

Geographically weighted regression

Roberto Molowny-Horas (CREAF-EMF)

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We load the abundance data for the Eurasian jay, as before.

```
suppressPackageStartupMessages(library(terra))
suppressPackageStartupMessages(library(sf))
pxy <- vect(st_read("Eurasian_jay.gpkg", quiet = T)) # We will use a SpatVector below.
```

Then, we fetch climatic variables and DEM data from the worldclim.org web site.

```
w <- rast(raster::getData("worldclim", var="bio", res=10)) # Bio variables.
dem <- rast(raster::getData("worldclim", var="alt", res=10)) # DEM in meters.
slope <- terrain(dem,"slope") # Slope in degrees
t_mean <- subset(w,"bio1")/10 # Annual temp.
p_total <- subset(w,"bio12") # Annual precip.
names(t_mean) <- "t_mean" # Naming.
names(p_total) <- "p_total"
names(dem) <- "dem"
names(slope) <- "slope"
```

Next, we crop those rasters for ease of use.

```
t_mean <- crop(t_mean, ext(pxy) + 1)           # Cropping rasters.
p_total <- crop(p_total, ext(pxy) + 1)
dem <- crop(dem, ext(pxy) + 1)
slope <- crop(slope, ext(pxy) + 1)
```

We will extract values of those rasters at the locations of the point pattern.

```
pxy$t_mean <- extract(t_mean, pxy, method="simple")$t_mean  # Add variables
pxy$p_total <- extract(p_total, pxy, method="simple")$p_total
pxy$dem <- extract(dem, pxy, method="simple")$dem
pxy$slope <- extract(slope, pxy, method="simple")$slope
pxy <- na.omit(pxy, field="")
```

It is better to use a planar geometry.

```
pxy <- project(pxy, "epsg:3109")
```

We next load the 'spgwr' R package to carry out Geographically Weighted Regression.

```
suppressPackageStartupMessages(library(spgwr))
```

We build a data.frame and create a SpatialPointsDataFrame object ('sp' R package)

```
library(sp)
df <- data.frame(pxy, crds(pxy))
colnames(df)[match(c("x", "y"), colnames(df))] <- c("Long", "Lat")
coordinates(df) <- ~Long+Lat
```

```
f <- formula(individualCount ~ t_mean+p_total+dem+slope)
bw <- ggwr.sel(formula=f,data=df)
print(bw)
```

```
## Bandwidth: 1241232 CV score: 2211.202
## Bandwidth: 2006351 CV score: 2213.744
## Bandwidth: 768363.1 CV score: 2208.463
## Bandwidth: 476113.7 CV score: 2212.686
## Bandwidth: 895338.1 CV score: 2209.13
## Bandwidth: 656733.8 CV score: 2208.417
## Bandwidth: 702423.6 CV score: 2208.327
## Bandwidth: 706888.5 CV score: 2208.328
## Bandwidth: 702301.1 CV score: 2208.327
## Bandwidth: 701911.6 CV score: 2208.327
## Bandwidth: 701918.9 CV score: 2208.327
## Bandwidth: 701919.2 CV score: 2208.327
## Bandwidth: 701919.3 CV score: 2208.327
## Bandwidth: 701919.1 CV score: 2208.327
## Bandwidth: 701919 CV score: 2208.327
## Bandwidth: 701919.1 CV score: 2208.327
## Bandwidth: 701919.2 CV score: 2208.327
## Bandwidth: 701919.1 CV score: 2208.327
## [1] 701919.1
```

