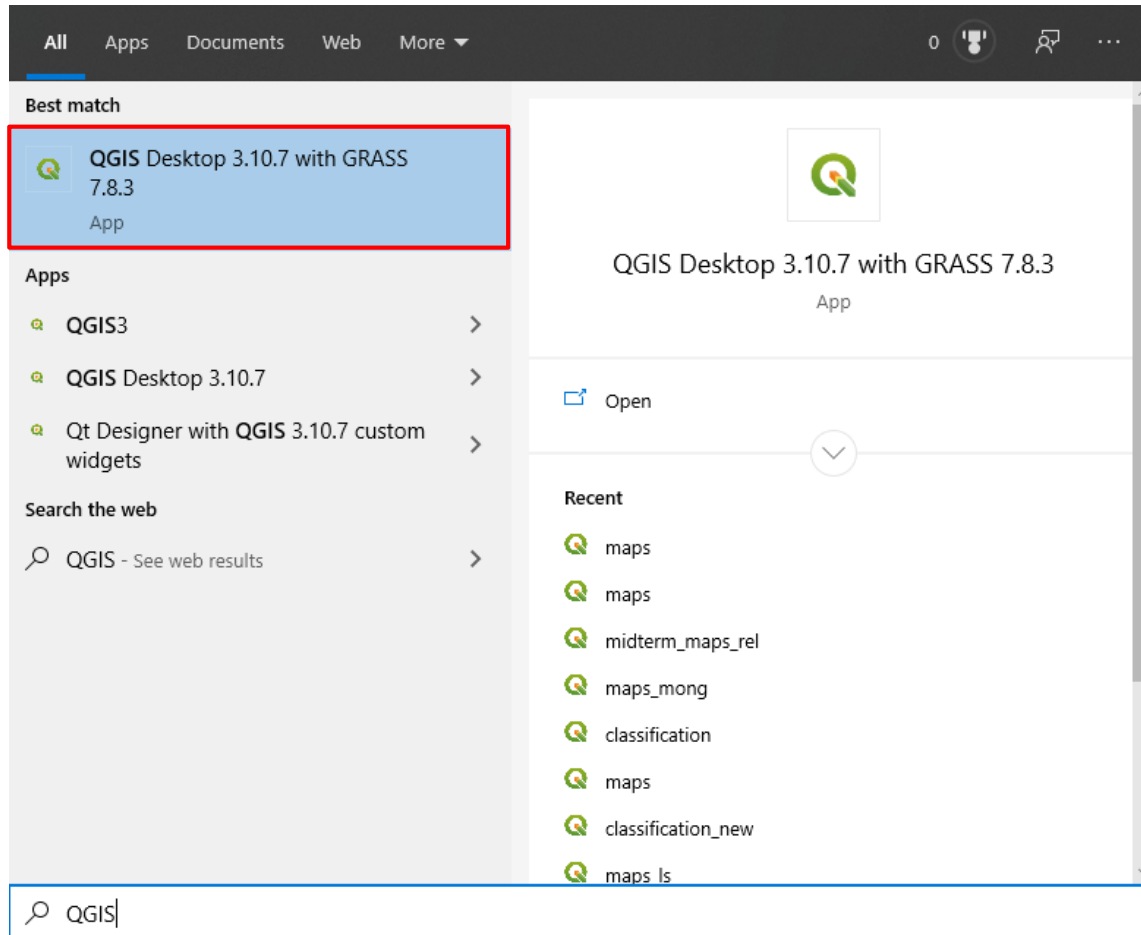


Satellite Data Analysis



How to open QGIS !

