GMES AND AFRICA

MONTHLY OCEANOGRAPHY BULLETIN

South West Indian Ocean

June 2020

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.

2.0 Highlights

Sea Surface Temperature

- For the month of June 2020, sea surface temperature was warm to much warmer above latitude 15^{o} S and relatively colder below.
- Temperature anomaly was seen to be higher than usual throughout the northern part of the Indian Ocean basin.
- Relatively lower temperature was observed in the waters of the Mascarene Islands and the southern part of Madagascar compared to the previous months.

Chlorophyll-a Concentration

- Higher Chl-*a* concentration were observed in the coastal regions of East African countries and Madagascar whereas in the Mascarene region, Chl-*a* concentration was relatively lower.
- Compared to the monthly mean climatology for June, Chl-*a* concentrations was higher than normal in the Mozambique Channel and near the Mascarene plateau.
- The region of low concentrations near Saya de Malha region could potentially be attributed to the high temperature recorded in the same area.

2.1 Sea Surface Temperature

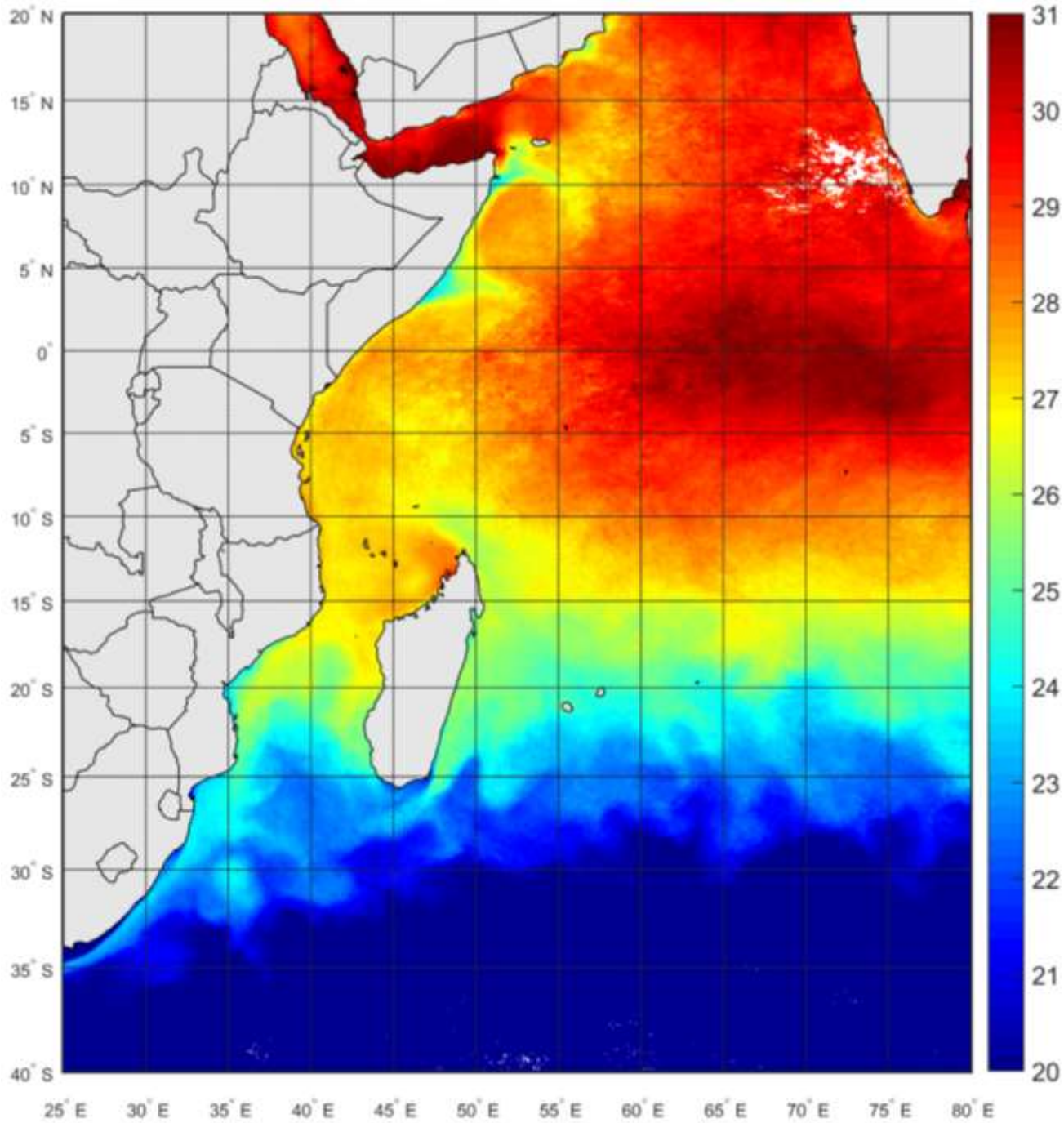

Figure 1: Mean sea surface temperature for the month of June 2020 (°C)

