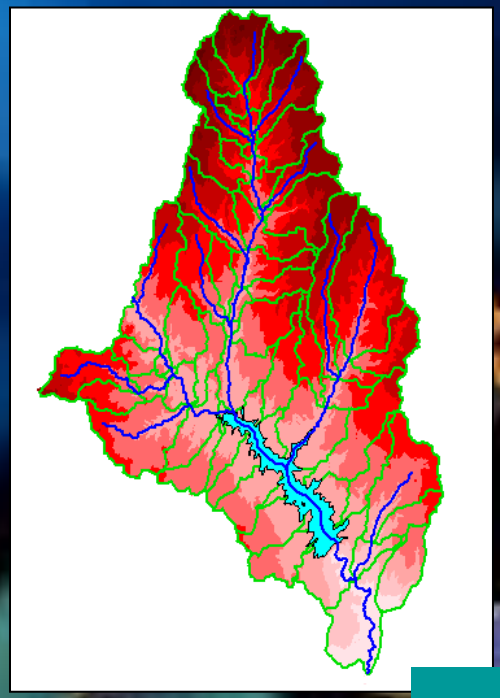
Course Title: Advances in Remote Sensing and GIS

Course Code: ENV-652

Topic:

Components/ Segments of Remote Sensing



Dr. Asif Sajjad
Assistant Professor
Department of Environmental Sciences
Quaid-I-Azam University Islamabad

Contents

1. Sensors (Active and Passive)
2. Platforms
   I. Airborne Platform
   II. Ground-based Platform
   III. Spaceborne Platform
3. Orbits

