Laboratory Practices in Earth Sciences: Landscape Mapping

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Lecture- 24

Hello everyone. So, today we will start with a new lab. So, today we will learn how we can generate the anaclyph that is a 3D surface model with the help of Cartosat-1 data. This exercise we will do on the NV. NV is a GIS software and with the help of NV and Cartosat data we can generate the anaclyph and DM of the Cartosat-1 data that is a spatial resolution of 2.5 meter.

As I already discussed, this data we can purchase from the NRSC. You can get the data from NRSC and you can generate the high-resolution DM with the help of this data on the GIS software. Before going to the generation of the DM and anaglyph, I will explain to you what is the difference between the DM, DSM and DTM. DM as I already discussed is a digital elevation model that acquires elevation data only from the bare earth surface and that removes all the elevation which are coming from the natural as well as the artificial artifacts.

DSM is a digital surface model that means the elevation is only coming from the bare earth as well as the artificial and natural features. That means the elevations are also included from the trees or houses or buildings. So, any kind of natural structures or natural as well as the artificial structures which are present on the earth surface. So, all the elevation data is included on the digital surface model. Another model is the digital terrain model.

It is also a DM, but when you are processing your DSM or DEM which includes the natural as well as the artificial elevation data. If you are removing this data from your DSM or DEM then it is called your DTM. Here you can see this is a DEM and this is a SRTM DEM of 30-meter resolution. So, although this is a SRTM DEM, here you can see over this area these are all the elevations which are coming from the vegetation. So, this is a kind of DSM, but when you are removing this error from the DSM or the elevation from this elevation which is coming from this vegetation.

So, that will be your DTM digital terrain model. So, here is another example of DEM. So, this is the DEM of SRTM data, but in three dimensions. Here you can see the elevation is only coming from the where earth. Here is another example of DEM.

So, you can also generate DEM with the help of real time kinematics. So, the RTK and

this is an instrument which is with the help of the GPS, the rover and base antenna. You can acquire the elevation data from the earth surface and you can process those elevation data on the GIS platform and you can generate the DEM. So, here you can see this is a high-resolution DEM of which is prepared with the help of RTK. Here is another example of a DSM, you can see this is a DSM which has been acquired with the help of UAV and this is also a high-resolution DSM.

Here you can see these are all the houses and these are all houses and these are all vegetations. So, the elevation data which are included on this DSM is coming from the bare earth as well as the houses as well as the trees. So, this is called the DSM. Here is another example of DSM and this is in three dimensions. Here also you can see that these are the houses and these are all the small trees.

So, the elevation which is included on this DSM is coming from the bare earth as well as from the natural as and artificial artifacts. So, these are some common differences between the DEM, DSM and DTM. So, now we will move forward to the Cartosat-1 data. So, as I already discussed, the Cartosat-1 mission was launched by ISRO in May 2005 and this satellite is acquiring the stereo pair data. It includes the two cameras with the panchromatic sensor and in which acquiring the data in visual range and these two cameras is the forward and another is the afterward camera.

So, this is a high resolution Cartosat data which is been launched by the ISRO in May 2005 and it include the two panchromatic camera and and the each pixel of this camera have a has a high special resolution of 2.5 meter which is covering the data in a visible range of visible region of 500 to 850 nanometer. So, the two bands which have been the forward and afterward camera are the band A the afterward image and the other is the band OF the forward image. This band F has another angle of plus 26 degree and the band A has another angle of minus 5 degree. So, with the help of these two forward and afterward cameras this satellite is acquiring stereo pair data with a special resolution of 2.

5 meters. So, in band A you can consider it as a left eye perspective image and band F you can use this for the right eye perspective image. As I already mentioned that this is a stereo pair data. So, you can consider band A as your left eye and band F as your right eye. So, with this left and right image you can generate the stereo pair observation with the help of this band A and band F. So, this Cartosat-1 data is also coming with the or with the RPC rational polynomial copy and because this is this is the ortho-grid data that means it is included with some ground control points and with the help of this ground control point you can ortho rectify this data.

So, these RPC values provide a true ground control point that can be used for image

triangulation and ortho rectification. So, this Cartosat data is available at the National Remote Sensing Center Hyderabad and you can purchase this data from the NRSC with a cost of parsing around 2000 Indian rupees and you can directly order this data from the Boonidhi portal as I already discussed in one of our previous labs. So, this Cartosat mission was launched in May 2005. So, the orbit is the sun synchronous orbit that is the polar orbit that means the satellite is rotating from pole to pole. So, all the satellites the earth observing satellites are acquiring data that is rotating from pole to pole.

