AusTemp - New thermal stress and marine heatwave monitoring tools for Australia

Pallavi Govekar[a*], Claire Spillman[a], Eduardo Klein-Salas[b] and Leo Li[b]

a. Bureau of Meteorology, Melbourne

b. Australian Ocean Data Network, Hobart

*Leader, IMOS SRS SST Products Sub-facility

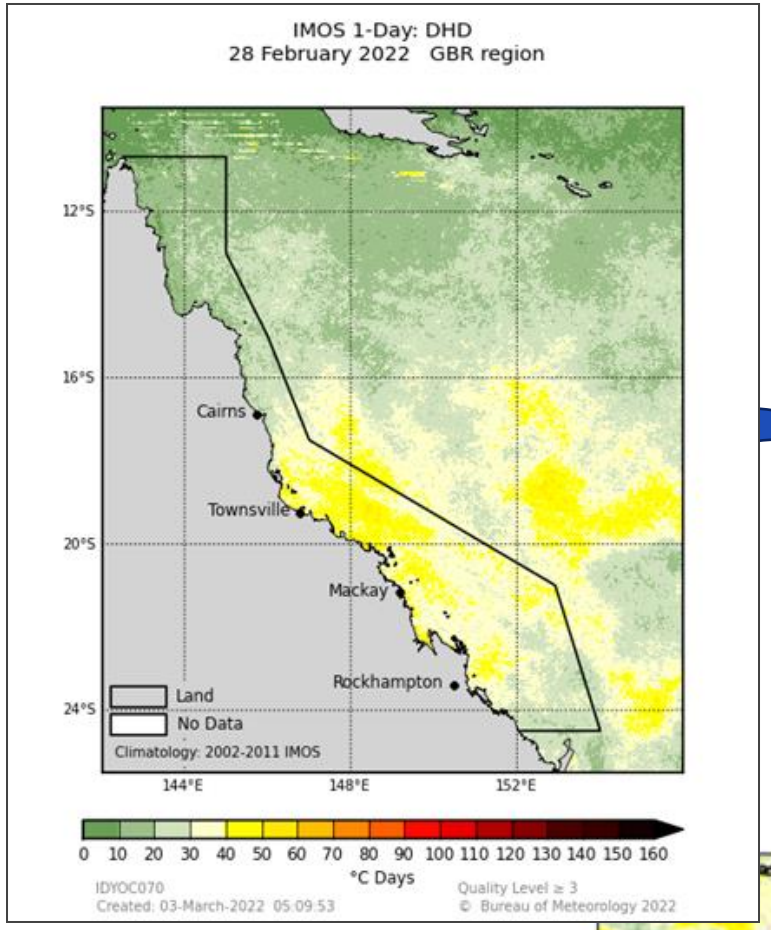
Pallavi.govekar@bom.gov.au

Forum for Operational Oceanography, Fremantle, WA, 19-20 November 2025

AusTemp

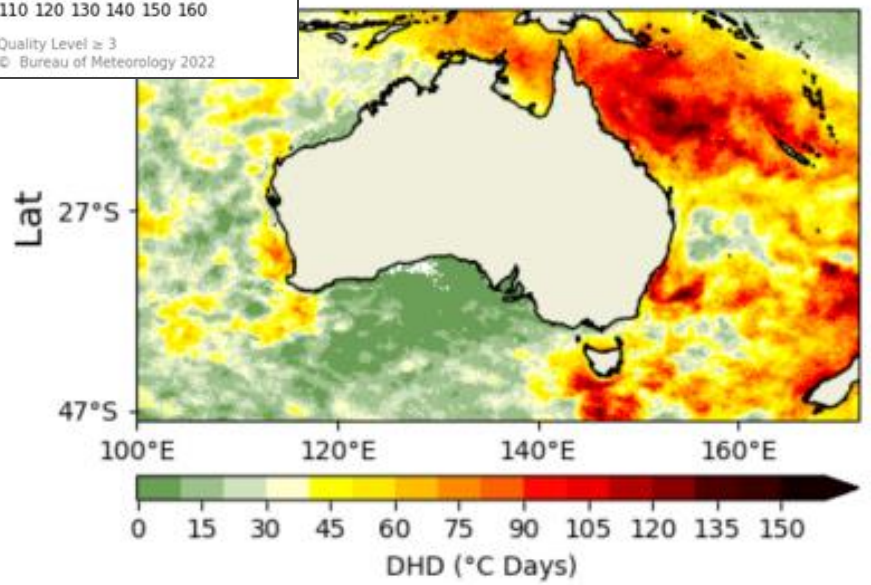
Improvements include:

- All Australian waters
- New GeoPolar MultiSensor L3S SST product
- SSTAARS climatology (1992-2016)
- Refined coral bleaching metrics
- New MHW metrics
- Supported and hosted by AODN
- Visualisation in IMOS Live



ReefTemp

AusTemp



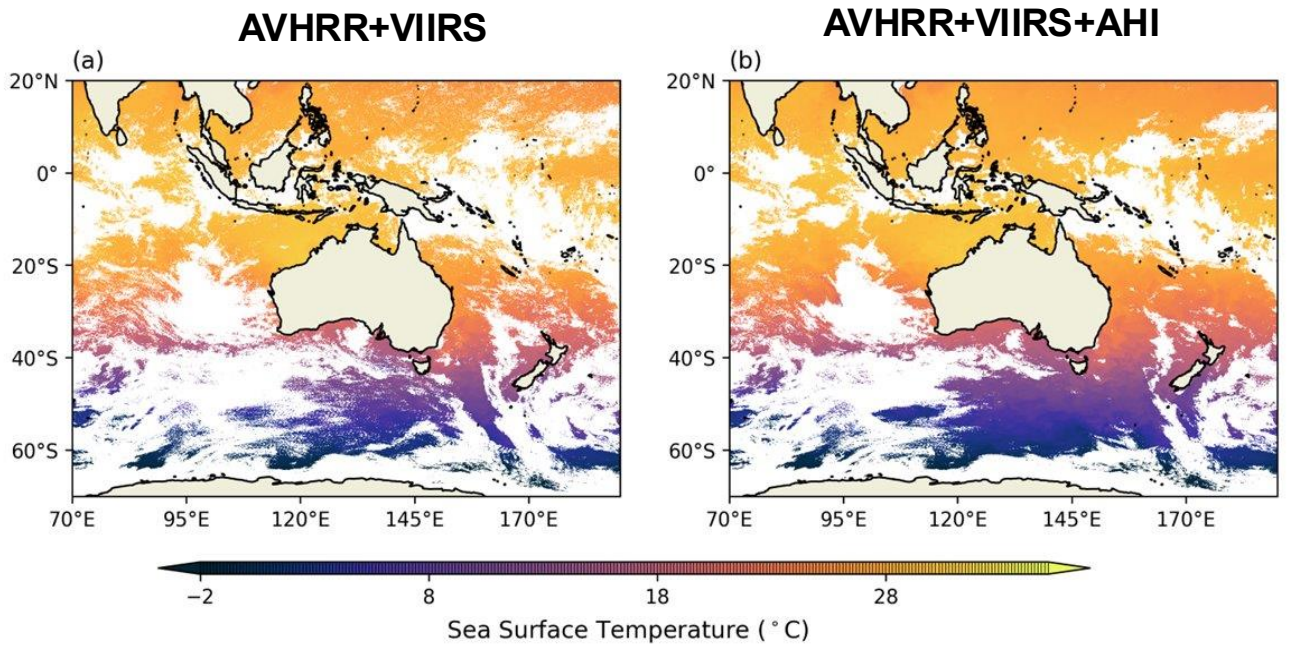
Govekar et al (2024), Govekar, Spillman et al (in prep)

New SST data: improved data coverage

- Data from Suomi-NPP, NOAA-20, MetOp-B, MetOp-C and Himawari-8/9 L3C files are composited using an equal weighted averaging method (Govekar et al., 2024) to construct the new GeoPolar MultiSensor L3S SST product.

- New GeoPolar MultiSensor L3S product has significantly more data coverage (on average 20%) than MultiSenosr L3S.

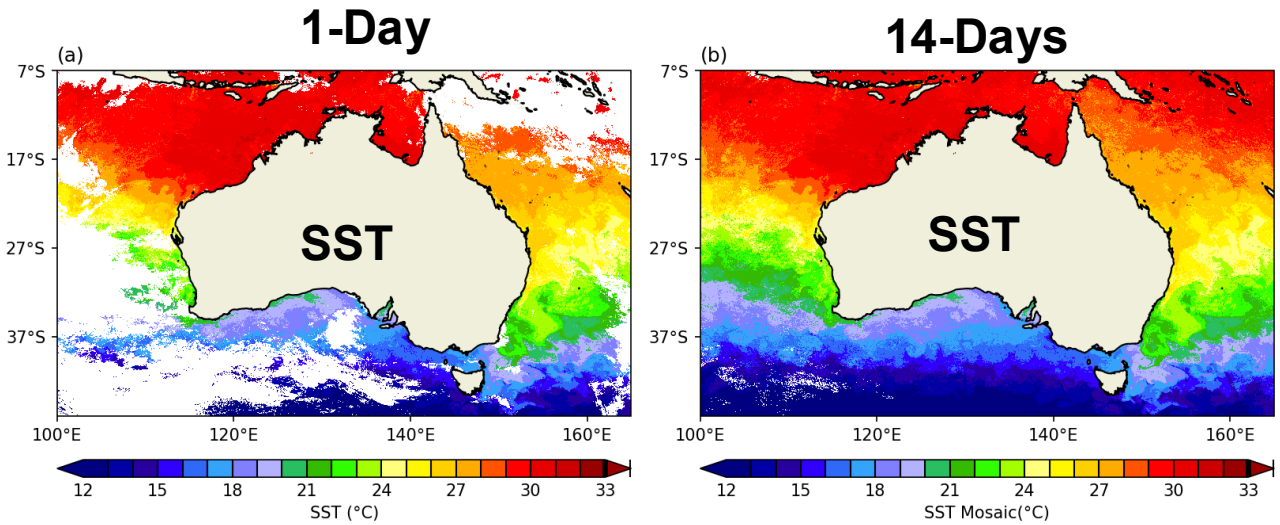
- Sea Surface Temperature (SST): Bias corrected (i.e. SST - sses_bias) SST at 0.2 m depth calculated using night-only GeoPolar Multisensor L3S product with quality_level > 2

