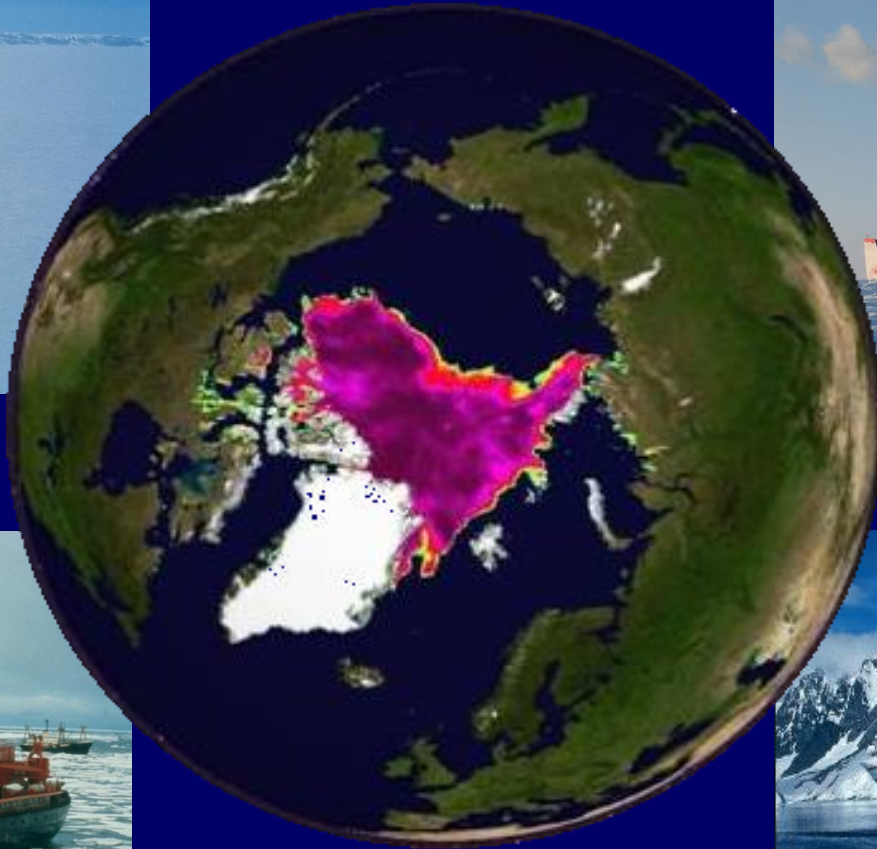


# The Changing Maritime Arctic: Space Needs for Marine Operations

*University of North Dakota, Department of Space Studies*

**Grand Forks, ND ~ 18 January 2011**



**Lawson W. Brigham, PhD**

**Professor, University of Alaska Fairbanks**

**Chair, Arctic Marine Shipping Assessment (2005-09)**

# **Topics ~ UND Presentation:**

- **Changing Arctic Marine Access**
  - **Current Arctic Marine Use**
- **Arctic Marine Shipping Assessment  
2009 Report**
  - **Post-AMSA Workshop Report**
  - **Review ~ Arctic Space Assets**

# Arctic Marine Geography

## CHALLENGES & RISKS

Northwest Passage

Draft

Intra-Arctic Route

Choke Point

Central Arctic Ocean Route (2100-nm)

Sea Ice

Cold Climate Ice-Free Ops

### Arctic Ocean Marine Routes

Arctic Marine Shipping Assessment of the Arctic Council (2005-2008)

- Northern Sea Route ●
- Northwest Passage ●
- Key Marine Routes

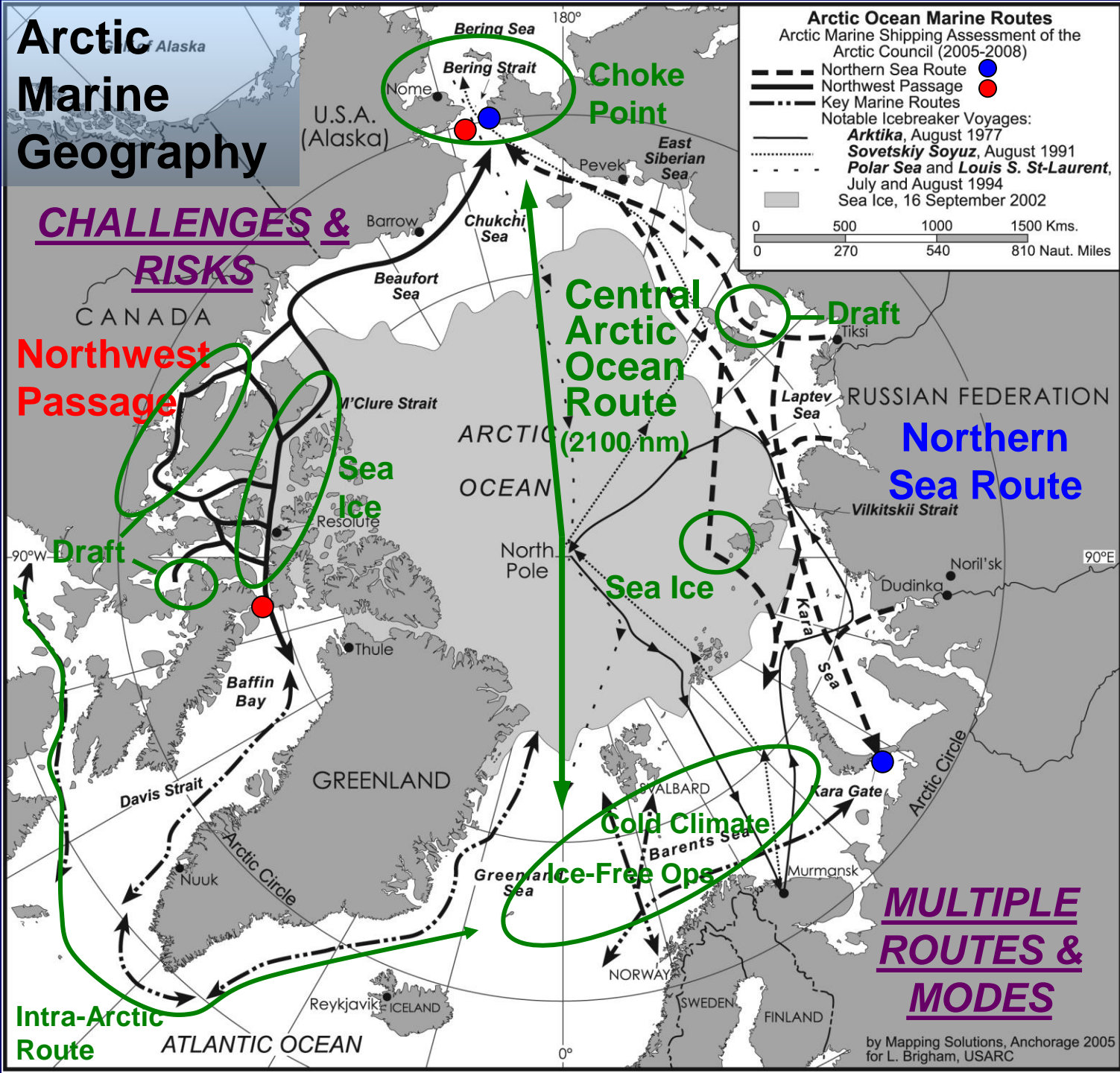
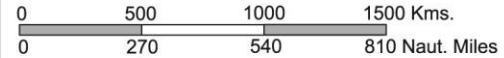
Notable Icebreaker Voyages:

*Arktika*, August 1977

*Sovetskiy Soyuz*, August 1991

*Polar Sea* and *Louis S. St-Laurent*, July and August 1994

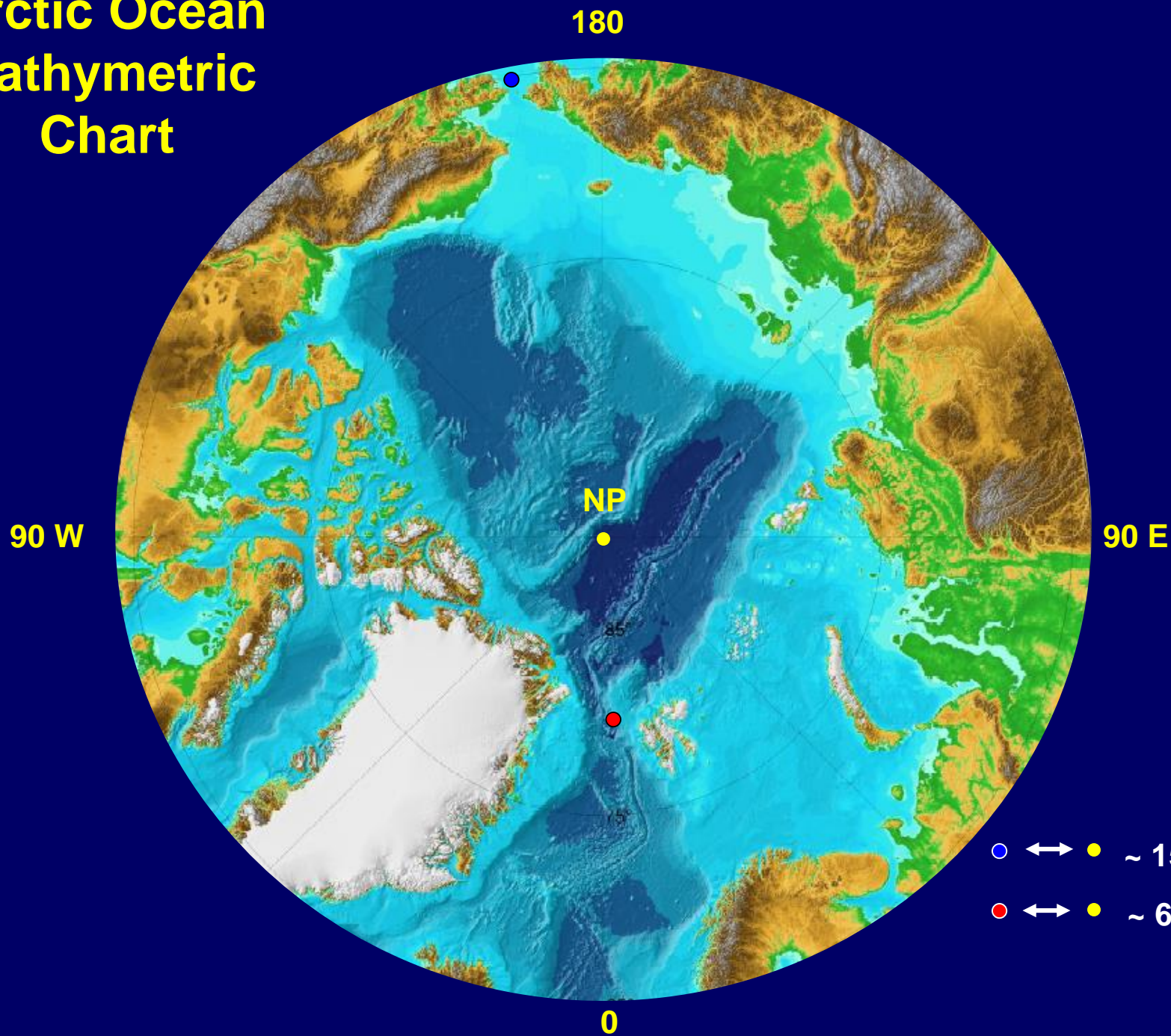
Sea Ice, 16 September 2002



## MULTIPLE ROUTES & MODES



# Arctic Ocean Bathymetric Chart









**2004 – 2009**

**Arctic Council ~ Intergovernmental Forum**

**AMSA Lead Countries for PAME ~ Canada, Finland & USA**

**AMSA Focus ~ Marine Safety & Marine Environmental Protection**

**13 Major Workshops & 14 Town Hall Meetings**

**Key Challenge ~ Many Non-Arctic Stakeholders**



Arctic Ministers' Approval 29 April 2009 ~  
Negotiated Text

Arctic Council  
Arctic Marine Shipping  
Assessment 2009 Report



**Table of Contents**

- Executive Summary with Recommendations
- Arctic Marine Geography Climate & Sea Ice
- History
- Governance
- Current Use/Database
- Scenarios to 2020 & 2050
- Human Dimensions
- Environmental Impacts
- Infrastructure



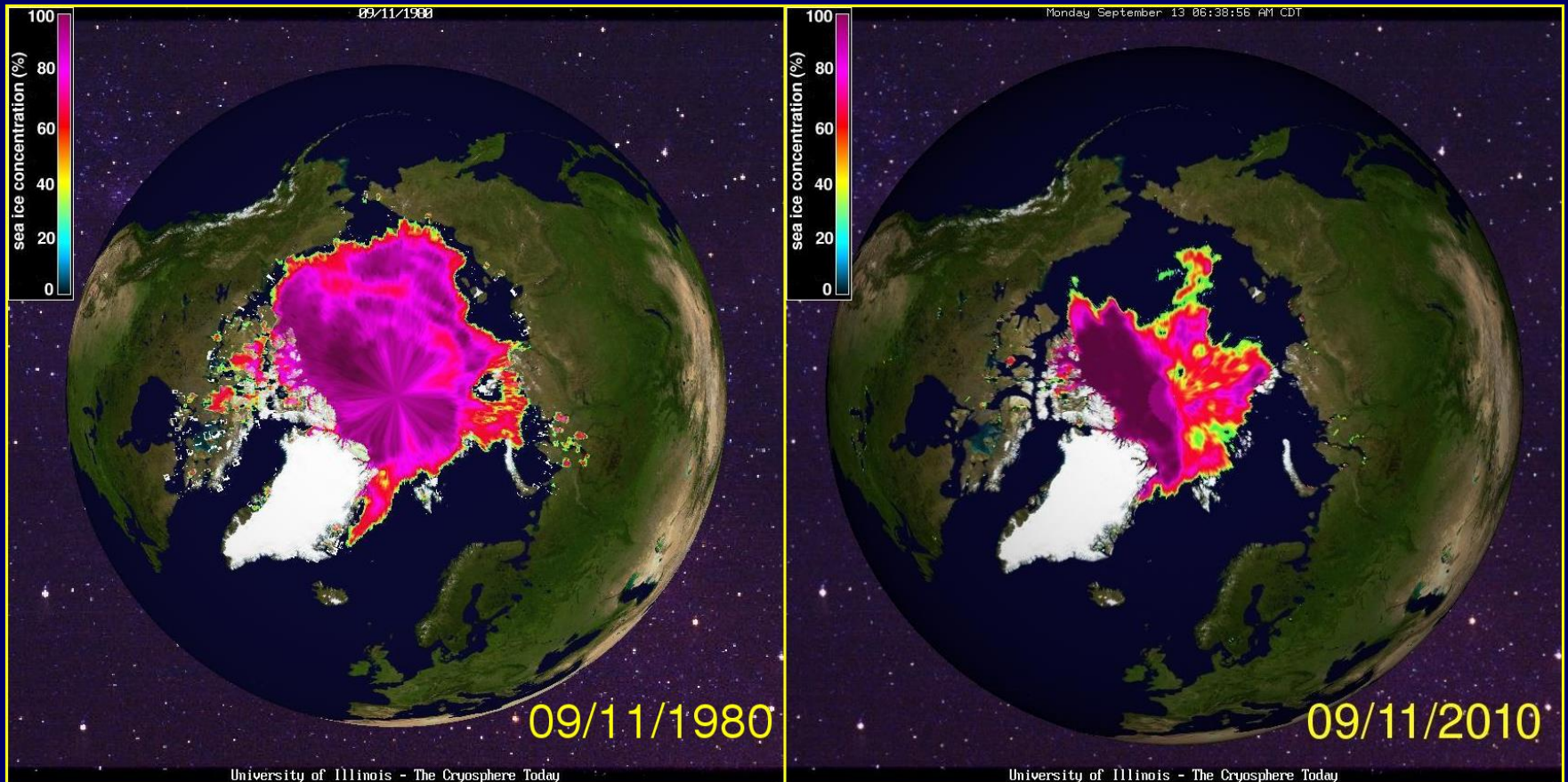
ARCTIC COUNCIL  
OF NORTH AMERICA AND  
EUROPE  
2016/2019

PAME  
Partnership of the Arctic Marine Environment

[www.pame.is](http://www.pame.is)

