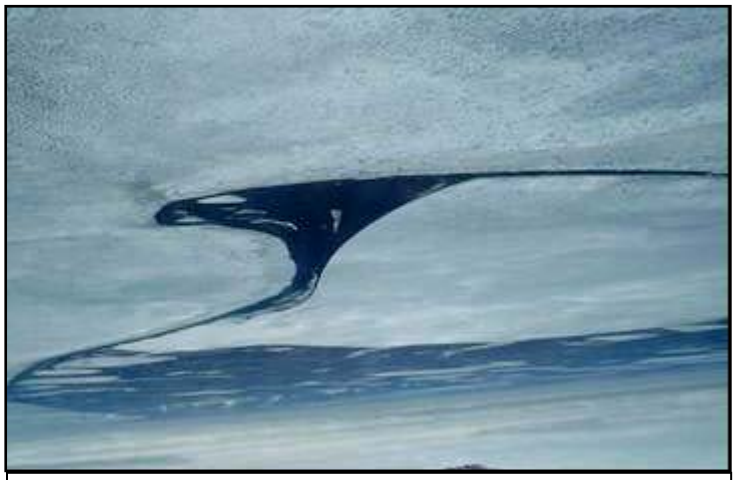
Geoinformatics at the Barrow High School
Exercise: Landfast Ice Detection and Mapping

Objectives: The objectives of this exercise are to use radar images for the Barrow area to

1. visually detect landfast sea ice
2. trace the extent of landfast ice using Arcview 3.3
3. measure the difference in extent of landfast ice on radar images of the same area acquired in different seasons to understand the variability in extent and the consequence of such variability.

Background information: Land-fast ice is a term used for sea ice that is attached to the coastal lands (see photo). As you may imagine, this thick layer of sea ice (land-fast ice) practically extends the coast for the coastal residents. Coastal residents can walk /snow mobile from their coastal lands onto this platform of ice and use this for hunting purposes. Knowledge of the extent of the landfast ice is therefore important. It is also important to know if the landfast ice edge meets open water or not as this determines the possibility of finding certain marine animals for hunting.



Land-fast ice near Barrow (Photo: Andy Mahoney, GI, UAF)

The extent of this land-fast ice depends on the time of the year. It also varies from year to year. Monitoring these changes is important for the local residents. When carried over a longer period of time and over larger areas, results of such monitoring activities may also help to understand how Earth processes are responding to the global climate change.

Data and tools:

1. Radar image of Barrow area for November 22, 2003 (b03nov22.tif)
2. Radar image of Barrow area for January 27, 2004 (b04jan27.tif)
3. Radar image of Barrow area for February 17, 2004 (b04_feb17.tif)
4. Radar image of Barrow area for July 8, 2004 (b04july8.tif)
5. Arcview 3.2a or higher

