



**GMES
AND AFRICA**



MONTHLY OCEANOGRAPHY BULLETIN

South West Indian Ocean

September 2021



Contents

| | |
|--|----|
| LIST OF ACRONYMS | 2 |
| 1.0 INTRODUCTION | 3 |
| 2.0 HIGHLIGHTS | 3 |
| 3.0 SEA SURFACE TEMPERATURE | 4 |
| 3.1 DESCRIPTION OF SEA SURFACE TEMPERATURE | 8 |
| 4.0 CHLOROPHYLL-A CONCENTRATION | 9 |
| 4.1 DESCRIPTION OF CHLOROPHYLL-A | 13 |
| ACKNOWLEDGEMENTS | 14 |
| ANNEX | 15 |



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

- During the month of September 2021, SST was still relatively low across the Indian Ocean, except for the region around the Chagos Archipelago.
- The average SST in the Mascarene region varied between 23 to 24 °C.
- The observed SST for the period of September 2021 was relatively similar to the climatological mean in the region of interest.
- The sea surface temperature was slightly below the climatological mean for the region around Mauritius Island.
- For the region around Rodrigues Island a slight positive anomaly was observed for September 2021.

Chlorophyll-a Concentration

- For September 2021, there was no major deviation between the average Chl-a concentration observed and the September climatological mean except for some localised regions.
- Typically, low Chl-a concentrations was observed in the Mascarene region compared to the northern and continental regions of the Indian Ocean.
- Unlike the previous months, the monthly time series analysis for the region around Mauritius Island indicates a negative anomaly for the region for the first time since mid-April.
- For the region off the coast of Somalia, a significant increase of around 5.0 mg/m³ in Chl-a concentration was observed for the month of September.

