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NPTEL ONLINE CERTIFICATION COURES

Digital Image Processing of Remote Sensing Data

Lecture – 18
Image Merging and Mosaicing Techniques

Dr. Arun K. Saraf
Department of Earth Sciences
Indian Institute of Technology Roorkee

Hello everyone and welcome to 18th lecture of digital images processing of remote sensing data course, this is a new topic and in which we are going to discuss image merging and mosaicing acting techniques you know that now a day's lot of chooses data is available there are very high resolution data a special resolution data available and multispectral data is also available and sometimes we required merge these two data sets and can create a new product which becomes much more useful, secondly this merging can also be exploded in change detection studies.

And we will be seeing during this discussion we will be seeing some examples as well secondly a lot of data since available and we some time we need to cover a large area with relatively higher special resolution data and therefore once scene cannot cover that our Area of interest, there might be 10 to 20 scene so that we download these sconce and then create a mosaicing and everyone would like to have a mosaicing which is seem less that joint of two scene should not be visible at all.

Though the data is acquired on different dates or time but still the aim is to create a seem less mosaicing so we will be discussing these two main things how digital image merging can be done what are the different options are available few options be would be able to only cover here there various other techniques are being developed on image merging because these are being developed because the large amount of remote sensing data is now available and most of the data is also available free of cost.

And mosaicing as well so let us start this merging one that image what is basically imaging merging or imaged fusion we say that the multi sensor image fusion.

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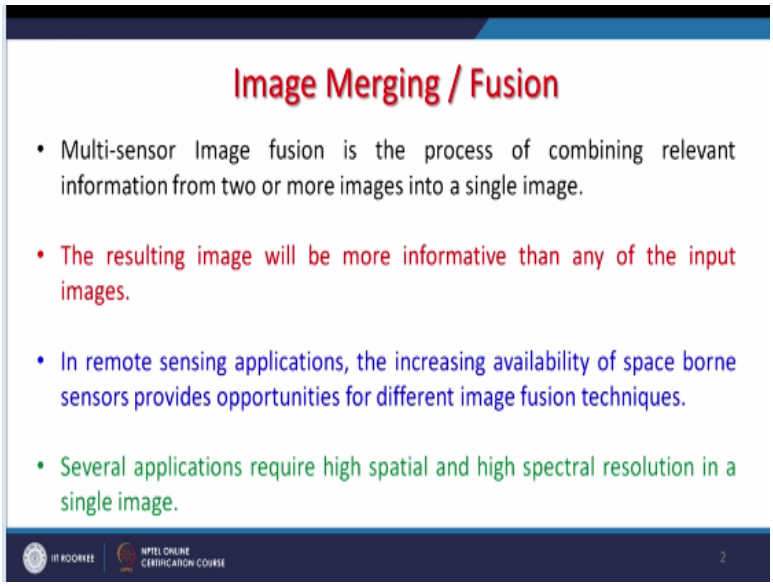

Is the process of combing relevant information from two or more images into a single image, so we might be looking for exploiting special resolution of one sensors image and spectral resolution of another this is also merging might be creating a different kind of merge image which is the same resolution but two different days for change data service studies and so resulting image will be more informative than any of the input images, so if you look the individual images you may not see those things.

May not interpret that thing but if you have a created merged product then it is much more useful in remote sensing applications the increasing availability of a space borne sensors in images provides opportunities for different image fusion techniques several applications required high special and high spectral resolution in a single image, and these two together may not be available but if we know how to merger them then when we can create the same product.

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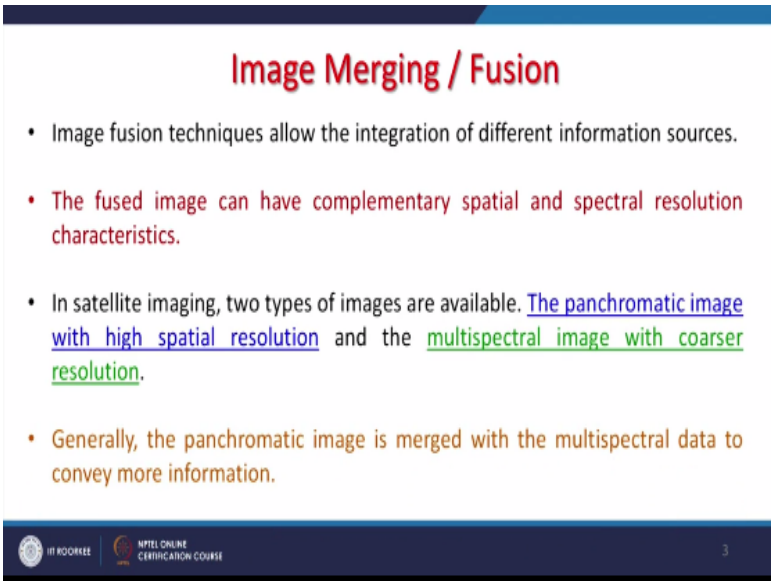

So image fusion techniques allow the integration of different information sources. And the fused image can have complementary special and spectral resolution characteristics and the in satellite imaging or satellite based remote sensing two types of image are available panchromatic which are covering quite wide part of visible part of EM spectrum and generally with high resolution high special resolution and multi spectral images with relatively course resolution the example is I can give here that like in IRS 1C1D we have two sensor one was the pen which as the 5.8 m resolution.

And less 3 sensor which was multi spectral and it as 23.5 cm 23m special resolution, so pen had a high resolution but single channel and black and white kind of image and where as you had multi spectral but relatively lower special resolution and therefore for creating a new product which will have higher special resolution n colors or spectral characteristics as well, then we can create such products using pen and this 3 data.

Similarly with other sensors the different combinations can be created in order to create this we need to explode this color cube which we have already discussed in pervious lectures so if you think that you have taken out a cone.
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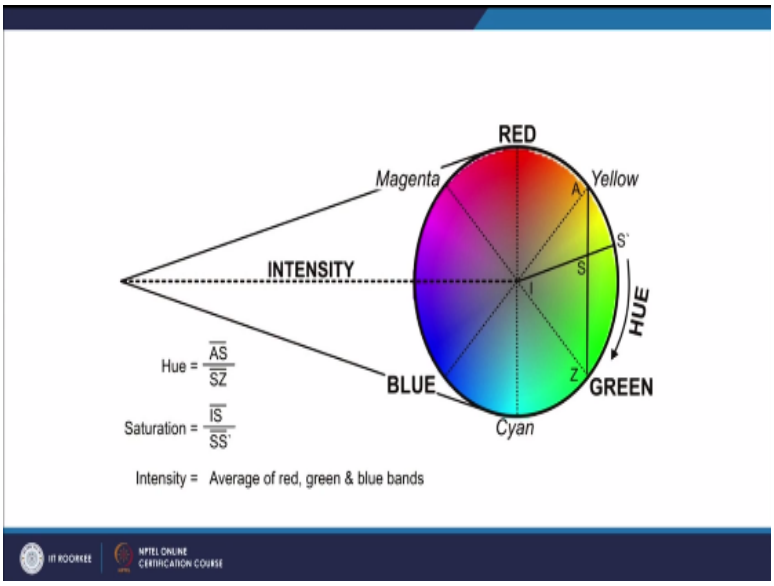

Out of a color cube then the base of the cone will have this Newton disk and all colors are here which are respected here through this marking as hue and e extreme members are red, green, blue or also there in between cayn, magenta, yellow is there and then this the you know the axis of this cone will have the intensity representation and then the radios will represent the saturation so this we explode this characteristics of color cube or the cone color cone and the create these fused image.

This is one technique of doing this thing and I am going to take an example as I have all ready indicated that IRS 1Cpen which as 5.8m resolution and IRS less 23.5 m so this was the multispectral the pen was panchromatic.

