Applications of Remote Sensing.

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Abstract:
Remote sensing is the phenomenon of obtaining information about an object by a sensor that is not in direct contact with the target of investigation. Any photography is a kind of remote sensing. To cover large areas from which information is required, we have to take photograph from larger distances. Aerial photography was first introduced in World War I for military uses. Now the more advanced technology of satellite imagery has emerged. Remote sensing refers to the activities of obtaining information about an object by a sensor without being in direct contact with the object.

Radio communication or space communication uses electromagnetic waves to carry information over a very long distance without use of wires. Radio waves ranging from 100 KHz to 300 GHz can be used for communication purpose. In case of electromagnetic wave, at any point of propagation, electric field and magnetic field are perpendicular to each other. Electromagnetic waves propagate through atmosphere above ground and through ionized particles above 100km and up to 400km. The lower layer is called troposphere and the ionized layer is called ionosphere. There are three ways by which radio waves propagate from transmitting antenna to the receiving antenna through; a) Ground wave propagation b) Sky wave propagation c) Space wave propagation. In the present paper our major focus to discuss the various applications of Remote sensing such as, Costal studies, Natural disaster, Agricultural and forestry, Archaeology etc.

Key Words: Remote sensing, Radio communication, Space communication, Ground Wave, Meteorology, Geological sensing etc.

Introduction:

A satellite equipped with appropriate sensors to acquire data can be placed in an orbit around the earth at any height having a period of revolution. It takes photographs or collects any other data or information desired and transmits it back to an earth station. This is known as remote sensing. The LANDSAT series of satellite designed for land uses applications. These satellites move in near polar orbits at an altitude of 918 km. The instrument on board which, over the years, has provided most of the data is a multispectral scanner. The satellite travels in a direction slightly west of south and make passes over the desired region many times a day. Thus, different parts of earth are scanned. The data obtained is transmitted to the receiving station on the earth.

Fig. 1 Remote sensing.

Taking photograph of any object relies on the reflected wave from object as we use visible light in normal photography. Waves of any wavelength in the electromagnetic spectrum can be used for this purpose by employing suitable sensors. However, selection of wavelength of the radiation depends on the effect of atmosphere including ionosphere and the nature of the objects to be scanned. The visible and near infrared bands are chosen to separate specific earth features such as vegetation and water. This is because the reflectance from different objects is different. The data from the thermal infrared bands are of high interest, particularly due to the fact that the thermal infrared data is a measure of surface temperature and can also be obtained at night. Microwave data are of particular relevance for certain hydrological variables such as soil moisture and perception. They can also be obtained at night and are not restricted to cloud-free conditions. The following are some useful applications of remote sensing[1].

1. Meteorology: (Development of weather systems and weather forecasting)

This is the application of science and technology to predict the state of atmosphere for a given location. It covers predictions ranging from short-lived to long-term weather. The information of interest includes, among others, the location and development of weather systems such as clouds, rainstorms, tropical cyclones, cold and warm fronts. Information needs a physical carrier to travel from the object to the sensor through an intervening medium. In remote sensing, the information carrier is the electromagnetic radiation the output of a remote sensing system is usually an image representing the object being observed. The way the image look depends on the source of electromagnetic radiation from the object and on the interaction of the electromagnetic radiation with the intervening medium. Applications of remote sensing span a wide range of fields. These include Meteorological satellites that detect clouds and moisture in the atmosphere. Weather radars that probe rain areas. Meteorological satellites can be used to keep track of weather systems days before they come close to an area. This is particularly useful in monitoring severe weather systems like tropical cyclones. The very basic application of meteorological satellite is in identification of clouds. Clouds can be broadly classified into three categories according to the cloud base height, namely, low, medium and high clouds. Some clouds, such as cumulonimbus (a type of thundery clouds), span the three layers. Sensors on board meteorological satellites are pointing towards the ground, enabling them to have bird eye view of the globe from the space. There are two types of meteorological satellites characterized by their orbits. They are geostationary satellites and polar-orbiting satellites.

