exercise 1
generating north and south pole geographic reference maps

In this activity you will learn how the north and south polar sea ice concentration data files were named, how to open and display the data files as images using *SEE Image* (a modification of *NIH Image* for Macintosh computers), and how to apply a color table to the images. You will also learn how to convert an image's pixel values to actual ice concentrations in percent.

Before working with any data it is important to understand their characteristics. A knowledge of the data type, data source, geophysical units, file naming convention, and temporal and spatial resolution are critical to ensure correct scientific interpretation. Equally important is the software tool available for displaying and analyzing these data—you will be using *SEE Image,* a modification of *NIH Image* for Macintosh computers that was developed especially for the Studying Earth's Environment From Space educational modules.

characteristics of the north and south polar monthly sea ice concentration data set for 1978–1996

Geophysical Measurement:	Sea ice concentration
Units of Measurement:	Percent
Data Source:	Satellites (Nimbus–7 SMMR and DMSP SMMI)
Temporal Resolution:	Monthly averages
Map Projection:	Polar stereographic, both poles
Spatial Resolution:	Nominally 25 km latitude x 25 km longitude
Software Application:	*SEE Image*

exploring monthly sea ice concentration at the poles

There are four types of data files provided here.

- Monthly-average sea ice concentration (SIC) image files for1978–1996 (219) for the North Pole region

- Monthly-average SIC image files for1978–1996 (219) for the South Pole region
- Land mask for the North Pole region (1 file)
- Land mask for the South Pole region (1 file)

The first two data types contain monthly-average values of sea ice concentration in percent over the North Pole and South Pole regions, respectively, excluding land. The spatial resolution of these images is approximately 25 square kilometers. This means that each pixel in the image has the equivalent geographic scale of about 25 km x 25 km.

For the four data types described above, the file names are constructed as follows:

North Pole monthly average SIC files for 1978–1996

nm**YYMM**i.tif

where

YY = last two digits of the year (from 78–96)
MM = two digits representing the month (from 01–12) where 01=January, 02=February, etc.

South Pole monthly-average SIC files for 1978–1996

sm**MM**i.tif

where

YY = last two digits of the year (from 78–96)
MM = two digits representing the month (from 01–12) where 01=January, 02=February, etc.

North Pole land mask

land_n.tif

South Pole land mask

land_n.tif

For the sake of quicker, easier downloading, in addition to the entire data set, we've made up special folders that contain only those files you'll need to complete each exercise. Be sure you have the exercise folder you'll be working with installed in

Desktop | HD | SEE Image | Data | Sea_Ice

before you begin the exercise.

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.

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* by double clicking on its icon.

