
##  [4] "ACQ_DATE"           "ACQ_TIME"           "BRIGHTNESS"
##  [7] "BRIGHT_T31"         "BRIGHT_TI4"         "BRIGHT_TI5"
## [10] "CONFIDENCE"         "CONFIDEN_1"         "INSTRUMENT"
## [13] "LAYER"              "SATELLITE"          "SCAN"
## [16] "TRACK"              "VERSION"            "GLOBCOVER_RD.color"
## [19] "coords.x1"          "coords.x2"          "optional"
```
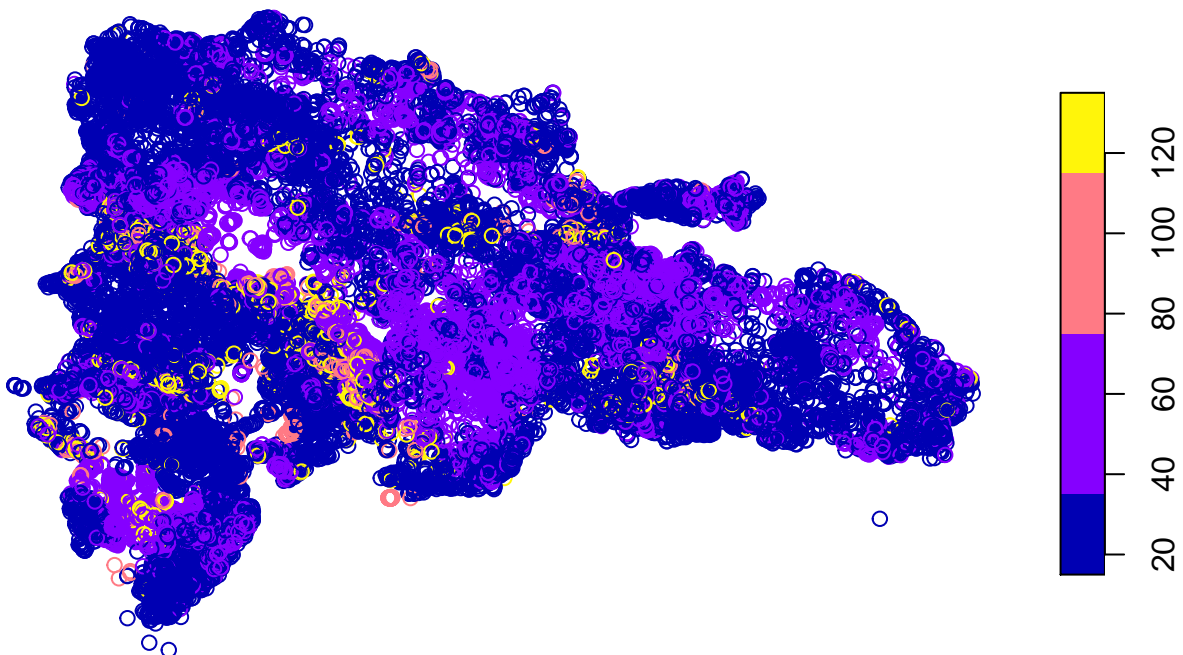
```
#
incForestales.sf <- st_as_sf(incForestales)
incendiosForestales <- st_intersection(incForestales.sf,mun4326)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
## Warning: attribute variables are assumed to be spatially constant
## throughout all geometries
```

```
plot(incendiosForestales['GLOBCOVER_RD.color'])
```


GLOBCOVER_RD.color

```
table(incendiosForestales$ENLACE)
```

```
##
## 010901 010902 010903 010904 011801 011802 011803 011804 011805 011806
```

```
##     52      4    199     31     76     30      5     58     22    270
## 011807 011808 011809 012501 012502 012503 012504 012505 012506 012507
##    230    129    102    197     62    187      4    783     44     23
## 012508 012509 021301 021302 021303 021304 022401 022402 022403 022404
##      7     26    398    925    223    115    495    180     44     47
## 022801 022802 022803 030601 030602 030603 030604 030605 030606 030607
##    360     31    187    363    101     15     49    170     84     72
## 031401 031402 031403 031404 031901 031902 031903 032001 032002 032003
##    377     47    107    223     60     45     14    356    338    236
## 040501 040502 040503 040504 040505 041501 041502 041503 041504 041505
##    224    371    193    804     87    634    284   1158    139    280
## 041506 042601 042602 042603 042701 042702 042703 050201 050202 050203
##    213    747    418    130    616    418    150    518     68    412
## 050204 050205 050206 050207 050208 050209 050210 051701 051702 052101
##    621    262     72     25    462    369    200    572     22    185
## 052102 052103 052104 052105 052106 052107 052108 053101 053102 053103
##     23     22     42    337    176     70    104    285     44    104
## 060301 060302 060303 060304 060305 060401 060402 060403 060404 060405
##    555    474    341    475    247    349    290   1325    126    127
## 060406 060407 060408 060409 060410 060411 061001 061002 061003 061004
##     42    146     84     36    551    128    267    423    213    150
## 061005 061006 061601 061602 070701 070702 070703 070704 070705 070706
##    152    308   1359   1536    216    265    102     83   1587    241
## 072201 072202 072203 072204 072205 072206 080801 080802 081101 081102
##   2221    784    407    154    901    441    579    148    931    541
## 081201 081202 081203 092301 092302 092303 092304 092305 092306 092901
##     68     85    120    265    797    178    231    223    235    358
## 092902 092903 092904 092905 093001 093002 093003 100101 103201 103202
##   1512    653    543     42    512    484     82      3     73      7
## 103203 103204 103205 103206 103207
##    241    151    518     10    376
```

```r
#Conversion a Poligono
munInc <-arrange(mun4326, ENLACE)
munInc$NumIncendios <- c(table(incendiosForestales$ENLACE))
plot(munInc['NumIncendios'])
```

# NumIncendios
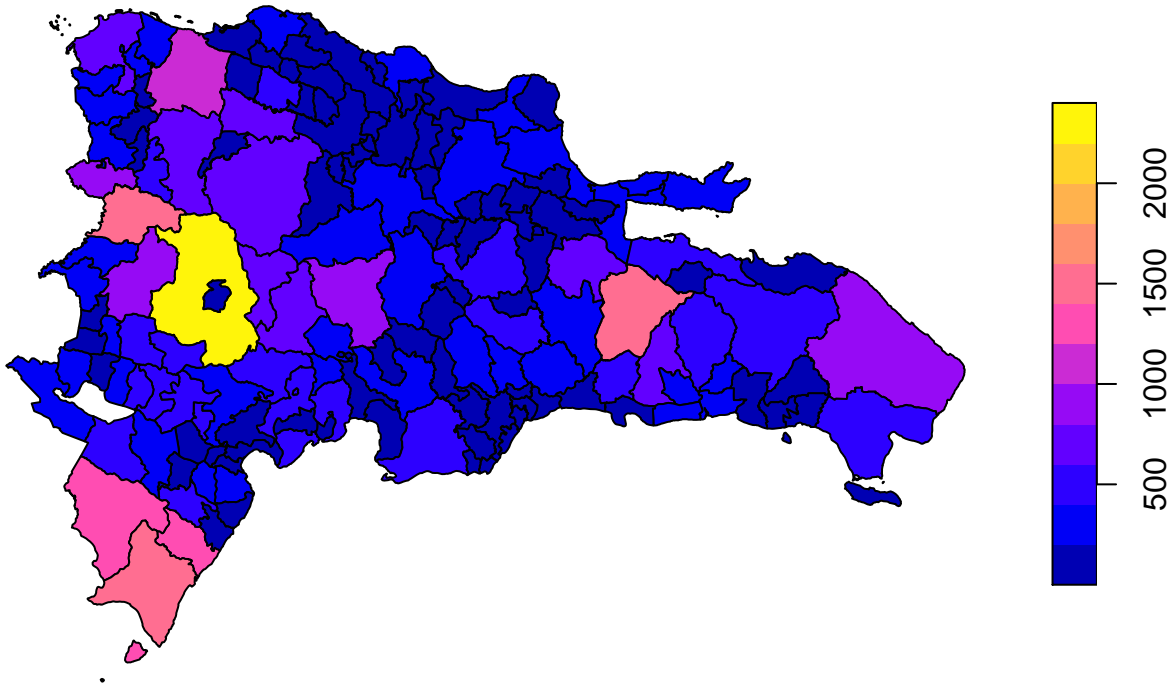

```
#Vecindad
munInc.sp <- as_Spatial(munInc)
colnames(munInc.sp@data)
```

```
## [1] "PROV"         "MUN"          "REG"          "TOPONIMIA"
## [5] "ENLACE"       "NumIncendios"
```

