exercise 3
observing southern hemisphere sea ice distribution and seasonal variability

This exercise has four sections. In the first three you'll use some of the tools from *SEE Image* to explore the seasonal variation of SIC in a *qualitative,* or descriptive manner, where you'll

- Create a stack of images and apply color to them and calibrate them
- Learn to create a movie, called an Animation, from the stack
- Create a Montage of the stack to observe seasonal changes.

The last section of this exercise will hone your *quantitative* skills in analyzing the data, where you'll

- Create and plot a time-series of SIC using *SEE Image* to collect the time-series data

Do A, B, and C now.

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.

B
make a stack of color images

1—Select 'File/Import'.

2—Go to Desktop | HD | SEE Image | Data | Sea_Ice | psiex3 | 1995. Click the "Open All" box then click OK.

3—Go to Desktop | HD | SEE Image | Data | Sea_Ice | psiex3 | 1996 | sm9601i.tif. Click the "Open" box then click OK. Repeat for files sm9602i.tif, sm9603i.tif, and sm9604i.tif.

4—Select 'Stacks/Windows to Stack' to put all 16 months (one whole year plus the previous fall) in a stack. Use the . key (also the > key) to move forward through the stack and the , key (also the < key) to move backward through the stack.

5—Select 'Options/Color Tables/SEAICE'. Note that the color LUT will be applied to all images in the stack.

6—Choose 'Options/Preferences' and select "Display Slice Titles Only." This will display the files names across the top of the stack when you move through the stack images with the [.>] and [,<] keys.

C

calibrate the top image of the stack with a saved calibration file

1—Select 'Analyze/Reset.'

2—Select 'Analyze/Calibrate.'

3—Click the Straight Line button and type "percent" (or "%") in the box titled Units of Measure.

4—Click the Open button in the dialog box and find the calibration standards file you saved and named "Ice_Standards" in Exercise 1. Click Open, click OK. Close the plot window that appears.

NOTE: if you don't have the calibration standards file because you skipped Exercise 1, Step E, stop this exercise and go back and do it now.

Calibrating the top image in the stack will cause all images in the stack to be calibrated with the same calibration standards. An open diamond is displayed to the left of the file name in the title bar of the stack when the images have been calibrated.

investigating seasonal variations in sic from an animation

A technique commonly used by scientists to visualize data collected over time is called animation. Each image in a stack is displayed automatically, and in sequence, to give the impression of a movie.

Do D now.

D

animate your stack

1—Select 'Stacks/Animate' to animate this stack. Use the number keys from 1 (slowest) to 9 (fastest) to control the speed. To stop the animation, click anywhere on the image.

1a. In what month is the sea ice areal extent a maximum?

____

1b. In what month is the sea ice areal extent a minimum?

____

2. In general terms, describe how the sea ice extent grows from February 1995 to September 1995. Consider

- is it a steady growth rate, or does it start growing quickly then more slowly later; or slower at first then more quickly later
- where does it start growing
- where are the largest initial changes?

3. In general terms, describe how the sea ice extent melts and recedes from September 1995 to April 1996. Consider

- is it a steady melt rate or does it start melting quickly then more slowly later; or slower at first then more quickly later
- where does it start melting
- where are the largest initial changes
- what significant event takes place in the Ross Sea in approximately November or December.

investigating seasonal variations in sic from a montage

E

make a montage of your stack

1—Select 'Stacks/Make Montage.' Enter "4" for columns, "4" for rows, "1" for increment, and leave the rest at the default. You'll see cameos of all 16 months' images on one screen.

2—Now experiment. Try entering 4 columns, 2 rows (or 2 columns, 4 rows) and 2 for the increment. This will display a montage of every other month, and each cameo will be larger.

Do E now.

4. Describe the marginal ice zone (MIZ) during freeze-up (winter). Consider

- is it wide
- is it narrow
- does the ice concentration vary rapidly or slowly across the MIZ?

5. If you completed Exercise 2, compare this Antarctic MIZ to that of the Arctic region.

Close this stack.

create a time series of the sea ice extent

The impact of sea ice on the environment would be of little consequence if sea ice were rare. But, the reality is that sea ice extends over a substantial area, mostly in polar regions, of course. At any given time, sea ice covers approximately 25 million square kilometers of Earth's oceans, making it as extensive as the area of the North American continent, which covers about 24.4 million square kilometers. We'll begin studying this by measuring the extent of sea ice for each month in a 16-month sequence of images.

