



**GMES
AND AFRICA**



MONTHLY OCEANOGRAPHY BULLETIN

South West Indian Ocean

July 2021



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List of Acronyms

AUC	African Union Commission
Chl- <i>a</i>	Chlorophyll- <i>a</i>
EU	European Union
GMES	Global Monitoring for Environment and Security
JRC	Joint Research Centre
MODIS	Moderate Resolution Imaging Spectrometer
MOI	Mauritius Oceanography Institute
SMI	Standard Mapped Image
SST	Sea Surface Temperature
SWIO	South West Indian Ocean

1.0 Introduction

This monthly bulletin is produced by the MOI under the GMES & Africa project and provides satellite based oceanographic observations of the South West Indian Ocean region. This issue focuses on remote sensing sea surface temperature and chlorophyll-*a* concentration. It is targeted at users from the marine and fisheries realm for monitoring purposes. It is also a source of information for researchers and the scientific community.

2.0 Highlights

Sea Surface Temperature

- SST was relatively low across the Indian Ocean, except for some localised regions in the northern part.
- The average SST in the Mascarene region was comparatively colder than the previous month by dropping further to around 23 - 25 °C.
- The observed SST for the period of July 2021 shows a typical tendency similar to the climatological mean in the region.
- For the Mascarene region, the sea surface temperature was slightly below the climatological mean.
- A relatively higher positive anomaly was observed off the coast of Toliara, Madagascar, unlike the previous couple of months.

Chlorophyll-*a* Concentration

- The average Chl-*a* concentration for the month of July 2021 is comparable to the climatological mean except for some localised regions.
- Relatively lower Chl-*a* concentration was recorded in the Mascarene region as compared to other regions.
- The monthly time series analysis for the region around Mauritius Island shows that the positive Chl-*a* anomaly observed since mid-April 2021 is increasing.
- A net increase of around 2.0 mg/m³ in Chl-*a* concentration was observed in the region around the Seychelles Islands compared to the previous month.

3.0 Sea Surface Temperature

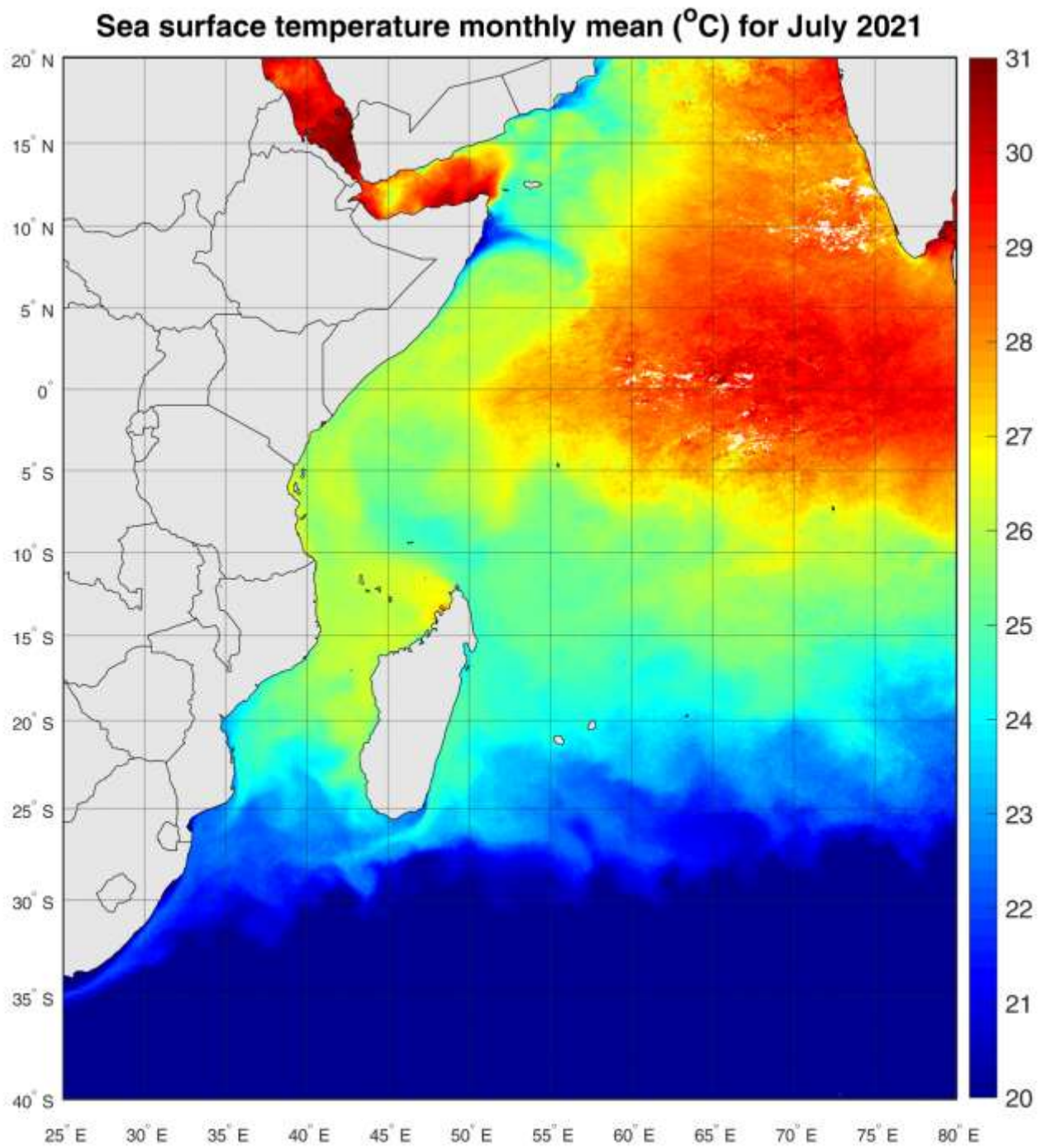


Figure 1: Mean sea surface temperature for the month of July 2021 (°C)

