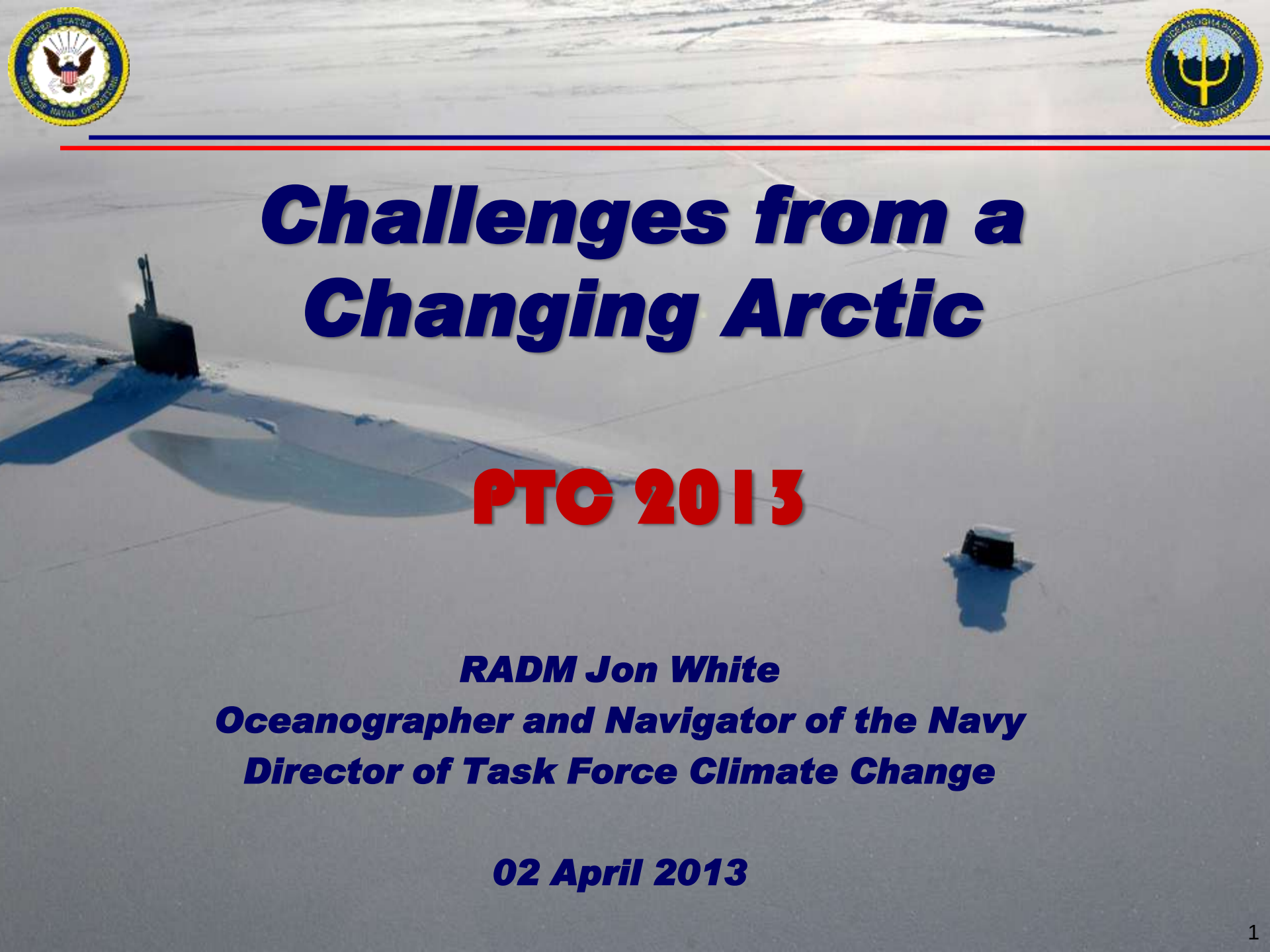


Challenges from a Changing Arctic

PTC 2013

RADM Jon White

Oceanographer and Navigator of the Navy

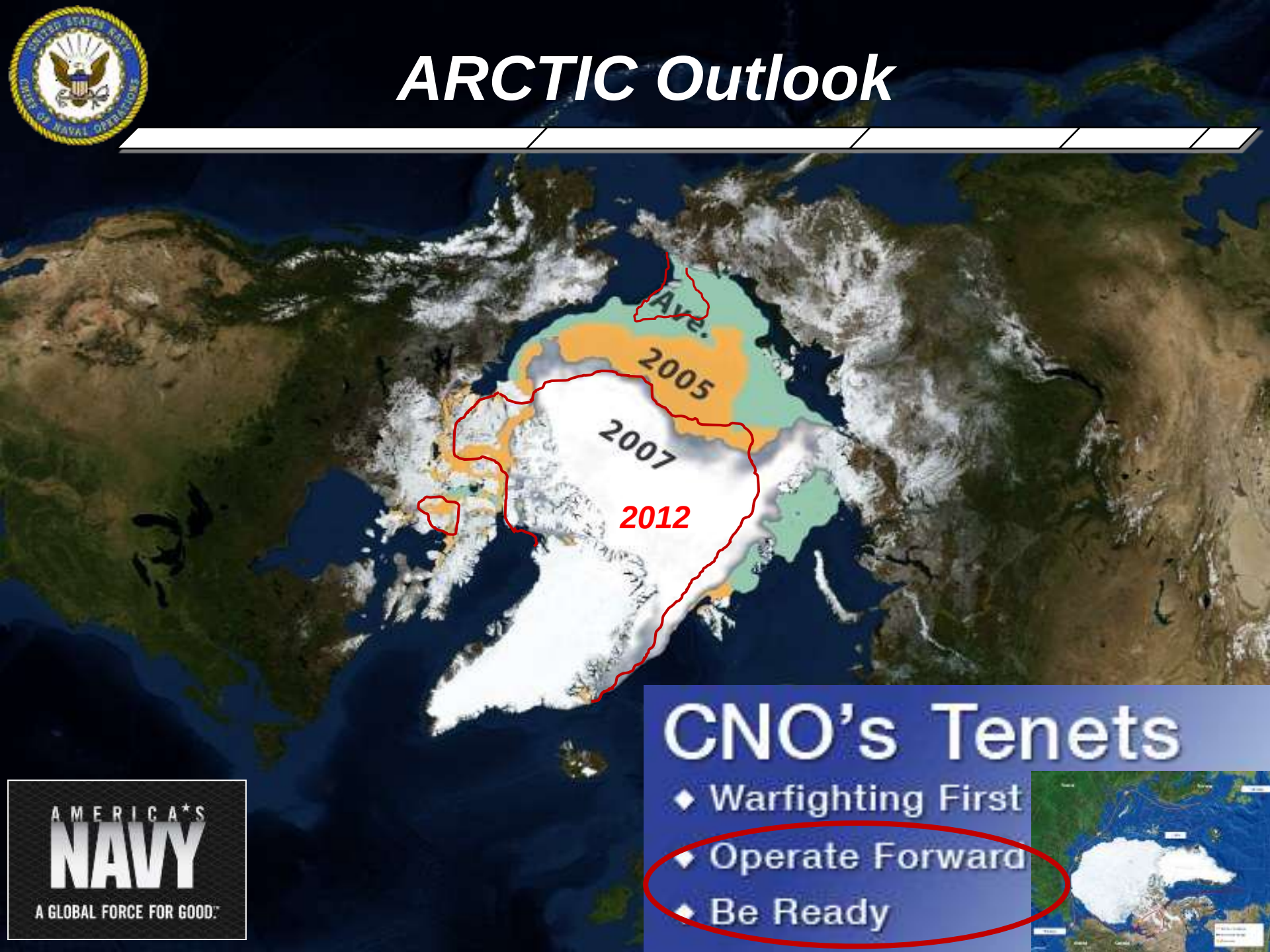
Director of Task Force Climate Change

02 April 2013

CNO's Sailing Directions

ADM Jon Greenert
Chief of Naval Operations (CNO)

