

# DAY 3

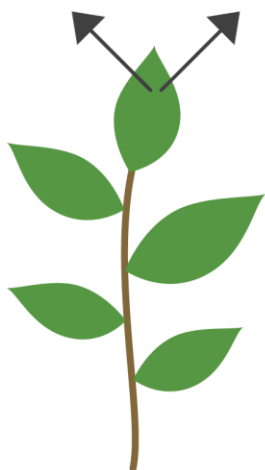
## Exercise 1

# Remote Sensing based Indices

# NDVI calculation

## HEALTHY VEGETATION REFLECTANCE

50% NIR 8% RED



**NDVI = 0.72**

## STRESSED VEGETATION REFLECTANCE

40% NIR 30% RED




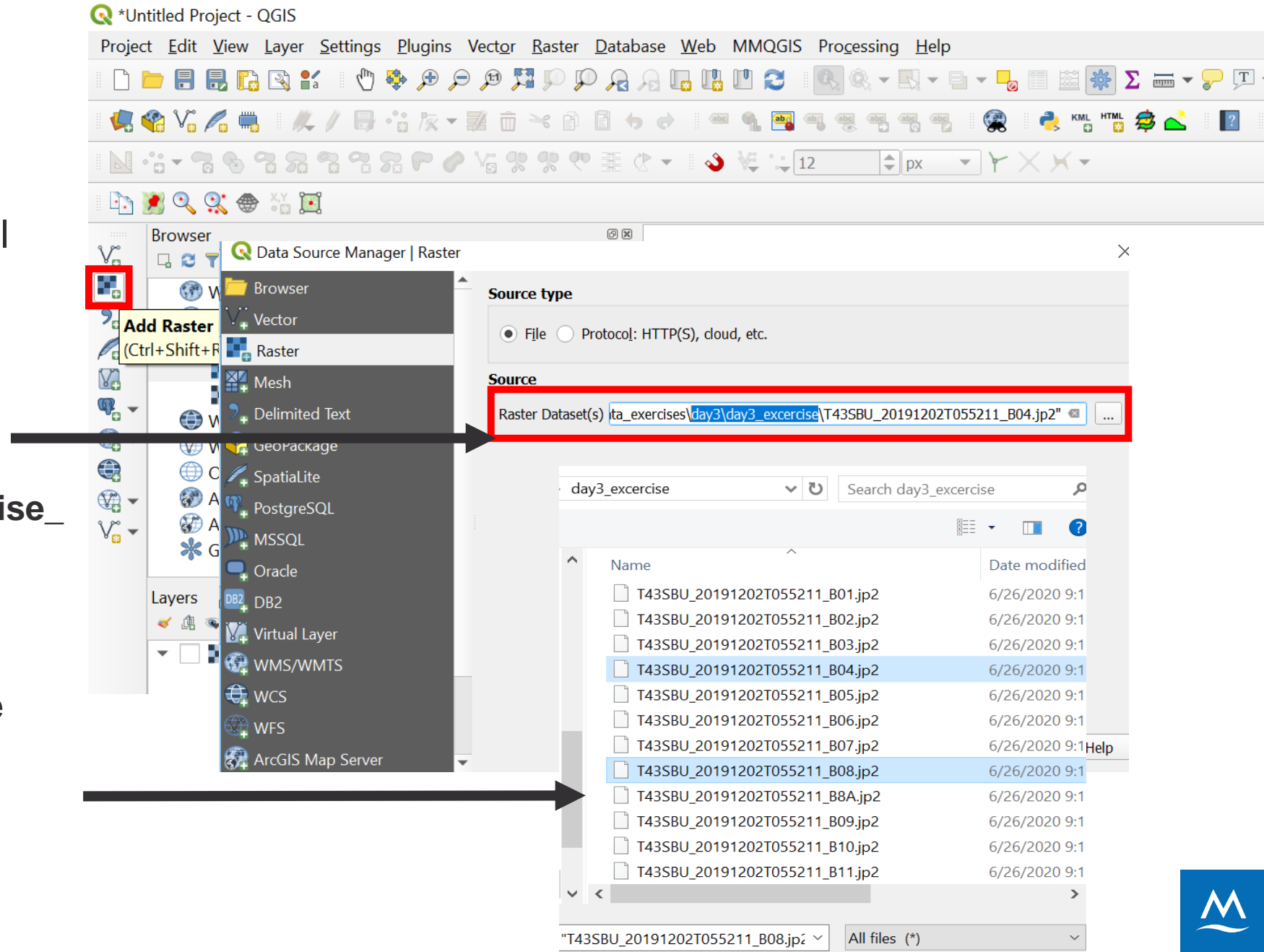
**NDVI = 0.14**

$$\text{NDVI} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}}$$

Band	Resolution	Central Wavelength	Description
B1	60 m	443 nm	Ultra blue (Coastal and Aerosol)
B2	10 m	490 nm	Blue
B3	10 m	560 nm	Green
B4	10 m	665 nm	Red