Sea surface temperature climatology ($^{\circ}\text{C}$) for July from 2002 to 2019

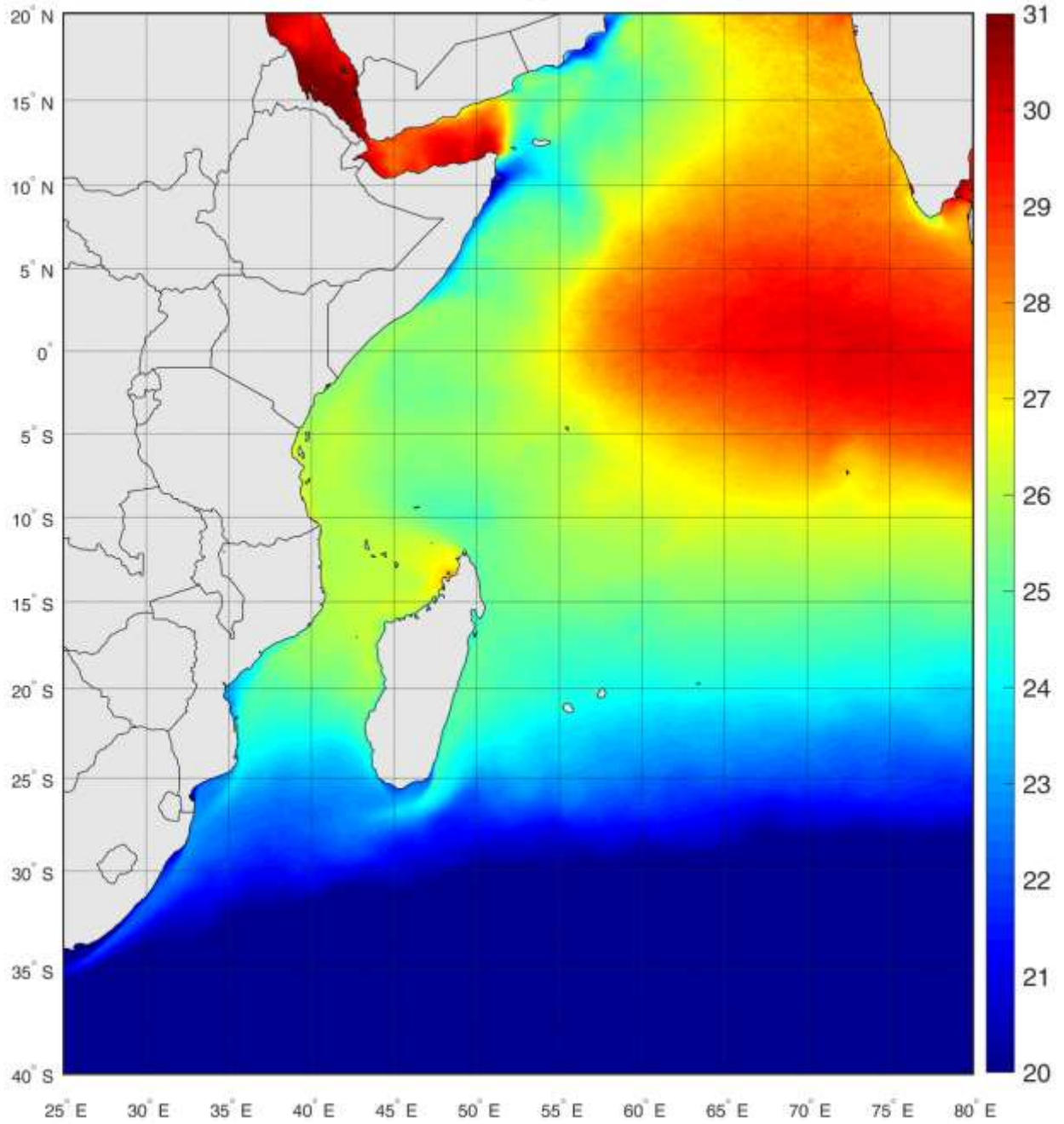


Figure 2: Sea Surface Temperature Climatology ($^{\circ}\text{C}$) for the month of July (2002 - 2019)

