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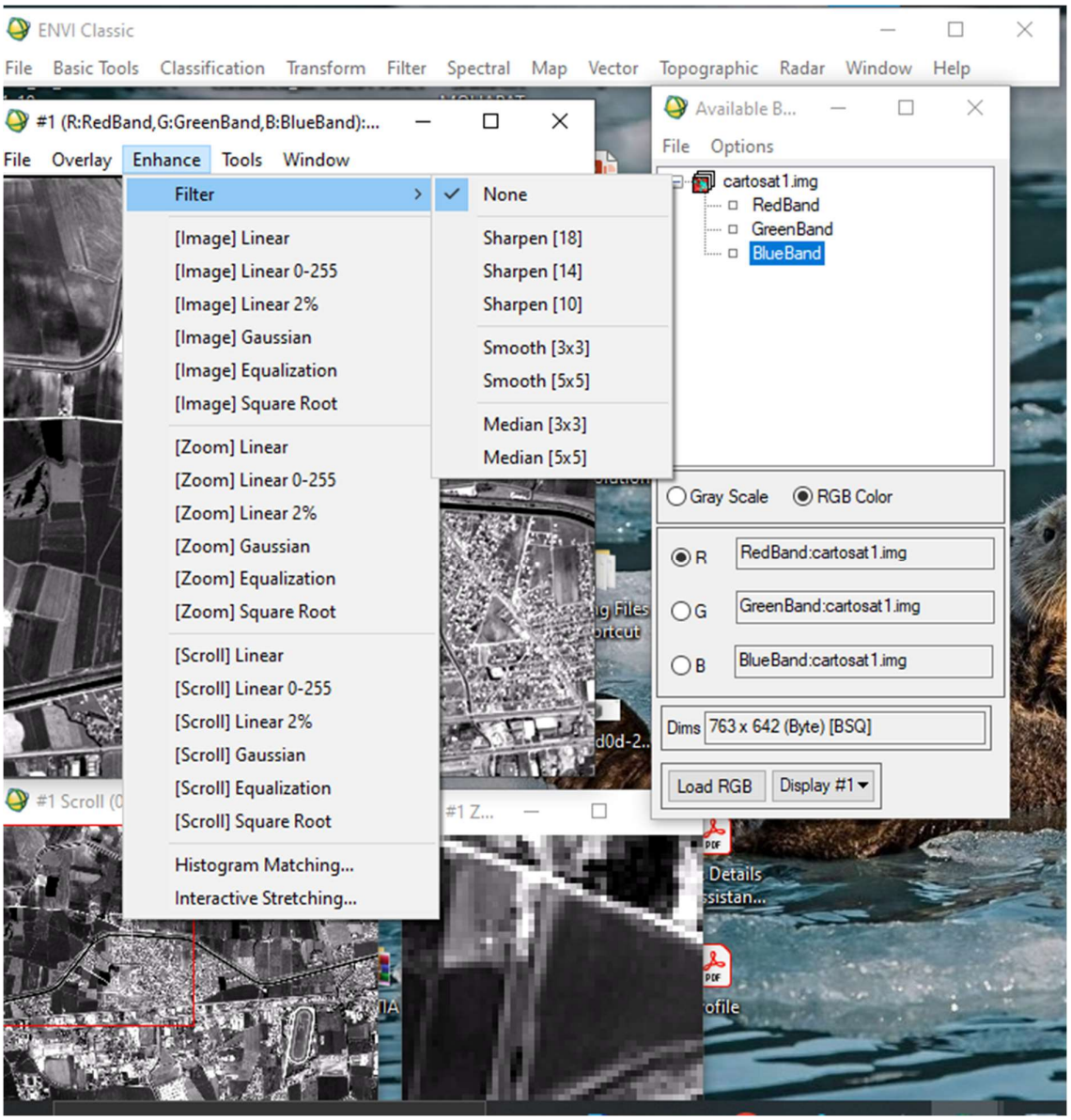
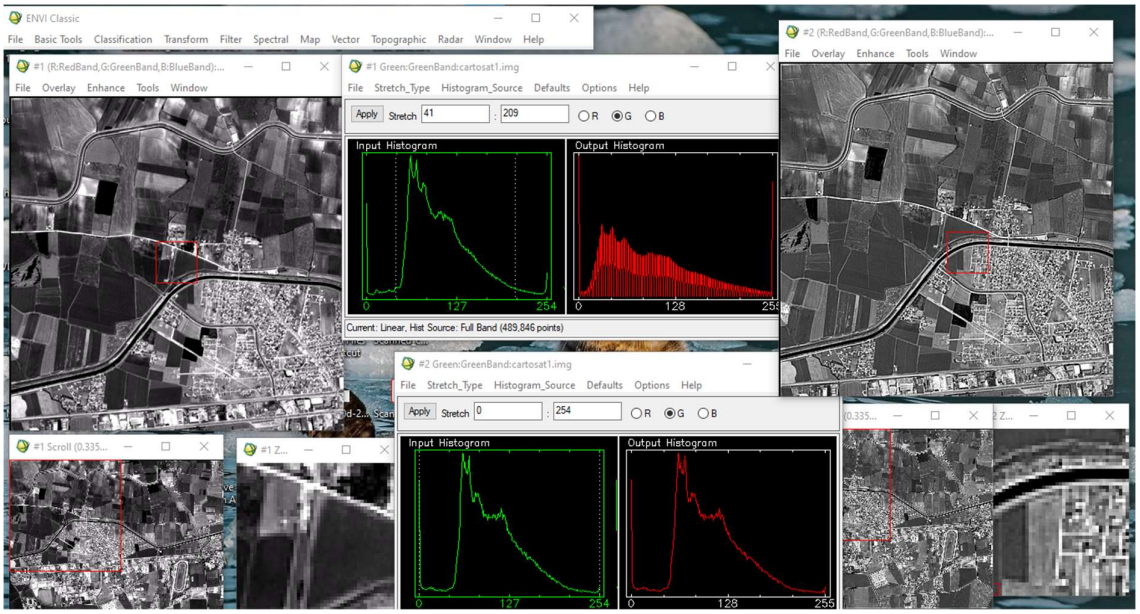
LAB 5 ASSIGNMENT

CE 593 ADVANCED REMOTE SENSING

FILTERS



[Image] Linear Filter



First image- Focuses more on mid-tone details, making features moderately clearer but maintaining some restraint.

