Paper Code: GIS 03

Principles of Remote Sensing

Concepts of Remote Sensing and its processes

PG Diploma in RS & GIS

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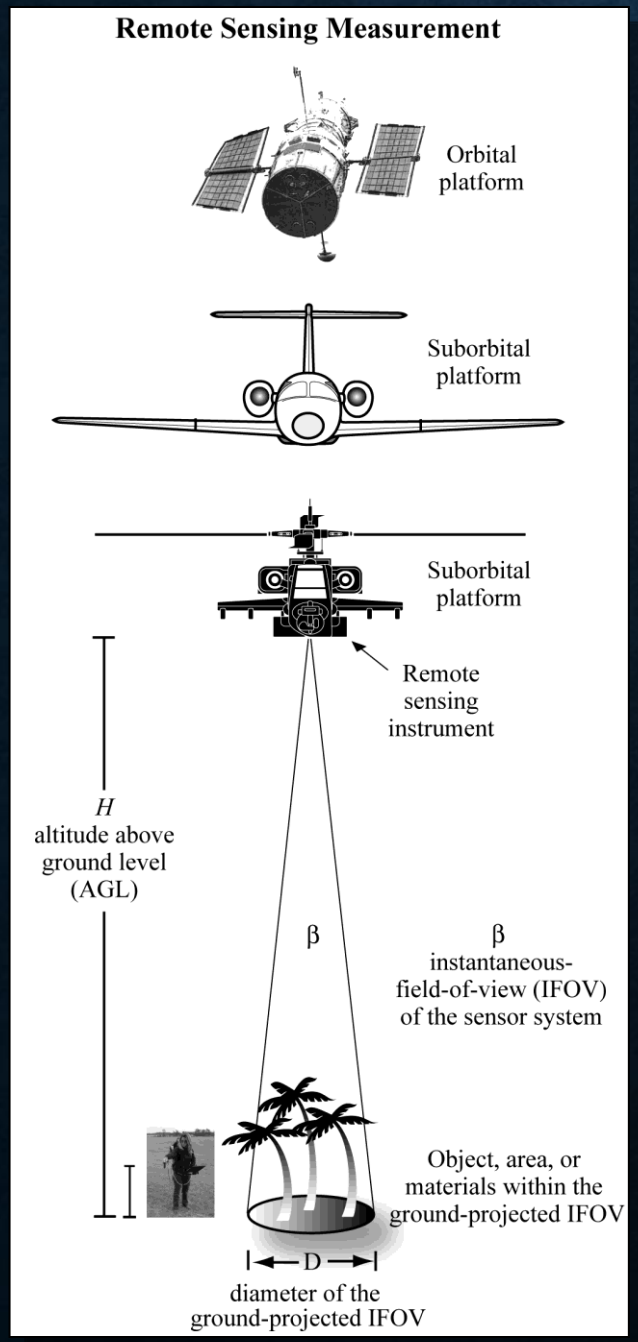
Today we will study on the topic on……

1. *What is Remote Sensing.*
2. *Process and Stages of Remote Sensing.*
3. *Different types of platforms of Remote Sensing*
4. *Types of Remote Sensing.*
5. *Advantage of Remote Sensing.*

What is remote sensing?



"The measurement or acquisition of information of some property of an object or phenomenon, by a recording device that is not in physical or intimate contact with the object or phenomenon under study" (Colwell, 1997).

Photogrammetry and *remote sensing* as (Colwell, 1997):

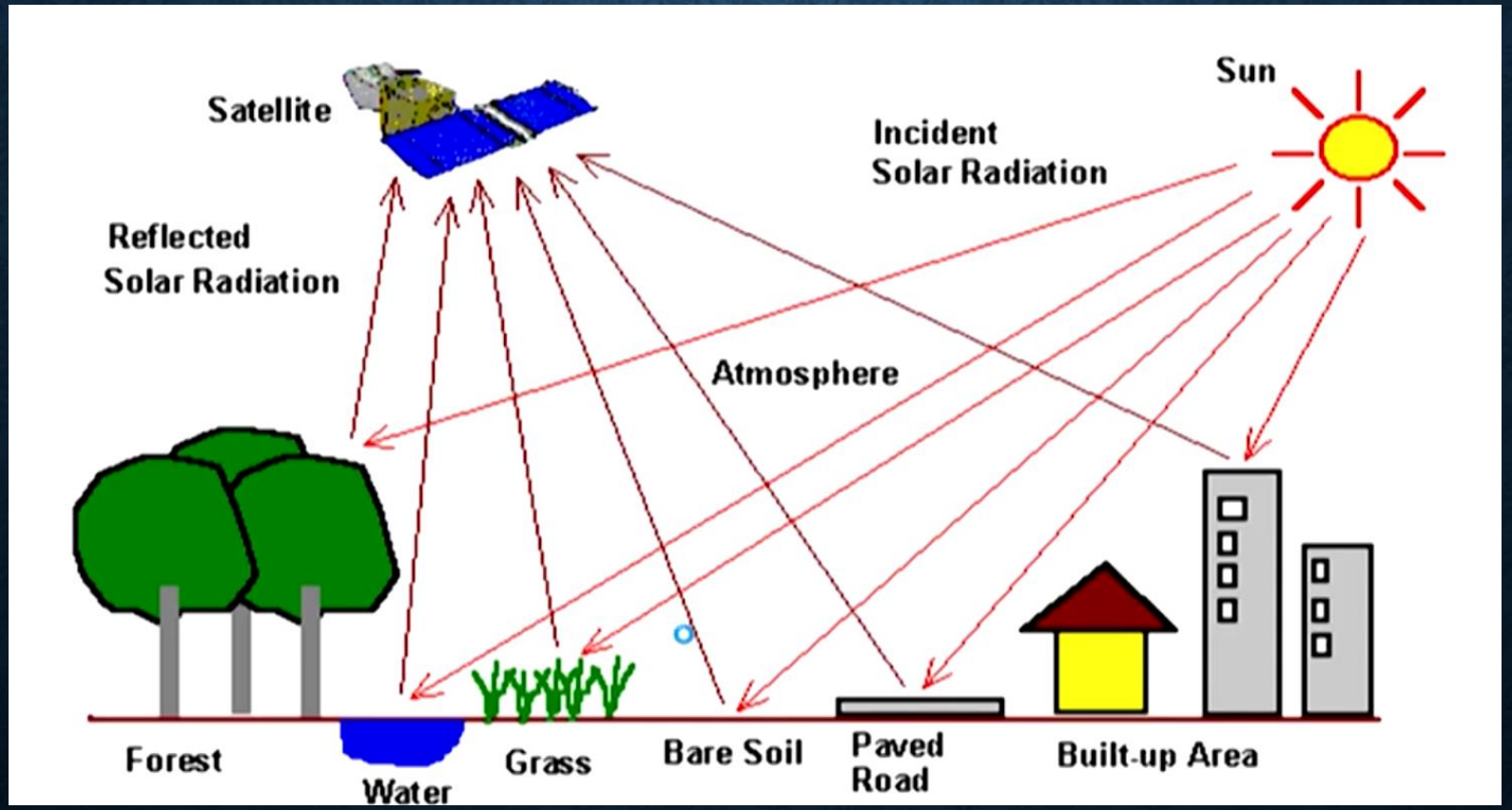
"The art, science, and technology of obtaining reliable information about physical objects and the environment, through the process of recording, measuring and interpreting imagery and digital representations of energy patterns derived from noncontact sensor systems".

