Geographic Information Systems
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Module No. #04
Lecture No. #20
Map Projections

Hello, Namaste to everyone I am back here with the last lecture of this particular module where I would be speaking on map projections. So, I have already covered what you mean by coordinate system, what is a map numbering system, what do you mean by datum geoids etc. Now we will look at the last part with a very important part which has projection. So projection is projecting coordinate system when we are trying to project our 3D surface into a 2D space wherein order 2D map whether can be printed.

And that can give you more information, or for people who want to look at it, so that is where we use projections.

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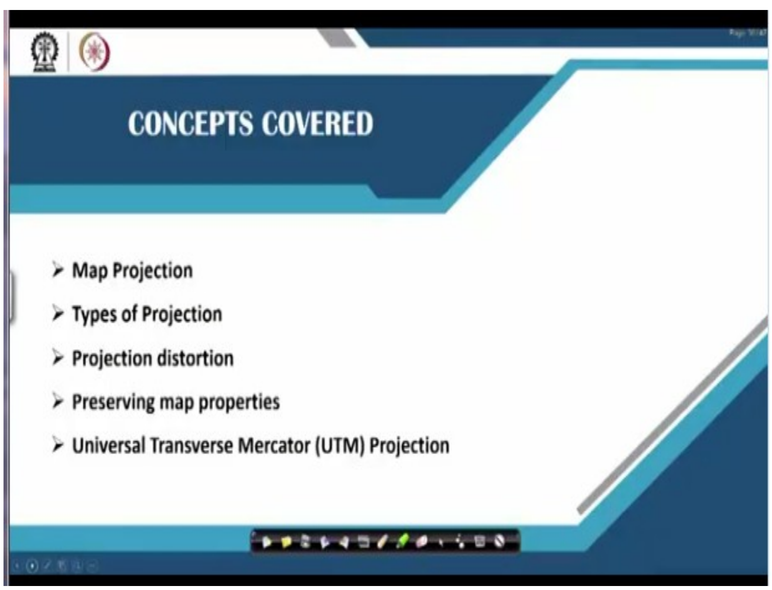

So, in today's class we would be looking at what do you mean by a map projection, types of projection, projection distortion if in case how that happens. Then preserving map properties when you are actually projecting, then I would go into some details of UTM projections we just normally the order of that of today, where people are at cross boundaries are using UTM as one of the projection systems of projecting the maps.

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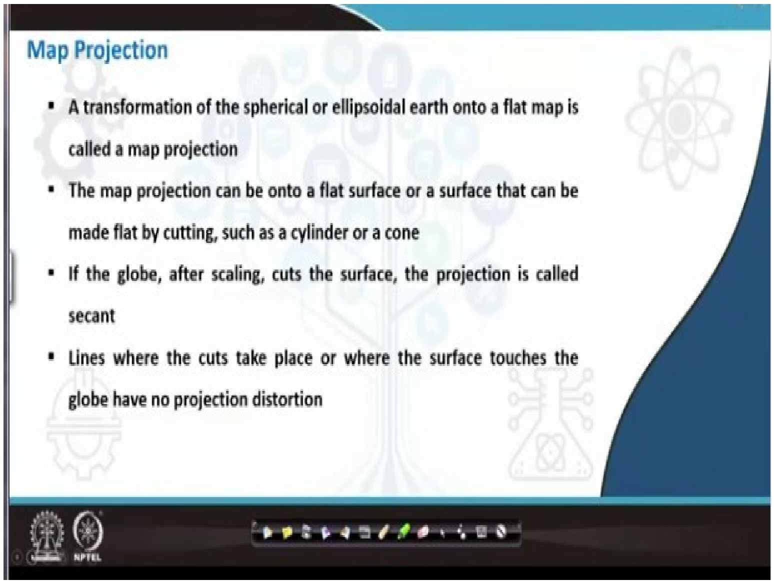

So, when I say map projections, it is a transformation of a spherical, so look at it, the earth is a spheroid or a spherical ok ellipsoidal earth into a flat map. You have a entire map here, so if I project the light here, the light that projects on the earth's surface here on the paper surface is nothing but your map. So that is from the 3D surface to a 2D surface using different systems that is nothing but a projection ok.

