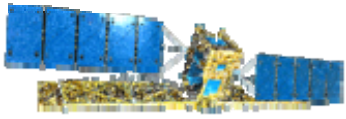


"Hielo en el Mar"

The National Ice Center

Activities During the International Polar Year



29 May 2009

Dr. Pablo Clemente-Colón
Chief Scientist National Ice Center
(This Briefing is Unclassified)



USCG



USN



NOAA



Outline

- **Why (am I not studying coral reefs)?**
- **Who (are the NIC partners)?**
- **Where (do we operate)?**
- **What (have we done during IPY)?**
- **What's Next?**





Sin Hielo en el Mar



***Recinto Universitario de Mayagüez
(RUM)***



Departamento de Ciencias Marinas



La Parguera, Lajas



Isla Magueyes



Laboratorio de Isla Magueyes



More Ancient History



**R/V Longhorn
Gulf of Mexico
Satellite Validation
Hydrographic Cruise**

E. Paul McClain, NESS Environmental Sciences Group

Richard Legeckis – VHRR/AVHRR IR Satellite Imagery

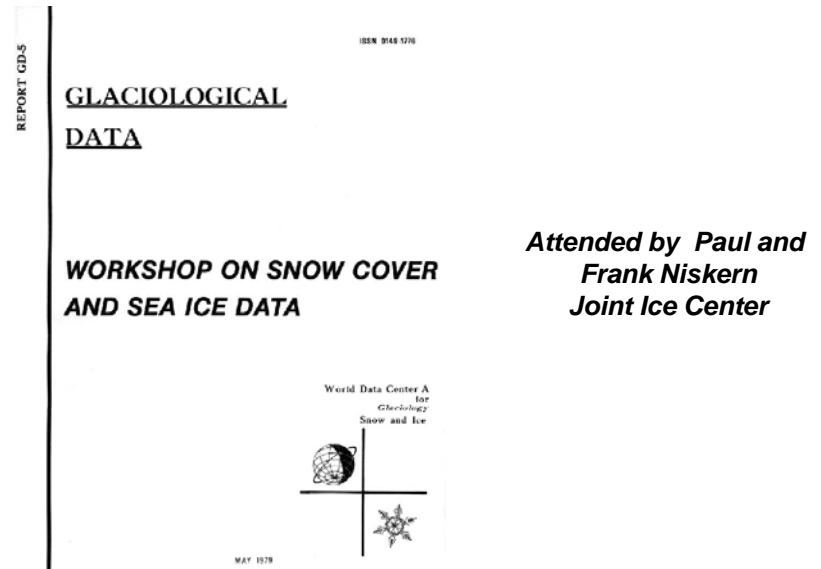
**On the circulation processes of the western/southwestern Gulf of Mexico:
a satellite and hydrographic view - 1980**

**SAR data analyzed by
Pat Deleonibus**



Seasat

24 June – 10 October 1978





Synthetic Aperture Radar (SAR)

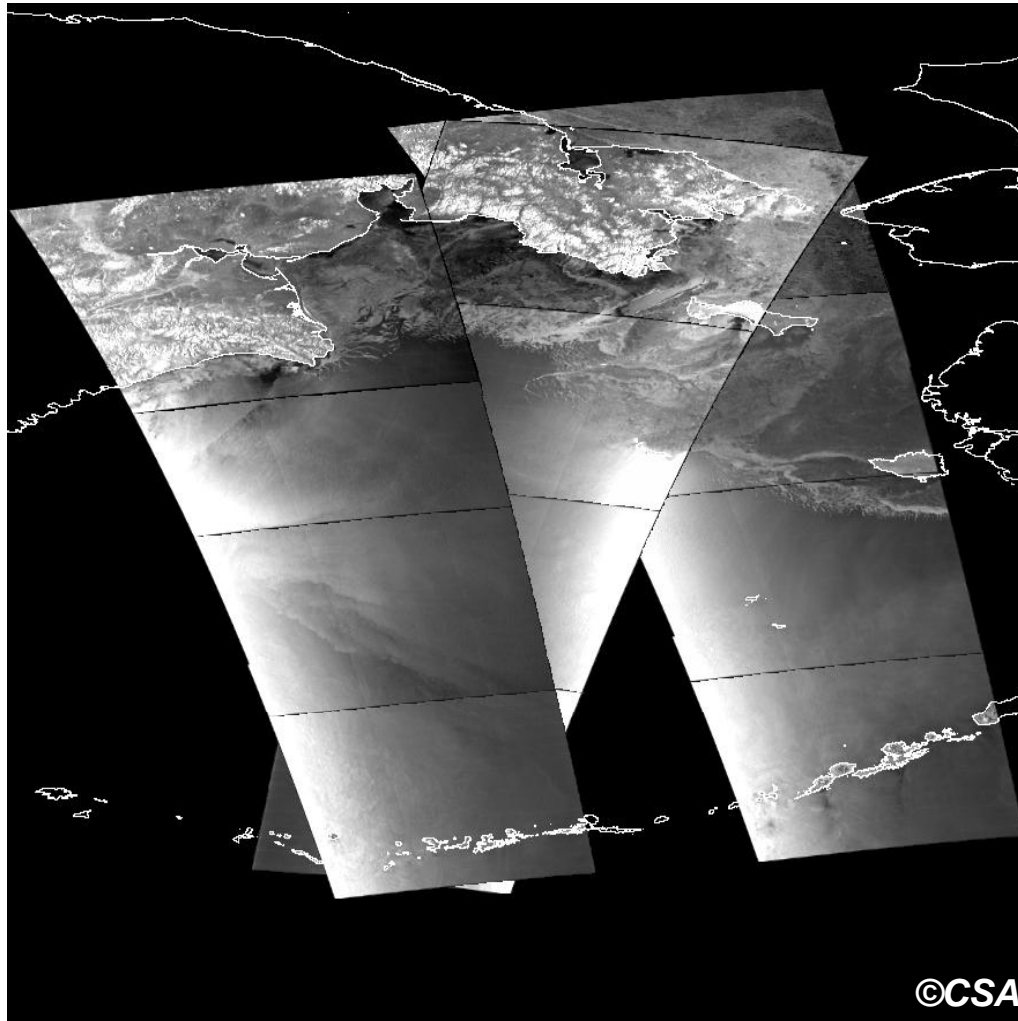
Hielo y Mar



ERS-1/ERS-2



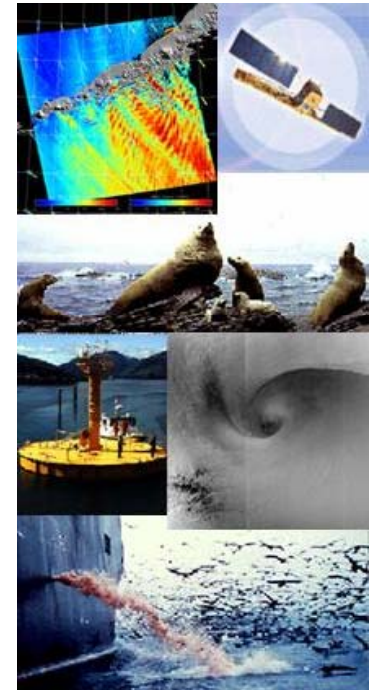
RADARSAT-1



©CSA

AKDEMO

w/ William G. Pichel



NESDIS AA
November '93 – April '99



NIC Mission and Structure

- **Tri-agency organization**
 - 60 military and civilian personnel in Washington, D.C. metro area
 - Global sea ice analysis and forecasting
- **International Partnerships**
 - **North American Ice Service (NAIS)**
 - Canadian Ice Service (CIS)
 - International Ice Patrol (IIP)
 - **International Arctic Buoy Programme (IABP)**
 - **International Ice Charting Working Group (IICWG)**



NAIS



IABP

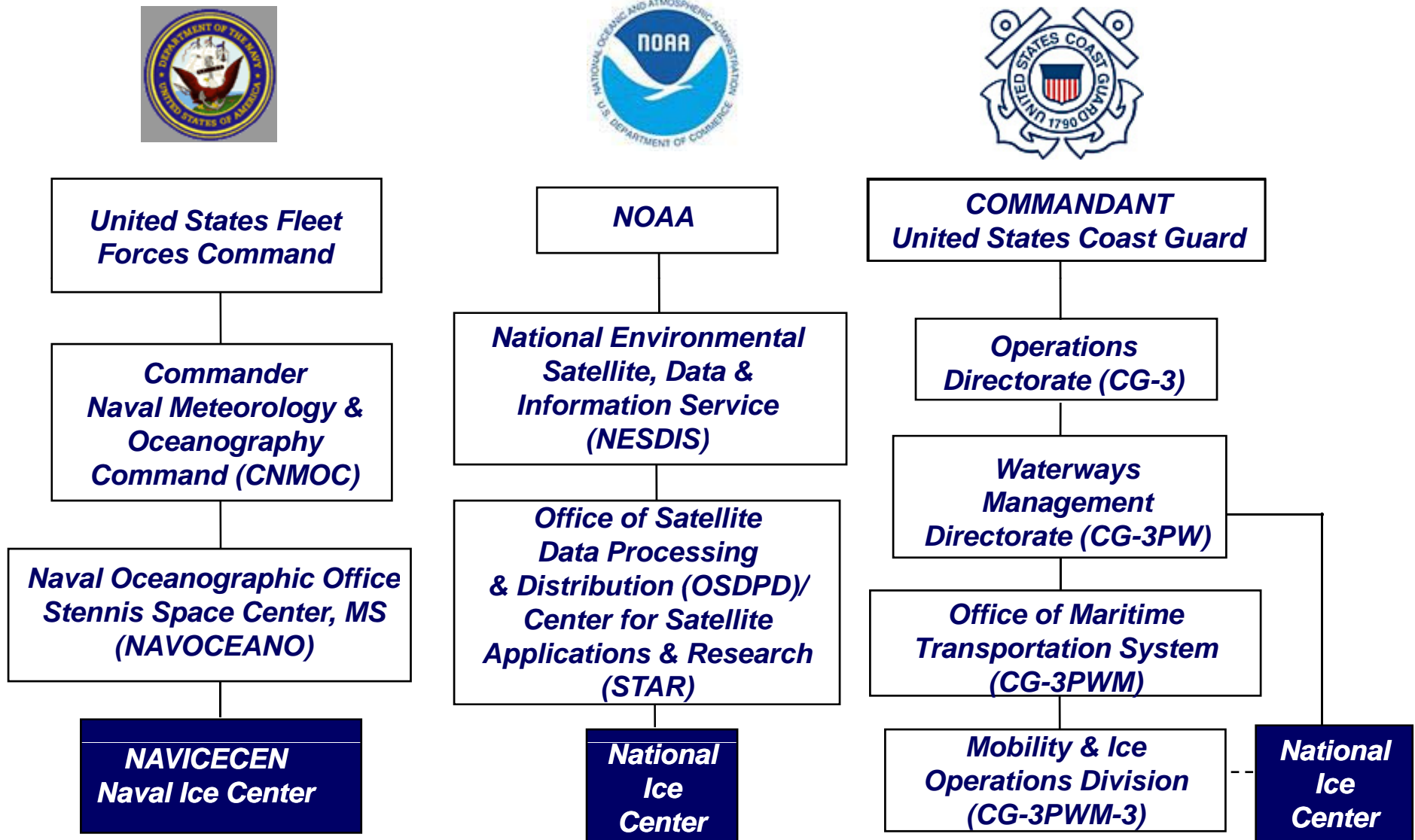


IICWG

Mission: provide the highest quality timely, accurate, and relevant snow and ice products and services to meet the strategic, operational, and tactical requirements of U.S. national interests across a global AOR.



NIC Organization Structure

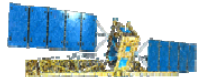




Operations and Product Generation

Human, Derived, Automated, and Reconfigured

Inputs



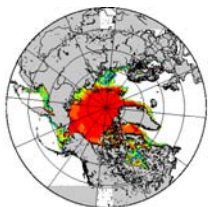
Satellites



Aircraft



Surface Obs



Models



Buoys

Expert Ice Analyses, Forecasting, and Quality Control

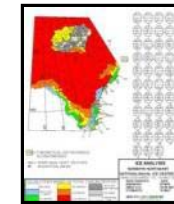


Data Fusion

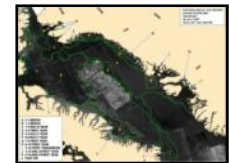
Derived Data Automation

Direct Data Dissemination

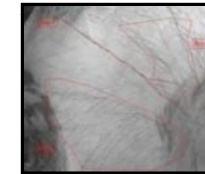
Products



Hemispheric and Regional Ice Charts

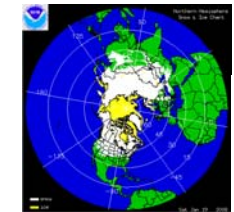


Annotated Images

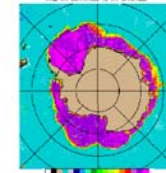


Fractures, Leads and Polynyas (FLAP)

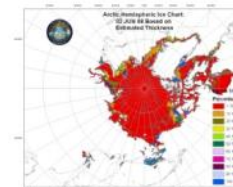
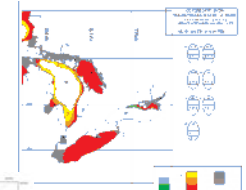
IMS snow and ice maps



Microwave Sea Ice Concentration products



Ice Forecast Outlooks

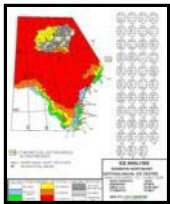


Ice Thickness Estimations

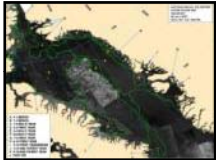


Customers

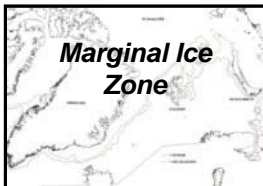
Products



Hemispheric Ice Charts

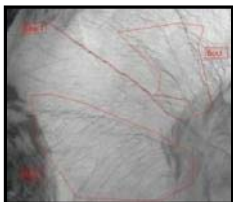


Annotated Images



Marginal Ice Zone

Special Arctic Oceanographic Synopsis (SPAROS)



Fractures, Leads and Polynyas (FLAP)



**Public web page
Dissemination**



**approx 140
customers**



USN



ONI



NSF



MSC



NWS



Local Gov.



NOAA



USCG

Mission/Goal Supported

**Battlespace Awareness
SA / ISR / I&W**

Scientific Research

Maritime Shipping

Commercial Fisheries

Oceanographic and Atmospheric Models (NWP)

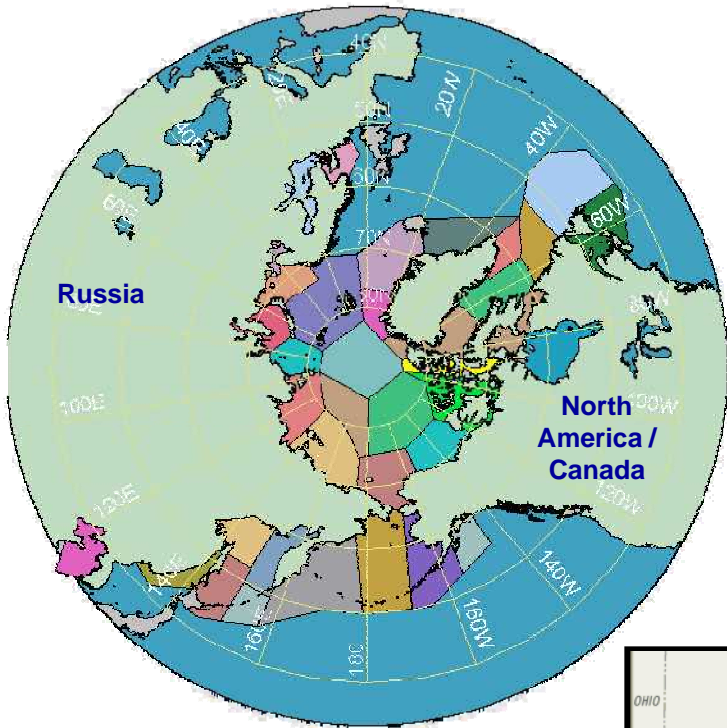
Safety of Life and Property At Sea

Safety of Navigation



Area of Responsibility - Global

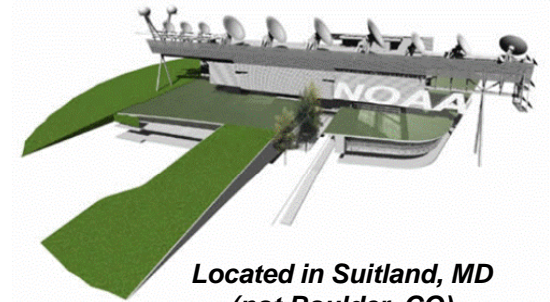
Arctic, Great Lakes, Antarctic



Arctic (including Sea Of Japan, Sea of Okhotsk, and Yellow Sea)



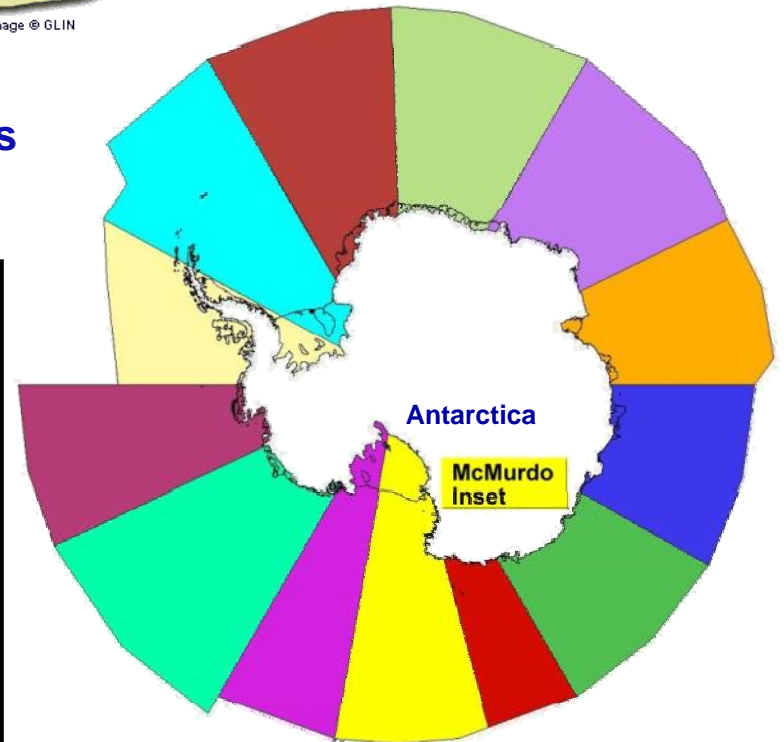
Great Lakes



Located in Suitland, MD (not Boulder, CO)



Chesapeake / Delaware Bays



Antarctic



International Polar Year



Tailored ice support for NASA IPY missions

| ID | Title | Co-ordinates | Publication Date | Thumbnail | Data |
|----|--|--|------------------------|-----------|---|
| 82 | CIS Daily Ice Chart - WMO Stage of Development - VRS39SD - Amundsen Gulf | (74.534, -133.457) (72.630, -98.465) | 2008-09-28 18:00:00 | | Download 143 KB, pdf |
| 83 | CIS Daily Ice Chart - WMO Stage of Development - VRS39CT - Alaskan Coast | (65.605, -106.692) (66.984, -131.712) (74.534, -133.457) (72.630, -98.465) | 2008-09-27 18:00:00 | | Download 198 KB, pdf |
| 84 | CIS Daily Ice Chart - WMO Stage of Development - VRS49CT - Alaskan Coast | (68.142, -126.083) (67.161, -152.646) (74.238, -160.526) (75.618, -122.698) | 2008-09-27 18:00:00 | | Download 180 KB, pdf |
| 85 | CIS Daily Ice Chart - WMO Stage of Development - VRS39SD - Amundsen Gulf | (65.605, -106.692) (66.984, -131.712) (74.534, -133.457) (72.630, -98.465) | 2008-09-27 18:00:00 | | Download 151 KB, pdf |
| 86 | CIS Daily Ice Chart - WMO Stage of Development - VRS39CT - Alaskan Coast | (65.605, -106.692) (66.984, -131.712) (74.534, -133.457) (72.630, -98.465) | 2008-09-27 18:00:00 | | Download 143 KB, pdf |

National Naval Ice Center

Products posted to IPY Portal

- **NIC provided sea ice and snow products are supporting IPY activities nationally and internationally.**
- **Continued to develop and/or update its Arctic and Antarctic ice chart climatologies**
- **The operational Snow and Ice Analysis and Mapping System (IMS) was transferred from NOAA/NESDIS to the NIC.**
- **Participated in research and validation of the use of radar altimetry over Arctic sea ice for the measurement of ice thickness.**
- **Provided experimental Arctic sea ice coverage charts from QuikScat scatterometer backscatter data through collaboration with NASA/JPL.**
- **Revisited the production of hemispheric partial sea ice concentration ice charts in the Antarctic region.**
- **Contributed ice charts to the GMES (Kopernikus) Polar View IPY webportal (<http://ipy-ice-portal.org>)**



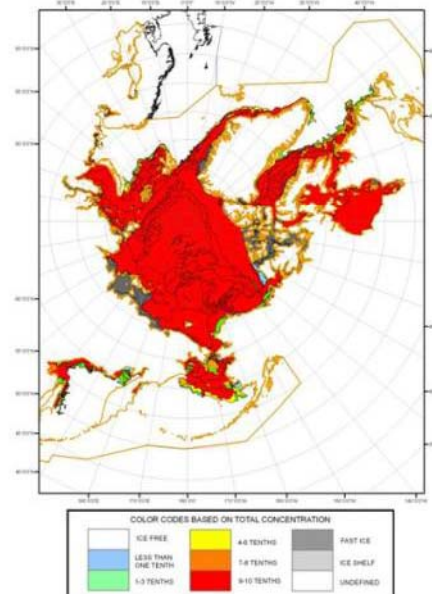
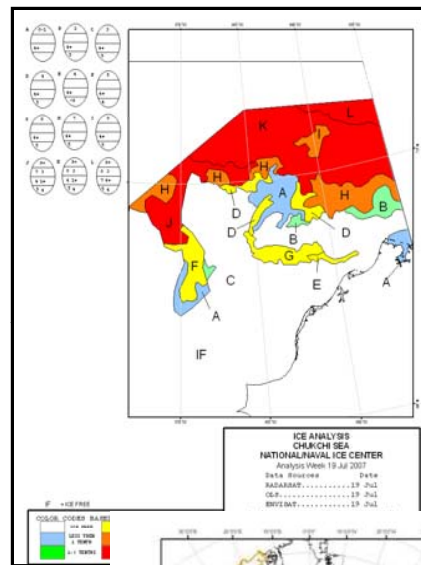
NIC – Routine Products

Weekly-Daily

Charts produced based on the detailed analysis of satellite data, observations, and model sources:

- RADARSAT-1 and 2;
 - ESA Envisat;
 - NASA QuikSCAT;
 - NASA Terra and Aqua;
 - DMSP;
 - NOAA
-
- Ship observations
 - Buoy data
 - Model Output

<http://www.natice.noaa.gov>



Weekly Products:

Weekly and bi-weekly Arctic and Regional Charts

Bi-weekly Antarctic Charts

Weekly Hemispheric Chart

Weekly Thickness Chart

Daily Products:

Ice Edge and Forecast

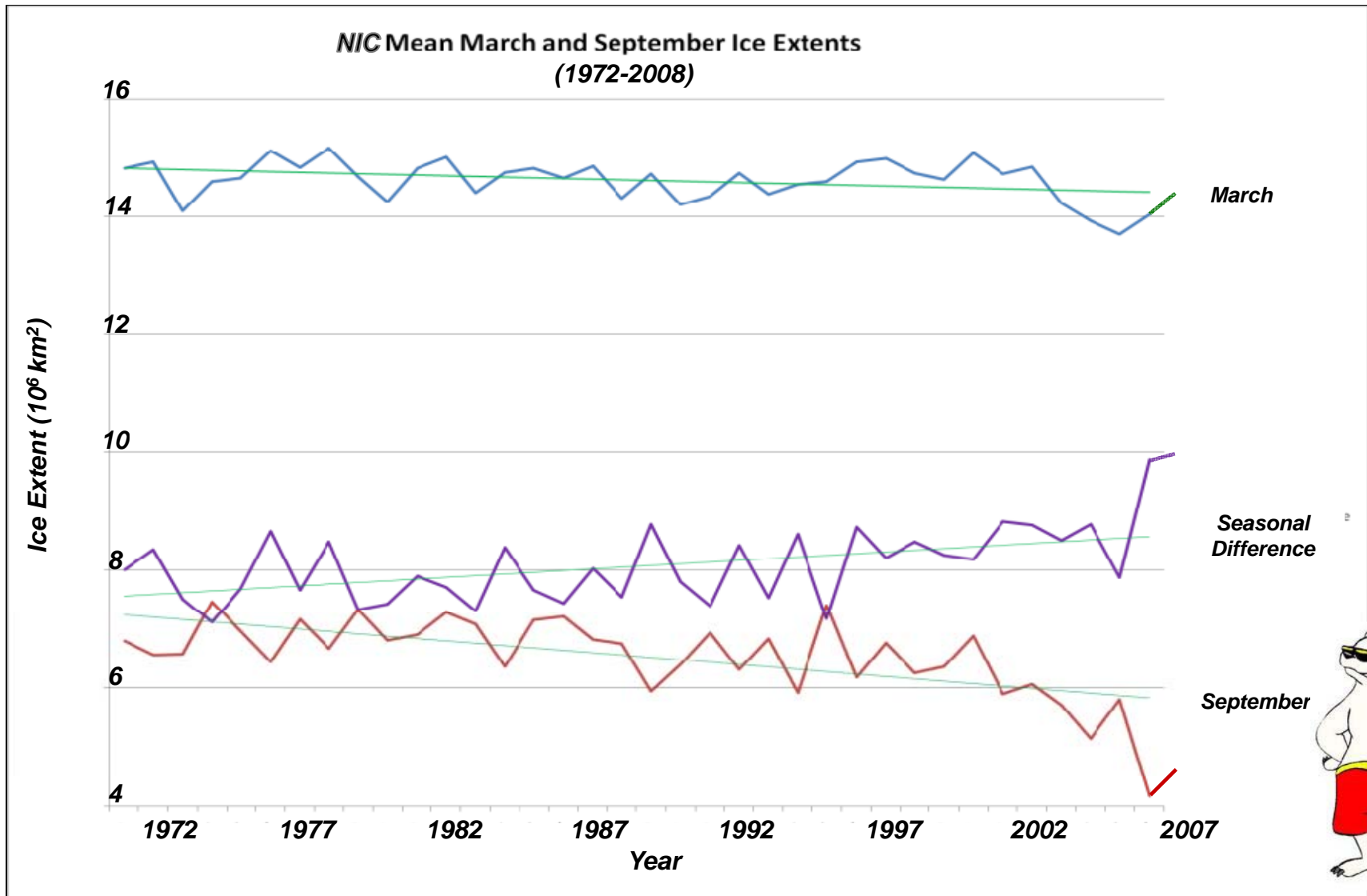
Marginal Ice Zone

Snow and Ice Product (IMS)

Antarctic Iceberg ID and Tracking

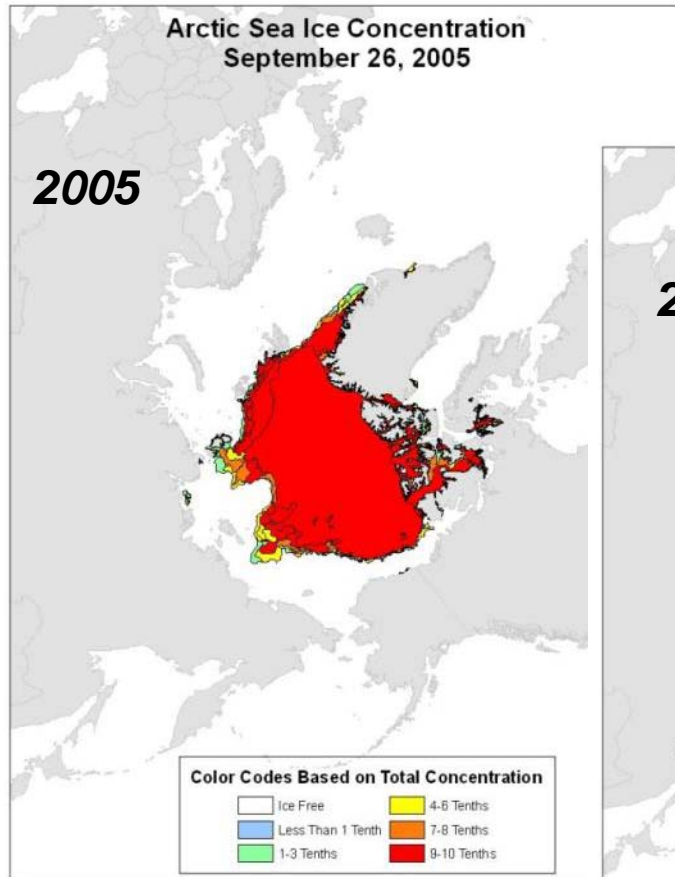


Arctic Sea Ice Extent Declining Trend





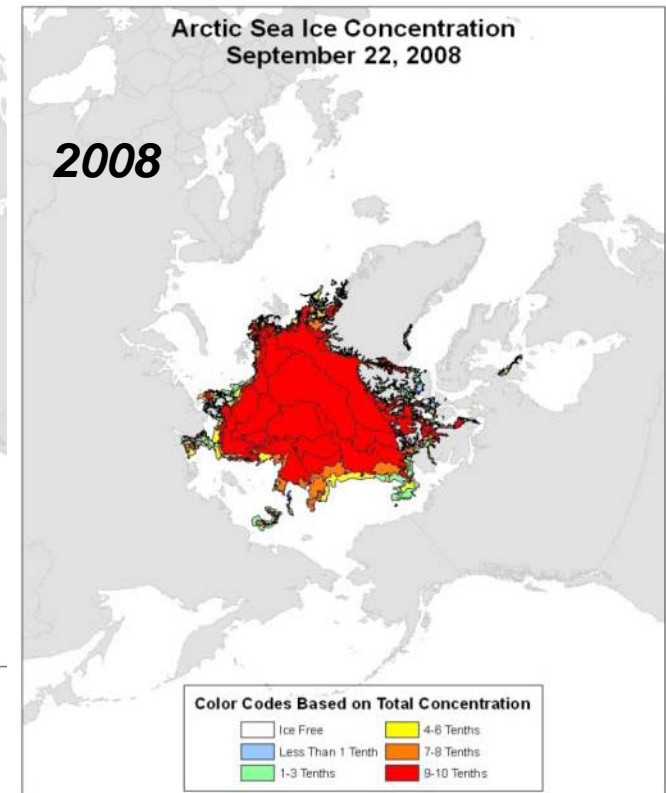
Summer Minimum Ice Conditions



**Total Ice Extent
4.99 million sq km**



**Total Ice Extent
3.98 million sq km**



**Total Ice Extent
4.67 million sq km**



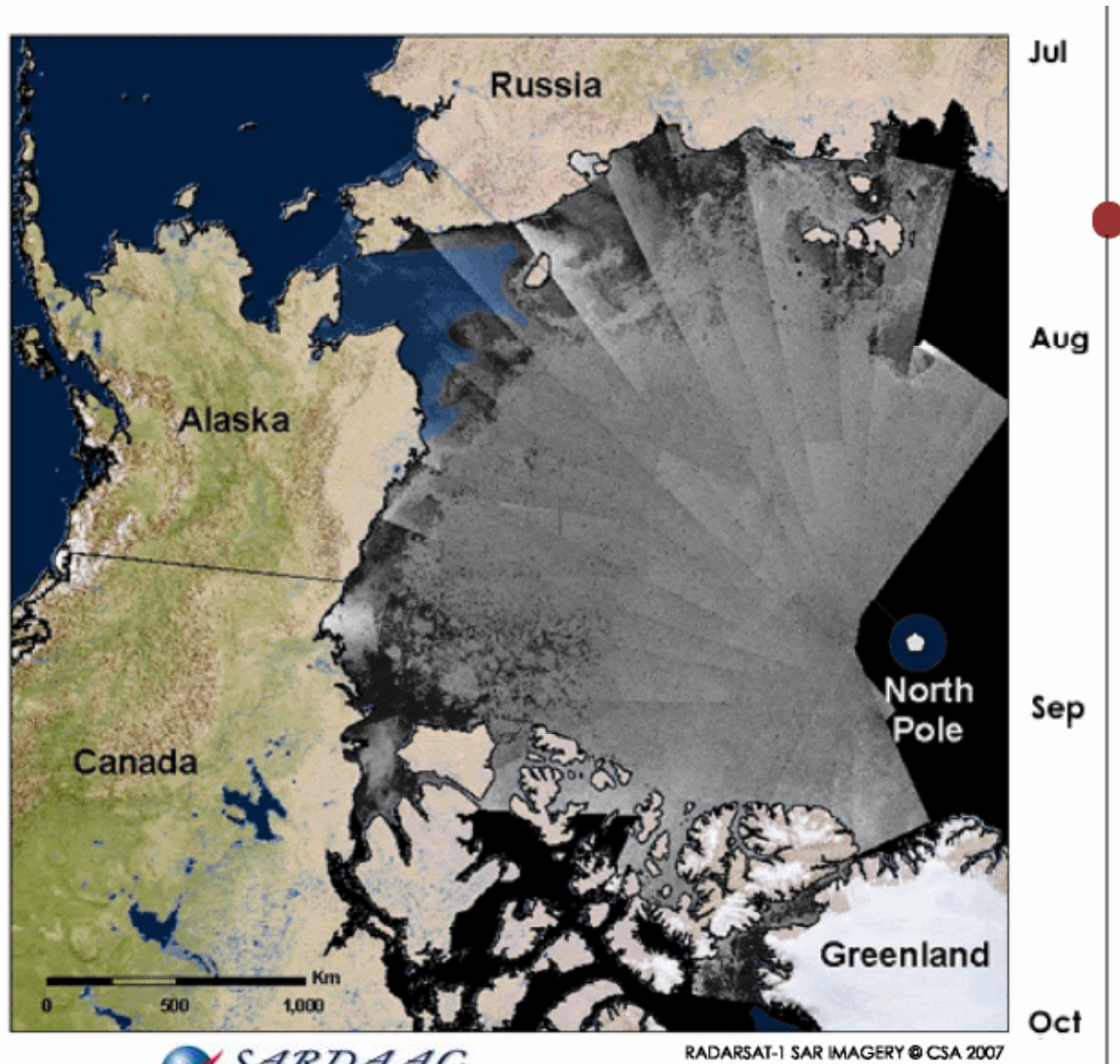
2007 Arctic Sea Ice Extent Record Minimum

Captured by CSA RADARSAT-1



The Alaska Satellite Facility (ASF) downlinks and mosaics Canadian Space Agency (CSA) RADARSAT-1 images of the western Arctic Ocean every three days. These synthetic aperture radar (SAR) images are acquired both day and night regardless of weather conditions. The data are used for research and operational monitoring of changes in sea ice cover. The animation to the right shows changing sea ice conditions from mid-July to mid-September and documents the evolution of a record minimum extent in 2007.

