Remote Sensing Essentials
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Lecture – 56
Limitation of Remote Sensing Techniques

Hello everyone and welcome to the new discussion on limitations of remote sensing techniques, so we have reached to the last discussion of this remote sensing essential course and why I wanted to discuss this part because so far people have really oversold remote sensing and some people have claimed or it is you know in the media or elsewhere that remote sensing can solve all the problems or most of the problems.

Especially related with the land or you know disasters and other things, so it is not true this is one of the techniques which can be employed this is not in universal technique and of course each and every technique is having limitation, so remote sensing and that is why I thought that very briefly I will also discuss the limitations of remote sensing techniques, of course in future some of the limitations which I am going to discuss may not prevail there may not be there in future.

But what current limitations which we witnessed with remote sensing that is what we are going to discuss and sometimes when we did not have expensive data then it was a when we did not have the inexpensive or free datasets we had this problem about when we want to cover a small area our area of study was small but still we had to buy the entire scene and for a small area it was expensive and even sometimes when we are going to study a small area.

Generally when we studied a small area and then we go for very high spatial resolution data maybe 1 meter or 60 centimeter or 30 centimeter and such datasets are still not available free of cost, so far what the data is available free of cost for us is generally having somewhere around 10 meter spatial resolution, if I want better spatial resolution data even for a small area to buy a full scene and that is going to be expensive so high that means the high spatial resolution data is still expensive affair even for one time analysis.

If we go over chain detection another thing it is going to be further expensive, so high spatial resolution data for a small area that option and the cost effectiveness is still not there and probably as a more high spatial resolution data but we available people will be looking more and more such datasets initially may not be free of cost, so that limitation one of the limitations of remote sensing is going to stay for some more time.

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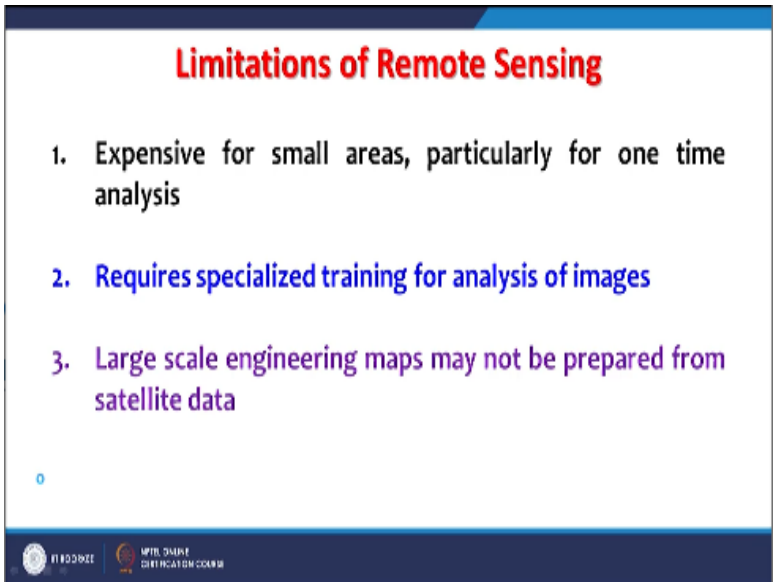

And of course when we want to analyze the data remote sensing data everyone cannot analyze the data, so you require some specialized training for a small area somebody is working on some project he would like to have some input from remote sensing they that organization may not be having experts on remote sensing, so they have to hire the expert and that basically includes the cost also, so that way one can consider one of the limitations.

But nowadays because a lot of image processing software's, GI software's and data remote sensing data or relatively coarser resolution is available maybe up to10 meter or higher or 30 meter and a lot of people have got the training to analyze the data, so it still some cost can be reduced but this say sometimes when we go for say interferometry data then everyone cannot process the software's used to be very expensive.

But a data product specific software's are now free of course like a sentinel one data and a good training can allow us to analyze data for a small area too, now if we want to go for large scale

that means very detailed engineering maps then again there might be some problem with the satellite data, suppose somebody is looking for very detailed street map or building, height of the building and so on so forth therefore and here sometime and one may find that remote sensing data is having limitations.

