MONTHLY OCEANOGRAPHY BULLETIN

South West Indian Ocean

November 2021

Contents

List of Acronyms

AUC	African Union Commission
Chl-*a*	Chlorophyll-*a*
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

- For the month of November 2021, SST was relatively higher than the previous month, especially in the Mozambique Canal and Mascarene region.
- The average SST in the Mascarene region increased to around 26 to 27 °C, typical to the climatological mean for November in the South West Indian Ocean region.
- A very high positive anomaly of above 1 °C was observed in the region south east of the Mascarene Islands in November 2021.
- The sea surface temperature was slightly above the climatological mean for the region around Mauritius Island.

Chlorophyll-a Concentration

- For November 2021, there was no major deviation between the observed Chl-a concentration and the climatological mean except for some localised regions.
- Typically low Chl-a concentration was observed in the Mascarene region as compared to the northern and continental regions of the Indian Ocean.
- The monthly time series analysis for the region around Mauritius Island shows that a relatively higher Chl-a concentrations observed for the region since the end of September 2021.
- For the region around Chagos Archipelago, an increasing higher positive anomaly was observed since the beginning of the summer season.
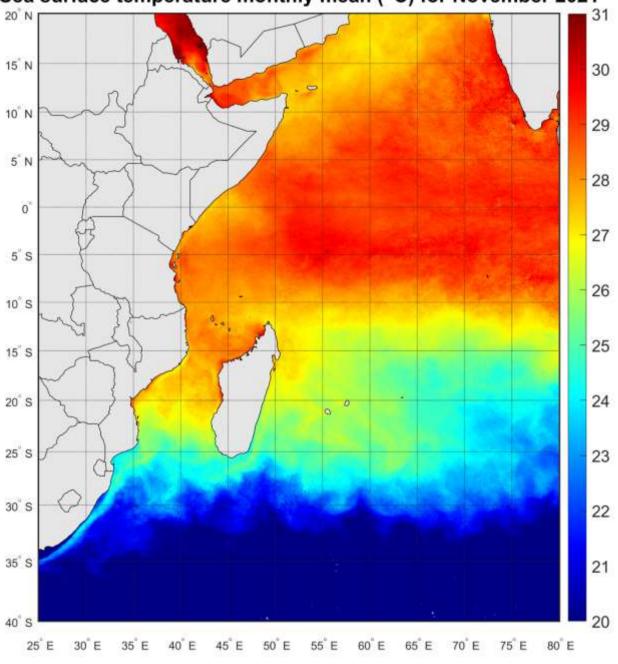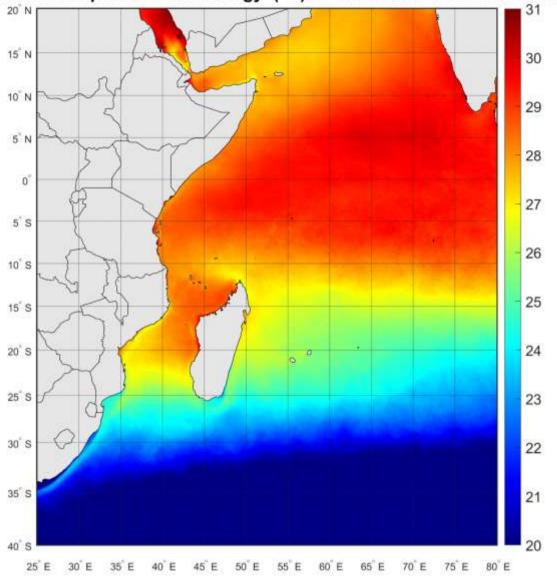
3.0   Sea Surface Temperature

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

Figure 2: Sea Surface Temperature Climatology (°C) for the month of November (2002 - 2019)
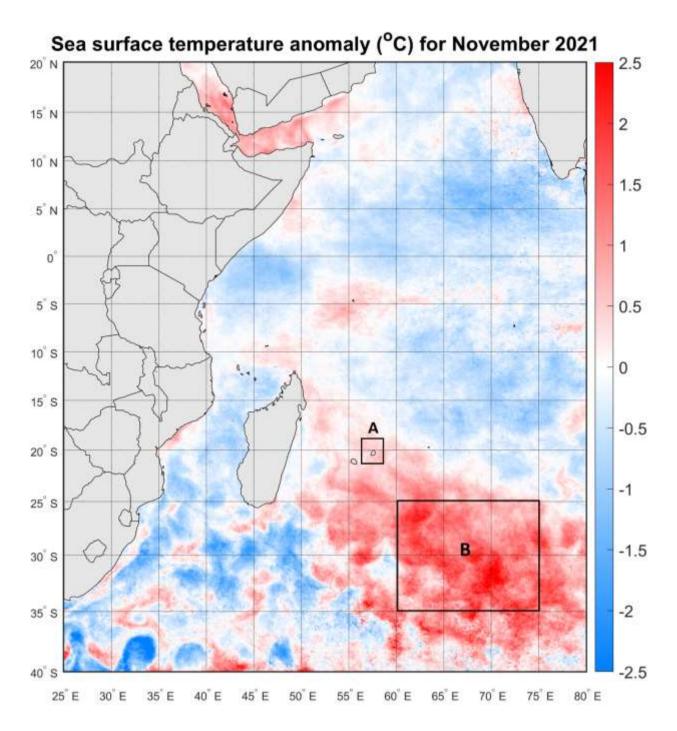
Figure 3: Anomaly of Sea Surface Temperature for November 2021 (°C)

