Geographic Information Systems
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Lecture-47
Demonstration through GIS software

Hello everyone! and welcome to this demonstration in which we are going to discuss how to prepare slope and aspect maps. If you recall our discussion which in the three previous lectures, we have discussed in detail about different methods of slope and aspect and all intricacies spatially about the z factor and other things. So, all these we will see when we do or we see the demonstration on a computer through GIS software.

Another important thing is that here I am going to take deliberately a digital elevation model which belongs to a part of Himalaya which is a highly rugged Terrain so that we can really see the conditions about slope and aspect and other associated intricacies spatially about z factor. So let us start with demonstration.

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So here, what I am going to do? Let me first add a digital elevation model and I am going to add a digital elevation model which is ASTER GDEM of 30-meter spatial resolution as also mention part of Himalaya so that we can see this thing. This is what the digital elevation model which I am going to add in our demonstration. This one-degree tile, I have downloaded from earth Explorer or similar, there are various search site from where you can download for you area of interest.

Now what we are going to do? First, we will perform the slope calculations or prepare a slope map using this digital elevation model. So, as you know that there are two ways to do it. Either this one which I prefer always so go for this search and through that, I can find very easily the tool which I am looking. Here so the toolbox is already there but instead of Toolbox, we can use search method which I find very easy.

We do not have to remember where exactly that tool is residing in the toolbox. If I just typed slope then I get at different places, how to create slope? I will use the slope which is a part of spatial analyst extension. So, this tool I find is most appropriate. The same way I can also do it on this tool bar but that is a different story. And now what I will do? We will add this digital elevation model which is being displayed here as our input raster.

And then we will choose one out of two methods; either that is a planner or geodesic. Of course, you have to provide where it would reside the results. So, if I accept this one as whatever is the default folder and output is going to be in degrees and this method planner, so first we will do with the planning method. And by mistake if you do not change these values about z factor then you may get some results.

So deliberately what I am going to do? Because it is not performed the calculation so what I am going to do? I will just use the default value, deliberately. We will prepare slope map which in degree. Method is a planner and z factor are one. And let us see what kind of output, it creates. Meantime what I can do? I can start feeding for the next one also. So let it do keep processing. I will use this one again and will keep as a separate here.

So here what I will do? I will rename the file because this time I am going to provide the z factor for this part of the world so that is 0.0000089. Just for simplicity, I am keeping their 89 and z factor, of course I will type as this value 0.0000089. This of course, we have calculated the location and z factor as you know, we are converting basically our height; that is the Z value into meters means height are in meters so we are converting meters into degree decimal as our xy coordinate.

So that is why, this z factor is being used. And then what we are going to have? The first map which we have just created which is also being displayed. I will show you soon. Now it is here and that one is when z factor is 1. Now here, everything remains same except the z factor is 1 which should have been. So let me now process this one also. So, we will have that means 2 Slope maps, top of each other with one the slope_tif1 is for z factor 1 and slope_tif89 would be for the z factor 0.0000089. Now these 2 maps have been generated here.

Now let us investigate here or explore what are the changes, it has brought while using 2 different z factors. So, what I will do? This is a Teri Reservoir area. So, what I will do? I will take this identify tool and let us see with very high slope values, what happens in these 1, so what we will choose to you know all visible layers and one once I press again. As you can see that tif1; that is the z factor 1 slope map for that particular cell giving value 39.54 degree. And whereas this with z factor 0.0000089, it is giving value 39.20.

That means, for this particular location for this particular cell if I keep z factor 1, then it is overestimating our slope. Let us try with some low values like this mid green area like this. So here with z factor of 0.0000089, the slope value is 19.927378 whereas z factor equal to 1, it is 20. Again here, when we keep z factor 1 which is not correct in this case because latitude and longitudes are in degree decimal and whereas the third axis; that is z axis or vertical resolution here is in meters.

So, these 2 values are different whereas in theory, we have discussed that z factor will allow us to convert one to another. So, what we are doing? We are converting this height value, that is in meters to DD by bringing this z factor. So, in that way, again let us see some other part. If I do it within the reservoir, let us see what happens? What values we get? Of course, it should come 0 because water bodies are flat from top and that is why in both these, it is coming 0.

