Australian Government
Bureau of Meteorology

Satellite data used by the Bureau of Meteorology

The Bureau currently uses data from over 30 international satellite instruments in weather prediction models and visualisation systems every day.

Bureau products and services

The Bureau's weather, climate, ocean and water services use data from Earth observation satellites. The Bureau's forecast models assimilate real-time data from over 30 international satellite instruments from satellites in low Earth orbit (LEO) and geostationary orbit.

The Bureau also generates many satellite-derived products, including Atmospheric Motion Vectors, and fog and low cloud, solar radiation, volcanic ash, sea surface temperature and Antarctic ice analysis.

Satellite data

The Bureau relies predominately on geostationary satellite data for most of its Earth observations for real-time forecasts and warnings, due to the frequent updates and low latency of the data. However, satellites in low Earth orbit host the instruments that are frequently used for improving our weather modeling accuracy.

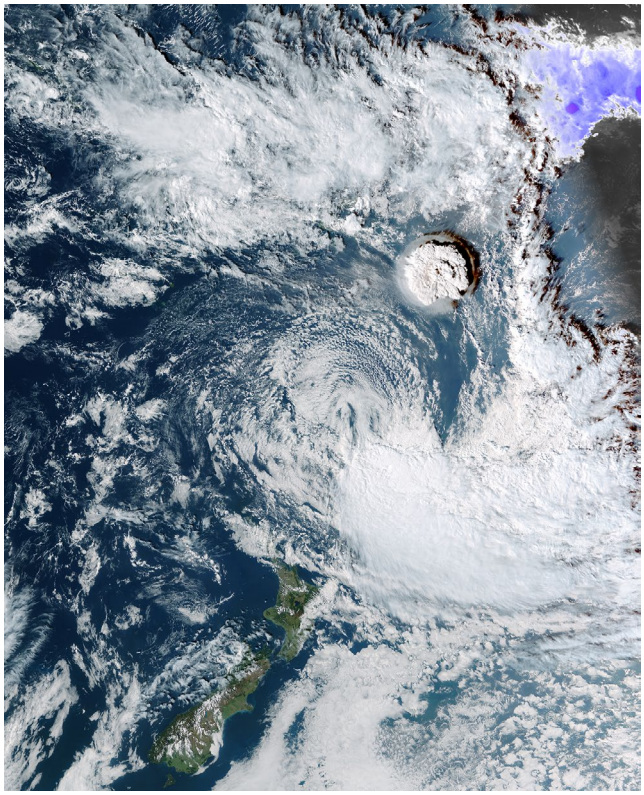
There are a wide range of instrument technologies hosted on geostationary and low Earth orbit satellites that are critical to the Bureau's services including the following key types of observation technology.

Infrared and visible images

Infrared images are derived from radiation emitted from the Earth and its atmosphere at infrared wavelengths. These images provide information on the presence of water vapour and the temperature of the underlying surface or cloud.

Visible images are a record of the visible light scattered or reflected towards the satellite from the Earth and clouds. They give meteorologists information that may not appear on infrared images.

The Bureau uses visible images and infrared images from satellites in both geostationary orbit and low Earth orbit.



A visible image from the Himawari-8 satellite showing the Hunga Tonga–Hunga Ha'apai volcanic eruption on 15 January 2022 at 0500 UTC. Image credit: Himawari-8 is operated by the Japan Meteorological Agency.

Infrared soundings

Hyperspectral infrared sounders provide high vertical resolution atmospheric sounding information.

Infrared sounders are sensitive to atmospheric temperature and moisture profiles, and can also be used to detect the height and extent of cloud cover. They improve forecast skill which assists in the early prediction of severe weather.

Microwave soundings and radiances

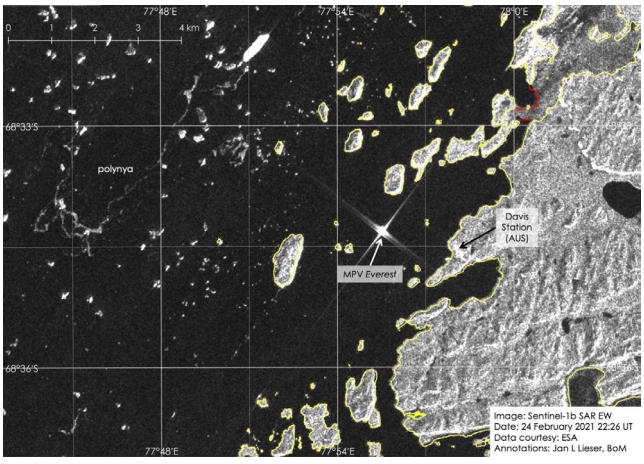
Microwave sounders provide global all-weather temperature and moisture information from the Earth's surface to the top of the atmosphere.

Microwave radiometers also provide valuable information about the Earth's surface, including soil moisture, sea surface winds and sea ice properties.

Synthetic Aperture Radar

A synthetic aperture radar (SAR) is an active sensor that can detect physical properties on the Earth's surface. It transmits microwave signals and then receives the echoes that are returned, or backscattered, from the Earth.

SAR observations are used in the Bureau's Antarctic ice services for measuring and inferring ice parameters like surface roughness, ice type, concentration and drift speed. Sea ice can present a hazard to marine operations and ocean vessels and installations.



A synthetic aperture radar (SAR) image from Sentinel-1 showing sea ice near Davis Station, Antarctica. The bright cross is a reflection off Antarctic supply ship MPV Everest. Icebergs are visible as white dots on the ocean. Image copyright European Space Agency.

Satellite altimeter data

An altimeter is a device that measures altitude—a location's distance above sea level. Satellite altimetry measures the time taken for a radar pulse to travel from the satellite to the sea surface and back to the satellite.

Altimeter data are essential for the Bureau's ocean model and ocean forecasting.

Global Navigation Satellite System

Global Navigation Satellite System (GNSS) refers to a group of synchronised satellites working together to provide position and timing data. The satellites receive signals from other GNSS satellites and from sensors on Earth. As the signals pass through the Earth's atmosphere they are refracted and slowed, providing information about water vapour in the atmosphere.

GNSS observations are increasingly important for terrestrial weather and space weather applications. Data from GNSS radio occultation and GNSS-to-ground observations can significantly improve forecast accuracy.

GNSS reflectometry can provide surface information for meteorological research and disaster preparedness, including estimating soil moisture, ocean surface winds and sea ice height, and mapping floods or wetlands.

Wind data instruments

Scatterometers are a type of radar instrument that can provide information about the speed and direction of wind over the ocean surface by detecting the backscatter from waves.

Upper atmosphere wind vectors can be generated from sets of infrared and visible images by tracking the movement of features such as clouds, to provide an indication of wind direction and speed.

Light detection and ranging (LiDAR) instrumentation is used to provide vertical profiles of wind vectors that are assimilated into weather models.

Contact us space@bom.gov.au www.bom.gov.au