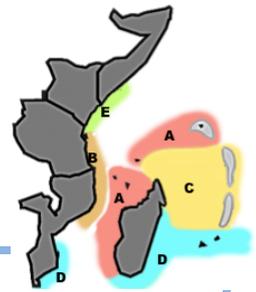


WESTERN INDIAN OCEAN – Regional coral bleaching alert

DATE OF THIS ALERT: 07 January 2019

<http://www.cordioea.net/bleachingalert/>

Contact: bleaching@cordioea.net



Bleaching Alert Level

- 'warning' – indications of warmer conditions that may result in some bleaching
- 'level 1' – moderate bleaching possible
- 'level 2' – severe bleaching likely

Letters in the brackets under the 'region' column refer to the WIO climatology regions, depicted in the map in the top right corner.

07 January 2019 – Coral bleaching forecast – Western Indian Ocean

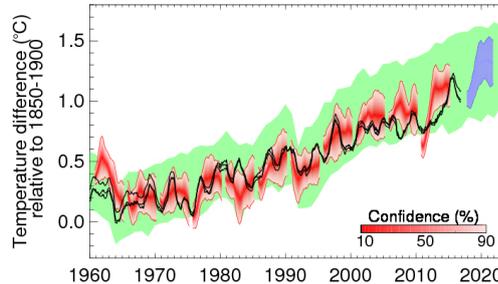
| Area | Region | Alert | Bleaching observations |
|----------------------|-----------------------|----------|------------------------|
| S Moz/S Africa | Cool, south (D1) | warning | |
| SWIO/E Madag | Cool, south (D2) | moderate | |
| SW Madagascar | Hot, south (A1) | moderate | |
| South Equat Curr | Moderate, central (C) | moderate | |
| East Moz Cha/Comoros | Hot, central (A2) | moderate | |
| NW Moz Cha /C Tanz | Warm, central (B) | moderate | |
| NW Seychelles | Hot, north (A3) | moderate | |
| Kenya-Somalia | Variable, north (E) | moderate | |

Indications are for a reasonably hot 2019 bleaching season in the Western Indian Ocean, with moderate to high bleaching expected, and first occurrence of bleaching around Madagascar. All monitoring programs, conservation areas and groups invested in coral reefs should initiate early observations to determine the first onset of bleaching in their area and report to the links below.

Report all bleaching (and non-bleaching) observations at the link above, or <https://goo.gl/forms/jP3Ke9cclt3VM9403>

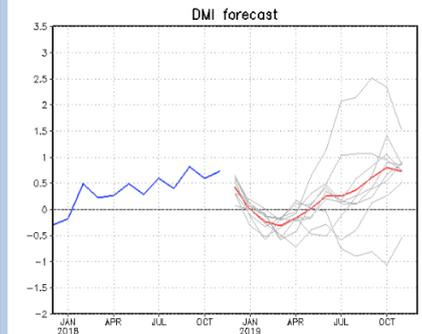
Global & Regional Indicators

2018 was relatively cool, compared to 2015-2017, which were among the hottest years ever recorded. The decadal predictions by the UK Met Dept, indicate a cool cycle for 2018-19 (see figure) and warmer temperatures from 2020 compared to 2015-17. This prediction will be updated in late January 2019.

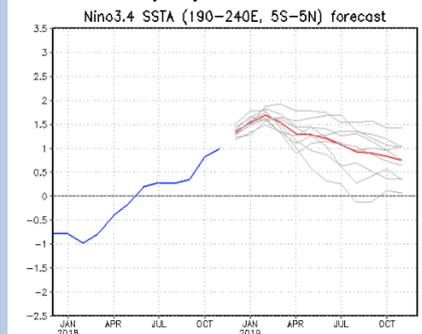


A new forecasting approach (<http://www2.cnrs.fr/en/3148.htm>) has predicted high temperature anomalies for SST globally from 2018-2022, and given the cool temperatures in 2018 and existence of reasonably strong El Niño currently, this suggests temperatures for 2020-22 may be extremely high, potentially for 2019 as well.

