Remote Sensing Essentials
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Lecture-50
Google Earth and Its Applications

Hello everyone and welcome to new discussion which we are going to have on Google earth and its applications. In the previous lecture we have discussed about little bit about Google moon and Mars. But as you know that the first product which was created was for Google earth are for the earth by the Google. So it is very well known Google earth, as you know it is a special product or a special custom design GIS software which for representation of 3D representation of the earth basically, and 2 main datasets have been used there.

So one dataset which is a digital elevation model from SRTM Shuttle Radar Topographic mission and that is in the background for elevation values which we seen on when we move our cursor and the bottom right corner we see the elevation values when we choose the terrain option of course and top of that you are having satellite images of various resolutions, as you keep zooming it and when you zoom in you start seeing higher and higher spatial resolution.

Satellite images and sometimes you can even see the images of 1 meter or even less spatial less means maybe 30 meter or 60, 30 centimeter or 60 centimeter satellite images and their of course these images directly cannot be downloaded, but lot of research work and lot of work can be done using these images. Because biggest advantages that whenever I want to see in the things in 3D perspective I do not have to do anything just I tilt to rotate and I start seeing things in 3D perspective so apart from these 2 datasets.

Then we are having and many other datasets we can switch on which are generally point data online data like boundaries of the political boundaries of the countries and locations of cities may be locations of earthquake epicenter many things are there and users can also at their own datasets and through these utilities which are available in now days in standard softwares like a KMLE files are there and which allows the users to see.

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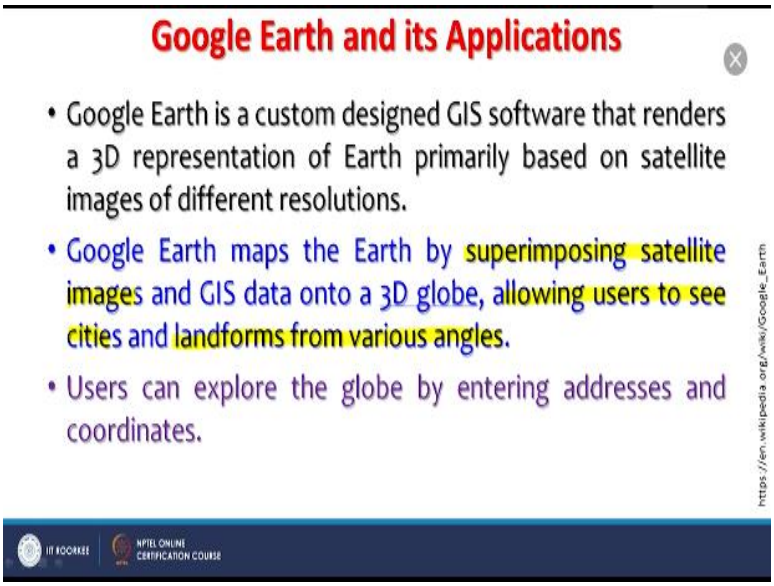

Their own datasets top of a Google earth slowly lot of applications have come up which are based completely on the Google Earth. Especially we find Google earth is very useful and like for studying landforms from various angles and satellite images which I have just mentioned originally first started with landsat images at say 30 meter resolution and later on high resolution satellite images where also now available or pasted on the Google Earth.

So as you zoom in it comes out so is a kind of a pyramid structure at a very course or when you are viewing a larger area than the maximum 30 meter spatial resolution satellite images are seen on the Google earth. But as soon as you start zooming in then small area is covered in very high spatial resolution images and the thing is the most important part is lot of data is available but it is available on your screen of desktop very quickly that allows us to study things very quickly search also and so many other things can be done with Google Earth.

Apart from this landform studies we can also use Google earth because it has become a sort of standard to geo reference our own satellite high resolution satellite image. Because the coordinates which are available through Google earth can be used to geo reference you know find out the common GCP ground control points in our input images and then geo referencing can be done and once say the geo referencing has been done.

Then we can send or paste these are geo reference images on the Google earth and can see whether the geo referencing has been a correct or not because in the Google earth you are having continuous images for entire globe so that way it is also very important.

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This is how various screenshots of Google earth there you know it is a very small utility you first you have to download and install your machine data is not on your machine that is the, I would say beauty of Google earth. Only that small program is on your machine so it does not occupy much space of your hard disk. When you start zooming it exploring the Google earth you start getting the data on your display only unless you go and save it but the it saves only the screenshot it does not save the original data.

But it allows us to study all parts almost all part of the earth on your desktop with course resolution to high resolution and not only that satellite images but elevation value. So you can use you can create or you can see not create it is already created. So you can see the many part of the earth in 3D especially mountainous terrain like this part is shown here. Glassier to terrain also you can see cities you can also see and many cities or buildings have now been made in true 3D so you can have even walk through kind of views on Google Earth.

