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REMOTE SENSING, GIS AND GPS TECHNOLOGY IN PRECISION FARMING

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Remote Sensing

Remote sensing is the art and science of making measurements of the earth using sensors on airplanes or satellites. It is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special cameras collect remotely sensed images, which help researchers "sense" things about the Earth.

- Cameras on satellites and airplanes take images of large areas on the Earth's surface, allowing us to see much more than we can see when standing on the ground.
- Sonar systems on ships can be used to create images of the ocean floor without needing to travel to the bottom of the ocean.
- Cameras on satellites can be used to make images of temperature changes in the oceans.

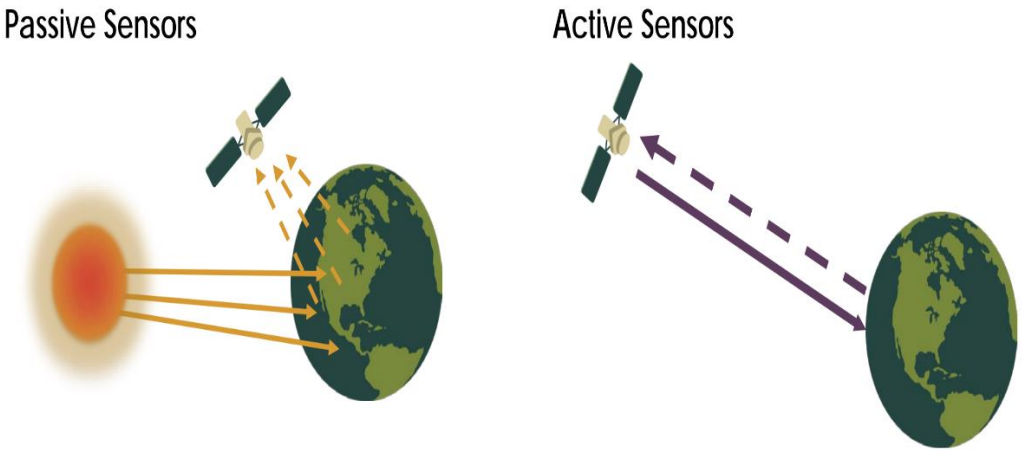
Types

Active Sensing : Active sensors, provide their own source of energy to illuminate the objects they observe. An active sensor emits radiation in the direction of the target to be investigated. The sensor then detects and measures the radiation that is reflected or backscattered from the target.

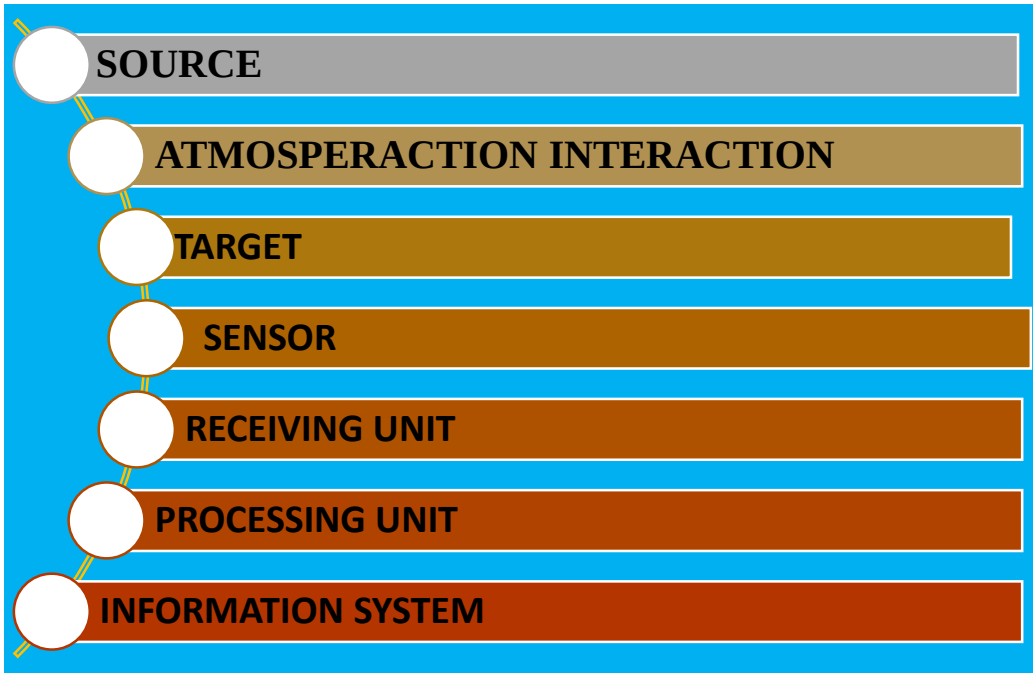
The sensor embodies within itself the source of illumination like a satellite equipped with a RADAR sensor. Active sensors throw their own energy to scan the object. RADAR and LiDAR are examples of active remote sensing which measure the time delay between emission and return.