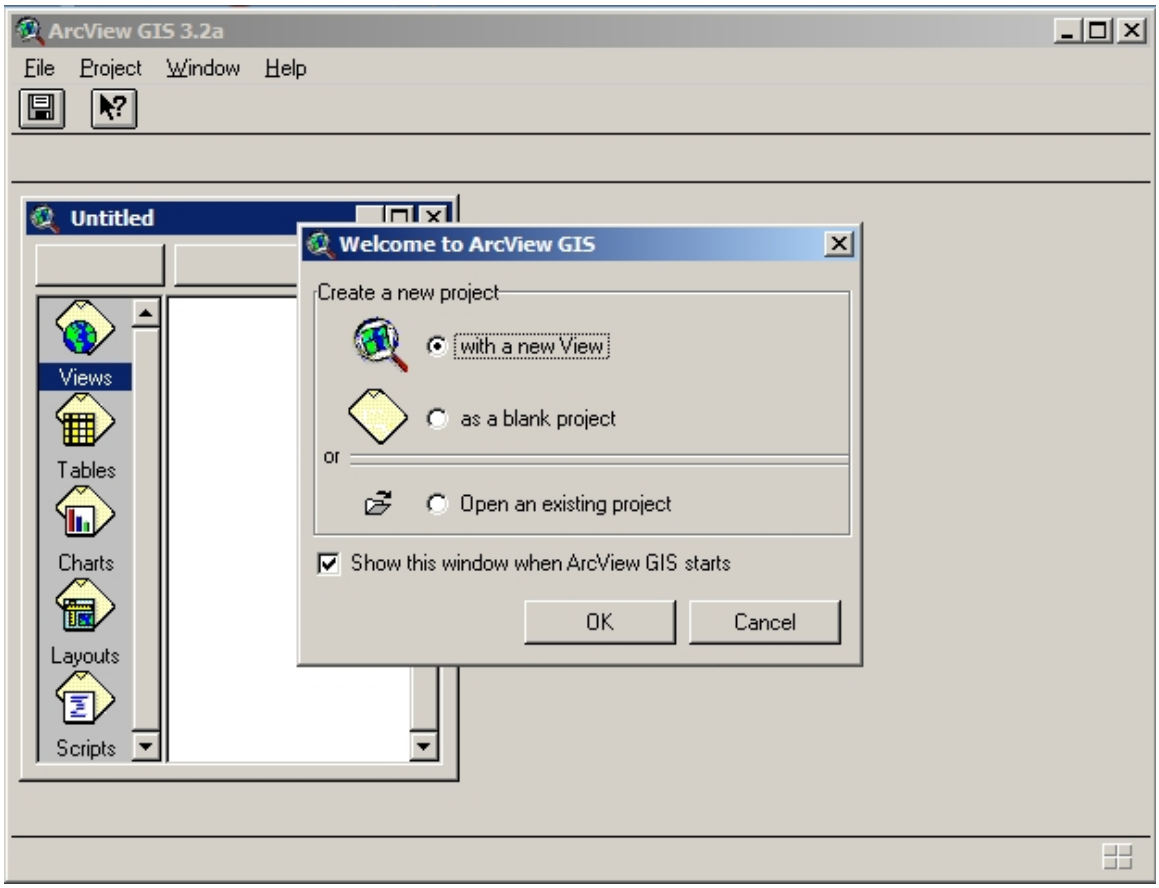
Grade/Level of skill/Time: This exercise is designed for students of grades 9-12. Basic knowledge of Arcview 3.3 is desirable. The exercise should take about 45 minutes.

About the data sets: The images provided are acquired by a Synthetic Aperture Radar which is mounted onboard a Canadian satellite called RADARSAT. The smallest unit of this image (pixel) is equal to 100 meters. This means that if you zoom in sufficiently and start seeing individual squares on the image, the smallest square (pixel) represnts 100 meteres on the ground.

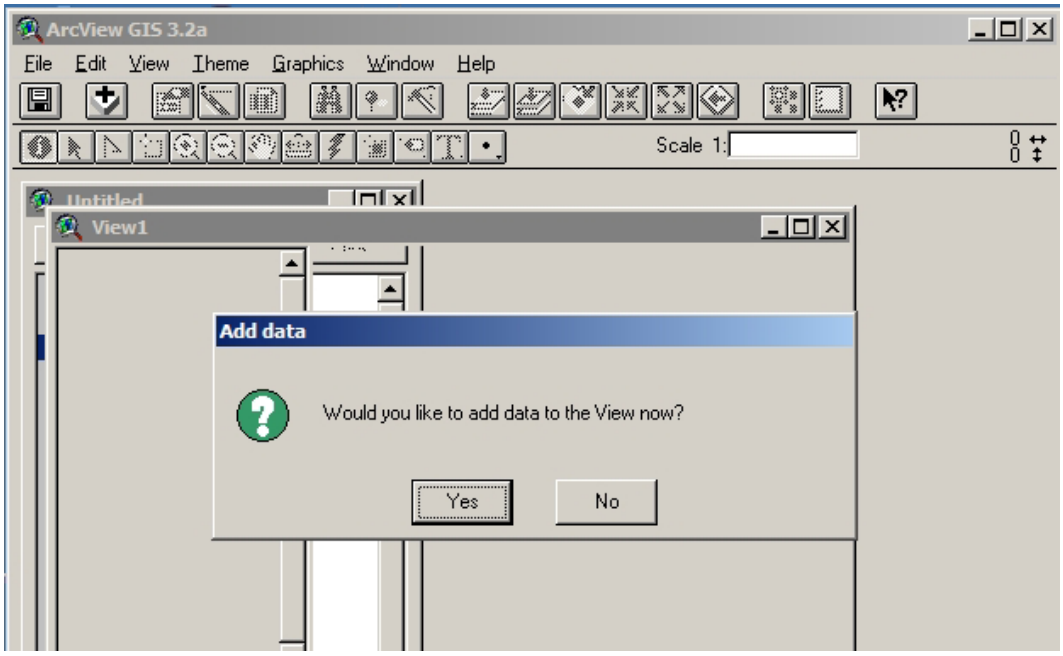
On the SAR images open water show up in dark, near black tones. Landfast ice, shows up as a continuous stretch of brighter tones, but with a more mixed 'salt-pepper' sort of look. Constructed areas, such as the city of Barrow, can be recognized by the very bright whitish tone, which is seen because the angular edges of the buildings serve as good reflectors.

