



Australian Government
Bureau of Meteorology



Report from the Australian RDAC to GHRSSST-XX

Helen Beggs¹, Pallavi Govekar¹, Christopher Griffin¹, Leon Majewski¹, Lixin Qi¹, Aihong Zhong¹
and Pavel Sakov¹

¹Bureau of Meteorology, Melbourne, Australia

²UNSW, Canberra, Australia

20th GHRSSST Science Team Meeting, Frascati, Italy, 3rd – 7th June 2019



Bureau of Meteorology RDAC Operational GHRSSST Products



11 May 2019

• Real-time GDS1.6:

- Daily Global 0.25° SSTfnd L4 ("GAMSSA")
- Daily Regional 1/12° SSTfnd L4 ("RAMSSA")

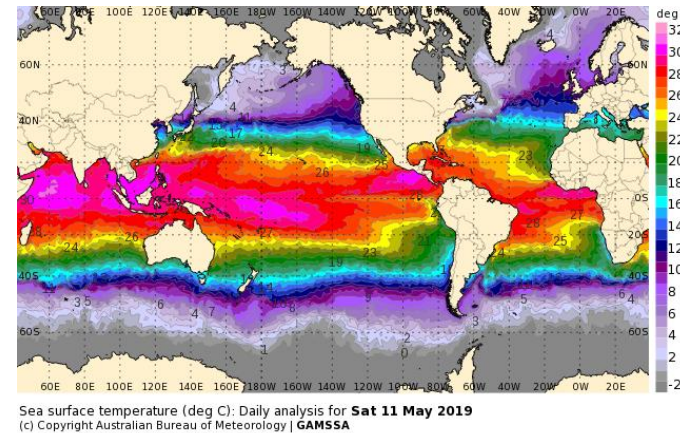
• Real-time GDS2.0:

- GAMSSA and RAMSSA L4 from 2008/2006 to present
- IMOS fv01 HRPT AVHRR SSTskin (NOAA-15/18/19)
 - 1 km L2P and 0.02° L3U, L3C, L3S
- IMOS fv01 VIIRS SSTskin from NPP
 - 0.02° L3U, L3C, Multi-Sensor (N18_AVHRR, NPP_VIIRS) L3S
- Himawari-8 10-min 2 km L2P SSTskin

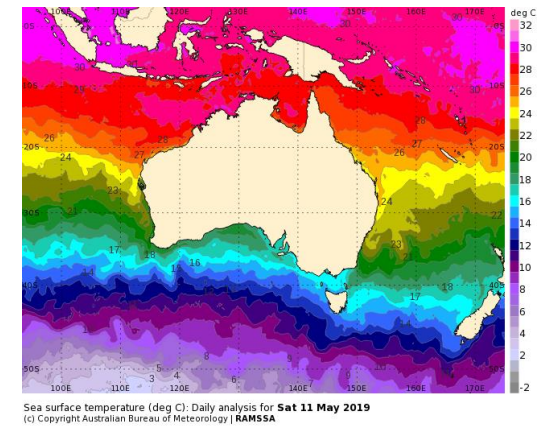
• Reprocessed GDS2.0:

- IMOS HRPT AVHRR L2P/L3U/L3C/L3S fv02 products from 1992 to 2016
- IMOS MTSAT-1R Hourly 0.05° L3U (2006 to 2010)

1-day 25 km GAMSSA L4 SSTfnd

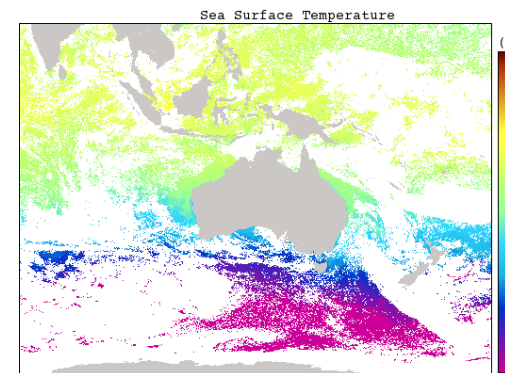


1-day 9 km RAMSSA L4 SSTfnd

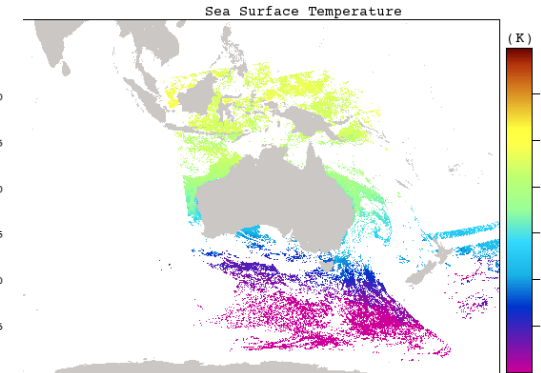


N18, NPP

1-day night Multi-sensor L3S SSTskin



1-day night AVHRR L3S SSTskin





Australian Government
Bureau of Meteorology

Bureau of Meteorology RDAC

Experimental GHRSSST Products

See Pallavi Govekar's Poster: Mon 4:30 pm



11 May 2019

• Real-time GDS1.6:

- Daily Global 0.25° SSTfnd L4 ("GAMSSA")
- Daily Regional $1/12^\circ$ SSTfnd L4 ("RAMSSA")

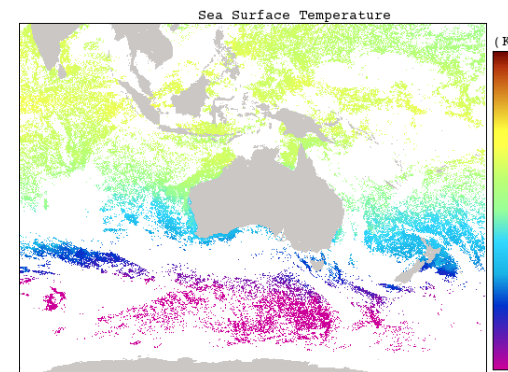
• Real-time GDS2.0:

- GAMSSA and RAMSSA L4 from 2008/2006 to present
- IMOS fv01 HRPT AVHRR SSTskin (NOAA-15/18/19)
 - 1 km L2P and 0.02° L3U, L3C, L3S
- IMOS fv01 FRAC AVHRR SSTskin from MetOp-B
 - 0.02° L3U, L3C
- IMOS fv01 VIIRS SSTskin from NPP and NOAA-20
 - 0.02° L3U, L3C, Multi-sensor (N18, MetOp-B, NPP, N20) L3S
- Himawari-8 10-min 2 km L2P SSTskin
- IMOS Himawari-8 0.02° hourly, 4-hourly and daily L3C

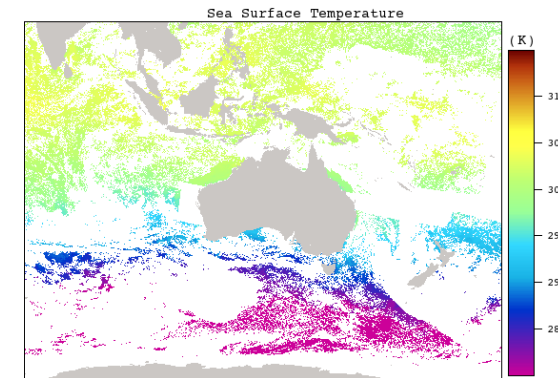
• Reprocessed GDS2.0:

- IMOS HRPT AVHRR L2P/L3U/L3C/L3S fv02 products from 1992 to 2016
- IMOS AVHRR + VIIRS L3C/L3S fv02 products from 2012 to 2016
- IMOS MTSAT-1R Hourly 0.05° L3U (2006 to 2010)

