First of all we have to install/download packages, and load them.

install.packages("ggplot2") install.packages("dplyr") install.packages("rnaturalearth") install.packages("rnaturalearthdata") install.packages("readxl") install.packages("formattable") install.packages("shiny") install.packages("rgdal") install.packages("ggpubr") install.packages("tidyr") install.packages("RColorBrewer") install.packages("sf") install.packages("raster") install.packages("sp") install.packages("writexl") library("writexl") library("sp") library("raster") library("sf") library("RColorBrewer") library("tidyr") library("ggpubr") library("rgdal") library("shiny") library("formattable") library("readxl") library("rnaturalearthdata") library("rnaturalearth") library("ggplot2") library("dplyr")

First of all set working directory

setwd("/Users/stella/Desktop/Guido Example")

We first look for the path to the file:

file.choose()

then we copy the route:

"/Users/stella/Desktop/Satellite/Shark1/164937-Locations.csv"

Then we charge the datasets:

shark1 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark1/164938-Locations.csv", header = TRUE ,sep = ",") shark1

shark2 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark2??/164940-Locations.csv", header = TRUE ,sep = ",") shark2

shark3 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark3/164939-Locations.csv", header = TRUE ,sep = ",") shark3

shark4 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark 4/164937-Locations.csv", header = TRUE ,sep = ",") shark4

shark5 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark5/220671-Locations.csv", header = TRUE ,sep = ",") shark5

shark6 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark 6/220672-Locations.csv", header = TRUE ,sep = ",") shark6

shark7 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark 7/220668-Locations.csv", header = TRUE ,sep = ",") shark7

shark8 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark 8/220667-Locations.csv", header = TRUE ,sep = ",") shark8

shark9 <- read.csv(file = "/Users/stella/Desktop/Satellite/Shark9/205170-Locations.csv", header = TRUE ,sep = ",") shark9

Now we want to calculate the number of transmissions (number of rows) and the number of

days that the satellite tag was active and emiting signals. To calculate days between dates:

Shark1_start <- as.Date("2016/10/17") Shark1_end <- as.Date("2017/01/27") a = seq(from = Shark1_start, to = Shark1_end, by = 'day') a

We make sure colnames are the same one to be able to merge

colnames(shark1) colnames(shark2) colnames(shark3)

Combine all shark data frames by row

allsharks <- rbind(shark1,shark2,shark3,shark4,shark5,shark6,shark7,shark8,shark9) allsharks

We have to filter out the bad pings

allsharks_mod <- filter(allsharks,Quality %in% c ("3","2","1","A"))

Instert shark table from an excel file/ Or you can also import dataset from Excel in

R studio envirnment

sharktable=read_excel("/Users/stella/Desktop/DCNA/Research/Sharks satellite research.xlsx") sharktable

LImpiamos las columnas que no nos hacen falta

sharktable<-subset(sharktable,select=-c(Comments, 14,15,16)) sharktable

Make table nice

customGreen0 = "#DeF7E9" customGreen = "#71CA97" customRed = "#ff7f7f" formattable(sharktable)

With the first command we alineate the column centre, right or left y and we write shark ID in bold (negrita)

With the second command we will add colors to the variables that we prefer. In general the most importants ones when working

with satellite data are otal transmission and number of dates

formattable(sharktable, align =c("l","c","c","c","c","c","c","c", "c", "c", "c", "c"), list("Shark ID" = formatter("span", style = style(color = "black",font.weight = "bold")), "Total transmissions"=color_bar(customRed), "Number of Days"=color_tile(customGreen0,customGreen)))

Create a basemap for the wide Caribbean

world <- ne_countries(scale = "medium", returnclass = "sf") world basemap <-ggplot(data = world) + geom_sf() + xlab("Longitude") + ylab("Latitude") + ggtitle("Wider Caribbean Region Map")+ coord_sf(xlim = c(-93, -58), ylim = c(7.65, 30.3), expand = FALSE) basemap

Add layers of shapefiles to a basemap (Guido's guidelines)

MPAs <- st_read("/Users/stella/Desktop/Guido Example/Input/MPA_caribbean.shp") EEZs <- st_read("/Users/stella/Desktop/Guido Example/Input/EEZ_Caribbean.shp") Countries <- st_read("/Users/stella/Desktop/Guido Example/Input/Countries_caribbean.shp") basemap <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = allsharks, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemap.PDF") basemap dev.off()

