Geographic Information Systems
Mr. Prakash PS
Ranbir and Chitra Gupta School of Infrastructure Design and Management
Indian Institute of Technology – Kharagpur

Lecture – 56
Introduction to R (Part – II)

Welcome to the course on geographic information system. So this is module 11 GIS software and in this hands on session, we are going to look at introduction to R and its functionalities.

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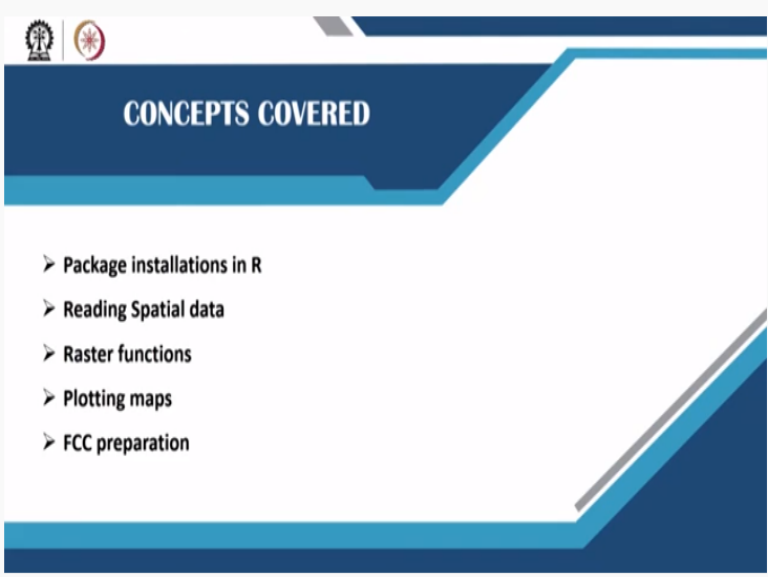

So the concept covered in this session are installing different packages in R reading spatial data and reading a raster and vector data's and different raster functions plotting maps in R and composing a false color composite using R. So in the previous session we have seen how to import excel files and how to subset the data and in in the upcoming sessions and this session we are going to see how in how to install different packages.

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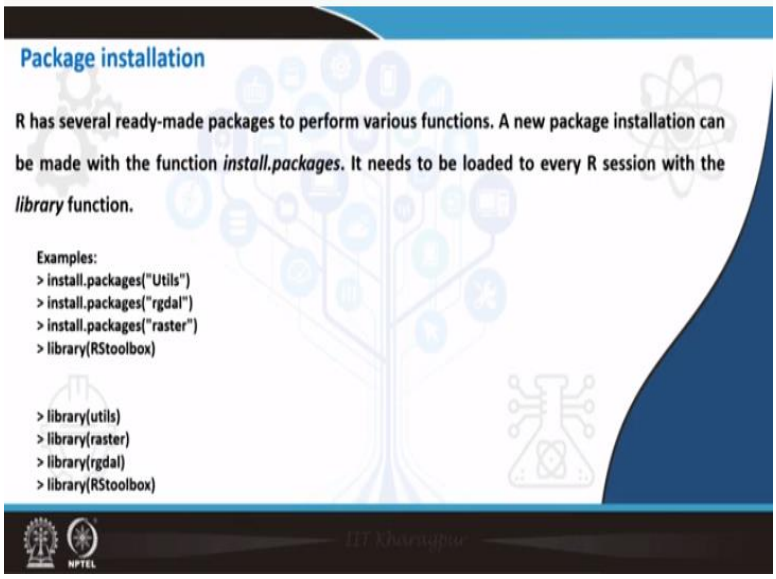

So packages can be installed using a command called install dot packages. So for this particular session we are going to require 3 important packages one is rgdal second is raster and third one is Rstoolbox. So once we install these packages, we also going to need call this packages as a library in our whenever we start R programming.

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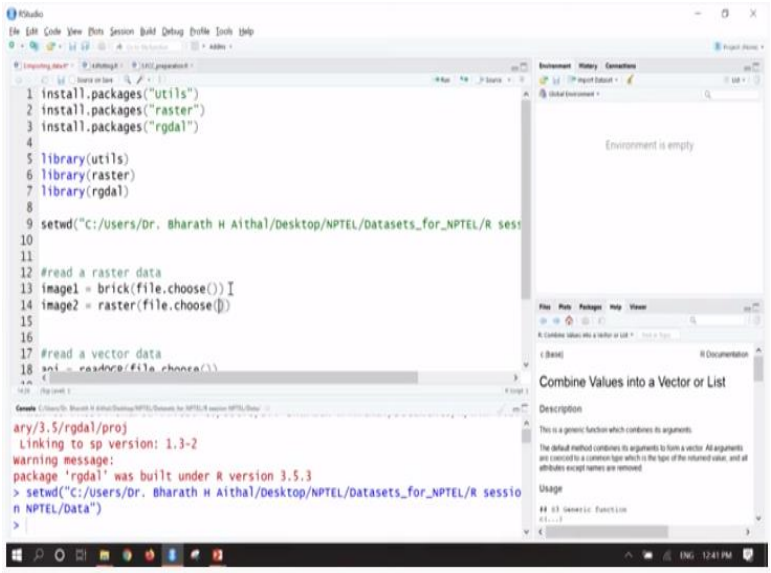

