INTRODUCTION TO REMOTE SENSING

Lab 4: Image transformation: generating indices in Google Earth Engine

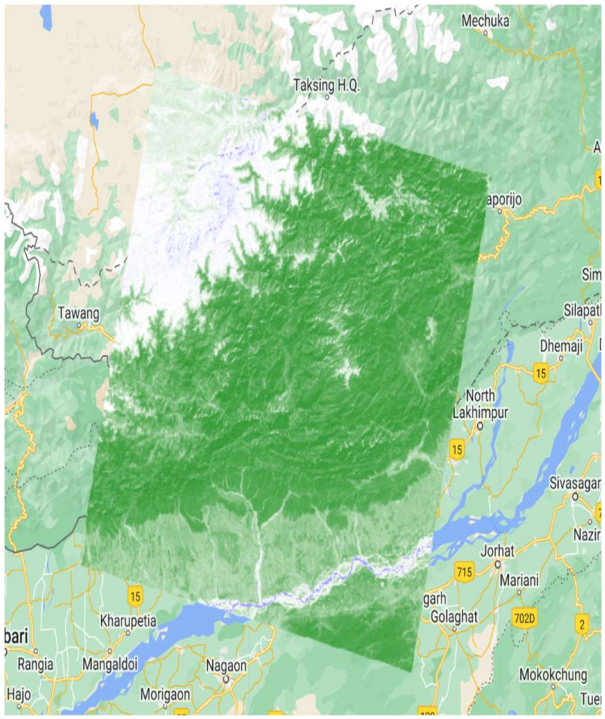
NAME: MST SANJIDA ALAM

a) Interpret the NDVI values observed in the satellite imagery.

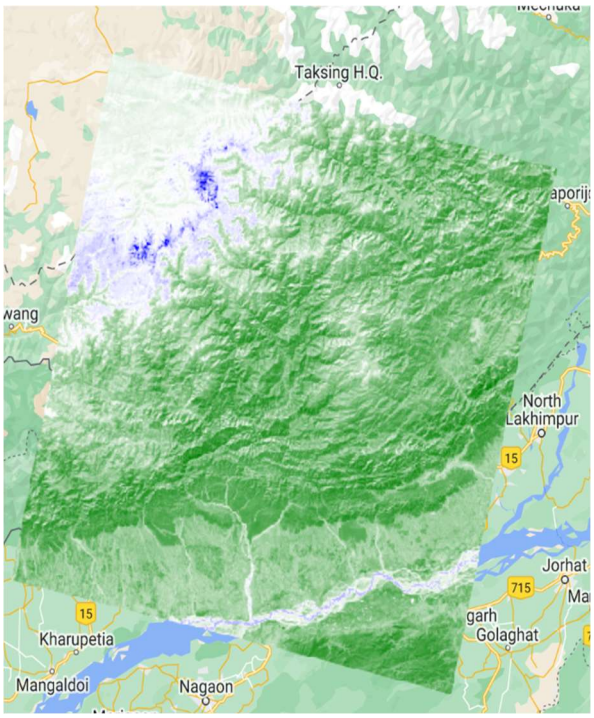
Ans:
NDVI stands for Normalized Difference Vegetation Index. It's a measure of the health and density of vegetation in an area. The values range from -1 to +1, where High positive values (closer to +1): Indicate dense, healthy vegetation. Values close to 0: Indicate bare ground, urban areas. Negative values: Usually indicate areas with water or snow or ice cover.

In the image, the areas with high NDVI values (green) represent dense vegetation, such as forests. The areas with lower NDVI values (Light Green) represent less dense vegetation and light-yellow/ brown areas represent bare ground, such as urban areas or agricultural fields and light blue color represents water bodies.
Negative values appear due to water presence, as well as for water bodies on land within the area of interest. The majority of the area has positive values referring to healthy vegetation distribution. There are some small patches of vegetation not so healthy distributed in the area's land territory as well. Low positive values appear in the bare ground, urban and agriculture area in this image.

b) Compare the NDVI and Enhanced Vegetation Index (EVI) results obtained in this lab. What similarities and differences do you observe between the results of these two vegetation indices? How can you explain these in terms of their sensitivity to vegetation characteristics?