One map with locations ploted for each shark

basemapshark1 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark1, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark1.PDF") basemapshark1 dev.off()

basemapshark3 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark3, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark3.PDF") basemapshark3 dev.off()

basemapshark4 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark4, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark4.PDF") basemapshark4 dev.off()

basemapshark5 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark5, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark5.PDF") basemapshark5 dev.off()

basemapshark6 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark6, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark6.PDF") basemapshark6 dev.off()

basemapshark7 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark7, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark7.PDF") basemapshark7 dev.off()

basemapshark8 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark8, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark8.PDF") basemapshark8 dev.off()

basemapshark9 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark9, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "Basemapshark9.PDF") basemapshark9 dev.off()

combine all this plots with ggarrange

Basemapsharks <- ggarrange(basemapshark1,basemapshark2,basemapshark3,basemapshark4,basemapshark5,basemapshark6,basemapshark7,basemapshark8,basemapshark9 + rremove("x.text"), labels = c("1", "2", "3", "4", "5", "6", "7", "8","9"), ncol = 3, nrow = 3) pdf(file = "Basemapsharks.PDF") Basemapsharks dev.off()

Adding colors to every map

First we add a column to each shark data that says a number of the month they are in:

shark1$Month <- c(1,4,4,4,4) shark3$Month <- c(1,4,4,4,4,4,4,4,4,4,4,22) shark4$Month <- c(1,1,1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,3,4,4,4,4,4,4,4,5,5,5,5,6,6,6,6,6) shark5$Month <- c(1,1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,2,2) shark6$Month <- c(1,1,1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2) shark7$Month <- c(1,1,1,1,1,1,1,1,1,2,2,2,2) shark8$Month <- c(1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2) shark9$Month <- c(1,1 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 ,2, 2, 2, 2, 2, 2, 2, 2 ,2 ,2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,2, 2 ,2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3 ,3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3 ,3 ,3 ,3 ,3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3 ,3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4 ,4,4 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5 ,5,5,5,5,5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6, 6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,6 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7 ,7, 7, 7, 7, 7, 7, 7, 7, 8, 8, 8, 8, 8, 8, 8, 8 ,8 ,8)

With this one the colors are a blue gradient

shark4color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark4, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "green", high = "red", space = "Lab", na.value = "grey50", guide = "colourbar", aesthetics = "fill")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark4color.PDF") shark4color invisible(dev.off())

With this one the colors change form green to blue

shark4color3 <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark4, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark4color3.PDF") shark4color3 invisible(dev.off())

sharks ploted in green/red

shark1color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark1, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark1color.PDF") shark1color invisible(dev.off())

shark3color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark3, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark3color.PDF") shark3color invisible(dev.off())

shark5color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark5, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark5color.PDF") shark5color invisible(dev.off())

shark6color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark6, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark6color.PDF") shark6color invisible(dev.off())

shark7color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark7, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark7color.PDF") shark7color invisible(dev.off())

shark8color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark8, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark8color.PDF") shark8color invisible(dev.off())

shark9color <- ggplot() + geom_sf(data = EEZs, color = "gray", alpha = .1, size = .01) + geom_sf(data = MPAs, fill = "green", alpha = .2, size = .1) + geom_sf(data = Countries, fill = "#666666", size = 0, alpha = .5)+ geom_sf() + geom_point(data = shark9, aes(x= Longitude, y=Latitude, color = Month), size = 4)+ scale_color_gradient(low = "#00F080", high = "#FF6666", space = "Lab", na.value = "grey50", guide = "colourbar")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE) pdf(file = "shark9color.PDF") shark9color invisible(dev.off())

Arrange all the sharks maps with colors by month

Sharks_coloured <- ggarrange(shark1color, shark3color, shark4color3, shark5color, shark6color, shark7color, shark8color, shark9color + rremove("x.text"), labels = c("1", "3", "4", "5", "6", "7", "8","9"), ncol = 2, nrow = 4) pdf(file = "sharks_coloured.PDF") Sharks_coloured dev.off()

Plot sharks locations

basemap + geom_sf() + geom_point(data = allsharks, aes(x= Longitude, y=Latitude), size = 4, shape = 23, fill = "darkred")+ coord_sf(xlim = c(-80, -55), ylim = c(7.65, 20), expand = FALSE)

WARNING:Coordinate system already present. Adding new coordinate system, which will replace the existing one.

