

Remote Sensing and GIS for Rural Development
Professor. Pennan Chinnasamy
Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology, Bombay
Week – 03
Lecture no. 02
Intro to Remote Sensing Data for Rural Development: Water

(Refer Slide Time: 0:16)



**Remote Sensing and GIS for
rural development
Week 3: Lecture 2**

PENNAN CHINNASAMY
FACULTY:
CENTRE FOR TECHNOLOGY ALTERNATIVES FOR RURAL AREAS (CTARA)
INTERDISCIPLINARY PROGRAM ON CLIMATE STUDIES (IDPCS)
CENTRE FOR POLICY STUDIES (CPS)
CENTRE FOR MACHINE INTELLIGENCE AND DATA SCIENCE (C-MINDS)

INDIAN INSTITUTE OF TECHNOLOGY - BOMBAY

NPTEL - REMOTE SENSING AND GIS FOR RURAL DEVELOPMENT

P.Chinnasamy@iitb.ac.in

Hello everyone, welcome to remote sensing and GIS for Rural Development NPTEL course, this is week 3, lecture 2. In this week, we have been specifically looking at the Indian government datasets, open source data sets that can be used for getting data for rural development. The last class we had an overview of Bhuvan website portal and we looked at some random data and how to download and link the data for rural development. In today's lecture, let us look at the specific data that we use to take from Bhuvan for water resources.

(Refer Slide Time: 1:16)

Intro to RS open source data sources water

- Satellite/Sensor
- Theme Products
- Program/Projects

Application Sector has Water applications

Source: ISRO/NRSC

So, what is the theme here and we would like to look at the Bhuvan open a Data Archive. Yesterday or in the last class, I had mentioned how to pick different tabs in the dashboard and one of the tabs was the thematic products which are stored in the Open Data Archive. So, what do you see the Open Data Archive is, satellite and sensors that you will see here. Theme products, so basically some data is aggregated as thematic products and some other data is kept as program under program and projects.

So, we will now look at is ISRO's Bhuvan website to understand the different sectors and spaces that are looking upon water. But before that, I will also touch upon a link within the Bhuvan website that has applications on water and very-very limited focused applications.

(Refer Slide Time: 3:20)

Open Data Archive

Enter City or Lat,Long or chemical or

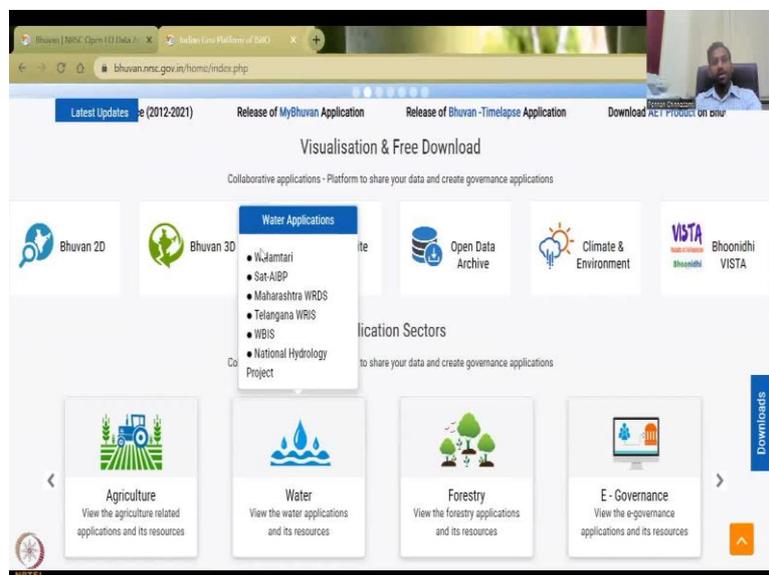
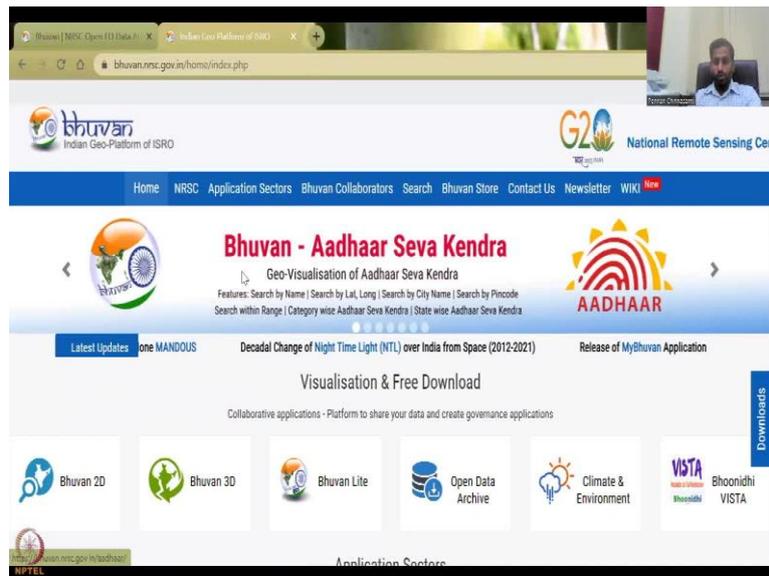
NRSC/ISRO Open data and product archive facilitates the user to select, browse and download data from this portal

Select Category: Satellite/Sensor Theme/Products

Select Project: National Information System for Climate

Select Group: Atmospheric and Climate Sciences

Select Product: Selected Products



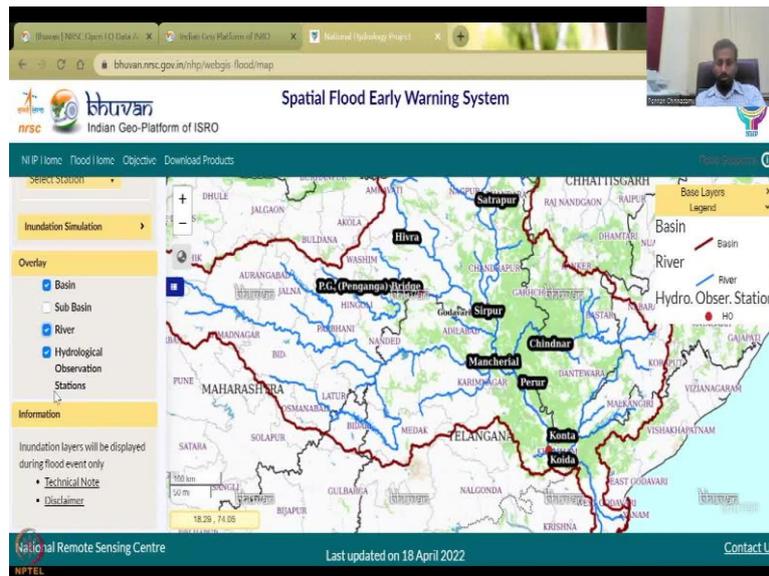
So, let us open the portal. So, we have Bhuvan website here and what we see is so we have the Bhuvan NRSC Open Data Archive, but before that, let me type the Bhuvan NRC website and show you that we do have if you scroll down the application sectors. In the application sectors we have water. So, in this there are very specific applications that have been developed using GIS data, one is Walamtari, Sat-AIBP, and Maharashtra WRDS, Telangana WIRS, does move so you can just click here to go back. And then you have the national hydrology project WBIS.

(Refer Slide Time: 4:08)

The screenshot shows the homepage of the Geospatial Hydro Products & Services portal. The header includes the logos for NRSC, Bhuvan, and ISRO, along with the text "National Remote Sensing Centre" and "National Hydrology Project". A navigation menu contains "Home", "About", "Project Teams", "Projects", and "Download Products". The main content area features a "About Portal" section with a text box explaining the portal's purpose and listing "1. Spatial Flood Early Warning - for Godavari & Tapi river basins". A video feed of a presenter is visible in the top right corner. The footer includes "National Remote Sensing Centre", "NPTEL", "Last updated on 18 April 2022", and a "Contact Us" link.

This screenshot displays a 3D topographic map of a river basin, likely the Godavari basin, with a river channel highlighted in blue. Below the map are four thumbnail images representing different hydrological products: "Flood Early Warning", "Evapotranspiration", "Glacial Lakes", and "Snowmelt Runoff". The interface includes the same header and navigation as the previous slide. A video feed of the presenter is in the top right. The footer contains "National Remote Sensing Centre", "NPTEL", "Last updated on 18 April 2022", and "Contact Us".

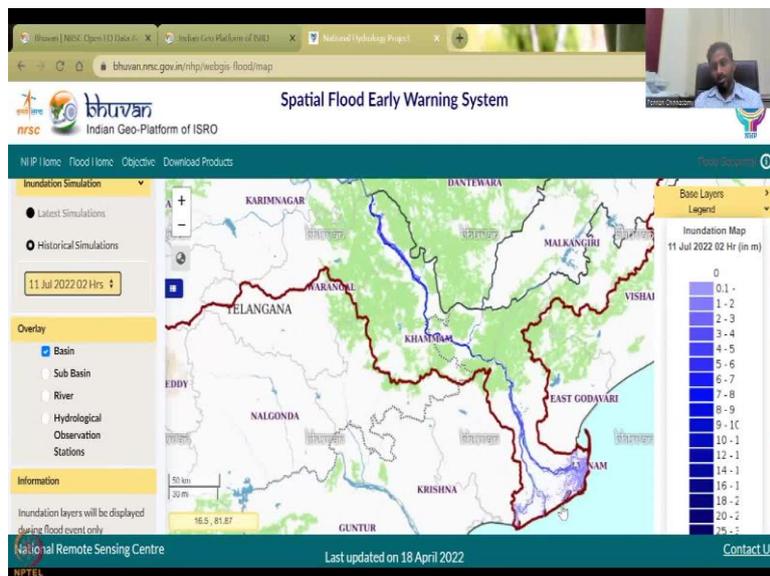
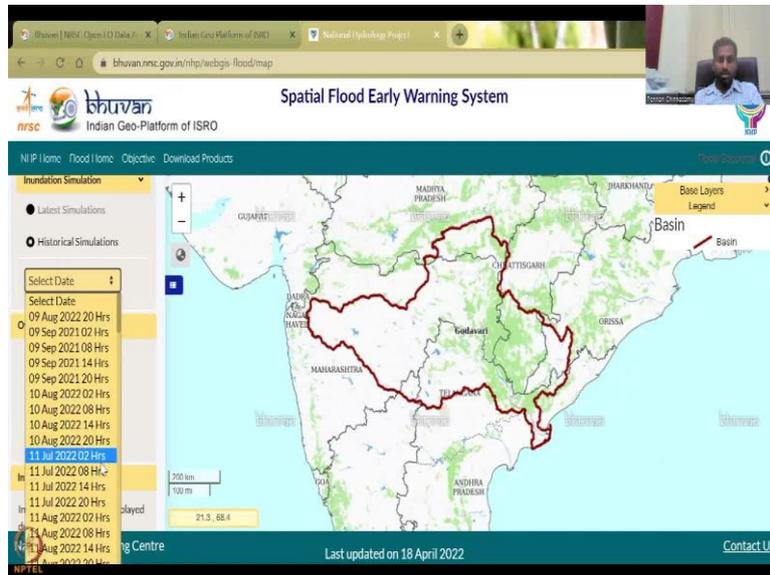
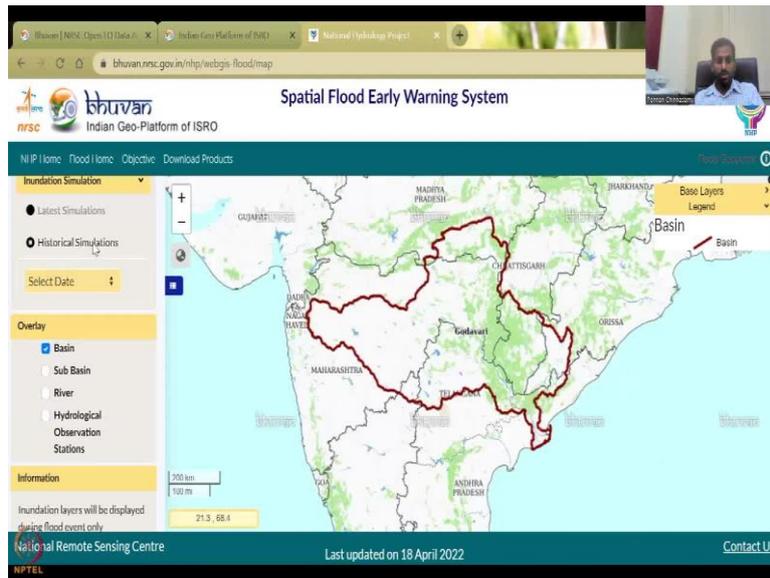
The screenshot shows the "Spatial Flood Early Warning System" interface. It features a map of India with a red outline of the Godavari basin. The left sidebar contains controls for "Select Basin" (set to Godavari), "Hydrograph" (set to Tapi), "Select Station", "Inundation Simulation", and "Overlay" options (Basin, Sub Basin, River, Hydrological Observation Stations). The map includes a legend for "Basin" and "Hydro. Obser. Station", a scale bar, and coordinates (21.78, 87.21). The header and footer are consistent with the previous slides, including the presenter's video feed.

