Hills Forest ReMapping

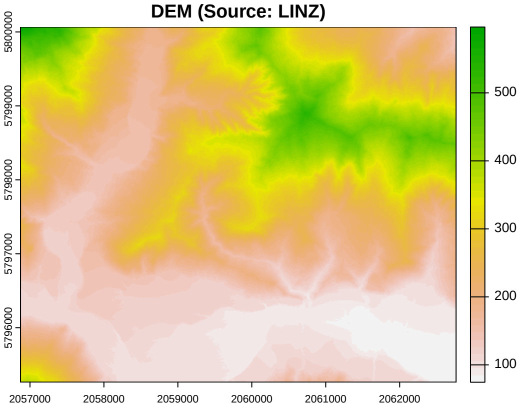
Summit-GIS

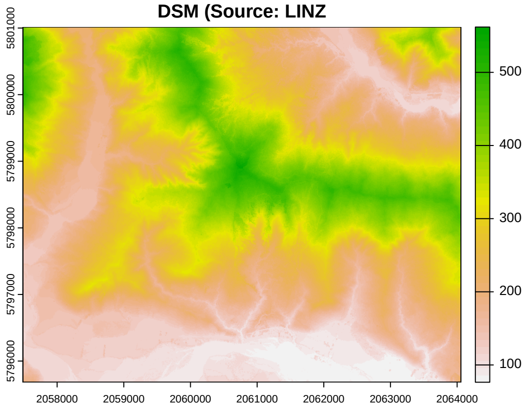
17/08/2023

Contents

Action:

Some notes on the data processing steps and mapping outputs completed in the remapping exercise of the Hills Forest Area. To map potential differences between official data layers and newly LiDAR-derived attributes, two variables were derived: ‘Stocking Density (stem/ha)’ & ‘Age Class’. Using DEM and DSM datasets sourced from the LINZ website, a stem map was derived by applying a variable window algorithm and a default taper function. With the stem map feature, two rasters were calculated showing a canopy height model and stocking density per hectare. This allowed some rough comparisons with values at StandID level using Establishment year and Stocking in stand records provided.





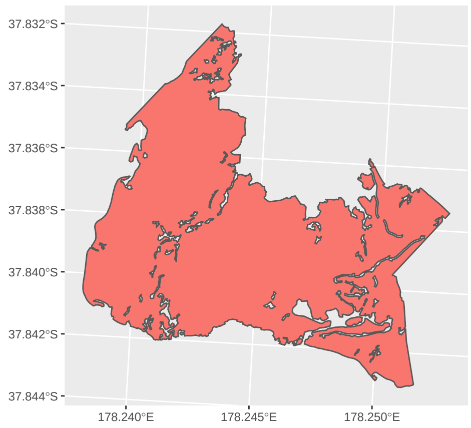
## 1. Inputs: LiDAR Projection

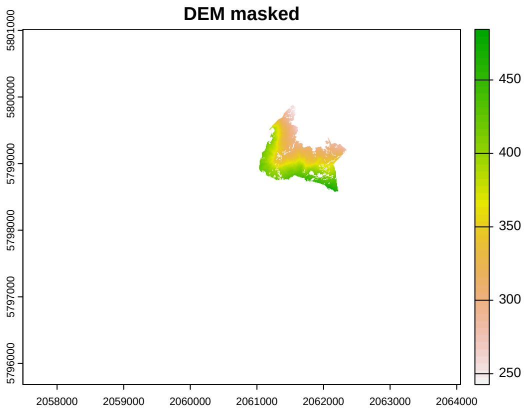
```
# Merge chunks
filez_dem = list.files("~/Desktop/Summit_Forestry/dem", full.names = T, all.files = FALSE, pattern = '.t
filez_dsm = list.files("~/Desktop/Summit_Forestry/dsm", full.names = T, all.files = FALSE, pattern = '.t
dem_raster_list <- lapply(filez_dem, raster)
dsm_raster_list <- lapply(filez_dsm, raster)
dem_raster = do.call(merge, c(dem_raster_list, tolerance = 1))
```

