Australian Government
Bureau of Meteorology

Satellite data used at the Bureau of Meteorology

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

The Bureau's satellite related responsibilities

The Bureau's weather, climate, ocean and water services are underpinned by Earth observation satellites. The Bureau's forecast models assimilate real-time data from around 30 international satellite instruments from satellites in Low Earth and Geostationary Orbits.

The Bureau also generates many satellite-derived products, including Atmospheric Motion Vectors, fog and low cloud, solar radiation, volcanic ash, sea surface temperatures 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 (LEO) host the instruments that have the greatest impact on improving weather model accuracy.

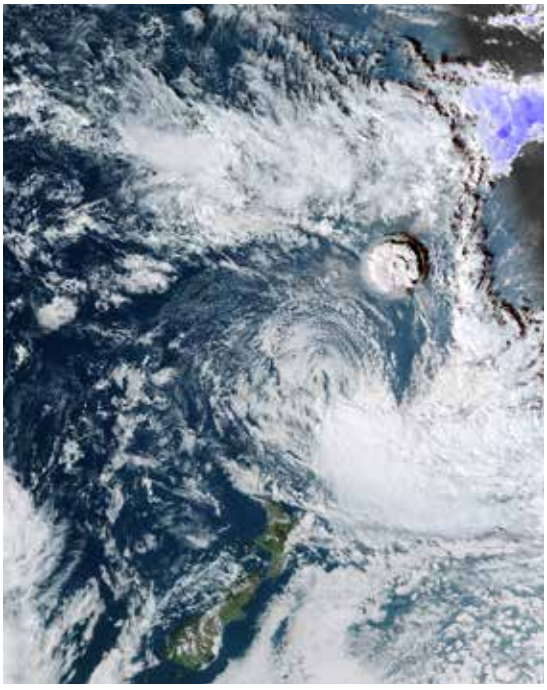
There are a wide range of instrument technologies on Geostationary and LEO satellites that are critical to the Bureau's services including the following key satellite observation types.

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 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 extra information that may not appear on infrared images.

The Bureau uses visible and infrared images from satellites in both Geostationary and Low Earth Orbits.



Himawari-8 visible image of the Hunga Tonga–Hunga Ha'apai volcanic eruption on 15 January 2022 0500 UTC.

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 and consequently assist in the early prediction of severe weather.

Microwave soundings and radiances

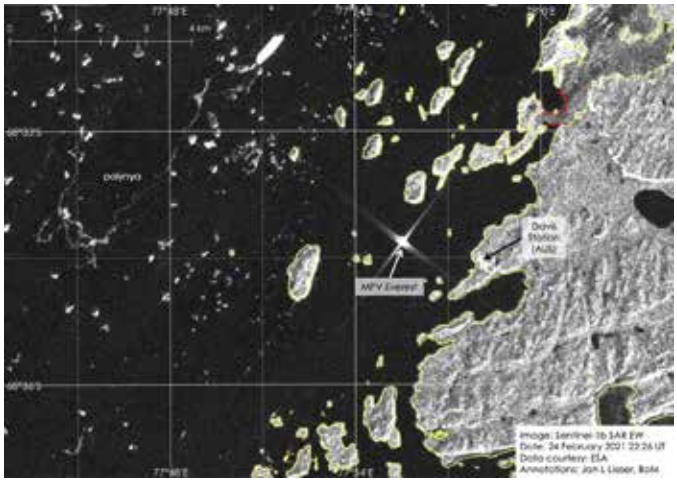
Microwave sounders provide global all-weather temperature and moisture information from the Earth's surface to top of the atmosphere.

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 first transmits microwave signals and then receives back the echos that are returned, or backscattered, from the Earth's surface to detect physical properties.

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 threaten marine operations and present a hazard for ocean vessels and installations.



Sentinel-1 SAR image of sea ice near Davis Station, Antarctica. The bright cross is a reflection off Antarctic supply ship MPV Everest. A few icebergs are visible as white dots on the ocean.
Image credit: 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 synchronized satellites working together to provide position and timing data. The satellites receive signals from other GNSS satellites and from sensors on Earth. As the signal passes through the Earth's atmosphere it is refracted and slowed, providing information about water vapour in the atmosphere.

GNSS related observations are increasingly important for terrestrial weather and space weather applications. GNSS Radio Occultation and GNSS-to-ground observations have significant impact on improving forecast accuracy. GNSS reflectometry is a new technique with potential to provide surface information relevant to meteorological and disaster resilience, including for estimating soil moisture, flood or wetlands mapping, ocean surface winds, and sea ice height.

Satellite winds

Scatterometers are a type of radar instrument that can provide information about wind speed and direction 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.

New Lidar instrumentation provide vertical profiles of wind vectors for assimilation into weather models.