**Remote Sensing and GIS for Rural Development**
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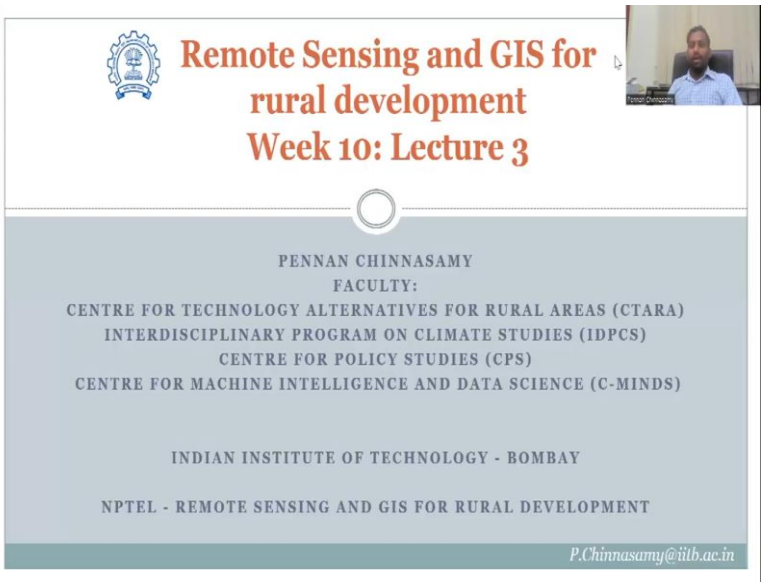
**Centre for Technology Alternatives for Rural Areas (CTARA)**
**Indian Institute of Technology, Bombay**
**Week – 10**
**Lecture – 3**
**NDVI Data Access**

(Refer Slide Time: 00:15)




Hello everyone. Welcome to the NPTEL course on Remote Sensing and GIS for Rural Development. This is Week 10, Lecture 3. In this week, we have been looking at NDVI, in particular, and using multi-source multi-theme data of the indicators that can be used for rural development in agriculture.

NDVI has been widely used because it gives you the healthiness of the plant and also can be used as a proxy for area acre coverage for vegetation. And these can be trickled down to other stakeholders that we discussed in the previous lectures like government agencies, insurance agencies, farmers for storage, business professionals for buying and creating the demand for the product.

All are linked to this healthy growing of agricultural crops. These have to be monitored regularly. And since observation data can be expensive, satellite-based data can be used. And in the previous exercise, we saw the 15-day window from Bhuvan, ISRO's website. So, now, if a particular pixel is moving from light green to dark green that means the plant is growing healthy.

Similarly, if every 15 days I am saying, if in a time frame it converts to gray from green to brown red then it means that the plant is has attained the peak growth and now it is it is dying down or ready to be harvested. If you see wheat rice, etcetera when it is growing it is very green and beautiful. But when you are going to harvest it, it turns the right color and the right color has a different signature on satellites and remote sensing data and that is where we have found that this NDVI as an indicator can help immensely on understanding the plant health, plant growth.

Then based on that what is the resources that are needed, both financially and natural resources or subsidies in fertilizers, water, pumping, etcetera. And we have seen one resource of it which is the Bhuvan ISROs database. Now, today we will go to the other resources as promised.

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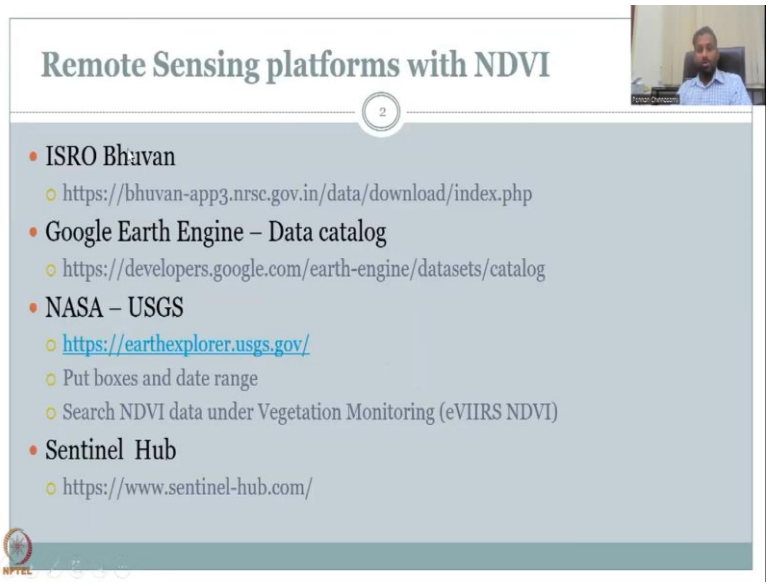


So, in the previous lecture, we looked at Bhuvan and if time permits, we can also look at how a pixel converts from one to the other in a particular time frame. But I would like to show the Google Earth engine which is really really impressive. So, let me share my Google Earth screen. So, the link is given but as usual I will share an empty window and start from scratch on how to search for it.

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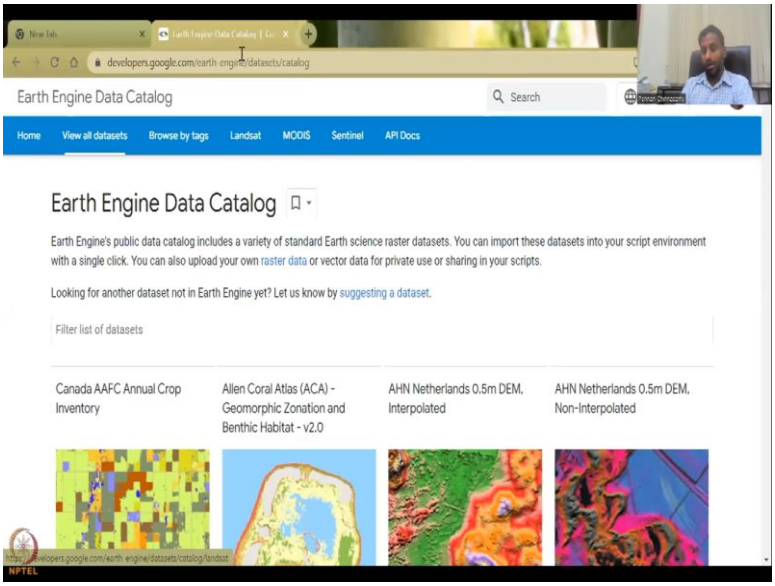


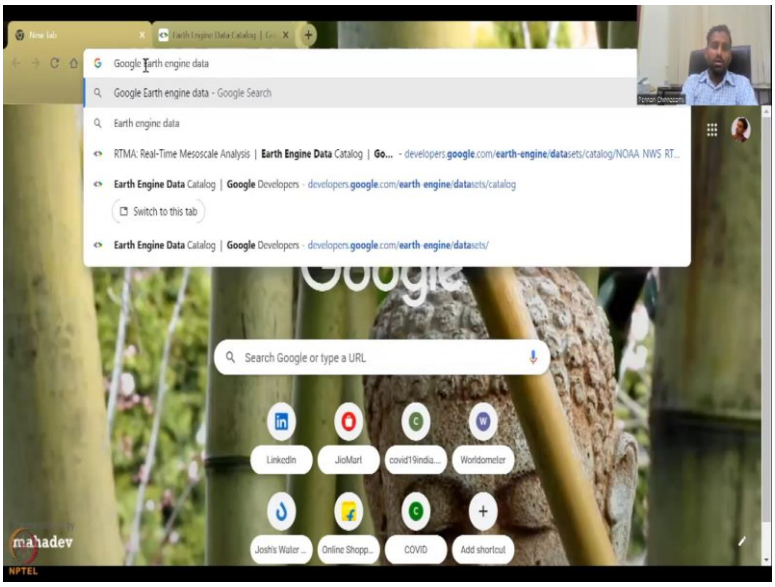


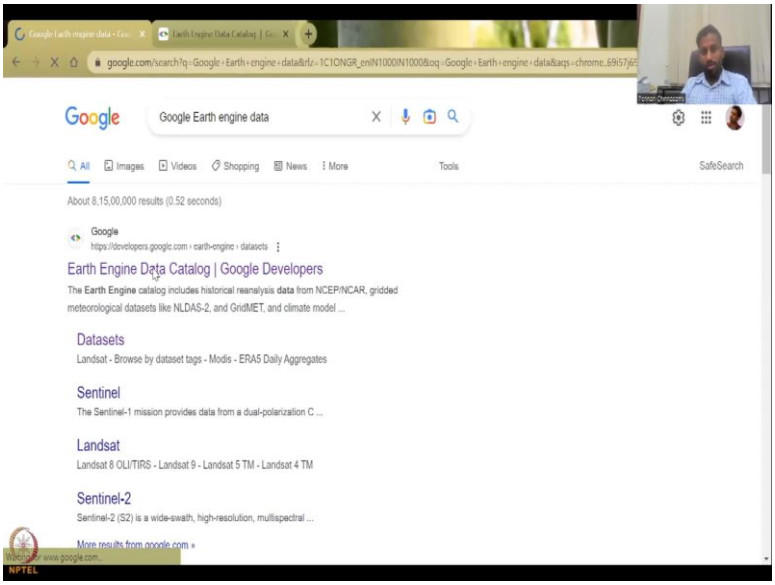

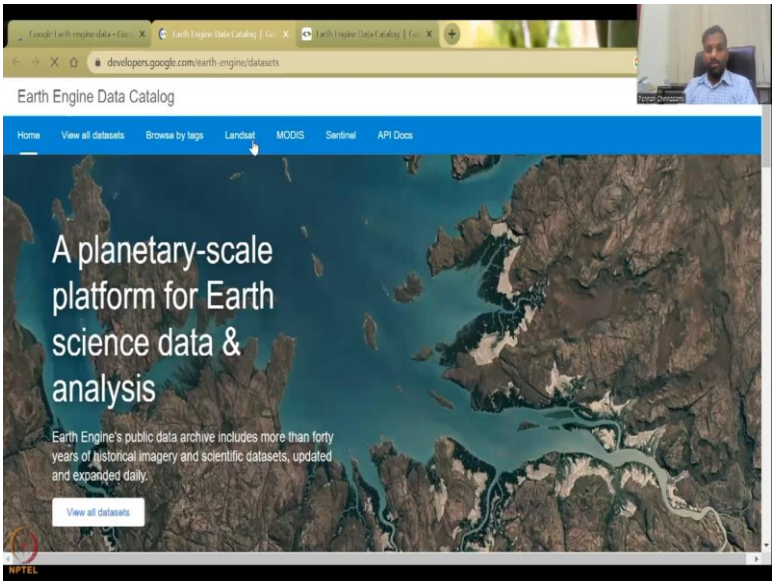
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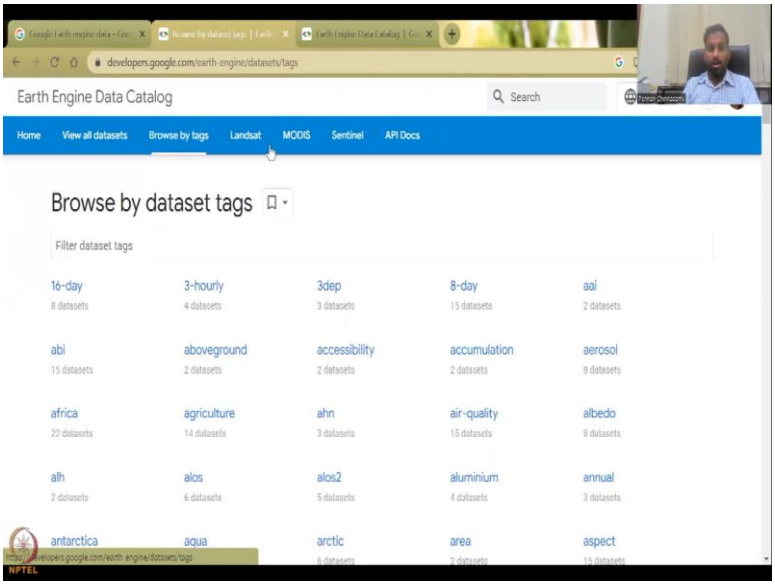
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8-day 15 datasets
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aboveground 2 datasets
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accumulation 2 datasets
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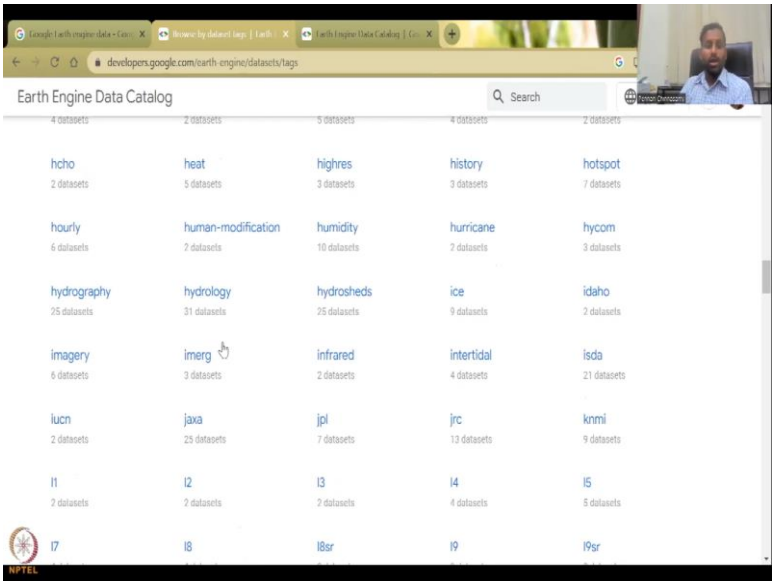
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imerg 3 datasets
infrared 2 datasets
intertidal 4 datasets
isda 21 datasets
iucn 2 datasets
jaxa 25 datasets
jpl 7 datasets
jrc 13 datasets
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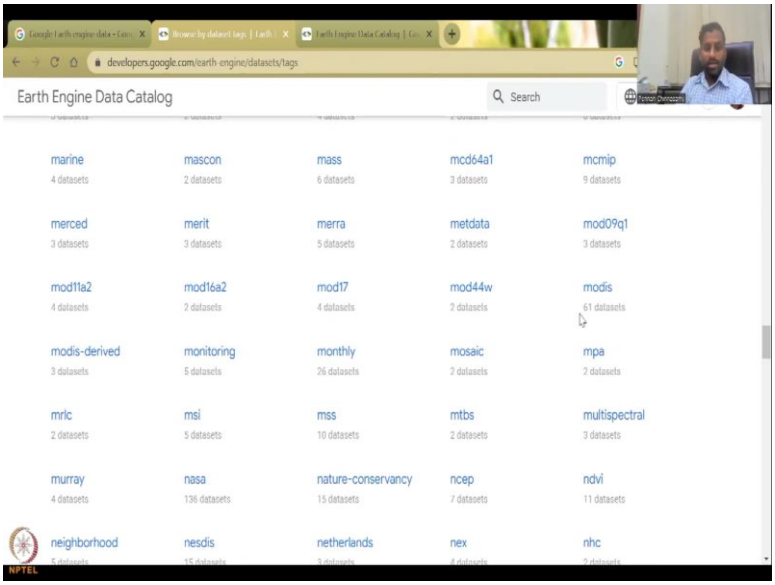
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mod11a2 4 datasets
mod16a2 2 datasets
mod17 4 datasets
mod44w 2 datasets
modis 61 datasets
modis-derived 3 datasets
monitoring 5 datasets
monthly 26 datasets
mosaic 2 datasets
mpa 2 datasets
mrlc 2 datasets
msi 5 datasets
mss 10 datasets
mtbs 2 datasets
multispectral 3 datasets
murray 4 datasets
nasa 136 datasets
nature-conservancy 15 datasets
ncep 7 datasets
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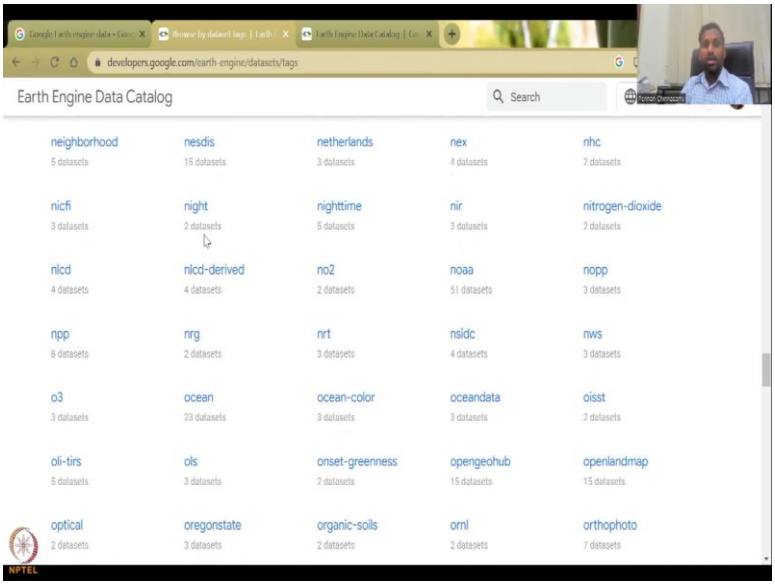
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no2 2 datasets
noaa 51 datasets
nopp 3 datasets
npp 8 datasets
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nrt 3 datasets
nsidc 4 datasets
nws 3 datasets
o3 3 datasets
ocean 23 datasets
ocean-color 3 datasets
oceandata 3 datasets
oisst 2 datasets
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openlandmap 15 datasets
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oregonstate 3 datasets
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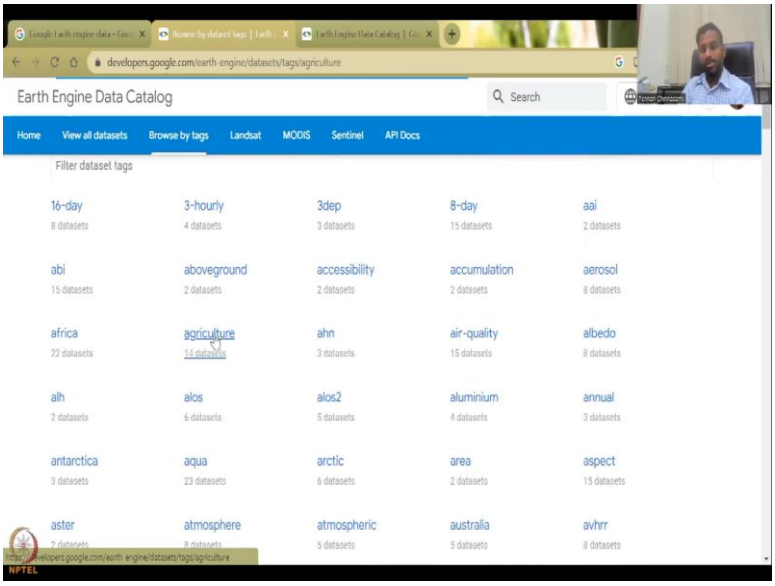
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area 2 datasets
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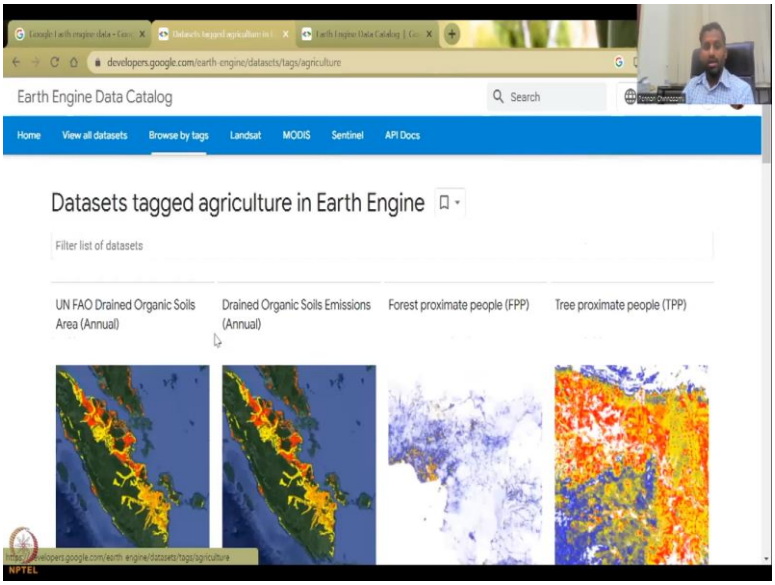
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Drained Organic Soils Emissions (Annual)
Forest proximate people (FPP)
Tree proximate people (TPP)
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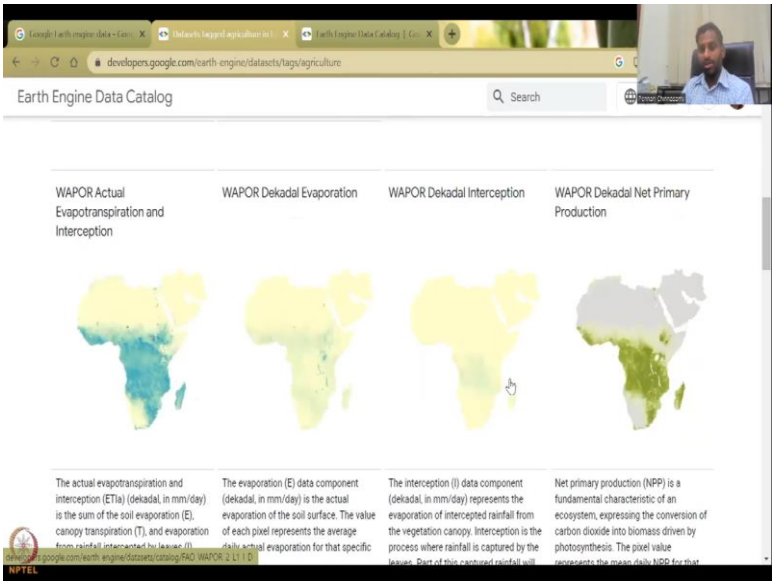
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WAPOR Actual Evapotranspiration and Interception
WAPOR Dekadal Evaporation
WAPOR Dekadal Interception
WAPOR Dekadal Net Primary Production
The actual evapotranspiration and interception (ETIa) (dekadal, in mm/day) is the sum of the soil evaporation (E), canopy transpiration (T), and evaporation
The evaporation (E) data component (dekadal, in mm/day) is the actual evaporation of the soil surface. The value of each pixel represents the average daily actual evaporation for that specific
The interception (I) data component (dekadal, in mm/day) represents the evaporation of intercepted rainfall from the vegetation canopy. Interception is the process where rainfall is captured by the
Net primary production (NPP) is a fundamental characteristic of an ecosystem, expressing the conversion of carbon dioxide into biomass driven by photosynthesis. The pixel value
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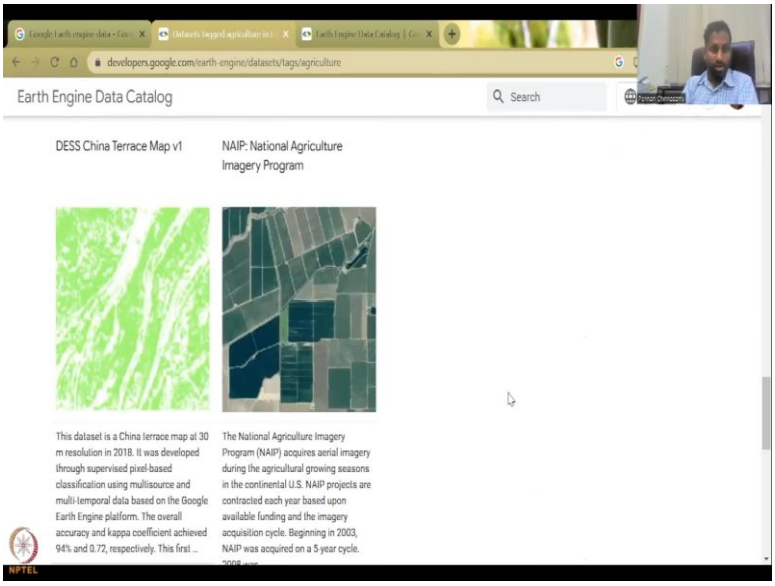
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DESS China Terrace Map v1
NAIP: National Agriculture Imagery Program
This dataset is a China terrace map at 30 m resolution in 2018. It was developed through supervised pixel-based classification using multisource and multi-temporal data based on the Google Earth Engine platform. The overall accuracy and kappa coefficient achieved 94% and 0.72, respectively. This first ...
The National Agriculture Imagery Program (NAIP) acquires aerial imagery during the agricultural growing seasons in the continental U.S. NAIP projects are contracted each year based upon available funding and the imagery acquisition cycle. Beginning in 2003, NAIP was acquired on a 5-year cycle.
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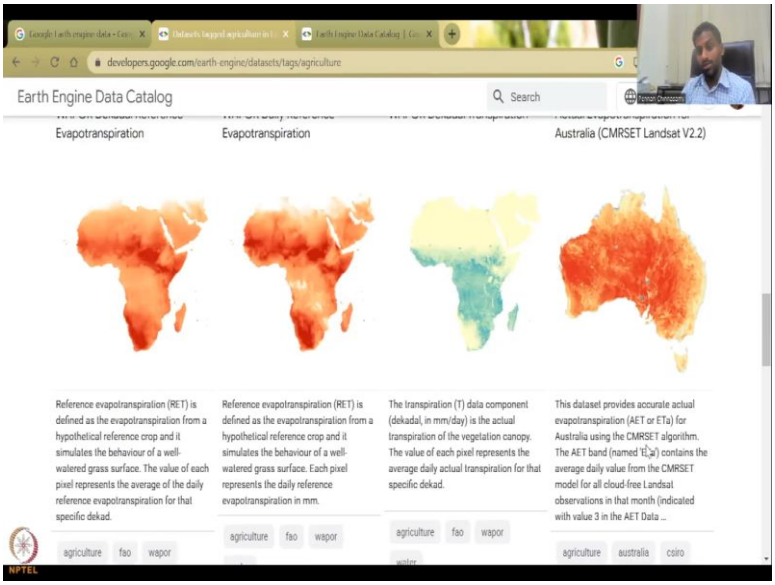


