Pontus Olofsson *(olofsson@bu.edu)*
Earth & Environment, Boston University

BOSTON UNIVERSITY

2. Extract local map

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2.1 Introduction

The global dataset contains several layers that need to be merged to create a map that can serve as a stratification for the sample. The layers of interest are tree cover, forest loss, forest gain, forest loss and gain, and the data mask that shows unmapped areas and water bodies. The tree cover layer is continuous and each pixel represents the percentage of tree canopy closure with trees being defined as vegetation taller than 5 m in height, and a threshold is required to create discrete forest and non-forest strata. This is a non-trivial task and the reader is referred to MGD Module 2 for further guidance.

The global data is delivered in granules of 10 by 10 degrees and several granules might need to be downloaded to cover the area of interest. If the study area is a country it is likely that the user wants to clip the map according to the country outline. In this case, a vector file showing the outline of the country is required.

In the instructions below, menus, buttons and other components of the graphical user interface are italicized while file names and directories are put in quotation marks.

2.2 Extract data

1. Go to http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.1.html and identify the upper left corner of the granule that you want to download in multiples of 10 (for example, 50N 070E).
2. In the virtual machine, open the *Terminal Emulator* and navigate to your working directory.
3. Download the script https://raw.githubusercontent.com/ceholden/misc/master/products/2013Hansen/dl_hansen.sh do the "2_stratification" directory.
4. In the "2_stratification" directory, type `./dl_hansen.sh 50N 070W` (to download granule with upper left corner 50N 070W). This will create subdirectory in your directory that contains the data layers needed to create the map: data mask, tree cover, forest loss and forest gain.

2.3 Create stratification

1. Within the virtual machine, start the QGIS Desktop

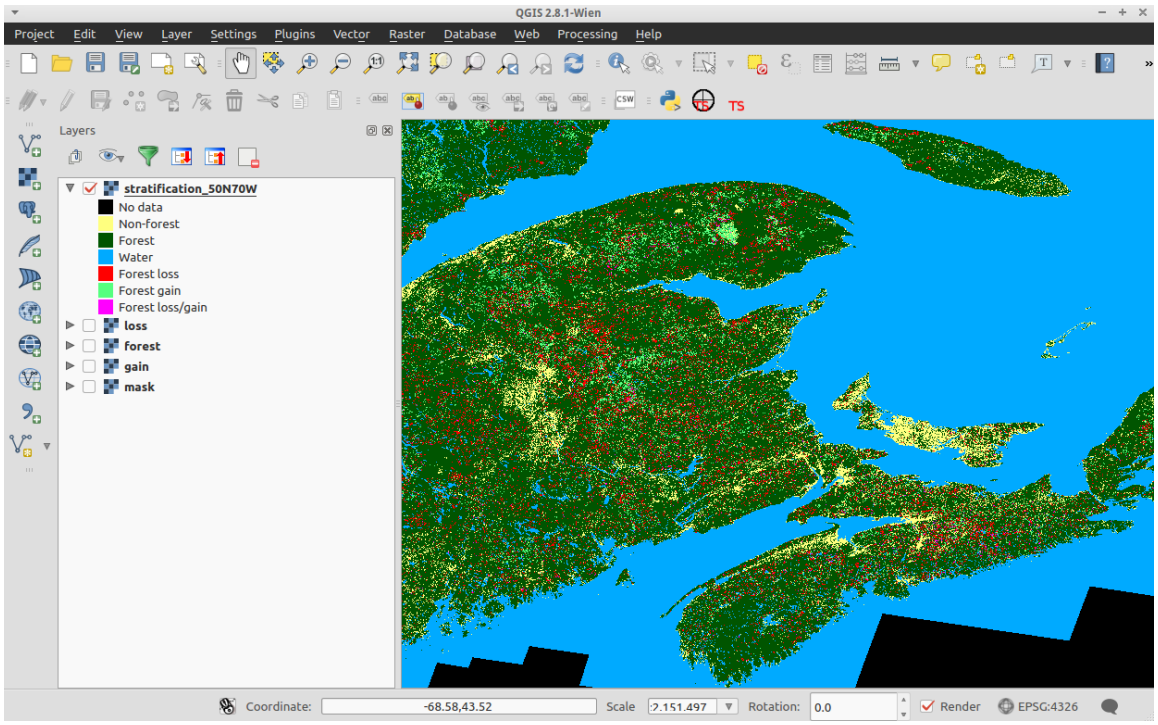
2. Clicking *Layer* > *Add Raster Layer* and navigate to the download directory and select the files "treecover2000*", "*datamask* *gain* *loss*"; rename these to "treecover", "loss", "gain" and "mask" by right clicking the layers in the *Layers* panel > *Rename*. Make sure you have downloaded the correct granule. If not, go back to subsection 2.2.
3. Open the *Raster calculator* from the *Raster* menu to create the final stratification. Make an expression that makes map where the map classes have the following values:

No data	0
Non-forest	1
Forest	2
Water	3
Forest loss	4
Forest gain	5
Forest loss/gain	6

   The expression should be the following (you can copy and paste into the *Raster calculator expression*) and specify an output file name in the stratification directory "/home/opengeo-vm/work/2_stratification" (call it "stratification_50N70W_32b" for example). (Note that in this example forest is defined as 10% tree cover – please specify a threshold for the tree cover.)

```
("mask@1" = 0)*0 + (("mask@1" = 1) AND (("treecover@1" > 10) = 0)
AND ("gain@1" = 0) AND ("loss@1" = 0))*1 + (("mask@1" = 1) AND
(("treecover@1" > 10) = 1) AND ("gain@1" = 0) AND ("loss@1" = 0))*2
+ ("mask@1" = 2)*3 + (("mask@1" = 1) AND ("gain@1" = 0) AND
("loss@1" = 1))*4 + (("mask@1" = 1) AND ("gain@1" = 1) AND ("loss@1"
= 0))*5 + (("mask@1" = 1) AND ("gain@1" = 1) AND ("loss@1" = 1))*6
```

4. The Raster calculator outputs data in 32 bit precision which is not needed as we only have seven pixel values. We will therefore convert the forest layer to 8 bit precision using a GDAL command: open a terminal and navigate to your working directory: `cd /home/opengeo-vm/work/2_stratification` and type: `gdal_translate -ot byte stratification_50N70W_32b.tif stratification_50N70W.tif` and hit the Enter key. This will create an 8 bit version of the forest layer; delete the 32 bit version to save space.
5. Right-click the newly created stratification in the *Layers* panel and click *Properties* > *Style*. In *Render type* select *Singleband psuedocolor*, click the plus sign 7 times and give each class a name according to the list of classes in point 7 and an appropriate color. Click *OK*. It should look like the screenshot below.