Convert Data frames to spatial data (sp)

Spatial_Shark2 <- SpatialPointsDataFrame(shark2[,7:8],shark2, proj4string = CRS(as.character(NA)),bbox=NULL) class(Spatial_Shark2)

Convert Data frames to spatial data (sf)

MPAs <- st_read("/Users/stella/Desktop/Guido Example/Input/MPA_caribbean.shp") EEZs <- st_read("/Users/stella/Desktop/Guido Example/Input/EEZ_Caribbean.shp") Countries <- st_read("/Users/stella/Desktop/Guido Example/Input/Countries_caribbean.shp") utm18nCRS <- crs(Countries)

Trying to do all together

Spatial_allsharks <- st_as_sf(allsharks,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_allsharks)

You can also do it separately

Spatial_Shark1SF <- st_as_sf(shark1,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark1SF)

Spatial_Shark2SF <- st_as_sf(shark2,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark2SF)

Spatial_Shark3SF <- st_as_sf(shark3,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark3SF)

Spatial_Shark4SF <- st_as_sf(shark4,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark4SF)

Spatial_Shark5SF <- st_as_sf(shark5,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark5SF)

Spatial_Shark6SF <- st_as_sf(shark6,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark6SF)

Spatial_Shark7SF <- st_as_sf(shark7,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark7SF)

Spatial_Shark8SF <- st_as_sf(shark8,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark8SF)

Spatial_Shark9SF <- st_as_sf(shark9,coords = c("Longitude", "Latitude"), crs=utm18nCRS) class(Spatial_Shark9SF)

overlay/overlap two sf.

First be sure that both CRS are equal, for that:

st_crs(Spatial_allsharks) == st_crs(EEZs) st_crs(Spatial_Shark4SF) == st_crs(MPAs) st_crs(Spatial_Shark4SF) == st_crs(Countries)

TRUE, then we continue

attribute variables are assumed to be spatially constant throughout all geometries

st_agr(Spatial_allsharks) = "constant" st_agr(EEZs) = "constant" st_agr(MPAs) = "constant" st_agr(Countries) = "constant"

Then we overlap both with the function st_intersection it gives us an output of a column of the EEZ where the shark was at all times!

allsharks_EEZ <- st_intersection (Spatial_allsharks, EEZs)

IT WORKS!!!!!

Then we overlap sharks with MPA

FIRST THIS; if not ERROR: Error in s2_geography_from_wkb(x, oriented = oriented, check = check) :

Evaluation error: Found 1 feature with invalid spherical geometry.

[1] Loop 0 edge 314 crosses loop 5 edge 24.

sf::sf_use_s2(FALSE)

Then we overlap sharks with MPA

allsharks_MPA <- st_intersection (Spatial_allsharks, MPAs) allsharks_MPA <- as.data.frame(allsharks_MPA)

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

THE INTERSECTIONS HAVE CREATED DUPLICATES, THIS REMOVES THEM

allsharks_MPA <- allsharks_MPA%>% distinct(Error.Semi.major.axis, Error.Semi.minor.axis, .keep_all = TRUE) allsharks_EEZ <- allsharks_EEZ%>% distinct(Error.Semi.major.axis, Error.Semi.minor.axis, .keep_all = TRUE)

CALCULATE THE PERCENTAGE OF DETECTIONS FOR EEZ

Check if there is any shark on high seas

allsharks_EEZ[allsharks_EEZ$GEONAME=='' |is.na(allsharks_EEZ)']

It doesn't seem like it because that data got deleted when we intersected it.

