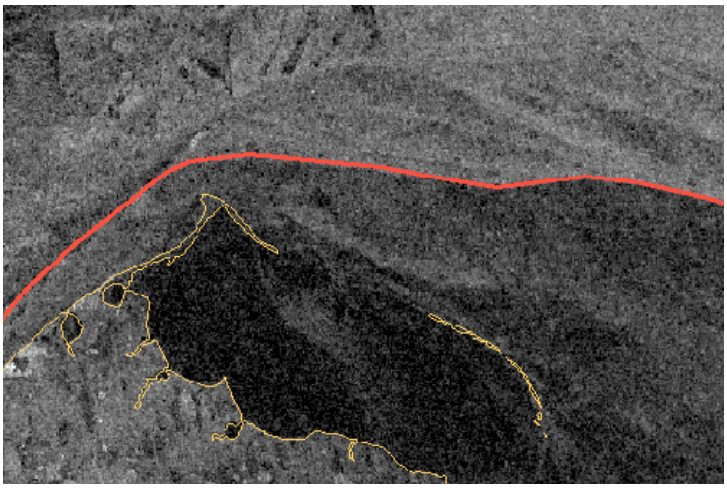
GIS Lesson 14
CHANGE OVER TIME: SHOREFAST SEA ICE
TEACHER INFORMATION



Lesson Summary: During this lesson students use GIS to analyze changes in the extent of shorefast sea ice. They extract information from multi-year and single year data and look for trends over time.

Objectives: Students will learn how to load and display multiple data layers in AEJEE and will use the measure tool to answer questions about what they see.

Estimated Time: 1 hour

Correlation to Alaska Standards

Geography A-6	Use spatial (geographic) tools and technologies to analyze and develop explanations and solutions to geographic problems.
Science E-1	Develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events.

BACKGROUND FOR THE TEACHER

For a discussion of shorefast (landfast) sea ice and to learn more about the data used in this lesson, see the Alaska Satellite Facility newsletter article “Examining Landfast Sea Ice on Alaska’s Northern Coast” at:
http://www.asf.alaska.edu/news_notes/2-2/examining-landfast-sea-ice-alaskas-northern-coast

MATERIALS

- Computers - one for each student is best or two students can share. The computers must meet the following specifications to run AEJEE:
  - Macintosh: MacOS 10.3 or above, 100 MB hard drive space, Internet connection; recommend G4 or faster processor and more than 64 MB RAM.
    - We recommend: Mac OS 10.4 or above, 500 MB hard drive space (400 MB for data).
- AEJEE software and MapTEACH GIS data can be downloaded from the MapTEACH website at http://www.mapteach.org, or provided by MapTEACH on a DVD by contacting:

  De Anne Stevens - MapTEACH
  Alaska Division of Geological & Geophysical Surveys
  3354 College Road
  Fairbanks, AK 99709-3707
  Tel: 907-451-5014
  E-mail: deanne.stevens@alaska.gov
- Copies of student instructions for the lesson.

INSTRUCTIONAL PROCEDURES

Getting Ready

- As always, try out the lesson on a classroom computer ahead of time.
- Make an overhead or PowerPoint slide of the example of radar imagery provided in the MapTEACH Ice_Data folder (Radar_Example).
- Consider whether you wish to preface this lesson with a more in-depth study of sea ice (see Teacher Resources).

Gear-up

- Work together with students to explore what shorefast sea ice is and why it is important to people living on the coast. A good teacher resource is the Sea Ice web page of the National Snow and Ice Data Center (http://nsidc.org/cryosphere/seaice/index.html)
- Show students an example of the radar imagery that was used to make the shapefiles they will be working with. An AEJEE-ready example of this imagery and the line marking the location of the edge of shorefast ice in this image can be found in the MapTEACH Ice_Data folder (Radar_Example). You may choose to use it only as part of the gear-up for this lesson, or as an additional exploration so students have the opportunity to better understand the source of the GIS data they are working with. Explain how the extent of shorefast sea ice is indicated by the transition from dark speckled areas (where little or no movement has taken place) to light speckled areas (where significant movement is taking place).