1-day night MetOp-B L3C SSTskin

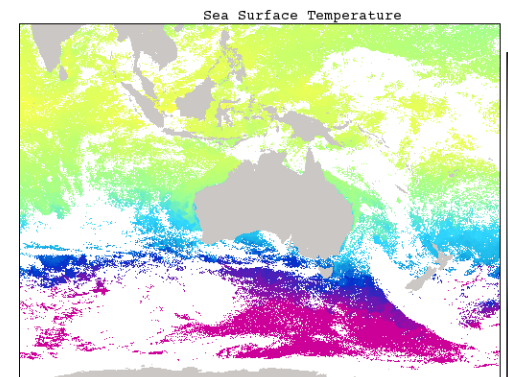


1-day night NOAA-20 L3C SSTskin

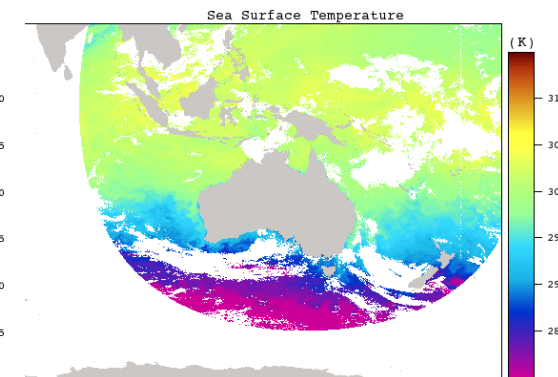


N18, MB, NPP, N20

1-day night Multi-sensor L3S SSTskin



1-day night Hw-8 L3C SSTskin





Data Availability



- **Real-time GDS1.6**

- RAMSSA/GAMSSA L4: JPL PO.DAAC, NOAA LTSRF and Bureau OPeNDAP server

- **Real-time GDS2.0**

- RAMSSA/GAMSSA L4: <http://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/SST/ghrsst/L4/catalog.html>

- IMOS fv01 HRPT AVHRR:

- L2P: BoM OPeNDAP server - Contact ghrsst@bom.gov.au

- L3U/L3C/L3S: <http://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/SST/ghrsst/catalog.html>

– **IMOS fv01 NPP VIIRS L3C/L3S:** <http://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/SST/ghrsst/catalog.html>

- **Experimental MetOp-B, NOAA-20, Himawari-8 L3C/L3S:** BoM OPeNDAP server - Contact ghrsst@bom.gov.au

- **Reprocessed GDS2.0**

- IMOS fv02 HRPT AVHRR:

- L2P: <http://dapds00.nci.org.au/thredds/catalog/rr5/satellite/GHRSSST/v02.0fv02/L2P/catalog.html>

- L3U/L3C/L3S: <http://portal.aodn.org.au> and

<http://dapds00.nci.org.au/thredds/catalog/rr5/satellite/GHRSSST/v02.0fv02/Continental/catalog.html>

– **IMOS AVHRR + VIIRS L3C/L3S:** Contact ghrsst@bom.gov.au

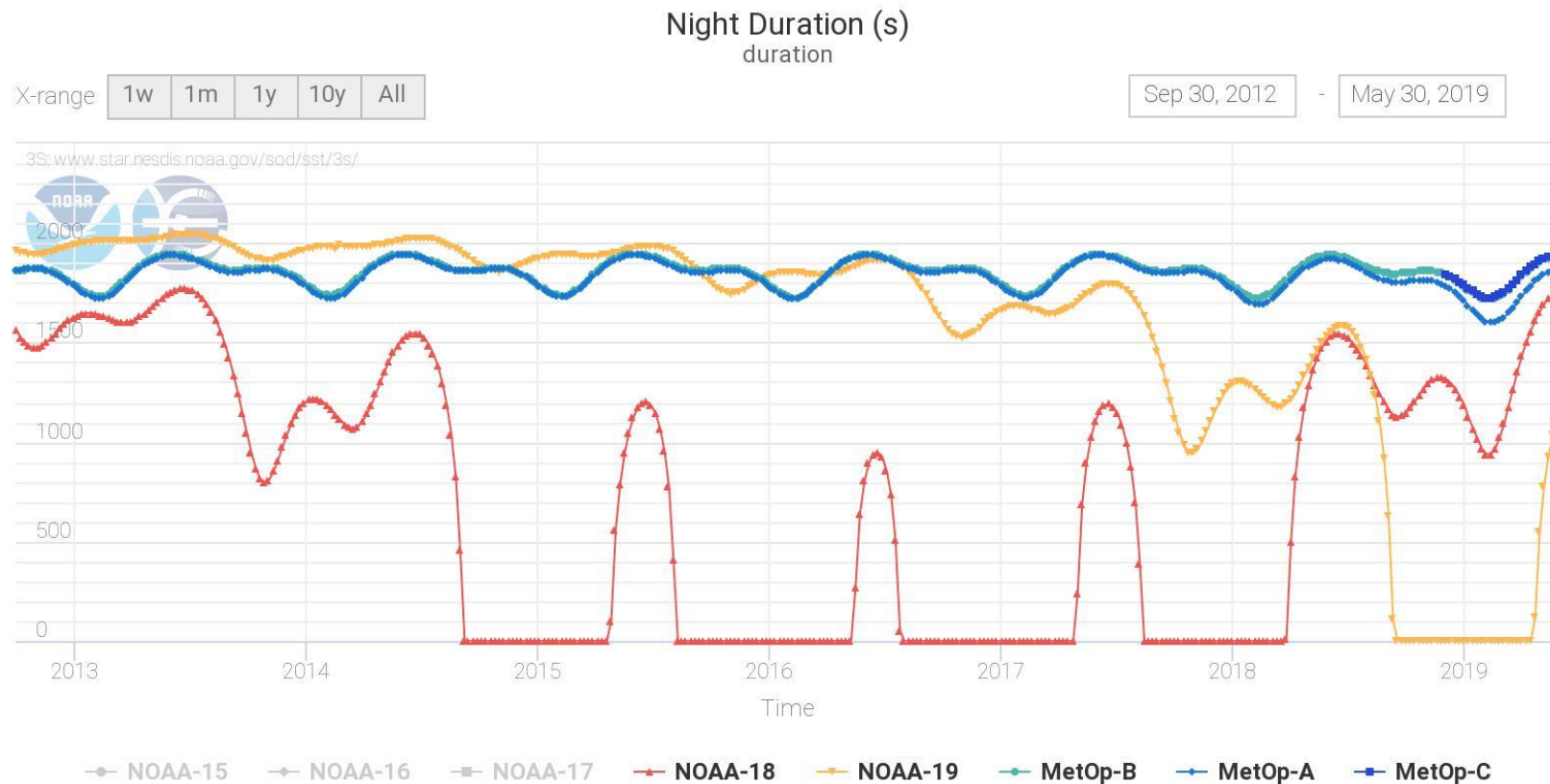
– IMOS MTSAT-1R L3U: IMOS Thredds server at

<http://rs-data1-mel.csiro.au/thredds/catalog/imos-srs/sst/ghrsst/L3U/mtsatsat1r/catalog.html>



Deterioration of NOAA-18 and NOAA-19 AVHRR SST

- NOAA-18 and NOAA-19's AVHRR calibrations have deteriorated due to passing into fully sunlit orbits since Sep 2014 and Sep 2018, respectively.

