Groundwater Hydrology and Management
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Lecture – 3
Rainfall Data

Hello, everyone, welcome to NPTEL course on groundwater hydrology and management. This is week 11 lecture 3. In this week, we have been looking at important data that we would need and require to manage groundwater properly. The explanation about the parameters and data has already been done in the previous weeks. In this week, we will be looking at exactly where we can get these data for better analysis.

So, we will start with the groundwater parameters on WRIS website, after which we also identified groundwater quality data that can be taken from these websites. I also want to urge that there are a lot of reports and publications from which data can be taken. This is called kind of data mining and data research, where you would read papers and then find data that is suitable for your work. You would also take data like groundwater levels, storage, et cetera, from government reports, which can later be incorporated into your work.

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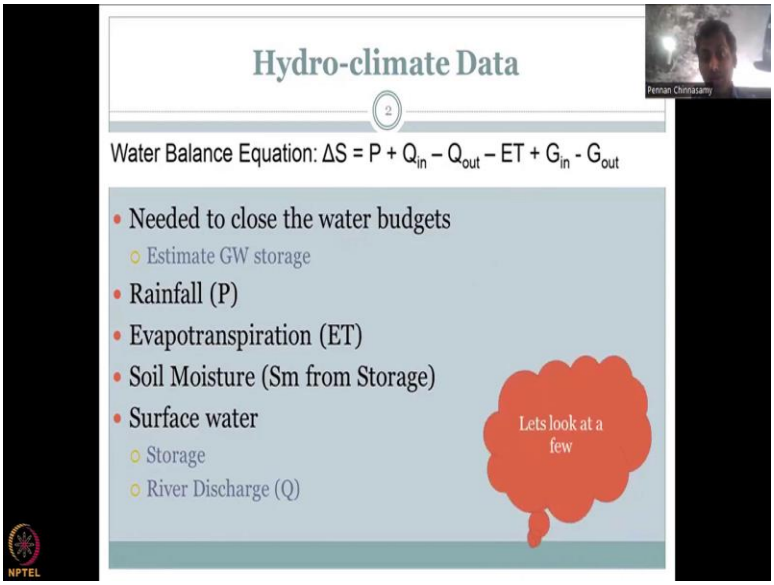

So, since we have already seen the most important groundwater data parts. Now, we will be focusing on the hydro climate data. Why do we need hydro climate data? We already saw in the hydrological water balance slide that there is a storage change, which is estimated from your

precipitation plus your Q in, which is your discharge coming in, you have it here and then minus your Q out which is your discharge going out.

We also could take the negative part in the equation coming from your ET because it is a loss. So, evapotranspiration is taken as a loss and ET, and you have G in and G out, so, groundwater in, groundwater out. So, this can be your net storage inside the basin or inside the watershed along the surface or it could be a storage in the groundwater. So, there could be either a surface storage which is given at the bottom or a groundwater storage.

So, if you make the equation in such a way that you are focusing on groundwater as the parameter, then this will be precipitation converted into your infiltration and coming in recharge, but all these will be captured here also. So, please understand that storage is a combination of your surface water plus groundwater. And then we would look into more focused on the groundwater for this course, because it is a groundwater course.

Still, you will need to understand the dynamics of all the other parameters for which you need to get the data. So, let us look one of the most important, we will not go to all the data sources because all of them are in the WRIS website. But I will just show you the major ones, which include your precipitation, your discharge, and evapotranspiration, groundwater levels have already been seen.

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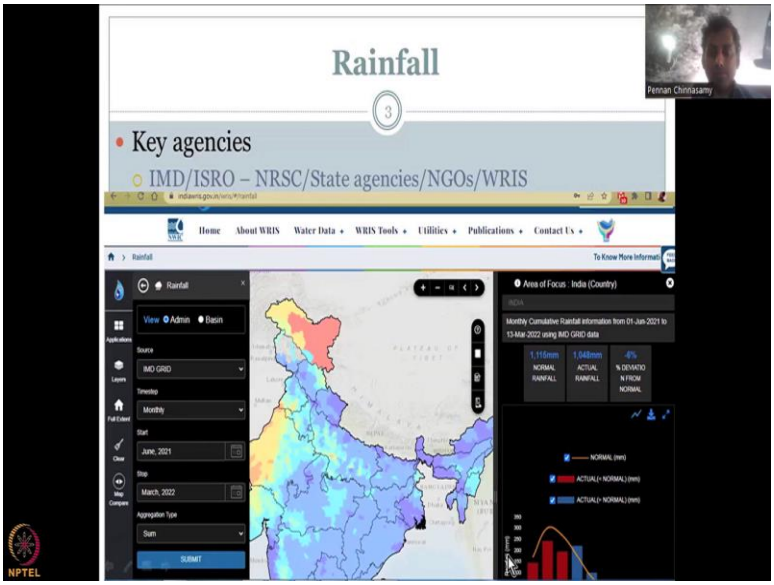

So, rainfall data is collected by IMD as a point observation data. IMD stands for Indian Metrological Department. It is the key nodal agency that is responsible for collecting these weather parameters and hydro climate parameters, most importantly rainfall and temperature, humidity, et cetera. Then what happens is because the location of IMD may not be important, fully covered, you would include ISRO data.

And ISRO data is a satellite data, Indian Space Research Organization. And then you have this state agency so NRC is wing under ISRO, which is responsible for collecting the data and providing it back to the community as a product. NRSC stands for National Remote Sensing Center. This is a national level agency under ISRO, then you also have RRSC, which is the regional remote sensing center.

Then you have the SRC, which is your State Remote Sensing center, and SAC, which is your space application center. So, you could see that the just the umbrella of ISRO has some satellite manufacturing designs et cetera. On the other side, there is launching all the hardware software, rockets and all and they also have a wing where they process this data and give it to the public in open source platforms.

We will look at the remote sensing data platforms also in this while we close up this course. And as I said NGOs also get data and all of this data can be housed in one location which is the WRIS website. There are other state agency websites also which would take these data out and store it individually in their own archives and database. But the government has given the permission to all states to host it on WRIS.

