

NOAA Coral Reef Watch
Seasonal Coral Bleaching Thermal Stress Outlook
(Experimental product, 2x2 degree spatial resolution)

Analysis of Current Coral Bleaching Thermal Stress and Seasonal Guidance Through November 2010
(August 2010)

[Note: The Bleaching Outlook discussed below is an experimental product and should be used as an indicator of potential general patterns rather than a precise predictor of thermal stress at any location. Actual conditions may vary due to model uncertainty, subsequent changes in climatic conditions, extreme localized variability, or weather patterns.]

SUMMARY:

The NOAA Coral Reef Watch (CRW) [satellite coral bleaching monitoring](#) shows sea surface temperatures (SSTs) have been above average throughout the Caribbean and Gulf of Mexico, and are already above the bleaching threshold in some areas. The CRW [Coral Bleaching Thermal Stress Outlook](#) (Figure 1) indicates that there is a high potential for thermal stress capable of causing coral bleaching in the Caribbean in 2010. The intensity of the stress is likely to increase [until mid-October](#).

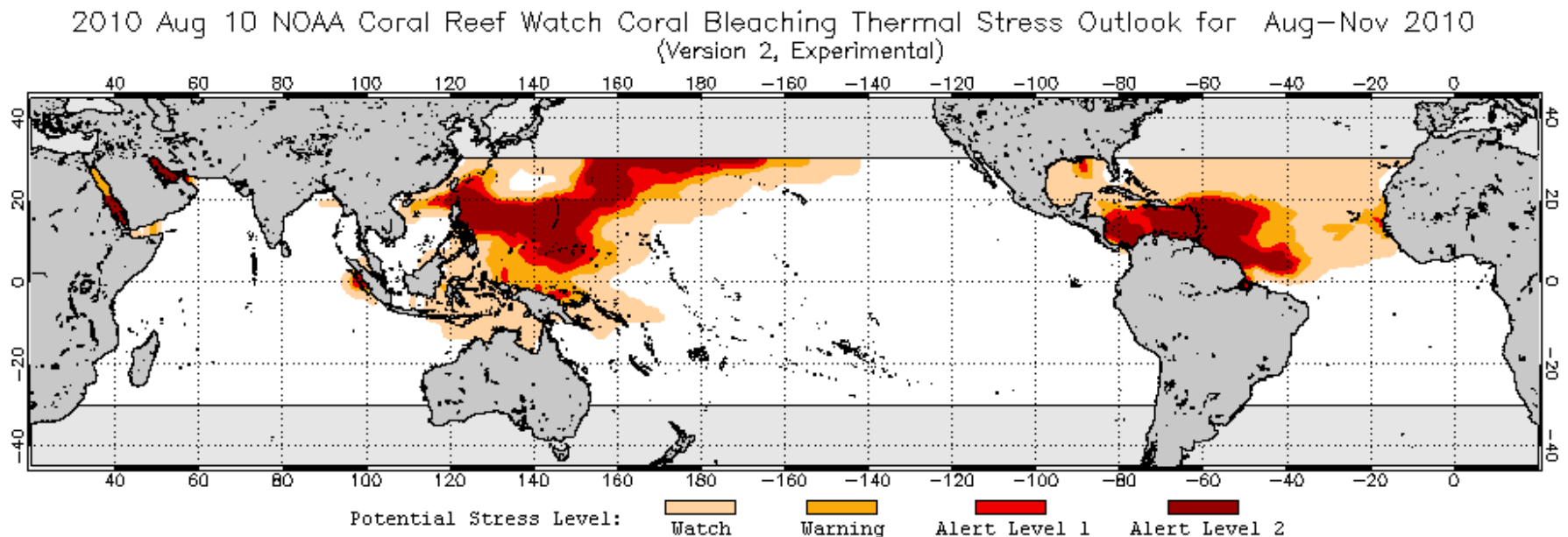


Figure 1. Global Coral Bleaching Thermal Stress Outlook for August–November 2010, issued on August 10, 2010.

According to the CRW HotSpot (Figure 2), there is currently bleaching-level thermal stress around a large region in the northwestern Pacific, with the highest stress currently centered on the Philippines. Note that clouds have covered these areas for a prolonged time period, so satellite data have not been updated regularly at many locations in this region. This may be causing the CRW products to overestimate the thermal stress. The outlook (Figure 1) shows that the thermal stress in the northeastern Philippines is expected to linger into September. The potential of high thermal stress is predicted to spread east into Guam, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, and the surrounding areas. Dissipation of this thermal stress may begin [in mid- to late-October](#).

The southern hemisphere and the entire Indian Ocean basin are expected to remain free from significant bleaching thermal stress through November 2010 (Figure 1).

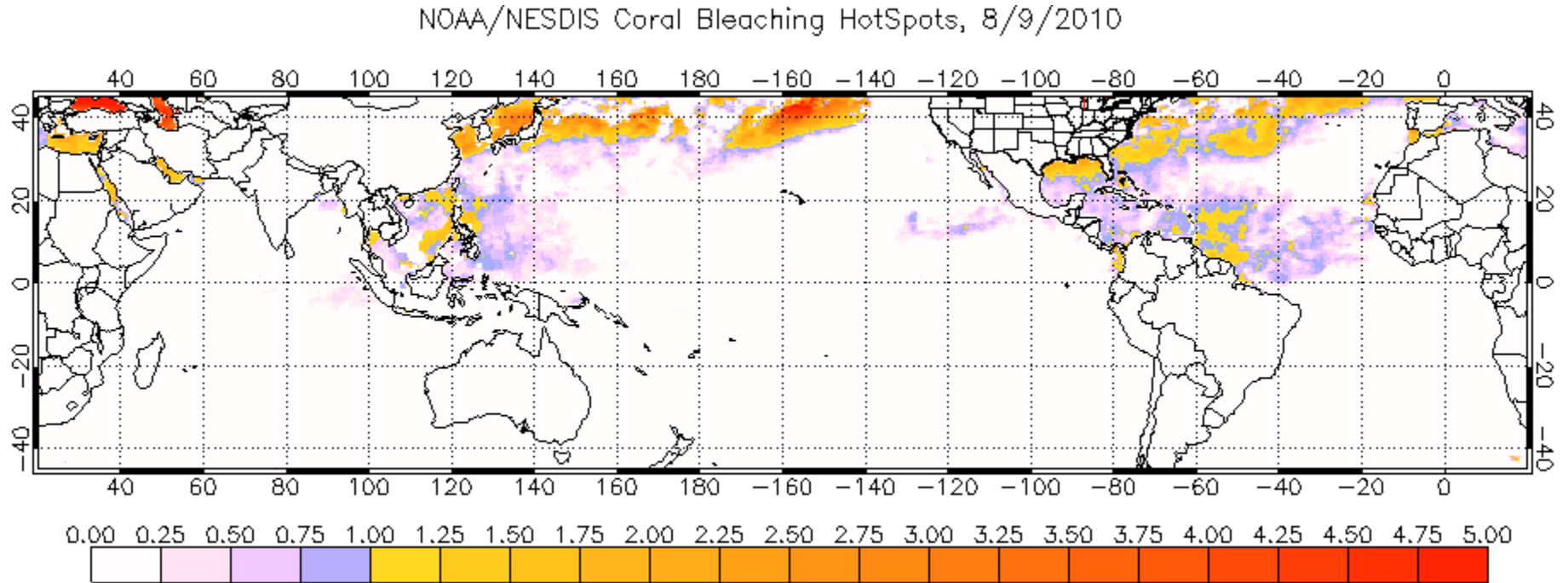


Figure 2. Global Coral Bleaching Thermal Stress HotSpot for August 9, 2010.