NDVI Image

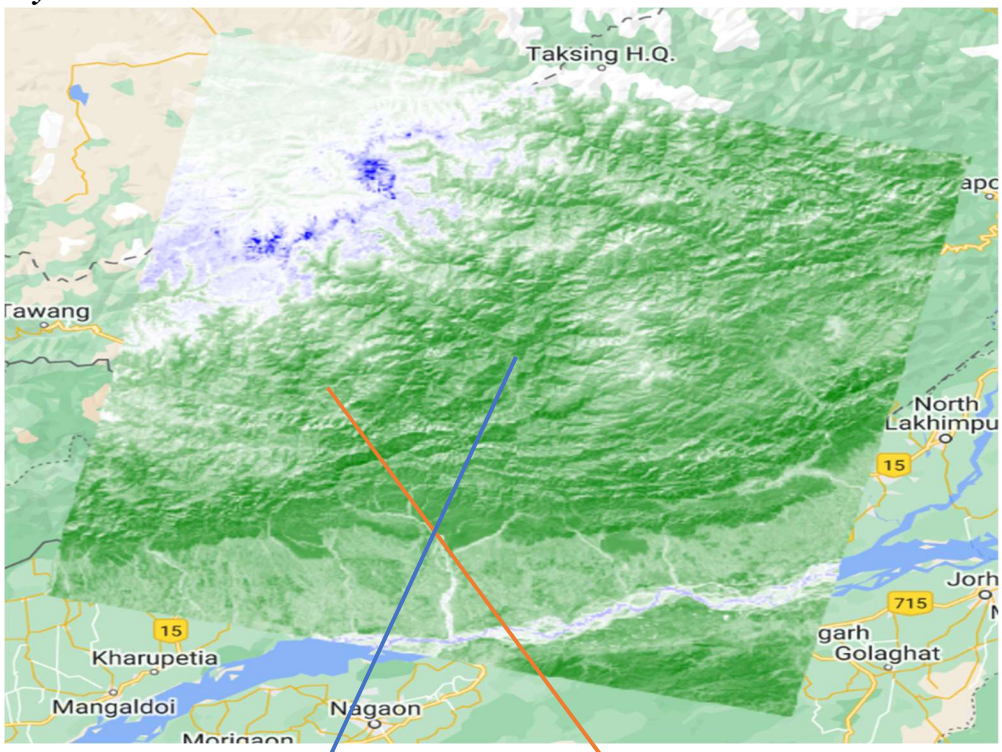


EVI Image

The Common similarities of NDVI and EVI, we observed that both are designed to assess the vegetation health and density and both of their value ranges from -1.0 to 1.0.
NDVI and EVI values are almost similar for this area; positive and close numbers on land and negative on water. EVI is designed to be less sensitive to saturation and is useful in areas with dense vegetation. It can differentiate between vegetation density in forests and agricultural areas where NDVI is seen to be saturated in those condition.

In terms of sensitivity to vegetation characteristics NDVI is more sensitive to the chlorophyll content whereas EVI is more sensitive to canopy structural variations such as leaf area index and canopy type. EVI also corrects for atmospheric conditions and canopy background noise. EVI is an improved version of NDVI that's more sensitive to dense vegetation and less affected by atmospheric interference.

c) ***Identify areas within the AOI that exhibit high and low vegetation density based on the NDVI and EVI maps. What factors might contribute to these variations in vegetation density?***



High Vegetation

```
▾ Pixels
  ▾ NDVI: Image (1 band)
      nd: 0.8048467040061951
  ▾ EVI: Image (1 band)
      constant: 1.0005395216566773
  ▾ EVI minus NDVI: Image (1 band)
      constant: 0.19569282928578413
```

Low Vegetation

```
▾ NDVI: Image (1 band)
    nd: 0.47749853134155273
▾ EVI: Image (1 band)
    constant: 0.2012501414575919
▾ EVI minus NDVI: Image (1 band)
    constant: -0.27624838270611324
```

The AOI has vegetation distributed all over, but small patches of it is not showing healthy vegetation in the land; these patches are relatively easy to identify with EVI. NDVI results show healthy vegetation distribution all over the image with values generally above 0.5 with the specific exception of patches. EVI has a similar performance when talking about values, there are mostly over 0.5 values except some places.

I think factor that has responsible for this is the geographic location of the area, it is a low deciduous forest zone on its majority, both ecosystems tend to be dense but the zone is also an area with urban zones and agricultural area leading to the patches of unhealthy and lack of vegetation.

d) Interpret the values of the image. What do negative and positive values mean?

The dark green color indicates vegetation cover which reflects the high EVI and NDVI value. Light green patches reflect low vegetation area which indicate low EVI and NDVI values. Light yellow or brown color indicates agriculture or urban area which reflects very low value. Blue color reflects waterbodies which means negative value for both of the images.

More Details Interpretation:

EVI:

EVI values range from -1 to 1, with higher values indicating denser and healthier vegetation:

-1 to 0: Non-vegetated areas or water

0 to 0.2: Bare soil or very sparse vegetation

0.2 to 0.4: Grasslands or sparse crops

0.4 to 0.6: Moderate vegetation density

0.6 to 1: Dense, healthy vegetation

NDVI:

NDVI values range from -1 to 1, with higher values indicating denser and healthier vegetation:

Negative: Areas with water surfaces, manmade structures, clouds

0.1 to 0.2: Bare soil

0.6 to 0.8: Temperate and tropical rainforests

1: The healthiest and heavy dense forest

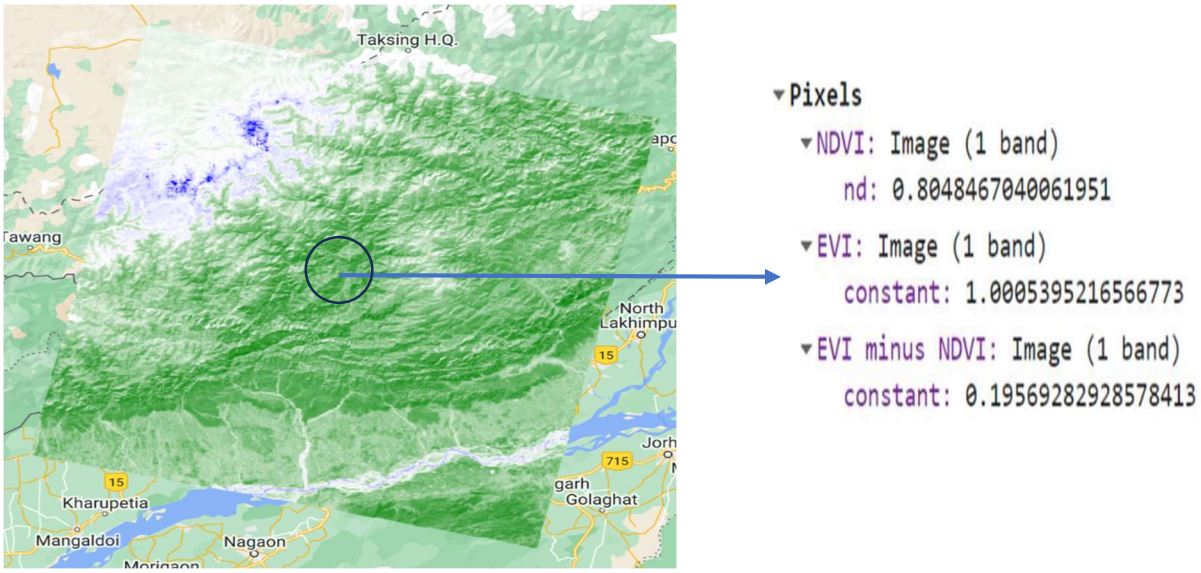
Positive values in both indexes mean vegetation, positive low values might indicate soil or low vegetation areas and finally negative numbers are for lack of vegetation/water.

