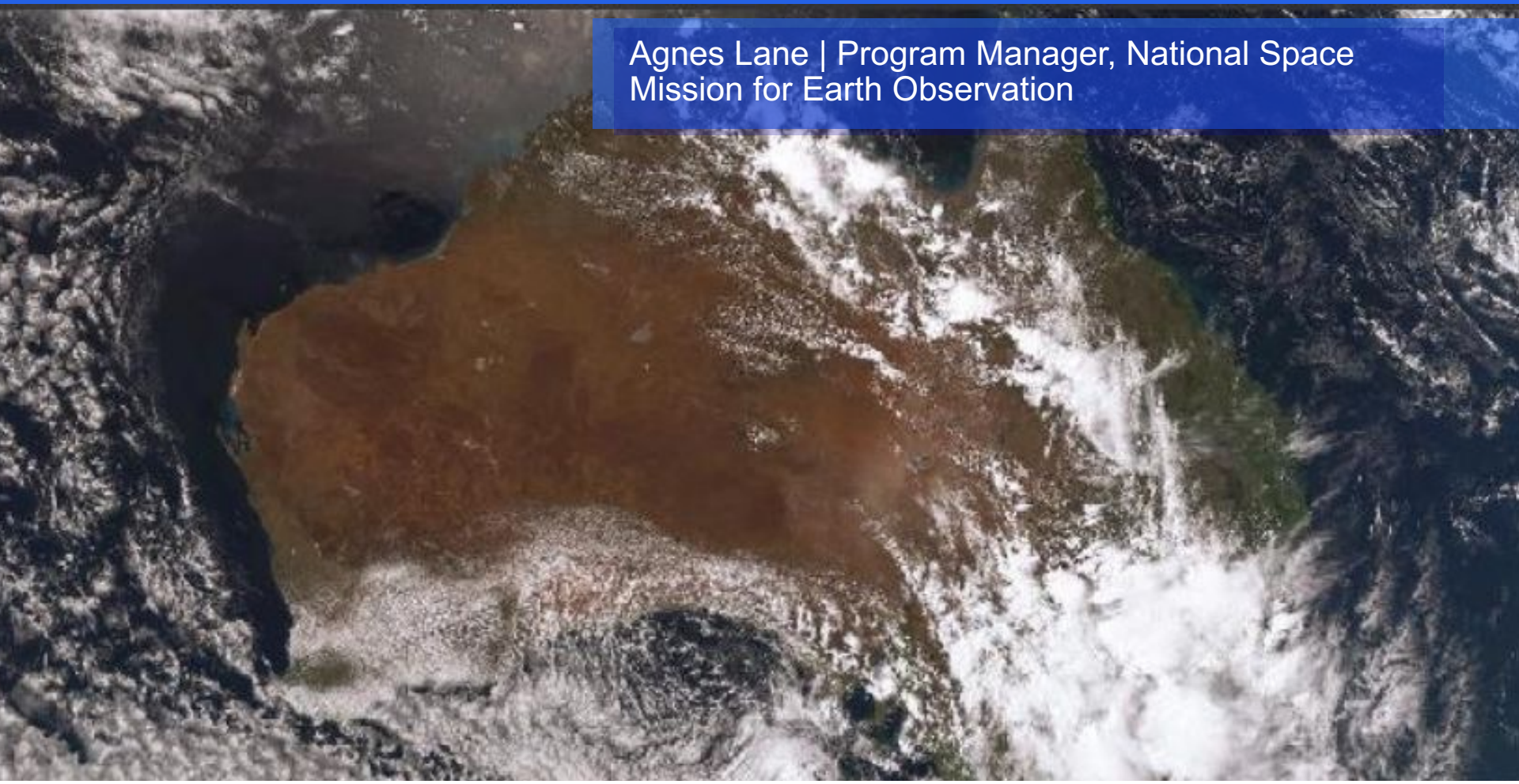
The Bureau of Meteorology

Utilisation of satellite observations at the Bureau of Meteorology

Agnes Lane | Program Manager, National Space Mission for Earth Observation

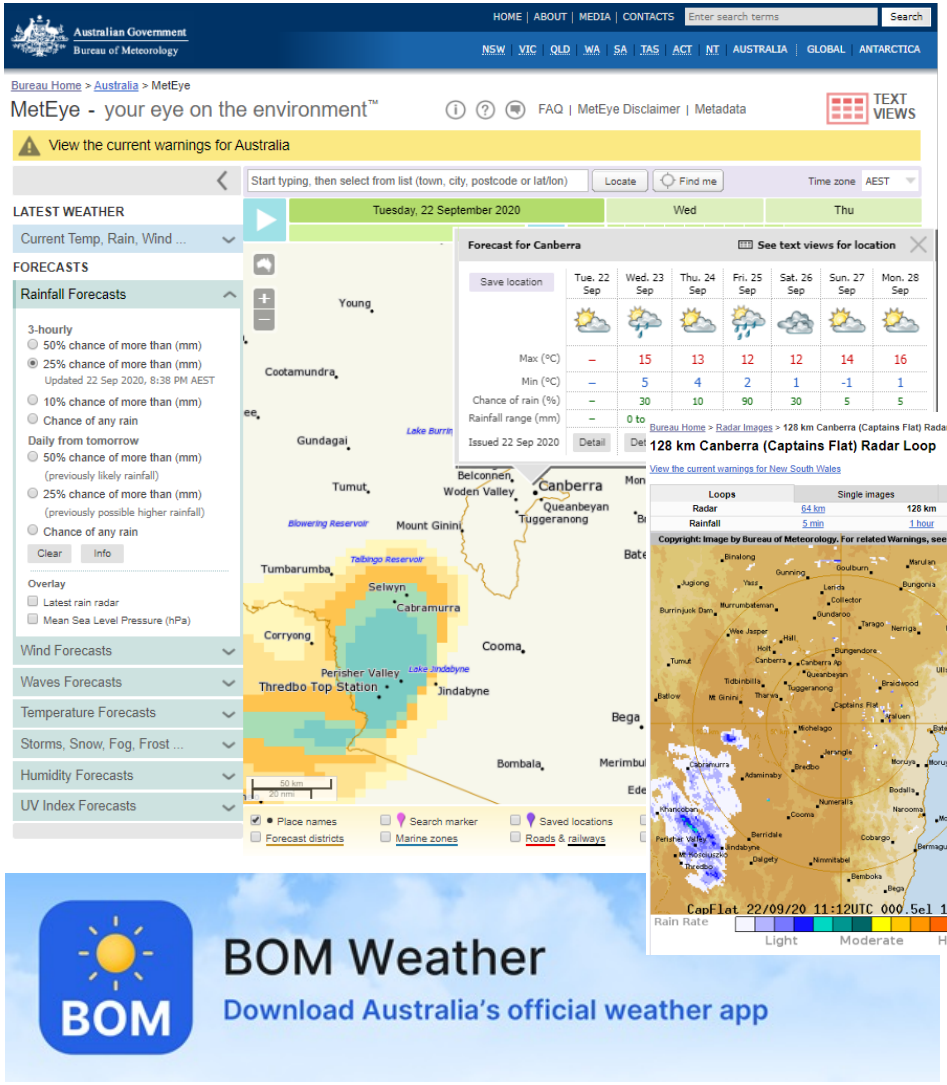


About the Bureau

The Bureau of Meteorology is Australia's national weather, climate, water and space weather agency.

We provide one of the most fundamental and widely used services of government.

We provide regular forecasts, warnings, monitoring and advice spanning the Australian region and Antarctic territory.



