NMDS_BBS_ROUTES.R

Liv

Sat Jul 18 17:14:51 2015

```
# packages

require(ggthemes)
```

```
## Loading required package: ggthemes
```

```
require(wesanderson)
```

```
## Loading required package: wesanderson
```

```
require(mclust)
```

```
## Loading required package: mclust
## Package 'mclust' version 4.4
## Type 'citation("mclust")' for citing this R package in publications.
```

```
require(ggplot2)
require(vegan)
```

```
## Loading required package: vegan
## Loading required package: permute
## This is vegan 2.0-10
```

```
require(dplyr)
```

```
## Loading required package: dplyr
##
## Attaching package: 'dplyr'
##
## The following object is masked from 'package:stats':
##
##     filter
##
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
require(data.table)
```

```
## Loading required package: data.table
##
## Attaching package: 'data.table'
##
## The following objects are masked from 'package:dplyr':
##
##     between, last
```

```
require(tidyr)
```

```
## Loading required package: tidyr
```

```
# data

# setwd() ## - just into the NCEAS-RENCI folder (your machine)
setwd("/Users/Liv/Documents/NCEAS_GIT/NCEAS-RENCI_2014/")

LC_routes_bbs <- read.csv("Landcover/LC_buffers_overtime.csv")

head(LC_routes_bbs)
```

```
##   RTENO reclass buffer YEAR total_pix    km2
## 1 66001       2    200 1992      2835  2.551
## 2 66001       2    400 1992      3869  3.482
## 3 66001       2   1000 1992      7447  6.702
## 4 66001       2   2000 1992     19434 17.491
## 5 66001       2   5000 1992     52058 46.852
## 6 66001       2  10000 1992    103693 93.324
```

```
#convert reclass to vegtype
reclass_table <- data.frame("reclass" = 0:7, "land_cover" = c("nodata", "water", "developed", "barren",

#merge conversion table with landcover
landuse_buffers <- merge(LC_routes_bbs, reclass_table, by = "reclass")

head(landuse_buffers) #have a look
```

```
##   reclass RTENO buffer YEAR total_pix     km2 land_cover
## 1       1 66006   5000 1998    7899.0  7.1091      water
## 2       1 66005   2000 2002     987.0  0.8883      water
## 3       1 66027   2000 2011     350.0  0.3150      water
## 4       1 66026   2000 2006     814.0  0.7326      water
## 5       1 66005   2000 1999     994.8  0.8953      water
## 6       1 66017   5000 1998   38417.7 34.5759      water
```

```
landuse_buffers_5000 <- subset(landuse_buffers, buffer == 5000 & YEAR %in% c(1992, 2009))
# just the 5000 buffer for 92

landuse_buffers_5000_1992 <- landuse_buffers_5000 %>% filter(YEAR ==1992) %>% select(RTENO, km2, land_c
  mutate(km2_abs = abs(km2)) %>% select(RTENO, km2_abs, land_cover) %>%  # this is required as some val
