Introduction to Remote Sensing
Dr. Arun K Saraf
Department of Earth Sciences
Indian Institute of Technology Roorkee
Lecture 01
What is Satellite based Remote Sensing

Hello, hello everyone this is Arun Saraf, from department of Earth Sciences IIT Roorkee and we are going to start a new course on introduction to Remote Sensing. Earlier I have also done the course on introduction to Geographic Information System and I would like to link these two courses with a word (aa) technology word which is called geo informatics and geo informatics constitute three technologies one is remote sensing another one is GIS i.e. geographic information system and third one is nowadays is very popular is and navigation system or global position system.

Now these three technologies are having three things in common. First of all these three things and technologies are digital, secondly they are special technologies that means they are all related with the location, location specific data handling and other things and third one all these three technologies are generic and that means that you can apply to (as) as if one can think and the application area.

So that is the best thing is that all these three technologies are getting nowadays integrated with other technologies like communication and other things and overall these technologies are becoming very powerful tool for and (and) in natural resource management, disaster management and so many other application. So first (aa) as I mentioned we are going to now discuss (ahh) all this (ahh) subject that is remote sensing in detail in next 20 lectures.

So first we will see that what is basically remote sensing technology we know that (aa) in all we go by the definition that is a (re) acquiring information or data about the Earth surface without actually being in contact with it. And the best example of the motion is our eyes we (abs aa) many things we observe through eyes without even touching them, but our eyes are not sensitive in all parts of electromagnetic spectrum our eyes are only sensitive in visible part of electromagnetic spectrum and therefore we use as a human we use a very small window of electromagnetic spectrum which we will see in later lectures in detail.

But there are some animal and words which are more sensitive in other parts of electromagnetic spectrum and one (aa) we consider as (bembel aa) mammal and that is your tape which have got a different kind of remote sensing and and it is having different kind of remote sensing technology that means it sense a eco-pulses and whatever in return it records it, and base on that is basically make the assessment about a tape this is how it works.

So our eyes are only sensitive in visible part not in infrared or thermal infrared that means through distances by looking the object you cannot assess the temperature of that object unless we know some other background information.

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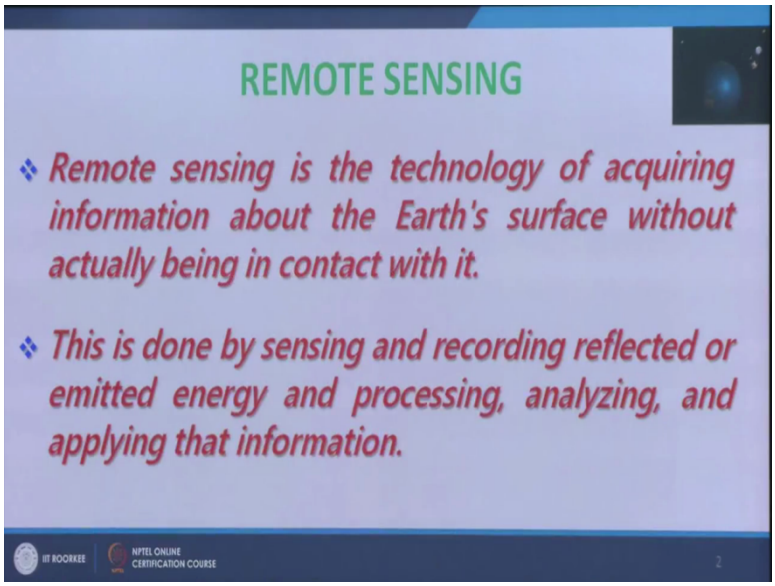

And this is a as you know now days there are various type of satellite are in space and what these satellites are doing basically they are recording whatever the reflected or am meted energy, (reflecte) for reflected energy you basically require some source and the best source for us is available is the sun.

So sun in during day time you know illuminates the part of the Earth and then whatever the reflected energy which reaches to the satellite is recorded. Emitted energy is as you know all natural objects which are having temperature above absolute zero also emitted energy and that energy can also be recorded in thermal part of electromagnetic spectrum, so that we will see later.

And in over all remote sensing what we do we do recording of a reflected or emitted energy we do the processing remote sensing also involves the analysis of remote sensing data and finally it is a and last that is not the least is the application part how to apply? How to use these data set which is huge data set now it is available from various type of satellites in for as I mentioned for natural resource management, disaster, civil engineering you name it now days people are using for (aaa) various application.