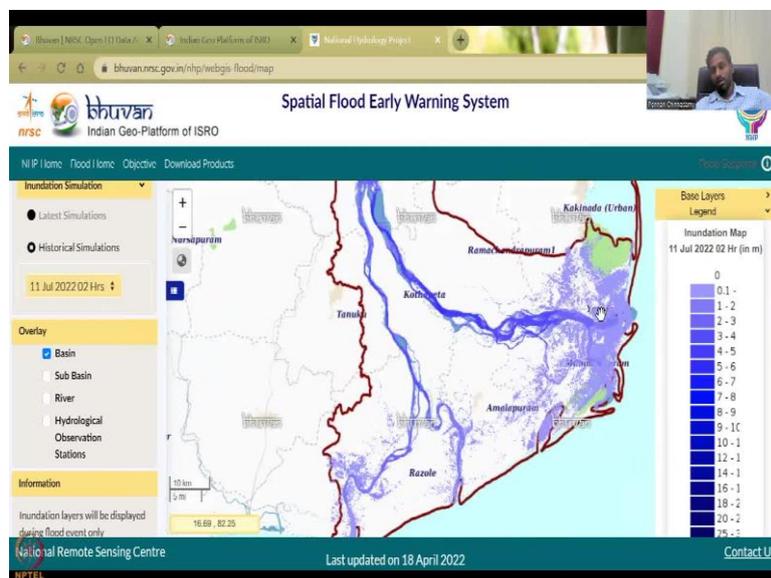
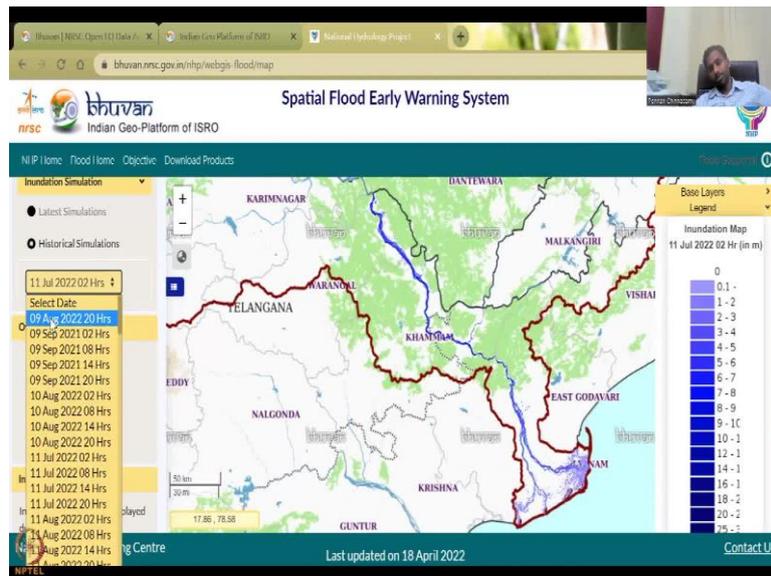


Let us click the national hydrology project to understand about the project and then where the data comes in. So, you could see read about the drought index they have created, decision support system, you can lower it and then see flood early warning systems that have been created for the basin. So, this here they have the Godavari basin or Tapi. So, across India, only two basins have been created that also clarifies the need for this course, that all areas cannot be mapped at once, it requires a lot of capacity and the students taking this course will be able to bring that capacity.

So, let us look at what are very basic for example, you have this Godavari basin and you have the observation data points. So, you can see here these are the observations data points, let us zoom in to see more. So, you have these observatory points and those are used to look at the rivers discharge and look at where the water is going to be about the flood level.

(Refer Slide Time: 5:21)





So, you can do an inundation simulation and remove these for now. And then you could see historic simulations, select a date, let us say some hours and you could see that these are where inundation happens, inundation is the level increases and comes out as floods. So, this is a very focused application and the latest data you have is August 9, 2022. So, there is a bit of delay, but still it is a good effort and a lot of understanding can be taken from this image like mostly here to see that the downstream locations are mostly getting flooded. So, you can see here the flood is here, so all these areas could be given a warning to go to different areas during floods, evacuate.

(Refer Slide Time: 6:24)

The screenshot shows the Bhuvan portal homepage. At the top, there are navigation links for 'Urban Water Body Information System on Bhuvan Portal' and 'Visualize Forest Fire Regimes between 2003 and 2021 on Bhuvan Disaster Portal'. The main heading is 'Visualisation & Free Download', with a sub-heading 'Collaborative applications - Platform to share your data and create governance applications'. Below this, there are six application icons: Bhuvan 2D, Bhuvan 3D, Bhuvan Lite, Open Data Archive, Climate & Environment, and VISTA Bhoonidhi VISTA. The 'Application Sectors' section below features four categories: E-Governance, Tourism, Urban, and Rural, each with a brief description of the applications and resources available. A 'Downloads' button is visible on the right side.

This screenshot shows the Bhuvan portal homepage with the 'Water Applications' dropdown menu open. The dropdown lists several projects: Walantari, Sat-AIBP, Maharashtra WRDS, Telangana WRIS, WBIS, and National Hydrology Project. The 'Application Sectors' section below now includes Agriculture, Water, Forestry, and E-Governance. The 'Water' sector is highlighted, indicating the user's current selection.

The screenshot displays the 'Water Resources Management Support: Maharashtra' application. The main interface features a map of Maharashtra with various districts labeled. A sidebar on the left provides navigation and information, including 'Water Bodies', 'Flood Information', 'Sugarcane Crop Monitoring', 'Irrigation Potential Utilisation', and 'Monitoring of Irrigation Infrastructure'. The top of the application shows the title 'Water Resources Management Support: Maharashtra' and a 'Welcome User' message. The bottom of the page includes a 'Discussion Forum | Send Mail | Legend' and 'Contact us | Disclaimer' links.

Water Resources Management Support: Maharashtra

Indian Geo-Platform of ISRO

Enter City or LatLon(coordinates) or ID

Tools | Link | Home

Water Resources Management Support

Water Bodies

- Reservoir/Tank Information
- Water Bodies
 - Water Bodies (India WRIS)
 - Water Bodies Information System (WBIS)
 - Water Bodies Fraction (3'x3', 15 Days)
- LULC
- Flood Information
- Sugarcane Crop Monitoring
- Irrigation Potential Utilisation
- Monitoring of Irrigation Infrastructure
- Field Data

Map | Satellite | Hybrid | Terrain | More

Indian Remote Sensing Satellites

75.32, 19.48

Discussion Forum | Send Mail | Legend | Contact us | Disclaimer

Water Resources Management Support: Maharashtra

Indian Geo-Platform of ISRO

Enter City or LatLon(coordinates) or ID

Tools | Link | Home

Water Resources Management Support

Water Bodies

- Reservoir/Tank Information
- Water Bodies
 - Water Bodies (India WRIS)
 - Water Bodies Information System (WBIS)
 - Water Bodies Fraction (3'x3', 15 Days)
- LULC
 - Select Date: DEC16x31,2
 - View
 - For more info
- Flood Information
- Sugarcane Crop Monitoring
- Irrigation Potential Utilisation
- Monitoring of Irrigation Infrastructure
- Field Data

Map | Satellite | Hybrid | Terrain | More

Indian Remote Sensing Satellites

80.13, 19.81

Discussion Forum | Send Mail | Legend | Contact us | Disclaimer

Water Resources Management Support: Maharashtra

Indian Geo-Platform of ISRO

Enter City or LatLon(coordinates) or ID

Tools | Link | Home

Water Resources Management Support

Water Bodies

- Reservoir/Tank Information
- Water Bodies
 - Water Bodies (India WRIS)
 - Water Bodies Information System (WBIS)
 - Water Bodies Fraction (3'x3', 15 Days)
- LULC
 - Land Use Land Cover (250K)
 - LULC 50K:2005-2006
 - LULC 50K:2011-2012
 - Activate Saipa | Deactivate Saipa
- Flood Information
- Sugarcane Crop Monitoring
- Irrigation Potential Utilisation
- Monitoring of Irrigation Infrastructure
- Field Data

Map | Satellite | Hybrid | Terrain | More

Indian Remote Sensing Satellites
WSA_dec26x2

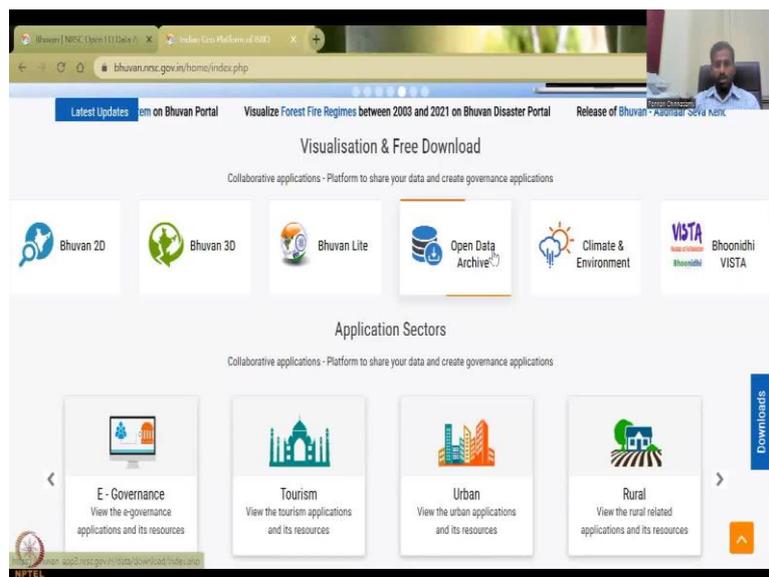
73.82, 19.28

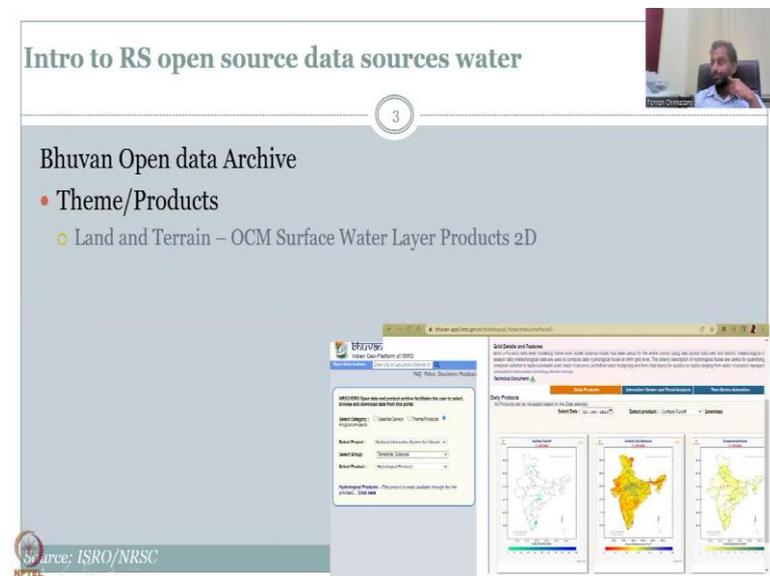
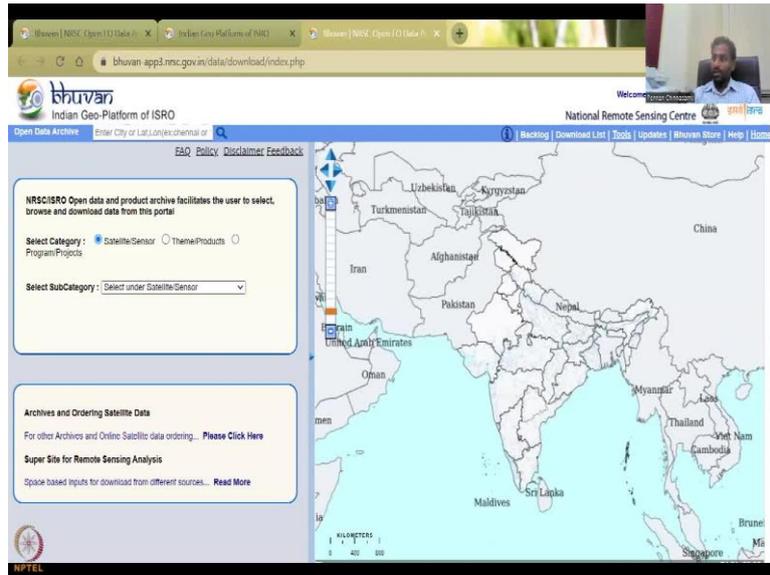
Discussion Forum | Send Mail | Legend | Contact us | Disclaimer