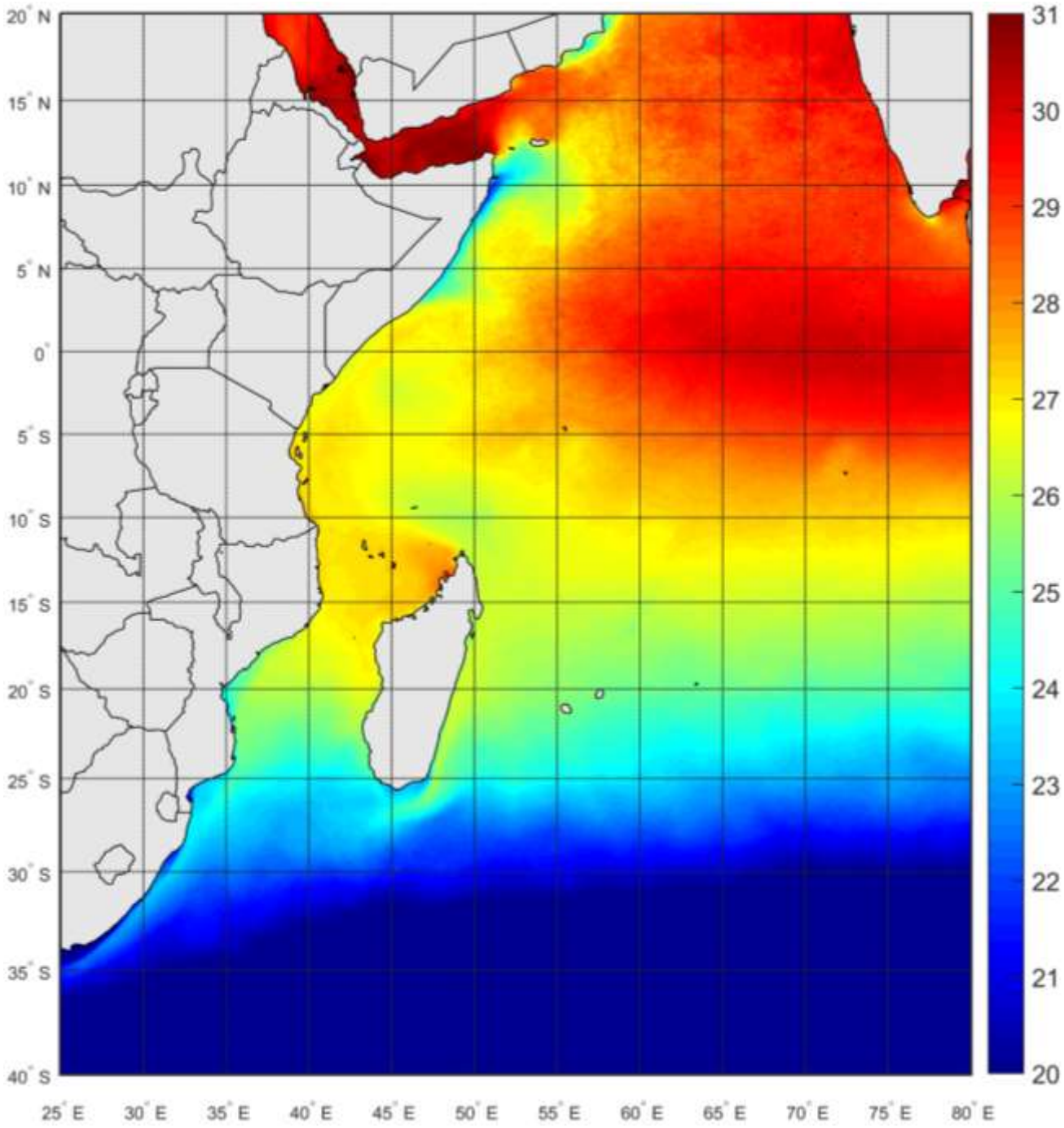

Figure 2: Climatology of sea surface temperature for June 2003 to June 2019 (°C)

