Remote Sensing Essentials
Prof. Arun K. Saraf
Department of Earth Sciences
Indian Institute of Technology - Roorkee

Module No # 07
Lecture No #35
False Topographic Perception Phenomena and its correction-1

Hello everyone and all are back again with the new topic on this remote sensing essential course and this topic falls topographic perception phenomena and it is correction is in 2 parts and I can promise that it is going to be very entertaining for everyone because this is the phenomena which is observed in satellite images of polar orbiting satellites remote sensing data of hilly terrain. So we start with a very famous foot print by astronauts on the moon surface and when Neil Armstrong put is first foot on the surface of moon.

This is what the photograph which was shared with the word community but it always (()) (01:20) specially that why this foot print is raised. If you see here the foot print is raised whereas we know on the surface of the moon the soil is loose. And if soil is loose then if somebody puts a weight or a his own foot on that then it should create a depression rather than raised ground and that has really (()) (01:47) for very long time that why it has happened.

But if we rotate this image which we are seeing on the photograph by 180 degree this is what we see and then that now the foot impression or the boot impression of Neil Armstrong is coming in correct perception.

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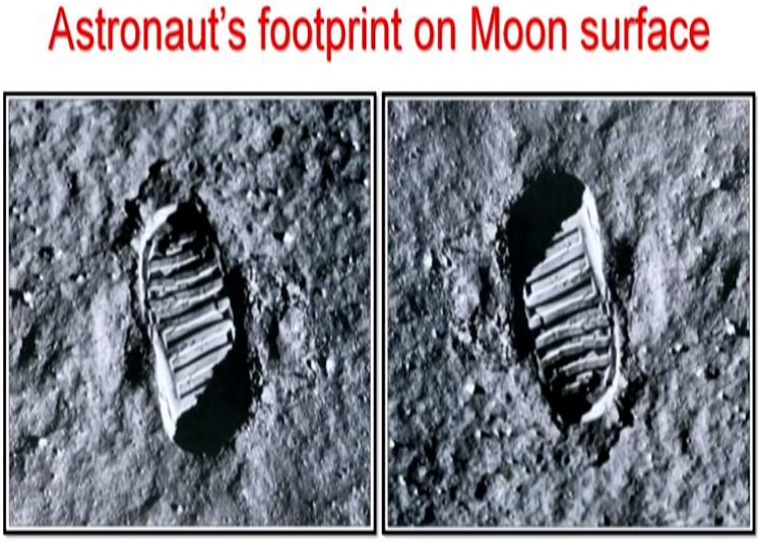

So the first one there is something wrong with the perception whereas the second one gives the depth perception which is the correct perception. So we will be discussion these two consecutive lectures that what is this phenomena and how it can be corrected and whether it is also present in the satellite images and then what are the correction techniques which might be available today.

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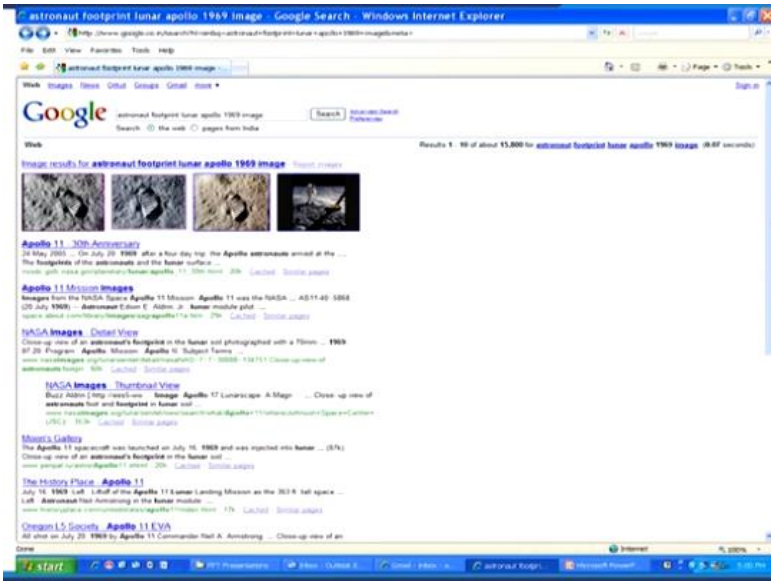

So if we check even today on Google search engine what we find that everywhere the foot print is shown as I have just shown that is a raised ground which should not have happened. But nobody has realized that what they are putting as a photograph is giving a wrong perception.