The transparent blue mask indicates the sea ice edge as determined by analysts at the National Ice Center (NIC).

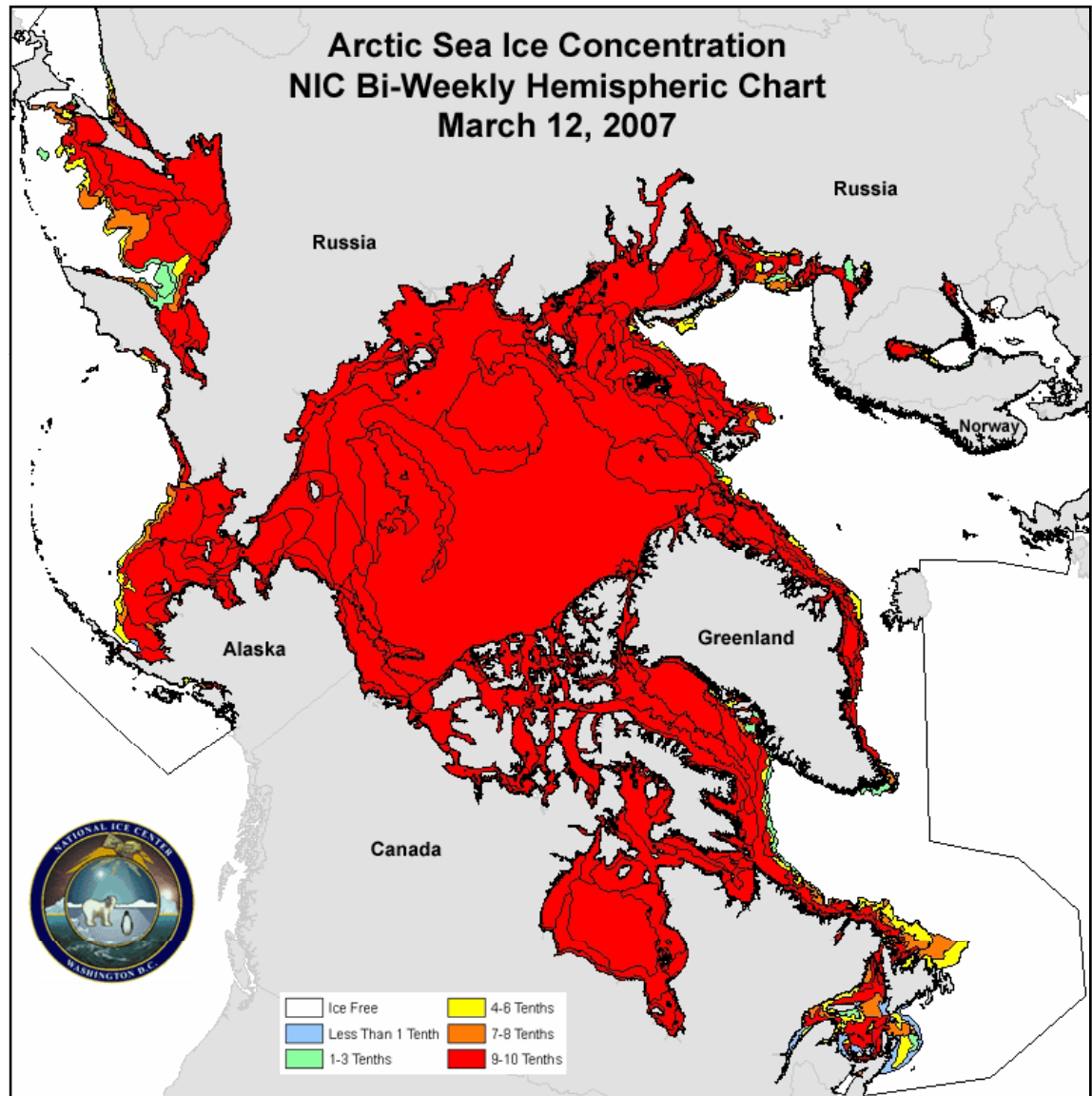


RADARSAT-1 SAR IMAGERY © CSA 2007



2007 Arctic Sea Ice Extent Record Minimum Evolution As Captured by NIC Charts

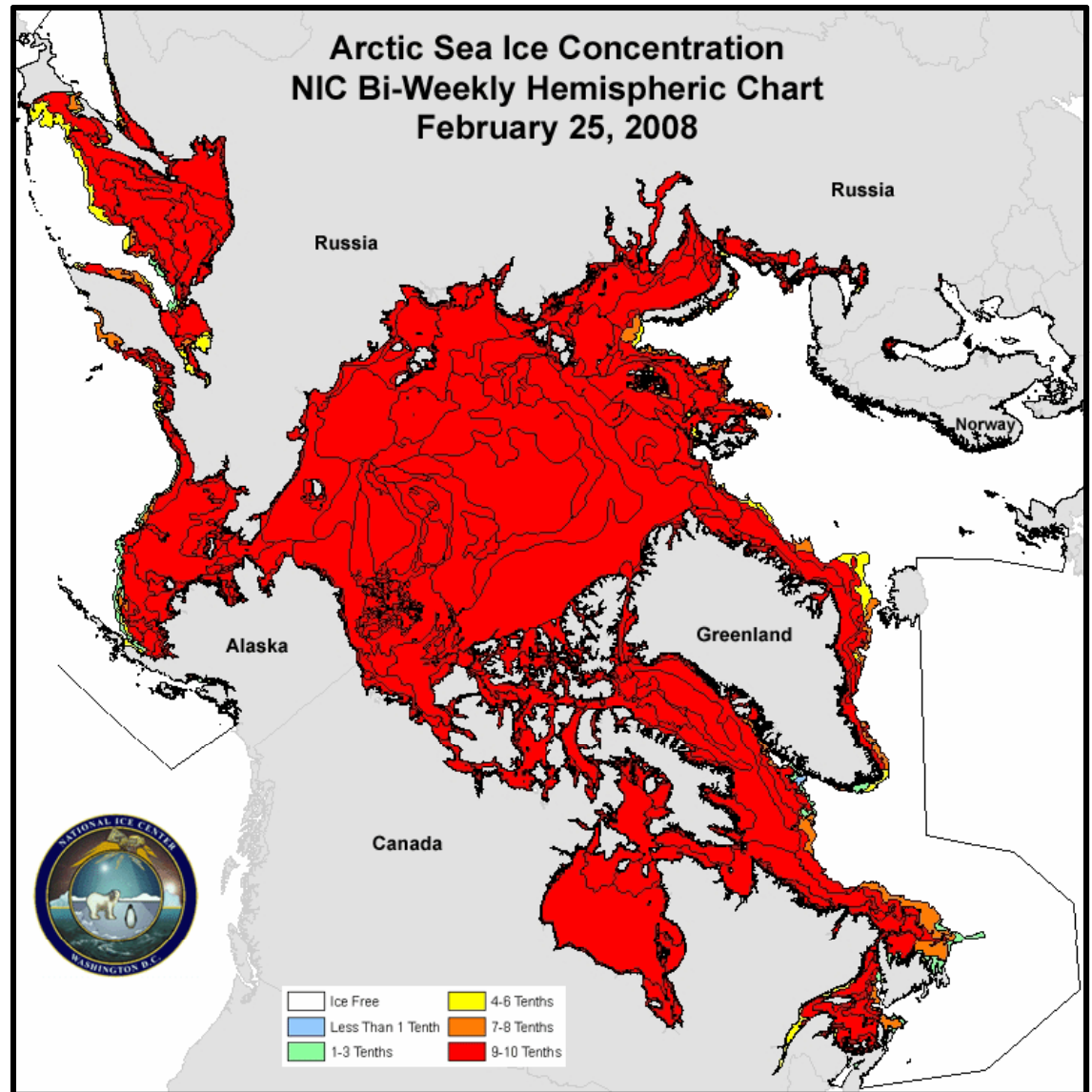
The National Ice Center produces weekly and bi-weekly Arctic charts that have captured the evolution of the 2007 sea ice extent record minimum.. The animation of bi-weekly NIC charts to the right shows changing sea ice conditions from March 12 to September 24 2007. NIC hemispheric charts are produced based on the detailed analysis of observations from a diverse number of satellite missions including CSA RADARSAT-1, ESA Envisat, NASA QuikSCAT, NASA Terra and Aqua, DMSP, and NOAA.





2008 Arctic Sea Ice Extent Minimum Evolution As Captured by NIC Charts

The National Ice Center produces weekly and bi-weekly Arctic charts that have captured the evolution of the 2008 sea ice extent minimum.. The animation of bi-weekly NIC charts to the right shows changing sea ice conditions from February to September 2008. NIC hemispheric charts are produced based on the detailed analysis of observations from a diverse number of satellite missions including CSA RADARSAT-1, ESA Envisat, NASA QuikSCAT, NASA Terra and Aqua, DMSP, and NOAA.

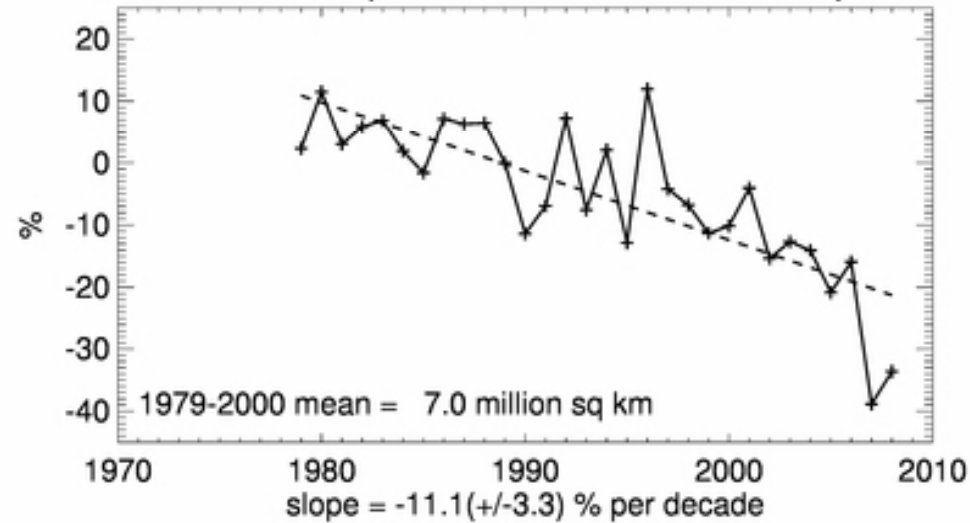




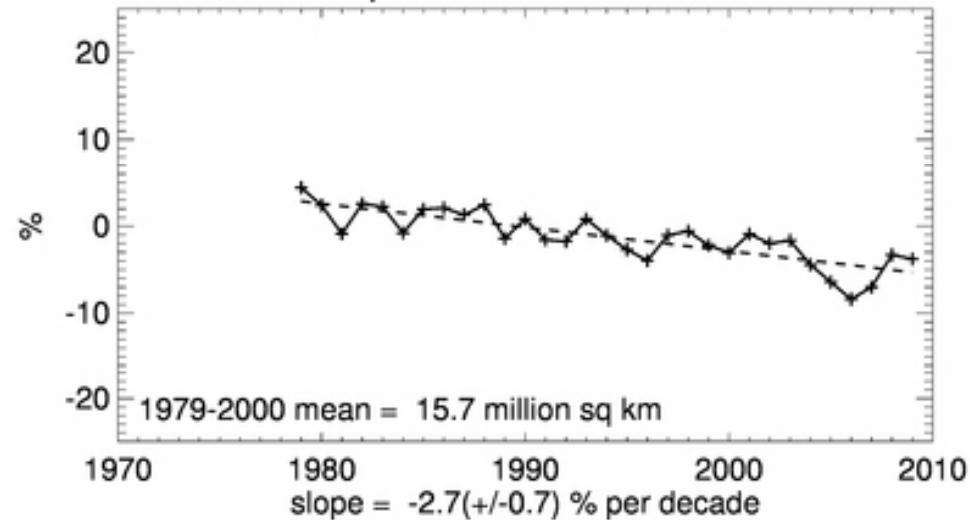
NSIDC Sea Ice Index (SII)



Northern Hemisphere Extent Anomalies Sep 2008

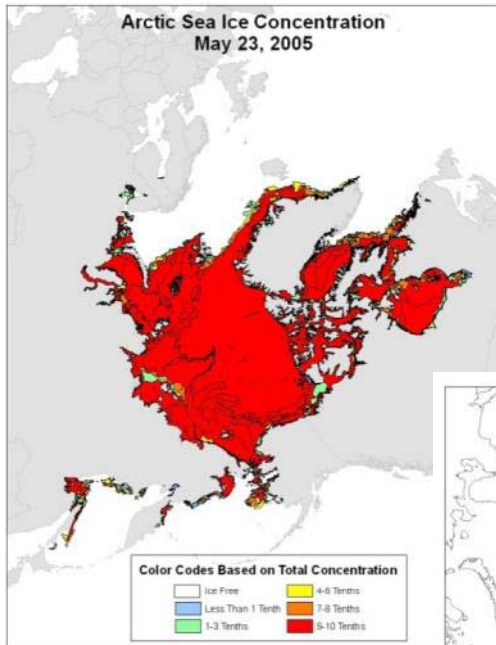


Northern Hemisphere Extent Anomalies Mar 2009



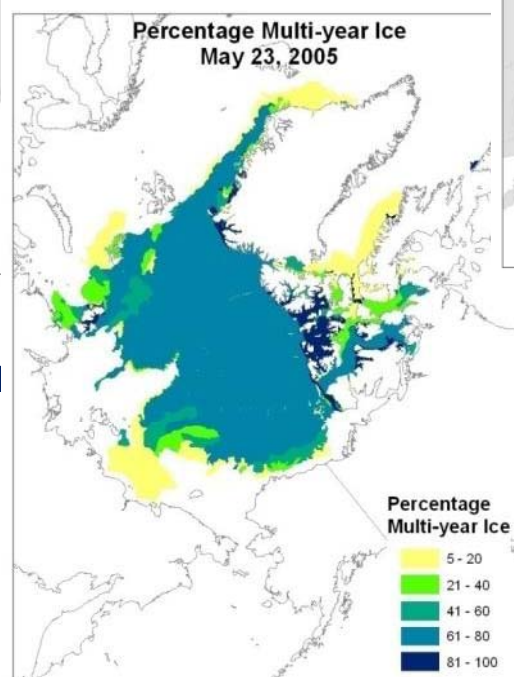


Arctic Sea Ice Extent vs. MYI Distribution

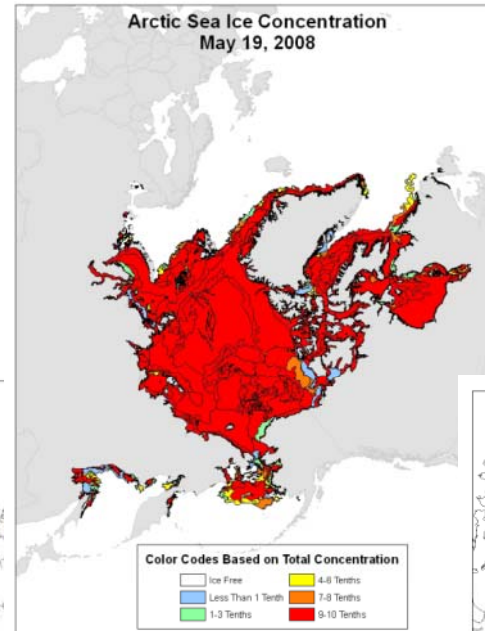


May 2005

**Total Ice Extent =
11.94 million sq km**

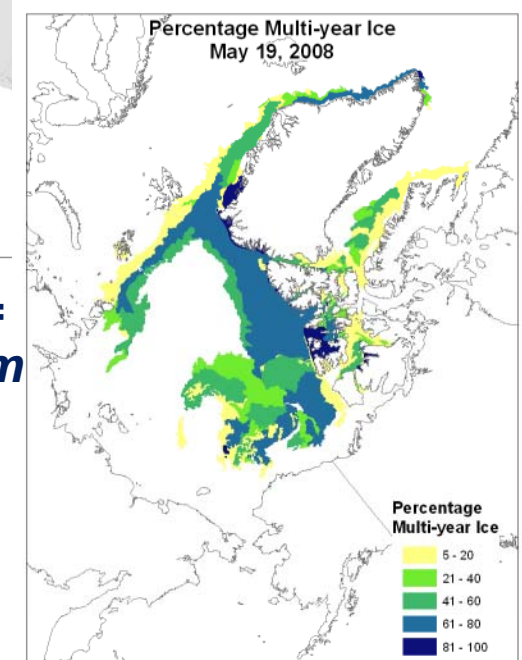


**MYI Ice Extent =
6.20 million sq km**



May 2008

**Total Ice Extent =
12.11 million sq km**

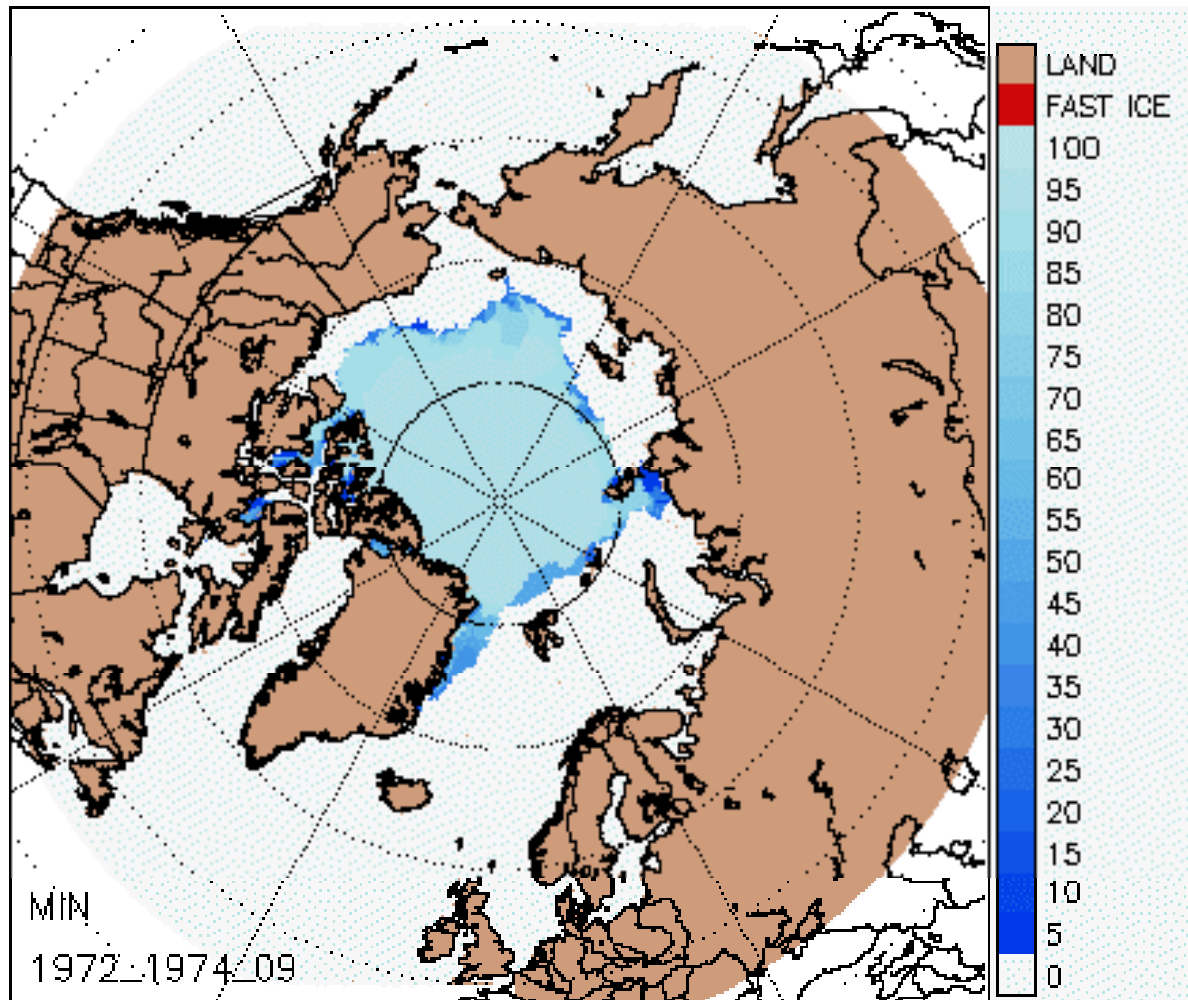


**MYI Ice Extent =
3.89 million sq km**



Arctic Climatology

NIC Arctic sea ice charts and 35 year climatology dataset



Uses

- Input to NIC analysis
- Input to numerical forecast models
- Climate research
- Mission / route planning



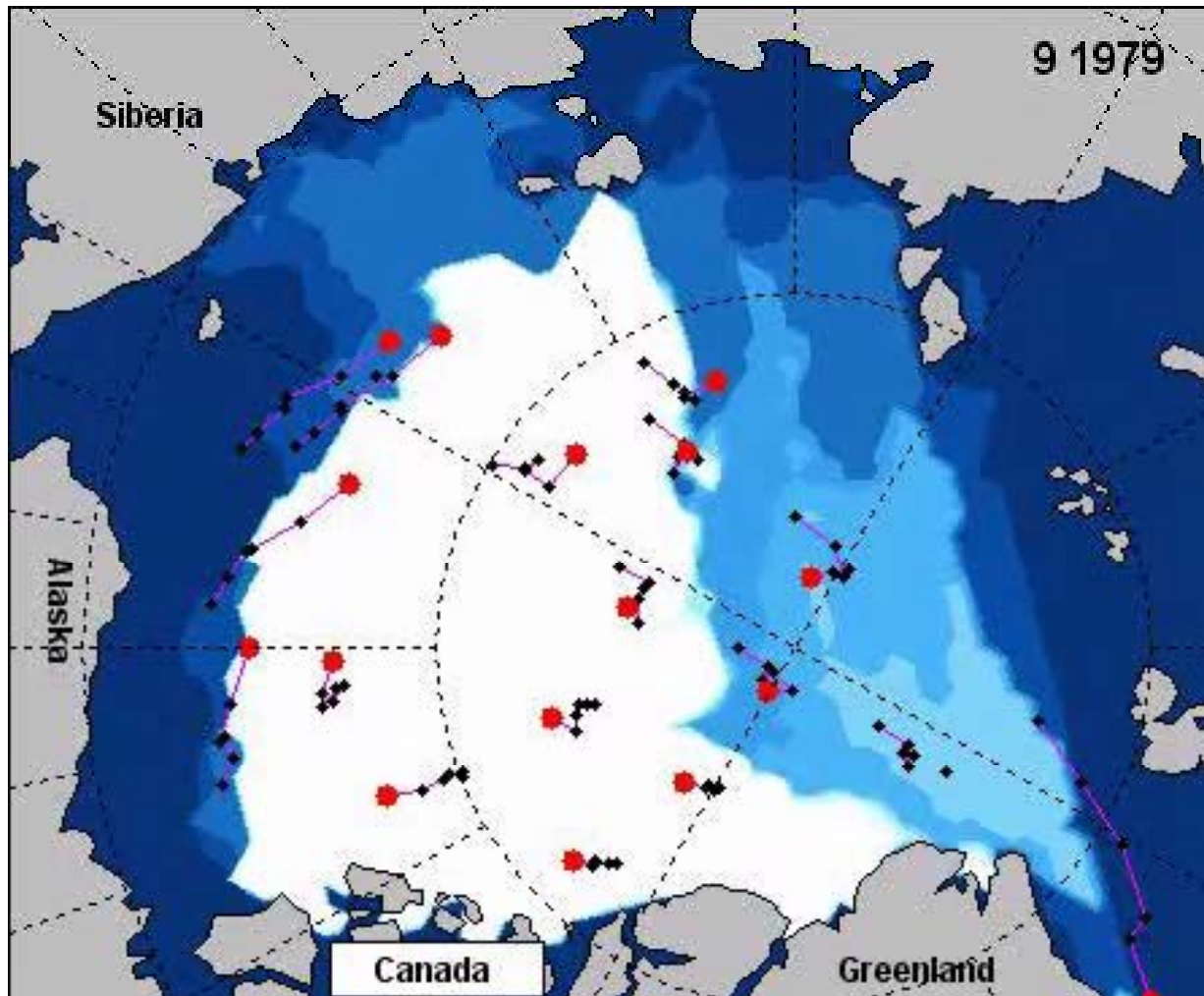
IABP

US Interagency Buoy Program (USIABP) International Arctic Buoy Program (IABP)

- NIC Science co-manages the US Interagency Buoy Program with UW/PSC and coordinates US Arctic buoy activities within the IABP
- The IABP is lead by Canada and U.S and is a key component of the Arctic Observing Network (AON)
- Arctic buoy data are critical to NWS and many other users providing weather forecasts, NWP, and climate modeling
- Arctic buoy data are used by NIC for operational ice chart analysis and supports the validation of satellite observations and sea ice models
- 120+ buoys are being deployed by over 18 field campaigns in 2008
- White Trident Mission deploys buoys for USIABP/IABP over the Arctic from Air National Guard C-130 but exploring other alternative use of USCG District 17th C-130s.
- IABP participants include 20 institutions in 9 countries, and 2 international organizations, the WCRP and EUMETNET



Buoy Ice Drift Model



- *Sea ice grows thicker with age.*
- *Prior to 1989, ice over 80% of the Arctic Ocean is at least 10 years old.*
- *High Arctic Oscillation (AO) conditions from 1989-1991 blew most of the older, thicker sea ice out of the Arctic Ocean.*
- *Younger (thinner) ice persist through today despite “normal” AO conditions.*



(Rigor et al. 2008)



Remarks By Secretary Kempthorne

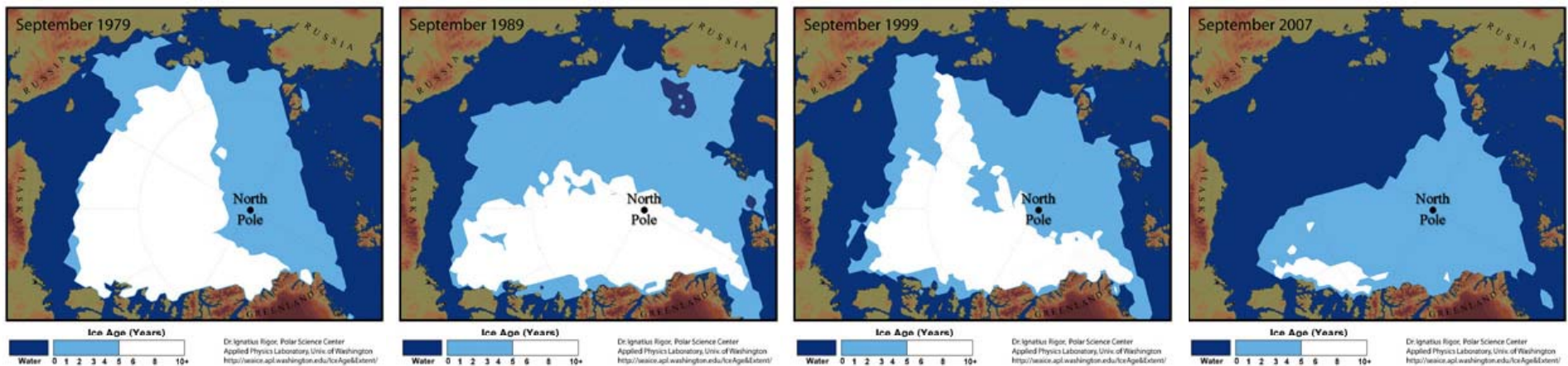
Press Conference On Polar Bear Listing, May 14, 2008

“Today I am listing the polar bear as a “threatened” species under the Endangered Species Act.

Today’s decision is based on three findings. First, sea ice is vital to polar bear survival. Second, the polar bear’s sea-ice habitat has dramatically melted in recent decades. Third, computer models suggest sea ice is likely to further recede in the future.

Because polar bears are vulnerable to this loss of habitat, they are, in my judgment, likely to become endangered in the foreseeable future - in this case 45 years.

Four graphics tell the story.”

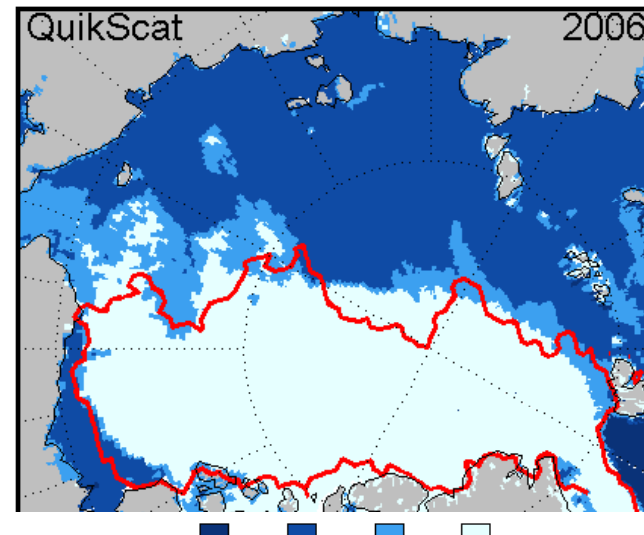
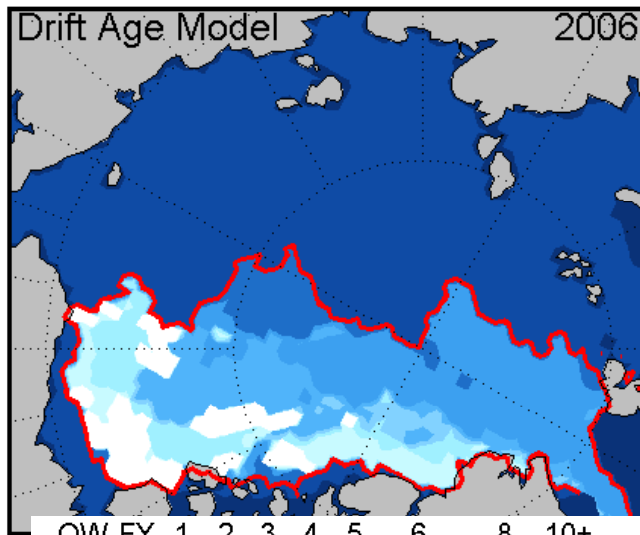
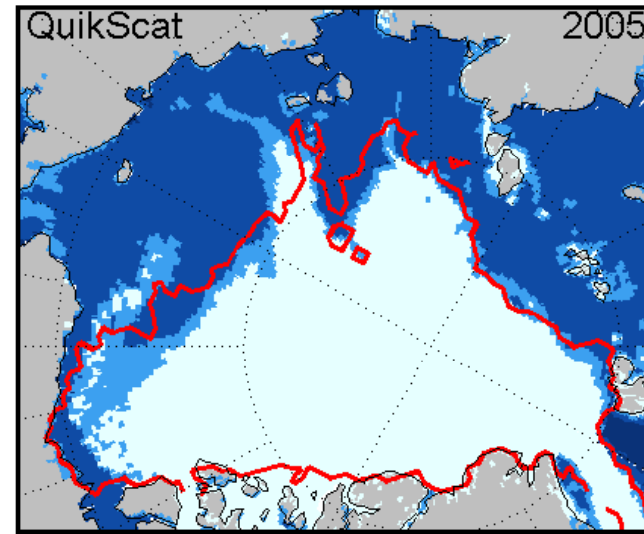
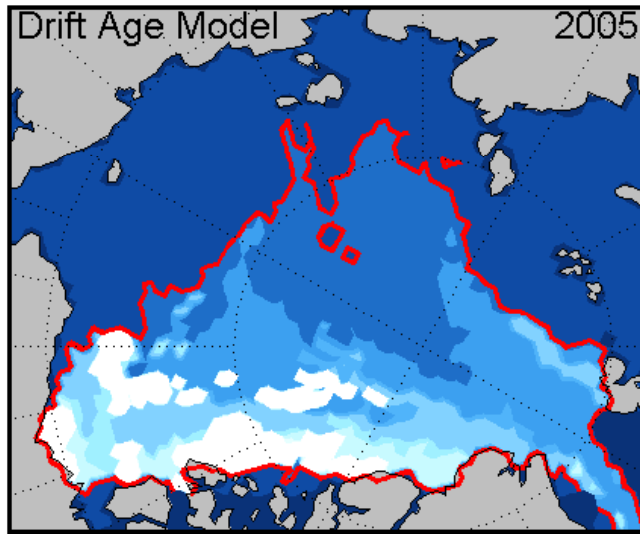


