# REDD+ for the Guiana Shield

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

Cloud Mask Processing

Objective : This tutorial is designed to explain how to make a mask form clouds on an optical raster and update thid cloud mask. This tutorial is based on OTB (Orfeo Tool Box) supervised classification algorithm called in QGIS and a model builder ONFICloudMaskMerge.model, installed as shown on video QgisModelBuilderInstall. At the end of this document you will find the data structure.
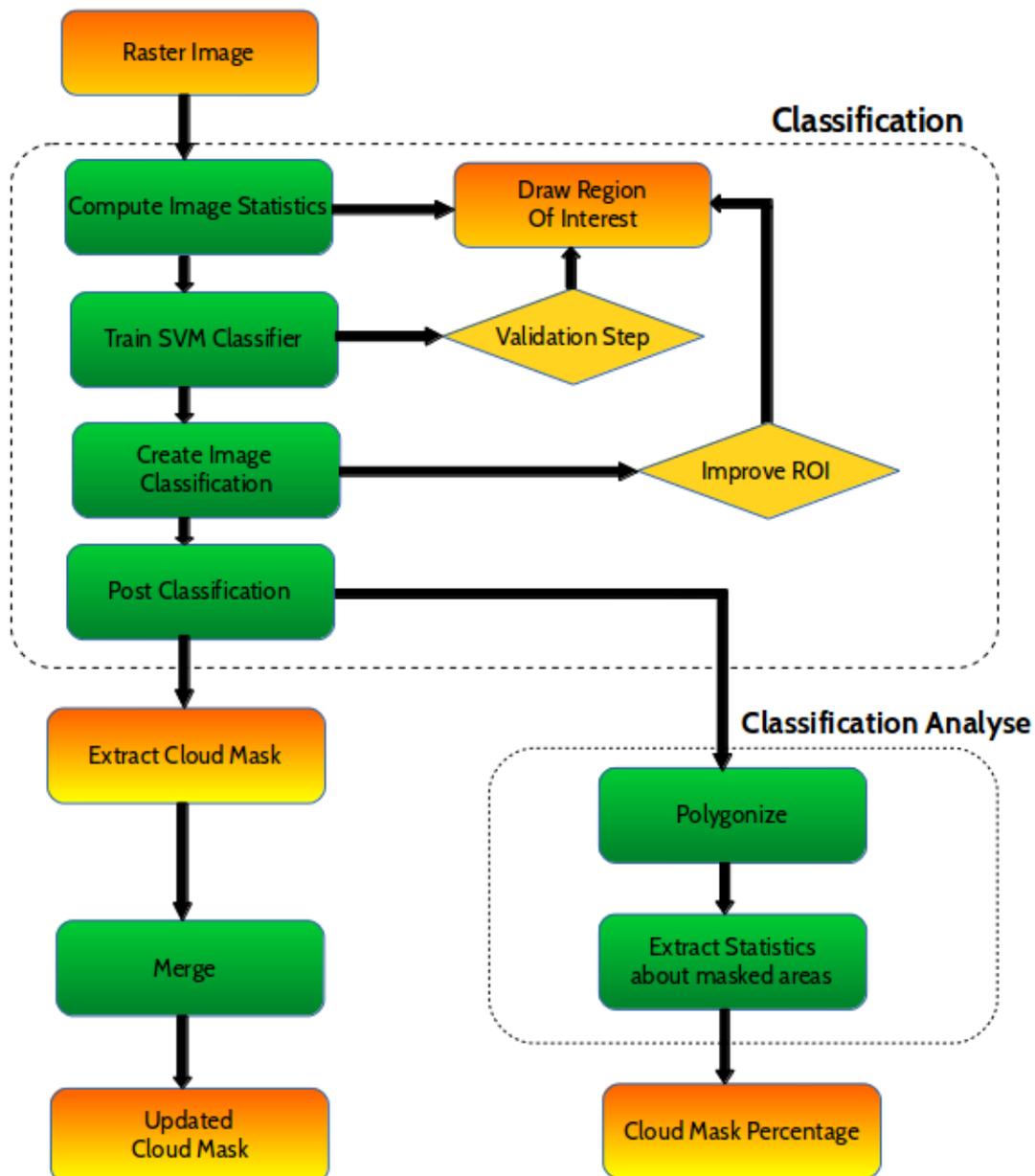
Main processing step

Classification

0 Directory Organisation

In order to avoid problems place your work directory at C:\\.
For each K/J and each image : create a new folder, as shown below, replacing K/J and Date by your image KJ and date of acquisition.
Copy your image as C:\\CloudMaskTraining\K-J1\Date1\Input\Sensor_KJ_Date.tif. Sensor can be SPOT or Landat.