  spread(land_cover, km2_abs) %>% #make data wide for nmds
  ungroup() %>% group_by(RTENO) %>%
  mutate(rowtotal = agriculture+ barren+ developed+   forest+ grassland_shrub +  water+ wetlands) %>%
  mutate(agriculture_prop = agriculture/rowtotal,
         barren_prop = barren/rowtotal,
         developed_prop = developed/rowtotal,
         forest_prop = forest/rowtotal,
         grassland_shrub_prop = grassland_shrub/rowtotal,
         water_prop = water/rowtotal,
         wetlands_prop = wetlands/rowtotal) %>% ungroup()  #there's quicker ways of doing this
head(landuse_buffers_5000_1992)
```

```
## Source: local data frame [6 x 16]
## 
##   RTENO agriculture barren developed forest grassland_shrub water wetlands
## 1 66001       364.5 0.4104     46.85 16.139           2.261 1.267    4.028
## 2 66002       382.5 0.4842     39.96  9.694           1.106 4.031    0.000
## 3 66003       496.8 0.1728     42.96 22.051           1.074 1.737   28.774
## 4 66005       444.0 0.6624     42.71 47.264           1.662 5.314    1.687
## 5 66006       321.4 3.5037     39.06 22.739           5.444 8.056   16.724
## 6 66008       362.2 1.5615     59.66 19.949           3.572 4.566    0.000
## Variables not shown: rowtotal (dbl), agriculture_prop (dbl), barren_prop
##   (dbl), developed_prop (dbl), forest_prop (dbl), grassland_shrub_prop
##   (dbl), water_prop (dbl), wetlands_prop (dbl)
```

```
range(rowSums(landuse_buffers_5000_1992[2:8])) #hu
```

```
## [1] 216.5 598.2
```

```
head(landuse_buffers_5000_1992[, -1])
```

```
## Source: local data frame [6 x 15]
## 
##   agriculture barren developed forest grassland_shrub water wetlands
## 1       364.5 0.4104     46.85 16.139           2.261 1.267    4.028
## 2       382.5 0.4842     39.96  9.694           1.106 4.031    0.000
## 3       496.8 0.1728     42.96 22.051           1.074 1.737   28.774
## 4       444.0 0.6624     42.71 47.264           1.662 5.314    1.687
## 5       321.4 3.5037     39.06 22.739           5.444 8.056   16.724
## 6       362.2 1.5615     59.66 19.949           3.572 4.566    0.000
## Variables not shown: rowtotal (dbl), agriculture_prop (dbl), barren_prop
##   (dbl), developed_prop (dbl), forest_prop (dbl), grassland_shrub_prop
##   (dbl), water_prop (dbl), wetlands_prop (dbl)
```

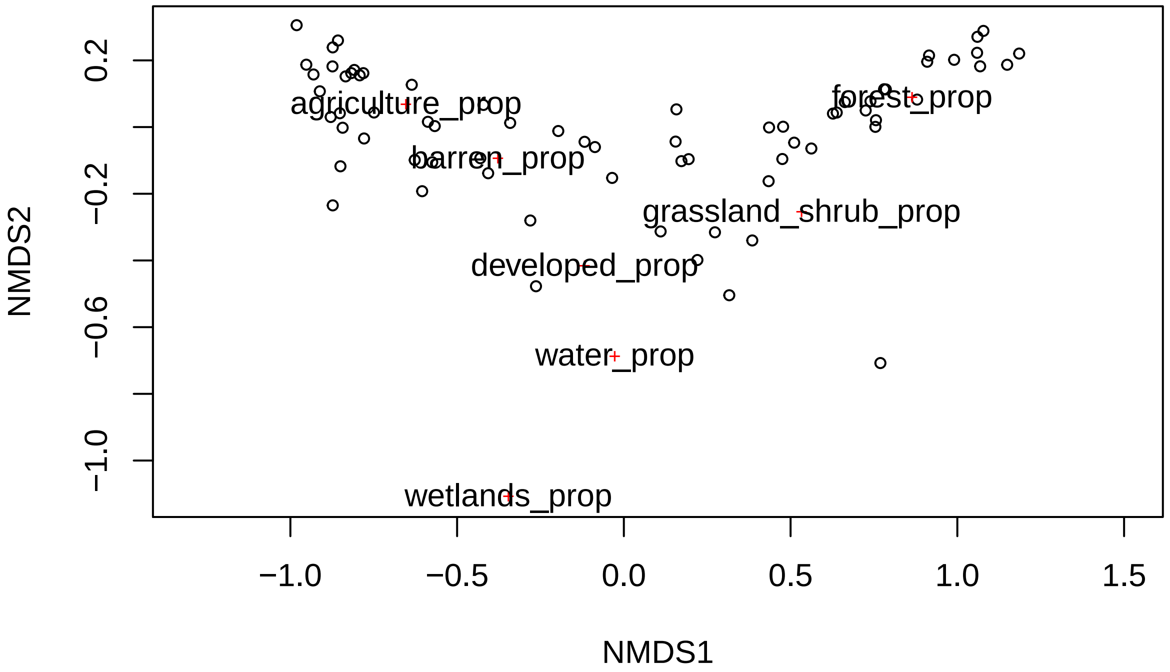
```
landuse_buffers_5000_nmds_prop <- landuse_buffers_5000_1992[ , c("agriculture_prop", "barren_prop",
                                                            "developed_prop", "forest_prop",
                                                            "grassland_shrub_prop", "water_prop",
