REMOTE SENSING 2 HOMEWORK 1

PREPARED BY

NAME SURNAME : ONAT BİNGÖL

STUDENT NUMBER : 010180617

DUE DATE : 22/03/2023

COURSE NAME : REMOTE SENSING 2

LECTURER : PROF. DR. ESRA ERTEN

The purpose of this assignment is to make geometric and radiometric corrections on an uncorrected image using the methods taught, using the SNAP applications.

Data Set Attribute	***Attribute Value***	***Data Set Attribute***	***Attribute Value***
Satellite ID	Landast 5	Image acquisition date and time	2007/06/06
Sensor ID	TM	Image Path number	180
Image Scene ID	LT51800312005157MTI00	Image Row number	031
Image Product ID	LT05_L1TP_180031_20050606_20200902_02_T1	Image quality	9
Sun elevation	63.29149694	Sun azimuth	128.65785632
Land Cloud Cover	1.00	Scene Cloud Cover	1.00
Corner Upper Left Latitude	42.70394	Corner Upper Left Longitude	28.24930
Corner Upper Right Latitude	42.38177	Corner Upper Right Longitude	30.45888
Corner Lower Left Latitude	41.12716	Corner Lower Left Longitude	27.75566
Corner Lower Right Latitude	40.81262	Corner Lower Right Longitude	29.91411
Corner Upper Left Lat DMS	42°42'14.18"N	Corner Upper Left Long DMS	28°14'57.48"E
Corner Upper Right Lat DMS	42°22'54.37"N	Corner Upper Right Long DMS	30°27'31.97"E
Corner Lower Left Lat DMS	41°07'37.78"N	Corner Lower Left Long DMS	27°45'20.38"E
Corner Lower Right Lat DMS	40°48'45.43"N	Corner Lower Right Long DMS	29°54'50.80"E

Table 1 Metadata table from of image from Landsat 5 TM Level 1 satellite

Table 1 is containing the metadata of my workspace area image at "*https://earthexplorer.usgs.gov*".

Image 1 Image of Landsat 5 TM Level 1 satellite with 180 Path and 31 Raw numbers dated May 11, 2007.

Figure 1 is the preview image of my workspace on "https://earthexplorer.usgs.gov/".

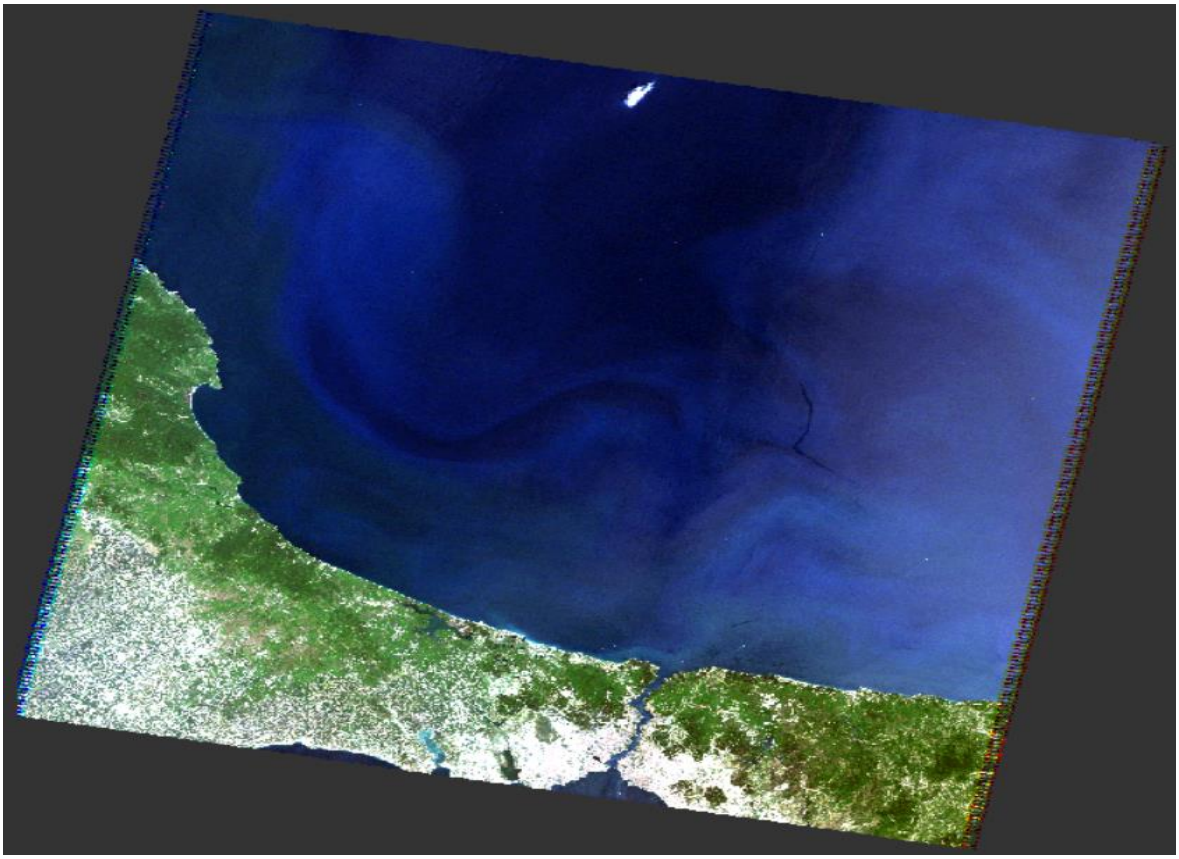


Image 2 Image that opened with SNAP program.