```
row.names(munInc.sp) <- as.character(munInc.sp$TOPONIMIA)
munInc.nb <- poly2nb(munInc.sp, queen = TRUE)
summary(munInc.nb)
```

```
## Neighbour list object:
## Number of regions: 155
## Number of nonzero links: 804
## Percentage nonzero weights: 3.346514
## Average number of links: 5.187097
## Link number distribution:
##
##  1  2  3  4  5  6  7  8  9 10 11 12 14
##  1 10 20 34 33 22 13 13  4  1  1  2  1
## 1 least connected region:
## JUAN DE HERRERA with 1 link
## 1 most connected region:
## LA VEGA with 14 links
```

```
plot(munInc.sp, border="grey", lwd=0.5)
plot(munInc.nb, coordinates(munInc.sp), add=T)
```
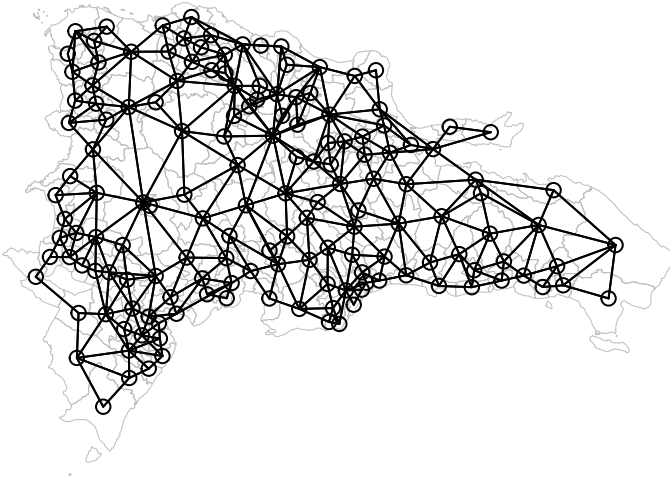


```
#Num Vecinos
coords <- coordinates(munInc.sp)
ident <- row.names(munInc.sp)
munInc.nb.k1 <- knn2nb(knearneigh(coords, k = 1), row.names = ident)
summary(munInc.nb.k1)
```

```
## Neighbour list object:
## Number of regions: 155
## Number of nonzero links: 155
## Percentage nonzero weights: 0.6451613
## Average number of links: 1
## Non-symmetric neighbours list
## Link number distribution:
##
##    1
## 155
## 155 least connected regions:
## MOCA CAYETANO GERMOSÉN GASPAR HERNÁNDEZ JAMAO AL NORTE PUERTO PLATA ALTAMIRA GUANANICO IMBERT
## 155 most connected regions:
## MOCA CAYETANO GERMOSÉN GASPAR HERNÁNDEZ JAMAO AL NORTE PUERTO PLATA ALTAMIRA GUANANICO IMBERT
```

```
card(munInc.nb.k1)
```

```
##   [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [36] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [71] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [106] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [141] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

```
plot(munInc.sp, border="grey", lwd=0.5)
plot(munInc.nb.k1, coordinates(munInc.sp), add=T)
```
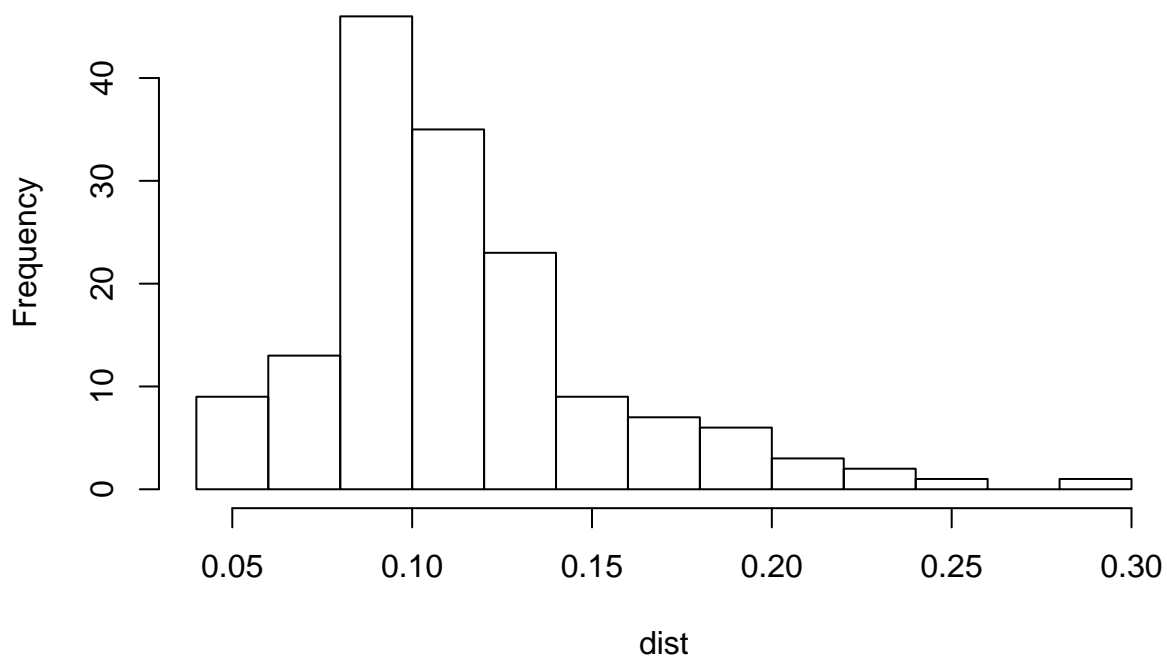


```
is.symmetric.nb(munInc.nb.k1)
```

```
## [1] FALSE
```

```
dist <- unlist(nbdists(munInc.nb.k1, coords))
summary(dist)
```
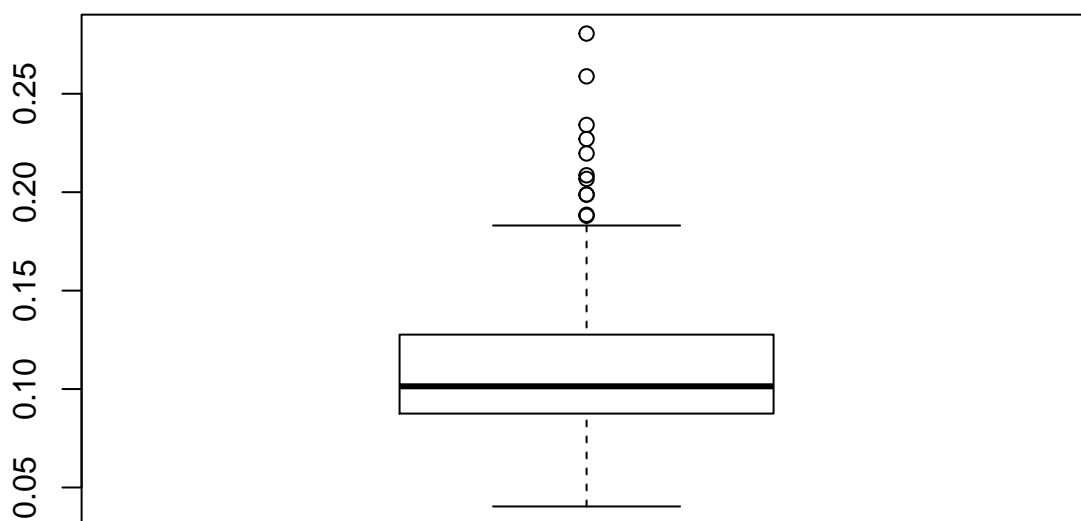
```
##     Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.04036 0.08754 0.10140 0.11396 0.12765 0.28058
```

```
hist(dist)
```

