Laboratory Practices in Earth Sciences: Landscape Mapping

Dr. Javed N Malik
Department of Earth Sciences
Indian Institute of Technology, Kanpur

Week- 01
Lecture- 04

Welcome back. So, today in this lecture we are going to talk about different types of aerial photographs. As soon as the word comes to our mind that is aerial, then basically it is communicating that we are taking the photographs at low flying height by using aircrafts or helicopters and even UAVs. So, even satellites are being used to take the high resolution aerial photographs. But mostly it has been seen that the aerial photographs are mainly the outcome of the low flying aircrafts and the photograph taken at low height to get the high resolution of the landforms information. So, why use aerial photos? There are few points , one is that it gives an opportunity to have a very improved vantage point, that is your viewpoint will be very clear and you can decide on your own where to fly and when to fly.

And mostly it has been seen that when there is clear atmosphere while low flying also it should not be hazy and early morning is good or at least and not during the noon time because we have very bright sunlight and that is also a disadvantage for this. But the advantage is mostly that if you fly in the morning you get very and during the evening hours you get a very good contrast of the landforms. It helps in defining situations at a point in time. So, that again you try to figure out what time you want to fly.

It will give you a permanent record because you can keep developing this or maybe if you are taking this on the digital platform then this can be in permanent record. So, there is no harm in losing this digital data. Can record information beyond the visible spectrum that we learned in the previous lecture. Increased spatial resolution as well as geometric fidelity. Why use aerial photographs instead of satellite images? Images as we discussed are taken by the multi spectral scanner MSS that is mostly Landsat. It has low resolution and it has different bands.

But this is basically you will get in and the resolution is less, but this gives in very high resolution. So, while taking the aerial photographs it has an ability to choose your own dates when to fly typically because if you are having the satellite images or the satellite data you may come across because during the clouds and you that will block the information which you want to collect in area of interest actually. So, it is relatively inexpensive. However, we usually say that if you hire an aircraft and you fly then it is going to be expensive, but as if you compare with the satellite launch and its production and all that. So, in that sense it is less expensive and you can fly as per your wish and as per your desire when the best season or maybe the clean atmosphere is available.

It is again definitely in higher resolution than the satellite images. So, these are the

advantages of using the aerial photographs and collecting the data for the landform mapping. Now, orientation of the photo types of aerial photography you may come across is not only just the most like vertical photographs that are ortho photographs, but you can get the data which is taken at an angle. So, mostly we try to look at the data and desire to have the data which are taken vertically with respect to your flying object and the camera. It comes as an oblique also.

So, you have oblique photographs also. High and low oblique again you can have and that again depends upon the. So, in my coming slides I will explain this. So, suppose you are having a flying object here and then the camera is fitted here. So, if it is vertical to the ground, then we say that these are all vertical photographs and vertical photographs are also termed as orthophotos.

So, this is one and then if you are flying the object is slightly tilted. So, then that means, the camera axis is also tilted with respect to the ground. So, that is what we call it. So, this is vertical and this one is your oblique. So, again it depends on the angle and all that and that at what angle up to what angle it is permissible to call this as a vertical.

It is mostly less than 3 degrees. So, I will come to this one later also. Then spectral characters of the film we have discussed very briefly in the previous lecture about the panchromatic data. So, you can do that and that is your black and white usually we call, but it is not truly black and white. It is sensitive to all complete visible spectrum.

So, that helps us in having different shades of gray actually and that is one thing. And you can have the infrared black and white photographs, ultraviolet, color and all that. So, these are the type of aerial photographs which one can use as per their requirement then color IR is also there. So, if you look at the classification of the photographs, then the following classification of the photographs are possible. So, this is one on the basis of the alignment of the optic axis, that is your camera axis, that is the optic axis.

Now, vertical photographs if the optic axis of the camera is held in a vertical or nearly vertical position and that is what we call the mainly the ortho photographs. And tilted one an unintentional or unavoidable inclination because mostly as I mentioned that we desire to have the vertical photographs and there are reasons for that because if you are having vertical photographs and nearly vertical, then that helps you in generating the digital elevation model up to a great precision. So, that is one reason. And of course, another reason is that whatever the landform or the object which you are trying to map or see from using the vertical photographs, they give you a true depth or the true topography or true elevation or height of that area. So, tilted is again an unintentional or unavoidable inclination of the optical axis from vertically producing a tilted photograph.

Oblique photographs taken with an optical axis intentionally inclined. So, this is intentionally done. So, this is this band and this covers a larger area than optical oblique photographs

following a different type of oblique photographs. So, these are like you are having a high oblique high angle oblique you can say or oblique which contains the apparent horizon. Horizon is basically the sky part you will be able to see in this.