So, this is one example there are multiple other examples for the application sector. I will do the Maharashtra WRDS, where it gives you resource support for managing the water. So, these are the dams that are in the Maharashtra state and for example, if I click water bodies, I can click that and all the water bodies are now coming up. So, initially, there was no water bodies, but now water bodies are coming up. And then you have a date to see what is the fraction and you have up to 2022 but let us do a few and then you can have number of water bodies fraction where the water bodies are present and the fraction etcetera.

So, you can see that the land use land cover is also done for two years. So, now if you see the land use land cover is done for two years for Maharashtra, one is in 2006 and another is 2012. So, definitely it is at least 10 years lag, so how would you use a 10 year old data is a question and for that we need to make our own land use land cover maps, either unsupervised or supervised classification based on our research needs.

(Refer Slide Time: 7:44)





So, let us jump into the Open Data Archive. I hope it has come up. So, I will say again, we will be doing two important phases, let us go back to the slides and then I will show you what we will be showcasing. We will be doing so now we have looked at applications now we will get into the open source data in Bhuvan for water, I have opened the Bhuvan Open Data Archive and thematic products we will be looking at the land and terrain OCM surface water layer products. So, I am going back to my portal.

(Refer Slide Time: 8:31)

The screenshot shows the Indian Geo-Platform of ISRO website. The 'Select Category' is set to 'Satellite/Sensor'. The 'Select SubCategory' dropdown menu is open, showing options: 'Select under Satellite/Sensor', 'Oceanic-OCM', 'Resoucest-1:Resoucest-2:LISS-III', 'MS-1: Hyperspectral Imager(HySI)', 'Cartosat-1', 'Resoucest-1:Resoucest-2:AVHRS', and 'SCATSAT-1: Scatterometer'. The 'Resoucest-1:Resoucest-2:AVHRS' option is highlighted. The map on the right shows the Indian subcontinent and surrounding regions.

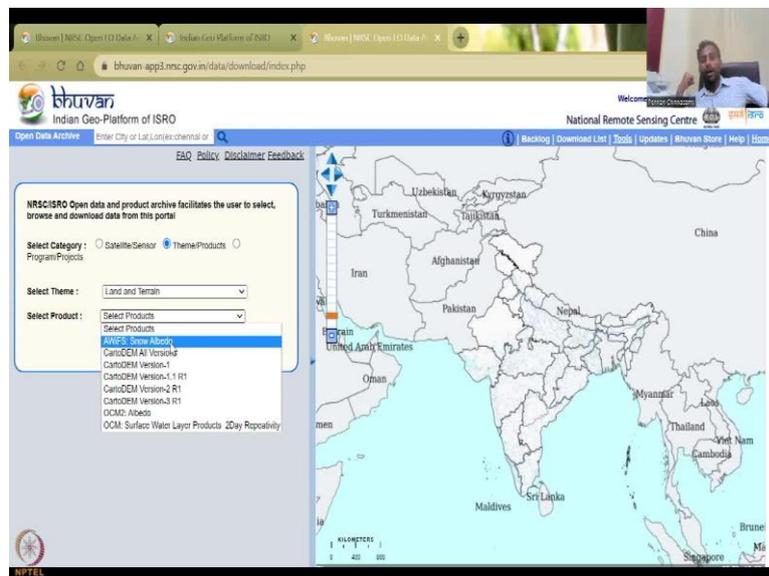
The screenshot shows the Indian Geo-Platform of ISRO website. The 'Select Category' is set to 'Theme/Products'. The 'Select Theme' dropdown menu is open, showing options: 'Select under Theme/Products', 'Select under Theme/Products', 'Land-Vegetation', and 'Ocean-Physical'. The 'Land-Vegetation' option is highlighted. The map on the right shows the Indian subcontinent with state boundaries and names.

The screenshot shows the Indian Geo-Platform of ISRO website. The 'Select Category' is set to 'Theme/Products'. The 'Select Theme' dropdown menu is open, showing the option: 'Select under Theme/Products'. The map on the right shows the Indian subcontinent and surrounding regions.

So, under theme and products. So, satellites, you have multiple satellites, but not readily they are marked as water, water needs some processing of the data. So, you have a multi spectral reflectance curves or you have hyper spectral images and from these images you construct the water bodies, you understand where the water bodies are present in across India at rural scales.

So, for that we will go to theme and products and we will say either of these so we have ocean and physical, we have land and vegetation and then we have land and terrain. So, land and terrain includes the water bodies inside the land, land and vegetation is mostly on the crops and the land, so it is mostly led by crops, whereas ocean and physical includes the ocean and physical products, so mostly in the sea and oceans.

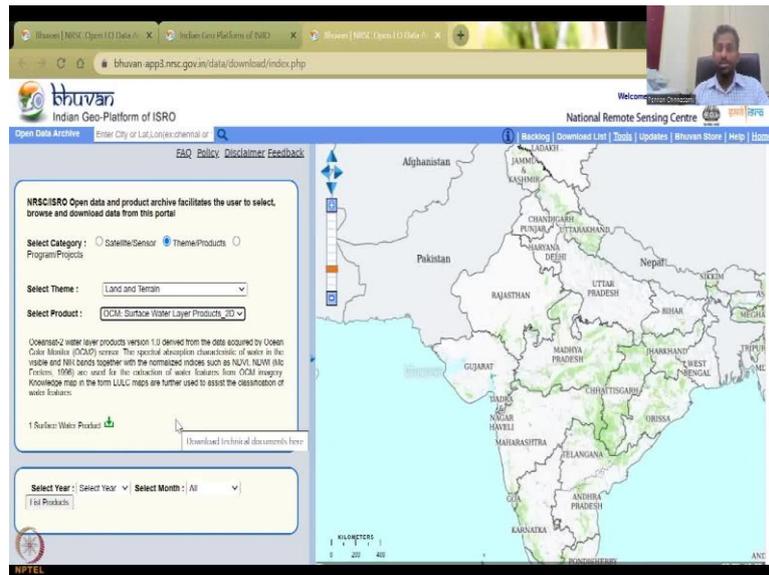
(Refer Slide Time: 9:39)



Since we are more focused on the rural entities, the rural entities are present mostly inside the land. So, let us take land and terrain and if I click this products, you will see multiple products that are kept. So, what we would need to do is, we would need to select the one which has relationships to water.

So, you have snow albedo, snow cover is converted to water availability in the Himalayan region, because there is a lot of snow and the snow is volume is then converted into a depth of water and which goes into the Ganges and other rivers so that is for that and mostly for your river discharge, but we will go to the OCM, OCM surface water layer two products.

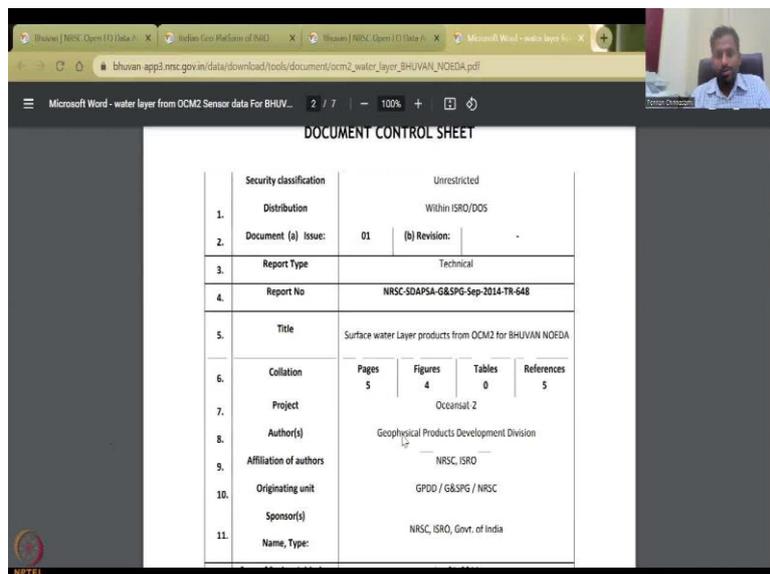
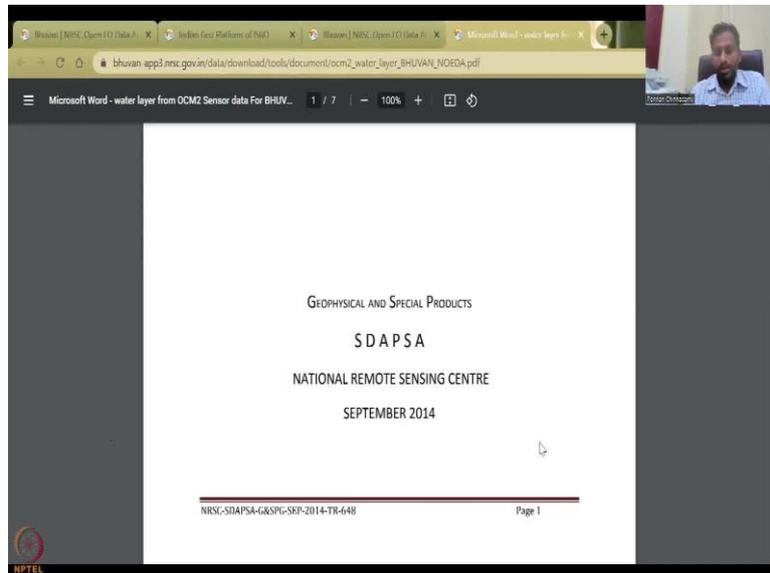
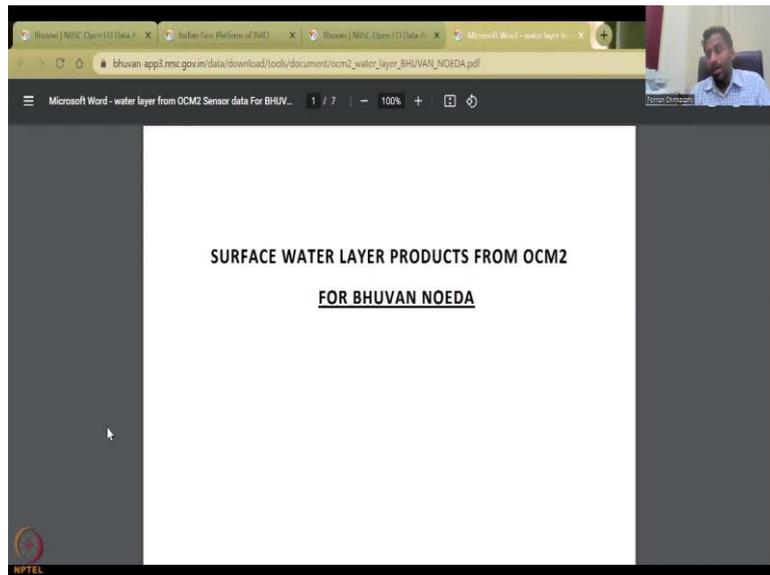
(Refer Slide Time: 10:24)