Sea surface temperature anomaly ($^{\circ}\text{C}$) for July 2021

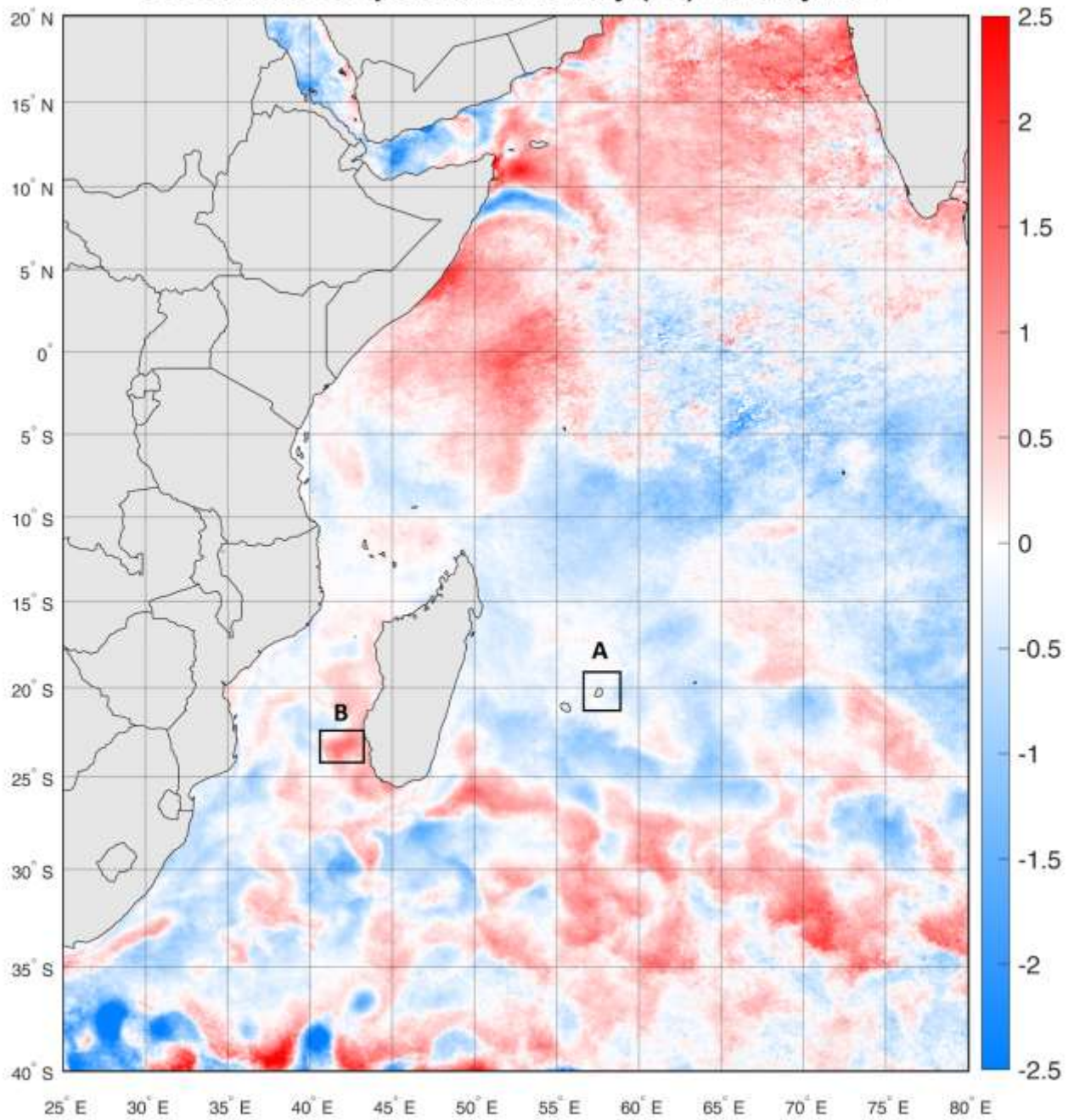


Figure 3: Anomaly of Sea Surface Temperature for July 2021 ($^{\circ}\text{C}$)

Time series generated from the monthly average for July 2021 and the climatological mean for July 2021 in the region highlighted in Figure 3, namely Region A around Mauritius Island; and Region B, off Toliara in the South West of Madagascar.

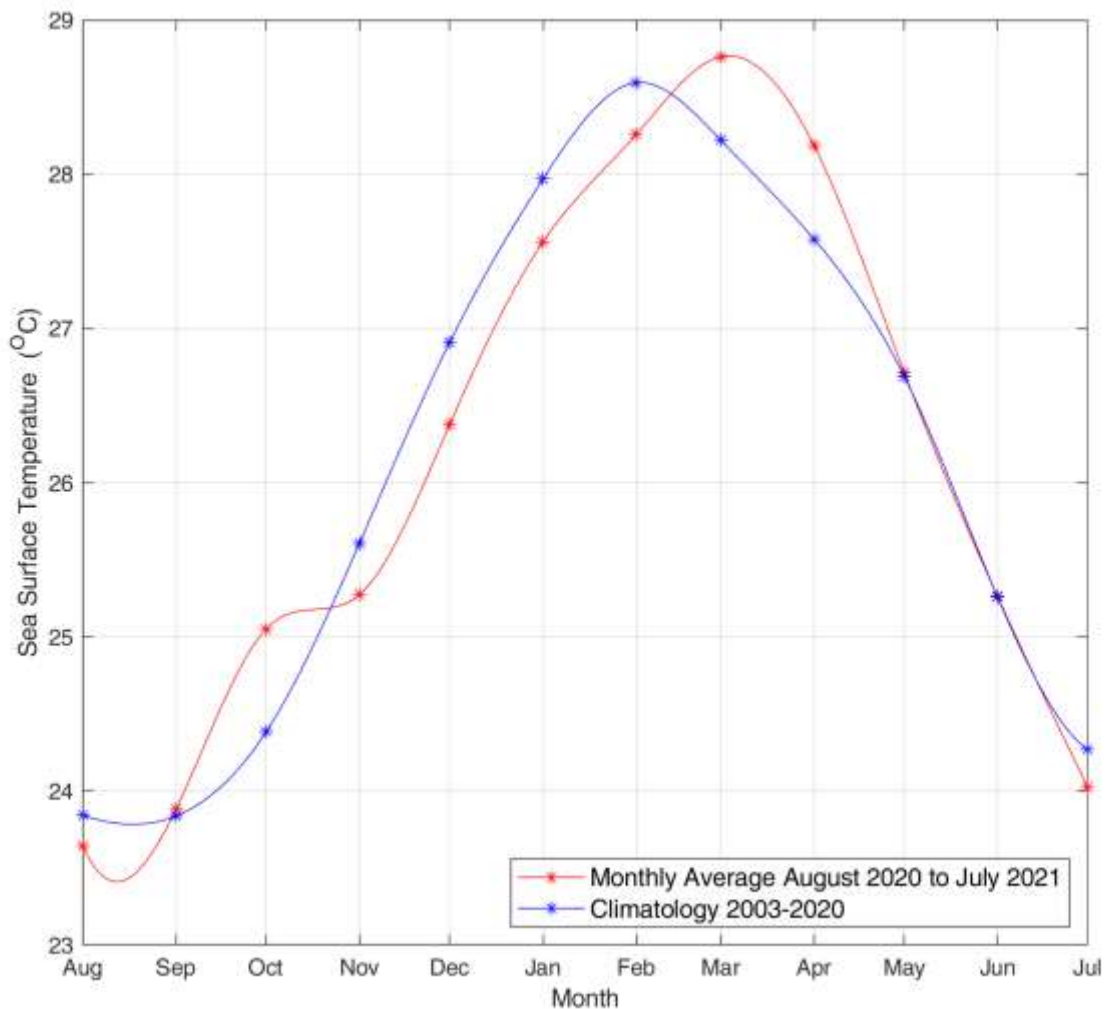


Figure 4: Temporal variation of sea surface temperature (°C) around Mauritius Island (Region A)