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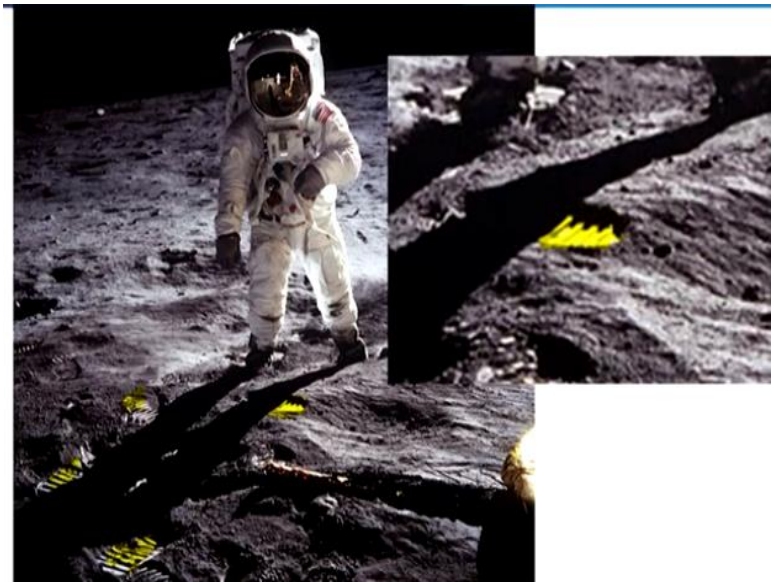

Now if you see this photograph of Neil Armstrong and the foot prints which you are seeing here like this one or this they are all in depression. So what was wrong with the first photograph of foot print that is really matter for concern here is the zoom part of this part and this is what you are seeing that foot print is in depression which is giving a correct perception.

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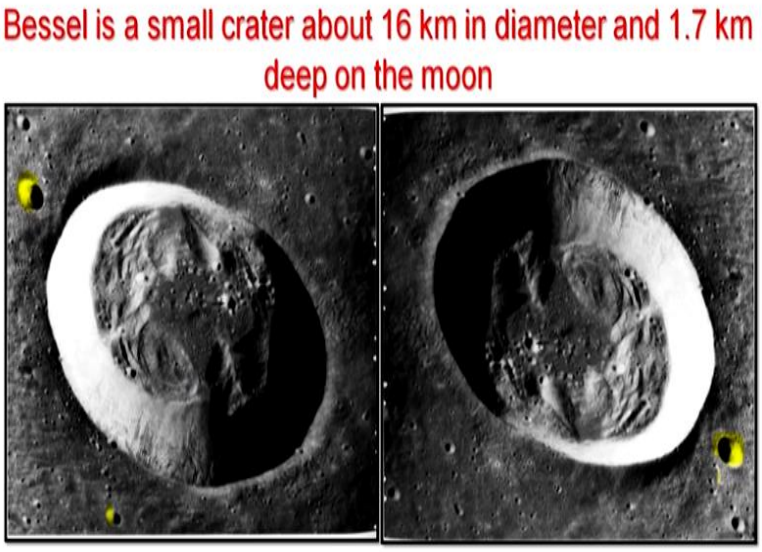

If you open say Google moon like Google earth you are also having on the same installation Google moon and Google mars also. So I would be giving an example of Google mars as well now when we see and elsewhere in the literature or on the internet and this is say crater but now again if it is a crater then why there should be raised ground even if you see the small crater apart from this big one everywhere they are showing as a raised ground.

In fact some (()) (04:14) or heavy body falls on the loose surface of the moon or on fallen on the loose surface of the moon there should have been depression rather than raised ground. So that is again the same problem and now here rotate this image by 180 degree then is upside down and if you see this crater which was raised ground and now this on the bottom right it is giving the correct perception including the bun which is base cell the biggest one is also giving the correct perception.

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So what is why such thing are happening let us see few more examples and then we will start explaining that why it is happening. Now again another example of another crater on the moon surface which is near the north pole recently lot of talk has been about the south pole because our orbiter was focusing and lander and (()) (05:15) also on the south pole but this it the photograph of north pole and what we see again crater though this mansion crater but it is this does not like a look like crater it say raised ground but when we rotate by 180 degree then we see as a depression and it gives a correct depth perception about the moon surface.

