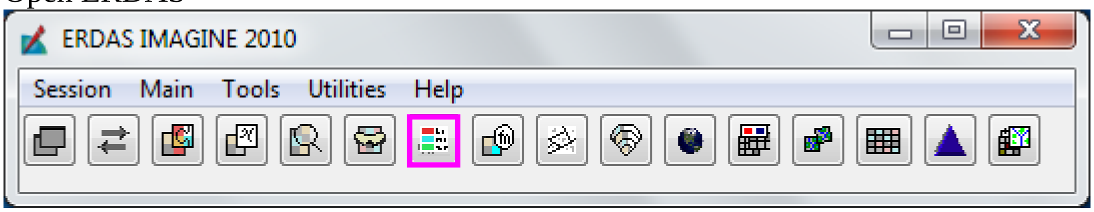
A step-by-step guide to
Map land use / land cover (LULC) including major crop eco-systems

This manual provides a step-by-step guide to the map LULC eco-systems. LU mapping involves various protocols such as unsupervised classification, decision tree algorithms, Spectral matching Techniques and accuracy assessment.

<u>Basic requirements:</u>
Software: Image processing software (ERDAS/ENVI/ER Mapper)
Ground-truth: Intensive field information for class labeling
Field knowledge is important

Open ERDAS

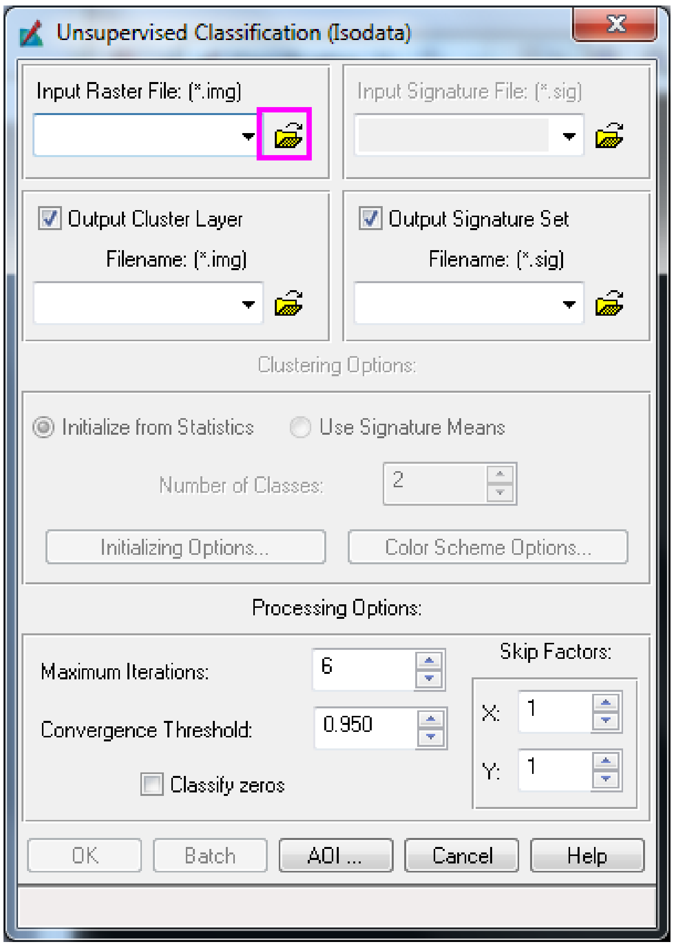


Click on **Image classification** icon (opens below window).

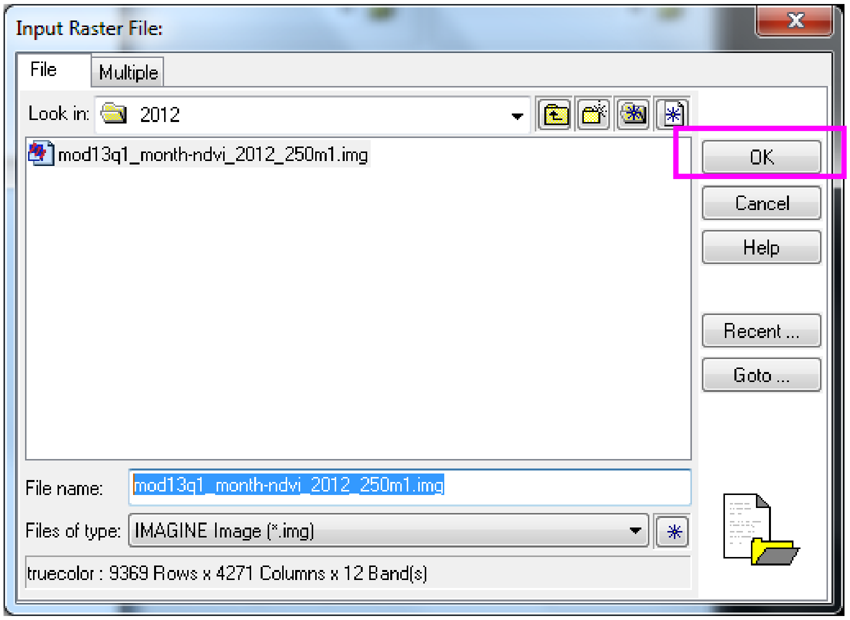
Click on **Unsupervised Classification option** as shown in above window and it opens