Histogram of dist


```r
boxplot(dist)
```



```r
(distmin <- min(dist))
```

```
## [1] 0.04036477
```

```r
(distmax <- max(dist))
```

```
## [1] 0.2805772
```

```
indicemin <- which(distmin==dist)
ident[indicemin]
```

```
## [1] "SAN JUAN"        "JUAN DE HERRERA"
```

```
indicemax <- which(distmax==dist)
ident[indicemax]
```

```
## [1] "HIGÜEY"
```

```
ident[order(dist)]
```

```
##    [1] "SAN JUAN"               "JUAN DE HERRERA"
##    [3] "BAJOS DE HAINA"         "SANTO DOMINGO OESTE"
##    [5] "LICEY AL MEDIO"         "PUÑAL"
##    [7] "NIZAO"                  "SABANA GRANDE DE PALENQUE"
##    [9] "LOS ALCARRIZOS"         "EL PEÑÓN"
##   [11] "FUNDACIÓN"              "SANTO DOMINGO DE GUZMÁN"
##   [13] "TAMBORIL"               "YAGUATE"
##   [15] "SABANA DE LA MAR"       "EL VALLE"
##   [17] "NEIBA"                  "VILLA JARAGUA"
##   [19] "BISONÓ"                 "VILLA GONZÁLEZ"
##   [21] "LOS RÍOS"               "BARAHONA"
##   [23] "POSTRER RÍO"            "SALCEDO"
##   [25] "TENARES"                "SANTIAGO"
##   [27] "AZUA"                   "PUEBLO VIEJO"
##   [29] "GUANANICO"              "IMBERT"
##   [31] "SAN JOSÉ DE OCOA"       "SABANA LARGA"
##   [33] "SAN CRISTÓBAL"          "SAN GREGORIO DE NIGUA"
##   [35] "SABANA YEGUA"           "TÁBARA ARRIBA"
##   [37] "NAGUA"                  "EL FACTOR"
##   [39] "YAMASÁ"                 "PERALVILLO"
##   [41] "QUISQUEYA"              "GUAYACANES"
##   [43] "ESPERANZA"              "VICENTE NOBLE"
##   [45] "JAQUIMEYES"             "LA CIÉNAGA"
##   [47] "PIMENTEL"               "LAS GUÁRANAS"
##   [49] "HONDO VALLE"            "JUAN SANTIAGO"
##   [51] "FANTINO"                "LA MATA"
##   [53] "CASTILLO"               "EUGENIO MARÍA DE HOSTOS"
##   [55] "JIMA ABAJO"             "CAYETANO GERMOSÉN"
##   [57] "VILLA TAPIA"            "ALTAMIRA"
##   [59] "EL LLANO"               "DAJABÓN"
##   [61] "PEPILLO SALCEDO"        "PARTIDO"
##   [63] "EL PINO"                "SABANA IGLESIA"
##   [65] "CRISTÓBAL"              "JAMAO AL NORTE"
##   [67] "SOSÚA"                  "PARAÍSO"
##   [69] "VILLA LOS ALMÁCIGOS"    "CABRAL"
```

```
##  [71] "SAN PEDRO DE MACORÍS"      "CONSUELO"
##  [73] "PUERTO PLATA"              "VILLA MONTELLANO"
##  [75] "CASTAÑUELAS"               "VILLA VÁSQUEZ"
##  [77] "MAIMÓN"                    "PIEDRA BLANCA"
##  [79] "LAS SALINAS"               "MOCA"
##  [81] "LA ROMANA"                 "GUAYMATE"
##  [83] "LOS HIDALGOS"              "GALVÁN"
##  [85] "CAMBITA GARABITOS"         "POLO"
##  [87] "PEDRO BRAND"               "LA DESCUBIERTA"
##  [89] "LAGUNA SALADA"             "EL CERCADO"
##  [91] "VILLA HERMOSA"             "MONTE CRISTI"
##  [93] "COTUÍ"                     "LAS MATAS DE SANTA CRUZ"
##  [95] "LA VEGA"                   "LOMA DE CABRERA"
##  [97] "PERALTA"                   "GUAYABAL"
##  [99] "LOS LLANOS"                "ENRIQUILLO"
## [101] "VILLA ALTAGRACIA"          "LOS CACAOS"
## [103] "LUPERÓN"                   "RAMÓN SANTANA"
## [105] "JÁNICO"                    "CABRERA"
## [107] "RÍO SAN JUAN"              "RESTAURACIÓN"
## [109] "RANCHO ARRIBA"             "ESTEBANÍA"
## [111] "ARENOSO"                   "VILLA RIVA"
## [113] "SÁNCHEZ"                   "MELLA"
## [115] "COMENDADOR"                "BÁNICA"
## [117] "SANTO DOMINGO NORTE"       "MAO"
## [119] "JIMANÍ"                    "BOCA CHICA"
## [121] "SAN ANTONIO DE GUERRA"     "CEVICOS"
## [123] "VILLA