Because groundwater does not have state boundaries nor your water basins have state boundaries. So, there is no point in restricting the data to just one state, you will have to share it to better manage it. And this novel idea has been used across many countries, wherein one rainfall portal is available and all the data is stored there. So, slowly all the state agencies are also putting their data.

Now, once you understand that, the IMD takes observation as a point and then converts it into a smooth surface which is a raster a pixel, it takes it at a point location, but then it converts it into an area, area of influence or area where it interpolates it into an area. Whereas the analysis by

default a satellite image or a satellite data, which comes as a raster or a grid, the state agencies are point data again, which are very useful for locations specific rainfall.

And these points need not be the same as IMD. For example, if IMD is putting a station along one street or in a village, the state agency might have it on the 10th Street in the village. So, there could be some differences in the rainfall calculation and estimation, just broadly view it as there are multiple agencies. One is at a national level observation data. One is at a national level satellite data.

And then you have the state agencies and NGOs. So, without further due, I am going to start the the website for ground, for the data that we can show for at least rainfall. So, what we have here is we are going to show that your rainfall data can be taken from the WRIS website. Since we already work on the WRIS a lot and you know how to navigate it from the previous data sources, we will continue to look at the new data sets that we are going to show.

And that includes your rainfall. So, I hope you could see it, it is coming up slowly because of the internet.

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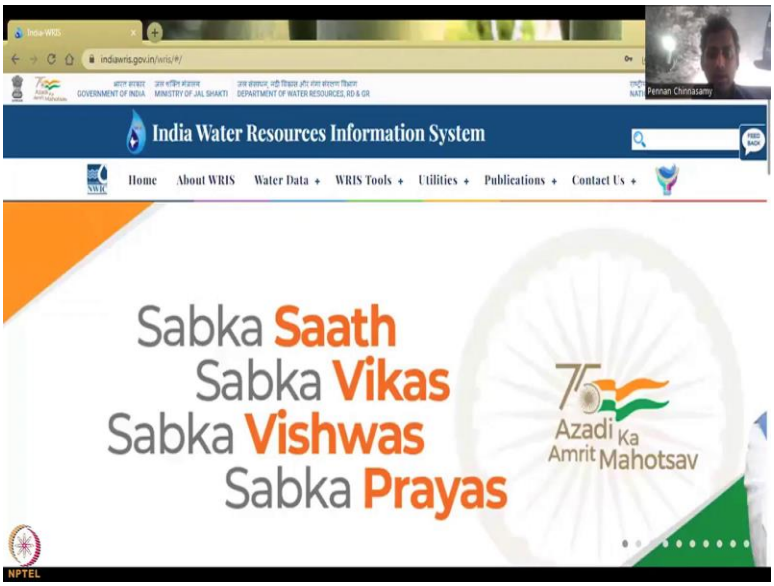

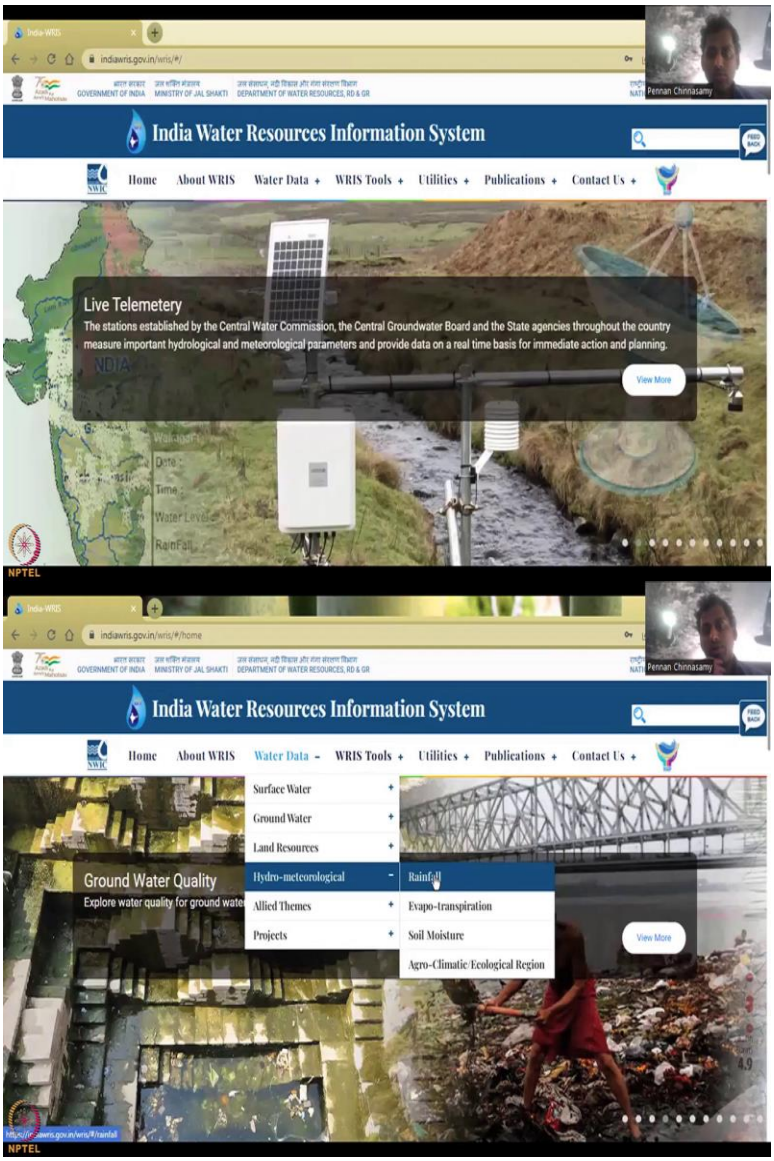

And as I said, you can have this you know in a fashion where you can have the data coming and then later you can have the remote sensing satellite data all coming in the same web page. What we need to understand is there might be some differences in the data that is collected at a point and location. So, now we have this WRIS website setup. What I am going to do is I am going to go back to home where we had the initial data.