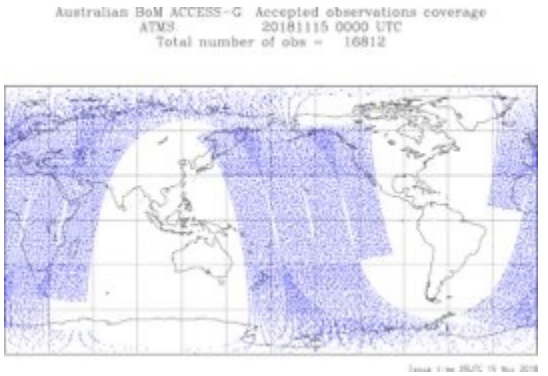
Why are satellite observations critical for the Bureau's weather services?

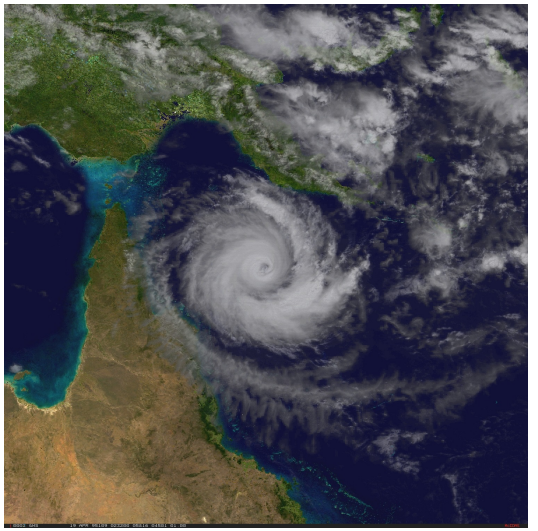
1. Satellite EO for **Numerical Weather Prediction** (NWP)

   - ✓ 95 % of observations assimilated by NWP are satellite observations
   - ✓ 36 million satellite observations assimilated per day
   - ✓ 70% of forecast accuracy attributed to satellite observations

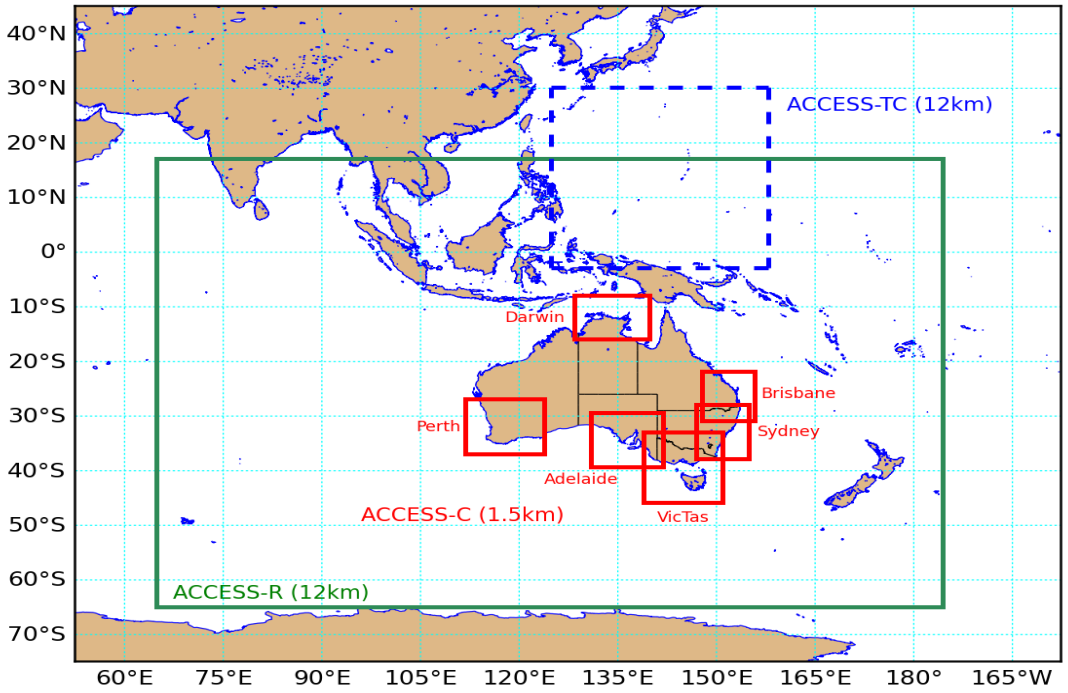
2. Satellite EO for **Nowcasting and situational awareness**

