Remote Sensing Data for Rural Development
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Week 03
Lecture 01
Intro to Remote Sensing Data for Rural Development

Hello, everyone, welcome to remote sensing and GIS for Rural Development NPTEL course. This is week 3, lecture 1.

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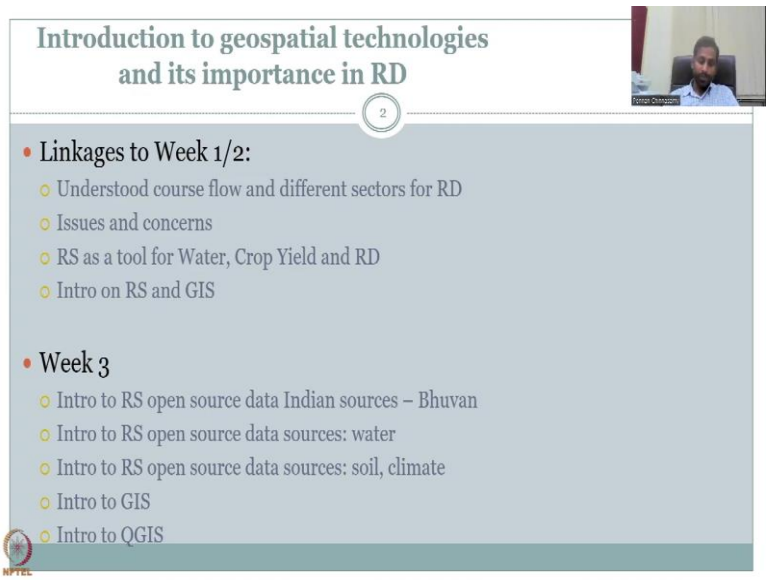

In the first slide today, I would like to talk about the introduction to geospatial technologies and importance in rural development. But before that, let us look at both, week 1 and week 2, and how they are linked to week 3. This is important because we need to tie the deliverable of each week together and understand the need of remote sensing and GIS. In the previous weeks, we understood the course introduction flow and different sectors for rural development.

We looked at the different ministries and how overlap exist and horizontally we can integrate between ministries for rural development. We also looked at certain issues and concerns. Now, the issues and concerns while there are multiple, all may not be solved or well studied using geospatial technologies. So, this course will handpick those kinds of issues and concerns wherein geospatial technologies can come in and provide solutions. Therefore, we looked at remote sensing as a tool majorly for water, crop yield and rural development.

Again, we stress the fact that rural development just does not mean that water resources are increased. There is housing, there is schooling, there is infrastructure that needs to also come together. And then we went into the introduction of remote sensing and GIS, very basics, but we did have some introduction. I was also clear that since this course should tie on a GIS and remote sensing introduction, I have given certain courses that students can learn and leverage if they do not have GIS right now.

This is a kind of an application of GIS or slightly advanced GIS. So, it is better to have both, remote sensing and GIS together as an application tool, not as a basic tool. So, please brush through the internet introduction courses for GIS and remote sensing. I have introduced but if you want in depth introduction, please go ahead.

So, in this week 3, we will be looking at certain tools and remote sensing data open source data, especially from Indian sources. While there are multiple sources, it is important to acknowledge the Indian sources for Indian agencies and Indian rural development. This is because some products are kept focusing on Indian regions within the Indian database. Then we talk about introduction to remote sensing as open source for water because water ties very, very importantly across the sectors.

In 2023, the UN water Congress will focus on this water as the only resource that ties across all the Sustainable Development Goals, all the 16 of them. So, it is not we are over emphasizing on water, but that is the reality. And so, we will start with remote sensing tools for water.

Then we will also look into some introduction of remote sensing tools for soil and climate. Again, I will stress mostly on open source data. There is plethora of paid data or proprietary data and proprietary software. But because we want every one student to come and participate, we need to keep the playing field level, which means all are invited to take this course, they should not be stopped because they do not have access to a proprietary software or a proprietary data set. So, everything that we use here is going to be open source.

Then after the introduction to the water vertical, we will look into some data on soil and climate, again, open source data and housed in the mobile network. Following which I will give a short introduction to GIS, there will be a detailed lecture series in the week 4 and also a small introduction to QGIS. So, all the GIS platforms, we will be discussing more on QGIS as the open source platform for our GIS work.

There will be two or three sessions that we record and show you how to do certain exercises for rural development using GIS. So, we will go through those, especially watershed boundaries and land use land cover and DMS, we need to see how you could quickly do some steps in QGIS and access these data. Again, in my field experience, I have seen many many areas and regions where the basics, the basics for assessing the rural development were missing. For example, if we talk about the rural livelihoods, crop area, watershed management, the watershed boundary is very very important.

However, they did not have the exact boundaries with them, for which GIS helps a lot. You can quickly do it if you know the steps and those are aspects that lead to tremendous rural development areas in your coming future. So, let us look into some of it in today's lecture series.

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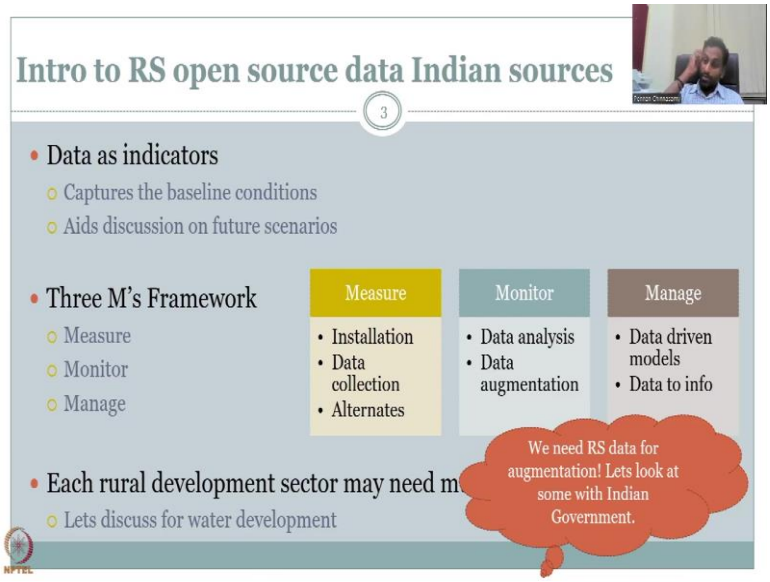

So, in the next slide, we also wanted to re-stress on the fact that data can be used as indicators. So, data can be used as an information to manage the land for rural development, but it can also be used as an indicator. So, it captures the baseline conditions and aids for future discussions and scenarios. The underlying goal is the three M's which include measure, monitor and manage. In the measure, monitor and manage, you need to set up instruments to measure; long time measurement becomes monitoring and then with measurements and monitoring data, you could do proper management.

Some people would convert the three M's as monitor model and then manage. How you manage? There are multiple tools. You can use models to predict or equations or assumptions visualizations, but that we leave it out. For now, the three M's in this case is you measure,

you monitor and then you manage. We also looked about, measuring requires installation data collection and alternates. That alternate data we are going to use this remote sensing data and the monitoring can also be done for data analysis, data augmentation and the management is driven by models and data information.

So, you convert your data into information which helps in management. Each rural urban sector may need multiple data and information. Because it is holistic in nature, it is complex in nature, just using water will not be enough. You need soil, you need temperature, you need management scenarios, land use land cover. So, every commodity, every variable that is important for the stakeholder has to be considered. So, this was never discussed for water development in the previous slides.

However, even to discuss with water, we claim that we need much more data, and we do not have the sources for the data. And for that, remote sensing is the tool. I have to emphasize on remote sensing and GIS in even week 3, because only then you will understand the remaining 9 weeks of using remote sensing and GIS. So, the first three weeks is kind of introductory. But still now we will jump into the different tools that are available. The idea is to let you start, go and play on these websites and download data and look at the data, at least visualize the data.

We will show you how to visualize the data. I would like you to start playing with the websites and accessing the data putting down some issues. If you find any issues, please send an email on the forum or contact the TA for the course, especially Mr. Pranav, and we will definitely look into it. So, we have, we do need remote sensing data for augmentation. The first aspect here in the measure, since we do not have installed data, we do not have observed data, we will be using alternative data and of the alternative data, remote sensing data is key. So, let us look into some of the government, especially Indian government data.

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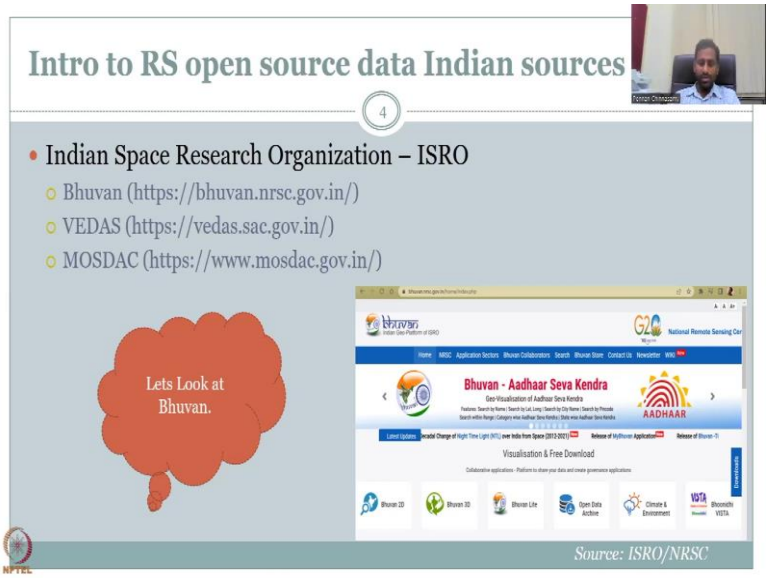

Open source data is the key word for today's lecture. The most predominant agency in this network ISRO - Indian Space Research Organization and they have multiple dashboards and portals data archives, where remote sensing data is stored. All of this could be used. Again, that will be itself, it is a course on itself, but we will discuss the most predominant ones used for assessing the resources leading to rural development. So, we do have Bhuvan, we also have Vedas. Vedas is also under the ISRO protocol, under ISRO's mandates.

You will not see ISRO everywhere, but you do understand that NRSC, Bhuvan, Vedas are all SAC, are all part of ISRO. The National Remote Sensing Center, Space Application Center-SAC, all these would contribute from ISRO, ISRO is the major body under, and that the verticals. So, you will not see ISRO's name as per se, but it is all under ISRO. Then we have MOSDAC, also coming as a very, very important protocol. So, all these data bases are useful for understanding the resources for rural development, especially water.