And then we go to water data come down to hydro metrological and first option is rainfall. So Hydro means water and metrological means the atmospheric data parameters et cetera. So, you have a set given here rainfall, evapotranspiration, soil moisture and agro climatic ecological

regions. We are not going to talk about that the last one now, we will just focus on the rainfall and the other data.

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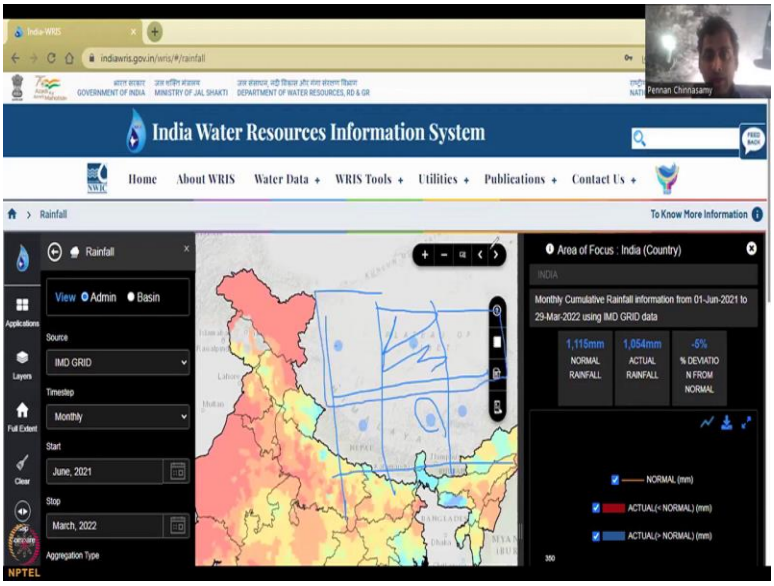

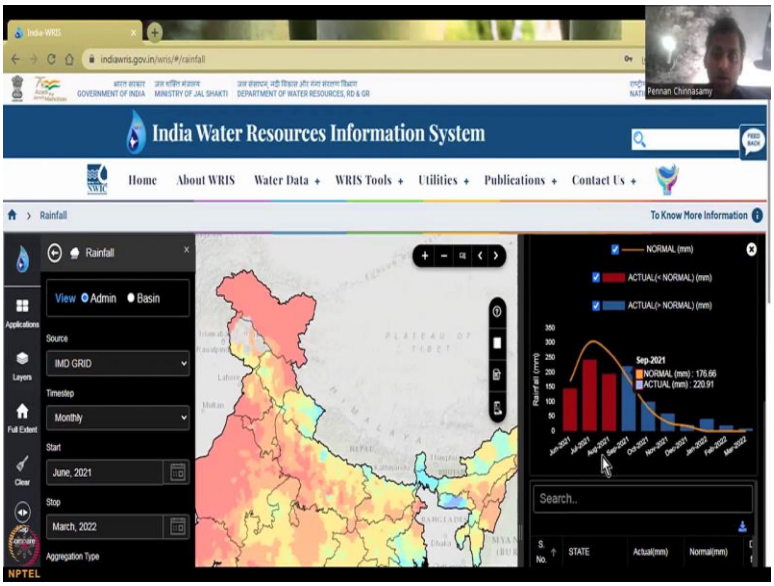

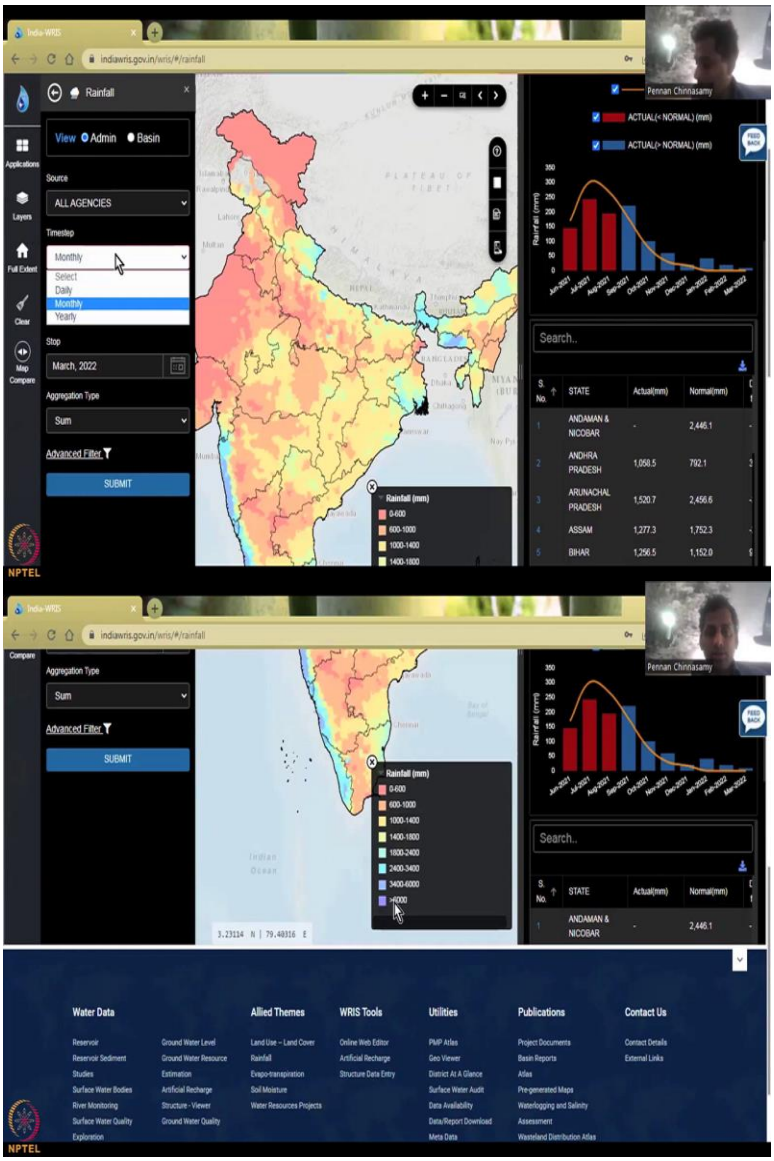

So, I am taking rainfall, it does take a little bit time depending on your internet speed, because it has to pull a lot of data to make this webpage open. It is opening now, you could see that while it populates it automatically by default takes a data range, which is 01 June 2021 to 29 March 2022 using IMD grid data. As I said, I IMD is a point data at our location they collect data and then they merge it with other products to give us space, a grid.

