
# HOMEWORK 2

***Earth Observation for data Science***

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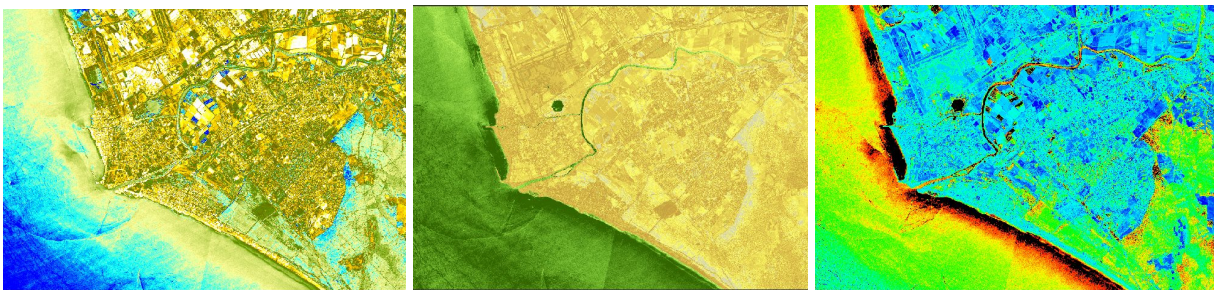
# 1. DATA EXPLORATION

For both summer and winter MSI images, combine B2, B3, B4 channels to create an RGB image and zoom in to observe visible details.

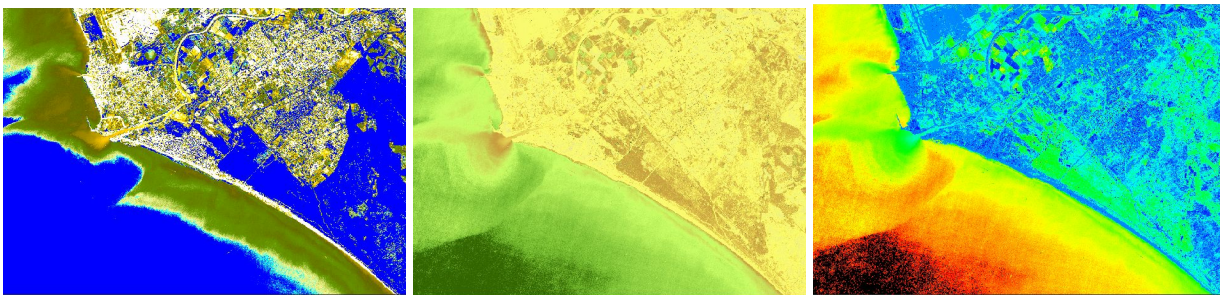
Fig 1. zoomed-in summer RGB image

Fig 2. zoomed-in summer RGB image

Summer: soil, vegetation and water.



Winter: soil, vegetation and water.



Subset around a lake/river and resample all B2, B3, B4 channels at 10 m and visualize them:

Fig 3. Subset RGB around a lake in summer

Fig 4. Subset RGB around a lake in winter

## 2. WATER AND VEGETATION NORMALIZED INDEX

a) For NWDI, when we adjust the histogram at a very high value, we can see white area corresponding to vegetation in RGB image, when comparing to figure 3, 4 above:

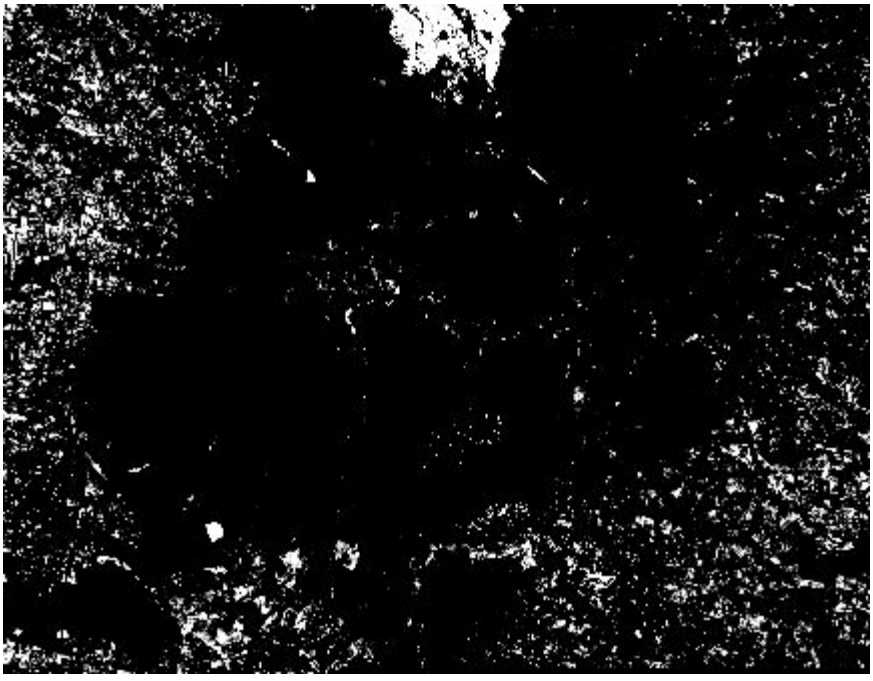


Fig 5: NWDI for water in leaves

Meanwhile for NWDI2, we adjust the histogram at a very high value, we can see white area which represent water area in RGB image, so we can say that NWDI can be used to build a water mask:

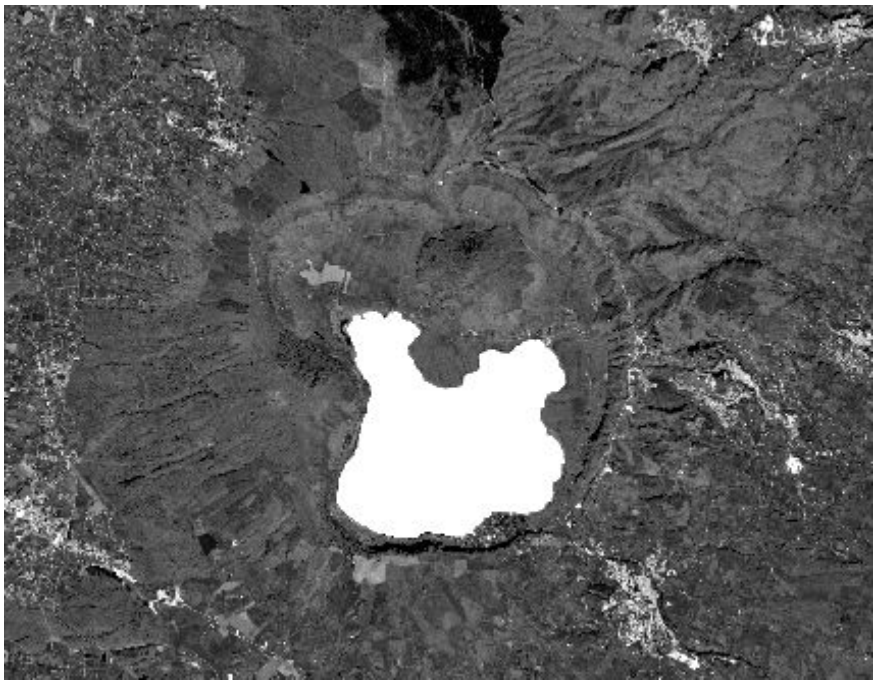
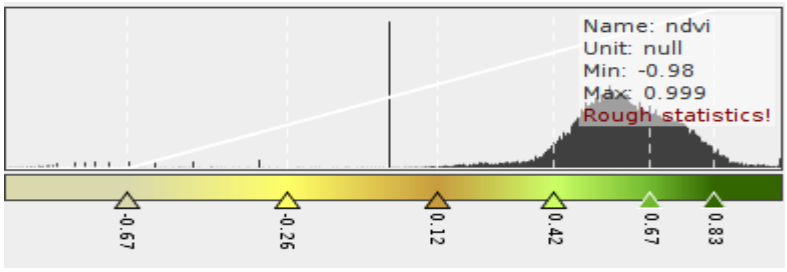


Fig 6: NWDI for water mask

b) Histogram of nvdi for summer image and summer image:



