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# Reef Referee



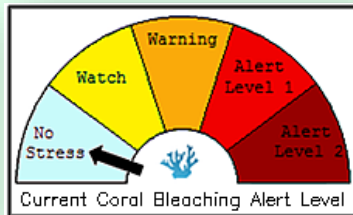
**CURRENT STATUS: 7th June 2017: NO STRESS**

**TRINIDAD & TOBAGO CORAL BLEACHING ALERT STATUS:**

**LOCATION: Caribbean: Trinidad & Tobago (09N-13N, 059W-063W)**

We are approaching Trinidad and Tobago's Coral Bleaching Season. Currently, T&T is under **NO STRESS** Conditions (blue status in Fig. 1a & 2). There are two patches of **WATCH** Level heat stress (yellow) west of

and proximal to T&T. The Sea Surface Temperature Trend is towards neutrality, with some adjacent patches of cooling (-0.5°C to 1.0°C and heating (+0.5°).

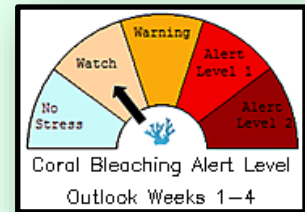


**Fig. 2: Current (6th Jun 2017) Heat Stress Gauge**

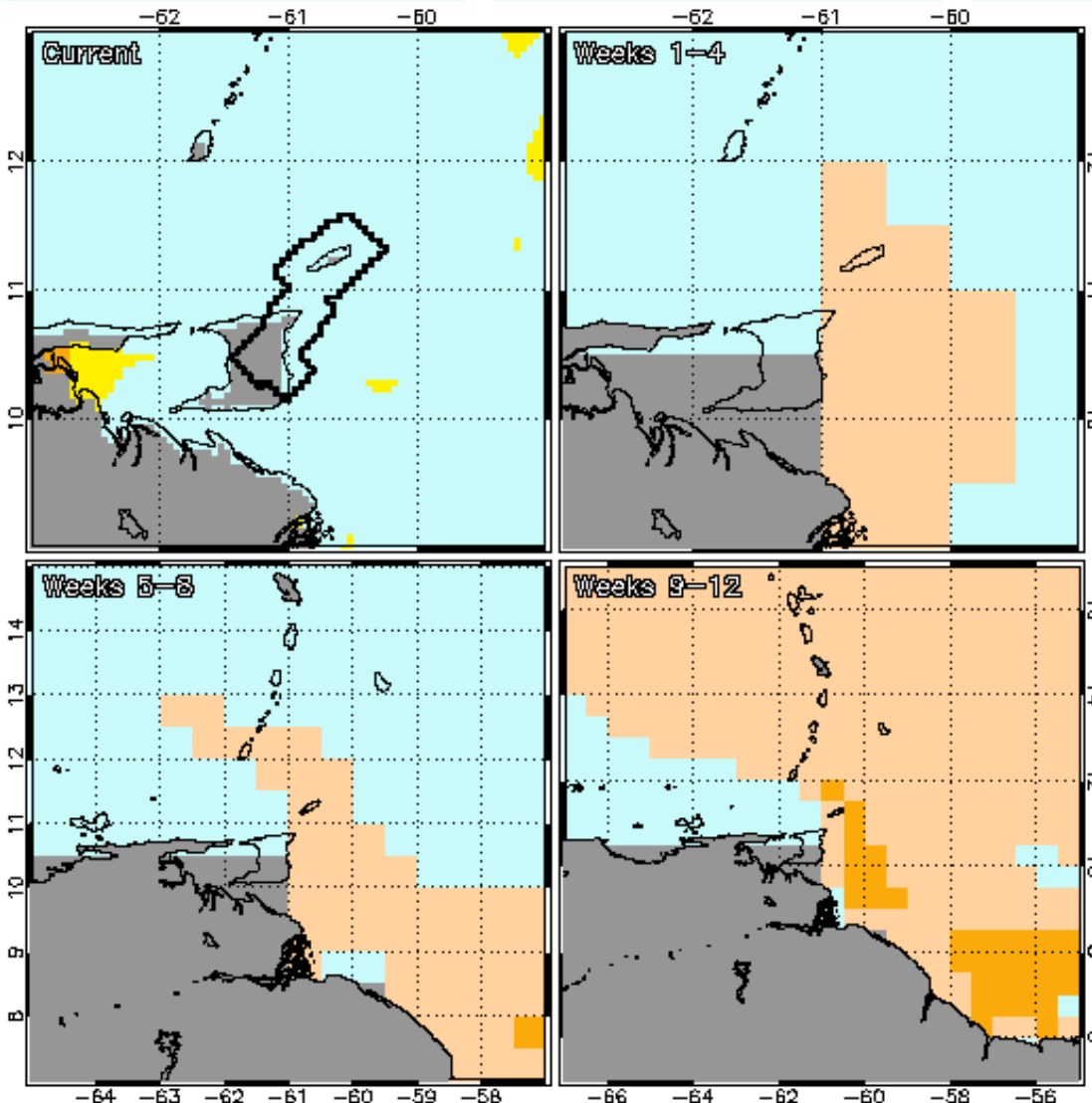
**TRINIDAD & TOBAGO CORAL BLEACHING**

**OUTLOOK:**

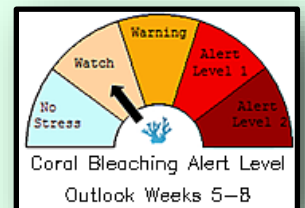
**WEEKS 1-4:** Jun-Jul shows an increase in heat stress to the **WATCH** status (Fig. 1b & 3).



**Fig. 3: 1-4 Week Outlook Heat Stress Gauge (Jun)**

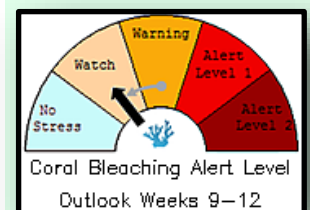


**WEEKS 5-8:** Jul-Aug shows heat stress persisting so that the Status remains **WATCH** (See Figs. 1c & 4).



**Figure 4: Outlook (Weeks 5-8) Heat Stress Gauge (Jul)**

**WEEKS 9-12:** August-September marks the **onset of the Peak Bleaching Season**. A general increase in heat stress is expected with a region east of Trinidad and Tobago reaching **WARNING** Level. T&T's status will fluctuate between **Warning** and **Watch** for this period. (See Figs. 1d & 5.)



**Fig 5: Outlook (Weeks 9-12) Heat Stress Gauge (Aug)**

**FIG 1: NOAA-CRW 7TH JUNE 2017 BLEACHING ALERT AREA COMPOSITE: CURRENT STATUS & 12-WEEK OUTLOOK**

## INTRODUCTION TO CORAL REEF WATCH:

### What is Coral Bleaching?