So let us jump to R program and startup the functions. So as I mentioned in the slide, so we need to install the packages here using install dot packages. So this is a onetime task for example if you want to install utils package, you just need to type install dot packages and run. So if you run install dot packages the utils package will get installed. So if it is already installed it will give

you an option saying that it is already installed do you want to reinstall again, or it will give some kind of warning if the version is not compatible.

So let us try to install next package which is raster. So we need to use double quotation inside of brackets to run this particular command. So once to once you try to install the raster it will get installed in your system. So to install these packages you need to have internet connection. So let us try to install rgdal package which is useful in bringing vector data which is useful in bringing vector data into the R environment it will take some time because of the package file. So the zip file will get downloaded to R environment and it will get installed by itself.

So once these files will get downloaded the next button is visible in the console. So that means the installation is done. So now we will try to call this one as a library here we need to call all these packages as a libraries in R so we can select all these together all these things and run it. So the libraries will get loaded in your systems. Once this is done let us try to set the directory for our file as I mentioned in the earlier session. So we need to use a forward slashes and using setwd function we can run we can set the directory for our working directory.

And to import the raster data we can use 2 command we can either use brick or raster. So similarly so instead of brick we can use image 2 is equal to raster and file dot choose function. So what is the difference between the brick and raster function. So brick is to import raster files having multiple bands. So raster is to bring the raster files having single bands.

Let us try to import a brick import a raster file using a brick command. I will run this using control and enter button. So once you do that the particular folder which we set as a directory will get open up. So if you go to import and open a raster file Jaipur quikbird PAN.

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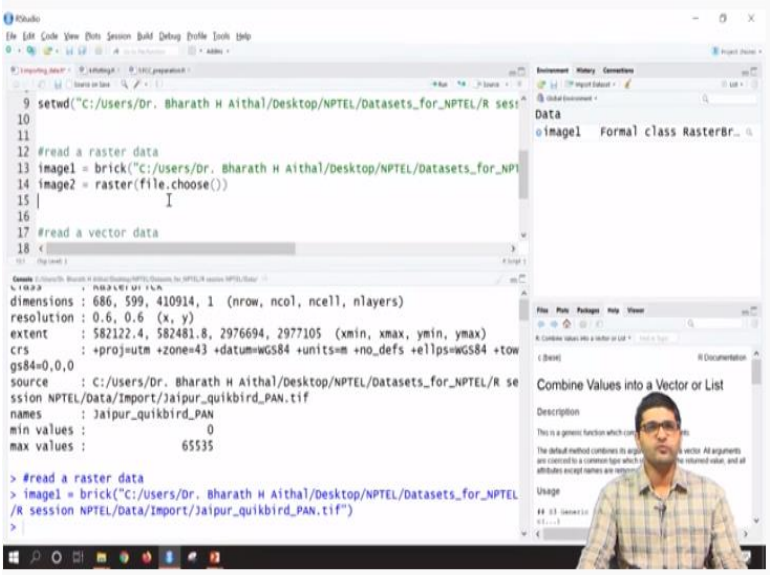

So this particular image will get open. So we can see its properties by going to image 1 and typing it in console as image 1 and run it, it will show its properties. What are the properties of this particular raster? This raster is nothing but a special image having a resolution of 0.6 meter which is having 1 band having number of rows is 686, number of column is 599 and total number of cells and number of bands is 1 that means it is a single band raster image having special resolution of 0.6/0.6 and it also gives extent the left, right, top and bottom latitude and longitude are x minimum, x maximum, y minimum or y maximum.

Also it used to give this information such as projection system is utm, zone is 43 and datum is wgs84 along with this it used the source from which directory this particular raster is coming from and what is its name? The file name and minimum and maximum value of the raster. So the entire metadata of the information or details of the information is visible once you run this particular image 1 variable so how do we get this image 1 variable by bringing in the raster using brick command.

So same process we can do using raster command as well just the difference is using brick command, we can bring multiple band raster's using raster we can bring in single band raster. So here inside brick there is a one more function there are 2 functions embedded here one is brick bracket and file dot choose bracket double quotations or double brackets. So if I remove this file dot choose and I can give the path here as well.

