Remote Sensing and GIS for Rural Development
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Week - 10
Lecture no. 47
Remote Sensing methods for crop area and health assessments

Hello everyone, welcome to the NPTEL course on Remote Sensing and GIS for Rural Development. This is week 10, lecture 2. In weeks 9 and 10, we are looking at specific remote sensing data that can be used for understanding land available for rural development in Priority agriculture, and how expansions can happen without compromising the natural resources.

On that note, we were looking at LULC change and one of the key changes for LULC is multi cropping which includes Rabi and Zaid cropping, if it is just monsoon crops, then or rainfall crops then we will not have much issues. However, if the cropping is increased the cropping cycles are increase in the monsoon anxiety seasons, then there is tremendous pressure on the land resources and water resources. This directly impacts the further development in rural regions.

So, therefore, there is a need for evaluating the suitable land for agriculture and development, development could be industrial development, housing development, et cetera. So, there is a need for using data to understand potential areas for development and there is also a need to use data for monitoring. Suppose that a development happens without planning, we need to understand if the development has an impact both positive and negative on the rural regions and talking about the natural resources and potentially the population. While these are not straightforward answers, many a times there is less data collected for these exercises.

Therefore, there is a need to collect other data. And we were looking at data mining proxy data approaches of which remote sensing and GIS platforms help a lot. So, we will continue our discussion using remote sensing data for such rural development scenarios in this lecture. At the end of 10 week, lecture 1, we noticed that crop statistics is an important information that is needed for rural development for reducing the impact of climate change on farmers and rural communities and also for planning, planning for future scenarios.

In that case, there should be data for statistics and we understood that there are lot of times there is data lag or insufficient data to make a conclusive evidence. So, therefore, we will be

looking at using secondary data remote sensing data for this purpose. So, let us go in as we discussed to explain what is synergize mapping.

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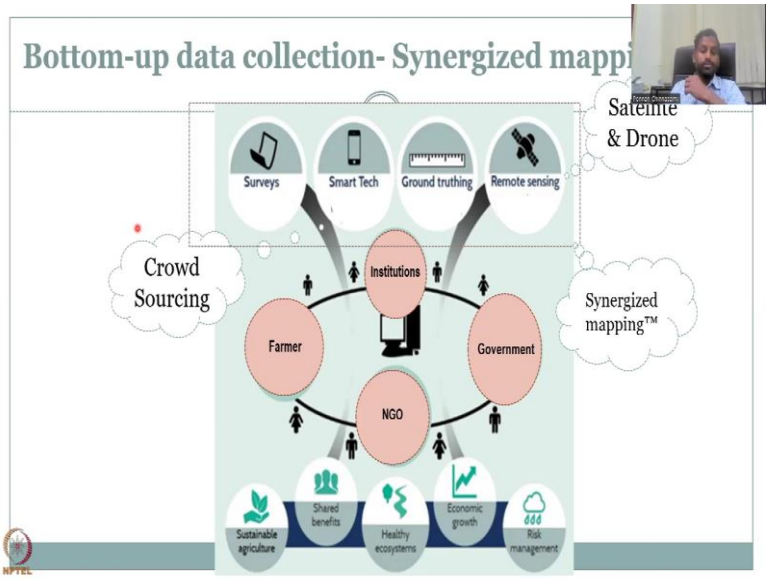

So, synergy is mapping as it is been trademark is bringing multi source data and multidisciplinary data together so, that scientific scientifically validated management plans can be developed or frameworks can be developed that can be readily applied to rural development scenarios. Let us just take the case of the Rabi and non-monsoon crop increase in rural regions and how it impacts or how crop statistics as needed. So, as we mentioned, if you just have government agencies, and if they are just collecting data by service and some ground truthing exercises, there is a big delay in the data that comes into the network. And therefore, there is unsustainable agricultural practices, the benefits are not shared equally, and the economic growth is reduced.

Moreover, the risk management is breached, because there is no early warning system or reflection of what is happening in the ground. Let us say for example, there is a cyclone. Maybe there is an early warning system to predict the cyclone. But there is no system that looks at the post cyclone analysis on crops, there is no mandatory and there is data expenses. On this note, we are looking at using remote sensing data for filling that gap. Let us see how that goes.

So, in summarize mapping, as you could see, there is multiple institutions, agencies that take part in data collection using multiple sources and multiple methods. So, you could see governments, institutions, farmers, who are the key stakeholders or rural communities, and

NGOs, who handhold, the farmers and rural communities, all of them collect data. And they may be trained in a particular data set. And they may not be talking to each other in terms of let us say, the health institutions are taking health variables, water quality variables, whereas farmers are only taking water level variables.

So, this is how we can have different players who are experts in certain disciplines. But overall theme is rural development. Under that there could be multiple themes such as rural education, rural health care, cropping, farm allied services, all of these can be mentioned and monitored and managed by different agencies. So, government always collects data whether it is enough or not is a second question. But it always collects data through surveys, mostly surveys, and some measurements.

So, let us say government is taking that data. And then we have institutions and NGOs who are slightly advanced in technologies, institutions include academic institutions like IIT Bombay, where I work. And that could include data capturing and data analysis using remote sensing products and GIS platforms. So, we have institutions who can do remote sensing and Smart Tech. We have governments who are doing surveys and groundtruth, the farmers themselves can provide data back to the system using Smart Tech, like mobile phones, or I just send an SMS or WhatsApp message, saying that if the water level is there, what is the water level? Or what crops they are growing? These are all important.

See the crops, they could change within a week, if they does not growing properly, if some calamity happens, or animal grazing happens, they just rip it off and put a new vegetation if needed. And that is where the ground up crowdsourcing data plays a vital vital role. So, we have the farmers data that can come in as not surveys because that government actually asked and maybe once every 3 months, farmers can give every week or even daily a WhatsApp message or WhatsApp image of what is the water levels.

And then we have Smart Tech and surveys combined as farmers, NGOs and institutions can be a little bit higher in technology. And so for examples, I was working with 3 NGOs before I joined IIT Bombay, and the technologies they have is really novel and cutting edge. So, this this helps in bridging the gap of issues, if any, like in terms of new technologies for bridging higher spatial resolution and temporal resolution data. So, NGOs or institutions can help farmers can help provide ground up data and government provides whatever data can they collect, all of them can come together. All of them are different disciplines can be different disciplines.

For example, the government can have a policy angle, whereas the farmers can have the actual angle on the ground. And they may be using multiple different tools, remote sensing, SmarTech surveys, and at multiple spatial and temporal frequencies. At the end of the day, all of them come to a one database and is being analyzed for rural development. That is called synergize mapping. So, we do have satellites and drones in the remote sensing very, very, I will pick up what are some examples of these tools. So, in the remote sensing, we do use open source satellites, like NASA's models, Landsat, our ISRO's resource act.

And rules are there from agricultural university, mapping and exercises, then we have crowdsourcing data from farmers. The farmers can give individual data or also NGO trained data through farmer, networks and communities. And also, there are multiple mapping communities that provide data. For example, OSM is a very good community that provides a lot of data for updating the attributes online.

So, in that network, let us have some examples of this synergize mapping, what we will be showing now is some datasets that have been created using the synergize mapping framework, especially the OSM data in the weeks to come. So, we have understood that NDVI can be an indicator for crop health monitoring and crop growth, wherein water application fertilizer application can be given.

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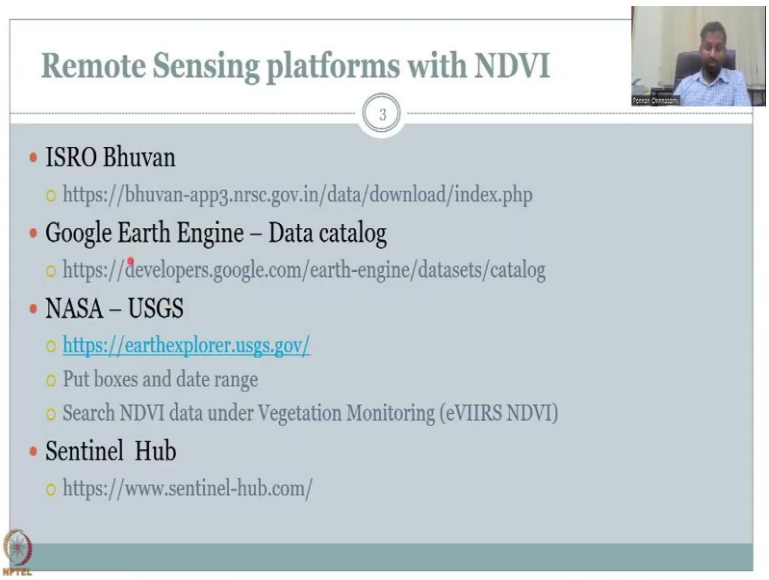

So, let us now look at the different NDVI products that are available on different platforms. So, ISRO Google has its own ISRO driven data and also NASA data driven products in ISRO's website. And then we have the Google Earth Engine, data catalog. The NASA's

USGS portals also have different images. And accessibility is straightforward using the Earth Explorer. And then we have the European agency Sentinel hub. So, I am giving the key ones which are highly used by scientific communities and researchers in the world. So, let us look at the first link, which is the ISRO Bhuvan. I will be sharing my screen now.

We look at all these examples, I will show you the methods to go and look at the data and download the data and use it for your exercises. We have already showed how to download data from both explorer, data engine et cetera. It is the same format and there are multiple tutorials just to download data, but less on applications of this data for a particular cause, where we have picked rural development as the cause. And we will be looking at the different products.

If you look here, the products are different not because of the algorithm the algorithm is the same NIR minus red by NIR plus red, we are not changing that formula, but the resolution the spatial temporal resolution of the data could be different depending on the instrument that is used and the data availability, Cloud Source coverage et cetera is different. So, we will be taking those data that are very helpful for the given location. And we will see how that can be used widely across the rural regions in India. So, let us go ahead with the first platform.

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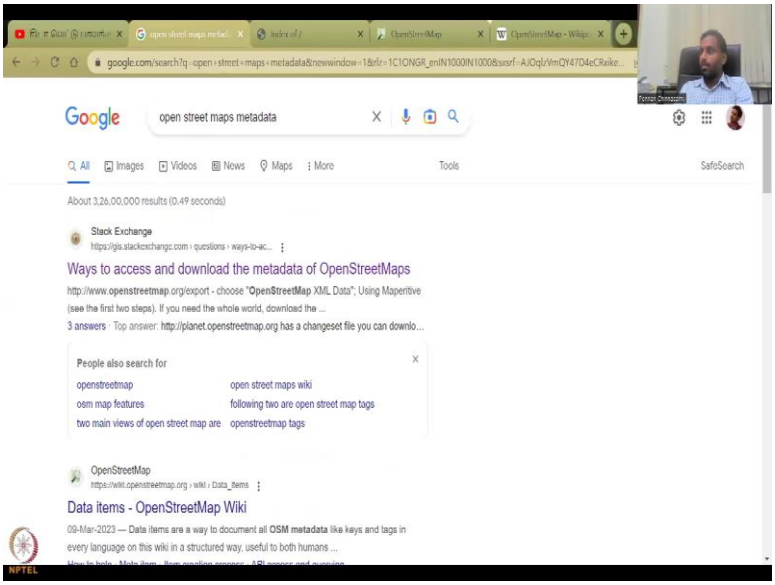

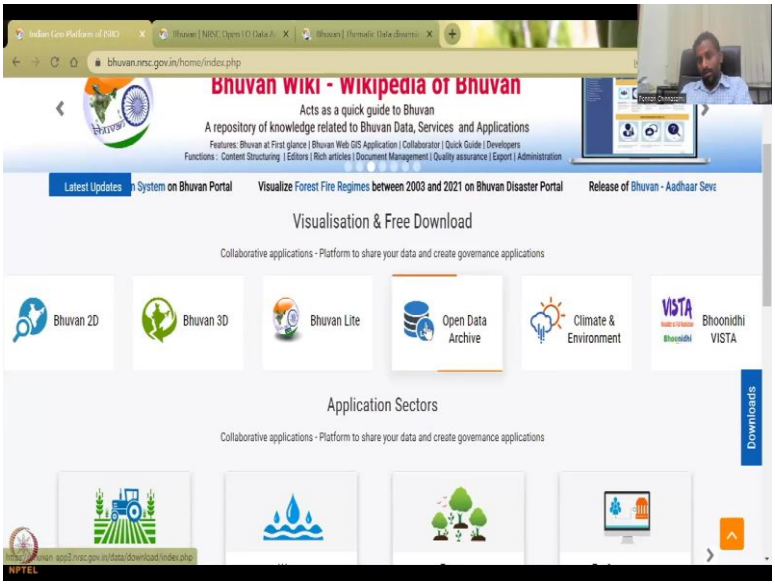

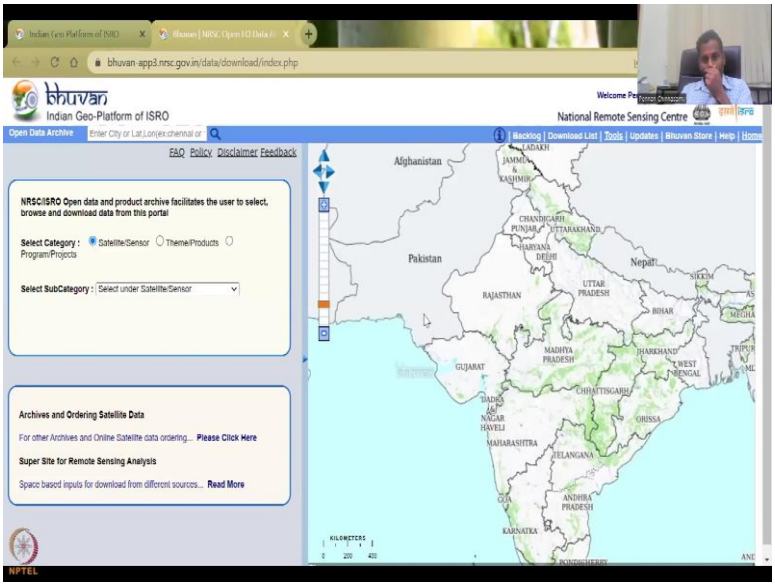

Remote Sensing platforms with NDVI

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- 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/

So, you could see that the first link, let me copy and paste so, that is going out of the slides. And when they open the first one where we will be discussing about the Bhuvan data set. So, I will be opening the full board link, because what is happening sometimes is the link to the dataset might change and get updated. So, let me share the Bhuvan's web page. So, here you have the Bhuvan's web page. And what you have here is the third. Sometimes this Open Data Archive automatic maps, as shown below, you could use thematic services, I will click it is the same, or you can open the Open Data Archive.

So, thematic opens 2 different portals. So, as I said, the first one from here, just visualize and download, we will be looking at the fourth tab, which is the Open Data Archive for accessing the Bhuvan and DVI data. So, I am just going to click it. There you have the Bhuvan data set.

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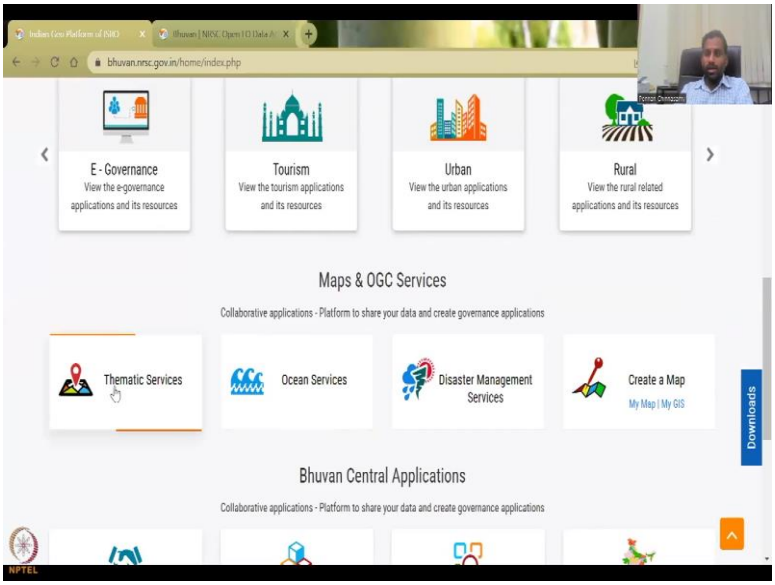

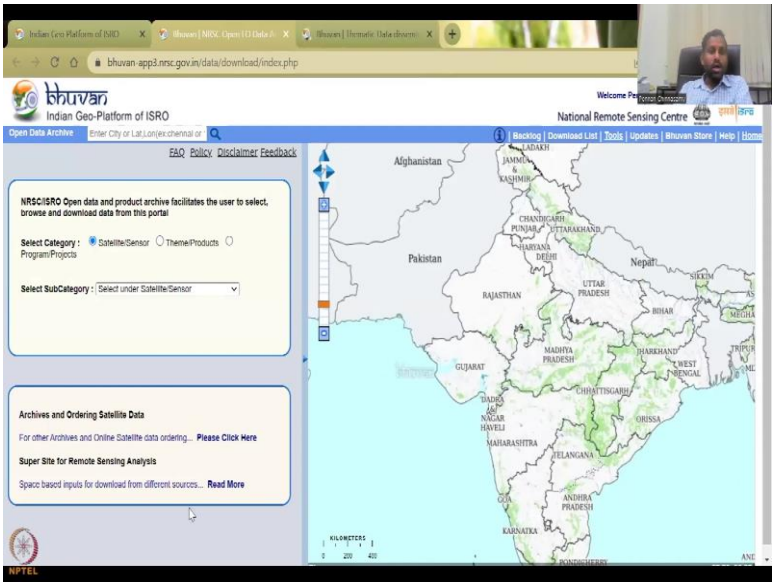

And also if you come down, you will see thematic services. I will be using my pointer, now this fine. So, we will be having the thematic services. I am going to open that too. So, first, let us go to the NRC open your data which we opened first, and in that there is theme and products.

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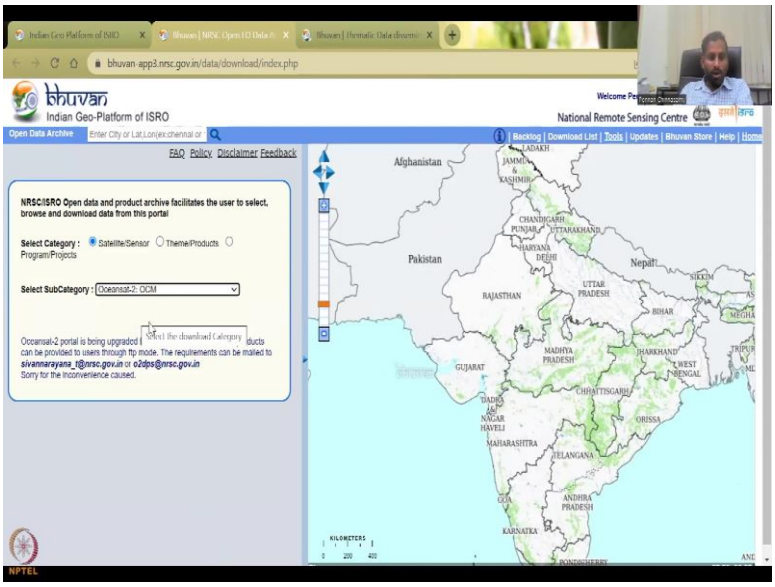

So, first is satellite sensor, you by reading you know that Ocean 2 sat has been used widely for NDVI calculations. However, when you look at it, there has been some upgradation doing better for better facilities. So, as I said, I even though I gave you the direct link to go and look at the thematic layers, suppose in this NPTEL courses run in a later time when this website does not work, it is always better to go to the parent website, which is Bhuvan. And from Bhuvan, you can easily identify where it is.

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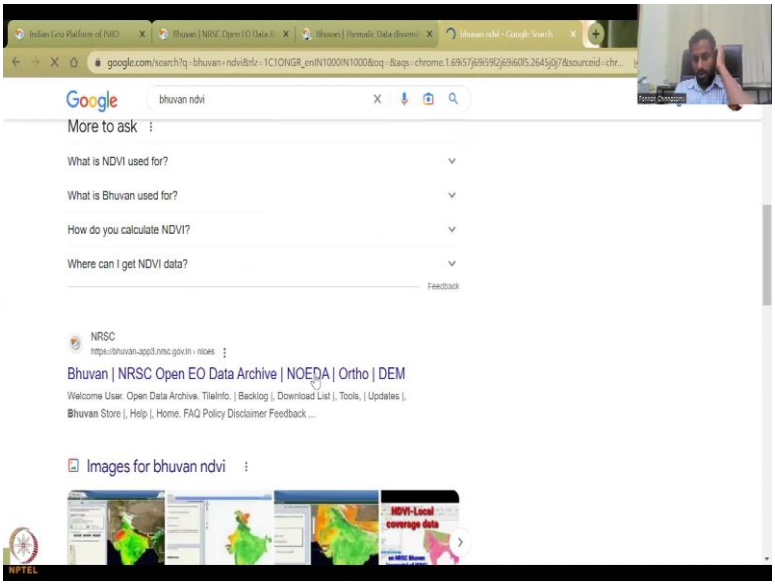

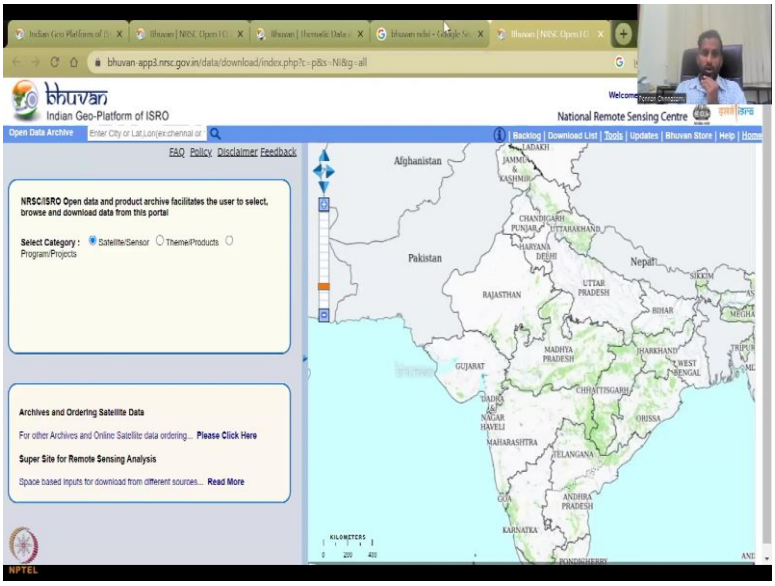

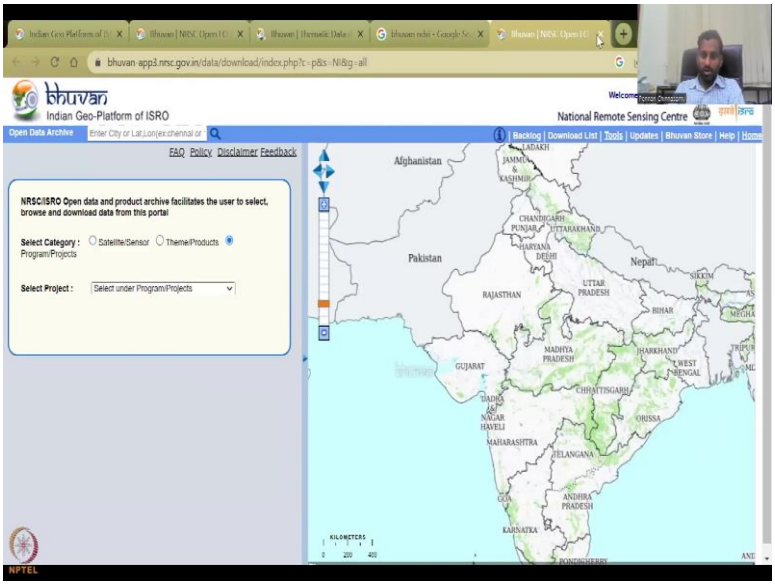

You can also type Bhuvan NDVI as I have searched before this class, and you could see that there are multiple links to open Bhuvan data. So, for example, if you open this, it again reroutes it back to the same products, as I mentioned.

