The Antarctic AMSR-E Sea Ice (AASI) Campaign: An Overview

Josefino C. Comiso
NASA/Goddard Space Flight Center

First AASI Workshop, 13 January 2005

GSFC, Rm A128, Bld 33

Objectives of the Workshop

- Assess the quality of data acquired in the Antarctic during the AASI 2003 and 2004 missions
- Identify data processing problems and coordinate the analyses of aircraft, satellite and insitu data
- Discuss data sharing and how joint efforts could help meet the goals of the program
- Evaluate to what extent the 4 flight missions were able to meet the science objectives and determine which aspects of the acquired data sets require the highest attention.

AASI Science Objectives

- to confirm the physical basis and the range of applicability of the assumptions made in the AMSR-E sea ice algorithm
- to establish the accuracy of the derived geophysical parameters
- to enable the compilation of consistent and accurate climate data sets
- to enable accurate estimates of heat and salinity fluxes in polynyas and divergence regions with the ice pack

Antarctic Statistics

- Antarctic Sea Ice – 3 to 19 million km^2
- Antarctica – 14 million km^2, larger than US (including Alaska)
- Sea level equivalent:

  Sea Ice = 0 m (the ice is floating)

  Antarctica = 75 m

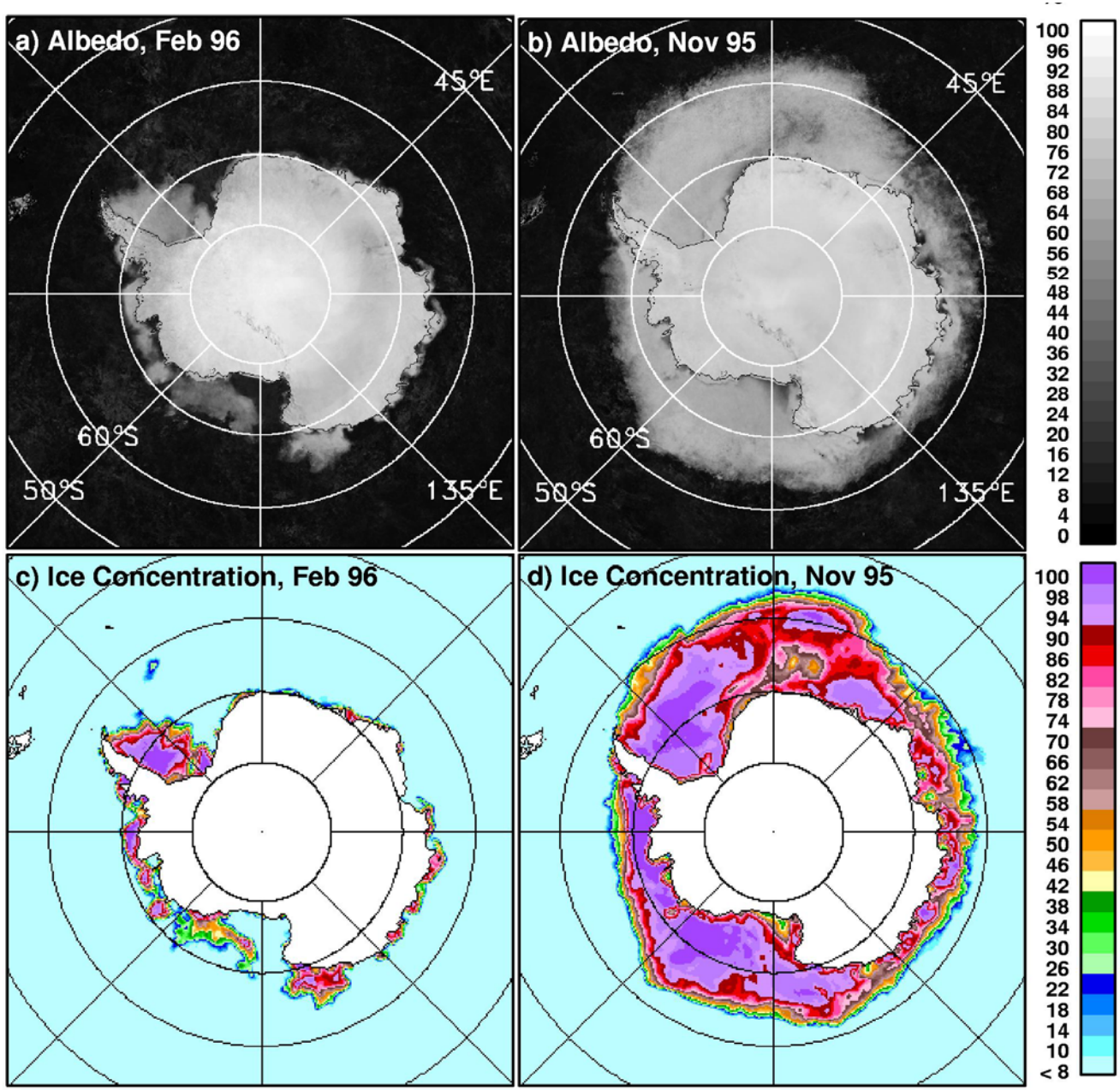
  West Antarctica = 6 m
- Summer temperature:

  West Antarctica: - 5 ^oC

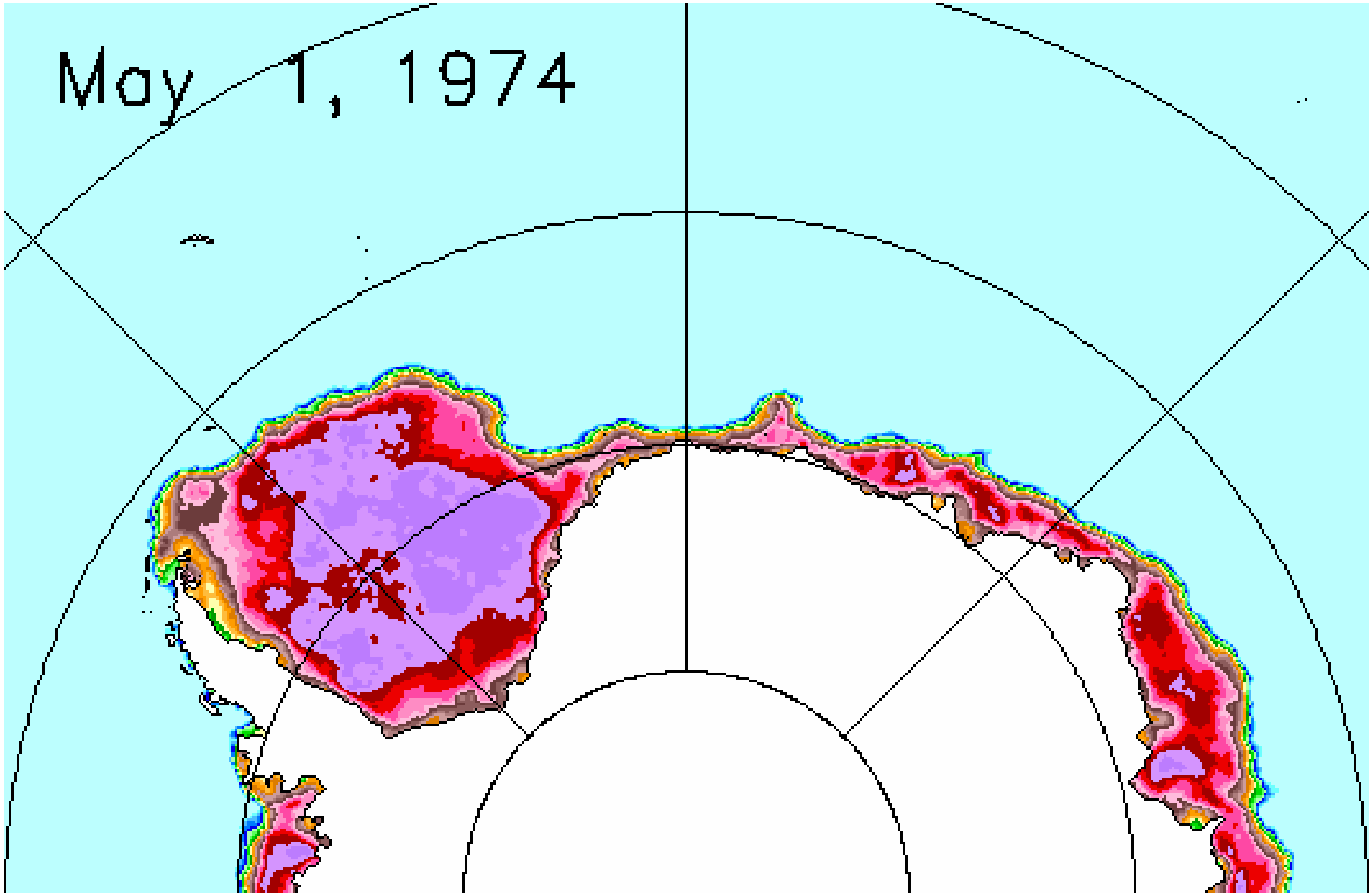
  East Antarctica: -30 ^oC

SH Sea Ice Cover using visible and passive microwave data

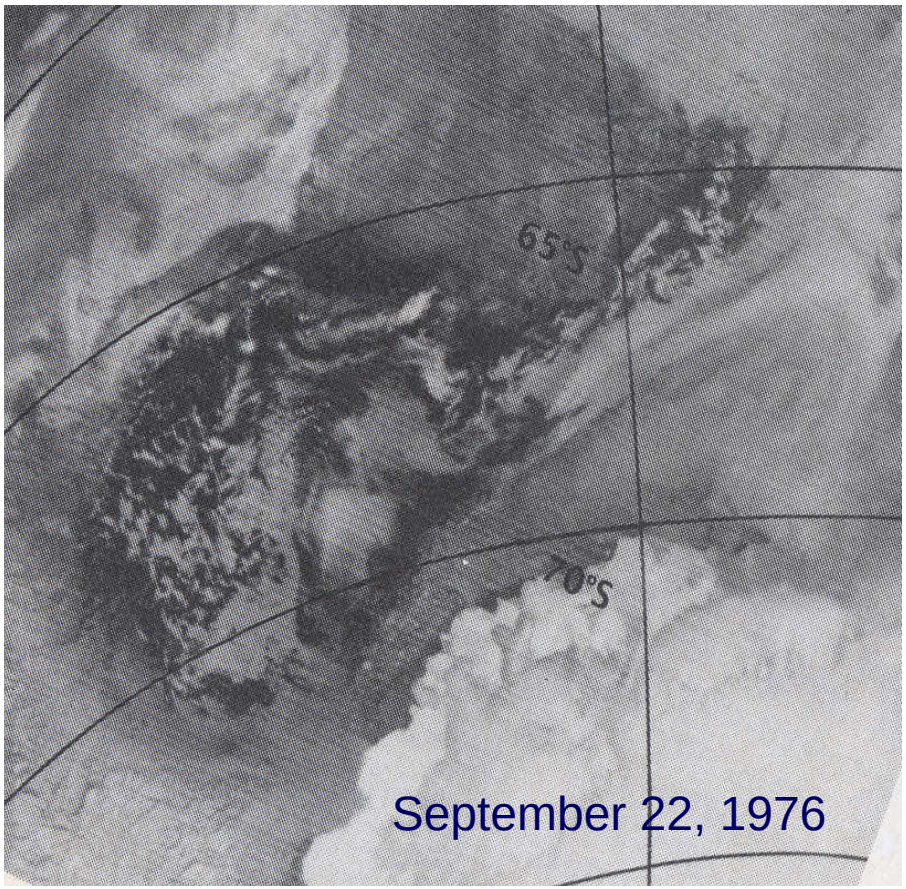
- Antarctic sea ice is more seasonal than the Arctic sea ice and has asymmetric seasonal distribution.
- Antarctic sea ice is surrounded by oceans while Arctic sea ice is surrounded by land.
- Coastal polynyas are prime sources of bottom water.