   - ✓ Satellite images are also used directly by forecasters during bushfires, flood, severe thunderstorms, TC and volcanic ash), sea ice service, fog, etc



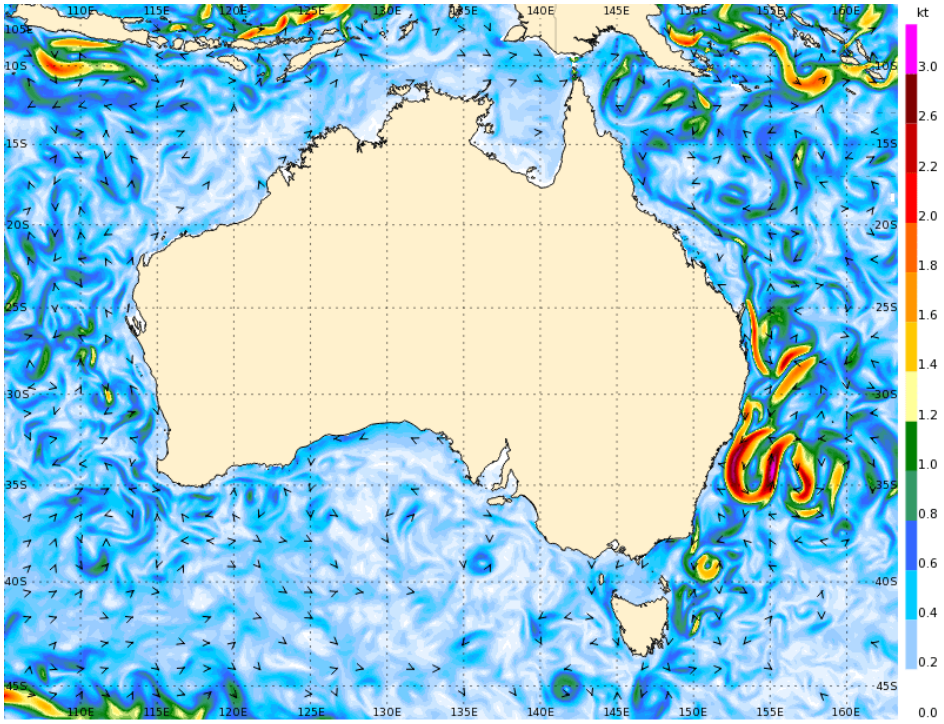


Global and regional atmosphere model: ACCESS

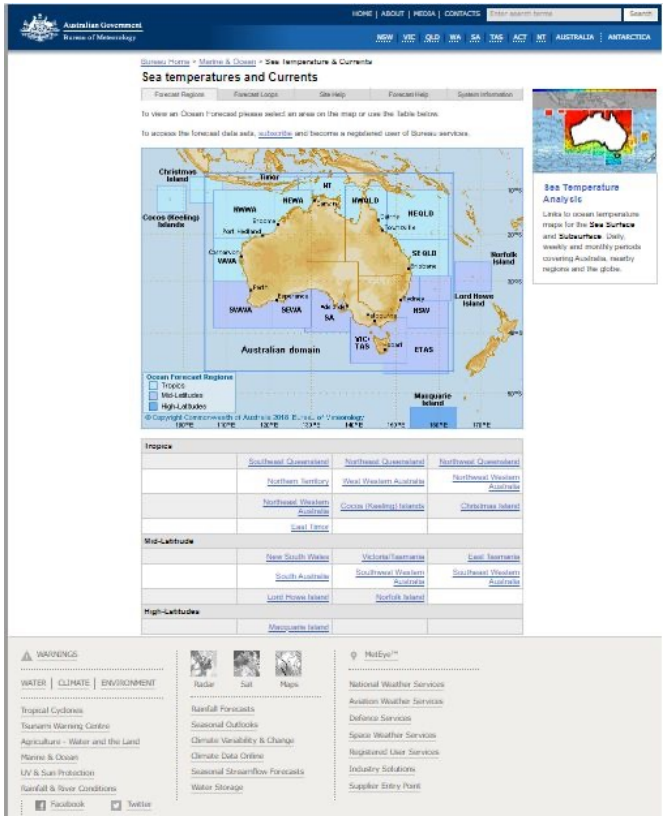


Model	Domain	Resolution
ACCESS-G	Global	0.17578125° longitude by 0.1171875° latitude (12km in the mid-latitudes, ~17km in tropics)
ACCESS-C3	City	0.0135° (1.5km)
ACCESS-TC	Relocatable	0.036° (4km)

Ocean Model: OceanMAPS



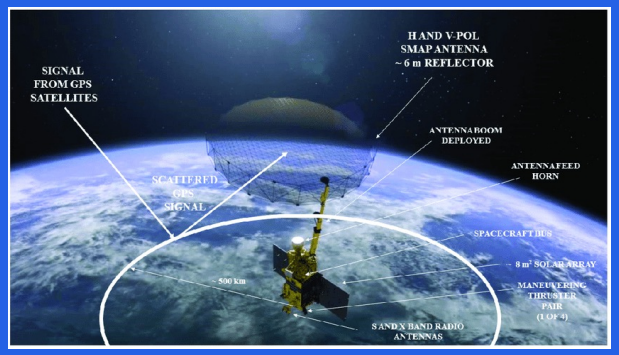
Surface Currents (knots): 24hr Average centred on **Tue 16 Feb 2021** 00UTC
Model Base Time: Mon 15 Feb 2021 12UTC
(c) Copyright Australian Bureau of Meteorology | **OceanMAPS**

