Satellite Imagery

Images of the weather comes to earth from satellites in two different types of orbits:

* The Polar Orbiting (POES) satellite system offers the advantage of daily global coverage, by making nearly polar orbits roughly 14.1 times daily. Since the number of orbits per day is not an integer, the orbital tracks do not repeat on a daily basis. Currently in orbit we have morning and afternoon satellites, which provide global coverage four times daily, and
* The geostationary (GOES) satellites provide the kind of continuous monitoring necessary for intensive data analysis. They circle the Earth in a geosynchronous orbit, which means they orbit the equatorial plane of the Earth at a speed matching the Earth's rotation. This allows them to hover continuously over one position on the surface. Because they stay above a fixed spot on the surface, they provide a constant vigil for the atmospheric "triggers" for severe weather conditions such as tornadoes, flash floods, hail storms, and hurricanes.

There are advantages and disadvantages to each kind of orbit.
Polar Orbits

Advantages:

- Closer to the earth with an orbit of about 530 miles (850 km) above the surface.

* Much more detailed images.
* Excellent views of the polar regions.

Disadvantages:

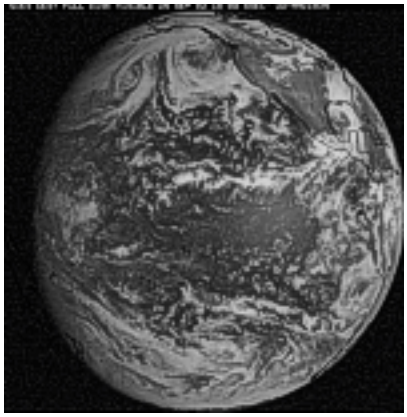
* Cannot see the whole earth's surface at any one time.
* The path of each orbit changes due to the earth's rotation so no two images are from the same location.
* Limited to about six or seven images a day since most of the time the satellite is below the earth's horizon and out of range of listening equipment.

Geostationary orbits (earth stationary)

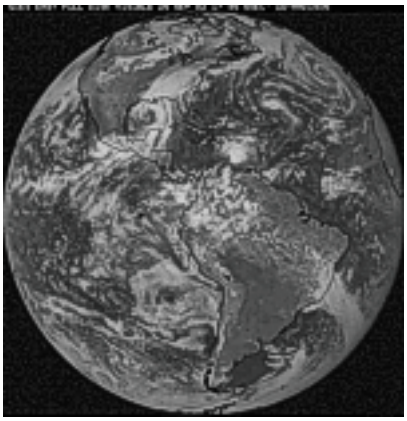
* Always located in the same spot of the sky relative to the earth.
* Can view the entire earth at all times.
* Can record images as fast a once every minute.
* View is always from same perspective so motion of clouds over the earth's surface can be computed.
* Also receives transmissions from free-floating balloons, buoys and remote automatic data collection stations around the world.

* Located about 22,000 miles (35,000 km) in space, providing less detail views of the earth.
* Views of the polar regions are limited due to the earth's curvature.

GOES West Visible



GOES East Visible

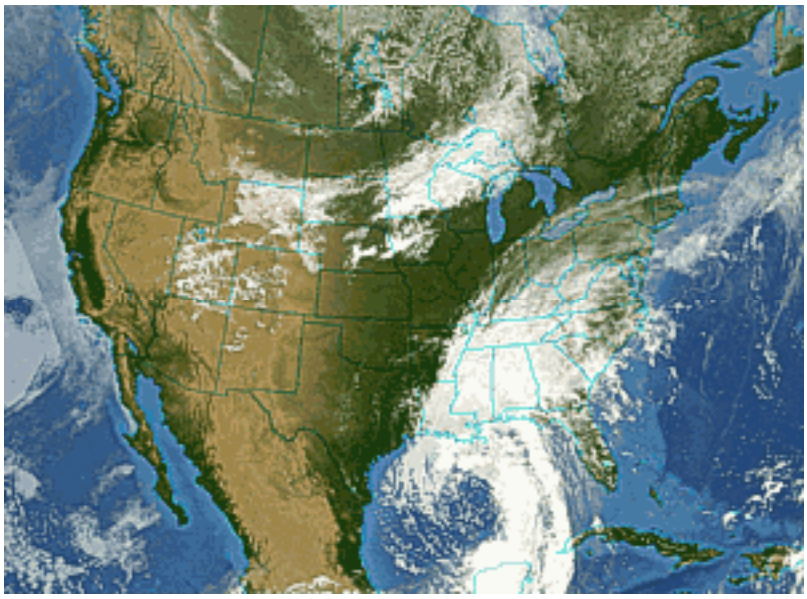


Images and perspectives

Geostationary Operational Environmental Satellites (GOES) satellites are a mainstay of weather forecasting for the National Weather Service. They are the backbone of short-term forecasting. The United States operates two meteorological satellites in geostationary orbit, one over the East Coast and one over the West Coast with overlapping coverage over the United States. Below are the views from each satellite. These are the two views the GOES satellites have of the earth. Click to enlarge.