Unsupervised classification and class temporal profile (NDVI curves) generation

Unsupervised classification using ISOCLASS cluster algorithm (ISODATA in Imagine 2010[TM]) followed by progressive generalization, was used on 12-band NDVI MVC MFDC constituted for the year 2012.

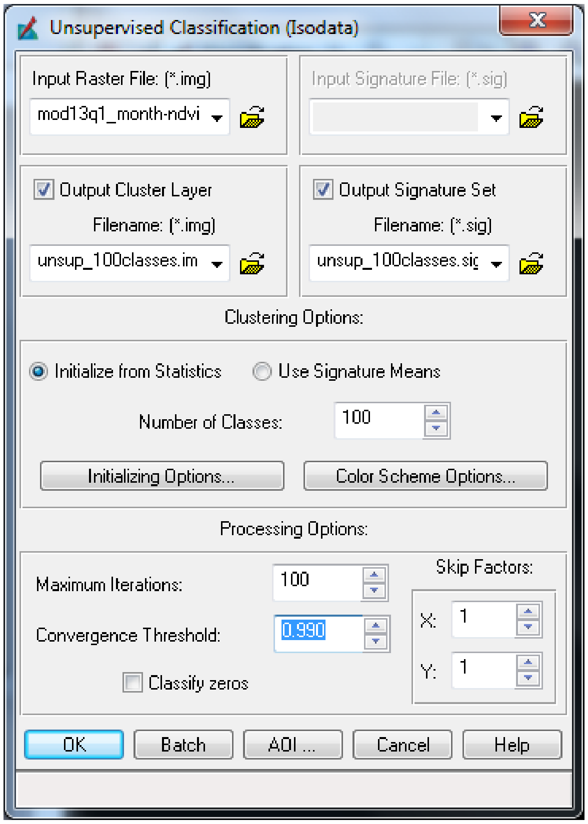


Click on **open icon** and it open below window.

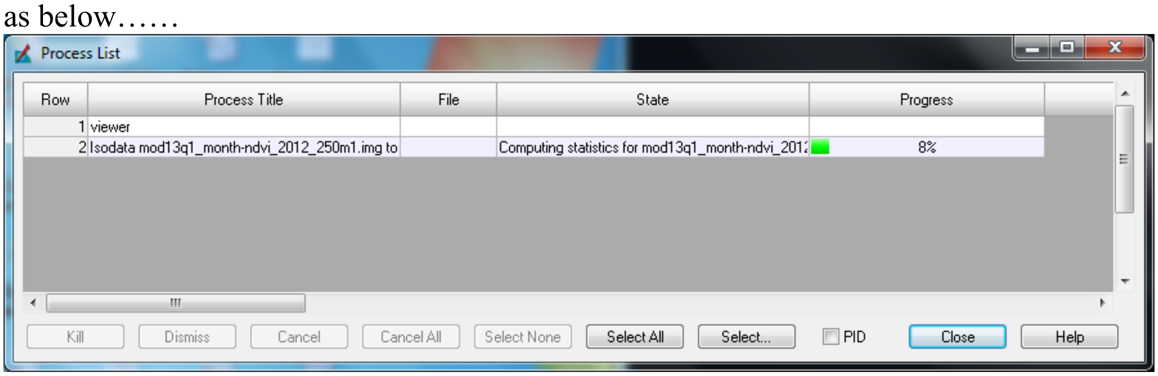


Select the mega-file composite and click on **OK**

The classification was set at a maximum of 100 iterations and convergence threshold of 0.99. In all 100 classes were generated for each segment. Use of unsupervised techniques is recommended for large areas that cover a wide and unknown range of vegetation types



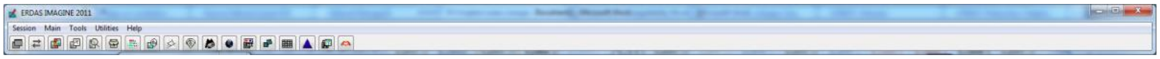
Click on **OK** option in main in Unsupervised Classification Manu and continue process as below……