B5	20 m	705 nm	Visible and Near Infrared (VNIR)
B6	20 m	740 nm	Visible and Near Infrared (VNIR)
B7	20 m	783 nm	Visible and Near Infrared (VNIR)
B8	10 m	842 nm	Visible and Near Infrared (VNIR)
B8a	20 m	865 nm	Visible and Near Infrared (VNIR)
B9	60 m	940 nm	Short Wave Infrared (SWIR)
B10	60 m	1375 nm	Short Wave Infrared (SWIR)
B11	20 m	1610 nm	Short Wave Infrared (SWIR)
B12	20 m	2190 nm	Short Wave Infrared (SWIR)

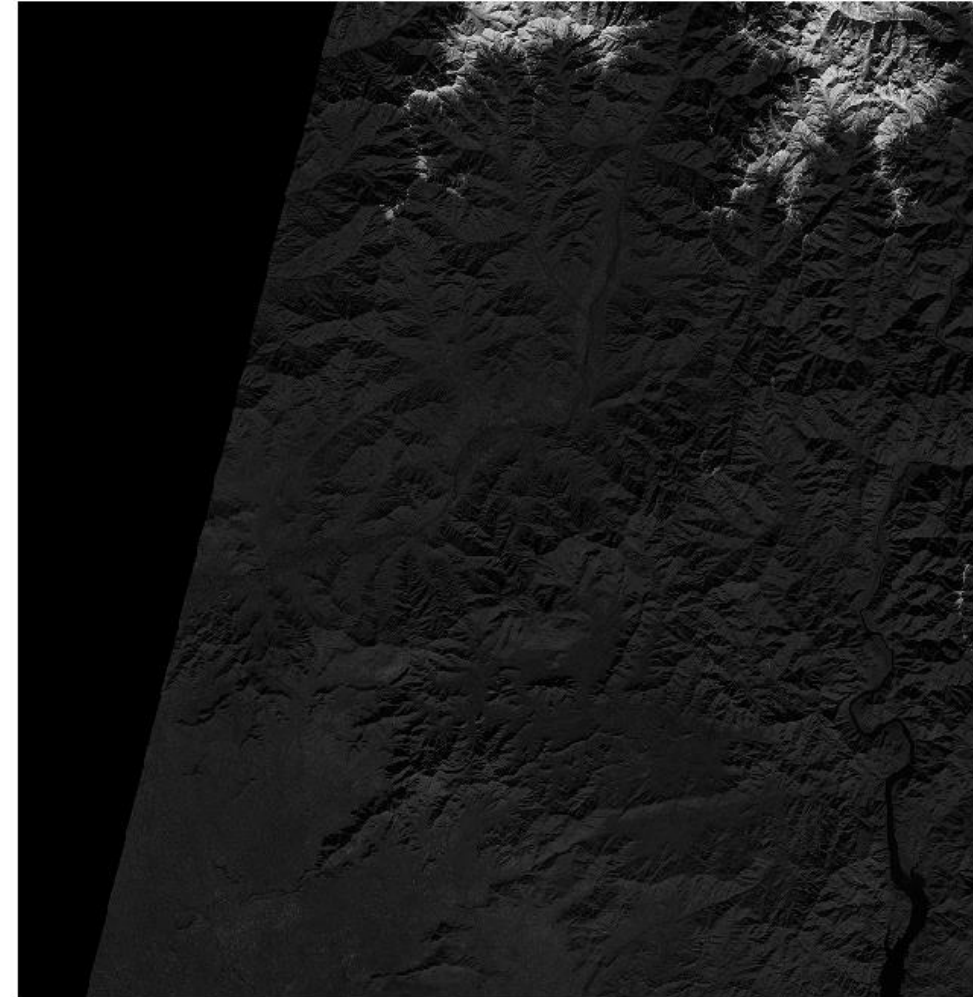
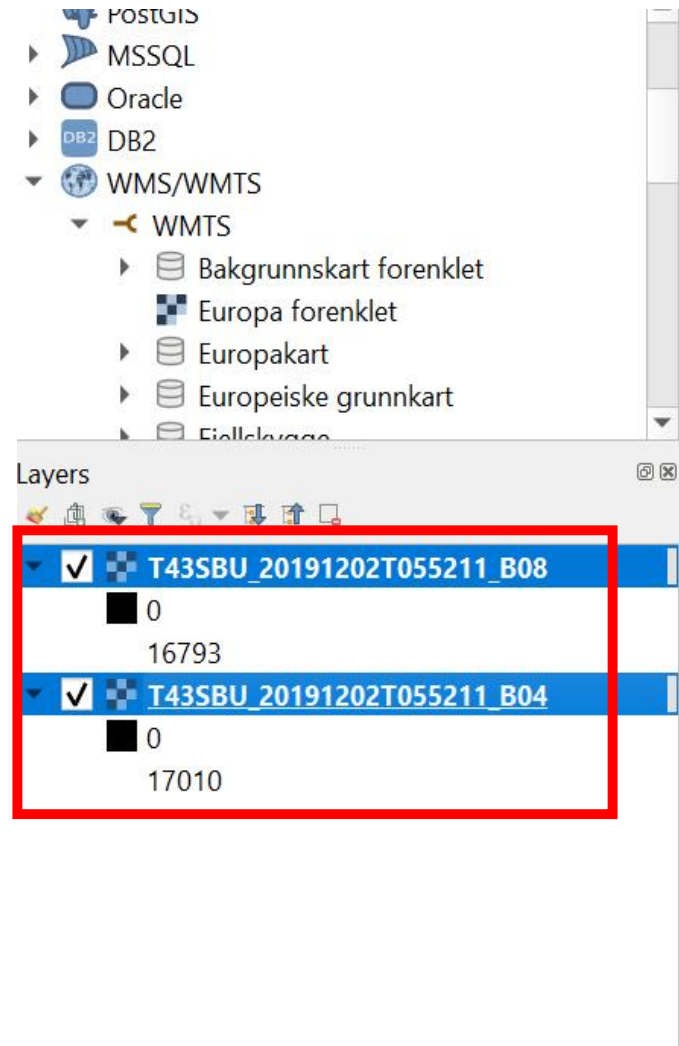
# NDVI calculation