Since the satellites are positioned over the equator, they are viewing the northern hemisphere at an angle so you can get a sense of the vertical development of the clouds. Also taller clouds will cast shadows onto lower ones so visible imagery is an excellent tool for locating developing thunderstorms.

However, computer enhancements of these images are common. Probably the most common enhancement is combining both GOES West and East into one image of the continental U.S. and changing the perspective . This view (the same time frame as the two above full disk views) has been enhanced to color the surface of the earth as well change the perspective to make it appear the satellite is directly over the center of the U.S.



Some colorized images help enhance different aspects of the weather by adding scientific information and some images are enhancing the image to make it more interesting to the viewer.

Types of images

These satellites are capable of providing information on clouds and moisture in three primary forms - visible, infrared (IR), and water vapor imagery.

Visible imagery

Visible image - Visible imagery is just like the name suggests; an image of the earth in visible light. This is a similar manner to that of a person taking a picture with a camera. The satellite detects senses sunlight reflected from objects within the viewfinder. In the case of the satellite, the objects are the upper surfaces of clouds. Thick clouds do a much better job of reflecting light and therefore appear brighter in visible photos.

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Infrared imagery

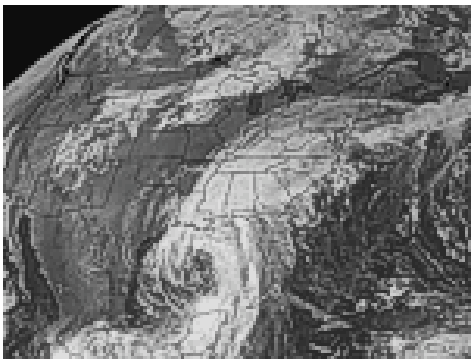
Infrared image - The obvious problem with visible imagery is that it is only available during the day. To combat this problem, the infrared (IR) sensor was devised. It senses radiant (heat) energy given off by the clouds. Warmer (lower in the atmosphere) clouds give off more energy than cold (higher) clouds. The IR sensor measures the heat and produces several images based upon different wavelengths in the IR range of the electromagnetic spectrum.

Often these images are color enhanced to help better distinguish the taller (coldest, usually from thunderstorms) cloud tops.

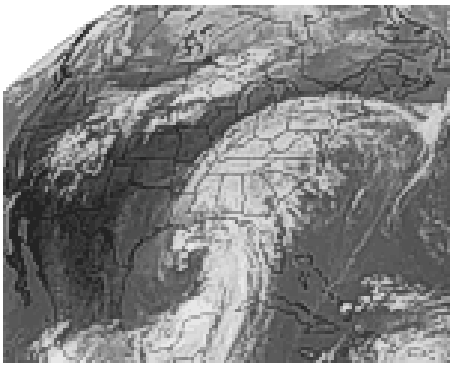
Water vapor imagery

Water vapor image - Water vapor imagery is unique in that it can detect water vapor (water in a gas state) in addition to clouds. However, due to absorption of energy by the atmosphere this view only "sees" of the top third of the troposphere. While the low level moisture is hidden from the satellite sensor, the upper level moist/dry areas is plainly observable. Moist areas show up as white dry areas as black.

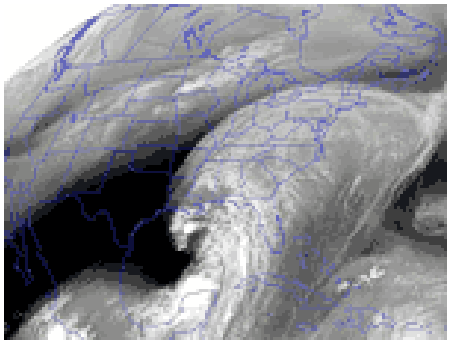
Derived satellite images
Lifted Index image –
The GOES satellites also have equipment that will acquire profiles of temperature and moisture for clear or partly clear fields of view. These profiles are further processed to produce several derived meteorological parameters. In addition, cloud tracking allows for the measurement of wind in the atmosphere. This information is used for input to the weather models which result in improved weather analysis and forecasting.



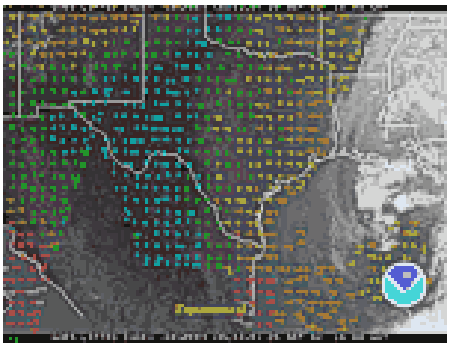
Visible Satellite Imagery



Infrared Satellite Imagery



Water Vapor Imagery



Lifted Index Satellite
Used for t-storm forecasting