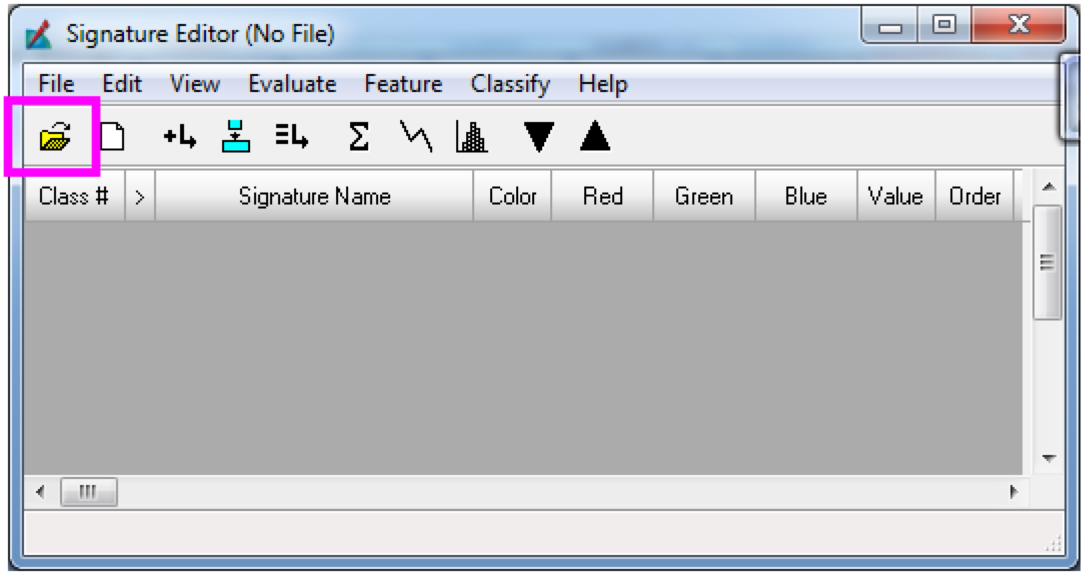
The 100 classes obtained on time series composite from the unsupervised classification were merged using rigorous class identification and labeling using protocols.

Class temporal profile (NDVI curves) generation: The signature file is used to plot the signature of each LULC class over time. This NDVI signature indicates the profile of vegetative intensity.

