Remote Sensing Essentials
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Lecture - 36
False Topographic Perception Phenomena and Its Correction-2

Hello everyone and welcome to false topographic perception phenomena and correction part 2, in which a we are going to discuss much more about the corrections of FTPP. In the first part we have discussed what exactly FTPP is and in which situations be observed FTPP? So, here now we are going to see in further details and this is what the arrangement which I was discussing in normal remote sensing images of a from remote sensing satellites which are being acquired from suns in Kona satellite or near polar orbiting satellites which are typical remote sensing satellite.

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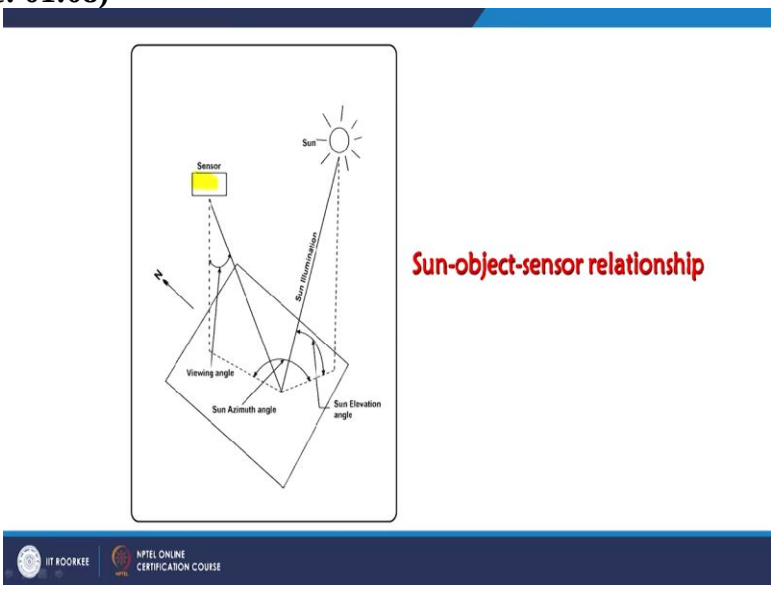

So, here is the sensor which is shown here and the sun position is this one and north is here. Now when this arrangement is there, then you can also have a feeling about what I was discussing about sun elevation angle and generally morning hours that means between 9.30 to 10.30 when, the images are required from sun synchronous satellites this angle that is this sun elevation angle is around 45 degree.

This is what it is shown in this a figure also and then we are having another angle which is more important here is the sun azimuth angle. That is the weather friends too so, in this situation the

sun is shown and from roughly from the southeast quadrant and if observer is here, which I have just marked, then what happens that when image is acquired, which is another image, then and that image will suffer from FTPP if image belongs to a hilly terrain.

Because if a image belongs to a flat terrain like indigent plane or deserts, where shadows are minimum and then you won not see FTPP. So, the main reason of this FTPP phenomena is because of shadows in a heavy dairies, shadows are and sometimes very large and they can give a deep depth perception quite easy. So, one, basically one method, which used to be there earlier, that a single image cannot give you depth perception, which is not true, which we have seen in part one that I have shown to several examples.

Not only images of the earth but also on moon that these images suffer from FTPP and there is a no reason and that they are not giving deaf perception offcourse, if they will not have been giving depth perception and using a single image, then we will not have been or should not have been seeing FTPP. So, this method was there earlier that in order to see depth perception you need to have 2 images from 2 different angles which is not now correct after identifying recognizing this FTPP phenomena and satellite images of terrain.

So, when this sun objective sensor relationship is there, which is happens in case of typical remote sensing satellites, and when in the morning hours, this is what now when one can argue that, why cannot have the sun on the northwest direction, that means the sun and the observer both are in the different hemisphere and see the sun will set the west before it reaches to northwest it will never reach actually.

So, it never reaches in the northwest direction and therefore, evening hours data acquisition is not possible that they so, offcourse, these orbits have been wisely and design and well tested how are that time probably FTPP phenomena was not realized for later in. Now, this is what I have been mentioning

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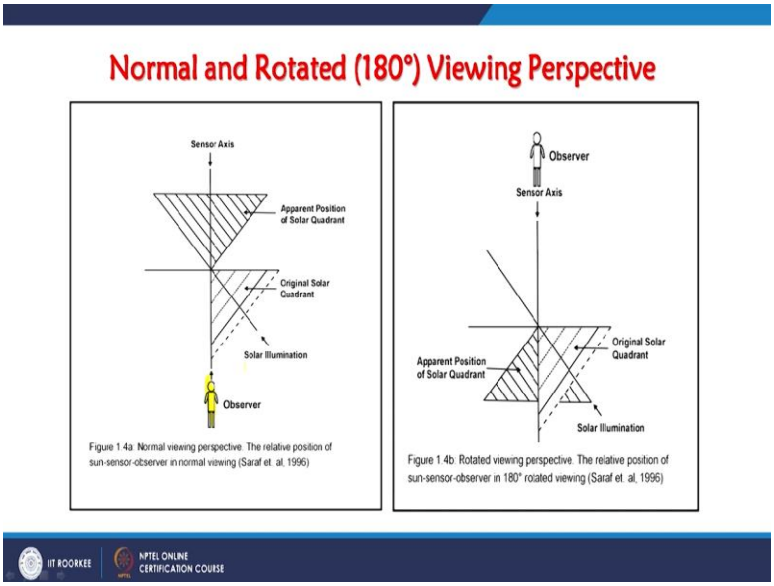

That when and this observer here and solar illumination in the same hemisphere, that is in the southern hemisphere, then we are bound to see FTPP when we rotate by 180 degree image, then the solar illumination or be we have shifted here, the position of the observer or we see by rotating 180 degree. We can also safe to the illumination angle also or azimuth solar sun azimuth and when we put observer and illumination source in opposite hemisphere.

Then we will not see FTPP so, when we rotate the image, this is what has happened that both goes in opposite hemisphere and then FTPP is gone. Now, what are the methods of corrections, one method which I have already discussed is the image rotation by 180 degree, which is very easy and physically or digitally it can be done very easy. But as I have also mentioned that when we use satellite images and they are products with other datasets in GIS platform or in geographic information system platform.

Then we are having problem if we rotate, then everything has to be routed and that will create hell of problems. So, in order to avoid those things, we need to have some other technique in which we should not rotate them yet but still get rid of FTPP and one technique

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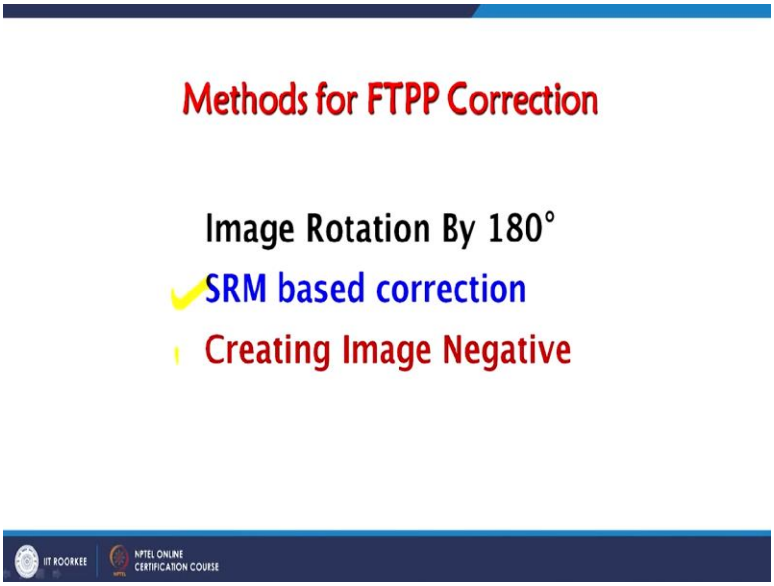

Which has come up which was developed by ourselves and that is the SRM that is the sidereal relief model based correction technique SRM is also called hill said in literature you may find sidereal relief model or in somebody for the same concept you may find a different terminology which is hills state so what is this basically and there is a product which is called digital elevation model most a lot of digital elevation models of different spatial resolutions of entire globe nowadays available for free download.

Now, by using these digital elevation model one can give a shadow or illumination source through a modeling and then we can create a different surface which is called sidereal relief model or different model which is called so the original many of these freely downloadable digital elevation models have been created using remote sensing images. So, first the remote sensing data that those datasets have been used either using SAR interferometer technique or using a stereo pair technique and using either of these techniques.

A digital elevation model of the globe has been developed of different resolutions and these DMs we can use to create a hill state or sidereal relief model of our choice. Our choice means that illumination source and illumination angle that is the sun azimuth and sun elevation and then in during this modeling, creating from DM to SRM can be changed as part of our requirements and then we can use some image processing.

