Exploring the Secrets of Satellite Imagery: Decoding Earth's Features through Visual Interpretation and Digital Image Processing

Elements of visual Image interpretation

1. Tone
2. Shape
3. Size
4. Pattern
5. Texture
6. Shadow
7. Association

1. Tone refers to the relative brightness of an image. It is a fundamental factor in distinguishing between different features.

2. **Shape** refers to the general structure or appearance of an individual object. The shape becomes a very distinctive clue for interpretation.

3. Size is important for understanding an object in relation to other objects in a scene. A quick estimate of the target size will give us a better result.

4. **Pattern refers to the spatial arrangement of visually identifiable objects. Systematic repetition of textures produces a recognizable pattern.**

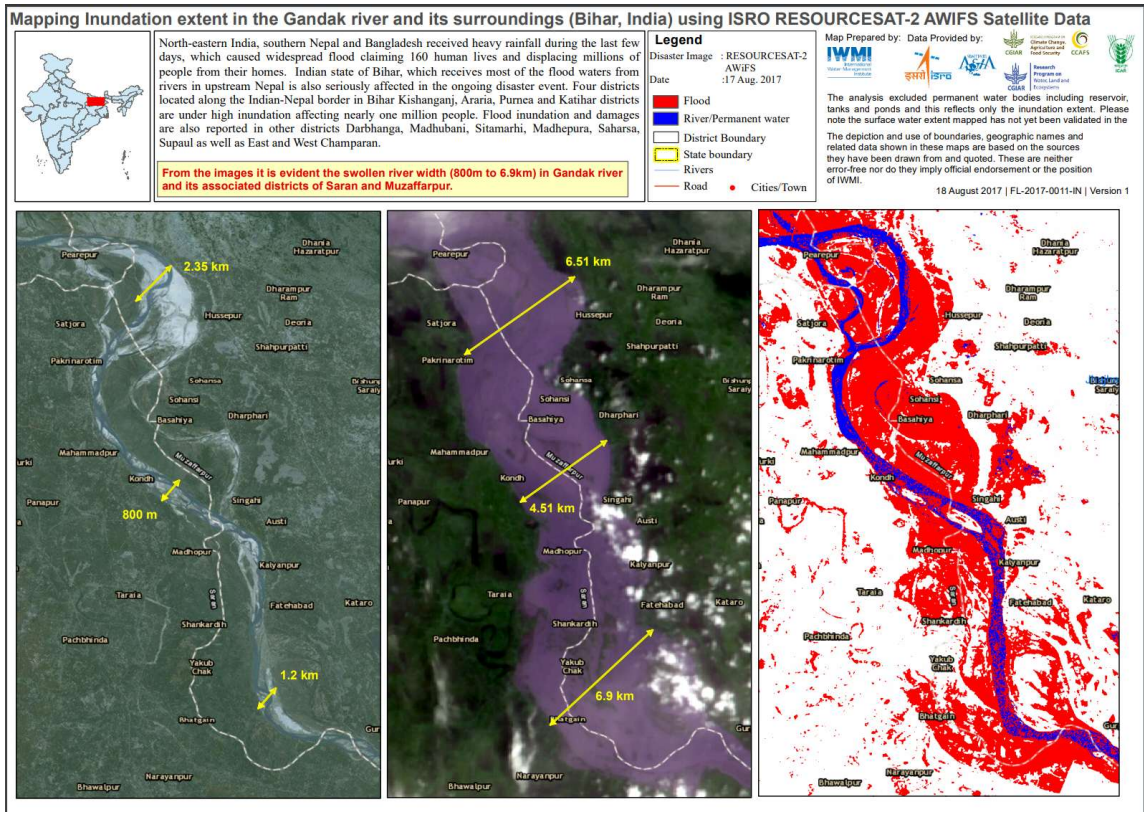
5. **Texture;** **At rough textures, the tonal levels change abruptly in a small space, while soft textures have very little tonal variation.**

6. **Shadow** enlighten the relative height of the target. Shadow can be used to enhance or identify topography and landforms, especially in radar images.

7. **Association** illuminates the target information, e.g .: at the university, we can identify the admin block, library, canteen, etc. .....

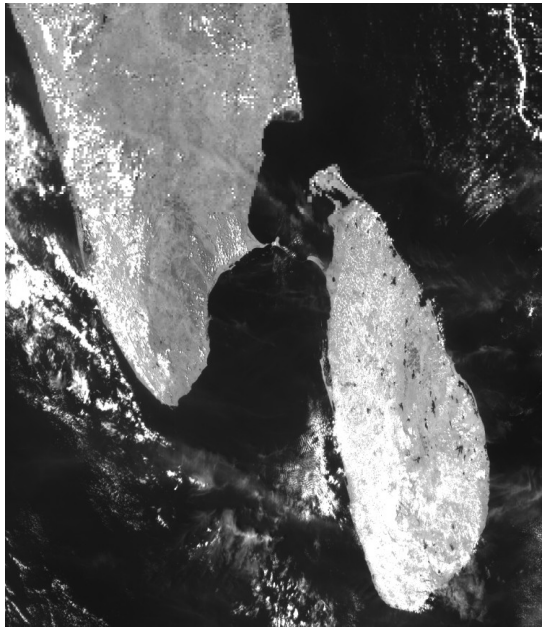
Digital Image interpretation & analysis

1. Preprocessing
2. Image Enhancement
3. Image Transformation
4. Image Classification



1.Preprocessing

- **Image restoration and rectification,**
- **Correct sensor- and platform-specific radiometric and geometric distortions of data.**
- **Radiometric corrections-scene illumination and viewing geometry, atmospheric conditions, and sensor noise and response.**
- **Convert and/or calibrate the data to radiance or reflectance units**