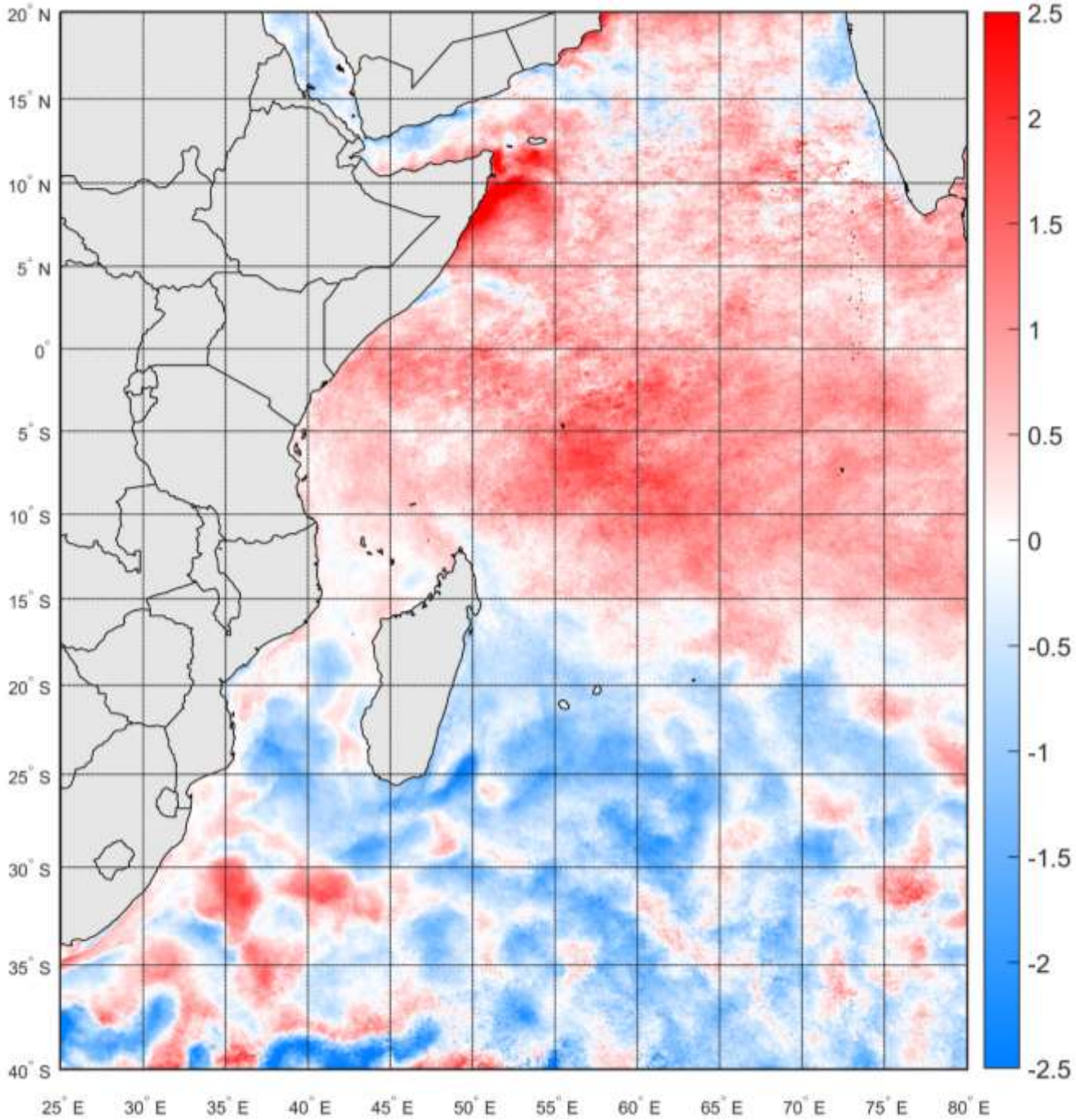

Figure 3: Anomaly of sea surface temperature for June 2020 (°C)

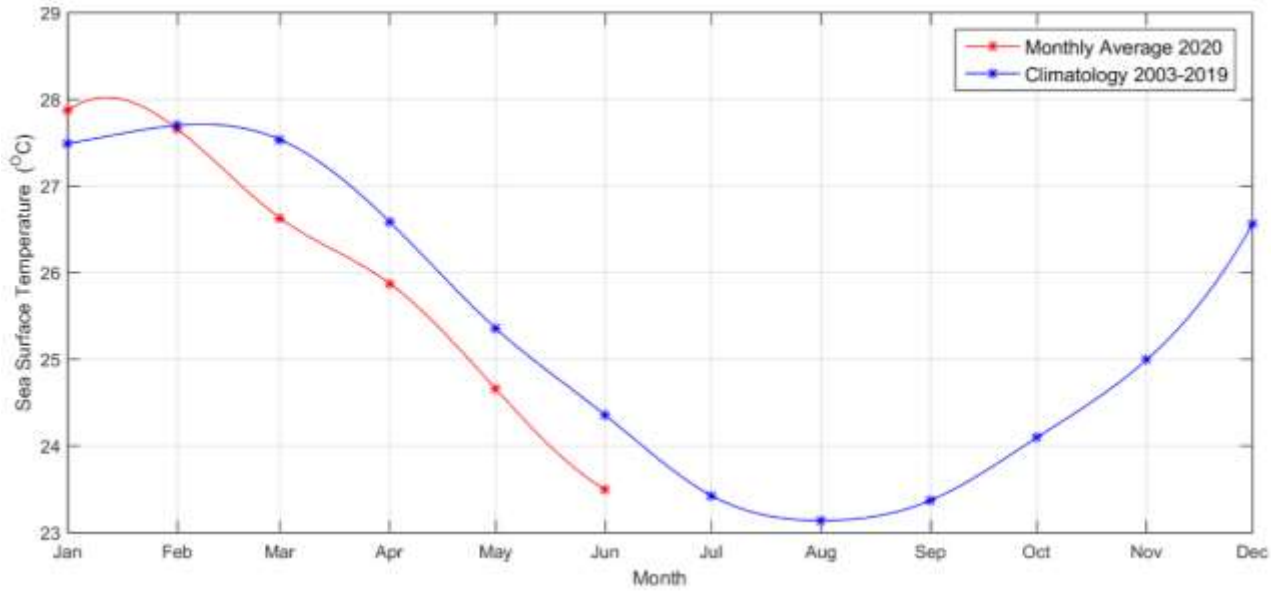

Figure 4: Temporal variation of sea surface temperature (°C) for the region south of Madagascar

2.2 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 June 2020. 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. From Figure 1, it can be observed that for the month of June 2020, sea surface temperature was warm to much warmer above latitude 15^{o} S and relatively colder below. Figure 3 shows temperature anomaly for June 2020 compared to the long-term average temperature (climatology) of that month from 2003 through 2019 (Figure 2). From the SST anomaly map, the blue colour represents temperatures that were cooler than average, the white colour shows near-average temperatures, while the red colour shows temperatures that were warmer than average.