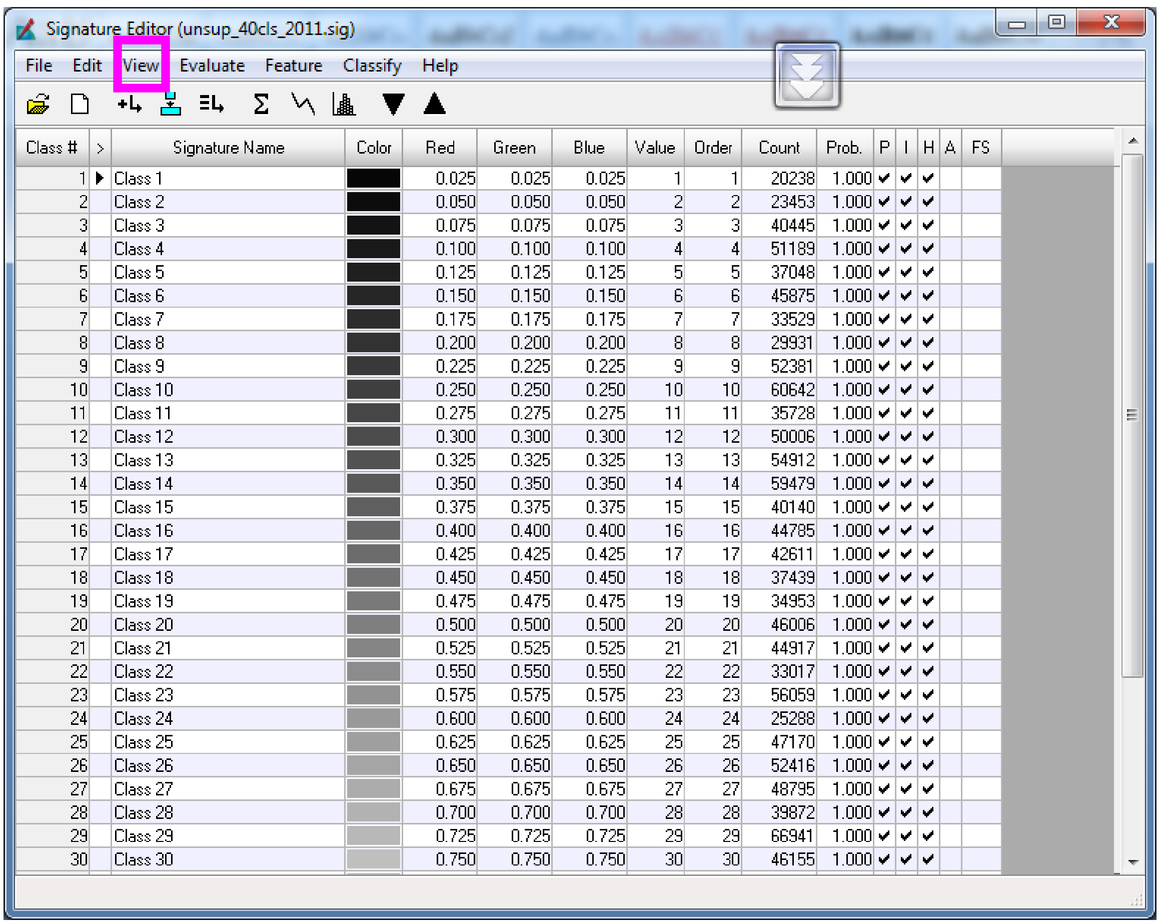
After unsupervised classification



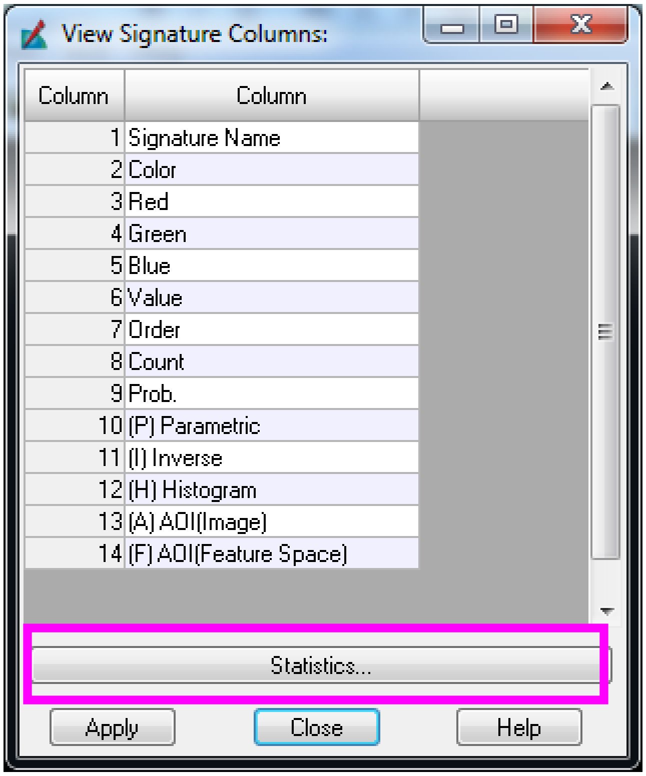
Open signature editor in classification menu



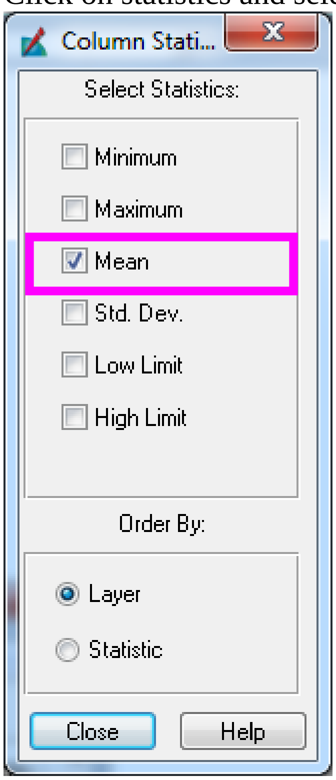
Select and open your signature file, it shows as below screen..



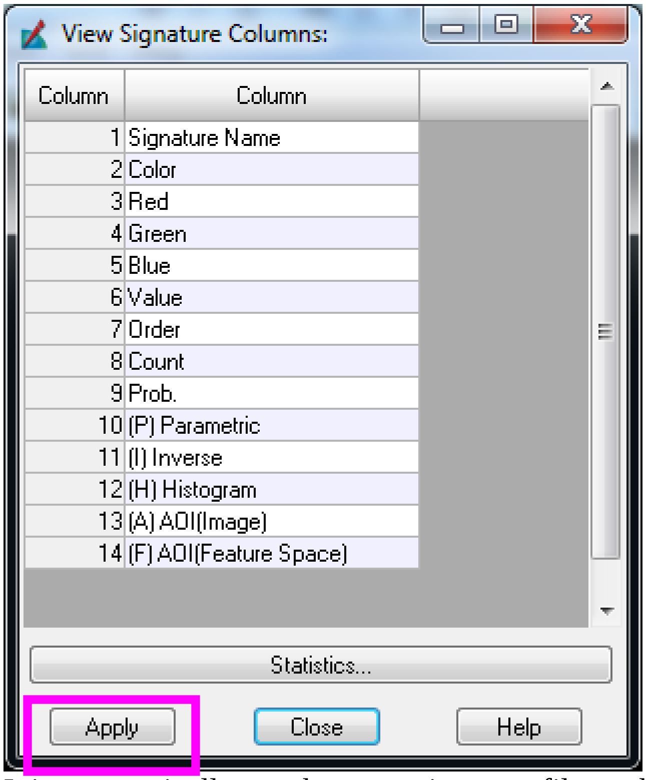
Click on view and select **Columns** (last commad) and you can see View Signature Column window