**11 September 1980**

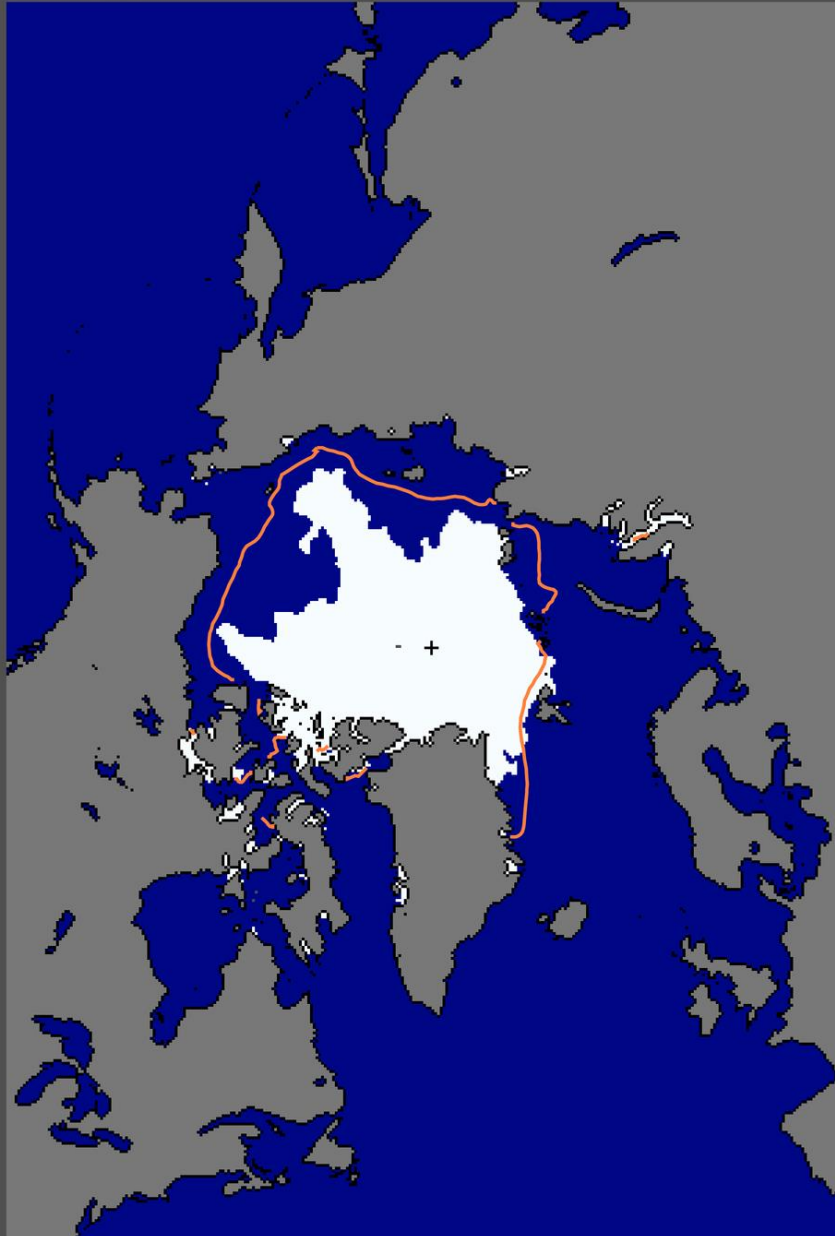
**11 September 2010**



**Source: University of Illinois – *The Cryosphere Today***



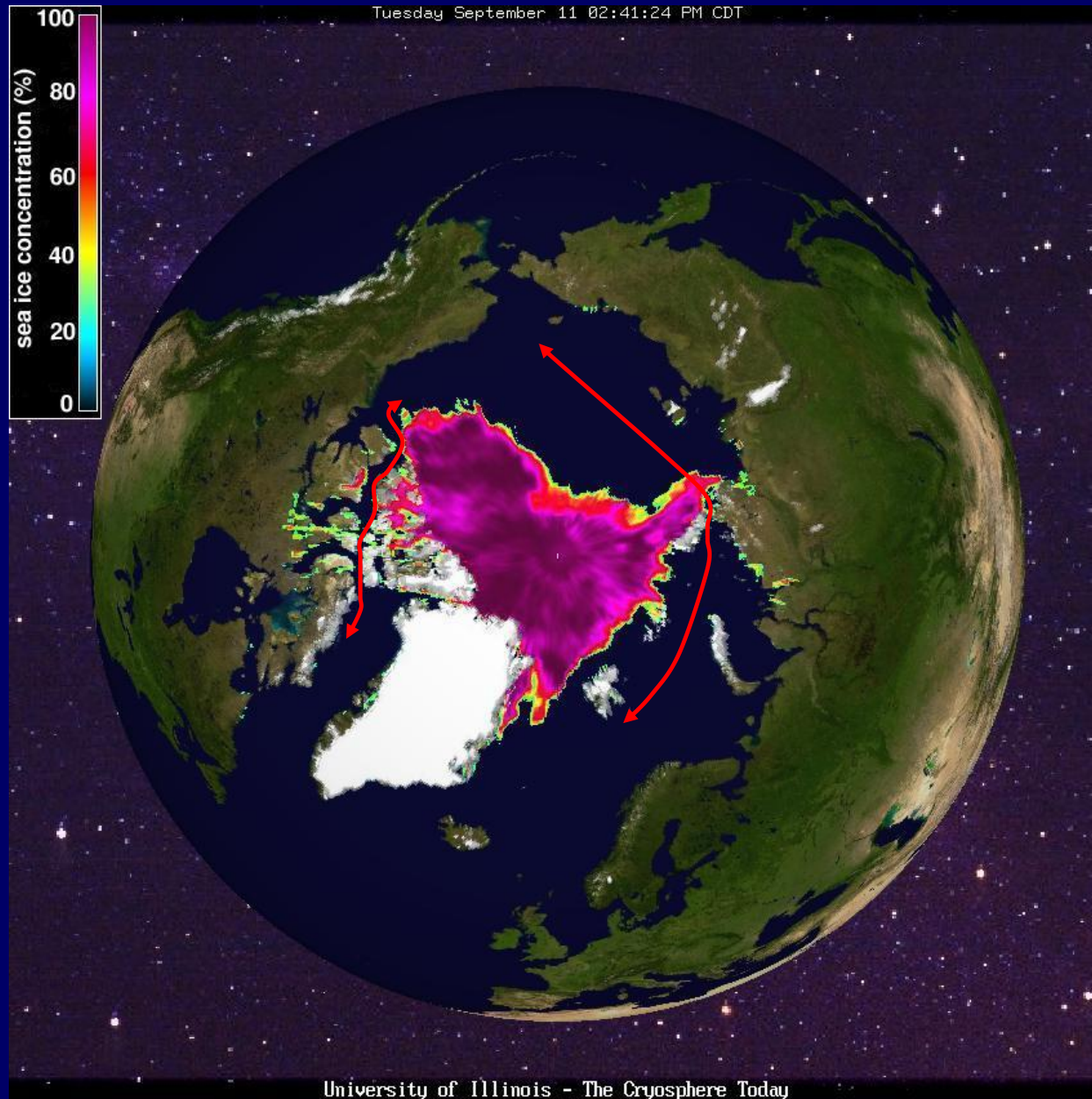
Sea Ice Extent  
09/10/2010



National Snow and Ice Data Center, Boulder, CO

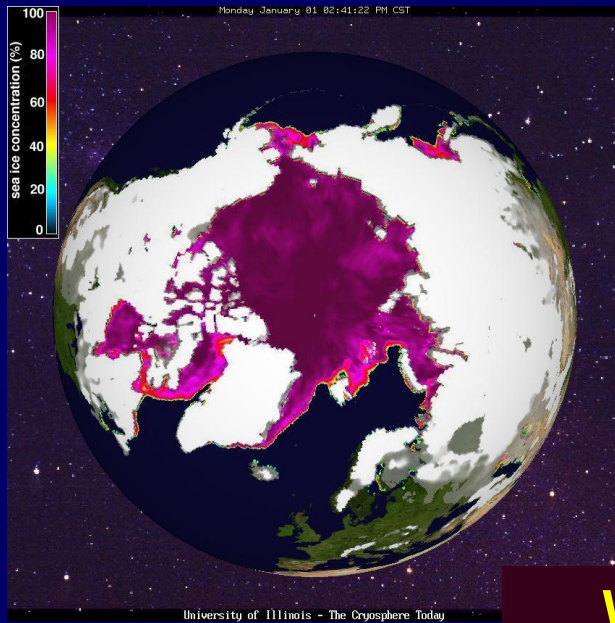
median  
1979–2000

# 11 September 2007

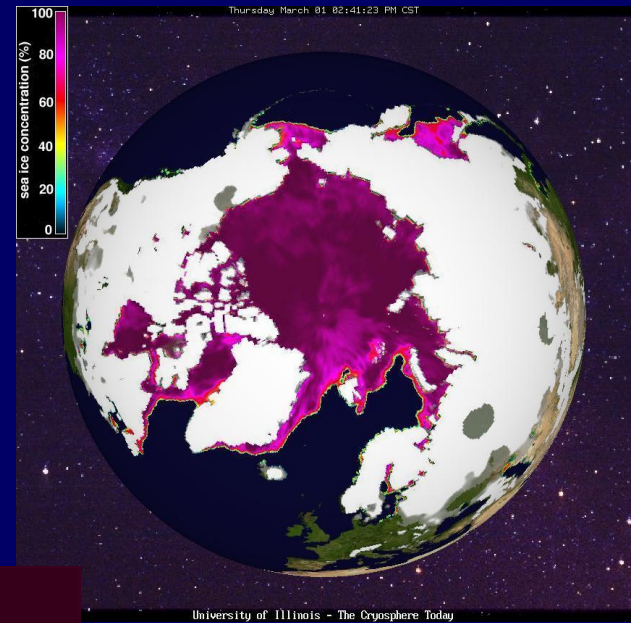




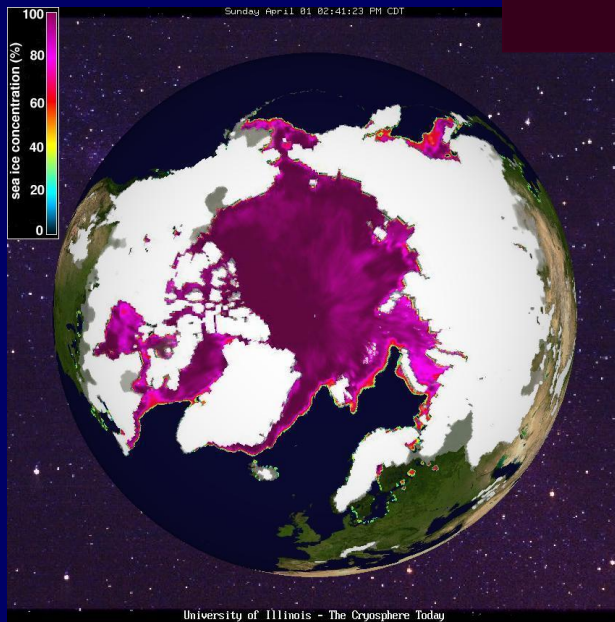
**1 January 2007**



**1 March 2007**

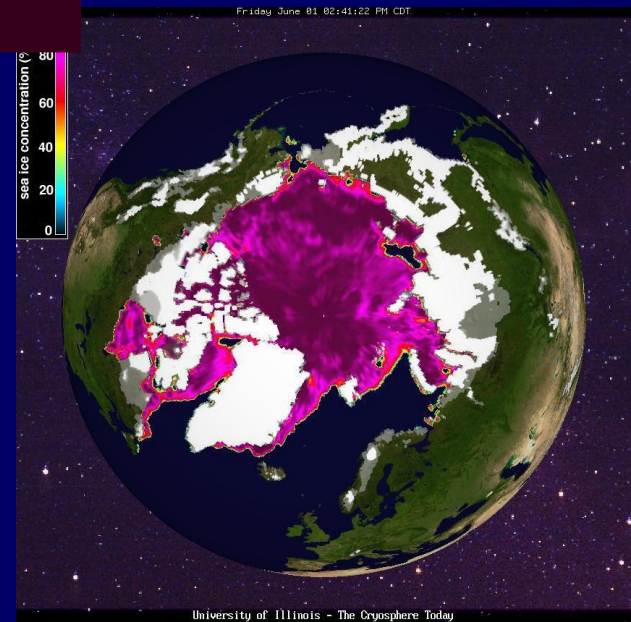


**1 April 2007**

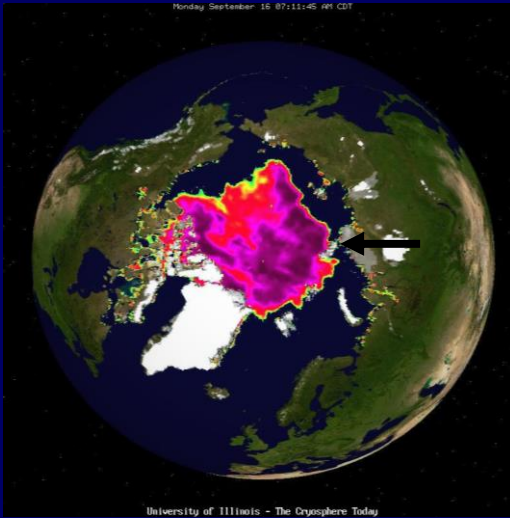


**Winter &  
Spring Months  
2007**

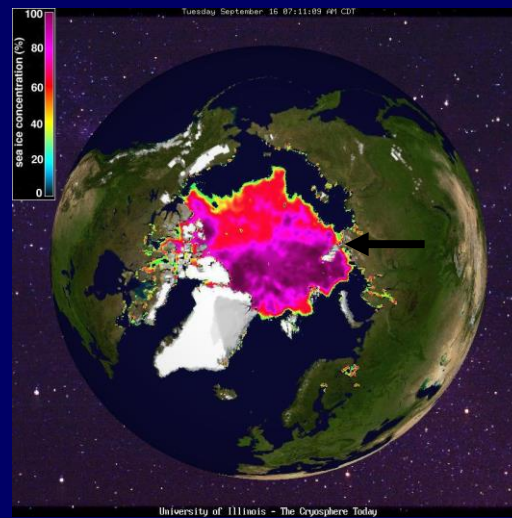
**1 June 2007**



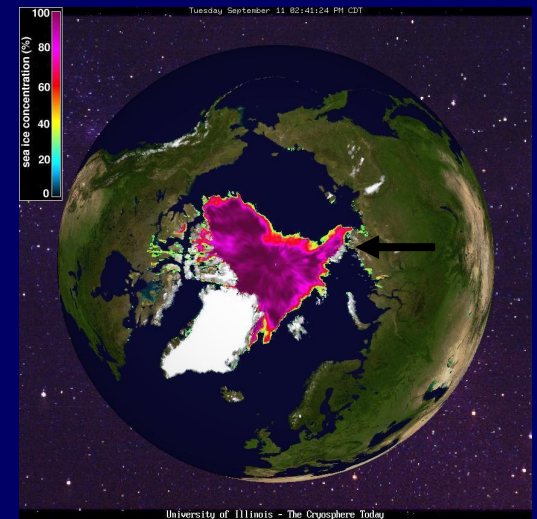
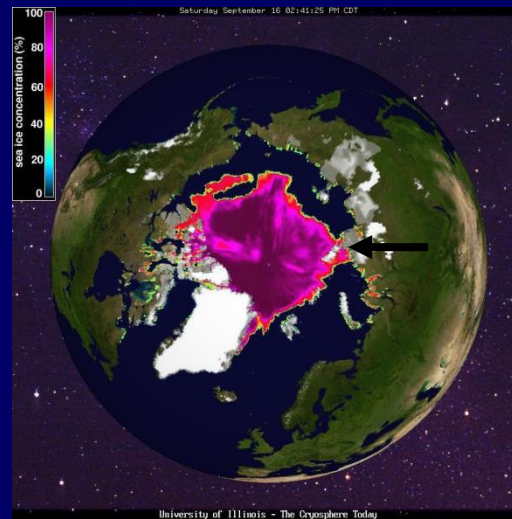
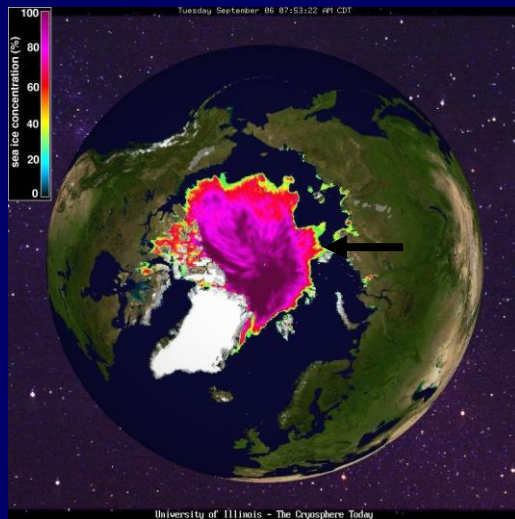
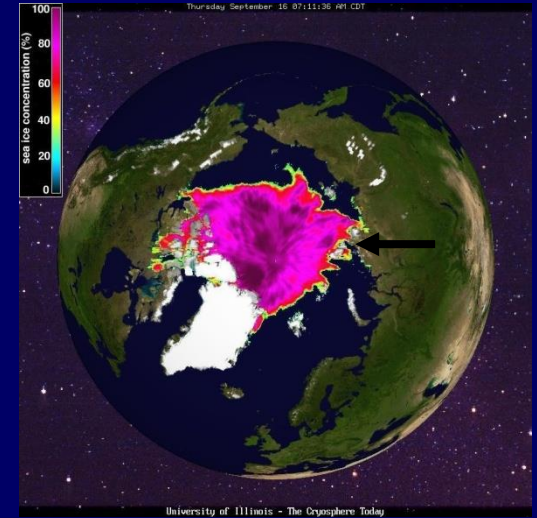
**16 September 2002**



**16 September 2003**



**16 September 2004**



**6 September 2005**

**16 September 2006**

**11 September 2007**

**Challenges & Risks ~ Year-to-Year Sea Ice Variability in Vilkitski Strait**





August 1994





May 1987

# Satellite Observing Systems for Ice Navigation

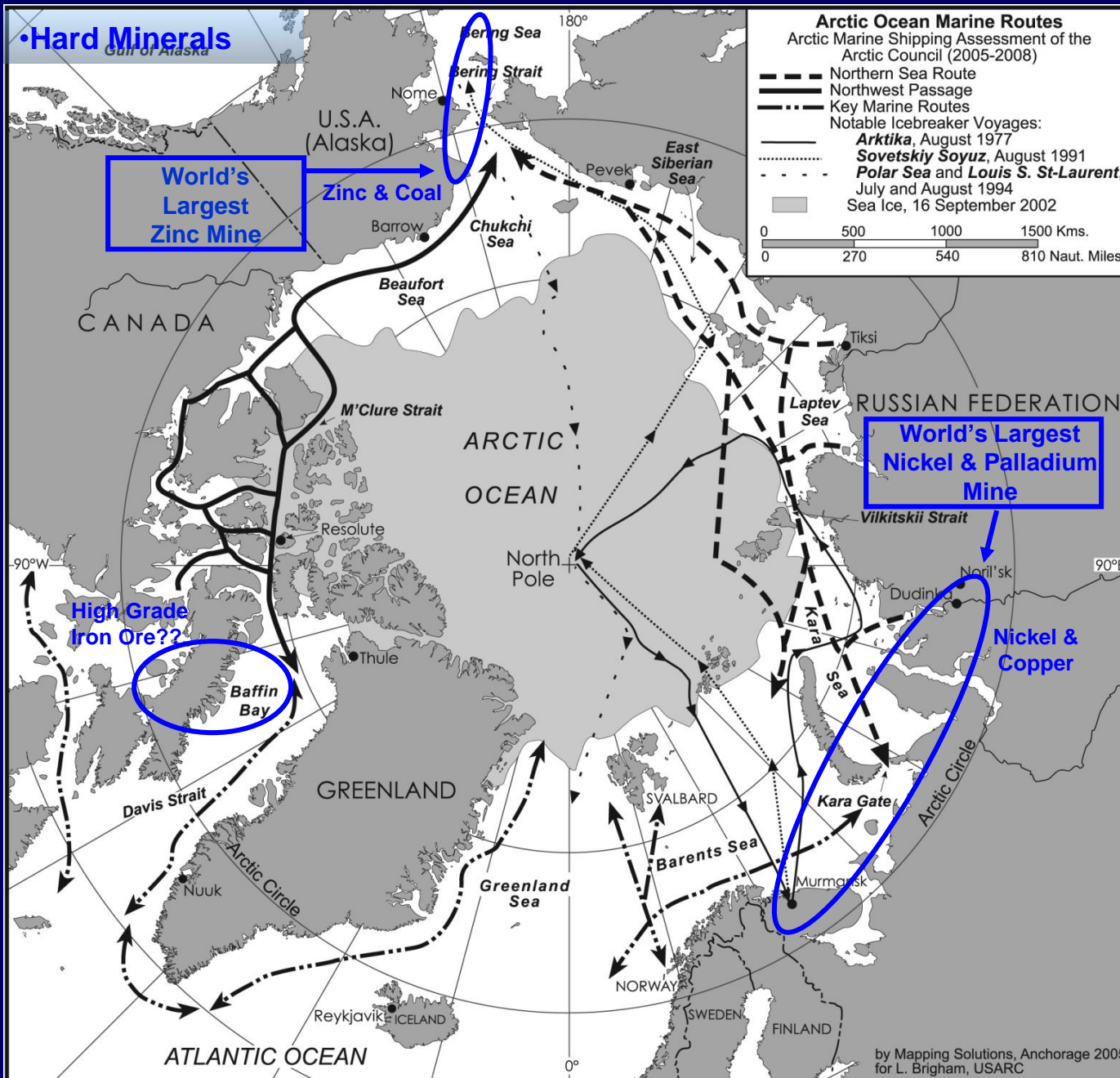
- ***Low Resolution: PMW & Scatterometers***  
10-50km; sea ice edge, concentration, ice drift;  
large scale info; real-time delivery
- ***High Resolution: SAR, Optical & Infrared***  
50 km down to 10m; ice floes, ridges, surface  
roughness, ice thickness limited; small scale info;  
near real-time delivery