Procedure:
Step 1. Start Arcview by double clicking on the Arcview icon**.**

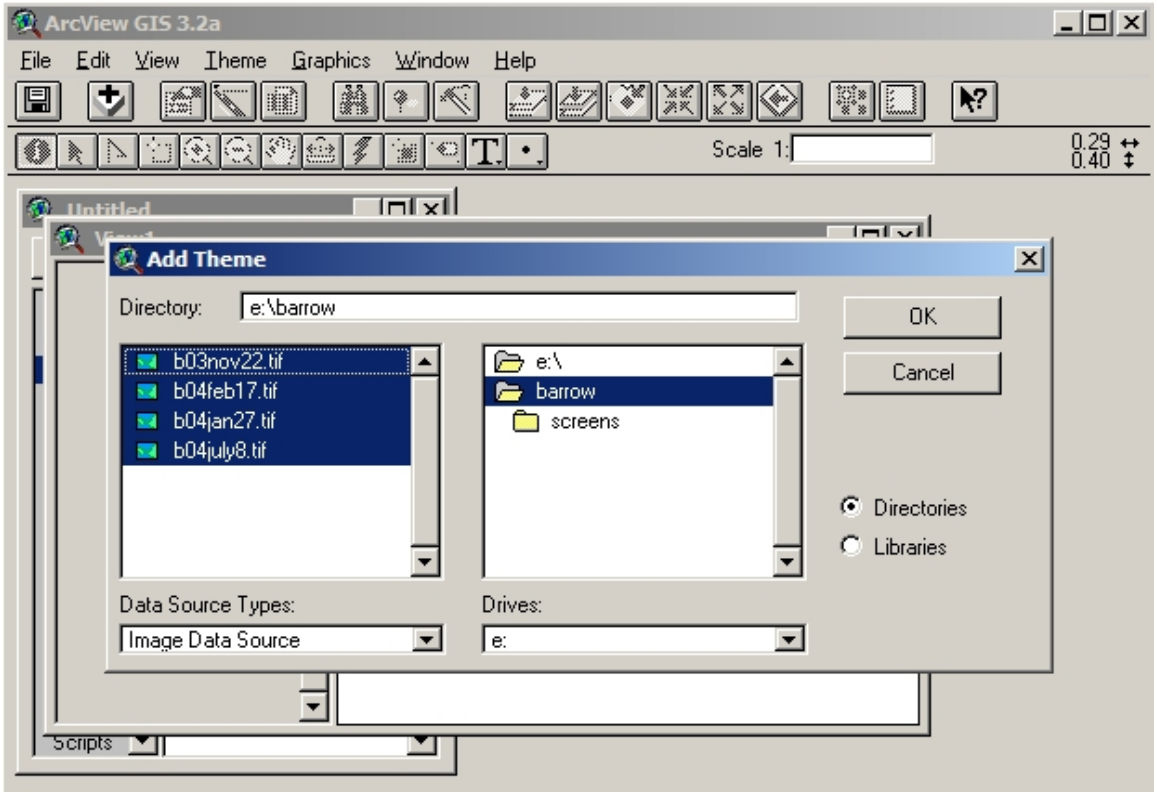
Step 2. Create a new project with a new view:



