Groundwater Hydrology and Management
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Lecture – 5
River Discharge Data

Hello everyone, welcome to NPTEL course on groundwater hydrology and management. This is week 11 lecture 5. So, in this week, we have been looking at the data that is needed for groundwater management, which is how do you collect data in the government format or the publication's format. And also we have been looking at by parameters, which means groundwater levels, hydraulic parameters, and also the water budget equation, parameters.

So, on that note, let me continue the last lecture for this week, which includes a very important aspect for groundwater management. So, groundwater management also includes surface water because as we have been seeing in the lecture, there is always a disconnect between groundwater management and surface water. People think that surface water is separate, groundwater is separate, but that is not the case as we saw in the water balance equation.

For the net storage, there is a component of groundwater that has to come in and also a component of surface water that has to come in, because if groundwater is high, then it gives water to the surface water which is rivers, lakes, ponds et cetera and therefore, groundwater will decrease. So, you will be doing management on groundwater, but you will also see that the groundwater is not increasing much because it goes into the surface water.

The same can happen on the other way also, the surface water if managed properly, and it is at a higher level than the groundwater then surface water will give to groundwater under the ground. So, these connections we have been establishing through the lecture series. And now, since we know that surface water is very important, we will be looking at some parameters.

To start with, we looked at surface water reservoir levels and how water goes in stores. See, if we know how much is stored then we know how much is available for groundwater recharge. And that is where the analogy we used.

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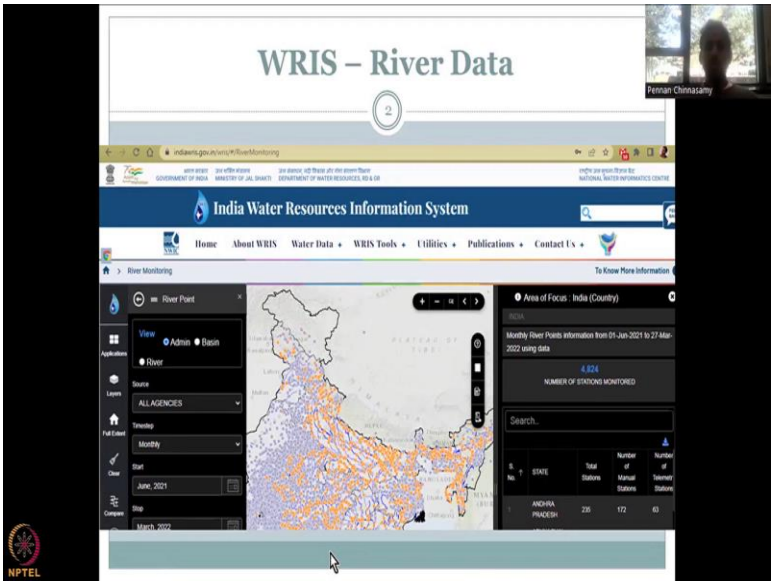

So, now, the other part of surface water is the running water which is a river, streams, discharge et cetera. And as I said, we will be looking at how this water is being recharged through these rivers and streams in the hydrological balance equation, for which we do need the discharge rate. Their units are different, I would like to warn that when you write the water balance equation, it is your mandate to make sure that the units are consistent.

Which means rainfall is millimeters, discharge is in millimeters, your level groundwater storage is in millimeters et cetera. So, all this unit has to be in the same cohesive manner, so that you could make some comparisons. So, this is the water data portal that we have been looking at for other parameters. We will now also look at the discharge data. As I mentioned, there is a lot of sensitive data or data that has been sensitive classified.

So, when you call it classified, that means that there is, it is not available freely for sharing between the public. So, we have to be careful on understanding this connection and the government is very protective of this data. So, if you are planning some water budget exercise research problem publication, make sure that the data is not as sensitive data.

Because then you cannot tell in the paper or in your thesis that the data is sensitive so I cannot do it. Pick a site, where you have all the data for your water balance so that you can establish the groundwater management protocol. So, moving on, let me go through this website as we have

been doing in the live fashion. So, I am going to pull up the India WRIS website as initially we have done.

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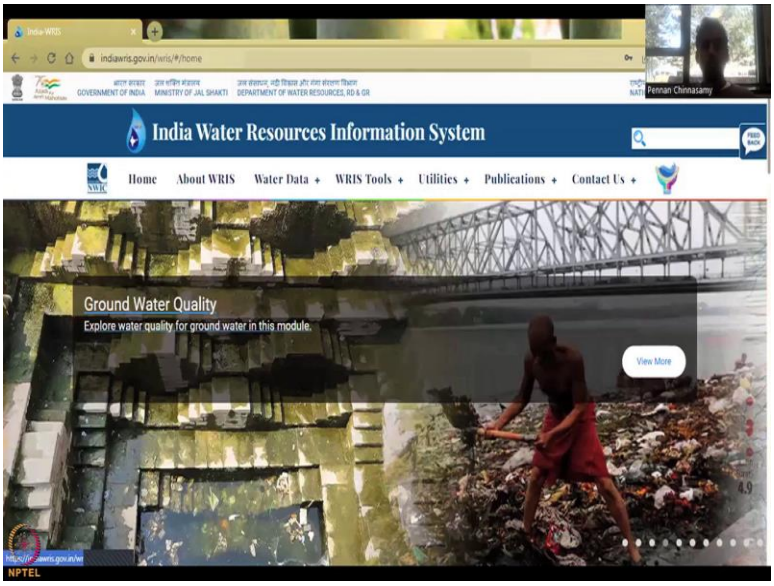

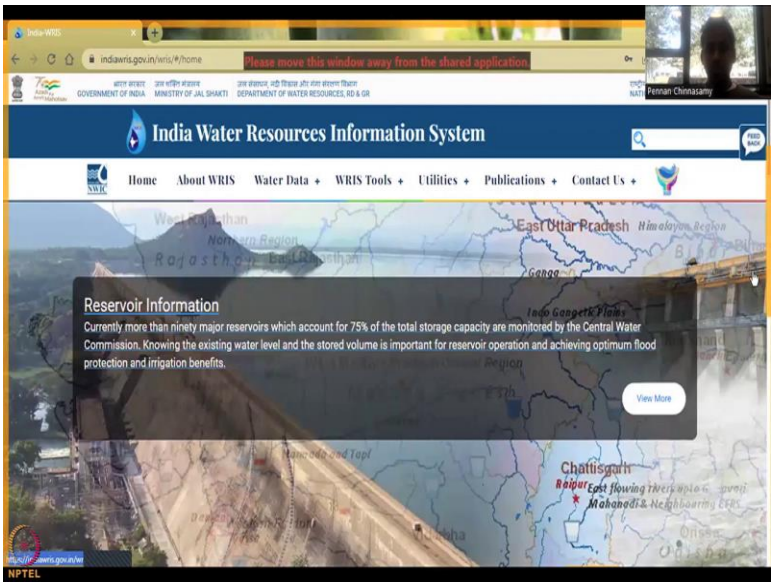

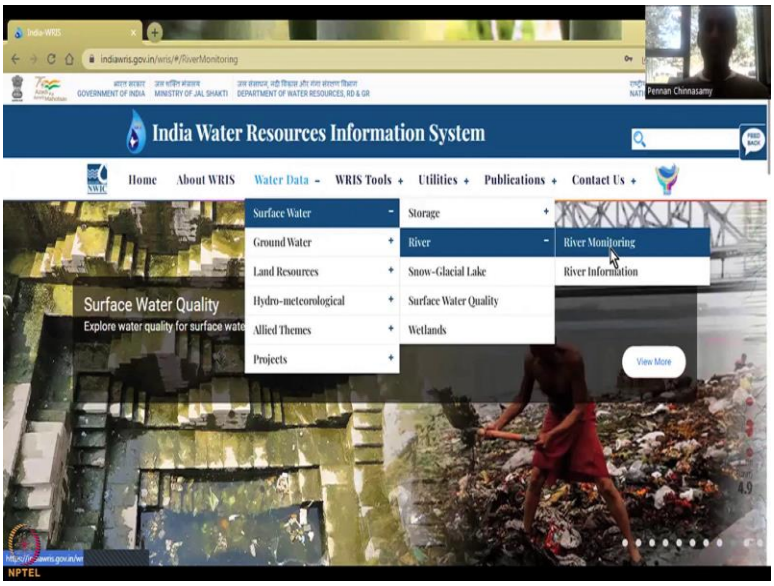

We will be doing the homepage and in the homepage. We do have all the data that is, that is going to come in in the data format we want. So, all these data we have been looking at and we go to the surface water storage, we looked at all the tanks. Now we will be looking at the surface water, the river. The others are also, the wetlands surface water quality, et cetera. But for our hydrological balance equation, we would stick with the river monitoring and river information data. So, I am going to go back, river monitoring.

