Survey to detect long-term variability in Pine Island Bay coastal Ice using archived Landsat imagery

Team Members:

Ya'Shonti Bridgers
Ryan Lawrence
Michael Jefferson Jr.
Glenn Michael Koch

Team Mentor:

Malcolm Lecompte

Overview

- Abstract
- Background
- Methodology
- Results
- Conclusion
- Future Research

Abstract

In the 2003 Antarctic Surface Accumulation and Ice Discharge project, the Pine Island Bay Region (include lat. and long) was identified as an area to exhibit rapid changes potentially due to climate warming.

Utilizing the 2003 Antarctic Surface Accumulation and Ice Discharge grounding line vector file, the Center of Excellence in Remote Sensing Education and Research Antarctica team surveyed the Pine Island Bay region from West 100° longitude to West 110° longitude to determine the accuracy of the grounding line and detect changes over decadal time intervals.

Through the use of Exelis Visualization Information Solutions' ENVI image processing software, Landsat images from 1973-2012 were co-registered to Landsat image data used to create the 2003 grounding line. The survey yielded no overall significant changes in the grounding line; however there were places that exhibited: 1) grounding line inaccuracy 2) evolutionary erosion of coastline 3) evidence that the current grounding line is placed too far sea-ward.

Background

In an effort to obtain a more accurate measure of the area of the Antarctic ice sheet and determine its mass balance, Dr. Robert Bindschadler, senior fellow at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center, lead an international team of glaciologists and computer scientists, including ECSU students on the 2003 Antarctic Surface Accumulation and Ice Discharge project.

In 2011, ECSU students observed the gradual reduction of an ice shelf in Pine Island Bay when comparing Landsat images spanning the years 1972 to the shelf's ultimate disappearance by January 17, 2003. The ice shelf was located within *ECSU Bay* at 73.945° South Latitude and 102.390 West Longitude lies on the Canisteo Peninsula. These observations suggested the Pine Island Bay coastal ice morphology were exhibiting long term changes possibly due to processes related to global climate change. The presence of other similar instances of long term change along the roughly 1000 km extent of the Pine Island Bay coastline was surveyed between 100° West Longitude to 110° West Longitude.

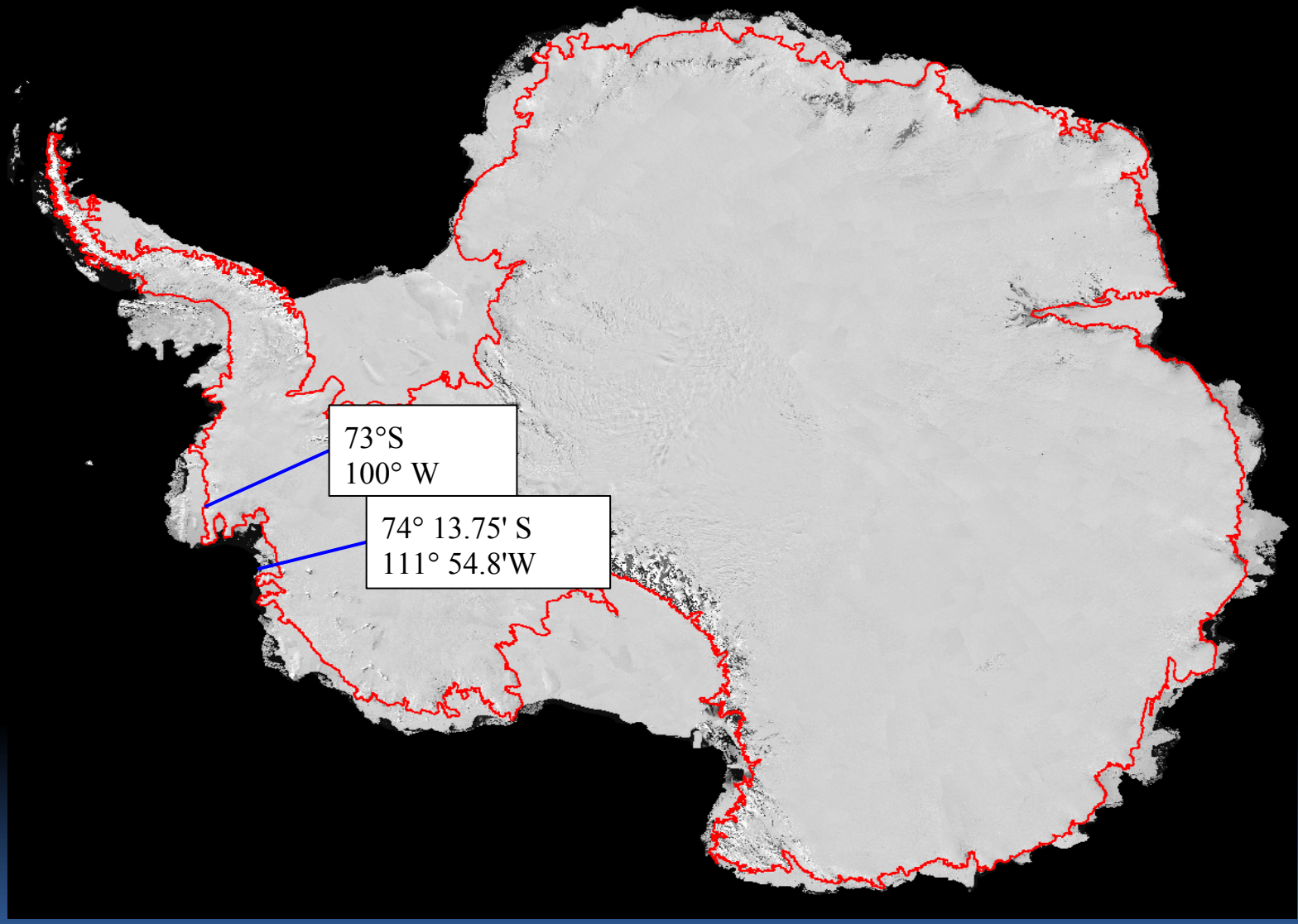
"Research by the U.S. Geological Survey has documented the retreat of every ice front in the southern part of the Antarctic Peninsula from 1947 to 2009"

