



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/>.

Sea Surface Temperature (SST) product exercises

1. What was the temperature around the Galapagos Islands on March 4, 2006?

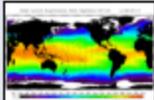
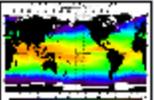
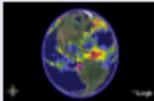
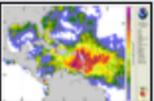
a. On the front page of the CRW website, look for the blue navigation bar on the left-hand side. Each of the operational products is listed here: images and animations for the global products, plus Virtual Stations data products.

b. Click on the fourth product in this navigation bar: **Sea Surface Temperature**.



c. This takes you to this year's page for the Sea Surface Temperature (SST) product. The image at the top will show the latest global SST, and the table underneath links to archived images for the current year. Click on **Image Archives**.

Data Formats Available

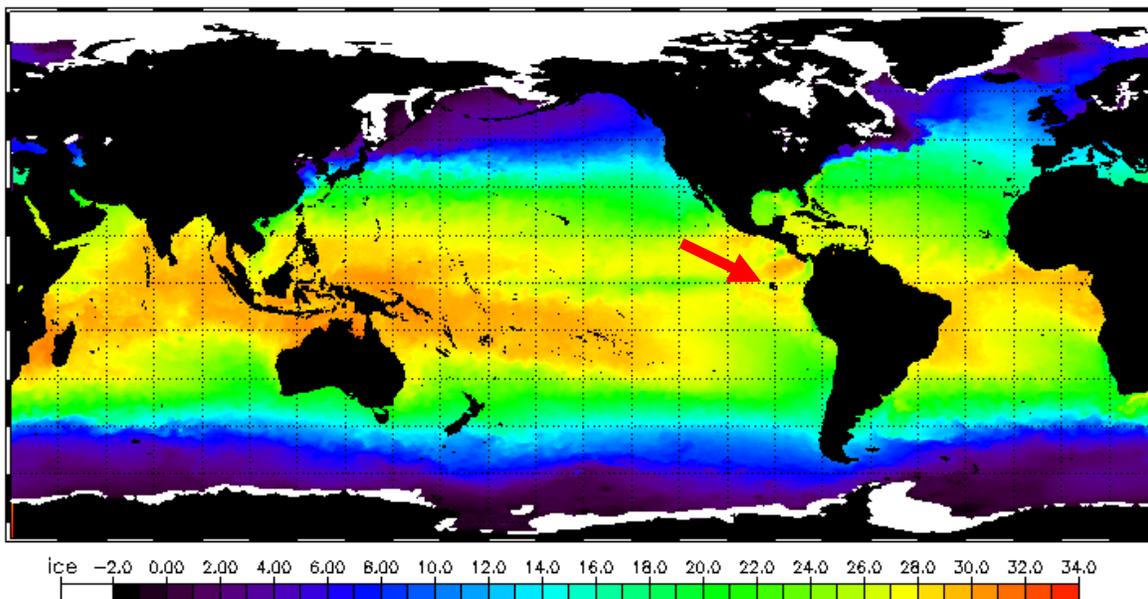
 <p>Image Archives Regional imagery and image archives from OSDPD.</p>	 <p>Animations Data animations and downloadable animated GIF files from OSDPD.</p>
 <p>Google Earth All of our satellite data products are available on Google Earth.</p>	 <p>HDF data files Raw data in Hierarchical Data Format (HDF), with free NOAA viewing software.</p>
 <p>Virtual Stations Imagery, graphs, ASCII data, and e-mail alerts for reef pixels around the world.</p>	

d. Scroll down this page, until you get to the bottom of the archive table. You will see links to previous years; click on **2006 50km Nighttime SSTs** to navigate to that year.

- [2013 50 km Nighttime SSTs](#)
- [2012 50 km Nighttime SSTs](#)
- [2011 50 km Nighttime SSTs](#)
- [2010 50 km Nighttime SSTs](#)
- [2009 50 km Nighttime SSTs](#)
- [2008 50 km Nighttime SSTs](#)
- [2007 50 km Nighttime SSTs](#)
- [2006 50 km Nighttime SSTs](#)
- [2005 50 km Nighttime SSTs](#)
- [2004 50 km Nighttime SSTs](#)
- [2003 50 km Nighttime SSTs](#)
- [2002 50 km Nighttime SSTs](#)
- [2001 50 km Nighttime SSTs](#)

e. Here you will see links to the global images, two per week for the whole year. Find the link for **March 4**, and click to access the global image. Locate the Galapagos Islands, off the west coast of South America.

