exercise 2
observing geographic, or spatial, variation of sea surface temperature (sst)

A

set up see image

1—Start *SEE Image* by double clicking on its icon

SEE Image 2.56/ppc

2—Select 'Options/Preferences.'

3—Make sure the 'Undo & Clipboard Buffer Size' is set to >500 k and that "Invert Y-Coordinates" is NOT selected. Click OK. *(If these preferences were already set and you didn't have to change anything, no message box will appear. Skip to step 8.)*

4—Click OK again to close the message box you'll see.

5—Select 'File/Record Preferences.'

6—Select 'File/Quit' to exit *SEE Image*.

7—Restart *SEE Image*.

8—Select 'Special/Load Macros.' Go to Desktop | HD | SEE Image | Macros | SEE_macros. Click Open.

Do A now.

what determines where the ocean is warm and cold?

Based on Figure 1

1a. Where would you expect to find the highest temperature waters in the Pacific Ocean? _____

1b. The lowest temperature waters? _____

To check your answer, study the image of the average annual SST for 1987, a representative year, by opening the file

Desktop | HD | SEE Image | Data | Oceans | sstex2 | ga1987t.tif

1c. Are you right?

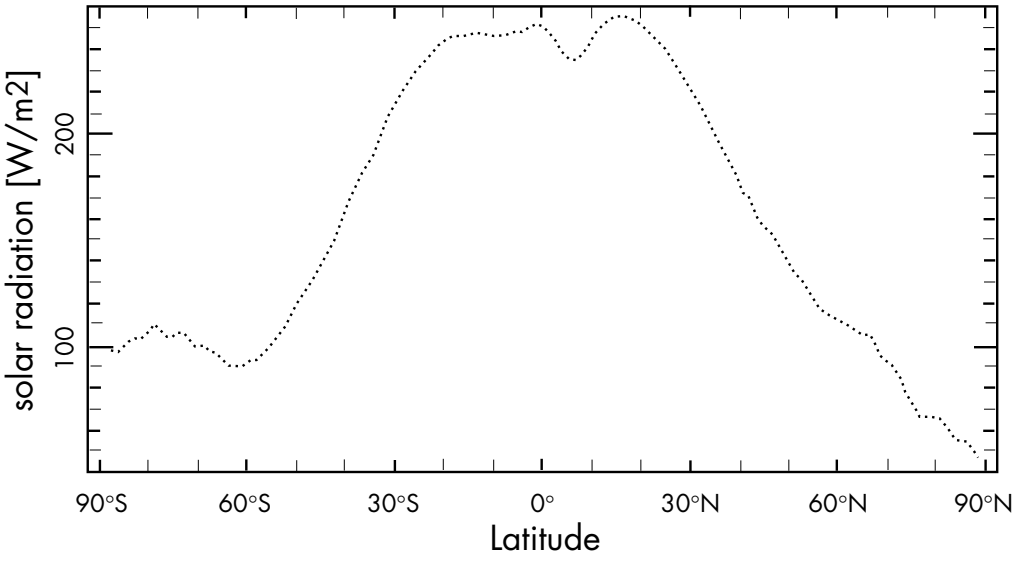

Figure 1. The distribution of solar radiation, in Watts/m², reaching the surface of the oceans as a function of latitude averaged over a 9-year period, 1981–1990. Figure 1 was computed for approximately 170° W longitude, which is just about in the middle of the Pacific Ocean.

1d. Were there any regions where your hypotheses were incorrect?

Close all images before proceeding.

qualitatively observing the geographic distribution of sst

Continue exploring the geographic variations of SST by studying one monthly SST image from the global monthly sea surface temperature data set for 1982–1998 using the Density Slice Tool in *SEE Image.*

Do B, C, and D now.

B

open a data file from any month

1—Select 'File/Import'.

2—Go to Desktop | HD | SEE Image | Data | Oceans | sstex2 | gm9503t.tif.

C

color your image

1—Select 'Options/Color Tables/SST'.