Remote Sensing

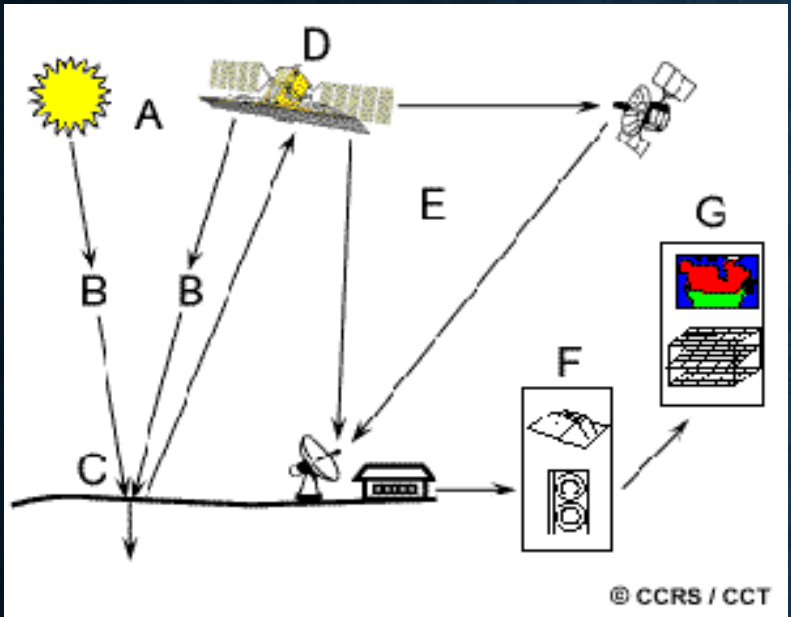
- ✓ Remote sensing is the technology of acquiring information about the earth's surface without actual being in contact with it.
- ✓ In simple word we can say that, anything which can sense from our eyes or cameras or senser without physical contact then we can say we are dong remote sensing.
- ✓ This is done by sensing and recording reflected or emitted energy and processing, analyzing and applying that information apply for different applications.

Remote Sensing

- ✓ Remote sensing process involves an interaction between incident radiation and the targets of interest.
- ✓ This is exemplified by the use of imaging systems where the following seven elements are involved



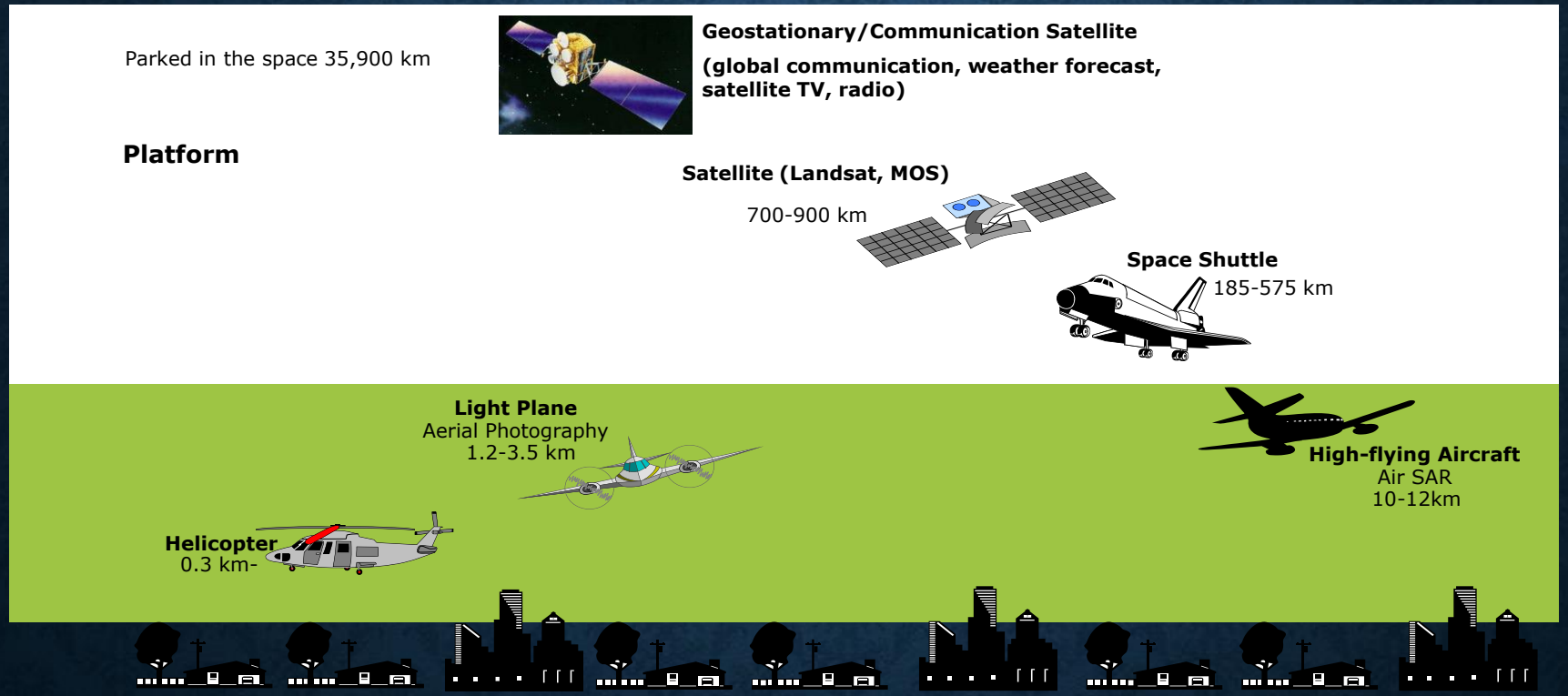
Process and Stages of Remote Sensing



1. **Energy Source or Illumination (A)** - an energy source illuminates or provides electromagnetic energy to the target of interest.
2. **Radiation and the Atmosphere (B)** - as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through.
3. **Interaction with the Target (C)** - interacts with the target depending on the properties of both the target and the radiation.
4. **Recording of Energy by the Sensor (D)** - after the energy has been scattered by, or emitted from the target, we require a sensor to collect and record the electromagnetic radiation.
5. **Transmission, Reception, and Processing (E)** - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).
6. **Interpretation and Analysis (F)** - the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated for different purpose or application.
7. **Application (G)** - Apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

REMOTE SENSING PLATFORMS

- **Altitude**: Altitude is the height of operation of a **remote sensing satellite** . The nature of an imagery captured by a **remote sensing satellite** varies depending on the altitude.