NOAA Current Experimental 50km Nighttime SST (C) 3/4/2006



f. Using the color bar at the bottom of the image, determine the sea surface temperature in the pixels closest to the Galapagos Islands. (Look at Answer #1 on the answer sheet to see if you got it right!)

2. Which summer was hotter in the US Virgin Islands: 2004 or 2005? Look at the entire summer season, not just the maximum temperature.

a. Return to the homepage and click **Virtual Stations**; then click on “All stations and products”.

Near-Real-Time Data

- Bleaching Alert Area
- Degree Heating Weeks
- HotSpots
- Sea Surface Temperature
- SST Anomaly
- Virtual Stations**

Operational Virtual Stations System (227 Stations)

Google Maps Interface

Caribbean (23 stations)

Station Name	Lat
Sancti Spiritus, Puerto Rico	18.0
San Bernardo, Colombia	10.0
Santa Marta, Colombia	11.5
Turks and Caicos	21.5
US Virgin Islands	18.0

All stations and products
Virtual Stations list, with links to time series graphs and data.

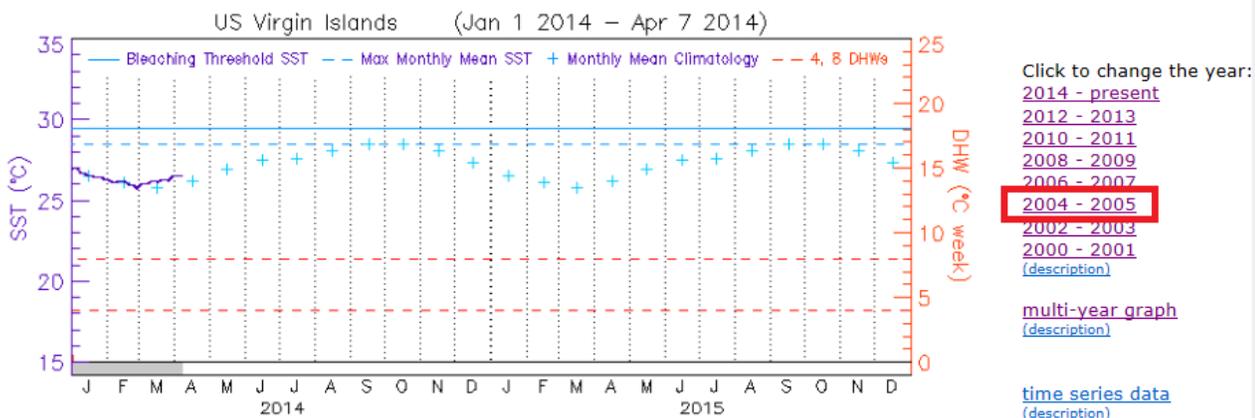
Current Status Summary
Text file that lists the current alerts and thermal stress status for all Virtual Stations.

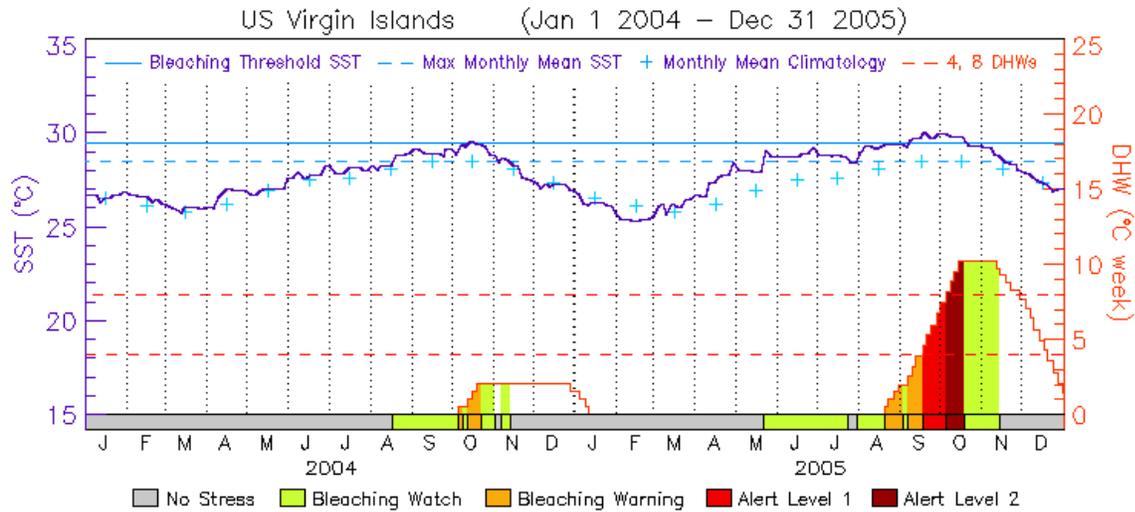
Station Locations
Text file that gives the latitude and longitude of each station.