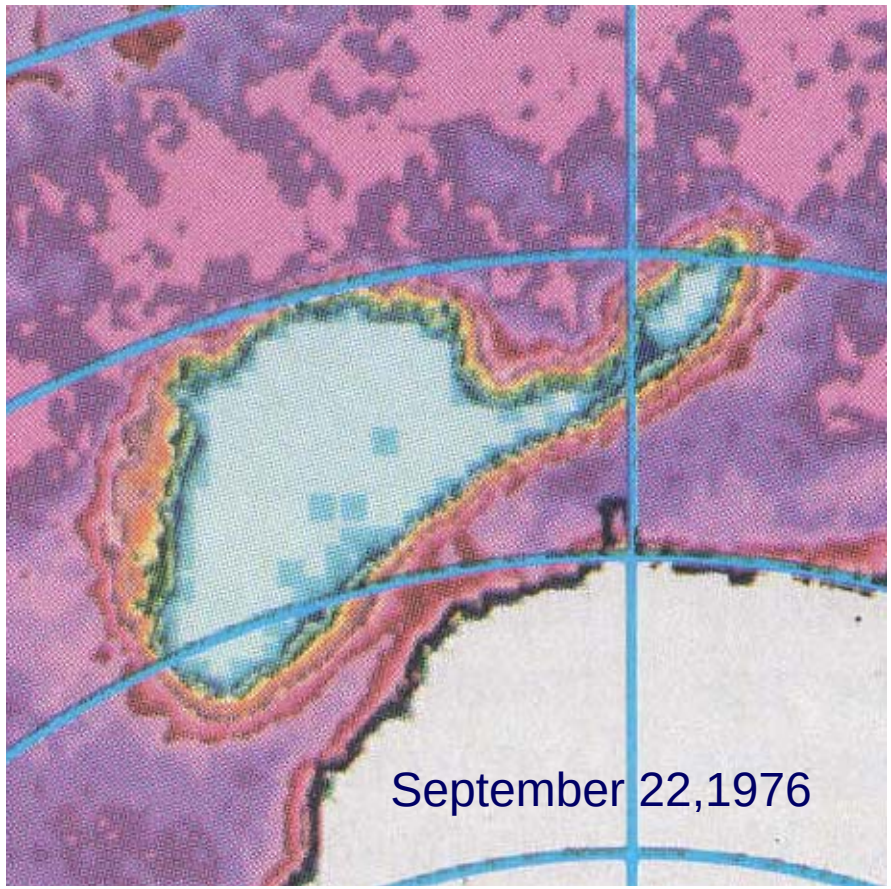


The large Weddell Polynya in 1974

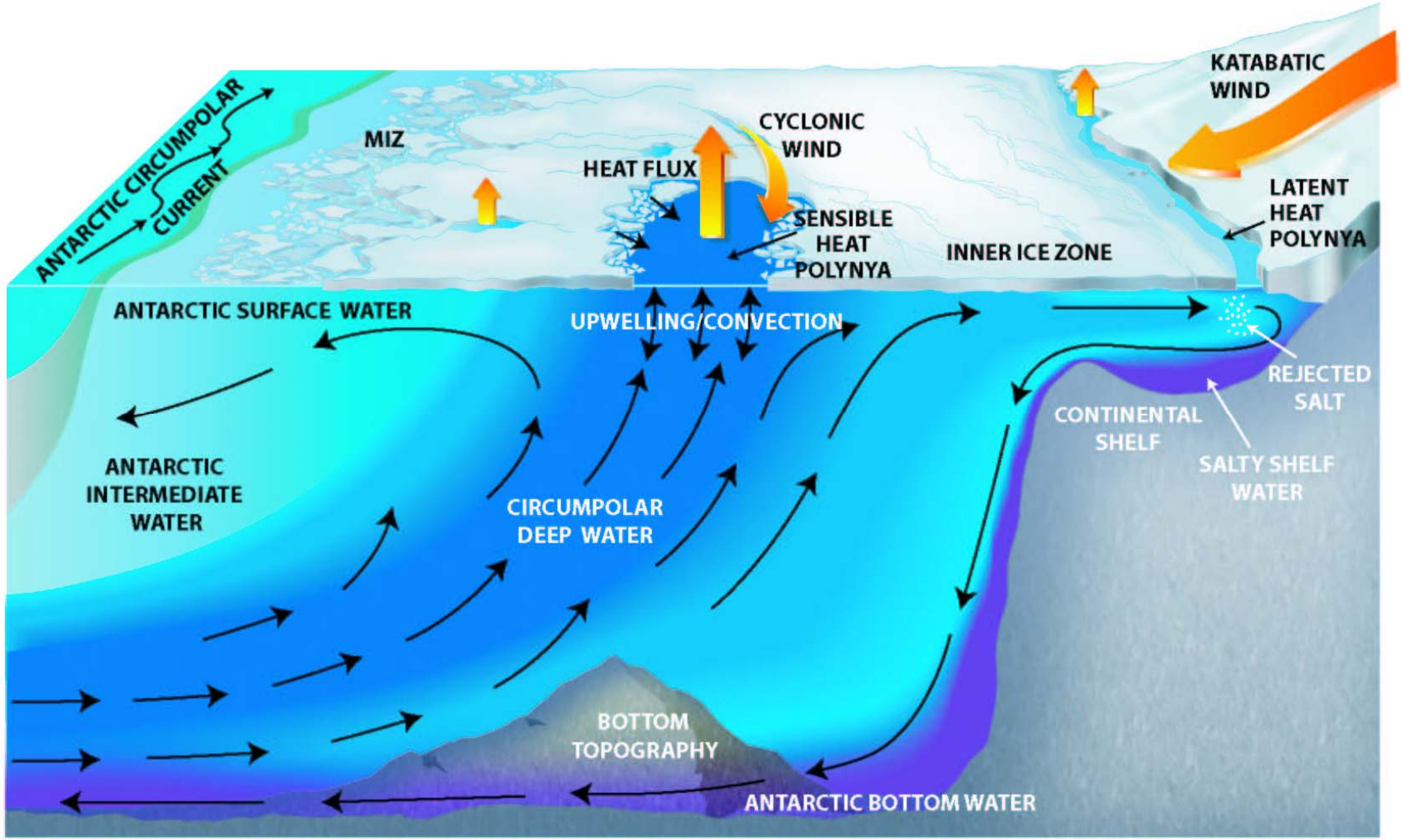


The Weddell Polynya 1974-1976





Schematics of Polynya Formation

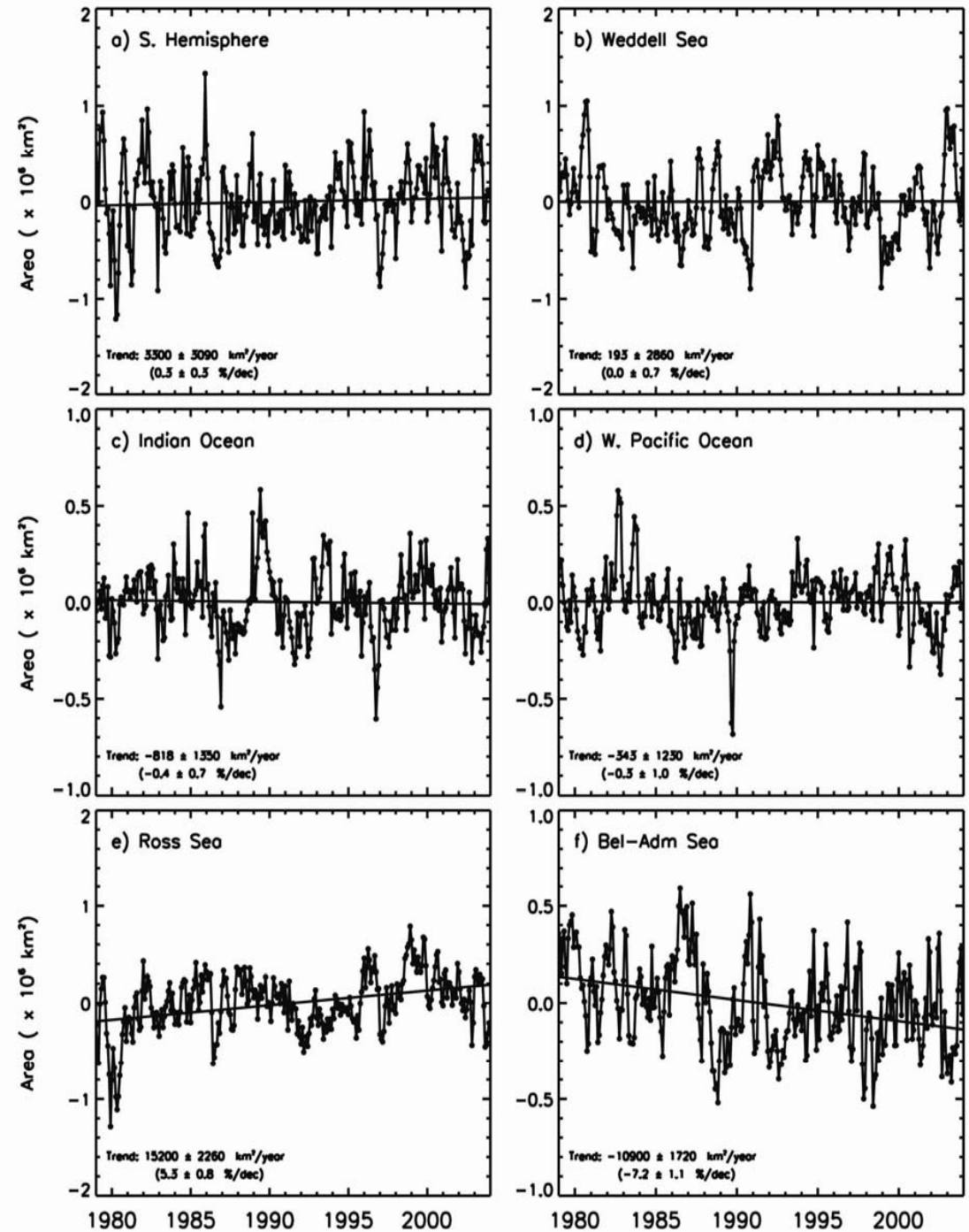


Ice Extent Trends in the Southern Hemisphere: 1979-2003

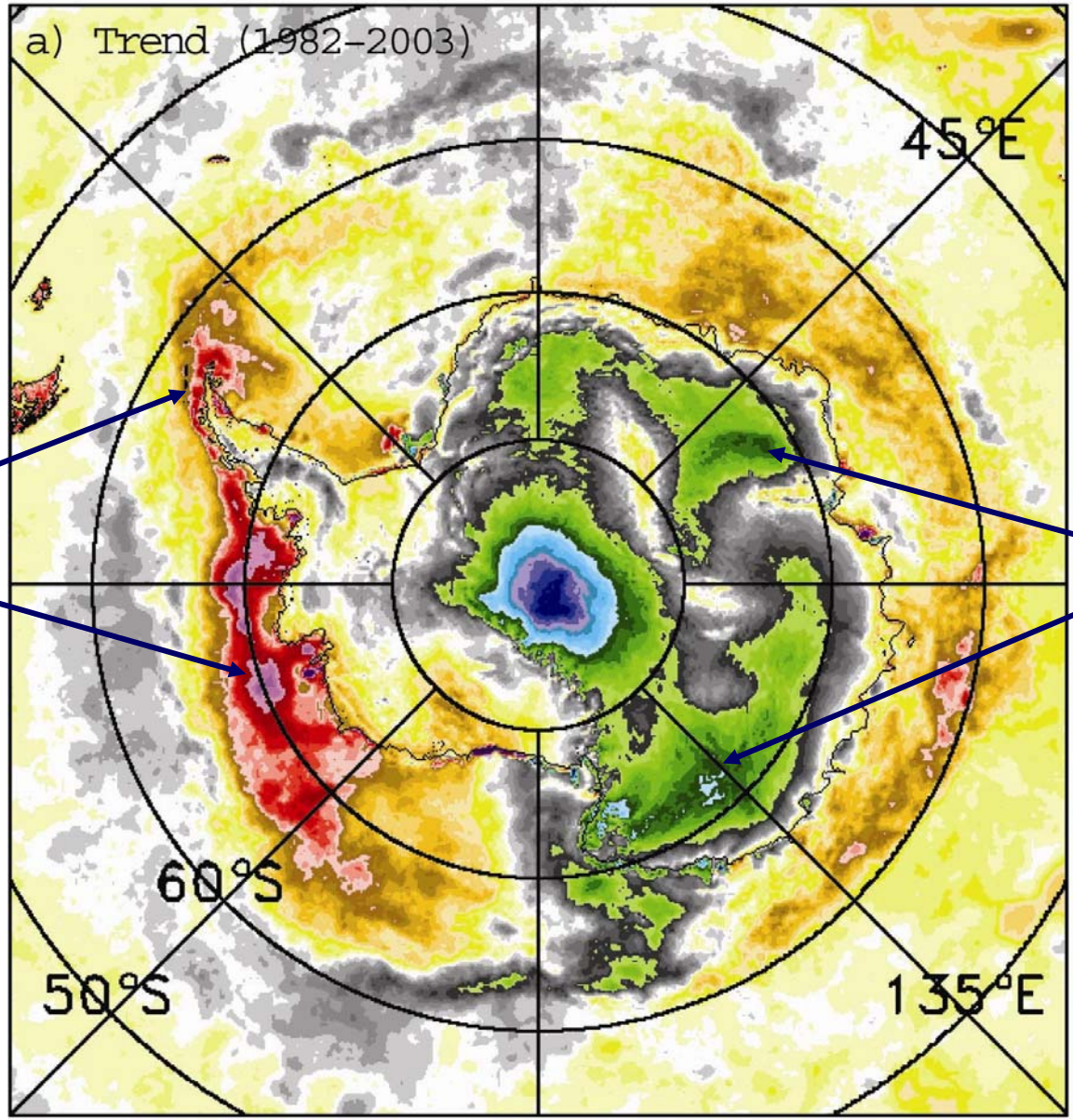
South. Hem: 0.3± 0.3

Regional: (%/decade)

