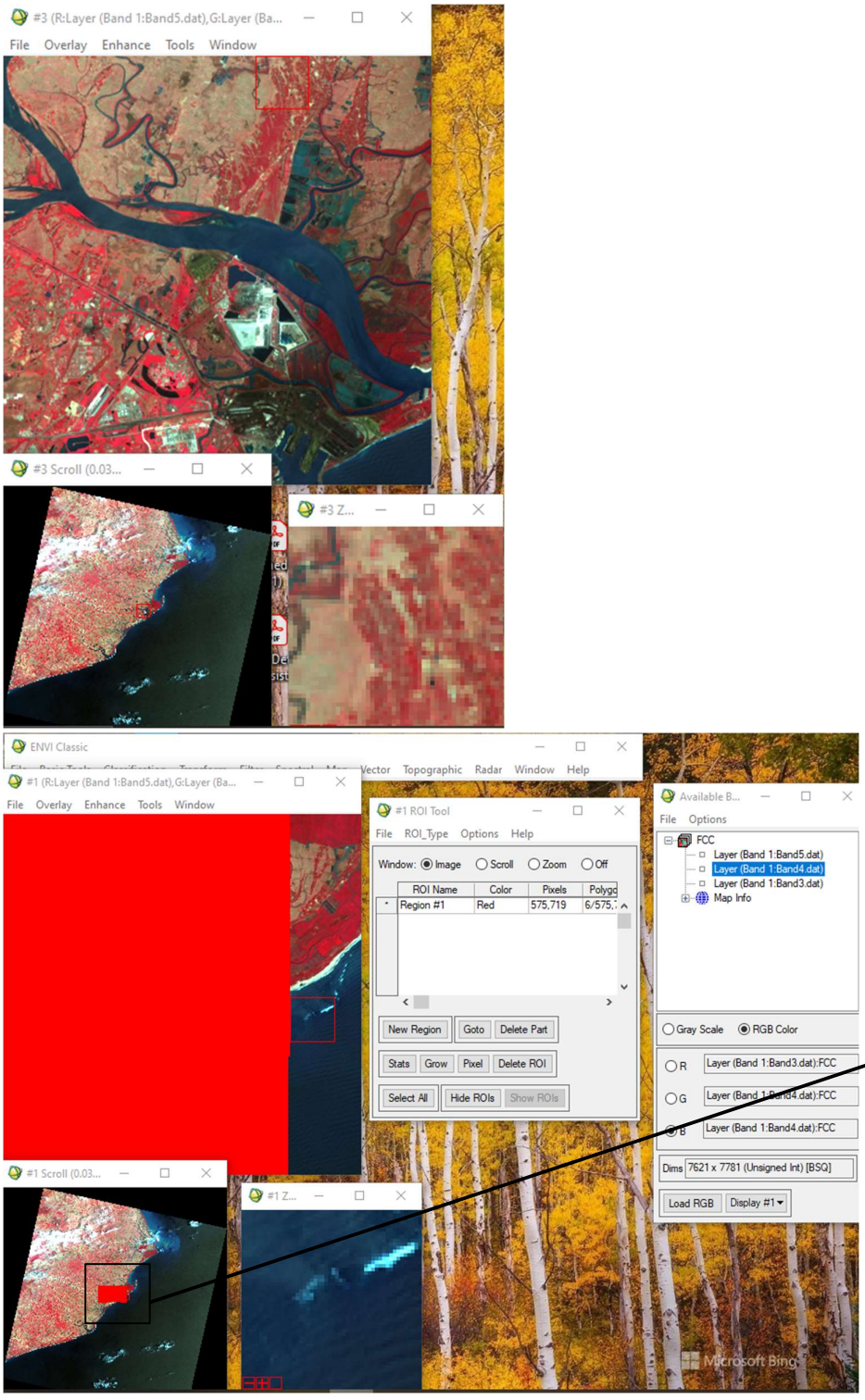
SRIMAYA MOHAPATRA ,244104010

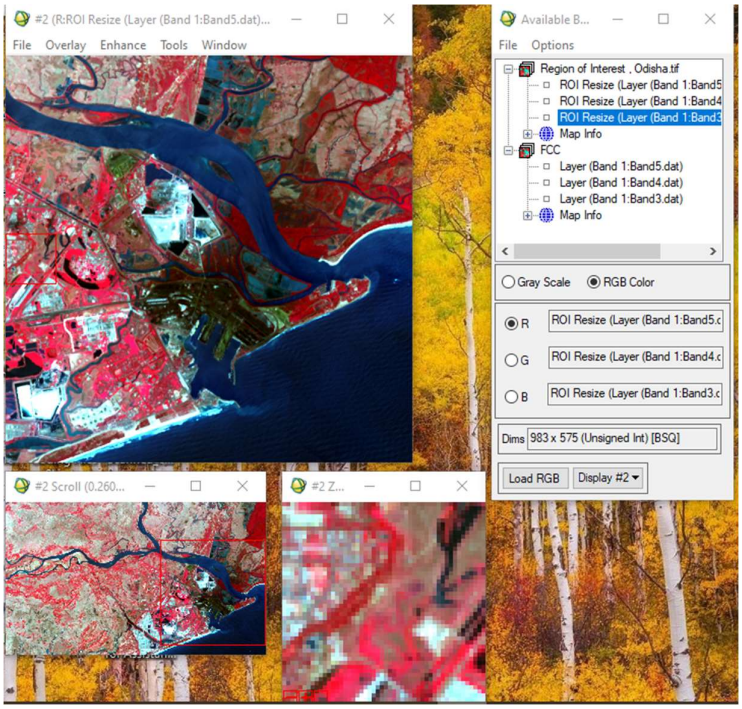
LAB 7B ASSIGNMENT

CE 593 ADVANCED REMOTE SENSING

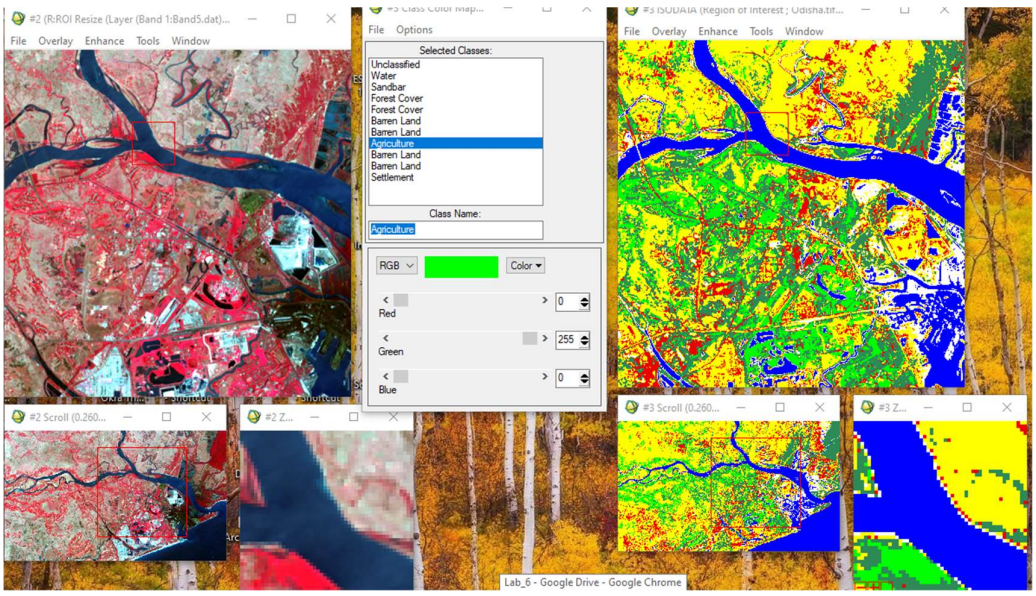
SUPERVISED CLASSIFICATION OF REGIONAL REMOTE SENSING IMAGE

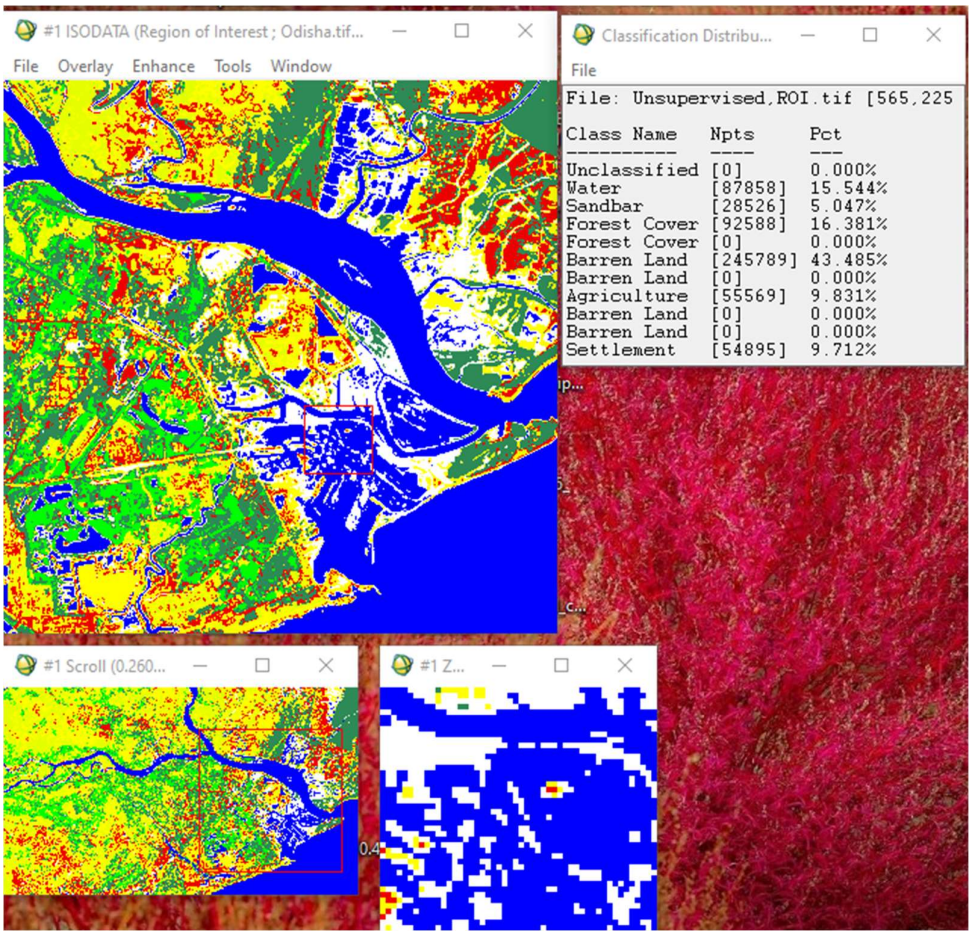


Region of Interest



Unsupervised Classification





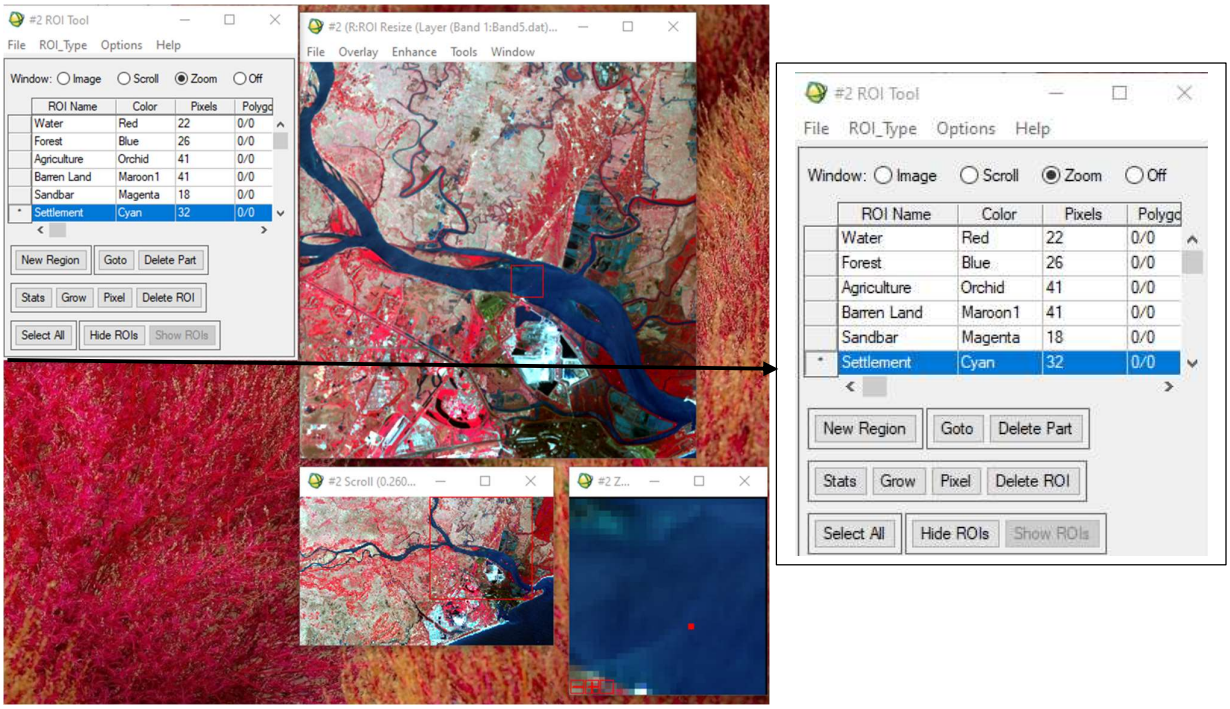