Now we have two options, either create a table or a data frame:

Better create a DF:

If we want to create a DATA FRAME:

EEZ_det <- as.data.frame(table(allsharks_EEZ$GEONAME)) EEZ_det

Now we have a frecuency table and we create a new column with the proportions, which will be the frecuency

Divided by the total number of detections/rows, which in this case is 787:

EEZ_det$Proportions <- (EEZ_det$Freq/787) EEZ_det

Now we have to organize the values of proportions from the highest to the lowest:

EEZ_det_organized <- EEZ_det[order(-EEZ_det$Proportions),]

Create a barplot out of the organized proportion data:

barplot(EEZ_det_organized$Proportions, main = "Percentage detections EEZ", xlab = "Exclusive Economic Zones", ylab = "Proportions of detections", names = c("SM", "SB", "SXM", "SA", "AIA", "TR", "VE","SVGN", "BB", "SE", "SL", "GD", "ATBR", "VI"), col = "darkred", horiz = FALSE)

CALCULATE THE PERCENTAGE OF DETECTIONS FOR MPAs

Check if there is any shark on high seas

allsharks_MPA[allsharks_MPA$NAME=='' |is.na(allsharks_NAME)']

It doesn't seem like it either same as before

If we want to create a DATA FRAME:

MPA_det <- as.data.frame(table(allsharks_MPA$NAME)) MPA_det

Now we have a frecuency table and we create a new column with the proportions, which will be the frecuency

Divided by the total number of detections/rows, which in this case is 546:

MPA_det$Proportions <- (MPA_det$Freq/546) MPA_det

Now we have to organize the values of proportions from the highest to the lowest:

MPA_det_organized <- MPA_det[order(-MPA_det$Proportions),]

Create a barplot out of the organized proportion data:

barplot(MPA_det_organized$Proportions, main = "Percentage detections MPA", xlab = "Marine Protected Areas", ylab = "Proportion of detections", names = c("Agoa","SM","Yarari","SA","MoW","SBIHR"), col = "darkred", horiz = FALSE)

Now we want to calculate the amount of time that the shark spent on each EEZ or MPA

First we need to fix the date variable

allsharks$Date <-as.POSIXct(allsharks$Date, format = "%H:%M:%S %d-%b-%Y")

Now we add an extra column just with the dates

allsharks$Fecha <- format(as.POSIXct(allsharks$Date), format="%d-%b-%Y")

allsharks$Time <- format(allsharks$Date,"%H:%M:%S")

HOW TO EXPORT A DATAFRAME IN EXCEL:

write_xlsx(Date frame, "path")

write_xlsx(allsharks,"/Users/stella/Desktop/Guido Example/")

Create a new data frame with the sharks that are not placed in any MPA or EEZ

allsharks$link <- paste0(allsharks$Date, "", allsharks$Ptt) allsharks_MPA$link <- paste0(allsharks_MPA$Date, "", allsharks_MPA$Ptt) allsharks_NoMPAoverlap <- allsharks[!allsharks$link %in% allsharks_MPA$link,]

test1 <- rbind(allsharks_MPA,allsharks_NoMPAoverlap) st_crs(allsharks_MPA) == st_crs(allsharks_NoMPAoverlap)

Create a new dataframe of all sharks and overlap it with MPA and EEZ in order to be able to calculate the

Amount of time each shark has spent in each EEZ or MPA. For that I already worked on the Excel for the rpeparation data

Since the data Argos gives has one single column for date and time and we need one just with the dates.

HOW TO IMPORT A DATAFRAME

allsharks_Date <- read_excel("/Users/stella/Desktop/Guido Example/Allsharks_DATE.xlsx")

Now we have to converst Data frame into an spatial data

Spatial_allsharks_Date <- st_as_sf(allsharks_Date,coords = c("Longitude", "Latitude"), crs=utm18nCRS)

Now we have to do the intersection with EEZ and MPA

allsharks_EEZ_Date <- st_intersection (Spatial_allsharks_Date, EEZs) allsharks_MPA_Date <- st_intersection (Spatial_allsharks_Date, MPAs) allsharks_MPA_Date <- as.data.frame(allsharks_MPA)

THE INTERSECTIONS HAVE CREATED DUPLICATES, THIS REMOVES THEM

allsharks_MPA_Date <- allsharks_MPA_Date%>% distinct(Error.Semi.major.axis, Error.Semi.minor.axis, .keep_all = TRUE) allsharks_EEZ_Date <- allsharks_EEZ_Date%>% distinct(Error.Semi.major.axis, Error.Semi.minor.axis, .keep_all = TRUE)