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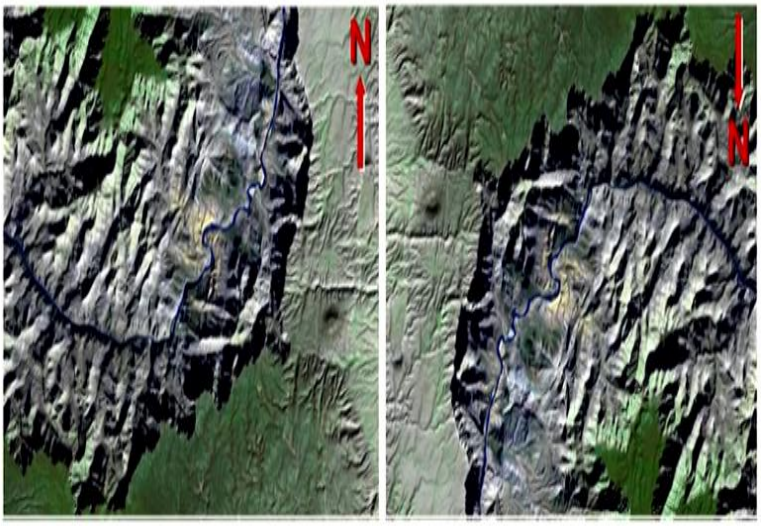

Now let us come back to the earth and this is a ikonos image as a sorry land sat image ETM image of a Colorado river which you are seeing the blue line in the center and north is upward. So when this kind arrangement is there what we are seeing that the river is flowing on the rich seems to and giving complete wrong perception which should not have happened like this but we rotate by 180 degree like now I have done it see the north as gone downward here and upside down and now river 2 as gone into the valley which is a correct perception.

So let us put both together and this is what we observed that on the left image when north upward we are getting wrong perception and when north is downward we are getting the correct perception.

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And this is the location and of the image which I was showing and this is a shaded relief model which has been derive from digital elevation model in few minutes time I will be discussion also little bit about digital elevation model and shaded relief model. So what you are seeing here and that in this one at last they are showing the Colorado river in the depression. But in our image when we see here that it is not in depression so there as to be something wrong with the satellite image.

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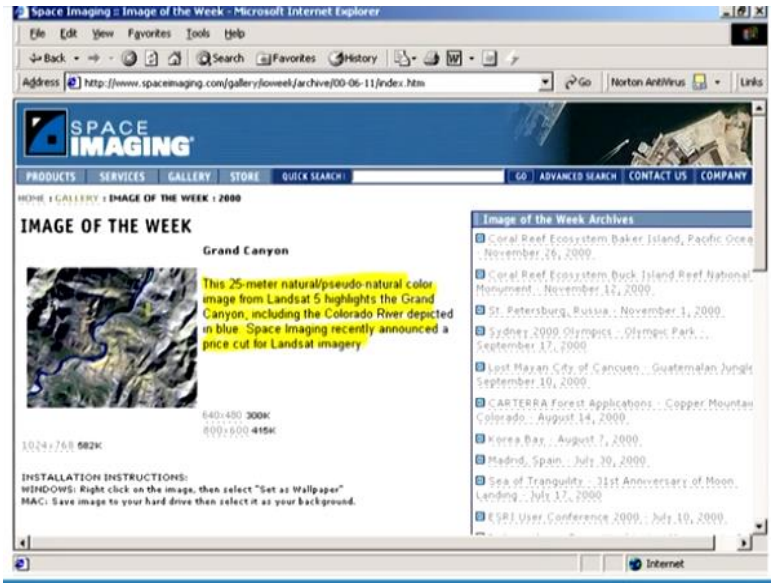

But when you open the image from where I have downloaded if you open the website of that one it say the Grand Canyon it writes a caption here about the you know image but there is mention

that there is no image rotated upside down and therefore though the river is appearing in the valley but there is not mention that this image has been rotated.

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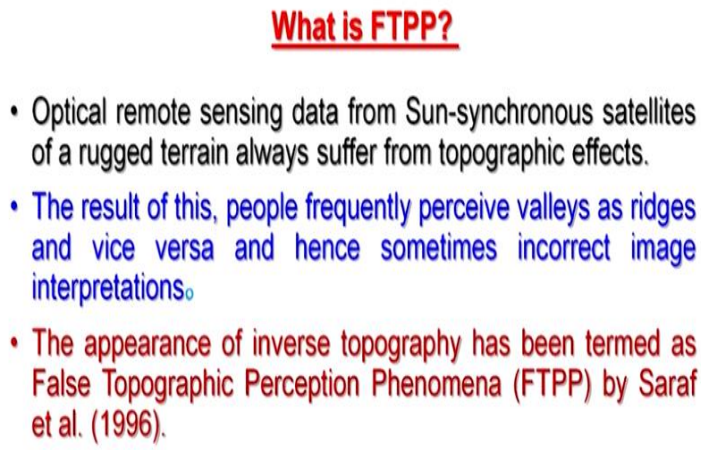

So what is this false topographic perception phenomena by now you must have realized that optical remote sensing data and the images which I have shown of Colorado river and few more we will be seeing from sun synchronous satellites or polar near polar orbiting satellites which are the typical remote sensing satellite when they are acquiring image of a rugged terrain like say Himalaya then this suffer from topographic effects.