So, these are all the polar satellites. So, Cartosat-1 is also a kind of polar satellite. So, there are three kinds of orbits available. So, the one is polar or sun synchronous orbit, another is the equatorial orbit that is acquiring data or the satellite is moving from equator to equator that means the not east to best and the other is your geosynchronous satellite that is basically your navigation satellite. So, all the satellites which are giving you are being used by this navigational organization.

So, those satellites are orbiting from an inclined orbit. So, those satellites orbits are called the geosynchronous geosynchronous orbits. So, this Cartosat-1 is your sun synchronous satellite's sun synchronous orbit and it has an orbit minute of 97 minutes that means it completes its one orbit around the globe in 97 minutes. So, the number of orbits per day is 14. So, in one day it will complete 14 orbit around the globe and the local time of equator crossing is 10: 30 AM. That means because this is a sun synchronous satellite.

So, this kind of satellite has a set of angles with the sun. So, that means, at 10: 30 AM every day this satellite will cross the equator and the temporal resolution of the satellites is 126 days. So, this satellite will acquire the data from the same region every 126 days and the special resolution of the satellite is 2.5 meters and the swath is 30 kilometers. S it means the ground coverage or the IFOV instantaneous field of view of these satellites is 30 kilometers.

So, here we have written some steps. So, to generate the DEM and the anaglyph on the N V software. So, first you have to install the N V software in your respective PC and once you will open your software you will see such type of window will open and here you can see some options are given over here and with the with the topographic module you can see there is a DEM extraction module and this DEM extraction module is especially used for the extraction of DEM. So, for that you have to use the Cartosat-1 stereo pair data or any kind of data which is having the elevation information that kind of data you can use to extract the DEM with the help of this DEM extraction module on the N V software. So, on this DEM extraction module you will see the DEM extraction wizard and once you will click on this DEM extraction wizard.

So, you have to choose the new file from the DEM extraction wizard and once you will choose the new file you will see that such a type of window will open here you can see some options are given. For example, the first option is a stereo pair image and on this stereo pair image you have to first select the stereo pair image. So, you you you are having the left stereo pair image and another is your right stereo pair image that means your band A and band F. So, you have to select accordingly left or right stereo pair image with the help of this option and once you selected your stereo pair image you would see the minimum and maximum elevation over here which is you can see the scene elevation in meter on your DEM extraction wizard. So, once you click on the select stereo pair image you would see that a new window will open and from here you can see the select input band and band information.

So, all the bands which you are selecting that you can see over here and the information regarding the band, the latitude longitude or the elevation or the acquiring information related to that particular band you will see all this information over here. So, from the open menu you can choose your new file and once you choose your new file it will direct you to your directory where your band is saved. So, you have to open both the forward and afterward band accordingly and once you open all you're both the band you can see the both the band in the select input band option and once you click on any of respective band and all the information regarding this band you will see on the right side in the band information option. In the band information option here you can see the dimension of this band or the size of the file, the format or the sensor type or the projection and the other information which is given to this respective band. Accordingly, you will also see the information which is related to band A also and once you open all of this band now you have to choose the RPC information or that is the rational polynomial coefficient.

So, this rational polynomial coefficient you would need you would need to do the triangulation or ortho rectification method. So, to do the ortho rectification you have to choose the rational polynomial coefficient for both of these bands. So, first you have to select the rational polynomial coefficient or RPC value for band F and then you have to choose for band A. So, first few things here you have to keep in mind if you are opening band F first then you have to choose the RPC value for band F first and then you have to choose the RPC values for band A and if you are opening your band A first during the selecting band or then you have opened your band F. So, accordingly you have to choose your RPC values for band A and band F.

So, here you can see once you will select your band A. So, you have to first choose the RPC value for band A. So, you can see in your raw data you will you will be having some information that would be your band A TIFF format, band A metadata in text format, band An RPC in text format and band An RPC underscore org dot text format. So, this band An

RPC org dot in dot text format in this file you have all the information regarding the band A. So, you have to open this file for the ortho rectification.