Stretch 41-209: Medium contrast stretch, showing mid-tone details.

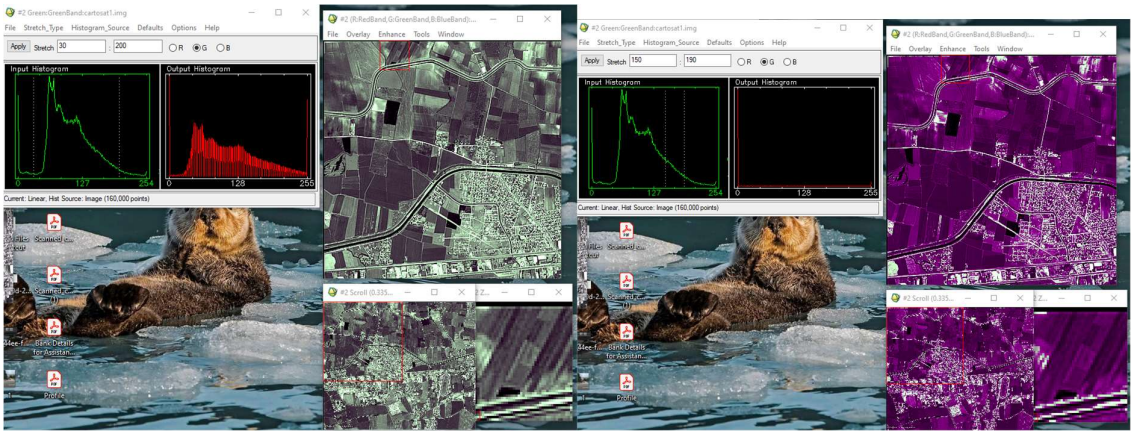
Before Stretch (Input Histogram): Image before stretching was low in contrast.

After Stretch (Output Histogram): pixel values are spread over the full range from 0 to 254.

Second image - Full stretch drastically increases contrast, revealing all features distinctly, including darker areas.

Image shows sharper differentiation between fields, roads, and urban areas.

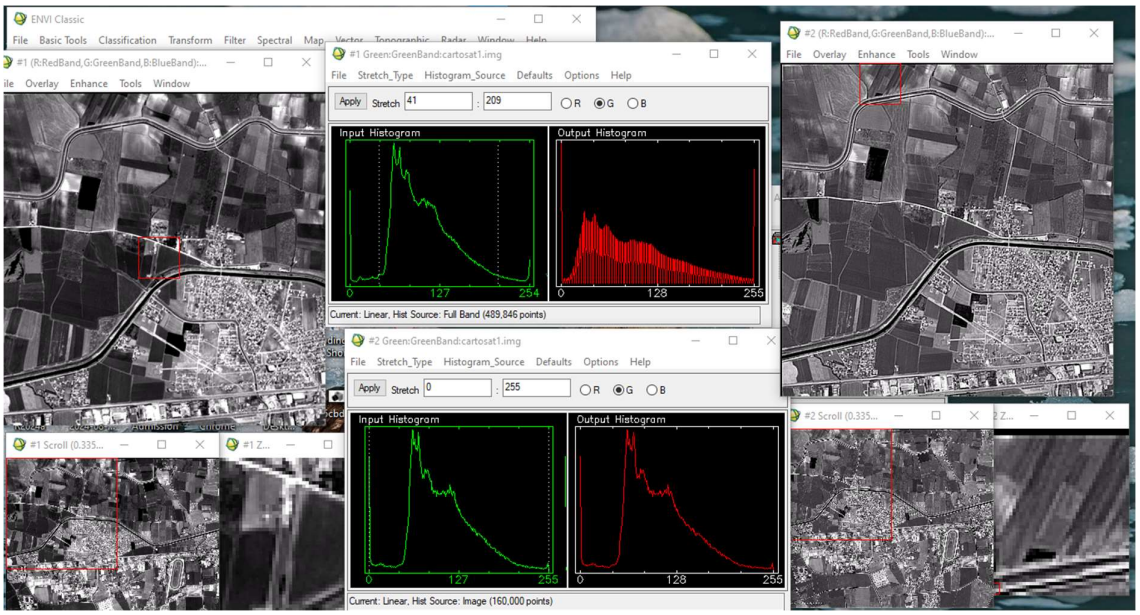
Stretch 0-254: Full stretch, pixel values across the entire intensity range for maximum contrast enhancement.



In the image, increasing the stretch value (ex.-2-253) expands the range of pixel intensities displayed, improving contrast by making features more distinguishable.

Decreasing the stretch value (ex.-150-190) narrows the intensity range, reducing contrast and making the image appear less defined.

[Image] Linear [0-255] Filter



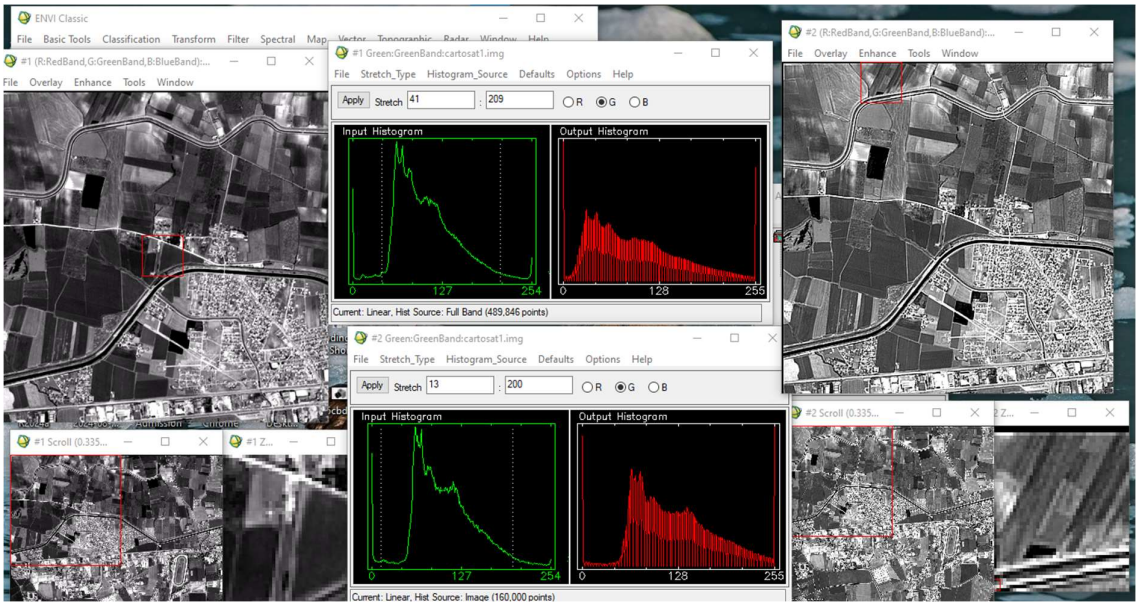
First image

Stretch 41-209: Medium contrast stretch, showing mid-tone details.