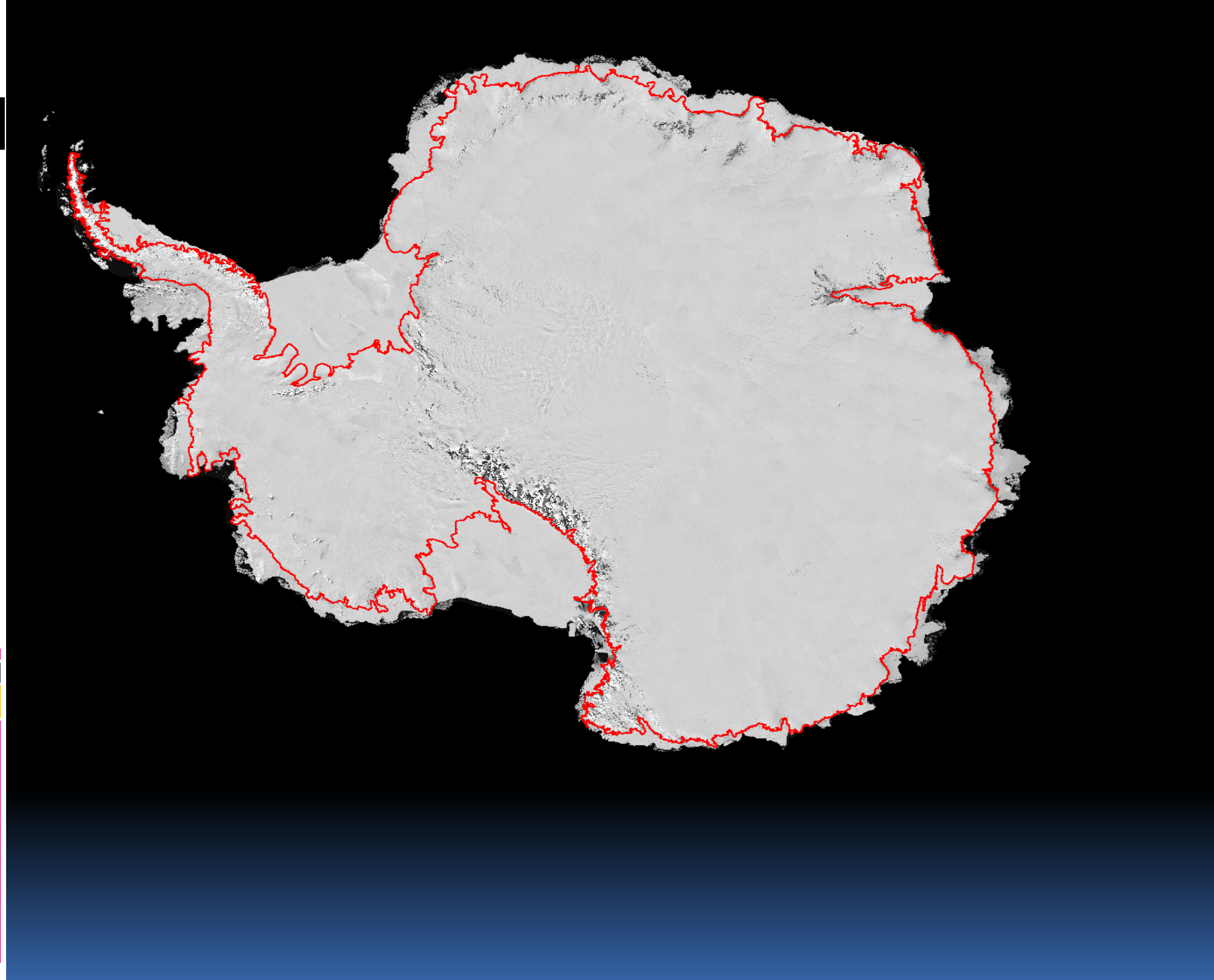
For an enhanced understanding of Earth's climate changes, as well as the polar regions, which are capable of contributing significantly to global sea-level change, these studies are of vital importance.