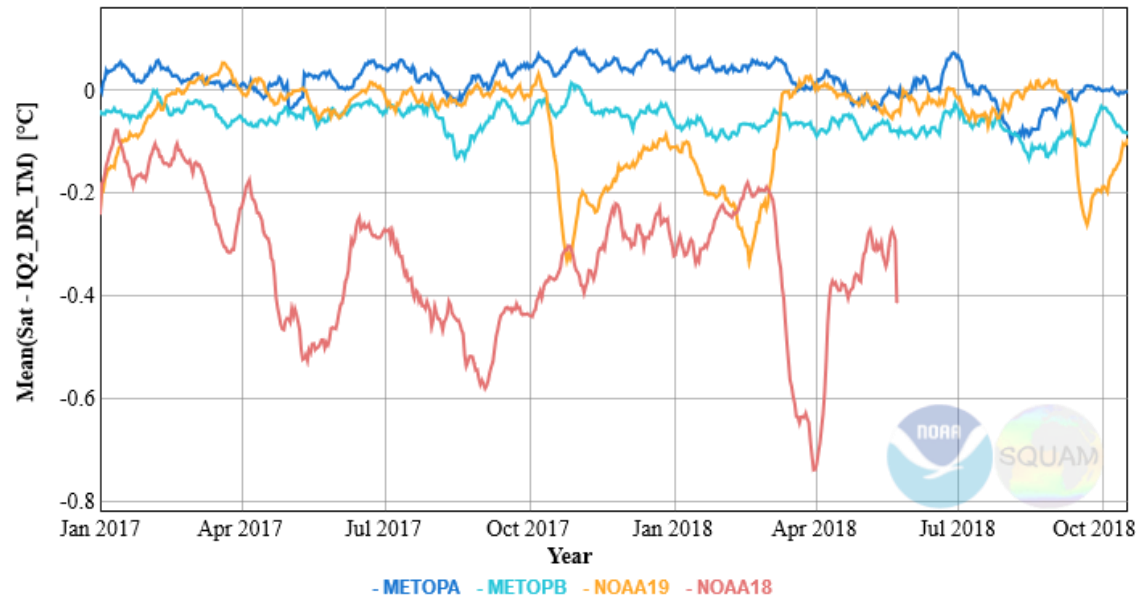




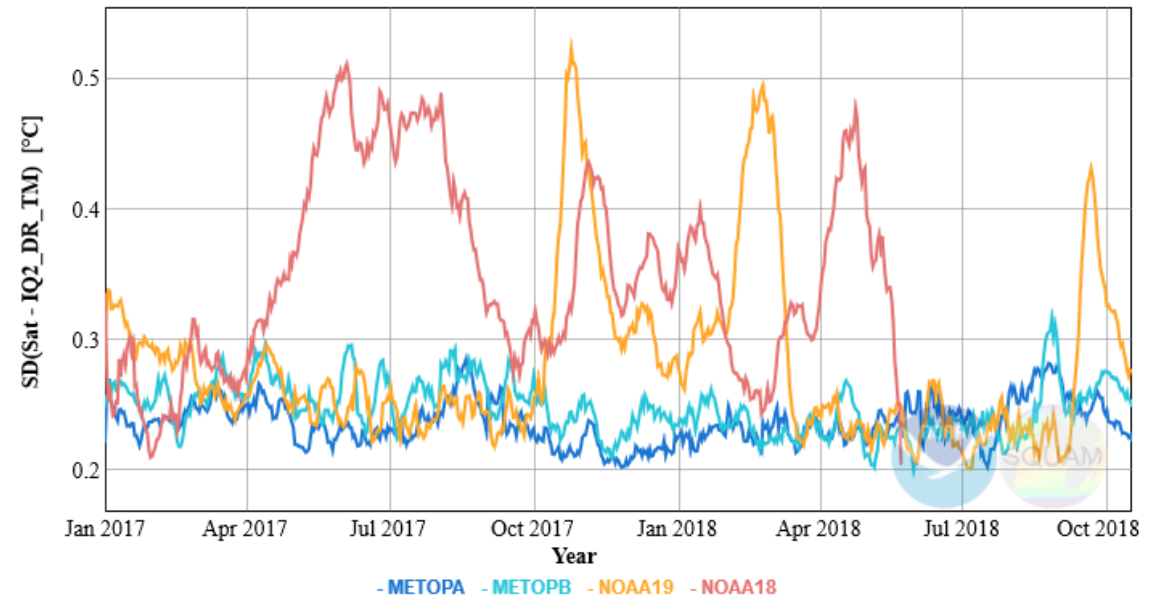
Deterioration of NOAA-18 and NOAA-19 AVHRR SST

- NOAA-18 and NOAA-19's AVHRR calibrations have deteriorated due to passing into fully sunlit orbits since Sep 2014 and Sep 2018, respectively.
- BoM removed NOAA-19 SST data from ocean models (7 Aug'18), Daily L4 (15 Sep'18) and IMOS L3S (24 Oct'18).