**Coral Bleaching** is the phenomenon by which corals expel the symbiotic photosynthetic algae contained within their cells **resulting in loss of colour and a degradation in health**. Bleaching is associated with unusually high temperatures which cause the algae to produce chemicals which damage the coral body. While coral reefs can gradually repopulate their algae to recover from mild events, severe and/or prolonged events can have a fatal impact.

### When is the Bleaching Season?

The peak of the **bleaching season** typically coincides with a region's peak in temperature. The peak bleaching season is January-March for the Southern Atlantic and Pacific Oceans; January-April for the Southern Indian Ocean, April-June for the Northern Indian Ocean; and July-September for the Northern Atlantic and Pacific Oceans.

The upper limit of "normal" temperature is defined as the Maximum of the Monthly Mean SST (MMM SST) climatology. The MMM SST is the highest Monthly Mean SST climatology. **Trinidad and Tobago's MMM SST is approximately 28.8°C and occurs in October.** Trinidad and Tobago's Coral Bleaching Season is therefore August to November, peaking September to October.

### What is a Coral Reef Watch?

A **coral reef watch** is a system of monitoring stressors on coral reefs in an effort to anticipate and mitigate the impacts. In this case, **heat stress** is monitored as an indication of the potential for **coral bleaching**.

### Stakeholders: Who should be concerned?

- Snorkelers
- Scuba Divers
- Fisher-Folks
- Coastal Communities
- Tourists
- Tourism Industry Operators
- Local Authorities
- All of us

### HOW DO WE MONITOR?

The National Oceanic and Atmospheric Administration's Coral Reef Watch (NOAA-CRW) uses satellites to collect near-real-time and long term environmental data from coral reefs; analyze patterns/trends; and forecast the impacts of coral bleaching. They have developed a specialized suite of **satellite coral bleaching monitoring products**, which includes: **Bleaching Alert Areas** (BAA), Sea Surface Temperature (SST), SST Anomalies (SSTA), **HotSpots** (HS), and **Degree Heating Weeks** (DHW).