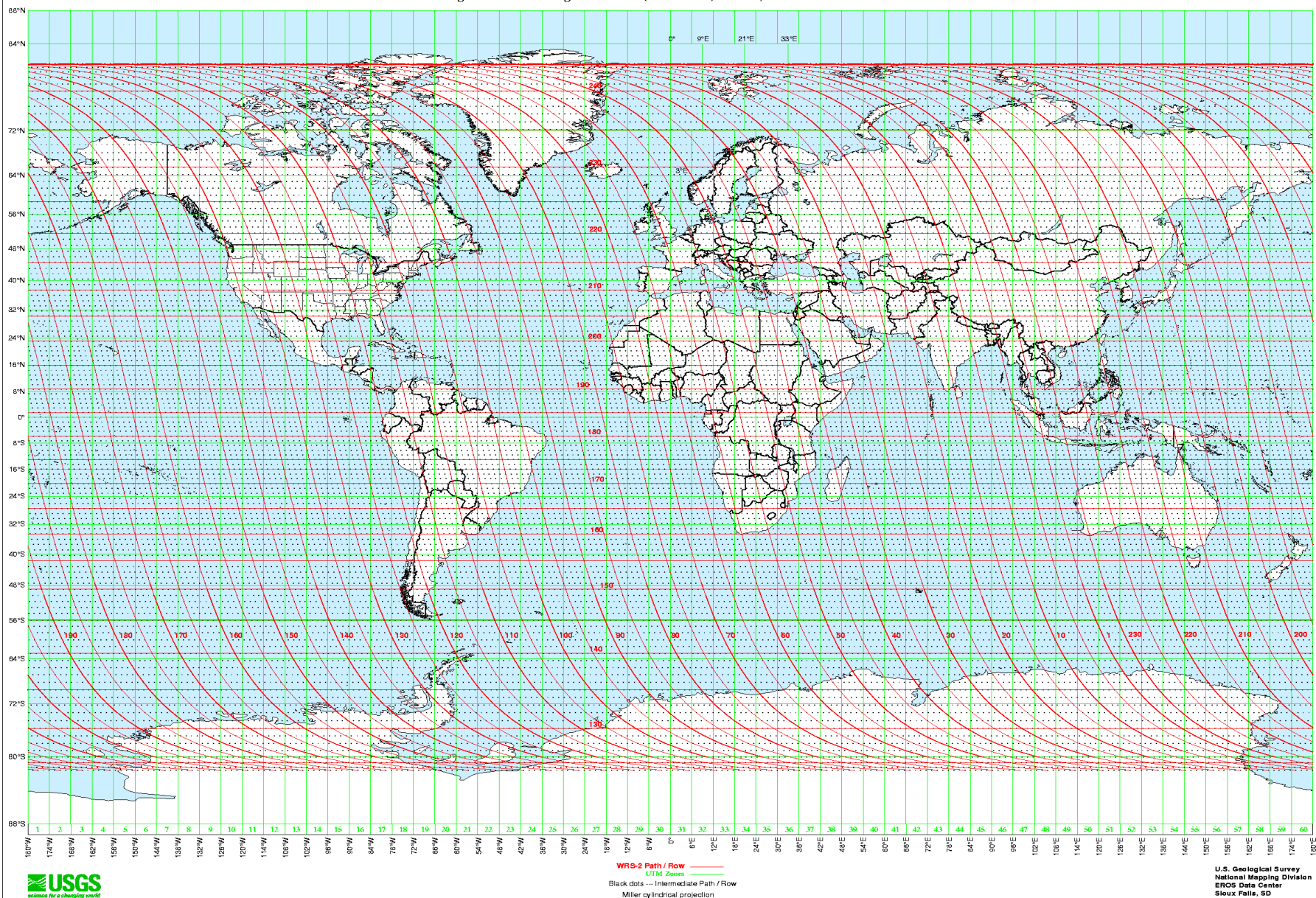


Recommended Plugins

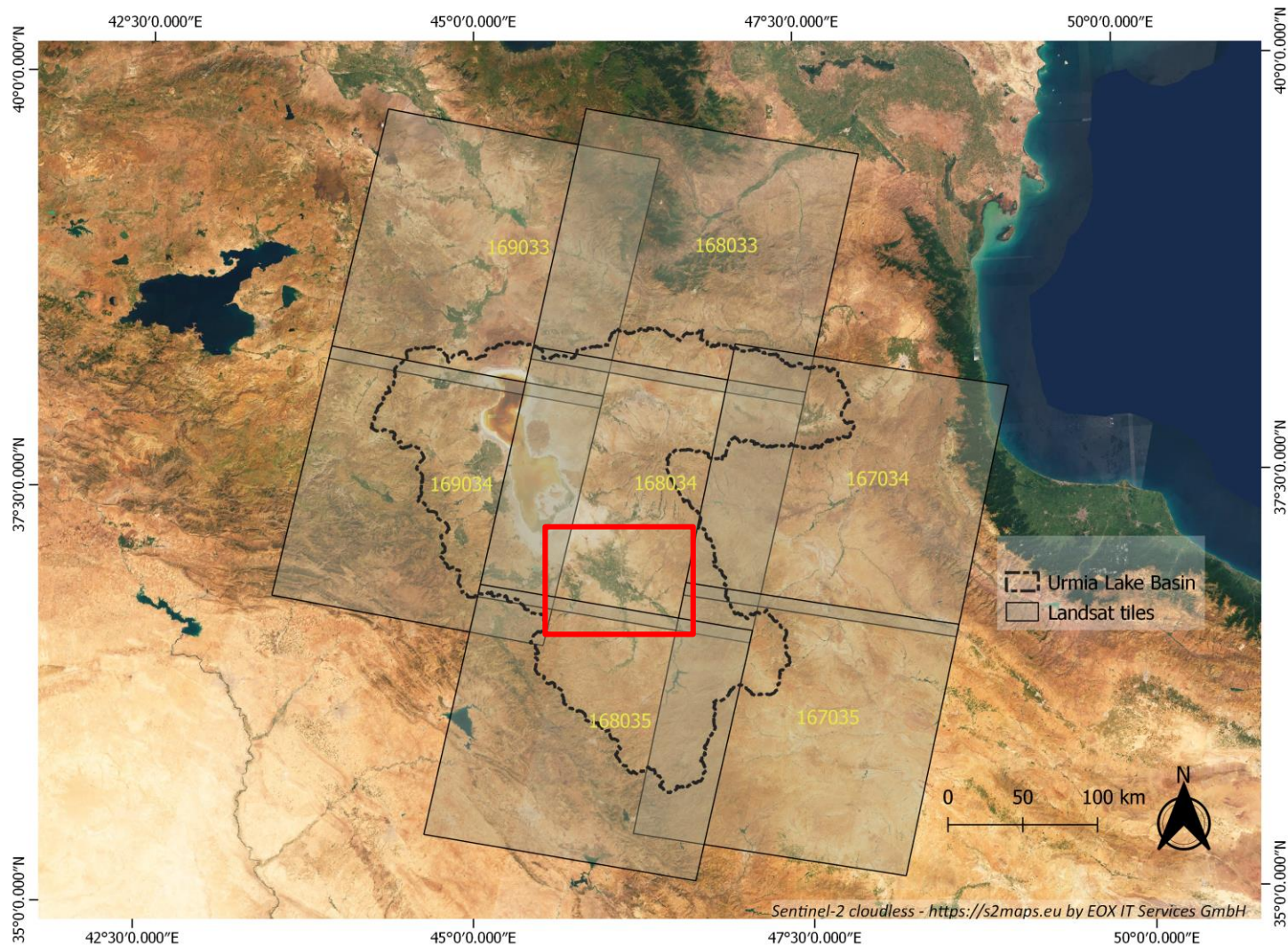
- SCP - Semi-Automatic Classification Plugin
- QuickMapServices
- Coordinate Capture

How Landsat 8 data are provided? Path/row concept

WRS-2 Night-time Ascending Path / Row (Landsats 4, 5 and 7) and UTM Zones



Path/rows over our study area !



One Landsat scene !

