Working example of using Convex Hull Ensembles with the `che` package

Matt Hill 2019

```
library(che)
library (raster)
#> Loading required package: sp
library (maptools)
#> Checking rgeos availability: TRUE
library (rgeos)
#> rgeos version: 0.5-2, (SVN revision 621)
#>  GEOS runtime version: 3.8.0-CAPI-1.13.1
#>  Linking to sp version: 1.4-1
#>  Polygon checking: TRUE

# simple world outline from maptools package
data("wrld_simpl")
```

this data is the in the `che` package - will implement neater soon....

```
load("../data/insect_dist.Rdata")
```

Bioclim data

```
bioclimall <- raster::getData('worldclim', var='bio', res=2.5)
```

Background creation

This is an important part of a presence-background type modelling. While the che is presence-only, we use GAMs to rank variable pairs based on relative performance, so the backround is used. In this example, the native range for the species is South Africa

```
e <- extent (10, 40, -35, -15)
SAfrica <- crop (bioclimall, e)
#convert to a stack
SAfrica <- stack(unstack(SAfrica))
```

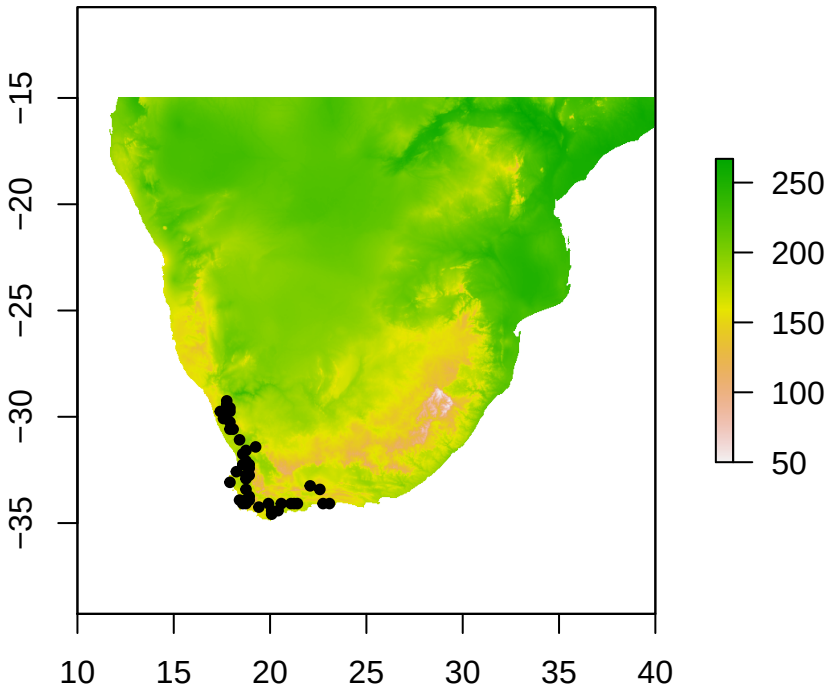
Species data

Halotydeus destructor

This mite is native to South Africa

```
dist <- insect_dist[insect_dist$Species =="h_destructor" & insect_dist$Range == "Native",]

sp_df <- cbind(as.data.frame(dist[,c("Longitude", "Latitude")]),raster::extract(SAfrica, as.data.frame(
plot (SAfrica[[1]])
points(as.data.frame(dist[,c("Longitude", "Latitude")]), pch=20)
```



Biomes

The biomes are available as a shapefile from WWF

```
if (!file.exists("official/wwf_terr_ecos.shp")){
  temp <- tempfile()
  download.file("https://c402277.ssl.cf1.rackcdn.com/publications/15/files/original/official_teow.zip",
  unzip(temp)
  unlink(temp)
}
terres <- readShapePoly("official/wwf_terr_ecos.shp")
#> Warning: readShapePoly is deprecated; use rgdal::readOGR or sf::st_read
```