So, this is the link which I have shared already. But suppose the link is not working, let us see. So, Google Earth engine. You can type NDVI directly or you can actually just type data and then just click on. So, you have the data sets, data catalog. So, go to here, the first one will come up, and under that there is multiple tabs.

So, you can say by satellites, landsat has been used for NDVI models has been used by NDVI Sentinel has been used for an NDVI but we will just look at tags. So, if you just click tags and type vegetation then you can see a multiple vegetation. But before that I want to explain what these tags are. The tags are like Twitter and Instagram that you put tags of a picture.

So, when a data set is created for quick access and search, these are like a keyword. So, the tags are given so that people can just type and then find. So, for example, for agriculture there is one. If you come down this arranged in alphabetical order. So, if you come down for crops, hydrology, you have hydrology and then you have landsat for the satellite itself or land fire as a product.

So, modis as a satellite and M N, so, we are coming at N now. So, n has NSD, NIR, nitrogen, et cetera. So, we do not have it as NDVI but we do have agriculture. So, let us quickly look at what do we have in agriculture. We also have deforestation which is also very important. So, let us say, agriculture and how many data sets are there.

You have the UN FAO drained soils, or the soils that are drained, organic soil emissions, decadental evaporation, net productivity, all these are related to agricultural productivity, etcetera. And then the national agricultural imagery program and there is something for just

the Chinese region. So, you have African regions also, very very focusedly done in Australia. These could be their own satellites that they map only their regions and we can also go by tags.

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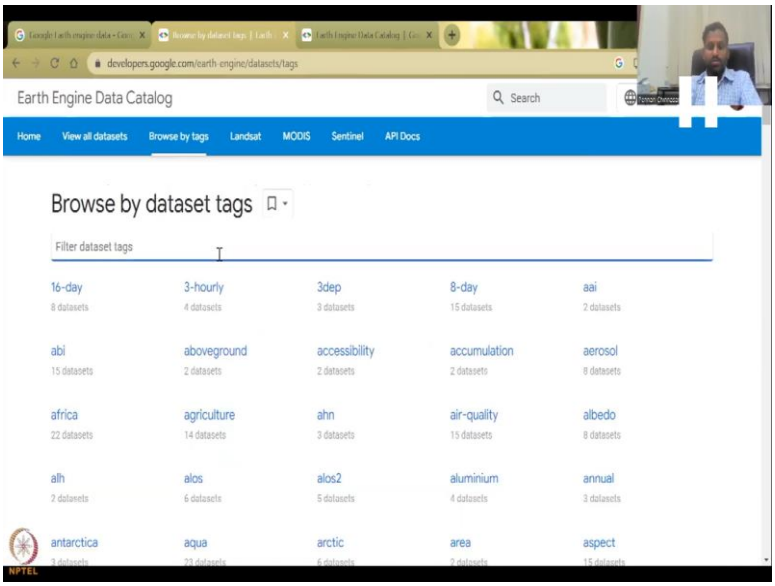


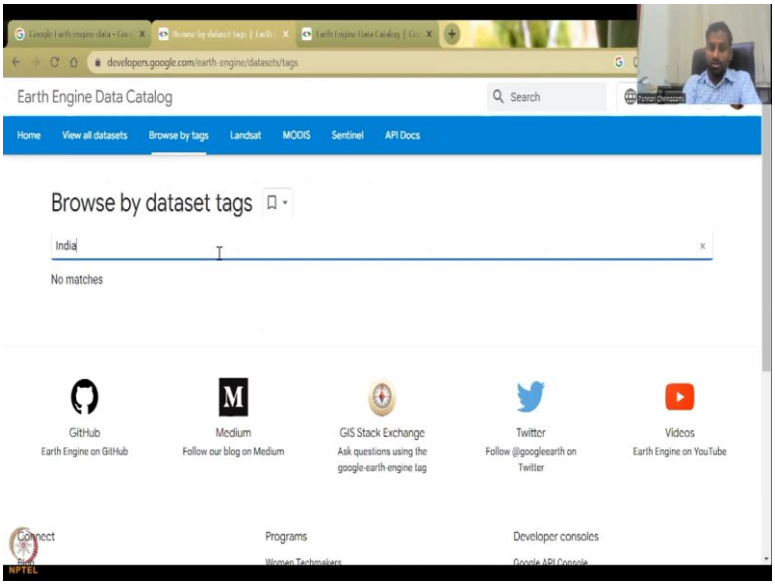

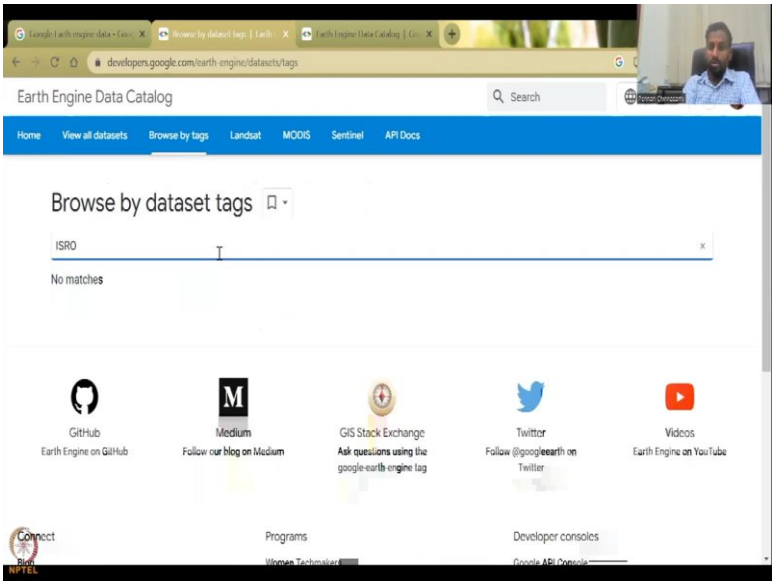
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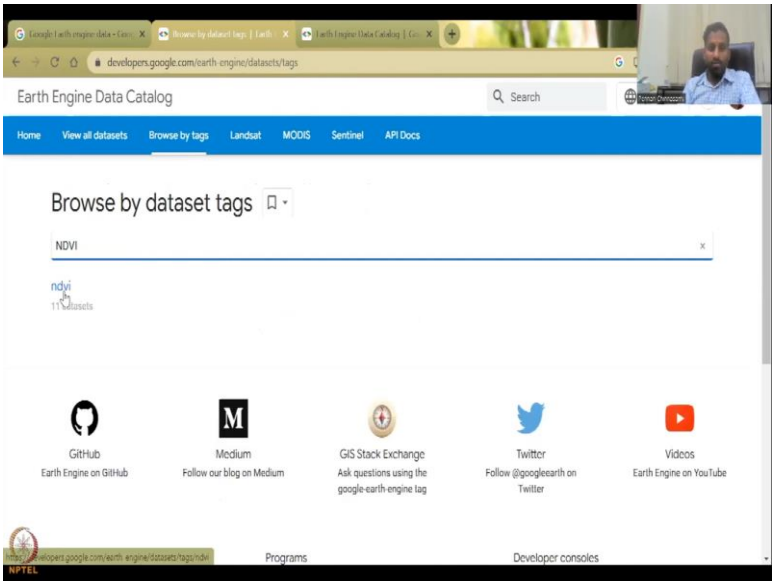
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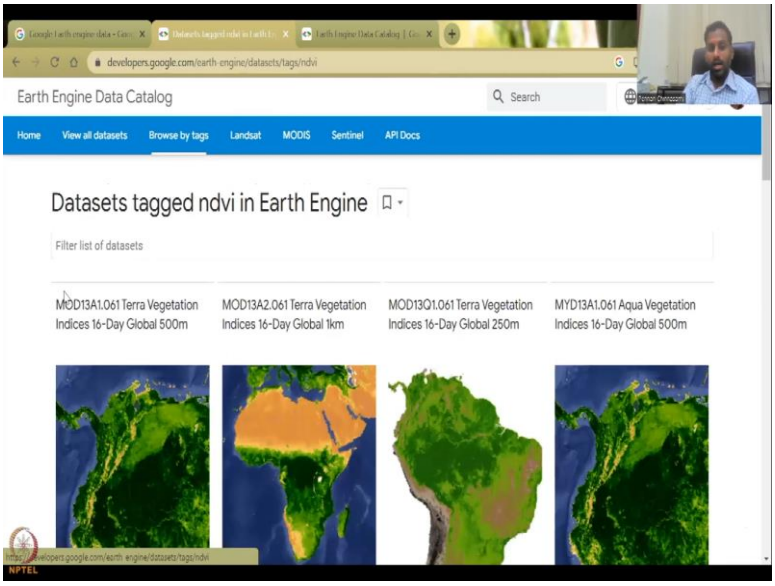
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MOD13A2.061 Terra Vegetation Indices 16-Day Global 1km
MOD13Q1.061 Terra Vegetation Indices 16-Day Global 250m
MYD13A1.061 Aqua Vegetation Indices 16-Day Global 500m
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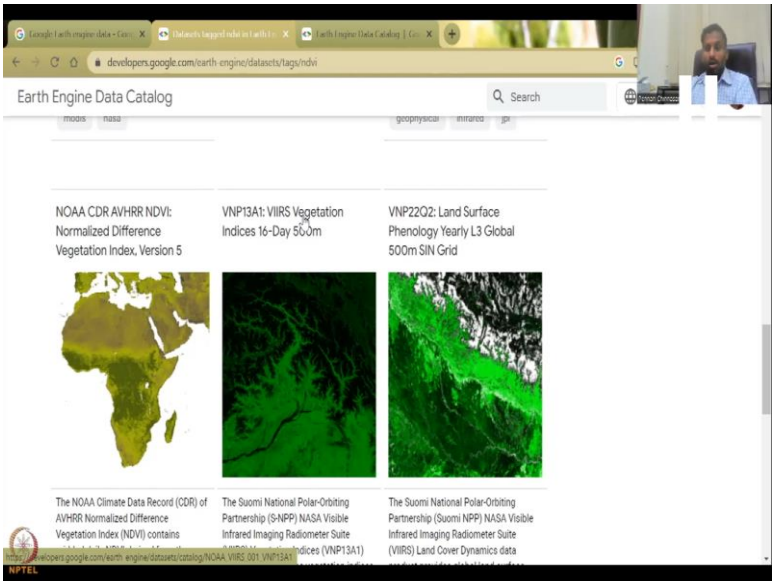
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Search
NOAA CDR AVHRR NDVI: Normalized Difference Vegetation Index, Version 5
VNP13A1: VIIRS Vegetation Indices 16-Day 500m
VNP22Q2: Land Surface Phenology Yearly L3 Global 500m SIN Grid
The NOAA Climate Data Record (CDR) of AVHRR Normalized Difference Vegetation Index (NDVI) contains
The Suomi National Polar-Orbiting Partnership (S-NPP) NASA Visible Infrared Imaging Radiometer Suite
The Suomi National Polar-Orbiting Partnership (Suomi NPP) NASA Visible Infrared Imaging Radiometer Suite (VIIRS) Land Cover Dynamics data
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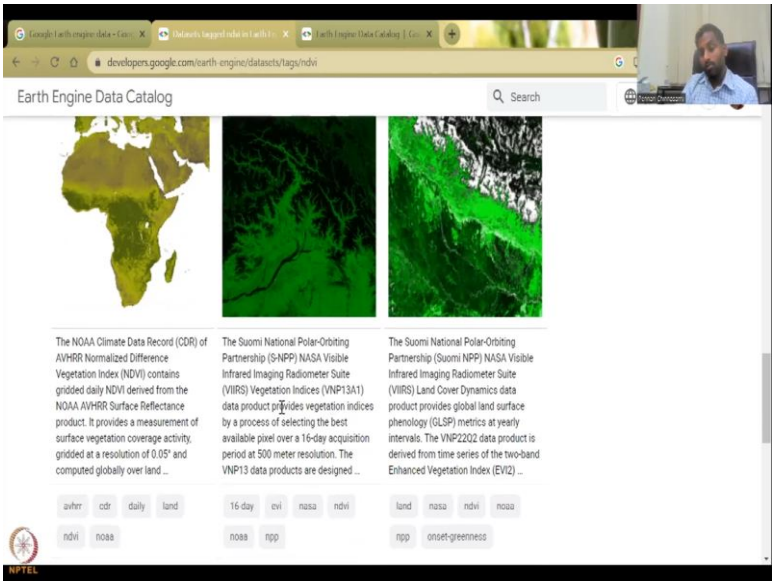
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The NOAA Climate Data Record (CDR) of AVHRR Normalized Difference Vegetation Index (NDVI) contains gridded daily NDVI derived from the NOAA AVHRR Surface Reflectance product. It provides a measurement of surface vegetation coverage activity, gridded at a resolution of 0.05° and computed globally over land ...
The Suomi National Polar-Orbiting Partnership (S-NPP) NASA Visible Infrared Imaging Radiometer Suite (VIIRS) Vegetation Indices (VNP13A1) data product provides vegetation indices by a process of selecting the best available pixel over a 16-day acquisition period at 500 meter resolution. The VNP13 data products are designed ...
The Suomi National Polar-Orbiting Partnership (Suomi NPP) NASA Visible Infrared Imaging Radiometer Suite (VIIRS) Land Cover Dynamics data product provides global land surface phenology (GLSP) metrics at yearly intervals. The VNP22Q2 data product is derived from time series of the two-band Enhanced Vegetation Index (EVI2) ...
avhrr
cdr
daily
land
ndvi
noaa
16-day
evi
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onset-greenness
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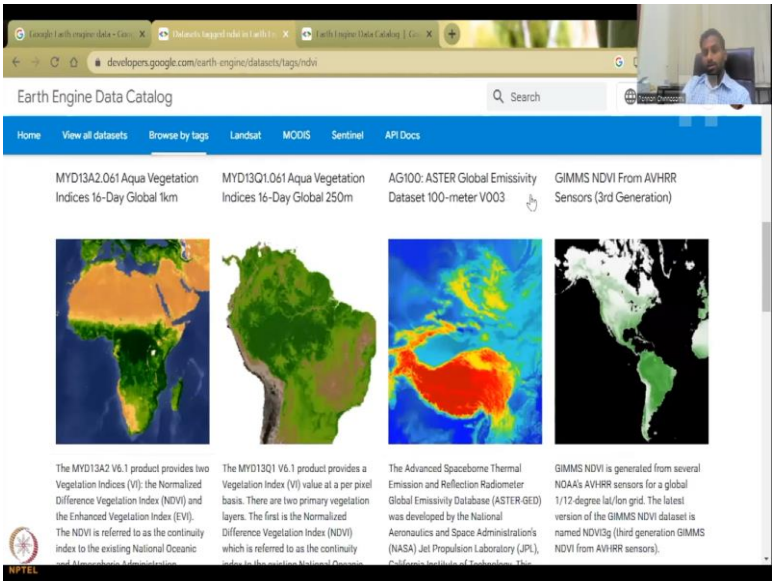
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MYD13A2.061 Aqua Vegetation Indices 16-Day Global 1km
MYD13Q1.061 Aqua Vegetation Indices 16-Day Global 250m
AG100: ASTER Global Emissivity Dataset 100-meter V003
GIMMS NDVI From AVHRR Sensors (3rd Generation)
The MYD13A2 V6.1 product provides two Vegetation Indices (VI): the Normalized Difference Vegetation Index (NDVI) and the Enhanced Vegetation Index (EVI).
The MYD13Q1 V6.1 product provides a Vegetation Index (VI) value at a per pixel basis. There are two primary vegetation layers. The first is the Normalized Difference Vegetation Index (NDVI)
The Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Emissivity Database (ASTER GED) was developed by the National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL),
GIMMS NDVI is generated from several NOAA's AVHRR sensors for a global 1/12-degree lat/lon grid. The latest version of the GIMMS NDVI dataset is named NDVI3g (third generation GIMMS NDVI from AVHRR sensors).
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So, you can click browse by tags and if it is very specific, you can also click India, there is no match, not updated yet. ISRO is also no match yet they do not have it as a tag and and as we saw in NDVI, we have 11 data sets and these are the 11 data sets. So, 11 data sets are available and this is. So, if you look at the Bhuvan, what was the resolution? It was one kilometer, 15 days.

Here, it is 16 days almost 15 days and then 500 meters. So, higher spatial resolution from this particular payload V I I R S. We will be seeing this in when we download the NASA data days from the earth Explorer. But for now, we can see that what are the different NDVI's that are there, land surface phenology, Aster Global emissivity NDVI can be created, GIMMS NDVI etcetera, etcetera. So, we have a global 16-day, 1 kilometer coverage which is as similar as our the one we have from Bhuvan and this is very very recent also.

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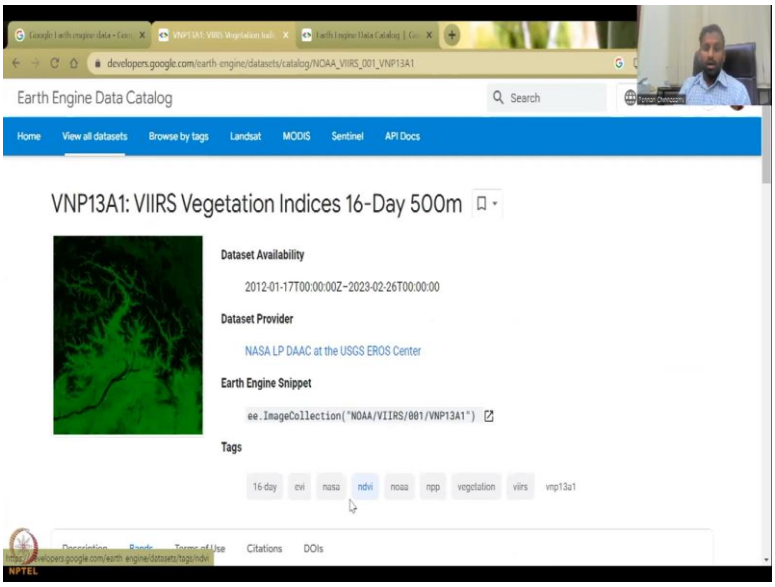


So, the one in Bhuvan we had stopped it. So, I am doing this on the same day. Why? Because I want to show what is the difference between the data sets, the recordings I am saying. I am doing it on the same day so that you can witness that which data set is best for your analysis. Suppose, you have a region and you are working for an Indian region and you you need to see that if the data is available from a particular date. So, in the Bhuvan region it was 2011, 2011 to 2021.

So, I said around 11 years whereas here it is 2012 till date. So, this is just. So, now, today is around the March. So, yeah. So, the last date, we have the 16th date which is February end. So, this is very very recent data. And it takes a year for this to appear in the Bhuvan. If you

go to Bhuvan you can get good data until 2021 but then you will have to wait for a year to get 2022 and 2023. So, only in 2024 you get 2022. So, there is approximately 2 years of, about one year, one and a half years of delay.