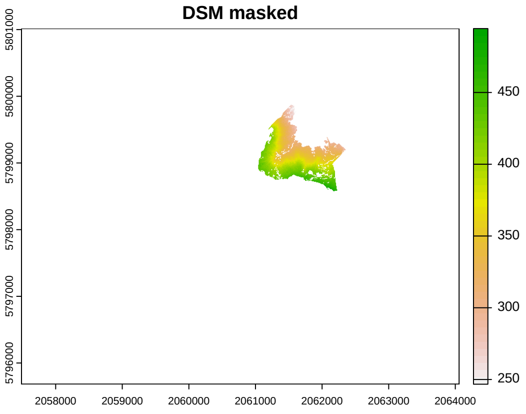
```
dsm_raster = do.call(merge, c(dsm_raster_list, tolerance = 1))
writeRaster(dem_raster, filename = "~/Desktop/Summit_Forestry/dem/dem_raster.tif", overwrite=TRUE)
writeRaster(dsm_raster, filename = "~/Desktop/Summit_Forestry/dsm/dsm_raster.tif", overwrite=TRUE)

# Rasterize and fill sinks
fill_sinks(dem = "dem_mosaic.tif", out = "dem_fill.tif", size = 1, overwrite = TRUE)
fill_sinks(dsm = "dsm_mosaic.tif", out = "dsm_fill.tif", size = 1, overwrite = TRUE)
writeRaster(dem_fill, filename = "~/Desktop/Summit_Forestry/dem/dem_filled.tif", overwrite=TRUE)
writeRaster(dsm_fill, filename = "~/Desktop/Summit_Forestry/dsm/dsm_filled.tif", overwrite=TRUE)

# Assign EPGS2193/NZGD2000
dem_rast = terra::rast(dem_filled)
dsm_rast = terra::rast(dsm_filled)
terra::crs(dem_rast) =  "epsg:2193"
terra::crs(dsm_rast) =  "epsg:2193"
terra::plot(dem_rast, main='DEM (Source: LINZ)')
terra::plot(dsm_rast, main='DSM (Source: LINZ')
```

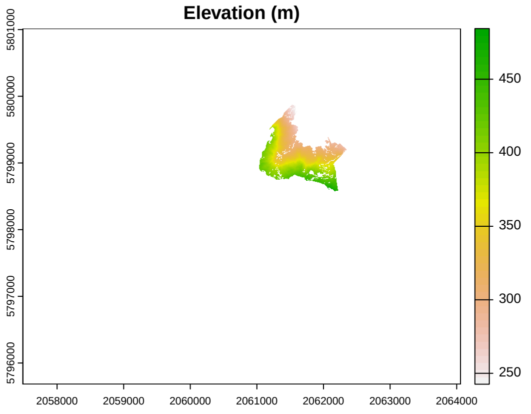
Input: AOI & Masking layers

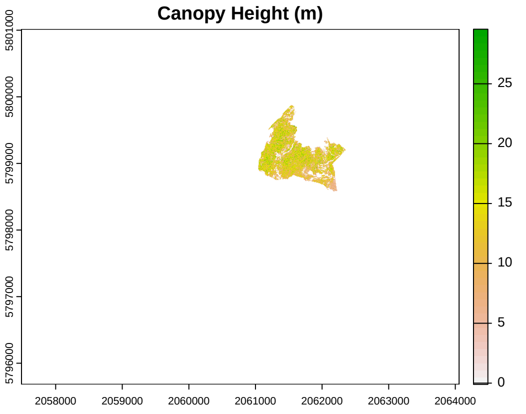
```
# Derive mask from single cutblock shapefile: HILL-0341-009
mask_sf = sf::read_sf("~/Desktop/Summit_Forestry/stands/HILL-0341-009.shp")
mask_rast = rasterize(vect(mask_sf), dem_rast, touches = TRUE)
terra::crs(mask_rast) =  "epsg:2193"
ggplot(mask_sf) + geom_sf(aes(fill = 'red'), show.legend = FALSE)

# Align & apply mask
mask_rast = terra::resample(mask_rast, dsm_rast, method="near")
dem_rast = terra::resample(dem_rast, dsm_rast, method="near")
dem_masked = mask(dem_rast, mask_rast, inverse=FALSE)
dsm_masked = mask(dsm_rast, mask_rast, inverse=FALSE)
plot(dem_masked, main="DEM masked")
plot(dsm_masked, main = "DSM masked")

# Derive CHM & save all rasters
elev = dem_masked
chm = dsm_masked - dem_masked
elev_raster = raster::raster(elev)
chm_raster = raster::raster(chm)
writeRaster(elev_raster, filename = "~/Desktop/Summit_Forestry/dem/elev_raster.tif", overwrite=TRUE)
writeRaster(chm_raster, filename = "~/Desktop/Summit_Forestry/dsm/chm_raster.tif", overwrite=TRUE)
plot(elev, main="Elevation (m)")
plot(chm, main="Canopy Height (m)")
```







