Remote Sensing and GIS for Rural Development
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Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology Bombay
Week 11
Lecture no. 01
Remote Sensing based indicators database

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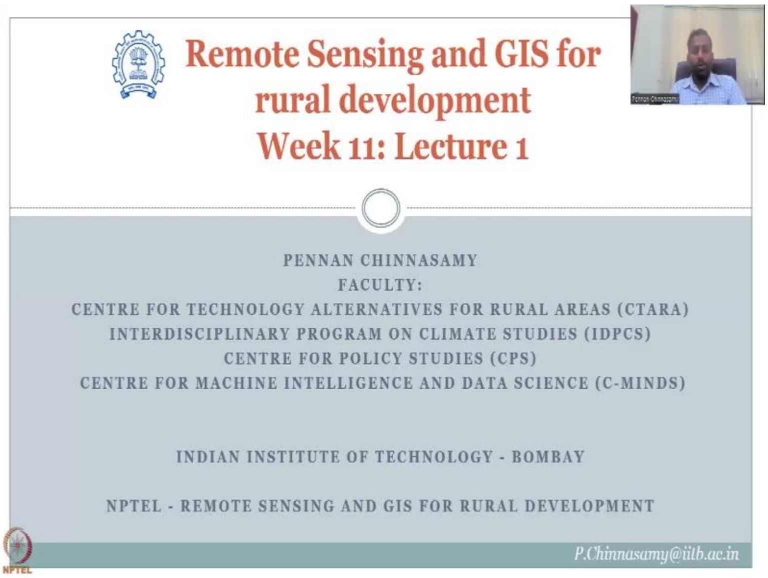

Hello everyone, welcome to the NPTEL course on remote sensing and GIS for rural development, this is week 11, lecture 1. While concluding week 10 we looked at a lot of indicators that can be used for crop statistics of the indicators, we look in depth on NDVI, the Normalized Difference Vegetation Index. And we looked at multiple platforms that can be used to share NDVI data as raw data. For example, Bhuvan, NASA's data, you could download it and do calculations.

However, we also showcased some platforms where the analysis has already been done and provided as an output. This is important, because we do get to see the analysed data quickly and look into the search aspects. So, now slowly, what is happening is we are getting high speed computing facilities, internet and memory capacities as clouds, so these data can readily be downloaded, applied, calculated for indicators. So, what is missing? What is missing is how do you apply these data? So, now, initially, we had data issues, but finding applications has become more-more difficult.

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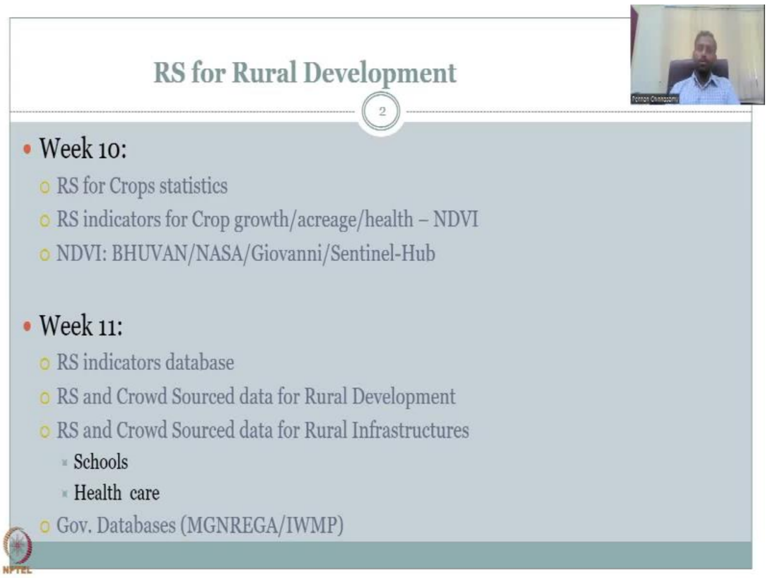

So, we are looking at remote sensing for Rural Development, datasets specifically. And as I said the week 10 we started with an analysis of remote sensing need for crop statistics, because there are a lot of issues in crop statistics in the current system, lot of latency, latency is delay and transparency. Transparency means is it unbiased, is it less prone to human and instrumentation errors, etc. So, there was less transparency in this aspect, because we do not know when the statistics was taken readily I am saying for a public or Research Institute.

Whereas, if you use remote sensing based data along with the observation data, there is more transparency, you know exactly when the image is taken, you have a to the minute when it was taken and download it. And you also have the proven record of the use of the data through scientific literature and lot of people have vouched for particular software's driven these remote sensing data.

So, now, we will look into further analysis of these indicators. So in week 10, we looked at crop indicators of a crop type and crop yield mapping and how they are very-very important for multiple stakeholders. So I am using the summary kind of summary between week 10 and week 11, because due to time availability, we have been focusing on each week separately and there is a continued link between each week which we will discuss in week 12 which is the last week.

So, in week 10 we looked at the need for remote sensing data for crop statistics, because there is delay there is data issues and data gaps along with bias and transparency. Then we looked at remote sensing indicators for crop growth and health acreage and NDVI was found through literature review as top crop indicator on vegetation indicator. If we remember that when we looked into each of these government portals, the Indian ones, the United States, the European Union's. The Indian through Bhuvan, the United States through NASA and Giovanni Earth Explorer and also the European Union's Sentinel hub.

We noticed that only 2 indicators came up as dominant and of that NDVI is the dominant across these platforms and our research papers and that is why we spend more time on explaining the theory of NDVI and what data is needed, how do you calculate it? When we step into how do you calculate NDVI we showed the equation of NIR minus red by NIR plus red, and then we said the range is minus 1 to plus 1, giving classes for the range as minus 1 is water, barren to plus 1 is the peak healthy vegetation.

However, even though this can be done geo gi software, we discussed the possibility of using platforms and the platforms were given as Bhuvan, NASA, Giovanni, Sentinel hub. So in week 11, what we will do is we will build upon these exercise and then showcase that the NDVI has been improved and we will stop with NDVI in lecture 10 itself, because there are multiple other indicators that we should be looking at. We will have a hands on quick indicator for water and also look at some other very-very important aspects.

So the more sensing indicators database, we will go through today in week 11 first lecture, followed by remote sensing tools, which are aided with crowdsourcing tools, I will revisit the synergized mapping schematic and show that how satellite data, government observation data and crowd sourced data can be pulled together in a complete platform and used for rural development.

So we will be using QGIS extensively in week 11 and showcasing how these data can be used, plotted, etc. We will go back and forth between Google Earth Pro, I have shown you how to install it, how to run it, so hopefully you could have Google Earth Pro installed and QGIS installed. Very-very important to install QGIS and keep it ready for this week's exercise. And then we have, as I said, the rural infrastructures we will dig into this is not just a rural remote sensing and GIS course for water management and crop management, but also health care, schools, roads are important.

The only issue here is most of the population is dependent on agriculture and for them, that is the livelihood that is where they want to see themselves for the full life, they do not want to come out into urban systems where education demands it the basic education is done. So as I would say normally in villages, you will see girl child stopping at 10, and boys also stopping at 9 and 10, 11, 12, maybe because he entered into farming, so only some have the opportunity to go out and study. So the schools are placed in the villages, but the higher education is outside the villages you will have to travel and come back.

So depending on a lot of social and economic limitations and challenges, you are allowed to go for education. So my father, as I said, came from a village studied a PhD in the US through these systems village school until tenth and then PUC in Trichy, the main town and then college in Chennai, and then PhD. in the US, whereas my mother did not have that option, she was stopped at tenth standard. So here is where a live example of rural limitations are there, slowly this is changing, which is good, only when it changes everyone has access to quality education.

So we will go through Week 11 specifically mentioning these schools healthcare systems and how they have to be updated by the government using the data from remote sensing and processing sources. Then we will also look into some government databases like MGNREGA and IWMP and showcase how these could be evaluated further used further for bridging the gap between the available data, then there is a data gap of errors and latency, the most important error in the gap or data gap is a data issue I will say is latency.

How can you prepare for the next 10 years if you have data only from the past 20 years data, let us say if I need to plan from 2023 to 2050 or 2023 to 2033, I do need data from 2011 to 22, however, it stops at 2011. For example, the census data we have is 2011. The next census data should come out soon, but due to COVID it was kind of stopped.

So, please think on these terms that for rural development to happen in a very sustainable way, we need to have current data and sometimes the data is limited due to challenges faced by the government, it is very-very expensive to send capacity to collect data in the villages, rural areas, cities are more easier because people commute within the city they get the data. But villages are very, very difficult in some areas where tribals are there it is very inaccessible also, the forest and livelihood options they have. So, that data is very difficult to get and for those reasons we can use remote sensing data.

So, that is what we will be using in this course of lecture, we will go through a particular beautiful software, community initiated, volunteer initiative, open source, that mixes remote sensing data and open source data and those who are taking this course I hope you can also contribute to the community by using the data, contributing data, and also checking if the data is correct or not.

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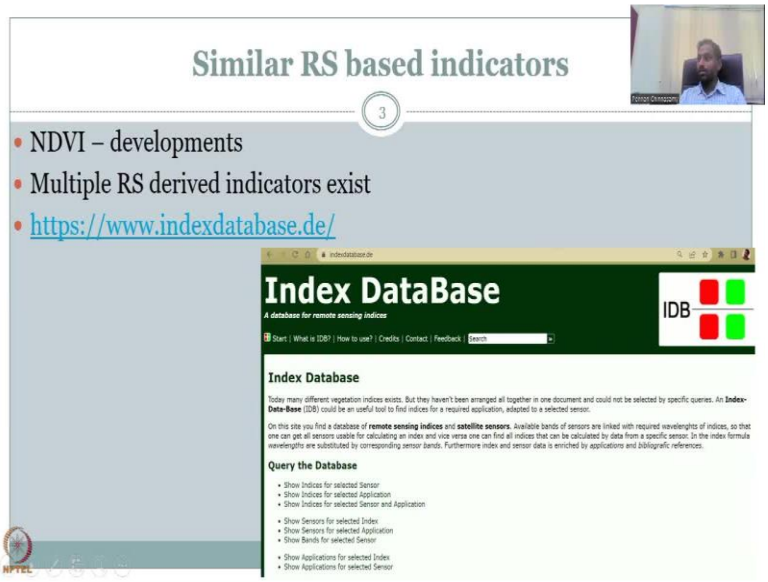

So, this we will start this week's lecture. And what we have noticed that NDVI has been used widely, but also there has been updations of NDVI or developments of NDVI. And that is multiple reasons, one is for a site specific regions and site specific conditions, maybe the NDVI did not work well. So they used an enhanced NDVI, E-NDVI is there. And some researchers would put their names in front saying, let us say Pennan NDVI, P-NDVI. So, these kind of NDVI's are also there in literature, the base is the same, the ideology is the same like which means that basic ideology is that a healthy plant will reflect more green and infrared, whereas a non-healthy plant will absorb the green color.

So you see a different set of colors, reflectance, and that is the basic principle that is being used. But E-NDVI would use hyper-spectral, multispectral images, rather than maybe red, they will use a different color, and then the principle is the same, so they will use it or it will be also crop specific. So for example, your green plants will always stay green, but then when it grows and starts to yield, it turns to brown like paddy and rice, I say. Normally, people remember wheat as brown, but when you go to the field, when it is growing, it is always green and then when it is mature it becomes brown or golden brown color, husk is the wheat paddy husk is also brown in color.

So these colors are reflected in a different way. So just because green is not there does not mean that the plant is healthy, it has matured, and then it is ready for harvest. So these are captured as different indicators, we will see some of them now, there are multiple-multiple remote sensing derived indicators, first is the same reason that costly to measure on the ground, observation data is limited, there is a big latency, latency as in gap between the data collected and the data distributed or published.

So for example, an observation data, the government will take the data, then bring it back, it takes a couple of weeks to travel from the rural to the cities where offices are there, then they start working on the data, cleaning the data, etc. etc. takes time, so that is why you see a latency of almost a year. So a year or six months between observation to putting it on the web page, whereas the remote sensing data is there, all you need is a model which has NDVI as a model already existing, you just apply the model to the observation data, and then see how the results come up.

On this note, I would like to say that just not NDVI there are multiple-multiple indicators a lot of people have done research and this website I have found is really-really impressive. It gives you almost all the indicators that you would like to access and the curators of this website have done really well. It is a database from Germany, a database for remote sensing indices, as it says on this part of the webpage. I will be happy to explain this in this current lecture in over the next 20 minutes.

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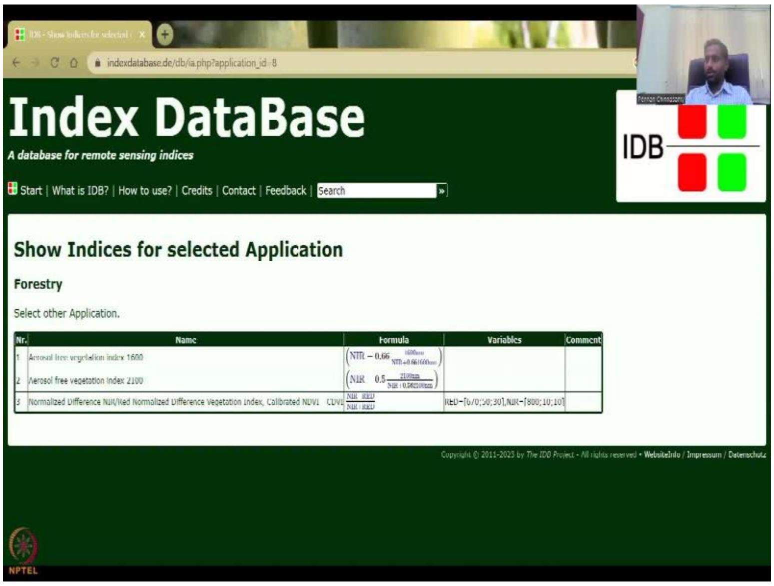

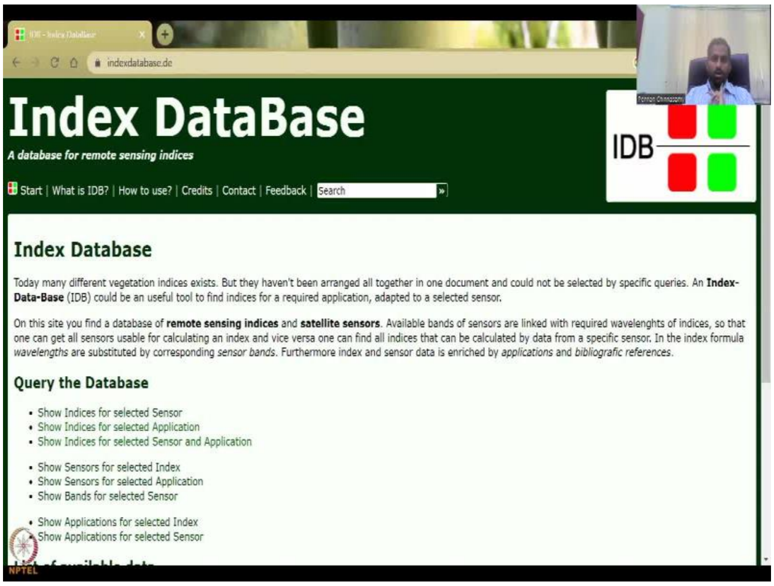
indexdatabase.de
Index DataBase
A database for remote sensing indices
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Index Database
Today many different vegetation indices exists. But they haven't been arranged all together in one document and could not be selected by specific queries. An Index-Data-Base (IDB) could be an useful tool to find indices for a required application, adapted to a selected sensor.
On this site you find a database of remote sensing indices and satellite sensors. Available bands of sensors are linked with required wavelenghts of indices, so that one can get all sensors usable for calculating an index and vice versa one can find all indices that can be calculated by data from a specific sensor. In the index formula wavelengths are substituted by corresponding sensor bands. Furthermore index and sensor data is enriched by applications and bibliografic references.
Query the Database
Show Indices for selected Sensor
Show Indices for selected Application
Show Indices for selected Sensor and Application
Show Sensors for selected Index
Show Sensors for selected Application
Show Bands for selected Sensor
Show Applications for selected Index
Show Applications for selected Sensor
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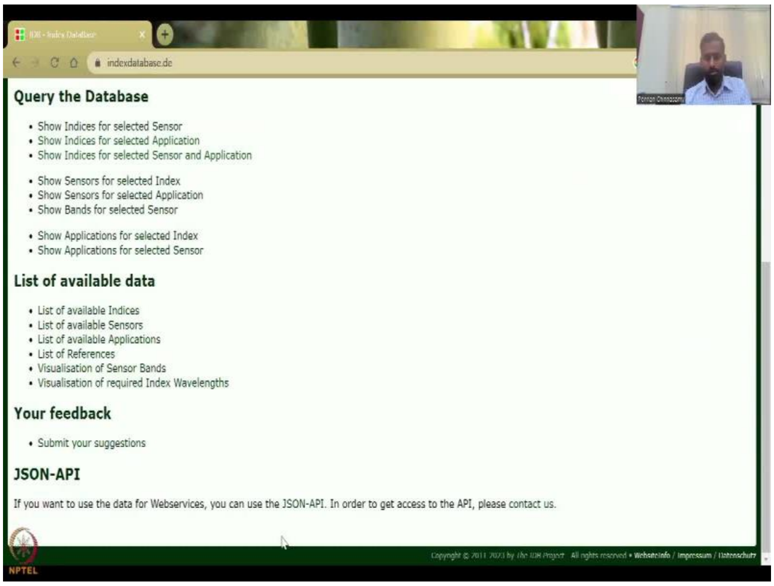
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Query the Database
Show Indices for selected Sensor
Show Indices for selected Application
Show Indices for selected Sensor and Application
Show Sensors for selected Index
Show Sensors for selected Application
Show Bands for selected Sensor
Show Applications for selected Index
Show Applications for selected Sensor
List of available data
List of available Indices
List of available Sensors
List of available Applications
List of References
Visualisation of Sensor Bands
Visualisation of required Index Wavelengths
Your feedback
Submit your suggestions
JSON-API
If you want to use the data for Webservices, you can use the JSON-API. In order to get access to the API, please contact us.
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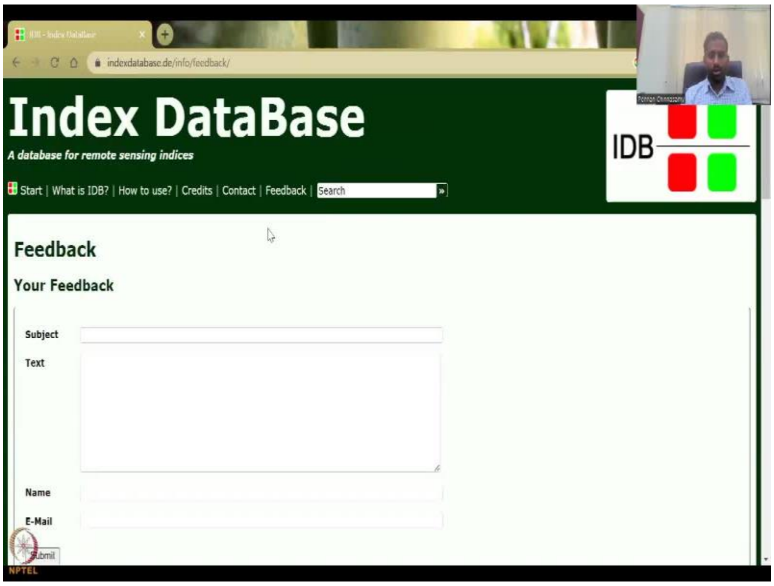
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IDB
Feedback
Your Feedback
Subject
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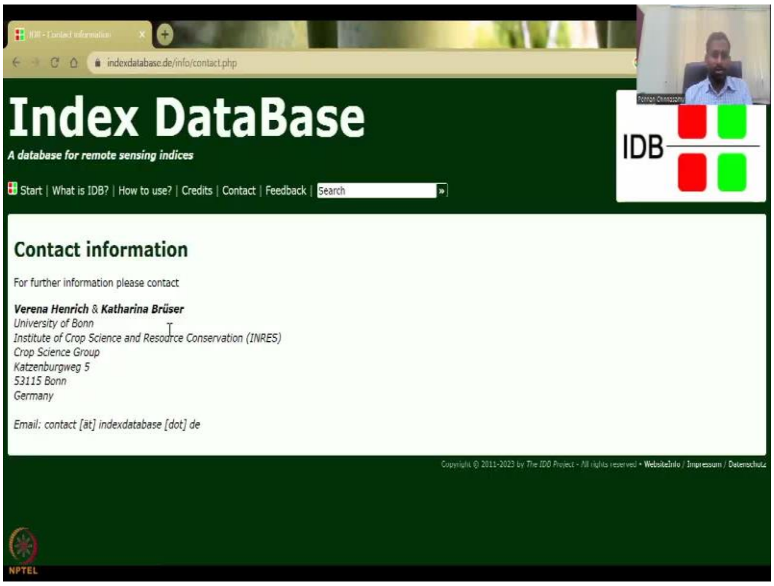

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IDB
Contact information
For further information please contact
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Germany
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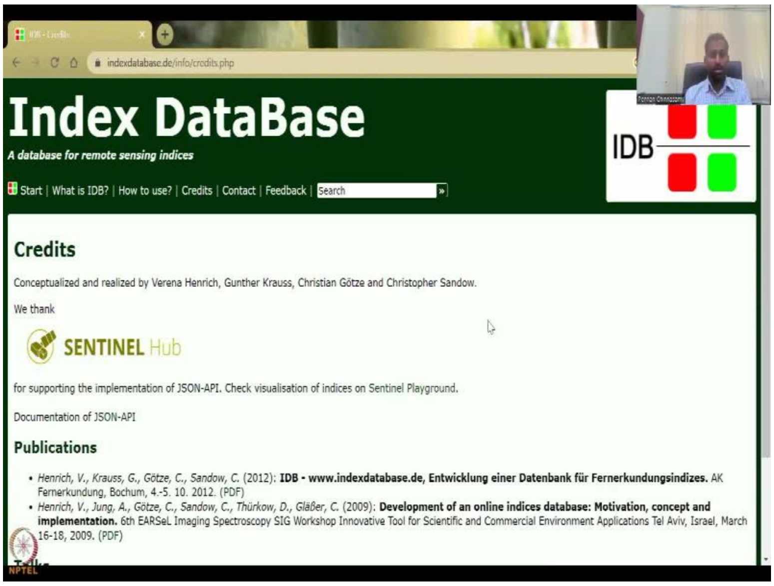

IDB - Credits
indexdatabase.de/info/credits.php
Index DataBase
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Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Credits
Conceptualized and realized by Verena Henrich, Gunther Krauss, Christian Götze and Christopher Sandow.
We thank
SENTINEL Hub
for supporting the implementation of JSON-API. Check visualisation of indices on Sentinel Playground.
Documentation of JSON-API
Publications
Henrich, V., Krauss, G., Götze, C., Sandow, C. (2012): IDB - www.indexdatabase.de, Entwicklung einer Datenbank für Fernerkundungsindizes. AK Fernerkundung, Bochum, 4.-5. 10. 2012. (PDF)
Henrich, V., Jung, A., Götze, C., Sandow, C., Thürkow, D., Gläßer, C. (2009): Development of an online indices database: Motivation, concept and implementation. 6th EARSeL Imaging Spectroscopy SIG Workshop Innovative Tool for Scientific and Commercial Environment Applications Tel Aviv, Israel, March 16-18, 2009. (PDF)
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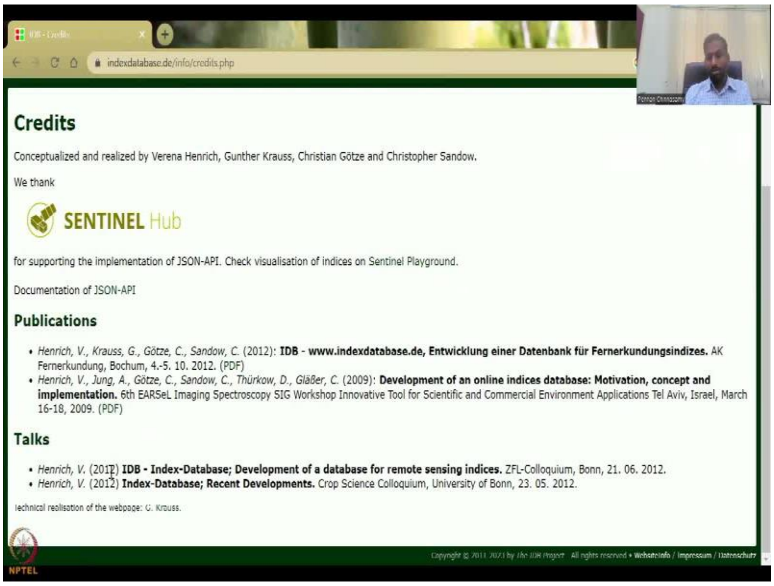

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Talks
Henrich, V. (2012) IDB - Index-Database; Development of a database for remote sensing indices. ZFL-Colloquium, Bonn, 21. 06. 2012.
Henrich, V. (2012) Index-Database; Recent Developments. Crop Science Colloquium, University of Bonn, 23. 05. 2012.
Technical realisation of the webpage: G. Krauss.
NPTEL

So, let us go through this link I will click the link and share now. So, we are opening the webpage, so hope my screen is visible yes it is. So, when you go to Start Page, normally the database or DE you will come to this and this is the logos they have, you can look at it as a database for remote sensing indices, indicators and create different vegetation taxes exist, but they have not been put in a common document which is very-very important, because you should not be redoing what others do, there is lots of indicators, just look at the positives and negatives, look at the literature review and then use it. But where do you use it, what is the formula etc.