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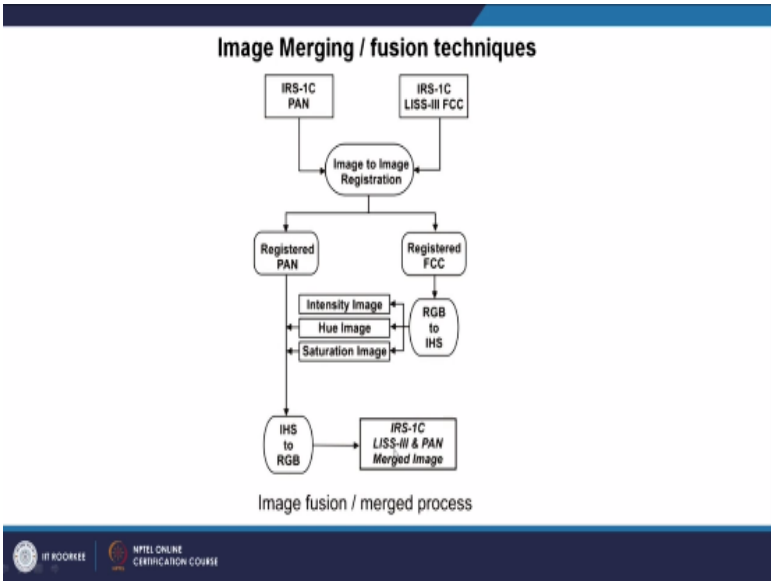

Black and white so first thing is image to image registration that you need to registers image to image that they fits or they stuck together very nicely now register pen will be kept on one side where as the registered FCC will be spited that is because if say FCC so it will be spited from RGB domain to HIS domain that is the intensity UN saturation domain as you know in color space color cube color space you can transform form one plane many RGB plane to IHS plane and this is what it is been it is being done here.

So this transformation from RGB domain to IHS is possible and this can be done on any standard digital image processing software or photo editing software's as well as so that now you are having instead of 3 components RGB 3 bands data which has started from here now you are having different components one is intensity image U image and saturation image now very trickery things is that the intensity image is dropped here or intensity image replaced by the register pen image and then backward transformation that is IHS to RGB.

And then you get a colored image as motioned here that IHS to RGB transformation is there and you get a color merged image having a special resolution of 5.8 m but multi spectral characteristics and the results I will show you, this is black and white image of 11 February 1997.

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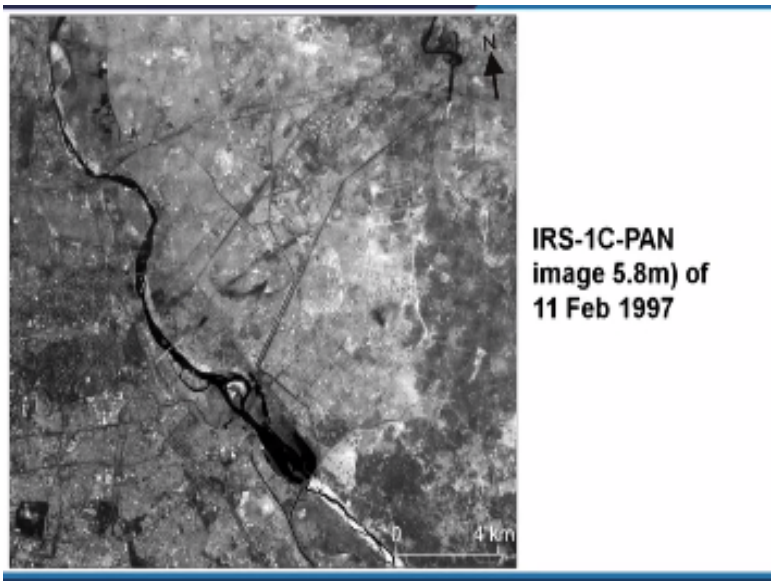

Of an hilly region and this is 5 m resolution this is panchromatic image single band image.

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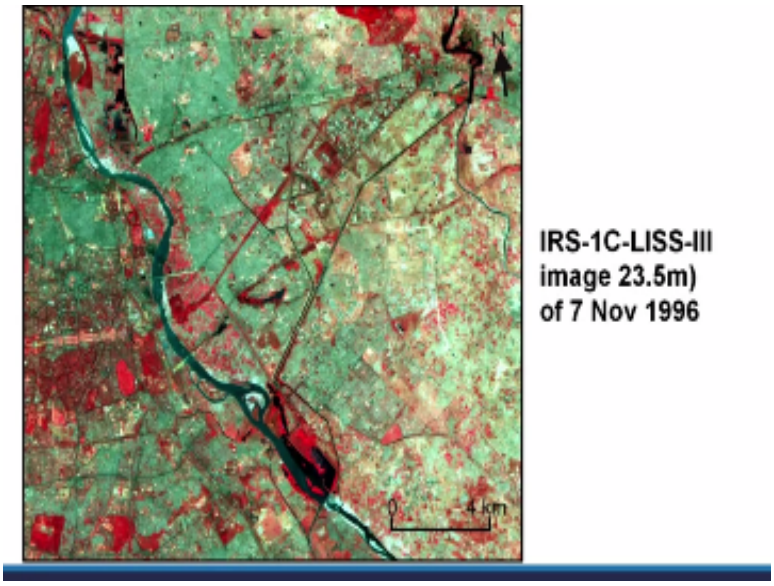

And here it is multi spectral image so 3 bands have been used of LISS-III having a spatial resolution of 23.5m of the same date as a sorry different deeds this is 11, February this is 7th November, does not matter cloud conditions and that remains same then you can merge this product as indicated through that earlier flow chart and a new a product is created fused or merged product.

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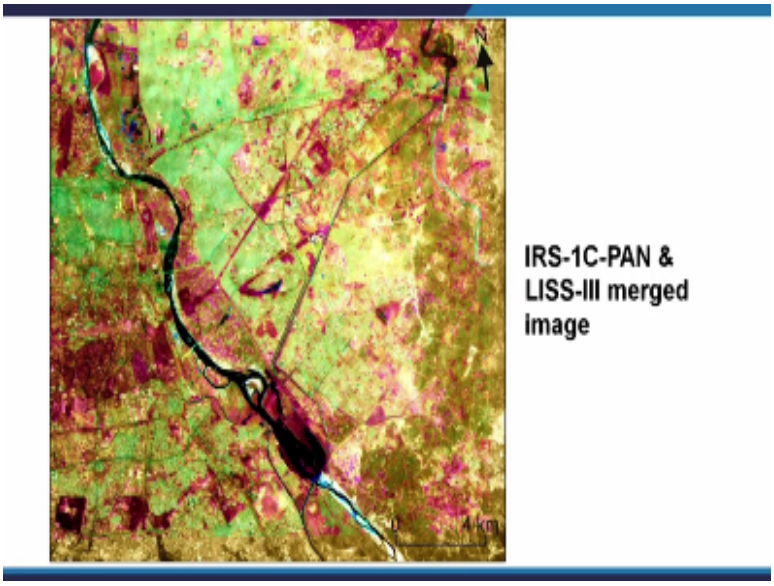

Which is having a higher space resolution but at the same time a multi spectral characteristics as well.

