Analysis

An analysis using LiDAR data to detect moose browsing effects, with ground truthing

```
library(readr)
library(ggplot2)
```

Get compiled dataset (see compile.R)

```
dat <- read_csv("../data/compiledDataset.csv")
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   locality_and_treatment = col_character(),
##   LocalityCode = col_character(),
##   LocalityName = col_character(),
##   Treatment = col_character(),
##   resolution_m = col_character(),
##   region = col_character()
## )
```

```
## See spec(...) for full column specifications.
```

```
head(dat)
```

```
## # A tibble: 6 x 27
##   locality_and_tr~ LocalityCode LocalityName Treatment Longitude Latitude
##   <chr>            <chr>        <chr>        <chr>         <dbl>    <dbl>
## 1 bratsberg_b      BRB          Bratsberg    B              10.5      63.4
## 2 bratsberg_ub     BRUB         Bratsberg    UB             10.5      63.4
## 3 didrik_holmsen_b DHB          Didrik Holm~ B              11.4      59.9
## 4 didrik_holmsen_~ DHUB         Didrik Holm~ UB             11.4      59.9
## 5 drangedal1_b     1DRB         Drangedal1   B               9.15     59.1
## 6 drangedal1_ub    1DRUB        Drangedal1   UB              9.15     59.1
## # ... with 21 more variables: Clear.cut <dbl>, Year.initiated <dbl>,
## #   LiDAR.data.from.year <dbl>, plot_density_m2 <dbl>, resolution_m <chr>,
## #   region <chr>, Moose2015 <dbl>, Reddeer2015 <dbl>, Roedeer2015 <dbl>,
## #   YrsSinceExclosure <dbl>, field_mean <dbl>, field_median <dbl>, mn <dbl>,
## #   md <dbl>, sd <dbl>, min <dbl>, max <dbl>, first_qu.25. <dbl>,
## #   third_qu.75. <dbl>, mad <dbl>, prod <dbl>
```

A quick data check

```r
table(dat$Treatment, dat$Clear.cut)
```

```
##
##      2000 2002 2003 2004 2005 2006 2007 2008 2009
##   B     1    4    3    7    8    4   10    7    1
##   UB    1    4    3    7    8    4   10    7    1
```

```r
table(dat$Year.initiated, dat$LiDAR.data.from.year)
```

```
##
##        2010 2011 2013 2015 2016 2017 2018 2019
##   2007    0    0    0    0    0    0    0    6
##   2008    4    4    0   18    2    2    0    0
##   2009    0    0    0    0    4   24    0    0
##   2010    0    0    0    0    4    4    4    0
##   2011    0    0    2    0    4    0    0    8
```

```r
table(dat$plot_density_m2, dat$resolution_m)
```

```
##
##     0,25 0,5
##   2    2  54
##   5   32   2
```

Something odd there...

```r
table(dat$region, dat$Treatment)
```

```
##
##              B UB
##   Hedmark   16 16
##   Telemark  14 14
##   Trondelag 15 15
```

```r
table(dat$LocalityName, dat$Treatment)
```

```
##
##                         B UB
##   Bratsberg             1  1
##   Didrik Holmsen        1  1
##   Drangedal1            1  1
##   Drangedal3            1  1
##   Drangedal4            1  1
##   Eidskog               1  1
##   Fet 3                 1  1
##   Fritsoe1              1  1
##   Fritsoe2              1  1
##   Furesdal              1  1
##   Halvard Pramhus       1  1
```

```
##   Hi_tydal              1  1
##   Kongsvinger 1         1  1
##   Kongsvinger 2         1  1
##   Kviteseid1            1  1
##   Kviteseid2            1  1
##   Kviteseid3            1  1
##   Maarud 1              1  1
##   Maarud 2              1  1
##   Maarud 3              1  1
##   Malvik                1  1
##   namdalseid_1kub       1  1
##   Nes 1                 1  1
##   Nes 2                 1  1
##   Nome_Cappelen1        1  1
##   Nome_Cappelen2        1  1
##   Notodden3             1  1
##   Notodden5             1  1
##   Notodden6             1  1
##   Nsb_Verdal            1  1
##   Selbu_Flub            1  1
##   Selbu_kl              1  1
##   Selbu_Sl              1  1
##   Singsaas              1  1
##   Sl_Tydal              1  1
##   Soerum                1  1
##   Stangeskovene Aurskog 1  1
##   Stangeskovene Eidskog 1  1
##   steinkjer_1BBb        1  1
##   steinkjer_2BBb        1  1
##   Stig Dahlen           1  1
##   Sub_Namdalseid        1  1
##   Truls Holm            1  1
##   verdal_1vb            1  1
##   verdal_2VB            1  1
```

Looks good.