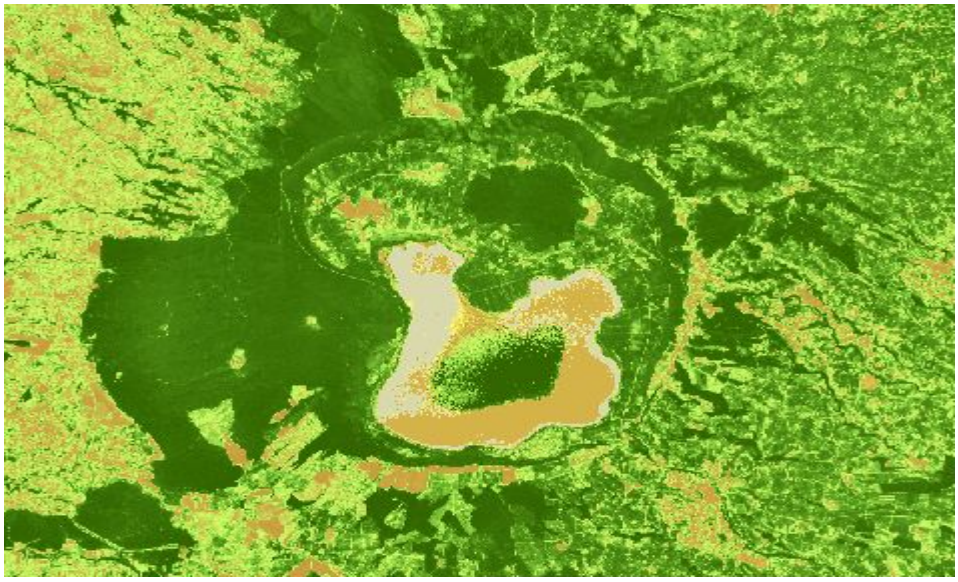
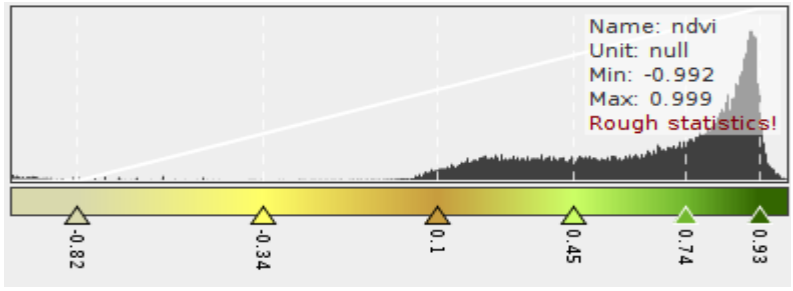


Fig 7: NVDI Histogram and summer image

Histogram of nvdi for winter image and winter image:



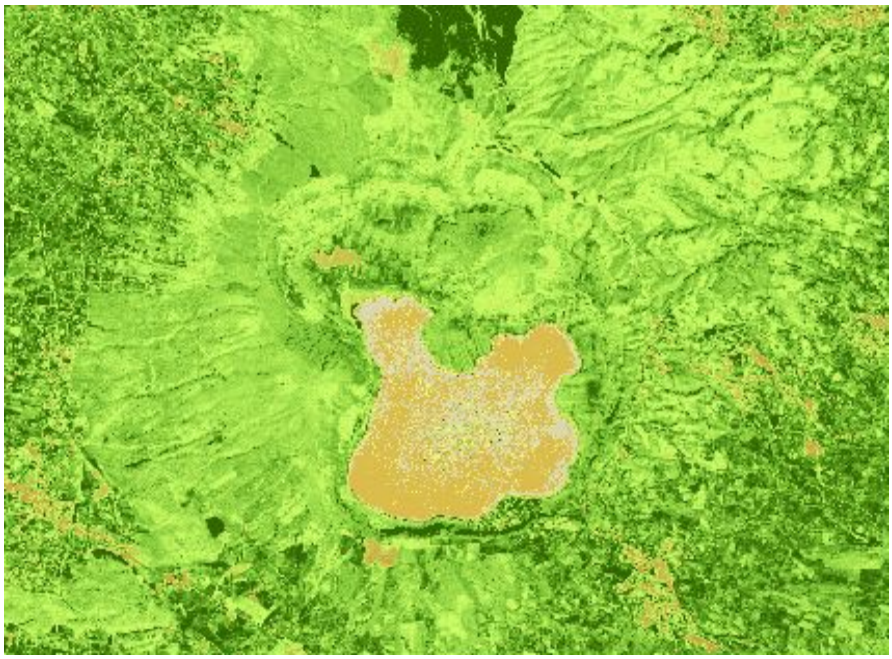



Fig 8: NVDI Histogram and summer image

# 3. SEA CHLOROPHYLL-A AND SEDIMENT ESTIMATION

a. Select a subset ROI within the summer and winter MSI image subsetting a coastline near a river estuary/delta.

