

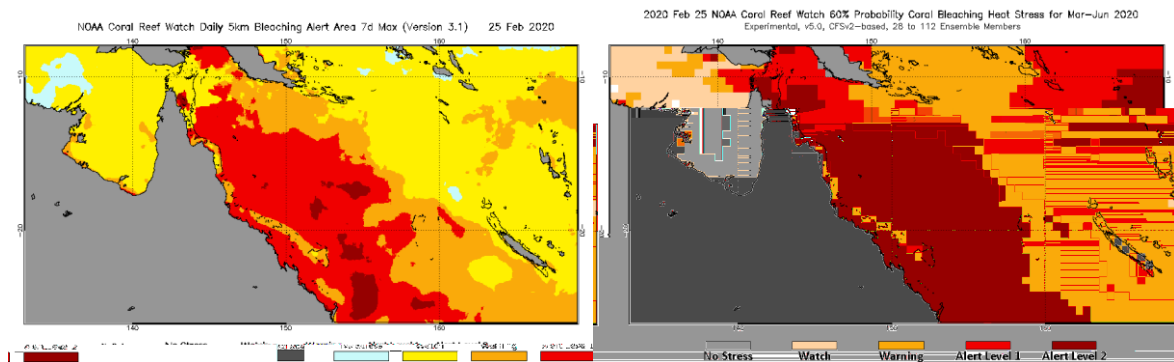
Status of Bleaching Heat Stress on the Great Barrier Reef, Australia – 2020

Published: February 25, 2020

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Summary:

NOAA Coral Reef Watch's (CRW) near real-time satellite products and modeled Outlook are indicating that in early 2020, it is likely the Great Barrier Reef (GBR) in Australia will experience its most widespread coral bleaching event in recent years. Current predictions suggest that this event is likely to be less severe than some of the more recent mass bleaching events (e.g., [2016 and 2017](#)), but that the most severe bleaching is expected in the far northern portion of the GBR (which was severely impacted in [2016](#)) and in the far southern reef areas. Additionally, peak bleaching will likely occur between February 25 and March 6, 2020 – unless weather patterns maintain heavy cloud cover over the GBR during this time.



NOTE: The NOAA CRW program has a suite of [daily global 5km-resolution satellite-based products](#) that help users understand the status and possible future of heat stress, which can lead to coral bleaching. The following information is intended to assist users as they follow the heat stress event currently unfolding on the GBR. While this discussion restricts itself to using CRW products, it is important to recognize that there are other sources of useful information that can assist the interpretation of CRW's products. These include the Australian Bureau of Meteorology's (BoM) [ReefTemp](#) heat stress monitoring products, and its [Australian Community Climate Earth-System Simulator-Seasonal \(ACCESS-S\)](#) seasonal forecast for coral bleaching risk. In addition, users may want to keep an eye on the BOM's [satellite images of cloud cover](#) and the [four-day weather forecast maps](#) (Mean Sea Level Pressure Prognosis).

Current Conditions (as of February 25, 2020):

Since early January 2020, sea surface temperatures (SSTs) along the GBR have been greater than the stress threshold (Maximum Monthly Mean, MMM). This has resulted in [Coral Bleaching HotSpots](#) greater than 1°C for the majority of the GBR (Figure 1). This means that

the majority of the GBR is currently accumulating harmful heat stress that can lead to coral bleaching.