3.0 Sea Surface Temperature

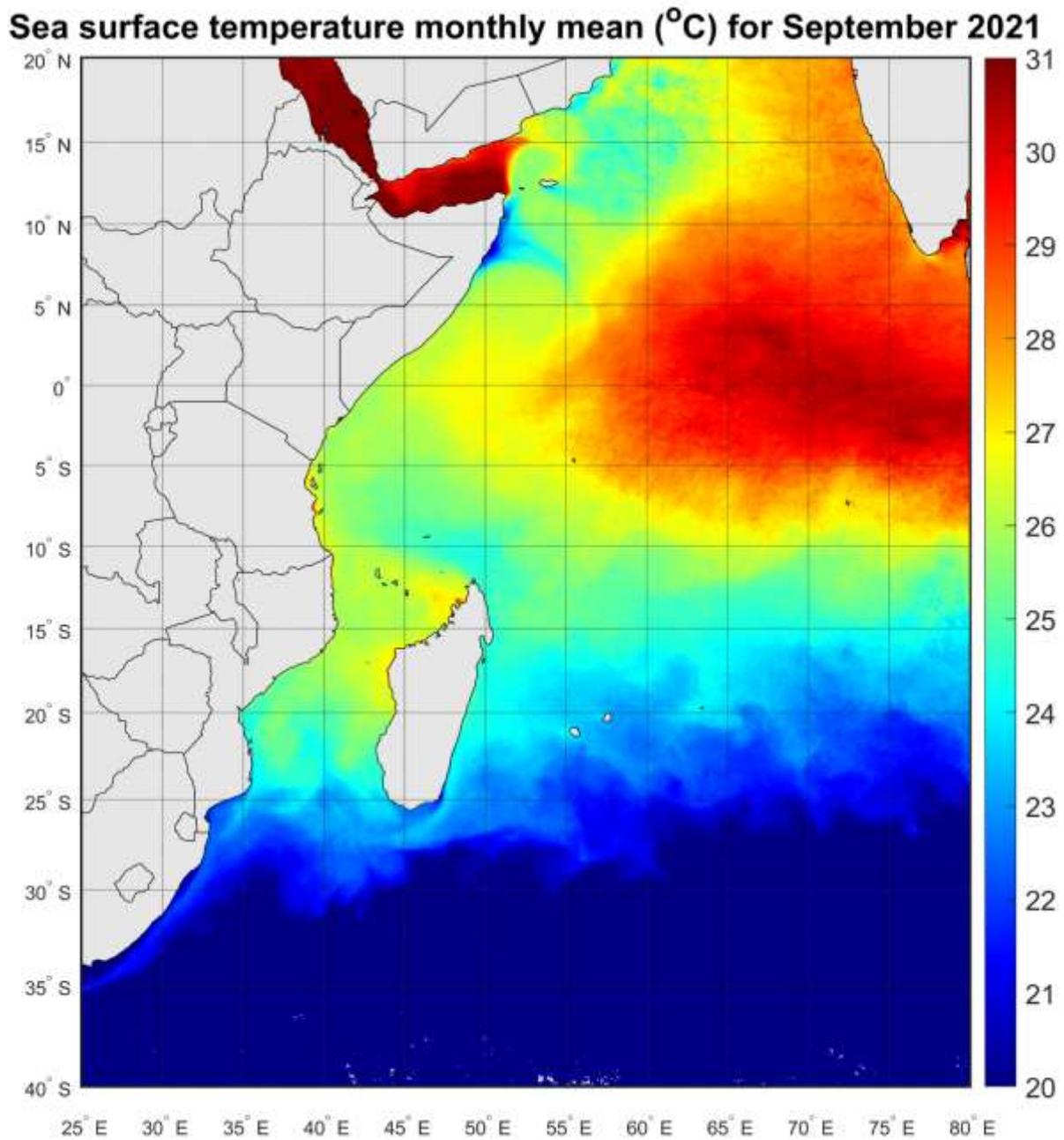


Figure 1: Mean sea surface temperature for the month of September 2021 (°C)

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

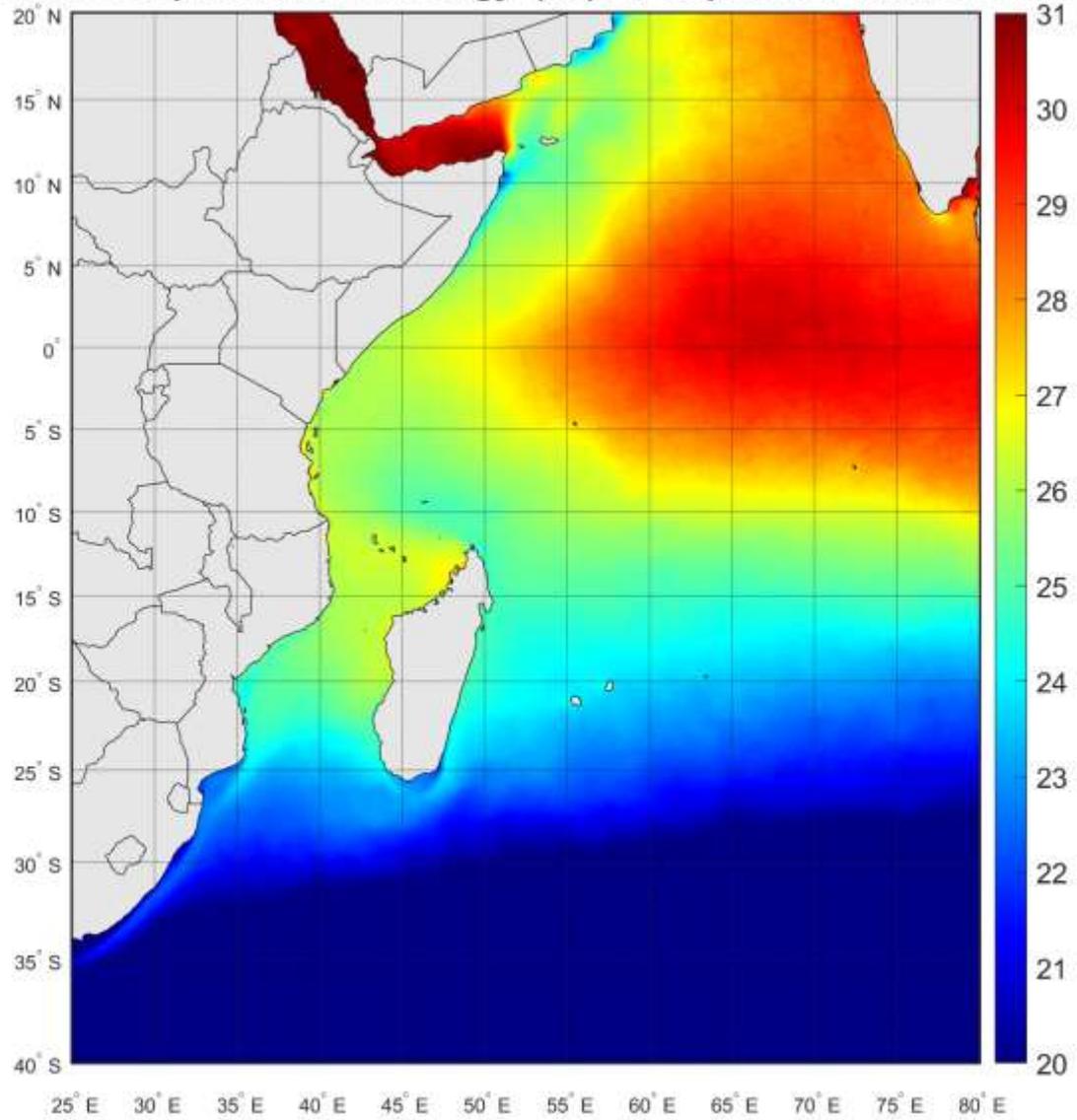


Figure 2: Sea Surface Temperature Climatology ($^{\circ}\text{C}$) for the month of September (2002 - 2019)