b. This takes you to a page that lists our 227 Virtual Station sites around the world. Find the cell in the table that says **US Virgin Islands**.

Station Name	Lat	Long	Alerts	Status	2012-13	2010-11	08-09	06-07	04-05	02-03	00-01	data
Puerto Rico	18.0	-67.5	multi-year	current	12-13	10-11	08-09	06-07	04-05	02-03	00-01	data
San Bernardo, Colombia	10.0	-76.0	multi-year	current	12-13	10-11	08-09	06-07	04-05	02-03	00-01	data
Santa Marta, Colombia	11.5	-74.5	multi-year	current	12-13	10-11	08-09	06-07	04-05	02-03	00-01	data
Turks and Caicos	21.5	-72.0	multi-year	current	12-13	10-11	08-09	06-07	04-05	02-03	00-01	data
US Virgin Islands	18.0	-65.0	multi-year	current	12-13	10-11	08-09	06-07	04-05	02-03	00-01	data

c. This page shows time series graphs for the US Virgin Islands pixel, starting in 2000. Find the 2004-2005 graphs, and compare the summer seasons.



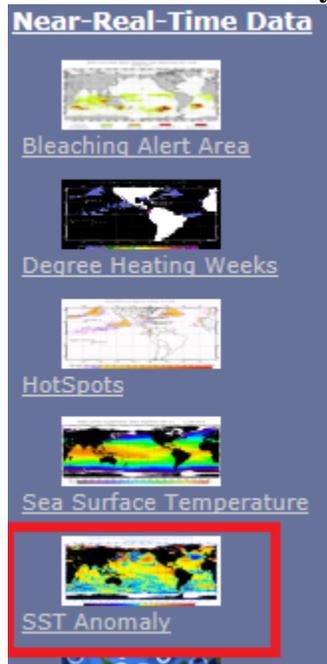


Remember that the dark-blue line shows the sea surface temperature from NOAA satellites. Which year had the warmer summer? (See #2 on the answer sheet.)

SST Anomaly exercises

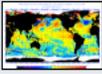
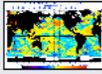
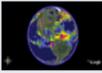
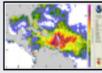
3. For the Caribbean image, November 1, 2007, which areas were anomalously warm/cool?

a. Return to the CRW homepage, and click on **SST Anomaly** in the left-hand navigation bar.



b. This takes you to the page for the current year of the SST Anomaly product. The latest image is at the top, and a table of archived images is below. Click in **Image Archives**.

Data Formats Available

 Image Archives Regional imagery and image archives from OSDPD.	 Animations Data animations and downloadable animated GIF files from OSDPD.
 Google Earth All of our satellite data products are available on Google Earth.	 HDF data files Raw data in Hierarchical Data Format (HDF), with free NOAA viewing software.
 Virtual Stations Imagery, graphs, ASCII data, and e-mail alerts for reef pixels around the world.	