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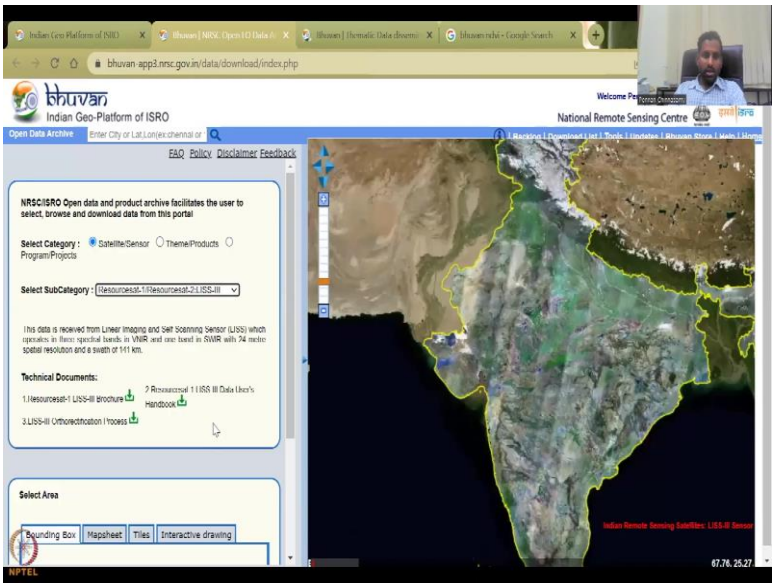

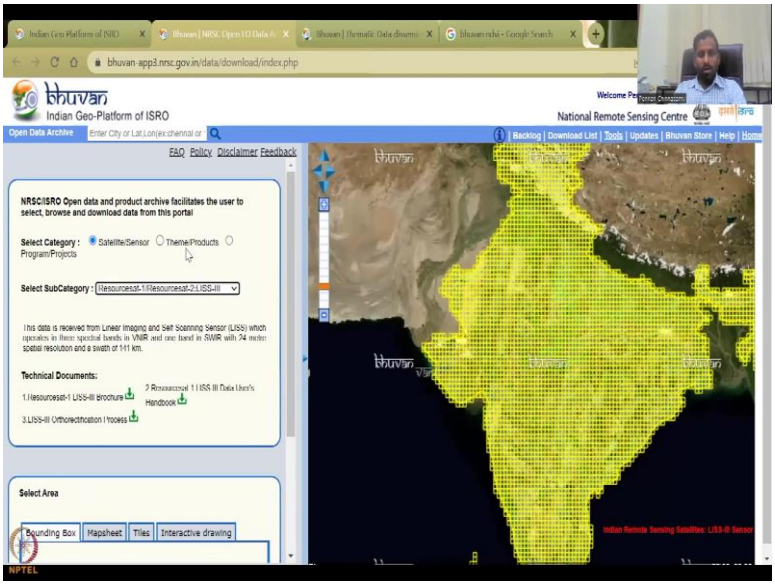

So, let us go to the first list. And by satellite, if you access, it gets difficult. So, it is better because sometimes as it said, oceansat is not giving so then you can go to resource add, and then see what resources are being mapped.

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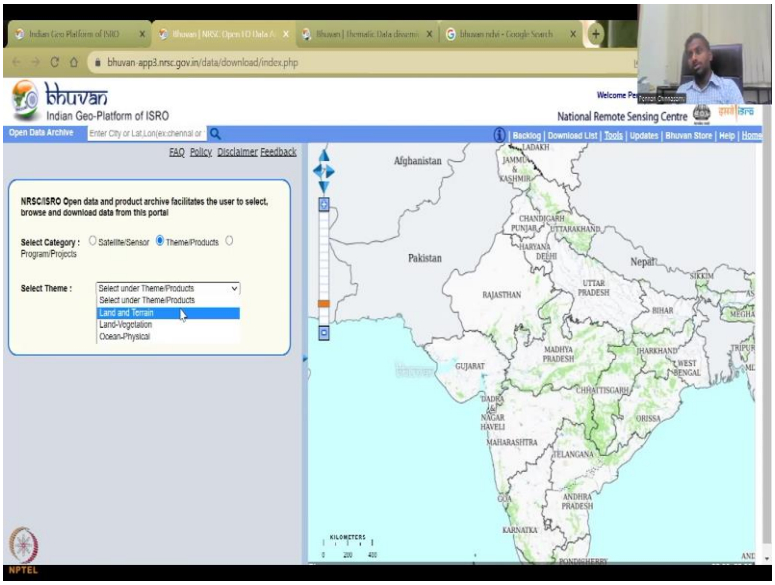

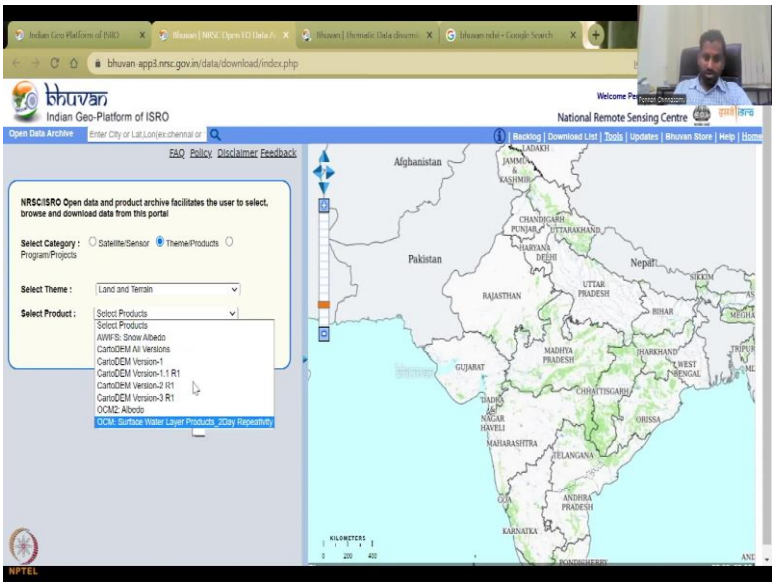

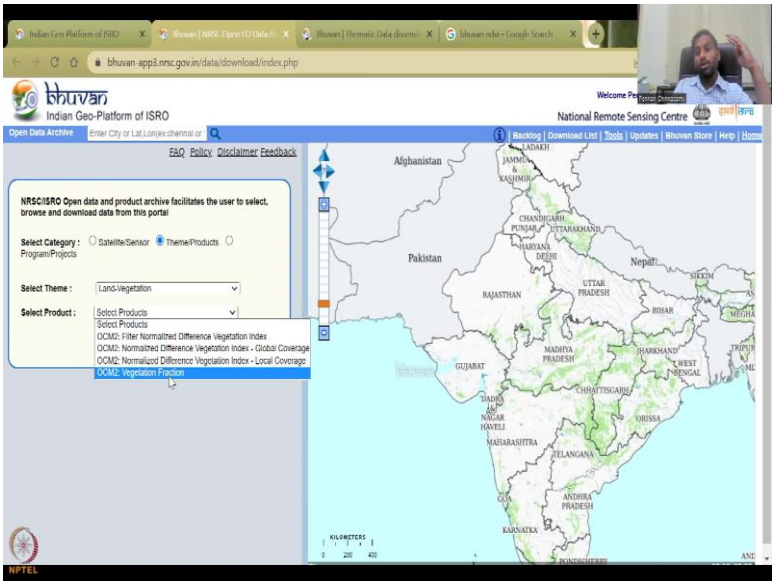

But we are going to go a theme and products because we want a product out. The raw data will have NIR and red but we do not want to calculate it because it is already there. Why do you have to calculate it when it is already there. So, we are going to use the Bhuvan's data products and you can see land and terrain is there, land vegetation is there. So, of the indicators for Agricultural and Rural Development, we have mentioned that the NDVI is very key and then we have the vegetation fraction cover is also there. But let us go to NDVI if available in the land vegetation, search the Select theme is land vegetation. So, let us go by terrain, terrain will just give you what are the versions of snow cover albedo, DM, digital elevation model, et cetera, we are going to do that, we are going to go to land vegetation.

And in the land vegetation, we can see that there are the 4 different parameters of which 2 data products are there. As I mentioned, the first one is NDVI so, you have the filter normal life difference vegetation index so, it is a filtered NDVI and then we have the NDVI global coverage. I am just going to click to see that okay, it goes global.

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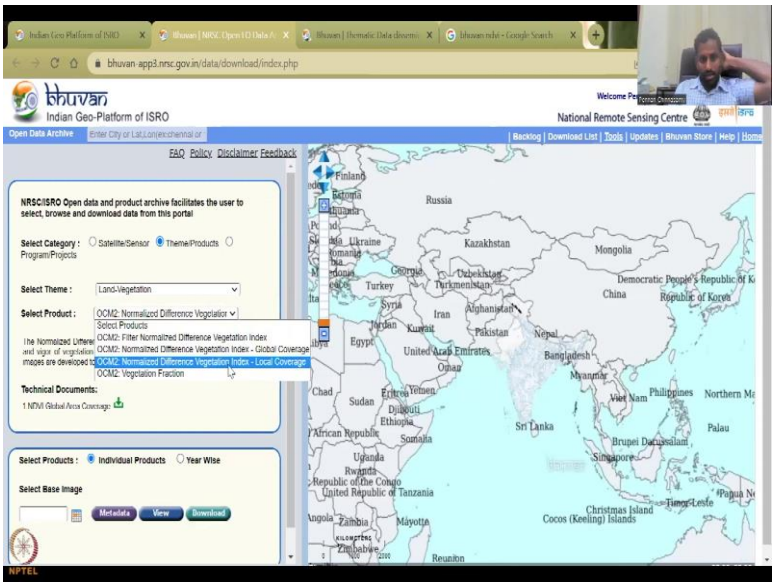

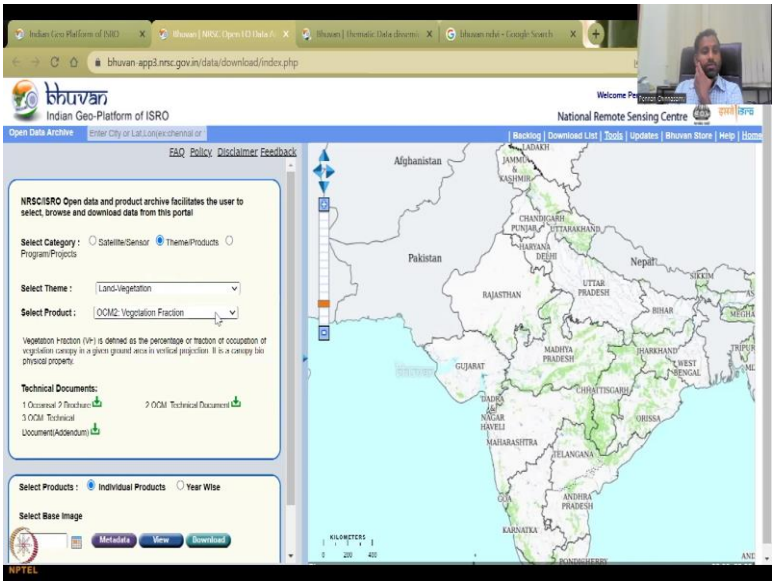

And then we have a local coverage where we are just going to look at India, OCM 2 again, OCM 2 is the satellite that has been used. But if you go to satellite sensor and do OCM, it will not show because it is saying is updated here it is coming up and then the last one is a vegetation fraction which we can take all OCM.

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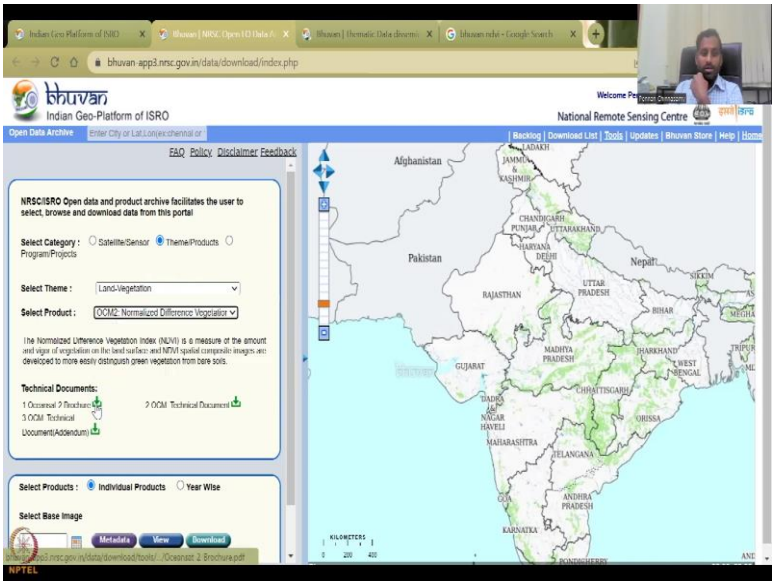

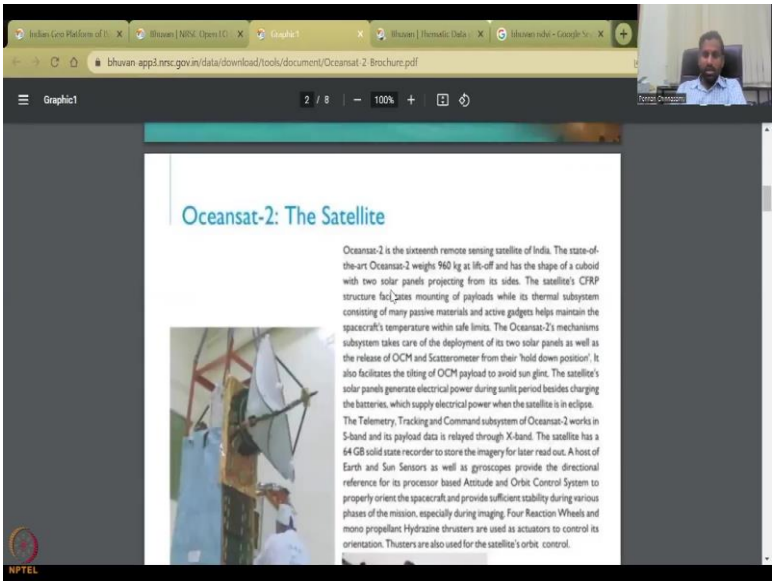
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Oceansat-2: The Satellite
Oceansat-2 is the sixteenth remote sensing satellite of India. The state-of-the-art Oceansat-2 weighs 960 kg at lift-off and has the shape of a cuboid with two solar panels projecting from its sides. The satellite's CFRP structure facilitates mounting of payloads while its thermal subsystem consisting of many passive materials and active gadgets helps maintain the spacecraft's temperature within safe limits. The Oceansat-2's mechanisms subsystem takes care of the deployment of its two solar panels as well as the release of OCM and Scatterometer from their 'hold down position'. It also facilitates the tilting of OCM payload to avoid sun glint. The satellite's solar panels generate electrical power during sunlit period besides charging the batteries, which supply electrical power when the satellite is in eclipse.
The Telemetry, Tracking and Command subsystem of Oceansat-2 works in S-band and its payload data is relayed through X-band. The satellite has a 64 GB solid state recorder to store the imagery for later read out. A host of Earth and Sun Sensors as well as gyroscopes provide the directional reference for its processor based Attitude and Orbit Control System to properly orient the spacecraft and provide sufficient stability during various phases of the mission, especially during imaging. Four Reaction Wheels and mono propellant Hydrazine thrusters are used as actuators to control its orientation. Thusters are also used for the satellite's orbit control.
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Readying Oceansat-2 for Thermo-vacuum test
Oceansat-2 being prepared for preLaunch tests
The eight band Ocean Colour Monitor carried by Oceansat-2 images a swath (strip of land or ocean) of 1420 km with a resolution of 360 metre and works in the Visible and Near Infrared region of the electromagnetic spectrum. The Ku-band Scatterometer with a 1m diameter antenna rotating at 20 rpm and generating two beams, works at a frequency of 13.515 Ghz. The Scatterometer covers a swath of 1400 km and operates continuously. ROSA is a GPS Receiver for atmospheric sounding by radio occultation. It determines position, velocity and time using GPS signals. Besides providing real-time navigation data with conventional accuracy, ROSA receives RF signals from the 'rising' GPS satellites near Earth's horizon through its occultation antenna and from the excess phase delay and Doppler measurements made by this payload, vertical profiles of atmospheric parameters (density, refractivity, temperature, humidity and pressure) will be derived upto an altitude of about 30 km.
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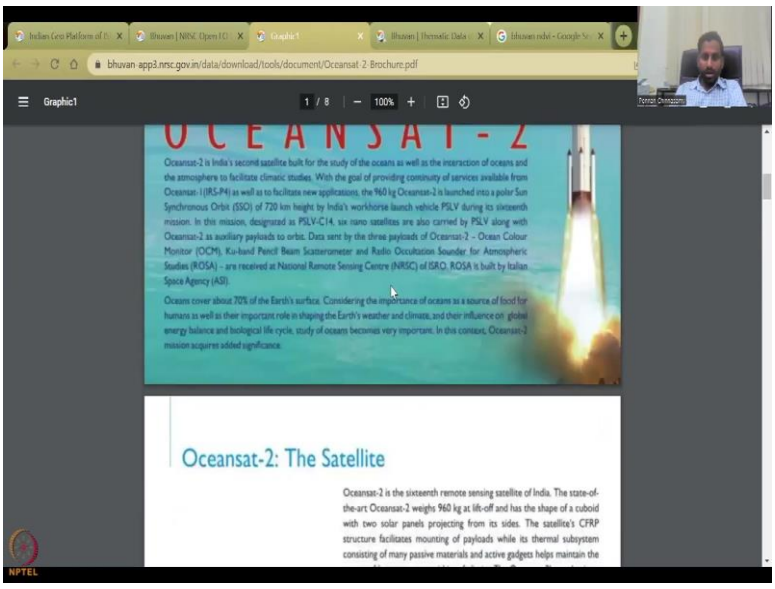
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OCEANSAT-2
Oceansat-2 is India's second satellite built for the study of the oceans as well as the interaction of oceans and the atmosphere to facilitate climatic studies. With the goal of providing continuity of services available from Oceansat-1 (IRS-P4) as well as to facilitate new applications, the 960 kg Oceansat-2 is launched into a polar Sun Synchronous Orbit (SSO) of 720 km height by India's workhorse launch vehicle PSLV during its sixteenth mission. In this mission, designated as PSLV-C14, six nano satellites are also carried by PSLV along with Oceansat-2 as auxiliary payloads to orbit. Data sent by the three payloads of Oceansat-2 - Ocean Colour Monitor (OCM), Ku-band Pencil Beam Scatterometer and Radio Occultation Sounder for Atmospheric Studies (ROSA) - are received at National Remote Sensing Centre (NRSC) of ISRO. ROSA is built by Italian Space Agency (ASI).
Oceans cover about 70% of the Earth's surface. Considering the importance of oceans as a source of food for humans as well as their important role in shaping the Earth's weather and climate, and their influence on global energy balance and biological life cycle, study of oceans becomes very important. In this context, Oceansat-2 mission acquires added significance.
Oceansat-2: The Satellite
Oceansat-2 is the sixteenth remote sensing satellite of India. The state-of-the-art Oceansat-2 weighs 960 kg at lift-off and has the shape of a cuboid with two solar panels projecting from its sides. The satellite's CFRP structure facilitates mounting of payloads while its thermal subsystem consisting of many passive materials and active gadgets helps maintain the
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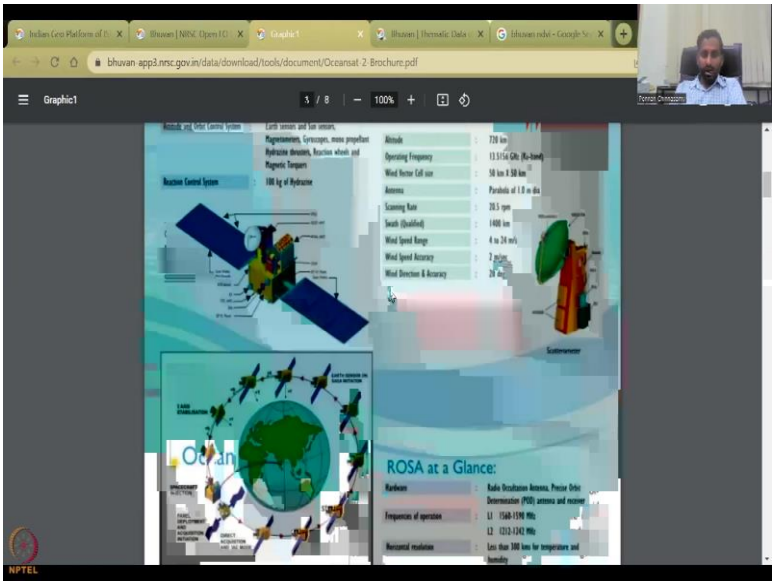
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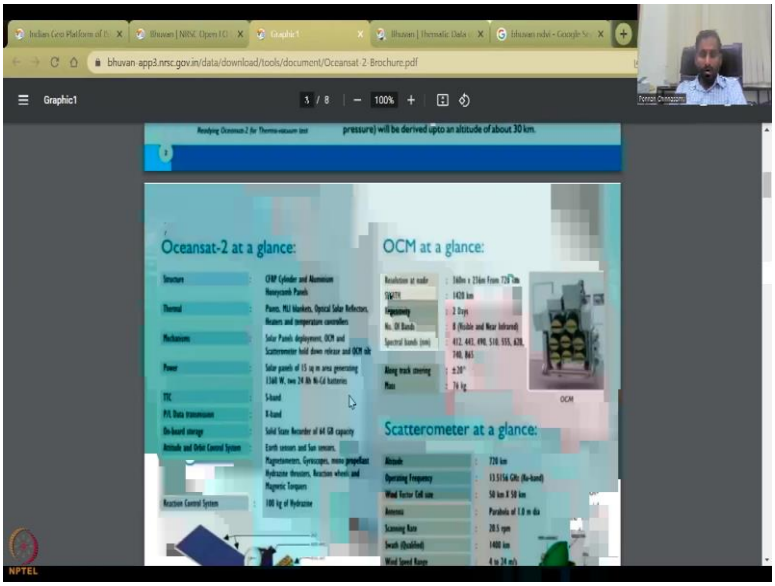
ROSA at a Glance: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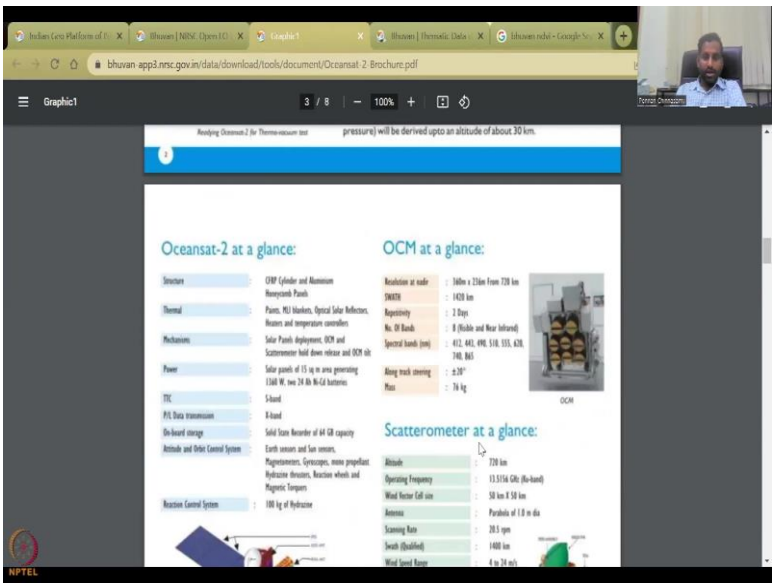
pressure) will be derived upto an altitude of about 30 km.
Oceansat-2 at a glance:
OCM at a glance:
Scatterometer at a glance: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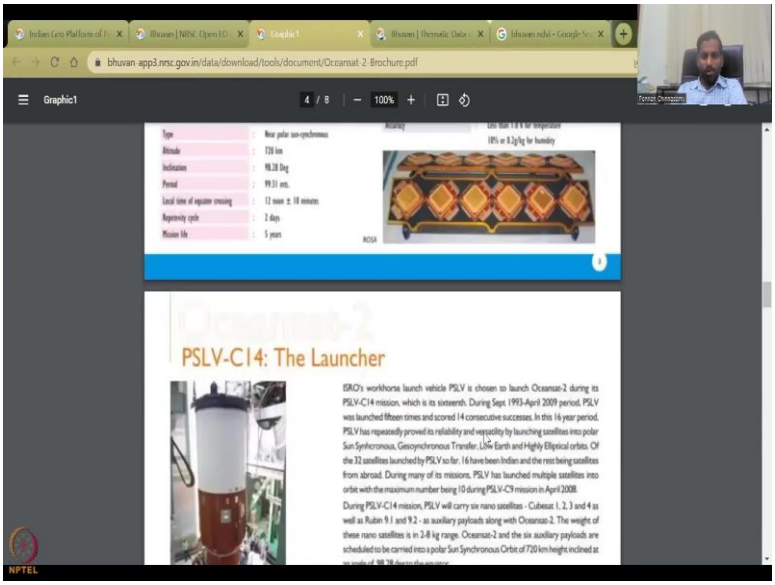