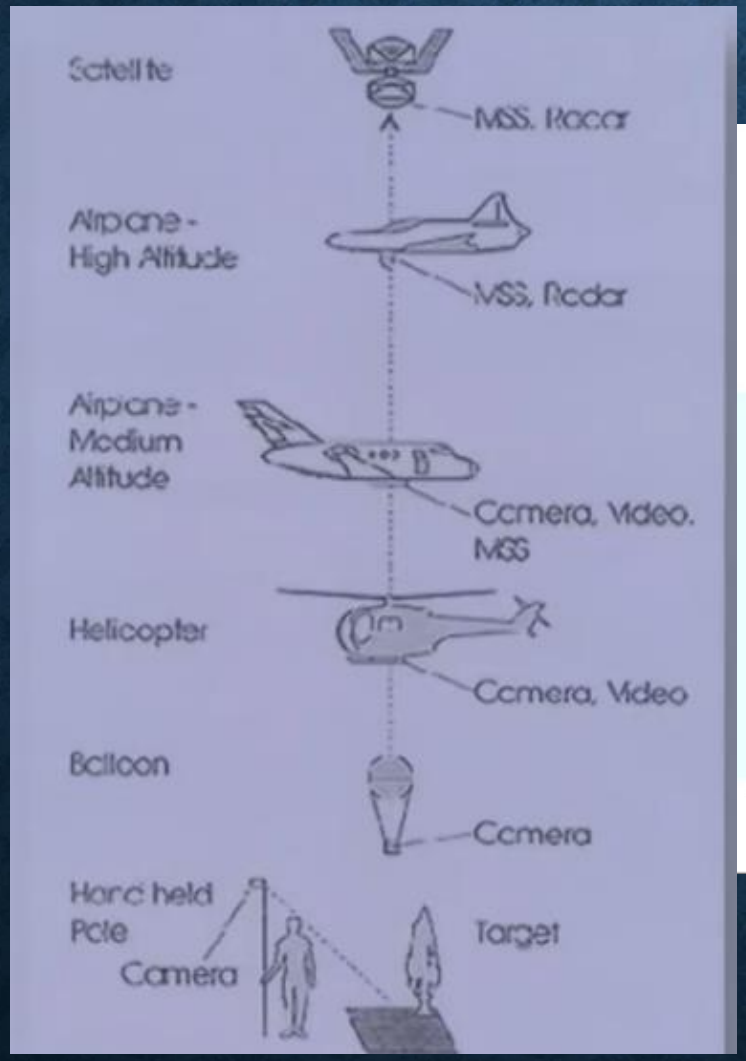


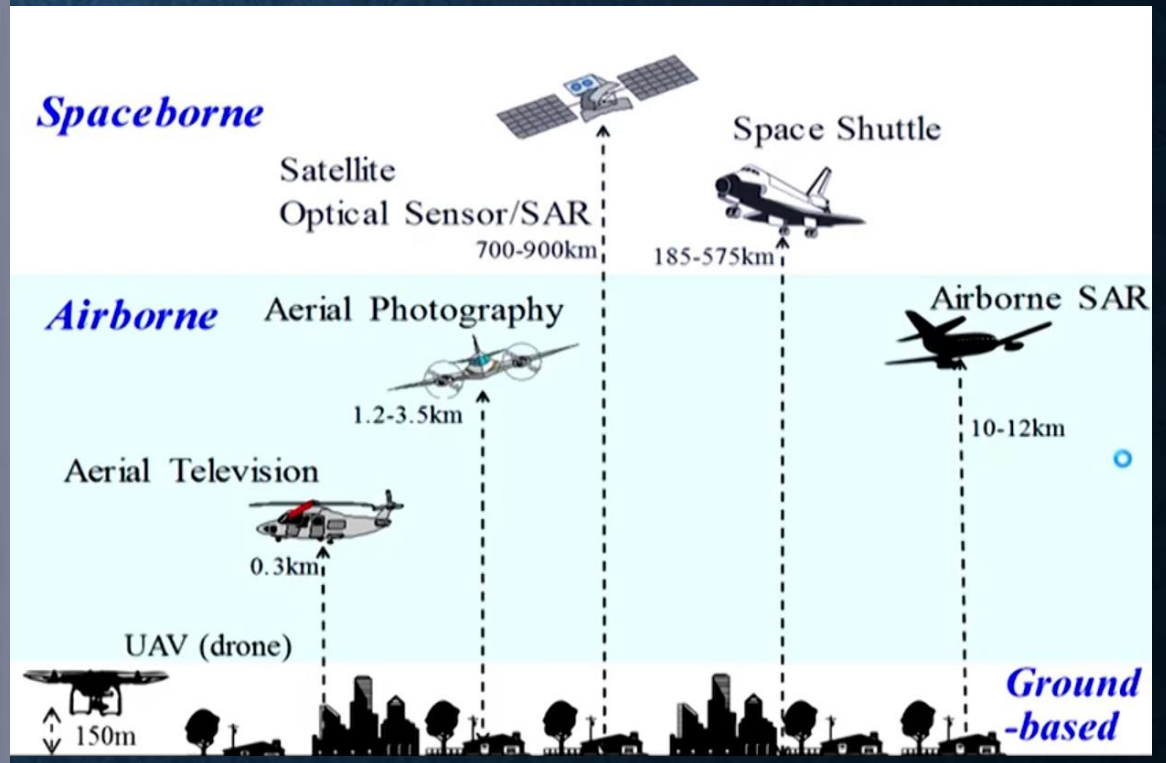
1.Ground Based 2.Air Based 3.Space Based

Remote Sensing Platforms

1. Ground Based
2. Air Based
3. Space Based

- ✓ Balloons
- ✓ UAVs / DRONES
- ✓ Helicopters
- ✓ Airplanes
- ✓ Satellites





Terrestrial Platform

Tripod with a reamed bar

Tripod

Terrestrial Platform

Ground based Platforms

Mobile hydraulic platforms:

Portable Masts (unstable in wind condition)

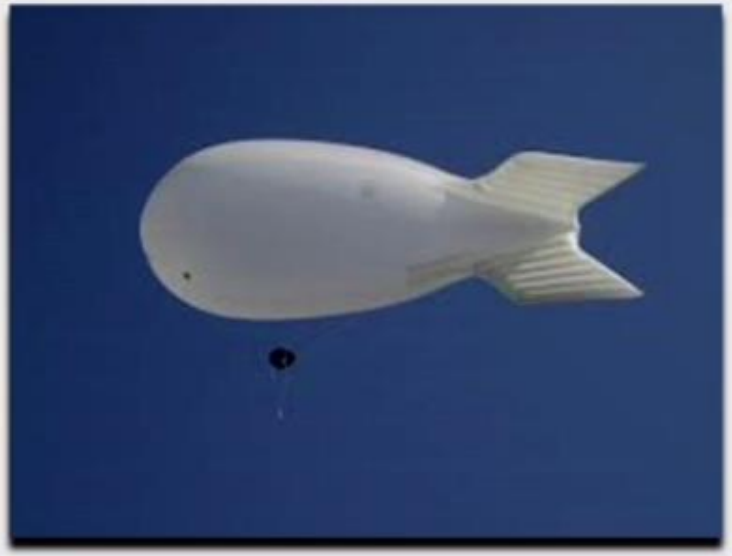
Weather surveillance Radar (Detects and tracks typhoons and cloud masses)

Low Altitude Platform

Pole

Kite

Drone
(DJI inspire 1)



Blimp

Airborne Platforms

- ✓Altitude range is 22 – 40 km.
- ✓Tool to probing the atmosphere
- ✓Useful to test the instruments under development

