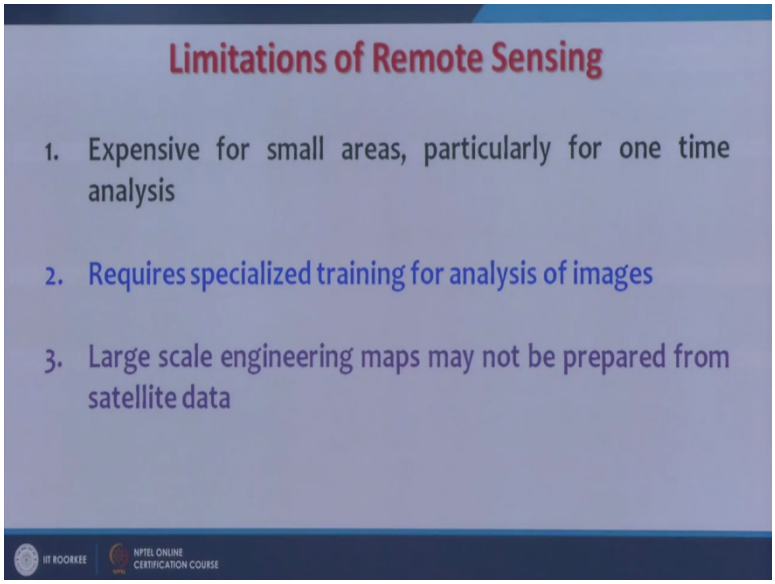
Introduction to Remote Sensing
Dr. Arun K Saraf
Department of Earth Sciences
Indian Institute of Technology Roorkee
Lecture 20
Limitations of Remote Sensing

Hello everyone and welcome to the last lecture of introduction to remote sensing course and we have seen a lot of we have throughout this course, we have discussed a lot of benefits of remote sensing. But as you know that not technology or tool is universal so remote sensing. Every tool is having some limitations so the remote sensing also and one by one we will see what are the limitations and and may be today's in present world we we might be considering them as a limitations but may be tomorrow, we have to remove from list of limitations of remote sensing.

(Refer Slide Time: 1:13)

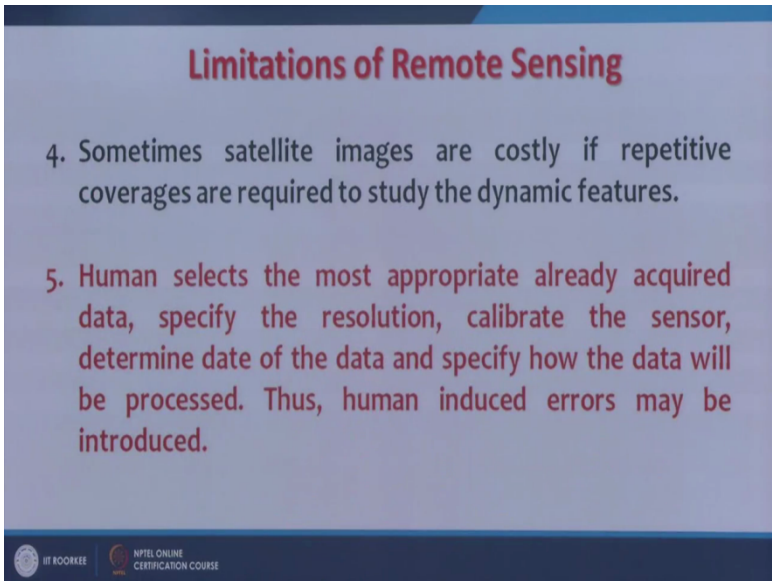


So but whatever the present remote sensing which is available to us, we will consider this because in past remote sensing has been oversold and some people have got impression that remote sensing can solve each and every (shal) problems which are being faced by the human. So this is not true and this are what we are going to see. Generally it is thought that for even a small area, the solution is expensive because if only 1 time analysis is required then we have to have data and that too data generally nowadays it is in digital form.

Then we have to have some expert system who will analyze the data, interpret the data, make inferences of the data. So initially it is thought that if for a small areas this is not a very cost effective solution, it is expensive solution which a as I have already mentioned that it requires a specialized training for images because everyone cannot start interpreting images, everyone cannot process the remote sensing data and therefore you require a specialist to do this thing or you require training for people those who are already working especially for analyzing remote sensing data.