Create a raster using biomes and native range points

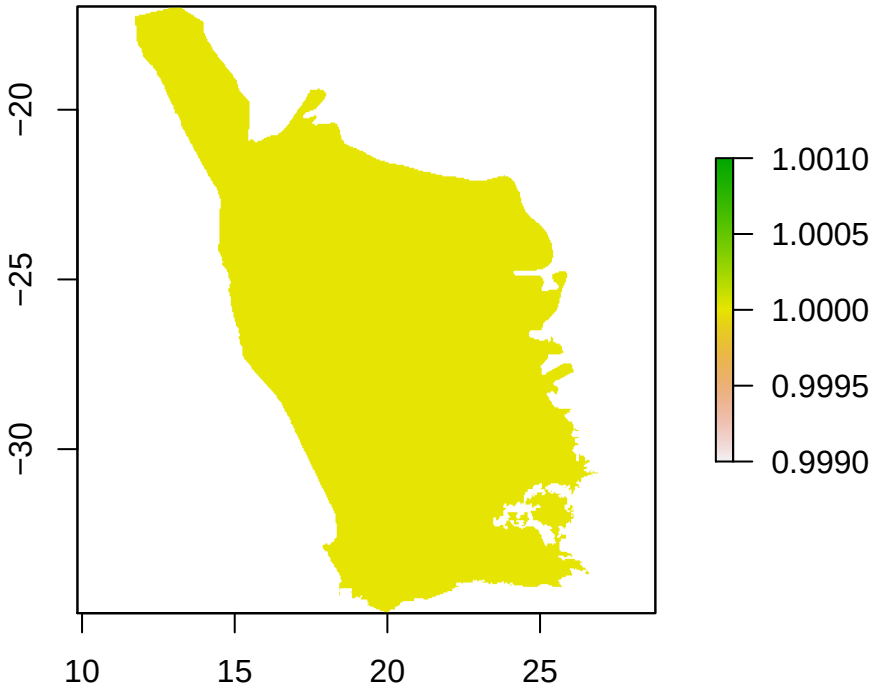
Using the `che::background_builder` function to set up sampling environment

```
clim <- cbind(as.data.frame(dist[,c("Longitude", "Latitude")]),raster::extract(SAfrica, as.data.frame(di

nat_ras <- background_builder(distrib=clim,
                              terres=terres,
                              wrld_simpl= wrld_simpl,
                              ref_rast = bioclimall[[1]])
#> Warning in `proj4string<-`(`*tmp*`, value = crs): A new CRS was assigned to an object with an existi
#> +proj=longlat +datum=WGS84 +ellps=WGS84 +towgs84=0,0,0
#> without reprojecting.
#> For reprojection, use function spTransform

#> Warning in `proj4string<-`(`*tmp*`, value = crs): A new CRS was assigned to an object with an existi
#> +proj=longlat +datum=WGS84 +ellps=WGS84 +towgs84=0,0,0
#> without reprojecting.
#> For reprojection, use function spTransform

plot (nat_ras)
```



Using the `che::prepare_data` function to prepare the data for the modelling process

```
model.data <- prepare_data(rasters=bioclimall, mask_raster=nat_ras, predict.to=SAfrica,
            spp.dist=clim[,1:2], w.val=1.e-6, bg.sample = 50000)
```

Parallel processing of GAMs

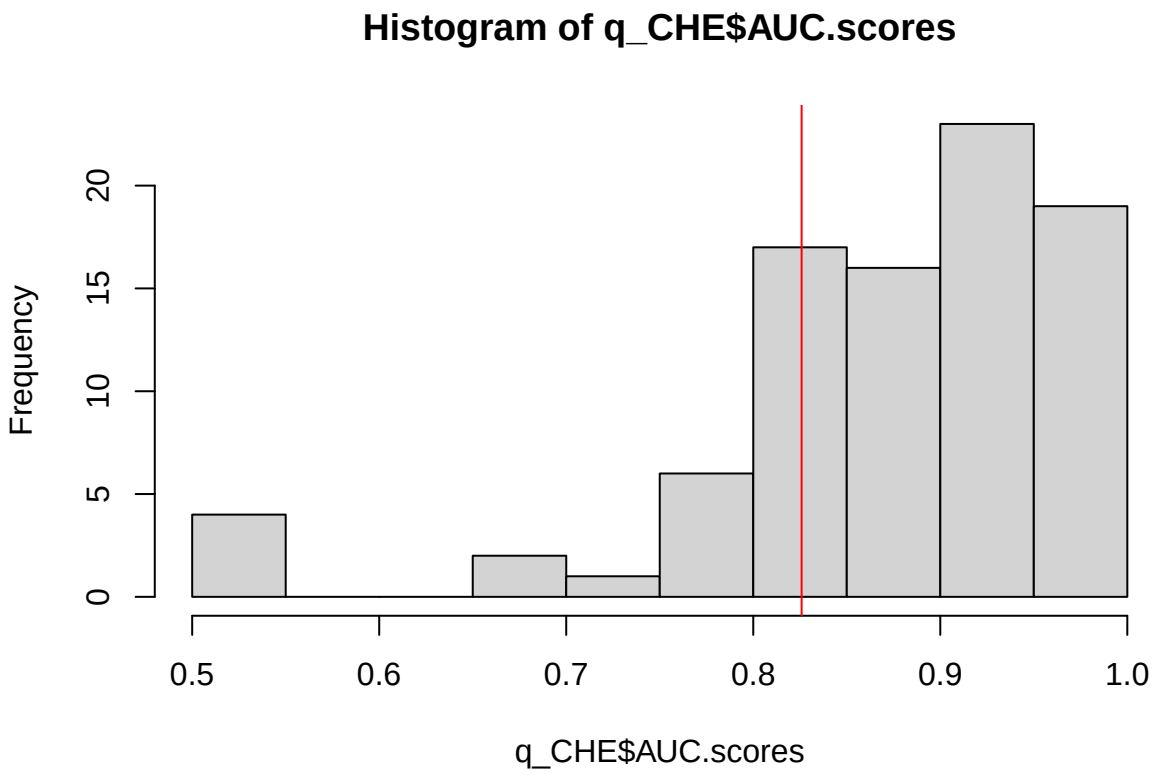
```
model.out <- che_model(spp = "h_destuctor", parallel = TRUE, model.data=model.data)
#> Loading required package: parallel
```

