Geographic Information Systems
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Lecture – 17
Pre-processing of Spatial Datasets - 03

Hello everyone! and welcome to the new discussion and this is the last part of pre-processing of spatial datasets. And here, we are again going to take further discussion on this image merging and image fusion in a little different way. As I said that in our earlier discussion that instead of 2 images of different spatial resolution, we can take 2 images of the same resolution but different dates.

So, one variable we can change and can remain within that color's space and can create new products. Here, what we are going to do? We are going to create a new product using image and a scanned map. And you would see the advantage.

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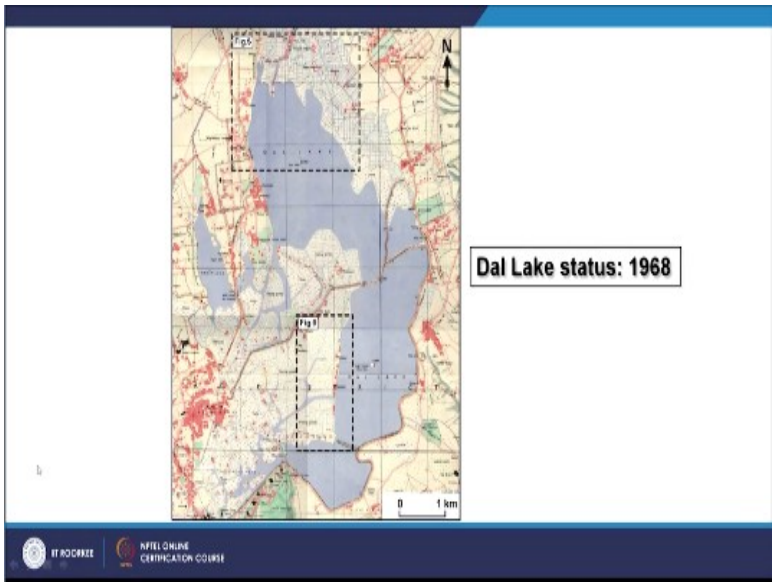

This is about the Dal lake which is in Srinagar, Kashmir and we are working for a project. I will tell you a little story about this that how this technique was developed. So, when that project we wanted to you know, restore this Dal lake and one more small lake is there that is called Nagin lake. So, we wanted to you know restore this Nagin lake. So, we wanted to restore you know the shape and water quality of these 2 lakes.

Now challenge was there that we wanted to have a very authentic record of shape of the lake through some, you know reliable maps and luckily, we got a map of 1968 of Survey of India which we considered and still we feel that their products are really very accurate and genuine. So, taking that 1968 as a base year. Now, we wanted to create a change in map in which we can show that what is the today's condition and what was in 1968.

And for today, of course you can resort to the satellite images whereas for 1968 as you know that they were no satellite images. Only in 1972 onward, we started getting Landsat data and some other satellite data. So, at that time, they were no satellite. So, we resorted to this you know, larger scale 1:12,000 scale map which had the authentic record of the shape of this Dal lake.

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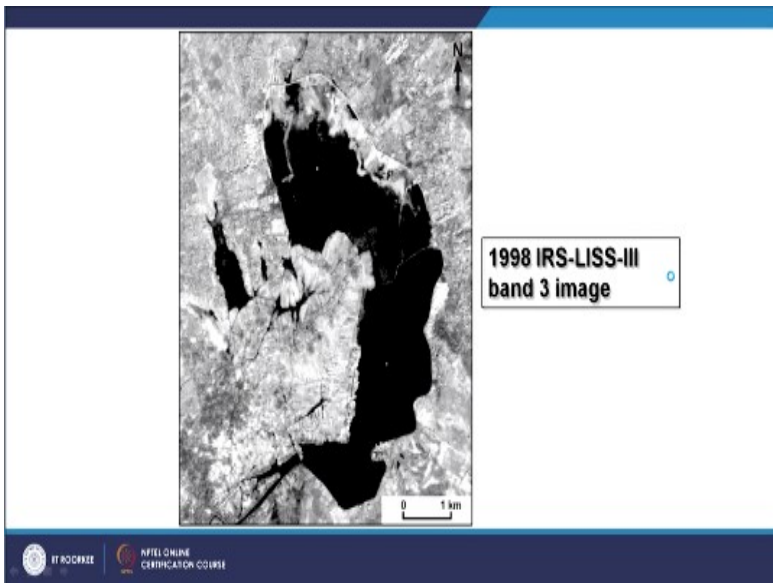