More Explorations

- Have students work with the example radar image and the associated shapefile of shorefast ice (found in the MapTEACH Ice_Data folder – "Radar_Example").
- Students can code the ice limit data they worked with in this lesson so each shapefile has a fill color (in the exercise, they use transparent fill and only use the outlines to measure distances). When the layers are arranged in chronological order in the Table of Contents, students can systematically turn the layers off and on to make a sort of time-lapse sequence of the extent of shorefast ice. Students can make observations about how the ice limit changes across the entire extent of the map area, as well as in specific locations.
- You may wish to have your students use graph paper to graph the measurements they make in this exercise, with time as one axis and distance from shore as the other axis.

MORE RESOURCES FOR STUDENTS OR TEACHERS

Background information on the University of Alaska Geophysical Institute's project that generated the data used in this lesson can be found at:
http://mms.gina.alaska.edu/

The National Snow and Ice Data Center's web page on Sea Ice offers a great deal of useful information for teachers or advanced students:
http://nsidc.org/cryosphere/seaice/index.html
The "Environment" tab includes a section on indigenous peoples' knowledge of sea ice and how it impacts them.

The web site of the Barrow Ice Observatory, including a live webcam, can be found at:
http://www.gi.alaska.edu/snowice/sea-lake-ice/Barrow_observatory.html

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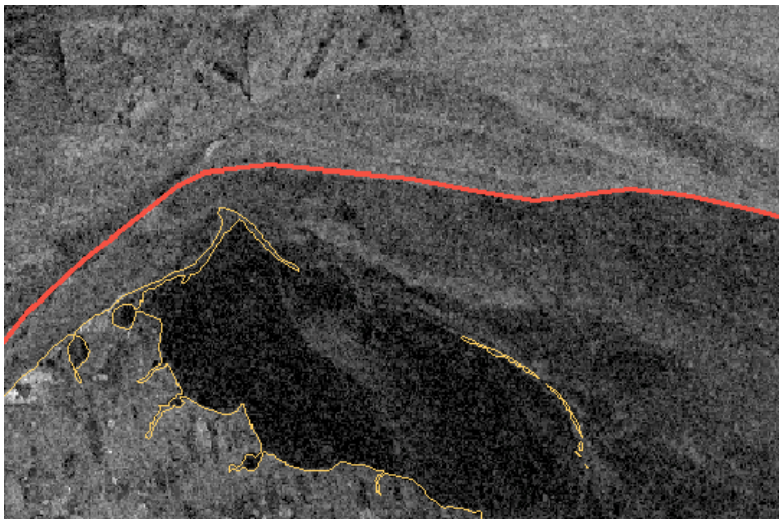
STUDENT EXERCISE



Objectives: Students will learn how to load and display multiple data layers in AEJEE and will use the measure tool to answer questions about what they see.