Second image -

Stretch 0-255: Full stretch, pixel values across the entire intensity range for maximum contrast enhancement.

[Image] Linear [0-255] Filter

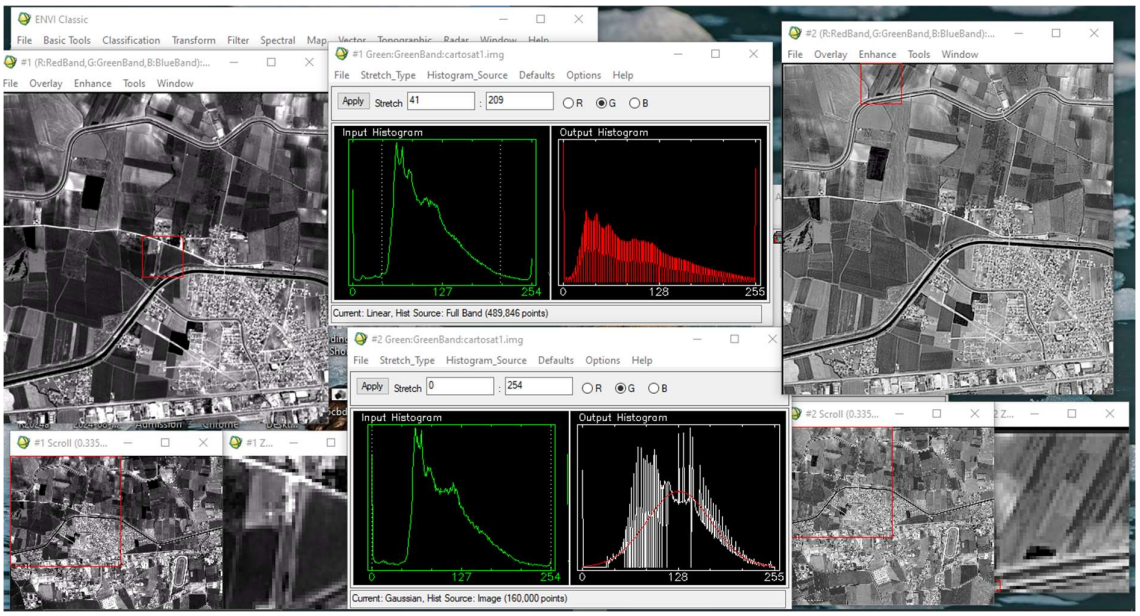


First image : Stretch 41-209

Second image -

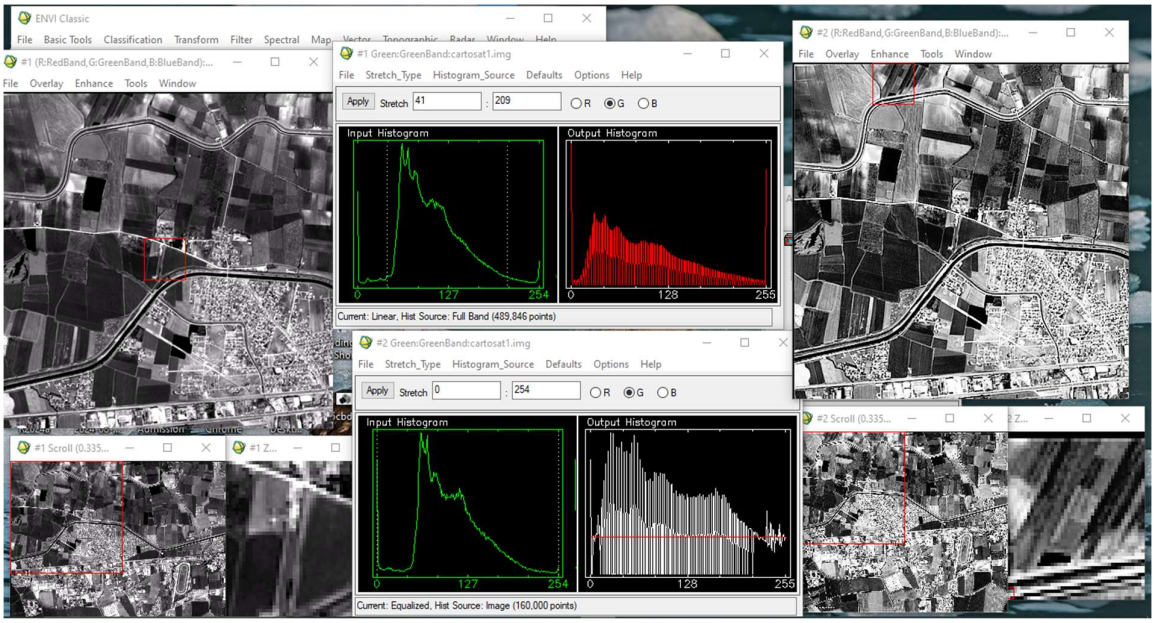
Stretch 13-200: image appears less contrasted, with little distinct differences between bright and dark areas