D

calibrate the image with a calibration file you created and saved

1—Select 'Analyze/Reset' and 'Continue.'

2—Select 'Analyze/Calibrate.'

3—Select the Straight Line Button. Type 'Deg. C' in the box titled Units of Measure.

4—Select 'File/Open' and find the calibration standards file you saved and named "SST_Standards." Click OK.

An open diamond will be displayed to the right of the file name in the title bar of the Display Window when the image is calibrated.

Do E now.

E

density slicing

1—Select the Density Slice Tool

from the Tools Window, which will put a solid block of color (default is red) on the LUT window.

2—Select the Eyedropper

from the Tools Window. Move your cursor to the middle of the solid block of red on the LUT. Notice that the cursor arrow turns into an Eyedropper when it is positioned in this density slice block on the LUT.

3—Double click with the Eyedropper on the red color block in the LUT window to bring up a color wheel and click once in the middle of the wheel. The window will now display gray as the "New" color. Click OK. The Density Slice color block (and the paint brush) in the LUT window should be gray.

4— Click once on the Density Slice Tool to reactivate it.

5—Click and hold on the bottom line of the Density Slice color block in the LUT window (Figure 2-a) and drag it so the 'Lower' value displayed in the Info Window is about 20. Next, click on the top line (Figure 2-b) and drag it so the 'Upper' value in the Info Window is 15. The width of the color block now corresponds to approximately 5°C. Verify this by looking at the gray color block on the color legend on the image (Figure 2-c). Put your cursor in the middle of the Density Slice color block in the LUT window, click and hold the mouse button down and slide the Density Slice color block so that the corresponding block on the color legend (in the Display Window) falls between 20° and 25°. In the image you'll see that all SST values that fall in the 20°–25° range of SST are now gray.

6—Click and hold in the middle of the Density Slice color block and drag it first to the top of the LUT window and then slowly drag it toward the bottom. As you drag the color block down the LUT Window you will highlight in gray those regions with the same SST values, and the range of values highlighted will display in the Info Window and on the Color Legend in the Display Window. Do this several times to familiarize yourself with this procedure. Note that neither the minimum pixel value of 0 nor the maximum pixel value of 255 can be highlighted by the Density Slice.