Acquired sensor data

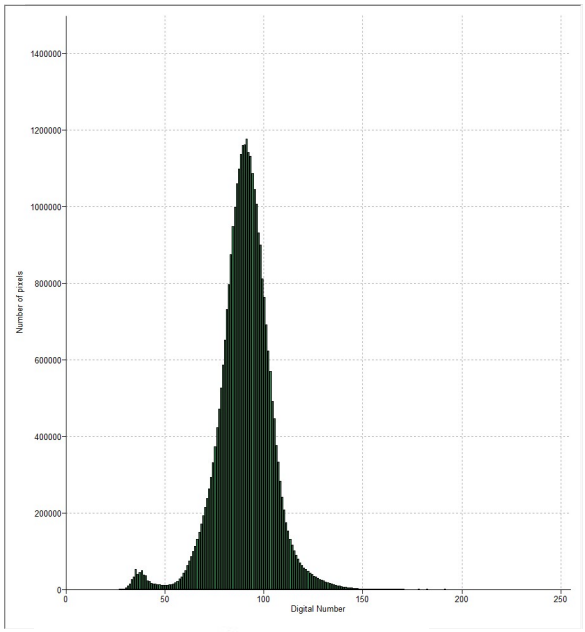
Geometrically corrected

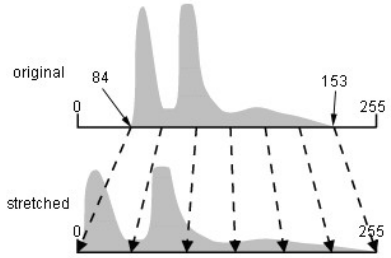
2. Image Enhancement

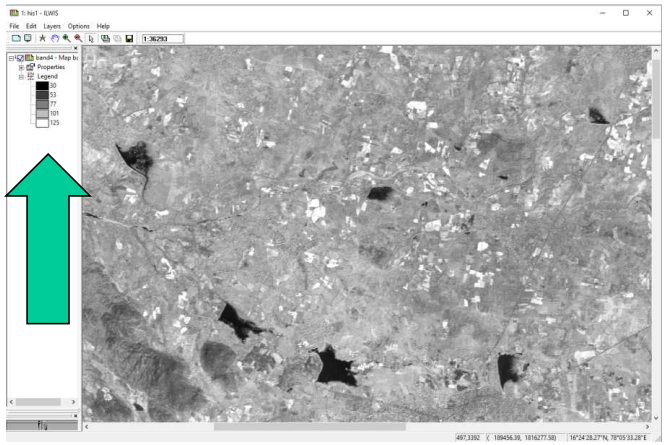
The key to understanding contrast enhancements is to understand the concept of an **image histogram**.

A histogram is a graphical representation of the brightness values that comprise an image.

The brightness values (i.e. 0-255) are displayed along the x-axis of the graph. The frequency of occurrence of each of these values in the image is shown on the y-axis.

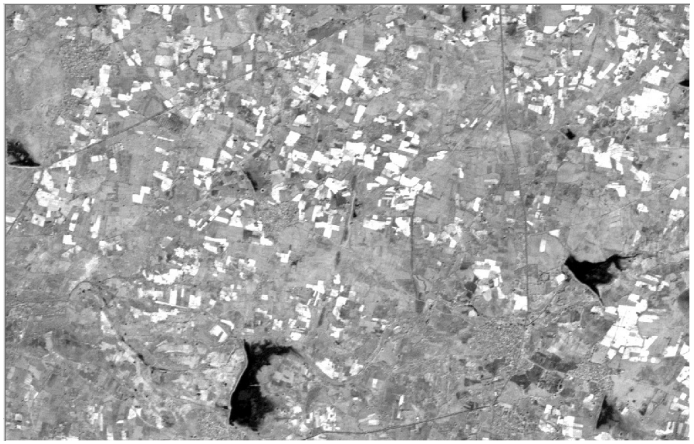




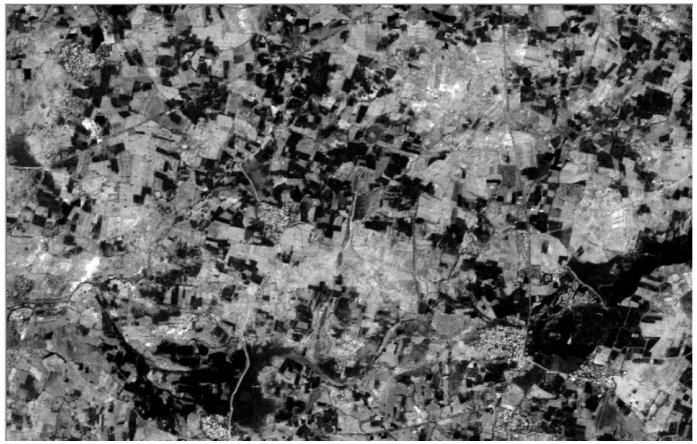


3.Image Transformations

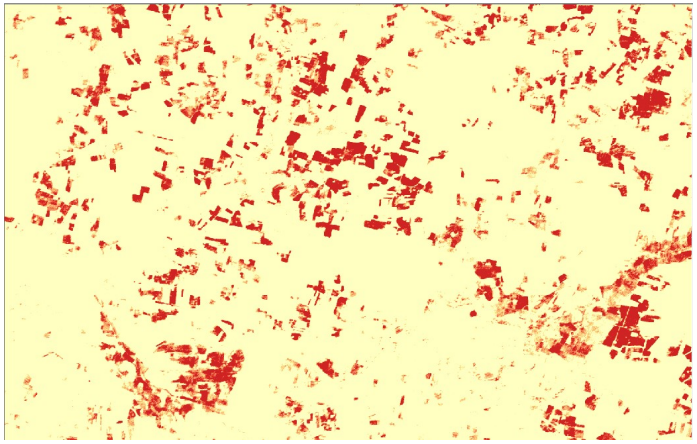
Image transformations typically involve the manipulation of multiple bands of data using arithmetic operations, image transformations generate "new" images from two or more sources which highlight particular features or properties of interest, better than the original input images.