[Image] GAUSSIAN Filter



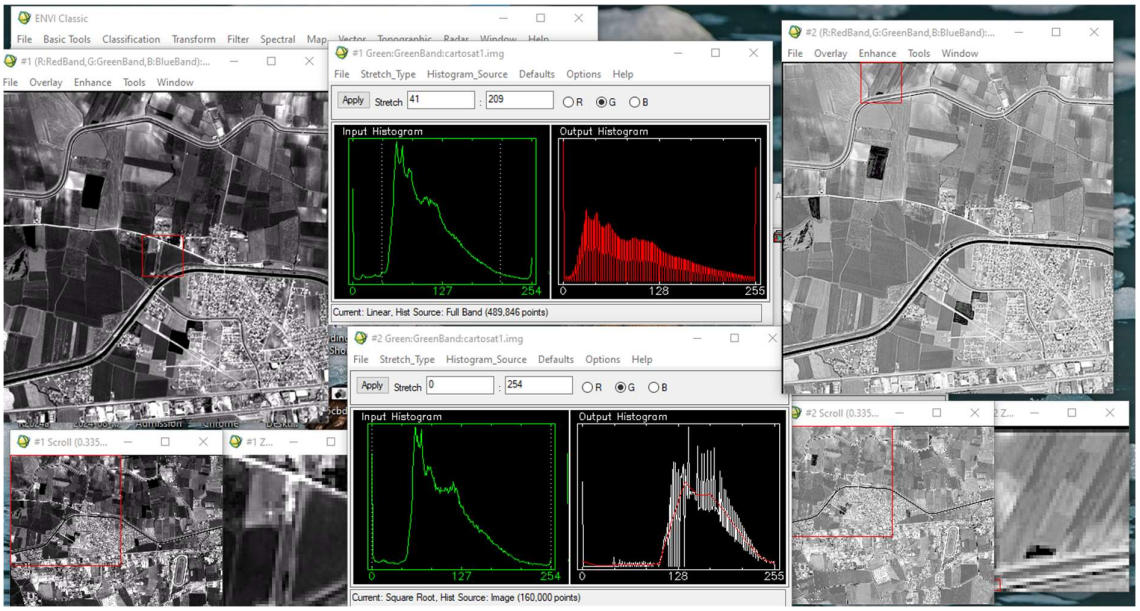
- The pixel values near the mean (middle) spread more uniformly across the range, values at the extremes very dark or very bright may not change as much.
- This is useful for understanding features in the middle range of pixel values, easier to identify subtle features, enhancing overall contrast.

[Image] Equalization Filter



- Histogram shows the distribution of pixel values in an **equalization** process. Histogram equalization adjusts the image contrast by redistributing the pixel intensity values more evenly across the range (0-255).
- The peaks in the histogram are spread across the range, indicates that the image's contrast has been enhanced, by brightening the darker regions.
- This enhancement makes more subtle details visible in both bright and dark areas of the image.