So the path of the file I can mention here and run this particular command. For example, I will show you show that instead of using a sub directory but instead of using file dot choose I can use the path of the file to import I just copy the path and put it inside brick data inside data there is a folder called import inside that there is a file called Jaipur underscore inside import folder there is a file called Jaipur underscore quik word underscore pan.

And just copy the name of this copy the name and bring it into qj bring it into R environment inside import folder there is a file called Jaipur quik PAN dot tif. So this is a tif file and then run it, so this also functions as importing a file. So instead of file dot choose we can do the path as well. So there is still we can input a raster data in R.

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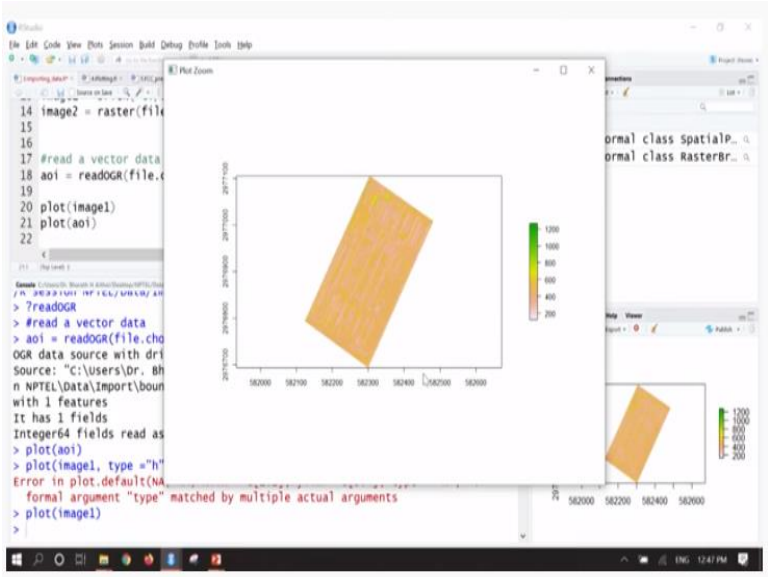

So let us try to input a vector data in R using a command called readOGR. So this particular command is coming from rgdal library. So how to check that suggest copy the function name and we can use question mark readOGR and run it right side we can see under help tab we can see readOGR coming from rjdal, readOGR vector maps into spatial object. So this is how we can see the help. Let us try to import an area of interest or using readOGR file.

I will just run this particular command. So if you run this particular command so the window is not appearing but actually there is a red button which came in here. That means a window is behind the R, so this is here. So I will bring in the boundary this is aoi with which we are we are

bringing into the R environment currently the aoi is come here. Let us try to plot the aoi using plot aoi this is a vector file which is plotted in R.

So here you can see a box a rectangular box which is a share file we bought it into R environment. Similarly, we can plot Jaipur share file which we read using image 1 variable. So we can use a plot image 1 type is h. So either you can use a directly plot image one command to plot the raster. So by running this particular command we can plot the raster here in R we can zoom and see the plotted raster as well.

This is how we can import a different and the vector files into R environment. So if it is having multiple band 3 images will get plotted here. So the label also has come up the values so of the pixel values from 200 to 1200 also X and Y coordinate as well.

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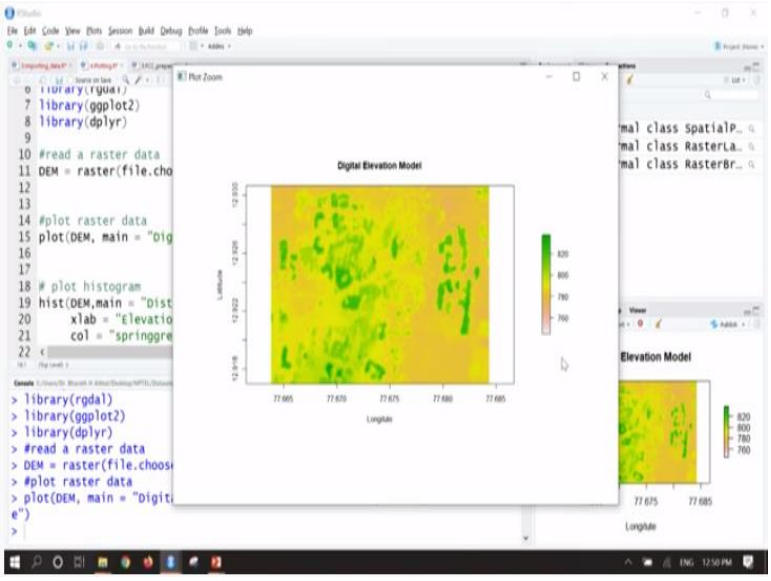

So for in the next exercise we will try to plot a digital elevation model using the same plot command and try to plot an histogram. So how to do that so to do that we need to have a library called ggplot and dplyr. So let us call these libraries at once select all this library and run. So here in the console you can see all the libraries will get loaded I will run it again. All the libraries have run so the setting working directory already done so the previous page we have done setting working directory it will open the same page.