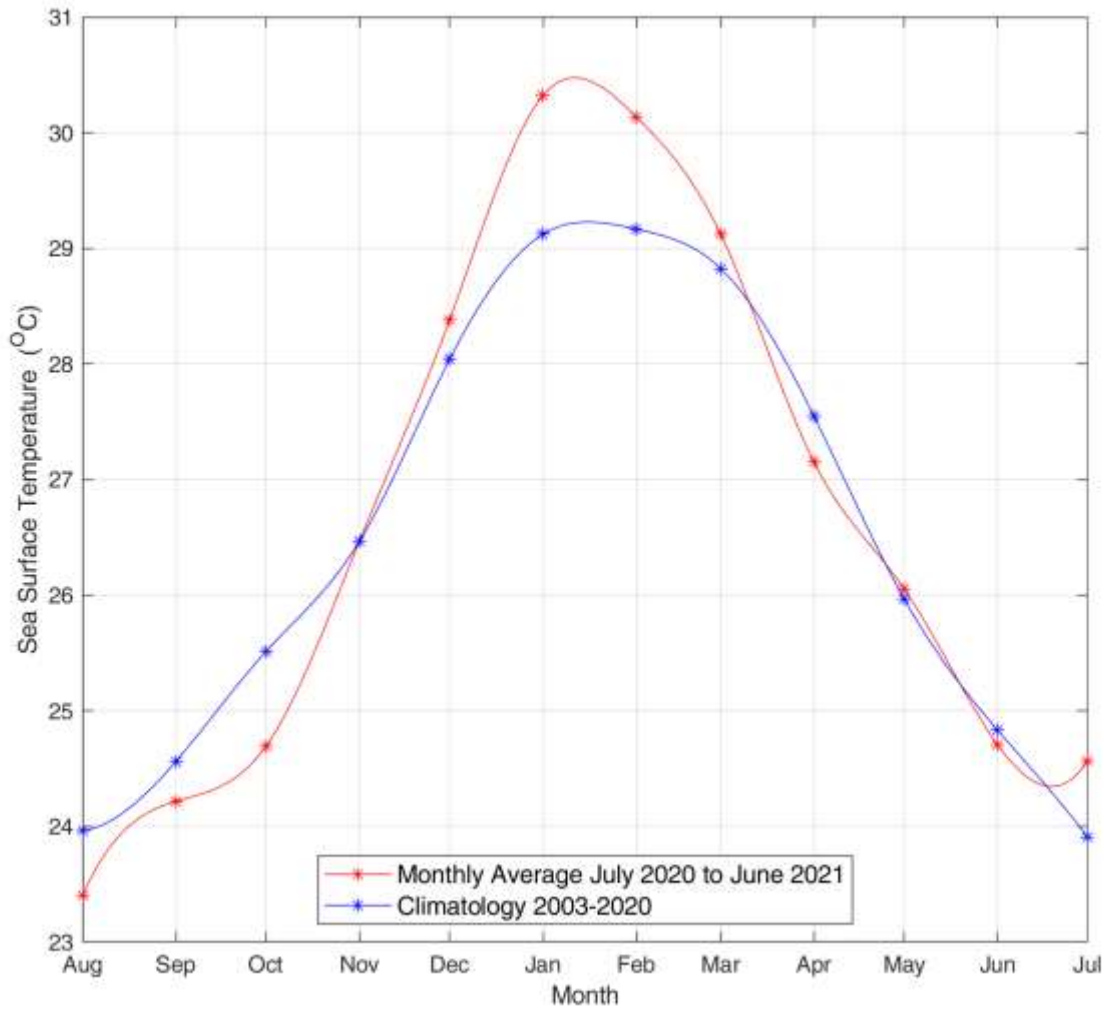


Figure 5: Temporal variation of sea surface temperature (°C) off Toliara, Madagascar (Region B)

3.1 Description of Sea Surface Temperature

Sea surface temperature (SST) is the temperature of the top millimetre of the ocean's surface. Figure 1 displays the SST variation for the month of July 2021. Warmer temperatures are represented in red and yellow, while relatively cooler temperatures are shown in green and blue. SST anomaly is a departure from average conditions.

During the month of July 2021, SST was relatively low across the Indian Ocean, except for some localised regions principally in the northern part. The average SST in the Mascarene region was comparatively colder than the previous month by dropping further to around 23 - 25 °C. Figure 2 represents the climatology for the month of July based on the average SST calculated from 2002 to 2019. The observed SST for the period of July 2021 shows a typical tendency similar to the climatological mean in the region of interest, as shown in the respective Figures 1 and 2.

Figure 3 shows a temperature anomaly for the period covered in this bulletin. The blue colour on the map represents temperatures that were cooler than the average, the white colour shows near-average temperatures, while the red colour shows temperatures that were warmer than the average. Unlike the previous months, the sea surface temperature was slightly below the climatological mean in the Mascarene region as confirmed by the time series analysis for the region around Mauritius (Figure 4, depicted by 'Region A' in Figure 3).

Figure 5 shows the temporal variation of SST off the coast of Toliara, Madagascar between latitude 23 °S to 25 °S and longitude 42 °E to 45 °E (Region B in Figure 3). The graph shows a relatively higher positive anomaly around that specific region, unlike the trend that was prevailing for the previous couple of months, that is, fluctuating around zero.