So a map projection can be onto a flat surface or a surface that can be made flat by cutting such as a cylinder or a cone. So it can be both I have already spoken about the 3 types of projections before. So, if the globe after scaling cuts the surface, the projection is called a secant ok, so keep this in mind, this is one of the concept that everyone has to know. So, if the globe after scaling cuts the surface of ok, the projection is then called a secant projection.

Lines where it cuts the cuts takes place where the surface stretches the globe have no projection distortion at all but the farther surfaces will have very huge distortions, ok.

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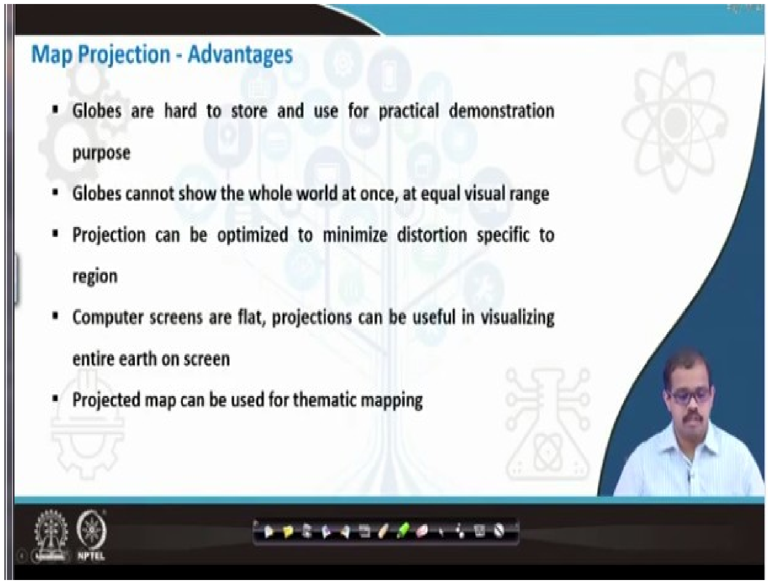

Now, when we look at globes are hard to store ok you cannot always carry and store globes at every place and for practical demonstration purposes, it may be used only in terms of small practical presentations are for explaining it for some small reasons. But when you are actually looking at the entire phenomena or the properties on the ground globes may not be so handy it though globe showcases the entire world at once it is equal to the visual range.

But projections can be optimized with the minimum distortion, specific to that particular region only. So you can be very specific to that region, the computer screens are extremely flat, now you get curve screens. But, when you look at projections that can be useful in visualizing the entire earth on a screen. If you have a globe it may not be possible, but when you have a digital paper that is in the form of a map then your computer screens can be very useful in terms of understanding.

But you are the curve screens may provide certain issues when you are trying to look at details of a particular map. Then you have a projected map that can be used for thematic mapping. So, I will show you some way some of the applications in form of thematic mapping maybe when we look at the practical class.

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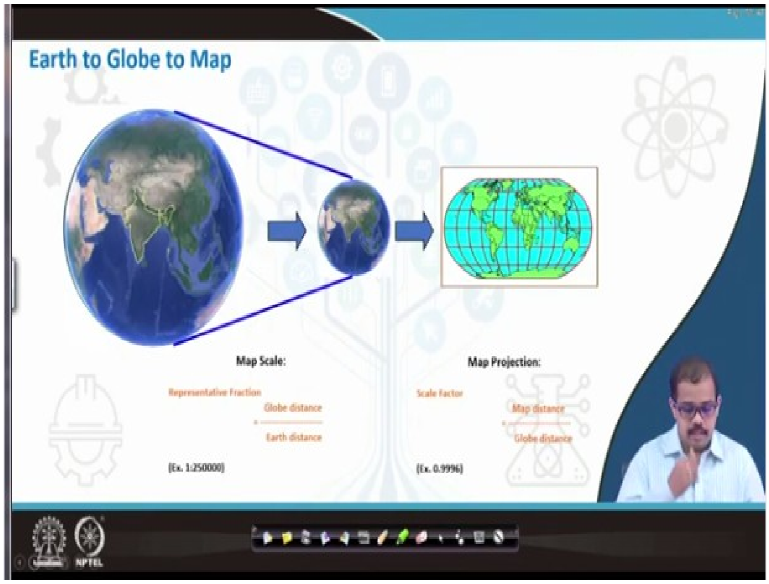

So, the first thing that people have to understand is the map scale and map projection, when I say map scale. Now I am going in terms of map scale and map projections, so when someone says map scale it is map scale it is the earth distance by it is a globe distance by the earth distance. That is for example, 1:250000 units for example, what we saw in the previous properties.

