Geostationary Satellites

Course: Remote Sensing and GIS (CC-11)

M.A. Geography (Sem.-3)

By

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Lecture-1

Concept:

A satellite which is stationary with respect to a given position of the earth is known as a geostationary satellite. This type of satellite is mainly deployed for communication and meteorological observations of the earth's surface. All communication satellites are geostationary like the INSAT series of satellites. A geostationary orbit is a special case of geosynchronous orbit. If we have a satellite in a circular orbit at geosynchronous orbit whose inclination is zero (orbit in the same direction as the earth's rotation), the satellite appears to be stationary with respect to the earth over the equator. This is called a geostationary orbit and the satellite is geostationary satellite. This type of satellite is launched on the equatorial plane and travels at the same angular velocity at which it rotates and in the same direction. Hence it remains above the same point on earth at all times. This is possible when the orbital altitude is about 36,000 km.

The satellites always move in a plane called the orbital plane which passes through the centre of the earth. The orbit could be circular or elliptical depending on the eccentricity. In either case, various orbits are possible depending on the inclination of the orbital plane with the plane containing the earth's equator (equatorial plane). If the orbital inclination is zero or 180 degree, the orbital plane lies in the equatorial plane. Such an orbit is called an equatorial orbit. When the inclination is 90 degree, the satellite moves over the poles i.e. the centre of the earth and the North and South Pole lie in the orbital plane. This is called a polar orbit. We can have a variety of orbits whose orbital inclination is between o degree and 180 degree and are generally termed as inclined

orbit. An orbit with inclination close to 90 degree is called a near polar orbit.

The path traced on the earth's surface by the sub- satellite point (the intercept on the earth by the line joining the satellite and the centre of the earth i.e. vertically below the satellite) is called the ground track (nadir trace).The ground track pattern and the sensor FOV decides the geographical area covered by the observation system."The satellites orbit is fixed in inertial space". If the earth were stationary, the same ground track will be traced for every revolution. The rotation of the earth causes a steady westward shift of the ground track. Thus the ground track is generated by the combined action of satellite orbital motion and the earth's rotation relative to the orbital plane. Thus a polar orbit can cover the complete globe if the sensor has the requisite FOV. For an inclined orbit say with an inclination of 30 degree , geographical coverage of ground track is restricted to + or – 30 degree latitude while for an equatorial orbit , the coverage will be around the equator depending on the FOV of the sensor.

When a spacecraft moves from North to South, the orbit crossing the equator is called a descending node crossing and when the orbit crosses south to North, it is called an ascending node crossing. A satellite in the inclined orbit will cross the equator two times during each orbit, once each in their ascending mode and in their descending mode.

Special Orbits:

We know that as the satellite height increases, the time taken for one revolution (period) also increases. At about 35,786 km height, the period is equal to one sidereal day i.e. 23 hours 56 minutes and 4.091

seconds. This orbit is called a geosynchronous orbit i.e. the orbital period is synchronised with the rotational period of the earth.

GEOSTATIONARY SATELLITES

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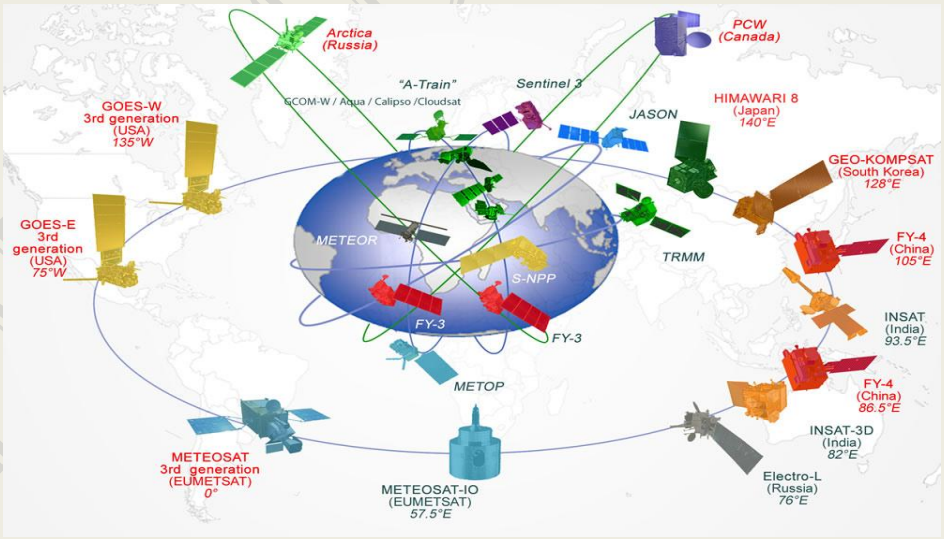