Repeat **Steps B and C**. Position the stack with the earliest January image on top.

Do F now.

F

set your measurements

1—Select 'Analyze/Set Scale.'

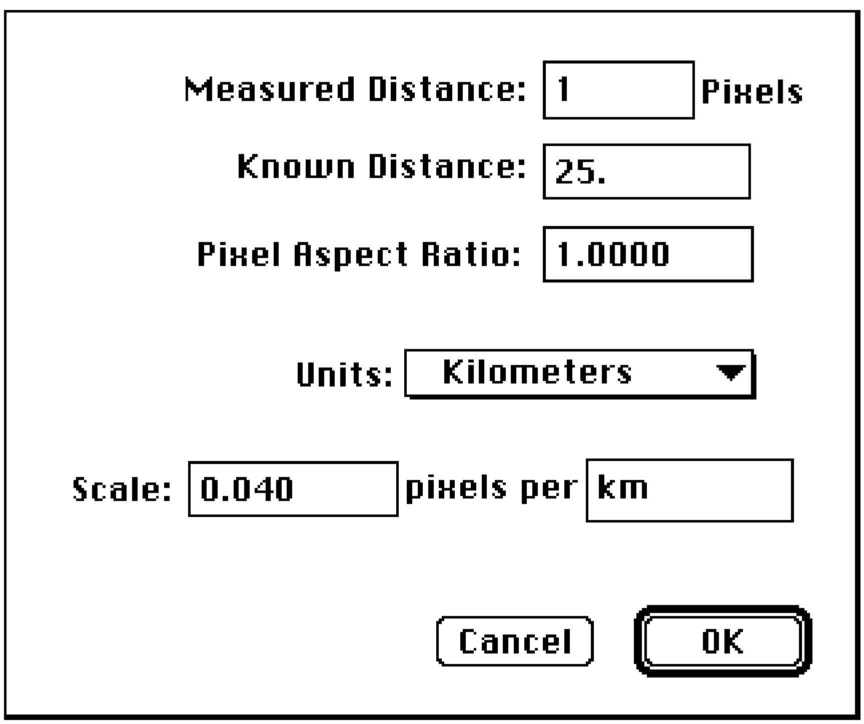
NOTE: For this to work correctly, you must set up the dialog box exactly in the order instructed, even though it jumps around the dialog box a bit.

2—Set Known Distance to "25."

3—Go down to Units and click and drag the menu bar to select "Kilometers."

4—Go back up and set Measured Distance to "1."

5—Make sure that the Pixel Aspect Ratio is set to 1 and the Scale reads 0.040. Click OK.



G

density slice your stack

Do G now.