# **(A) Space Assets~ Monitoring the Physical Environment**

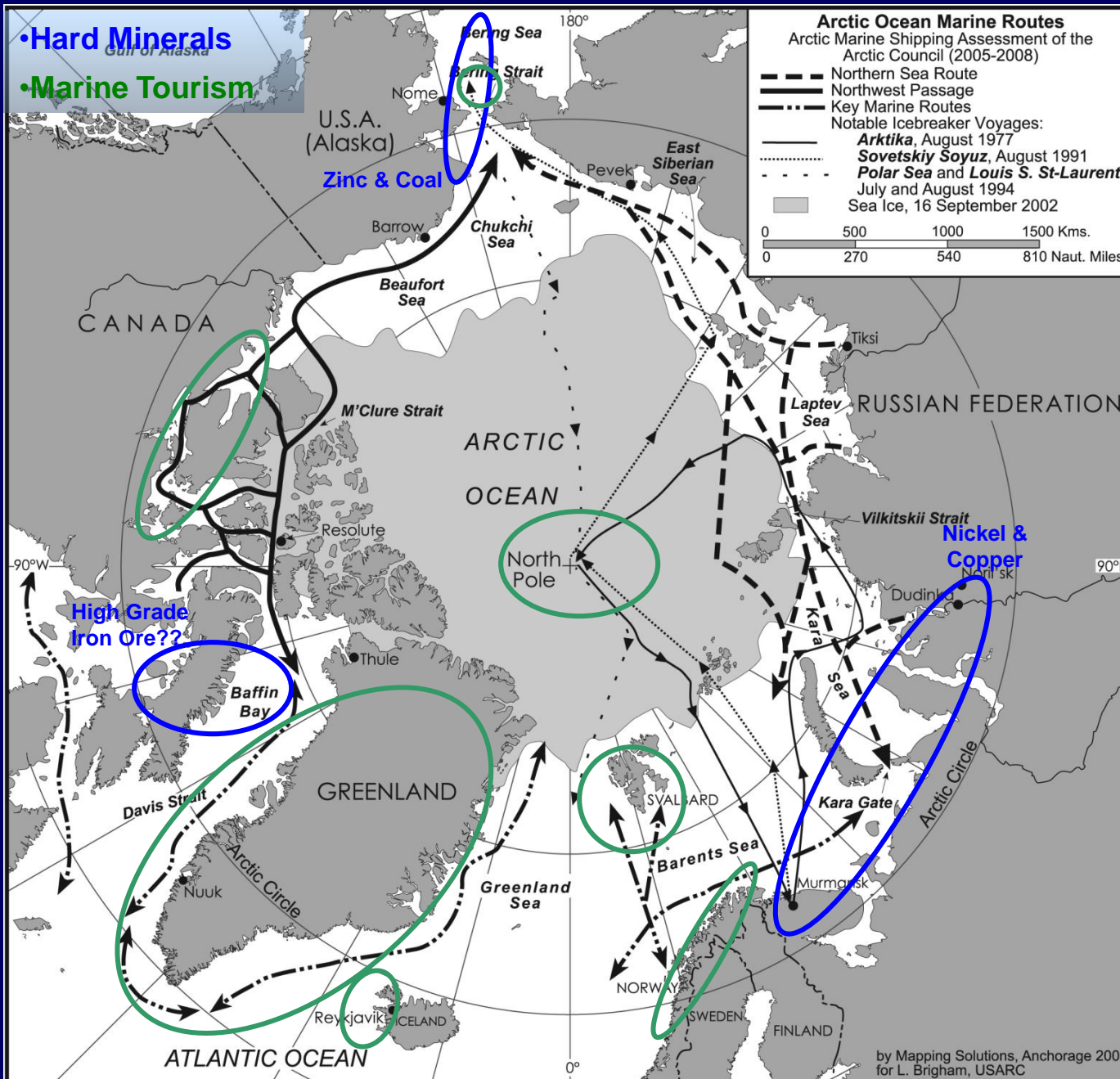
- **Continued Passive Microwave Record of Sea Ice Retreat ~ Lower resolution, circumpolar coverage**
- **Improved Satellite Sea Ice Thickness Measurements ~ Real-time observations**
- **Enhanced Satellite SAR Coverage ~ Route optimized for improved safety**
- **Meteorological Satellite Challenge ~ Geo-stationary locations limit coverage in the Arctic**
- **Continued lack of U.S. SAR Satellite ~ U.S. Arctic sea ice coverage**



# Today's Arctic Commercial Marine Use



# Today's Arctic Commercial Marine Use

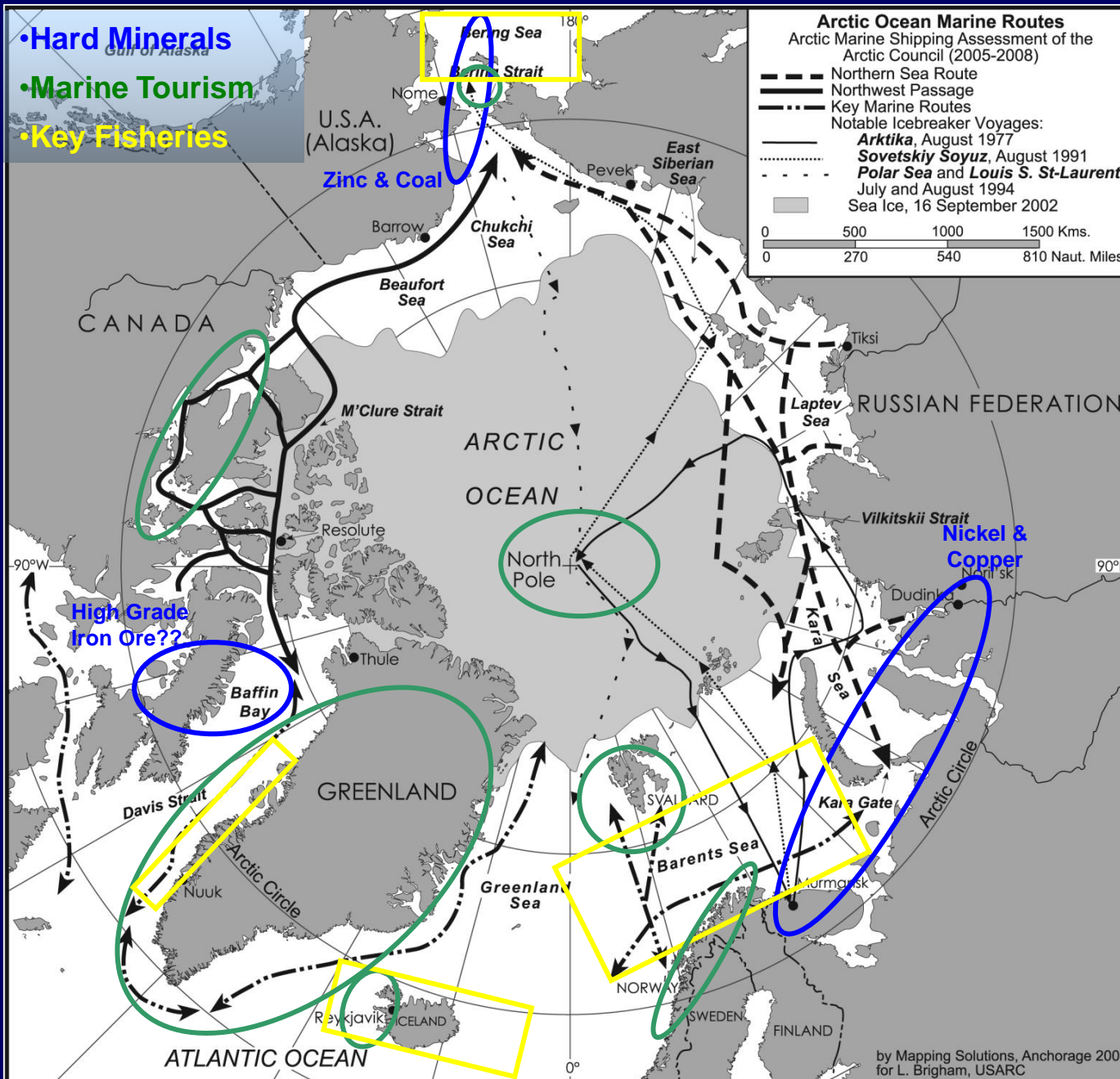




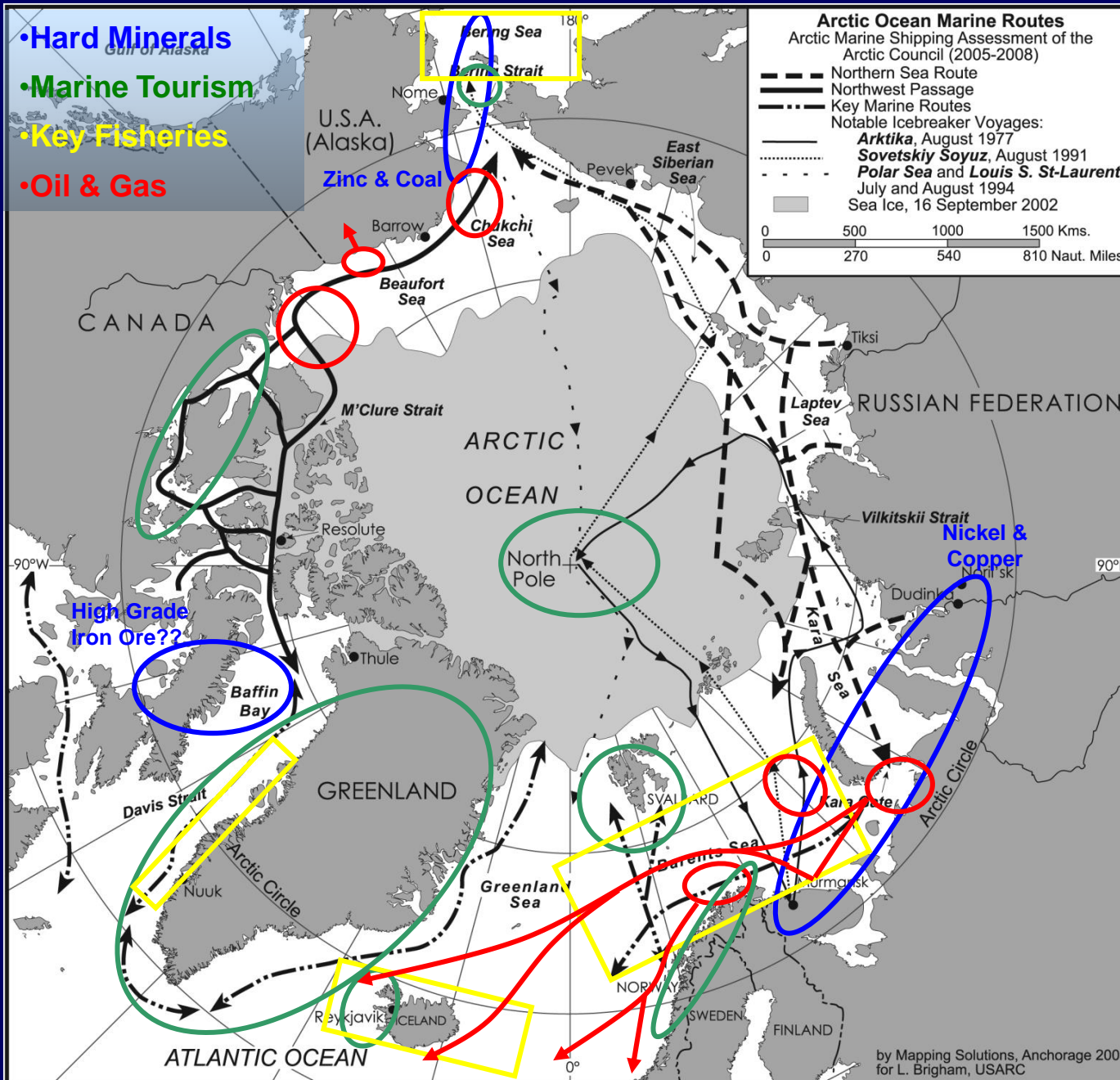
# Arctic Cruising



# Today's Arctic Commercial Marine Use



# Today's Arctic Commercial Marine Use





# Варандейский нефтяной отгрузочный терминал

- ✓ Объем транспортировки – 12 млн. т сырой нефти в год
- ✓ Навигационный период – 365 дней
- ✓ Порт назначения – порты Европы и Северной Америки

МЕСТОРОЖДЕНИЯ ТИМАНО-ПЕЧОРСКОЙ НЕФТЕГАЗОНОСНОЙ ПРОВИНЦИИ

БЕРЕГОВОЙ РЕЗЕРВУАРНЫЙ ПАРК 325 000 М<sup>3</sup>

БАРЕНЦЕВО МОРЕ

НЕНЕЦКИЙ АУТОНОМНЫЙ ОКРУГ

СМЛОП "ВАРАНДЕЙ"

ЛУКОЙЛ

Танкер усиленного ледового класса девейтом 70 646,6 тонн

СТАЦИОНАРНЫЙ МОРСКОЙ ЛЕДОСТОЙКИЙ ОТГРУЗОЧНЫЙ ПРИЧАЛ

ВЕС 14.000 ТОНН  
ВЫСОТА 65,5  
ГЛУБИНА МО

ВАРАНДЕЙСКИЙ НЕФТЯНОЙ ОТГРУЗОЧНЫЙ ТЕРМИНАЛ ПРЕДНАЗНАЧЕН ДЛЯ ЭКСПОРТА МОРСКИМ ПУТЕМ НЕФТИ, ДОБЫВАЕМОЙ ЛУКОЙЛОМ В ТИМАНО-ПЕЧОРСКОЙ НЕФТЕГАЗОНОСНОЙ ПРОВИНЦИИ. ТЕРМИНАЛ ПРЕДСТАВЛЯЕТ СОБОЙ УНИКАЛЬНУЮ, НЕ ИМЕЮЩУЮ АНАЛОГОВ В МИРОВОЙ ПРАКТИКЕ, СИСТЕМУ МОРСКОЙ ТРАНСПОРТИРОВКИ БОЛЬШИХ ОБЪЕМОВ НЕФТИ В АРКТИКЕ.

ВНОТ ДАЕТ ВОЗМОЖНОСТЬ С НАИМЕНЬШИМИ ЗАТРАТАМИ КРУПНОГОДИЧНО ЭКСПОРТИРОВАТЬ НЕФТЬ ПРИ СОХРАНЕНИИ ЕЕ КАЧЕСТВА ПО КРАТЧАЙШЕМУ МОРСКОМУ ПУТИ ДО ЕВРОПЕЙСКОГО И СЕВЕРОАМЕРИКАНСКОГО РЫНКОВ. ТЕРМИНАЛ ЯВЛЯЕТСЯ ВАЖНЕЙШИМ ЭЛЕМЕНТОМ ИНФРАСТРУКТУРЫ, КОТОРАЯ ПОЗВОЛЯЕТ ВЕСТИ ОБУСТРОЙСТВО НОВЫХ МЕСТОРОЖДЕНИЙ В ТИМАНО-ПЕЧОРСКОЙ НЕФТЕГАЗОНОСНОЙ ПРОВИНЦИИ

Толщина льда 1,25 – 1,8 м.  
Средняя продолжительность ледового периода – 213 дней.