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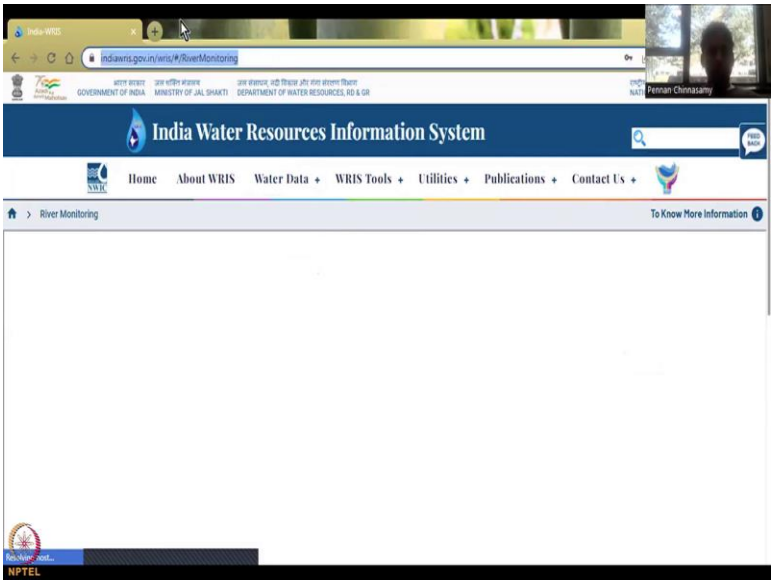

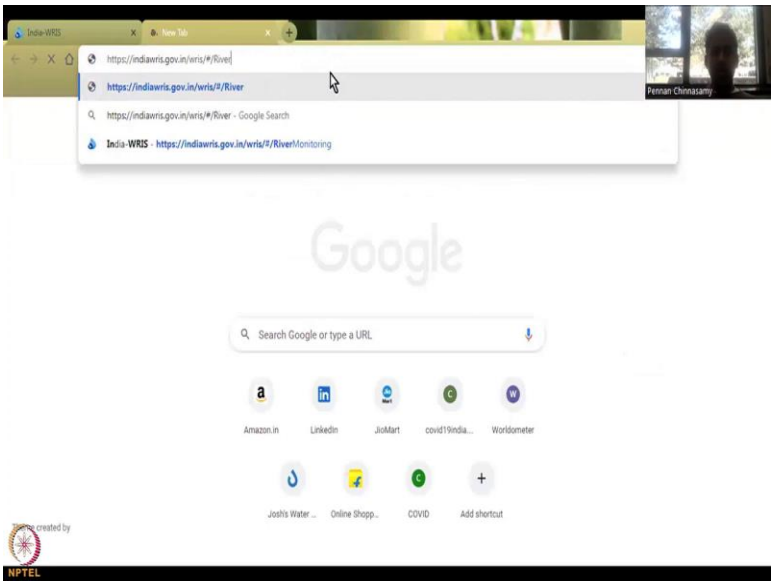

The river information gives you the basic information of these river networks. Like for example, you have your, length of the river, the shape file that is given in the government. So, you can have that, I am just going to do the river monitoring again. So, that we could we could easily understand what is available for us to download.

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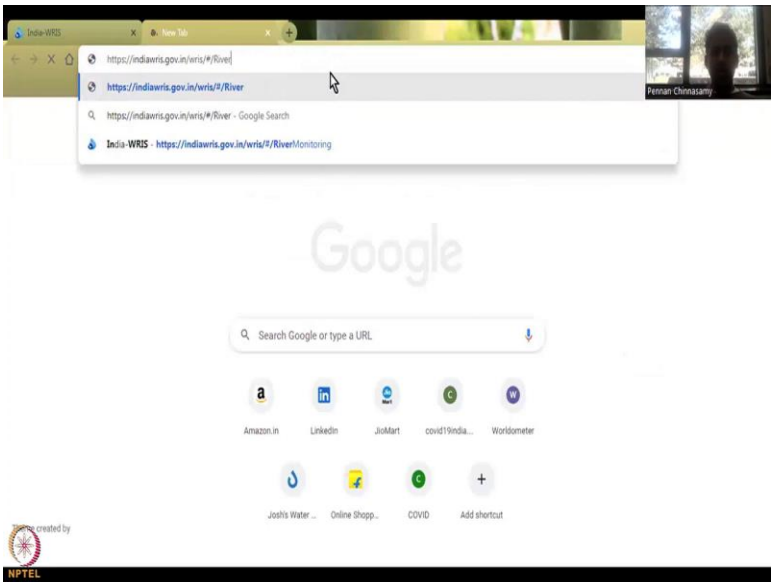

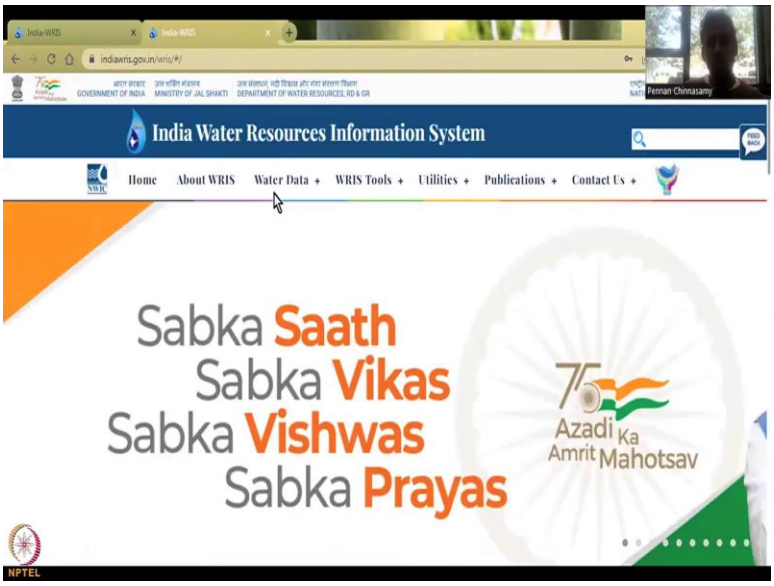

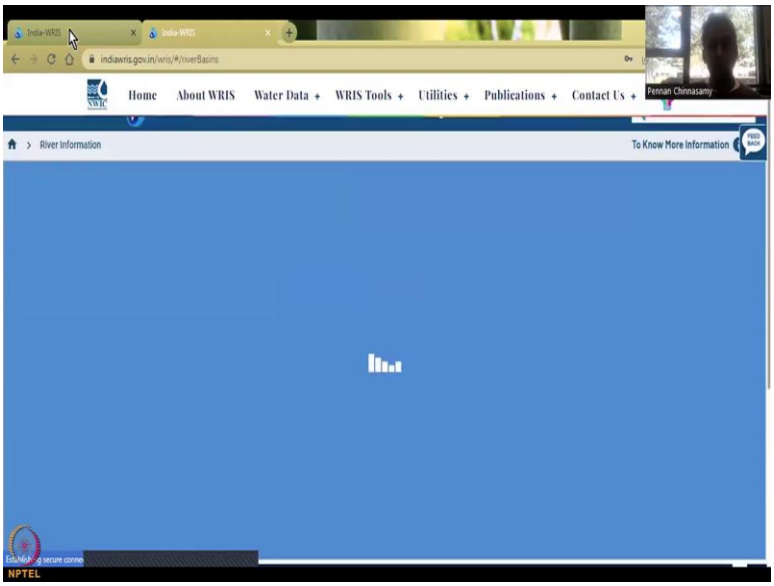

So, here, it is slowly the downloading as I said, based on the internet speed and connectivity, you can see this blue line. So, if this blue line is moving, then that means that the internet is still collecting the data. So, you have to give it some time. So, now it has run.

We will just quickly look at this here. So, you have the surface water river information, it is basically the information about the basins, the basin boundaries, the area, the statistics, et cetera. Sometimes the information does take a long time. So, let it populate while we go back to the river water discharge measurement portal. So, what is going to happen here is as same your right side has the India focus and it has date from 1st June 2021 to 31st, march 2022.

So, today until today, so, you can look at the date 31st March 2022 is very recent. And you could actually see the live data that has been collected at least one or two hours before. So, we have how many stations around 4824 total stations that have been monitored across India for this time period. And then if you come down by pulling this, so there are multiple sliders. So, there is one on the top and then one on here. So, here you can just scroll and then it will work.

Here, if you go to the pointers, it will work. So, you have all these states and number of stations that are being monitored and how many of them are manual. Manual is where they go and take the measurement in a periodic faction, not daily, but sometimes some of them are mentioned daily. And then there are a lot of telemetry stations, out of the total you could say around 30 percent of them are the total in the telemetry.

Telemetry would directly relate a data and that data comes to your dashboards and stuff. So, please understand that there are possibilities of increasing these telemetry if there is a lot of science and development on low cost sensors and effective sensors. So, this telemetry data is what is responsible for giving you this upto date data on the website, 31st march.

