Tutorial for degradation monitoring in SEPAL

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INTRODUCTION AND OBJECTIVES

In the context of the REDD+, Cambodia has a national program that benefits from support of FAO for the establishment of its National Forest Monitoring System. As noted in Cambodia 2016 FREL submission, degradation of forests represent a significant source of emissions that couldn't be accounted for at the time because the information to support was not robust and reliable enough.

The use of dense time series to analyze trends in forest cover change is one of the different approaches to monitor degradation through remote sensing[1]. This approach is computationally intensive and requires to process large volumes of data.

Verbesselt et al. (2010, 2012), Dutrieux et al. (2015) and DeVries et al. (2015) used the Breaks for Additive Seasonal and Trend (BFAST) approach to demonstrate that time series can be decomposed into trend, seasonal, and remainder components and that the time and number of changes can be detected at high temporal resolution (i.e., 16 days), enabling detection of tree cover change and separation from phenology signal.

The same authors developed the bfastSpatial package (R language) which provides utilities to perform change detection analysis on time-series of spatial grid data, such as the Landsat satellite imagery.

FAO has developed the System for Earth Observation Data Access, Processing and Analysis for Land Monitoring (https://sepal.io), a big-data processing platform that combines super-computing power, open-source geospatial data processing software and modern geospatial data infrastructures like Google's Earth Engine.

In collaboration with the University of Wageningen, FAO has adapted the bfastSpatial package into a functional processing chain (https://github.com/yfinegold/runBFAST/) that uses both Google Earth Engine (GEE) for the preparation of the time series and SEPAL for the processing of the algorithm itself.

This tutorial is developed for the GDANCP/MOE team and aims at:
- providing an introduction to cloud computing
- training the staff to the use of the bfastSpatial package within SEPAL
- training the staff to the use of Object-Based processing chain on the server

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[1] Assessing Forest Degradation. FAO Lessons Learned. In: Proceedings of the Joint GFOI/GOFC-GOLD Expert Workshop #2 on "Approaches to monitoring forest degradation for REDD+". GFOI. 2014. http://www.gfoi.org/rd/second-rd-workshop/.

REQUIREMENTS

All necessary data for the completion of this tutorial is available at
https://github.com/lecrabe/ws_khm_20180507

Background information on the OpenForis initative
www.openforis.org

You can request Access to SEPAL with the following
1/ have-open a GMAIL account (in order to access Google Earth Engine functionality)
2/ get the account registered and white listed in Google Earth Engine
https://earthengine.google.com/signup/
3/ open an account in SEPAL https://tinyurl.com/sepal-access

If not completed, please fill in the quick intro survey:
https://goo.gl/forms/Jv2mCTLhMGYHjiQh2

CONTENT OF THE TUTORIAL

1. Create an AOI

Load the exercise shapefile of 20x20 tiles in a GIS
"~/ws_khm_20180507/data/tiling/exercise.shp"
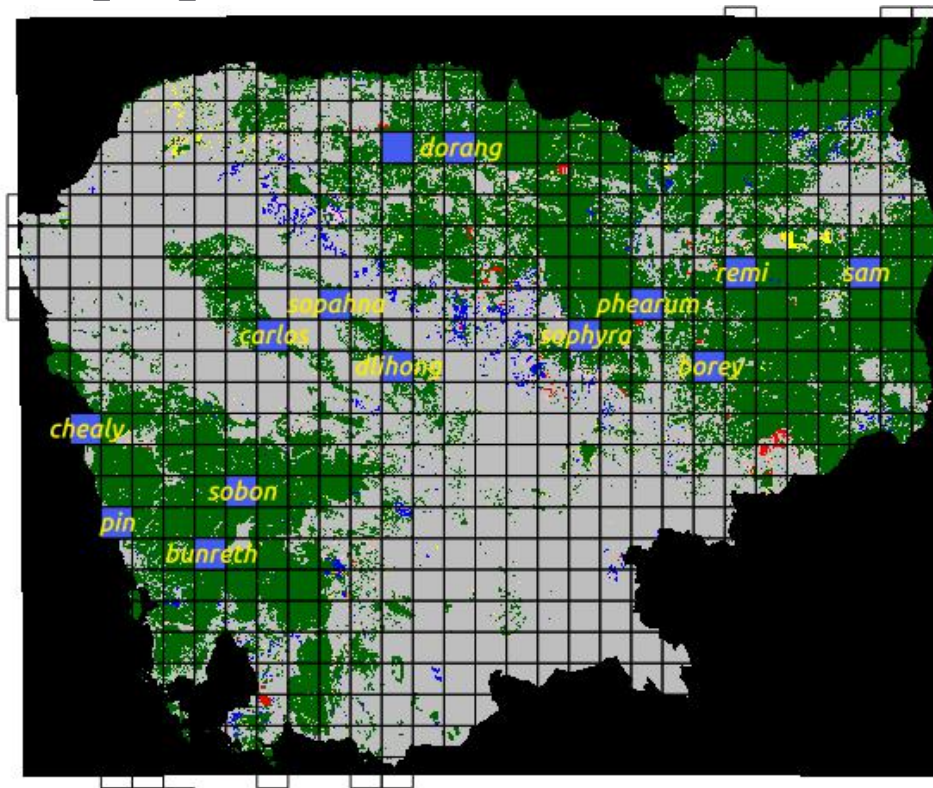
Select the tile corresponding to your name, Save the tile as KML
Load the tile as a Fusion Table, make it public, copy the FT ID

For example: 1wap3W1OmwjGwQl7WSxBWoSFrKEtuFrNsxZEm5cL2
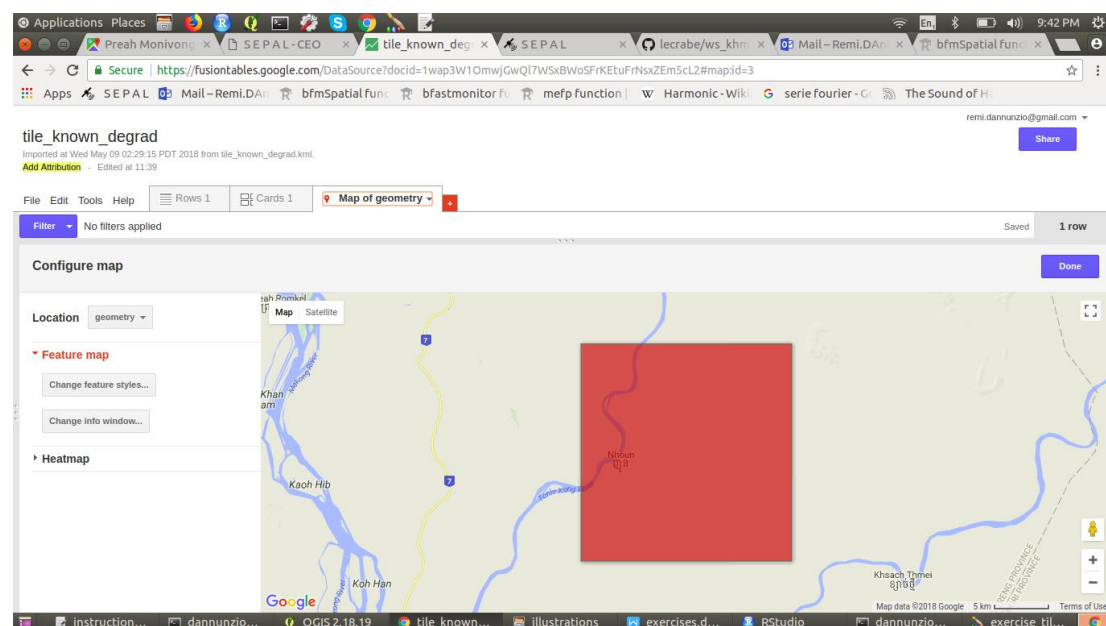
2. Generate Data