- Open QGIS in your Laptop
- Click on the  sign in the **manage layers toolbar** panel
- A window opens
- Navigate to your image data folder  
(D:\day2\day2\_exercise\exercise\_2)
- Select the bands to add in the QGIS (band 8 and band 4 in this case)



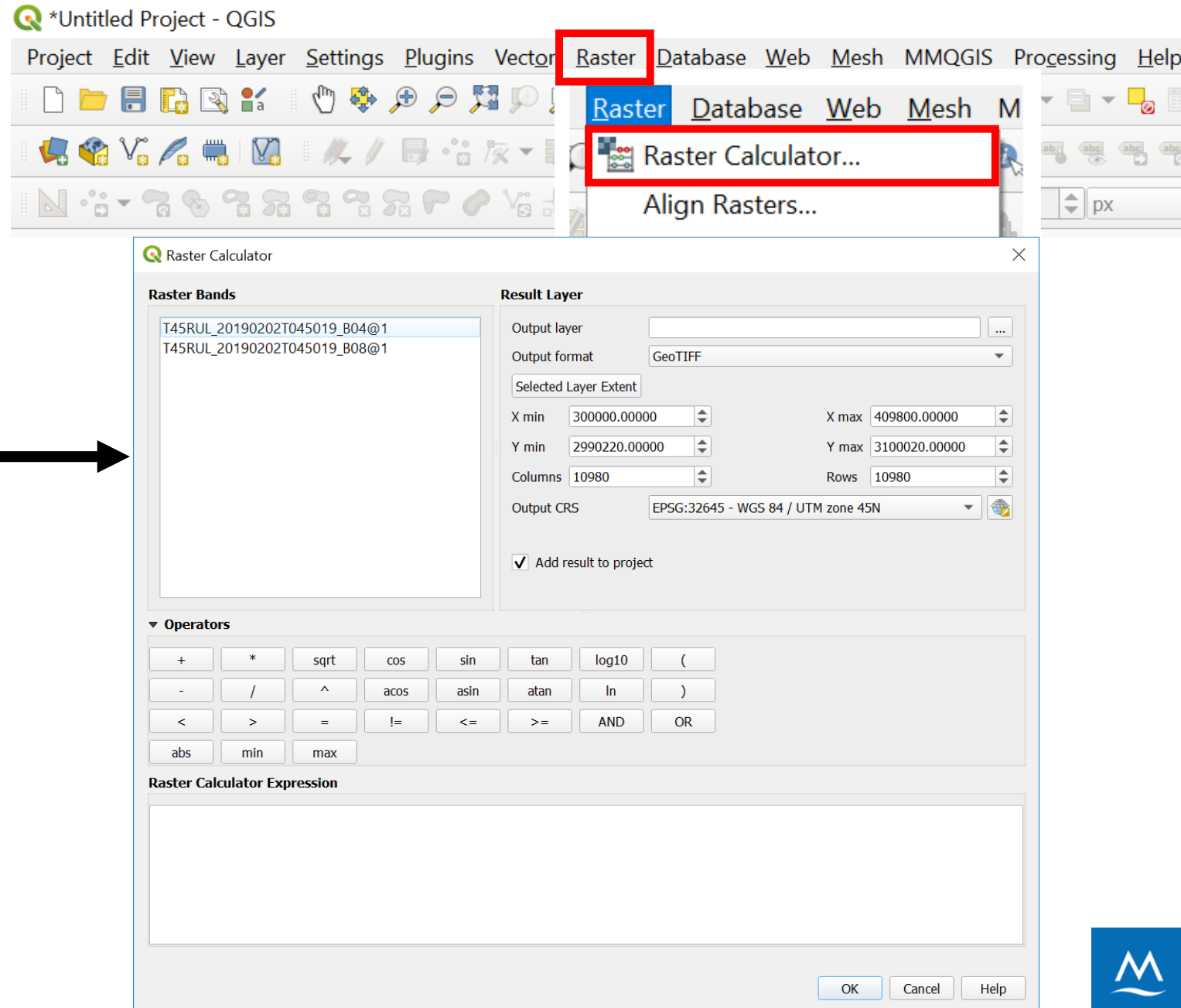
# NDVI calculation

- Select the bands to add in the QGIS (**band 8 and band 4 in this case**)
- Click **ADD**
- The layers are added in the layer panel



# NDVI calculation

- Click on the **Raster->Raster calculator** from the top panel tab
- A **Raster calculator** window opens



# NDVI calculation

- Place the NDVI calculation formula in the **Raster Calculator Expression**

**Example** ( "T43SBU\_20191202T055211\_B08@1" -  
"T43SBU\_20191202T055211\_B04@1")/  
("T43SBU\_20191202T055211\_B08@1" +  
"T43SBU\_20191202T055211\_B04@1")

- Click on the **Output layer** and select the output folder and name the output file as **NDVI**

- Make sure the **expression is valid** →

- Click **OK**

Raster Calculator

**Raster Bands**

T43SBU\_20191202T055211\_B04@1  
T43SBU\_20191202T055211\_B08@1

**Result Layer**

Output layer: Pakistan\New folder\rough\NDVI ...

Output format: GeoTIFF

Selected Layer Extent

X min: 199980.00000 X max: 309780.00000  
Y min: 3790200.00000 Y max: 3900000.00000  
Columns: 10980 Rows: 10980  
Output CRS: EPSG:32643 - WGS 84 / UTM zo

☒ Add result to project

**Operators**

+ \* sqrt cos sin tan log10 (   
- / ^ acos asin atan ln )   
< > = != <= >= AND OR   
abs min max