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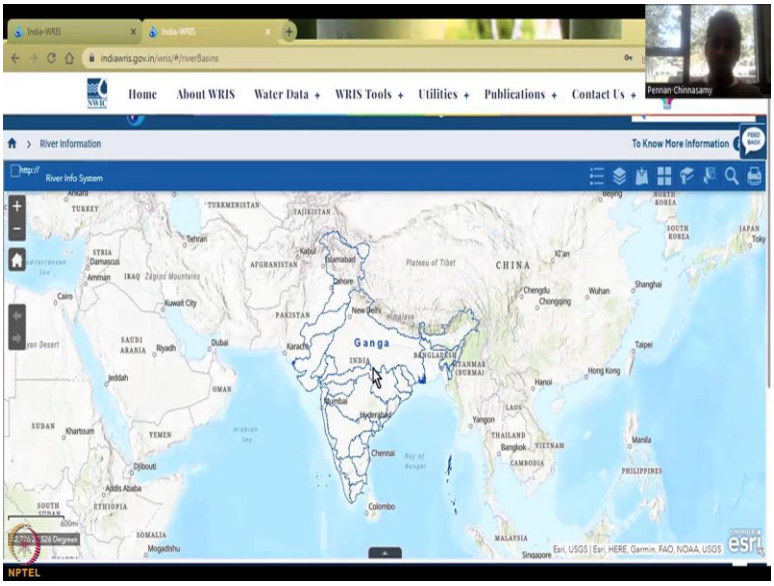

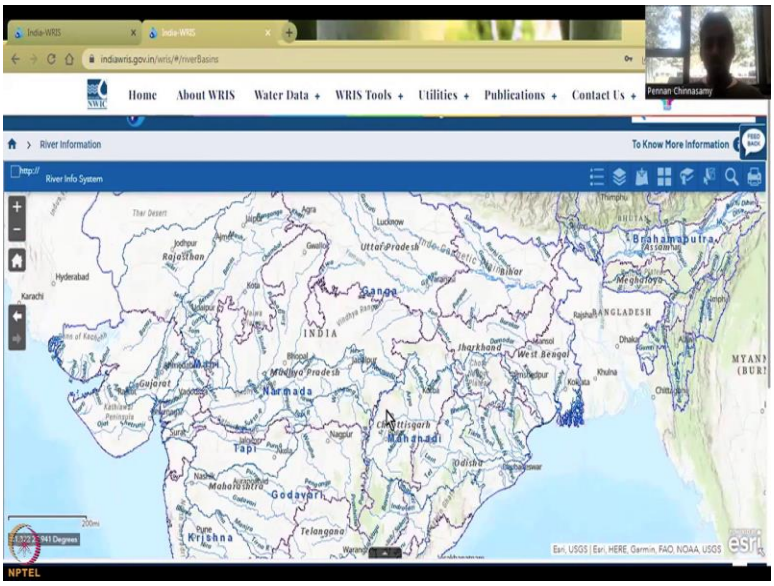

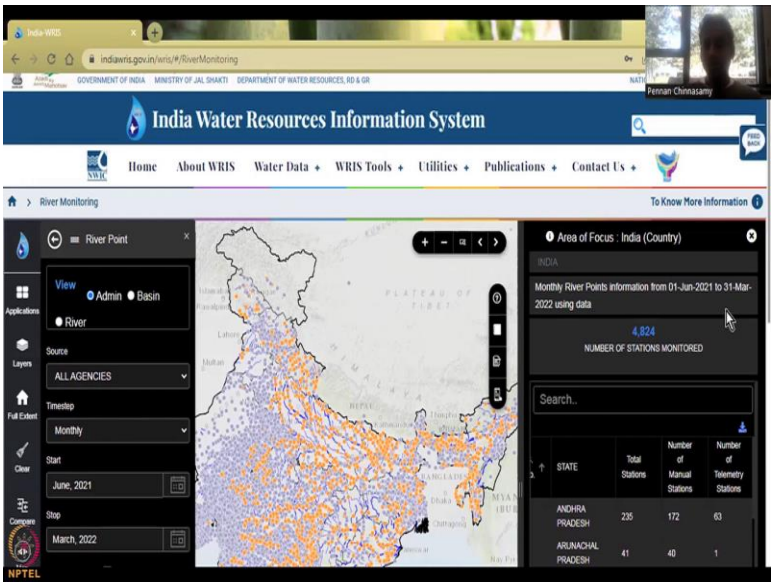

So, coming back so you could see that still the thing is populating and now the boundaries are there. So, all it gives you is the boundaries of the river basin, the river info et cetera. They are updating these websites as in when needed. So, if you zoom in you do get the different boundaries, sub basins the river network as I mentioned, et cetera. You could download these as file and then use it for your research.

Closes for internet bandwidth. We are back to the river monitoring station. So, where does this come? We come as Q in, Q out. So, in the water balance equation that we showed yesterday also on the last class this comes as a water balance number. Basically, when how much water comes

in and how much water goes out, this difference in the water discharge also gives you how much bass flow is happening, which is the groundwater flow coming into the river.

And also how much the river is giving back as seepage into the groundwater aquifer. So, we will come down and we will see that there are multiple states and all these stations are monitored. Let us go to a particular state, let us say Tamil Nadu. There is a reason why I am going to pick Tamil Nadu, because I did mention the sensitivity data et cetera.

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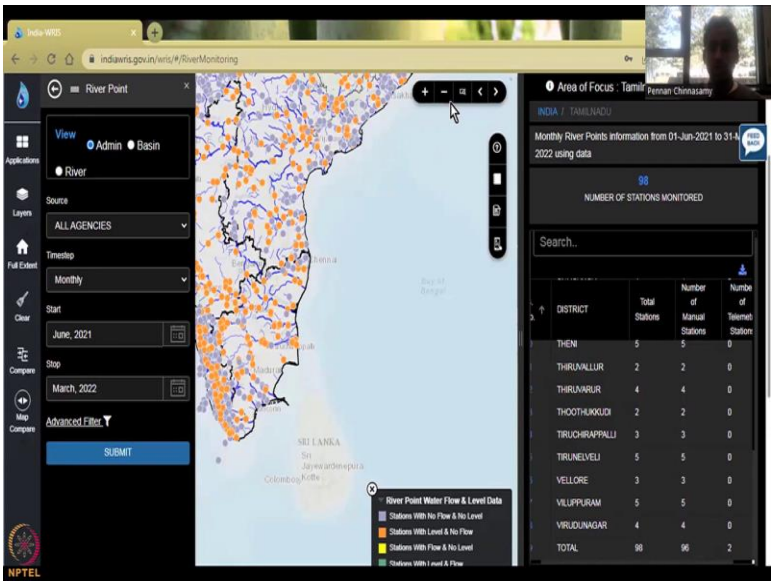

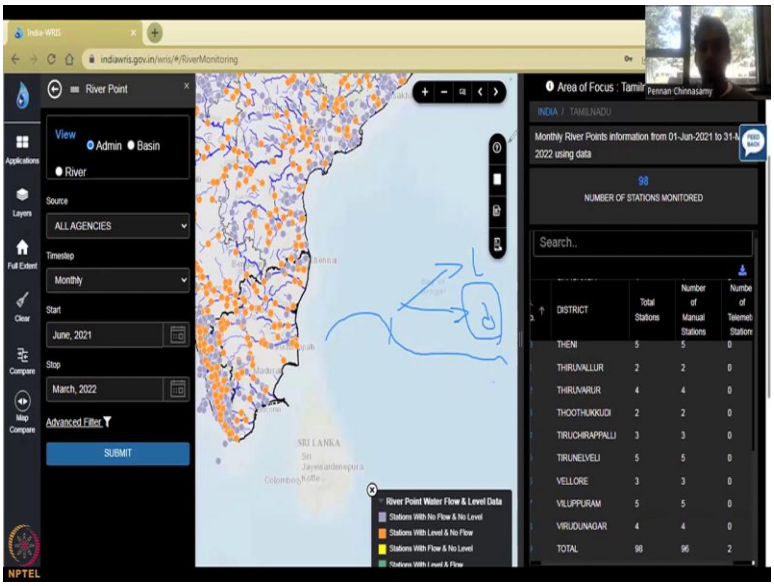

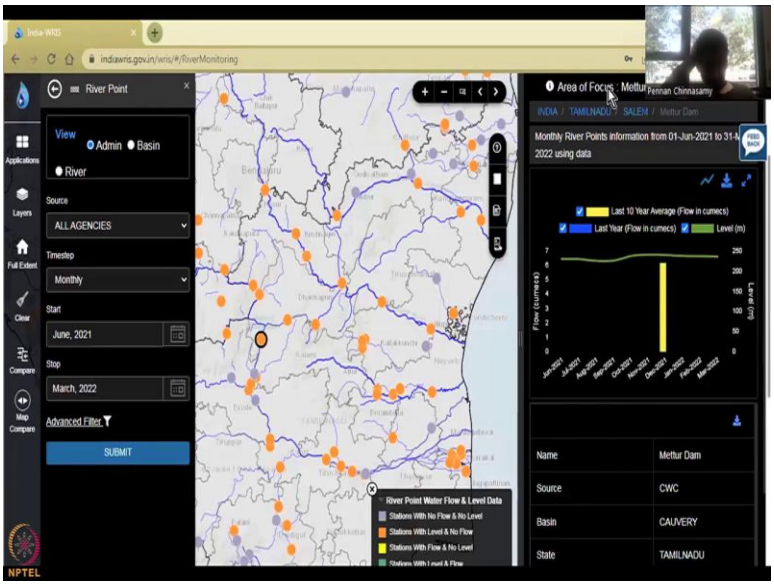

So, when I click the state as I have done in the previous data sets also, you will have it shown as a darker outline and then the state name comes here. Then all the data gets populated as per the timeline. So, 98 stations are there and these other districts. If you click the districts then the station name will come along the river. It is not a block because rivers do not flow as a block, it is wherever the river flows, they will put stations.

I would also want to talk about this legend, what does it mean? It is stations with no flow and no level is given as gray which means these stations are there but it is not working. But, or not collecting data for your time period, stations with no flow and level. So, normally what happens is when there is a river, you just draw it. So, you have a river network and they will put a station. This station can give you either level or the discharge.

So, level is that how much level of water is flowing in the river and that level is converted to a volume by empirical models. So, or the statistics that they use is called the rating curve where they establish a relation between the level and the discharge. At the end of the day you need a volume or a rate discharge. So, the other instruments as I said they can give you a flow which is discharge, a flow rate.