ARCTIC Outlook



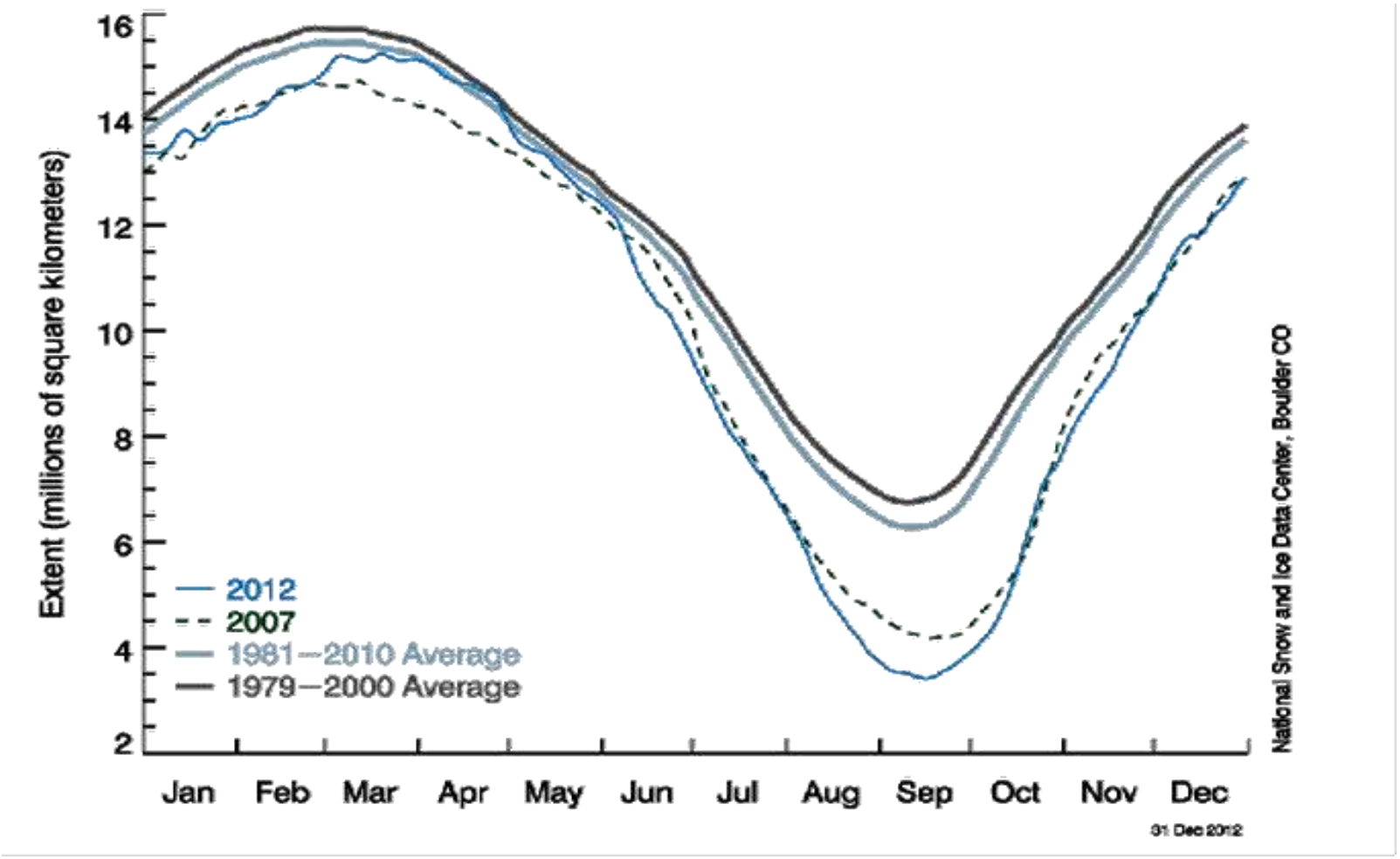
CNO's Tenets

- Warfighting First
- Operate Forward
- Be Ready

AMERICA'S NAVY
A GLOBAL FORCE FOR GOOD.

Arctic Sea Ice Extent - 2012

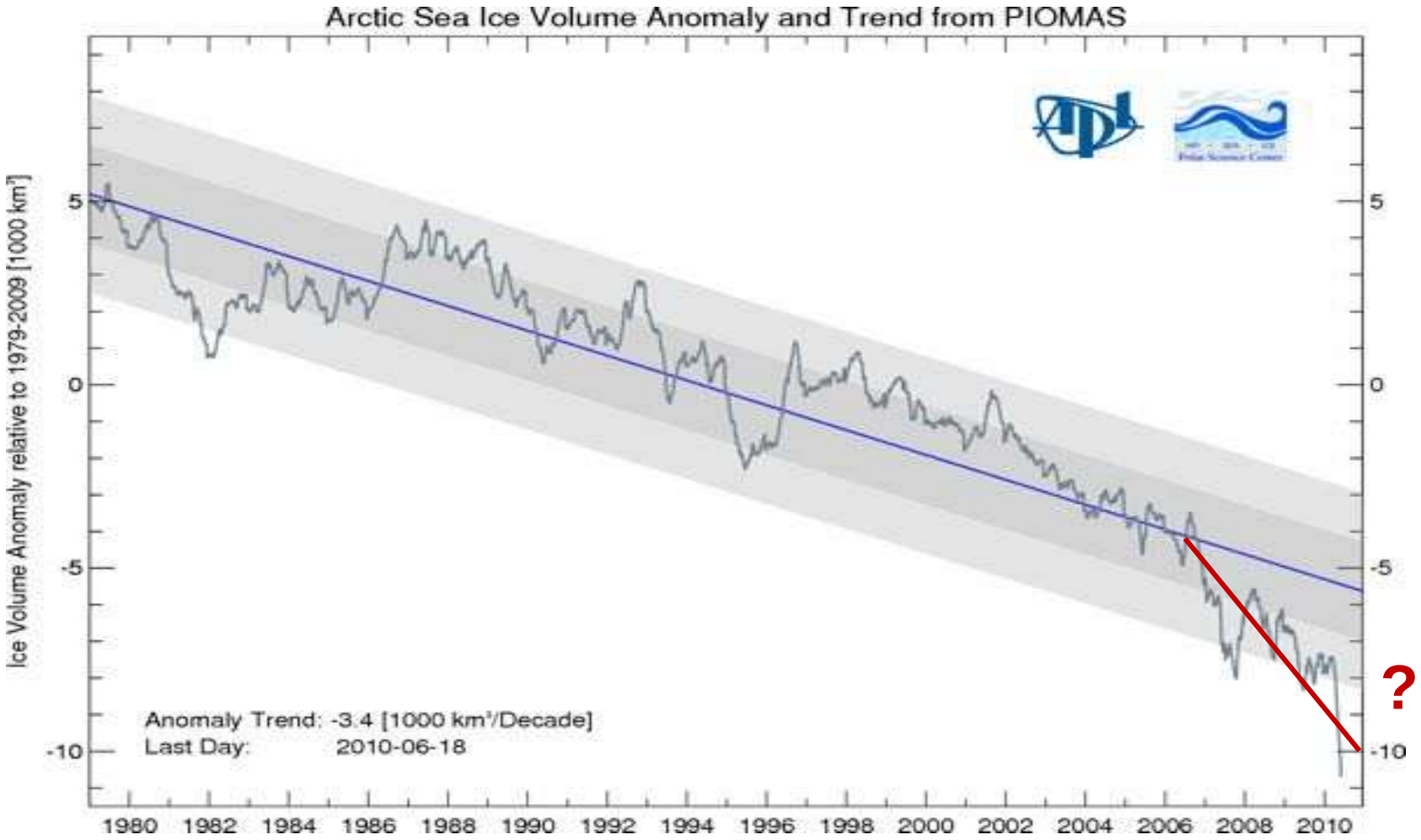
Area with at least 15% ice coverage



Arctic sea ice extent – record low in Sep 2012 (previous record 2007)