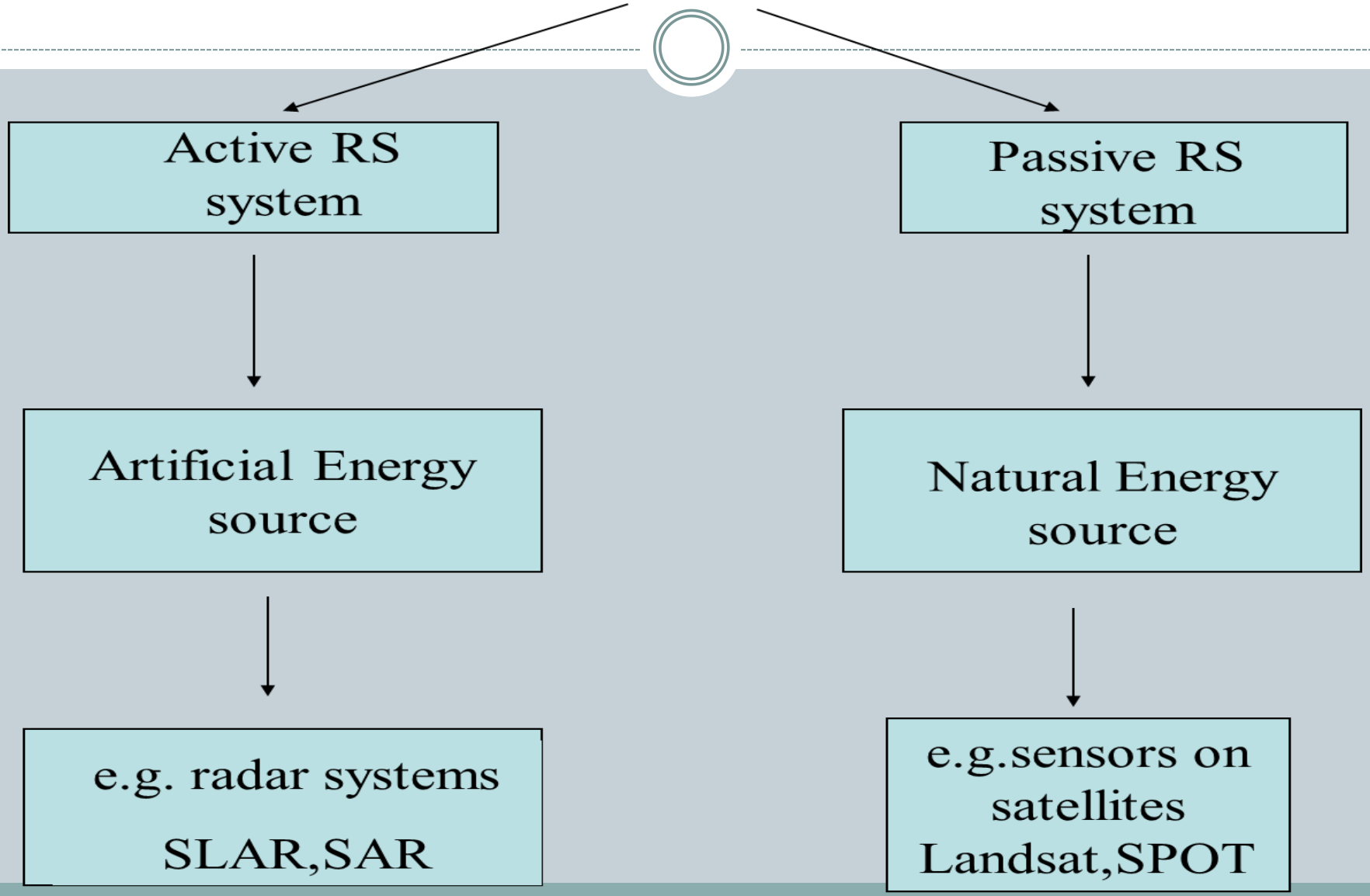
Remote Sensing Sensors

Active and Passive Remote Sensing

Introduction

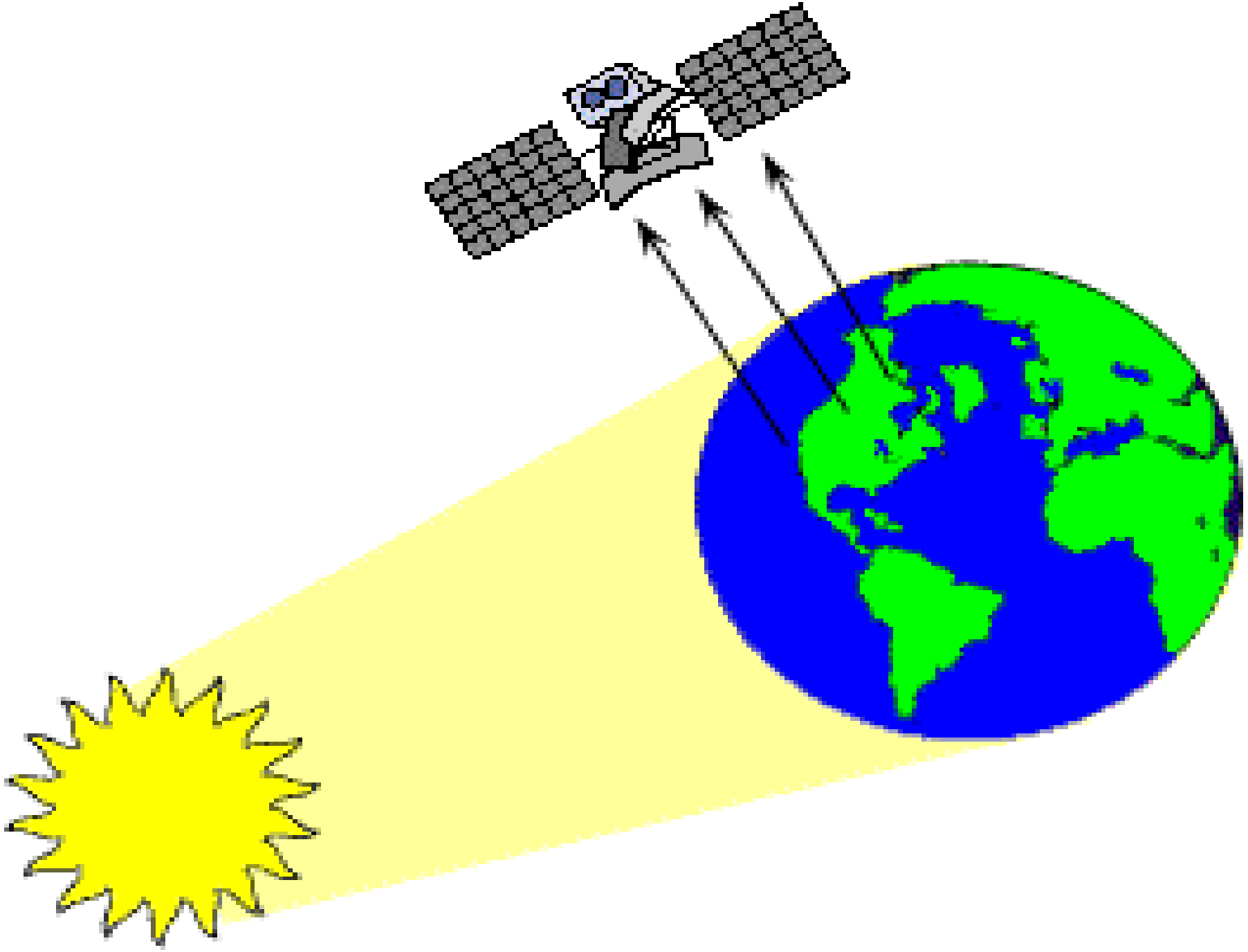
- Remote sensing relies on the measurement of electromagnetic (EM) energy. EM energy can take several different forms. The most important source of EM energy at the Earth's surface is the Sun, which provides us, for example, with (visible) light, heat (that we can feel), and UV light, which can be harmful to our skin.