It is slightly expensive to have a discharge meter that is why people put levels and then convert it to discharge later using rating curves. So, that is what is mentioned here. So, what happens here is we have a stations with no flow stations with level and no flow. So, which has a level but no

flow in the, in the river data flow monitoring sensor is not given. And then you have stations with flow and no level so, the opposite.

Stations where with, flow is there but no level is there and then you have, let us move this out so that you can see it. Stations with level and flow both of them are blue in color. So, if for now we can just quickly look at the map and then you could see that there is not many that actually collects data for that particular time period. And when you, when you just move your mouse around these points you can actually see where the data is coming.

So, both level and flow you may not get often. Level only you will get a lot and the level is converted to a discharge. So, let me pick a particular as I said, why Tamil Nadu is the reason we will see the sensitive data also. So, what has happened is we will lookay into some of this data it has taken some time the internet, the data on the back behind this let it let it work it out. Now it is moving. So, you have this is coming from Karnataka and coming in.

So, let us say this one is Vazhavachanur, this is the boundary and then it comes down southern Sathanur Dam et cetera. And here is also you have Kugekodi in Karnataka and then the river flows into Mettur dam. So, Mettur dam is pretty okayay, it is good because that actually provides a lot of irrigation water to all around the surrounding area, the command area. So, what you would see is the last 10 years flow, average flow is given.

And you also see the water levels increasing and decreasing as per the need. And then we also what we see is... So, when we go to this data point, what has happened is it has the last 10 year average flow into cumecs, cubic meters per second. And then it also shows you the last year which is not available and the level is always there. So, the flow has been intermediate that is the measurement of flow.

And that is where you see it is as orange stage with level and no flow. So, let us remove the flow data because anyway it is not there and then you can also remove this. So, you can see that the level of flow, the level of the water in the Mettur dam river site is monitored every single month this particular time period.

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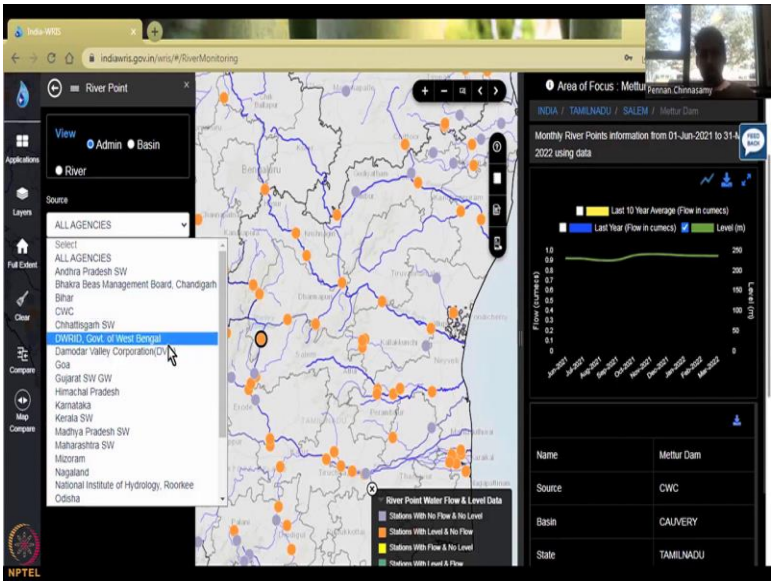

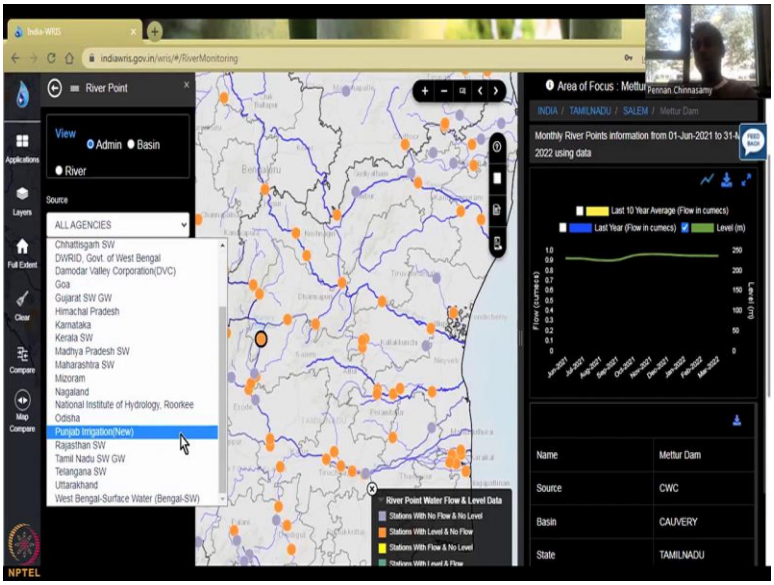

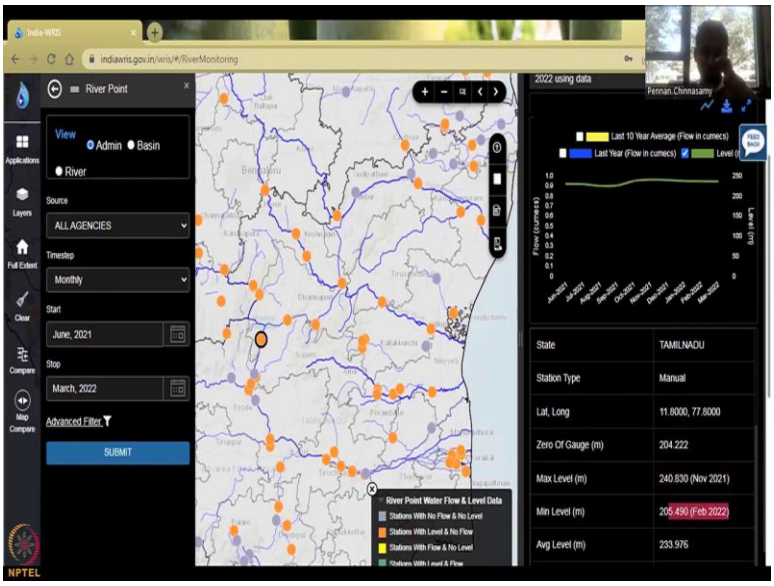

You can also do it as year, year or daily. Daily is what the data comes in. And that agencies are, multiple agencies are there since we have zoomed into Tamil Nadu mostly the agencies in Tamil Nadu will be shown here. But you can see that there are state agencies, central agency CWC, these are state DWRD, Damodar Valley, Valley et cetera. And then as I said some NGO kind of activities and others are also monitoring the data. The point is the data would come in all these different sites, but then they have put it in here to make sure that everyone has access to this data.

We also see the National Institute of hydrology Roorkee which is the, very important body of hydrology research in the country. And they monitor most of these river data because they have been given the, mandate by the government to monitor and maintain these data. And you could see that they also have some stations. So, always it is best to have all agencies here and then do this search so that you can get at least the best data.

Once you have put all agencies then here you can come and see who is owning the data. So, here you could see it is CWC, which is your Central Water Commission and the river Kaveri is the basin of the, of the station that is there the lat long zero gauge in meters and the max level is 240 on November main level during that period, during the period what you put average level et cetera. Again, the discharge they will not give you.

So, that is the sensitive part, from the level you cannot estimate the Q in Q out because that discharge is not, it is a sensitive data that they will not give. At least they will give you the level which is from which you can try to estimate the discharge if possible. So, for example, if I put

the last 10 years, so, for this data point, there is one level and a flow data so you can have some correlations, and that is how rating curves are established.

So, let us go ahead with a different date. And just say let us say I am going to do a daily. So, here internet has been a little bit slow, so let us give it some time. Yes daily. And then I will put a shorter period so that we can quickly search the database. And then always go to a year which you know has had data. So, and then pick a monsoon time also, so that you know that data is coming otherwise you will see a lot of gaps.

So, let us say June to December, June one to December we will capture the above the monsoons, 2021 December 31 summit. So, once the data is loading, you will be able to see other discharge data coming in. And so, if your study area is one of those areas, which needs the discharge, I strongly recommend you select that data point where you can get this discharge measurement.