Supervised Classification

Supervised classification is a machine learning technique where the algorithm is trained on labelled data to classify new data into predefined categories.

For Supervised training, analyst must select representative pixels for each of the categories.

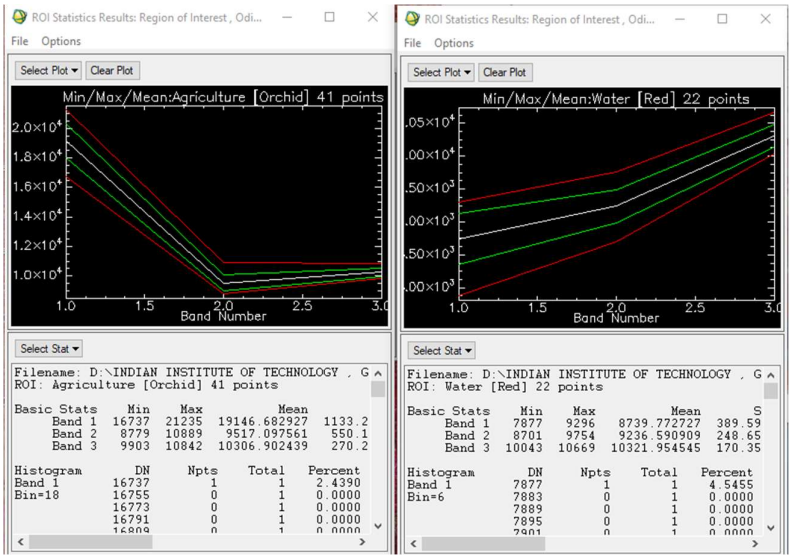
In this image below, it includes a LANDSAT 8 image of a region of Odisha, a subset which includes region of interest of Coastal region of Odisha, where Supervised Classification is done.

On the left-hand side, a **Region of Interest (ROI)** tool is used, which mainly shows the categories selected for the supervised classification:



These classes represent different land cover types that are being used for the classification process.