From observation, the SST was seen to be higher than usual throughout the northern part of the Indian Ocean basin. For instance, SST above 30^{o} C was recorded in the region East / North East of Seychelles compared to an average of around 28 ^{o} C for the same region. Relatively lower temperature was observed in the waters of the Mascarene Islands and the southern part of Madagascar compared to the previous months. This phenomenon could be attributed to the numerous anti-cyclones during the month of June 2020. Figure 4 shows the temporal variation of sea surface temperature for the region south of Madagascar. From the graph, it can be observed that since February 2020, temperature at this region is below average for the selected region.

3.0 Chlorophyll-a Concentration

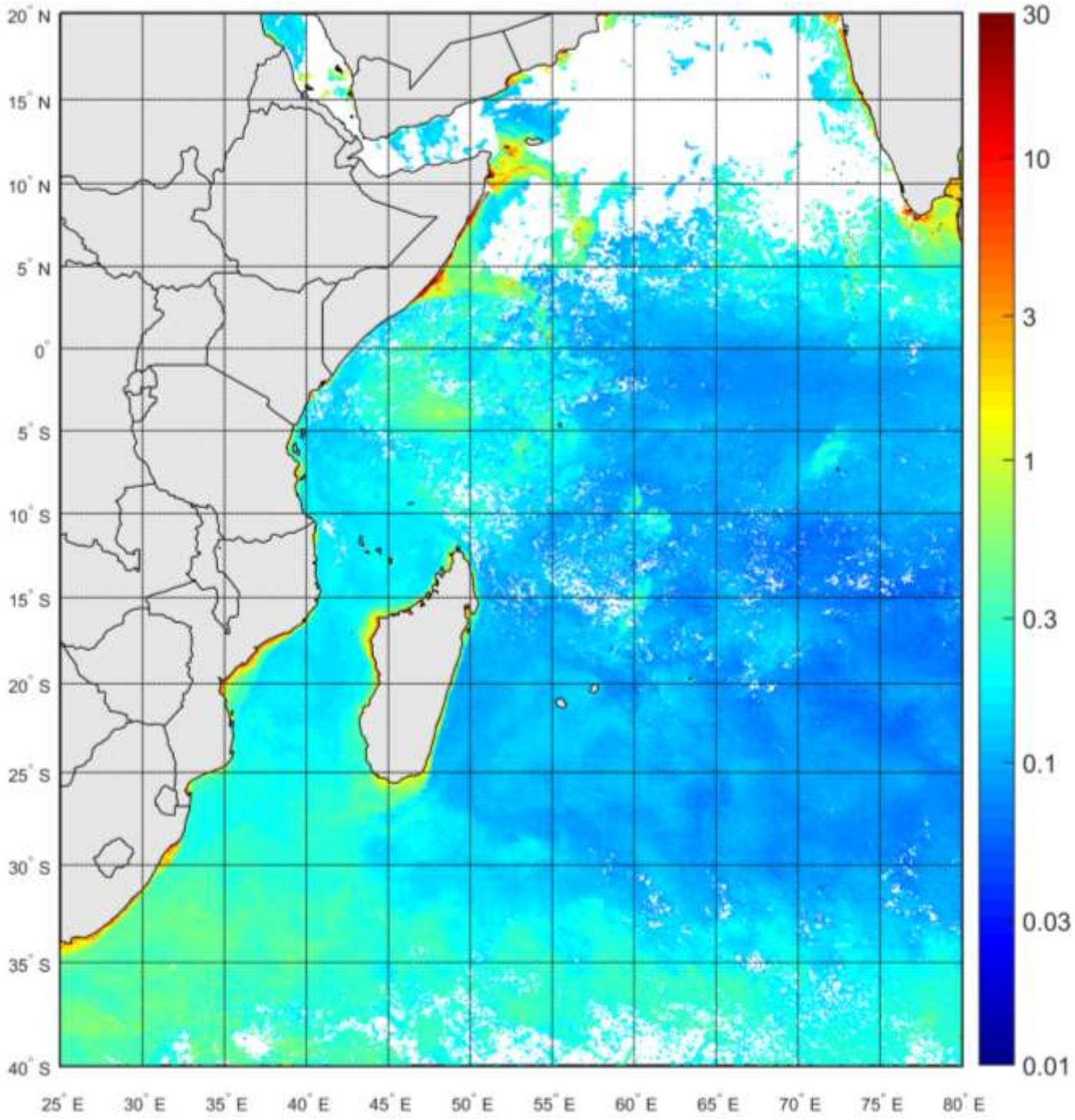

Figure 5: Mean chlorophyll-*a* concentration for the month of June 2020 (mg/m^3)