Caribbean Analysis and Outlook

Current conditions:

The CRW satellite monitoring shows that the development of thermal stress has already started in the Caribbean, bearing a similar signature to the thermal stress observed at the same time period in 2005, the year of a record mass coral bleaching event. SSTs in most of the Caribbean region and tropical Atlantic Ocean have been significantly above the normal for most of 2010 (Figure 3). Temperatures in the Gulf of Mexico and Florida Keys increased dramatically in early May, rising nearly 2°C over several days at some locations. Warming in Florida followed an extreme cold outbreak in January 2010 that resulted in significant coral mortality. Two tropical storms (Alex in June and Bonnie in July) and other tropical depressions have temporarily relieved some thermal stress in the northern Caribbean, Gulf of Mexico, and Florida Keys (Figure 3). However, the thermal stress has quickly bounced back in these areas (Figure 4). Bleaching recently has been reported from parts of Puerto Rico.

NOAA Coral Reef Watch Mean Satellite Nighttime Sea Surface Temperature Anomalies Jan–Jul 2010

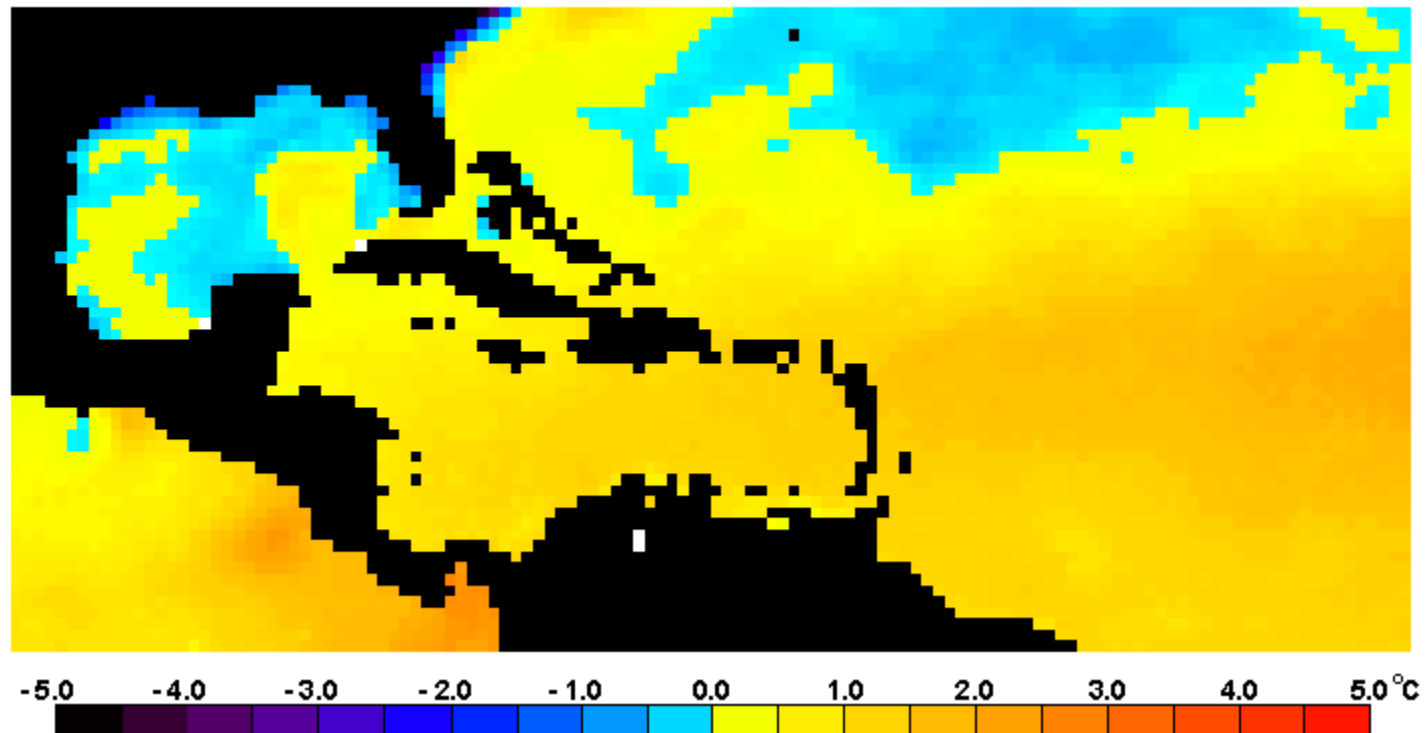


Figure 3. Mean SST anomaly for January-June 2010 in the Caribbean region.