So, if you are taking photos that I have taken, I will show them. So, that is high angle oblique and low angle oblique also. So, the low angle oblique is not apparent. So, you just take the ground, you are not taking the horizon, that is the horizon is your sky part. So, that is a low oblique because if you tilt your camera and take mostly people do when they are sitting in the aircraft and from the aircraft window you try to take the photographs that is basically and oblique photographs by your DSLR cameras or even people are taking with the I am their smartphone, but smartphone is not very high resolution camera is been used, but mainly you will in a sense you will collect the oblique photographs or you are going to you click the oblique photographs.

Now, another one is a trimetrogon combination of vertical and two oblique photographs in which the central photo is vertical and the side ones are oblique. So, I would say that this is very much similar actually not exactly, but very much similar to what we take a shot of in panorama. So, what you have in the panorama is that if you are viewing from here and then you are having the you are taking this terrain. So, it will be something like this. So, this portion coincides with the optic axis.

So, if you are having the optic camera lens here then this is almost vertical, but this one is oblique. So, this is what you will see that the two sides are oblique at a certain angle and the center one will be almost vertical. So, this is just showing the plan view of that. So, if you have those things then you have this trimetrogon photograph type of photographs. Then convergent one, convergent one is a pair of low oblique take obliques taken in sequence along a flight line in such a manner that both the photographs cover essentially the same area with their axis tilted at a fixed inclination from the vertical in opposite direction.

So, you are clicking the same area, but the inclination from the vertical is in the opposite direction. So, this is the end in the direction of the flight line. So, the forward exposure of the first station forms a stereo stereo pair for the backward. Now, these are the ways I will come to this also when we are talking about the stereoscopy and all that and how this camera is being used. So, for example, if you are trying to, you are having an aircraft here and you are trying to take a photograph of, for example, this area over here for example, you have this area here.

So, the first photograph is taken here by the forward camera and then there is another photograph taken from here if the flight moves further this side. Then you take the same photograph here. So, this is forward and after cameras are there. So, two different cameras will take and that will give you sort of what we call the stereo vision of that and that we will talk about when we are talking about the stereoscopy part. So, these are the examples which have been shown here: if you are having the vertical photograph and your flight is almost

vertical and the sensor or you can say the camera which you are using is having its optical axis almost vertical to the ground surface.

So, and then you are having an inclined axis where you are taking. So, this is a low angle where this high angle is. So, angle is changing here and as I said above, a high angle oblique will cover a larger area and it will also expose or cover your horizon. And you have multiple cameras you can take an overlap of photographs. So, that can generate the overlapping and this can also be helpful in having your stereo photographs and the panorama.

But in panorama as I was talking about in the one of the trigonometric photographs that will give you a distortion at the edges. This could be vertical, but this will give some distortion to the photographs which are taken in this direction. So, there are the classification and the comparison of the photographs. If you see in this table there is one type of photograph then you have the vertical low angle and high angle. So, if you read out here horizontally. So, the characteristic vertical is like 3 degrees less than 3 degrees. If you have the angle then you classify that as in that is a characteristic you can classify as a vertical photograph.

Horizon does not appear where the high angle horizon appears and the coverage is least here. And as I said that in high angle you will have the greatest. You can cover the large area because if you are for example, if you are having you are covering this portion here with a vertical maxis. So, you will be able to cover very less area, but when you are viewing the angle here then you will be able to cover a large area actually. So, that is one of the reasons that you will be able to cover the higher, larger area or the greater coverage will be there.

And then the area in sense of the recording which will be done or the data which will be acquired will be rectangular, this will be trapezoidal and this also will be trapezoidal and so on. So, difference with the map if you are having in terms of the scale and the shape of the object of course, there will be some sort of distortion, but when you are taking the stereo photographs that can be sorted out. So, even if you look at the vertical one the difference with the map is the actual map distance and the and your photograph will be least here. And this will be little bit more than the least, but this one has the greater because you are taking oblique photographs. So, the advantages are easiest to map here and then this one is also more or less similar, but this one here is economical and illustrative.

So, it is much cheaper than this one because you are covering a larger area. So, this is a comparison of that one. So, scale wise, as I said, is also uniform if flat terrain is there, otherwise you have some sort of an undulation that decreases from the foreground to background decreases from the foreground . These remain the same. Now, let us see more details about these photographs. The vertical photographs are mainly what we see.

So, if you are having vertical aerial photographs over a level terrain then you will have this as your optic axis and more details will come across. This is an angle at an angle you are flying. So, this is what like having low angle made photographs again you are not exposing the

horizon here. So, the horizon is not shown in the photograph you do not see. So, if this is terminology I will come.