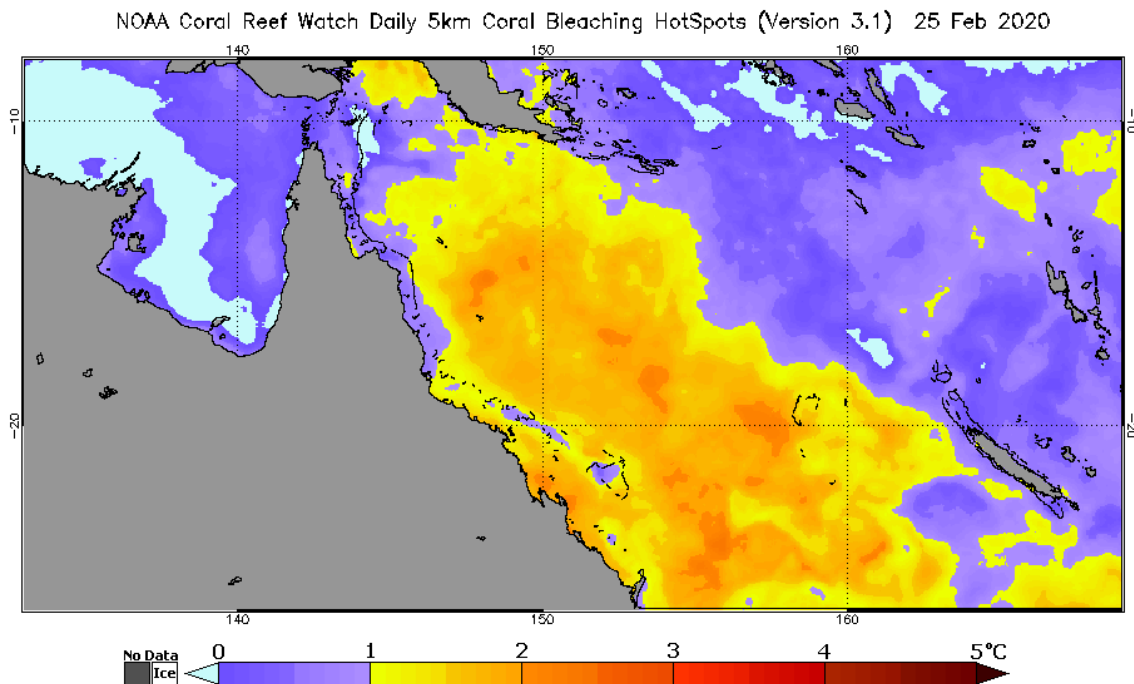


Figure 1. CRW's [daily global 5km Coral Bleaching HotSpot](#) values show that most of the GBR is currently accumulating heat stress that leads to coral bleaching, as indicated by the yellow and orange coloring in the image.

CRW's [daily global 5km 7-Day SST Trend](#) (Figure 2) provides a measure of the change in SST over the past week. When combined with the Coral Bleaching HotSpot (Figure 1), the SST Trend product helps clarify if the heat stress accumulation has been increasing or decreasing.