1 Import And adjust Raster Display

Open Qgis, import raster image, create pyramids and adjust raster data as shown on the video ImportAndAdjustRasterDisplay.
Save your project as C:\\CloudMaskTraining\K-J1\Date1\Output\

Click here to see the video:

01-ImportAndAdjustRasterDisplay.mp4 or YouTube

2 Compute Raster Statistics

Compute raster statistics using the Qgis function as shown on the video ComputeImageStatistics. Those statistics will be used to normalise the image
Save your statistic file as C:\\CloudMaskTraining\K-J1\Date1\Output\Sensor_KJ_Date_Stat.xml

Click here to see the video:

02-ComputeImageStatistics.mp4 or YouTube

3 Create ROI (Region Of Interest)

The step focuses on creating Region of interest shapefile as show on the video CreateROIShapefile.
Be careful to select of every pixel radiometry : the classifier know just what you teach.
Take care that your qgis project and your shapefile are in the same coordinate system as your image.

Value of Field "class"	Name	Class Color
0	Other	Violet
1	Cloud	Blue
2	Shadow	Green

Save your shapefile as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIv1\ROIv1.shp, v1 stand for version 1.

Click here to see the video:

03-CreateROIShapefile.mp4 or YouTube

4 Train SVM Classifier

Compute the classification model as shown in TrainSVMClassifier, this step aims at defining rules of classification. Don't close the window at the end of the computation, it will help you to validate your model.

Save your model file as C:\\CloudMaskTraining\K-J\Date\Output\ROIv1\ROIv1_Model.txt

Click here to see the video:

04-TrainSVMClassifier.mp4 or YouTube

5 Validation Step

This step aims at verifying that the training worked well by analysing the classification statistics.

To be well balanced, the training sample must contain between 200 and 500 pixels. If on class count less than 200 pixel, you should add ROI polygons of this class in a new shapefile and improve your ROI as shown on video ImpoveROI. The second shapefile should be saved as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIv2\ROIv2.shp

The table shown is a confusion matrix :

		Classification Result		
		1-Cloud	2-Shadow	3-Other
True ROI	1-Cloud	1042	4	0
	2-Shadow	7	881	32
	3-Other	0	17	996

In green : Pixels well classed.

In red : Omission errors. Example : 32 pixels from the shadow class have been classed into the Other class by mistake, in this case, 32 pixels of shadows are missing to the shadow class.

In orange : Commission errors. Example : 17 pixels have been classed into the Shadow instead of Other, in this case 17 pixels are in excess Shadow.

Kappa index : One clue about the classification result, to use with the confusion matrix.

Recall of class : producer accuracy: omission errors.

Precision of classification : user accuracy : commission errors.

If your Kappa index is lower than 0.8, draw again your ROI starting from scratch in a new shapefile saved as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIv2\ROIv2.shp

6 Create image classification

Click here to see the video:

05-CreateImageClassification.mp4 or YouTube

Save your classification file as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIvX\ROIvX_Classification.tif, X standing from your version number.

7 AdjustClassificationDisplay

Click here to see the video:
06-AdjustClassificationDislay.mp4 or YouTube

8 Validation Step

Look carefully your classification result, compare it with the raster data. If the mask does suites you, go further, if not, improve your ROI as shown on video ImproveROI (Region Of Interest) with a new shapefile saved as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIv2\ROIv2.shp

Click here to see the video:
03bis-ImpoveROI.mp4 or YouTube

9 PostClassification

In order to delete the smallest pixel aggregations a post classification process is proposed on video PostClassification. This post classification sieves the classification.
You can make some test on the sieve threshold, and see the result, and select the best post-classification model. One way to do it is to try with 10 pixels and after 20 or 30 if necessary.
Save your post classification file as C:\\CloudMaskTraining\K-J1\Date1\Output\ROIvX\ROIvX__Classification_SieveY.tif, Y standing for the threshold.

Click here to see the video:
07-PostClassification.mp4 or YouTube

10 Reprojection

If your image is not in the same coordinate system as your other images you have to reproject the input image and the final result of the classification the the coordinate system of the others as shown on the video ReprojectRaster.
Be careful to remove 0 from the no data value during the reprojection, you need to keep the background to merge images.