Air Based Platform Advantage and Disadvantage

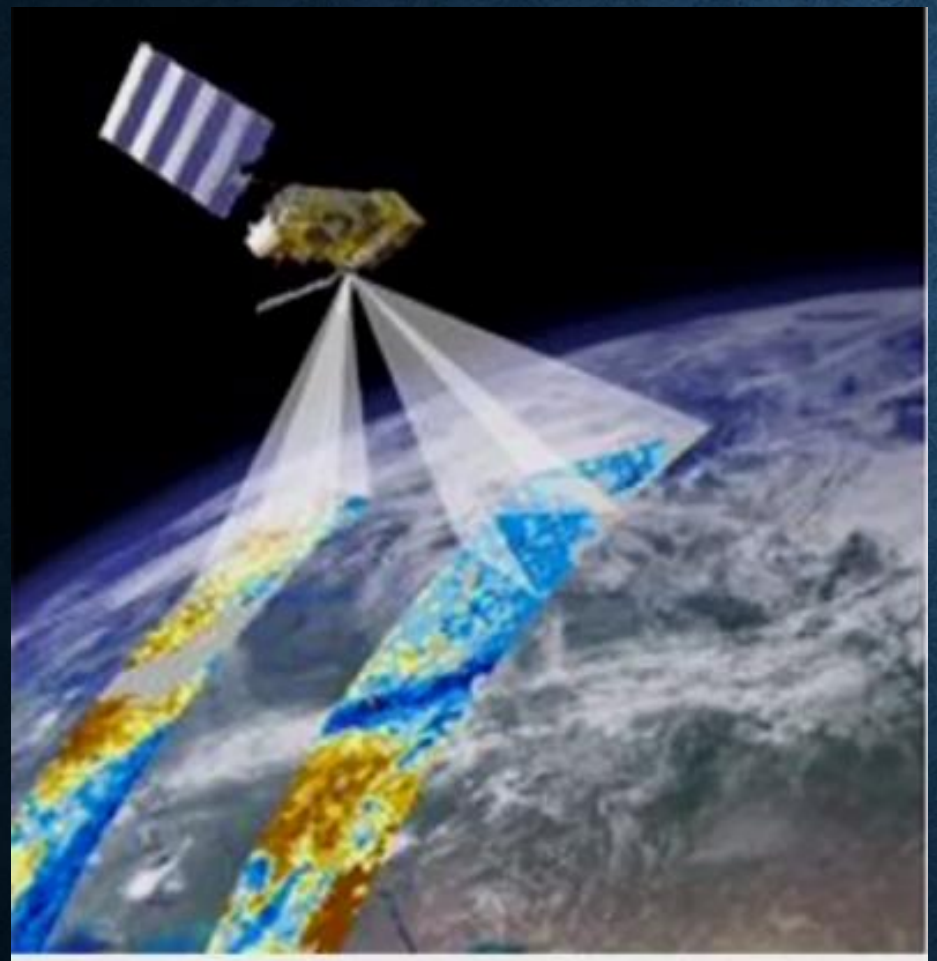
Advantage

- ✓ High spatial resolution (20 cm or less)
- ✓ Analog photograph is possible
- ✓ Easy to change their schedule to avoid weather problems
- ✓ Sensor maintenance and repair is easy

Disadvantage

- ✓ Permission required to intrude
- ✓ Many passes to cover large area
- ✓ Swath is much less compare to satellite
- ✓ High cost per unit of area

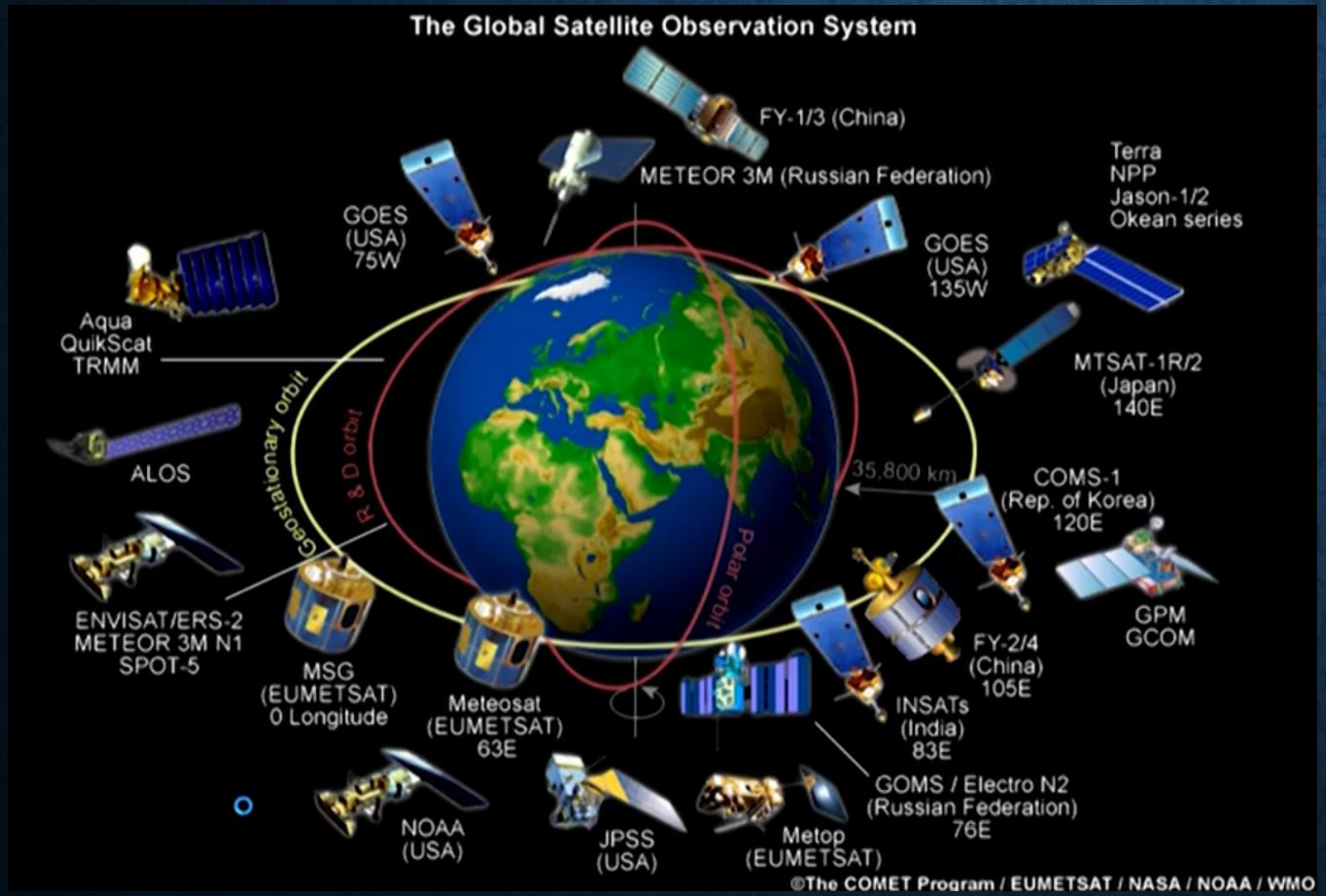
Spaceborne Platform



Satellite

Shuttle

Spaceborne Platform



- ✓ Sensors are mounted on board a spacecraft
- ✓ Example: Rockets, satellites and space shuttles