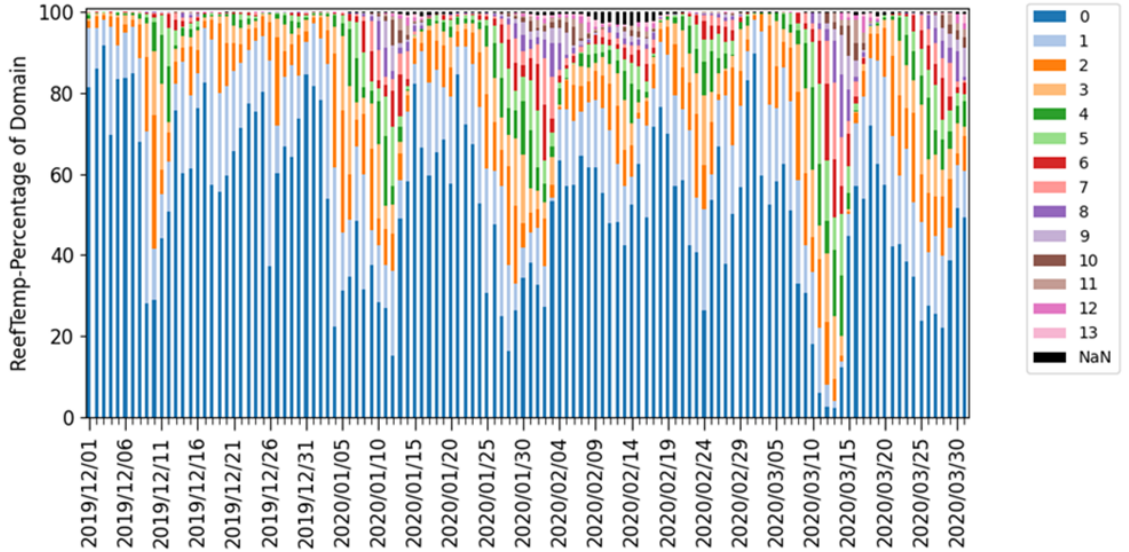


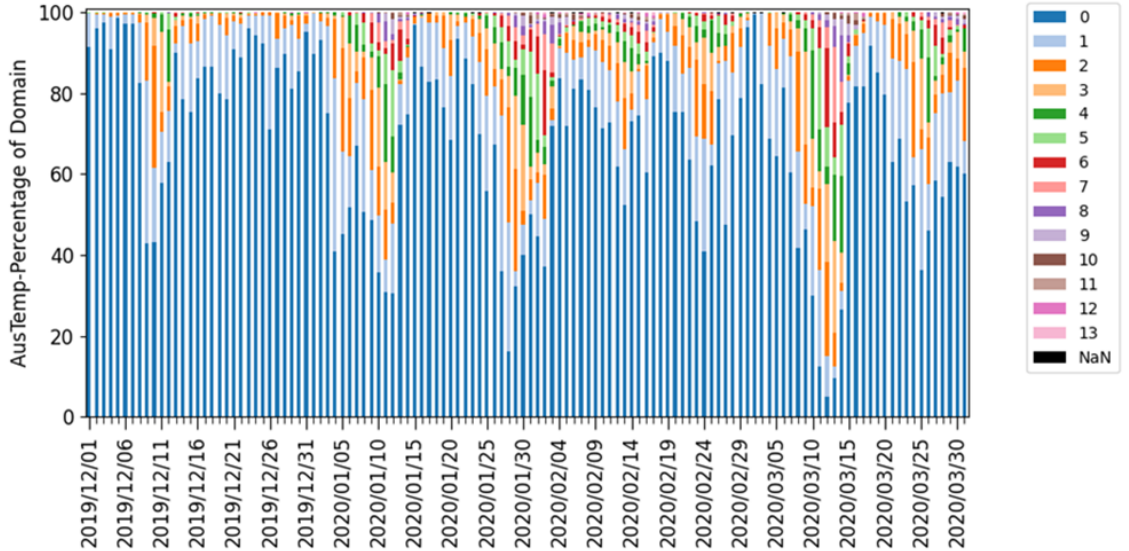
Filling gaps in SST

❖ A mosaic technique where the system fills each pixel that has missing data with the most recent daily SST available for the prior 13 days of the current day for that pixel was used to fill in data gaps.

SST data coverage from night Geo-Polar Multi-sensor L3S SST for 31 March 2020





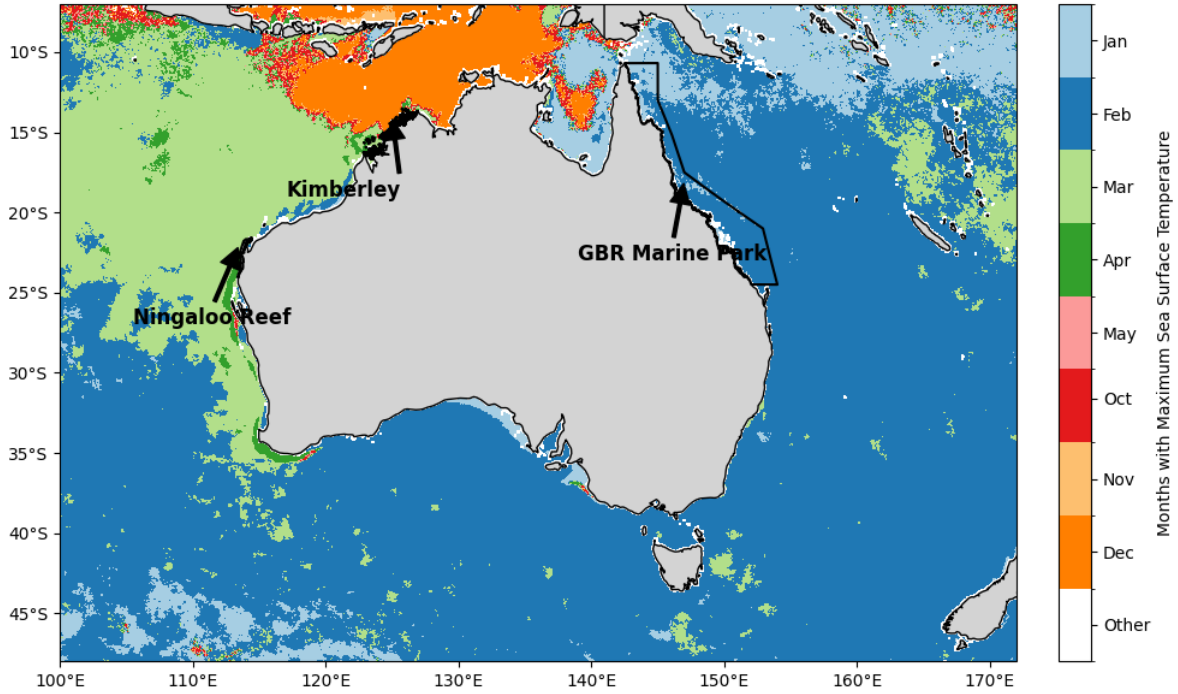


Daily STAARS Climatology

❖ The SST Atlas of Australian Regional Seas (SSTAARS) climatology constructed using 25 years of night-time daily AVHRR L3S data for the 1992-2016 period was used as a baseline climatology in AusTemp

❖ Daily 90th , 50th and 10th percentiles are used to calculate MHW and MCS categories

Month of Max SST



Months of maximum SST using daily mean temperature from SSTAARS climatology (1992-2016

Heat stress monitoring products

13 November 2025

- Sea Surface Temperature Anomaly (SSTA):

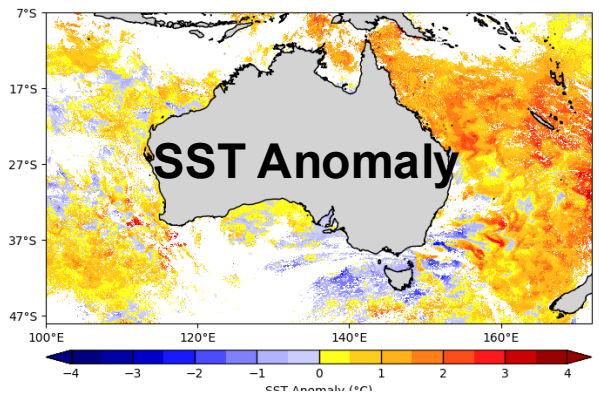
$$SSTA_{x,y} = SST_{x,y} - climatology_{today}$$

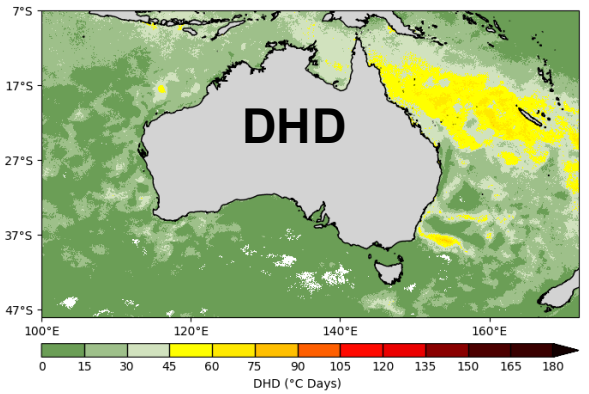
- Degree Heating Days (DHD): Accumulated for 1st October-31st May

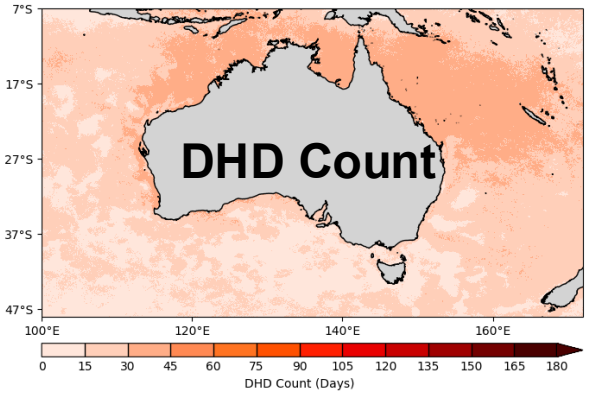
$$DHD_{x,y} = \sum_{t_0=1^{st}\,\boldsymbol{Oct}}^{t_{1=today}} SSTA_{x,y}\,, where\ SSTA_{x,y} > 0^oC$$

- Degree Heating Day Count (DHD count): This indicates the number of days that contributed to the DHD value reported for the pixel.