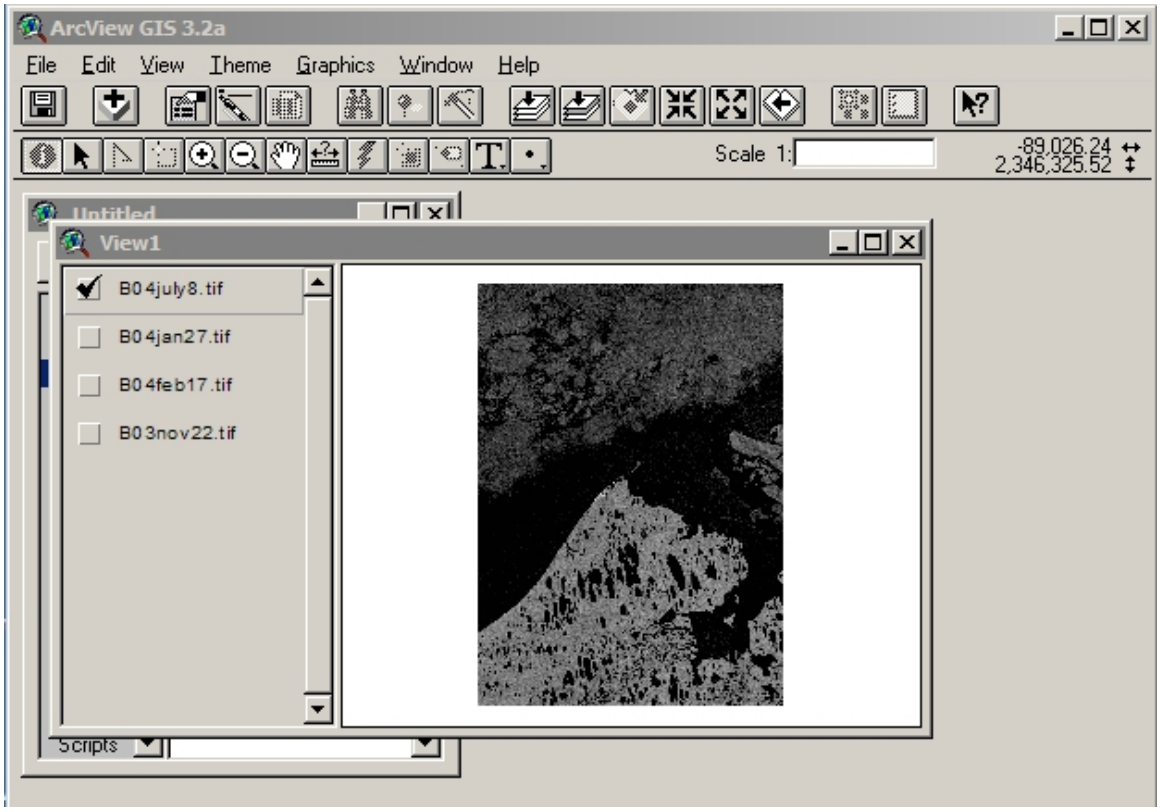
Step 3. Add data to the view (say 'yes' to the question 'would you like to add data now)



Step 4. In the window for Add theme, navigate to the correct directory where your data is stored. Also, change the data source type to 'image data source'