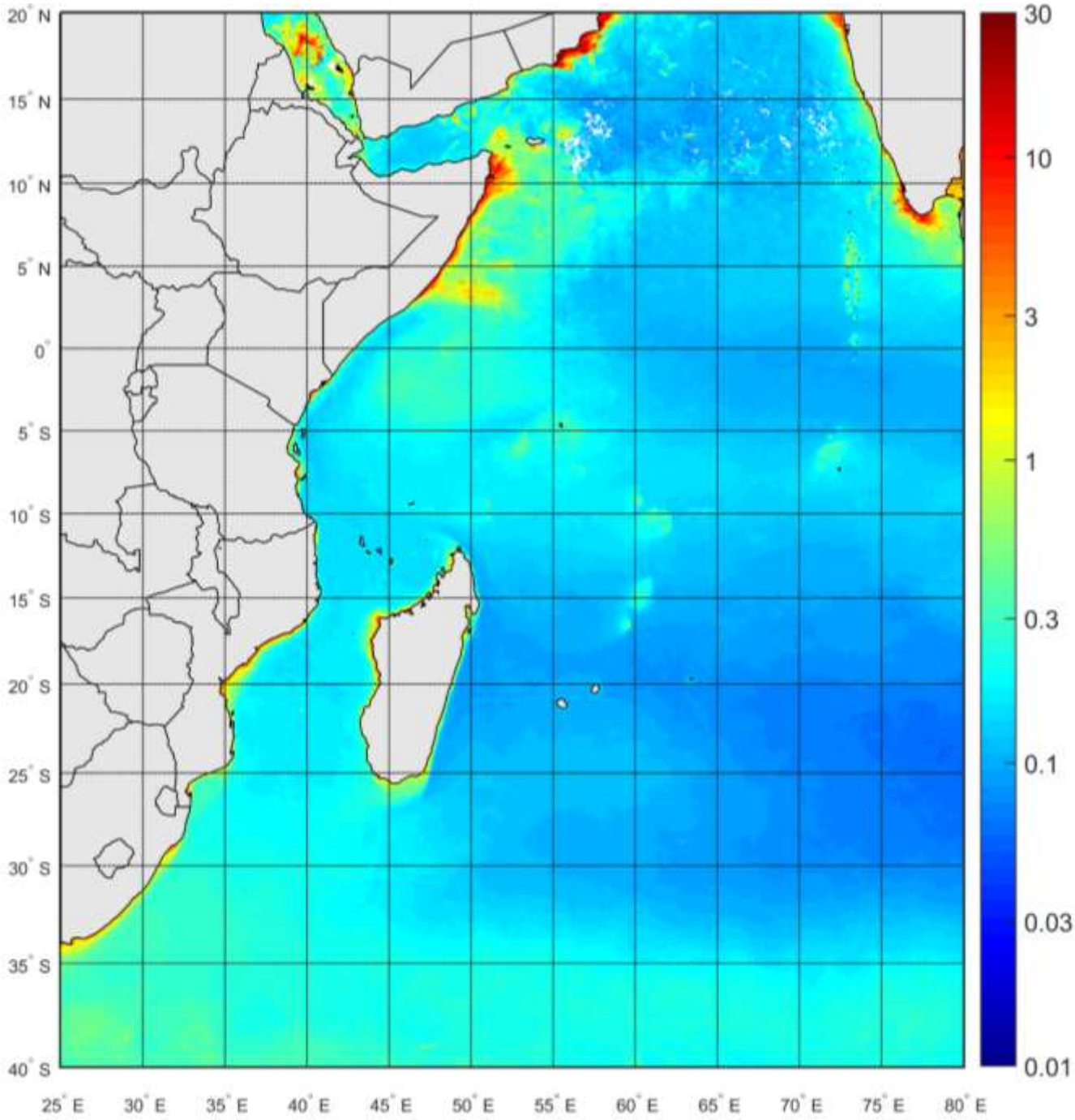

Figure 6: Climatology of chlorophyll-*a* for June 2003 to June 2019 (mg/m^3)