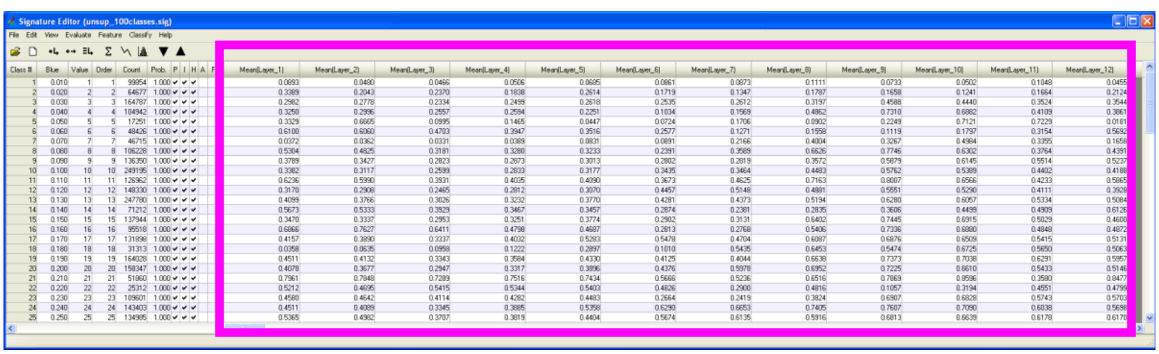
Click on statistics and select mean as shown below window



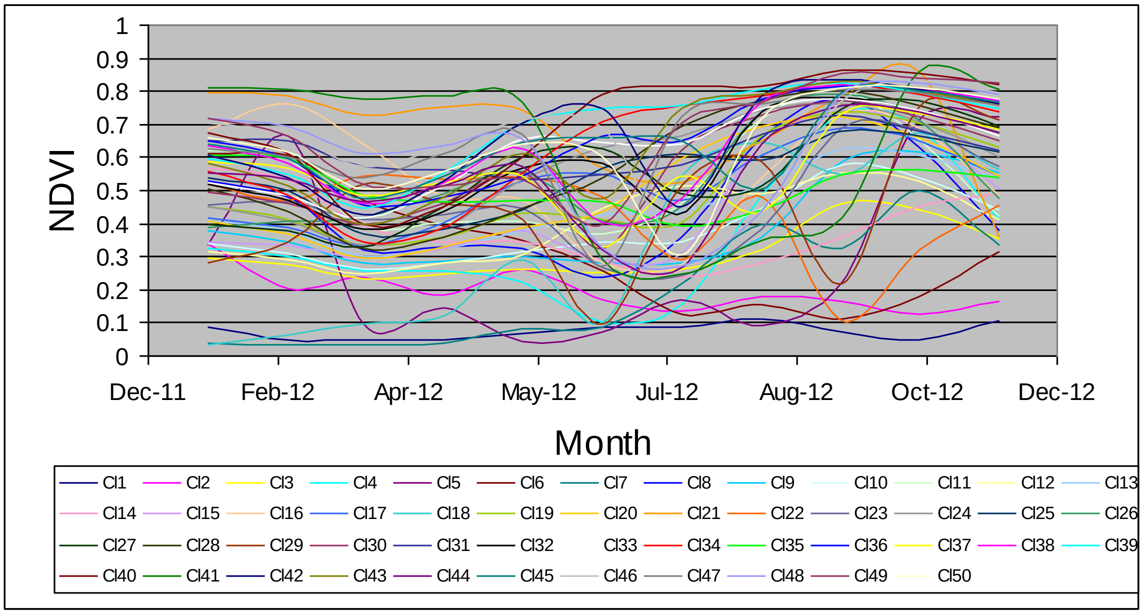
After select mean option then apply icon as below window