But when we look at the map projections this is the scale factor that is a map distance to the globe distance the way the flattened map distance is there to the globe distance, that is nothing but your scale factors. It will be in the form of a decimals, so this is essentially useful when you are actually providing to distortion less maps and what kind of scale factor, it has to improve to give you exact distances on the ground. So scale factor is extremely important in terms when you are looking at the distances.

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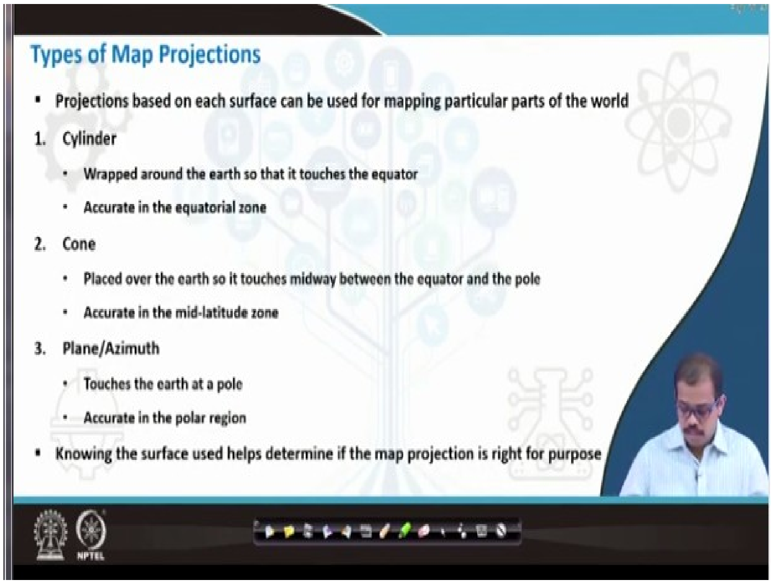

If someone is trying to look at the types of a map, so type of map projections there are mainly 3 different types of map projections. We have already spoken about this, you have a cylinder ok. Now let us say this is a cylinder ok, I have wrapped a paper around the cylinder, now the paper is with the ink ok. Now it the cylinder forms the entire I mean sorry for example let us take this as an earth surface which is spheroid ok.

Now I wrap the paper like a cylinder, your cylinder is actually in the circular shape along a length. So if you have wrap this paper in a form of a cylinder, now you have a the ink that has been put on it. Now I open this particular paper from one particular fashion, the ink that marks that have found on this particular paper is in the form of a cylindrical projection ok. So this particular type of projection is act accurate in terms of equatorial zones only.

So, if someone is working with the equatorial zoning and looking at those maps than the cylindrical projection is extremely useful in such issues. The next thing that we would look at in the map projection as the cone, now if again if I consider this as a spheroid, if I have this is a spheroid ok. Then we have a cone that is put on it, which means that portion which a sharper is on the upper range and the lower portion which has bigger diameter is put on this particular earth's surface.

Now you have the ink that is actually moulded on this paper, so once you open this particular paper. So the projections that the sea of the land surface on this particular map is nothing but a conic projection, ok. So, why is this conic projection necessary is when you have certain data that you are actually looking at in the mid latitude then you need a conic projection. So, then you have other projections such as azimuth or a plane projections, when you look at azimuth or plane projections it is some of those projections which test earth's surface.

Again if we have the earth surface something like this ok when we as a spheroid. So now if you have a projection which has projected something like this and oblique maybe or completely on the north pole or completely on the south pole or towards the easting. So, this particular projections if I have a light source that is actually a emitting like this and you have a source that is providing the projection details.