So, this person has put in very-very well and a lot of lot of information is there we just see how this is going to be. So you can give feedback, we will come back we can put your name, numbers and give a feedback contact is Verena Henrich and Katharina Bruser of University of Bonn, institute of crop science. And then credits, who they give credit conceptualize, realized by Verena Henrich, Ginthar Krauss, Christian Gotze, and Christopher Sandow and they thank Sentinel hub, because it is not only Sentinel data, it is a lot of data that has been put up, it is old, they started in 2012, almost 10 years old, but still it gets updated, which is really fascinating.

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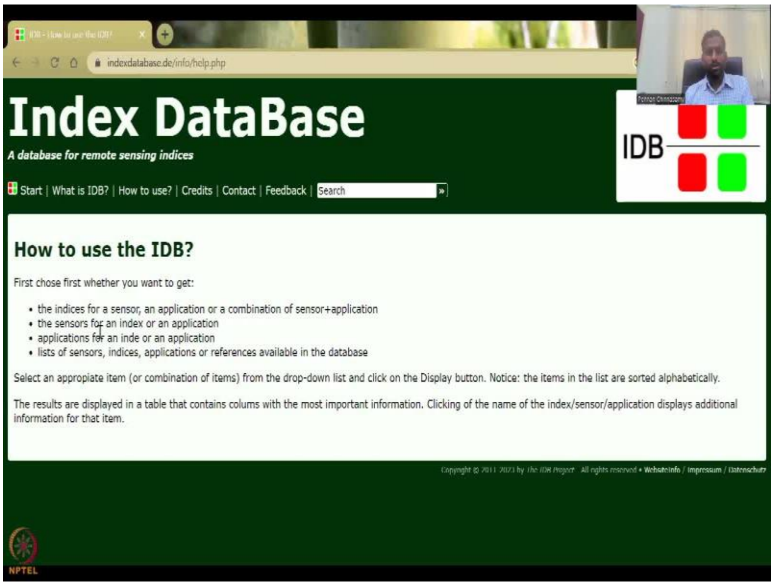

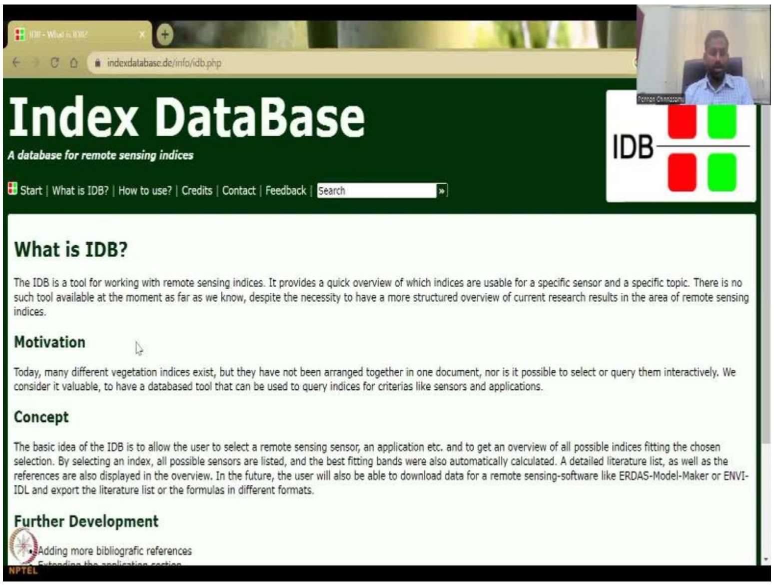

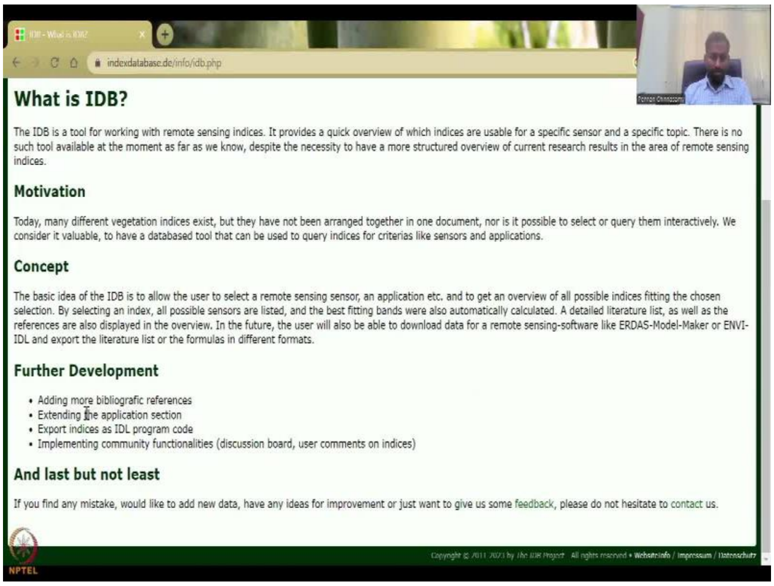

And then how to use it is the some tutorials, indicators, click, etc. So which we will do now. So what is IDB is further development, they are adding more references, so you do not have to do the literature review, they are doing it for you, and if you have any mistakes, any new data that can be added, which is missing from this database, you can put it in the contact feedback section and then give it to them. So here it is, you can also do a search NDVI, etc. and then see if you could search for a particular database.

Then what you could do is you can actually look into the different sections in this database that can be created and you can see that how people have been used using citing. So it is also good to cite it. It is not needed as they did not put any disclaimers, but it is always good that you can tell your friends and how I am saying I immensely been helped by this website, a lot of my students, I hear this on day one, the PhD students to go through it, because you do not have to reproduce what others are doing already.

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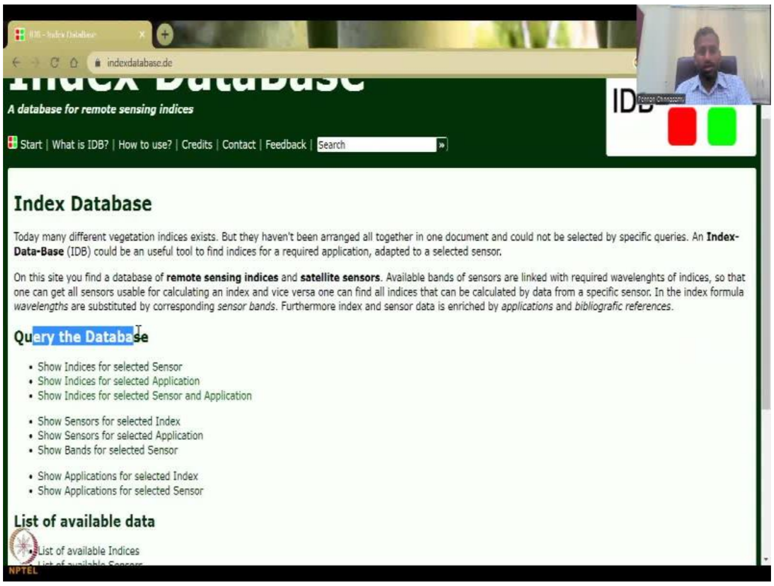

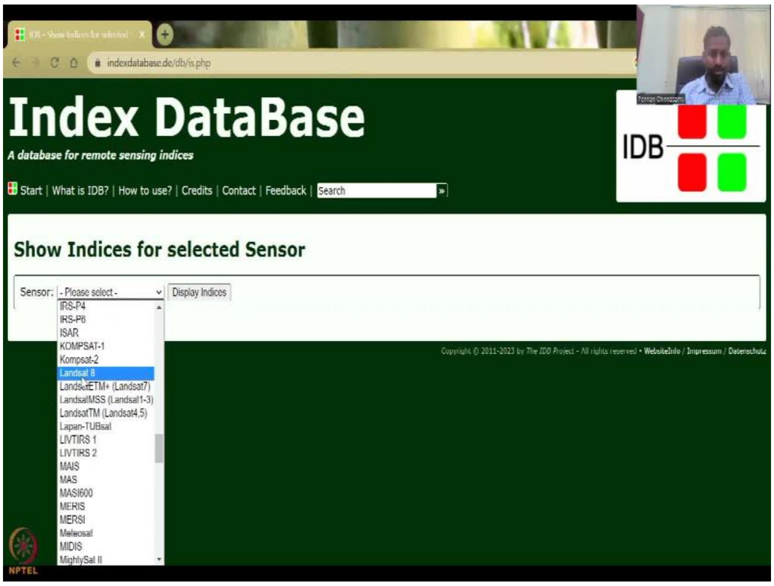

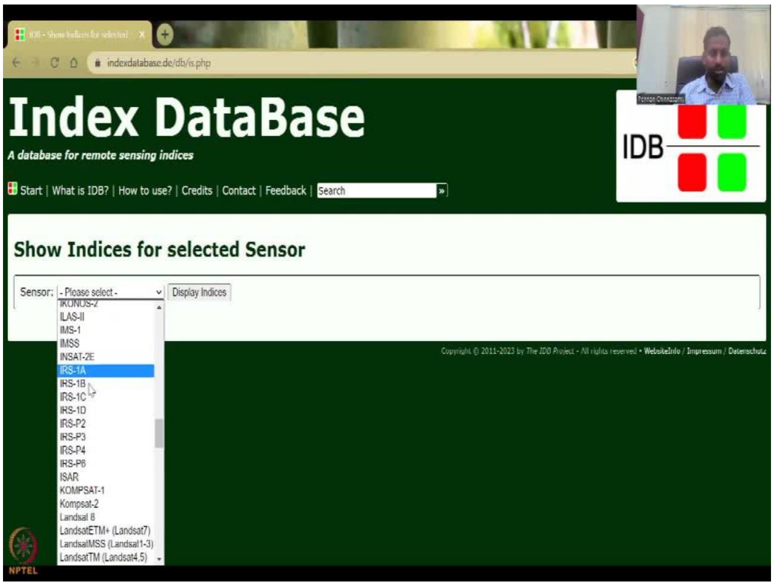

indexdatabase.de/db/is.php
Index DataBase
A database for remote sensing indices
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Show Indices for selected Sensor
Sensor: - Please select -
Display Indices
ILAS-II
IMS-1
IMSS
INSAT-2E
IRS-1A
IRS-1B
IRS-1C
IRS-1D
IRS-P2
IRS-P3
IRS-P4
IRS-P6
ISAR
KOMPSAT-1
Kompsat-2
Landsat 8
LandsatETM+ (Landsat7)
LandsatMSS (Landsat1-3)
LandsatTM (Landsat4,5)
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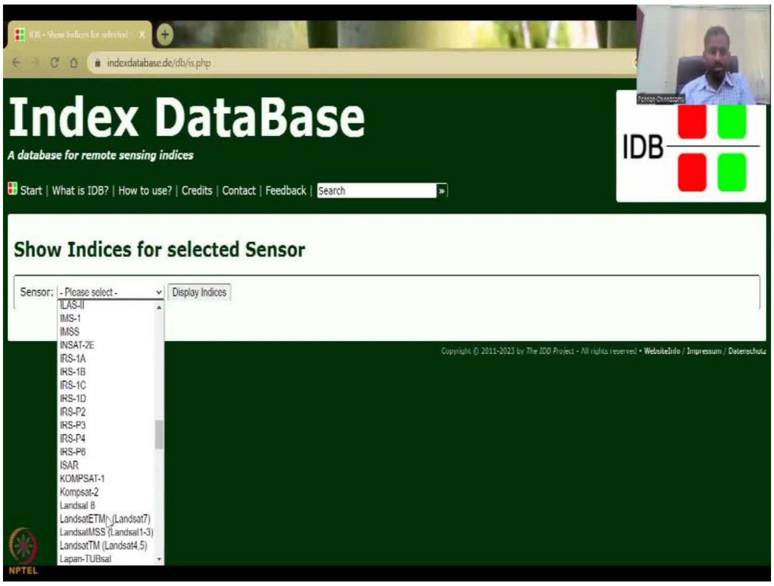

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Sensor: - Please select -
Display Indices
ILAS-II
IMS-1
IMSS
INSAT-2E
IRS-1A
IRS-1B
IRS-1C
IRS-1D
IRS-P2
IRS-P3
IRS-P4
IRS-P6
ISAR
KOMPSAT-1
Kompsat-2
Landsat 8
LandsatETM+ (Landsat7)
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LandsatTM (Landsat4,5)
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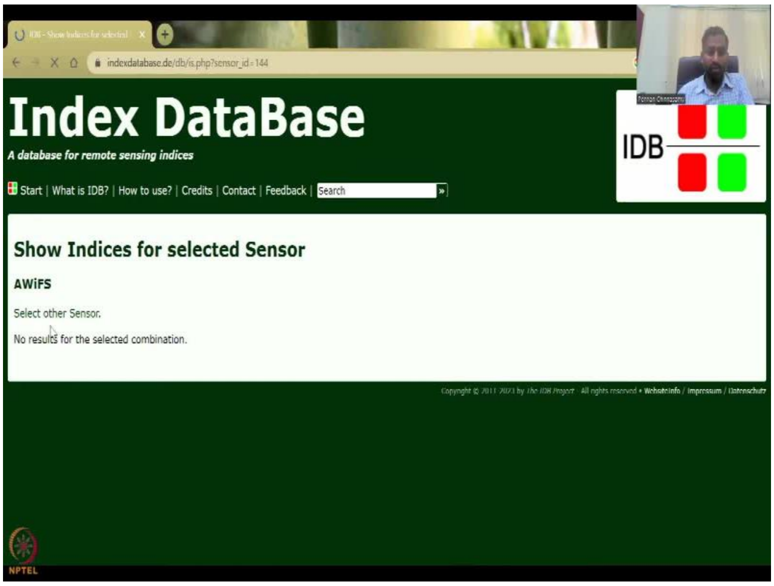

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Index DataBase
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AWiFS
Select other Sensor.
No results for the selected combination.
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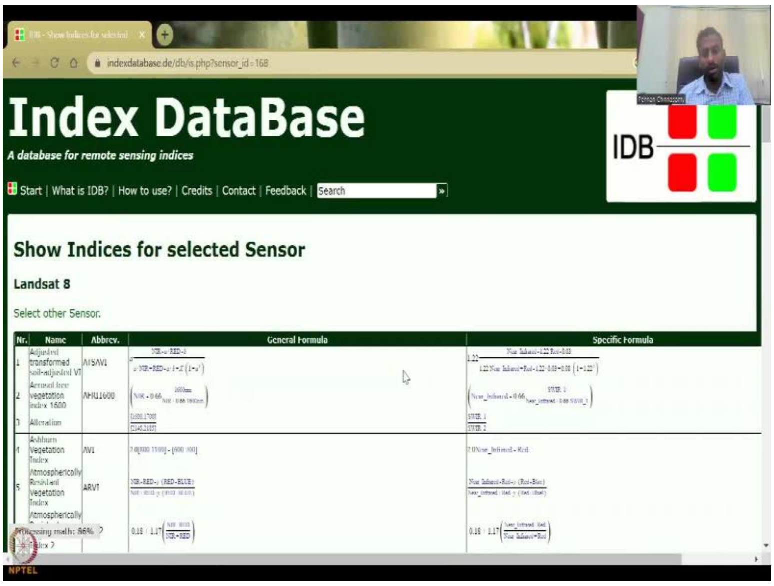
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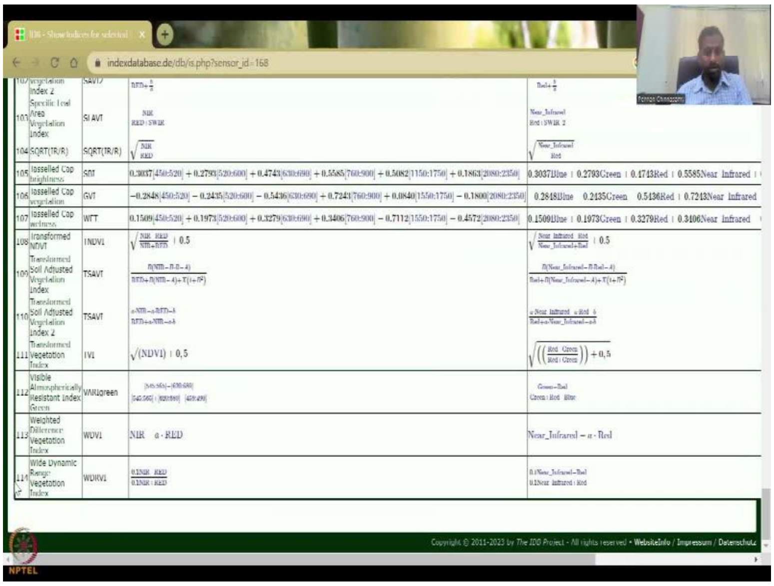
indexdatabase.de/db/is.php?sensor_id=168
Tasselled Cap brightness
Tasselled Cap vegetation
Tasselled Cap wetness
Transformed NDVI
Transformed Soil Adjusted Vegetation Index
Transformed Vegetation Index
Visible Atmospherically Resistant Index Green
Weighted Difference Vegetation Index
Wide Dynamic Range Vegetation Index
NPTEL


indexdatabase.de/db/is.php?sensor_id=168
Atmospherically Resistant Vegetation Index 2
Blue-wide dynamic range vegetation index
Carbonate
Chlorophyll Index Green
Chlorophyll vegetation index
Coloration Index
Corrected Transformed Vegetation Index
Difference NIR/Green Green Difference Vegetation Index
Differenced Vegetation Index MSS
Enhanced Vegetation Index
Enhanced Vegetation Index 2
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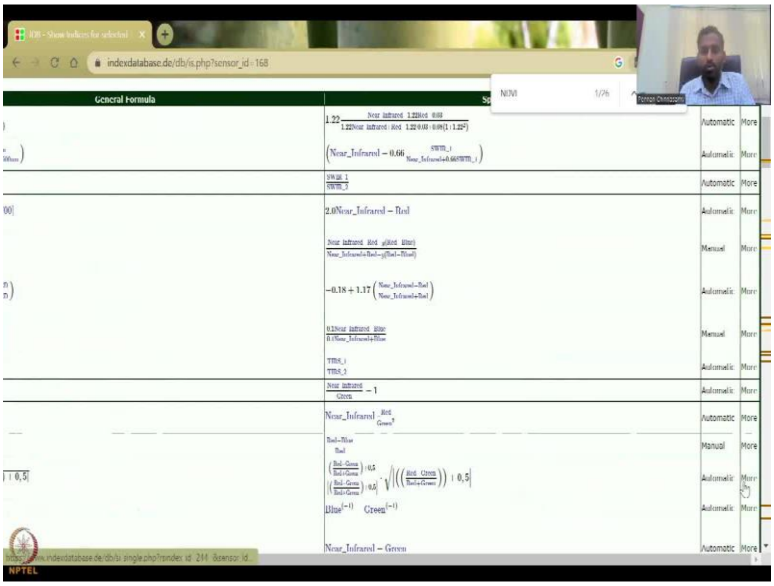
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General Formula
Automatic
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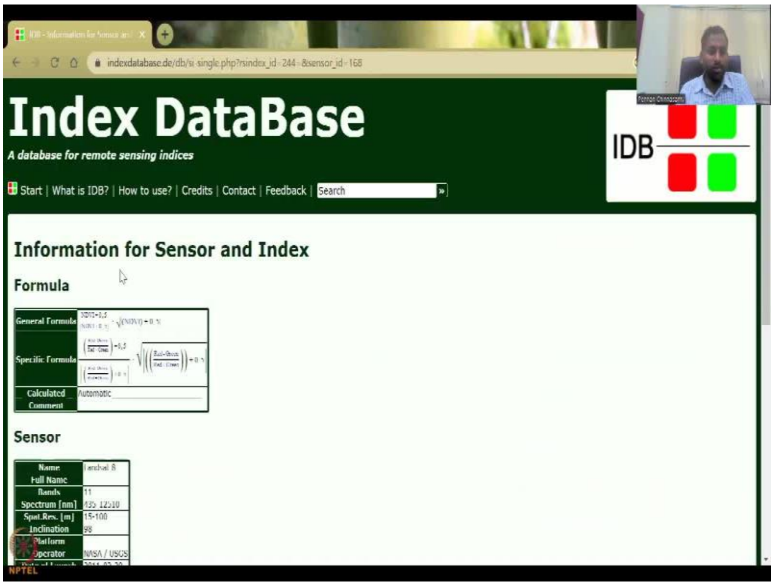
indexdatabase.de/db/si-single.php?rsindex_id=244&sensor_id=168
Index DataBase
A database for remote sensing indices
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Information for Sensor and Index
Formula
General Formula
Specific Formula
Calculated
Comment
Automatic
Sensor
Name
Full Name
Bands
Spectrum [nm]
Spat.Res. [m]
Inclination
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Operator
Landsat 8
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NASA / USGS
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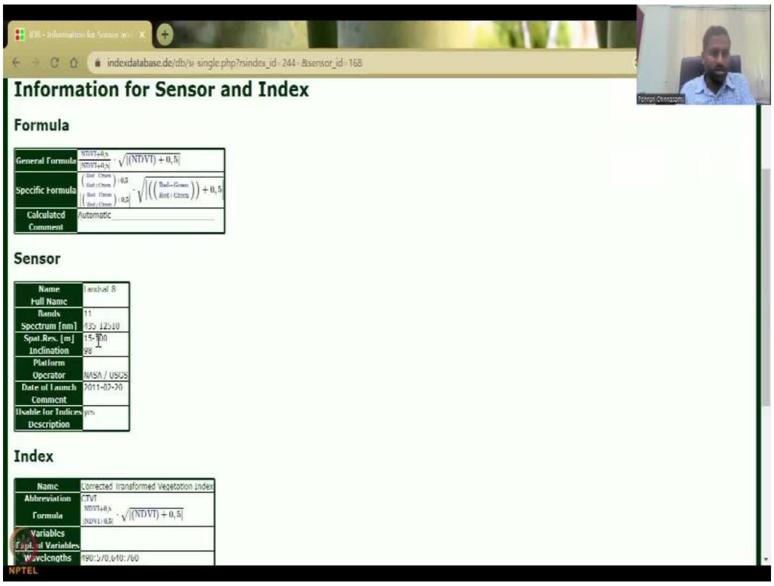
indexdatabase.de/db/si-single.php?rsindex_id=244&sensor_id=168
Information for Sensor and Index
Formula
General Formula
Specific Formula
Calculated
Comment
Automatic
Sensor
Name
Full Name
Bands
Spectrum [nm]
Spat.Res. [m]
Inclination
Platform
Operator
Date of Launch
Comment
Usable for Indices
Description
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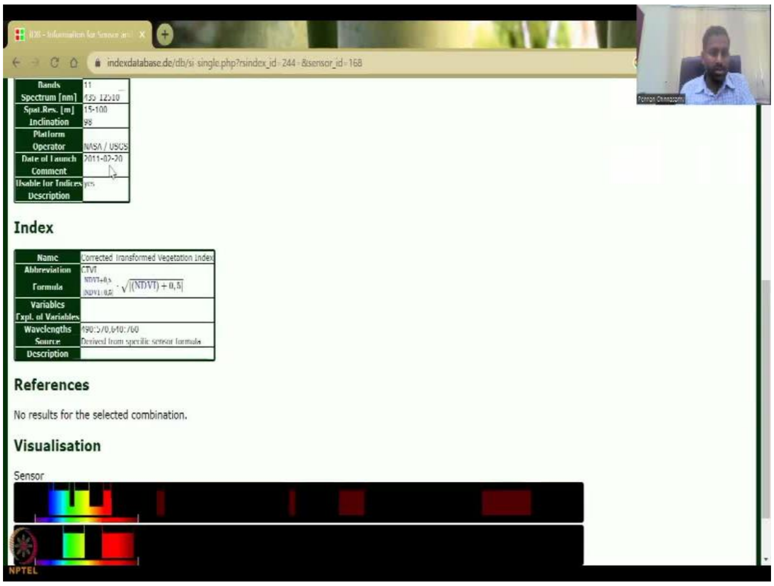
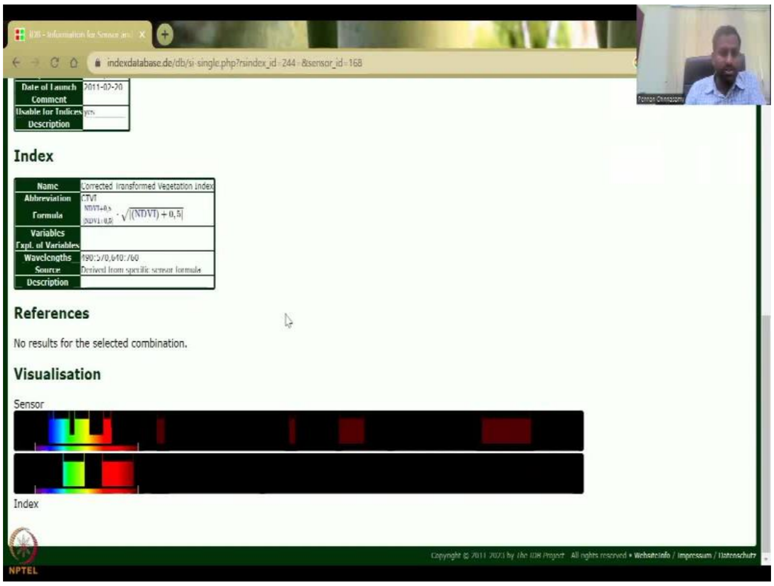
NASA / USGS
2011-02-20
Index
Name
Abbreviation
Formula
Variables
Wavelengths
Corrected Transformed Vegetation Index
CTVI
NPTEL





So here it is, you can start from here, you can search the database for a particular sensor, a satellite sensor, so if someone has said in a talk, but let us say that list 3 is used. So if you could click this and then say that what sensor it is, and then you can go down to the particular sensor and then see if it is available. So Landsat 8, for example is available, IRS is available. And then all these registration indexes all sensors, it is not only for vegetation, as it says in the writing it says vegetation, but it is not only for vegetation, there is water, land management, every other thing that can be used is there.