So, first you have to select this file and you have to open and accordingly you have to select the RPC values for band F also. So, you have to open both RPC files in this band and once you have selected the RPC for both this file now you will see here the minimum and maximum elevation for your data. So, for this respective data you can see the minimal minimum elevation for this area is 400 meters and the maximum elevation is 5100 meters. So, once you can see the elevation data over here now you have to click on the next option and a new window will open here. You have to choose a certain kind of information you have to assign to this GCP value. For example, this GCP is the ground control point. So, the image which you have selected to generate the DEM if you are you have the ground control point that is the true latitude or longitude of this region.

So, that you can choose from your file and if you do not have the GCP values in that case you just select the no GCP or relative DEM value only. So, this GCP value if you are adding in a DEM, will enhance the resolution or the sharpness of the DEM. So, if you are having the GCPs then it is ok if not then you can choose the no GCP value and you click the next option. So, once you click on the next option now you have to give certain more information. So, that is what would be your tie point.

Tie points are basically the common point in both the images, so that you have to select because in this image ortho rectification you have to just overlap the two images over each other to generate the DEM or an eclipse. So, in this process how you will do this you have to do this with the tie points. So, a tie point would be some common point or features in both the images which you can easily identify and when you identify this tie point on both the images. So, with the help of this tie point both images will overlap to each other.

So, you have to select the tie point. So, to generate the tie point here three options are available first is to generate a tie point automatically. So, with this option you can generate the number of tie points automatically the system will generate the tie point and then you have to manually rectify those tie points and to generate the DEM. So, here to generate the tie point automatically here certain options are given the number of tie point search window size, window moving size or regional elevation. So, this information you have to provide to generate the tie point automatically. Another second option is to define tie points manually or interactively.

So, with this option you have to choose the tie point manually and the number of ties points you want to choose that you would do with the help of the window which will open up in the next slide. So, with this a window you will choose some common position or the points

in both the images. So, you have to do it manually. So, with this option define tie point interactively you can do this. If you have previously done this exercise and you have some kind of tie point you previously saved.

So, that file you can use from this third option is read tie point from the file. So, with this read tie point from the file you can upload your tie point directly from your file and that you can use to generate the DM. So, once you have assigned or you have chosen your criteria. So, then you have to click next. For example, in this exercise we have chosen the generate type and automatic option and here you can see we have assigned the system to generate 25 tie points with the search window 81 and moving a window size 11 and the regional elevation is 2750. So, the system or the software will automatically choose some common point and that will give you the 25 tie points, but this tie point will associate the error.

So, that you have to manually rectify. So, once you have done this you just click on the next now you will see that automatic tie point generation window is open and once it is done 100 percent. So, you will see a few windows will open here you can see both your band A that is your afterward image and band F that is your forward image. So, here in this is scroll 1 here this is scroll 1 you would see your forward image. So, this is your entire image here you can see and this is scroll 2 here you would see your for afterward image and for a particular reason suppose this is your here in this screen here you can see it is 1. So, the tie point which is number 1 for example, this area so, this area you can see over here.

So, this is this you're this the band 1 and band 2 this window is basically the zoomed portion of this area. So, the where we have marked the or the system has automatically assigned the tie point number 1. So, this is your zoom up portion of this area and another window you can see that is in pixelated form in zoom 1 and zoom 2. So, these two windows are basically the further zoom up portion or in the pixelated form of the area where the where we have assigned or the in this case the system has marked 1. So, this reason is you can see over in this zoom window in the pixelated form.

So, this pixelated window you can manually zoom in or zoom out to get a pixelated representation to more accurately mark the tie point. So, you can do this with the help of this plus or minus sign. So, once you have understood all the of the basic idea of all these windows then you have to assign your tie point in case you are marking the tie point with the manual option, but in this case this the we have chosen the automatic option. So, here you can see system has automatically assigned 25 tie points. So, you can see this 25-tie point is manually just automatically distributed over any point for this. For example, the tie point number 1 you can see the point where the location where this point 1 is has been

marked is not equal to the same place which is marked in band A or B and F.

So, these two locations are different or the two objects are different. In this case what will happen is your parallax would be higher. So, here you can see this is your maximum y parallax. So, for this case it is 89. So, to generate the d m or the anaclyph this parallel should be minimum.

So, generally we are trying to keep this parallel below 1. So, the high parallax value will give you more accurate d m or more accurate anaglyph. So, here with this dam extraction wizard you can see some more options are given. So, with this option you can manually adjust the tie point which is associated with the error. So, here you can see first the left right stereo pair coordinate here you can see the left x and lefty this is basically your longitude and latitude for this respective image or the point where 1 has been marked because presently this window we are seeing over our software.