Red/Green/Blue BAND (true color) COMBINATIONS

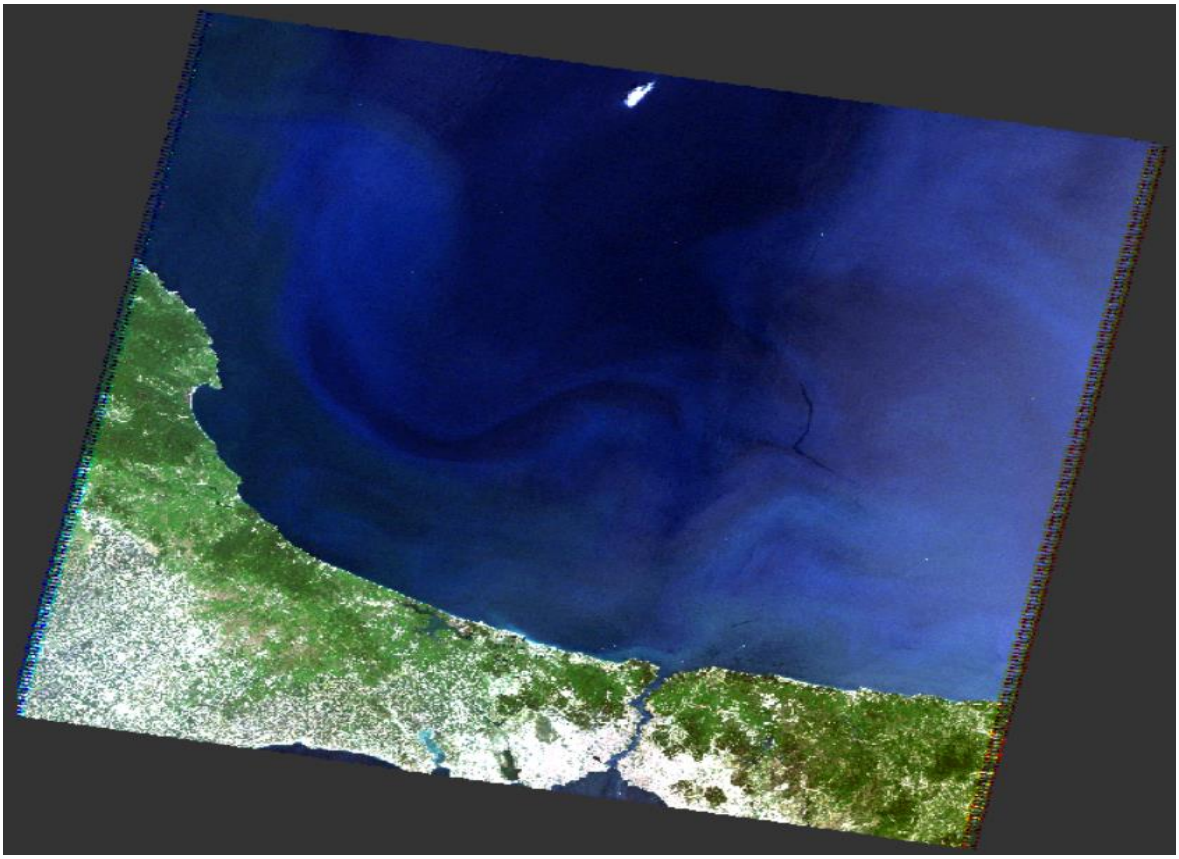


Image 3 Image that opened Red-Green-Blue Band Combinations

The band combination for "natural color". Because the visible bands are combined, ground features show in hues that correspond to how the human visual system perceives them. For example, healthy vegetation is green, recently cleared fields are extremely light, unhealthy vegetation is brown and yellow, roads are gray, and shorelines are white.

Visible Red, Visible Green and Visible Blue make up this combination. The color scheme shown here comes the closest to being an accurate representation of color in a Landsat 5 TM image. This band combination is known as "Natural Color". When the visible bands are employed in this combination, ground characteristics show in colors that are identical to how things seem to the human visual system. As can be observed in Picture 4, healthy vegetation is dark-green and green, while poor vegetation is brown. Urban areas are white and light yellow, while water areas are dark blue and the little body of water in the land area is light blue and cyan. Urban studies could make use of it. Moreover, this band configuration offers the greatest water penetration as well as the best sediment and

bathymetric data. This band set's drawback is that it typically results in a fuzzy image. Nonetheless, despite this haze, objects, such as automobiles, can be seen on the sea surface (as seen in zoomed images).

Image 4 Zoomed images

SWIR/NIR/RED COMBINATIONS

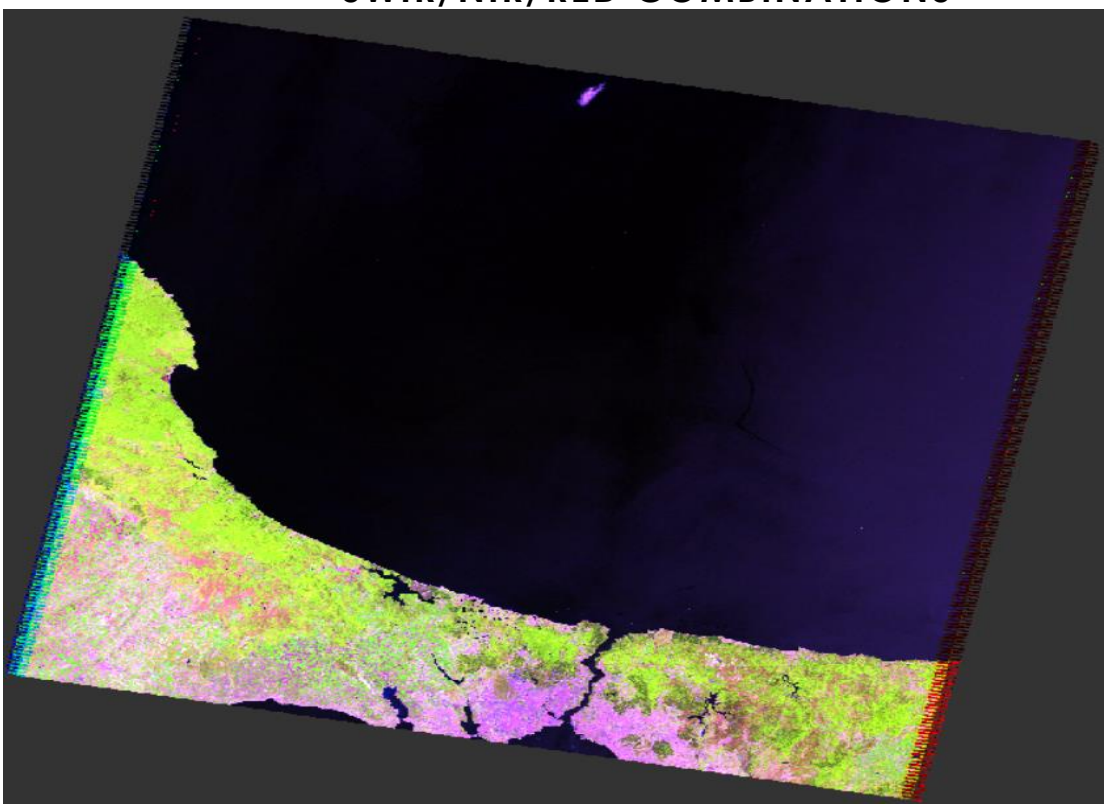


Image 5 Image that opened SWIR-NIR-RED Band Combinations

This combination provides the user with a great amount of information and color contrast. Healthy vegetation is bright green and soils are mauve. The 5 4 3 combination uses TM 5 which has the most agricultural information. This combination is useful for vegetation studies, and is widely used in the areas of timber management and pest infestation.

In this combination consist of SWIR1, NIR, and Visible Red. If Image 5 is examined; the settlements are white-pink in color, the vegetation is in combinations of green and neon green color, and all water bodies are dark blue. This combination provides the user with a large amount of information and color contrast for urban and vegetation body separation in land area. Looking at the zoomed images below, it can be observed that the cultivated agricultural lands are in green tones, while the uncultivated lands are in pink tones. Compared with the previous Natural Color combination, it can provide visible information, especially on the diversity of plant areas. Neon green and green areas indicate vegetation areas. With this combination, visual interpretation of natural disasters such as forest fires and floods can be made.