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

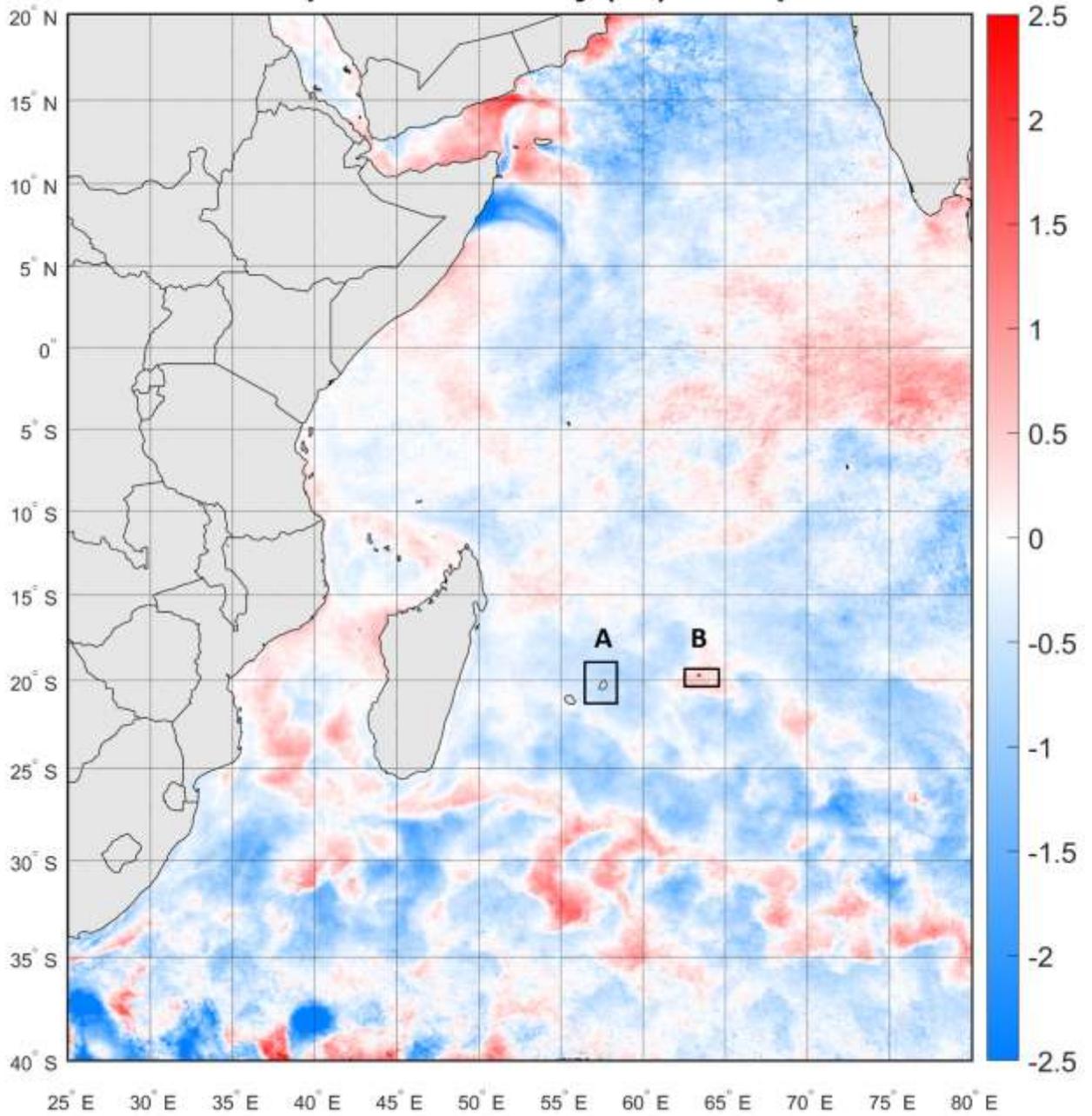


Figure 3: Anomaly of Sea Surface Temperature for September 2021 ($^{\circ}\text{C}$)

Time series generated from the monthly average for September 2021 and the climatological mean for September 2021 in the region highlighted in Figure 3, namely Region A around Mauritius Island; and Region B, around Rodrigues Island.