So what it means basically if an from the same satellite and even from the same sensor if image is acquired from of a flat terrain like indo Gangetic plan or may be some desert areas their shadows are minimum and then you will not see false topographic perception phenomena's. So this FTPP is only seen in a rugged terrain and that too with sun synchronous satellite. We will be also seeing what are other intimacies associate with FTPP. So because of FTPP what happens as we have also observed in craters in foot prints and also Colorado river that we perceive valleys as races and vice versa.

And therefore sometimes if we use this images we might go for wrong interpretations of these images. So that is the problem associated with FTPP so whoever is using images of rugged terrain from the sun synchronous satellite or polar orbiting satellite must know that these images are suffering from FTPP. And either one technique which has come up already that is by rotating

180 degree you can get rid of FTPP and then you make the interpretation there are few more FTPP corrections techniques which have been developed which I will be discussing very soon.

And when FTPP is present then this inverse the appearance of inverse topographic which are have termed as false topographic perception phenomena in the year 1996 through a publication. So first time this phenomena was accepted in the remote sensing literature though people have been facing this problem. So if you recall that since 1972, 74 onward the remote sensing satellite become available to the civilian community so between 1972 to 1996 in during this entire period remote sensing literature remain silent about FTPP.

Though user of these images of a rugged terrain where facing this inverse topography or false topographic perception phenomena and now what are the causes of FTPP? So we will see one by one what are the causes and first causes is topographic relief if the terrain is flat there are no shadows then FTPP will not be observed. So this FTPP is observed on a in a hilly terrain or in a rugged terrain.

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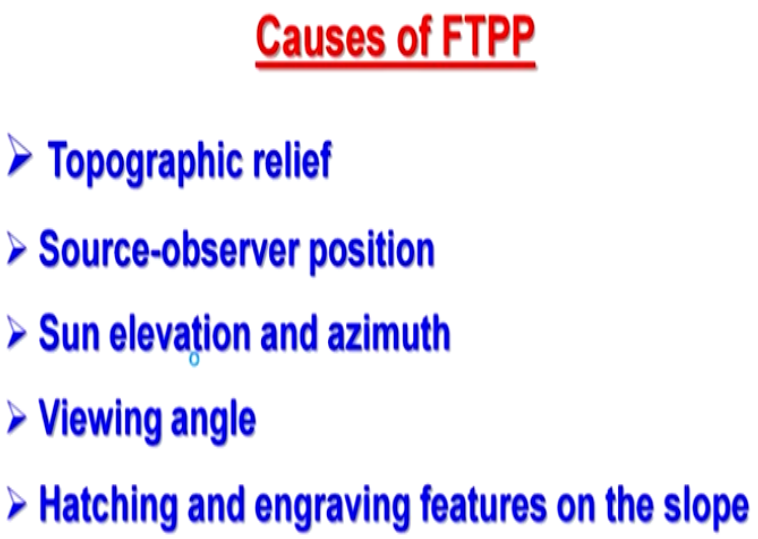

Secondly as source observer position this happens because the source is the illumination source which we are talking here the position of the sun and where the observer is. So what is happening in normal remote sensing images that these satellites acquiring images at it somewhere between 9.30 to 10.30 local time and at that time the sun is that in the south east

quadrate. And observer when keeps the image north upward that means the observer is also in the same hemisphere that is the southern hemisphere.

So when this arrangement is there and that image if belongs to a hilly terrain rugged terrain then AB are bound to see FTPP we will still further in this and sun elevation and azimuth also place very important role as you know that this elevation we talk about the that means it origin that is 0 degree to the overhead that is 90 degree. So elevation sun elevation will between 0 to 90 degree in a vertical plane.

Whereas azimuth is measured in horizontal plane and it varies between 0 to 359 degree that means total 360 degree variation are there. So and fourth one is the viewing angle from where things are being viewed where the basically the position of the observer and the next causes of the FTPP is the hatching and engraving features on the slope. Because in hilly terrains these features are also present and they create a depth perception or false topography perception.