Image 6 Zoomed images

For Land/Sea Discrimination Combinations

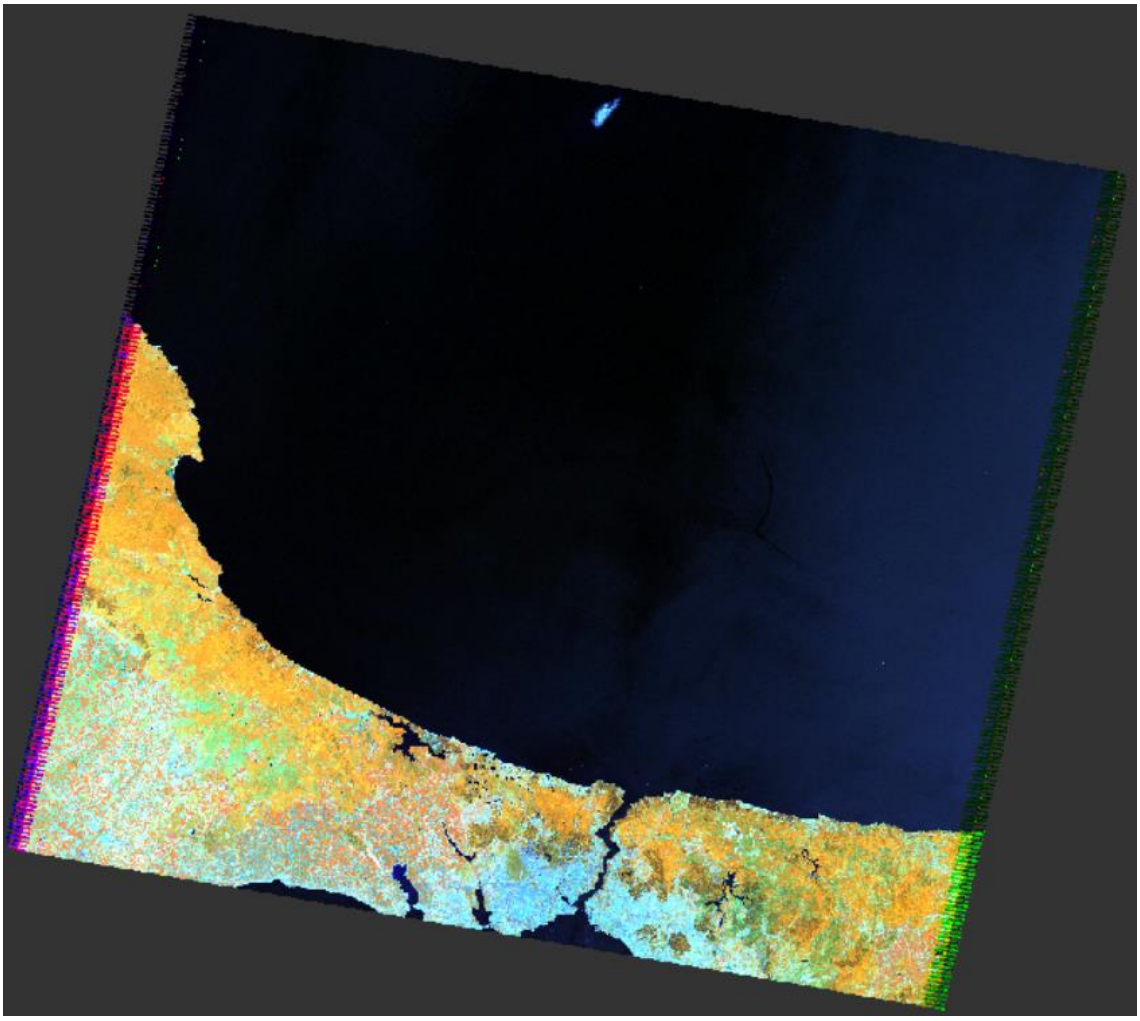


Image 7 Image of Landsat 5 TM Bands 4, 5, 3 Combinations

This combination of NIR , MIR and red offers added definition of land-water boundaries and highlights subtle details not readily apparent in the visible bands alone. Inland lakes and streams can be located with greater precision when more infrared bands are used. With this band combination, vegetation type and condition show as variations of hues (browns, greens and oranges), as well as in tone. The 4,5,3 combination demonstrates moisture differences and is useful for analysis of soil and vegetation conditions. Generally, the wetter the soil, the darker it appears, because of the infrared absorption capabilities of water.

The Image 7 that a combination of NIR , SWIR1, Visible Red that is known False Color. This image shown that the vegetation is orange-brown in color, the unhealthy

vegetation is green, the locations with water are black, and the city areas are lilac in color as seen in zoomed images below. This combination offers black-water boundaries and highlights fine details that are not easily visible only in the visible bands. Inland lakes and streams can be placed with greater precision when the more infrared band is used. Looking at Image 7, a clear picture stands out because the two shortest wavelength bands are not included. By using more infrared bands, inland lakes and streams can be distinguished more precisely. With this combination of bands, variation in vegetation types can be seen. The combination of RGB 4, 5, 3 shows differences in humidity and is useful for analyzing soil and vegetation conditions. Variations in moisture content are evident with this set of bands. Generally, the more soil is wetted, the darker it looks due to the water's ability to absorb infrared. It can be said that this band combination is the most common band combination for Landsat imagery.