These maps were produced using buoy observations from the USIABP/IABP

http://www.doi.gov/secretary/speeches/081405_speech.html



Sea Ice Age from Buoys vs. QuikSCAT



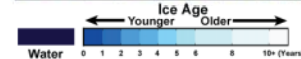
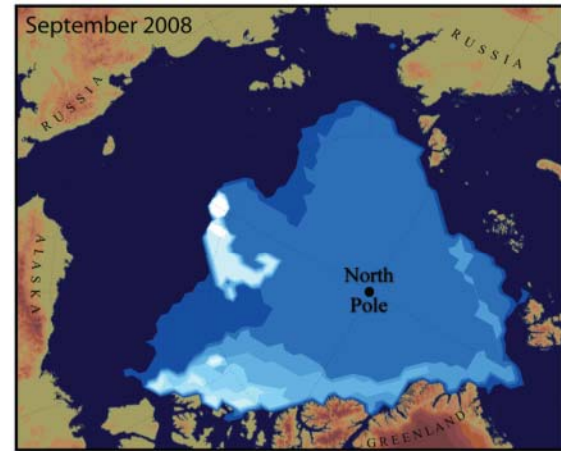
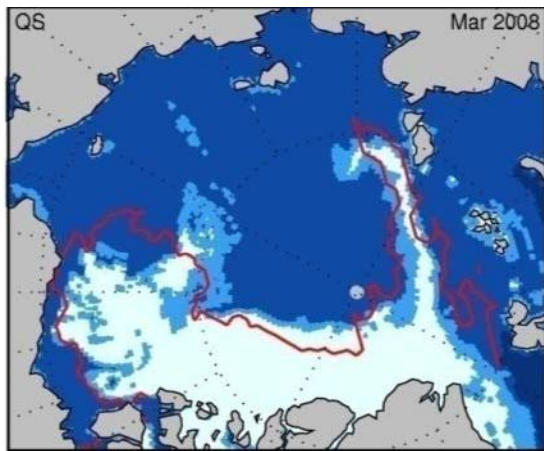
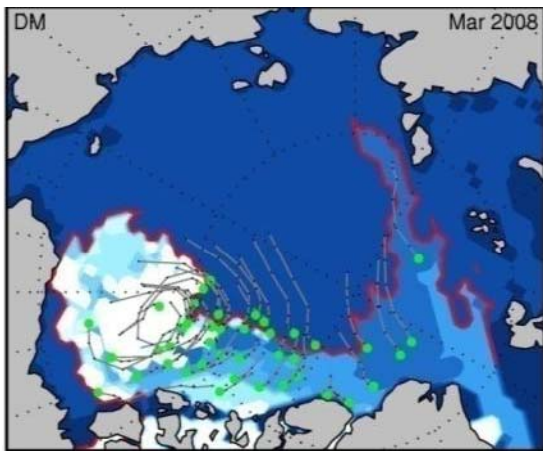
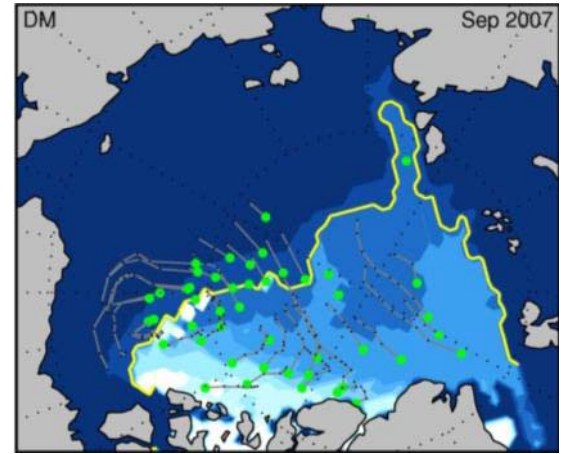
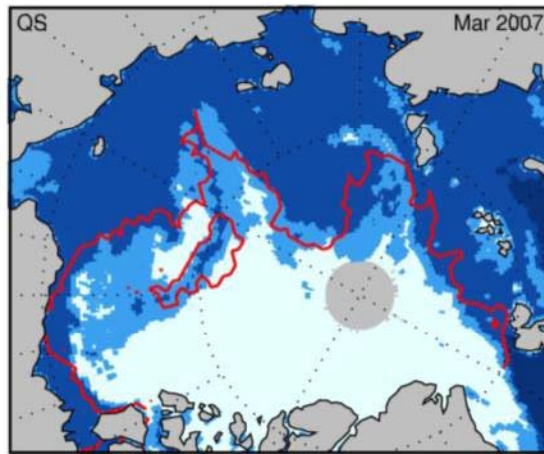
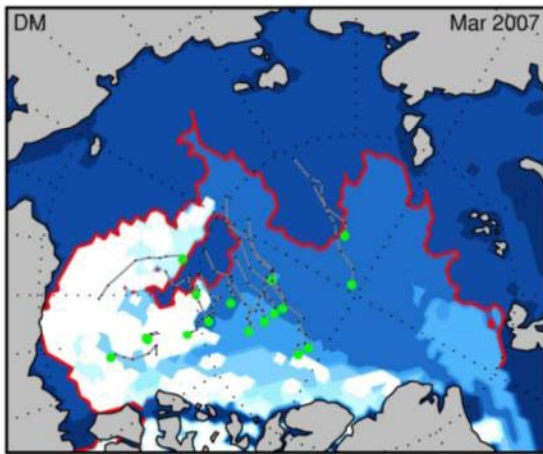
OW FY 1 2 3 4 5 6 8 10+

OW FY mix MY

(Nghiem et al. 2007)



Dramatic Loss of MYI and Near Record Minimum in 2008

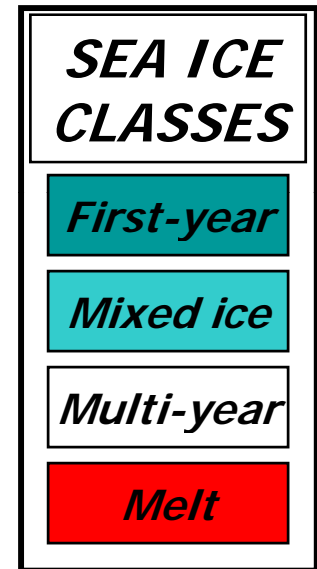
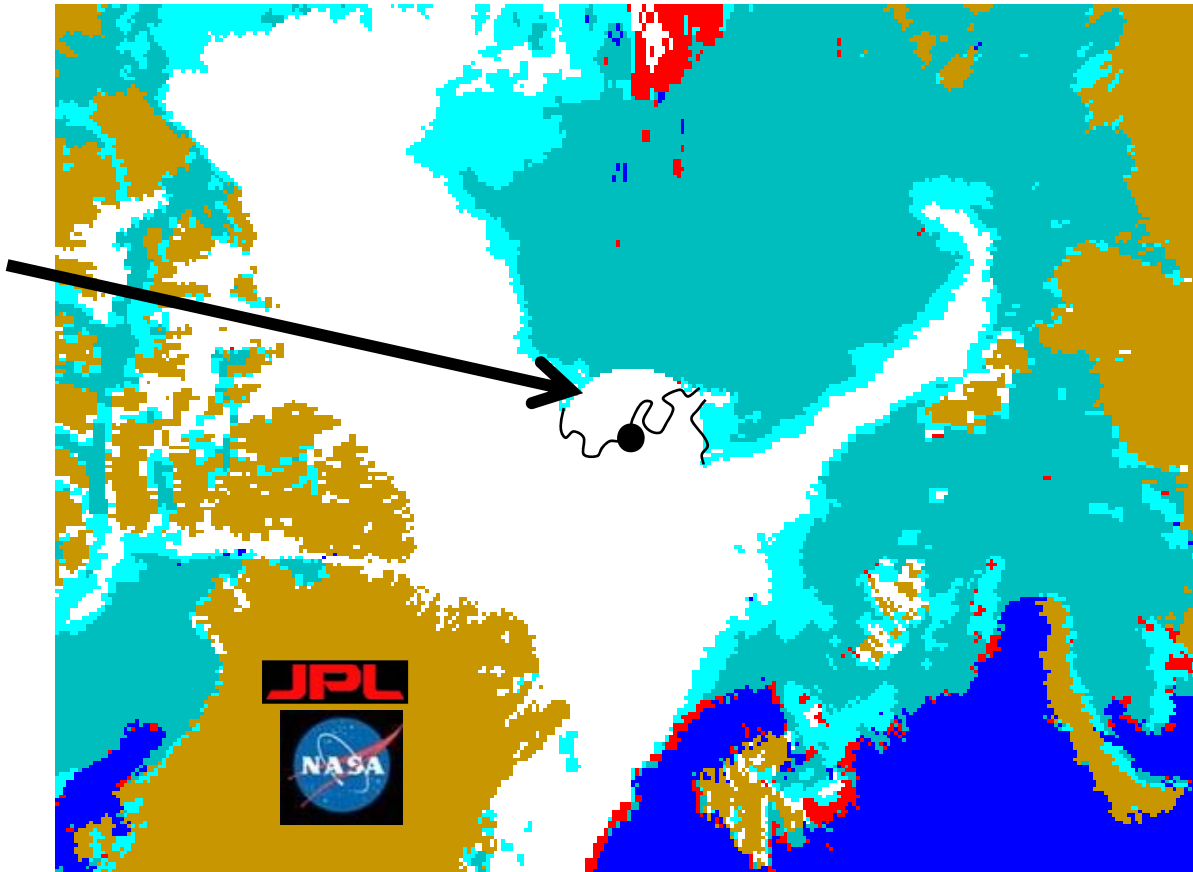


Dr. Ignatius Rigor, Polar Science Center
Applied Physics Laboratory, Univ. of Washington
<http://seaice.apl.washington.edu/iceAge&Extent/>



New Arctic Ice Charting Concern

*Typical
Satellite
Imagery
Blind
Spot*

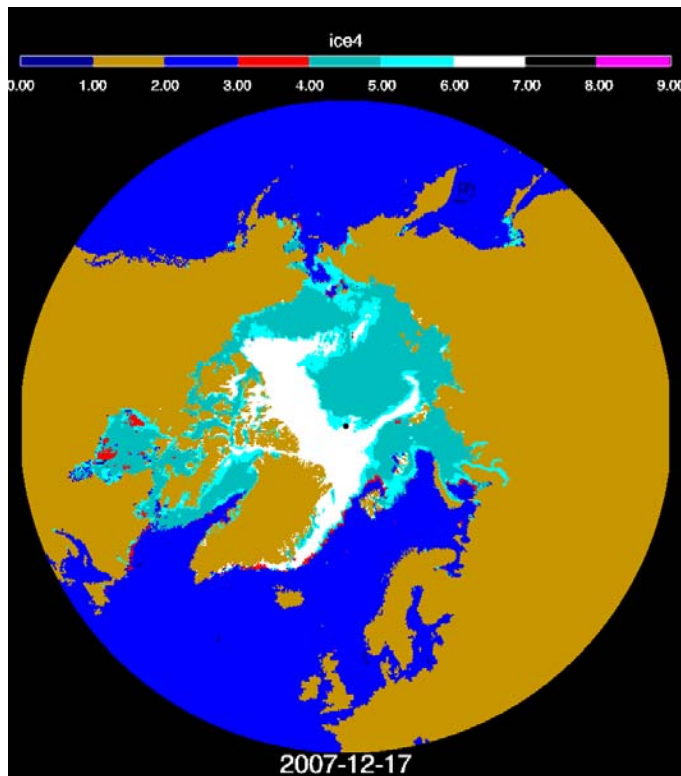


Perennial ice boundary at North Pole by 12/2/2007



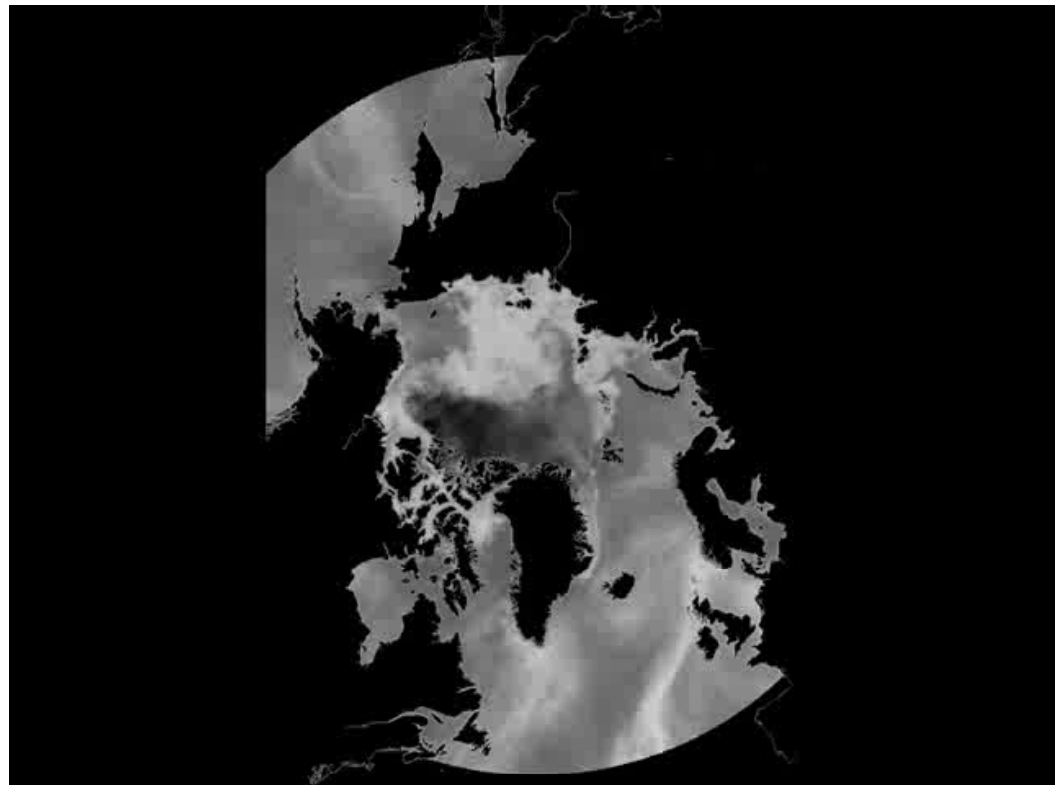
Alternative Data Sources for Multi Year Ice Analysis in the High Arctic

***Updated JPL Quikscat
Combined H & V pol product
17JAN08***



Reduced Blind Spot effect

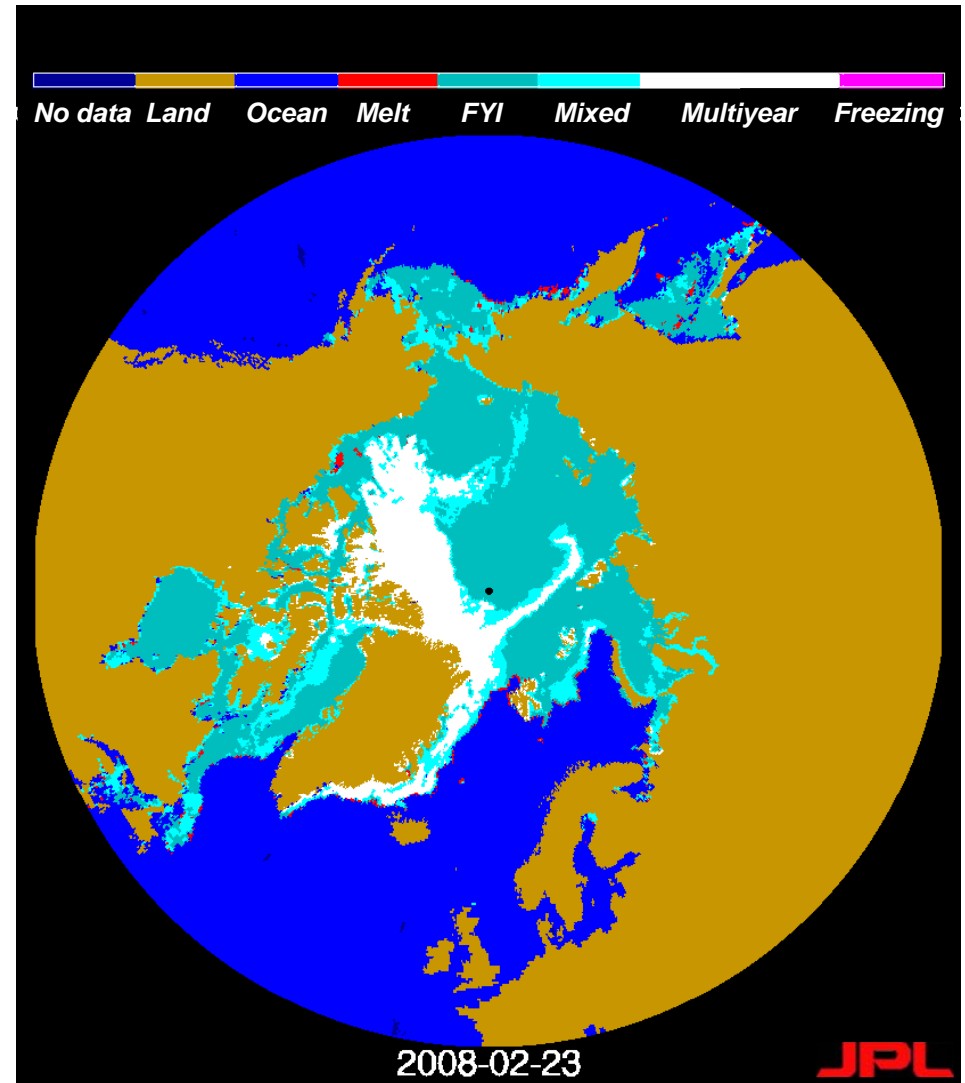
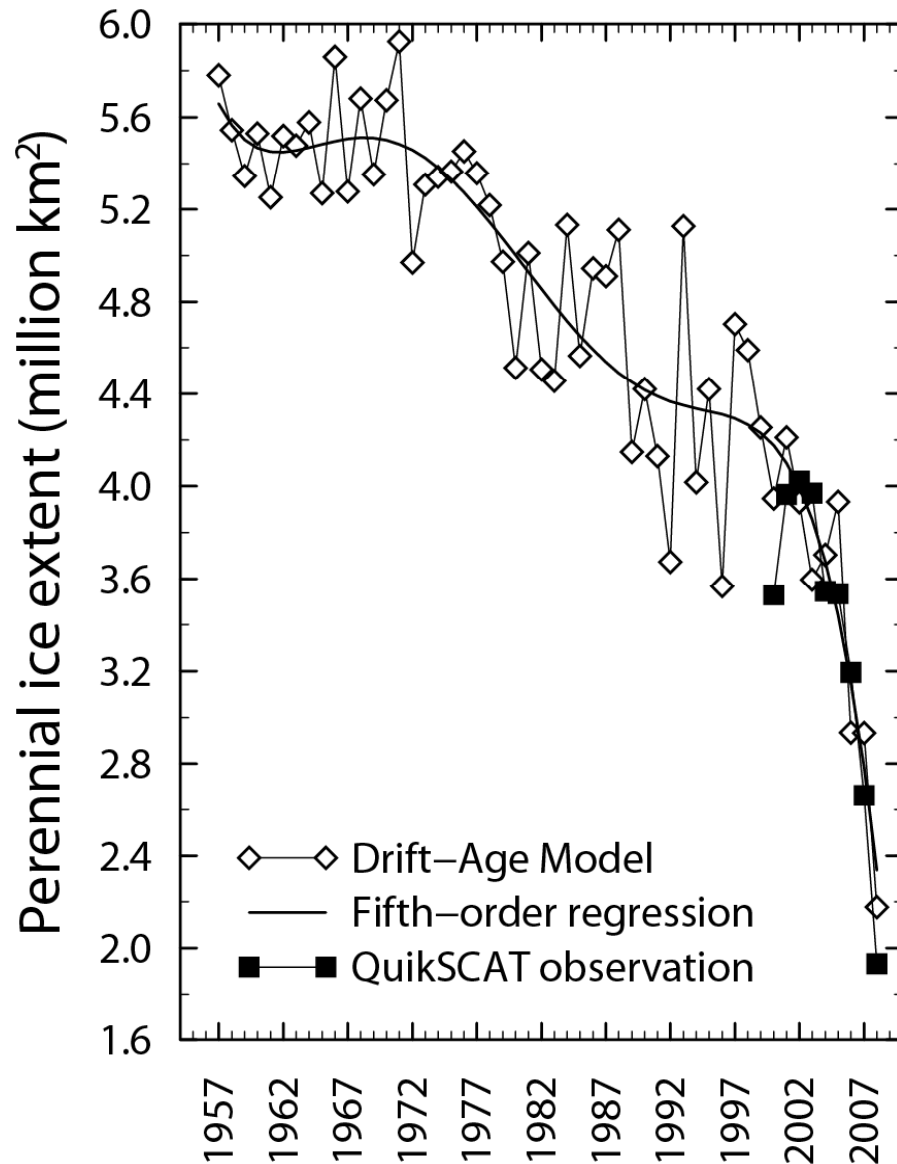
***AMSU 89 GHZ T_B
02NOV07-12JAN08***



Data added to the winter analysis



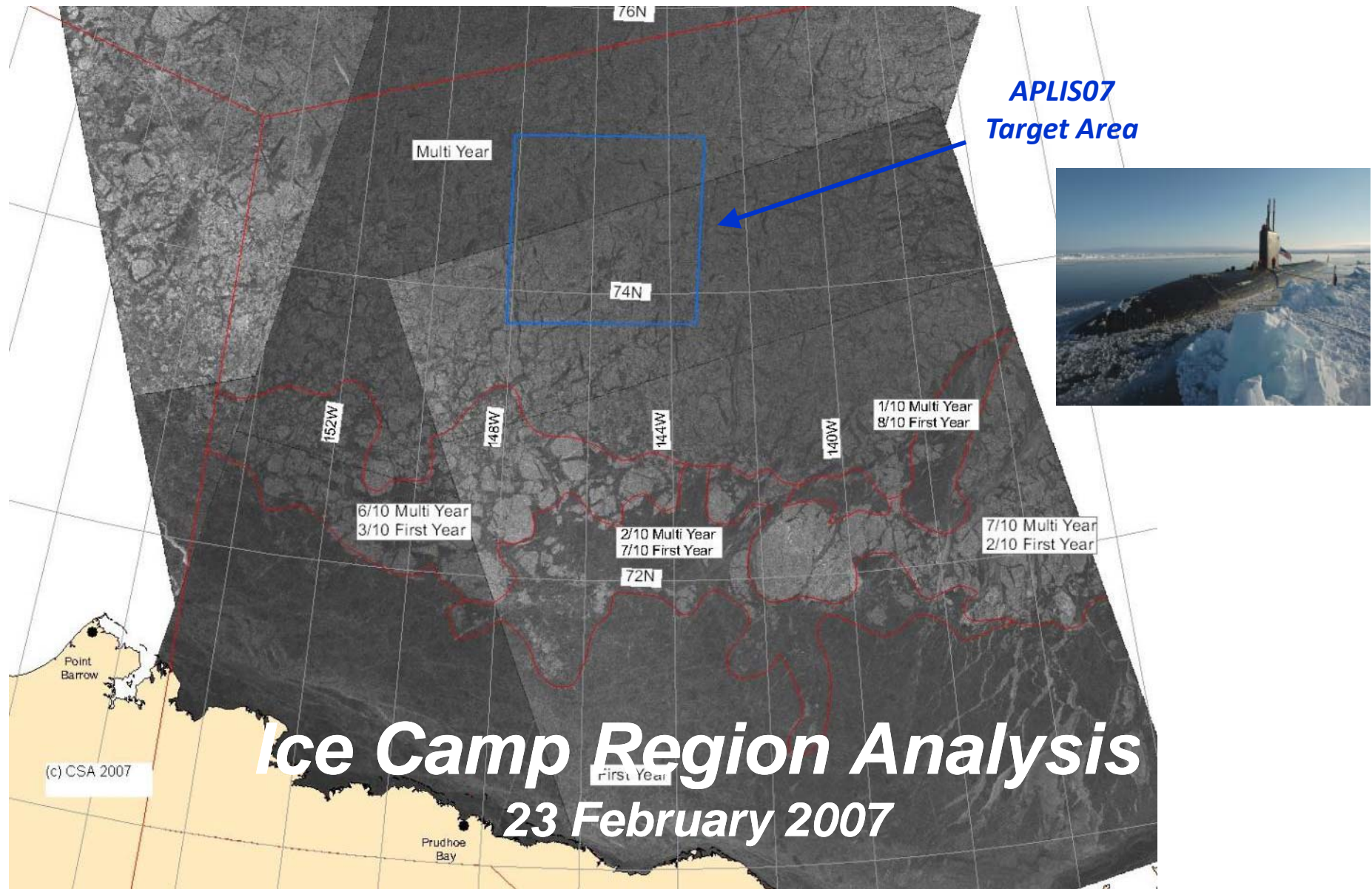
Perennial Sea Ice Change 1957-2008



Rigor, Nghiem, Clemente-Colón, Perovich, Richter-Menge, Neumann, and Ortmeyer GRL, 2008.



2007 APLIS U.S. NAVY Ice Camp (ICEX)





2007 APLIS U.S. NAVY ULS Data

- *One or two U.S. Navy ULS track lines match with IceSat data tracks.*
- *There is no 2007 processed data available, yet.*
- *Unfortunately, the particular recorder used makes it more difficult to extract draft measurements than from previous datasets.*
- *PSC (Mark Wensnahan) believes that we can extract the data but it would take significant amount of coding.*
- *An AON proposal that includes 2007 ULS processing have been submitted to NSF by PSC.*





NIC Situational Awareness Products

HMS TIRELESS – March 2007



**HMS
TIRELESS
surfaced at
ICEX '07**

“Within the hour I was able to find and safely conduct a controlled surface through a gap in the ice therefore avoiding any damage to the submarine” – Commanding Officer, HMS TIRELESS

Last Updated: Wednesday, 21 March 2007, 22:36 GMT

[E-mail this to a friend](#)

[Printable version](#)

Two sailors killed on submarine

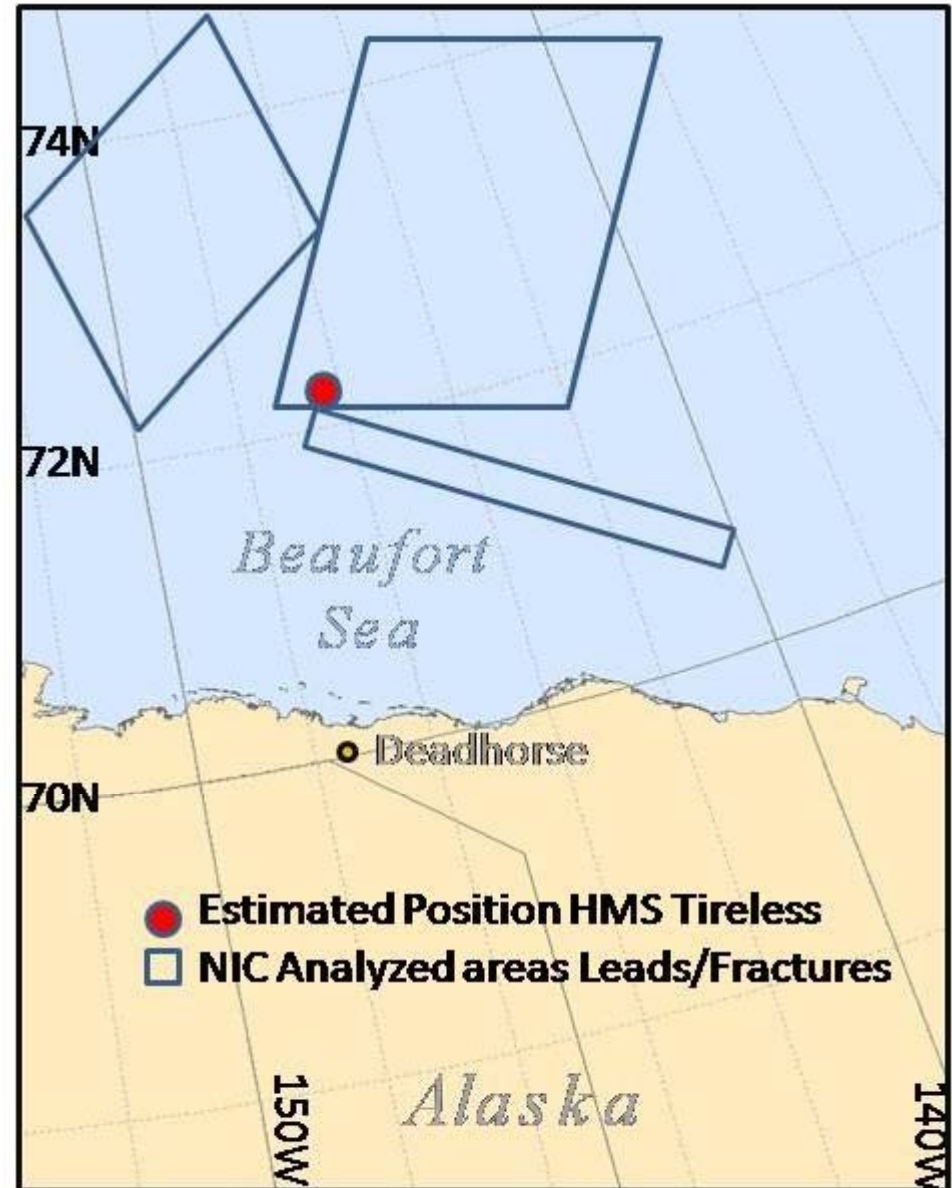
Two British sailors have died in an accident on a nuclear submarine.

The Ministry of Defence (MoD) confirmed there had been an explosion on HMS Tireless during an exercise under the Arctic icecap at 0420 GMT on Wednesday.



ROYAL NAVY
One injured sailor was airlifted to hospital in Alaska

“More significantly I achieved a six-day under ice transit without incident...”