e) Use the inspector tool to see how the different values change across the image. What patterns can you identify?

In general, NDVI values are greater than EVI ones, there are some exceptions throughout the hole AOI but not so many. Zones where the EVI has higher values than NDVI the EVI minus NDVI index has slightly higher values. In this case the NDVI and EVI show numbers quite similar making it a little hard to find a defined pattern numerically speaking, on a visual instance one can identify the difference in saturation done by EVI.

f) Circle an area in your image where EVI is greater than NDVI. Why can this be?

In this image where EVI (Enhanced Vegetation Index) is higher than NDVI (Normalized Difference Vegetation Index) in a specific area, it usually indicates a region with very dense vegetation, where EVI's ability to correct for background noise and atmospheric effects allows it to better differentiate between high levels of plant density, while NDVI might become saturated and less sensitive in such conditions.

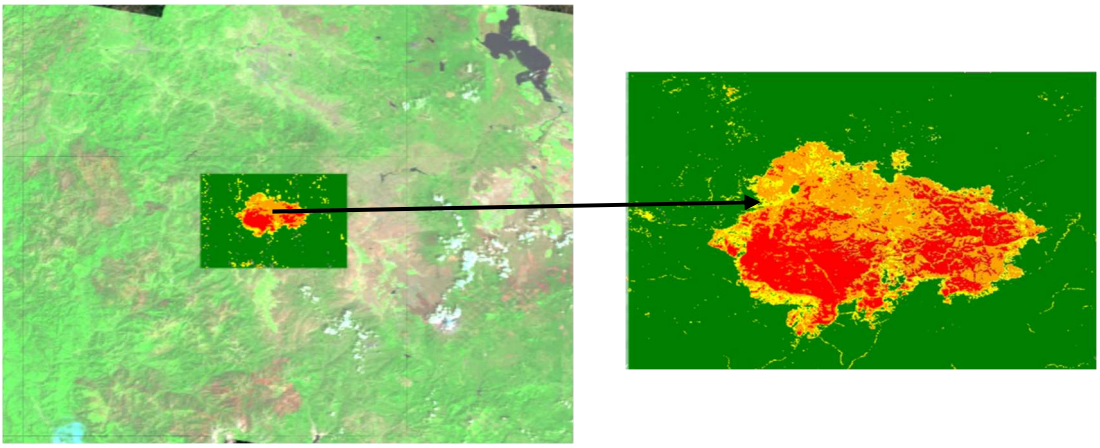


g) In the prefire color composite, which sections of the electromagnetic spectrum are utilized? Additionally, what colors represent vegetation, water, and bare soil in the composite?

- SWIR 2, Near Infrared and Red.
- In the image green represents vegetation, dark gray areas show water bodies (no reflection), brown/gray color for soil, including urban areas and lack of vegetation.

h) Identify the fire scar. What color is it in the false color composite? Why? (Think in terms of the spectral curve of burnt areas)

The burn scar (-122.8593. 41.8227) is reddish color which is the false color composite image. This is because burnt area has a much lower reflectance in the NIR and SWIR band, as vegetation has been destroyed. Besides, we can see a difference in Band 10 (ST_B10) corresponding to surface temperature, there is an increase in these values compared to the pre fire ones, hence, the color appearance. Even though this band was not specified for the composite it can help us identify the reason why this area looks different.



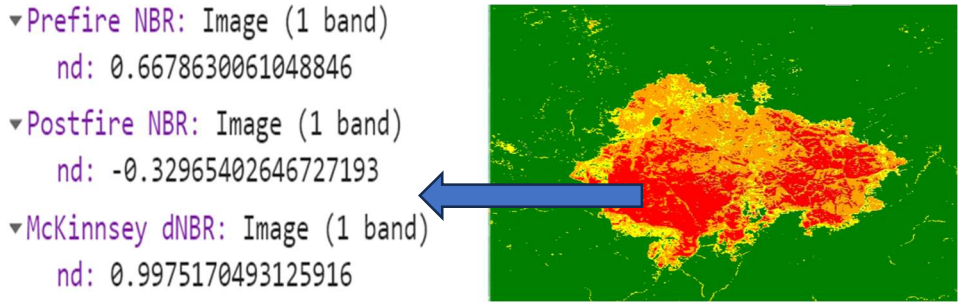
Fire Scar

i) Switch between NBRprefire and NBRpostfire maps. Identify the area with the largest visual difference- this is the area of the fire. Use the inspector to identify the values pre-fire and post-fire within the fire scar. Are the values postfire positive or negative within the fire scar? Are the values of the dNBR positive or negative within the fire scar?