                                                            "wetlands_prop")]

landuse_buffers_5000_nmds <- landuse_buffers_5000_1992[ , c("agriculture", "barren", "developed",
                                                       "forest","grassland_shrub",
                                                       "water", "wetlands")]

nmds_veg <- metaMDS(landuse_buffers_5000_nmds_prop, 'jaccard', k = 3) #using jaccard instaead of defaul
```

```
## Run 0 stress 0.01946 
## Run 1 stress 0.01916 
## ... New best solution
## ... procrustes: rmse 0.02027  max resid 0.07241 
## Run 2 stress 0.01871 
## ... New best solution
## ... procrustes: rmse 0.006509  max resid 0.04805 
## Run 3 stress 0.01949 
## Run 4 stress 0.01917
## ... procrustes: rmse 0.01934  max resid 0.06333
## Run 5 stress 0.01945
## Run 6 stress 0.0199
## Run 7 stress 0.01945
## Run 8 stress 0.01916
## ... procrustes: rmse 0.006248  max resid 0.0474
## Run 9 stress 0.02072
## Run 10 stress 0.01926
## Run 11 stress 0.01917
## ... procrustes: rmse 0.01822  max resid 0.06265
## Run 12 stress 0.01834
## ... New best solution
## ... procrustes: rmse 0.009231  max resid 0.05225
## Run 13 stress 0.01781
## ... New best solution
## ... procrustes: rmse 0.005832  max resid 0.04525
## Run 14 stress 0.02039
## Run 15 stress 0.0178
## ... New best solution
## ... procrustes: rmse 0.000181  max resid 0.0007818
## *** Solution reached
```

```
# using 3 dimensions = could use 2.  For us, NMDS1 v 2 and NMDS1 v 3 both split data niclely along ag g
nmds_veg
```

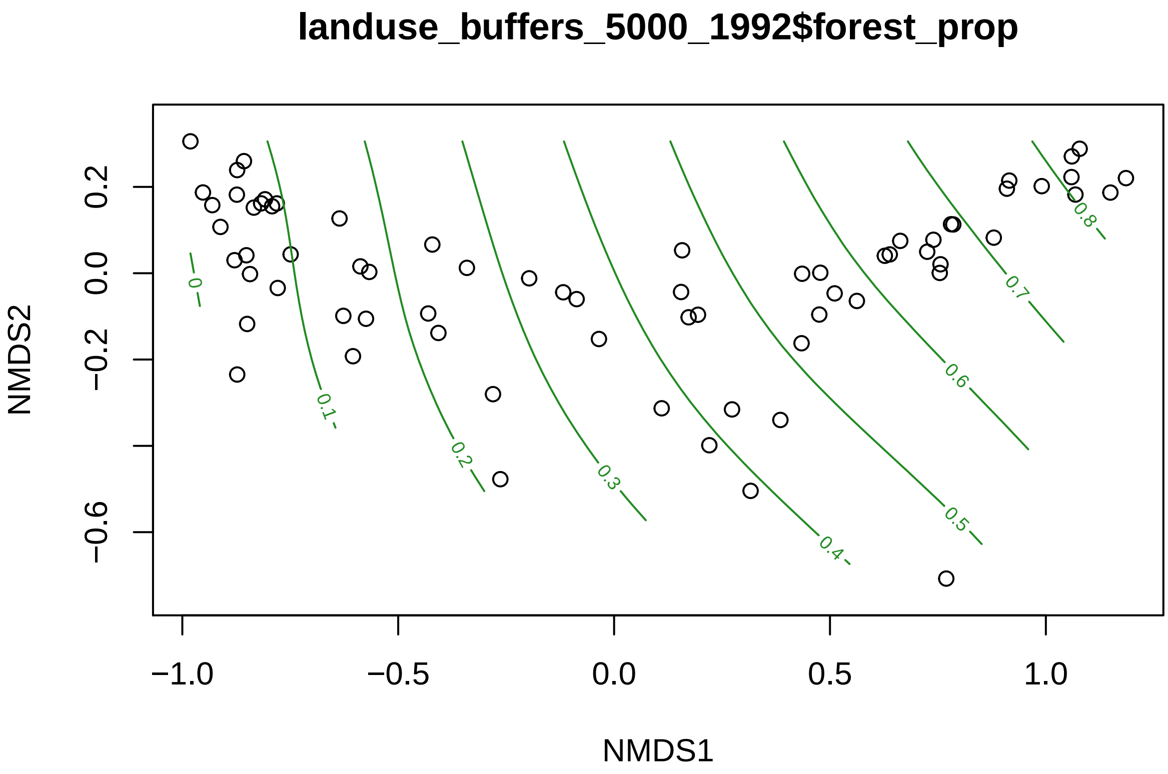
```
##
## Call:
## metaMDS(comm = landuse_buffers_5000_nmds_prop, distance = "jaccard",      k = 3)
##
## global Multidimensional Scaling using monoMDS
##
## Data:     landuse_buffers_5000_nmds_prop
## Distance: jaccard
##
## Dimensions: 3
## Stress:     0.0178
## Stress type 1, weak ties
## Two convergent solutions found after 15 tries
## Scaling: centring, PC rotation, halfchange scaling
## Species: expanded scores based on 'landuse_buffers_5000_nmds_prop'
```

```
#base plot
plot(nmds_veg)
text(nmds_veg, "species")
```



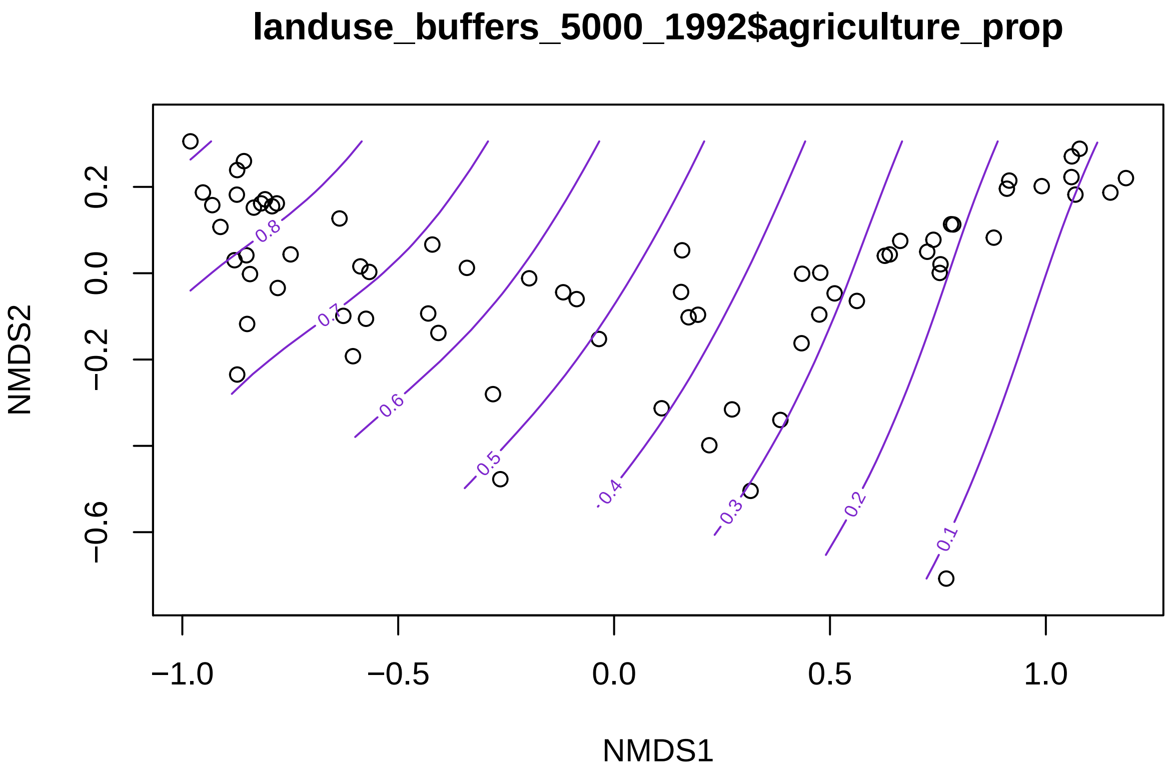
```
#extract scores for plotting
landuse_buffers_5000_1992$NMDS1 <- scores(nmds_veg)[,1]
landuse_buffers_5000_1992$NMDS2 <- scores(nmds_veg)[,2]
try(landuse_buffers_5000_1992$NMDS3 <- scores(nmds_veg)[,3])


clust_veg <- Mclust(landuse_buffers_5000_nmds)
#plot(clust_veg)
landuse_buffers_5000_1992$classification <- as.factor(clust_veg$classification)

ordisurf(nmds_veg, landuse_buffers_5000_1992$forest_prop, col = "forestgreen")
```