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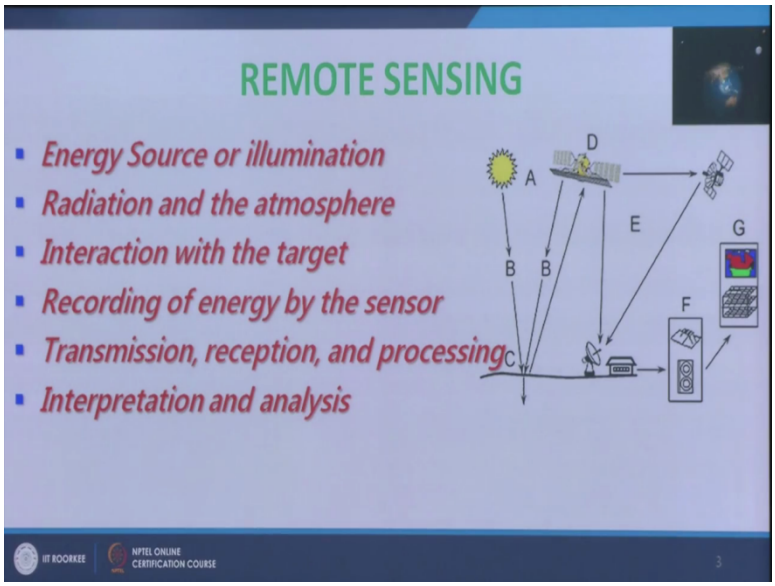

So first as you can see here that there is a illumination source which is source which is some is available to us and then we are having a satellite and then there might be a different type of satellite then we are having a ground station and then we are having recording facility analysis facility at the ground. So first as I have mentioned for this reflecting remote sensing we required energy source that Sun is available for us and the radiation and the atmosphere in between and the (aa) we are having between the Earth and the Sun we are having these phenomena.

Especially the atmosphere and then whatever the interaction it has it has with the front objects, like for example if the solar energy is falling on water it will have a different reflections, if it is falling on the bear ground it will have a different if it is on (())(6:13) it will have different. So the interaction with target is also important and that makes with the basis of basically the image making and image inter potential and analysis and this what we do after this reflection and then

again going through the atmosphere finally it is recorded by the satellite and these satellite then which are having different type of sense which we will see later.

Then this involves the transmission of data from satellite to ground Earth stations or different satellites and finally you do the processing and analysis and then of course interpretation and analysis are very very important because lot of now days data is available but not much analysis or interpretations are being done. And the new innovations are always required, integration with other data sets are also required while doing interpretation and analysis. So this set basically covers the entire remote sensing in a nut shell and of course as I have mentioned application are there people are developing new applications are been developed very regularly almost every day.

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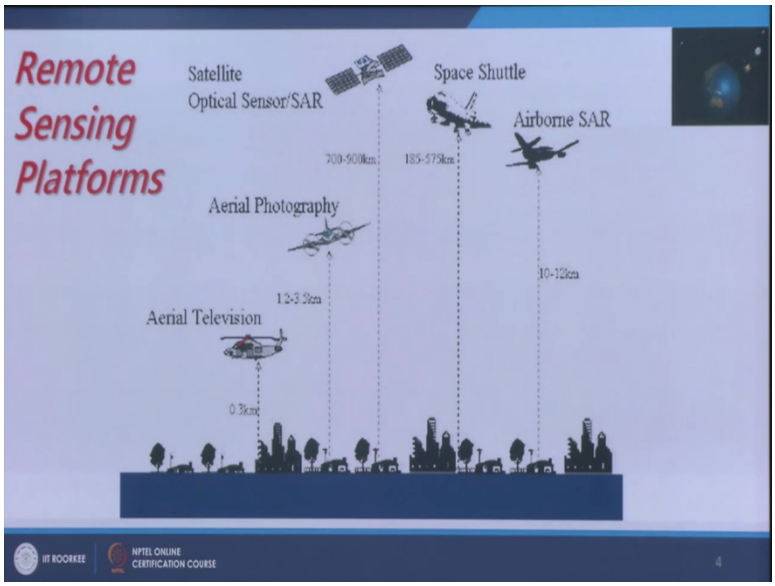

As you know that within one day, the current or the present day remote sensing didn't not start it took a lot a lot many years and we will see the history as well. So that remote sensing is also consider when we are using helicopters or aerial aero planes which is consider as aerial photography and later on we started putting our sensors also there on the aero planes, and then we are having optical sensors or other sensors through the satellite and having different distances like your helicopters are might be at 300 meter 400 meter or 1 kilo meter where as aerial photographic can be done from higher space.