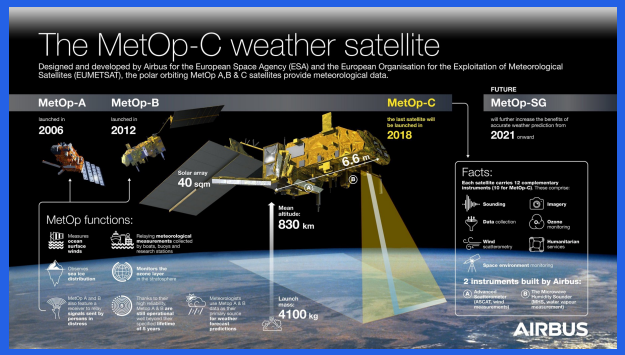


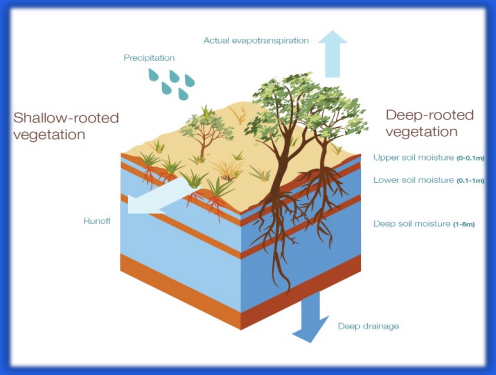
OceanMAPS forecasts are near-global (75 N to 75 S), eddy-resolving (0.1 degree grid spacing), and stretch out to 7 days.

Publicly available images of 24-hour averages for the Australian region are located on the external web.
http://www.bom.gov.au/oceanography/forecasts/index.shtml

Hydrological model: AWRA-L



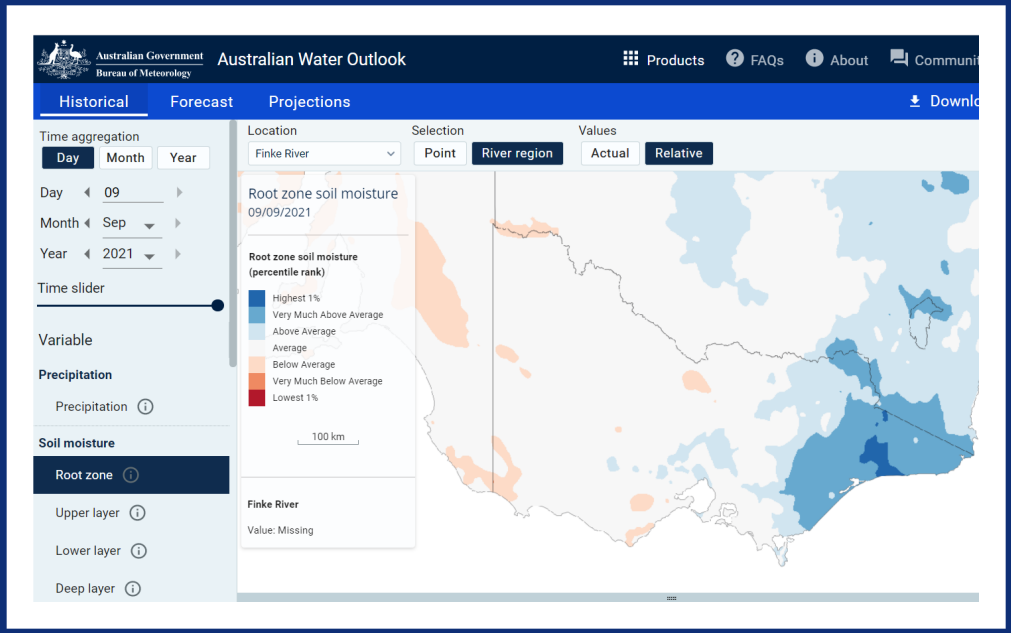




SMAP Enhanced L2 Radiometer Half-Orbit 9 km

ASCAT NRT 12.5 km (Metop -B and -C)

AWRA-L upper layer soil moisture



Satellite Data Assimilation: observations & requirements

ACCESS NWP

NOAA-15
NOAA-18
NOAA-19
DMSP F-17
Aqua
Coriolis
SUOMI-NPP
NOAA-20
METOP-B
METOP-C
GCOM-W1
Himawari-8
GNSS-ground (various)

GOES-16
GOES-17
FY-3C
FY-3D
FY-3E
Meteosat-8
Meteosat-11
Sentinel-3A
Sentinel-3B
ScatSat-1
TerraSAR-X
Tandem-X
GRACE (2 sats)

Locally-received observations from Metop-B/C, NOAA-18, -19, -20, SNPP, Terra, Aqua

OceanMAPS

Sentinel-3A
Sentinel-3B
Jason-3
SARAL
Cryosat2
Satellite SSTs
Sentinel-6

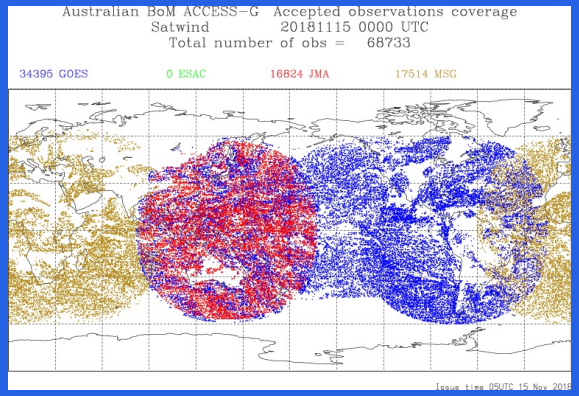
Future:
SWOT (wide swath altimetry)
SSMIS and AMSR-2 ice concentration
SAR