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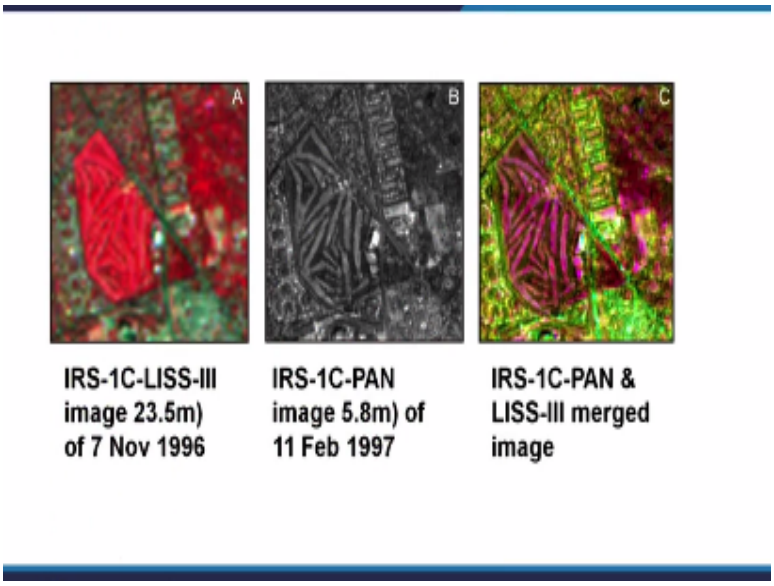

I will say a June part from the same image so this is the multi spectral image in RGB component this is the PAN image as you can see this is the example of a golf courts having 18 holes here and when if you see the prom and the final product this is what you see that all these that is which are not possible in LISS-III image because of having 23.5 m resolution now are visible in merge image but the same time that bit is which are available in PAN image they will be black and white because in panchromatic image but here you see in colors, so this is the advantage of merging and this merging technique this based on this RGB 2 Asia's and dropping the intensity image and replacing it is a very easy thing which can be done.

But the prior the requirement is that these two images which you one is trying to merge have to be registered very accurately, if they registered accurately then you can create a very sharp product sometime these product are also called panzer product because your image looks much sharper then if I look only this FCC or false color composite image having this relatively courser space resolution but multi spectral so that is why it is called PAN sharp. Panchromatic data is used and they sharper colored image has been created.

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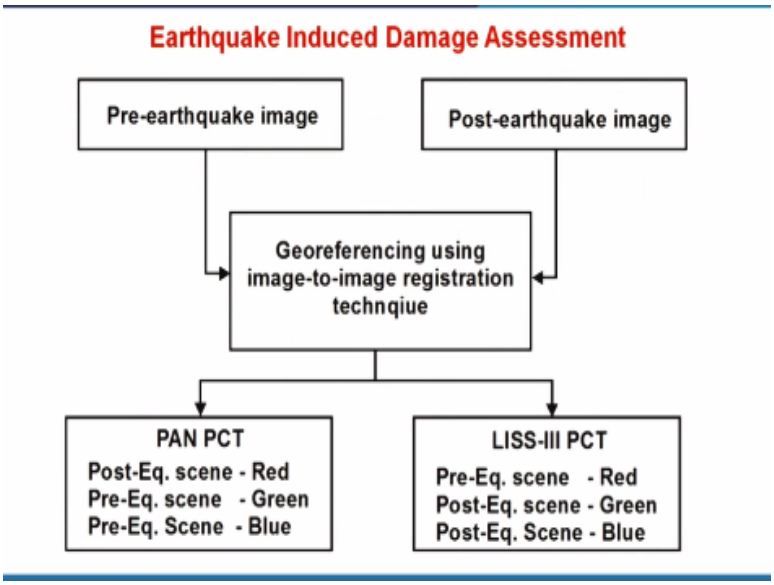

Now technique is almost same applications are different input also is different here and then new types of a new way of exploiting the same technique, here instead of having two different spatial resolution images we can involve two different dates from same sensor of the same area and can create a new product the two examples are here I have involved in case of a pre-earthquake image this is Panchromatic image, post-earthquake is also panchromatic image and a this is a geo referencing so that means registration image to image registration has to be done for both dates images and when you create a color composite so this is not a standard one, so a new name is given pseudo color transformation, what is done in pseudo color that the post image is having a sign in the red color.

Pre channel pre earthquake image is repeated twice giving green and blue color so you get an output with this PAN, the similarly using this 3 data a different combination is also created and then outputs are different so we will see the both outputs. So first let us go for the PAN one.

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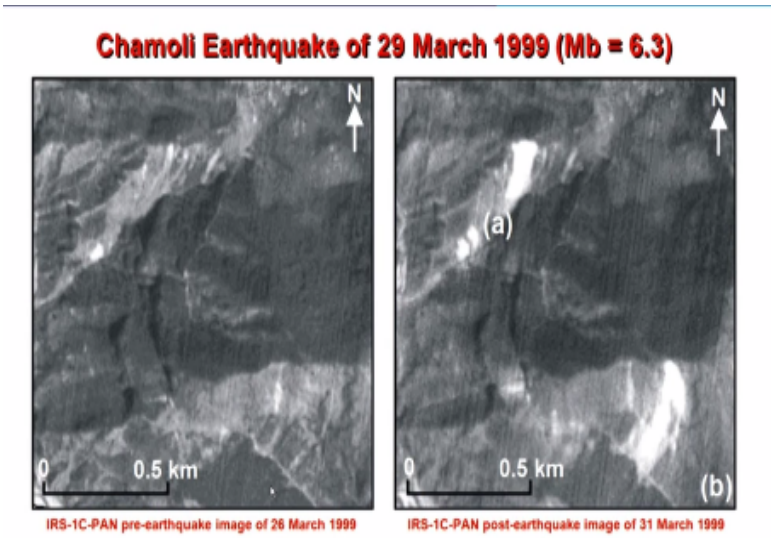

On the left side what you are seeing is a pre-earthquake image and just after the five days a post earthquake image was also required and this is about a earthquake which occurred on 29th march 1999 in Uttarakhand which is called Chamoli earthquake of 6.3 magnitude and what you see here if I compare these two images that there are new lens slides which has appeared here but one has to compare these two.

And while doing comparison one can make mistakes and the full information about the changes which has occurred between these 5 days induced by an earthquake event cannot be exploited so the best thing is to do this pseudo color transformation and by this the both pre and post images pseudo through that the same image fuse and concept has been exploited here.

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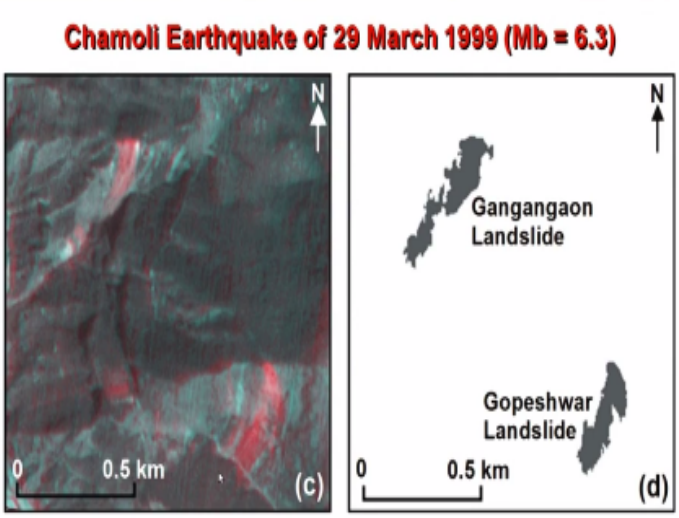

And red colors are indicating the changes which has occurred between 5 days in terms of reflectivity because of, if a lens slide is occurred all the vegetation will get up routed and fresh surfaced are exposed which will have high reflection and therefore if I assign for post image the red color then I am getting the changes are in red color and the other colors are showing an basically no changes especially the white one.

White one that means between post and pre there is no change in the reflectivity and therefore everything rebel remain white no color is assigned whereas blue and green color are saying that there are also no changes and if I mask everything just keep the red color then I can exactly map what are the changes which has occurred between 5 days induced by that earthquake event has been done in the case of this earthquake about these two landslides.