**Raster Calculator Expression**

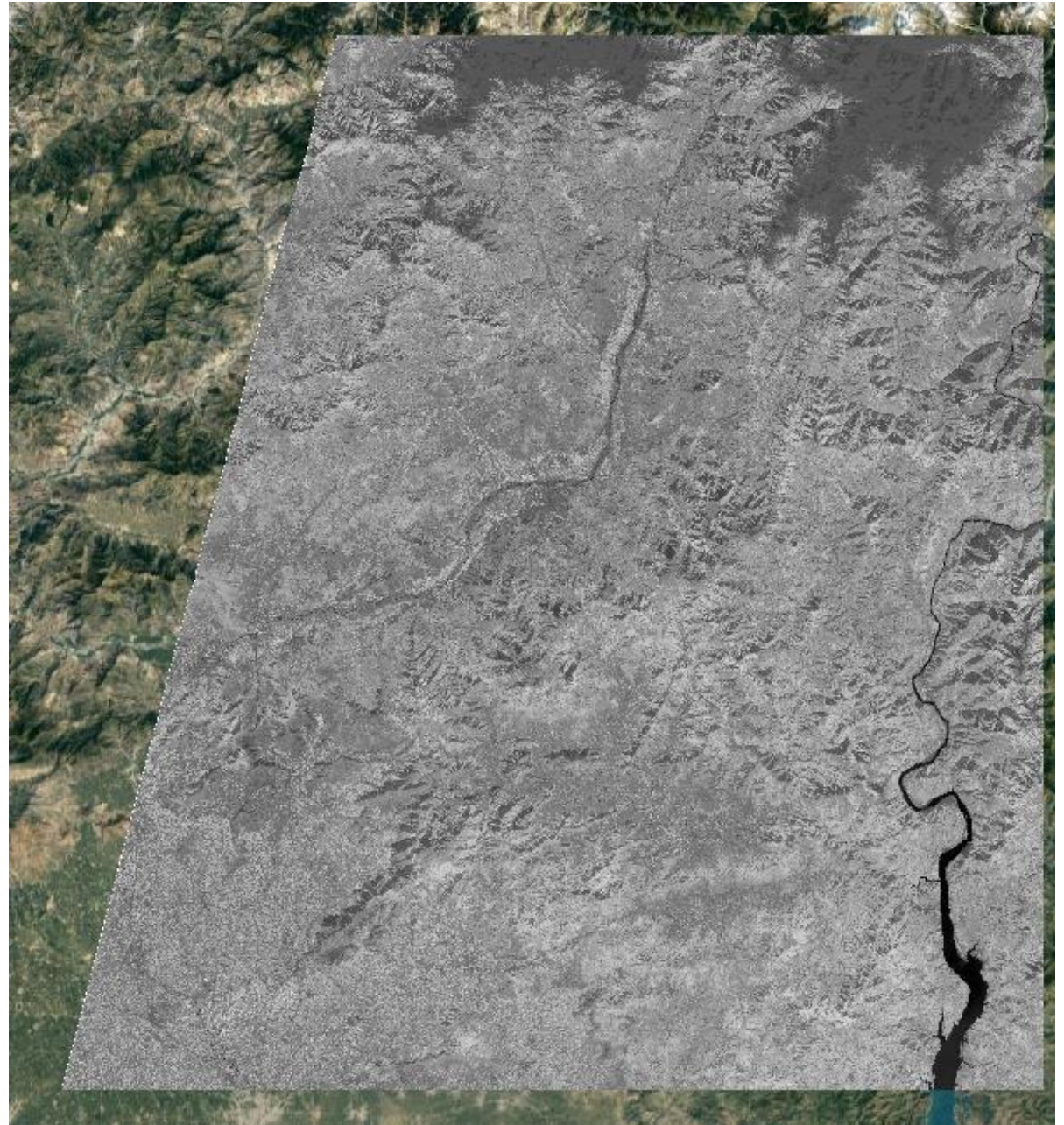
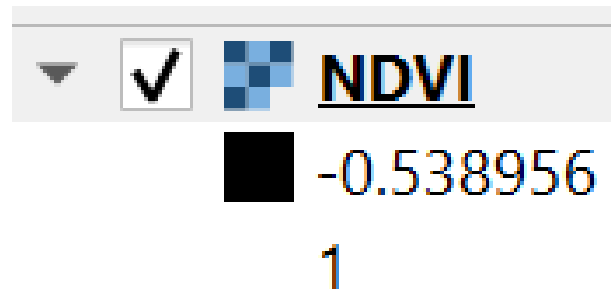
( "T43SBU\_20191202T055211\_B08@1" - "T43SBU\_20191202T055211\_B04@1" ) /  
( "T43SBU\_20191202T055211\_B08@1" + "T43SBU\_20191202T055211\_B04@1" )