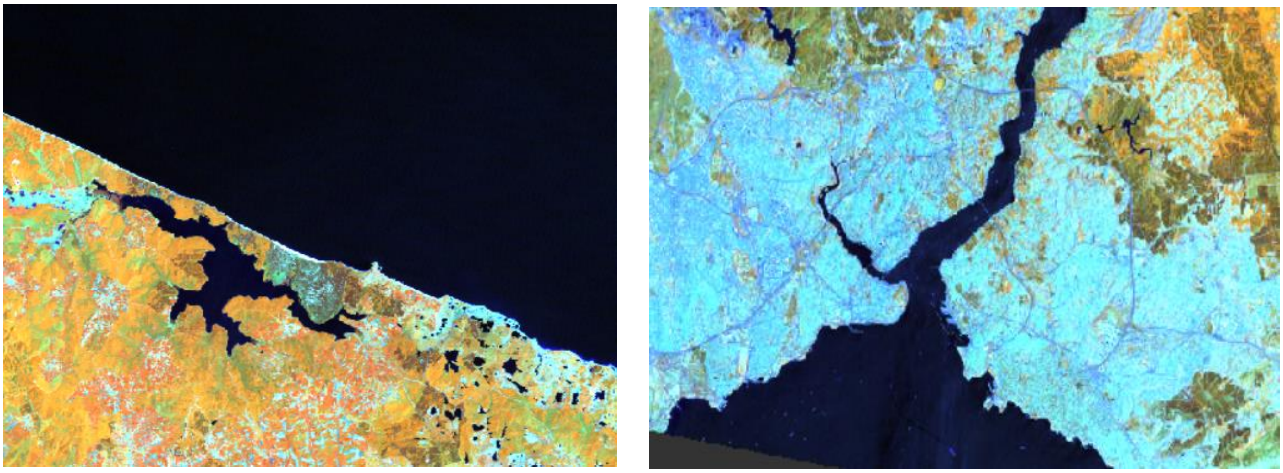


Image 8 Zoomed images

For Vegetation Discrimination Combinations

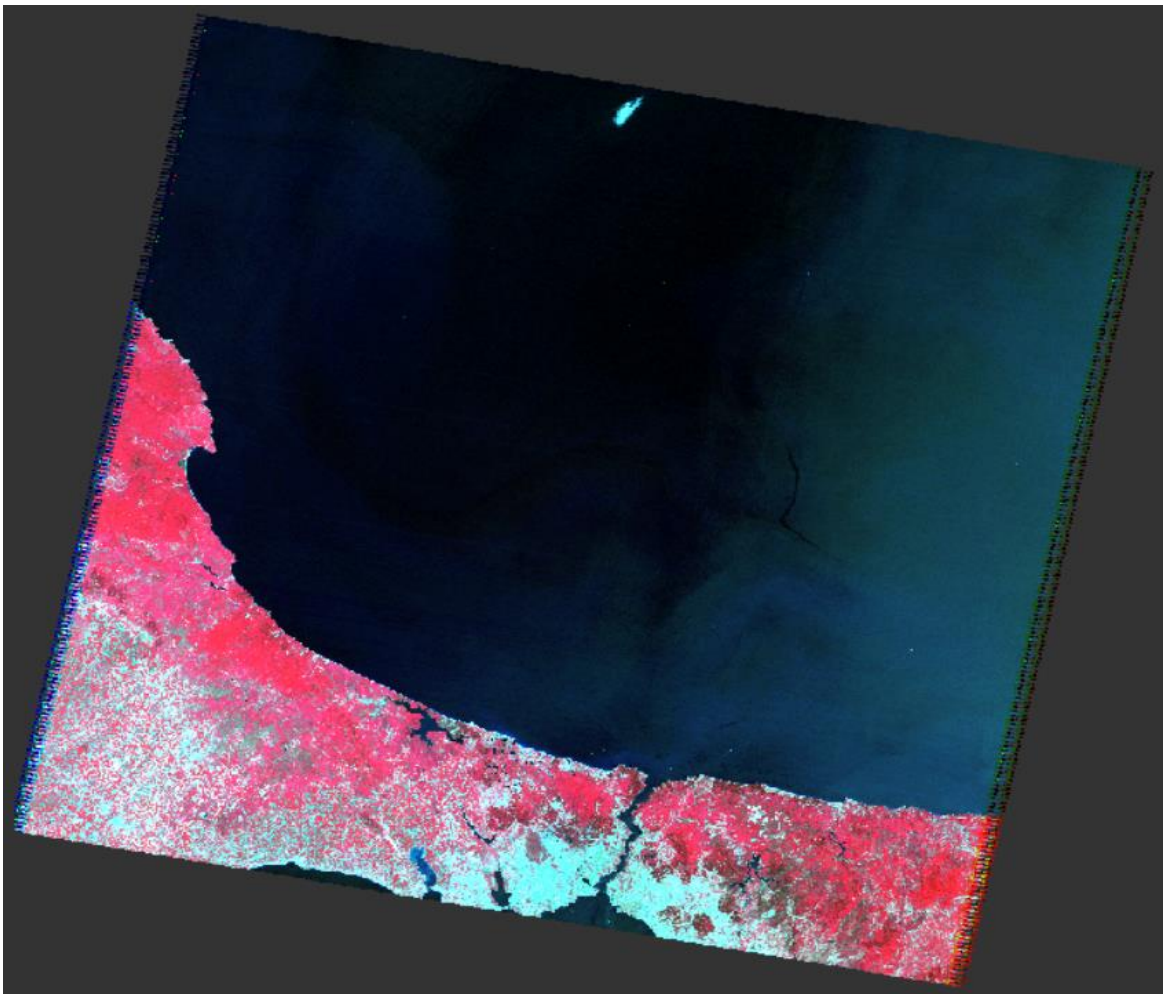


Image 9 Image of Landsat 5 TM Bands 4, 3, 2

The typical composite with "artificial colors". Shades of red dominate the vegetation, cyan blue dominates metropolitan areas, and soils range from dark to light brown. Clouds, ice, and snow are all white or light cyan. Red coloration on coniferous trees will be deeper than on hardwoods. This common band combination is helpful for crop growth stages, drainage and soil pattern monitoring, and vegetation studies. Lighter reds typically denote grasslands or poorly vegetated environments, while deep reds typically suggest broad leaf and/or richer flora. Urban regions that are densely populated are depicted in light blue. Results from this TM band combination are comparable to those from conventional color infrared aerial photography.

NIR, Visible Red and Visible Green make up this band combination. Figure 12 depicts the band combination in the subsetted area of the province of Istanbul. The sea is shown in dark blue tones, lakes are shown in lighter blue tones than the sea, urban areas are shown in gray-light cyan tones, vegetation is shown in red tones, and soils range from dark to light green . This common band combination can be used to monitor the development of crop agriculture or vegetation studies. As observed in zoomed pictures, dark reds typically denote dense, broadleaved vegetation, whereas pale reds denote grasslands or regions with little vegetation. Zoomed photos show heavily populated urban areas as light cyan.

Similar to the RGB 3, 2, 1 image, this combination also contains the NIR band, making it easier to distinguish between different types of vegetation and defining land-water boundaries. This is a frequent band combination, however Landsat MSS data did not include one. Together with these, it is the band combination in which the sea surface vehicles may be seen most clearly.