Open https://sepal.io

2.1 Generate satellite imagery Time Series for an index

Start Search / Time Series
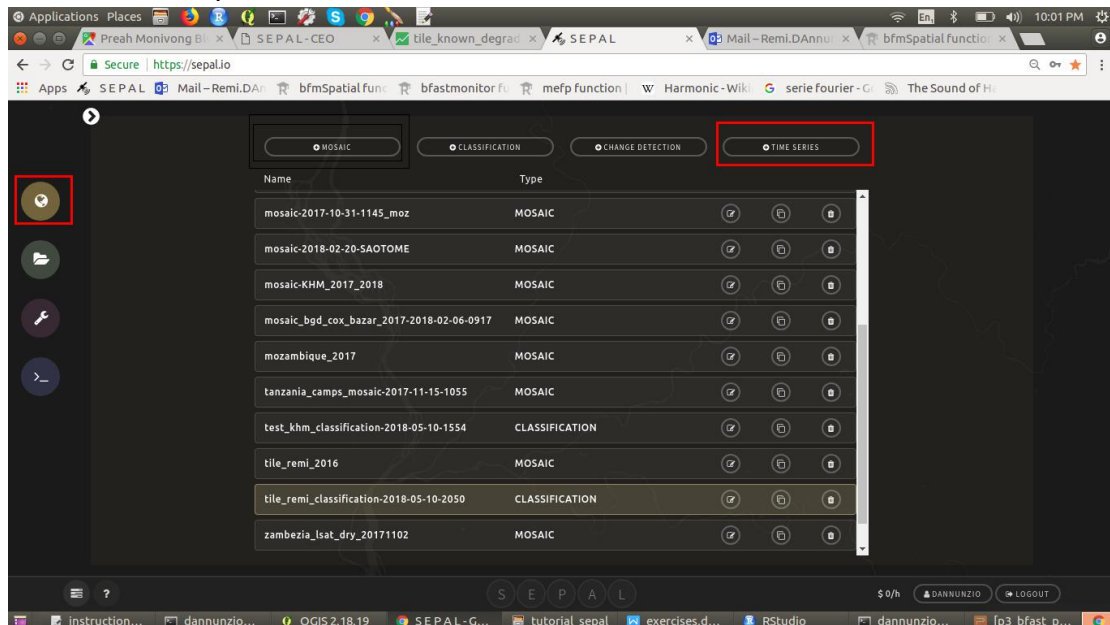
Change the name, Use the FT ID as Area of Interest
Select dates 2010-01-01 to Current date
Select NDMI, BRDF correct
Export your Time Series to SEPAL
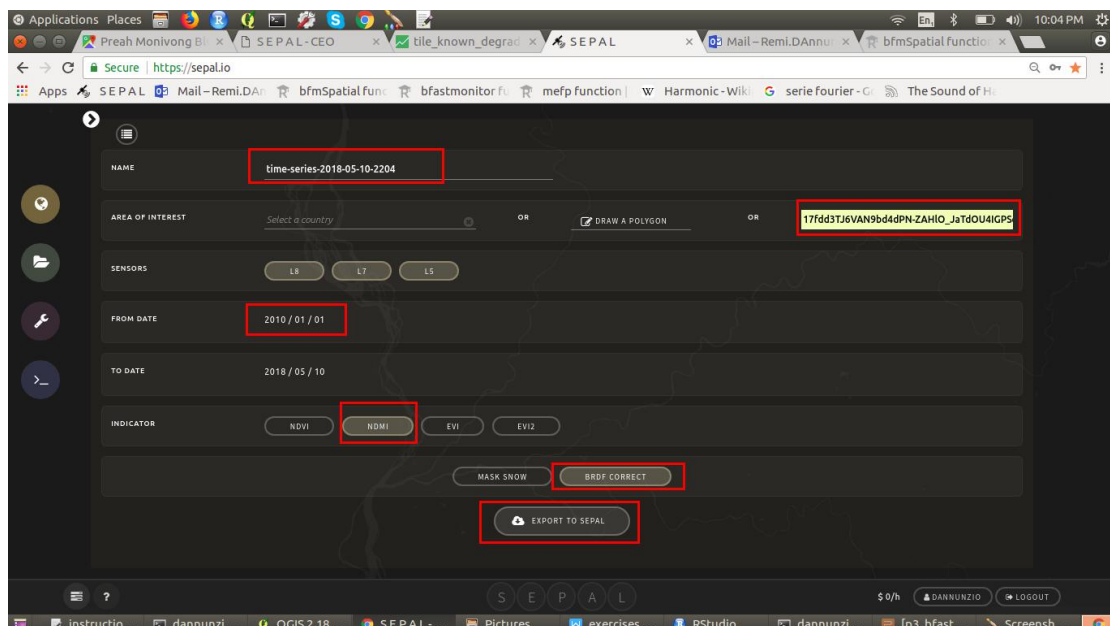
2.2 Generate a satellite imagery Mosaic