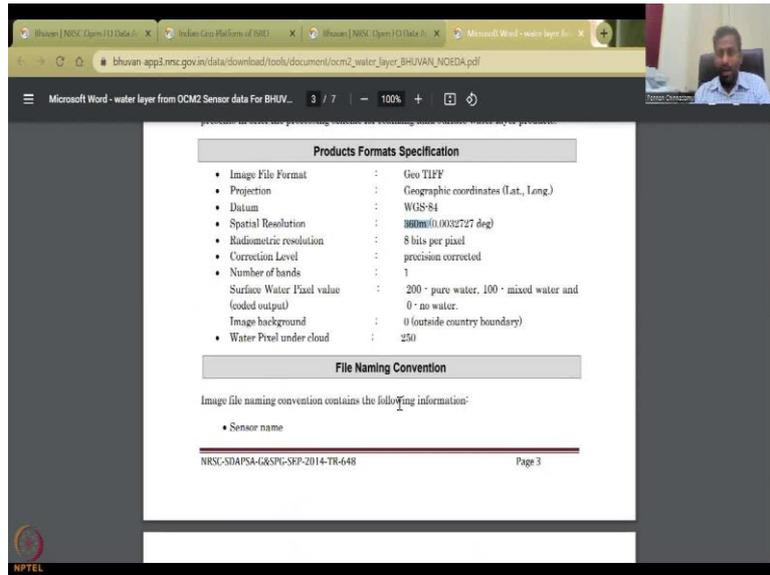


It is a 2d product, which means it will give you the x-y dimensions across space, it will not give you the z which is the depth, that is tricky, it is harder to estimate but for now, we will only look at the 2d surface. So, it says ocean to water bodies version number 1, so version is how many iterations they have, how many updates they have, so we are still it is in version 1. It is derived from the ocean color monitor OCM to sensor and then it is in the visible and NIR bands.

So, the spectrum that is being analysed is the visible spectrum and some NIR bands with normalize in the sense such as NDVI, NDWI etc. which are used to extract the water bodies. So, based on the reflectance of the water and land into the satellite, they can estimate if it is coming from land, if it is coming from water. Again, this requires you to take the basics of remote sensing there are a lot of NPTEL courses, I have already mentioned that, it is slightly advanced we are looking at for rural development. So, then they have used some other knowledge maps to do classifications and some categorization of the data.

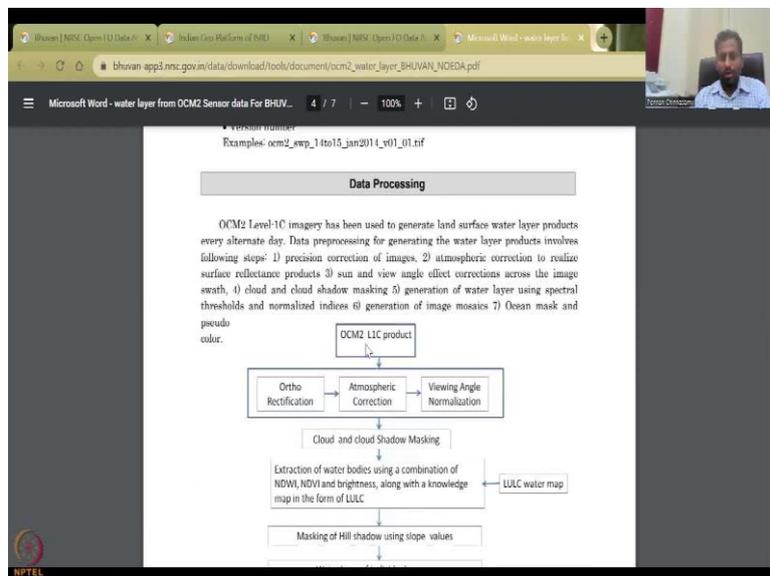
(Refer Slide Time: 11:56)

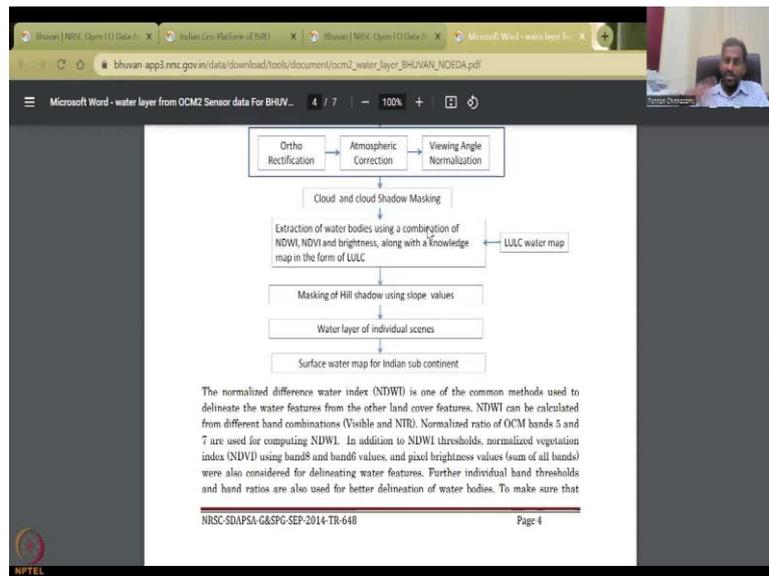




So, let us look at the surface water product. Please give it some time to load and if you could come down it is still 2014, 8 years old document but has been used well for the product. So, you have water and no water is 0, pure water is 200, mixed water is 100 and then you have a spatial resolution of 360 meters, each pixel is 360 meters, there is no definite amount of temporal resolution, but I think since it is a driven model, you do get it every lakh days of one or two days.

(Refer Slide Time: 12:41)





And then it shows you how the data has been processed. So, first the product comes from the sensor, there is some rectification, atmospheric correction, and then angle normalization, because, if the satellite is tilted, then you have an elongated image. So, all these angles are normalized, atmospheric errors are corrected, the cloud cover everything is corrected, ortho-rectification is done and then cloud shadow masking is taken out the cloud, shadow is also casting some images distortion in the images that is also removed. And then water bodies are extracted using a combination of NDWI, NDVI, brightness, so all these are indices, indices which are created by a combination of the bands.

So, remote sensing tells that color white color is not white it is in different bands with GI. So, same thing when pulse light pulse gets reflected it can come in multiple bands and depending on your sensors acceptance or absorption, you will collect data. So, here we are using a visible spectrum an NIR spectrum, so you will get some VGR plus near infrared and that is enough to make this NDVI and NDWI. Just search for NDWI or NDVI you will get a lot of materials on how it is calculated. Sometimes added here, sometimes they do not but that is fine.

(Refer Slide Time: 14:16)

Figure 2 Water layer extracted from 10-13 for the month of April 11(66) and overlay on color composite

To assess the accuracy of the water extraction, visual analysis was carried out by comparing extracted water layer with original reflectance image as well as with AWIF's water maps of the same period. Accuracy was more than 90% for large water bodies but accuracy of detection was falling down with decreasing area by perimeter ratio. Water layer

water maps of the same period. Accuracy was more than 90% for large water bodies but accuracy of detection was falling down with decreasing area by perimeter ratio. Water layer images thus generated for entire OCM2 IAC (Local Area Coverage) data over Indian Sub continent is shown in Figure 2a and 2b for the month of Nov 13 and Feb 14 respectively.

Figure 2a Water layer extracted for the dates 19 and 20th of Nov'13 for Indian subcontinent

NRSC-SDAPSA-G&SPC-SEP-2014-TR-648 Page 6

pseudo color.

```

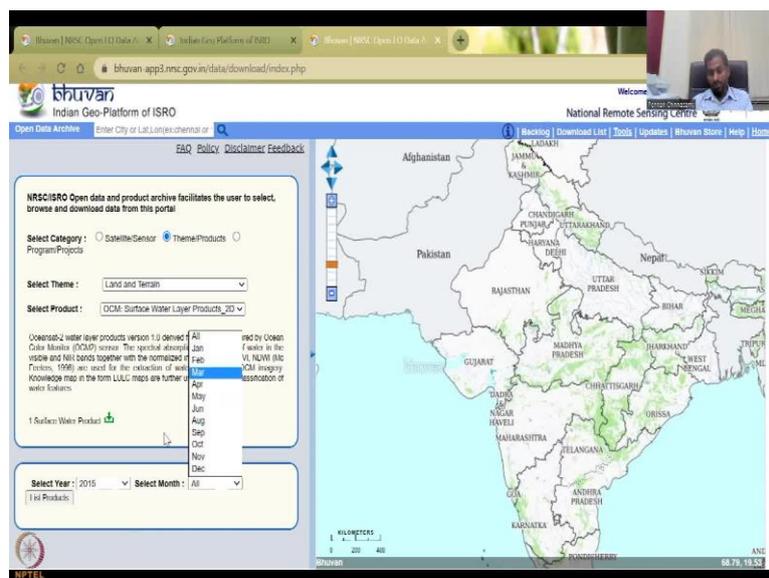
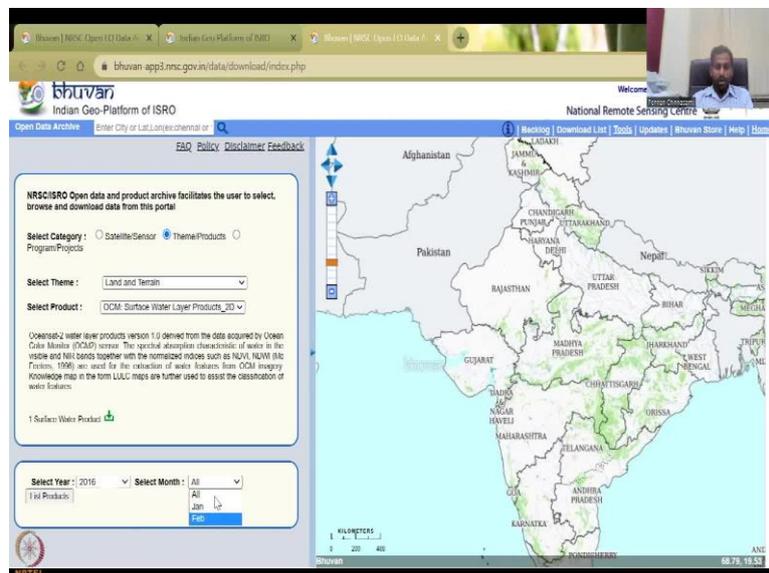
graph TD
    A[OCM2 LIC product] --> B[Ortho Rectification]
    B --> C[Atmospheric Correction]
    C --> D[Viewing Angle Normalization]
    D --> E[Cloud and cloud Shadow Masking]
    E --> F[Extraction of water bodies using a combination of NDWI, NDVI and brightness, along with a knowledge map in the form of LULC]
    G[LULC water map] --> F
    F --> H[Masking of Hill shadow using slope values]
    H --> I[Water layer of individual scenes]
    I --> J[Surface water map for Indian sub continent]
  
```

The normalized difference water index (NDWI) is one of the common methods used to delineate the water features from the other land cover features. NDWI can be calculated from different band combinations (Visible and NIR). Normalized ratio of OCM bands 5 and 7 are used for computing NDWI. In addition to NDWI thresholds, normalized vegetation index (NDVI) using bands and band0 values, and pixel brightness values (sum of all bands) were also considered for delineating water features. Further individual band thresholds and band ratios are also used for better delineation of water bodies. To make sure that

And then you could see here that how a raw image is then converted into color composite where coloring is given blue for water. And then you have this entire India map extracted with pure water as blue, mix water as pink color, water pixel under cloud is black, mostly the hilly regions and then background is white. So, these are the water bodies based on the reflectance for different dates, so that is done.