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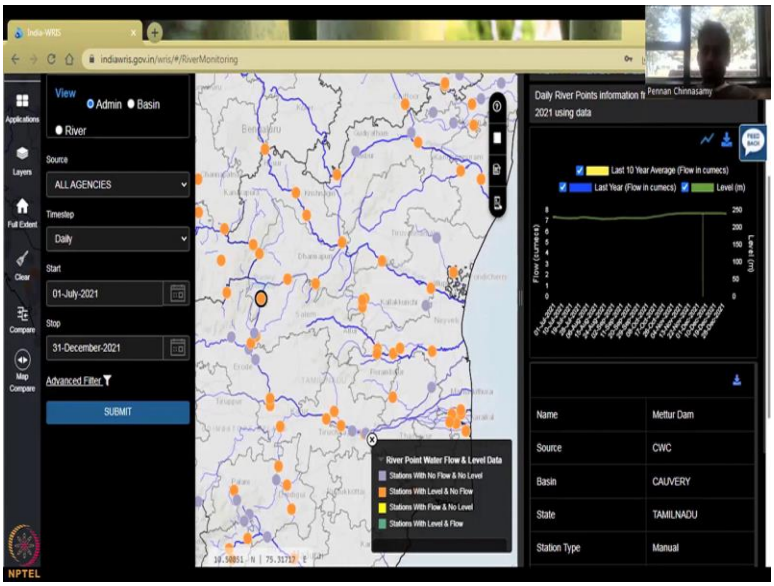

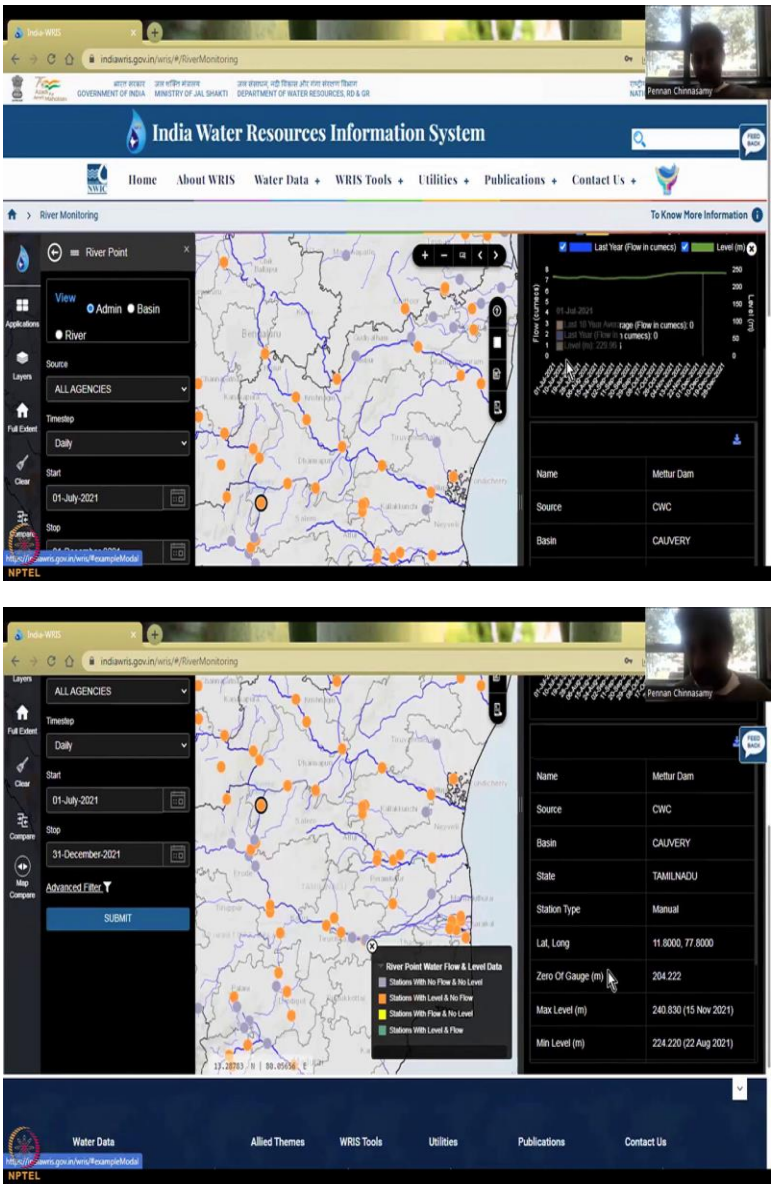

So, while it is populating also I would like to tell, that the level yeah here it has populated.

And you could see that the same station that we selected is still holding well you can go up and double check. So, it is India, Karnataka, Salem, Mettur Dam. And the Mettur dam's level is given for that particular period and every day data is taken. So, every single day there is data, you could download it as an Excel file, CSV file and then make these other other estimates like trend analysis, and slope of the curve, et cetera, et cetera.

So, be very careful in monitoring these data and see how you get to set up this data connection for your water budget. So, we have seen this. So, then let us go to the Ganges basin, which is one

of the, I am just going to click full extent, one of the most sensitive basins because there is a trans boundary river. So, in a trans boundary river, it is very difficult to get data because there is a lot of, misunderstanding about the data.

And so, the government has made sure that not everyone gets that particular data. So, this is going to go up and zoom out. So, once you zoom out to the India scale, you will be seeing the other data for this time period.

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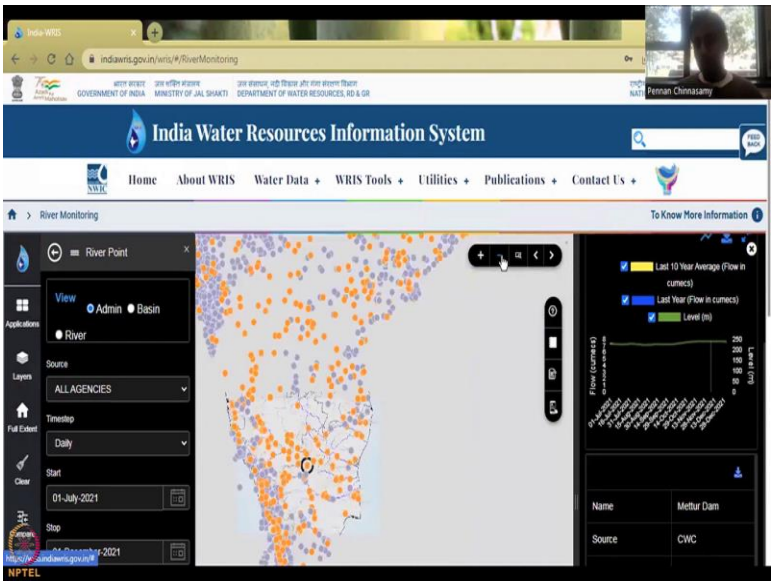

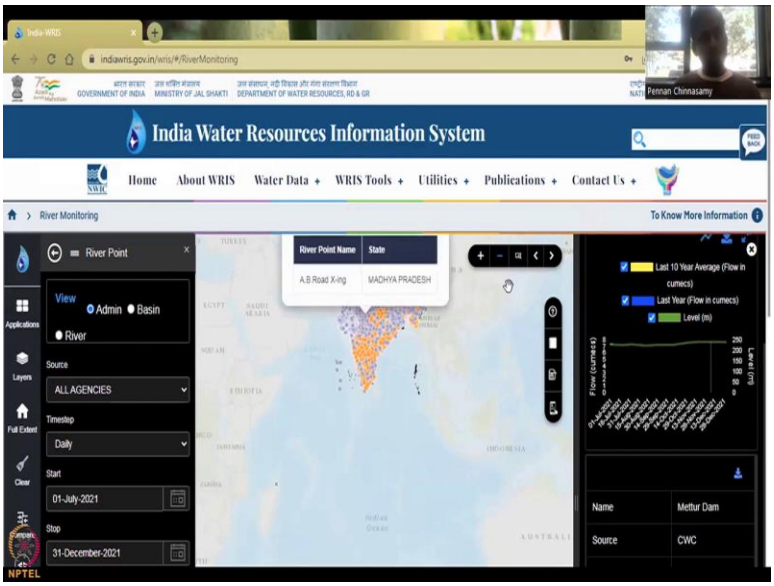

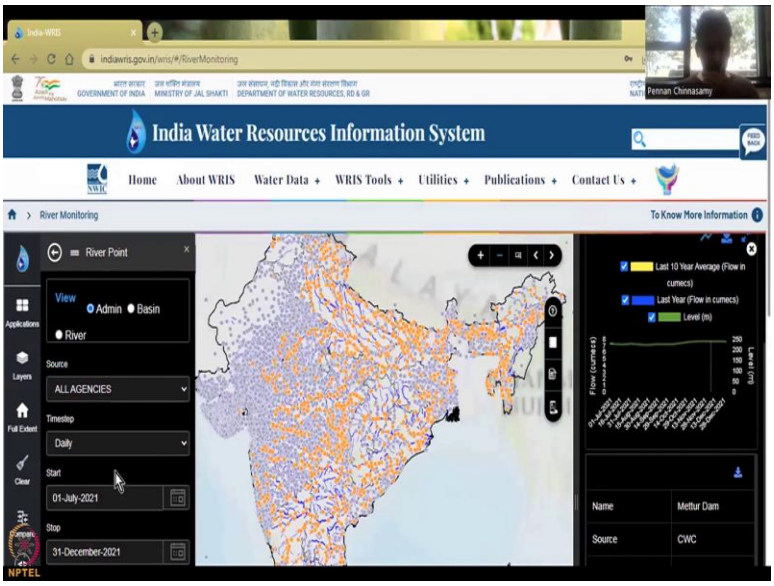

What I am going to do is you will see the color of these gray dots, which means that there is no data, it starts to convert into blue and orange. You need to see orange blue is most likely not going to happen. Because not all the sites are going to measure the discharge which is expensive, flow.

So, they will measure the level and from the level you go to the flow. So, that is where I am trying to say that we let us shoot for some data in the basin that has a discharge for your, for you to look at. So, now since we have already done this time period, you could see a lot of data that is being populated.