- Weddell: 0.0 ± 0.7
- Indian: -0.4 ± 0.7
- W. Pacific: -0.5 ± 1.0
- Ross: 5.5 ± 0.8
- Bel-Amun: -7.2 ± 1.1

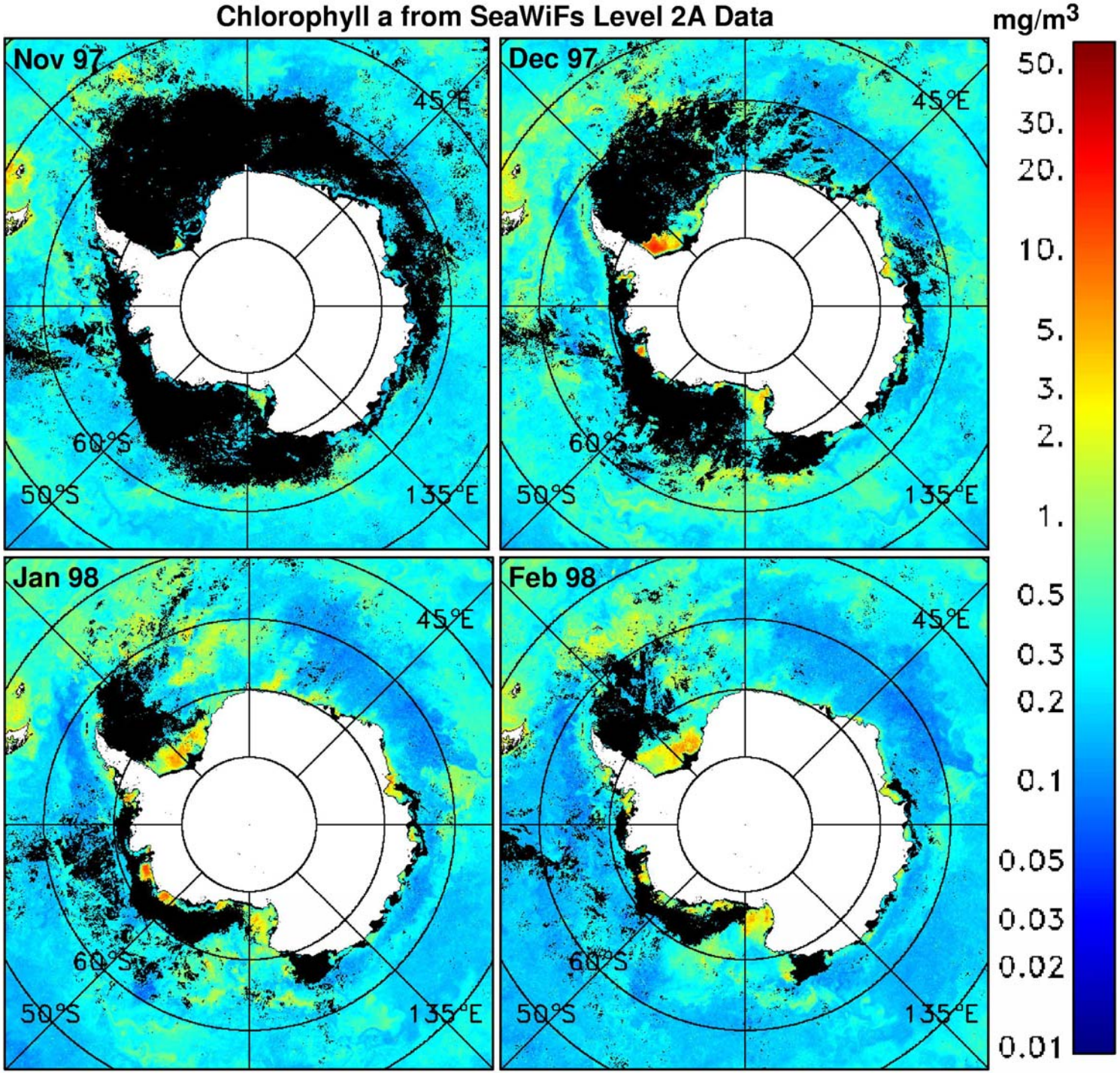


Surface Temperature Trends, 1981 to 2003

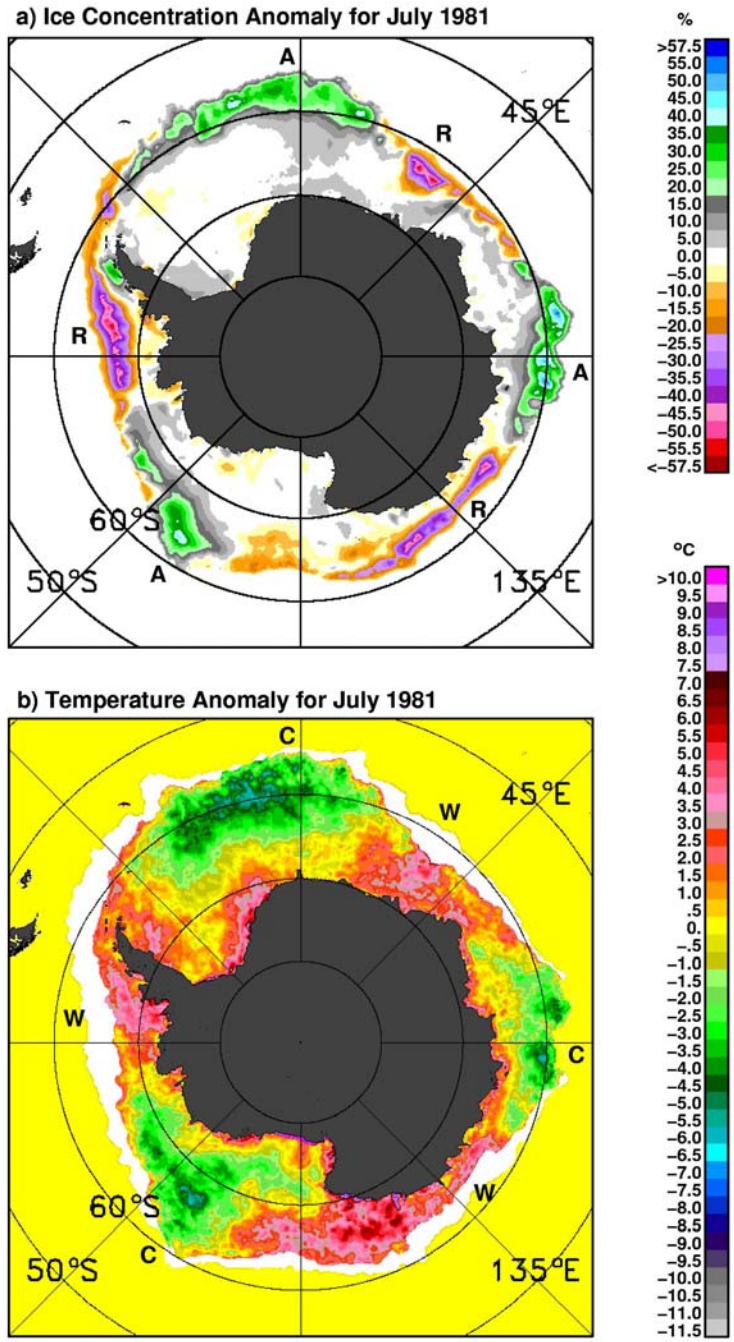


Warming

Cooling

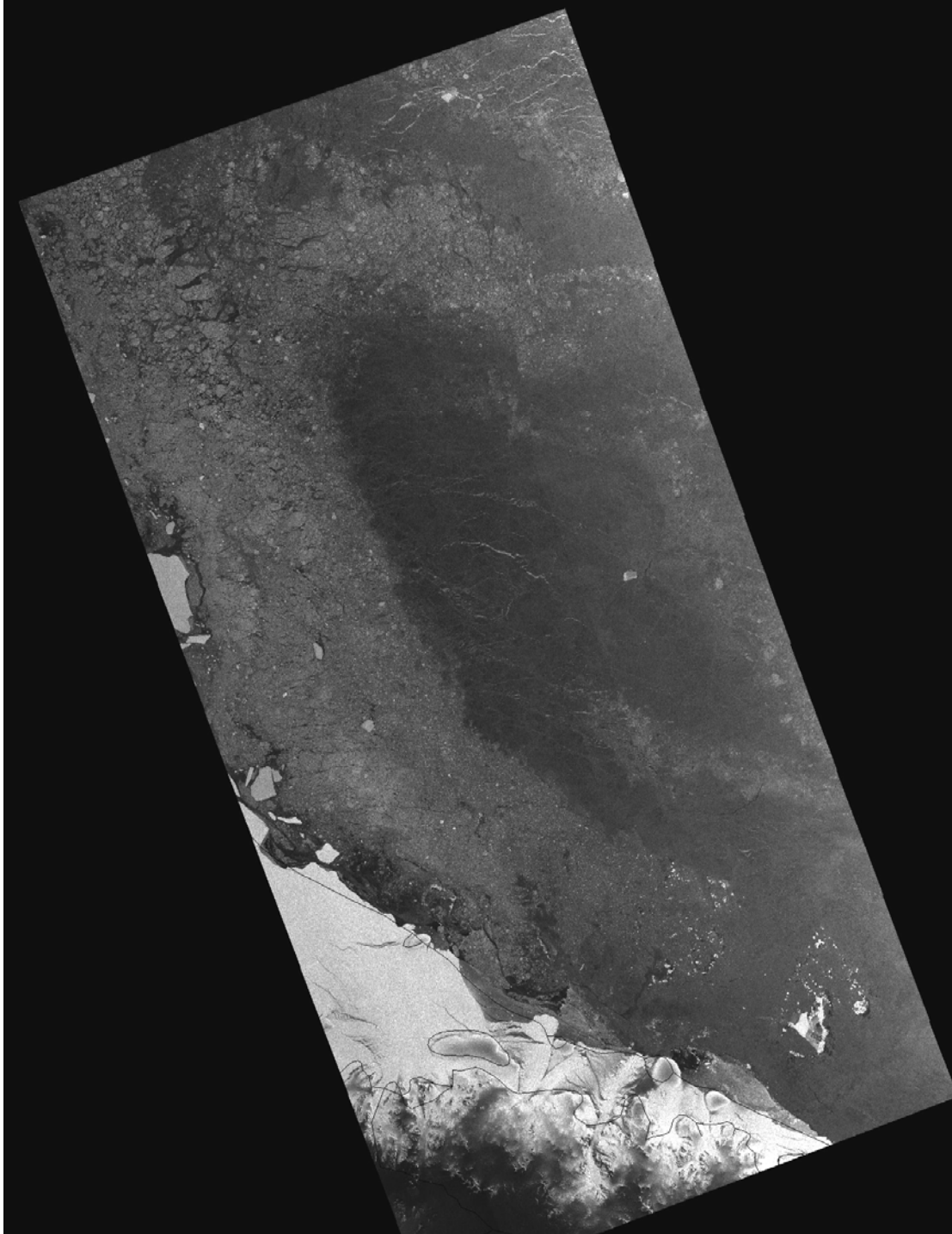

Chlorophyll a from SeaWiFs Level 2A Data
mg/m3
Nov 97
Dec 97
Jan 98
Feb 98
45°E
60°S
50°S
135°E
50.
30.
20.
10.
5.
3.
2.
1.
0.5
0.3
0.2
0.1
0.05
0.03
0.02
0.01

Anomalies in Ice and Temperature



Ice Type and Emissivity Studies

Envisat ASAR data



AASI-2003 Campaign

- Instrumentation:

  PSR A&CX – AMSR simulator

  D2P- Cryosat simulator – snow/ice thickness

  ATM- Lidar –snow/ice thickness

  THOR – Lidar – snow/ice thickness

  Digital/Video Cameras-ice concentration
- Flight Plan

  4 over the Bellingshausen Sea and ship

  4 over the Weddell Sea

AASI-2003 Campaign flight plan

Instrumentation:

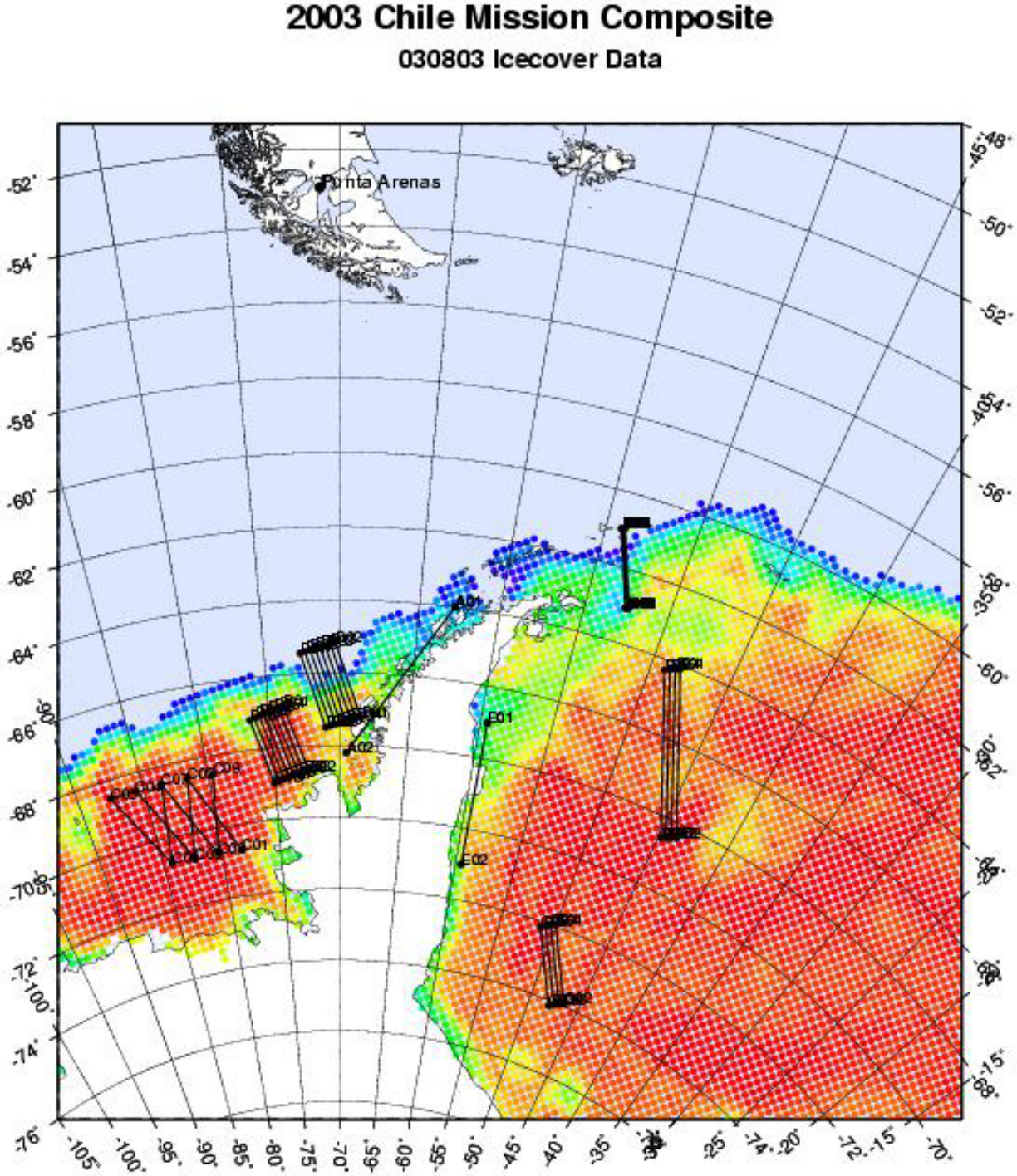
PSR A&CX – AMSR simulator simulator

D2P- Cryosat snow/ice thickness

ATM- Lidar –snow/ice thickness

THOR – Lidar – snow/ice thickness

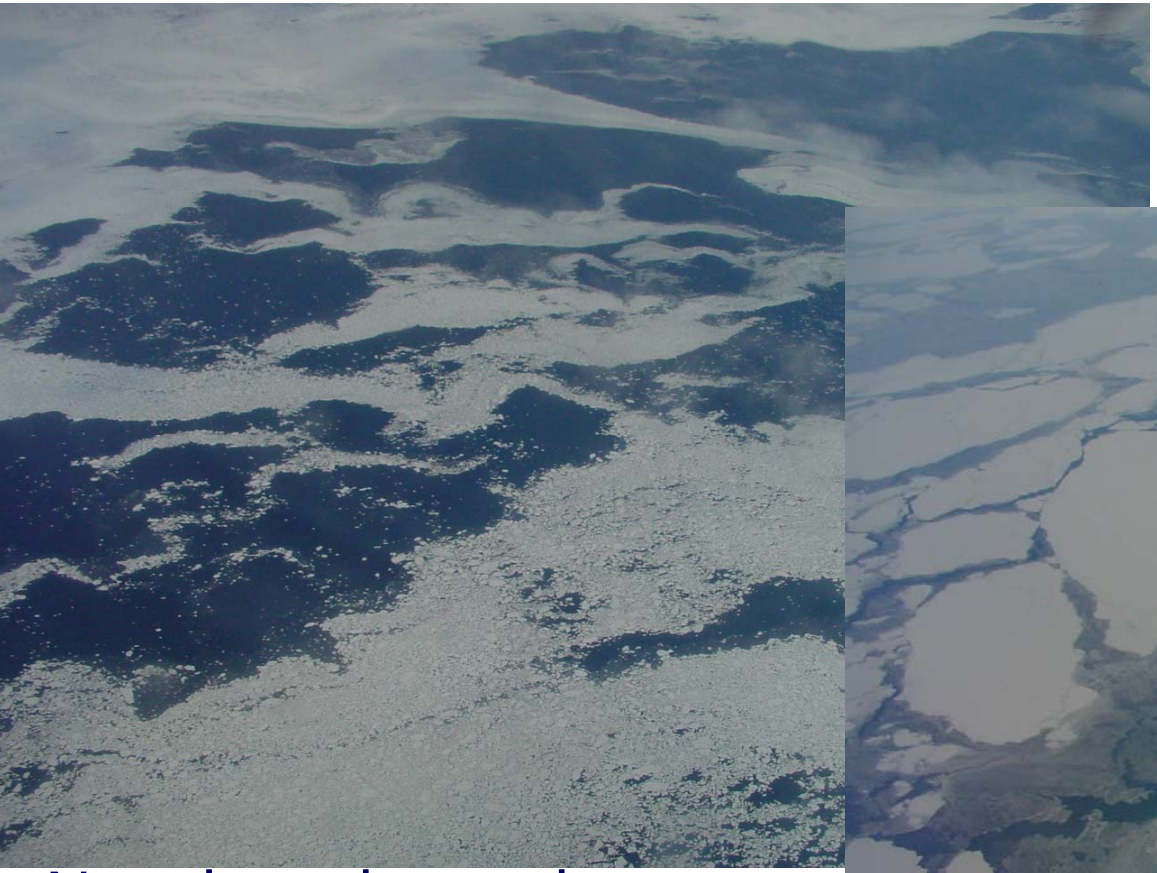
Digital/Video Cameras- ice concentration



Ship Measurements
photos by Koni Steffen

Sea ice cover in the Bellingshausen Sea on 25 August 2003

Photo from P3 by F. Nishio



Near ice edge region

Within the ice pack

AASI 2004 P3 Flight Objectives

- Emissivity and Ice Type – Weddell Sea

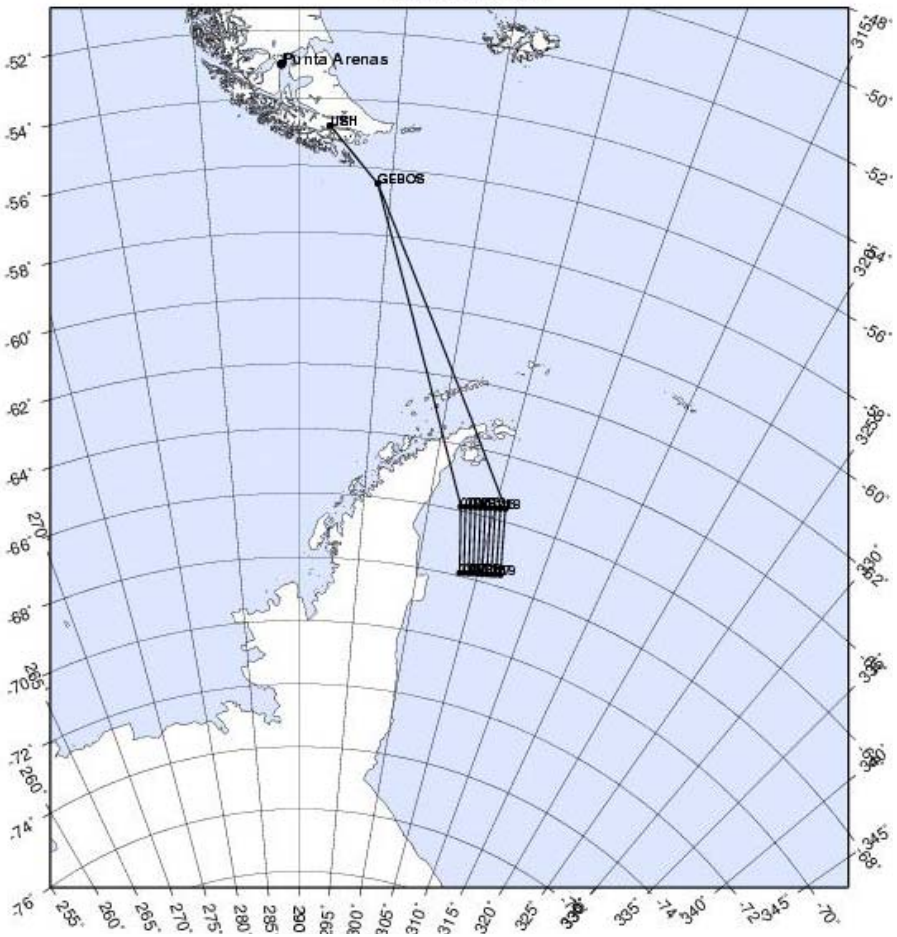
  2 Flights – one high and one low
- Emissivity and Ice Type – Bellingshausen Sea – 2 Flights – one high and one low
- Coastal Polynya Study – Weddell Sea

  - 1 Flight – high and low altitude
- Layering and Flooding Study – Weddell Sea

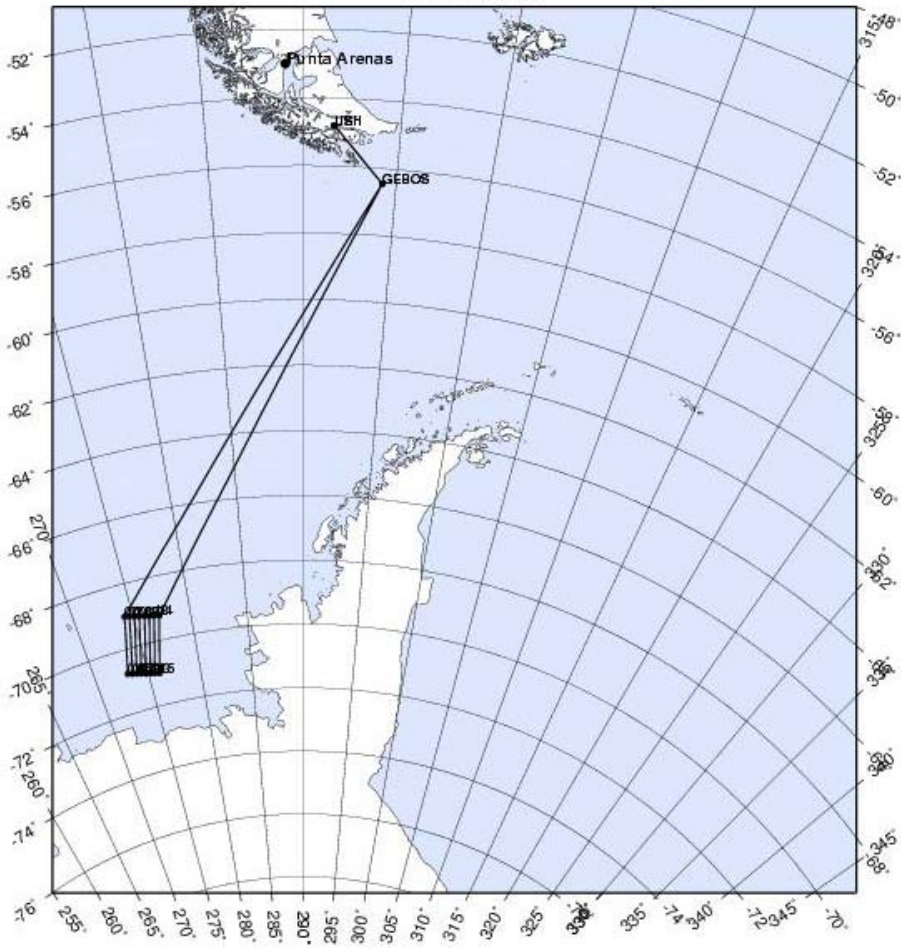
  - 1 Flight – high altitude
- Underfly IceSat orbital track for the same day if possible.