So we can definitely use this for multiple-multiple users. So this is the Indian satellite and it is saying like do you have any indicators specifically built for the Indian satellite? No, it is not. So you can come back and then say, Landsat. So what indicators have been made on Landsat, and you can see that it is tremendously 114 indicators have been done. So as indicated, we just look at NDVI. So I am just going to click search here and control F and if I say NDVI 26 versions of NDVI have done, it is not just the NDVI but there is a composite NDVI, I will show you how it is different. So it is not called the NDVI it is called character transformation index. So CTVI and but the NDVI is used here.

So somewhere as I said, NDVI becomes is the base and then it gets updated and or regularly improved for a particular region or something. And here they could see, you could see that they given the formula. So red minus green, red plus green is the NDVI part they have used, visible red or visible green you can use if you do not have NIR. So red is given in the front minus green by red plus green. And then you can see here the citations automatic, calculator automatic, you can go to more info, and then it will give you a beautifully it will give you the formula specific calculator, what are the sensors that have been used, the sensors launch date kind of metadata for it, very important on the spectrum, spatial resolution completed 100 meters inclination and sometimes you also get the temporal resolution. So these are the sensors that have been used as the colors in the sensors that are being used.

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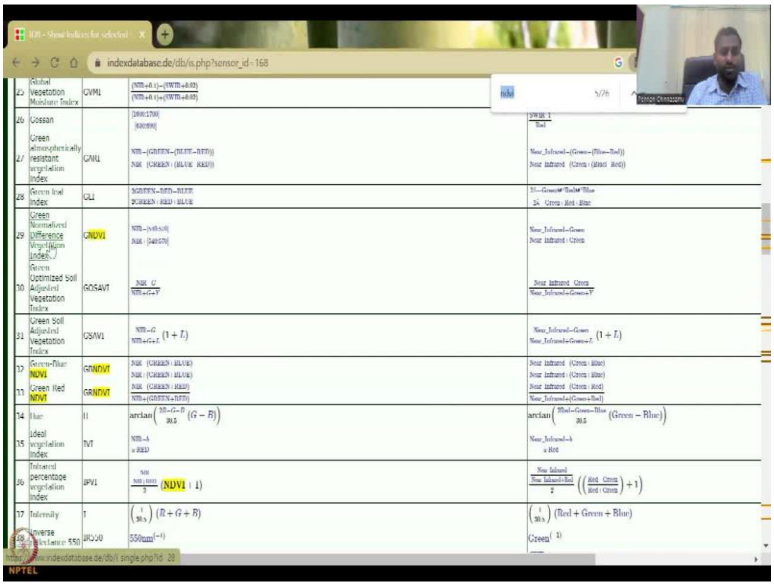
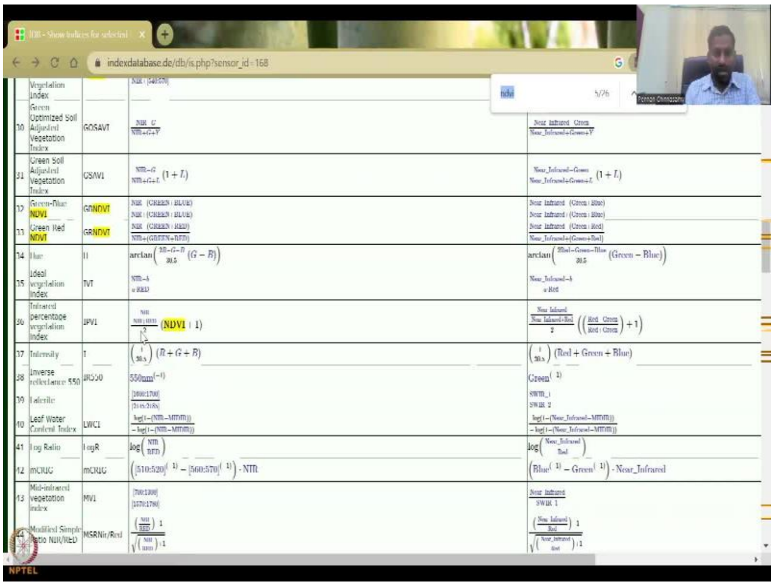
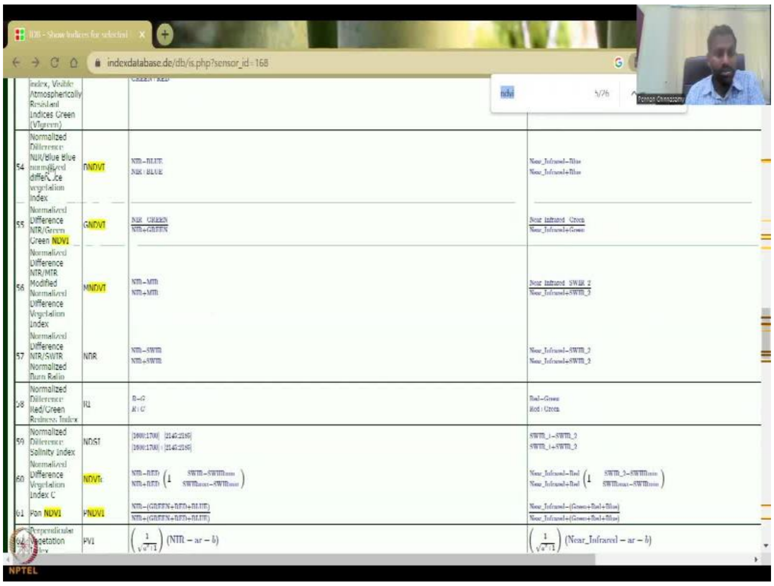




IDB - Show Indices for selected
indexdatabase.de/db/is.php?sensor_id=168
ndvi 5/26
30 Green Optimized Soil Adjusted Vegetation Index GOSAVI
31 Green Soil Adjusted Vegetation Index GSAVI
32 Green-Blue NDVI GBNDVI
33 Green Red NDVI GRNDVI
34 Hue H
35 Ideal vegetation index IVI
36 Infrared percentage vegetation index IPVI
37 Intensity I
38 Inverse reflectance 550 IR550
39 Laterite
40 Leaf Water Content Index LWCI
41 Log Ratio LogR
42 mCRIG mCRIG
43 Mid-infrared vegetation index MVI
44 Modified Simple Ratio NIR/RED MSRNir/Red
NPTEL



IDB - Show Indices for selected
indexdatabase.de/db/is.php?sensor_id=168
ndvi 5/26
Index, Visible Atmospherically Resistant Indices Green (VIgreen)
54 Normalized Difference NIR/Blue Blue-normalized difference vegetation index BNDVI
55 Normalized Difference NIR/Green Green NDVI GNDVI
56 Normalized Difference NIR/MIR Modified Normalized Difference Vegetation Index MNDVI
57 Normalized Difference NIR/SWIR Normalized Burn Ratio NBR
58 Normalized Difference Red/Green Redness Index RI
59 Normalized Difference Salinity Index NDSI
60 Normalized Difference Vegetation Index C NDVIc
61 Pan NDVI PNDVI
62 Perpendicular Vegetation Index PVI
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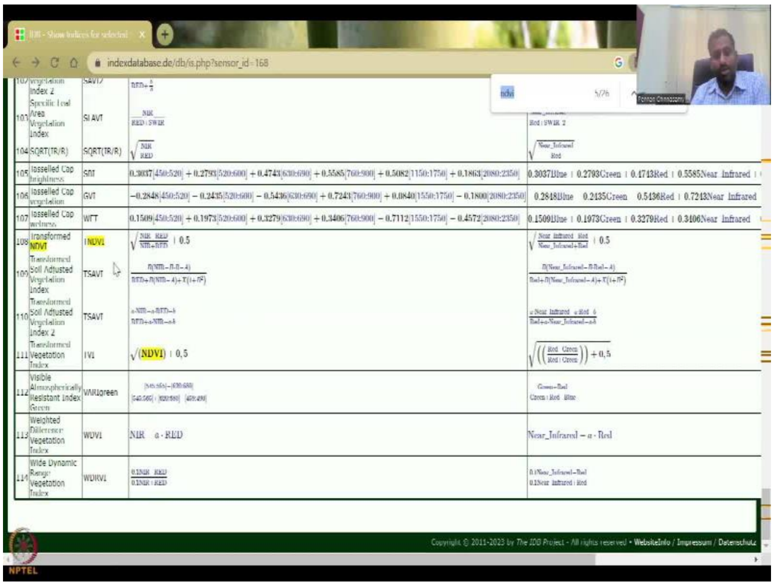

IDB - Show Indices for selected
indexdatabase.de/db/is.php?sensor_id=168
ndvi 5/26
103 Specific Leaf Area Vegetation Index SLAVI
104 SQRT(IR/R) SQRT(IR/R)
105 Tasselled Cap brightness SBI
106 Tasselled Cap vegetation GVI
107 Tasselled Cap wetness WET
108 Transformed NDVI TNDVI
109 Transformed Soil Adjusted Vegetation Index TSAVI
110 Transformed Soil Adjusted Vegetation Index 2 TSAVI
111 Transformed Vegetation Index TVI
112 Visible Atmospherically Resistant Index Green VARIgreen
113 Weighted Difference Vegetation Index WDVI
114 Wide Dynamic Range Vegetation Index WDRVI
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So we will go back here click back NDVI and so before populated I have done it. So let me just say NDVI. So let us look at another one. So here we have the green Normalized Difference Vegetation Index, where instead of near infrared minus red, it is near infrared minus green, and that is why G comes in front. So someone has done that G-NDVI, green, blue NDVI. So instead of Near Infrared minus red, it is green plus blue. And so you will have to add green plus blue first and undo it.

So normally, you do not see all these indicators on the bigger dashboards because these are updated or developed further, and yet it does not have that much of literature review or people using it. So it is not yet as popular as the other indicators. So infrared percentage, vegetation index is IPVI, so near infrared by near infrared plus red by 2 kind of averaging it. So average, so NIR divided by the average of NIR by red and then NDVI is added to it kind of multiplied. And then we have B-NDVI, which is known by its difference blue near blue instead of red, you are using blue. And then green normalized difference green NDVI, instead of red, you are using green. And then NDVI C.

So vegetation like see a lot of multiple, higher-higher end updation is happen. Red blue, instead of red is just red, blue. And then we have D-NDVI. So it is not actually 26 because there is double calculating somewhere I would say, around 10 to 15. Even if you divide it by 2, you will have around 15 indicators, there will be more there will be added on to this as an NDVI.

So this also actually for example also you can say as NDVI drag because near infrared minus red near infrared plus red is your NDVI, so it is kind of point one times your NDVI which is your wide dynamic range vegetation index. So, people have used NDVI and from there they are built further NDVI structures. So, this is a by sensor.

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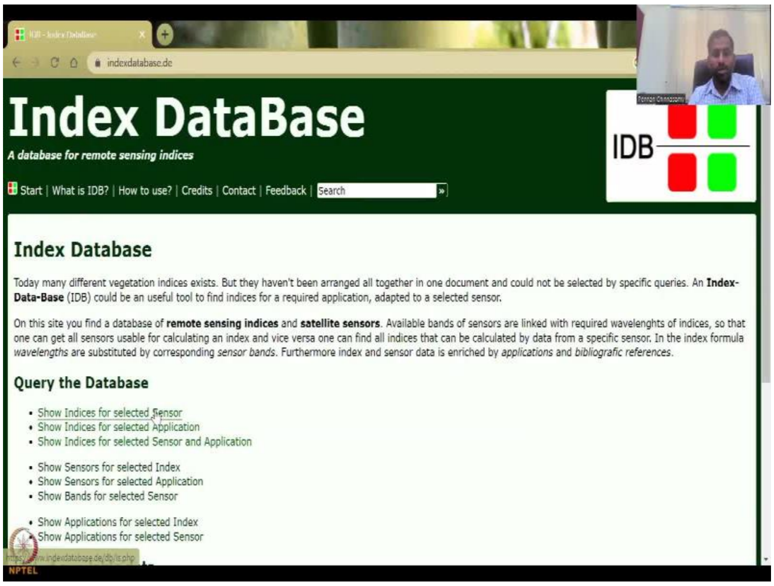

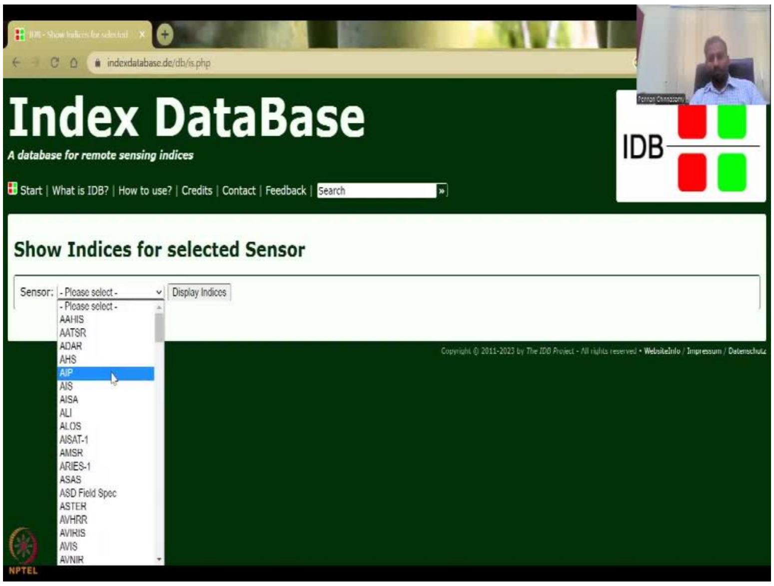

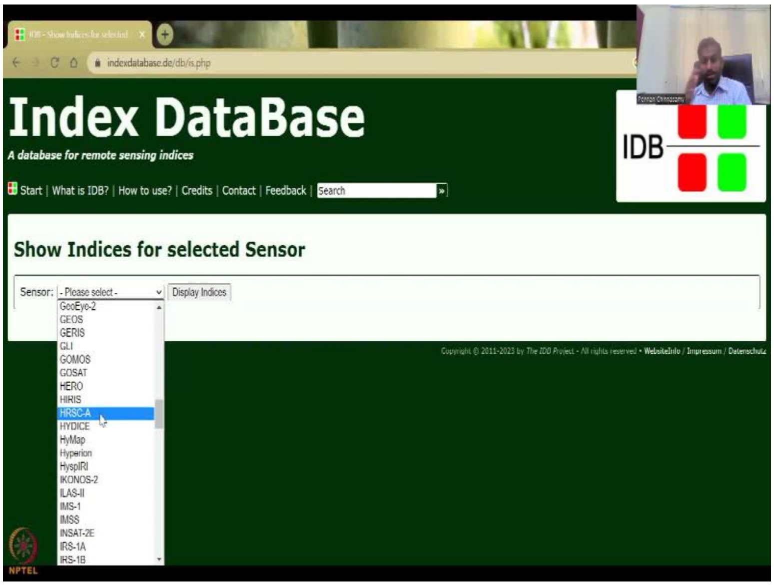

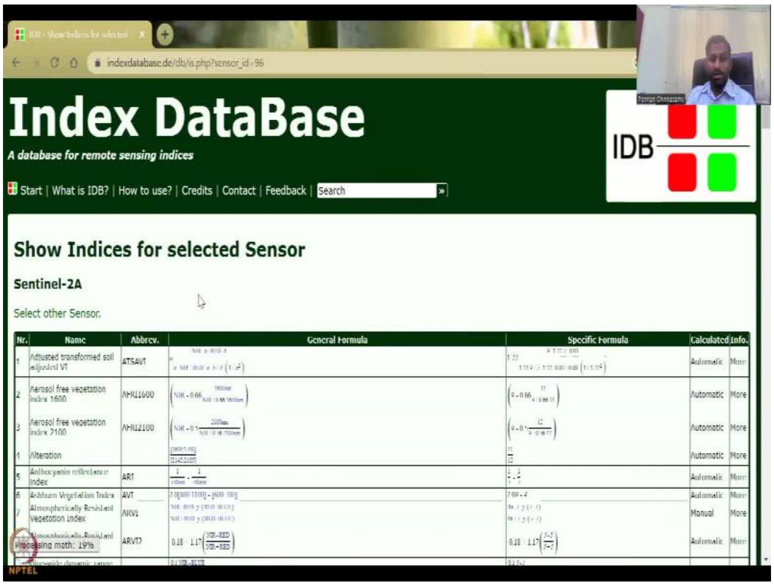

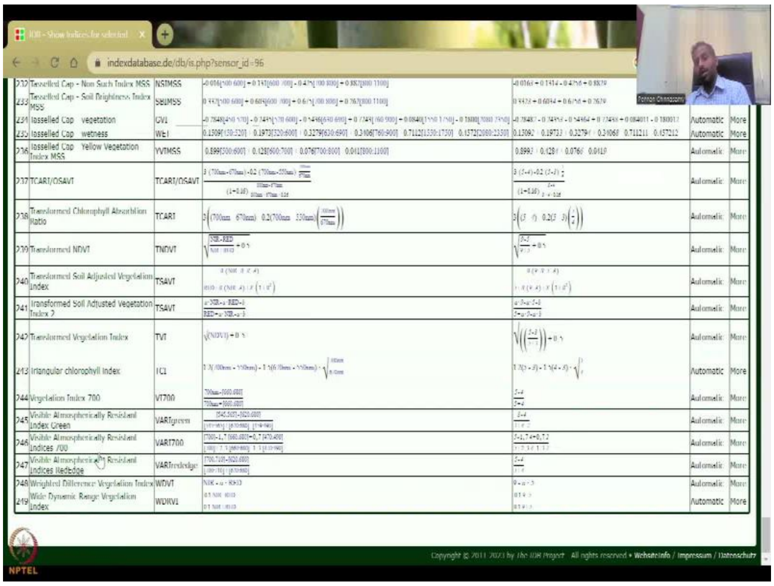

So let us go to the start again and do one by one. So, if you can do the sensor, it will first give you all the sensors available here. So satellite is one and then there is a sensor. So satellite is the payload, so first steps are this the rocket is there, the rocket has the satellite in the nose part or somewhere in the body, it gets launched into space and then the satellite is put into orbit. Inside the satellite, there are sensors, there are cameras, and those are different-different sensors. So here we have different sensors, the mission is different, the sensor is different, but one mission can have multiple satellites, and multiple satellites can have multiple sensors. So one satellite need not have only one sensor, it can have multiple.

So, these are the exact sensors. So you have Sentinel 2A which is very-very famous. And if you can click on the indicators, you can see much much much more than 144 that we saw earlier is 250 and counting because of the high-high spatial resolution. 15-16 days is really good, but more important here is the size, the spatial resolution. So 10 meters to 30 meter is a very good resolution, especially for developing nations like India, where the average land holding size is very small.

So think about your average landholding size, so at least you can have 10 pixels into to your dominant landholding size in India, which is very good to take out crop signatures, and very specific crop dynamics for development. So you have 144 in the Landsat one part where approximately here we have 249 and it is still getting updated.

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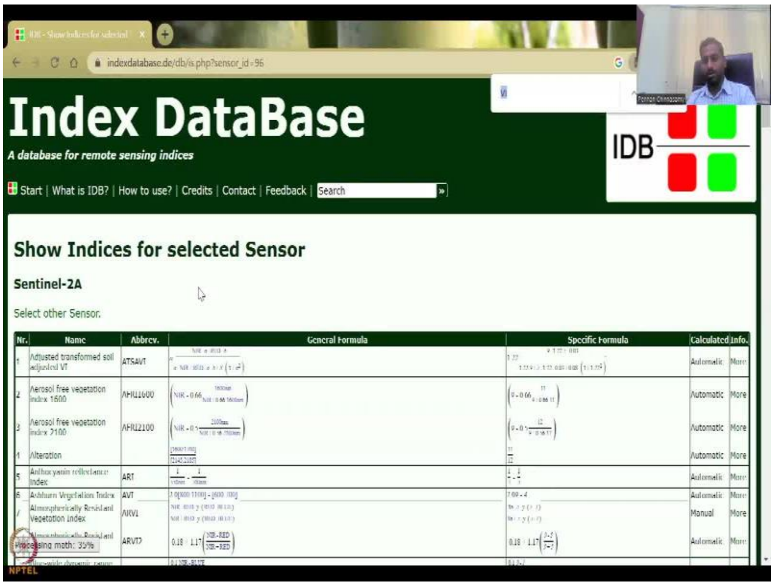