Then you are having very high distance surface of the Earth about the satellites which are mainly polar orbiting satellite I am talking. Then might be some times they are having Space Shuttle vision and which are may not be at that height as 700 to 900 but maybe between 185 to 575 and then there are another for SAR Interferometry or some data remote sensing we use are different. Now days one more thing we can add here is now at these a UAV unmanned vehicles are also been use (ana aa) remote sensing as well.

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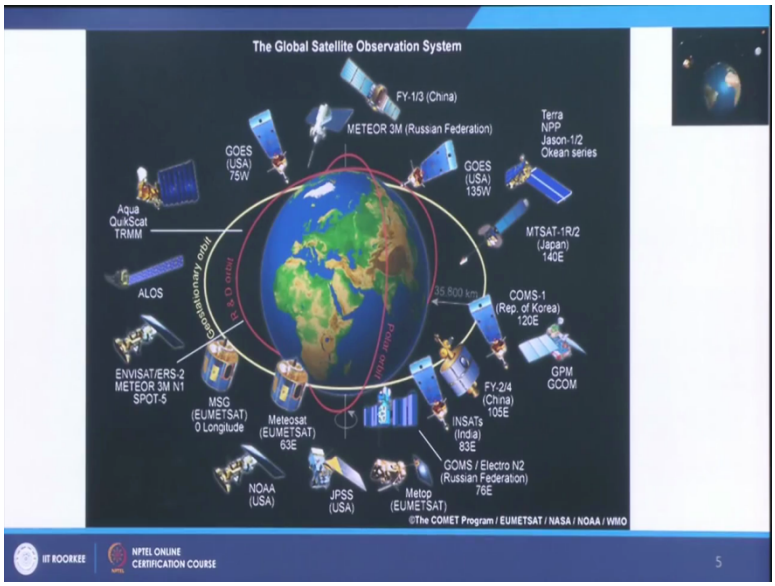

As I mentioned earlier that now days the Earth is envelope with hundreds of satellite launched by different countries, as you can see the cluster of different satellites are there our inset satellites is also here and there NOAA satellites which started in 70's and then many many satellites are there and which this is F51 to 3, F52 to 4 and these where the Chinese satellite and so on so forth. And there if you will see carefully you would find that there are 2 3 types of orbits are also sole at different distances. So this is just a representative that how Earth is being enveloped by different types of satellite which are orbiting around the Earth. Some of them might not be working or there are many many many more satellites which are working which are not sole in this figure.

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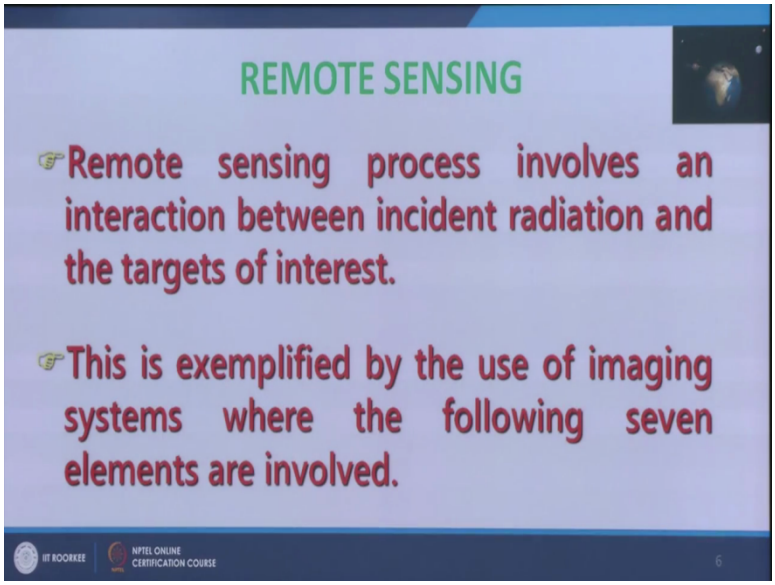

Now as we progress further in this that the remote sensing process involves an interaction between incident radiation and targets of interest and in this case when we are having regular satellites orbits the target of interest is been scanned on very regular basis depending on the height of the satellite depending on special resolution of the satellite these targets of interest are being recorded. And then this is exemplified by the use of imaging system, most of these system we are not having a like digital camera like a snap shot except a neurological satellites like inset or these communication satellites where we are having snapshots otherwise we are having imaging system which scans line by line or part of the Earth and then transmit the data towards the earth through Earth station we record the data we interpret the data analyze the data and make different applications.