So, today's lecture is on water. So, we will definitely look into all these resources, but Bhuvan is very, very key. I have given you the links here so that you could go and check and see how these work. But because this course may be rerun, because already we have 1000 plus students registered on this course, it may be rerun. So, for those who are watching it as a rerun episode, please understand that sometimes the links are outdated. So, in those things, just search on your website, Bhuwan ISRO or Bhuwan NRSC and you will get the updated link.

So, this keeps on updating, any website keeps on updating, and with the updates, the link also changes. So, for example, SAC may be newer than NRC. So, you have a different website.

So, please make sure that if this is a rerun course you are watching, please make sure that if the link does not work, do not complain on us. When I put it on, it does work, I do check it. So, your duty is to search for it online and you will definitely find. So, when you click on Bhuvan, it automatically adds the default tags behind the webpage - home index dot php and you will come to woman's portal.

So, I took it very very recently. So, you could see that G 20 is being promoted a lot because 2023, India is the lead for the G 20. We are the host and organizing country. So, every nation under the G 20 will come to India and you will see how its prominently placed in ISRO's Bhuvan website. So, it says Indian geo platform of ISRO. So, basically all the data that ISRO handles for the public will be put here for free visualization and free download. Initially the down was not free. But now it has become more open source.

There is always time taken by the agency to download, assess, and then put it up to open platforms, we need to be aware of it. It is not like a satellite is capturing data today, tomorrow you will get it. There is a lot of post processing. There is lot of algorithms that run behind in the background. So, we do need to give it time for it to come to this website. Just for natural disasters - hurricanes, cyclones, droughts, floods, for that MOSDAC is very good. You can see quickly, within an hour or so data. But then the other aspects you will mostly see data timelag.

So, let us look into the dashboard itself. If you go to the website, you will see most of these different links to click, Bhuvan 2D, Bhuvan 3D, Bhuvan light open data archive, climate and environment and Bhoonidhi Vista. Here today since it is going to be on water, we will look at Bhuvan 2d and open data archive. So, both are equally important. Bhuvan 3d is more fancier, Bhuvan light is for those who cannot have good access to internet, you can use that. But Bhuvan 2d and open data archive are good enough for today's lecture.

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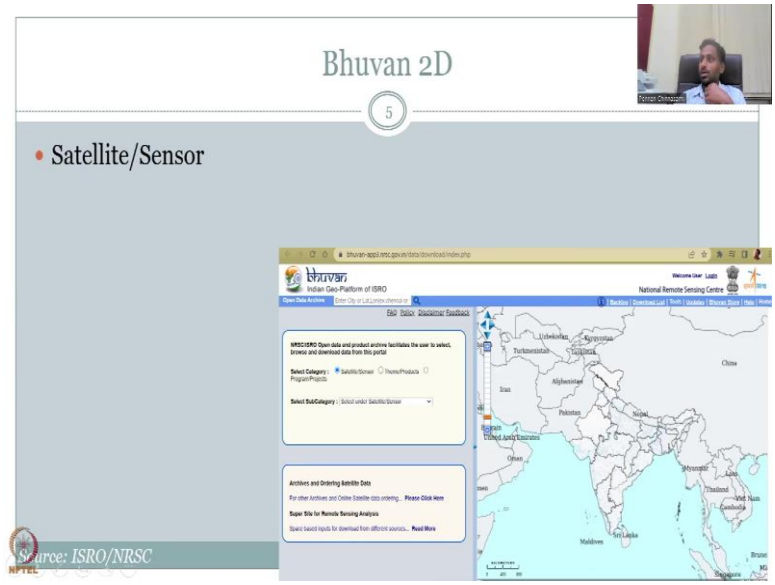

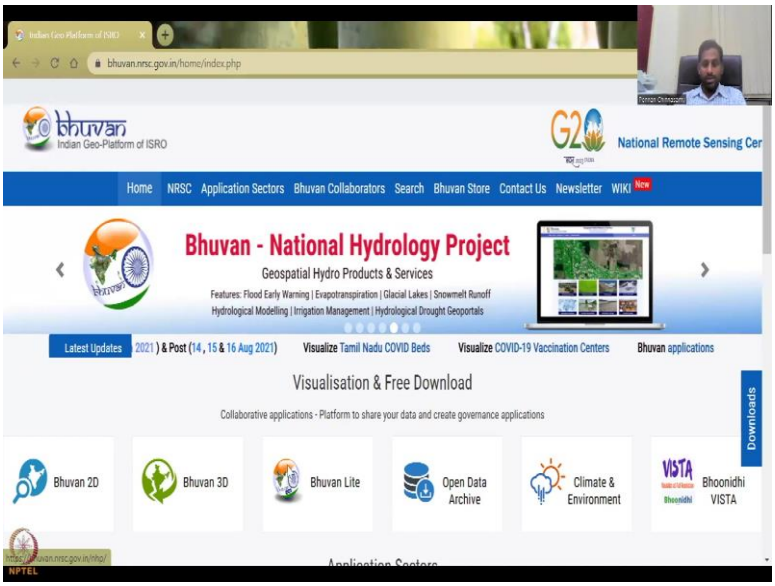

So, let me click on the website so that we could go through the Bhuvan portal. What steps I will be using, I will just show here quickly. We will go to this platform of data from Bhuvan and then there is three categories that have been kept - satellite sensor category, team and products, program projects, and then under that we will select data. So, let me share the screen for the new data that we are going to use. So, first, let me share the platform. This is the platform that you will be seeing under the Bhuvan link.

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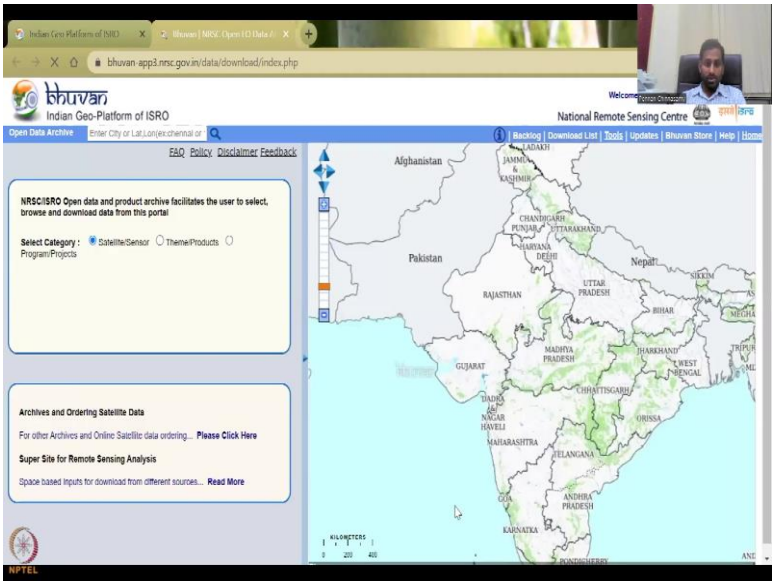

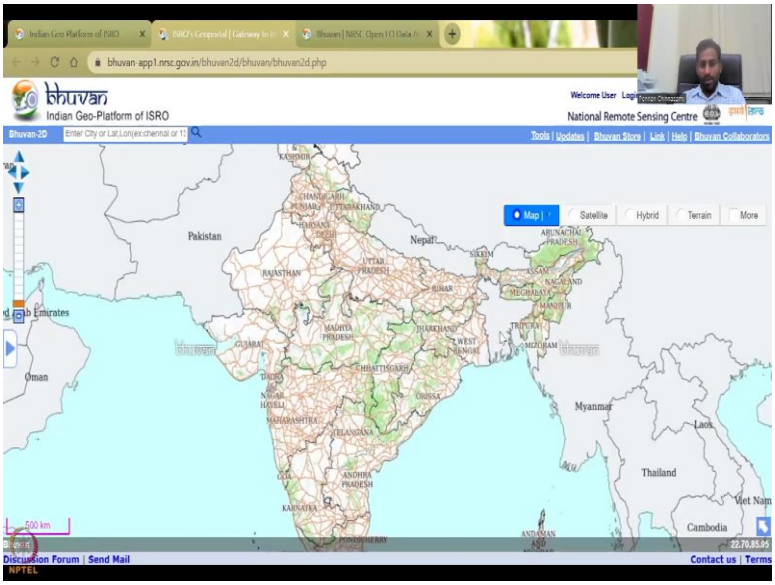

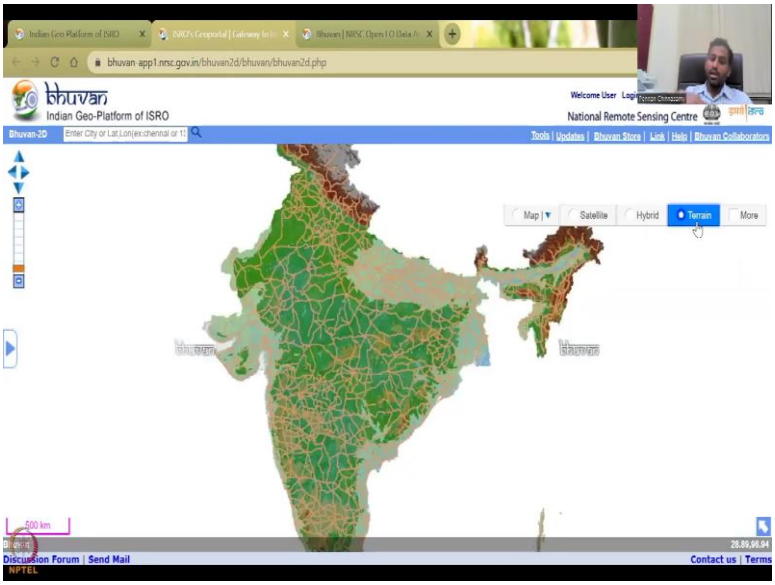

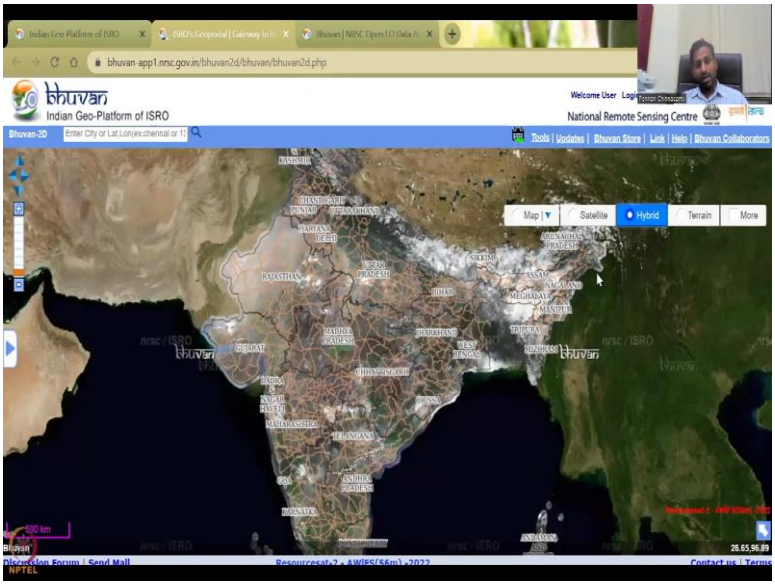

And then as I said there is multiple different links, we will be clicking on Open Data Archive just to show what we will be looking at. So, in today's lecture, we will be looking at Open Data Archive. The Bhuvan 2d is first let me introduce Bhuvan 2d before we jump in. It is mostly to look at the map with different terrains. Terrain is the land use land cover and elevations and how you could see like higher elevations of different color and then hybrid mode with satellite image and with some GIS shapefiles in it.