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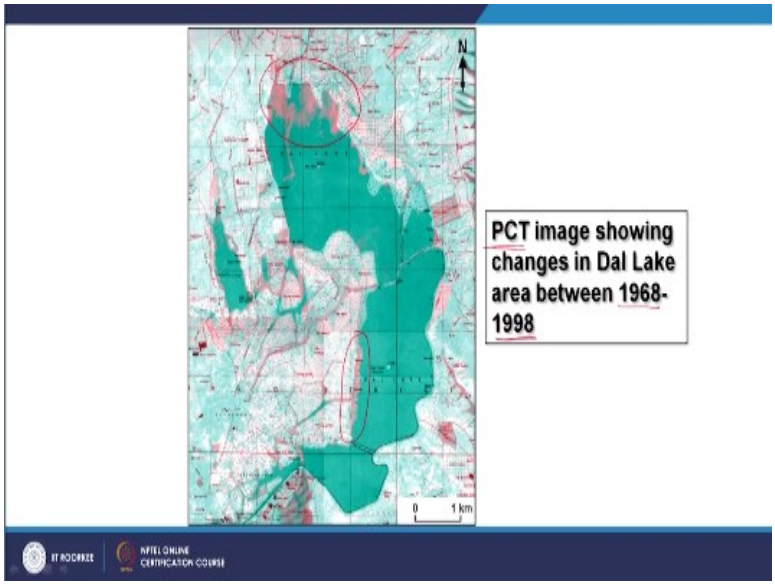

So, in order to detect the changes which was occurred between 1968 and in 1998, we took this satellite image of IRS LISS-III and this is band 3 image and then using that again color's space concept or the pseudo color transform image concept, we prepared a new product which had the map as well as your image. So, map belongs to 1968 and the image belongs to 1998.

Now 30 years time difference change detection map or image was created here which very clearly shows that which are the areas which have been encroached or which are the areas where the shape of the lake has distorted because of human activities or some maybe the natural one also.

So, there are a few points which one can interpret very easily that the northern part of this Dal lake as you can see here that lots of red areas appearing. These red areas are showing the changes which has occurred bring in 1968 to 1998 in terms of growth of vegetation because as you know that in this Dal lake, it is quite shallow lake. The average depth is about 1.1 meter so it is a very shallow lake but it is a huge lake; huge water body and there are lot of people which grow vegetables on floating farms.

And that means they have created lot of these growth of vegetation or either on the floating farms like this in the northern part. And this area is full of these houseboats which is the near this boulevard or the Dal gate and so here, you also see that there is lot of growth of vegetation. Further if you see 1968 map, you would see that they have a connection between the Dal lake and the Nagin lake.

And there were connections and these Shikaras or small boats used to go from one lake to another lake. But in this image, you would find that all those channels have been blocked because of growth of vegetation. So, if we want to see the changes which has occurred in last those 30 years and 2 things; where the changes have occurred and how much changes have occurred that can be detected through this technique; pseudo color transformation technique and that comes under this whole discussion that is image merging or image fusion.

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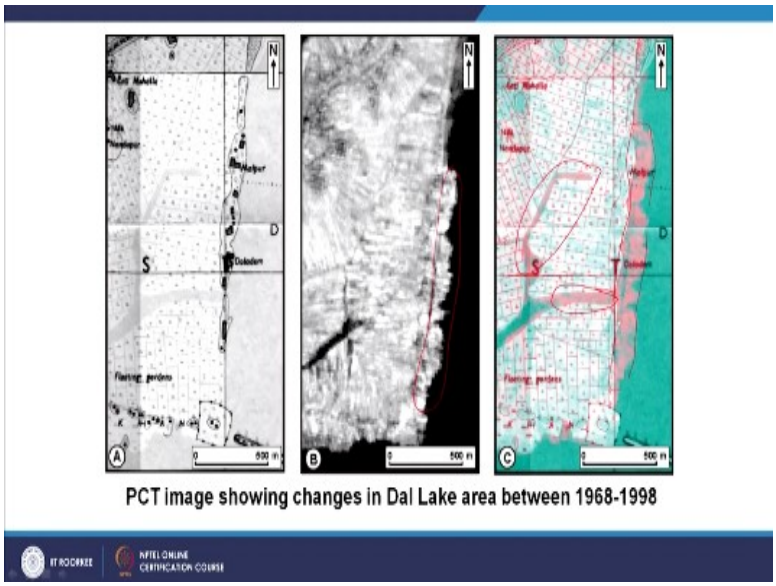