```
## Loading required package: mgcv
## Loading required package: nlme
##
## Attaching package: 'nlme'
##
## The following object is masked from 'package:dplyr':
##
##     collapse
##
## The following object is masked from 'package:lme4':
##
##     lmList
##
## This is mgcv 1.8-4. For overview type 'help("mgcv-package")'.
##
## Attaching package: 'mgcv'
##
## The following object is masked from 'package:mclust':
##
##     mvn
```



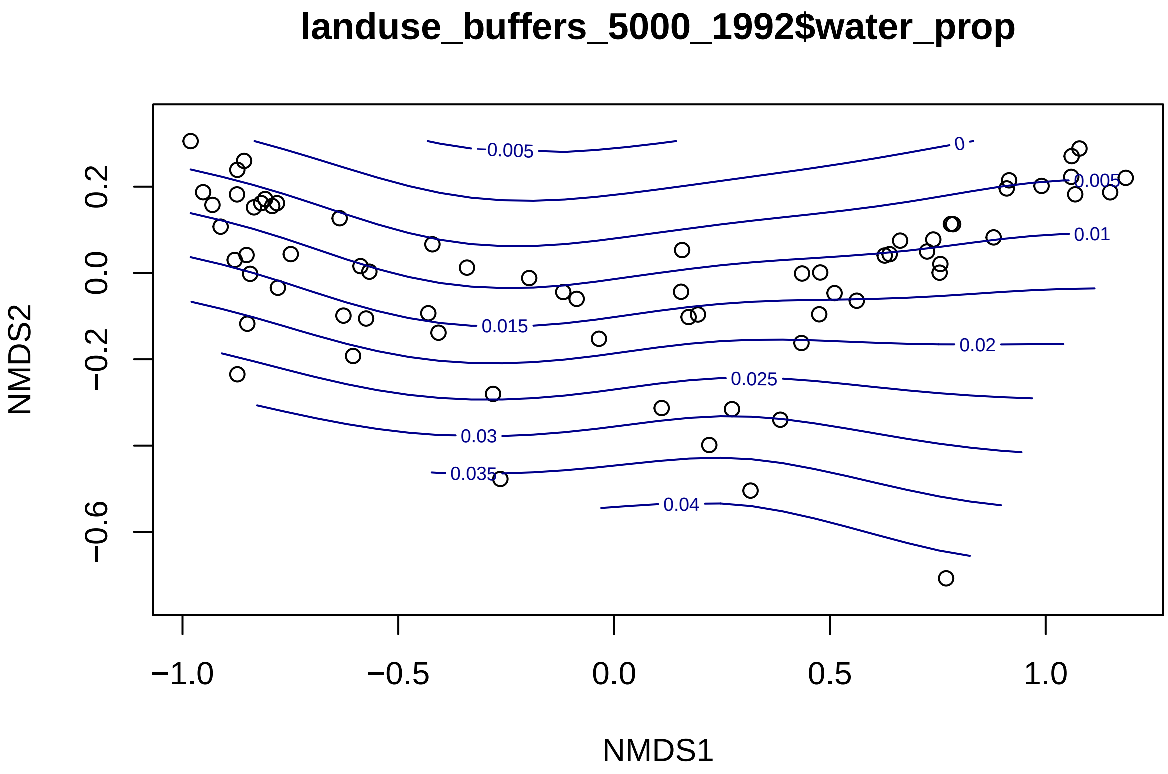
```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## y ~ s(x1, x2, k = 10, bs = "tp", fx = FALSE)
## <environment: 0x7ffed3632fc0>
##
## Estimated degrees of freedom:
## 8.44  total = 9.44
##
## REML score: -195.4
```

```
ordisurf(nmds_veg, landuse_buffers_5000_1992$agriculture_prop, col = "purple3")
```



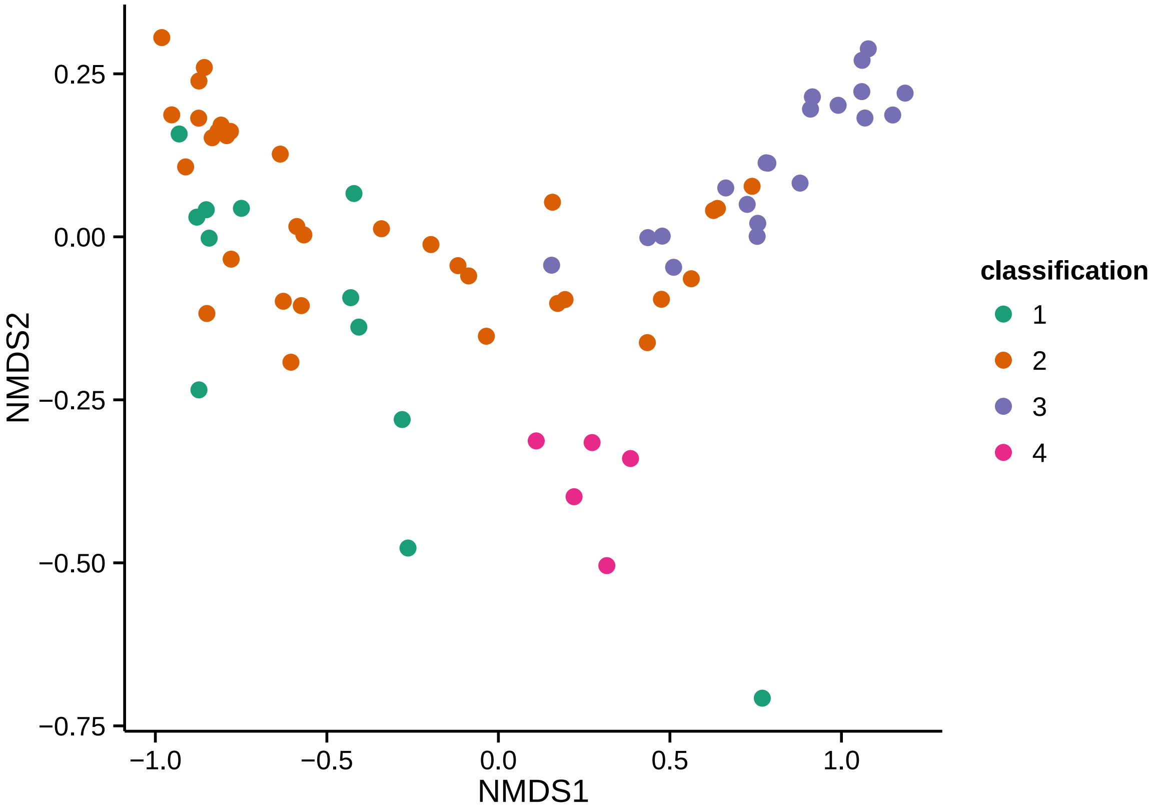
```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## y ~ s(x1, x2, k = 10, bs = "tp", fx = FALSE)
## <environment: 0x7ffed27f5040>
##
## Estimated degrees of freedom:
## 8.65  total = 9.65
##
## REML score: -215.1
```

```
ordisurf(nmds_veg, landuse_buffers_5000_1992$water_prop, col = "darkblue")
```

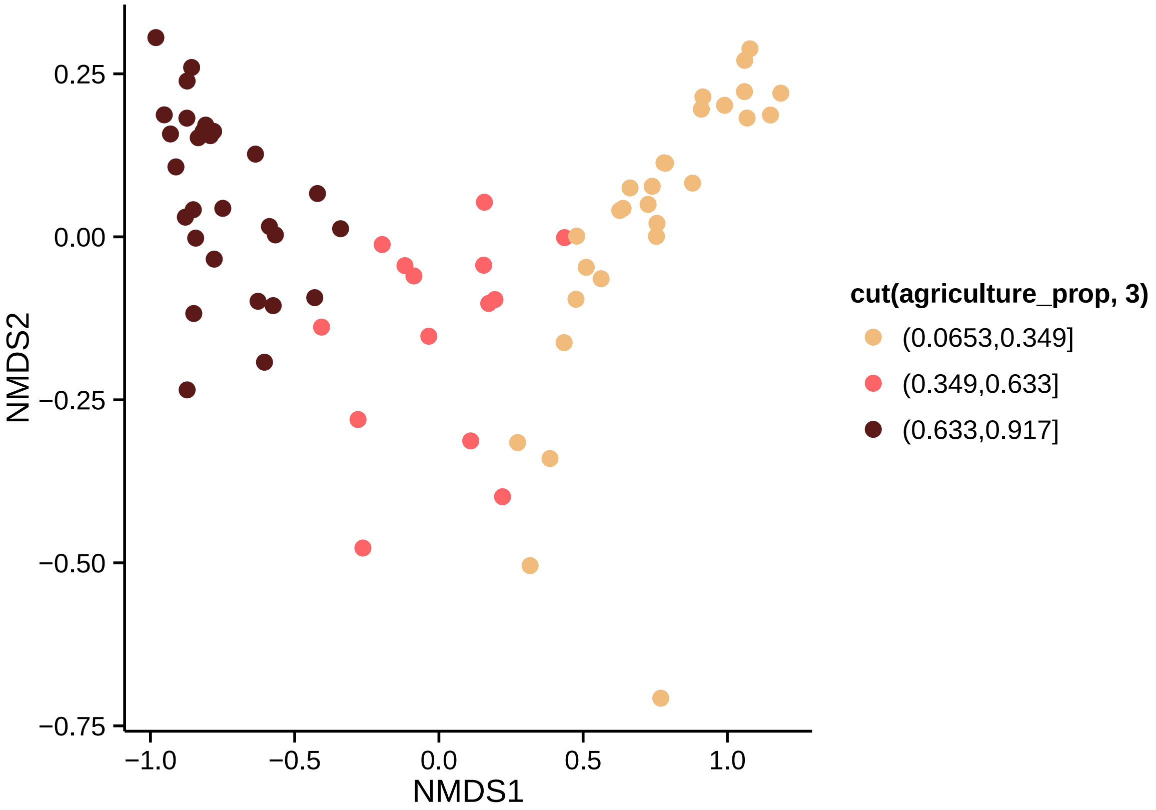


```
##
## Family: gaussian
## Link function: identity
##
## Formula:
## y ~ s(x1, x2, k = 10, bs = "tp", fx = FALSE)
## <environment: 0x7ffed3a03260>
##
## Estimated degrees of freedom:
## 4.1  total = 5.1
##
## REML score: -189.1
```

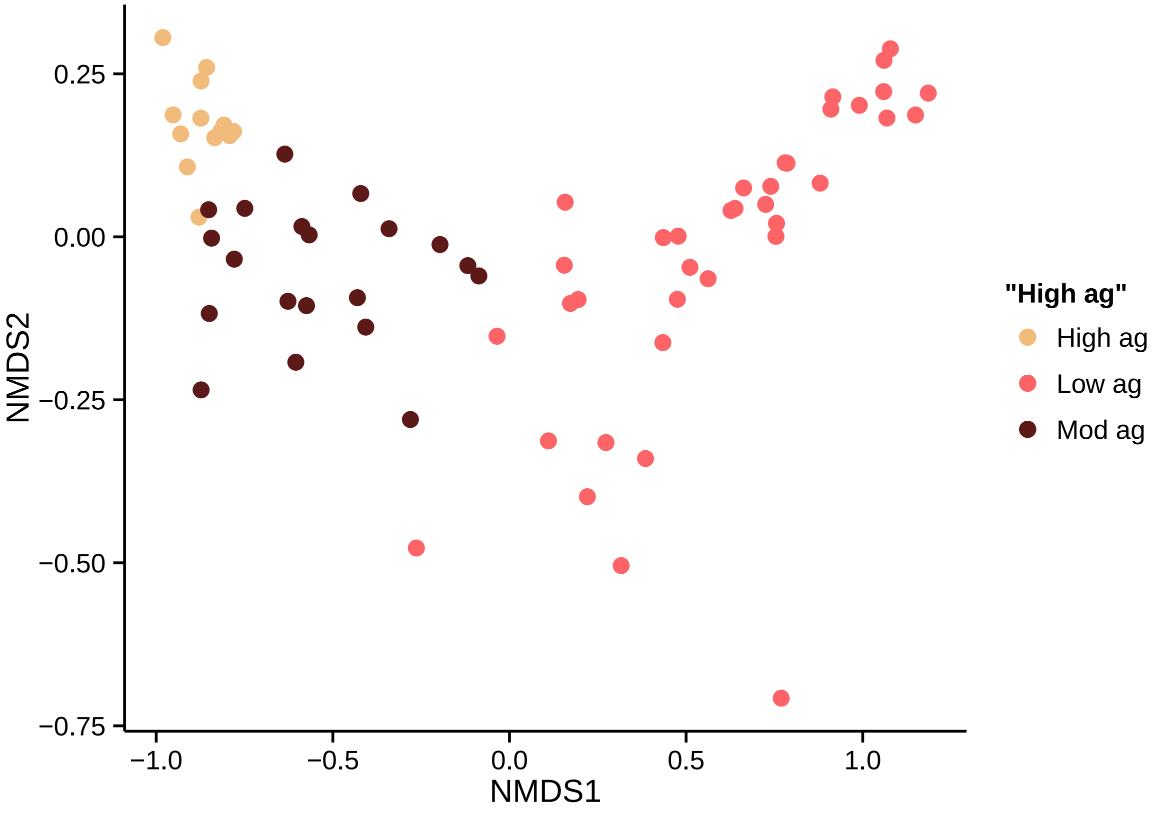
```
ggplot(landuse_buffers_5000_1992, aes(x = NMDS1, y = NMDS2)) +
  geom_point(aes(colour = classification), size =3)+
scale_colour_brewer(palette = "Dark2")+
  theme_classic()
```



```
ggplot(landuse_buffers_5000_1992, aes(x = NMDS1, y = NMDS2)) +
  geom_point(aes(colour = cut(agriculture_prop,3)), size =3)+