Large scale engineering maps may not be prepared from satellite data. This is another limitations and that if we are looking for very high for a small area, a large scale map and where some engineering structures are going to be umm created then probably remote sensing cannot play measure role. So that is 1 sort of limitation because as you know that one of the biggest advantages of remote sensing is synoptic view. Now what is if it's changing. People are looking for higher and higher spatial resolution data and therefore they are looking small areas but in much more detail, much more clarity they are looking and therefore up to certain extent, this may work but (af) beyond that, it starts giving some problem so large scale engineering maps may not be prepared from satellite data.

(Refer Slide Time: 3:21)



If we continue on this, the 4th limitation one can identify is sometimes satellite images are costly. If repetitive coverage are required to study the dynamic features but as as we have been discussing that the many satellite images especially from Landsat series or some other satellites, if coarser resolution satellites if you talk then more or less that data is free. For example from NOAA AVHRR, that data is free, from Modis data is free, even from Landsat which is a moderate resolution, a special resolution data, that is also free.

But none the less, if somebody is really looking for a a complete continuous time series data and (re) for such analysis which requires the you know to study the dynamic features then one has to buy the data and the when you have to buy the successive satellite images for the same area, it may be expensive, especially like studying agricultural related you know outcrop, outputs or crops or disease in the plant and so and so forth. For that purpose, you really require a data of certain time that may not be available free of cost and therefore you are might be having they say you have to buy and it may be expensive as well.

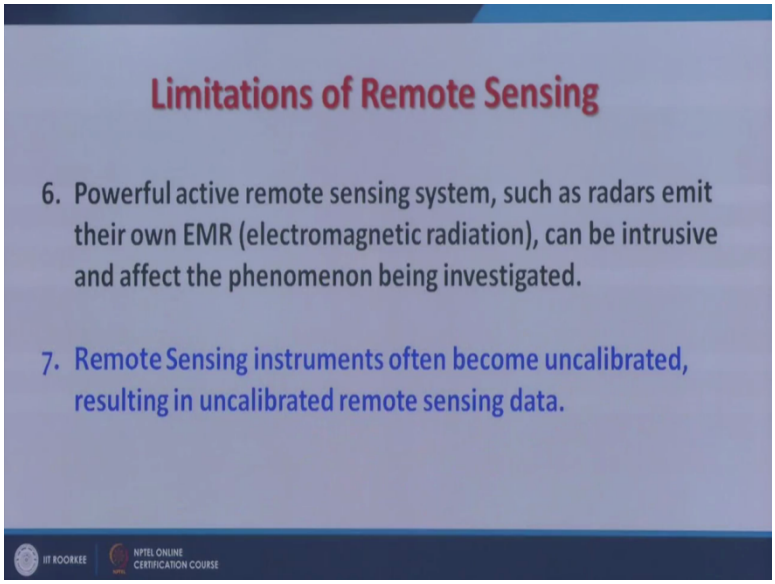
Now another thing is that sometimes, though remote sensing completely um records things unbiasedly but human is human role is always always there so human slagged the most appropriate already acquired data. (especia) especially finding the resolution to calibrate the sensor determine date of data pre decide that which date data now this may give (sa) some problem that how the this data will be processed thus human induced errors may be introduced because if we don't have the complete information about that particular area.

And for example as in previous discussion we were suppose working on groundwater recharge point of view if wrongly I choose a pre monsoon and post monsoon image then I am going to make wrong interpretation though (re) remote sensing recording is completely unbiased the but the choosing of the data of scene or date of data is human judgment and that may, for that particular year, that may be not good so one has to before one decide certain things for chain detection or such kind of a studies for some time, at least some back you know some time series data has to be studied first for that area if we start employing for that.

So this is very important to choosing a data, date is chosen by the human. Sometimes it is also depending because the (sa) a moderate resolution or high resolution satellites are not orbiting everyday of the same part of the earth so whenever it is available, you have to have and that may

be little different what one is looking so that may include or induce some errors of some biased in our interpretations.