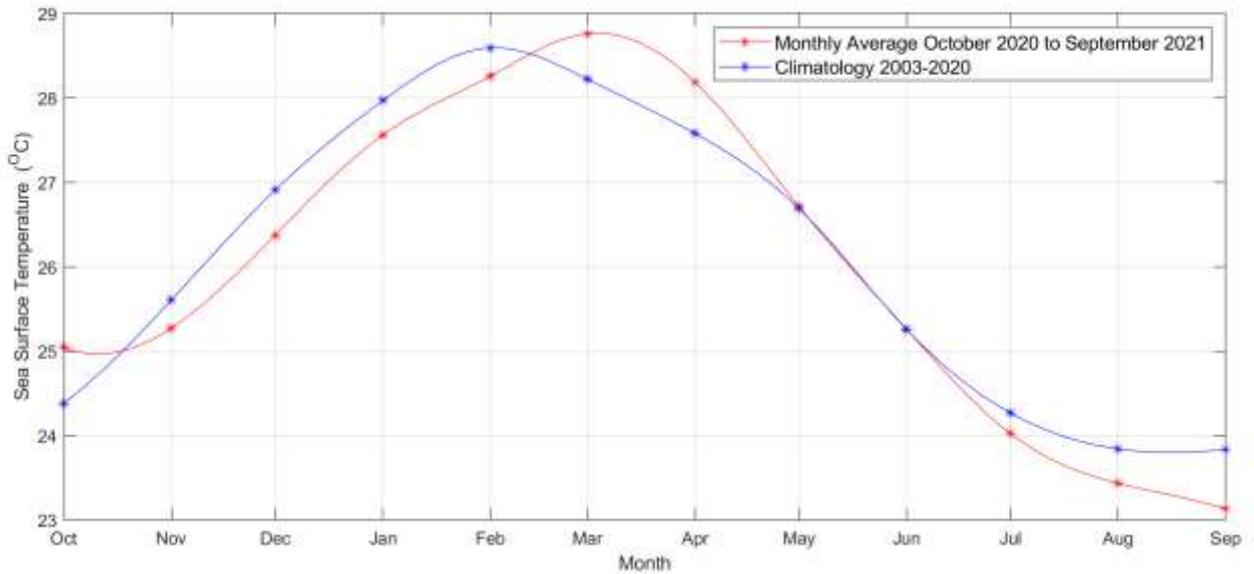


Figure 4: Temporal variation of sea surface temperature (°C) around Mauritius Island (Region A)

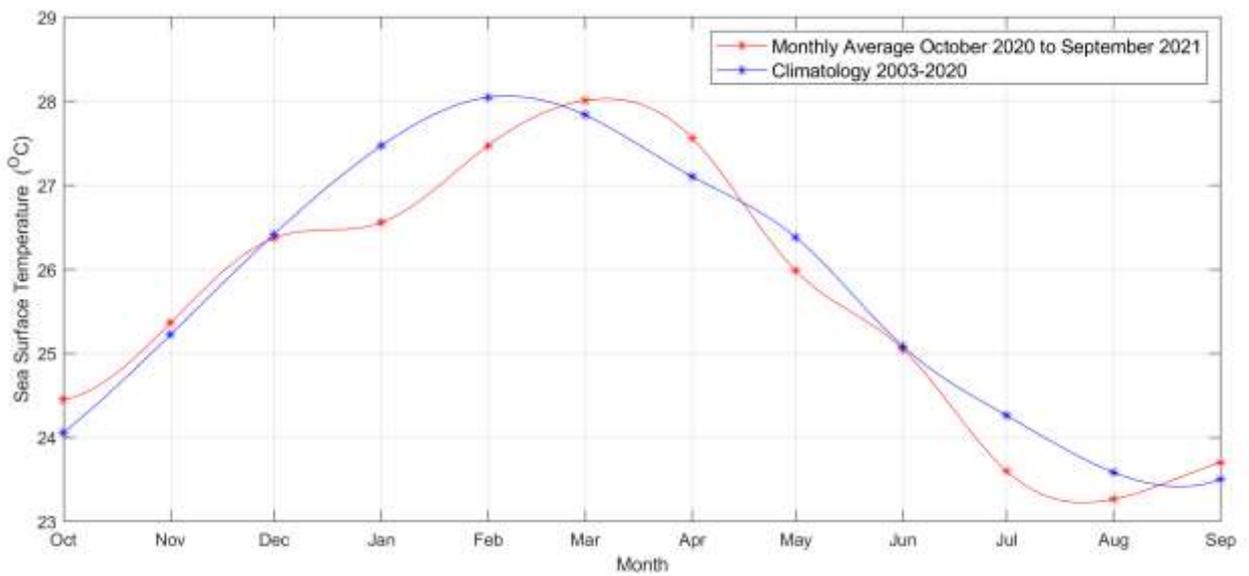


Figure 5: Temporal variation of sea surface temperature (°C) around Rodrigues Island (Region B)

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 September 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 September 2021, SST was still relatively low across the Indian Ocean, except for the region around the Chagos Archipelago. The average SST in the Mascarene region varied between 23 to 24 °C. Figure 2 represents the climatology for the month of September based on the average SST calculated from 2002 to 2019. The observed SST for the period of September 2021 was relatively 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 chart for the month of September 2021. 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. The sea surface temperature was slightly below the climatological mean for the region around Mauritius Island, as confirmed by the time series analysis (Figure 4, depicted by 'Region A' in Figure 3). The same observation is being reported since July 2021.