Click here to see the video:
08-ReprojectRatster.mp4 or YouTube

11 Temporal and Spatial Fusion

In the step you will merge two raster mask form différents dates over the same footprint or with a small overlap into one updated mask, as shown on the video UpdateMask.
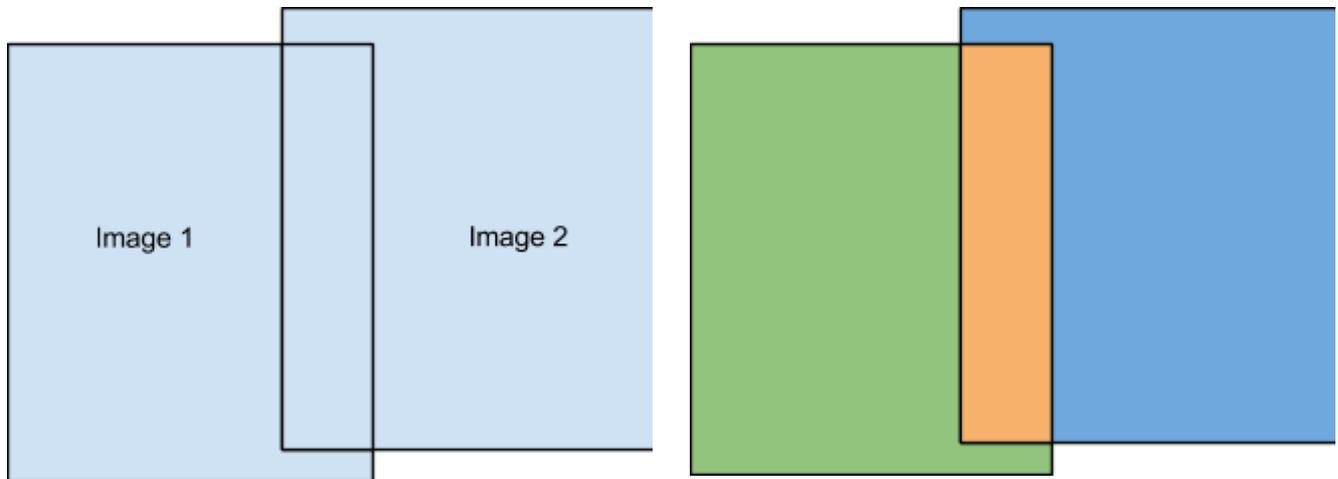
Your merged mask is composed by your cloud mask from images 1 and 2 over the green and blue area, and the intersection of cloud mask overlap over the orange area, because you just want to mask area where there is cloud on both image.

If you want to merge the result with a third image, your files will be :

> Classification 1 : Cloud mask merged
> Image 1 : Covered area merged
> Classification 2 : Cloud mask from the third image
> Image 2 : third image.

Merge with an image with no cloud at all : create a empty classification without any cloud using the raster calculator as shown on the video BuildAnEmptyClassification and merge it nomaly.

Click here to see the video:
09-UpdateCloudMask.mp4 or [YouTube](#)

Create a Virtual Raster (Landsat Data)
If you have a Landsat Data, you have to concatenate bands 1 to 6 into one single image. On way to do it is to build a virtual raster as shown on the video BuildAVirtialRaster.

Click here to see the video:
00-BuildVirtualRaster.mp4 or [YouTube](#)

Classification Analyse

This part of the tutorial is designed to analyze the classification results. First, the goal is to extract statistics about cloud presence.

12 Polygonize
If you are fully satisfied with the result you can now turn your raster data into a vector and delete the background data as shown on the video Polygonize. In order to lower the complexity of the vector, you can also simplify the geometry.

When your mask is extracted, save it as C:\\CloudMaskTraining\K-J1\Date1\Result\Sensor_KJ_Date_Stat_Mask.shp.

Click here to see the video:
10-Polygonize.mp4 or YouTube

13 Extract statistics

This step aims at computing statistics about covered area as shown in video ExtractStatistics.
Create an excel file containing those different informations :

K-J	Date	Footprint area (ha)	Masked area (ha)	No Data %

Reminder : 1ha = 10 000m^2 = 0,01 km^2

Click here to see the video:
11-StatisticExtraction.mp4 or YouTube

Annex : Data structure

C:\\ONFI_CloudMaskTraining
    NoDataStatisitics.xls
    KJ1
        KJ1_CloudMask.shp
        Date1
            Input
                Imagery_Frame1_Date1.tif
            Output
                Imagery_Frame1_Date1_Stats.xml
                ROIv1
                    Imagery_Frame1_Date1_ROIv1.shp
                    Imagery_Frame1_Date1_ROIv1_Model.txt
                    Imagery_Frame1_Date1_ROIv1_Classif.tif
                ROIv2
                    Imagery_Frame1_Date1_ROIv2.shp
                    Imagery_Frame1_Date1_ROIv2_Model.txt
                    Imagery_Frame1_Date1_ROIv2_Classif.tif
                    Imagery_Frame1_Date1_ROIv2_Classif_Sieve30.tif
            Results
                Frame1_Date1_CloudMask.shp
            qgisProject.qgs
        Date2
    KJ2
        Date1
        Date2
        Date3