### Bleaching Alert Areas

**Bleaching Alert Areas (BAA)** are maps that outline maximum bleaching heat stress that a pixel has experienced during the most recent seven consecutive days (see Fig. 1, 2 and 3). The outlines in black (Figure 1) were developed using reef location references based on a global 5-km reef pixel mask.

The **5 Bleaching Alert Risk Levels** based on the values of CRW's 5-km Coral Bleaching **HotSpot** and **DHW** products (See Table 1), each corresponding to a different level of heat stress are as follows:

1. **No Stress:** no heat stress has accumulated, HS equals 0.

2. **Bleaching Watch:** issued when low heat stress exists, HS more than 0°C but less than 1°C and SST is below the Bleaching Threshold
3. **Bleaching Warning:** issued when the HS is equal to or greater than 1°C, but SST is above Bleaching Threshold and DHW begins accumulating ( $0 < DHW < 4$ ).
4. **Alert Level 1:** issued when the SST is above the Bleaching Threshold and DHW value reaches 4°C-weeks, indicating that significant bleaching is expected within a few weeks of the alert.
5. **Alert Level 2:** issued when SST is above the Bleaching Threshold and DHW reaches 8°C-weeks, indicating that widespread bleaching and significant mortality are likely.

STRESS LEVEL	HOTSPOT (HS)	DHW	OUTCOME
NO STRESS	0	n/a	No bleaching
WATCH	$0 < HS < 1$	n/a	No bleaching
WARNING	$1 \leq HS$	$0 < DHW < 4$	Bleaching Possible
ALERT 1	$1 \leq HS$	$4 \leq DHW < 8$	Bleaching Likely
ALERT 2	$1 \leq HS$	$8 \leq DHW$	Mortality Likely

TABLE 1: NOAA-CRW 5 LEVELS OF BLEACHING ALERTS

**HotSpots (HS)** highlight areas where the current SST exceeds the Maximum of the Monthly Mean SST (MMM SST) climatology. The **Coral Bleaching Threshold** represents the temperature at which bleaching is expected and is defined as the MMM SST plus one degree Celsius (MMM SST +1°C). A HotSpot value of 1.0°C indicates that the SST is above the Bleaching Threshold.

**Degree Heating Weeks (DHW)** gives a cumulative measure of the intensity and duration of heat stress expressed in °C-weeks by totalling HS stress greater than 1.0°C over a 12 week period. DHW values over 4°C-weeks have been shown to cause significant coral bleaching, while values of 8°C-weeks have been shown to cause widespread bleaching with some mortality.

### TRINIDAD AND TOBAGO VIRTUAL STATION:

CRW's Virtual Stations (Figure 6) provide real-time information on heat stress status, Sea Surface Temperature (SST); Sea Surface Temperature **Anomaly** (SSTA); HotSpot (HS) and Degree Heating Weeks (DHW) corresponding to the 90th percentile HS value to give a comprehensive overview of all reefs in a predetermined region. SSTA is the difference between the actual SST and the as the long-term **Monthly Mean SST**, the baseline for 'normal'.

#### Trinidad and Tobago

(2017-06-05)



Current Coral Bleaching Alert Level

[Alert Gauges & Outlook](#) | [Time Series Graphs & Data](#)

Data values derived from 90th percentile HotSpot

SST = 27.921

Anomaly = 0.881

HotSpot = 0.000

DHW = 0.000

FIGURE 6: NOAA-CRW TRINIDAD & TOBAGO VIRTUAL STATION

## THE OUTLOOK:

NOAA-CRW's weekly-updated experimental **4-Month Coral Bleaching Heat Stress Outlook product (4.0)** is based on the daily SST forecast from the NOAA/National Weather Service National Centers for Environmental Prediction's (NCEP) Climate Forecast System Version 2 (CFSv2). Weekly probabilistic outlooks, at  $0.5^{\circ} \times 0.5^{\circ}$  spatial resolution, from up to 112 ensemble members predict coral bleaching heat stress up to 4 months (typical length of a bleaching season).

From sixteen forecast runs per day the Weeks 0-4 Outlook is generated from 112 ensemble members; Weeks 5-11 from 49 members; Weeks 12 to 36 from 28 members, where Week 0 is the first future week to produce probabilistic outlooks. The 90% Chance maps show heat stress predicted by 90% of the members and similarly, the 60% chance maps show heat stress predicted by 60% of members. The relationship between the predicted heat stress levels and potential bleaching severity is based on CRW's pre-defined stress levels.