- **New minimum was anticipated**
- **Decrease is expected to oscillate over time**

Arctic Sea Ice Volume



Rate of <u>volumetric decrease</u> – potentially faster than predicted

Navy Arctic Strategy

National Arctic Strategy

- ***Under construction → being led by National Security Staff (NSS)***
- ***Will address:***
  - ***National and Regional Security***
  - ***Responsible Stewardship***
  - ***International Cooperation***
- ***Arctic changes are creating new opportunities and threats to our strategic interests.***

Arctic Considerations

Greater access means increased…

Arctic shipping

Oil and gas extraction

Commercial fishing

Arctic tourism

Future Scenario?

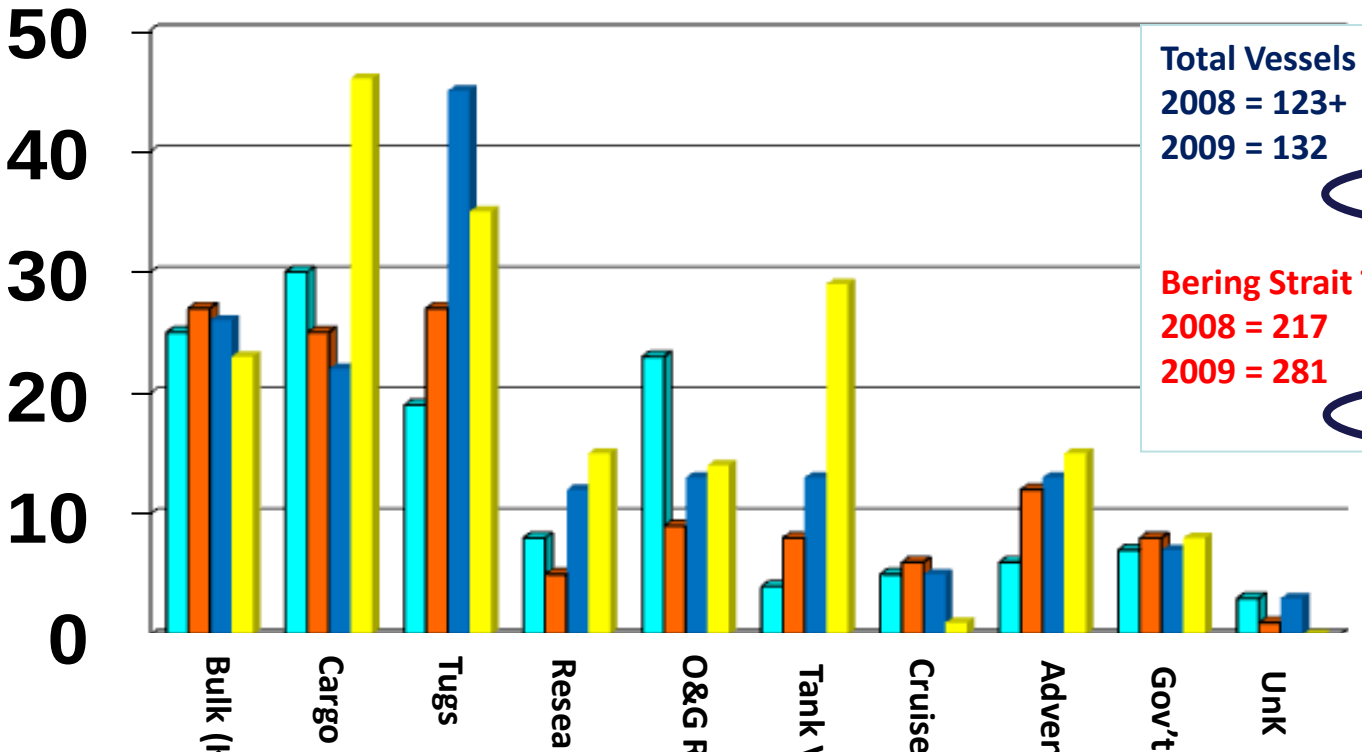
=

Great Potential/Great Opportunity → Great Cost/Great Risk

Bering Strait Transit Activity

2008 2009 2010 2011

[NSR vessels increased from ~20 in 2010 to 58 in 2011]