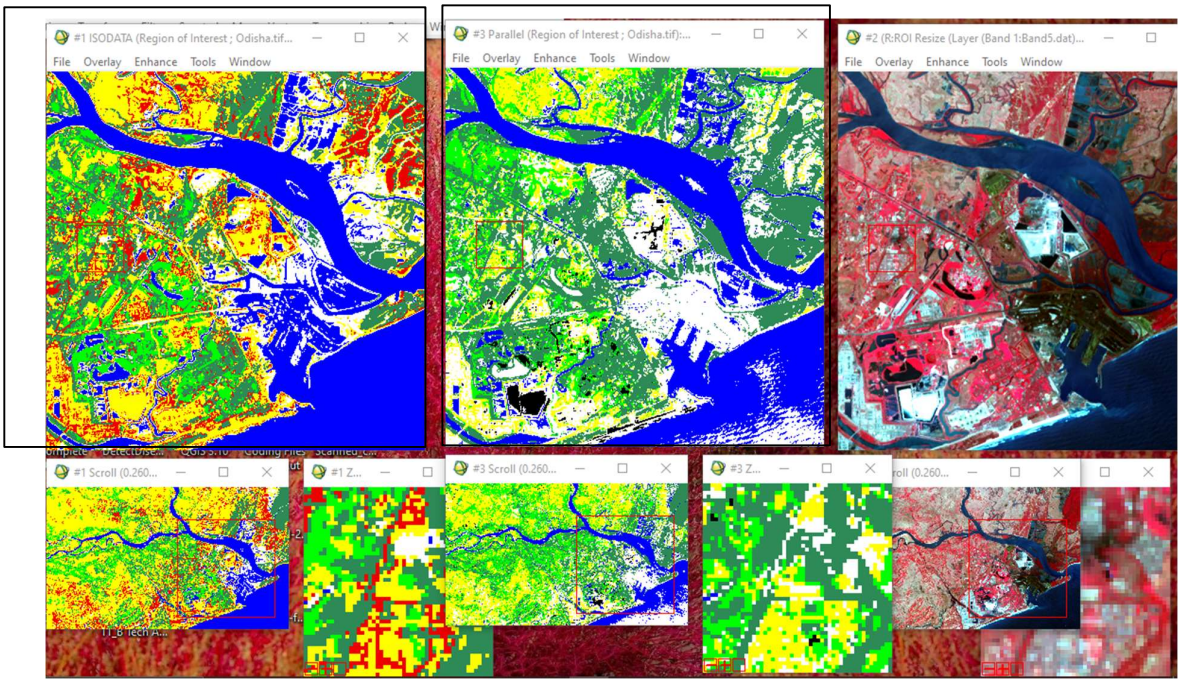
The number of pixels for each class (e.g.,water) indicates the areas that have been selected as representative samples for each class.



Statistics shows the spectral behaviour of the selected regions across different spectral bands.

The x-axis represents band numbers, while the y-axis shows the reflectance/DN values for each band.

Unsupervised Image **Supervised Image**



Parallelopiped Classifiers

In this classifier, the feature space is divided into regions that resemble multi-dimensional rectangles (parallelepipeds).

Each of these parallelepipeds is associated with a particular class, and the classification is performed based on whether a data point falls inside one of these predefined parallelepiped regions.

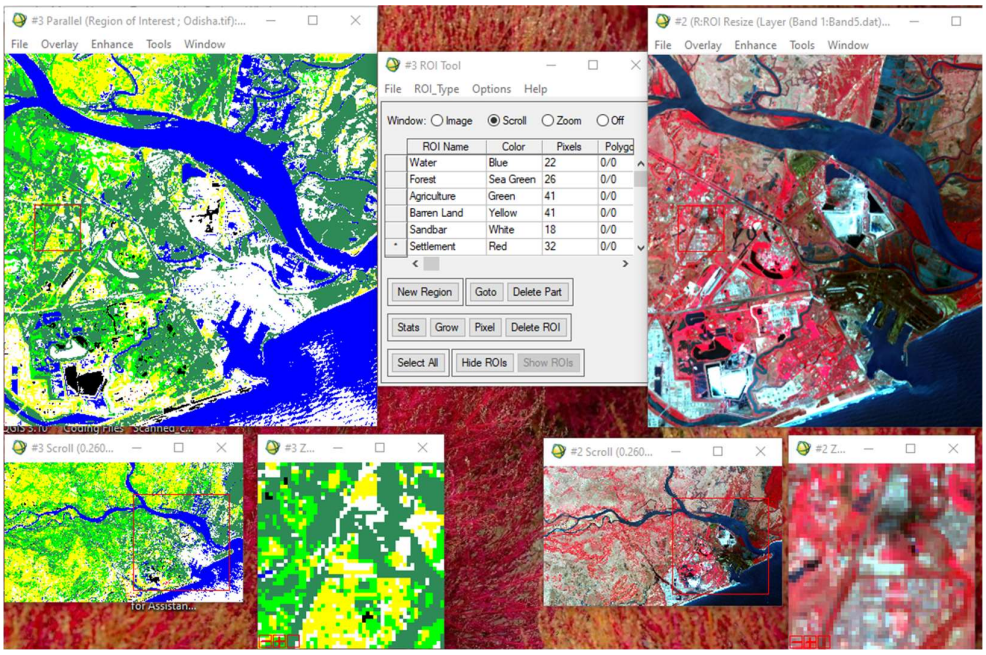


Fig -image classified by parallelepiped classifier and Original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOTE SENSING\Lab 8\

Overall Accuracy = (108/180) 60.0000%
Kappa Coefficient = 0.5243

	Ground Truth (Pixels)				
Class	Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	22	0	0	0	3
Forest [Sea G	0	26	28	0	7
Agriculture [	0	0	13	2	0
Barren Land [	0	0	0	39	0
Sandbar [Whit	0	0	0	0	8
Settlement [R	0	0	0	0	0
Total	22	26	41	41	18

Fig -Accuracy assessment by confusion matrix for parallelepiped classifier, Overall accuracy = 60%

Minimum Distance Classifier

It classifies an unknown data point by assigning it to the class whose mean is closest to the data point, based on some distance metric, mainly calculate the mean vector for each class.

MDM classifies each pixel to the nearest class.

The most common metric used is the Euclidean distance, other distance measures like Mahalanobis distance can also be applied.