So playing with the same concept but inputs are different there in first example input was PAN was higher spatial resolution LISS-III was relatively lower space resolution, PAN is panchromatic that is multi spectral here both are panchromatic images of two different dates and in-between there is an earthquake event and this is what the change it actions studies in which we can also exploit the same image fusion another example from the same earthquake two areas.
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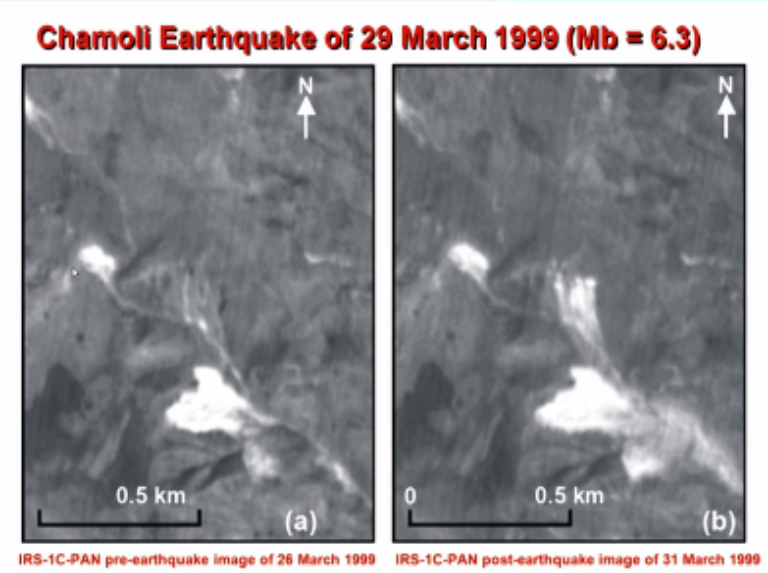

Same areas with the two dates images which you are saying 26th march, 31st marsh in-between earthquake has occur there where already some landslides and after this the existing lens slides having large and few new one has also come which you can see on the right side of image especially in the center part of this image.

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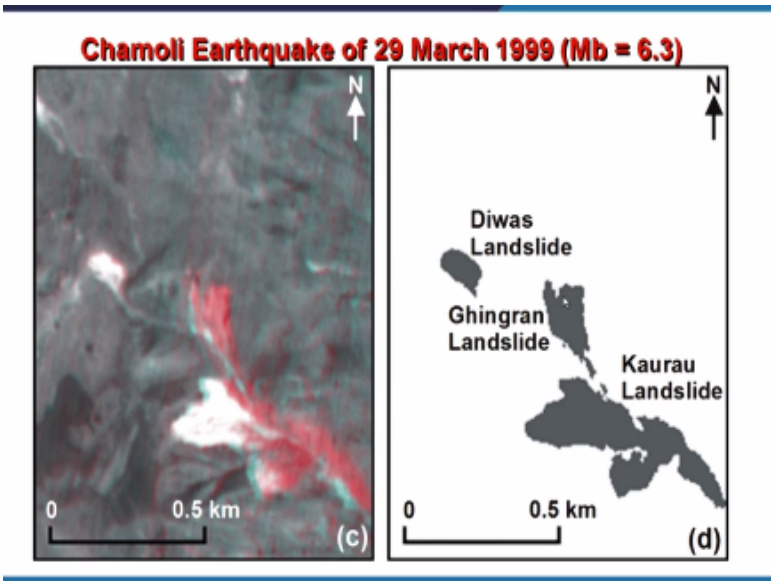

And when create this pseudo color transform image exactly we know where changes have occurred in terms of reflectivity and that use the new landslides so existing land slide have widened and this is what you can do, you can mask everything keep a wide part and red part and get the complete accurate map of the land slide affected part of that area, so this is very good advantage of digital image processing.

Especially pseudo color transformation technique for chain detection studies, similarly in many other cases we have done exploited the same way.

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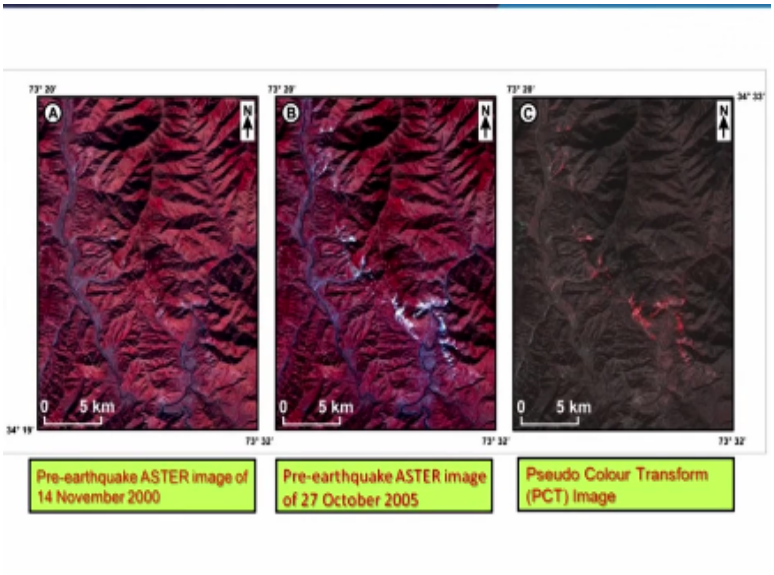

Here instead of just PAN we had the multi spectral no problem the same way it can be exploited and you can still can create a pseudo color transform image.

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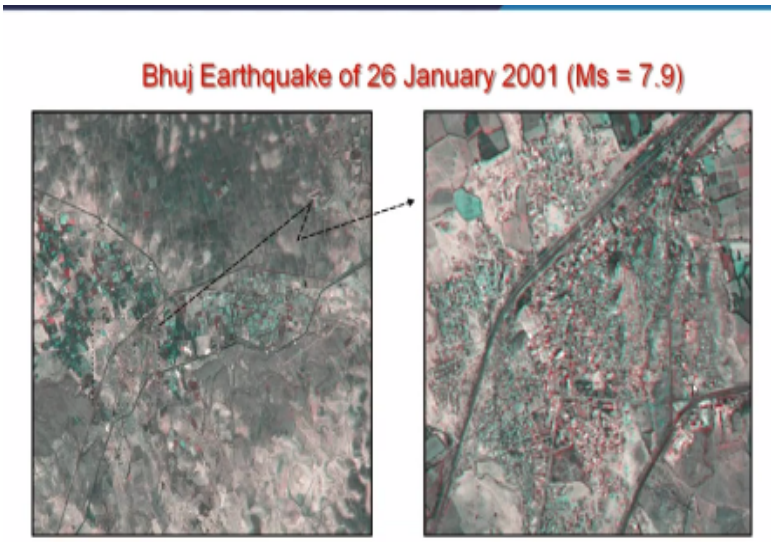

And if you are having one having very high resolution data and one is working in earthquake related studies then changes at the level of house, house level changes can also be detected and which was done by us in case of Bhuj earthquake that the Bhuj town was maximum affected.

This is again pseudo color this is pseudo color image this is the zoom part right part is the zoom part and wherever you are seeing the red patches these are the changes which has occurred between those dates in between the earthquake has occurred and the attribute these changes to the 26 January, 2001 Bhuj earthquake. Another example, instead of using pen data in this example I have exploited the infrared channel data.

So multi spectral images coming from less three infrared channel was taken and you know that the water or moisture will have a completely different signatures in infrared that means that is the new, what happen in case of this Bhuj earthquake that new water bodies in some parts of earthquake affected region appeared and that means that you will get more black areas or darker areas in your post earthquake image.

So what in this case, what it was done for the pre image red color was assigned for post image green and blue are assigned and therefore you are seen the changes, so scheme assignment of this color is scheme has change compared to the pan data, but the results which you are seen the all red areas are showing the changes.