IR

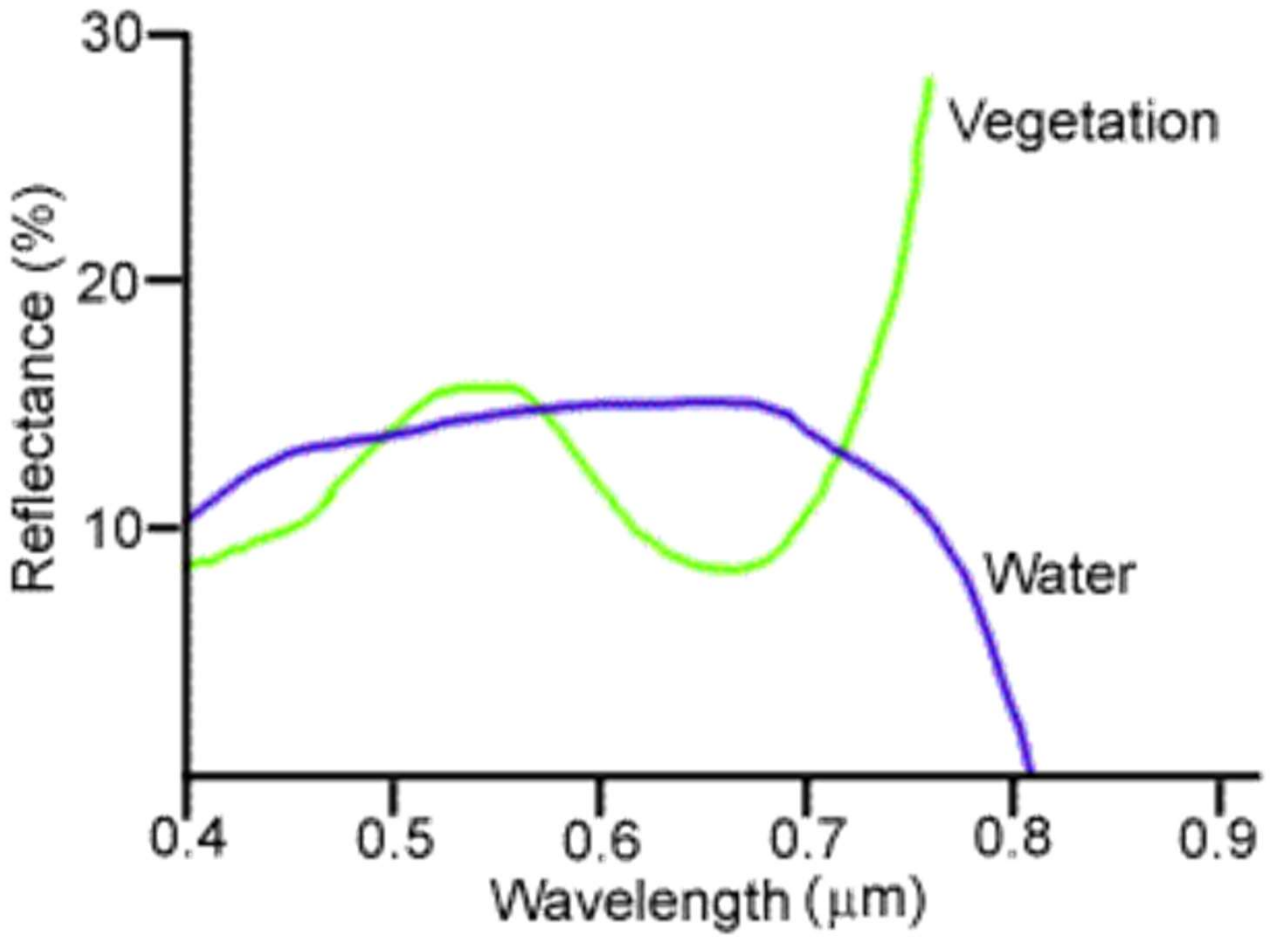


R



NDVI= (IR-R) / (IR+R)

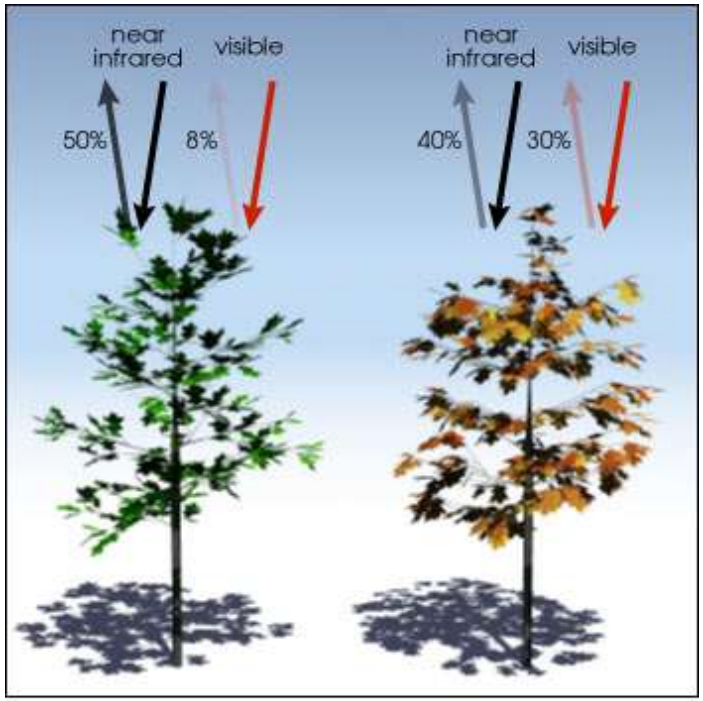
spectral response Or Spectral signatures