NOAA/NESDIS SST Anomaly (degrees C), 8/9/2010

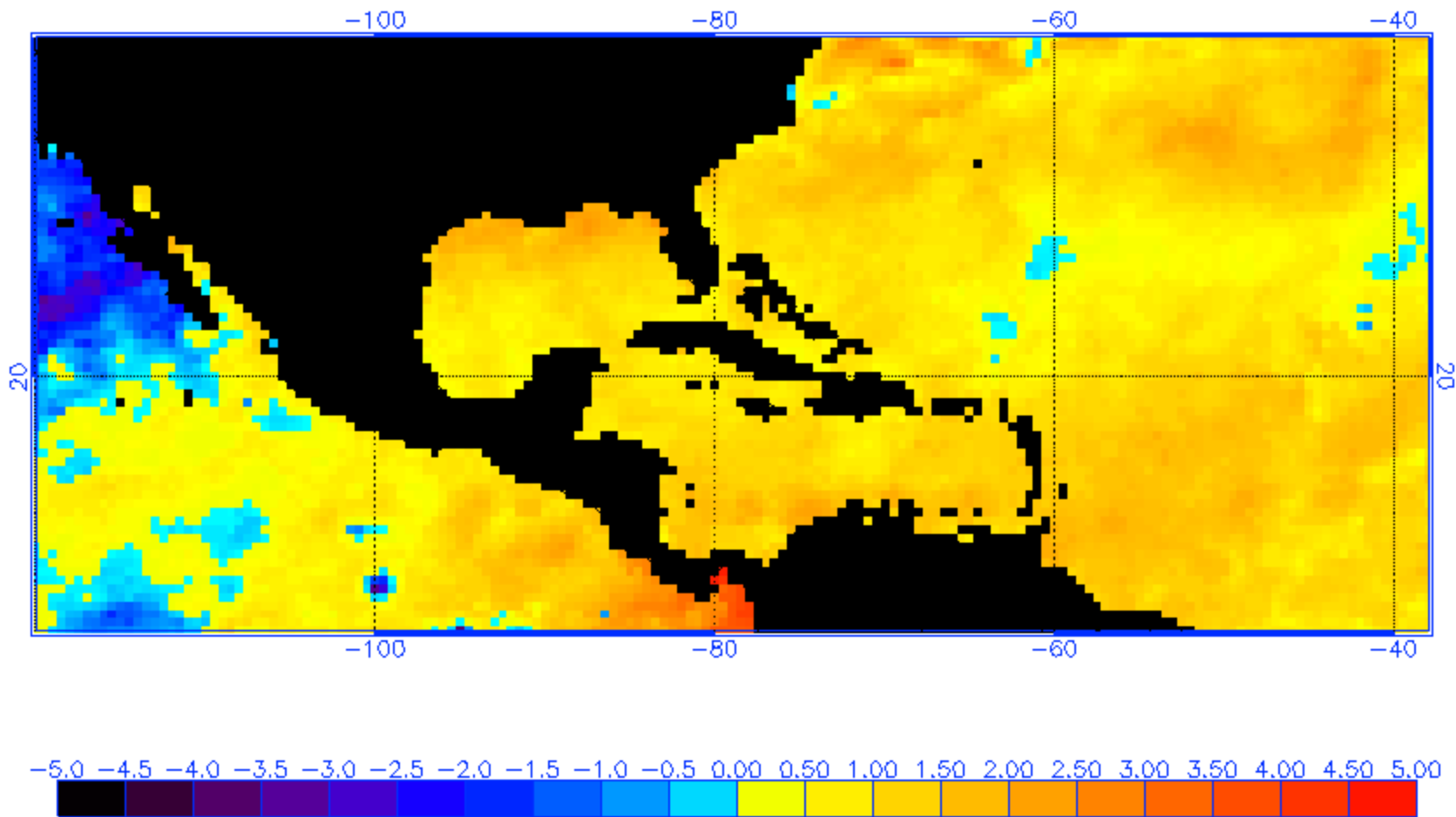


Figure 4. SST anomaly of August 9, 2010 in the Caribbean region.

Degree Heating Weeks (Figure 5) currently show low to medium levels of thermal stress built up in the northern Bahamas and the central Lesser Antilles island arc, centered east of Dominica and Guadeloupe. DHWs around 4, high enough to cause significant bleaching, have been observed on the Caribbean coast of Panama and Costa Rica.

NOAA/NESDIS Degree Heating Weeks for last 12 Weeks – 8/9/2010

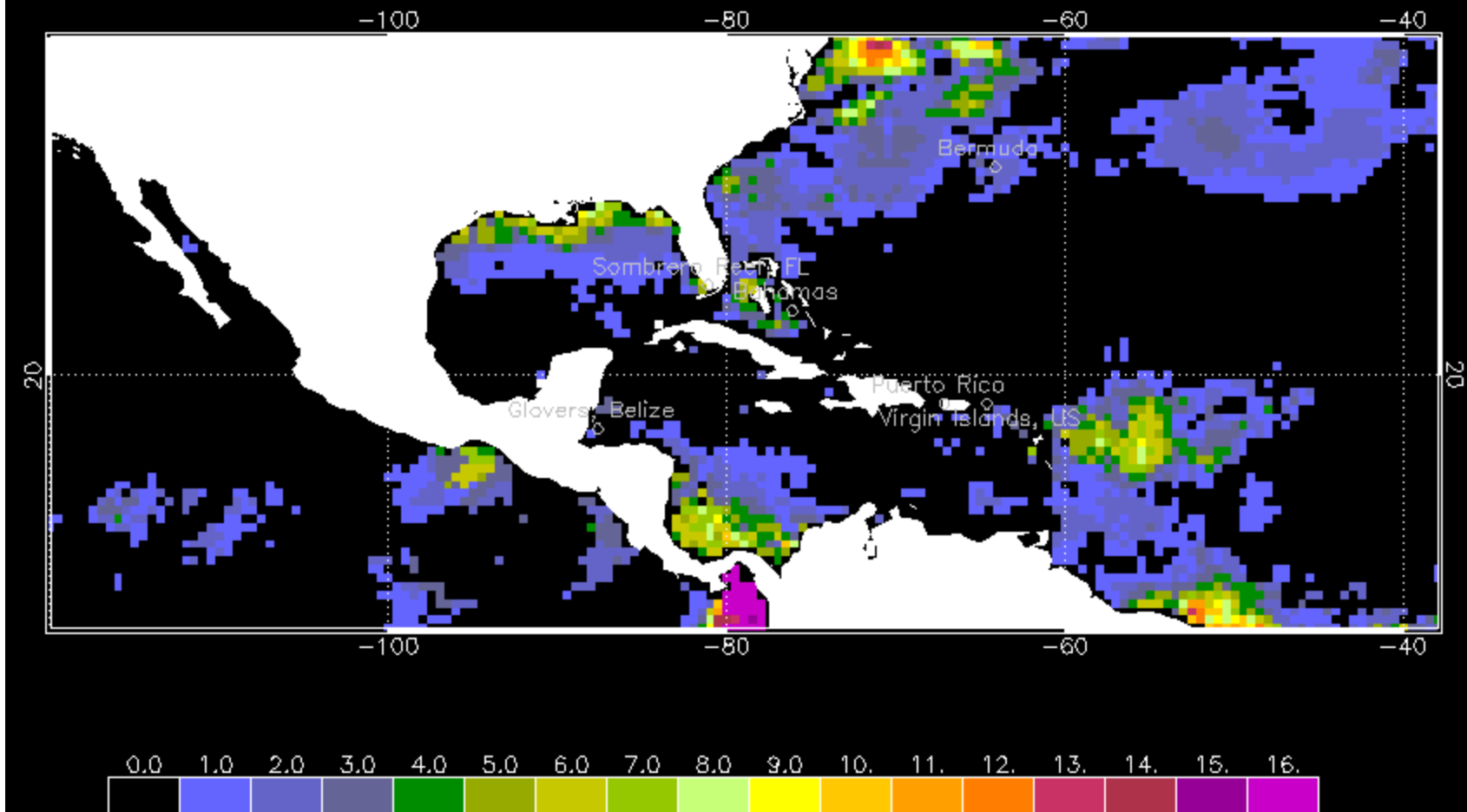


Figure 5. Degree Heating Weeks from August 9, 2010 show the accumulated thermal stress that can lead to coral bleaching.

Bleaching outlook:

The CRW Coral Bleaching Thermal Stress Outlook continues to indicate a high potential for thermal stress capable of causing significant coral bleaching in the Caribbean in 2010 (Figure 6). The region potentially at greatest risk fills the region east from Nicaragua past the island of Hispaniola to Puerto Rico and the Lesser Antilles, and south along the Caribbean coasts of Panama and South America. The intensity of the potential thermal stress is predicted to increase [until mid-October](#). The Caribbean typically experiences elevated temperature during the second year of an El Niño event, with the 2009-2010 El Niño ending in May 2010. The region described here as having the highest potential to experience bleaching-levels of thermal stress is the same region that has been anomalously warm for most of 2010.