Total Vessels in the Arctic

2008 = 123+ 2010 = 158

2009 = 132 2011 = 185

2012 = 243

Bering Strait Transits

2008 = 217 2010 = 425

2009 = 281 2011 = 407

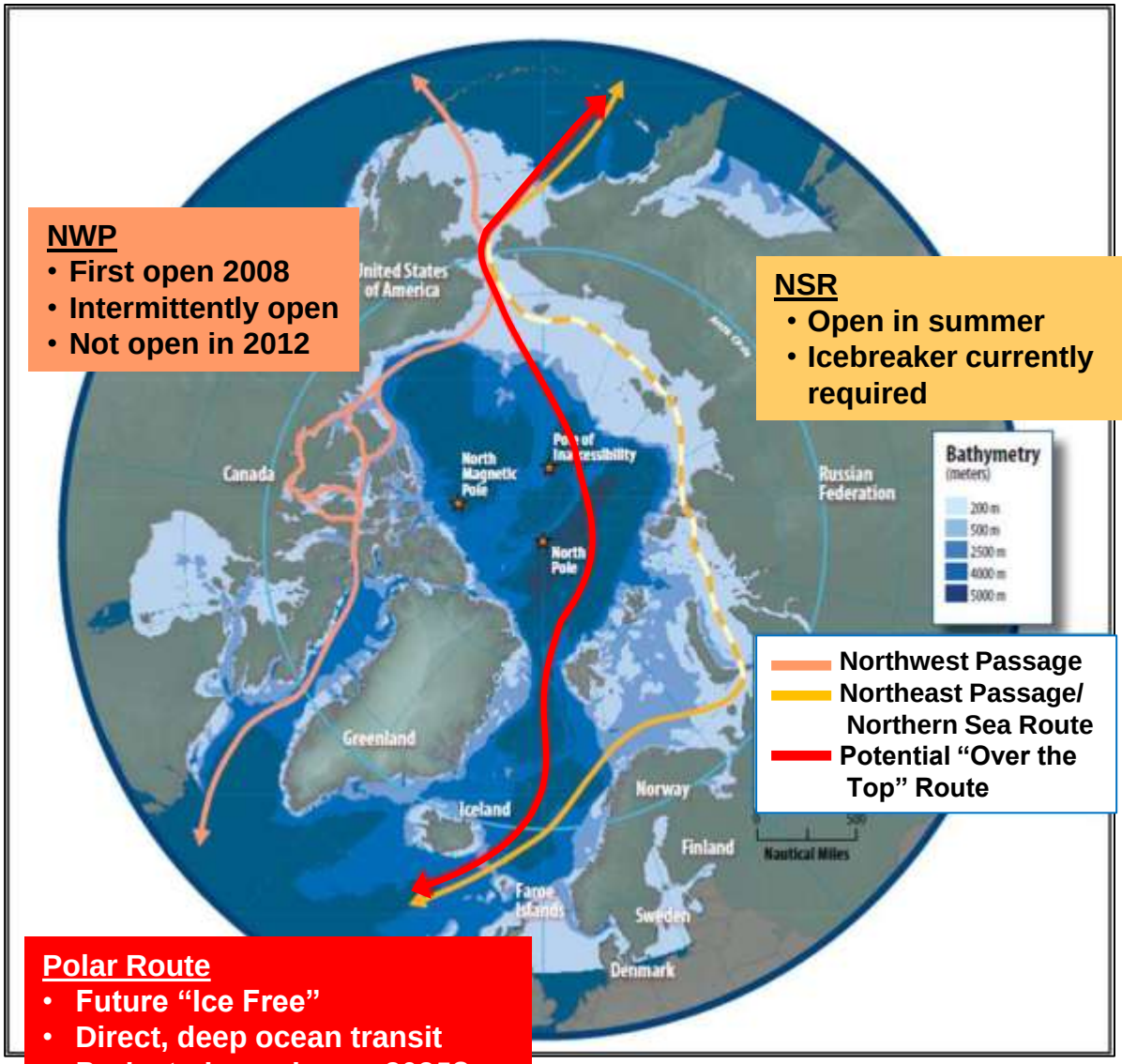
2012 = 483

Arctic Shipping Routes

Shipping across the Arctic cuts significant time off traditional Europe-to-Asia routes.

	Transit in Days		
Bergen, Norway	via Suez	via NSR	via Pole
Hong Kong, China	36	29	26
Shanghai, China	39	27	24
Yokohama, Japan	41	24	21

*Assumes time-distance at 12kts. No other considerations (ice, NSR Delays, weather, insurance, …).

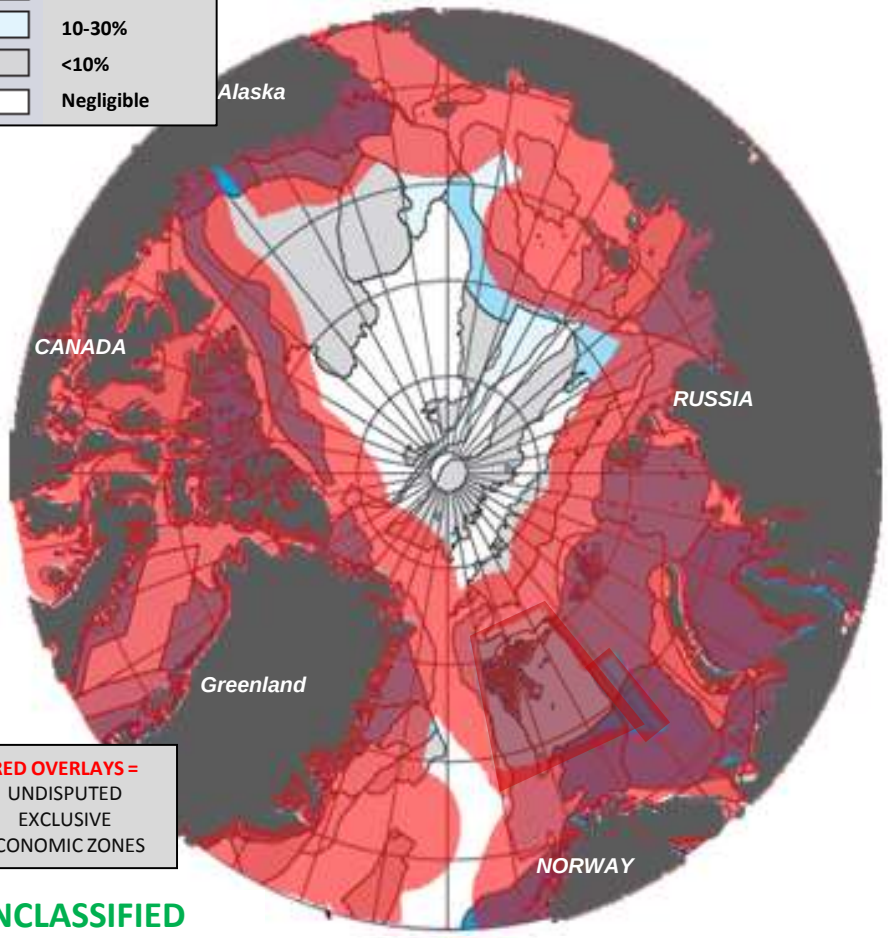


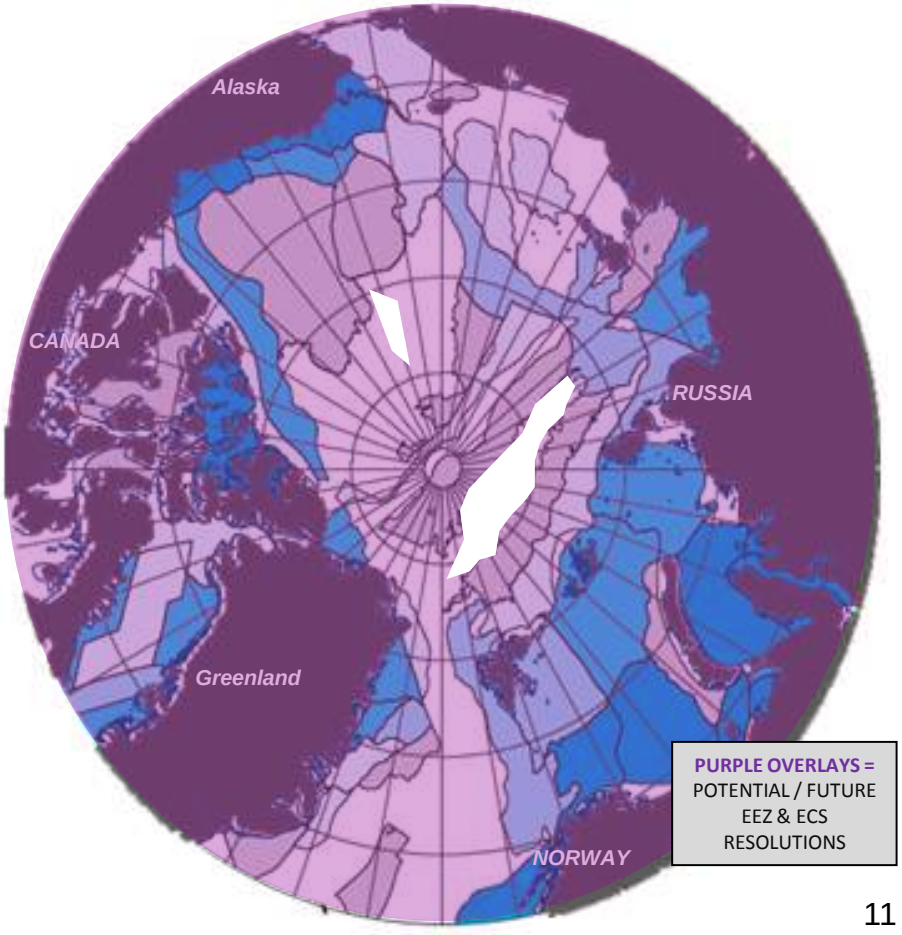
Future Activity & Resources

Oil & gas resource ownership … due to undisputed EEZ ownerships…and potential Extended Continental Shelf Resolutions