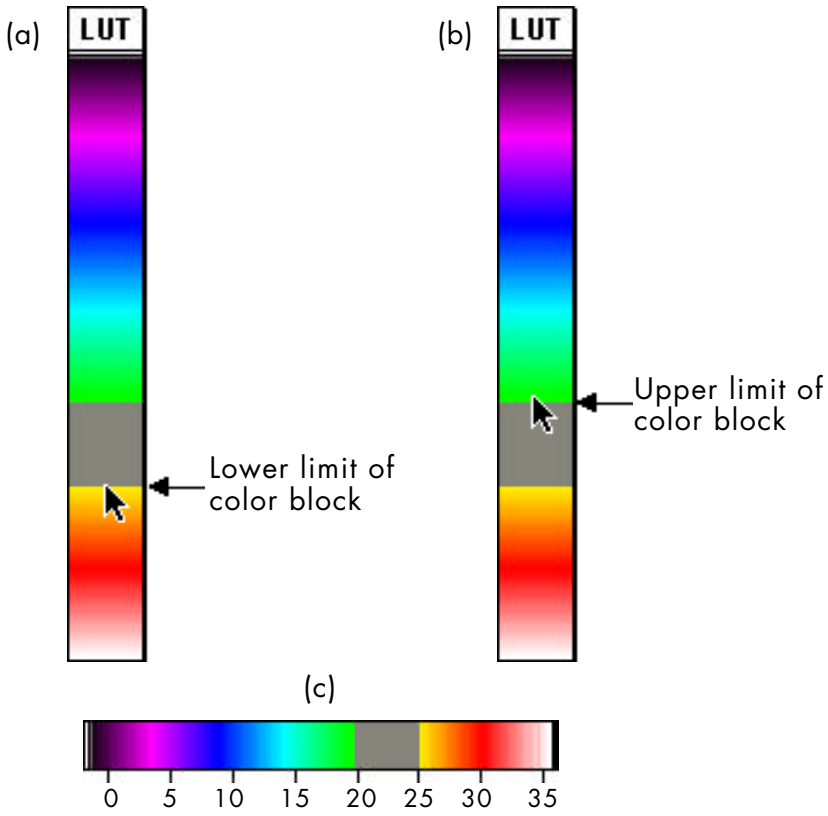

Figure 2. The position of the color block within the LUT windows (a, b) and on the color scale portion of the image window (c), while using the density slice tool.

Now you can answer some questions about the distribution of SST around planet Earth.

2. Indicate the month and year of the image you opened and are using to answer questions 3, 4, and 5.

Month _____ Year _____

3. Use the Density Slice to highlight the warmest SSTs (between about 25° and 30°). Where do they occur and why?

Now do the same thing for the coldest SSTs (between about 0° and 5°).
4a. Describe the distribution of SST in this range for the Southern Hemisphere

4b. and for the Northern Hemisphere.

5. Study the geography of the Southern Hemisphere and describe a unique feature of the southern high latitudes that may affect SST. How do high latitude regions in the Northern Hemisphere differ in this respect from high latitude regions in the Southern Hemisphere?

Double click on the Density Slice Tool to deactivate it. This will return the LUT to the SST Color Table.

quantitatively observing the geographic distribution of sst

You will now use another of *SEE Image*'s analysis tools to observe, in a more quantitative way how SST varies along lines of similar latitude and longitude. The tool you will use is called the Plot Profile Tool. You may use the image you already have open on your screen or a new one. Be certain that the image used is calibrated.

Do F now.

F

plot profiling

1—Select 'Options/Profile Plot Options' to create plots with fixed axes scales. Click on the box for "Fixed y-axis scale." Enter "0" for minimum and "35" for maximum. Click OK.

2—Select the Plot Profile Tool

from the Tools Window. Use it to draw a line on the image, from west to east at 45° S latitude using Figure 3 as an example. HINT: To draw a straight line, hold down the *shift* key while drawing the line. When you release the mouse button a new window will appear with the plot of SST as a function of distance on the image along the east-west line you drew at 45°S. It will look something like Figure 4. You may change the size of these plots by selecting 'Options/Profile Plot Options,' clicking on Fix Plot Size, and typing in a new size. Try 400 for width and 250 for height. Click OK.

3—Select 'Analyze/Plot Profile' to create the plot in the new size.

4—Save the resulting plot in a new file as follows:

'Edit/Copy Plot'

'File/New' (the default values are OK) Click OK.

'Edit/Paste.' Click once in the middle of the plot you just pasted and hold down the mouse while you drag this plot to the upper left corner of the new window.

5—With the Text Tool

annotate this plot with the month and year and the latitude along which this east-west plot was created.