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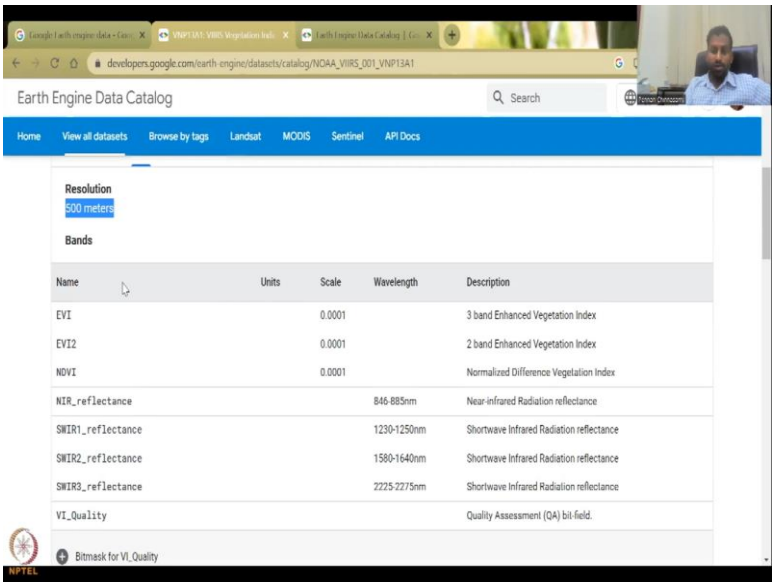


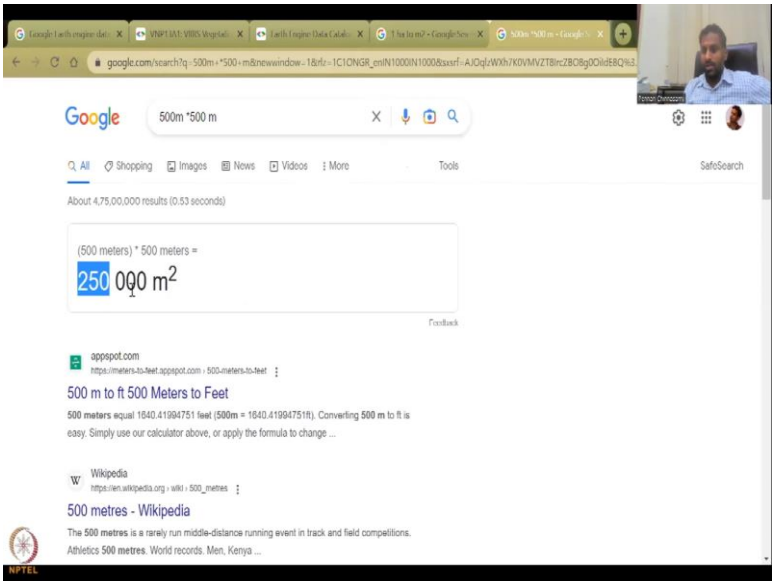

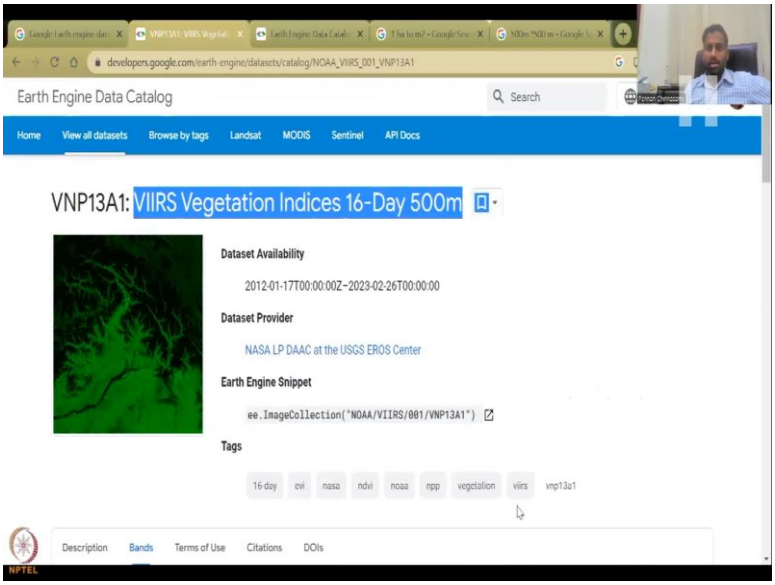


Whereas here you have it all. And it is not only one particular area, it is for the globe. And the resolution is much much better than Bhuvan. It is 500 meters because the average land holding size is one hectare. So, one hectare is pretty small. So, just let us say, one hectare to meters square.

So, we get around 10,000 square meters. And this pixel is 500 times 500 meters. So, this pixel is around a 250 meters. So, we have 250,000 meters square, this one. But think about one kilometer that is double of this. So, somewhere these are still not as small as we want it but for free source we can do it.

And if we know that in a particular belt we have almost the same things across 500 by 500 meters and this is pretty good. So, I will show you how to use it one by one. So, we looked into this VIIRS vegetation index 16 day and it is a composite of indexes, not only NDVI that is what Google Earth gives, engine gives.

So, Google the engine collects the data sets that are available and couples it for the payload. So, this is the payload or the satellite and we have these other bands. So, these are not the bands like. So, this is the bands which are the NIR, SWIR, etcetera, etcetera and then they use this for creating these indicators.

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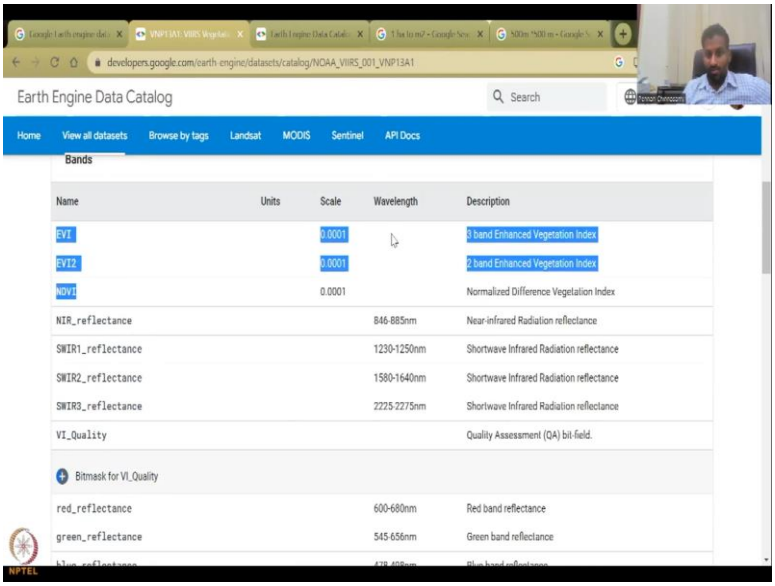
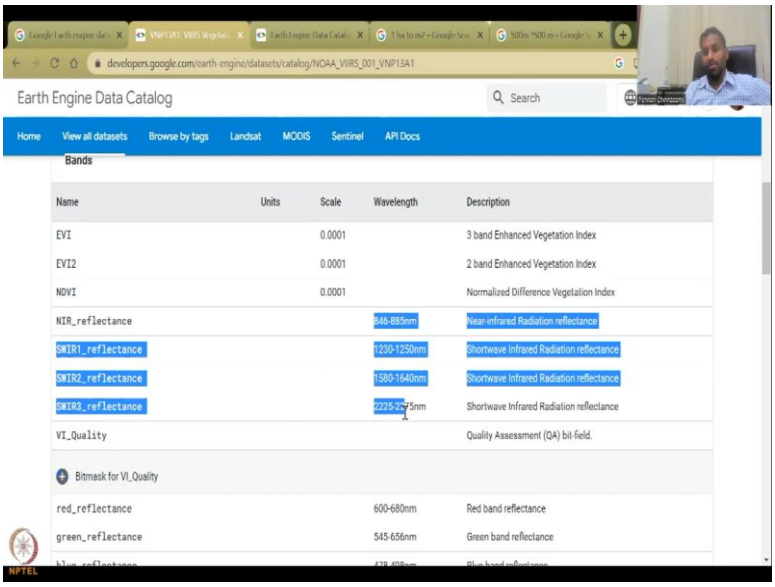
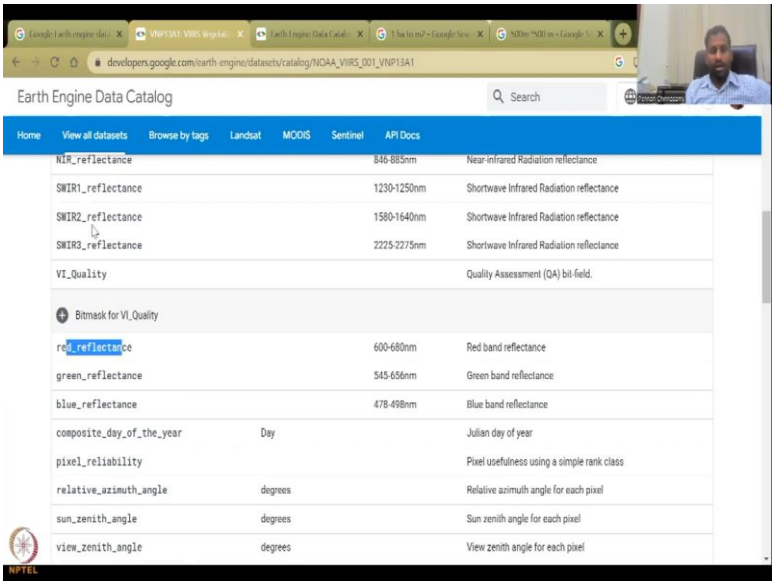
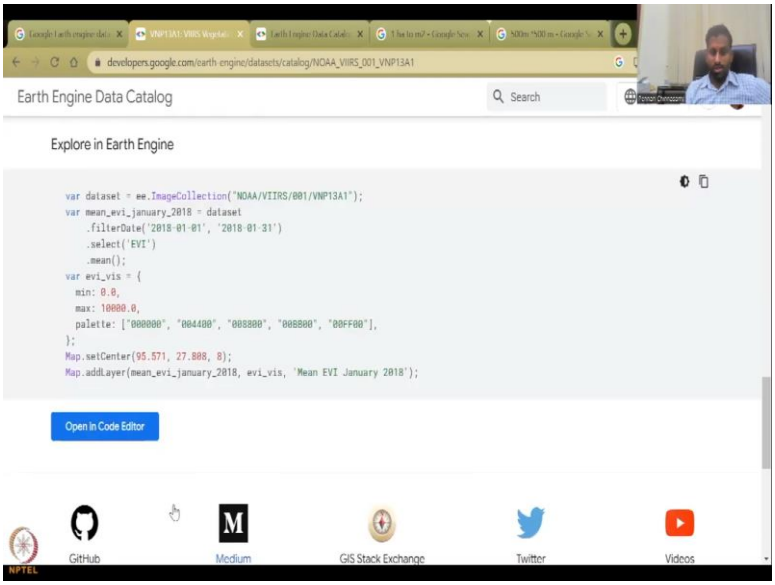


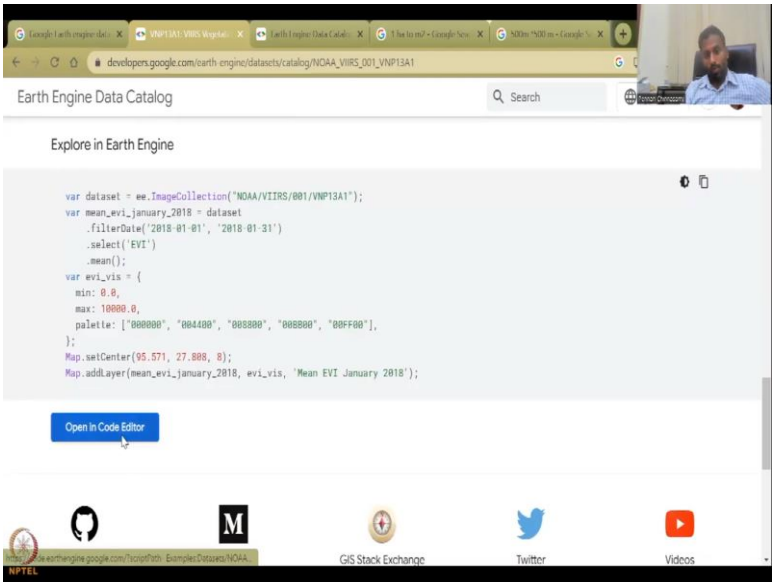



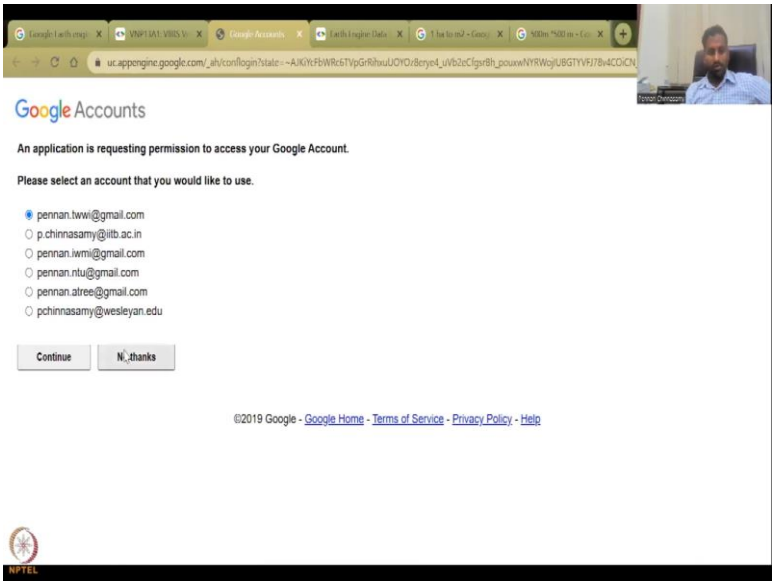



So, the indicators will not have a wavelength, you can see, whereas these are available. And there are rescale. So, if you see that they are rescaled to particular values which are double checked by them. So, normalized vegetation index is what we want. This is the enhanced vegetation index.

Let us not get into that because every time they create new new indexes, indices but we will keep the NDVI which is very well known. And then we have the qualities, the band reflectance, green, blue, red. So, as we said the red near infrared. So, NIR minus red by, divided by NIR plus red is NDVI which has been done already by the Google Earth engine.

(Refer Slide Time: 10:47)

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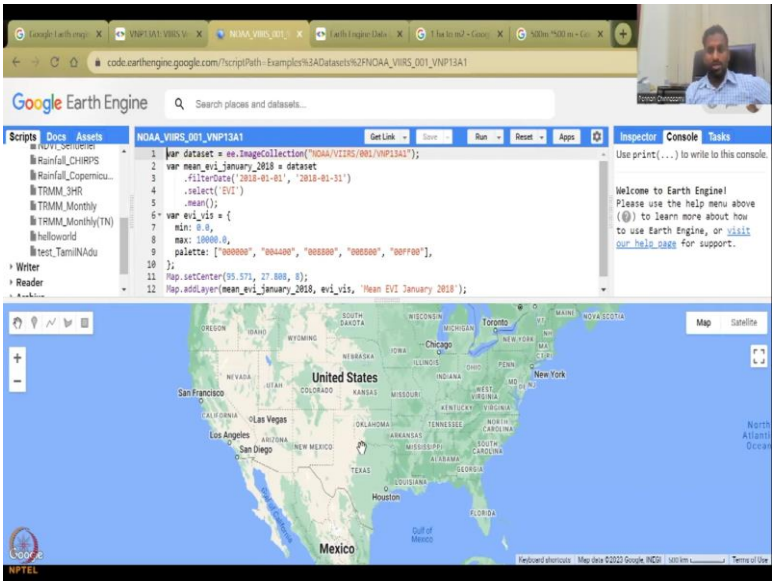
Google Earth Engine
Search places and datasets...
Scripts
Docs
Assets
NOAA_VIIRS_001_VNP13A1
Get Link
Save
Run
Reset
Apps
Inspector
Console
Tasks
var dataset = ee.ImageCollection("NOAA/VIIRS/001/VNP13A1");
var mean_evi_january_2018 = dataset
.filterDate('2018-01-01', '2018-01-31')
.select('EVI')
.mean();
var evi_vis = {
min: 0.0,
max: 10000.0,
palette: ["000000", "004400", "008800", "00FF00"],
};
Map.setCenter(95.571, 27.808, 8);
Map.addLayer(mean_evi_january_2018, evi_vis, 'Mean EVI January 2018');
Use print(...) to write to this console.
Welcome to Earth Engine!
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Reader
Map
Satellite
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San Diego
Houston
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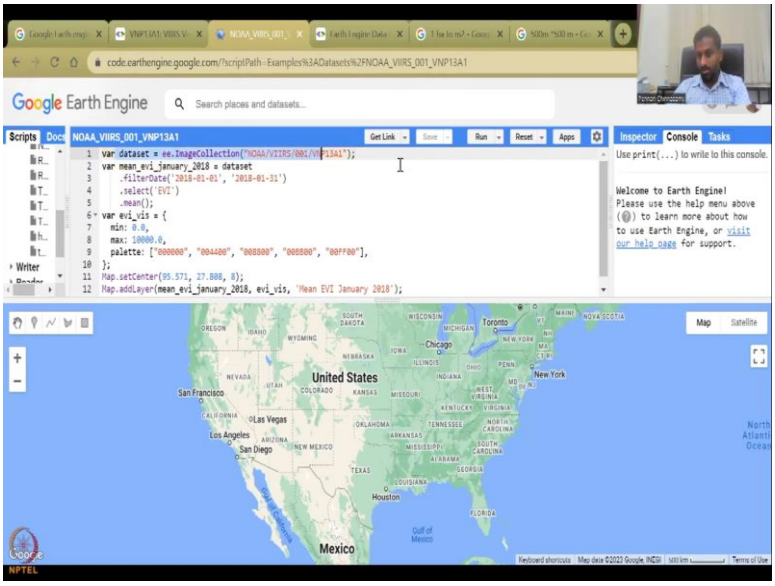
Google Earth Engine
Search places and datasets...
Scripts
Docs
NOAA_VIIRS_001_VNP13A1
Get Link
Save
Run
Reset
Apps
Inspector
Console
Tasks
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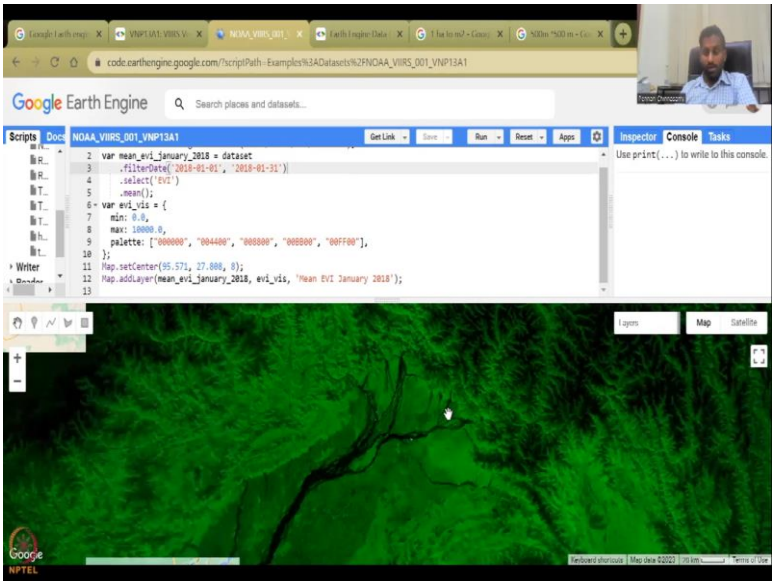
Map
Satellite
United States
Mexico
Toronto
Chicago
New York
San Francisco
Las Vegas
Los Angeles
San Diego
Houston
NPTEL

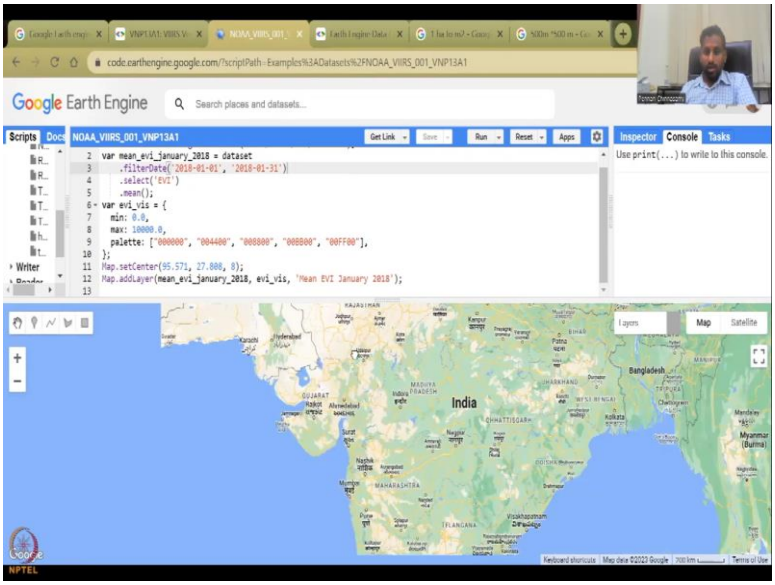
So, if you open the code, it will ask for which email you would like to use. So, you have multiple emails in Gmail. So, you can take which Gmail you would like to use and then you can look at where and how you would like to put the dates. So, this is for the globe and it can be changed as per need.

As I said this learning into the coding world does take time but will not get into that for now, in the basic remote sensing class. When we go to advanced level, yes, we will do some coding on this. I can share some codes that we have written through my students, one of my students shivanand has written good quotes. I will show you how the result is. This is mostly to showcase the remote sensing tools and how they are powerful compared to the other tools so that you can widely use them for NDVI analysis.

So, here is the data set, the data set is taken as VIRS, the versions are given here and then what it means is January 2018 data set. So, all these are mean they have taken. This is where you can pick and choose. So, here you could see that the mean date, mean January evi is being taken and given here. So, we have 2018 into 2018 01 and this this is the evi, not the NDVI, but if you run it, we can see how the code runs.