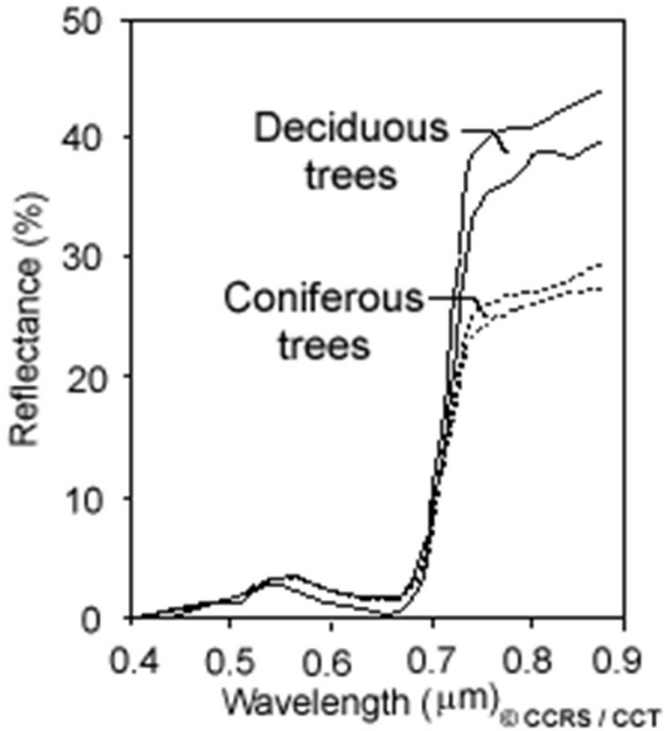
Normalized Difference Vegetation Index (NDVI)

$$NDVI = \frac{(NIR - R)}{(NIR + R)}$$

Calculations of NDVI for a given pixel always result in a number that ranges from -1 to +1; however, no green leaves gives a value close to zero. A zero means no vegetation, and close to +1 (0.8 - 0.9) indicates the highest possible density of green leaves.

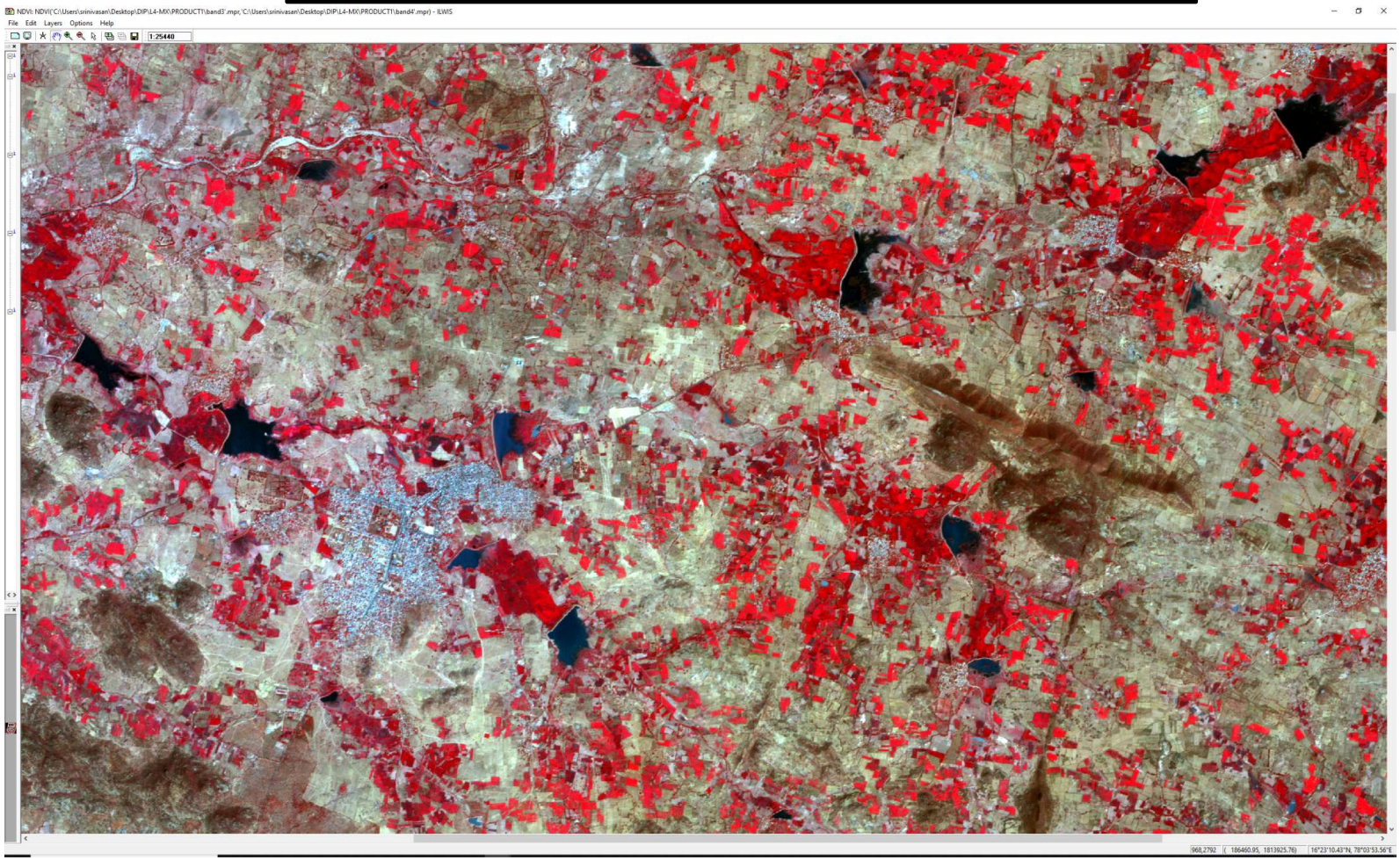


$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72$ $\frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$