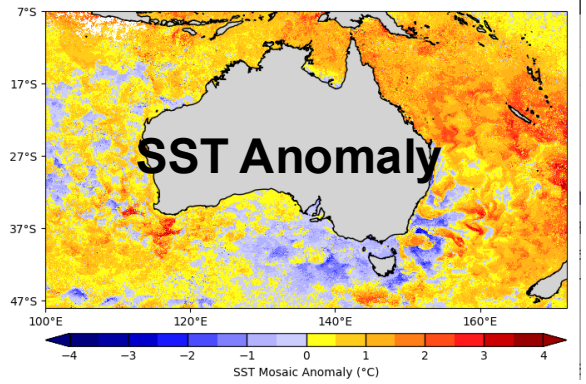
1-Day

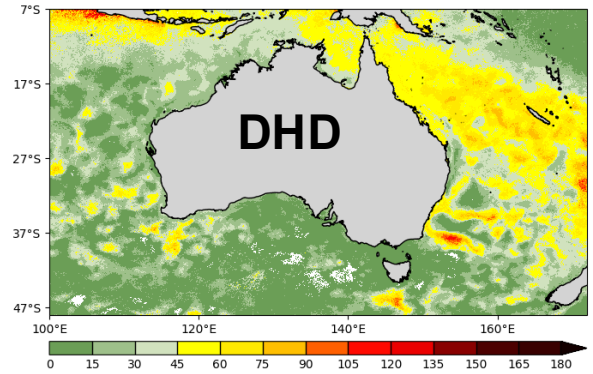


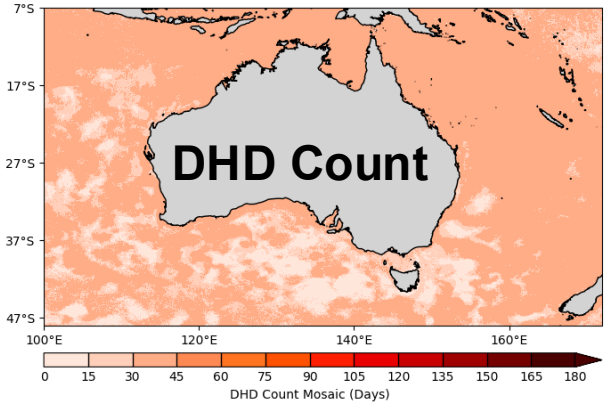




14-Day







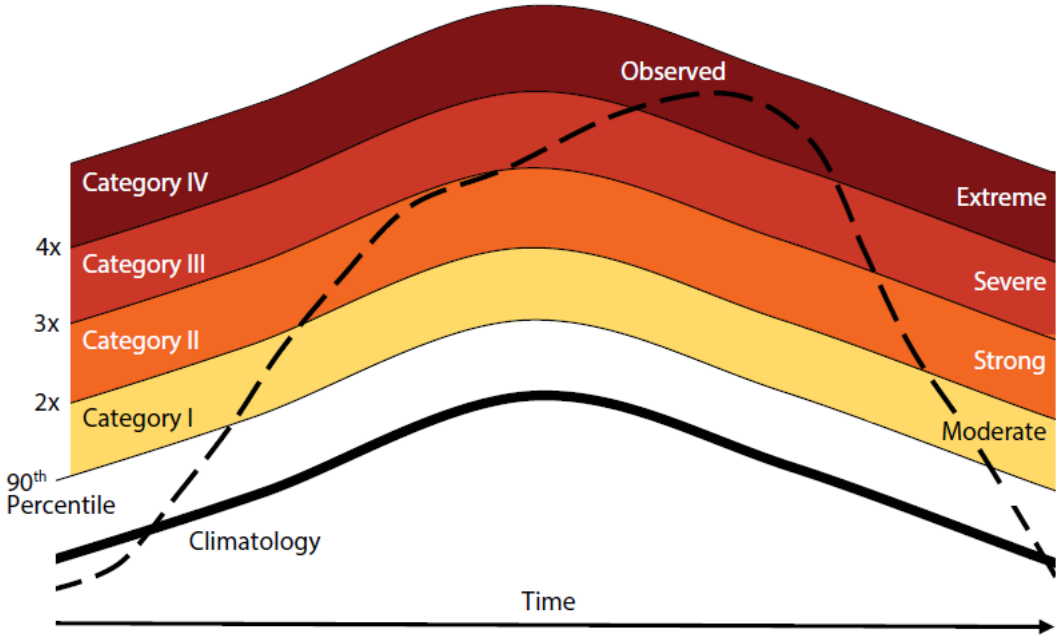
MHW/MCS Categories

SST > SST_{90} (t) →MHW,
SST < SST_{10} (t) →MCS

$$I(t) = \frac{SST(t) - SST_{90}(t)}{SST_{90}(t) - SST_{50}(t)}$$

Every pixel is categorized as

- Moderate: if the peak SSTA exceeds the 90th percentile but is less than 2 times the intensity threshold ($1 \leq I(t) < 2$),
- Strong: if the peak SSTA is between 2 and 3 times the intensity threshold ($2 \leq I(t) < 3$)
- Severe: if the peak SSTA is between 3 and 4 times the intensity threshold ($3 \leq I(t) < 4$),
- Extreme: if the peak SSTA exceeds 4 times the intensity threshold (($I(t) \geq 4$).



Hobday et al., 2018

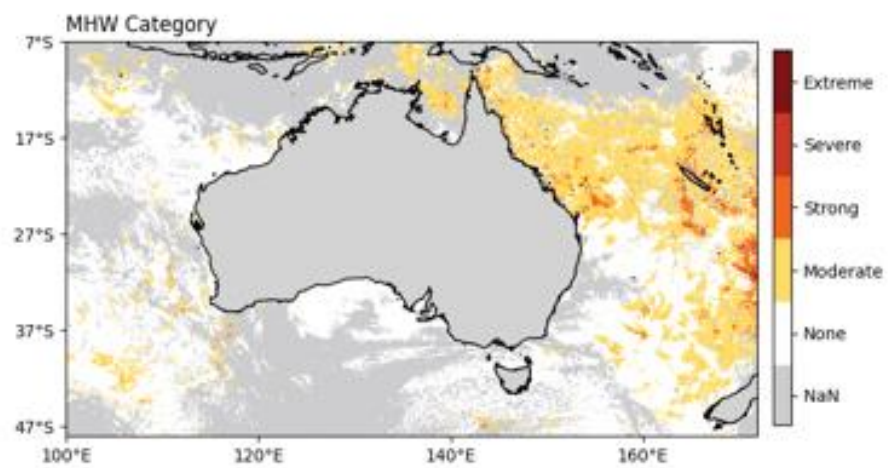
Daily climatology (mean) is replaced by 50th percentiles (median) to avoid extreme values

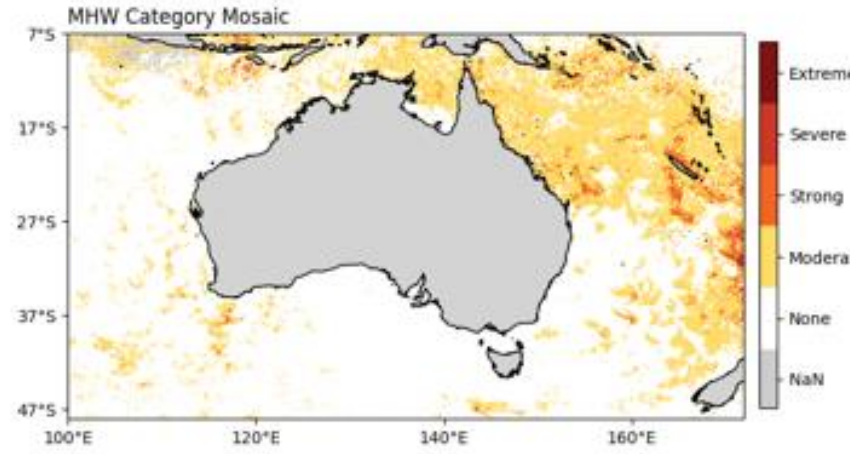
Marine heatwave metrics

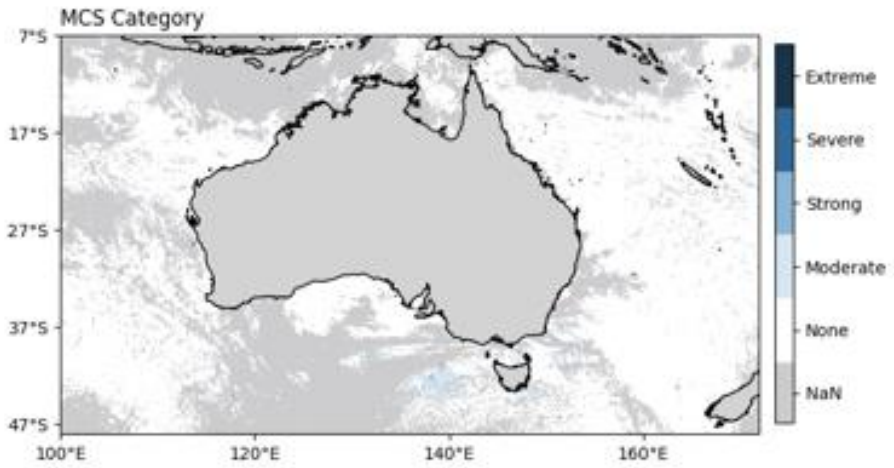
- Utility for other sectors
- Verification of realtime forecasts
- Compare with DHD

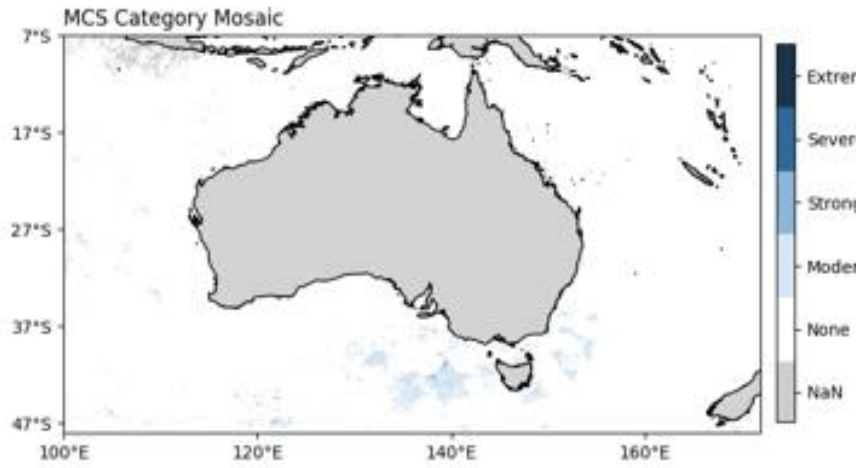
MHW and MCS categories for 13th November 2025