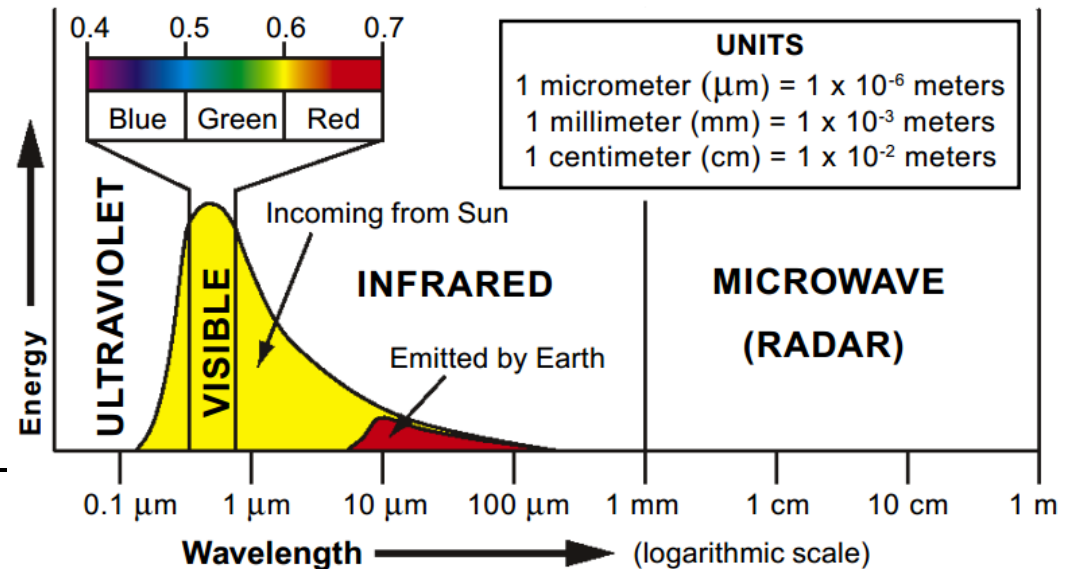
- 180 km X 180 km
- Always provided in respective **Universal Transverse Mercator (UTM) zone**
 - **Miandoab Irrigation System (MIS)** in UTM 38 North zone
 - What is the EPSG value for UTM 38 North zone
- Acquisition time: 10:00 – 10:30 AM Local time
 - In metadata the acquisition time is given in Greenwich Mean Time (GMT) zone

Landsat 8 file structure

- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_ANG.txt
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B1.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B2.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B3.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B4.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B5.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B6.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B7.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B8.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B9.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B10.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_B11.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_BQA.TIF
- 📄 LC08_L1TP_168034_20190524_20190604_01_T1_MTL.txt



Landsat 8	Bands	Wavelength	Resolution
		(micrometers)	(meters)
Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	Band 1 - Ultra Blue (coastal/aerosol)	0.43 - 0.45	30
	Band 2 - Blue	0.45 - 0.51	30
	Band 3 - Green	0.53 - 0.59	30
	Band 4 - Red	0.64 - 0.67	30
	Band 5 - Near Infrared (NIR)	0.85 - 0.88	30
	Band 6 - Shortwave Infrared (SWIR) 1	1.57 - 1.65	30
	Band 7 - Shortwave Infrared (SWIR) 2	2.11 - 2.29	30
	Band 8 - Panchromatic	0.50 - 0.68	15
	Band 9 - Cirrus	1.36 - 1.38	30
	Band 10 - Thermal Infrared (TIRS) 1	10.60 - 11.19	100 * (30)
	Band 11 - Thermal Infrared (TIRS) 2	11.50 - 12.51	100 * (30)



Naming convention !

LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX

- L = Landsat
- X = Sensor ("C"=OLI/TIRS combined, "O"=OLI-only, "T"=TIRS-only, "E"=ETM+, "TM"=TM, "M"=MSS)
- SS = Satellite ("07"=Landsat 7, "08"=Landsat 8)
- LLL = Processing correction level (L1TP/L1GT/L1GS)
- PPP = WRS path
- RRR = WRS row
- YYYYMMDD = Acquisition year, month, day
- yyyymmdd - Processing year, month, day
- CC = Collection number (01, 02, ...)
- TX = Collection category ("RT"=Real-Time, "T1"=Tier 1, "T2"=Tier 2)

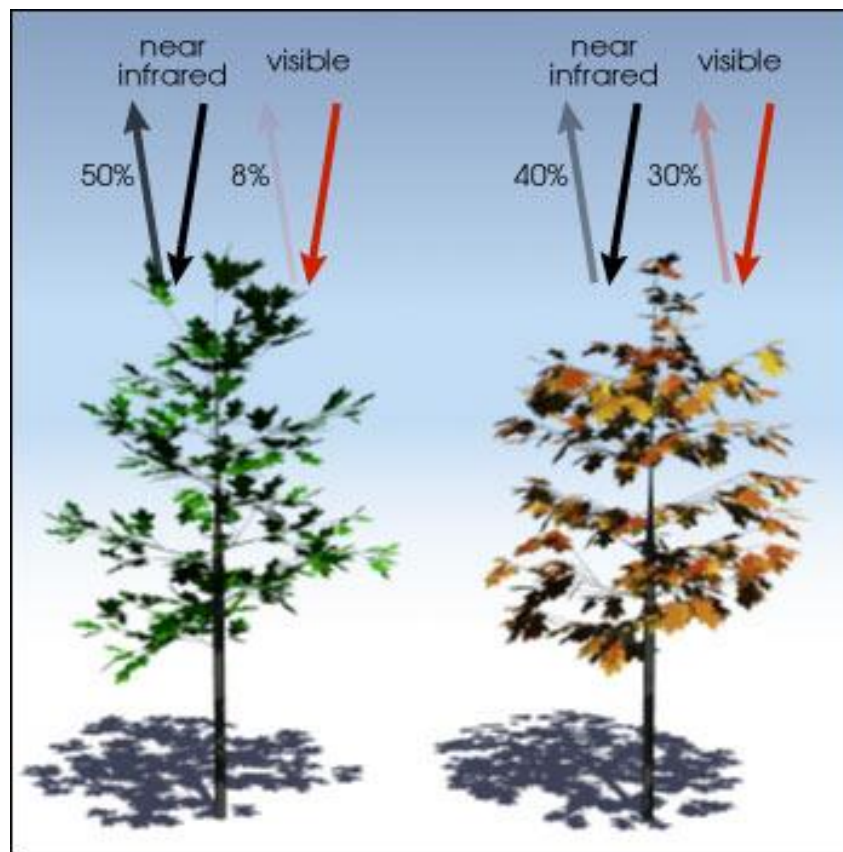
LC08_L1TP_168034_20190524_20190604_01_T1

Spectral Vegetation Indices

- Arithmetic combinations of different wavelength bands
- The combination of InfraRed and Visible bands enhances vegetation and compensates for some effects of soil background, shadows, viewing angles and atmosphere etc.
- For example, the ratio between NIR band and Red band could enhance vegetation from other land cover types
 - $VI = NIR/Red$
 - $VI = \text{Band 5} / \text{Band 4}$ (for Landsat 8)
- Most popular vegetation index is NDVI
 - Normalized Difference Vegetation Index (NDVI)