Advantage:

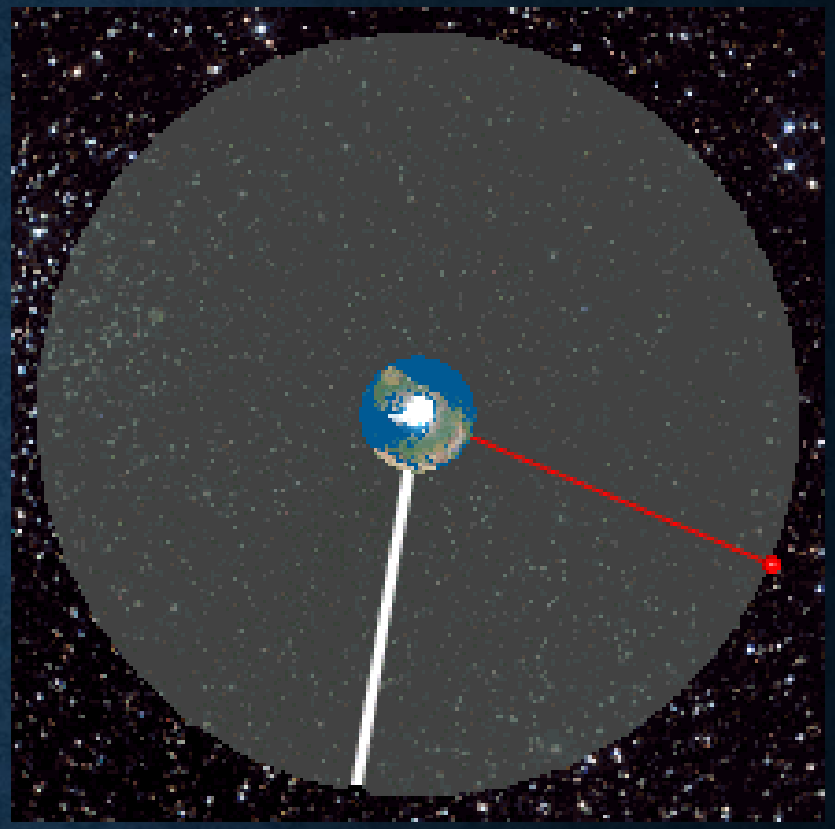
- ✓ Cover large geographical area
- ✓ Repetitive coverage of an area of interest

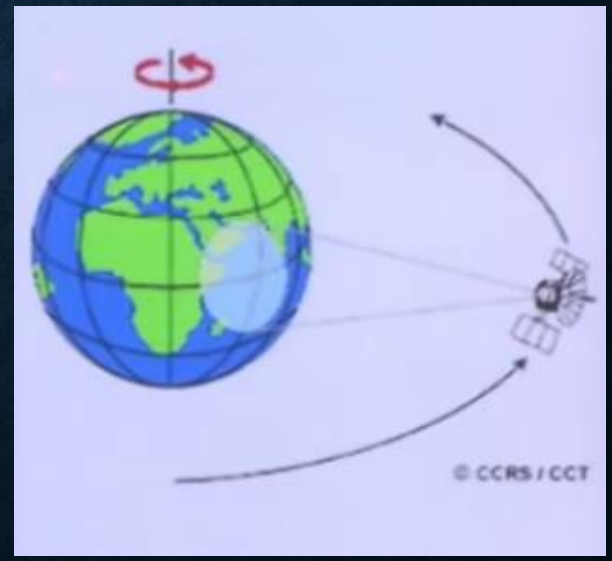
Orbit

1. Geostationary orbit –

Satellites at very high altitudes (35,000 Km. from Earth surface), which view the same portions of the earth's surface at all time. An orbit revolves at speed which match the rotation of the Earth. A worldwide network of operational geostationary meteorological satellites

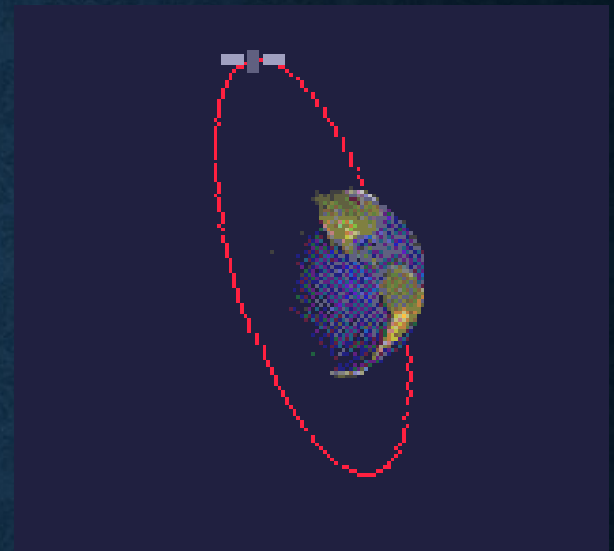
- ✓ Geostationary Operational Environmental Satellite (GOES) - The United States
- ✓ Meteosat [Eumetsat] - Launched by the European Space Agency and operated by the European Weather Satellite Organization,
- ✓ MTSAT - The Japanese Satellite, Operated by JMA, Monitoring typhoons and other weather condition in Asian-Oceanic Region
- ✓ INSAT or KALPANA Series Metrological Data providing in India





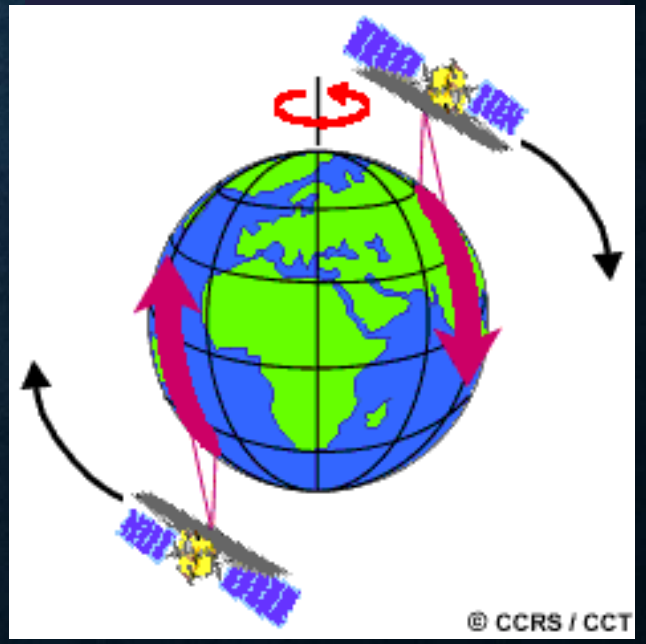
2.Sun synchronous orbit –

Many remote sensing platforms are designed to follow an orbit (basically north-south) which, in conjunction with the Earth's rotation (west-east) so called '**Sun synchronous orbit'** allows them to cover most of the Earth's surface over a certain period of time.