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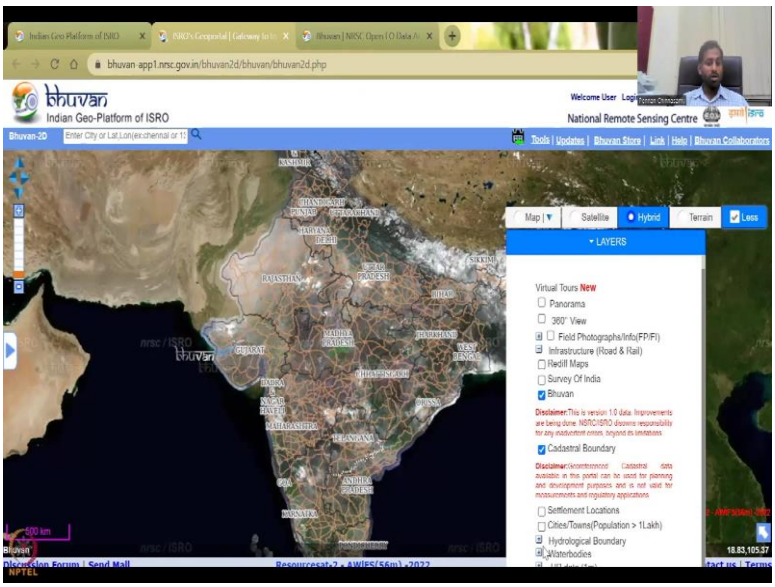

And then there is more when you could see survey data, cadastral maps, hydrological boundaries, for example, let me say watersheds in India, it does take time to load but let me do a basin map. You can see the blue line coming. So, the Ganges basin is big, the name

comes against basin, Narmada basin etcetera, you can remove that off and then all the other maps can. So, any other satellite, just pure satellite, and then the base hydrology.

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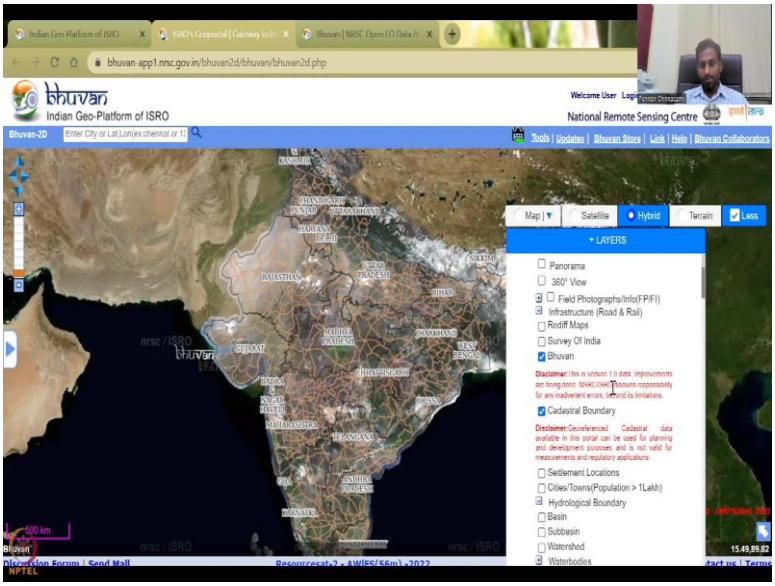

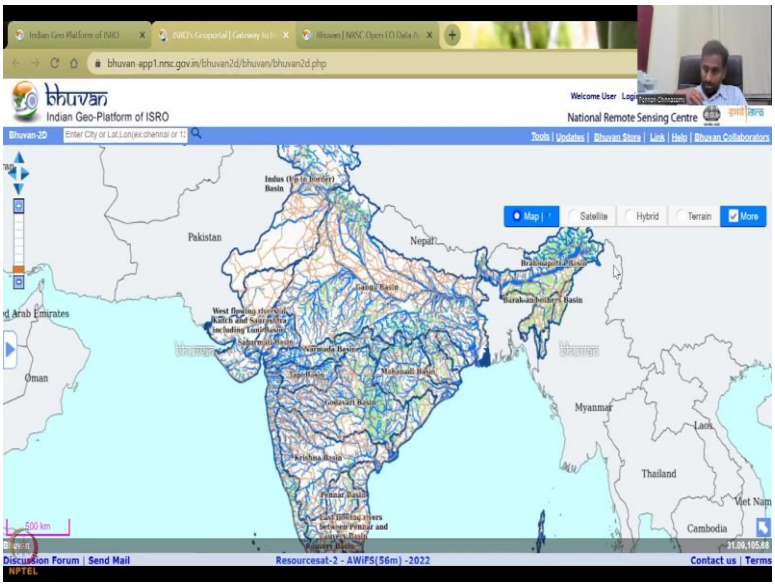

Since we are doing water, I just want to introduce the base hydrology map. In the base hydrology map, hydrology is a study on the movement of water and the key movement of water is the rivers, the streams etcetera. So, what do you see, the blue line here is the stream network, rivers and stream network.

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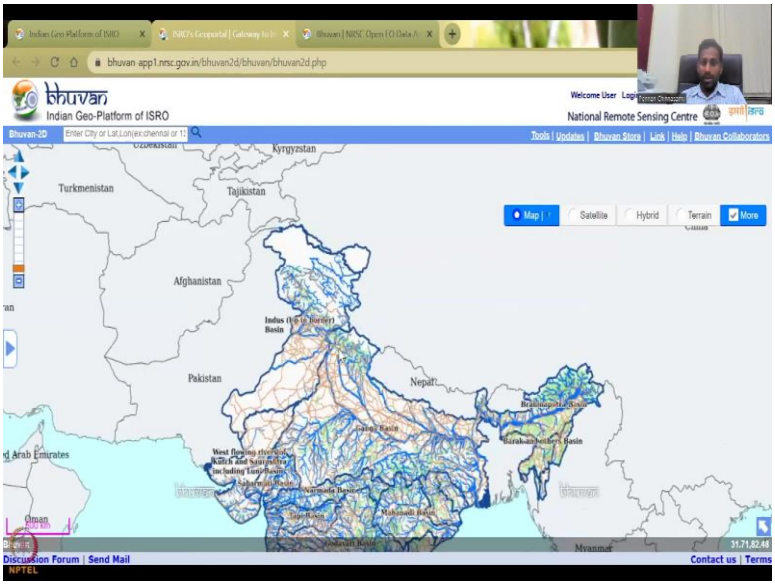

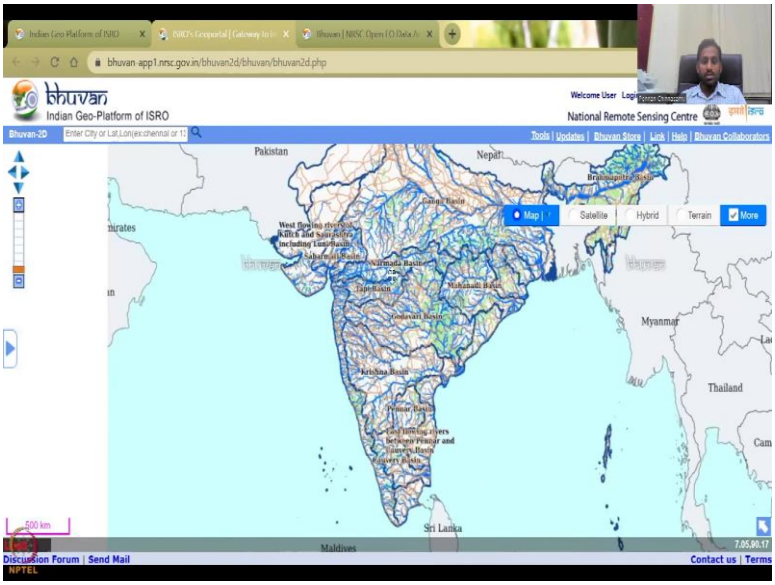

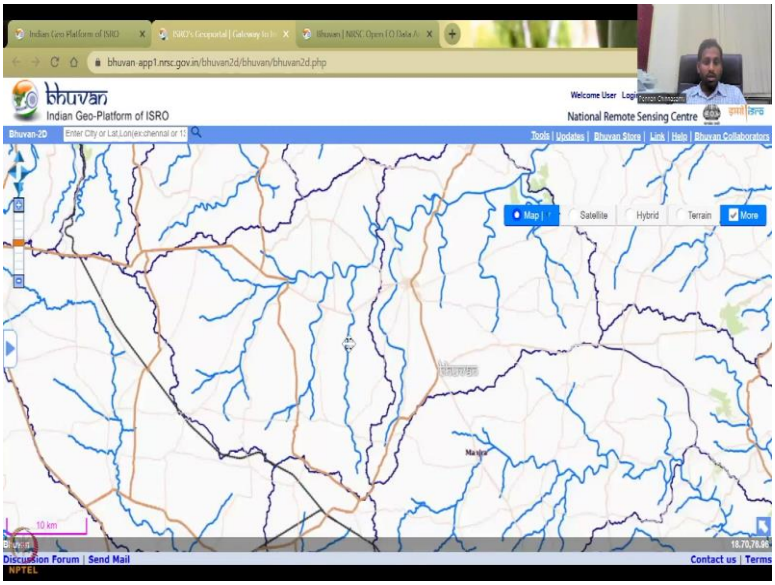

You can pull the map as pan, and then you can zoom in using your mouse. When you zoom out, you have the smaller regions. Small-small streets are not visible. But if you zoom in, you could see all the small streams and stuff. It is not a data for you to go and extract readily. For that you have the Open Data Archive. Archive is a place where you put your data.

