High Resolution Satellite SST over the Australasian region from IMOS

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10th AOMSUC, Melbourne, Australia, 4th – 6th December 2019
Several satellites provide Sea Surface Temperature (SST) data
Spatial coverage may be improved by merging data from satellite sensors that have different equatorial crossing times
At BoM, we currently produce a range of SST products using infrared data from:

- **Polar orbiters:**
  - NOAA-18 AVHRR (ECT 9 am/pm)
  - MetOp-A (ECT 9 am/pm)
  - MetOp-B (ECT 9:30 am/pm)
  - Suomi-NPP VIIRS (ECT 1:20 pm/am)
  - NOAA-20 VIIRS (ECT 1:20 pm/am)

- **Geostationary satellite:**
  - Himawari-8 AHI

... and microwave data from:

- **Polar orbiter:**
  - GCOM-W AMSR-2 (ECT 1:30 pm/am)
As a contribution to IMOS, we provide five types of GHRSST format Level 2, level 3 and level 4 SST products:

- **L2P** (geolocated, native resolution of sensor)
- **L3U** (swath, gridded)
- **L3C** (multiple swath, gridded)
- **L3S** (multiple sensor, gridded)
- **L4** (multiple sensor, statistically interpolated, gridded)
Australia’s HRPT AVHRR SST

- Passive infra-red sensors on polar-orbiting satellites provide the highest resolution SST observations from space (~1 km at nadir) but cannot sense SST under cloud.

- Pre-2000 (MODIS) the only wide swath, 1 km resolution, satellite SSTs available were direct-broadcast AVHRR SST from NOAA polar-orbiters.

- Australia has direct broadcast ("HRPT") 1.1 km AVHRR L0 data back to 1992 from reception stations in Australia and Antarctica.

- L0 data accurately geolocated and “stitched” into swaths
Resolution: 0.02° x 0.02°

1, 3, 6, 14 days or 1 month

Available: 1992 to present

Inputs: 1.1 km AVHRR radiances from NOAA-11 to NOAA-19 (currently NOAA-18 only)


Uses:

IMOS HRPT AVHRR L3S Composites


Resolution: 0.02° x 0.02°

1, 3, 6, 14 days or 1 month

Available: 1992 to present

Inputs: 1.1 km AVHRR radiances from NOAA-11 to NOAA-19 (currently NOAA-18 only)

Data Access: http://portal.aodn.org.au

Uses:

Resolution: 0.02° x 0.02°
1, 3, 6, 14 days or 1 month
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Inputs: 1.1 km AVHRR radiances from NOAA-11 to NOAA-19 (currently NOAA-18 only)
Data Access: http://portal.aodn.org.au
Uses:

http://oceancurrent.imos.org.au
Resolution: 0.02° x 0.02°

1, 3, 6, 14 days or 1 month

Available: 1992 to present

Inputs: 1.1 km AVHRR radiances from NOAA-11 to NOAA-19 (currently NOAA-18 only)

Data Access: http://portal.aodn.org.au

Uses:


http://oceancurrent.imos.org.au
**Resolution:** 0.02° x 0.02°

1, 3, 6 days or 1 month

**Available:** 2012 to present

**Inputs:** Real-time: 1.1 km NOAA-18 AVHRR, 1.1 km MetOp-B AVHRR, 0.75 km Suomi-NPP VIIRS, 0.75 km NOAA-20 VIIRS

Reprocessed: Additional data from NOAA-15/19 AVHRR, MetOp-A AVHRR

**Data Access:**


Reprocessed: email [ghrsst@bom.gov.au](mailto:ghrsst@bom.gov.au)

**Uses:**

- BoM ReefTemp NextGen (21 Nov 2018 – now)
Resolution: 0.02° x 0.02°
1, 3, 6 days or 1 month
Available: 2012 to present
Inputs: Real-time: 1.1 km NOAA-18 AVHRR, 1.1 km MetOp-B AVHRR, 0.75 km Suomi-NPP VIIRS, 0.75 km NOAA-20 VIIRS
Reprocessed: Additional data from NOAA-15/19 AVHRR, MetOp-A AVHRR
Data Access:
Real-time: http://portal.aodn.org.au
Reprocessed: email ghrsst@bom.gov.au
Uses:
- BoM ReefTemp NextGen (21 Nov 2018 – n)
- IMOS OceanCurrent (2018 – now)
Validation of L3S vs Buoy SST

L3S-01day, night only, monthly statistics, 1 Jan 2018 - 8 May 2019

AVHRR-only L3S (N18, N19)