The grid is nothing but let me draw it is like your graph paper. So, you have this as a point data, it is a little bit big. So, this is your point location where the measurements are taken. And now this is going to be converted into a grid. So, we will make it as a grid. And so, what happens is

whatever is within this grid is taking the value of this point. So, this is 50 millimeters of rainfall and this whole grid is given 50 millimeters grid.

Like that all of the grids I will take one value based on the point data they have. If they do not have a point data in the box, then it is interpolated. And this creates a beautiful map. So, it does not mean that every inch of India is monitored for rainfall using IMD. But it is interpolated, those who would like to have more information can search what interpolation means and understand the part.

So, as you know, there is a right panel which is similar to the groundwater data. In the right panel, you have the India focus, and then the date and then the normal rainfall NRF or RF which is your average rainfall for the past years. And then you have the actual rainfall and how much deviation. So, right now, you could see that 115 millimeter rainfall is there for a normal and the actual is a little bit lesser.

So, it is if you do the calculations, it is 5 percent lesser. When you come down, you could see that there is a graph, which says clearly which months is below the average. You can see June, July, August 2021 has been below the long term average. And the other months have picked up more rainfall than the average time. So, it is slightly a shift or a double peak happening. And so one peak happening, you have a double happening which is also a concern.

Because for example, if a farmer says I am going to plant my June crop, like June 6, the rainfall comes in Maharashtra, western ghat region. So, if they say I am going to plant my crops, and then suddenly there is a good rainfall which hits the crops and then a dip in rainfall, then there is a loss. So, this is what this graph shows in the overall trend, how does your year perform or the data that we have?

So, what I am going to do is I am going to say all agencies because I want all the data to be present. And if you click the timestamp, there is daily monthly and annual. Please be informed that daily and monthly are good to understand the variations in the rainfall, whereas the yearly will just be a big number. And we will not know like these double peaks are these things happening. So, it would be good to understand the differences in the scale resolution.

The data, the point data is collected every hourly or sub daily or at least at daily intervals. And then it is summed to a month and all the months are summed are added to an annual rainfall. Remember rainfalls are normally given us annuals or seasonal. So, then, so for that you need to understand daily which is converted to monthly and then monthly converted to annual MCs. The other important aspect about rainfall data is the millimeters unit.

It comes in millimeters, which is given here. And you could see that overall average is given us 115 normal rainfall, and most of the regions do not get that rainfall. So, if it is below the average normally it is zero to 600, 600 to 1000 are in the red region and then your 1000 to 400 are the yellow region and the blue and the green are where good rainfall is happening, which is above the average rainfall you could see here above the average rainfall.

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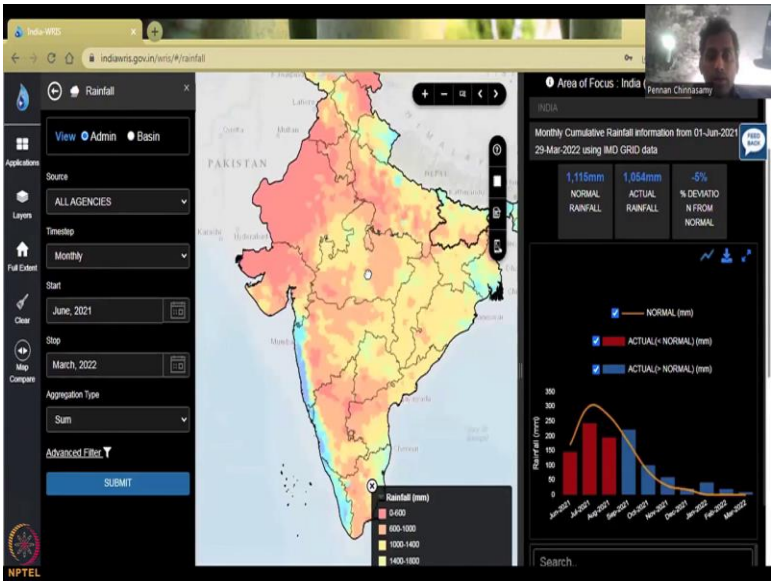