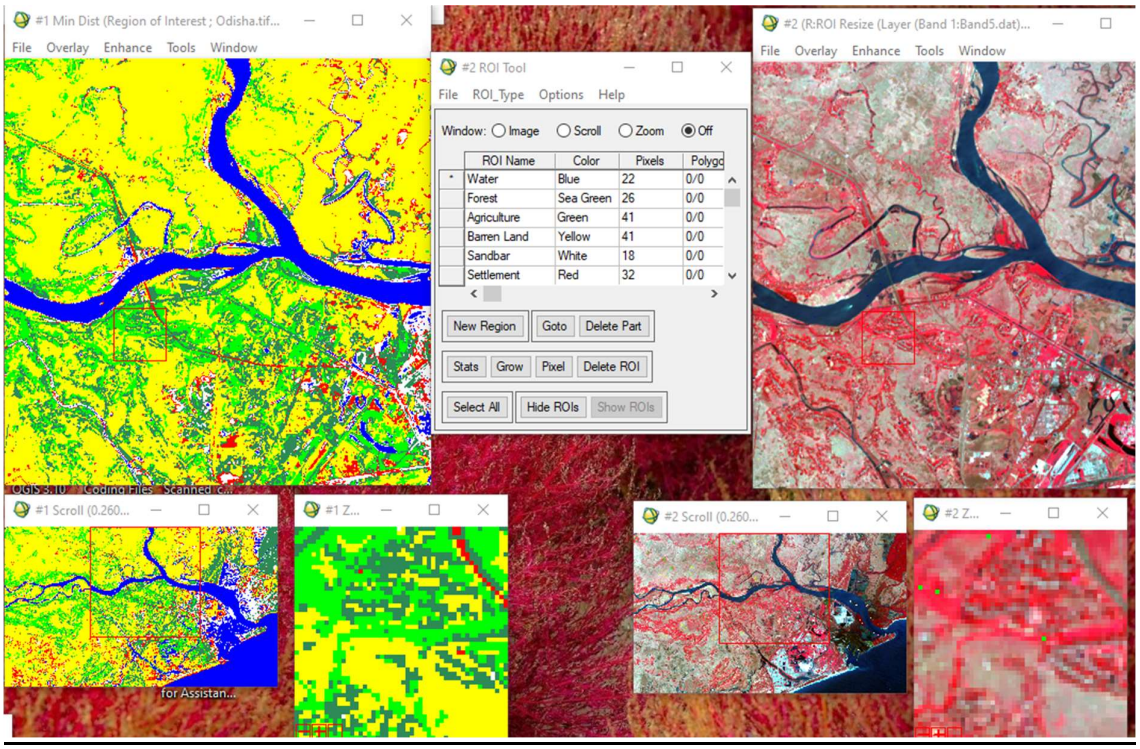


Fig -image classified by Minimum Distance Classifier and original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOTI

Overall Accuracy = (145/180) 80.5556%
Kappa Coefficient = 0.7621

Class	Ground Truth (Pixels) Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	22	0	0	0	5
Forest [Sea G	0	19	1	0	0
Agriculture [	0	5	37	0	0
Barren Land [	0	0	3	41	3
Sandbar [Whit	0	2	0	0	8
Settlement [R	0	0	0	0	2
Total	22	26	41	41	18

Fig -Accuracy assessment by confusion matrix for Minimum Distance Classifier , Overall accuracy = 80.556%

Mahalanobis Distance Classifier

The Mahalanobis distance is a generalized measure of distance that accounts for correlations between variables, making it more flexible and powerful than Euclidean distance, especially when the data distribution of each class has a different spread or covariance structure.

The Mahalanobis distance scales the Euclidean distance by the shape of the distribution defined by the covariance matrix, makes it sensitive to the shape, orientation, and spread of the data within each class.

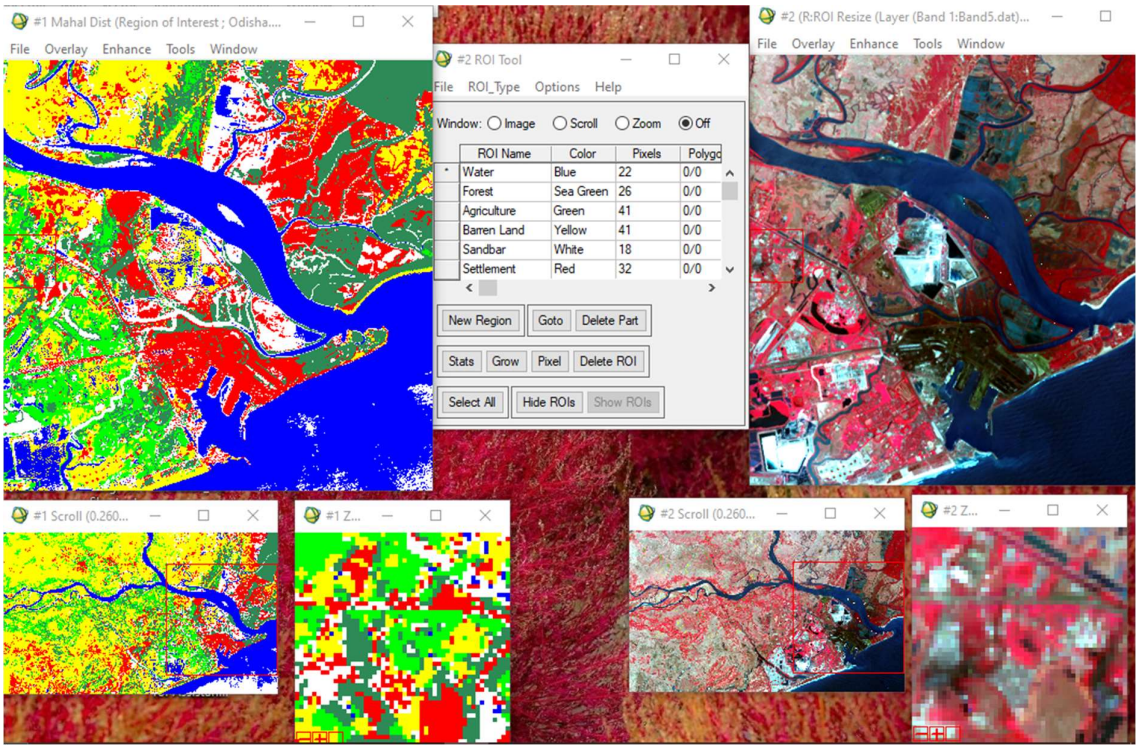


Fig -image classified by Mahalanobis Distance Classifier and original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOT

Overall Accuracy = (129/145) 88.9655%
Kappa Coefficient = 0.8559

Class	Ground Truth (Pixels) Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	22	0	0	0	3
Forest [Sea G	0	23	1	0	4
Agriculture [	0	3	38	0	0
Barren Land [	0	0	2	41	3
Sandbar [Whit	0	0	0	0	5
Total	22	26	41	41	15

Fig -Accuracy assessment by confusion matrix for Mahalanobis Distance Classifier, Overall accuracy = 88.9655%

Maximum Likelihood Classifier

It calculates the likelihood of a pixel for different classes , mainly assign each class of highest likelihood

The conditional probability of feature vector X to be in class C1 is **P(Ci/X)**

P(Ci/X) is computed using Bayes Theorem in terms of **P(Xi/Ci)**

$$\mathbf{P(Ci/X) = \frac{P(Xi/Ci)P(Ci)}{P(X)}}$$

Determine the probability of an object belonging to particular class given to particular value X has occurred

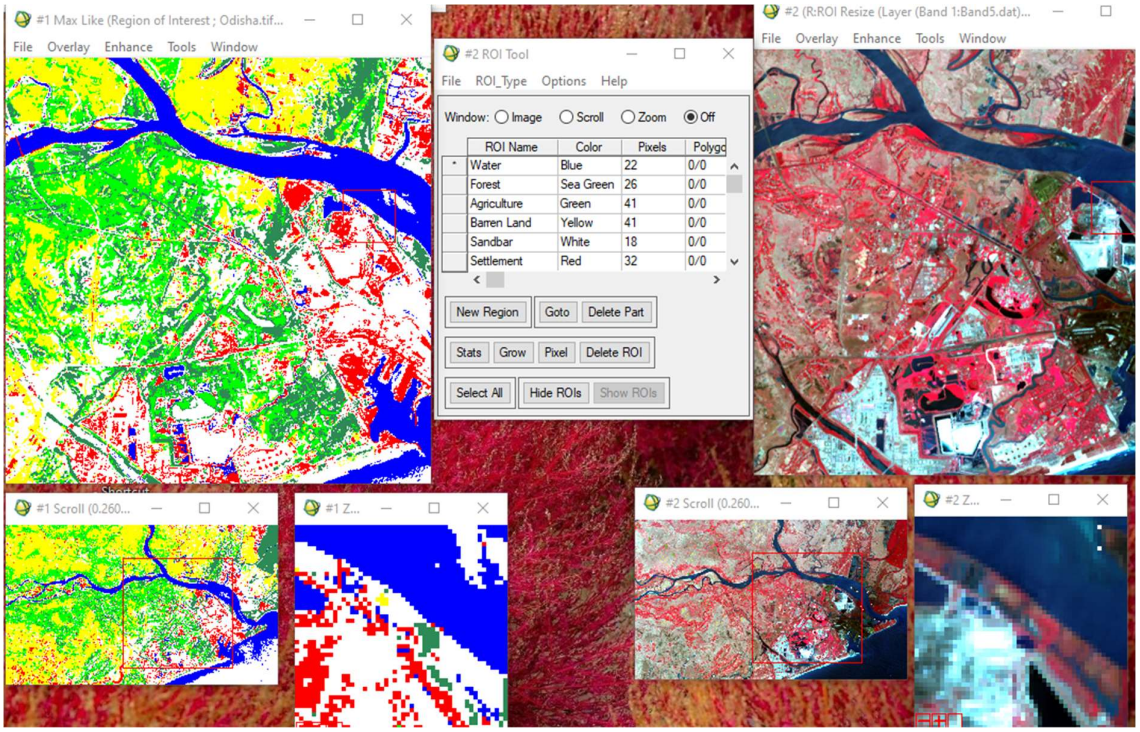


Fig -image classified by Maximum Likelihood Classifier and original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOTE SENSI

Overall Accuracy = (164/180) 91.1111%
Kappa Coefficient = 0.8914

Class	Ground Truth (Pixels) Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	22	0	0	0	2
Forest [Sea G	0	24	2	0	4
Agriculture [	0	2	39	0	0
Barren Land [	0	0	0	41	0
Sandbar [Whit	0	0	0	0	10
Settlement [R	0	0	0	0	2
Total	22	26	41	41	18

Fig -Accuracy assessment by confusion matrix for Maximum Likelihood Classifier, Overall accuracy = 91.1111%

Spectral Angle Mapper Classifier

Spectral Angle Mapper (SAM) classifier for classifying hyperspectral or multispectral imagery based on the spectral signature of different materials.

It is a based spectral classification method that calculates the spectral angle between a reference (training) spectrum and the spectrum of each pixel in the image, treating them as vectors in a multi-dimensional space.