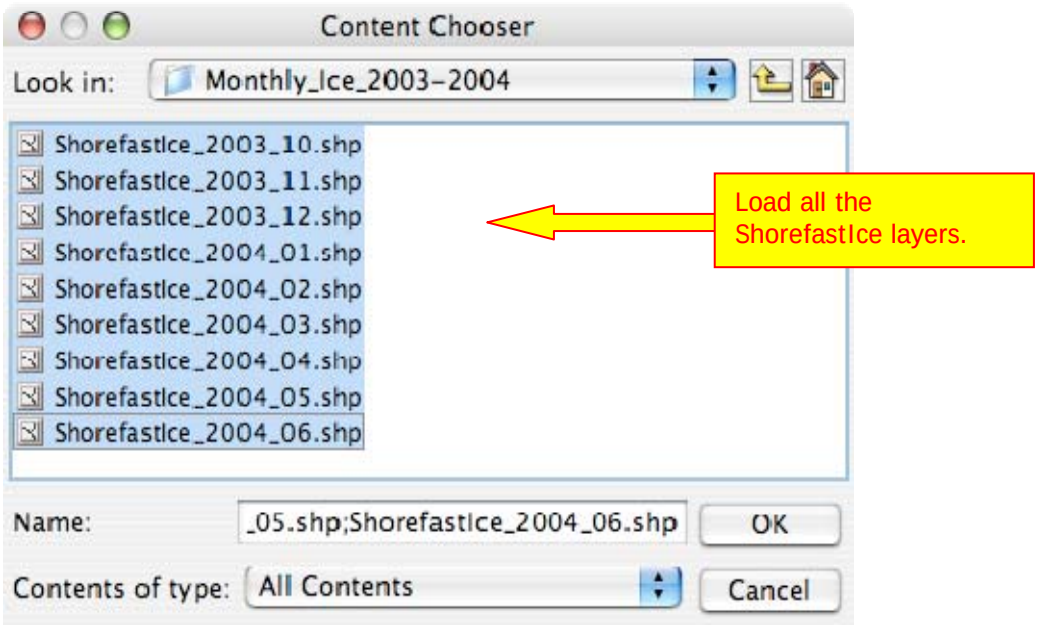
Estimated Time: 1 hour

As you have seen in class and in earlier lessons, satellite images can show many different kinds of features. Today you will be working with shapefiles that scientists have made by using computers to interpret radar imagery. The shapefiles you will be using show the extent of shorefast sea ice along the northern coast of Alaska during different years and during different times of the year.

Explore 1: One Year of Ice Data

1. **Open AEJEE** and make your window bigger by clicking on the green button in the top left of the window.

2. Navigate to the **Ice_Data** folder, open the folder **Monthly_Ice_2003-2004**, and load all of the shapefiles into your project. The easiest way to do this is to click on the top file name in the Content Chooser and then shift-click on the bottom file name to highlight all the file names.



Each of these shapefiles marks the extent of shorefast sea ice during one month between October 2003 and June 2004, which is almost a full 1-year cycle. You can tell the date of the ice limit by looking at the name of the shapefile, which includes the year and the month of that data. For instance, ShorefastIce_2004_03 is the shorefast ice limit in March (the 3rd month) of 2004.

3. **Set your map projection** to **Regional Projections / Albers Equal Area (Ellipsoid) / Alaska** in Systems, with a Datum of **WGS84 (World Geod. Sys. 1984)**.

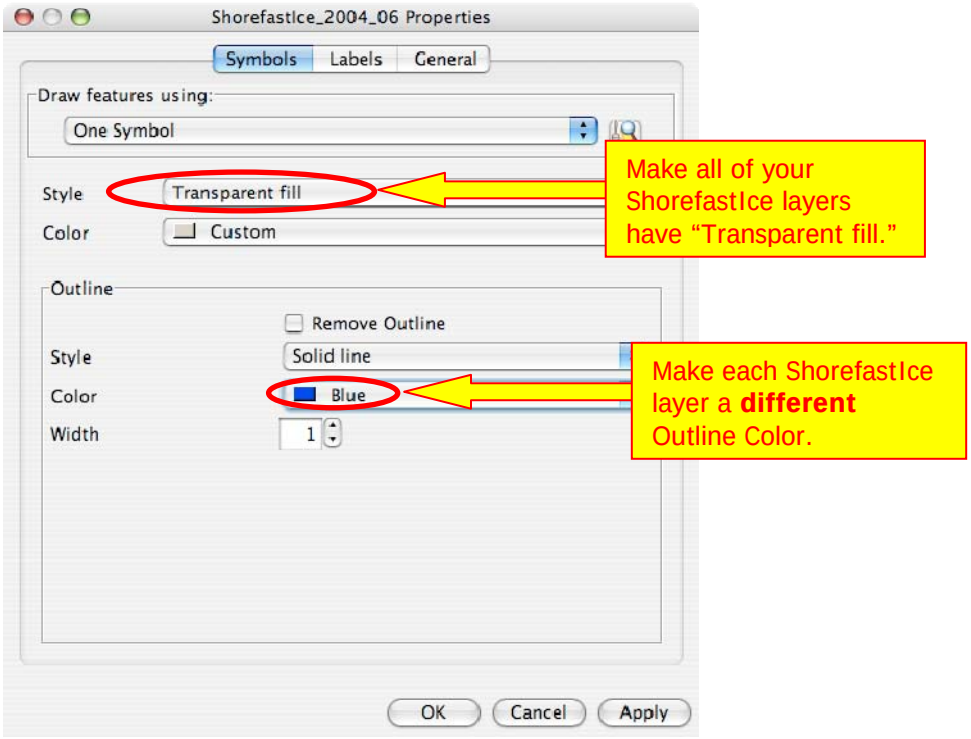
4. **Add NorthernCoastDetailed.shp** from the **North_Alaska_Coast** folder in **Ice_Data**.