Types of RS sensor system



Passive Sensor

- **Passive sensors** are those which detect naturally occurring energy. Most often, the source of radioactive energy is the sun.
- Detection of reflected solar energy, for example, can only proceed when the target is illuminated by the sun, thus limiting visible light sensors on satellites from being used during a nighttime pass.
- The Thematic Mapper, the primary sensor on the Landsat satellites, is a good example of a passive sensor.



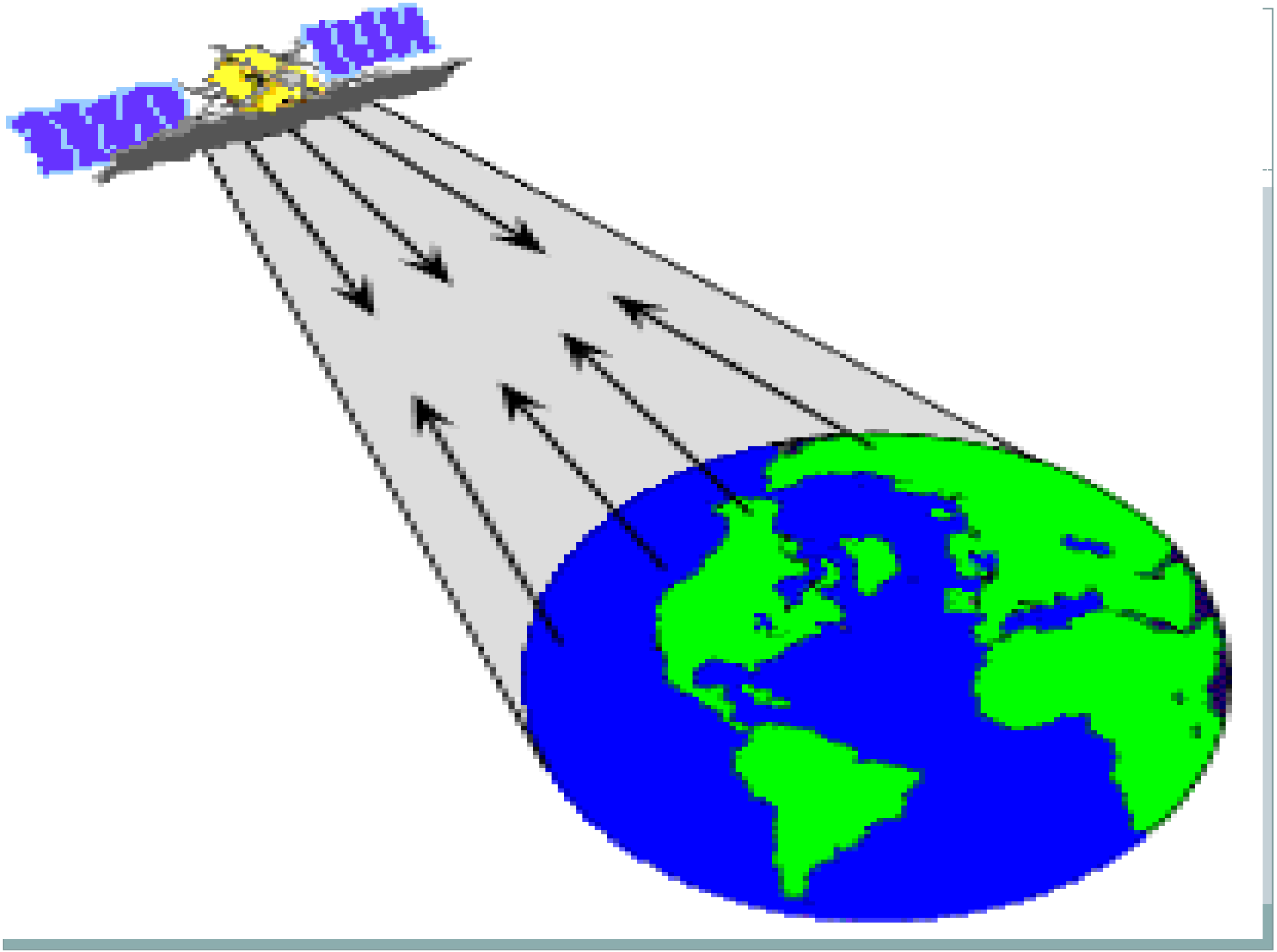
Passive remote sensors

- ***Radiometer***
- ***Imaging Radiometer***
- ***Spectrometer***
- ***Spectro radiometer***

Active Sensor

- Active Sensors provide their own energy source for illumination of the target by directing a burst of radiation at the target and use sensors to measure how the target interacts with the energy.
- Most often the sensor detects the reflection of the energy, measuring the angle of reflection or the amount of time it took for the energy to return.
- Active sensors provide the capability to obtain measurements anytime, regardless of the time of day or season.

Doppler radar is an example of an active remote sensing technology.



Active remote sensors

- ***Radar (Radio Detection and Ranging)***
- ***Scatterometer***
- ***Lidar (Light Detection and Ranging)***

2. Platforms

- In remote sensing; most sensors are mounted on platforms.

I. Airborne Platform
II. Ground-based Platform
III. Spaceborne Platform

- Platforms can be moving viz. aircraft, satellite; or static viz. pole, cherry picker etc.

Platforms

- Airborne remote sensing / observations
  - 100 m to 40 km
- Spaceborne remote sensing / observations
  - 150 to 36000 km

Airborne Remote Sensing / Observation

Airborne platforms are used to collect very detailed images and facilities the collection of data over any portion of Earth's surface at any time but it is very expensive platform as compared to ground based platforms