Key Terms

- **Landsat:** The Landsat Program is a series of earth-observing satellites jointly managed by NASA and the USGS
- **ENVI:** ITT Visual Information Solutions ***ENVI*** product family provides a variety of software solutions for processing and analyzing geospatial imagery
- **Glacier:** a large, slow moving mass of ice resting on land that formed from an accumulation of snow over time
- **Ice Shelf:** a thick mass of ice that is still attached to a glacier but floats on water
- **Grounding Line:** the boundary between "grounded" ice resting on land and any associated floating ice comprising a retaining ice shelf

Area Of Interest





Methodology

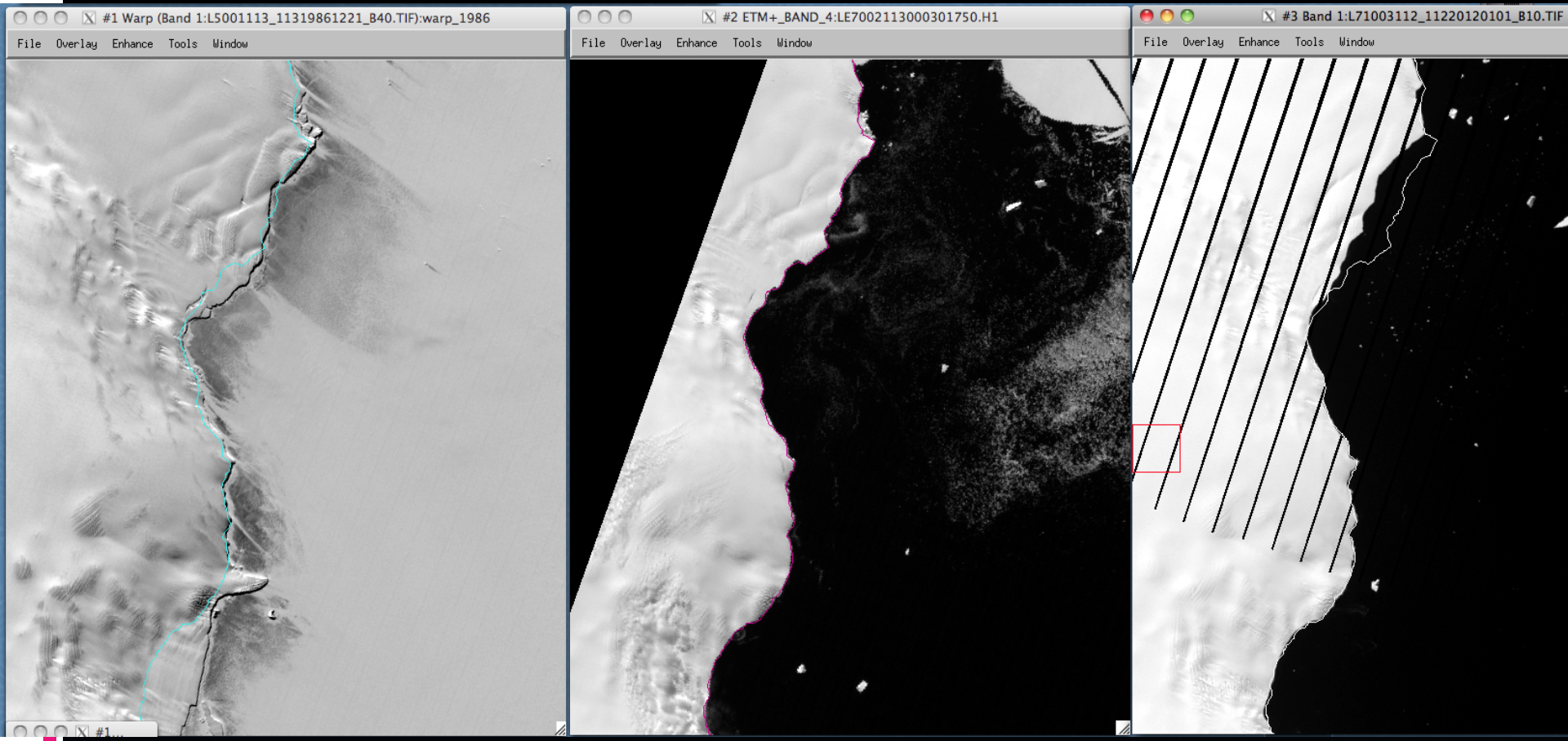
- Landsat images of the study area were obtained from the LIMA website and the USGS GLoVIS archives. The images were selected using the following criteria: 1) spatially covered study area [path (latitude delimeter) and row (longitude delimiter) of] 2) clarity (< 20% cloud cover) and 3) age.