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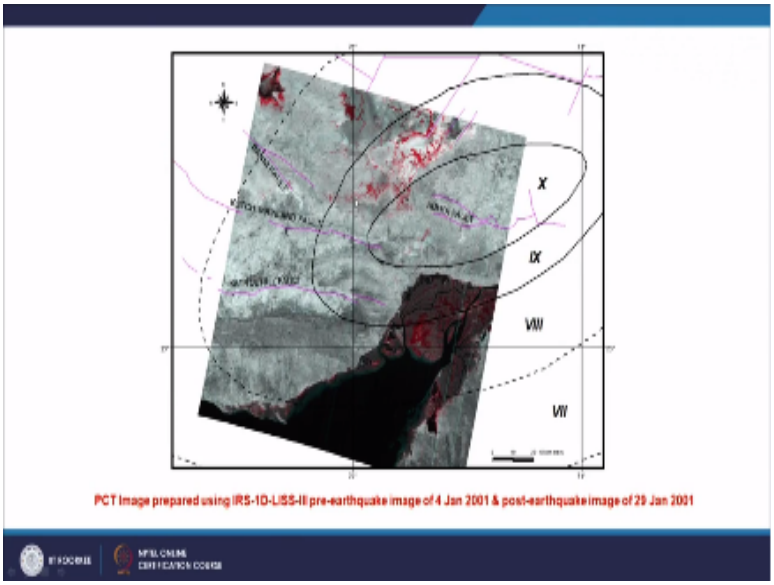

In term of water bodies or moisture between those two dates and in between the earthquake has occurred so here the dates where 4 January, 29th January on 26 earthquake has occurred, so the post earthquake image was very close to this one and it could record the appearance of water body and this is not simple thing there is a cosicmi phenomena associated with an earthquake event sometimes you can obverse which is called liquefaction and this is the liquefaction mapping very accurate liquefaction mapping.

First time in the world was done and exploited using the pseudo color transformation techniques so merging is alright, but one can also expand little bit, do little bit innovations and can create new products which are very, very useful. One more example I will give you instead putting two images having different spatial resolution or image of the same spatial resolution of two different dates one can also merge in map with image, and this is the example is shown here.

Because we were looking the changes which had occurred in this Dal Lake region of Srinagar, Jammu and Kashmir between 1968 and 1998 that means the 30 years time difference we were looking the changes in terms of vegetation growth at the perimeter of this lake, Dal Lake. So we had a very large scale survived India map of dull lake region, so we scanned and treated as a color image and now this colored image in which wherever the vegetation or the water bodies was here the blue color that compound was taken.

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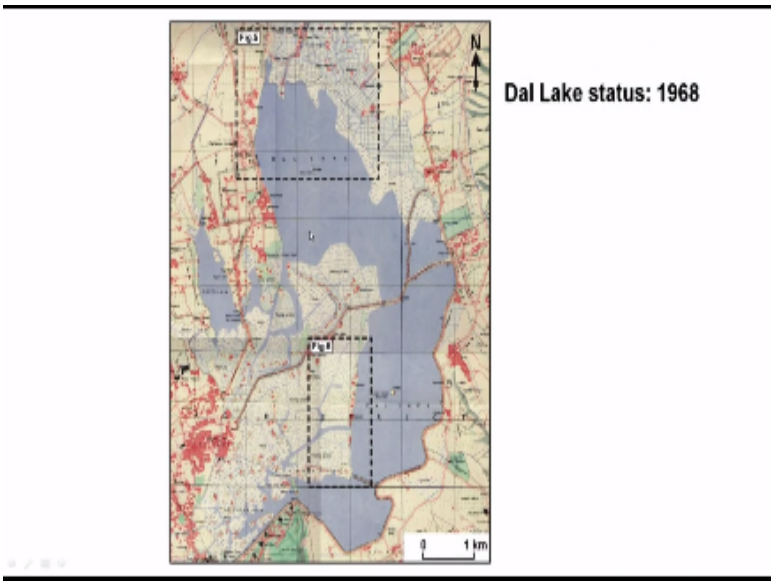

Dal Lake status: 1968

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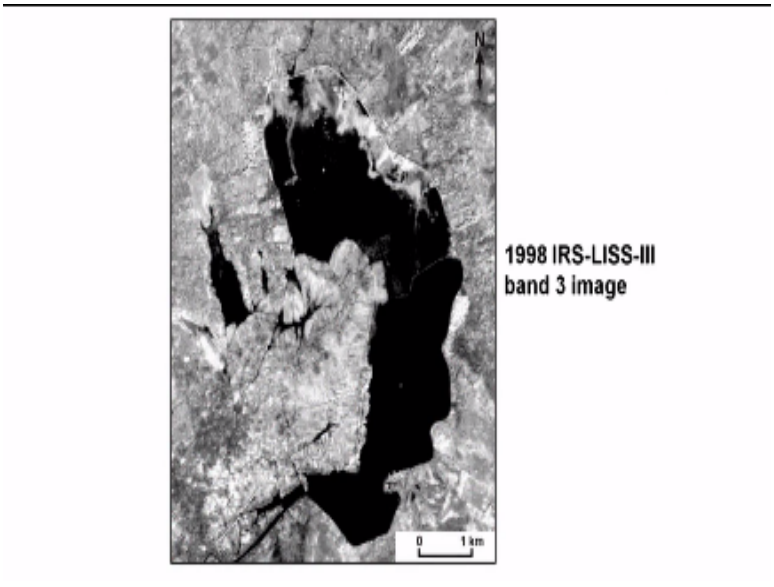

1998 IRS-LISS-III
band 3 image

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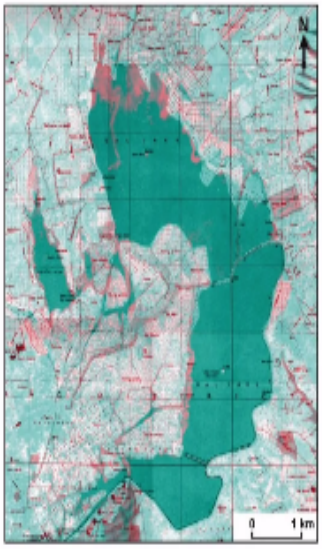

PCT image showing changes in Dal Lake area between 1968-1998

Along with this and a new product was created so what you are seeing in this one wherever the vegetation has grown inside the Dal Lake and the reference line is 1968, so in 30 years time difference whatever the changes which has occurred in terms of vegetation growth are all in this merged or fused image, so this is also pseudo color image but it is not in that sense is true one because one input is map another is scanned map, another one is the satellite image.

But still if registration has done very accurately then one can exploit the same tools for this purposes as well and for change detection studies, so here if you see this original map you would find that they where connectivity between Dal Lake and Nigeen Lake. And the Shikara used to

go very easily through one lake to another. But later on 1998 when the image was a quite as you can see at places this has been blocked because of growth of vegetation or some farming practices within the water channels.

Also in the northern part or on the edge the gate has you are seen the encouragement of the vegetation within the lake body.

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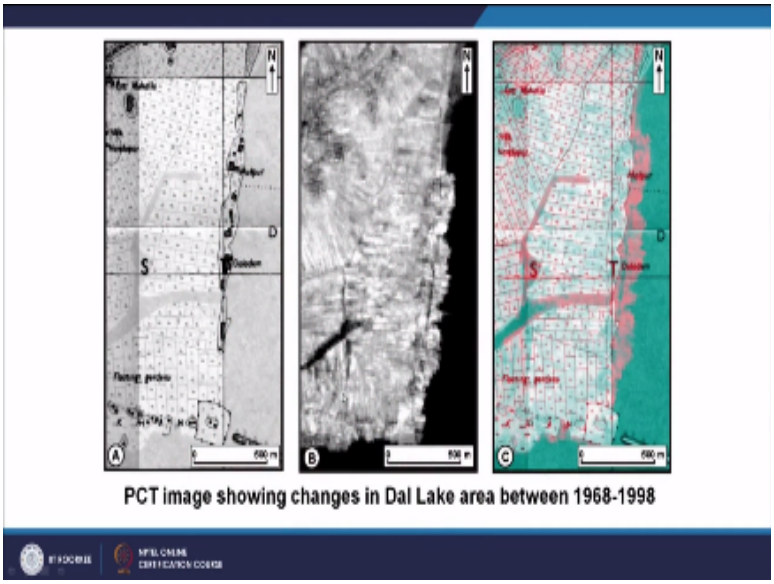

And this is one zoom part of this area which you are seeing here this is the zoom part image showing this is the map exploiting the blue color compound here is the corresponding satellite image of 1998, this is 68, this is 1998 and this is what infused product pseudo color transform image where you are seeing all changes in the vegetation or in water body which has occurred in last 30 years.