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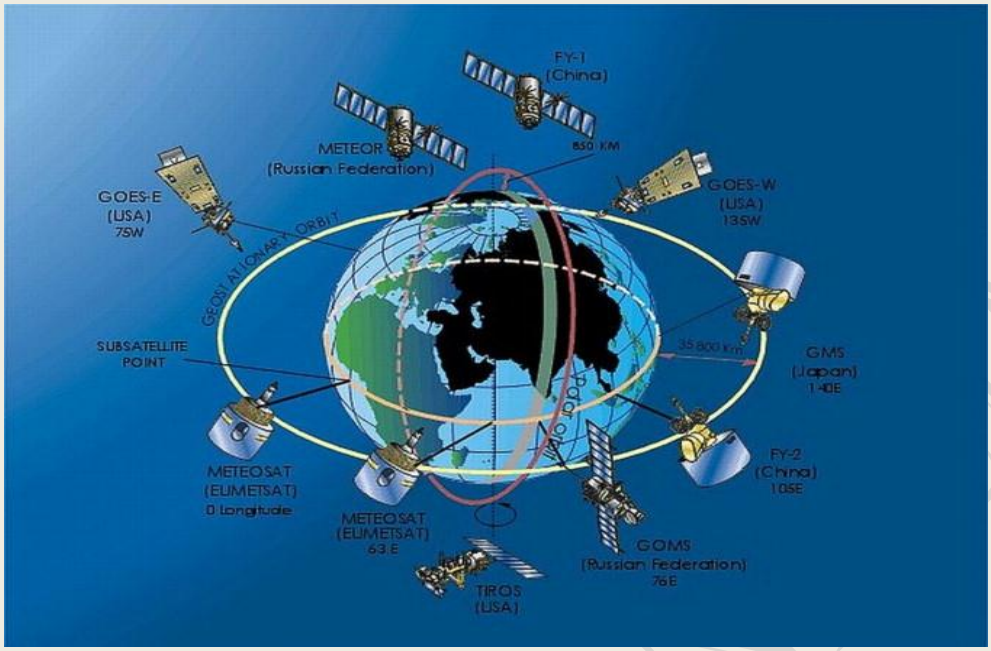