There are other green areas also. So, if I go in that area and do it. Let us see what happens to these very dark green areas like here? Still, they are not like water body. Still, they have very gentle slopes. So, when z factor is 1, it is coming 3.949 and when Z factor is 0.0000089 then it is 3.90. So again, what we are observing that if our x,y,z units are same and we keep z factor 1 then it is going to overestimate our slope values.

So, it is always good, always desirable that we must take care about this x, y and z scale, that this should be equal. If they are not equal then we should use the z factor and convert. It is rather easy to convert our meters into DD which have done in this demonstration. If you recall that what we have used? We have used the same planner method. Except for z factor, rest of the

things remain same. Now, I am going to generate another 2 Maps one with planer and with z factor 1 and with geodesic and z factor 0.0000089. So let us do it.

I will keep here, will give some name. So, for geodesic, I give the name geo and 1 which indicates that z factor, I am going to keep 1. And here geodesic and once I choose your geodesic, you do not have to bother about z factors. Now it is asking the z units are in meter. So, if they are not in meters then we have to be very-2 careful about this. So, by doing this exercise, you have to be little careful about the units again.

For time being because I said, I will keep z factor 1 and see what happens to our output. Then we will try to compare this one, with the one for which we use the planner method with same Z factor. We will rather compare all three to see you what are the changes and then find the differences also. Generally, if you see visually, you may not find much differences but if we do it with zoom part for individual cell then we start getting these things.

So again, we will remain in this area. I am going to choose again and all three you know surfaces or all three slopes' maps created with three different methods are here. This the top one is showing which is geodesic method and z factor is 1 where this value is 53.137. And whereas when we keep the correct Z factor; that is 0.0000089, it is giving 52.98 and while z factor 1 planner method, we are getting 53.32. So, for this particular cell, this geodesic method because both are having z factor 1.

So, both are giving quite close results, whether it is geodesic method or planner method. Now let me choose another area which is not very high sloped area. Here now, you would see large difference that this geodesic method with z factor 1 is 4.46 whereas the correct z factor giving you 4.2 and whereas this z factor 1, planner method is giving 4.26. So that means that geodesic z factor 1 is really overestimating the slopes.

So, whenever you perform any such analysis, whether you are using slope tool or any other tool, the best way if you are having some ground information or prior information about certain locations of the slope conditions, you can always check, verify or we also say in the Remote

Sensing domain as ground truthing. So, you can do the ground truthing if the data available to you. If it is not then later on also, on the field can be verified; whether it is calculating true or not.

One way as I have told you if you know any high ending slopes, already you can test or like I know here this is the flat Terrain means it's a water body. And my 2 slope maps with planner methods having different z factors are giving value 0 whereas with geodesic and z factor 1 is giving 0.00983. So, that means this one is not giving for this particular cell. It is not giving accurate value. Now let me try in some other parts which is not the part of reservoir but part of the river.

Again, in our two planner methods with 2 different z factors, their values are 0. But here with geodesic z factor 1, we are getting some value. So that means that geodesic the z factor 1 is really giving us very relatively wrong values because instead of keeping z factor 1, if we choose the correct units that means if we make x, y and z units equal then hopefully we should be getting more accurate results.

So, it is always true as I have also told several times that in GIS after each and every step, one should check for errors. And only if you are satisfied with the results, then you should go ahead. Otherwise, you recheck, is there something wrong? Whether it is with the scales, units, z factor and so on. So, with this way, you will be able to produce most reliable result and one should know all the details that what it has followed while this calculating such surfaces like slope map in this example

Now, what I am going to do? Next is I will go for the aspect. So again, we take the same digital elevation model which is the ASTER GDEM 30- meter and will try to calculate instead of slope, here we will calculate aspect. And let us see what happens with what are the options available and so on. Again, I will choose aspect spatial analyst extension tool.

And same way, you have to provide the file. So, this is my input digital elevation model and here what I will do? I will use word for planner, I will say 1P. Or 1 can remove here, just say _P and

here, no other options are available. So, you need not to bother in this time and the let us go and do it. Output is going to be a floating point, not integer. So, we will see that how 2 different methods; whether they bring the different results or not.