Artist also and you know those who make drawing sense other if they want to give a 3D perception they too uses this techniques hatching techniques to give a depth perception. I will be showing an example of that one also.

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Now we come to the satellite images and these image is from ikonos satellites of 1 meter resolution and this is Tsangpo river and Tsangpo in Tibet Brahmaputra is called in Tsangpo in

Tibet and what you are seeing here in this image that northeast upward and river is flowing on the range. Now geomorphological topographically it is impossible that river flows on the region. River has 2 flow in the valley so why we are perceiving like this so when I was mentioning about the sun position or sun azimuth that means when the these images are required they are acquired generally in the morning hours between 9.30 to 10.30.

And at that time sun is in the southeast quadrate and when this arrangement and we are also observing north keeping north upward. So assuming that we are also situated in the southern hemisphere sun is also in the southern hemisphere. So when this thing this arrangement is there we are bound to see FTPP of on remote sensing images of a hilly terrain like this image which we are seeing.

But if I rotate this image what happens basically that I have forced now sun to go in the northwest quadrate by rotating by 180 degree. And once I have rotated that means now observer that means me is in the southern hemisphere and the illumination source that is the sun is in the northern hemisphere. When the illumination source and observer are in the opposite hemisphere then we will not see FTPP and this is what you are seeing that now this Tsang po river is flowing in the valley which is giving a correct perception topographically geomorphologically it is correct.

But what has happened that north as gone downward so we have to if we want to use these images along with some other data sets then every data sets have to be rotated by 180 degree or we develop some other technique by in which we do not have to rotate but we still can get of FTPP. So those techniques we will be seeing also.

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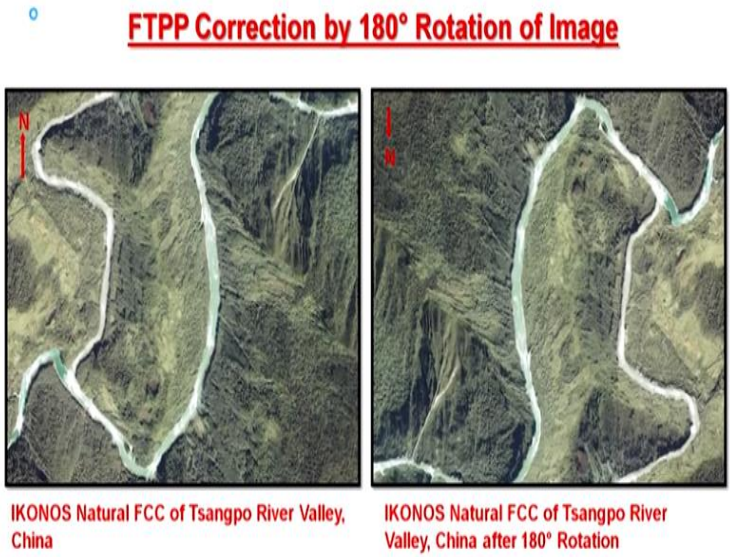

Now I am going to put both these same image one is north upward and another on right side is north downward and the difference you can see and the effect of FTPP you can see. So right side image does not have the effect because the eliminations source and observer is gone into completely different hemisphere. Whereas in the left image the observer and illumination source both are in the same hemisphere and that image belongs to hilly terrain and therefore we are seeing FTPP in the left image.

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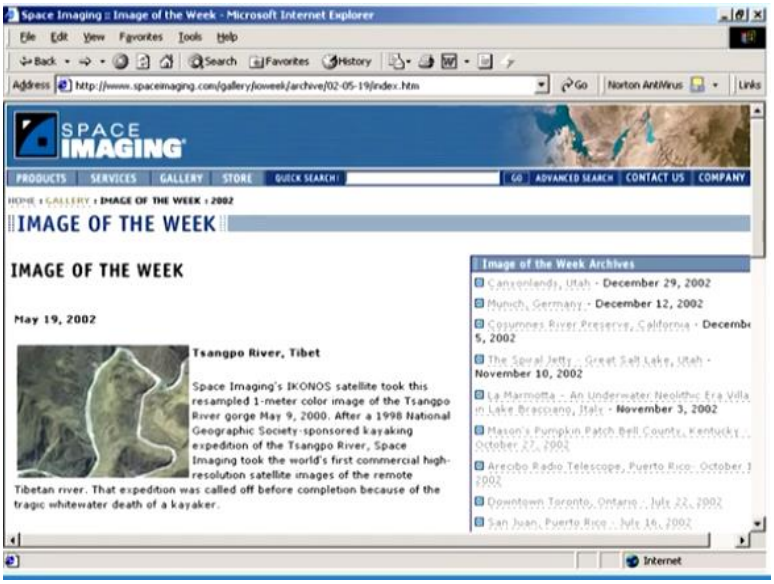