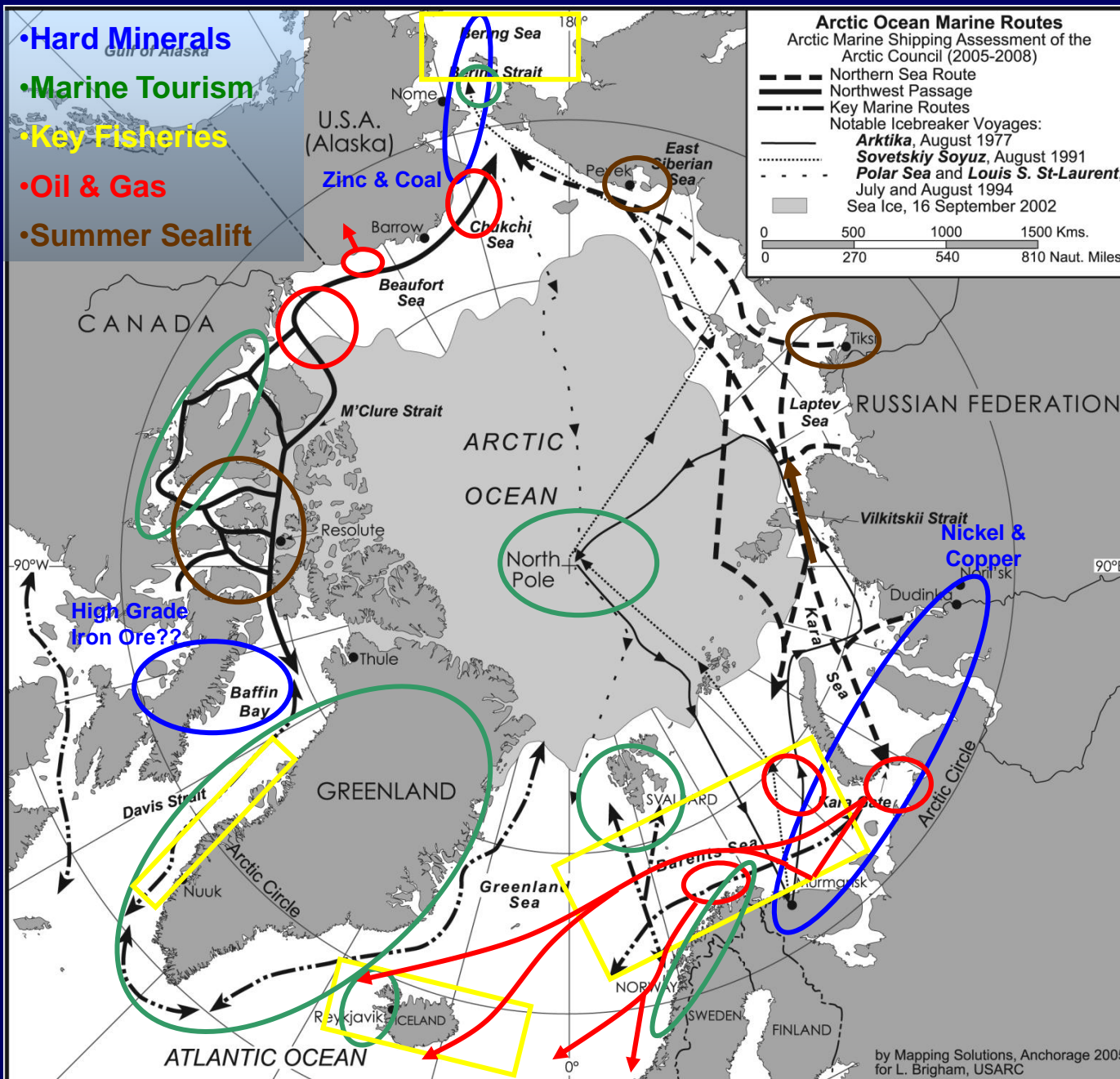
ДВЕ НИТКИ ПОДВОДНОГО ТРУБОПРОВОДА: ДЛИНА 22,6 КМ, ДИАМЕТР 820 ММ





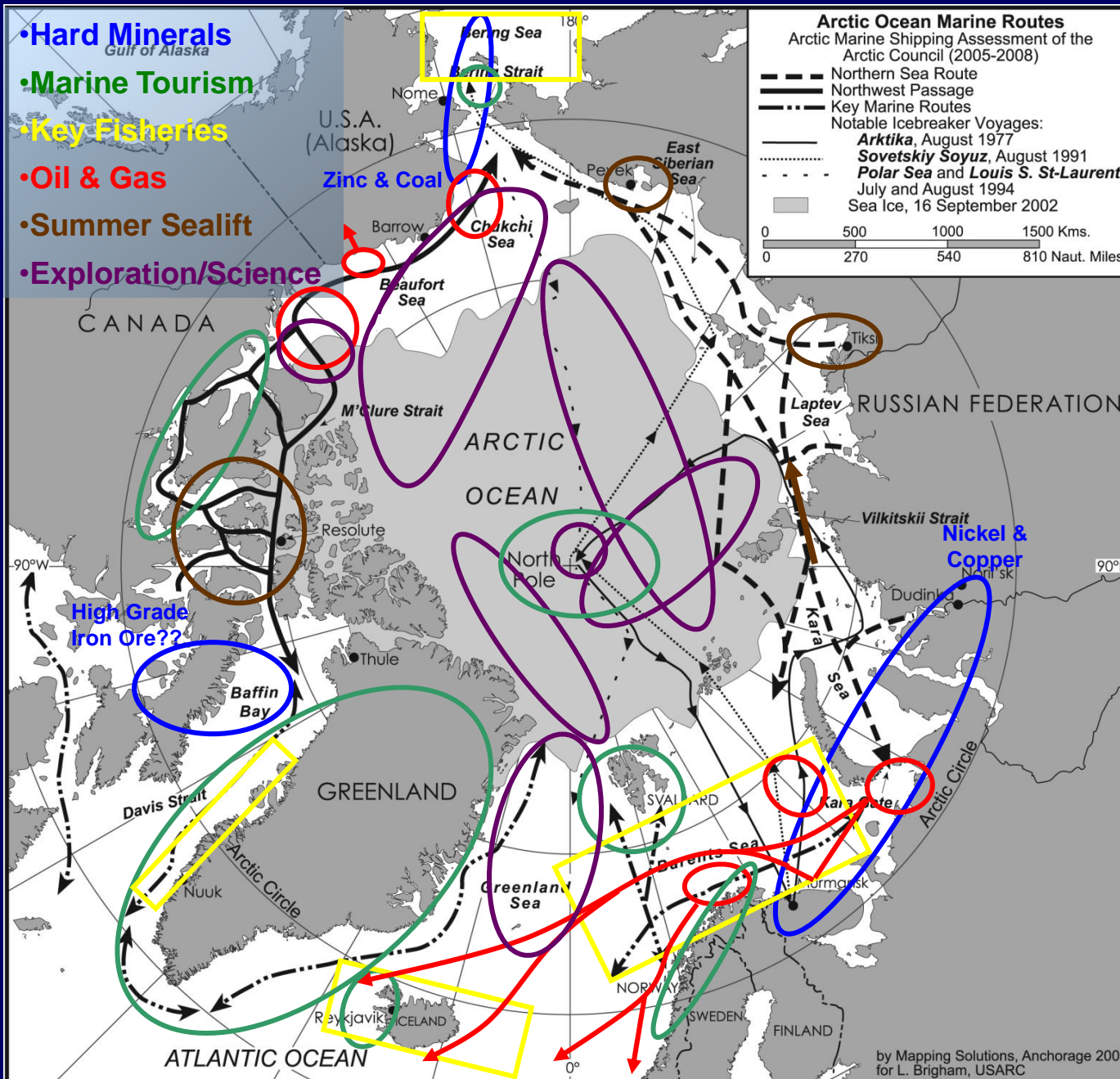


# Today's Arctic Commercial Marine Use





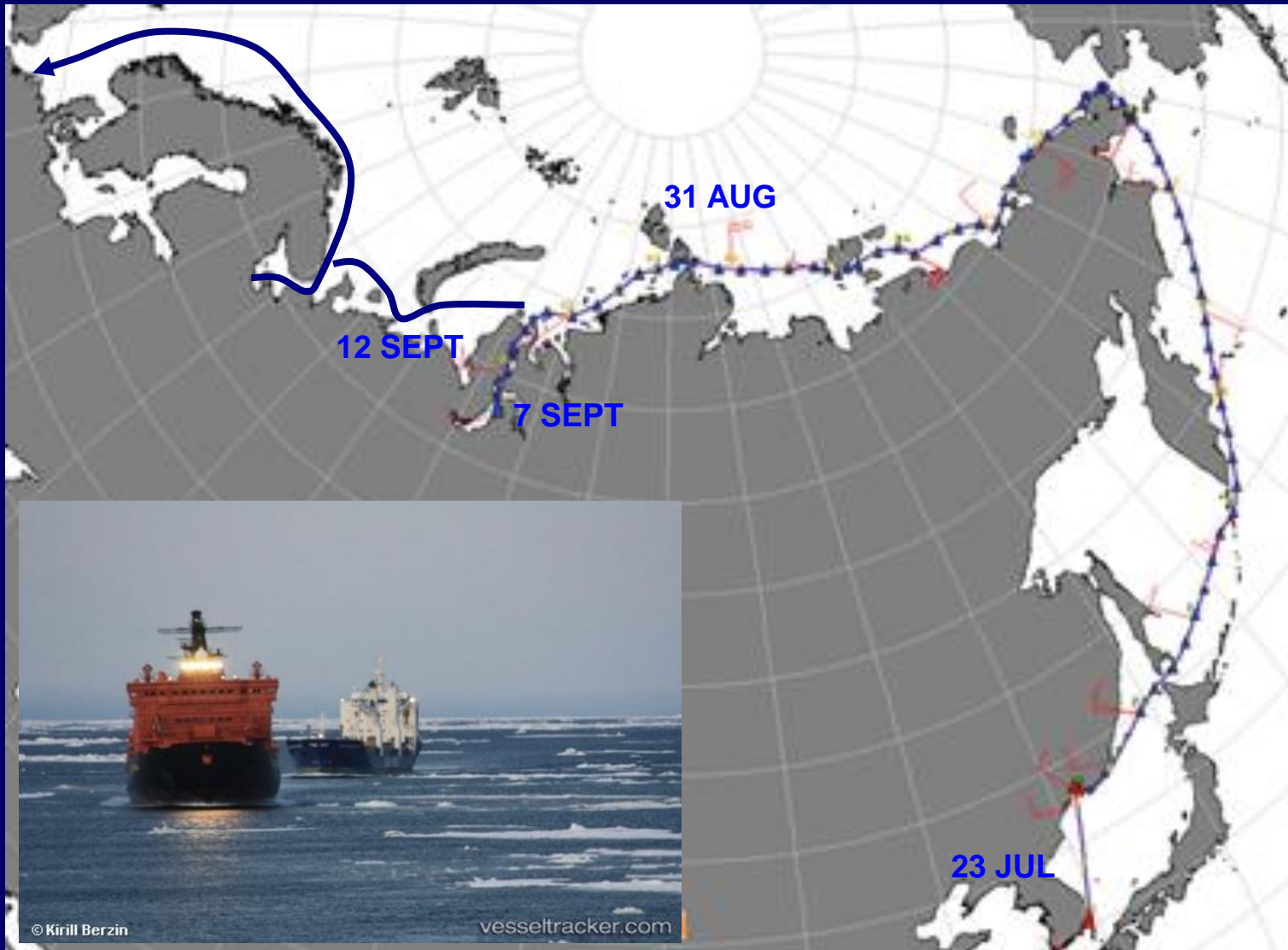
# Today's Arctic Commercial Marine Use



# **Linkages to the Global System**

- **International Fishing**
- **Global Marine Tourism industry**
- **Hard Minerals ~ Zinc, Nickel, Tin, Copper, High Grade Iron Ore, etc.**
- **Hydrocarbons ~ Offshore Oil & Gas**
- **Regional Trade to Northern Communities**
- **Research & Exploration**





**Summer Northeast Passage  
2009 Voyages of *Beluga Fraternity* & *Beluga Foresight***

# *Beluga* NSR-NEP Voyages Summer 2009







© Klaus Frühauf

vesseltracker.com



© Martin Kramer

vesseltracker.com



**Summer Northeast Passage  
2009 Voyages of *Beluga Fraternity* & *Beluga Foresight***



# ***Icebreaker Transits to the North Pole & Trans-Arctic Voyages (1977-2010):***

- 83 Transits to the North Pole (70 Russia, 6 Sweden, 3 USA, 2 Germany, 1 Canada, 1 Norway)
- 39 Ship Transits to the NP in 2004-2010
- 7 Trans-Arctic Voyages (1991, 1994, 1996, 2005)
- Single Non-summer NP Voyage (*Sibir* Voyage May-June 1987)



**‘Clear Evidence of  
Central Arctic Ocean  
Navigation’**

**25 May 1987 ~ North Pole  
Soviet Nuclear Icebreaker *Sibir*  
‘A Walk Around the World!’**

## **(B) Space Assets ~ Monitoring Arctic Marine and Aviation Use**

- **Monitoring & Tracking Vessels ~  
Enforcement & Tracking Individual Ships**
- **Enhancing Arctic Marine Domain  
Awareness ~ Data Fusion Efforts**
- **Mapping & Assessments of Changing  
Marine Use ~ Multiple Use Management &  
Conflict Avoidance**
- **Tracking Arctic Aviation Routes & Aircraft**



**AMSA Scenarios:  
Plausible Futures for Arctic  
Navigation to 2050**

**~ Complexity ~**

# AMSA Key Uncertainties for Future Arctic Marine Transportation

- Stable legal climate
- Radical change in global trade dynamics
- Climate change is more disruptive sooner
  - Safety of other routes
- Socio-economic impact of global weather changes
- Oil prices (55-60 to 100-150 USD?)
- Major Arctic shipping disasters\*\*\*
  - Limited windows of operation (economics)
    - Rapid climate change
  - Maritime insurance industry
- China, Japan & Korea become Arctic maritime nations
  - Transit fees
- Conflict between indigenous & commercial use
  - Arctic maritime enforcement
- Escalation of Arctic maritime disputes
  - Shift to nuclear energy
  - New resource discovery
    - World trade patterns
- Catastrophic loss of Suez or Panama Canals
  - Global agreements on construction rules and standards