2010 Aug 10 NOAA Coral Reef Watch Coral Bleaching Thermal Stress Outlook for Aug–Nov 2010
(Version 2, Experimental)

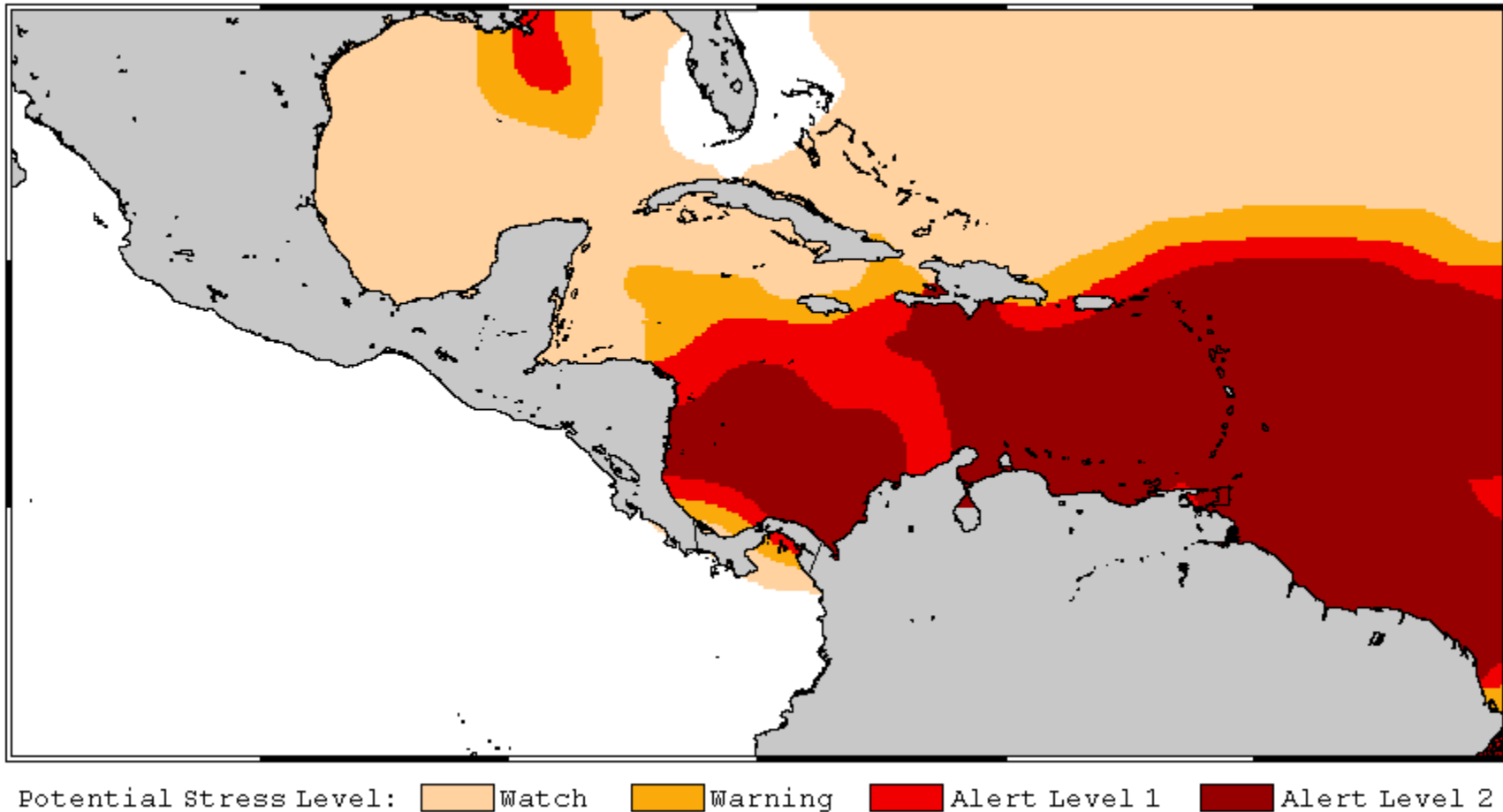


Figure 6. Caribbean Coral Bleaching Thermal Stress Outlook for August-November 2010, issued on August 3, 2010.

Comparison to the 2005 mass bleaching event:

In 2005, a record breaking mass coral bleaching event in the Caribbean along with the most active hurricane season on record in the Atlantic Ocean followed a similar pre-bleaching season SST anomaly pattern. This preheating increases the likelihood that temperatures will exceed bleaching thresholds during the following bleaching season, indicating high potential for thermal stress above levels required for significant coral bleaching.

In 2005, the active hurricane season cooled waters in the Florida Keys and Gulf of Mexico greatly reducing the coral bleaching stress. However, the lack of tropical cyclones around the Lesser Antilles contributed to consistently warm temperatures in the epicenter of the 2005 mass coral bleaching event. This year, two tropical storms (Alex in June and Bonnie July) and other tropical depressions have temporarily relieved some thermal stress in the northern Caribbean, Gulf of Mexico, and Florida Keys (Figure 3). However, the thermal stress has quickly bounced back in these areas (Figure 4). Given the record-breaking mass coral bleaching in 2005 and the similarity in the pattern of the thermal stress between this year and 2005, the development of this year's thermal stress in the Caribbean needs to be monitored closely.

Northwestern Pacific Analysis and Outlook:

Current conditions:

The thermal stress that caused bleaching in Southeast Asia has abated, but stress has moved into the central and northern Philippines (Figure 7). Temperatures across much of the western tropical Pacific are above normal at the moment, especially along the west coast of the Philippines where bleaching has been reported. However, the Alert Level 2 areas seen in the Gulf of Thailand and the eastern South China Sea may be over-estimated, as three months of persistent cloud cover have prevented updates to the satellite SST data since May 2010 at some locations.