1-day | **14-day**

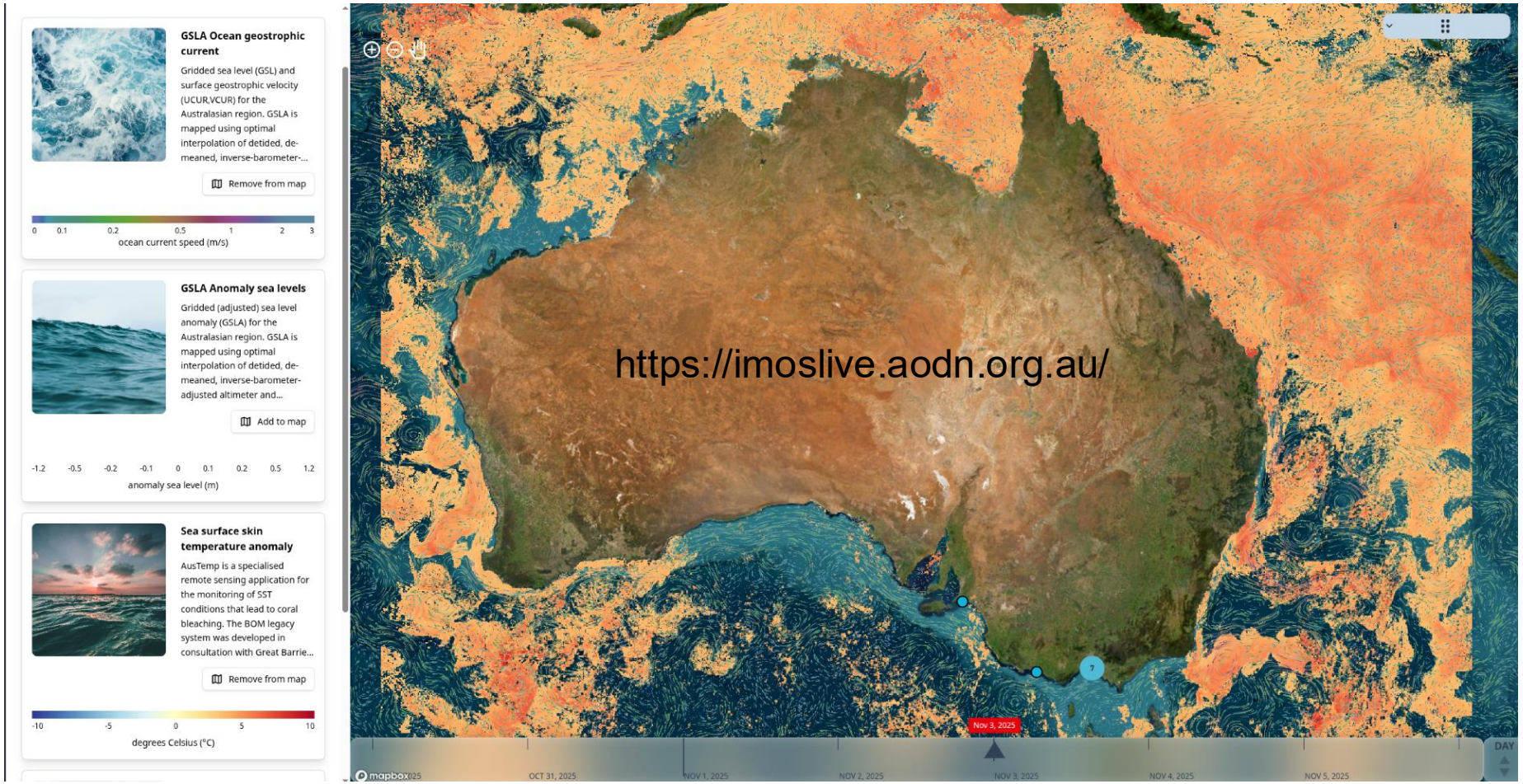








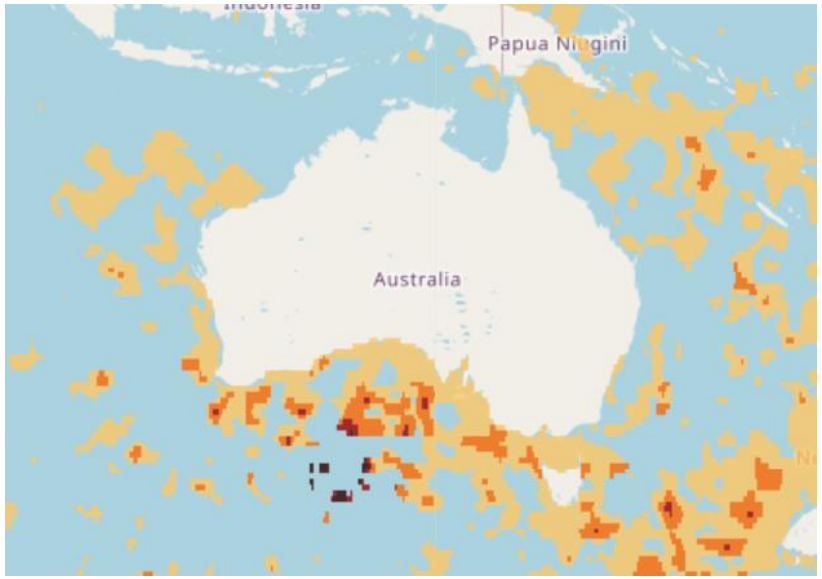
AusTemp in IMOS Live



AusTemp data : https://thredds.aodn.org.au/thredds/catalog/IMOS/SRS/AusTemp/catalog.html

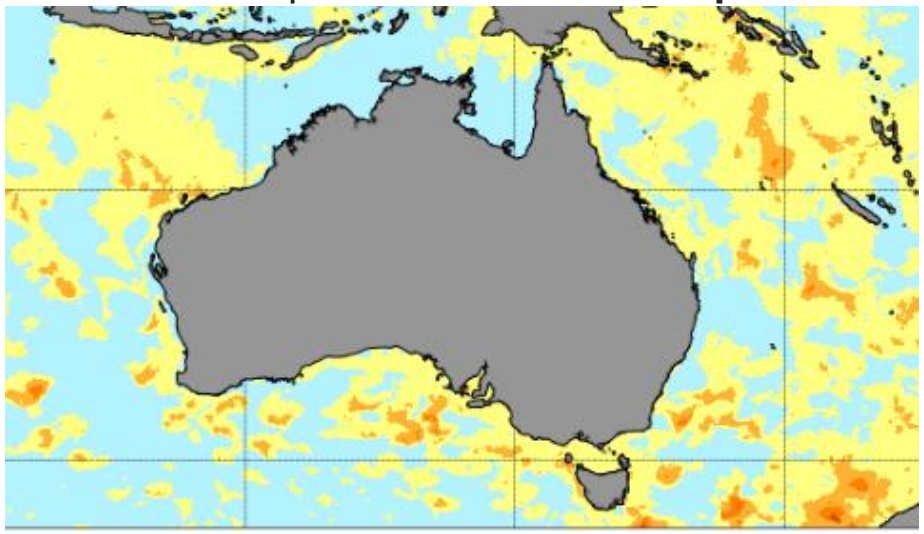
Marine Heatwave Category 26 April 2025

25 km DOISST v2.1, 1982 – 2011 clim period)



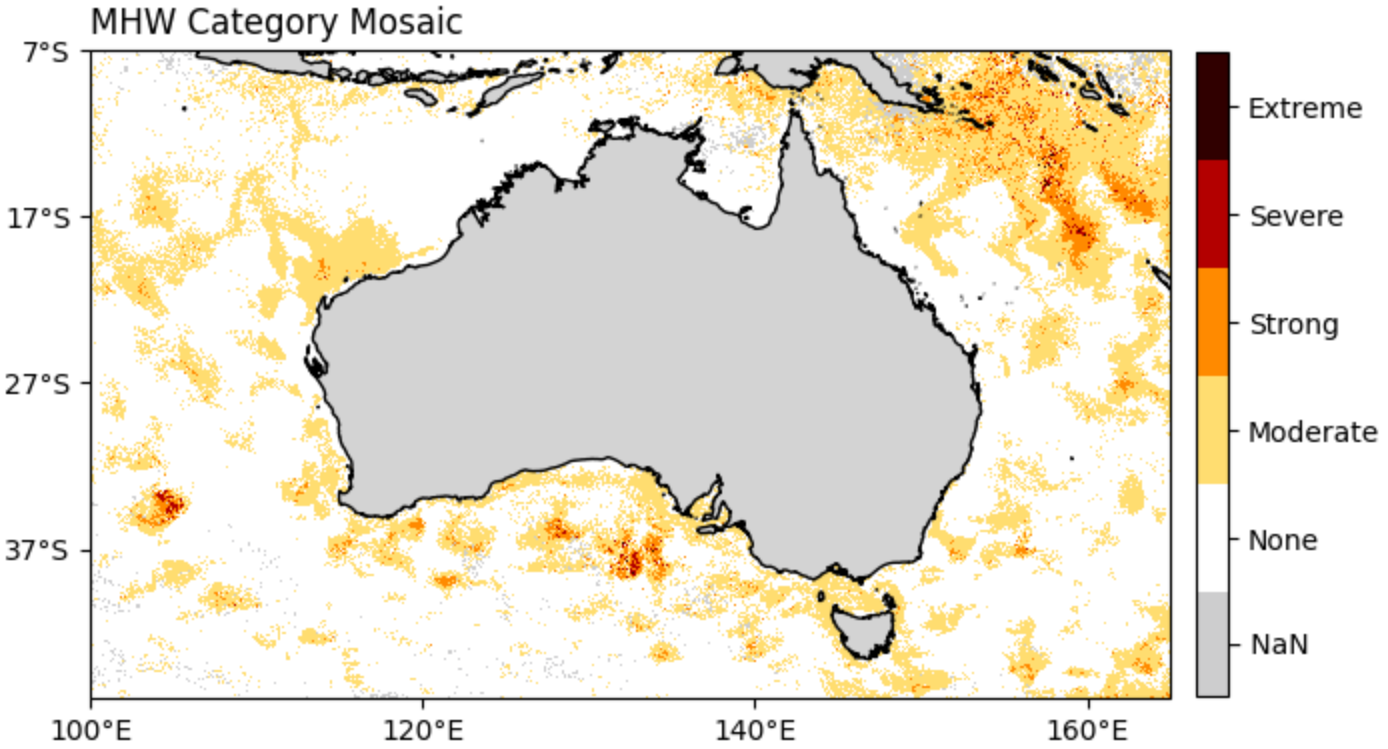
https://www.marineheatwaves.org/tracker.html

5 km Geo-Polar Blend SST Analysis, the baseline time period of **1985 – 1990 plus 1993**



https://coralreefwatch.noaa.gov/product/marine_heatwave/

Bureau's experimental product, available on NCI
2 km MultiSensor L3S, SSTAARS climatology, 1992-2016