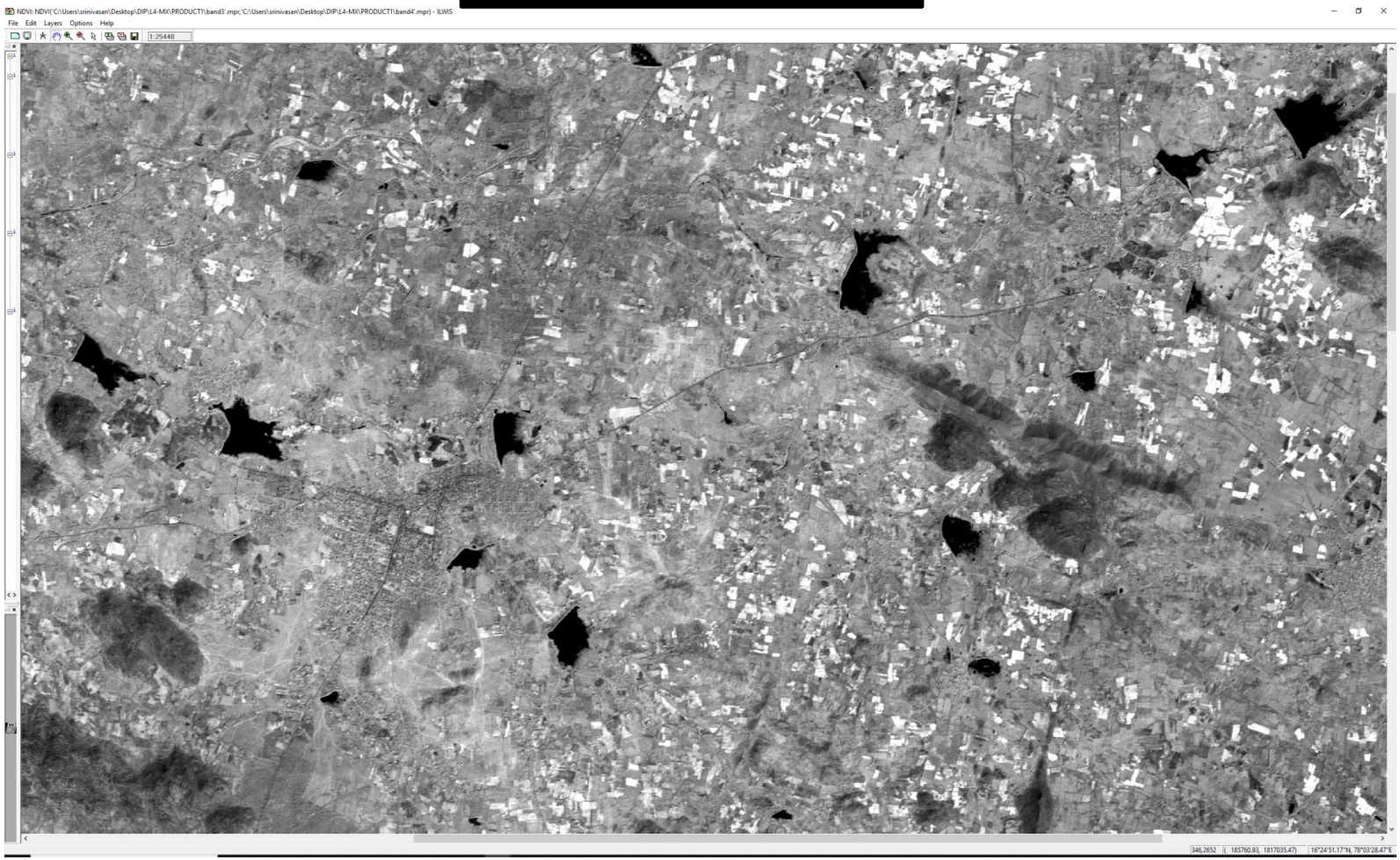


Courtesy: earthobservatory.nasa.gov

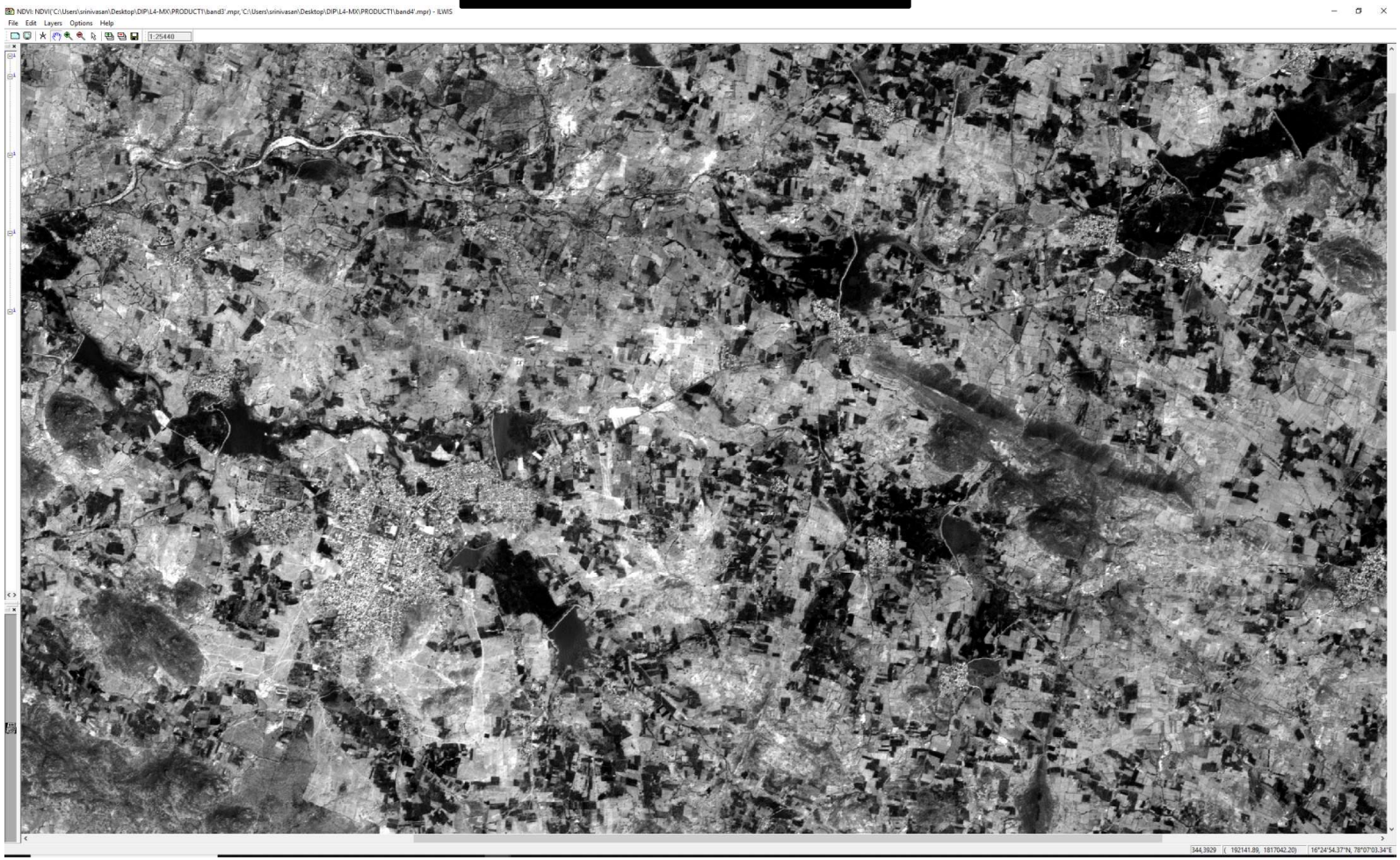
LISS-IV- FCC [(IR 0.77 - 0.86 µm), R (0.62 - 0.68 µm), G (0.52 - 0.59µm)]