Pill image processing techniques or transformation color transformation technique to create FTPP corrected image without rotating by 180 degree so, the example we will be seeing soon. Now, the third possibility and whichever we have also developed is creating image negatives rather than using a digital elevation model than driving a sidereal relief model of our choice having appropriate sun azimuth elevation.

And if we take a simple image, a false color composite or color composite image and do some image processing techniques perform some image processing technique, there too we can also get rid of FTPP. So example from SRM and creating image negatives we will are going to see now what when we go for SRM

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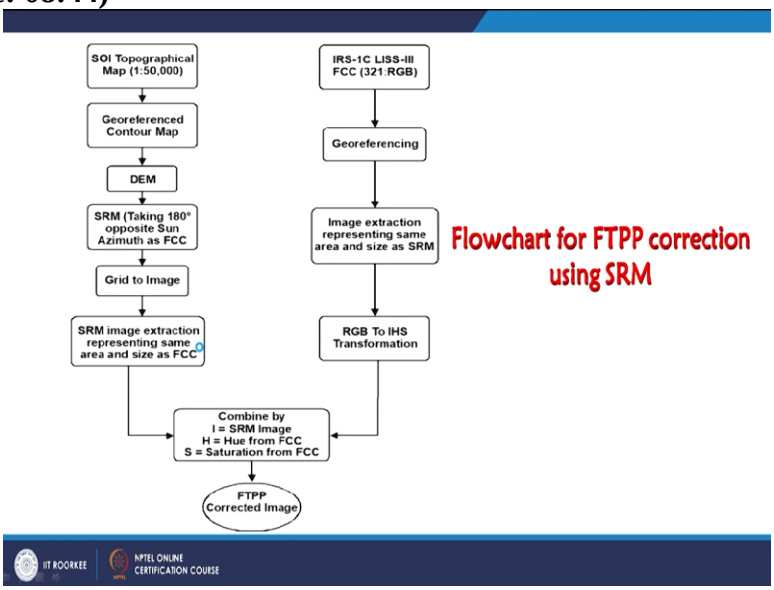

Though this flowchart may sound a little complicated, but let me make things very simple. Basically, you need to have a sidereal digital elevation model of almost same resolution, space resolution as or satellite image which is suffering from FTPP. Now, when we use this digital elevation model and what we need to do, we need to create a sidereal relief model which is having oppose it solar azimuth compared to what satellite images having because satellite image it is having soon sun azimuth which is in roughly in the southeast quadrant.

But we want to create through this digital elevation model hill setting modeling and we want to force the sun to go in the northwest quadrant and that can be done very easily on a GIS platform or even on some image processing software. So, like it does and when this is there, then what we

need to do that the color composite which we are having, we will split in 3 components and this what it is soon here that it will be split it in 3 components and this is a IHS that is Intensity Hue and saturation, this is what it is shown here.

That color composite image will be split into 2, 3 components using any standard digital image processing software's and now we will have 3 components IHS Intensity Hue and Saturation. So, what is done in the next step is that intensity image is replaced by the SRM which is having opposite sun azimuth has compared to FCC. So, now this SRM is replacing the intensity image which we have splitted from RGB and remaining 2 components that is hue and saturation will go as it is so hue and saturation are going as it is.

And once now, we are having 3 components I as SRM which is having opposite angel to the satellite image opposite sun azimuthal angle and then we are having same hue and same saturation. Now, in the last step is we combined or do the inverse transformation that is from IHS is to RGB. So, we started with RGB the splitted RGB into 3 components IHS, I of the image is dropped and it is replaced by SRM or sidereal relief model.

Which is having opposite sun azimuth has compared to what satellite images is having and when we do the reverse transformation that is from IHS to RGB we see an image which is not which will not be suffering from FTPP corrected me without rotating the image by 180 degree. Let us see now

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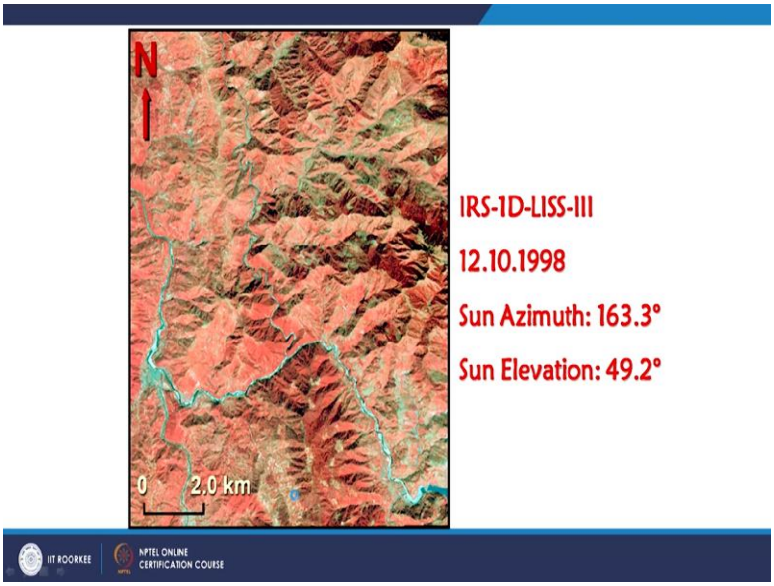

So, this is one image of Himalayan terrain and in the center what you are seeing the Bhagirathi river and as you can see that image is suffering from FTPP and therefore, the Bhagirathi river is appearing to flow on the rich with geomorphological, topographically it is impossible. Now, another points to note here that the word north is upward and now that if you see the sun azimuth which is 163.3 degree and when you download a satellite image and you can also download the and this meta data of that image particular image and through metadata.

You can know when that image was a quiet what was the sun azimuth and sun elevation angle and even if you have a not getting that metadata file, there are models are available by which you can provide the and you know center location in terms of latitude longitude of for your image or a study area and the date on which the image was acquired this much information is very much required so, once you have provided these 2 information that is the location.

Center location of the image and the date of the image again you can drive this sun azimuth and San elevation angle. But if you are having metadata then wonderful this will be give you more accurate information so, here what when this image from IRS our Indian remote sensing satellite list 3 sensor when it was acquired in the on the 12th October 1998. At that moment, and that at that moment the sun azimuth was at 163.3 degree and when this situation was there, the image is suffering from FTPP. Now, what as I have discussed through that flow chart that

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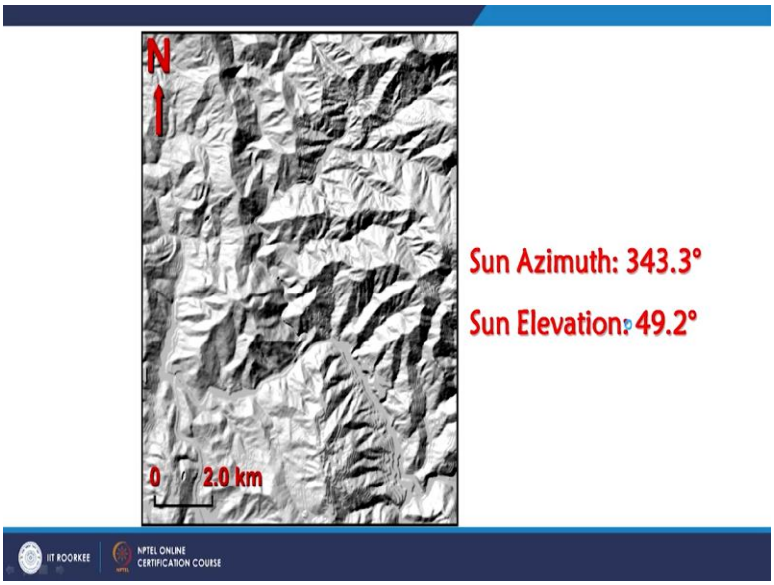

Using digital elevation model of the same area and almost have the same spatial resolution, a shiftily model has been created. So, if you add 180 degree to 163.3 degree, this is what you will end up with 343.3 degree means the sun azimuth in the this image is roughly here in the southeast quadrant has been modeled or sifted through this modeling in the northwest quadrant by adding 180 degree and the now and the sun elevation has been kept as it is, there is no change in the sun elevation 49.2 in the original image, so, in the miser relief model is the same.

So, we have played only with the sun azimuth, we have forced the sun to illuminate that area from the northwest direction rather than from southeast direction and when we have forced like this now, the you can see that the Bhagirathi river has gone in the valley that means it is giving us a correct perception. So, but this becomes this image this SRM becomes our intensity image so, what is done as I also explained through that flow chart.