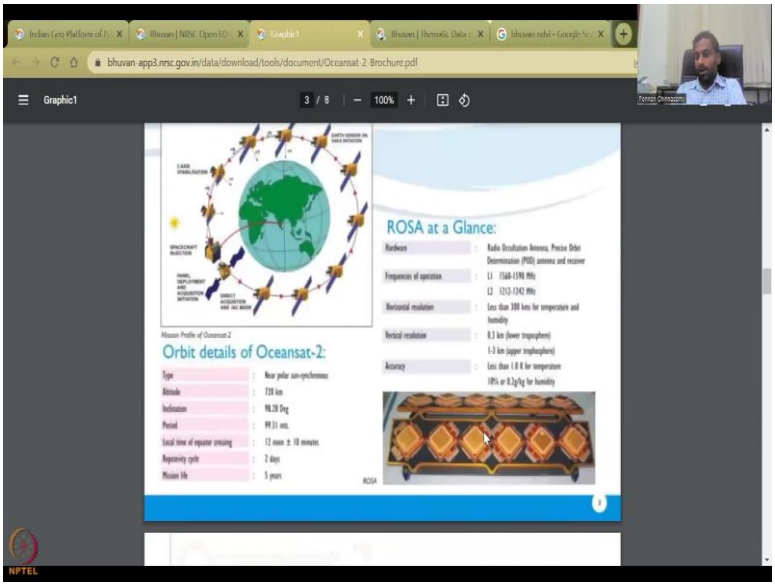

So, let us go to the first NDVI local coverage. And then we can as I said look at the browser of what this has been done, these are the satellites of Oceansat to the satellite range, et cetera et cetera. We will anyway look at the metadata when we download the data. So, all this can be read for interest.

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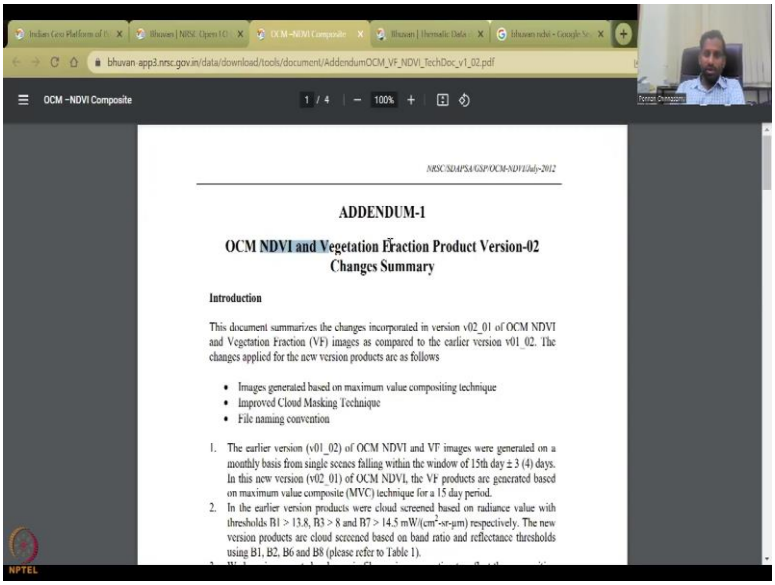
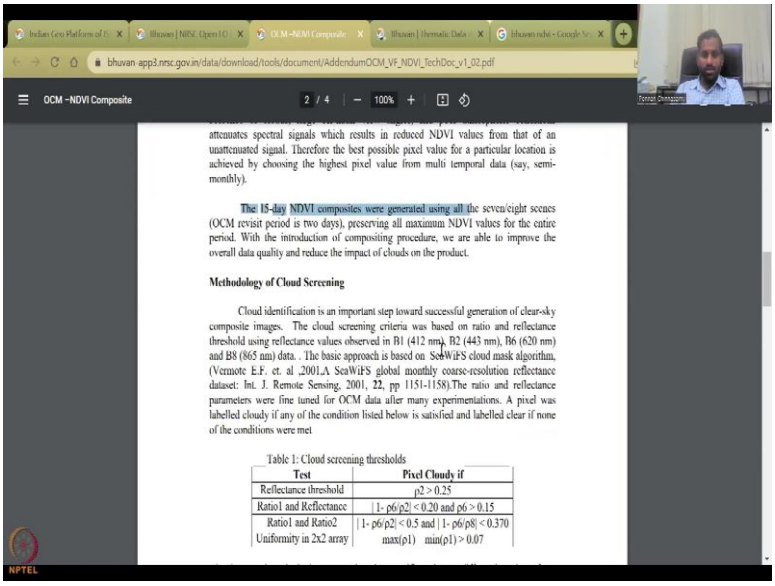
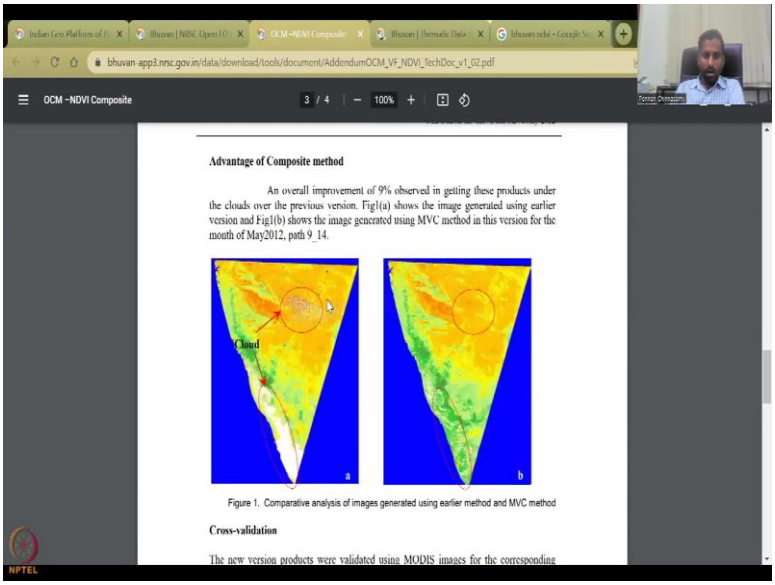
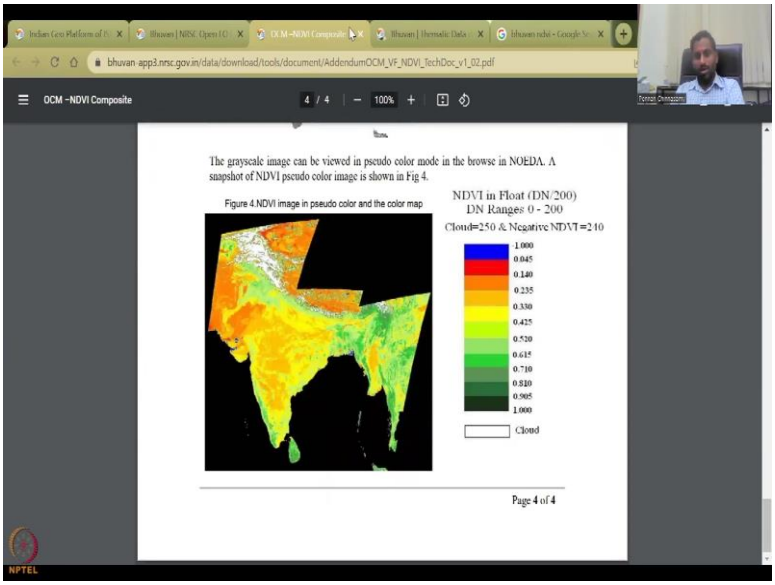




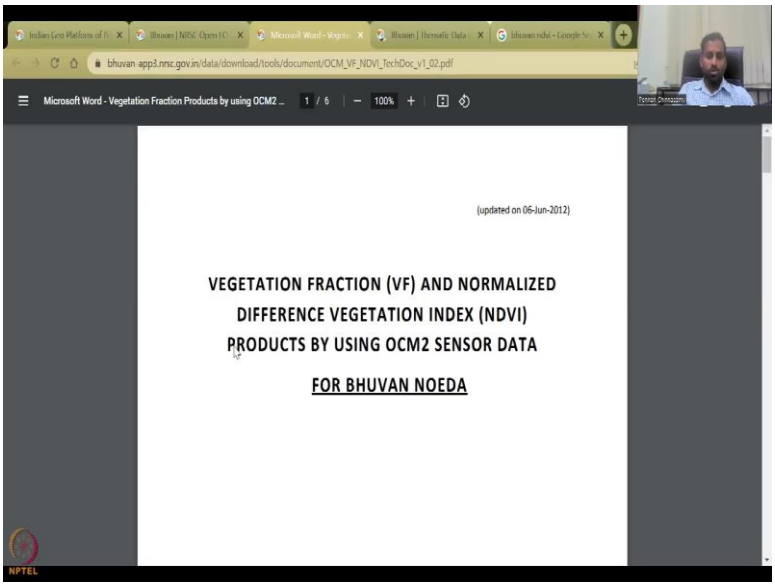




And then we have the technical documentation addenda which is an addition to the technical data site. So, it says NDVI and recession fraction, how they did it, what is the methodology, et cetera, et cetera. It is the 15 day NDVI composites, so every 15 days the data was collected and the cloud cover was removed. But analysts generated using earlier methods and MVC method where the cloud cover has been removed and or negotiated.

So, we have the range, as I said in the previous example, 1 to minus 1, 1 is vegetation, whereas minus 1 is water bodies, and we can have that.

(Refer Slide Time: 20:28)



for the VF products realization, this data is also provided as a product for a given month.

Products Formats Specification

• Image File Format	:	Geo TIFF
• Projection	:	Geographic coordinates (Lat., Long.)
• Datum	:	WGS-84
• Spatial Resolution	:	1080m (0.01017 deg)
• Radiometric resolution	:	8 bits per pixel
• Correction Level	:	precision corrected
• Number of bands	:	1
• DN-VF conversion rule	:	VF = (0.5 × DN) (in %)
• DN – NDVI conversion rule	:	NDVI = (0.005 × DN) (in float)
• Usable range of DN	:	0 – 200
• Masked Label values	:	250 (clouds) and 240 (NDVI less than 0)
• Image background	:	255

File Naming Convention

Image file naming convention contains the following information

- Sensor name
- Product name
- Month of reference
- Year of reference
- Version number

The Oceansat-2 mission was envisaged as the continuity service provider to IRS-P4 data users. Oceansat-2 has onboard 3 payloads, namely, OCM2, Ku-band Scatterometer and ROSA (developed by the Italian Space Agency, ASI). Oceansat-2 was launched into a near polar sun-synchronous orbit of 720 km altitude. The local time of pass is 12 noon + 10 minutes. The OCM2 is an 8-band multi spectral camera operating in the Visible-Near IR Spectral range. This camera provides an Instantaneous Geometric Field of View of 360 m covering a swath width of 1420 km. This wide swath enables the OCM2 to provide a repetivity of 2 days for any given area. For further details, please refer to webpage http://www.nrsc.gov.in and further following links >> Satellite Data/Mapping and >> Missions.

Data Processing

OCM2 Level-1C imagery has been obtained to generate a monthly product. To make genuine representation of the vegetation growth, selection of datasets was ordered and processed for dates of passes around middle of the month. Accordingly, day 15th of each month +/- 3 (4) days were first checked for cloud free conditions up to 99% to select scenes to cover the country boundary. Leaving the monsoon period (June-September), monthly products are realized by following this selection approach. Two steps of data processing are involved: 1) Data preprocessing to prepare the base data, and 2) Generation of intermediate NDVI imagery to realize finally VF products.

Data preprocessing for generating the VF products involves following steps: 1) precision correction of images, 2) cloud masking, 3) sun and view angle effect corrections across the image swath, 4) atmospheric correction to realize top-of-atmospheric reflectance product, 5) generation of image mosaics, and 6) generation NDVI images.

OCM2_NDVI products are at 4-byte float value. In the NDVI product, all pixels with values less than or equal to zero were brought to zero to enhance the variation in vegetation more predominantly.

For estimation of the VF, the mosaic-pixel model suggested by Zu Liang et al. (http://www.isprs.org/proceedings/XXXVII/congress/8_pdf/10_WG-VIII-10/12.pdf) is carried out. The present study attempts to estimate the vegetation fraction only for highly vegetated parts (identified from Land Use Land Cover map) of the country. In the non-vegetation cover area, the vegetation fraction is zero. The vegetation fraction is given by

$$VF = \frac{NDVI - NDVI_0}{NDVI_\infty - NDVI_0}$$

The NDVI is usually sensitive to vegetation. However, NDVI of some special features will be similar to that of vegetation. It is difficult to identify vegetation and non-vegetation areas by using only the NDVI data, and land cover classification map is needed. Land use/land cover (LULC) classification map is used to delineate vegetation areas from the non-vegetated ones. LULC map was available for the entire country at a scale of 1:250, 000. This map can be downloaded from NRSC BHUVAN webpage (http://www.bhuvan.nrsc.gov.in). Using this LULC map a mask was generated to reflect the regions falling into the Kharif, Rabi, Zaid, Double/Triple cropping, Grassland and Shifting cultivation patterns. The mask was laid on each of the the NDVI images to identify the pixels falling into these regions. Histogram of these pixels values was used to determine $NDVI_0$ and $NDVI_\infty$ for each image, taking care to avoid contaminated pixels by leaving 1% into consideration on either ends of the histogram. The vegetation fraction is calculated for all pixels using the global minimum and maximum value obtained from vegetated area. An image mosaic of the VF products for the year 2011 is shown in Figure 1.

bhuvan-app3.nrsc.gov.in/data/download/tools/document/OCM_VF_NDVI_TechDoc_v1_02.pdf

Microsoft Word - Vegetation Fraction Products by using OCM2 ... 4 / 6 100%

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Products horizontal Accuracy

Geometric accuracy of the VF and NDVI products is better than 500 m.

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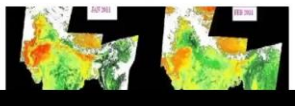
bhuvan-app3.nrsc.gov.in/data/download/tools/document/OCM_VF_NDVI_TechDoc_v1_02.pdf

Microsoft Word - Vegetation Fraction Products by using OCM2 ... 5 / 6 100%

Geometric accuracy of the VF and NDVI products is better than 500 m.

Thematic Mapping Accuracy

Though elaborate comparison was not made so far with ground measured vegetation indices, a comparison is made with reference to NDVI products from MODIS sensor data by visually identifying common regions of the images. Mean values of these regions are considered for analysis. Figure 2 shows the correlation plot for three months data between the OCM2 and MODIS products. A good overall correlation between these products is noticed (R^2 = 0.980). The root mean square error (RMSE) between these products is found to be 0.0278, with an overall variation of the OCM2 NDVI products with respect to MODIS NDVI data of about 5.2%.