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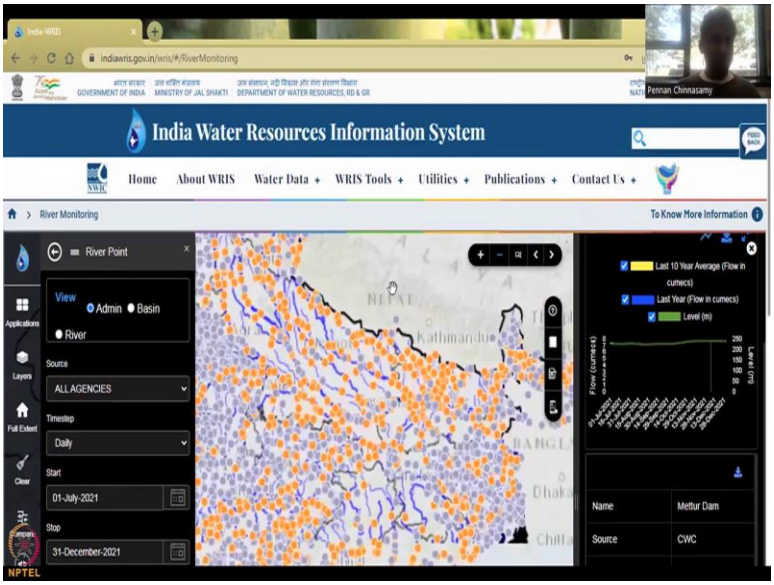

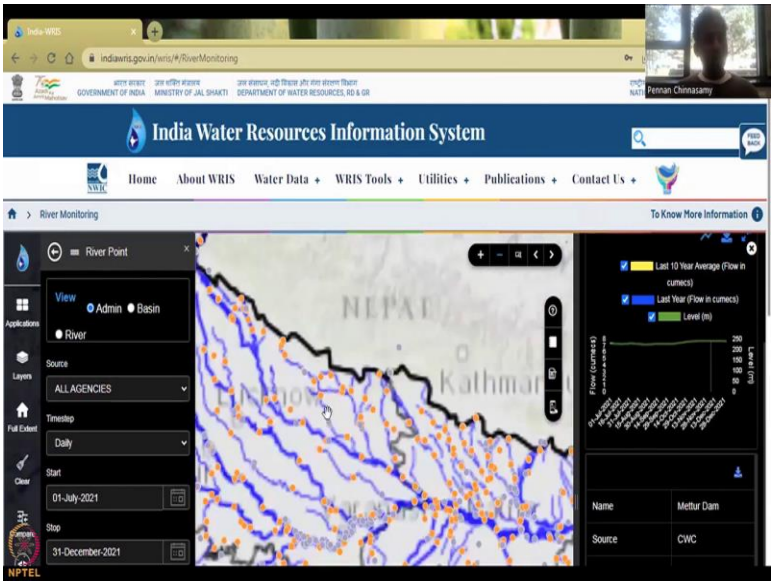

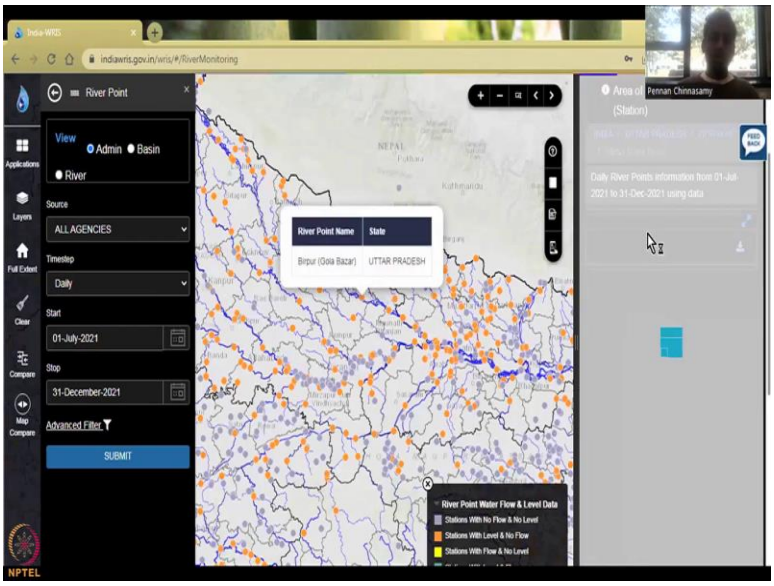

And sometimes you will see that it is there but for example like this in the Ganges, you can click one of the sites. And it will tell that, the data is available, but this classified data. So, this classified data means it is not available for public. It is a sensitive data mark locations are classified please log in to access it. Wherein you have to log in give a permission why you want to use the data et cetera.

So, this also if you cannot get it online now, at least you know that the agency is there CWC and the location of the lat longs are there and all these other data is, is blacked out which is, means that they will not give you the actual level and flow because it is a classified data. Similarly, such data exists in almost all these basins and the classification is done by their rules and regulations. So, please be careful in understanding how we are going to look at these data if it is classified.

So, it is very important to understand that classification part. So, I am going to do a monthly, just be careful, as I said, when you have this basin and you are happy that all the data is there, not all data is available. You will have this kind of disclaimer which says classified data, you will not get this data, for which you will have to write permissions and or get it from the local authority.

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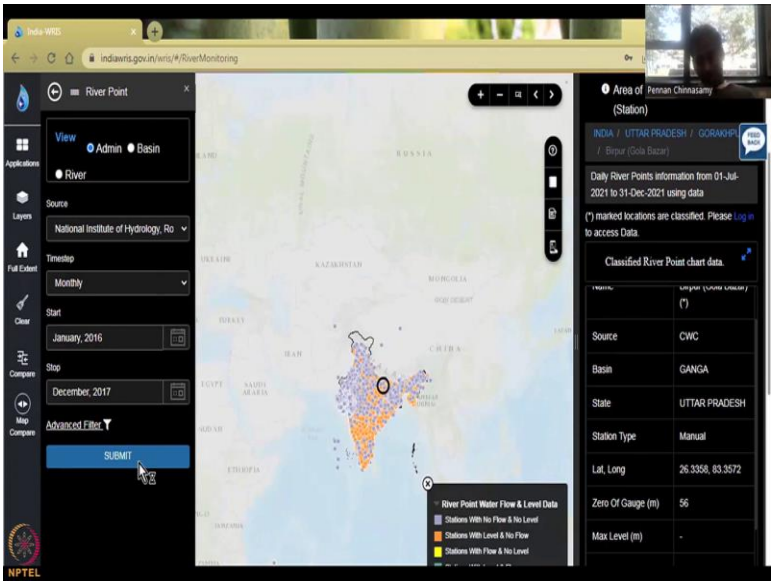

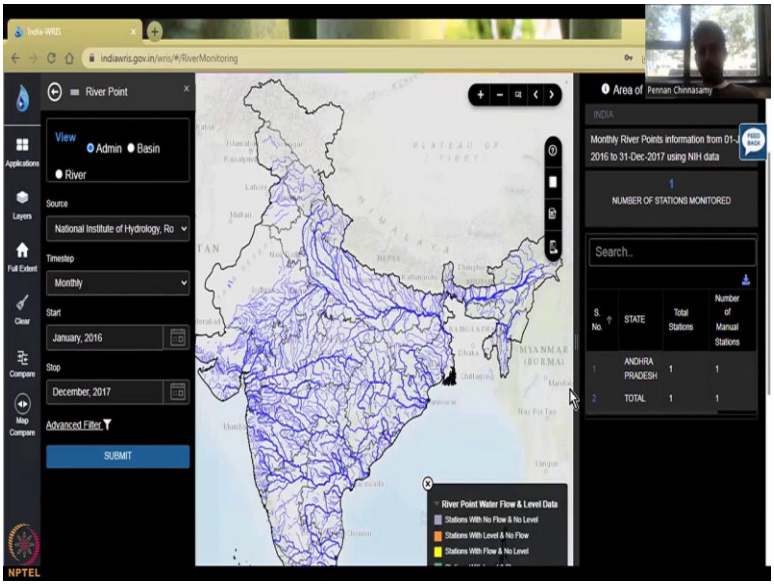

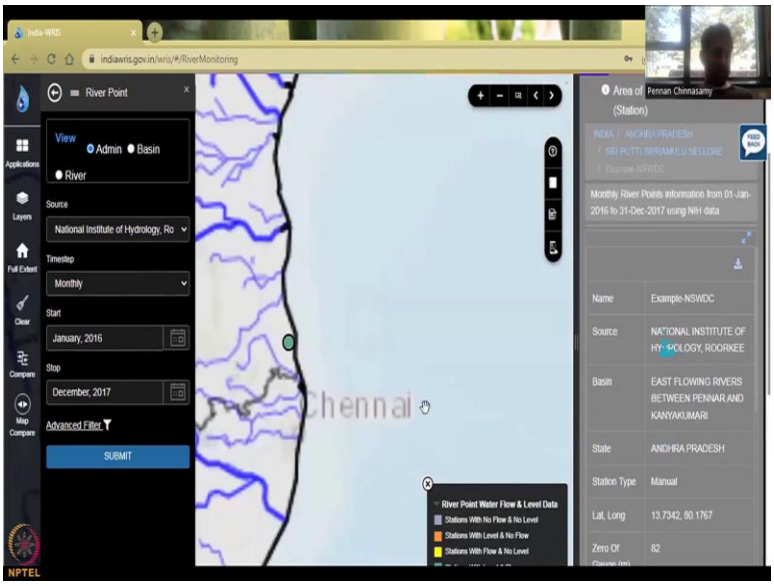

So, I am going to go to a particular state agency. Let us see if they have all the flow data that we want. I for sure know some good agencies that have been constantly putting it for everyone to access or you can also use the National Institute of Hydrology. Let us do a monthly in a very short period because of the and the period does not matter at least, you know that it is there for a long time. So, you will be able to access and based on your internet.