This is colored image that is the RGB image so, this image is split it into 3 components IHS I intensity image H is hue that is colors and S is the saturation about the colors. So, 3 components are there 1 component that I original I of the image is dropped and it is replaced with this 1 which we are seeing that is the sidereal relief model having opposite sun azimuth angle and 2 component that is Hue and saturation remain same.

And then when we when we perform the backward transformation that means from IHS to RGV this is what we get. Now here the sun azimuth in real citizen and it is not possible because as I have already mentioned that when we need sun to illuminate the terrain from northwest direction, which is impossible because before the sun reaches could reach there it will set in the best so, it will never reach in the northwest direction.

But we can model it and this is what exactly it has been done in this case that we have model the sun to go in the northwest director and illuminate the terrain and when observe and in what you would notice that we are not rotated north here or we have not rotated they may not remain upward. So, that that means this image can then be used along with other datasets on a GIS platform so, this correction, which you have just observed, is without rotating.

But implying a shady relief model of opposites sun azimuthal then getting rid of FTPP and this is what exactly has happened, though there are because none technique is universal. And here also we are having some artifacts which you are seeing in very bright blue color and we because of in the original image these areas in our bear in the complete set and as you can also observe here that these areas are in the complete setup.

So, when the areas are incomplete shadow in this FTPP be corrected image and these might appear as artifacts otherwise everything is in order and they which is without rotating be got rid of FTPP in this image. Now, the problem with this technique and one is of course, artifacts in this example you are seeing some examples you may not if terrain is not so rugged, then these problem you might not observe the other problem is all the time you require a corresponding digital elevation model corresponding.

I mean of almost same spatial resolution and that may create problem because now we are moving from relatively coarser spatial resolution images to very high spatial resolution images of 1 meter of 60 centimeter. So, corresponding digital elevation model at the same resolution as satellite images are not available and therefore, this technique cannot be implied and for those images, which are having high spatial resolution.

So, this is one limitation is there with this technique, but more example of this technique we will see and this is again of the Himalayan terrain, you are seeing again Bhagirathi river which is flowing here like this.

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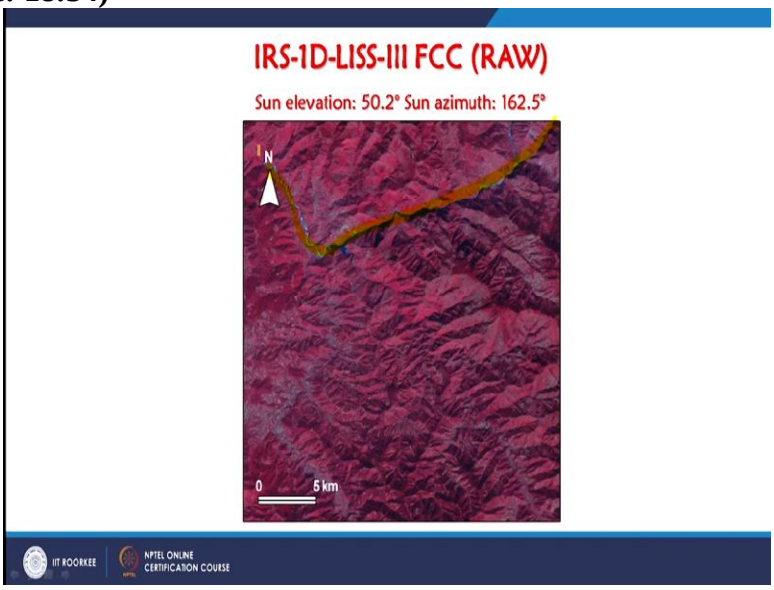

And this is of course false color composite from our own satellite IRS the list 3, the sun elevation and sun azimuth the important point to note here is the sun element is there.

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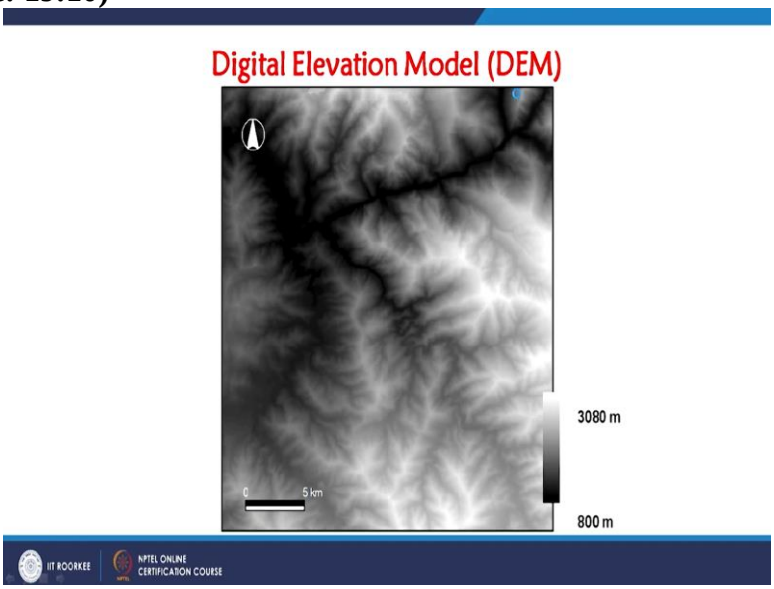

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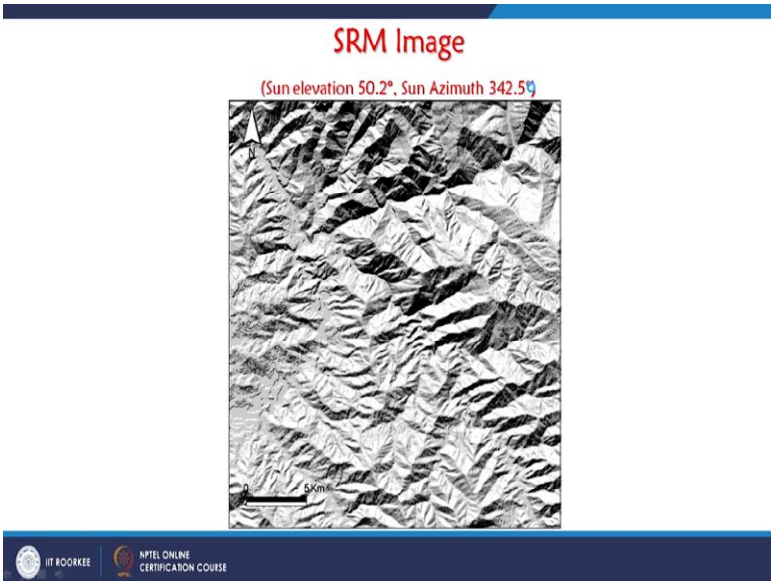

So, this is the digital elevation model and this is the sidereal relief model derived from digital elevation model where the sun the azimuth has been the sun has been forced to illuminate the terrain from northwest direction that means that what the original image has 162, 180 has been added and we end up with 342.5 and when this is the situation and then same replacing this with the intensity image and the UN centuries image remains same backward transformation from IHS to RGB and we end up with this image. So north in this image north is upward no issue about that.

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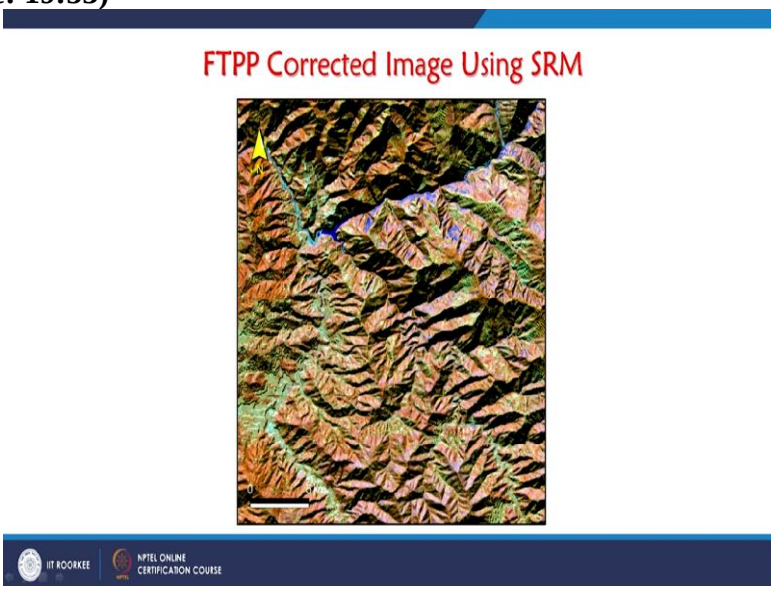

And river has gone into the valley that means the FTPP has gone and this image or the product scan or his product can be used with other datasets without rotating the image. That is the

underlying point that here we are not rotating the image, but is still getting rid of FTPP all 3 things together.