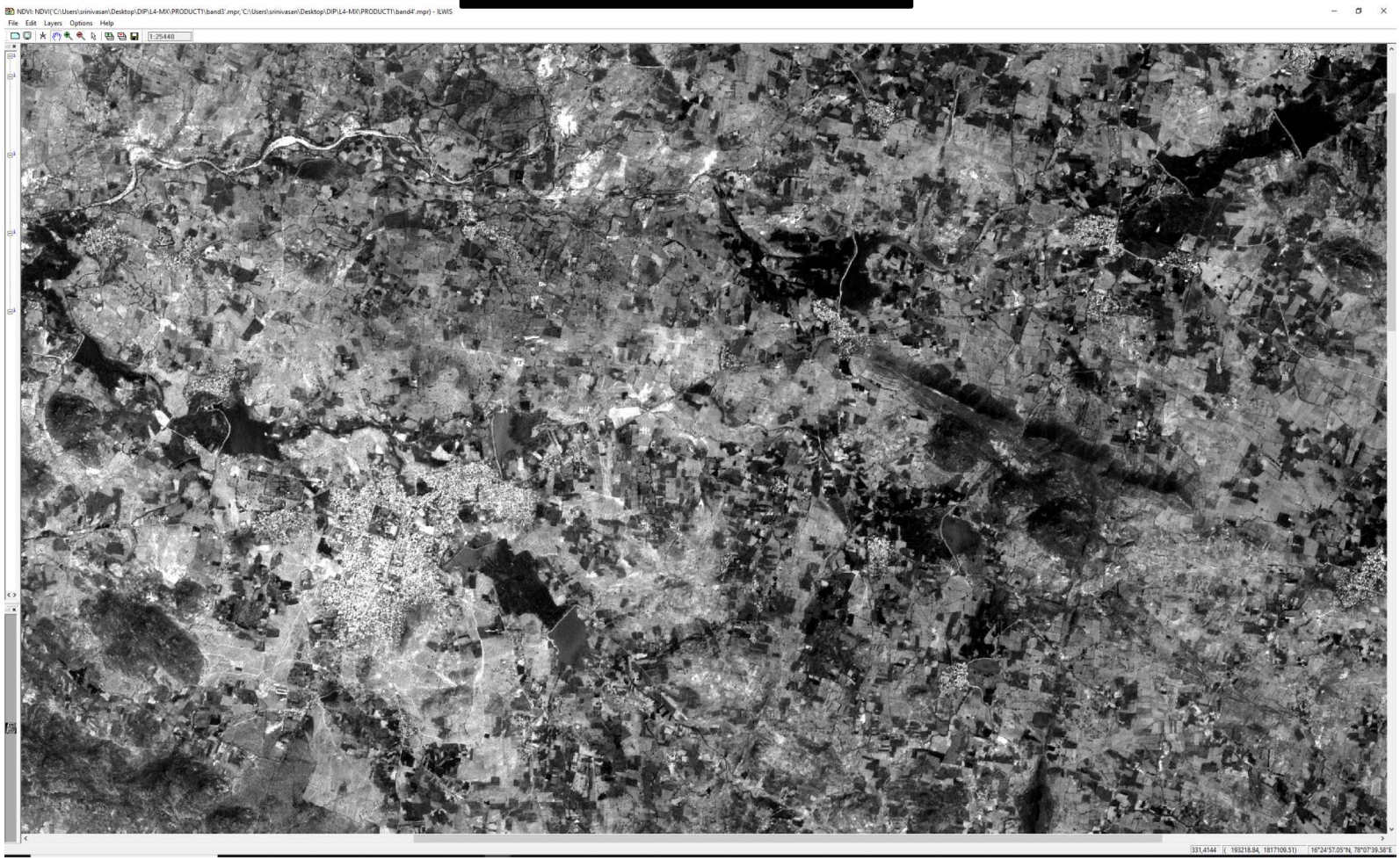
LISS-IV- IR 0.77 - 0.86 µm



LISS-IV- R 0.62 - 0.68 µm



LISS-IV- G 0.52 - 0.59 µm