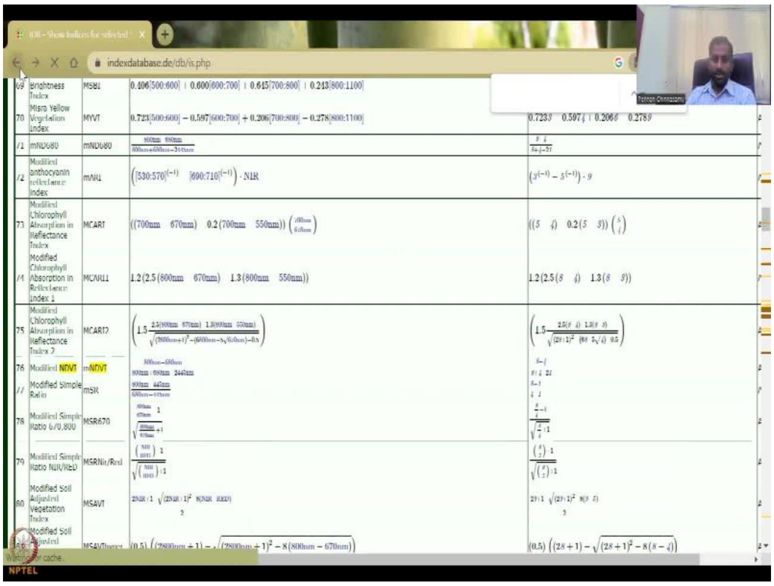

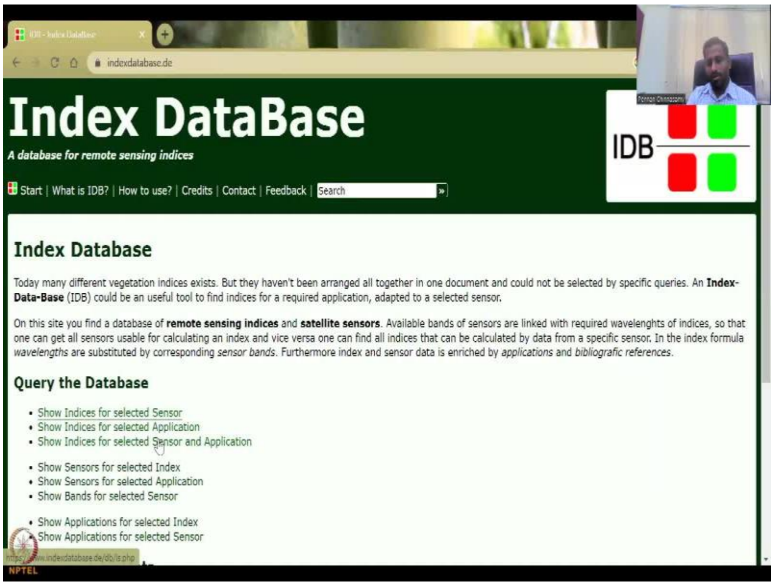
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Index Database
Today many different vegetation indices exists. But they haven't been arranged all together in one document and could not be selected by specific queries. An Index-Data-Base (IDB) could be an useful tool to find indices for a required application, adapted to a selected sensor.
On this site you find a database of remote sensing indices and satellite sensors. Available bands of sensors are linked with required wavelenghts of indices, so that one can get all sensors usable for calculating an index and vice versa one can find all indices that can be calculated by data from a specific sensor. In the index formula wavelengths are substituted by corresponding sensor bands. Furthermore index and sensor data is enriched by applications and bibliografic references.
Query the Database
Show Indices for selected Sensor
Show Indices for selected Application
Show Indices for selected Sensor and Application
Show Sensors for selected Index
Show Sensors for selected Application
Show Bands for selected Sensor
Show Applications for selected Index
Show Applications for selected Sensor
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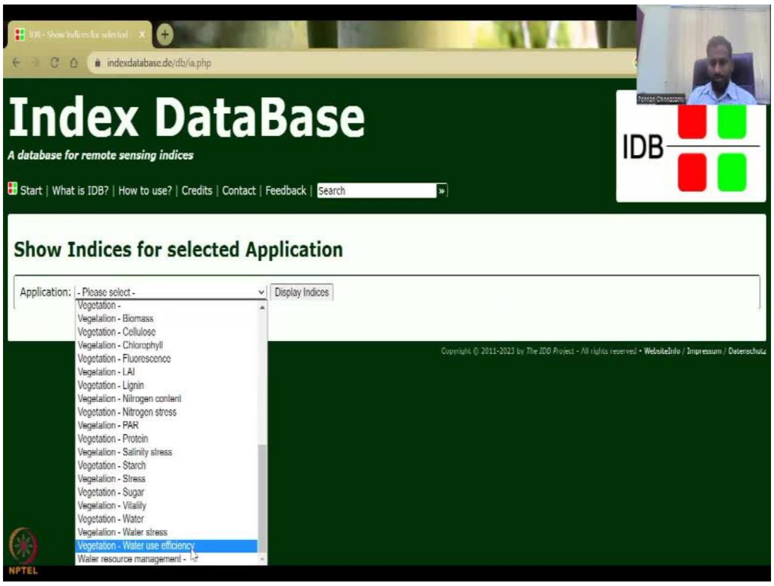
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Application: - Please select -
Display Indices
Vegetation -
Vegetation - Biomass
Vegetation - Cellulose
Vegetation - Chlorophyll
Vegetation - Fluorescence
Vegetation - LAI
Vegetation - Lignin
Vegetation - Nitrogen content
Vegetation - Nitrogen stress
Vegetation - PAR
Vegetation - Protein
Vegetation - Salinity stress
Vegetation - Starch
Vegetation - Stress
Vegetation - Sugar
Vegetation - Vitality
Vegetation - Water
Vegetation - Water stress
Vegetation - Water use efficiency
Water resource management -
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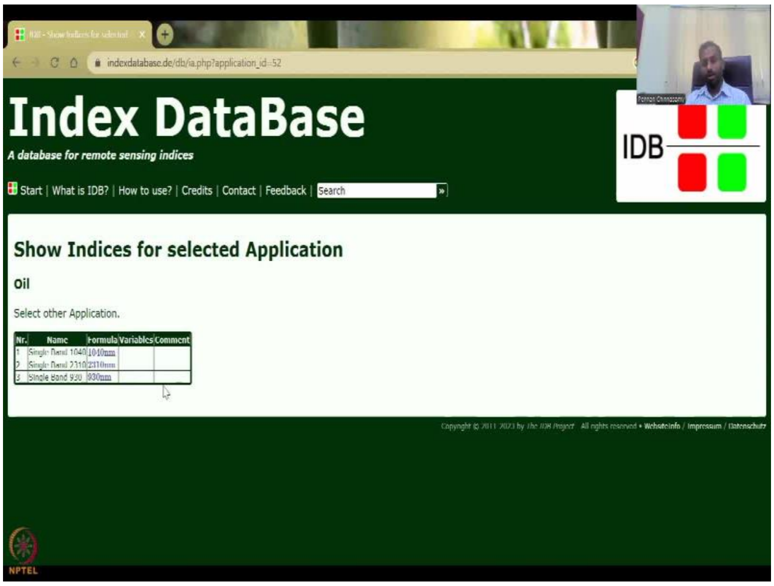
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IDB
Show Indices for selected Application
Oil
Select other Application.
Nr. Name Formula Variables Comment
1 Single Band 1040 1040nm
2 Single Band 2310 2310nm
3 Single Band 930 930nm
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Let us also look at the NDVI in this one. How many NDVI, there is 32. And even if you do it by that is 18, or something 16 by plus 2, I am saying just in case. So at least some higher than the previous version. Why VI NDVI. So vegetation index is really very high. And you can see the modified M is there, which is different from what was there in the Landsat. This is because not only the resolution, but the sensors that are use is much different, the sensors that it could be a multispectral sensor or hyper-spectral sensor, or infrared band is added.

So we will go back, that is what sensor is. The second and third are really good. So second is very important for us application, what application do we want to use? Here you will see not only agriculture aspect of rural development, we will see multiple aspects say water management for domestic industrial water use in agricultural areas, water use efficiency for vegetation, all these are agriculture, oil availability, or how do you how do you sense oil from various indicators. So you can just take it from a band, there is no indicator, you just use in band, that is all it says.

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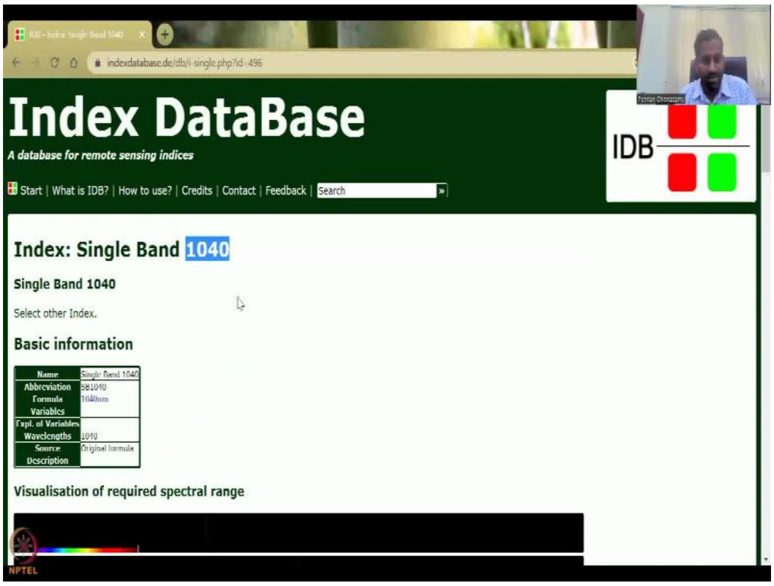

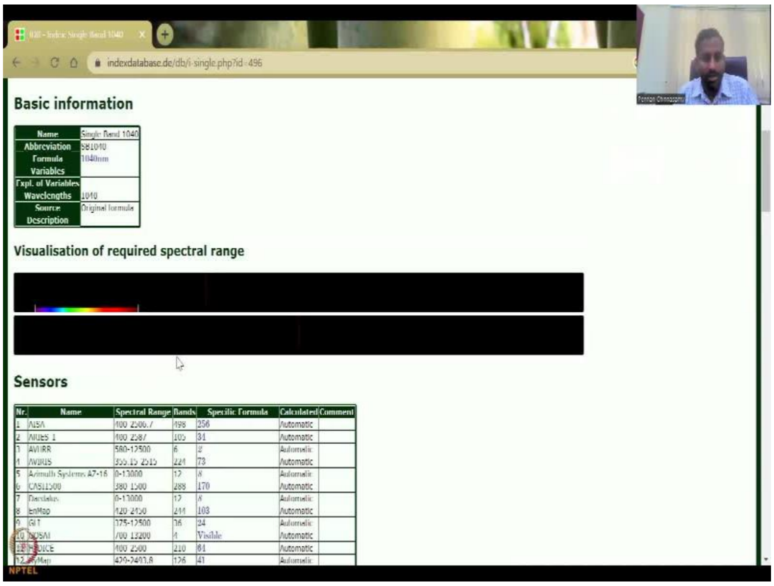

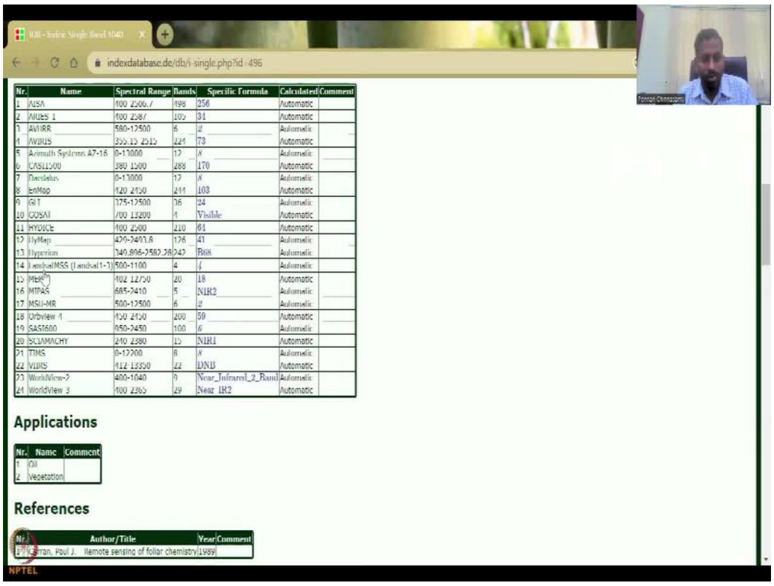

So when you click this band, you can also see which satellites are giving this band. So for example, I click the band for oil, it is a single band 1040 wavelength, so nanometers is wavelength, and then it says that all these sensors can give. So, now what you do go back to the sensor, and then extract that particular band for a while. So, indicator is a multiple bands, you put an algorithm you get an output. So NIR minus red, NIR plus red NDVI. But if one band is enough, so, you do not need all the bands or an indicator just use the man and that is what this article is saying 1040 is enough, and who gives 1040? All these sensors give to a 1014, so 24 indicators kind of say you can sync.

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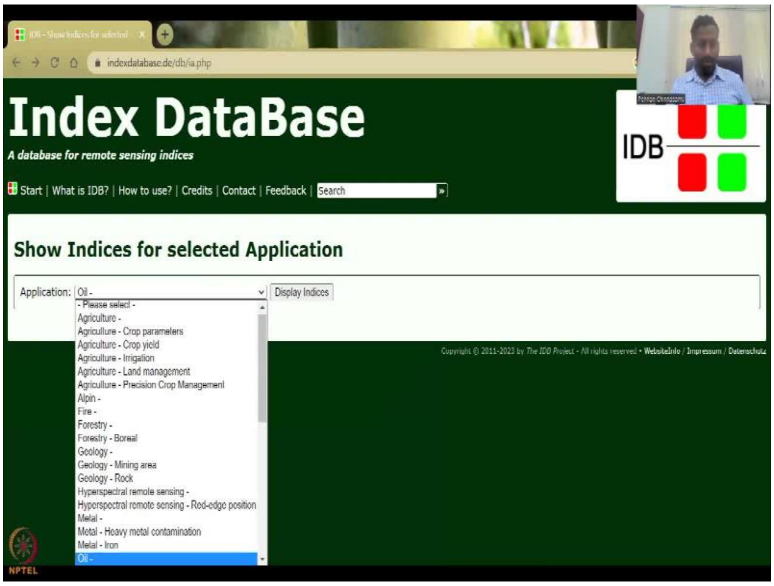

So, that is oil in terms of oil, and then you have the metal, metal, heavy metal contamination, metal iron, so, these also can help in associating the land quality and the health quality because if it has too much iron in the ground, and if it leaks into the water, then people when they drink it, they get really bad health issues. Especially you will see that in the rural areas with a lot of iron oxides present in the soil. And then we have hyper-spectral remote sensing and multispectral remote sensing, the geology, the ground type, the rock type is there. And then you have the forest what type of forest cover this is also linked to the tribals, livelihood options and biodiversity conservation like animals, birds, plants, herbs, medicinal plants, etc.

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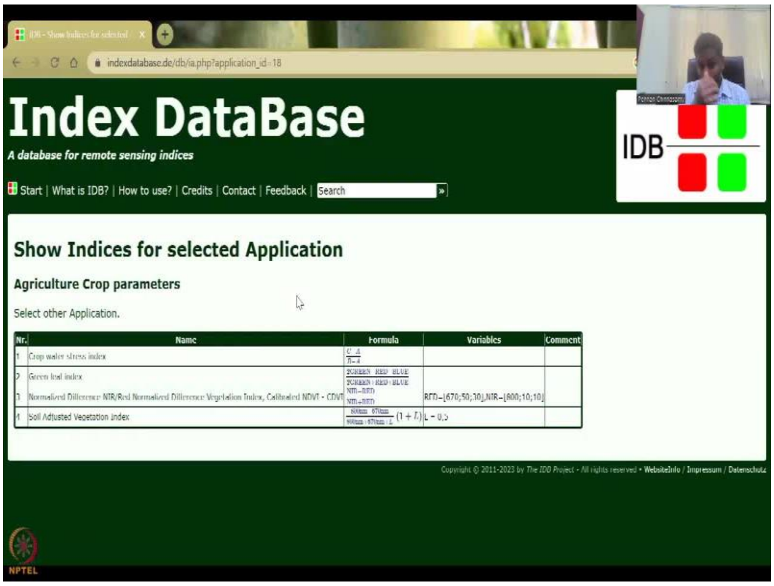

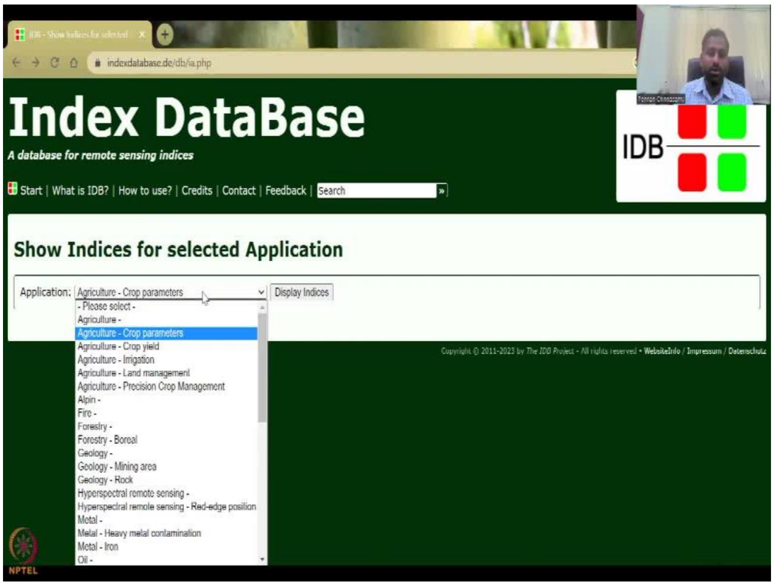
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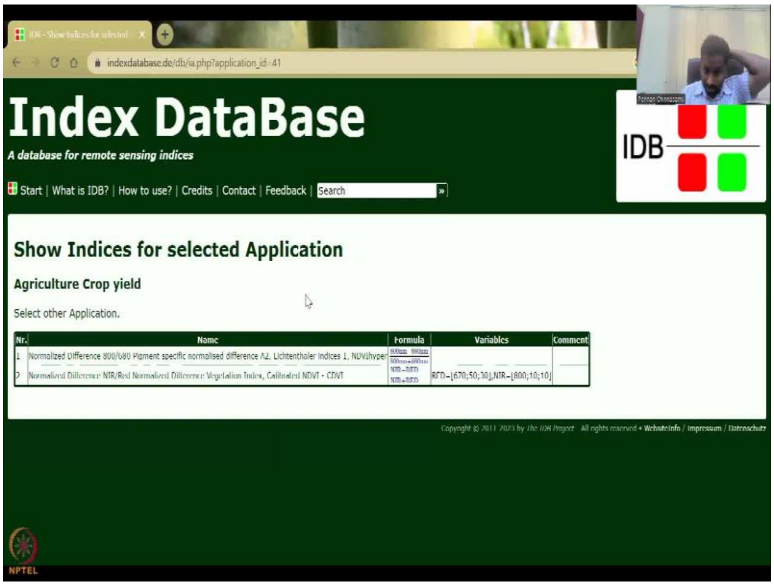
Application: Agriculture - Crop parameters
Display Indices
- Please select -
Agriculture -
Agriculture - Crop parameters
Agriculture - Crop yield
Agriculture - Irrigation
Agriculture - Land management
Agriculture - Precision Crop Management
Alpin -
Fire -
Forestry -
Forestry - Boreal
Geology -
Geology - Mining area
Geology - Rock
Hyperspectral remote sensing -
Hyperspectral remote sensing - Red-edge position
Metal -
Metal - Heavy metal contamination
Metal - Iron
Oil -
NPTEL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IDB
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Agriculture Crop yield
Select other Application.
Nr. | Name | Formula | Variables | Comment
1 | Normalized Difference 800/680 Pigment specific normalised difference A2, Lichtenthaler Indices 1, NDVIhyper
2 | Normalized Difference NIR/Red Normalized Difference Vegetation Index, Calibrated NDVI - CDVI | NIR−RED / NIR+RED | RED=[670;50;10],NIR=[800;10;10]
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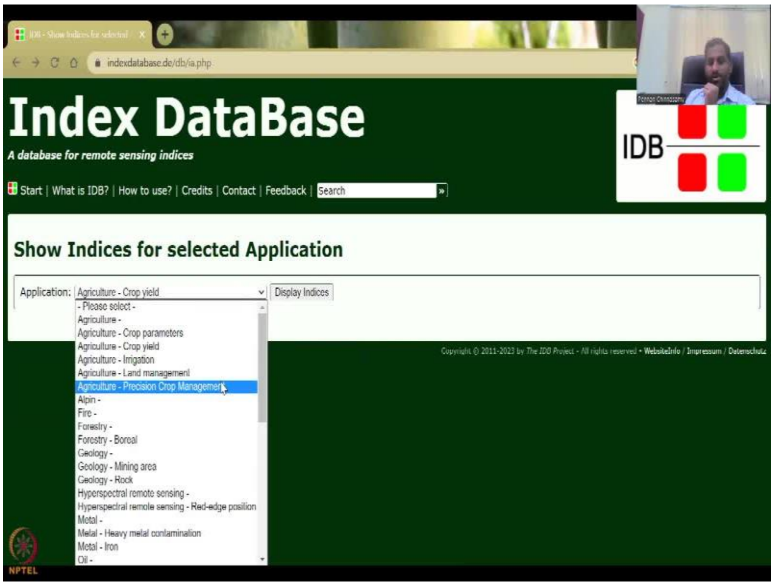
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IDB
Show Indices for selected Application
Application: Agriculture - Crop yield
Display Indices
- Please select -
Agriculture -
Agriculture - Crop parameters
Agriculture - Crop yield
Agriculture - Irrigation
Agriculture - Land management
Agriculture - Precision Crop Management
Alpin -
Fire -
Forestry -
Forestry - Boreal
Geology -
Geology - Mining area
Geology - Rock
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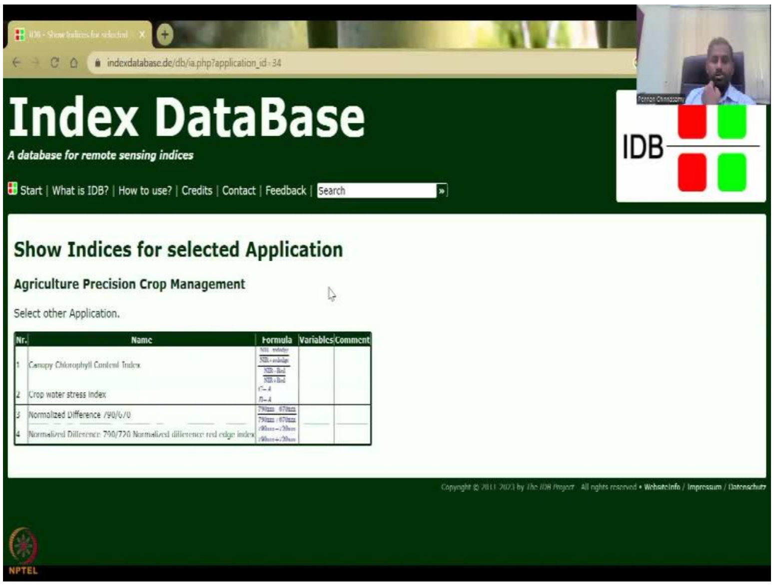
Hyperspectral remote sensing - Red-edge position
Metal -
Metal - Heavy metal contamination
Metal - Iron
Oil -
NPTEL



So and then you have Alpin and then you have agriculture. So precision crop management, crop yield, crop irrigation. Let us look at the crop parameters, what indicators we have, we have the green leaf index, crop water stress, yes, for sure we have the NDVI calibrated and other NDVI’s and then the Soil Adjusted Vegetation Index.

So you have a couple of indexes here, vegetation index is there but then there is a soil adjusted also. When you click it all the people who have done it will come since we have done a lot of crop parameters, let us go to crop yield and then if it is steady indicators, as we have used, NDVI has used a lot, if it is hyper NDVI, normal NDVI is there normal difference is the pigments specified is there, and then the normalized difference NDVI minus CDVI is also there.

So, you can use this to get at the area because if it is green in the healthy growing season, we assume that it is crops not only for us. So for example, in the Sangli region, most of the land is covered by sugarcane, I will not expect a forest to grow there unless otherwise it is a conservation area. So that is the agricultural crop yield. Irrigation land management, precision crop management, what indicators can be used is very-very specific the chlorophyll content because a healthy plant has high chlorophyll and then the drop water NDVI etc. etc. will come.