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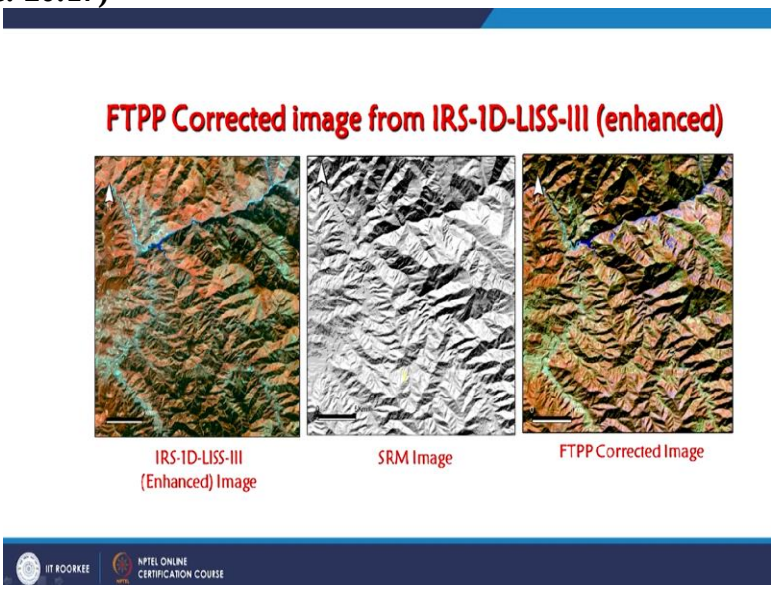

This is the input image which is suffering from FTPP offcourse this is color composite false color composite. This is the shady relief model having solar illumination from the northwest direction where is in the originally image the sun azimuth, in the southeast direction and when we do this transformation, what we having the sun here in the northwest direction observer, and the north is upward, but it is still we are not having FTPP in this image.

Now, one more technique, which I would like to bring here is about the negative creating negative of intensity image and in this technique, we do not require corresponding sidereal relief model because in the earlier one the problem which we started facing when we start using high space resolution model and corresponding digital elevation models of that resolutions become difficult to acquire so, therefore, some other technique should have been developed this is what we have done it that a color composite false color composite is RGB a typical RGB image. So, we can what we can do

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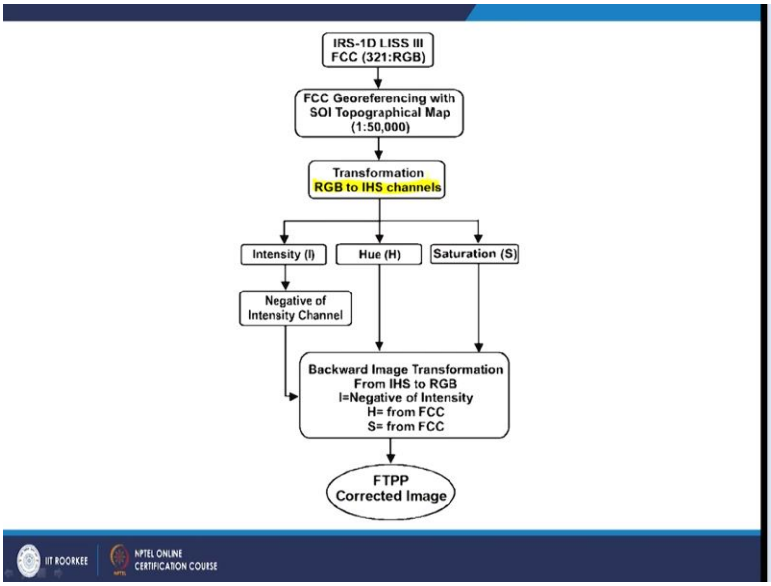

We can split that RGB into 3 different channels we have when we have been discussing this gallery space, we have discussed that within color cube, we can use various planes to project our image or data and one a typical one is the RGB and that is red green blue. Another one can be IHS that is intensity use saturation. Another plane in which we can project the data is CMY that is cyan magenta yalo which printing devices use it.

So, within color cube lot of minorities, lot of play can be done and we can take the benefit and can get rid of such phenomena like FTPP. So, RGB is splitted into a color images split it into 3 components that is IHS and here what it is done and that intensity negative of intensity image is created and when we create a negative of intensity image, what we are doing basically, we are forcing the sun to go from southeast quadrant to northwest quadrant and once it is done.

Then a backward image transformation that means from IHS to RGB is done though so, intensity component is the negative of intensity image of original RGB, then hue and saturation will remain same as in Natalya technique.

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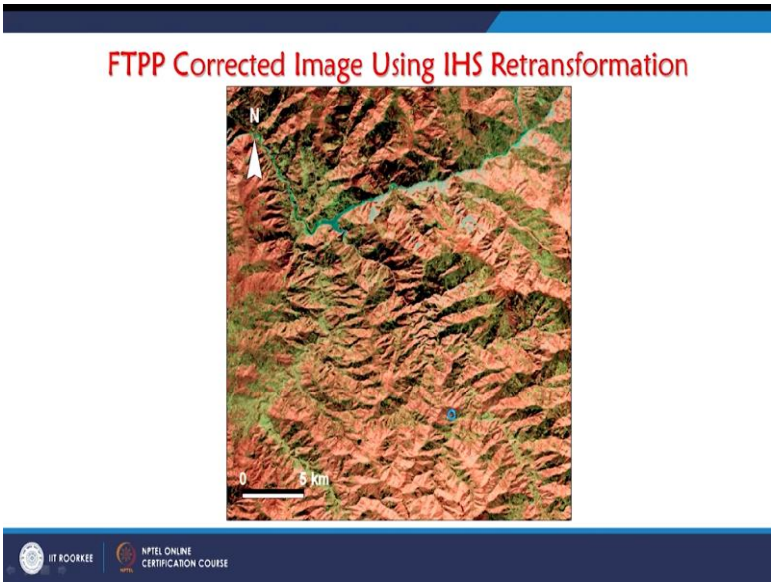

When once it is done then we get rid of FTPP without implying digital elevation model or a CW model so, very quickly, without using much software or depending on the software or depending on the sidereal relief model of corresponding spatial resolution, we can just get rid of FTPP and that too without rotating the image. So, this is the latest development which we did a few years back and that getting rid of FTPP without a rotating.

And without implying sidereal relief model. However the areas in the original image which has incomplete shadow are giving some artifacts and some color variations as compared to original FCC. Otherwise, FTPP has gone and is still no reliable interpretations can be done because if we are seeing and he made which is suffering from FTPP that means inverse typography, then we are bound to make wrong interpretations.

So, it is always required whenever we are using images of hilly terrain that first get rid of FTPP by any of these techniques and then we start doing interpretation and one should not perform interpretation of images of a hilly terrain terrain in without getting rid of FTPP otherwise, wrong interpretation will be done and if those derivatives of interpretations are being used for other analysis, then the analysis may also create wrong results.

So, it is a user of satellite images of a terrain must be aware that a phenomenon exists which is false topographic perception phenomena, 3 techniques which we have developed. Depending on

your requirements, one can use those techniques and can get rid of FTPP before starting, analyzing or interpreting your satellite image and the same image

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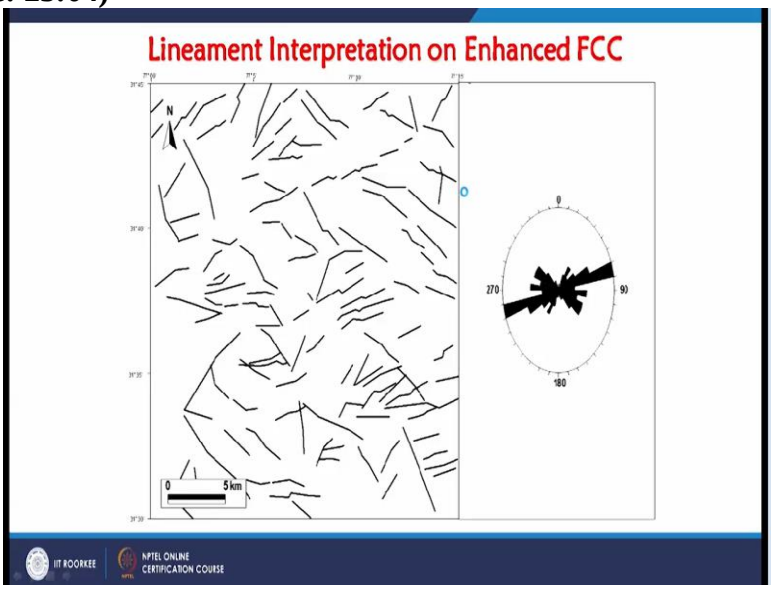

Input image on the left side, which is suffering from FTPP on the right side you are seeing and you know, the image, which has got rid of FTPP without rotating and without implying a shaded relief model. So, resolution is spatial resolution issue will never arise in such kind of FTPP correction technique and this is the exercise which I got it done through students, and very interesting that the image was used.