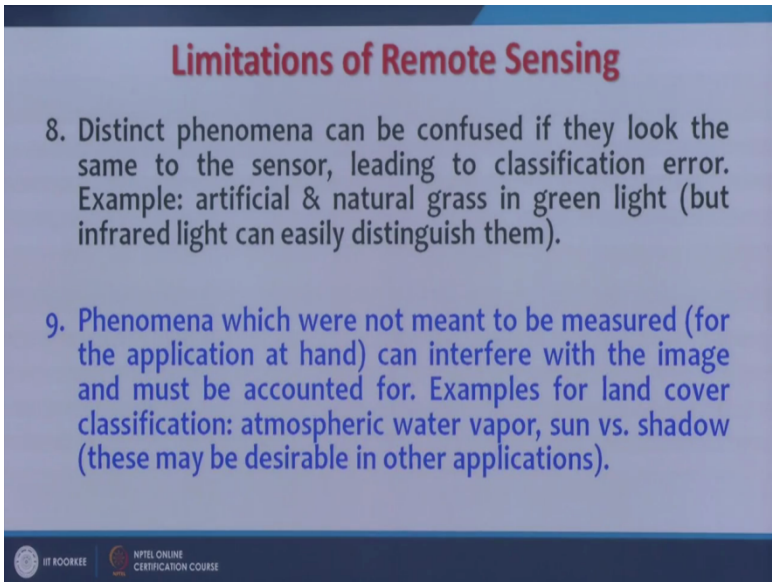
(Refer Slide Time: 6:41)



If we go further on this, powerful active remote sensing systems mainly I am talking about radar systems and which emits the (ya) EMR EMR electromagnetic radiation can be intrusive and affect the phenomena being investigated. So this radiation which is being caused by the satellite may affect a particular phenomena so in very in a sensitive area, that might be a limitation. Remote sensing instruments often become uncalibrated resulting in uncalibrated remote sensing data.

Before the launching, everything was in order, it was all calibrated, everything got tested and further tested but after the launch, you don't have much controls left and therefore the calibrations, if (grow) goes bad then you don't have much choice so that is another a big problem that though on ground it was calibrated but later on if sometimes goes wrong, it cannot be calibrated because nobody can go and hold that satellite and do the calibrations again so that is another limitations especially from those who are operating the satellites, remote sensing satellites.

(Refer Slide Time: 7:54)



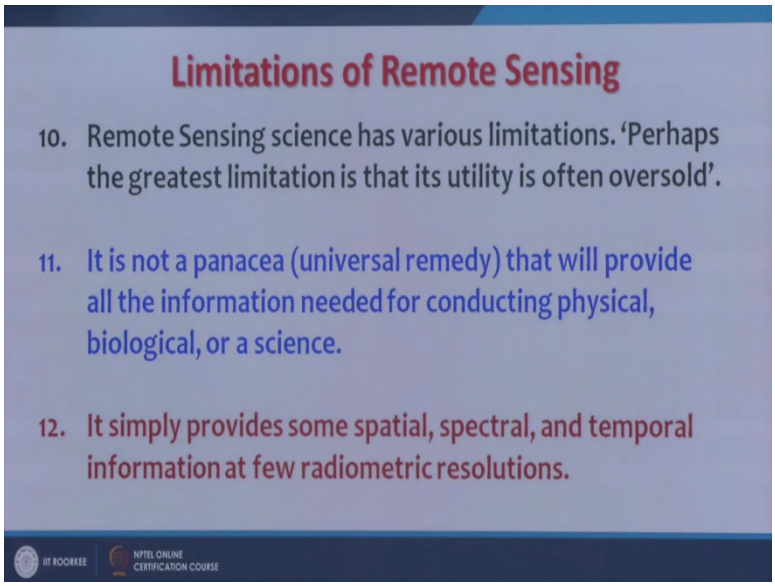
Another one is the distinct phenomena can be confused if they look the same by to sensor leading to classification errors. Of course (class) when we were discussing the classification of remote sensing data (I) this this point came that even if I employ the classification technique or same data at training sets of the same area but 2 different dates images, I am going to have different kind of errors or different kind of accuracies on my classification data. So classification of satellite images is always there is a some issues will always be there especially about the accuracy of the data because if I can go and check everything on the ground then you don't really require then remote sensing.

So we we always minimize or optimize the field work or ground truthing and just employing the remote sensing so but these things are improving further because of some other techniques which are coming based on artificial intelligence or neural network and others which are improving our classification of satellite data and that become very reliable. Phenomena which we are not meant to measure for the application at hand can interfere with the image and must be counted for. Anything which is there may not be useful if I am looking something which is little different than what is present and that may create some confusion.

For example, a land cover classification is done then atmospheric water vapor, sun versus shadow are also present in the images. These are creating problems, these are reducing my or

creating errors in my classification, image classification but these are already inbuilt in the image so we have to handle these things very very carefully so this is another very big limitations of remote sensing data that whatever is present in 1 scene, within 1 satellite scene or image, one has to handle. Even if one is working for groundwater, it has to be handled. If it is one one working for to prepare a land use land cover map, that has to be handled very carefully.