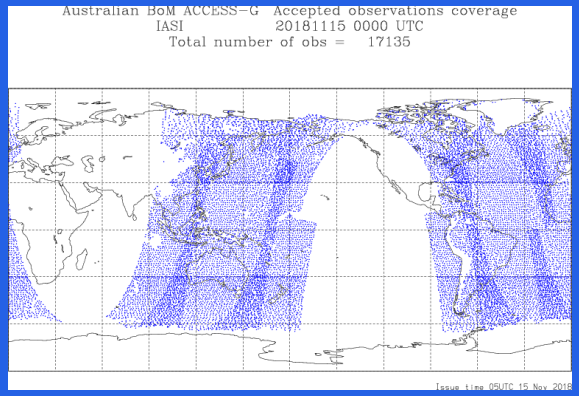
AWRA-L

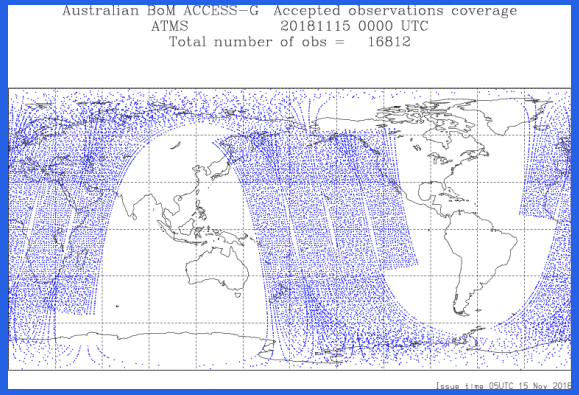
SMAP
AMSR2

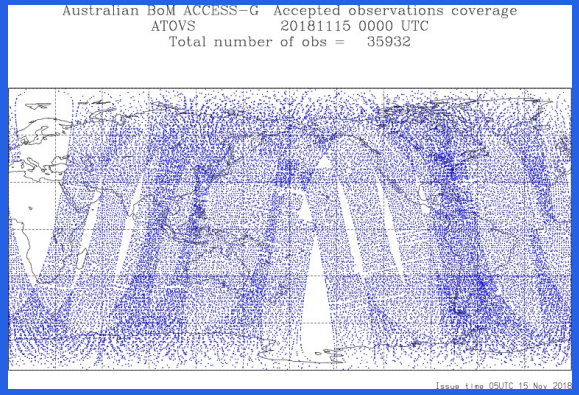
Requirements collected and coordinated by GODEX-NWP

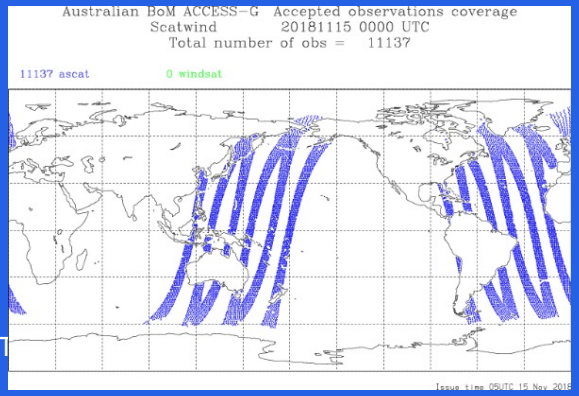
Satellite instruments

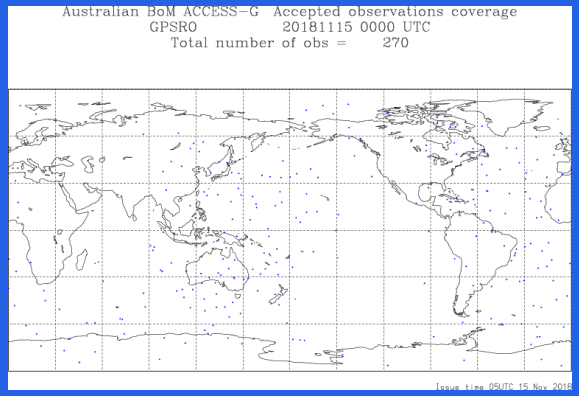












- Microwave sounder
- IR sounder
- VIS/IR imager
- Scatterometer
- Microwave imager
- GPS RO
- Altimeter
- GNSS to ground
- SAR
- Precipitation Radar

