REDD+ for the Guiana Shield

**Technical and Regional Platform for the
Development of REDD+ in the Guiana Shield**

MACAPA DATA FUSION - STEP1

Objective

This tutorial is designed to explain how to combine different data in same study site.

In particular we will show how to merge different classifications. It's useful when you need to fill gap (due to cloud for example in optical imagery) or when you want to take the best of among different sources such as Radar classification, Optical classification or any other relevant source map

We will use Landsat 8 assumed to be the best reference (not necessary true and depending on project) to create the main classification. In addition we will use radar data to first fill the gap and second improve detection of some specific classes as Water for example or Swampy vegetation.

We need to do the following things:

The goal

The goal is to used Landsat 8 and ALOS2 and or Sentinel-1 in complementarity

The different steps are:

1. Define the classes to map

2. Classify Landsat 8

3. Classify Radar

4. Merge the 2 classification

For step 1 we will focus on the following classes:

| Class	DN value
Forest	10
Swampy vegetation	21
Low Vegetation	22
Bare soil	31
Water	32
Urban area	40

Practical Work: Data pre-processing

In order to be able to merge classification results of the different datasets we need to have exactly the same resolution, projection and extent. So we need to "align" the different raster.

Here we consider that we will align raster that are already pre-processed (pan-sharpening or filtering).

The proposed methodology can be applied whatever the dataset to compare.

The following diagram show all the different steps:
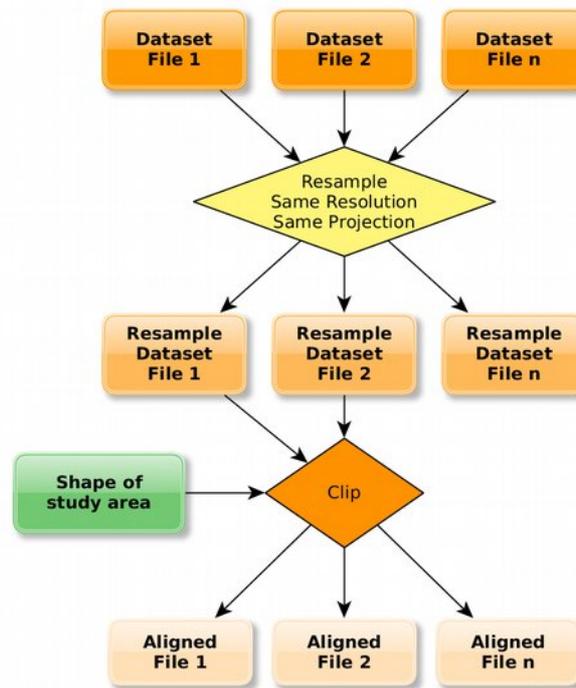
1) Layer stack the dataset (here only Landsat 8)

To create the new layer stack file we need first to load and check only the necessary band (all Landsat 8) and order them as you want in the output vrt file.

Click here to see the video

QgisRasterLayerStacking.mp4

2) Resample all the dataset to same pixel size and same EPSG

in order to align raster we need first to resample all the dataset with same pixel size (highest, lowest, or average depending on requirements. The most conservative is to use worst pixel size) and same projection (EPSG).

Click here to see the video

ScriptResampleWithPixelSize.mp4

3) Create a polygon to define the study area

For every project we work on specific area that cover general smallest area than the remote sensing data. In order to reduce the processing time and reduce the storage volume it's better to define the study area and used it to clip all the dataset.

So, create a polygon shapefile with same projection that the dataset and digitize the study area.

Click here to see the video

TopologicDigitalization.mp4

4) Clip each period to reduce the size of the datasets and obtained aligned rasters

Clip each dataset.

Click here to see the video about that

ClipRaster.mp4

Practical Work: Create Stratification of Landsat 8 data

1) Optimize the display

Before any data manipulation it's essential to optimize the display of the data. Indeed, whatever the data used, the display can only show 255 levels for 3 bands contrary to a lot of dataset that can contain for example for Landsat 8 11 bands coded with 12 bits equivalent to 4096 levels.

Consequently, every display of the same dataset should probably be different for every screen and every people.

However, the most important is to optimize the display for you study area and your landscapes of interest.

Click here to see the video

ImproveRasterDisplay.mp4

2) Define the classes

Before any classification process it's important to take time to define the classes of your final map by given the following elements:

- Name of the class
  Example: Flooded forest

- Description of the class
  Example: Minimum area of 1 ha covered by trees with closed canopy and with water on the ground