When I gave this to students, when image was suffering from FTPP and they did the interpretation of lineaments and then I got rid of FTPP and asked them to do interpretations against them and what do you observe, which you can also see through these gurus diagram, that the you know, the directions have completely change of different features and this here this northeast, southeast direction features.

Which we are you know not do so, prominent in the interpretation, we are highlighted in the images which will FTPP be corrected. So, this is what I wanted to demonstrate that if an image is suffering from FTPP one is bound to make wrong interpretations and therefore, it is very much required to first correct FTPP image should be corrected for FTPP and then interpretation should be done and this is also linear interpretation on corrected FCC also it is there.

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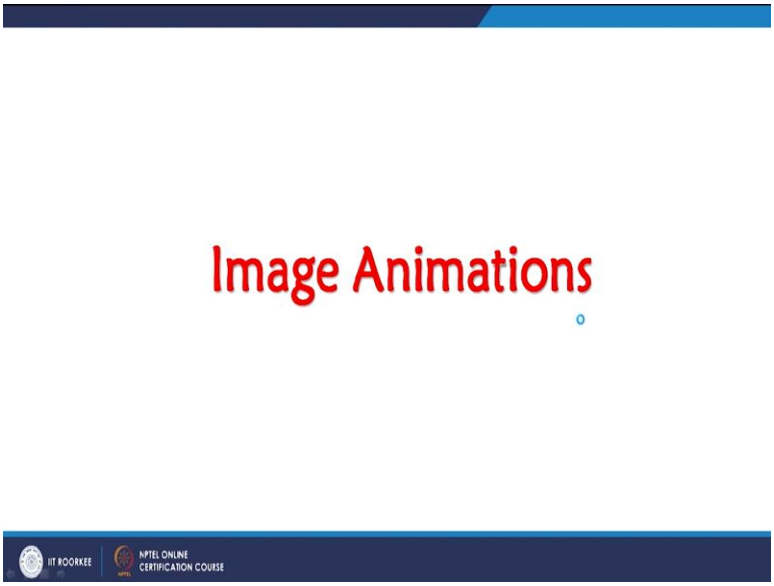

Now, 2 more things I am going to show to you the rule of how this what I have done and that I developed a you know simulated animation simulated animation means there are eight scenarios, which has put in a sequence a bit some time gap and also position of the sun. So, when they this animation is starts what you would see that the sun is rotating and when the sun is in the southern hemisphere observers is also in the southern hemisphere, you will have you would observe FTPP.

When sun goes in the northern hemisphere, observer remain in the southern hemisphere, you will not observe FTPP So, now we will be seeing this a image animation, as I have just explained that, here, the position of the sun is changing and when we see the sun changes position, the depth perception also changes and the same time we will also be seeing how FTPP appears and disappears so, let us have this animation.

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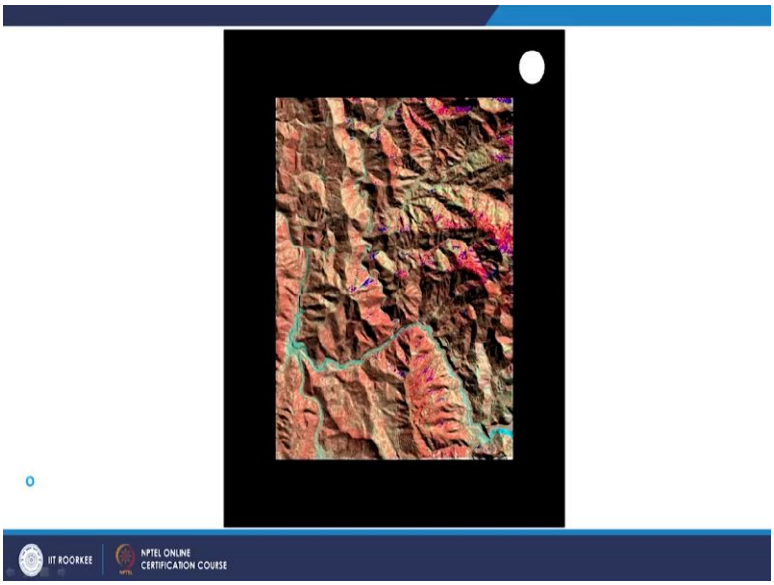

What we are seeing when the sun is in the southern hemisphere, we are seeing an FTPP but when sun goes in the northern hemisphere, we do not see FTPP. So, what how this image has been created or this animation let me explain eight scenarios north south, east, west and north east, southeast, southwest, and northwest. Eight scenarios were created using that shady relief model of eight different locations of the sun or sun azimuth then backward transformation. So eight times the topography corrections or FTPP has been done.

And so 4 times what you are seeing in this, when the sun is in the southern hemisphere, though, this is white and in the background is a black, one might say this is moon but it is believed this is the position of the sun which we are showing here. So when the sun goes in the southern hemisphere, we are observing FTPP when Sun goes in the northern hemisphere, we do not observe FTPP and please note that we have just change the sun azimuthal angle not the sun elevation angle so here now as soon as now sun is gone in the northern hemisphere.

Observer in the southern hemisphere, we do not see FTPP so, when both observer and sun are in opposite hemisphere like this it currently then we are not saying now we are seeing FTPP and when it goes again see it is we are not observing FTPP. So this further explains, and that what is the role of sun azimuth in case of FTPP and this clearly, clearly demonstrate and that FTPP occurs when the sun azimuth or the solar illumination or illumination source and the observer are in the same hemisphere when they are in opposite hemisphere.

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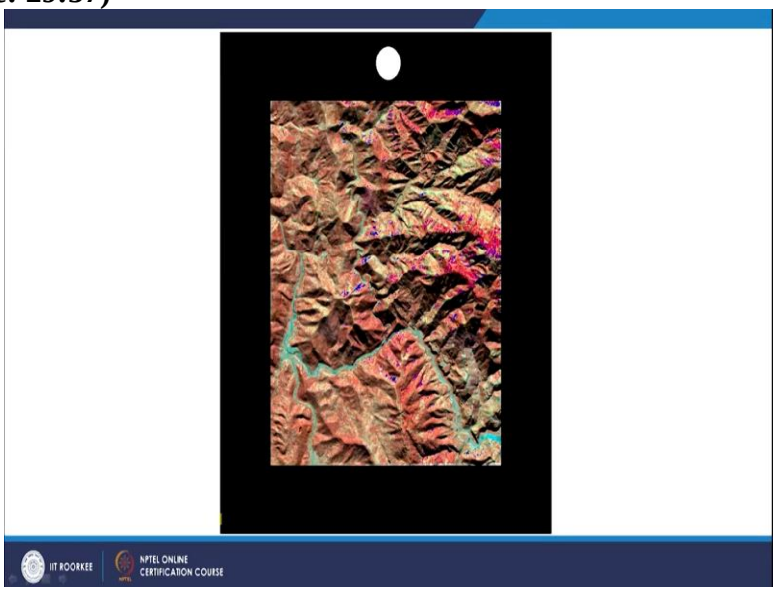

We will not be seeing FTPP as being demonstrated animation now, we are going to observe another animation in which instead of you know creating simulated images for the sun azimuth in this animation, the sun azimuth has been kept same that is in the northwest direction without FTPP and FTPP corrected images and every 5 degree is starting from origin images successive images has been created and put in animation.

So, this is that is why I use the word simulated animation so, in this simulated animation what you are seeing, when sun is the near horizon you see very darkness in the image shadows are very large and there for the depth perception is the maximum and the sun is near horizon that is 5 degree or 10 degree when sun goes overhead the shadows becomes minimum and depth perception reduces significantly. So, this demonstrates that how sun elevation also plays a role and for the depth perception and also it you know cancel that mirth.

Which says that for seeing a depth perception in satellite image one require images from 2 different directions that is not correct in that way. So, here one can see that how sun elevation and will plays very important role, why I am discussing this animation here, because during winter season and this is this situation in winter season and sun is in the low horizons, our near horizon in the early morning when images are being acquired.