(Refer Slide Time: 10:09)



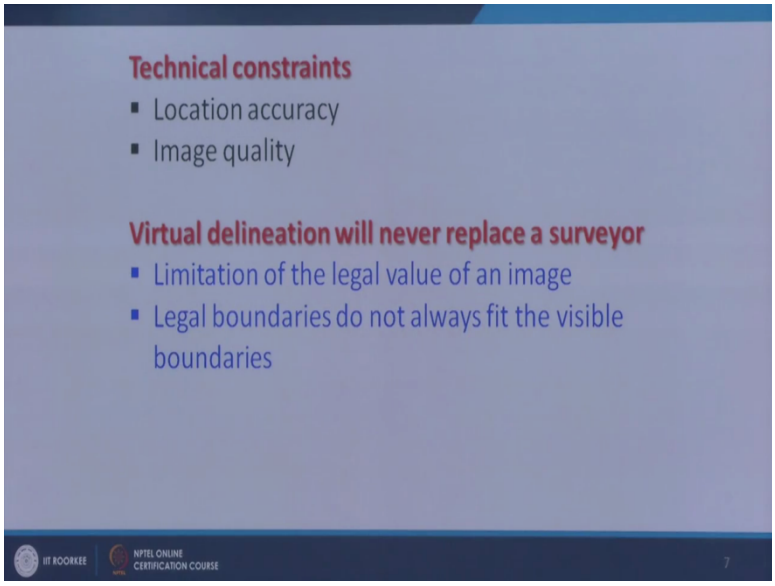
Now one more is the remote sensing science has various limitations. Perhaps the greatest limitation, its utility to often oversold. This I have already mentioned this point that it is oversold. People have advocated that it can solve each and every problem of the world but this is not true and that is one of the you know high expectations people are having and it is not always remote sensing can solve but of course, indirectly or directly it can provide certain inputs towards the (natu) problems especially related with natural features, natural disasters, natural phenomena and it is not panacea that that this will provide all information needed for conducting physical, biological or a science, this is not a complete solution, it's not a universal tool.

Every technique is having its own limitations and unnecessarily if one apply which, may not be applicable then you may create results which um which are going to be highly unreliable and may create some problems in future so one has to think that whether this tool, that is remote sensing technique can really be employed in a to solve certain problem or not. If it is not then

one should not go but sometime may not be directly, sometimes indirectly the information which can be gathered from remote sensing can go into to solve certain problems as one of the inputs as layer, one of layers, data layers or (dat) theme to solve a problem. So this this is another limitation of remote sensing. It is a what basically remote sensing providing is spatial, spectral and temporal information at few radiometric resolutions so for everything for every place, every information is not available.

So you sometimes you get the high spatial resolution but you don't get the high radiometric resolution and may be you are getting like hyperspectral data so very high spectral resolution but you are having relatively very small strip, very small coverage of that part. Now that means what? Suppose there is um you know from mineral mineral resource point of view, there might be a mineralization zone but the (a) the data hyperspectral data I am having for a small area so that kind of analysis, a reliable analysis cannot be performed so all these all all 4 types of resolutions, there is 1 desires, the data at those resolution may not be available for all the area so this we can consider as one of the limitations as well.

(Refer Slide Time: 13:03)

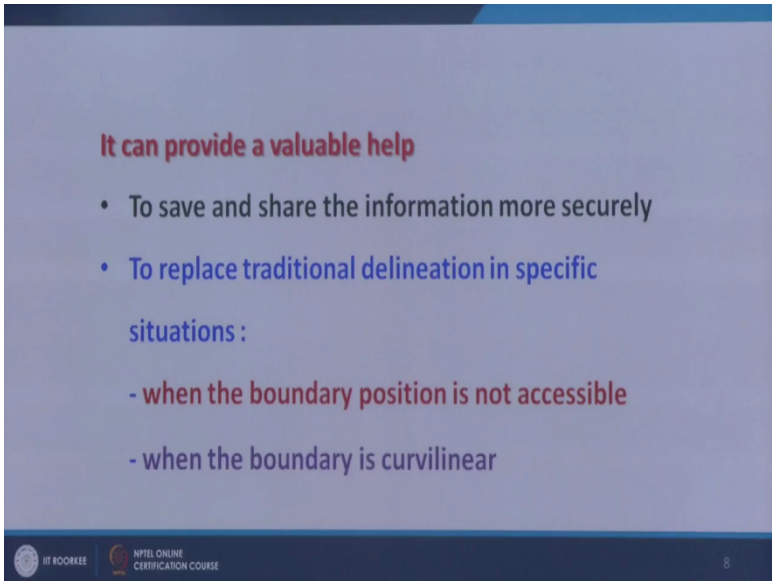


Other technical constraints are the locations accuracy which can be solved to some extent by employing differential GPS, Google Earth data and better geometric or georeferencing but still it may suffer from some local accuracy or location problem. Image quality always a issue though