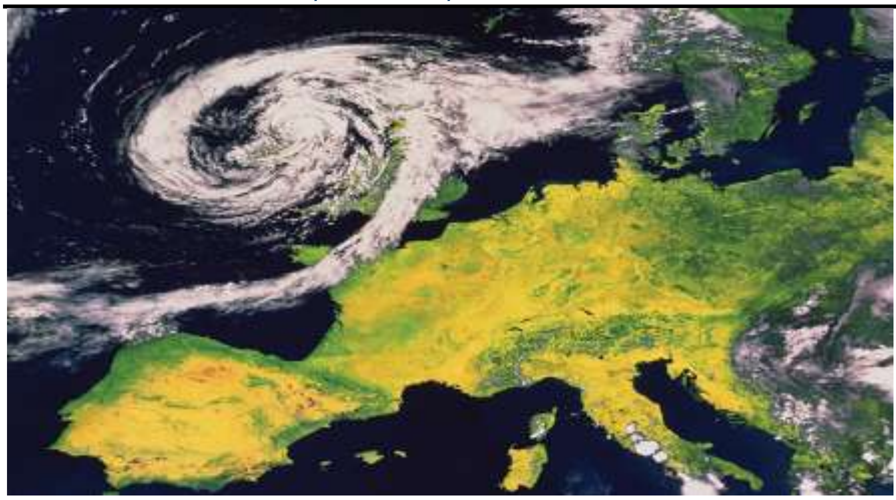

Figure 2: Weather forecasting.

As the name suggests, a geostationary satellite is stationary relative to the earth. That is, it moves above the equator at the same rate as the earth's rotation so that all the time it is above the same geographical area on the earth. In this manner, it is capable of taking cloud images of the same area continuously, 24 hours a day. As it is some 35,800 kilometers from the earth, it is capable of taking cloud pictures covering part of the whole globe. These satellites together provide full coverage of the earth. Polar-orbiting satellites are low-flying satellites circling the earth in a nearly north-south orbit, at several hundred kilometers above the earth. Most of them pass over the same place a couple of times a day. As they operate at a distance closer to the earth, they are only capable of taking cloud images of a limited area of the earth each time. Compared with geostationary satellites, polar-orbiting satellites offer fewer and smaller cloud pictures. However, the advantage is that the cloud pictures obtained are of much higher resolution. Different clouds have different characteristics in terms of shape and pattern and have different tones in the visible and infrared images. These differences enable the identification of clouds using a combination of the visible and the infrared images. For instance, fog and low dense clouds are characterized by their sharp boundary and smooth texture on satellite image.

2. Oceanography; (Sea surface temperature, mapping of sea -ice and oil pollution monitoring)

Oceanography is important to many of the nation's social concerns, including the following: Global Change. The ocean plays a important role in regulating both natural and human-induced changes in our planet. The role of ocean circulation and the coupling of the ocean. The average temperature of the ocean surface waters is about 17 degrees Celsius (62.6 degrees Fahrenheit). 90 % of the total volume of ocean is found below the thermocline in the deep ocean.

3. Climatology: (Monitoring climate changes).

Remote sensing techniques, and specifically satellite images, have been already successfully used in a wide range of climate change fields, such as for: (i) investigating global temperature trends, both at the ocean surface and in the atmosphere, (ii) detecting changes in solar radiation affecting global warming,

It is used in aerial sensors to detect or locate objects on the earth's land surface or atmosphere, by means of transmitting electromagnetic radiation. Remote sensing has improved weather forecasts, showing wind movement and atmospheric temperature obtained from space[2].