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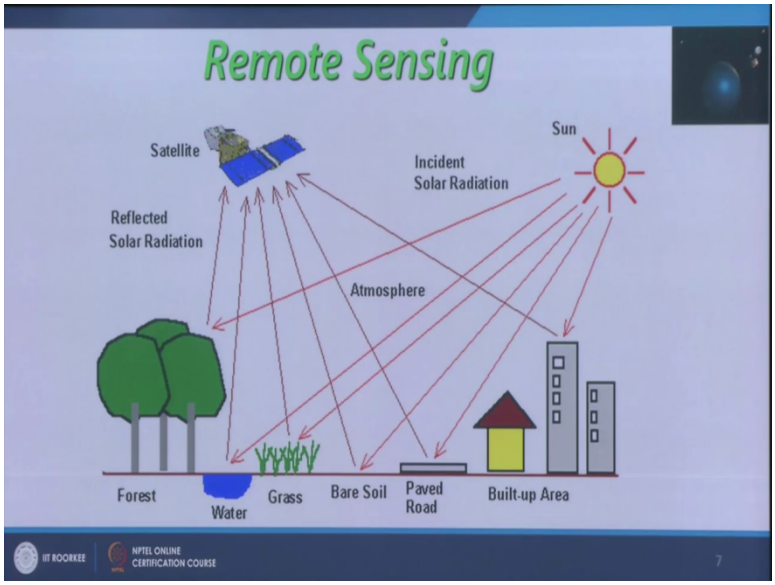

Now as you can see that for these reflected remote sensing or specific remote sensing we require a source of energy which is Sun is there and there is one satellite in sole and this energy of the Sun has to travel from the and atmosphere through the atmosphere. It reaches on the different types of the object which is present on the Earth which is starting from the building and may not be very high building and maybe the road, bare soil, grass, water bodies, forest and different type of objects are there.

Then these reflected energy reflected solar radiation has to go back again to the satellites through this atmosphere and lot of changes might also occur lot of errors maybe introduce during these transmission or (aa) this reflected radiation from the Earth toward the satellite. So that is also how to correct it how to improve our images that is also done in a digital image processing or satellite data. So that is also part of remote sensing.

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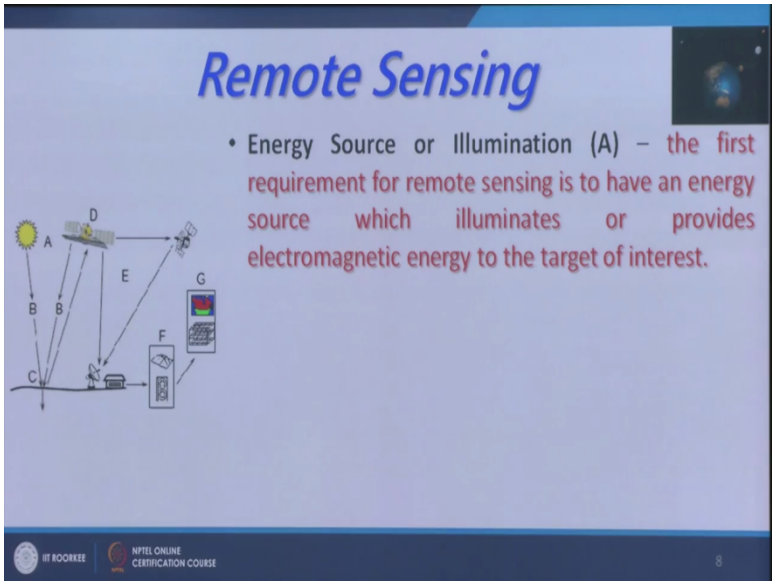

Now as a one by one we will go as A is the illumination source which is shown there as a Sun which a first requirement for remote sensing is to have a energy source without that energy source we cannot have a illuminations or we cannot have recordings of any targets of interest. And as I also mentioned that if you don't have the illumination source the natural emittance or the natural emission of energy which is coming out of the different object may also work there.