ISABELA"             "TAMAYO"
## [125] "LAS YAYAS DE VIAJAMA"      "SAN IGNACIO DE SABANETA"
## [127] "GASPAR HERNÁNDEZ"          "SANTO DOMINGO ESTE"
## [129] "LAS TERRENAS"              "SAN FRANCISCO DE MACORÍS"
## [131] "DUVERGÉ"                   "MONCIÓN"
## [133] "VALLEJUELO"                "PADRE LAS CASAS"
## [135] "BOHECHÍO"                  "HATO MAYOR"
## [137] "JARABACOA"                 "LAS MATAS DE FARFÁN"
## [139] "PEDRO SANTANA"            "BONAO"
## [141] "LAS CHARCAS"               "BANÍ"
## [143] "SABANA GRANDE DE BOYÁ"     "CONSTANZA"
## [145] "GUAYUBÍN"                  "MONTE PLATA"
## [147] "EL SEIBO"                  "MICHES"
## [149] "OVIEDO"                    "SAN JOSÉ DE LAS MATAS"
## [151] "BAYAGUANA"                 "SAMANÁ"
## [153] "PEDERNALES"                "SAN RAFAEL DEL YUMA"
## [155] "HIGÜEY"
```

```r
#Ponderadoes espaciales
munInc.w.W <- nb2listw(munInc.nb)
munInc.w.W
```

```
## Characteristics of weights list object:
## Neighbour list object:
## Number of regions: 155
## Number of nonzero links: 804
## Percentage nonzero weights: 3.346514
## Average number of links: 5.187097
##
## Weights style: W
## Weights constants summary:
##      n    nn  S0       S1        S2
## W 155 24025 155 65.94606 650.7687
```

```r
munInc.w.B <- nb2listw(munInc.nb, style = 'B')
munInc.w.B
```

```
## Characteristics of weights list object:
## Neighbour list object:
## Number of regions: 155
## Number of nonzero links: 804
## Percentage nonzero weights: 3.346514
## Average number of links: 5.187097
##
## Weights style: B
## Weights constants summary:
##      n    nn  S0   S1    S2
## B 155 24025 804 1608 19520
```

```r
#Correlacion Incendios
munIncPerc <- munInc %>%st_centroid() %>%  mutate(
  'IncPercentage' = munInc$NumIncendios/sum(munInc$NumIncendios)*100,
  'IncPercentage_log' = log1p(munInc$NumIncendios/sum(munInc$NumIncendios)*100),
  'AreaKm2' = as.numeric((st_area(munInc)/1000)),
  'IncXArea' = (munInc$NumIncendios/AreaKm2),
  'IncXArea_log' = log1p(munInc$NumIncendios/AreaKm2),
  x=unlist(map(geom,1)), y=unlist(map(geom,2)))  %>%
  st_drop_geometry()
```

```
## Warning in st_centroid.sf(.): st_centroid assumes attributes are constant
## over geometries of x
```

```
## Warning in st_centroid.sfc(st_geometry(x), of_largest_polygon =
## of_largest_polygon): st_centroid does not give correct centroids for
## longitude/latitude data
```

```r
#Join
munIncPercPol <- munInc %>%
  merge(munIncPerc, all.y=TRUE)
plot(munIncPercPol['ENLACE'])
```
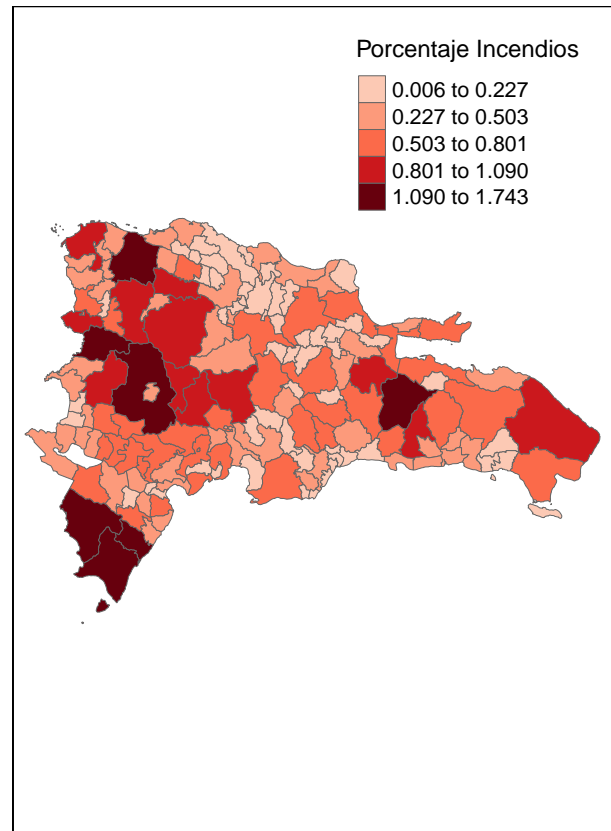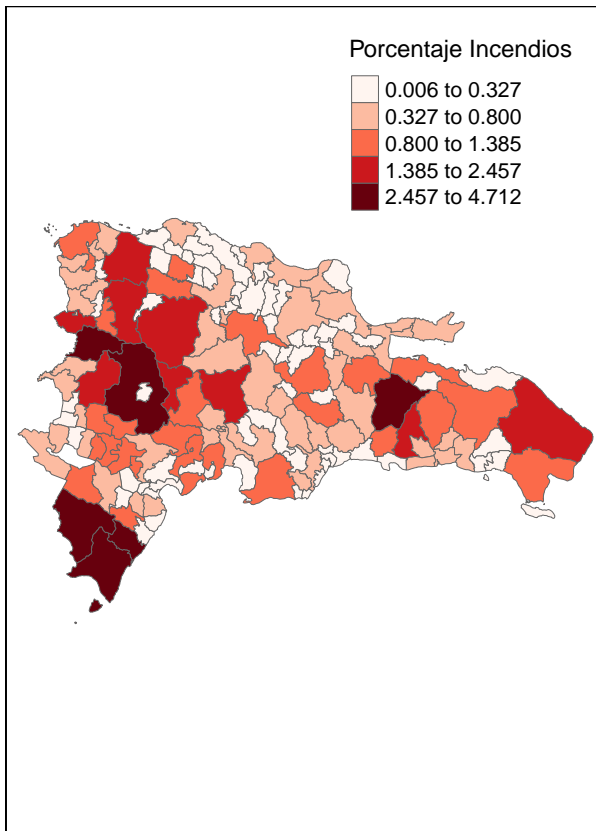
ENLACE
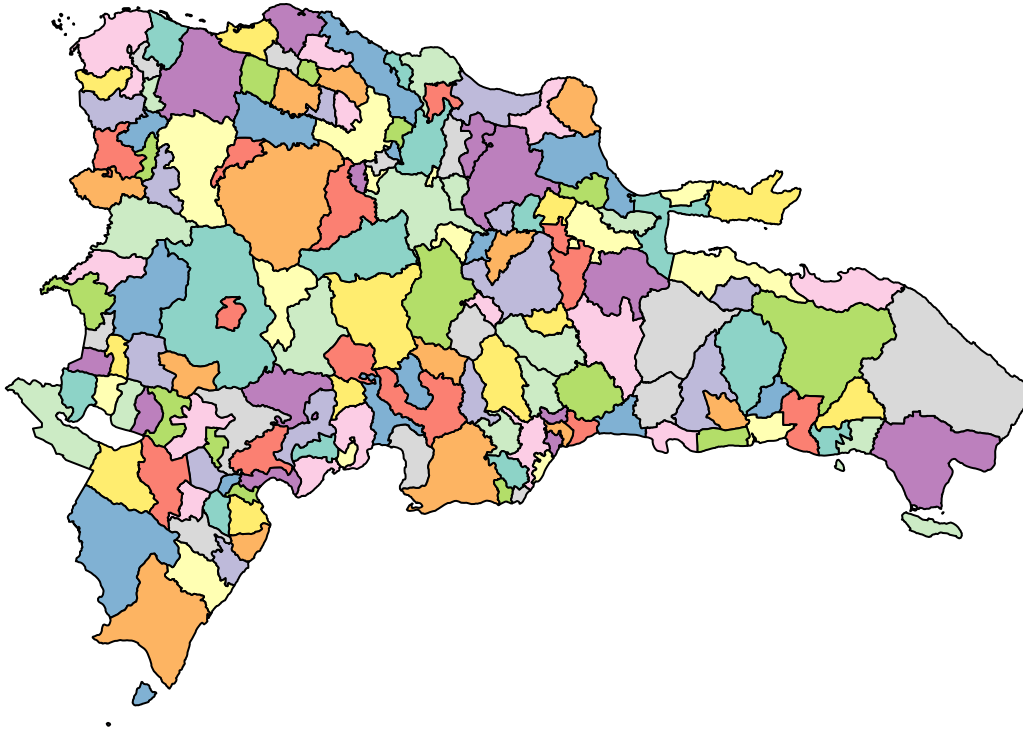

```r
#Mapa Porcentajes
p1 <- tm_shape(munIncPercPol) +
  tm_fill(col = "IncPercentage", style = 'jenks',
          palette = brewer.pal(9, name = 'Reds'), title = 'Porcentaje Incendios') +
  tm_borders(lwd = 0.5)

p2 <- tm_shape(munIncPercPol) +
  tm_fill(col = "IncPercentage_log", style = 'jenks',
          palette = brewer.pal(9, name = 'Reds'), midpoint = NA, title = 'Porcentaje Incendios') +
  tm_borders(lwd = 0.5)

tmap_arrange(p1,p2)
```
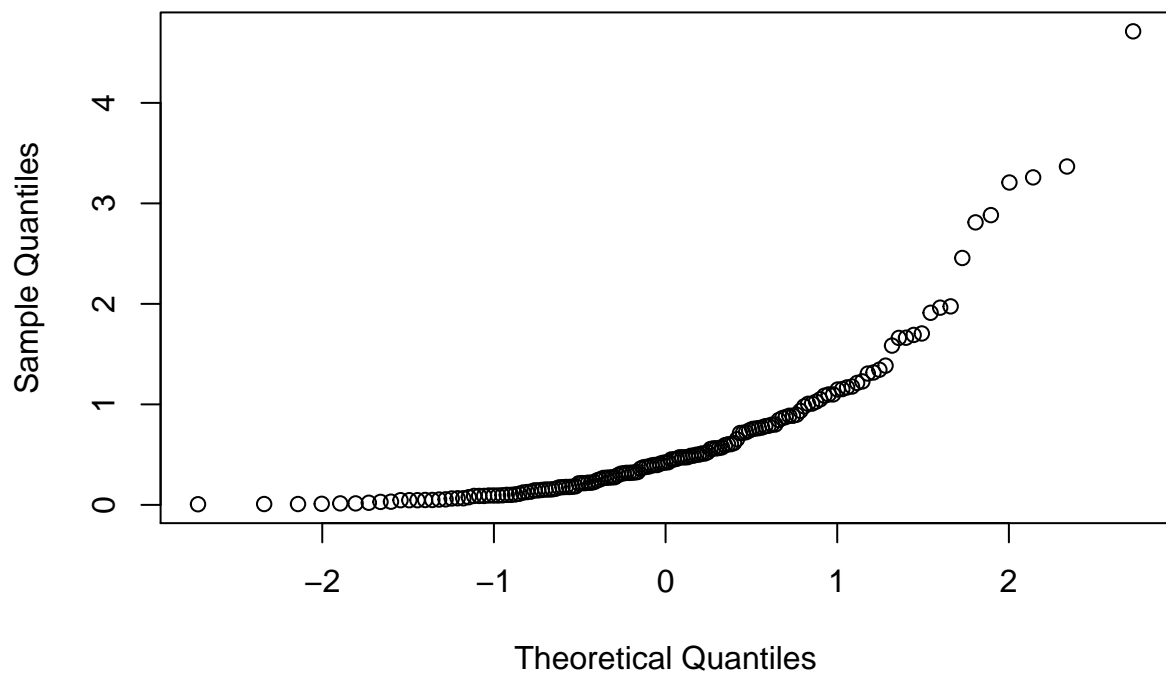
```
#qq
qqnorm(munIncPerc$IncPercentage)
```
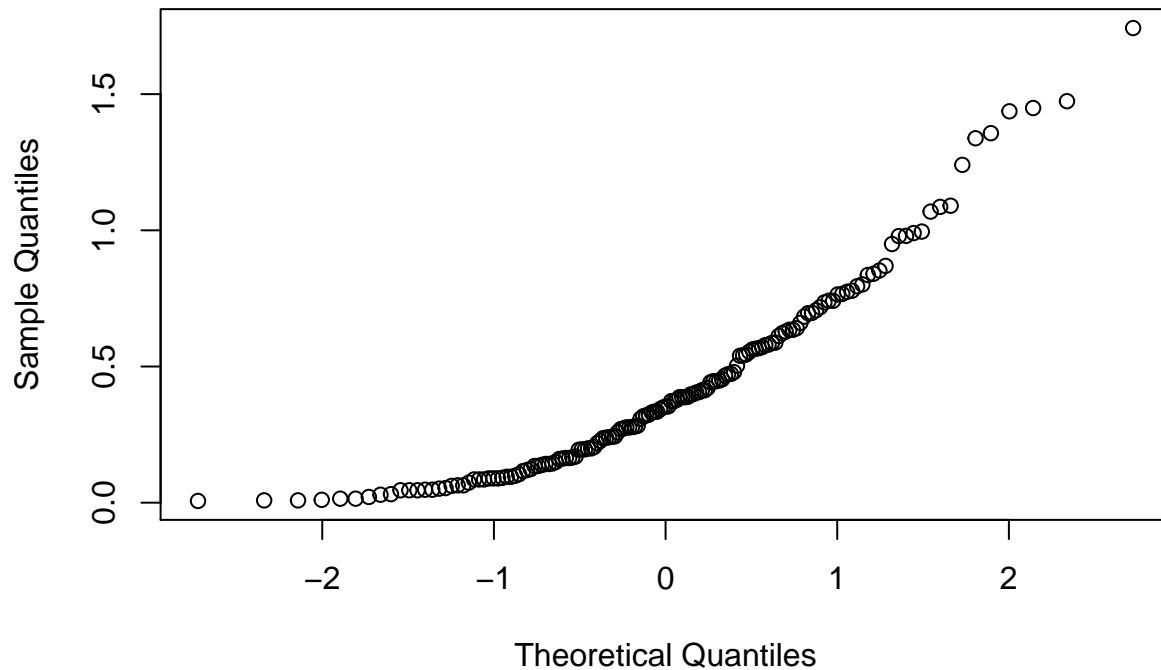
Normal Q–Q Plot

```
shapiro.test(munIncPerc$IncPercentage)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  munIncPerc$IncPercentage
## W = 0.74127, p-value = 3.202e-15
```

```
qqnorm(munIncPerc$IncPercentage_log)
```