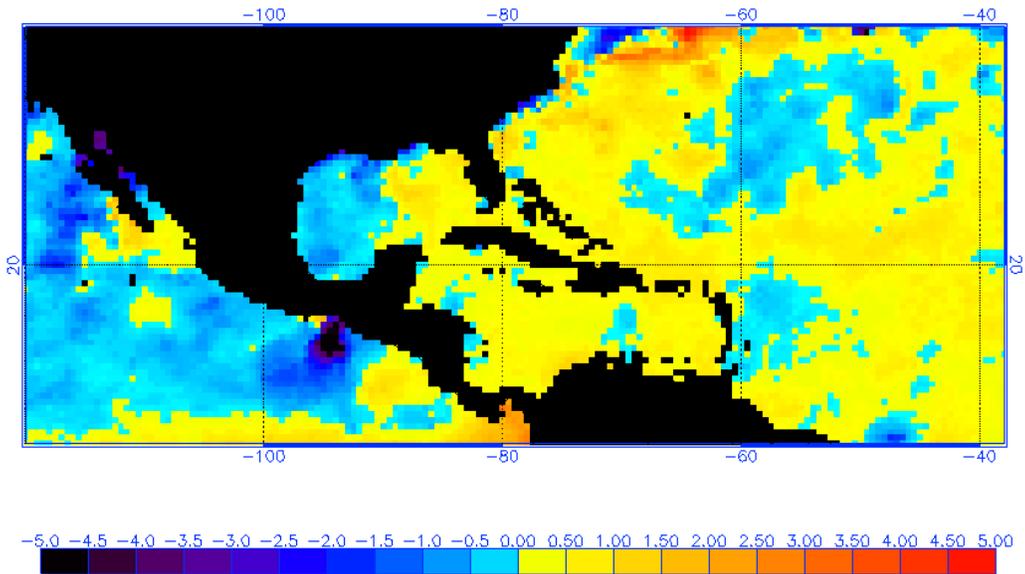
c. Scroll to the bottom of the page to locate 2007 archived anomalies.

- [2013 Anomalies](#)
- [2012 Anomalies](#)
- [2011 Anomalies](#)
- [2010 Anomalies](#)
- [2009 Anomalies](#)
- [2008 Anomalies](#)
- [2007 Anomalies](#)
- [2006 Anomalies](#)
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- [2000 Anomalies](#)
- [1999 Anomalies](#)
- [1998 Anomalies](#)
- [1997 Anomalies](#)
- [1996 Anomalies](#)

There will be an image at the top of the page, with an archive table below. Scroll down in the table to find November 1; then click on **Caribbean**.

November	1	5
	Caribbean	Caribbean
	E.Hemi	E.Hemi
	Global	Global
	Full Global	Full Global
	Pacific	Pacific
	W.Hemi	W.Hemi

NOAA/NESDIS SST Anomaly (degrees C), 11/1/2007



d. Which areas are warmer than the long-term mean? Which areas are cooler? (See #3 on the answer sheet.)

4. Compare the global SST Anomaly on May 5, 1998, to the SST Anomaly one year later. What change do you see in the global anomaly patterns? What might have caused this change?

- a. Navigate back to the 2007 SST Anomalies page; then scroll down below the archive table until you see other years. Click on **1998 Anomalies**.
- b. This takes you to the archive page for 1998. Right-click on the link for May 5, and open the image into a new browser window or tab.
- c. Now go to the SST Anomaly archive page for 1999. Right-click on the link for May 4, and open the image in a new browser window or tab.
- d. Compare these two global images, one year apart. What changes do you see in the SST Anomaly patterns? What might have caused these changes? (#4 on the answer sheet.)

Bleaching Threshold exercise

5. For the Oahu Virtual Station, which month is the warmest? What is the maximum monthly mean, and what is the bleaching threshold temperature?

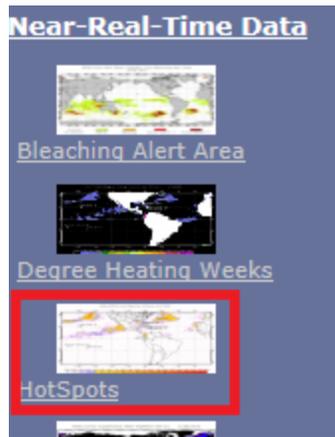
- a. We will answer this question by looking at the time series graphs for NOAA CRW's Virtual Stations product. Return to the NOAA CRW homepage and click Virtual Stations in the blue navigation bar. Then click on "All stations and products".
- b. On this page, you will see each of the operational Virtual Stations listed. Find the cell in the table that says **Oahu**; click on it.
- c. These graphs show the time series data at this station, with the mean for each month plotted as a light-blue cross. Use the graphs to answer these questions:

Which month is the warmest on average? What is the maximum monthly mean? What is the bleaching threshold temperature? Hint: try using the 2000-01 graph, so you can clearly see the monthly means. Note that these values are fixed and do not change from year to year. (#5 on the answer sheet.)