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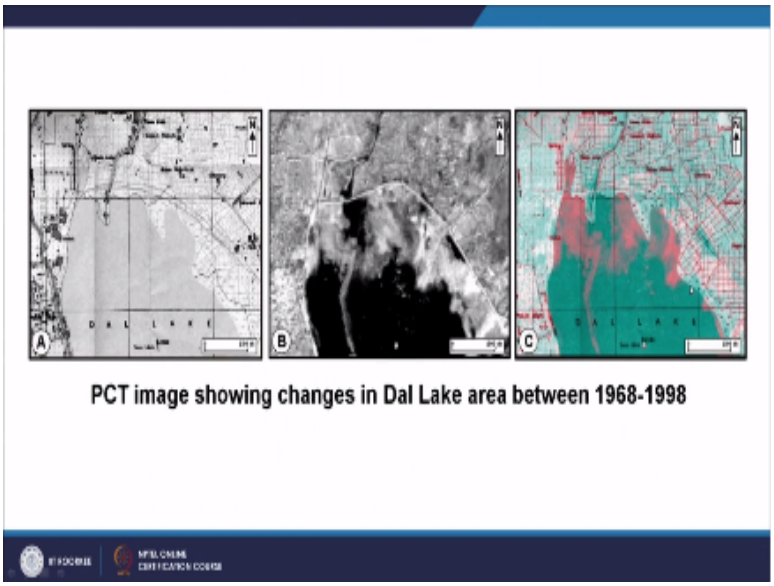

Similarly one more example from northern part of the lake this is the map, this is the satellite data having 30 years time difference and this is the merge image. So more only two images can be merge of different spatial resolution, but two images of the same spatial resolution from same sensor but of two different dates can be merged or a map and image can also be merged.

Similarly we can also exploit the same concepts same tool in instead of having map one can have a digital elevation model or product derived from digital elevation model which is a set relief model. And in this example, this is what we have done this is the satellite image which is suffering from

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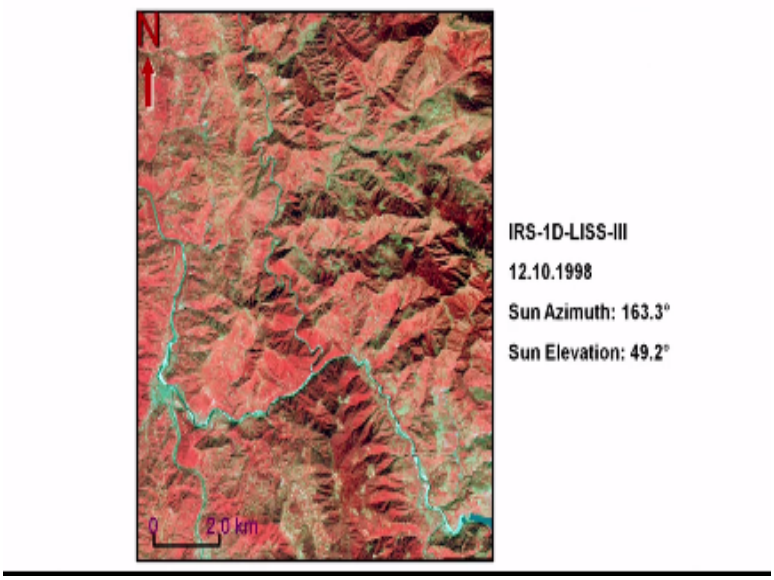

Falls topographic perception phenomena that means the like here if I say that the river is flowing seems that river is flowing on the range but we know topographically geo-morph graphically that a river cannot flow on the range river will flow always in the valley. But this is the pseudoscopic vision which we get and this vision creates us a falls topographic perception about the topography.

So we wanted to, if we want to get red of this one then the same concept can be applied that means that if I rotate this image by 180̊ that means I am forcing sun from southeast quadrant, this is the exact as you can see this is the sun azimuth to northwest quadrant and when the viewer and illumination source are in two opposite hemispheres then one would not see FTTP of a helirant in images of helirant and this is what has seen here.

So this image is having sun azimuth here corresponding digital elevation model was created and then a schedule relief model was created.

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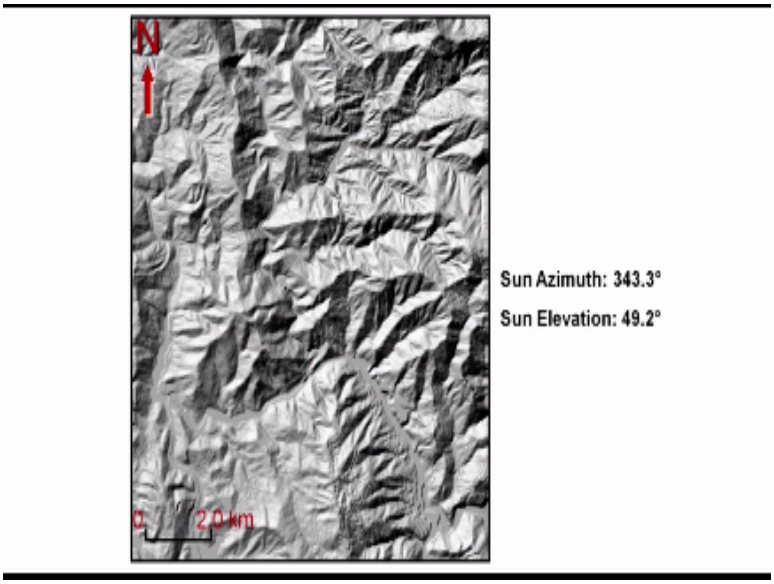

Having a sun azimuth 343 so if you add as 163+180 it becomes 343.3 that means now in this one I have assumed the illumination source roughly in the northwest corner and if you see even in the schedule relief model you would find that this Bhagirathi valley which is a tribute of gangeous have gone in the valley which is the correct perception now we are having two products one is the satellite image false color composite which is suffering from FTPP and another is schedule relief model which is not suffering from FTPP.

So same concept same thing can be exploited they have to registered perfectly one and then the splitting of this you are remote sensing image into three components HIS and so this what is done HIS is done and this I of the satellite image is dropped down and replaced by this schedule relief model.

And then backward transformation so once you do it now we will get an image a product which is not suffering from FTPP but still in color because this schedule relief model is just in is not having any surface information is it just having elevation information but here because of this satellite over thing you have having non surface information and no effects of FTPP.

So in this way also one can exploit his image fusion or an image merging techniques so that word definitely only for an images it means that it is only for images but it is note it is the concept basically so instead of having two images of different space of resolution one can have two images of different dates but same space resolve resolution may be prompt same or one can have map an image or can have an image and schedule relief model.

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And then still can merge and can create a beautiful product like here and can resolve a in which in this example is false photographic perception and phenomena one more example for this that this one first one is what you are seeing is satellite image and which is a raw image not an enhanced.

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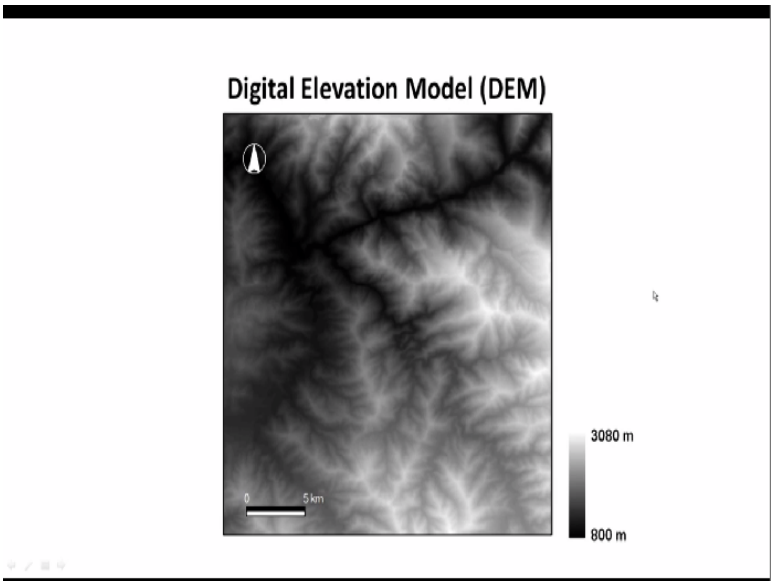

And then you are having a digital elevation model.