## **SUMMARY OF INDICES:**

- Present SST: 27.921°C
- SST is above the Monthly Mean SST Climatology for May
- SSTA: 0.881
- SST is below the MMM SST of 28.8°C
- HS: 0.000
- DHW: 0.000
- SST is below the Bleaching Threshold of 29.8°

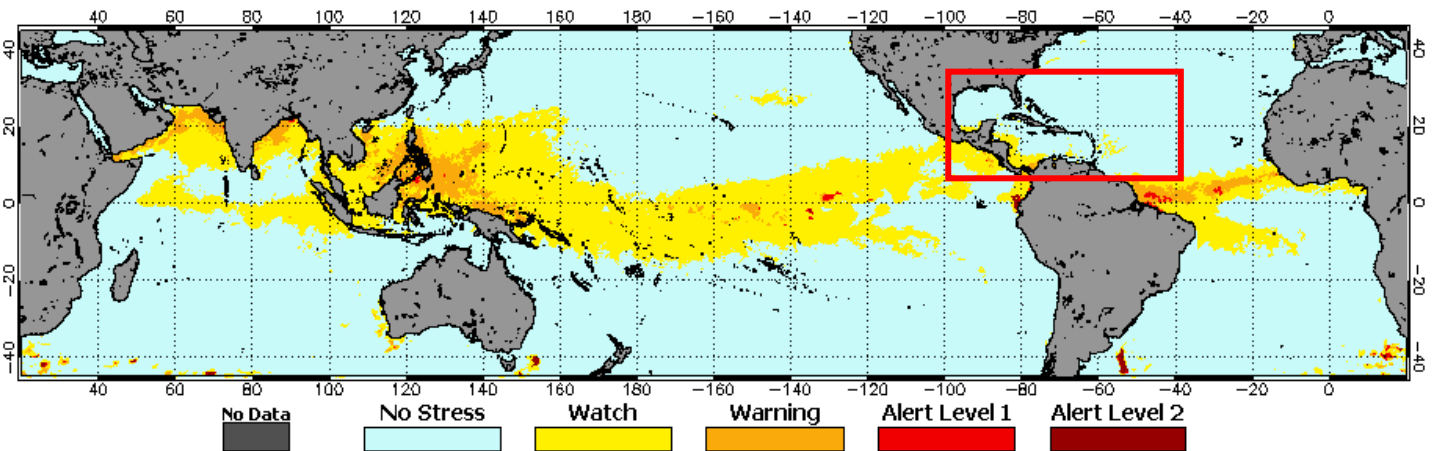


FIGURE 7: NOAA-CRW 5TH JUNE 2017 GLOBAL CORAL BLEACHING ALERT STATUS:

## GLOBAL STATUS:

Currently, we are exiting the peak of the Southern Hemisphere's Bleaching Season and entering the Northern hemisphere peak season (See Figure 7). Heat Stress exists primarily along the equatorial band as regions under Bleaching WATCH. However, patches of more intense heat stress do exist. The region of greatest heat stress exists in the Pacific Ocean along the equator, reaching a maximum of Alert Level 2 near Ecuador and Columbia. The largest area of heat stress in the Northern Hemisphere exist east of Africa and South of Asia.

## GLOBAL OUTLOOK:

As expected, Heat Stress is expected to increase in the Northern Hemisphere and decrease in the Southern Hemisphere (Figure 8). Temperatures are expected to increase significantly in the Arabian Sea; near Micronesia; along the west coast of North America-Mexico and off the east coast of North America.

Of more relevance for us in the Caribbean, is the area of heat stress expected along the equator in the Atlantic Ocean. This has potential to influence Trinidad and Tobago.