(Refer Slide Time: 12:39)




Google Earth Engine
Search places and datasets...
Scripts
NOAA_VIIRS_001_VNP13A1
Get Link
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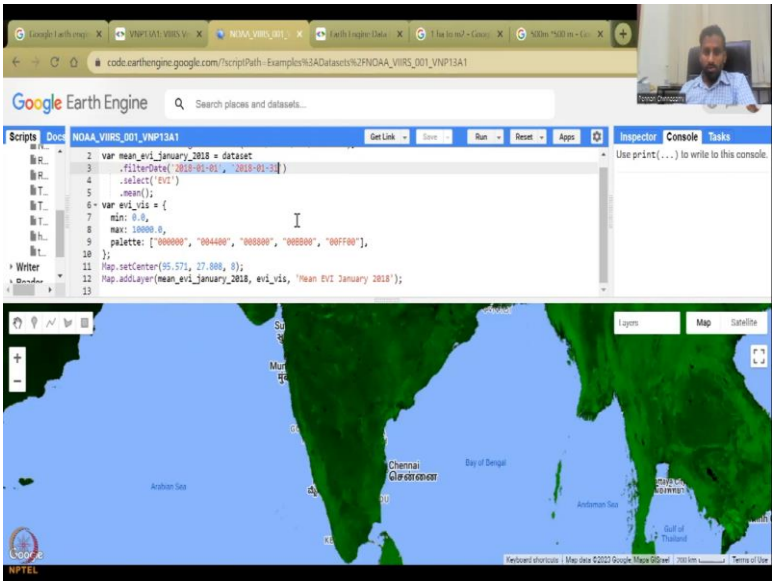
Apps
Inspector
Console
Tasks
Use print(...) to write to this console.
var mean_evi_january_2018 = dataset
.filterDate('2018-01-01', '2018-01-31')
.select('EVI')
.mean();
var evi_vis = {
min: 0.0,
max: 10000.0,
palette: ["000000", "004400", "008800", "00B800", "00FF00"],
};
Map.setCenter(95.571, 27.808, 8);
Map.addLayer(mean_evi_january_2018, evi_vis, 'Mean EVI January 2018');
India
Bangladesh
Map
Satellite
NPTEL


Google Earth Engine
Search places and datasets...
Scripts
NOAA_VIIRS_001_VNP13A1
Inspector
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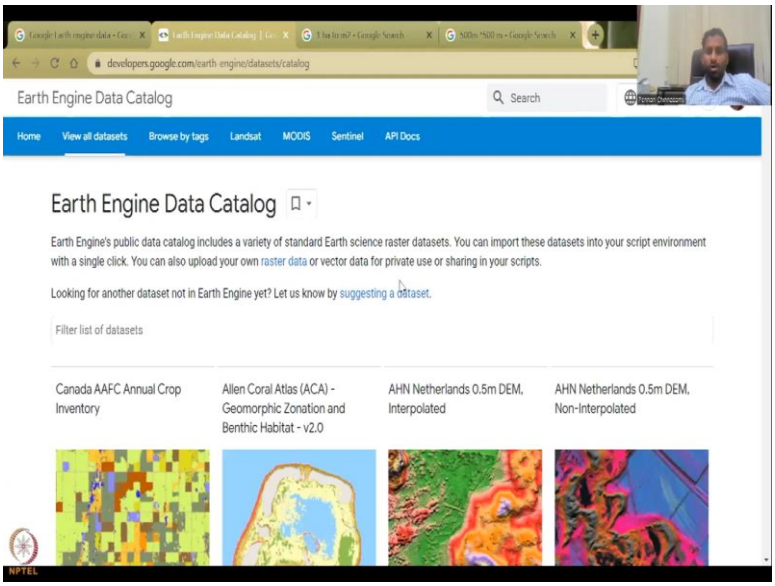
Tasks
Use print(...) to write to this console.
Chennai
Bay of Bengal
Arabian Sea
Andaman Sea
Gulf of Thailand
Map
Satellite
NPTEL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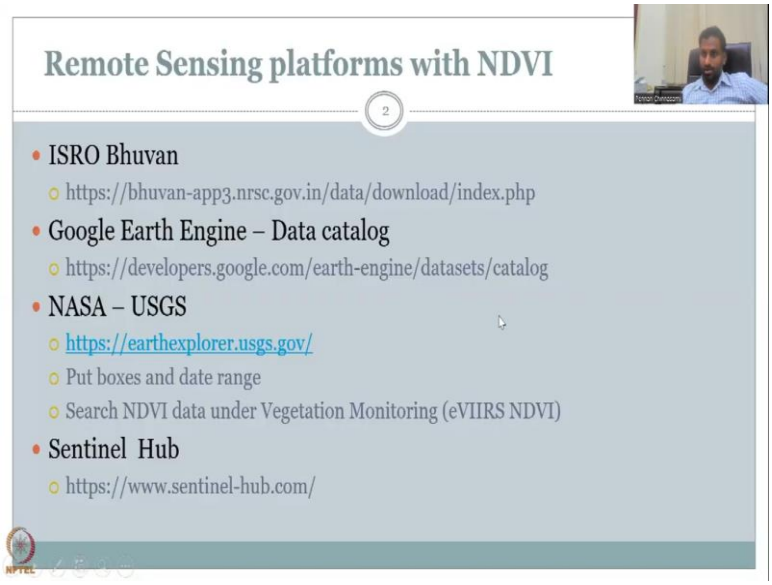
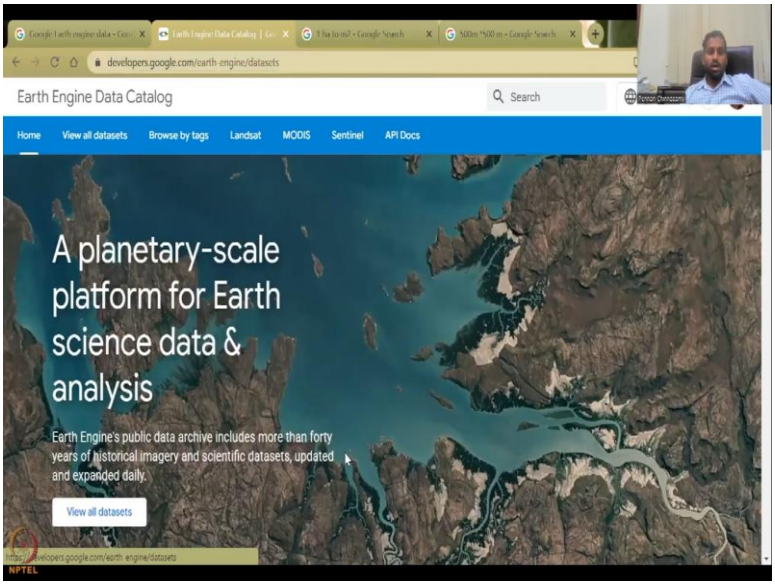
AHN Netherlands 0.5m DEM, Non-Interpolated
NPTEL


Remote Sensing platforms with NDVI
2
ISRO Bhuvan
https://bhuvan-app3.nrsc.gov.in/data/download/index.php
Google Earth Engine – Data catalog
https://developers.google.com/earth-engine/datasets/catalog
NASA – USGS
https://earthexplorer.usgs.gov/
Put boxes and date range
Search NDVI data under Vegetation Monitoring (eVIIRS NDVI)
Sentinel Hub
https://www.sentinel-hub.com/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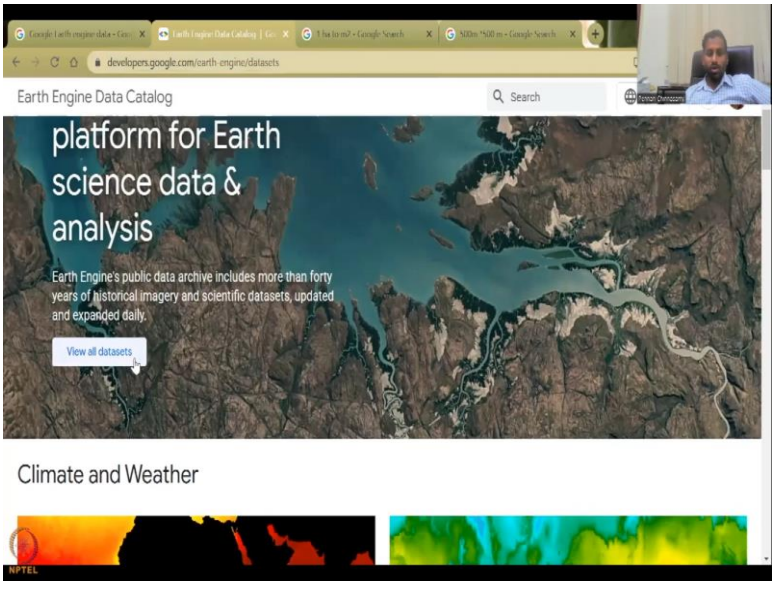
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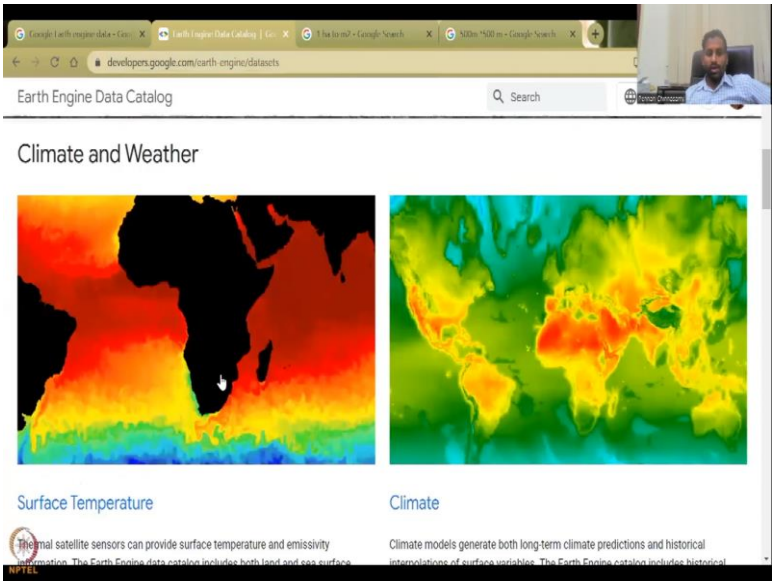


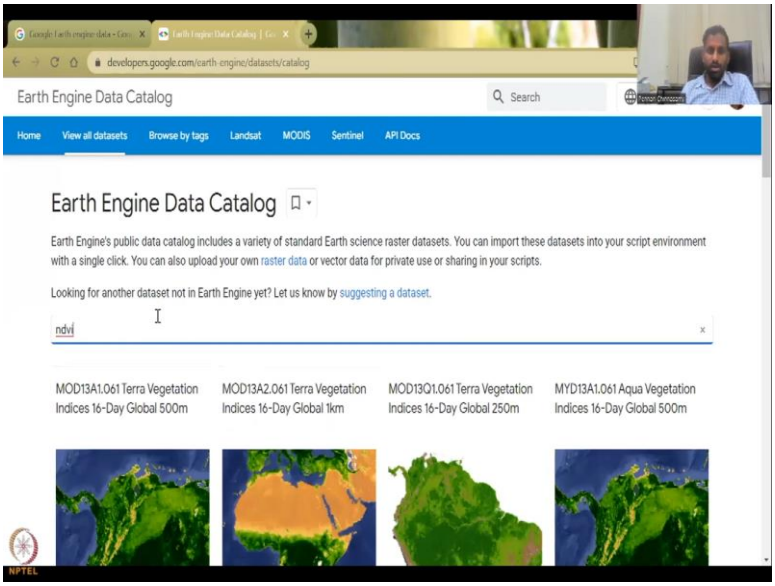

So, basically it just quickly takes up the data set and then plots the vegetation index, really beautiful and very quick and the resolution is very very good. So, there it is. It is actually plotted in our own Indian region which is good but if you can zoom out you can actually see India being the layer.

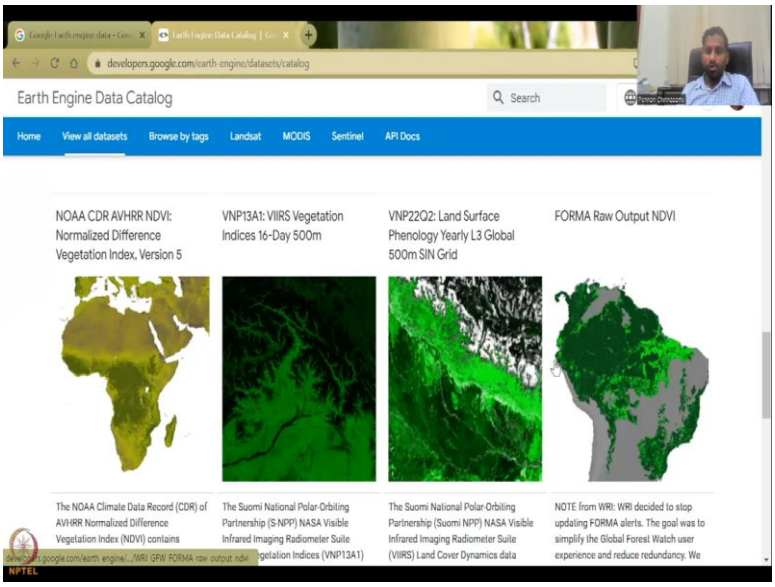
So, the layers here is get get populated in Google Earth engine. So, this is a vegetation fraction for January, you can see January 1 to January 18, the composite vegetation has been taken. Here, the legends are not clear. So, you will have to download it put it in GIS and do it. But what this does for you is it gets the data for you quickly and all you have to do is download the data and use it on your QGIS platform as a raster and then does the other calculations.

So, as I promised, I will show the other NDVIs that I have. So, before that let us close this so that I can show you the other tab that we opened. So, these are the Earth engine catalog. So, the link I have given on the presentation is the link for the data sets, the data catalogs. You can see here the data catalogs and if you click that you will get into this website which is this Earth data catalogs. How do you go there?

You go to data catalog, it will come here and then here you can say home or view all data sets. The home comes like this for Earth engine and you can see view all data sets, climate weather, climate agriculture, etcetera, etcetera. High imagery you can take. You can say just view all data sets or browse by tags. The browse by tags we already have done. So, let us not get into that part now, we only look into view all data sets. It does take some time depending on the internet. So, here we are.

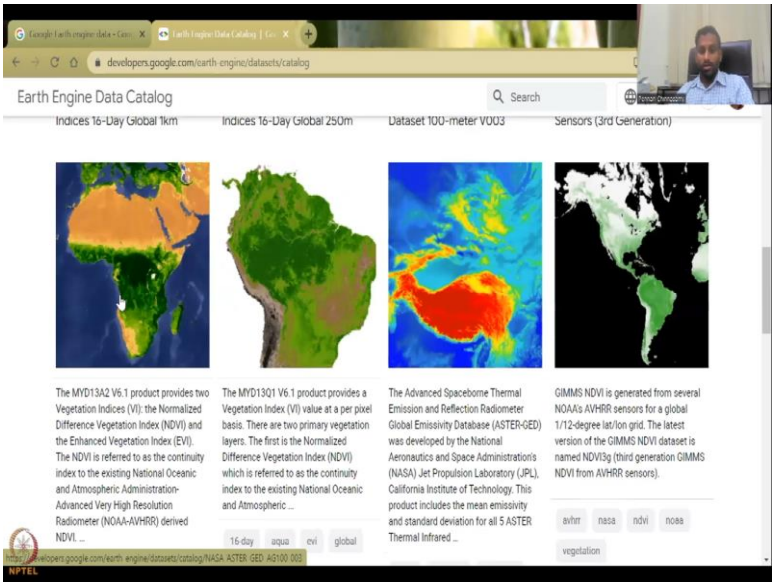
(Refer Slide Time: 14:44)

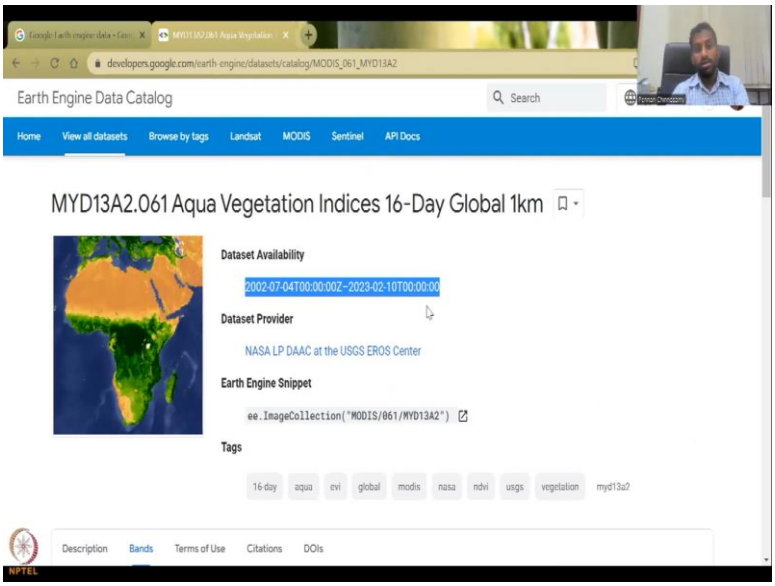


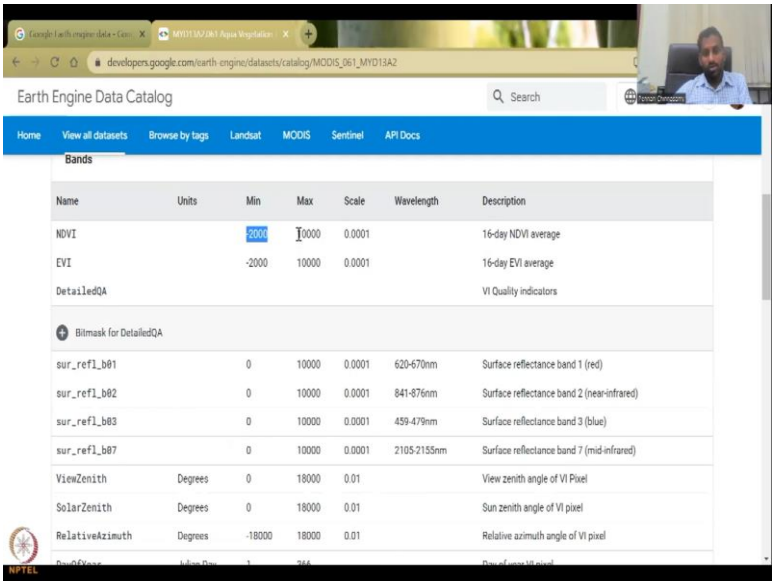



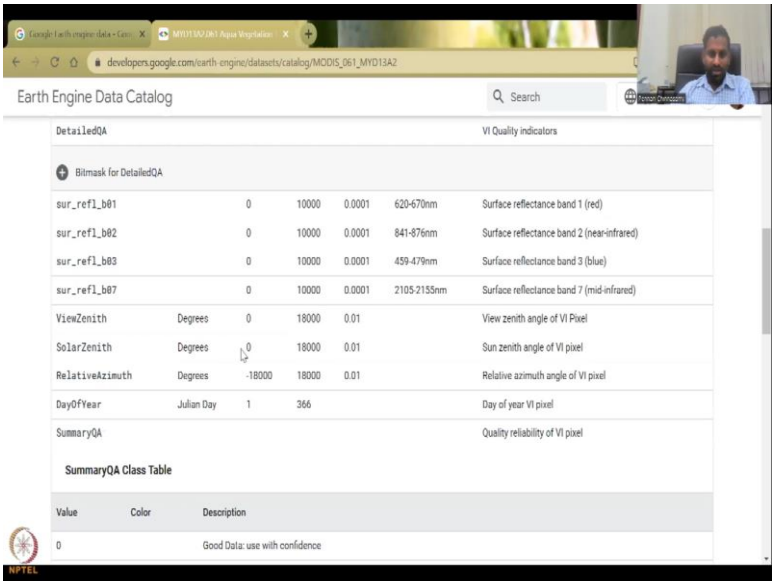

So, here we can just type NDVI and there you are. We do not have type enter, you can type enter but then you can also see all the NDVI data here. Here you would see 1 2 3 4, 4, 8, 12, in the other one, well, we in the other one we saw 11. So, here somewhere else it searches for the word NDVI not the tag. So, here somewhere it could have said that this data can be used for NDVI. So, then you can use it for NDVI and then do it.

