

Atmospheric conditions monitoring with GOES

(Geostationary Operational Environmental Satellite)

Introduction

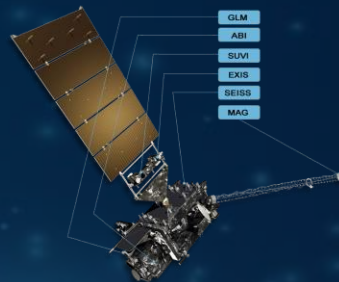
Condensed abstract

The GOES series of spacecrafts is designed to operate in geostationary orbit (~35,786 km above ground) with the main purpose of monitoring atmospheric conditions.



Technical details

The GOES-R series (GOES-16 to GOES-19) are NOAA's currently active geostationary satellites, providing real-time weather data and lightning tracking with a spatial resolution ranging from 0.2 km to 2 km and a revisit time of 5 minutes.



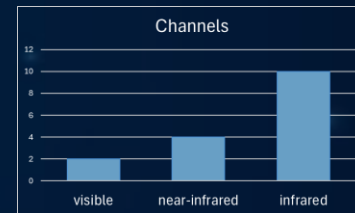
They have three main sensor arrays:

- Earth-pointing sensors (e.g., ABI, GLM) for atmospheric conditions monitoring
- Solar-pointing sensors (e.g., EXIS, SUVI) for solar observations
- In-situ sensors (e.g., SEISS, Magnetometer) to measure orbital particles and magnetic fields

Earth observation instruments

ABI

The advanced baseline imager (ABI) of the GOES-R spacecraft has 16 channels to monitor earth's surface.

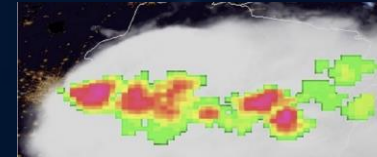


The different channels of the ABI allows to extract various information such as clouds, water, vegetation, moisture and smoke.

GLM

The Geostationary Lightning Mapper (GLM) is the first instrument of the GOES series to detect and map lightning.

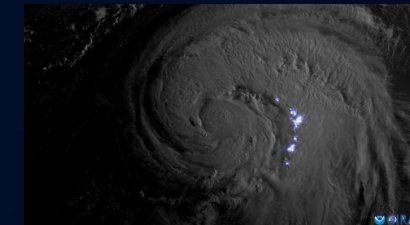
Lightning activity gives valuable insights into storm evolution, allowing forecasters to issue warnings earlier. The GLM tracks lightning events, helping to assess the risk of ground strikes



GOES in action

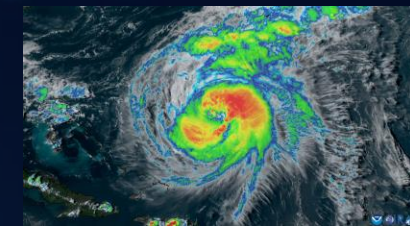
In August 2024, GOES-16 tracked Hurricane Ernesto as it intensified from a tropical storm into a Category 2 hurricane.

The satellite provided real-time infrared imagery and lightning data, allowing forecasters to predict the areas most at risk.



GOES-16 GLM captures lightning flashes within Hurricane Ernesto on August 15th, 2024. (CSU/CIRA & NOAA)

Ernesto caused heavy flooding and strong winds in the Virgin Islands and Puerto Rico before hitting Bermuda as a Category 1 hurricane. GOES-16's data was crucial to issue warnings and guiding emergency responses



GOES-16 ABI monitors Hurricane Ernesto as it approaches the Island of Bermuda on August 16th, 2024. (CSU/CIRA & NOAA)

<https://www.goes-r.gov/mission/history.html>

<https://www.goes-r.gov/spacesegment/instruments.html>

https://fr.wikipedia.org/wiki/Geostationary_Operational_Environmental_Satellite

<https://www.nesdis.noaa.gov/our-satellites/currently-flying/geostationary-satellites/goes-r-series-spacecraft-instruments>

<https://satlib.cira.colostate.edu/event/hurricane-ernesto/>

<https://www.goes-r.gov/multimedia/print.html#Fac%20Sheets>

History

GOES 4-7

- 3D data (enable vertical profiling)

GOES 13-18

- Hemisphere imaged every 5min in the visible and IR ranges (ABI)
- Continuous collection of data on space environment

GOES 19

- Solar imaging



GOES 1-3

- Spin-stabilized
- 2D data (no vertical dimension)

GOES 8-12

- Stable orientation in space
- Complete hemisphere imaged every 25min in 5 spectral ranges

GeoXO

- Imager with 18 spectral bands
- Hyperspectral spectrometer providing a map of pollutants emitted into the atmosphere