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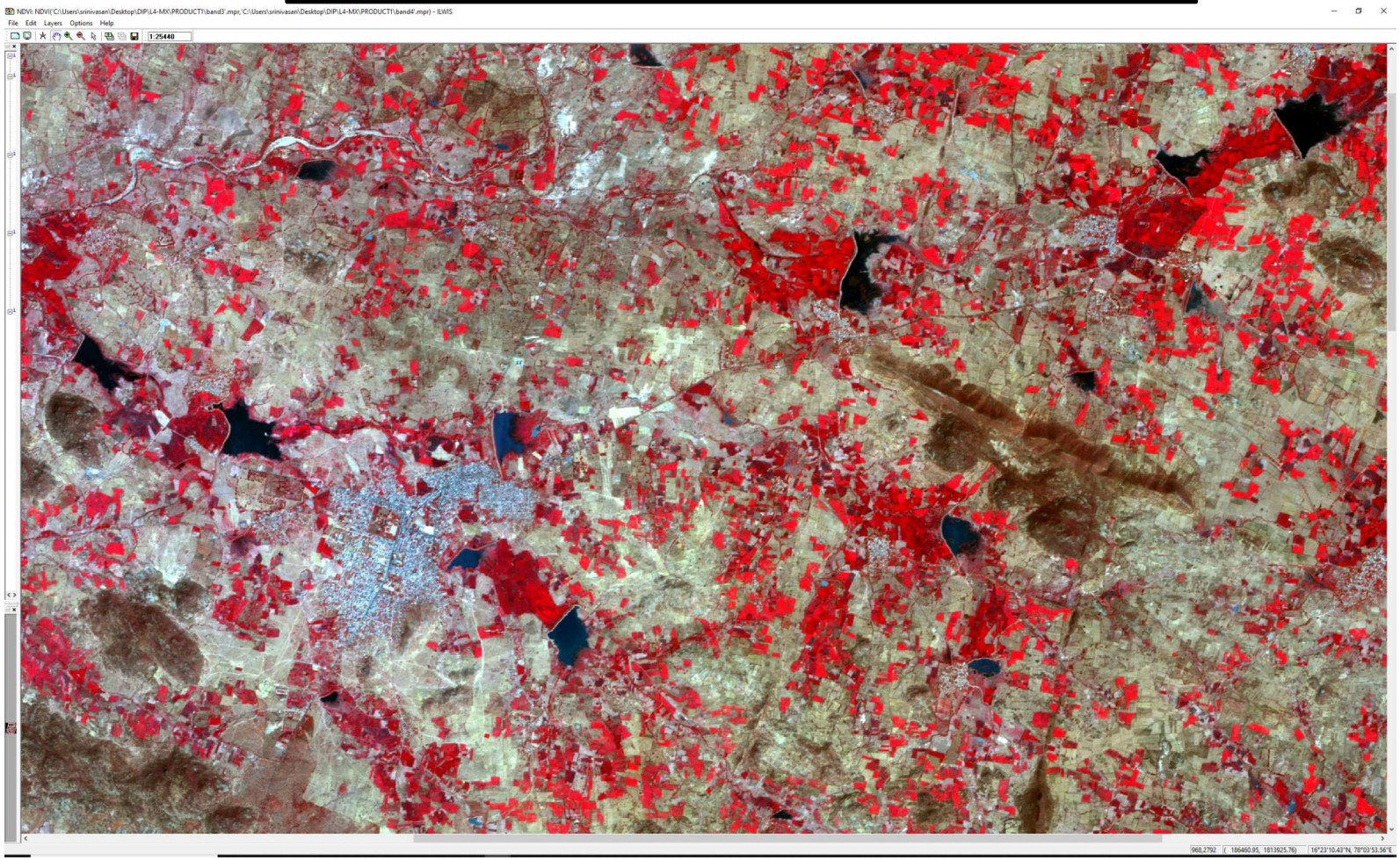
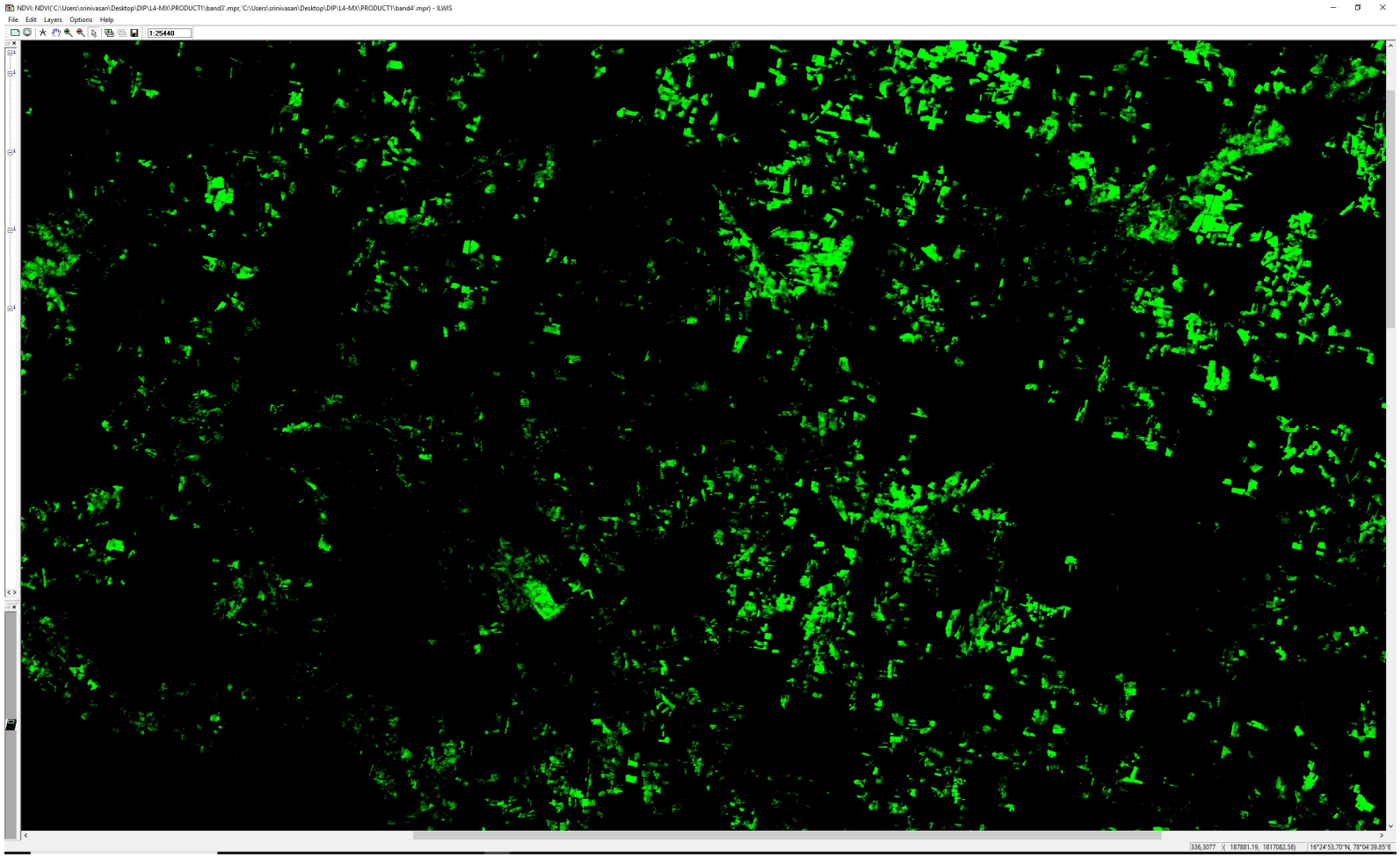
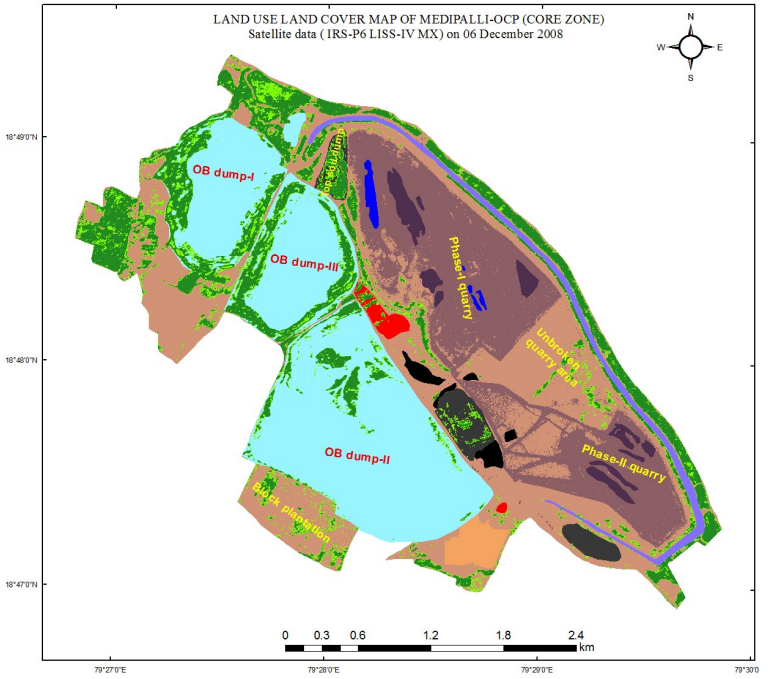