Indian Ocean Dipole (DMI)

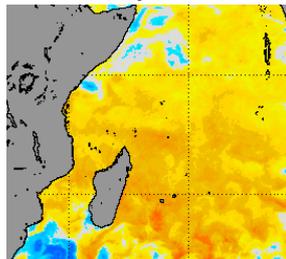


ENSO index (3.4)

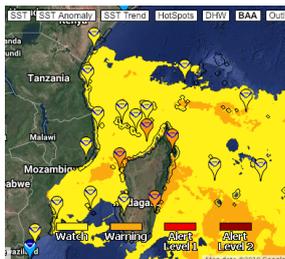


NOAA Products – 4 January 2019

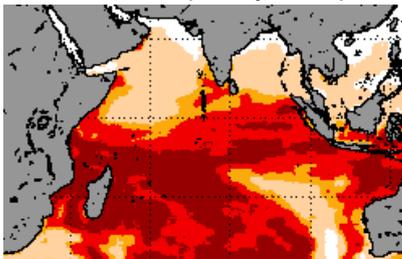
SST Anomaly



Virtual stations



Season outlook (Jan-Apr 2019)

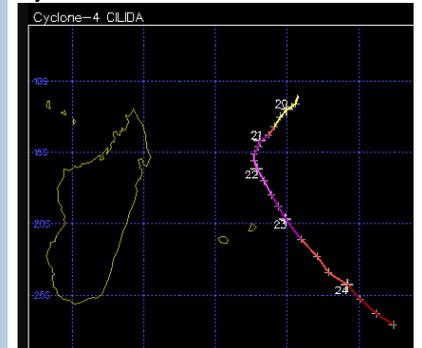


At the beginning of January, temperatures across the entire WIO are over 1°C warmer than usual for the same time period, and all except NOAA's southern-most virtual stations (South Africa) are on bleaching watch status, with 4 on bleaching warning. The seasonal outlook predicts moderate bleaching across the region with greater than 60% probability.

Expectation for 2019 - Indications are for a reasonably hot 2019 bleaching season in the Western Indian Ocean, with moderate to high bleaching expected.

Bleaching observations – Jan 2019 - Bleaching observations were made in Tanga in November/December 2018 (by S. Riedmiller) and Chole Bay, Mafia island, that likely correspond with warming conditions at the end of the southeast monsoon, but not indicative of 2019 seasonal bleaching, apart from perhaps being due to high background temperatures going into 2019.

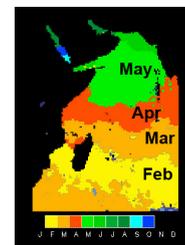
Cyclones



Cyclone Cilida traversed the banks area and east of Mauritius from 20-24 December 2018.

WESTERN INDIAN OCEAN – Regional coral bleaching alert

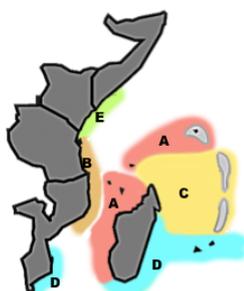
DATE OF THIS ALERT: 07 January 2019



Explanations

WIO climatology regions

Since 2014, bleaching reporting regions are used as defined by SST analysis from the last decade (2003-2009 as 'background' years, and 2010 as a year of high bleaching), rather than a longer historical record that includes pre-1998 SSTs. Five SST zones were identified:



A – the hottest region; the East Mozambique Channel and Comoros (reported as SW Madagascar and the NE Madagascar Channel) and the NW Seychelles islands. Split into 3 sub-regions.

