

REMOTE SENSING FOR NATURAL HAZARD STUDIES

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Lec 10b: Data Type and Remote Sensing Products-Part B

Hello everyone, welcome back to Lecture 10; this is Part 2. So, in Part 1, we discussed the data type; now we will discuss the Remote Sensing Products. So, you might have heard that there are many space agencies that are involved in remote sensing, So, what is a space agency? So, a space agency focuses on space exploration, research, and development, often with the goal of advancing scientific knowledge, developing space technologies, and promoting international cooperation in space activities. So, there are many space agencies that are involved in these activities. So, what are the major activities? So, the first one is launching rockets and spacecraft, then developing and building satellites, conducting space missions to explore planets and other celestial bodies, developing and testing new technologies for space travel, then training astronauts and space scientists, what is the purpose of this? So, when we say the purpose of space exploration or the space programs, So, here the first one is to explore and understand the universe, to develop and deploy space technologies, to conduct scientific research in space, to promote international collaboration in space exploration, and to benefit humanity through space-related advancements. So, what is the purpose? Now, you just have to see this particular image.

So, this is the evolution of how Earth has evolved, whether we are going to this phase, whether we are going back to this phase, or whether we are going to some other processes, and how our planet will be after hundreds of years, thousands of years, or millions of years that we try to understand, So, how will we understand this when we try to understand Earth? We also correlate with other planets, and then we try to understand the universe, what processes are taking place or acting on a particular planet, how things are changing, and how Earth has reached this particular time with all these lives. So, whether it is possible on any other planet or not, or whether we are going towards extinction or we are going to have some other processes, we are also trying to look for potential future human worlds, whether we can find an alternative home. So, is it possible for an Earth-like planet? So, that is why we are spending so much time and energy on the exploration of Earth, as well as other planets. For other planets, remote sensing is the only tool by which we can conduct space exploration effectively.

So, in other planetary exploration, we have remote sensing as a very, very important tool. So, when we talk about this space agency, some of the prominent space agencies from around the world are listed here. So, the first one in this list is ISRO, the Indian Space Research Organization in India, then the National Aeronautics and Space Administration, which is NASA in the USA. Then, the European Space Agency (ESA), which is from Europe, the Japan Aerospace Exploration Agency (JAXA), which is from Japan, the Russian Federal Space Agency, which is from Russia, and the China National Space Administration (CNSA), which is from China. So, these are some of the prominent space agencies, but there are many other space agencies.

So, this list is not complete. This is just for the example so that you will understand what we mean by space agency, what their role is, and what their purpose is. So, that is why I made this list. Now, here you can see some notable space missions. So, the Mars mission was very famous.

So, in the news, you might have heard about the Mangalyaan, So, the Mangalyaan is nothing but the Mars Orbiter Mission (MOM). It was very famous. India's first interplanetary mission is orbiting Mars. The next one was the Perseverance Mars Rover; this is NASA's rover for exploration, and it is for the Jezero crater on Mars. InSight lander, this was again from NASA, so it was meant to study the interior of Mars. Then we also explored the lunar missions. So, there were many missions: Chandrayaan 1, 2, and 3. So, here is India's third lunar mission aiming to land a rover on the moon's surface, because we wanted to collect some of the in situ information. Chang'e mission includes China's lunar exploration program, including a sample return mission. So, a sample was also collected.

So, these are some items from the list; it is not the complete list. This is just to tell you that there are many activities going on for space exploration and to understand our own planet, Earth. Juno mission. This was launched by NASA, ESA, and ASI, So, like that, we have many missions focusing on different objectives and different aims, So, with different aims and objectives, these missions were launched, and we are trying to understand our universe and our own planet to survive on this particular planet and to know what will happen to us in the near future or in the future, So, when we talk about these space activities, the satellites play a major role, So, when we talk about planetary exploration, we are sending satellites and capturing data. As I mentioned in the previous lectures, spaceborne satellites are the career.

Spaceborne Satellite Sensors

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Satellite sensors are instruments mounted on satellites orbiting Earth or other planets, capturing data across various electromagnetic spectrum bands about the surface and atmosphere, including images, temperature, and other parameters.

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So, remember that satellites are the carriers of the payloads, and they carry instruments, equipment, or systems designed to perform specific functions or tasks while in orbit, such as communication, observation, or navigation. So, these are satellites and payloads because they are carrying these instruments. So, the scientific or technological instrument carried on board a satellite for a specific purpose is termed a payload. So, these are the payloads. which are mounted on this particular satellite and are doing the measurement.