scale_colour_manual(values = wes_palette("GrandBudapest"))+
  #scale_colour_gradient(high = "purple3", low = "orange")+
  theme_classic()
```



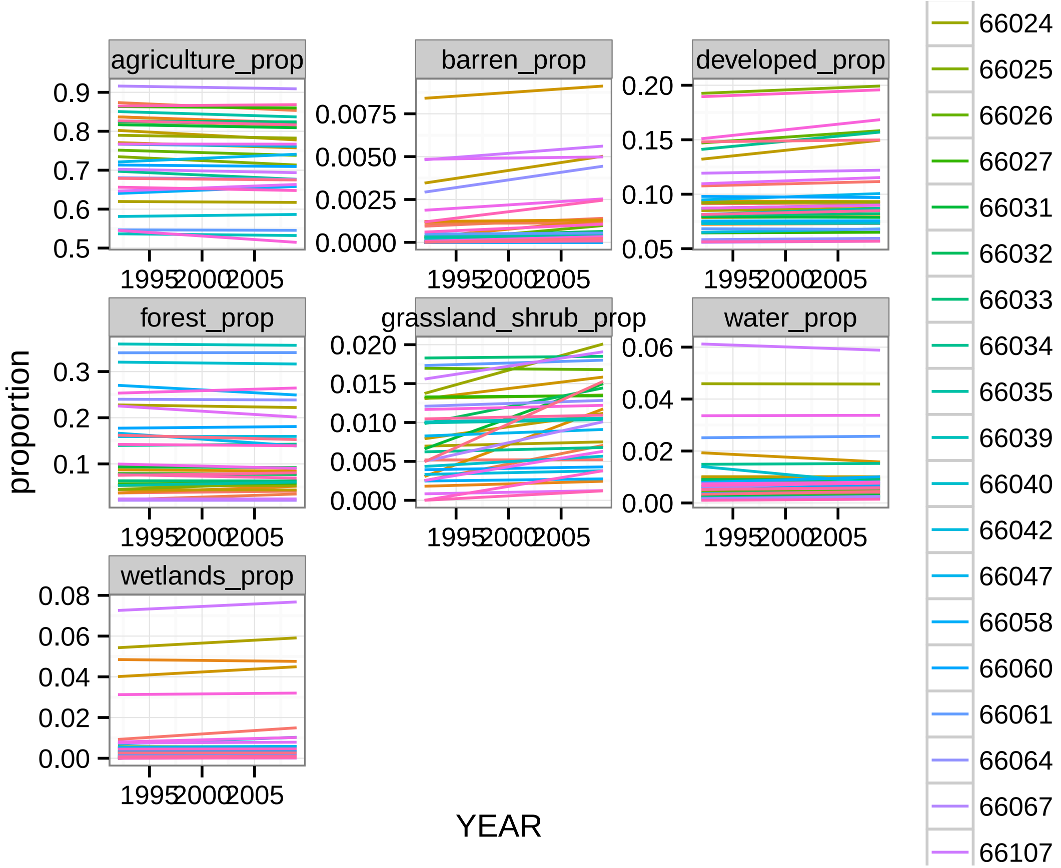
```
ggplot(landuse_buffers_5000_1992, aes(x = NMDS1, y = NMDS2)) +
  geom_point(data = landuse_buffers_5000_1992 %>% filter(agriculture_prop > 0.8 ),
             size=3, aes(colour = "High ag"))+
  geom_point(data = landuse_buffers_5000_1992 %>% filter(agriculture_prop < 0.8 & agriculture_prop > 0.5
             size=3, aes(colour = "Mod ag"))+
  geom_point(data = landuse_buffers_5000_1992 %>% filter(agriculture_prop <= 0.5),
             size=3, aes(colour = "Low ag"))+
  #geom_point(aes(colour = cut(agriculture_prop,3)), size =3)+
 # geom_text(data = species_scores, aes(x = NMDS1, y = NMDS2, label = landuse), size = 6)+
  scale_colour_manual(values = wes_palette("GrandBudapest"))+
  #scale_colour_gradient(high = "purple3", low = "orange")+
  theme_classic()
```



```
# RTENOS of high ag routes:
high_ag_RTENO <- landuse_buffers_5000_1992 %>% filter(agriculture_prop > 0.5) %>% select(RTENO, agricul

#write.csv(high_ag_RTENO, file = "BBS_data/high_ag_RTENO_5000.csv")


### for the 2009 data

landuse_buffers_5000_2009 <- landuse_buffers_5000 %>% filter(YEAR ==2009) %>% select(RTENO, km2, land_c
  mutate(km2_abs = abs(km2)) %>% select(RTENO, km2_abs, land_cover) %>%  # this is required as some val
  spread(land_cover, km2_abs) %>% #make data wide for nmds
  ungroup() %>% group_by(RTENO) %>%
  mutate(rowtotal = agriculture+ barren+ developed+   forest+ grassland_shrub +  water+ wetlands) %>%
  mutate(agriculture_prop = agriculture/rowtotal,
         barren_prop = barren/rowtotal,
         developed_prop = developed/rowtotal,