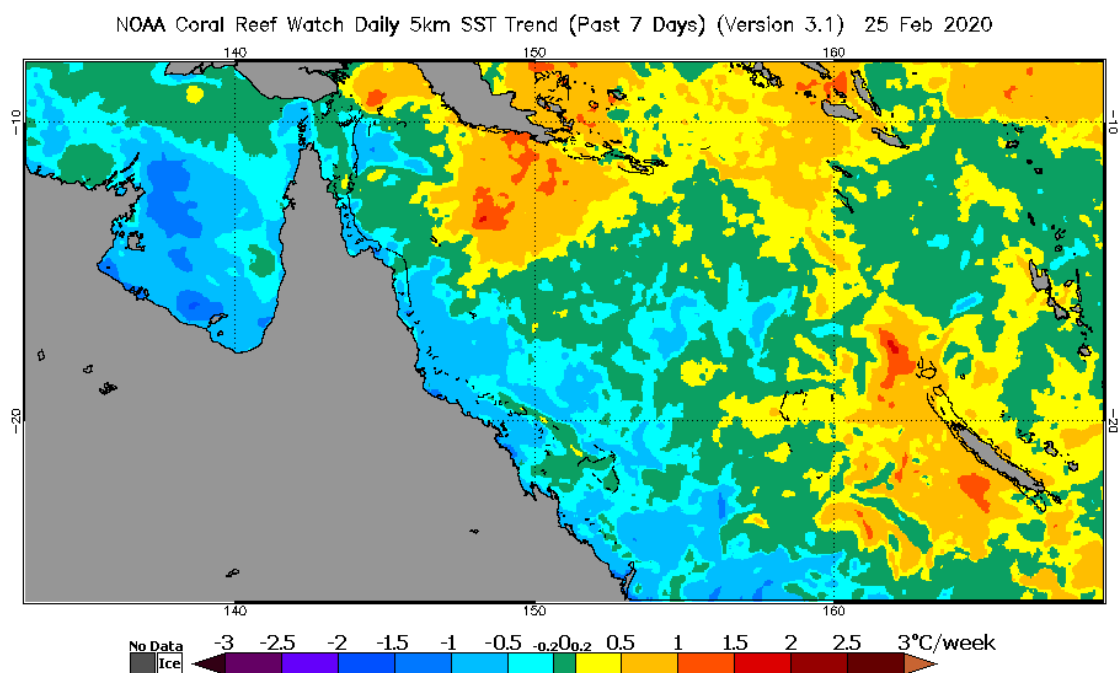


Figure 2. CRW's [daily global 5km 7-Day SST Trend](#) product shows temperature trends along the GBR over the past week.

CRW's [daily global 5km coral bleaching Degree Heating Week \(DHW\)](#) product (Figure 3) depicts the current level of accumulated oceanic heat stress. This is the key factor that determines coral bleaching. The entire GBR has been accumulating DHWs and, hence, damage from heat stress. A DHW above 0, but below 4, is considered the period when bleaching starts. By a DHW of 4, significant bleaching can be expected. Once DHW values increase to 8 and above, severe, widespread bleaching and significant mortality of heat-sensitive species are expected.

The actual DHW value at which bleaching becomes significant on a reef can vary from event to event. Previous GBR observations suggest that by a DHW of 4, significant bleaching is underway and observable. We don't definitively know why the difference exists from one event to another. However, research suggests that contributing factors include, but are not limited to, light levels, a change in species composition of reefs following previous mortality events, pre-conditioning, adaptation, and different oceanographic conditions.

Note that most of the GBR's DHW values are lower than they are in the deeper surrounding waters, due to the strong tides up and down the GBR. The tides affect the mixing of hot surface waters with cooler subsurface waters. This manifests as cooler water at the surface and is an extremely important mechanism to consider when assessing the potential for coral bleaching on the GBR.