Passive Sensing : Passive sensors, on the other hand, detect natural energy (radiation) that is emitted or reflected by the object or scene being observed. Reflected sunlight is the most common source of radiation measured by passive sensors.

The sensors gather radiation that is emitted or reflected by the object or surrounding areas. Sunlight reflection is the most common source of radiation measured by passive sensors. Examples of passive remote sensors are photography, infrared, and radiometers. Passive sensors are more used because it provides great quality satellite imagery. The passive sensor is superior within the field of technical observation of the planet, such as Multispectral and Hyperspectral technology.



Steps in Remote Sensing



Remote Sensing Major Applications Area

- **Weather**
- **Forestry**
- **Agriculture**
- **Surface changes**
- **Biodiversity**

GIS

A geographic information system (GIS) is a computer-based tool for mapping and analyzing feature events on earth. GIS technology integrates common database operations, such as query and statistical analysis, with maps. GIS manages location-based information and provides tools for

display and analysis of various statistics, including population characteristics, economic development opportunities, and vegetation types. GIS allows you to link databases and maps to create dynamic displays. Additionally, it provides tools to visualize, query, and overlay those databases in ways not possible with traditional spreadsheets. These abilities distinguish GIS from other information systems, and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies.

GIS is an invaluable tool in a planning and monitoring of natural resources like soil, land use etc. at a regional or national level. It can be used as decision making tool in agriculture. It can take into account of soil fertility, gradient of lands, annual rainfall, availability of rural labour and access to the markets.

GPS

GPS is being used to achieve precision farming and enables farm planning, field mapping, soil sampling, crop scouting, and yield mapping. GPS also allows farmers to work during low visibility field conditions such as rain, dust, fog, and darkness. GPS is being used to correlate production techniques and crop yields with land variability. The correlation enables the farmers to develop the most effective soil/plant treatment strategies, hence enabling higher farm production. Today, farmers in developed countries use GPS mapping for more precise application of pesticides, herbicides, and fertilizers; better control and dispersion of these chemicals are possible through precision agriculture, thus reducing expenses, producing a higher yield, and creating a more environmentally friendly farm.