So the projection that falls because of this forms nothing but a plane or azimuth projection. So, though we have discuss this I am trying to revise this aspect, so that the next part of what we are understanding will be on the right track. So I am knowing the surface are used helps actually determine the right type of a projections that are required.

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So when let us go into more details of cylindrical projections, so now earth intersects the cylinder act on one circle that is the tangent case. If you look at this, you have a tangent to have a secant I have already spoken about the second case, you have a transverse case, you have a oblique case. So cylindrical projections can be looked at in all of these cases, so each earth intersects the cylinder has 2 small circles in the secant cases, I have even shown you in my previous slides.

And points where the cylinder touches earth has absolutely no distortions but where it has further from that particular point it is where you have the higher amount of distortions. Then projections can be based on axis that are parallel to the earth surface ok or the earth rotational axis at 90 degrees to it that is the transverse or at the angles that are oblique. So you can have 60 degree, you can 70 degree, it forms an oblique angles to the particular location.

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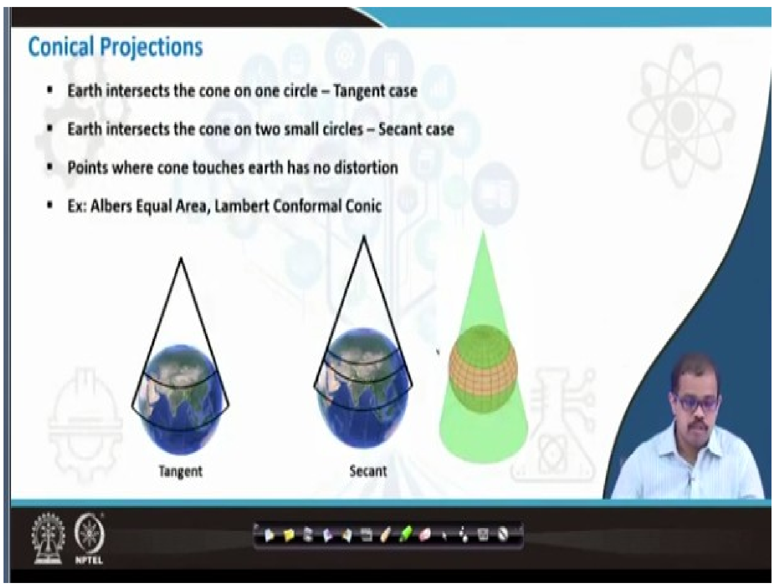

So that is about the cylindrical projections, but when you look at the cone, so as I said it is based on the conic and mid latitude regions have the regions where the accurate representations can be form. So earth intersects as it has a cone if I take this as earth and if you have a conal representation. So if it is a tangent then it intersects at only one circle whereas in a secant case it is at 2 points, normally that is how you differentiate a tangent in a secant which we have seen.

And points where cone touches the earth has absolutely no distortions in every case where it is touching the cone it does not have a distortions. But point does is projected here on the non conal surface or non touching surface, so that is where you find the most distortions. So a good examples of this is lambert conformal conic projection which was used as an example in my previous slides.

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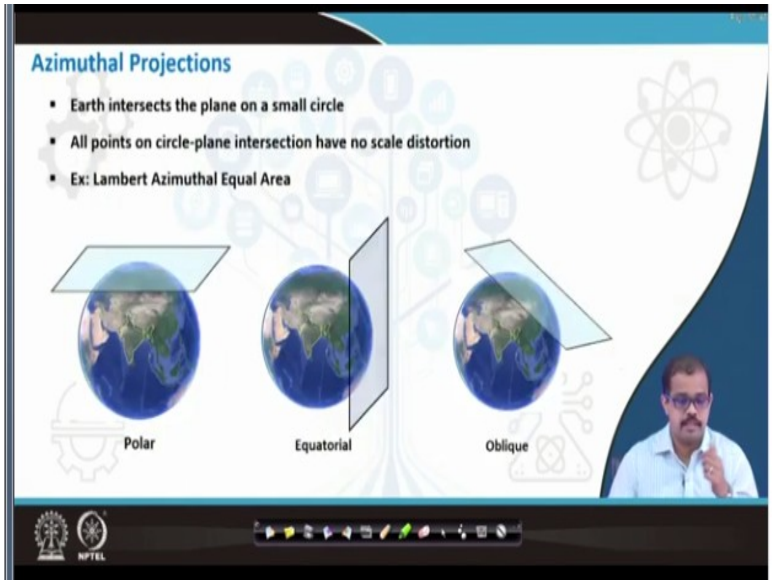