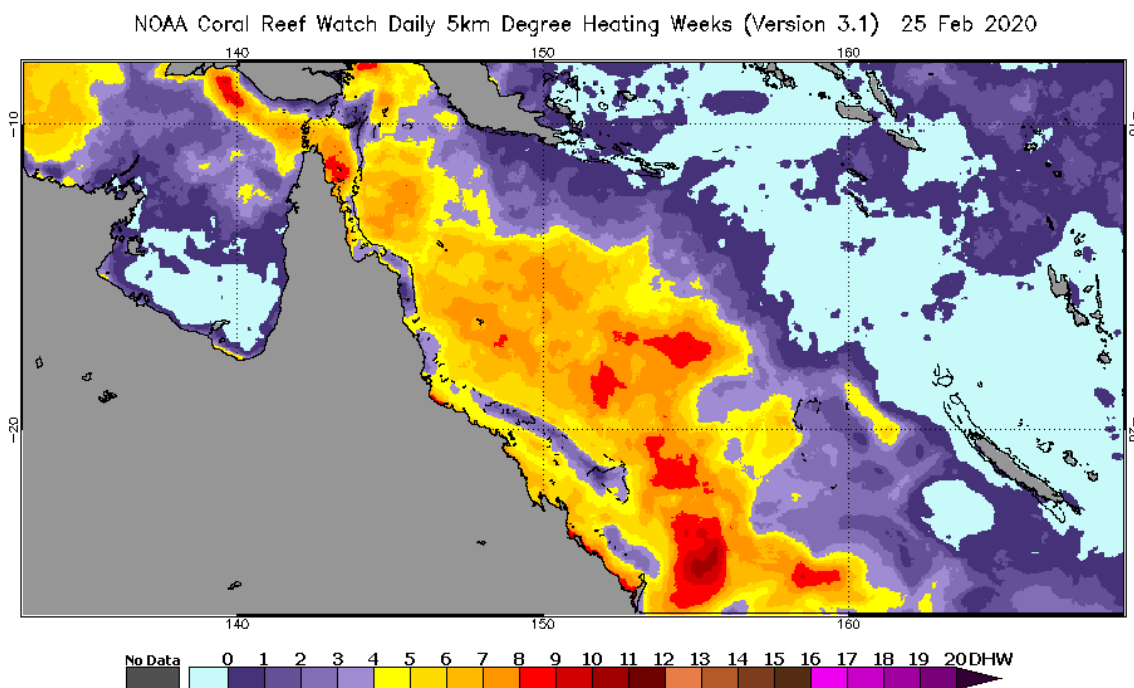


Figure 3. CRW's [daily global 5km satellite coral bleaching DHW](#) product shows accumulated heat stress leading to coral bleaching along the GBR.

Figure 4 is a plot of the tidal range at Townsville, Australia (approximately midway along the GBR). It can be used as a very rough proxy for mixing along the GBR, where a high tidal range has stronger currents, and hence more mixing, than periods where the tidal range is relatively small with weaker currents and hence less mixing. The plot suggests a period of relatively weak mixing is expected between February 25 and March 6, 2020. If weather conditions are

conducive to bleaching during this period, given that the GBR is already accumulating oceanic heat stress, it is likely that widespread coral bleaching will occur.