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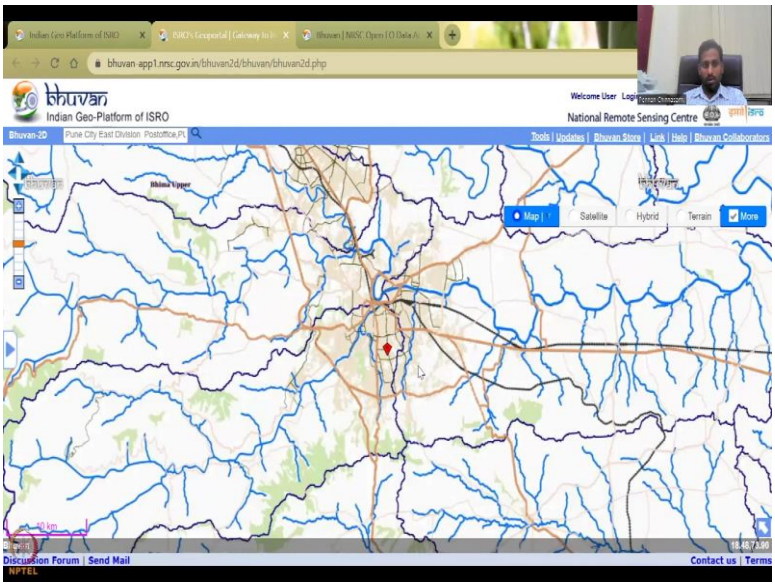

So, let me see if we could put a lat long or city's name. So, if I say Pune, it does ask you where exactly? So, let us say Pune city, and then you can see the Pune city coming up, this is the Pune city and rivers and other things around it - the Bhima and other basins around it. So, how the data is collected etcetera is not clearly given here because this is just as a visualization tool. For that we will go into the Open Data Archive. So, I will close this.

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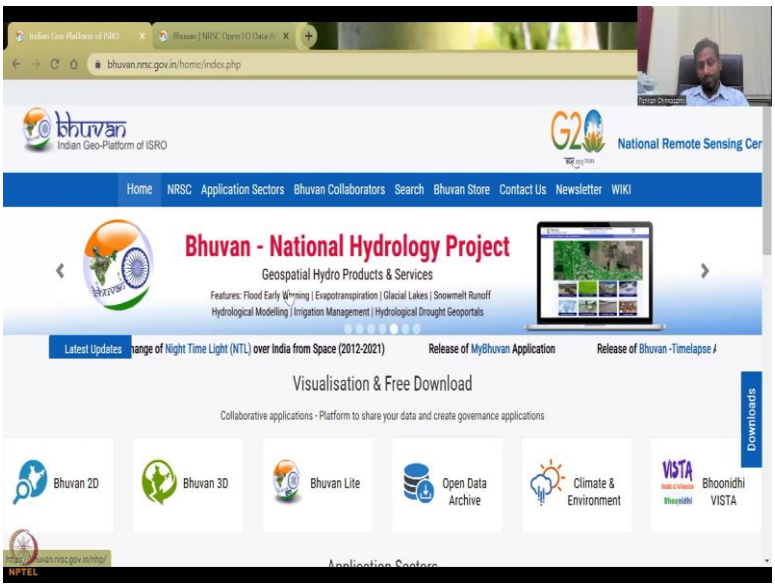

So, we had the Bhuvan and you could see that word is also actively involved in the national hydrology project, where geospatial hydro products are given and most or all of it is for rural development, because flood early warnings are needed for creating resilience and adaptation for farmers and rural entities.

When a flood comes, you do not see houses washed away in cities as much as it happens in rural villages, mass number of people have to be evacuated in rural villages, and most importantly, most of the houses, the land is submerged in water, all the crops are lost. So, that is where the impetus comes in saving the people.

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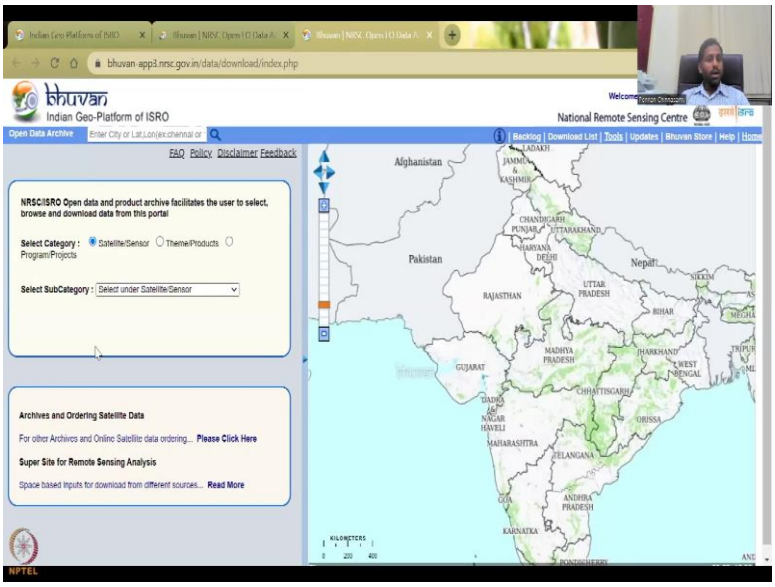

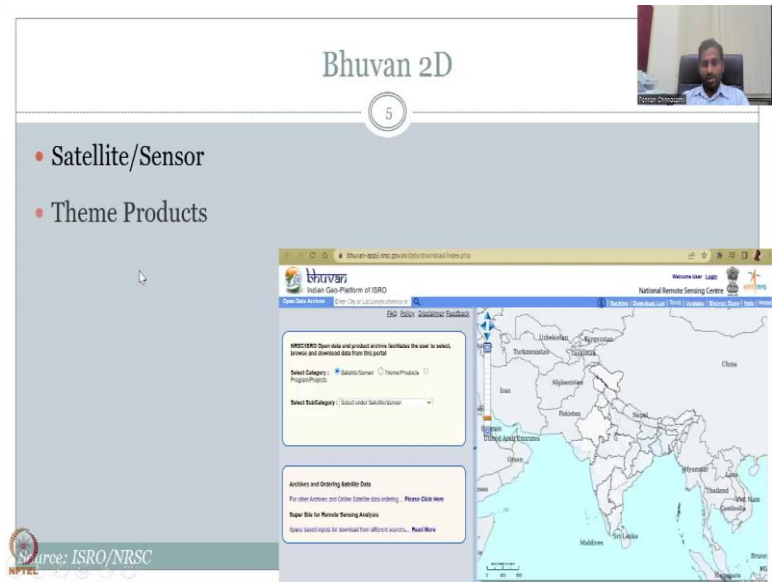

So, let us go to Open Data Archive, and this page opens up. As I said, there are three categories - satellite sensor, theme products and program projects. We will go into the first

category. Let me also share the screen - my presentation, where we did see that. We will be looking at satellite sensor and theme products, program projects.

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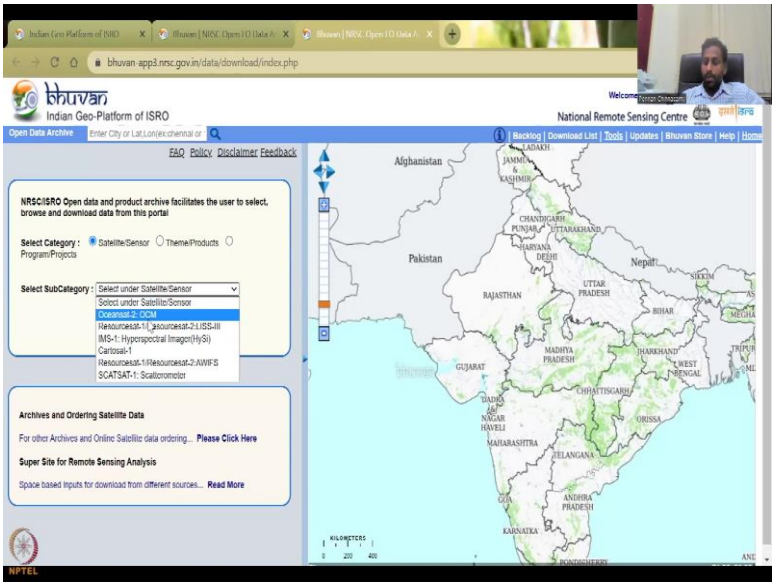

Today we will be looking at introducing the Bhuvan 2d and Open Data Archive. So, I have talked about the hydrology part. Now, I will talk about the 2d part and open data archive. So, here in the Open Data Archive, you have satellites and sensors. When I click the satellite and sensor, what do I see is the different satellites that are launched by India and which is collecting data for public good. You do not see the sensitive data here that is not to be shared, which is used for security of the country and all.

So, these are more civilian satellites, for civilian purposes. So, you have oceansat, you have resourcesat, as the name suggests, it is for monitoring resources, the LISS-III, L I S S 3 and then you have the hyperspectral images and then you have the cartosat mostly for cartography which is mostly into the elevation profiles, charting maps and all those stuff; then you have resourcesat2 which is AWiFs. So, there are two resourcesat platforms - 1 and 2 and then LISS and then AWiFs and then we have SCATSAT scatterometer.

Each satellite carries different sensors and based on the sensors, the application varies. So, for example, you have hyperspectral images, those are mostly used for understanding the crop differences, the land use land cover at a very minute scale, whereas your resourcesat and your AWiFs mostly for land use land cover, those kinds of things. Oceans is for mostly oceans, there are thermal cameras to monitor the thermal temperature, the water temperature in the oceans and also across the water bodies.