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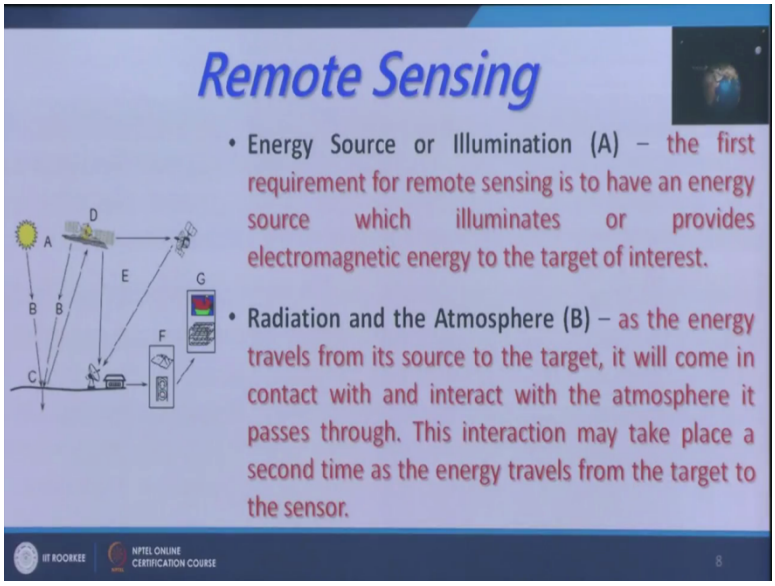

So that also there then we are having the radiation and atmosphere as I have mentioned that the solar radiation which reaches to the Earth has to go back to the satellite through again the atmosphere. So there is B component which is shown in this figure as the energy travels to the source to its target it will come in contact and interact with the atmosphere. So initially it will interact and then it passes through and this interaction may take place and may take few seconds as a energy travels from target to the sensor, so we are more concern when our solar radiation or reflected energy is going back from the Earth surface towards the satellite because that is what which is recorded by the satellite and that is what it creates the problem for us.

Suppose if there are clouds in during the day time in this passive remote sensing this reflecting part the clouds will create problem and then what satellite will record, satellite will record clouds not the part of the Earth, so this is the major issue, so the atmosphere plays a very very important role while this solar radiation reflected solar radiation reaching towards the satellite.

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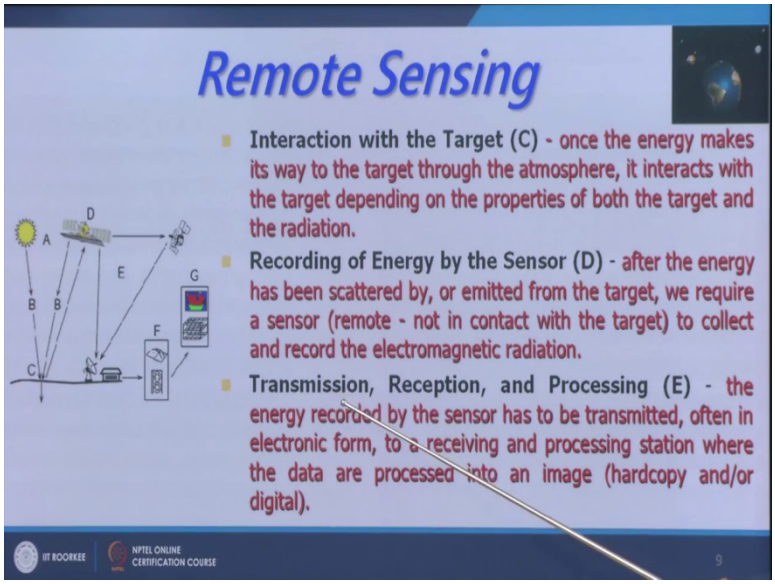

Then a the C component is the interaction with the target so their once the energy hits or the solar energy hits the object that makes it get through the target through the atmosphere it interacts with the target depending upon the properties of the both the target and the radiation here the properties as I have mentioned just two slides back that whether this a solar radiation is falling on a building or a bear soil or a rocket sources or water bodies or vegetation it will behave differently, and therefore the signature which it will reflect towards the satellite are also going to

be different and this makes basis on our image which will show these object in different, in digital values basically and we assigns these different values different colours so we see things in different colours.

And the D component is recording of energy by the sensor once the this reflected solar energy reaches to the satellite it is recorded by the sensors which are present and the recording system which are on board of the different satellites so after the energy is been scattered by or emitted as I have also mentioned earlier that a once this energy goes through the atmosphere through the satellite it has to pass through the atmosphere and this then create some problem.

Like their might be some absorptions their might be some scattering and different types of scattering which we will also see later, and which requires a sensor remote not in target to collect and record the electromagnetic radiations, so you require a require a complete recording system on board the satellite and there are satellites of also which not only records but the same time they also transmit the data towards the Earth.