PROBABILITY OF AT LEAST ONE 50 MILLION BARREL EQUIVALENT FIELD IN MARKED SECTOR

- 100%
- 50-100%
- 30-50%
- 10-30%
- <10%
- Negligible





RED OVERLAYS = UNDISPUTED EXCLUSIVE ECONOMIC ZONES

PURPLE OVERLAYS = POTENTIAL / FUTURE EEZ & ECS RESOLUTIONS

Navy Arctic Strategic Objectives

Contribute to safety, stability, & security in the region

Signed 21 May 2010

Safeguard U.S. maritime interests in the region

Strengthen existing & foster new cooperative relationships in the region

Protect the American people, our critical infrastructure, & key resources

Ensure Navy forces are capable and ready

Towards the desired end state → a safe, stable, and secure Arctic

Navy's Arctic Mission Analysis

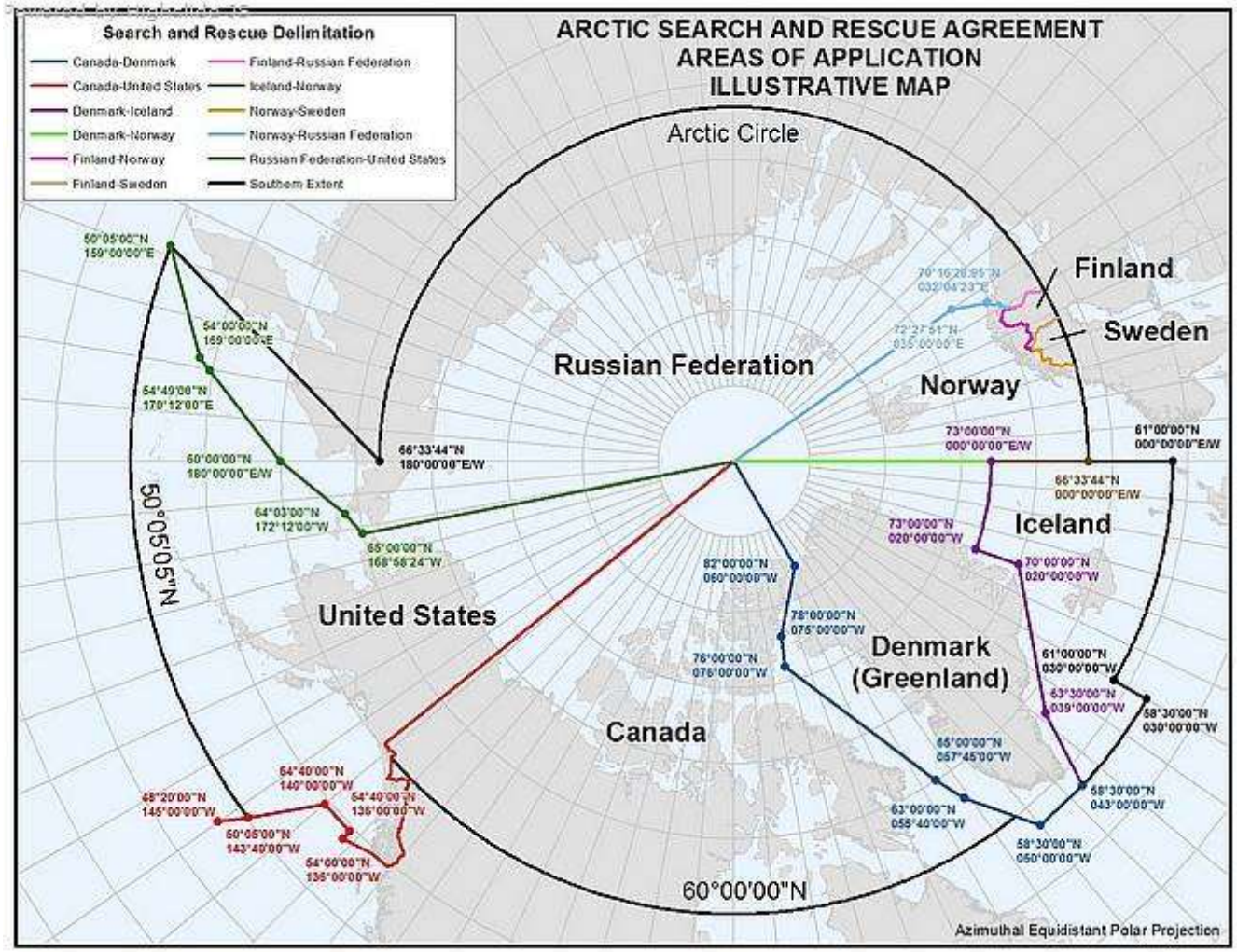
- ***6 Mission Areas:***
  1. ***Regional Security Cooperation***
  2. ***Maritime Security / SAR / MDA***
  3. ***Preventing Conflict / Deterrence***
  4. ***HA/DR / DSCA***
  5. ***Freedom of the Seas / Sea Control***
  6. ***Force Projection***

Roadmap update will consider accelerated timelines.

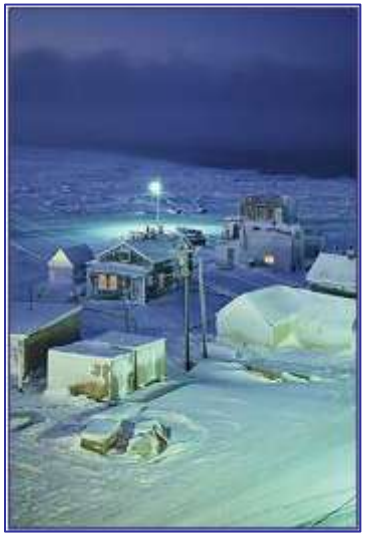
Timeframe	Conditions
2020	• Ice cover spans < 10% of Arctic Basin during summer • Major waterways open 50-60 days/yr; easy passage 20-30 days • Trans-Arctic navigation is limited and difficult
2030	• Major waterways open 110 days/yr; easy passage 45 days • NWP has multi-yr drifting ice; NSR shipping capacity limited by shallow straits • Transit over North Pole possible but limited
2040	• Major waterways are consistently open; increasingly busy in summer • NSR/NWP transits possible 130 days/yr; 75 days easily navigable • Transit over North Pole viable

?