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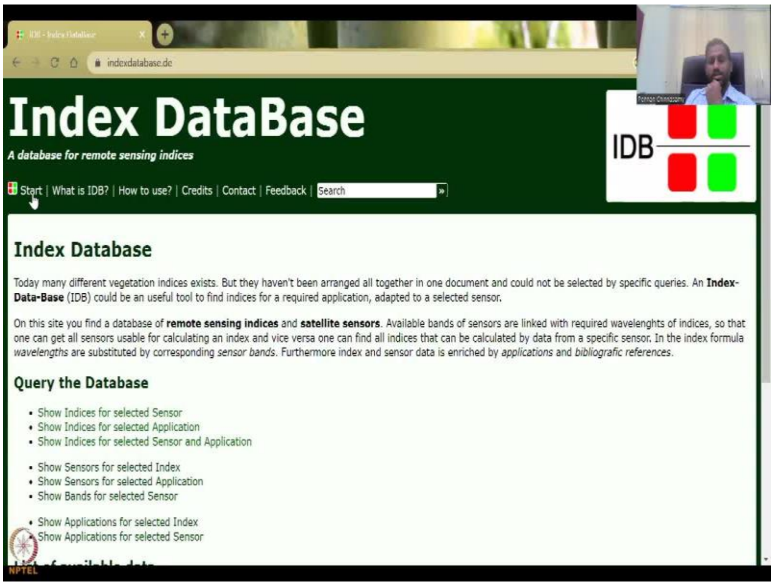

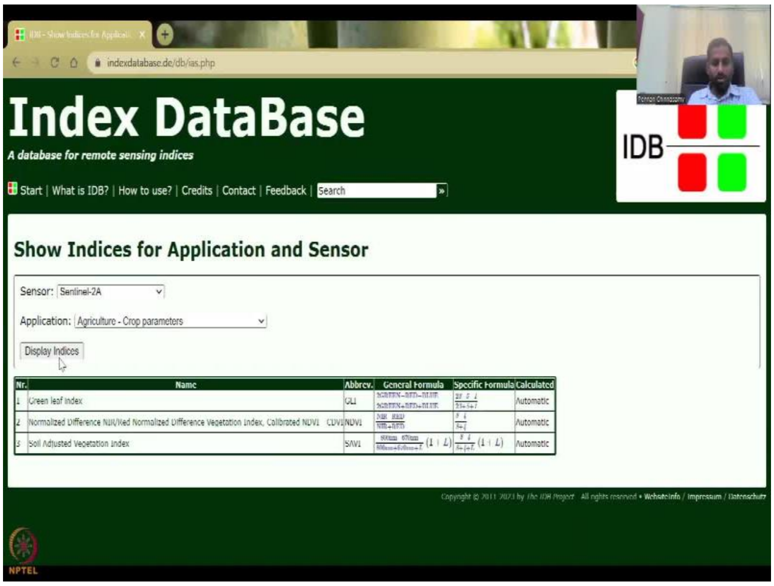

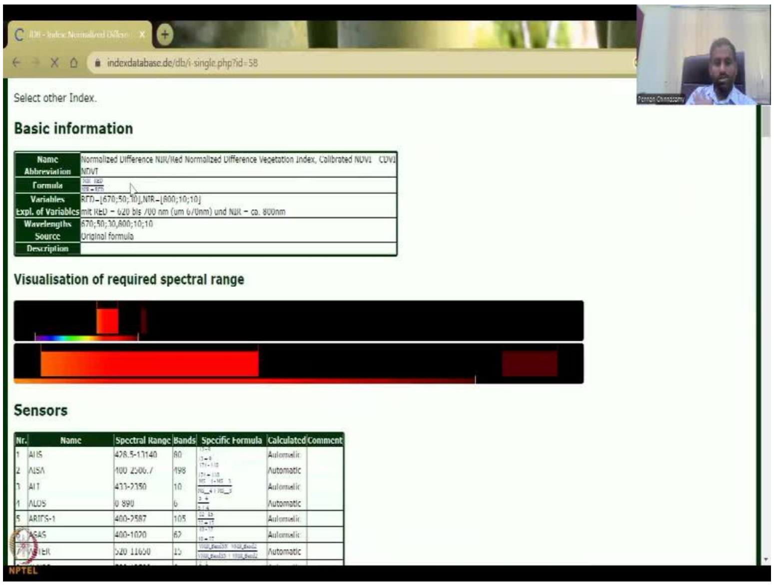

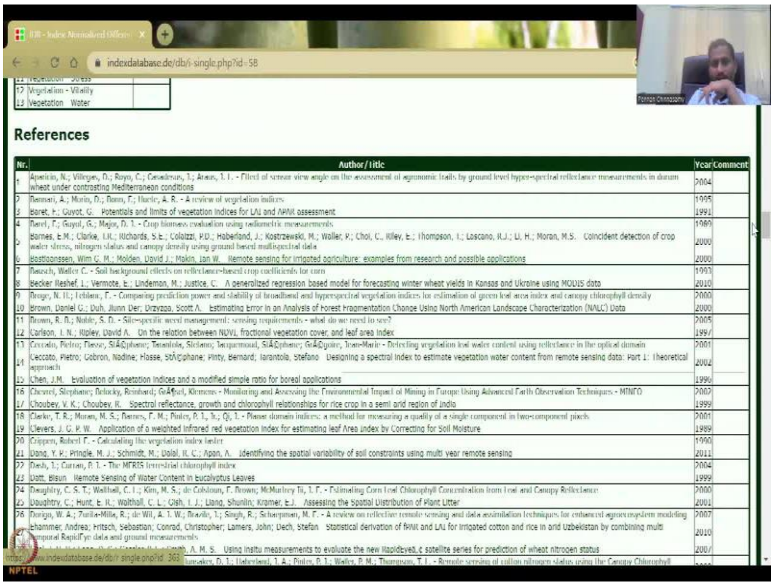

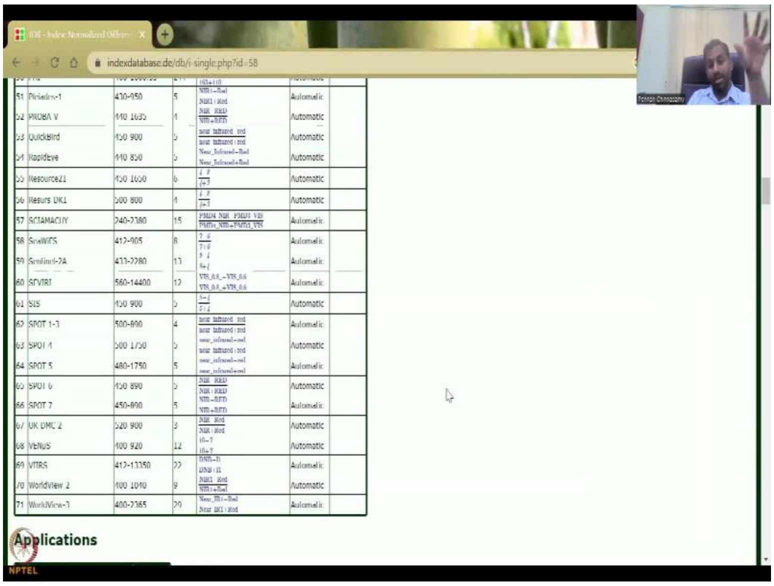

So I am going to go back to the start and then say that it is sensor and application. So how do you combine these two? Let us say I want the very latest, so Sentinel I want, Sentinel 2A, and then I will say what are the applications for that in crop parameters, and then display indices. So you have Greenleaf normal. So now we can club as a search as a query, I want both of them I only want Sentinel 2A and that where is it used for agriculture. So instead of going through all the crop parameters, I can go through this and then say, find what agricultural crop parameters Sentinel are available.

So you can see it, click the indicator, it has a formula, all the sensors that are being used. And then the applications where it can be applied and references. Here is where I feel they have to do more justice is to update these references, still its 2012 date, but again, these are done on voluntary time and so, still what they have as data as links to the data is really-really impressive.

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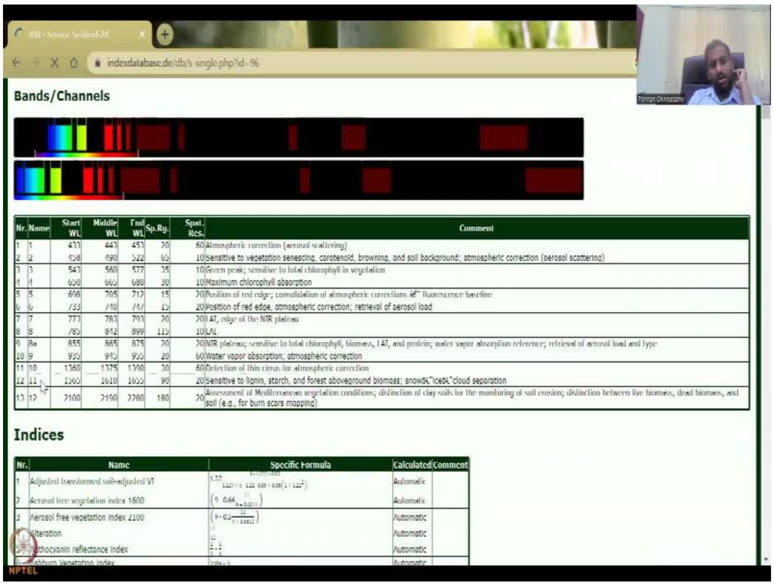
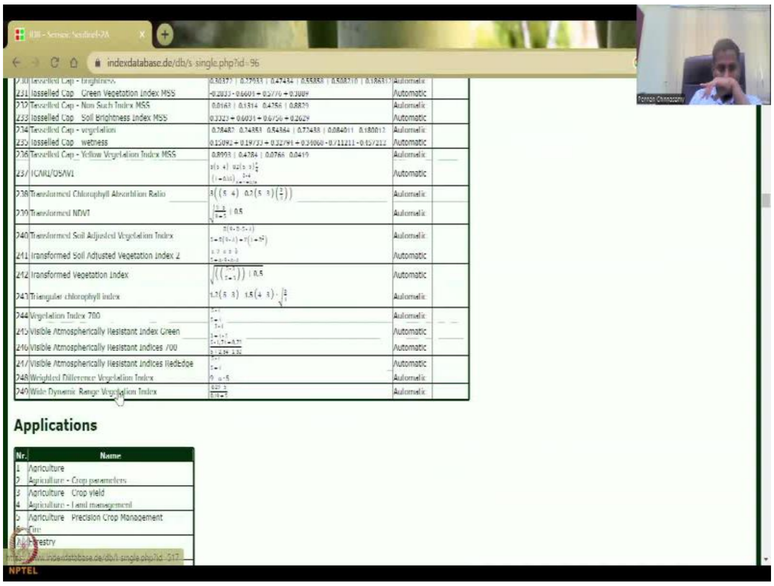
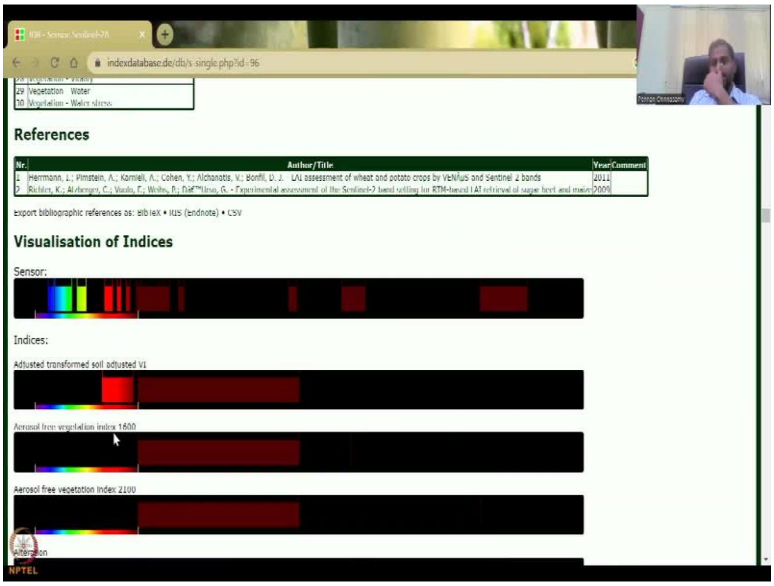
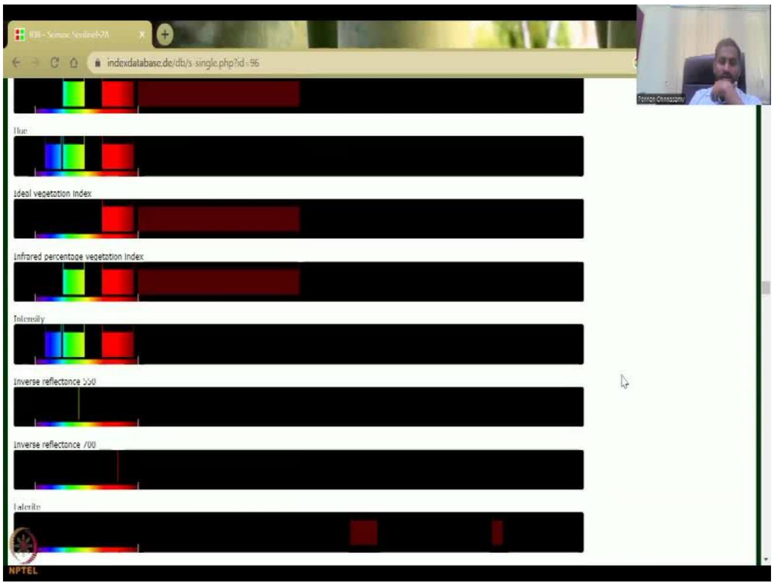





indexdatabase.de/db/s-single.php?id=96
29 Vegetation Water
30 Vegetation - Water stress
References
Nr. | Author/Title | Year | Comment
1 | Herrmann, I.; Pimstein, A.; Karnieli, A.; Cohen, Y.; Alchanatis, V.; Bonfil, D. J. - LAI assessment of wheat and potato crops by VENµS and Sentinel 2 bands | 2011
2 | Richter, K.; Atzberger, C.; Vuolo, F.; Weihs, P.; D'Urso, G. - Experimental assessment of the Sentinel-2 band setting for RTM-based LAI retrieval of sugar beet and maize | 2009
Export bibliographic references as: BibTeX • RIS (Endnote) • CSV
Visualisation of Indices
Sensor:
Indices:
Adjusted transformed soil adjusted VI
Aerosol free vegetation index 1600
Aerosol free vegetation index 2100
NPTEL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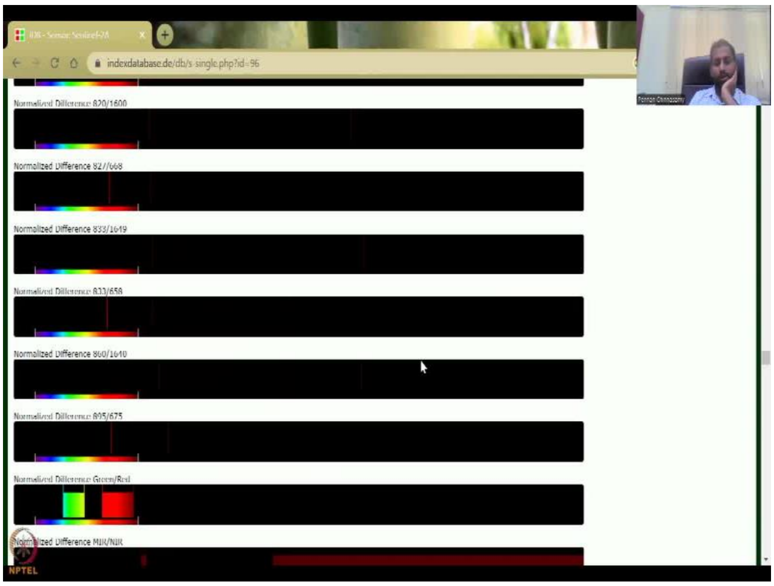
Hue
Ideal vegetation index
Infrared percentage vegetation index
Intensity
Inverse reflectance 550
Inverse reflectance 700
Laterite
NPTEL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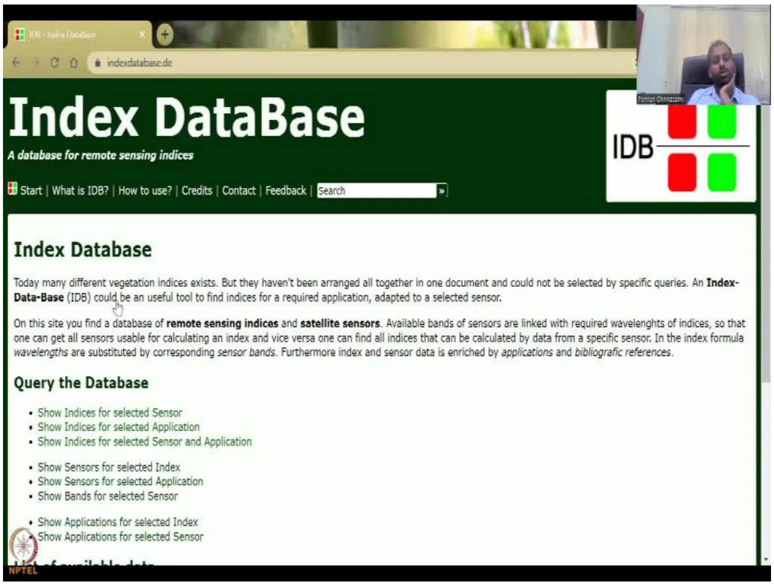
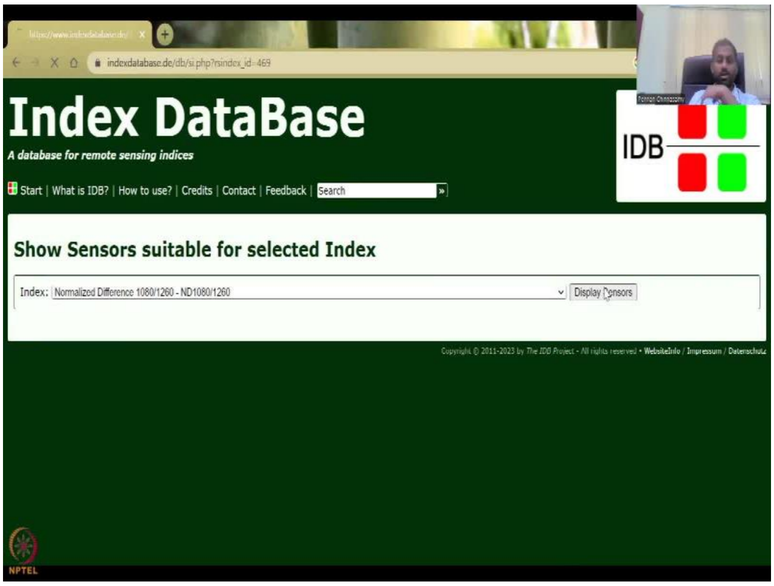
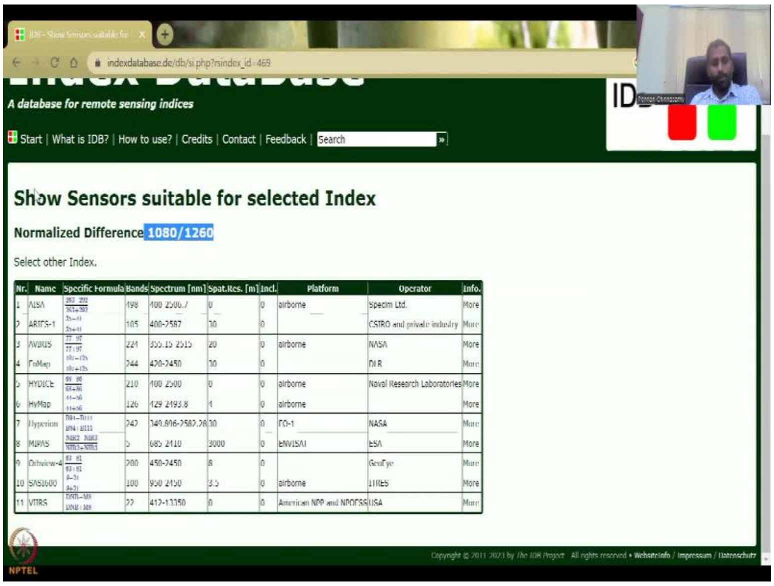
Normalized Difference 820/1600
Normalized Difference 827/668
Normalized Difference 833/1649
Normalized Difference 833/658
Normalized Difference 860/1640
Normalized Difference 895/675
Normalized Difference Green/Red
Normalized Difference MIR/NIR
NPTEL

So, I am going back to Sentinel 2A, you can say what are the channels what are the bands, so, there are 12 bands given as starting wavelength and middle wave, ending wave and so wavelength is arranged. So, if you say green color, it is range of colors and then these are the indicators that have been made using the Sentinel 2A, we saw that to be 249 which is the same here, applications, references etc. So, there stops in 2012 then later add. So, these are the different spectrums, the colors that are available in Sentinel 2A, which we can see here. So all the different types are here.

(Refer Slide Time: 32:03)



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A database for remote sensing indices
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
Show Sensors suitable for selected Index
Normalized Difference 1080/1260
Select other Index.
Nr. Name Specific Formula Bands Spectrum [nm] Spat.Res. [m] Incl. Platform Operator Info.
1 AISA 498 400-2500.7 airborne Specim Ltd. More
2 ARIES-1 105 400-2587 30 CSIRO and private industry More
3 AVIRIS 224 355.15-2515 20 airborne NASA More
4 EnMap 244 420-2450 30 DLR More
5 HYDICE 210 400-2500 airborne Naval Research Laboratories More
6 HyMap 126 airborne More
7 Hyperion 242 30 EO-1 NASA More
8 MERIS ENVISAT ESA More
9 Orbview-4 200 450-2450 8 GeoEye More
10 SASI600 100 950-2450 airborne ITRES More
11 VIIRS 22 American NPP and NPOESS USA More
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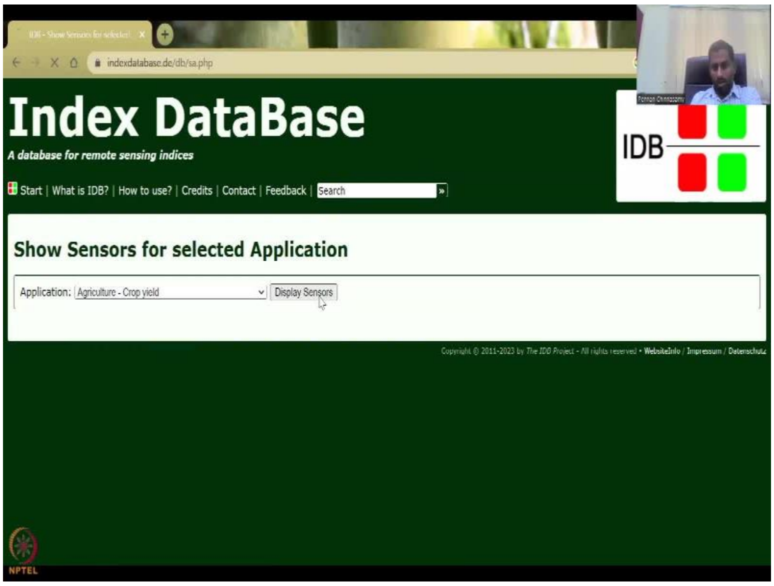
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Index DataBase
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Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Show Sensors for selected Application
Application: Agriculture - Crop yield
Display Sensors
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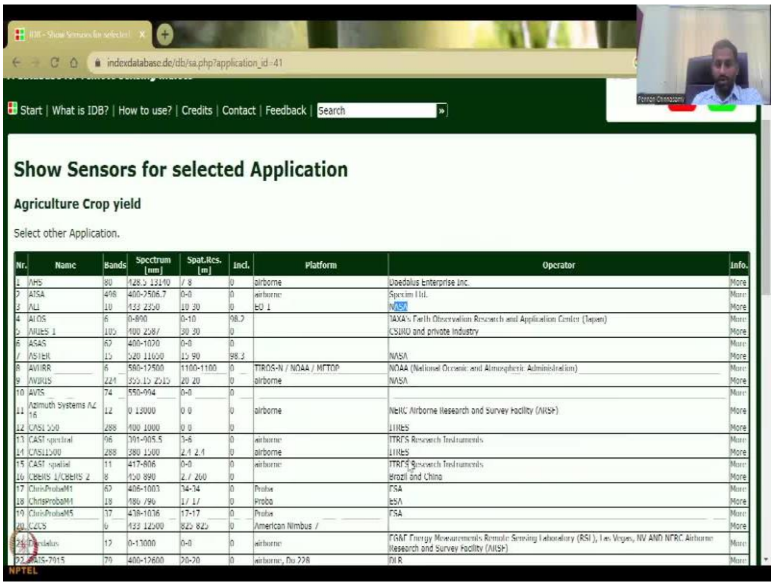
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Agriculture Crop yield
Select other Application.
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1 AHS 80 airborne Duncan Enterprise Inc. More
2 AISA 498 400-2506.7 airborne Specim Ltd. More
3 ALI 10 EO-1 NASA More
4 ALOS JAXA's Earth Observation Research and Application Center (Japan) More
5 ARIES-1 105 400-2587 30-30 CSIRO and private industry More
6 ASAS 62 400-1020 More
7 ASTER NASA More
8 AVHRR 6 TIROS-N / NOAA / METOP NOAA (National Oceanic and Atmospheric Administration) More
9 AVIRIS 224 355.15-2515 20-20 airborne NASA More
10 AVIS More
11 Azimuth Systems AZ-16 12 airborne NERC Airborne Research and Survey Facility (ARSF) More
12 CASI 550 288 ITRES More
13 CASI spectral ITRES Research Instruments More
14 CASI1500 288 airborne ITRES More
15 CASI spatial 11 airborne ITRES Research Instruments More
16 CBERS 1/CBERS 2 Brazil and China More
17 ChrisProbaM1 Proba ESA More
18 ChrisProbaM4 Proba ESA More
19 ChrisProbaM5 Proba ESA More
20 CZCS American Nimbus More
21 Daedalus 12 airborne More
22 DAIS-7915 79 airborne, Do 228 DLR More
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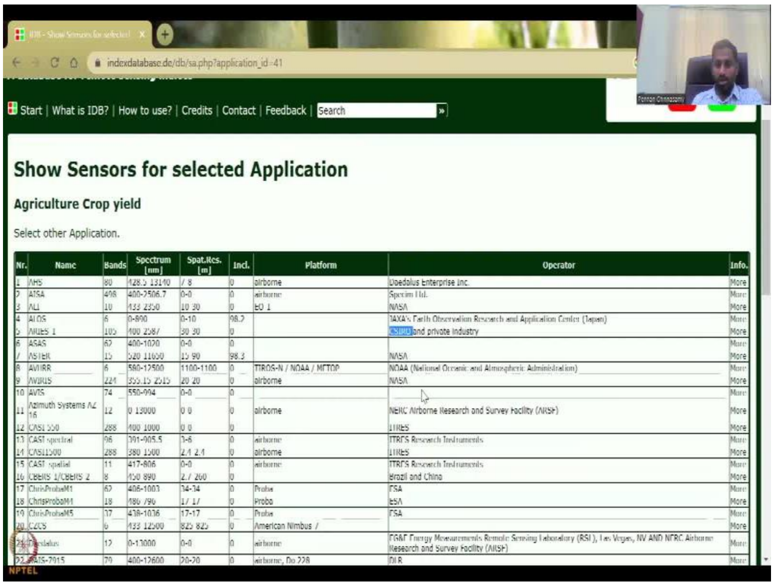
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Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
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Agriculture Crop yield
Select other Application.
Nr. Name Bands Spectrum [nm] Spat.Res. [m] Incl. Platform Operator Info.
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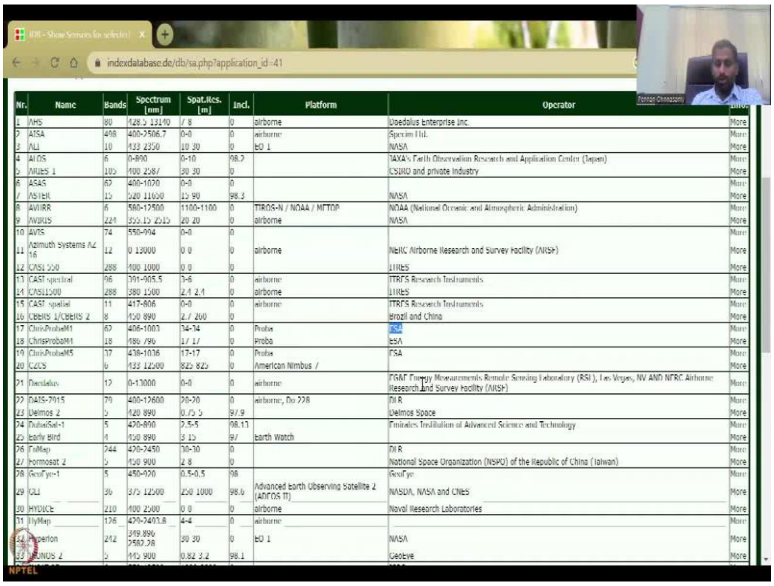
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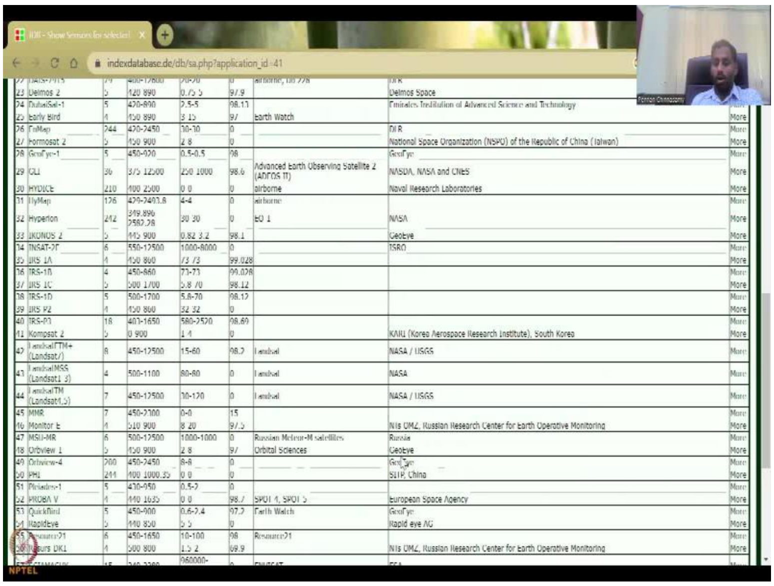
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NPTEL