Time series generated from the monthly average for November 2021 and the climatological mean for November 2021 in the region highlighted in Figure 3, namely Region A around Mauritius Island; and Region B, south-east of the Mascarene Islands.
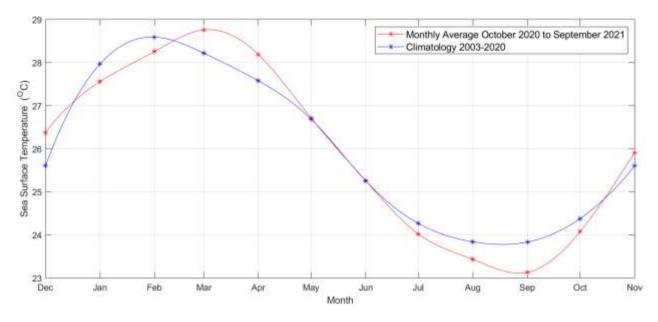

Figure 4: Temporal variation of sea surface temperature (°C) around Mauritius Island (Region A)
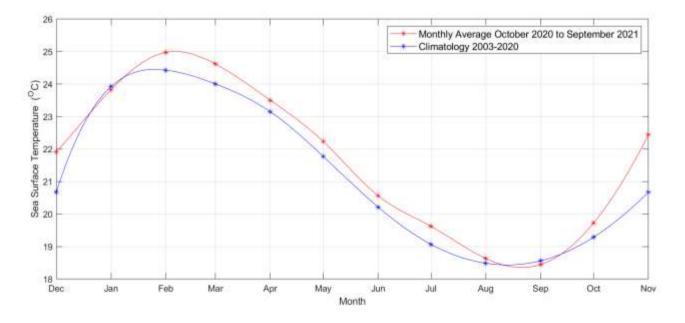

Figure 5: Temporal variation of sea surface temperature (°C) south-east of the Mascarene Islands (Region B)

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 November 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.

For the month of November 2021, SST was relatively higher than the previous month, especially in the Mozambique Canal and Mascarene region. The average SST in the Mascarene region increased to around 26 to 27 °C. This observation is typical to the climatological mean for November in the South West Indian Ocean region, as shown in Figure 2 that represents the climatology based on the average SST calculated from 2002 to 2019.

Figure 3 shows a temperature anomaly chart for the month of November 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 image shows a very high positive anomaly in the region south east of the Mascarene Islands. For the region around Mauritius Island, the sea surface temperature was slightly above the climatological mean after around six months, as confirmed by the time series analysis (Figure 4, depicted by 'Region A' in Figure 3).

Figure 5 shows the temporal variation of SST observed in the region south-east of the Mascarene Islands (Region B in Figure 3). As mentioned above, a very high positive anomaly of above 1 °C was observed around that specific region for the first time since the beginning of the year.
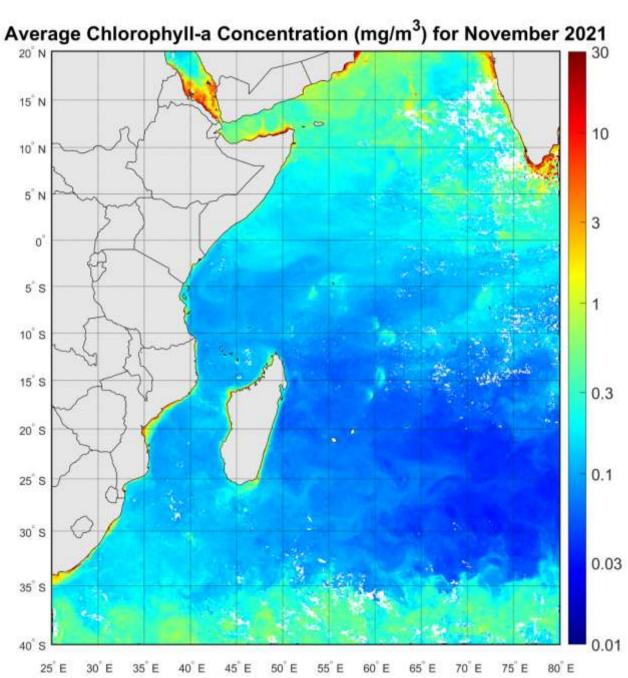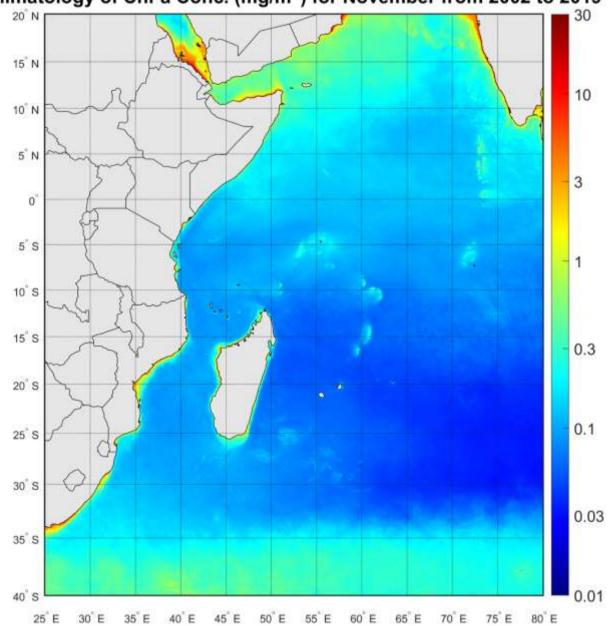
4.0 Chlorophyll-a Concentration