Normal Q–Q Plot


```
shapiro.test(munIncPerc$IncPercentage_log)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  munIncPerc$IncPercentage_log
## W = 0.89833, p-value = 6.953e-09
```

```
munIncPerc %>% lm(IncPercentage ~ x, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 1.6534, df = 1, p-value = 0.1985
```

```
munIncPerc %>% lm(IncPercentage ~ y, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 1.1426, df = 1, p-value = 0.2851
```

```
munIncPerc %>% lm(IncPercentage_log ~ x, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 0.61098, df = 1, p-value = 0.4344
```

```
munIncPerc %>% lm(IncPercentage_log ~ y, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 1.3799, df = 1, p-value = 0.2401
```

```
match(attr(munInc.w.W$neighbours, "region.id"), munIncPerc$TOPONIMIA)==1:155
```

```
##   [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [15] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [29] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [43] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [57] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [71] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [85] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [99] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [113] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [127] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [141] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [155] TRUE
```

```
(gmoranw <- moran.test(x = munIncPerc$'IncPercentage_log', listw = munInc.w.W ))
```

```
##
##  Moran I test under randomisation
##
## data:  munIncPerc$IncPercentage_log
## weights: munInc.w.W
```

```
##
## Moran I statistic standard deviate = 6.9272, p-value = 2.146e-12
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic        Expectation           Variance
##       0.348674184       -0.006493506         0.002628733
```

```
(gmoranb <- moran.test(x = munIncPerc$'IncPercentage_log', listw = munInc.w.B))
```

```
##
##   Moran I test under randomisation
##
## data:   munIncPerc$IncPercentage_log
## weights: munInc.w.B
##
## Moran I statistic standard deviate = 7.8512, p-value = 2.06e-15
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic        Expectation           Variance
##       0.374437198       -0.006493506         0.002354052
```

```
moran.plot(x = munIncPerc$IncPercentage_log, listw = munInc.w.W)
```
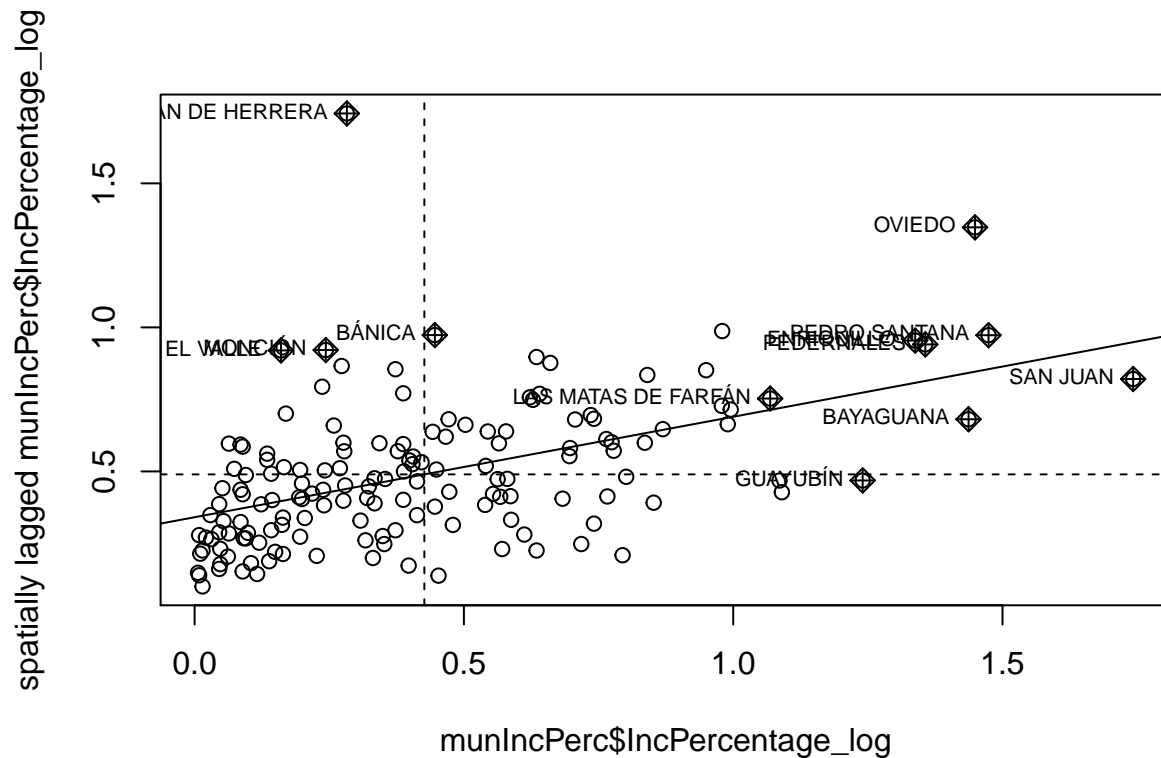


```
source('lisaclusters.R')
lisamap(objesp = munIncPercPol,
```
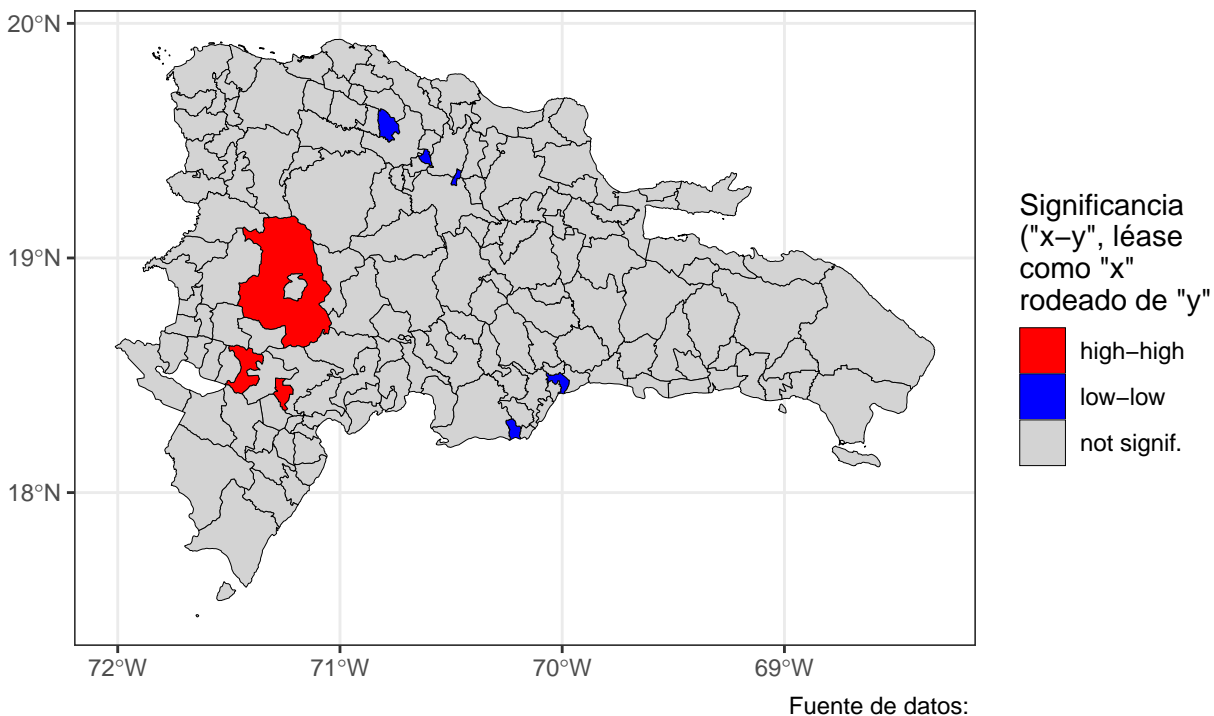
```
        var = 'IncPercentage_log',
        pesos = munInc.w.W,
        tituloleyenda = 'Significancia\n("x-y", léase\ncomo "x"\nrodeado de "y"',
        leyenda = T,
        anchuratitulo = 1000,
        tamanotitulo = 16,
        fuentedatos = '',
        titulomapa = paste0('Clusters LISA de Porcentaje de Incendios Forestales'))
```