5. **Add Towns** from the **Infrastructure** folder.

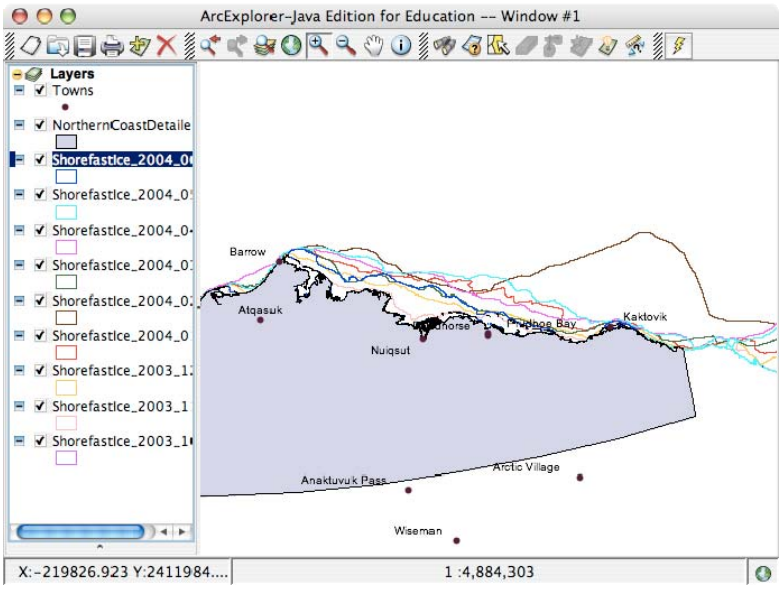
6. **Symbolize NorthernCoastDetailed** any way you like.

7. **Symbolize Towns** any way you like, and **label** it with the **town names**.

8. **Symbolize all the ShorefastIce layers** so that the **Style** is **Transparent fill** and the **line colors are all different** so you can easily tell the difference between the different layers.

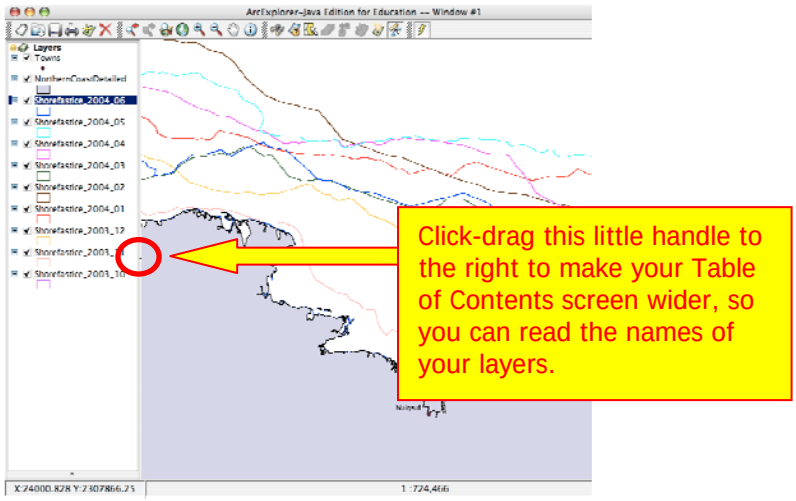


Your map might look something like this:



9. **Zoom in** on an area of the coast that interests you, making sure that your view includes all the shorefast ice extent lines that extend out to sea from that area.