But most importantly, you should know that it is multiple banks. So, it is like for example, green minus NIR by green plus NIR, so this is a fraction and then the fraction converts into an index. So, that index is used here for calculating the water bodies, that is all this document says, you will learn all this in the basics of remote sensing again.

(Refer Slide Time: 15:20)



So, here you could select a year. So, you could see that 2016 is the latest. So, why I am asking you to learn these from Bhuvan and other things is so that you could construct the latest data for your research. Here, they have already done it for time period and you know, that they have used ocean stat to which has near infrared and visible spectrum, so there are multiple data that we will come across in the next lectures, you can construct the same image that I am going to show for a much-much newer date here, it is only 2016 and only two months, if it is 2015, you have all the months. So, even 2016, only two months are available, let us say 2015 and then let us say we peak August.

(Refer Slide Time: 16:12)

The screenshot shows the Bhuvan web interface. At the top, there is a navigation bar with the Bhuvan logo and the text "Indian Geo-Platform of ISRO". Below this, there is a search bar and a "Select Year" dropdown menu set to "2015". A "Select Month" dropdown menu is set to "Aug". Below these menus is a table of data products for August 2015. The table has columns for "Period", "Metadata", "View Map", and "Download". The "Period" column lists dates from August 2004 to August 2015. The "Metadata" column contains "Metadata" links, and the "View Map" column contains "View" links. The "Download" column contains "Download" links. To the right of the table is a map of India showing water level products. The map is color-coded and includes a scale bar and a north arrow. The interface also includes a "FAQ Policy Disclaimer Feedback" link and a "National Remote Sensing Centre" logo.

Period	Metadata	View Map	Download
Aug02004-2015	Metadata	View	Download
Aug07004-2015	Metadata	View	Download
Aug0810-2015	Metadata	View	Download
Aug1103-2015	Metadata	View	Download
Aug1201-2015	Metadata	View	Download
Aug1518-2015	Metadata	View	Download
Aug1701-2015	Metadata	View	Download
Aug1801-2015	Metadata	View	Download

The screenshot shows the Bhuvan web interface. At the top, there is a navigation bar with the Bhuvan logo and the text "Indian Geo-Platform of ISRO". Below this, there is a search bar and a "Period" dropdown menu set to "Aug07to04-2015". Below this menu is a table of data products for August 2015. The table has columns for "Period", "Metadata", "View Map", and "Download". The "Period" column lists dates from August 2004 to August 2015. The "Metadata" column contains "Metadata" links, and the "View Map" column contains "View" links. The "Download" column contains "Download" links. To the right of the table is a map of India showing water level products. The map is color-coded and includes a scale bar and a north arrow. The interface also includes a "FAQ Policy Disclaimer Feedback" link and a "National Remote Sensing Centre" logo.

Period	Metadata	View Map	Download
Aug07to04-2015	Metadata	View	Download
Aug08to05-2015	Metadata	View	Download
Aug08to12-2015	Metadata	View	Download
Aug08to14-2015	Metadata	View	Download
Aug08to16-2015	Metadata	View	Download
Aug08to20-2015	Metadata	View	Download
Aug08to22-2015	Metadata	View	Download
Aug08to24-2015	Metadata	View	Download
Aug08to28-2015	Metadata	View	Download
Aug08to30-2015	Metadata	View	Download
Aug08to31-2015	Metadata	View	Download

Indian Geo-Platform of ISRO National Remote Sensing Centre

Open Data Archive Enter City or Lat,Long,coordinates or

FAQ Policy Disclaimer Feedback

1 Surface Water Product

Select Year: 2015 Select Month: Aug

Period	Metadata	View Map	Download
Aug202015-2015	Metadata	View	Download
Aug27to08-2015	Metadata	View	Download
Aug30to19-2015	Metadata	View	Download
Aug11to13-2015	Metadata	View	Download
Aug12to14-2015	Metadata	View	Download
Aug15to18-2015	Metadata	View	Download
Aug17to19-2015	Metadata	View	Download
Aug19to20-2015	Metadata	View	Download
Aug21to22-2015	Metadata	View	Download
Aug23to24-2015	Metadata	View	Download
Aug25to28-2015	Metadata	View	Download
Aug29to31-2015	Metadata	View	Download

NPTEL

Indian Geo-Platform of ISRO National Remote Sensing Centre

Open Data Archive Enter City or Lat,Long,coordinates or

FAQ Policy Disclaimer Feedback

1 Surface Water Product

Select Year: 2015 Select Month: Aug

Downscaled water level products version 1.0 derived from the data acquired by Ocean Data Monitor (ODM) sensor. The spectral albedo of water in the visible and NIR bands together with the normalized indices such as NDMI, NDMI (M. Frazier, 1996) are used for the calculation of water features from DSM imagery. Knowledge map in the form of LULC maps are further used to assist the classification of water features.

Period	Metadata	View Map	Download
Aug202015-2015	Metadata	View	Download
Aug27to08-2015	Metadata	View	Download
Aug30to19-2015	Metadata	View	Download
Aug11to13-2015	Metadata	View	Download
Aug12to14-2015	Metadata	View	Download
Aug15to18-2015	Metadata	View	Download
Aug17to19-2015	Metadata	View	Download
Aug19to20-2015	Metadata	View	Download
Aug21to22-2015	Metadata	View	Download
Aug23to24-2015	Metadata	View	Download
Aug25to28-2015	Metadata	View	Download
Aug29to31-2015	Metadata	View	Download

NPTEL

Indian Geo-Platform of ISRO National Remote Sensing Centre

Open Data Archive Enter City or Lat,Long,coordinates or

FAQ Policy Disclaimer Feedback

1 Surface Water Product

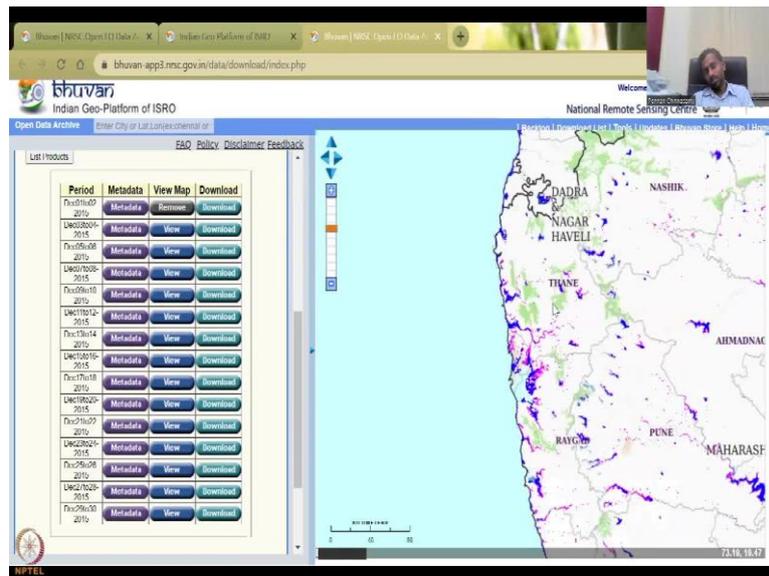
Select Year: 2015 Select Month: Dec

Period	Metadata	View Map	Download
Dec15to08-2015	Metadata	View	Download
Dec16to09-2015	Metadata	View	Download
Dec19to10-2015	Metadata	View	Download
Dec20to12-2015	Metadata	View	Download
Dec23to14-2015	Metadata	View	Download
Dec25to16-2015	Metadata	View	Download
Dec27to18-2015	Metadata	View	Download
Dec29to20-2015	Metadata	View	Download
Dec31to21-2015	Metadata	View	Download
Dec27to28-2015	Metadata	View	Download
Dec21to20-2015	Metadata	View	Download
Dec29to30-2015	Metadata	View	Download
Dec27to28-2015	Metadata	View	Download

Dec17to12,2015

- Pure Water
- Mixed Water
- Water Pixel under Cloud

NPTEL



So, every third day as I said, has been given in August. So, it was 3, 4, 7, 8, 9, 10, so there are some lags and delays. If I see click view, you can see the data now being map. So, the blue is again the water bodies, the pink is the mix color and black is no water and incomplete data or water pixel under cloud. So, basically, which is masked there are some but there. And we know that during August, we get some good floods in Maharashtra. So, you can see that it is so let us remove the layer and you will see an updated layer now, where we need to do a view again. So, you will see all these blue-blue colors coming up.

Let us select another month, we do know that in December month, it was really flooding in some areas. You see all the floods have come up excess water, so all the surface water getting big. These actually show that there has been a lot of inundation and water impure water because of mixing with soil, eroded soil and other resources. So, this is very-very important, you could download this data, I will show you how to log in.

(Refer Slide Time: 17:55)

The screenshot shows the Bhuvan login page. The browser address bar displays 'bhuvan_app3.nrc.gov.in/data/download/index.php4'. The page header includes the Bhuvan logo and 'National Remote Sensing Centre'. A 'Login' window is open, showing a 'Bhuvan-Single Sign On' form with fields for 'Username:' and 'Password:'. A note above the form states: 'Bhuvan is now using "Central Authentication Service(CAS)" to enable Single Sign-On(SSO), you can use the same log-in credential if you are already registered with Bhuvan. Registration is optional in Bhuvan. However, some features require registration. Registered users are having privilege to share the data, collaborate with other bhuvanties, Forum etc. If not registered, it only takes a few moments to register so it is recommended you do so.' To the right, a map of Maharashtra is visible with labels for JADRA, NASHIK, JAGAR, JAVELI, AHMADNAG, PUNE, and MAHARASH.

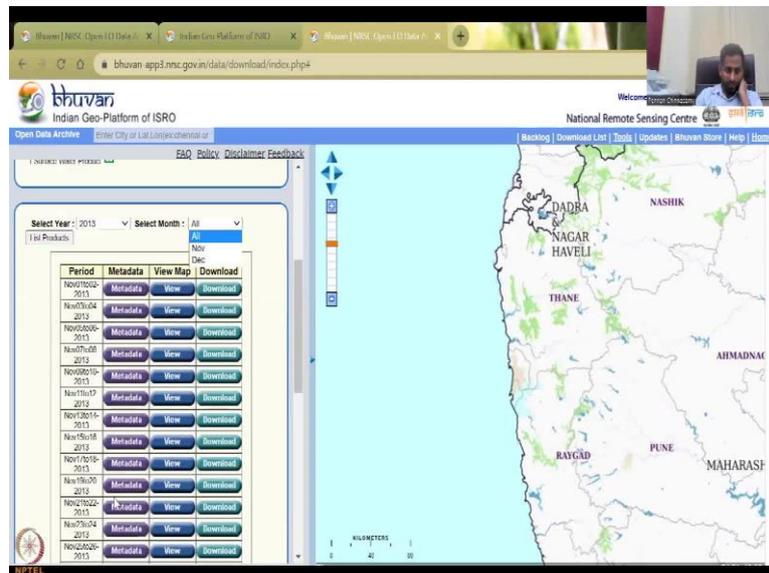
The screenshot shows the Bhuvan login page with the password field and CAPTCHA. The browser address bar displays 'bhuvan_app3.nrc.gov.in/data/download/index.php4'. The 'Login' window is open, showing the 'Password:' field and a CAPTCHA image with the text 'Gtjbykw'. Below the CAPTCHA is an 'Enter Captcha:' field and a green 'LOGIN' button. Links for 'Change Password?', 'Forgot Password?', 'New User?', and 'Didn't receive the account activation link?' are visible. The page footer indicates 'Powered by Apero CAS'. To the right, the same map of Maharashtra is visible.

The screenshot shows the Bhuvan 'Account and Profile Information' page. The browser address bar displays 'bhuvan_app3.nrc.gov.in/data/download/index.php4'. The page header includes the Bhuvan logo and 'National Remote Sensing Centre'. The 'Account and Profile Information' section is open, showing a 'Subscribe' dropdown set to 'Bhuvan Newsletters'. The 'Account' section includes fields for 'User Name', 'Email', 'Country' (set to 'India'), 'Telephone', and 'Organization' (with a dropdown menu showing 'Governmental', 'Academic/Research', 'Private Sector', 'NGO', and 'Others'). The 'Profile' section includes fields for 'First Name', 'Last Name', 'Gender', 'Password', and 'Purpose'. A 'Submit' button and a 'Click here to Login' link are at the bottom. To the right, the same map of Maharashtra is visible.