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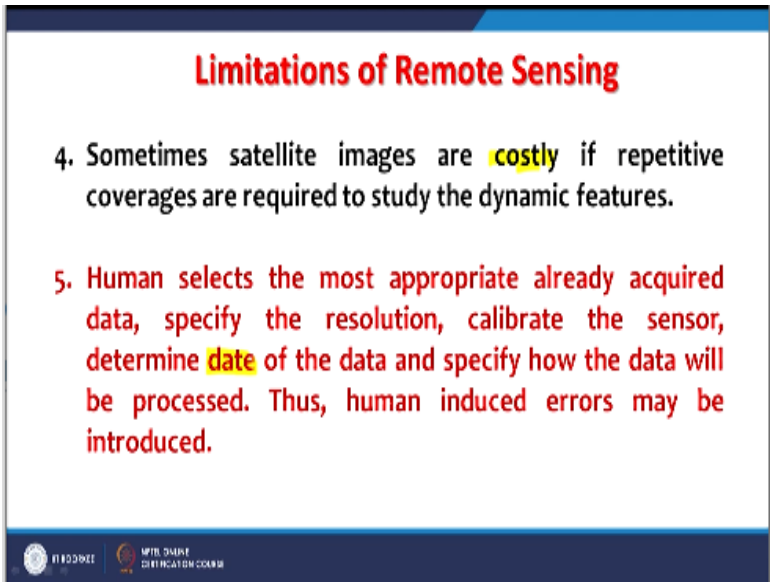

And if we go for further such a limitations of remote sensing data and then it is costly if repeated coverage's are required to study the dynamic feature costly because of small area at high spatial resolution data is not available free even one-time data is very expensive the swath available is may be like IKONOS and the you know the scene width is going to be just 11 kilometer if my area of study is having width of 30 kilometer then I might be requiring even 3 or 4 scene to cover even one time data.

And if I want to do the change attacks and studies that means I require multiple scenes and that is costly affair, so that is why if repeated coverage or change detection studies are required to study the dynamic features might be vegetation dynamic features or some changes due to flooding earthquake landslides all those things can be studied but it will add the cost in our projects now also another point is that we may be considered as limitations of remote sensing is the human select the most appropriate already acquired data.

Because if we go for even free datasets then whatever is available be select and we also consider before downloading the data or acquiring the data is the spatial resolution the calibrate the sensor determined the data date of the data that is very important and specify how data will be processed and thus many times say the human induced errors may also be introduced here because everything is being selected by a human and sometime we are having background of some part of the world about weather conditions.

And if I apply the same background for other parts of the world I may and can I can make and wrong decisions about selecting the data and therefore our results and can get affected, so a knowledge very much knowledge of that particular area which is being studied and should have especially about terrain conditions especially about the meteorological condition climatic conditions then appropriate data scene can be selected very nicely, now another limitation which can be considered is the

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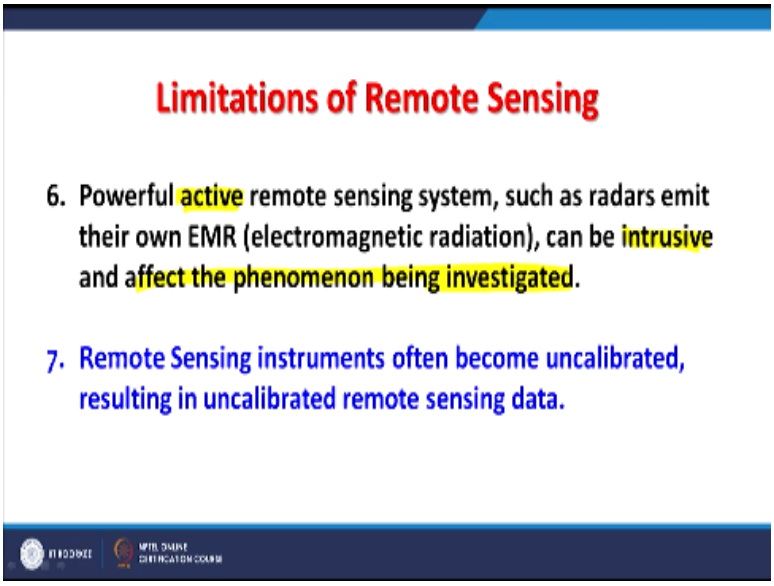

About when we go for active remote sensing data that is microwave data and as you know that it the data and the data is acquired when the instrument itself emits their own EMR that is electromagnetic radiation and can be intrusive this data or this EMR can be intrusive and can affect the phenomena being investigated, so sometimes say if certain things which are very sensitive to EMR radiation then radiation then they may have that affect may also come in your that objects as well as in that data.