NOAA Coral Reef Watch Satellite Coral Bleaching Alert Area
09 Aug 2010

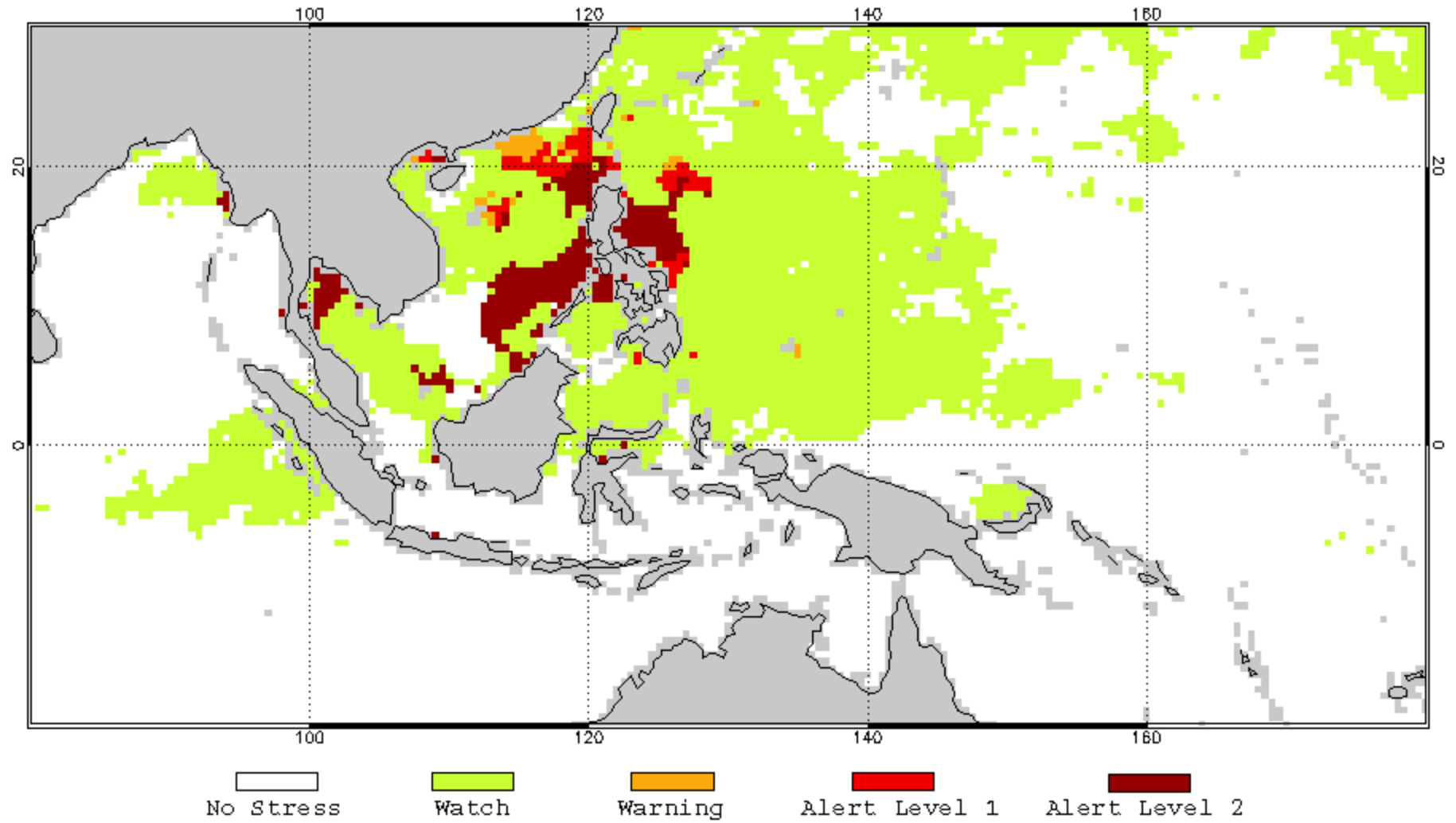


Figure 7. CRW satellite coral bleaching alert areas of August 5, 2010.

Bleaching outlook:

The high temperatures that have caused mass coral bleaching in the Philippines may persist in the northern-most Philippines [into September](#). As the summer continues in the northern hemisphere, our outlook (Figure 8) shows that temperatures in the northwestern Pacific will increase during the next few months. The outlook indicates that there is a high potential of thermal stress capable of causing bleaching in Guam, CNMI (Commonwealth of the Northern Mariana Islands), FSM (Federated States of Micronesia), and the surrounding areas [until late October and early November](#).

2010 Aug 10 NOAA Coral Reef Watch Coral Bleaching Thermal Stress Outlook for Aug–Nov 2010
(Version 2, Experimental)

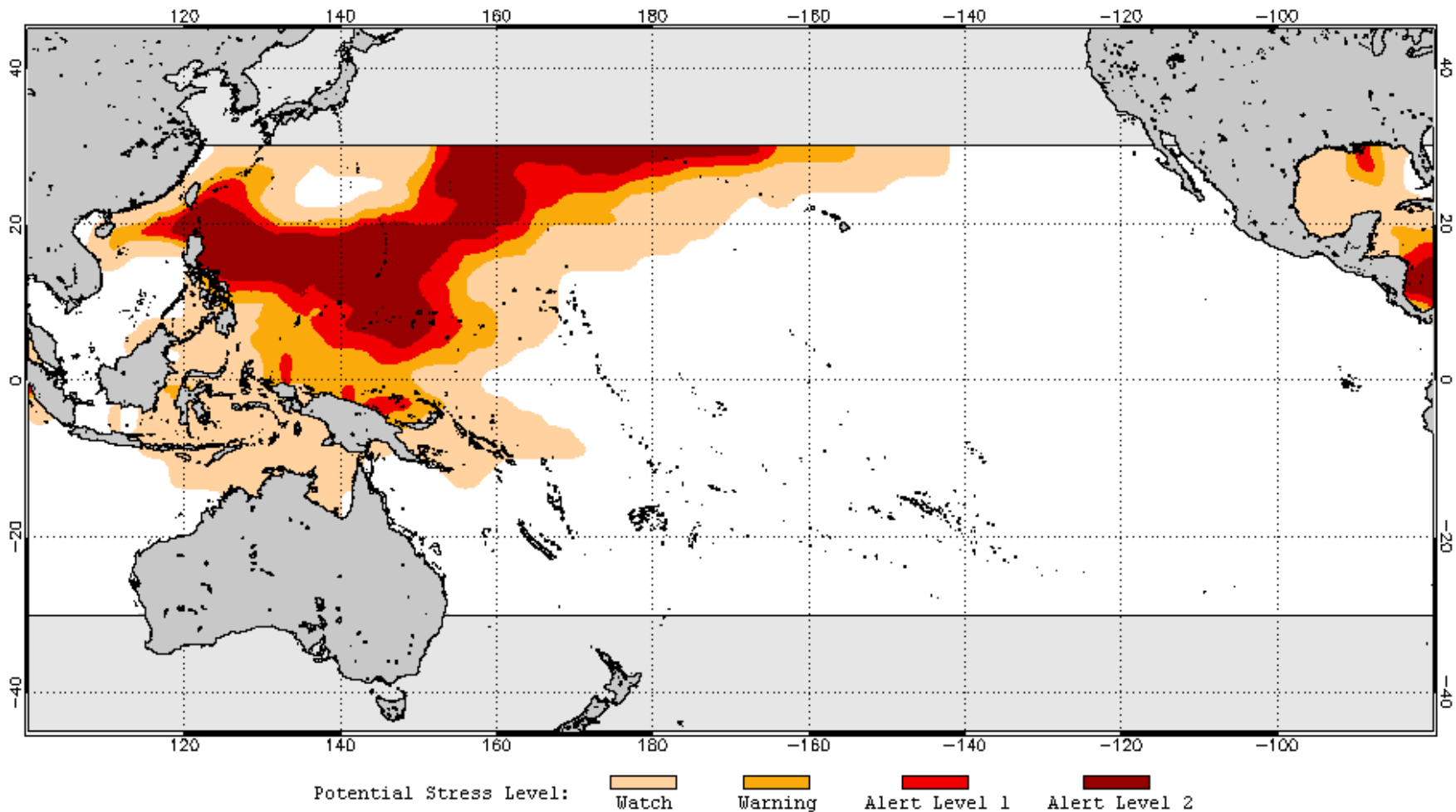


Figure 8. Pacific Ocean Coral Bleaching Thermal Stress Outlook for August–November 2010, issued August 10, 2010.

Indian Ocean 2010 Bleaching Season Retrospective:

With the 2009-2010 El Niño, the Indian Ocean experienced significant coral bleaching thermal stress since the beginning of this year in a spatial pattern similar to that seen in 1998 (Figure 9). Most of the northern Indian Ocean and Southeast Asia regions have been experiencing intensive thermal stress. Significant bleaching has been reported in the Maldives, both sides of the Thai Peninsula (Andaman Sea and Gulf of Thailand), Malaysia, Singapore, Cambodia, parts of Indonesia, and the Anilao region of the Philippines. Bleaching was observed in southwestern and northeastern Madagascar earlier this year.

NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area Jan–Jul 2010

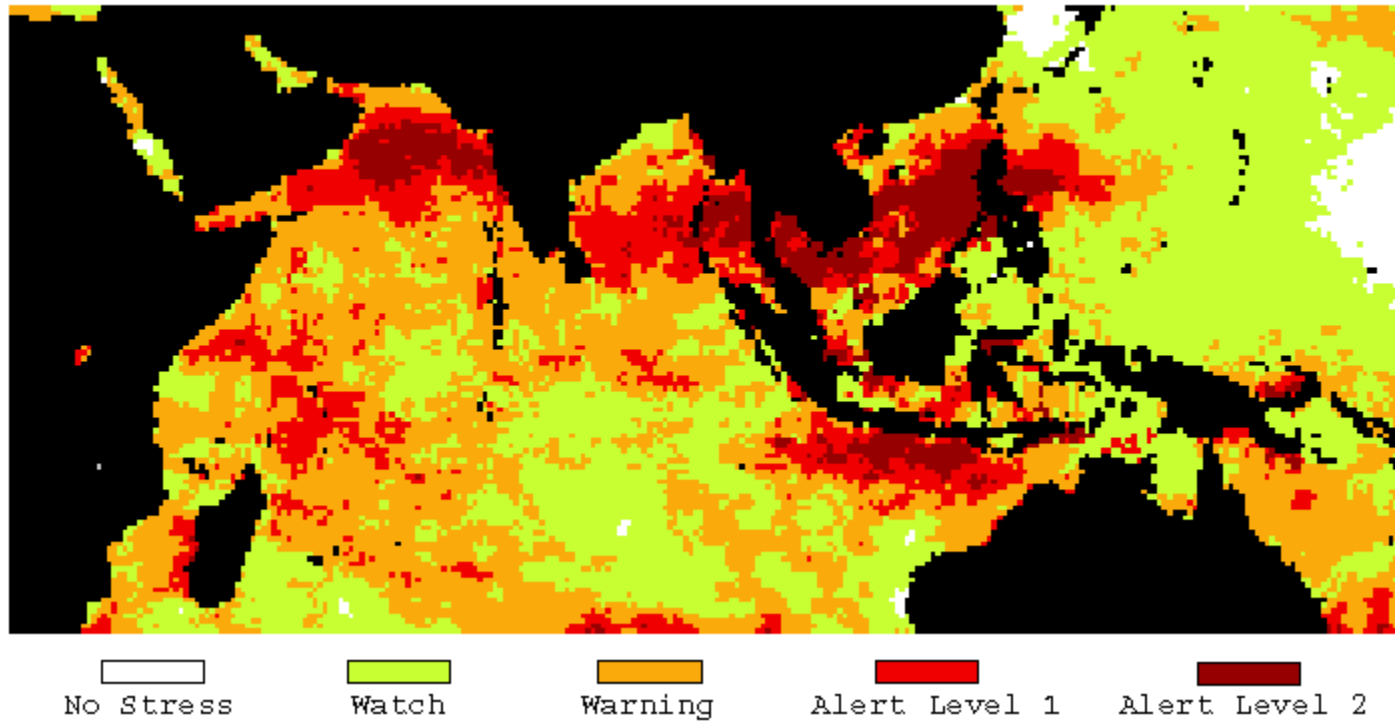


Figure 9. Maximum level of bleaching thermal stress in January–July 2010.

The thermal stress has now dissipated in the Indian Ocean and most of Southeast Asia. Many areas in this region have been experiencing persistent cloud cover since early May, which should be favorable for corals. recovery from the mass bleaching.

The CRW Bleaching Outlook has been predicting well the overall high thermal stress in the Indian Ocean since the beginning of 2010,

indicating an active bleaching season (Figure 10). However, our the outlook issued earlier this year under-predicted the high thermal stress observed in the Bay of Bengal (Figure 9) and over-predicted the thermal stress in the region off Sumatra where low levels of thermal stress were observed. This is most likely caused by the relatively low skill level of the LIM model (the SST prediction model of the CRW outlook system) in this region in the Bay of Bengal and off Sumatra. Further evaluation and testing of a new scheme to refine the LIM are underway to improve the skill in this region.

2010 Mar 16 NOAA Coral Reef Watch Coral Bleaching Thermal Stress Outlook for Mar–Jun 2010

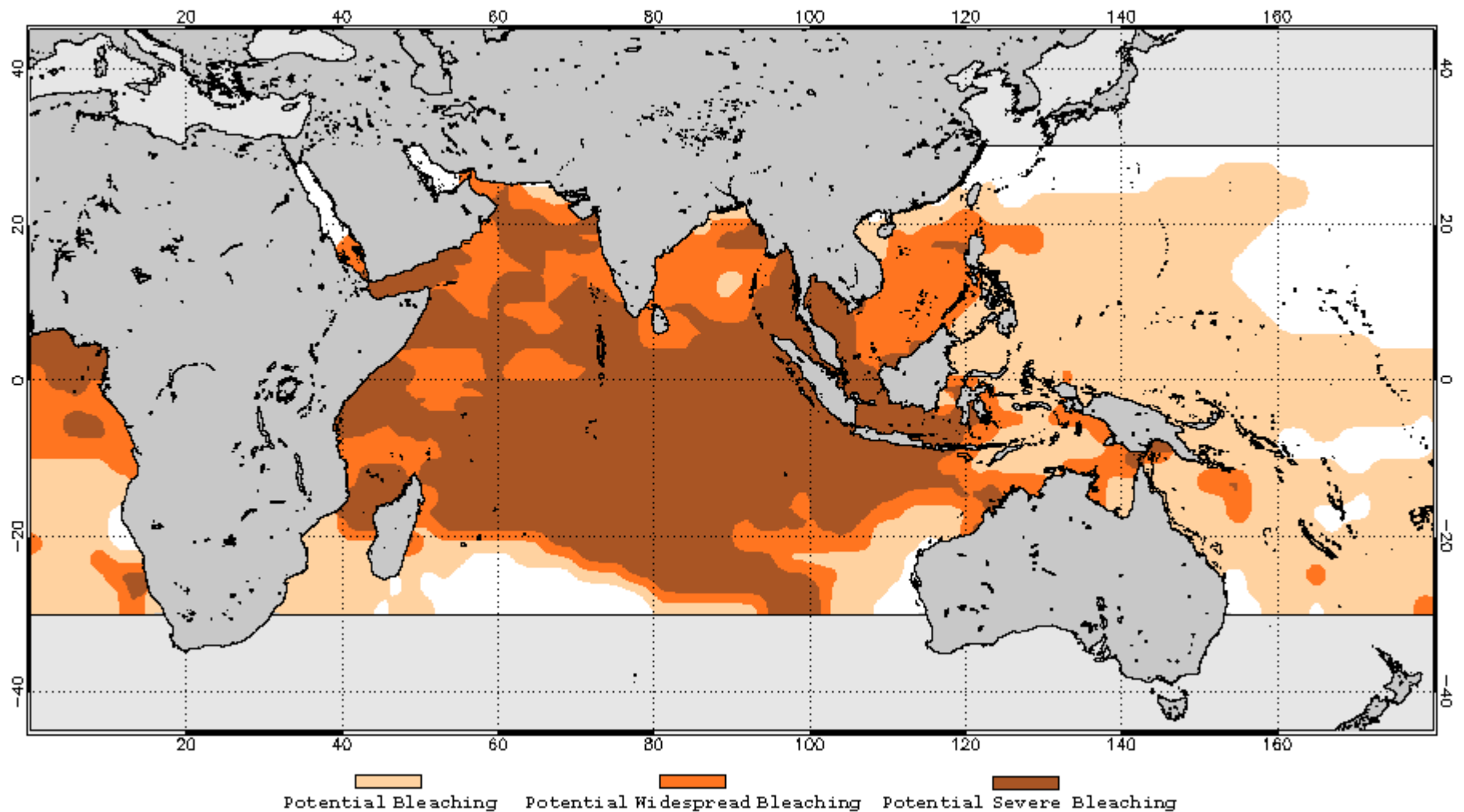


Figure 10. Indian Ocean Coral Bleaching Thermal Stress Outlook for March-June 2010, issued on March 16, 2010