Then we have azimuthal projections of a example, this is a polar projection that is represented here. This is your spheroid, so you have a maybe a planar surface that is put on towards it is poles this forms a polar projection if it is on the equator it forms a equatorial projections if it is oblique it forms oblique projections a very good example of a azimuthal projection is the Lambert azimuthal equal area projections.

So, it is we will look at it somewhere in when we are looking at defining area etc. equal area projections are extremely useful when you are calculating different earth surface in terms of area representation etc. So we will look at this probably in next module of my presentations.

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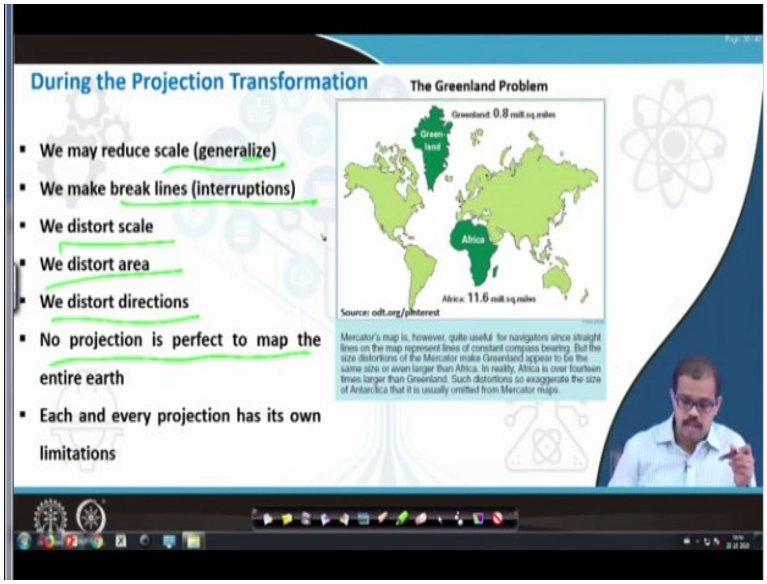

So, a very important thing that you have to understand during the transformation is that you may reduce a cells that is you here you are actually generalizing. For example if you are looking at it here you are generalizing certain aspects of a cell, then you are interrupting us you are making or breaking. So, that is your interrupting certain part of information that has been transmitted from a 3D surface.

Then you are distorting we may distract scale which means we the amount of representation that I have already spoken about how the scale distort. But the we are distorting the scale in terms of information also, we distort area the true representation of the map may not be the true representation on the ground ok. We distort directions we did see some examples here, no projections in is perfect to the map of the entire earth, so that is the thing that we have to remember all the time.

And every projections has certain limitations in terms of projecting different parts of the earth surface. So look at that projections which are way you are located and use those projections for the locational information which would be much better in terms of projecting the earth surface. Exactly for example, when we are looking at tangent and secant those are the places where the intersection of the earth surface takes which means that these are the points where you have exact map locations.

So, look at those locations for exact details and if you are located in those details use that certain those kind of projections for your analysis, ok.

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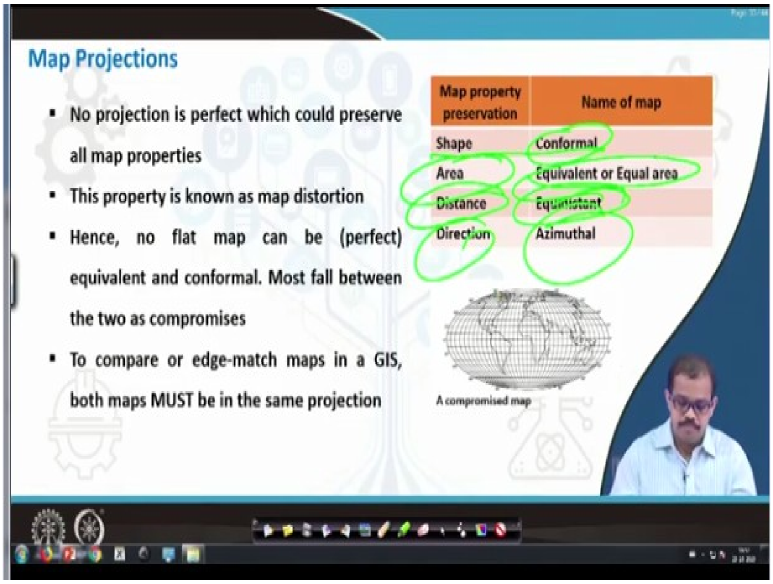