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bhuvan-app3.nrsc.gov.in/data/download/tools/document/OCM_VF_NDVI_TechDoc_v1_02.pdf

Microsoft Word - Vegetation Fraction Products by using OCM2 ... 5 / 6 100%

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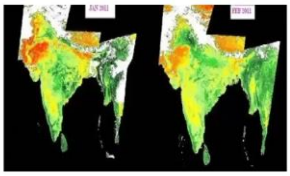

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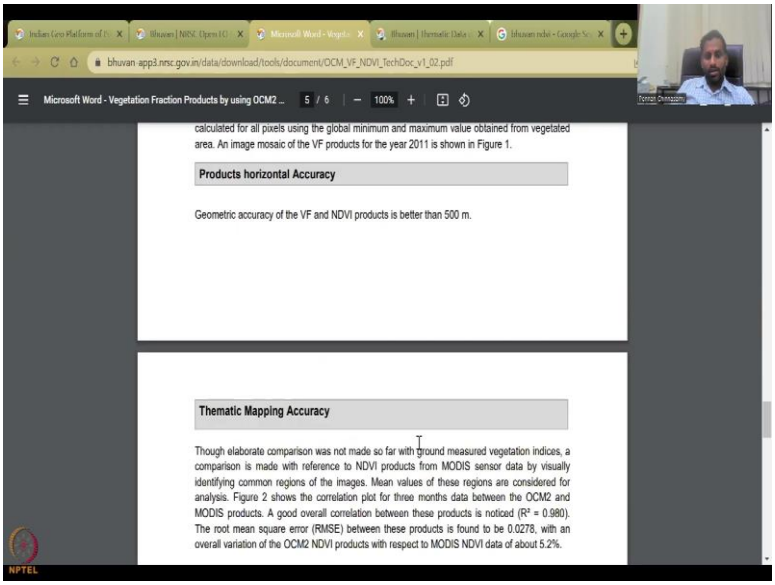
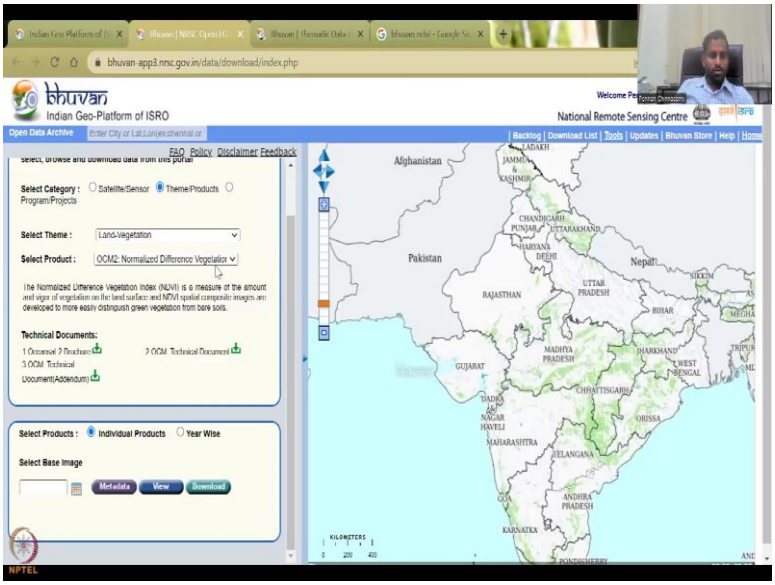
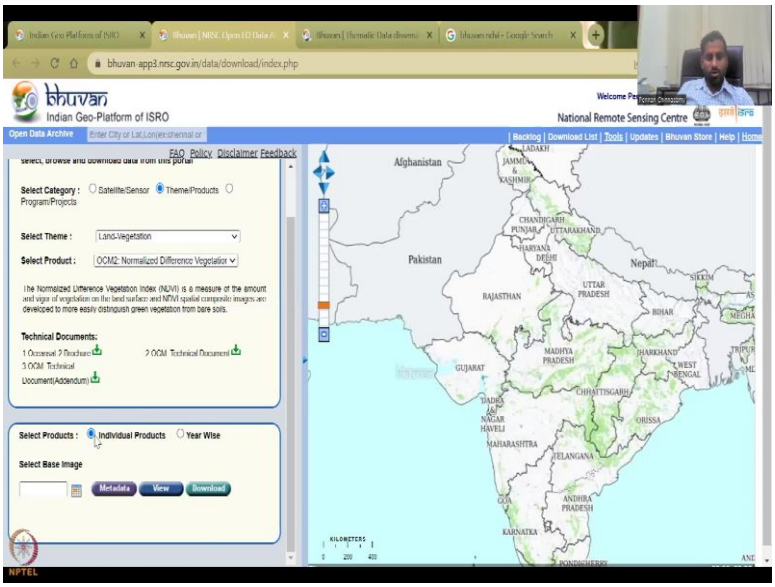


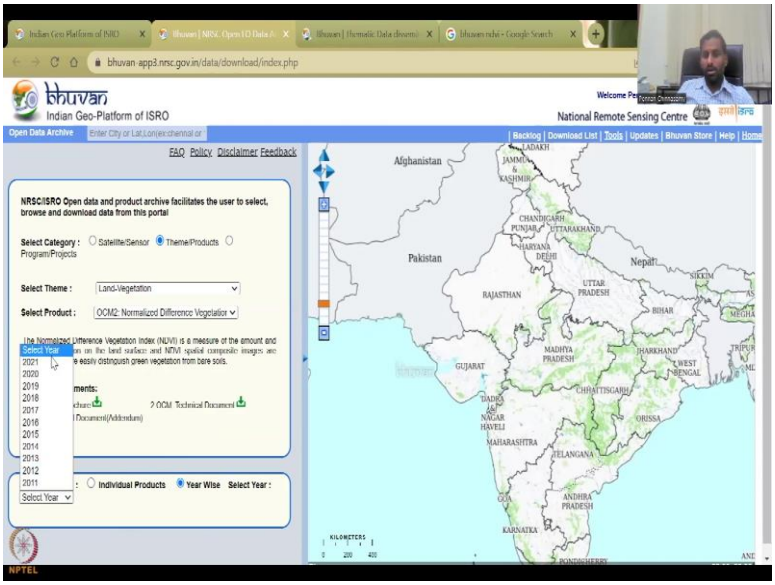
So, the last is the technical document, it is always important to go through these documents, and it says almost sometimes it is duplicated, but we will just see if something we need to be careful about. For example, the spatial resolution is around 1 kilometers so, 1000 meters and these your reference coordinates are given data processing how they did it and the NDVI function what they used. So, we as I said, NIR minus red, NIR plus red and that is what we also used for our index and then the recession fraction is NDVI minus NDVI not and NDVI infinity minus NDVI also, if you look into what these NDVI not just NDVI is, you will get more information about is it is it affecting the Kharif, Rabi, or Zaid double cropping.

And then so how do you determine histogram of the speed pixels was then used to determine NDVI. So, again, these these products are kind of less use compared to NDVI. So, I am going to first show the NDVI product and then we can have a call.

(Refer Slide Time: 21:45)



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Select Product : OCM2: Normalized Difference Vegetation
Select Year
2021
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
Individual Products Year Wise Select Year :
Afghanistan
Pakistan
Nepal
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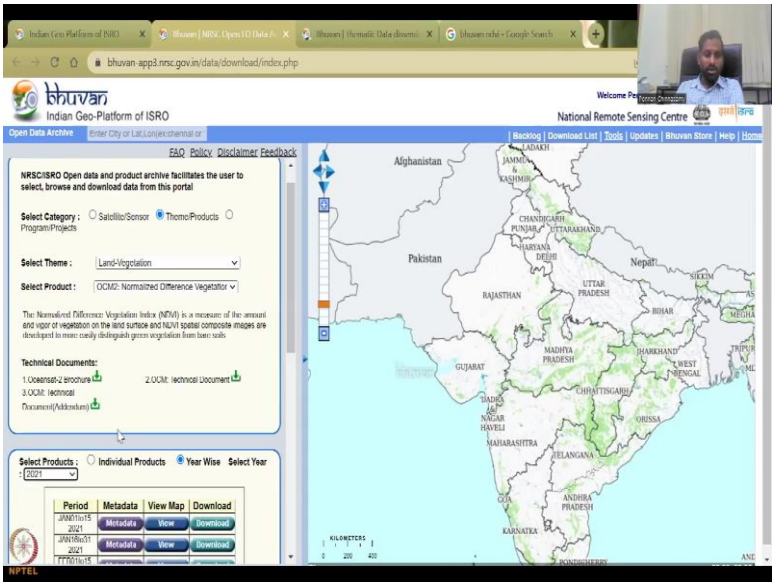
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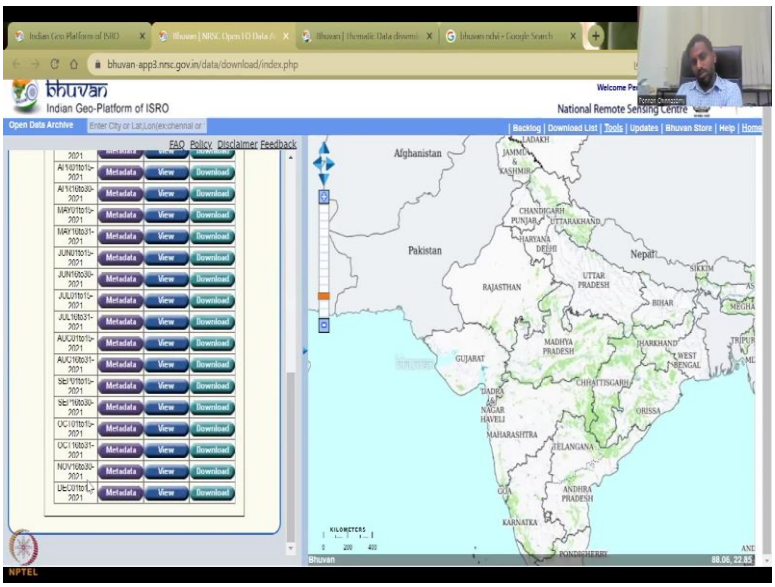
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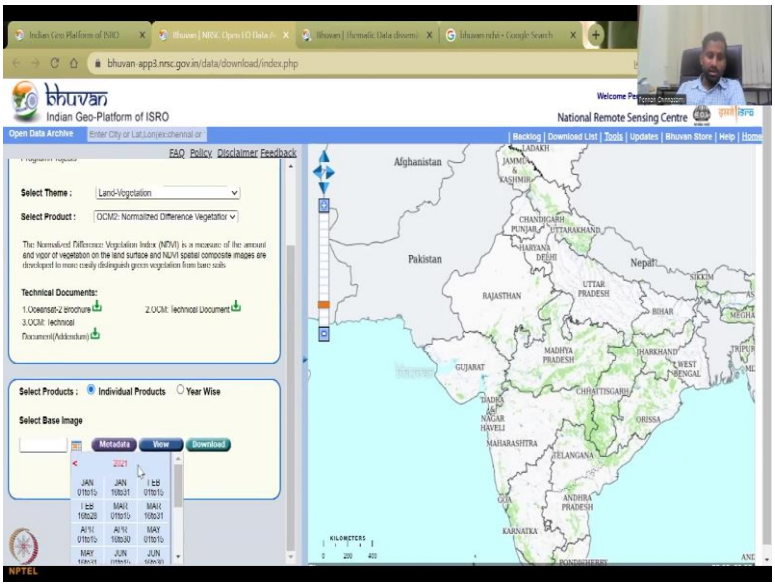
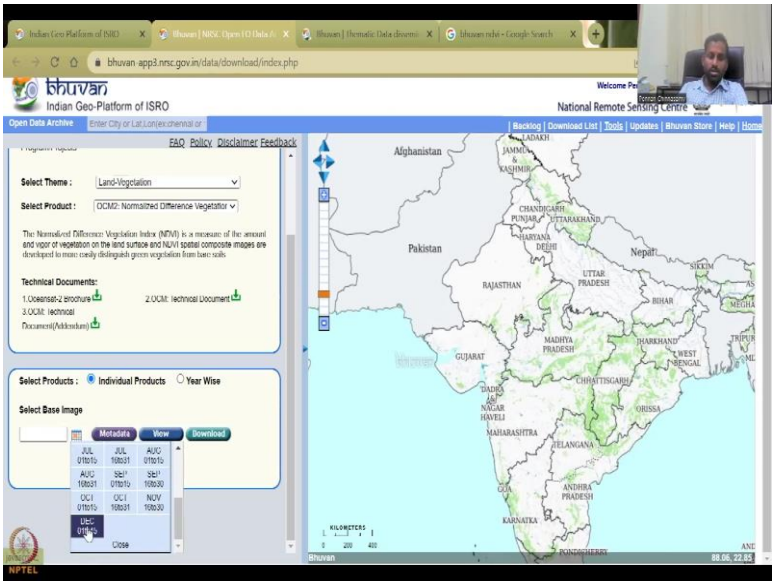
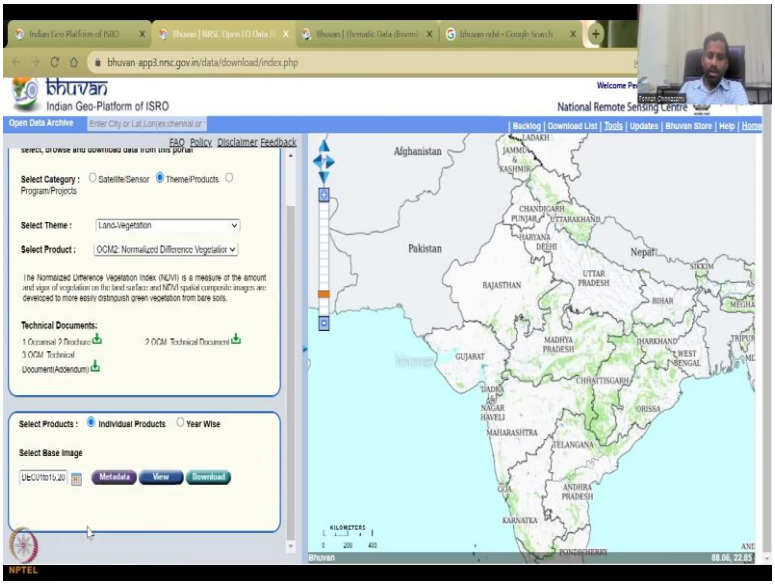
So, look at this NDVI product and then we can go to individualize products or year wise, if you click year wise you will first know how many years are available? So, from 2011 to 2021, so approximately 10 years, 11 years of data is available on Bhuvan. But you can go to 2021. And then you can just quickly see which are the maps.

(Refer Slide Time: 22:10)



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Select Category : Satellite/Sensor Theme/Products
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Select Theme : Land-Vegetation
Select Product : OCM2: Normalized Difference Vegetation
The Normalized Difference Vegetation Index (NDVI) is a measure of the amount and vigor of vegetation on the land surface and NDVI spatial composite images are developed to more easily distinguish green vegetation from bare soils.
Technical Documents:
1.Oceansat-2 Brochure
2.OCM Technical Document
3.OCM Technical Document(Addendum)
Select Products : Individual Products Year Wise
Select Base Image
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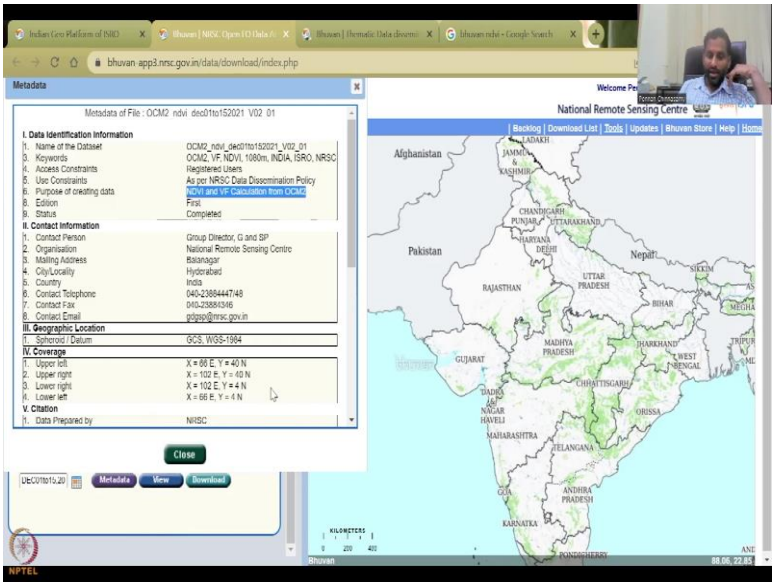
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2. Keywords OCM2, VF, NDVI, 1080m, INDIA, ISRO, NRSC
3. Access Constraints Registered Users
4. Use Constraints As per NRSC Data Dissemination Policy
5. Purpose of creating data NDVI and VF Calculation from OCM2
6. Edition First
7. Status Completed
II. Contact Information
1. Contact Person Group Director, G and SP
2. Organisation National Remote Sensing Centre
3. Mailing Address Balanagar
4. City/Locality Hyderabad
5. Country India
6. Contact Telephone 040-23884447/48
7. Contact Fax 040-23884346
8. Contact Email gdgsp@nrsc.gov.in
III. Geographic Location
1. Spheroid / Datum GCS_WGS-1984
IV. Coverage
1. Upper left X = 66 E, Y = 40 N
2. Upper right X = 102 E, Y = 40 N
3. Lower right X = 102 E, Y = 4 N
4. Lower left X = 66 E, Y = 4 N
V. Citation
1. Data Prepared by NRSC
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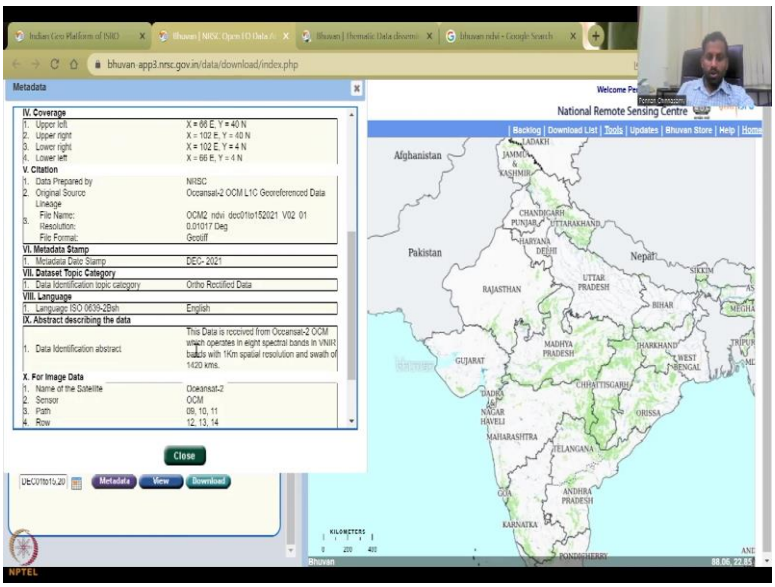
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IV. Coverage
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2. Upper right X = 102 E, Y = 40 N
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4. Lower left X = 66 E, Y = 4 N
V. Citation
1. Data Prepared by NRSC
2. Original Source Oceansat-2 OCM L1C Georeferenced Data
3. Linkage
File Name: OCM2_ndvi_dec01to152021_V02_01
Resolution: 0.01017 Deg
File Format: Geotiff
VI. Metadata Stamp
1. Metadata Date Stamp DEC- 2021
VII. Dataset Topic Category
1. Data Identification topic category Ortho Rectified Data
VIII. Language
1. Language ISO 0639-2Bsh English
IX. Abstract describing the data
1. Data Identification abstract This Data is received from Oceansat-2 OCM which operates in eight spectral bands in VNIR bands with 1Km spatial resolution and swath of 1420 kms.
X. For Image Data
1. Name of the Satellite Oceansat-2
2. Sensor OCM
3. Path 09, 10, 11
4. Row 12, 13, 14
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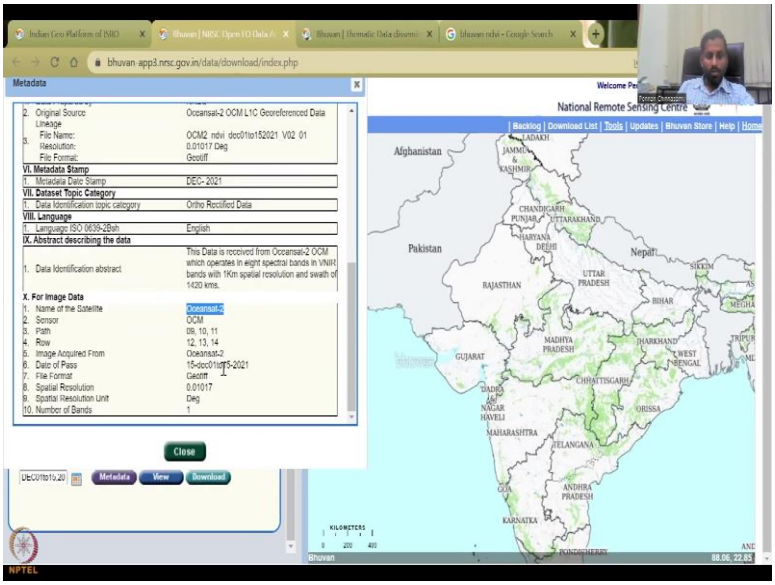
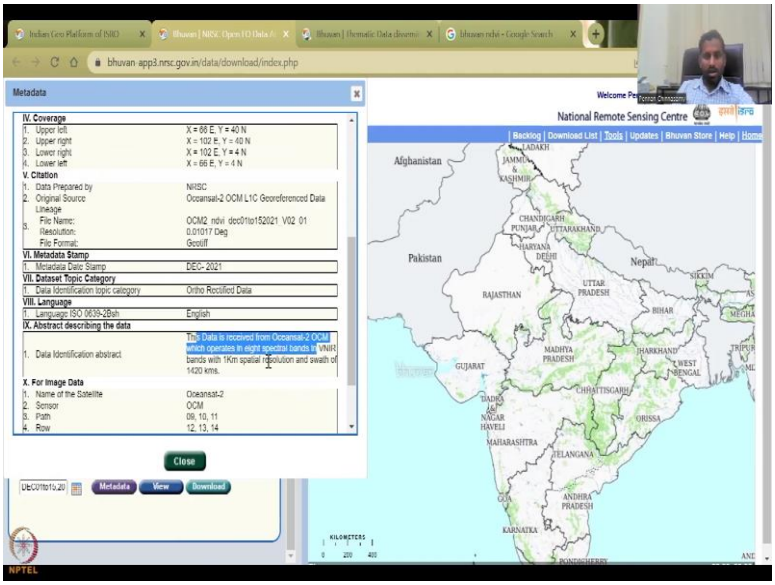


If you even if you do individual products, the same thing, click the calendar to click the calendar then the year comes and the individual product comes until December. You want to go to the previous year you can click the previous year and there we go.

So, let us go to the recent most recent one which is December and then you can click metadata for December the document as a full forms, but the most important ones we will quickly look at what is the addition, what is the data, it is for NDVI and we have calculation. The coordinate reference system is GCS, WGS 1984, which is good, which is what we are using throughout this exercise and lecturers. Name of the satellite is important so oceansat and then in what format it comes it comes in GeoTIFF the spatial resolution in degrees and it has been given approximately as 1 kilometer.

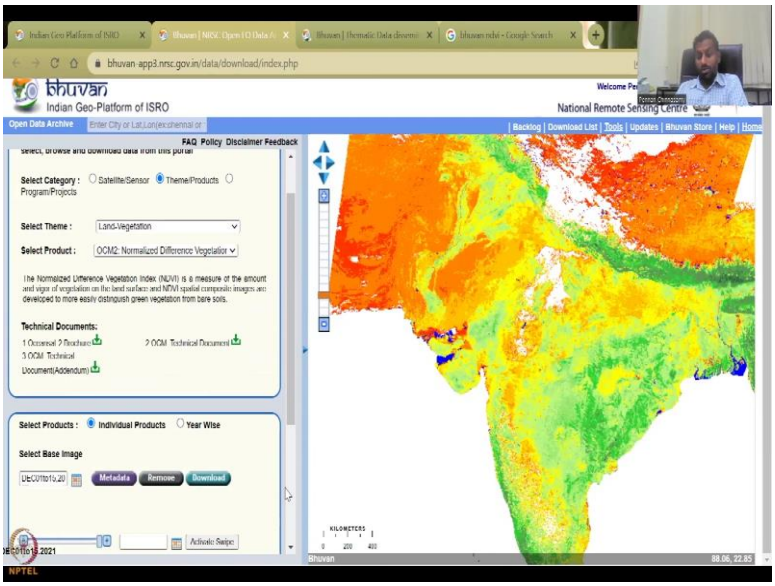
A number of bands is just 1 because this is a product it is not like a satellite raw image. If you go to satellite raw image you will see like number of bands and that has been calculated to get this data problem. It has been rectified some other defy certification has been done. And then you know, what is the sensor is the OCM sensor.