10. Make your **Table of Contents** screen a little **wider** so you can see the full names of all your data layers. Do this by click-dragging the tiny button you can barely see in the middle of the bar separating the Table of Contents from the map screen.



11. Pick a point on the coast as your starting point and **use the Measure tool** to **measure the distance from that point on the coast to the edge of the shorefast sea ice for each of the months of data** you have in your project. Try to make all your measurements along a single, imaginary straight line extending out from the point you have chosen as your starting point. Use **Kilometers** as your units, and record your measurements in the space provided below:

October 2003 _____

November 2003 _____

December 2003 _____

January 2004 _____

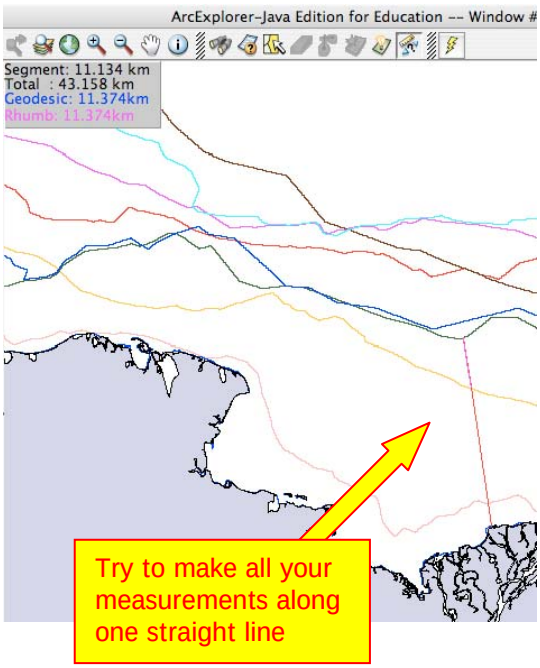
February 2004 _____

March 2004 _____

April 2004 _____

May 2004 _____

June 2004 _____



Interpreting Data

Which month had the most shorefast sea ice for your chosen location on the coast?

_____

Which month had the least? _____

In general, was there any pattern or trend to the extent of shorefast sea ice over time for your chosen location on the coast?

_____

If you observed a pattern or trend, please describe it:

_____

_____

Compare your results with someone else in your class who chose a different part of the coast. Did you get the same results?

_____

What is your best guess about why or why not?

_____

_____

_____

Save your project in your MapTEACH_work directory.