Figure 5 shows the temporal variation of SST observed around Rodrigues Island (Region B in Figure 3). The graph shows a slight positive anomaly around that specific region for September 2021.

4.0 Chlorophyll-a Concentration

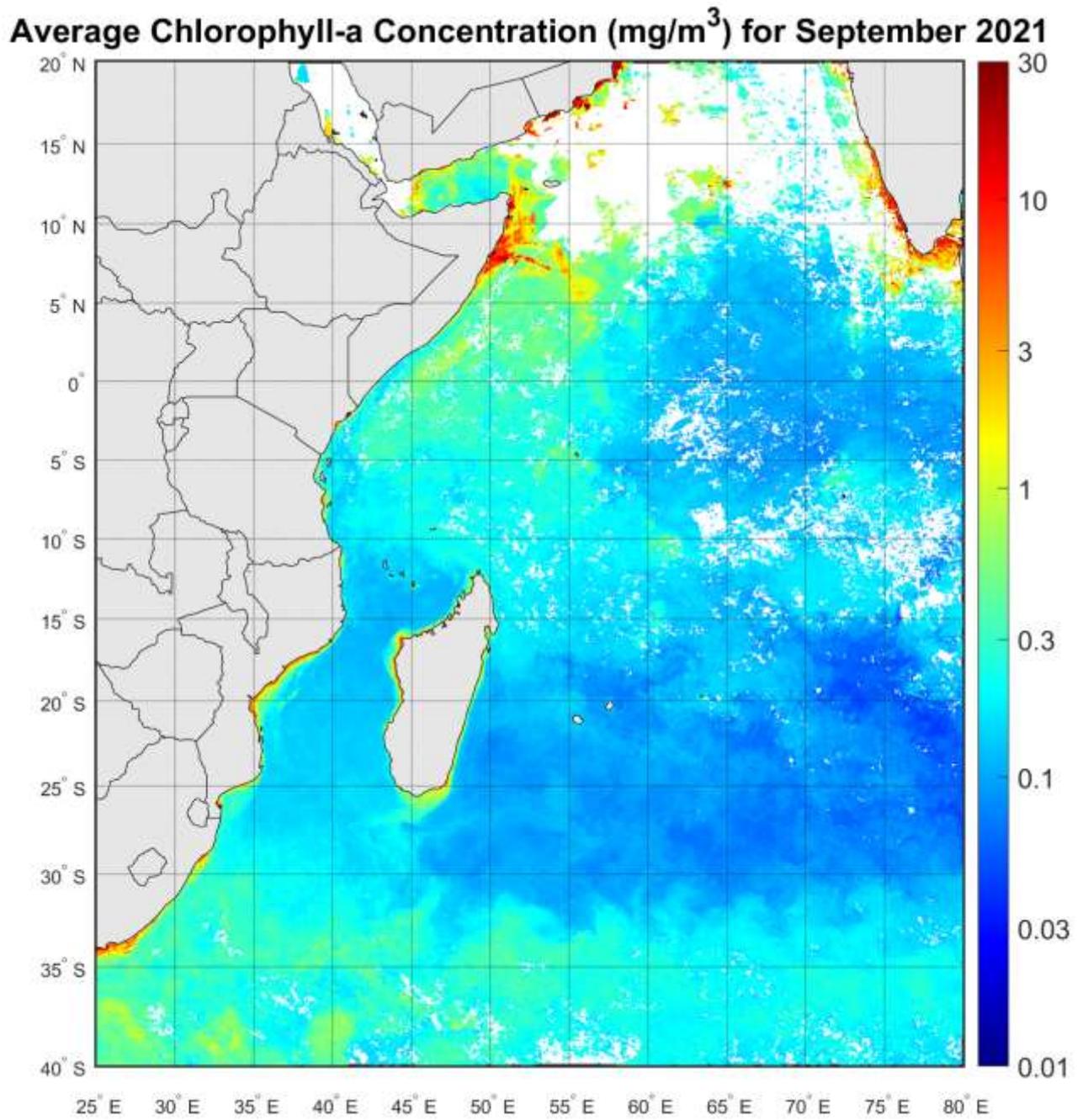


Figure 6: Mean chlorophyll-*a* concentration for the month of September 2021 (mg/m^3)