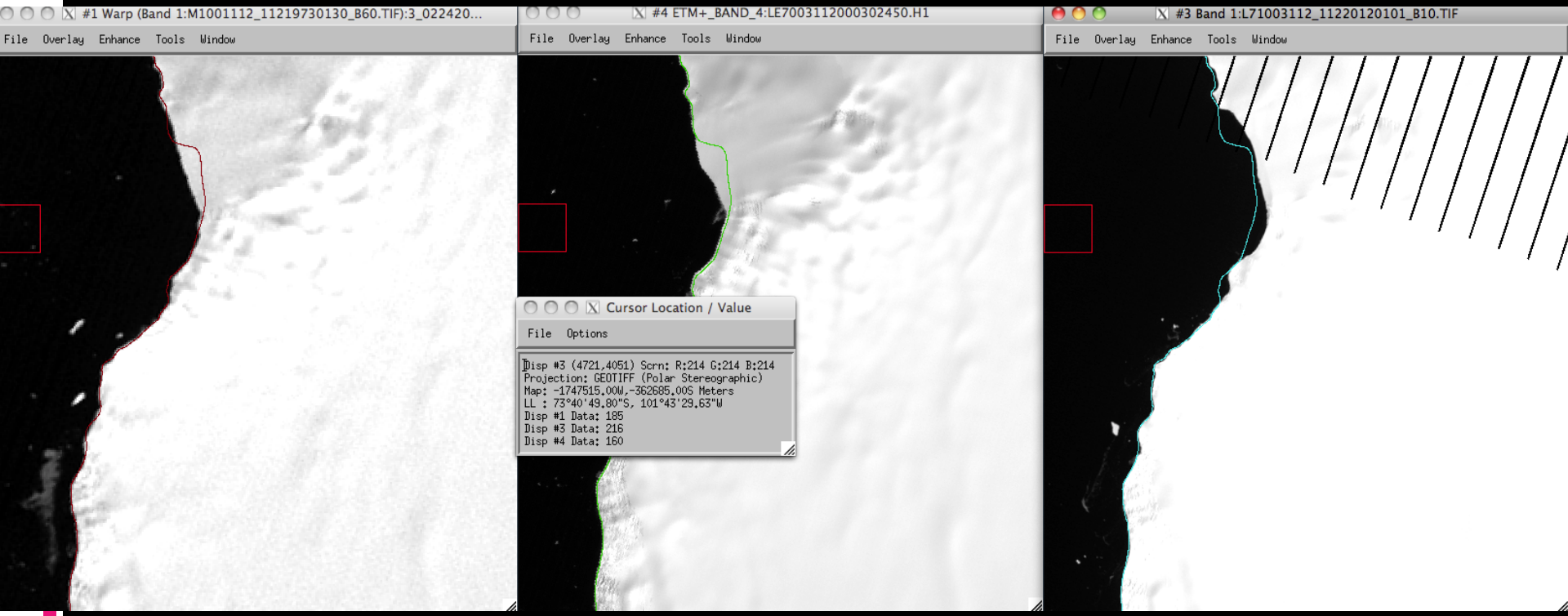
- Available images were downloaded from the years from 1973 to 2012.

- Through the use of ENVI® software, the ASAID grounding line vector file was truncated to specifically encompass the study area. Afterwards, the images were overlay with the vector image.

- Due to the variation in pixel size resolution of the satellites, the 2003 LIMA Landsat 7 image served as a reference point for previous images, which were image-image registered using a five or more ground control (geo-referenced) points to ensure accuracy.

Results


#1 Warp (Band 1:L5001113_11319861221_B40.TIF):warp_1986
File Overlay Enhance Tools Window
#2 ETM+_BAND_4:LE7002113000301750.H1
File Overlay Enhance Tools Window
#3 Band 1:L71003112_11220120101_B10.TIF
File Overlay Enhance Tools Window


#1 Warp (Band 1:M1001112_11219730130_B60.TIF):3_022420...
File Overlay Enhance Tools Window
#4 ETM+_BAND_4:LE7003112000302450.H1
File Overlay Enhance Tools Window
Cursor Location / Value
File Options
Disp #3 (4721,4051) Scrn: R:214 G:214 B:214
Projection: GEOTIFF (Polar Stereographic)
Map: -1747515.00W,-362685.00S Meters
LL : 73°40'49.80"S, 101°43'29.63"W
Disp #1 Data: 185
Disp #3 Data: 216
Disp #4 Data: 160
#3 Band 1:L71003112_11220120101_B10.TIF
File Overlay Enhance Tools Window