         forest_prop = forest/rowtotal,
         grassland_shrub_prop = grassland_shrub/rowtotal,
         water_prop = water/rowtotal,
         wetlands_prop = wetlands/rowtotal) %>% ungroup()  #there's quicker ways of doing this
head(landuse_buffers_5000_2009)
```

```
## Source: local data frame [6 x 16]
##
##   RTENO agriculture barren developed forest grassland_shrub water wetlands
## 1 66001       369.6 0.6305     50.18  18.38           2.346 1.640    6.718
## 2 66002       381.3 0.5078     41.06  15.54           3.153 4.111    1.117
## 3 66003       494.3 0.7844     44.08  31.07           1.476 2.418   28.677
## 4 66005       456.6 0.7382     44.69  47.66           6.614 5.326    1.766
## 5 66006       320.0 3.8515     39.38  26.86           6.691 6.675   18.983
## 6 66008       360.3 2.3278     69.26  20.08           5.174 4.681    1.408
## Variables not shown: rowtotal (dbl), agriculture_prop (dbl), barren_prop
##   (dbl), developed_prop (dbl), forest_prop (dbl), grassland_shrub_prop
##   (dbl), water_prop (dbl), wetlands_prop (dbl)
```

```
landuse_buffers_5000_2009 <- subset(landuse_buffers_5000_2009, RTENO %in% high_ag_RTENO$RTENO) %>% sele
landuse_buffers_5000_1992 <- landuse_buffers_5000_1992 %>% filter(agriculture_prop > 0.5 & RTENO %in% la

high_ag_17 <- rbind(landuse_buffers_5000_2009, landuse_buffers_5000_1992) %>% gather(landusetype, propo

ggplot(high_ag_17, aes(x = YEAR, y = proportion)) +
  geom_line(aes(colour = as.factor(RTENO), group = RTENO)) +
  facet_wrap(~ landusetype, scale = "free") +
  theme_bw()
```



```
high_ag_17_nmds <- rbind(landuse_buffers_5000_2009, landuse_buffers_5000_1992)
names(high_ag_17_nmds)
```

```