Search and Rescue Responsibilities



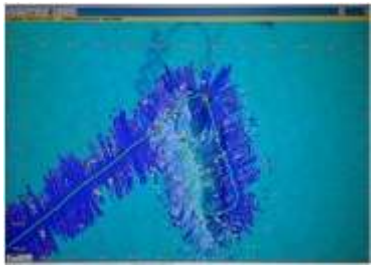
U.S. Arctic Region Challenges



Limited infrastructure to support operations

Limited comms and satellite sensors

Limited ice- breaking capabilities



Incomplete charting

Limited Search and Rescue assets

Harsh operating environment

High cost of operations

Limited Arctic experience

For the U.S. Navy, the Arctic is a challenge, not a crisis

Capabilities Based Assessments

- ***Arctic CBA → Gaps identified in Arctic CBA consist of an inability in the Arctic to fully:***
  - ***Provide Environmental Information → Environmental CBA = 11 Gaps***
  - ***Maneuver Safely on the Sea Surface***
  - ***Conduct Training, Exercises, & Education***
  - ***Maneuver Safely in the Air***
  - ***Sustain the Force***
  - ***Establish Line of Communication***
  - ***Provide Reliable High Data Rate Comms***
  - ***Provide Accurate Navigation Information***
  - ***Maneuver Safely or Quickly on Ground***
  - ***Operate Kinetic Weapons***
  - ***Collect Required Intelligence***
  - ***Disrupt Enemy Weapon Systems***

CBA Recommended Near-term Actions:

- **Coordinate with COCOMs**
- **Assess effectiveness of Navy platforms, systems, and design standards for Arctic**
- **Act as a contributing stakeholder in studying the Arctic**
- **Strengthen partnerships**
- **Develop DoD scenarios**

Roadmap update will focus on resolving gaps & near term actions

Aviation Capability Analysis

UAV

P-3/P-8

Potential Missions

C2
ISR
MDA
Extend Comms
SAR
ASW
HA/DR
Refueling
R&D

HELO

Challenges

- Communications
- Logistics (Refueling,…)
- Basing/Divert Fields
- Extreme Weather (Icing,…)
- Systems & Sensors

Surface Capability Analysis

AMPHIB

CRUDES

Potential Missions

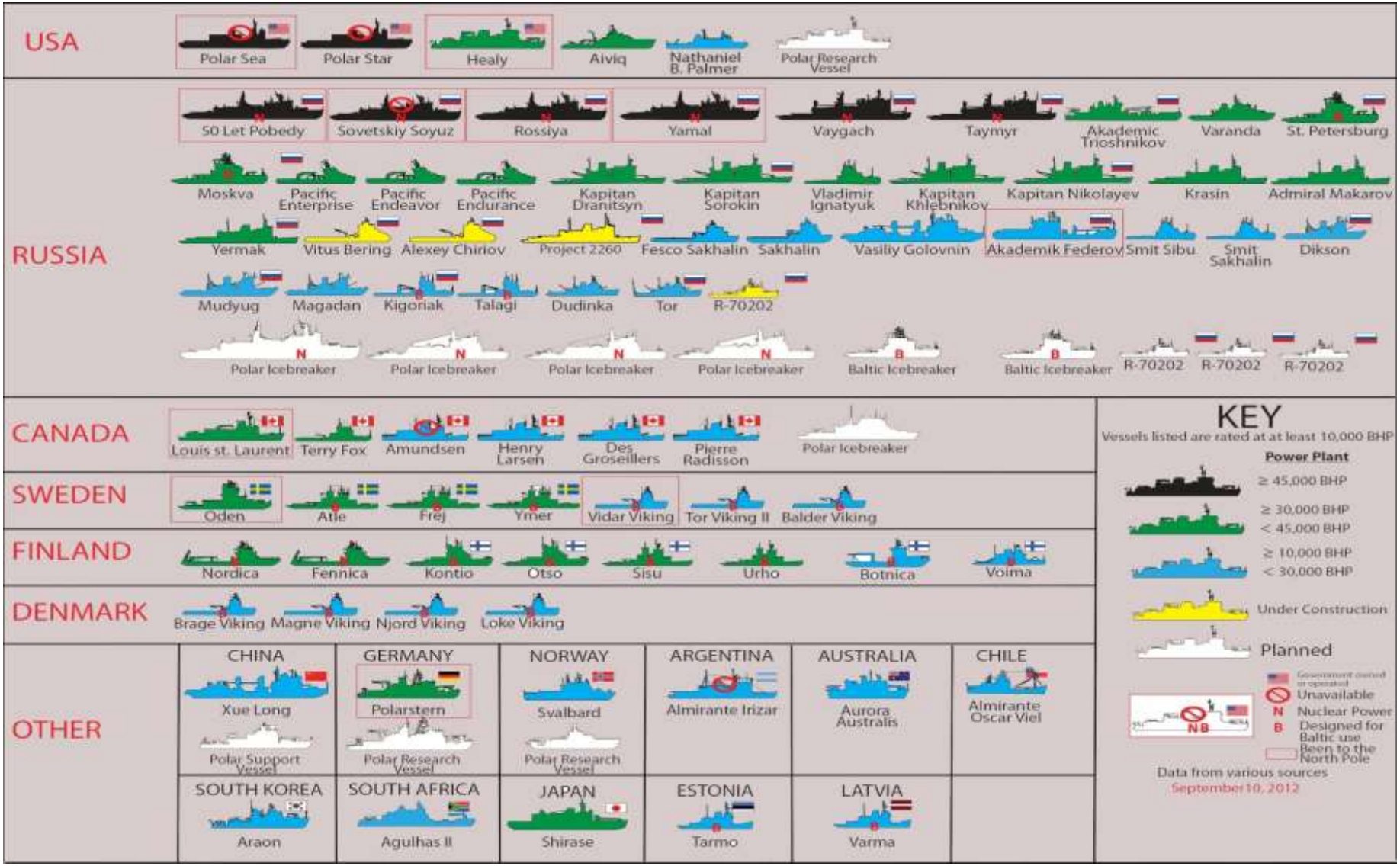
MDA
FON
HA/DR
SAR
BMD
TSC
R&D

MSC (AO, T-AGS)