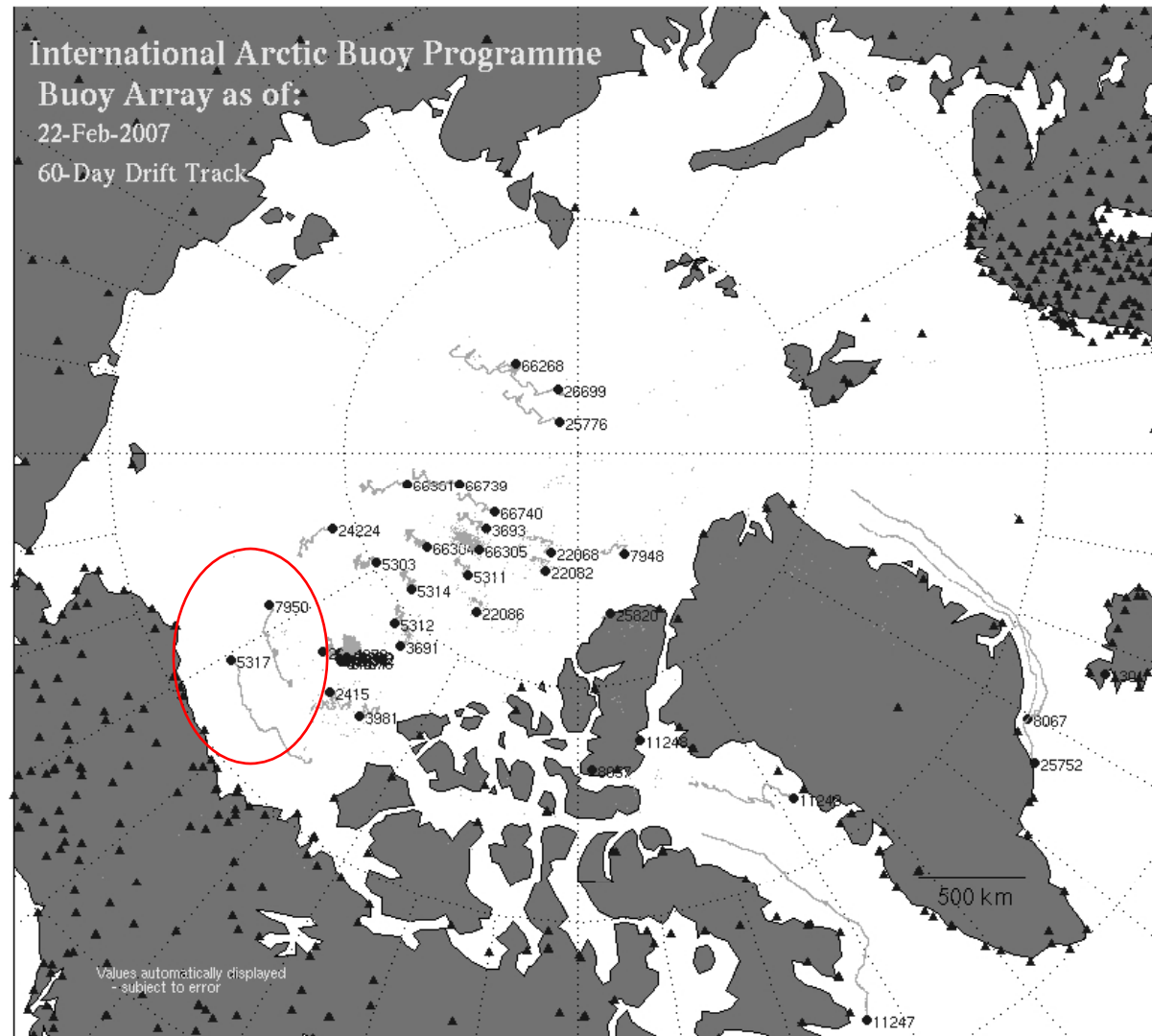


SEDNA

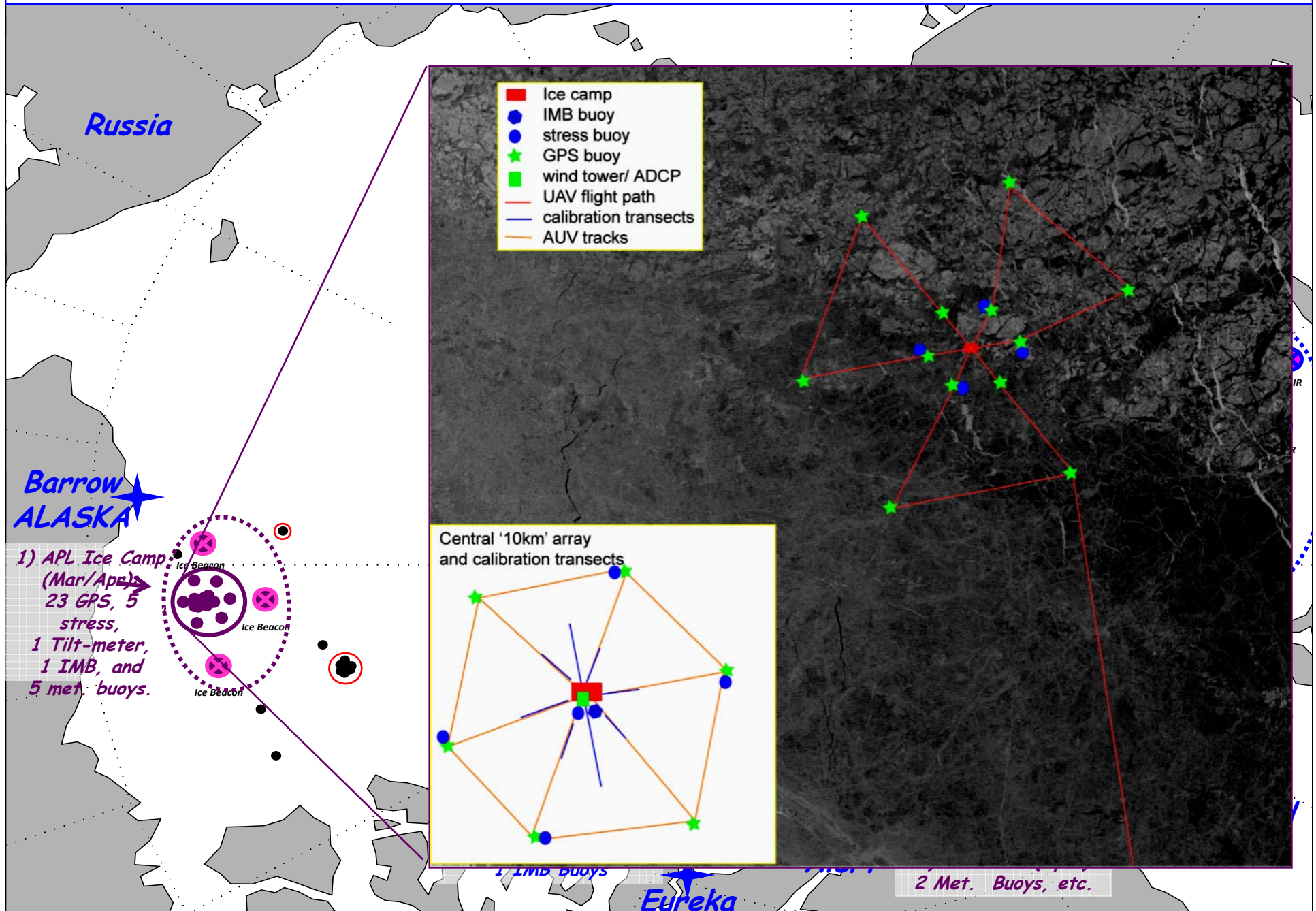




Pre-Ice Camp 2007 IABP Network



Applied Physics Lab (APL) Ice Camp – April 2007







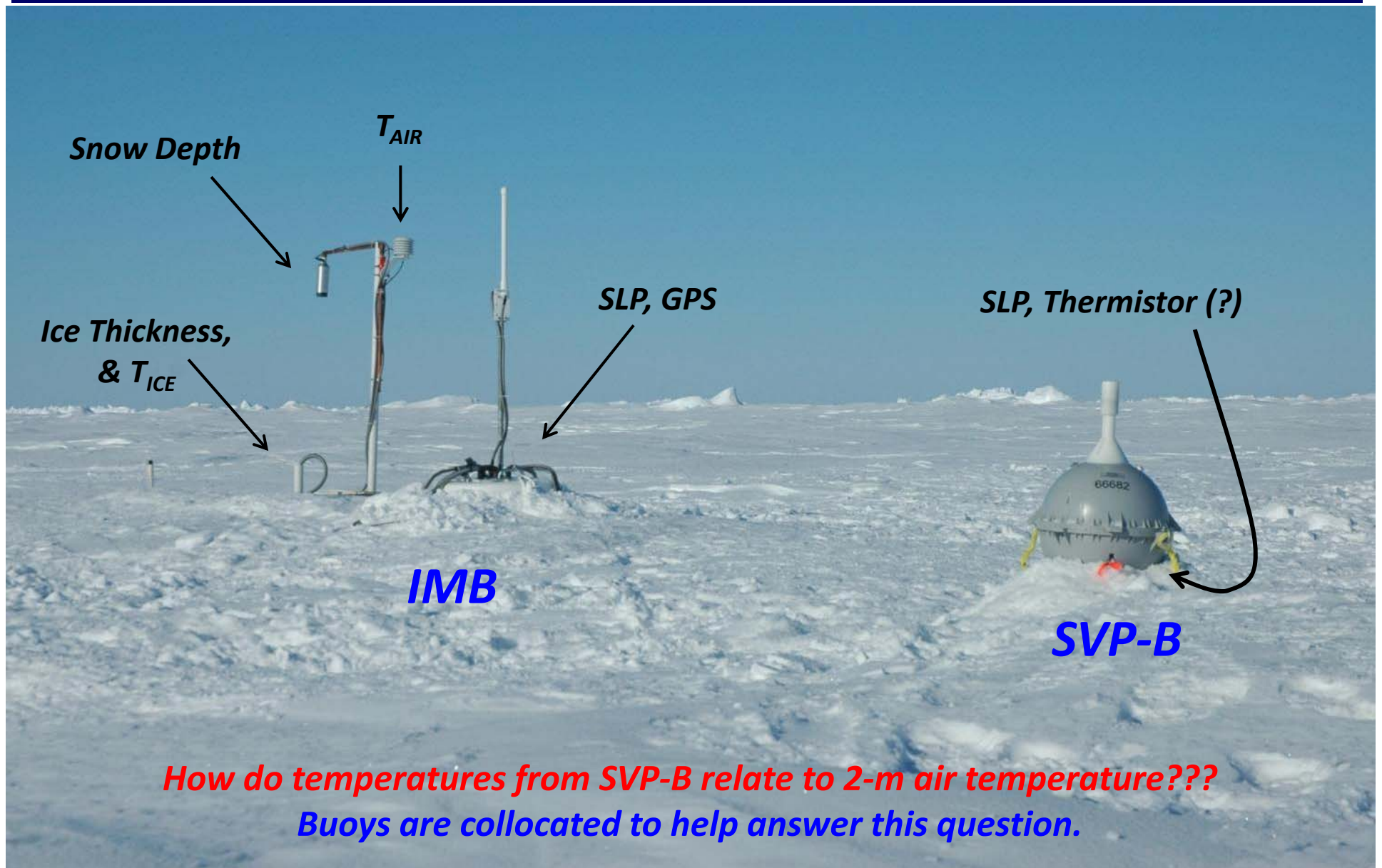


Testing SVP-B Ocean Drifting Buoys at APLIS



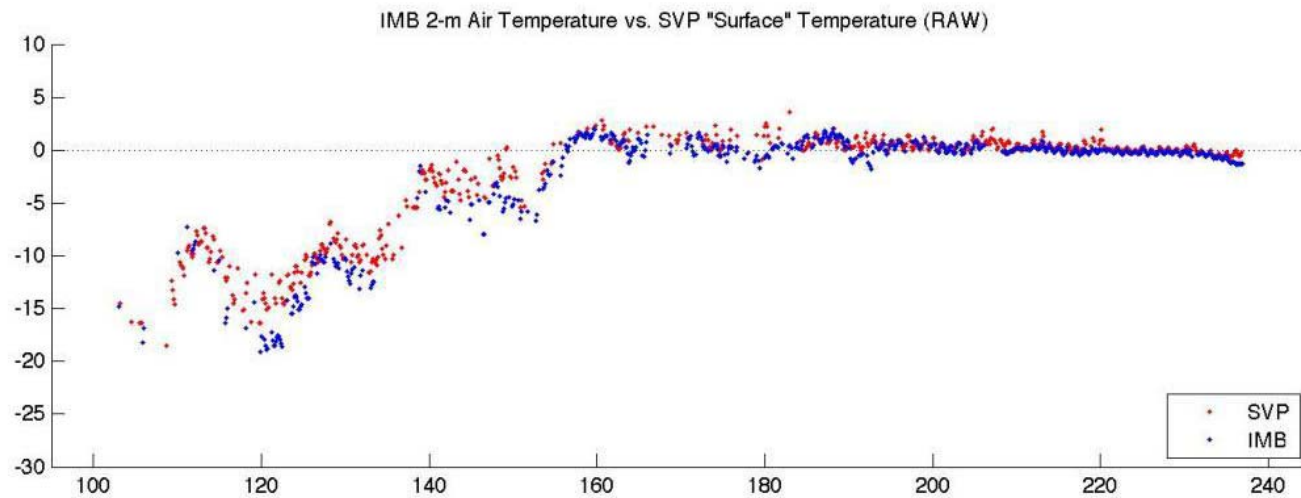
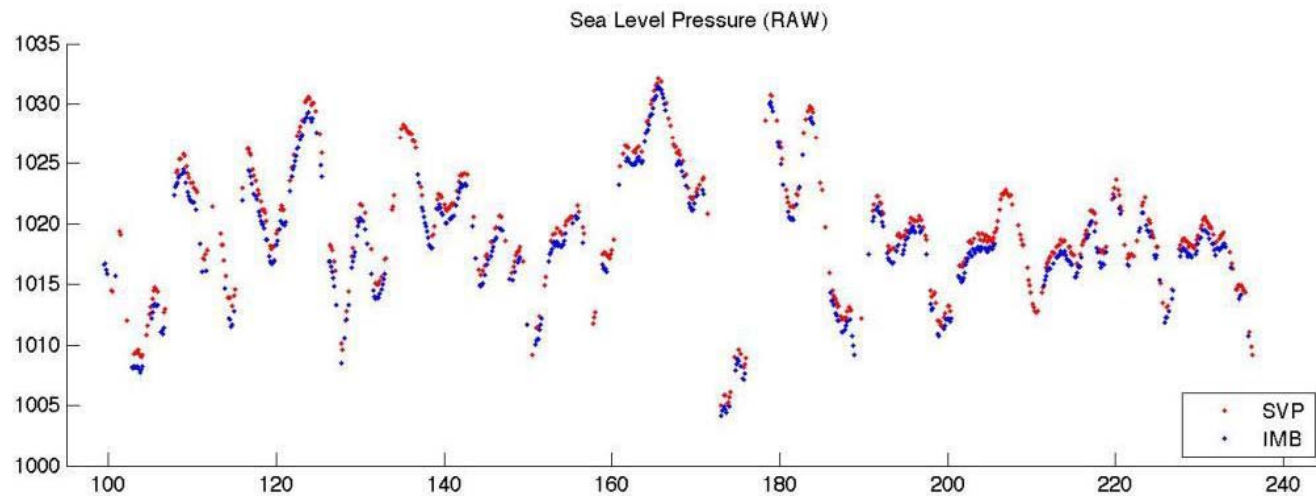


Ice Mass Balance (IMB) & SVP Buoys



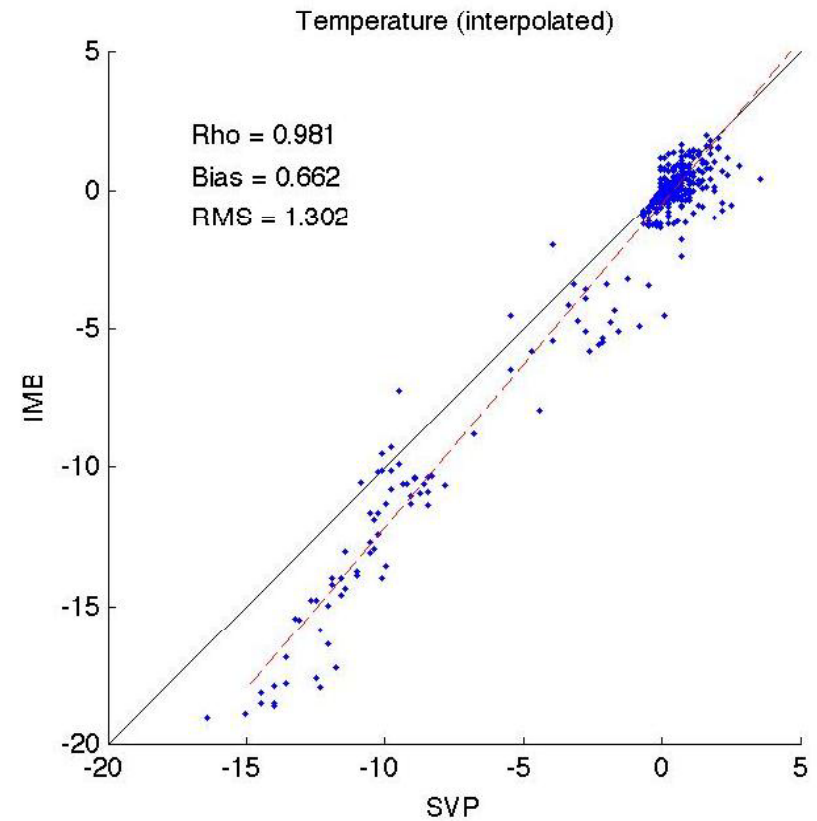
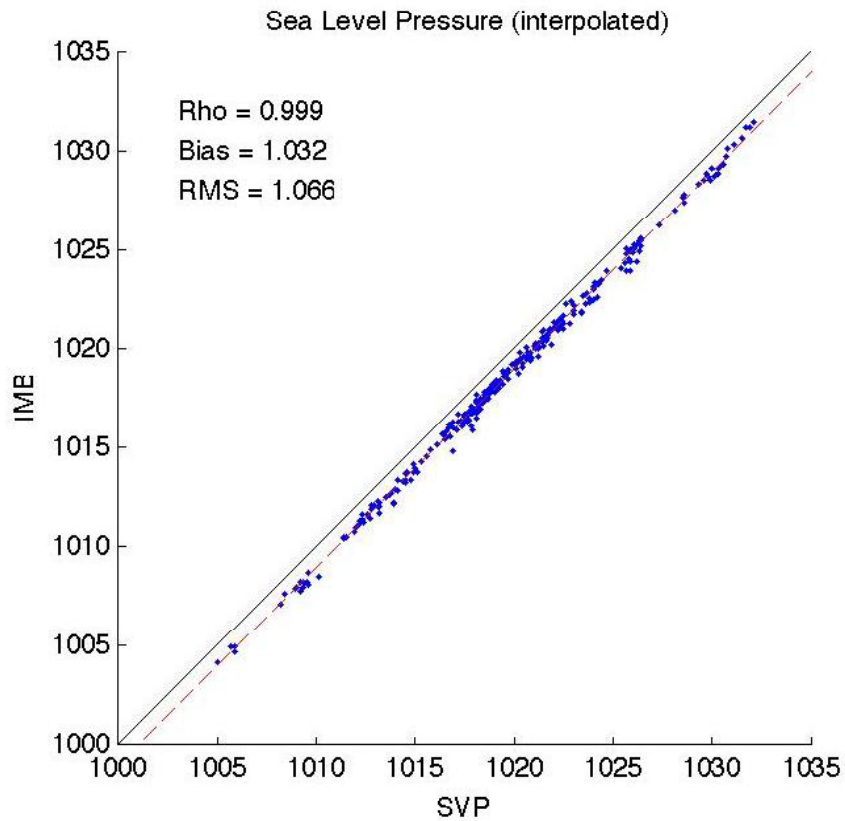


SVP-B VS IMB Experiment





SVP-B VS IMB Experiment





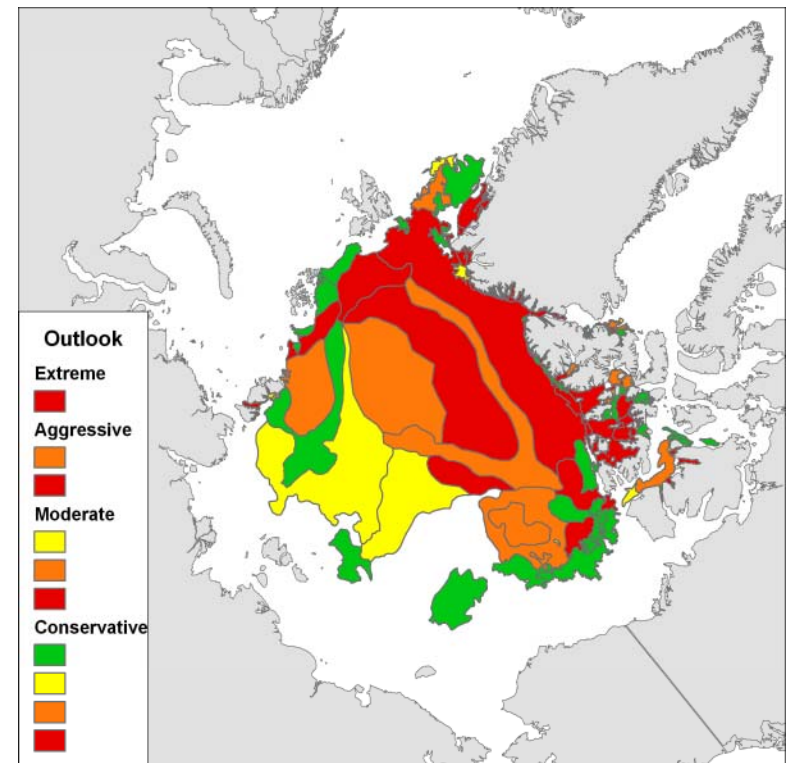
2008: *SEARCH* Arctic Sea Ice Outlook

Goal: Provide a forum for comparing various techniques for determining Arctic sea ice extent minimum for 2008

- 20 participating groups
- Statistical, model, and “gut-feeling” methods
- Average of forecasts matched actual minimum value (~4.6 million km²)

NIC: Used ArcGIS to create a range of forecasts

- Rules based on forecaster insight
- Conservative, Moderate, Aggressive, Extreme
- Process iterated between Science and Operation groups
- Forecasts too low for 90-day outlook, but 60-day outlook captured value
- Process too human-dependent?



NIC Provisional Seasonal Outlook issued 5 August 2008

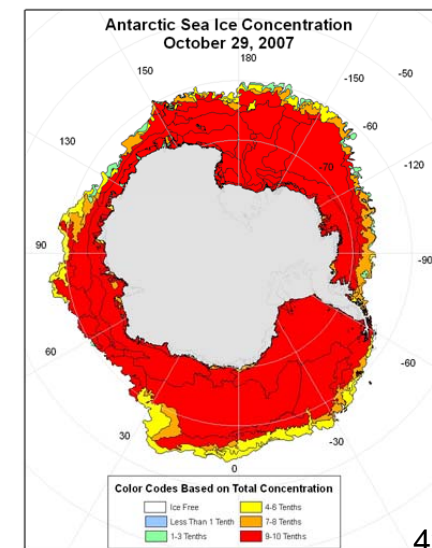
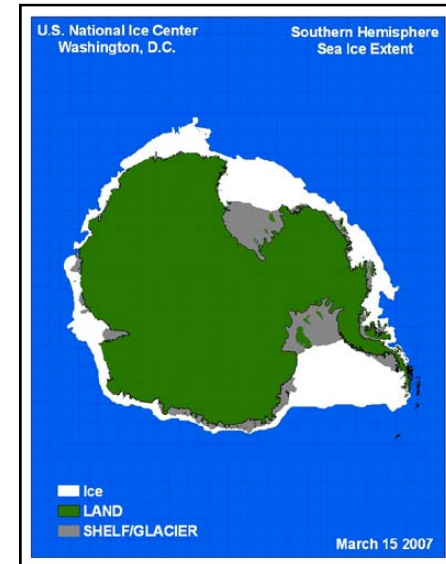
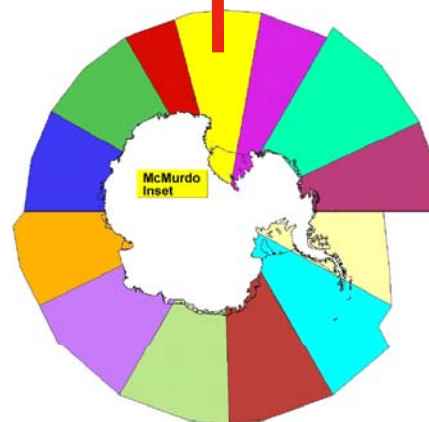
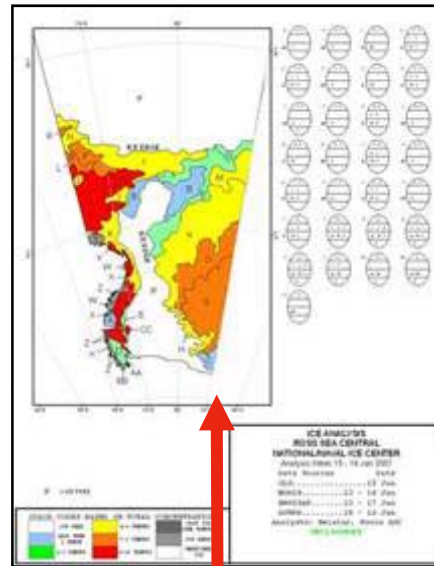
NIC Seasonal Forecasting Efforts Lead by Dr. Todd Arbetter, UCAR Visiting Scientist



Improving Antarctic Hemispheric Coverage

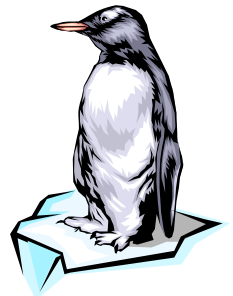
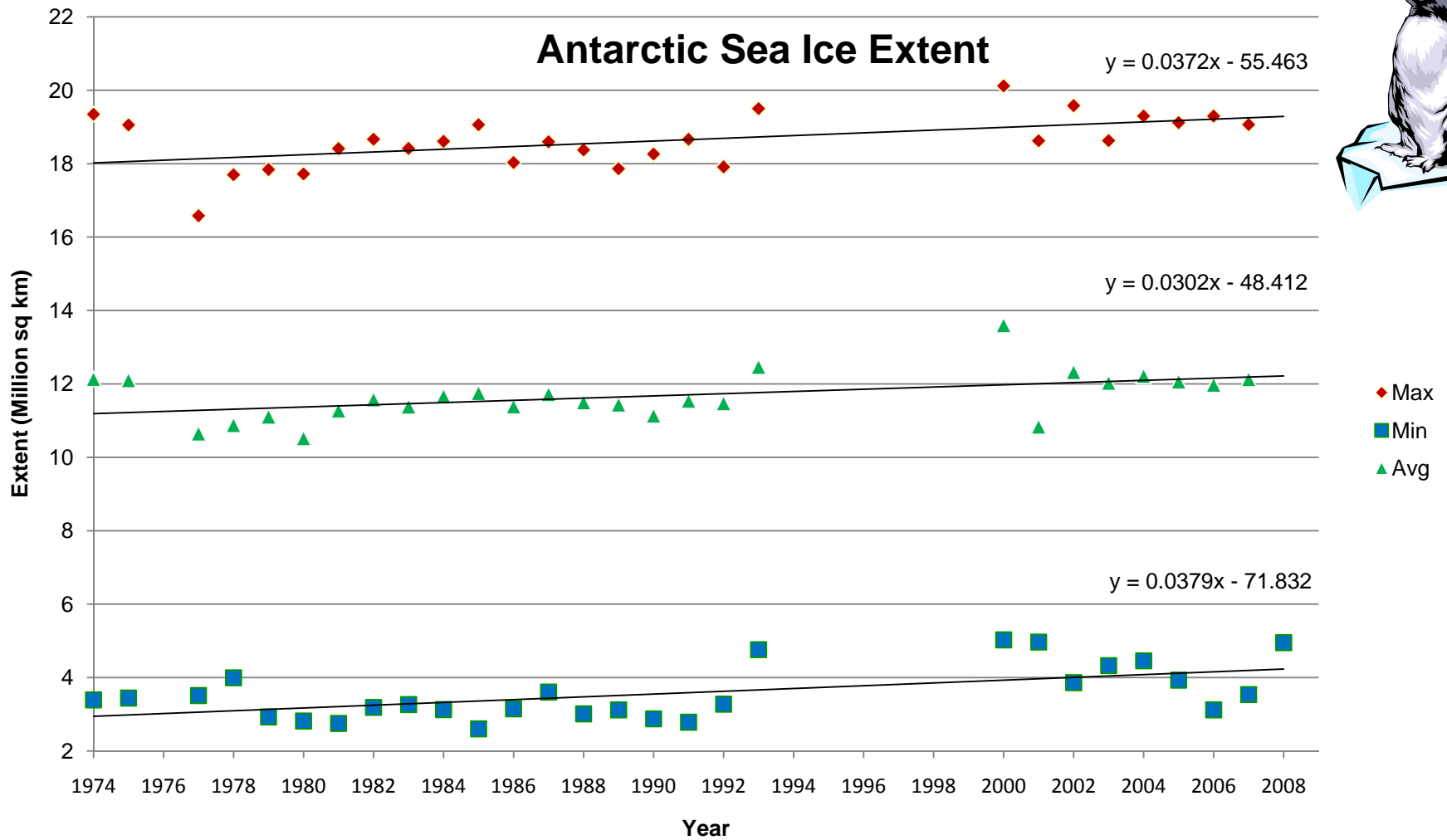
Sea Ice Extent and Concentration

- **Enhancement of the analyses through increased use of Envisat data.**
- **Extension of the sea ice partial concentration analysis to all Antarctic regions (presently only done for the Ross Sea)**
 - *This analysis can be used to produce an ice thickness proxy chart*
- **Development of an MIZ product**
- **Completion of the Antarctic sea ice chart climatology**
- **Manpower analysis to support a weekly ice charting of the Antarctic region that may include outside partners through an Antarctic Desk.**
- **Revisiting Requirements for Antarctic sea ice and iceberg products.**





NIC Antarctica Sea Ice Extent Trend



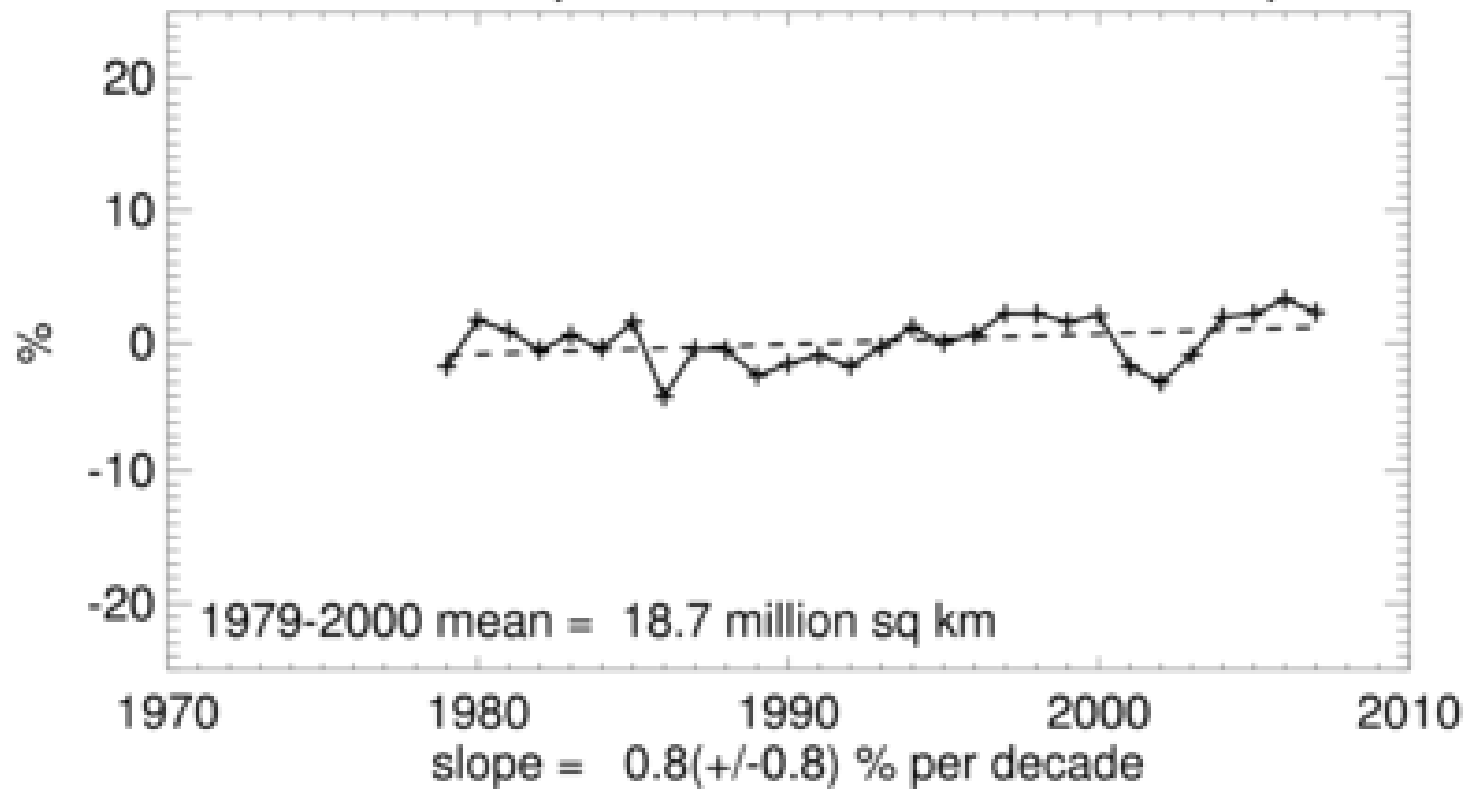
Slightly positive trend since 1974



NSIDC Sea Ice Index (SII)



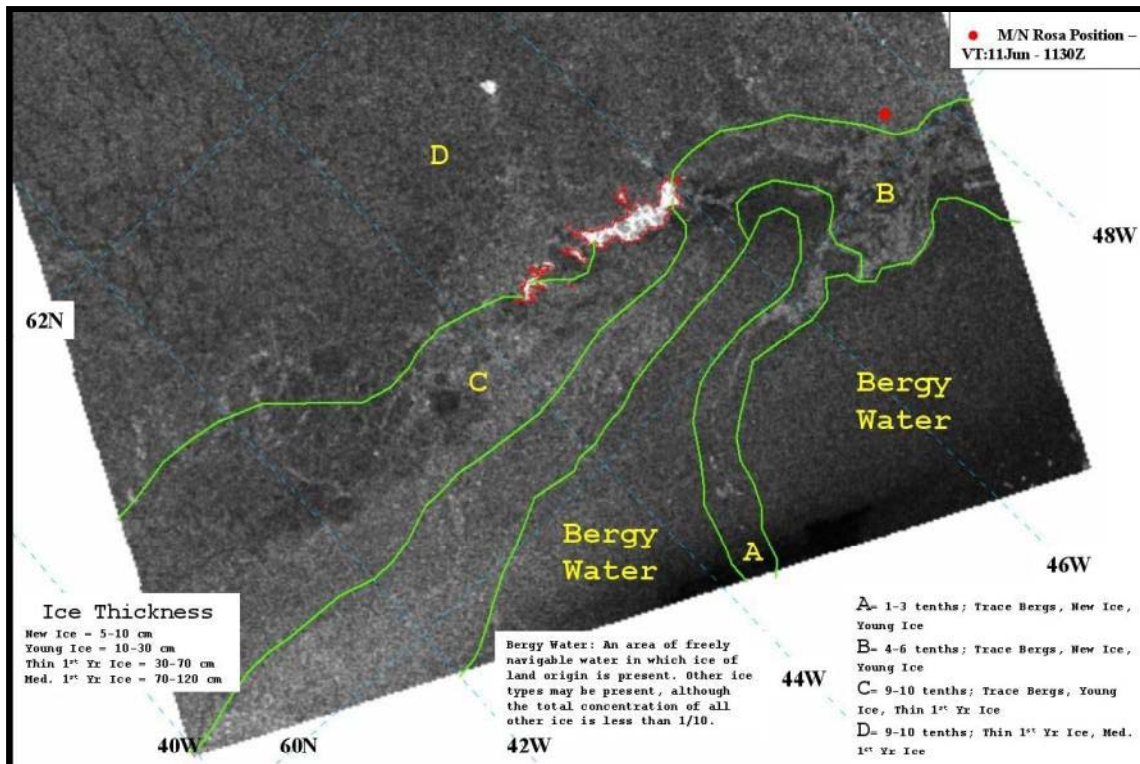
Southern Hemisphere Extent Anomalies Sep 2007





NIC Responds to International Emergencies

M/V ROSA



Operated by the Argentines



“We have received the requested satellital information and we are extremely grateful for the important collaboration that you offered us. For your knowledge the satellital information was very useful to us. It was a relevant element in our planning during the assistance to the M/V "Rosa" ship in proximities to the Islas Orcadas during the 11, 12 and 13 june.”

