A new 2 km Sea Surface Temperature Atlas of the Australian Regional Seas (SSTAARS)

Summary

We use 25 years of Advanced Very High-Resolution Radiometer (AVHRR) data from NOAA Polar Orbiting Environmental Satellites received by six Australian and two Antarctic receiving stations to construct a detailed climatology of sea surface temperature (SST) at 20 cm depth around Australasia.

- Raw scans have been accurately navigated
- Only night-time nearly cloud-free data are used to reduce diurnal bias and cloud contamination
- Irradiances have been processed and fitted to *in situ* drifter data following international GHRSST protocols to help reduce instrument bias
- A pixel-wise (2km) climatology (with four annual sinusoids) and linear trend are fit to the data using a robust fitting technique
- Monthly non-seasonal percentiles are also derived

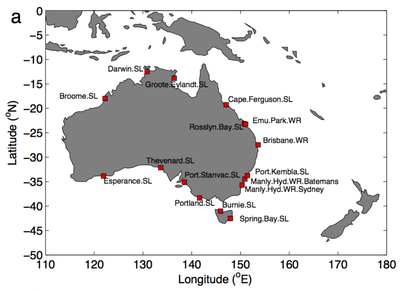


***Figure 1**: a) Locations of long and relatively continuous near surface in situ temperature records from either coastal tide gauge sites (SL) or offshore wave-rider sites (WR); b) RMS difference in the seasonal cycle between the in situ and Atlas estimates as a function of distance between the in situ measurement site and the nearest Atlas pixel.*

Validation

- Used temperatures from coastal tide gauges and wave-rider buoys, not used to de-bias the satellite data (Figure 1a)
- Climatology based on *in situ* observations was compared to SSTAARS
- The major driver of difference is the distance between the *in situ* site and the nearest Atlas pixel (Figure 1b).
- The more offshore wave-rider sites show very good agreement with the Atlas as they can be most closely collocated with an Atlas pixel
- For co-locations within 3km, RMS errors are 0.2° C or less, and within 1km, 0.1° C or less, comparable to the average drifter matchup errors

Coverage

- The coverage for June and December is shown in Figure 3 in observation count per pixel
- Sampling is very seasonally dependent, due to cloudiness
- Pixels near Australia have more observations, with sampling dropping off with distance from Australian satellite receiving stations due to reduced reception of direct broadcast NOAA satellite data by these receivers.

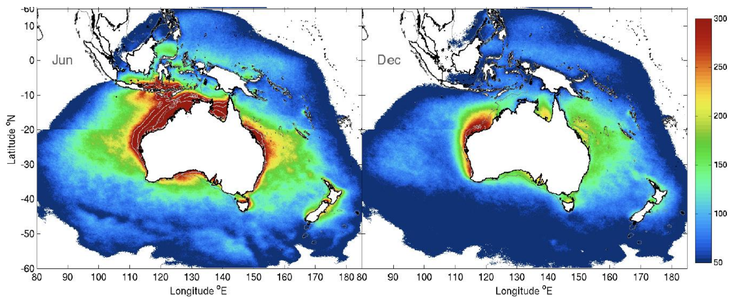


***Figure 3**: The number of days of good observations in each ~2 km pixel in each selected month over the IMOS SST archive used to make the Atlas. For reference the maximum possible coverage would be around 700 days. Left: June; and Right: December.*

25 Year Trends

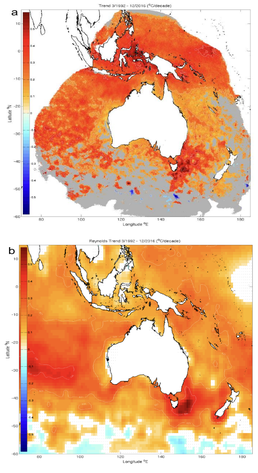


***Figure 2:** Estimates of the linear SST trend from 3/1992-12/2016: a) from the IMOS SST archive and b) from the NOAA OI V2 weekly SST. Units are °C/decade and the contour interval is 0.2 °C/decade. Grey stippled regions mark where the trend is smaller than 2 times the standard error (95% significance level).*

Key phenomena revealed

- Indonesian Throughflow warm advection (Figures 4 and 5)
- Summer tidal drawdown over tropical shelves (Figures 6 and 7)
- Tidally-driven reef-flat mixing (Figures 6 and 7)
- Boundary current flows and their seasonality (Figures 8 and 9)
- Cross-shelf gradients of variance due to mesoscale eddies (Figure 9)
- Suppression of the annual cycle by warm advection along the Lleeuwin Current pathway (Figures 8 and 9)

Data Access

IMOS Integrated Marine Observing System

SSTAARS Atlas files: https://portal.aodn.org.au/search?uuid=79c8eea2-4e86-4553-8237-4728e27abe10

IMOS AVHRR daily night-time L3S data used as input: https://portal.aodn.org.au/search?uuid=79c8eea2-4e86-4553-8237-4728e27abe10

***Figure 4 (top left):** Climatological SST from the Atlas for the Indonesian Seas shown every 2 months. The colour scale is adaptive and changes every month to help better reveal spatial contrasts. Grey contours mark the 50m (thin) and 200m (thick) isobaths.*