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

NDVI

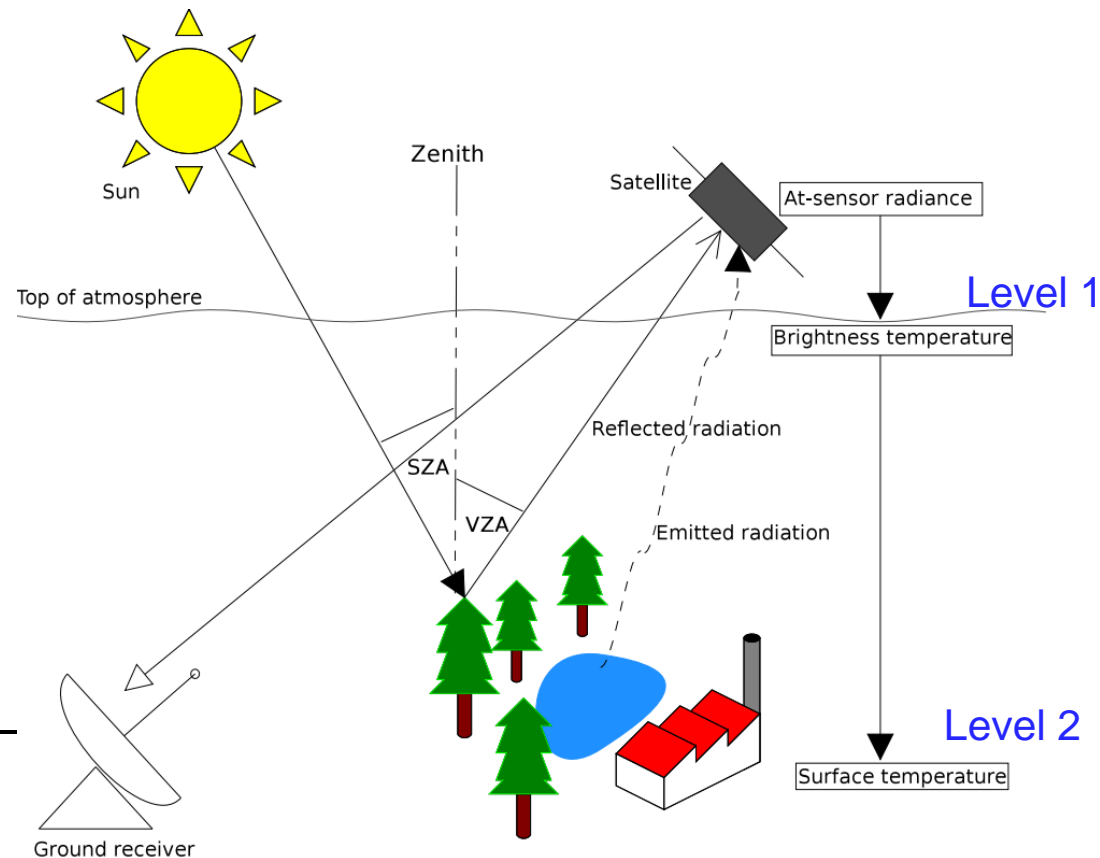


$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72$$

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

Preprocessing Landsat 8 data

1. Radiometric Calibration - Converting Digital Number to Top Of Atmosphere (TOA) reflectance.
2. Mask out cloud and shadow pixels using a cloud mask from BQA band
3. Atmospheric correction – Convert TOA reflectance to Surface reflectance



Radiometric Calibration

Band 1 – 9 -> DN to TOA reflectance

Bands 10,11 -> DN to Brightness temp

Exercise today !

Question:

1) How much irrigated area in Sq.km was there in the study area in 2019?

Objectives:

- To find the extent of irrigated area using three Landsat data you have downloaded representing the growing season!
- Compute univariate statistics of NDVI, Temperature (Band10) and Elevation over the different landcover types in study area and present as a table
- Compute area statistics in Sq.km of different landcover types in study area and present as a table
- Prepare a map layout showing irrigated area with all the map essentials and indicating the new computed irrigated area in sq.km

P.S: Let's consider Band 10 as a proxy to Surface temperature

Steps

- Pre-process Landsat data and compute NDVI for each date
- NDVI and Temperature over growing season (represented by three Landsat data)
- Compute surface area of different land cover types in sq.km
- Compute statistics to understand range of NDVI and Temperature over each land cover type
- Compare average NDVI and Temperature (Histograms?) over irrigated area to understand an unique trend and thresholds
- Apply those thresholds to extract irrigated area.

P.S: Do not use any classification algorithm

Data provided

- Study area boundary (Vector)
 - MIS boundary (Vector)
 - Elevation – 30m (Raster)
 - Landcover map – 250m (Raster)
-
- You have downloaded three Landsat data for dates 24 May 2019, 27 July 2019 and 28 August 2019

Time to crunch data !!!