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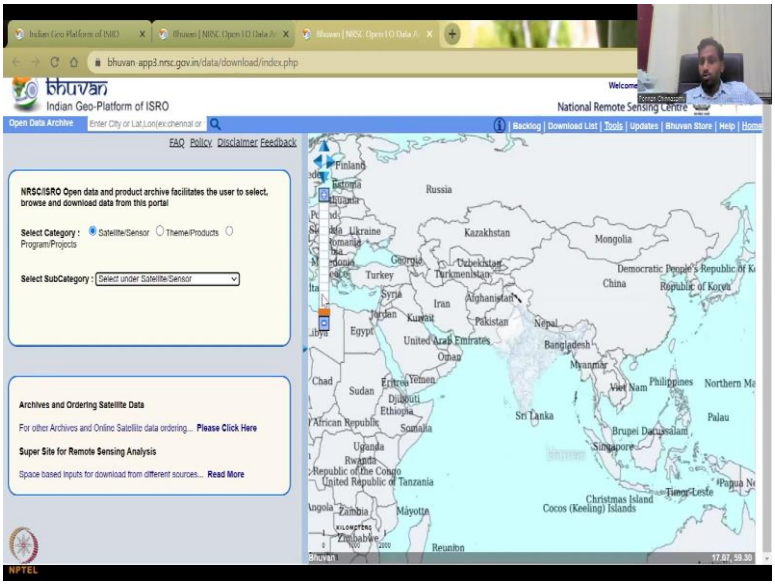

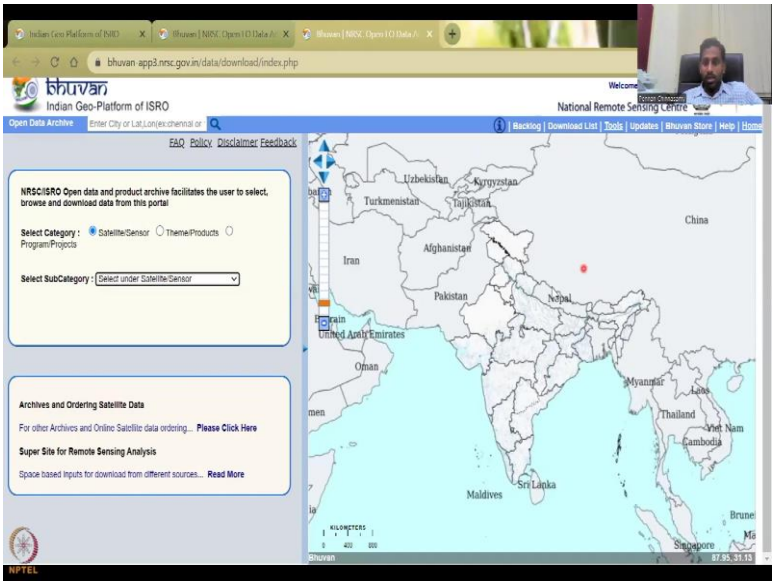

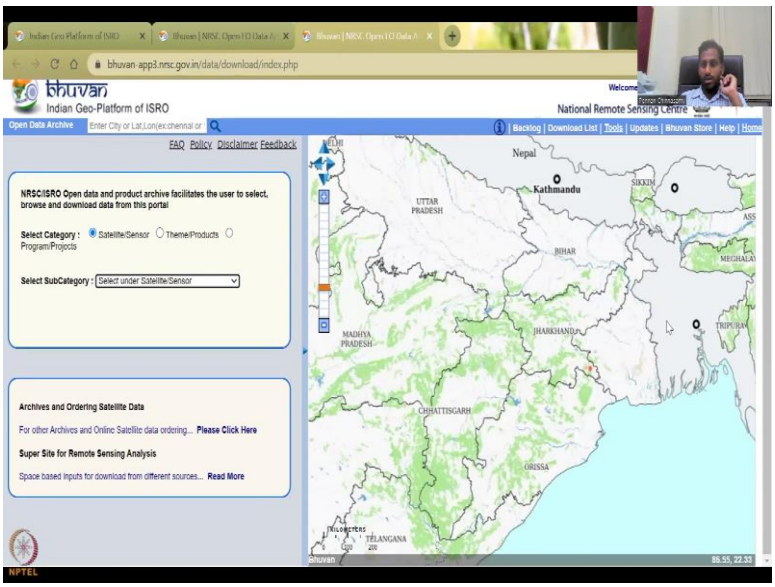

So, if you zoom in zoom out these two pointers you see, I hope you can see my pointer or let me have the pointer spotlight for you. So, you can see here. So, normally this part is the map part and whenever you play with the input here, this is expected to change. So, today's lecture, I will go through the dashboard itself. Please see how to understand this dashboard because very, very important before we jump into each product. So, you have the left right to just move the map. You can also drag and hold, the map will move; zoom in zoom out as plus and minus, and you could I think maybe because of me sharing, it is not letting me… so I have refreshed it, now you could see it moving.

So, as I said, sometimes it works or gets stuck, do not worry about it, just you will see that if I move my hand and then hold the mouse and then drag it, you can drag. Here you do not see a place where you could quickly access the data, you will need to log in. So, if you can see here, there is a login option, I am going to use my spotlight again so that you can see. So, you could see here there is a login option where you will need to create a username, create a login password and do it.

When you create it, please mention it is for academic, you are a student, those kinds of things will be asked because they want to know what you are going to use the data for. Is it for commercial? Is it for public, just for knowledge and research? Or are you a student who's working on a thesis, dissertation, etcetera? NGOs also use, so they use it sometimes for free work or also there are companies that use it for commercial value. So, ISRO needs to be careful about how many people are using it for what costs. So, that is where you have it.

The boundaries are more accurate here. So, please use these boundaries for anything that you use for Indian regions, these boundaries are very very accurate because it is from the Government of India. So, you could go to your login, I do have a login profile. Next time, in the next class I will start with my login, but today I will not get into that. We will get into this part. So, you have dragged and move. Now there is Bhuvan Store, tools, updates, download list etcetera. So, you can play with those. So, as I said the satellite and sensor differs. So, based on the satellite you can do.

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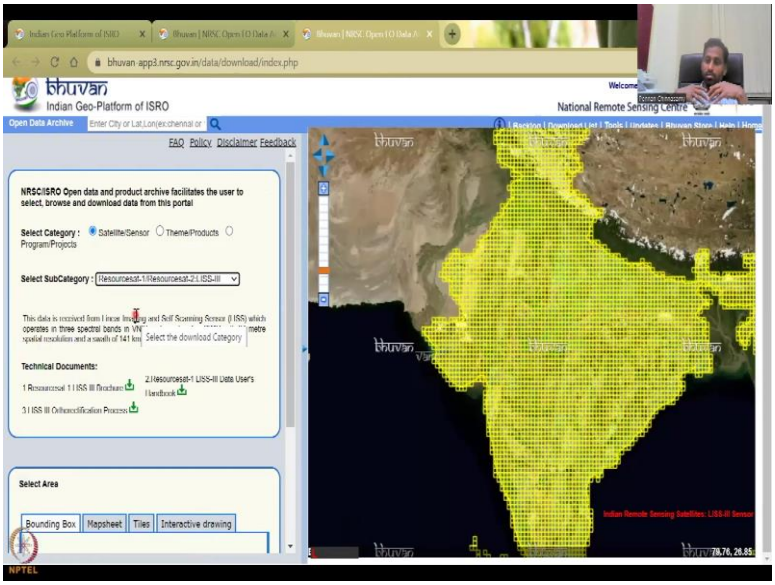

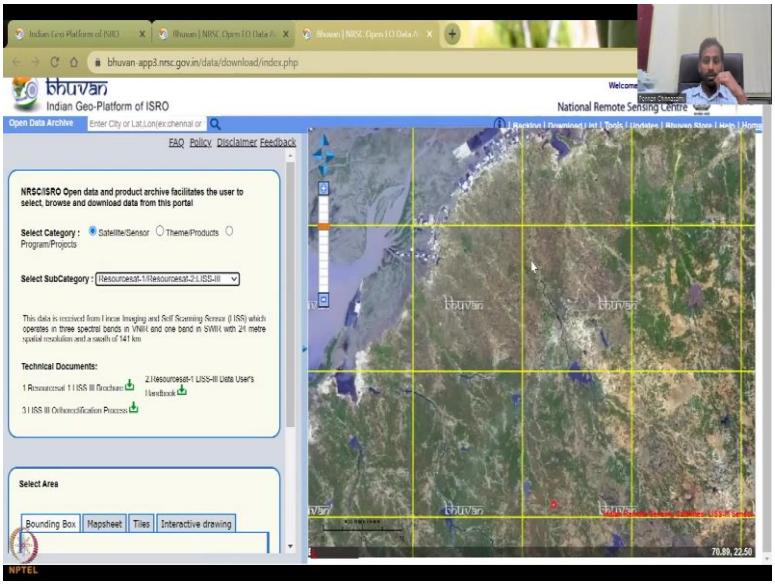

If you want to read about it, let us say resourcesat, you just click the resource and then the map updates by itself. Each time is what you buy data okay. So, that box that you see, the line that you see that is what you buy data for. So, for example, the grid will come based on your internet speed. So, for me it might come faster, for others it might be slower. So, just wait it will come. So, you see the grid box and that is the bounding box you can have here as your study area to download the data.

So, to learn about this, I am just going to show one satellite, you can learn about others similarly, you can actually click the brochure.