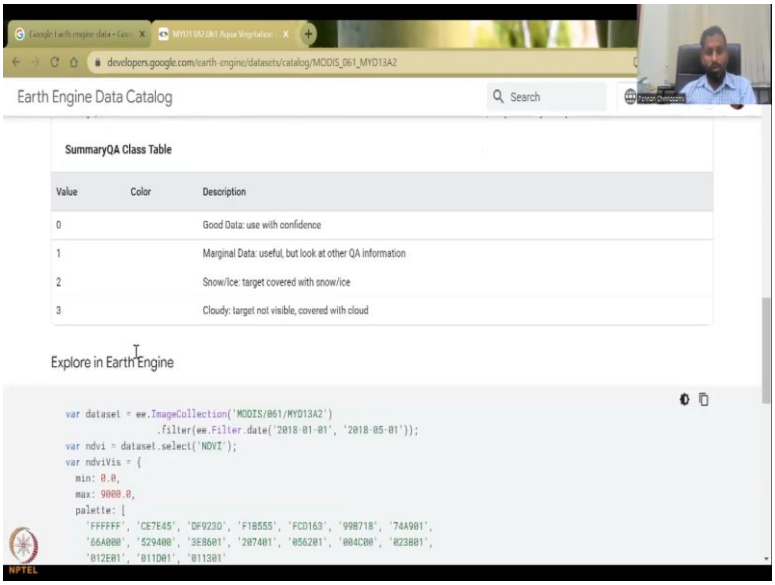
(Refer Slide Time: 15:16)



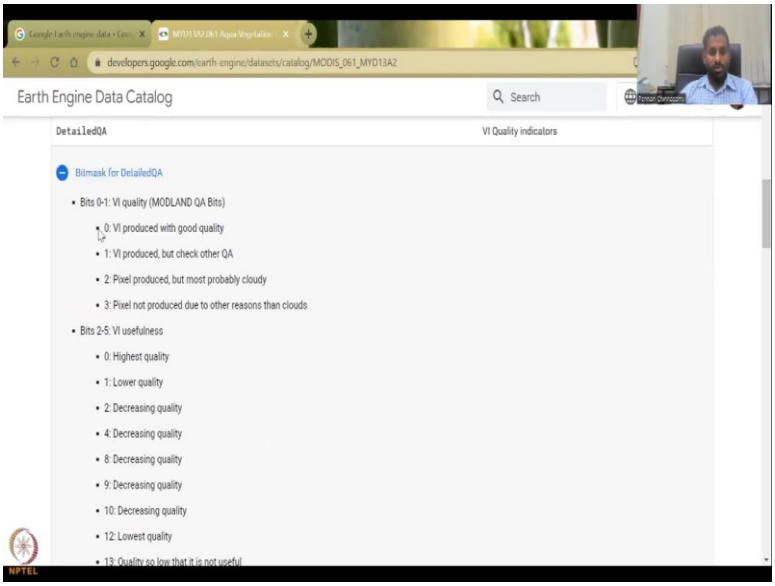


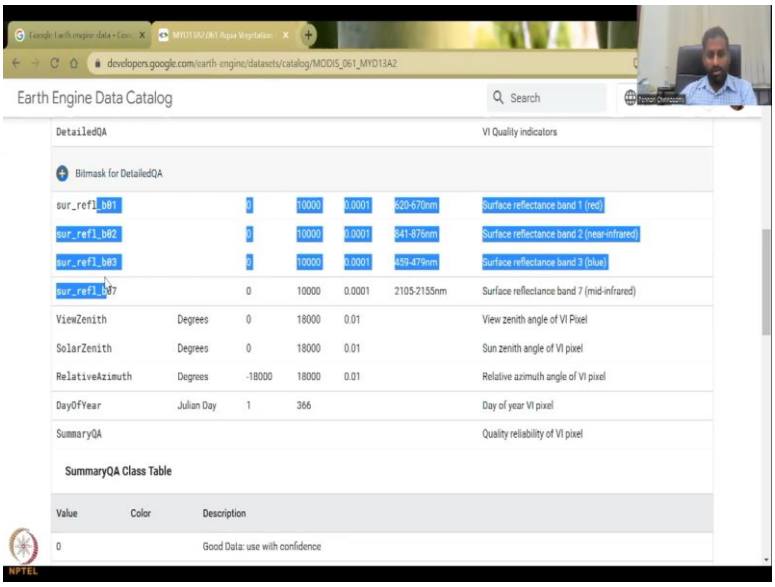



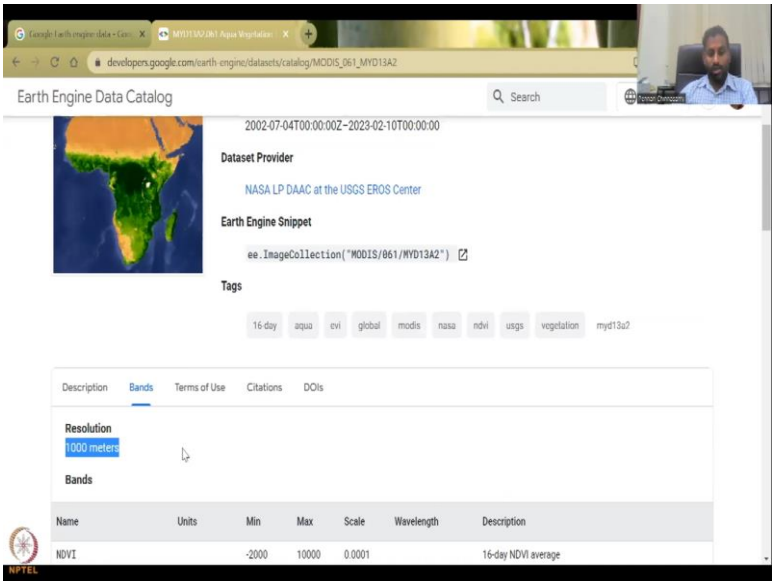

So, as we can look at this one, for the global, it is from 2002 till date. So, this is much much older than the Bhuvan data which is available, readily available. Again the Bhuvan data was from 2011. This is 20 years or more than 20 years of data, 21 years accounting I would say or like 2022 7. So, yeah, approximately 20 years plus data you have.

And you can see that what are the bands they have? They have NDVI with a range of minus 2000 to 10000. Again, this range you have to normalize it back to minus 1 to 1, which lot of papers will give you the details. And then as I said you can also have these values which are getting populated, cloud cover, do not use this data, good data use with confidence is zero. Summary of class tables. And then you have the NDVI that has been calculated.

(Refer Slide Time: 16:17)

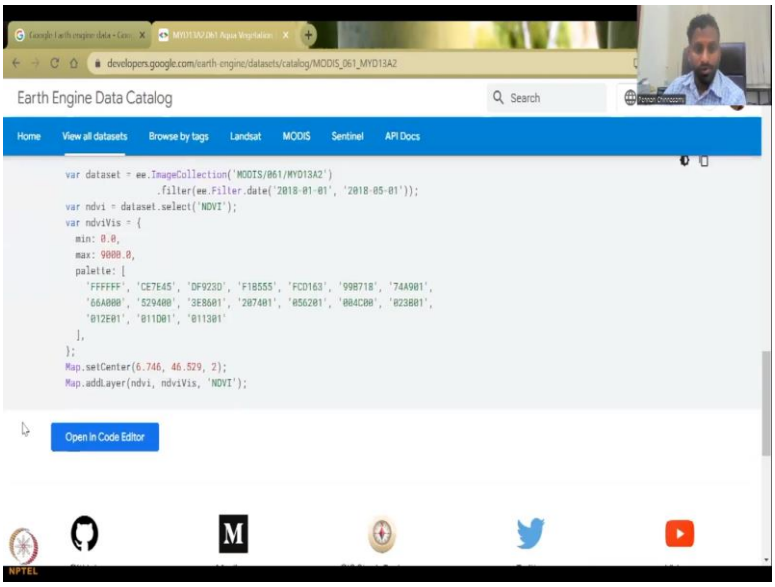


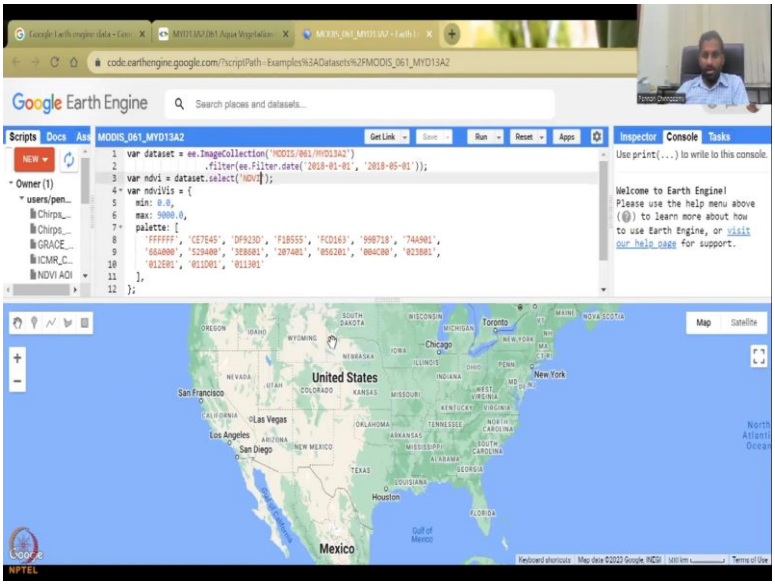



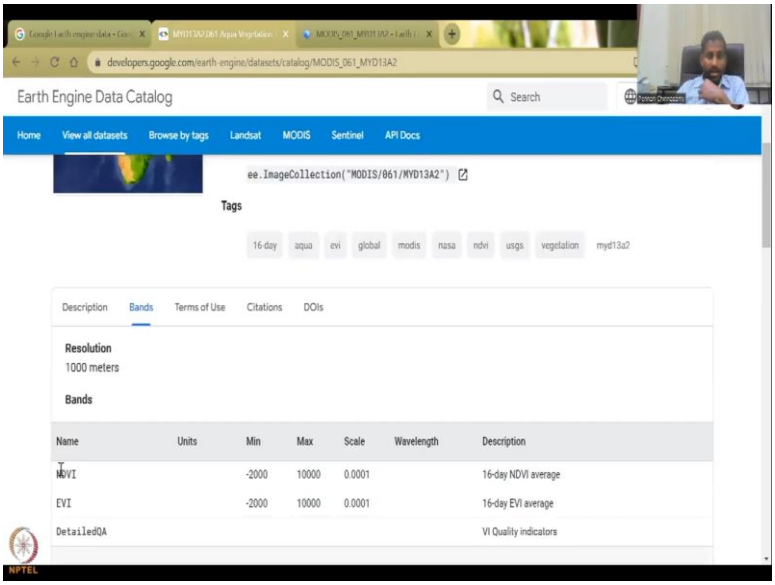



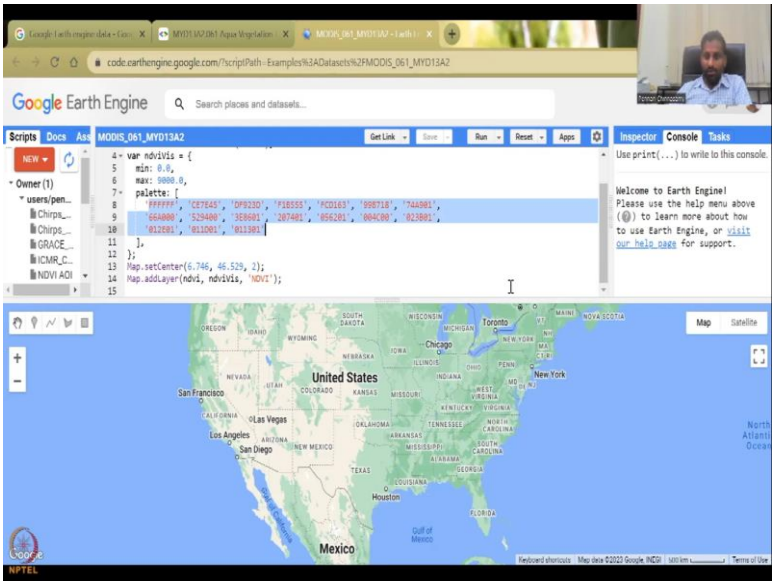
And then some more data about what are the visual, the data wavelengths etcetera are given here. So, here it is, the scale is also 500 meters approximately and rescaled back. So, here they give you a thousand meters one kilometer. So, one kilometer is the same as the Bhuvan data. So, what is different here? The difference here is that it is having better spatial resolution in terms of time series. 1000 meters is the same but you have here from 2002 whereas the Bhuvan was from 2011.

(Refer Slide Time: 16:56)



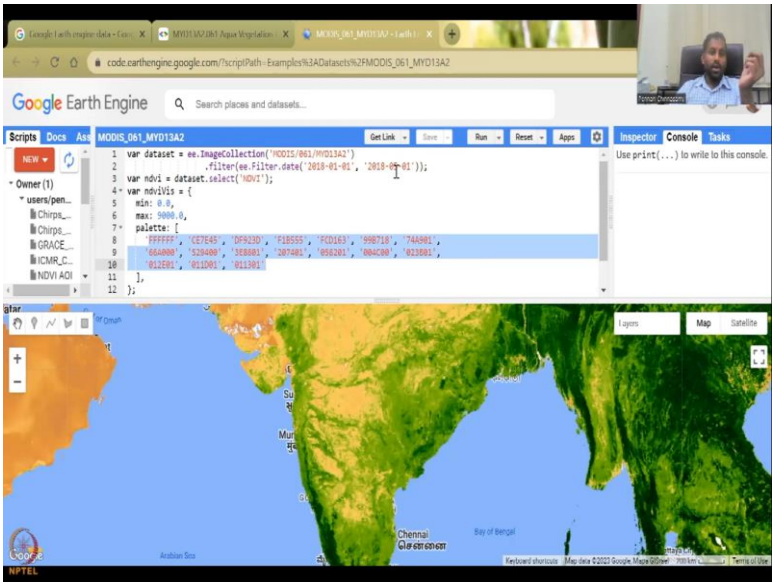


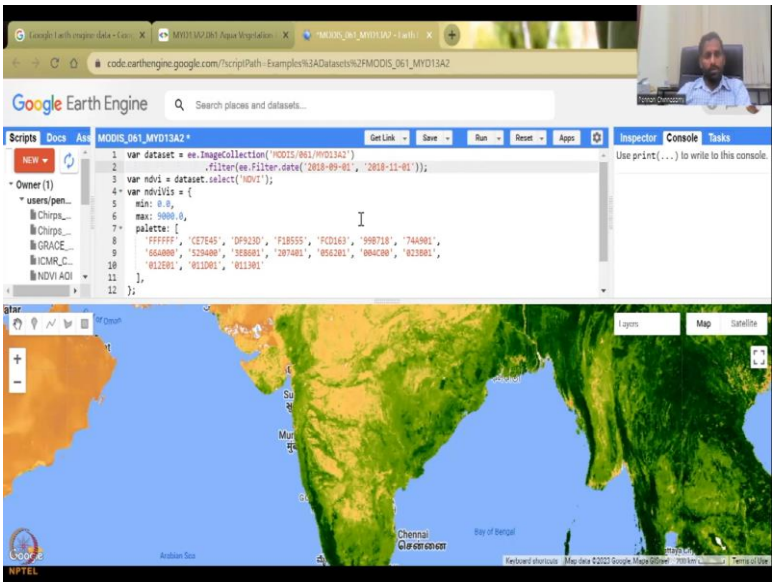




So, if you open the code editor, let us say if they have NDVI always will have to plot in NDVI. So we have minimum max. And then what data is it taking? NDVI. So, in a selecting NDVI. So, select NDVI is the band. So, if I select evi, I have to type evi here. So, it is basically the VAR data set, is a variable data set, we are defining the data set as the image, and within the image, there are multiple bands which are given here and the band name.

So, this is not a band name, only these 2 are the band names. So, you can type whatever band you want, either evi or NDVI. We have typed NDVI and it will do the mean, the mean from 2018 to 2008. 1 1 2 5 1. So, it is just year, month and date. So, you have the month which is 4 4 5 months of data 4 months of data and then we have the palette which is the coloring. Again, I will not get into the details of codings and it goes to the map center lat longs that have been given and the map add layer is NDVI.

(Refer Slide Time: 18:14)

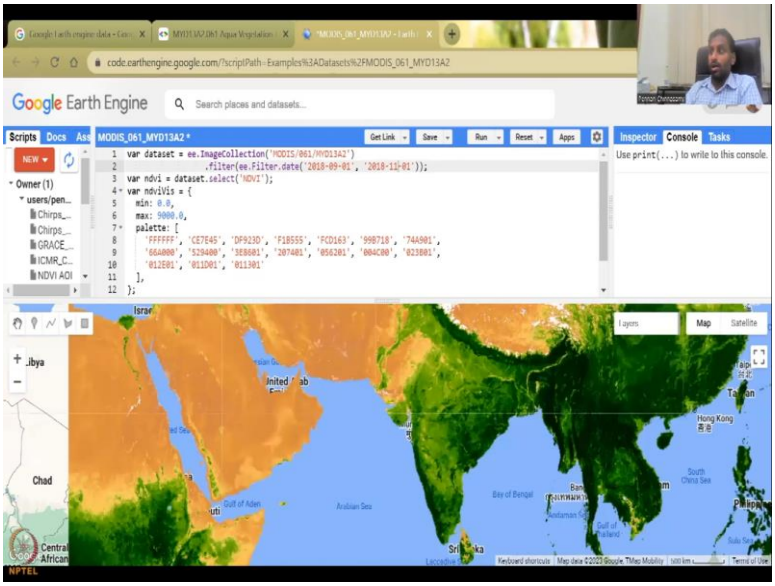



So, if I just quickly run it, you will see that the entire globe NDVI is being created and there you are. Within a couple of seconds, based on my internal speed. There is no computing here. It just goes through the super computer and Google Earth engine and then they give you the NDVI.

So, here if you see, this is the month of 1 to 5 and maybe it is an average they have done but let us do. So, you see Maharashtra, May month is pretty pretty in the summer but now, I am going to run the post monsoon season or during the monsoon and the post monsoon season. Let us say September. So, let us say 9 to 11 and then I am just going to run. So, now, I am changing the date and then running it.

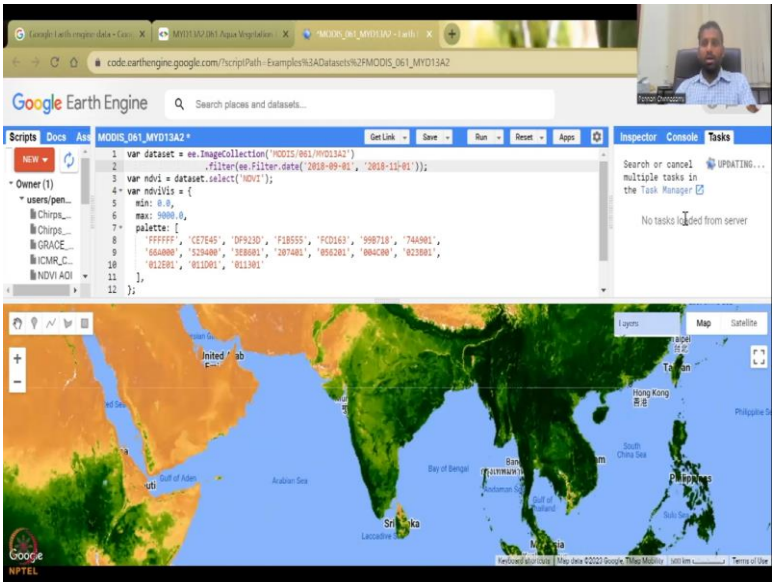
(Refer Slide Time: 19:10)




So, you could see how, see the indeed the initial version had all brown but now, all is green. So, how quickly we could do this without monitoring is the beauty. So, what we see here is a full layer of NDVI during the post monsoon season and beautifully it covers the entire globe. And how we can extract it for the Indian region is by using a mask which has already been taught in this lecture series.

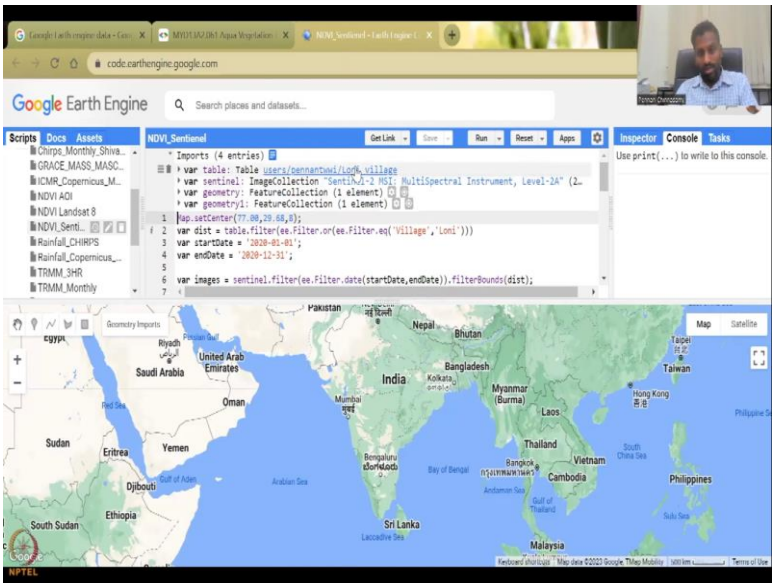
There is a lot of Google Earth engine tutorials done by Google and other resources. Please, go through it, it is very very useful for understanding the practical use of this data and you would also get a lot of benefits of using the supercomputer, the computing facilities that can be accessed online. So, here I am also going to show you some other feature.

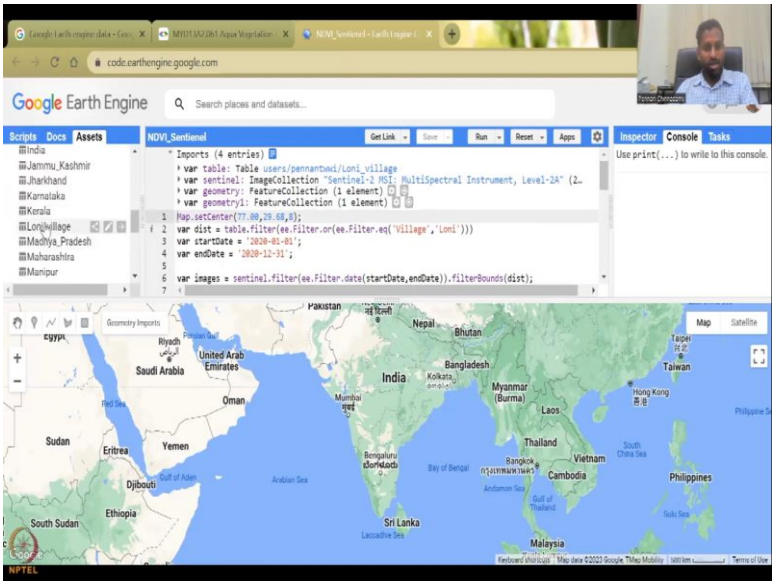
(Refer Slide Time: 20:22)




So, in the tasks you could see like what has been run and it is been updating, you can open your task manager, all these you can learn from different resources. But as I promised, let us I am going to show you what advanced, how just a small snippet of advanced computing in Google Earth engine.