Fig 9: ROI in summer and winter (20/07/2017 and 10/02/2018)

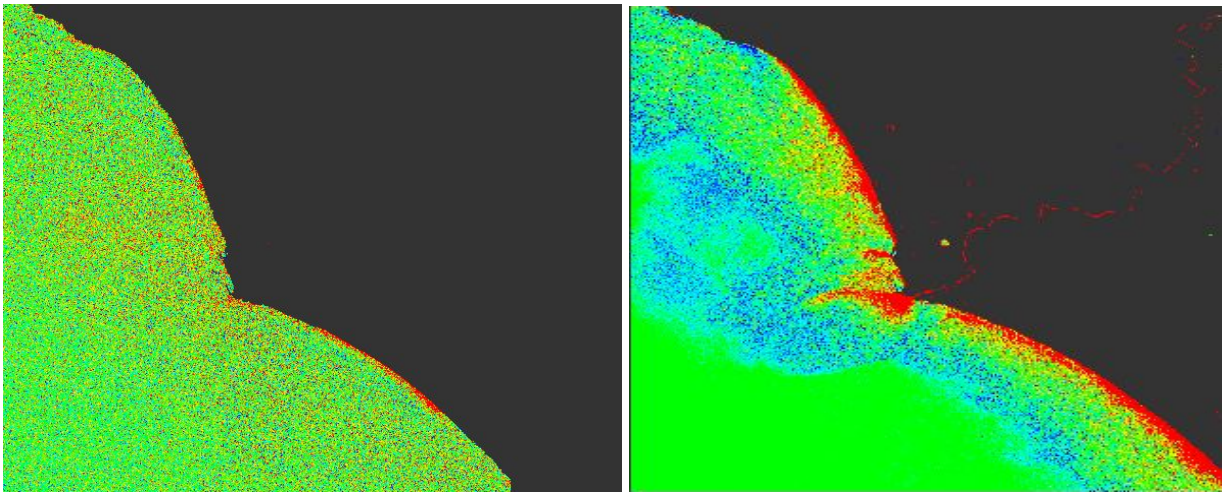


Fig 9: chlorophyll-a (Chl-a) and
total suspended sediments (TSS) in colour

b. Implement at the EmpReg regressive algorithms (see below) to estimate chlorophyll-a (Chl-a) and total suspended sediments (TSS) using SNAP formula processing tool

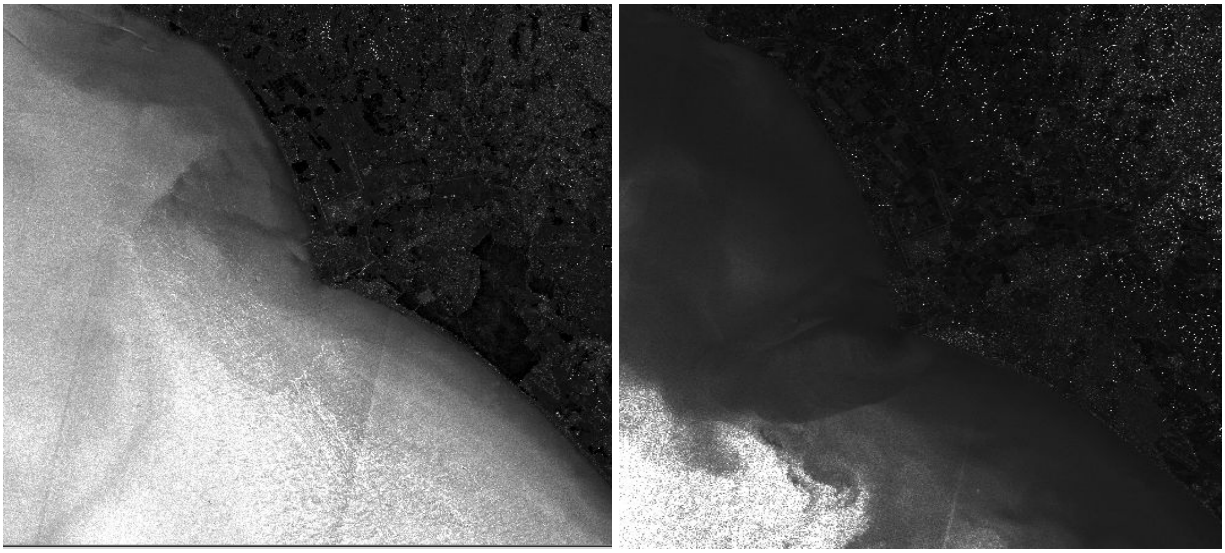


Fig 10: EmpReg regressive algorithms for both images

c. Compare estimated chlorophyll-a (Chl-a) and total suspended sediments (TSS) for a winter and summer cases by making the image differences.