What is the optic axis, the exposure station or center then what is your principal point and all that we will learn because this you are going to use for your labs actually. So, high resolution as I said that it will expose the or photograph the horizon also and and of or mainly over the flat terrain. And this is what we say this one this line is the plum line actually. So, this is again we can say the camera axis.

So, this is your camera. So, the camera axis a line passing through the center of the camera lens and is perpendicular to the negative. So, negative will be somewhere within this one here and then positive you develop that will give, but the positive plane that marks almost perpendicularly is your camera axis. And if it is vertical in a sense of, if the vertical axis then that line is also termed as your plum line. So, this is your plum line or vertical axis. So, these are a few terminologies which have been shown here.

So, if you are having for example, you are taking a photograph this is a negative here. So, this you are having the negative here and this part I will also explain when I am talking about the stereoscopy and all that again. So, this is your negative here and we are trying to view points A, B, C and D here. So, how it appears on the positive positive exactly will give you the same replica. So, you have this is marked by this the 4 corners have been marked on the positive plane. This is what we are talking about the negative and positive.

So, earlier we were like a few decades back we used to use the analog cameras, where you are having the negatives and then we go to the lab and get it printed as in positives. But also in our childhood days we used to have some negatives which we used to see . It is inverted when you project it on on the wall or anywhere with the light putting the torch and all that you will see the positive there on that. So, this is exactly the same. So, this is you are having the B here this is C and this one is D. Whereas, when you see this in negative this is all like in in different and so, the B is going here where you used to have D and this will be your A dash and this is denoted by C dash and D dash.

So, this O is your exposure like center, this O is the exposure center and that is over here also this is what has been in the positive and then the vertical line which coincides to the ground is termed as the Nadir point or principal point of that photograph. So, ultimately what we are going to use is this one here. We are interested in this one thing. So, this we are going to use. So, we have so, even if you have the photographs and all that that you can you can identify the principal point or the center of the photograph considering that we if the aircraft view almost vertically.

And that is what has been termed as your optical axis. And the height from the so, this is your exposure center. So, this is your length of or you can say the focal length of your lengths. So, that will be your F and the height from the exposure center to the datum. So, datum will

be your datum actually.

So, this will be with respect to the mean sea level. So, if you have datum and this is topography. So, this is the ground that you are mapping actually. So, this if you in later on we will come, but this will what if you take this one this will be denoted at small h actually. So, the height of the aircraft usually takes into consideration the focal length also.

But if you take this one here, this will be the height of from the mean sea level that is from the datum to the exposure center. So, we will see how we are going to identify the flight direction. Suppose you are just getting photographs and you are asked to identify the line of flight or the flight direction in which the aircraft flew that also one can identify. So, these are a few points, but let us move further and then see that these are some photographs which we collected. This is from satellite corona satellite data and again the information which we got is from this is freely available now, but not not you can freely available in the sense, but you need to pay for that.

But earlier this was then classified data and collected by the US spy satellite, but now you can have this data ordered by the US geological survey and you can buy this. So, this is of Kutch area and where you see the hills here and then hills here and then some drainage over here and location which is known as Lodi. I have kept this photograph upside down because I just wanted to show you the photographs which we took using the DSLR camera. I think SLR cameras at that point of time because of this photograph we took at the time of the 2001 Bhuj earthquake. So, this is what we are having again as we discussed that. So, immediately you can identify what type of photograph is this actually of course, this is an oblique, but this one is yours.

So, this one is your low oblique reason because no horizon is seen here. So, this is a low oblique photograph and if you. So, if you compare this one here. So, I will just show you where exactly we are looking at.

So, this portion is this one here. So, again you can say that why there is no pond here, but this is this was the barrage which was or the small earthen dam which was been constructed on this river. So, you can see the river which is coming here and these are the two ridge lines actually you can see here this one and another one is here. These are the two ridge lines which you can prominently mark. So, this was generated for the photograph which was a low angle photography. Again, another photograph which we took again that shows the oblique photograph, but this time what you see here is this is your what we can say high oblique because the horizon is exposed.

So, this is one way of classification of the different types of photographs. This is another photograph which slightly shows the horizon. So, you can classify in the high angle photography high angle oblique photographs. So, low sun if you see there is no horizon here and you can see the landform which had been marked here showing the displacement on the

surface.

So, this is again a low sun angle aerial oblique photograph. So, this is another one which is again we can classify as in low oblique photograph over here and this again we took using the aircraft and flying at very low height and we have stitched these photographs and then that gives you a sort of a mosaic. So, the first photograph is this one here, second is this and third one is this. So, anyway we will stop here and continue in the next lecture discussing more about aerial photographs and stereoscopy. Thank you so much.