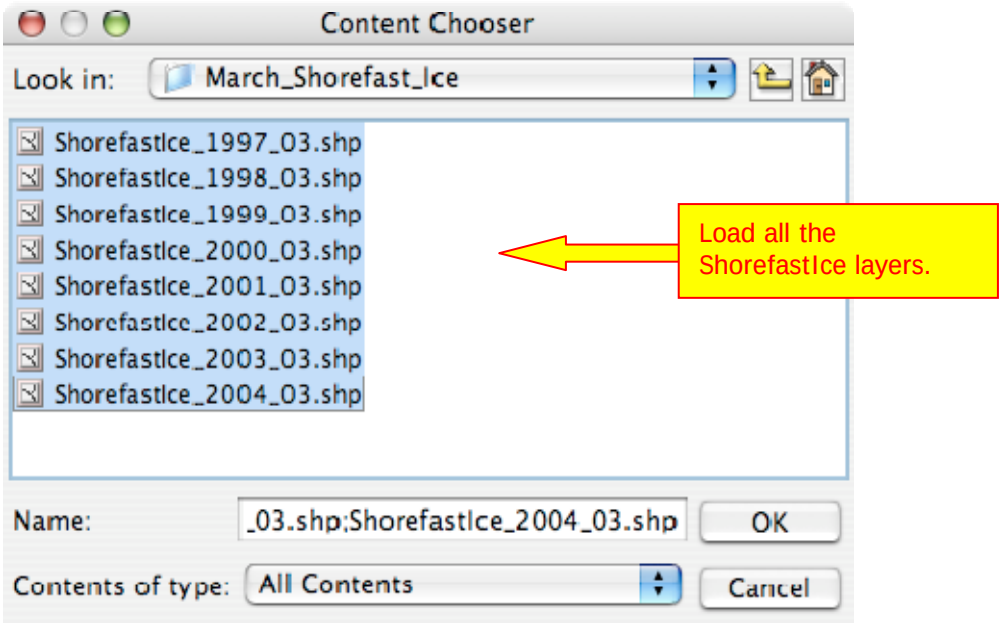
Show your project to a teacher.

Teacher sign-off: _____

Explore 2: Multiple Years of Ice Data

1. Start a new AEJEE project.

2. Navigate to the **Ice_Data** folder, open the folder **March_Shorefast_Ice**, and load all of the shapefiles into your project.



   These shapefiles show the extent of shorefast sea ice during March for each year from 1997 to 2004. You can tell the date of the ice limit by looking at the name of the shapefile, which includes the year and the month of that data. For instance, ShorefastIce_1999_03 is the shorefast ice limit in March (the 3rd month) of 1999.

3. **Set your map projection** to **Regional Projections / Albers Equal Area (Ellipsoid) / Alaska** in Systems, with a Datum of **NAD83 (North American Datum 1983)** and a Transformation of **NAD83 – Alaska**.

4. **Add NorthernCoastDetailed.shp** from the **North_Alaska_Coast** folder in Ice_Data.

5. **Add Towns** from the **Infrastructure** folder.

6. **Symbolize NorthernCoastDetailed** any way you like.

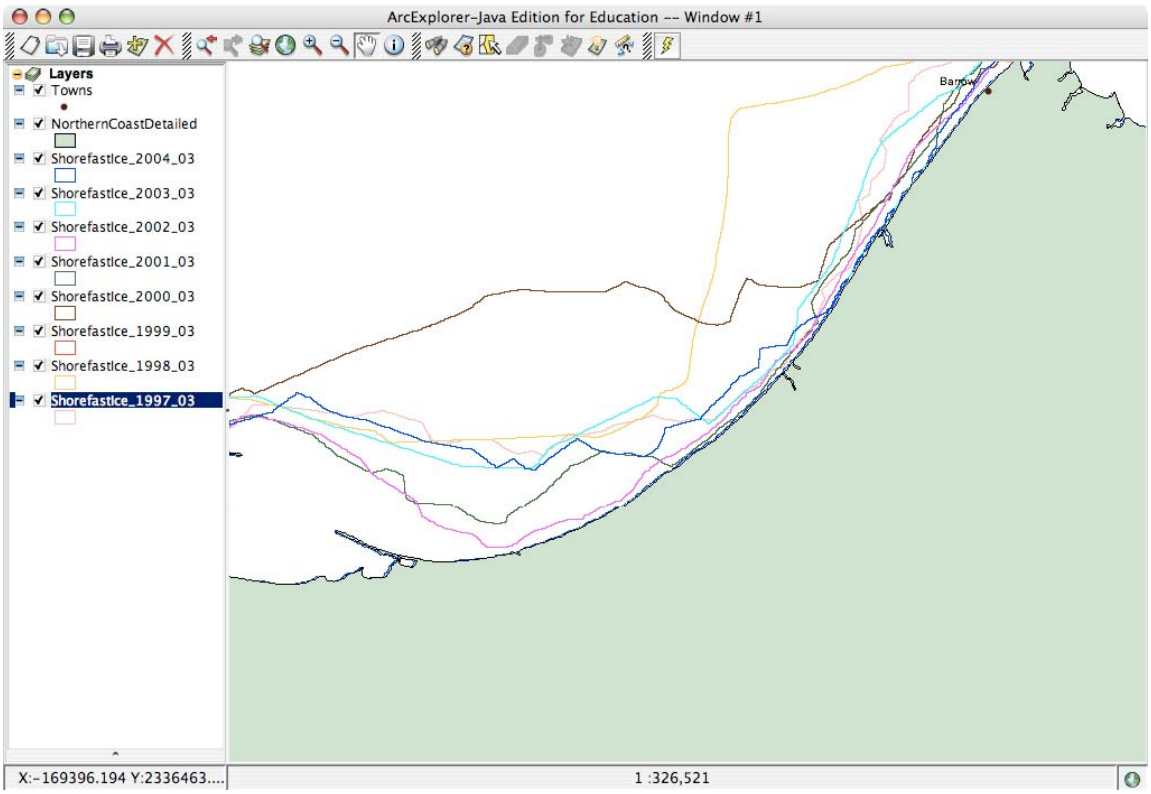
7. **Symbolize Towns** any way you like, and **label** it with the **town names**.