# “Stricken cruise ship off Antarctic evacuated”

MSNBC- 11/23/07

## *M/V Explorer*



# Groundings ~ Canadian Arctic Aug-Sept 2010



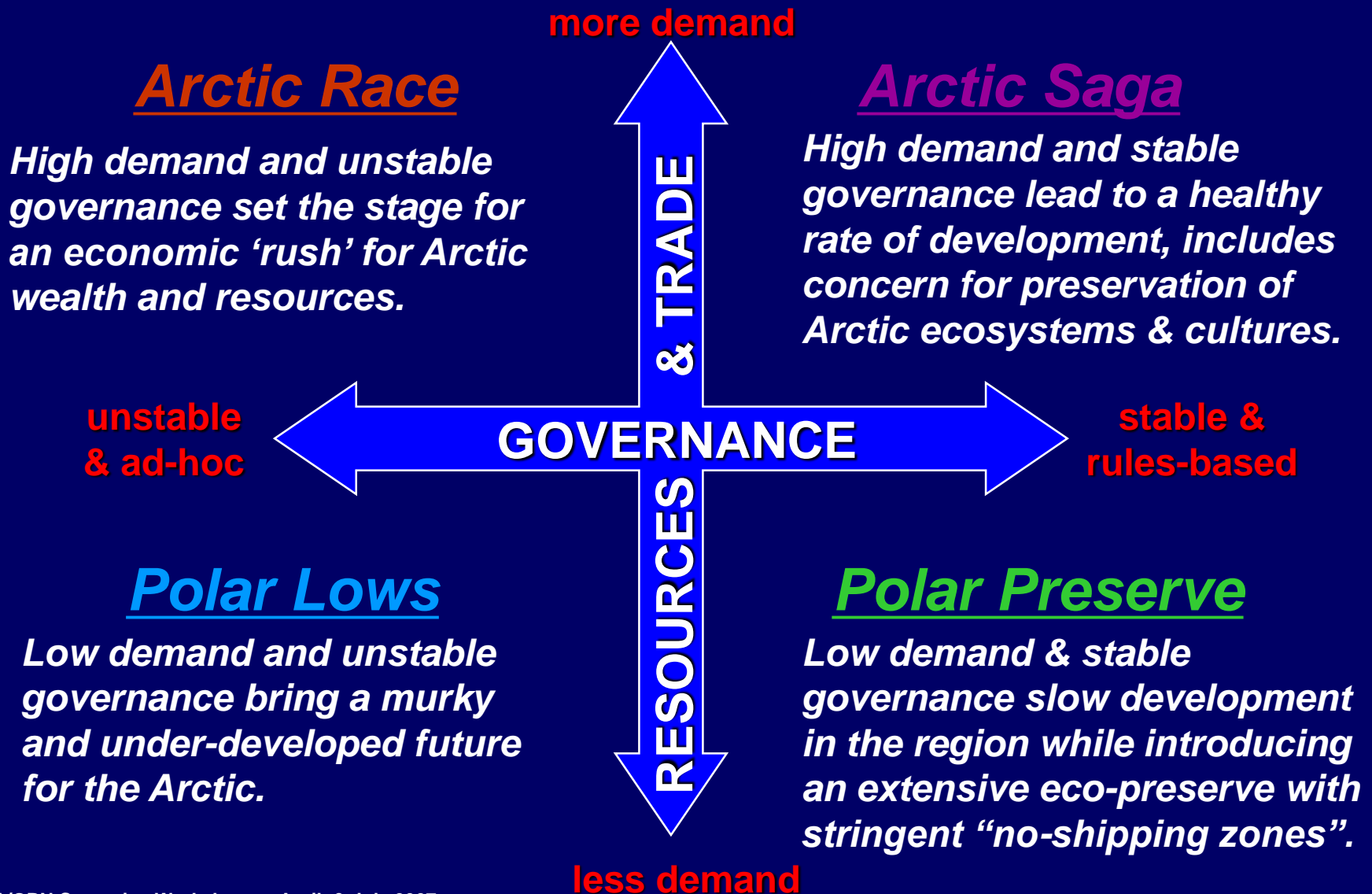
**M/V Clipper Adventurer**



**M/T Nanny**



# Scenarios on the Future of Arctic Marine Navigation in 2050

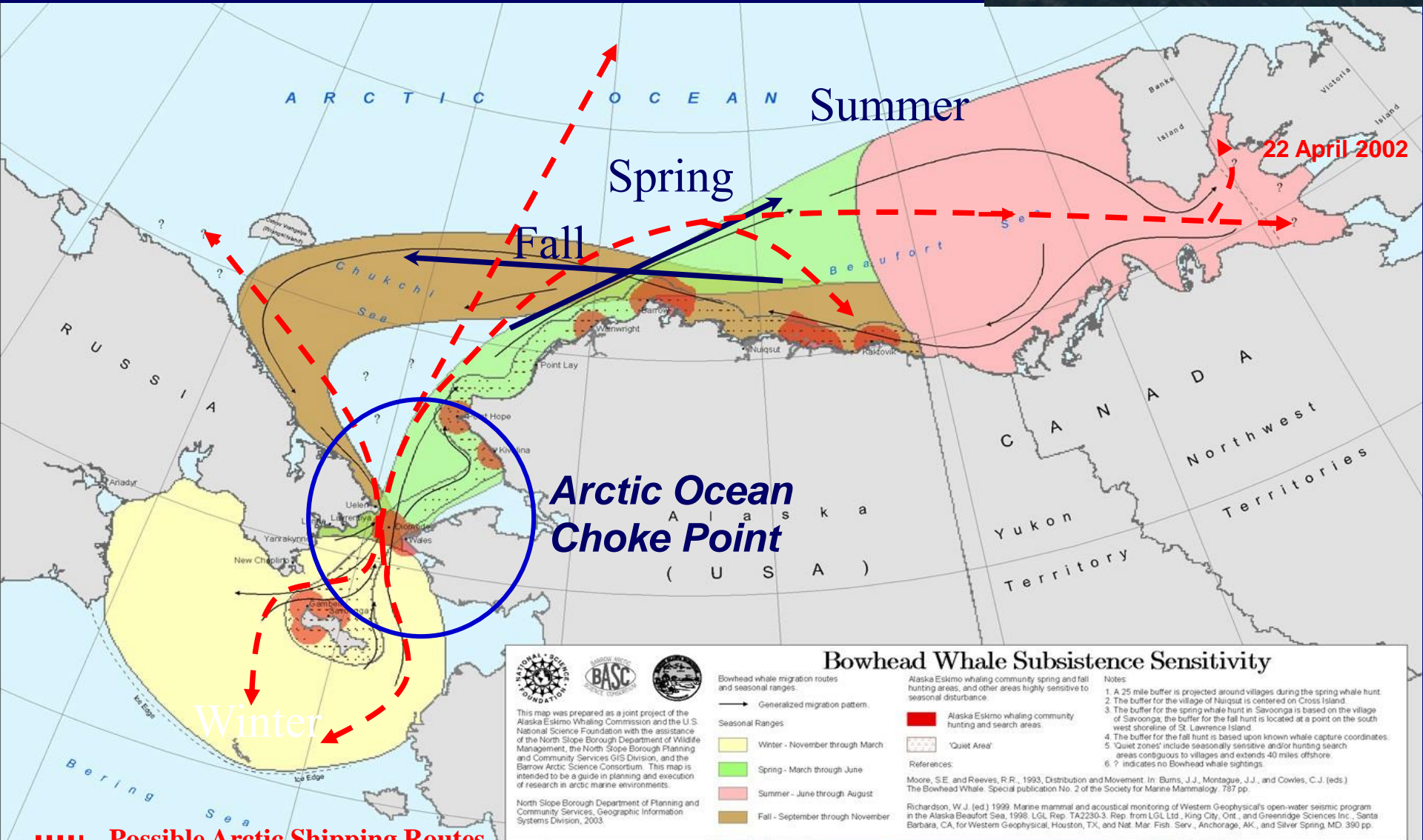


# Wild Cards

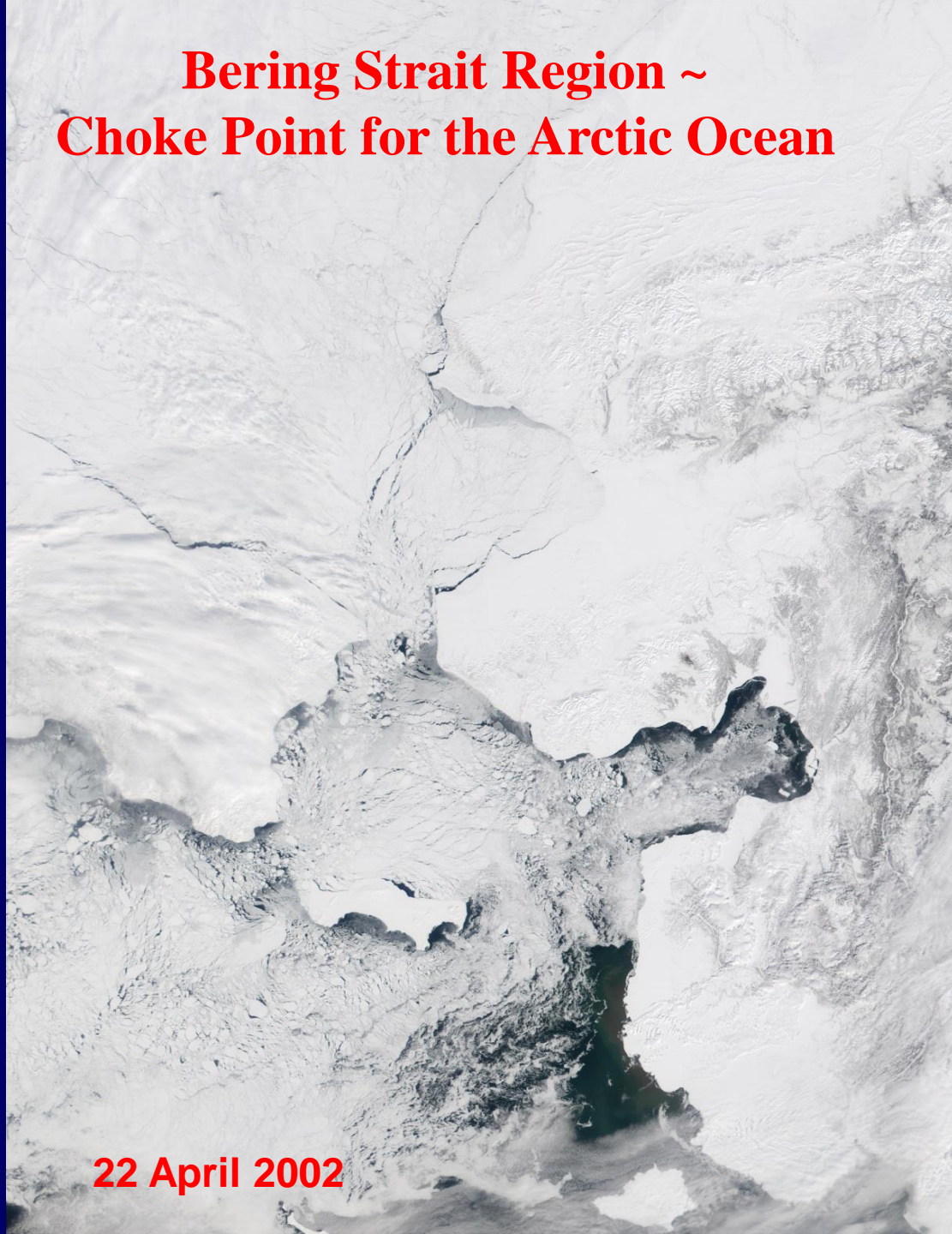


# 'Wild Card' Issue 1 ~ Multiple Ocean Use Management & Enforcement

## Bowhead Whale Migrations & Arctic Marine Operations



**Bering Strait Region ~  
Choke Point for the Arctic Ocean**



**22 April 2002**



# 'Wild Card' Issue 2 ~ Arctic Ship Emissions Unintended Consequences & Uncertain Regulation



## New pathway to pollution in Arctic

ONE of the bonuses of global warming is the potential for new shipping routes to open up through the Arctic as ice retreats, shortening journeys by many thousands of miles. There is a downside, however. **New northern passages could significantly boost levels of low-lying ozone as ship exhausts pump pollutants into the pristine environment.**

Climate models indicate that the northern passages – the north-east coast of Siberia, northern Alaska and around the Canadian archipelago – may be open to shipping during the summer months from around 2050

onwards. Claire Granier, from the University of Pierre and Marie Curie in Paris, France, and her colleagues calculated the likely ozone emissions associated with such a scenario, assuming that the routes would be accessible for six months of the year.

Emissions of nitrogen oxides and carbon monoxide from ships could triple ozone levels, making them comparable to those in industrialised regions today (*Geophysical Research Letters*, DOI: 10.1029/2006GL026180).

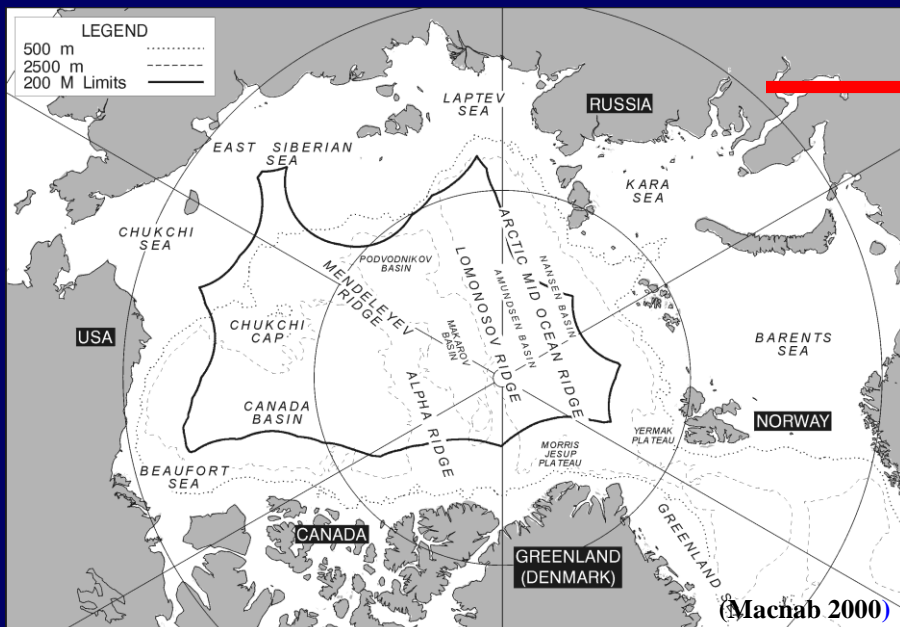
"The Arctic is a very sensitive region and these very high ozone levels are likely to have a serious impact on plant life," says Ulrike Niemeier, a co-author from the Max Planck Institute for Meteorology in Hamburg, Germany.

***New northern passages could significantly boost levels of low-lying ozone as ship exhausts pump pollutants into the pristine environment.***

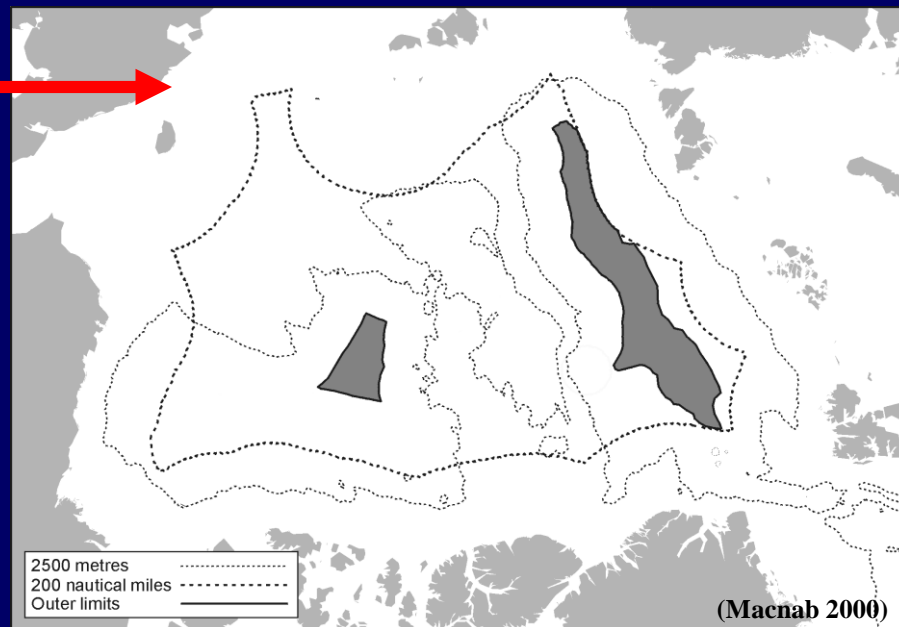
***Emissions of nitrogen oxides and carbon monoxide from ships could triple ozone levels, making them comparable to those in industrialized regions today.***



## Today's Maritime Arctic (200 NM Exclusive Economic Zone)



## Hypothetical - Future Maritime Arctic (After UNCLOS Article 76)



## The ILULISSAT Declaration

- Conference of 5 Coastal States Bordering on the Arctic Ocean (Canada, Denmark & Greenland, Norway, Russia, USA)
  - 27-29 May 2008 ~ Ilulissat, Greenland
  - LOS/UNCLOS Provides 'Solid Foundation'
- 'We therefore see no need to develop a new comprehensive international legal regime to govern the Arctic Ocean.'

**'Wild Card' Issue 3 ~ Continuing Challenge**

# U.S. Geological Survey Report ~ July 2008



## Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle

The U.S. Geological Survey (USGS) has completed an assessment of undiscovered conventional oil and gas resources in all areas north of the Arctic Circle. Using a geologic probability-based methodology, the USGS estimated the occurrence of undiscovered oil and gas in 33 geologic provinces thought to be prospective for petroleum. The sum of the mean estimates for each province indicates that 59 billion barrels of oil, 1,669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids may remain to be found in the Arctic, of which approximately 84 percent is expected to occur in offshore areas.



Overcasted mountains north of the Labyrinth Group under a midlight rainbow near Gullhorn Lake, Alaska, summer 2007. USGS photo by David Brumbaugh.

### Introduction

In May 2008, a team of U.S. Geological Survey (USGS) scientists completed an appraisal of possible future additions to world oil and gas reserves from new field discoveries in the Arctic. This Circum-Arctic Resource Appraisal (CARA) evaluated the petroleum potential of all areas north of the Arctic Circle (66°50' north latitude); quantitative assessments were conducted in those geologic areas considered to have at least a 10-percent chance of one or more significant oil or gas accumulations. For the purposes of the study, a significant accumulation contains recoverable volumes of at least 50 million barrels of oil and/or oil-equivalent natural gas. The study included only those resources believed to be recoverable using existing technology but with the important assumption for offshore areas that the resources would be recoverable even in the presence of permanent sea ice and oceanic water depth. No economic considerations are included in these initial estimates; results are presented without reference to costs of exploration and devel-

opment, which will be important in many of the assessed areas. So-called unconventional resources, such as coal bed methane, gas hydrates, oil shales, and tar sands, were explicitly excluded from the study. Full details of the CARA study will be published later.

A number of offshore areas in Canada, Russia, and Alaska already have been explored for petroleum, resulting in the discovery of more than 400 oil and gas fields north of the Arctic Circle. These fields account for approximately 240 billion barrels (BBOE) of oil and oil-equivalent natural gas, which is about 10 percent of the world's known conventional petroleum resources (cumulative production and remaining proved reserves). Nevertheless, most of the Arctic, especially offshore, is essentially unexplored with respect to petroleum. The Arctic Circle encompasses about 6 percent of the Earth's surface, an area of more than 21 million km<sup>2</sup> (8.1 million mi<sup>2</sup>), of which about 4 million km<sup>2</sup> (1.5 million mi<sup>2</sup>) is offshore and more than 7 million km<sup>2</sup> (2.7 million mi<sup>2</sup>) is on continental shelves under less than 200 m of water. The entire Arctic continental shelves may constitute the

geographically largest unexplored prospective area for petroleum remaining on Earth.

### Methodology

A newly compiled map of Arctic sedimentary basins (Arthur Greene and others, unpublished work) was used to define geologic provinces, each containing more than 3 km<sup>3</sup> of sedimentary strata. Assessment units (AUs)—mappable volumes of rock with common geologic traits—were identified within each province and quantitatively assessed for petroleum potential. Because of the sparse seismic and drilling data in much of the Arctic, the usual tools and techniques used in USGS resource assessments, such as discovery process modeling, prospect delineation, and deposit simulation, were not generally applicable. Therefore, the CARA relied on a probabilistic methodology of geologic analysis and analog modeling. A world analog database (Chapman and others, 2006) was developed using the AUs defined in the USGS World Petroleum Assessment 2000 (USGS World Assessment Team, 2000). (Continued on back page)