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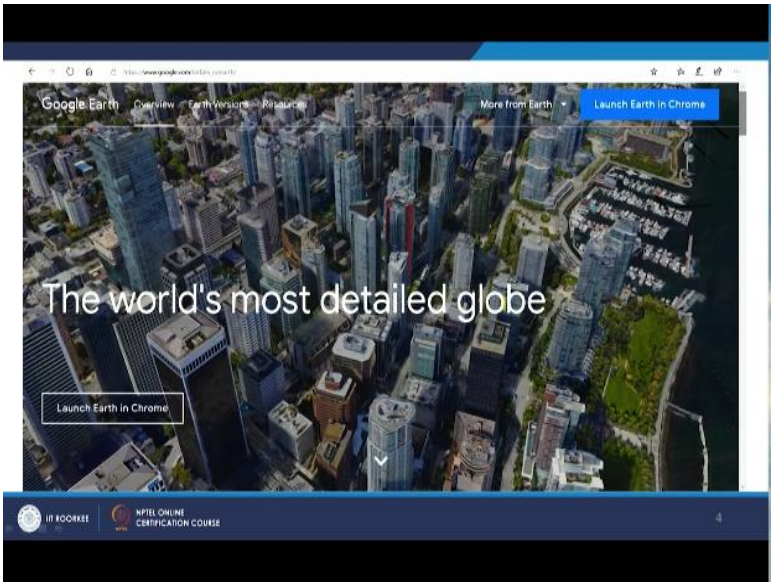

So most the worlds most detailed globe as it is said is the Google earth is and it is I should say it is a wonderful product which scientist civil engineers are scientists can really exploited and this can be complementary to what we do in the field. So before going in the field we can have the idea about the part of the terrain the conditions and the land cover land use of that area where we are going to do some field investigations so in that way Google earth is definitely very useful. Now this program can be as I have said also it can be downloaded on smart phone or tablet do it becomes very slow.

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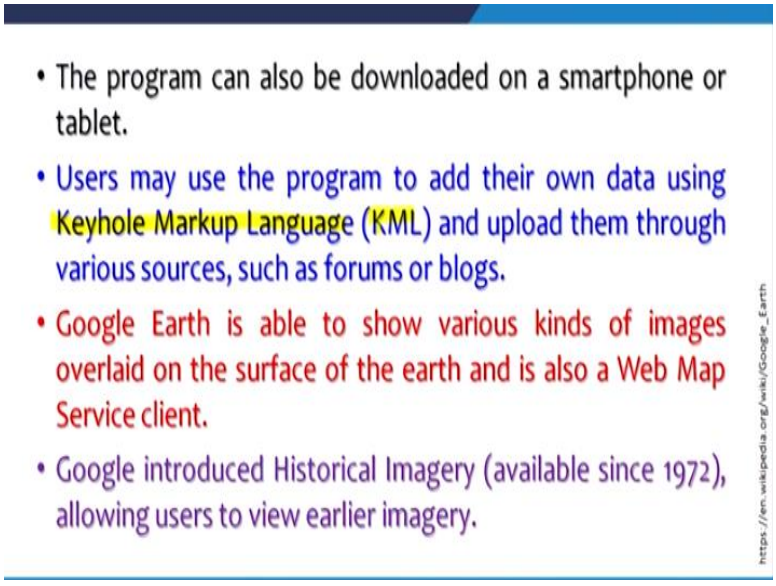

The keyhole markup language that is KML and you get add your own data by converting your own data into KML or KMLE you know zipped file and then add those files in your already

install Google earth and can see your own data on the Google earth as well. So it shows the as I have already mentioned that various kinds of images which are over laid on the surface of the earth through this Google earth and say basically also having a web map service client also.

That means if somebody is looking for a high resolution datasets to buy to that extent you can get the scene indices of different high resolution satellite images and then you can order those datasets to those companies who supply the data. So that is why it is web map service client also that kind of detailed information otherwise I will here by used to have index seen index map of say landsat or other IRS another satellite.

And based on those index may be used to identify the scene indices and then we use to order the data. Now everything is has been organized on Google earth not only for landsat or IRS. But almost many satellites who are have which are having high resolution and spatial resolution satellite images and those things can the scene indices details date of the scene everything can be noted and then can be order.

Google has also very importantly this I like this part of the Google earth most is the historical imagery or available or archive and which is available since 1972 that means the, from the first landsat MSS, MSS is of courses a scanner or sensor. So MSS images since 1972 onward are available in the archive and this makes you know last for this 45 years of data more than 45 years of data allows us to study to do lot of change detection studies maybe related with water bodies it may be related with vegetation changes in landforms and so on so forth.

So this archive of a used number of big data of this satellite images especially from landsat series have allowed us to use Google earth for change detection studies. So you do not have to do the geo referencing of all those scenes anything just move that cursor backward and forward and you get images of different dates and years on so there everything there is a sort of a stack of 20, 30, 40 images for almost all parts of the earth.

And most of these images which have been put on Google earth in this historical imagery are also cloud free and you can choose the exact date, time, season and can get the those images on the moon and can see the changes which has occurred in those last 45, 46 years of time.