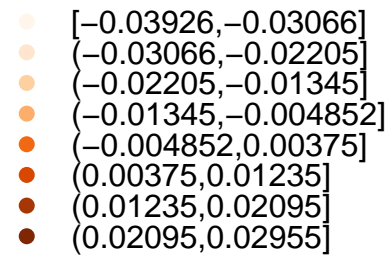
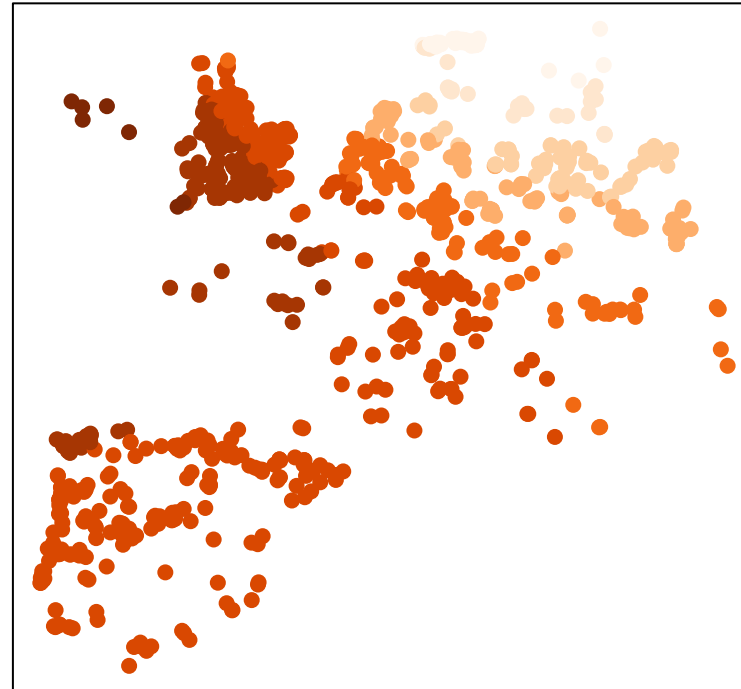
Once the optimum bandwidth has been calculated, we move on to performing a basic GWR.

```
out <- gwr(formula=f,data=df,bandwidth=bw)
```

We are ready to show a plot of the variables.

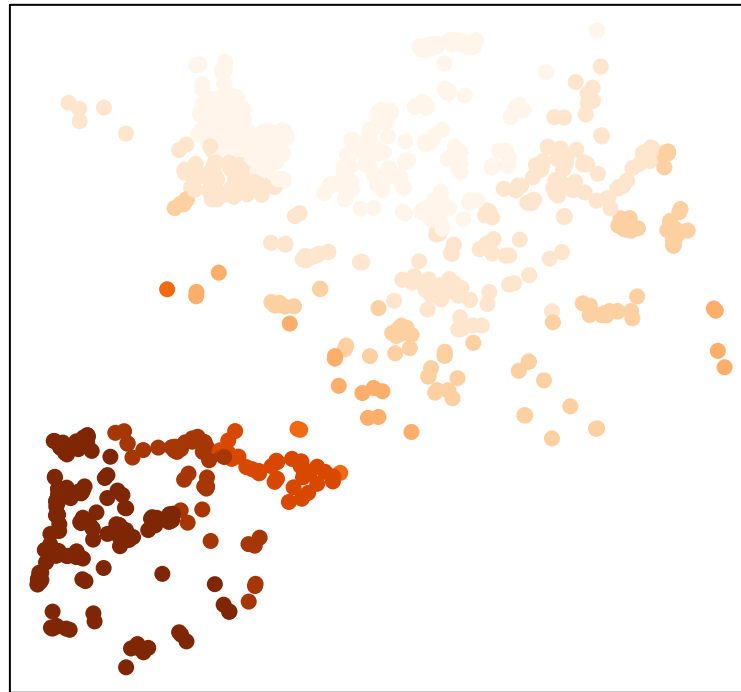
```
library(RColorBrewer)
spplot(out$SDF["t_mean"],col.regions=brewer.pal(9,"Oranges"),cuts=8,main="Temperature - GWR")
```

Temperature - GWR



```
spplot(out$SDF["p_total"],col.regions=brewer.pal(9,"Oranges"),cuts=8,main="Precipitation - GWR")
```