40	IRS-P3	18	403-1650	580-2520	98.69			
41	Kompsat 2	5	0 900	1 4	0		KARI (Korea Aerospace Research Institute), South Korea	
42	LandsatETM+ (Landsat7)	8	450-12500	15-60	98.2	Landsat	NASA / USGS	More
43	LandsatMSS (Landsat1 3)	4	500-1100	80-80	0	Landsat	NASA	More
44	LandsatTM (Landsat4,5)	7	450-12500	30-120	0	Landsat	NASA / USGS	More
45	MMR	7	450-2300	0-0	15			More
46	Monitor E	4	510 900	8 20	97.5		NIs OMZ, Russian Research Center for Earth Operative Monitoring	More
47	MSU-MR	6	500-12500	1000-1000	0	Russian Meteor-M satellites	Russia	More
48	Orbview 1	5	450 900	2 8	97	Orbital Sciences	GeoEye	More
49	Orbview-4	200	450-2450	8-8	0		GeoEye	More
50	PHI	244	400 1000.35	0 0	0		SITP, China	More
51	Pleiades-1	5	430-950	0.5-2	0			More
52	PROBA V	4	440 1635	0 0	98.7	SPOT 4, SPOT 5	European Space Agency	More
53	QuickBird	5	450-900	0.6-2.4	97.2	Earth Watch	GeoEye	More
54	RapidEye	5	440 850	5 5	0		Rapid eye AG	More
55	Resource21	6	450-1650	10-100	98	Resource21		More
56	Resurs DK1	4	500 800	1.5 2	69.9		NIs OMZ, Russian Research Center for Earth Operative Monitoring	More
57	SCIAMACHY	15	240-2380	960000-960000	0	ENVISAT	ESA	More
58	SeaWIFS	8	412-905	0-0	0	SeaStar/OrbView-2	GeoEye	More
59	Sentinel 2A	13	433 2280	10 60	98.6		ESA	More
60	SEVIRI	12	560-14400	1000-3000	0	MSG (Meteosat Second Generation)		More
61	SIS	5	450 900	1 4	98	Space Imaging		More
62	SPOT 1-3	4	500-890	10-20	0	SPOT		More
63	SPOT 4	5	500 1750	10 20	0	SPOT	CNES (Centre National d'Etudes Spatiales)	More
64	SPOT 5	5	480-1750	2.5-20	98.7	SPOT	CNES (Centre National d'Etudes Spatiales)	More
65	SPOT 6	5	450 890	1.5 6	98.2	AstroSat 500		More
66	SPOT 7	5	450-890	1.5-6	98.2	AstroSat-500		More
67	UK DMC 2	3	520 900	22 22	0		British Surrey Satellite Technology Limited (SSTL), UK	More
68	VENµS	12	400-920	0-0	0			More
69	VIIRS	22	412 13350	0 0	0	American NPP and NPOESS	USA	More
70	WorldView-2	9	400-1040	0.46-0.52	0			More
71	WorldView 3	29	400 2365	0.31 30	0			More

So I will go back to now this part show sensor for selected index. So you can select an index and see what the sensor is available, NDVI, hyper NDVI, so as I said, we already know this because we went to NDVI just NDVI and then we selected the sensor. So these are sensors that give this particular 1080 to 60 NDVI. Then we have show sensors for selected application and then show bands for search terms. So here it is, in the indicators, what are the indicators for the applications here what is the sensor, I am not going to talk about the indicator says let us say what are the sensors that are giving these data? So these are the sensors.

So these are the basic base sensors that are collecting the data and then giving it to you, you do the indicators and then assess the benefits. The operators are here you have NASA for example CSIRO, the Australian company and then you have the ESA, the European Space Space Agency, and then gold eye, geo eye, so etc. are all private and government partnerships etc. So, you have the central nationally tourists specialists CNES, British survey these are part of the ESA also, and the USA for sure the NASA.

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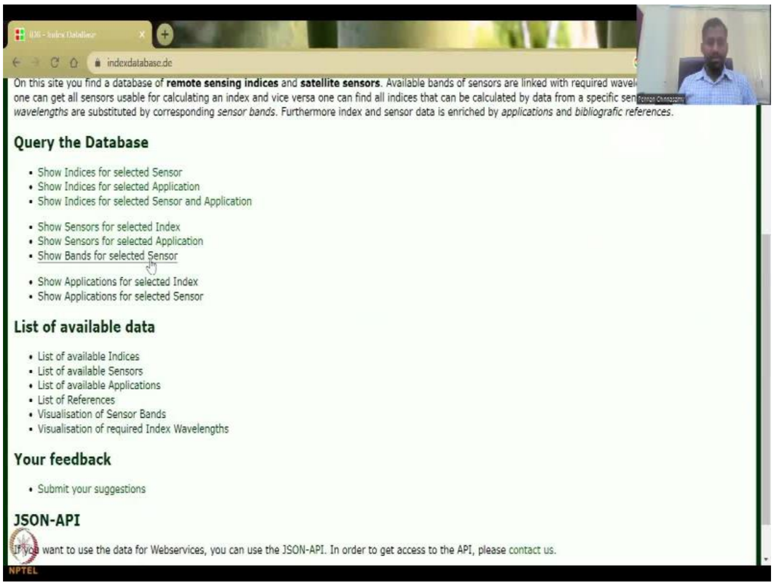

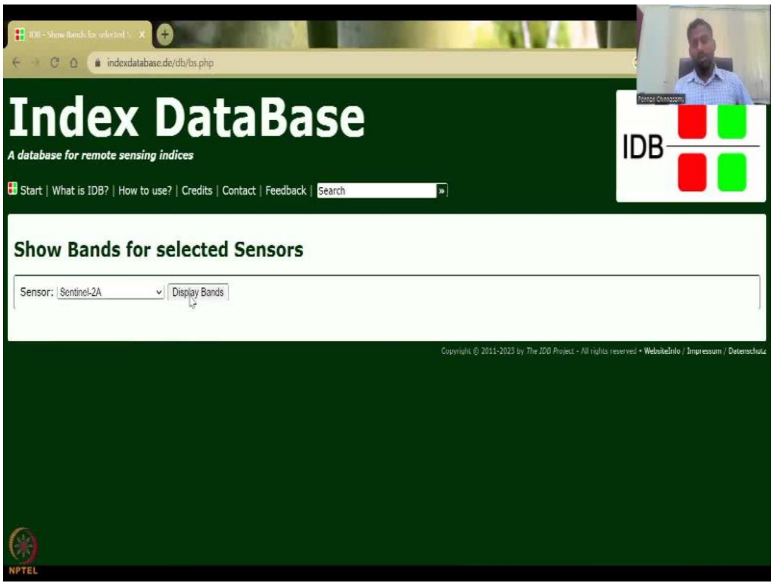

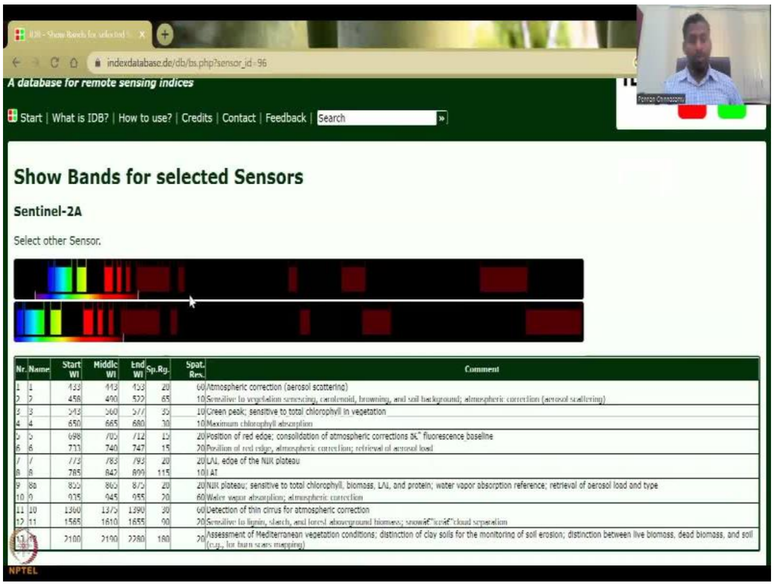

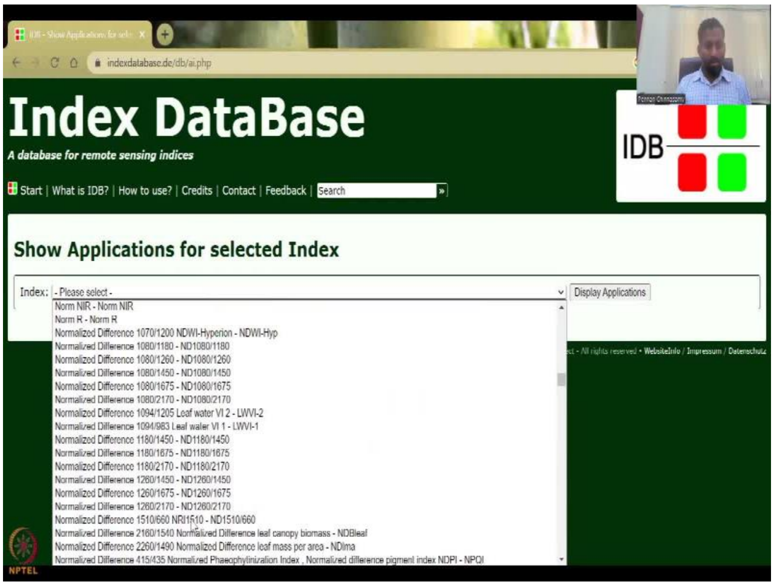
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Index DataBase
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Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Show Applications for selected Index
Index: - Please select -
Display Applications
Norm NIR - Norm NIR
Norm R - Norm R
Normalized Difference 1070/1200 NDWI-Hyperion - NDWI-Hyp
Normalized Difference 1080/1180 - ND1080/1180
Normalized Difference 1080/1260 - ND1080/1260
Normalized Difference 1080/1450 - ND1080/1450
Normalized Difference 1080/1675 - ND1080/1675
Normalized Difference 1080/2170 - ND1080/2170
Normalized Difference 1094/1205 Leaf water VI 2 - LWVI-2
Normalized Difference 1094/983 Leaf water VI 1 - LWVI-1
Normalized Difference 1180/1450 - ND1180/1450
Normalized Difference 1180/1675 - ND1180/1675
Normalized Difference 1180/2170 - ND1180/2170
Normalized Difference 1260/1450 - ND1260/1450
Normalized Difference 1260/1675 - ND1260/1675
Normalized Difference 1260/2170 - ND1260/2170
Normalized Difference 1510/660 NRI1510 - ND1510/660
Normalized Difference 2160/1540 Normalized Difference leaf canopy biomass - NDBleaf
Normalized Difference 2260/1490 Normalized Difference leaf mass per area - NDlma
Normalized Difference 415/435 Normalized Phaeophytinization Index , Normalized difference pigment index NDPI - NPQI
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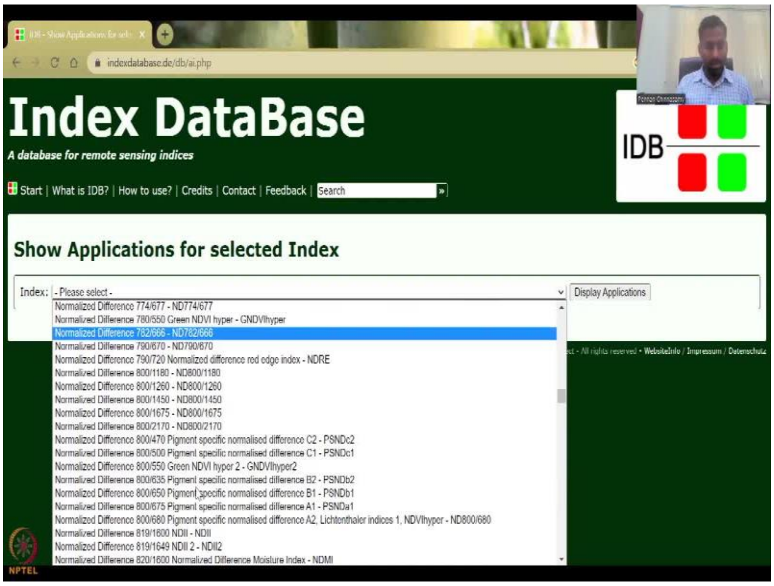
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IDB
Show Applications for selected Index
Index: - Please select -
Display Applications
Normalized Difference 774/677 - ND774/677
Normalized Difference 780/550 Green NDVI hyper - GNDVIhyper
Normalized Difference 782/666 - ND782/666
Normalized Difference 790/670 - ND790/670
Normalized Difference 790/720 Normalized difference red edge index - NDRE
Normalized Difference 800/1180 - ND800/1180
Normalized Difference 800/1260 - ND800/1260
Normalized Difference 800/1450 - ND800/1450
Normalized Difference 800/1675 - ND800/1675
Normalized Difference 800/2170 - ND800/2170
Normalized Difference 800/470 Pigment specific normalised difference C2 - PSNDc2
Normalized Difference 800/500 Pigment specific normalised difference C1 - PSNDc1
Normalized Difference 800/550 Green NDVI hyper 2 - GNDVIhyper2
Normalized Difference 800/635 Pigment specific normalised difference B2 - PSNDb2
Normalized Difference 800/650 Pigment specific normalised difference B1 - PSNDb1
Normalized Difference 800/675 Pigment specific normalised difference A1 - PSNDa1
Normalized Difference 800/680 Pigment specific normalised difference A2, Lichtenthaler indices 1, NDVIhyper - ND800/680
Normalized Difference 819/1600 NDII - NDII
Normalized Difference 819/1649 NDII 2 - NDII2
Normalized Difference 820/1600 Normalized Difference Moisture Index - NDMI
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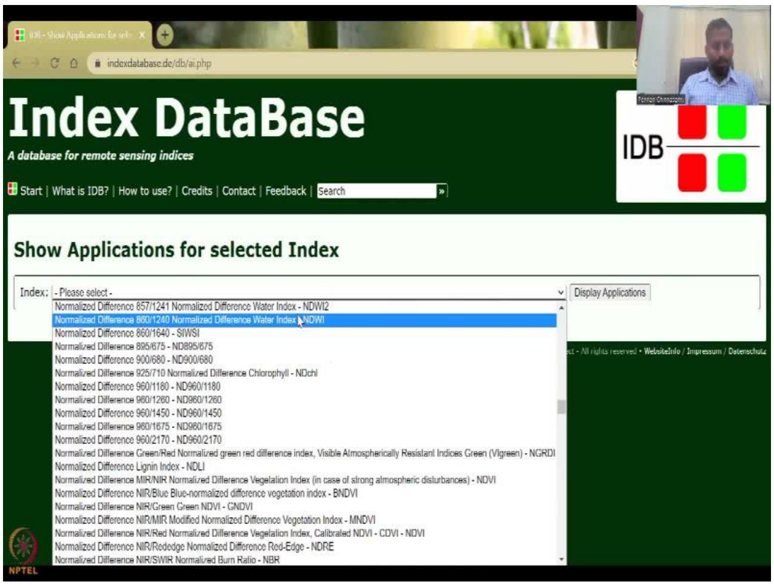
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Index DataBase
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Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Show Applications for selected Index
Index: - Please select -
Display Applications
Normalized Difference 857/1241 Normalized Difference Water Index - NDWI2
Normalized Difference 860/1240 Normalized Difference Water Index - NDWI
Normalized Difference 860/1640 - SIWSI
Normalized Difference 895/675 - ND895/675
Normalized Difference 900/680 - ND900/680
Normalized Difference 925/710 Normalized Difference Chlorophyll - NDchl
Normalized Difference 960/1180 - ND960/1180
Normalized Difference 960/1260 - ND960/1260
Normalized Difference 960/1450 - ND960/1450
Normalized Difference 960/1675 - ND960/1675
Normalized Difference 960/2170 - ND960/2170
Normalized Difference Green/Red Normalized green red difference index, Visible Atmospherically Resistant Indices Green (VIgreen) - NGRDI
Normalized Difference Lignin Index - NDLI
Normalized Difference MIR/NIR Normalized Difference Vegetation Index (in case of strong atmospheric disturbances) - NDVI
Normalized Difference NIR/Blue Blue-normalized difference vegetation index - BNDVI
Normalized Difference NIR/Green Green NDVI - GNDVI
Normalized Difference NIR/MIR Modified Normalized Difference Vegetation Index - MNDVI
Normalized Difference NIR/Red Normalized Difference Vegetation Index, Calibrated NDVI - CDVI - NDVI
Normalized Difference NIR/Rededge Normalized Difference Red-Edge - NDRE
Normalized Difference NIR/SWIR Normalized Burn Ratio - NBR
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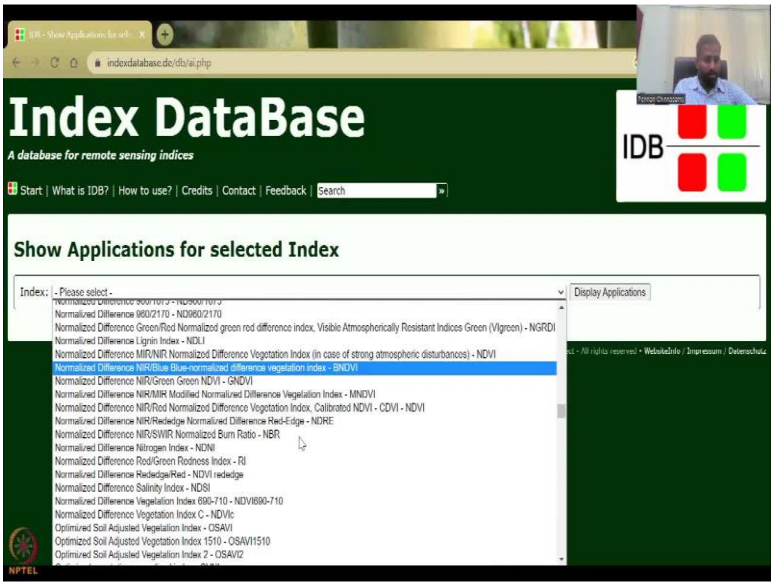

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IDB
Show Applications for selected Index
Index: - Please select -
Display Applications
Normalized Difference 960/2170 - ND960/2170
Normalized Difference Green/Red Normalized green red difference index, Visible Atmospherically Resistant Indices Green (VIgreen) - NGRDI
Normalized Difference Lignin Index - NDLI
Normalized Difference MIR/NIR Normalized Difference Vegetation Index (in case of strong atmospheric disturbances) - NDVI
Normalized Difference NIR/Blue Blue-normalized difference vegetation index - BNDVI
Normalized Difference NIR/Green Green NDVI - GNDVI
Normalized Difference NIR/MIR Modified Normalized Difference Vegetation Index - MNDVI
Normalized Difference NIR/Red Normalized Difference Vegetation Index, Calibrated NDVI - CDVI - NDVI
Normalized Difference NIR/Rededge Normalized Difference Red-Edge - NDRE
Normalized Difference NIR/SWIR Normalized Burn Ratio - NBR
Normalized Difference Nitrogen Index - NDNI
Normalized Difference Red/Green Redness Index - RI
Normalized Difference Rededge/Red - NDVI rededge
Normalized Difference Salinity Index - NDSI
Normalized Difference Vegetation Index 690-710 - NDVI690-710
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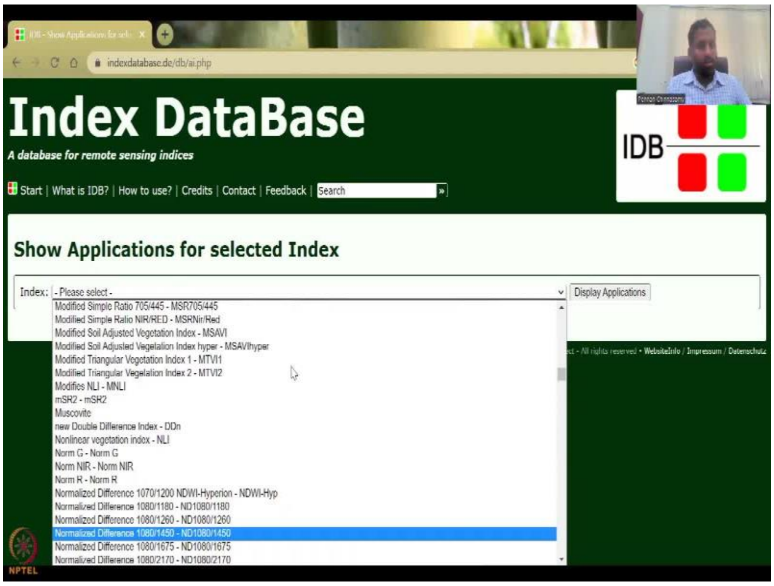

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IDB
Show Applications for selected Index
Index: - Please select -
Display Applications
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Modified Simple Ratio NIR/RED - MSRNir/Red
Modified Soil Adjusted Vegetation Index - MSAVI
Modified Soil Adjusted Vegetation Index hyper - MSAVIhyper
Modified Triangular Vegetation Index 1 - MTVI1
Modified Triangular Vegetation Index 2 - MTVI2
Modifies NLI - MNLI
mSR2 - mSR2
Muscovite
new Double Difference Index - DDn
Nonlinear vegetation index - NLI
Norm G - Norm G
Norm NIR - Norm NIR
Norm R - Norm R
Normalized Difference 1070/1200 NDWI-Hyperion - NDWI-Hyp
Normalized Difference 1080/1180 - ND1080/1180
Normalized Difference 1080/1260 - ND1080/1260
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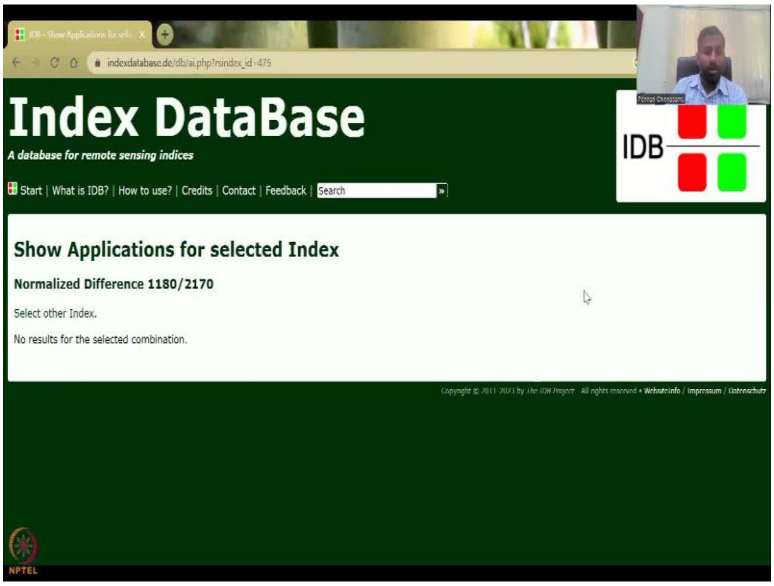