The visual difference between the NBR pre fire and NBR post fire maps is the fire scar.

Whitin the fire scar there are negative values for Postfire NBR.

Whilst for dNBR values are positive. We get these values because of the vegetation damage and increasing burn severity.

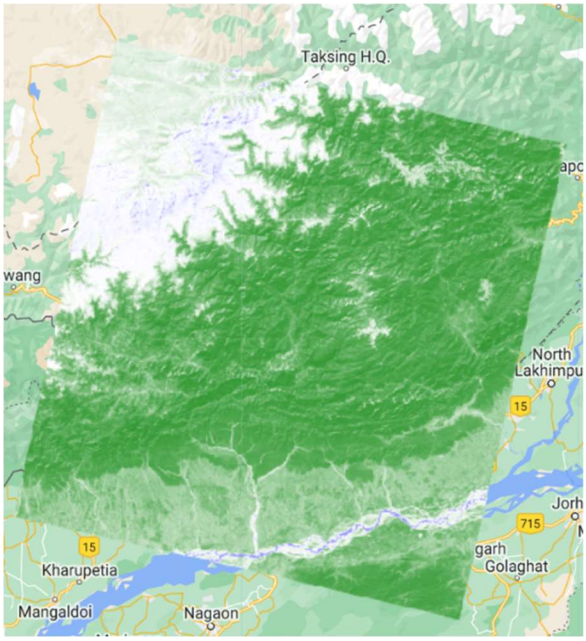


j) What is the area of moderate and high severity burning?

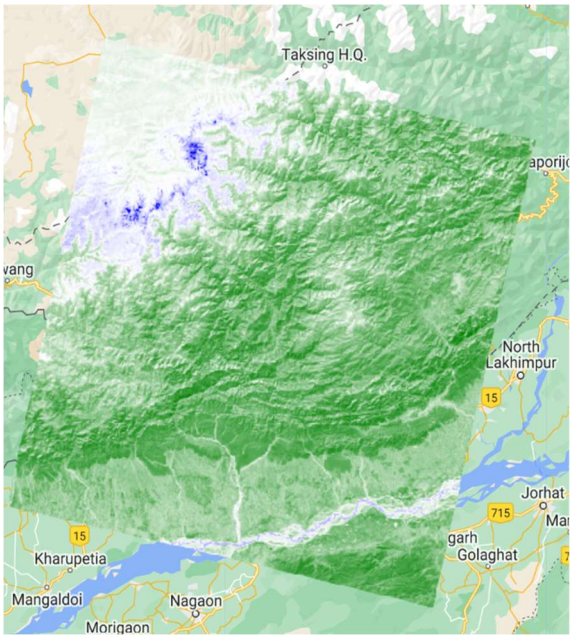
The area of moderate and high severity burning is 236 square kilometers.

Part -1

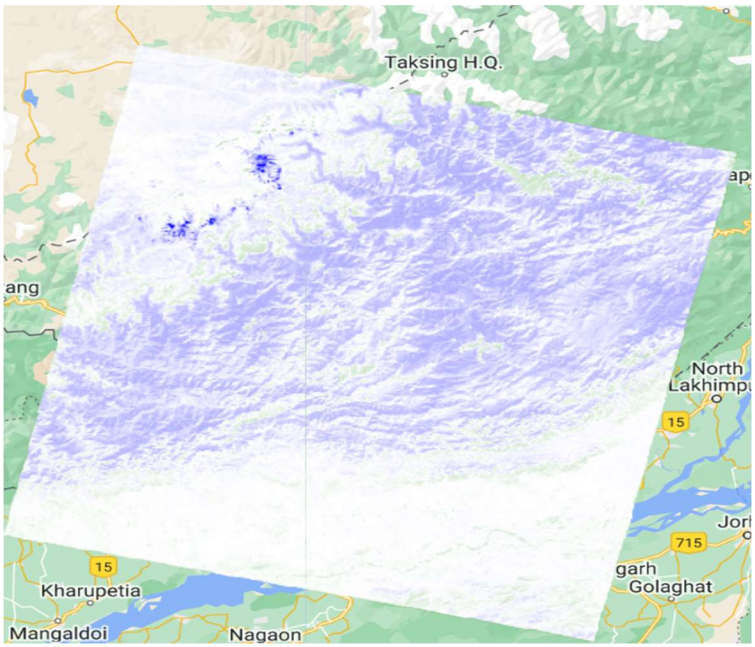
Link: https://code.earthengine.google.com/5a6c0de8d80f1baa7a4eb94895791e67