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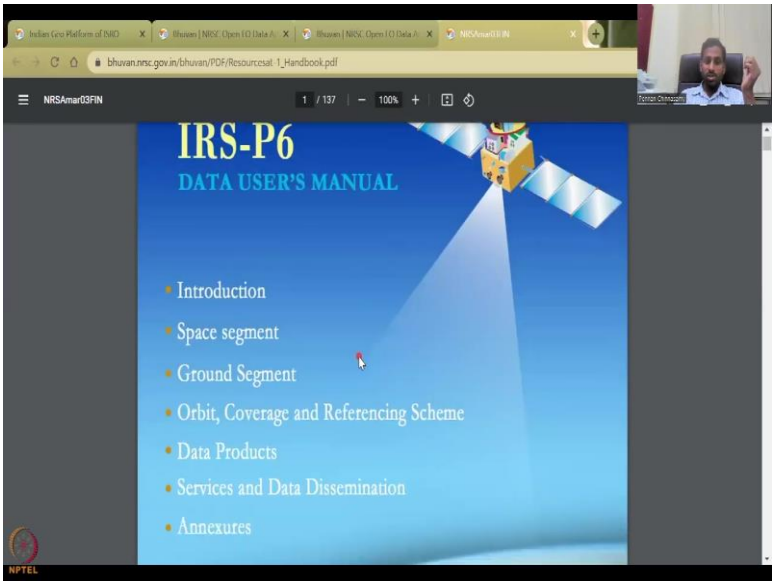

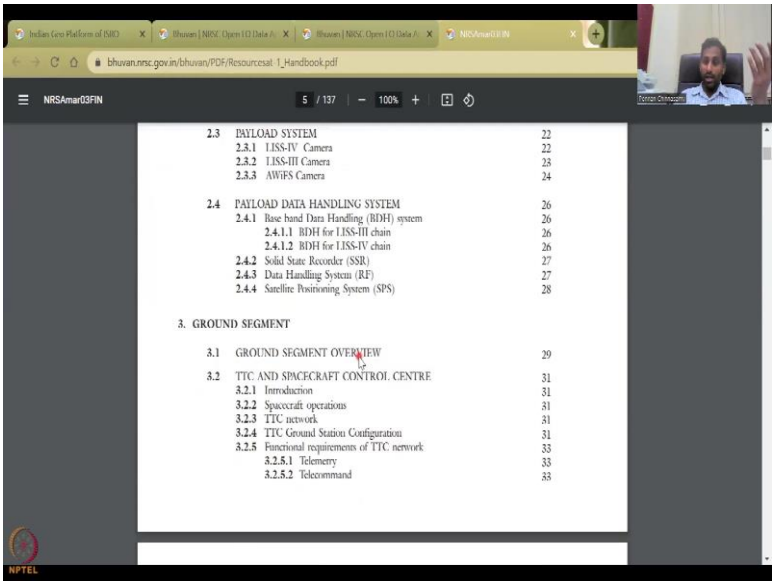

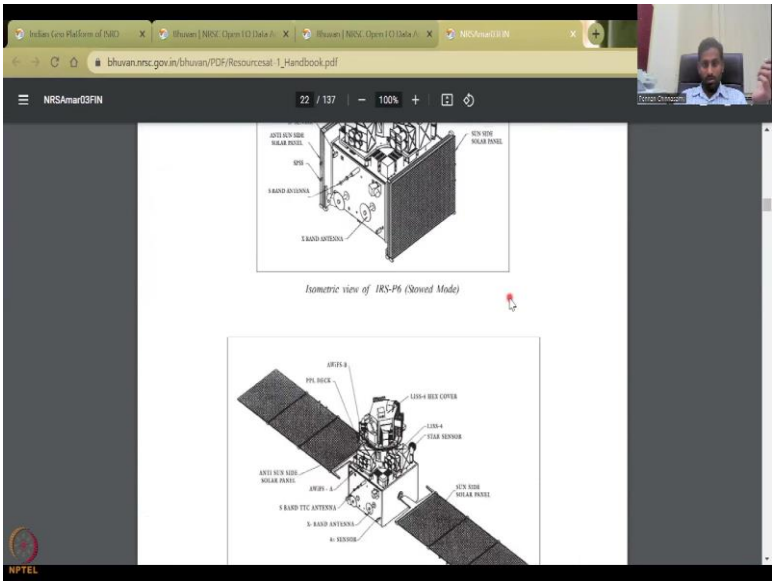

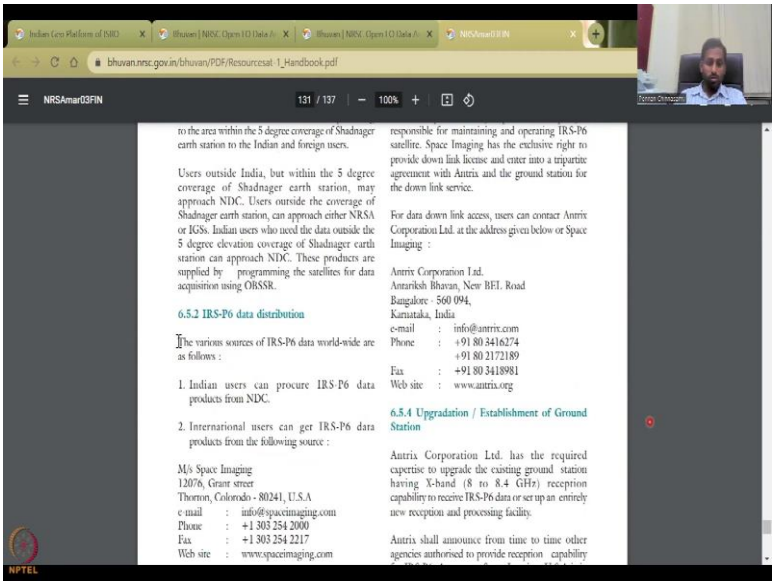

The brochure is a very simple for everyone to use booklet which tells you about the sensor. So, this is the satellite and the sensor that has been used, what is the payload data handling? How to download the data? All these are very, very important. So, you can see the schematic of the satellite itself. What are the specifics of the satellite? When was it launched? What are the resolutions? 5.8 meters, etcetra. Remember, we talked about spatial and temporal resolution. So, those are the two very very important factors that are needed. And then how much heavy it is, temperature, battery, everything.

So, this is not part of the course but at least when you use it, you should know what is the satellite and how to get the information regarding the satellite. For example, if a student is using it for their thesis, you could go here and take all the data - the metadata related to the satellite; where they procured the instruments that went into the data, the data dissemination, etcetra.

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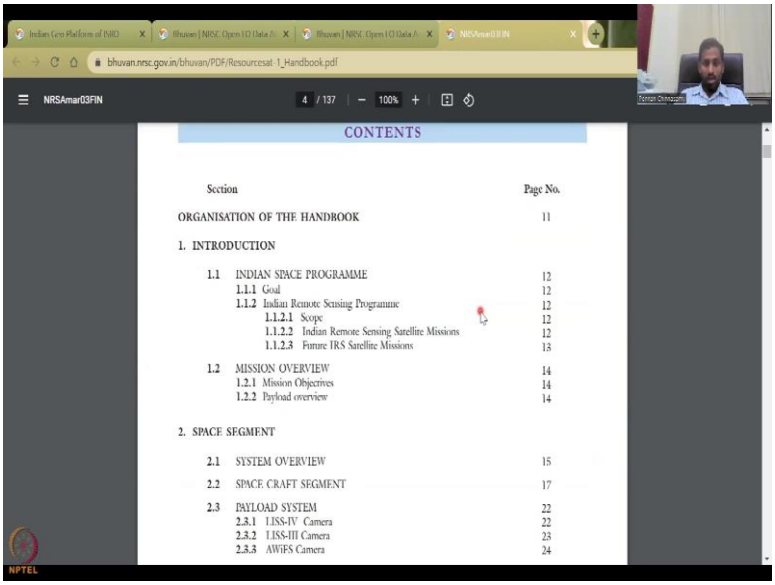

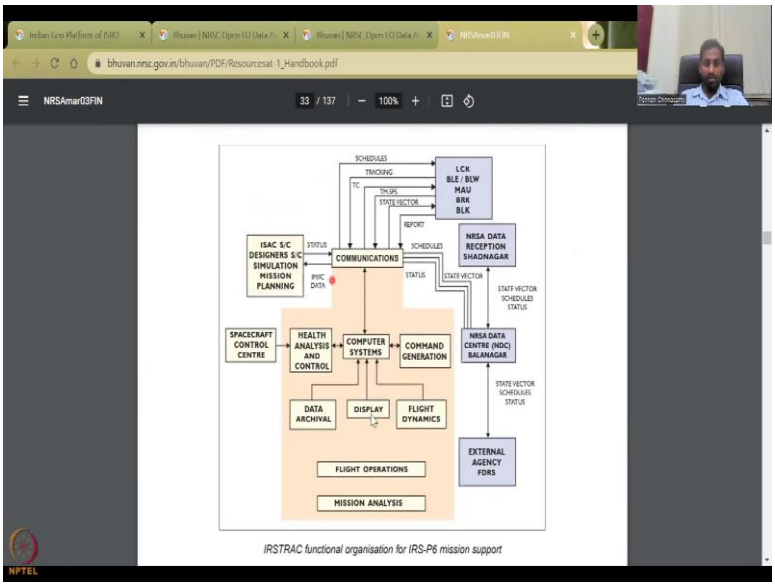

That is a brochure and then there is a handbook, user's handbook, how to use the data. So, that is also available as a different book. So, you can go and look at the scope when it was done, how it is done, what are the different data that comes in, how is the data schematic, everything.

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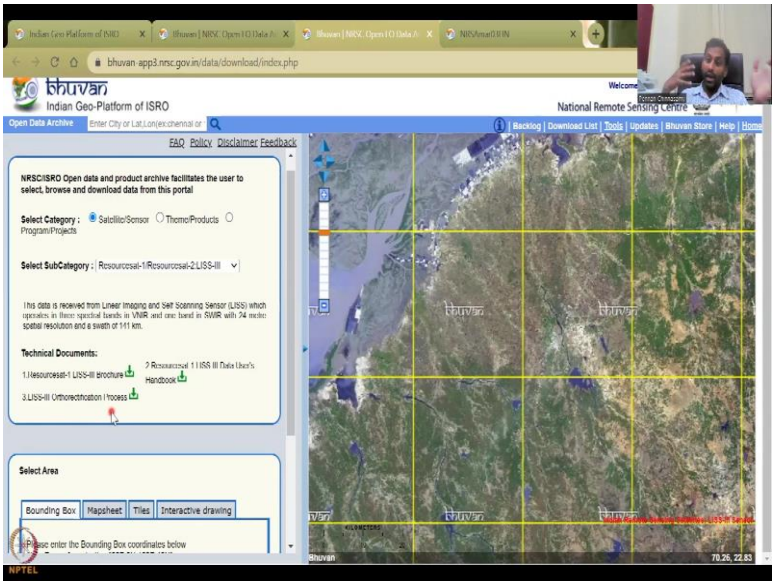