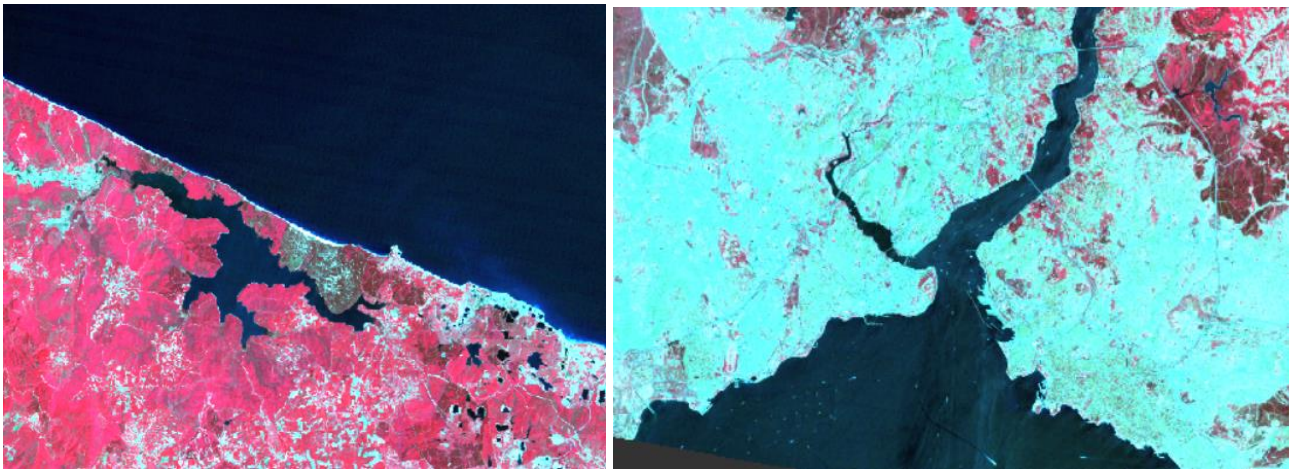


Image 10 Zoomed images

For Urban Discrimination Combinations

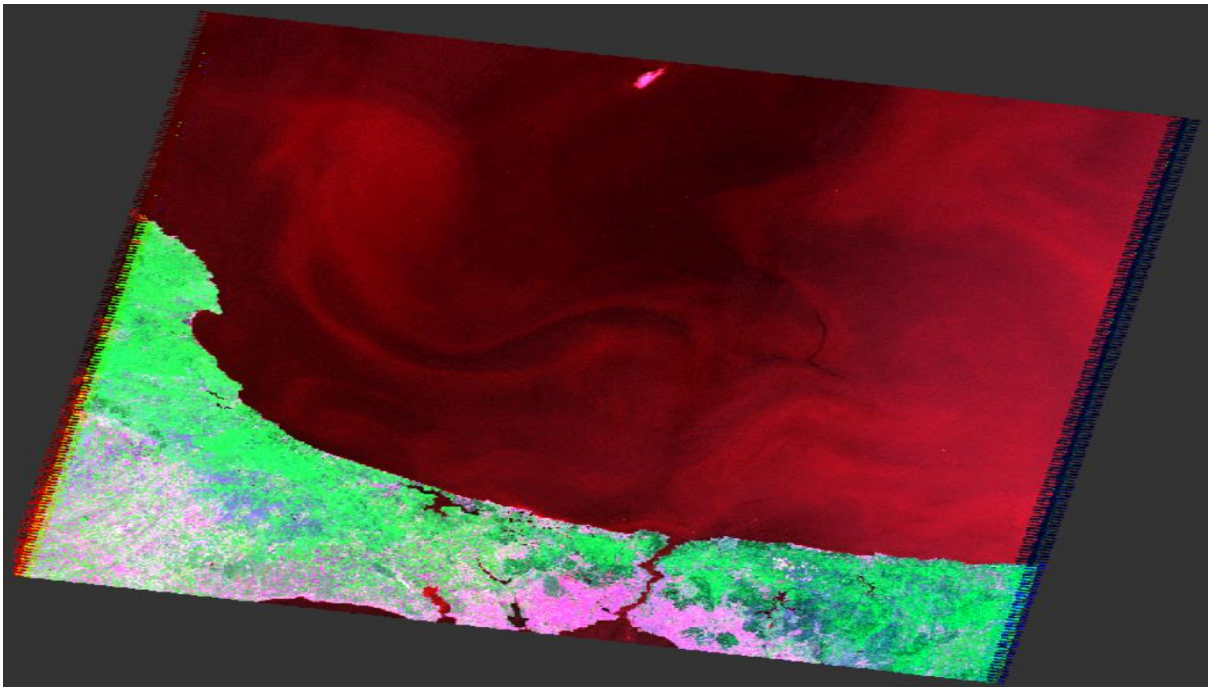


Image 11 Image of Landsat 5 TM Bands 1, 4, 7

The final band configuration is SWIR2, NIR, and Visible Blue (radiances 1, 4, and 7 respectively). It was shown in this combination as in Image 11. When these bands are combined, vegetation-covered areas seem dark and light green, water bodies appear red, and urban pink tones are seen . Zoomed photos revealed that productive lands were green, while unproductive ones were seen in lavender tones. Red does not reflect as well as urban individuality. In other words, NIR and SWIR2 bands exhibit strong reflections from asphalt and buildings. Water does not reflect much from the near infrared region at the same time. Buildings and asphalt could be distinguished more clearly due to the reduced reflection of water in metropolitan areas.

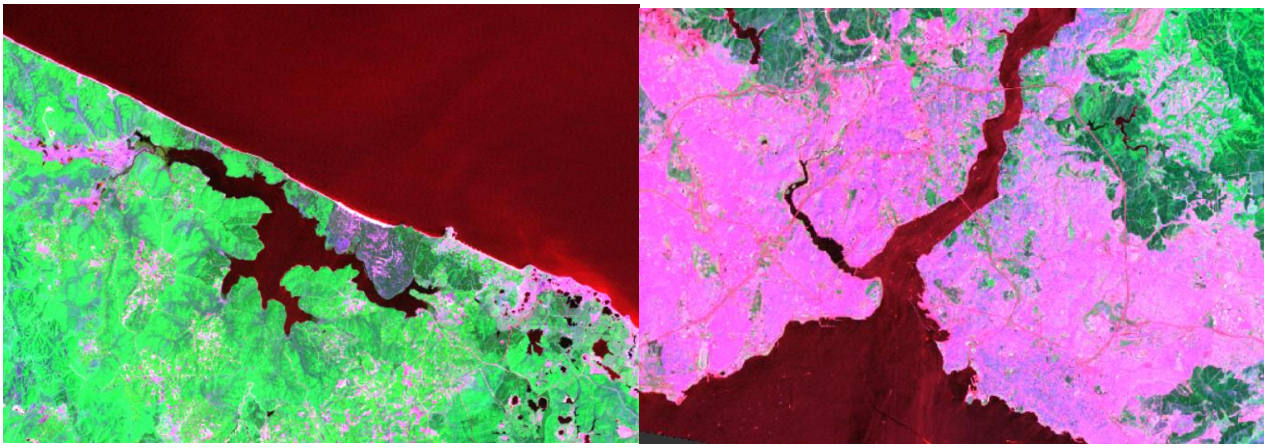


Image 12 Zoomed images

As a consequence, 1, 4, and 7 were deemed to be the best combinations for the visual study of the land cover. Nonetheless, based on the results of the investigation, this situation might be different. For instance, the vegetation distribution for 4,3,2 might be superior. However, due to the blurriness, RGB 4, 3, 2 states that this combination was not proven to be helpful in displaying the distribution close to the city area. The combination of 4,5,3 separates the city from the sea. Also, it was found that RGB 4, 3, 2 and RGB 4, 5, 3 both produced images that were sharper and more successful in separating water than RGB 4, 3, 2. Nonetheless, homes and plants make up the majority of the subgroup image. by observing. Nonetheless, homes and plants make up the majority of the subgroup image. While examining the 1, 4, 7 combination, it is evident that it is equally as distinct as the RGB 4, 5, 3. The fact that this combination both clearly displays the intricacies in the metropolitan area and presents the vegetation contrasts in shades of green is what makes it stand out. Moreover, it is possible to distinguish between land and sea just as effectively as the other combination