NDVI



EVI



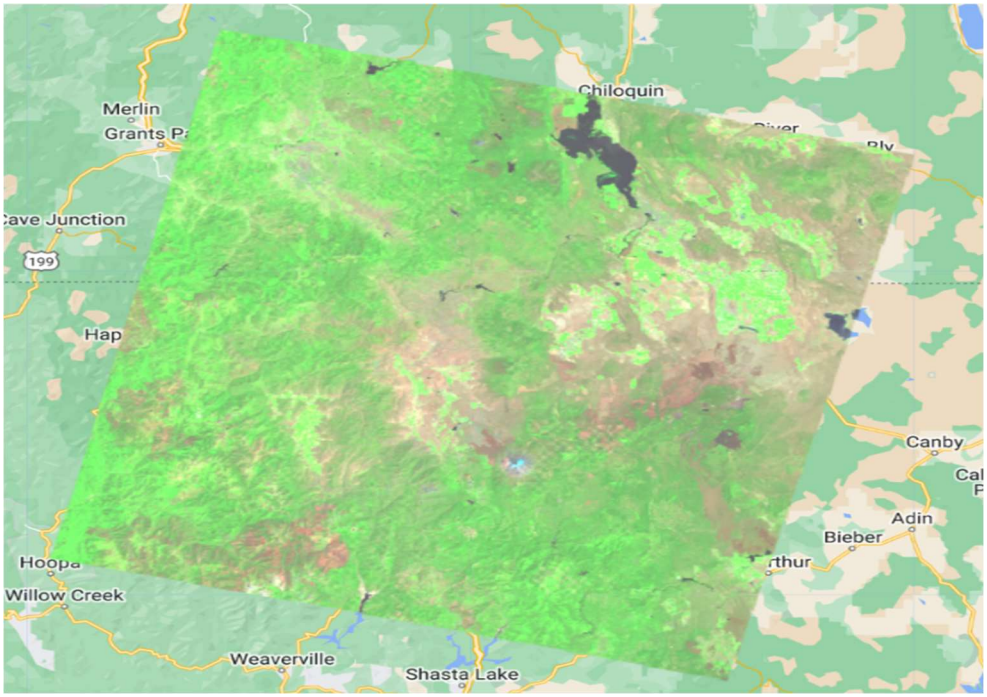
EVI MINUS NDVI

- NDVI and EVI values min -1 and max 1. Strong green means healthy vegetation, light yellow or greenish patches means unhealthy vegetation and white /blue areas have no vegetation /water. EVI minus NDVI highlighted less saturated area.

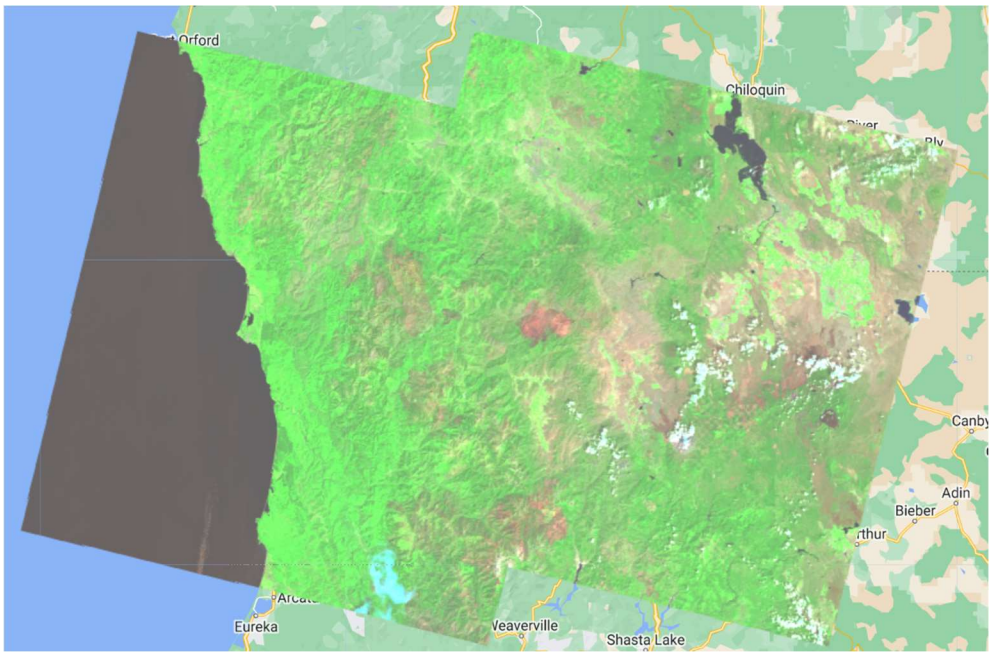
Part 2

Link: https://code.earthengine.google.com/1a556f565ebd6faf6a2a1926524c519e

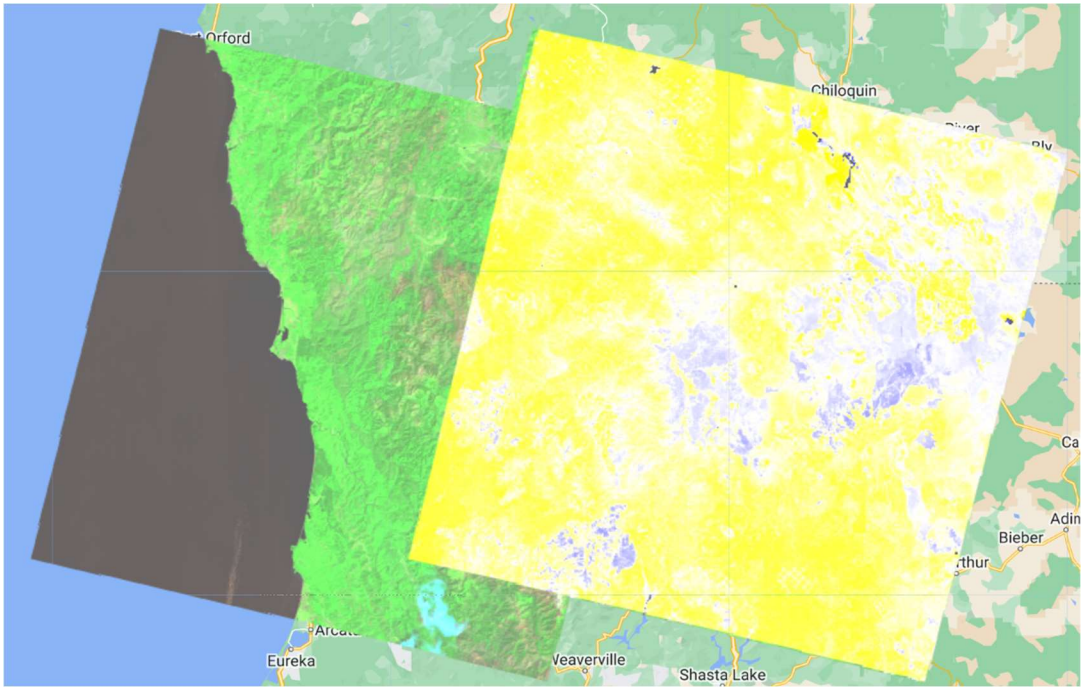
- **Prefire Image:** Bands 7, 5, 4. False color composite.