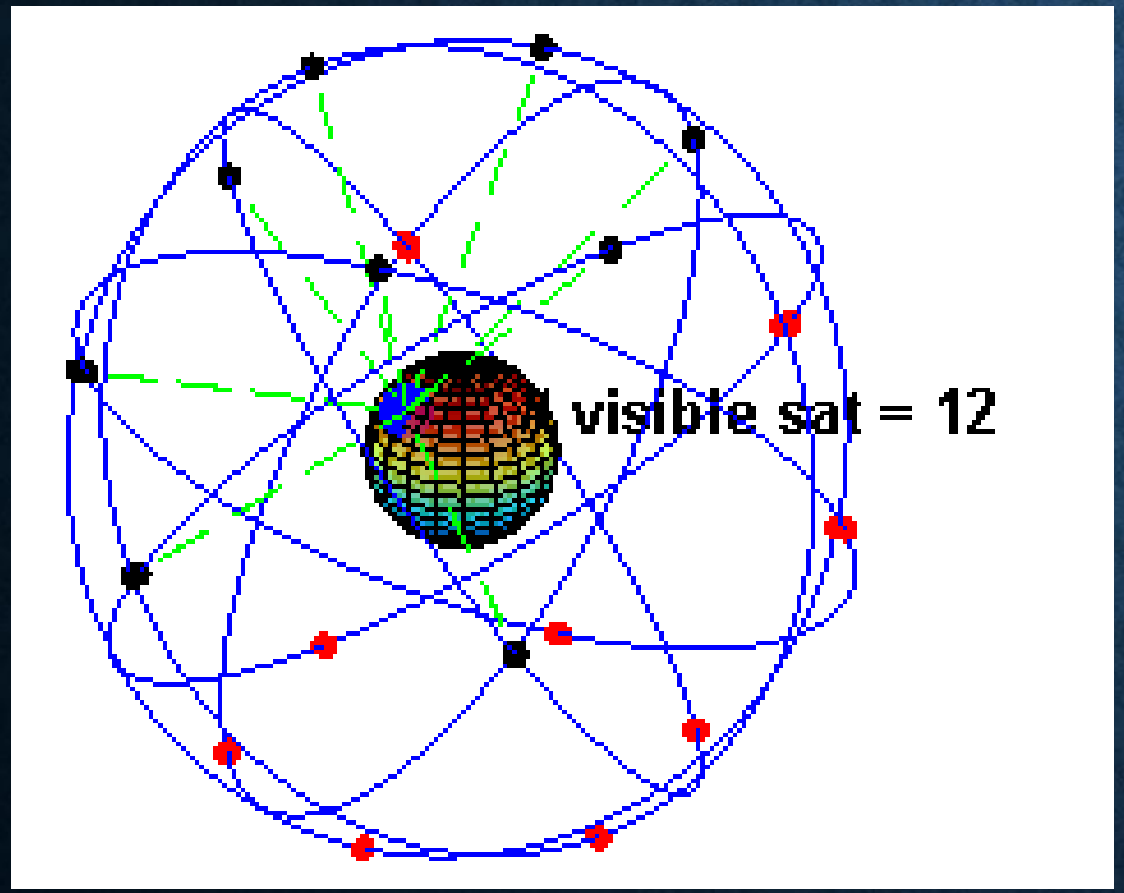


- ✓ In this orbit the **remote sensing satellite** allows to cover most of the earth's surface over a certain period of time (**crosses the same point at approximately same (local) time**).

- ✓ The time interval after which a **remote sensing satellite** repeats its path is called **repeat circle**.



3.Geosynchronous Orbit
Example: NAVSTAR: Navigation System Timing and Ranging



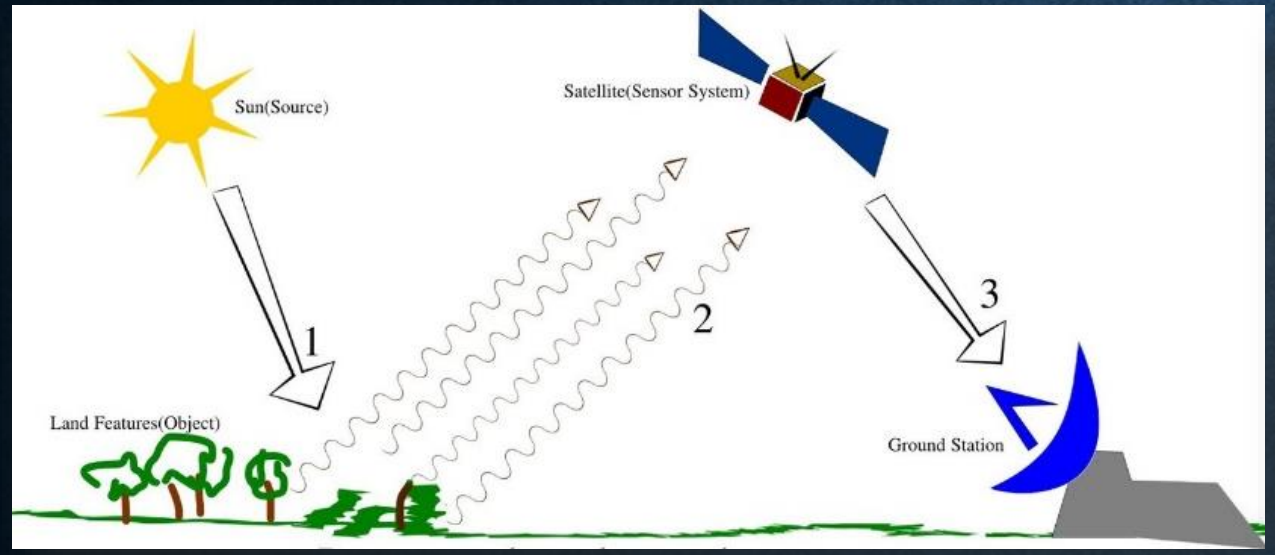
- ✓ 24 satellites in 12 hour orbits 12,000 mile (20,200 kilometer) high orbits
- ✓ Two orbits around Earth every day
- ✓ 4-8 satellites available above 15 degrees from horizon line
- ✓ Positions available anywhere in the world, 24/7

Navigation System	No. of Satellites	Inclination	Satellites x Orbit Planes
GPS	24	55	4 x 6
GLONASS	24	64.8	8 x 3
GALILEO	30	56	9 x 3
QZSS	(1~)	41	(1~) x 1
BeiDou	35	55	6 in geostationary orbits, 8 in 55-degree inclined geosynchronous orbits and 7 in medium Earth orbits
IRNSS (NAVIC)	7	30.5	3 are geostationary orbit (GEOs) and they will be located at 32.5° East, 83° East and 131.5° East longitude. Other 4 are geostationary satellites (GSO) in orbits of 24,000 km apogee and 250 km perigee inclined at 29 degrees.