HotSpots exercise

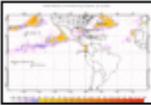
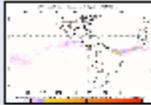
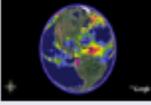
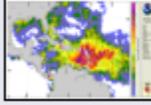
6. In question #3, you looked at a SST Anomaly image for the Caribbean region on November 1, 2007. Compare that image to the Coral Bleaching HotSpots data for the same date and area. Look for areas that are unusually warm in the anomaly image. Were they warm enough to be above the MMM? What areas had HotSpots, and where were they the highest? Were any areas above the bleaching threshold?

- a. Go back to the NOAA CRW homepage; click on **SST Anomaly** in the left-hand navigation bar. Using the SST Anomaly archives, pull up the image for the SST Anomaly in the Caribbean on November 1, 2007.
- b. In a new window, navigate back to the NOAA CRW homepage. Click on **HotSpots** in the left-hand navigation bar.



c. This takes you to the HotSpots page for the current year. Click **Image Archives** and scroll down to “2007 HotSpots”. Click on the link.

Data Formats Available

 <p>Image Archives Regional imagery and image archives from OSDPD.</p>	 <p>Animations Data animations and downloadable animated GIF files from OSPO.</p>
 <p>Google Earth All of our satellite data products are available on Google Earth.</p>	 <p>HDF data files Raw data in Hierarchical Data Format (HDF), with free NOAA viewing software.</p>
 <p>Virtual Stations Imagery, graphs, ASCII data, and e-mail alerts for reef pixels around the world.</p>	

d. The 2007 page has an image at the top, then a table of links to archived images. Find November 1, 2007, and click on the **Caribbean** link.

e. Use this HotSpots image and the SST Anomaly image from the same date to answer these questions: Look for areas that are unusually warm in the Anomaly image. Were they warm enough to be above the MMM? What areas had HotSpots, and where were they the highest? Were any areas above the bleaching threshold? (#6 on the answer sheet.)

Degree Heating Weeks (DHW) exercises

7. Using the Pacific Ocean’s Degree Heating Weeks (DHW) image from September 20, 2002, was there bleaching in Hawaii? Compare the stress in the main Hawaiian Islands to the Northwestern Hawaiian Islands. What pattern of bleaching would you expect?

a. Return to the CRW homepage. Click on **Degree Heating Weeks** in the left-hand navigation bar.



b. Click on **Image Archives**, and scroll to the bottom of the page. Click on “2002 Degree Heating Weeks”.

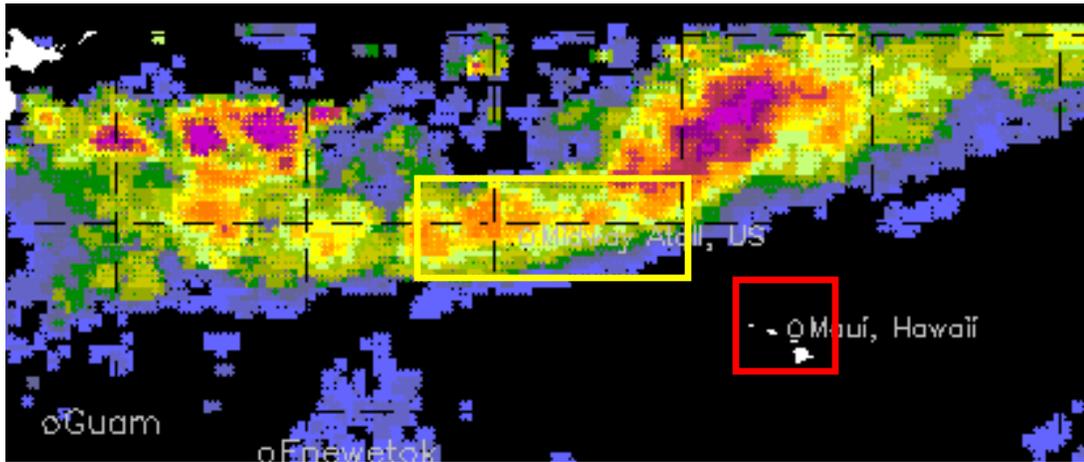


c. Scroll down the page to find September 20, 2002 for the **Pacific** region.