So, for this window for point 1 you can see the latitude and longitude and in the second option view and edit tie point with this panel you can edit your tie point. For example, I want to just correct the location for my tie point. So, first you have to delete this point and you have to choose a common location. For example, in this image you have to first see which two areas or which object you can clearly identify in both the image in band F and band A and you select one similar object that could be your house or that could be your road cross cut.

It is similar to what we have explained in one of our labs. So, how to mark the tie point. Similarly, you have to choose your location or your object where you want to add your tie point. Once you have identified, you just click the area first in the scroll 1 image in this image and then the same area you have to choose on the same scroll 2 image. For this case, we have already chosen where we can see this area in this zoomed portion, but here you cannot identify because these two areas are different. So, to select a common area you have to first click on the scroll 1 and then scroll 2.

And then if you are identifying the same area on both the image in the band A and band F then only you select a common point or common object with the help of this band A and band F. And once you do that, you have to go to the pixelated window. On this pixelated window, you have to select the same location and the pixel level. So, for that you can zoom this pixel values because if you are what will happen to if you are zooming this pixel value. So, that will now you can see this pixel window is showing for this much area and if you are zooming this pixelated window, this area will be minimized.

Suppose, I am keeping this zooming portion to 60x for example. So, on this 60x this will

show you a single dot in both the images. So, that would be giving you a higher accurate tie point and your parallax would be minimum in this case. And suppose, I am keeping it in 1x. So, in this condition you can see this pixel value could be anywhere on this box for both band A and band F.

So, that will give you a more error in your parallax. So, parallax is basically your shifting. What is happening whenever you are seeing a single object or anything with two different angles? So, there would be a slight shifting or displacement in your object when you are seeing it due to your angle variation. So, that is giving you a parallax. You can do a simple exercise if you want to see this finger with the help of these two eyes.

So, you can consider these two eyes as you're a camera and suppose if you are closing one eye you would see that you can feel that your finger is shifting. So, this shifting is basically called the parallax. So, that is also happening in case of satellite data acquisition. So, during the satellite data acquisition there are two kinds of shifting one is parallax x and another is parallax y. So, in parallax x so, suppose this is your flight direction and your data are acquiring suppose this is your all the scenes are acquiring.

So, if you are shifting or shifting in the object is parallel to the flight direction. So, that will be your x parallax. So, that is your x parallax and if your shifting is orthogonal or the right angle to the flight direction.

So, that is your parallax. So, this is your x and y parallax. So, this parallax is basically associated with the displacement or shifting of your object. So, to generate the DEM or the high-resolution DEM or the Ennequilif you have to keep this parallax below 1. So, that you can do by editing your tie points. So, once you have done all this exercise or you have marked all your points accurately then you can go to the next option and here you will see that here you can see.

So, here you can see we have marked 125 points and now the parallax is 0.75. So, with this 0.75 you can generate a high-resolution DEM or the Ennequilif. So, here you can see. So, in the earlier slide these were the two different objects which the system had automatically selected.

Now, we have corrected this point and here you can see these two points: point 1 on the band F and band A is on the same location. So, this will give you a minimum y parallax. Now, you can see the y parallax is 0.75; earlier it was around 90. So, once you have marked your number of tie points or you have corrected the y parallax now you would be able to generate the Ennequilif or the DEM.

So, you have to just go to the next option. So, here some more options are available. You can explore this option while doing this exercise. So, here you can see the show table. So, with this show table option you would be seeing all the tie points which you have marked or the error associated with those tie points. So, you will see over here and you can save this tie point with this save option. So, if you are saving this time you can use your means in future exercise to generate the Ennequilif.

Suppose if you have a mark 125 165 tie points for the first time and then you want to add more tie points in the coming days. So, in that case you have to first save those tie points. So, to save these ties points you can simply use this option and to restore a tie point. So, you can restore your tie point from this option. So, this likely error ranking will open a table and you can see which tie point is giving you the most error.

So, you can identify the highest ranking of the tie point in terms of error and you can delete those tie points accordingly and you can choose the new location or new object or mark a new tie point with delete that the tie point which is having the most error. So, after doing all this exercise you just click on the next option and once you have clicked on the next option now the new window will open here you can see two options one is left epipolar image and another is right epipolar image. So, what is happening? So, epipolar means this Cartosad one data is the panchromatic data which is acquiring information in the visible range. So, that is having three bands: first is red and then RGB is red, blue and green.