I will show you some blow up of these parts that this is of course, black and white of that scanned map and here, this is the area where things have been encroached. And as you can see very clearly, all these red areas are showing growth of vegetation and see this channel; this channel has also been blocked. These channels have also been blocked. These channels, were allowing passage to connect to the Nagin lake and other parts of this area.

So, all those we are blocked because of growth of vegetation, no care was taken. And you know, the health of the lake also deteriorates because of it is going away from its natural existence. So, for in order to restore that thing, we decided that we can go back to 1968 because that is the authentic data available to us.

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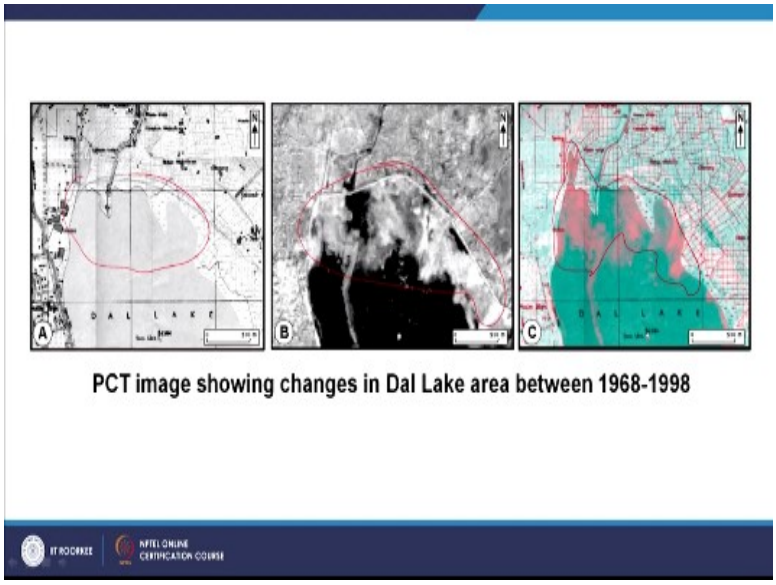

One more for the northern part as you can see that in the 1968 image, there were hardly any growth of vegetation in this part but in 1998 after 30 years, you see large growth. This is infrared channel and infrared channel is showing high reflectance value for green vegetation. And when we bring in the PCT, we can clearly demarcate which are the areas which have been encroached or which are the area which have been blocked because of growth of vegetation.

And therefore, of course the shape of Dal lake has also got changed in those 30 years. Now if I want to do the comparison between 1998 to say 2020, no issues. Again, I can imply the latest images. I can use old images. I can create a pseudo color transform image and again I can see that what has happened between these 2 dates. The other advantages of the pseudo color transform are that whenever we want to imply different satellite images, map or images together for change detection, this is perhaps the best technique; highly reliable because no bias will be there

Only requirement is image to image registration and then pseudo color transformation that means we are playing within color's space. I will give you one more a little different example where one completely synthetic image has been used because this image is suffering from a phenomenon which is called false topographic perception phenomenon.

And this happens in all satellite images of all parts of the earth, moon and mars. This is what it has been checked of hilly terrain So like this image on the left side is suffering from that

false topographic perception phenomena; FTPP. Now we wanted to remove that FTPP phenomena. So, what we did?