Ice Emissivity/Type Studies

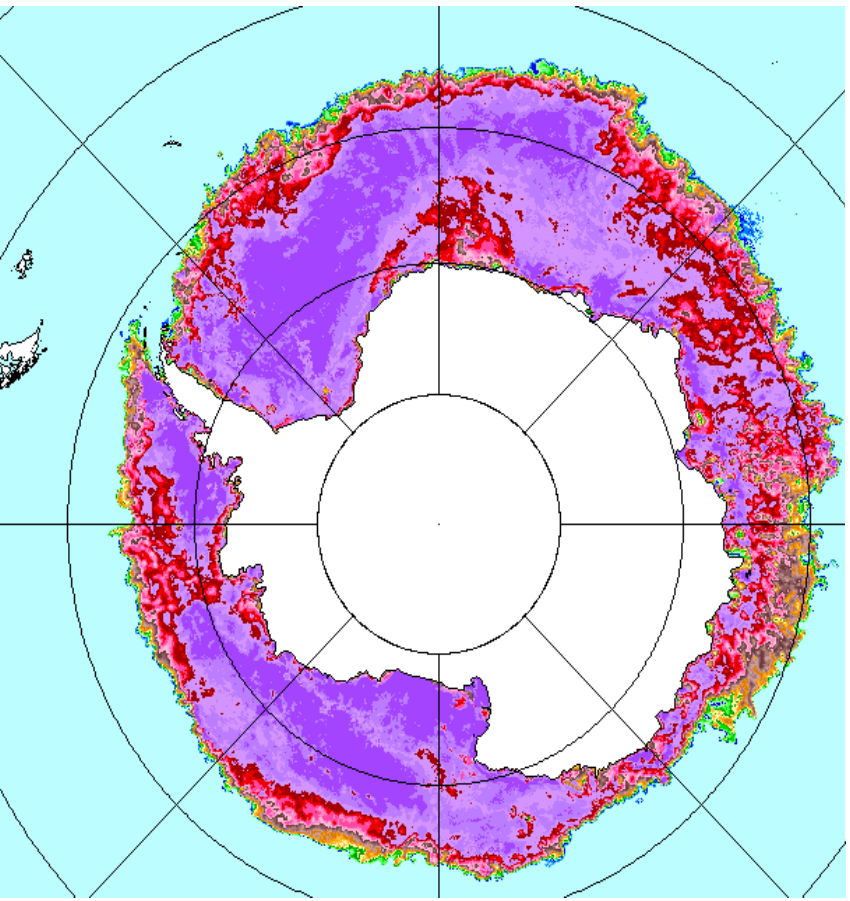
Mission3 WCH
10 lines of 230 km length, spaced 16.5 km
Mission duration: 9.7 hours
-66.76/-55.4/348.2

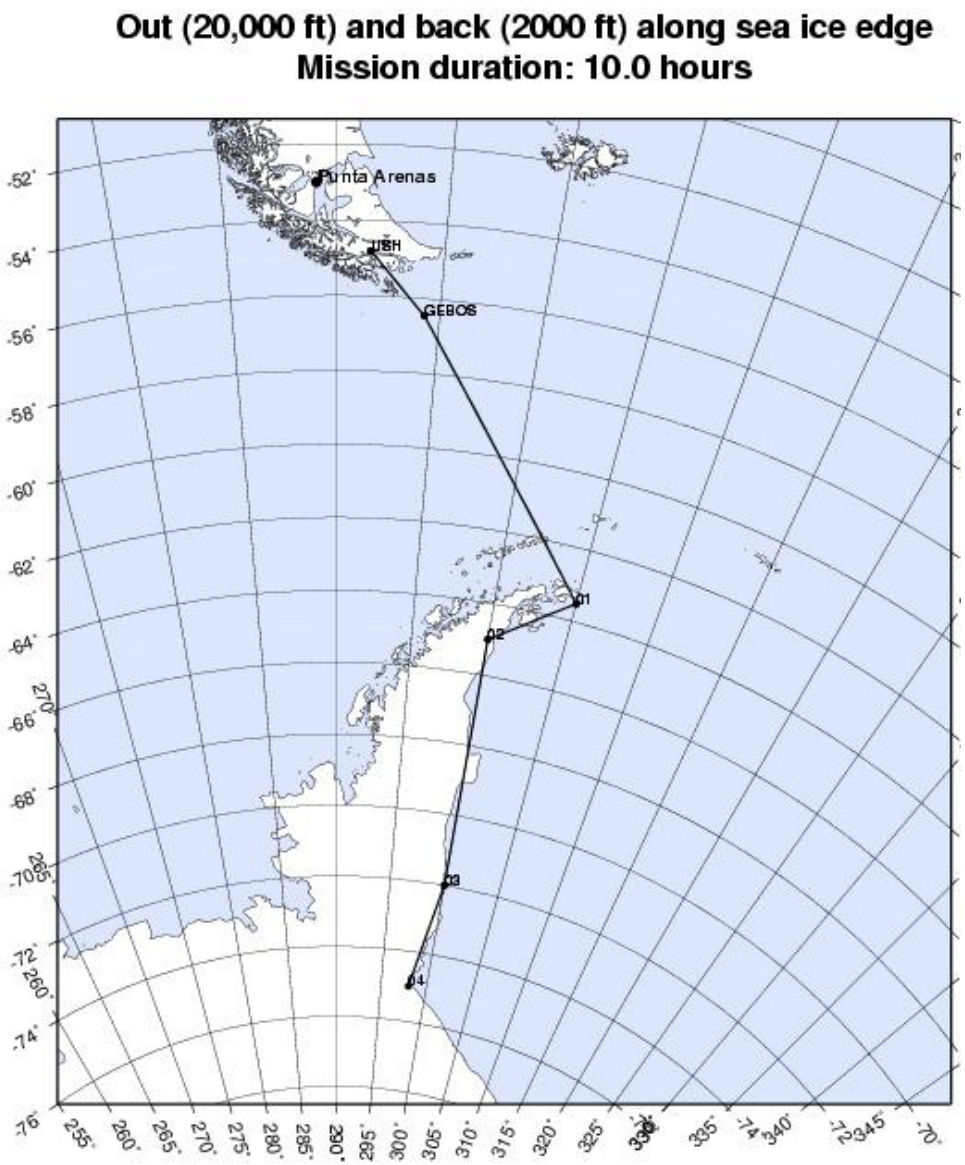


Mission5 BCH
8 lines of 200 km length, spaced 16.5 km
Mission duration: 10.0 hours
-70/275.2/013.0