Mean (NAVO AVHRR SST – Buoy SST)
GAC, NAVO, Night, outlier retained



STD (NAVO AVHRR SST – Buoy SST)
GAC, NAVO, Night, outlier retained

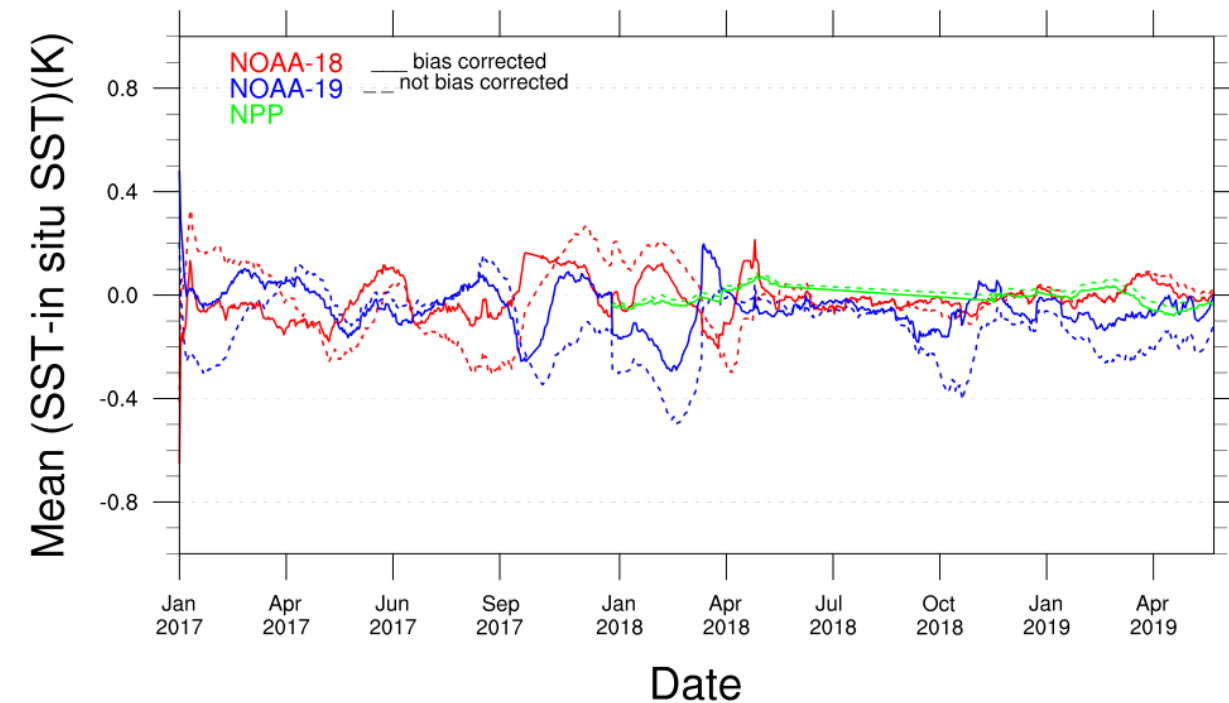




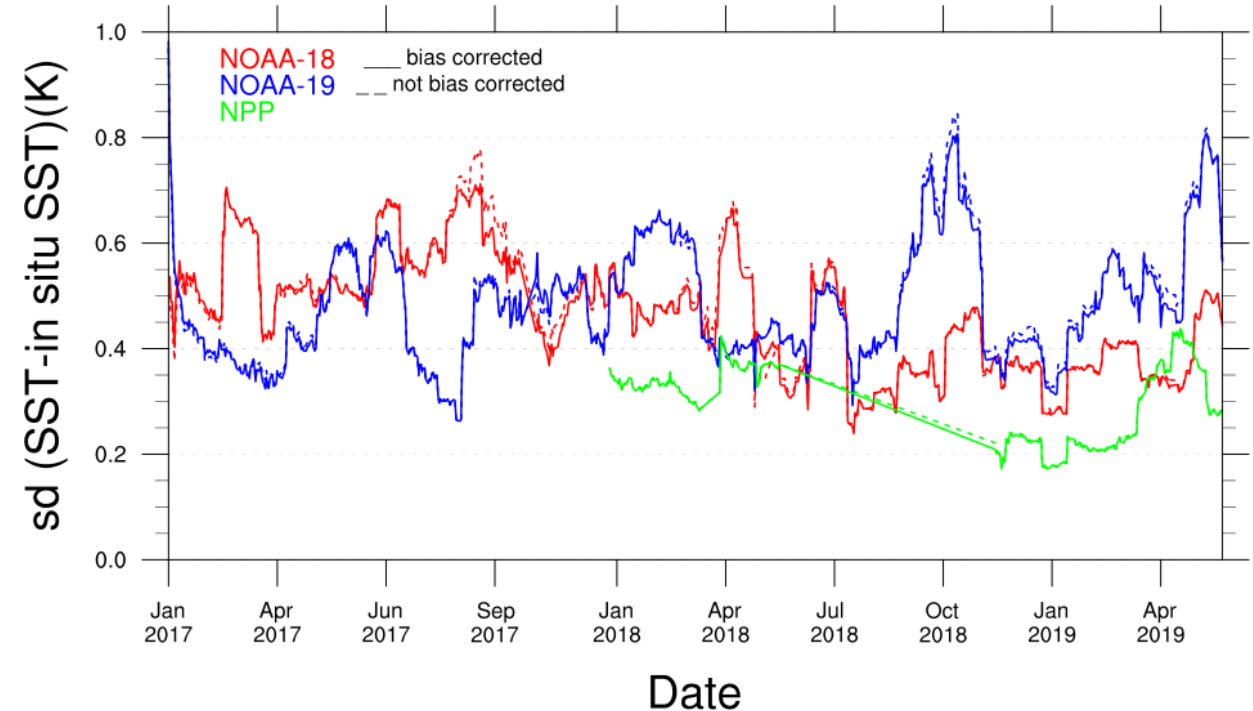
Deterioration of NOAA-18 and NOAA-19 AVHRR SST

- NOAA-18 and NOAA-19's AVHRR calibrations have deteriorated due to passing into fully sunlit orbits since Sep 2014 and Sep 2018, respectively.
- BoM removed NOAA-19 SST data from ocean models (7 Aug'18), Daily L4 (15 Sep'18) and IMOS L3S (24 Oct'18). IMOS NOAA-18 SSTs are still ingested into IMOS L3S as errors are relatively small since Aug 2018.

Mean (IMOS L3C SST – Buoy SST)



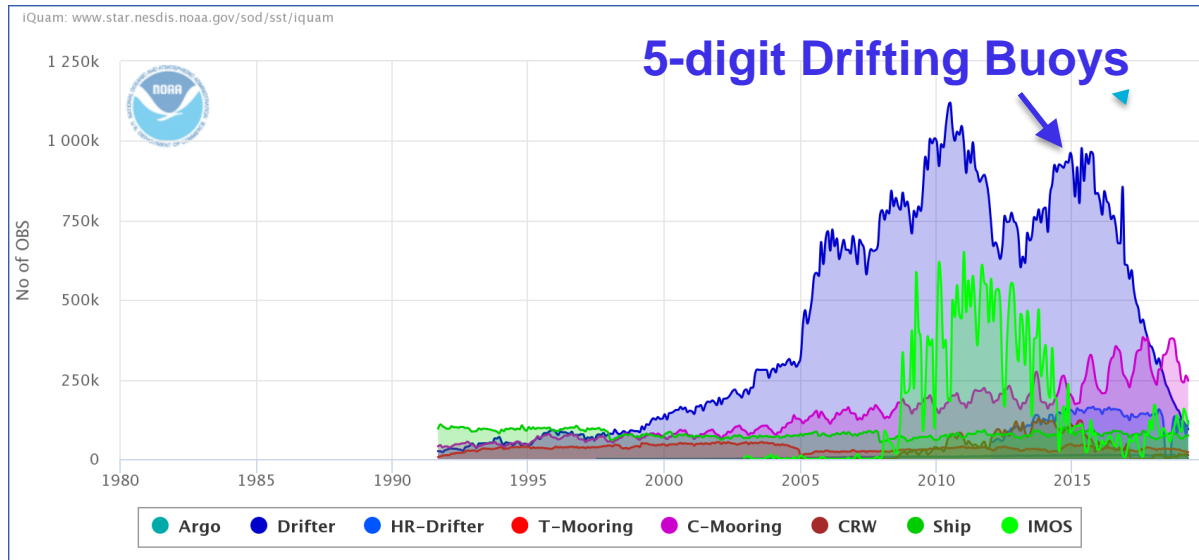
STD (IMOS L3C SST – Buoy SST)



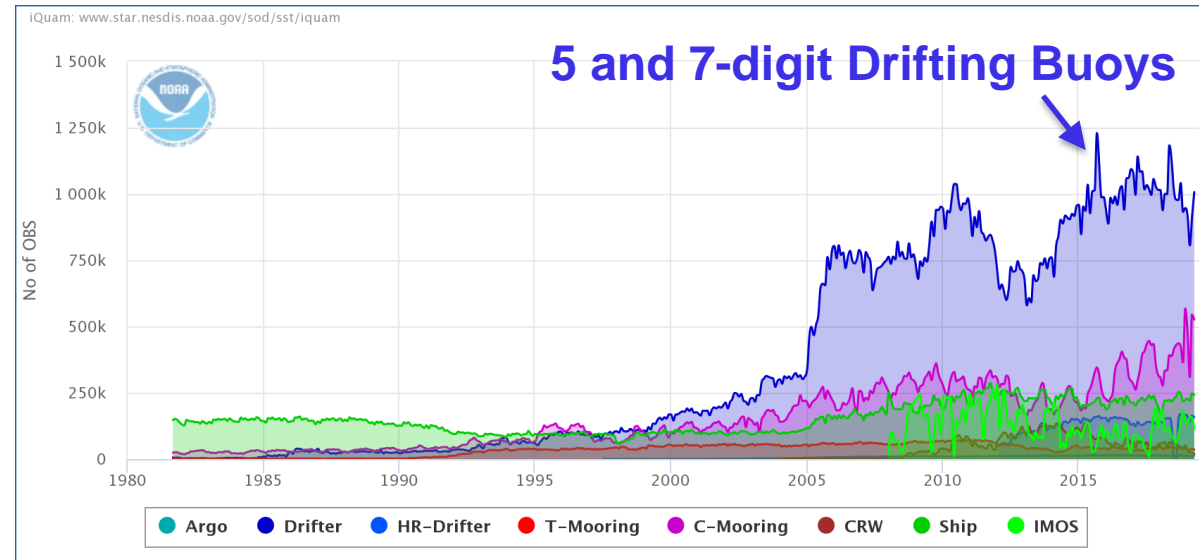


Ingest of 7-digit ID Drifting Buoys into SST systems

- Since 2016 the number of 5-digit ID drifting buoys providing SST data to GTS has steadily decreased, with new drifting buoys all having 7-digit IDs
- BoM started ingesting 7-digit ID drifting buoy SSTs into IMOS SST systems from 9 Dec 2016 and SST analyses from 1 July 2018
- Several ocean systems (e.g. ICOADS, iQUAM v2.0, SQUAM, Pathfinder v5.3 and ERSST, RTG_HR, NCEP OI.v2, NCEI OISST v2 SST analyses) do not yet ingest 7-digit ID buoy data