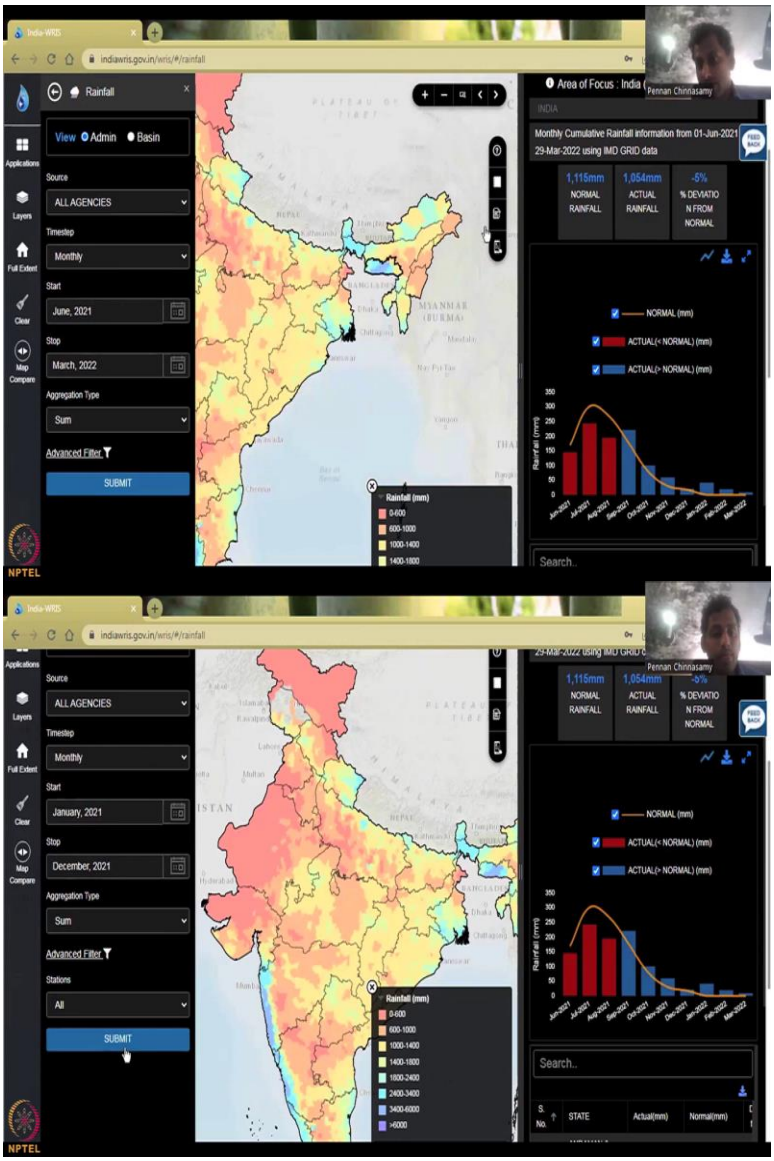

There are some regions with more than 6000 millimeters as they mentioned. And I, I will assume mostly it is here where Cherrapunji and et cetera are there. Where it is one of the worst betters part of the planet we have. So, that is the beauty of India where we have the extreme high rainfalls in the planet and also a deserted region where there is not much rainfall, all in the same country. So, let us do one study, I am going to take the annual rainfall for 2021.

So, let us go Jan, to December. So, you can see that I have taken a year 2021. For some reason, the long term data is not showing right now. But most of the time, the long term data does show up. So, do not worry about why it is not showing up. So, just check the website often. And you

will eventually get it you can also give a feedback, maybe they will reply to you by email if you can contact them why the data has not come.

So, I will just show you how long the data exists. You could see here that the data if you click the same as the groundwater. If you click years, and then go back, it goes up to 1970 this is the first year that you have this monthly or daily data taken from rainfall. And then the latest as is given here is 29 months, just two days before this recording. So, I am going to leave it at the same date Jan 2021, December 2021.

And I want a sum not the average, average would give me only the monthly average of the whole of India, which there is not much use of it because monthly average is different for different regions. The monsoon period is different for different regions. Let us take for example Kerala and Maharashtra both are getting the monsoon from along the western ghats but the Kerala monsoon first comes and then after that some days later the rainfall happens in Maharashtra.

So, let us do some and then advanced filter does its work, this is all stations or telemetry or manual. So, you just want to say all see Telemetry is there data is collected through the instrument and GSM box relays the data back to the computer. And then you have the the manual where a person goes and collects the data every day, and then records it and submit database.

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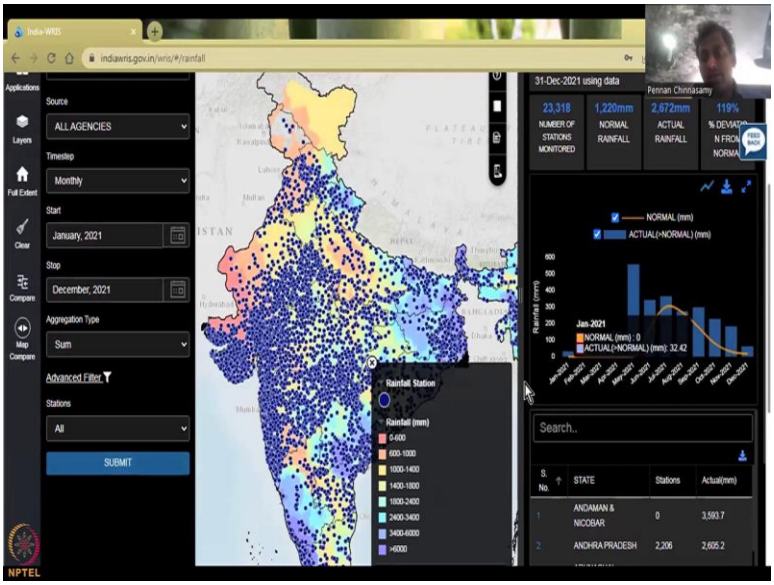