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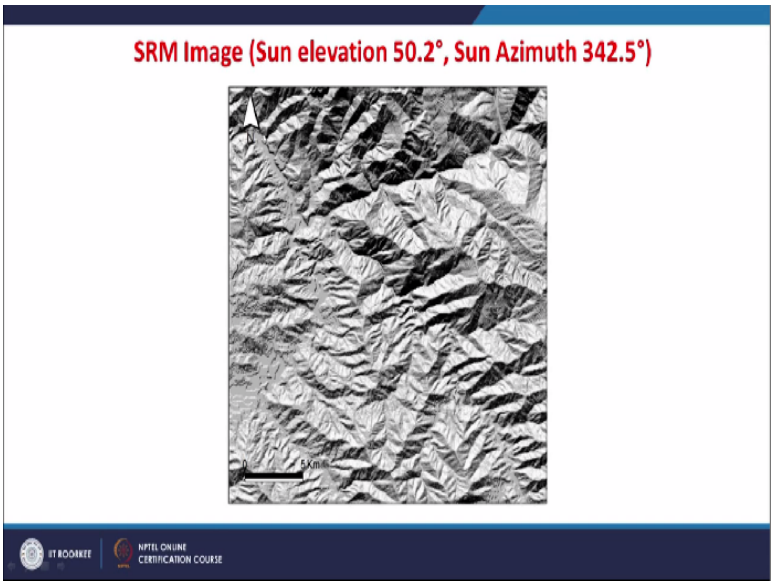

Then schedule relief model which is opposite to the satellite image elimination is created in which the river is flowing in the valley in original image if you see a river is flowing on the image which is in a correct perception here is the correct perception but this is purely based on elevation data doesn't have any ground coverage or land used or land cover here and they were in merge and create a new image which is intensity part have been replaced with schedule relief model and then product is visible here.

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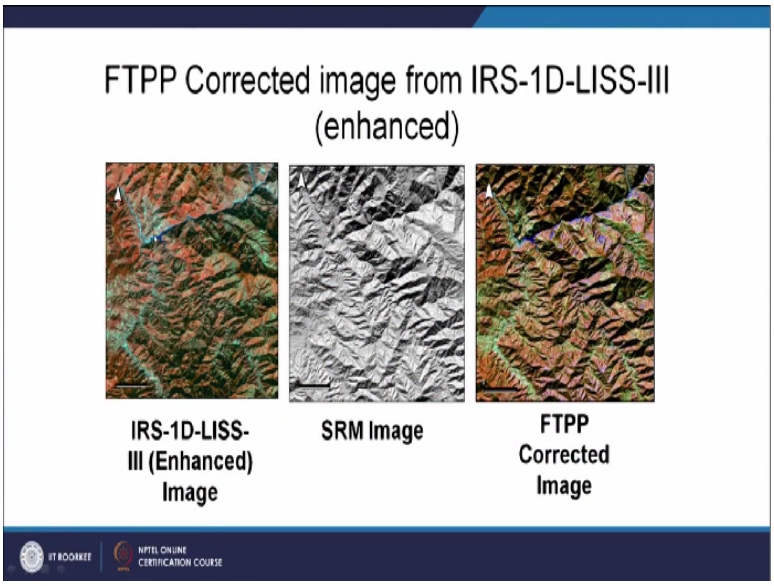

And so here that river is in valley all three together this is the now process the FCC here the intensity component have be replaced by the schedule relief model and then backward transformation to achieve domain and this what using here so there are various space of exploiting and the concept of the image chosen is image merging this is not necessary that one should have only an image is of two different displaceable resolution one can have of same resolution different dates one can have map an image one can have image and schedule relief model.

There can be various permutation and combination the ultimate aim is to exploit these tools digital image processing tools for our own applications and if its tools and using this concept of hither color space or image fusion and or it has to be followed that registration part one has to remember it has to very accurate.

Now we come to the second part of this discussion that is the image mosaicing is I have been mentioned that there are sometimes the area of interest is larger than the image because each image will have affix size from effect sensor so it might be covering an area of say 140 km wide 140 km but your area of interest is larger than so what you will do.

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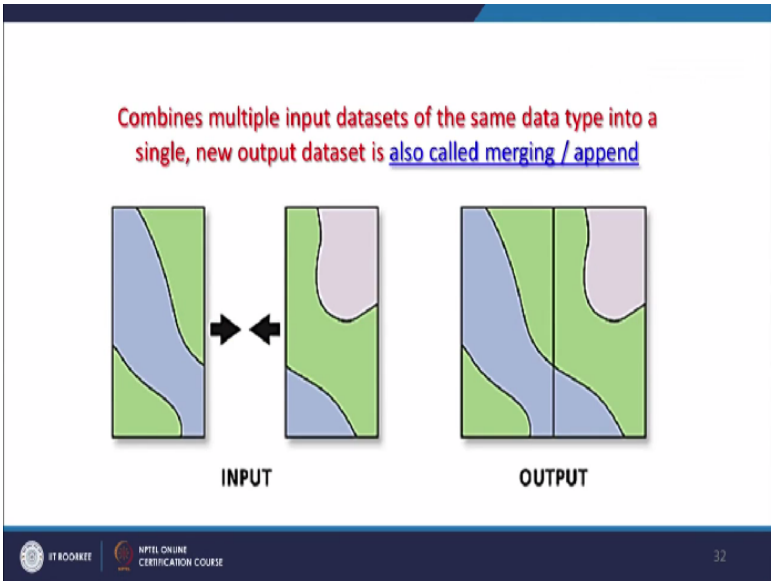

What you have to create a mosaic or collage kind of thing and this is a done like this that this systematic tool and maps are shown but the same thing can be done in case of satellite images and then you merge but you don't want to see this scheme you want to create a product which is a completely seamless product.

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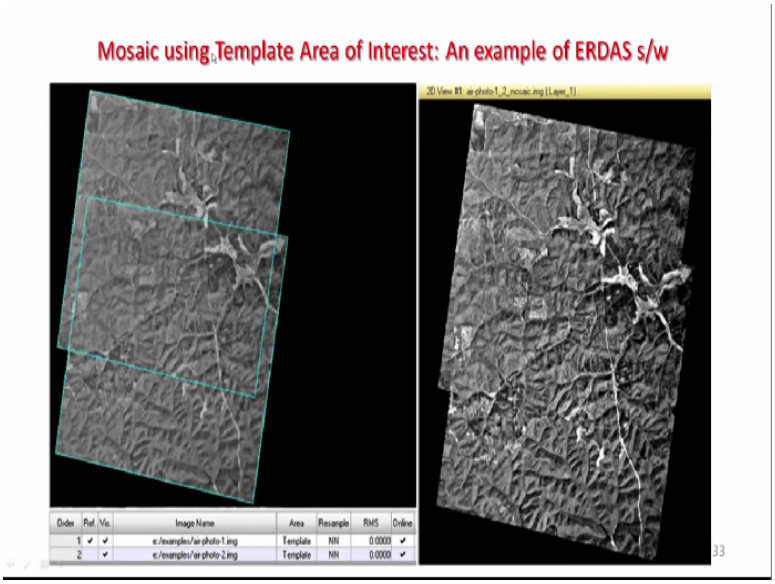

Thus the aim and this is possible that digital image processing techniques one example is given here that mosaic using template area of interest that I declare this is my area of interest two images are here and this side can be done by standard software like ERDAS and this example here and then you see merged image.