Also, many times say you know of course the calibration of remote sensing instruments which are onboard of satellites is done by different agencies but sometime you may get poorly calibrated or un calibrated data and which may give you a completely wrong results or the data might be having big errors and though it might be difficult to even remove those errors, so as we discussed when we have been discussing the distortions associated with the remote sensing data we discussed the distortions radiometric distortions.

And there the calibration plays very important role, so whenever you start downloading or utilizing dataset a new datasets of a completely different sensor which you did not have the experience or past experience then the best thing is to spend some time and find out whether the they how best the instrument has been calibrated especially this will require when you are going for quantitative analysis of remote sensing data they are this calibration or a poor calibration can affect your results extensively.

So one has to be careful by utilizing this data. Further we see that time and then there is some sort of a confusion and that looked the same to the sensor and which may lead to the classification errors.

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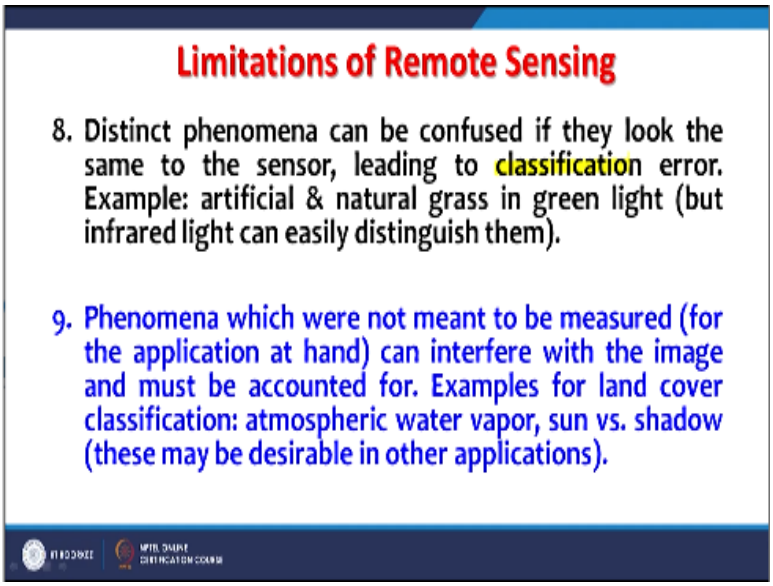

For example artificial and natural grass is green light but infrared light can easily distinct them, so what it means basically when we go for classification of the data a single band based classification may not be very good, so if you are working say with vegetation and you are using multispectral data one channel in your color composite should be infrared channel, so that you can distinguish between natural grass and artificial grass otherwise they everything will look green and you may classify completely wrongly.

So in that way it is at classification stage one has to be little careful about the data and a phenomena which we are not meant to be measured and for the application at hand whatever the application one is working can interfere the image and must be accounted for example land cover classification, so the atmospheric water vapor which may affect our results and we are ignoring it not knowing it and when we do our classification we may get poor results.

So we have to bother about if we go if we want better results accurate result through classification then we have to bother about all these details like atmospheric water vapor and sun verses shadow this is this can be a big problem also if you recall the discussion on false topographic perception phenomena, so if you are seeing you know the topography in inverse present because of FTP present then you may go you may do the wrong classification your classification results may have errors.

So that the sun versus shadow option or that complication one has to be aware while doing the classification then the classification results and one may find quite accurate, so all these thing will come through our experiences working extensively on the data on different sensors then many such and many such errors or limitations may not come for an expert or who is having experienced long experience of working on remote sensing data further that a remote sensing you know if we consider as this science or a technology has various limitations perhaps the greatest limitation is that utilities often oversold.