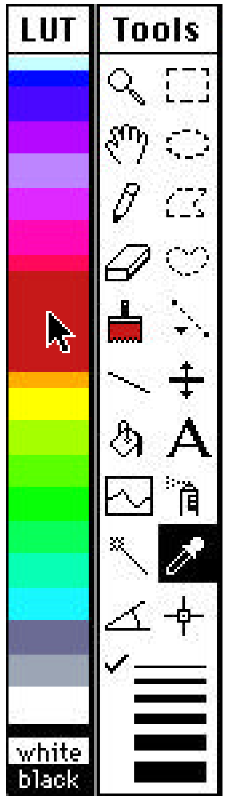
1—Double click the Density Slice Tool

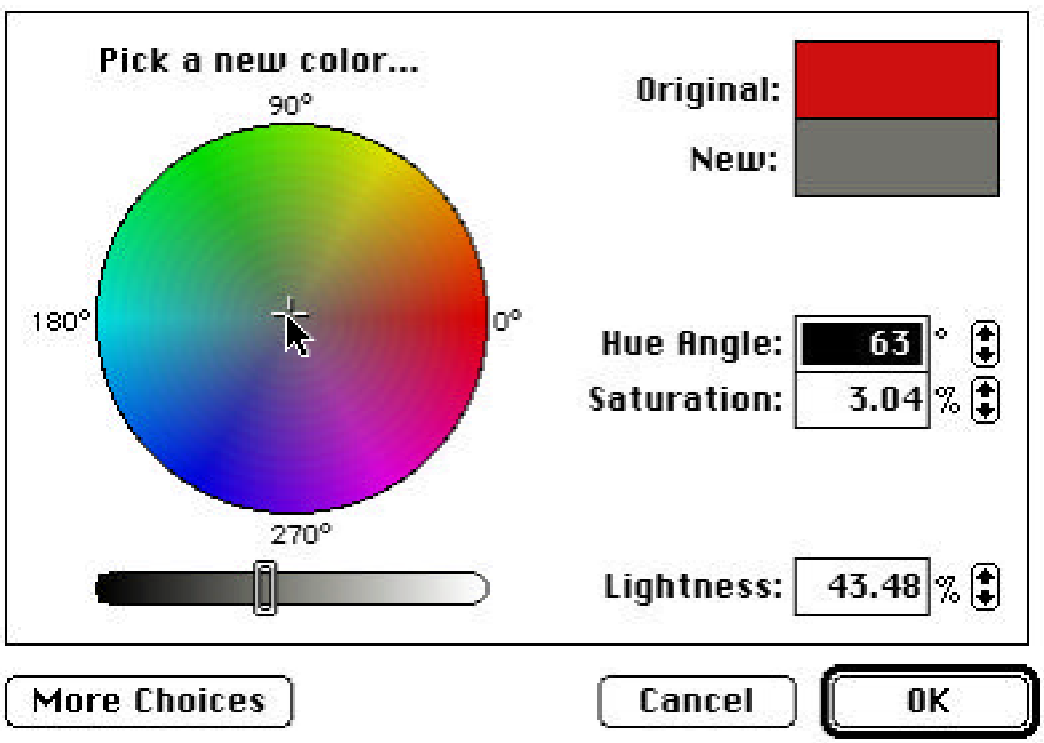
in the Tools Window, which will put a solid block of color (default is red) on the LUT window.

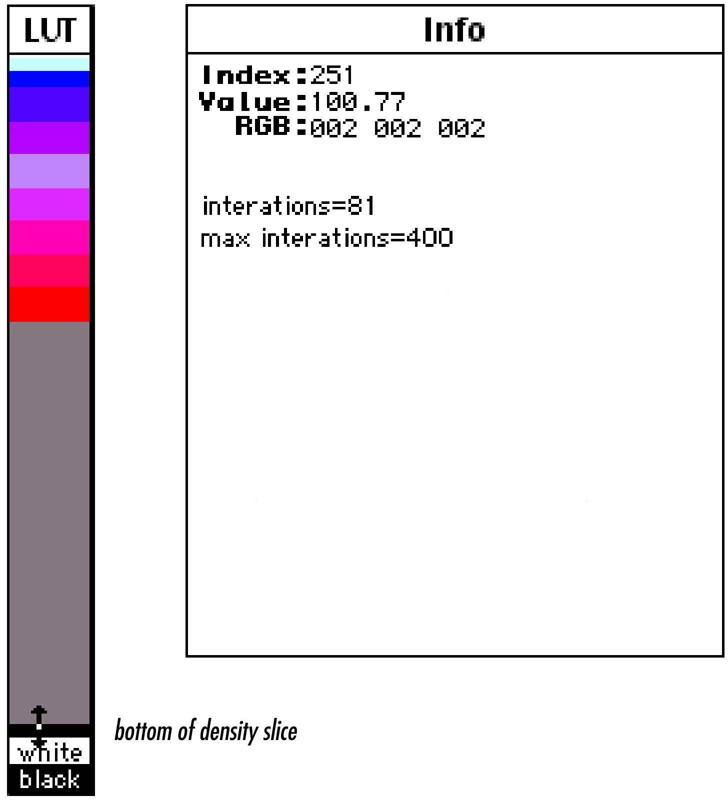
2—Select the Eyedropper

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 in the LUT window will turn gray.