Start Search / Mosaic
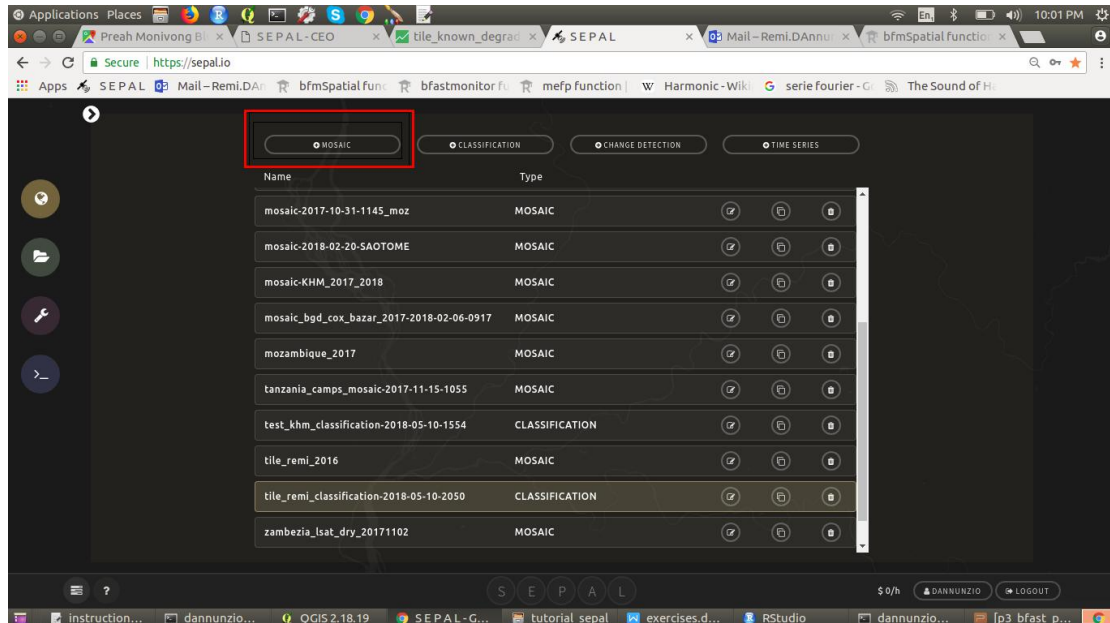
Change the name
Use the FT ID as Area of Interest
Select LANDSAT
Select date 2016-02-14
Press Search
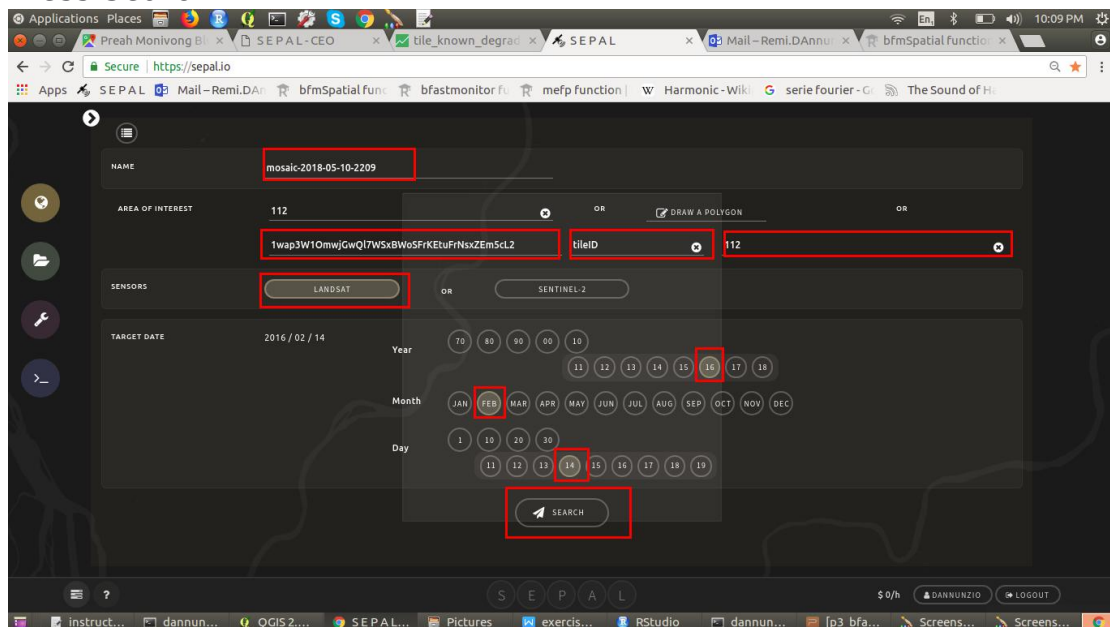
Press Auto-Select and Submit
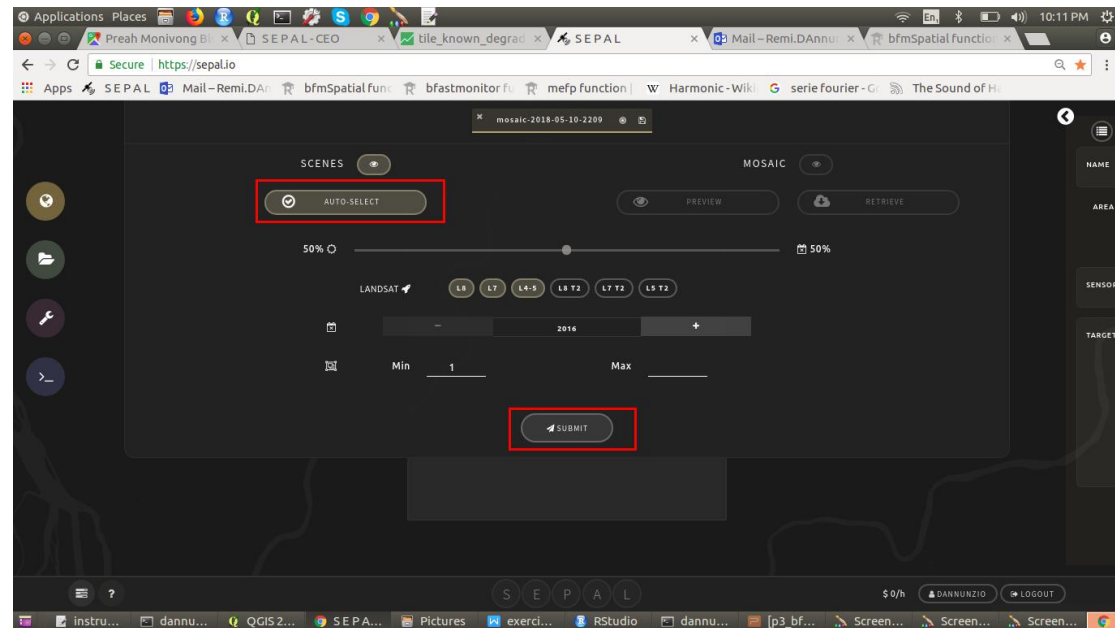
Press Preview and Select a band combination
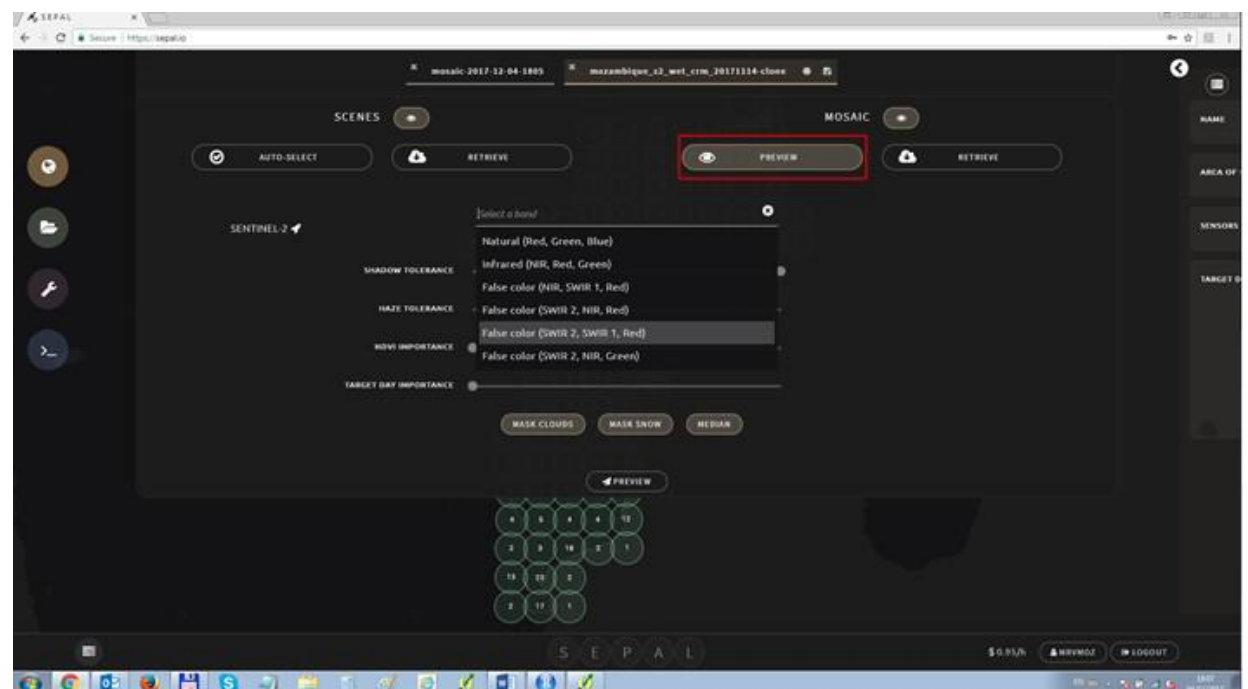
Change the scenes if needed by clicking on them
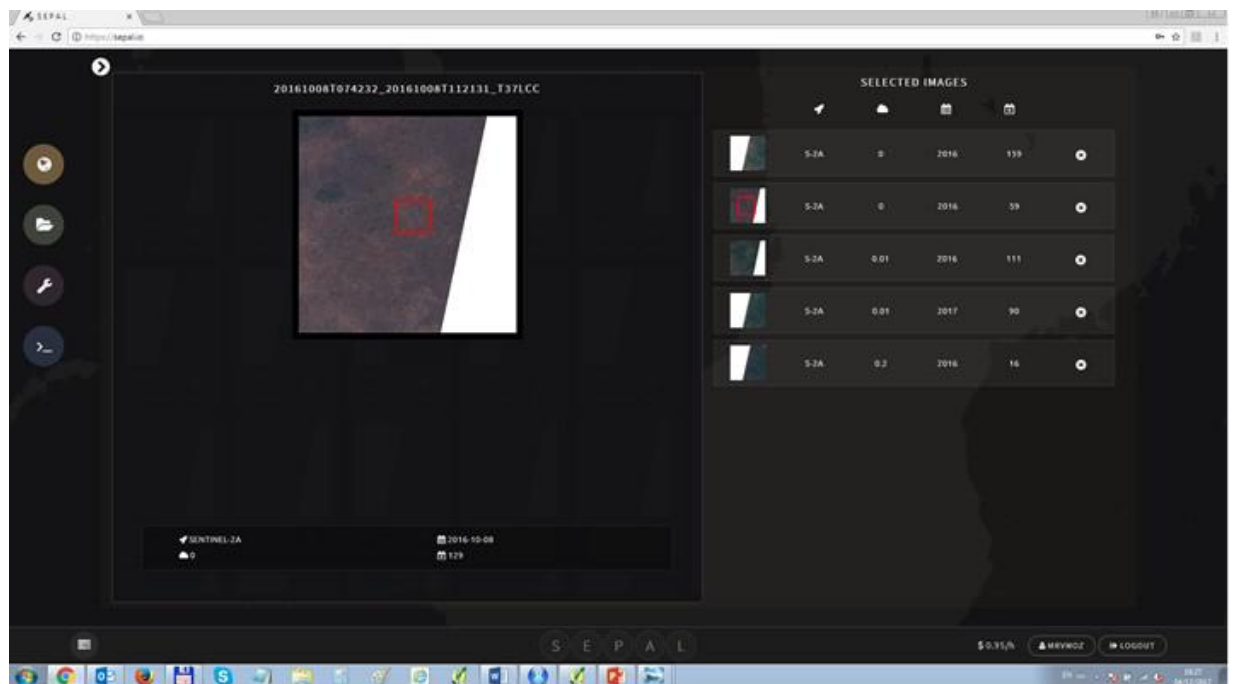
Once you are satisfied with your mosaic, you can save as a recipe in the top right button. You will be able to access again your mosaic with the saved parameters.