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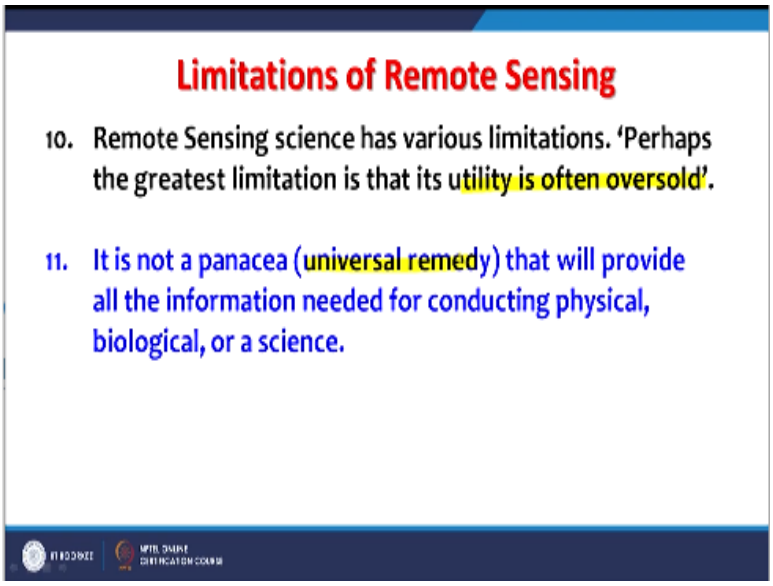

This I said in the beginning that remote sensing technology has been oversold by ourselves only many people among ourselves have claimed that it can solve each and every problem but it is not true and one should not take any technology in that way I have also mentioned that no technologies in universal, so this is neither a universal remedy and will not provide the information needed for conducting physical biological or a science, this is an input and that input may go for various kind of application various kinds of projects.

So everything cannot be solved and can be solved by remote sensing only in many things of course remote sensing plays very important role it will be playing very important role better data will be available to us, we will be doing more good work using remote sensing data and various spectral bands data is available, radar data available microwave and passive microwave data but still it is not a universal technology that everything every problem can be solved by remote sensing.

No because if we work in and this optical remote sensing data like visible infrared thermal infrared then cloud creates problem to us if we work in the microwave data active microwave data then in an for a hilly terrain there are problems are there, so every branch of remote sensing for every type of remote sensing data available from different satellites will have their limited usage that means the Landsat data cannot be applied everywhere same with the Sentinel radar data cannot be applied for everywhere.

So similarly remote sensing technology and need not to be applied everywhere unless it is very much required and it provides the better thing then only it should be applied and now should not be oversold at all and what it basically providing some spatial spectral and temporal information at few radiometric resolutions this is what it is providing, but as I say that if we go for hyper spectral remote sensing.

So there you are having very high spectral resolution nanometer bands are available but your swath becomes just 5 or 6 kilometer thick or wide and there you are having coverage problem, so one thing you have solved another problem has been added and therefore no dataset in remote sensing is universal neither this technique too.

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Now what our technical constraints and this location accuracy that means the geo referencing part that may be always true and especially with very high resolution spatial data because you require in order to do the geo referencing or develop a locally location accuracy you require a very highly accurate ground control points or GCPs, now from where you will get GCPs because for everything you cannot go in the field and use the DGNSS and collect by yourself that may be a problem.

So this location accuracy with especially with the high very high resolution spatial resolution satellite images like 60 meter 60 centimeter or 1 meter will always be a problem there but as GNSS data is getting improved and some other resources are available for and these geo referencing to some extent we can solve the problem but for very high resolution satellite images this problem will always be there, now image quality sometimes.

We get high spatial resolution but the radiometric resolution or quantization or number of bits assigned for that particular panchromatic band may be just 6 bit or 7 bit so the image quality we are getting high spatial resolution by but not relatively high radiometric resolution and that will and deteriorate the image quality, so one has to be careful about that part also, so virtual delineation will never replace a surveyor.

This is what is so what we and the remote sensing inputs are basically virtual delineation and they of course if one does not believe on remote sensing the best thing is to go in the field and check in one to one scale because after all remote sensing images are also modeled that is why they are called images, so whatever is the spatial resolution for that particular spatial resolution there is only one reflection or an emission value is available.