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 Northwestern Hawaiian Islands.

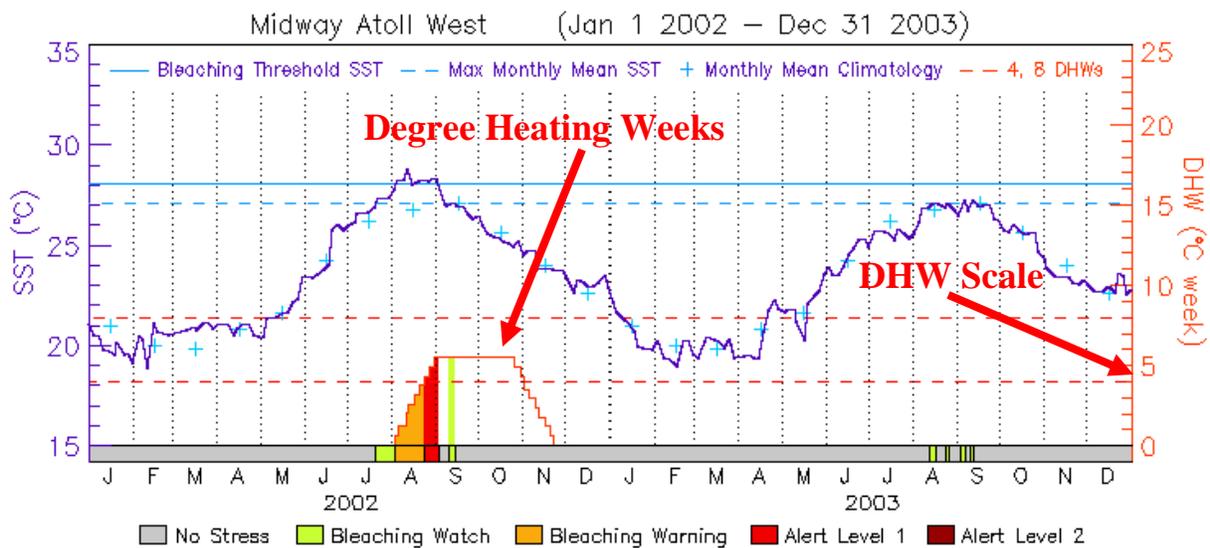


e. Now look at the DHWs in those areas for September 20, 2002. Was there bleaching? Compare the Northwestern Hawaiian Islands to the Main Hawaiian Islands. What pattern of bleaching severity would you expect? HINT: [this page of the tutorial](#) shows how DHWs relate to bleaching. (#7 on the answer sheet.)



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

- Return to NOAA CRW homepage. Click on **Virtual Stations** in the left-hand navigation bar. Click on “All stations and products”
- You will now see all of the operational Virtual Stations. Find and click on **Midway Atoll North**.
- These graphs show the time series data at this Virtual 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 the example image below from Midway Atoll West:



d. Use the 2002 Midway Atoll North graph to answer these questions: When did thermal stress start and end. In other words, when did the 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 also available, if you want more precision in your answer; go back one page to the Virtual Stations table, and click on the link for **data** under Midway Atoll North. (#8 on the answer sheet.)

Satellite Bleaching Alert (SBA) exercise

9. What was the highest alert level for the Virtual Stations in the US Virgin Islands and Bermuda in 2005? Based on these alerts, was bleaching predicted at these two locations?

- a. Return to the CRW homepage and navigate to the **US Virgin Islands** Virtual Station.
- b. On the time-series graph for 2004-05, look through the alerts that were issued during 2005. What was the highest alert level? Would bleaching have been predicted at this station?
- c. Go back one page to the Virtual Stations list. Locate **Bermuda**. On the time-series graph for 2004-05, look through the alerts that were issued during 2005. What was the highest alert level? Would bleaching have been predicted at this station?