Figure 1

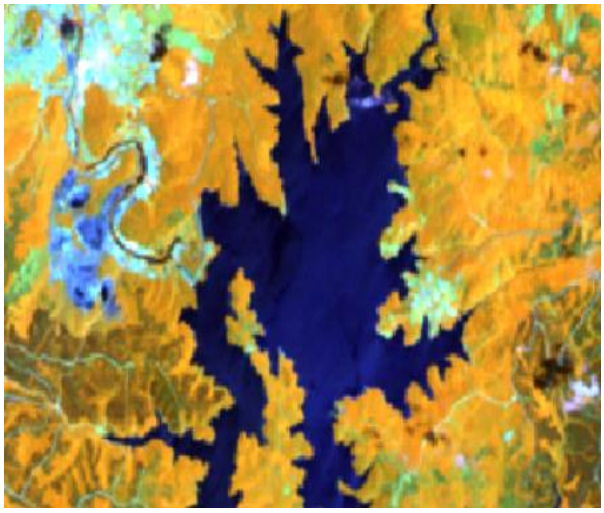


Figure 2

Figure 3

Figure 4

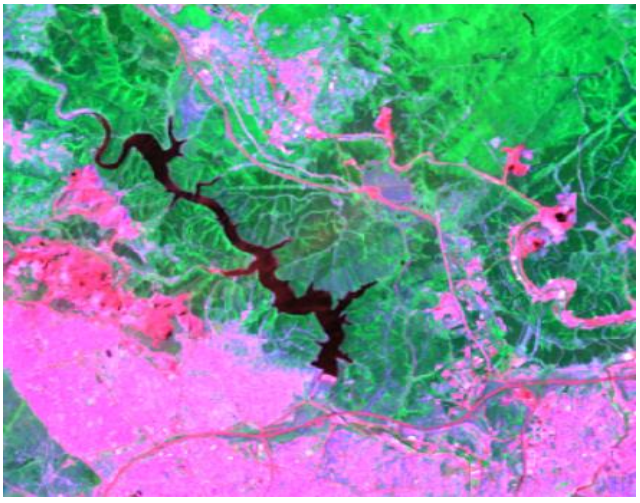


Figure 5

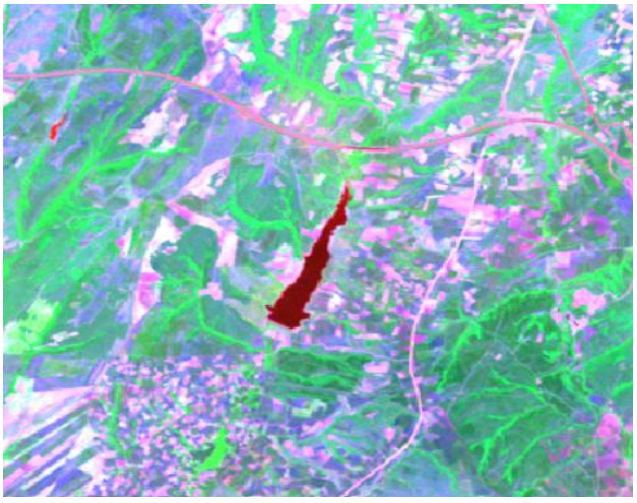
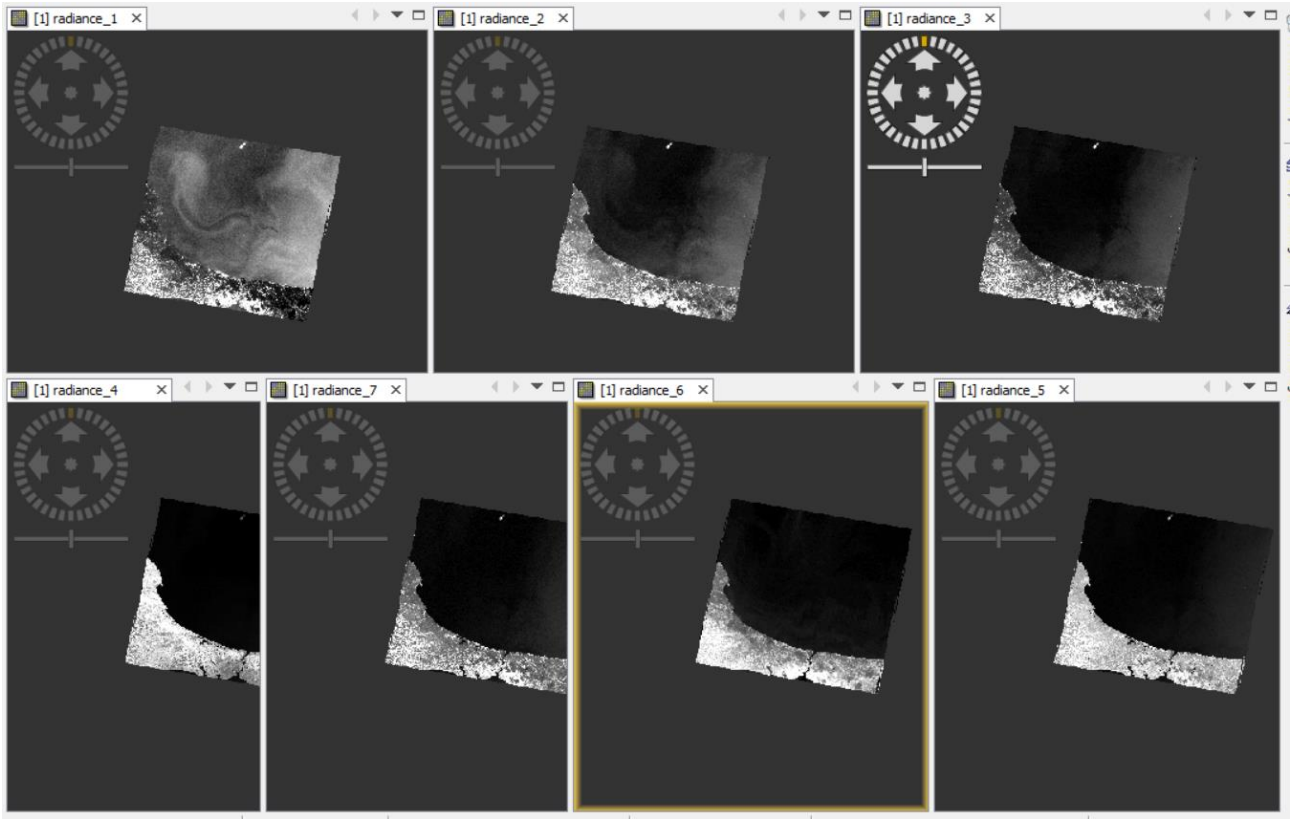
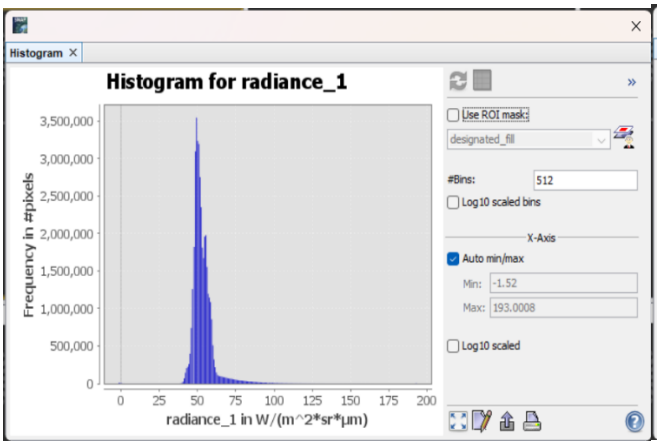
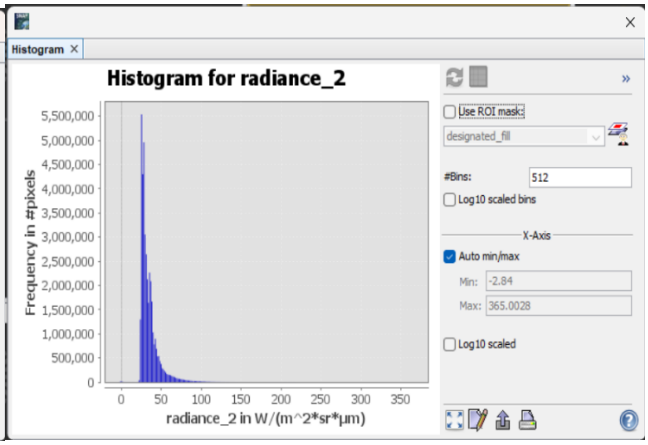