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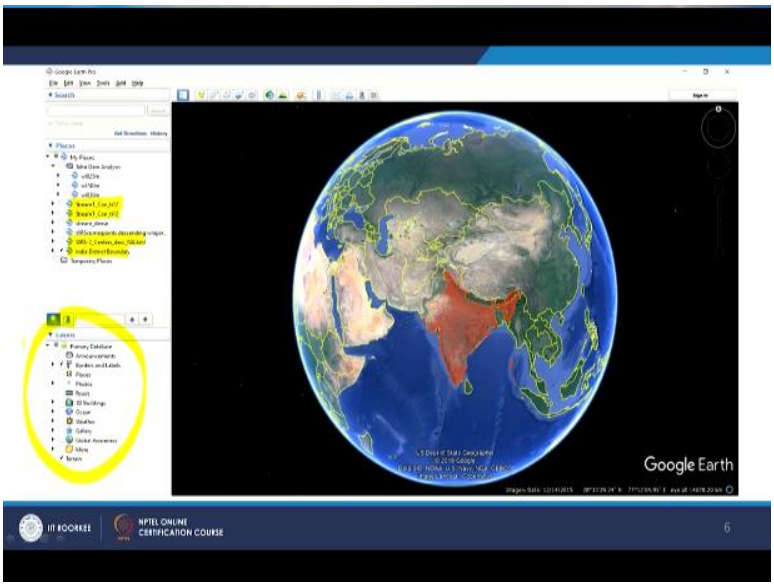

When we see the Google earth I am showing hear the screenshot of part of India and when you choose the like India district boundary. So old district boundaries are also shown here, so political boundaries that are layer is there. So it is a custom design basically is custom design GIS software which is not only having your digital elevation model in the background. But it is also having satellite images of various resolutions.

It is also helps in archives of satellite images as I mention 1972 onward but apart from that it is also having several other datasets which otherwise you have to search here and there may not get as organized as on Google Earth, like streams you can get you can get the political boundaries you get this WRS these are the schemes or index maps for different satellites also and various such layers you get here these layers are there and you can add your own layers as well that is the biggest advantage one of the biggest advantage of Google earth.

That you too can add your own dataset, you can share your dataset with others also otherwise on your desktop machine on your machine you can see your own dataset along with other dataset in Google Earth. So it is custom design GIS software with lot many facilities are there. Earlier

when there are 2 products Google earth and Google pro now so Google pro we, you have to buy or pay some money to have access to Google pro.

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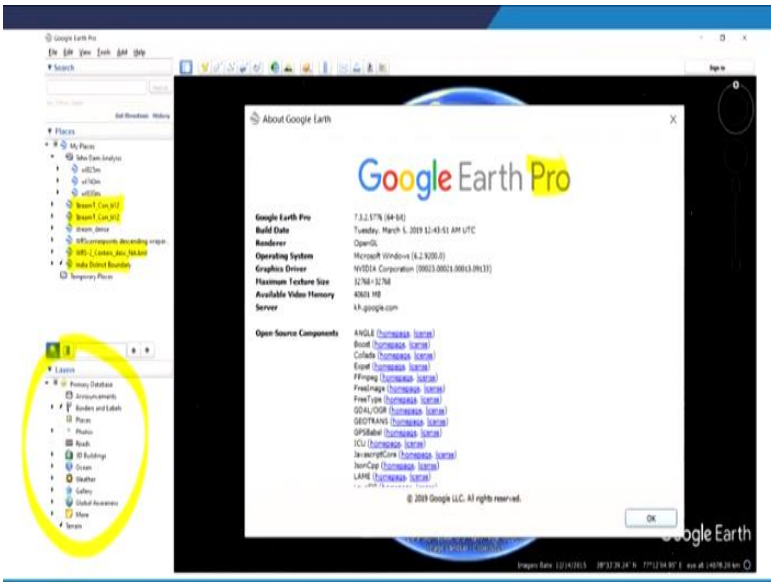

But now a latter on Google pro 2 has been made free of cost so that makes our very good for scientific uses especially when you want to grab orders save an image which is being displayed in the view of this Google Earth. Then Google pro allows you to do that part and simple Google earth was not allowing and that part or that thing to do it on Google earth. So Google whenever now you install Google earth install Google earth Pro latest version which is a 64bit very fast and lot of data is available.

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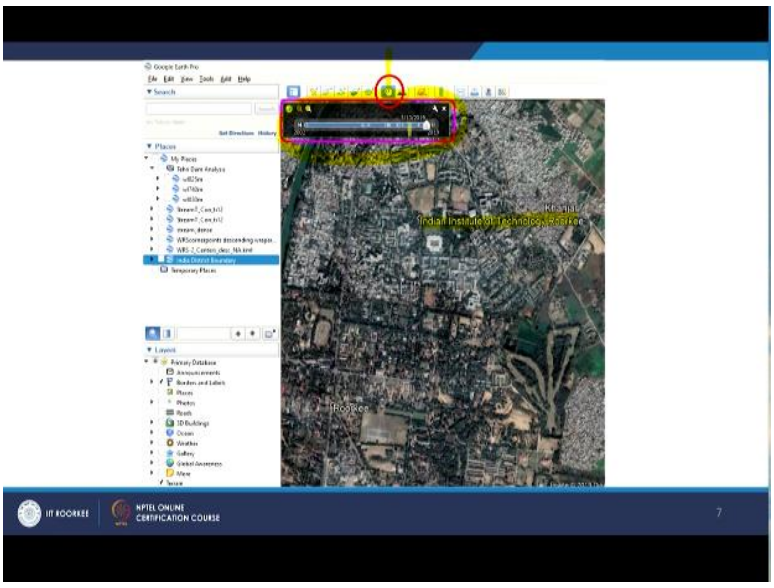