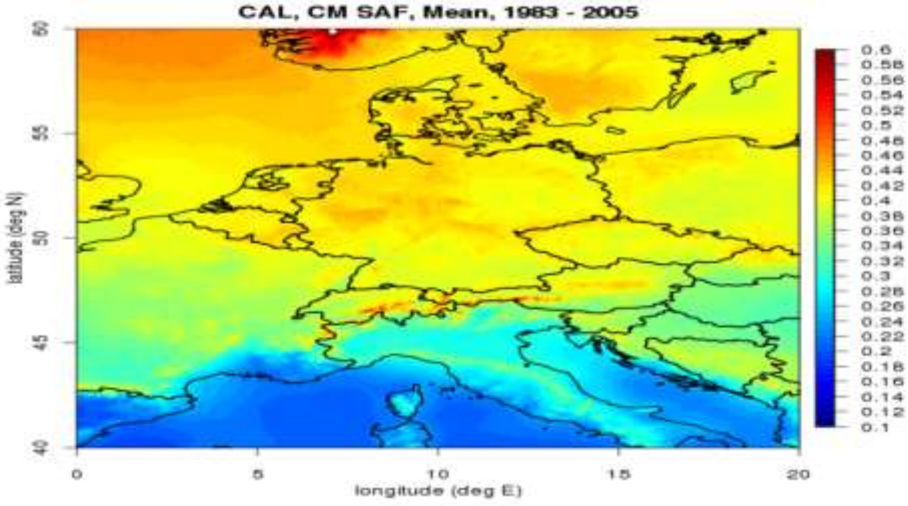

Figure 3: Climatology - monitoring climate changes.

A weather satellite is a type of satellite that is primarily used to monitor the weather and climate of the Earth. Satellites can be polar orbiting (covering the entire Earth asynchronously), or geostationary (hovering over the same spot on the equator).

4. Costal studies: (Sewage, industrial waste and pollution monitoring)

Costal or marine pollution occurs when harmful effects result from the entry into the ocean of chemicals, particles, industrial, agricultural and residential waste, noise, or the spread of invasive organisms. Eighty percent of marine pollution comes from land. The heavy concentration of activity in coastal areas, combined with pollutants flowing from streams far inland and others carried through the air great distances from their source, are the primary causes of nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, sedimentation, and other. दिस

Figure 4: Industrial waste.

Industrial waste is generated by manufacturing or industrial processes. The types of industrial waste generated include cafeteria garbage, dirt and gravel, masonry and concrete, scrap metals, trash, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and similar wastes.

5. Geological surveys.

Remote sensing data can help studies involving geological mapping, geological hazards and economic geology (i.e., exploration for minerals, petroleum, etc.). Such techniques are particularly beneficial for exploration of inaccessible areas, and planets other than Earth. Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. A Lidar (Light Detection and Ranging) image created with data collected by NOAA's National Geodetic Survey.

Figure 5; Geological surveys.

The most common are visible and infrared sensors, followed by microwave, gamma rays and rarely, ultraviolet. They may also be used to detect the emission spectra of various chemicals, providing data on chemical concentrations in the atmosphere. Radiation in the reflected IR region is used for remote sensing purposes in ways very similar to radiation in the visible portion. The reflected IR covers wavelengths from approximately 0.7 µm to 3.0 µm.

GPS is a technology used to get coordinates that "fix" points on the earth, whereas "remote sensing" is a technology to learn something about materials or objects on the earth. GPS uses the triangulation of multiple satellite positions to determine the GPS receiver's location[4].

6. Archaeology:

Remote sensing has been able to assist archaeological research in several ways during the past years, including detection of subsurface remains, monitoring archaeological sites and monuments, archaeolandscapes studies, etc

Light detection and ranging, or LiDAR, has changed the face of archaeology by making it possible to measure and map objects and structures that might otherwise remain hidden. Mapping with light. Lidar, or "light detection and ranging" technology, directs hundreds of thousands of pulses of light toward the ground Predictive modeling is a vital application for GIS in archaeology. By incorporating historic map data, physical details of an area's landscape and known information about past inhabitants, archaeologists can accurately predict the positions of sites with cultural, historical or agricultural relevance.

Figure 6; Archeology remote sensing.

Maps are important to archaeologists because maps illustrate the connection between artifacts, Eco facts, features, and the landscape. These connections, or associations, are sometimes referred to as spatial relationships by archaeologists.