$grafico

Clusters LISA de Porcentaje de Incendios Forestales

```
##
## $objeto
## Simple feature collection with 155 features and 16 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: -72.01147 ymin: 17.47033 xmax: -68.32354 ymax: 19.93211
## epsg (SRID):    4326
## proj4string:    +proj=longlat +datum=WGS84 +no_defs
## First 10 features:
##    PROV MUN REG              TOPONIMIA ENLACE NumIncendios IncPercentage
## 1    01  01  10 SANTO DOMINGO DE GUZMÁN 100101            3   0.006364562
## 2    02  01  05                   AZUA 050201          518   1.098947726
## 3    02  02  05            LAS CHARCAS 050202           68   0.144263408
## 4    02  03  05    LAS YAYAS DE VIAJAMA 050203          412   0.874066531
```

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```
## 5      02  04  05          PADRE LAS CASAS 050204         621  1.317464358
## 6      02  05  05                  PERALTA 050205         262  0.555838425
## 7      02  06  05             SABANA YEGUA 050206          72  0.152749491
## 8      02  07  05             PUEBLO VIEJO 050207          25  0.053038018
## 9      02  08  05            TÁBARA ARRIBA 050208         462  0.980142566
## 10     02  09  05                 GUAYABAL 050209         369  0.782841141
##    IncPercentage_log   AreaKm2      IncXArea IncXArea_log         x
## 1        0.006344394  91496.44 3.278816e-05 3.278762e-05 -69.94175
## 2        0.741436136 416240.47 1.244473e-03 1.243699e-03 -70.80988
## 3        0.134761118 246535.55 2.758223e-04 2.757843e-04 -70.54611
## 4        0.628110685 430819.68 9.563166e-04 9.558596e-04 -70.99966
## 5        0.840473639 573560.72 1.082710e-03 1.082124e-03 -70.91135
## 6        0.442014580 129359.98 2.025356e-03 2.023308e-03 -70.78275
## 7        0.142149950 113903.67 6.321131e-04 6.319134e-04 -70.88809
## 8        0.051679337  48080.24 5.199641e-04 5.198289e-04 -70.78029
## 9        0.683168845 274864.78 1.680827e-03 1.679415e-03 -70.91510
## 10       0.578208238 235349.38 1.567882e-03 1.566654e-03 -70.76497
##          y                   geometry puntuacionz lagpuntuacionz
## 1  18.48488 MULTIPOLYGON (((-69.89794 1... -1.19133383     0.35324679
## 2  18.42093 MULTIPOLYGON (((-70.71457 1...  0.89259640    -0.55810348
## 3  18.39184 MULTIPOLYGON (((-70.50185 1... -0.82728200     0.35821362
## 4  18.60405 MULTIPOLYGON (((-70.85774 1...  0.57132720    -0.74175652
## 5  18.80900 MULTIPOLYGON (((-70.77551 1...  1.17336033     0.21171873
## 6  18.60198 MULTIPOLYGON (((-70.73131 1...  0.04375864    -0.10336069
## 7  18.41374 MULTIPOLYGON (((-70.83014 1... -0.80633521    -0.22051577
## 8  18.39309 MULTIPOLYGON (((-70.79387 1... -1.06281265     0.31361084
## 9  18.49605 MULTIPOLYGON (((-70.83352 1...  0.72741298    -0.09605209
## 10 18.71745 MULTIPOLYGON (((-70.68664 1...  0.42985749     0.45866074
##       quad_sig
## 1  not signif.
## 2  not signif.
## 3  not signif.
## 4  not signif.
## 5  not signif.
## 6  not signif.
## 7  not signif.
## 8  not signif.
## 9  not signif.
## 10 not signif.
```
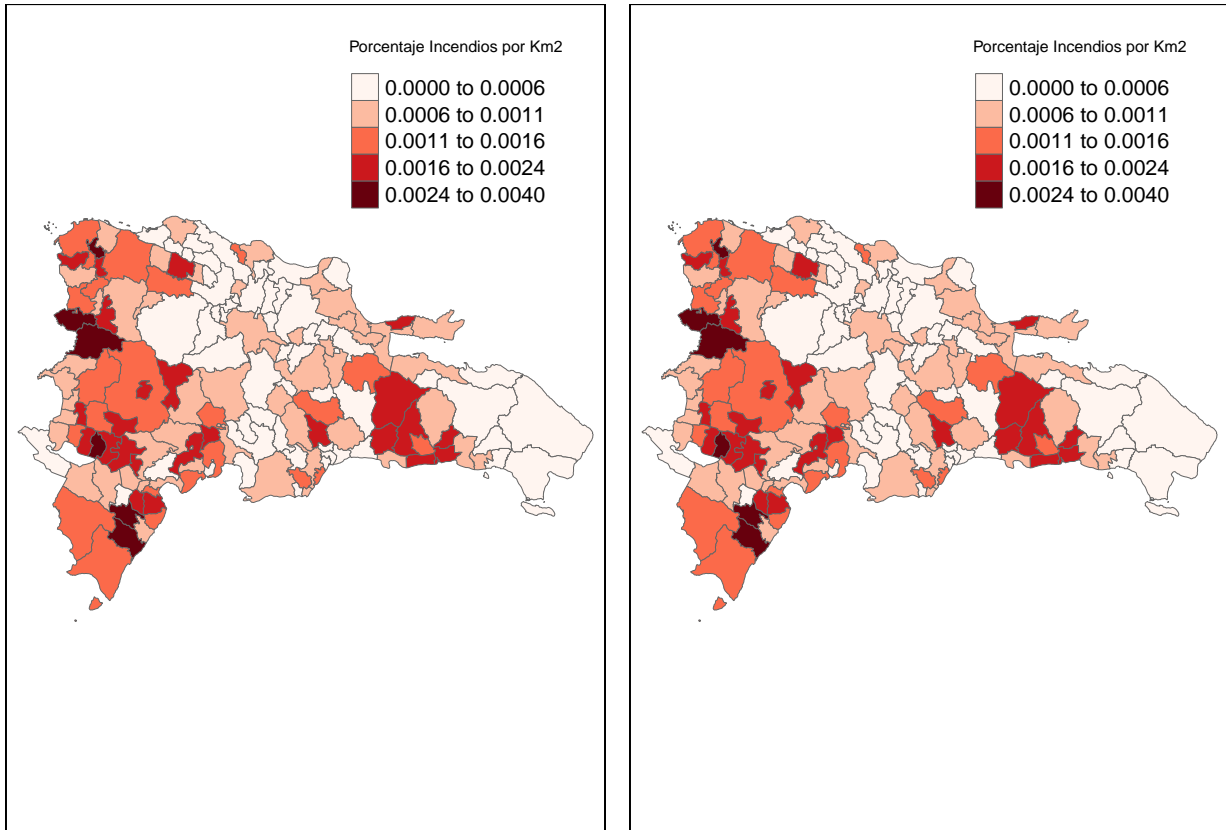
```r
# Mapa Porcentaje por Km2
p3 <- tm_shape(munIncPercPol) +
  tm_fill(col = "IncXArea", style = 'jenks',
          palette = brewer.pal(9, name = 'Reds'), title = 'Porcentaje Incendios por Km2') +
  tm_borders(lwd = 0.5)
p4 <- tm_shape(munIncPercPol) +
  tm_fill(col = "IncXArea_log", style = 'jenks',
```