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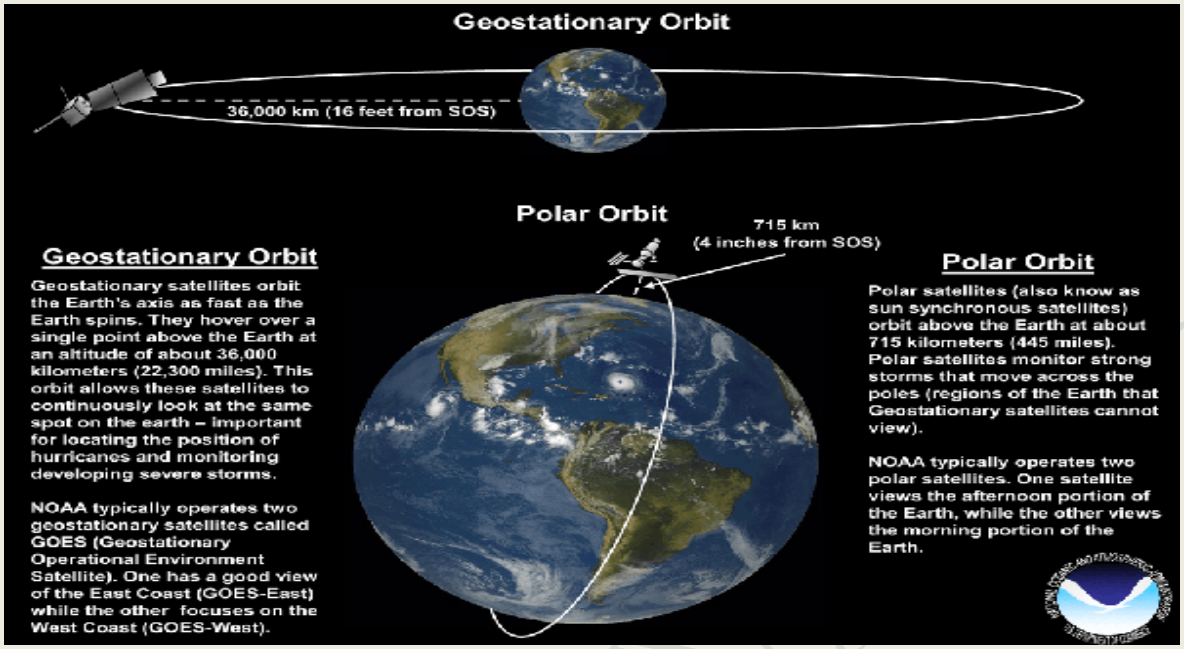
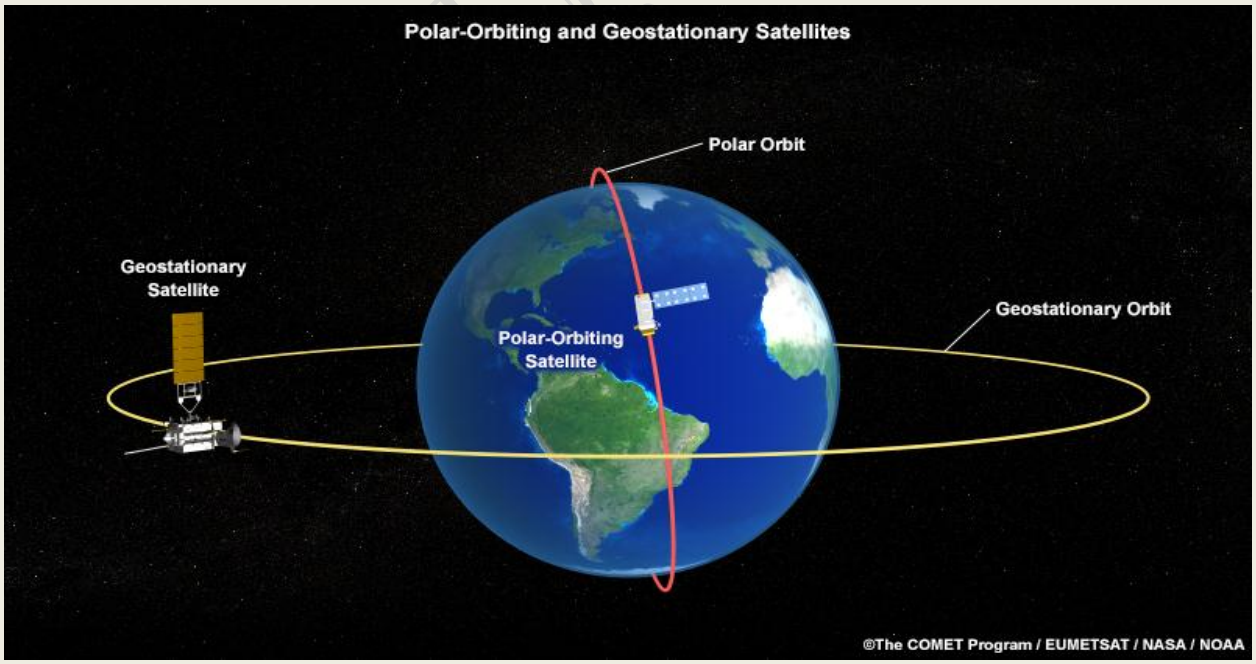
4. GEOSTATIONARY ORBIT


Geostationary Orbit
36,000 km (16 feet from SOS)
Polar Orbit
715 km
(4 inches from SOS)
Geostationary Orbit
Geostationary satellites orbit the Earth's axis as fast as the Earth spins. They hover over a single point above the Earth at an altitude of about 36,000 kilometers (22,300 miles). This orbit allows these satellites to continuously look at the same spot on the earth – important for locating the position of hurricanes and monitoring developing severe storms.
NOAA typically operates two geostationary satellites called GOES (Geostationary Operational Environment Satellite). One has a good view of the East Coast (GOES-East) while the other focuses on the West Coast (GOES-West).
Polar Orbit
Polar satellites (also know as sun synchronous satellites) orbit above the Earth at about 715 kilometers (445 miles). Polar satellites monitor strong storms that move across the poles (regions of the Earth that Geostationary satellites cannot view).
NOAA typically operates two polar satellites. One satellite views the afternoon portion of the Earth, while the other views the morning portion of the Earth.

5.


Polar-Orbiting and Geostationary Satellites
Polar Orbit
Geostationary Satellite
Polar-Orbiting Satellite
Geostationary Orbit
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