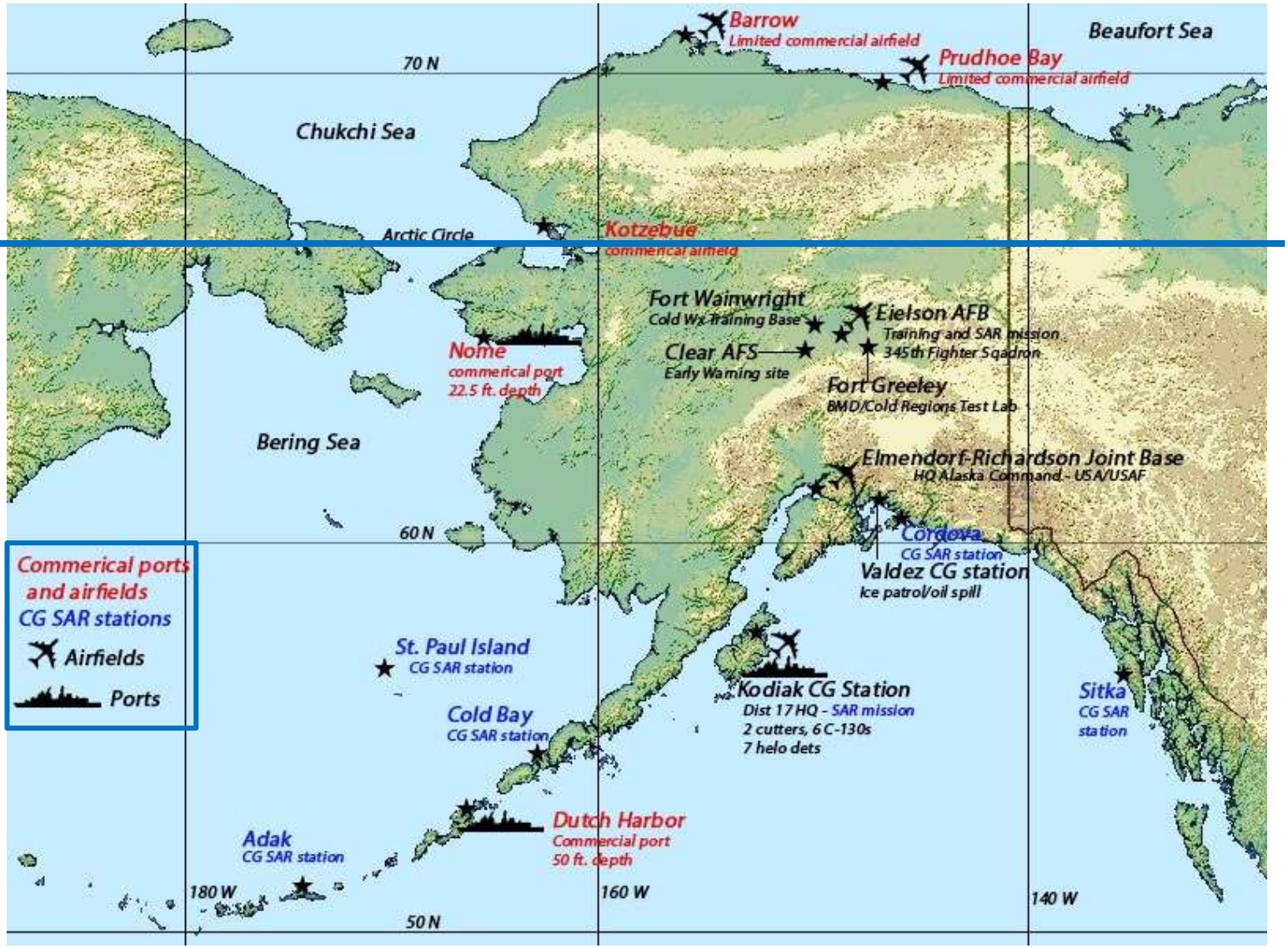
Challenges

- Infrastructure
  - Deep water ports
  - Sea Basing
- Safety of Navigation/Charts
- Communications
- Ice-strengthening
- Systems & Systems
- Time-Distance
- Logistics
- Extreme Weather

Global Ice Breaker Picture



Geography – Infrastructure Analysis



International Engagement Priorities

Arctic Council

(Prohibited by Charter from dealing with military security issues)

Member States: Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, United States

Accredited Observer States: France, Germany, The Netherlands, Poland, Spain, United Kingdom

Pending Observer Applicant States: China, India, Italy, Japan, Singapore, South Korea, (EU also an applicant)

Chairmanship:
Current – Sweden
May 2013-15 – Canada
May 2015-17 – United States

Military Forums

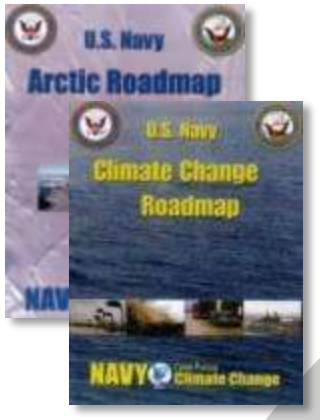
Arctic Security Forces Roundtable

- ASFR11 Ops, Infrastructure, MDA, T&E
- ASFR12 – MDA, Comms
- ASFR13 – Aug 2013

Northern CHOD

- 2012 (Canada) – Theme: DSCA
- 2013 (Denmark)

U.S. Navy
Task Force Climate Change



Capabilities & Requirements

Strategy, Policy & Investments

Research & Assessment

Roadmaps

Monitor Conditions

Update

NAVY Task Force Climate Change

Science-based approach, cooperative partnerships, risk assessments

ONR Arctic Research Program

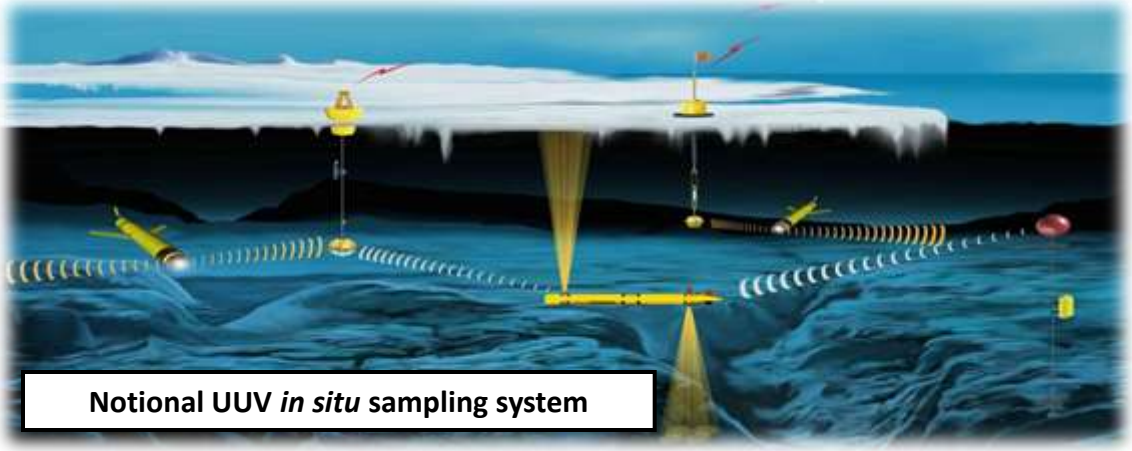
To Better Understand and Predict the Arctic Environment

Coordinated research activities between NRL and ONR

Primary Thrusts:

- Exploration of **new technologies and methodologies** (platforms, sensors, communications) that will enable persistent observation and operation in the Arctic ocean environment
- **Improved basic physical understanding** of the Arctic environment and important coupled processes operating in the Arctic region
- Development **fully-integrated Arctic System Models** incorporating the ocean, sea ice, waves and atmosphere for improved prediction at longer lead times, including the use of **satellite SAR data** for assimilation into integrated models

SAR Sea Ice Imagery



Notional UUV *in situ* sampling system

Advances in technology will be required to enable an interagency Arctic Observing Network that will support scientific exploration and be able to initialize predictive models of the environment

NRL's DISTANCE: Determining the Impact of Sea Ice Thickness on the Arctic's Naturally Changing Environment

Combined LiDAR/Radar Airborne Instrumentation for Ice Field Mapping and Thickness Determination

10 GHz High-Power, Pulse-Limited Radar Altimeter

- ~3nsec pulse-width => 32m diameter footprint @300m altitude
- Wave-form digitization for mixed (lead & ice) returns < 1 cm vertical resolution of features @ 10 kHz
- Updated for 2012 field season to be fully coherent

Scanning Topographic LiDAR

- < 1 cm range resolution
- Wave-form digitization for mixed (lead & ice) returns