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Normalized Difference 1180/2170
Select other Index.
No results for the selected combination.
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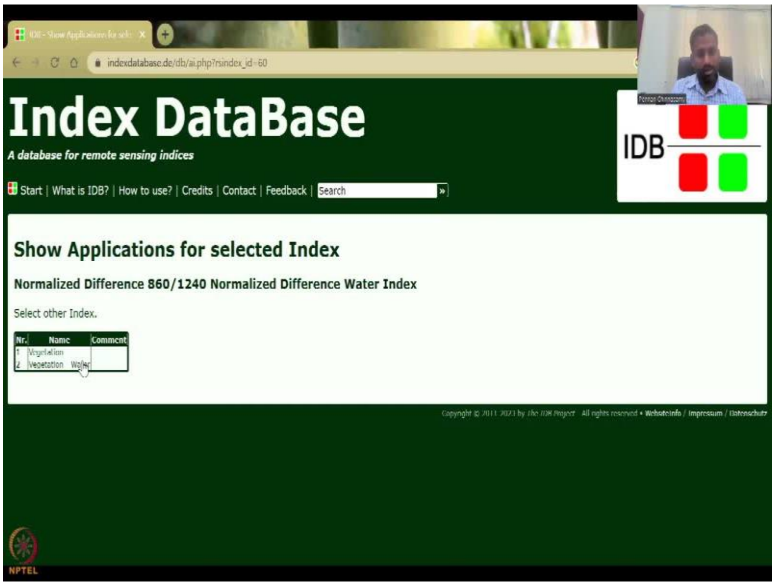
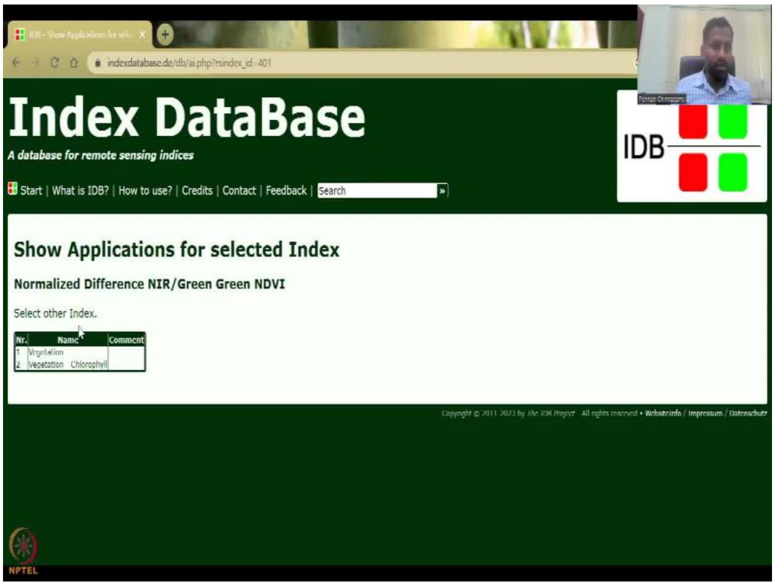
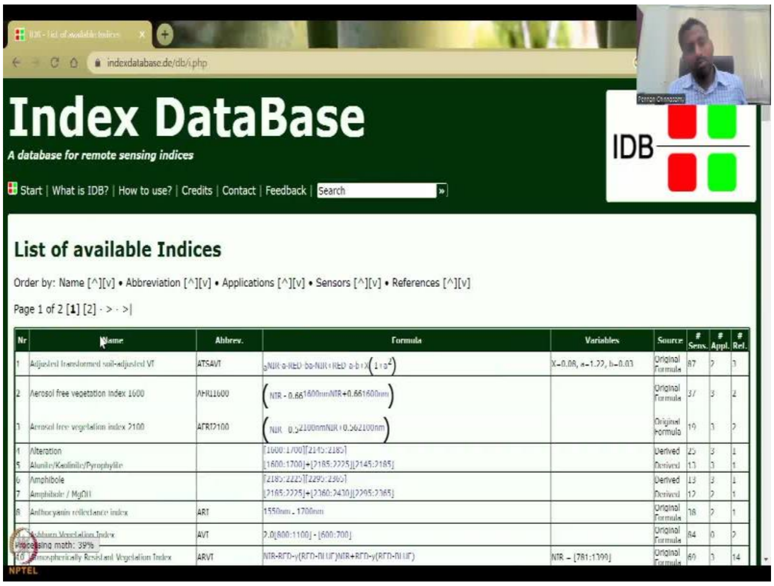


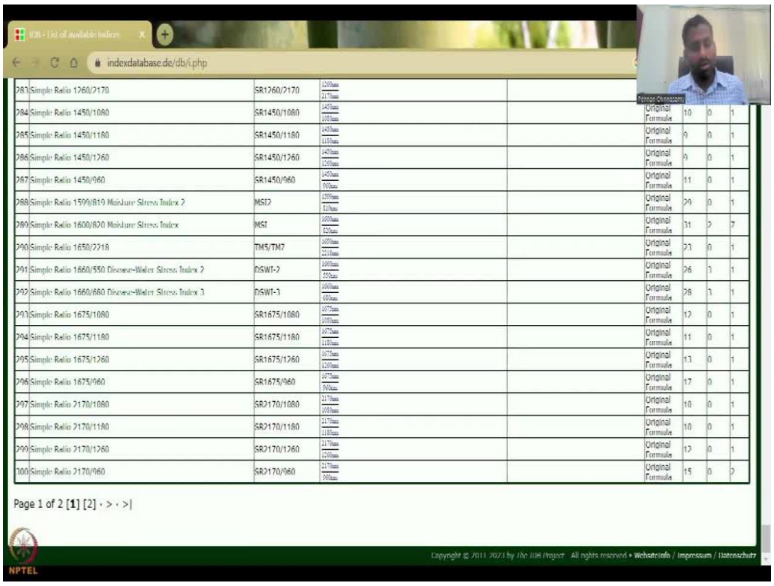


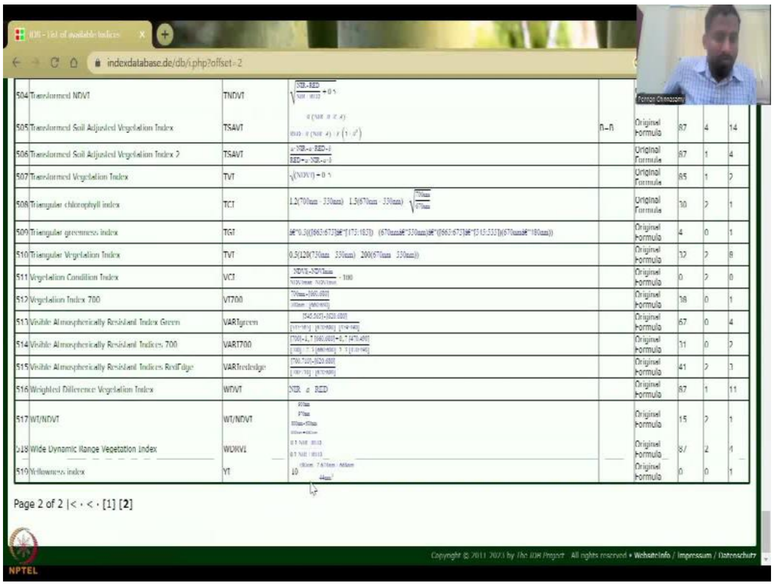
So then we go to bands for selector sensor what is the bands that are available as we do not know sometimes we have to search so for example, we did search for Sentinel in the previous lecture just to make sure that we are in the correct domain. And here are the bands, so it has around 13 bands, 8, 8 a, etc. 8 is around the NAI region and it gives you the colors of these bands where the bands are coming which is visible plus the near infrared or VNIR we do have some sensors for that. So we have all these and then we have show applications for selected index or show applications for selected sensor, index we can do. We can say again NDVI modified NDVI is there and just the normalized vegetation difference index NDVI. We have the NDWI reference Water Index, and then all the NDVI's are here.

Pan NDVI, PNDVI optimized, so you can just choose a particular NDVI and then see if it actually works along, so let us say I am going to choose this one display the applications where can be applied. No, do a random search for another one. We do not know that NDVI, NDWI, we know the applications, vegetation and water. So it picks up again, the, I do not see it getting updated from 2012, which is okay, at least this part, you can get it from literature, surveys and stuff. So all these NDVI's are getting really good applications, G NDVI is for vegetation and chlorophyll, you can get that information also.

(Refer Slide Time: 35:26)

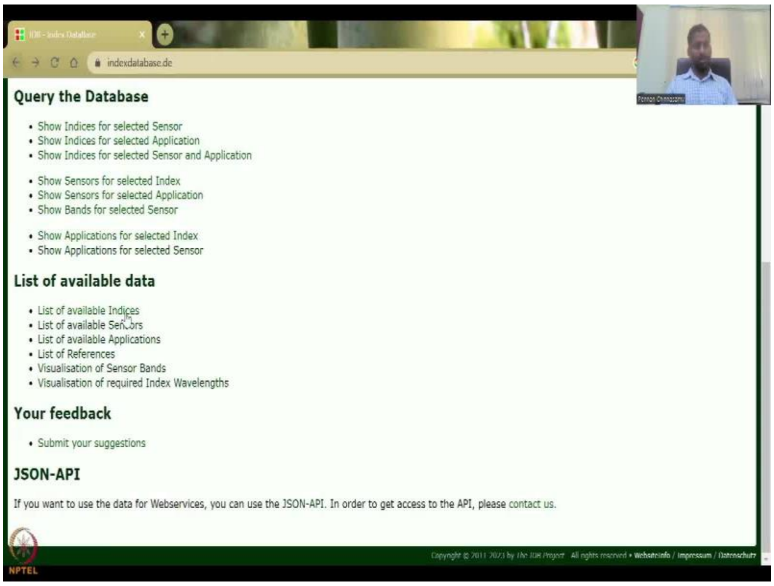


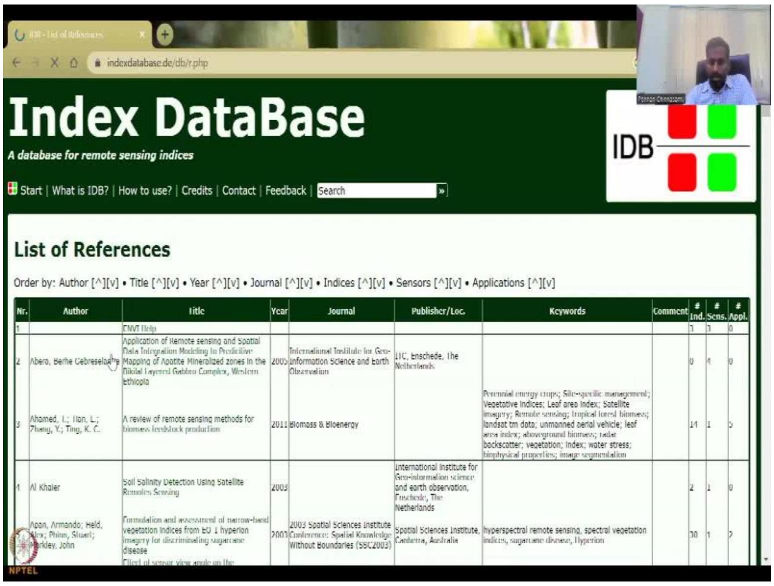




So these are the show applications by index, show application by sensor, list of data available, indices available references, indices is this list that we had, and you can look at how many sensors indicators are there, all these are driven by remote sensing indicators, we have 300, I would say 300 plus, let us see how big it is. Yes around 590 indicators, and all of them driven by remote sensing. So if you want to use these indicators, if you know someone has told about an indicator for rural development, can directly come here, look at the formula, click on the indicator, it will take you to the references, go back and then get it. So the most important is the formula, how to do it? We have already done it in class using that pasture calculator.

(Refer Slide Time: 36:20)





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List of References

Order by: Author [^][v] • Title [^][v] • Year [^][v] • Journal [^][v] • Indices [^][v] • Sensors [^][v] • Applications [^][v]

Nr.	Author	Title	Year	Journal	Publisher/Loc.	Keywords	Comment	# Ind.	# Scns.	# Appl.
1		ENVI Help						1	1	0
2	Abera, Berhe Gebreselassie	Application of Remote sensing and Spatial Data Integration Modeling to Predictive Mapping of Apatite Mineralized zones in the Bikilal Layered Gabbro Complex, Western Ethiopia	2005	International Institute for Geo-information Science and Earth Observation	ITC, Enschede, The Netherlands			0	4	0
3	Ahamed, T.; Tian, L.; Zhang, Y.; Ting, K. C.	A review of remote sensing methods for biomass feedstock production	2011	Biomass & Bioenergy		Perennial energy crops; Site-specific management; Vegetative indices; Leaf area index; Satellite imagery; Remote sensing; Tropical forest biomass; landsat tm data; unmanned aerial vehicle; leaf area index; aboveground biomass; radar backscatter; vegetation; index; water stress; biophysical properties; image segmentation		14	1	5
4	Al Khaier	Soil Salinity Detection Using Satellite Remote Sensing	2003		International Institute for Geo-information science and earth observation, Enschede, The Netherlands			2	1	0
5	Apan, Armando; Held, Alex; Phinn, Stuart; Markley, John	Formulation and assessment of narrow-band vegetation indices from EO 1 hyperion imagery for discriminating sugarcane disease	2003	2003 Spatial Sciences Institute Conference: Spatial Knowledge Without Boundaries (SSC2003)	Spatial Sciences Institute, Canberra, Australia	hyperspectral remote sensing, spectral vegetation indices, sugarcane disease, Hyperion		30	1	2
		Effect of sensor view angle on the								

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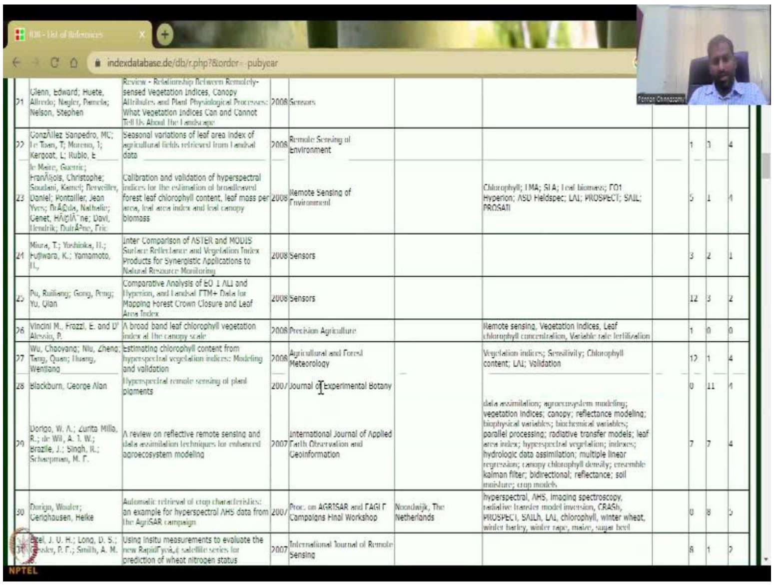

IDB - List of References

indexdatabase.de/db/r.php?&order=-pubyear

Nr.	Author	Title	Year	Journal	Publisher/Loc.	Keywords	Comment	# Ind.	# Scns.	# Appl.
21	Glenn, Edward; Huete, Alfredo; Nagler, Pamela; Nelson, Stephen	Review - Relationship Between Remotely-sensed Vegetation Indices, Canopy Attributes and Plant Physiological Processes: What Vegetation Indices Can and Cannot Tell Us About the Landscape	2008	Sensors						
22	GonzÃ¡lez Sanpedro, MC; Le Toan, T; Moreno, J; Kergoat, L; Rubio, E	Seasonal variations of leaf area index of agricultural fields retrieved from Landsat data	2008	Remote Sensing of Environment				1	1	4
23	le Maire, Guerric; FranÃ§ois, Christophe; Soudani, Kamel; Berveiller, Daniel; Pontailler, Jean Yves; BrÃ©da, Nathalie; Genet, HÃ©lÃ¨ne; Davi, Hendrik; DufrÃªne, Eric	Calibration and validation of hyperspectral indices for the estimation of broadleaved forest leaf chlorophyll content, leaf mass per area, leaf area index and leaf canopy biomass	2008	Remote Sensing of Environment		Chlorophyll; LMA; SLA; Leaf biomass; EO1 Hyperion; ASD Fieldspec; LAI; PROSPECT; SAIL; PROSAIL		5	1	4
24	Miura, T.; Yoshioka, H.; Fujiwara, K.; Yamamoto, H.,	Inter Comparison of ASTER and MODIS Surface Reflectance and Vegetation Index Products for Synergistic Applications to Natural Resource Monitoring	2008	Sensors				3	2	1
25	Pu, Ruiliang; Gong, Peng; Yu, Qian	Comparative Analysis of EO 1 ALI and Hyperion, and Landsat ETM+ Data for Mapping Forest Crown Closure and Leaf Area Index	2008	Sensors				12	3	2
26	Vincini M., Frazzi, E. and D' Alessio, P.	A broad band leaf chlorophyll vegetation index at the canopy scale	2008	Precision Agriculture		Remote sensing, Vegetation indices, Leaf chlorophyll concentration, Variable rate fertilization		1	0	0
27	Wu, Chaoyang; Niu, Zheng; Tang, Quan; Huang, Wenjiang	Estimating chlorophyll content from hyperspectral vegetation indices: Modeling and validation	2008	Agricultural and Forest Meteorology		Vegetation indices; Sensitivity; Chlorophyll content; LAI; Validation		12	1	4
28	Blackburn, George Alan	Hyperspectral remote sensing of plant pigments	2007	Journal of Experimental Botany				0	11	4
29	Dorigo, W. A.; Zurita Milla, R.; de Wit, A. J. W.; Brazile, J.; Singh, R.; Schaepman, M. E.	A review on reflective remote sensing and data assimilation techniques for enhanced agroecosystem modeling	2007	International Journal of Applied Earth Observation and Geoinformation		data assimilation; agroecosystem modeling; vegetation indices; canopy; reflectance modeling; biophysical variables; biochemical variables; parallel processing; radiative transfer models; leaf area index; hyperspectral vegetation; indexes; hydrologic data assimilation; multiple linear regression; canopy chlorophyll density; ensemble kalman filter; bidirectional; reflectance; soil moisture; crop models		7	7	4
30	Dorigo, Wouter; Gerighausen, Heike	Automatic retrieval of crop characteristics: an example for hyperspectral AHS data from the AgriSAR campaign	2007	Proc. on AGRISAR and EAGLE Campaigns Final Workshop	Noordwijk, The Netherlands	hyperspectral, AHS, imaging spectroscopy, radiative transfer model inversion, CRASh, PROSPECT, SAILh, LAI, chlorophyll, winter wheat, winter barley, winter rape, maize, sugar beet		0	8	5
31	Eitel, J. U. H.; Long, D. S.; Gessler, P. E.; Smith, A. M. S.	Using insitu measurements to evaluate the new RapidEye satellite series for prediction of wheat nitrogen status	2007	International Journal of Remote Sensing				8	1	2

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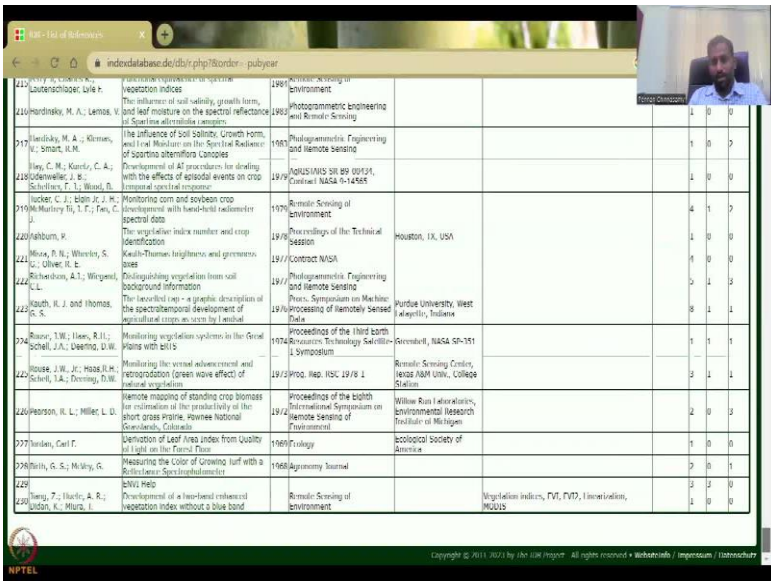

IDB - List of References

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Nr.	Author	Title	Year	Journal	Publisher/Loc.	Keywords	Comment	# Ind.	# Scns.	# Appl.
215	Perry Jr, Charles R.; Lautenschlager, Lyle F.	Functional equivalence of spectral vegetation indices	1984	Remote Sensing of Environment						
216	Hardinsky, M. A.; Lemas, V.	The influence of soil salinity, growth form, and leaf moisture on the spectral reflectance of Spartina alterniflora canopies	1983	Photogrammetric Engineering and Remote Sensing				1	0	0
217	Hardisky, M. A.; Klemas, V.; Smart, R.M.	The Influence of Soil Salinity, Growth Form, and Leaf Moisture on the Spectral Radiance of Spartina alterniflora Canopies	1983	Photogrammetric Engineering and Remote Sensing				1	0	2
218	Hay, C. M.; Kuretz, C. A.; Odenweller, J. B.; Scheffner, E. J.; Wood, B.	Development of AI procedures for dealing with the effects of episodal events on crop temporal spectral response	1979	AgRISTARS SR B9 00434, Contract NASA 9-14565				1	0	0
219	Tucker, C. J.; Elgin Jr, J. H.; McMurtrey Iii, J. E.; Fan, C. J.	Monitoring corn and soybean crop development with hand-held radiometer spectral data	1979	Remote Sensing of Environment				4	1	2
220	Ashburn, P.	The vegetative index number and crop identification	1978	Proceedings of the Technical Session	Houston, TX, USA			1	0	0
221	Misra, P. N.; Wheeler, S. G.; Oliver, R. E.	Kauth-Thomas brightness and greenness axes	1977	Contract NASA				4	0	0
222	Richardson, A.J.; Wiegand, C.L.	Distinguishing vegetation from soil background information	1977	Photogrammetric Engineering and Remote Sensing				5	1	3
223	Kauth, R. J. and Thomas, G. S.	The tasselled cap - a graphic description of the spectraltemporal development of agricultural crops as seen by Landsat	1976	Procs. Symposium on Machine Processing of Remotely Sensed Data	Purdue University, West Lafayette, Indiana			8	1	1
224	Rouse, J.W.; Haas, R.H.; Schell, J.A.; Deering, D.W.	Monitoring vegetation systems in the Great Plains with ERTS	1974	Proceedings of the Third Earth Resources Technology Satellite-1 Symposium	Greenbelt, NASA SP-351			1	1	1
225	Rouse, J.W., Jr.; Haas,R.H.; Schell, J.A.; Deering, D.W.	Monitoring the vernal advancement and retrogradation (green wave effect) of natural vegetation	1973	Prog. Rep. RSC 1978 1	Remote Sensing Center, Texas A&M Univ., College Station			3	1	1
226	Pearson, R. L.; Miller, L. D.	Remote mapping of standing crop biomass for estimation of the productivity of the short grass Prairie, Pawnee National Grasslands, Colorado	1972	Proceedings of the Eighth International Symposium on Remote Sensing of Environment	Willow Run Laboratories, Environmental Research Institute of Michigan			2	0	3
227	Jordan, Carl F.	Derivation of Leaf Area Index from Quality of Light on the Forest Floor	1969	Ecology	Ecological Society of America			1	0	0
228	Birth, G. S.; McVey, G.	Measuring the Color of Growing Turf with a Reflectance Spectrophotometer	1968	Agronomy Journal				2	0	1
229		ENVI Help						3	3	0
230	Jiang, Z.; Huete, A. R.; Didan, K.; Miura, T.	Development of a two-band enhanced vegetation index without a blue band		Remote Sensing of Environment		Vegetation indices, EVI, EVI2, Linearization, MODIS		1	0	0

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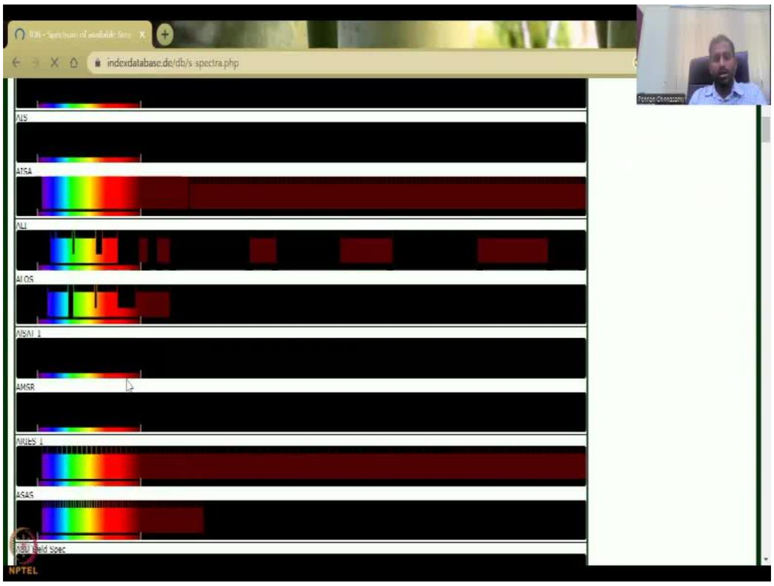
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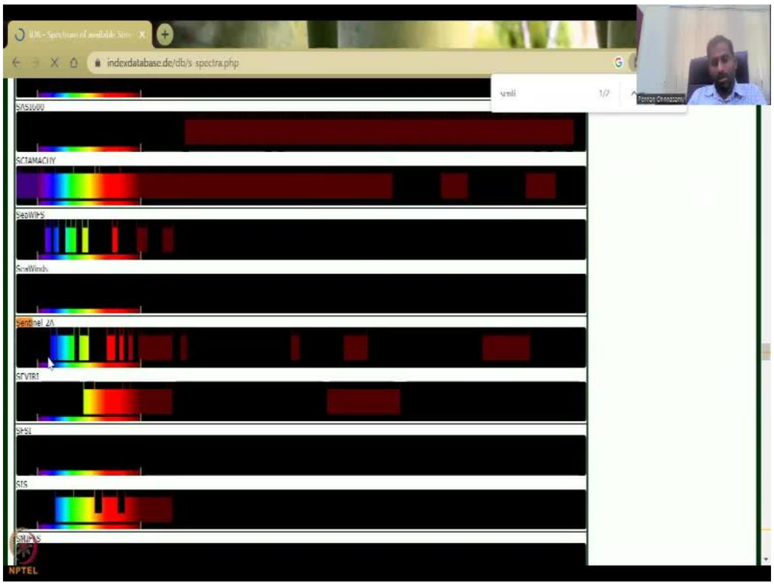
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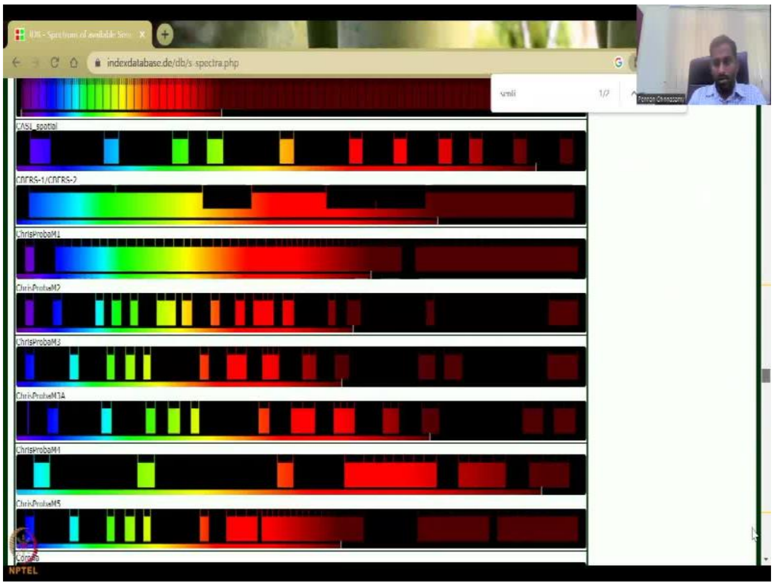
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ChrisProbaM3A
ChrisProbaM4
ChrisProbaM5
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So these are the lists and then the list of the other indicators, indices, sensors, applications, lists of references, what they have been using as references, as I said, most of it is all of it is year. Let us see the latest they have the earliest is 1960s. The latest is 2011, because the website was done in 2012, they have not updated the references, but the indicators are getting updated because you can see that they are updating all the indicators. And then visualization of sensor bands, you can see how the bands are there for a particular satellite sensor. And examples Sentinel, so for Sentinel these are the bands that are in the sensors, not all of it is covered. So the wavelength goes in the bottom in the x axis, again, it is just still populating all these sensors are taken here. So think about how many datasets they would have used together.