So, if you click login, it will ask for your username and password. I already have a username setup, but you can also do a new user or forgot password. What you should know is that these passwords are important and you can go through the new user setup. As I said, you will have to give the user name, your organisation, if your government, private sector or what organisation details, first name, last name, gender address, PIN code and what you are going to use it for purpose. You do want to subscribe for the letters, Yes or No. You will get an email link for your acceptance, so you can definitely go and see but username is there your email you could see and then.

So, let me type in my login so that we can quickly see if it is eligible to log in. So, sometimes you have to update your login. So, make sure that you have an updated email. If you forget your login, you can always get the password back by sending a request link. So, I am going to get the links that are needed for this password. And yes, in the next class, I will log in and come I do not want to share my credentials online. So, let me log in for the next class and then show you how to extract these data.

(Refer Slide Time: 19:58)



Browser | NISCC Open L13 Data | Indian Geo Platform of ISRO | bhuvan | NISCC Open L13 Data |

bhuvan-app3.nisc.gov.in/data/download/index.php#

Metadata

As per NISCC Data Dissemination Policy
 S. Use Constraints: Suijary Water Layer Calculation from OCM2 LAC data
 6. Purpose of creating data: First
 8. Edition: Completed
 9. Status: Completed

II. Contact Information

1. Contact Person: Group Director, G and SP
 2. Organization: National Remote Sensing Centre
 3. Mailing Address: Bangalore
 4. City/Locality: Hyderabad
 5. Country: India
 6. Contact telephone: 040-2338441/118
 7. Contact Fax: 040-23384340
 8. Contact Email: nscc@nrscc.gov.in

III. Geographic Location

1. Spherical Datum: GCS_WGS_1984

IV. Coverage

1. Upper left: X = 68 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 = 68 E, Y = 4 N

V. Citation

1. Data Prepared by: NISCC
 2. Original Source: Occasat-2 OCM L1C Georeferenced Data
 3. File Name: OCM2_wap_19oct20_Nov13_V01_01
 4. Resolution: 0.00327272 Deg
 5. File Format: GeoTiff

2013
 Nov0200-2013 Metadata View Download
 Nov0708-2013 Metadata View Download
 Nov0903-2013 Metadata View Download
 Dec010403-2013 Metadata View Download
 Dec030004-2013 Metadata View Download

National Remote Sensing Centre
 | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

Browser | NISCC Open L13 Data | Indian Geo Platform of ISRO | bhuvan | NISCC Open L13 Data |

bhuvan-app3.nisc.gov.in/data/download/index.php#

Metadata

1. Data Prepared by: NISCC
 2. Original Source: Occasat-2 OCM L1C Georeferenced Data
 3. File Name: OCM2_wap_19oct20_Nov13_V01_01
 4. Resolution: 0.00327272 Deg
 5. File Format: GeoTiff

VI. Metadata Stamp

1. Metadata Date Stamp: 16:07:14

VII. Dataset Topic Category

1. Data Identification topic category: [Other Resolved Data](#)

VIII. Language

1. Language ISO 639-2/639: English

IX. Abstract describing the data

1. Data Identification abstract: This Data is received from Occasat-2 OCM which operates in eight spectral bands in VNIR bands with 300 metre spatial resolution and swath of 1400 kms.

X. For Image Data

1. Name of the Satellite: Occasat-2
 2. Sensor: OCM
 3. Image Acquired From: Occasat-2
 4. Date of Pass: Nov19oct20 2013
 5. File Format: GeoTiff
 6. Spatial Resolution: 0.00327272
 7. Spatial Resolution Unit: Deg
 8. Number of Bands: 1

2013
 Nov0200-2013 Metadata View Download
 Nov0708-2013 Metadata View Download
 Nov0903-2013 Metadata View Download
 Dec010403-2013 Metadata View Download
 Dec030004-2013 Metadata View Download

National Remote Sensing Centre
 | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

Browser | NISCC Open L13 Data | Indian Geo Platform of ISRO | bhuvan | NISCC Open L13 Data |

bhuvan-app3.nisc.gov.in/data/download/index.php#

Metadata

1. Data Identification topic category: [Other Resolved Data](#)

VIII. Language

1. Language ISO 639-2/639: English

IX. Abstract describing the data

1. Data Identification abstract: This Data is received from Occasat-2 OCM which operates in eight spectral bands in VNIR bands with 300 metre spatial resolution and swath of 1400 kms.

X. For Image Data

1. Name of the Satellite: Occasat-2
 2. Sensor: OCM
 3. Image Acquired From: Occasat-2
 4. Date of Pass: Nov19oct20 2013
 5. File Format: GeoTiff
 6. Spatial Resolution: 0.00327272
 7. Spatial Resolution Unit: Deg
 8. Number of Bands: 1

XI. Pseudo Color Codes

DN Value	Description
1	No Water/Background
2	Mixed Water
3	Pure Water
4	Water pixel under cloud

2013
 Nov0200-2013 Metadata View Download
 Nov0708-2013 Metadata View Download
 Nov0903-2013 Metadata View Download
 Dec010403-2013 Metadata View Download
 Dec030004-2013 Metadata View Download

National Remote Sensing Centre
 | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

Browser | NSIC | Open ID Data | Indian Geo-Platform of ISRO | bhuvan | NSIC | Open ID Data | bhuvan-app3.nrc.gov.in/data/download/index.php#

bhuvan
Indian Geo-Platform of ISRO

Welcome | National Remote Sensing Centre | ISRO

Open Data Archive | Enter City or LAL/geochemical or | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

FAQ Policy Disclaimer Feedback

Period	Metadata	View Map	Download
Nov0100-2013	Metadata	View	Download
Nov0304-2013	Metadata	View	Download
Nov0606-2013	Metadata	View	Download
Nov0708-2013	Metadata	View	Download
Nov0809-2013	Metadata	View	Download
Nov1101-2013	Metadata	View	Download
Nov1301-2013	Metadata	View	Download
Nov1505-2013	Metadata	View	Download
Nov1705-2013	Metadata	View	Download
Nov1805-2013	Metadata	Remove	Download
Nov1905-2013	Metadata	View	Download
Nov2102-2013	Metadata	View	Download
Nov2304-2013	Metadata	View	Download
Nov2602-2013	Metadata	View	Download
Nov2703-2013	Metadata	View	Download
Nov2903-2013	Metadata	View	Download
Dec0103-2013	Metadata	View	Download
Dec0300-2013	Metadata	View	Download

Browser | NSIC | Open ID Data | Indian Geo-Platform of ISRO | bhuvan | NSIC | Open ID Data | bhuvan-app3.nrc.gov.in/data/download/index.php#

bhuvan
Indian Geo-Platform of ISRO

Welcome | National Remote Sensing Centre | ISRO

Open Data Archive | Enter City or LAL/geochemical or | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

FAQ Policy Disclaimer Feedback

Period	Metadata	View Map	Download
Nov0100-2013	Metadata	View	Download
Nov0304-2013	Metadata	View	Download
Nov0606-2013	Metadata	View	Download
Nov0708-2013	Metadata	View	Download
Nov0809-2013	Metadata	View	Download
Nov1101-2013	Metadata	View	Download
Nov1301-2013	Metadata	View	Download
Nov1505-2013	Metadata	View	Download
Nov1705-2013	Metadata	View	Download
Nov1805-2013	Metadata	Remove	Download
Nov1905-2013	Metadata	View	Download
Nov2102-2013	Metadata	View	Download
Nov2304-2013	Metadata	View	Download
Nov2602-2013	Metadata	View	Download
Nov2703-2013	Metadata	View	Download
Nov2903-2013	Metadata	View	Download
Dec0103-2013	Metadata	View	Download
Dec0300-2013	Metadata	View	Download

Browser | NSIC | Open ID Data | Indian Geo-Platform of ISRO | bhuvan | NSIC | Open ID Data | bhuvan-app3.nrc.gov.in/data/download/index.php#

bhuvan
Indian Geo-Platform of ISRO

Welcome | National Remote Sensing Centre | ISRO

Open Data Archive | Enter City or LAL/geochemical or | Backlog | Download List | Tools | Updates | Bhuvan Store | Help | Home

FAQ Policy Disclaimer Feedback

Period	Metadata	View Map	Download
Nov0100-2013	Metadata	View	Download
Nov0304-2013	Metadata	View	Download
Nov0606-2013	Metadata	View	Download
Nov0708-2013	Metadata	View	Download
Nov0809-2013	Metadata	View	Download
Nov1101-2013	Metadata	View	Download
Nov1301-2013	Metadata	View	Download
Nov1505-2013	Metadata	View	Download
Nov1705-2013	Metadata	View	Download
Nov1805-2013	Metadata	Remove	Download
Nov1905-2013	Metadata	View	Download
Nov2102-2013	Metadata	View	Download
Nov2304-2013	Metadata	View	Download
Nov2602-2013	Metadata	View	Download
Nov2703-2013	Metadata	View	Download
Nov2903-2013	Metadata	View	Download
Dec0103-2013	Metadata	View	Download
Dec0300-2013	Metadata	View	Download

So, this is how you would log in and collect data for your exercise. And again, you can refresh it to another year, let us say 2013, all months this products, then all the months will come that the data is available. Only November, December is available, that is fine. And then we can do the view, you could have the sea and nation, the water bodies coming up, and then you could do the download button, you need to log in as I said, it will ask you for the login, but more importantly, you could look at the metadata.

So, where was this data collected, when was it collected, and then where was it sample, what was the number of addition? If you have any questions, you could send an email or call them and then the coverage area coverage, those kinds of things. So, any rectification done, what rectification was done? And then it says 8 spectral bands be NIR band which is 360 meter resolution and sort of 1420 kilometers. Number of bands is only one use for this study. And what are the values is 0, 100, 200, 250. 0 is the background which is white color, whereas mix water is pink, pure water is blue, and water pixel under cloud is kept as black. You do not see that here, but you could see definitely, let us say near the Powai region and stuff.

So, what you see here is pink color on the sides. I hope you could see that in this water bodies, which is blue. And then let me remove it just for the sake of it, you can see this is a water body in a normal map. So, the base map is a Bing map or a Google map which is just a normal map which is colored taking on the land use land cover for a particular year, but what has happened is when you add the satellite data which predicts the water boundary, so sometimes there is overlap and goes beyond.

So, this is where you can calculate the area of the water body when you download, there is an exercise that we will do to show you how to estimate this water body area and then take the value out. And then you have the pink color, the pink color resembles the mixed water so which means it is not blue exactly in color, but it could be muddy, sandy or brown water it is because of water mixing and an runoff that comes on the streets. So, you could see that on the boundaries it is always impure but in the centre of the lake it is still okay.

This is the same anomaly for your water bodies also in terms of the rivers. Sometimes this is also considered blue because the boundary is kept like this, boundary is kept like this so you will see some blue color there and Bangladesh is also monitored. So, we have come across a layer where readily you could take the data, I would request you to look at what is NDVI and in NDWI, and then you will understand how these maps are made for data. So, moving on, we will go to the next product.