Expression valid

OK Cancel Help

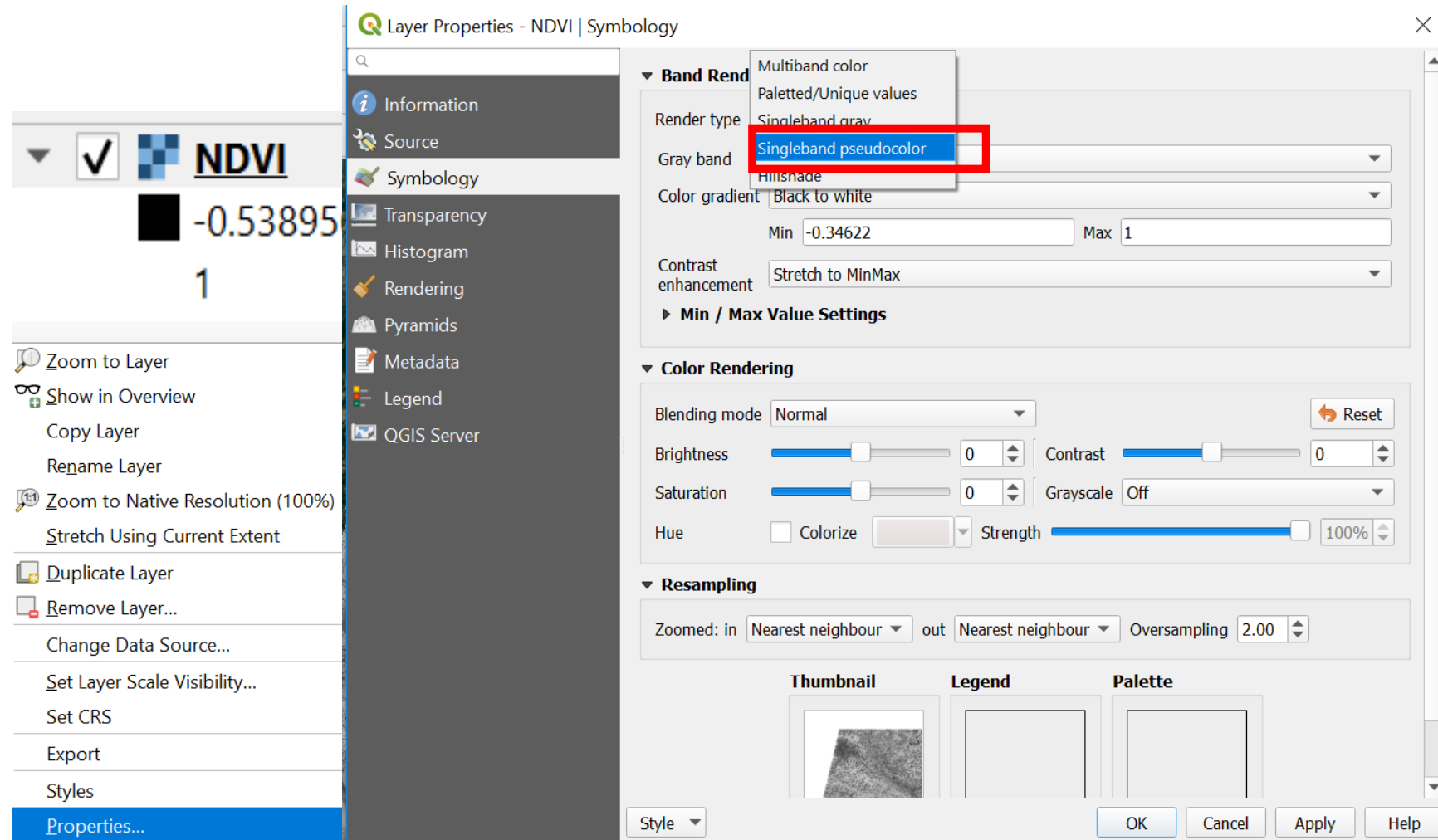
# NDVI calculation

- Calculated NDVI image appears in the **layers panel**
- The range varies from -0.51 to 1