Fig 11: EmpReg regressive algorithms image difference

d. Compare estimated chlorophyll-a (Chl-a) with the one from SNAP MCI (Maximum Chlorophyll Index) plugged-in algorithms.

_ For the figures below, the one on the left is from EmpReg regressive algorithm while the one on the right is from SNAP Maximum Chlorophyll Index.

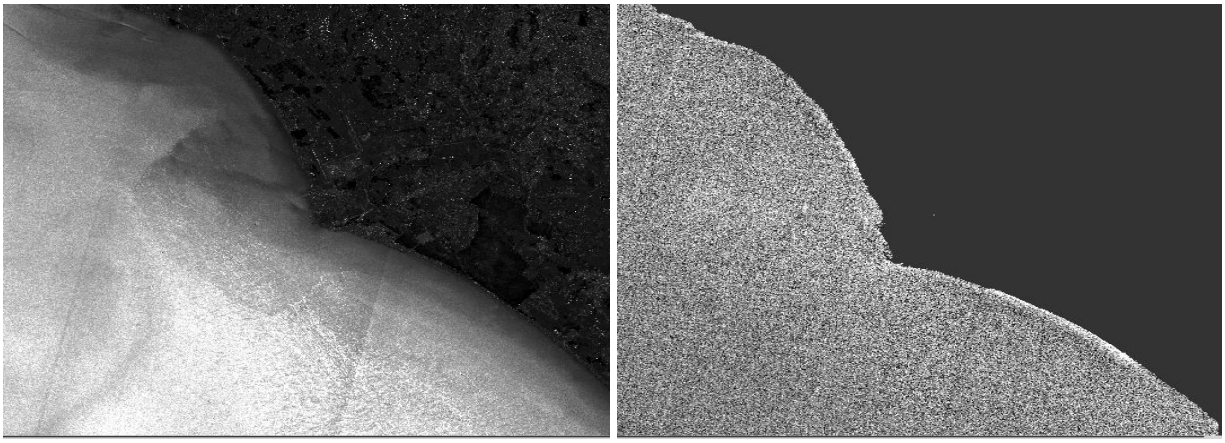
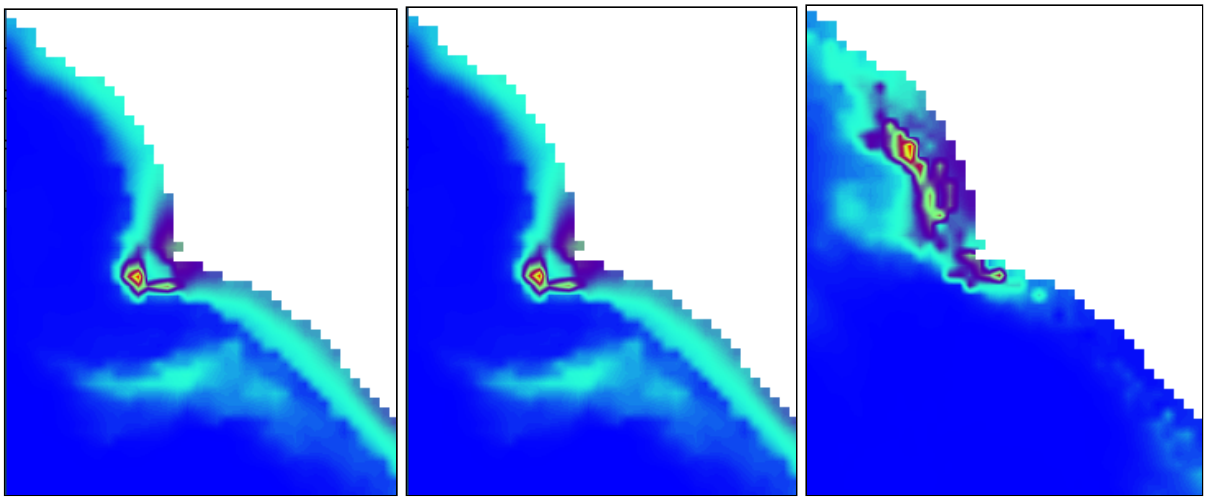