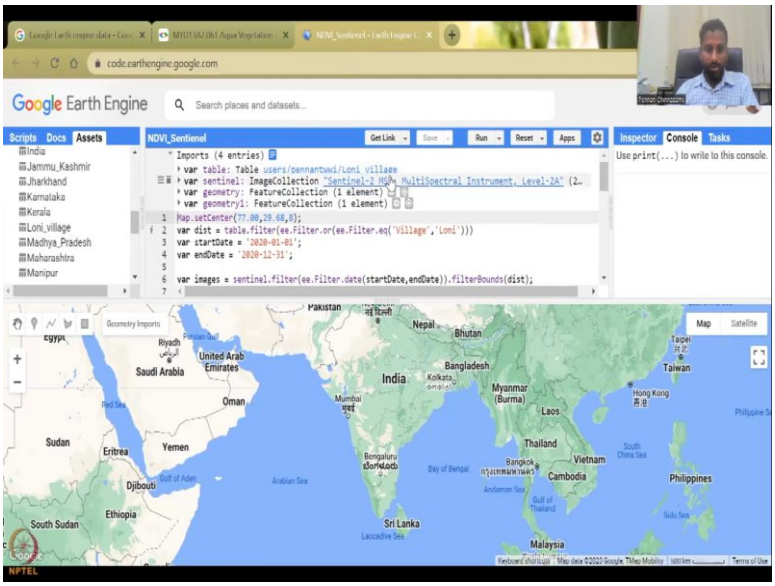
(Refer Slide Time: 20:42)

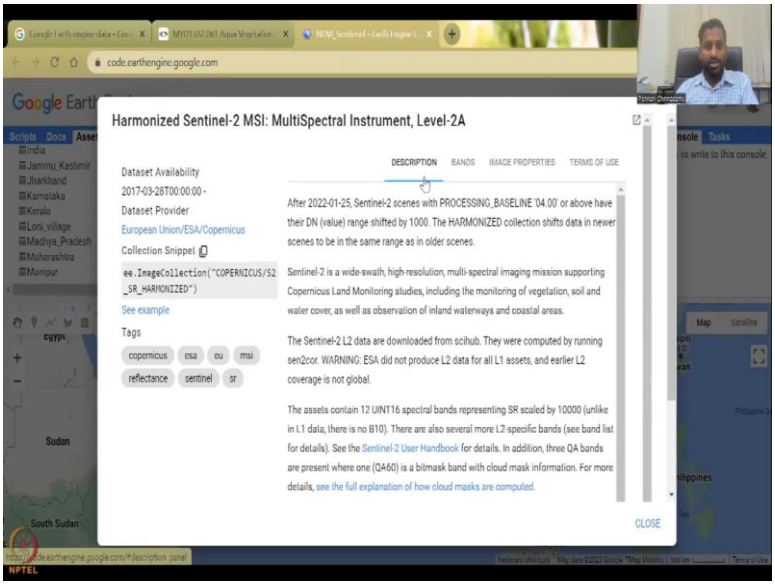


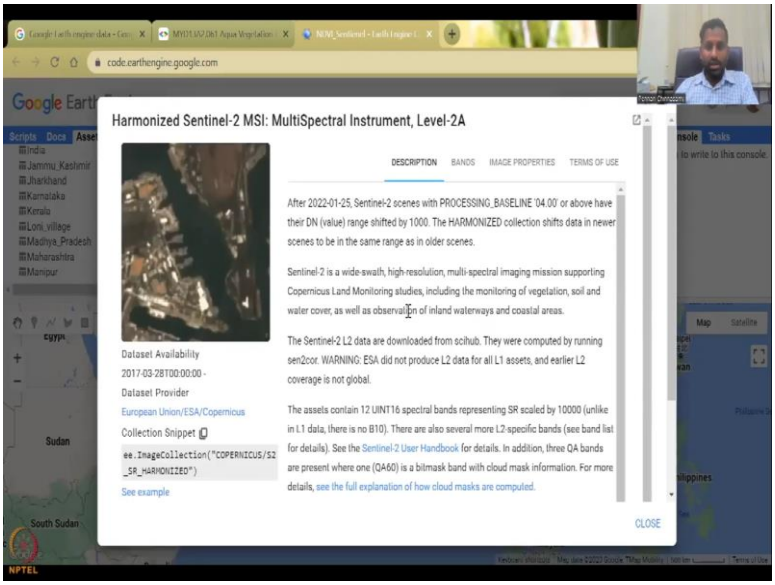



So, here I am taking the sentinel data set. I am taking one village which is Loni village. I have the boundary of Loni village in my assets. If you come down, you see I have Loni village. I have imported the Loni village into this Google Earth engine in my account that is why you have to go and choose your Google account. I have that as a table. So, Loni village variable is being done.

(Refer Slide Time: 21:09)

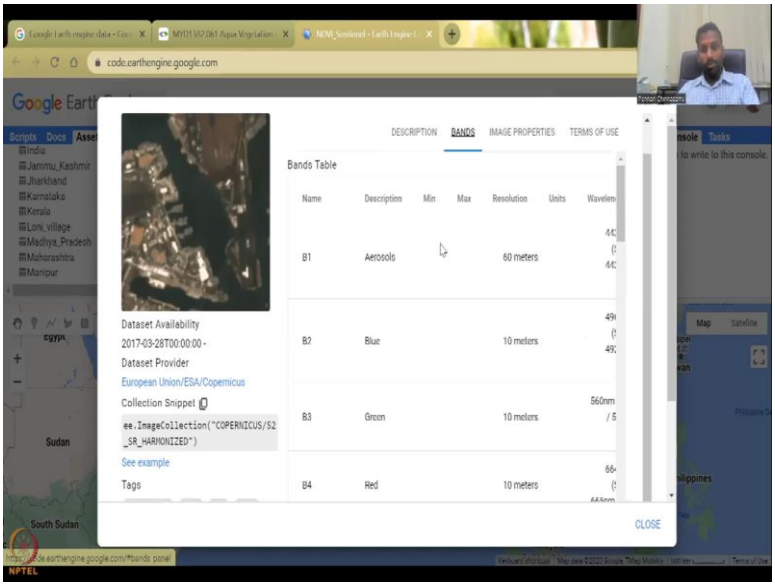




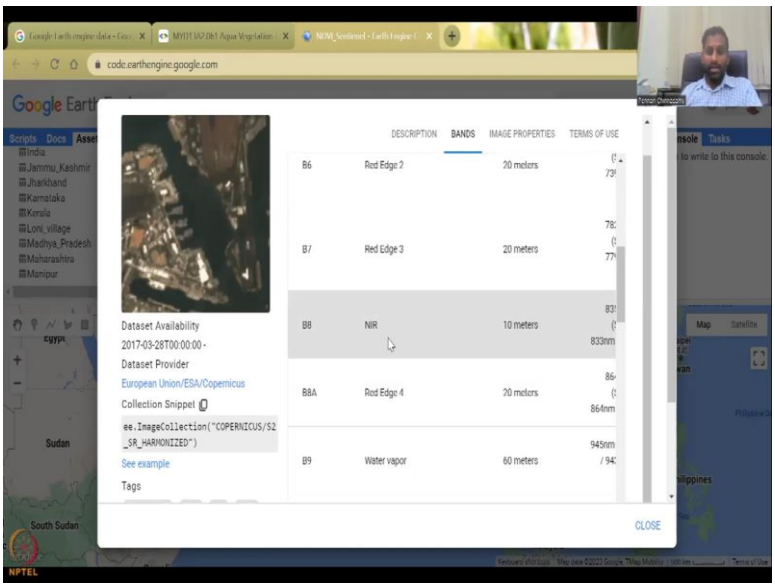

I have taken the sentinel data set. I am just going to click on the data set to show what is sentinel. So, what is the sentinel 2 data set? It has a lot of bands. Let us open this data set in the whole full form. Let me open it. Yeah.

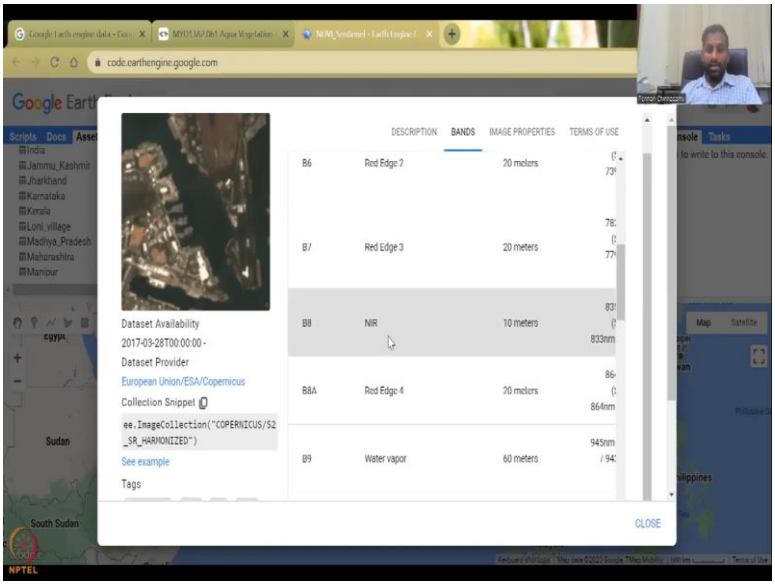
(Refer Slide Time: 21:30)




So, what are the bands available? We have aerosols, blue, green, red, red edge, red edge and NIR. So, now, what is the equation in this particular Sentinel? What would be the equation for NDVI?

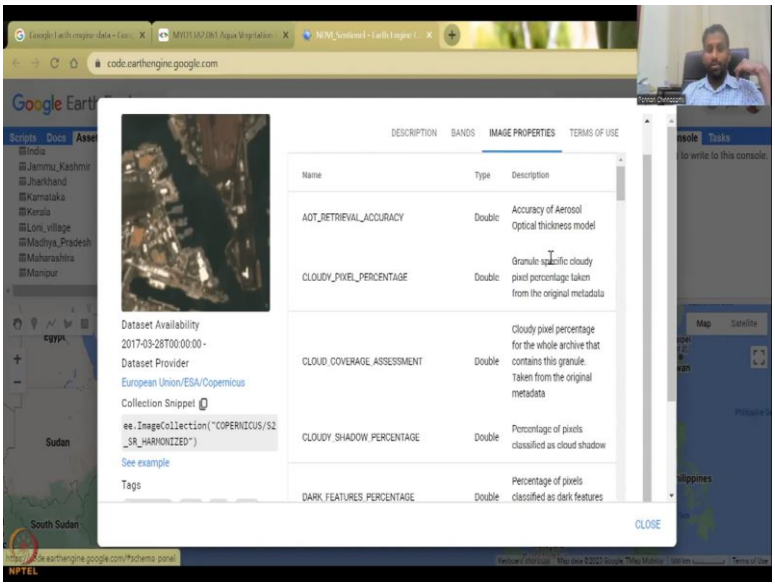
(Refer Slide Time: 21:43)





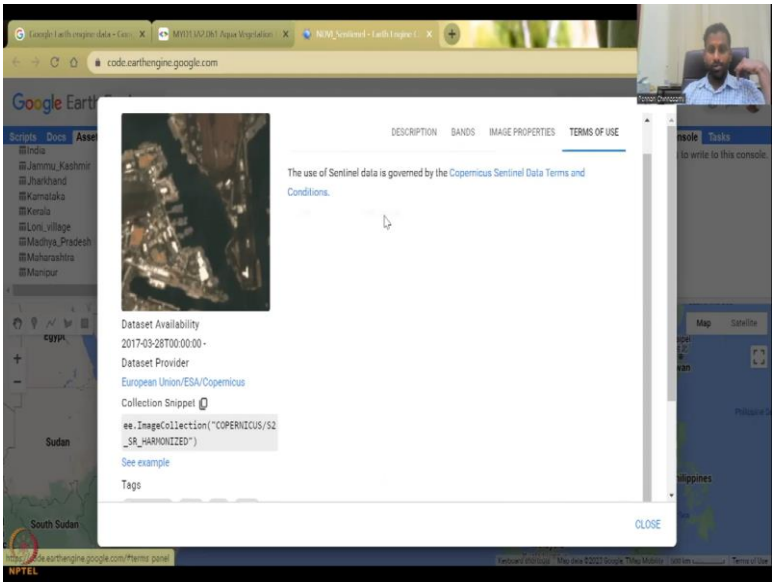

It is B8 minus red, red is B4. So, B8 minus B4 divided by B8 plus 4. So, and the resolution is 10 meters, just look at how good the resolution is 10 meters and then this is also 10 meter. So, this is the highest free open source image available for us to do these calculations, that is why we use these calculations. But this is the raw, they have not done NDVI. We will do NDVI based on this. So, because here you could see that there is all these multi bands are available.

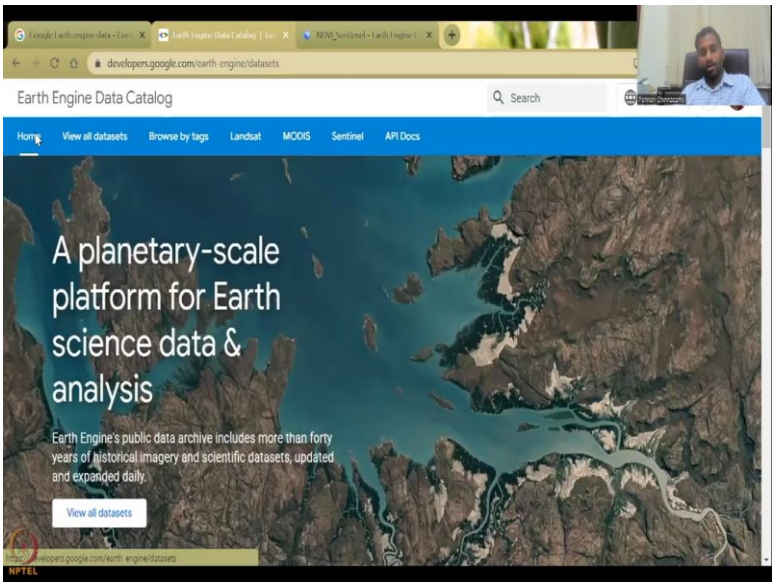
(Refer Slide Time: 22:22)

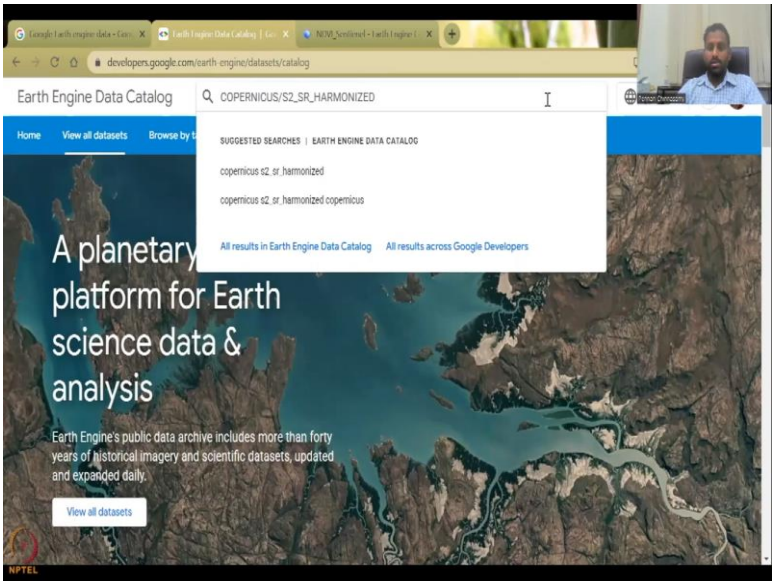


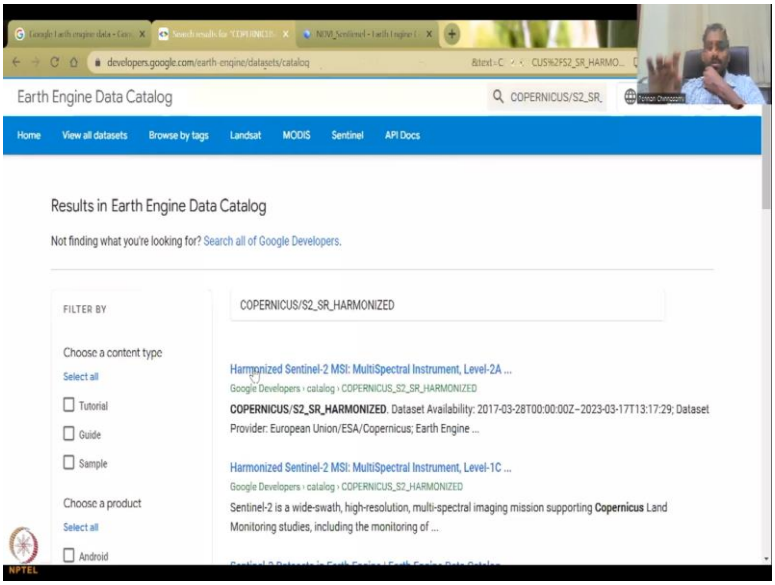

And then the image properties, what they are.

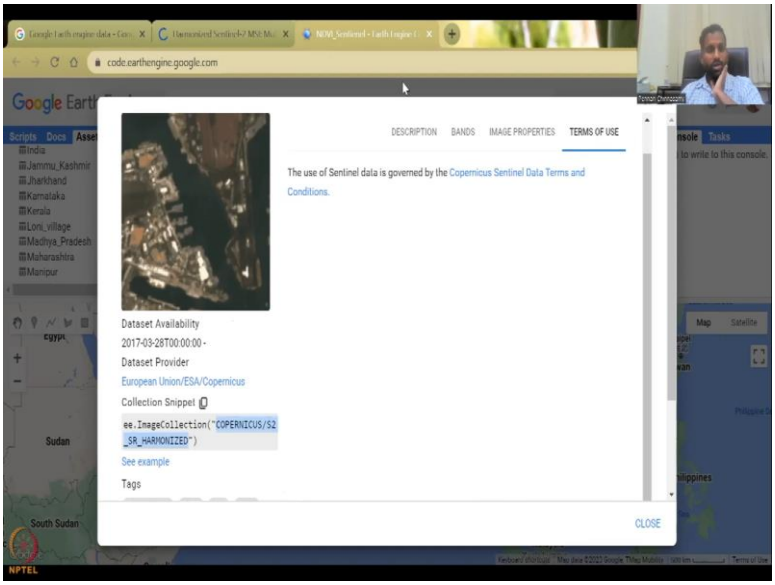
(Refer Slide Time: 22:26)



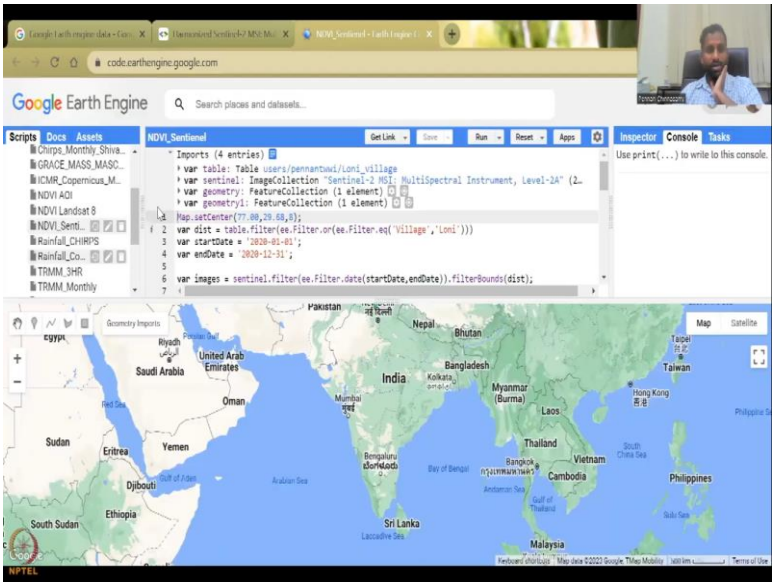



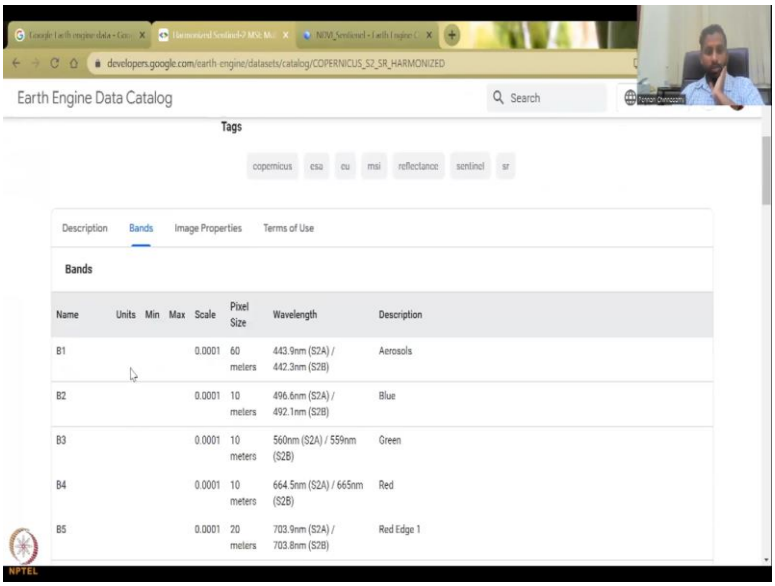


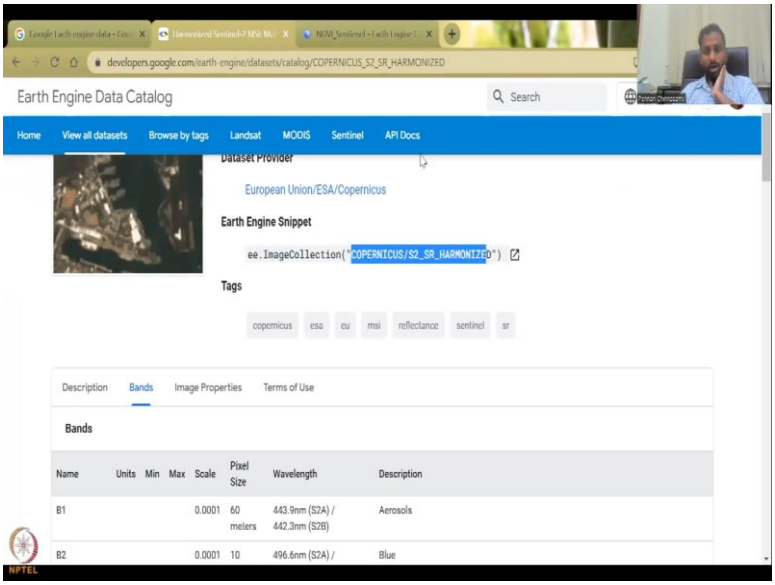




And then in terms of use, it is open source. So, you can use it. So, let us just see the COPERNICUS. This is the link to the data set. I am just copying this, going back to my Google Earth engine data home and you can click on view all that datasets or you can search it here, just click okay and then it comes here. Harmonize Sentinel multispectral image. So, let us click it which is already imported here in my other resource. So, I am just going to close this. Because I have already these are my scripts.