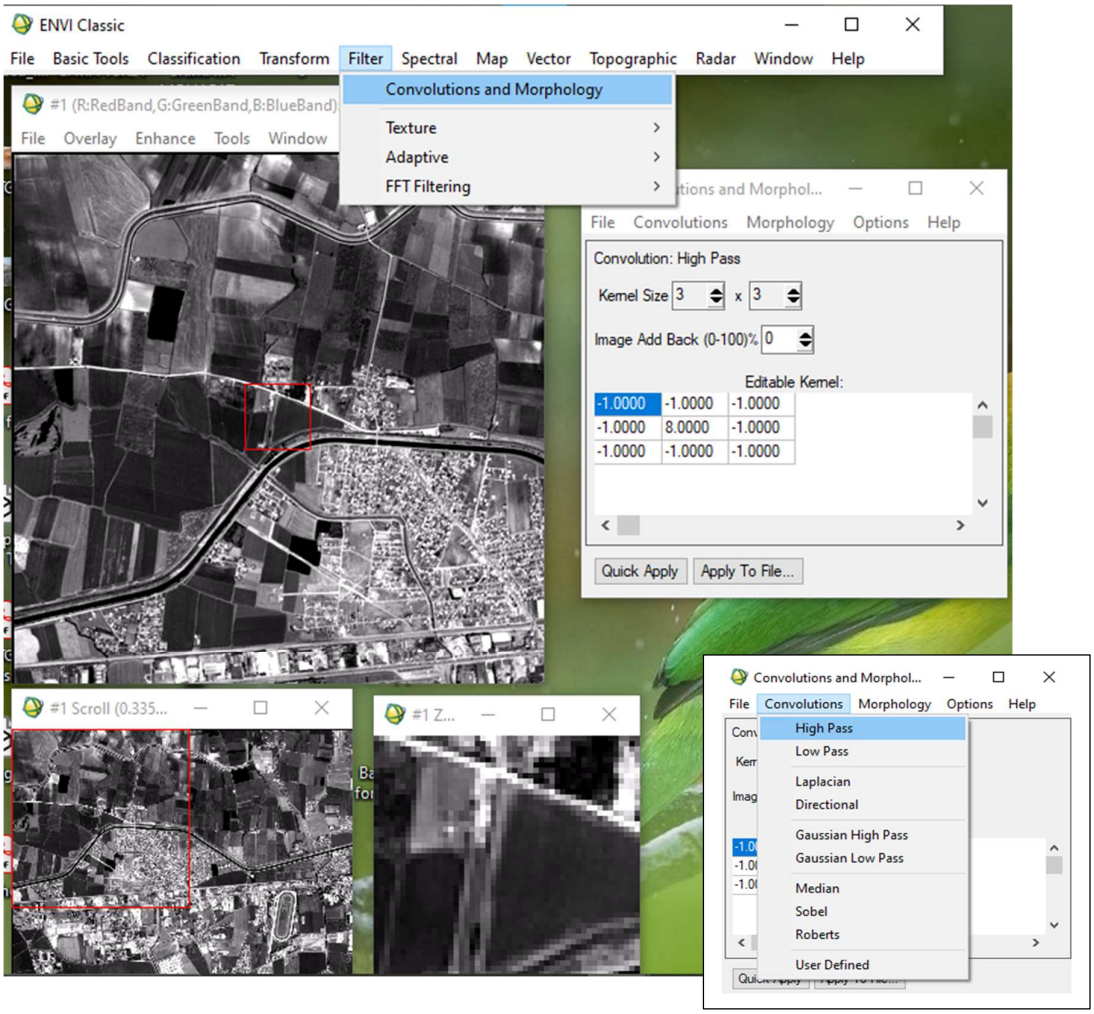
[Image] Square Root Filter



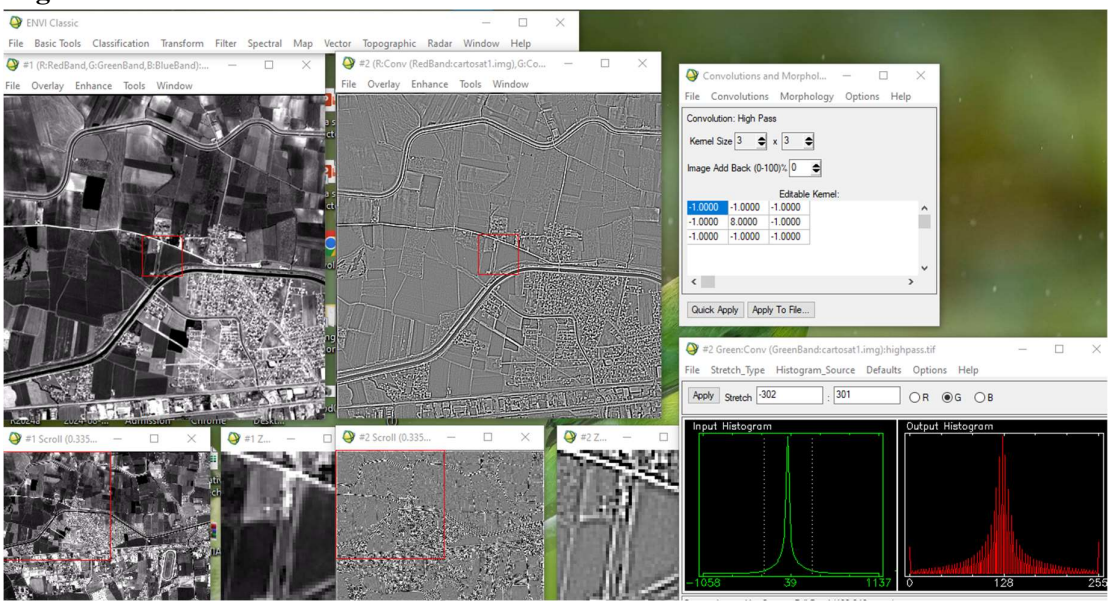
- Enhancement mainly contrasts along edges or boundaries in the image, resulting in a sharpened or clearer representation of features like roads, buildings, or field boundaries.

- The **red curve** highlights changes made by the filter or enhancement method, a high-pass filter or edge enhancement, has been applied.
- Pixel intensities more uniformly across the range.

Convolutions and Morphology



High Pass



A typical high-pass kernel emphasizes differences between the neighbouring pixel intensities.

-1 -1 -1

-1 8 -1

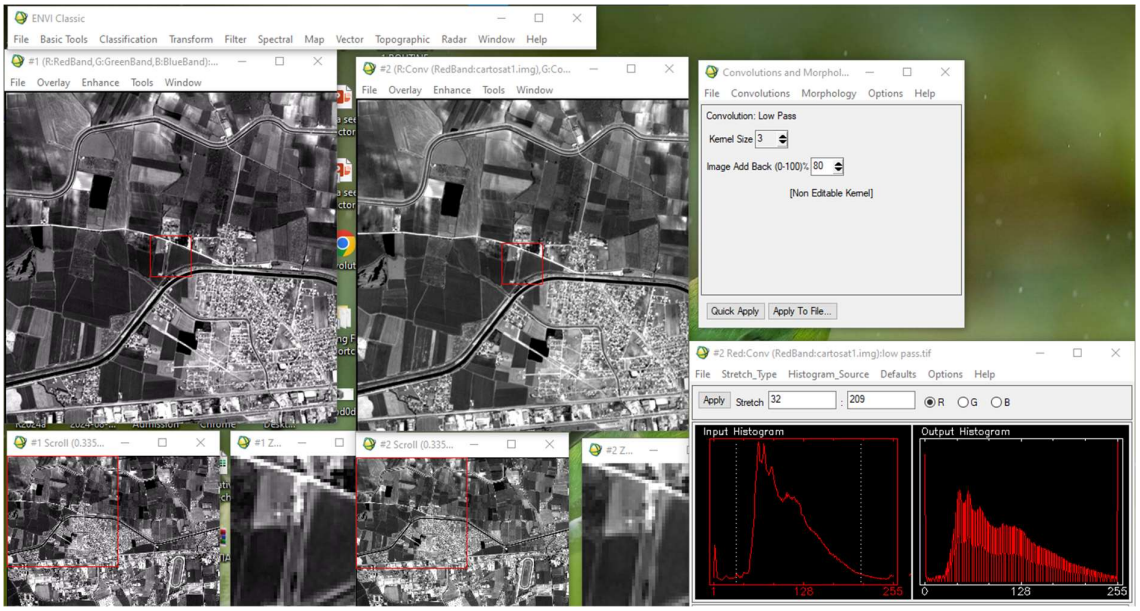
-1 -1 -1

The sum of the kernel values is usually zero or a small value, sharp changes (edges) are highlighted.

The centre pixel has a positive weight (8 in this case), meaning it retains its intensity.

The surrounding pixels have negative weights (-1), which subtract their values from the centre pixel, amplifying changes in intensity between the centre pixel and its neighbours.

Low Pass



A **low-pass filter** for blurring or smoothing operation.

The idea is to average pixel values with their neighbours, reducing the changes in intensity.

The kernel values in a low-pass filter are positive, and the sum of the kernel values equals 1, the overall brightness of the image remains the same.

Laplacian

Laplacian kernel is mainly used for **edge detection**.

The Laplacian highlights regions where the intensity changes rapidly, corresponds to the edges in the image.

0 -1 0

-1 4 -1

0 -1 0

Mainly computes the difference between the centre pixel and its four direct neighbours (top, bottom, left, right).

The center pixel's value is multiplied by 4, and its neighbours' values are subtracted.

The Laplacian filter also enhances noise, which consists of small, random changes in pixel intensity.

Directional

A directional filter in image processing is a filter that is specifically designed to respond to edges, gradients, or features in a particular direction.