Now when you go and the from where the I have downloaded this image this is the space agency or space imaging company which as launched the satellite ikonos on their website also they have rotated the image without mentioning in the caption. So they too have realized that if they do not

rotate the image and they say that this is the Tsang Po river then users of internet feel that there is something wrong with the image. So without mentioning in the caption though they have rotated the image and realize that they had a FTPP exist but no acknowledgement of that here.

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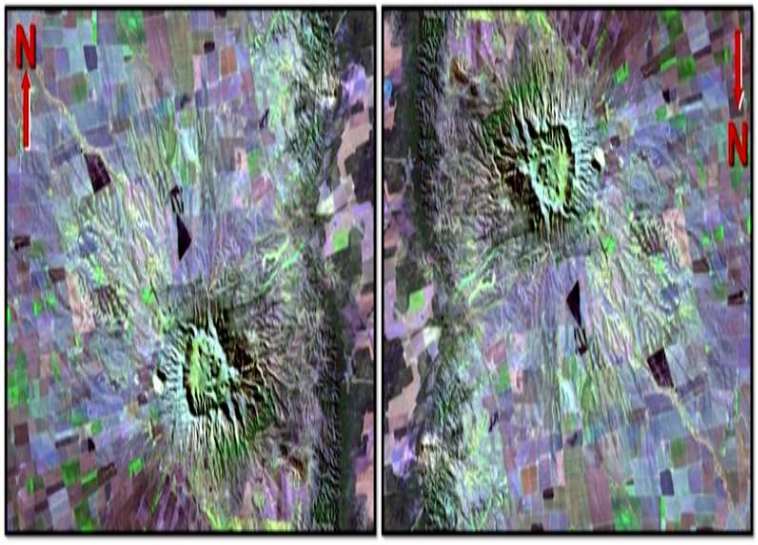

Elastic few more examples that is striking example if I say this is volcano a area which is having volcano no one would believe because here when north is upward volcano is in the depression its cannot happen. The volcano will always have raised ground so if rotate by 180 degree when north has gone downward now I am seeing volcano and an incorrect perception I can see the lava flows also and the volcanic neck also and all the features geomorphic features which are associated with volcano can be observed here.

But in the previous when the image having north upwards these features are difficult to observe and therefore I will make wrong interpretation. But here once I have rotated by 180 degree things have come into correct perception. When I put both together you can realize the differences in between these 2 images on the left side or right side though which is a same image but the right one has been rotated upside down.

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Again on the same side they have they too have rotated without mentioning that why they have rotated. So indirectly they are accepting that this FTPP exist but no acknowledgment of that.

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Let us take one more example like here in this image if I say this is snow covered peak why is snow in depression and not on the region is which is when north is upward. But this is again completely wrong perception but if I rotate by 180 degree now I am seeing a snow peak which is really on the higher ground this is what has a happened in the real situations that is snow will fall or will remain for sometime on only on the higher ground there on the lower ground you can glaciers and higher features which are associated with that and this snow covered peaks are also there are glacier geomorphology is also there.

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Now this is the location of that mount Rainer of which have seen the image when put both together this is what we observe. On the left image we are having FTPP that image is suffering from FTPP when image is rotated by 180 degree north become downward now image there is no FTPP affect.

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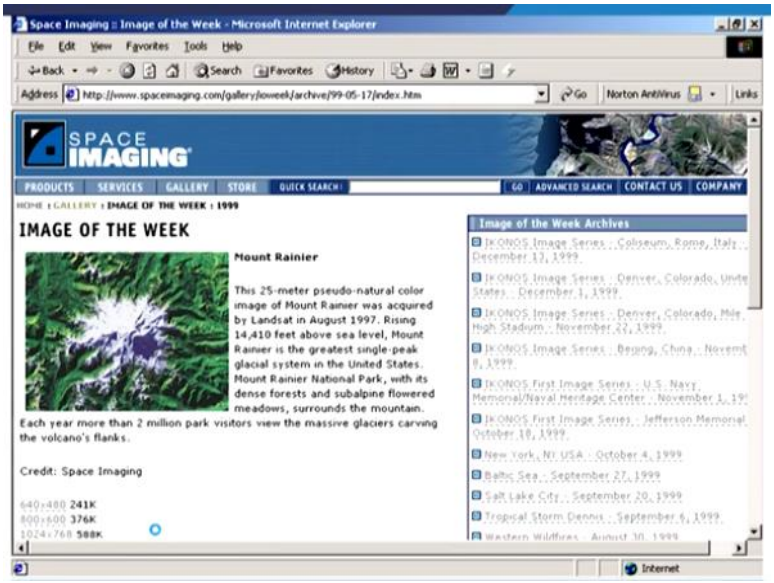

Again the same problem they have rotated the image but they have not mentioned that why they have rotated the image.