Now within that pixel there might be lot of variations on the ground which have not been recorded only the average reflections have been recorded if I take the example of 10 meter spatial resolution, so within that 100 square meter ground area only one pixel value is available whereas in the on the ground itself there might be lot of variations with in that 100 square meter area therefore it never will replace the reality or a surveyor.

And if one is and one need that kind of detailed information then only way is to go in the field at one to one scale and get the data now sometimes say about this limitation about the legal value many countries have started using satellite data as evidence in the courts also for various kind of disputes maybe environmental related disputes maybe and crime related disputes or many other disputes are there some time there are disputes on political boundaries sometimes there are disputes on utilization of river water sometimes between countries or between even states.

And sometimes there might be disputes related with your land records or sometimes say there are disputes with the insurance companies that somebody has claimed that due to certain natural disaster my house or my building has got damaged but how to make sure that it whether due to only that disaster that building or house has got damaged or there were already and poor construction or already damaged building.

So for that we generally the insurance agency may resort to the remote sensing data which is prior to that natural disaster and then do the chain detection study and can say to that and whoever is claiming that is sorry your building or your house was already damaged before that disaster but whether these things will extend to the legal scrutiny that remain a big question, so some countries are allowing.

Now remote sensing data as evidence in the court but may this is limited to only few countries, so this limitation is still continuing it is not universally accepted yet as a legal value of an image but I am sure in future and this will also improve a lot of such disputes a remote sensing data because remote sensing images are unbiased and once we start getting free datasets even of 10 meter or less than that.

Then if I say anything then anybody can check download the same dataset of the same resolution of the same date and can verify so in that way these way it can add to the more to the legal value, legal boundaries do not always fit with the visible boundaries especially with the land record so that is another constraint with remote sensing for example somebody is having a agricultural land. Now is there the as per land records and the boundary is having may not match

And therefore there will be again some conflicts or some issues will be there some technical constraints are also there with the remote sensing technology, so that we have to live with that also location accuracy I have already mentioned image quality I have also mentioned, so these things are going to stay for some time. But slowly there will be less limitations more utilization of remote sensing data including in courts as well what it provides basically let us see some positive point before we end and this discussion that it is save and share the information more securely.

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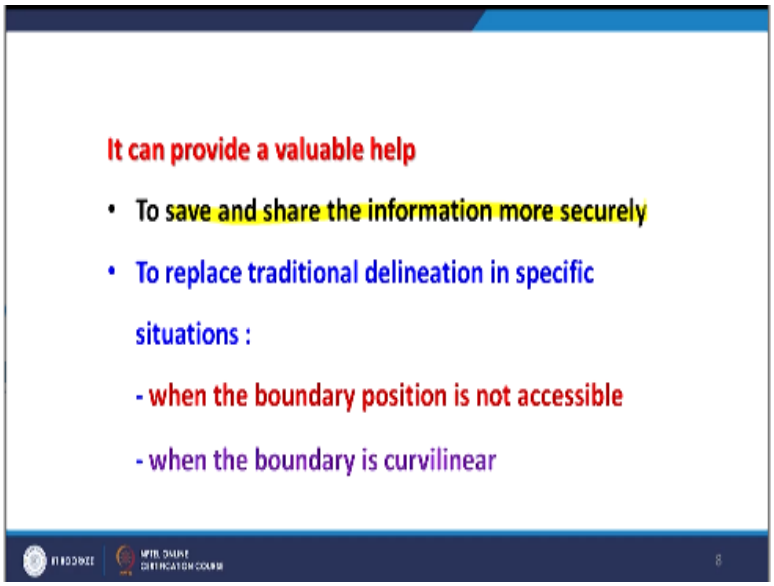

It replaced traditional delineation in specific situations for example when the boundary position is not accessible especially we can see the things what is happening in neighborhood where we may not have access and when the boundary is curvilinear then again and remote sensing can play very important role now this is about the spatial resolution and how things have been changing since.