iQUAM v2.0: <https://www.star.nesdis.noaa.gov/sod/sst/iquam/>



iQUAM v2.1: <https://www.star.nesdis.noaa.gov/sod/sst/iquam/>



Australian Government

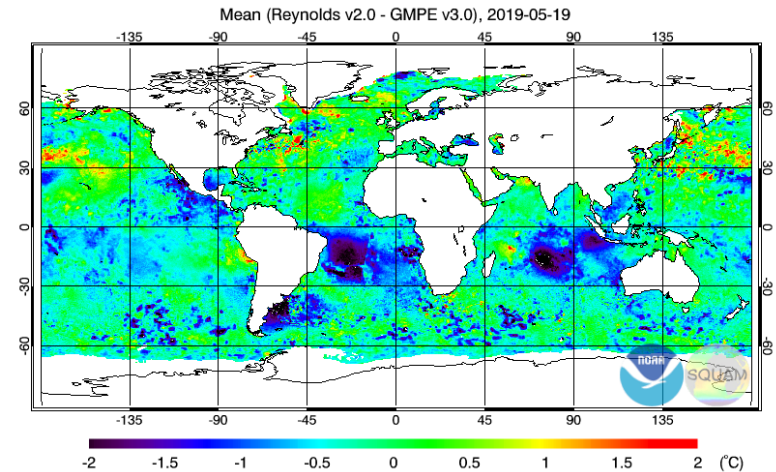
Bureau of Meteorology

Issues to be raised at G-XX

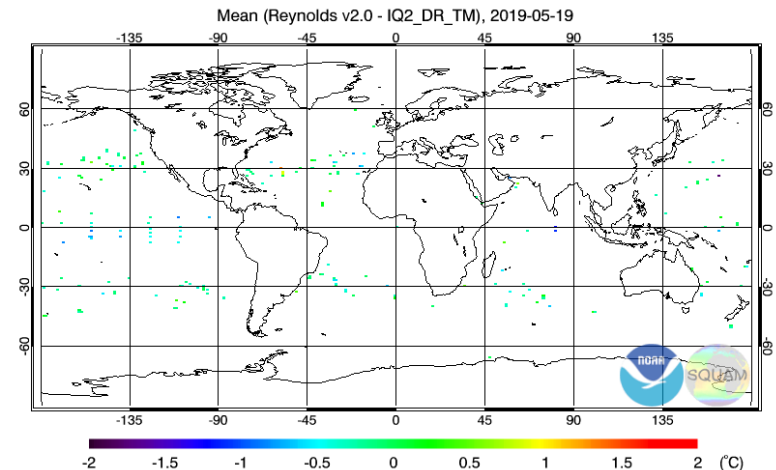
19 May 2019

- How can we ensure that all available drifting buoy data are ingested into operational SST analyses and composites?
- Metadata on **all** upstream inputs (inc. in situ data used for regression/SSES and L4 used for BGF) should be included in GHRSSST file headers
- Challenges with ingesting VIIRS SST into legacy OI SST analysis systems
 - It would be good to share experiences

Mean (OISST v2 L4 – GMPE SST)



Mean (OISST v2 L4 – Buoy SST)





Australian Government

Bureau of Meteorology

Future of GHRSSST

How does GHRSSST assist with continuity of long-term SST analyses and composites, particularly those based on AVHRR-only, with AVHRR data ceasing after MetOp-C?

- Users, particularly climate scientists, require stable and unbiased satellite SST
- Need to demonstrate that changing to other sensors (such as VIIRS or SLSTR) has not changed regional biases in the climate data record
- Educating users re. new GHRSSST products and their strengths and weaknesses is key!



Australian Government

Bureau of Meteorology

Future BoM SST Work in 2019-2020

- Tune optimal interpolation of ACSP0 VIIRS L3U SSTs into RAMSSA and GAMSSA daily SST analyses before operational release
- Continue to develop new "GSAS" L4 product based on Ensemble OI
- Add NOAA-20 VIIRS L3U data to all BoM L4 and ocean models
- Improve cloud-clearing and SSES of BoM Himawari-8 SST



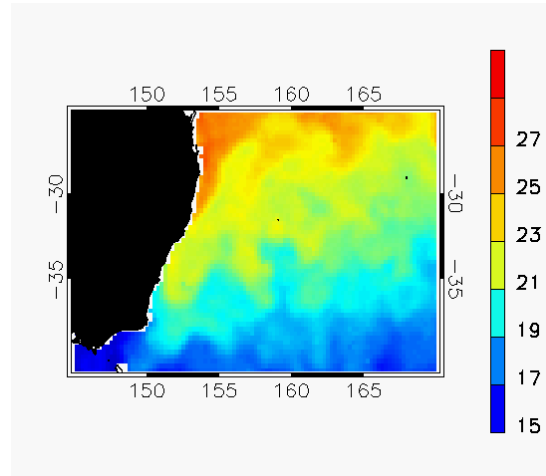
Australian Government
Bureau of Meteorology

Adding VIIRS data to Daily SST Analyses (GAMSSA and RAMSSA)

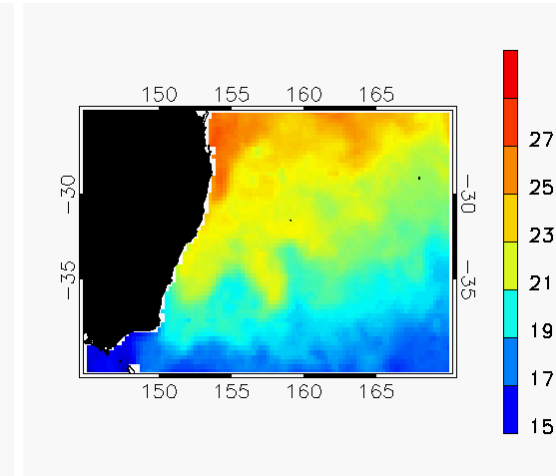
11 May 2019

- ACSP0 1/50° VIIRS L3U SST data is being tested for ingestion into the Bureau's operational daily SST analyses (1/4° GAMSSA and 1/12° RAMSSA)
- Night-only ACSP0 VIIRS L3U QL=5 data collated to daily 1/4° and 1/12° L3C SSTfnd
- Data further thinned by striding to 1/2° (GAMSSA) and 1/3° (RAMSSA) (similar to CMC0.1deg analysis)
- Ingested with NAVO GAC AVHRR, JAXA AMSR-2 and in situ SSTfnd into test RAMSSA and GAMSSA
- Further tuning of OI configuration required to reduce noise