So, remember that satellites are the carrier payloads, which are basically your sensors or the instruments that actually work. So, the platform is your satellite. Satellite sensors are instruments mounted on satellites orbiting Earth or other planets, capturing data across various electromagnetic spectrum bands about the surface and atmosphere, including image temperature and other parameters. So, here you can see some of the satellites that are in this particular figure, and these are capturing the information in different wavelengths. So, various bands of the electromagnetic spectrum are used to capture the information.

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Earth Resources Technology Satellite launched on 23 July 1972.

LANDSAT SATELLITES : The longest Continuous global record of the Earth's Surface.

Landsat 1 (1972) to Landsat 9 (2021)

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And this information is about the surface and atmosphere. Here it can be an image, it can be only

the values. So, both of them are remote sensing, So, spaceborne, they are carrying the payloads, and the payloads are basically the sensor. So, these sensors are one of the examples, and they are from the Earth Resource Technology Satellite, which was launched on the 23rd of July 1972, and later on, in 1975 or so, it was renamed as Landsat satellites. Since 1972, these Landsat satellites have been continuing.

So, we have various series: Landsat 1, 2, 3, 4, 5, 6, 7, 8, 9, and the latest was launched in 2021. That is why we call it the longest continuous global record of the Earth's surface, and this is one of the datasets that is available in the public domain. So, if you are familiar with remote sensing data products, you might have heard of or used the Landsat data, and here this particular graph tells you the different band combinations that are available for these Landsat datasets. Some examples of spaceborne satellite data.

So, here you have Sentinel, MODIS, ALOS PALSAR, ASTER, HYPERION, IRS, Cartosat, ResourceSat, Aryabhata, and then IKONOS; these are available from different space agencies. This is not the list of a particular space agency; it is a mixture. So, these are some of the commonly used satellite datasets, which are popular, but this list is not the complete list. So, some of the key resources I want to highlight are here. If you are willing to work in this particular area, you can get the data from USGS Earth Explorer, NASA Earth Data Search, Copernicus Data Space Ecosystem, Sentinel Hub, Bhuvan-ISRO, NOVA, and Google Earth Engine.

Meteorological and Oceanographic Satellite Data Archive Center of ISRO. So, these are the agencies that are giving you the datasets, but again this list is not the complete list. You may explore more addresses or the webpage where you can get more of the various datasets. The digital elevation model you have is one of the most popular: SRTM. which is the Shuttle Radar Topography Mission.

Then Aster GDEM, this is from the Advanced Spaceborne Thermal Emission and Reflection Radiometer Global DEM. GTOPO30, AW3D30, IKONOS, and Cartosat are providing you with the digital elevation models. Now, we will try to correlate these or use them in the GIS Information System. Now, we have learned about the data types and the remote sensing products. Now, we will try to use this information together, and we will have the GIS environment.

So, before we continue with the GIS, we should understand what we mean by GIS. So when we say "geographic information system," it is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. Now, there are all types of spatial or geographic data that are very, very important. So, what we mean by spatial or geographical is unclear. So, the data set which has the latitude and longitude information means the location information.

When we have the latitude and longitude information for a given data set, it becomes spatial or geographic data, Now, here we will refer to this sentence again. So, it is a system designed to capture and store information, meaning we are capturing and storing the data. So, when we are capturing the whole remote sensing data, we are storing it, which means we are maintaining the database; then we are playing with that data as we analyze it. So, the analysis is also within the geographic information system; we are managing it or updating the information because you may have collected some data. Here, it is not necessary to have the data from remote sensing; it can be from your field, So, once you have collected the data from the field, let us say the water table depth.

Then we have air quality, then we have the population, then we have this map. and all these records are against this particular point. So, in GIS, we are capturing data, going to the field, doing the measurements, and then storing it. So, we are making this table here, and here it will be x, y, and now the attribute we can generate. So, here this is the first one, this is the second one, this is the third one.

So, the first, second, third everything can be stored here. Then, other parameters are also listed here: 5, 6, 7. So, everything is listed here. So, we are storing it; then we are trying to analyze it and then we are also trying to manage means, let us say this is still 2025.

After we did this study, maybe the next group of people is also doing the same measurement. So, they will update this information. So, let us say that in 2030 we have some more information. So, we are updating the information, So, this is managing this, and now finally we will be representing the information in terms of a map, which is also a key role of a geographic information system. GIS allows the integration of many data sets in a single map.