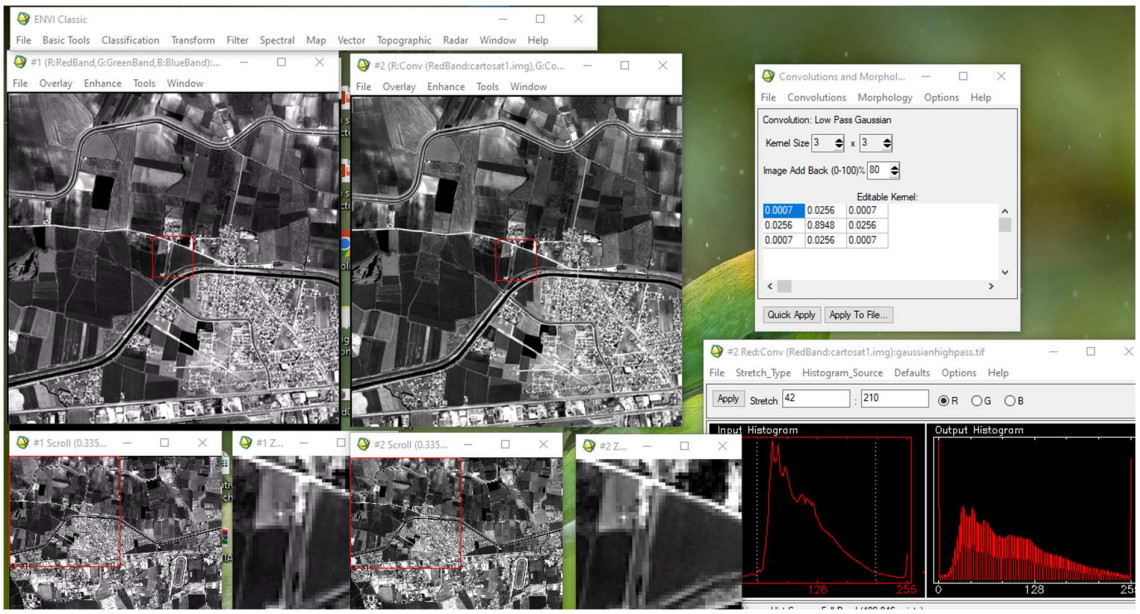
Gaussian High Pass

A Gaussian High-Pass Filter is a type of filter used in image processing to enhance high-frequency components in an image.

High-frequency components typically correspond to rapid changes in intensity, such as edges, fine details, and textures.

Gaussian high-pass filter will enhance the regions, making edges sharper

Gaussian Low Pass

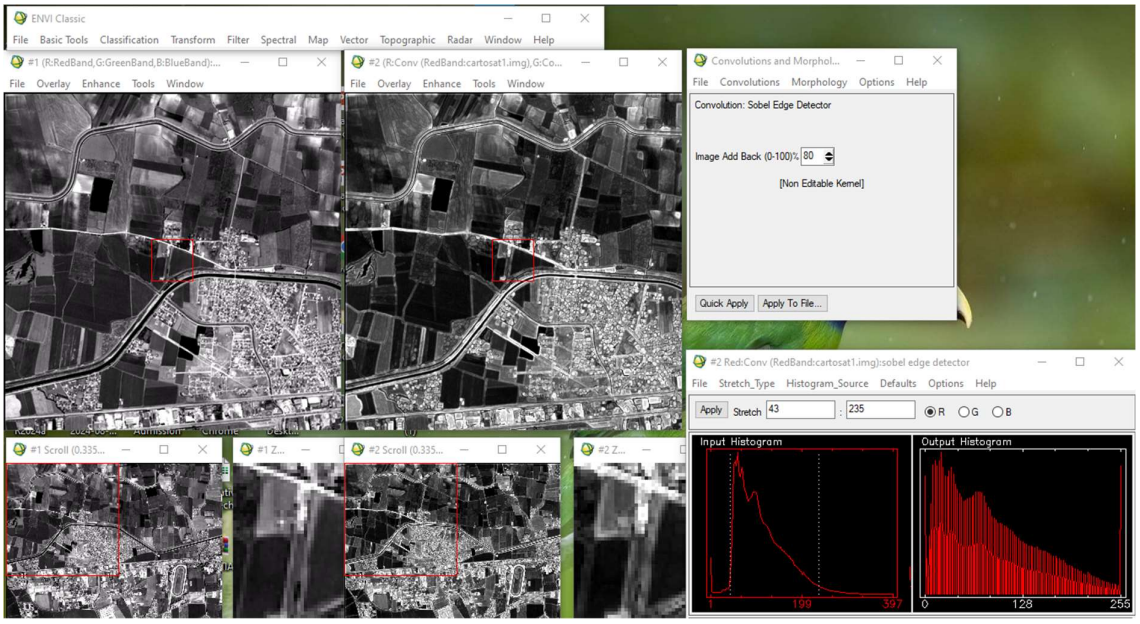


A **Gaussian Low-Pass Filter** is a smoothing filter used in image processing to reduce noise and blur an image. It suppresses high-frequency components ,such as edges, sharp details, and noise while retaining low-frequency components ,such as smooth transitions and gradual changes in intensity

Median

A **median filter** is a non-linear digital filtering technique commonly used in image processing to reduce noise while preserving the edges of an image.

Sobel Edge Filter



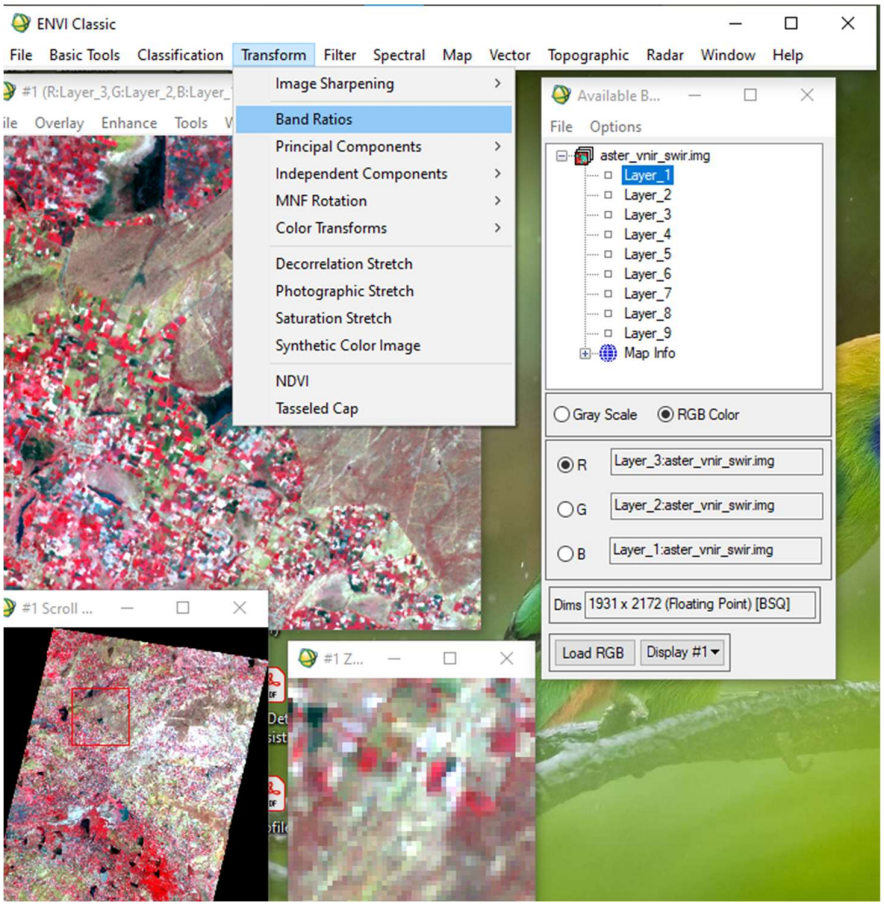
The Sobel edge filter is a popular image processing technique used to detect edges in images.