```
        palette = brewer.pal(9, name = 'Reds'), title = 'Porcentaje Incendios por Km2') +
  tm_borders(lwd = 0.5)
```
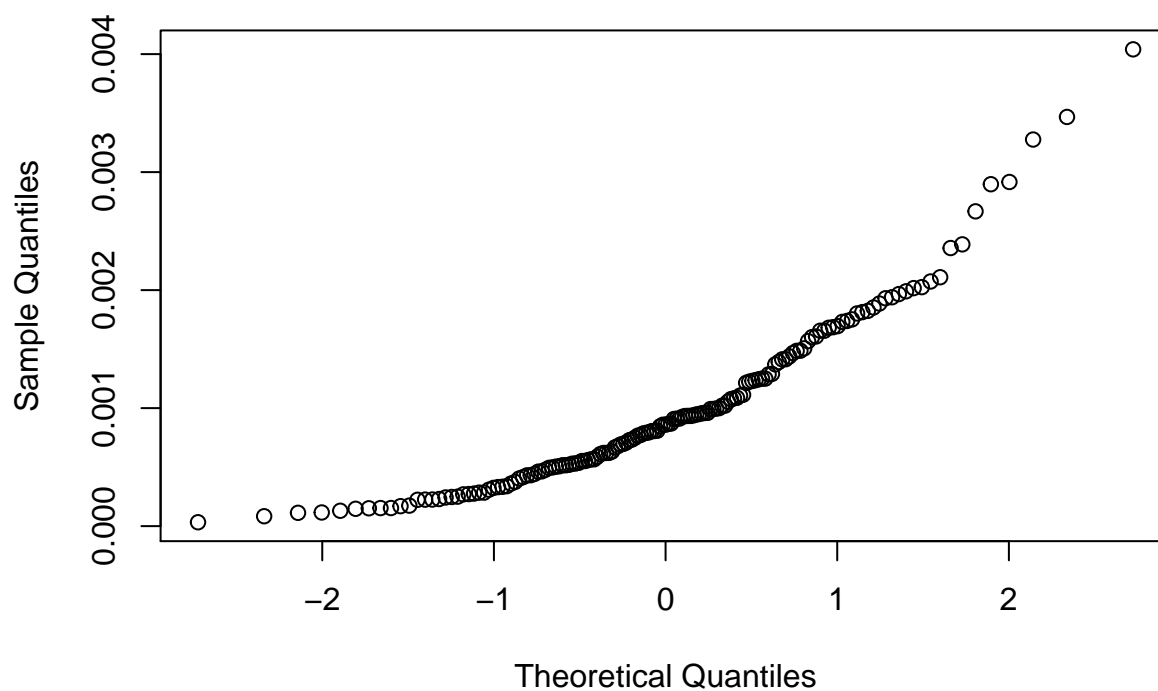
```
tmap_arrange(p3,p4)
```



```
#qq
qqnorm(munIncPerc$IncXArea)
```
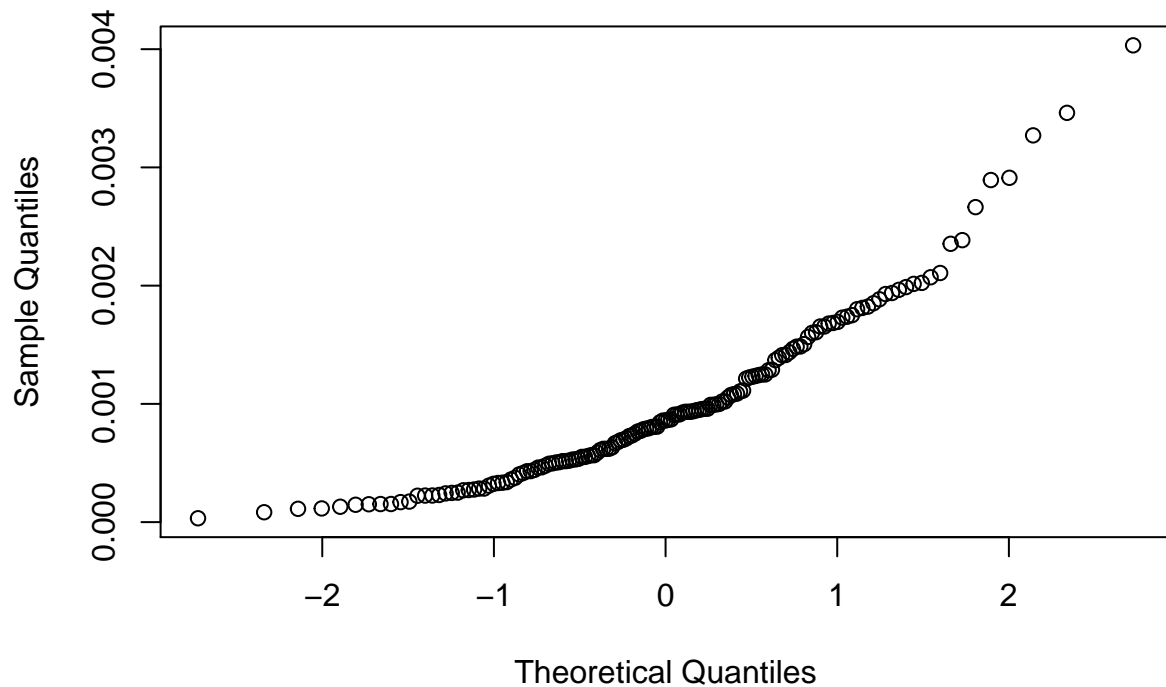
Normal Q–Q Plot


```
shapiro.test(munIncPerc$IncXArea)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  munIncPerc$IncXArea
## W = 0.89846, p-value = 7.076e-09
```

```
qqnorm(munIncPerc$IncXArea_log)
```

Normal Q–Q Plot


```r
shapiro.test(munIncPerc$IncXArea_log)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  munIncPerc$IncXArea_log
## W = 0.89875, p-value = 7.342e-09
```

```r
munIncPerc %>% lm(IncXArea ~ x, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 3.3994, df = 1, p-value = 0.06522
```

```r
munIncPerc %>% lm(IncXArea ~ y, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 0.41244, df = 1, p-value = 0.5207
```

```r
munIncPerc %>% lm(IncXArea_log ~ x, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 3.3927, df = 1, p-value = 0.06548
```

```r
munIncPerc %>% lm(IncXArea_log ~ y, .) %>% bptest()
```

```
##
##  studentized Breusch-Pagan test
##
## data:  .
## BP = 0.41022, df = 1, p-value = 0.5219
```

```r
match(attr(munInc.w.W$neighbours, "region.id"), munIncPerc$TOPONIMIA)==1:155
```

```
##   [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [15] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [29] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [43] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [57] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [71] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [85] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
##  [99] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [113] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [127] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [141] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
## [155] TRUE
```

```r
(gmoranw <- moran.test(x = munIncPerc$'IncXArea_log', listw = munInc.w.W ))
```