Edit the Name if needed
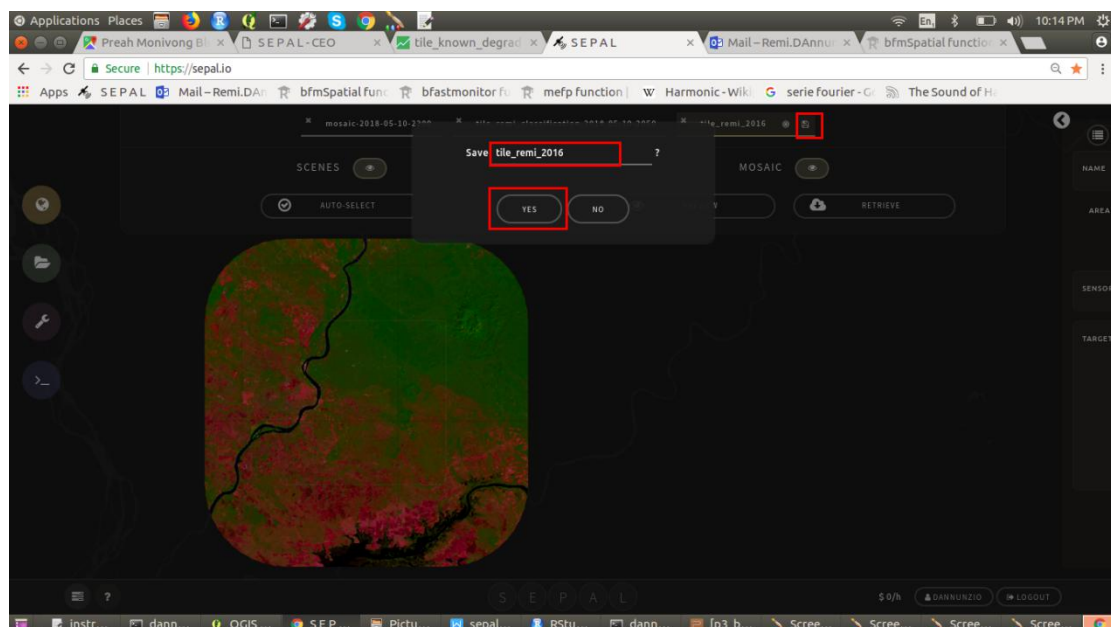
Press Retrieve with bands Green, Red, NIR, SWIR2, BRDF correct, median, surface reflectance.
Choose SEPAL to export your mosaic.
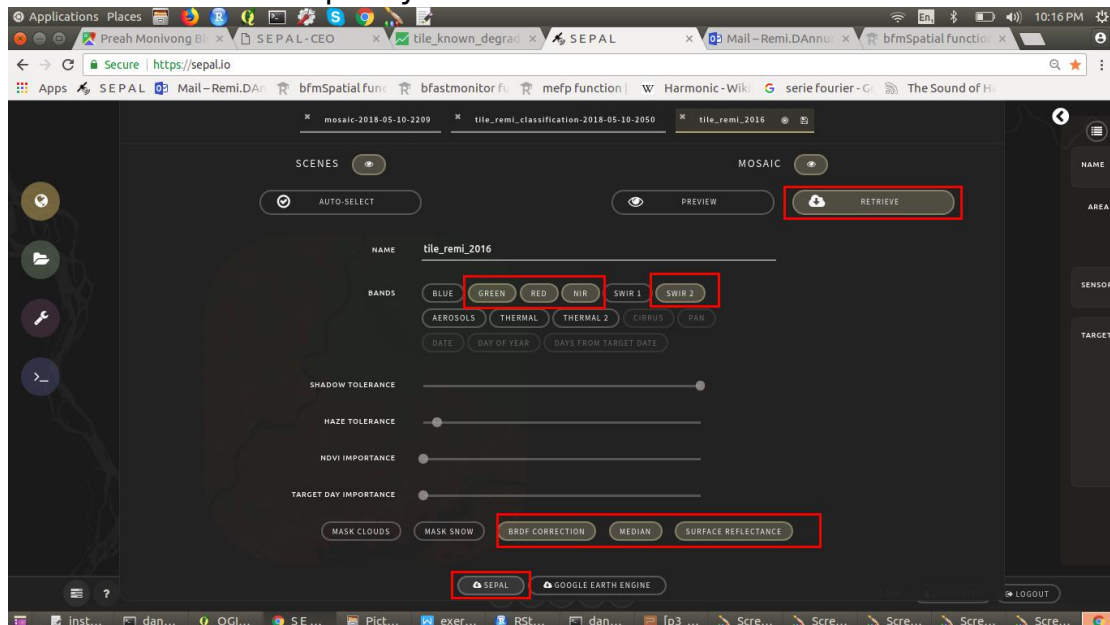
You can monitor the download progress in the bottom left icon
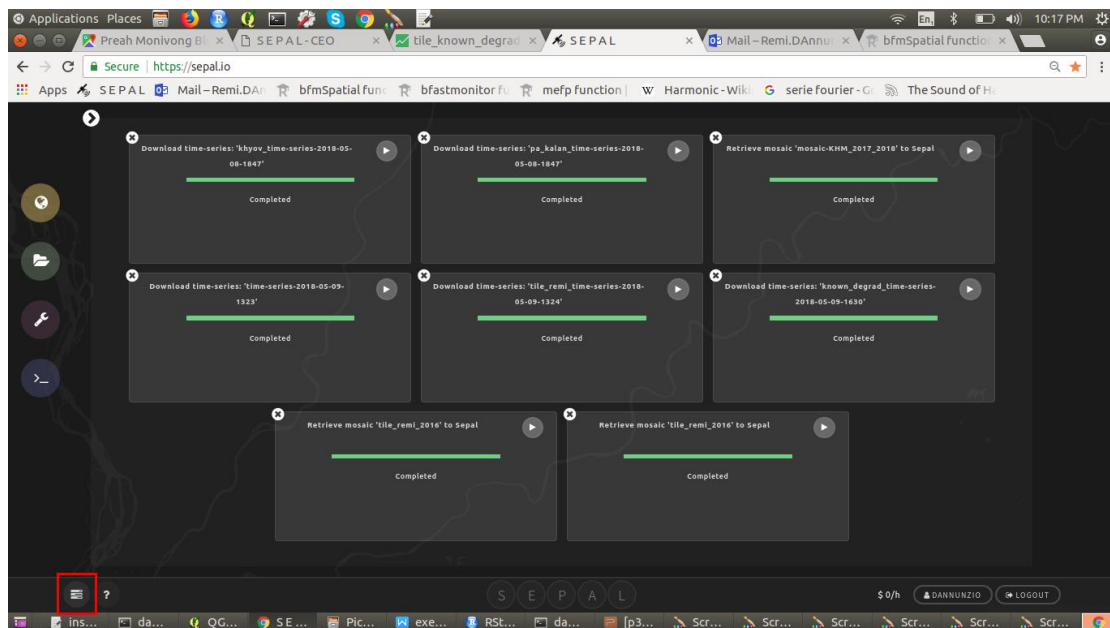
3. Run BFAST

Check your budget, kill any t2 instance

Open the terminal and start a #6 instance (type 6 and ENTER)