And therefore, if you doing some analysis of having images of winter season and summer season, then you would you will face this problem of different set of conditions. So, once would be aware though through modeling using different sidereal relief models, one can correct one image and then another image can be used for comparison, but when 2 images of 2 different seasons are being used for certain purposes.

One must be aware that because of sun elevation angle, they might be having different shadows and therefore, different shadow conditions and depth perception and the same with the sun azimuth also. So, this one has to keep in mind when we are using satellite images and especially I am talking about hilly terrain, because most challenging is using satellite images of terrain like Himalaya which is highly regarded this example is also from Himalaya of Bhagirathi river valley, which is a part of or a tributary of Ganges.

Now, what we see that day once we published our work out there and identified this FTPP phenomena, people who started using our work and they have started incorporating in their publications and also started developing their own thing and though here and this blue at all have mentioned in their paper, that FTPP is a relief inversion problem and firstly identified by Seraph at all in 1996. There is a clear cut acknowledgement though this should have been updated here that it is not any

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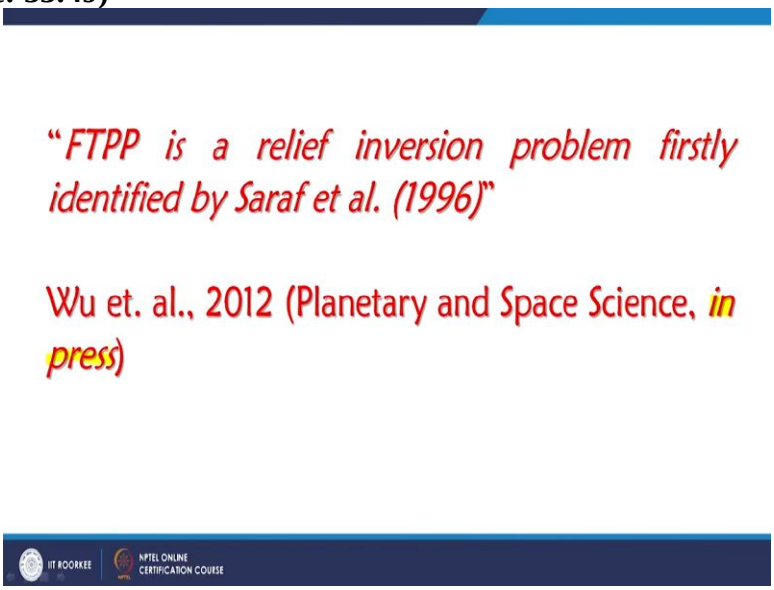

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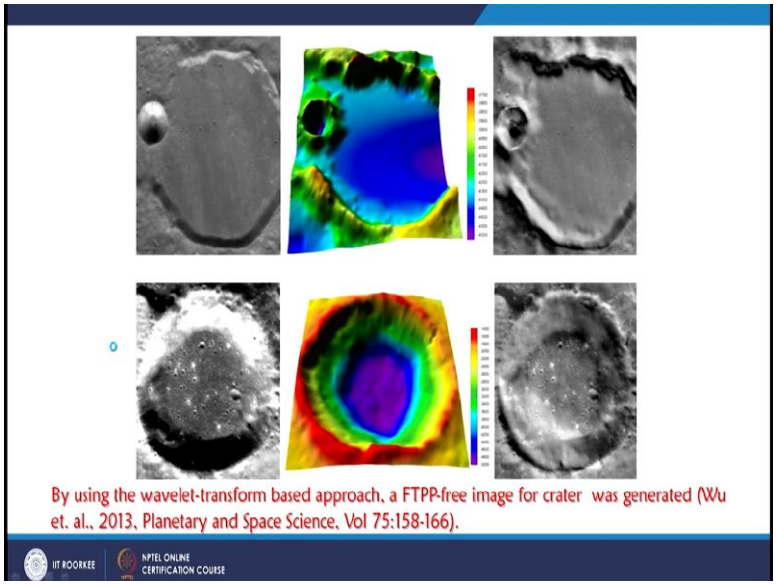

More impressed this paper has already been published anyway. So we what they have done, they have implied wavelet transformation which is a very strong very powerful technique in image processing and they have taken image of moon surface and also a digital elevation model and using that digital elevation model and opposite direction and shadow relief model which was created in the in the middle row,

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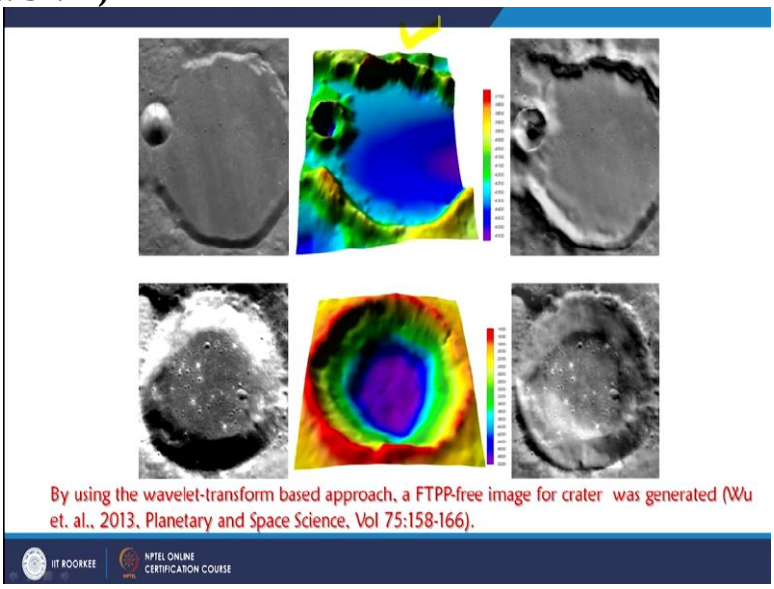

Middle column and then and this same way that transformation is done so, when this is done, then through this wavelet transformation, you see without rotation FTPP has gone on the right image, see the compared with the left image, extreme left image and right image of the same

area. But the left image is suffering where north is upward left image is suffering from FTPP when you see and when using the shadow relief model and through a wavelet transformation.

Then what you see that FTPP has gone without rotating the image in this technique and who at all have used and sidereal relief model of opposite direction. Another example also soon about the creator of moon surface and then certain relief model of the same area and the middle bottom middle and then on the right bottom image, which is now and do and does not suffer from FTPP without rotating that has been corrected.

But there is a limitation in their work the examples which I have shown from colored images or false color composite or RGB images here very cleverly what they have done, they have taken only black and white images. So, there are no 3 components and therefore, the artifacts which I have mentioned in my correction technique, the problem of artifacts will not arise here, because it is a single channel image single band image, but nonetheless, a technique was developed.

And which is based on the wavelet transformation and FTPP has been corrected, once it has been corrected for one band, it can be implied to correct for other channels or other events and then finally, a color composite can also be created. So, likewise that, this FTPP phenomena which we have discussed, and the causes of FTPP, what are the reasons which are causing the FTPP and where these are occurring in a (( ))(36:40), and not only on the surface of the earth.

But also on the moon and also FTPP is observed on the surface of the mars and you can check also on the Google mars. So, when you install Google earth, and the same time, Google moon and Google mars are also installed and they are also you can observe on the left image like here and this is mars

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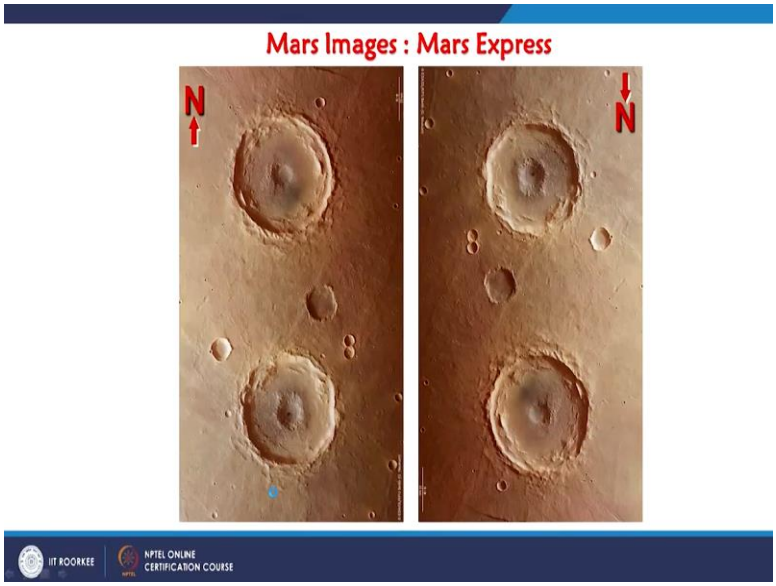

Express and the critter area and on the left image is suffering from FTPP and because sand azimuth is from the southeast direction and therefore, you are seeing you know the creator not incorrect perception, but in this when I rotated this image by 180 degree then we start seeing things in correct perception.