So if you are having a appropriate set up for recording this data and live also simultaneously once the part of the Earth is being scanned by the satellite the same time the data is been recorded by the satellite and also it is directly being broadcasted towards the Earth stations and that can also been recorded so immediately we get the data about that particular part of the Earth for which the satellite is over passing. And the last one here is E E component that is transmission research and processing.

So transmission is done by the satellite the energy recorded by the sensor on board of satellite has to be transmitted or recorded then often it is in electronic form that is digital form then it has to be received by Earth stations which are spread over the different parts of the Earth in different countries, processing station is required the data some initially processing done and later on some advance processing or digital image processing of that data is also done. Some people may go for hard copies or now days more popular one is a digital image processing.

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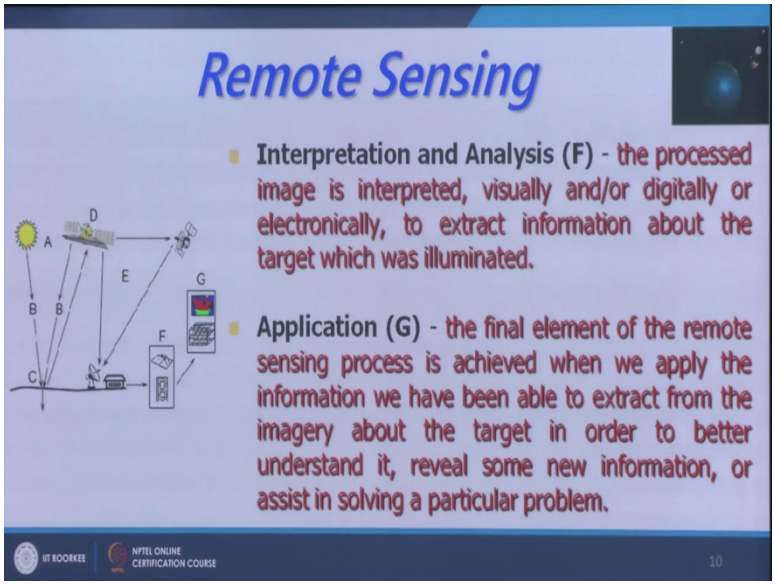

Now one after these you come with the F component that is the inter potential analysis so that the image which is recorded on the sensor of board of the satellite may not show initially the object which one might be looking or the differentiation between the object and therefore lot of processing is required. First processing is to correct do the correction of radio metric corrections their might be some problems about the sensors, scanners and those things has to be corrected.

Generally these things has to be corrected by the operators of those satellites or Earth stations then their comes analysis part the comes the how to remove the atmospheric distortions, because the reflecting energy is going through the atmosphere and this causes the lot of distortions in the data ultimately the images and these has to be removed so that our image becomes much more sharp or much more useful interpretable.

And then these there are some other advance image processing which are applied and ultimately we go for a better recognition or classification of images and we prepare using a satellite image we can prepare a forest density map, using a satellite we can make land use map or may be ethological map or structural map all kinds of map then can be derived using remote sensing data.

So we put all this in interpretation and analysis and finally the G component that is application that is the most important one is the data is there every set up is there but the data has to be

applied data has to be used somewhere. Now there are lot of applications are there people are employing data or a you're a even weather forecasting, weather monitoring if you are having the long term data then climate change people are using the data and for applications like simple preparing land use, land cover maps for forest cover maps, for vegetation density maps, even for agriculture production forecasting what is going to be the output through (rodi) ready crop or a wheat crop and so on and so forth.

Maybe mineral exploration, maybe in oil exploration, water exploration, so in a they this is a long list of applications some of the application may be is still not been developed or explore and I am sure with more data and more type of different type of sensors people will explore more application of remote sensing as well. So depends were we and most important thing whenever there is a disaster occurs whether it is a flooding or earthquake or landslide first thing people look remote sensing data and that is the true very good application of remote sensing because of these disasters the first causality is the communication.

The communication becomes very weak or very poor and there forth you have to do some (aaa) you have to find some information for rescue and rehabilitation only that is possible now days through remote sensing. So that is the data is the first look for remote sensing data. So this brings the basically very brief the introduction of remote sensing. In this course in next 19 lectures we will be seeing all this things components in much more detailed we will start with different parts of electromagnetic spectrum and we will end different applications, few examples is will show that how remote sensing can successfully being implied for water resources maybe for earth quake related studies and so on so forth. Thank you very much.