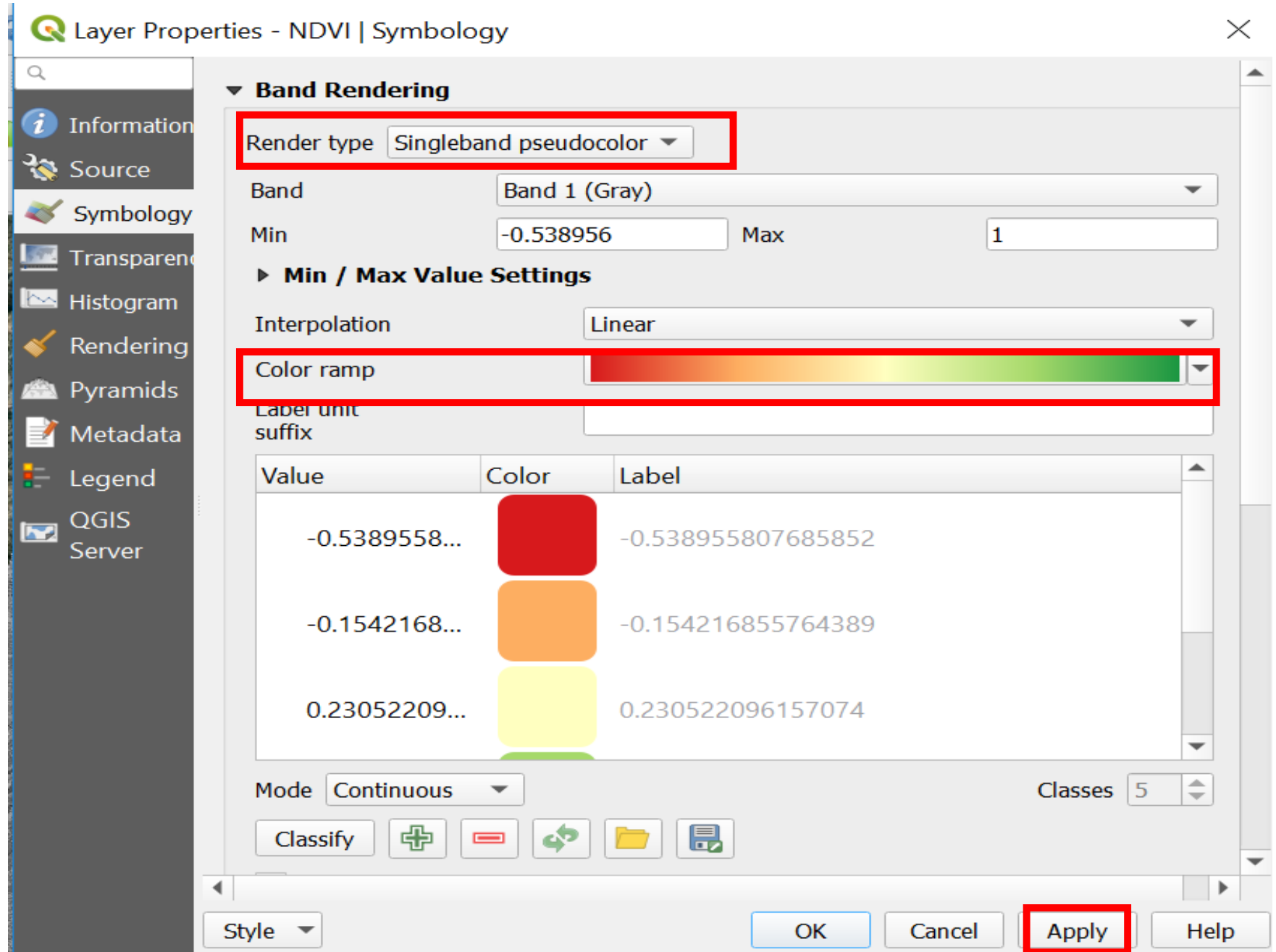
# NDVI calculation

- **Right click** on the NDVI layer-> **Properties**
- Click on **Symbology** and select **Singleband pseudocolor** from the **Render type**
- Choose a suitable color ramp
- Click on **Apply** and **OK**

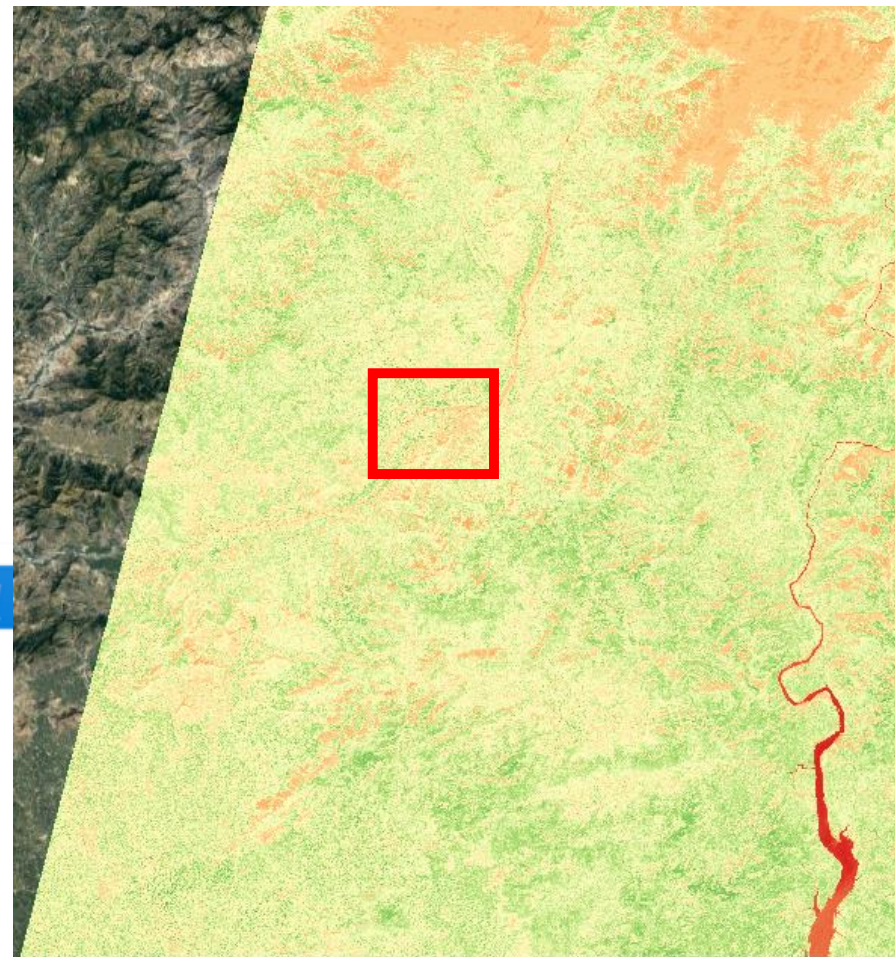


# NDVI calculation

- Choose a suitable **color ramp**
- Click **Apply** and analyze the image



# NDVI calculation



**Do the similar exercises for  
water and snow extraction**

Vegetation

1. Enhanced Vegetation Index (EVI 2):  $2.5 * ((\text{NIR} - \text{RED}) / (\text{NIR} + 2.4 * \text{RED} + 1))$

Formula:  $2.5 * \text{Float} ((\text{"T43SBU\_20191202T055211\_B08.jp2"} - \text{"T43SBU\_20191202T055211\_B04.jp2"}) / (\text{"T43SBU\_20191202T055211\_B08.jp2"} + 2.4 * \text{"T43SBU\_20191202T055211\_B04.jp2"} + 1))$