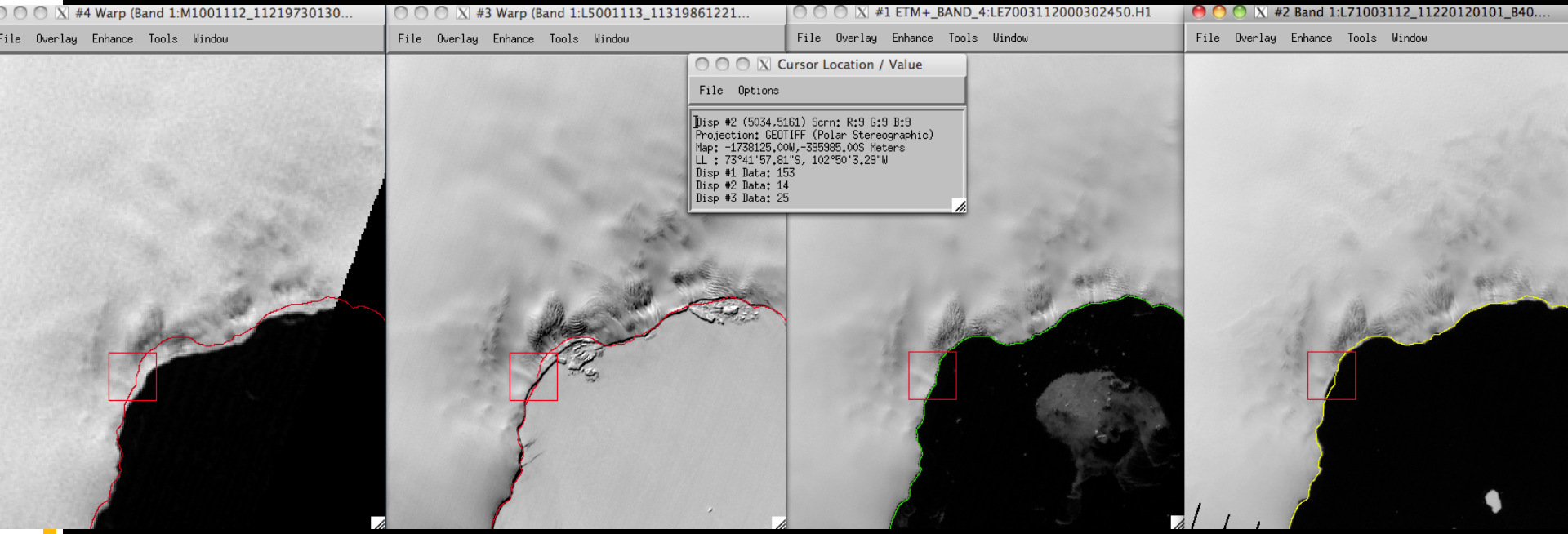
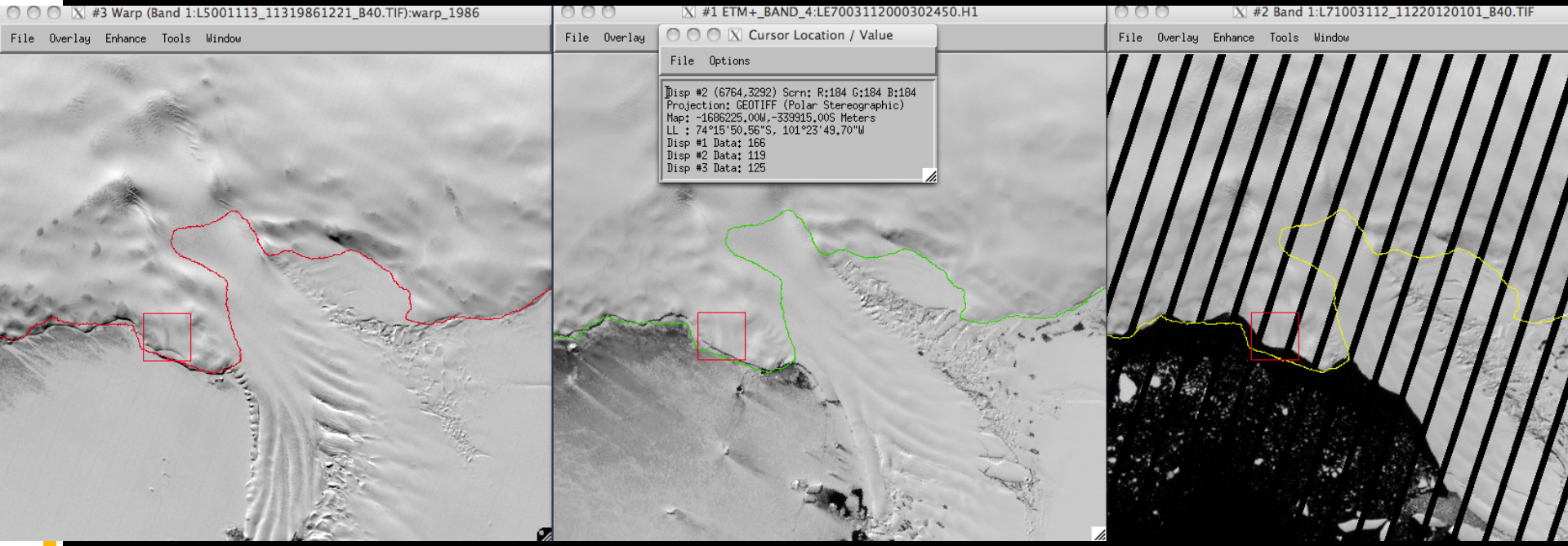