## “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle”

–13% Undiscovered Oil

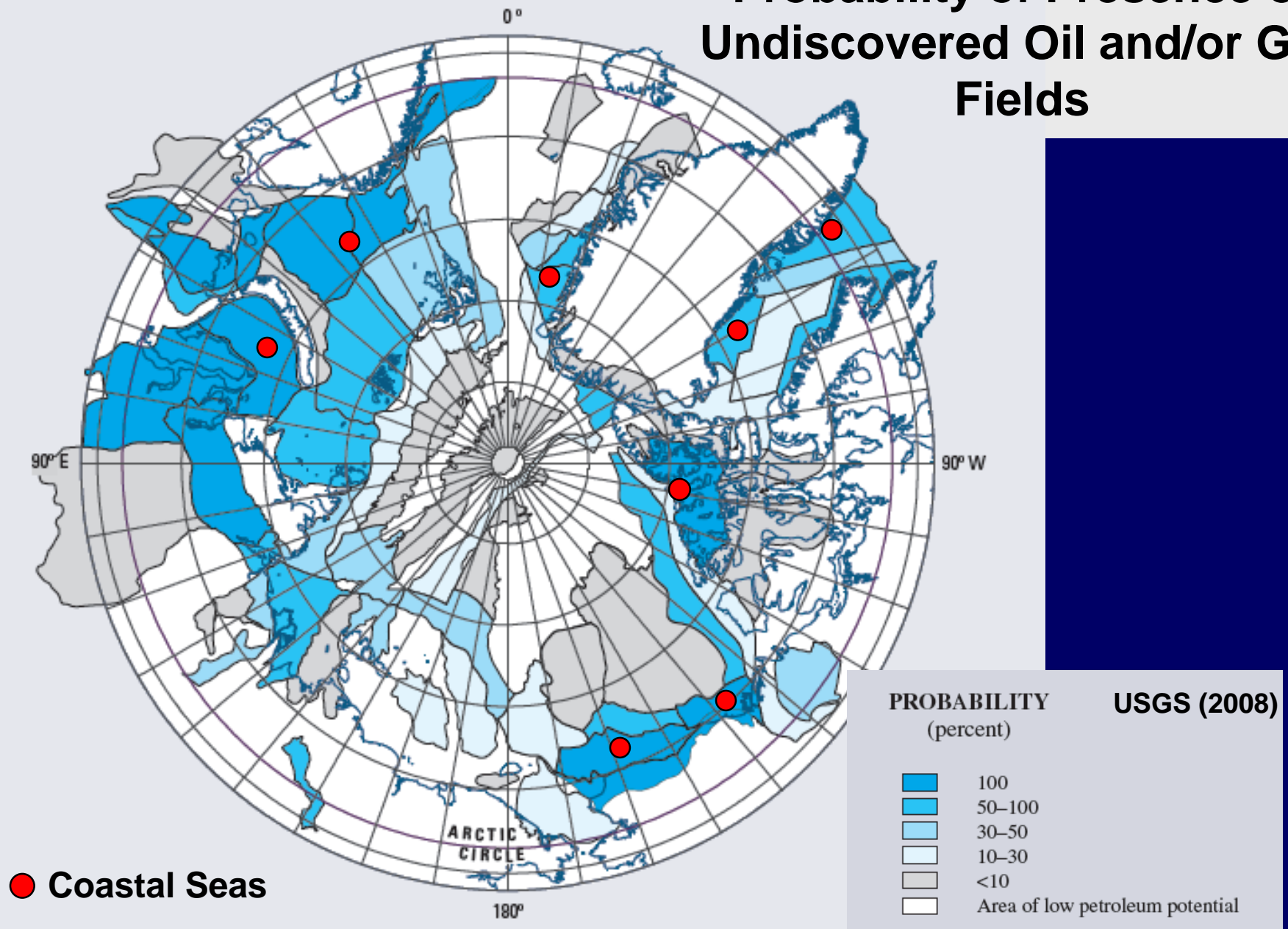
–30% Undiscovered Natural Gas

–20% Undiscovered Natural Gas Liquids

<http://pubs.usgs.gov/fs/2008/3049/>

## ‘Wild Card’ Issue 4A ~ New Resource Discoveries

# Probability of Presence of Undiscovered Oil and/or Gas Fields



**'Wild Card' Issue 4B~ New Resource Discoveries**





**'Wild Card' Issue 5 ~ New Technology**

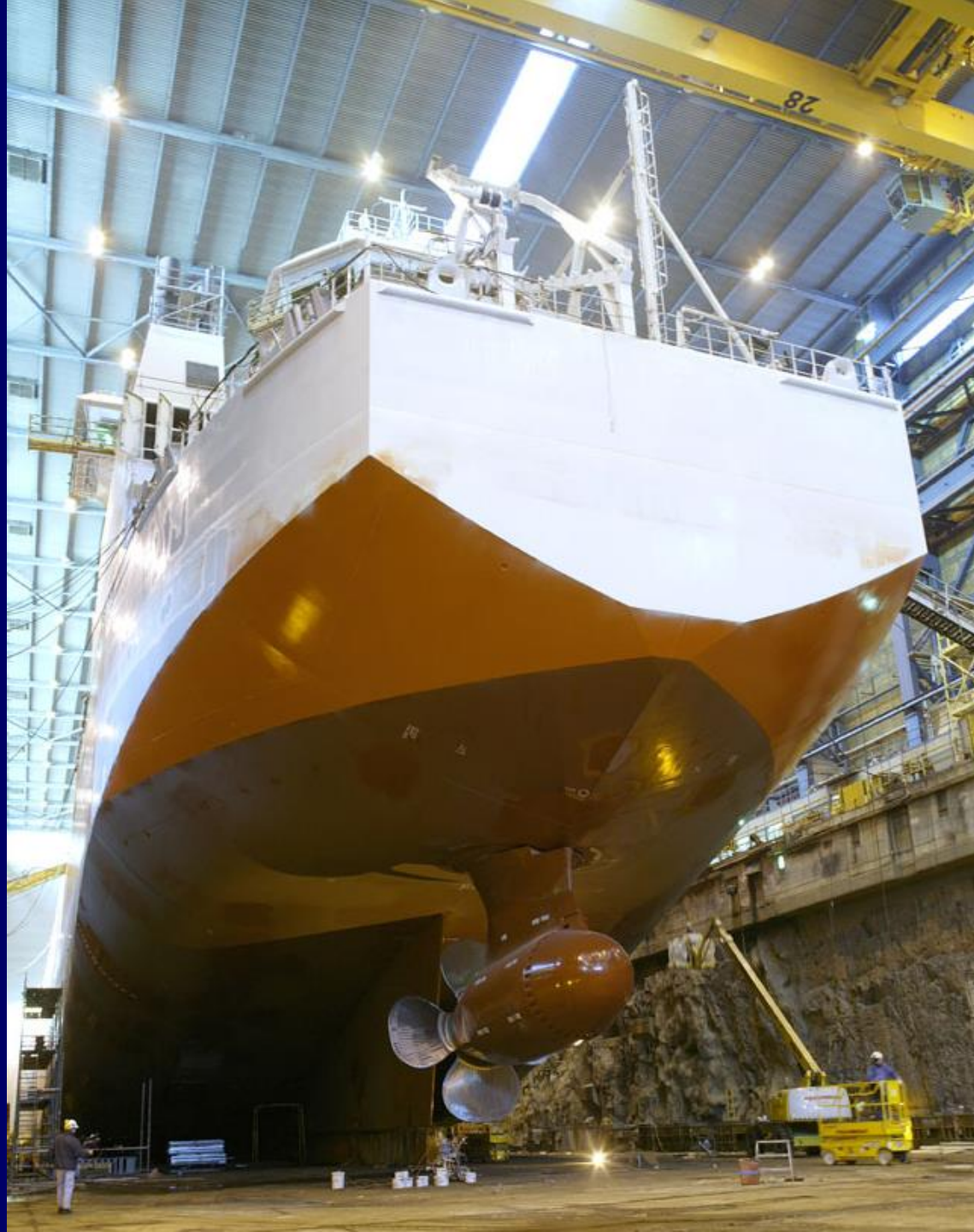
**Aker Arctic Technology**

## Future Convoy Requirements?



**Icebreaking (Double Acting) Container Ship  
*Norilskiy Nickel* in the Kara Sea Aker Arctic  
March 2006**

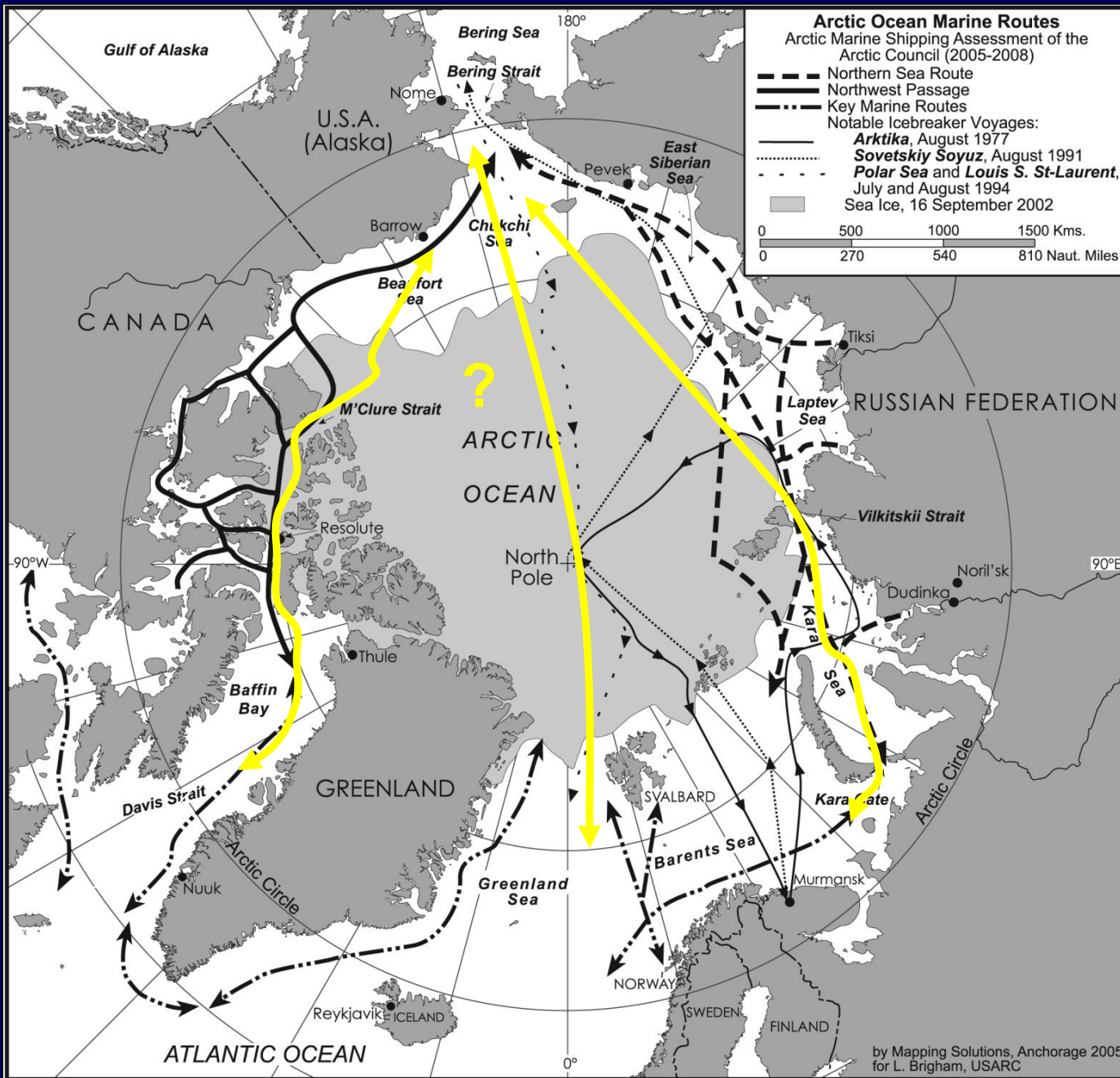




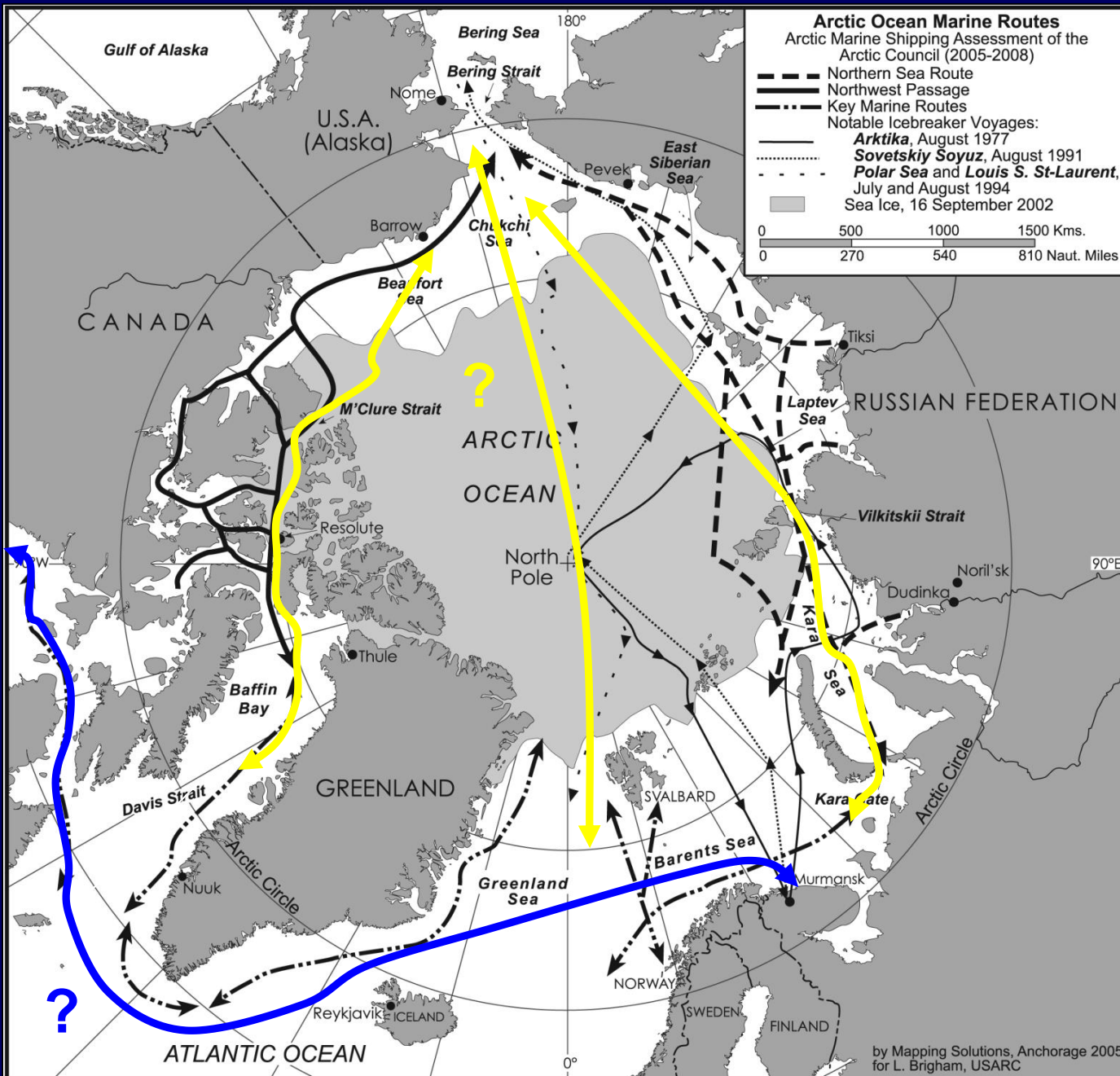
**Aker Arctic  
Technology**



# Future Arctic Marine Transport Modes

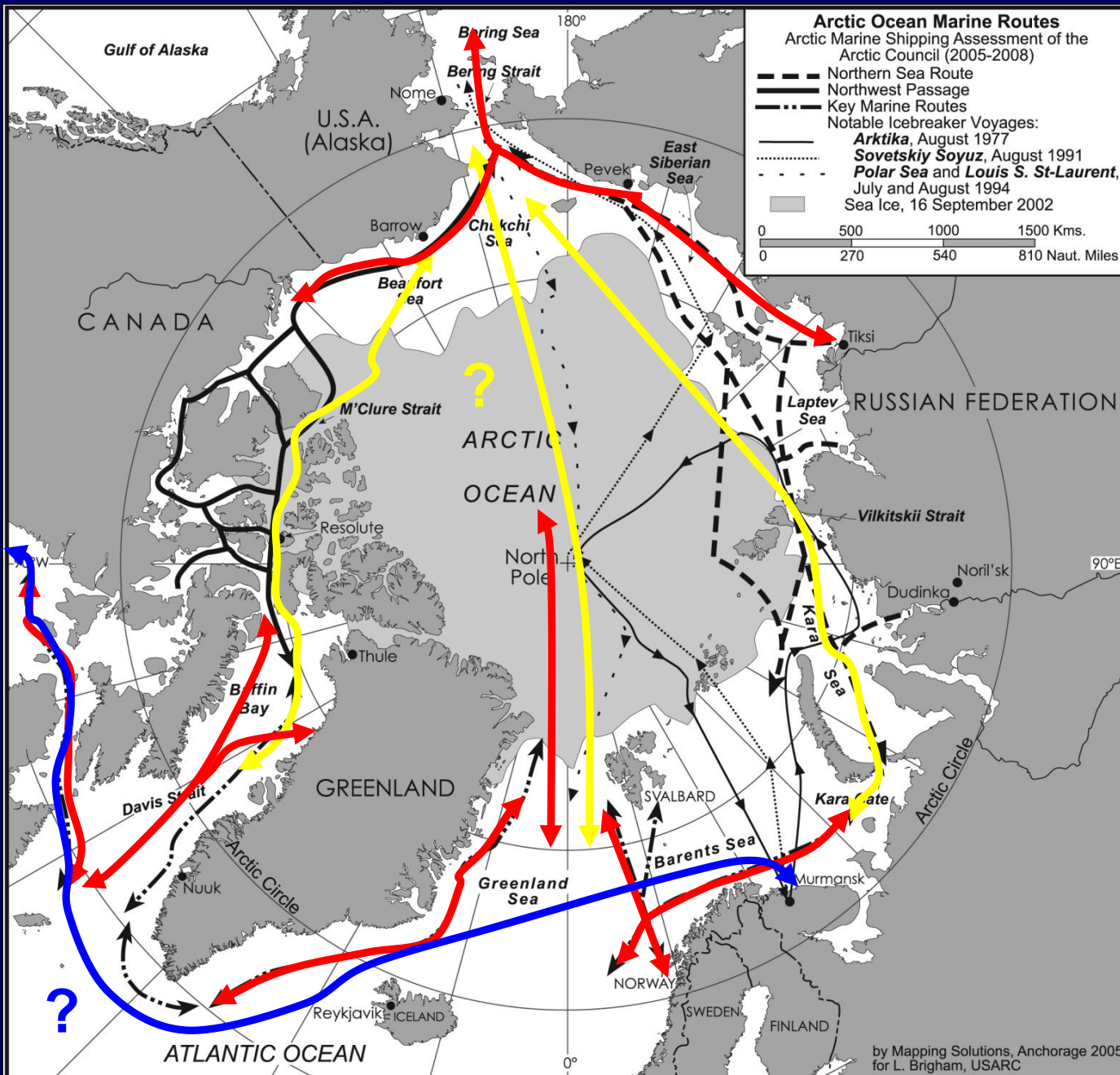


# Future Arctic Marine Transport Modes



Churchill  
to  
Murmansk  
Route

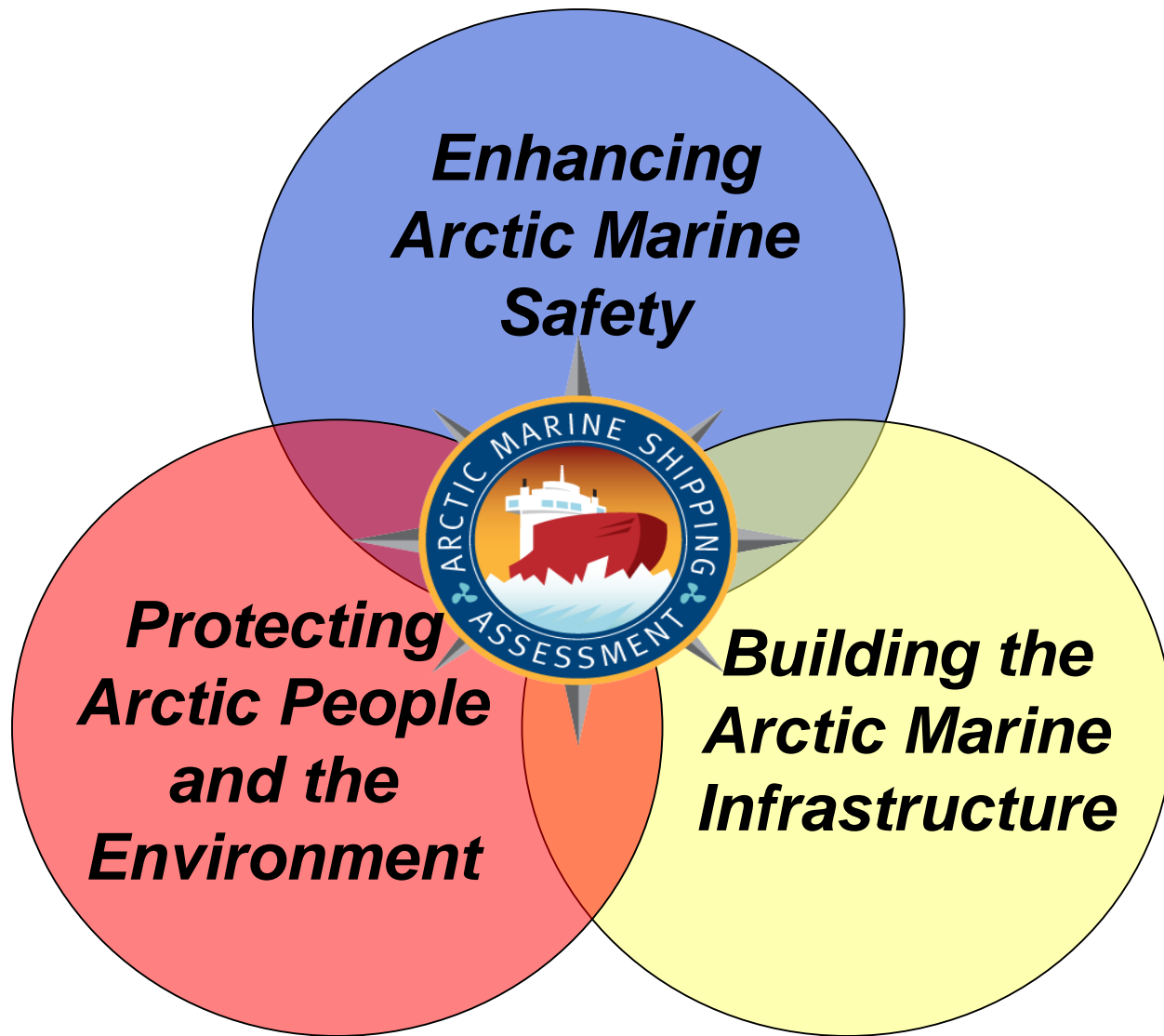
# Future Arctic Marine Transport Modes





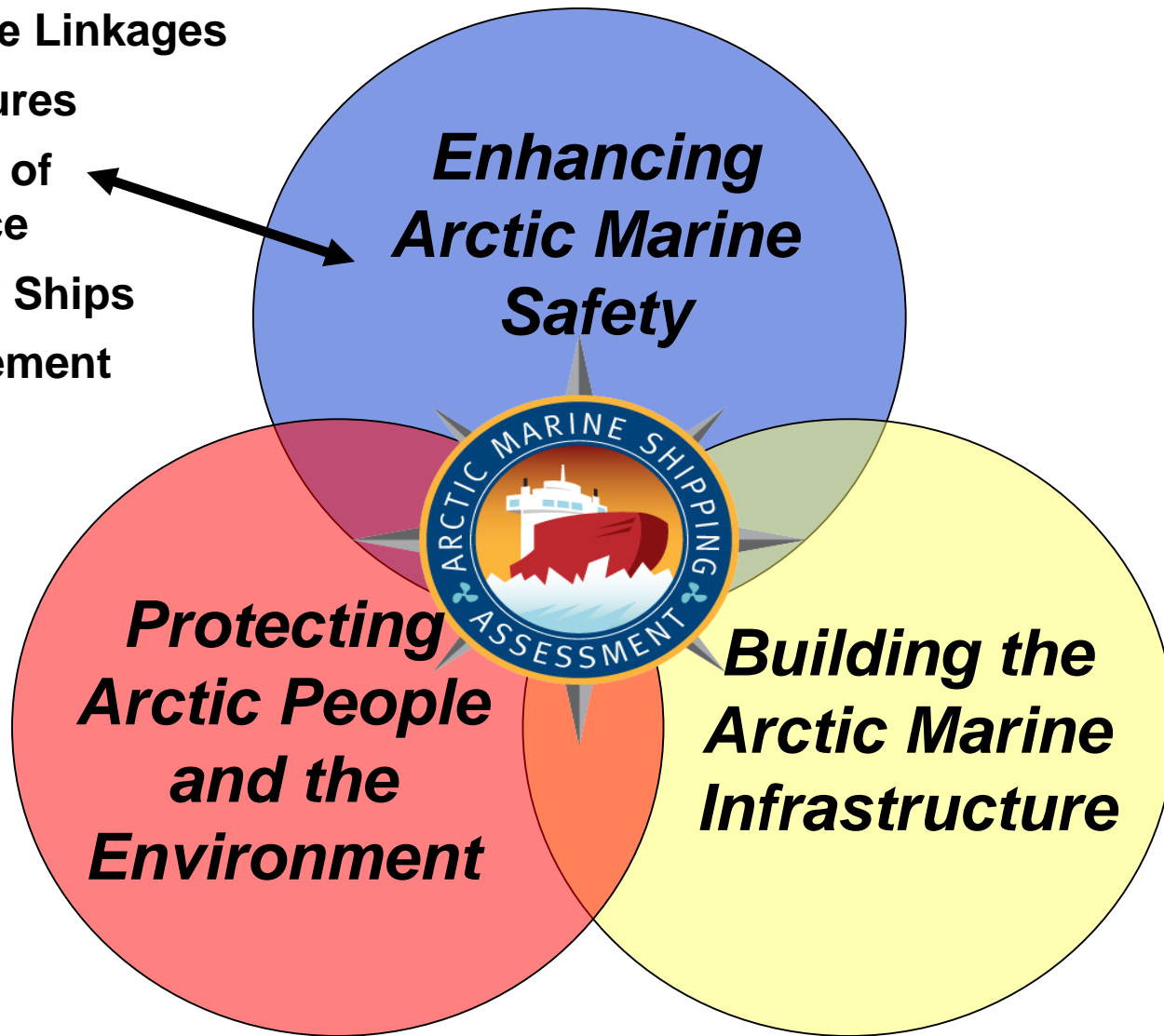
# **Selected AMSA Key Findings**

- A~ UNCLOS: Fundamental framework & IMO ~ Competent UN agency**
- B~ Winter Arctic sea ice cover remains**
- C~ No special, mandatory IMO environmental standards**
- D~ Today ~ nearly all destination traffic**
- E~ Key drivers: Natural resource development & regional trade plus governance**
- F~ Future Arctic transport: many factors of uncertainty**
- G~ Arctic residents: concerns & recognition of benefits**
- H~ Most significant threat: release of oil**