2. Soil Adjusted Vegetation Index (SAVI):  $(\text{NIR} - \text{RED}) * (1.0 + \text{L}) / (\text{NIR} + \text{RED} + \text{L})$

Formula:  $\text{Float} ((\text{"T43SBU\_20191202T055211\_B08.jp2"} - \text{"T43SBU\_20191202T055211\_B04.jp2"}) * (1.0 + 0.5)) / (\text{"T43SBU\_20191202T055211\_B08.jp2"} + \text{"T43SBU\_20191202T055211\_B04.jp2"} + 0.5)$

Here L is a constant and varies by the amount or cover of green vegetation: in very high vegetation regions, L=0; and in areas with no green vegetation, L=1; default: 0.5

Vegetation/Crop Water index

3. Normalized Difference water index (NDWI):  $(\text{NIR} - \text{SWIR}) / (\text{NIR} + \text{SWIR})$

Formula:  $\text{Float} (\text{"T43SBU\_20191202T055211\_B08.jp2"} - \text{"T43SBU\_20191202T055211\_B12.jp2"}) / \text{Float} (\text{"T43SBU\_20191202T055211\_B08.jp2"} + \text{"T43SBU\_20191202T055211\_B12.jp2"})$

Absorption by vegetation liquid water in the NIR channel is negligible, while in the SWIR channel it is very high. If Vegetation Water Content (VWC) decreases, then reflectance in the SWIR channel increases significantly. Thus, the Normalized Difference Water Index (NDWI) value – that combines information from the NIR and the SWIR bands – decreases, reflecting dry vegetation that is experiencing drought stress

## Indices and formula

### WATER

**1. Normalized Difference Water Index (NDWI):**  $(\text{Green} - \text{NIR}) / (\text{Green} + \text{NIR})$

$\text{Float}("T43SBU\_20191202T055211\_B03.jp2" - "T43SBU\_20191202T055211\_B08.jp2") / \text{Float}("T43SBU\_20191202T055211\_B03.jp2" + "T43SBU\_20191202T055211\_B08.jp2")$

**2. Water Ratio Index (WRI):**  $(\text{Green} + \text{Red}) / (\text{NIR} + \text{SWIR})$

$\text{Float}("T43SBU\_20191202T055211\_B03.jp2" + "T43SBU\_20191202T055211\_B04.jp2") / \text{Float}("T43SBU\_20191202T055211\_B08.jp2" + "T43SBU\_20191202T055211\_B011.jp2")$

### SNOW

**1. Normalized Difference Snow Index (NDSI):**  $(\text{Green} - \text{SWIR}) / (\text{Green} + \text{SWIR})$

$\text{Float}("T43SBU\_20191202T055211\_B03.jp2" - "T43SBU\_20191202T055211\_B12.jp2") / \text{Float}("T43SBU\_20191202T055211\_B03.jp2" + "T43SBU\_20191202T055211\_B12.jp2")$

**2. Snow Water Index (SWI):**  $\text{Green}(\text{NIR} - \text{SWIR}) / ((\text{Green} + \text{NIR})(\text{NIR} + \text{SWIR}))$

$(\text{Float}("T43SBU\_20191202T055211\_B03.jp2" * ("T43SBU\_20191202T055211\_B08.jp2" - "T43SBU\_20191202T055211\_B12.jp2")) / (\text{Float}("T43SBU\_20191202T055211\_B03.jp2" + "T43SBU\_20191202T055211\_B08.jp2") * ("T43SBU\_20191202T055211\_B08.jp2" + "T43SBU\_20191202T055211\_B12.jp2"))$

### Others

**1. Normalized difference built-up index (NDBI) :**  $\text{SWIR} - \text{NIR} / (\text{SWIR} + \text{NIR})$

**2. Bare Soil Index (BSI):**  $(\text{SWIR} + \text{RED}) - (\text{NIR} + \text{BLUE}) / ((\text{SWIR} + \text{RED}) + (\text{NIR} + \text{BLUE}))$

A photograph of a rugged, snow-capped mountain peak under a clear sky. The mountain's face is dark and rocky, with patches of white snow and ice. To the right, a steep, brownish mountain slope descends. A large, white, stylized chevron graphic is overlaid on the left side of the image, pointing upwards and to the right.

**Thank you**

**Let's protect  
the pulse.**