So, if your internet is slow, I would recommend you do it in chunks which means do every year and then add it because in Excel you just have to copy and paste all the data together. So, let us take 2016, and then let us say Jan too much, December let us let us take 12 data points. So, I am going to click the 2016 again now let us do one more year and then say 2017. So, we will have 24 points, and then I am going to click okay.

So, while it is populating again this bottom part is also going to change. And you could see that National Institute of Hydrology has only one monitoring station in this entire area. And it is in Andhra Pradesh. I am just going to click it. That is National Institute of Hydrology is located in Roorkie, not Andhra Pradesh, and that is a station. So, what does it say? The station has flow and level. So, I am just going to click it. It is an example data set.

So, they are trying to do an example, this is how beautifully it comes out. You have the level, you have the flow, and also the last year reflow and the current year flow. So, last 10 years flow is there, the level of the water is that the level unit is in meters as the flow is in cumecs cubic

meters per second. It is a rate, flow is always a rate. And also you have the last year flow is missing, however the last 10 years data is there.

So, it is an example which is they have been setting it up manually collecting the data, and also giving all the other information. Max discharge, minimum discharge, we have only put from Jan to, to December so that is why we see this. If I click this as daily, then this data also change. So, let us not do that. I am going to go to CWC data set. And let us say I want a monthly because there is a lot of good datasets in Kerala region that we have taken for our studies personally.

So, I am going to go let us say if Kerala code is there, okay Kerala is there. Kerala surface water board, monthly is fine. And then I am going to take because why Kerala has a good data is because they are affected by these floods, frequent floods. There is a lot of rainfall that happens. So, it is very important for them to maintain good database of these floods, and how this data comes in.

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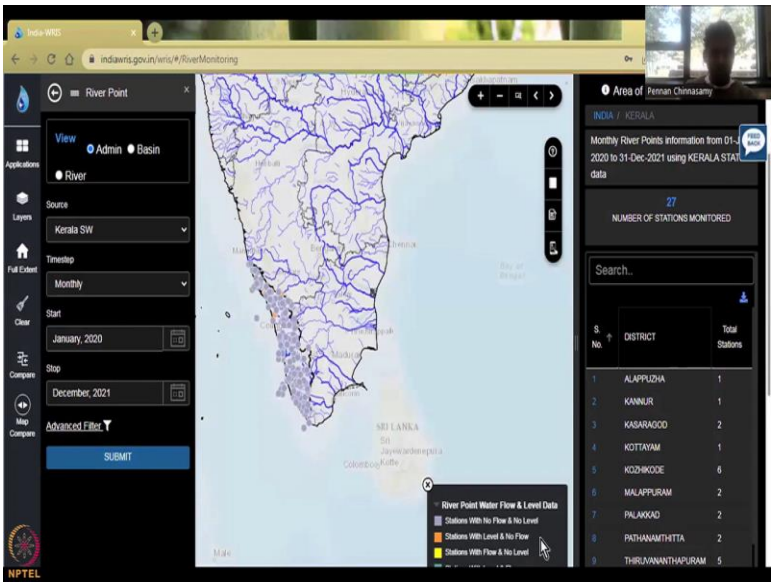

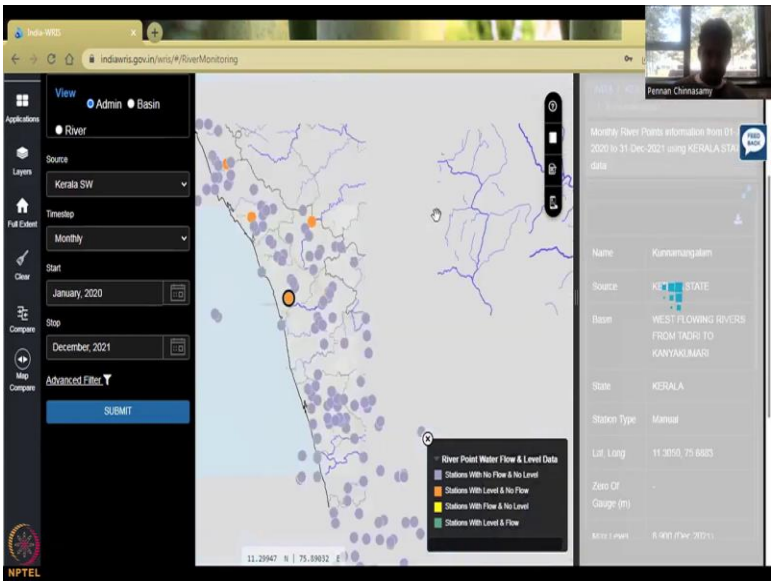

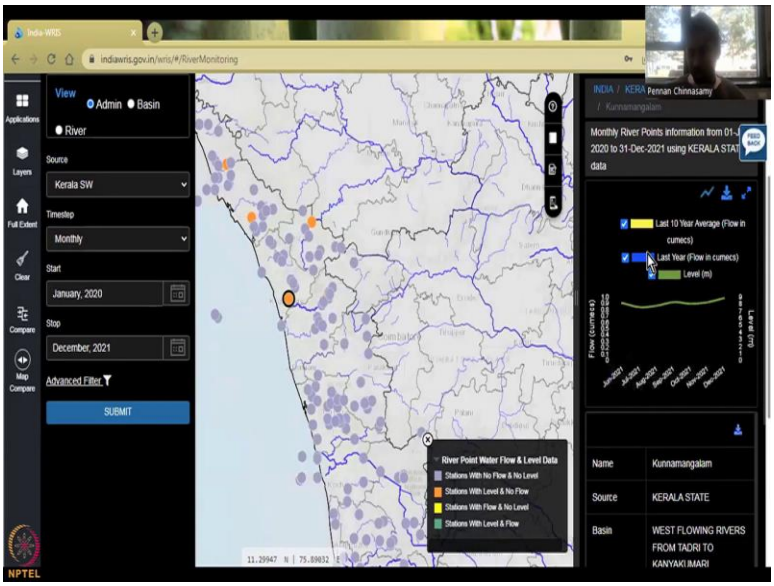

So, while it is populating, you can see all the points are gray, which is stations, but no flow. You can come here and see, maybe there are they are sensitive, they are not giving it because if you have so many stations, for sure, you will have to be monitoring some of it. So, there are some here, these are the errors that I am talking about. The geo location in the map, so you have to be careful and read the data if it is the correct station that you are monitoring.

Let us take this one for example. It says Kunnmangalam. Let us, I am going to click it and then it opens the data into a particular river flowing saying west flowing rivers from Tadri to Kanyakumari. But this river name you have to see if that river is that exact river that you are you it flows from this point to this point. Because we do not know where this point is. Here you can

see that this point is out on the sea you do not have like that in the sea Kottiyoor equal to and state is not there.

So, you have to use Google Maps or other maps to find where the exact location of this station is. This may not be the case for all the stations but in some states, it does happen. So, I am just going to click this station to see the data populates yes it does, there is no flow but there is level with level data for the period. I am going to click again last one for today, we will be looking at the CWC data.

Let us take only for Kerala. So, and then just doing this submit again. Then to find Kerala we just have to go down. You can actually remove the river layers but it is very necessary all the river layers to see and you could see beautifully that there are a lot of green dots coming now. So, the green means stations with level and flow. So, let us go here. So, why has it changed suddenly, what did we do? It is basically your agency that we select. So, the agency is what we have selected okay Indian is right there it is to a full extent.

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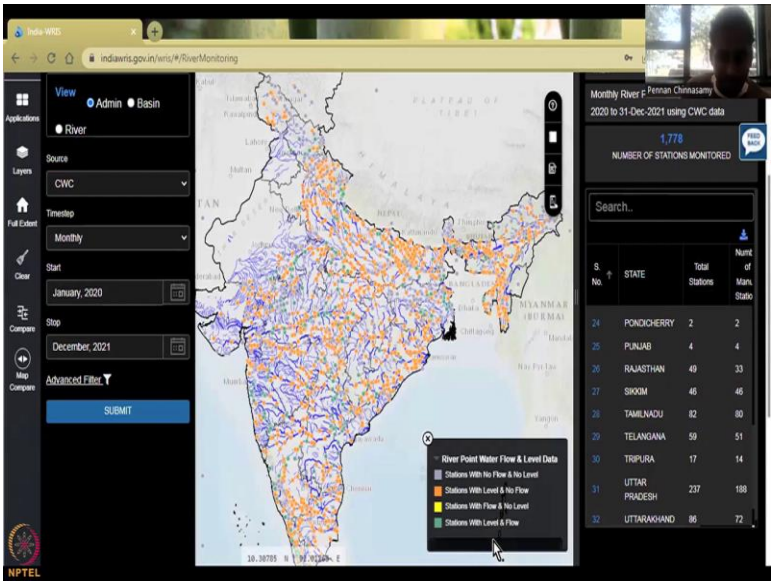