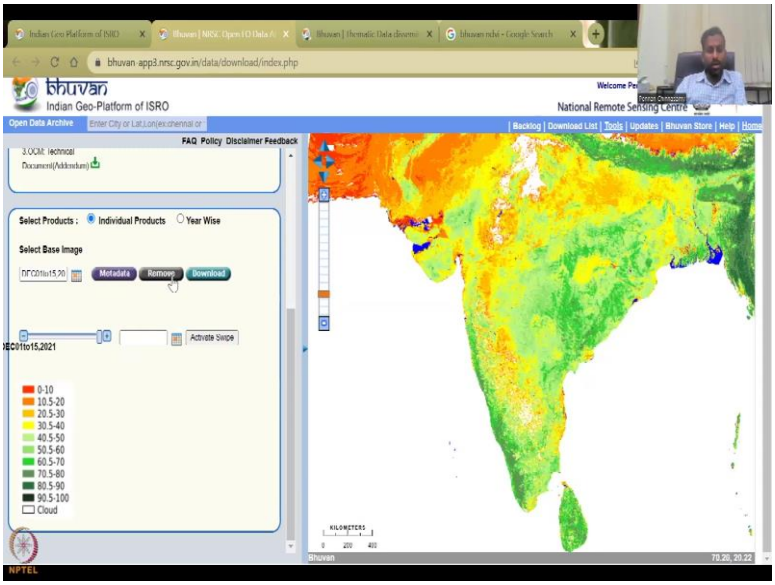
(Refer Slide Time: 23:23)



Since these are given at every 15 days, the they do not specifically mention the temporal resolution et cetera. So, this data is a promotion set which operates in eight bands so, eight bands near in the VNIR. So, in the VNIR there are eight bands with 1 kilometer spatial resolution every 15 days of the VNIR, NIR is taken and R is taken subtracted and divided by NIR plus R.

(Refer Slide Time: 23:53)

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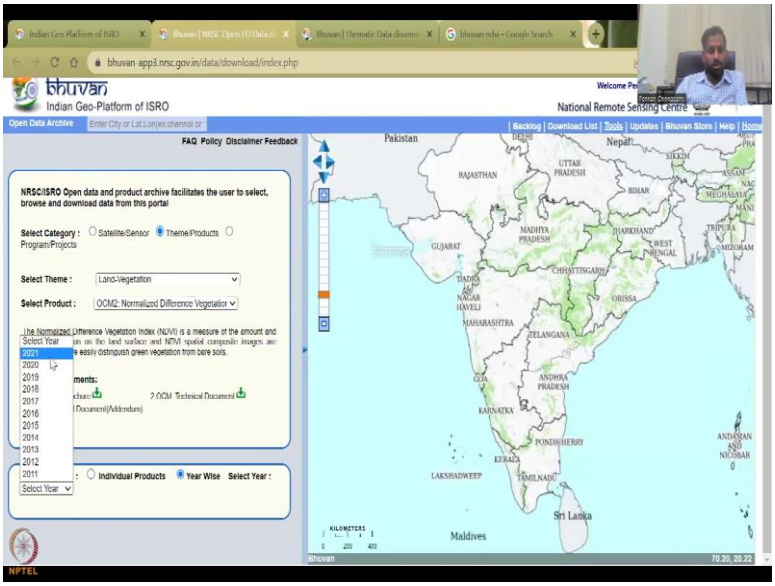
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Select Product : OCM2: Normalized Difference Vegetation
Select Year
2021
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
Individual Products Year Wise Select Year :
Pakistan
Nepal
RAJASTHAN
UTTAR PRADESH
BIHAR
SIKKIM
GUJARAT
MADHYA PRADESH
JHARKHAND
WEST BENGAL
TRIPURA
MIZORAM
CHHATTISGARH
ORISSA
MAHARASHTRA
TELANGANA
ANDHRA PRADESH
KARNATKA
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KERALA
LAKSHADWEEP
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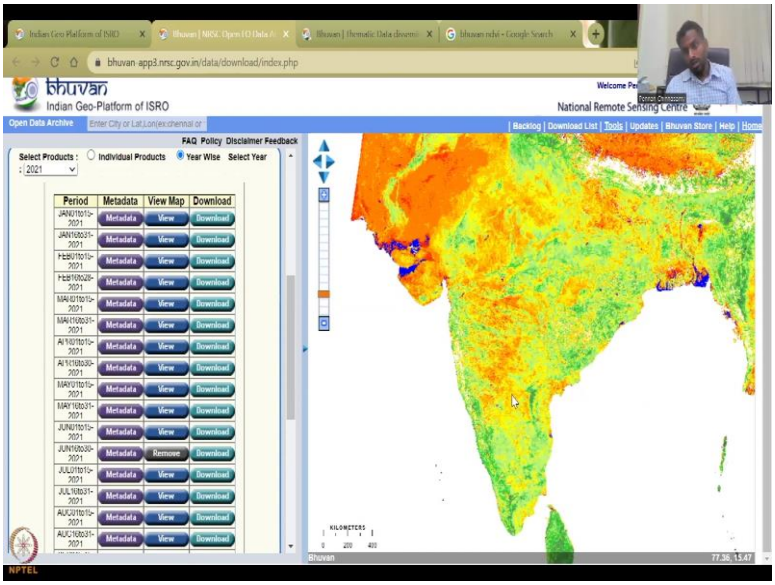
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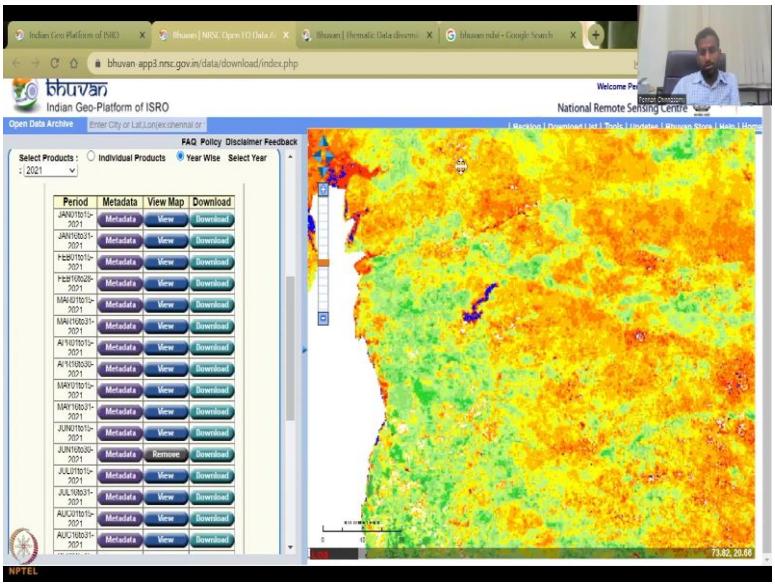
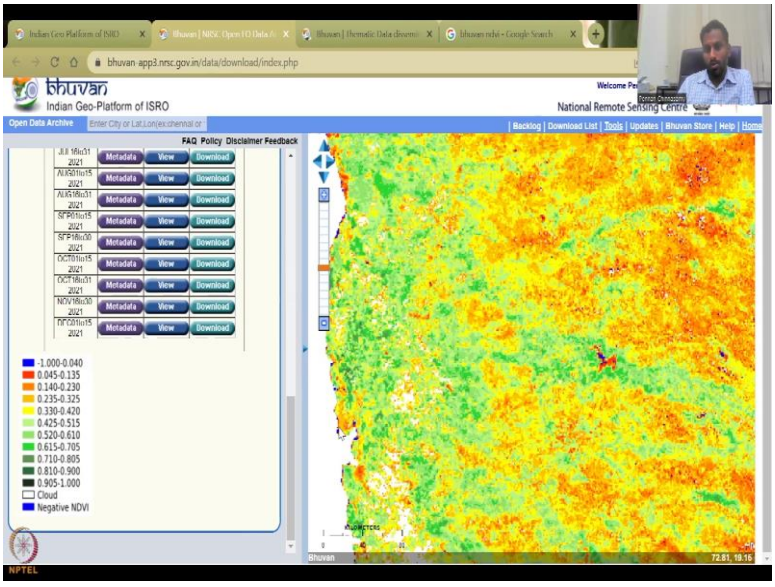
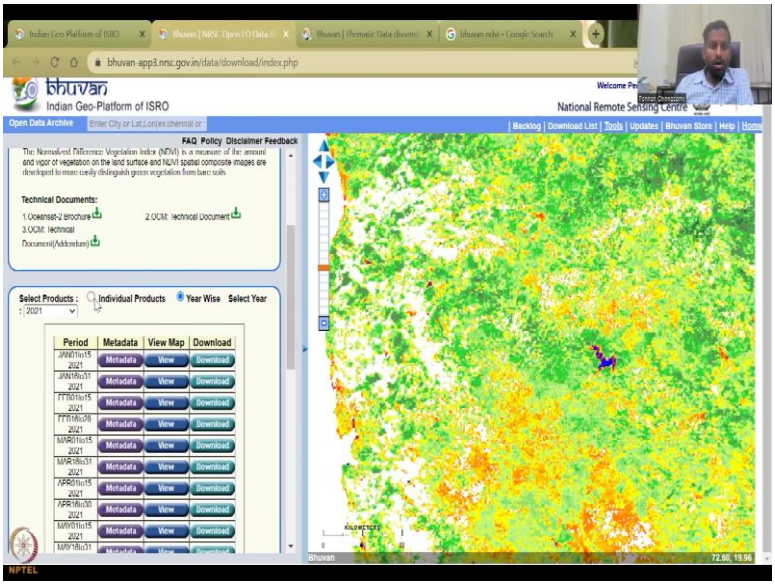
So, as I said there is a 15 day window so, let us quickly view it and then you could see if you view it or we could see that there is some cloud cover which is given in the white thing and because in December time we do have cloudy covers, if you pick the year wise and let us say 2021 June approximately June view, there is less cover because in peak summer times you don't have much cloud thick clouds with water vapor covering, condensation, so you have this which is good. So, I have viewed the June 2021.

(Refer Slide Time: 24:37)







So, you have that you can also zoom into a particular region, so we have zoomed in into Maharashtra again. And if you could see that minus 1 is the water bodies along the coast and wherever the water bodies are there is minus around the water bodies still it is water reflecting so, it is red, but the dark greens and the greens give you the vegetation. So, normally in June, there is not much vegetation. So, we will not have much, but after June after August, during the peak monsoon, so let us say September first week, you will have more vegetation.

So, there, there it is you have now all these red areas are now covered with green. So, you can also do this as a year wise product or individual products, which allows you to swipe and show him what swipe means.

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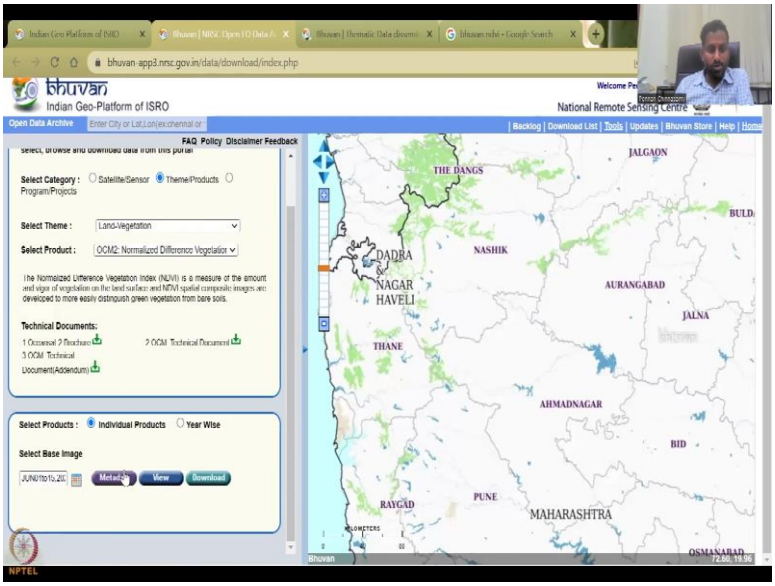

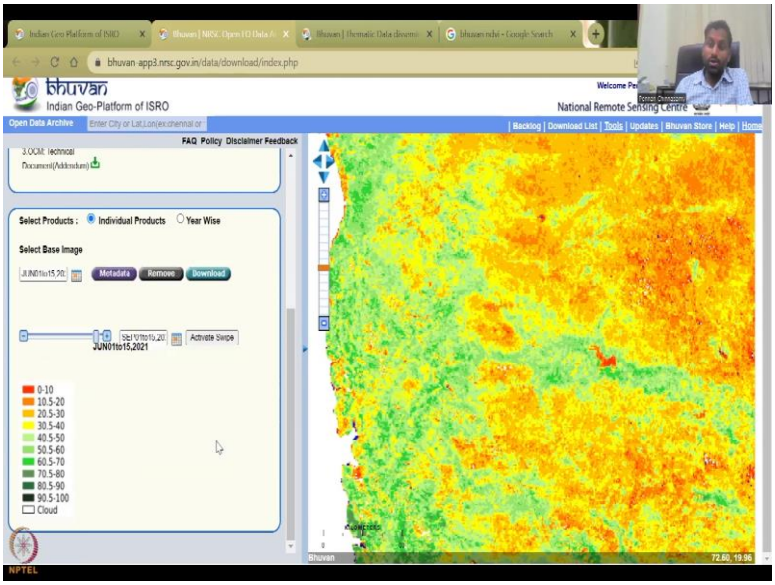

So, let us go back to the same analysis, we pick June 1 week, so I am going to click June, and I am going to say view. Once it views, then you can say activate swipe. We will have to select the image. So, the first image is there already June 15. So, now I am going to put as I said, September 1 week, because that is after the monsoon, there will be a lot of crops, June is kind of the peak summer, so or after the summer will June first week, maybe some rain will be there.

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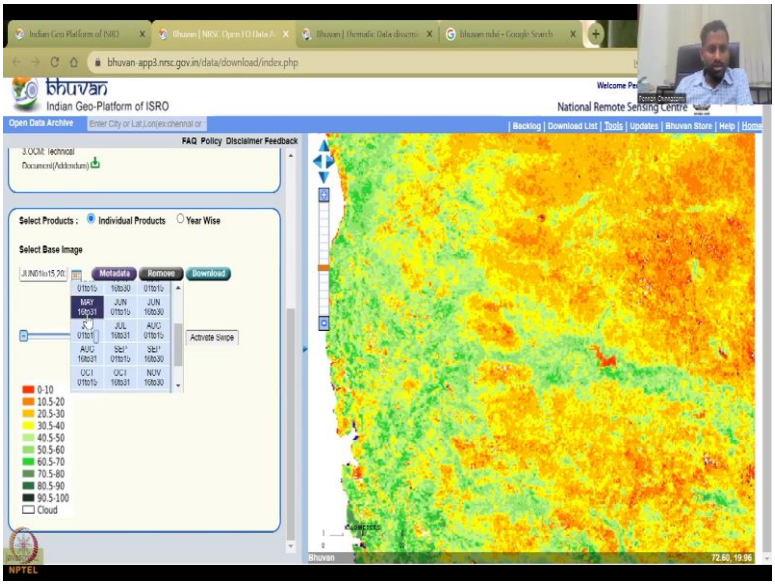

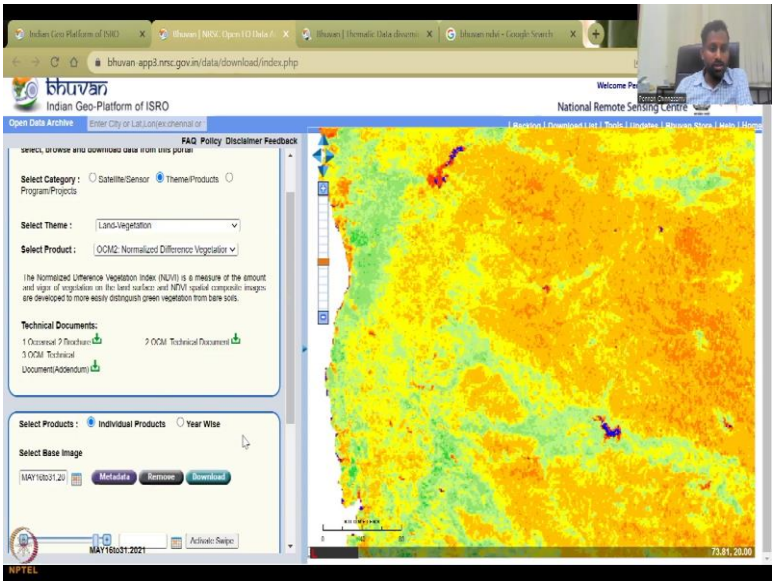
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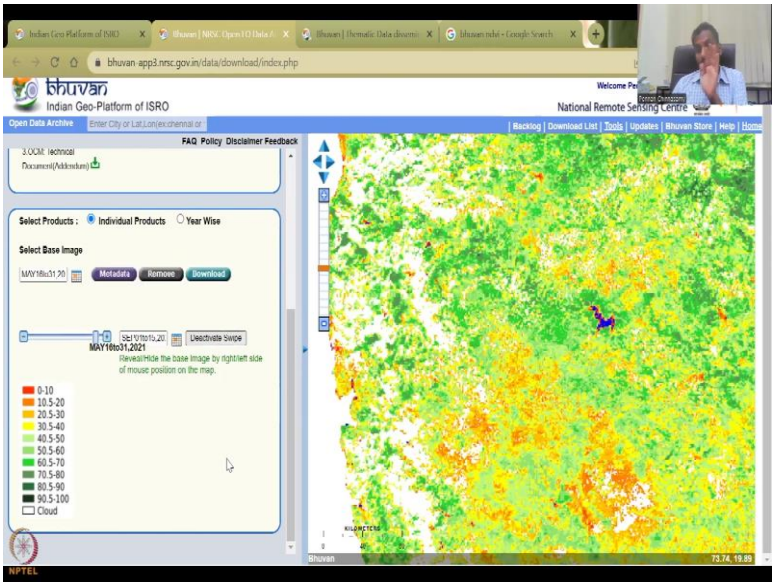
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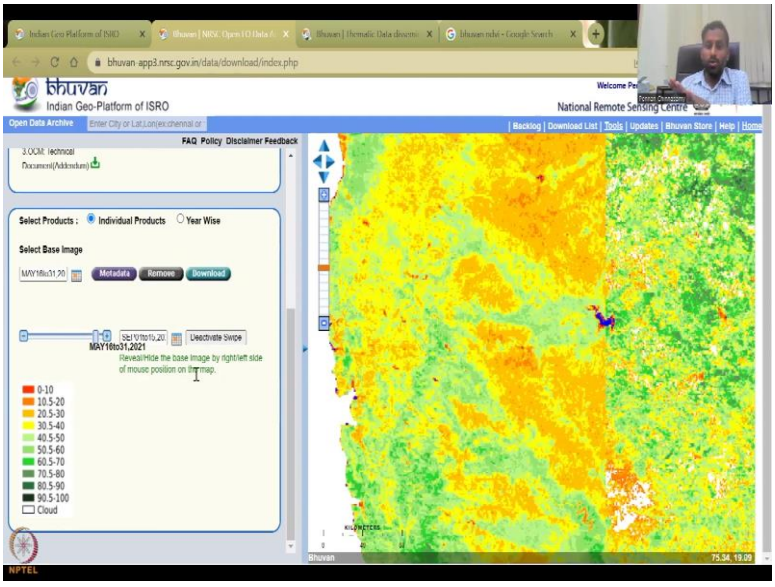
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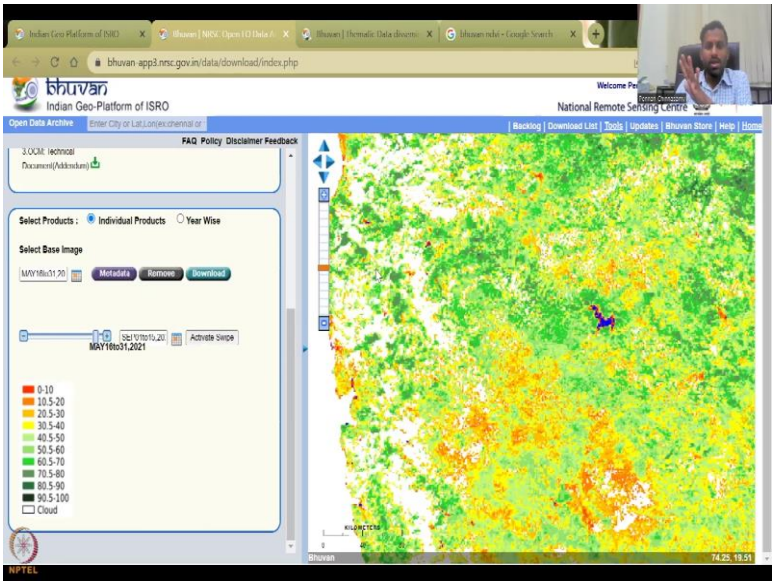

So, let us push it to May 30th, 31st, May 16 to 31st, get the view, see there is a lot of red color. We will just keep it like that. And then now I am going to take this second. So, 2 dates we can take. So, I am going to take the second September 1 week, activate swipe. So, on this layer, what you see is this September 1 to 15 average of 2021. And if I move my mouse, so that is what I have activated, activated the swipe and deactivate the swipe. So, if I move the mouse, nothing happens, I am seeing the September month, But if I activate swipe, and I move my mouse, then you will see that, let us do it again.