The Bureau's ground station network

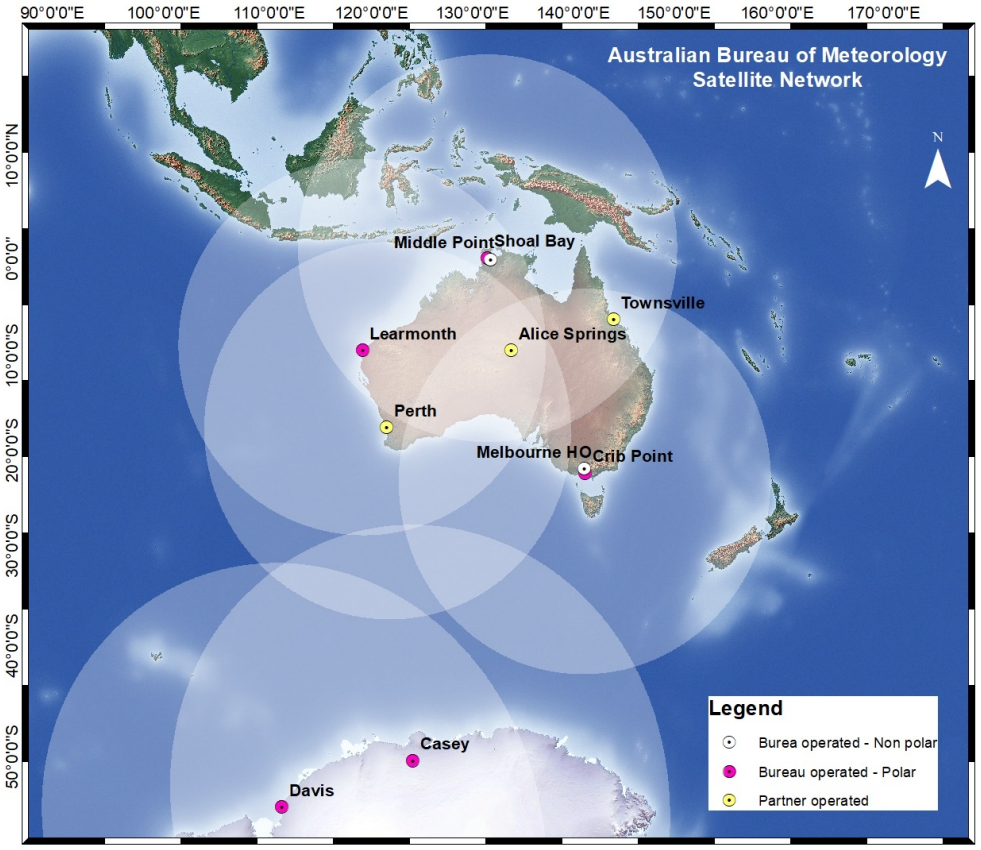
Ground network includes:

- 5 polar tracking ground stations (Crib Point, Learmonth, Shoal Bay, Casey, Davis)
- COSMIC-2 (Middle Point)
- FY-2 and TARS (Crib Point)

Upgrades completed to receive JPSS-2 at all sites

All sites will be upgraded to receive EPS-SG by end 2023.

The polar tracking ground stations are part of the Direct Broadcast Network (DB-Net), providing low latency data for NWP.

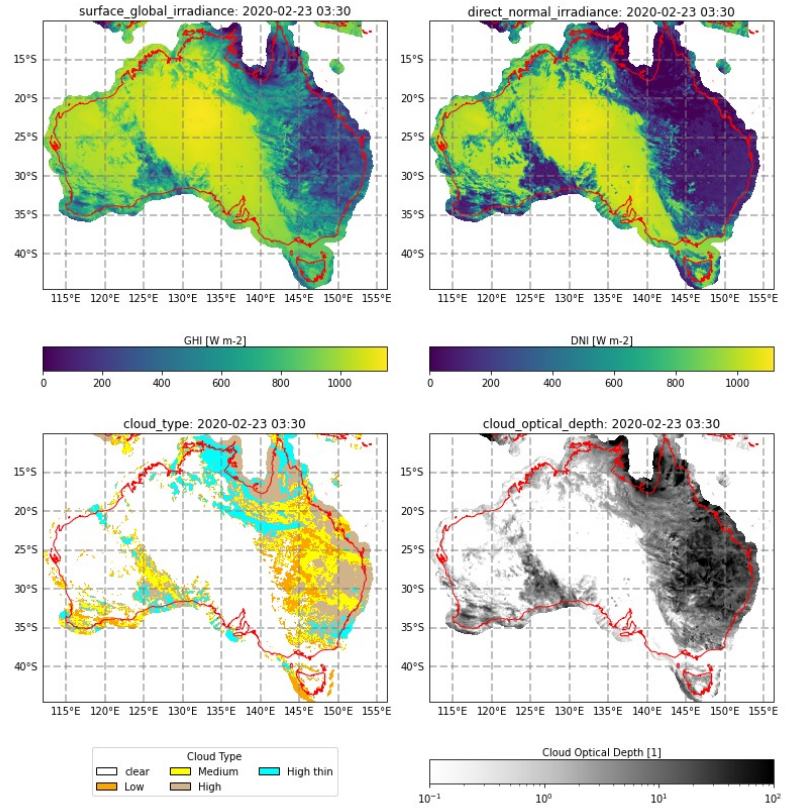


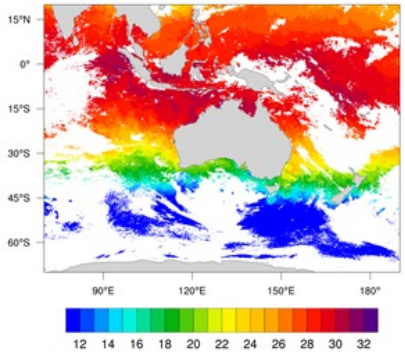
Satellite products

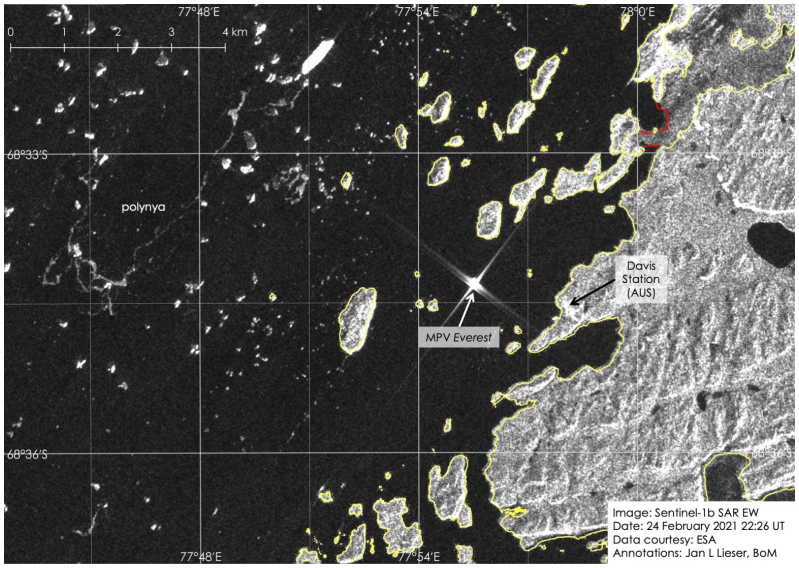
Products developed in the Bureau:

- Solar Irradiance
- SSTs
- Cloud properties and precipitation
- Volcanic Ash (RGBs and predictions)
- Fog and low stratus

Many others via internet, GTS etc. from international partners





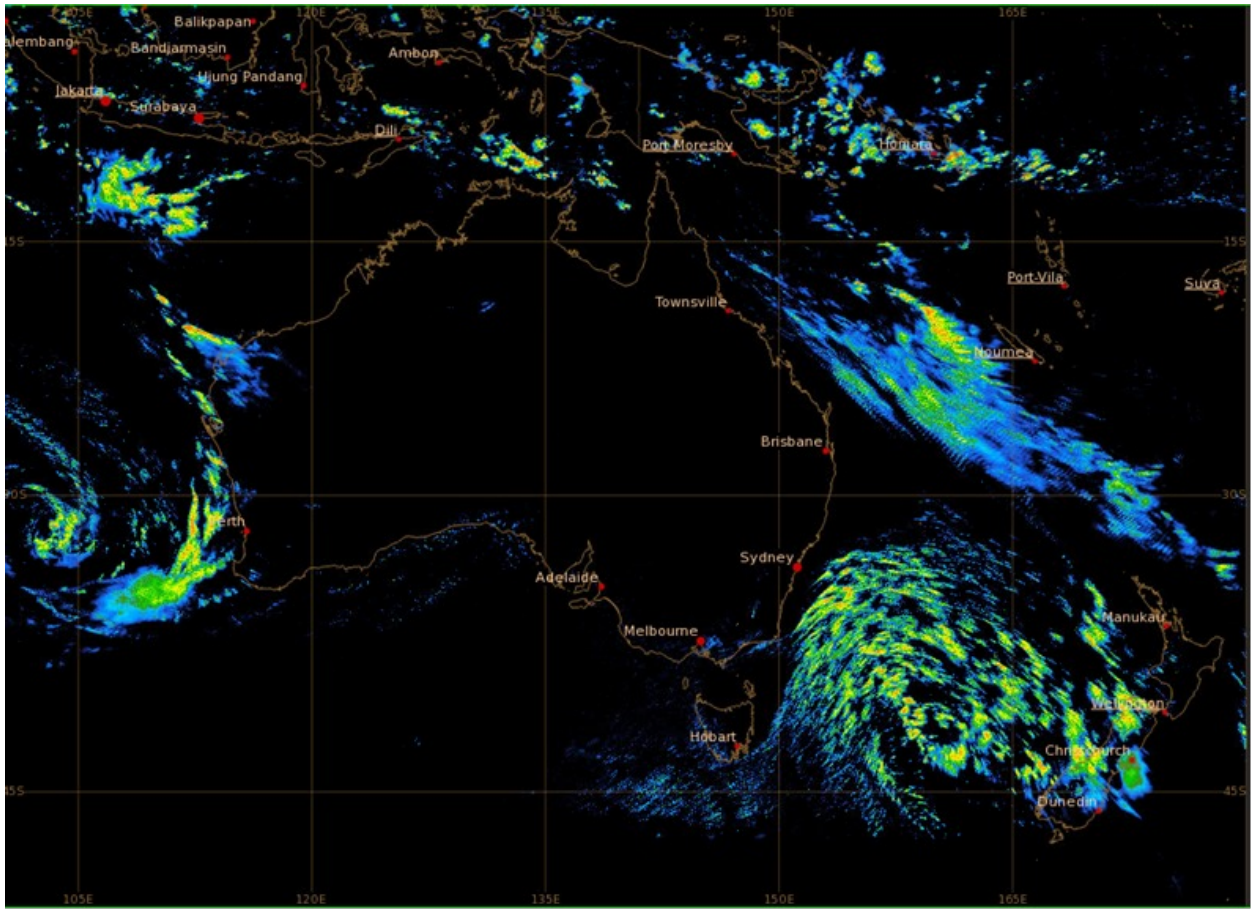


Nowcasting : new products

Satellite Precipitation

New product for forecasters using Himawari-8, lightning data, NWCSAF GEO, model output:

- 2km resolution
- Every 10 minutes
- Australian region and coastal zone
- Includes uncertainty
- Verification with rain gauges, GSMAP NOW, GPM/iMerg