So, it has created a aspect map with the planner method. I will do it with another method and then we will compare and see that what these two are bringing differences. What are the differences in values which we can inspect by using this I tool. Okay! so this one. And what I will do? I will go for geodesic so I will use g word for geodesic and instead of planner, we will choose geodesic method. One other thing, we will be doing with slope map that we will try to create a differences map.

And will see that where the more differences are there and where the less differences in slope maps are there and that way you can create a separate layer which would be the difference of two method so that will give you the exact this thing. Now here, it has now created 2 aspect maps which you can see very clearly, that the top one which we are seeing currently is based on geodesic method and this one is on the planer method.

Now if I zoom it in certain part. Again, I will try to zoom the same part as that part of our Teri reservoir and do it with this identify tool. So, if I click on a red area, both are giving the values, though geodesic method is again giving 5.460, whereas this planner method is giving 5.389 but these are the direction. So, they are all falling in this range, that is the north facing slope.

And if I go for this one; the pink colour one like here then the values are very high. Again, here in this particular case, geodesic gives less value as compared to the planner. Whether it is true in all other cases that we can also check it. Yes! So, the planner is giving more value than geodesic. So likewise, you can inspect if you are having ground information. You can verify otherwise if it is possible, it can be checked in the field and then you can accept the product. Plus, also this part we have also discussed that when values are less than 1 or -1 value is assigned, As you can see here that for the reservoir part

Any method weathers its geodesic or planner method; both are giving minus value. So that means that this is the flat part because water body, the top of that is the flat part. And this continues to quite a large extent but later on, things may not be that visible because the river thickness reduces but the dam is here. So, these two rivers; one is coming, the Bhagirathi and this one is the Belangana, they are coming and then there is a downstream.

So, if you click any part of this reservoir body, you would get -1 value, that indicates the flat because top of water surface is flat. Now I am going to create a difference map between 2 sloping surfaces. So here we can use of raster calculator; raster calculator we will choose from spatial analyst extension. Here since we are having 3 slope maps. So, what I am going to do? I will use this one; the one which was giving z factor 1 and planner one. So, I will use that one because that was giving higher values and then the geodesic one.

So, I will use the planner one which is this one, with z factor 1 and say this minus then slope map with z factor 0.0000089. And let it save in our default database and go for results. Still calculating but soon it will end. So, now this is the difference map. So, we will inspect this difference map along with two inputs which we have used to create this difference map. So, if I zoom on white parts then I should be getting a high difference.

And what we did? We subtracted this one file slope_tif1 file – slope_ tif89. 89 stands with correct z factor, instead of 1 z factor. So, the difference of course in the positive and this is what you are getting. Another important thing which you can notice here that there are no values which are less than 0 or less than 1 or anything. That means that if I choose z factor 1 which is incorrect, I am going to overestimate slope values.

If I choose z factor 0.0000089, whether it is a planner method or any other method then I get more accurate values. So, it basically convinces us that care will be taken about the z factor that is that x,y scale should be equal z scale and this can be managed with the z factor. So, we tried on a very white area. Let us try on some dark areas where values might be very low. Here values are very low, input values are also given and then you see that no negative values are there. Of course, if I go for water body part, all three since inputs at zero so the difference will be also

zero. So basically, one has to evolve his own method of checking things, apart from what we can discuss here or discuss in the literature. One has to depending on what tool he or she is using and should device own methods to check for errors.

So, this difference method is another very good method, plus looking the minimum value and maximum value will give you an idea that what is really happening with your dataset. And sometimes you can create some nice products. Nice means here, more accurate products then it is may not be possible. Image differencing techniques or ratio techniques are very popular in digital image processing of satellite data but similar concept because this is also raster so similar concept can also be employed.

Instead of creating a new product, we are creating a product to check for the differences between two methods and by which you can very judiciously evaluate that which method is more appropriate for that particular site or that of area of interest. So, tools are available. We have to evolve our own way, take care about the scales, unit, z factor and hope you would get very good results.

Very good means here reliable results which you can present with high level of confidence. So, with this, I end this demonstration. Thank you very much.

(Video Start Time: 29:42)