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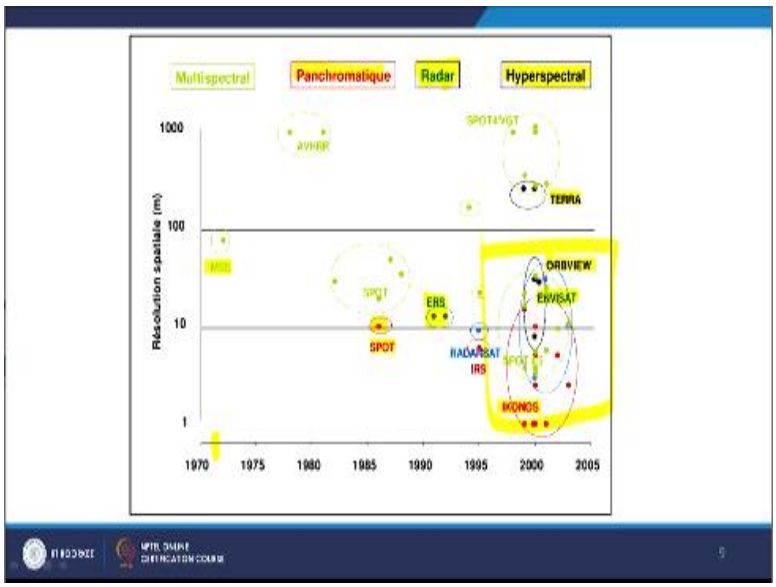

Inception of civilian remote sensing data MSS that is Landsat MSS in 1972 and since then so we had and that multispectral data and then we started getting panchromatic data and somewhere in 1986 here from spot and later on we get we got also radar data from ERS that was the first

civilian remote sensing radar data, microwave data and then of course now we are also started getting hyper spectral data.

And maybe from overview or TERRA and satellite and of course Radar dataset of ENVISAT is still continuing and Panchromatic data from IKONOS is still continuing this is not a latest figure it is up to only of 2005 but if we plot for 2019 or 20 then lot of new options are available and as you can realize that in 1972 there were only one of sun was is here now a lot of options started coming after 2000.

And here the resolution we are also going or improving on the spatial resolution and now we are focusing more between about 1 2 and 10 meter also, so that is what we are achieving and slowly all our kind of options all kinds of data is becoming available most of the data is becoming available free of cost and most of the applications which we know today are under development can utilize the data and do lot of work.

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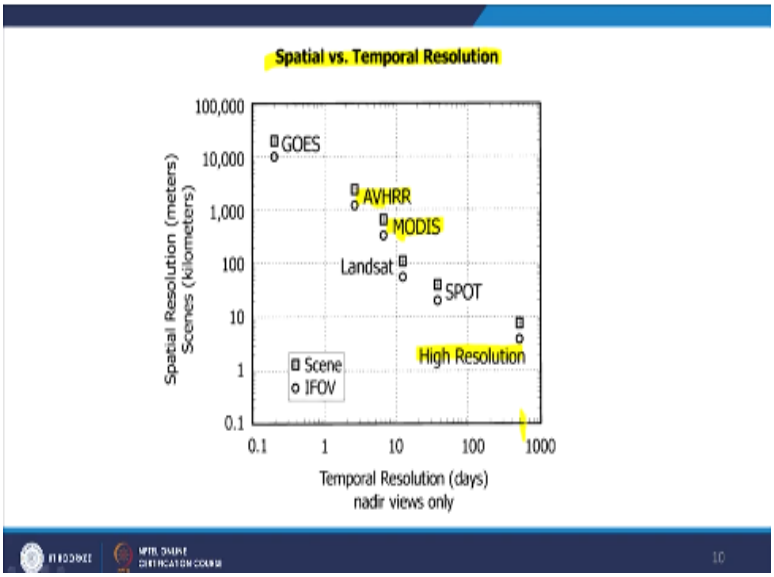

Also this is spatial versus temporal resolution. So datasets like from you know AVHRR you can have on daily basis MODIS also you can have daily basis high resolution data as you go higher and higher spatial resolution the swath width reduces and you get the data maybe after many days sometimes the cloud conditions of meteorological conditions are not favorable so when

after say 15 days or 20 days or 28 days when the same satellites again orbiting the same area at the time it might be completely cloudy.