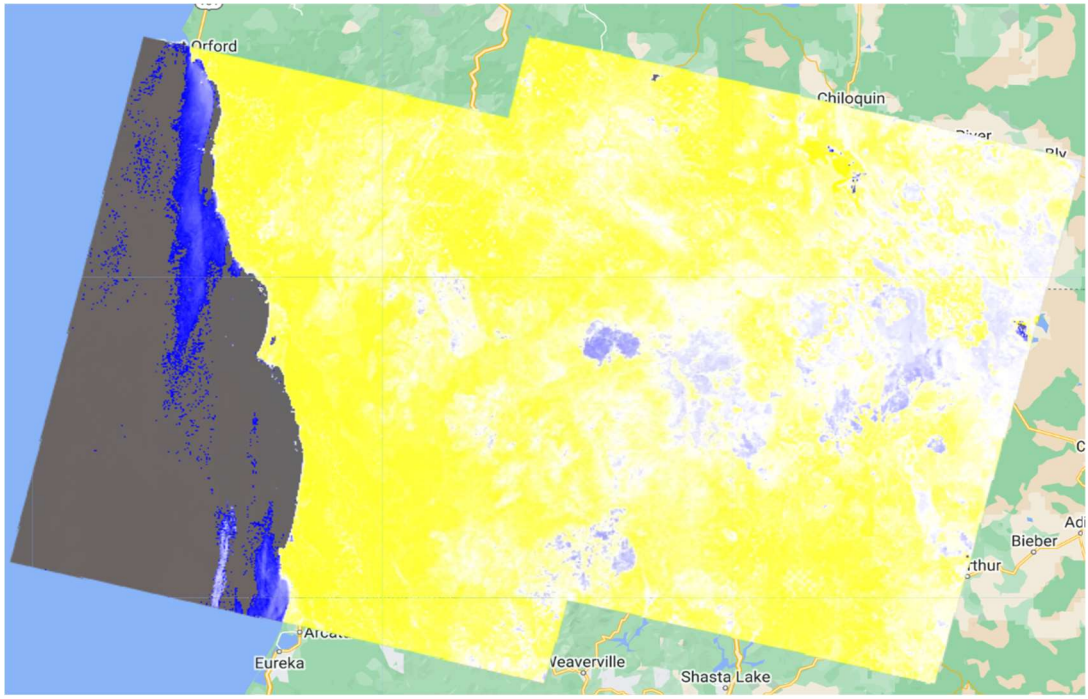
- **Postfire Image:** Bands 7, 5, 4. False color composite Image.



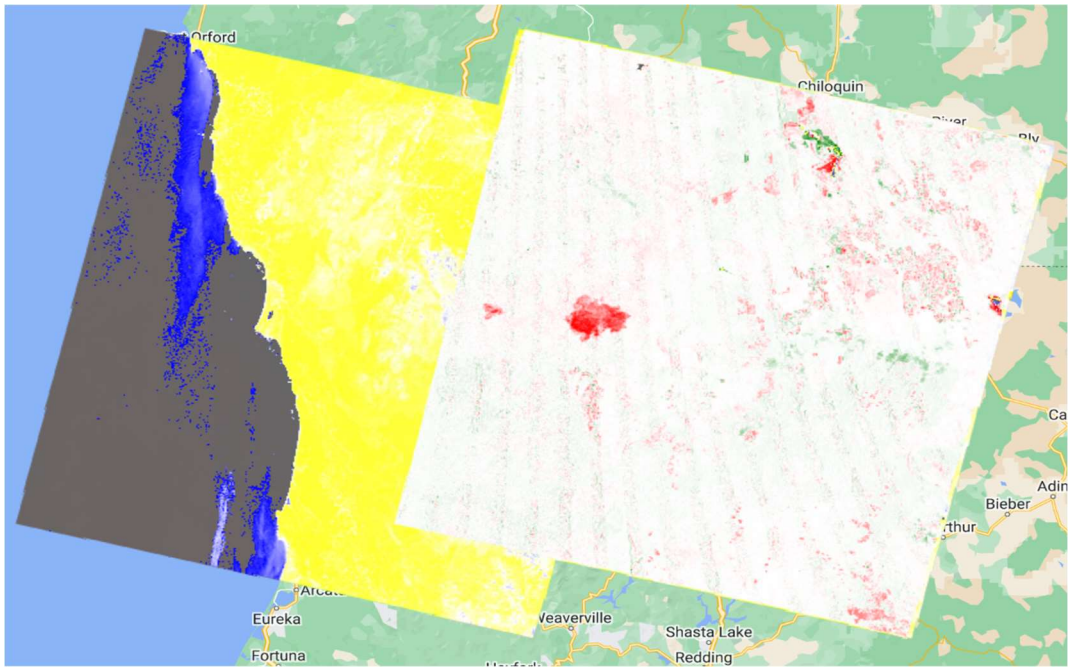
- **Prefire NBR Image:** Bands SR_B5 and SR_B7.