7. Water resources surveys:

The process involves investigations on the quality, quantity, effects of climate change, protection of water resources and the integrated relationship between surface water and groundwater. Water exposed on the surface can be detected using visible, infrared and radar images, while freshwater entering natural basins needs thermal infrared sensors. Water resource mapping related to the specific area and compare the evolution in the years[3].

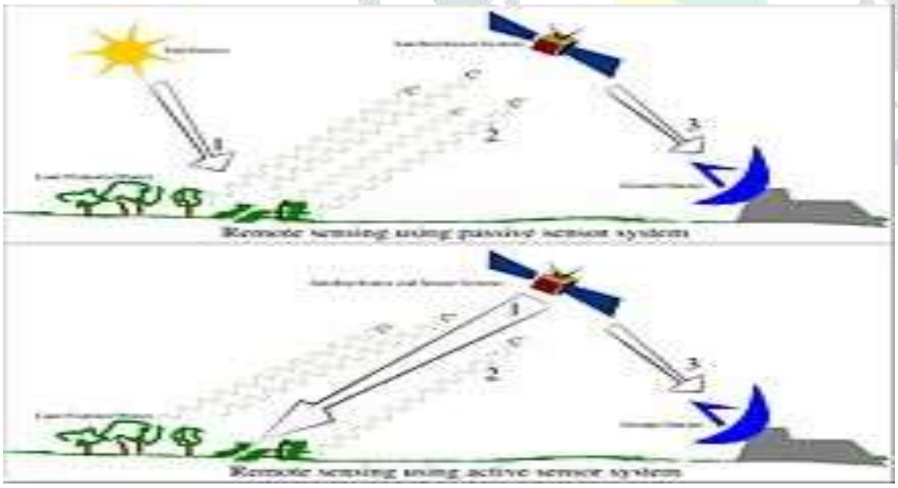

Figure 7: Water resource survey.

Of these, the resources most available for use are the waters of the oceans, rivers, and lakes; other available water resources include groundwater and deep subsurface waters and glaciers and permanent snowfields. The current limitations for image-based remote sensing applications are mainly due to sensor attributes, such as restricted spectral range, coarse spatial resolution, slow turnaround time, and inadequate repeat coverage.

8. Urban land use surveys.

The term “land use survey” includes all those surveys used to register the different aspects of land use as they exist at the moment of survey. Land use surveys are therefore “surveys of present land use”.

The three methods in Surveying all measurements are horizontal, can be inclined; reduce to horizontal and vertical components in plotting. Distance between 2 points on a plan or map is always horizontal distance irrespective of their elevation, (distance between their projection on horizontal plane). The ground survey, air survey and satellite survey are carefully analysed.

9. Agricultural and Forestry.

Remote sensing can detect, identify, classify, evaluate and measure various forest characteristics in two ways: qualitatively and quantitatively. In a qualitative way remote sensing can classify forest cover types to: coniferous and deciduous forest, mangrove forest, swamp forest, forest plantations, etc4.

Figure 8: Agriculture and forestry remote sensing.

It gives the soil moisture data and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil. Through remote sensing, farmers can tell where water resources are available for use over a given land and whether the resources are adequate. The form of crops developed in an area, crop state, and yield can be considered. Recording crop state by remote sensing can get the crop status in addition to the condition and progress of their development.

10. Natural disaster:

Remote sensing can assist in damage assessment and aftermath monitoring, providing a quantitative base for relief operations. It is used to map the new situation and update the databases used for the reconstruction of an area, and can help to prevent that such a disaster occurs again. Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological etc.

Figure 9; Natural disaster- tsunami.

The sensed data on wind patterns and trends in ocean rise have been useful in predicting the onset of hurricane and flood disasters. Such information has been used predict likely land areas to be affected and early relocation of identified vulnerable groups.

Result and Discussion:

In the present paper, we have seen the various applications of remote sensing which are very useful to mankind for survival on earth. Such as, development of weather systems and weather forecasting. To study the surface temperature of sea, mapping of sea-ice and oil pollution monitoring. The use of Science and Technology to development and to discover the natural resources using remote sensing i.e. water resources surveys, geological surveys, agricultural foresting.

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