(Refer Slide Time: 23:04)

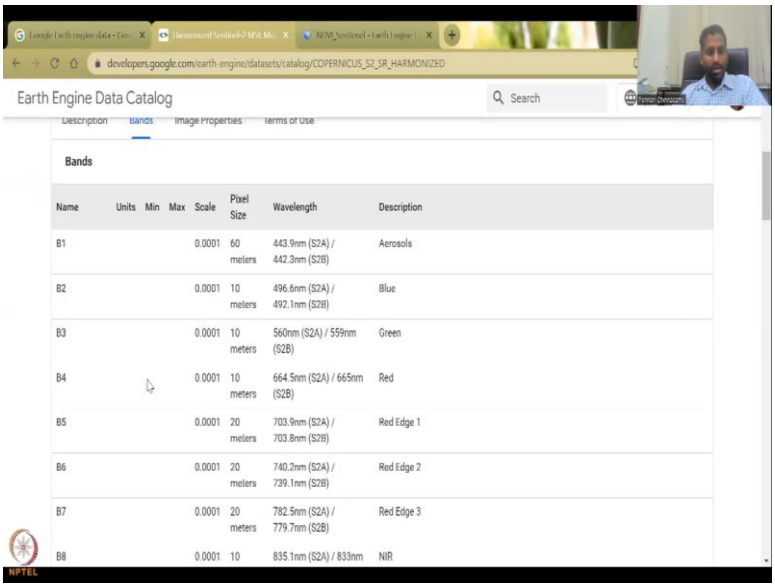


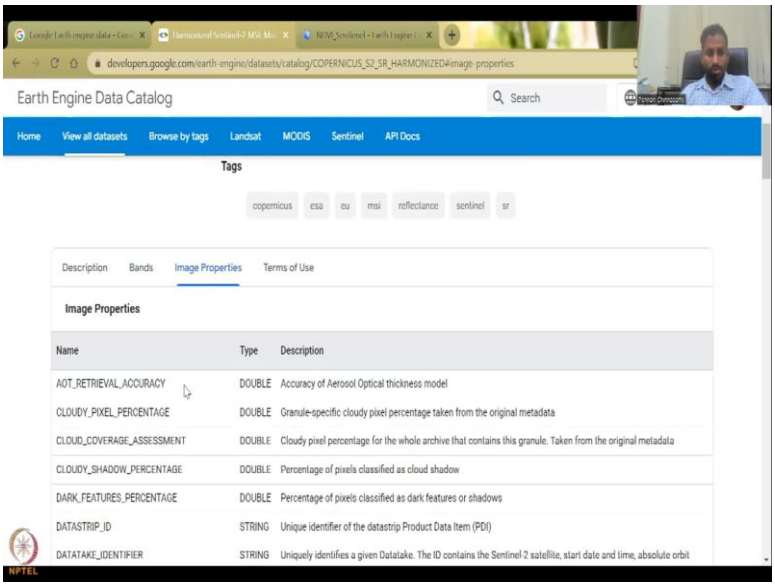



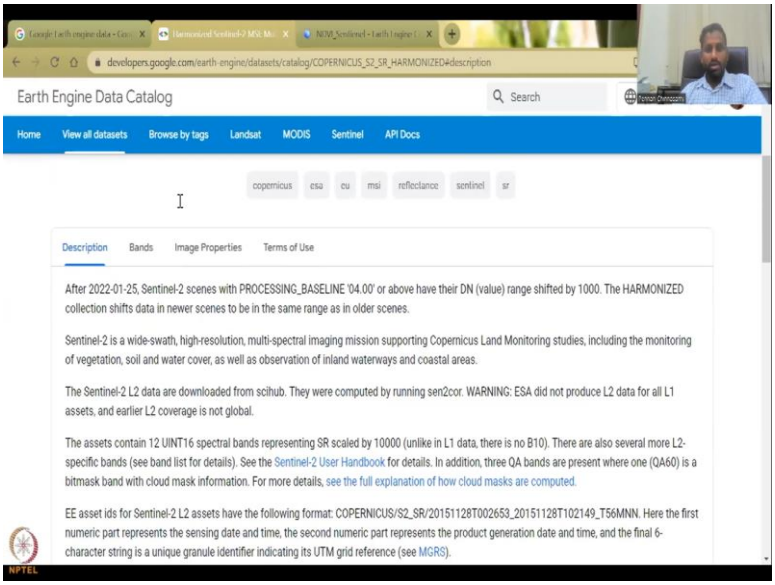



We have written codes, as I said one of my student has written these codes, and then we are here. So, the same thing is is populated here. All you could see is the image, just check this name if it is the same S2 SR harmonized, we have the image collection from S2 multispectral level 2, yes. So, that is the image collection we have. And then you can also search for the band.

(Refer Slide Time: 23:39)

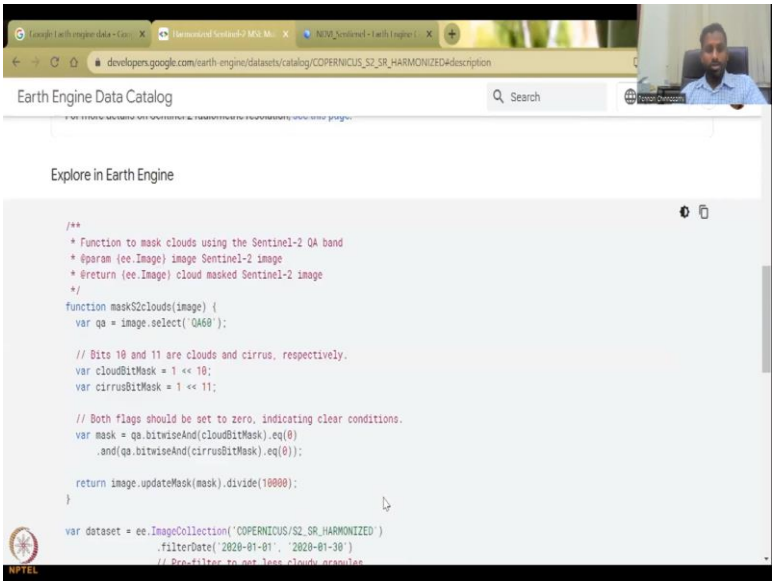


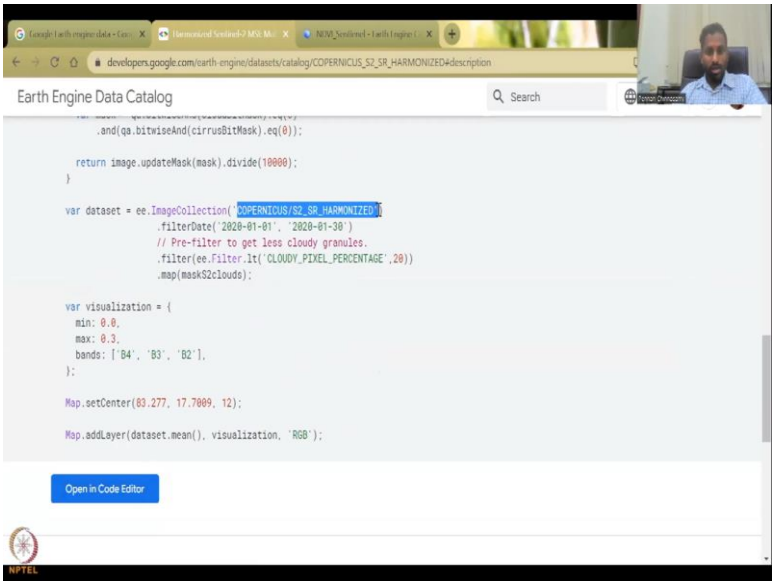



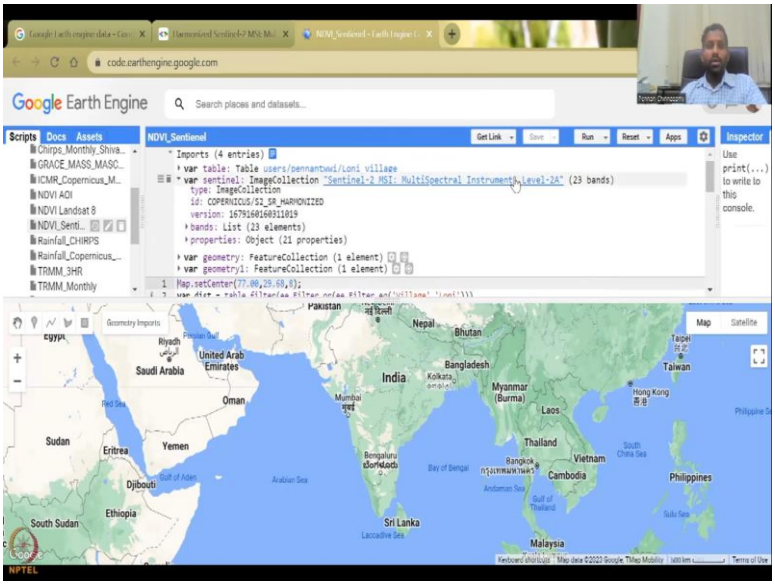



So, the bands, the names of the bands are here, B8 is 10 meters and then B4 I said is also 10 meters. These are given in this property. So, image copy is also the same, description it is the same that we used in the previous image.

(Refer Slide Time: 23:57)

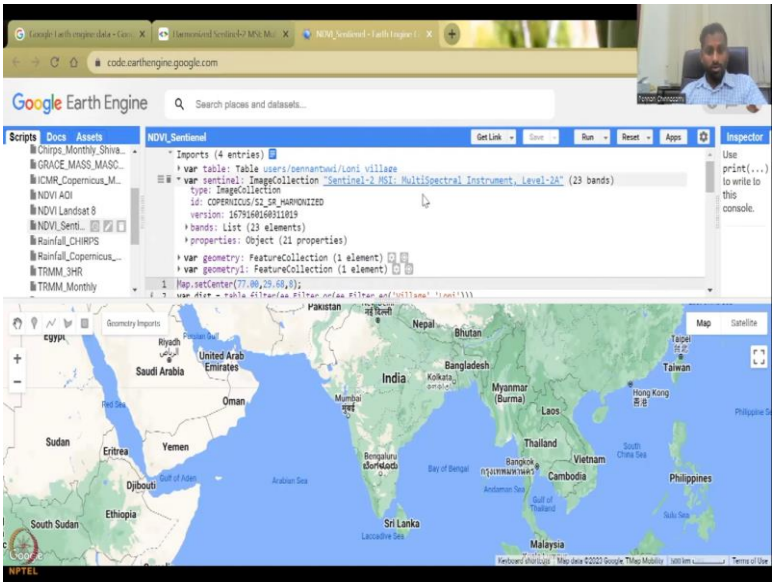


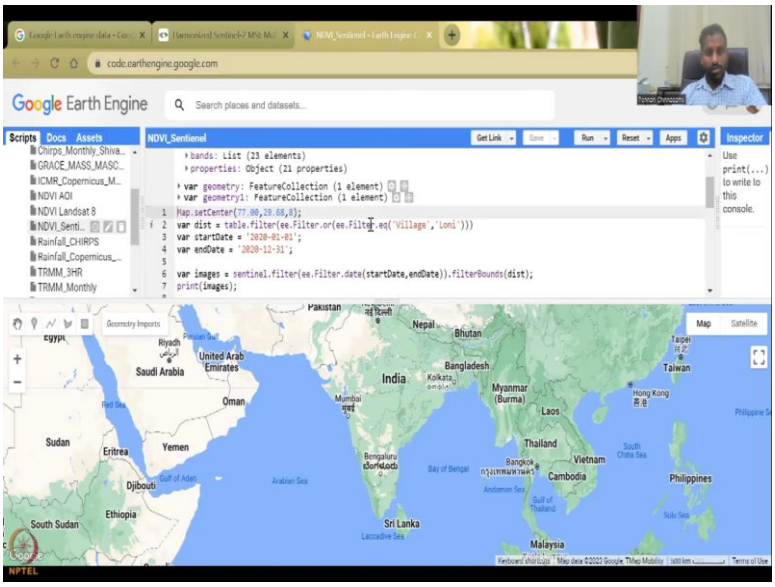



So, it says that this is the code that we can download and use COPERNICUS S2 SR harmonize is the image classification and it is given here as 2A. Let me see if I can just 23 bands are there.

(Refer Slide Time: 24:15)

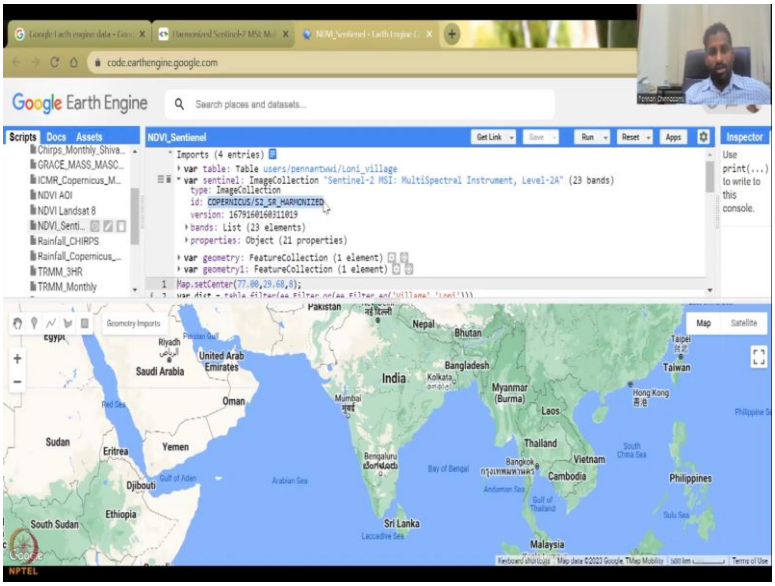


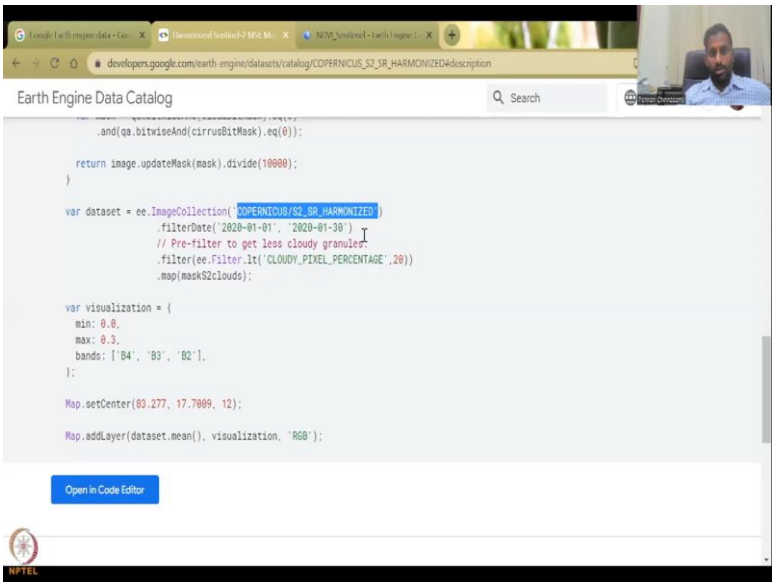



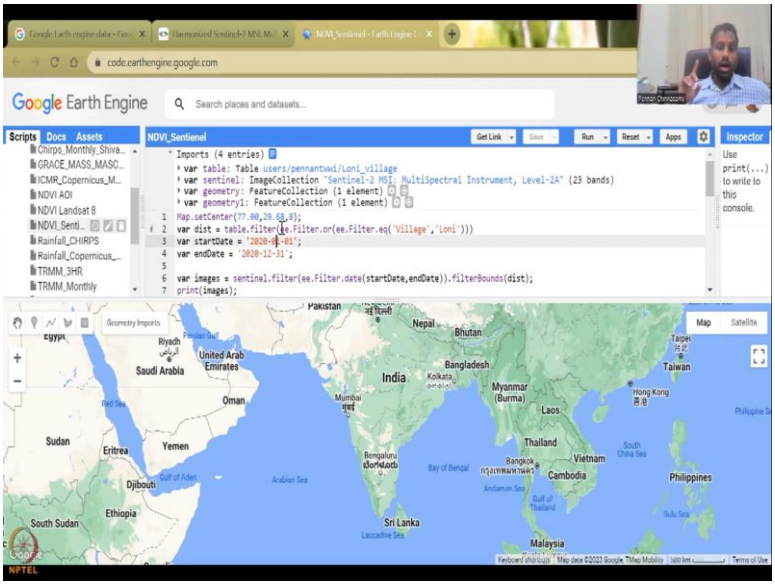

And you could also bring it down into this element. So, this is kind of advanced, but let me show you what this can do. So, this can actually, this code can actually take Loni village and only make Loni village which is in Maharashtra region, populate with the NDVI data. I do not want the entire Globe which will take some time of my internet.

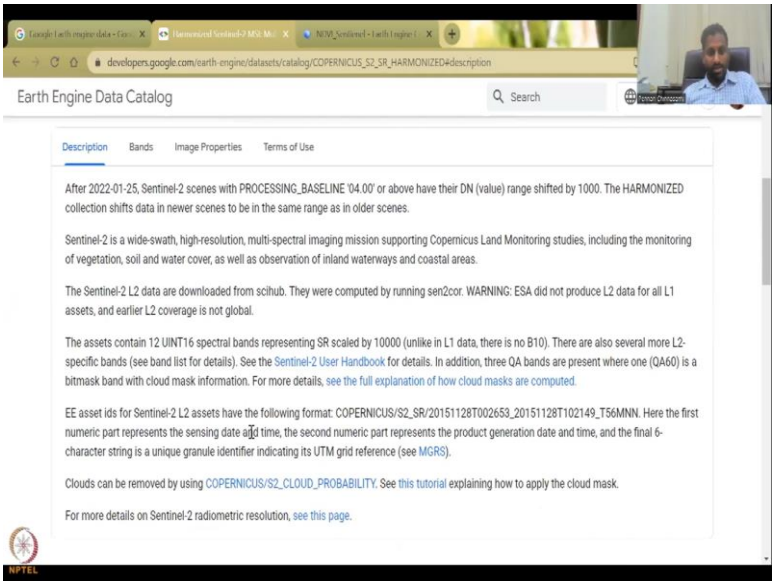
So, I do not want that. So, the processing is not done on your computer, but then when it comes to your computer, your internet and computing speed is needed to put it onto the screen. So, we do not want to delay that. So, I am just using the village which I want to use and then.

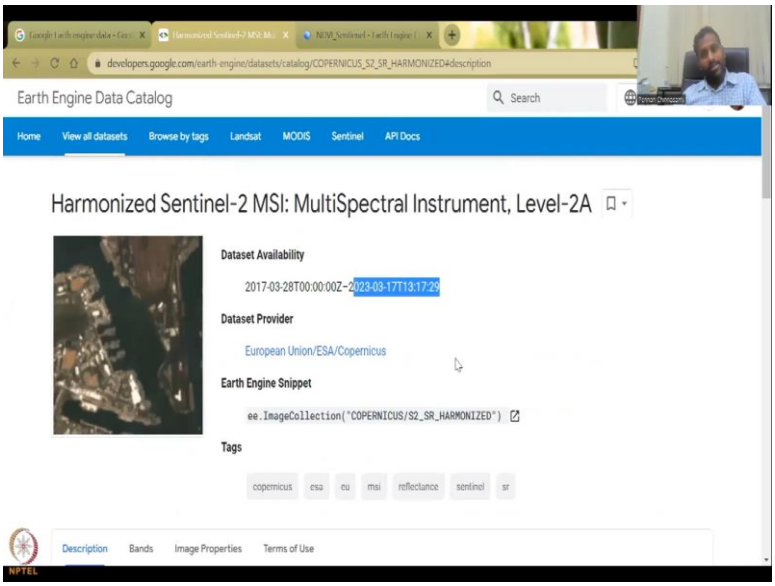
(Refer Slide Time: 24:54)





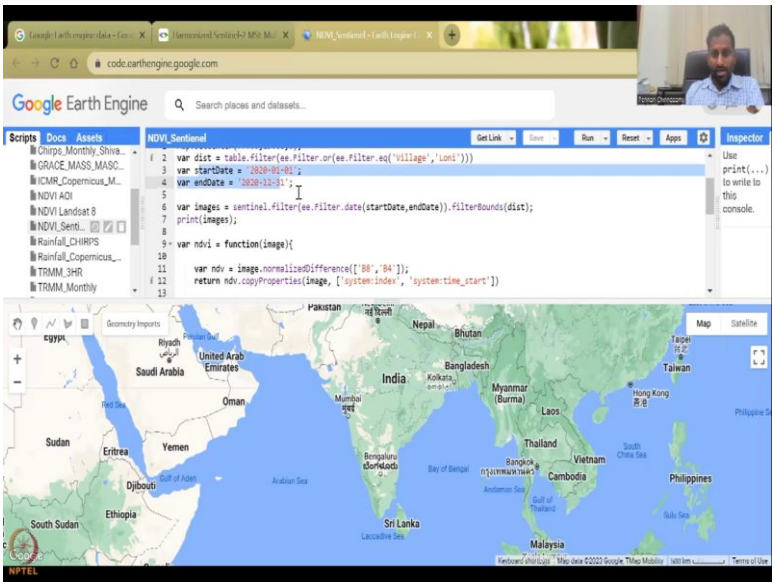

So, this is the ID here COPERNICUS SR2 harmonized which is this the same COPERNICUS SR2 SR harmonized and then the version is there, number of bands are there which is fine. I am just going to click this up. So, then the feature, feature 1 element these are just created for our geometry.

The map centers going to go to Loni village and then the filters only for that and the date service. So, they the dates are 1 1 to 12 31. So, one whole year I am going to take the data every 16 days. So, that is what this data set tells, every 16 days the data has been collected. You can see the. So, to run 2017 to 2023.

So, this is not as new as the Bhuvan ocm data, however, this is very very high resolution. That is one kilometer, this is 10 meters. So, I would recommend using this one at least for

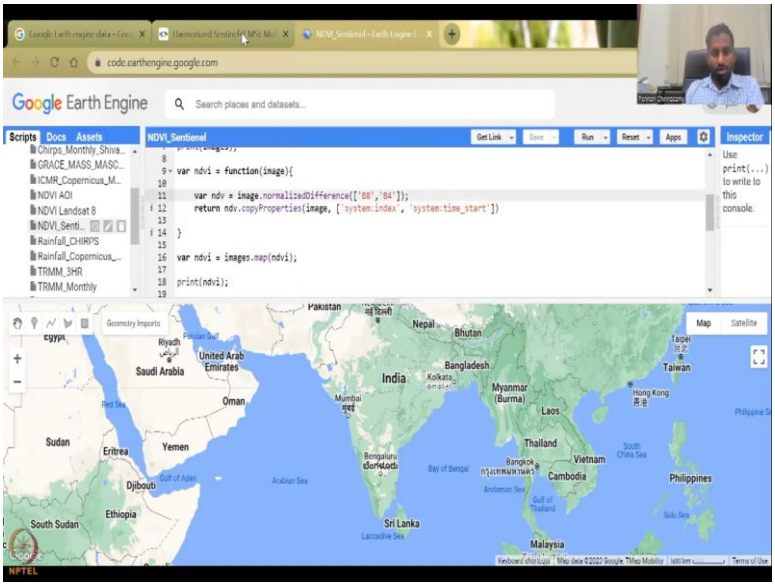
now. 10 meters with some close processing but at least good for 30 meters resolution, 90 meters resolution. So, you could see here that this data set has been done. It is also bi-weekly as as done here.