(Refer Slide Time: 23:48)

Intro to RS open source data sources water

3

Bhuvan Open data Archive

- Theme/Products
 - Land and Terrain – OCM Surface Water Layer Products 2D
- Program/Projects
 - Terrestrial Sciences – Hydrological Products

Source: ISRO/NRSC

bhuvan

Indian Geo-Platform of ISRO

National Remote Sensing Centre

Open Data Archive

FAQ Policy Disclaimer Feedback

Select Category: Satellite/Sensor Theme/Products

Program/Projects

Select Project:

- Select under Program/Projects
- Select under Program/Projects
- CarboDEM-1 are Sea
- Hydrological System for Climate and Environment Studies (H2CSE)

Map showing India and surrounding countries: Uzbekistan, Turkmenistan, Kyrgyzstan, China, Afghanistan, Pakistan, Nepal, Iran, United Arab Emirates, Oman, Myanmar, Laos, Thailand, Viet Nam, Cambodia, Sri Lanka, Maldives, Brunei, Singapore.

bhuvan
Indian Geo-Platform of ISRO

National Remote Sensing Centre

Open Data Archive

FAQ Policy Disclaimer Feedback

NRSC/ISRO Open data and product archive facilitates the user to select, browse and download data from this portal

Select Category: Satellite/Sensor Theme/Products

Select Project: National Information System for Climate

Select Group:

NPTEL

bhuvan
Indian Geo-Platform of ISRO

National Remote Sensing Centre

Open Data Archive

Select Products:
 Annual Cropland Data set
 AWFS: Snow Albedo
 AWFS: Water Bodies Fraction
 Forest Fire Regime
 Forest Fraction Cover
 Forest Type 5km grid
 Hydrological Products
 Indian Soil Datasets
 Land Degradation
 Mesoscale compatible inputs for: MMS
 Mesoscale compatible inputs for: WRF
 Net Ecosystem Productivity - GIMMS
 Net Ecosystem Productivity - MODIS
 Net Primary Productivity - GIMMS
 Net Primary Productivity - MODIS
 OCM2: Albedo
 OCM2: Filter Normalized Difference Vegetation Index
 OCM2: Normalized Difference Vegetation Index - Global Coverage
 OCM2: Normalized Difference Vegetation Index - Local Coverage

Select Category: Satellite/Sensor Theme/Products

Select Project: National Information System for Climate

Select Group:

Select Product:

NPTEL

bhuvan
Indian Geo-Platform of ISRO

National Remote Sensing Centre

Open Data Archive

Select Products:
 Annual Cropland Data set
 AWFS: Snow Albedo
 AWFS: Water Bodies Fraction
 Forest Fire Regime
 Forest Fraction Cover
 Forest Type 5km grid
 Hydrological Products
 Indian Soil Datasets
 Land Degradation
 Mesoscale compatible inputs for: MMS
 Mesoscale compatible inputs for: WRF
 Net Ecosystem Productivity - GIMMS
 Net Ecosystem Productivity - MODIS
 Net Primary Productivity - GIMMS
 Net Primary Productivity - MODIS
 OCM2: Albedo
 OCM2: Filter Normalized Difference Vegetation Index
 OCM2: Normalized Difference Vegetation Index - Global Coverage
 OCM2: Normalized Difference Vegetation Index - Local Coverage

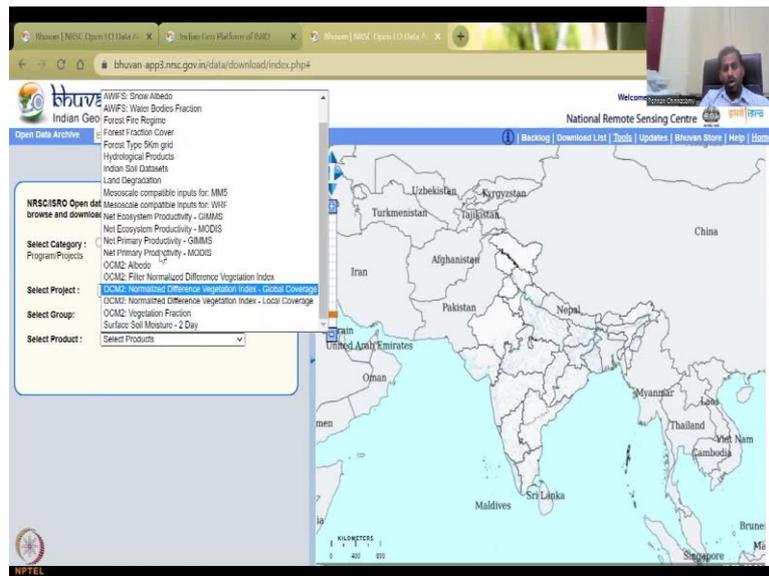
Select Category: Satellite/Sensor Theme/Products

Select Project: National Information System for Climate

Select Group:

Select Product:

NPTEL



So, we have looked at the applications we have had Open Data Archive, Theme products, land and terrain product has been looked at, now we will go to program projects terrestrial, science, and hydrological products here we will have many-many different products. So, we will have to go back to program and project so resets itself and in the program and products National Information System for climate and environmental studies NICES and under that there is a hydrological terrestrial sciences, so terrestrial is land, atmospheric above the land in situ data is the observation data, Cryospheric is the cold regions, whereas Ocean Sciences is there in the ocean. So, Cryosphere is mostly on the Himalayan regions, let us say terrestrial.

And then here you will see a lot of products, select a product, select a project, select the group in the group base as a terrestrial and in the terrestrial what do you want to see. So, there is a lot of land products and water products. So, for example, you have cropland data, snow albedo, water bodies fraction, forest fire, forest fires are more land. There is a hydrological products that is what we want to see. And then in Indian soil database, land degradation, soil surface soil moisture, the soil keep for the next class, but we will look at the hydrological products.

(Refer Slide Time: 25:13)

NICES Hydrological Science
Near Real Time Hydrological Modelling - Products & Services
National Remote Sensing Centre

Experimental Hydrological Fluxes using Land Surface Model

Description of terrestrial hydrological flux components in terms of their geographical distribution and chronological variation is useful for water resources management, drought/flood assessment and climate related research. Earth Observation (EO) data from multitude platforms are providing wide ranging datasets that are useful for creation of spatially distributed parameters appropriate for hydrological budgeting and modeling.

Macro-scale, process based hydrological (Variable Infiltration Capacity - VIC) model has been adopted for modelling water balance components at uniform grid level. VIC, a semi-distributed & physically based hydrological model, solves both the water balance and the energy balance (Liang X., 1994). Model computes evapotranspiration, surface runoff, soil moisture, base flow and energy fluxes at the predefined grid resolution (few km to hundred km).

Grid Details and Features

9min (~16.5km) Grid level modelling frame work (water balance mode) has been setup for the entire county using Geo-spatial data sets and historic meteorological data. Current season daily meteorological data are used to compute daily hydrological fluxes at 9min grid level. The orderly description of hydrological fluxes are useful for quantifying spatial and temporal variation in basin/sub-basin scale water resources, periodical water budgeting and form vital inputs for studies on topics ranging from water resources management to land-atmosphere interactions including climate change.

[Technical Document](#)

**HYDROLOGICAL FLUXES AT 0.15°
SPATIAL RESOLUTION**

**HYDROLOGICAL FLUXES AT 0.05°
SPATIAL RESOLUTION**

Daily Products

All Products can be visualized based on the date selected.

Select Date : [11-Jan-2022] Select product : [Surface Runoff] Download

Surface Runoff 11 Jan 2022

Surface Soil Moisture 11 Jan 2022

Evapotranspiration 11 Jan 2022

Hydrological Science

Near Real Time Hydrological Modelling - Products & Services

Experimental Hydrological Fluxes using Land Surface Model

Description of terrestrial hydrological flux components in terms of their geographical distribution and chronological variation is useful for water resources management, assessment and climatic related research. Earth Observation (EO) data from multiple platforms are providing wide ranging datasets that are useful for creation of distributed parameters appropriate for hydrological budgeting and modeling.

Macro-scale, process based hydrological (Variable Infiltration Capacity - VIC) model has been adopted for modeling water balance components at uniform grid level. VIC, a semi-distributed & physically based hydrological model, solves both the water balance and the energy balance (Liang X., 1994). Model computes evapotranspiration, surface runoff, soil moisture, base flow and energy fluxes at the predefined grid resolution (few km to hundred km).

Grid Details and Features

6min (~18.5km) Grid level modelling frame work (water balance mode) has been setup for the entire country using Geo-spatial data sets and historic meteorological data. Current season daily meteorological data are used to compute daily hydrological fluxes at 6min grid level. The orderly description of hydrological fluxes are useful for quantifying spatial and temporal variation in basin/sub-basin scale water resources, periodical water budgeting and form vital inputs for studies on topics ranging from water resources management to land-atmosphere interactions including climate change.

Technical Document

Daily Products

All Products can be visualized based on the Date selected

Select Date : [11-Jan-2022] Select product : Surface Runoff Download

Surface Runoff
Surface Soil Moisture
Evapotranspiration

Hydrological Science

Near Real Time Hydrological Modelling - Products & Services

Experimental Hydrological Fluxes using Land Surface Model

Description of terrestrial hydrological flux components in terms of their geographical distribution and chronological variation is useful for water resources management, assessment and climatic related research. Earth Observation (EO) data from multiple platforms are providing wide ranging datasets that are useful for creation of distributed parameters appropriate for hydrological budgeting and modeling.

Macro-scale, process based hydrological (Variable Infiltration Capacity - VIC) model has been adopted for modeling water balance components at uniform grid level. VIC, a semi-distributed & physically based hydrological model, solves both the water balance and the energy balance (Liang X., 1994). Model computes evapotranspiration, surface runoff, soil moisture, base flow and energy fluxes at the predefined grid resolution (few km to hundred km).

Grid Details and Features

6min (~18.5km) Grid level modelling frame work (water balance mode) has been setup for the entire country using Geo-spatial data sets and historic meteorological data. Current season daily meteorological data are used to compute daily hydrological fluxes at 6min grid level. The orderly description of hydrological fluxes are useful for quantifying spatial and temporal variation in basin/sub-basin scale water resources, periodical water budgeting and form vital inputs for studies on topics ranging from water resources management to land-atmosphere interactions including climate change.

Technical Document

Daily Products

All Products can be visualized based on the Date selected

Select Date : [11-Jan-2022] Select product : Surface Runoff Download

Hydrological Science

Near Real Time Hydrological Modelling - Products & Services

Experimental Hydrological Fluxes using Land Surface Model

Description of terrestrial hydrological flux components in terms of their geographical distribution and chronological variation is useful for water resources management, assessment and climatic related research. Earth Observation (EO) data from multiple platforms are providing wide ranging datasets that are useful for creation of distributed parameters appropriate for hydrological budgeting and modeling.

Macro-scale, process based hydrological (Variable Infiltration Capacity - VIC) model has been adopted for modeling water balance components at uniform grid level. VIC, a semi-distributed & physically based hydrological model, solves both the water balance and the energy balance (Liang X., 1994). Model computes evapotranspiration, surface runoff, soil moisture, base flow and energy fluxes at the predefined grid resolution (few km to hundred km).

Grid Details and Features

6min (~18.5km) Grid level modelling frame work (water balance mode) has been setup for the entire country using Geo-spatial data sets and historic meteorological data. Current season daily meteorological data are used to compute daily hydrological fluxes at 6min grid level. The orderly description of hydrological fluxes are useful for quantifying spatial and temporal variation in basin/sub-basin scale water resources, periodical water budgeting and form vital inputs for studies on topics ranging from water resources management to land-atmosphere interactions including climate change.