bottom of density slice

G

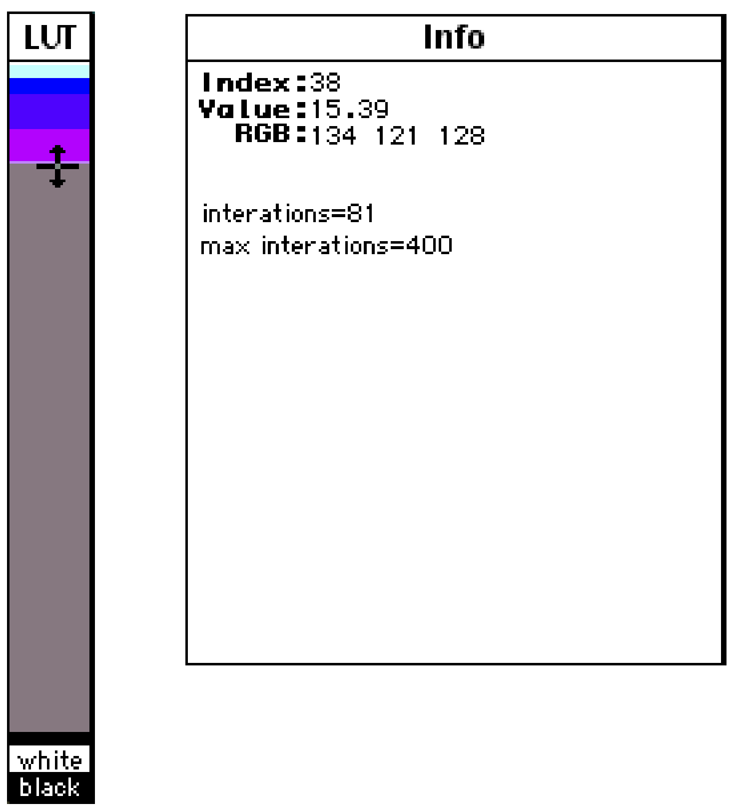
density slice your stack, continued

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

5 — On the bottom of the gray Density Slice color block, click, hold, and drag the mouse down until the Value in the info window shows approximately 100% (get as close as possible). Release the mouse button.

6 — Repeat step 5, this time dragging the top of the Density Slice to a value of 15%.

top of density slice



G

density slice your stack, continued

7 — Select 'Analyze/Options' and make sure that Area, Mean, and Standard Deviation are selected. Click OK.

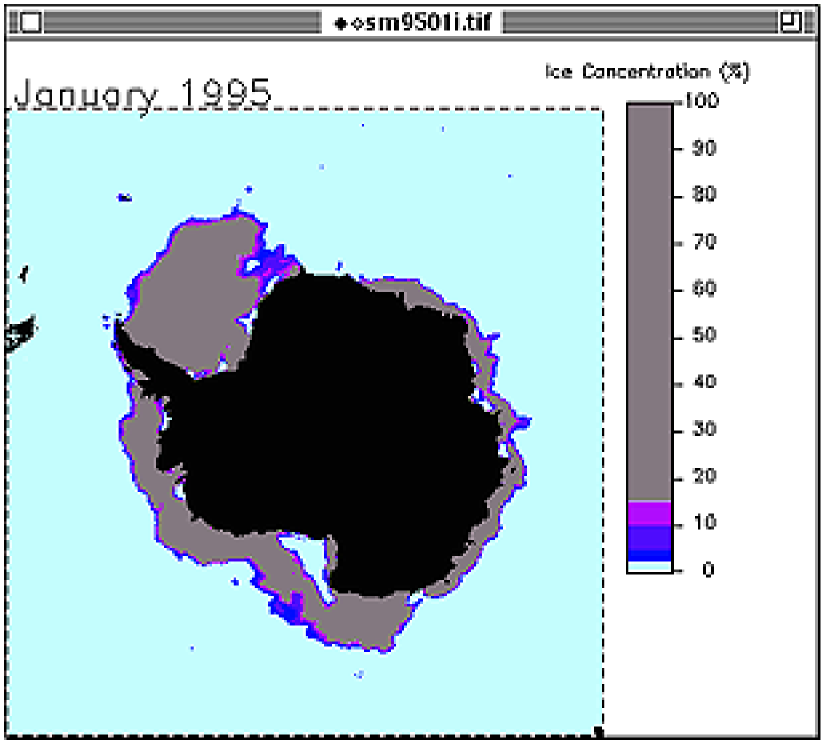
8 — Use the Rectangle Selection Tool

and select just the image window, as shown.