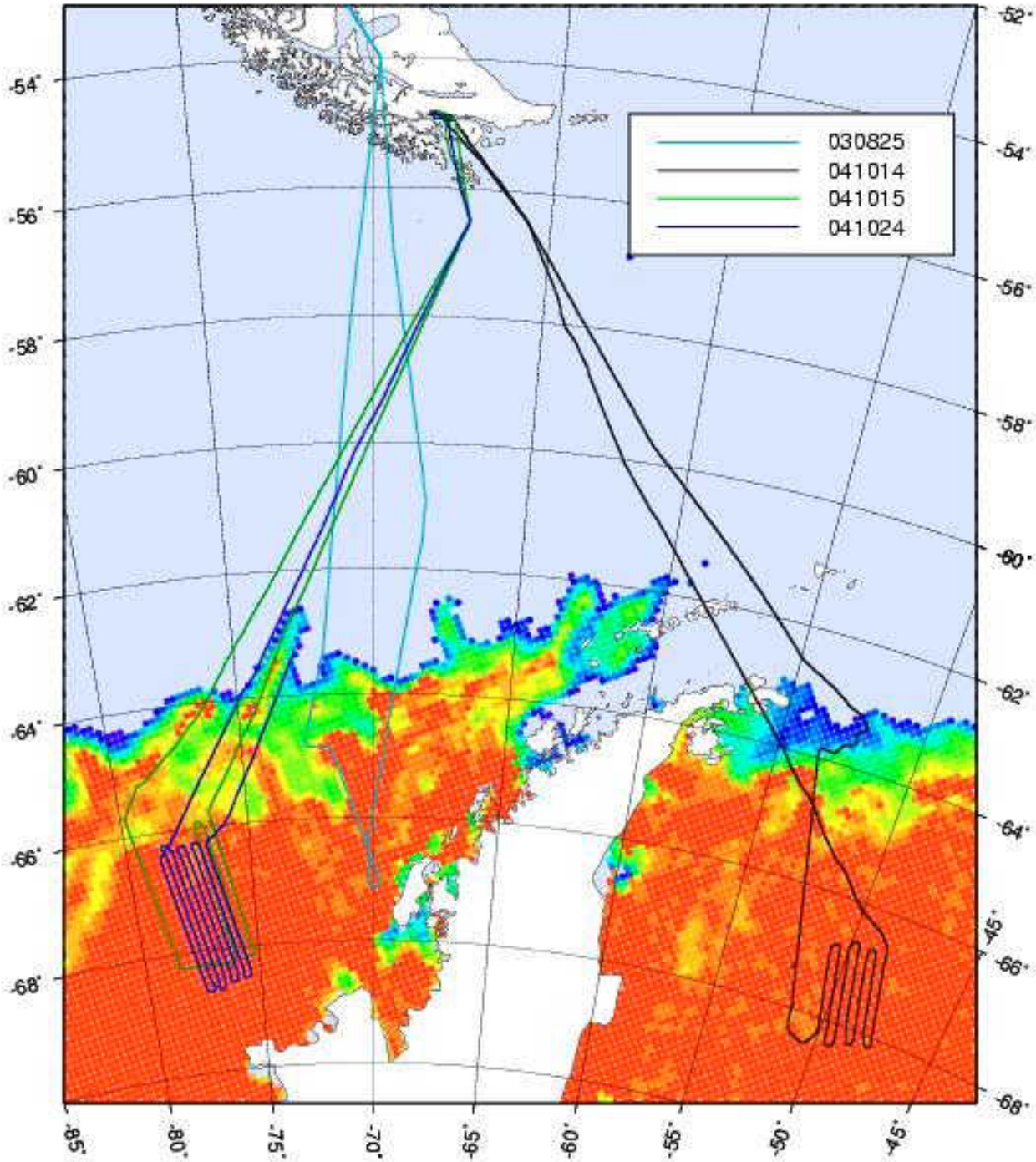


The coastal polynya study

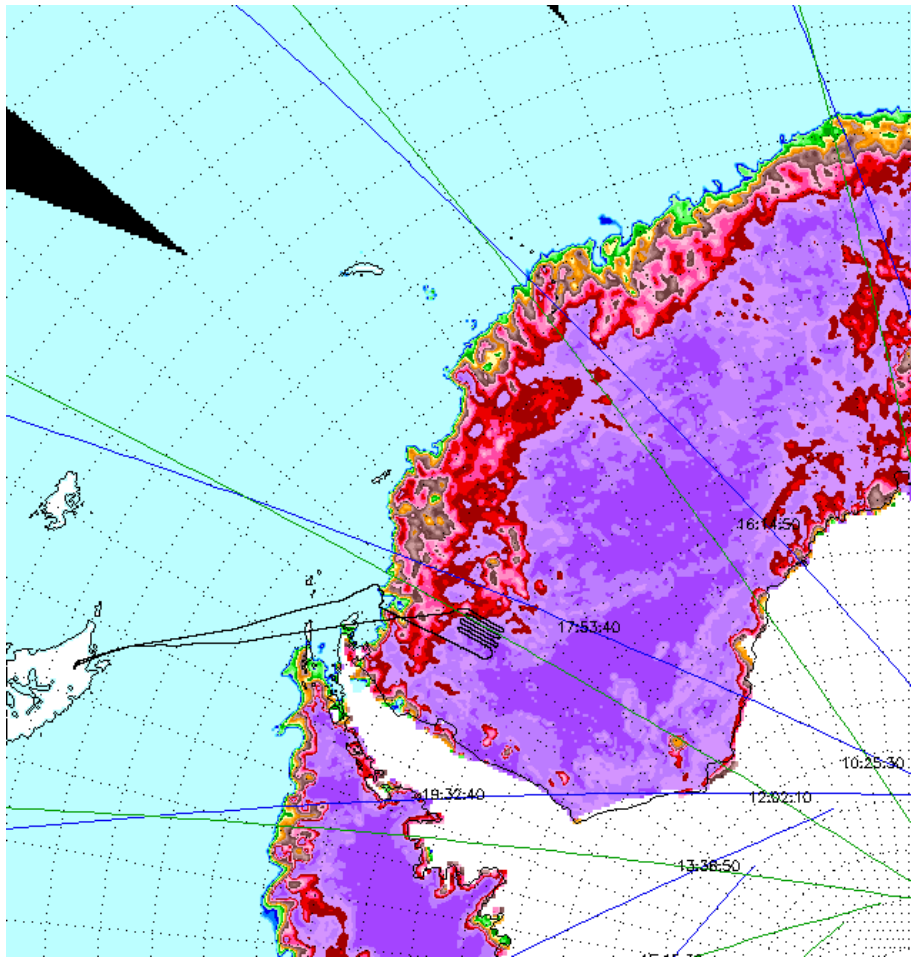




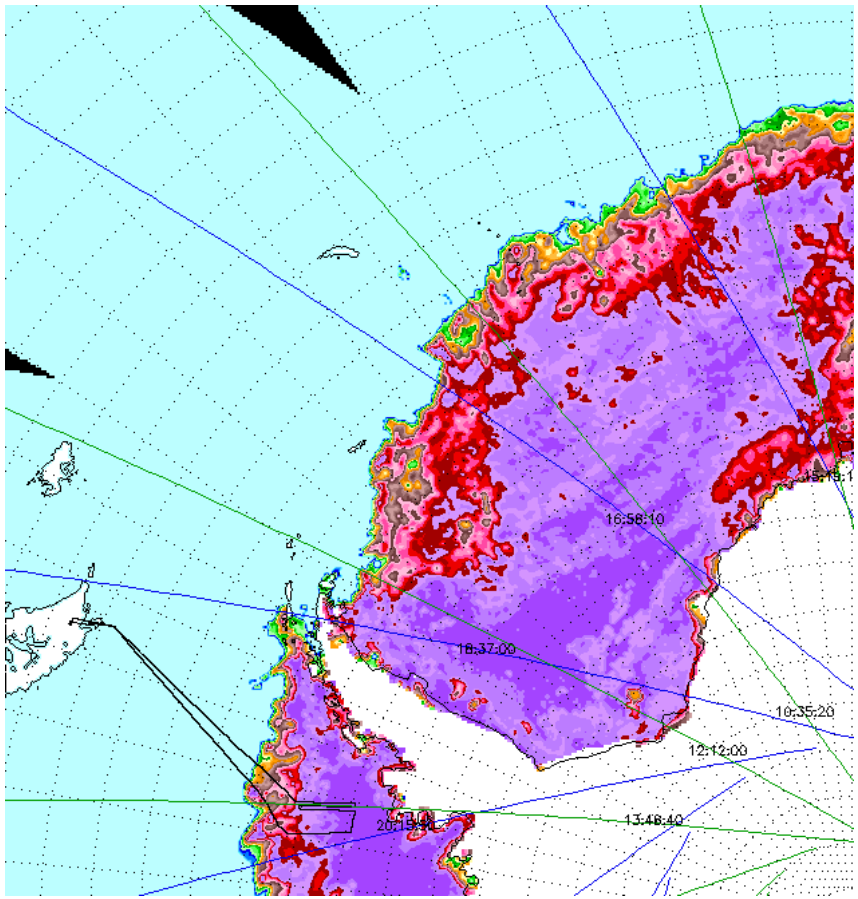
Summary of actual AASI Flight Tracks 2003 and 2004



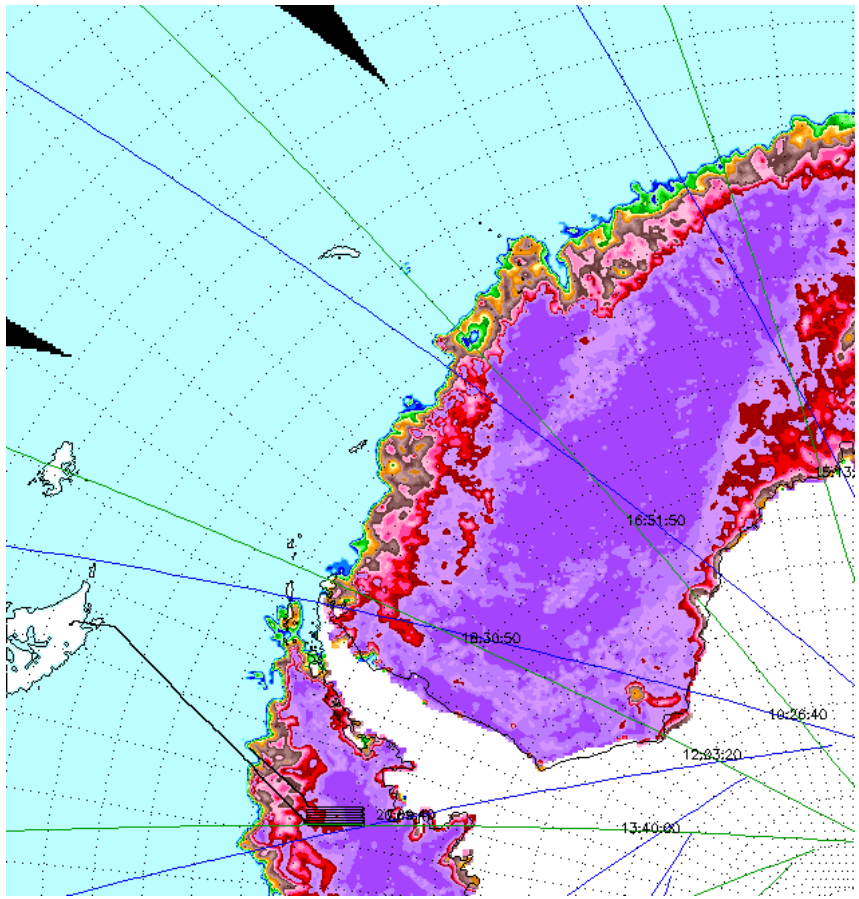
First P3 Flight with Coordinated IceSat Orbital Path (high altitude)