-- AGENCIA NACIONAL SAR MARITIMA, FLUVIAL Y LACUSTRE ARGENTINA



Climatological Patterns and Predictions

Observing a Major Shift in the Distribution and Extent of Sea Ice in the Arctic Ocean

***Dr. Pablo Clemente-Colón, Chief Scientist
U.S. National/Naval Ice Center
Pablo.Clemente-Colon@natic.noaa.gov – 301-394-3105***

***18 July 2008
Eugene Francis Auditorium (Physics Building, UPR-Mayagüez)***

This brief is UNCLASSIFIED





USCGC Healy 2007 UNLOS Cruise



USCGC HEALY conducts operations in the Arctic



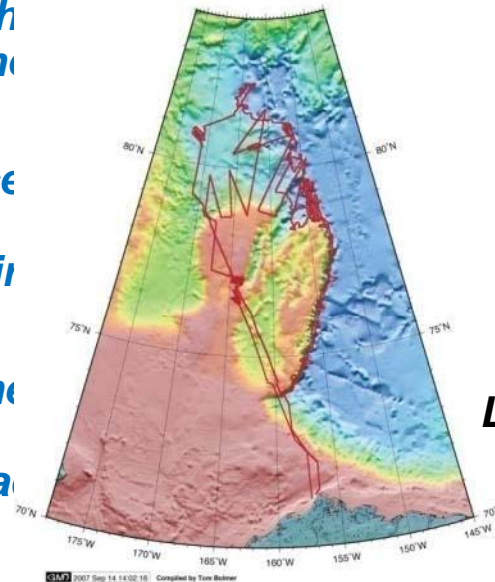
2007 Healy Cruise Sea Ice Observations

- *NIC provided daily analysis of available SAR (RADARSAT-1 and Envisat), visible, and passive microwave satellite data.*
- *Hourly sea ice characterization and weather observations were recorded through the cruise following the ASPeCt methodology*
- *Photographs of sea ice and atmospheric conditions were acquired at least hourly*
- *Healy's aloftconn camera images at 5-minute intervals were also made available*
- *IABP buoys deployed*

Helfrich



HLY0703 08/17/07 - 09/15/07



AG1 Park

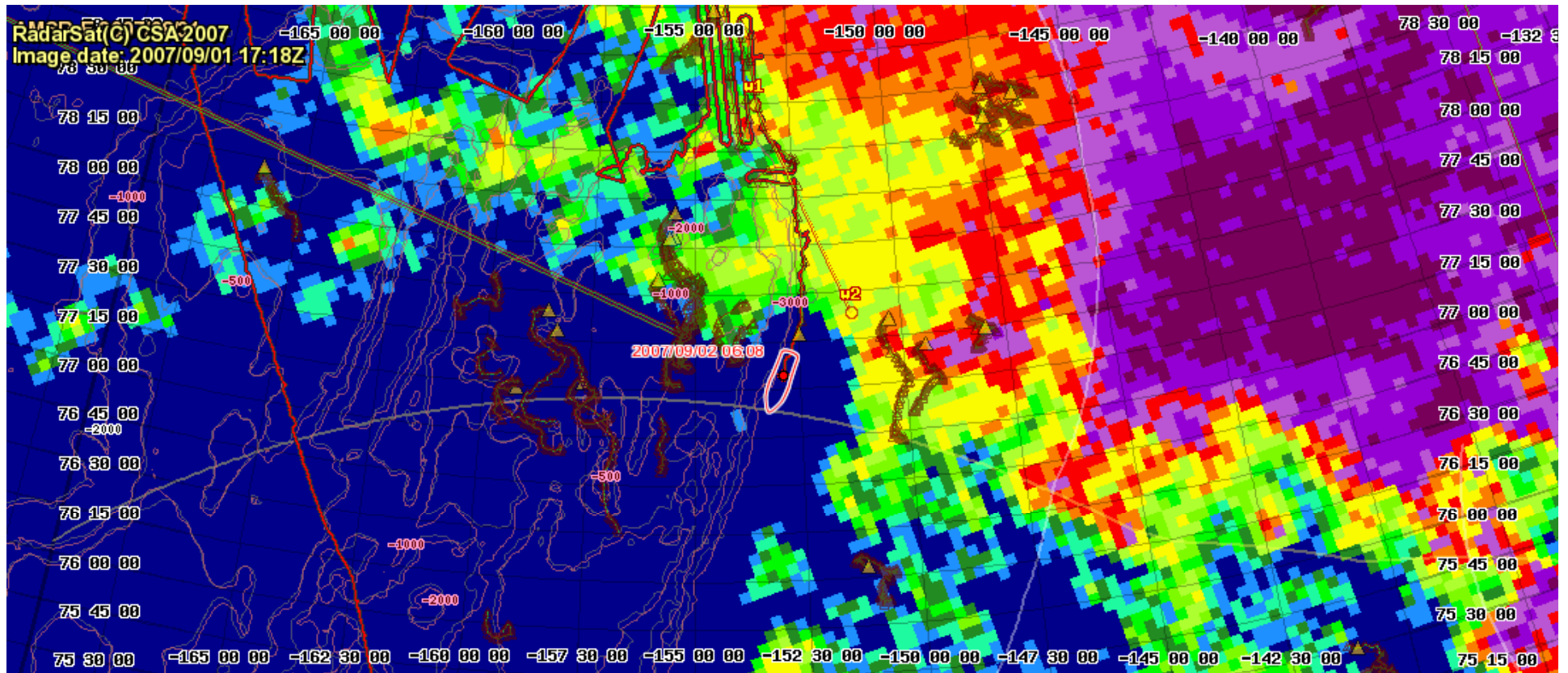
LT Wagonseller



Data is organized for cross-correlation with charts and other products

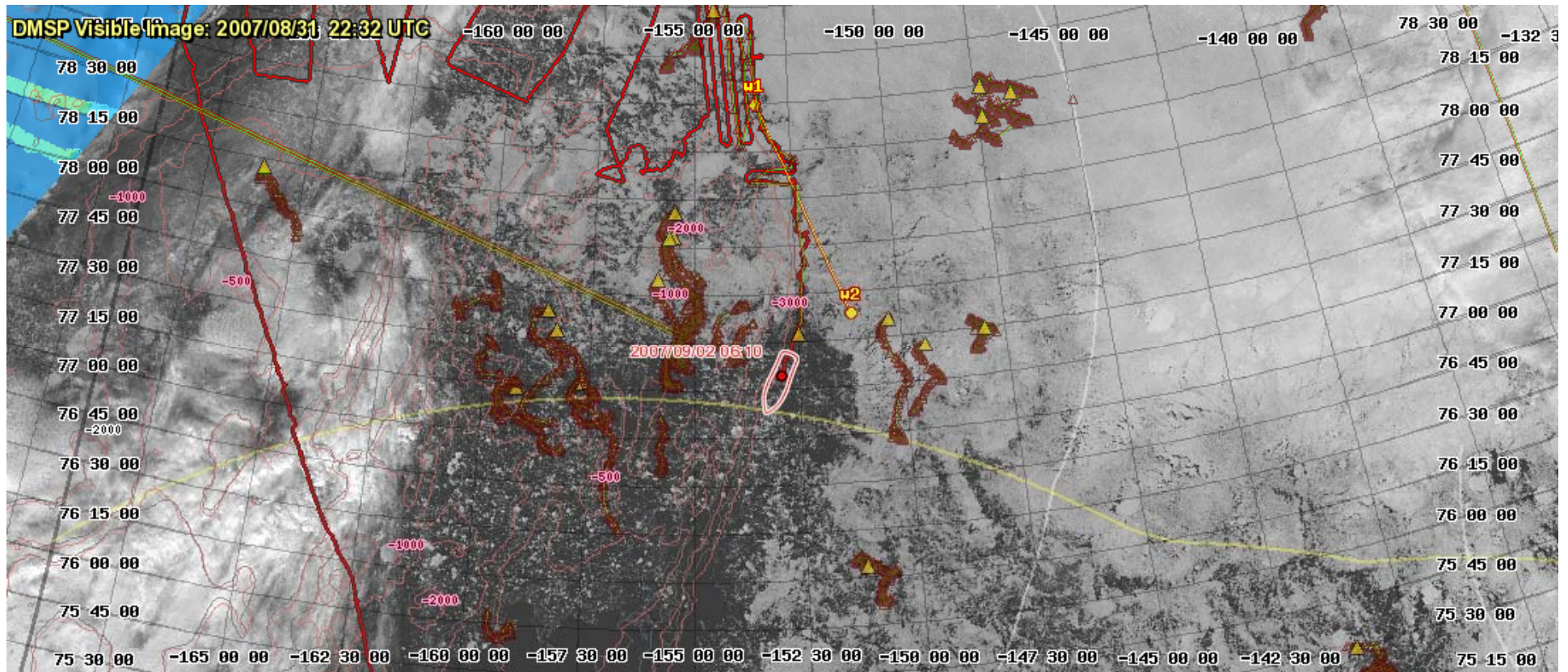


AMSR-E Passive Microwave Sea Ice Concentration



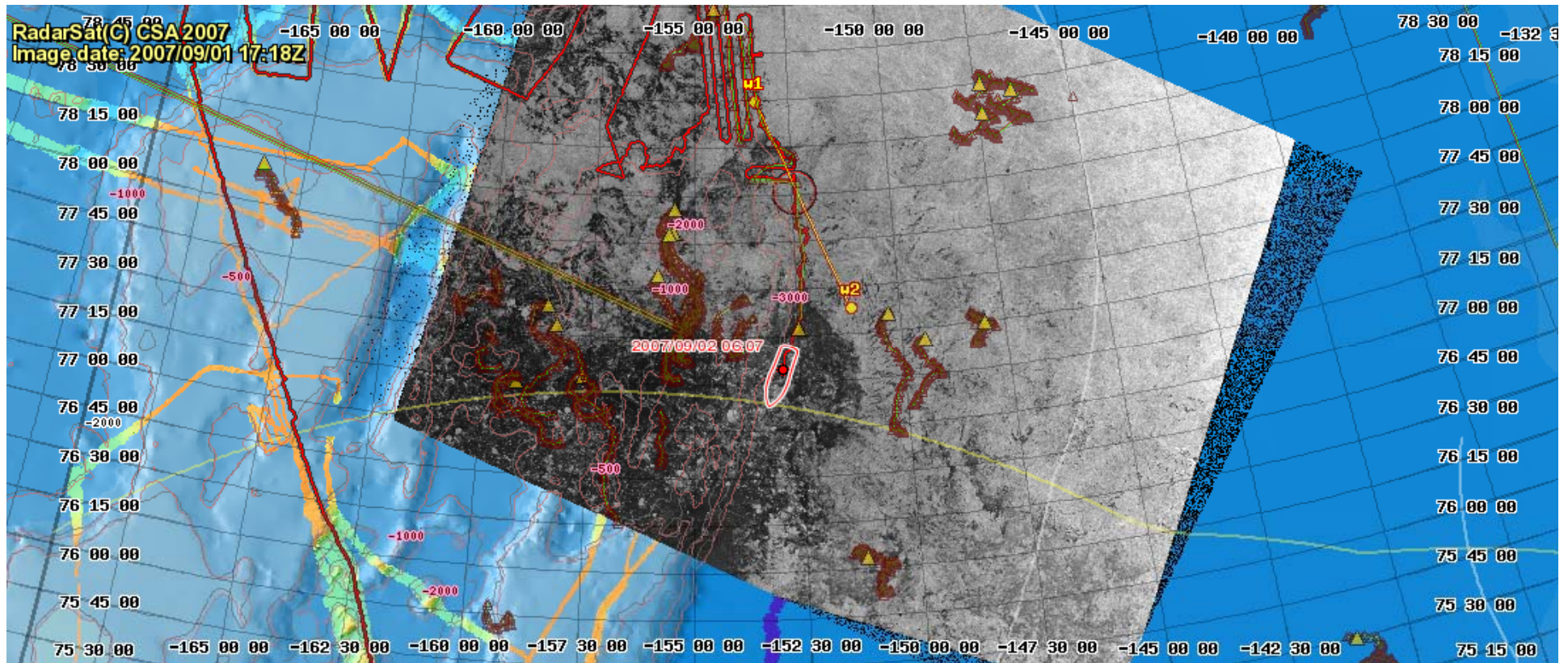


DMSP Visible Sea Ice Detection



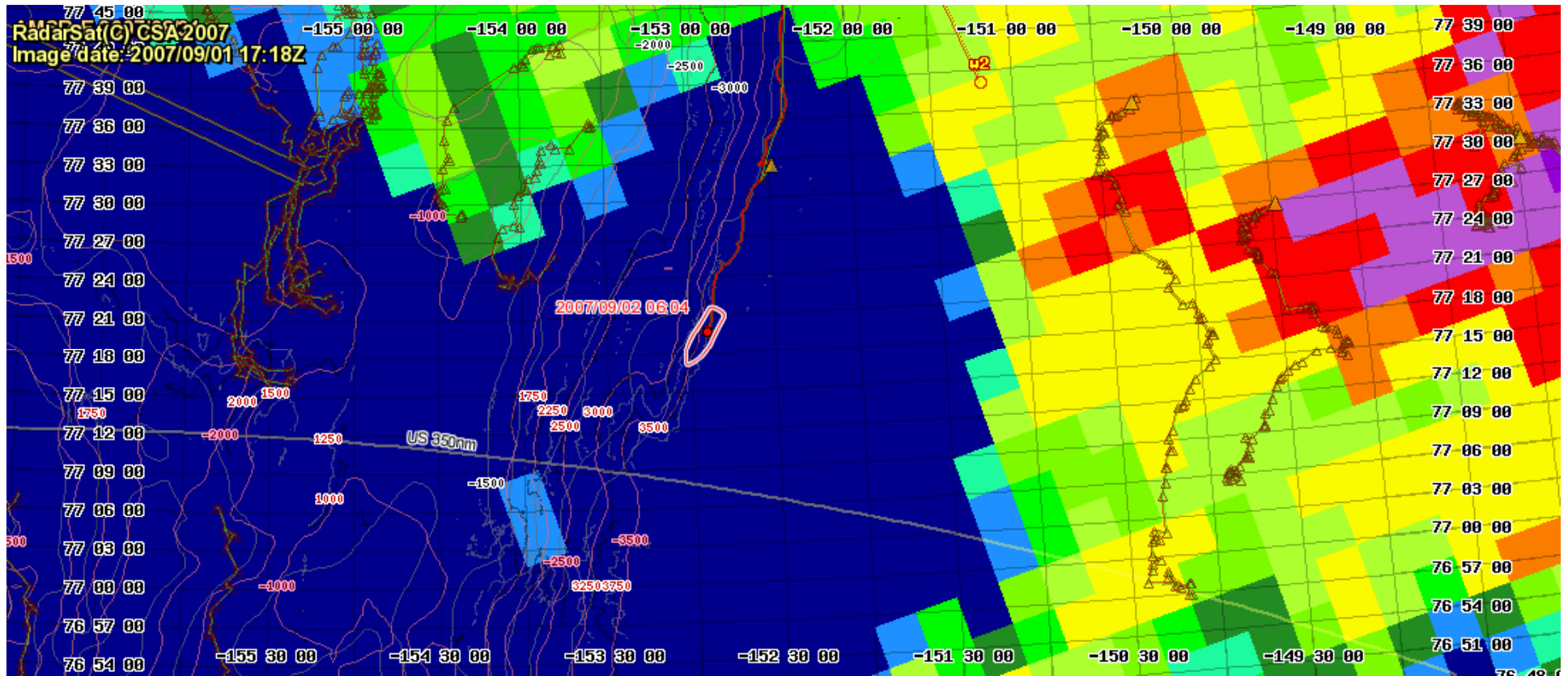


RADARSAT-1 SAR Sea Ice Detection



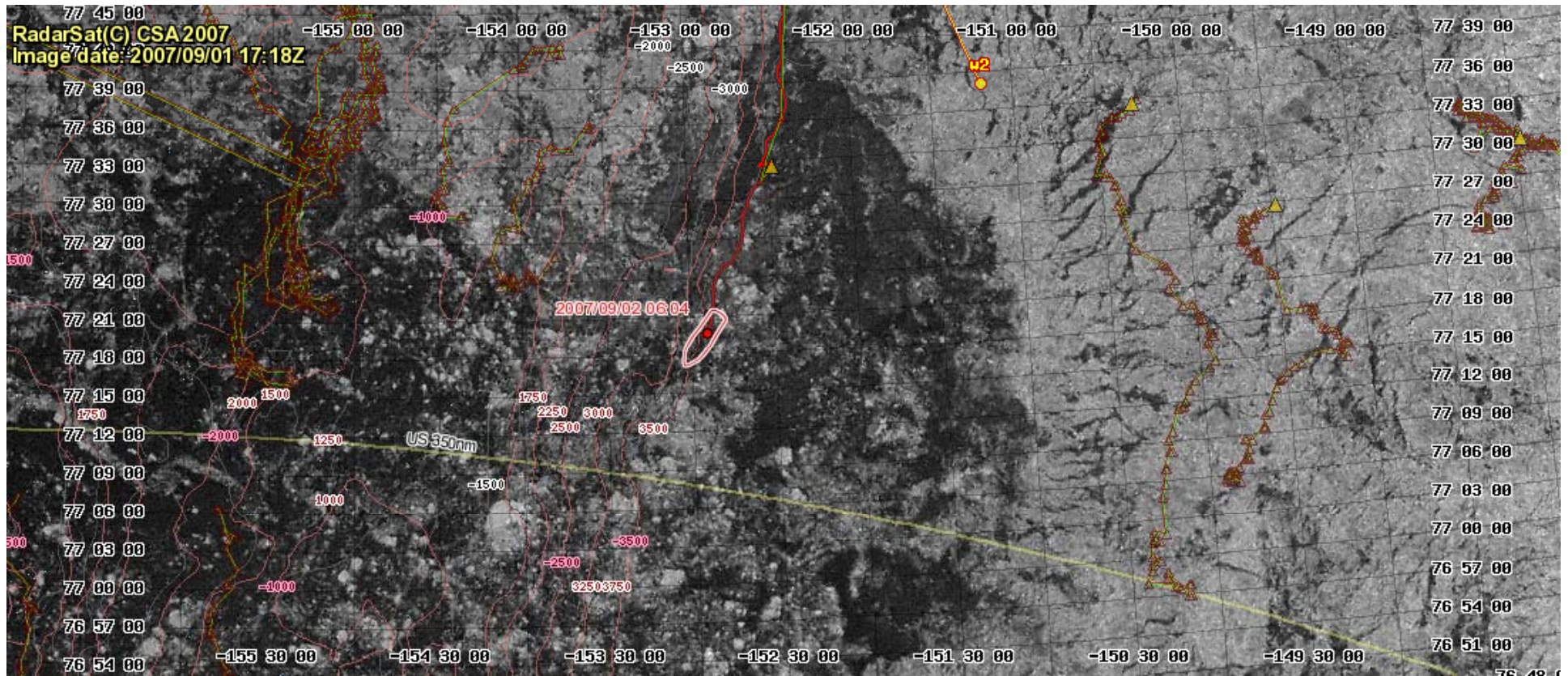


AMSR-E Passive Microwave Sea Ice Concentration





RADARSAT-1 SAR Sea Ice Detection

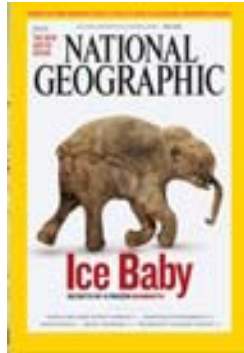








Healy Cruise Documented in NGS Article



BY MCKENZIE FUNK

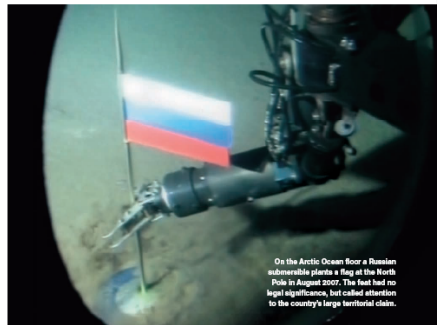
THE OFFICE OF ARTUR CHILINGAROV, the bearded polar explorer and anointed Hero of the Russian Federation, is at the end of a long hall in the Duma, Russia's parliament, where he is deputy speaker. Its entrance is guarded by a poster of a nuclear icebreaker, the *Yamal*, a 492-foot monster with rows of painted-on fangs, and inside is a knee-high wooden penguin and two chicks, a pair of carved walrus tusks, and eight miniature porcelain polar bears—an iconography of the Arctic and Antarctic. On a wall is a portrait of Vladimir Putin. Chilingarov sits in a leather chair in a dark suit with the Hero's gold star pinned to his breast, and next to him sits a four-foot-high globe, normal in every way but one: It has been spun off its axis, reoriented such that both Poles are visible: the Earth turned on its side.

It is winter in Moscow, three months after Chilingarov planted a Russian flag on the seafloor at the North Pole, an apparent landgrab that created a diplomatic row and a flurry of global headlines. Now he is campaigning for an election in which his party—Putin party—will soon trounce its closest rival by a six-to-one

margin. He is a busy man, and he skips the niceties when I sit down. "It took us seven days and seven nights to reach the North Pole," he says. "The ice was heavy. It was not a simple task." Near the Pole, Chilingarov's ship found an opening in the ice, and in went two submersibles, *Mir I* and *Mir II*. Chilingarov was in the first one. His goal: the true North Pole, was 14,000 feet below.

"It was dark, very dark," he says of the descent. "Of course it was risky. Of course we were scared." He and fellow parliamentarian Vladimir Grachev, a businessman who had paid half a million dollars for his berth, peered out the portholes. *Mir II*, which had one more paying adventurer, a Swedish businessman, and an Australian tour operator, Mike McDowell, followed. The descent was to take nearly three hours, the return to the surface that long again. Meanwhile, the ice pack would be drifting. If they could not find the opening, they would be stuck. "The depressing thing," Chilingarov tells me, "was knowing no one could come rescue us." Just after midnight *Mir I* touched down on the flat, fine clay of the seabed. The sub scraped up samples of ocean floor, then moved to the Pole itself, where its robotic arm firmly planted a titanium Russian flag in the muck.

"Why did we place it? Well, anytime a country wins something, it installs its flag," he says. Many countries' flags are planted on the surface ice at the North Pole, he points out. At the South Pole there are flags. On top of Mount Everest there are flags. "The Americans even put one on the moon," Chilingarov says. He pulls out a photo of the titanium flag and robotic arm,



On the Arctic Ocean floor a Russian submersible plants a flag at the North Pole in August 2007. The feat had no legal significance, but called attention to the country's large territorial claim.

dramatically signs it with a black marker, and hands it to me. "This is one of the world's greatest geographical achievements," he proclaims. "In proud the Russian flag is there." Then he stubs at the photo with his finger, pointing out empty space on the seabed. "Look here, and here, and here, and here," he says. "There is plenty of room for other nations' flags." Chilingarov mentions that the expedition, widely believed to be an official act of the Kremlin, was privately funded. Putin, far from endorsing him to the Pole, had initially cautioned that the dive was too dangerous. A patriot and a politician, well aware his feat made him a national hero, Chilingarov glosses over other little-known details: that the idea originated not with him but with three foreigners—McDowell and two Americans—in 1997; that he joined the team less than a year before the 2007 dive; that McDowell's company had previously been offering a *Mir* dive to the "real North Pole" to anyone with a spare \$95,000, and that the seabed samples they gathered were redundant, of questionable utility to science.

PHOTO BY ANDREW HUTTON/GETTY IMAGES FOR NATIONAL GEOGRAPHIC



ARCTIC LANDGRAB

As rising temperatures melt the polar ice cap, five countries race to map their claims to a new energy frontier. The stakes are huge. Nearly a quarter of the world's undiscovered oil and gas may lie beneath the seabed of this vast wilderness.

Denmark and Sweden hired a Russian helicopter to help map the Arctic seafloor around Greenland.



In three decades the rimland of sea ice has freed more than a million square miles of ocean for research and commerce.

106 NATIONAL GEOGRAPHIC • MAY 2009

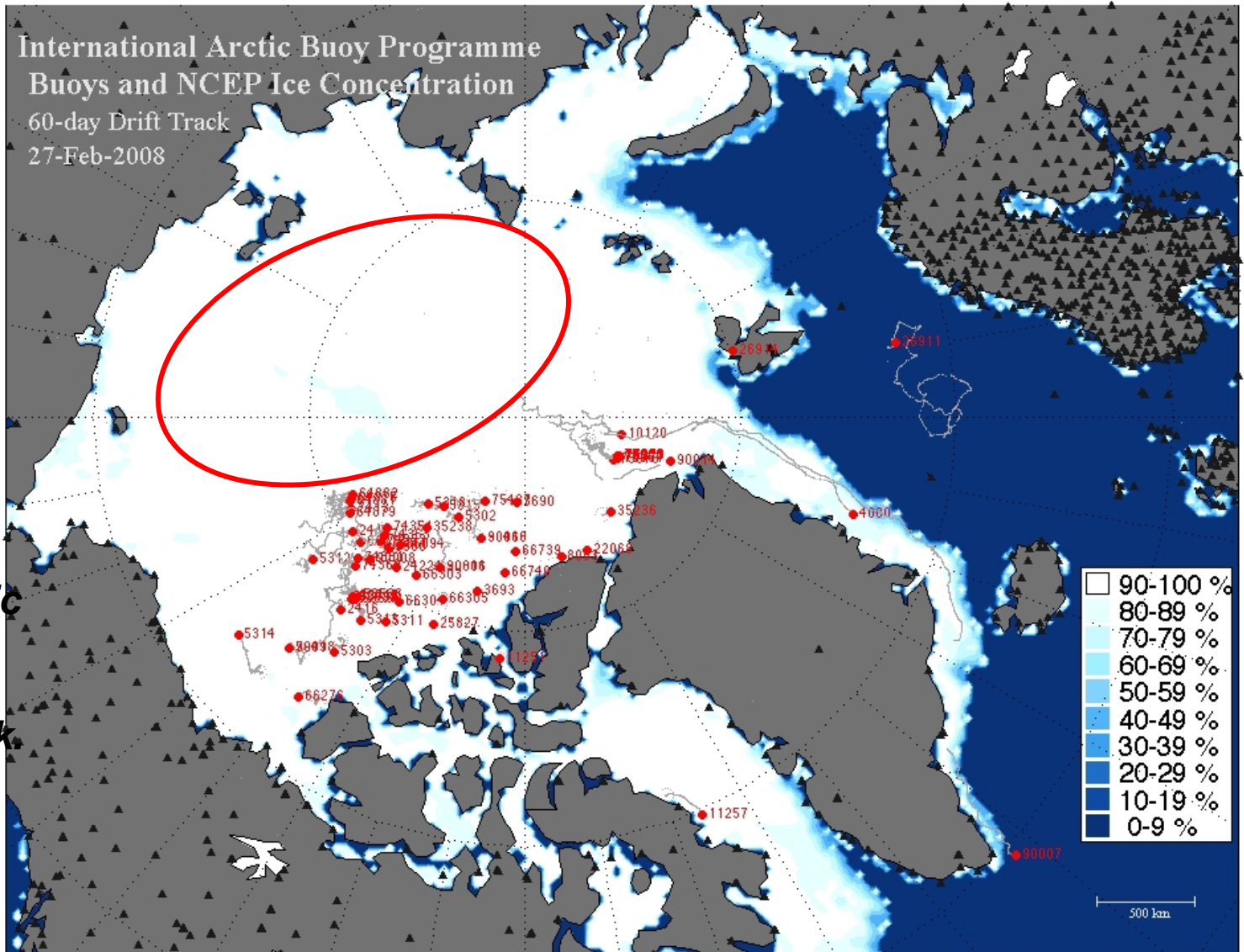
ARCTIC LANDGRAB 107





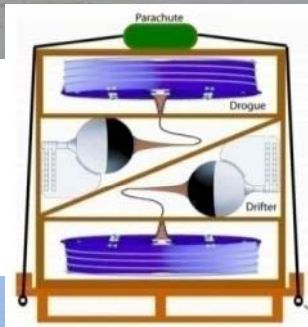
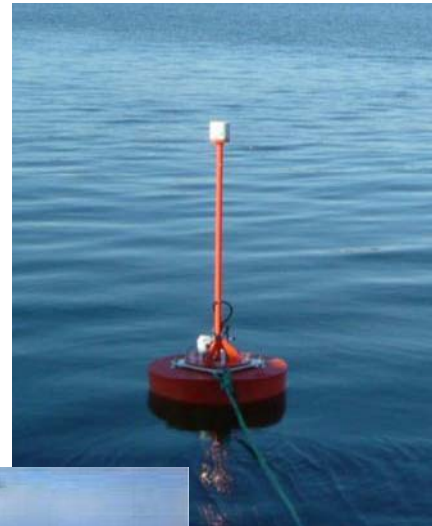
Impact of MYI Extent on IABP Buoy Distribution

Lack of perennial sea ice is significantly impacting the distribution of the International Arctic Buoy Program observing network.



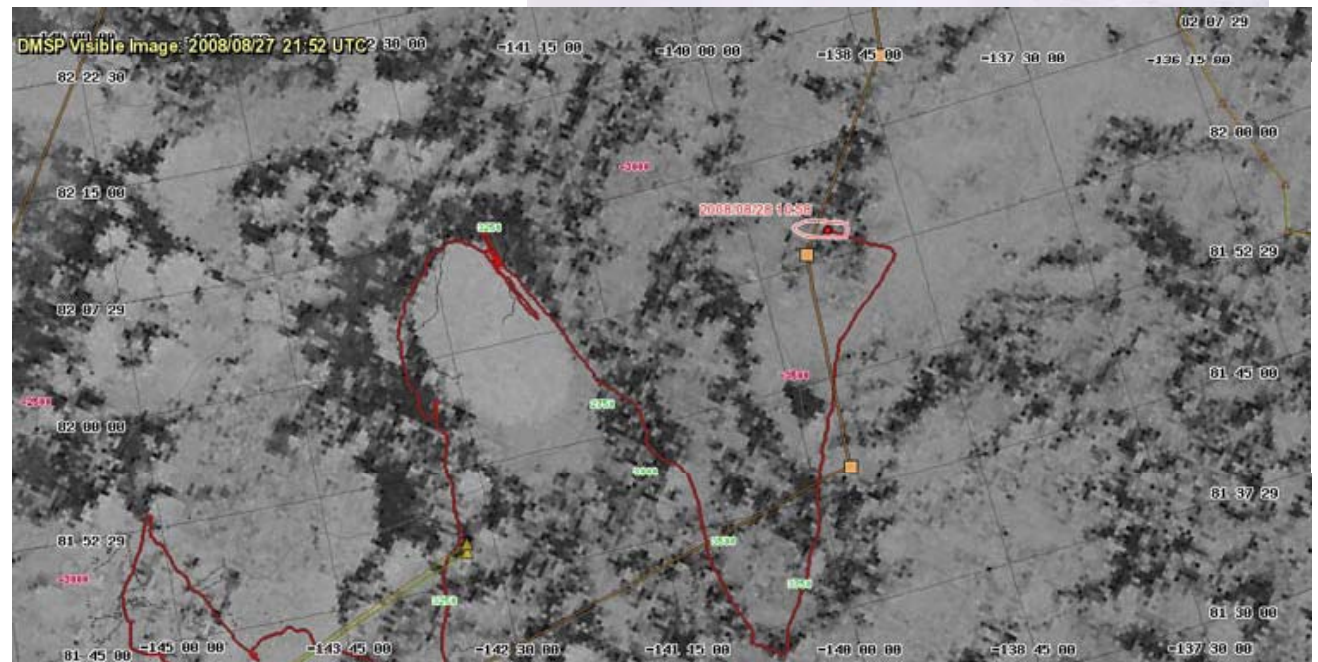


New Seasonal Ice Beacons, Ocean Buoys, and Deployment Alternatives Needed





Deployment of the AXIB Seasonal Buoys From the Healy in 2008





Airborne Expendable Ice Buoys (AXIB) (NOAA SBIR)

- Provides a low cost aircraft droppable seasonal buoy (with also surface deployment capability)



NIC co-manages the US Interagency Buoy Program with UW/PSC and coordinates US Arctic buoy activities within the IABP

- Sensors/measurements include surface air temperature, surface pressure, GPS location, and Argos transmitter



Arctic buoy data are critical to NWS and many other users providing weather forecasts, NWP, and climate modeling

- Replaces/Complements present ice beacons providing operation in ice and open water through freeze/thaw cycles



Arctic buoy data are used by NIC for operational ice chart analysis and supports the validation of satellite observations and sea ice models

- On the ice testing in Lake Champlain, VT and two deployments in the Arctic during HLY0805



Provide alternatives to present White Trident C-130 drops over MYI



NAIS Coordinated Support of U.S.-Canada UNCLOS Arctic Mapping in 2008

**Joint US-
Canada
Extended
Continental
Shelf Mapping
Cruise HLY0806**



Photo USGS

CCGS St. LAURENT and USCGC HEALY operating in the Arctic



Photo USGS



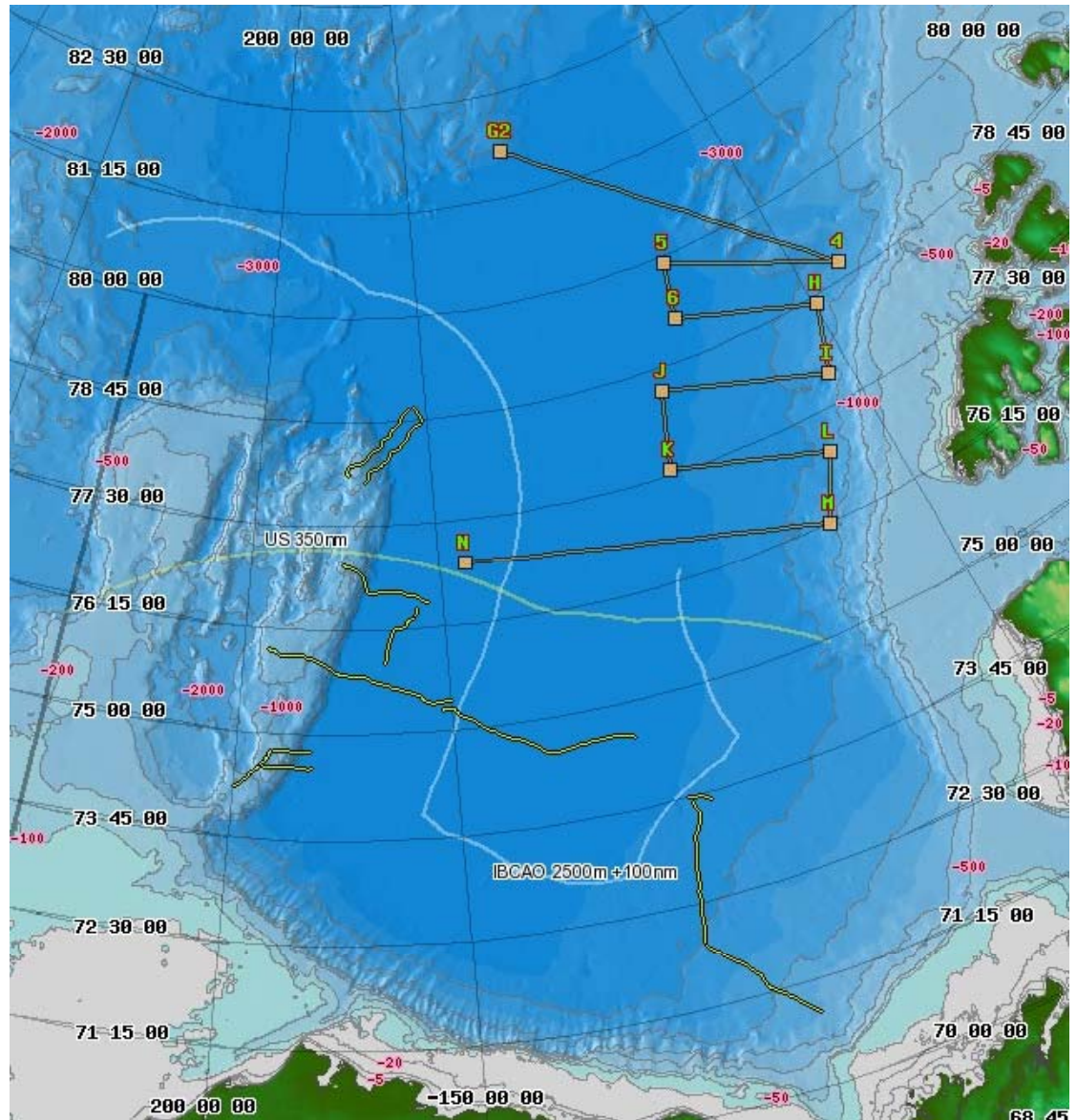
K. Berberich (NIC analyst), B. Molyneux (Canadian ISS), P. Clemente-Colon (NIC Chief Scientist) onboard USCGC HEALY