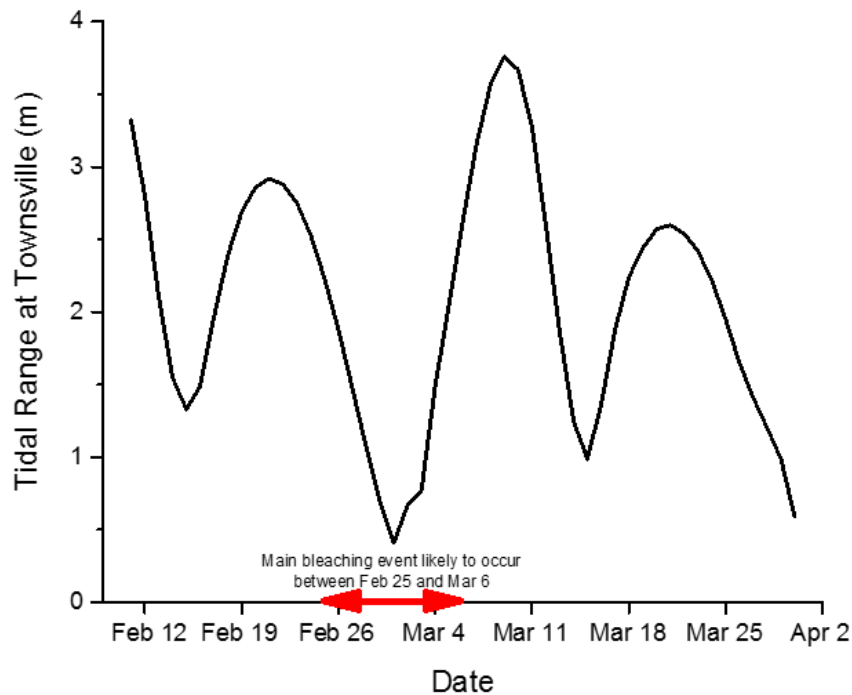
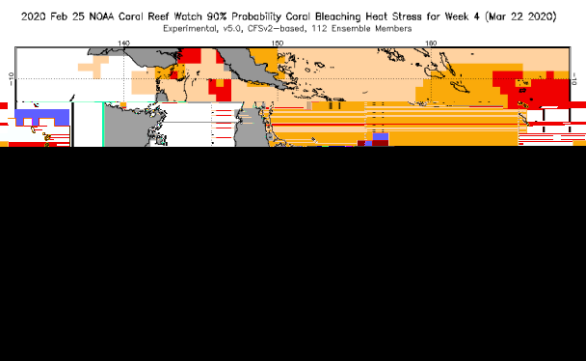
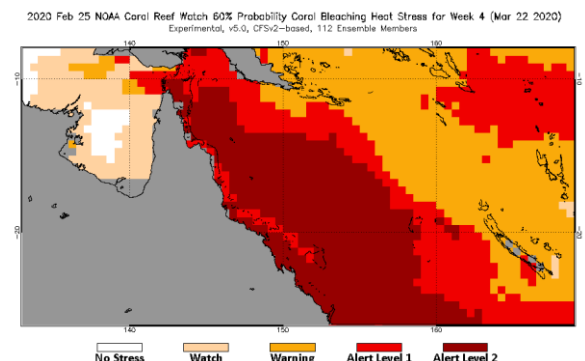
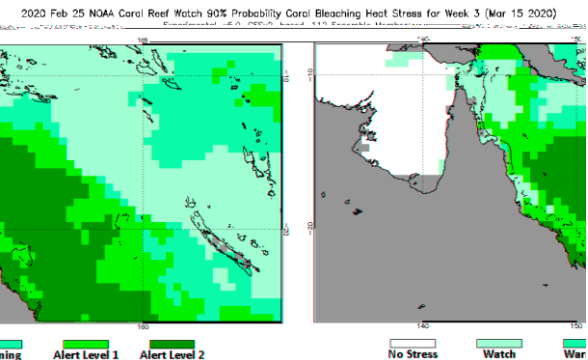
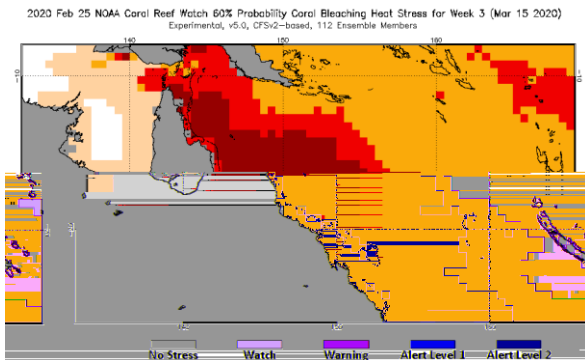
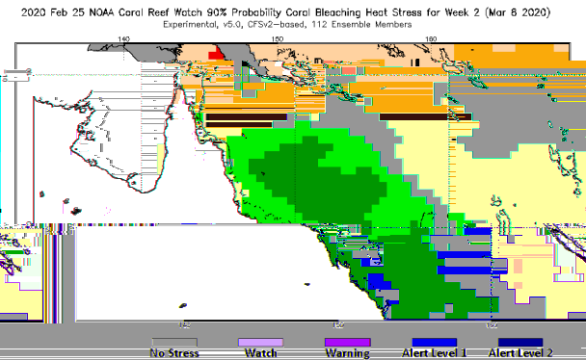
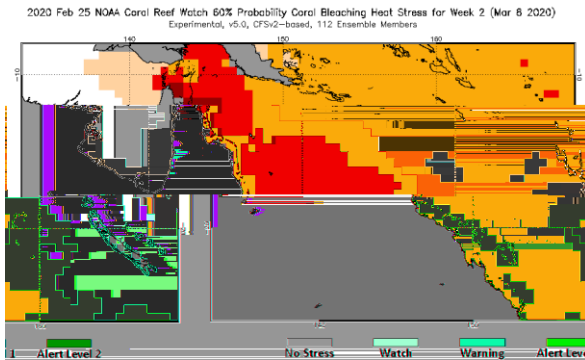
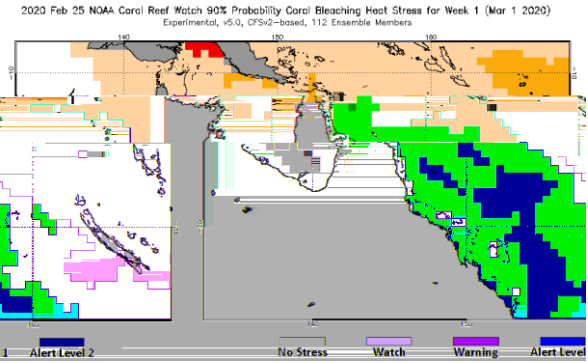


Figure 4. Plot of Townsville, Australia tidal range for February 11 to March 30, 2020.