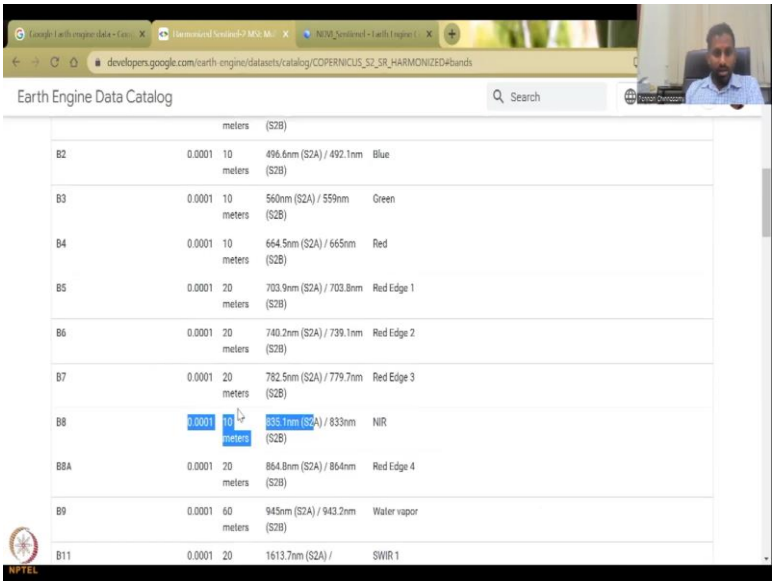
(Refer Slide Time: 26:09)

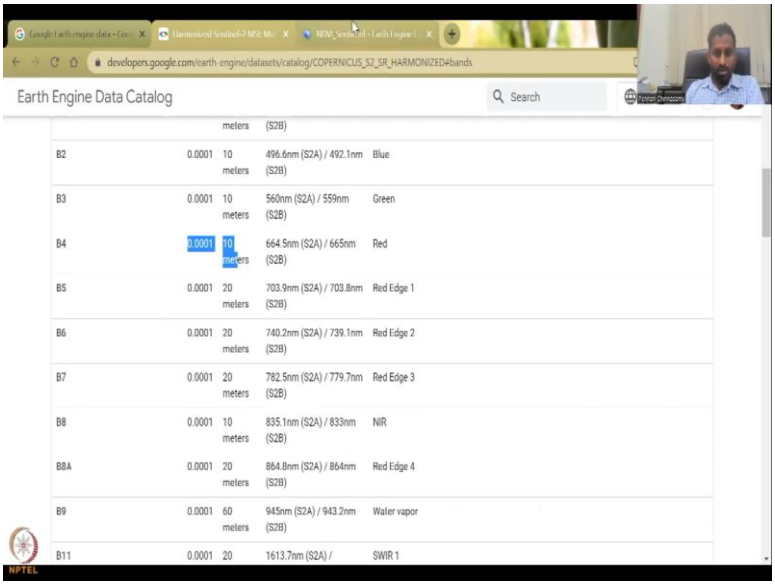


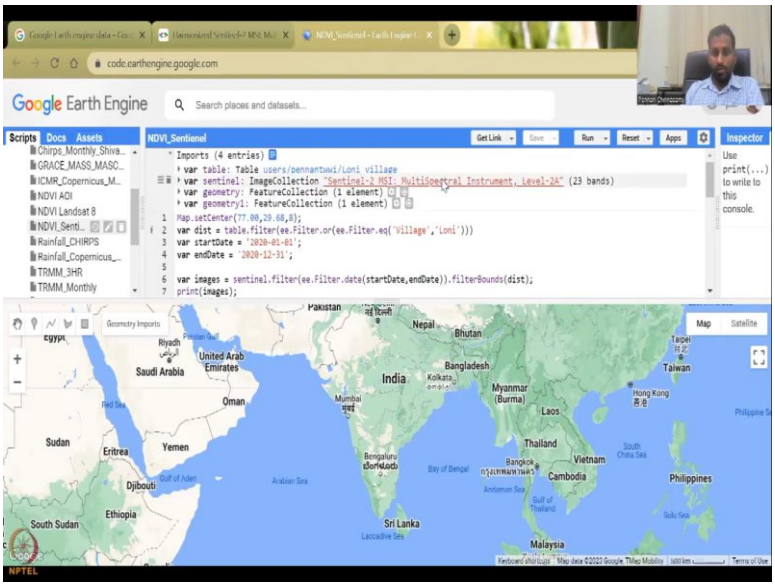

So, we have the files start and end date which is given here. So, as the start and end date is done, the data is being filtered. That is what this code says.

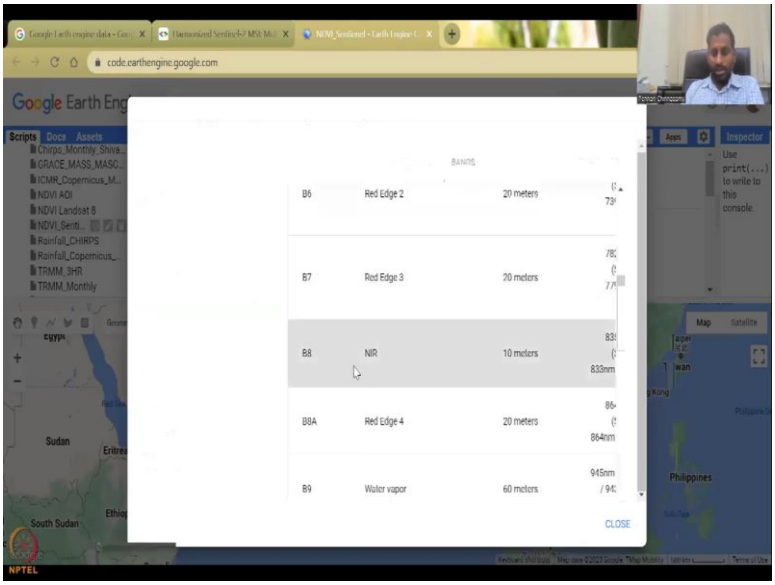
(Refer Slide Time: 26:18)

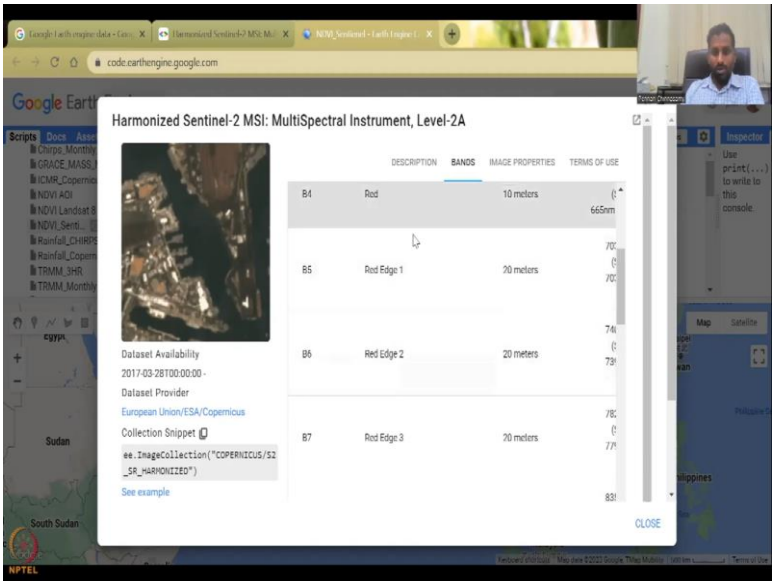


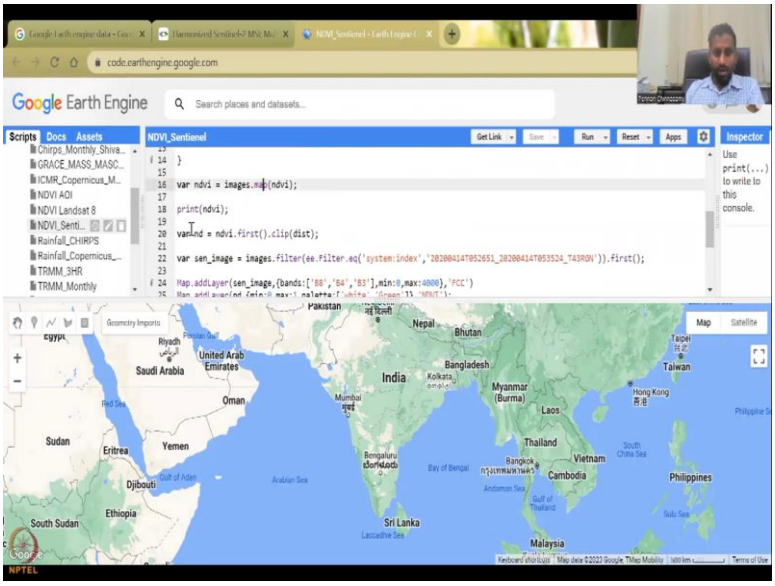

developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED#bands
Earth Engine Data Catalog
Search
meters (S2B)
B2 0.0001 10 meters 496.6nm (S2A) / 492.1nm (S2B) Blue
B3 0.0001 10 meters 560nm (S2A) / 559nm (S2B) Green
B4 0.0001 10 meters 664.5nm (S2A) / 665nm (S2B) Red
B5 0.0001 20 meters 703.9nm (S2A) / 703.8nm (S2B) Red Edge 1
B6 0.0001 20 meters 740.2nm (S2A) / 739.1nm (S2B) Red Edge 2
B7 0.0001 20 meters 782.5nm (S2A) / 779.7nm (S2B) Red Edge 3
B8 0.0001 10 meters 835.1nm (S2A) / 833nm (S2B) NIR
B8A 0.0001 20 meters 864.8nm (S2A) / 864nm (S2B) Red Edge 4
B9 0.0001 60 meters 945nm (S2A) / 943.2nm (S2B) Water vapor
B11 0.0001 20 1613.7nm (S2A) / SWIR 1
NPTEL


developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED#bands
Earth Engine Data Catalog
Search
meters (S2B)
B2 0.0001 10 meters 496.6nm (S2A) / 492.1nm (S2B) Blue
B3 0.0001 10 meters 560nm (S2A) / 559nm (S2B) Green
B4 0.0001 10 meters 664.5nm (S2A) / 665nm (S2B) Red
B5 0.0001 20 meters 703.9nm (S2A) / 703.8nm (S2B) Red Edge 1
B6 0.0001 20 meters 740.2nm (S2A) / 739.1nm (S2B) Red Edge 2
B7 0.0001 20 meters 782.5nm (S2A) / 779.7nm (S2B) Red Edge 3
B8 0.0001 10 meters 835.1nm (S2A) / 833nm (S2B) NIR
B8A 0.0001 20 meters 864.8nm (S2A) / 864nm (S2B) Red Edge 4
B9 0.0001 60 meters 945nm (S2A) / 943.2nm (S2B) Water vapor
B11 0.0001 20 1613.7nm (S2A) / SWIR 1
NPTEL


code.earthengine.google.com
Google Earth Engine
Search places and datasets...
Scripts Docs Assets
NDVI_Sentienel
Get Link Save Run Reset Apps
Inspector
Use print(...) to write to this console.
Imports (4 entries)
var table: Table users/pennantswi/Loni village
var sentinel: ImageCollection "Sentinel-2 MSI: MultiSpectral Instrument, Level-2A" (23 bands)
var geometry: FeatureCollection (1 element)
var geometry1: FeatureCollection (1 element)
Map.setCenter(77.08,29.68,8);
var dist = table.filter(ee.Filter.or(ee.Filter.eq('Village','Loni')))
var startDate = '2020-01-01';
var endDate = '2020-12-31';
var images = sentinel.filter(ee.Filter.date(startDate,endDate)).filterBounds(dist);
print(images);
Chirps_Monthly_Shiva...
GRACE_MASS_MASC...
ICMR_Copernicus_M...
NDVI AOI
NDVI Landsat 8
NDVI_Senti...
Rainfall_CHIRPS
Rainfall_Copernicus_...
TRMM_3HR
TRMM_Monthly
Map
Satellite
Pakistan
Nepal
Bhutan
Bangladesh
India
Myanmar (Burma)
Taiwan
Hong Kong
Laos
Thailand
Vietnam
Cambodia
Philippines
Saudi Arabia
United Arab Emirates
Oman
Yemen
Sudan
Eritrea
Djibouti
Ethiopia
South Sudan
Sri Lanka
Malaysia
NPTEL


code.earthengine.google.com
Google Earth Eng
Scripts Docs Assets
Inspector
BANDS
B6 Red Edge 2 20 meters
B7 Red Edge 3 20 meters
B8 NIR 10 meters
B8A Red Edge 4 20 meters
B9 Water vapor 60 meters
CLOSE
Sudan
South Sudan
Philippines
NPTEL


code.earthengine.google.com
Harmonized Sentinel-2 MSI: MultiSpectral Instrument, Level-2A
DESCRIPTION BANDS IMAGE PROPERTIES TERMS OF USE
B4 Red 10 meters
B5 Red Edge 1 20 meters
B6 Red Edge 2 20 meters
B7 Red Edge 3 20 meters
Dataset Availability
2017-03-28T00:00:00 -
Dataset Provider
European Union/ESA/Copernicus
Collection Snippet
ee.ImageCollection("COPERNICUS/S2_SR_HARMONIZED")
See example
CLOSE
Sudan
South Sudan
NPTEL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NDVI_Sentinel
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Inspector
var ndvi = images.map(ndvi);
print(ndvi);
var land = ndvi.first().clip(dist);
var sen_image = images.filter(ee.Filter.eq('system:index','20200414T052651_20200414T053524_T43RGN')).first();
Map.addLayer(sen_image,{bands:['B8','B4','B3'],min:0,max:4000},'FCC')
Pakistan
Nepal
Bhutan
Bangladesh
India
Myanmar (Burma)
Laos
Thailand
Vietnam
Cambodia
Philippines
Taiwan
Hong Kong
Saudi Arabia
United Arab Emirates
Oman
Yemen
Sudan
Eritrea
Djibouti
Ethiopia
South Sudan
Sri Lanka
Malaysia
Map Satellite
NPTEL

And then it says normalized difference is B8 and B4. So, you can come here and see which is the bands B8 is NIR and D4 is the red which is also given in this link. If you click this link, the bands are here. It says B8. B8 is NIR minus B4 which is red. So, this is the NDVI formula which we discussed earlier. And then it gives the dates, filter bound system. So, it is just going to say NDVI is equal to map NDVI, print NDVI, etcetera, etcetera.

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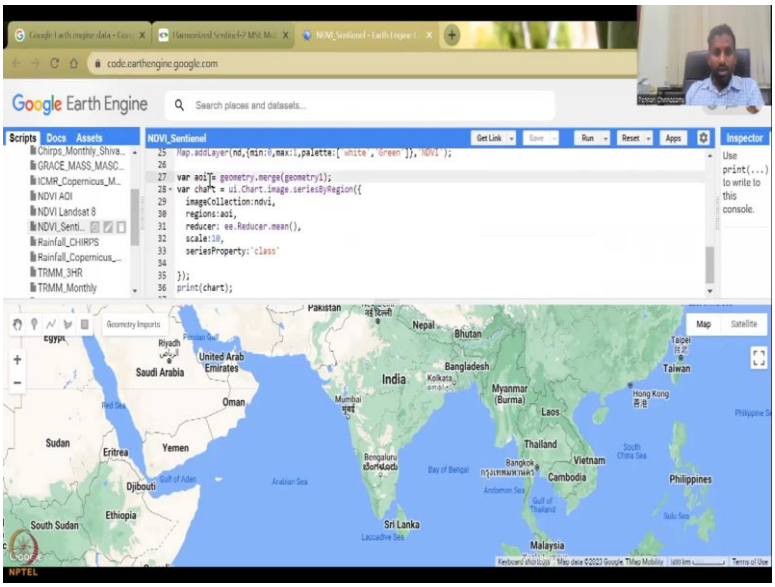


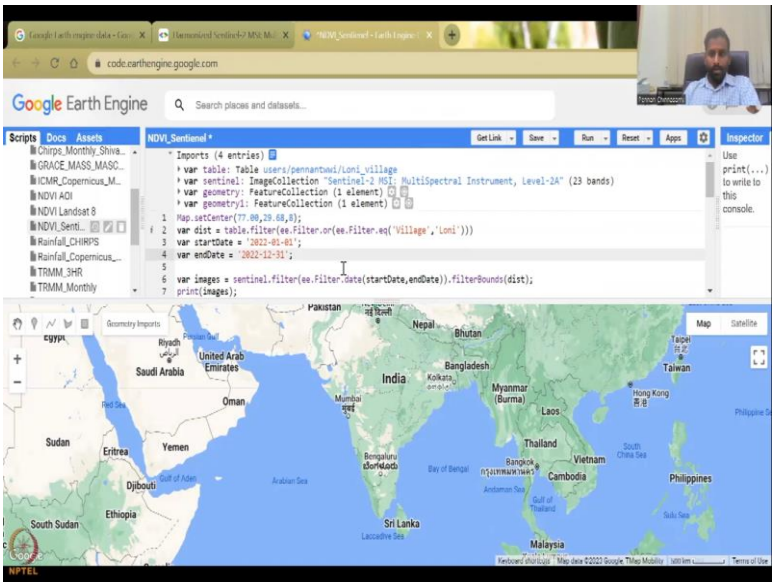

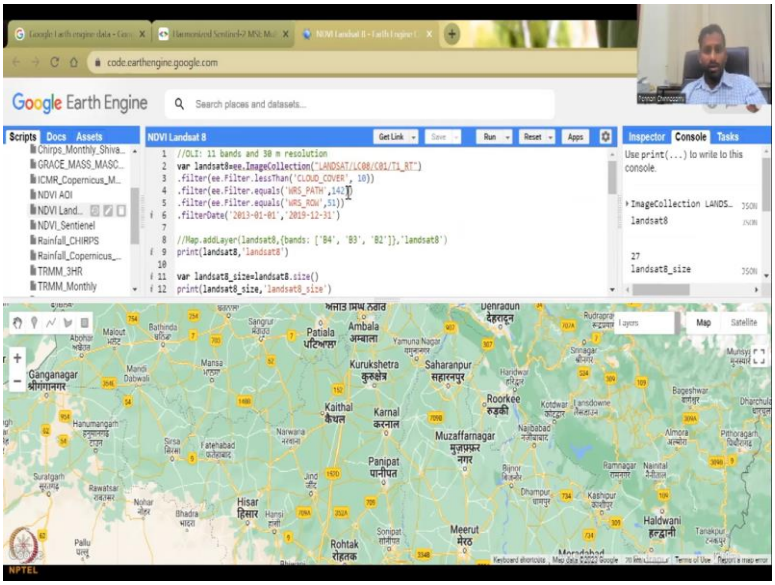


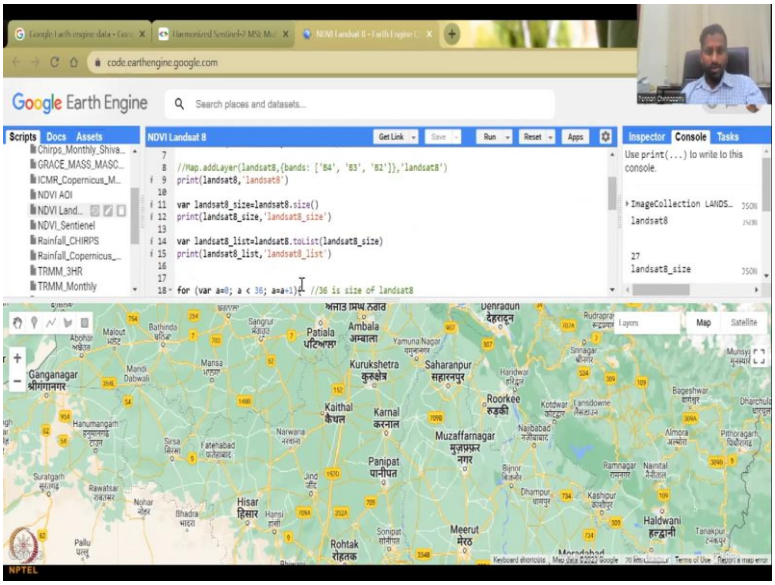


So, for this particular area, it is going to chart. So, why this code was written is not to visualize but to create a chart for a particular area. So, let us do the updated time frame for this. 2022 to 2022 December. I have not done it because this is the first time I am changing the date. I am running it. So, let us go here. So, first what it does?

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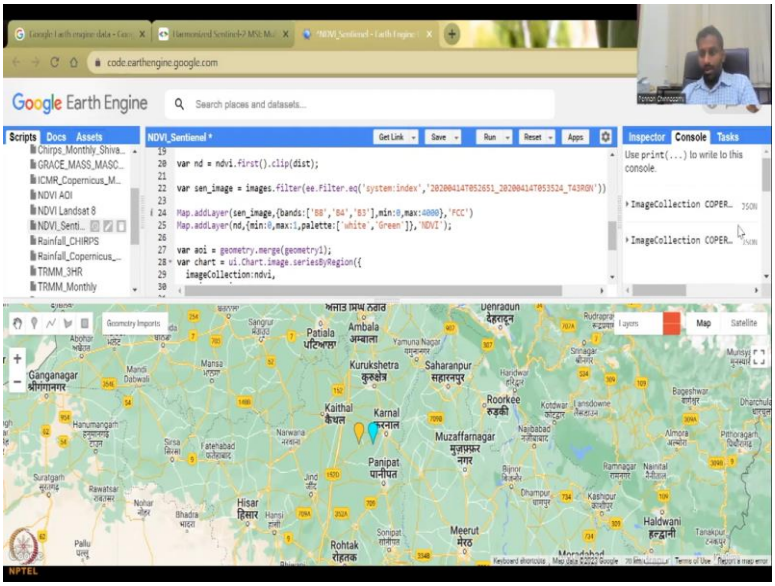


It goes to Loni village and then you can see here it is populating the village and all the images are being. So, always you have to keep, making sure that the code is running as per the particular area of interest. So, here also I have given the location as the tables that you have seen here.

And you can close this also. So, basically, Google Earth engine is there. I would refrain from teaching the editing codes and stuff right now, but at least where the data has been stored and can be used for your purposes. So, in the next class I will teach about Earth Explorer and Sentinel Hub. Thank you.