B – the second hottest region; East African mainland coast from 7-18°S (Zanzibar/Dar es Salaam to Primeiras/Segundas islands), and including the Northwest Mozambique Channel

C – a moderate/intermediate region; the South Equatorial Current region, comprising the Mascarene Banks, southern Seychelles islands and NE Madagascar

D – the southern cooler regions; SW Indian Ocean islands, E and S Madagascar and S Mozambique and South Africa. Split into 2 sub-regions.

E – the cooler northern but highly variable region; the Kenya-Somali coast, including Pemba island and N Tanzania coast (Tanga).

Because of latitudinal variation (e.g. in A) and geographic splitting (e.g. A and D), we report in 8 sub-regions.

Alert levels

Statistical analysis of alerts from 2007-13 indicated that low confidence is attached to an alert of 'low' bleaching risk (i.e. not zero risk, but not severe). By contrast, predictions of 'mid' and 'high' risk of bleaching were more reliable. Accordingly, the alert is being presented as:

- **'warning'** – indications of warmer conditions that may result in some bleaching
- **'level 1' – moderate bleaching possible**
- **'level 2' – severe bleaching likely**

These findings match the categories used by NOAA, with 'watch', 'bleaching level 1' and bleaching level 2' categories.

Sea Surface Temperatures (SST)

The surface of the sea heats up by direct insolation, causing stress to corals and other shallow water organisms. Satellites directly measure the skin-temperature of the sea, providing these maps and coral bleaching products for early warning.

Predicted Bleaching

The Bleaching Thermal Stress Outlook is based on sea surface temperature (SST) forecasts generated by the Linear Inverse Model from the NOAA Earth System Research Laboratory. In a normal year, the Outlook forecasts no potential for bleaching. The baseline years for calculations (i.e. the climatology) are 1985-93, excluding 1991

and 1992 due to high atmosphere volcanic dust from Mt. Pinatubo.

Wind-driven mixing

Wind is an important physical factor influencing conditions conducive to coral bleaching. Wind-driven mixing reduces temperature stress and wind generated waves can scatter harmful levels of incoming solar radiation.

- Cyclones - cause strong mixing, reducing SST.
- Doldrums - periods of sustained low wind promote stratification, and heating of the upper layers of water. They therefore promote environmental conditions adverse to corals experiencing thermal and/or light stress.

El Niño/Southern Oscillation (ENSO)

The El Niño/Southern Oscillation (ENSO) is the most important coupled ocean-atmosphere phenomenon to cause global climate variability on interannual time scales.

Multivariate ENSO Index (MEI) - Negative values of the MEI represent the cold ENSO phase (La Niña), while positive MEI values represent the warm ENSO phase (El Niño).

The Southern Oscillation Index (SOI) is calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin (Note, negative SOI is equivalent to positive MEI).

The Niño 3.4 index is similar to the SOI, but focused on the central Pacific Niño region, straddling the equator and from 170-120°W. It has been found to be most strongly associated with climatic consequences in the African region, so is used here.

Indian Ocean Dipole

The Indian Ocean Dipole is analogous to the ENSO, but for the Indian Ocean. It is calculated using the Dipole Mode Index (DMI), which calculates the gradient between the western equatorial Indian Ocean (50E-70E and 10S-10N) and the south eastern equatorial Indian Ocean (90E-110E and 10S-0N).

Global indicators

Local temperatures are affected by global and regional trends. With global warming, temperatures are expected to rise over longer periods (decades), but significant variation can occur between years, and under the influence of regional and multi-year factors such as ocean-atmosphere interactions across the Pacific and Indian Ocean.

Data sources

- <http://www.metoffice.gov.uk/news/releases/archive/2014/2015-global-temp-forecast>
- <http://coralreefwatch.noaa.gov/>
- <http://australiasevereweather.com/cyclones/index.html>
- <http://www.mtotec.com/>
- <http://www.cpc.ncep.noaa.gov/>
- http://www.ioc-goos-oopc.org/state_of_the_ocean/sur/ind/dmi.php
- <http://www2.cnrs.fr/en/3148.htm>