So when I say map projections it has certain limitations, for example, no projection is perfect, which could preserve all map properties. So the property is this property of this called as a map distortion. There are certain distortions where the map property may not be represented in a true form. So, there hence any flat map can be perfect, it cannot be perfect, equivalent and conformal at the same time, most fall between 2 components.

Either it is equivalent or conformal maybe it has conformal or maybe just it is equivalent. So no map can be both equivalent and conformal some map preservative properties are here. For example if you look at shape as one of the property it is only conformal if your map is preserving the shape of the earth surface then it is conformal map, if it is preserving the property of an area then it is equivalent or equal area map that is what I explained about the Lambert equidistant map.

Then if you are looking at a distance then it is only an equidistant map if you are looking at direction, then it you have an azimuthal map which would give you much more details. So as to compare each edge match maps in GIS both maps must have the same projections that is what I am repeating at all along. So everything should be in the same projection system in order to match 2 maps, no 2 maps can be match if they are in 2 different production system ok.

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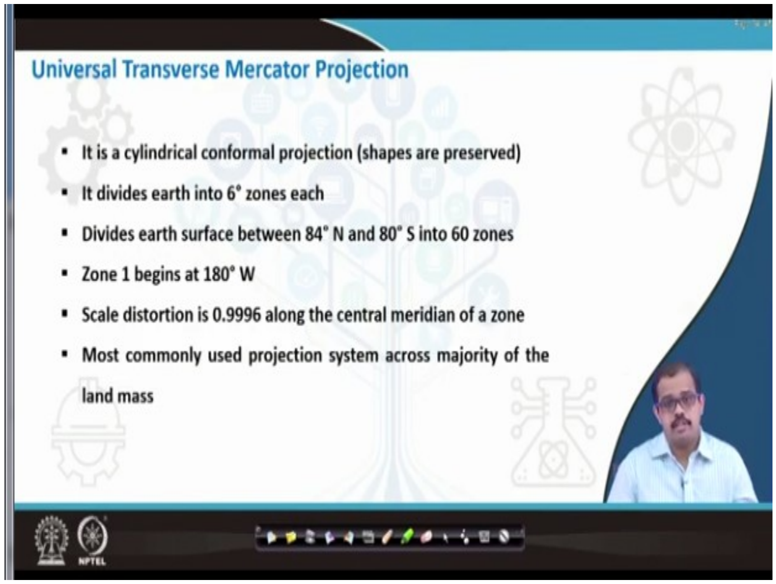

So let me come to the universal transverse marketer as one of the systems. So it is a cylindrical conformal projections that which means to say that shapes is preserved. ok. So it divides earth into 6 degrees zones every zone is divided into 6 degrees divides earth between 84 north and 60 degree south into 60 zones. So zone 1 began begins at 180 degree west.

So the representation of this I have already shown but in the next slide will also see some representations of the UTM. Then scale distortions is 0.996 which will be approximately to 0.97 the distortion is about 0.03. So along the central meridian of the zone, so we should keep this in mind every zone has a central meridian and when you are looking at that particular central meridian you have certain distortions.

Most commonly used projection system, most of the mapping system today are most of the data usage systems in GIS or any of the other aspects related to GIS whether it is remote sensing cartography etc. Most of the systems this particular UTM projection or cylindrical projection.