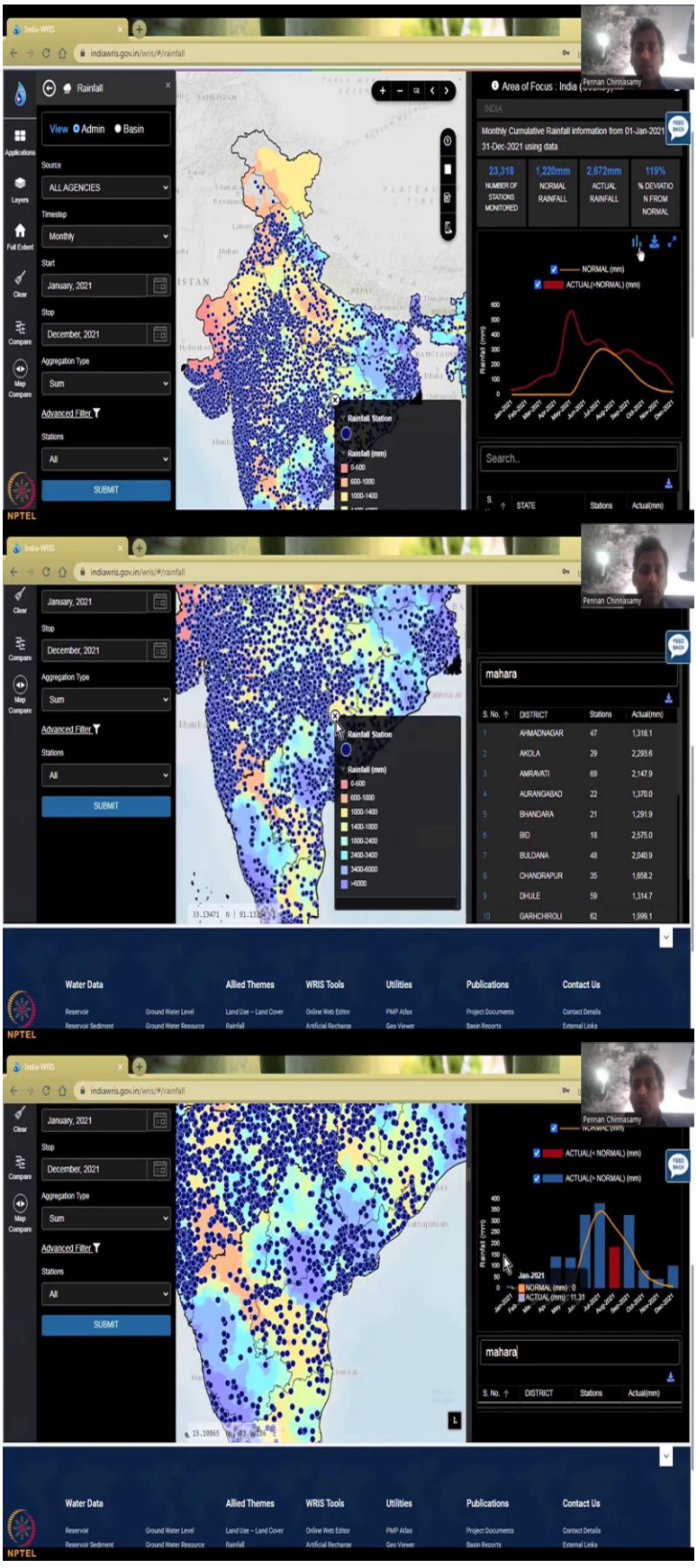
India-WRIS
indiawris.gov.in/wris/#/rainfall
Pennan Chinnasamy
Rainfall
View Admin Basin
Source
ALL AGENCIES
Timestep
Monthly
Start
January, 2021
Stop
December, 2021
Aggregation Type
Sum
Advanced Filter
Stations
All
SUBMIT
Area of Focus : India
INDIA
Monthly Cumulative Rainfall information from 01-Jan-2021 to 31-Dec-2021 using data
23,318
NUMBER OF STATIONS MONITORED
1,220mm
NORMAL RAINFALL
2,672mm
ACTUAL RAINFALL
119%
% DEVIATION FROM NORMAL
NORMAL (mm)
ACTUAL(>NORMAL) (mm)
Rainfall (mm)
Search..
S. No.
STATE
Stations
Actual(mm)
Rainfall Station
Rainfall (mm)
0-600
600-1000
1000-1400
1400-1800
1800-2400
2400-3400
3400-6000
>6000
mahara
DISTRICT
AHMADNAGAR 47 1,318.1
AKOLA 29 2,293.6
AMRAVATI 69 2,147.9
AURANGABAD 22 1,370.0
BHANDARA 21 1,291.9
BID 18 2,575.0
BULDANA 48 2,040.9
CHANDRAPUR 35 1,658.2
DHULE 59 1,314.7
GARHCHIROLI 62 1,999.1
ACTUAL(< NORMAL) (mm)
ACTUAL(> NORMAL) (mm)
Jan-2021
NORMAL (mm) : 0
ACTUAL (mm) : 11.31
maharaj
Water Data
Reservoir
Reservoir Sediment
Ground Water Level
Ground Water Resource
Allied Themes
Land Use – Land Cover
Rainfall
WRIS Tools
Online Web Editor
Artificial Recharge
Utilities
PMP Atlas
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Let us say all just for the clarity, and I have clicked submit. Now, you have a beautiful picture of the how the rainfall has occurred and where it is almost zero. And where it is increasing and decreasing based on the monsoon onset. You could see that in across India, how many stations are there. So, there is 23000 plus stations recording data throughout India. There is not many here in the Kashmir part.

But then there is a total taken per year for that data range. And then you average it and then take the long term average and actual rainfall is for this period one January to 31 Jan, December 2021. So, that is exactly one year of data. And this is how much rainfall we get 2672. That is 119 percent more positive than the overall trend, which shows that really 21 has been a blessed year with good rainfall.

There is also been a lot of floods, but at least most of the rainfall has helped in recharging your groundwater system which is important for this lecture. So, now I am also going to show you how to zoom into a particular location and a particular station. So, now you can download this data, you can convert it into a line graphs by clicking the line, you can download the data by clicking this button, we have already seen this in the groundwater class.

And there all the states are here, since IIT Bombay is from Maharashtra, let me just type Maharashtra and Maharashtra comes. Once I click Maharashtra, what happens is similar to the rainfall, groundwater data that we do see, groundwater also I will just check if with Maharashtra remains there at least.

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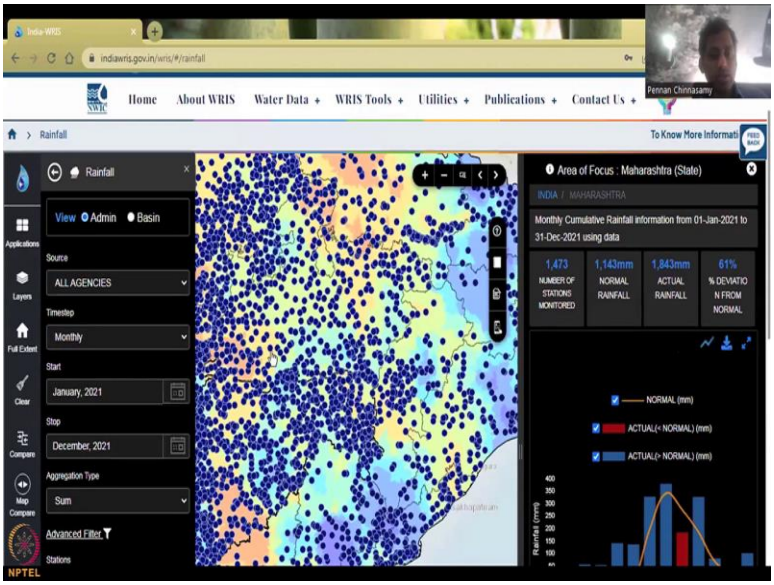