Update your repository by typing the following in the terminal:

```
cd ws_khm_20180507
git pull
```
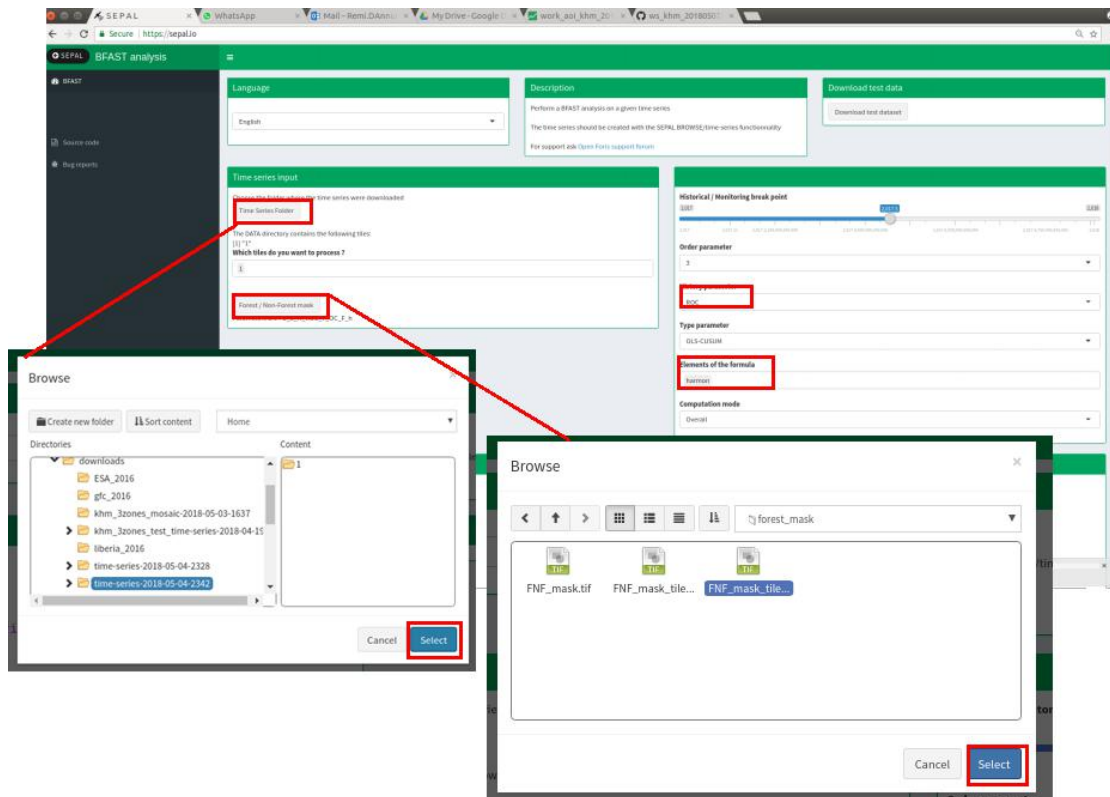
Go to Process / Time Series Analysis
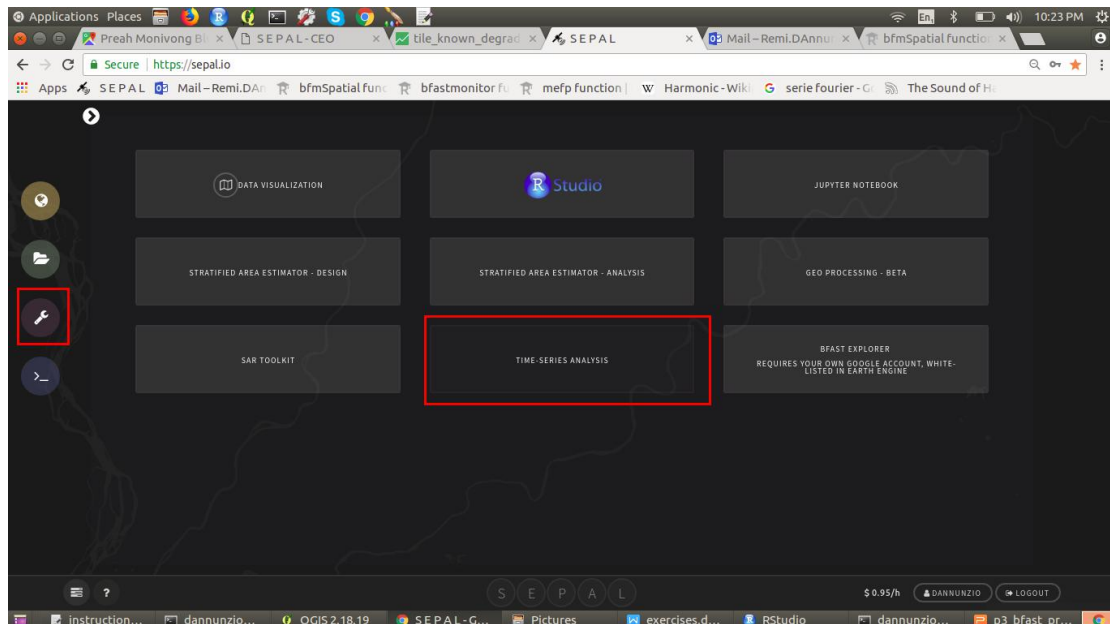
Select the tile you exported
Load the forest mask and select "FNF mask"
Change your options for History (All) and Formula (h+t)
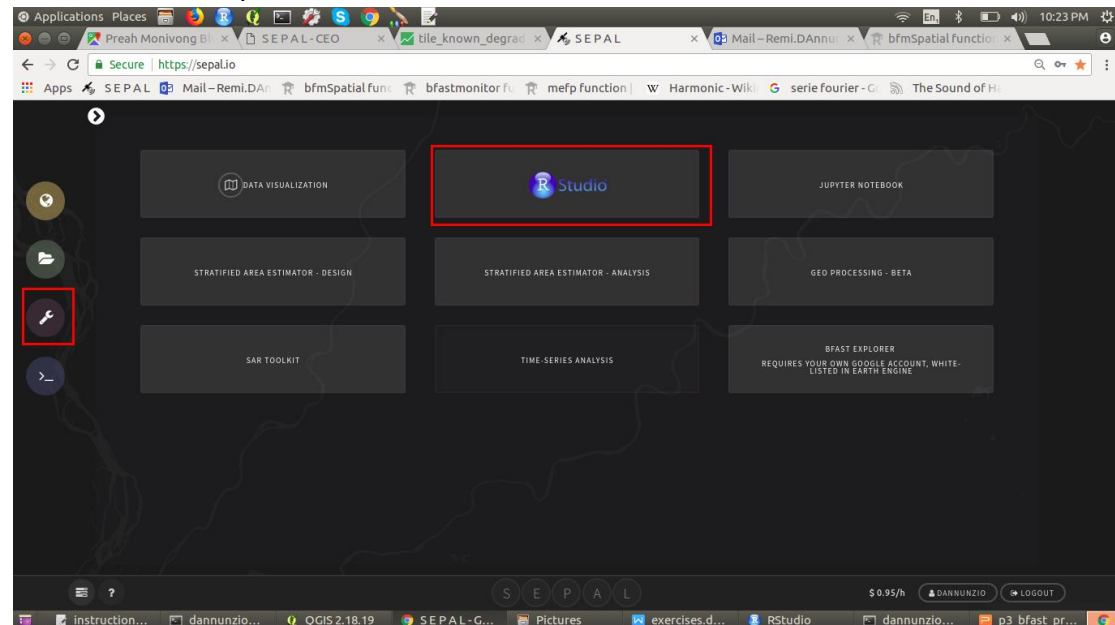Launch the process

Download the product to your computer using either Browse or a SSH/FTP solution like FileZilla

4. GFC spatial integration exercise

Check your budget, kill any instance
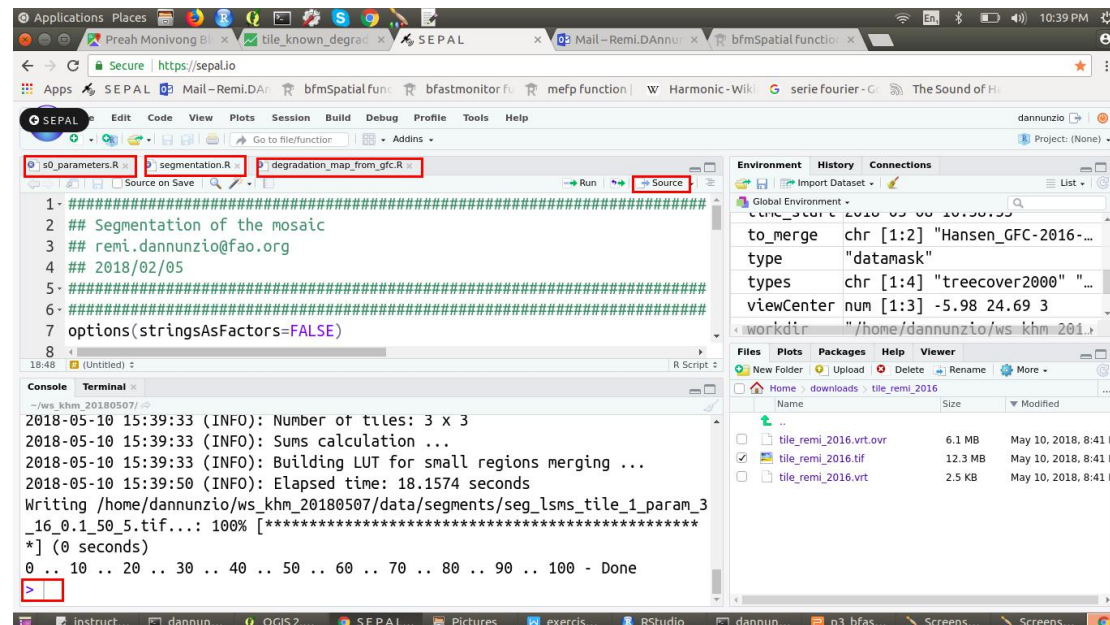Open the terminal and start a #4 instance
Go to Process / RStudio

