Blog Help Files: Satellite Basics

There are two types of Earth-observing satellites: polar-orbiting and geostationary.

Polar-orbiting satellites are in low altitude orbit around the Earth, at approximately 700-800 km. They orbit the Earth multiple times per day, and their orbital path passes almost directly over the north and south poles, as shown in Figure 1. The Earth rotates underneath the path of a polar-orbiting satellite, so each time the satellite makes a pass over the Earth, it views a different region of the surface. Consequently, polar-orbiting satellites obtain global or near-global coverage, but they only provide at most 1-2 observations of a particular area on Earth each day. This is the opposite of geostationary satellites, which provide coverage of only a limited area but make measurements almost continuously.

Terra, Aqua, and Aura are examples of NASA polar-orbiting satellites that provide many measurements used for air quality analysis. Terra and Aqua provide true color images and aerosol optical depth (AOD) measurements, while Aura provides measurements of ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2).

Polar-orbiting satellites cross the equator at the approximately same local time on Earth, regardless of the time zone, so their local "overpass time" is basically the same each day. For example, Terra crosses the equator at approximately 10:30 AM local time, while Aqua and Aura cross the equator at approximately 1:30 PM local time. As a result, Terra provides morning observations, while Aqua and Aura provide afternoon observations.

Summary: Polar-Orbiting Satellites

- Low altitude orbit (~700-800 km)
- Orbit around North and South Poles
- Earth rotates under satellite as it orbits, so each time satellite makes a pass over Earth, it observes a new area
- Low temporal resolution (observe same area on Earth at most 1-2 times per day)
- Global coverage
- Used for a variety of applications, including air quality, land cover, water quality, and vegetation studies
- Examples:
    - Terra
        - Launched in 1999
        - 10:30 AM equatorial overpass
    - Aqua
        - Launched in 2002
        - 1:30 PM equatorial overpass
    - Aura
        - Launched in 2004
        - 1:30 PM equatorial overpass

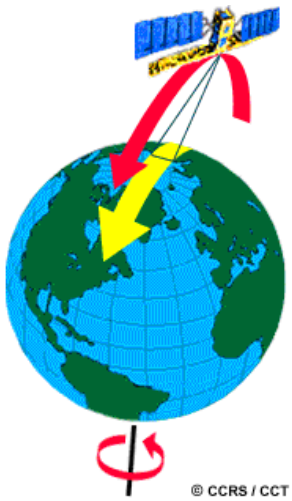

Figure 1. Representation of a polar-orbiting satellite

Geostationary satellites are in high altitude orbit around the Earth, at approximately 38,500 km. At this altitude, the orbital period of the satellite matches the rotation speed of the Earth, such that the satellite appears to remain stationary over the same region on Earth, as shown in Figure 2. Consequently, geostationary satellites provide nearly continuous measurements of a specific region of the Earth's surface. This is in contrast to polar-orbiting satellites, which have global coverage but limited measurements of the same area on Earth each day. Geostationary satellites are used primarily to monitor meteorological conditions and severe storm development.

The Geostationary Operational Environmental Satellites (GOES)* are examples of NOAA geostationary satellites. GOES provide frequent measurements of visible, infra-red, and water vapor wavelengths that are used by meteorologists to determine the threat of severe weather in the United States.

Summary: Geostationary Satellites

- High altitude orbit (~35,800 km)
- Orbital period of satellite matches rotational speed of Earth
- Continuously observes same area on Earth
- Very high temporal resolution (minutes – hours)
- Designed to monitor meteorological conditions and severe storm development, including hurricanes, tornadoes, and floods
- Example: GOES (Geostationary Operational Environmental Satellites)

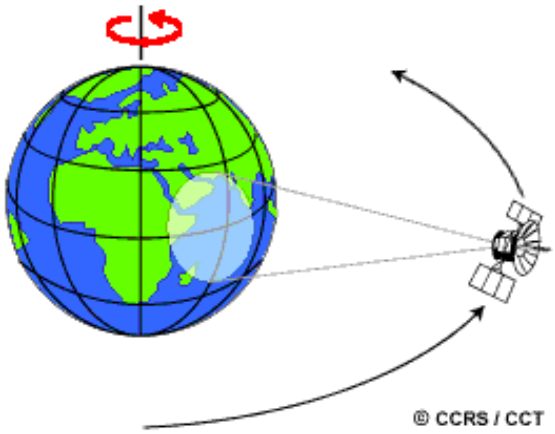

Figure 2. Representation of a geostationary satellite

*For more information about GOES products, see the **Aerosol Optical Depth (AOD)** and **GOES Imagery Help Files.**