



The goal of these hands-on exercises is to reinforce the concepts taught in the online tutorial, using simple examples, and to familiarize users with our website so they will know where to find each of the products. For each exercise, please follow along, starting from the main page of the NOAA Coral Reef Watch website:
<http://coralreefwatch.noaa.gov/satellite>.

DHW exercises

1. Using the Pacific Ocean's Degree Heating Weeks image from 20 Sept, 2002, was there bleaching in Hawaii? Compare the stress in the main Hawaiian Islands vs. the Northwest Hawaiian Islands—what pattern of bleaching would you expect?

- a. On the CRW homepage, click on **Degree Heating Weeks** in the left-hand navigation bar.

A screenshot of the NOAA Coral Reef Watch website. The left-hand navigation bar contains several links: "Anomaly Animations", "Bleaching HotSpots", "HotSpot Animations", "Degree Heating Weeks" (circled in red), "DHW Animations", and "Coral Bleaching Virtual Stations". The main content area features a large text block explaining the symbiotic relationship between coral and zooxanthellae, and how stress leads to coral bleaching. To the right of the text is a photograph of coral reefs showing significant bleaching, with white and yellow patches among the coral. Below the text is another photograph of a coral reef with a large, white, bleached area. The text also mentions that bleaching events reported prior to the 1980s were generally attributed to localized phenomena like storms or pollution, while events since 1980 have not been easily explained.

- b. Scroll down past the current image and the archive table of this year's data to find the links to past years. Click on **2002 Degree Heating Weeks**.
- c. Find the cell for September 20th in the table of links. Click on **Pacific** to see the Pacific Ocean DHWs for that date.

- d. To locate Hawaii, look for the two Virtual Stations in this archipelago: Maui and Midway. In the image below, the red box shows the Main Hawaiian Islands and the yellow shows the Northwest Hawaiian Islands.



- e. Now look at the DHWs in those areas for September 20th, 2002. Was there bleaching? Compare the Northwest Hawaiian Islands to the Main Hawaiian Islands. What pattern of bleaching severity would you expect? HINT: [this page of the tutorial](#) shows how DHWs relate to bleaching. (#1 on the answer sheet.)

2. Now we will look at this 2002 Northwest Hawaiian Islands thermal stress event in more detail by focusing on the Midway Atoll Virtual Station. When did thermal stress start and end? Over what time do you think significant bleaching occurred?

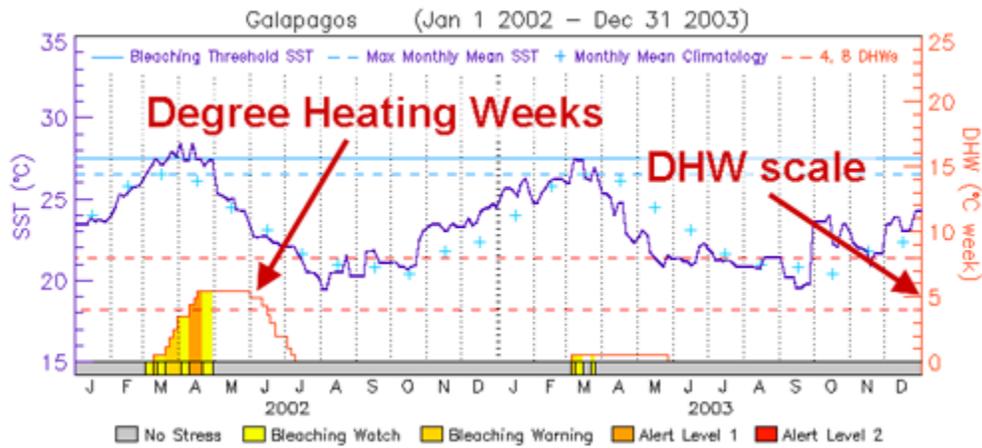
- a. Return to the website's front page, and scroll down to find **Time Series at 24 Sites** in the left-hand navigation bar. Click on the **Current** icon.



- b. On this page, you will see each of the operational Virtual Stations listed. Find the cell in the table that says **Midway Atoll, US**. Below the title will be a link that says **Graphs**; click on that link.