Copy your mosaic from the "~/Downloads/tile_xxx_mosaic" folder into the "ws_khm_20180507/data/mosaic_lsat" folder
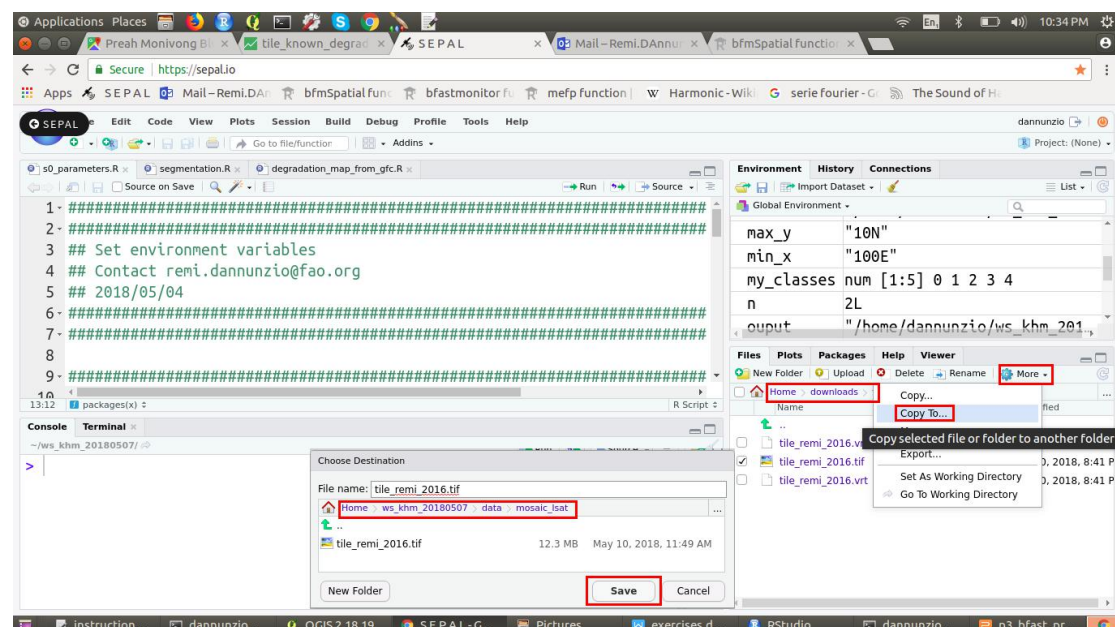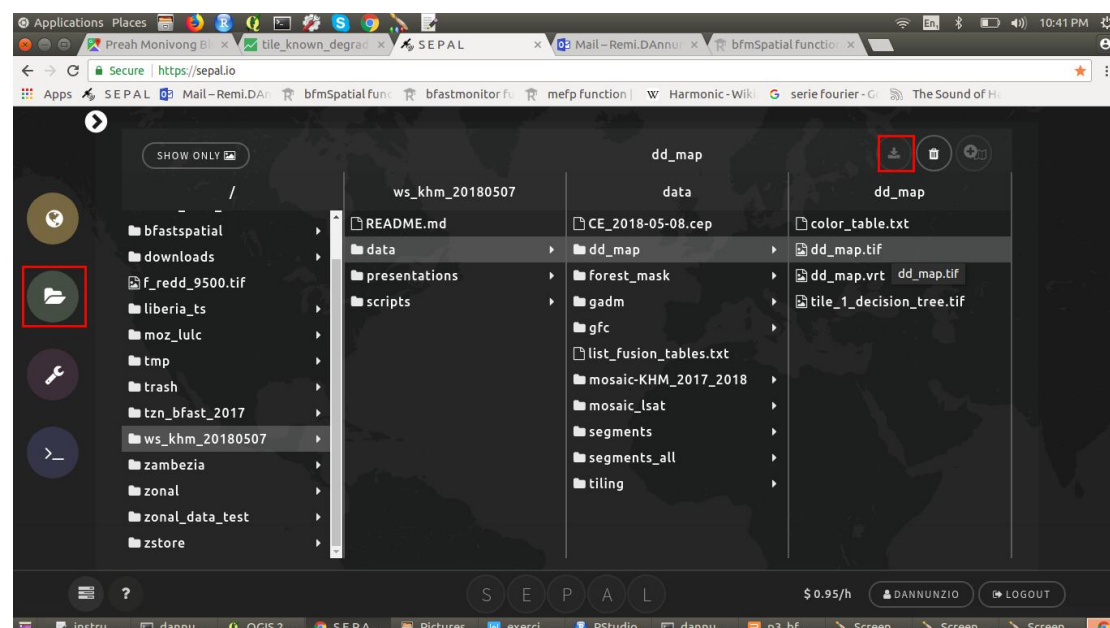
Load the different scripts from the workshop folder and source them, in that order

1. s0_parameters.R
2. segmentation.R
3. degradation_map_from_GFC.R

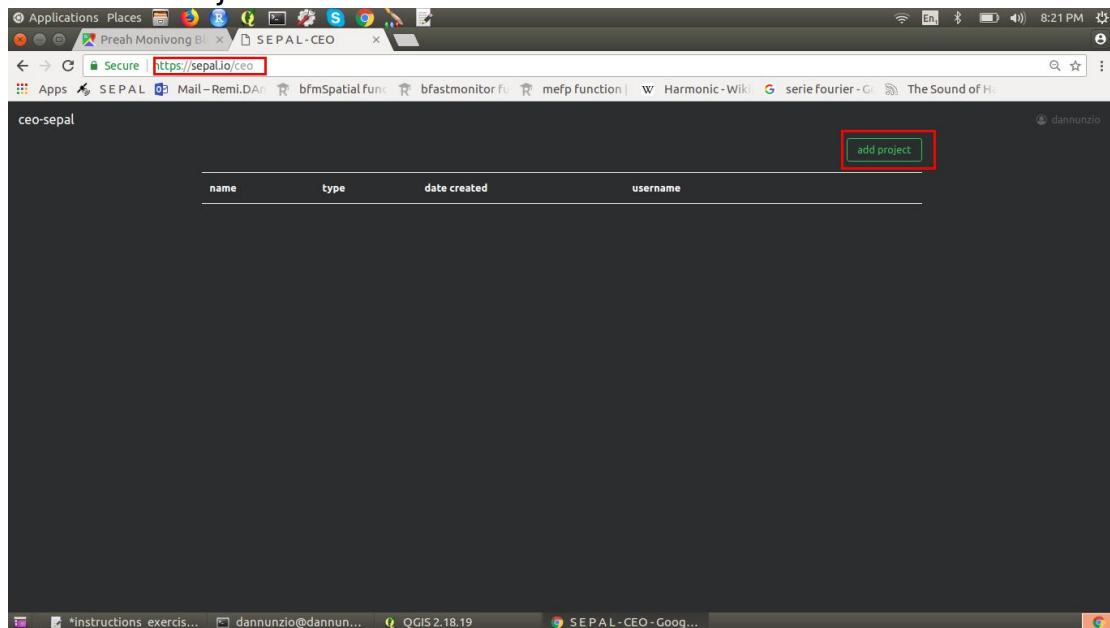Every script has finished running when you have a blue prompt on the last line of the console.

Download the product to your computer using either Browse or a SSH/FTP solution like FileZilla
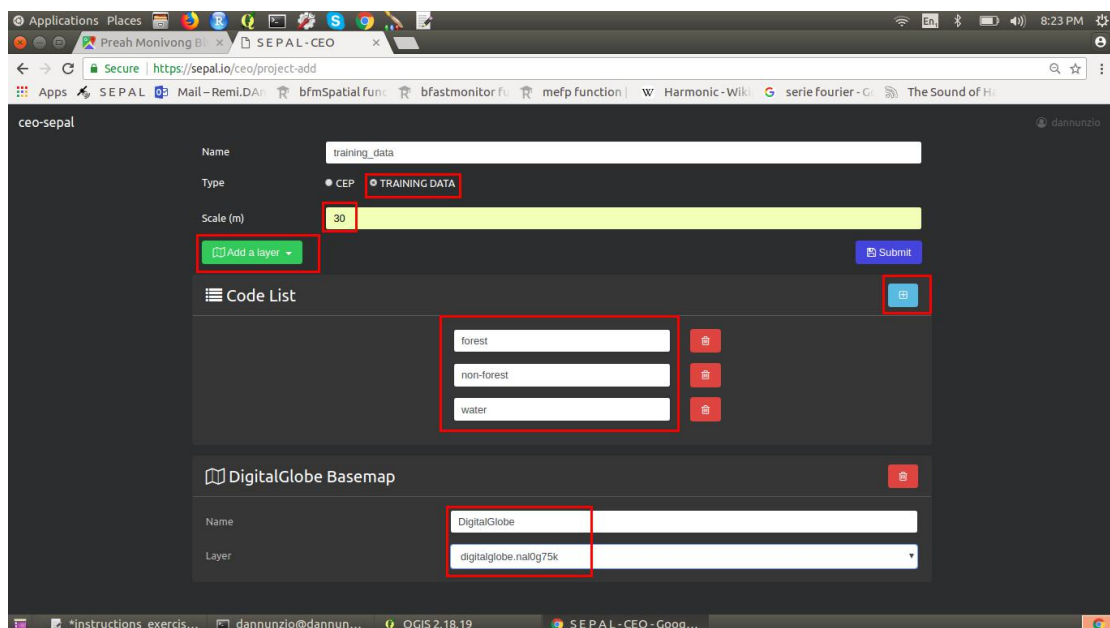
5. Classification exercise in CEO