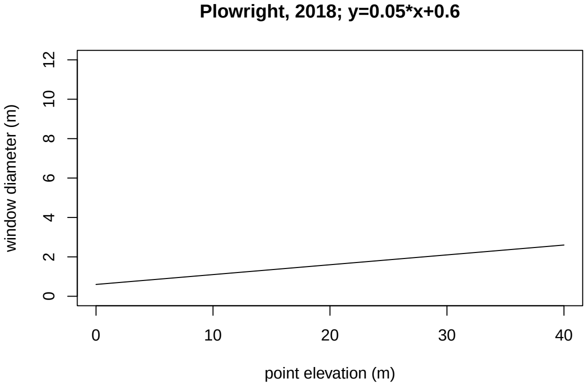




Input: Variable Window Function

```
# Used Plowright's window function as temporary fix here:
# https://cran.r-project.org/web/packages/ForestTools/vignettes/treetop_analysis.html
wf_plowright<-function(x){
  a=0.05
  b=0.6
  y<-a*x+b
  return(y)}
heights <- seq(0,40,0.5)
```

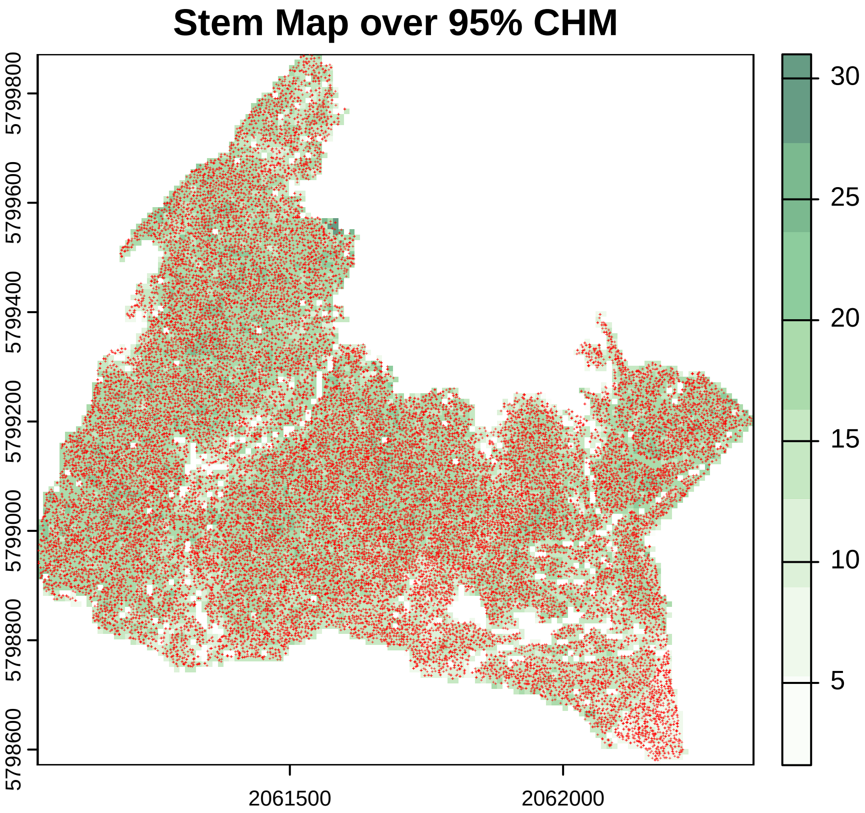
```
window_plowright <- wf_plowright(heights)
plot(heights, window_plowright, type = "l", ylim = c(0,12), xlab="point elevation (m)", ylab="window dia
```