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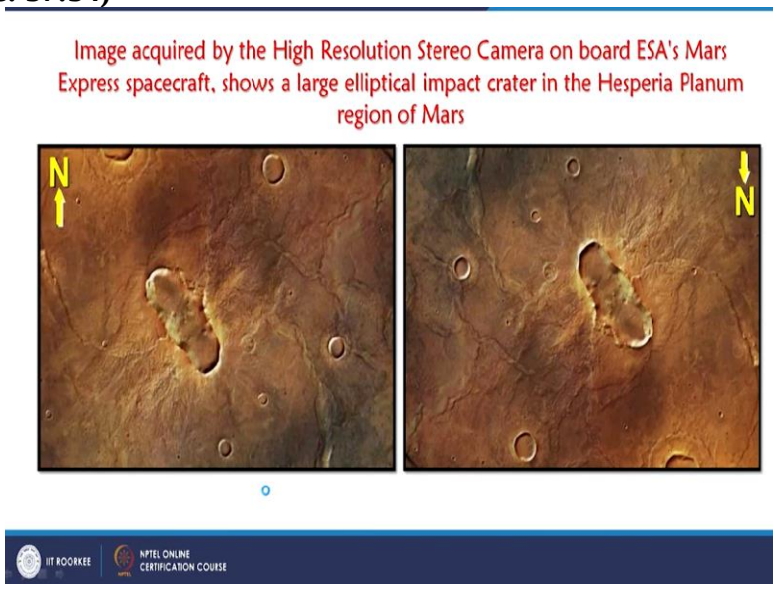

So, that means, what we can see after seeing one more example of surface of the mars satellite images of surface of the mars which is having also some ruggedness and that what we can say here with the lot of confidence that the images acquired by polar orbiting satellites or suns in corolite satellites of hilly terrain not only of Earth, Moon or Mars will always suffer from FTPP this is a strong and bold statement which I have made that images of a hilly terrain.

Acquired from polar orbiting satellites of any part of the globe or moon or Mars will always suffer from FTPP that means, we can say that FTPP is a universal phenomenon and for of course for the flittering and anybody who started or who uses these images of hilly terrain of any of these bodies, earth Moon or Mars planet or satellite. Then one should be aware about the phenomena, one should whenever using, one should make corrections and then start doing the interpretations.

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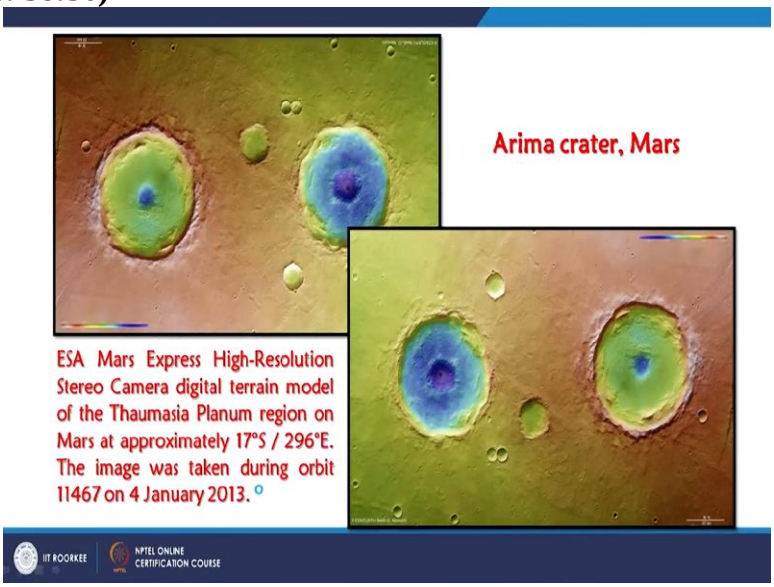

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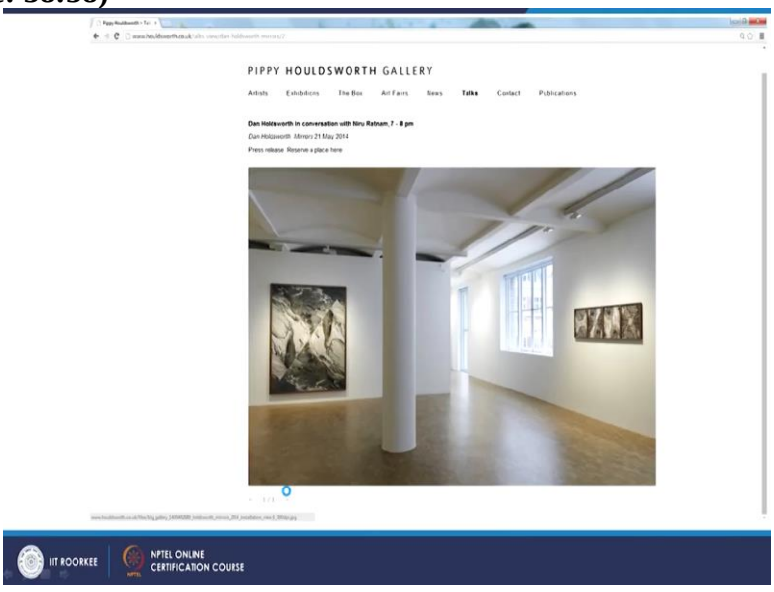

One more example is here of Mars surface Arima crater. Again, the same scenario is her very interestingly, that is why in the part one I have said that it is going to be entertaining. So, this is what I am going to show entertaining and there is a artist and whose name is Houldsworth, what he has identified this phenomena and much later offcourse, and what he has started putting his own gallery, which is called Houldsworth pippy house gallery and what they what he has done that they are taking one image.

Which is suffering from FTPP and then part of that image, you know the rotated image and then put created college like here which you are seeing or like here, which you can see again from the same den Houldsworth

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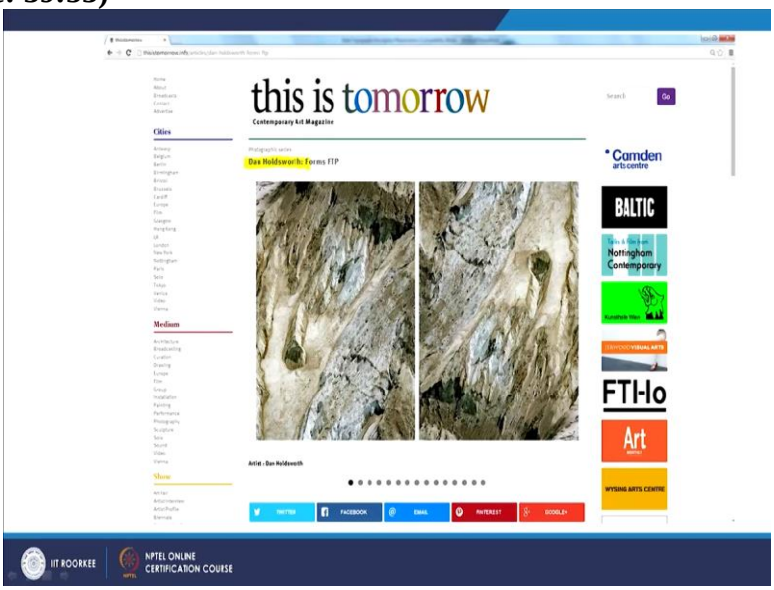

And they also mention that forms FTP that is false topographic perception. So on the left image which is suffering from FTPP, and then right image, and which is just rotated off by 180 degree of first image is not suffering from FTPP. So even artists to have exploited and this FTPP for their own benefits, you remember that simple engraving or etching features can create depth perception and that was developed by artist. So, this FTPP is now going back to artist again through the satellite images and showing this thing.

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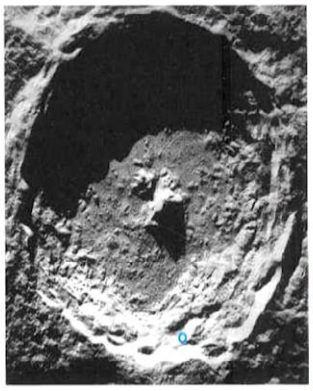
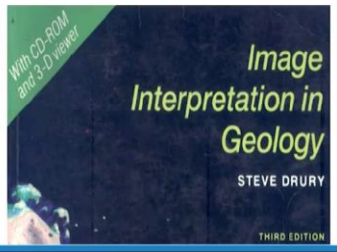


Fig. 2.18 Viewed this way up the image is clearly that of a crater with a central peak. Viewed from the top of the page th image should 'flip' from reality to inverted relief.