CAPT F. Sommer (USCGC HEALY) and CAPT M. Rothwell (CCGS LAURENT)

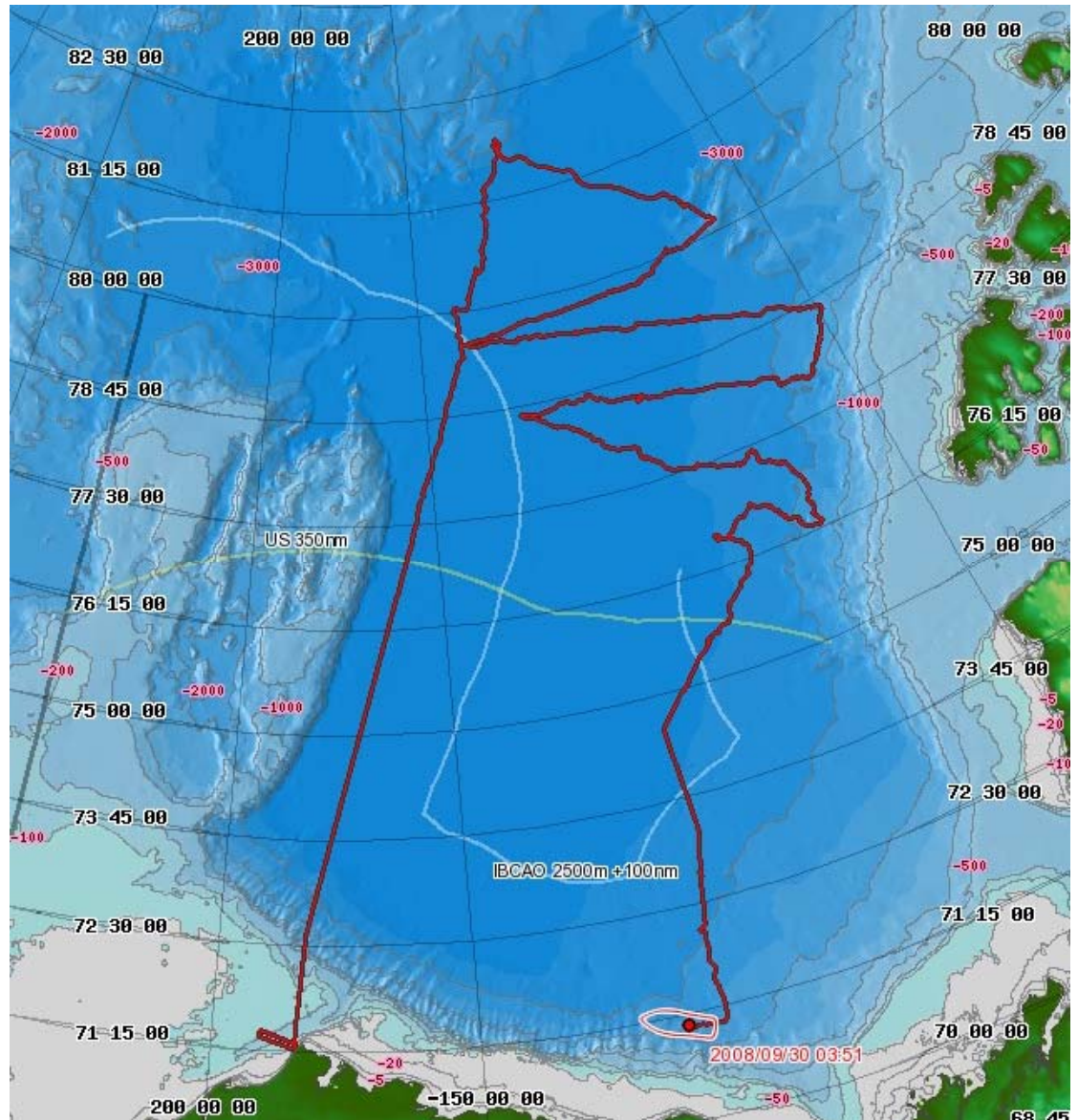


HLY0806 Cruise Track Plan



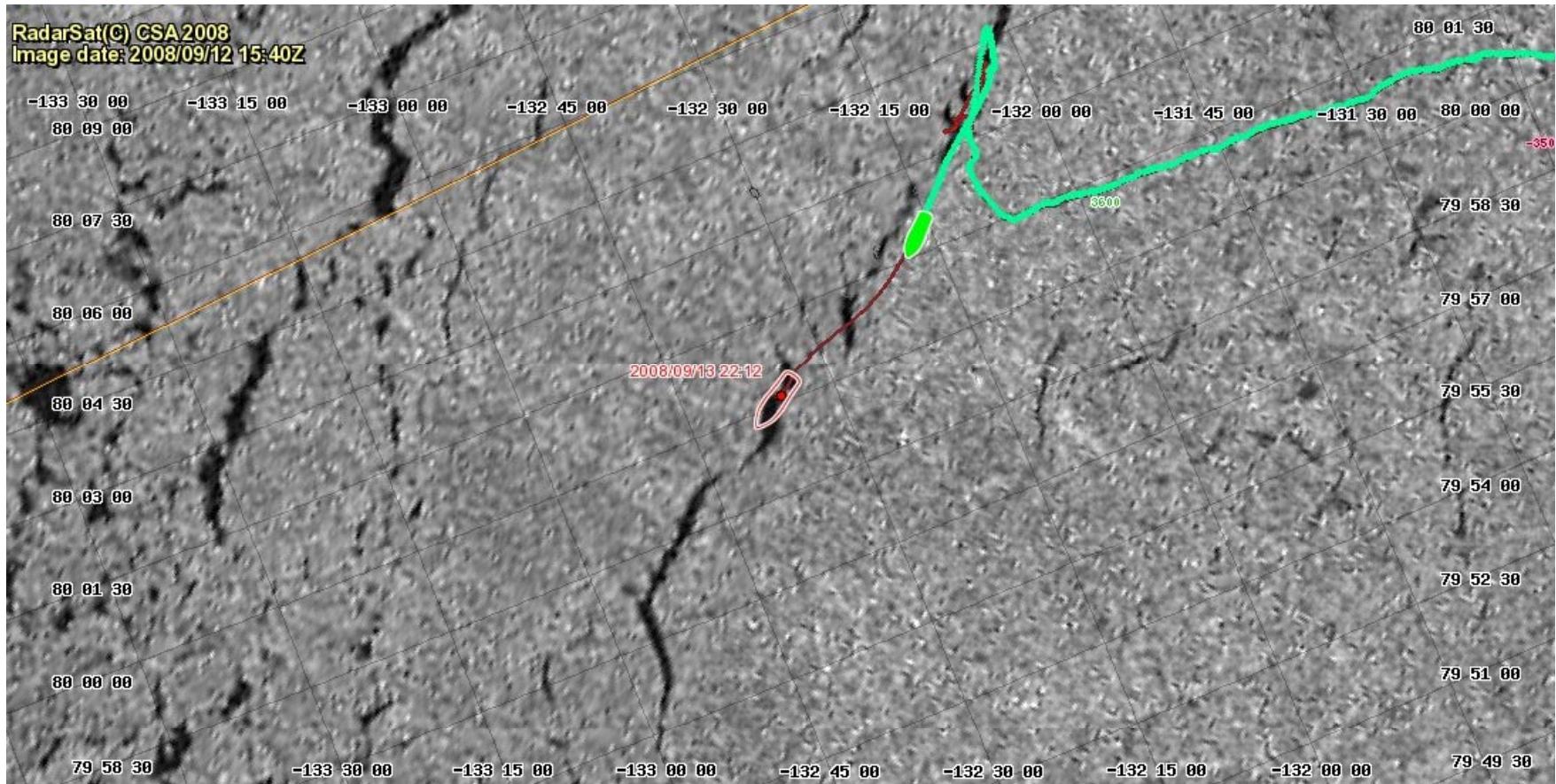


HLY0806 Cruise Actual Track





Exploited of Leads and Polynyas in SAR Imagery



New/Young Ice
Thin First Year Ice



"Finger - Rafting"



9/22/2008 2:52



9/22/2008 2:52

Dynamic Build-up of First Year Ice



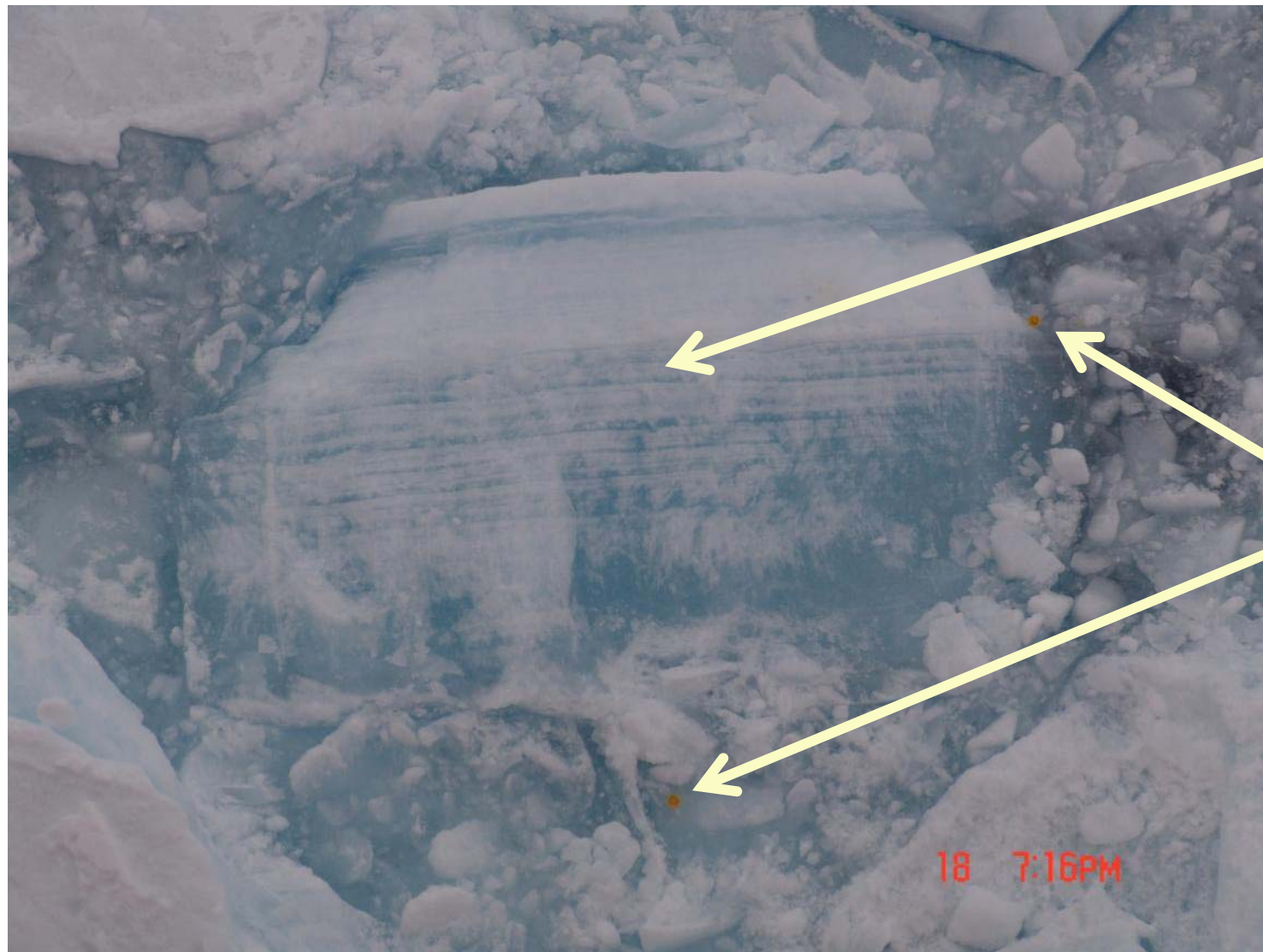
9/19/2008 6:18

MYI/FYI





Ice Observations From the Bridge Deck Reference Markers



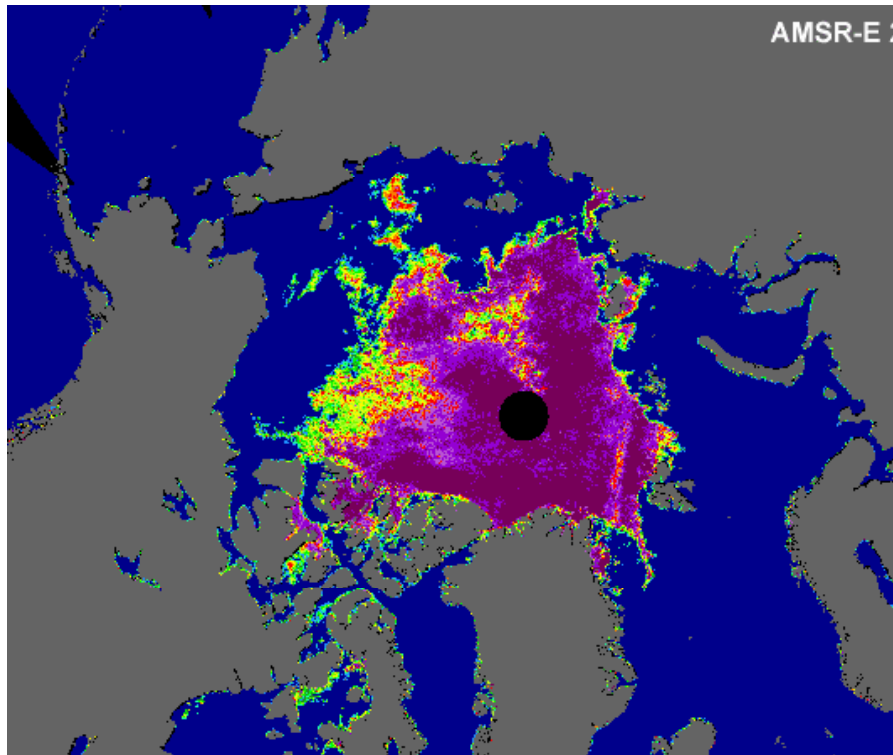
***Floe thickness
3.2 m thick***

***Oranges
3" diameter***

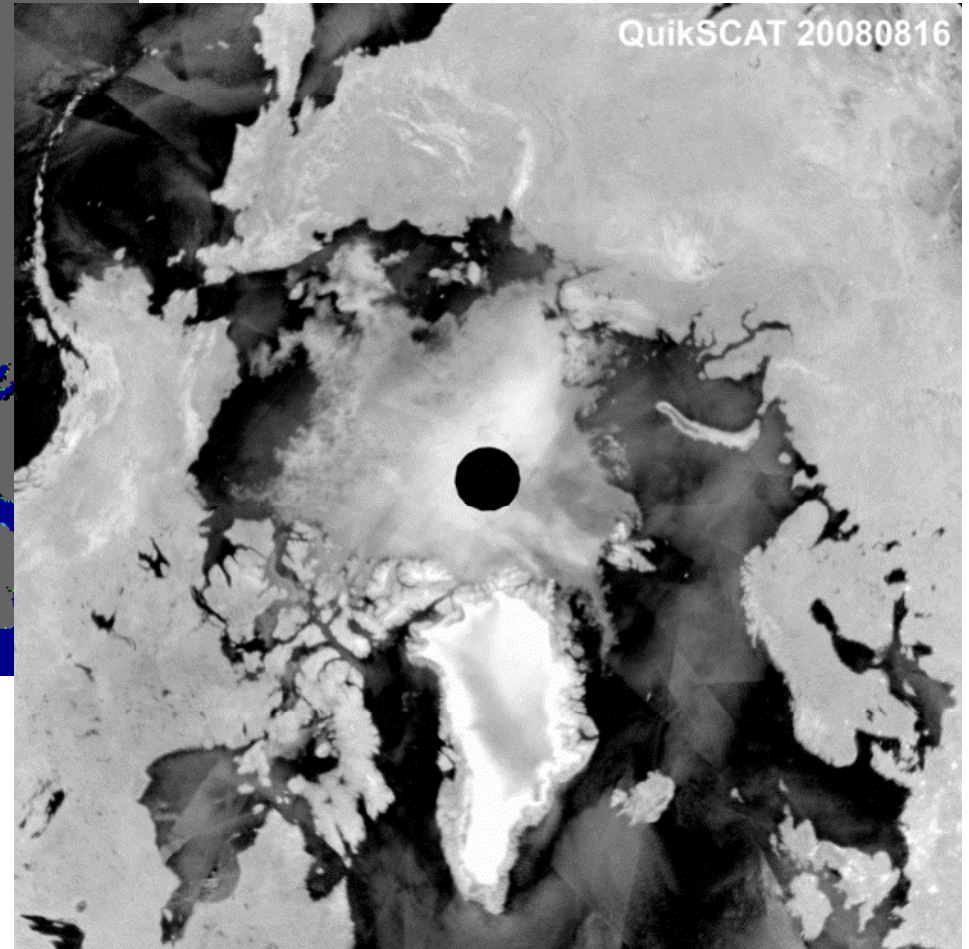
18 7:16PM



Pan-Arctic Conditions During HLY0805-06



***Passive Microwave Sea Ice Concentration
20 August-27 September 2008***



***Active Microwave Sea Ice Backscatter
20 August-26 September 2008***



R/V XUE LONG Observed 14 Miles Away

- ***Chinese-flagged, ice-strengthened research and logistics vessel. It is China's only polar vessel.***
- ***Government-owned, but not associated with the Chinese Navy. It is commanded and crewed by civilians.***
- ***Operated by the Polar Research Institute of China, subordinate to the State Oceanographic Administration.***
- ***Hosted 110 Scientists and deployed buoys for the IABP.***
- ***Plan for a July-September 2010 Trans-Arctic attempt.***





HLY0805 Polar Bear Sighting



Clemente-Colón/Fernández



While Under the Ice...



Russian nuclear submarine makes 30-day trip under Arctic ice - 2

30/09/2008 13:43 (Adds details in paras 7-8)

MOSCOW, September 30 (RIA Novosti) - A Russian Delta-III class ballistic missile submarine has successfully sailed from a naval base in northern Russia to the Pacific Ocean under the Arctic ice floe, a Navy spokesman said on Tuesday.

"The Ryazan strategic nuclear submarine arrived at a naval base on the Kamchatka Peninsula after a more than 30-day underwater trip," Capt. 1st rank Igor Dygalo said.

Ryazan is a Project 667BDR (Delta III class) strategic nuclear submarine, which entered service with Russia's Northern Fleet in 1982. It has a crew of 130 and can travel underwater without coming to the surface for up to 90 days.

The submarine is armed with 16 R-29RM (SS-N-23 Skiff) ballistic missiles with a range of 8,000 km (about 5,000 miles).

Commenting on the submarine's successful mission, Russian Navy Commander, Adm. Vladimir Vysotsky said it had reaffirmed the Russian submarine fleet's ability to conduct strategic missions in the Arctic.

"The Navy continues to play an important role in safeguarding Russia's maritime economic and research activity throughout the world, including in the Arctic," the admiral said.

The Russian Defense Ministry said on Tuesday that the Ryazan, which was previously part of Russia's Northern Fleet, will be reassigned to the Pacific Fleet and will patrol the Pacific Ocean on a regular basis.

With the addition of the Ryazan SSBN, Russia's Pacific Fleet will have 10 Delta III class ballistic missile submarines in service.

other articles

| | |
|------------------|--|
| 20:18 27/10/2008 | Russia's new nuclear attack submarine starts sea trials |
| 19:12 22/10/2008 | Russia says media reports on possible Arctic conflict 'alarmist' |
| 19:12 16/10/2008 | Russian PM urges long-term plan for nuclear ice-breaker fleet |
| 18:17 11/10/2008 | Russia's Dmitry Medvedev observes Barents Sea drills - 2 |



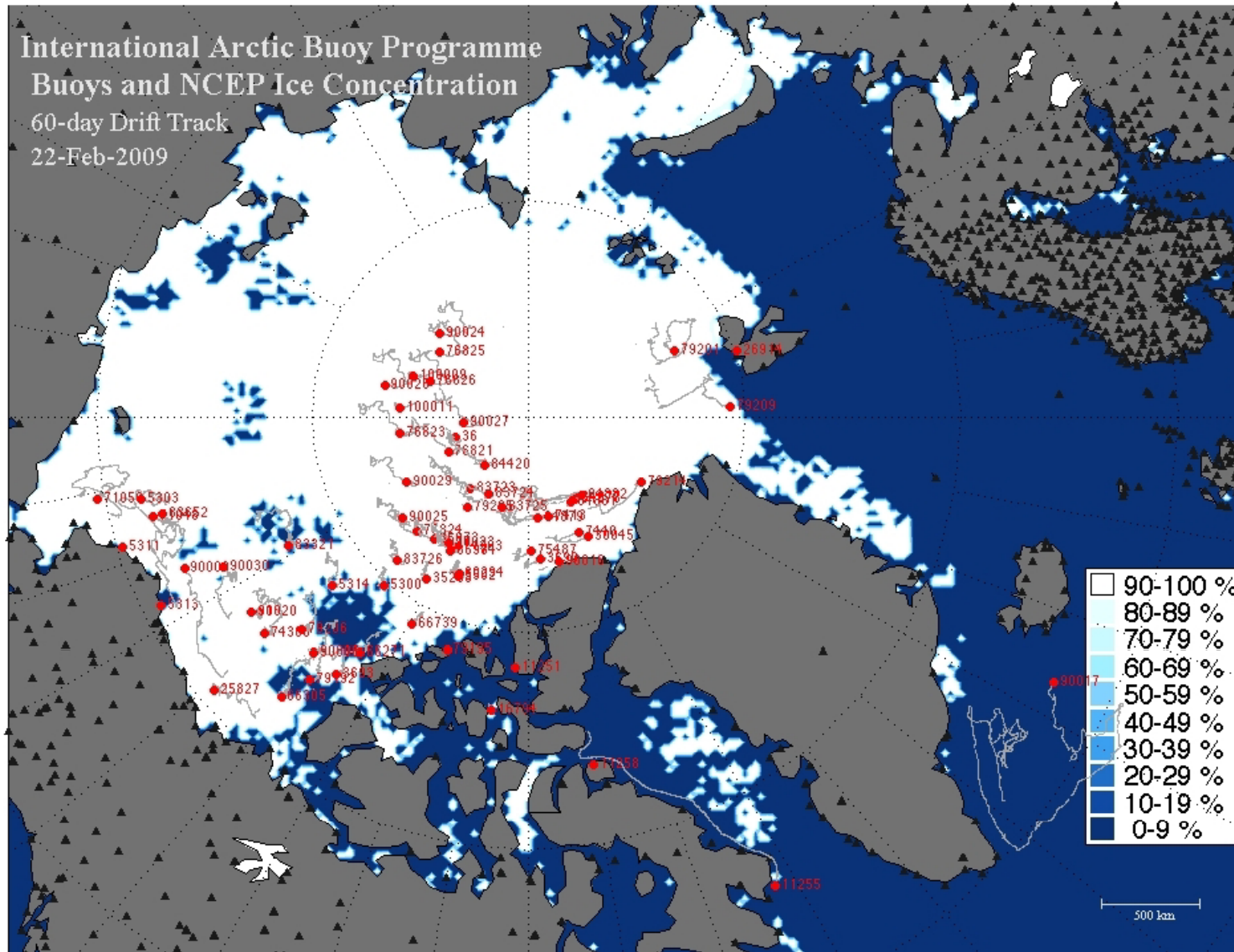


Helo Recovery of the ICEXAIRs





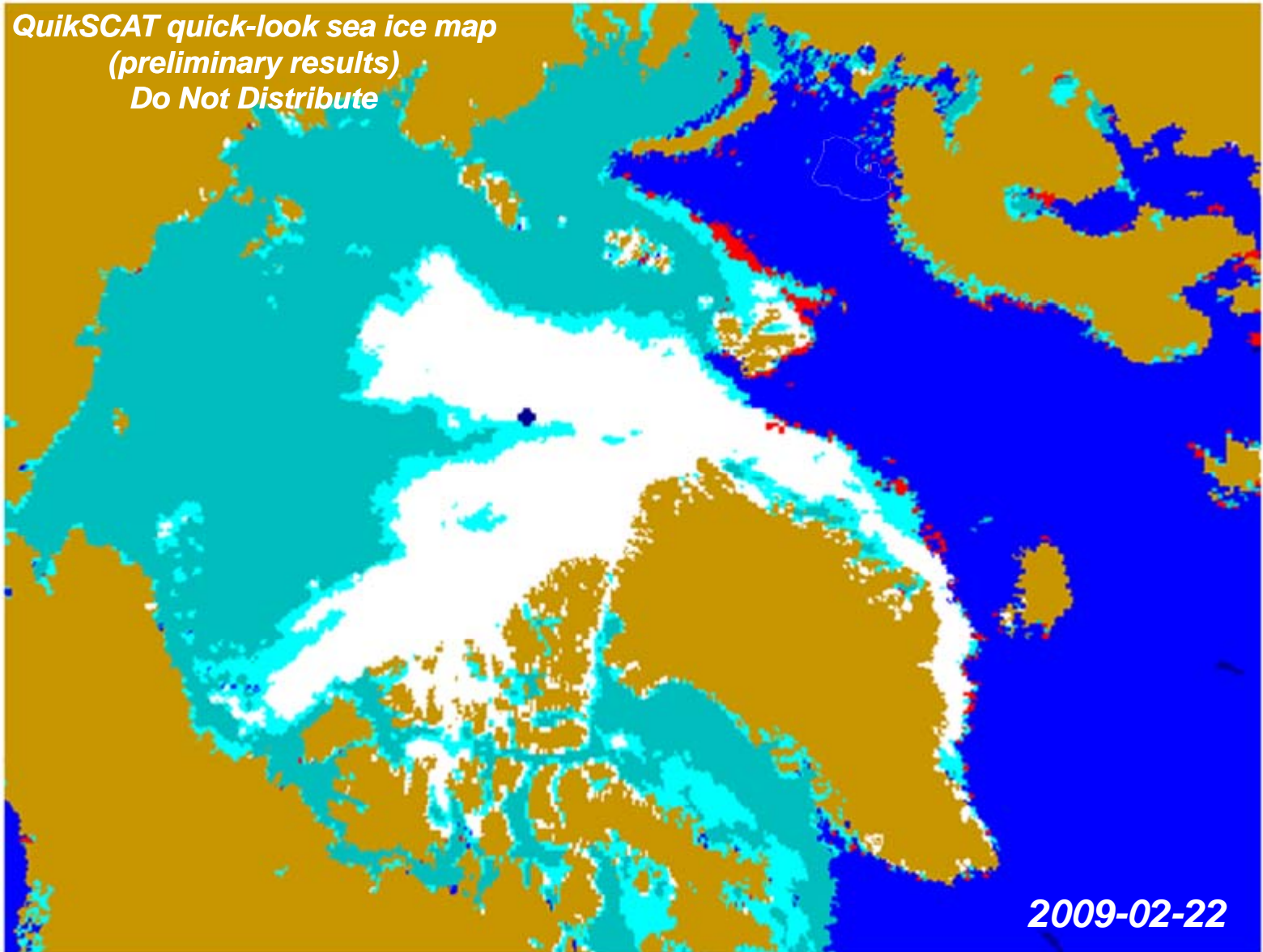
IABP Network Distribution – February 2009





QuikSCAT MYI Distribution – February 2009

*QuikSCAT quick-look sea ice map
(preliminary results)
Do Not Distribute*





March-April 2009 APLIS

- ***Classified Navy ice camp only, although ASL was open to an unclassified component in same general location as the 2007 camp.***
- ***Better ULS data collection is expected.***
- ***Smaller more restricted classified camp did not allow for non-Navy activities.***
- ***In addition, new PSC logistics, crew on training, and limited time availability of the old crew after the classified camp did not help.***
- ***NOAA/NASA planned airborne altimetry component with limited field participation to be undertaken over the Danish Camp off Ellesmere Island.***
- ***We were able to deploy two IABP buoys at the Navy camp during the visit by a USNA professor and two midshipmen.***

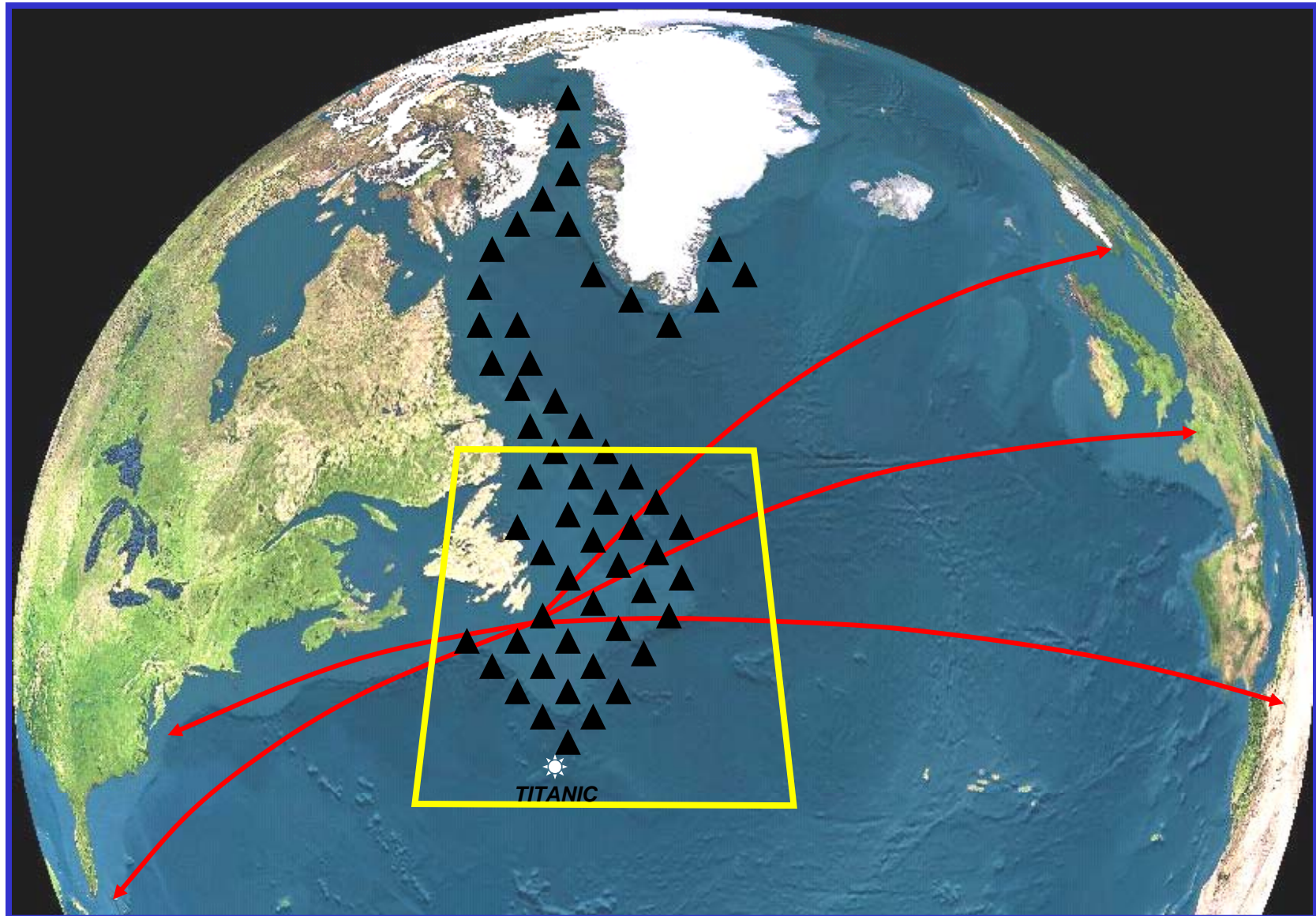


International Ice Patrol (IIP)



<http://www.uscg.mil/lantarea/iip/home.html>

IIP Purpose: Promote safe navigation in the northwest Atlantic Ocean when the danger of iceberg collision exists.