So let us try to read a raster now. So let us try to read a digital elevation model since the red button is here so we can open the window. So inside a folder called data there is a digital elevation model fine I will import digital elevation model into R environment so that has come up here we can see now we will try to plot digital elevation using plot command. So here under plot we need to mention the variable name digital elevation model and the mean is to give the title and x lab and y lab used to give the x and y direction labels.

So if I click on the line 15 which is having the plot function and run it the digital elevation model will get plotted. So right now we have plotted digital elevation model here we can clearly see there is a title saying that digital elevation model which we have mentioned here, and x lab and y lab also had has come up latitude and longitude and latitude. So clearly mentioning it is somewhere in between 77 degrees and 12 degrees.

And at the right side, we can see the legend showing that elevation varying from 760 to 820 having varied colors. So the plotted map can be exported into a PDF or image format using export command. Here if you click on image it will get exported into image format if you want to convert it into PDF that also can be done.

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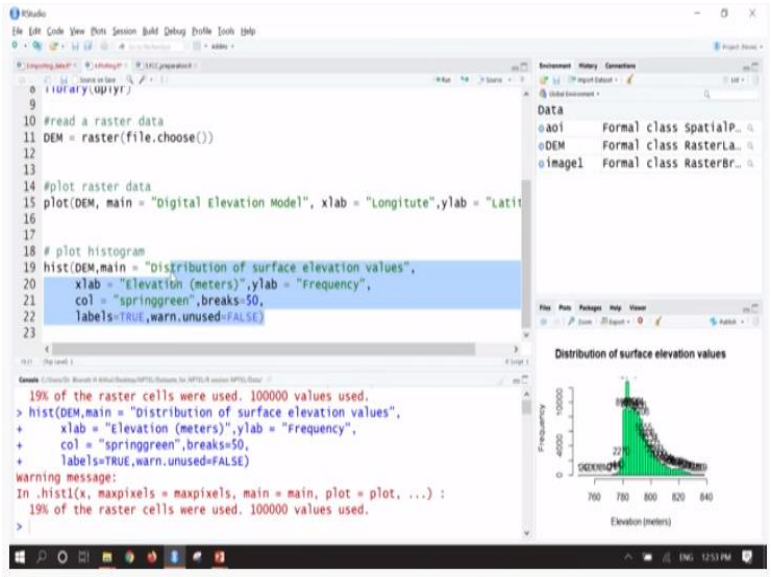

So if you want to plot a histogram so histogram is a representative is the plot between the pixel values and the number of or the frequency of pixel values. So using hist command we can plot

the histogram. So here digital elevation model is the raster we need to call. So here we already have a digital elevation model and we can view the title as distribution of surface elevation values x lab is elevation y lab is the frequency.

Since we are using a histogram y lab will be the frequency and we can give number of breaks and the colors and labels are true. So if you run this entire command the histogram of this particular digital elevation will get plotted. So I will zoom, and we will inspect the histogram. So here we can see the elevation having more than somewhere around 710 meters is having maximum number of pixels.

Frequency versus elevation or pixel values is the histogram of this particular raster. This is how we can plot the histogram of any raster. So if you want to plot a histogram of an image also that also can be done. So instead of the elevation there will be pixel values in the x direction. So here also the variable such as brakes can be changed if you want to have more breaks or less breaks that also can be done.

For example, if the breaks is 10 the histograms will have only 10 breaks. We will try to inspect that if you run that the number of breaks in histograms have changed to 10. Only 10 breaks are that if you want to have more finer breaks let us try to see that as well let us have 50 breaks in the histogram and run it. We need to select the entire command and then run it. So there are 50 breaks in the histogram.

So this is clearly a visible there are total number the number of breaks have been increased from 10 to 50. So in this exercise we have seen how to import the packages how to import the libraries and how to import a digital elevation model or any raster into R environment and finally plot it and to generate histogram of the raster. Next, we are going to see how to generate the raster statistics.

For example, if you want to see what is the maximum elevation value in this particular raster. For example, using this particular graph we will not be able to understand the what is the

maximum value of the pixel what is the mean value of the pixel? Those can be done using sales statistics command. We will try to see it here itself.