4.0 Chlorophyll-a Concentration

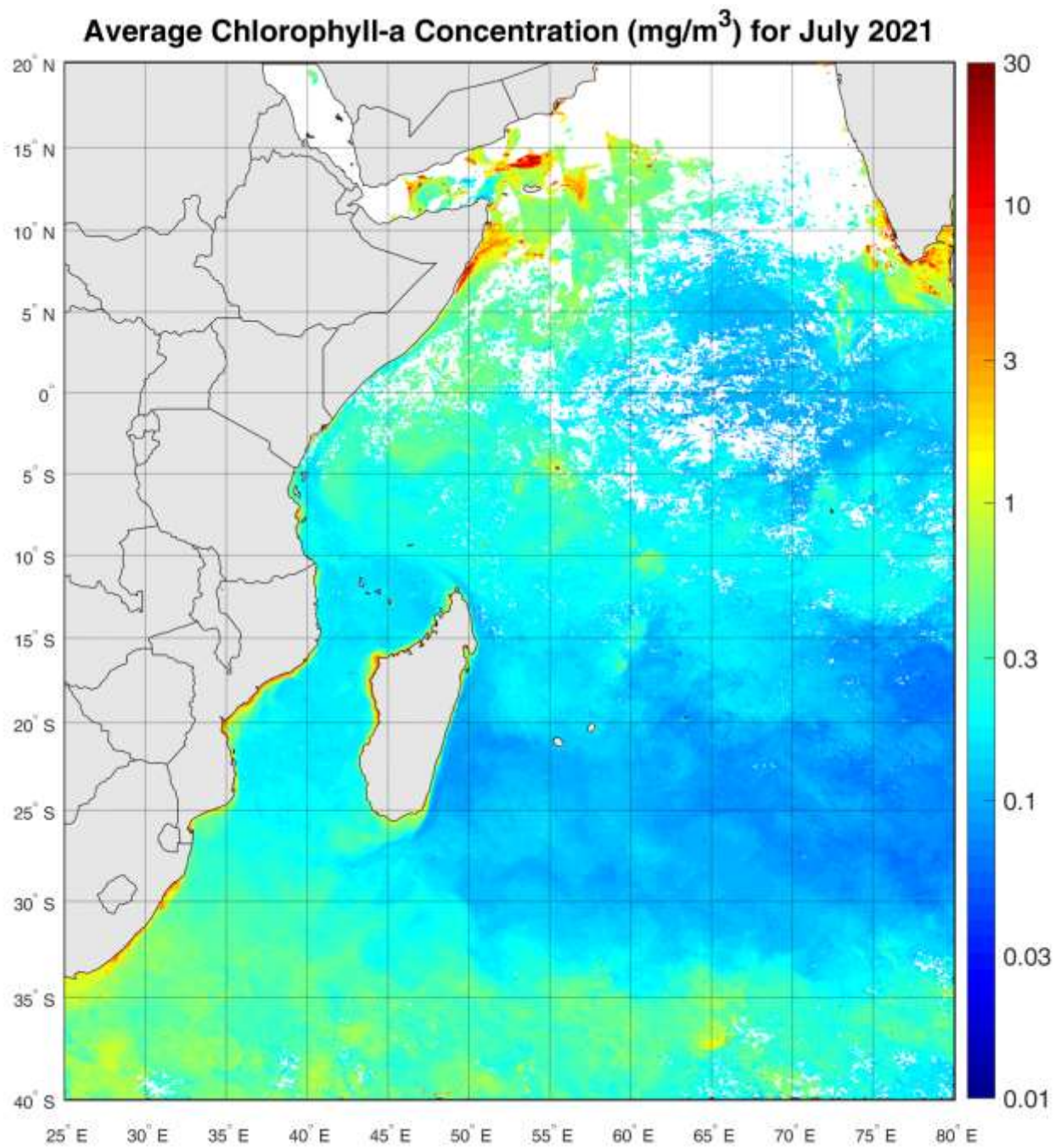


Figure 6: Mean chlorophyll-*a* concentration for the month of July 2021 (mg/m^3)