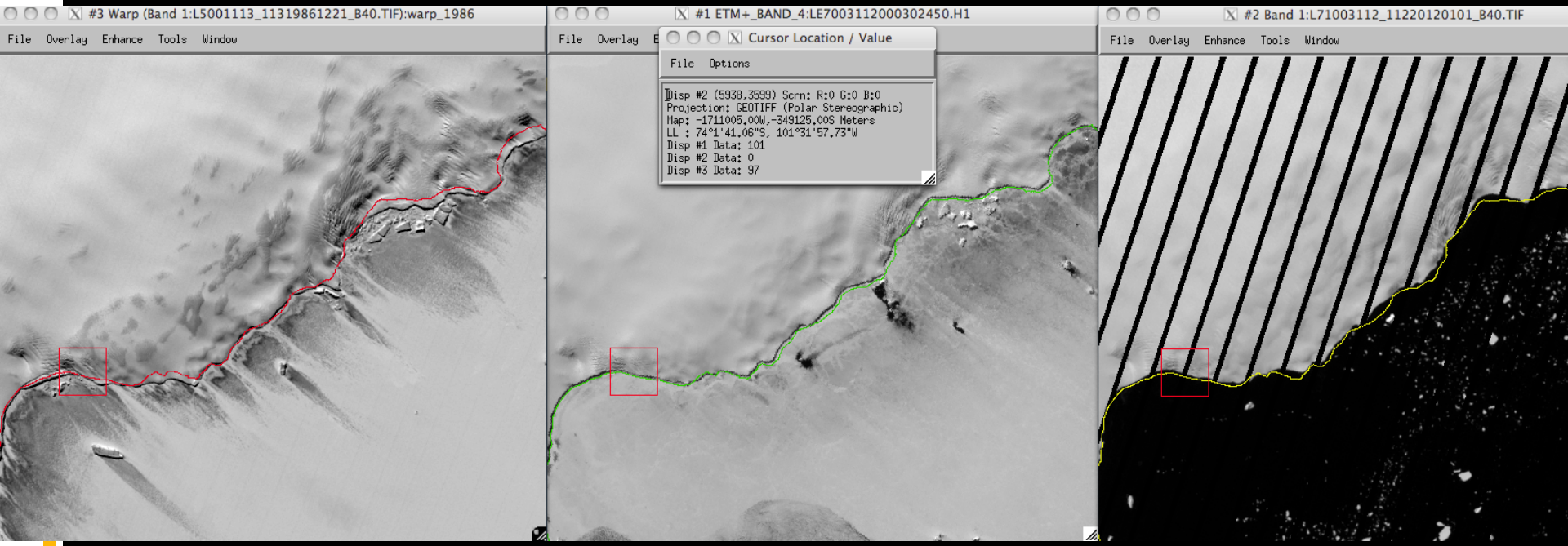