If you go for high spatial resolution images as you can see this is Indian Institute of Technology, Roorkee campus is seen here very detailed map or a satellite images you can see. The purpose here I was trying to show is about this archive. So when you choose this option which is a kind of binding clock and even you move this cursor you can see the images, this image of 13th May 2019 latest more or less latest image at very high spatial resolution of IIT Campus.

If I remove this cursor towards the left and then I can see the old images of the same part of the Earth, which I am currently displaying at the same scale. So you do not have to bother about geo referencing, you do not have to bother about change in scale the what you are seeing only the change in the images you are going through the archive. So many images are available for this part of the earth and many almost all parts of the 20, 30 such images are now available and most of these images are cloud free of almost every season images are available.

So for in Indian perspective you are having images of summer, you are having images of monsoon period clouds free of course and images of winter spring all those images are there.

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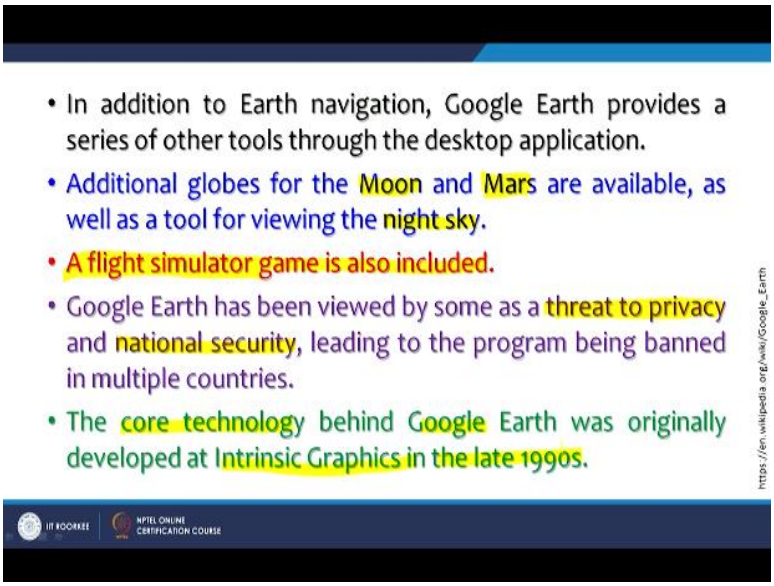

So these archive data can be accessed very easily with them and of course apart from this earth navigation through Google Earth. Google earth also provide series of other tools through desktop applications and I have already mentioned about the in the previous discussion about Google

mars and Google moon and which are also available only through this installation. So when you choose this option here which is given then you choose to other Google.

That means Google earth and Google mars and Moons are also available and they are also available to view in the night sky as well. If a flight simulator is also there though it is a game but it can be used for many scientific purposes especially those who are using for UAB's for drones planning and drone missions first they can do that part on the Google simulator or Google earth, plan everything and then you know use the these drones.

So in that way that that kind of training can be done on the Google earth as well and it is sometimes there is some issues related with the privacy and national security also. So some country protested or contested with the Google earth to remove very high resolution satellite images of certain part of the country, people made complaint including India and then Google earth accommodated those things and they got rid of a very high resolution satellite images.

Those, sensitive part so called sensitive part of the earth and including of part of India also they removed .But if you go and the interesting part is that the high resolution satellite images of some parts of India cannot be seen in India. But if you go in other countries open the same product you are able to see. So this concern about national security and threat to privacy and only within India but not outside.

So there is any way you know the problem for the Google earth or those who are related with this kind of assessment about privacy or threat and other things. But it is a wonderful product that technology which was the core technology which was used for is being used in Google earth was originally developed that intrinsic graphics. It involves lot of graphics is there all these images are nothing but the graphics and your digital elevation models and in the late 90's and this technology was developed and of course since about more than 10 years now we are having Google earth available to us wonderful product in that way.