9 — Select 'Analyze/Reset' to clear any previous measurements.

10 — Select 'Analyze/Show Results.'

11 — Beginning with the earliest September image, apply 'Analyze/Measure.' You'll see the area, mean, and standard deviation data appear in the Results window. Use the [.>] key to activate the next image and apply 'Analyze/Measure' to it. Continue through the entire stack in this manner until you gather the information for all 16 months, as shown in the following example.



Results

	Area	Mean	S.D.
1.	6030000.00	61.45	27.92
2.	3607500.00	59.98	25.35
3.	5043125.00	58.99	24.81
4.	7870625.00	68.45	23.19
5.	11257500.00	73.34	22.32
6.	14201250.00	74.79	21.14
7.	16739375.00	76.62	20.89
8.	18897500.00	77.39	19.95
9.	19424375.00	76.75	19.29
10.	19063750.00	73.28	19.81
11.	16535000.00	71.00	22.04
12.	11753625.00	61.44	25.92
13.	6363125.00	55.30	25.85
14.	3052500.00	58.59	28.05
15.	4692500.00	55.37	28.71
16.	8100000.00	60.00	28.38

6. Record the data from your Results window onto the table on the next page.

Southern Hemisphere Areal Sea Ice Extent

MONTH Years: ______ – ______	AREA (square kilometers)	MEAN SIC (in percent)	STANDARD DEVIATION (%)
January	------------------		
February	------------------		
March	------------------		
April	------------------		
May	------------------		
June	------------------		
July	------------------		
August	------------------		
September	------------------		
October	------------------		
November	------------------		
December	------------------		
January	------------------		
February	------------------		
March	------------------		
April	------------------		

7a. Plot a time series of the sea ice area (as a function of time) for the Antarctic region. Plot the month on the X axis and the area on the Y axis.

7b. What is the **minimum** areal extent in square kilometers?

____

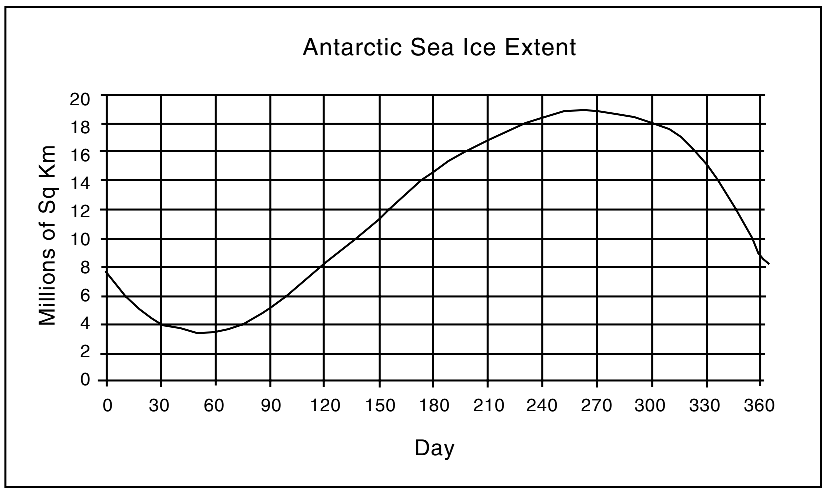
7c. What is the **maximum** areal extent in square kilometers?

____

7d. What is the percent difference?

7e. How does this compare with the Arctic?

8a. Compare your results to the figure below depicting the 1978–1987 average seasonal cycle determined from SMMR data.



Average seasonal cycle for the Antarctic (from Gloersen et al., 1992)

8b. Compare your results here to your answers to questions **1a – 3.** Does this more quantitative analysis improve the quality of your earlier answers and your confidence in those answers?

9. Compare the shape or trends seen in the Arctic and Antarctic time series you created and comment on differences in the seasonal cycles of each.

10a-b. For advance exploration, plot the Mean Percent SIC as well as the Standard Deviation, each as a function of time.

10c. What additional information regarding the seasonal changes in the character of the Antarctic sea ice cover can you deduce from these plots?

end of polar sea ice processes computer lab exercise 3