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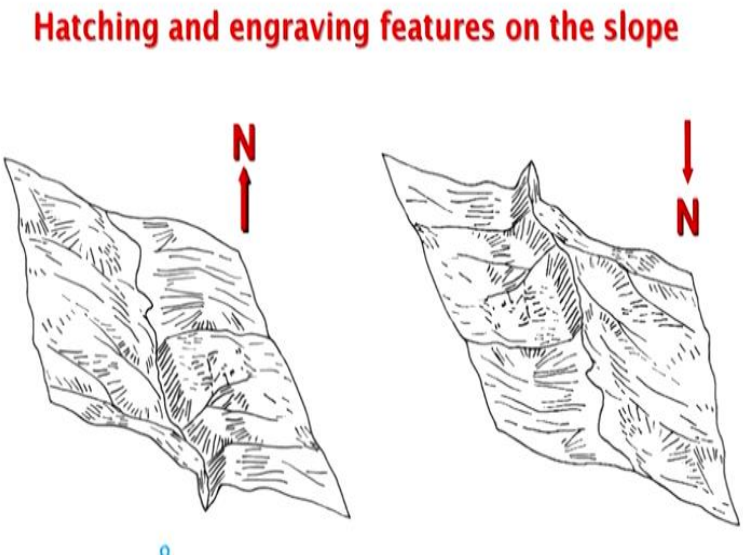

I also gave example of hatching and engraving features which gives us a depth perception this is one example this is not a satellite image just simple drawing and I have taken from the geomorphology book. And what we see here that a valley is shown here and some tributaries are also there and it is also giving a depth perception. But when I rotate this drawing by 180 degree like I have been doing with satellite image this is what has happened.

That now on the right side this sketch is showing FTPP so artist also exploits this kind of thing using hatching and engraving features to give a depth perception. So FTPP exist almost everywhere when these arrangements are there that the viewer and the illumination source if it both are in the same hemisphere we are bound to see FTPP.

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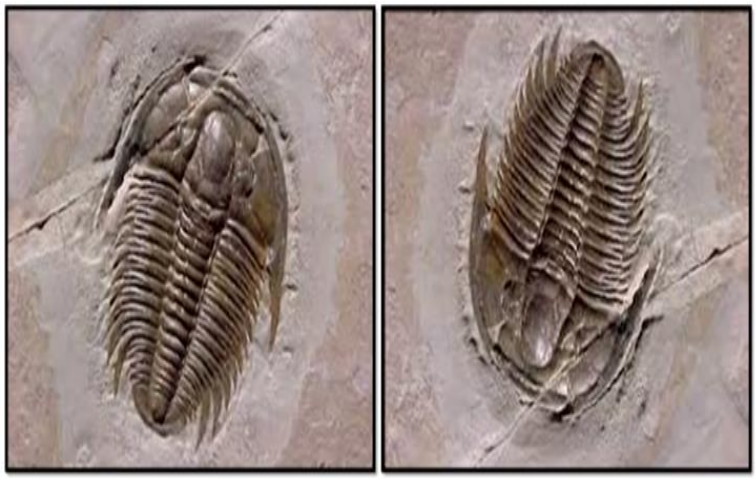

Trilobites, from the Early Cambrian period.

In a (()) (20:43) also and where people study fossils this is what they published generally this is what it is shown to us. But it might not be correct one though it is you are seeing that animal is shown here which is trilobites here is shown but when I rotate this image then I see a complete different picture and this is what happening that this is giving a impression that this is a cast of a animal.

So there is scenario of something like mold and cast and this is what we are seeing so even if I get in the field and the right image if I rotate by 180 degree I get the left image and which gets very good impression about the that fossil or that animal which was there.