So you may say orbit and likewise so that is why here in temporal resolution it is shown, so high spatial resolution data may not be available as frequently as relatively low spatial resolution data from AVHRR or MODIS.

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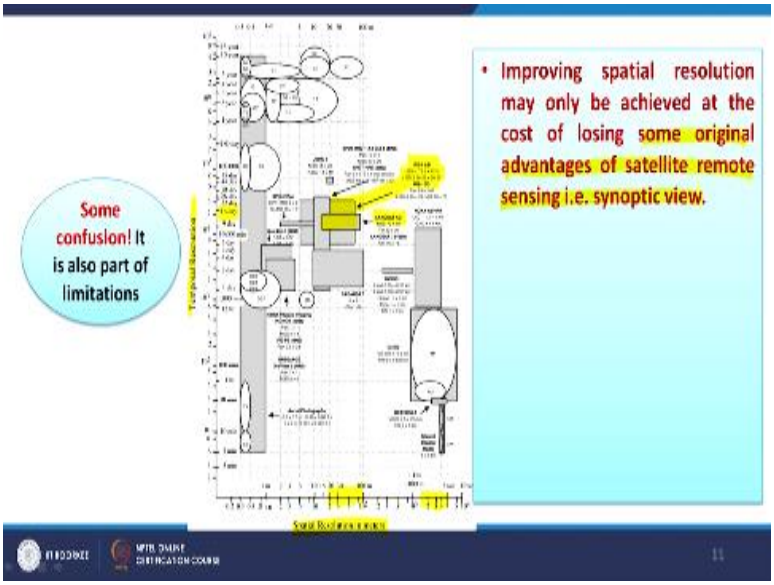

A lot of other such comparisons can be seen about the spatial resolution versus temporal resolutions and also continuity of the data from individual satellites, so lot of these things are there if I take the example of say Landsat 4 and 5 then I am having the spatial resolution between 30 meter and 280 meter or maybe less also in this part here but the same time the temporal resolution.

I am getting somewhere not 16 days and this is generally has been very common 16 days repeat cycle for many of such satellites are there that is why there is a clutter and clustering here in this plot and IRS also A and B they also provide data but maybe 18 days and so on and resolution by the spatial resolution again depending on which senses data is being used that is in this IRS area, so in the same way as in Landsat so lot of options lot of things are becoming available.

And such plots are becoming cluttered because so many satellite data available and so many satellite data is also available free of cost so that way one can really get sometimes maybe little confusion and we may also consider is part of our limitations that for particular application which satellite data I should use for particular application which is spatial resolution digital elevation I should use because at 30 meter spatial resolution 3 4 options of digital elevation models are available so which one to use again.

You have to do some analysis you have to study you have to read the some paper if you are working to that research they will find out that which type of digital elevation model would be a suitable for a sigh like a hilly terrain or flat terrain similarly which type of satellite data would be available or would be better for your kind of study, so you have to decide one spatial resolution you have to decide on a spectral resolution.

You have to decide on temporal resolution as well if one is working for change detection studies so improving spatial resolution may only be achieved at cost of losing some original advantages of satellite remote sensing that is synoptic view this I have been mentioning in this course higher the spatial resolution narrow the swath width and the mean the point which we used to see in favor of remote sensing that remote sensing provides the synoptic view is getting limited.

So that point is very valid here that higher spatial resolution are going against the synoptic view and due to the underlying physics principles therefore it is usually not possible to have both very high spectral and high spatial resolution simultaneously if I take example of thermal images thermal layer datasets or thermal channels relatively coarse resolution thermal channels data are available not at very high resolution.

So there is there has to be some compromise on this both high spectral and high spatial resolution data may not be available all the time, so this brings to the end of the discussion this particular discussion about limitations and advantages of remote sensing and also end of discussion on this course that is remote sensing essentials. I very much hope that you must have enjoyed this course.

And what I can only suggest is that the whatever I have discussed is just part of entire remote sensing subject and because of limitations of time and other you know and this is structure of such courses, so a lot of resources are available a lot of texture or you know for studies available and through books through journals and of course through net also lot of data is available, lot of software's are available. So only thing is jump into it and start doing start analyzing by yourself and slowly one can become you know expert on remote sensing. So this brings to end of this course as well thank you very much.