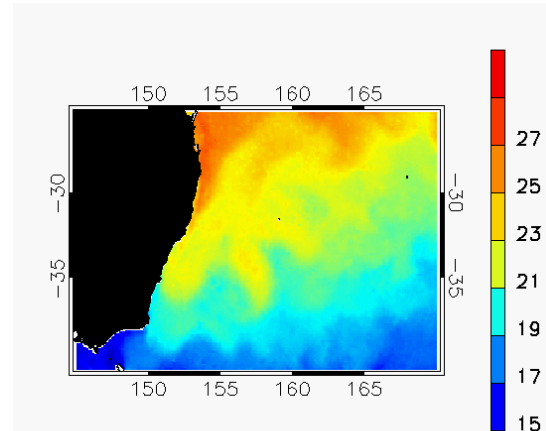
Operational GAMSSA



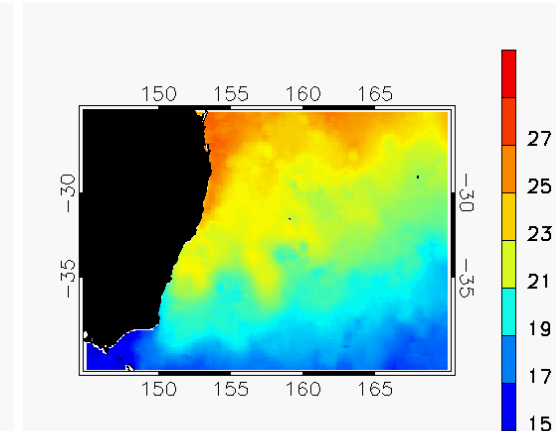
GAMSSA (with VIIRS)



Operational RAMSSA



RAMSSA (with VIIRS)



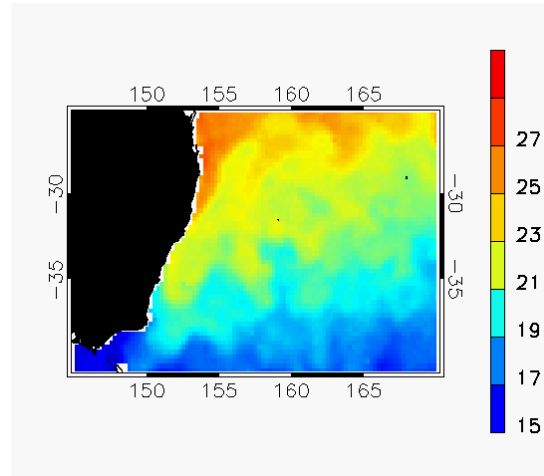


Adding VIIRS data to Daily SST Analyses (GAMSSA, RAMSSA and GSAS)

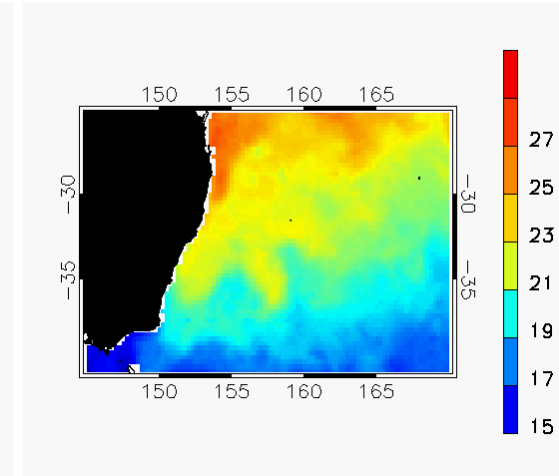
11 May 2019

- ACSP0 1/50° VIIRS L3U SST data is being tested for ingestion into the Bureau's operational daily SST analyses (1/4° GAMSSA and 1/12° RAMSSA)
- Night-only ACSP0 VIIRS L3U QL=5 data collated to daily 1/4° and 1/12° L3C SSTfnd
- Data further thinned by striding to 1/2° (GAMSSA) and 1/3° (RAMSSA) (similar to CMC0.1deg analysis)
- Ingested with NAVO GAC AVHRR, JAXA AMSR-2 and in situ SSTfnd into test RAMSSA and GAMSSA
- Further tuning of OI configuration required to reduce noise
- ACSP0 VIIRS L3U night-only SST also ingested into test EnOI 1/10° GSAS, after striding to 1/25°

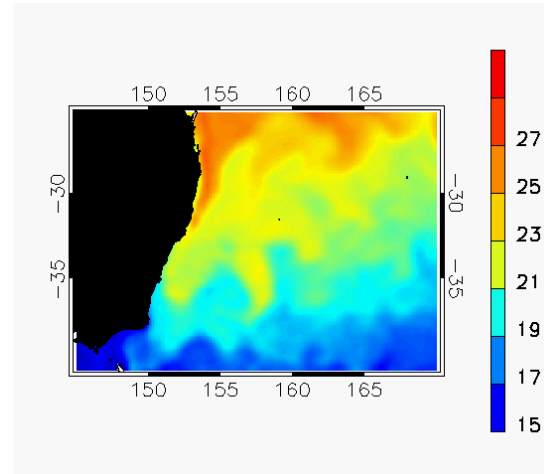
Operational GAMSSA



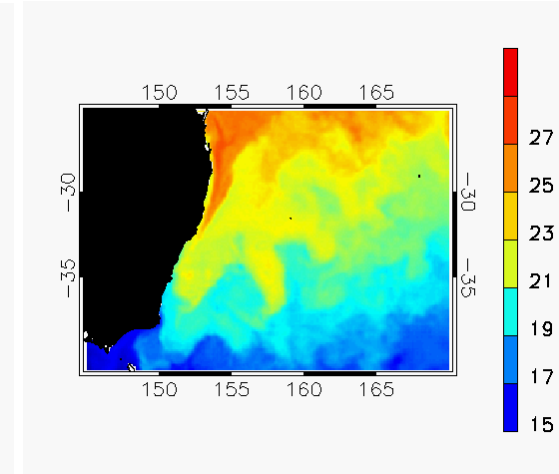
GAMSSA (with VIIRS)



CMC (with VIIRS)



GSAS (with VIIRS)





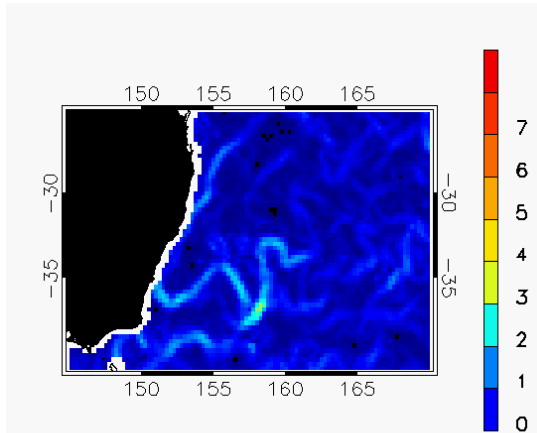
Australian Government
Bureau of Meteorology

Adding VIIRS data to Daily SST Analyses (GAMSSA, RAMSSA and GSAS)