we have moved much faster and higher in terms of a spatial resolution but still image quality remain the concern and the virtual delineation will never replace a surveyor. That use whatever we employ computer, artificial intelligence, neural network but the interpretation of satellite image, the analysis is always a human intensive thing also in some countries, remote sensing data is being used as in legal system as as evidence and so that where also there are some limitations of having legal value of a satellite image but still it can serve lot of purpose there.

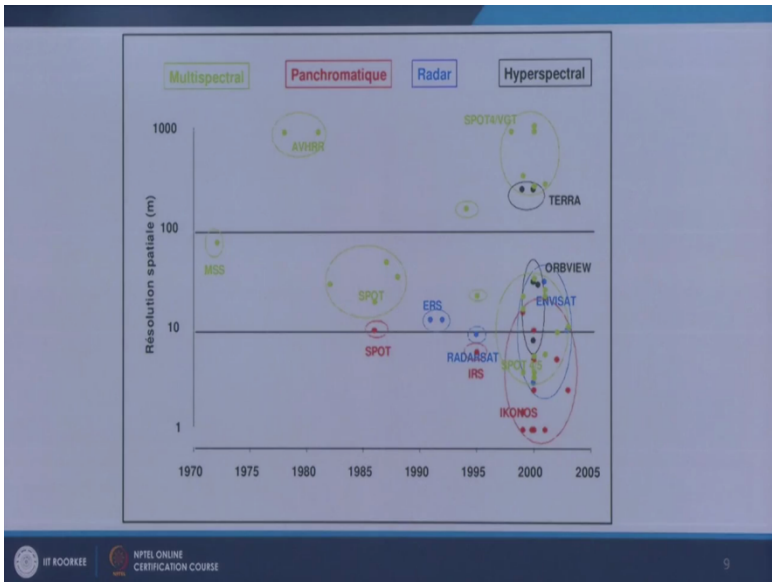
Legal boundaries do not always fit with the visible boundaries because the legal boundaries are on the maps, not on the ground and therefore not in the satellite images so therefore there might be some mismatches and some problems are there. There are some technical constraints, local accuracy part, we have already discussed image qualities is also a big issue.

(Refer Slide Time: 14:38)



So it can provide, though it provides very valuable help and to save and share the information more securely and replace traditional delineation in specific situations and when the boundary position is not accessible, this is, this is another advantage that remote sensing provides the data where human can sometimes not reach very easily. So inaccessible areas, you can still have the data and boundary, when the boundary is curvilinear and so one, still you have the things.

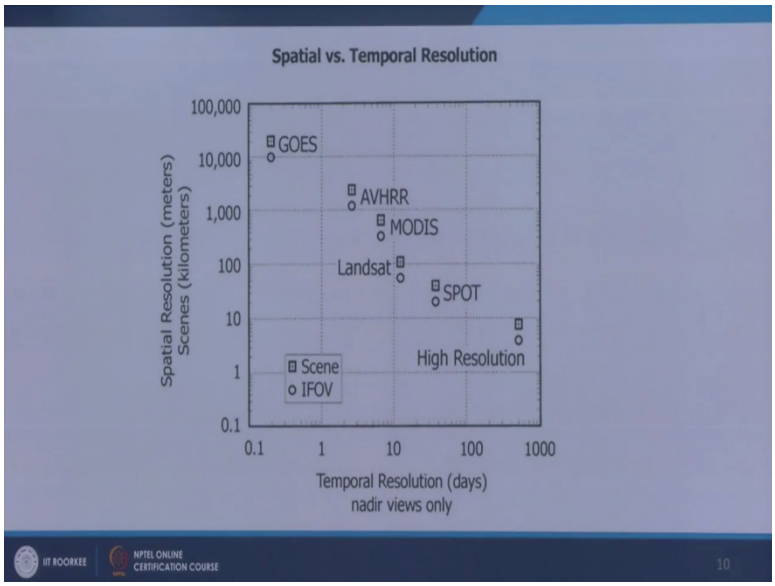
(Refer Slide Time: 15:14)



Now if we start looking little bit about the future of remote sensing so we have seen the limitation, there are various limitations and some of over some of the limitations we are going to overcome but on some limitations, they might remain there. For example, we are moving towards higher and higher spatial resolution data and this is what where we are moving and where we we from where we started, basically we started with multi spectral data.