## [1] "RTENO"                "agriculture_prop"     "barren_prop"
## [4] "developed_prop"       "forest_prop"          "grassland_shrub_prop"
## [7] "water_prop"           "wetlands_prop"        "YEAR"
```

```
nmds_veg_years <- metaMDS(high_ag_17_nmds[ , 2:8], 'jaccard', k = 2) #using jaccard instaead of default
```

```
## Run 0 stress 0.05882
## Run 1 stress 0.09259
## Run 2 stress 0.05882
## ... New best solution
## ... procrustes: rmse 1.142e-05  max resid 4.171e-05
## *** Solution reached
```

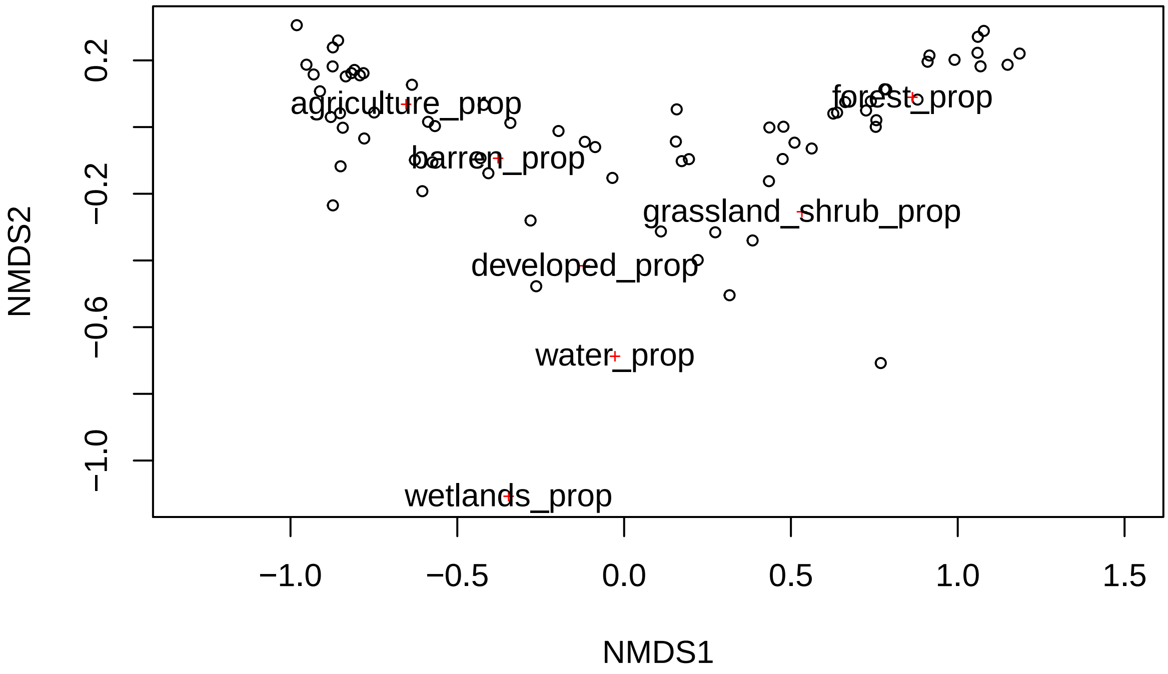
```
# using 3 dimensions = could use 2.  For us, NMDS1 v 2 and NMDS1 v 3 both split data niclely along ag g
nmds_veg
```

```
##
## Call:
## metaMDS(comm = landuse_buffers_5000_nmds_prop, distance = "jaccard",      k = 3)
##
## global Multidimensional Scaling using monoMDS
##
## Data:     landuse_buffers_5000_nmds_prop
## Distance: jaccard
##
## Dimensions: 3
## Stress:     0.0178
## Stress type 1, weak ties
## Two convergent solutions found after 15 tries
## Scaling: centring, PC rotation, halfchange scaling
## Species: expanded scores based on 'landuse_buffers_5000_nmds_prop'
```

```
adonis(vegdist(high_ag_17_nmds[ , 2:8], "jaccard") ~ YEAR, strata =  "RTENO", data = high_ag_17_nmds)
```

```
##
## Call:
## adonis(formula = vegdist(high_ag_17_nmds[, 2:8], "jaccard") ~      YEAR, data = high_ag_17_nmds, stra
##
## Terms added sequentially (first to last)
##
##           Df SumsOfSqs MeanSqs F.Model    R2 Pr(>F)
## YEAR       1     0.004  0.0040   0.102 0.002   0.97
## Residuals 64     2.518  0.0394         0.998
## Total     65     2.522                 1.000
```

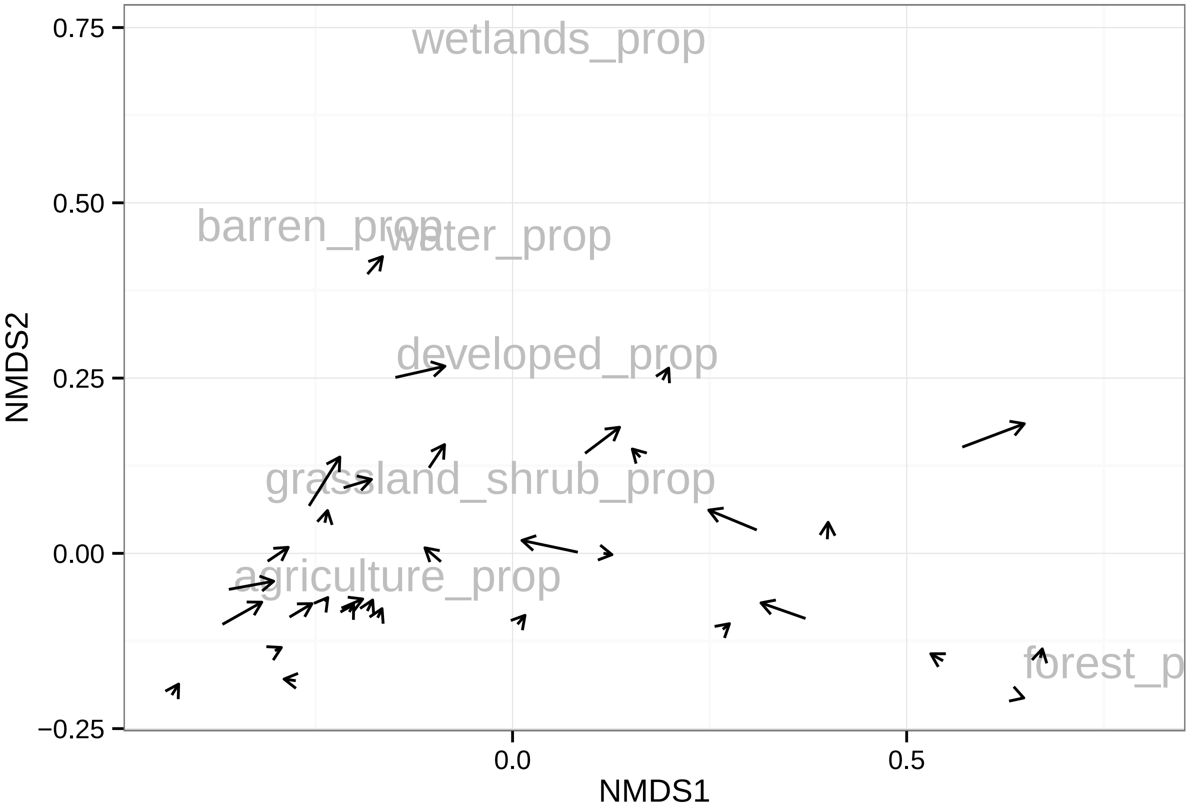
```
#base plot
plot(nmds_veg)
text(nmds_veg, "species")
```



```
species_scores <- data.frame(scores(nmds_veg_years, "species")); species_scores$vegtype <- row.names(spe
#extract scores for plotting