Technical Document

Daily Products

All Products can be visualized based on the Date selected

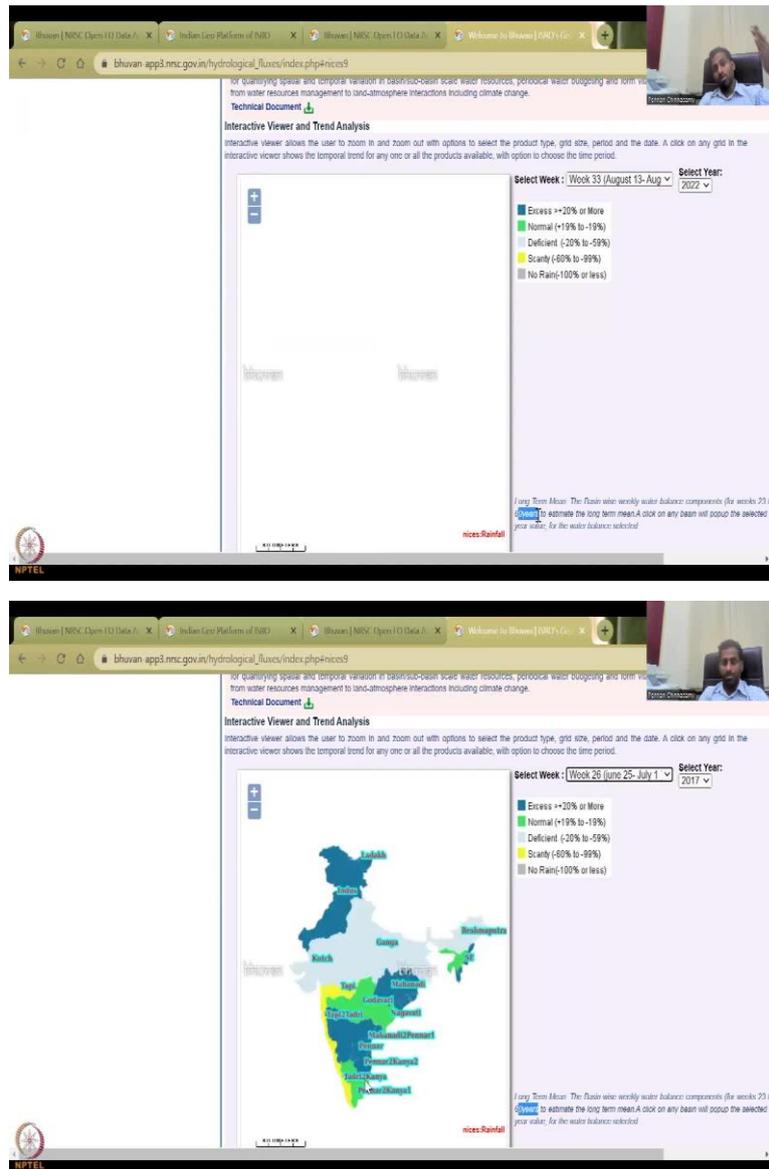
Select Date : [11-Jan-2022] Select product : Surface Runoff Download



If you click hydrological products, you will be opening up a new website. So, it goes here with some technical documentation which gives you what is the pixel level and you could see it as 16.5 kilometers, it is pretty big, but it is good for some applications. Let us look at a hydrological fluxes spatial resolution 0.15. So, you could see here on eleventh January, what are the different hydrological parameters that has been measured. So, if you remember in the lecture 2, we looked at the water balance for a rural village, which includes the precipitation, surface runoff, storage, and then evapotranspiration, which is the water taken out of the system due to plant and evaporation, and all the other things.

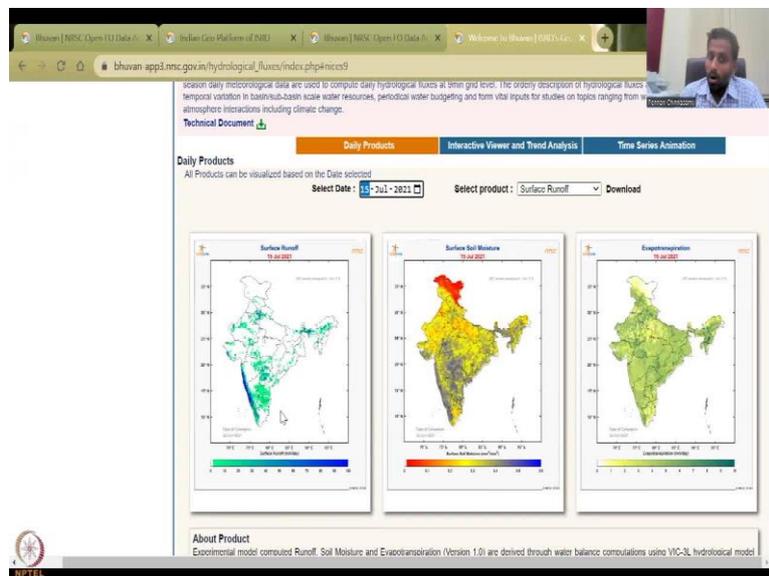
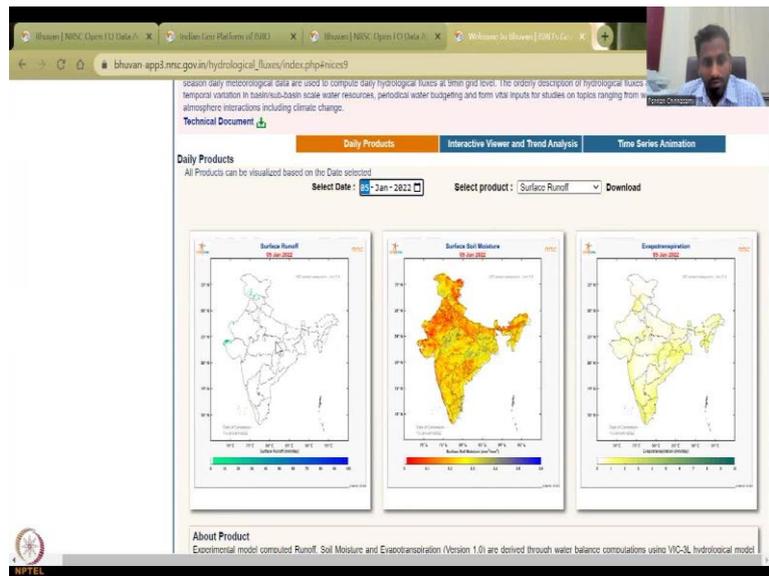
So, what has happened is for a particular date, you can look at the data products. So, here you do not have data for 2023, Jan, the latest you have is eleventh and then you have three products you can take. Surface runoff, evapotranspiration, and surface soil moisture, there is no rainfall, so rainfall you have to estimate separately this is only the products that are taken. On the left hand side, we can also look at forecasts surface runoff, cumulative surface runoff, climate indices is precipitation index, centralized runoff index and then fluxes.

(Refer Slide Time: 26:46)



So, rainfall you can get it from here for a particular date. So, you can see a particular date for a particular year you can take, so let us say 2022, you can take for week 33 I have selected, does take some time and it tells you if there is access to them. So, basically from an average it has a 20-30 year average, and above average or below average is the 60 years they have taken.

So, 60 years average and above or below the water level is it there or not this is what are the product this purchase, there are some other products which looks at only 20 to 30 years, but this product looks at 60 years and for some reason it does not pick up. So, let us do a different, now when it comes up.



Then we will take the spatial resolution, let us take 0.05 degree which is much-much smaller, does not load because of internet speed. Let us do again hydrological products and then we will do 0.15, it readily opens, sometimes there is a lag on the so I am showing it live for the class so that is why we cannot record it, so I am just doing it while I am conducting the lecture, there is sometimes it does not work. So, just be patient with the Bhuvan website, you have this products.

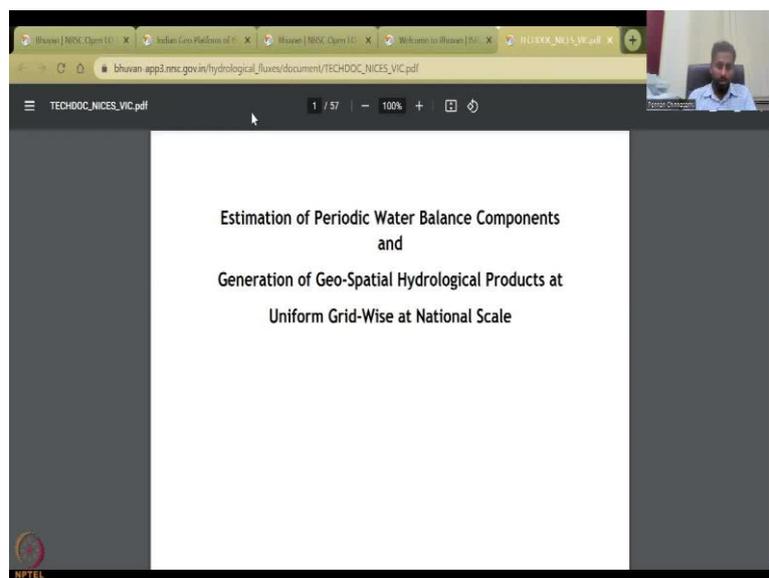
So, you can select a different date let us select first of Jan or fifth of Jan. And then you could see that the surface runoff millimeters per day is there, soil moisture available and then where is the evapotranspiration happening. So, there is less runoff here and almost no runoff in the other areas in that day. So, in that day there has been only when there is a rain is there is runoff, do not think that all rivers flowing, why is there enough not accounted for, that is discharge, but there is rainfall and rainfall pushes the water.

So, when is the big monsoon season at least in Maharashtra it is in the June. So, let us take June, July, kind of mid July and you can see here now all the areas green in most part and Western ghats where the monsoon is picking up that is in blue color, there is more surface runoff, because there is rainfall and water brings out the discharge.

And then you have because there is water there is positive soil moisture and if you see the soil moisture also increasing in most parts blue color, this is like light blue, this color is not black, it is blue, which means that it is above an increasing and then evapotranspiration. This is driven by the plants, crops and then trees, so you can see that most of these Western Ghats and other regions is very-very high, which means there is a lot of water that is taken up by the plants and transpired.

So, you could also download these products as I said, it is not at real time or near real time scenarios. However, you can learn on how to use this data and then use to do the data, like use the tools that we are going to teach this class to do the data.

(Refer Slide Time: 31:03)



TECHDOC_NICES_VIC.pdf 16 / 57 100%

Estimation of Periodic Water Balance Components and Generation of Geo-Spatial Hydrological Products at Uniform Grid-Wise at National Scale

The area under each soil textural class is converted into corresponding soil property and grid-wise representative value for each soil property is estimated through area weighted average.

The hydraulic properties of different soil texture classes used in preparation of soil parameter are given in the Table 3 and sample extract presented in Figure 7.

Table 3: Hydraulic properties of the various soil types used in the study

Property	Soil Texture											
	clay heavy	silty clay	clay light	silty-clay-loam	silt loam	sandy clay	loam	sandy clay-loam	sandy loam	loamy sand	sand	
A sat bulk density	0.11	0.37	0.11	0.57	2.20	1.61	0.14	1.55	1.13	5.03	9.47	10.81
bubbling field capacity	1.42	1.37	1.42	1.40	1.29	1.45	1.58	1.53	1.64	1.61	1.56	1.53
wilting point	37.30	34.19	37.30	32.56	37.30	20.76	29.17	11.15	28.08	14.66	8.69	7.26
quartz content	0.88	0.79	0.88	0.75	0.63	0.65	0.82	0.61	0.63	0.40	0.26	0.22
Slope of retention curve 10	0.60	0.519	0.60	0.431	0.125	0.229	0.568	0.304	0.395	0.178	0.109	0.109
Max. Soil Moisture (%)	0.25	0.08	0.25	0.09	0.05	0.19	0.50	0.41	0.61	0.69	0.85	0.95
Max. Soil Moisture (lv)	12.28	9.76	12.28	7.48	3.05	3.79	1.19	5.30	8.66	4.84	3.99	4.10
Max. Soil Moisture (lv)	0.50	0.52	0.50	0.51	0.48	0.48	0.44	0.46	0.43	0.45	0.46	0.46

TECHDOC_NICES_VIC.pdf 12 / 57 100%

Hydrological Modeling Using VIC Model

Figure 3: Methodological framework of VIC Hydrological modelling

Conclude

4

- Indian RS data exist.
- More info on the dataset and tutorials from ISRO are available at:
 - BHUVAN: <https://youtu.be/GjaueiRIEU4>
 - VEDAS: <https://youtu.be/Qy1hU8FNQ8>
 - MOSDAC: <https://youtu.be/q33C4PriTLo>

And here is the water balance components and how they have created so I just clicked on a technical document and you can read it. So, as an exercise, when you can discuss these in your classwork, in your research work, I recommend you to go through this these kinds of materials, because it gives you a good reading document. And here they are given how they calibrate the model. So, the model we are using is VIC variable infiltration capacity model.

So, I think this is good for introducing the remote sensing data for water from Bhuvan resources. That is, it for the Bhuvan data products. With this, I conclude today's lecture. Again, I am putting the video tutorials for these products, feel free to go and look at these products for your research. Thank you.