B

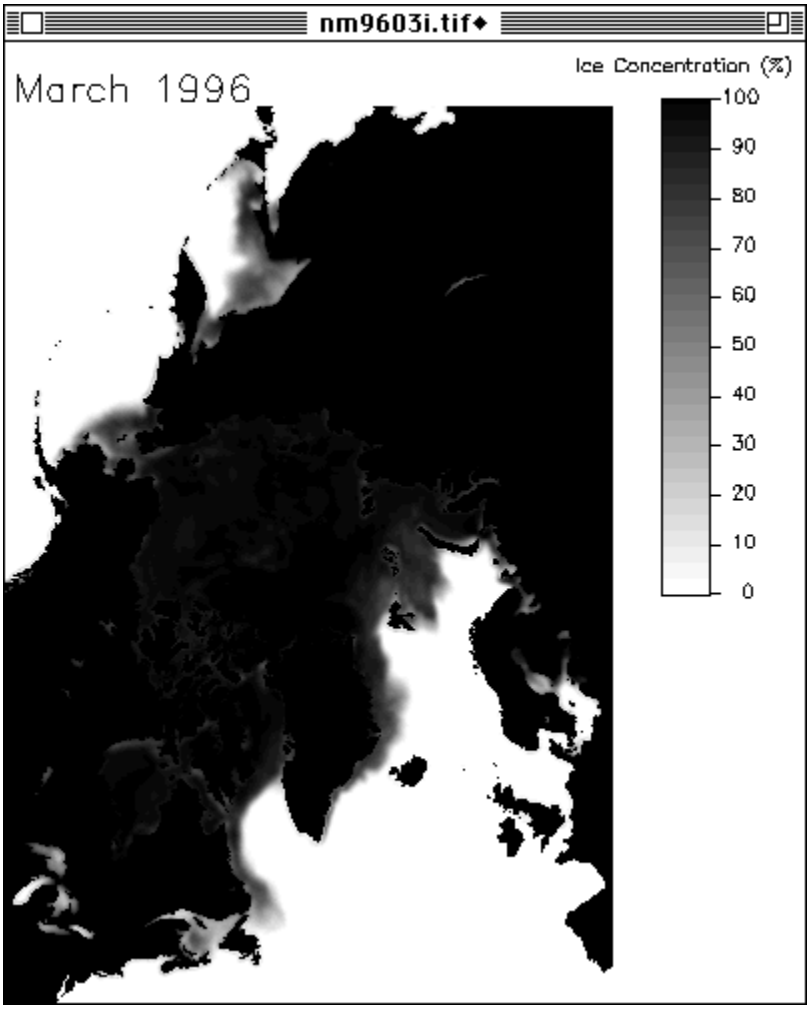
open a data file

1 — Select 'File/Import'.

2 — Go to Desktop | HD | SEE Image | Data | Sea_Ice | psiex1 | nm9603i.tif. Click on "Open."

opening and displaying a sea ice concentration data image

Do A and B now.



You should see this image on your screen, which shows monthly average sea ice concentrations for March 1996.

1. Write down the name of the file you imported.

_____

2. Interpret the file name and record the year and month of the SIC image you displayed.

Month _____ Year _____

adding color to the image

To better distinguish the differences in sea ice concentration of the polar regions we can apply color to the image using a color table, also called a color look-up table (LUT), that assigns SIC values (in percent) to each color.

Do C now.

C

color your image

1—Select 'Options/Color Tables/SEAICE'.

The image should now be displayed in color and the LUT window will display the color range used. Notice that the LUT window corresponds to the color legend on the image. This legend associates the color of the pixels in the image to their corresponding sea ice concentration in percent.

What colors were assigned to each of the following in the image?