Climatology of Chl-a Conc. (mg/m^3) for September from 2002 to 2019

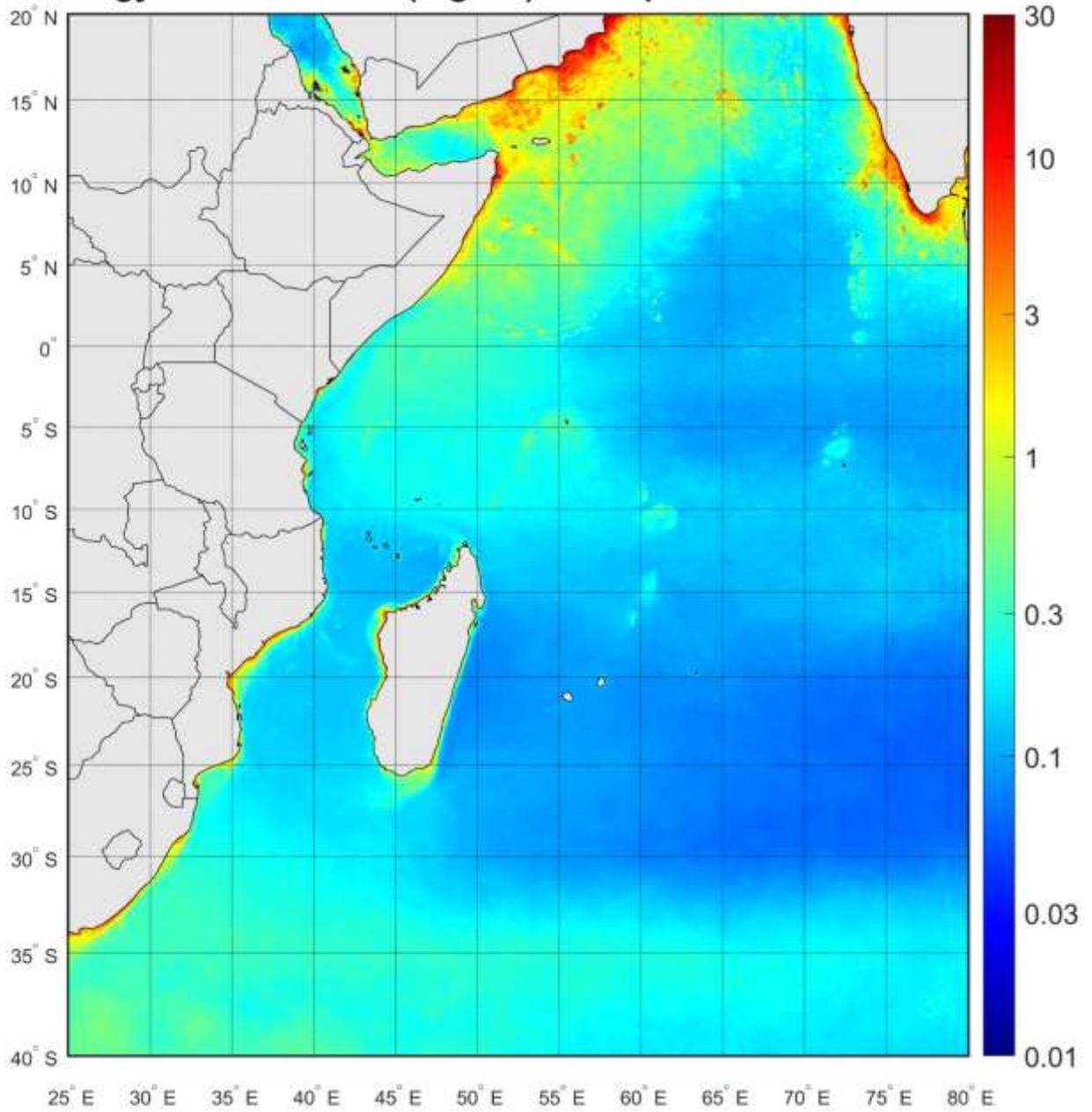


Figure 7: Chlorophyll-a Climatology (mg/m^3) for the month of September (2002 -2019)