- Code value
  Example: 10

3) Main Processing steps
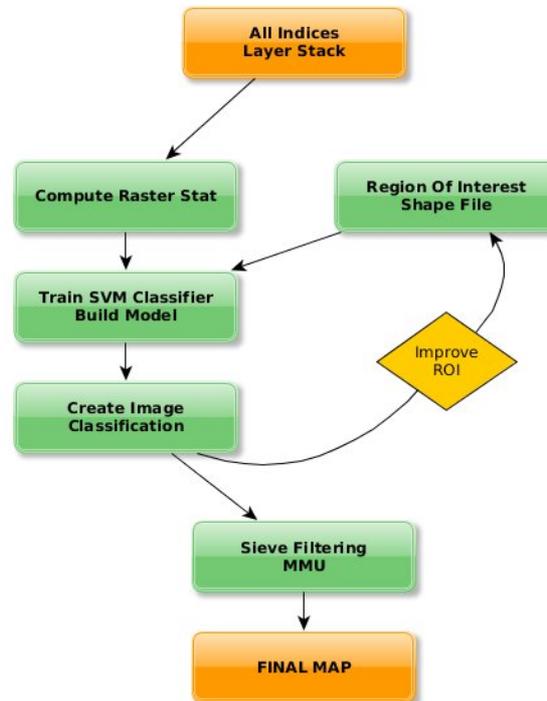
4) Import the Layer Stacked data

In Qgis, Import the raster using this icon:

5) Create No data mask

This step is important if you have background with different value in the band. The goal is to create a mask in order to erase (in the next step) this background with unique value.

Click here to see the video

QgisBuildNoDataMask.mp4 or YouTube

6) Erase the background value with the No data mask (Optional)

If in your raster you have the same background value for all bands it's not necessary to do this step.

The goal is to create a mask in order to erase (in the next step) this background with unique value. The goal is to vectorize the mask and use it to clip the original data raster using a new No data value, -999 for example.

Click here to see the video

QgisMaskRasterWithRasterMask.mp4 or YouTube

7) Compute raster statistics

Based on the new clipped data raster, we will use in Qgis the OTB tools that will create a file containing for each band the mean and stdev. To that it's important to give the Background no data value. This step will create an XML file.

Click here to see the video

QgisClassificationStep1-RasterStat.mp4 or YouTube

8)   Create ROI (Region Of Interest) shapel file

In order to use Supervised classification tools we need to create a shape file that will contain polygon with one field name (class for example) that will contain the code of the study class. For example it could be:

1 for Forest, 2 for Savannah and 3 for water area.

Click here to see the video

QgisClassificationStep2-CreateShapeROI.mp4 or YouTube

9)   Train the SVM classifier

Using the input raster, its statistics file previously created and the shape file containing the ROI, we will train the SVM (Support Vector Machine) classifier which will create what is called a model file. This file contain all the "memory" of the training step.

Click here to see the video

QgisClassificationStep3-TrainSVMClassifier.mp4 or YouTube

10)   Create image classification

Using the input raster, its statistics file previously created and the model file previously created, we will create the classification file.

Click here to see the video

QgisClassificationStep4-CreateClassificationFile.mp4 or YouTube

Remove small pixel aggregate and apply MMU (Minimal Mapping Unit)

In order to remove small pixel aggregate which are not significant and also to apply a specific MMU, it's important to apply a sieve filtering in classification post-processing. Usually and whatever the data we estimate that we need to remove pixel aggregate lower than 10 pixels.

Click here to see the video

QgisClassificationStep5-SieveClassification.mp4 or YouTube

Practical Work: Create Stratification of radar data

To create the classification of radar data we use exactly the same methodology as Landsat 8 data.

Practical Work: Merge the 2 classifications

1) Define the interesting classes of each classification

Based on the classes used before and as suggested in the goal of this exercise we will consider to use Landsat classification as main map.

But, we will use radar classification first to fill the gap in Landsat 8 cloudy area.

In addition, because radar data are often more sensitive to moisture on vegetation we can made assumption that Swampy vegetation class is better in Sentinel-1 classification.

In summary we will use the following layers order by overlap:

- radar: Water and Swampy vegetation

- Landsat 8: all classes except cloudy area

- radar all classes (to fill cloudy area on Landsat 8 classification)

2) Extract interesting classes in new raster classifications

Based on previous step we need to create the following layers:

- radar: Water and Swampy vegetation

- Landsat 8: all classes except cloudy area

To do that we will use r.reclass tools of grass in processing toolbox to create:

- radar: new layer with only Water and Swampy vegetation classes. All other class are converted to no data value = 0

- Landsat 8: all cloud or shadow are set to no data = 0

Use the video tutorial to create your conversion rules to create new layers.

Click here to see the video

GrassReclassClassification.mp4

3) Merge the classification

Now the goal is to merge this 3 layers

- radar: Water and Swampy vegetation

- Landsat 8: all classes except cloudy area

- radar all classes (to fill cloudy area on Landsat 8 classification)

To do that we will use the tool to mosaic raster layer called "create virtual raster".

As shown in the video, before mosaicking this 3 layers you need to load and check only these 3 layers. Then you need to order them at the top of layer area the main layer and at the bottom the last additional layer as shown here:

1. radar all classes (to fill cloudy area on Landsat 8 classification)

2. Landsat 8: all classes except cloudy area

3. radar: Water and Swampy vegetation

Click here to see the video

MergeClassificationAsMosaic.mp4

4) Export your merged classification

To finish the work and in order to easily share your classification, we need to export the vrt file previously created to tif as shown in the video.

Click here to see the video

ExportRaster.mp4

Practical Work: Happy of the results

Did you find that results are good ?