```r
#############################################################
###UNCONSTRAINED ORDINATION ANALYSIS-----------------------
library(vegan)
##PCA with enviro data
PCA <- rda(env.tab.s, scale = F)
PCA


#Total inertia
sum (apply (env.tab.s, 2, var))


#Variance explained by PC1
4.597/15


#plot PCA results
biplot(PCA, display = 'species', choices=c(1,2))
biplot(PCA, display = 'species', choices=c(2,3))


##selection of PCA axes
#above-average eigenvalue
mean(PCA$CA$eig)
barplot(PCA$CA$eig)
lines(c(0,15), c(1,1), col="red")


#PCA scores
PCA.sc <- scores(PCA, choices = c(1,2), display = "sites")
head(PCA.sc)


#map first PCA axis
library(berryFunctions)
colPoints(coord$X, coord$Y, PCA.sc[,1], add=F)
colPoints(coord$X, coord$Y, PCA.sc[,2], add=F)
```

```
###PCoA------------------------------------------------------------

#claculate PCoA

pcoa <- cmdscale(beta.bc, k=3)

head(pcoa)


#plot ordination diagram

plot(pcoa[,1], pcoa[,2])


#add partition from clustering analysis

cl.ward #<- cutree(clust.ward, 4)

plot(coord, pch=21, bg=my.cols[cl.ward])


plot(pcoa[,1:2], pch=21, bg=my.cols[cl.ward])


#plot 2nd and 3rd axis

plot(pcoa[,2:3], pch=21, bg=my.cols[cl.ward])


#fit enviro. variables

ef <- envfit(pcoa[,1:2], env.tab.s)

ef

plot(pcoa[,1:2], pch=21, bg=my.cols[cl.ward])

plot(ef)


#fit to 2nd and 3rd axis

ef2 <- envfit(pcoa[,2:3], env.tab.s)

ef2

plot(pcoa[,2:3], pch=21, bg=my.cols[cl.ward])

plot(ef2)


#plot surface

plot(pcoa[,1:2], pch=21, col="black", bg=my.cols[cl.ward],
cex=1.3)
```

```
ordisurf(pcoa[, 1:2], forest$Diversity, col="black", add=T)


###NMDS-------------------------------------------------------
##2D
nmds <- metaMDS(beta.b, k=3, trymax = 30, previous.best=F)
nmds
stressplot(nmds)
ordiplot(nmds)


#export scores
nmds.sc <- as.data.frame(scores(nmds))


#add partition from clustering object
plot(nmds.sc[,1:2], pch=21, col="black", bg=my.cols[cl.ward],
cex=1.3)


#plot 3D
library("vegan3d")
library("rgl")


ordirgl (nmds, col=my.cols[cl.ward])
rgl.bg(color = "white")
```