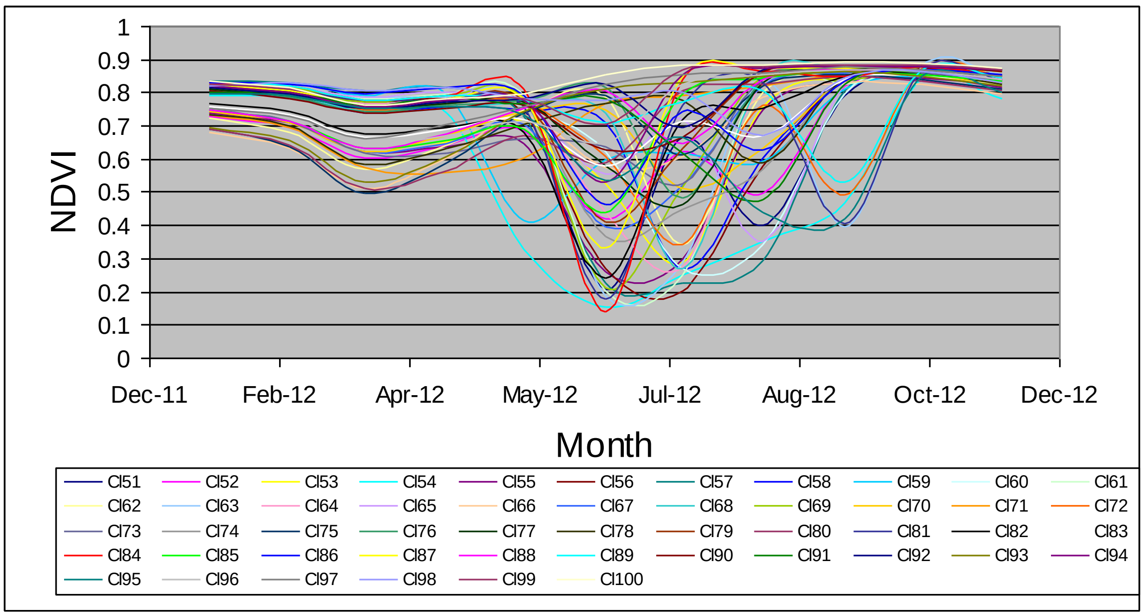


It is automatically attach to you signature file as show in below



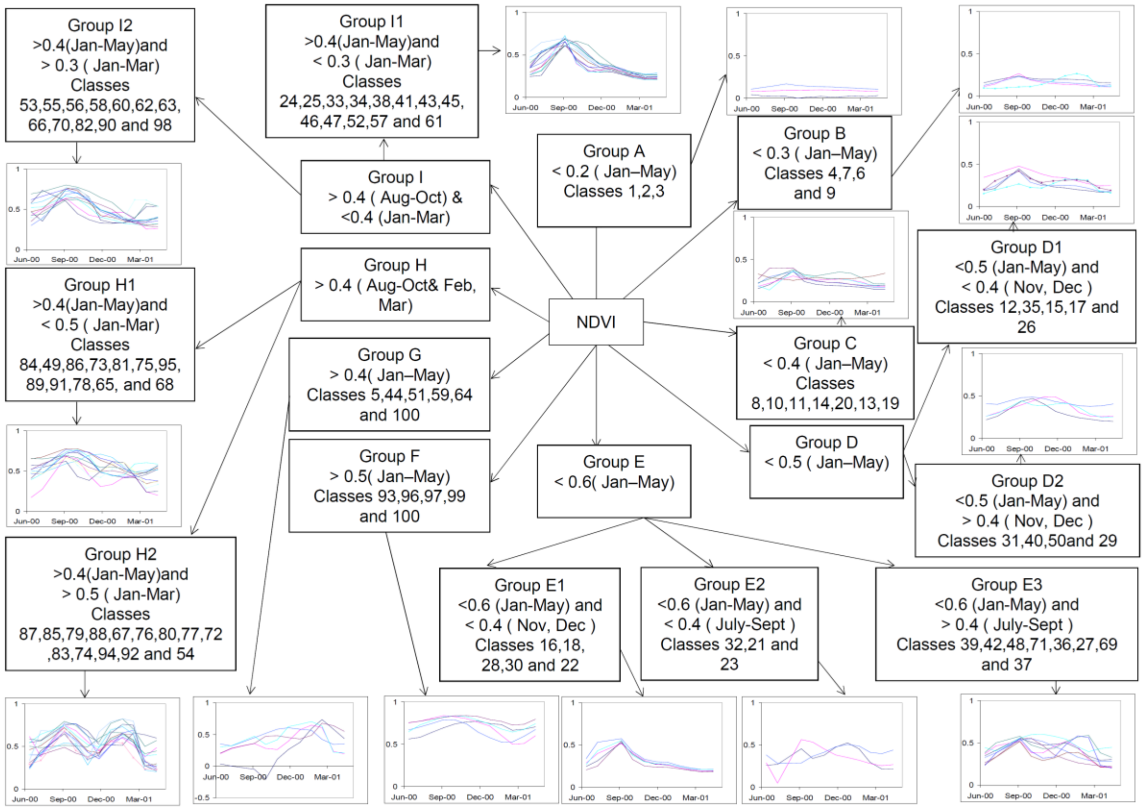
Select the statistics and paste to your .xls file (excel file).