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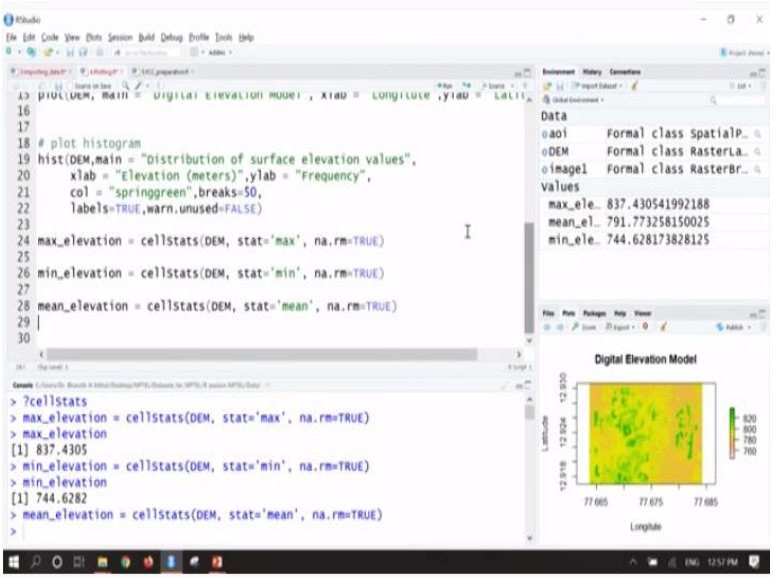

So there is a command called cell statistics There is a function called cells statistics We will try to see its syntax question mark cellstats and run it. So it shows that it gives the syntax for cells statistics. So here we just need to copy this syntax from the help command and put it into R environment. So this cells statistics can be of mean, maximum or minimum or standard deviation also.

So for this particular digital elevation model we will see what is the maximum elevation is equal to cellstats instead of x it will here it will be digital elevation model variable DEM I will type here DEM stat is going to be maximum this time and I remove all other variables which are not necessary and then run this particular command. So now we calculated what is the maximum elevation of this particular raster. So the value has come up with the right side we will also inspect here if you copy maximum elevation and put it here and run.

So it is saying 837.43, 837 is the maximum elevation of this particular raster which we are seeing in the screen left side. So in the plot we can see, so here it is showing 820. So what is the maximum value of the pixel in the entire scene? That is 837. These kinds of statistics, we can get it using cells statistics command. Let us also see what is the minimum value as well. So I will

copy the entire command and paste it into next line and instead of max I will say as min minimum and instead of maximum elevation it will be minimum elevation and then run it.

So we see what is the minimum elevation copy these things and put it into console and then run it. So minimum elevation is 747.62 the value ranges from 740 pixel value ranges from 744 to 837 this is how we can inspect the maximum and minimum value or after raster using cellstats command. We can also see mean and standard deviation as well. Let us try to inspect what is the mean value.

So if you use the same command and use mean as the stats and let us change the variable name as mean and then run it, it gives the mean value it is here as well. The mean value is 791.77 the calculations the raster calculations happen very fast this is one of the advantages of using R for simple calculation simple raster functions in R.

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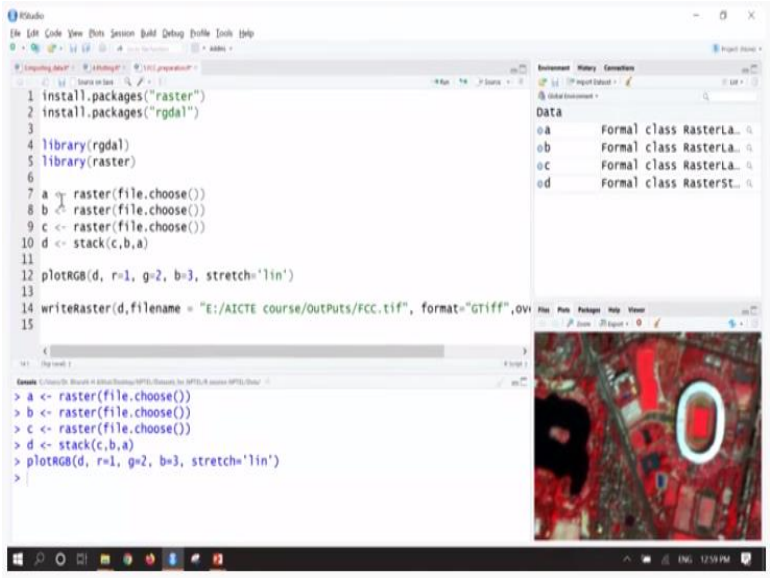

So let us proceed to the next exercise which is that is false color composite preparation. So in the earlier sessions we have seen how to download LISS4 or landsat imagery to your system using registering in Bhuvan website or USGS website and finally download into your system. In this session, we are going to see how to stack these images and prepare a false color composite. False color composite can be prepared using 3 bands.

So let us try to import the libraries as well Here I will import these 3 libraries and then path is already set since we have used the earlier R function as well. So I will clear the environment before doing the stacking I will clear the map view also can use the broom button to clear all these things. Once it is cleared let us try to import 3 bands, I will import the band a so if you run raster file dot choose and assign it to a so 1 band will get imported.