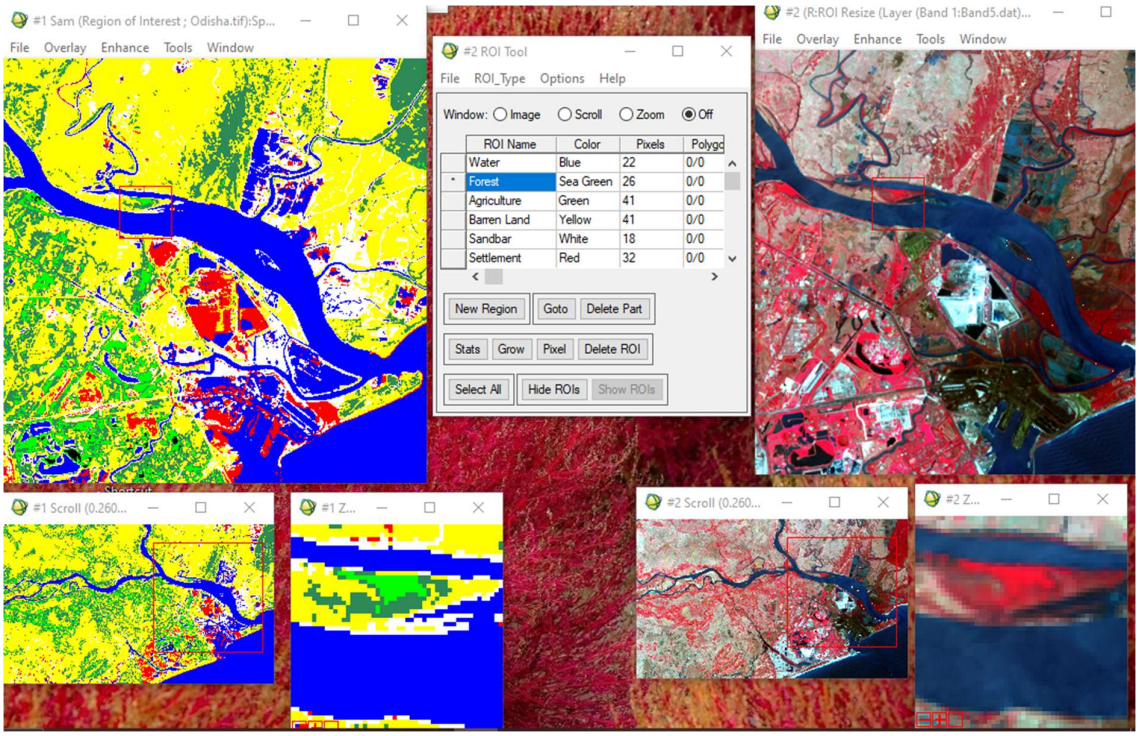


Fig -image classified by Spectral Angle Mapper (SAM) Classifier and original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOT

Overall Accuracy = (137/180) 76.1111%
Kappa Coefficient = 0.7071

	Ground Truth (Pixels)				
Class	Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	22	0	0	0	4
Forest [Sea G	0	16	11	0	0
Agriculture [	0	6	30	0	0
Barren Land [	0	4	0	41	5
Sandbar [Whit	0	0	0	0	5
Settlement [R	0	0	0	0	4
Total	22	26	41	41	18

Fig -Accuracy assessment by confusion matrix for Spectral Angle Mapper (SAM) Classifier, Overall accuracy = 76.1111%

Spectral Information Divergence Classifier

Spectral Information Divergence (SID) classifier measures the divergence between the probability distributions of the spectral signatures for each pixel and the reference spectra (training data).