TYPES OF REMOTE SENSING SATELLITE

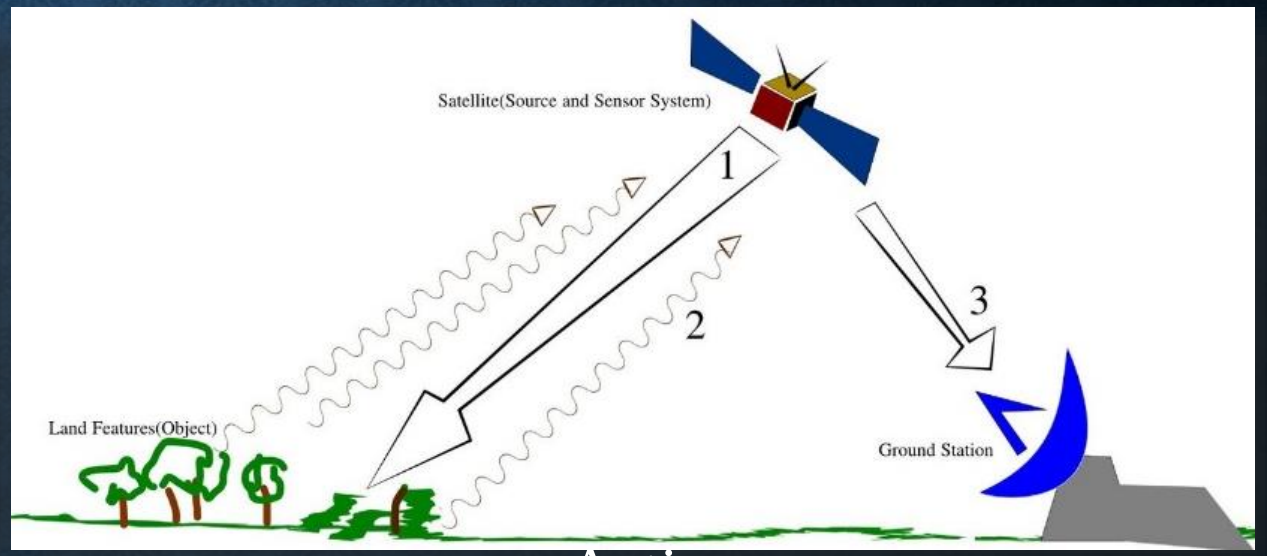
✓ **Sensors**: Sensors are of two kinds-passive and active **(in term of energy source)**.

Passive sensors are those which accept reflectance from natural object whereas active sensors accept reflectance from man-made objects



Passive

Example: Resource set Satellite Data (Landsat, IRS, SOPT, Cartosat, Ikonos,)



Active

Example: Synthetic Aperture Radar (SAR)
Light Detection and Ranging (LIDER)
Radio Detection and ranging (RADAR)
RISAT, ALOS, Sentinal, Envisat, ERS, Radarsat

PASSIVE VS ACTIVE REMOTE SENSING

Passive Remote Sensing

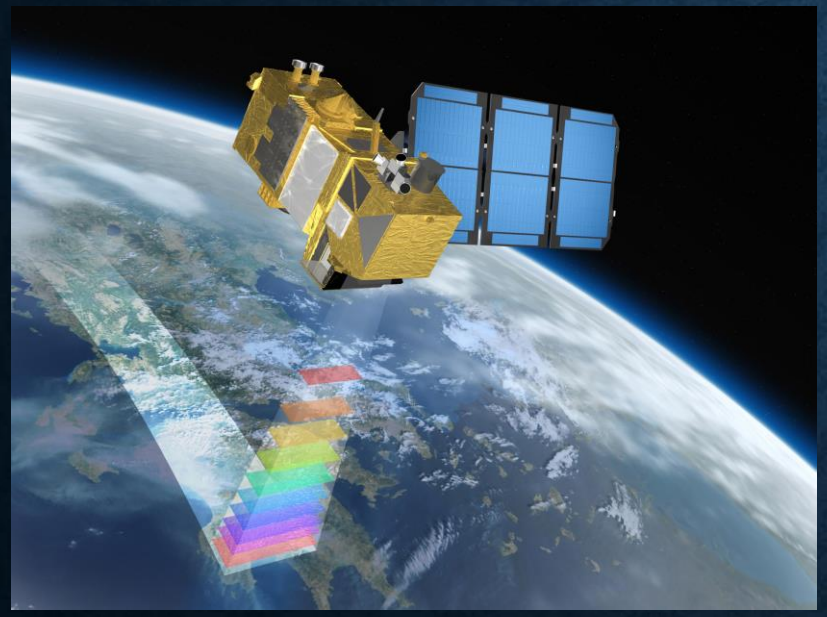
- ✓ Does not employ any external of source of energy.
- ✓ Measure either reflected radiation from sun (can be operated only during daytime) or the emitted radiation from the surface (day/ night operation).
- ✓ Suffers from variable illumination conditions of sun and influence of atmospheric condition.

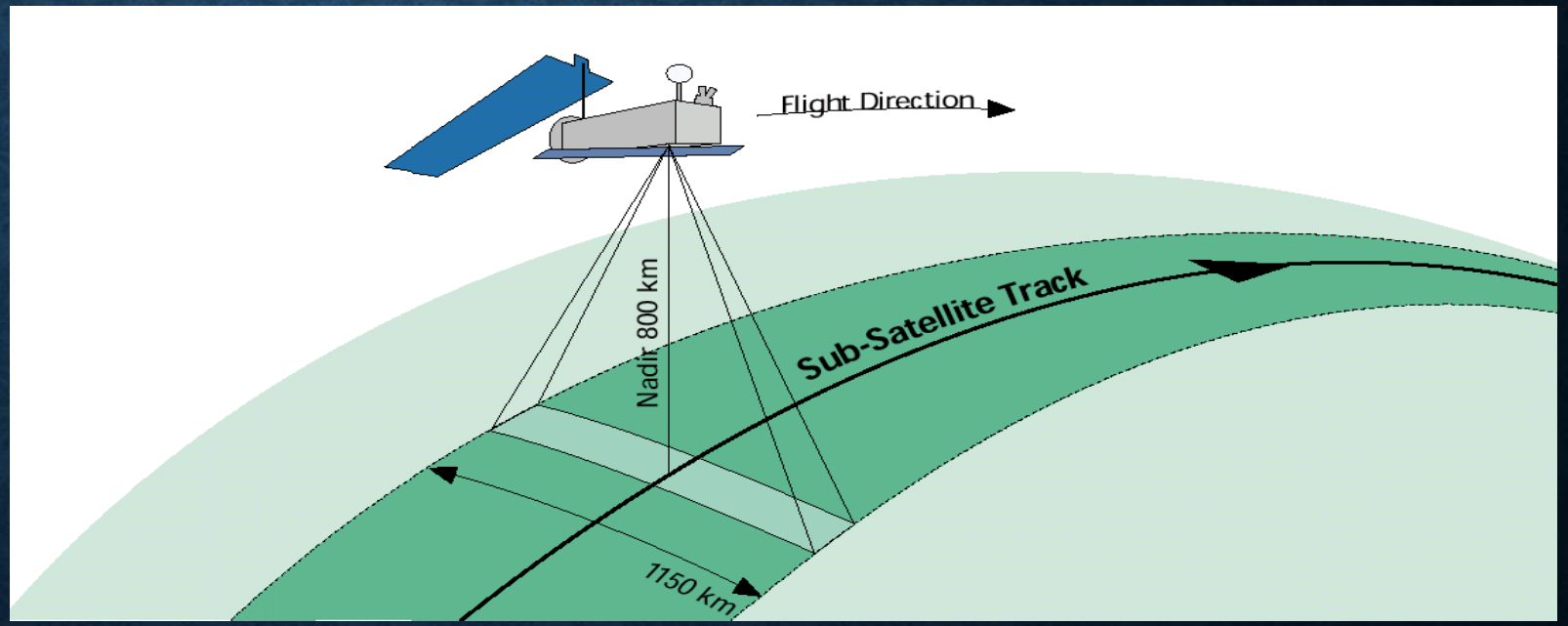
Active Remote Sensing

- ✓ Has its own source of emery.
- ✓ Active sensors emit a controlled beam of energy to the surface and measure the amount of energy reflected back to the sensor.
- ✓ Controlled illumination signal.
- ✓ Day/night operation.