Climatology of Chlorophyll-*a* Concentration (mg/m^3) for July from 2002 to 2019

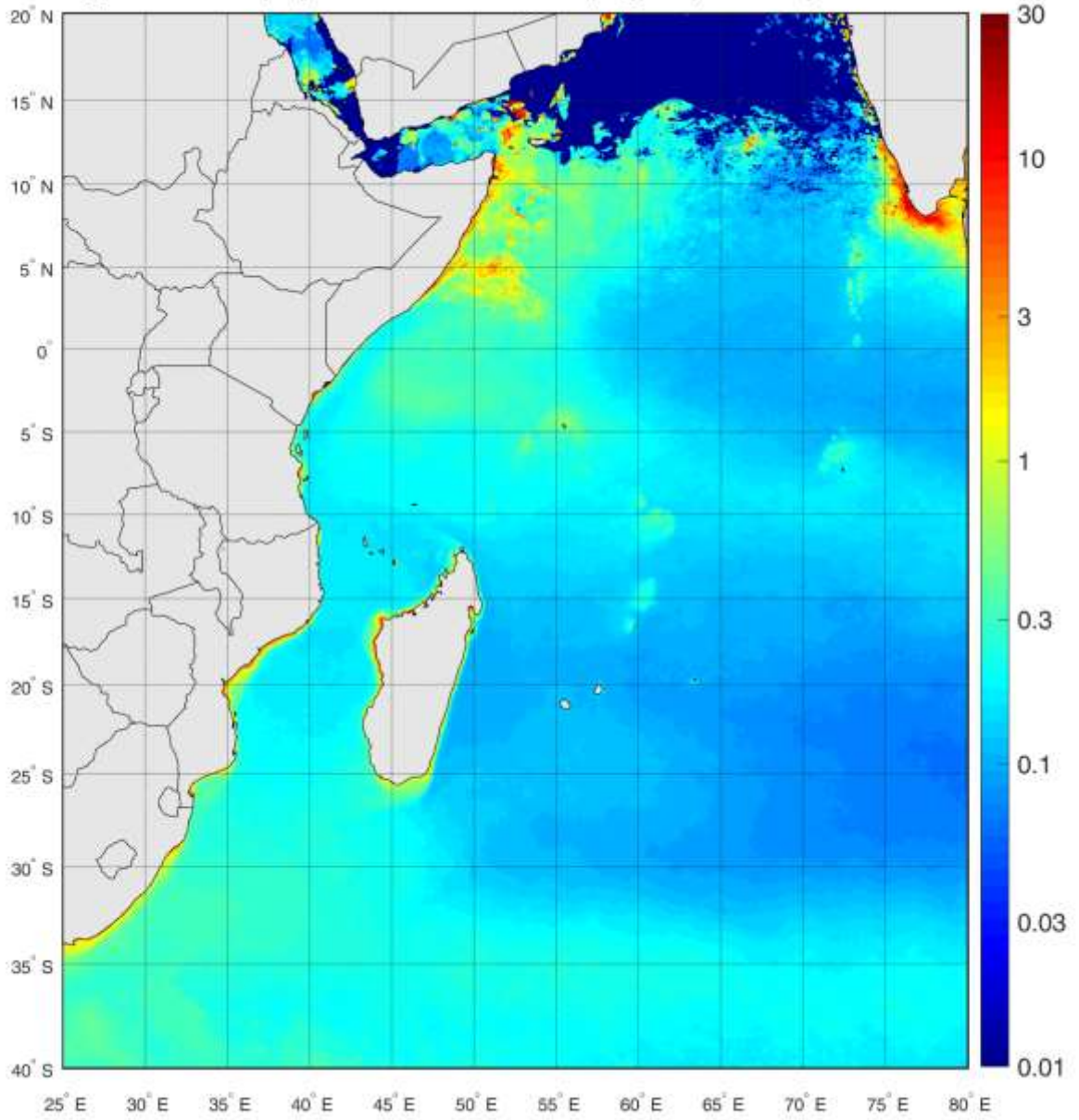


Figure 7: Chlorophyll-*a* Climatology (mg/m^3) for the month of July (2002 -2019)

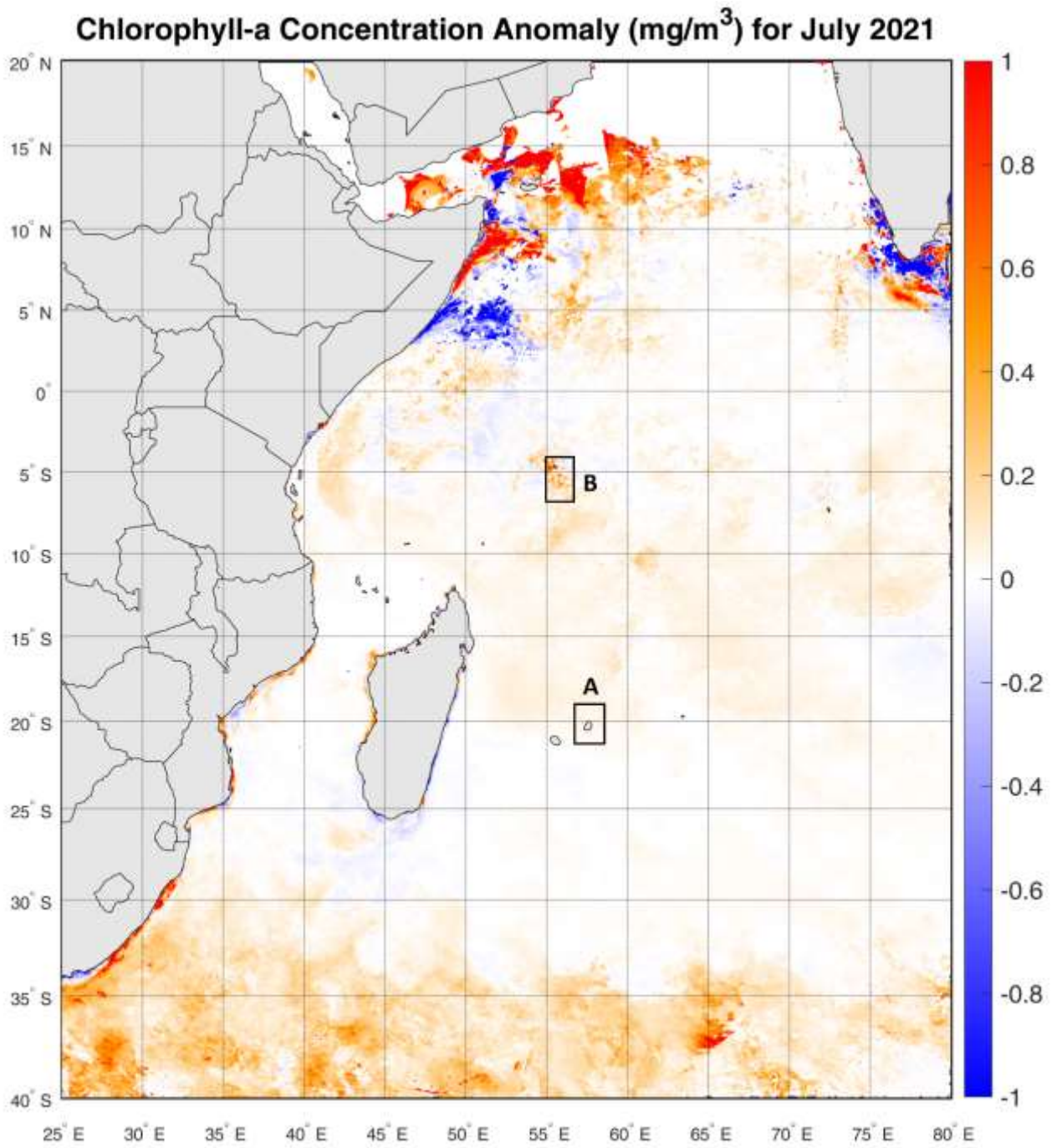


Figure 8: Anomaly of chlorophyll-*a* for July 2021 (mg/m^3)

Chlorophyll-a time series generated from the monthly average for July 2021 and the climatological normal for July 2021 in the regions encircle in Figure 8, namely region A around Mauritius and region B, around Seychelles Islands.