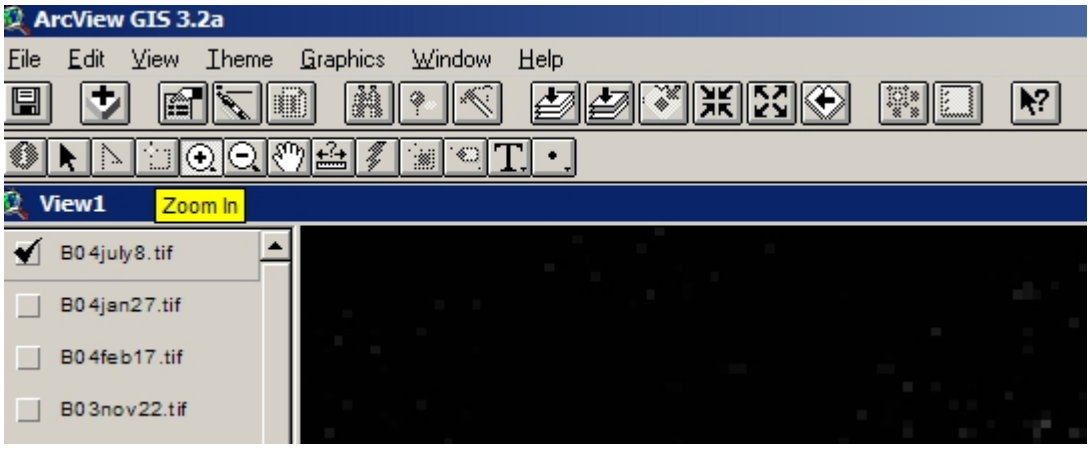


Step 5. Select the summer time image of Barrow (b04july8.tif) and press OK

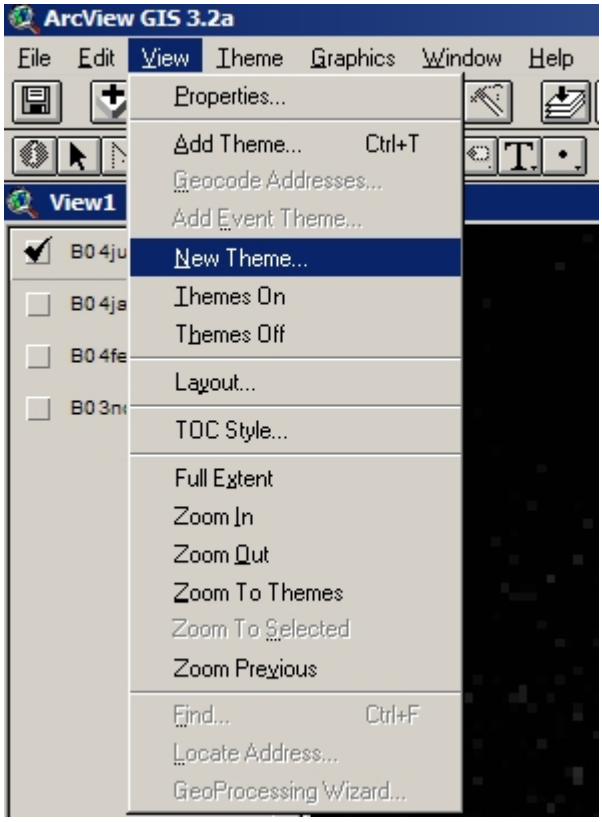


Step 6. Check the box next to the image name in the left frame to view the image in the main image viewing frame. Make sure that the image you select is now the active theme (the theme that is active has a raised button).

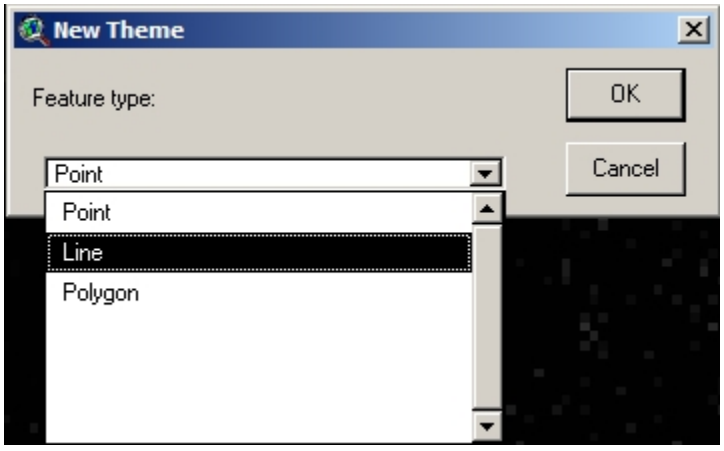
Step 7. Zoom into the coastal area near the Barrow city using the zooming tool.



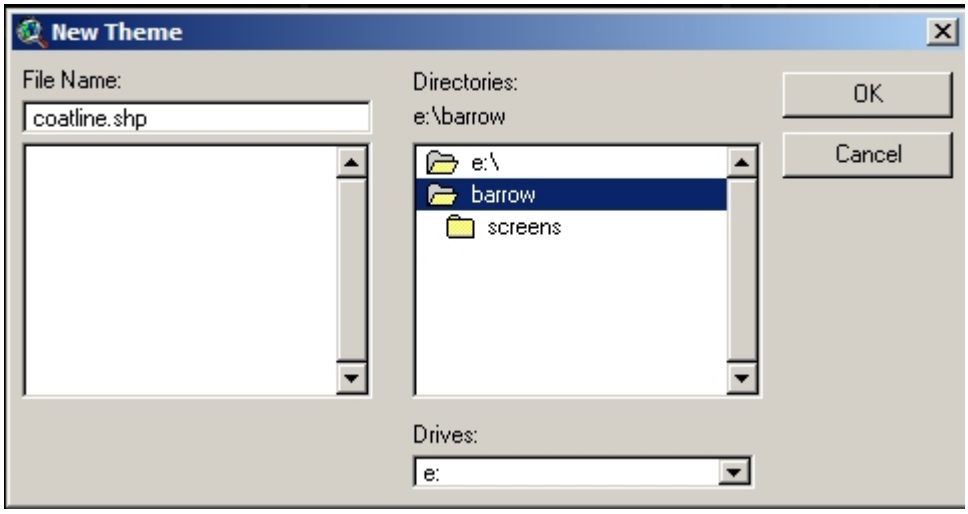
Step 8. Add a new theme to the view



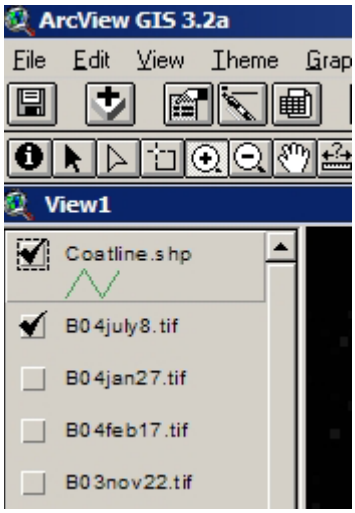
Step 9. As we want to trace the extent of the landfast ice, the theme we will add needs to be a line feature