NDVI= (IR-R) / (IR+R); NDVI>0



4.Image Classification and Analysis

Digital image classification uses the spectral information represented by the digital numbers in one or more spectral bands, and attempts to classify each individual pixel based on this spectral information. This type of classification is termed **spectral pattern recognition**.



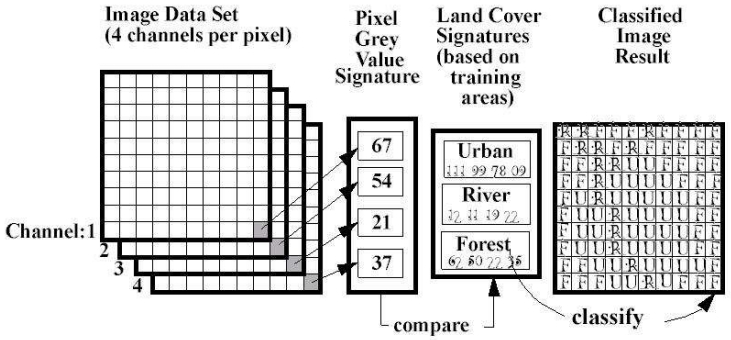
classification

supervised classification

In a **supervised classification**, the analyst identifies in the imagery homogeneous samples of the different surface cover types (information classes) of interest. These samples are referred to as **training areas**. The selection of appropriate training areas is based on the analyst's familiarity with the geographical area and their knowledge of the actual surface cover types present in the image. Analyst is "supervising" the categorization of a set of specific classes.

unsupervised classification

Unsupervised classification techniques do not require the user to specify any information about the features contained in the images.



Thank you...

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