Now, to understand this, maybe one group of people or one person has developed a map; this is the capital of states, Now the second group of people has generated the state boundary. So, this is the state boundary. Now, the third group of people is generating the surface water map. So, this is a fluvial system, and here you have one lake. Now, taking these 3 groups together, we can overlay this information and create one map, which is basically the fluvial map, and then we will place the state boundary here.

Please do not mind; I may not match these boundaries, but this is just for the example, Now, we are putting the capital of these states here for each polygon we will have. So, now you can have this kind of map generated because GIS is enabling the integration of datasets. Now, once we have this kind of map, we will easily calculate whether this capital is far from this fluvial system, whether this particular capital is very far from the next capital of the adjacent state, how far it is, and whether this fluvial system or this river crosses all the states of this particular country or not. So, this kind of information is possible to extract only when we are working with GIS. Because GIS will have the spatial or geographic data,

which includes latitude and longitude information, it is important to extract the information or even to integrate different data together; otherwise, it will not match the boundaries, here it enables the visualization I explained you question whether this particular capital is far from the river channel or not. Analysis of the data interprets the data correctly. So, here you will try to understand the relationship patterns and the trends more efficiently. So, that is the advantage when we are dealing with datasets in a geographic information system environment, So, GIS is an organized collection of computer hardware, software, geographic data, and a group of people that are present here to capture, store, update, manipulate, analyze, or display the data. Now, here it can be a group of people; maybe the first group is responsible for capturing, the second is responsible for storing, the third group is responsible for updating, the fourth group is responsible for manipulating, and the fifth group is responsible for analyzing and displaying.

So, it is not necessary to have it with one group; it is also possible in GIS when multiple people are involved. So, let us first understand that when we talk about a geographic information system, we should start with the data. So, when we collect the data, we try to store it correctly. So, whether this is information or whether it is different, So, I will explain to you with one of the basic examples.

So, this is the question. So, when we try to answer whether data is the information or information is different. So, before that we need to answer some of the questions. So, whether data and information are both the same. So, they are different; data is of little use unless it is transformed into information, Information is the answer to a query based on raw data. We transform data into information through the use of an information system.

So, we will try to understand with some examples, and I hope you will be very clear about these concepts. When we communicate our information to a computer, we basically put these values because computers understand only numbers, but when we try to see them, we will not be able to remember all these values, but what computer will it be converted to some letters, and these are very easy to remember, So, here you see, this is the data; this is the information. So, we do not remember this, but we will easily identify or understand it. So, this is the information, and this is the data. So, without information, that data is of no use.

Now, what is an information system? So, here we will see some examples. Now, you have an information system, just assume this is an information system and you have a question, So, when you have a question, you put that query here in the information system, and then you get the answers. So, this is called information system. So, it is basically a database. So, the information system is a system that is able to answer your query.

Now, some of the information systems are phone books. When you go to the library, you have a catalog or, nowadays, the Google search engine or any other search engine, which

is one of the best examples. But that will not be the information system; here we are talking about the information system that is, again, the digital information system where everybody is connected through the internet knowingly and unknowingly, we are sharing our data, our location information, and when we are traveling from A to B, we are sharing our velocity and the speed of the vehicle as we try to reach B from point A.

We are sharing our mobile datasets. So, on that basis, it can calculate what the speed is at which you are moving. So, that information is used to suggest to others how much time it will take to reach from A to B. So, this is one of the examples. how this digital information system work. So, the digital information system is an integration of hardware and software that enables advanced research, communication, education, awareness, etc.

So, nowadays you might be confused about some topics, and then immediately you will search for them on the internet, you will search and get so many answers, and then it is your wisdom to select which one. So, information whatever is available in internet that is not correct. So, it is not wise to randomly use or absorb that particular information. So, wisely use the correct information, and then you have to understand that particular statement. So, when we say geographic information system data acquisition procurement, that is also part of it; data management, that is also part of it; then qualitative and quantitative analysis, that is also part of this GIS system.

So, this is one example I would like to show you so that you will understand in which areas or in which domain GIS is used. So, here you can see the list is not limited to this, So, the application of GIS and remote sensing products has increased over time. Nowadays, most of the people working in hazard-related studies have the remote sensing products. So, remote sensing and GIS together make a very powerful tool to be used in hazard studies. So, with this, I will end this lecture.

Thank you.