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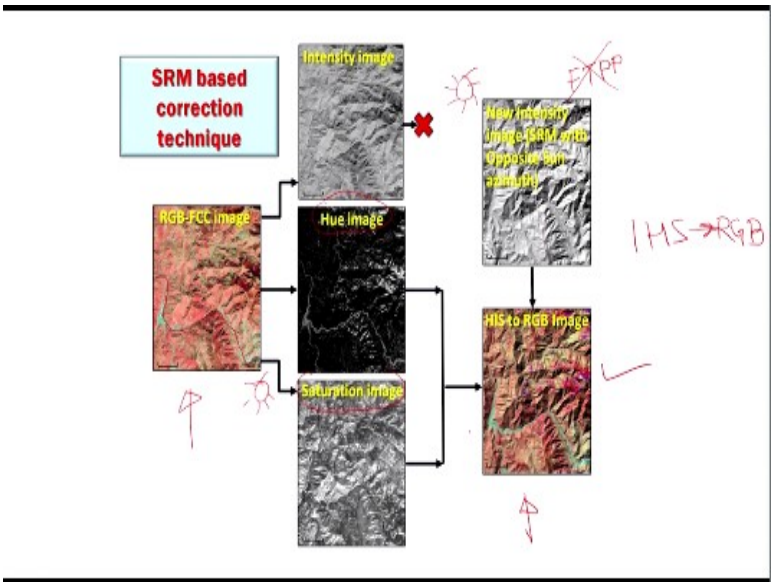

We splitted this RGB or FCC image into 3 components, HIS. Again, you are playing within the color's space. So, first RGB image using 3 bands of the sensor or the satellite bands where you know, edit to make this color composite. Now this color composite has been splitted into 3 components; intensity, hue and saturation. Now, what we did?

We removed or we got rid of this intensity image because as you can see, it is suffering from FTPP. And rest these 2 images of IHS transform; hue and saturation continue in our processing and the intensity image was replaced by a simulated image which has been created using digital elevation model. And this image is called pseudo relief model in which as per our you know requirements; we can create our own illumination source rather than depending on natural illumination source which is sun.

So normally in the satellite images, when the images are acquired in morning hour, the sun is in the southeast quadrant. But in this image, what we did? We created this simulated image using sun illumination direction is from Northwest quadrant. And why which we could get rid of FTPP that is false topographic perception phenomena. So, now this image which is of course, becomes intensity image is not suffering from FTPP.

And these 2 images; hue and saturation image continue in this composition. And what we did? Again, IHS to RGB. And when we do this backward transformation as done here, if you

compare this input image which is here and this is output image, you would notice that this Bhagirathi river you know, as it was visible that it is flowing on the ridge which is not possible.

Because it was happening due to FTPP, is no more suffering from FTPP and that river has gone into the valley and now we are getting correct perception. So, a big phenomenon which was affecting our image interpretation, image analysis has been removed using again image merging technique and here instead of going for different dates or instead of going for different spatial resolution images, we brought a new concept here; a pseudo relief model that was derived from a digital elevation model.

And that digital elevation model was created using contours available in the Survey of India toposheets. Nowadays lot of digital elevation models at high spatial resolutions are also available which have been generated using different satellite image processing techniques. Those can also be implied and then this FTPP can be removed very successfully.

So, in all these examples in the previous lecture or here, I am showing all kinds of possibilities with playing within color's space and creating new and very useful products. Otherwise, individually these images or maps cannot be those useful or interpretation becomes very-2 difficult. So, all the changes by some means if you can bring within one image and then color will depict, you can do the masking and you can bring all changes very nicely.

Here, we exploited the same concept of color's space, created a new product and got rid of false topographic perception phenomena. So, just in you know, large part I will show.

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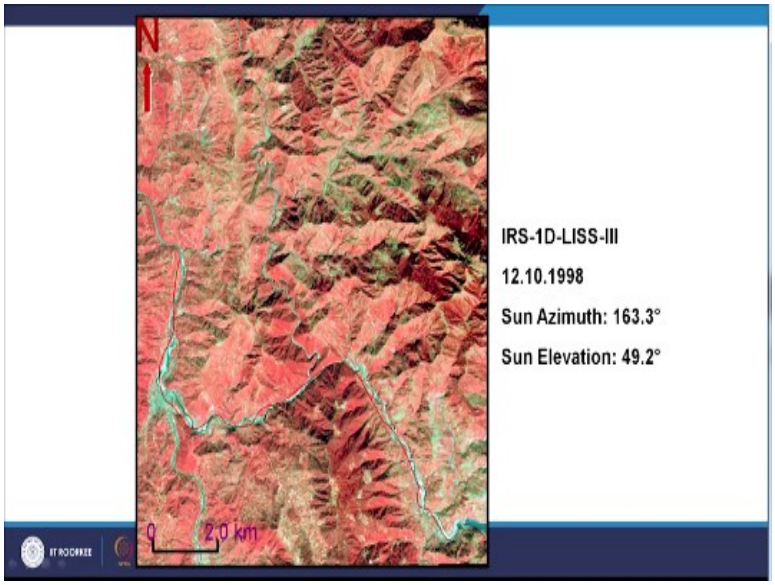

This image is suffering from FTPP. This is having FTPP. As you can see that here, the Bhagirathi which is tributary of Ganga seems to be flowing on the ridge which is not possible at all, Geo-morphological or topographically.