Summary and future plans

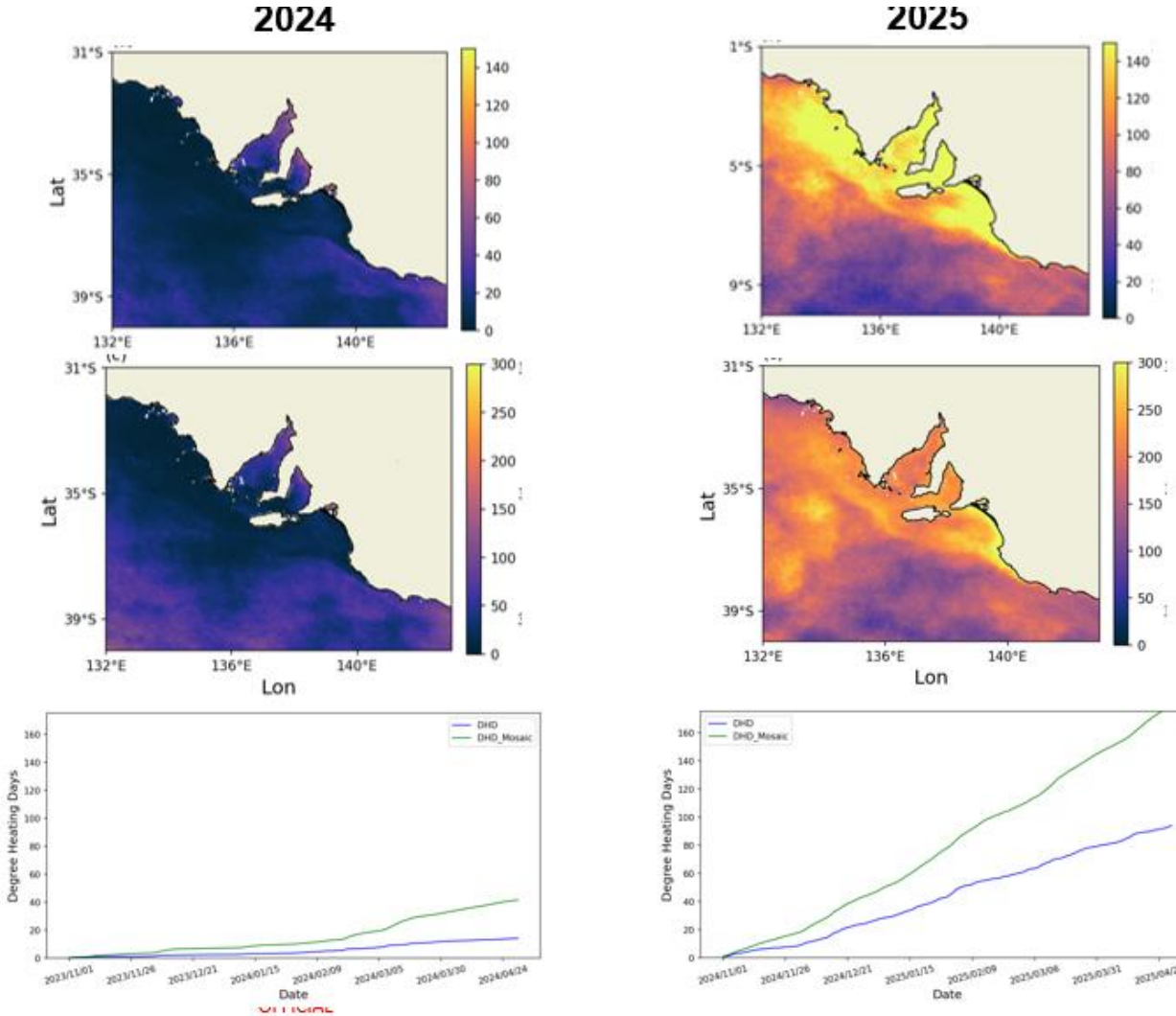
- GeoPolar MultiSensor L3S SST product provides more contemporary data for mosaic SST products, representing closely conditions of the present day.

- Newly developed experimental thermal stress and MHW monitoring metrics are at a very high spatial resolution, exhibiting greater feature resolution.

- Heat stress and MHW monitoring metrics will be made available in netcdf format in near real time by AODN and displayed in IMOS Live https://imoslive.aodn.org.au/

- Available daily products on NCI/AODN (for 1 day and 14-day Mosaic):
  - Sea Surface Temperature (SST)
  - Sea Surface Temperature Anomaly (SSTA)
  - Degree Heating Days (DHD)
  - Degree Heating Days Count (DHDC)
  - Marine heatwave category (MHW Category)
  - Marine Cold spell category (MCS Category)

, South Australian coast, DHD 30th April

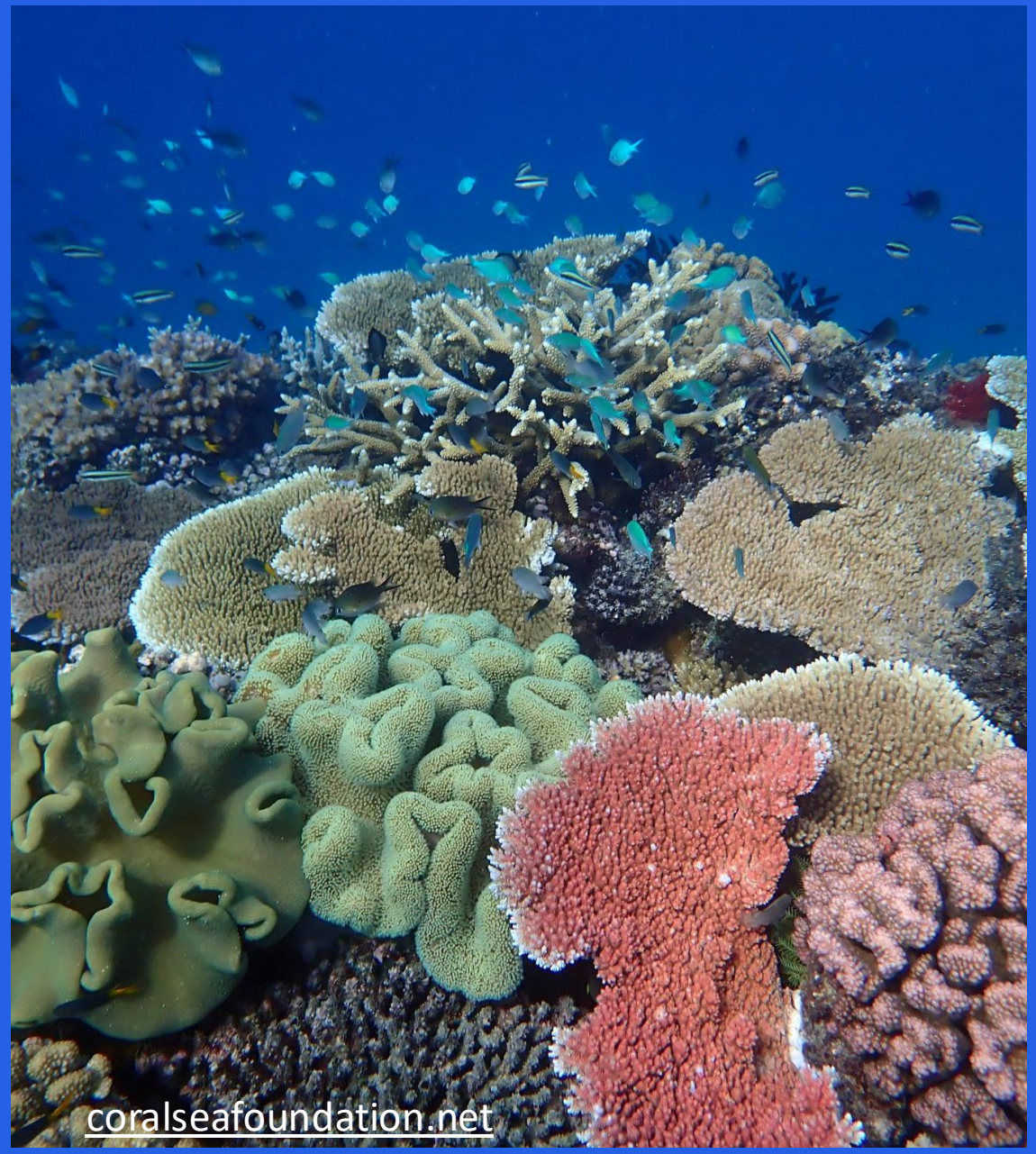


The Bureau of Meteorology

Thank you

Pallavi Govekar

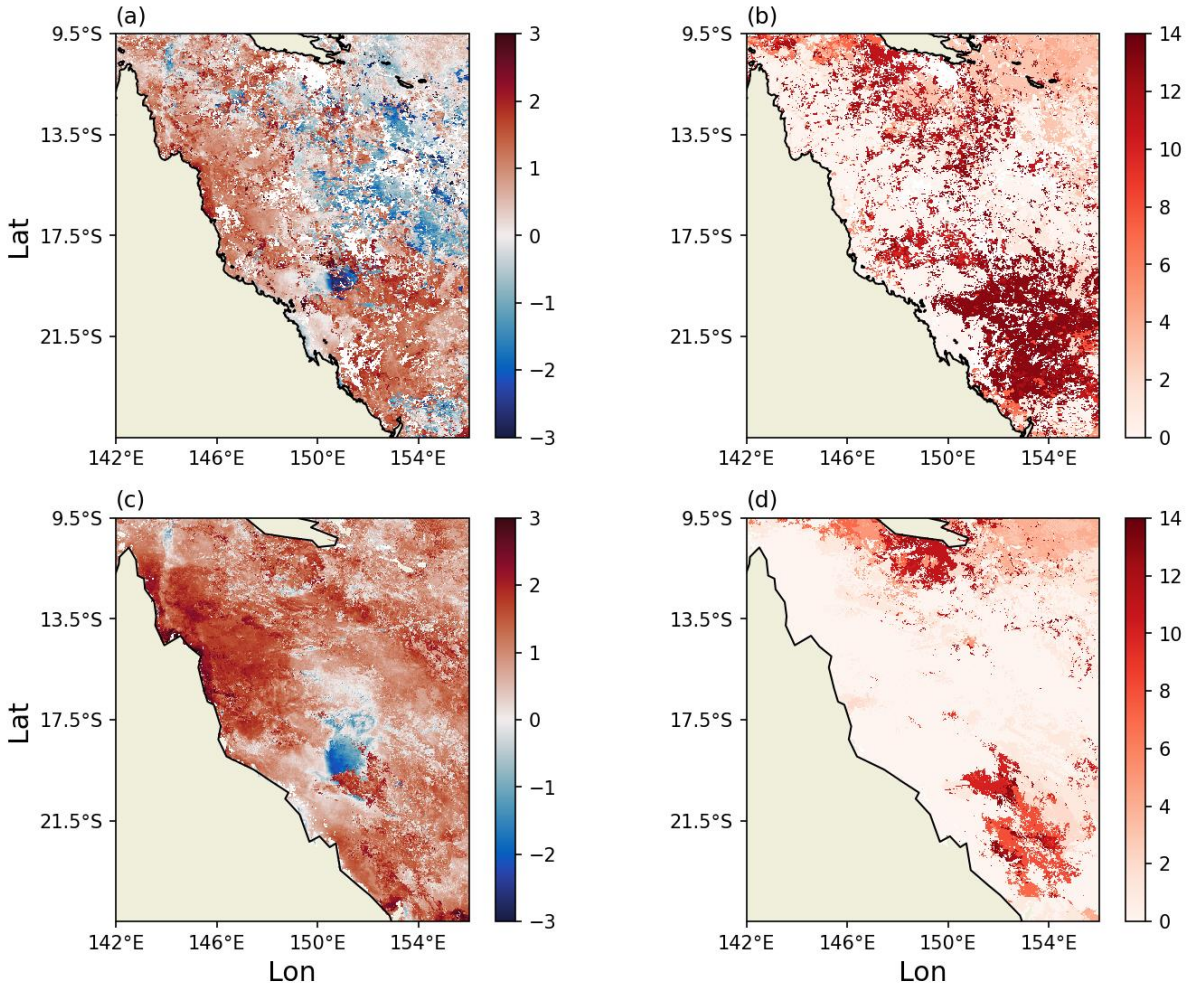
Pallavi.govekar@bom.gov.au



Supplementary Slides

Case study 1:

Cyclone Debbie in March 2017 – arrested coral bleaching due to significant cooling around Townsville.