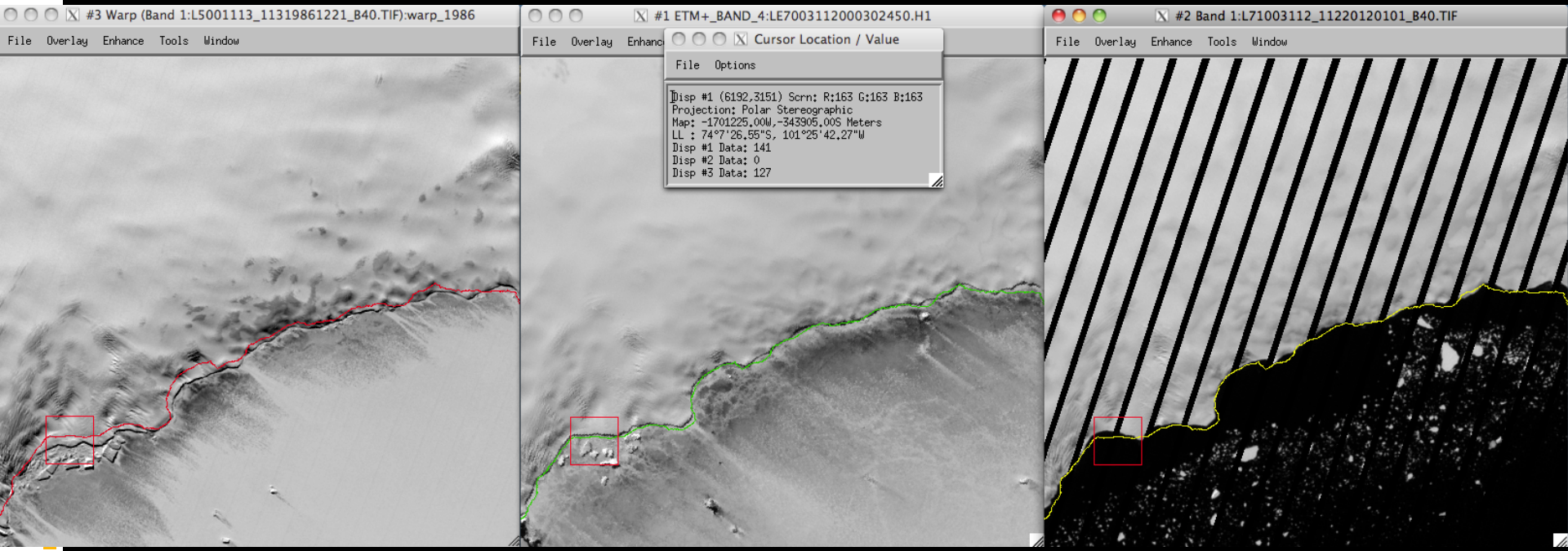
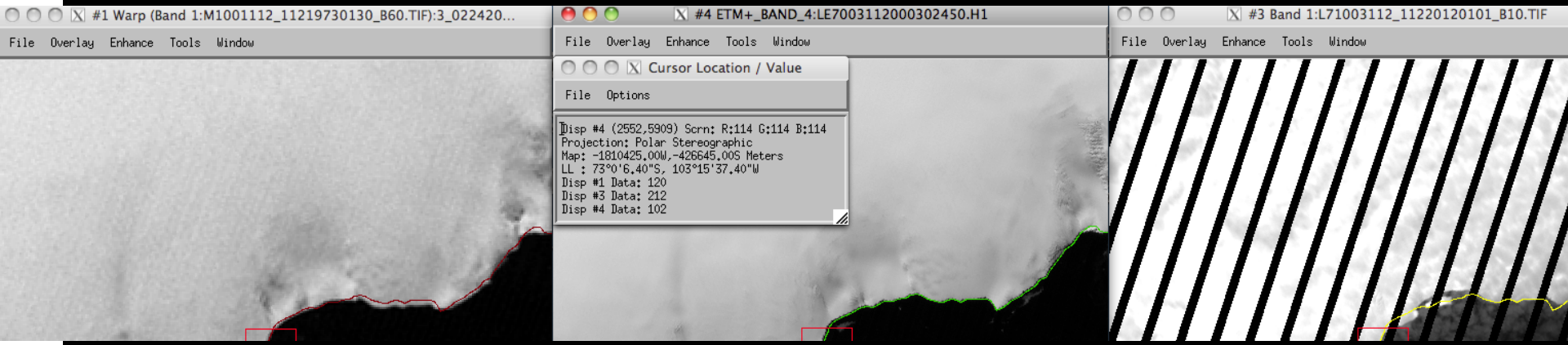