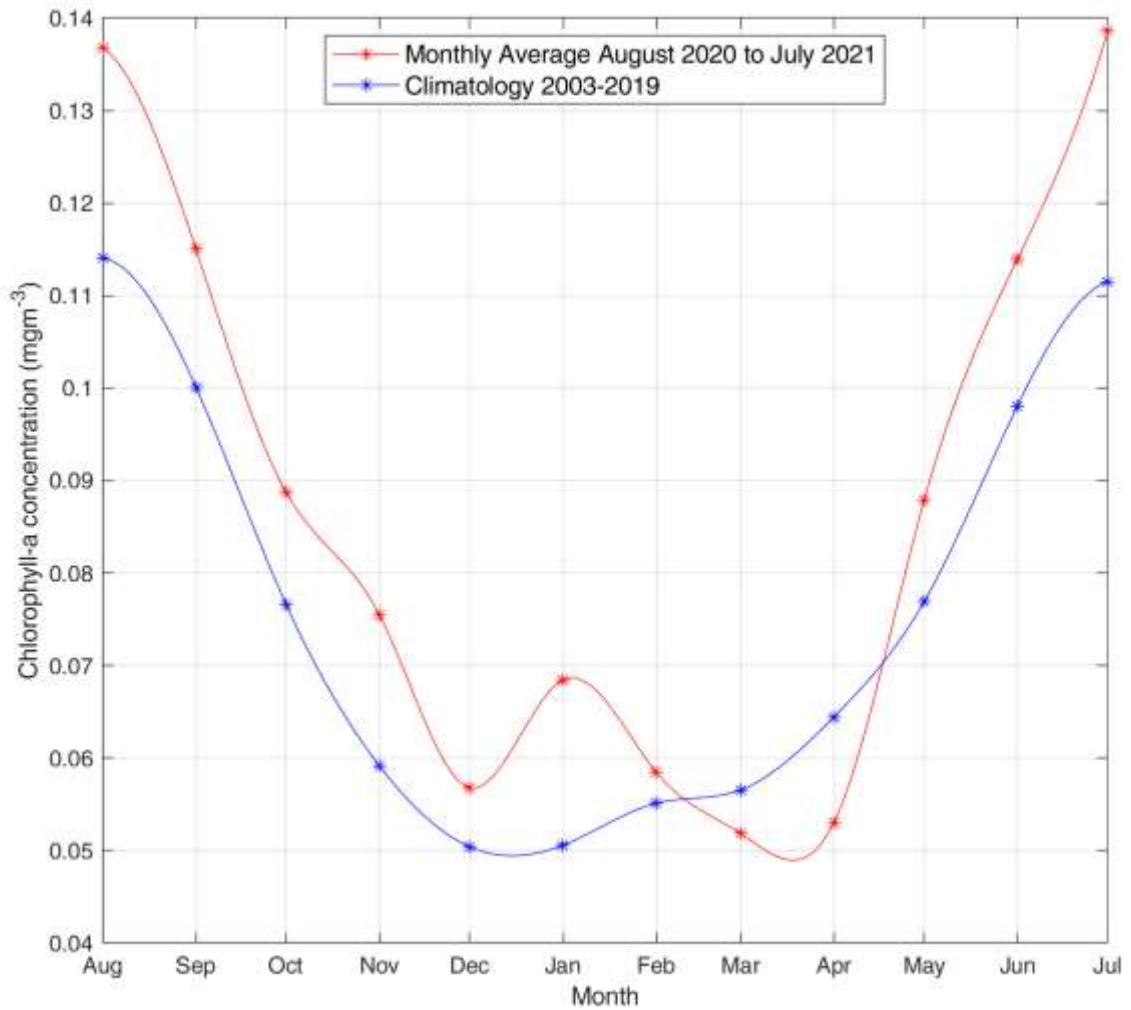


Figure 9: Temporal variation of chlorophyll-*a* (mg/m³) around Mauritius Island (Region A)