Plots etc

Lets first compute canopy growth per year since exclosure

```
dat$canopygrowth <- dat$md/dat$YrsSinceExclosure
summary(dat$canopygrowth)
```

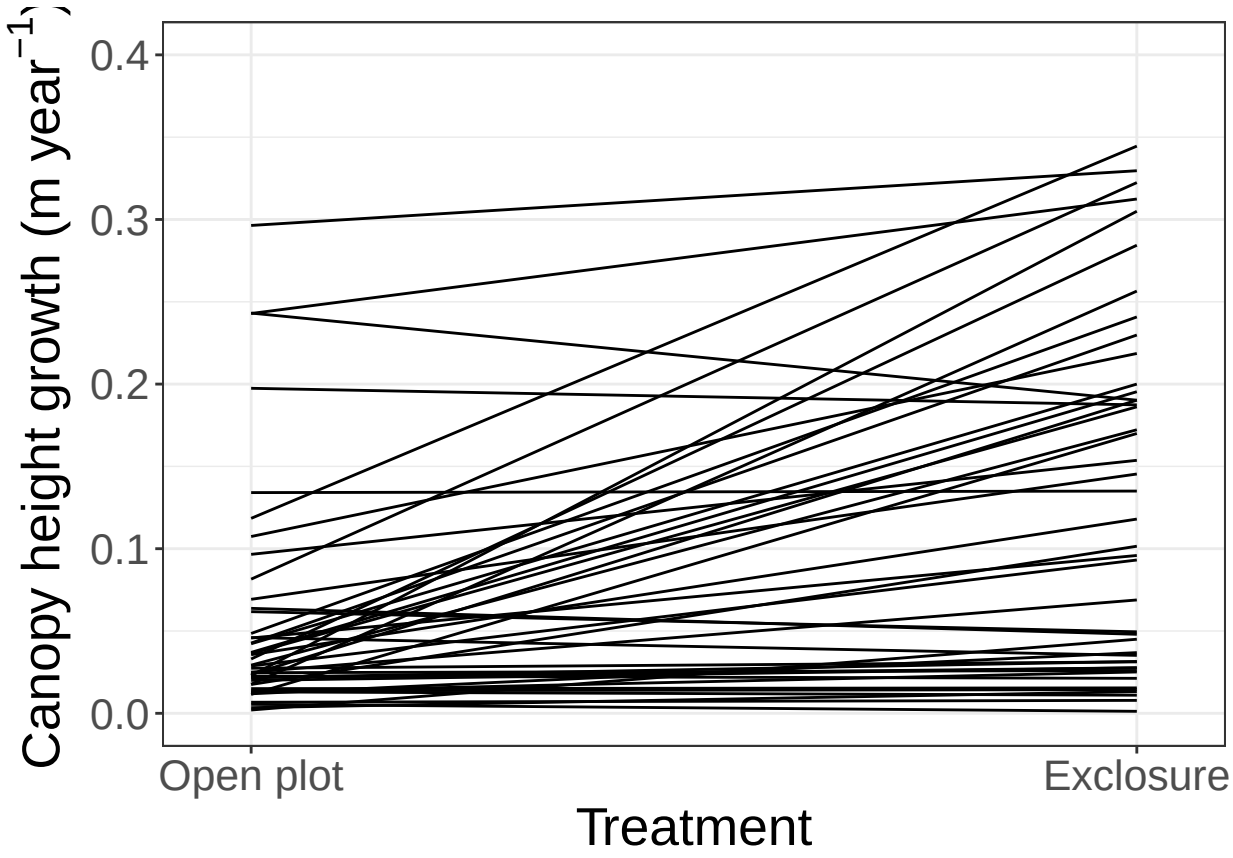
```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## 0.001214 0.022698 0.045375 0.096275 0.165922 0.420857
```

The numbers are in meters I'm pretty sure

```
dat$Treatment <- as.factor(dat$Treatment)
levels(dat$Treatment) <- c('Open plot','Exclosure')
(chg_treat <- ggplot(dat, aes(x=Treatment, y=canopygrowth, group=LocalityName))+
```

```
  geom_line()+
  labs(y=expression(paste('Canopy height growth (m year'^'-1', ')')), x='Treatment')+
  scale_linetype_manual(breaks = c("Exclosure", "Open plot"),
                        labels = c("Open plots", "Exclosures"), values=c(1,2))+
  scale_x_discrete(limits = c('Open plot', 'Exclosure'),
                   breaks = c('Open plot', 'Exclosure'), expand = c(0.1,0))+
  theme_bw()+
  theme(text = element_text(size = 20))+
  ylim(0, 0.4))
```

```
## Warning: Removed 1 rows containing missing values (geom_path).
```



Remove sites with top productivity

```
dat2 <- dat[dat$prod<0.8,]
dim(dat2)
```

```
## [1] 86 28
```

Lost 4 rows, i.e two localities

```
(chg_prod <- ggplot(data = dat2)+
  geom_point(aes(x = prod, y = canopygrowth,
                 colour= Treatment, shape=region))+
```

```
   geom_smooth(aes(x = prod, y = canopygrowth, colour= Treatment),
               method = "lm")+
  labs(y=expression(paste('Canopy height growth (m year'^'-1', ')')), x='Productivity')+
  theme_bw()+
  scale_color_manual(values = c("gray0", "gray60"))+
  labs(colour="Treatment", shape="Region")+
  theme(text = element_text(size = 20))+
  ylim(0, 0.4)+
  theme(legend.position = 'right',
                              legend.justification = c("left", "top"),
                              legend.box.just = "left",
                              #legend.margin = margin(5, 5, 5, 5),
                              legend.text = element_text(size=12))
)
```