- I~ General lack of marine infrastructure (exceptions: coast of Norway & northwest Russia)**



**AMSA RECOMMENDATIONS ~ THEMES**

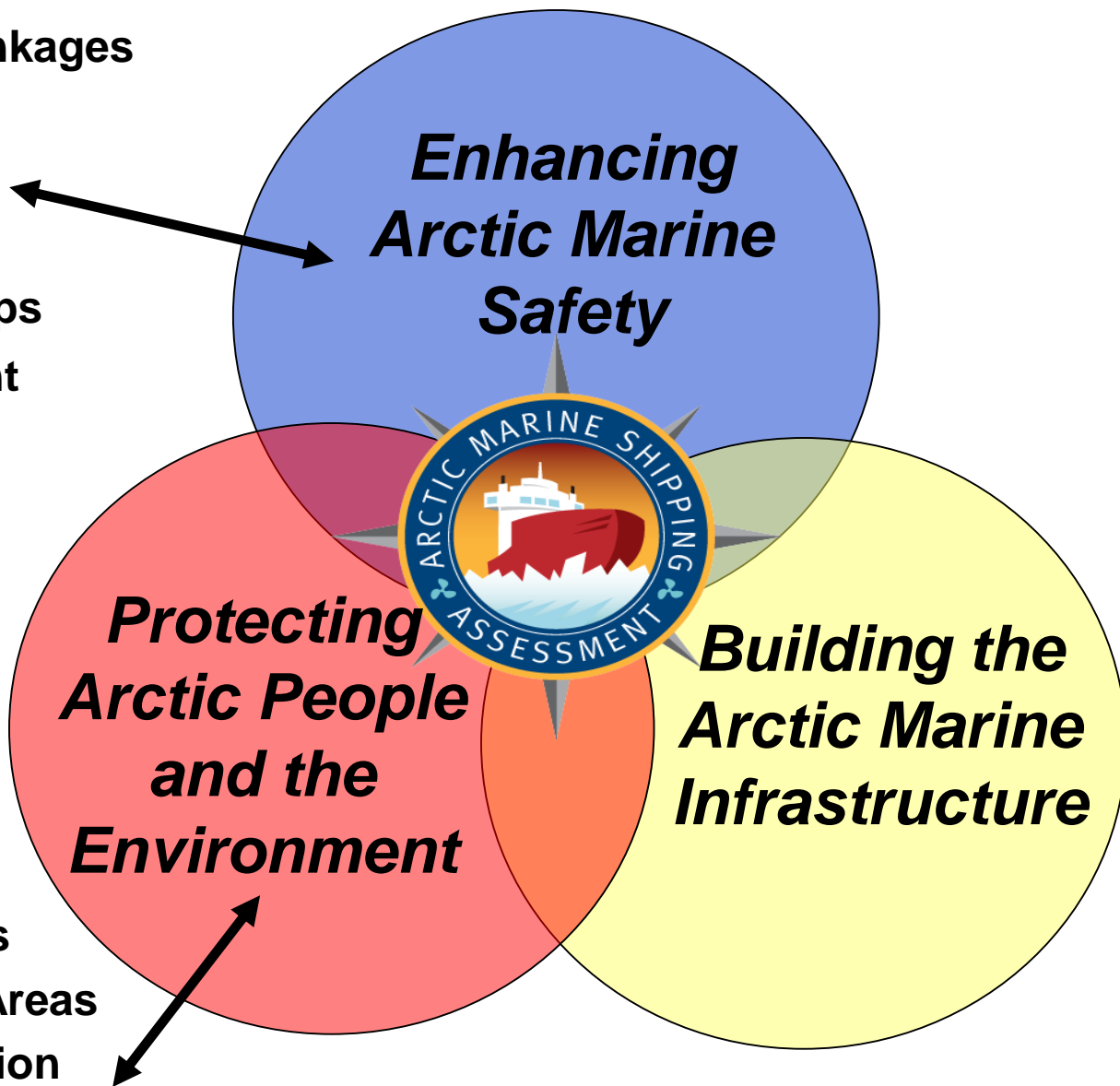
- Arctic State Linkages
- IMO Measures
- Uniformity of Governance
- Passenger Ships
- SAR Agreement



**AMSA RECOMMENDATIONS ~ THEMES**



- Arctic State Linkages
- IMO Measures
- Uniformity of Governance
- Passenger Ships
- SAR Agreement

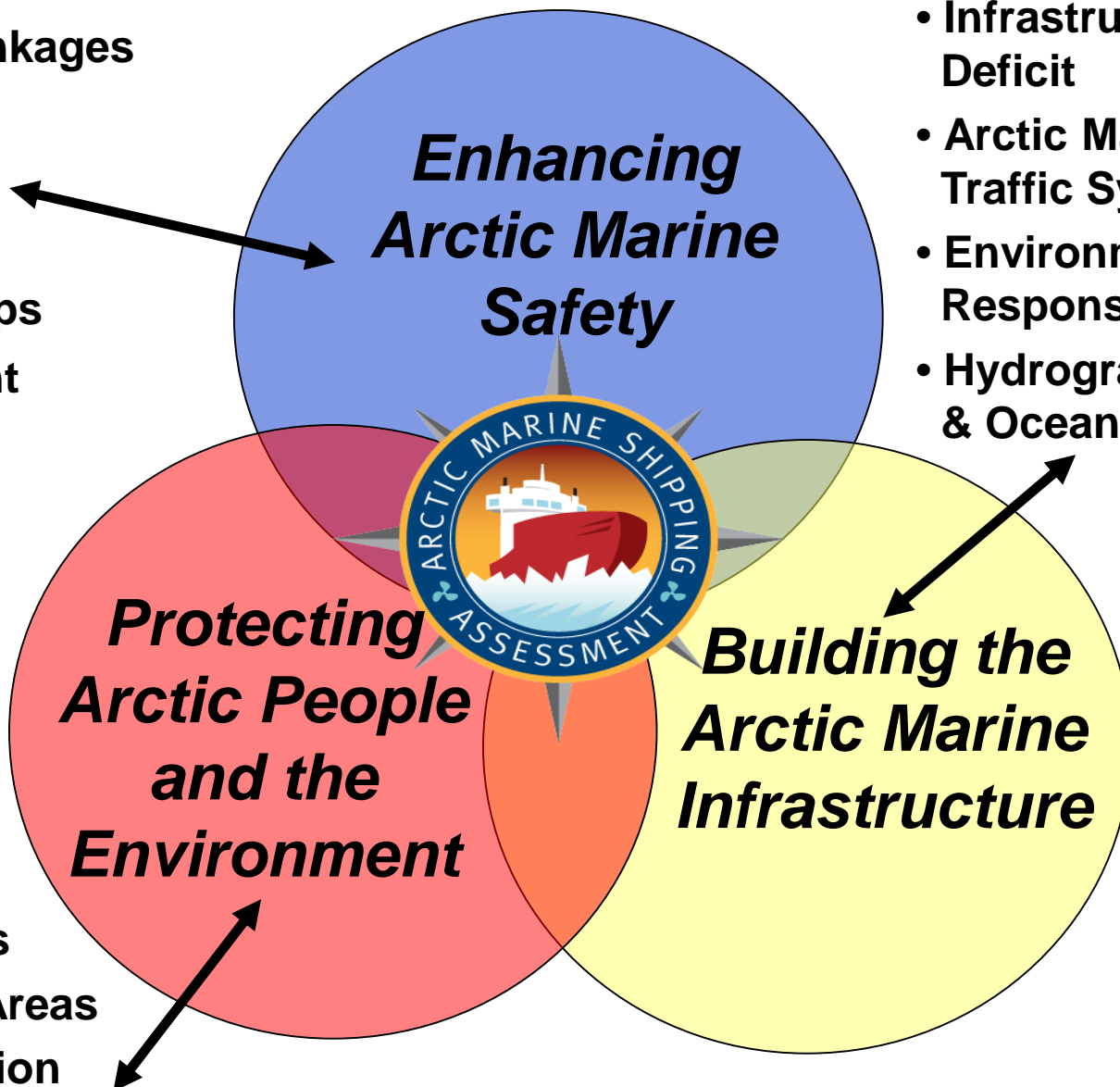


- Indigenous Use
- Community Engagement
- Invasive Species
- Special Marine Areas
- Oil Spill Prevention
- Marine Mammal Impacts
- Air Emissions

**AMSA RECOMMENDATIONS ~ THEMES**

- Arctic State Linkages
- IMO Measures
- Uniformity of Governance
- Passenger Ships
- SAR Agreement

- Infrastructure Deficit
- Arctic Marine Traffic System
- Environmental Response Capacity
- Hydrographic, Met & Ocean Data



***Protecting Arctic People and the Environment***

***Building the Arctic Marine Infrastructure***

***Enhancing Arctic Marine Safety***



- Indigenous Use
- Community Engagement
- Invasive Species
- Special Marine Areas
- Oil Spill Prevention
- Marine Mammal Impacts
- Air Emissions

**AMSA RECOMMENDATIONS ~ THEMES**

# **(C) Space Assets ~ Arctic Marine Infrastructure**

- **Enhanced Search & Rescue ~ Monitoring & Response**
- **Improved Environmental Response ~ Monitoring Spills**
- **Improved Marine Communications in the Central Arctic Ocean ~ Addressing Coverage Gaps**
- **Requirements for Public-private Partnerships ~ Marine Communication Satellites**