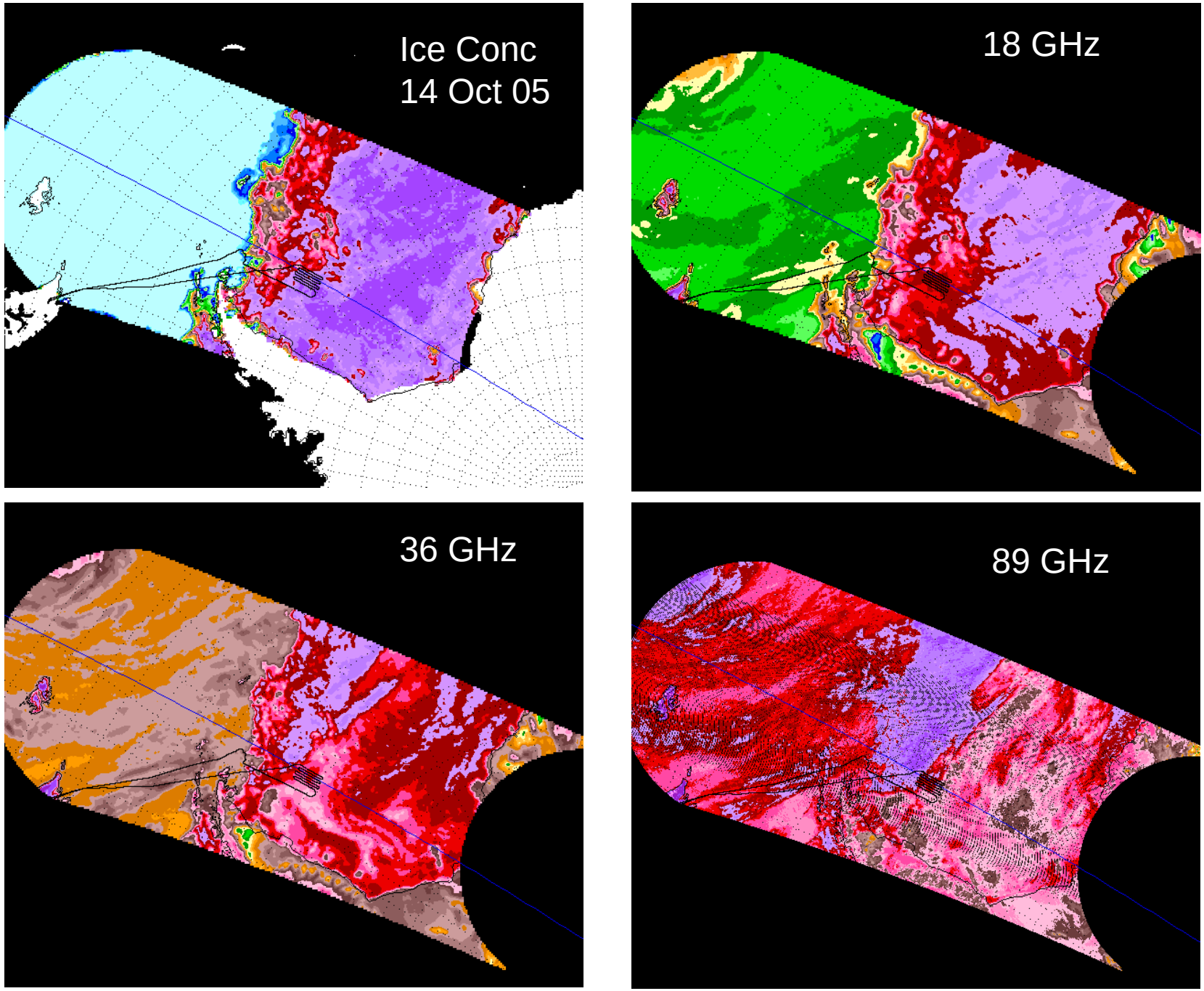


Second Flight at low altitude with coincident IceSat orbit

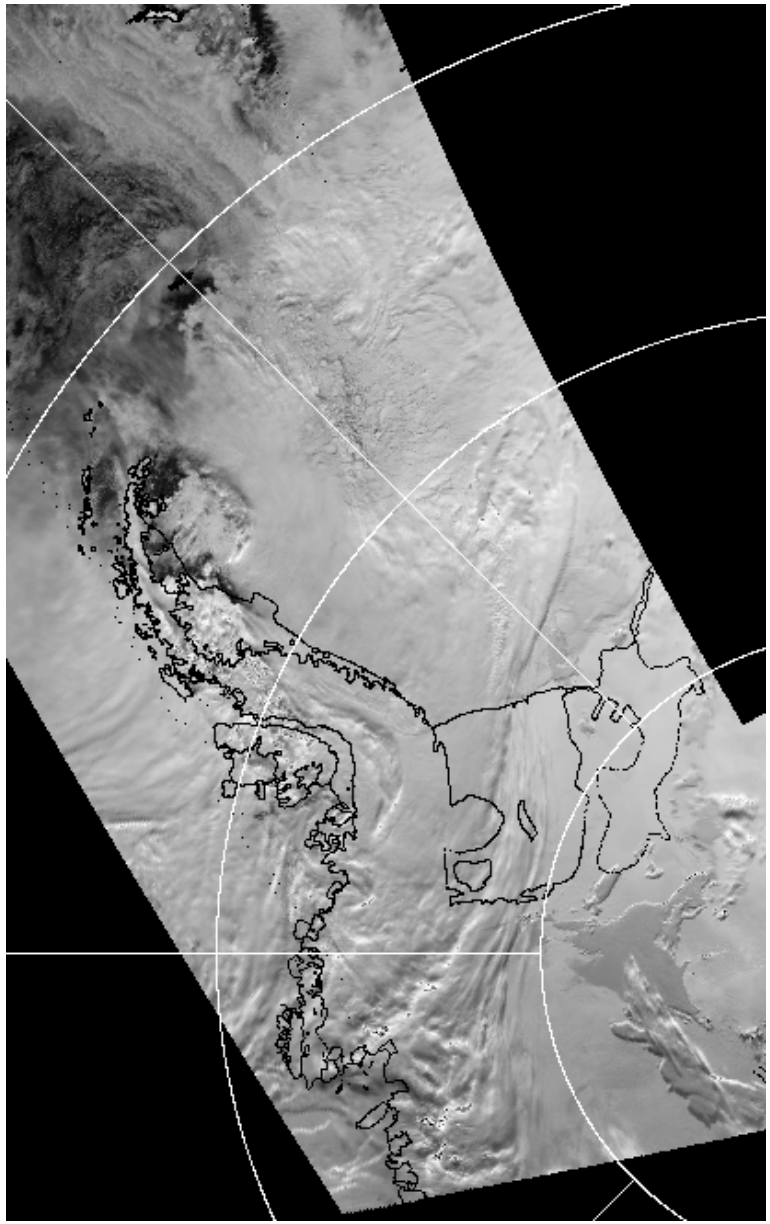


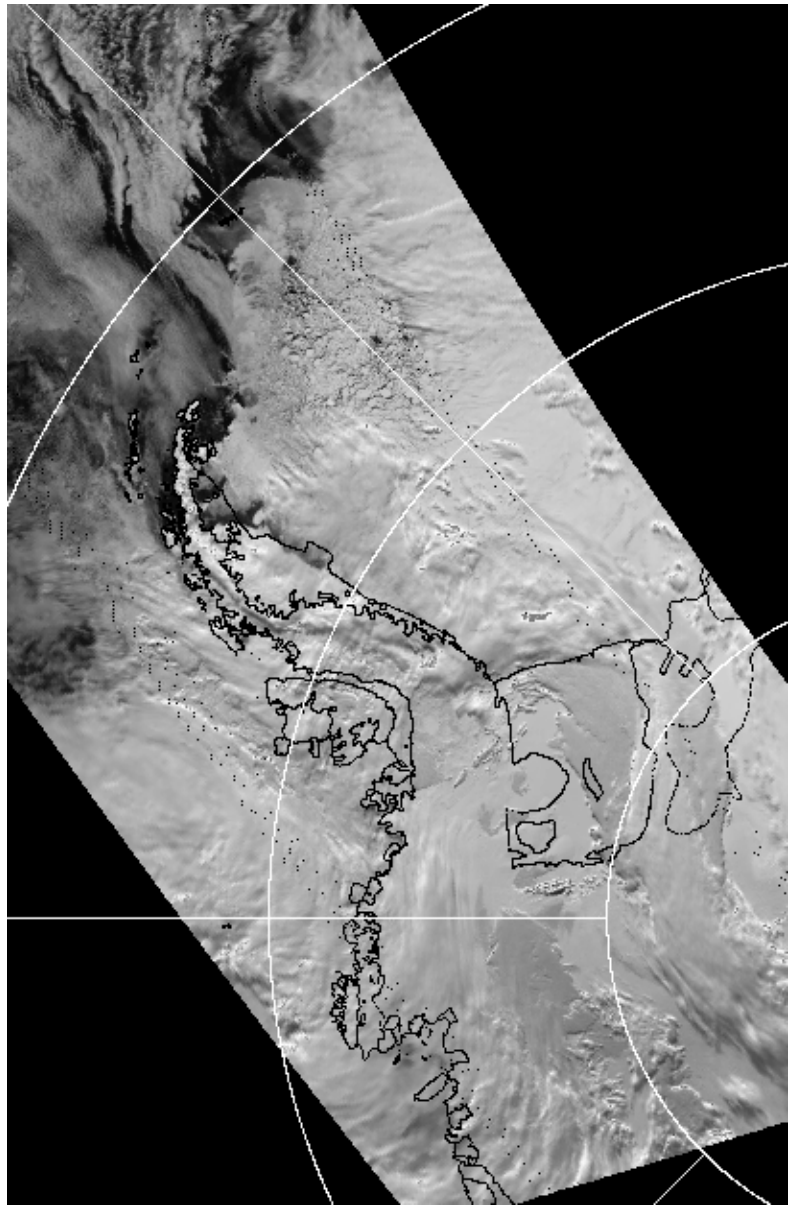
Third Flight at high altitude with coincident IceSat orbit