About Coral Reef Watch's new Coral Bleaching Seasonal Outlook product (Version 2):

An improved version (Version 2) of the CRW Coral Bleaching Seasonal Outlook product was released this month along with this bleaching alert message. Except for Figure 10 and Figure 11 used in comparisons below, all Outlook images used in this alert message are from the Version 2 outlook product. CRW has implemented a significantly improved outlook algorithm for deriving bleaching thermal stress levels from sea surface temperature forecasts in this new version. This new version improves the accuracy of the outlook both in predicting the timing of the development of the thermal stress and also the intensity of the predicted thermal stress. For instance, this new version greatly reduced the overestimation of the 2009 thermal stress in the Caribbean when compared to Version 1 of the outlook (Figure 11). We have also adjusted our categories of potential bleaching thermal stress levels to include five different stress levels that match the stress levels used in CRW Bleaching Alert Area satellite monitoring product. This will enable readers to directly compare thermal stress categories between the Outlook and observations.

Figure 11 shows the bleaching outlook for the 2009 Caribbean bleaching season, produced by the previous (Version 1) bleaching outlook system, where the potential widespread bleaching level was estimated for most of the Caribbean region and the potential severe bleaching level was estimated for a portion of the eastern Caribbean.

2009 Jul 07 NOAA Coral Reef Watch Coral Bleaching Thermal Stress Outlook for Jul-Oct 2009

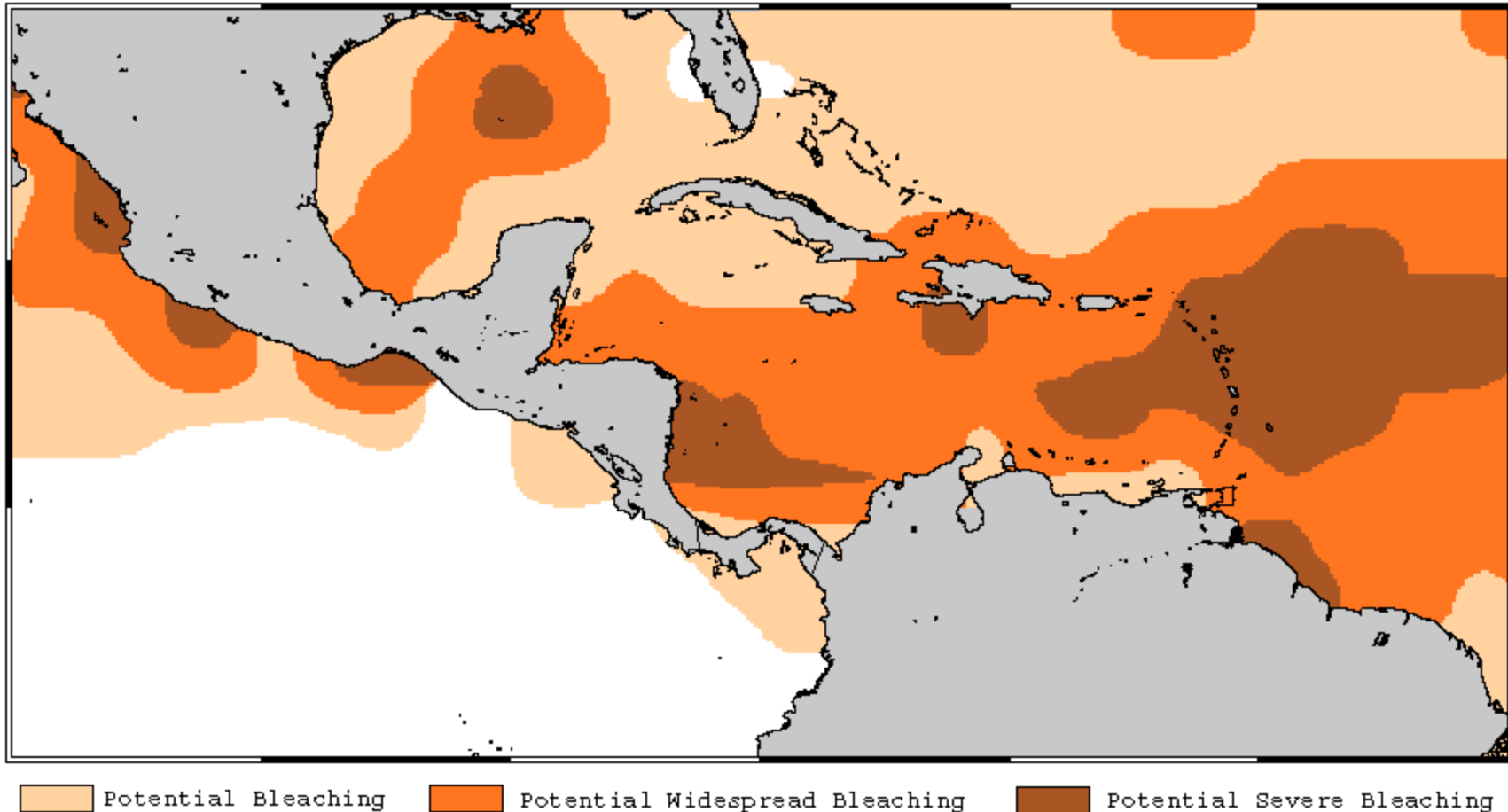
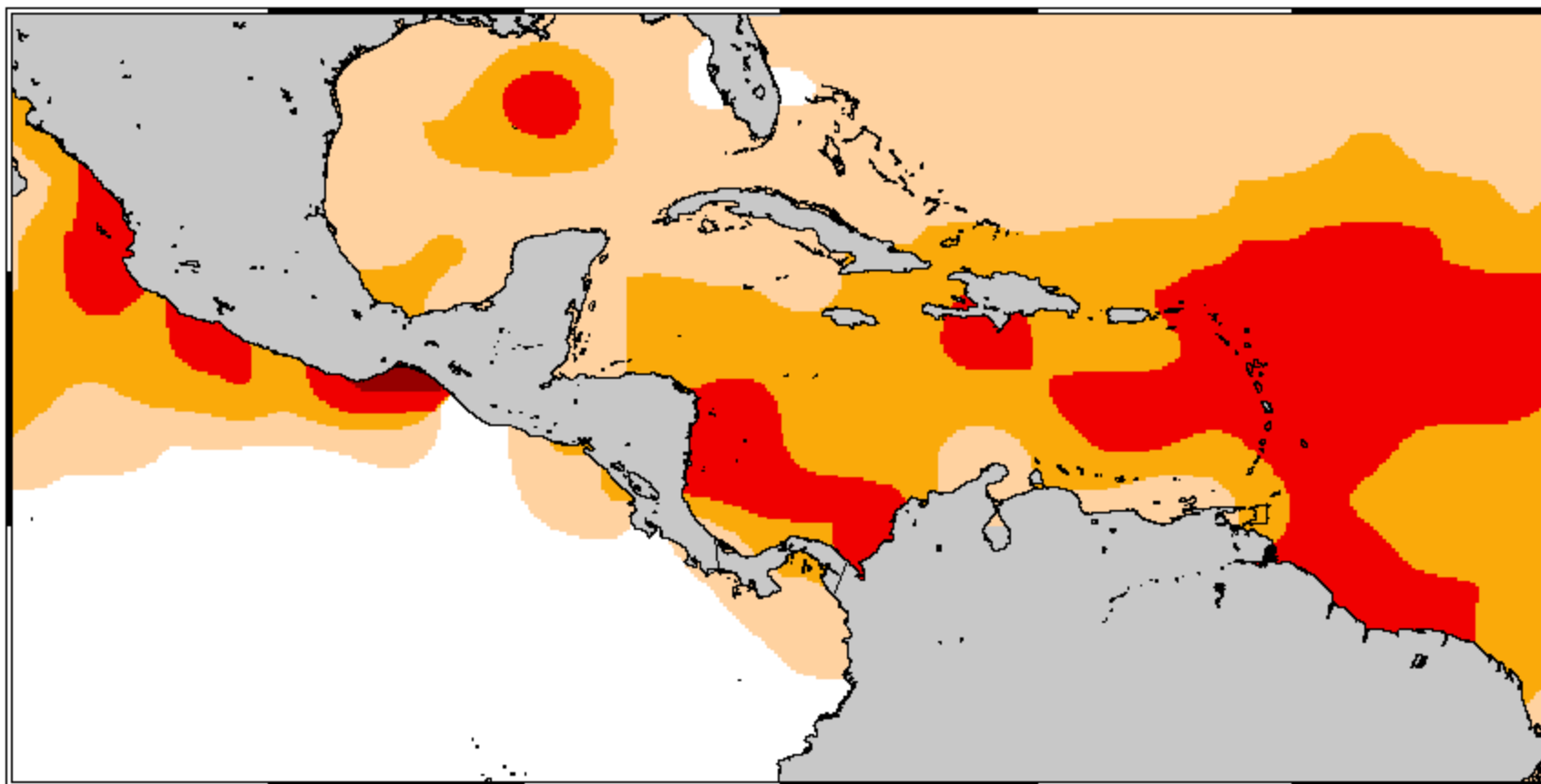