For false color composite, I have kept LISS band 2, LISS band 3 and LISS band 4. LISS band 2 is the green band and green red and infrared band. I will import the green band first. Once I import the green band next, I will import. Similarly, I import the red band as well and thirdly, I will import the infrared band also here infrared band I will import. So now we have 3 bands separately imported in R environment abc.

So simply we need to stack in opposite order cba using stat function. We can use stat function to make a stacking of these 3 images to prepare false color composites. So I will assign this stack image into a new variable called d and run it. So now d is created d is showing here So let us first before exporting this stack amount let us try to plot it so is it proper or not, we can see here itself. So if you run the plot command the image will appear here. We can zoom it and see if you zoom here plotted image can be seen here. So if you want to see the specific bands, we can plot them also and you can see.

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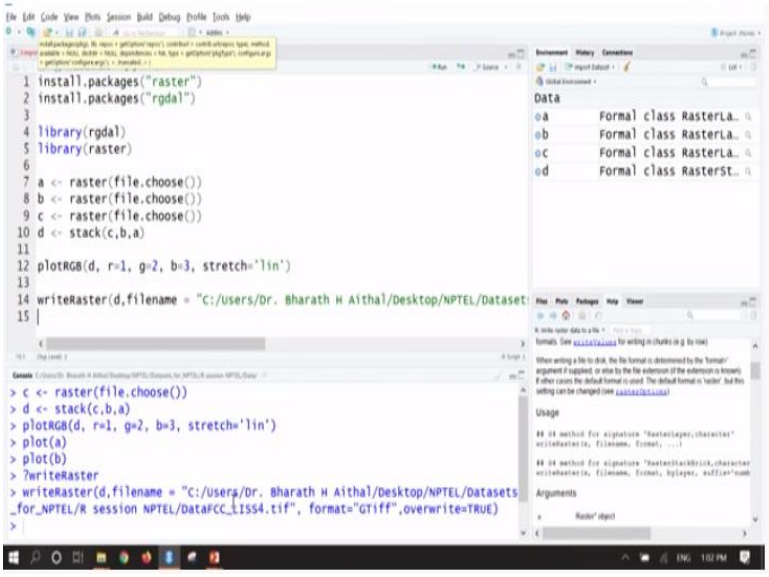

I will just plot band a and run it here we can see this is only band a so it can plot b this is band b and similarly band c also I can project if we collegiate if you make a stack of these 3 things and make it a false color composite this will look something like this in which a vegetation looks in red color. To explore this particular d or the false color composite which we created we can use a command called writeRaster.

So there is a function called writeRaster so how exactly it works We can see go and check it in question mark writeRaster and run it. If you run that particular command write dot raster x comma file name, we need to mention. So here the file the x will get replaced by d and file name we are mentioning along with the path. So here since we have set the directory, we do not need to mention the path.

We just have to mention it as FCC and give the format geoTiff overwrite if an existing file is there, we will name it as FCC LISS 4 since this is a image from LISS4 imagery so I will rename it as LISS4 and then run. So now this particular LISS imagery has been exported into the folder. So where exactly it come up, we will try to see that. So, it must be in the folder import, it must be in the folder here if we set the directory so not here.

So since we need to mention the path here, let us mention the path and then run it again. So path is in R itself, we have the path. Let us go to the path; let us try to export it to this particular path to the data folder and then go to R file and then mention the path along with the filename. So now under the desktop NPTEL folder under data sets, this particular file will get saved. So I will just run it again. Now let us go and inspect the file is there or not?

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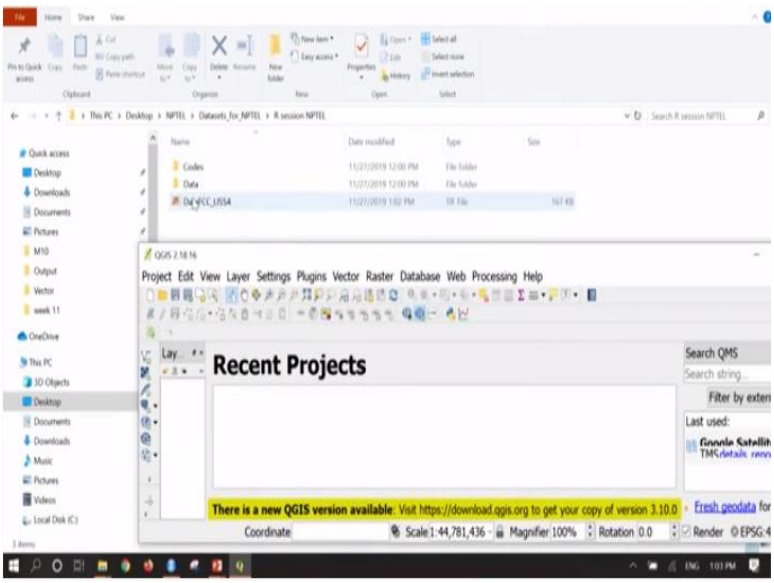

It should be under data let us go and run it again. Okay R session NPTEL here it is the file has come up here. So since we are mentioned path till here. So let us go and see this particular false color composite in QGIS. In QGIS software we can just bring this particular file and see false color composite has been created.