8. **Symbolize all the March_Shorefast_Ice layers** so that the Style is **Transparent fill** and **the line colors are all different** so you can easily tell the difference between the different layers.

9. **Zoom in** on an area of the coast that interests you, making sure that your view includes all the shorefast ice extent lines that extend out to sea from that area.

10. Make your **Table of Contents** screen a little **wider** so you can see the full names of all your data layers.

Your map might look something like this:



11. Just like you did with the one-season data in the last activity, pick a point on the coast as your starting point and **use the Measure tool** to **measure the distance from that point on the coast to the edge of the shorefast sea ice for each of the years of data** you have in your project. Remember to try to make all your measurements along a single, imaginary straight line extending out from the point you have chosen as your starting point. Use **Kilometers** as your units, and record your measurements in the space provided:

March 1997 _____

March 1998 _____

March 1999 _____

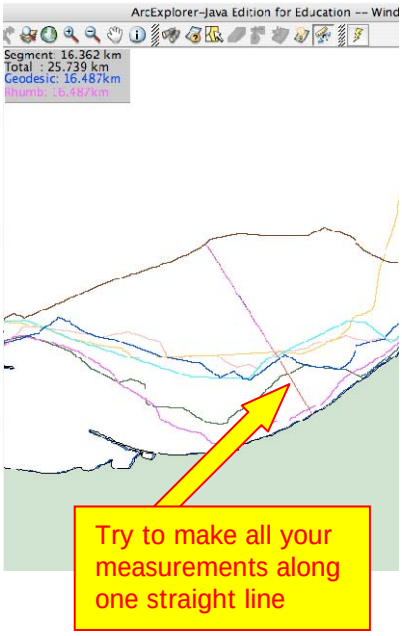
March 2000 _____

March 2001 _____

March 2002 _____

March 2003 _____

March 2004 _____



Interpreting Data

Which year had the most shorefast sea ice for your chosen location on the coast?

_____

Which year had the least? _____

In general, was there any pattern or trend to the extent of shorefast sea ice over time for your chosen location on the coast?

_____

If you observed a pattern or trend, please describe it:

_____

_____

Compare your results with someone else in your class who chose a different part of the coast. Did you get the same results?

_____

What is your best guess about why or why not?

_____

_____

_____

If global warming is real, what would you expect the data to look like?

_____

_____

_____

Do your results tend to support or refute global warming?

_____

Do you think this is enough data to prove or disprove global warming?

_____

Why or why not?

_____

_____

_____

_____

_____

Save your project in your MapTEACH_work directory.

Show your project to a teacher.

Teacher sign-off: _____