there are some examples of airborne platform

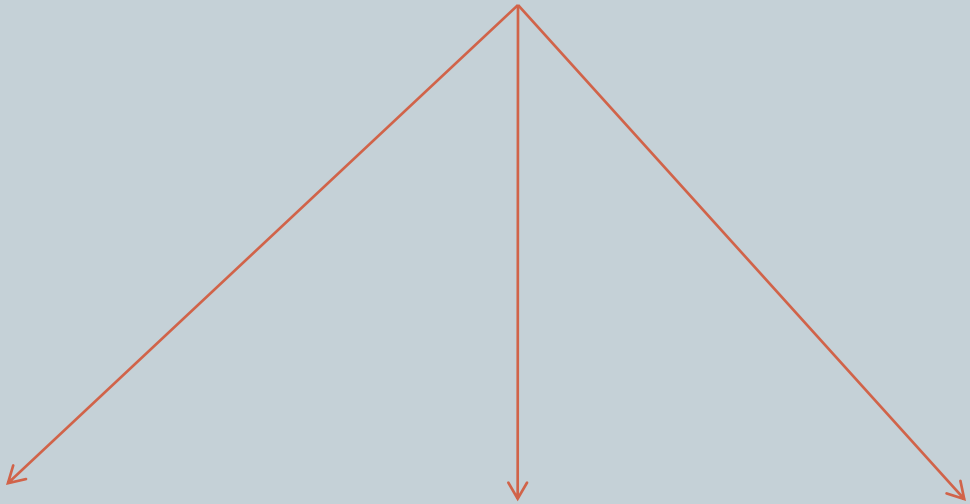
1 aeroplane

2 high altitude aircraft

3 helicopters and others

Air Craft Based Platforms

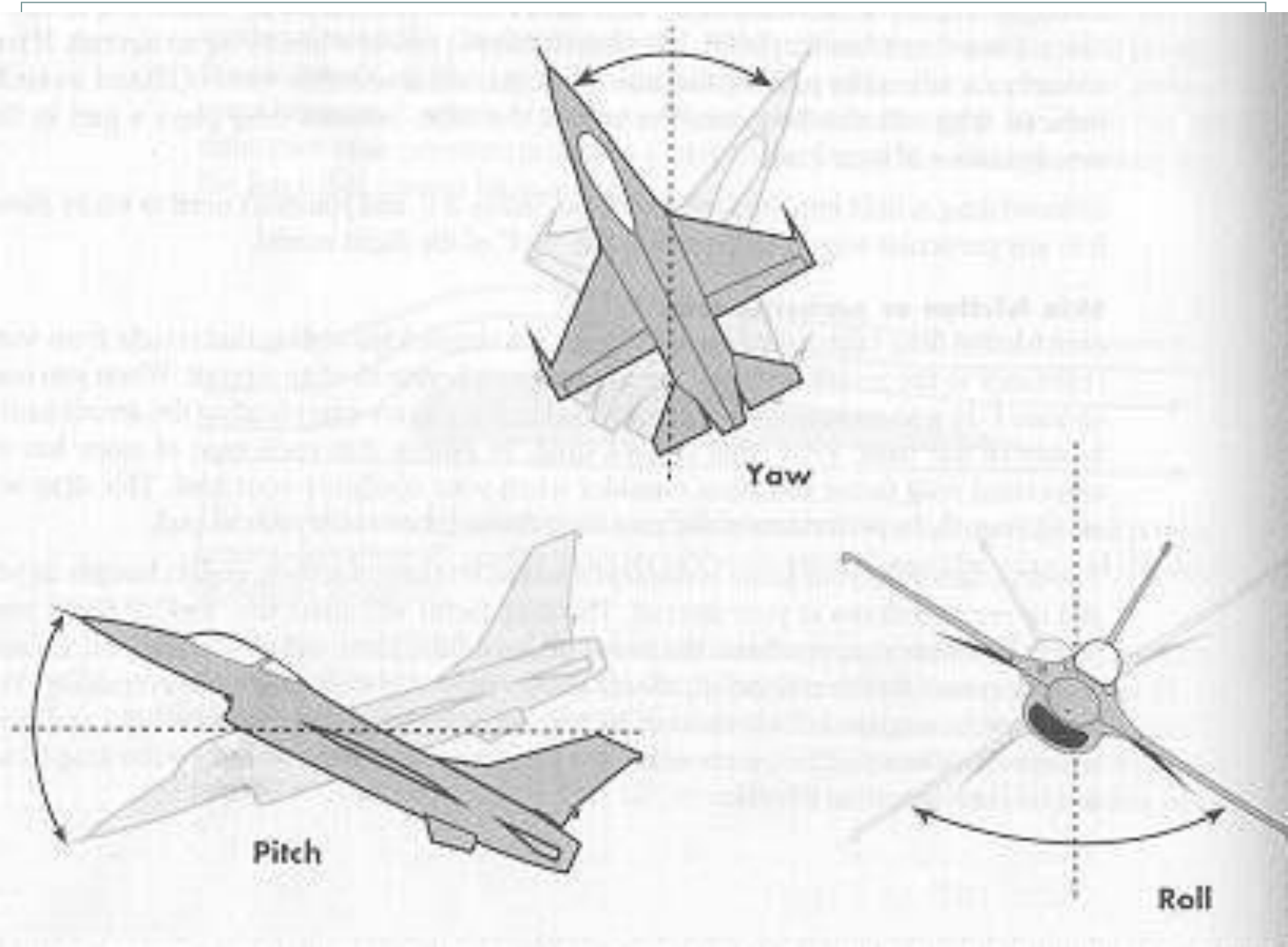
Aircraft Orientation



Roll Angle

Pitch Angle

Yaw Angle


Yaw
Pitch
Roll

Air Craft Based Platforms

- Different types of aircraft depending on operational requirements and available budget.
- Mainly influenced by wind conditions
- Not Widely used by the public due to
- Owning
- Operating
- Maintaining
- Employing (professional flight crew)

Ground Based Platforms

Ground based platform used to record detail information about the surface very closely. Some example of ground based platform are

1ground vehicle
2 tower
3 air balloon
4 kite and others

the height of ground based platform is up to 50 m or in the other words we can say that the ground based platforms are found above 50 m from the Earth surface

Ground Based Platforms

- Tall building
- cherry-picker
- Crane
- Pole
- etc.