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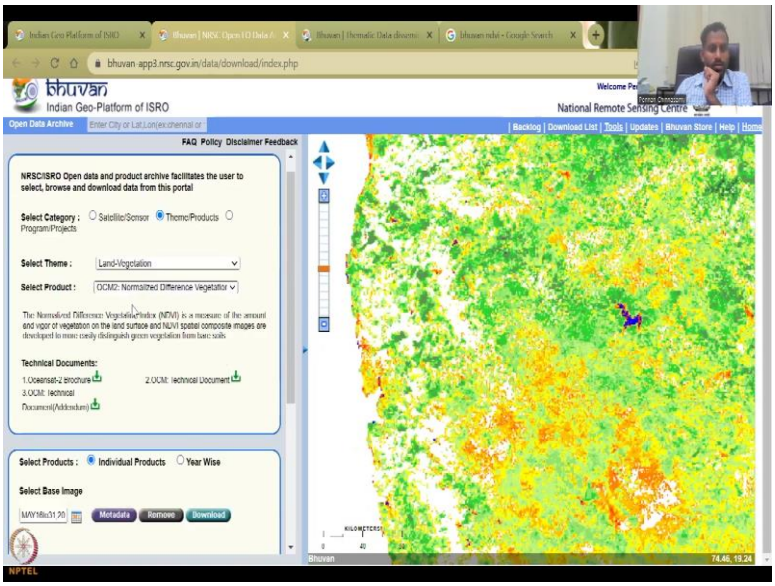

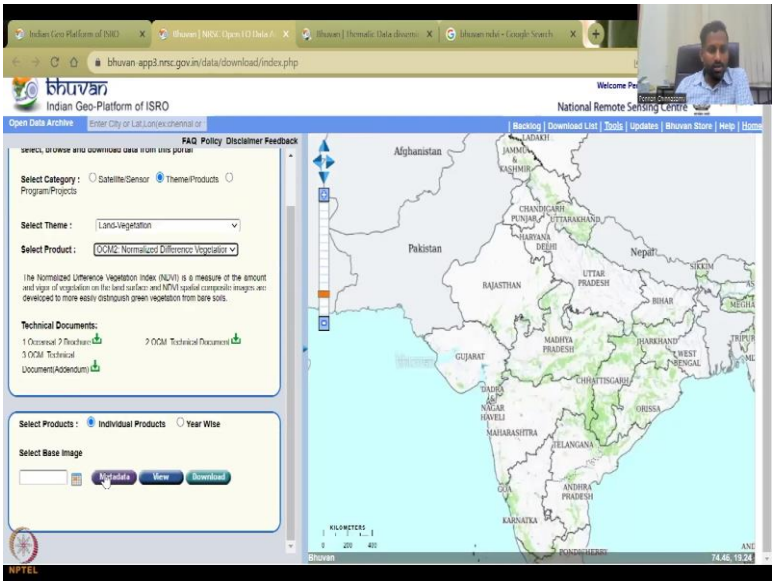
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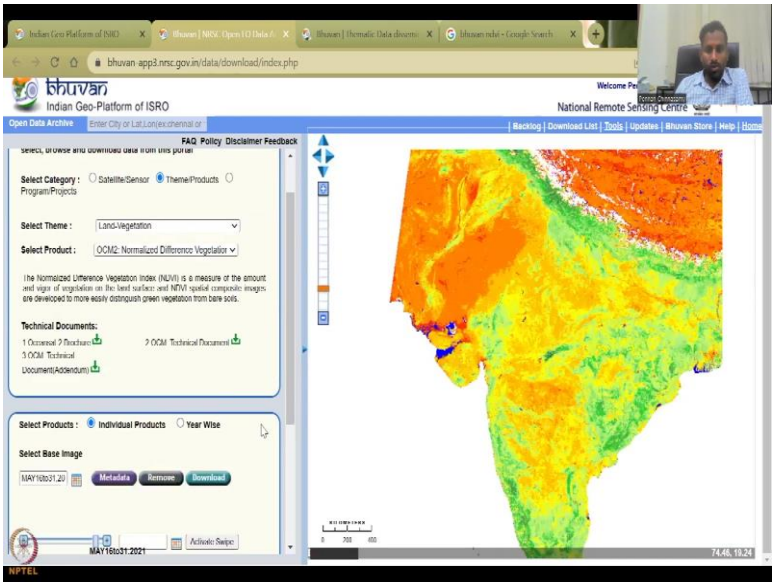
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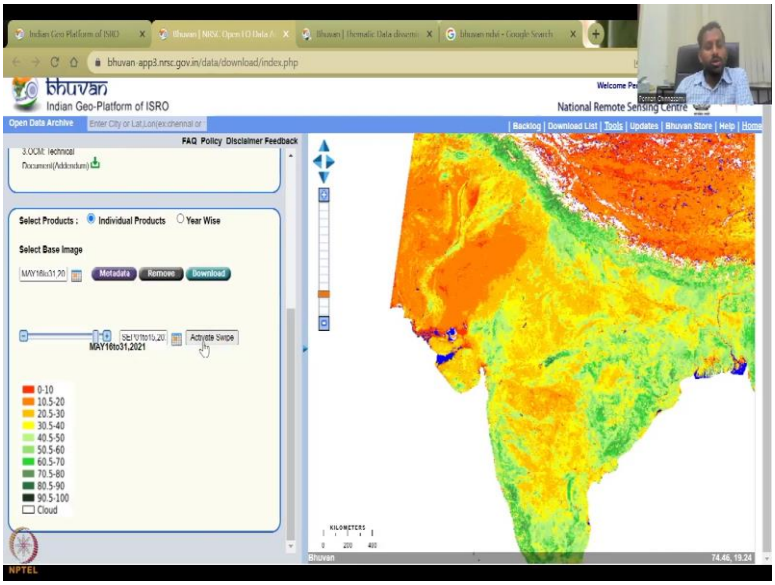
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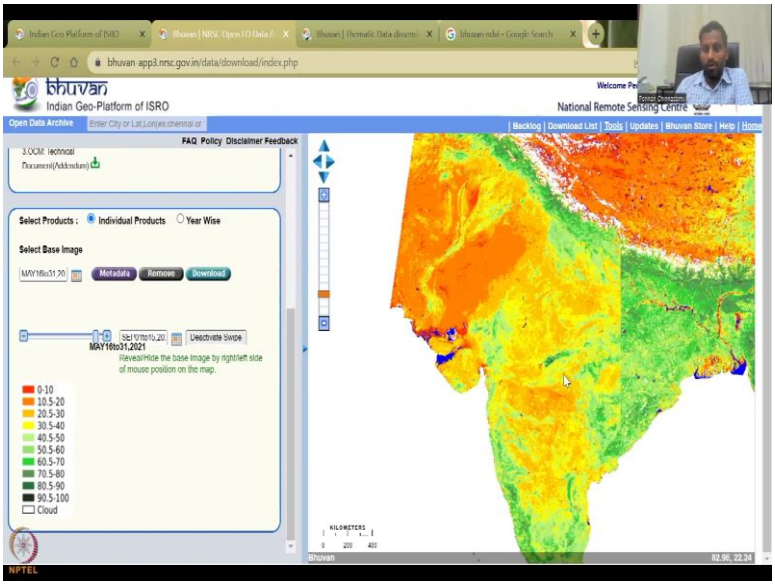

We will have to go to land products, local coverage. Sometimes as I said, it does get really stuck, which is good. I am doing this again. So, we will go to May view. So, we have this red color. And then I am going to pick September first week, activate swipe. Now we have 2 images, and I am going to swipe, see, there we go. So, now if I move my mouse, you could see that it is changing. So, if you could zoom into all these areas, all these red areas, which have, what does red mean? Red means not any vegetation, and blue means water. So, that is minus 1, 0 to 10 is really bad.

So, all these areas which had no crops now, after the peak monsoon, you could see that turning green, so this is the monsoon irrigation, we can say. I have zoomed in. And the process does take some time, it may take more time for you depending on the internet. And the availability, you can see here it says loading. I do not know where it is. So, I am just going to zoom out a little bit. So, again, we have this going on, which is good.

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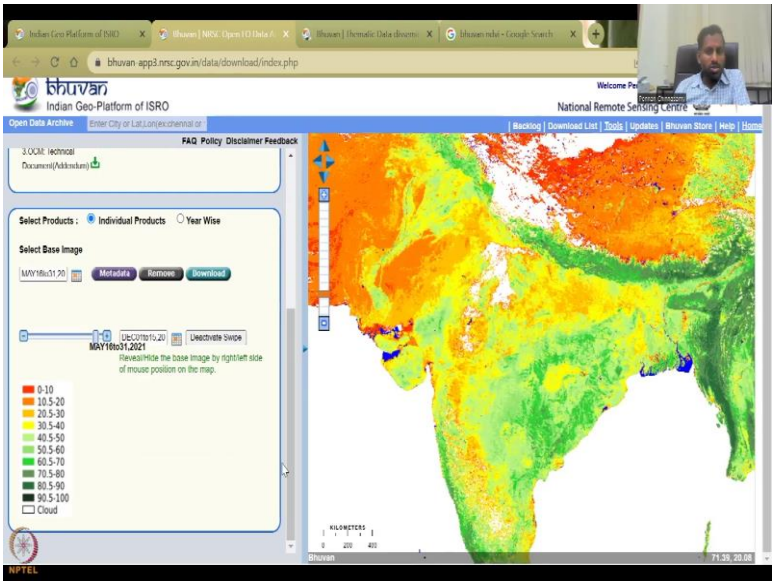

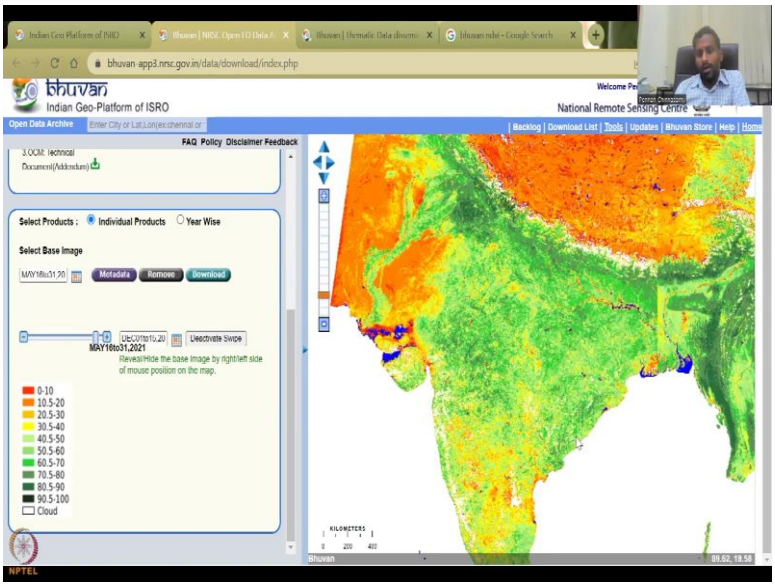

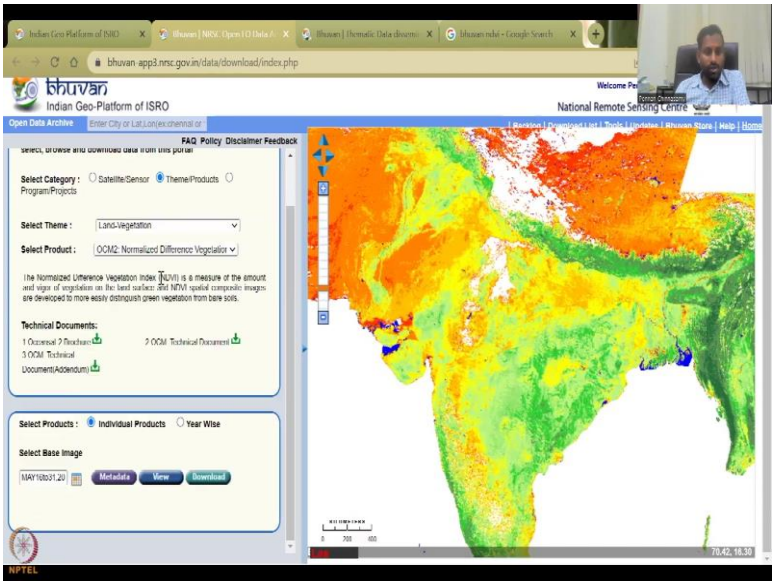

Now I am going to take another timeframe, which is the December first week, why do I need December first week, that is the winter crop, so we can see how much the winter crop is done. Not much you could see but it's good. So, the first one is still being activated as the previous one. So, I will have to remove this.

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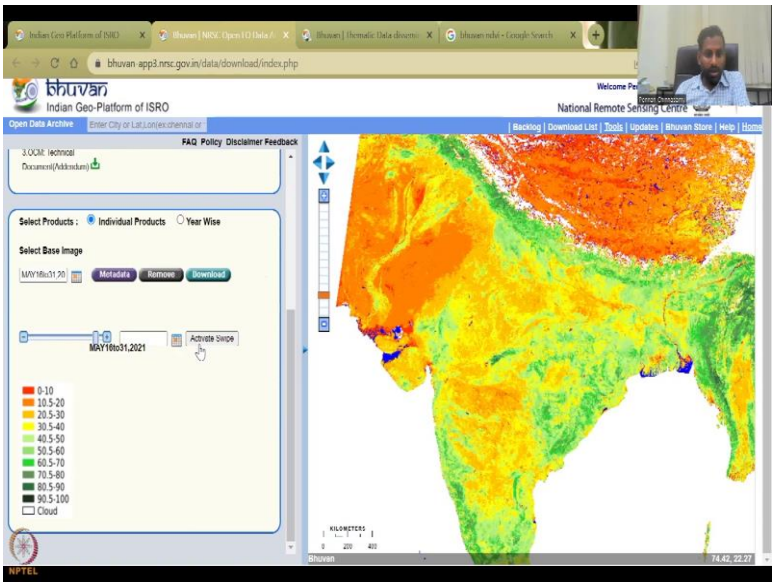

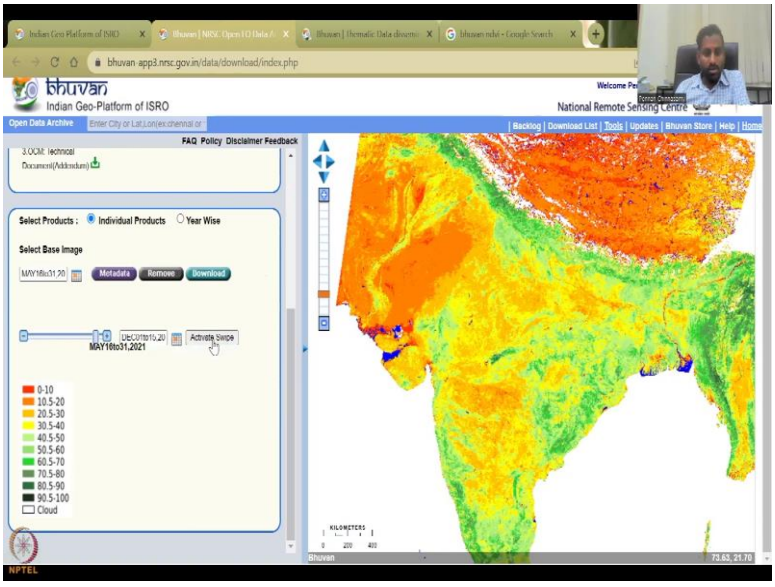

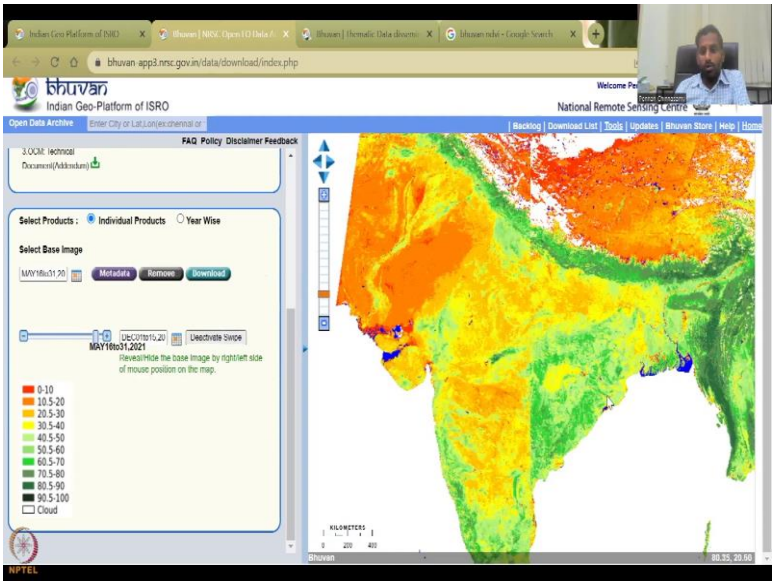
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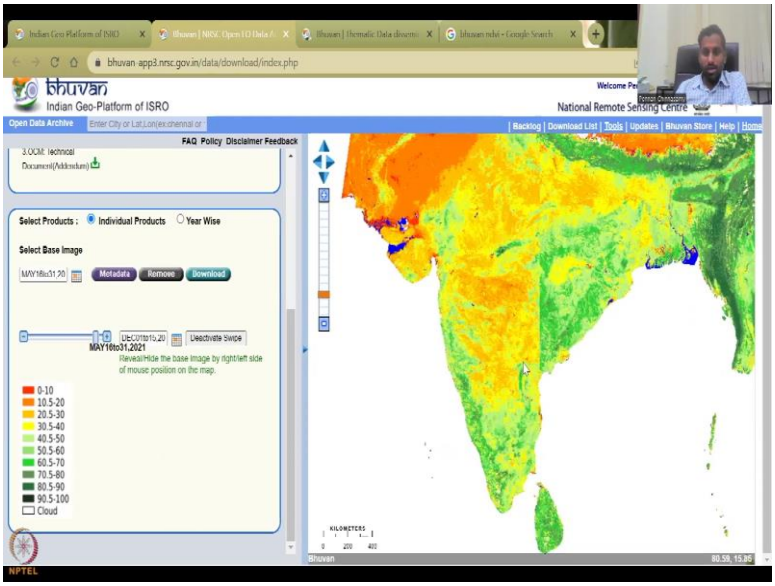
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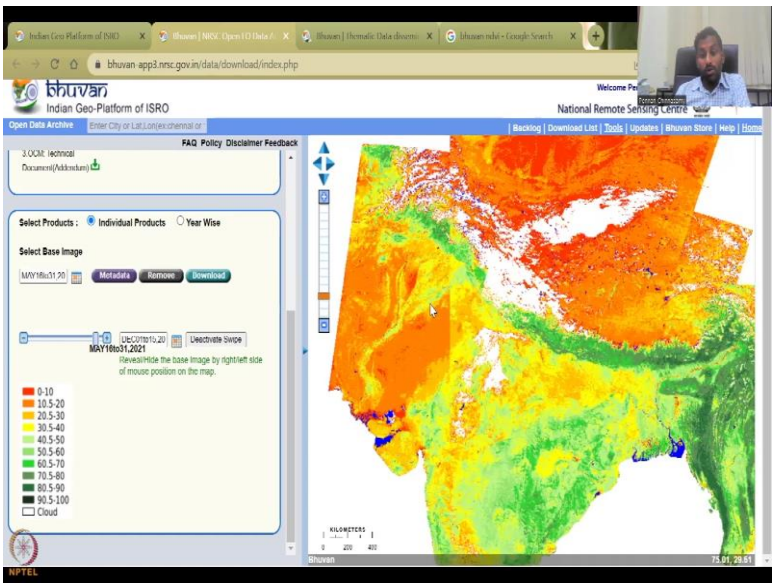
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And then view this again. So, now we have the May month and then we have activating the December month, activate swipe. So, now if you go back and forth, the May month is there, the September month is gone. So, underneath is a May end, which is the peak summer and then on top of it is my current December month. So, December, which is the month I could see the winter crops. So, you could see that in the dual residue. And with groundwater irrigation, there is some crops growing in this area in this central region of Maharashtra, UP et cetera. There is lot of green happening in this area and that is all because of using of residual moisture and groundwater. Especially if you can see here the Punjab, Haryana region where there is lot of groundwater pumping, as we studied in week 9 end of lectures. So, all this data can be helpful. So, wherever there is an NDVI of above 0.5 whereas in the green color in this image, so this is a percentage for some reason they have put it as full numbers. So, it is divided by 100.

So, you can have this as all these areas where you have the red color, which is turning into 3 is winter crops. You can call it Rabi in some regions or Zaid in some regions it is happening. So, that is one. And then the second monsoon season that we also looked at is during March and April.

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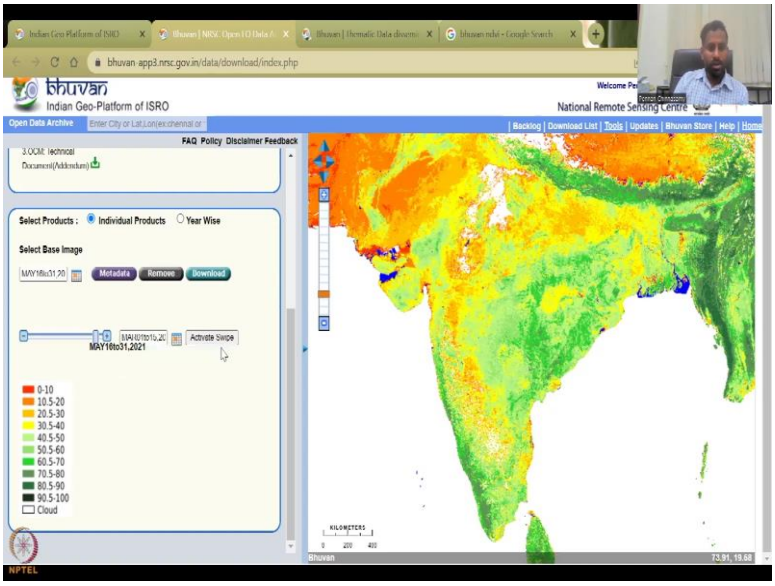

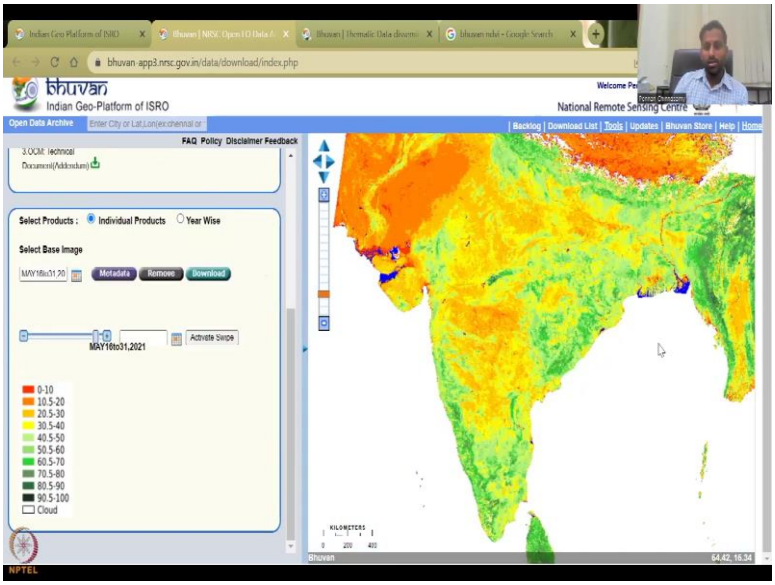

So, if we say that, let us look at March and April, and then we activate the swipe. So, now it has been loaded. So, what you see at the background is for some reason, it is still the June data coming, so May is there.

