This code shows a simple spatial analysis which includes spatial data plotting and some statistical problems. Meanwhile, this code could be a part of practical problems which might be relevant to the environment problems. The code shows below.

#load packages

library(maptools)

library(prettymapr)

library(raster)

library(GISTools)

library(tmaptools)

#load shape files (this shape file was download from https://www.census.gov/geo/maps-data/data/cbf/cbf\_state.html)

us <- "cb\_2016\_us\_state\_500k.shp"

usa <- read\_shape(file=us)

#read incident files

incident.data <- read.csv("pipeline.csv")

#aggregate the total incidents for states

totalpipelines <- table(incident.data$State)

totalpipelines <- totalpipelines[names(totalpipelines) != ""]

dataframe <- data.frame(state = names(totalpipelines), incidents = as.numeric(totalpipelines))

#main function

map <- function(usa, dataframe, legend.pos, incident) {

#extract coordinates for states

coords <- coordinates(usa)

data <- usa@data

#merge coordinates and usa data together

data <- cbind(data, coords )

#merge the data

mergedata <- merge(data, dataframe, by.x = "STUSPS" ,by.y= "state")

mergedata <- mergedata[order(mergedata$GEOID), ]

#extract the useful data

dataframe <- mergedata[ ,c(1,10,11,12)]

colnames(dataframe) = c("state","long", "lat", "incidents")

#cut breaks of the incidents using 25%, 50%, 75% values

breaks<- quantile(dataframe$incidents,

c(0,0.25,0.5,0.75,1) )

#check the value of the legend

breaks

cuts <- cut(dataframe$incidents, breaks=breaks,

labels =c("1", "2","3","4"))

#states map

states <- map("state")

#cols, here set alpha

#paint the similar color as sample

cols <- col2rgb('lightblue')/256

points(dataframe[,c(2:3)], pch=19, cex=as.numeric(cuts),col= rgb(cols[1,1],cols[2,1],cols[3,1],alpha = 0.6))

#use the breaks value

legend (legend.pos, rev(c("2","32","81","151","1964")),

pch = 19, col=rgb(cols[1,1],cols[2,1],cols[3,1], alpha=0.6), pt.cex=5:1, bty="n",ncol = 1)

#title of map

title("Inncidents of USA")

#scalebar

addscalebar(pos ="bottomright")

#northarrow

addnortharrow(scale = 0.5)

}

map(usa, dataframe, legend.pos = "bottomleft", "incidents")

#part 2 first part

library(tigris)

library(readxl)

library(RColorBrewer)

library(rio)

library(maps)

library(tmaptools)

library(sp)

library(raster)

library(prettymapr)

#load shape files (this shape file was download from https://www2.census.gov/geo/tiger/TIGER2017/TRACT/)

cal <- "tl\_2017\_06\_tract.shp"

california <- read\_shape(file=cal)

#read incident files

data <- read.csv("pipeline.csv")

#select the useful column

data2 <- subset(data, State == "CA" & Recorded.Long.Lat == "YES")

#load population data for california state( which is download from https://www.california-demographics.com/counties\_by\_population)

population <- import("ca.xlsx")

population <- data.frame(population)

population[,2] <- tolower(gsub(" County","",population[,2]))

#plot california state map filled by population, more grey higher population

population.map <- map("county", "california", fill = TRUE, col = rev(paste0("grey", rank(population$Population)+30)))

#plot water in the map

coordinates <- coordinates(california)

cuts <- cut(as.numeric(as.character(california@data$AWATER)), breaks= c(0,100, 1000, 10000,100000,1000000), labels =c("1", "2","3","4","5"), include.lowest = TRUE)

#larger circle more water

cols <- col2rgb('lightblue')/256

points(coordinates, pch=19, cex= as.numeric(cuts)/2,col= rgb(cols[1,1],cols[2,1],cols[3,1],alpha = 0.5))

#plot legend

legend("bottomleft", rev( as.character(c(100, 1000, 10000,100000,1000000))),

pch = 19, col="lightblue", pt.cex= (5:1)/2, bty="n",ncol = 1)

#just plot the locations of incidents using red circles

cols <- col2rgb('red')/256

points(data2[,c(9,10)], pch=19, cex=1.5,col= rgb(cols[1,1],cols[2,1],cols[3,1],alpha = 0.5))

#if plot legend or not

#title of map

title("California Incidents")

#scalebar

addscalebar(pos ="bottomright")

#northarrow

addnortharrow(scale = 0.8)

# second part create a buffer

data(vulgaris)

#read the shape file which is download from https://www.census.gov/geo/maps-data/data/cbf/cbf\_counties.html

cal.b <- "cb\_2016\_us\_county\_500k.shp"

us.boundary <- read\_shape(file=cal.b)

#select the california

cal.boundary <- us.boundary[us.boundary$STATEFP=="06",]

#create the buffer

ua <- urban\_areas(cb = TRUE)

cal.boundary1 <- ua[cal.boundary,]

plot(cal.boundary)

plot(cal.boundary1,add=TRUE, col="blue")

alb <- '+proj=aea +lat\_1=29.5 +lat\_2=45.5 +lat\_0=37.5 +lon\_0=-96

+x\_0=0 +y\_0=0 +ellps=GRS80 +datum=NAD83 +units=m +no\_defs'

cal.boundary2 <- spTransform(cal.boundary1, alb)

#create a buffer

cal.buf <- gBuffer(cal.boundary2, width = 20000)

cal.buffer <- spTransform(cal.boundary, alb)

plot(cal.buffer, lty = 3)

plot(cal.buf, add=TRUE, col="yellow")

plot(cal.boundary2, add=TRUE, col="blue")

#plot incident points

points(data2[,c(9,10)], pch=21, bg="red")