Chlorophyll-a Concentration Anomaly (mg/m^3) for September 2021

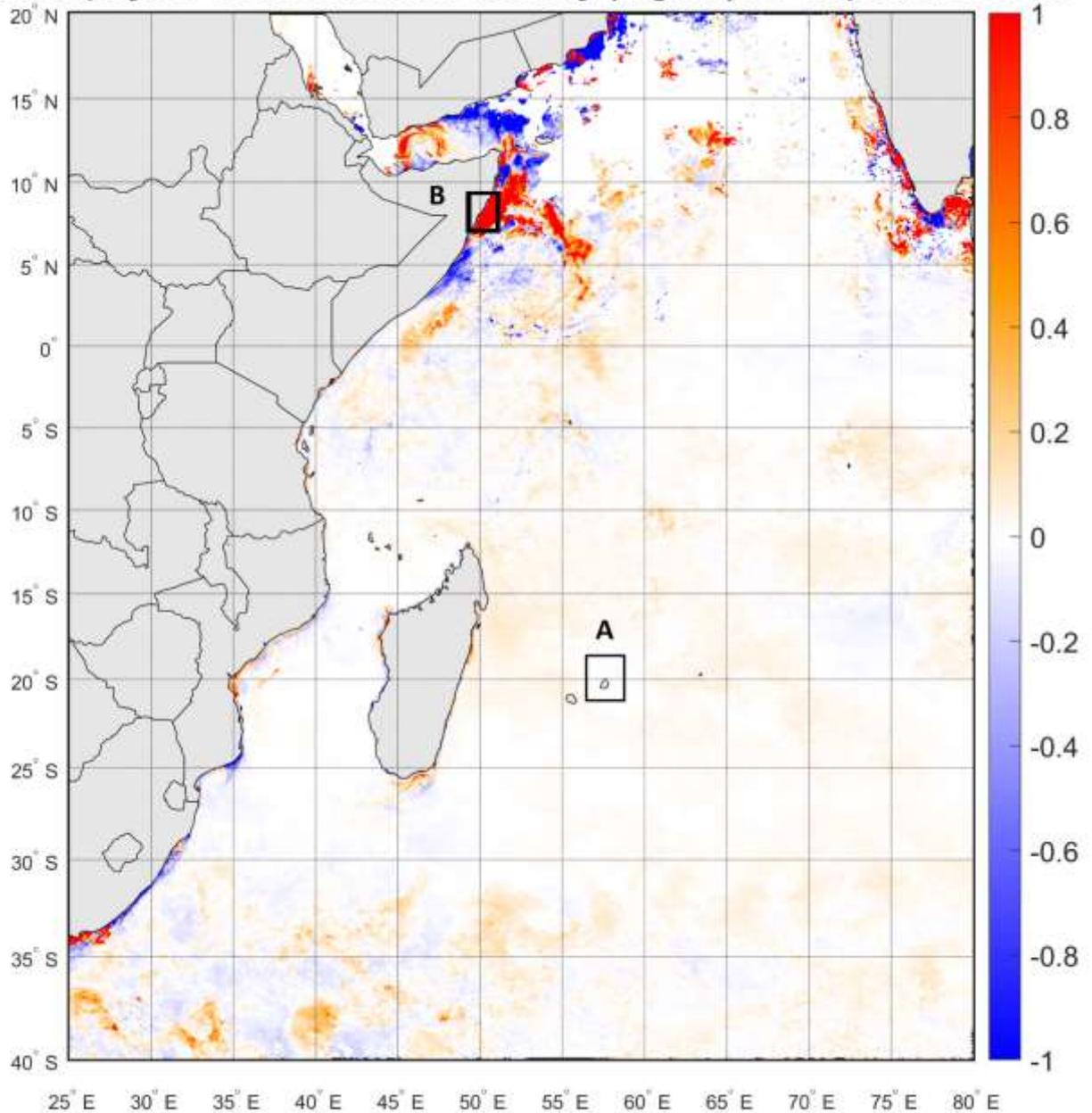


Figure 8: Anomaly of chlorophyll-*a* for September 2021 (mg/m^3)

Chlorophyll-*a* time series generated from the monthly average for September 2021 and the climatological normal for September 2021 in the regions encircle in Figure 8, namely region A around Mauritius and region B, off the coast of Somalia.

