```
print( paste(system.file(package="dismo"), "/java/maxent.jar", sep='') )
library(dismo)
library(raster)
library(rnaturalearth)
library(rnaturalearthdata)
library(sf)
library(dplyr)
library(lubridate)
library(stringr)
"D:/fx_software/R-3.5.1/library/dismo/java/maxent.jar"

# download occurrences
## Notophthalmus viridescens is the Scientific Name for the Eastern Newt
east_newt = gbif(genus="Notophthalmus", species = "viridescens", download=TRUE)

saveRDS(east_newt,"occ_Notophthalmusviridescens")
east_newt=readRDS("occ_Notophthalmusviridescens")


# clean occurrences
## removes occurrences without lat or long data, or points at 0
east_newt_clean = subset(east_newt, (!is.na(lat))&
                         (!is.na(lon))&
                         (lat!=0)&
                         lon!=0)
## removes duplicated occurrences
east_newt_unique = east_newt_clean[!duplicated(east_newt_clean[c("lat","lon")]),]
east_newt_final = east_newt_unique



east_newt_final <- east_newt_final %>%
  # Replace slashes with NA (or keep first date if you prefer)
  mutate(clean_date = str_extract(eventDate, "\\d{4}-\\d{2}-\\d{2}")) %>%
  mutate(clean_date = ymd(clean_date)) %>%
  filter(clean_date >= ymd("2005-01-01"))

# make occurrences spatial
coordinates(east_newt_final) <- ~ lon + lat
myCRS1 = CRS("+init=epsg:4326")
crs(east_newt_final) <- myCRS1

## Load in Climatic varibles from WorldClim (Got from
https://geodata.ucdavis.edu/climate/worldclim/1_4/grid/cur/)
# clim_list = list.files("data/bio_10m_bil/", pattern = ".bil$", full.names = T)
clim_list = c("data/bio_10m_bil/bio1.bil",
              "data/bio_10m_bil/bio5.bil",
              "data/bio_10m_bil/bio6.bil",
              "data/bio_10m_bil/bio12.bil",
              "data/bio_10m_bil/bio16.bil",
              "data/bio_10m_bil/bio17.bil")
clim = raster::stack(clim_list)

# # Crop to USA Boundaries
usa <- ne_countries(country = "United States of America", scale = "medium", returnclass =
"sf")
clim <- crop(clim, extent(usa))
clim <- mask(clim, usa)

usa_sp <- as(usa, "Spatial")
east_newt_final <- east_newt_final[usa_sp, ]

##########STARTING DOWN HERE
```

```r
#define study area
occ_buffer = buffer(east_newt_final, width = 2*10^5)
plot(occ_buffer, col="black")
plot(east_newt_final, add=T, col="blue")
clim_mask = mask(clim, occ_buffer)

# look at climatic data
plot(clim_mask[[6]],
     xlim = c(-140, -60), ylim = c(20, 55))
plot(east_newt_final,add=T,col="red")



#further clean data
extracted_condition = extract(clim[[1]], east_newt_final)
table(is.na(extracted_condition))
east_newt_final=subset(east_newt_final, !is.na(extracted_condition))
plot(clim[[1]])
plot(east_newt_final,add=T, col="blue")

#define study area
occ_buffer = buffer(east_newt_final, width = 2*10^5)
plot(occ_buffer, col="black")
plot(east_newt_final, add=T, col="blue")

clim_mask = mask(clim, occ_buffer)
plot(clim_mask[[1]])
plot(east_newt_final, add=T, col="blue")

# randomly select background points

clim_mask = mask(clim, occ_buffer)

set.seed(1)
bg = sampleRandom(x=clim_mask,
                  size=10000,
                  na.rm=T,
                  sp=T)
plot(bg, col="black")
plot(east_newt_final,add=T,col="blue")

# extract environmental conditions
env_bg = extract(clim,bg)
env_occ = extract(clim, east_newt_final)

env_bg = as.data.frame(env_bg)
env_occ = as.data.frame(env_occ)


# structure the data for maxent
myPredictors = rbind(env_occ,env_bg)
head(myPredictors)

myResponse = c(rep(1,nrow(env_occ)),
               rep(0,nrow(env_bg)))
head(myResponse)

model =maxent(x=myPredictors, p=myResponse)
model

ped_world = predict(model,clim)
plot(ped_world, xlim = c(-200, -50), ylim = c(0, 100))


# future layer predictions may be under
```

```
(https://geodata.ucdavis.edu/climate/worldclim/1_4/grid/fut/ccm3_bio_10m.zip)

# load in future data layers

fut_clim_list = c("data/ccm3_bio_10m/ccm3_bio1.bil",
               "data/ccm3_bio_10m/ccm3_bio5.bil",
               "data/ccm3_bio_10m/ccm3_bio6.bil",
               "data/ccm3_bio_10m/ccm3_bio12.bil",
               "data/ccm3_bio_10m/ccm3_bio16.bil",
               "data/ccm3_bio_10m/ccm3_bio17.bil")
fut_clim = raster::stack(fut_clim_list)
names(fut_clim) = names(clim)
fut_usa = predict(model, fut_clim)
plot(fut_usa)

write.csv(east_newt, "eastern_newt.csv")

library(ggplot2)
env_occ$bio1_celsius <- env_occ$bio1 / 10
ggplot(env_occ, aes(x = bio1_celsius)) +
  geom_histogram(binwidth = 1, fill = "red", color = "black") +
  labs(
    title = "Eastern Newt Occurrence by Annual Mean Temperature",
    x = "Annual Mean Temperature (°C)",
    y = "Number of Eastern Newt Occurrences"
  )

ggplot(env_occ, aes(x = bio12)) +
  geom_histogram(binwidth = 100, fill = "blue", color = "black") +
  labs(
    title = "Species Occurrence by Annual Precipitation",
    x = "Annual Precipitation (mm)",
    y = "Number of Occurrences"
  )

env <- summary(env_occ)
head(env)
tail(env)
```