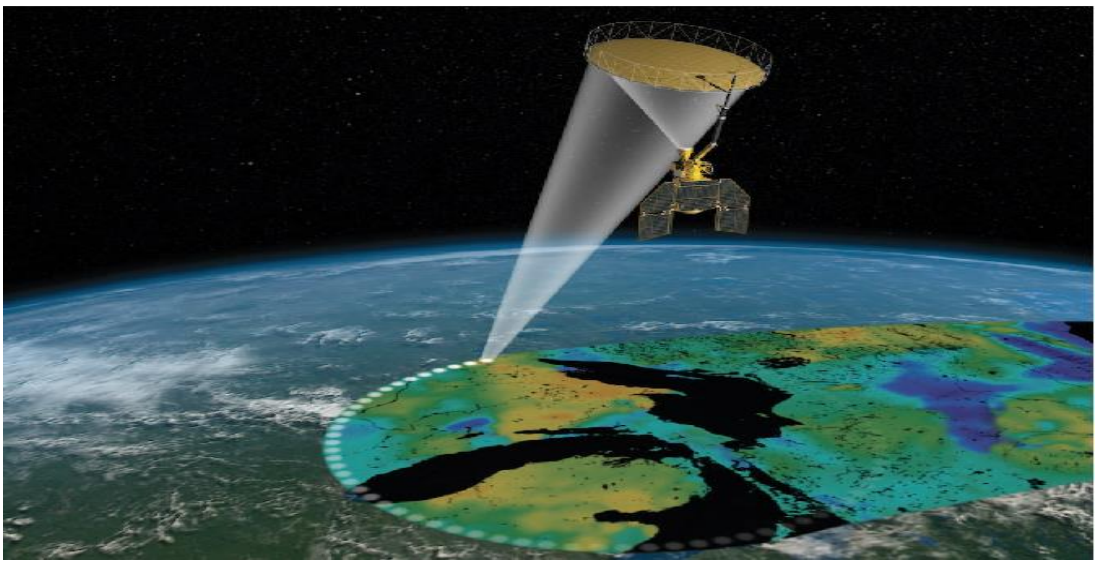
Application of remote sensing in agriculture?

1. **Identifying crop conditions :** Satellite imagery and normalized difference vegetation index(NDVI) technologies are used in order to monitor global food supplies. Healthy crops area reflect green where other areas reflect red or blue.
2. **Determining the soil moisture content :** Active and passive sensors of a satellite in space are used in order to determine soil moisture content. Many earth sciences such as water cycle, flood, and drought are based on the content of soil moisture.
3. **Crop production forecasting :** Remote Sensing is used to predicting crop production and yield over a given field and determine how much of the crop will be harvested under the specific conditions. The researcher can predict the crop quantity that will be produced in given farmland over a given period of time

4. **Determining crop damage and crop progress :** In the event of crop damage or crop progress, remote sensing technology can be used to penetrate the farmland and determine exactly how much of a given crop has been damaged or under stress and the progress of the remaining crop in the farm.
5. **Crop condition analysis and stress detection :** Remote sensing technology plays an important role in the assessment of the crop health condition and the extent to which the crop has withstood stress. This data can be then used to determine the quality of the crop.
6. **Drought Monitoring :** Remote sensing technology is used to monitor the weather patterns including the drought patterns over a given area. The information is used to forecast the rainfall patterns of an area and also tell the time difference between the current and the next rainfall which can be helpful to keep track of the drought.
7. **Water content determination of the field crop :** Apart from determining the soil moisture content, remote sensing also plays an important role in the estimation of the water content in the field crops.
8. **Crop health analysis :** Health analysis of a crop can be also determined which helps in determining the overall crop yield.
9. **Disaster Management and Mitigation :** Today a well-developed GIS systems are used to protect the environment. It has become an integrated, well developed and successful tool in disaster management and mitigation. GIS can help with risk management and analysis by displaying which areas are likely to be prone to natural or man-made disasters.
10. **Surveying :** Land survey is measuring the distance and angles between different points on the earth surface. An increasing number of national and governments and regional

organizations are using GNSS measurements. GNSS is used for topographic surveys where a centimeter level accuracy is provided. These data can be incorporated in the GIS system. GIS tools can be used to estimate area and also, digital maps can prepared.

11. **GIS for Fisheries and Ocean Industries :** GIS tools add value and the capability to ocean data. ArcGis is used to determine the spatial data for a fisheries assessment and management system. It is extensively used in the ocean industry area and we get accurate information regarding various commercial activities. To enhance minimizing cost for the fishing industry. Also it can determine the location of illegal fishing operations.



12. **Pest Control and Management:** Pest control helps in the agricultural production. Increasing in the rate of pest and weeds can lead to decrease in the crop production. Therefore GIS plays an important role to map out infested areas. This leads in the development of weed and pest management plan.