3a. Land: _____

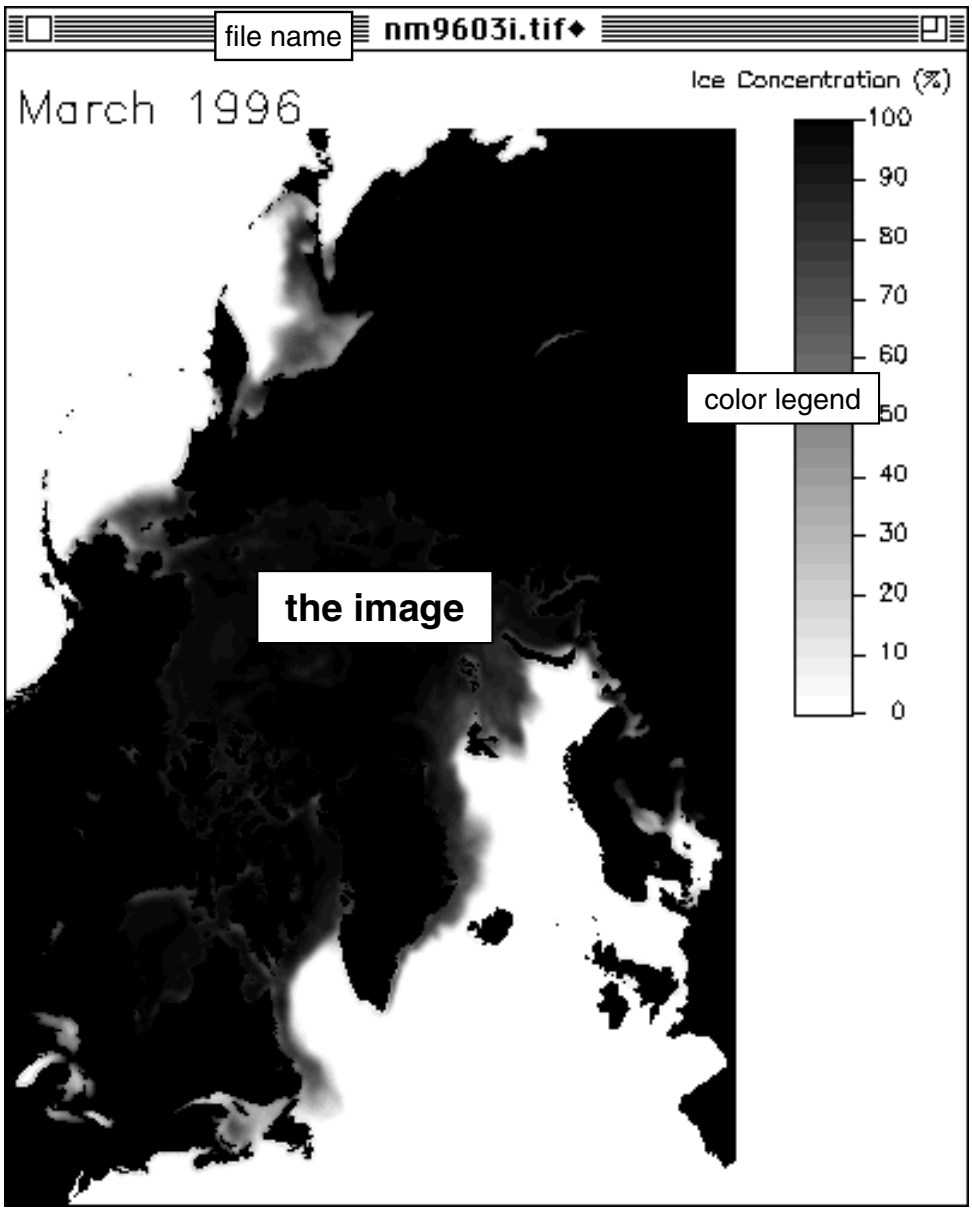
3b. Open water: _____

3c. 100% (or near 100%) ice covered waters:

_____

understanding display windows and images

If you do not have a North Pole SIC image open on your screen, open one now. You don't need to apply color to this image. It will look like this. This is called the Display Window.



Notice the elements that make it up. Across the top of the Display Window the **file name** is displayed. In the top, right corner there is a **color legend**, labeled with the units of the data. To the left of the color legend, the **month and year** of the data are displayed. In these exercises, "the image" refers to only the infor-

mation within the latitude-longitude annotations. "Display Window" refers to the entire figure including the color legend and annotations. In most of these exercises, you will be working with only the image itself, not the entire Display Window.

Close all images now.

creating north and south pole geographic reference maps

Using books, atlases, and WWW resources at your disposal, create geographic reference maps for the North and South Poles by labeling important geographic features on a printed copy of the Northern Hemisphere and Southern Hemisphere Land Mask.

Do D now.

D

printing maps

1—Choose 'File/Open' and select Desktop | HD | SEE Image | Data | Sea_Ice | psiex1 | land_n.tif. Click OK.

2—Choose 'File/Print Image' to get a hardcopy of the North Pole land mask.

3—Choose 'File/Open' and select Desktop | HD | SEE Image | Data | Sea_Ice | psiex1 | land_s.tif. Click OK.

2—Choose 'File/Print Image' to get a hardcopy of the South Pole land mask.

Label your maps with geographic features as follows:

Northern Hemisphere Land Mask

a. Canada	b. Greenland	c. Norway
d. Asia	e. Bering Sea	f. Sea of Okhotsk
g. Barents Sea	h. Greenland Sea	i. Labrador Sea
j. Hudson Bay	k. Norwegian Sea	l. Kara Sea
m. Laptev Sea	n. Chukchi Sea	o. Beaufort Sea
	p. Baffin Bay	

q. the lines of constant latitude

r. the lines of constant longitude

s. draw and label with **red** the warm water currents that flow from the Equator toward the pole

t. draw and label with **blue** the cold water currents that flow from the pole toward the Equator

Southern Hemisphere Land Mask

a. East Antarctica	b. West Antarctica	c. Indian Ocean
d. Atlantic Ocean	e. Pacific Ocean	f. Weddell Sea
g. Ross Sea	h. Amundsen Sea	i. Bellinghausen Sea

j. the lines of constant latitude

k. the lines of constant longitude

l. Antarctic Circumpolar Current

the relationship between pixel value and sea ice concentration value in percent

Repeat **Steps B and C** substituting data file
Desktop | HD | SEE Image | Data | Sea_Ice | piex1 | sm9608i.tif

4. Interpret the file name and record the year and month of the SIC image you displayed.

Month _____ Year _____

Move the cursor around in the image you opened. Look at the number associated with Value in the Info Window. These are the pixel values associated with each color. The images are stored as byte data with pixel values between 0 and 255 ($2^8 = 256 = 1$ byte). This is a way to compactly store data in a digital format. As you move your cursor around in the image using the mouse, the Info Window shows you the X and Y coordinates of the current position of the cursor, relative to the lower left corner of the Display Window, and the pixel Value associated with that position in the image. Become familiar with this notation before moving on.

The relationship between pixel values, which range from 0 to 255, and the actual SIC values, which range between 0% and 100%, is an important one to understand. Pixel values of 0, 254, and 255 are the only three that do not correspond to an SIC value in percent. They are always reserved to delineate certain features of an image. For instance, a pixel value of 255 is used for all annotations like the month and year, the border around the image, and the labels on the color legend.