So with this in mind, let us take a look at heat stress on the GBR over the next couple of weeks. To do this, we use CRW's modeled [Four-Month Coral Bleaching Outlook](#). The Outlook product is updated once per week (each Wednesday, Queensland, Australia time).

Figures 5 and 6 are the various Outlook forecasts for the likelihood for coral bleaching on the GBR for the next five weeks. They suggest that heat stress will cause bleaching across the entire length of the GBR. More specifically, the Outlook suggests that the week with the highest probability of bleaching (Figure 6) is the period nearest the neap tides, centered on March 1, 2020. It's worth noting that the Outlook does not have tidal mixing embedded in the model, and yet we know that tidal mixing has a huge influence over heat stress on the GBR.



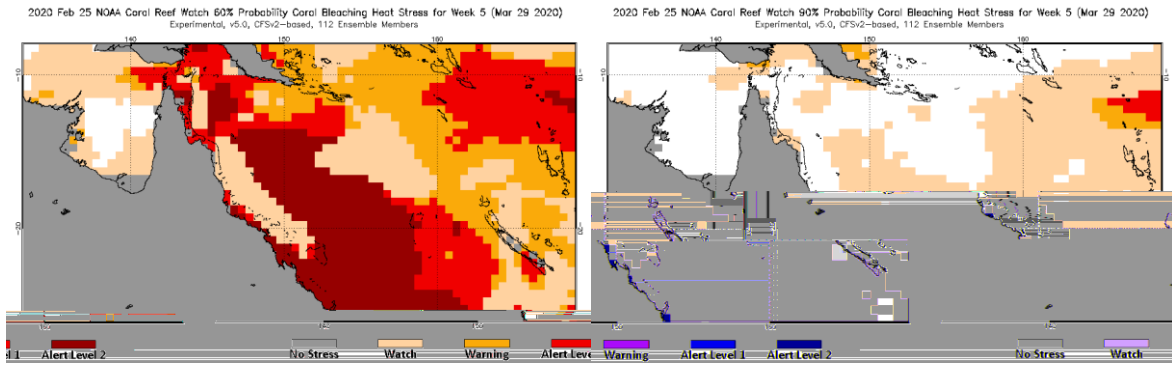


Figure 5. CRW's current [Four-Month Coral Bleaching Outlook](#), for the next five weeks, for the GBR region. Each row in the 2x5 panels represents the predicted accumulated heat stress for the week beginning March 1 (row 1), March 8 (row 2), March 15 (row 3), March 22 (row 4) and March 29, 2020 (row 5). The left image in each row shows the levels of heat stress predicted along the GBR by 60% of the model's ensemble members; the right image indicates the levels of heat stress predicted by 90% of the ensemble members.