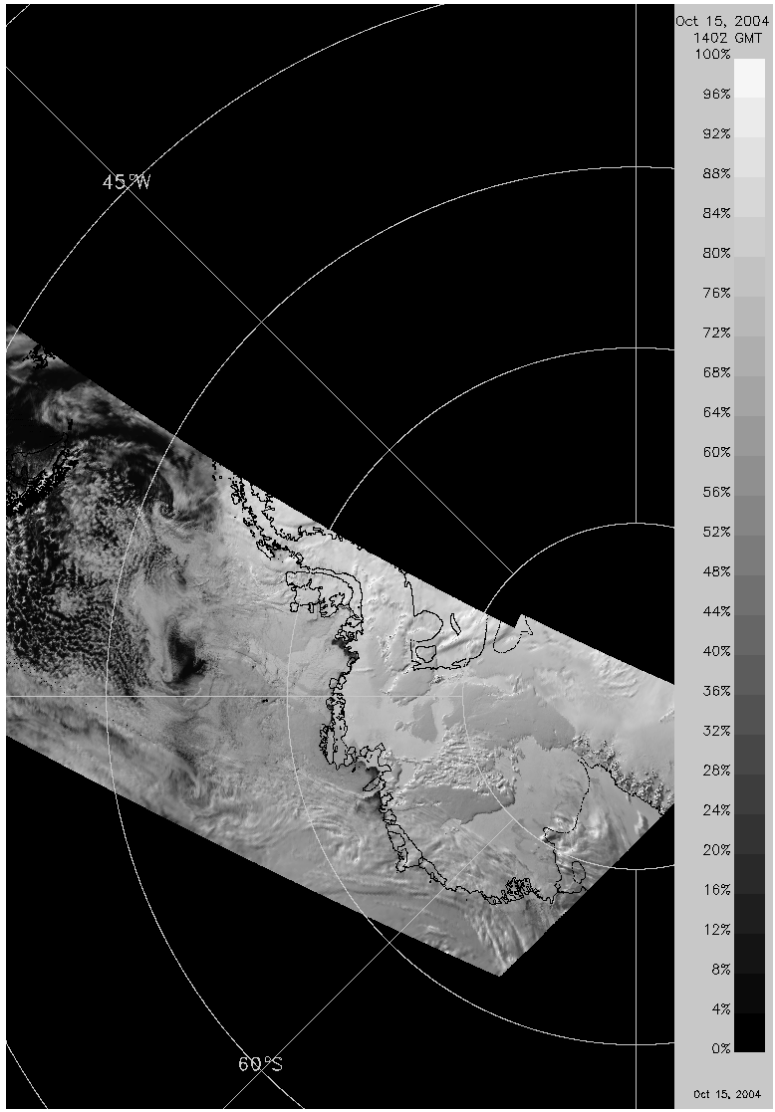

Ice Conc
14 Oct 05
18 GHz
36 GHz
89 GHz

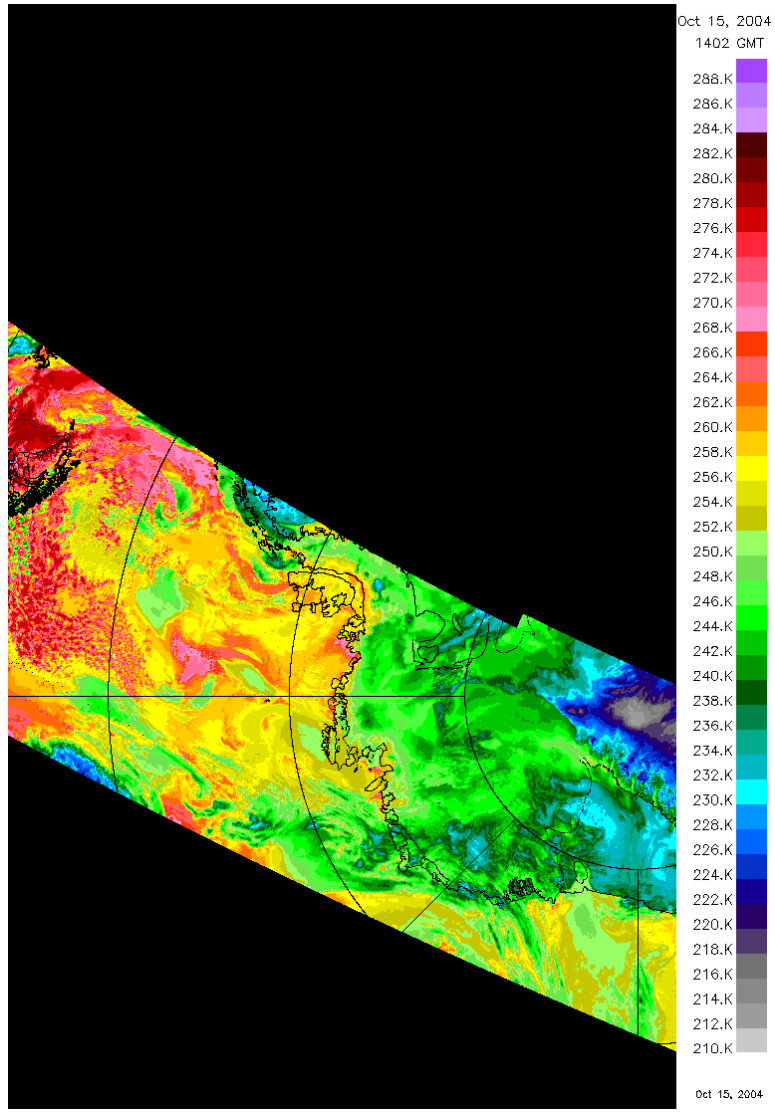
11-12 October 2004 GAC



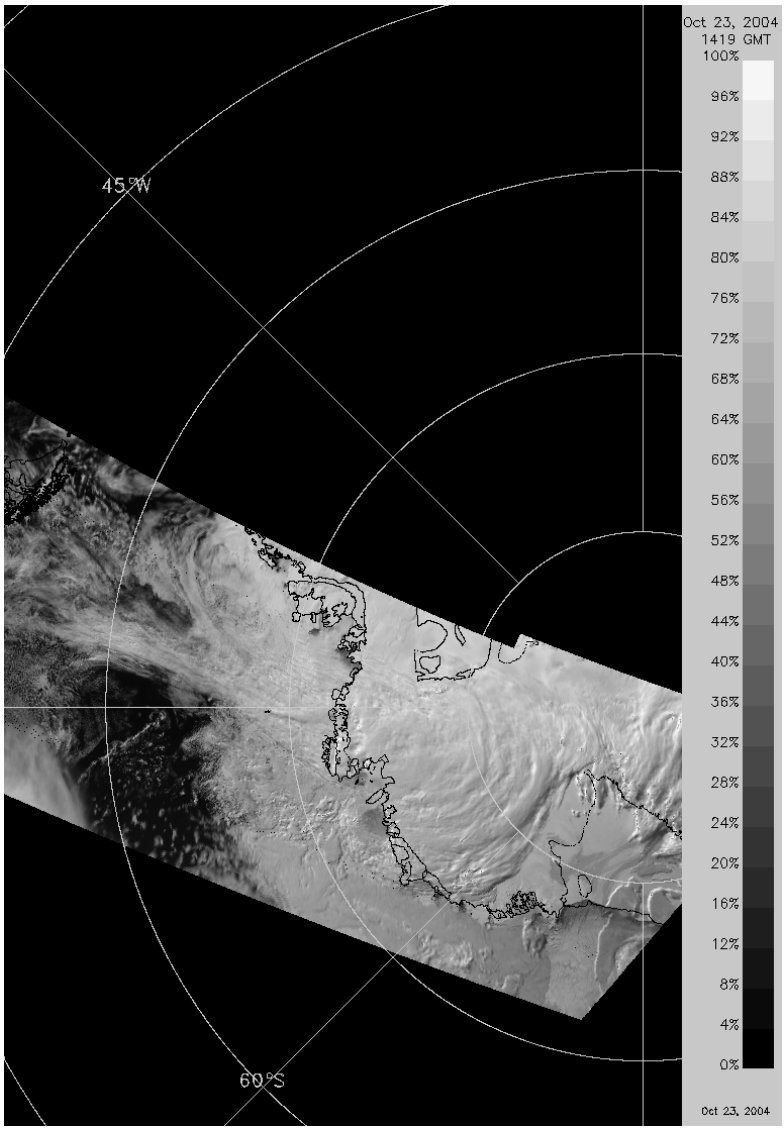


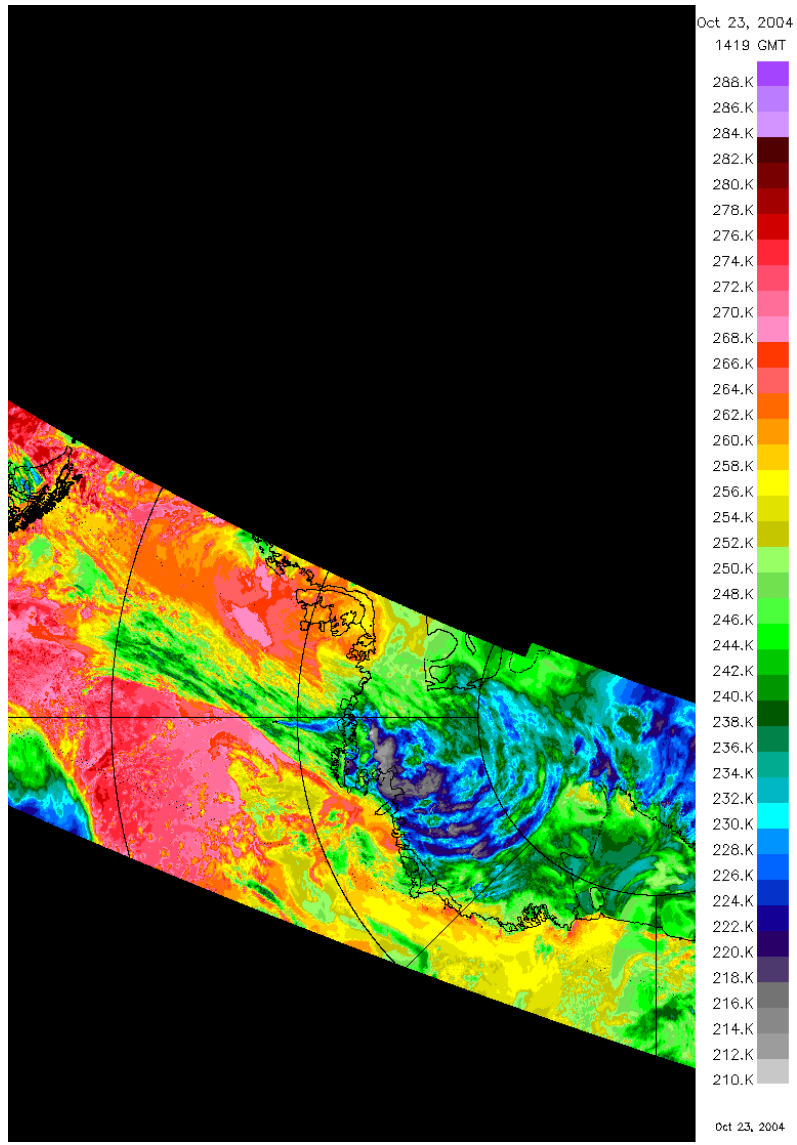
15 October 2004 AVHRR images



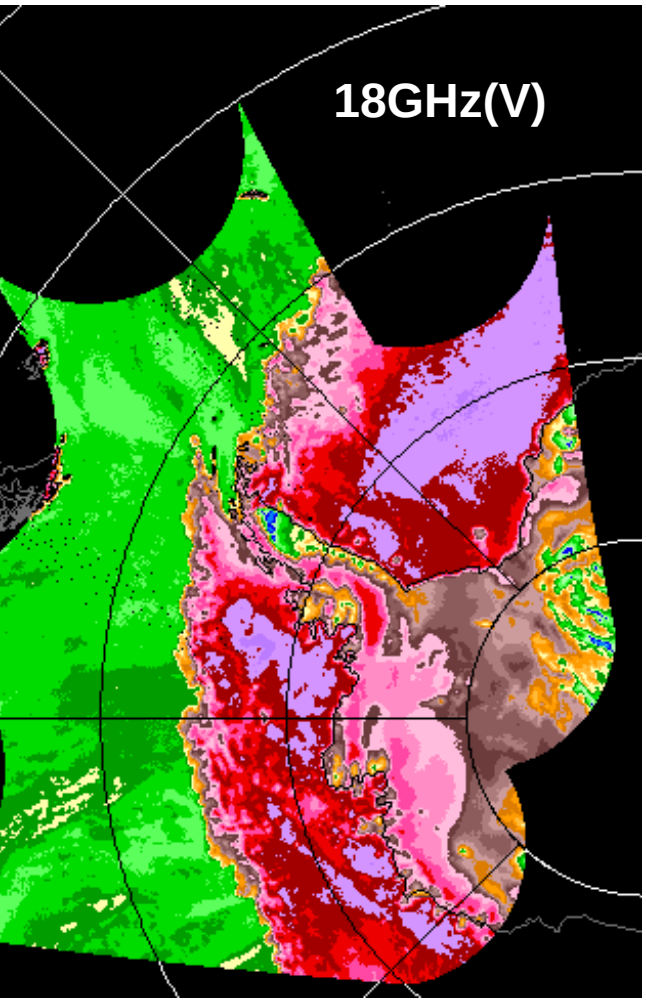


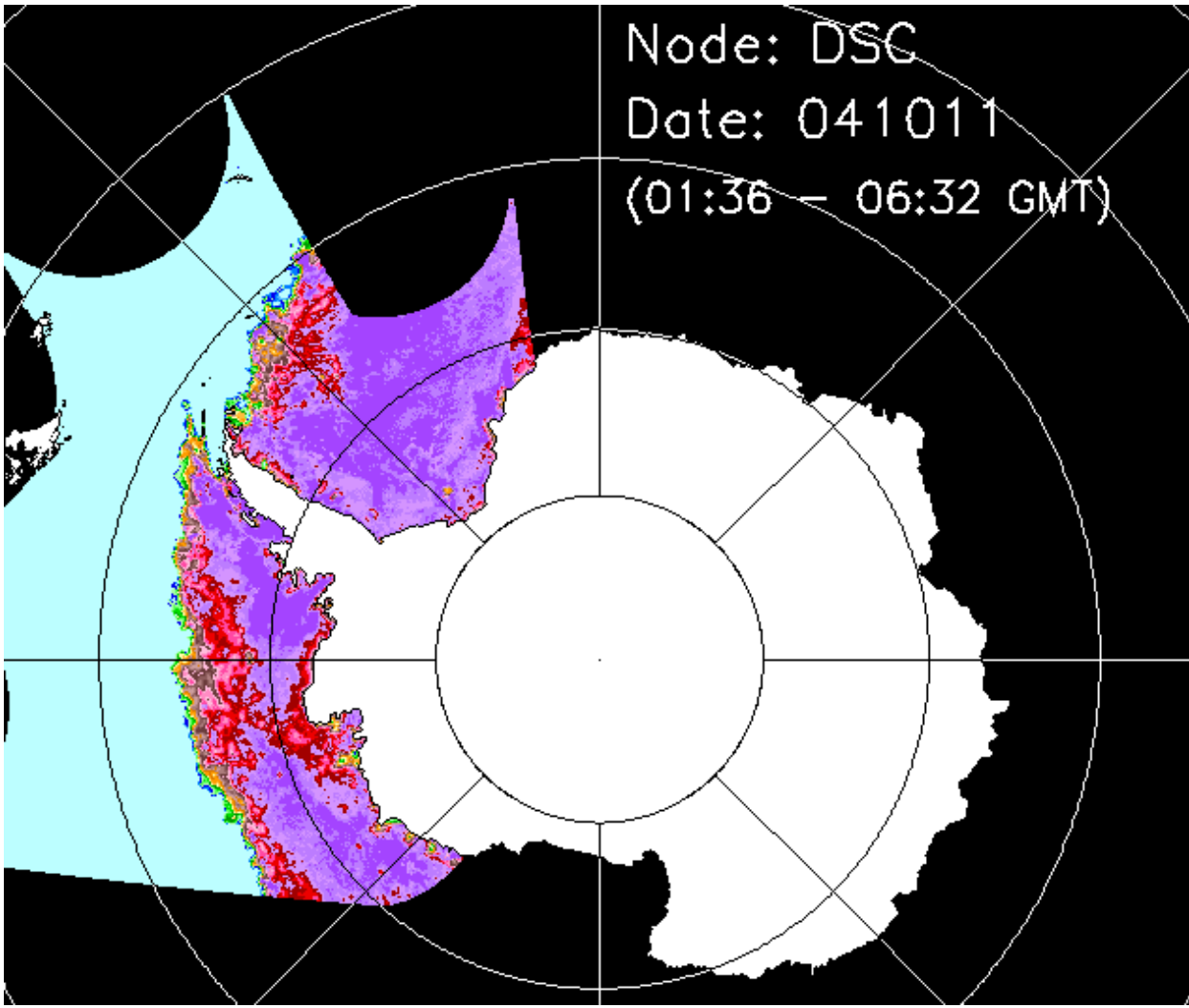
AVHRR data, 23 October 2004





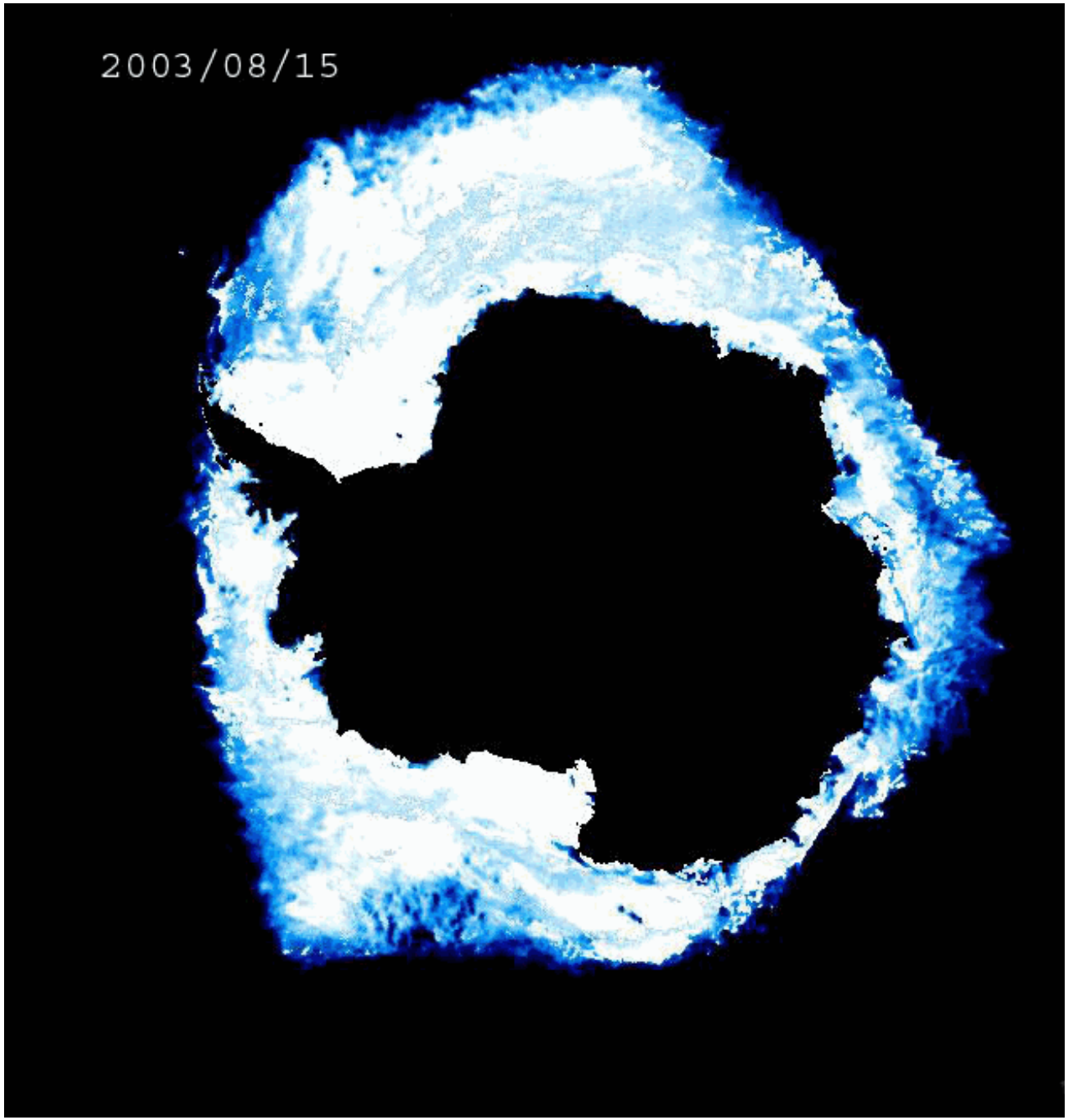
Aqua/AMSR-E TB and IC
11 October 2004





AMSR-E
IC

Aug 2003
VH37
V1837



Summary

- The AASI Mission suffered aircraft hardware problems two years in a row. However, some unique data sets were collected and we should evaluate how the data can be used to fulfill some of the validation objectives.
- The mission involves observations from different sensors and different platforms. Data fusion and joint efforts are required to make full utilization of the data sets.