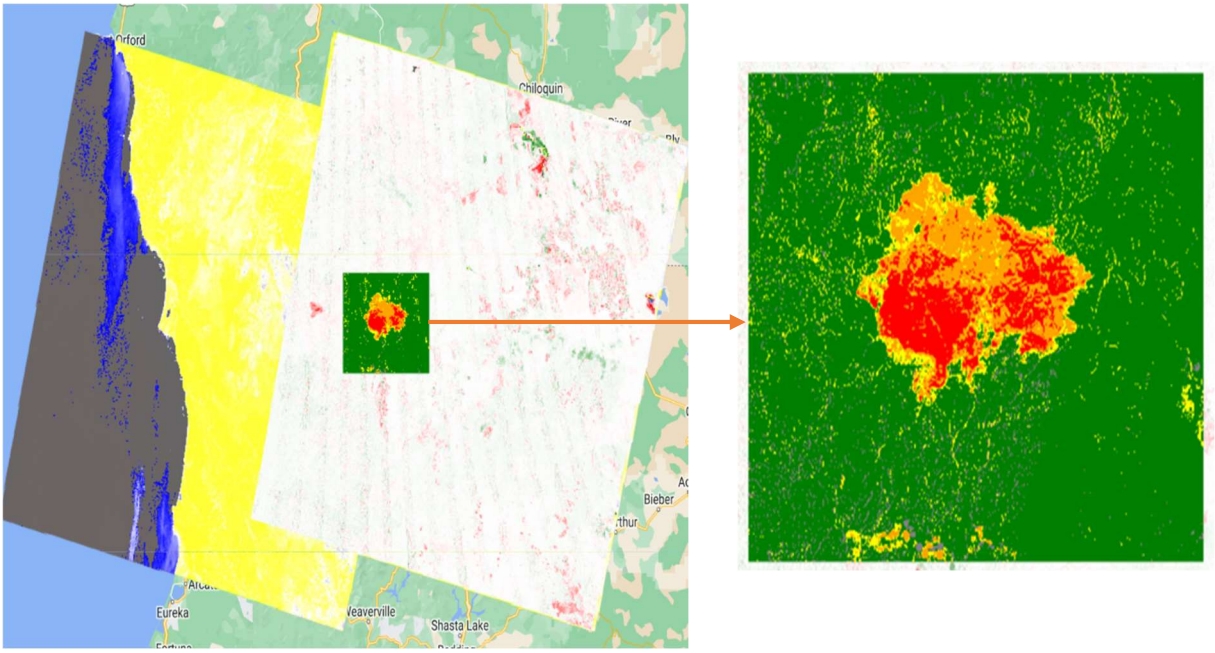
- **Postfire NBR Image:** Bands SR_B5 and SR_B7. Fire scar showed in this image.



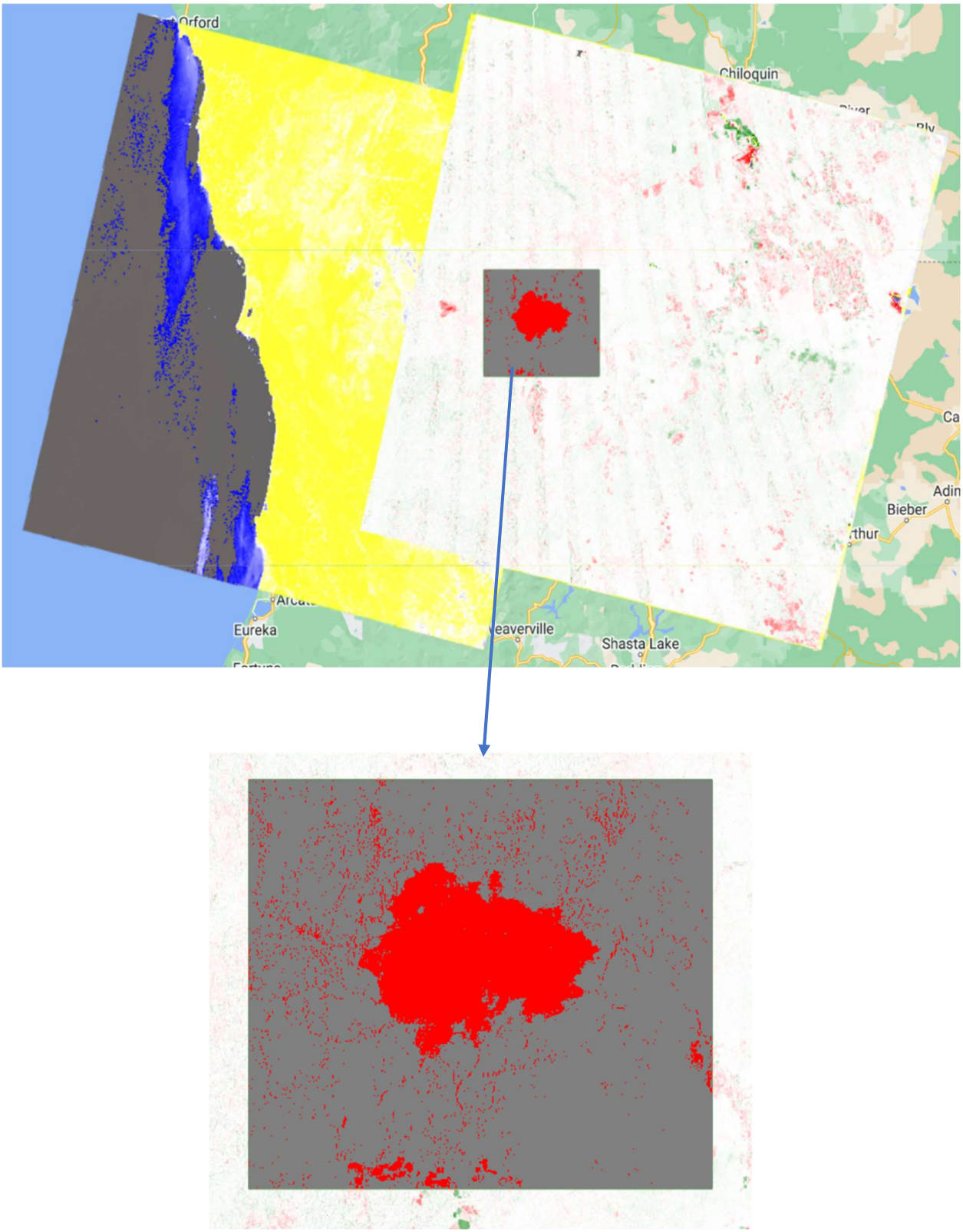
- **Mckinnsey dNBR:** Green, white and red palette is used in this image. The severe burnt area appears on intuitive red color.