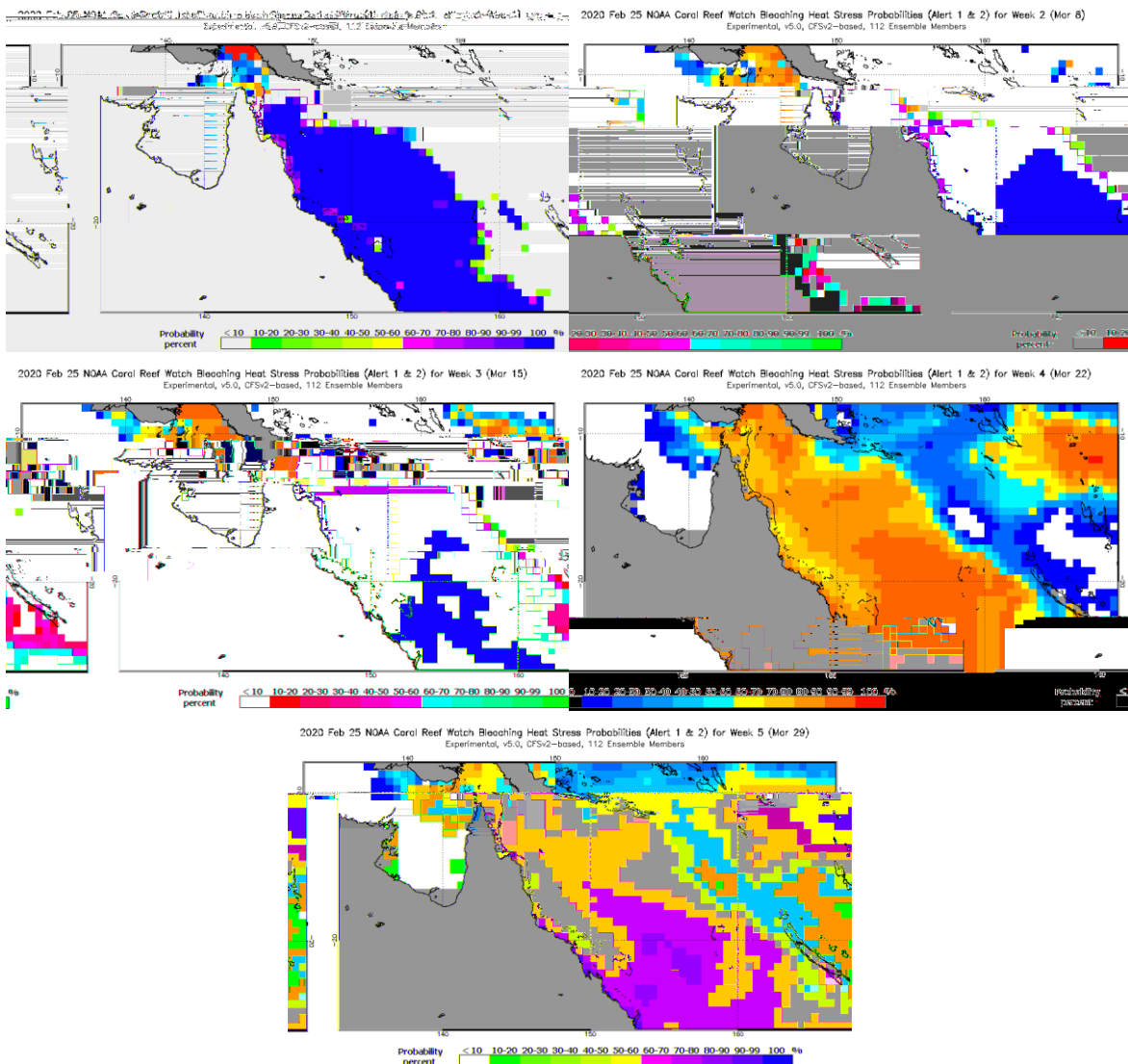


Figure 6. CRW's current [Four-Month Coral Bleaching Outlook](#), for the GBR region, displaying the probability, for the week beginning March 1 (top row, left), March 8 (top row, right), March 15 (middle row, left), March 22 (middle row, right) and March 29, 2020 (bottom row), that the bleaching heat

stress level will reach or exceed Bleaching Alert Levels 1 (associated with significant bleaching) and 2 (associated with severe, widespread bleaching and significant mortality).

Of note, the Outlook currently predicts continued heat stress in the southern end of Swains Island and the Capricorn and Bunker Group, including Heron and One Tree Islands, even as the second set of neap tides is occurring (approximately March 13-18). This may mean that in addition to it being widespread, coral bleaching may be more severe in these areas than along the rest of the GBR.