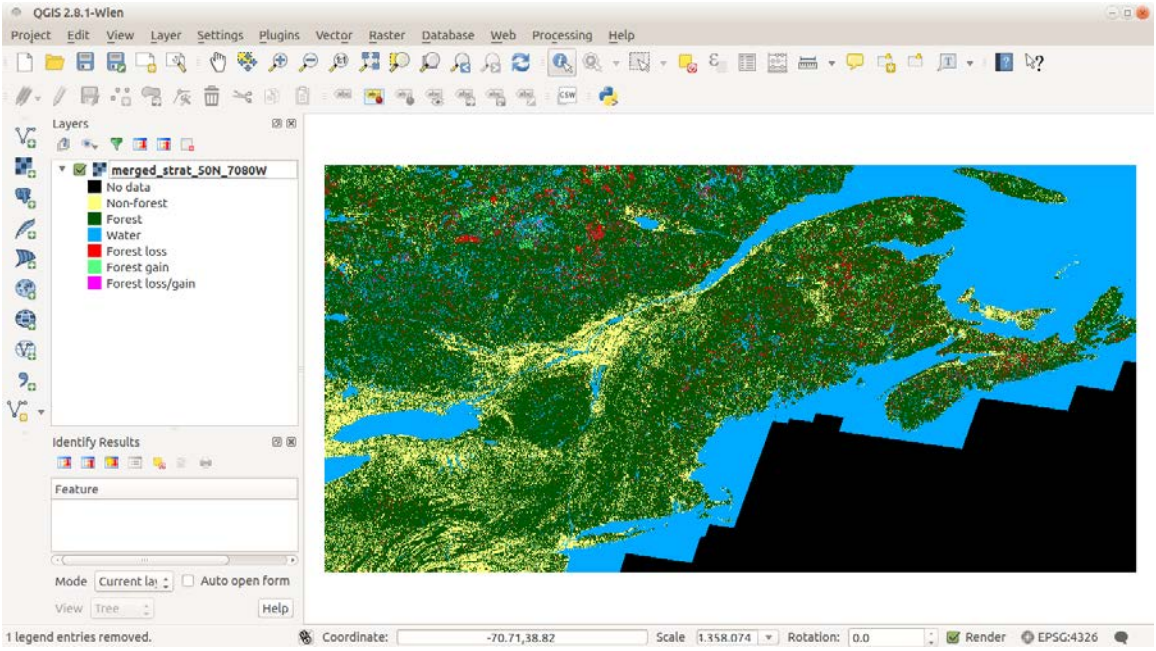


6. OPTIONAL: If a forest/non-forest map is desired: open the file named "*treecover2000*" by clicking the *Layer* > *Add Raster Layer* and navigate to the download directory. Make sure you have downloaded the correct granule. If not, go back to subsection 2.2.
7. Open the *Raster calculator* from the *Raster* menu; double-click the tree cover layer listed in *Raster bands*; in the *Raster calculator expression*, specify a threshold for the tree cover such that the expression reads `"Hansen_GFC2013_treecover2000_50N_070W@1" > T` where T is a threshold between 0 and 100.
8. Specify an output layer (call the file "forest2000_50N70W_32b" or something similar) and click *OK*.
9. Again, the output is in 32 bit precision and for the sake of space should be converted to 8 bit precision using GDAL: `gdal_translate -ot byte forest_32b.tif forest.tif` and hit the Enter key. This will create an 8 bit version of the forest layer; delete "forest_32b.tif" to save space.

2.4 Mosaic granules

1. If more than one granule is required to cover the study area, repeat steps 2.2 and 2.3 for each granule. Each granule should be stored in your working directory as separate subdirectories named according to the upper left latitude and longitude.
2. In this example, I have two granules, 50N 80W and 50N 70W covering the northeastern US and southeastern Canada that I will need to merge. This can be done using the gdal_merge.py program which can be executed in terminal (http://www.gdal.org/gdal_merge.html) or from QGIS. To do the latter:

3. Create a new folder called “merged” in the stratification directory and copy to the folder the stratifications for each granule created in section 2.3 (you can do this in the terminal using the *mkdir* and *cp* commands or using the *Caja* file browser).
4. Click *Raster* > *Miscellaneous* > *Merge*; highlight *Choose input directory*...; browse to the “merged” folder and specify an output name (“merged_strat_50N_7080W” or something similar); leave the other options blank except for *Grab pseudocolor...* and click *OK*. The output should look like below:

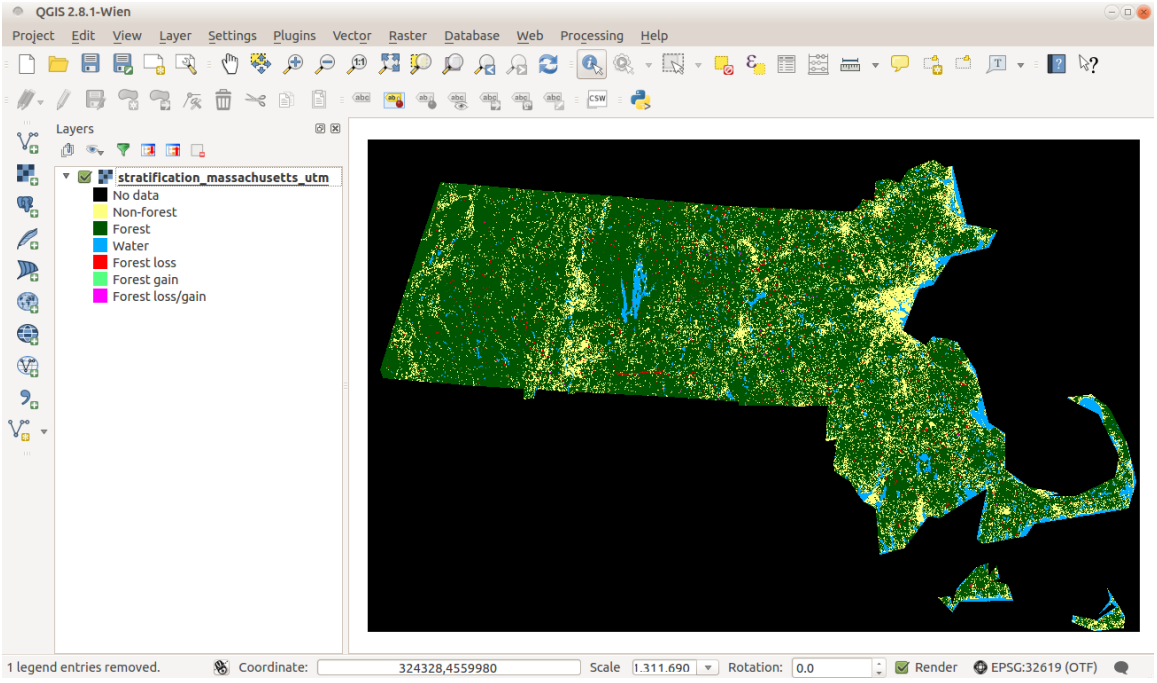


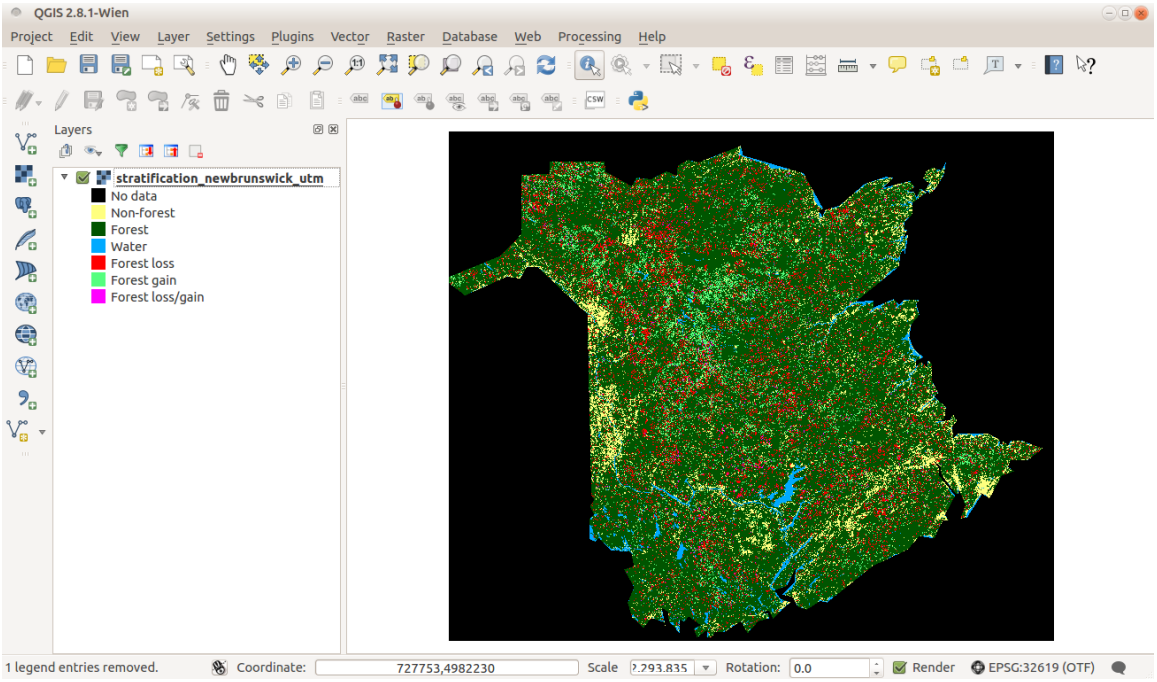
2.5 Clip and project

1. In this example, I want to create two local change maps: one of the Canadian province of New Brunswick and one of the US state of Massachusetts. Open the shapefile that contain a polygon for your area of interest. (I will start with New Brunswick using “new_brunswick.shp”.)
2. Clip the stratification by clicking *Raster* > *Extraction* > *Clipper*; select the stratification as input, specify an output (“stratification_newbrunswick”) and set “new_brunswick.shp” as *Mask layer*; click *OK*.
3. Apply the same palette as for the larger stratification and close all other layers.
4. Open a terminal and navigate to the stratification directory: `cd /home/opengeo-vm/work/2_stratification`
5. The data is delivered in angle-correct projection and we want to reproject it to an area-correct projection: click *Raster* > *Warp*; set input file “stratification_newbrunswick” and output to “stratification_newbrunswick_utm”; set *Source SRS* to “EPSG:4326” (WGS 84); set *Target SRS* to “ESPG: 32619” (UTM Zone 19 N); click *Edit* at the bottom right (pencil) and add `-tr 30 30` such that the expression reads:
   `gdalwarp -overwrite -s_srs EPSG:4326 -t_srs EPSG:32619 -tr 30 30 -of GTiff /home/opengeo-vm/work/2_stratification/stratification_massachusetts.tif`

`/home/opengeo-vm/work/2_stratification/stratification_massachusetts_utm.tif`; click *OK*.

6. Set the coordinate reference system for the display to UTM Zone 19 N in *Project* > *Properties* > *CRS*.
7. Redo for Massachusetts and project to UTM Zone 19 N. Your screen should look like below:





You have now created a stratification that you will use in Section 3, Sampling Design.