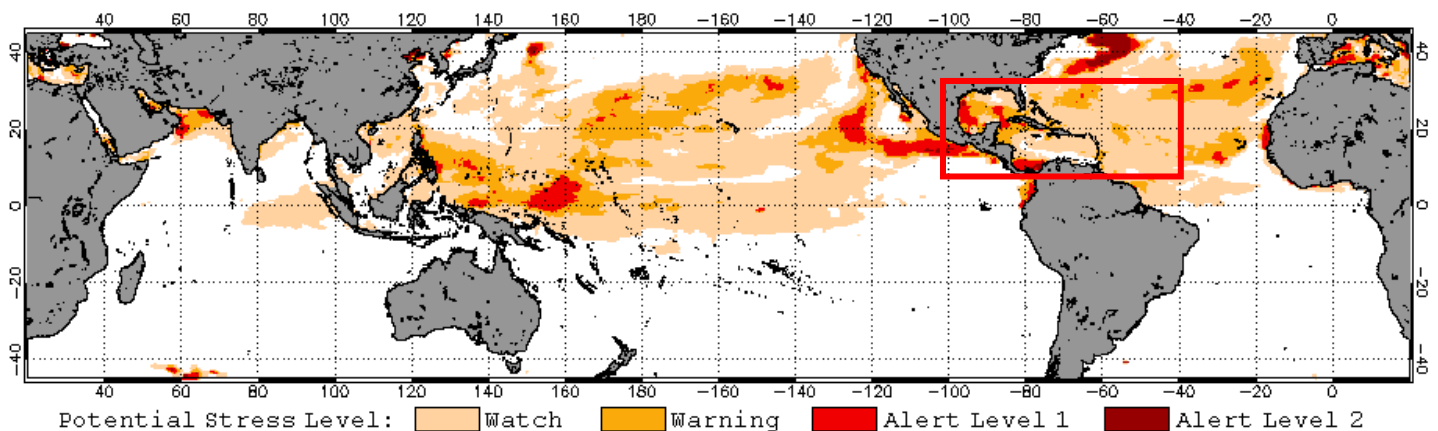


FIGURE 8: NOAA-CRW JUNE 6TH 2017 90% PROBABILITY GLOBAL BLEACHING ALERT AREA 12-WEEK OUTLOOK (JUN-SEP)

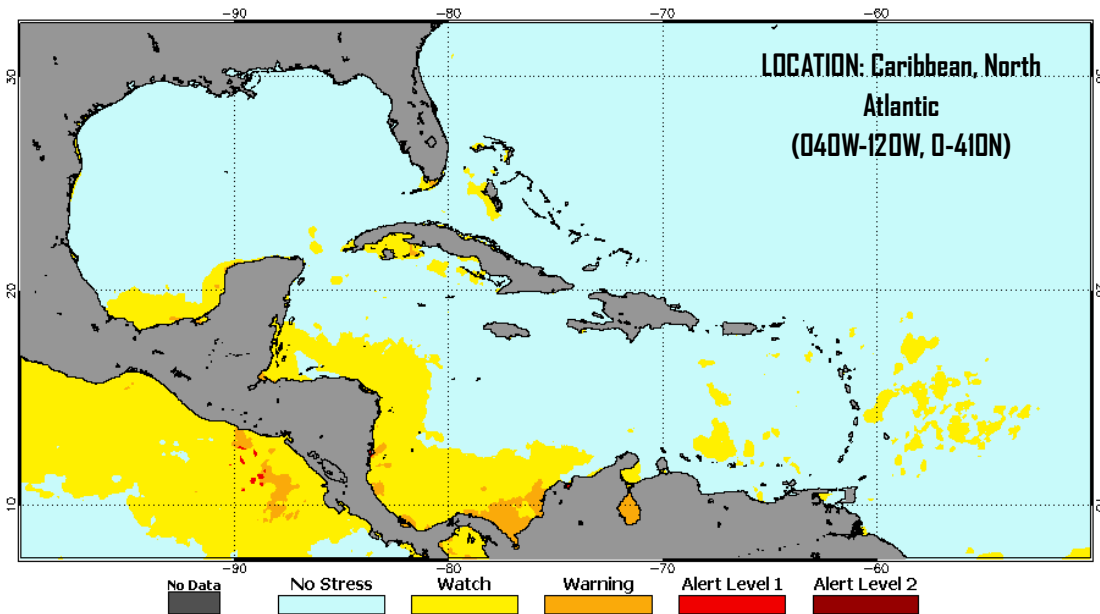


FIGURE 9: NOAA-CRW 5TH JUNE 2017 CARIBBEAN CORAL BLEACHING ALERT STATUS:

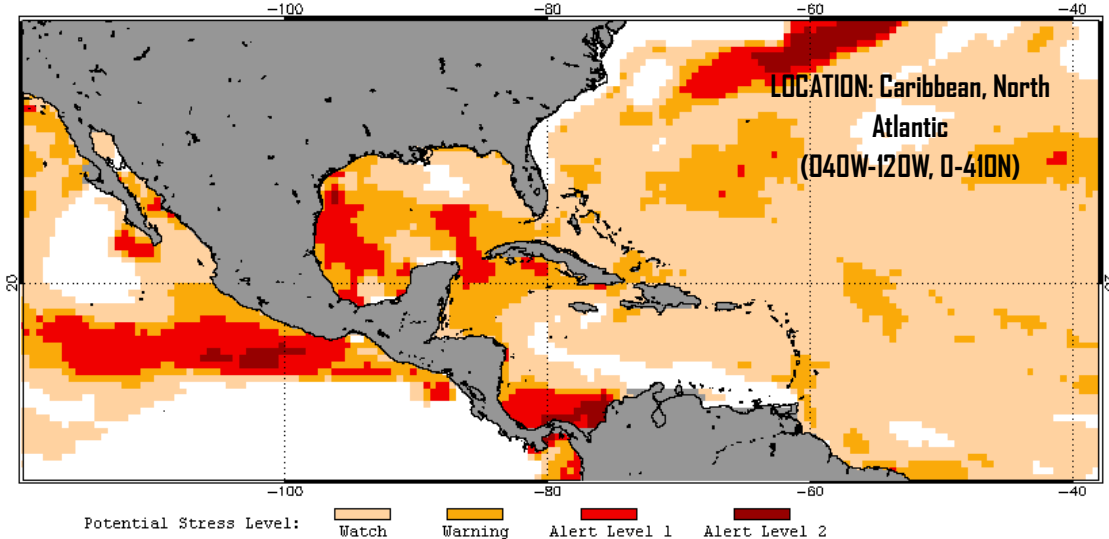


FIGURE 10: NOAA-CRW JUNE 6TH 2017 90% CARIBBEAN BLEACHING ALERT AREA 12-WEEK OUTLOOK (JUN-SEP 2017)

**ACKNOWLEDGEMENTS:**

THE TRINIDAD AND TOBAGO METEOROLOGICAL SERVICE (TTMS) WOULD LIKE TO THANK THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) & THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY (CIMH) FOR THEIR CONTINUED SUPPORT AND GUIDANCE TOWARDS THE ADVANCEMENT OF ATMOSPHERIC AND HYDROLOGICAL SCIENCES.

**Next Issue: 2017-July**

**Bleaching Alert Area Status**

**T&T Virtual Station**

**Indices Summary**

**What is a Coral Reef**

**Hard vs. Soft**

**What do corals eat?**

**What do corals need to survive?**

**Outlook**

**RESOURCES:**

- NOAA-CRW. (2013, updated daily). *5-km Regional Virtual Stations*. Retrieved 05 18, 2017, from NOAA Coral Reef Watch: <https://coralreefwatch.noaa.gov/vs/map.php>
- NOAA-CRW. (2013, updated daily). *5-km Satellite Coral Bleaching Heat Stress Alert Area Product*. Retrieved 05 18, 2017, from NOAA Coral Reef Watch: [https://coralreefwatch.noaa.gov/satellite/bleaching5km/index\\_5km\\_baa\\_max\\_r07d.php](https://coralreefwatch.noaa.gov/satellite/bleaching5km/index_5km_baa_max_r07d.php)
- NOAA-CRW. (2013, updated daily). *Trinidad and Tobago 5-km Bleaching Heat Stress Gauges*. Retrieved 05 18, 2017, from NOAA Coral Reef Watch: [https://coralreefwatch.noaa.gov/vs/gauges/trinidad\\_tobago.php](https://coralreefwatch.noaa.gov/vs/gauges/trinidad_tobago.php)
- NOAA-CRW. (2013, updated weekly). *4 Month Coral Bleaching Heat Stress Outlook*. Retrieved 05 18, 2017, from NOAA Coral Reef Watch: [https://coralreefwatch.noaa.gov/satellite/bleachingoutlook\\_cfsoutlook\\_cfs.php](https://coralreefwatch.noaa.gov/satellite/bleachingoutlook_cfsoutlook_cfs.php)

Compiled by Asalma Abdullah-Muhammad,  
Weather Observer, TTMS

**REGIONAL STATUS:**

The majority of the Caribbean Basin is currently under “NO STRESS”, as indicated by the blue in Fig. 9. However, a region of heat stress, reaching a maximum level of Bleaching WARNING, exists along the Central American-South American portion of the Caribbean. An area of heat stress also exists east of the Caribbean.

**REGIONAL OUTLOOK:**

Heat Stress is expected to continue accumulating within the Caribbean, raising the region’s status from No Stress to WARNING (Fig 10).

Three areas of concern exist: Along the Central American-South American border, heat stress is expected to intensify to ALERT LEVEL 2 and ALERT LEVEL 1 Status. Additionally, heat stress is expected to increase to ALERT LEVEL 1 in the Gulf of Mexico.

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