Ground Based Platforms

CHERRY PICKER

SPACE BORNE REMOTE SENSING

Space Borne Platforms

- Spaceborne remote sensing is carried out using sensors that are mounted on satellites.
- Monitoring capabilities of a sensor are to a large extent determined by the parameters of the Satellite's orbit.
- Continuous Monitoring (Meteorology)
- Global Mapping (Land Cover Mapping)
- Selective Mapping (Urban Areas)

Space Borne Platforms

3. Orbit

- The path of an artificial satellite as it revolves around another body.

Characteristics of an Orbit.

- Altitude
- Inclination angle
- Period
- Repeat Cycle

Characteristics of an Orbit

- Altitude
  - The distance from satellite to the mean surface
  - 600-800 altitude for polar orbits and 36000 km for geostationary orbits.
- Inclination angle
  - The angle between the orbit and the equator.
- Period
  - Required time to complete one cycle around the object (The Earth)

Characteristics of an Orbit

- Repeat Cycle.
  - The time between to successive identical orbits.
  - So, it may be conceived as the time between two image of the same area.

Types of Orbit

- Sun-synchronous orbit
- Geostationary orbit
- Polar Orbits:

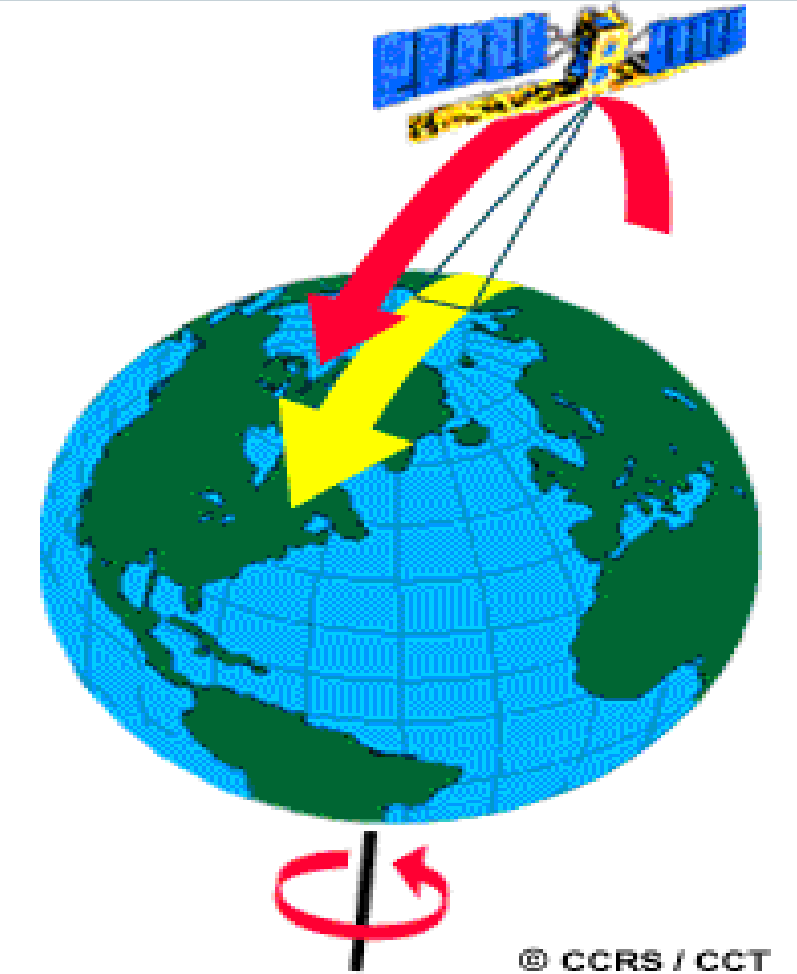
Sun-synchronous Orbit

- 600-800 km orbit
- Satellite always passes overhead at the same local time
- Allows satellite to take images, one at night and one in the morning ,for 24 hours.
- Cross the equator at mid-morning (around 10:30)

Examples

The ERS-1, ERS-2 and Envisat of European Space Agency, as well as the RADARSAT-2 of the Canadian Space Agency, are all operated in such Sun-synchronous orbits.

