NOTE

Throughout these exercises, the navigational paths shown in italics are for use only by those who are using the TOMS Ozone CD set as their data source.

A

importing, stacking, and coloring monthly average images for 1992

1 — *Insert the disk OPT_004B from the TOMS set.*

2 — Select 'File/IMPORT TOMS ASCII'.

3 — Enter "95" for the Minimal Value for scaling and "601" for the Maximum value for scaling, and "12" for number of images to process. Click OK.

4 — Go to Desktop | HD | SEE Image | Data | Ozone | ozex7 | GM9201.N7T
Desktop | OPT_004B | Y92 | GM9201.N7T. Click **Open**. All 12 monthly images will open overlaying each other automatically.

5 — Select 'Stacks/Windows to Stack'.

6 — Select 'Options/Color Tables/TOMS' to color the stack.

B

applying an overlay of the continents to the stack

1 — Select 'File/Open' and go to Desktop | HD | SEE Image | Overlays | LATLONG.TIF. Click Open.

2 — Select 'Edit/Select All' then 'Edit/Copy Selection'.

3 — Click on the stack of images.

4 — Select 'Special/MultiPasteReplace'. The overlay will now be pasted onto each of the images in the stack.

5 — Close the LATLONG.TIF window.

C

animating the images

1 — Select 'Stacks/Animate' to begin the animation.

When an animation is running, use the number keys 1–9 to change the speed of the animation. Lower numbers animate the images at slower speeds. Clicking anywhere on the desktop will stop the animation. The stack and image titles will not change during the animation.

using monthly and annual averages to monitor seasonal changes in total column ozone for 1979 and 1992

In Exercise 4 we used the monthly average images of TOMS total column ozone values from 1979 to observe the seasonal fluctuations of atmospheric ozone values. In this exercise we will observe seasonal changes in the monthly average images for 1992 and compare these to 1979.

BEFORE YOU BEGIN THIS EXERCISE

make sure you have read through the Introduction to Module 1: Stratospheric Ozone Computer Lab Exercises document and have completed Sections 1–4 of the tutorial, *Using SEE Image With TOMS Ozone Data.*

Do A, B, and C now.

C, continued

Images can be viewed one at a time or stepped through manually using the period (.) key to move forward and the comma (,) key to move backward. When you reach the last image in the stack you must go backward through the stack to return to the first image. The stack and image titles will change during this process.

investigating average monthly ozone values for 1992 through animation

Animate or move sequentially through the GM9201.N7T–GM9201.N7T stack and observe the monthly average images.

1. Do the same seasonal changes appear to be happening in the northern and southern polar regions? Use the colors (or ozone values) to justify your answer.

To compare seasonal distributions of ozone in 1992 to 1979 it will be useful to generate a montage of the 12 images and compare this to the montage you saved for the 1979 images in a previous exercise.

Do D now.

D

making a montage of the 12 images

1 — Select 'Stacks/Make Montage'

2 — Enter '3" for columns, "4" for rows, "1" for increment and leave the rest at the default settings. Click OK.

3 — Select 'File/Save'. Go to Desktop | HD | SEE Image | Data | Ozone. Select TIFF format and save the image as "Montage92."

investigating ozone values from a montage

Visually examine the 1992 montage images. You will notice that in all of the images there are no-data areas, which are black. Ignore these for the following questions.

2a. What general statement can you make about the pattern of global ozone distribution for any one of the images?

2b. Is a distribution pattern more prominent zonally (east-west along a line of latitude) or meridionally (north-south along a line of longitude)?

Why is this so?

As you move the cursor over areas in any of the images you will see an ozone value (in Dobson Units) displayed in the Info window.

3a. Determine the approximate maximum and minimum ozone values that appear for the year and note the associated image color. You may wish to record the minimum and maximum values for several month to help determine the yearly low and high values.

(1 = January, 2 = February, 3 = March...)

maximum _____   minimum _____
color _____   color _____

Which geographic regions (north or south polar, north or south midlatitudes, tropics) show maximum change over 1992? Why do you think this is so?

3b. Make a general statement about seasonal changes in ozone values for this year based on your observations of the montage.

comparing 1992 to 1979 monthly average ozone values from montages

Do E now.

Depending on the size of your display monitor, you may have to move the two montage images for comparison as you answer the next questions.

4. Compare the first four months in the northern hemisphere on both montages. What can you say about the change in ozone values from 1979 to 1992 for this region?

E

opening the 1979 montage image

If you are using data from the TOMS Ozone CD set, you must first make a montage of the 1979 gridded monthly data. Repeat steps A, B, and D, using the OPT_004A disk and replacing 92 with 79 where appropriate. Select 'File/Save' and go to Desktop | HD | SEE Image | Data | Ozone. Select TIFF format and save as "Montage79."

1—Select 'File/Open'

2—Go to Desktop | HD | SEE Image | Data | Ozone | Montage79. Click Open.

5. Look at all the months on both montages for the tropical regions. Has there been a change in the ozone values?

Explain.

6. Move the cursor over various regions on both montages and look at the corresponding ozone values in the Info window. Remember that the value will have meaning only if the window you are investigating with the cursor is selected. What region has experienced the most significant change from 1979 to 1992?

Explain your answer based on ozone values.

Close both montages when you are finished but keep the stack (GM9201.N7T–GM9201.N7T) open. Do not save changes unless directed by your instructor.

investigating monthly average images and a yearly aAverage ozone image

7. It is possible to compute a yearly average image using the monthly average images. Based on what you have generated previously, what might you expect to see on an image that represents a yearly average? Explain.

F

creating a yearly average image from the monthly averaged images

1—Select the GM9201.N7T–GM9201.N7T stack.

2—Select 'Special/CalcAvgStack'. Enter "GlobalAve92" for the image title. Click OK. This will generate an image that represents an average of the 12 monthly images for 1992.

Although this does calculate an average of the 12 monthly averages, it does not calculate the "true" yearly average. The result of this calculation is sufficient for our purpose to illustrate differences in average yearly ozone from year to year. The "true" yearly average would need to be calculated using all of the daily images for a particular year. This is possible using SEE Image; however, the memory requirements are quite high. If you would like and have the time, create a stack using all of the images for one year and then run 'CalcAvgStack' on the stack.

Do F now.

Using the (.) and (,) keys, move through the 1992 monthly average stack (GM.9201.N7T–GM9201.N7T) Compare each monthly image with the yearly average image (GlobalAve92).

8a. How does the GlobalAve92 image compare to the monthly images? Explain.

8b. How did your prediction of what the yearly average image would look like compare to the actual image? Explain.

8c. In general, how do the yearly average ozone values vary over the globe? Do significant hemispheric differences exist? Explain.

Close all stacks and images when finished.

end of stratospheric ozone computer lab exercise 7