Safety of Life at Sea (SOLAS) Convention Countries



Belgium



Canada



Denmark



Finland



France



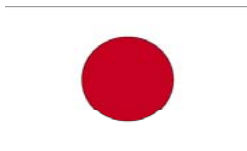
Germany



Greece



Italy



Japan



Netherlands



Norway



Panama



Poland



Spain



Sweden



United Kingdom





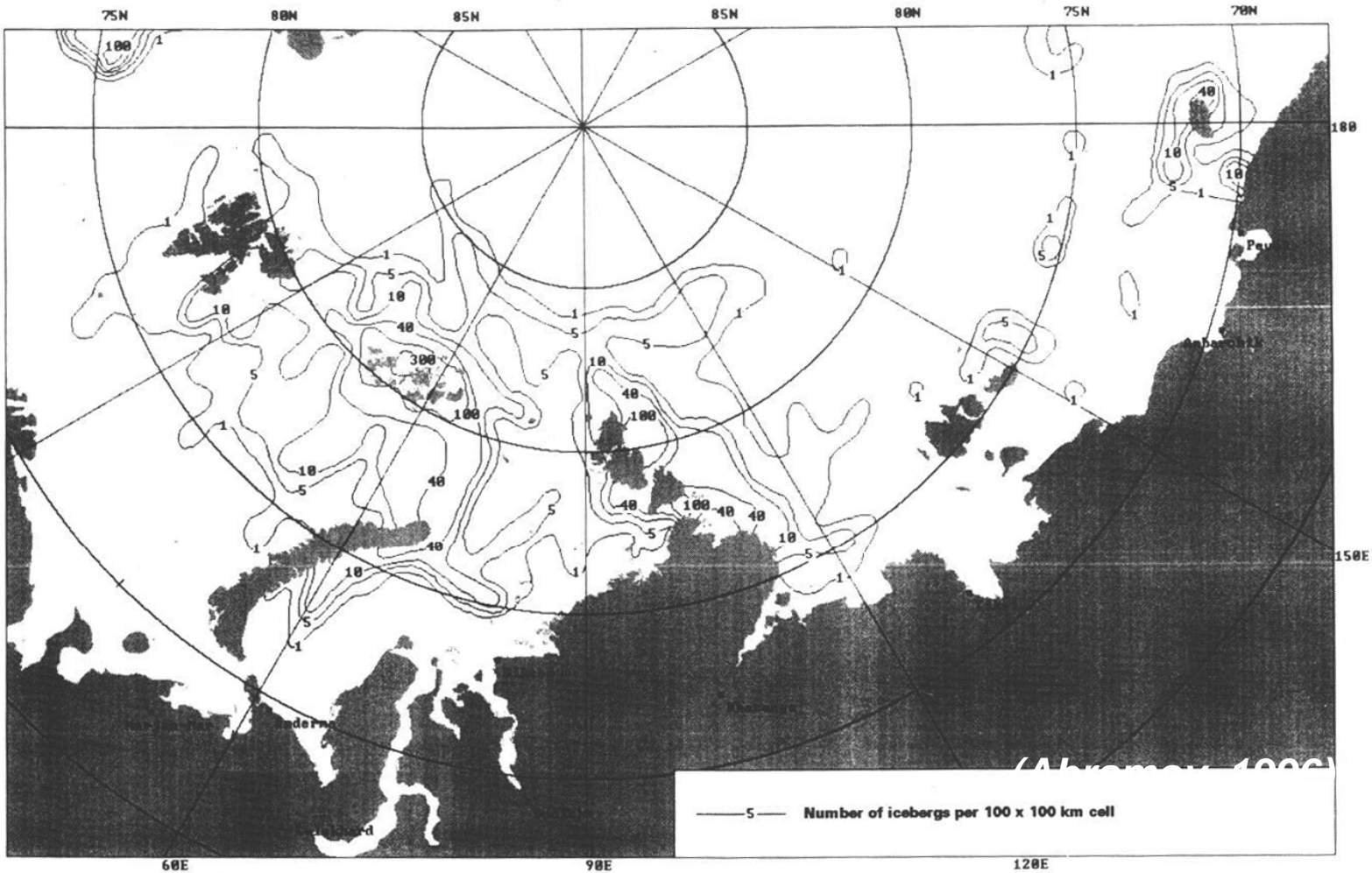
2008 IIP Ice Reconnaissance Deployment (IRD5)





Monthly maximum number of icebergs in August

The present number of icebergs in the Arctic Basin is much larger than that reported





Icebergs in the Arctic Basin



North-eastern Barents Sea, April 16, 2006



North-eastern Barents Sea, April 17, 2006



North-western coast of Novaya Zemlya, April 17, 2006



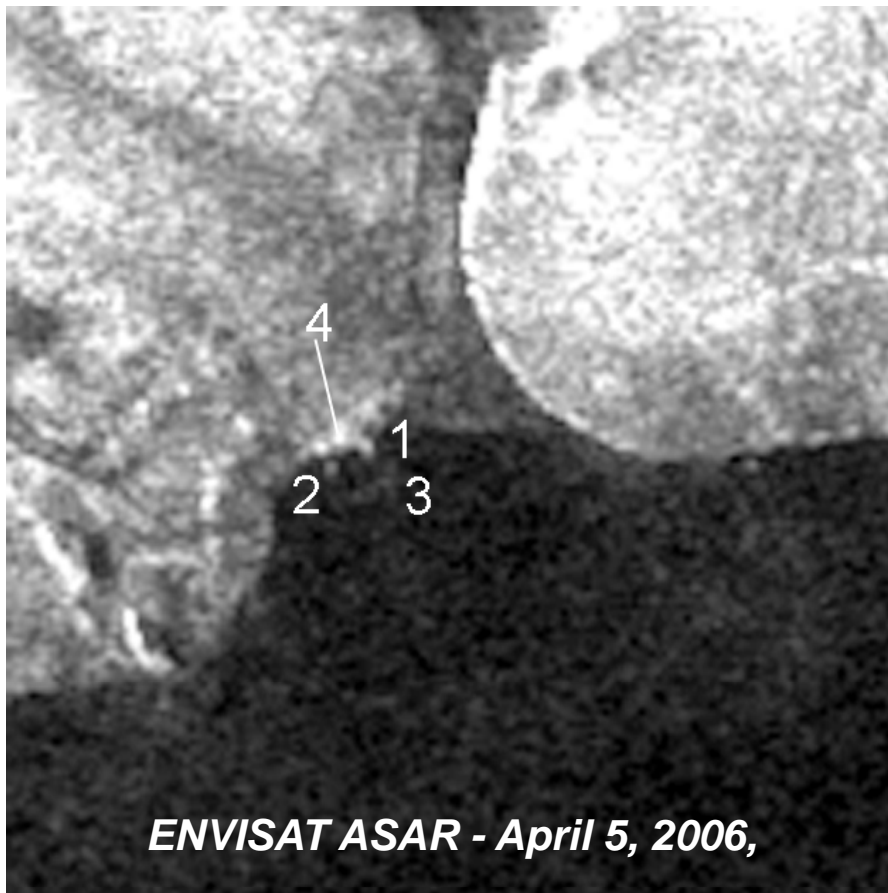
FJL, Salm island, April 25, 2006

Courtesy of Vitaly Alexandrov, Nansen International Environmental and Remote Sensing Center (NIERSC)

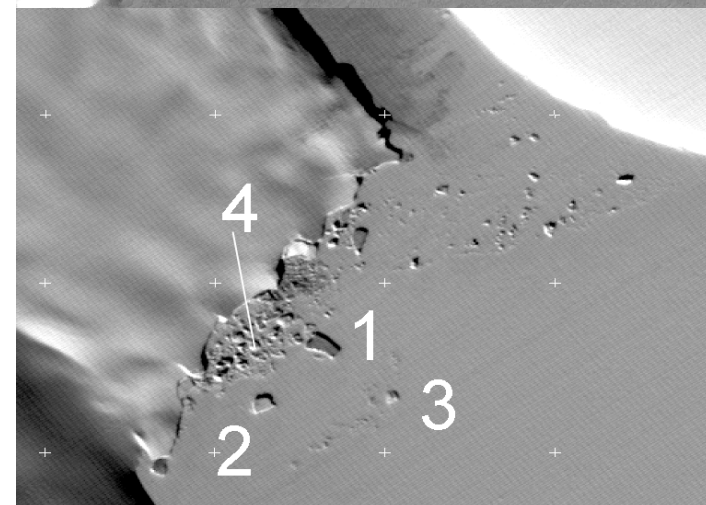
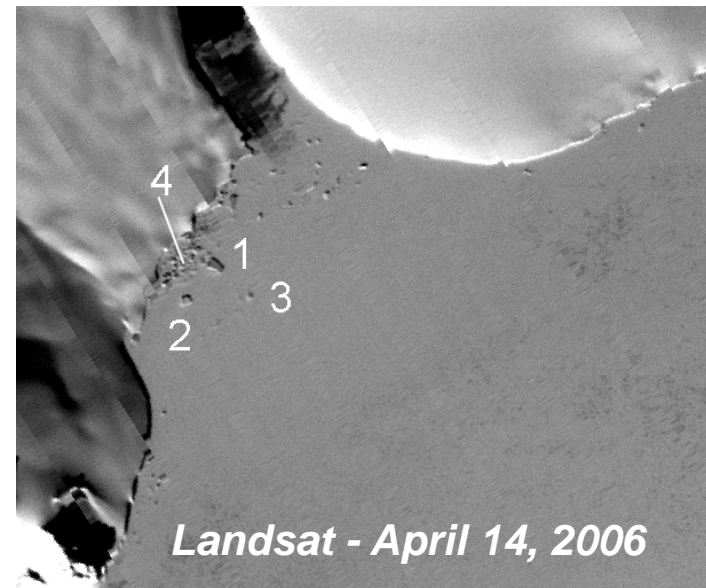


Arctic Iceberg detection

SAR and visible images

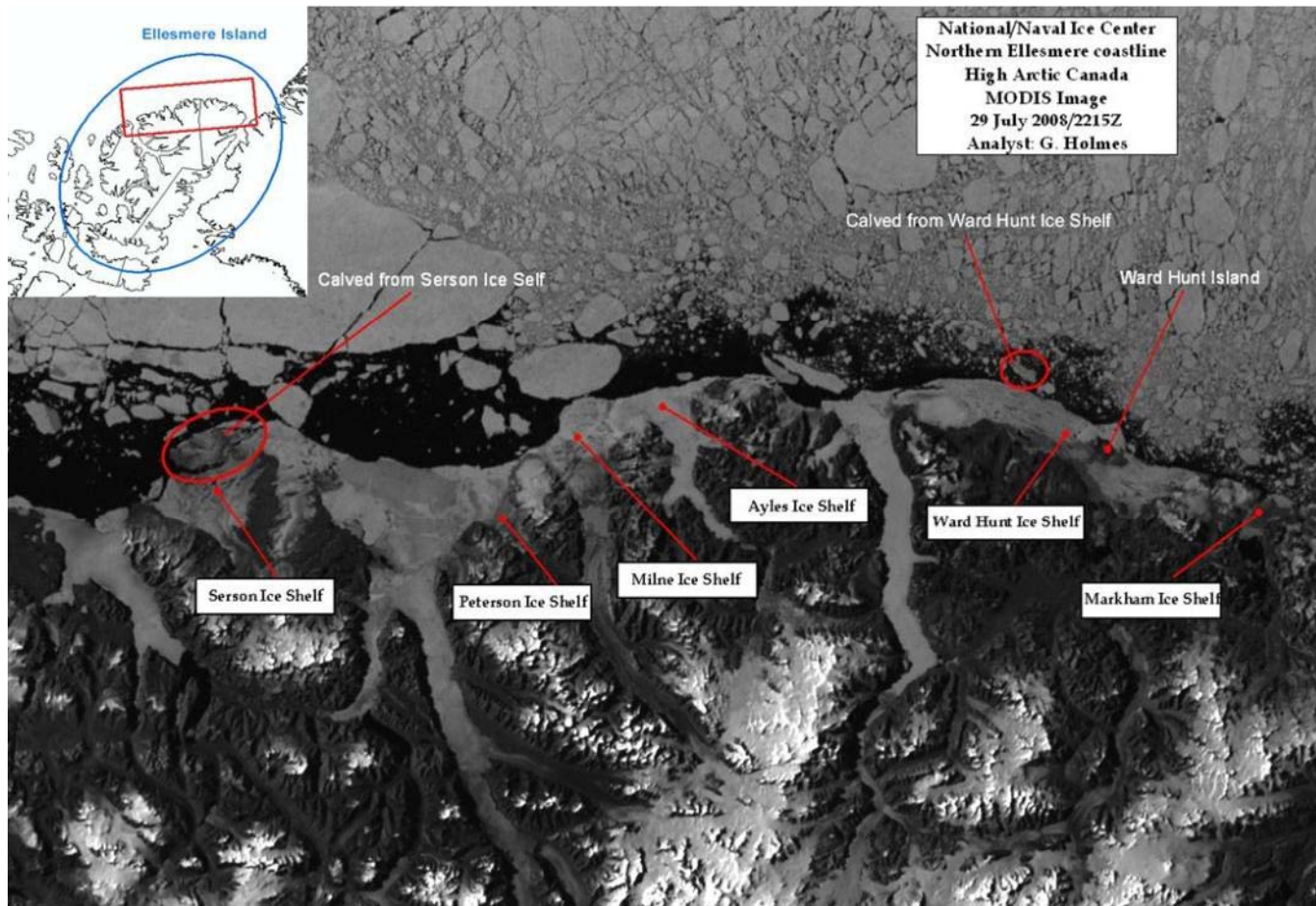


*Courtesy of Vitaly Alexandrov, Nansen
International Environmental and Remote Sensing
Center (NIERSC)*





Ellesmere Island Icebergs

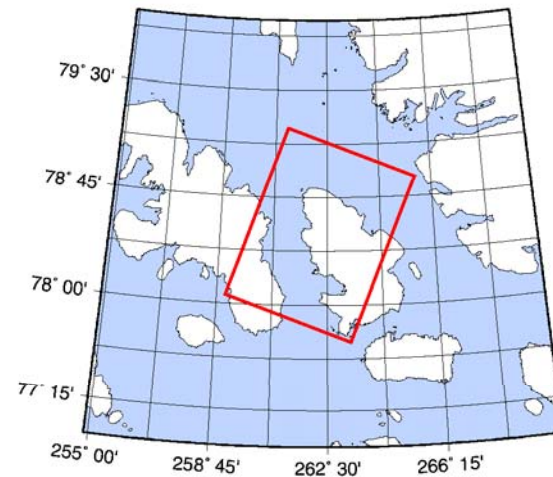
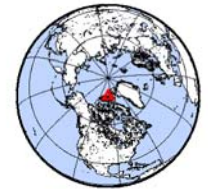
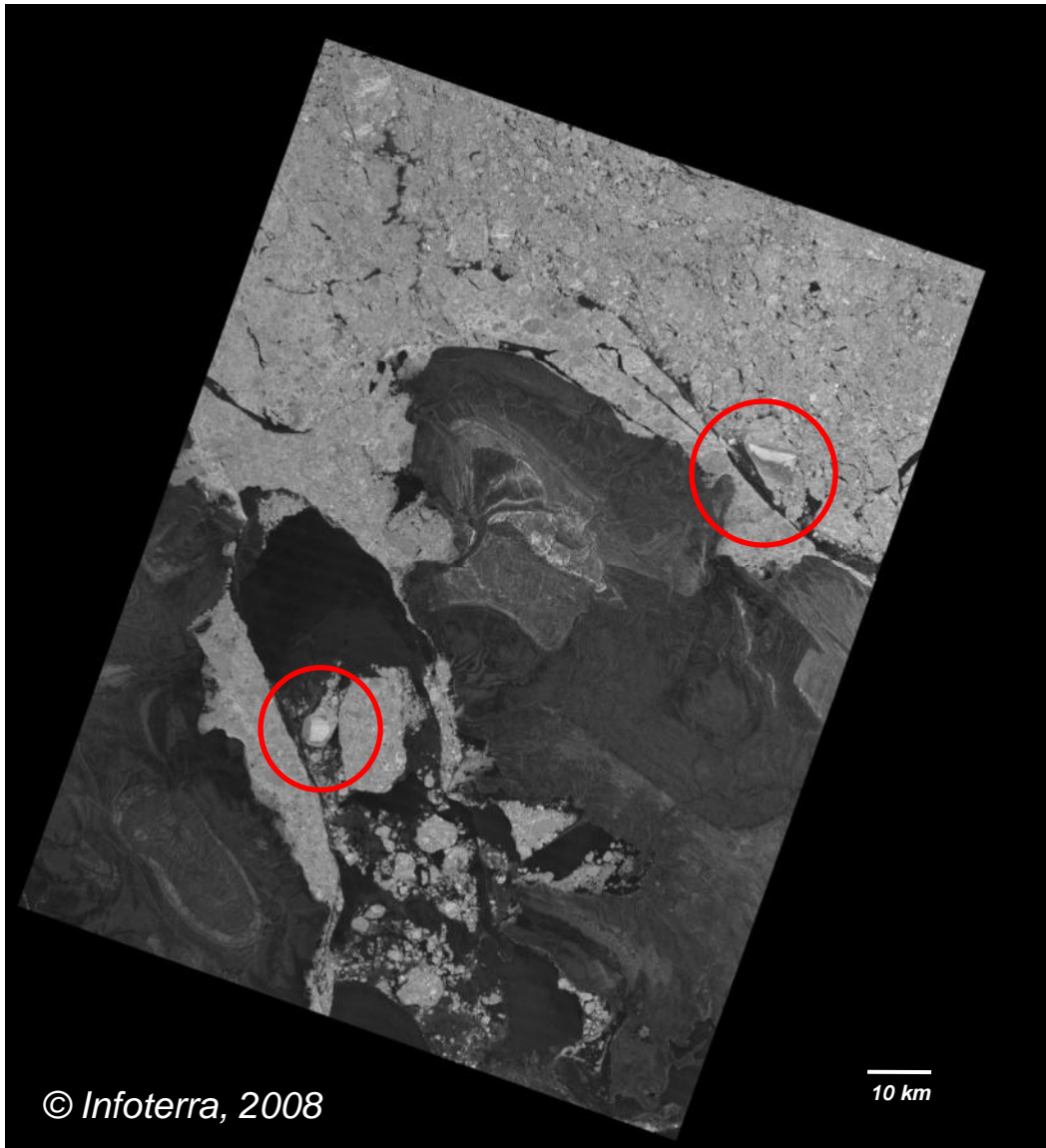


Ellesmere Is. ice shelves are also calving large icebergs into the Arctic Ocean.



Ice Islands off Amund Ringnes Island

March 03, 2008 – TerraSAR-X HH 16 m ScanSAR Mode



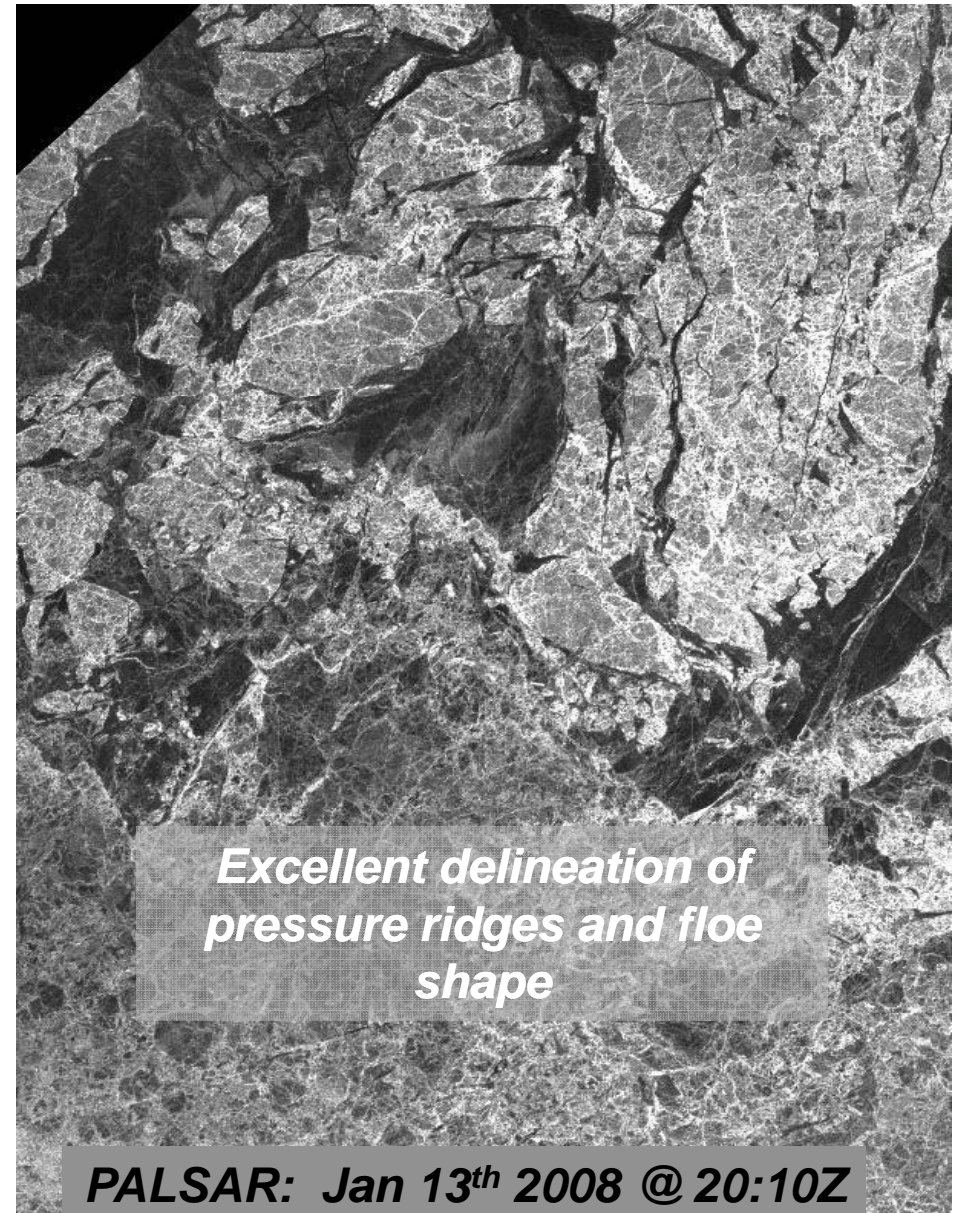
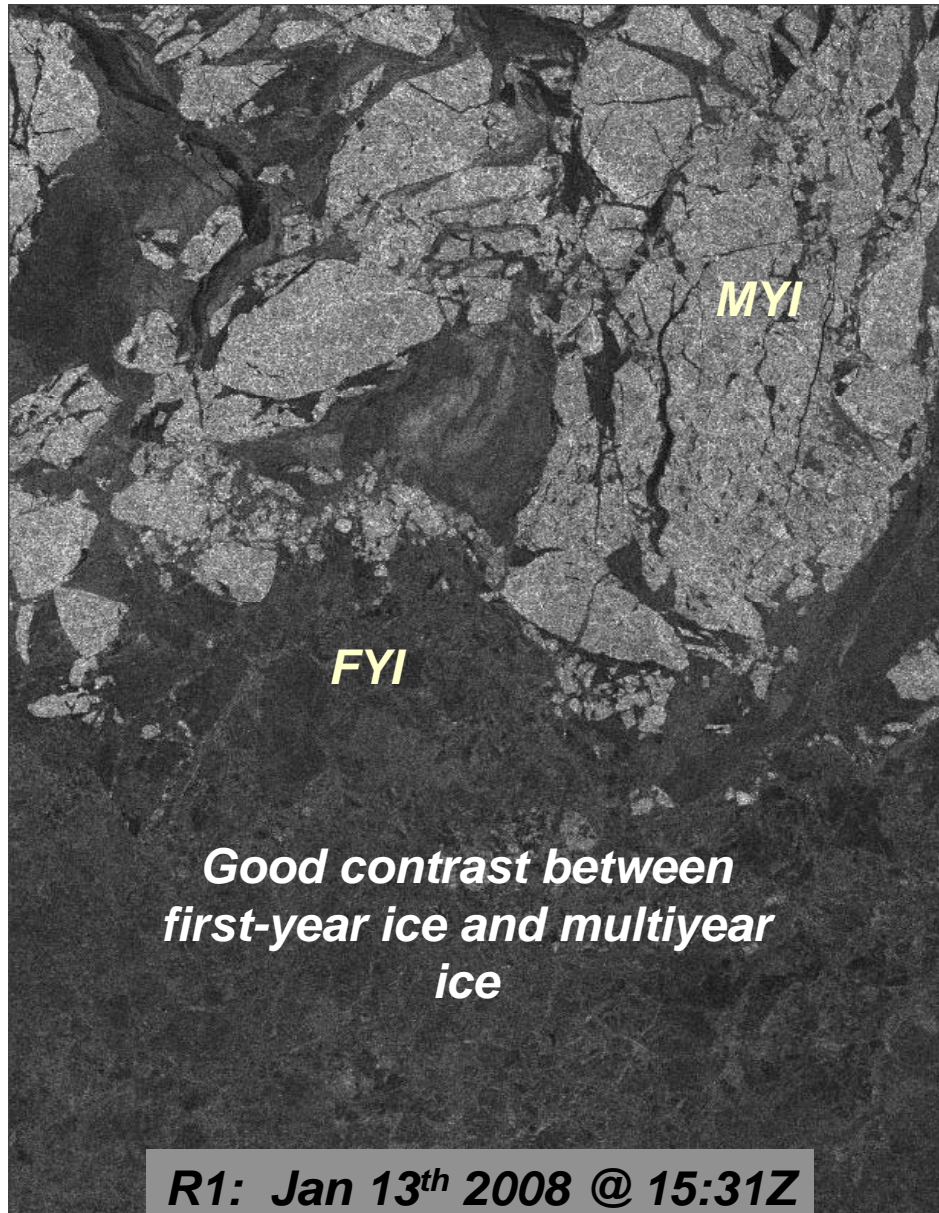
acquisition mode : "SC" / "scan_010" / "HH" / "R"
product type : "GEC" / "RE"
start time UTC : "2008-03-03T13:46:41.381154"
stop time UTC : "2008-03-03T13:47:01.108154"
orbit cycle / no. / dir. : 24 / 3985 / 144 / "D"

Courtesy of Infoterra



Satellite Multiband Research Collaboration

L-band SAR Data Improves Ridge Detection





Arctic Ice Islands vs. Antarctic Mega-Icebergs



Louis S St-Laurent - 392.49' in length

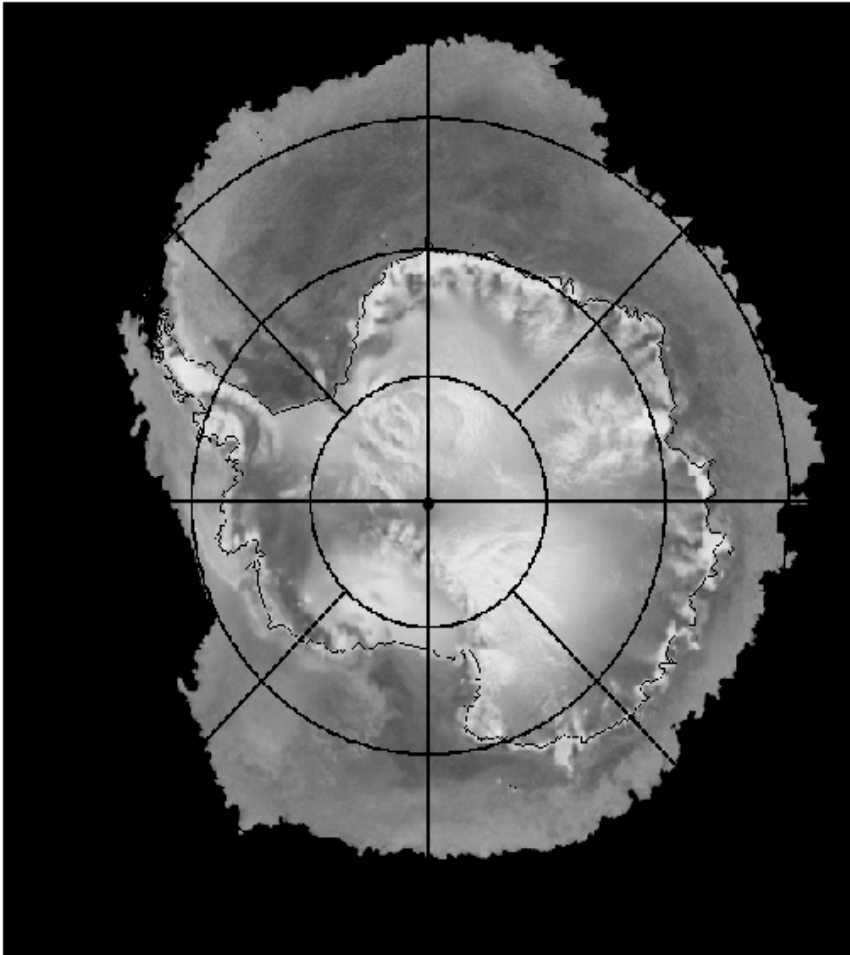
Roger Revelle - 277' in length





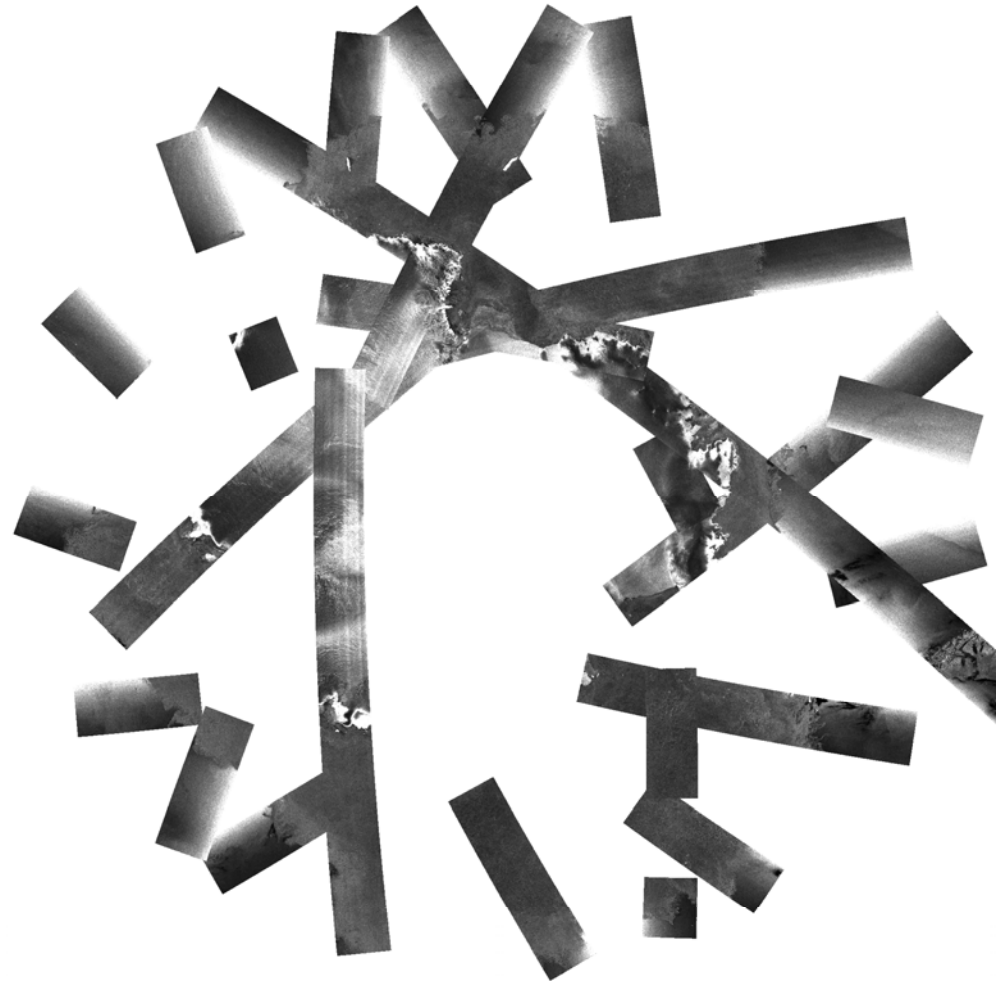
Began Operational Use of Envisat Hemispheric Data in 2007

Southern Hemisphere Quikscat
00z 9/18/2005



Ice Mask

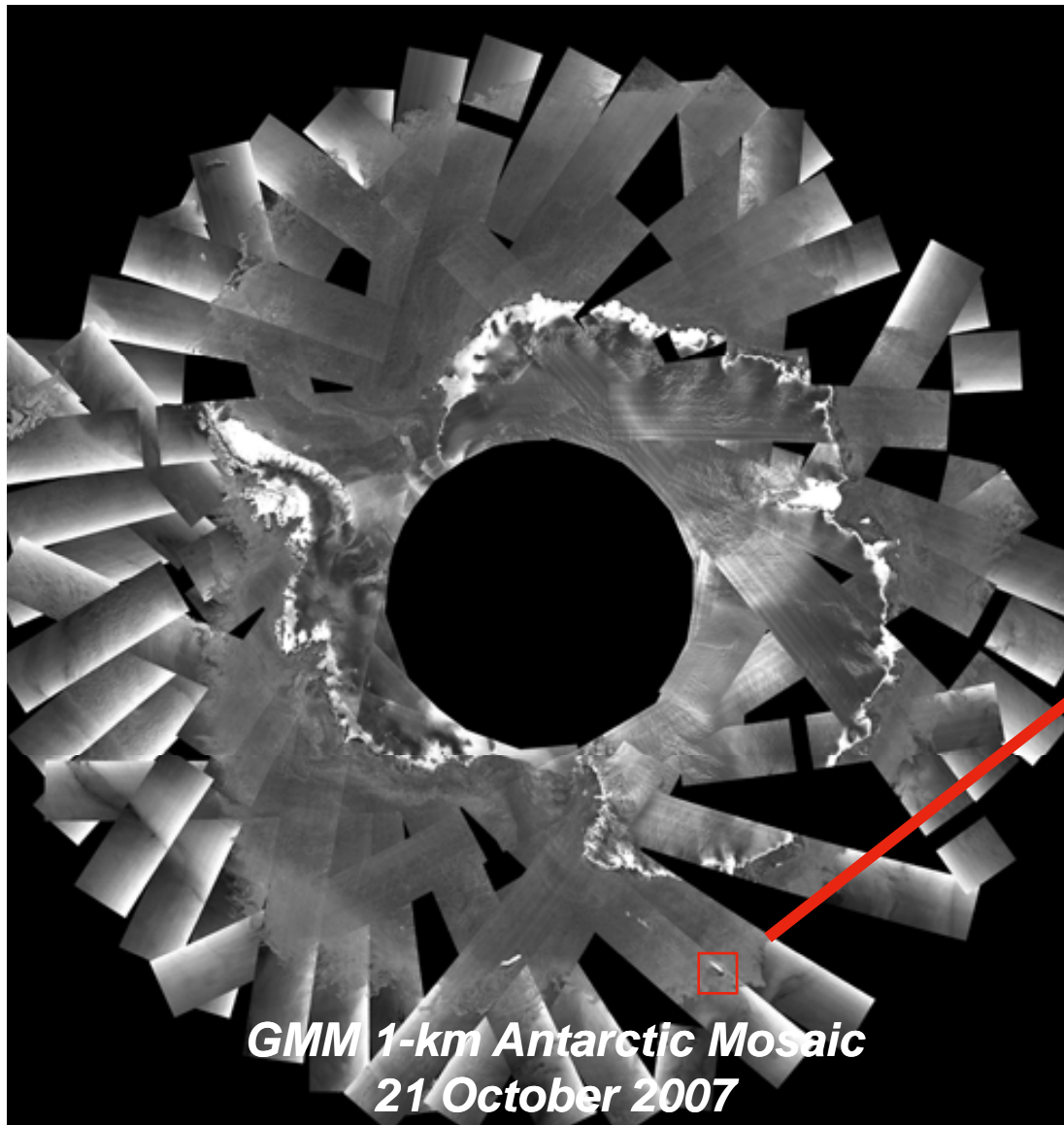
National Ice Center - Polar Science Team



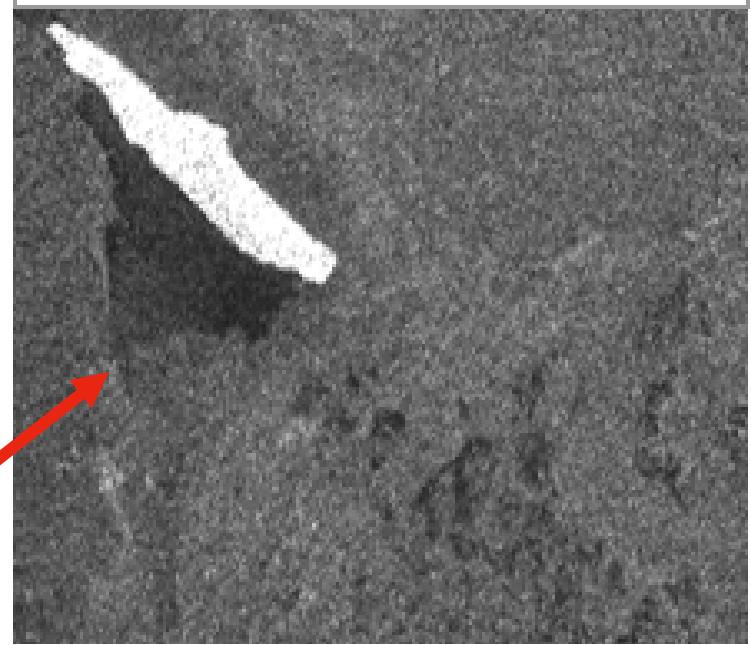
GMM 1-km Antarctic Mosaic
21 October 2007



Envisat ASAR GMM 3-day Mosaic



*GMM 1-km Antarctic Mosaic
21 October 2007*



EARTH OBSERVATION FOR POLAR MONITORING





SIMBA Sea Ice Deformation 2008 Palmer Antarctic Cruise



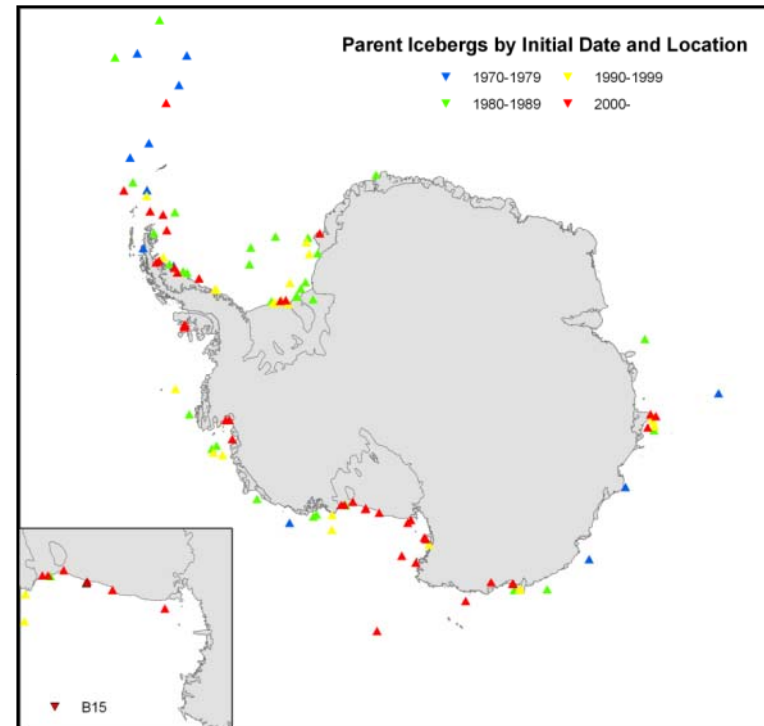


NIC Antarctic Iceberg Tracking Database

Antarctic Icebergs are identified and named based on quadrant and sequential number:

***A = 0-90W (Bellinghausen/Weddell Sea)
B = 90W-180 (Amundsen/Eastern Ross Sea)
C = 180-90E (Western Ross Sea/Wilkesland)
D = 90E-0 (Amery/Eastern Weddell Sea)***

Presently icebergs must be at least 10 nautical miles along the long axis, and must be south of 60S. (Exceptions made for operational requirements.)