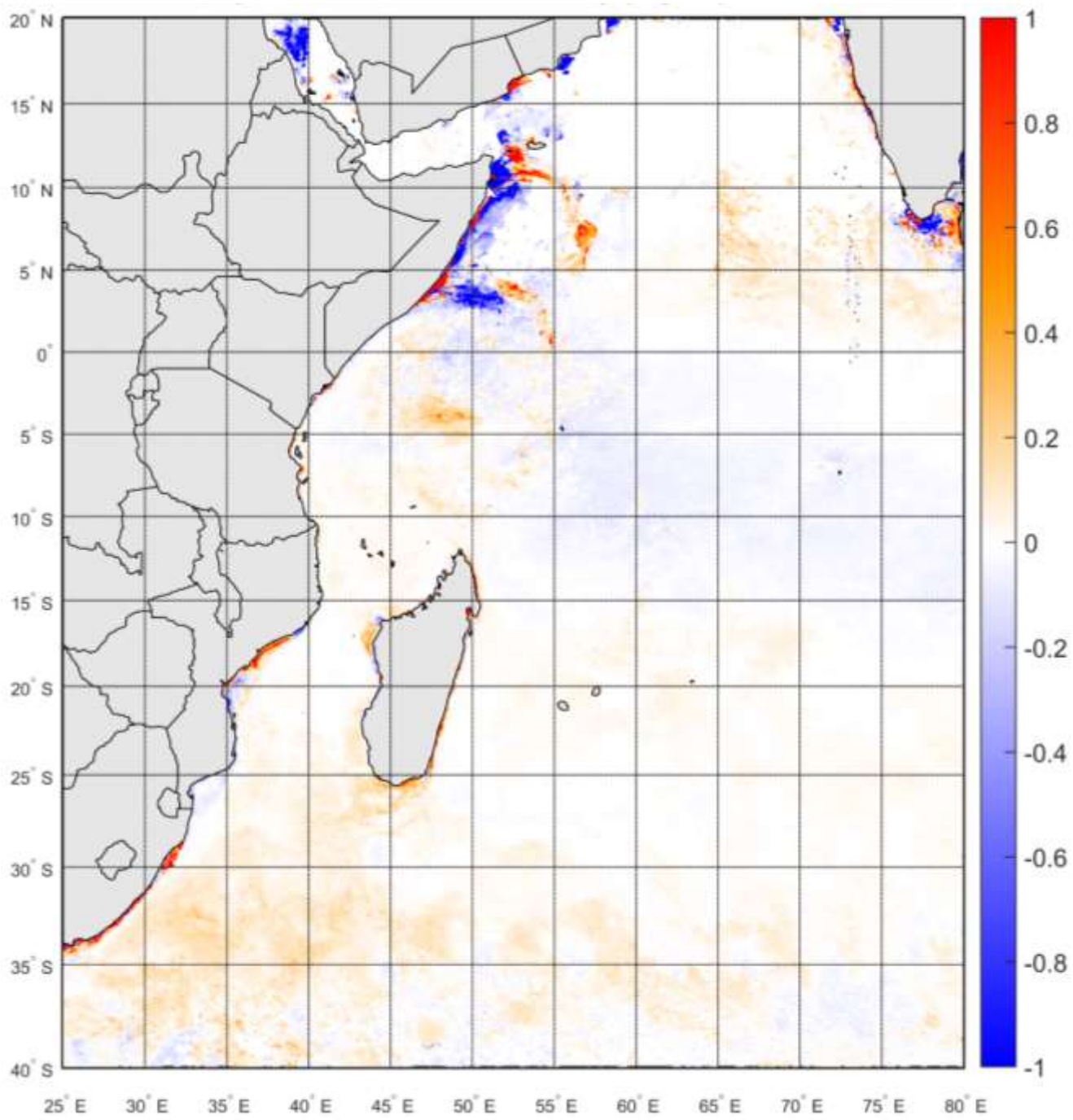

Figure 7: Anomaly of chlorophyll-*a* for June 2020 (mg/m^3)