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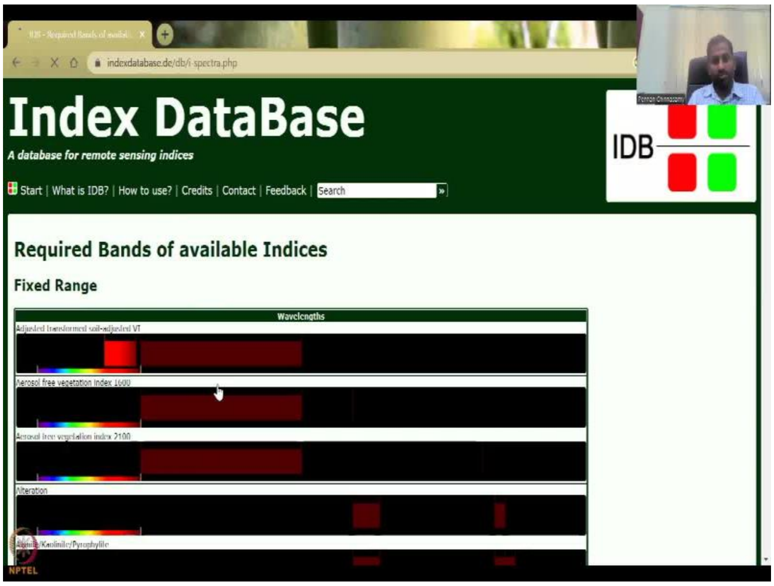

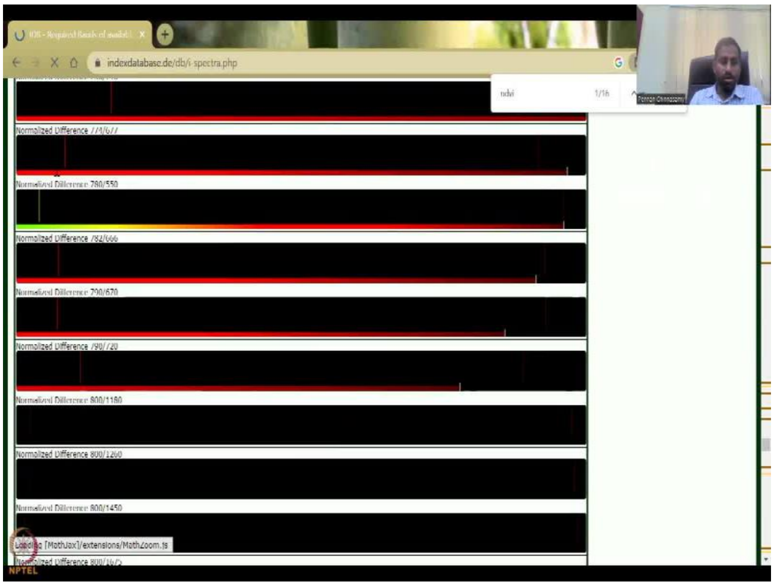
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Normalized Difference 774/677
Normalized Difference 780/550
Normalized Difference 782/666
Normalized Difference 790/670
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Normalized Difference 800/1180
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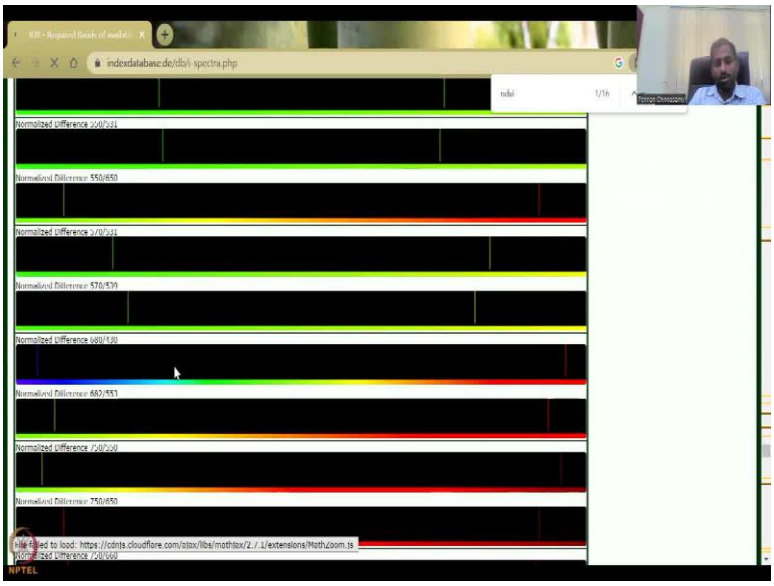
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Normalized Difference 682/553
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Normalized Difference 960/1260
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Normalized Difference 960/1675
Normalized Difference 960/2170
Normalized Difference Green/Red
Normalized Difference Lignin Index
Normalized Difference MIR/NIR
Normalized Difference NIR/Blue
Normalized Difference NIR/Green
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So if you look at this worldview, it has all these big, big colors, big big bands, and that is why it is expensive, it is not free, you will have to pay for these worldview kind of sensors. In the visualization required index wavelengths, you can visualize that for a particular indicator and stuff, where what are the wavelengths that you need, what are the bands that you need, this is the visible, but you need some in the near visible range also as indicated here. Most of it you can cover by using your normal available indicators. There is a lot of information, lot of data available here normal difference in the width the green is this one by 575, 539, I can see how it is getting populated. And as you would expect, there is also in the red region.

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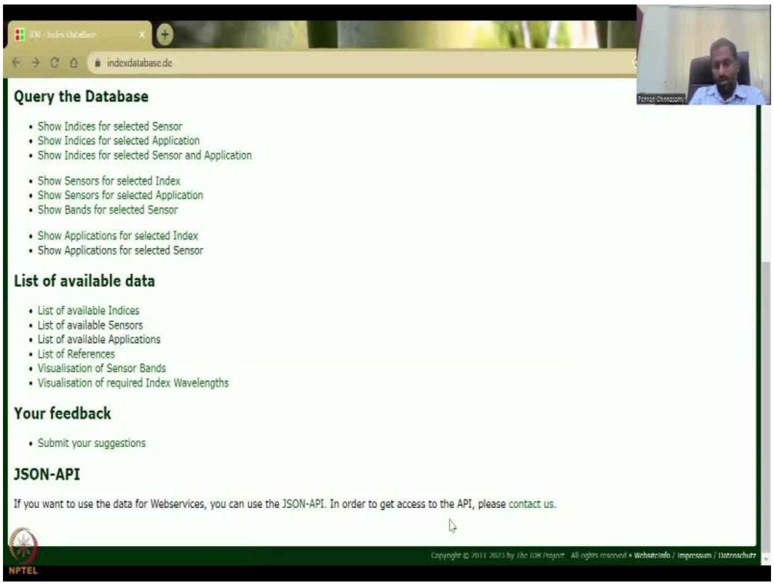

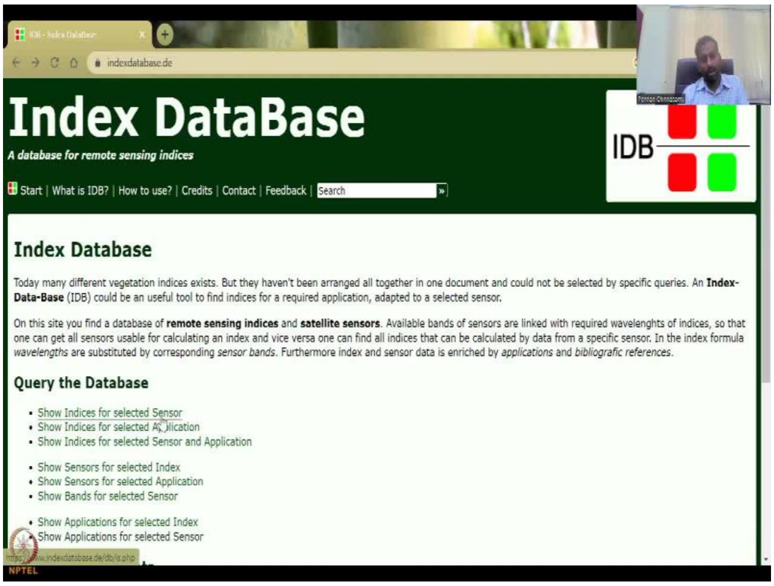

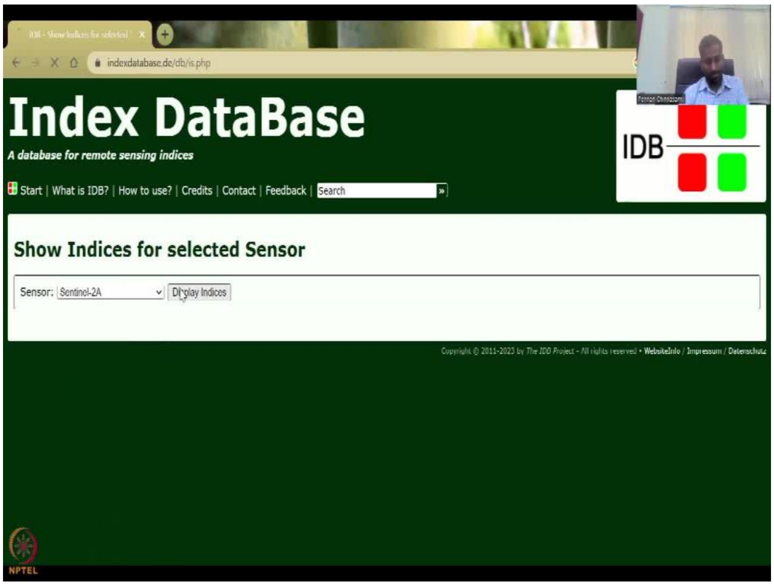
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Index DataBase
A database for remote sensing indices
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
IDB
Show Indices for selected Sensor
Sensor: Sentinel-2A
Display Indices
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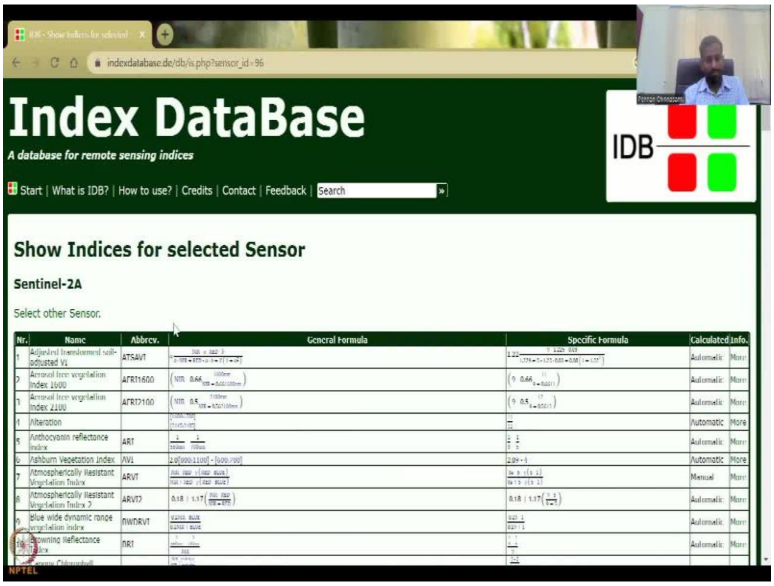
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Sentinel-2A
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General Formula
Specific Formula
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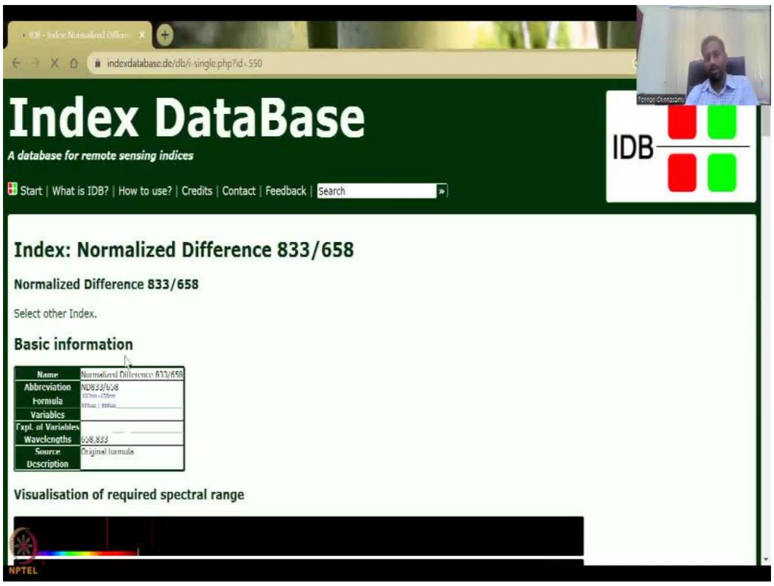
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A database for remote sensing indices
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Normalized Difference 833/658
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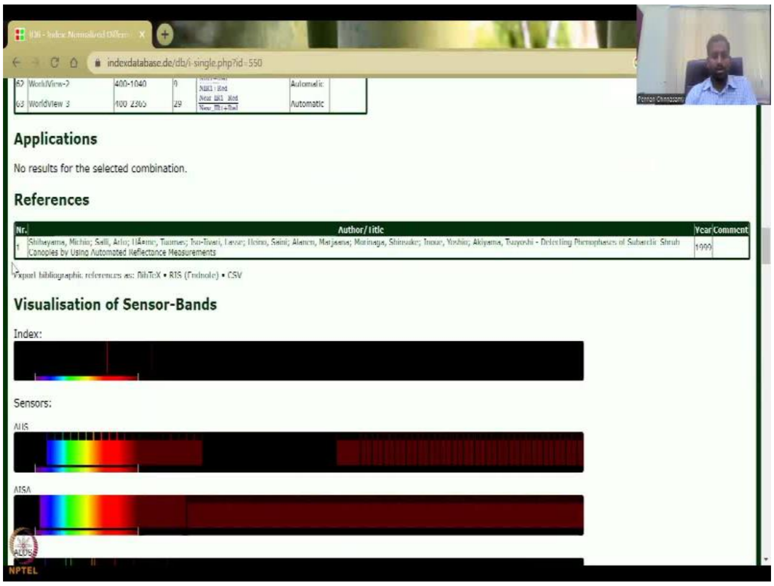
Basic information
Name
Abbreviation
Formula
Variables
Expl. of Variables
Wavelengths
Source
Description
Visualisation of required spectral range
NPTEL



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62 WorldView-2 400-1040 9 Automatic
63 WorldView-3 400-2365 29 Automatic
Applications
No results for the selected combination.
References
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1 Shibayama, Michio; Salli, Arto; Häme, Tuomas; Iso-Iivari, Lasse; Heino, Saini; Alanen, Marjaana; Morinaga, Shinsuke; Inoue, Yoshio; Akiyama, Tsuyoshi - Detecting Phenophases of Subarctic Shrub Canopies by Using Automated Reflectance Measurements 1999
Export bibliographic references as: BibTeX • RIS (Endnote) • CSV
Visualisation of Sensor-Bands
Index:
Sensors:
ALIS
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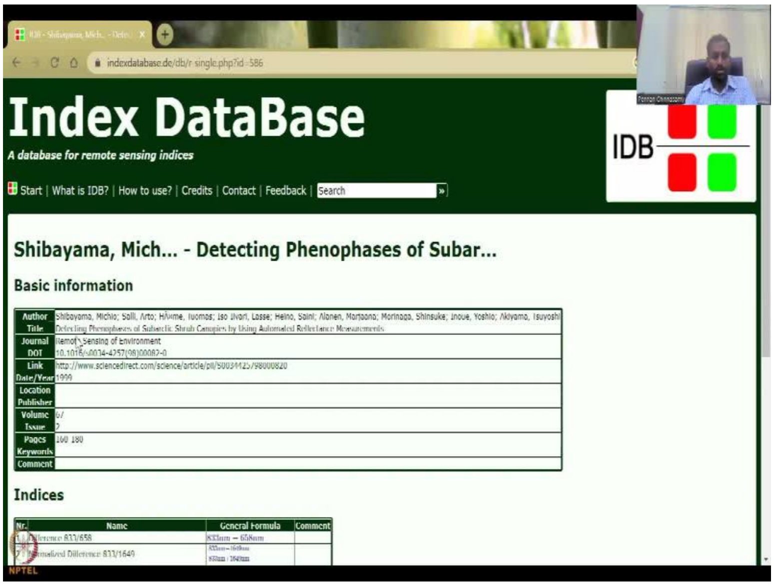

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Index DataBase
A database for remote sensing indices
IDB
Start | What is IDB? | How to use? | Credits | Contact | Feedback | Search
Shibayama, Mich... - Detecting Phenophases of Subar...
Basic information
Author Shibayama, Michio; Salli, Arto; Häme, Tuomas; Iso Iivari, Lasse; Heino, Saini; Alanen, Marjaana; Morinaga, Shinsuke; Inoue, Yoshio; Akiyama, Tsuyoshi
Title Detecting Phenophases of Subarctic Shrub Canopies by Using Automated Reflectance Measurements
Journal Remote Sensing of Environment
DOI 10.1016/s0034-4257(98)00082-0
Link http://www.sciencedirect.com/science/article/pii/S0034425798000820
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Location
Publisher
Volume 67
Issue 2
Pages 160-180
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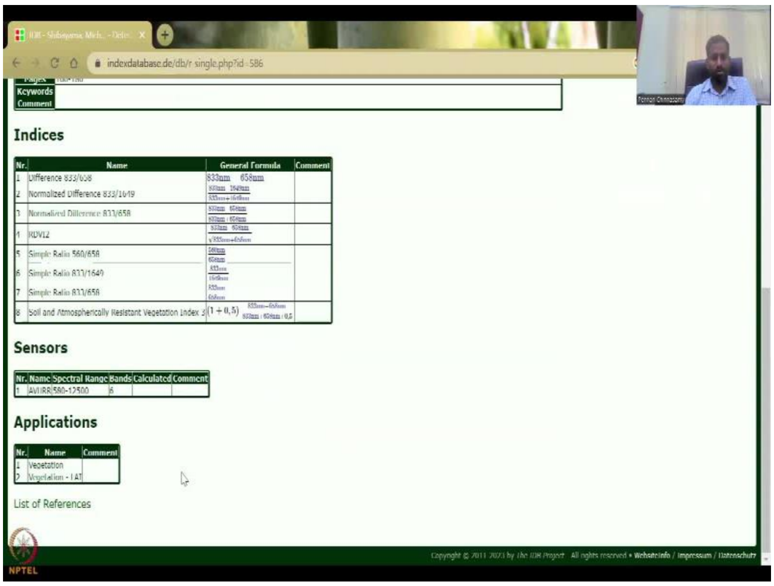
NPTEL



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4 RDVI2
5 Simple Ratio 560/658
6 Simple Ratio 833/1649
7 Simple Ratio 833/658
8 Soil and Atmospherically Resistant Vegetation Index 3 (1 + 0,5)
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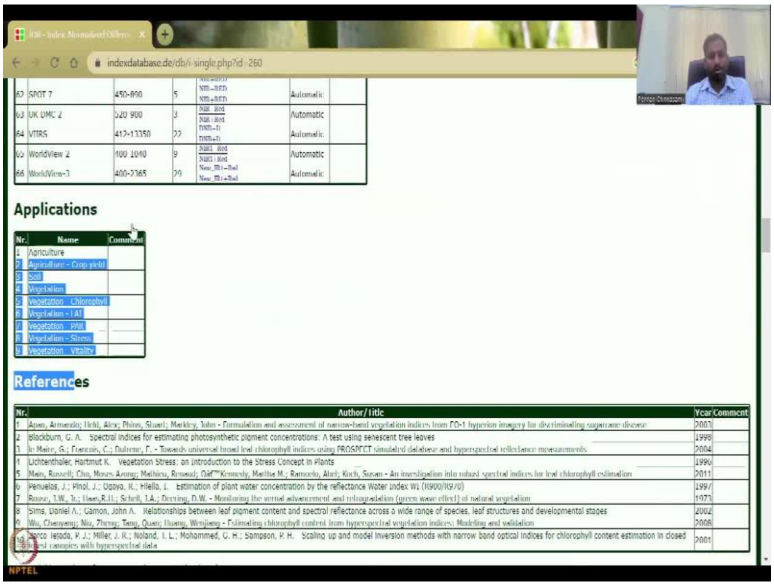

So with this you can also use the web services and then you can ask them how to use it directly. So JSON API can be used and that can actually quicken your aspect, this is for mostly for learning and seeing what data is available then from here you can go to the database that I initially shown. So as I said, doing this would take a lot of time for a PhD student for a master's student to read papers, read the applications, who is the owner, what is the formula, etc. everything is given here.

Then I expect you to use it directly into your analysis part or your part where you have your values and regions. So this is not region specific, there is nowhere you can put India, global, Malaysia, Australia, etc. or US, but you will have to put it later in your links. So this can give you links to the different sensors and applications etc. it will actually tell you like where you can get different data sets, different indicators you can get.

Then let us see if you click on one of these, there is enormous differences you can get on the indicators, the sensors that they do, the references for that. You can click on this it goes to the paper hopefully, yes, it goes to the paper and then this paper what are the other indicators they have discussed about all these things are given. Very well done, I would say and then the applications part also. So, I hope you will use this for your analysis and see where it can be used the sensors that can be used applications are a lot in agriculture, lot of references, etc. So, I will stop with this is a beautiful database for finding the indicators, the formulas, the wavelengths, the bands and also for sensors. I will see you in the next class. Thank you.