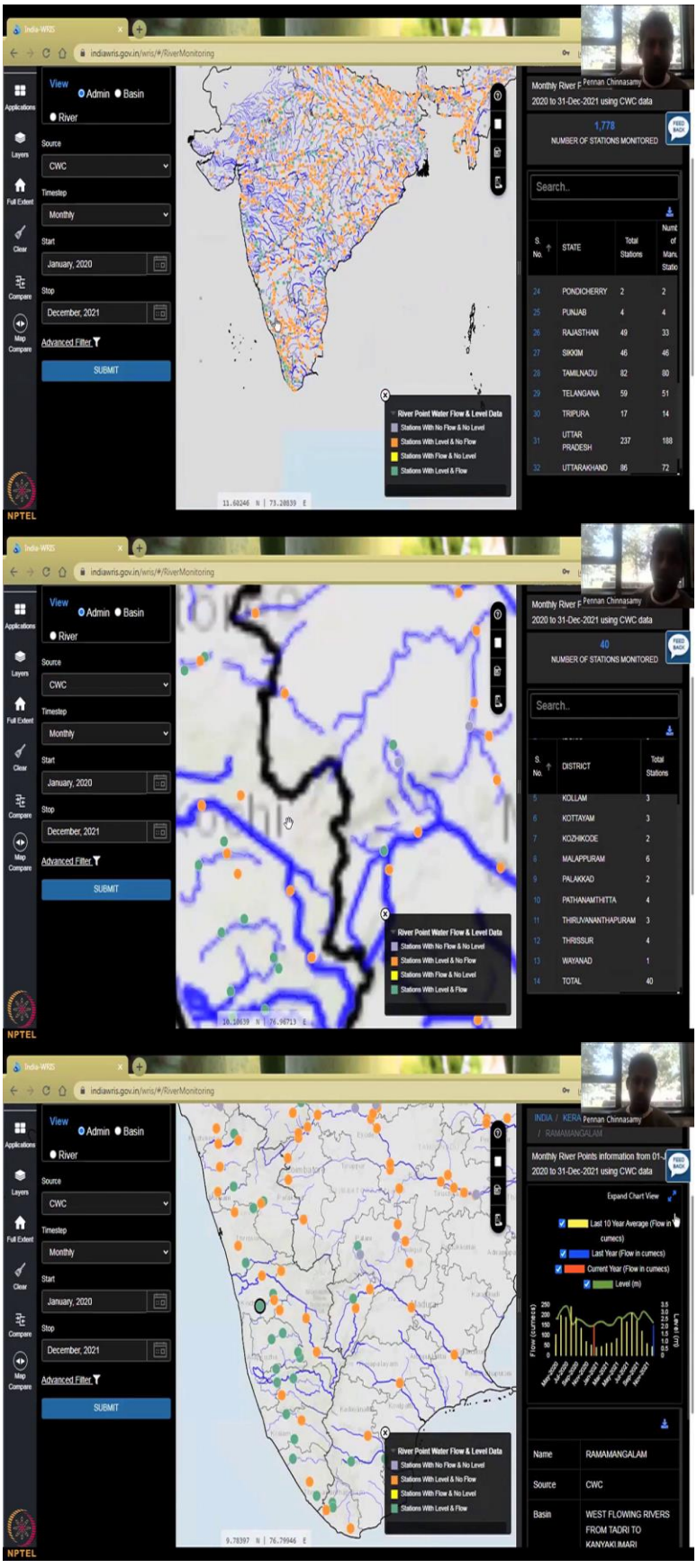
India-WRIS
indiawris.gov.in/wris/#/RiverMonitoring
View
Admin
Basin
River
Source
CWC
Timestep
Monthly
Start
January, 2020
Stop
December, 2021
Advanced Filter
SUBMIT
Applications
Layers
Full Extent
Clear
Compare
Map Compare
NPTEL
Pennan Chinnasamy
Monthly River P
2020 to 31-Dec-2021 using CWC data
1,778
NUMBER OF STATIONS MONITORED
FEED BACK
Search..
S. No.
STATE
Total Stations
Numb of Mann Statio
24 PONDICHERRY 2 2
25 PUNJAB 4 4
26 RAJASTHAN 49 33
27 SIKKIM 46 46
28 TAMILNADU 82 80
29 TELANGANA 59 51
30 TRIPURA 17 14
31 UTTAR PRADESH 237 188
32 UTTARAKHAND 86 72
River Point Water Flow & Level Data
Stations With No Flow & No Level
Stations With Level & No Flow
Stations With Flow & No Level
Stations With Level & Flow
11.60246 N | 73.28839 E
Monthly River P
2020 to 31-Dec-2021 using CWC data
40
NUMBER OF STATIONS MONITORED
Search..
S. No.
DISTRICT
Total Stations
5 KOLLAM 3
6 KOTTAYAM 3
7 KOZHIKODE 2
8 MALAPPURAM 6
9 PALAKKAD 2
10 PATHANAMTHITTA 4
11 THIRUVANANTHAPURAM 3
12 THRISSUR 4
13 WAYANAD 1
14 TOTAL 40
10.10439 N | 76.90713 E
INDIA / KERA
/ RAMAMANGALAM
Monthly River Points information from 01-
2020 to 31-Dec-2021 using CWC data
Expand Chart View
Last 10 Year Average (Flow in cumecs)
Last Year (Flow in cumecs)
Current Year (Flow in cumecs)
Level (m)
Flow (cumecs)
Level (m)
Name RAMAMANGALAM
Source CWC
Basin WEST FLOWING RIVERS FROM TADRI TO KANYAKUMARI
9.78397 N | 76.79946 E

So, you have, I am just going to hold and move or you can just click Kerala here. You see that there has been a lot of green dots and the green dots are you have to check if it is on the river channel. if it is not on, on the side like this, maybe it is a tribute to the so you just have to be careful.

So, here I could see that on the blue line it is Arangali and then Ramamangalam. So, let us take Rama mangalam in Kerala, beautiful graph has come up which has last 10 years of data.

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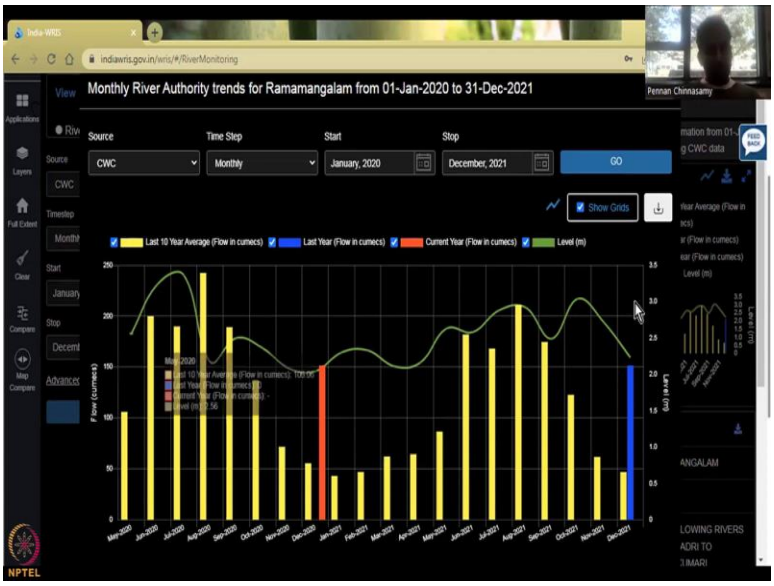

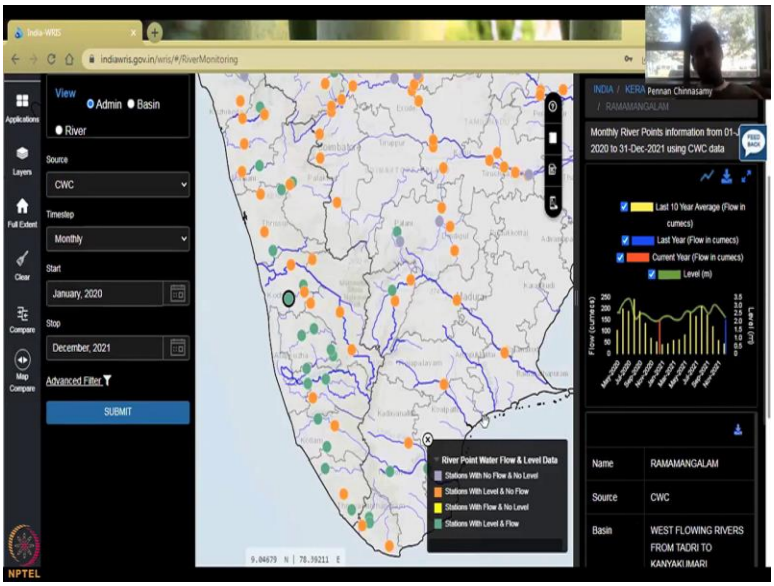

We will click this go full expanse so that you can see it. You can see that there is a good you know, up and down sinusoidal wave because of the rainfall when, when it happens et cetera. So, here is where your monsoon comes in. So, June July you will see a peak and then also in December time you would see some updates. So, mostly the November December there will be a big rainfall that happens in Kerala which is being caught in floods and stuff.

So, you have this, you can also show the grids just to say, we know the number now 200 is the flow and also the level which is green is here 2 point 2.5 meters from the base of the measuring device. The last year flow is only given for this, but again, you have a good data set and the current year flow is only given here. So, the 10 year flow is good. And all this data has been shown up. So, we will come out and with this I will conclude this week's lecture.

There is no recap because I think all the, all the data is there. Maybe I will start a recap the next week and then we will get into some more data and setting up a conceptual model in week 12. I will see you in next week. Until then, please take care. Bye.