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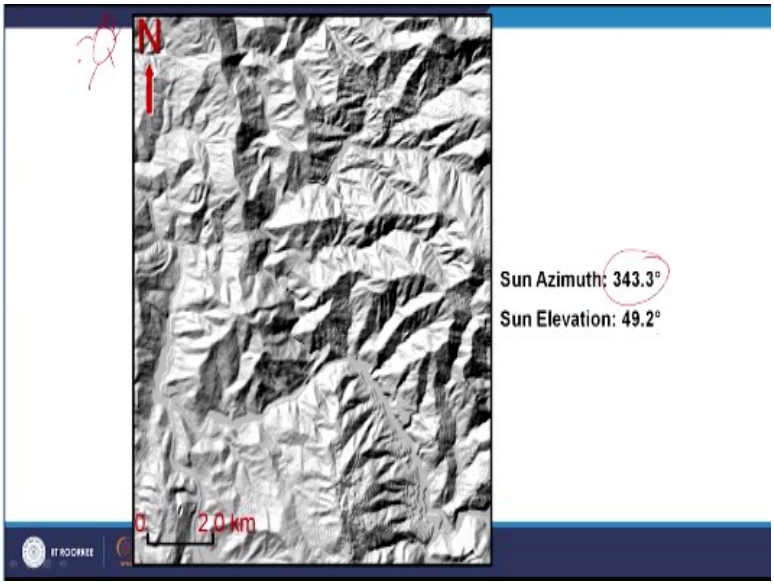

And if you notice here, the sun azimuth that means it is somewhere in the southeast quadrant and in this stimulated image which is becomes our intensity image, sun is in the northwest quadrant. You can notice these angles that here, it is 163. If you add 180 degree that means you are forcing sun to illuminate in this one and since this is simulated image.

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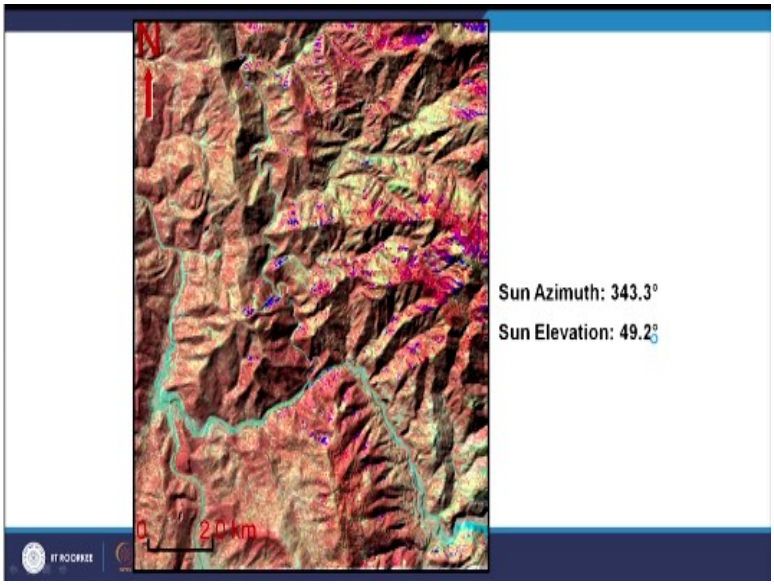

So, when we combine these 2, we get a new product in which river is flowing in the valley giving the correct perception that means we got rid of FTPP. And we got a new product which is very useful and reliable interpretations image analysis can be performed on this image very easily. Otherwise on the original image which is suffering from FTPP, if it attempts are made, people will make a wrong interpretation. So, in order to avoid, again we have used this image merging or image fusing technique.