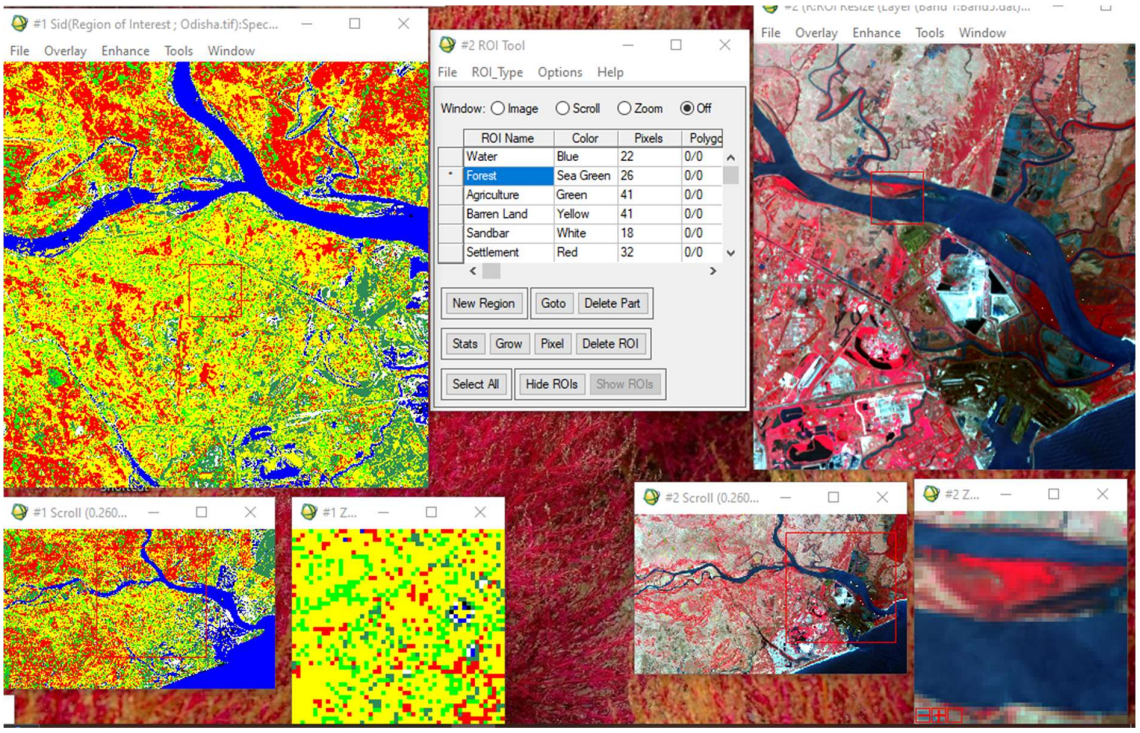


Fig -image classified by (SID) Classifier and original satellite image

Class Confusion Matrix

File

Confusion Matrix: D:\INDIAN INSTITUTE OF TECHNOLOGY , GUWAHATI\CE593 , ADVANCED REMOTE SENSI

Overall Accuracy = (65/180) 36.1111%
Kappa Coefficient = 0.2263

Class	Ground Truth (Pixels) Water	Forest	Agriculture	Barren Land	Sandbar
Unclassified	0	0	0	0	0
Water [Blue]	21	0	0	0	6
Forest [Sea G	0	16	0	3	1
Agriculture [	0	2	9	14	0
Barren Land [	1	7	30	2	0
Sandbar [Whit	0	1	0	0	11
Settlement [R	0	0	2	22	0
Total	22	26	41	41	18

Fig -Accuracy assessment by confusion matrix for (SID) Classifier, Overall accuracy = 36.1111%

Binary Encoding Classifier

The binary encoding classifier leverages binary codes(1 or 0) to represent distinct classes or features, and it compares the encoded representations to classify the data

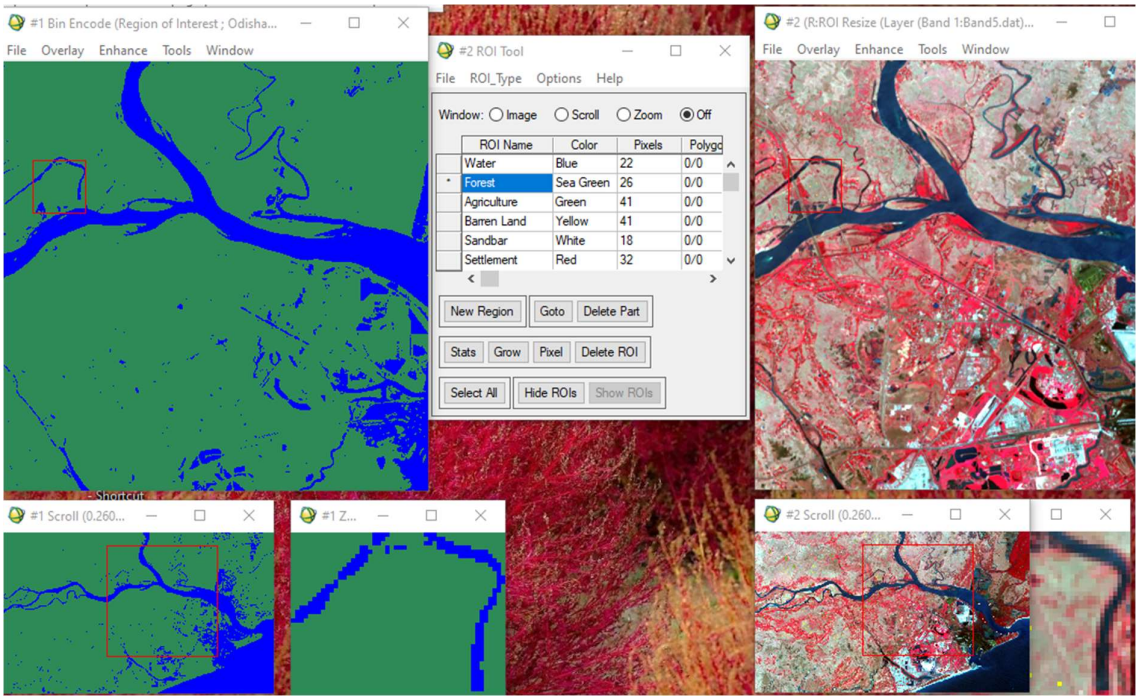


Fig -image classified by binary encoding classifier and original satellite image

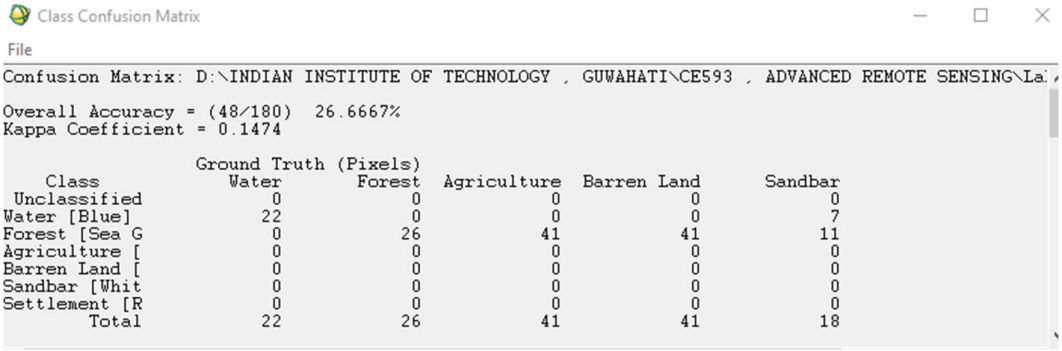


Fig -Accuracy assessment by confusion matrix for binary encoding classifier, Overall accuracy = 26.6667%

Conclusion:

Above from all the classifiers which is used in the original satellite image as shown , Maximum likelihood classifier was found to be the best for this particular satellite image which is having am Overall Accuracy of 91.1111%