5a. Move your cursor over some of the annotations (which are black) and write down the pixel value. _____

5b. What pixel value is associated with land? _____

5c. What pixel value is associated with open water? _____

6a. In the image itself (not the entire Display Window), what do white areas represent?

6b. What is the approximate range of pixel values associated with white areas in the image?

_____

The following table contains the pixel values from an SIC image (we'll call this variable X). Move the cursor along the color legend in the Display Window so that the Value in the Info Window corresponds to each of the pixel values in column X. Read the corresponding SIC value in percent from the color legend, and write the values in the Y (Ice Concentration) column in the table.

7.

	X Pixel Value	Y Ice Cencentration (%)
1	17	
2	63	
3	91	
4	120	
5	145	
6	172	
7	215	
8	234	
9	248	

using see image to calibrate pixel values to sea ice concentration values in percent

The *SEE Image* application can automatically calibrate the pixel values of an image with known SIC values in percent. Please go through the following exercise now so you will be familiar with this process for later explorations.

E

make a calibration standards file

1—Choose 'Analyze/Reset' to eliminate any previous measurements.

3—Click on the Info Window and drag it into view.

4—Choose 'Analyze/Options' and select only "Mean Density." Mean Density calculates the average pixel value in a selected area when you select 'Analyze/Measure.' Make sure "Max Measurements" is set to at least 30. Click OK.

5—Use the Magnifying Glass Tool

from the Tools Window to zoom in on a region so you can select individual pixels using the Rectangular Selection Tool

from the Tools Window. Using the Rectangular Selection Tool, draw a rectangle to capture a single pixel. The pixel will blink black and white if your selection took.

6—Choose 'Analyze/Measure.' Make at least 10 more 1x1 rectangular selections in other parts of the image. Choose pixels from the full range of ice concentrations. After each pixel is selected, choose 'Analyze/Measure.' Be sure not to include any of the image annotations or land in your small selections.

7—Choose 'Analyze/Show Results.' The Results Window will look like this.

8—Now by reading the SIC values from the color bar on the image itself, write down the ice concentration value in percent associated with each pixel value in the Mean column of the Results Window (add rows as you need them).

9—Choose 'Analyze/Calibrate.' In the dialog box select the Straight Line button and type in "percent" for the Unit of Measure.

10—Type in the known SIC values, from the table at right, in the second column of the table in the dialog box.

11—Click the Save button in the dialog box and name the file Ice_Standards. *Be sure you save this file in a place on your hard drive where you'll be able to find it later.* This will save these calibration points in a file so that next time you need to calibrate an image you simply open this standards file. Click OK. You'll again see the Calibration dialog box.

12—Click OK and a plot window will appear that shows you the points you selected from the image, the line of best fit through those points, and the coefficients of the line of best fit.

If it's not still open, repeat **Steps B and C** on data file
Desktop | HD | SEE Image | Data | Sea_Ice | piex1 | sm9608i.tif

8. Interpret the file name and record the year and month of the image you displayed.

Month _____ Year _____

Do E now.

Results

	Mean
1.	239.50
2.	248.00
3.	236.00
4.	226.00
5.	213.00
6.	211.00
7.	183.00
8.	144.00
9.	114.00
10.	95.00
11.	42.00
12.	12.00
13.	7.00

Mean Pixel Value	Ice Concentration (%)

9a. Based on this plot, how well does a straight line describe the relationship between pixel value and ice concentration?

9b. What is the slope of this line? _____

9c. What is the intercept of this line? _____

You may close this plot without saving it. The image has now been calibrated.

Now move your cursor around in the image and watch the Info Window. You'll see the actual ice concentration displayed for each pixel, with the corresponding pixel value in parentheses.

HINT: Once an image has been calibrated, an open diamond appears to the right of the file name across the top of the image.

If you'll be working with many images during a given session (as is the case for many of these exercises), calibrate the first one you open at the beginning of the session. All subsequent images will then be calibrated; you'll know that they are by the presence of the open diamond (in a stack, the open diamond appears to the left of the file name). Likewise, if you'll be working with a series of images in a stack, first create the stack, then calibrate the first image in the stack and the rest will automatically be calibrated.

To use a previously saved standards file, follow these steps.

- Select 'Analyze/Reset' and Continue
- Select 'Analyze/Calibrate'
- Select the Straight Line button
- Type "Percent" in the box titled Units of Measure
- Select 'File/Open,' find the standards file you saved earlier
- Click OK.

Before proceeding to the next exercise,

- Close all images
- Select 'Analyze/Reset' to clear all measurements.