high_ag_17_nmds$NMDS1 <- scores(nmds_veg_years)[,1]
high_ag_17_nmds$NMDS2 <- scores(nmds_veg_years)[,2]

require(grid)

head(high_ag_17_nmds)
```

```
## Source: local data frame [6 x 11]
##
##   RTENO agriculture_prop barren_prop developed_prop forest_prop
## 1 66001           0.8222    0.001403        0.11164     0.04090
## 2 66002           0.8534    0.001137        0.09191     0.03479
## 3 66003           0.8200    0.001301        0.07312     0.05155
## 4 66005           0.8104    0.001310        0.07932     0.08460
## 5 66006           0.7575    0.009117        0.09323     0.06359
## 6 66008           0.7778    0.005025        0.14953     0.04336
## Variables not shown: grassland_shrub_prop (dbl), water_prop (dbl),
##   wetlands_prop (dbl), YEAR (dbl), NMDS1 (dbl), NMDS2 (dbl)
```

```
high_ag_17_nmds_wide_NMDS1 <-  high_ag_17_nmds%>% select(RTENO, NMDS1, YEAR) %>% spread(YEAR, NMDS1)
names(high_ag_17_nmds_wide_NMDS1) <- c("RTENO", "NMDS1", "NMDS1end")
high_ag_17_nmds_wide_NMDS2 <-  high_ag_17_nmds%>% select(RTENO, NMDS2, YEAR) %>% spread(YEAR, NMDS2)
names(high_ag_17_nmds_wide_NMDS2) <- c("RTENO", "NMDS2", "NMDS2end")

arrow_data <- merge(high_ag_17_nmds_wide_NMDS1, high_ag_17_nmds_wide_NMDS2)

ggplot(high_ag_17_nmds, aes( x= NMDS1, y = NMDS2)) +
  #geom_point(aes(colour = factor(YEAR))) +
  geom_text(data = species_scores, aes(x = NMDS1, y = NMDS2, label = vegtype), size = 6,
            colour = "grey")+
  theme_bw() +
  geom_segment(data = arrow_data,
               aes(x = NMDS1, xend = NMDS1end, y = NMDS2, yend = NMDS2end),
               arrow = arrow(length = unit(0.2, "cm")), colour = "black")
```


wetlands_prop
barren_prop
water_prop
developed_prop
grassland_shrub_prop
agriculture_prop
forest_p
NMDS2
NMDS1