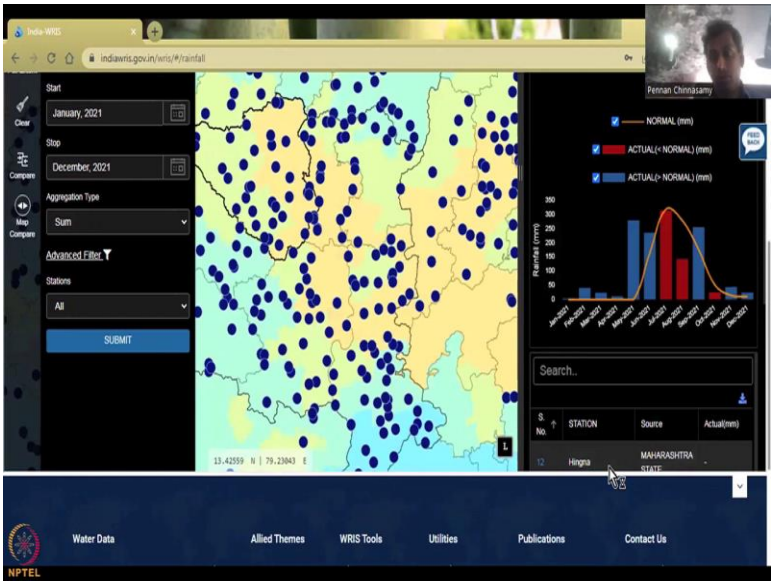

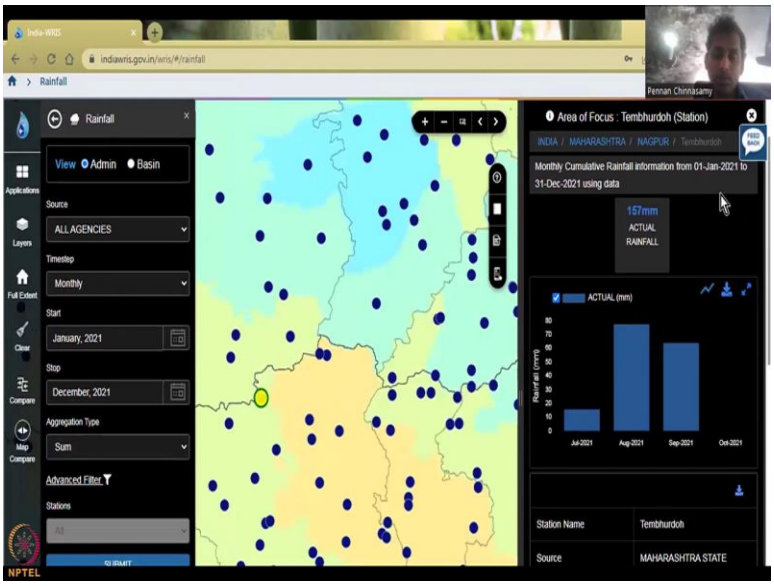

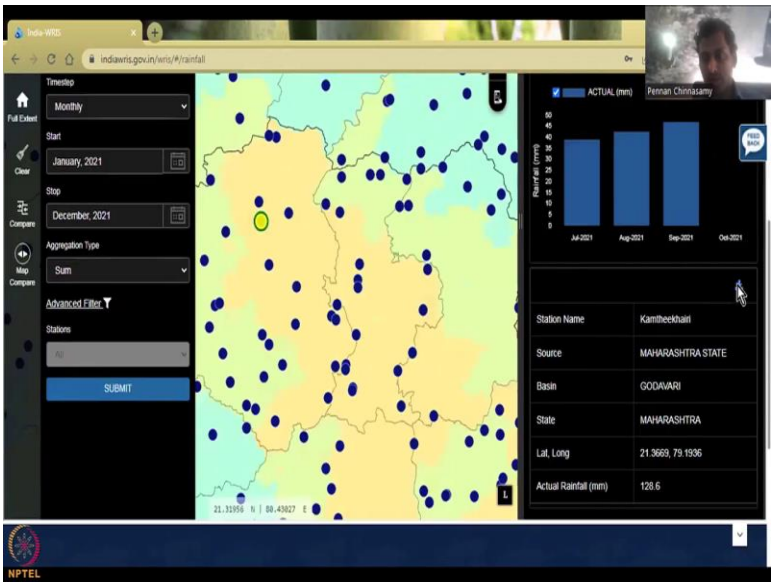

So, here you can see that Maharashtra has been selected, because of the dust is not clearly visible. So, this is Maharashtra selected and that comes here. Now what has happened is the total number of stations come down. Even though you see all of India's stations, what has been used for this average is 1473. And the deviation is plus 61 percent. And then the data has come. Now I also want to focus on 8 particular districts.

So, let me delete this to see all the districts and I am going to say maybe Amaravati, I will take the data. You will be surprised to see that once I click on the data sets, there will be other data that we never looked at in this exercises. Because most of the time we are told which data is

available on the slides. But here what happens is they do not tell you exactly where the data samples taken on the drop down menu.

But when you look at the station, it is coming. So, I have selected Nagpur, you can see Nagpur district has been selected and these are the stations. So, in that way how many 34 stations so if you come down and count all this there will be 34 stations in Nagpur, 35 is our total. So, here is where the source is given. You could see here that Maharashtra state, the state government body has sponsored a lot of stations and they are monitoring it.

And then you have the CWC, which is the Central Water Commission, another agency which is responsible for water data, especially the discharge data. Then you have to see where all else IMD data is there. But it is not in this at least picture. So, I am going to click one here and look at it when you have a dash when a dash is put at the actual millimeter rainfall column. That means that station is there, but it is not collecting data, some issue is there.