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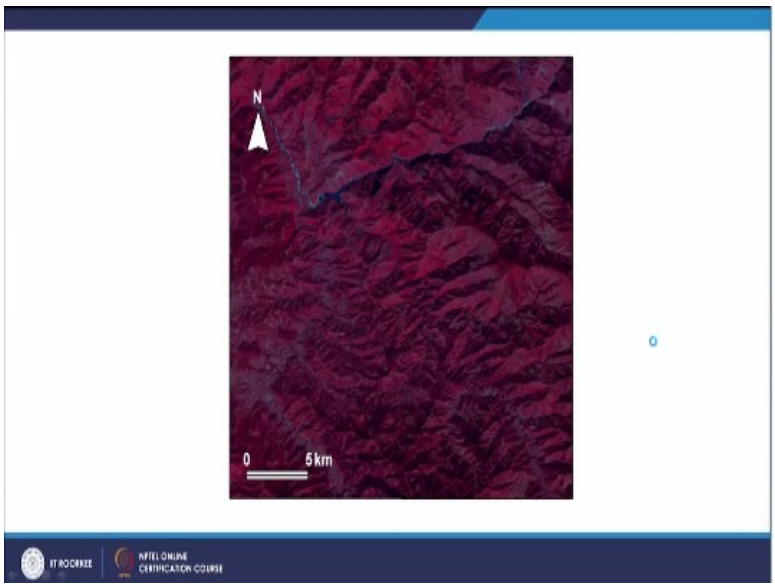

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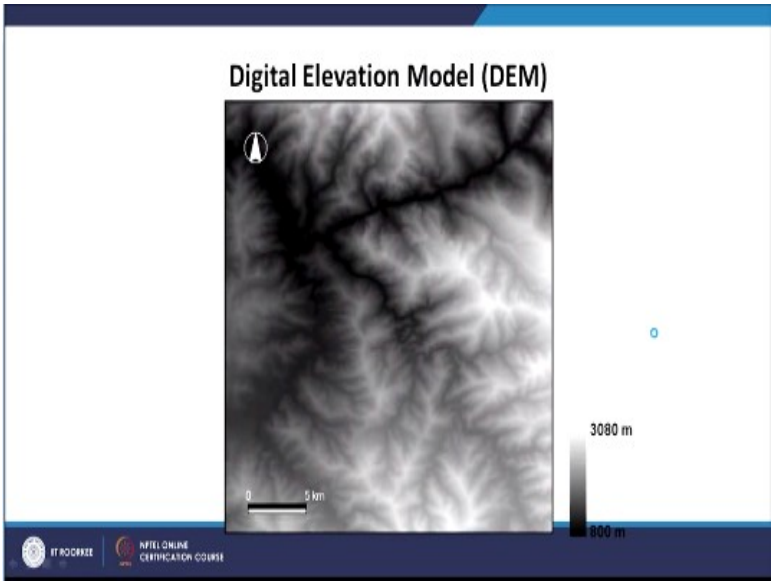

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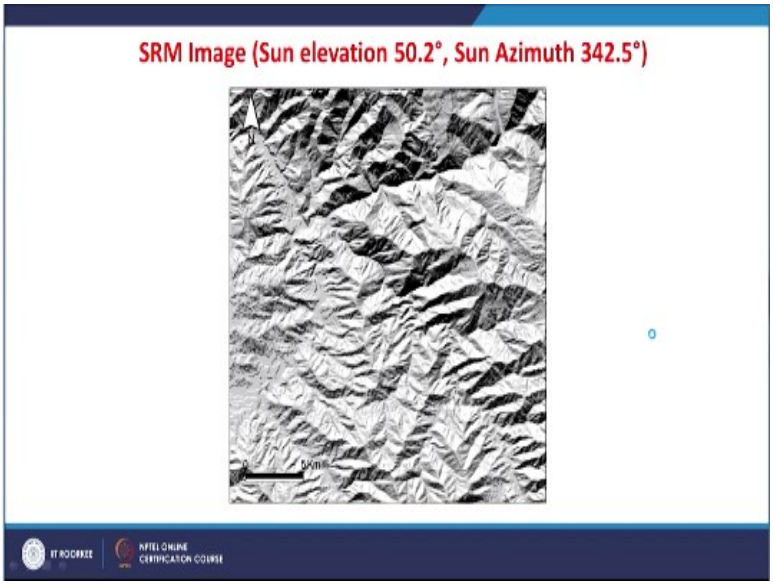

Similarly, one more example is here that this is input image. This is a digital elevation model. And now this digital elevation model has been created using opposite sun azimuth angle.