So, this RGB is basically assigned or separated into two colors. So, first is your cyan color and another is your red color. So, this cyan and red color is giving you a 3D perspective. So, this left epipolar image means that your blue and green color is assigned to a cyan color and your red color is separately assigned to another band. So, that process is called that process and the generation of a new image is called the epipolar image. So, you have to choose the output for your epipolar image and you can set your directory and for this left epipolar image and right epipolar image and here you can also see the epipolar parameter.

So, that is the reduction factor. So, the reduction factor means you can increase or decrease your pixel size. So, that you can do by these reduction factors. So, this one means your pixel size is 2.5 meter and if you want to increase or decrease you have to change this reduction factor value and another option is you examine epipolar results that are RGB and RGB left right and right left left. So, as I already told you, this epipolar image means your blue and green are assigned to a single band that is your cyan color and your red color is assigned to another band that is your red band.

So, with the help of this left epipolar or right epipolar you would be able to generate your aneclip that would be your 3D perspective view. So, that you can choose from here. So,

this will change accordingly how you have chosen your band A or B and F. So, that accordingly you have to choose your left right or right left. For example, if doing the aneclip generation you have chosen first your forward band that is your band F.

So, that is your right and after that you have chosen your band A that is your left band. So, you have to choose this option right left left option. So, that will give you a positive perspective view of your anyclip and if you are choosing the left right right option. So, this will give you a negative perspective of anyclip. So, to choose the left right option you have to first choose the first band A that is your left and then you have to choose the band F that is your right.

So, for that condition you can choose left right right. So, once you have chosen your output directory for left epipolar and right epipolar image you just simply click on the next. So, a new window will open here you have to assign or you can see some basic information regarding your DEM. So, here you can see the projection system that is your WGS 84 or UTM 43 and here you can see the latitude longitude information and here you can see the pixel information. So, these are some default values you do not need to change anything from here you simply click on the next option and here a new window will open here you can see some basic information regarding the DEM extraction parameters. So, here you can see the minimum correlation background value edge trimming, trimming, window size, terrain relief and terrain detail.

So, in the on the terrain relief if you want to get the highest resolution from your DEM you you can change this moderate to high option or if you want to get a low resolution DEM you can keep it to the low or moderate and you can also shuffle this terrain detail that would be from level 4 or level 1 to level 8 if you get to if you want to get the moderate moderate DEM then you can keep it to the moderate in the middle that would be 4 or if you get the highest high resolution DEM you can keep it to the 7 or 8 or if you want to get the low resolution DEM you can keep it to 1 and from the DEM result you can see the output data type is integer and another is your floating point. So, you can choose so this integer will give you the low-resolution DEM and your floating-point option can get the high-resolution DEM. So, based on your interest you can choose this option or you can shuffle these options and once you have chosen your option you can just give the directory for your output DEM and you click on the next option. So, once you click your next option you can see some processing. The software will do some kind of processing so the first option is your creating a left epipolar image. So, you can see that the the directory which you have assigned for your left epipolar image so this left epipolar image will generate that would be your blue and green color is assigning to a single band that would be your cyan color so that image will generate and the image will be saving in your directory and another window will open once this is this has been done and then another window will

open that will create your right epipolar image and similarly this right epipolar image will generate and that would be your single band of red color so this this will this will vary according to what you have chosen during your band selection so if you are choosing your band F first in on that case your right epipolar image would be your red color and your left epipolar image would be your cyan color if you are selecting your the band a first then your right epipolar image would be your cyan color or left epipolar image would be your red color so this will vary according to the based on the selection of your band during the initial steps so another window will open that will build your parallax so the the tie point which you have marked for both the band A and band F so this tie point will be with the help of this tie point your both the band A and F will overlap to each other and that overlapping will be done through the parallax building so with the help of the those tie point the parallax image will be generated and then another window will pop up and that will be generate your DEM so here you can see all the some methods on which method this this the system is processing your sample or the your map so here for example the DEM generation is has been done in done by the triangulation method or this epipolar generation is been doing by the by bilinear resampling method so all this bilinear or the nearest neighbor I already explained you in in previous lecture so once all this processing has been done so you would see two window will open first the DEM extraction wizard option or the another is the band window so here you you would see all the band which has been opened on the software and the on the DEM wizard you would see two option one is load DEM result to display another is load DEM result to display with editing tool so you you can simply click on the DEM load DEM result to display and this will display you the DEM so here you can see your DEM has been generated and the this DEM is a high resolution DEM of with a special resolution of 2.