Figure 11. Version 1 Coral Bleaching Thermal Stress Outlook for the 2009 Caribbean bleaching season (July-October), issued on July 7, 2009.

The retrospective bleaching outlook for the same time period (July-October) of 2009 (Figure 12), produced by the new Version 2 bleaching outlook system indicates that the maximum potential thermal stress reached only Alert Level 1 - a level of thermal stress at which bleaching is usually seen but not severe. The potential thermal stress predicted by this new outlook matches much better the observed thermal stress present in the region in 2009 (Figure 13), reducing the over-prediction seen in many recent years in the version 1 Outlook.

2009 Jul 07 NOAA Coral Reef Watch Coral Bleaching Thermal Stress Outlook for Jul–Oct 2009
(Version 2, Experimental)



Potential Stress Level: Watch Warning Alert Level 1 Alert Level 2

Figure 12. Retrospective Version 2 Coral Bleaching Thermal Stress Outlook for the 2009 Caribbean bleaching season (July–October).

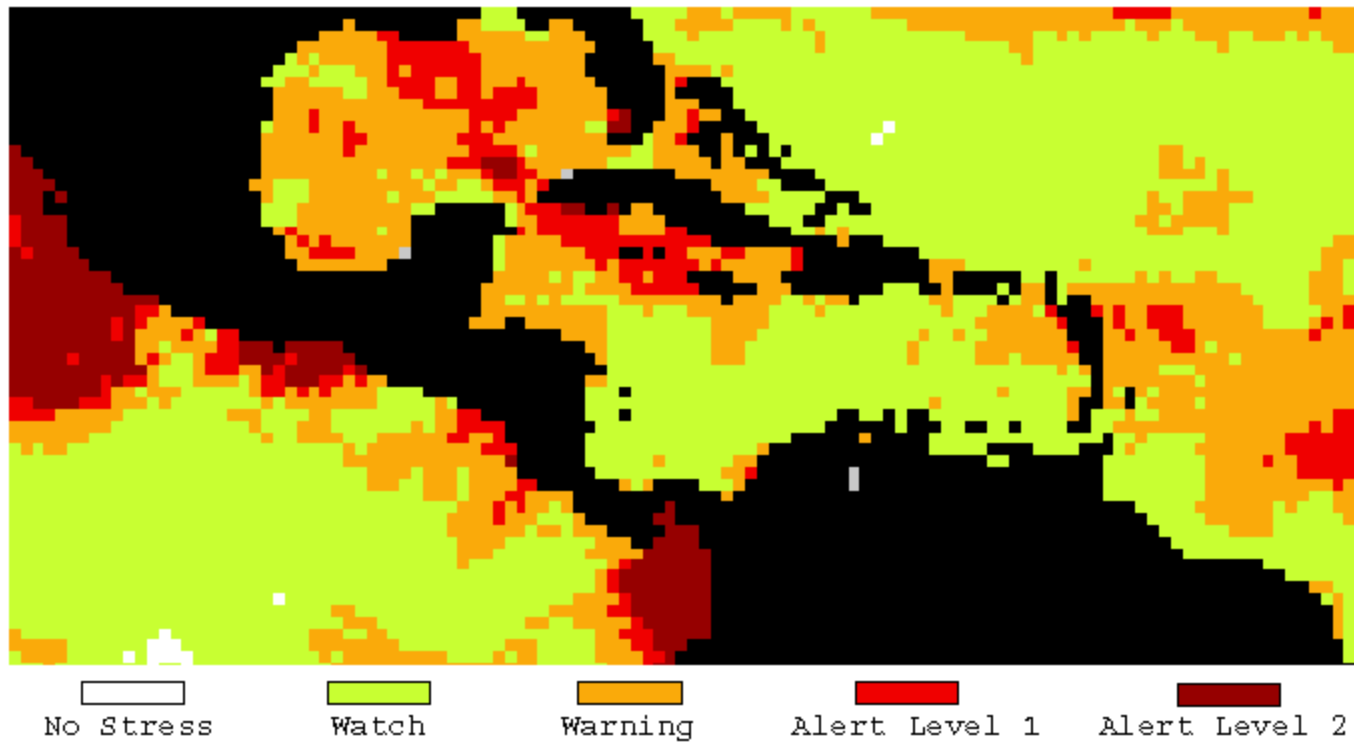


Figure 13. Maximum level of bleaching thermal stress for 2009.

While Version 2 still over-predicted the thermal stress in the eastern Caribbean during 2009 and did not predict the warming along the southern coast of Cuba and the Caymans, it is important to remember that the outlook system only provides guidance on the potential for bleaching-level stress. Actual weather patterns will frequently vary from the model in strength and location.