Improved remote sensing technologies have enhanced NIC's capability of identifying and monitoring icebergs.

Analysts are primarily using ENVISAT imagery for Southern Hemisphere iceberg detection.

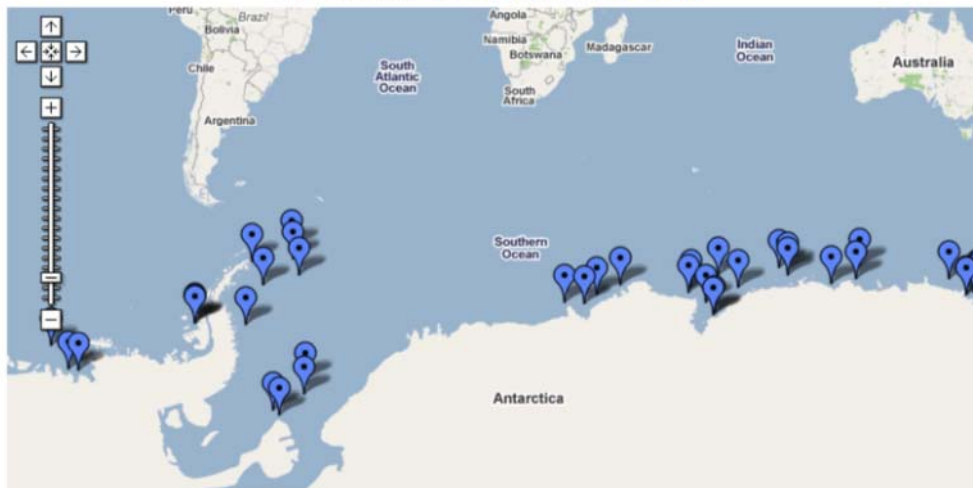
***The NIC iceberg website gets the most hits from the public.
<http://www.natice.noaa.gov/products/iceberg/>***



Antarctic Iceberg Tracking

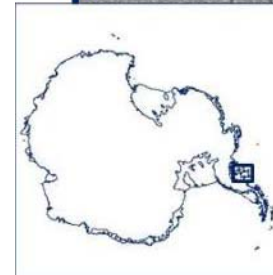
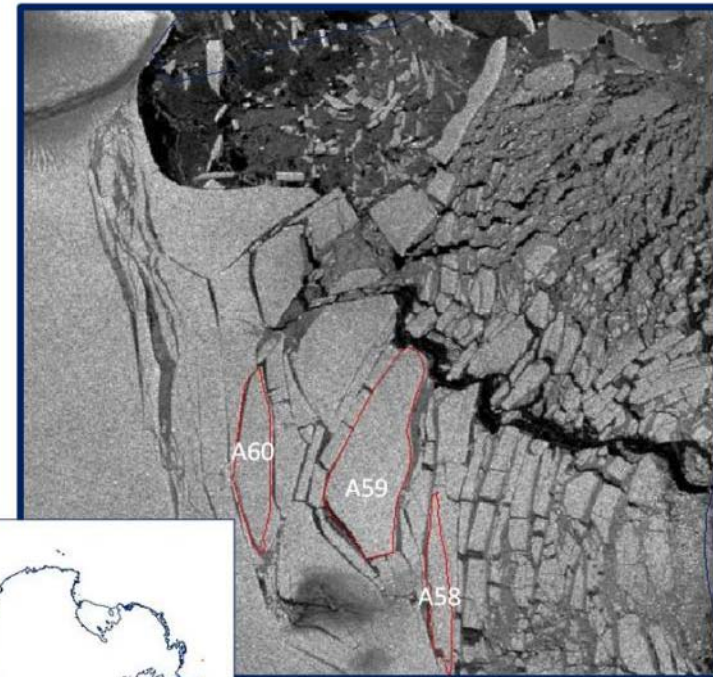


CURRENT ANTARCTIC ICEBERG POSITIONS



- ***Icebergs 10NM long and longer numbered and tracked.***
- ***Revisiting Requirements for Antarctic sea ice and iceberg products.***

Wilkins Ice Shelf



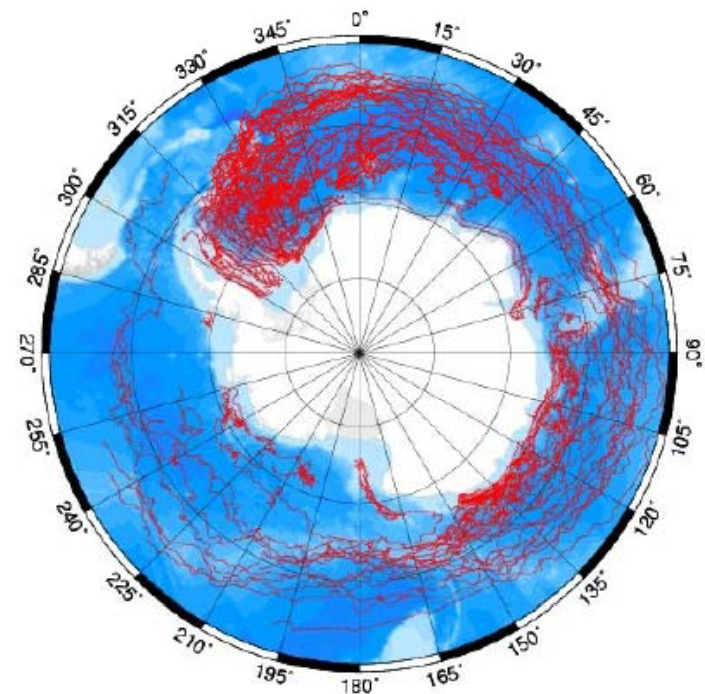
ENVISAT image from May 1, 2009

NIC continues to monitor icebergs calving from the northern front of the Wilkins Ice Shelf. Following the April 5, 2009 collapse of the ice bridge that connected the Antarctic mainland to Charcot Island, the area seems to have become destabilized with numerous icebergs calving from the remaining shelf ice. The NIC will only name and track those icebergs 10nm or longer.



International Programme for Antarctic Buoys

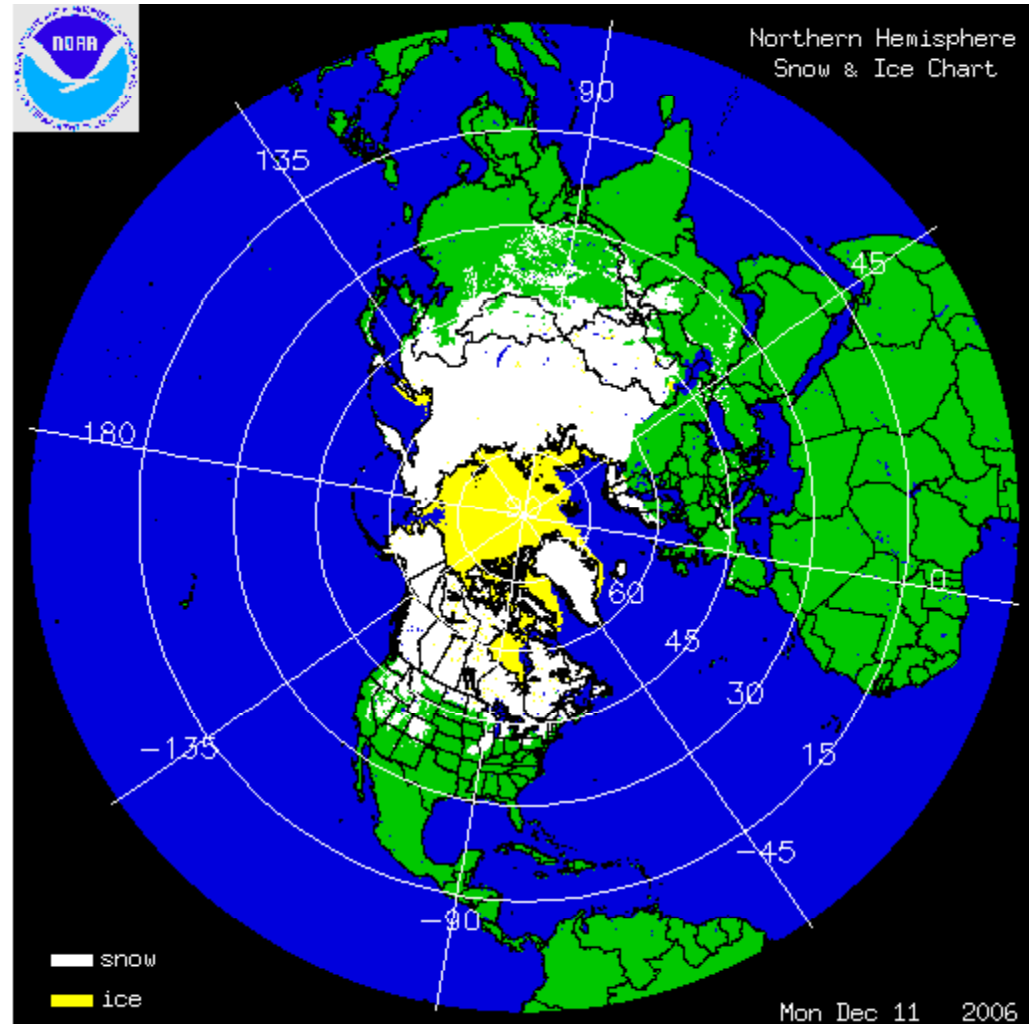
- *NIC participates in IPAB*
- *PSC and NIC are developing plans to establish a US interagency effort to maintain a network buoy observation in the main U.S. region of operations (Amundsen/Bellingshause and Ross Seas)*
- *This will include the airborne and shipborne deployment of ocean drifters, seasonal and ice mass balance buoys.*
- *An draft proposal for NSF is under review by potential collaborators.*





NIC Snow and Ice Product

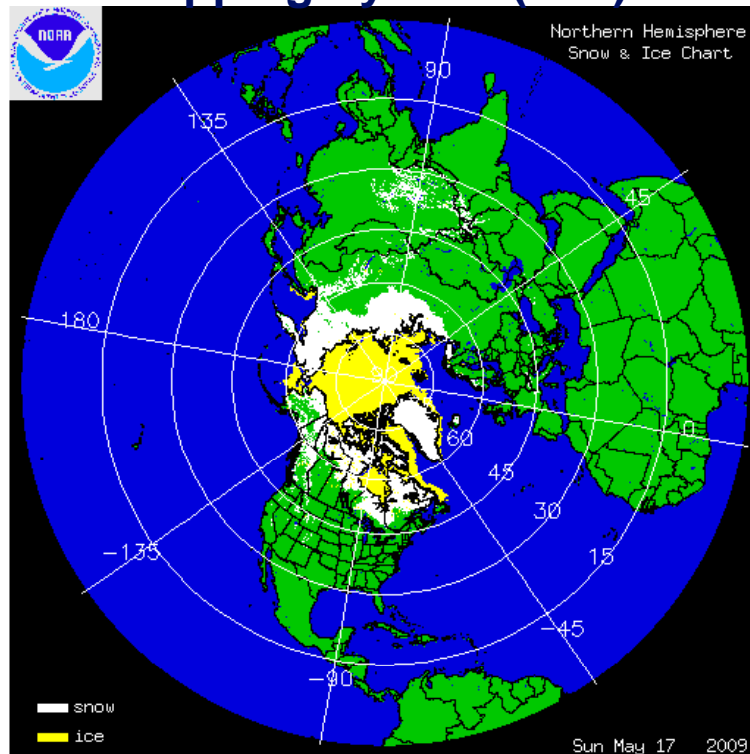
- ***Interactive Multi-sensor Snow and Ice Mapping System (IMS)***
- ***Transitioned from Satellite Analysis Branch (SAB) of NESDIS in 2008***
- ***Daily Northern Hemisphere snow and ice chart***
- ***Used as input into several NWS computer weather prediction models, and by many other agencies worldwide***





New Operational SII Product Under Development

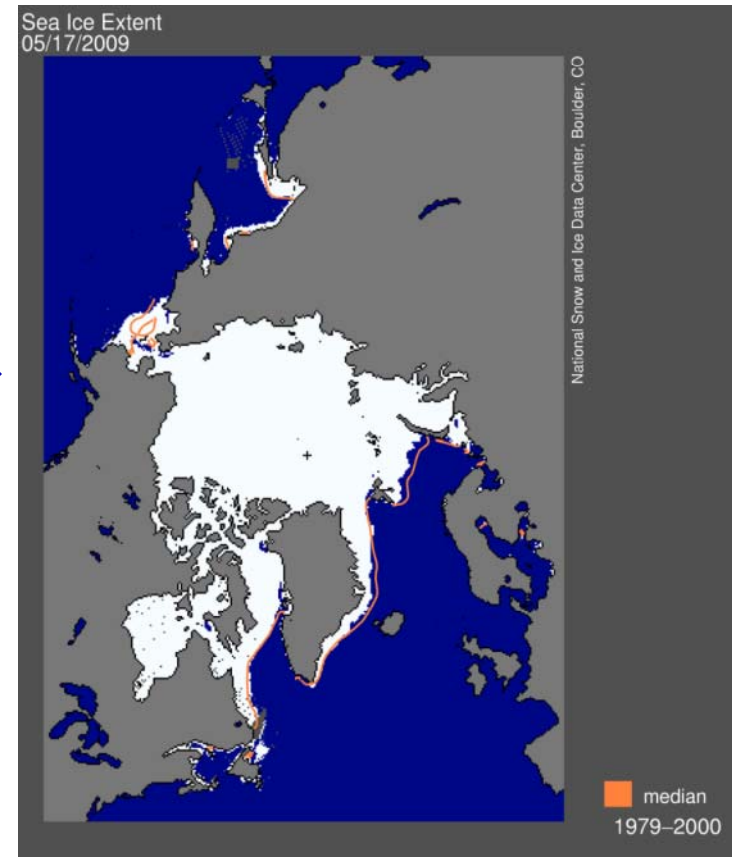
Interactive Multi-Sensor Snow and Ice Mapping System (IMS)



- 4km Daily Northern Hemisphere analysis

Inputs: Visible, Infrared, Microwave, Derived snow/ice products, Surface Observations

An Operational Sea Ice Index (OSII)

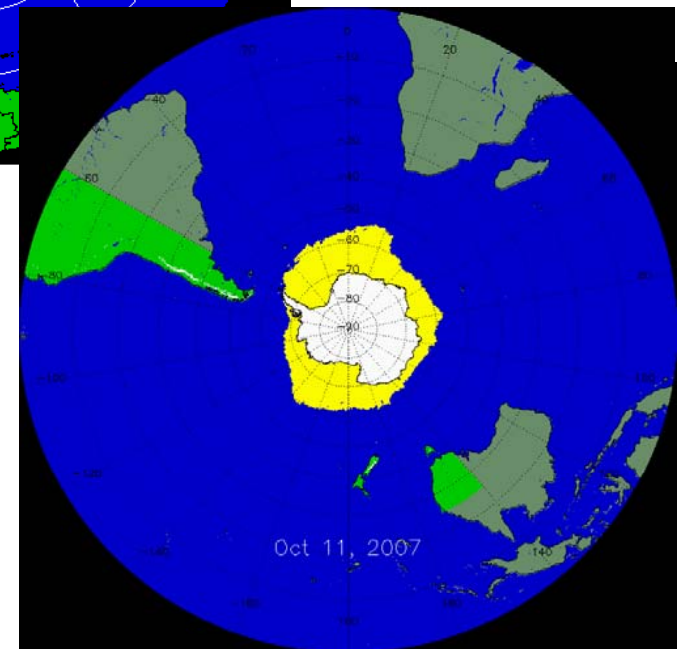
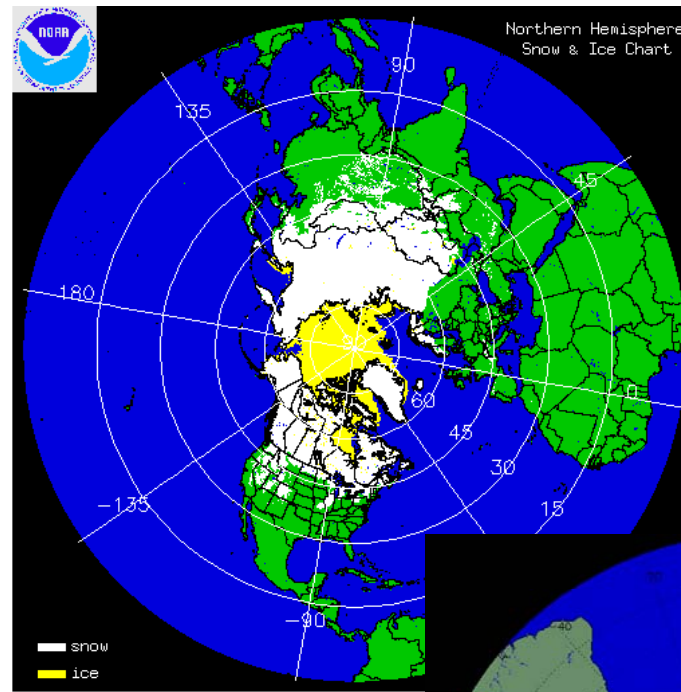


To complement the NASA-developed methods using passive-microwave data from the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSM/I).



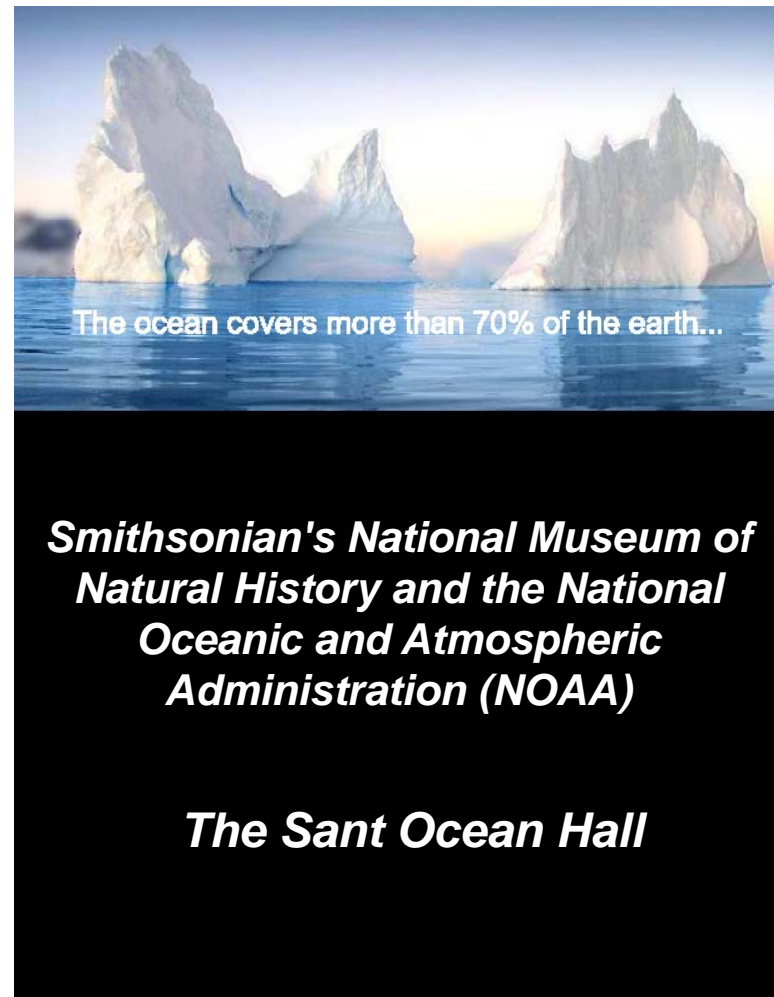
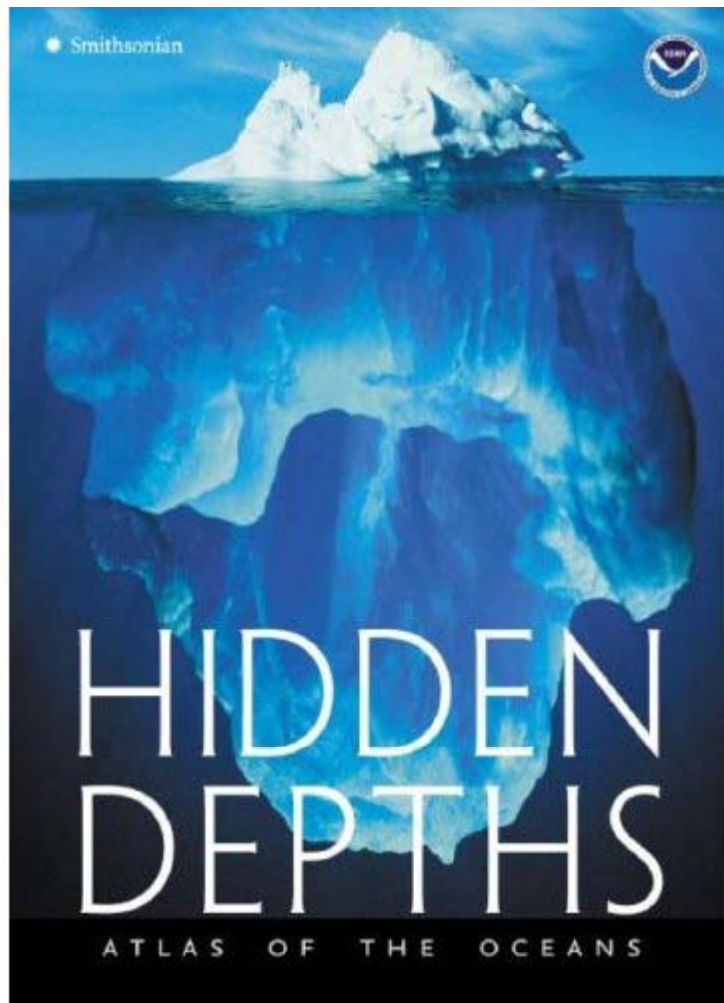
Plans for Global Snow and Ice Monitoring

- **Interactive Multi-sensor Snow and Ice Mapping System (IMS) for daily Northern Hemisphere snow and ice chart**
- **Implement and refine the NESDIS/STAR Auto-snow algorithm and product for the Southern Hemisphere**





IPY Contributions to the Smithsonian





2011 APLIS SEDNA Plans

- *Beaufort Sea APLIS are planned to take place every two years.*
- *ASL would be once again open to an unclassified component.*
- *NSF have expressed interest in supporting a full unclassified component then.*
- *ONR, NOAA, CRREL, NASA, USARC, and many other organizations are interested in seeing this happen and look forward to strong inter-agency collaboration.*
- *The SEDNA team has started to develop a proposal based on the findings as well as new questions raised by the 2007 experiments.*
- *Perhaps the sea ice will cooperate and we will still have a good MYI floe to establish the ice camp.*





ESA Kopernikus dedicated missions: Sentinel-1

Sentinel-1: C-band SAR mission



Sentinel-1a: launch end 2011

Sentinel-1b: foreseen 2014

Applications:

- monitoring sea ice zones and the arctic environment
- surveillance of marine environment
- monitoring land surface motion risks
- mapping in support of humanitarian aid in crisis situations

4 nominal operation modes:

- strip map (80 km swath, 5X5 m res.)
- interferometric wide swath (250 km swath, 20X5 m res.)
- extra wide swath (400 km swath, 25X100 m res.)
- wave (5X20 m res.)

2300 Kg spacecraft mass

Sun synchronous orbit at 693 Km mean altitude

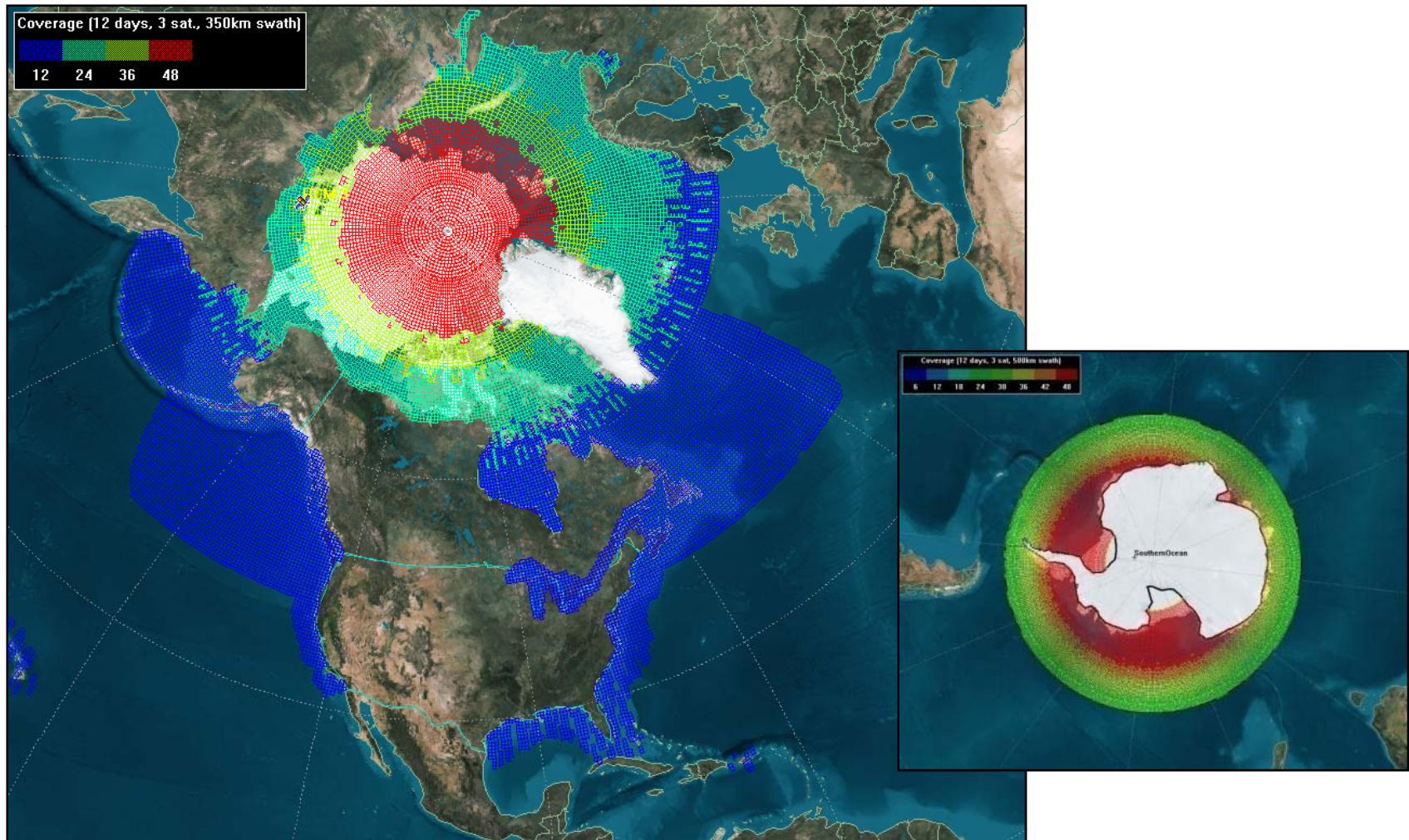
12 days repeat cycle

7 years design life time, consumables for 12 years



CSA RADARSAT Constellation Mission (RCM)

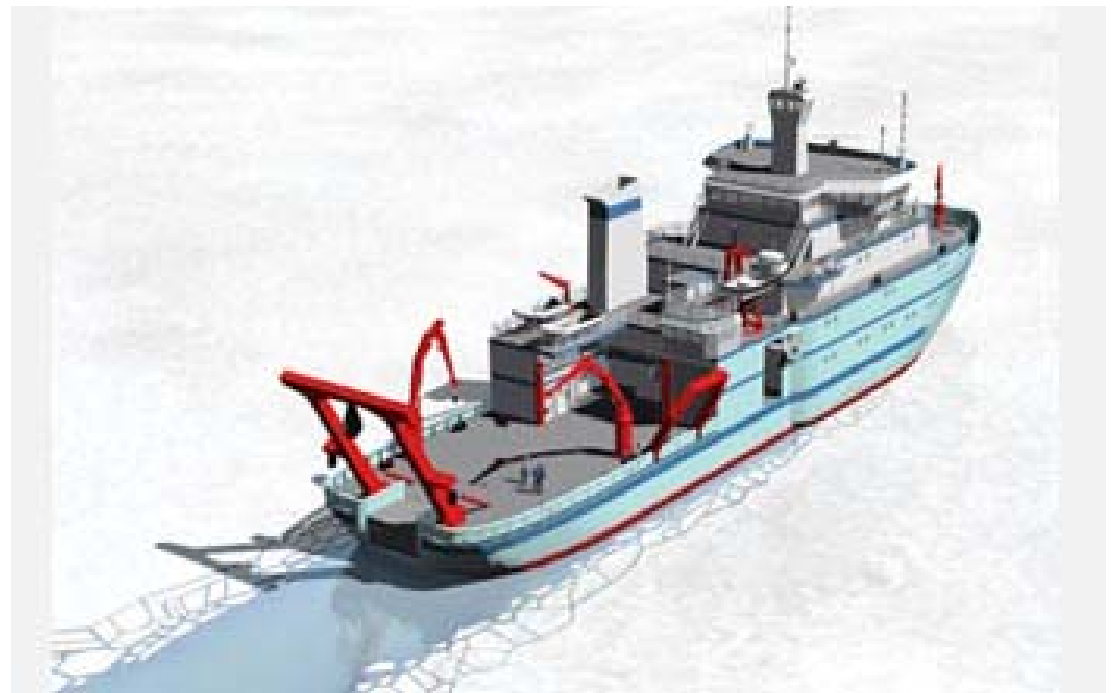
Total Canadian + US maritime zones with 350 km swath





NSF Announced First Major Award Under American Recovery and Reinvestment Act to the Alaska Region Research Vessel (ARRV)

- A 242-foot research ship that has a hull designed specifically to operate in seasonal Arctic sea ice and open waters surrounding Alaska.***
- Will carry more than 500 researchers and students annually and spend as many as 300 days per year at sea.***
- Will allow researchers to work in moderate ice-covered waters.***
- Delivery of the vessel is anticipated for 2013 with science operations beginning in 2014.***





Arctic Ice-Diminishing Impacts Symposium Series

Symposium: Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations



**July 10-12, 2007
U.S. Navy Memorial & Naval Heritage Center
701 Pennsylvania Avenue, N.W.
Washington, DC**



Sponsored by: National Ice Center and United States Arctic Research Commission

3rd Symposium on the **Impacts of an Ice-Diminishing Arctic** on **Naval & Maritime Operations**

**Co-hosted by
The U.S. National Ice Center & The U.S. Arctic Research Commission**

**June 9-11, 2009
U.S. Naval Academy
Annapolis, MD**



<http://www.star.nesdis.noaa.gov/star/IceSymposium.php>