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Satellite images (also **Earth observation imagery**, **space borne photography**, or simply **satellite photo**) are images of Earth collected by imaging satellites operated by governments and businesses around the world. Satellite imaging companies sell images by licensing them to governments and businesses such as Apple Maps and Google Maps. It should not be confused for astronomy images collected by space telescope.

USES

Satellite images have many applications in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscape, geology, cartography, regional planning, education, intelligence and warfare. Less mainstream uses include anomaly hunting, a criticized investigation technique involving the search of satellite images for unexplained phenomena.[4] Images can be in visible colors and in other spectra. There are also elevation maps, usually made by radar images. Interpretation and analysis of satellite imagery is conducted using specialized remote sensing software.

There are five types of resolution when discussing satellite imagery in remote sensing: spatial, spectral, temporal, radiometric and geometric. Campbell (2002)[5] defines these as follows:

- spatial resolution is defined as the pixel size of an image representing the size of the surface area (i.e. m^2) being measured on the ground, determined by the sensors' instantaneous field of view (IFOV);

- spectral resolution is defined by the wavelength interval size (discrete segment of the Electromagnetic Spectrum) and number of intervals that the sensor is measuring;
- temporal resolution is defined by the amount of time (e.g. days) that passes between imagery collection periods for a given surface location
- Radiometric resolution is defined as the ability of an imaging system to record many levels of brightness (contrast for example) and to the effective bit-depth of the sensor (number of grayscale levels) and is typically expressed as 8-bit (0–255), 11-bit (0–2047), 12-bit (0–4095) or 16-bit (0–65,535).
- Geometric resolution refers to the satellite sensor's ability to effectively image a portion of the Earth's surface in a single pixel and is typically expressed in terms of Ground sample distance, or GSD. GSD is a term containing the overall optical and systemic noise sources and is useful for comparing how well one sensor can "see" an object on the ground within a single pixel. For example, the GSD of Landsat is ≈30m, which means the smallest unit that maps to a single pixel within an image is ≈30m x 30m. The latest commercial satellite (GeoEye 1) has a GSD of 0.41 m. This compares to a 0.3 m resolution obtained by some early military film based Reconnaissance satellite such as Corona.[*citation needed*]

The resolution of satellite images varies depending on the instrument used and the altitude of the satellite's orbit. For example, the Landsat archive offers repeated imagery at 30 meter resolution for the planet, but most of it has not been processed from the raw data. Landsat 7 has an average return period of 16 days. For many smaller areas, images with resolution as high as 41 cm can be available.[6]

Satellite imagery is sometimes supplemented with aerial photography, which has higher resolution, but is more expensive per square meter. Satellite imagery can be combined with vector or raster data in a GIS provided that the imagery has been spatially rectified so that it will properly align with other data sets.

Public Domain

Satellite imaging of the Earth surface is of sufficient public utility that many countries maintain satellite imaging programs. The United States has led the way in making these data freely available for scientific use. Some of the more popular programs are listed below, recently followed by the European Union's Sentinel constellation.

Landsat

Landsat is the oldest continuous Earth observing satellite imaging program. Optical Landsat imagery has been collected at 30 m resolution since the early 1980s. Beginning with Landsat 5, thermal infrared imagery was also collected (at coarser spatial resolution than the optical data). The Landsat 7 and Landsat 8 satellites are currently in orbit. Landsat 9 is planned.

MODIS

MODIS has collected near-daily satellite imagery of the earth in 36 spectral bands since 2000. MODIS is on board the NASA Terra and Aqua satellites.

Sentinel

The ESA is currently developing the Sentinel constellation of satellites. Currently, 7 missions are planned, each for a different application. Sentinel-1 (SAR imaging), Sentinel-2 (decameter optical imaging for land surfaces), and Sentinel-3 (hectometer optical and thermal imaging for land and water) have already been launched.

ASTER

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is an imaging instrument onboard Terra, the flagship satellite of NASA's Earth Observing System (EOS) launched in December 1999. ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems (J-space systems). ASTER data is used to create detailed maps of land surface temperature, reflectance, and elevation. The coordinated system of EOS satellites, including Terra, is a major component of NASA's Science Mission Directorate and the Earth Science Division. The goal of NASA Earth Science is to develop a scientific understanding of the Earth as an integrated system, its response to change, and to better predict variability and trends in climate, weather, and natural hazards.[7]

- Land surface climatology—investigation of land surface parameters, surface temperature, etc., to understand land-surface interaction and energy and moisture fluxes

- Vegetation and ecosystem dynamics—investigations of vegetation and soil distribution and their changes to estimate biological productivity, understand land-atmosphere interactions, and detect ecosystem change
- Volcano monitoring—monitoring of eruptions and precursor events, such as gas emissions, eruption plumes, development of lava lakes, eruptive history and eruptive potential
- Hazard monitoring—observation of the extent and effects of wildfires, flooding, coastal erosion, earthquake damage, and tsunami damage
- Hydrology—understanding global energy and hydrologic processes and their relationship to global change; included is evapotranspiration from plants
- Geology and soils—the detailed composition and geomorphologic mapping of surface soils and bedrocks to study land surface processes and earth's history
- Land surface and land cover change—monitoring desertification, deforestation, and urbanization; providing data for conservation managers to monitor protected areas, national parks, and wilderness areas

Meteosat

Model of a first generation Meteosat geostationary satellite.

The Meteosat-2 geostationary weather satellite began operationally to supply imagery data on 16 August 1981. Eumetsat has operated the Meteosats since 1987.

- The Meteosat visible and infrared imager *(MVIRI),* three-channel imager: visible, infrared and water vapour; It operates on the first generation Meteosat, Meteosat-7 being still active.
- The 12-channel *Spinning Enhanced Visible and Infrared Imager (SEVIRI)* includes similar channels to those used by MVIRI, providing continuity in climate data over three decades; Meteosat Second Generation (MSG).
- The *Flexible Combined Imager (FCI)* on Meteosat Third Generation (MTG) will also include similar channels, meaning that all three generations will have provided over 60 years of climate data.


Pléiades Neo
30 cm
Revisit capacit y
twice daily, anywhere
Daily acquisition capacity:
2,000,000 km²
Pléiades 1a/1b
50 cm
Revisit capacity
daily, anywhere
Daily acquisition capacity:
700,000 km²
Vision-1
90 cm
Daily to 8 days, anywhere,
depending on latitude and
partner satellites
Daily acquisition capacity:
20,000 km²
SPOT 6/7
1.5 m
Revisit capacity
daily, anywhere
Daily acquisition capacity:
6,000,000 km²
RADAR
Constellation
From 25cm to 40 m
Revisit capacity
daily for most latitudes
Daily acquisition capacity:
5,400,000 km²
DMC
Constellation
From 12 to 24 m
Revisit 3-5 days anywhere
Daily acquisition capacity:
10,000,000 km²