Figure _. The sequence of images (1973; 1986; 2003; 2012) depicts a an inaccurate placement


#3 Warp (Band 1:L5001113_11319861221_B40.TIF):warp_1986
File Overlay Enhance Tools Window
#1 ETM+_BAND_4:LE70031120000302450.H1
File Overlay
Cursor Location / Value
File Options
Disp #2 (6764,3292) Scrn: R:184 G:184 B:184
Projection: GEOTIFF (Polar Stereographic)
Map: -1686225.00W,-339915.00S Meters
LL : 74°15'50.56"S, 101°23'49.70"W
Disp #1 Data: 166
Disp #2 Data: 119
Disp #3 Data: 125
#2 Band 1:L71003112_11220120101_B40.TIF
File Overlay Enhance Tools Window

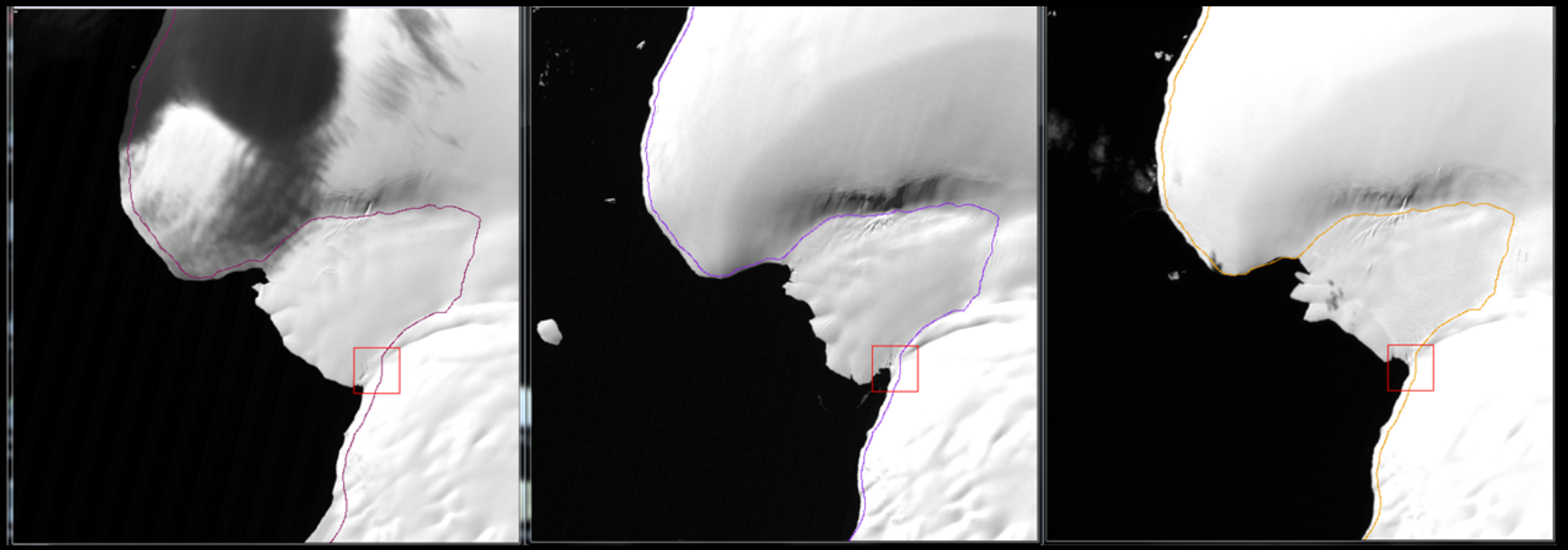

#3 Warp (Band 1:L5001113_11319861221_B40.TIF):warp_1986
File Overlay Enhance Tools Window
#1 ETM+_BAND_4:LE7003112000302450.H1
File Overlay
Cursor Location / Value
File Options
Disp #2 (5938,3599) Scrn: R:0 G:0 B:0
Projection: GEOTIFF (Polar Stereographic)
Map: -1711005.00W,-349125.00S Meters
LL : 74°1'41.06"S, 101°31'57.73"W
Disp #1 Data: 101
Disp #2 Data: 0
Disp #3 Data: 97
#2 Band 1:L71003112_11220120101_B40.TIF
File Overlay Enhance Tools Window

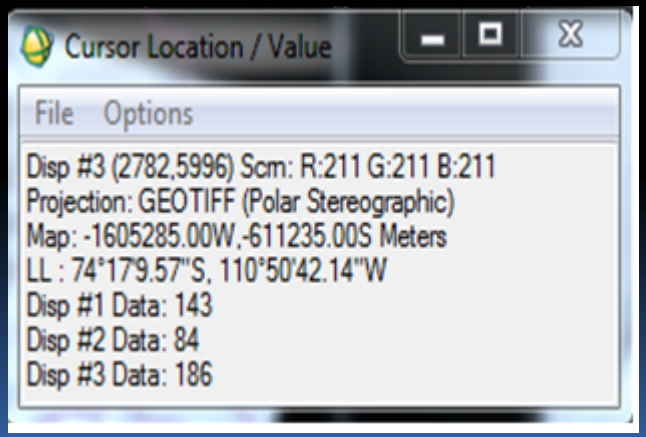

#3 Warp (Band 1:L5001113_11319861221_B40.TIF):warp_1986
File Overlay Enhance Tools Window
#1 ETM+_BAND_4:LE7003112000302450.H1
File Overlay Enhanc
Cursor Location / Value
File Options
Disp #1 (6192,3151) Scrn: R:163 G:163 B:163
Projection: Polar Stereographic
Map: -1701225.00W,-343905.00S Meters
LL : 74°7'26.55"S, 101°25'42.27"W
Disp #1 Data: 141
Disp #2 Data: 0
Disp #3 Data: 127
#2 Band 1:L71003112_11220120101_B40.TIF
File Overlay Enhance Tools Window


#1 Warp (Band 1:M1001112_11219730130_B60.TIF):3_022420...
File Overlay Enhance Tools Window
#4 ETM+_BAND_4:LE7003112000302450.H1
File Overlay Enhance Tools Window
Cursor Location / Value
File Options
Disp #4 (2552,5909) Scrn: R:114 G:114 B:114
Projection: Polar Stereographic
Map: -1810425.00W,-426645.00S Meters
LL : 73°0'6.40"S, 103°15'37.40"W
Disp #1 Data: 120
Disp #3 Data: 212
Disp #4 Data: 102
#3 Band 1:L71003112_11220120101_B10.TIF
File Overlay Enhance Tools Window

Area of interest at three time intervals:

1984 1997 2003





- download 001_113 02/2012 to look at changes in the PIG region.... compare to 1986, 2003.....the image is down loadable....

Conclusion

1) There are places where the GL is inaccurate, i.e misplaced over an ice-shelf [need to include lat. and long, which should be in the photos]

2) Evolutionary erosion of coastline in places such as

3) Overall, no significant changes in the area of Pine Island Bay, and no change in the ECSU Bay..... However, there is evidence of the GL being placed to far sea-ward.

Future Work

- Conduct measurements for the survey areas that resulted in an apparent ice-shelf reduction
- Investigate the Antarctic Peninsula in the vicinity of the Larsen Ice-Shelf

References/Acknowledgements

- GloVis: glovis.usgs.gov
- LIMA: lima.usgs.govs
- ENVI: http://www.ittvis.com/language/en-us/productsservices/envi.aspx
- The Landsat Program: http://landsat.gsfc.nasa.gov/
- Dr. Robert Bindshadler, Glaciologist at NASA Goddard