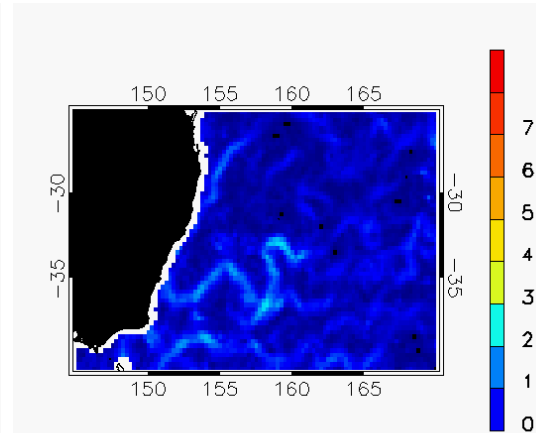
7 - 14 May 2019

- ACSP0 1/50° VIIRS L3U SST data is being tested for ingestion into the Bureau's operational daily SST analyses (1/4° GAMSSA and 1/12° RAMSSA)
- Night-only ACSP0 VIIRS L3U QL=5 data collated to daily 1/4° and 1/12° L3C SSTfnd
- Data further thinned by striding to 1/2° (GAMSSA) and 1/3° (RAMSSA) (similar to CMC0.1deg analysis)
- Ingested with NAVO GAC AVHRR, JAXA AMSR-2 and in situ SSTfnd into test RAMSSA and GAMSSA
- Further tuning of OI configuration required to reduce noise
- ACSP0 VIIRS L3U night-only SST also ingested into test EnOI 1/10° GSAS, after striding to 1/25°

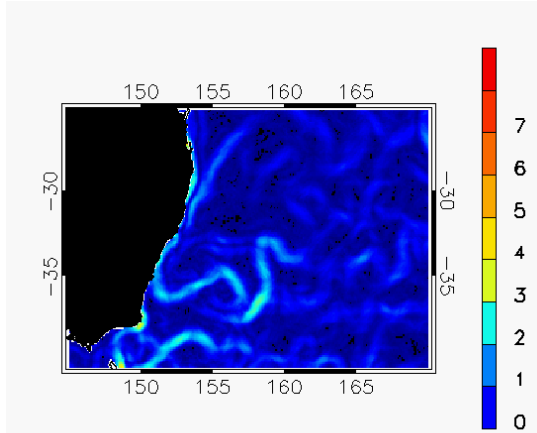
Operational GAMSSA



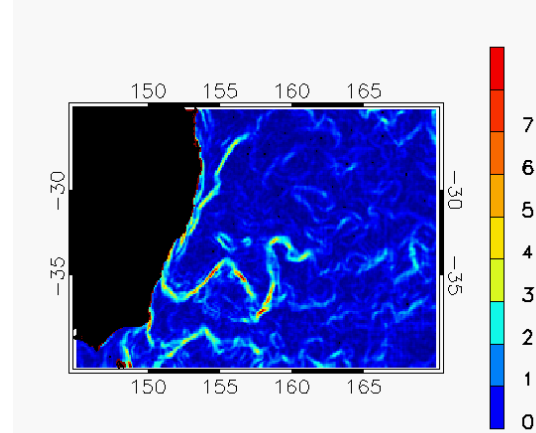
GAMSSA (with VIIRS)



CMC (with VIIRS)



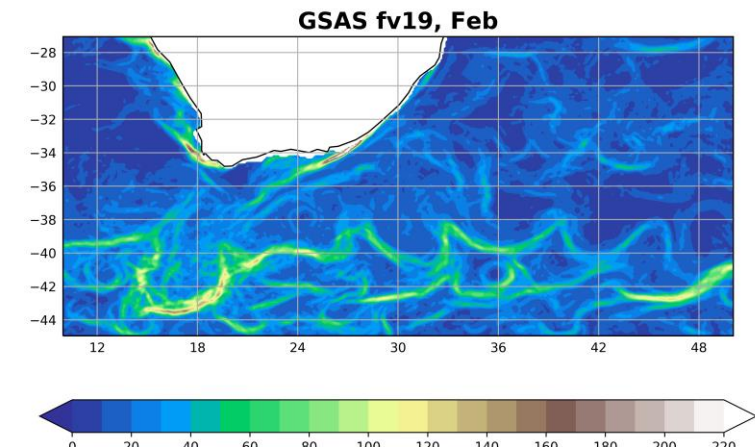
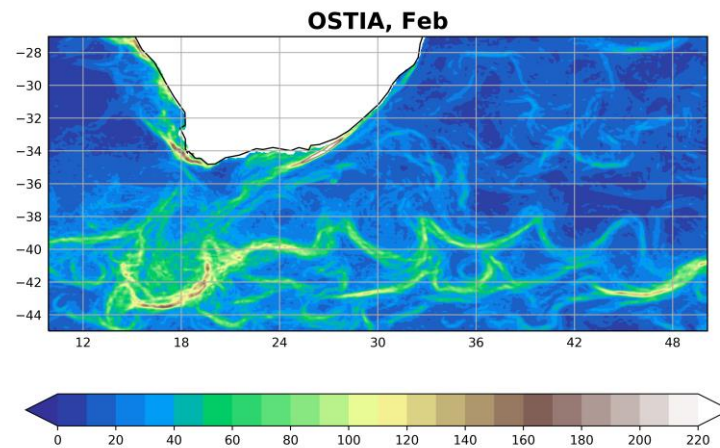
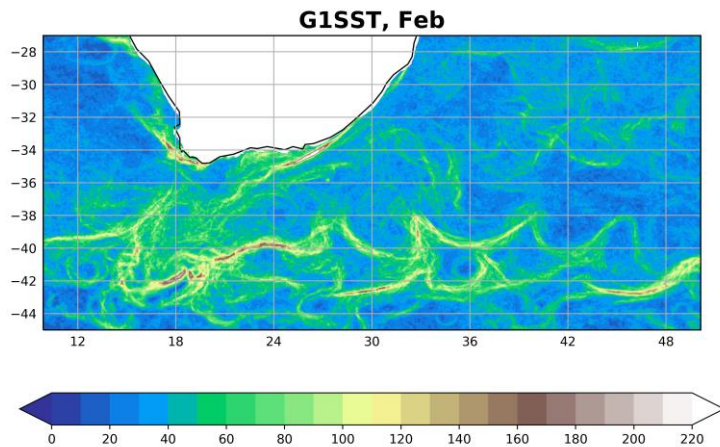
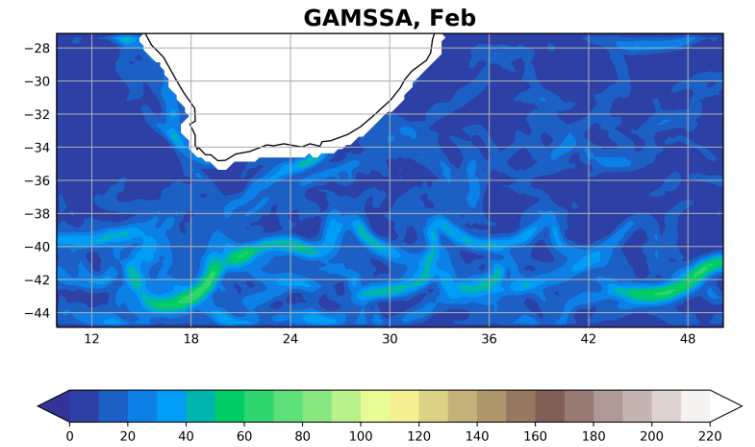
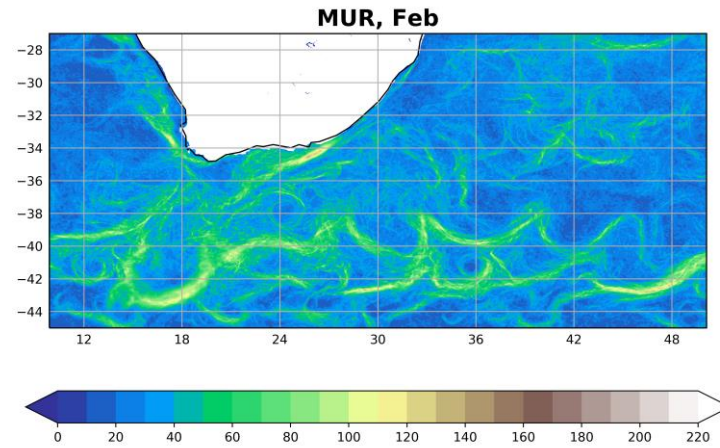
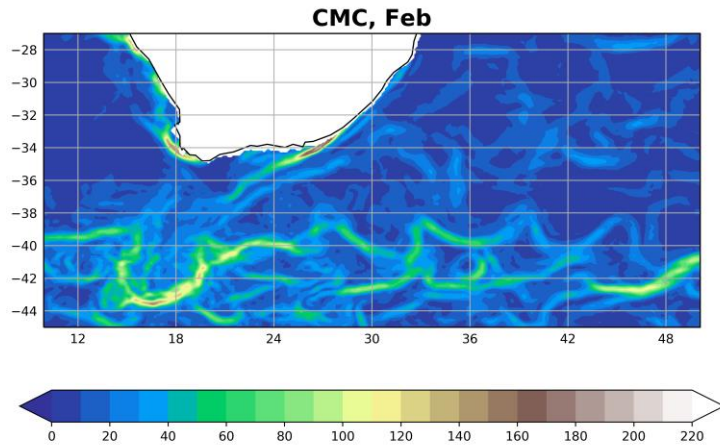
GSAS (with VIIRS)