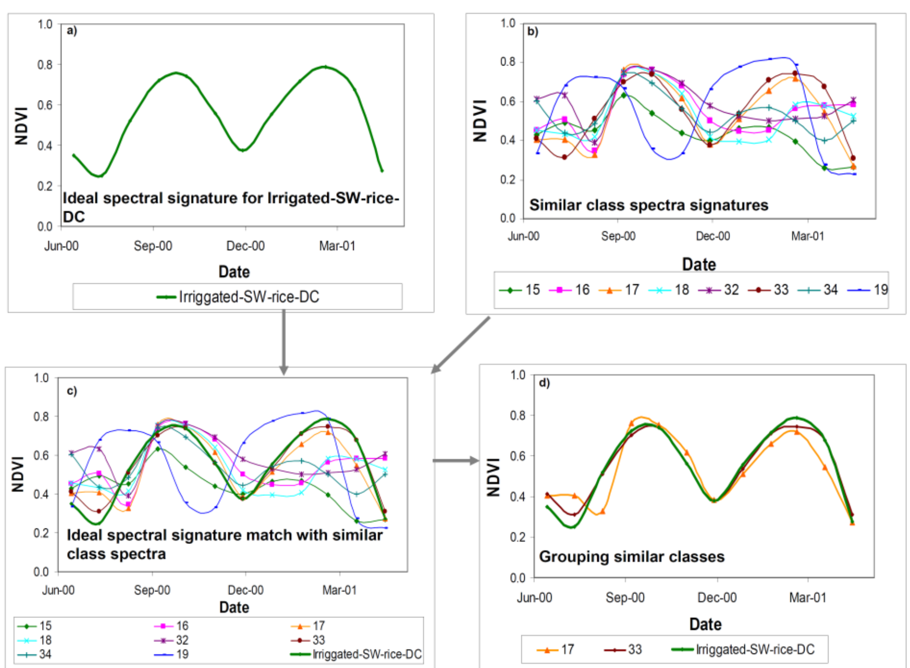


Class spectral signatures of unsupervised classes derived using MODIS 500m mega-file data-cube (MFDC) for year 2012

The **Decision Tree** is based on NDVI thresholds at different stages in the season that define the vegetation growth cycle, and these algorithms help to identify similar classes. The dates and thresholds values were derived from the ideal temporal profile. The decision tree for 100 class's example is shown in below figure. This first stage reduced the total number of classes from 100 to 38.



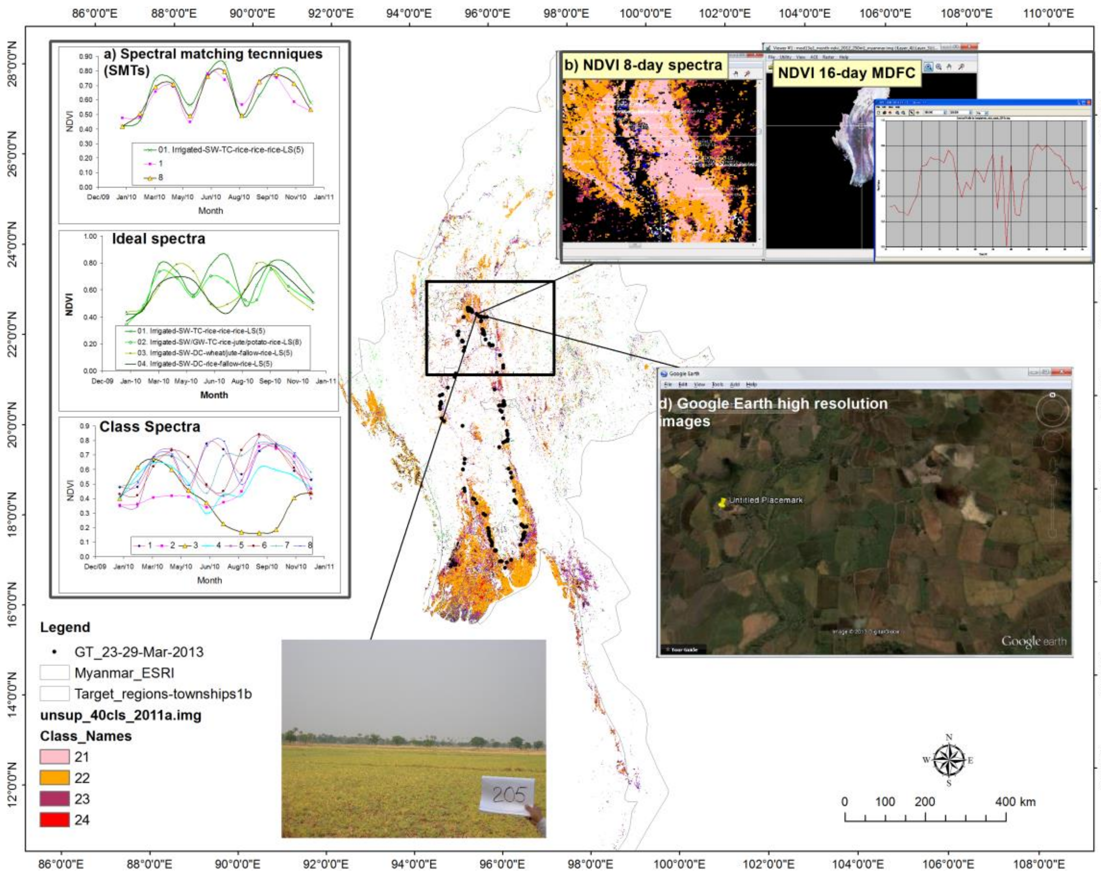
Spectral matching techniques (SMTs) match the class spectra derived from classification with an ideal spectra-derived MODIS MFDC based on precise knowledge of land use from specific locations.