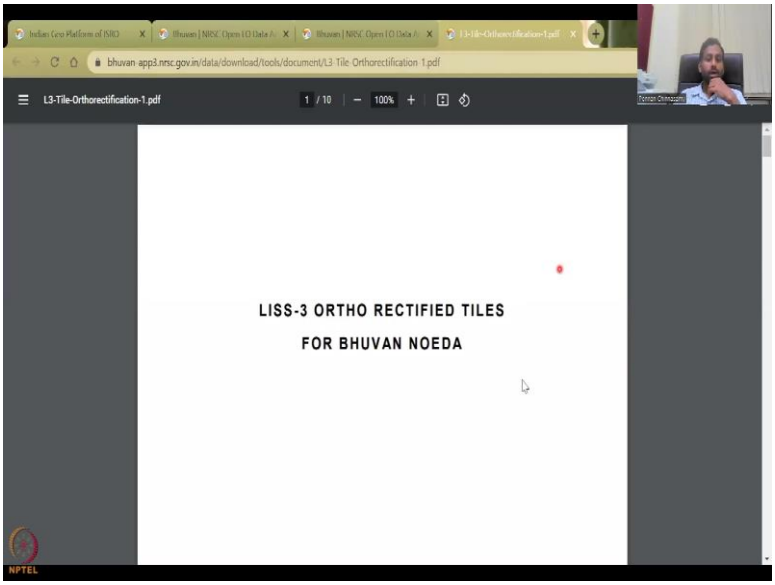

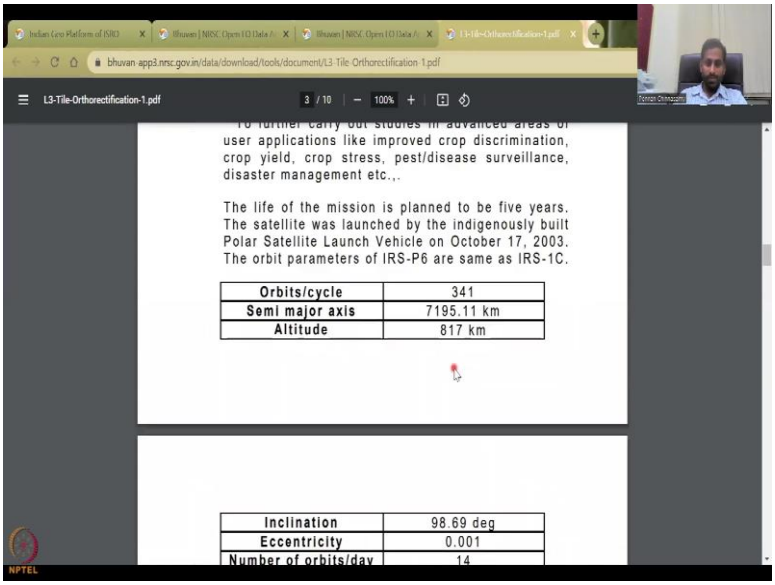

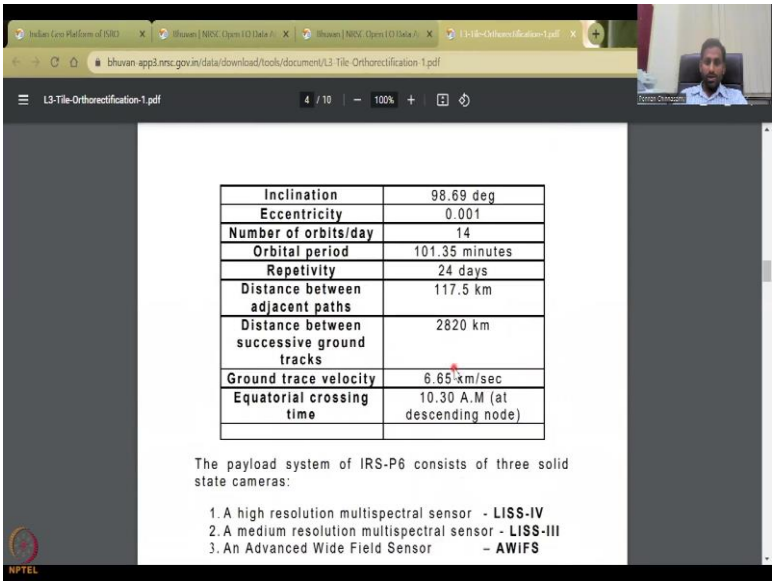

And then the ortho rectification process. So, some data has issues because of leakages and data sharing etc. So, it is important to understand the errors and what algorithms they use to eradicate those errors. If you click that, you will get this part. So, how do you eradicate, what type of images, what type of errors that come, all these are given; the orbit cycle, inclination of the satellite, number of days, repetivity 24 days, which means spatially resolution is at I think they mentioned that 10 meters, 220 meters etcetera.

But then most important, the repetivity is 24 is the temporal scale. So, here it is, the resolution is also 23.5 meters. So, each band also differs spatially because of the camera and where it was built. So, here's 23.5 meters is the spatial resolution, I said 20, so it is around 23.5 whereas, your 24 days, once in 24 days, it comes to the same location. So, that is the temporal resolution.

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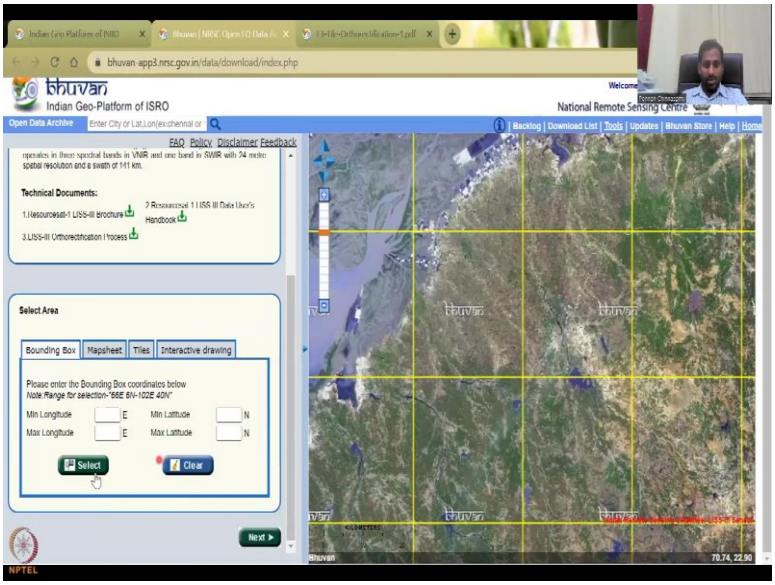

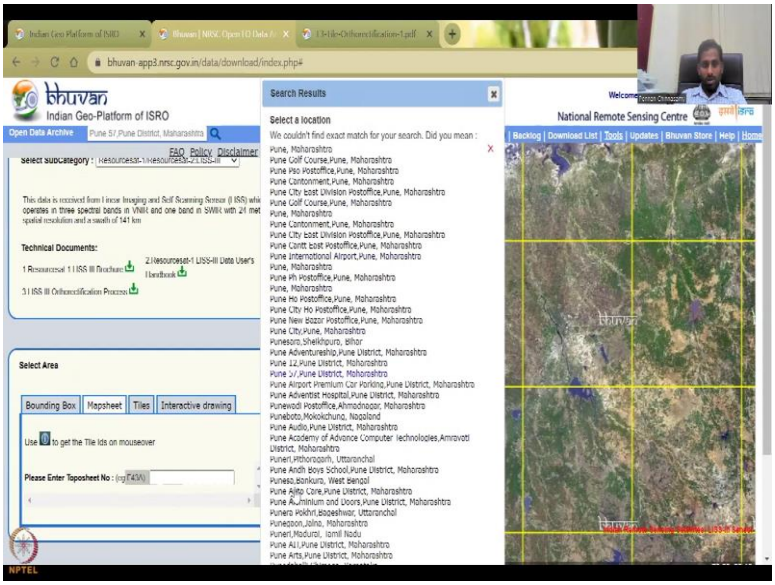

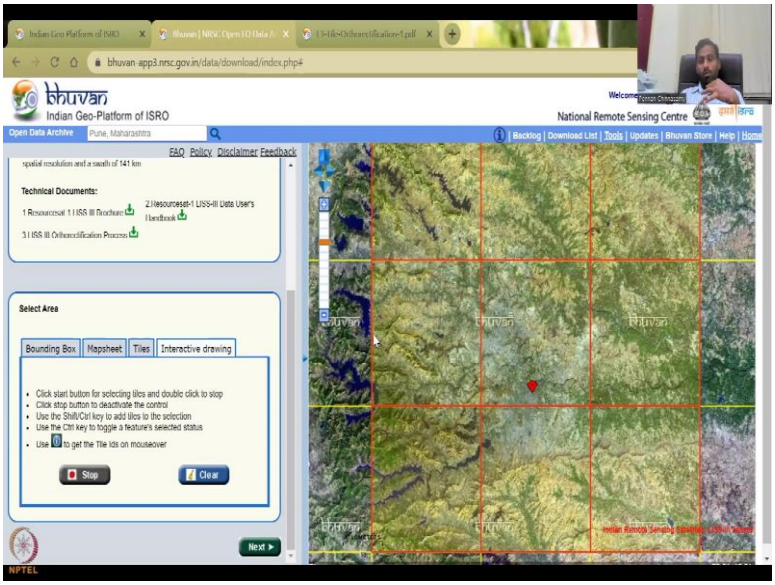

So, now we have looked at the different technical documents and now, you can do a bounding box, you can select; if you do not know the lat longs of the study area you want, which you can put here, you can also type in as I did – Pune or Mumbai, let me see if it comes up. Pune does not come up. So, you can actually put a lat long here, or if you do not know, you can actually select. I think it does not like the pointer. That is why it is not working.

So, you can put here, lat lon, min lat long, or even take the map sheet code. So, those who know about map sheets, on bottom of the map, there is a sheet number, you can take the map sheets. So, now the Pune is loading. So, I typed Pune, so it is loading now, it does take some time. So, let us say Pune, Maharashtra and get it. So, when you use this, just wait for a long time, it does. Tiles is, click start button for selecting the tile.

So, these are the tiles which when you download, you download the data by tiles. If you say India, not all India will come up, you will have to download the data as tiles. So, I'm just going to click Start button and then click here. So, you see the tile has been selected. Now I can download the data. I can do stop and interactive drawings also, you can select different start. So, you can see I'm going to draw like this very crazily and then I double click, all the tiles that I select will be there.

So even if a little bit it goes into the tile, it will be selected. Now I can download the data. Remember that only download the data that your study area is going to be used. So, that is the important part. The first part of all satellite data analysis is to identify your study area and only download the data for your study area. If you download all the data, then your computer is going to be suffering with too much data coming in, it is going to get slow on the GIS platform. Avoid it.

Initially those days, yes, we had to download all and then discard the unwanted data. But now they are giving you the benefit. You can clear and then let us do it again. So, you are given the benefit - just click on what tile you want. So, as I said Pune is what I want, so I'm just going to click Pune, that's it, that's enough and then you stop, and put your boundary one also you can tell. Good.