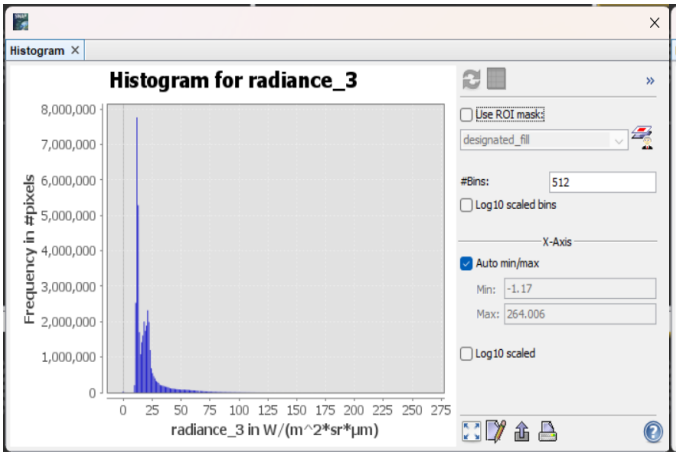
Figure 6

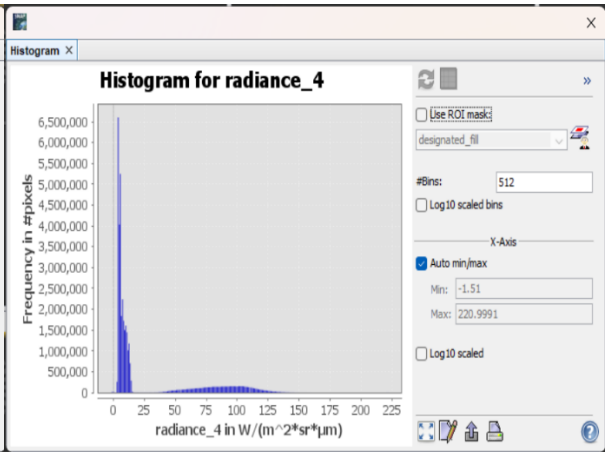
Bands Image / Image Histograms

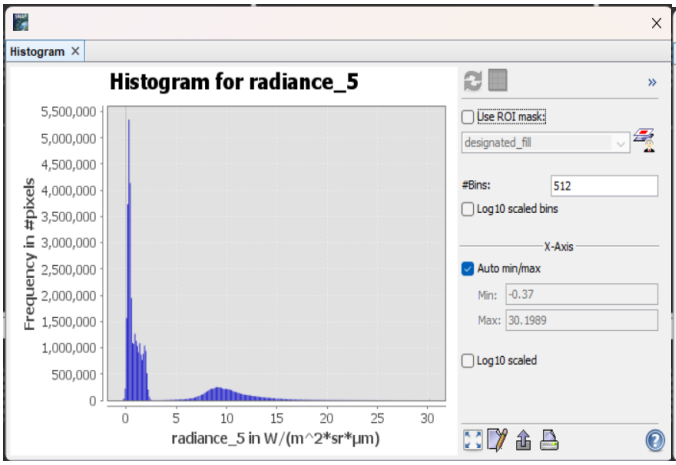


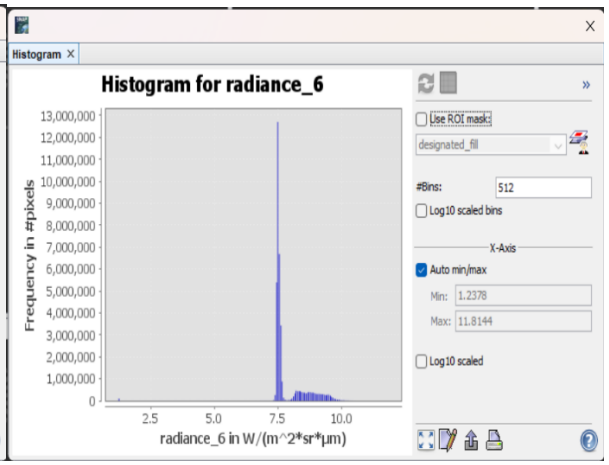


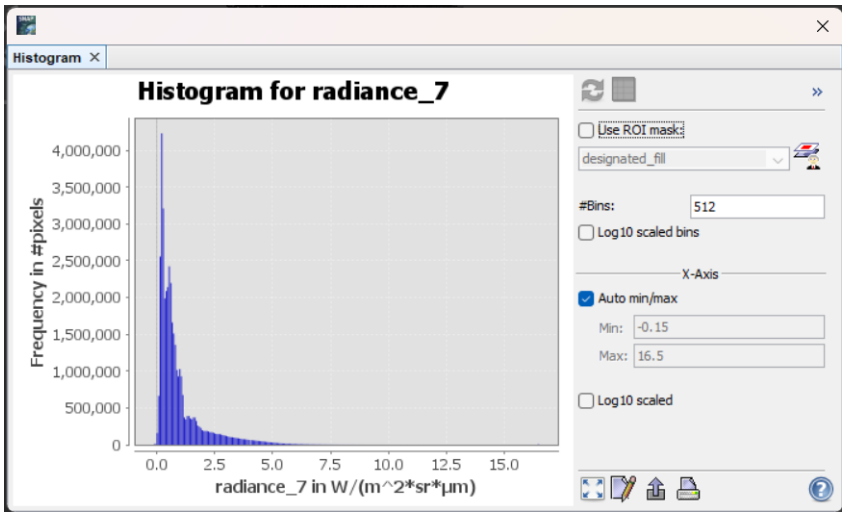












The histograms of the bands of the original image appear on the top and side.

Feature Space

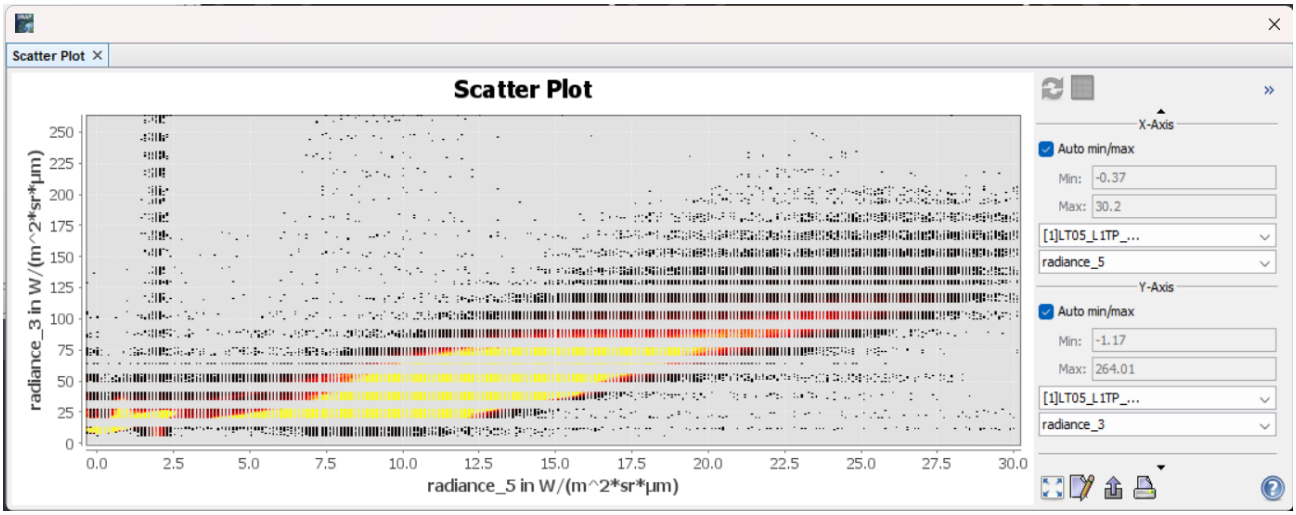


Image 13 NIR-RED bands

The red band was dispersed up to 250, whereas the NIR band was only visible up to 30, according to the scatter plot image made up of the combination of the NIR Band and Red Band above. It can be claimed that the near-infrared band and the red band have a beneficial association. The association with the near-infrared lessens due to this positive relationship between the two bands, and there is also a linear separability. So, it may be claimed that they are situated in nearby spectral band areas. Plotting the NIR reflection versus the Red reflection for the Landsat 5TM satellite picture results in a scatter diagram with a point line of pixels representing bare terrain and a point cluster of pixels entirely covered by plants.