Especially I am talking since the inception of Landsat 1 and a MSS sensor and then we moved to the Spot and ERS, radar set, IRS, Landsat and Envisat and all kinds of data so we are having multispectral data, we are still having panchromatic data, we are also having radar data, we are also having hyperspectral, so all kinds of data as we time passing, this cluster of, this cluster of different satellites as you are seeing here is becoming you know really dense compared to what it was in the 1972. So all kinds of options are available, all kinds of data is available, some of them are free, some in costing but all kinds of options are available to employ such data in remote sensing.

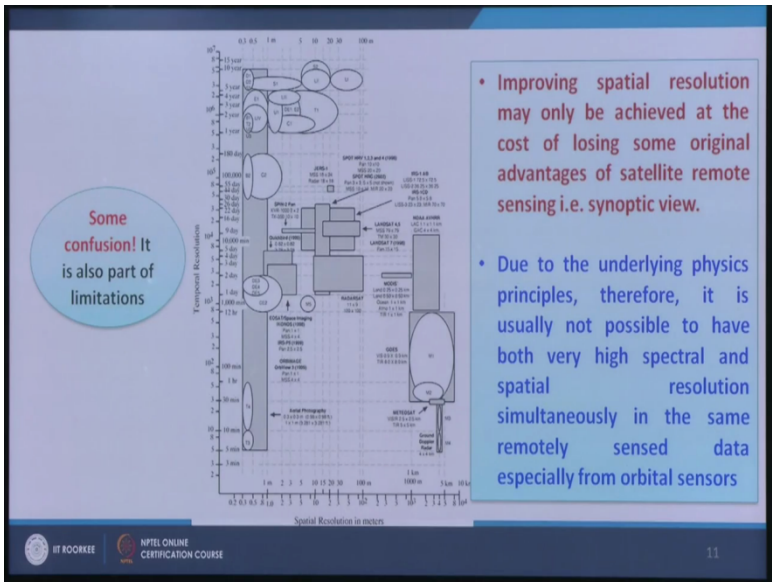
(Refer Slide Time: 17:04)



Now there is a always discussion this whether a spatial resolution is preferable or temporal resolution. As we have been discussing on this that if you go higher and higher spatial resolution and the temporal resolution reduces, because higher resolution means the narrow swath, less ground coverage by an orbit of a satellite and therefore the repetitivity becomes poor, that means the temporal resolution reduces so it's a tradeoff between temporal resolution versus spatial resolution.

If you want higher temporal resolution, may be on daily, on daily basis images like NOAA AVHRR then you have to compromise on special resolution, you have to remain in say 1 kilometer spatial resolution but if you want to (go) go for 30 centimeter resolution then you have to be prepared that the next data you are going to have have for the same area may be after 28 days or so on. So these are the limitations that spatial versus temporal resolution and therefore there is a tradeoff, different scenes are available, different types of data is available but still the limitation continues.

(Refer Slide Time: 18:00)



Also as you can see that this is spatial resolution and temporal resolution, there are choices are there, lot of systems are not available and even in our image processing becomes reliable, if the bends are located on the same (EM) same parts of EM spectrum then data from 2 satellites can also be used in tandem so that that approach is also being followed for certain type of applications especially applications related with natural disasters and others.

So may be in if we get some confusion, we can always say might be the (li) limitation of remote sensing and also this spatial resolution as as we have been discussing is improving original advantages and though it is going against the original as a original advantage with remote sensing work, it it provides the synoptic view but if you go for higher resolution, you are covering a very small area but in 2, in good details so it's a tradeoff.

Do you want a large area to cover or do you want a small area but in detail so both options are available, that's the good part of current remote sensing and due to some limitations of physics or electronics, though we want very spectral resolution and here spatial resolution data simultaneously but it is not possible so that kind limitations and and are also resolving and things are improving on these fronts as well. So this brings to the end of this particular discussion about limitations of remote sensing and a little future about GIS future about remote sensing but also it

brings to the end of this very small course on introduction to remote sensing so thank you very much all the best, thank you.