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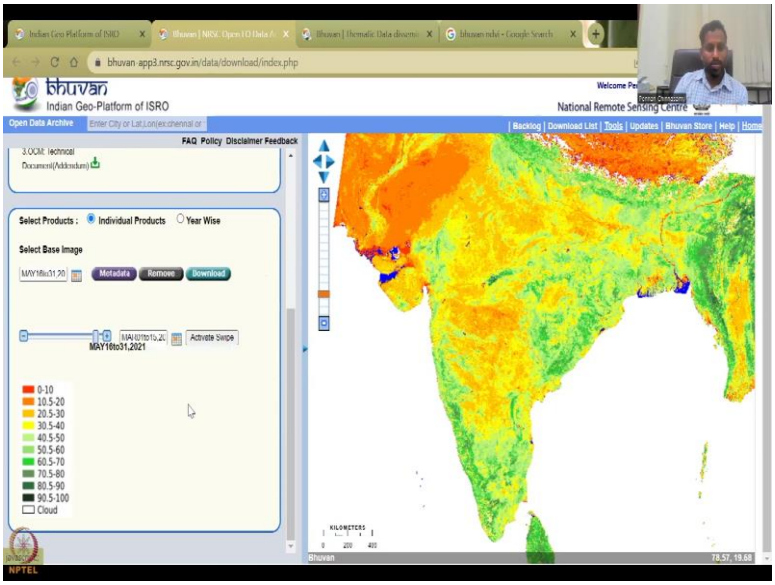

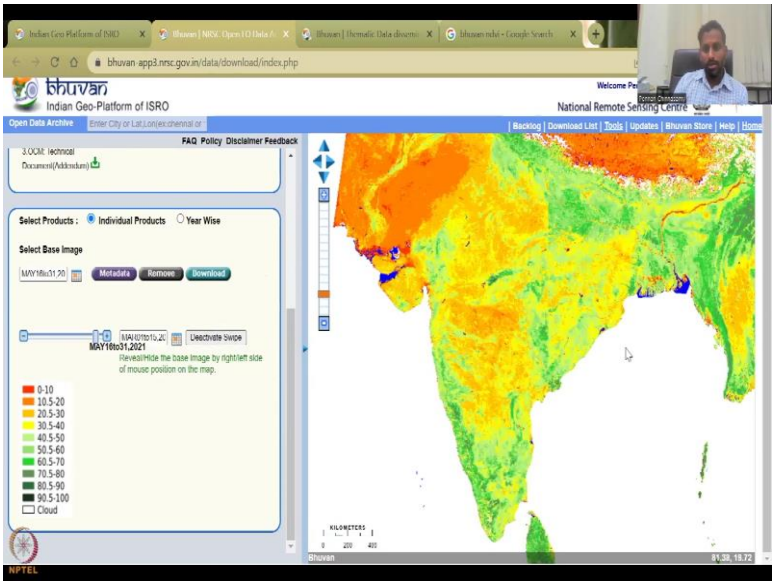

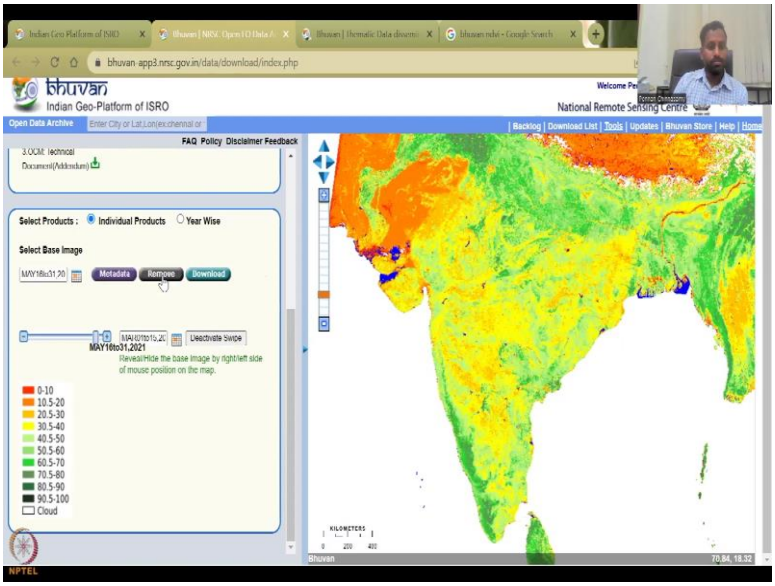

And then I am going to look at the March data, activate swipe. And see you could see that.

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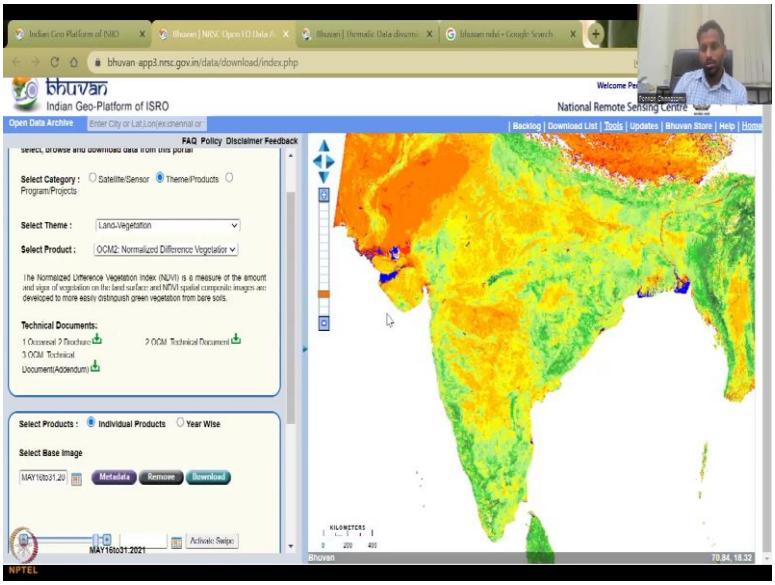

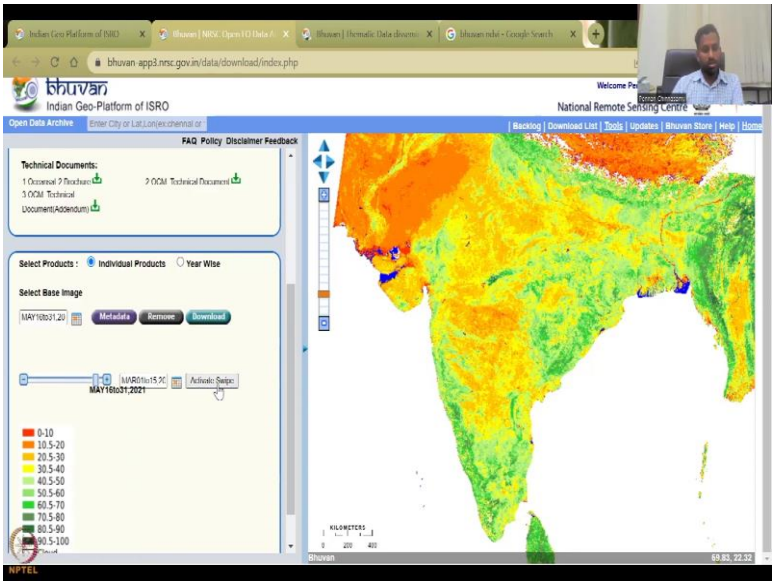

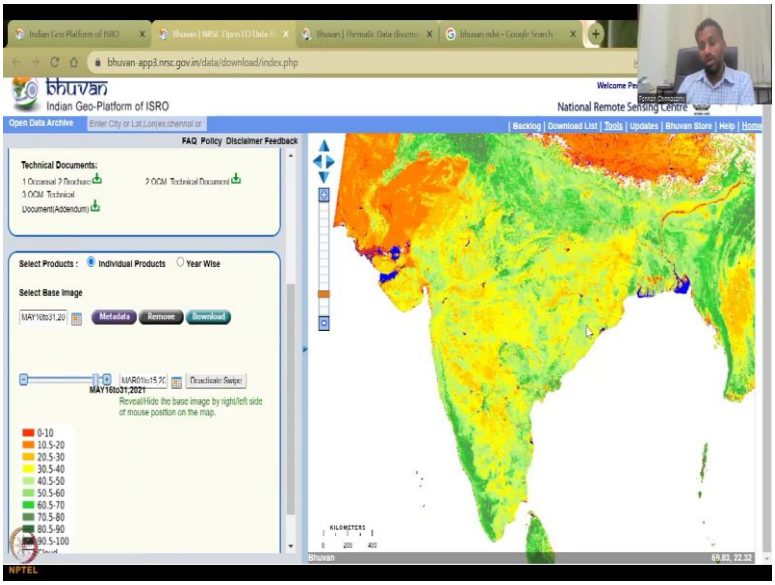

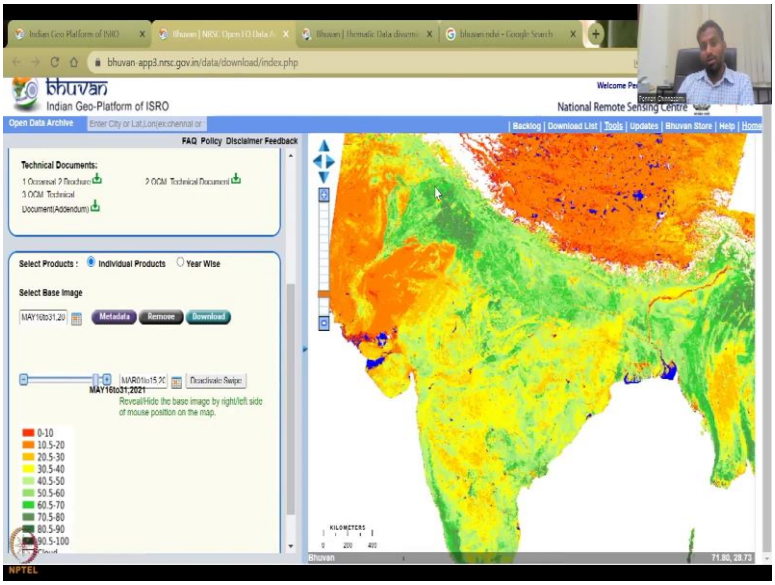

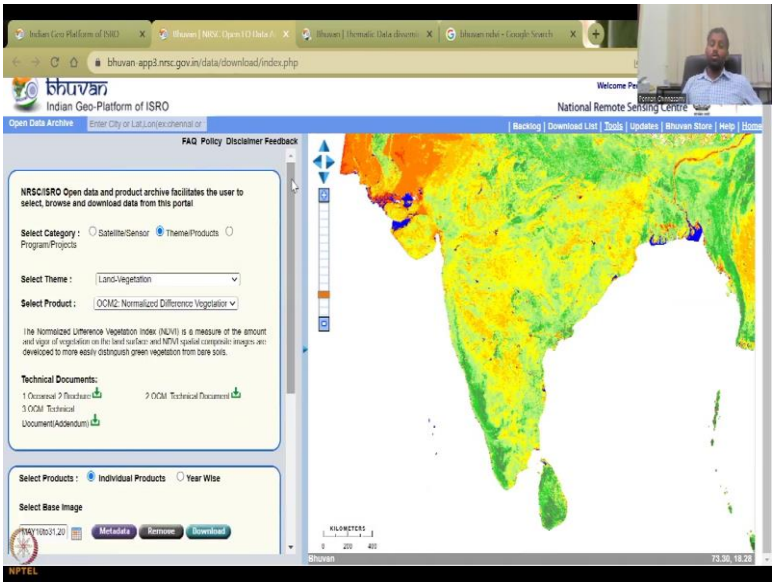

Going to pick me and, and view so, lot of red, which means not much cropping going on. And then I am going to choose much then activate swipe, so now you can see lot of green. So, these green, all these greens are where something happens, all these greens, and there is some monsoon also but still, you could see that all these red color gets more and more during May. So, the summer season, people normally do not grow much, it is too costly to bring water pump water and put it so, that is why people refrain from taking this data the cropping out. So, that is how you could take NDVI.

Again, NDVI would require you to download the images like we did in LULC classification, we download the images and then pick the bands and subtracted and this is kind of an advanced level so, I do not want to go in depth of the process whereas NDVI data is already

available. So, I am just going to show you how useful it is. And you can see that quickly by these images you can do and you can download.

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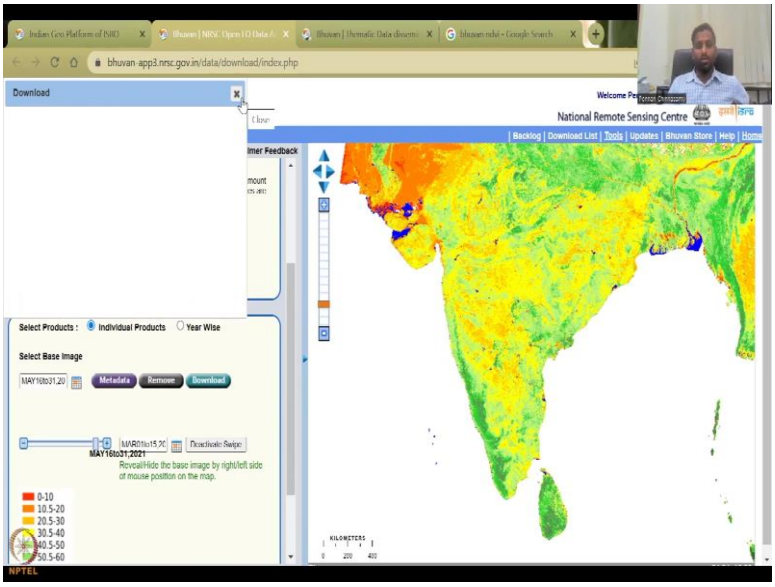

So, you can download this image or you can batch download and then do it. So, I will have to log in and download and stuff, which we have already done in the previous classes. So, I will refrain from downloading it. So, that is the one product.

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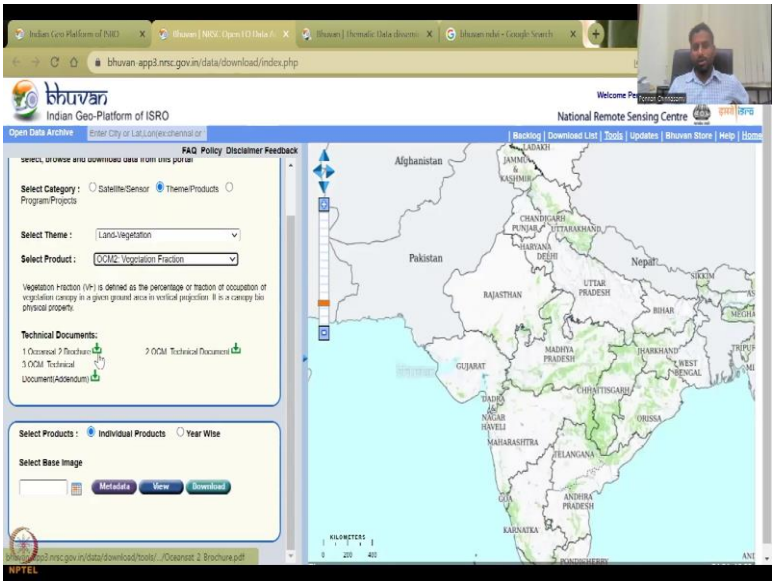

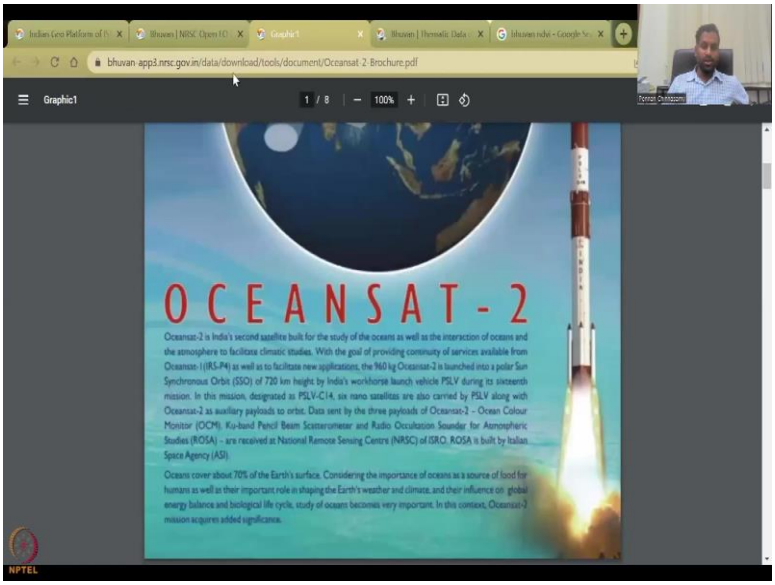

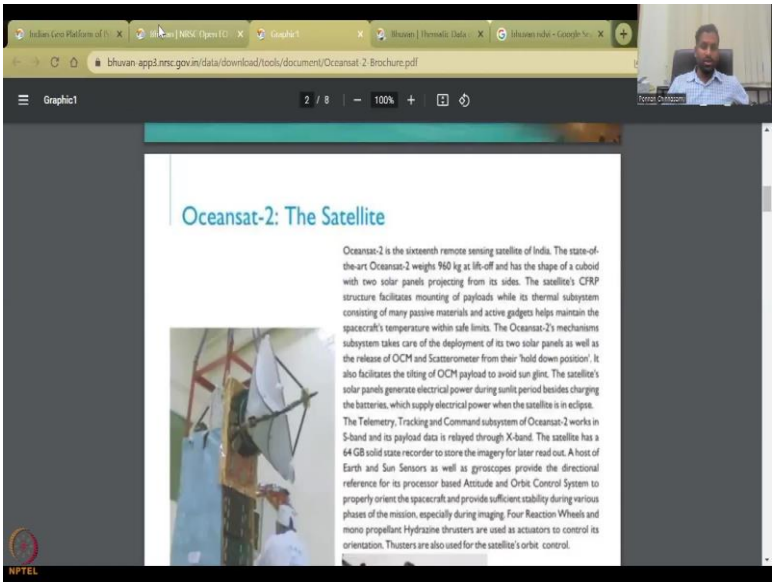

You can also look at the vegetation fractions and recession fractions how they are calculated, what are the equations et cetera is given here in the technical document.

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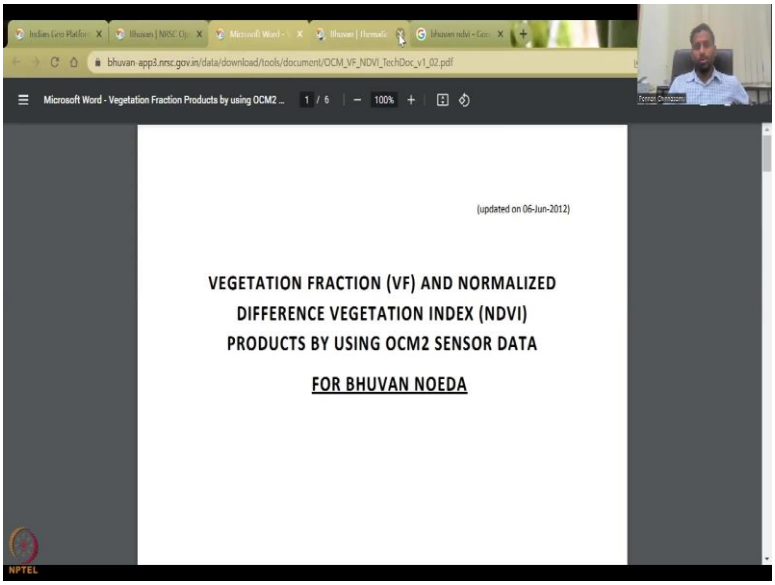

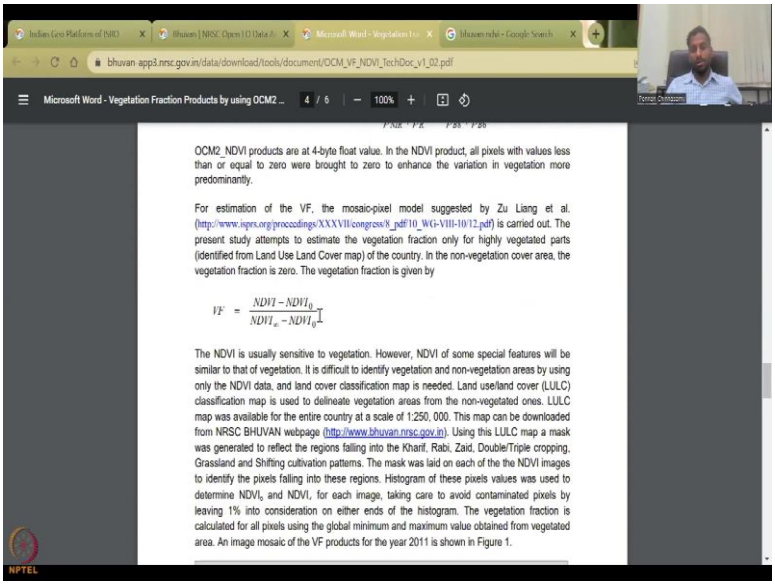

And you could go through and read it and also give citations for it as I said NDVI minus NDVI 0, NDVI infinity minus NDVI 0.