Open https://sepal.io/ceo
Click Add Project

Select Training Data
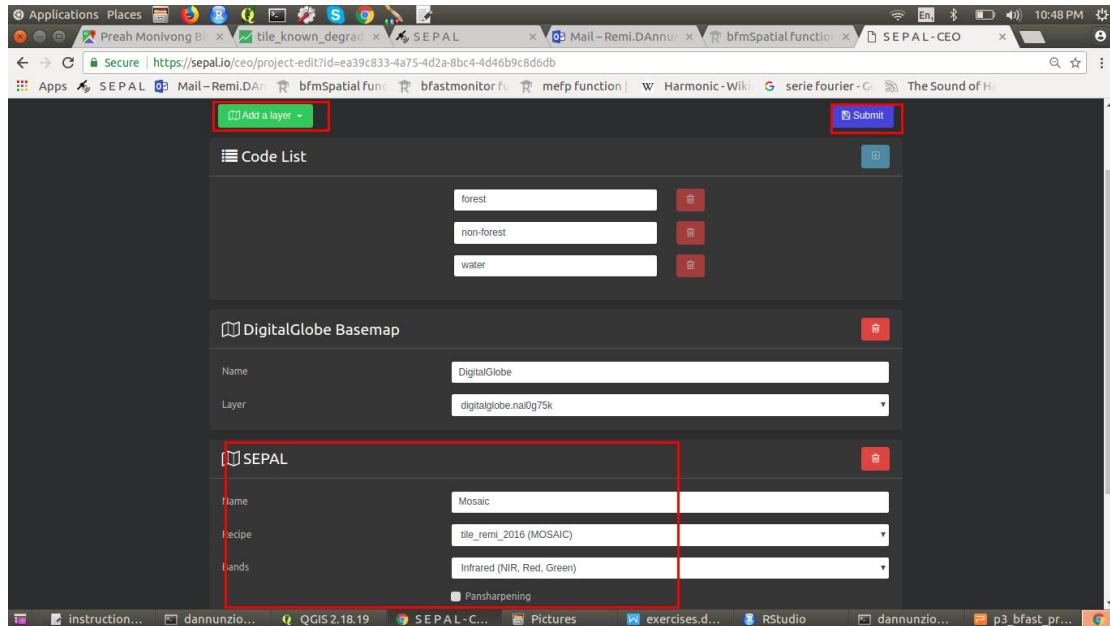Choose a Name (e.g "Exercise - training data")
Select 30m for the scale
Add several Land Cover codes in the Code list (e.g Forest, Non-Forest, Water)
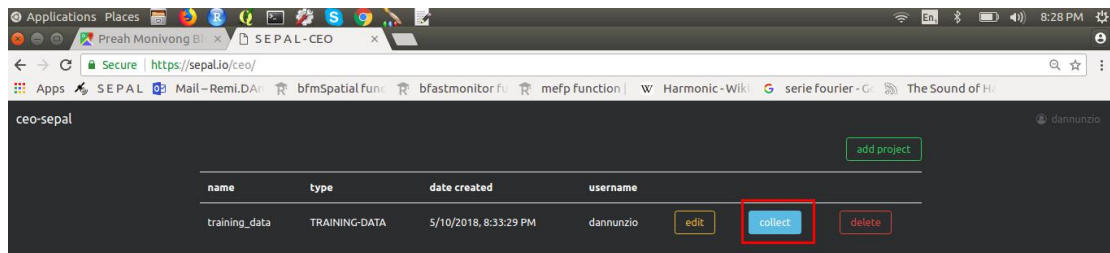Add Layer with Digital Globe (call it Digital Globe)

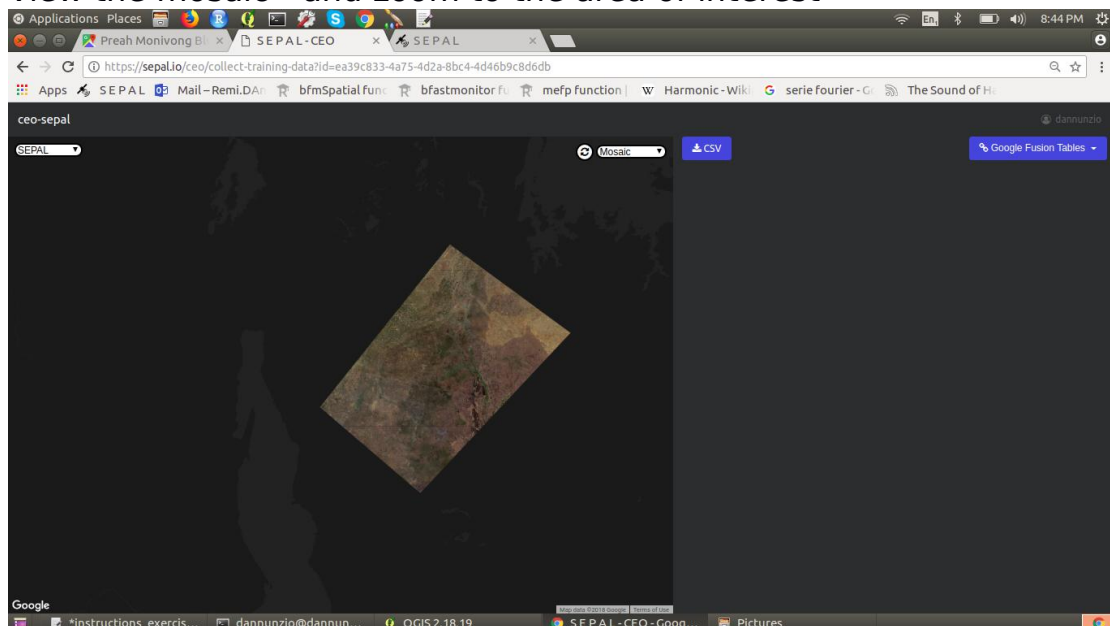Add Layer with SEPAL and choose the mosaic you saved in exercise 2.2
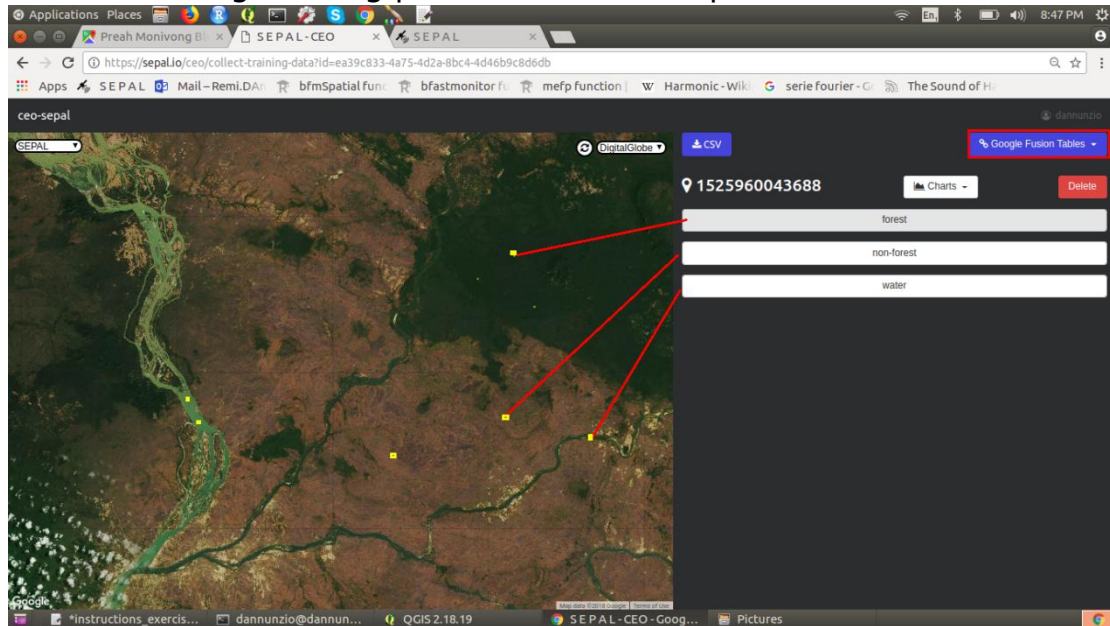
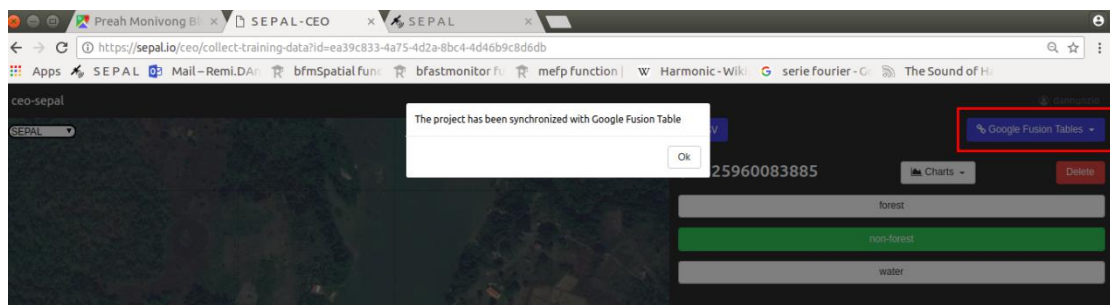Click Submit