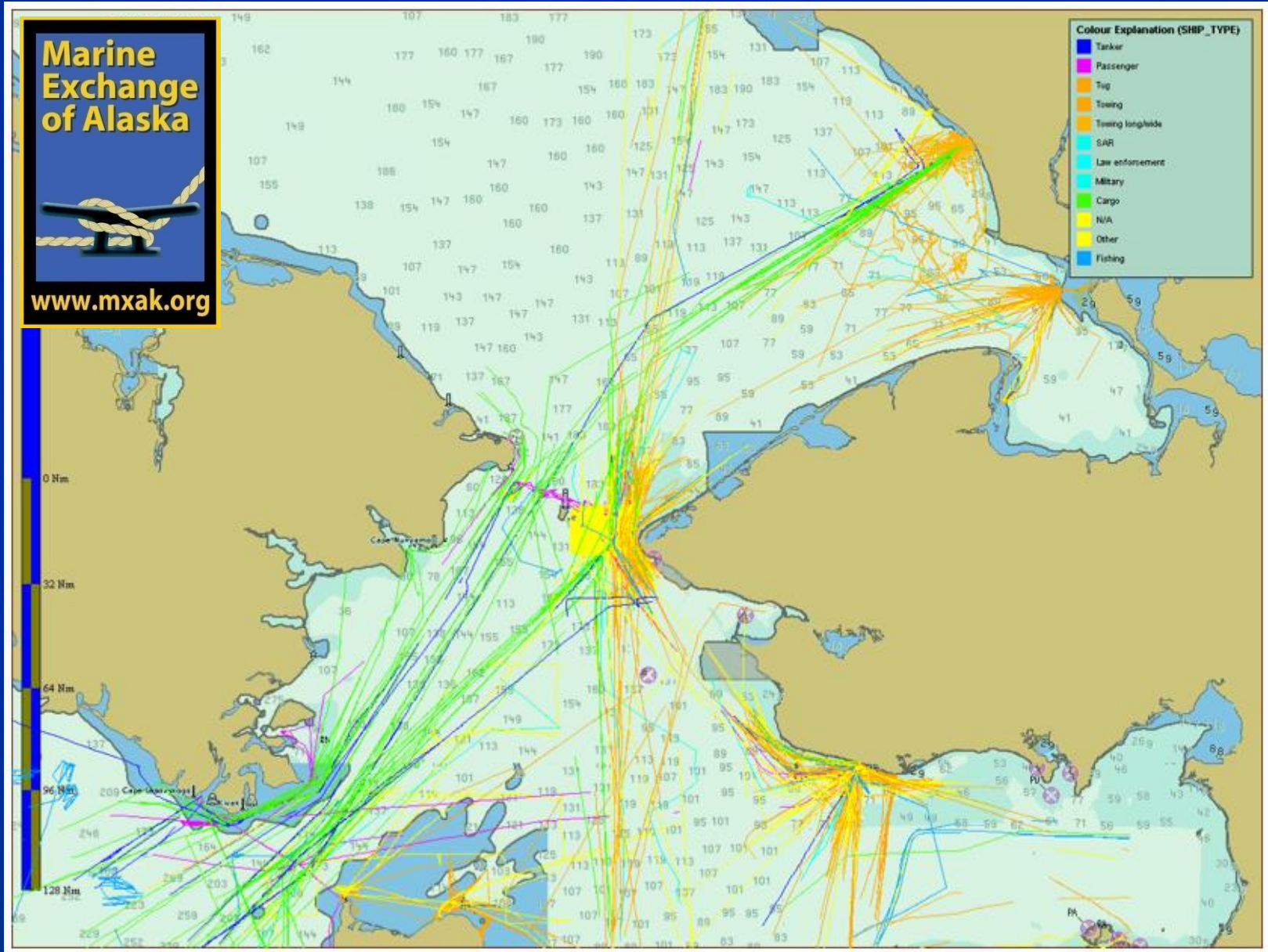


## **AMSA Recommendation from the Arctic States ~ IIIB. Arctic Marine Traffic System**

- ~ ***“Comprehensive system to improve monitoring & tracking”***
- ~ **Near, real-time data shared among the Arctic States**
- ~ **Vessel ID, tracks, data fusion & analyses, detection of any anomalies**



# Bering Strait Region shipping by vessel type: 1 May – 6 September 2010





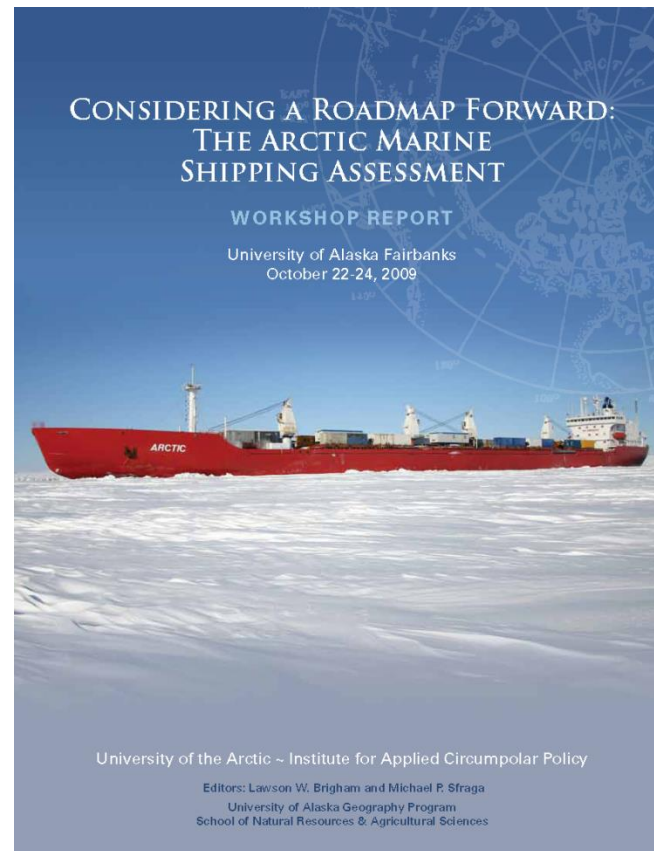
# **AMSA 2009:**

- **Baseline Assessment**
- **Arctic Council Policy Document**  
~ Negotiated Text Approved 29 April 2009 ~
- **Strategic Guide**

[\*\*www.pame.is\*\*](http://www.pame.is)



# CONSIDERING A ROADMAP FORWARD: THE ARCTIC MARINE SHIPPING ASSESSMENT



**Workshop**  
**October 22-24, 2009**

**UNIVERSITY OF ALASKA FAIRBANKS**



# Enhancing Arctic Marine Safety

## I. Enhancing Arctic Marine Safety

### I.A. Linking with International Organizations

ROADMAP AND ACTIONS	KEY ISSUES
<ul style="list-style-type: none"> <li>PAME to bring together experts on shipping from the Arctic states to identify common interests and develop unified positions and approaches.</li> <li>Identify an Arctic state lead country to facilitate an IMO meeting of experts on Arctic safety issues.</li> <li>For a consistent approach on Arctic shipping issues, the Arctic states should coordinate.                             <ul style="list-style-type: none"> <li>Input from all actors and stakeholders in each state including regional interests.</li> <li>Input from different government agencies who attend various international organizations (for example IMO, ILO and WMO).</li> <li>Input from stakeholders and government departments who attend a particular organization (such as IMO).</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Taking into consideration the opinions and ideas of other interested stakeholders before approaching international organizations (such as IMO), the Arctic states may have a potential agreed position.</li> <li>Knowing who is and is not represented at the international organizations.</li> <li>Early, proactive actions will improve communications on all Arctic shipping issues.</li> </ul>

### I.B. IMO Measures for Arctic Shipping

ROADMAP AND ACTIONS	KEY ISSUES
<ul style="list-style-type: none"> <li>Guidelines have been updated to become the IMO 'Guidelines for ships operating in polar waters.'</li> <li>Arctic Council to send a letter to Arctic marine interests as a whole to promote the December 2009 IMO Assembly resolution applying guidelines to polar waters.</li> <li>Arctic states to promote the application of the polar guidelines with industry and others as appropriate, to national and international interests.</li> <li>IMO Maritime Safety Committee (MSC) has tasked the Design and Equipment Subcommittee to develop a mandatory polar code in 3 sessions (Feb 2010, Autumn 2010, and Spring 2011).</li> <li>Adoption will be by tacit or implied amendment to SOLAS and MARPOL Conventions.</li> <li>Having agreed the polar code is to become mandatory, the Arctic states encourage other interested states/parties to participate, engage and support adoption and implementation of the polar code.</li> <li>Influential for communication and consensus building for the mandatory polar code are the Consultative Parties of the Antarctic Treaty.</li> </ul>	<ul style="list-style-type: none"> <li>These Guidelines now apply to Arctic and Antarctic waters whether ice-covered or not.</li> <li>Polar code will have a mandatory Part A and recommendations in Part B.</li> <li>Construction requirements (hull and machinery) will be in both the polar code and International Association of Classification Societies (IACS) rules.</li> <li>Ice navigator competence requirements must be clearly defined in STCW Convention; requirements to have an ice navigator aboard will be in the polar code.</li> <li>Need for a model ice navigation course and to establish acceptance criteria for simulations as partial training fulfillment.</li> <li>Need for theoretical training, including the incorporation of contemporary local knowledge, together with practical experience in ice.</li> <li>Lack of Arctic marine infrastructure needs to be considered for independent operations.</li> <li>Endorsement of certificates to include bridge and engineering personnel, desirable for operators to be familiar with ship conditions when operating in remote and ice-covered waters.</li> </ul>

### I.C. Uniformity of Arctic Shipping Governance

ROADMAP AND ACTIONS	KEY ISSUES
<ul style="list-style-type: none"> <li>PAME to conduct a survey/inventory of national or regional regulations, standards and guidelines with the aim of harmonizing safety and pollution prevention measures in keeping with UNCLOS.</li> <li>Required surveys and inventories from the AMSA research agenda include:                             <ol style="list-style-type: none"> <li>Comparative study of how Arctic states address liability and compensation, especially for bunker fuel spills and hazardous/noxious substance incidents.</li> <li>Survey of existing and potential fee systems for icebreaking and other Arctic services, such as navigational aids, charting, SAR, and ice information services, provided by the Arctic states.</li> <li>Survey of ballast water practices and invasive species threats from Arctic shipping and a comparison of Arctic state approaches to ballast water exchanges and treatments.</li> <li>Review of how bilateral and regional cooperation in addressing Arctic marine operations might be enhanced using other international approaches and experiences.</li> </ol> </li> <li>Draft language for a potential international agreement or designation (PSSA) in keeping with UNCLOS on safety and pollution prevention measures in regions of the central Arctic Ocean beyond coastal state jurisdiction for consideration by IMO.</li> </ul>	<ul style="list-style-type: none"> <li>Key examples of Arctic state regulations for possible integration in the harmonization of measures:                             <ul style="list-style-type: none"> <li>Canada: Reporting scheme, guidelines for cruise ship operation; ballast guidelines for tankers and barges; equivalent standards for construction of Arctic class ships; Arctic shipping/waters pollution prevention regulations; oil transfer guidelines.</li> <li>Russia: Guidelines for operation on the Northern Sea Route; Arctic port regulations.</li> <li>United States: Marine Mammal Protection Act; cruise ship discharge regulations in Alaska.</li> <li>Greenland: mandatory reporting scheme; regulations for the safety of navigation.</li> <li>Norway and Russia: Results of Barents 2020.</li> <li>WWF-Gap Analysis study.</li> <li>Industry and NGO surveys and standards.</li> </ul> </li> </ul>

### I.D. Strengthening Passenger Ship Safety in Arctic Waters

ROADMAP AND ACTIONS	KEY ISSUES
<ul style="list-style-type: none"> <li>Include in an Arctic Council letter (for distribution of polar guidelines to operators), the IMO enhanced contingency guidance for cruise ships in polar waters.</li> <li>Request cruise ship associations (CLIA and AECO) to develop harmonized best practices for operating in remote and ice-covered conditions (for example, mother ship and tenders).</li> <li>Invite cruise ship associations to make presentations to PAME and Arctic expert meetings at IMO.</li> <li>Organize an international workshop/conference on cruise ship safety in Arctic waters with cruise operators and regulators.</li> </ul>	<ul style="list-style-type: none"> <li>Need to encourage the formation of cruise ship organizations that cover all Arctic waters, such as IAATO in Antarctic waters.</li> <li>Urgo passenger ship operations in polar waters to be carried out in tandem with sufficient capacity for mutual rescue.</li> <li>Passenger ship operators to document and mitigate risks and hazards associated with potential grounding in poorly charted waters.</li> </ul>

### I.E. Arctic Search and Rescue (SAR) Instrument

ROADMAP AND ACTIONS	KEY ISSUES
<ul style="list-style-type: none"> <li>U.S. currently chairing an Arctic Council task force to draft a multinational Arctic SAR agreement, to be completed by 2011 for signature by the Arctic Ministers; first meeting December 2009.</li> <li>Coordinate the use of existing resources and deploy them in the most effective manner that will cover any response gaps.</li> <li>Arctic Council to urge all Arctic states, and EPPR, to participate in the process for a SAR agreement.</li> </ul>	<ul style="list-style-type: none"> <li>Requirement for a comprehensive review of current, national SAR (maritime and aviation) capabilities for the Arctic.</li> <li>Evaluation of the adequacy of cooperative SAR agreements and arrangements for addressing increasing commercial use of the Arctic Ocean and Arctic airspace.</li> </ul>

# Funding Issues

14 CONSIDERING A ROADMAP FORWARD: THE ARCTIC MARINE SHIPPING ASSESSMENT

## Funding Issues

Key issues not addressed in AMSA are the broad financial and funding concerns linked to each of the AMSA recommendations. The Fairbanks workshop experts identified several significant areas that require near-term funding and also reviewed issues related to the need for liability and compensation mechanisms in the Arctic.

**Indigenous Marine Use Surveys** – A key requirement in most regions of the Arctic, and one of the AMSA recommendations, is the need for surveys of indigenous marine use. Up-to-date baseline data on regional and local patterns of indigenous use of Arctic waters is necessary to assess the impacts from increasing Arctic marine operations. Significant discussions were held on this topic in Fairbanks due to the complexities and sensitivities of conducting such human use surveys. There was general agreement that the surveys could not be conducted in one unified circumpolar effort (although the baseline data could be merged later to construct a unified 'picture'). Public appropriations from national and regional governments are key since these surveys relate to subsistence living, marine safety, environmental protection and multiple use management of Arctic marine waterways. Broad scale surveys are nominally the responsibility of governments, national and regional. However, private sources of funding, such as from NGOs and nonprofit foundations, could also be important at the local, community level for detailed studies and surveys. Grants or surveys from industry sources (for example, natural resource developments related to mining) could be used to support surveys in preparation of new marine transportation systems and navigation in local waterways.

**Marine Infrastructure Elements** – The lack of adequate marine infrastructure in most of the Arctic (except for the Norwegian coast and northwest Russia) to support current and future levels of Arctic marine activity is a key finding of AMSA. Large public and private investments will be necessary to provide an adequate safety net for marine operations and environmental protection. Public and private funding for satellite communications and environmental monitoring are urgently required to fill existing Arctic gaps in coverage. Enhancing environmental response capacity may require public-industry funding of equipment to be cached in remote Arctic locations. A mandatory ship tracking and monitoring system will require public appropriations and the potential for pooling funding among the Arctic states. Public funding of enhanced Arctic weather and sea ice information may also mandate cost recovery schemes. Hydrographic surveys and charting are urgent requirements and these activities need significant national investments; cost recovery through industry user fees may be necessary, for example, in remote Arctic regions of seasonal marine traffic. The World Bank and other international financial institutions should be considered for Arctic port facilities and overall marine infrastructure. Coordinated investments for such elements as ports and aids to navigation should be discussed by the Arctic states.

**Liability and Compensation Challenges** – Robust, effective oil spill liability trust funds are required in the Arctic; funds can come from public-private partnerships and they could be based on regional or bi-lateral agreements. Two national models are Canada's Ship-source Oil Pollution Fund and the U.S. Oil Pollution Act of 1990. A conference on liability-compensation issues for Arctic marine incidents should be organized by the Arctic states and industry interests.

• Indigenous Marine Use Surveys

• Marine Infrastructure Elements

• Liability and Compensation Challenges





# Summary ~ Key Policy Issues Ahead

CONSIDERING A ROADMAP FORWARD: THE ARCTIC MARINE SHIPPING ASSESSMENT 15

## Summary ~ Key Policy Issues Ahead

During the course of the workshop discussions revealed a number of high priority issues as critical outcomes of AMSA. The Co-editors of this report have developed a list of key policy issues from the discussions in Fairbanks that require attention in the near-term to enhance Arctic marine safety and marine environmental protection. Throughout the workshop the highest priority issue consistently noted was the urgent need for a mandatory Polar Code developed by the International Maritime Organization. Implementation of mandatory rules for polar ship construction, design, equipment, operations and ice navigator competency was considered by the workshop participants as the crucial first step for protecting Arctic people and the environment in an era of increased marine operations in the Arctic Ocean.

The following lists are provided as summaries of Arctic policy issues derived from the expert discussions of the AMSA Workshop:

### I. Highest Priority Arctic Policy Issues Related to AMSA:

- A mandatory Polar Code developed by the IMO.
- Full tracking and monitoring of Arctic commercial ships (mandatory AIS).
- An Arctic SAR agreement – an ongoing Arctic Council SAR Task Force is to produce a binding agreement by spring 2011.
- Surveys of indigenous marine use so that multiple use strategies in Arctic waterways can be developed.
- A circumpolar response capacity agreement – an agreement among the Arctic states (and possibly non-Arctic states) for pooling resources and enhancing regional capacity.
- Implementation of an Arctic Observing Network among the 8 Arctic states and non-Arctic states – a network to support scientific research and marine operations.

### II. High Priority Arctic Policy issues Related to AMSA:

- A critical Arctic marine infrastructure requirement – increased hydrography and surveying of Arctic waters for enhanced navigation charts.
- Oil spill research on prevention best practices and responses to oil released in Arctic ice-covered waters.
- Enhanced research, including mitigation measures, on the impacts on marine mammals, and other migratory fauna, of increased Arctic marine operations.
- Identification of specific ballast water/invasive species issues and prevention strategies related to Arctic marine operations.
- A comprehensive study to identify potential Arctic marine areas, including the central Arctic Ocean, for possible designation as IMO Particularly Sensitive Sea Areas (PSSAs).
- Marine industry development of harmonized best practices for all cruise ships operating in Arctic waters, including operational strategies for mutual rescue.
- Studies on the application of ecosystems-based management to Arctic coastal regions.
- A comparative study of Arctic state liability and compensation strategies for marine incidents with a view to developing future uniform measures.
- Fully developed IMO ice navigator competency requirements included in the STCW; mandatory requirement for onboard ice navigator as part of the Polar Code.
- Enhanced marine communications systems in the Arctic, including full coverage satellite communications in the central Arctic Ocean.

## Highest Priority

- Mandatory Polar Code
- Full Tracking and Monitoring of Commercial Ships (Mandatory AIS)
- Arctic Search and Rescue (SAR) Agreement
- Indigenous Marine Use Surveys
- Circumpolar Response Capacity Agreement
- Arctic Observing Network Implementation



© Reuters, Ltd.

# Arctic Space Assets Key to:

- **Monitoring the Physical Environment**  
~ Improve Ice Thickness Measurements; Continued Record of Arctic Sea Ice Retreat
- **Enhanced Coverage for Arctic Sea Ice Charting**  
~ Route Optimization & Safety
- **Monitoring & Tracking Vessels**  
~ Enforcement & Vessel Management
- **Enhanced SAR & Environmental Response**
- **Improved Marine Communications in the Central Arctic Ocean**
- **Mapping & Assessments of Changing Marine Use ~ Multiple Use Management / Conflict Avoidance**

*Thank You*