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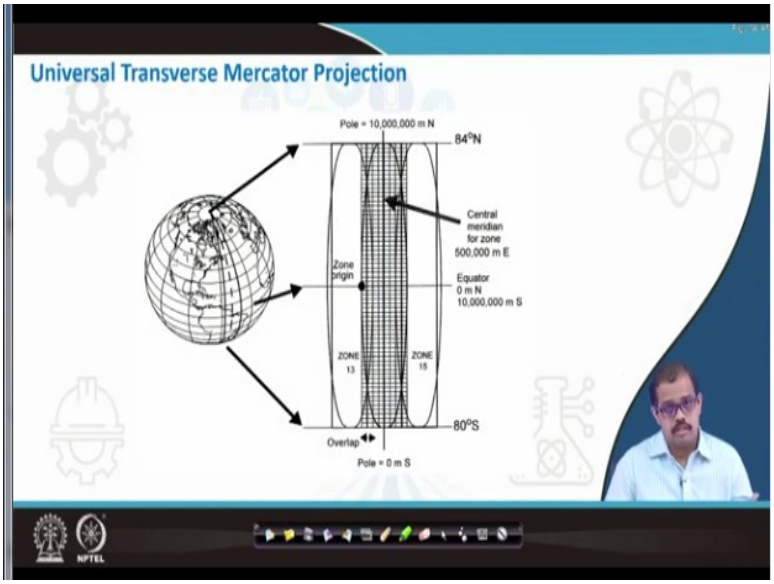

So, this is representing the entire UTM system, so you have all the zone origin here which is an equator and you have a central meridian that is for that particular zone that is represented here. And when you look at this particular map generated through a cylindrical opening.

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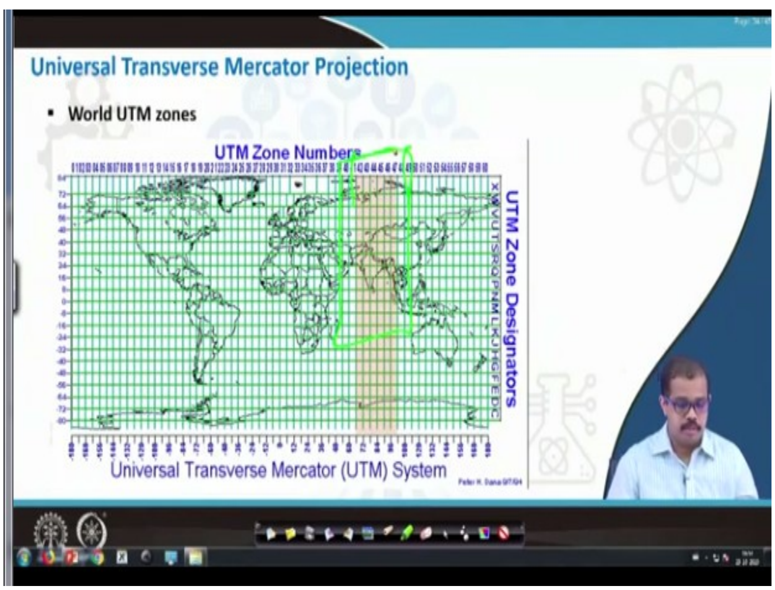

Now, if you look at the entire UTM zones, you can see this is representing the zone numbers here ok. This is representing the zone number and you can see India lies between somewhere between 42nd zone and the 48th zone or just stopping at the 47th zone. So this particular zone is where you can find of your UTM world UTM zones for Indian regions. So, when you are looking at a why specifically UTM zones you probably you will understand when you look at the practical part of different zone numbers ok.