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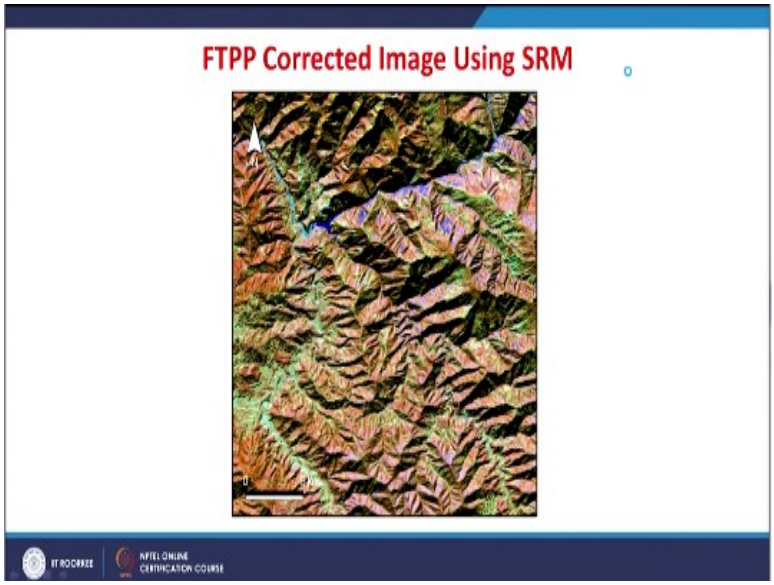

And then you get a new product something like this. So, this is FTPP corrected image. Nowadays, you do not have to create your own digital elevation model. You can imply already available digital elevation models and can get rid of FTPP using this image merging or image fusion technique.

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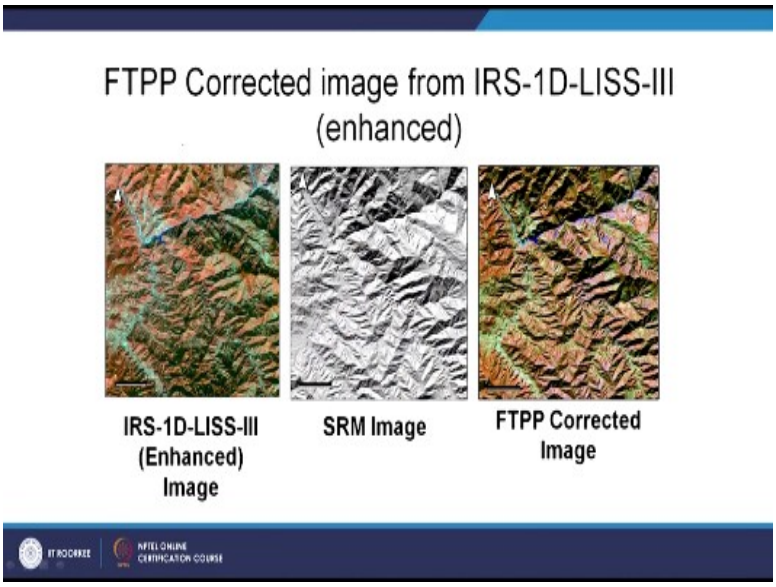

All 3 images together; this is suffering from FTPP, this one; the leftmost image. The centre image is a shaded relief model which was created using digital elevation model and this is FTPP corrected image where river; again this is Bhagirathi river, is flowing in the valley which is giving us a correct perception.

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So, we made a certain publication based on our work. Like here, I showed the example of IRS and the PAN sharpen; the first example in the previous lecture and other places.