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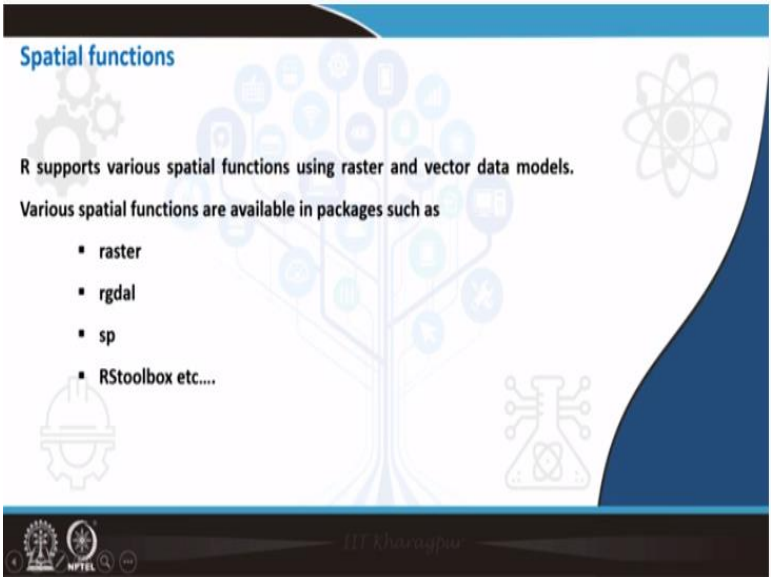

In this particular session, we have seen how to install the packages how to run spatial functions.

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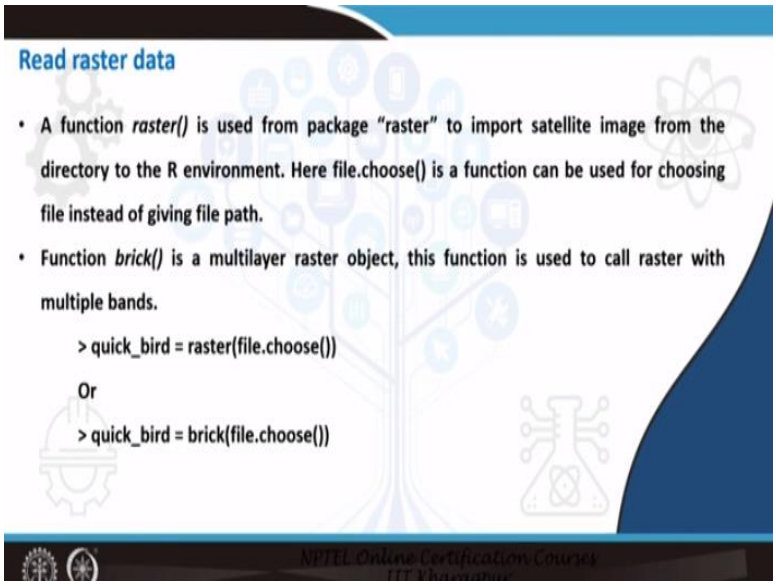

And how to read raster data.

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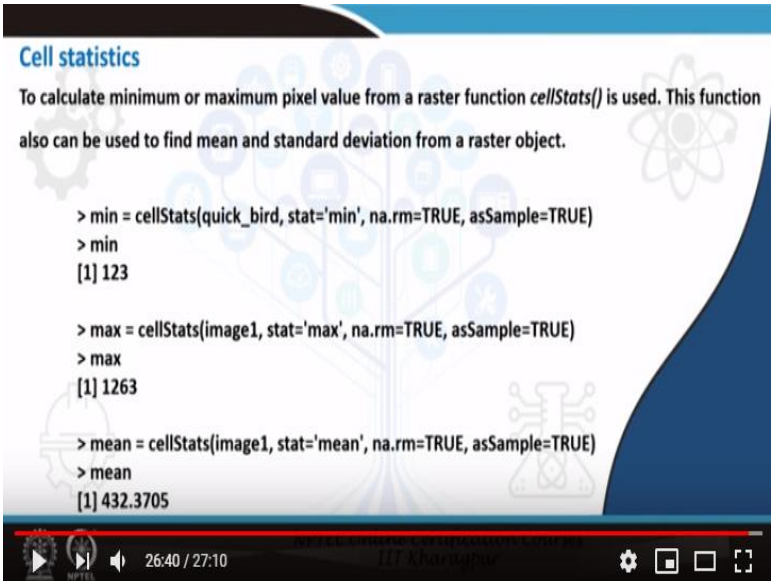

How to do cell statistics?