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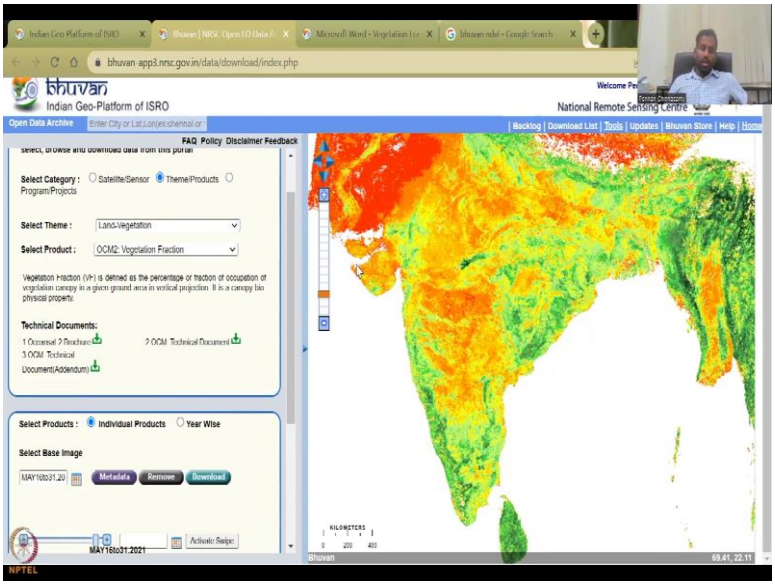

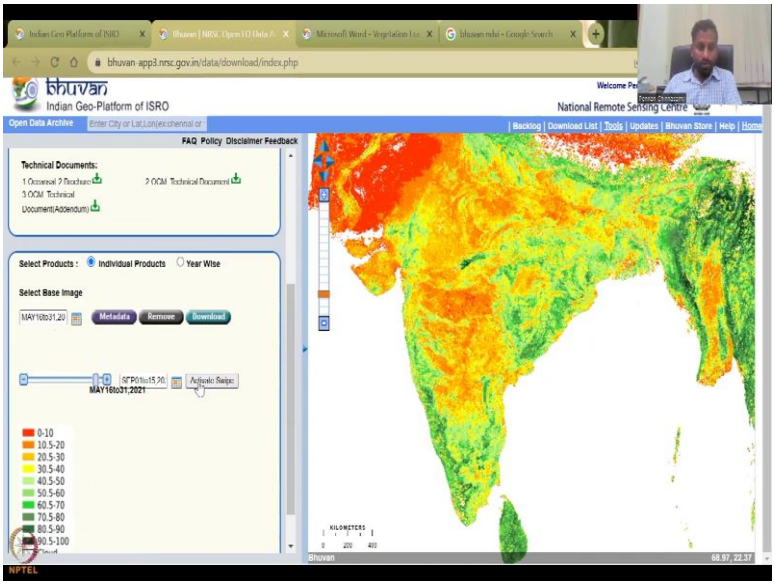

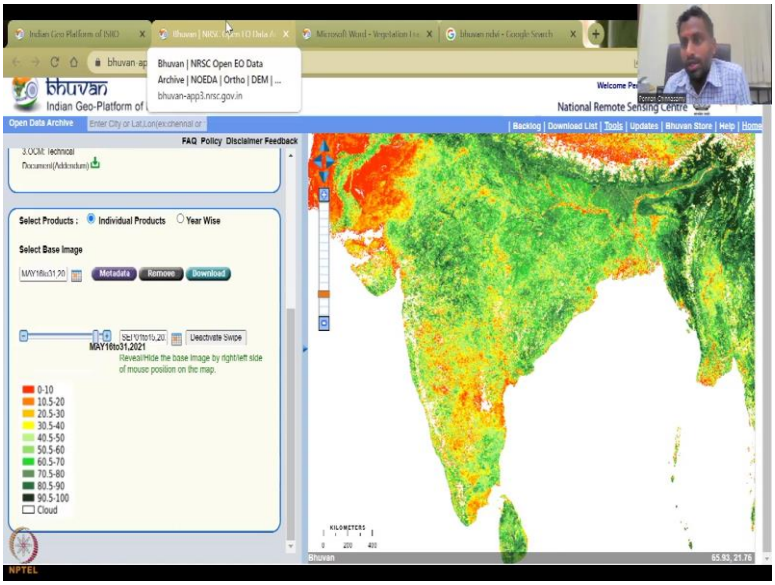

And then let us look at the same month which is May and then we can view so, it is almost reflects the same whereas the process is kind of an advanced NDVI so, you have some values more sharper and finer, but as I said NDVI does the job. So, you can always use NDVI. So, this is good for understanding where the crops are growing in the winter period. And also let me just do that again, activate swipe, so, now we have the vegetation fraction of 100 percent in these areas along Ganges basin and then some basins we do not have.

So, 1 kilometer resolution is pretty cause still given the fraction of farmers we have in the area we have but still it works. So, these are the 2 products in Bhuvan. In the next classes, I will go through each and every other resources that are available.

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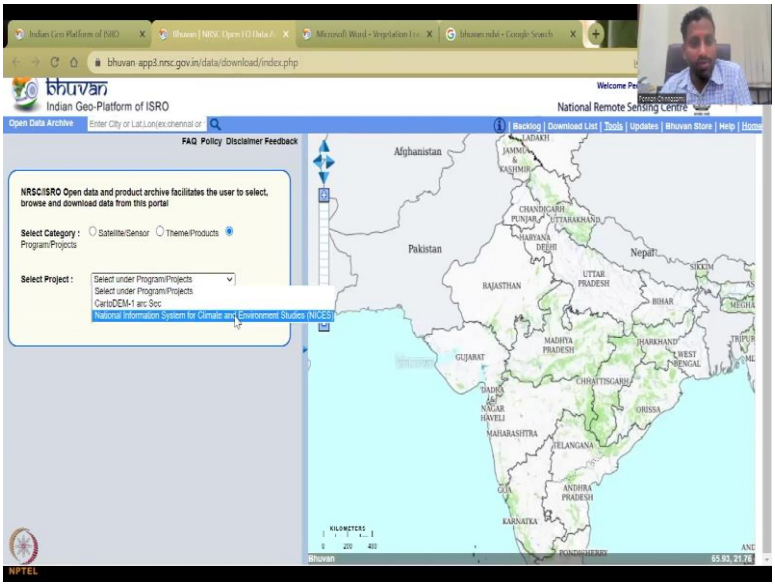

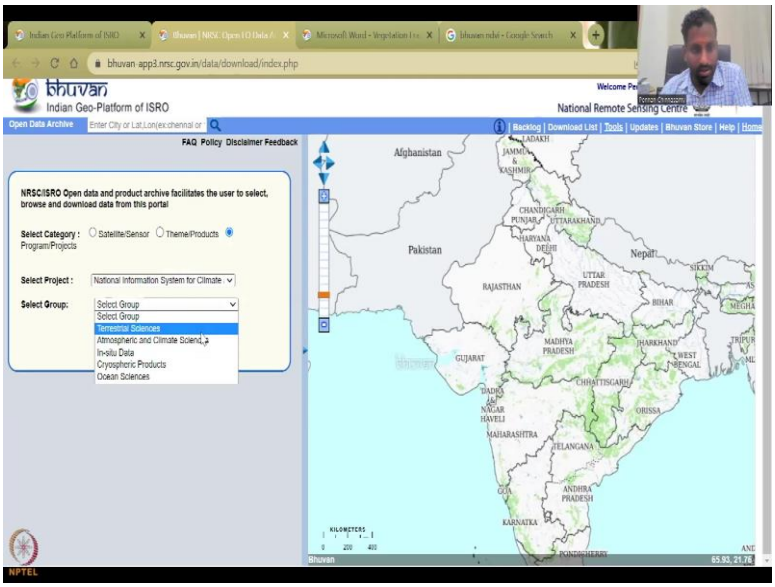

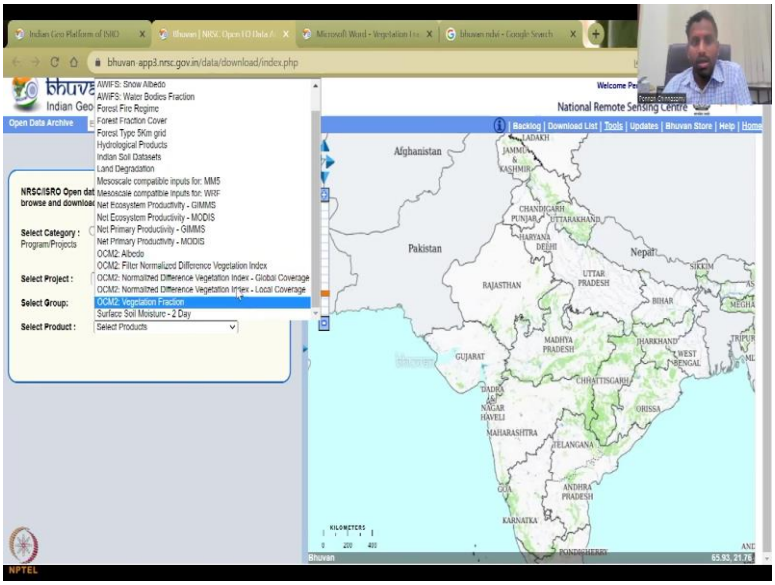

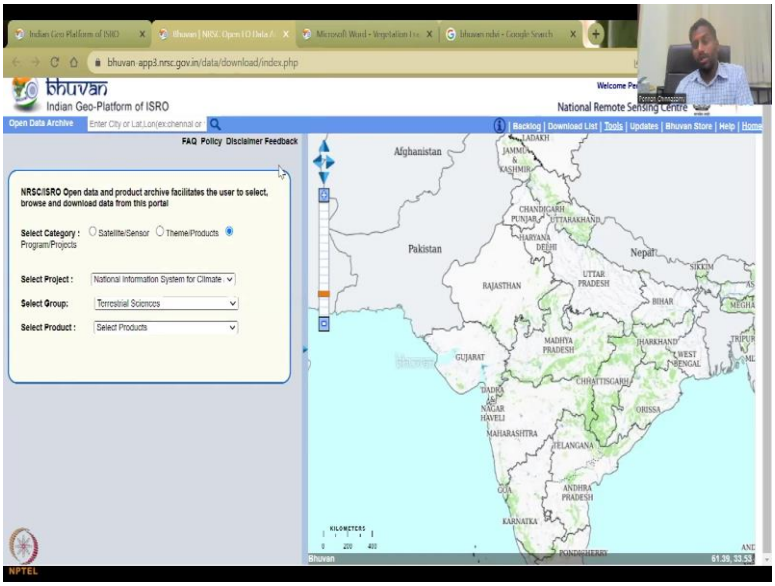

Again please go through the different programs you will see the same product also given in different indicators let us say terrestrial signs. And then you also see the same here. The whatever you saw in the previous ones, the three OCMs, the 4 normalized 3 normalized vegetation index NDVIs and one vegetation fraction is also here. So, there is duplication within the website but it is okay just for you to look at and map it if needed. So, NDVI is pretty important it has been widely used please use it for understanding the winter crops area, the summer crops area. And if you need to find the area what would you do? You would extract the pixels.

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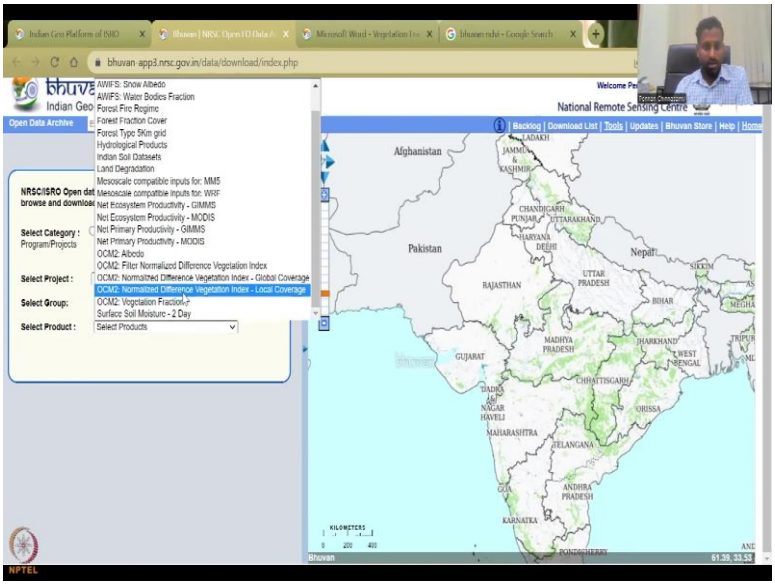

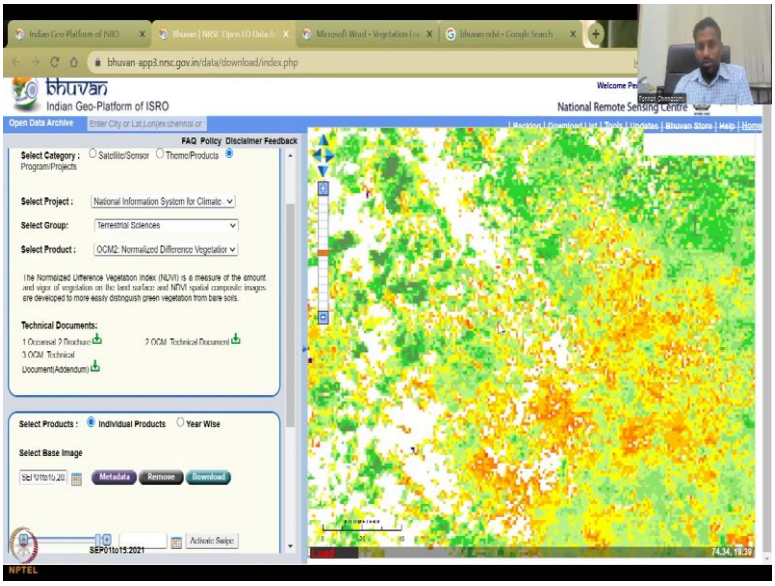

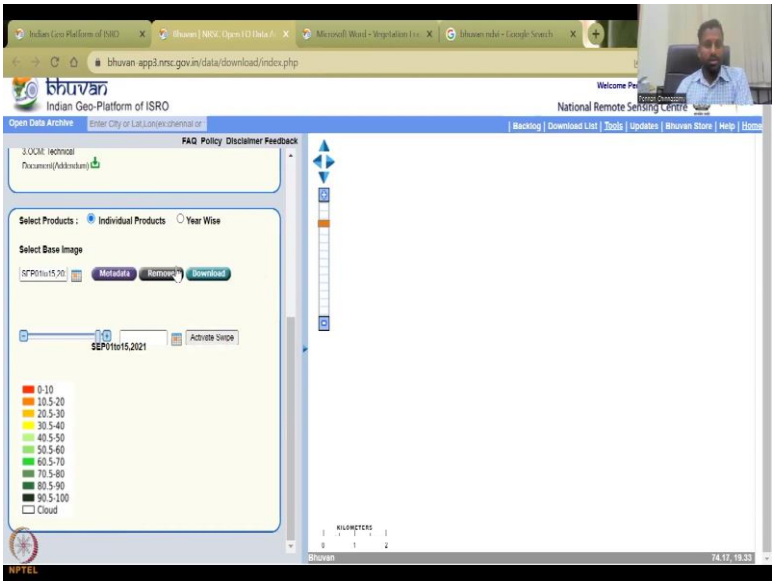

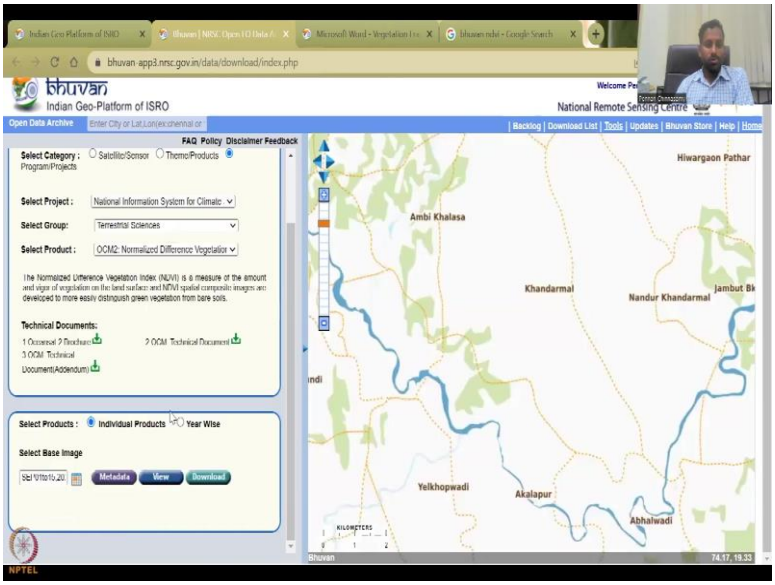

So, let us quickly show from this angle mean the same thing but let us do it and then let us pick September again, then view, so each pixel is 1 kilometer. So, if you pick a parcel within your village, if your village has a 10 kilometer area very rough 10 kilometer area and 2-3 pixels, three pixels are dark green which indicates that it is vegetation. So, then what you do is so, if it is not going through Bhuvan just zoom out a little bit it will bring it out. So, the data gets populated, sometimes it does take time. So, it will remove this and then take a new one.

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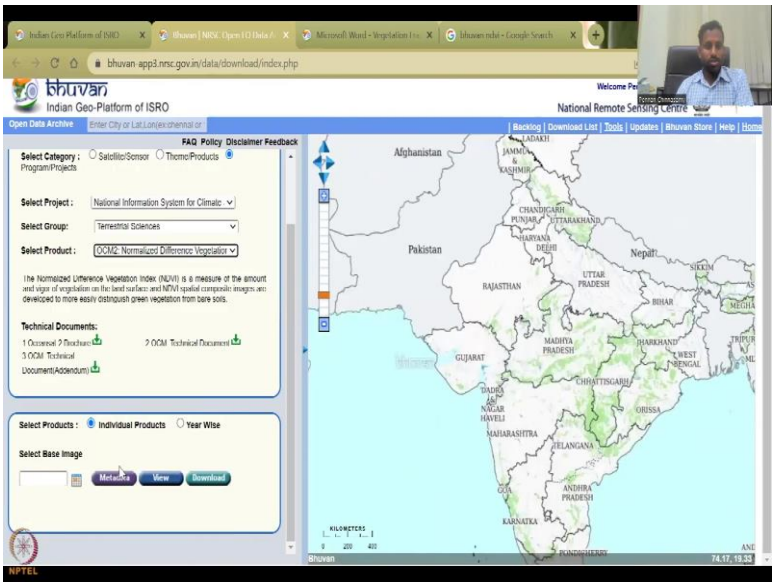

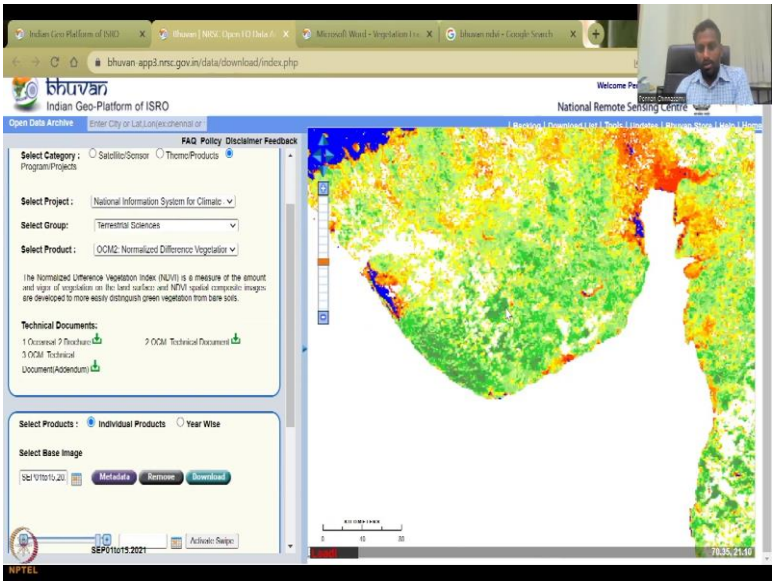

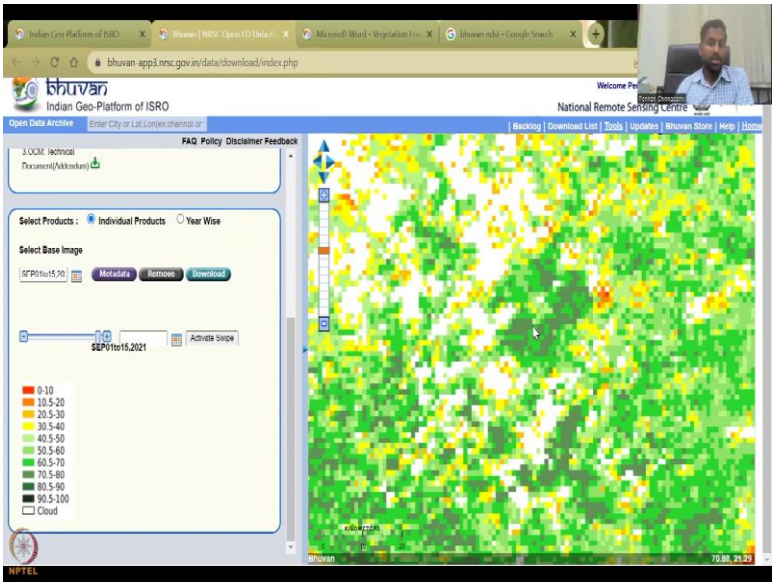

Sometimes if you want anyone just go back and up and forth, local coverage, pick a date September 21. And then you have so, as I said, let us say in the Gujarat region you are doing it and just zoom in and it will say, this area if you want to say, how much of this area has been cultivated 100 percent, very healthy vegetation, then you can easily calculate so, 1, 2, 3, 4, 5, 6, so 6 pixels 6 kilometers. So, that is how approximately you could do this but in visualization, I am saying but if you extract it into Google, your GIS platforms, especially the QGIS, then you can say that I want these to be clustered and in the clustering area can be removed.

So, that is a kind of an advanced level. I will not teach it for this class. But I am just going to tell you that if you know the pixel area and the number of pixels that are in that particular class, you can easily multiply by the area of the pixel to get the total area. So, with this, I will

stop today’s lecture. I will conclude today’s lecture and look forward for the next lecture on Google Earth Engine data for NDVI and NASA and sentinel data for NDVI. Thank you.