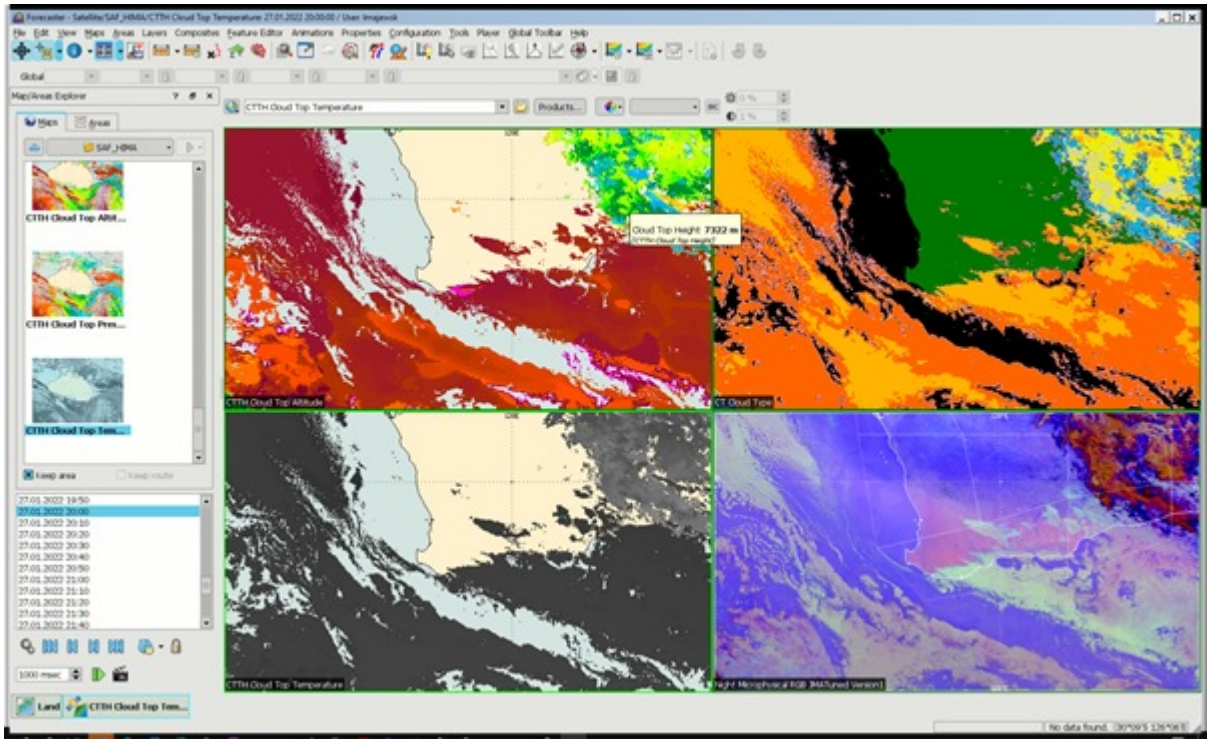


Nowcasting: new products

National Satellite-based Cloud Analysis

New product for forecasters using Himawari-8, model output, GAMSSA SSTs :

- 2km resolution
- Identifies cloud free areas, types of cloud, cloud top parameters, presence of snow or sea ice, dust clouds, volcanic plumes and smoke.



Nowcasting : future plans

National satellite-based storm cells detection

Will provide tracking and nowcasts of the location, direction and intensity of storms including thunderstorms across the entire country. Will rely on Himawari-8 and lightning data. For use by forecasters.

National storm blending

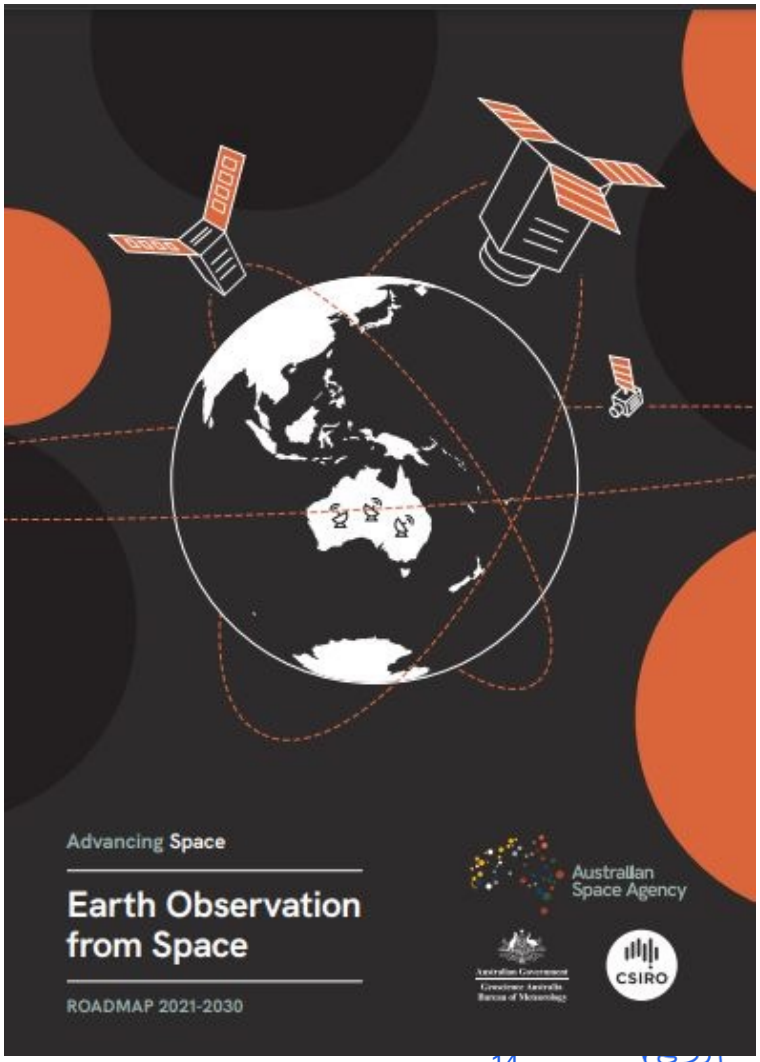
Will provide maps of storm cells severity from radar and satellite observations across Australia, in near real-time. For use by forecasters.

Vision for Australian Earth Observation satellites

The Australian Space Agency released the EO Roadmap in November 2021.

Builds on the Civil Space Strategy 2019-28 to: **significantly grow its market segment from around 10,000 jobs and a market size of $3.9 billion to up to another 20,000 jobs and $12 billion by 2030**

In the EO Roadmap, the Bureau articulates an ambition for an operational Meteorological satellite capability by the 2030s.



Planning for Australian meteorological satellites

UNSW Canberra Space CDF workshop, October 2022

To explore the feasibility of Australian meteorological satellites, the Bureau is working with UNSW Canberra Space on 3 Pre-Phase A studies:

- Microwave sounder
- Lightning sensor
- SAR

Reports will be publicly available in early 2023.

The Bureau of Meteorology

Thank you

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