```
##
##  Moran I test under randomisation
##
## data:  munIncPerc$IncXArea_log
## weights: munInc.w.W
##
## Moran I statistic standard deviate = 7.6926, p-value = 7.207e-15
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic       Expectation          Variance
##      0.386575214      -0.006493506       0.002610878
```

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```
(gmoranb <- moran.test(x = munIncPerc$'IncXArea_log', listw = munInc.w.B))
```

```
##
##  Moran I test under randomisation
##
## data:  munIncPerc$IncXArea_log
## weights: munInc.w.B
##
## Moran I statistic standard deviate = 7.97, p-value = 7.932e-16
## alternative hypothesis: greater
## sample estimates:
## Moran I statistic       Expectation          Variance
##      0.378897197       -0.006493506         0.002338207
```

```
moran.plot(x = munIncPerc$IncXArea_log, listw = munInc.w.W)
```
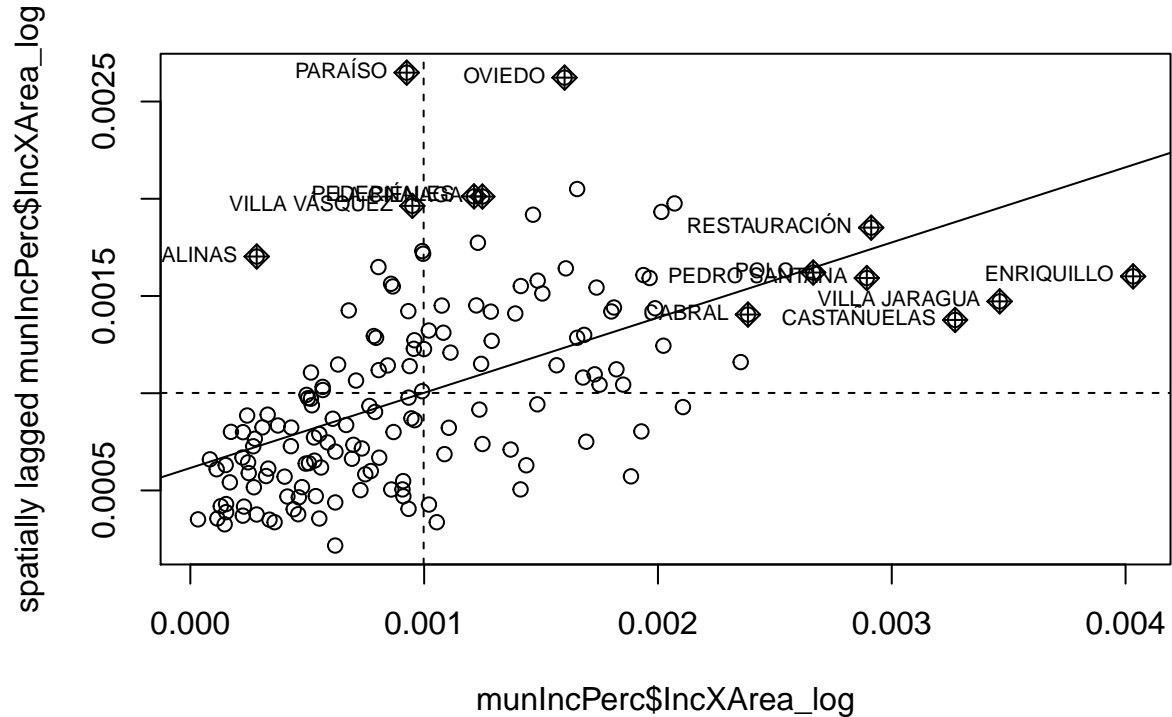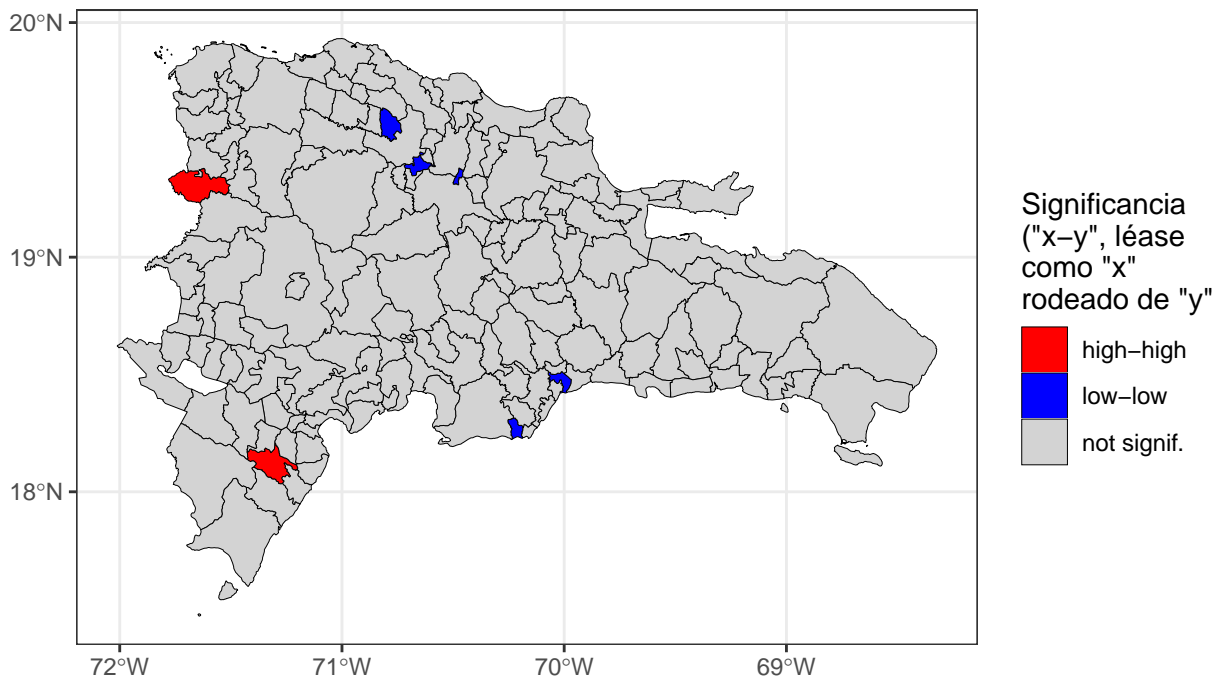


```
source('lisaclusters.R')
lisamap(objesp = munIncPercPol,
        var = 'IncXArea_log',
        pesos = munInc.w.W,
        tituloleyenda = 'Significancia\n("x-y", léase\ncomo "x"\nrodeado de "y"',
        leyenda = T,
        anchuratitulo = 1000,
        tamanotitulo = 16,
        fuentedatos = '',
        titulomapa = paste0('Clusters LISA de Porcentaje de Incendios Forestales'))
```

$grafico

Clusters LISA de Porcentaje de Incendios Forestales

```
##
## $objeto
## Simple feature collection with 155 features and 16 fields
## geometry type:  MULTIPOLYGON
## dimension:      XY
## bbox:           xmin: -72.01147 ymin: 17.47033 xmax: -68.32354 ymax: 19.93211
## epsg (SRID):    4326
## proj4string:    +proj=longlat +datum=WGS84 +no_defs
## First 10 features:
##    PROV MUN REG               TOPONIMIA ENLACE NumIncendios IncPercentage
## 1    01  01  10 SANTO DOMINGO DE GUZMÁN 100101            3   0.006364562
## 2    02  01  05                    AZUA 050201          518   1.098947726
## 3    02  02  05             LAS CHARCAS 050202           68   0.144263408
## 4    02  03  05     LAS YAYAS DE VIAJAMA 050203          412   0.874066531
## 5    02  04  05         PADRE LAS CASAS 050204          621   1.317464358
## 6    02  05  05                 PERALTA 050205          262   0.555838425
## 7    02  06  05            SABANA YEGUA 050206           72   0.152749491
## 8    02  07  05            PUEBLO VIEJO 050207           25   0.053038018
## 9    02  08  05           TÁBARA ARRIBA 050208          462   0.980142566
## 10   02  09  05                GUAYABAL 050209          369   0.782841141
##    IncPercentage_log   AreaKm2     IncXArea IncXArea_log          x
## 1         0.006344394  91496.44 3.278816e-05 3.278762e-05 -69.94175
## 2         0.741436136 416240.47 1.244473e-03 1.243699e-03 -70.80988
## 3         0.134761118 246535.55 2.758223e-04 2.757843e-04 -70.54611
```

```
## 4        0.628110685 430819.68 9.563166e-04 9.558596e-04 -70.99966
## 5        0.840473639 573560.72 1.082710e-03 1.082124e-03 -70.91135
## 6        0.442014580 129359.98 2.025356e-03 2.023308e-03 -70.78275
## 7        0.142149950 113903.67 6.321131e-04 6.319134e-04 -70.88809
## 8        0.051679337  48080.24 5.199641e-04 5.198289e-04 -70.78029
## 9        0.683168845 274864.78 1.680827e-03 1.679415e-03 -70.91510
## 10       0.578208238 235349.38 1.567882e-03 1.566654e-03 -70.76497
##          y                      geometry puntuacionz lagpuntuacionz
## 1  18.48488 MULTIPOLYGON (((-69.89794 1... -1.34612576     0.66116666
## 2  18.42093 MULTIPOLYGON (((-70.71457 1...  0.34298868     0.29866905
## 3  18.39184 MULTIPOLYGON (((-70.50185 1... -1.00716698     0.26239636
## 4  18.60405 MULTIPOLYGON (((-70.85774 1... -0.05852211    -0.81213107
## 5  18.80900 MULTIPOLYGON (((-70.77551 1...  0.11760616     0.62767676
## 6  18.60198 MULTIPOLYGON (((-70.73131 1...  1.43047345     0.26522721
## 7  18.41374 MULTIPOLYGON (((-70.83014 1... -0.51039837     0.39803286
## 8  18.39309 MULTIPOLYGON (((-70.79387 1... -0.66674625     0.55638749
## 9  18.49605 MULTIPOLYGON (((-70.83352 1...  0.95077431     0.06916901
## 10 18.71745 MULTIPOLYGON (((-70.68664 1...  0.79348187     0.43751696
##         quad_sig
## 1  not signif.
## 2  not signif.
## 3  not signif.
## 4  not signif.
## 5  not signif.
## 6  not signif.
## 7  not signif.
## 8  not signif.
## 9  not signif.
## 10 not signif.
```

7 Referencias