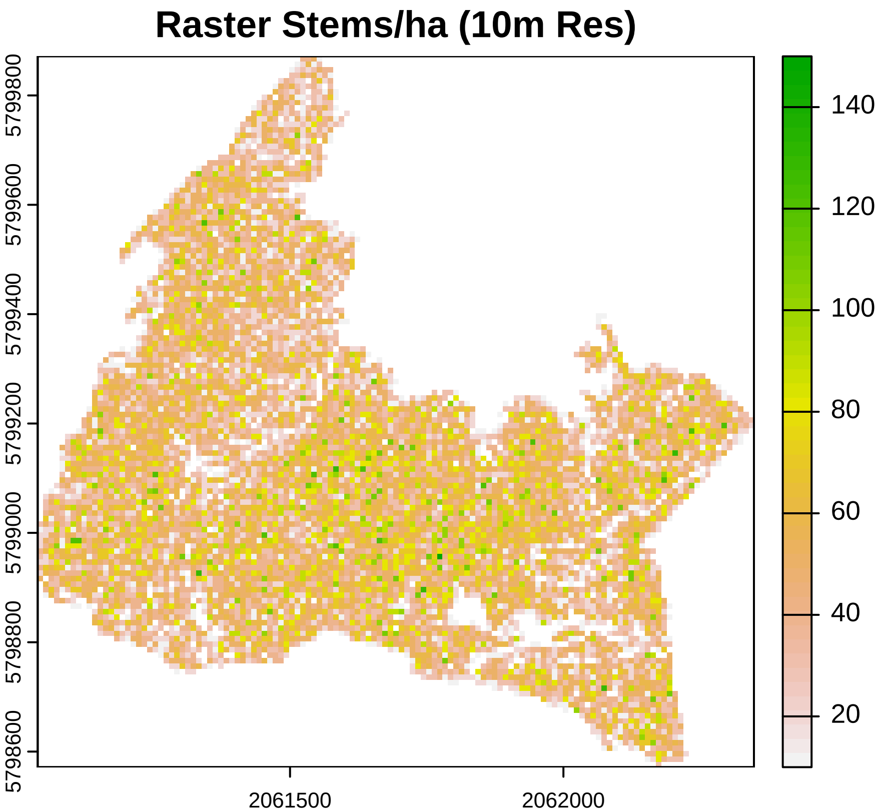


Output: 95% Canopy Height & Stem Count Layers

```
kernel <- matrix(1,3,3)
chm_raster = focal(chm, w = kernel, fun = median, na.rm = TRUE) %>% raster()
ttops_1.5mfloor_plowright = ForestTools::vwf(chm_raster, wf_plowright, 1.5)
writeOGR(ttops_1.5mfloor_plowright, "~/Desktop/Summit_Forestry/stands", "treetops_hills_009_masked", dr

quant95 <- function(x, ...)
  quantile(x, c(0.95), na.rm = TRUE)
custFuns <- list(quant95, max)
names(custFuns) <- c("95thQuantile", "Max")

# Derive output rasters and assign resolution
ttops_1.5mfloor_height <- ForestTools::sp_summarise(ttops_1.5mfloor_plowright, grid = 10, variables = "
stem_count_raster = ttops_1.5mfloor_height[["TreeCount"]]
chm_95height_raster = ttops_1.5mfloor_height[["height95thQuantile"]]
raster::writeRaster(chm_95height_raster, filename = "~/Desktop/Summit_Forestry/stands/chm_95height_10m.
raster::writeRaster(stem_count_raster, filename = "~/Desktop/Summit_Forestry/stands/stem_count_10m.tif"

mypalette<-brewer.pal(8,"Greens")
stem_count_rast = terra::rast(stem_count_raster)
stem_count_ha = 10*stem_count_rast
chm_95height_rast = terra::rast(chm_95height_raster)
stem_count_ha_sf = st_as_sf(ttops_1.5mfloor_plowright)
{plot(chm_95height_rast, col = mypalette, alpha=0.6, main="Stem Map over 95% CHM")
plot(st_geometry(stem_count_ha_sf["treeID"]), cex = 0.2, pch="+", col = 'red', lwd=1, alpha=1, add=TRUE
plot(stem_count_ha, main="Raster Stems/ha (10m Res)")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: "/home/seamus/Desktop/Summit_Forestry/stands", layer: "treetops_hills_009_masked"
## with 34585 features
## It has 3 fields
```


Stem Map over 95% CHM
5799800
5799600
5799400
5799200
5799000
5798800
5798600
2061500
2062000
30
25
20
15
10
5


Raster Stems/ha (10m Res)
5799800
5799600
5799400
5799200
5799000
5798800
5798600
2061500
2062000
140
120
100
80
60
40
20