Click Collect

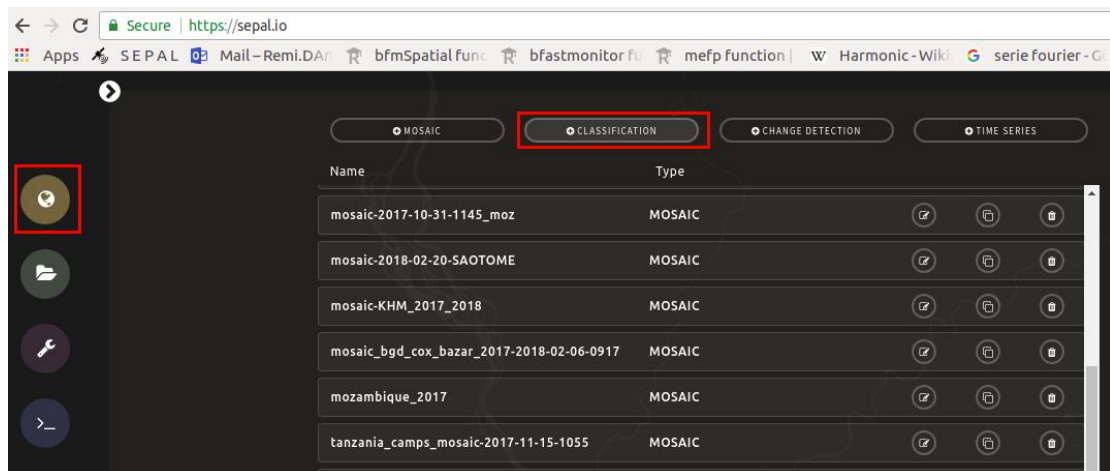View the mosaic   and zoom to the area of interest

Start collecting training points (start with 3 per class)

Click on Google Fusion Tables and Export
When it is Synchronized, click on Clipboard

Go to https://sepal.io and open Search / Classification

Using the mosaic recipe and paste the FT ID you just created (copied to clipboard already). Use the "class" attribute.
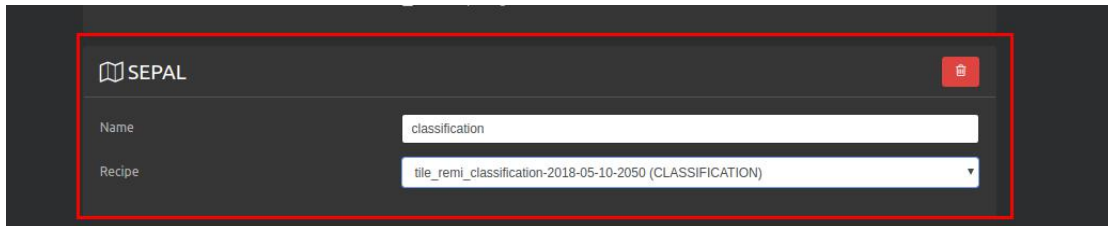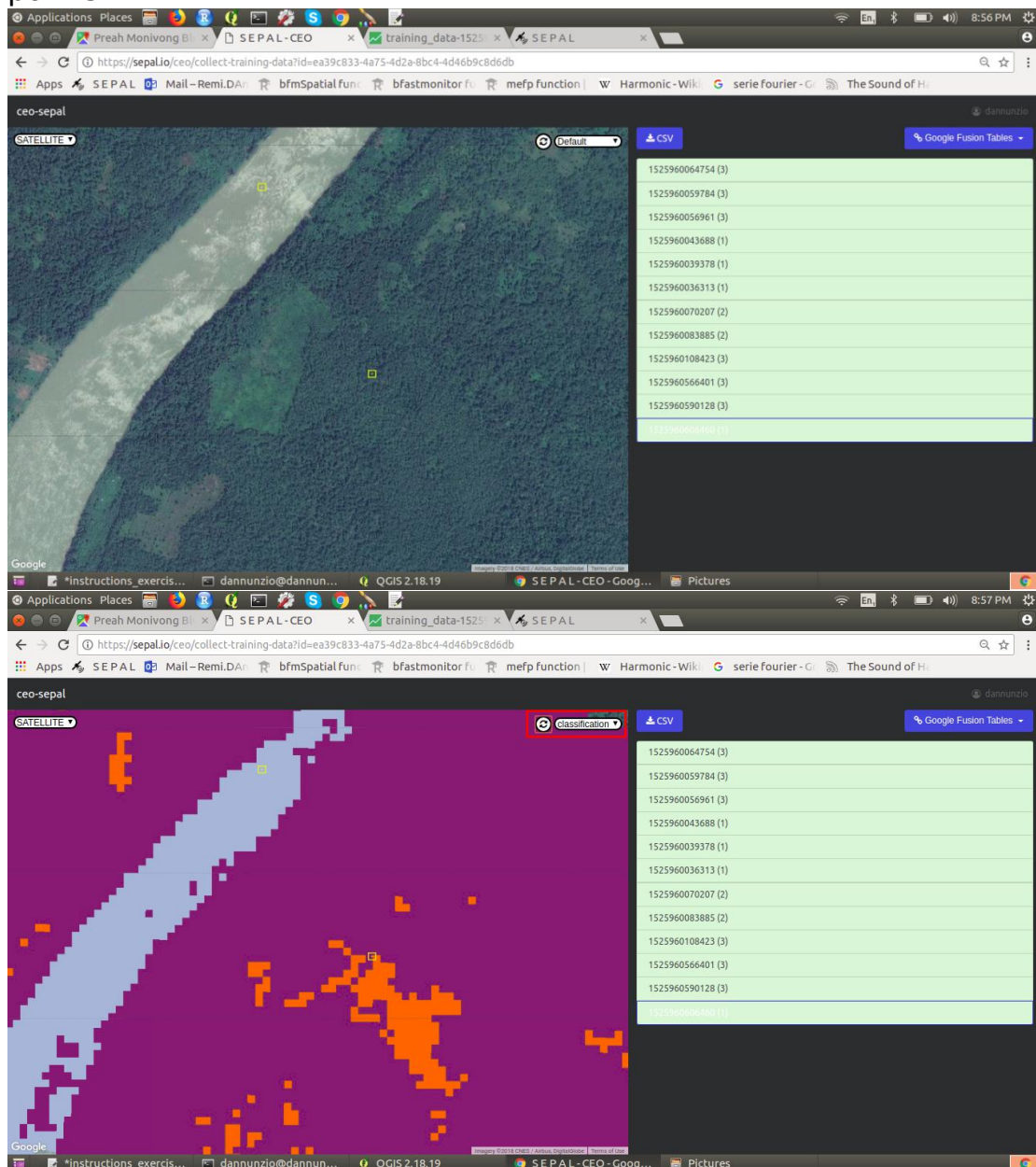

Save the classification

Go to sepal.io/ceo, edit the project and add a new SEPAL layer
Choose the classification you just saved
Click submit and Collect

Load the classification
Assess where you have classification errors and collect more training
points

Update to see the classification being iterated on the fly

Finally go to sepal.io and retrieve your land cover map