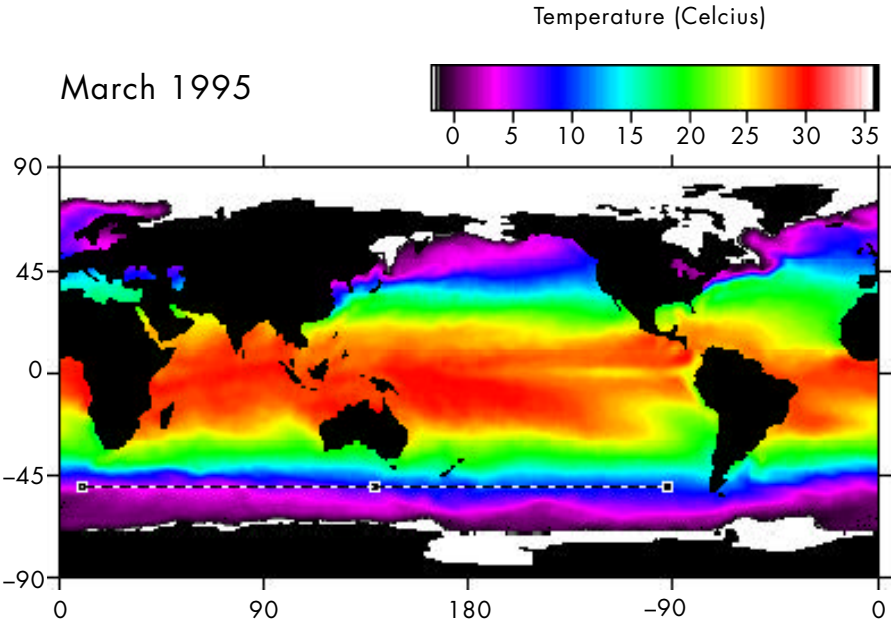

Figure 3

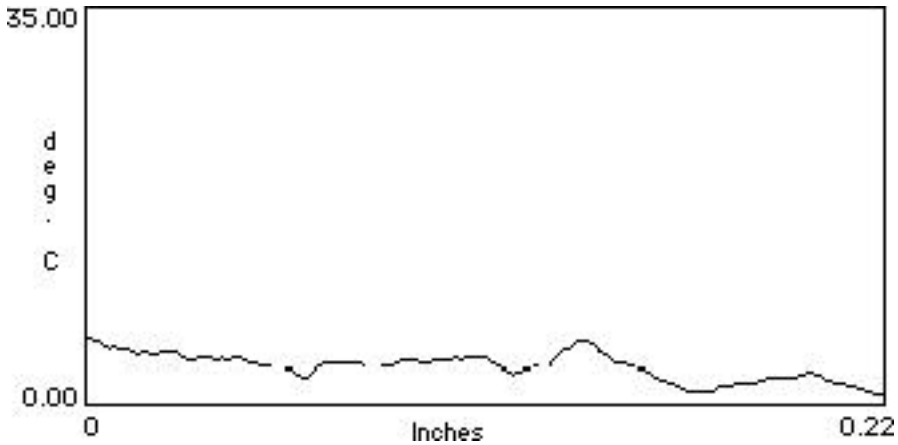

Figure 4

F

plot profiling, continued

6—Click on the SST image to activate it. Do the same thing as in step F-2, but draw the profile from north to south along a line of constant longitude (try 170°W). Paste this plot into the same file as the east-west plot using the following steps.

'Edit/Copy Plot'

Click on the east-west plot window to activate it.

'Edit/Paste" and move the N-S plot below the first one.

7—Annotate the plot as in step F-5

Now you can answer the following questions. Plan to hand in the plots you created. If you can't print them, just sketch them. Be sure to label all axes and indicate the location where the profiles were made.

6a. Study the two plots you just made. Write down the east-west range of variability in SST (read the max. and min. values from the plot).
Max. SST: _____ Min. SST: _____ Range: _____

6b. Write down the north-south range of variability in SST, as above.
Max. SST: _____ Min. SST: _____ Range: _____

7. In general, how does SST vary along lines of similar latitude from east to west?

8. How does SST vary along lines of similar longitude from north to south?

9. What is the basis for this distribution of SST?

Locate two regions on the image you have opened where SST doesn't follow the distinct east-west distribution you observed in the plot you created.

Describe where these regions are relative to the nearest land mass.
10a. Region 1:

10b. Region 2:

Open the ocean currents map in *SEE Image*

Desktop | HD | SEE Image | Data | Oceans | sstex2 | ocean_currents.tif

and describe the ocean currents for the two regions you have named above.
11a. Region 1:

11b. Region 2:

12. If, in an average year, the tropics receive more heat from the Sun than they lose, and the poles lose more heat than they receive from the Sun, what is preventing these regions from just continuing to heat up and cool off, respectively, until they are uninhabitable? Study the map of ocean currents and the image of SST you've been working with to describe a mechanism to answer this question.

Close all images.