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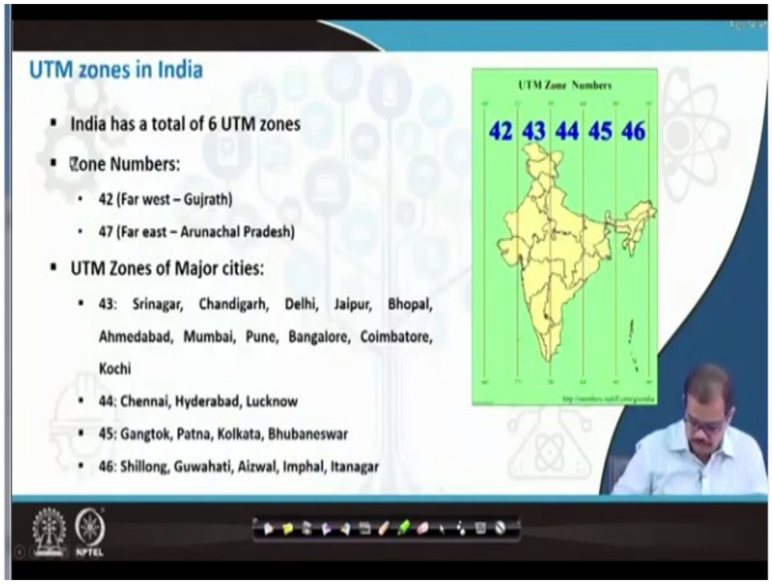

So when you look at Indian part, Indian subcontinent has a total of 6 UTM zones zone numbers 42 as far west that is for Gujarat and 47 as far east that is for your Arunachal Pradesh, when you look at certain major cities that fall in different zones, 43, you have Srinagar, Chandigarh, Delhi, Jaipur, Bhopal, so these all come under the 43rd zone you can see somewhere here.

You have 44th zone which is falling here, where some of other major cities like Chennai, Hyderabad can be found, you have 45 which is far eastern zone. And the last part of the eastern zone allies in 46 and some part in 47. So when you see the western part Gujarat the major part of Gujarat falls in 42nd zone and some part in the 43rd zone. So this is about the UTM zone classifications in India.

So probably you have now we have understood the coordinate systems, the datums, the geoids why the geoids has to be used and why the datums has to be used, what is the different referencing systems and then we have looked at different projection systems in terms of map projections.

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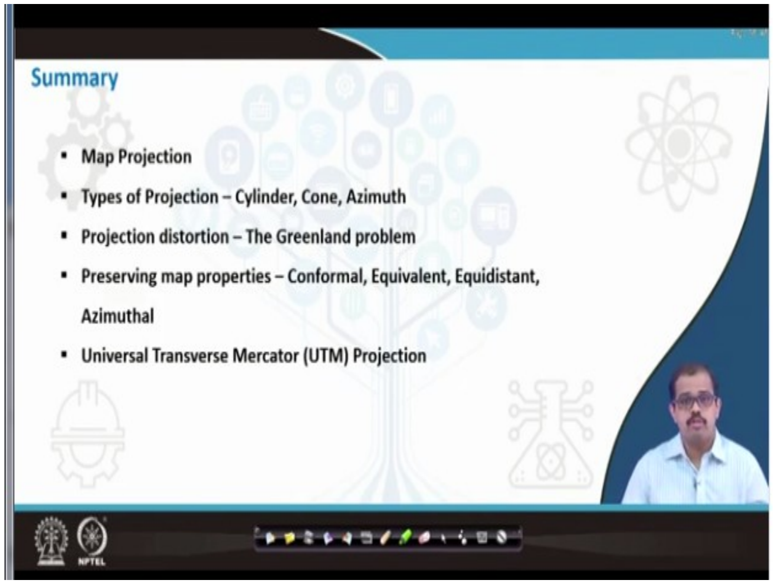

To summarize this particular class we looked at different map projections the type of projections cylindrical, cone and azimuthal. So cylindrical as wrapping a paper as a cylinder across the spheroid of the earth surface then you have a cone, conical shape a projection that comes out of the earth surface. Then you have azimuthal shape where the flat surfaces on the poles earth on the equator or is more oblique.

Then when we look at preserving map properties either it is conformal equivalent, equidistance or azimuthal it can be between 2 different aspects but it cannot have every aspect. Then, we look at what is UTM projections and we looked at different zones in that UTM operation belongs in India. So understanding this entire module would actually help you in and the mapping exercise that we would take up.

But I would suggest everyone to go back to survey of India website download the map and look at the entire map system and also look at the entire indexing system of a particular map. So once you have understood that the rest things can be easily understood how to convert it into a digital scale and also looking at the extracting features on additional map. So that would give you more information, so as of now I finish with this thank you very much, let us meet in the next class.