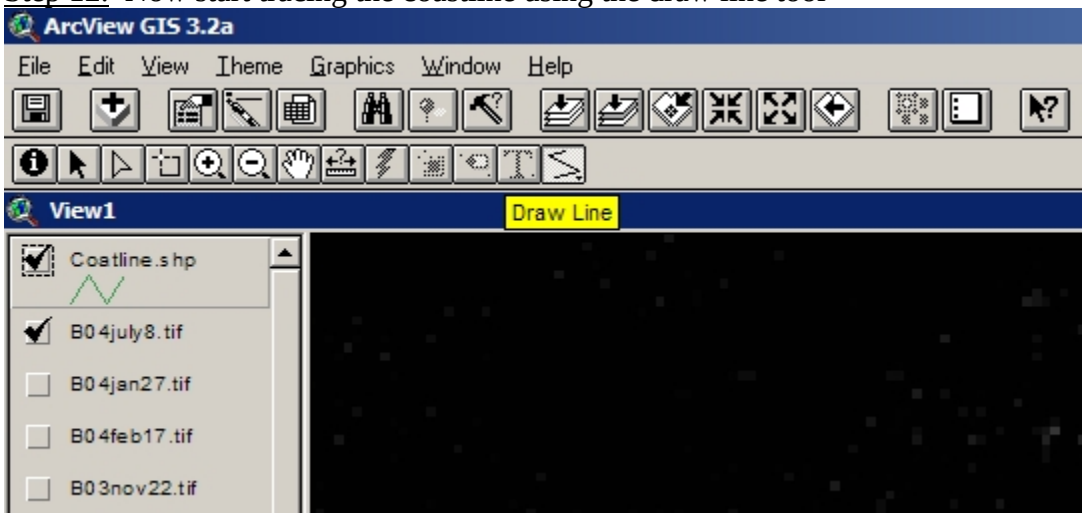
Step 10. Give a meaningful name to the new theme. (coastline.shp).



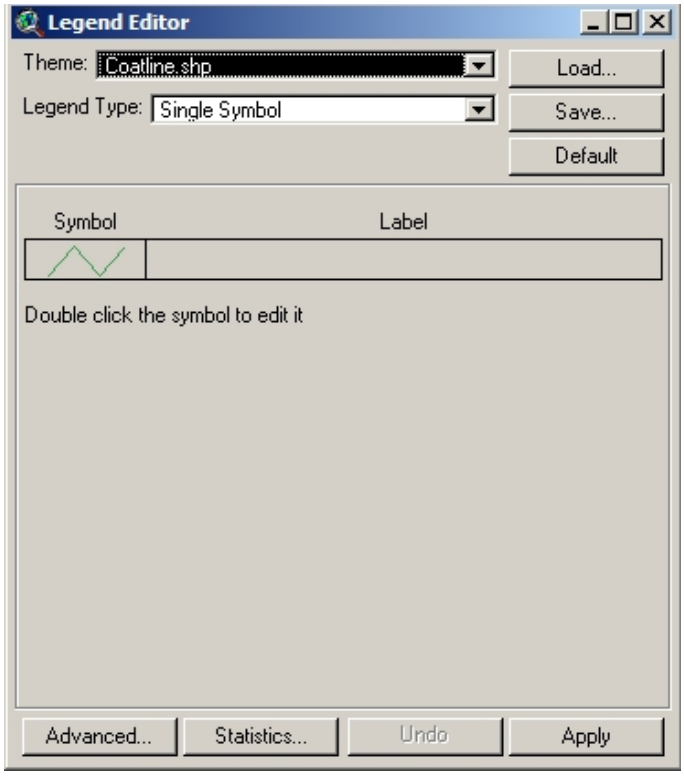
Step 11. This will add a new shape file in the view. Again, ensure that the coastline shape file is selected and the active theme