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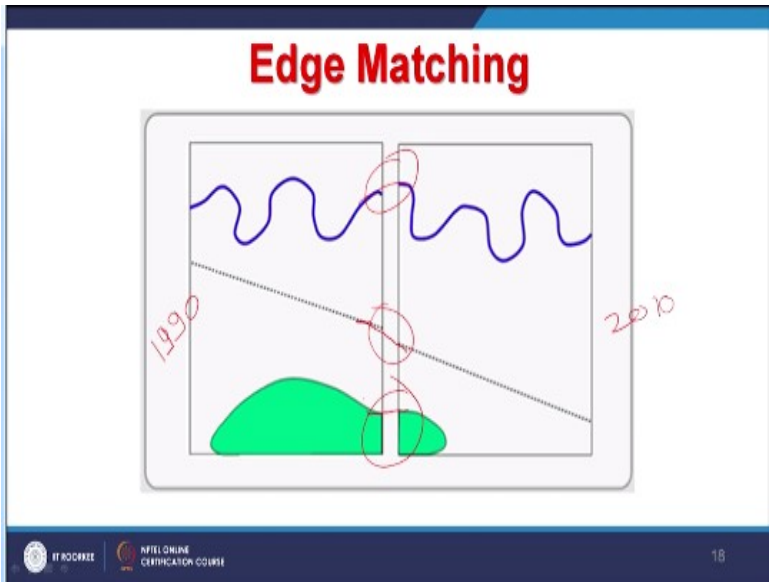

Now, there were one more topic after this image merging, image fusion is edge matching. So, very briefly I will touch at this point because it will depend basically how best 2 datasets are available to. What is their quality? And time differences are minimum. If suppose I am having 2 survey of India toposheets; one belongs to say 70's, one belongs to you know, say 2020.

Now there might be a difference at the edges which I will notice significantly because of maybe little different map projections have been used or changes which has occurred in the field. So, suppose this image belongs to 1990, this image belongs to 2010. Now I am having

20 years time difference. So, if this has been surveyed in 2010 and edge to edge, I am trying to match, there will be mismatch something like here or something like here or even for polyline something like here.

So, this is the kind of surgical operation which one has to really do it manually; there is no automatic methods, no software has ever developed like that. So, when manually you know, vectorized or digitized the data. At that time, care is taken so that you continue with this one like this. You continue with this one like this and also like this. So, manually edge matching process has to be done or archived.

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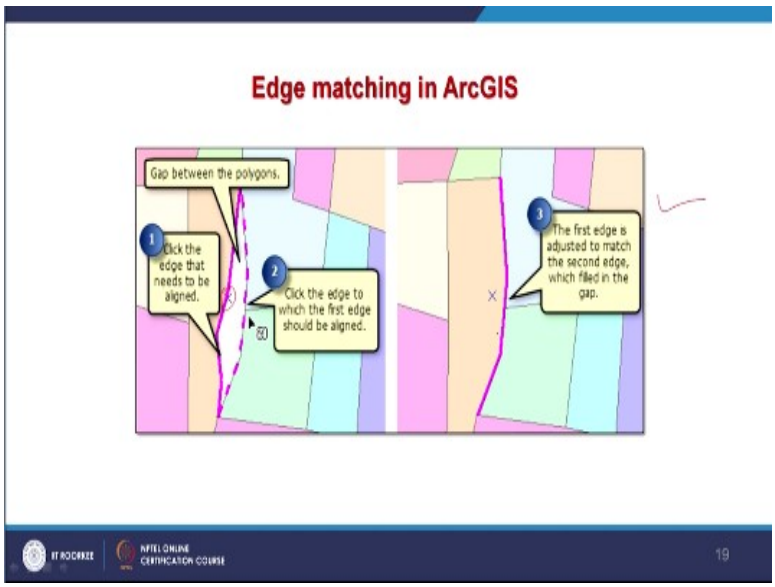

And similarly, I am showing one more example here that sometimes you may get an artifacts polygon like this. Now it has to be removed because by while checking, it was found that this is not required really. This is an artifact. So, how you do it? Again, this has to be done manually because system does not know that which polygon is the genuine one and which one is the artifact or due to error. So again, this has to be removed as in the right image, it has been done.

So first, the edges will be adjusted to match the edges of this polygon on the right side and then gap is removed successfully. So, this way, the edge matching can be done very successfully. However, in most of the cases, it will be done manually. There is no automatic method. So, depending on the problem, when you are doing edge matching whether 2 toposheets or within one map, there might be edge matching with the polygons.

But in case of 2 edges and deposit, there may be edge matching required for polygons or merging 2 polygons of 2 different toposheets into one and polyline and other such features. So, every such operations related with edge matching has to be done manually. So, this brings to the end of this discussion about the pre-processing of spatial datasets. So, we have now completed all 3 you know, parts of this pre-processing. Thank you very much.