Apply the horizontal and vertical kernels to the image using convolution.

Robert Edge Detector

It is particularly used for detecting edges at diagonal orientations.

Band Ratio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File Basic Tools Classification Transform Filter Spectral Map Vector Topographic Radar Window Help
Image Sharpening
Band Ratios
Principal Components
Independent Components
MNF Rotation
Color Transforms
Decorrelation Stretch
Photographic Stretch
Saturation Stretch
Synthetic Color Image
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Layer_2:aster_vnir_swir.img
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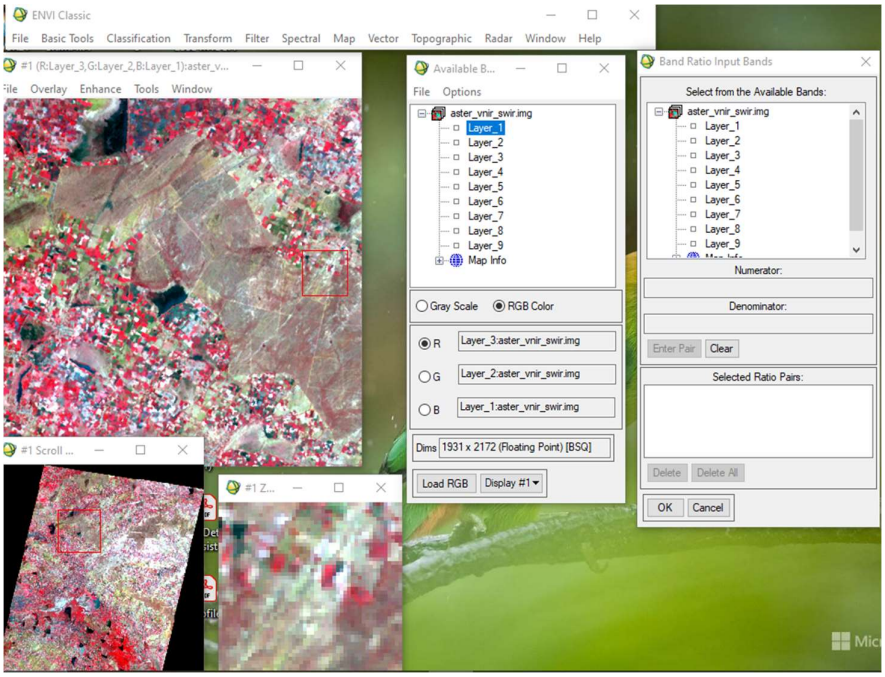
ENVI Classic
File Basic Tools Classification Transform Filter Spectral Map Vector Topographic Radar Window Help
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Layer_2:aster_vnir_swir.img
Layer_1:aster_vnir_swir.img
Dims 1931 x 2172 (Floating Point) [BSQ]
Load RGB
Display #1
Band Ratio Input Bands
Select from the Available Bands:
Numerator:
Denominator:
Enter Pair
Clear
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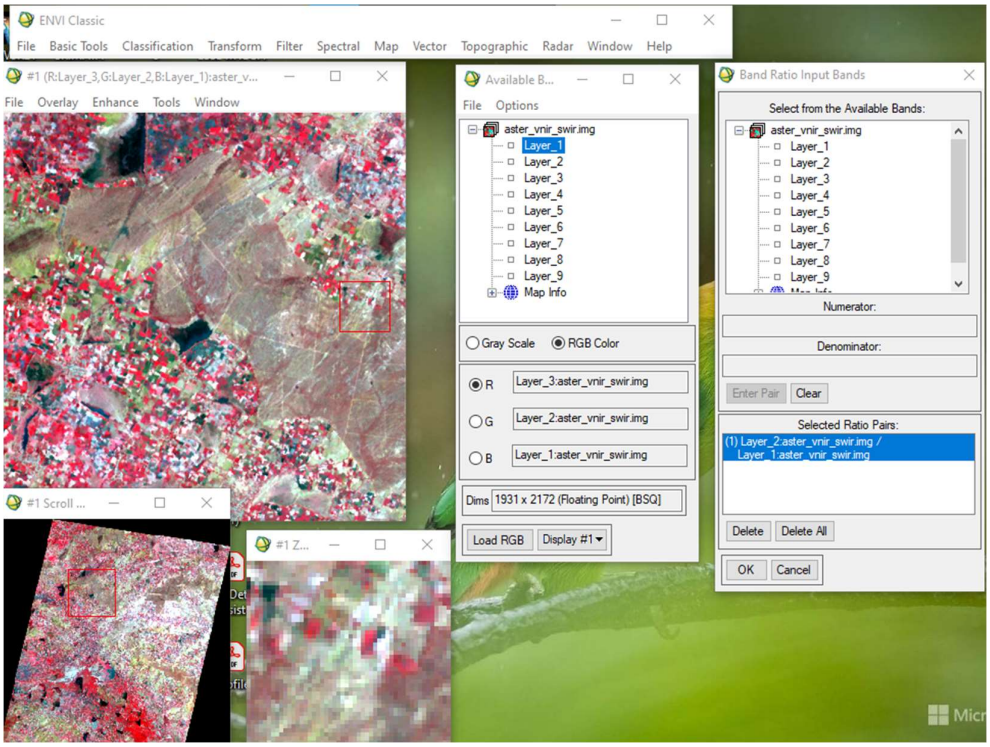
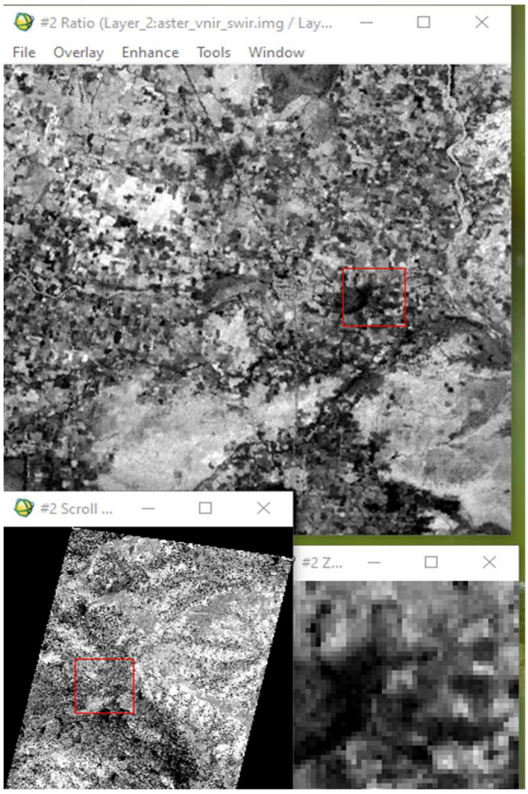
Delete
Delete All
OK
Cancel
#1 Scroll ...
#1 Z...