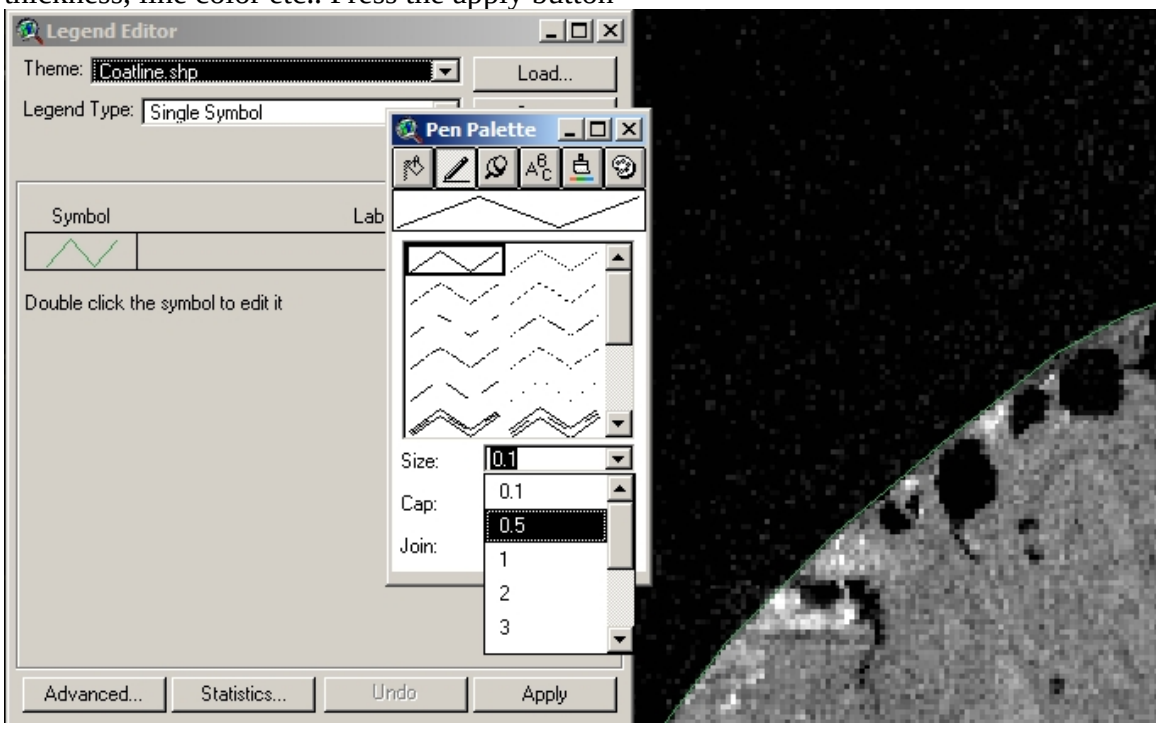
Step 12. Now start tracing the coastline using the draw line tool



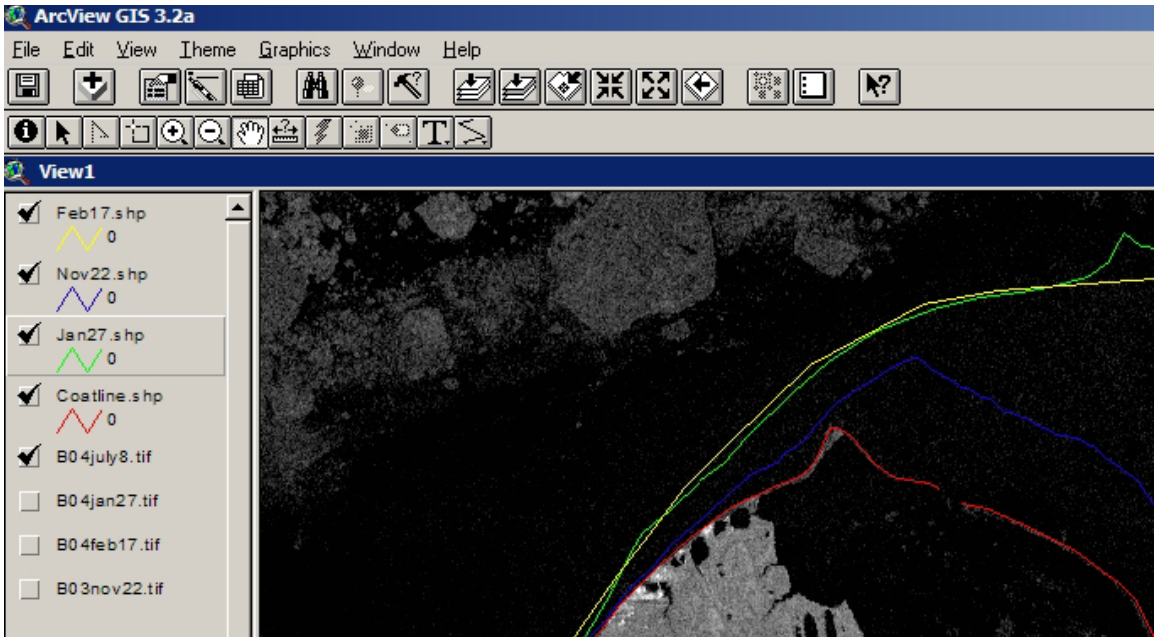
Step 13. Double click on the coastline.shp button in the left panel to start the legend editor