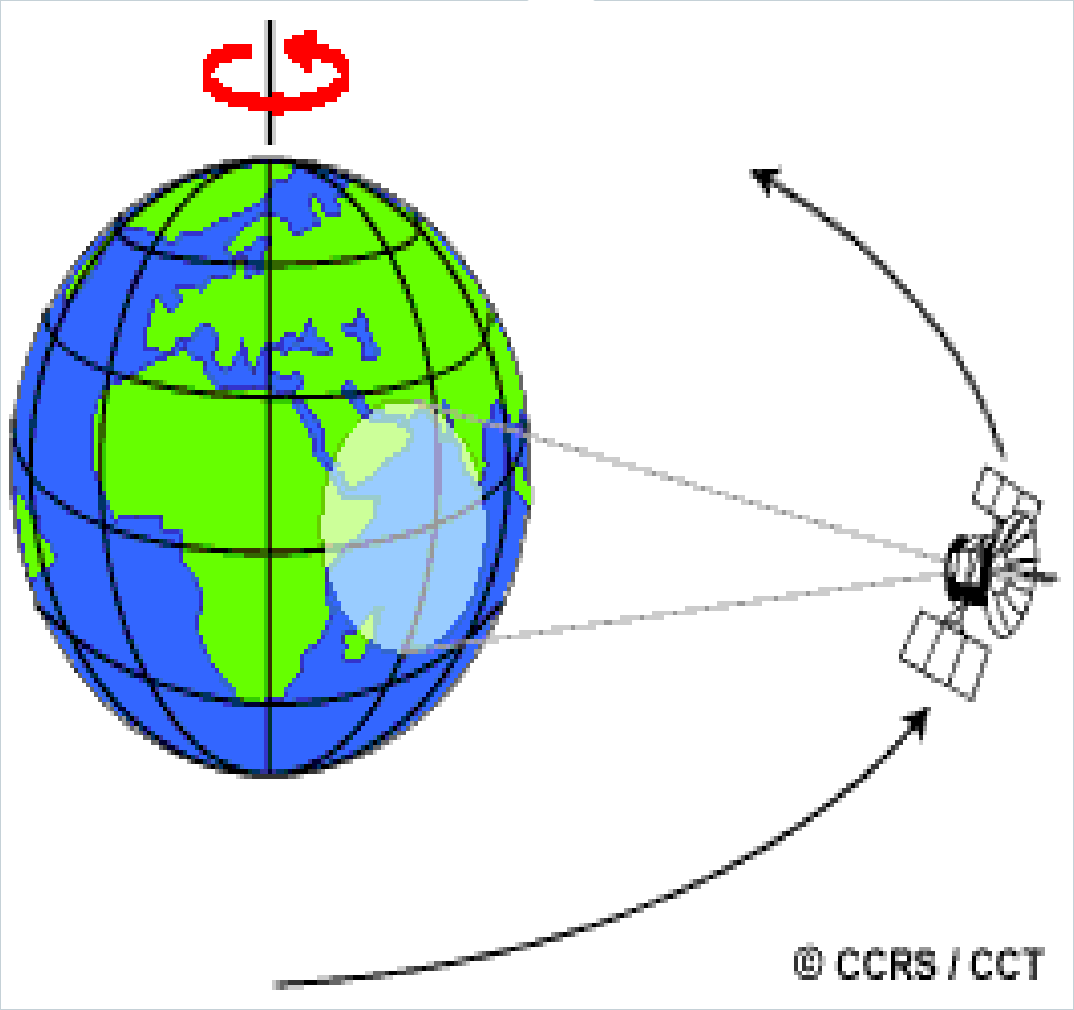
Sun-synchronous Orbit



Geostationary orbit

- Satellites at very high altitudes, which view the same portion of the Earth's surface at all times have **geostationary orbits.**
- An orbit placed right above the equator
- Positioned approximately 36000 km above the Earth's equator, these satellites orbit at the same speed as the Earth's rotation, effectively remaining stationary relative to a fixed point on the planet'.
- Examples:
- GOES 15
- Galaxy 15
- Galaxy 12, 13, 11

Geostationary orbit



Polar orbits

- These orbits have an inclination near 90 degrees. This allows the satellite to see nearly every part of the Earth.
- A polar orbit travels north-south over the poles and takes approximately an hour and a half for a full rotation. As the satellite is in orbit, the Earth is rotating beneath it. As a result, a satellite can observe the entire Earth's surface in a time span of 24 hours.
- These satellites have many uses such as measuring ozone concentrations in the stratosphere or measuring temperatures in the atmosphere.
- Examples Landsat, Worldview and Sentinel 2

Near Polar Orbits