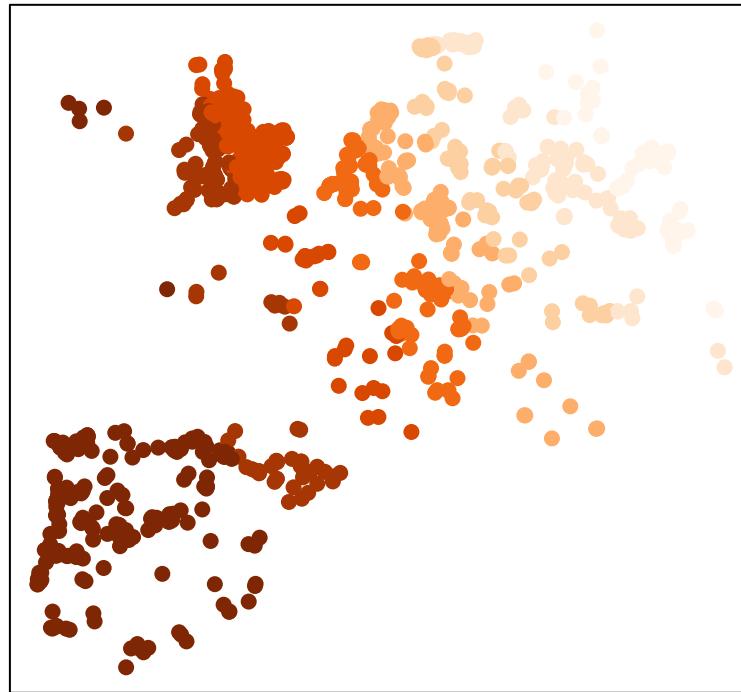
Precipitation - GWR



- [-0.0001876,-0.0001225]
- (-0.0001225,-5.748e-05]
- (-5.748e-05,7.566e-06]
- (7.566e-06,7.261e-05]
- (7.261e-05,0.0001377]
- (0.0001377,0.0002027]
- (0.0002027,0.0002677]
- (0.0002677,0.0003328]

```
spplot(out$SDF["dem"], col.regions=brewer.pal(9, "Oranges"), cuts=8, main="DEM - GWR")
```

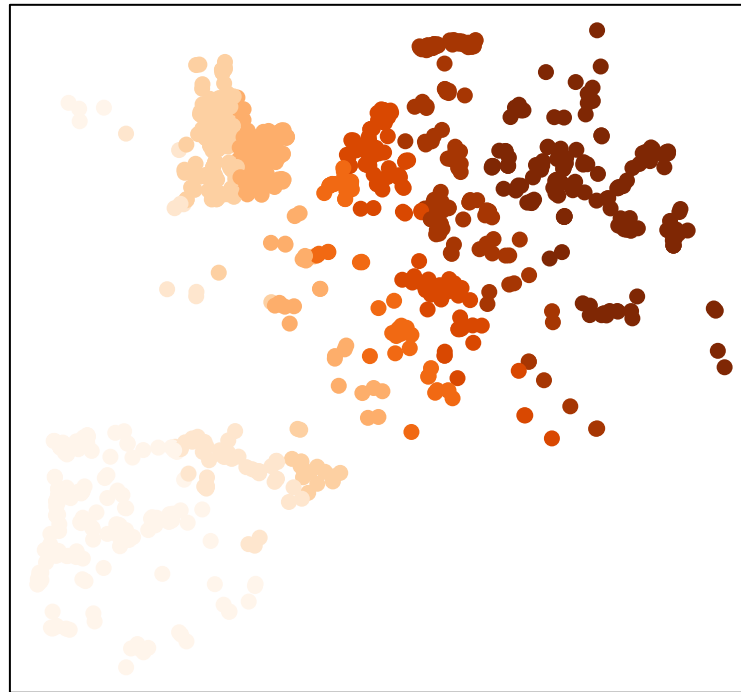
DEM - GWR



- [-0.0007112, -0.0005573]
- (-0.0005573, -0.0004034]
- (-0.0004034, -0.0002495]
- (-0.0002495, -9.565e-05]
- (-9.565e-05, 5.824e-05]
- (5.824e-05, 0.0002121]
- (0.0002121, 0.000366]
- (0.000366, 0.0005199]

```
spplot(out$SDF["slope"],col.regions=brewer.pal(9,"Oranges"),cuts=8,main="Slope - GWR")
```

Slope - GWR



- [0.01149,0.08416]
- (0.08416,0.1568]
- (0.1568,0.2295]
- (0.2295,0.3022]
- (0.3022,0.3748]
- (0.3748,0.4475]
- (0.4475,0.5202]
- (0.5202,0.5929]