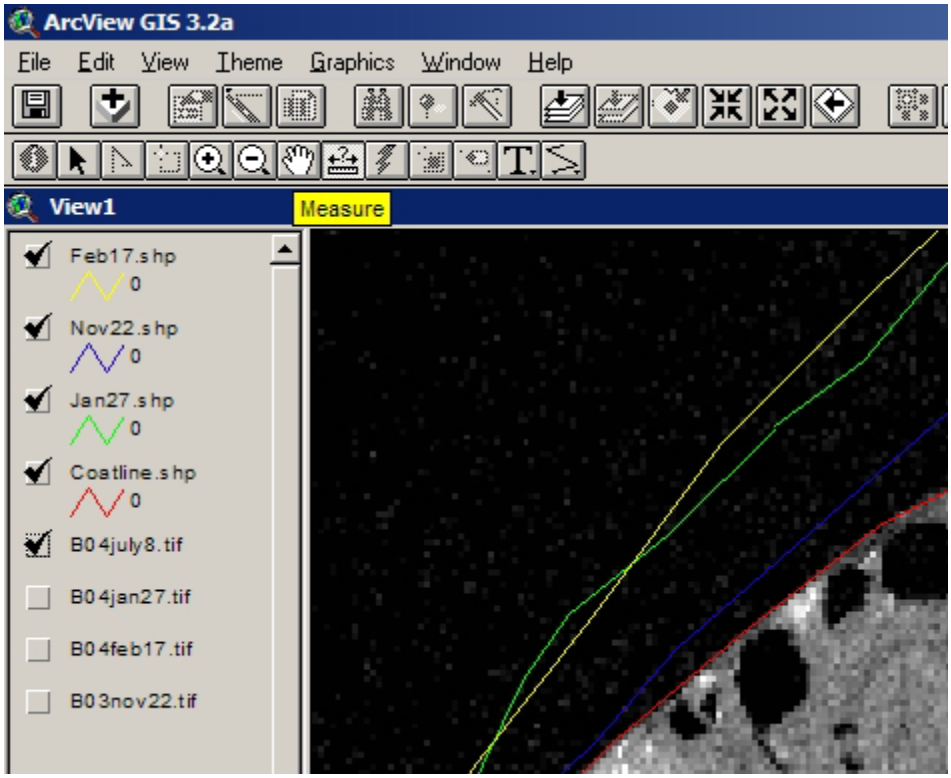
Step 14. Double click on the symbol button (with a jagged line) for more options on line thickness, line color etc.. Press the apply button



Step 15. To trace the landfast ice edge for other dates, select the tif image of the other dates and repeat the procedure from step 8 through step 14. Assign a different color to each of the shape files so generated. Display the 4 vector shape files on top of the july 2004 image. Below is a sample of what your view may look like.



Step 16. Use the measure tool to measure the extent of the landfast ice edge from the shore.



Important: At all stages kkep saving the work you are doing. You can save the whole project by going to the File => Save project option and giving a meaningful project name.

If you are familiar with the map composing and printing options of ArcView, then try to print out the results of your project.

Expected outcome:

1. Digitized boundaries (coverage) of the land-fast ice edge for four different dates in four different colors, displayed over the July 8, 2004 radar image.
2. An estimate on the difference in extent in the different date images
3. A discussion on (a) the reasons for fluctuating extent of landfast ice (b) the positive and negative implications of such fluctuation of landfast ice on a seasonal basis and over several years.

Acknowledgement: We acknowledge the help provided by Andy Mahoney in selecting the appropriate datasets used in this exercise and in sharing his field knowledge with us. The original data sets were acquired by the Alaska Satellite Facility at the Geophysical Institute, University of Alaska Fairbanks.

Additional information:
http://www.gi.alaska.edu/~mahoney/Research/FIDynam.html
http://psc.apl.washington.edu/LandFastIce/

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