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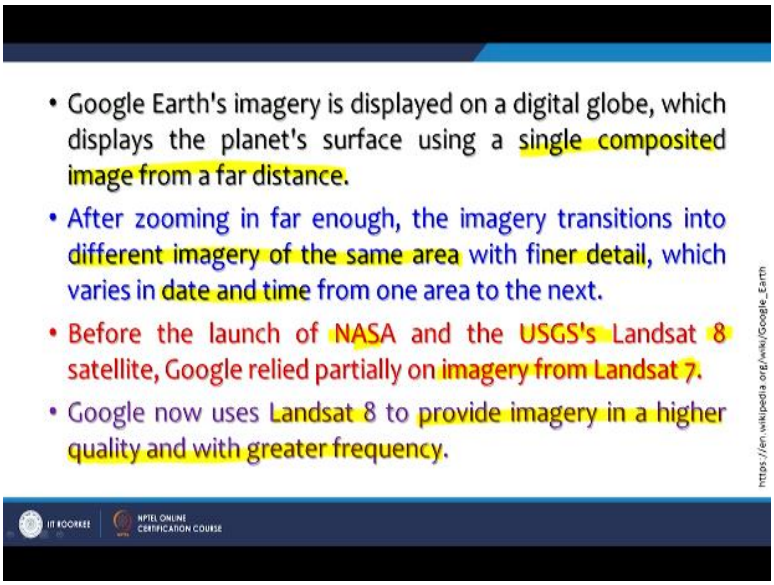

As you know that Google earth images or imageries is displayed on a digital globe and which displays the planet surface using a single composite image from the far distance. So when we see from far from earth we see a complete one image that means the seams with in different scenes are not visible but when as soon as we start going zooming it then we start seeing different imageries of the same area.

Minor final details and sometimes we get seams very visible seams because of the time and date difference between 2 adjacent scenes. So whenever we find this kind of situation the best way to avoid this is either go little zoom out or zoom in and if it is possible which is still allowing us to cover your study area. Then probably you may not see the scene or go back little in the time that through the archive you may again can avoid this seems as well.

Before the launch of NASA and USGS's landsat 8 Google basically relied mainly on the images up to satellite images up to landsat 7. But of course these landsat images are also now available of course through Google Earth. But if you want the original dataset to be downloaded then there are other resources from where you can have these images of your study area. Very easily you can download and that too is free of cost.

So now Google earth uses landsat images to provide imagery at a higher quality and with greater frequency as compared to webby compare will landsat 1 or 2 with the landsat MSS sensor here is

the OLI thematic map sensor and of course it is having much better spatial resolution and image quality is also better and the frequency that is the temporal resolution is also good.

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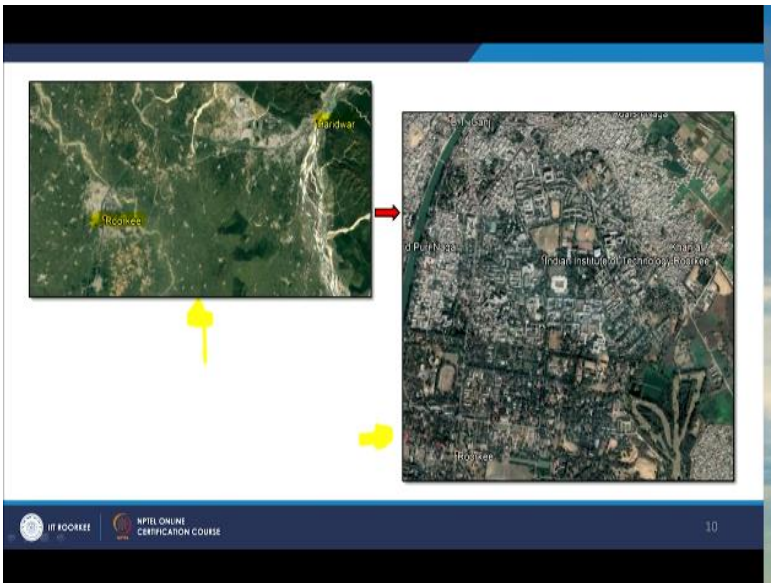

As you can see at certain scale at certain zoomy scale you see that entire area which includes Haridwar, Roorkee you seen when you start zooming it you get much more detailed images. So at this stage you might be seeing and may be landsat 15 meter resolution satellite images. But when you come to this zoom level you might be seen images at 1 meter resolution or 4 meter spatial resolution. So as you start zooming it in the Google earth the image will change and you keep getting higher and higher spatial resolution images.

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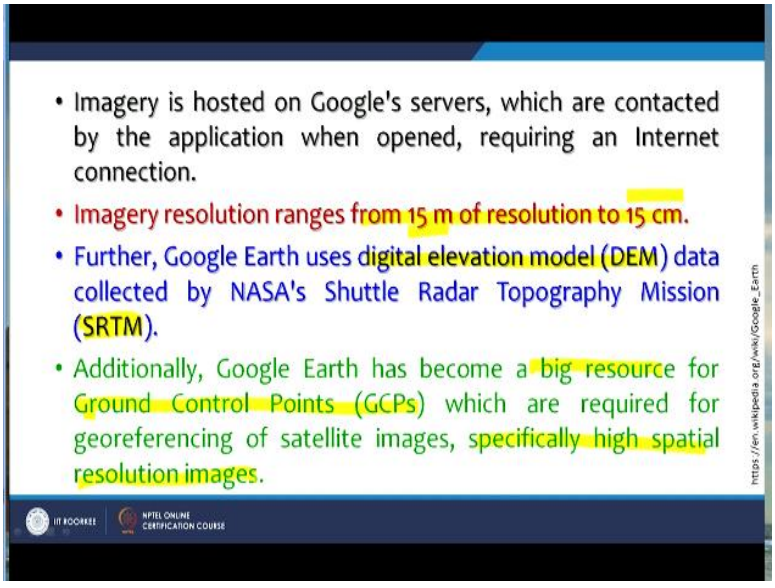