Fig 12: EmpReg regressive algorithms and SNAP MCI

e. Download Chl-a and TSS products around the target area in the same summer days but in year 2018, 2019 or 2020 from international Copernicus Marine Service:



2018 2019 2020

f. Despite the Copernicus products offer for a wide range of dates as well as a vast cover area, the spatial resolution is way worse than the images from SNAP. Looking at the above images over our ROI, we can hardly draw any conclusions except for the fact that the concentration of chlorophyll-a seems to increase over the year. There are also limited options while editing the low resolution images downloaded from Copernicus Marine Service.

# 4. SCENE CLASSIFICATION

a. Using L2 MSI summer image, select scene classification masks
There are 4 classes in this image: vegetation, water, urban and bare soil

Fig 12 : Classification mask

b. Reproject the subset image Lat/Lon WGS84 geographic coordinate system.

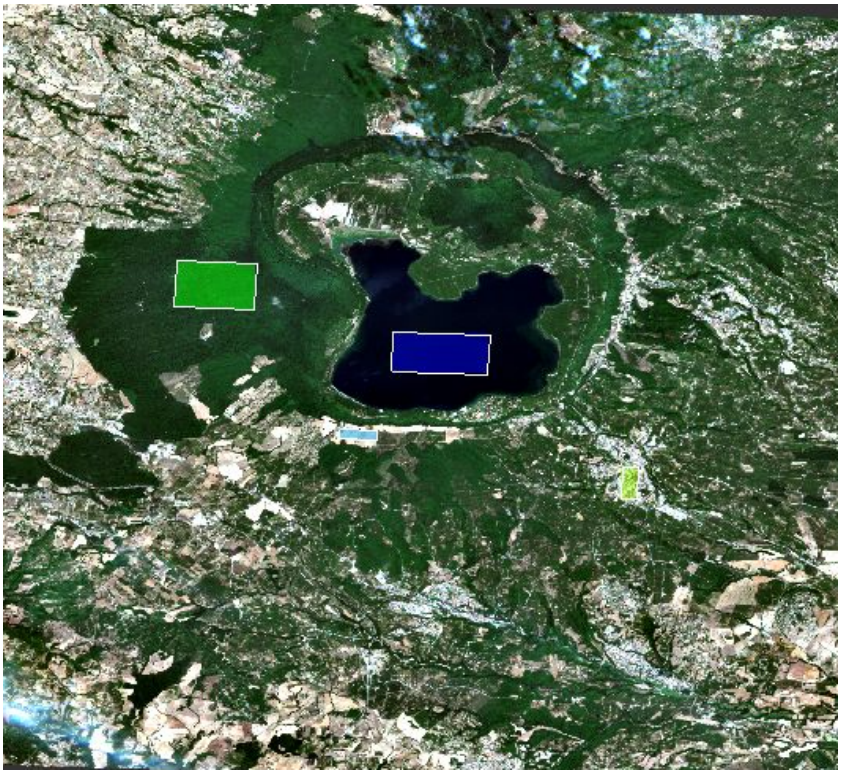


Fig 13: Reprojected image

Results of classification algorithm:

- Maximum Likelihood:

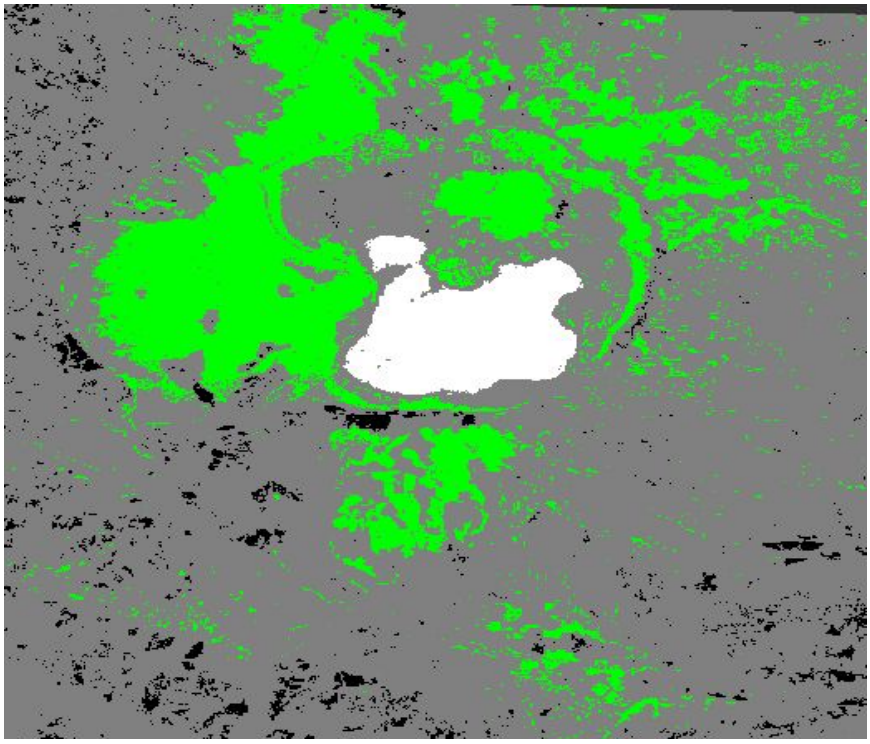


Fig 14: Maximum Likelihood result

| Label | Colour | Value | Frequency | Description |
|---|---|---|---|---|
| no data | | -1 | 0.000% | no data |
| vegetation | | 0 | 16.303% | |
| water | | 1 | 3.421% | |
| urban | | 2 | 77.426% | |
| soil | | 3 | 2.850% | |

Fig 15: Maximum Likelihood classification class percentage

- Random Forest:

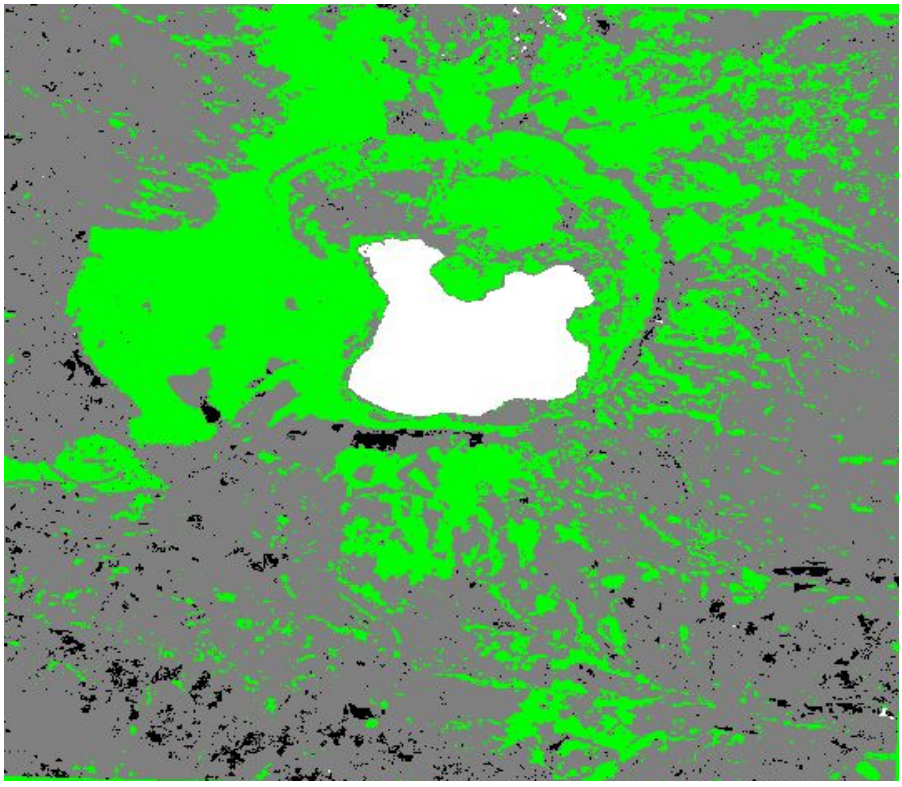


Fig 16: Random Forest result

| Label | Colour | Value | Frequency | Description |
|---|---|---|---|---|
| no data | | -1 | 0.000% | no data |
| vegetation | | 0 | 34.477% | |
| water | | 1 | 3.667% | |
| urban | | 2 | 59.884% | |
| soil | | 3 | 1.973% | |

Fig 17: Random Forest class percentage

c. From both of the classification results, when compared to the true mask from the original image, we can see that the Random Forest gives better results in comparison to Maximum Likelihood.