<p style="text-align: center;"><u>Bermuda</u></p> <p style="text-align: center;">Graphs Data* Alerts</p>	<p style="text-align: center;"><u>Midway Atoll, US</u></p> <p style="text-align: center;">Graphs Data* Alerts</p>
<p style="text-align: center;"><u>Sombrero Reef, FL</u></p> <p style="text-align: center;">Graphs Data* Alerts</p>	<p style="text-align: center;"><u>Oahu-Maui, HI</u></p> <p style="text-align: center;">Graphs Data* Alerts</p>

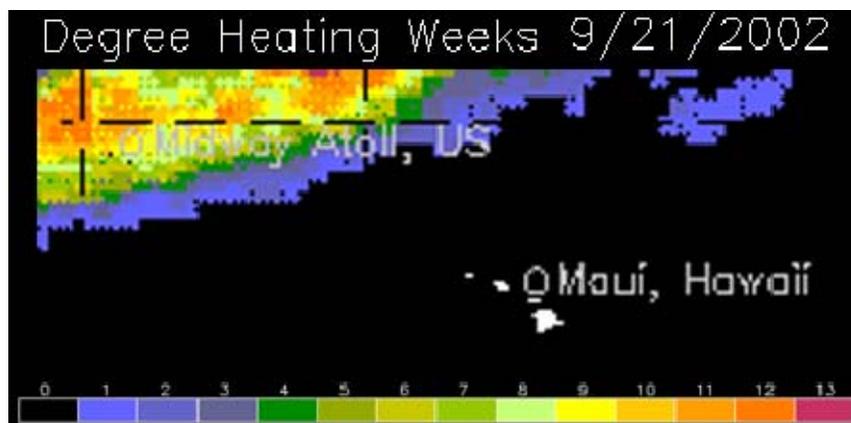
- c. These graphs show the time series data at this station. SST and monthly means are shown at the top of the graph; Degree Heating Weeks are shown as a separate trace in the bottom section of each graph. Note that the DHW scale is on the right axis, as in this example from the Galapagos:



- d. Use the 2002 Midway Atoll graph to answer these questions: When did thermal stress start and end—that is, when did DHWs begin to accumulate, and when did the SST drop below the bleaching threshold? Over what time do you think significant bleaching occurred? Hint: a text file of this data is available, if you want more precision in your answer. Go back one page to the Virtual Stations table, then click on **Data** under Midway Atoll. (#2 on the answer sheet.)

ANSWER SHEET: Degree Heating Weeks

1. The DHWs were highest at the northern end of the Northwest Hawaiian Island chain, reaching a maximum of around 11 or 12 °C-weeks near Midway Atoll. The values then decreased sharply as you move south and east, and disappeared altogether before you're halfway to the Main Hawaiian Islands. In areas around Midway where the DHWs were above 8 °C-weeks, you would predict widespread bleaching and some coral mortality. South and east of there, a zone where DHWs were between 4 and 8 °C-weeks should have seen significant bleaching, especially in sensitive species. Areas in the blue colors, less than 4 °C-weeks, may have experienced mild bleaching. NOAA monitoring cruises surveyed for bleaching just after this 2002 thermal stress; they reported the first mass bleaching in the Northwest Hawaiian Islands, with a gradient of bleaching that was highest in the far northwest ([Kenyon et al., 2006](#)).



2. By looking at the graph and at the text data file, we can see when the temperature first crossed the bleaching threshold: July 30th, 2002. In the data file, you can determine this date because it's the day when DHWs are greater than zero, and the HotSpot also goes above one. On the graph, you can see when the SST trace crosses the bleaching threshold (solid light-blue line). The thermal stress ended on September 7th, 2002. In the data file, you can see when this happens because the HotSpot goes back below one and the DHWs are no longer increasing. On the graph, you can look for the date when the SST crosses back below the bleaching threshold. You expect to see significant bleaching when DHWs are greater than 4 °C-weeks. At this Virtual Station, DHWs remained above 4 °C-weeks from August 16th through November 4th, so we can expect that bleaching occurred during this time period.