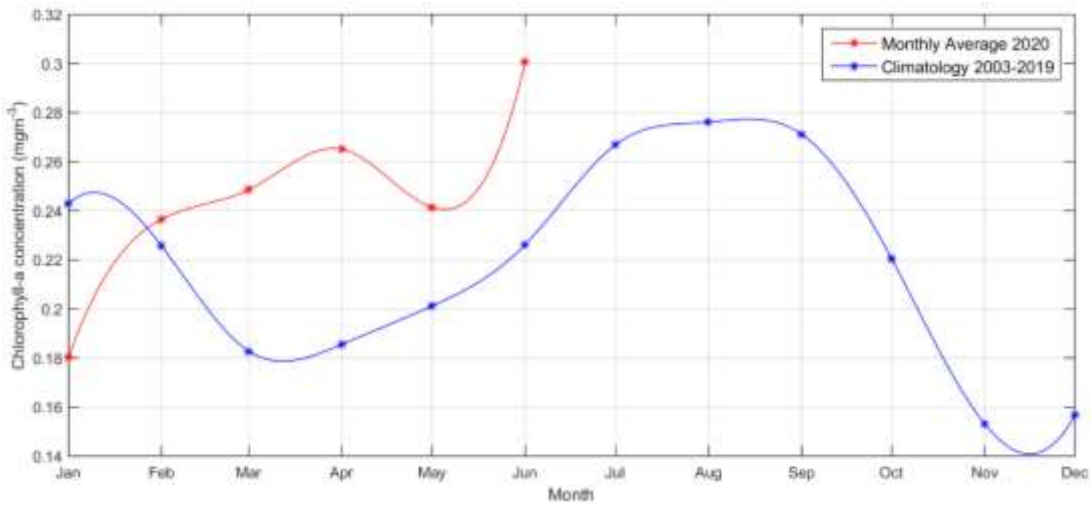

Figure 8: Temporal variation of chlorophyll-*a* (mg/m^3) for the Tanzanian region

3.1 Description of chlorophyll-a

Figure 5 shows chlorophyll-*a* concentration in milligrams of chlorophyll-*a* per cubic metre of seawater for the month of June 2020. Regions where chlorophyll-*a* concentration were very low, indicating very low numbers of phytoplankton are blue and those where chlorophyll-*a* concentrations were high, are shown in red. Land is light grey, and places where there is no data is represented in white.

Higher Chl-*a* concentration were observed in the coastal regions of East African countries and Madagascar whereas in the Mascarene region, Chl-*a* concentration was relatively lower. Compared to the monthly mean climatology for June, Chl-*a* concentrations was higher than normal in the Mozambique Channel and near the Mascarene plateau.

The region of low concentrations near Saya de Malha region could potentially be attributed to the high temperature recorded in the same area. High Chl-*a* indicates high primary production, an essential condition for fish aggregation and fish catch while positive Chl-*a* anomaly shows higher concentration of Chl-*a* than the average observed for the same period. In addition, prevailing anti-cyclones in the southern region could also explain the positive Chl-*a* anomaly potentially caused by upwelling, that is, the upward flow of bottom water nutrients to the surface.

Figure 8 shows the temporal variation of Chl-*a* for the region off coast of Tanzania where the deviation from the monthly mean were significant since a couple of months. The graph shows that since February a higher concentration of Chl-*a* than the monthly climatology was observed, with a difference of +0.075 mg/m^3 in June 2020.

Acknowledgements

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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. Chlorophyll-*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 Ocean Color.

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.