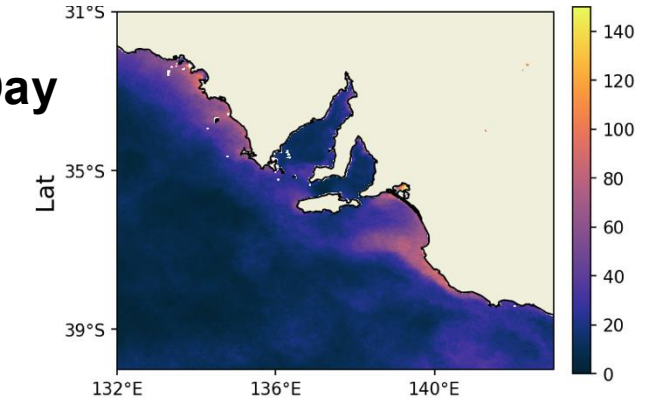
(a)14-day SST Anomaly Mosaic, (b) mosaic pixel age using current operational MultiSensor L3S SST, (c) 14-day SST Anomaly Mosaic and (d) mosaic pixel age using GeoPolar MultiSensor L3S for 31st March 2017

- Need improvement over gap filling method.

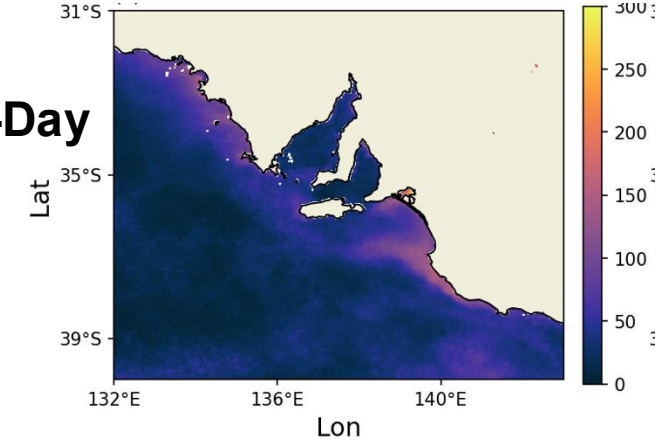
Case study 2, South Australian coast, DHD 30th April