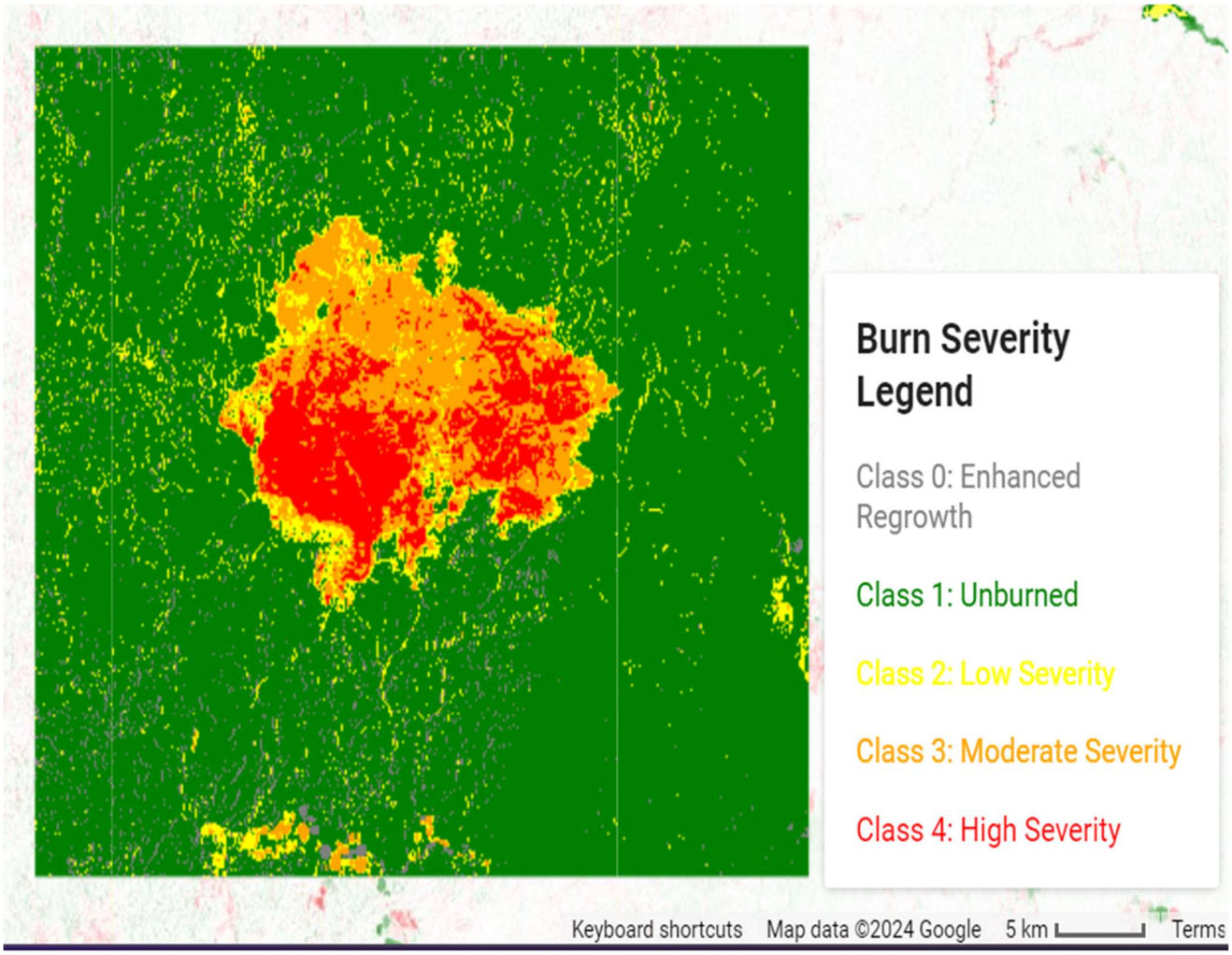
- **Burn Severity:** Classified severity of burn area and identify them with colors; Unburned (green), Low (yellow), Moderate (orange), and High (red).



- **Burned:** Enhances burnt areas across the image without classification.



Burn Severity Map



FINISH