Multi-Sensor L3S (N18, N19, MB, NPP, N20)
Daily Regional and Global Multi-Sensor L4 analyses (RAMSSA and GAMSSA)


Resolution: Daily 0.083° regional, 0.25° global

Available: RAMSSA: 2006 - present; GAMSSA: 2008 - present

Method: Optimal interpolation (Beggs et al., 2011, AMOJ, 61)

Inputs:
- NAVOCEANO GAC AVHRR (METOP-A/B) L2P SST
- JAXA AMSR-2 (GCOM-W) L2P SST
- NOAA ACSPO VIIRS L3U (NOAA-20, NPP) SST (RAMSSA only)
- Buoy and ship in situ SST (GTS)
- NCEP 9 km Sea Ice Analyses


Uses: BoM NWP and seasonal prediction models
- Validating ocean models
Daily Regional and Global Multi-Sensor L4 analyses (RAMSSA and GAMSSA)


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Uses: BoM NWP and seasonal prediction models

- Validating ocean models
- GHRSSST Multi-Product Ensemble
- Monitoring Marine Heatwaves
Resolution: 10 min, 2 km\(^2\) at nadir, full disk

Available: 8 Mar 2016 to real-time over full disk on H-8 GEO projection

Inputs: ~2 km 10 min radiances from AHI radiometer on JMA's geostationary Himawari-8 satellite

Method: JMA H-8 AHI radiances trained to one day of ACSPO VIIRS L2P SST

Access: NCI (contact ghrsst@bom.gov.au)

Uses: Ingesting into CSIRO's IMOS OceanCurrent 4-hourly, 2 km L3 SST maps for Fisheries applications
IMOS Himawari-8 L3C Composites

Resolution: Hourly, 4-hourly and Daily night-time, 0.02° x 0.02°

Domain: IMOS Australian grid (70°E to 190°E, 70°S to 20°N)

Available: 1 Oct 2017 to present
Aim to reprocess back to July 2015

Inputs: BoM Himawari-8 L2P SST

Access: Contact ghrsst@bom.gov.au

Uses:
• Coastal model verification
**Resolution:** Hourly, 4-hourly and Daily night-time, 0.02° x 0.02°

**Domain:** IMOS Australian grid (70°E to 190°E, 70°S to 20°N)

**Available:** 1 Oct 2017 to present

Aim to reprocess back to July 2015

**Inputs:** BoM Himawari-8 L2P SST

**Access:** Contact ghrsst@bom.gov.au

**Uses:**
- Coastal model verification
- Studying coastal upwelling
Resolution: Hourly, 4-hourly and Daily night-time, 0.02° x 0.02°

Domain: IMOS Australian grid (70°E to 190°E, 70°S to 20°N)

Available: 1 Oct 2017 to present

Aim to reprocess back to July 2015

Inputs: BoM Himawari-8 L2P SST

Access: Contact ghrsst@bom.gov.au

Uses:
- Coastal model verification
- Studying coastal upwelling
- Studying diurnal warming
Summary

• Different SST products suit different applications…

• IMOS produces several high-resolution, regional satellite SST products useful for monitoring Marine Heatwaves, coastal upwelling, diurnal warming and climate trends over Australasian waters

• Available via http://portal.aodn.org.au

• Book chapter on selecting SST products for Australasian applications available:

   Search for: "Researchgate Beggs 2019 Temperature"

• Contact: helen.beggs@bom.gov.au
Resolution: 0.02° x 0.02°

Depth: Drifting buoy depths (approx. 0.2 m)

Available: 1992 to 2016 over Australian domain


Method: Robust fitting algorithm applied to cloud-free de-biased pixels, using 4 seasonal harmonics.

For each 0.02° pixel: daily climatological SST, mean, decadal trend, monthly seasonal harmonics and percentiles

Uses: Reference for IMOS OceanCurrent SST anomalies and percentiles.

Access: http://portal.aodn.org.au (search for "SSTAARS")

https://doi.org/10.1016/j.jmarsys.2018.07.005
Useful sites for information on IMOS GHRSSST products

GHRSSST products: [https://www.ghrsst.org/quick-start/](https://www.ghrsst.org/quick-start/)


IMOS Multi-sensor GHRSSST Products: 


GHRSSST L4 (inc GAMSSA) Validation/Inter-comparison: 
[http://www.star.nesdis.noaa.gov/sod/sst/squam](http://www.star.nesdis.noaa.gov/sod/sst/squam)