Maybe the person did not go and collect data, or the instrumentation is broken under repair maintenance. So, for now, let us take number 30. And the station name is Tembhurdoh. Tembhurdoh and you could see that in June, July, the rainfall picks up and then comes down in September and there is not much rainfall. You do not see other data in the first Jan to 31st December only this much you see and we will have to go with that rainfall.

Because here we just go given an exercise of how to identify the stations and stuff. So, for example, if you want that station in that particular district, you can also click on it. So, I am going to click on another station to see if there is good data and as I said mostly the data is not available, but here luckily we do have data. Now, if you come down you can download this data into your Excel, PDF or tabular format.

And it is also giving you a lat long which means exact location of the station. Please understand the format of that number, it is very useful to understand that these decimals are given to correctly position you at that point and that is what is happening here. We have selected that point and we have the lat long which gives you the exact location and the actual rainfall which is the total rainfall in that period is given us 138.6 which the division is given here. And there is a small report if needed generated by these websites to support the data.

So, now we have started with India rainfall coming to Maharashtra state, then come say to Nagpur and Nagpur to Kamtheekeri which is the flowchart what we want. Kamtheekeri is the, the Kamtheekeri we have come from India Maharashtra, Nagpur to Kamtheekeri. So, please understand this is the format in which this website houses the data India, state, district and then these stations. You could download this and keep it for your analysis.

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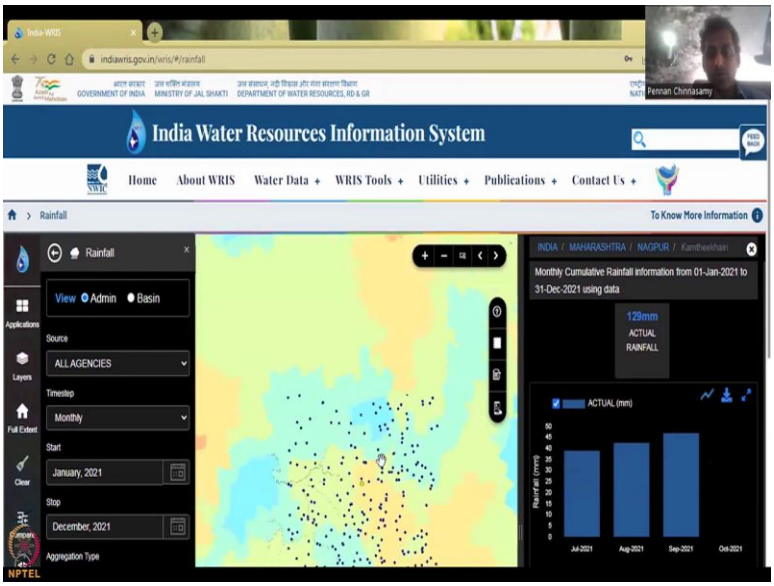

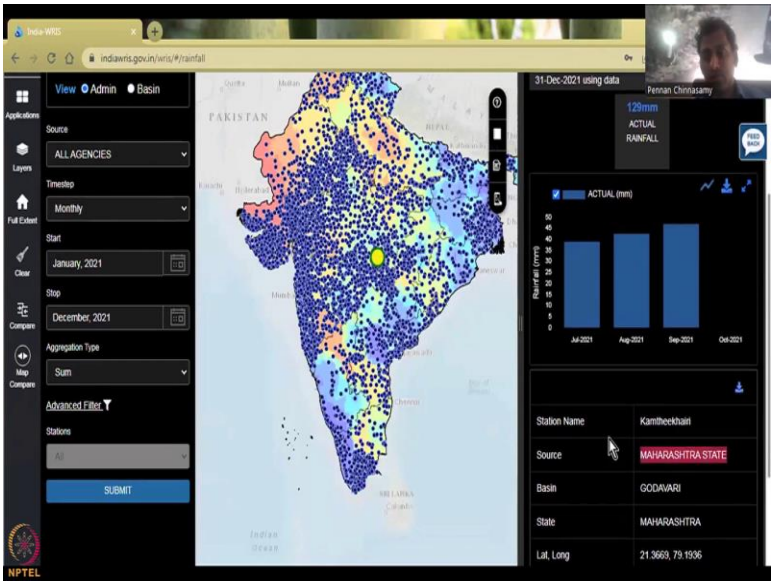

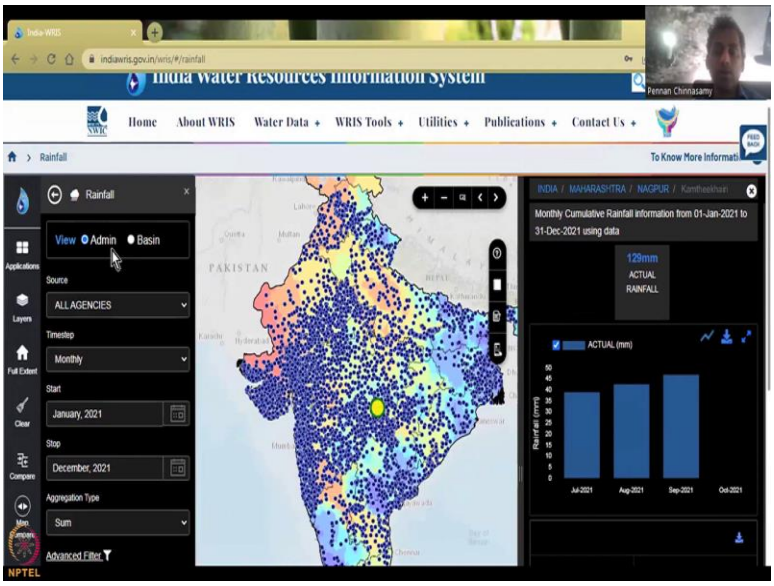

And further you could also select which locations you want. Most of the data will not be available as we saw not all data is available and it is also good to understand which is the agency that is supporting this data and also the basin in which the data is placed, which is Godavari Basin Maharashtra state, the agency is Maharashtra state.

So, with this I have showed you how to date rainfall all the other data aspects are the similar as your locations and groundwater data that we discussed. I will see you in the next class for the next dataset. Thank you.