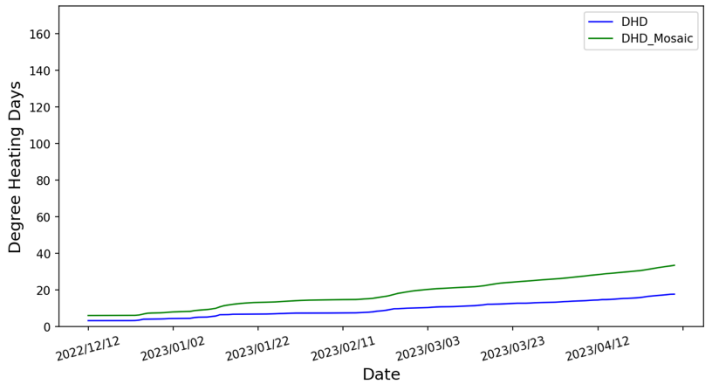
2023

1-Day

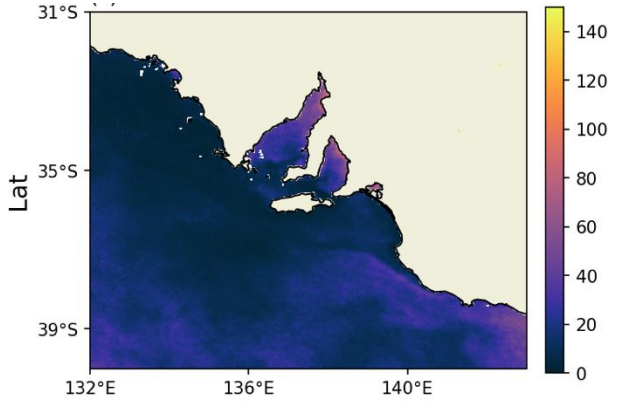


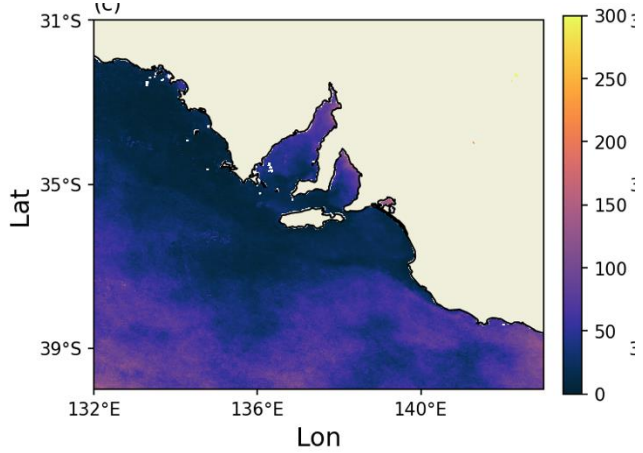
14-Day

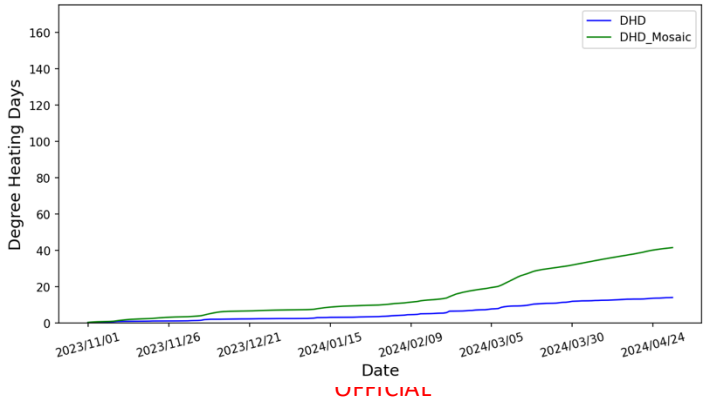




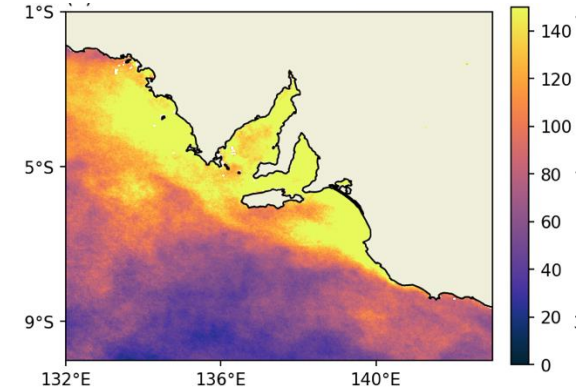
2024

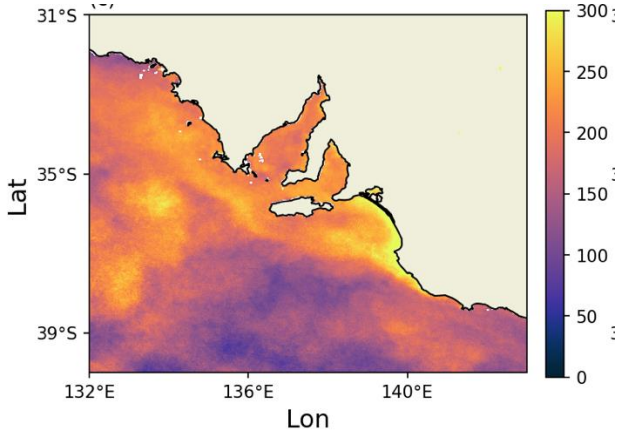


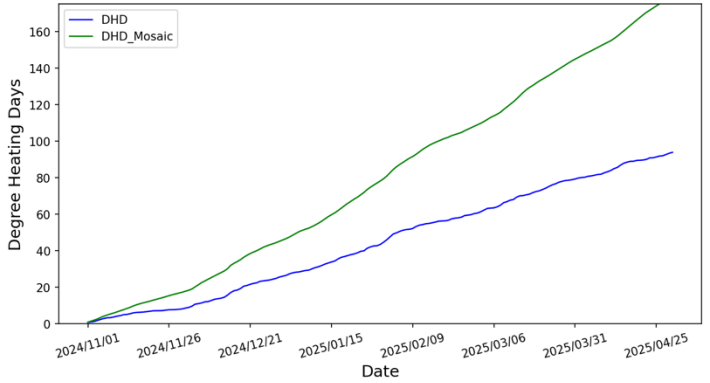




2025



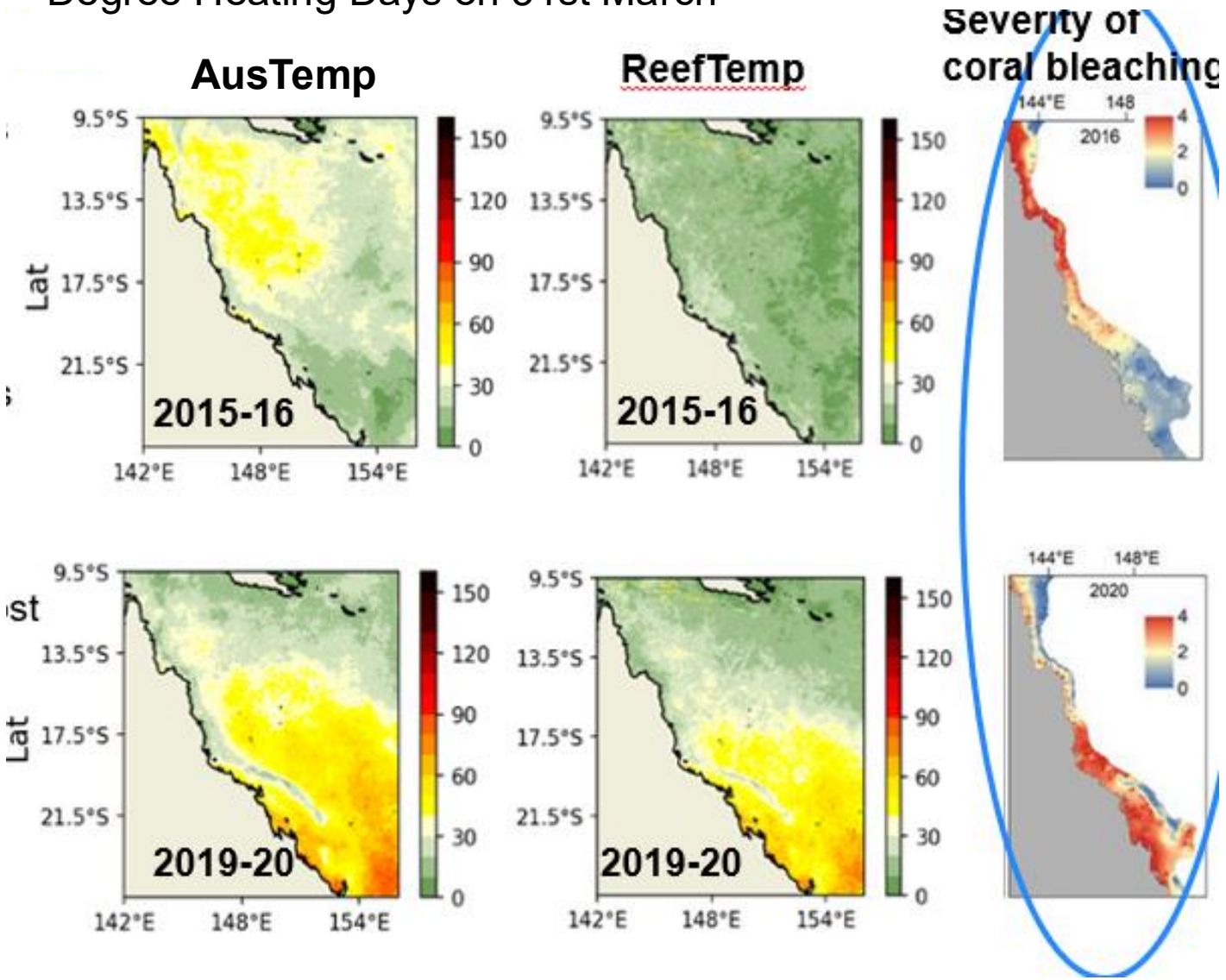




AusTemp vs ReefTemp

Narrative remains same:
AusTemp provides more detail

Degree Heating Days on 31st March

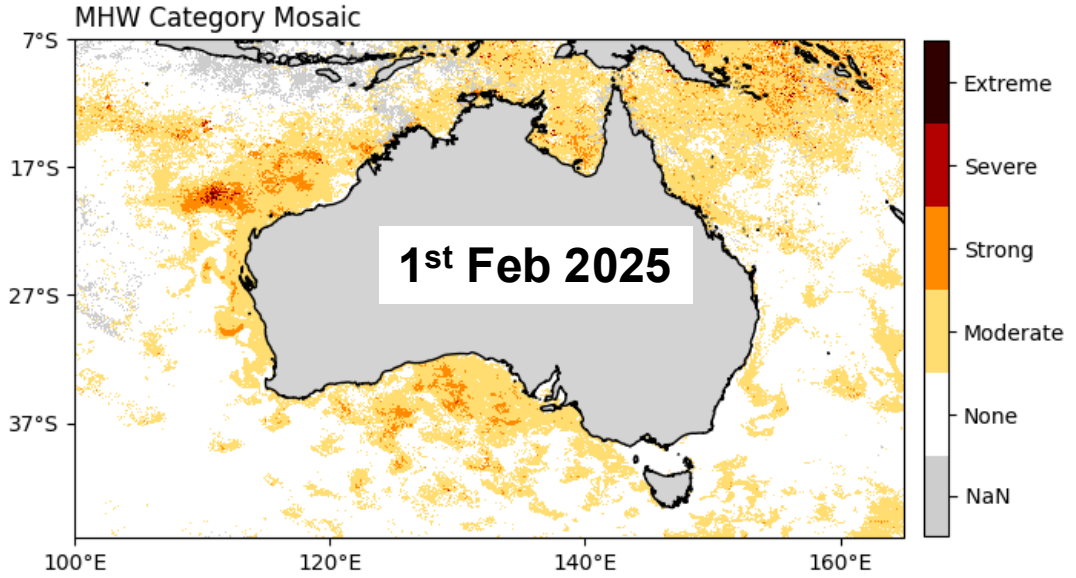


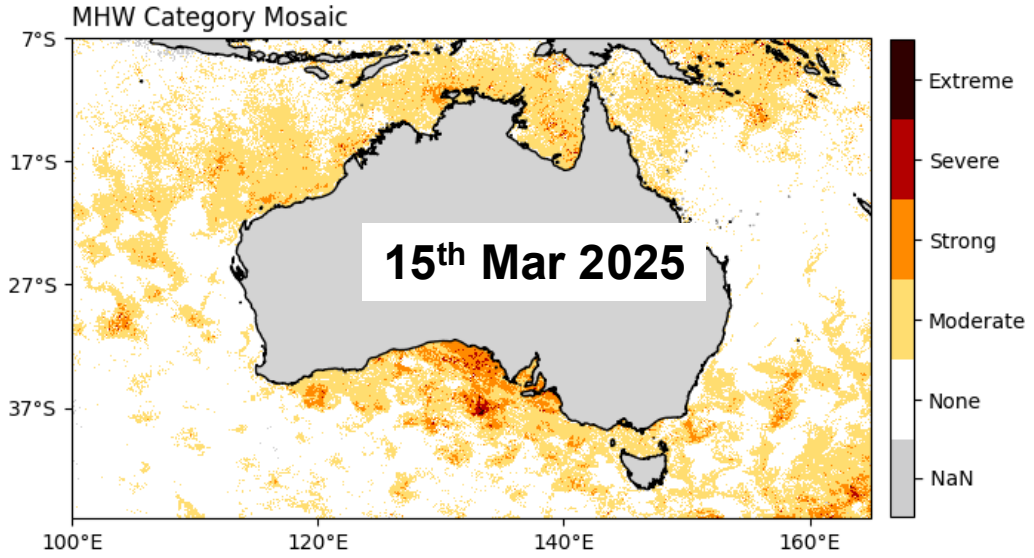
Hughes et al., 2021: Geographic extent and severity of coral bleaching during major events in 2016 and 2020, measured by extensive aerial scores: 0 (<1% of corals bleached), 1 (1%–10%), 2 (10%–30%), 3 (30%–60%), and 4 (>60%). The number of reefs surveyed was 1,135 (2016) and 1,036 (2020)

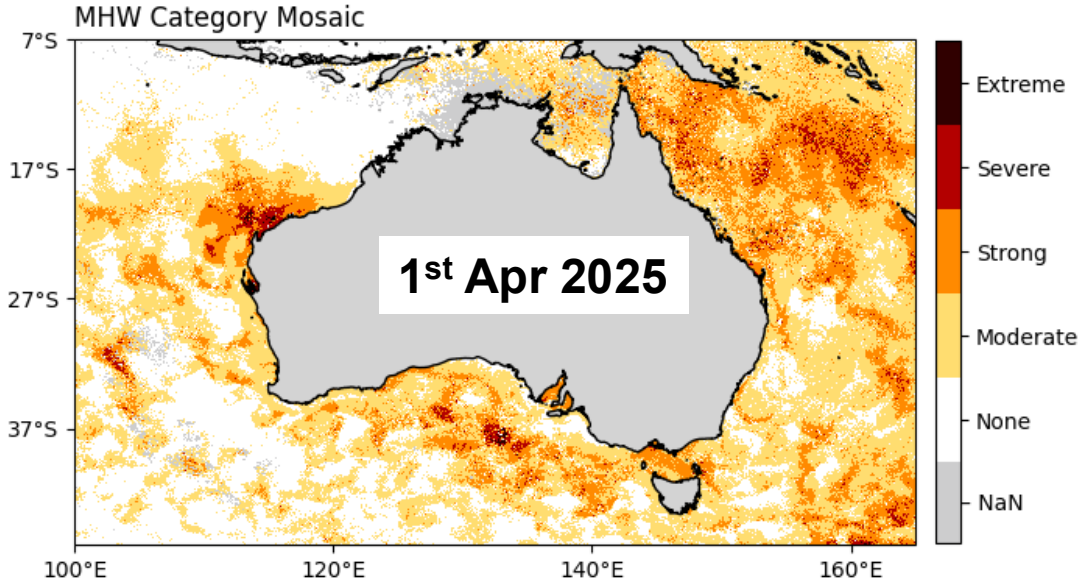
Case study 2

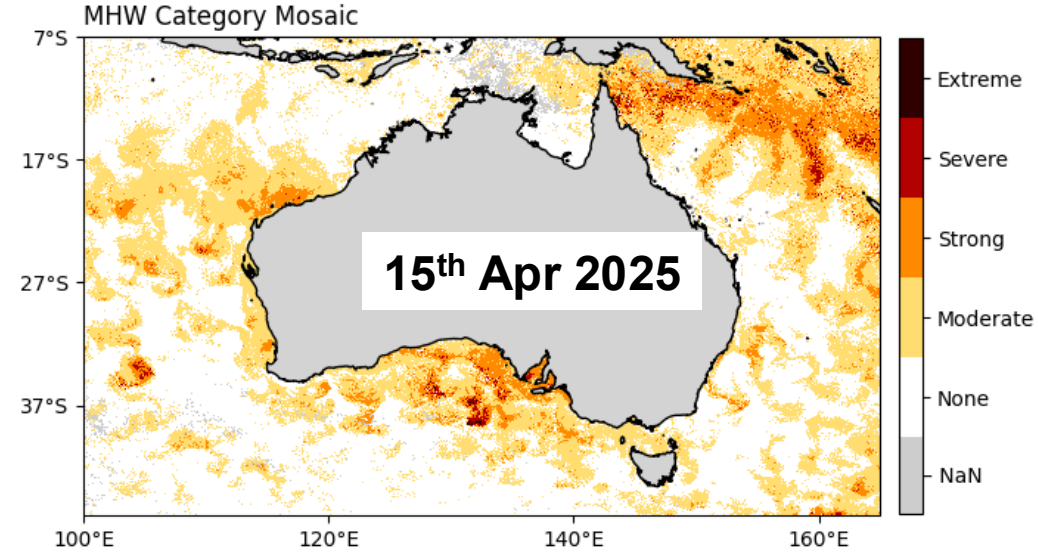
South Australian coast, Algae bloom, March-May 2025