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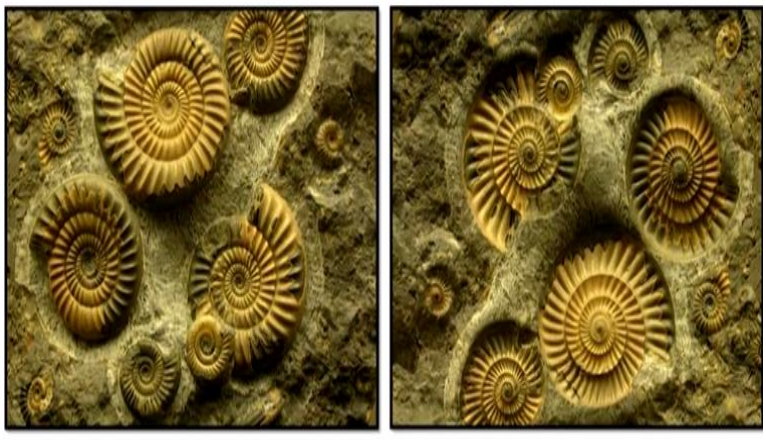

Ammonite fossils of the Creatures date to the Early Jurassic Period (188-184 million years ago).

One more example we will see these are the Ammonites are there again a different type of fossils and of Jurassic early Jurassic period are there and what we are seeing again they are nicely coming up in this photograph. But when I rotate this photograph by 180 degree then it is nothing but the depression so which one is correct only the person who as collected or seen or taken the photograph can tell whether he saw the left scenario or on the right scenario.

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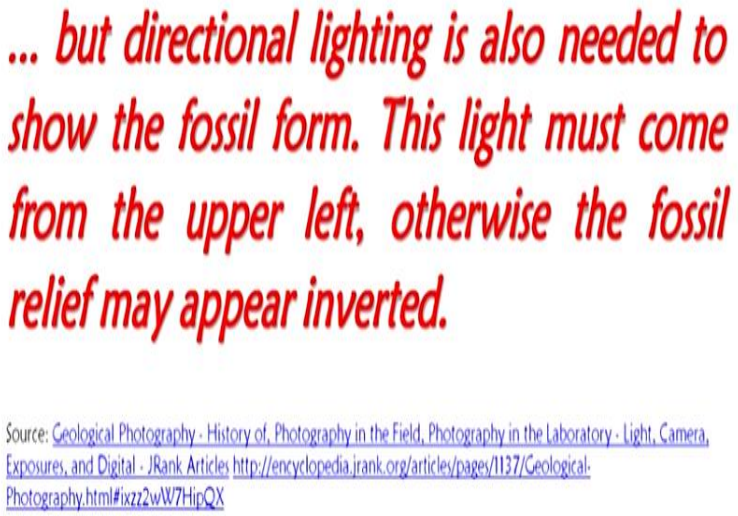

And therefore in the books of an ontology it is mention that you know the direction of light when the photograph is being taken must be kept from the upper left that means from the north west direction. So this is what it writes that directional lighting is also needed to show the fossil form. So 2 examples of trilobites and Ammonites which we have seen that this light must come from the upper left. So there is a direct acknowledgement that when the illumination source is in the opposite hemisphere.

Then we will see a correct perception otherwise the fossil relief may appear and rotate and this is what there is a acknowledgement about this low the exact terminology like false topography perception phenomena has not been used. So even in (()) (23:27) the light source right taking a photographs must be kept in the upper left corner that is in the north west direction. If it is kept in the south east direction then you would see a completely different form of fossil.

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Similar kind of situation can also come in the coins which has lot of raised part and depression like this one example I am showing here and those who would like to test themselves they can download such images of fossils or satellite images of hilly terrain or images of coins and then if they rotate by 180 degree not flip I am saying it is not vertical flip it is not horizontal flip it is rotation by 180 degree.

So if you rotate see the same coin looks completely different say mold and cast kind of scenario because of suffering from FTPP because of the particular direction which has been used while taking this photograph. And one more example see here this is 1 cent of US and this is the situation which we see so this brings to end of part one of false topography perception phenomena in the next part what we are going to do discuss here so far what we are seen is about the phenomena that why it is occurring and which situations it is occurring.

It is occurring in satellite images I have shown several examples of satellite images it is occurring in incase of drawing it is occurring FTPP seen with the fossils also FTPP is also seen with the coins. One correction technique has already been discussed that is the rotation by 180 degree but when we use satellite images along with other data sets in GIS then these things that means the rotation of 180 degree might not be possible and therefore it is very much required to develop some or discuss some other technique which we have developed in recent past.

So that without rotating the image I should or we should be able to rid of FTPP so this is what we are going to discuss in part 2 for time being thank you very much.