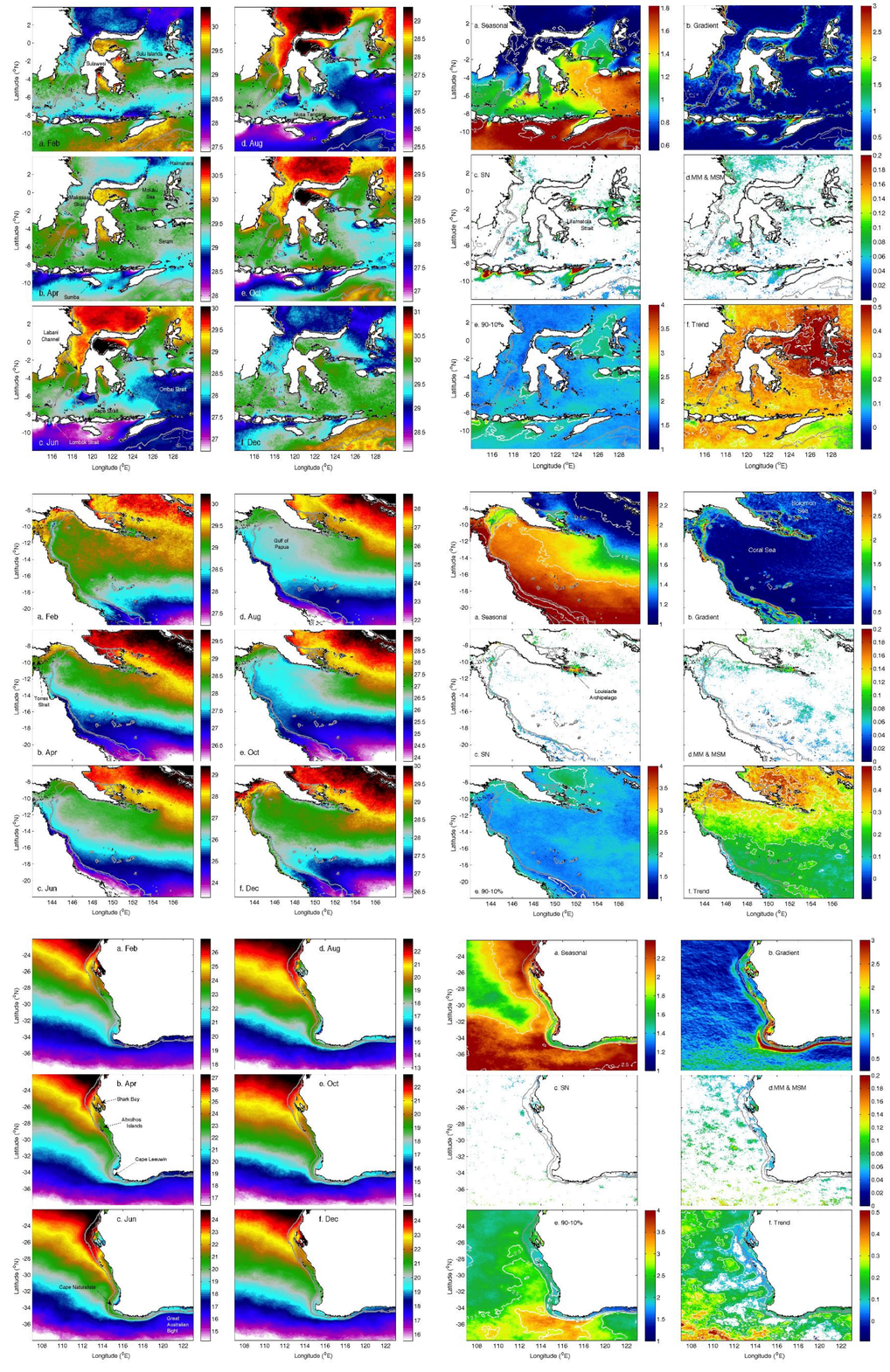
***Figure 5 (top right):** For Indonesian seas a) amplitude of the seasonal fit; b) magnitude of the lateral gradient of the mean field (°C/degree longitude/latitude); c) spring-neap and d) MSm plus Mm tidal harmonic response (using same colour bar); e) non-seasonal variance as captured by the 10th-90th percentile range; and f) the fitted linear change per decade. Values are only plotted where the fitted response is significant at the 95% level (2 times the standard error). All units are in °C except where noted otherwise. Grey contours mark the 50m (thin) and 200m (thick) isobaths.*

***Figure 6 (middle left):** As for Figure 4 but for the Central and Northern GBR, Gulf of Papua, and the Coral Sea.*

***Figure 7 (middle right):** As for Figure 5 but for the Central and Northern GBR, Gulf of Papua, and the Coral Sea.*

***Figure 8 (bottom left):** As for Figure 4 but for waters off southwestern Australia (showing Lleeuwin Current).*

***Figure 9 (bottom right):** As for Figure 5 but for waters off southwestern Australia (showing Lleeuwin Current).*



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