MHW categories





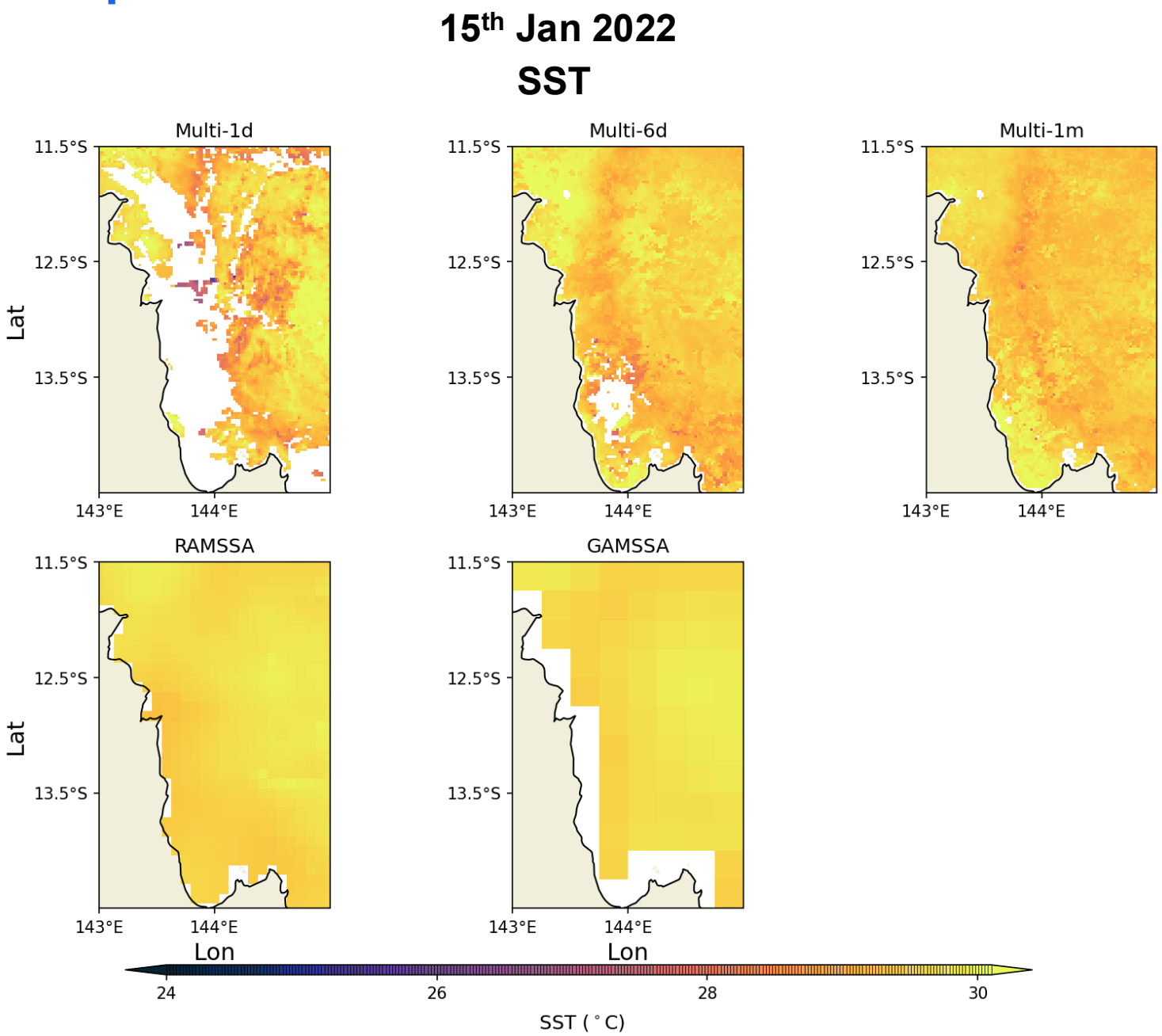


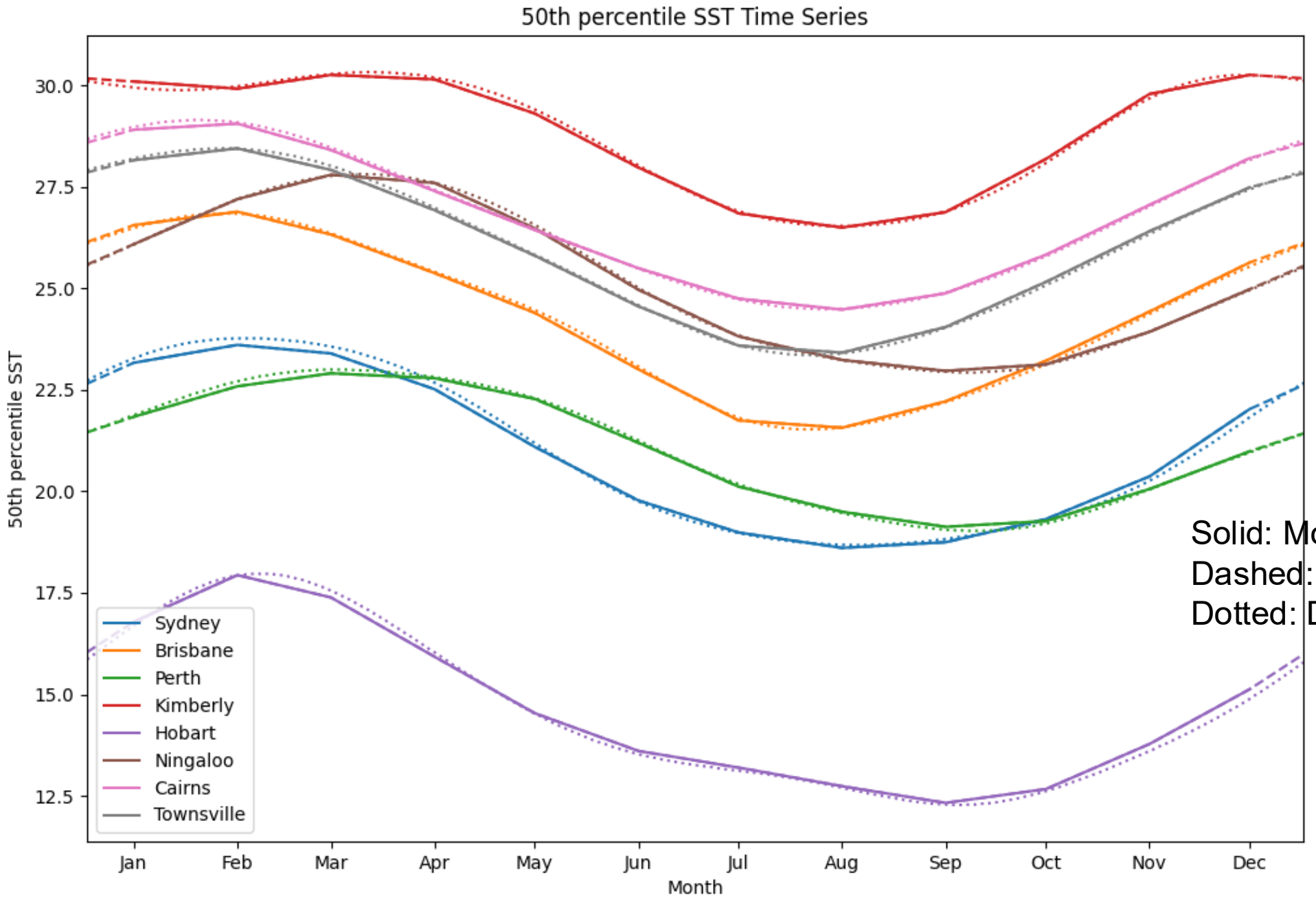


Other questions

- Anything specific needed for WA coast?
- Are you happy with the colour schemes and intervals used on the plots?

SST from different products-



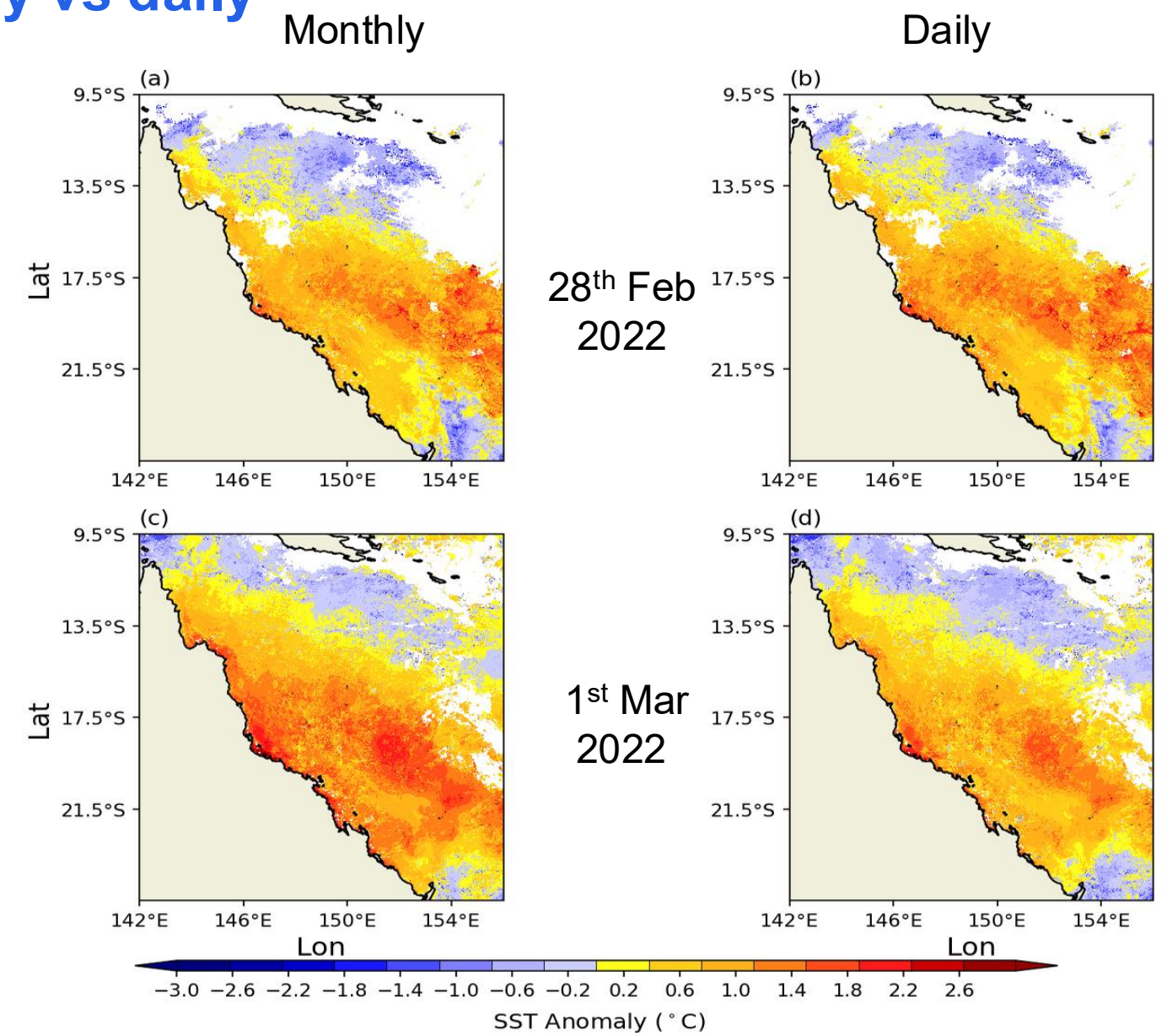


Solid: Monthly 50th percentile
Dashed: Daily 50th percentile
Dotted: Daily mean

Climatology differences – monthly vs daily

SST Anomaly calculated using (a) and (c) monthly SSTAARS climatology, (b) and (d) daily SSTAARS climatology and for 28th Feb 2022 and 1st March 2022

Daily climatology removes the jump (if using a monthly climatology) between from one month to the next



Climatology differences

Difference between the 1992-2016 SSTAARS and 2002-2011 IMOS monthly climatologies for (a) November (b) December (c) January (d) February (e) March and (f) April over the GBR region. Red is where SSTAARS is warmer than IMOS.