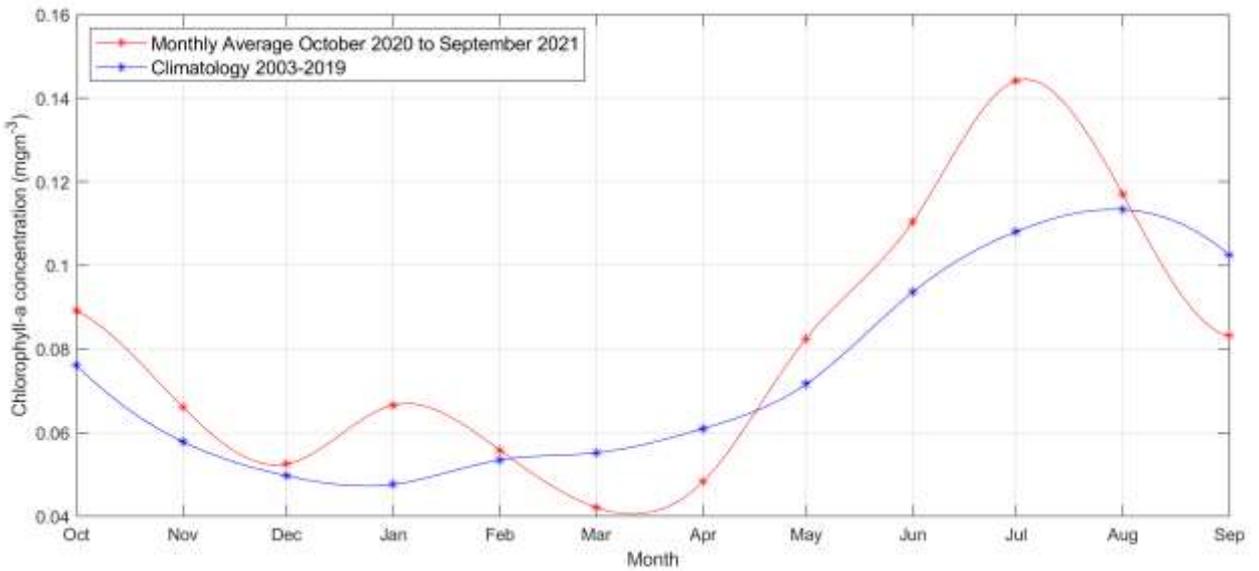


Figure 9: Temporal variation of chlorophyll-*a* (mg/m^3) around Mauritius Island (Region A)

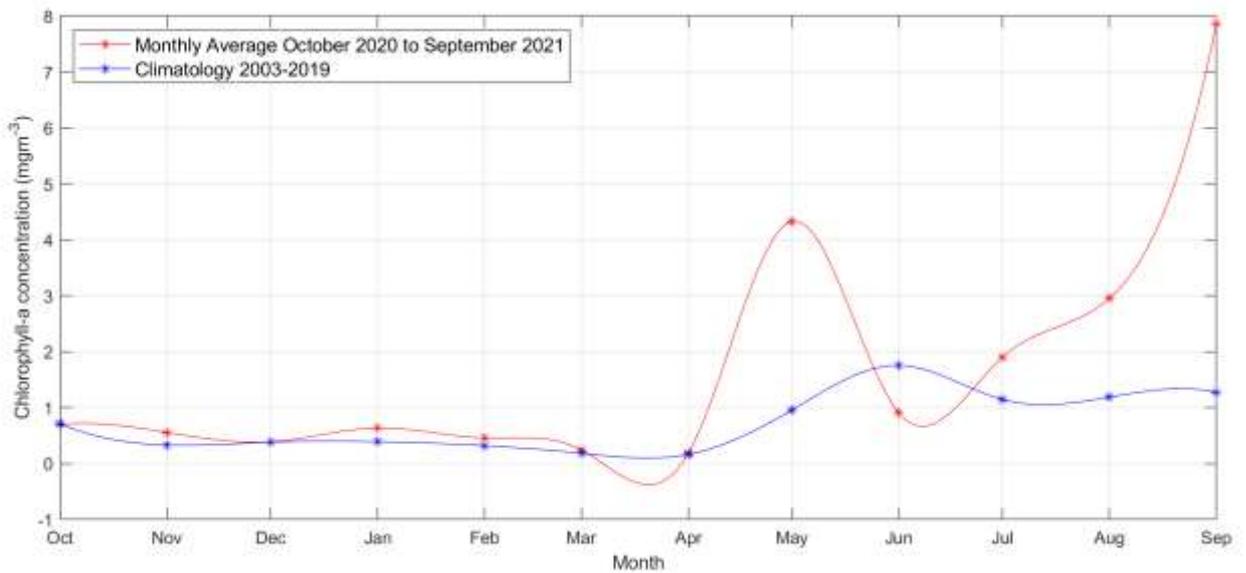


Figure 10: Temporal variation of chlorophyll-*a* (mg/m^3) for the region off the coast of Somalia (Region B)

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 September 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.

During the month of September 2021, there was no significant deviation between the average chlorophyll-a concentration observed and the September climatological mean (Figure 7). Typically low Chl-a concentrations was observed in the Mascarene region compared to the northern and continental regions of the Indian Ocean. The anomaly map (Figure 8) for September 2021 confirms that there was no major deviation from the climatology, except for some localised regions such as off the coast of Somalia.

Figure 9 shows the monthly time series for the region around Mauritius Island (region A in Figure 8). Unlike the previous months, the graph shows a negative anomaly for the region for the first time since mid-April 2021.

Figure 10 shows the temporal variation of Chl-a for region B in Figure 8, that is, for the region off the coast of Somalia. The graph shows a significant increase of around $5.0 \text{ mg}/\text{m}^3$ in Chl-a concentration in that region compared to July 2021 and an unusual increase of more than $6.0 \text{ mg}/\text{m}^3$ above the climatological mean.

Acknowledgements

This bulletin was compiled within the framework of the GMES & Africa project. Data used for the processing was obtained from OceanColor. Mauritius Oceanography Institute (MOI) acknowledges the contribution of the Joint Research Centre (JRC) team as well as any other people who collaborated in the issue of this bulletin.

Disclaimer

The Mauritius Oceanography Institute assumes no legal liability or responsibility for how this information is used. This bulletin has been produced with the financial assistance of the European Union (EU) through the African Union Commission (AUC). The contents of this bulletin can under no circumstances be regarded as reflecting the position of the EU and the AUC.



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.