SWATH

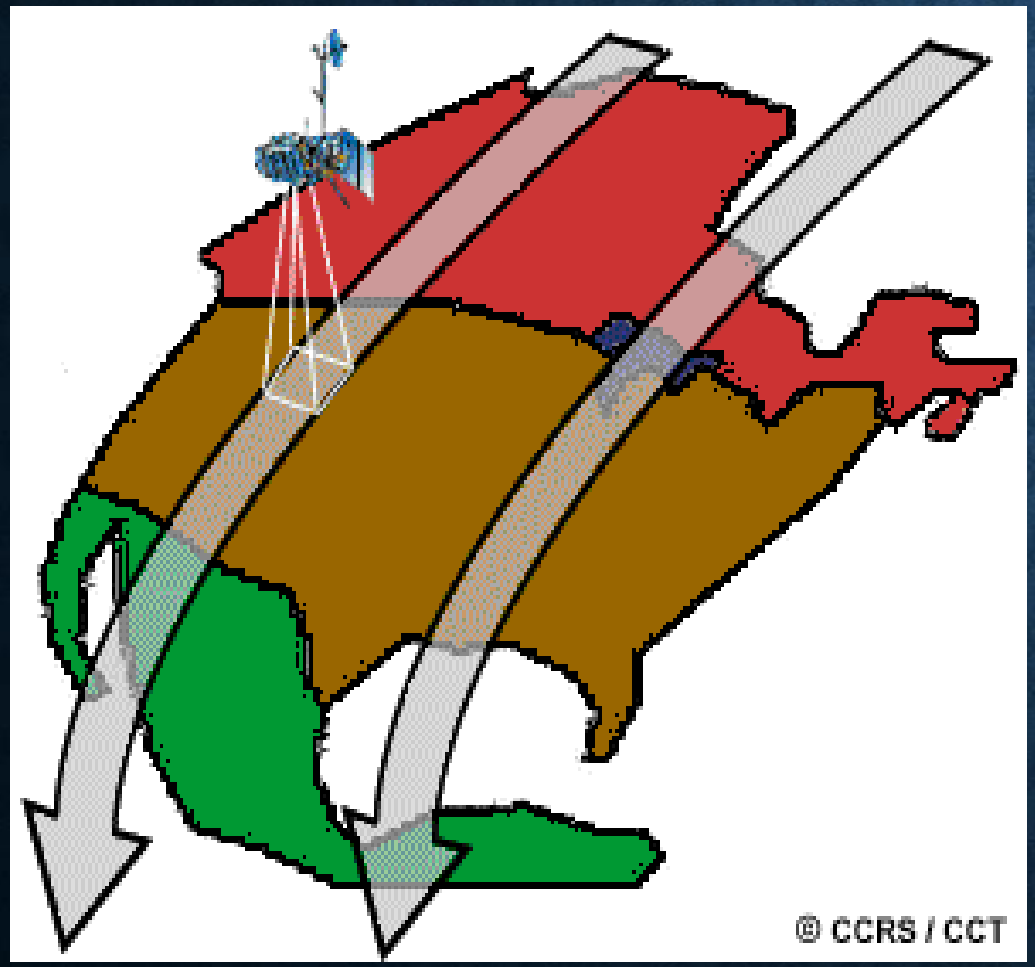
- As a satellite orbits around the Earth, the sensor "sees" a certain portion of the Earth's surface. The area imaged on the surface, is referred to as the **swath**. generally vary between tens and hundreds of kilometers wide.



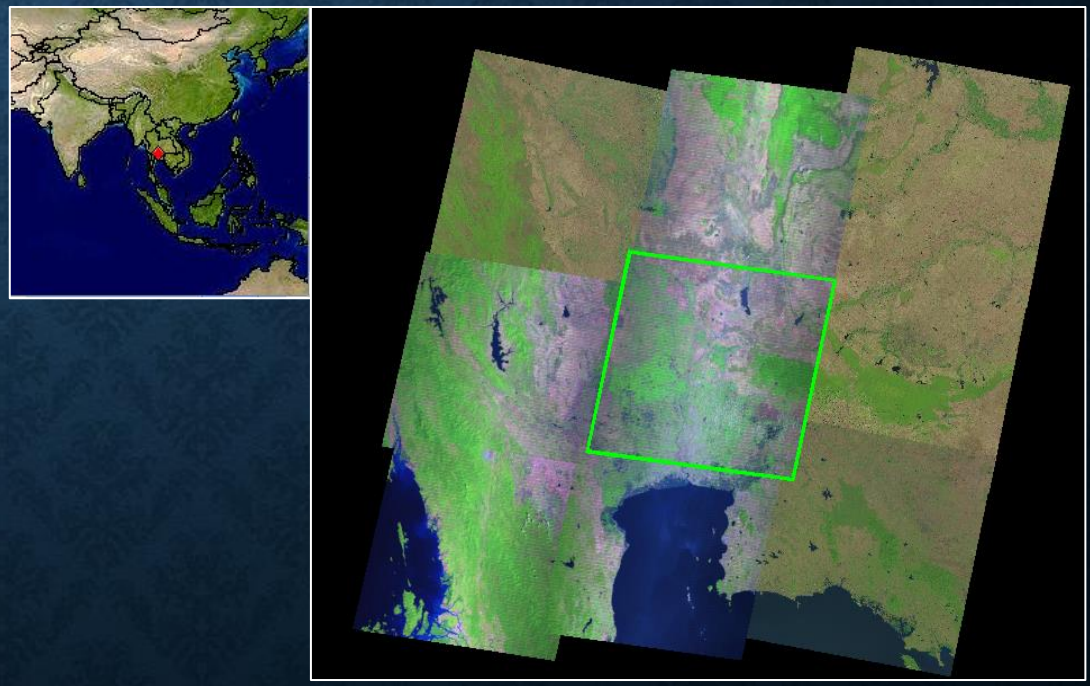


Example : Ikons 11 km swath

Consecutive Path



- As the satellite orbits the Earth from pole to pole, its east-west position would not change if the Earth did not rotate. However, as seen from the Earth
- Satellite path is shifting westward because the Earth is rotating (from west to east).
- This apparent movement allows the satellite swath to cover **a new area with each consecutive pass**.



ADVANTAGES OF REMOTE SENSING

- ✓ Synoptic view
- ✓ Global coverage
- ✓ Repeatability
- ✓ Multispectral data
- ✓ Multi resolution
- ✓ Systematic collection of data
- ✓ Data can be collection where inaccessible areas
- ✓ Processing and analysis is fast
- ✓ Microwave remote sensing can penetrate clouds
- ✓ Updating or revision of exiting maps
- ✓ Color composites ensure the details of the area
- ✓ In natural disaster studies and rescue mission become easy and fast
- ✓ Overall cost and time effective