Basically the images which are hosted on Google servers which are contacted by applications so when as soon as you open and select the area through study or see on your screen or display on screen these images start coming through internet on your screen and resolutions varies from 15 meter to 15 centimeter but this 15 meter in some sense is not true because the landsat MSS images are available which has resolution of about 79 meter or roughly 80 meter resolution.

So resolution spatial resolution varies from you can save from 80 meter to 15 centimeter for part of India how many parts of India we do not have images for 15 centimeter resolution. Because of the issue which I have just discuss related with privacy and security of the country. So those images have been requested by Google earth to remove and however even if it is 1 meter or 5 meter spatial resolution images are available which are very good and a lot of applications for lot of study those resolution images can still be used very reliably successfully very accurately.

Of course digital elevation model it is there earlier it started with a 90 meter spatial resolution digital elevation model. Now it is having 30 meter SRTM digital elevation model in the background. When I was discussing about Google earth or Google mars I mentioned that in Google earth and Google mars you can see the weir surface or terrain surface of these 2 bodies Google earth moon and mars, but in case of Google earth you cannot see the bear surface that means the only the terrain surface of Google Earth.

Always this is a digital elevation model from SRTM is always in the background. So elevation values definitely you can get but you do not see a shadow relief model of digital elevation model of the earth without satellite image that is my point was here. Google earth has become is big resource for ground control points I have already mentioned in order to do the geo referencing of especially the high spatial resolution satellite images of our study area.

So sometimes we do not have any other source of reliable ground control points accept we go in the field and collect through DGNSS. So instead of doing that thing if we can rely on the GCP's which we can collect on Google earth then still we can perform very high quality geo referencing of high resolution satellite images imply in Google Earth.

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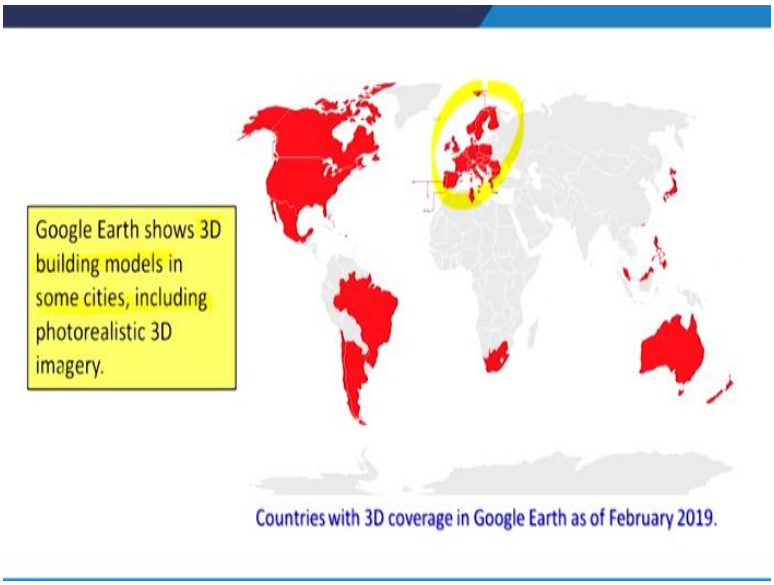

Now the 3D buildings of many parts of the world are also included in Google earth as you can see that these red part entire USA, Canada and Mexico and lot of countries of South America, Australia and entire Europe has been covered and the cities buildings models are in 3D are available and that is which is called photo realistic 3D imagery are available. So when you zoom it to that level you start seeing a 3D perspective and not only 3D perspective but 3D coverage or 3D buildings of those areas. Unfortunately part of China, India and Gulf countries we do not have such a 3D building models yet.

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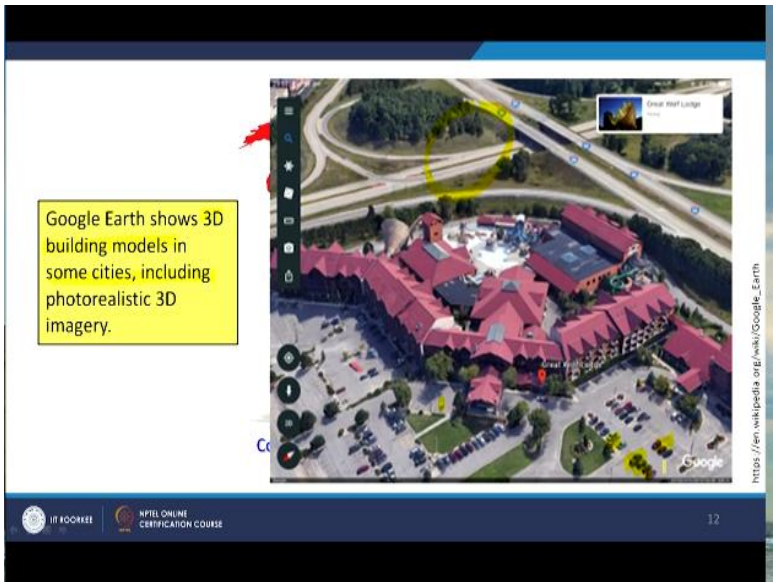