Reconcile outputs

```
q_CHE <- che_out(model.out, 0.25)
```

The historgram shows the distribution of relative predictor pair performance, the redlie indicating where the bottom 25% would be excluded from.

```
hist(q_CHE$AUC.scores)
abline(v=q_CHE$AUC.thresh, col="red")
```



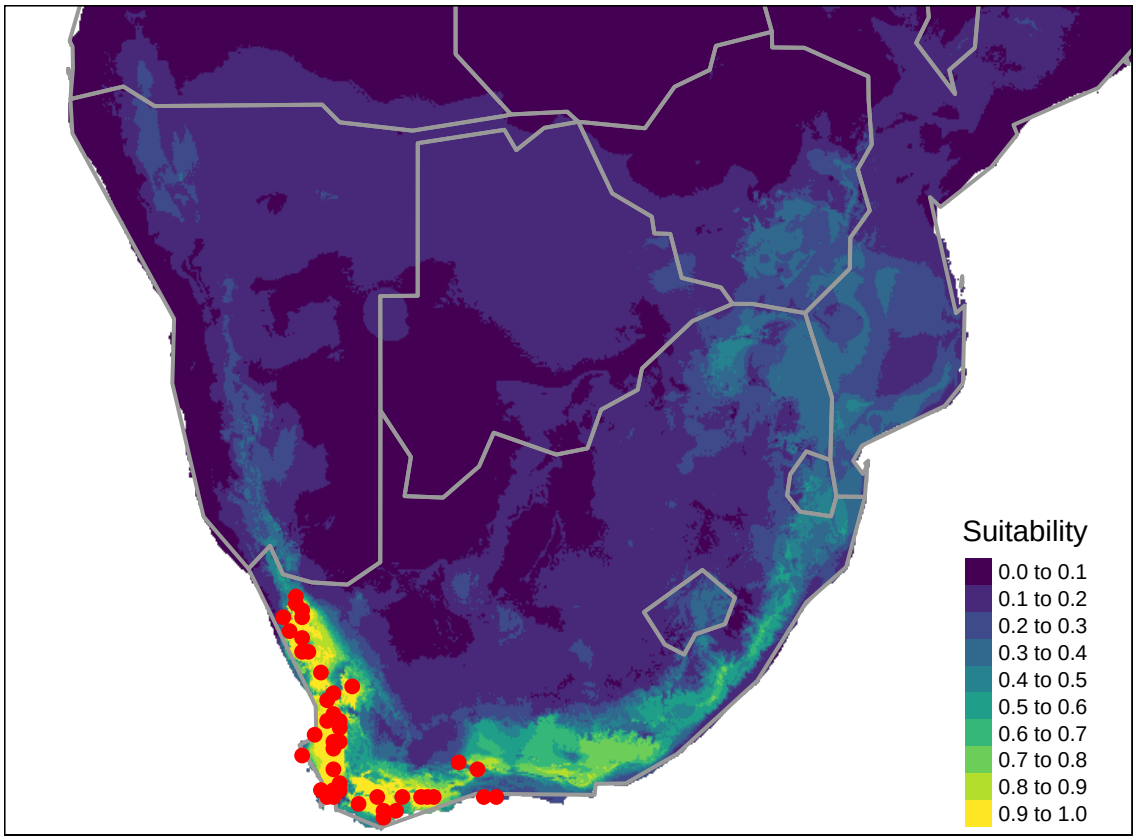
The resulting map can be plotted using your plotting package of choice, `tmap` is quite useful.

```
library(tmap)
library (classInt)
library (viridis)
#> Loading required package: viridisLite


c_dist <- dist[,2:3]
coordinates(c_dist) <- ~Longitude+Latitude

tm_shape(q_CHE$predicted)+
  tm_raster(palette=viridis(10), n=10,
            style="pretty", title="Suitability")+
  tm_shape(wrld_simpl)+
  tm_borders(col="grey60", lwd=2)+
  tm_shape(c_dist)+
```

```
  tm_dots(size=0.3, col="red")+
  tm_layout(legend.position=c("right", "BOTTOM"))
#> Warning: The shape wrld_simpl is invalid. See sf::st_is_valid
#> Linking to GEOS 3.8.0, GDAL 3.0.4, PROJ 6.3.1
#> Warning: Currect projection of shape c_dist unknown. Long-lat (WGS84) is
#> assumed.
```



Overall its done a reasonable job. There is now an opportunity here to test the model predictions using presence-only indices like the Boyce score etc.