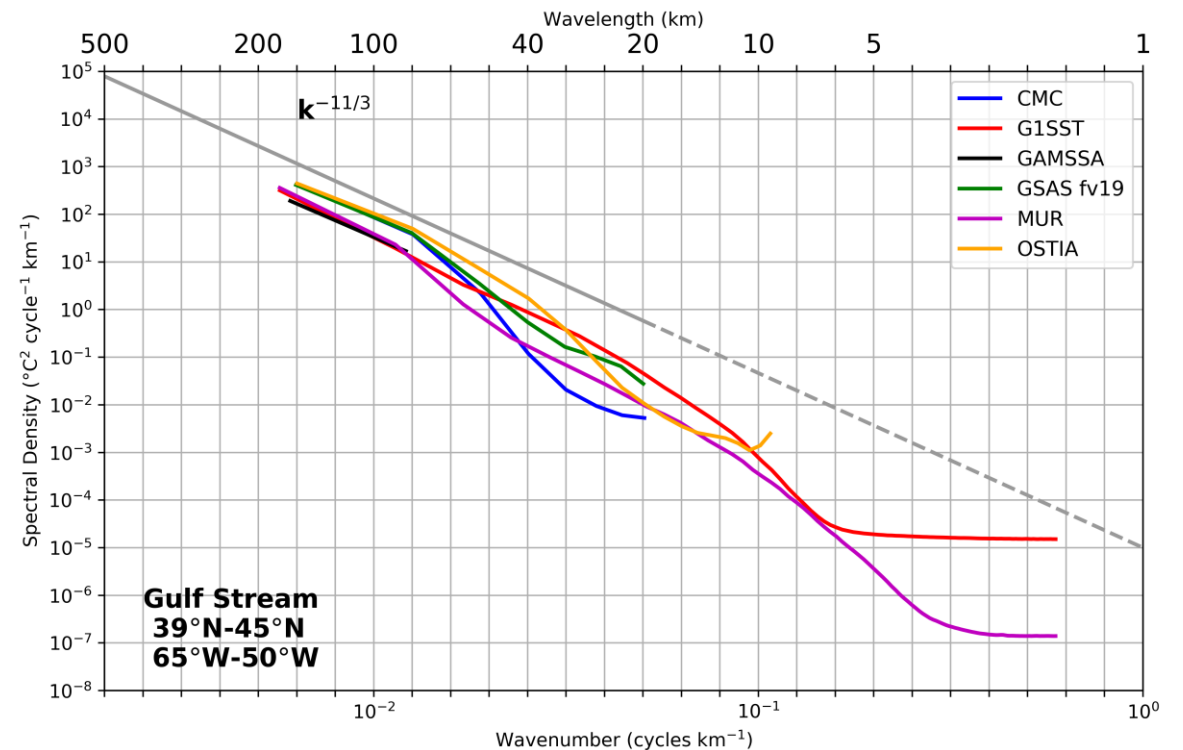
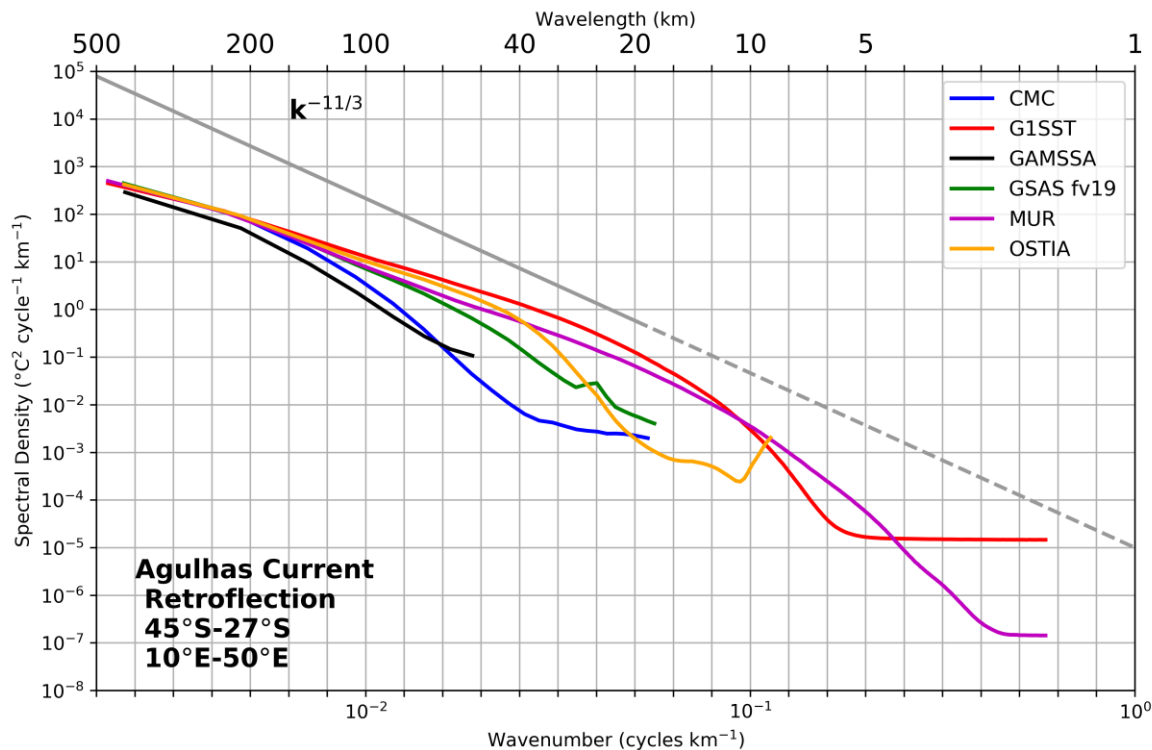
Australian Government
Bureau of Meteorology

Met Office SST Gradient Maps (courtesy Simon Good)





Met Office Spectral Density Plots (courtesy Simon Good)





Australian Government

Bureau of Meteorology

Questions?

Thank You!

Contact: helen.beggs@bom.gov.au