And in between of course on the edges you know that this is having two seams mosaic image you have a two seams but if I cut this one then in the between there is no seams is visible so that's the advantage because an the histograms have been also circularized and the seam part has been completely removed from here.

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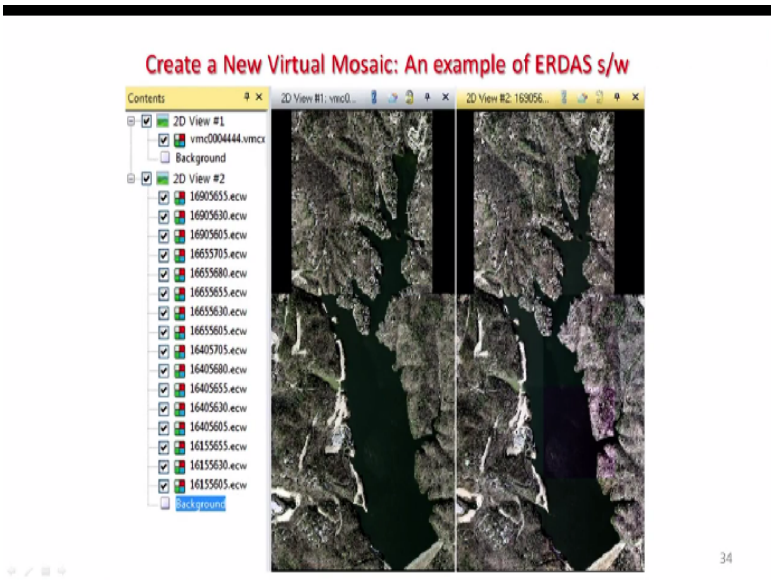

There are some other examples of circulating new virtual mosaic again the example is coming from ERDAS and you get a red of seam here the seam is little visible it disappears completely here.

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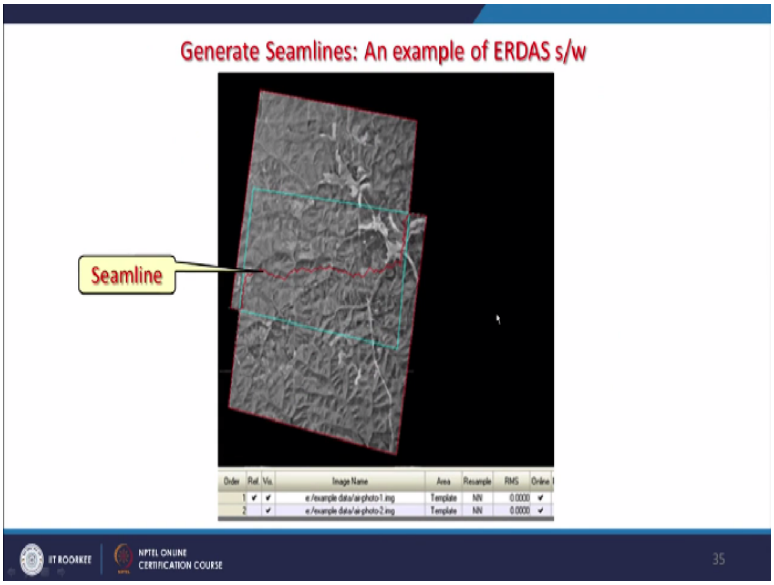

So lot of processing are possible it is not necessary that one can have same which is just a straight line but you can have a seam which is arbitrary lien so this is an another example that I can create a seam which is arbitrary line.

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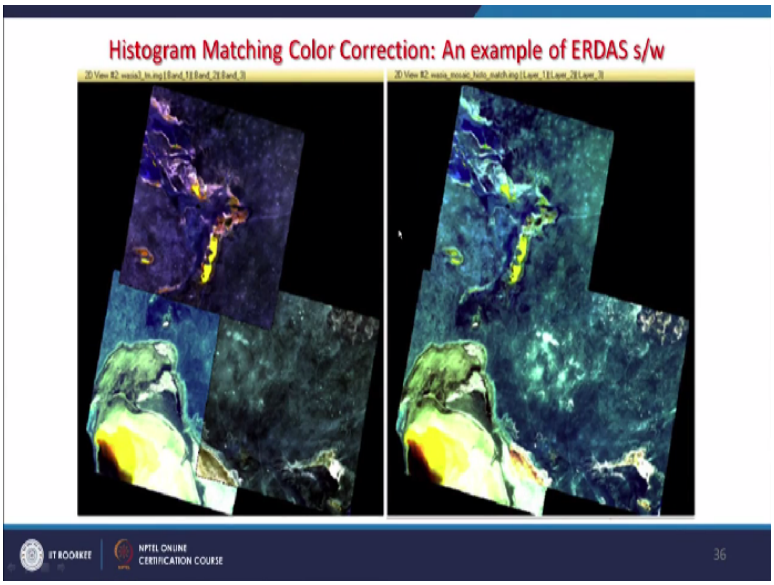

And again I merged this one get it histogram matching in an image mosaicing is the one of the very common technique here the three seams are given they are having different represent different colors may be belonging to different dates but leaving the same sense of course and then by matching histogram color corrections can be done and you can create a seamless mosaic which is given in this example.

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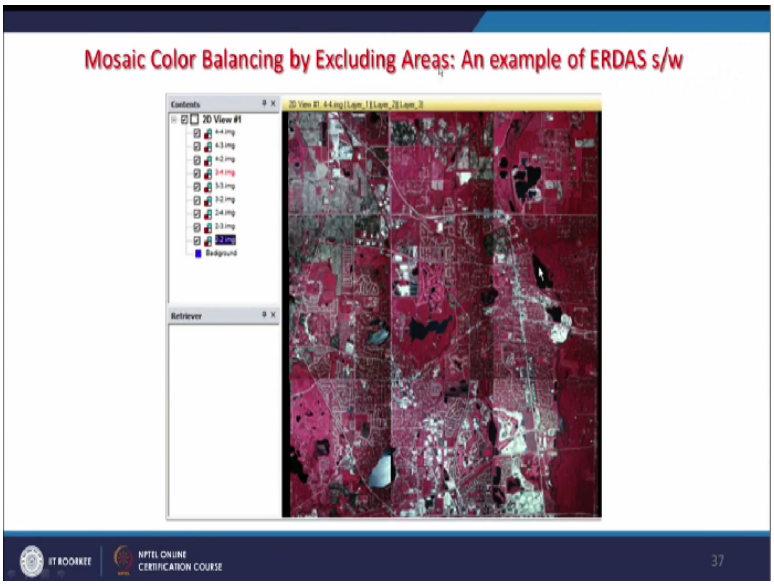

And it is not build difficult to do it so mosaicing is very common process but one has to do it many times your area of interest is larger than one single image an another example is here given by balancing by excluding areas an you balance the areas here because otherwise the seams are visible very clearly so you can create a product in which a this seams will not been visible.

So the purpose of mosaicing digital image processing the mosaicing is that we don't want to see the seam implied by the histogram matching or color matching or whatever various techniques are able by which we can create seamless mosaic so this brings to an end of this discussion thank you very much.

For Further Details Contact
Coordinator, Educational Technology Cell
Indian Institute of Technology Roorkee
Roorkee – 247667
E Mail: etcell.iitrke@gmail.com. etcell@iitr.ernet.in
Website: www.iitr.ac.in/centers/ETC, www.nptel.ac.in

Web Operators
Dr. Nibedita Bisoyi
Neetesh Kumar
Jitender Kumar
Vivek Kumar

Production Team
Sarath. K
Pankaj Saini
Arun. S

Camera
Mohan Raj

Online Editing
Jithin. K

Video Editing
Jithin. K

Graphics
Binoy. V. P

NPTEL Coordinator
Prof. B. K. Gandhi

An Educational Technology cell
IIT Roorkee Production