



thermal-infrared
image of Earth
from the GOES-8
weather satellite

March 2011 NSTA Share-A-Thon

Thermal Infrared Image of Earth

This is an infrared image of Earth taken by the GOES-8 weather satellite. GOES-8 was launched in 1994 and is now decommissioned.

The picture was taken at a wavelength of about 4 microns (4 millionths of a meter). The GOES satellite has a camera sensitive to 4-micron infrared radiation because water vapor both absorbs and emits strongly at that wavelength. The label “thermal infrared” refers to the portion of the infrared band that is radiated most strongly by material at typical Earth temperatures, from wavelengths of about 3 microns to about 30 microns. For comparison, human eyes see radiation with wavelengths of about 0.4 to 0.7 microns.

“GOES” stands for Geostationary Operational Environmental Satellite. “Geostationary” means an orbit about 22,000 miles (36,000 Kilometers) above Earth’s surface, with a period of exactly 24 hours, so the satellite seems to hover over one spot on the equator. This is also called a Clarke orbit, named after the late Arthur C. Clarke, the science fiction author who pointed out that it would be a good location for communications and other types of satellites.

The Earth’s surface itself is not visible in this image because atmospheric water vapor is completely opaque at a wavelength of 4 microns. Instead, what is seen is the infrared glow from that water vapor, represented by the color red for a certain average temperature range. The yellow patch across the center represents extra-warm tropical water vapor. The band of black spots across the image above the tropics represents cool water vapor in the tops of high-altitude thunderstorm clouds.

For the same reason that GOES cannot see the ground from outside Earth’s atmosphere at a wavelength of 4 microns, ground-based observatories, even at the tops of mountains, have limited vision of celestial objects at 4 microns and many other infrared wavelengths. NASA’s Stratospheric Observatory for Infrared Astronomy (SOFIA) will carry a 2.5-meter (100-inch) telescope at altitudes of 39,000 to 45,000 feet (12 to 14 kilometers), above most atmospheric water vapor, to have a nearly unobstructed infrared view of the universe.

(photo credit: NASA)