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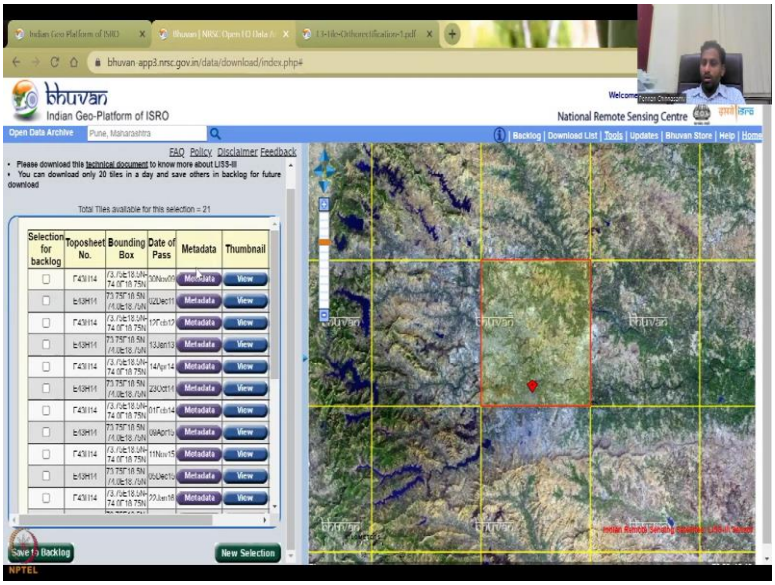

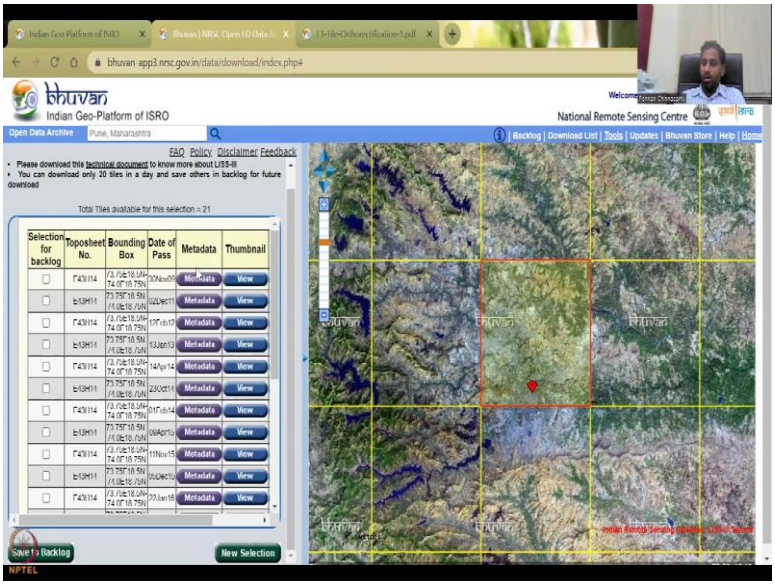

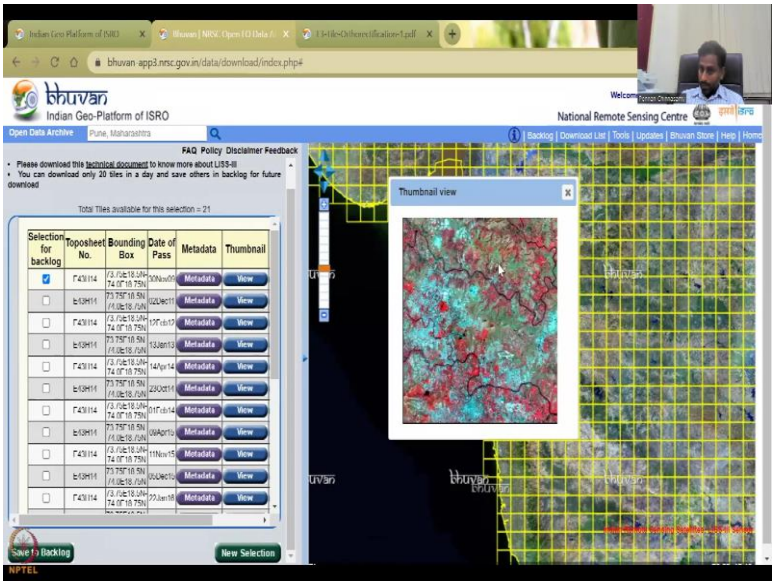

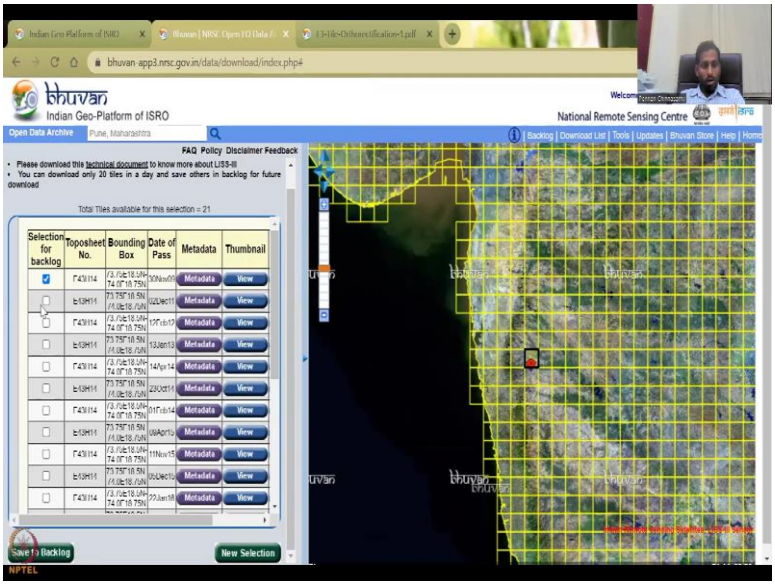

So, now this is next. You can see that the data if you click on next, you can actually see what you have downloaded. So, this is the satellite data, if we download we will get for that particular time. So, there is a grid and the meta data is data about the data. So, if you click that, all the relevant data information will be coming. This is very important for students to cover especially on what was the locations, the datum, the projection, the coordinate system and then what was the rectification done, it was ortho rectified, the resolutions, spatial resolution unit, so it is degrees, what was the file format, everything.

When you download this data, it is automatically georeferenced, which means it goes directly into QGIS on Pune. So, in other terms, you have to download and then attach the Pune location to it. Here, the Pune location is already embedded in the data.

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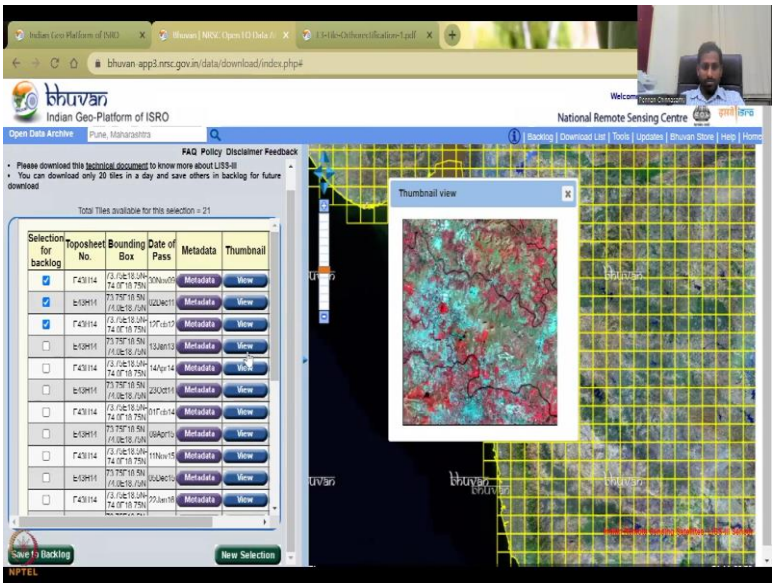

So, all the times that you want, you can do. And this is the time, as I said 24 days once it takes, sometimes you can get earlier days also and then you can just click click, click and then view, it will pop up. So, you can see how the data is differing as per the time sequence. And whatever you want, only that you can select and then you download, you do not have to download all the tiles. The tile is the same, but here, what changes is your time, the time of when the data was taken changes.

So, I am going to stop here for the time and I am going to go back quickly to the presentation.

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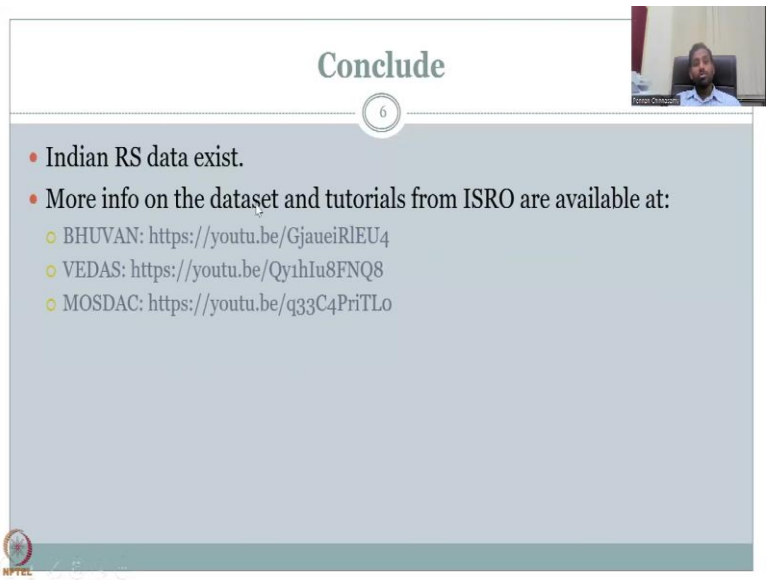

And in the presentation, we have just concluded today's presentation, as Indian remote sensing data exists, please go and look into the tutorial. So, initially, I gave you the link for the data set. Now I'm giving you the link to go and look at the tutorials. So, please go ahead and look at the tutorials. You will find it very, very helpful, especially each tutorial is crafted for Bhuvan, Vedas and MOSDAC.

If the dot does not help, please make sure that you have access to the link for youtube. That is very important because you will need to use this for your entire project. So, as I said, if there is any question on using these tools and making your project, please do not feel shy to request. I will reshare the slide again, the conclusion slide and if it does not work with the dot q, we can use these links. So, thanks for staying a little bit longer today's class because of the portal. In the next class, I will go only for water and we will discuss that lecture. Thank you.