Figure 6: Mean chlorophyll-*a* concentration for the month of November 2021 (mg/m³)
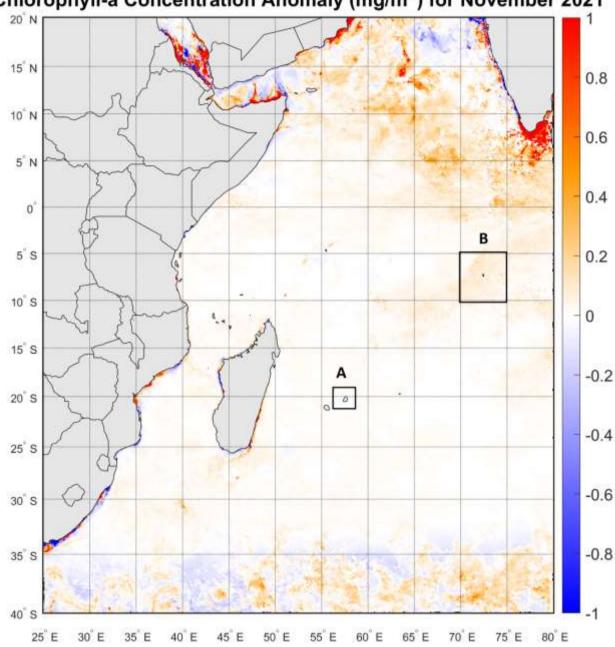
Climatology of Chl-a Conc. (mg/m³) for November from 2002 to 2019

Figure 7: Chlorophyll-*a* Climatology (mg/m³) for the month of November (2002 -2019)

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

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

Chlorophyll-a time series generated from the monthly average for November 2021 and the climatological normal for November 2021 in the regions encircle in Figure 8, namely region A around Mauritius and region B, around the Chagos Archipelago.
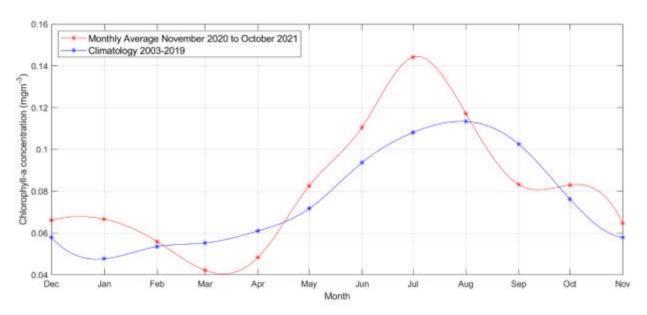
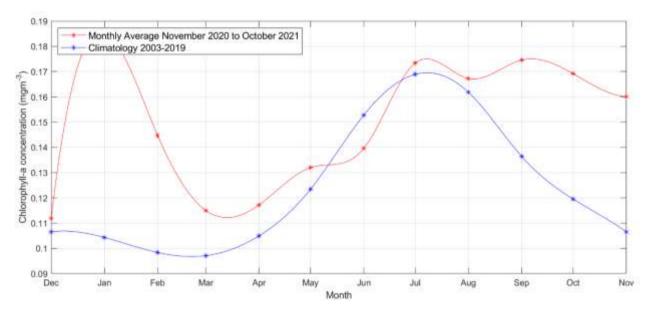**Figure 9:** Temporal variation of chlorophyll-*a* (mg/m^3) around Mauritius Island (Region A)

Figure 10: Temporal variation of chlorophyll-*a* (mg/m^3) for the region around the Chagos Archipelago (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 November 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.

For the month of November 2021, there was no major significant deviation between the observed chlorophyll-a concentration (Figure 6) and the climatological mean (Figure 7) except for some localised regions. Typically low Chl-a concentration was observed in the Mascarene region as compared to the northern and continental regions of the Indian Ocean. This observation is confirmed by the anomaly map for November 2021 (Figure 8).

Figure 9 shows the monthly time series for the region around Mauritius Island (region A in Figure 8). The graph shows that a relatively higher Chl-a concentrations observed for the region since the end of September 2021.

Figure 10 shows the temporal variation of Chl-a for region B in Figure 8, that is, for the region around the Chagos Archipelago. Asobserved, an increasingly higher positive anomaly is being observed in that region since the beginning of the summer season.

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.

Annex

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.