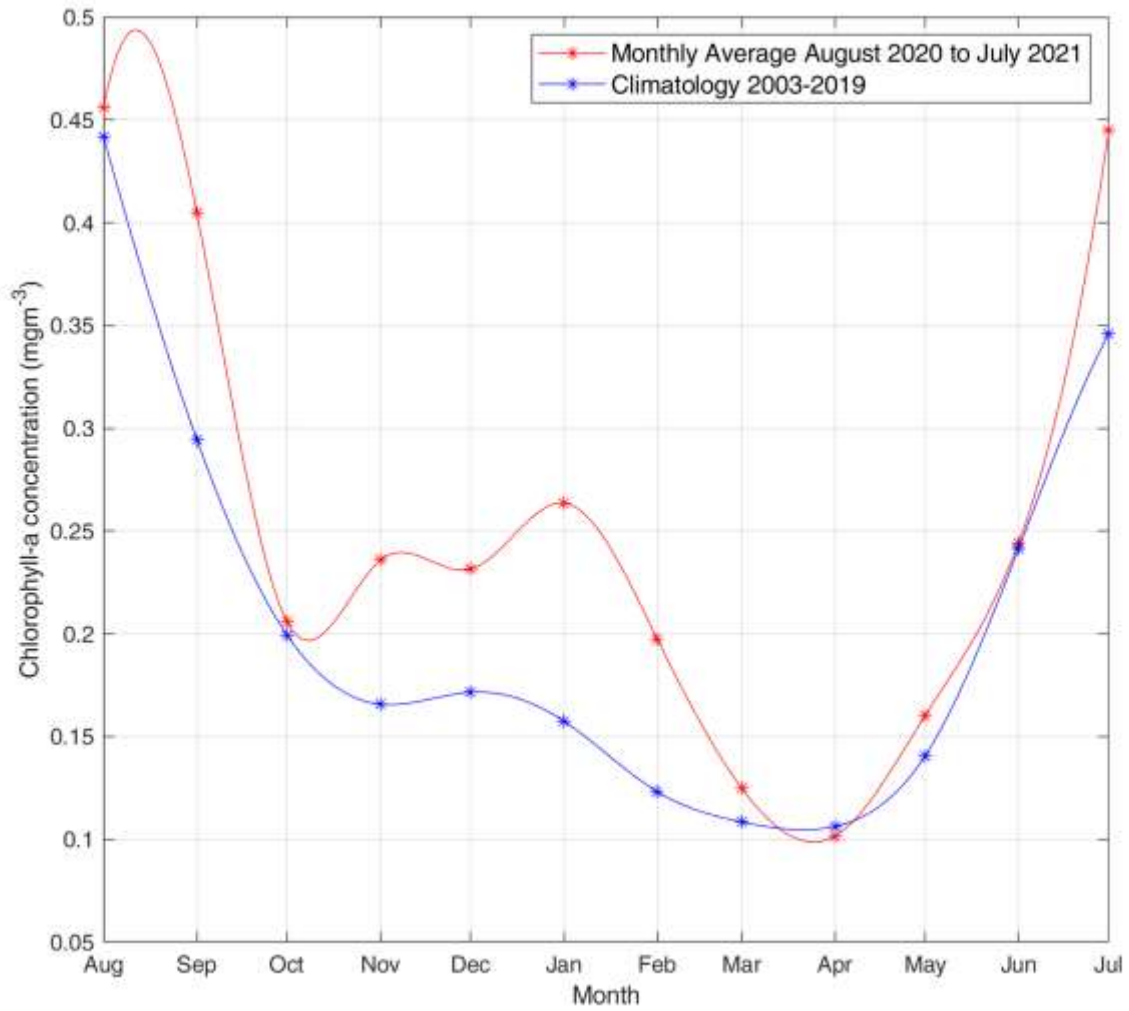


Figure 10: Temporal variation of chlorophyll-*a* (mg/m³) for the region around Seychelles Islands (Region B)

4.1 Description of Chlorophyll-a

Figure 6 shows the Chlorophyll-a concentration in milligrams of Chl-a per cubic metre of seawater (mg/m^3) for the month of July 2021. The regions where the Chl-a concentration was very low, indicating a low abundance of phytoplankton, are in blue and those where the Chl-a concentration was high are shown in red. Land is light grey, and places where there is no data (e.g. cloud cover) is represented in white.

A high Chl-a concentration usually indicates a high primary productivity, an essential condition for fish aggregation and fish catch, while a positive Chl-a anomaly shows a higher concentration of Chl-a than the average observed for the same period.

The average chlorophyll-a concentration for the month of July 2021 is generally comparable to the climatological mean (Figure 7) with lower Chl-a concentrations in the Mascareigne region while comparatively higher off the continental coasts. Meanwhile, the anomaly map in Figure 8 shows that for this month, a relatively higher chlorophyll-a content was observed compared to the climatological mean across the Indian Ocean except for some localised regions as it was the case in June 2021.

Figure 9 shows the monthly time series for the region around Mauritius Island (region A in Figure 8). The graph shows a positive Chl-a anomaly observed since mid-April 2021 which is increasing.

Figure 10 shows the temporal variation of Chl-a for region B in Figure 8, that is, for the region around the Seychelles Islands. The graph shows a net increase of around $2.0 \text{ mg}/\text{m}^3$ in Chl-a concentration in that region compared to the previous month that is also around $1.0 \text{ mg}/\text{m}^3$ above the climatological mean for July.

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Description of Environmental Indicators

Sea Surface Temperature (SST) reflects the storage of thermal energy in the upper mixed layer of the oceans. Sea surface temperature anomalies have practical applications to fisheries and coastal waters management, including coral reef monitoring and prediction of red tides or other harmful algal blooms.

SST Anomaly means a departure from a reference value or long-term average. A positive anomaly indicates that the observed temperature was warmer than the reference value, while a negative anomaly indicates that the observed temperature was cooler than the reference value.

Chlorophyll-a (Chl-a) is the light-harvesting pigment found in marine microscopic photosynthetic plants, known as phytoplankton. Its concentration is widely used as an index of phytoplankton biomass and is also used as a proxy for primary production. *Chl-a* absorbs most visible light but reflects some green and near-infrared light. By measuring what kind of light is absorbed and reflected, satellites can measure chlorophyll-*a* concentrations in the ocean, thus providing valuable insights on the health of the ocean.

Chl-a Anomaly is a variation from the mean chlorophyll-*a* concentration.

Datasets

Level 3 SST and *Chl-a* Standard Mapped Image (SMI) dataset was used from the Moderate Resolution Imaging Spectrometer (MODIS) data, with a spatial resolution of 4 km. The Level 3 SMI products are image representations of binned data products obtained from OceanColor (<https://oceandata.sci.gsfc.nasa.gov/>).

Indicator Calculation

Monthly SST anomaly images were created using the processed monthly satellite data and the monthly climatology data. The monthly anomalies were calculated relative to the respective monthly mean. The SST climatology was obtained from MODIS data (2003-2019). The nominal pixel resolution is 4 km. The SST anomalies were calculated from the difference of the monthly composite with its respective monthly climatology based on the interval from 2003 to 2019.

Similarly, the *Chl-a* anomalies were calculated from the monthly average and the monthly climatology based on the interval from 2003 to 2019.