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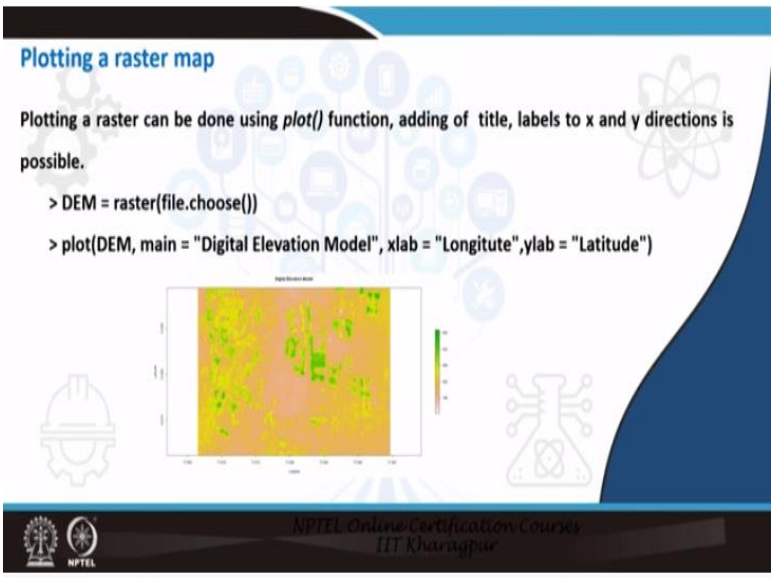

And plotting master data.

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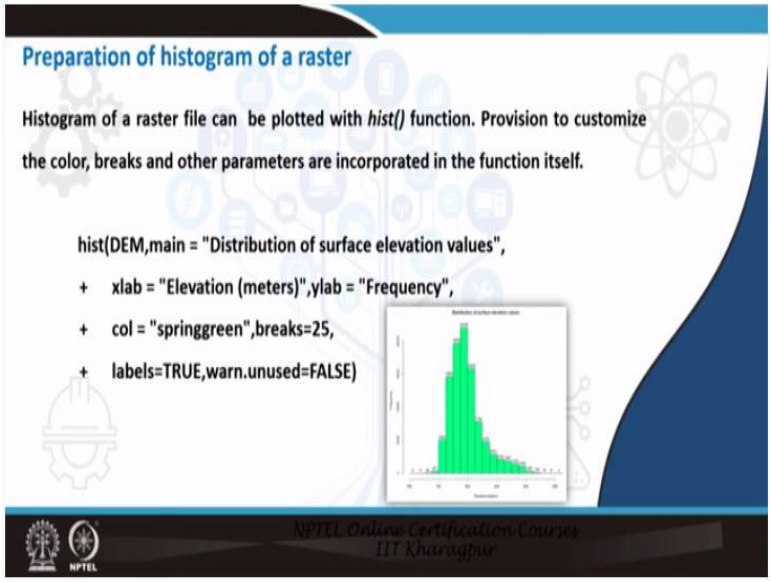

And creating histograms.

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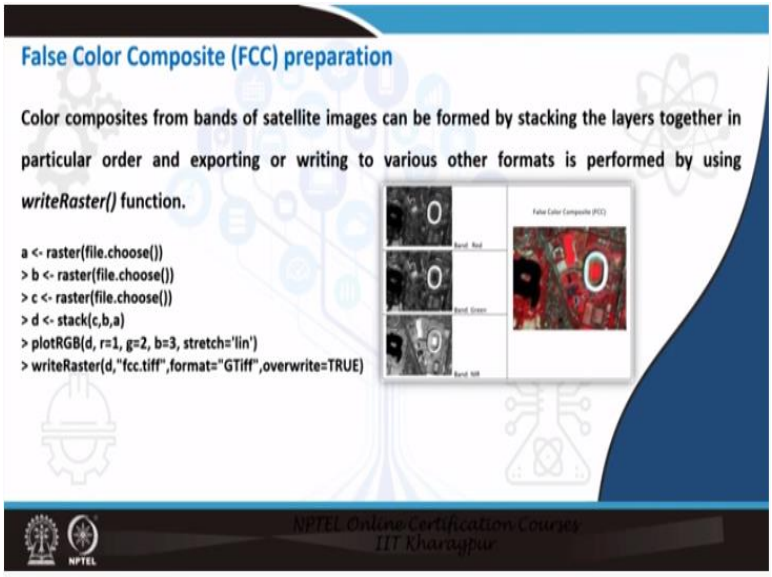

And finally creating false color composite. So till here in the past 2 sessions we have seen installing packages, reading spatial data on the plotting maps and preparing false color composites or from different bands of the imagery being downloaded from the Bhuvan or any other geo portal. Thank you.