Spectral matching technique (SMT). In SMTs, **t**he class temporal profiles (NDVI curves) are matched with ideal temporal profile (quantitatively based on temporal profile similarity values) in order to group and identify classes as illustrated for a LULC class in this figure. a) Ideal temporal profile illustrated for "irrigated- surface-water-rice-double crop"; b) similar class temporal profile signatures, c) ideal temporal profile signatures match with similar class temporal profile, and d) the ideal temporal profile (in deep green) matches with class temporal profile of classes 17 and 33 perfectly (Gumma *et al.*, 2011b).

Class Identification and Labeling

The class identification and labeling process involves the use of Spectral Matching Techniques, location wise spectral signatures, ground-truth and Google Earth images shown in below.



Class identification and labeling using a) Spectral matching techniques, b) NDVI 8-day time series, c) Field-plot data and d) Google Earth high resolution imagery (above example showed for Irrigated-surface water-TC-vegetables-rice-rice-LS, during files visit, the status of field can see the photo graph, this reflects in signature as low NDVI in August).

After grouping classes based on DT and SMTs, class names were assigned for each class using a three-step naming procedure: such as class spectra (monthly MVC, 16-day NDVI), field plot, and Google Earth data.

Class spectra and the time-series NDVI MVC plots are ideal for understanding the differences that occur (a) within and between seasons, (b) between rice and other crops, and (c) between irrigation source (e.g., irrigated versus rainfed). The main advantage of using the NDVI 16-day time-series curves is to identify the aus season, a very short season, which we cannot identify with monthly composite curves. For example, section 4.1 (Fig 4.1) shows the distinct differences between triple-/double-/single-cropped rice with irrigation and rainfed cropped rice. Irrigated areas have much higher NDVI and are double-cropped (two crops in a calendar year). Similarly, the rainfed submergence areas have significantly lower NDVI during the aman season and are limited to one crop per year (during the boro season).

Field-plot data, some of 191 field-plot points collected across Myanmar during March 2013 for field visits, were used for class identification and class naming.

Google Earth verification is used for class identification and lebleing, since Google Earth provides very high-resolution images from 30 m to sub-meter resolution for free and is accessible through the Web. This data set was also used for class identification and verification, especially in areas that are difficult to access during field visits. Though Google Earth does not guarantee pinpoint accuracy, the zoom-in views of high-resolution imagery were used to identify the presence of any agriculture bunds, vegetation conditions, and irrigation structures (e.g., canals, irrigation channels, open wells). It was observed from the digital globe option on Google Earth that most of the high-resolution images were acquired after 2000 and, on average, Google Earth high-resolution imagery is one to three years old (Google Earth Help). When definitive answers were not available (e.g., absence of crops bunding, irrigation structures), we did not use that particular Google Earth data point in the analysis. Google Earth high-resolution imagery, when used along with other distinct data sets, provides supplemental supportive results.

Finally mask and reclassification, in the rigorous class-naming process described earlier, there were often “mixed” classes. The unresolved classes are masked out from original monthly NDVIMVC data and classified into 5 to 10 or more sub-classes (depending on the extent of area and complexity), and the class identification and labeling process as described previously was repeated. The main purpose is to split the mixed classes.

Resolving the Mixed Classes

The class identification and labeling process helps in identifying, grouping, and labeling many classes. However, some complex classes remain unresolved as mixed, as purity of these classes could not be adequately validated using field-plot data and/or very high resolution imagery, and/or bispectral plots, and/or other means. The mixed classes have more than one type of field plot data points fall on one class, these classes considered as mixed classes and is selected for further analysis to resolve mix class. For example, some of fragmented shallow groundwater irrigated areas are spectrally (e.g., NDVI, band reflectance) mixed with other crop classes. In such cases, we adopted a number of steps to resolve the mixed classes. First, we masked the mixed class and reclassified the class using the mega file data cube covering this mixed class area. Such finer classification on a focused area, helped resolve some mixed classes. Second, we used additional information such as elevation and slope to resolve the mixed classes. The mixed classes was first masked out from the original Landsat/MODIS data set Together with other spatial data layers (precipitation zones, elevation zones and tree cover categories) and spatial modeling, 5 to 10 or more sub-classes were identified (depending on complexity and area extent). The identification and labeling process as described previously was repeated afterwards.