5 meter so you can simply you can save this DEM with the right click on this scroll window so once you you are right clicking on with the help of your mouse on this scroll one window so you will see a new pop-up window will open here few options are given and with the help of save images you can save your image in the TIFF format so you can see here you have to choose the resolution that would be a 64 64-bit format image and you can select this with the help of this drop-down menu and you can select the vsq or vil format any of this format would be good for the high generation of high resolution DEM so you can choose this option and you have to simply choose the TIFF geotiff format from this drop-down menu and you can assign your the output directory and you can save your DEM so with this window you would be able to save your DEM or this DEM would be the high resolution DEM with a special resolution of 2.5 meter in case of Cartosat 1 data so another window was your this available band list so with this help of this band list you can simply load the band and you can generate the aneclip that is your 3d representation of the surface and that you can see on a 2d monitor with the help of 3d glasses so as I already mentioned that this aneclip would be consisting with the red and cyan color so you

would be needing the red and cyan color 3d glasses to get the information from the aneclip so we will see that how we can see the aneclip with the help of this different bands so here you would see that what type of information you have input in your a key and we platform and what you have got from this processing so you have added the band a band F and band a information and you you have got the band F left a people are image band a right a people are image and them so this DEM we have shown you that how you can save or you can see your band so now we will see that how we can generate the or see an eclip so to generate the aneclip first you have to choose the RGB value because this this is the red and cyan color or the RGB values so you have to choose the RGB color and once you have clicking once you are clicking the RGB value you would see three options one is our red green and blue so to generate a positive structure view so you have chosen band F first and then band a during the band selection so you have to choose the right a people are image in the red red option and then left a people are image for the green or blue so with this selection you will you would be able to get a positive view of your an eclip and suppose if you are selecting the left a people are image on the on the right band so and right a people are image on the green or blue band so you would be seeing the negative structure of the an eclip so to select the image you have to simply double click on the on this option right a people are image so you have to keep the cursor on the red and then you have to double click on the right a people are image and you would be able to select the different band once you have selected all the band and simply you click the load RGB value and that will be enabled the few windows will open and here you can see this is your an eclip so this this is a 3d representation of the of your data and with the help of 3d glasses with the red and cyan color so you would be able to get the information or geomorphological or tectonal geomorphological information from this an eclip so here you can see this is your this is scroll one is having the entire image or entire data and this this window is having a information for this particular area only because this we have selected this reason so this on this window you would be able to see the information only for this specific reason and on this zoom window you would be only seeing the information for this rectangle area so this information you will see on the zoom zoom window to save this an eclip you simply go to the scroll one and right click over this image and you would be you would be able to save as your image as a tip format so you save your image in tip format and that you can see or analyze in any GIS software or image viewer image viewer software so with this help of this an eclip to extract the information from this an eclip you you you would need the 3d glasses so 3d glasses which is having the red color so this is your red color glass and another is your cyan color so this red and cyan color would be needing to extract the information from the an eclip so this will filter the red and cyan color from the from your image and you you you would be able to see the image or or the geomorphic feature in three dimensions so you can imagine that with the help of this 3d images or the with a high spatial resolution of 2.5 meter you would be able to get the all kind of information so for example you can get the scarf detail or you can get the terraces with a spatial resolution of

2.5 meter so that kind of information you would be used during the mapping part so you have to first identify all the tectonal geomorphic features from your data and then you you you would trace all this information with the help of GIS software and you can prepare the a tectonal geomorphic map so this is a example of tectonal geomorphic map so here this map has been prepared with the help of the cartosid one an eclip so here you can see we have mapped the terraces different level of terraces and the alluvial fan surfaces geology of the reason fault fault scarf and the different geomorphology so this this all information has been traced from the an eclip on the on the QGIS that is a GIS platform so when you open your an eclip on the GIS platform you identify your geomorphic features and you trace your geomorphic feature and prepare a such kind of map so this will give you a detailed mapping of the your area so in next lecture we will teach you or we will explain you that how we can use this data on the GIS platform that would be on the QGIS and how we can prepare such type of tectonal geomorphic map with the help of cartosid one data on the GIS platform so thank you. .