But I am sure I am very soon be might be having one example is shown here this is what you see in the 3D view of many buildings very high resolution individual cars can be seen even if you

see very carefully you can identify probably some few months when the data was being acquired at the time if somebody would have been there that can also be recorded. So very high resolution satellite images are there very detailed information is available. Google earth is also now integrated with this street view for some areas not all areas.

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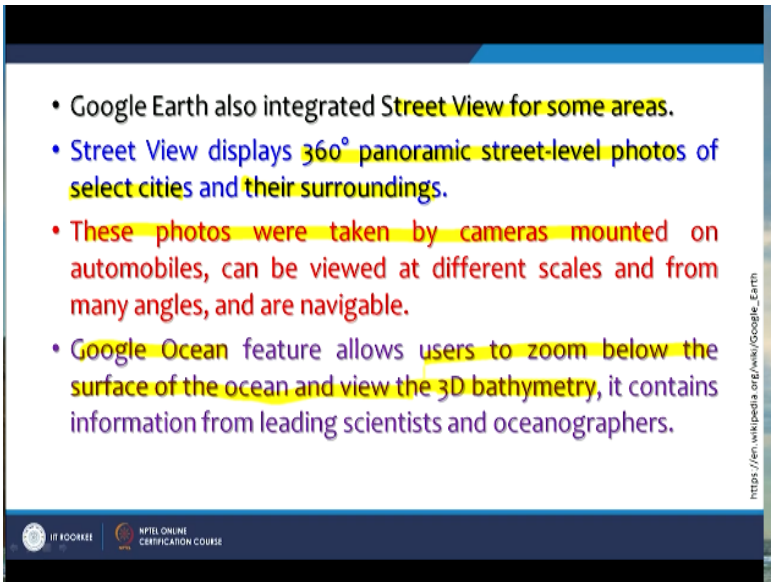

So if you are having 3D building coverage for those countries again you are having these street view of those areas and the advantage with this street view which because it is displace the 360 degree panoramic street level photograph. So of course these photographs are taken in the on the ground and then they are have been put through this and display and which provides as a 360 degree so you can move your cursor and zoom in zoom out.

And can see all the surroundings in all sites that means 360 degree panoramic street photos of select cities are there and surroundings and these are very helpful and these are basically currently we can say ultimate things of GIS Remote sensing and that is sitting anywhere on the globe we can see the complete 3D panoramic street level or can have a feeling of street level perspective view of any part or many parts of the cities and their surroundings.

These are very useful from tourist point of view and others but they sometimes people misuse these information that is why many countries are not allowing Google earth to have such a 360 panoramic views of the street. Of course these as I am mention this photos are taken by cameras

mounted on some vehicle automobiles and then they collect is images of different scales and from many angles and then they are integrated.

Through Google earth and which are available there one additional thing which you get of course on Google moon and mars you do not have the water bodies. So you cannot have in a ocean part or that part in case of moon and mars but in case of Google earth we are having Google ocean which allows user to zoom in and whatever the you know the surface and subsurface information that is the 3D with symmetry of them oceans is also available to some extent and which can allow us to study lot of things in water and oceanographers as well.

And these are things which very useful for navigation in the water and also many explorations also that where is more depth and where is less depth and all kinds of studies related with oceanography can be done from Google ocean as well. So you do not have to do any extra installation just start zooming in ocean or sea part of the earth and you start seeing all those details there, so in summary and that is also about Google earth, Google moon and mars that it was first released in 2005.

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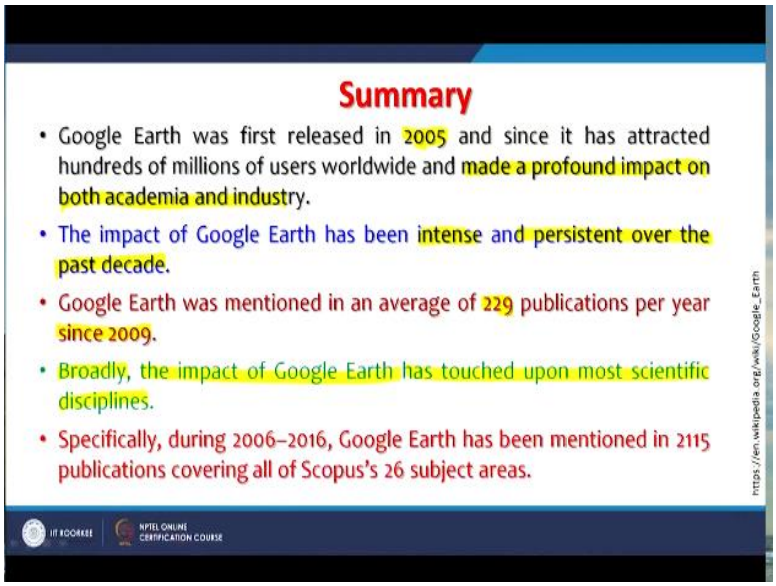