2/1 ratio





Band ratio of ferric iron

- **band ratio** is dividing the reflectance value of one band by another.
- For ferric iron, the **Red/NIR ratio** (Band 2 / Band 1) is commonly used.
- **Bright/White Areas:** High ferric iron concentration
- **Dark Areas:** Low ferric iron concentration

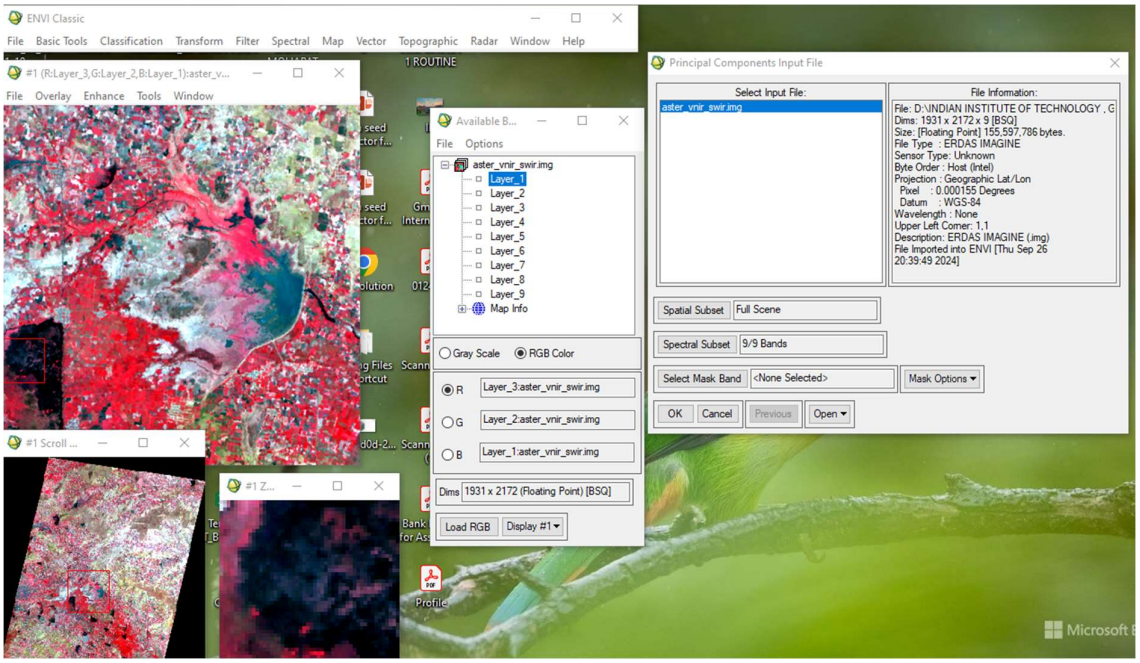
NDVI Ratio

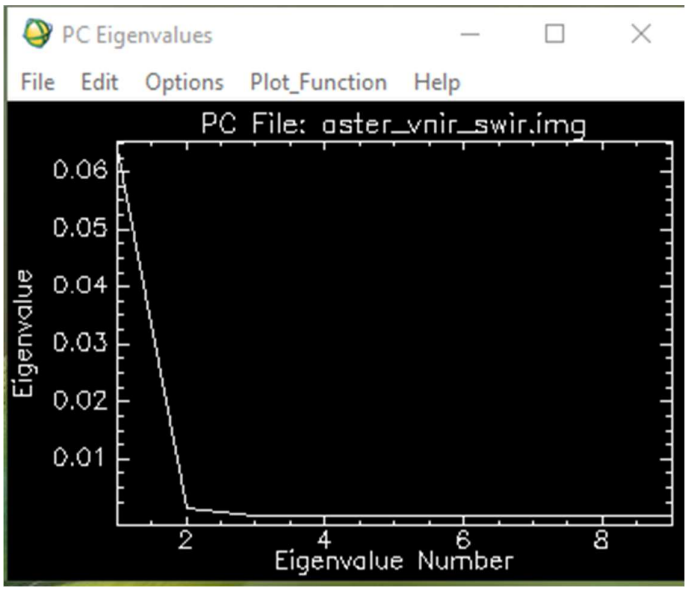
NDVI = (NIR – RED) / (NIR + RED)

The value of NDVI can indicate different things, including:

- Water bodies
- Barren rocks, sand, or snow
- Shrubs and grasslands or senescing crops
- Dense vegetation or tropical rainforest

Principal Component Analysis





Principal Components Analysis – Most of the information in the dataset represented by the first two principal components and the further components does not value very much for the analysis

Eigenvalue allow the selection of a few principal components for further processing, such as classification or image compression, discarding components that capture less useful information