One more example, here is like a in the book, very famous book, image interpretations in geology by STEVE DRURY and hear what he has mentioned about this critter that view this up image is clearly that a creator with a central peak viewed from top of the page the image should flip from a reality to an inverted relief. So, if it is rotated by 180 degree that means the going the sending, forcing the sun to go in the northwest quadrant, then you do not see FTPP, this is what it is demonstrated in this book.

And so, people have X, after our publication and later work on corrections people are started accepting that FTPP phenomena exists in the satellite images of hilly terrain weather images of earth, Moon or Mars and also now it is part of the literature. So they say this is about the images in the central you know, FTPP in the satellite images, one more a small thing which I want to show you, because in satellite images the depth perception or FTPP is occurring.

Because of shadow and contrast, the shadow creates the contrast between 2 adjacent objects, one is illuminated one is shadow, and when this situation comes a completely different perception is developed and this is what it is demonstrated here that I am going to show

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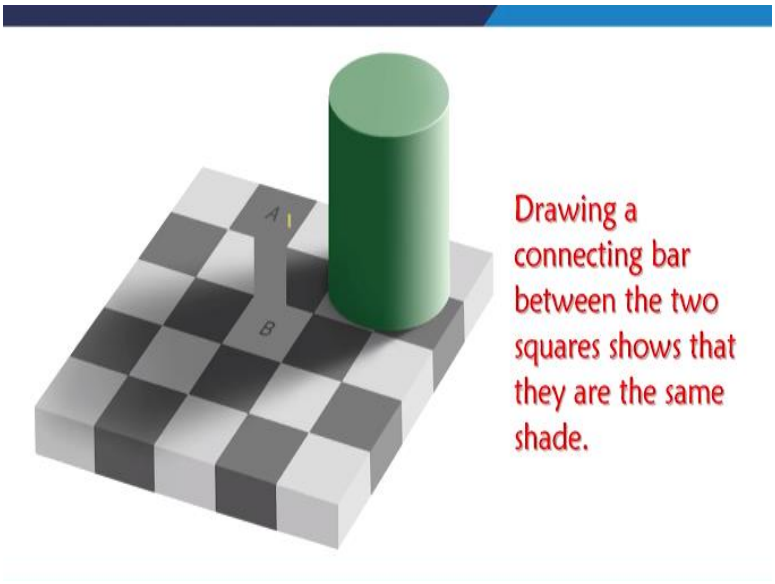

This checker blocks and 1 and there are 2 blocks which has one is mark with A another one is mark B and if I say that these blocks we are A and B we are marked these letters are written, both are having same seed of greed, no one would believe. But exactly this is what happened in case of satellite images too. So, what I am going to demonstrate here is slowly, slowly one by one I will hide everything except leave these 2 blocks.

2, you know square if I can call A and B and they see that weather difference in the seats exist or disappear. So let us have a closer view on A and B keep watching and slowly I am hiding the remaining areas except A and B and see now they are see A and B are having the same seat. So, now what is the basically region let us go back and see again observe again whether the difference is created when we start removing these you know, parts from there.

Now again they are have not the reason is because of the surroundings. The neighborhood basically this is what exactly happens in case of satellite images. Here there is no question of say depth but what I am trying to demonstrate when then 2 contrasting things are in adjacent position in neighborhood then the our perception changes and this is what happens in case of satellite images of hilly terrain here like block A or this is square A surrounded by lighter parts.

Therefore, it is appearing as darker and whereas, oppose it too contrary to this the B block or B squared is surrounded by darker and in relative terms it is appearing as it is being perceived as a

relatively brighter as compared to surrounding squares. So, when we start hiding what is happening we are hiding the surroundings and when the surroundings are hidden, then we do not see any difference between them.

So, in absolute terms they are having the same seat, but because of surrounding we are getting the wrong perception. So, this is what also happens in case of satellite images when I say that even a single image hilly terrain can give you depth perception because of the shadow and shadow creates the contrast with the surroundings and a completely different perception.

And this is what is basically and if I draw a connecting bar between these 2, but we see that they are having almost same shade, and because the bar is having the same shade, and both there is when the bar part comes in the B, we do not see any boundary when bar part goes in the A we do not see any bounty again. So, that the, the point which I was trying to mention is A and B are having the same shade of grey.

Howard the surroundings of both A squad and B squad are different and therefore, their appearance is completely different. So, this perception and this is why we gave this name the false topographic perception phenomena, because this is the shadows is creating a completely different perception in our brain and therefore, we are seeing FTPP.

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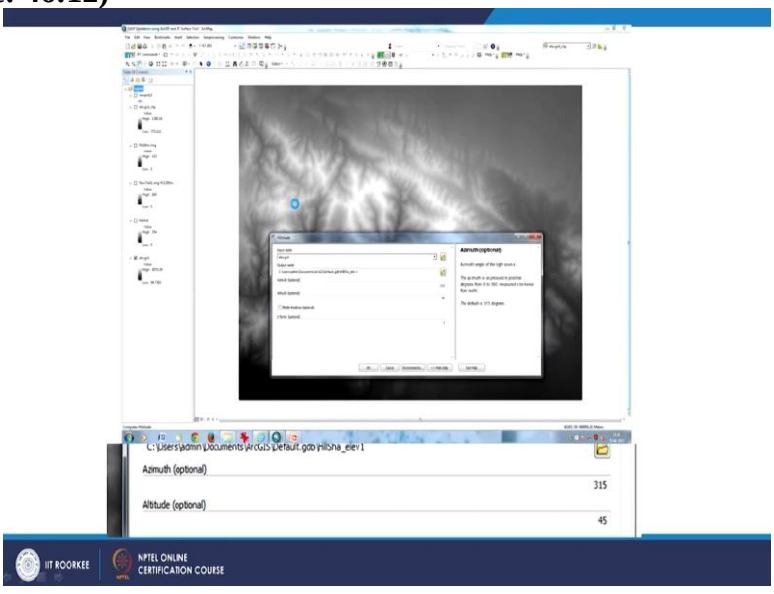

Even if you see the some softwares and in whichever, which allows us to create a suddenly model this is example from ArcGIS whenever you go for creating a hill seed, which is here like a seed and automatically the values which will come about the azimuth is always a azimuth angle and will come always from the, north or from this direction. In the default, the softwares have been set like this, see here 315, 45 not a not near 145 or something.

So, the developers of the software have kept the default Value while creating hill said that the illumination sources come or should be located in the northwest direction without basically accepting or acknowledging the false topographic perception phenomena.

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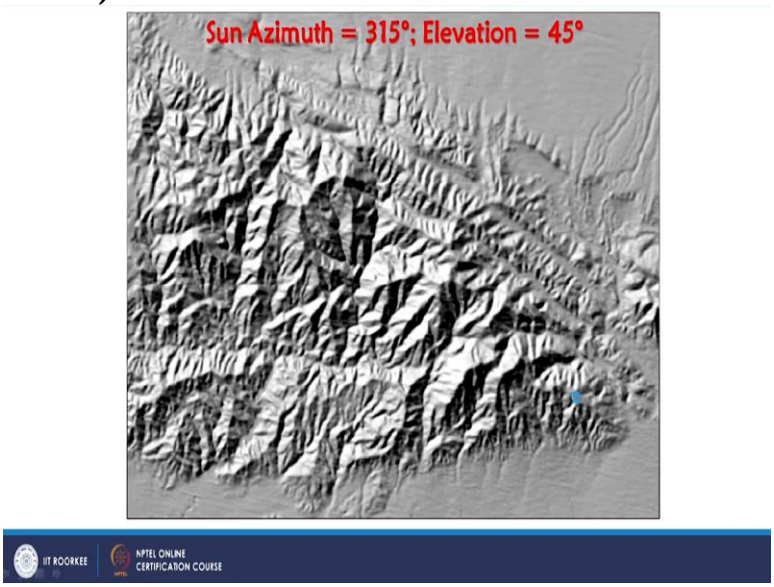

And one example, one more example is here that the sun azimuth when you are having a 315 degree this is what you see the terrain, but when I change that means that illumination sources here that same terrain looks completely opposite and this is the point which I was mentioning that when the observer and the solar illumination source is in the same hemisphere, one is bound to see FTPP like here in this one we are see.

So, this brings to the end of this discussion. For me it has been very interesting and through this work, we have published a series of papers 4 paper so far and about this identifying fall faster. topographic perception phenomena then different correction techniques and also paper on the moon surface observed that FTPP was observed there. So this brings to the end of this part 2 of false topographic perception phenomena. Thank you very much