And since it has attracted hundreds of millions of users worldwide so wonderful product custom design GIS software and it provides not only satellite images not only the terrain surface or elevation values but many information's in 360 degree panoramic street view are possible and

has made a profound impact on both academia and industry and people like whenever they go in the field before that it is always better it is always desirable to study that area through Google earth get a feeling of that one.

And you can optimize your field work with the help of Google Earth you can plan many things I also mention that you can plan this and drone missions and through this safe in flight simulators on Google earth and many things can be done. Before really one venture on in the field or in the ground so it has really made a huge impact on the many studies which involves the surface of the earth as well as oceans.

And has intense has been intense and persistent over past decade this impact has been on Google Earth. Google earth was mentioned and an average of 229 publications per year since 2009. So it is getting lot of citations of Google earth, because lot of people are using Google earth data for various kind of studies even if may not be it is not a substitute for field work no way it can be complementary it can allow us to plan the things and many things you can plot on Google Earth.

Which you can just show as a location of your study area or location of earthquake, epicenter of your location of groundwater wells, location of buildings, future buildings, bridges all kinds of things can be done and these things can be shared with others so you have to just send that link or a small file KML file or KMLE file through net to somebody through email to someone and as soon as he will double click on that file his Google earth if it is already installed on his machine will open and that the data which you have supplied I will be displayed on screen.

So that is a very good advantage to share the data, maps, images anything which relates with the coordinates earth coordinates system can be shared very easily. So the largely broadly we can say that impact of Google earth has touched up on most scientific disciplines. Most scientific disciplines including civil engineering including earth sciences in Botanical Research, Zoological research all those in natural disasters too.

And urban planning and in this town planning people have started extensively we have used from our own experience and working we have use Google earth images to study the

development of landslide induced by eraser weir long at the in on the boundary of a Tarry reservoir. Because old images are there when reservoir was not there and new images are there in between images are there. So you can you can see that at what time and how the landslide started developing and how slowly a small in a debris fall.

And it is very small landslide or indication of landslide was there and later on those have become full flash landslides. Because of this archive available through Google earth you can study the development of any such changes which are happening on the surface of the earth. So there are lot of applications of Google earth many new will come people will because they as it is getting and which from and it assets and not only the images but 360 degree, 3D and many other layers are getting added into the Google Earth.

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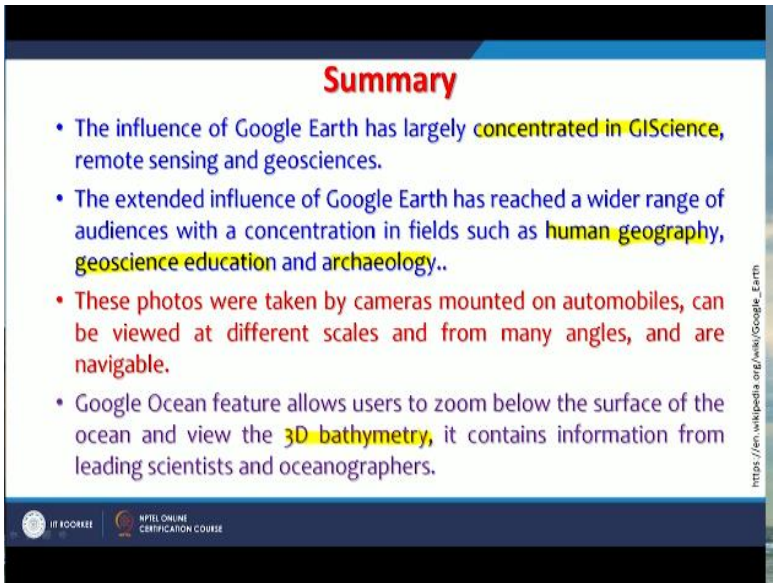

Also GIS science as I said this is custom design GIS software so Google earth has also largely concentrated in GIS Science, Remote Sensing, Geo sciences, Civil engineering, Archaeology in a Geography or Gio science education also human Geography other things people have started using Google app, because you say it has got huge resource of information, data which is available there and these also the 3D, 360 degree panoramic street view is also allowing us.

Even tourist have started using if I have to go in some new place and if these 360 degree panoramic views are available I put the location and I start seeing the things. So I can become

familiar before I land there I can become familiar of that part of the world and I can save my time and even resources so a lot of things are being then 3D symmetry is also I have already mentioned that is also there.

So this brings to the end of this discussion about Google moon, Google mars,Google earth and lot of advantages associated with these products. So this brings to the end of this discussion thank you very much.