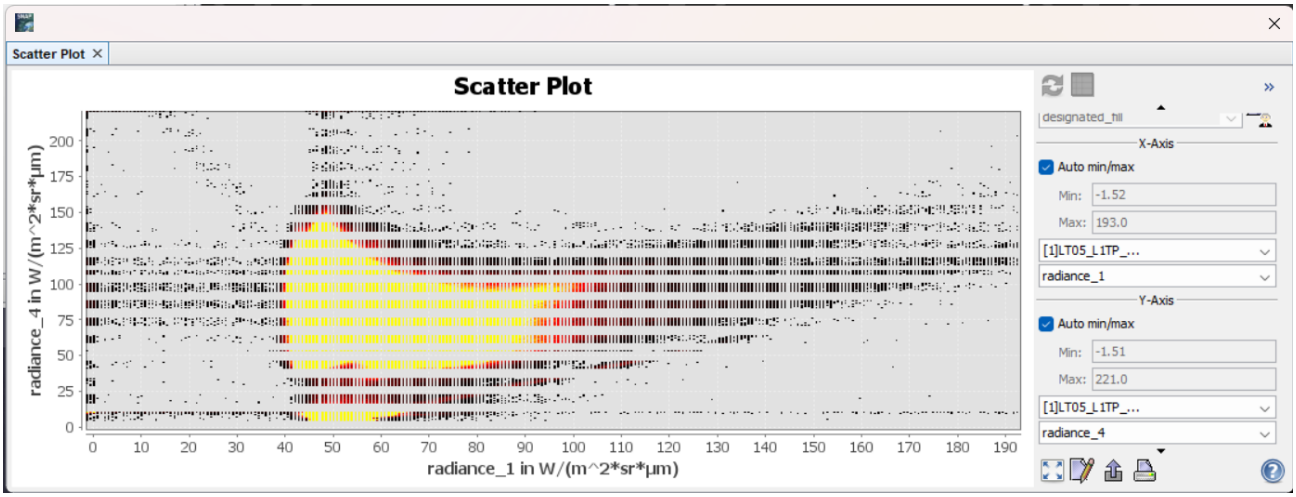


Image 14 Blue-SWIR bands

According to the scatter plot image consisting of the combination of SWIR Band and Blue Band above; while the Blue band was distributed up to 190, the NIR band was observed up to 200. There appears to be a positive correlation because small x values correspond to small y values and large x values correspond to large y values. However, it is a weak correlation because the data points are clustered far and scattered around this best-fit line. In addition, this mess is caused by the fact that a value has multiple equivalents. The Blue and SWIR bands may indicate the highest errors due to the higher influence of the atmosphere.

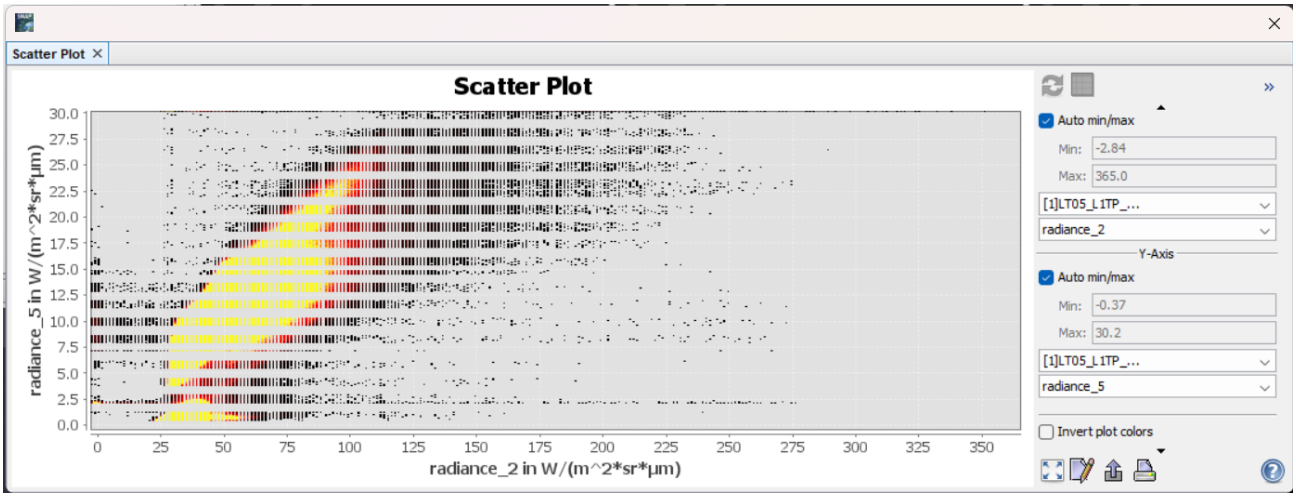


Image 15 GREEN-TIR bands

According to the scatter plot consisting of the above Green Band and TIR Band combination; The green band was distributed up to 350, while the TIR band was observed up to 11. Data points are strongly correlated because they cluster very closely around this

optimal line. Looking at the upper part of the graph, a negative correlation is seen after an approximate value. A value of 30 for the Green band corresponds to the TIR values. Therefore, there is a multimodal for this scatter plot created with Green and TIR band.

COMPARITON OF ORIGINAL AND SUBSET IMAGE STATISTICS

Considering the A region, any area with a dimension of 1000 × 1000 pixels from the complete dataset was a subset since the path is 180 row 31 as stated in the homework.

*Image 16 Natural Color Image of the Subsetted Area with 1000 * 1000 Pixels*

STATS / IMAGE BANDS	Min	Max	Mean	Median	Standard Deviation	Contrast Ratio	Coefficient Variation	Maximum Error
Band 1	-1.5199	193.0008	52.9809	51.3159	11.0635	-127.8145	0.3649	0.1945
Band 2	-2.8399	365.0028	39.7843	37.0335	10.9248	-128.5211	0.2407	0.7184
Band 3	-1.1700	264.0060	19.5894	30.3724	11.9452	-225.6410	1.0418	0.3678
Band 4	-1.5100	220.9991	27.5074	7.3644	34.4951	-146,6667	1.8945	0.2225
Band 5	-0.3700	30.1989	3.1562	0.7763	4.3709	-81.0810	2.1415	0.0305
Band 6	1.2378	11.7590	7.8218	7.5203	0.6214	7.4808	0.1762	0.0105
Band 7	-0.1500	16.5000	0.7468	.5409	1.0672	-110.0727	3.4499	0.0166

Table 2 Original image statistics

STATS / IMAGE BANDS	Min	Max	Mean	Median	Standard Deviation	Contrast Ratio	Coefficient Variation	Maximum Error
Band 1	40.6006	193.0008	49.2932	48.6779	16.5669	4.9217	0.2225	0.1524
Band 2	21.7794	237.5612	38.1149	38.3946	9.0152	16.8691	0.5736	0.2158
Band 3	8.2260	229.5540	20.9979	37.9664	9.0834	25.9060	1.3844	0.2213
Band 4	2.8701	175.4460	75.7598	95.3643	47.2412	140.2367	0.7532	0.1726
Band 5	-0.3700	30.1989	10.5598	7.3410	4.8673	-232.3053	0.8074	0.0306
Band 6	7.5506	10.2639	8.2363	9.1557	0.4484	1.4808	0.1096	0.0027
Band 7	-0.1500	13.4191	1.2679	1.3901	0.9655	-195.4814	1.4690	0.0139

Table 3 Subset image statistics

The tables above contain the statistical information for both the original image and the subset image.

The values in the 2 images are equal when looking at the Maximum column. This is due to the fact that the subset area still contains the original image pixel with the highest value. Yet it appears that the Minimum values differ. This is due to the fact that the original image's pixels with the lowest value are not located in the subset region. In the highest portions of the original image, the sea area is still prominent. But in the subgroup region, land predominates. As a result, the subset area's minimum values are higher. due to the low values of the pixels that correspond to the sea.

The contrast ratios in the original image are high due to the huge disparity between the minimum and maximum values of the pixels, however this ratio is reduced in the subset image.