Digital True Color Photogrammetry

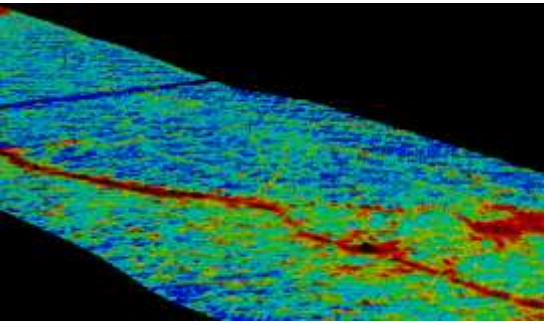
- Lead discrimination

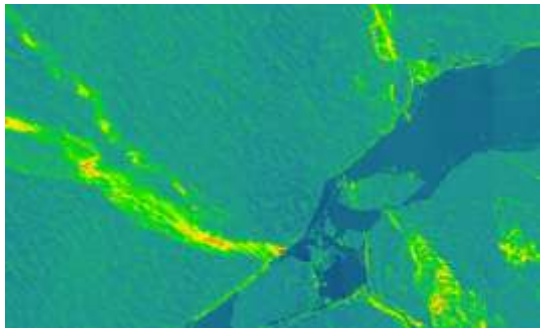
Webcam

- Lead discrimination and possible ice velocity for 2013 field season

Previous Campaigns

- Skagit Bay, Afghanistan, Arctic, Greenland, etc

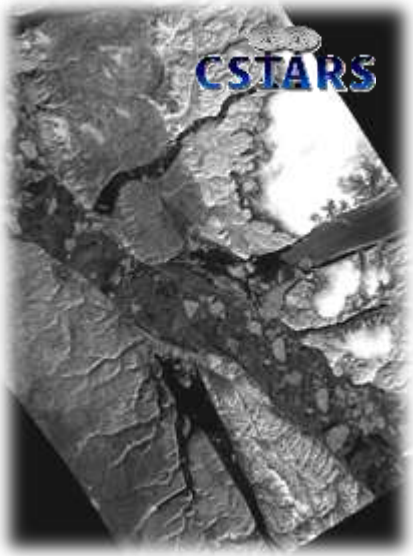




FY13/14 NOPP Topic: Arctic Modeling and Prediction

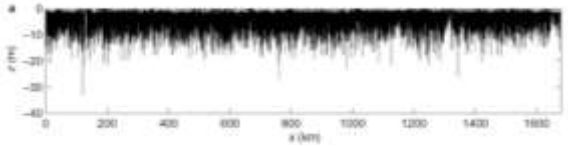
Develop an improved modeling capability for the Arctic for both basic understanding and prediction

- Coupling ocean models with ice, wave, and atmospheric models in the Arctic
- Data assimilation techniques for the Arctic Ocean
- Building tools to help optimize the Arctic observing system
- Role of remote sensing and *in situ* data in constraining Arctic models
- Improved models and methods for prediction of sea ice (nowcast to 6+ months)

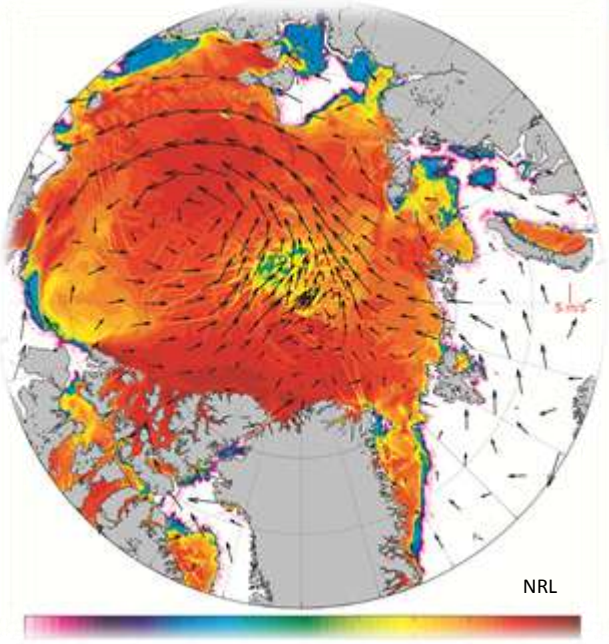


Integrated Arctic System Models
ocean – ice – wave – atmosphere

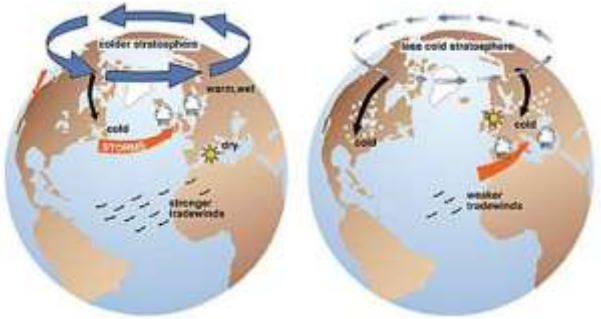
Advanced
Data Assimilation



Ice thickness measured from below



Coupling with Global Earth System Models



J. Wallace, University of Washington

Toward Improved Arctic System Prediction

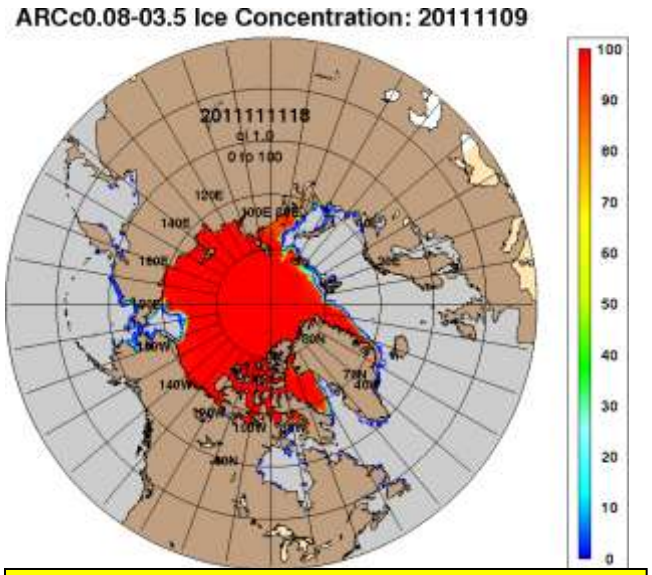
NRL's Arctic Cap Nowcast/Forecast System (ACNFS)

ACNFS consists of 3 components:

- Ice Model : Community Ice CodE (**CICE**) *(DOE/LANL)*
- Ocean Model: HYbrid Coordinate Ocean Model (**HYCOM**)
- Data assimilation: Navy Coupled Ocean Data Assimilation (**NCODA**)

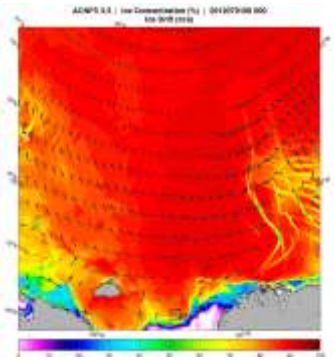
Currently, ACNFS uses boundary conditions from GOFS 3.0

The Arctic Cap model will be integrated into the fully-coupled Navy **ESPC** model in coming years

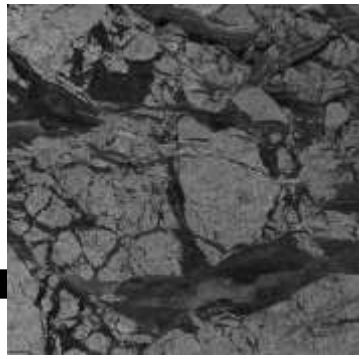


Model grid resolution ~ 3.5 km

Black line denotes independent ice edge analysis from National Ice Center (NIC). Animation spans Nov 2011 – Nov 2012.



Models will require high-resolution observations for initial conditions



ONR/NRL Major Arctic S&T Efforts

◆ MAJOR FIELD EXPERIMENT ▲ INDIVIDUAL OR PILOT EXPERIMENT

ONR DRI: Emerging Dynamics of the Marginal Ice Zone - Understand the air-ice-ocean-wave processes governing the evolution of the new marginal ice zone (MIZ) in the Beaufort Sea north of Alaska (FY12-FY16)

ONR DRI: Sea State and Boundary Layer Physics of the Emerging Arctic Ocean - Understand the impact of open water in the Arctic Ocean on sea state, waves, surface fluxes into the atmosphere on the retreat of sea ice.

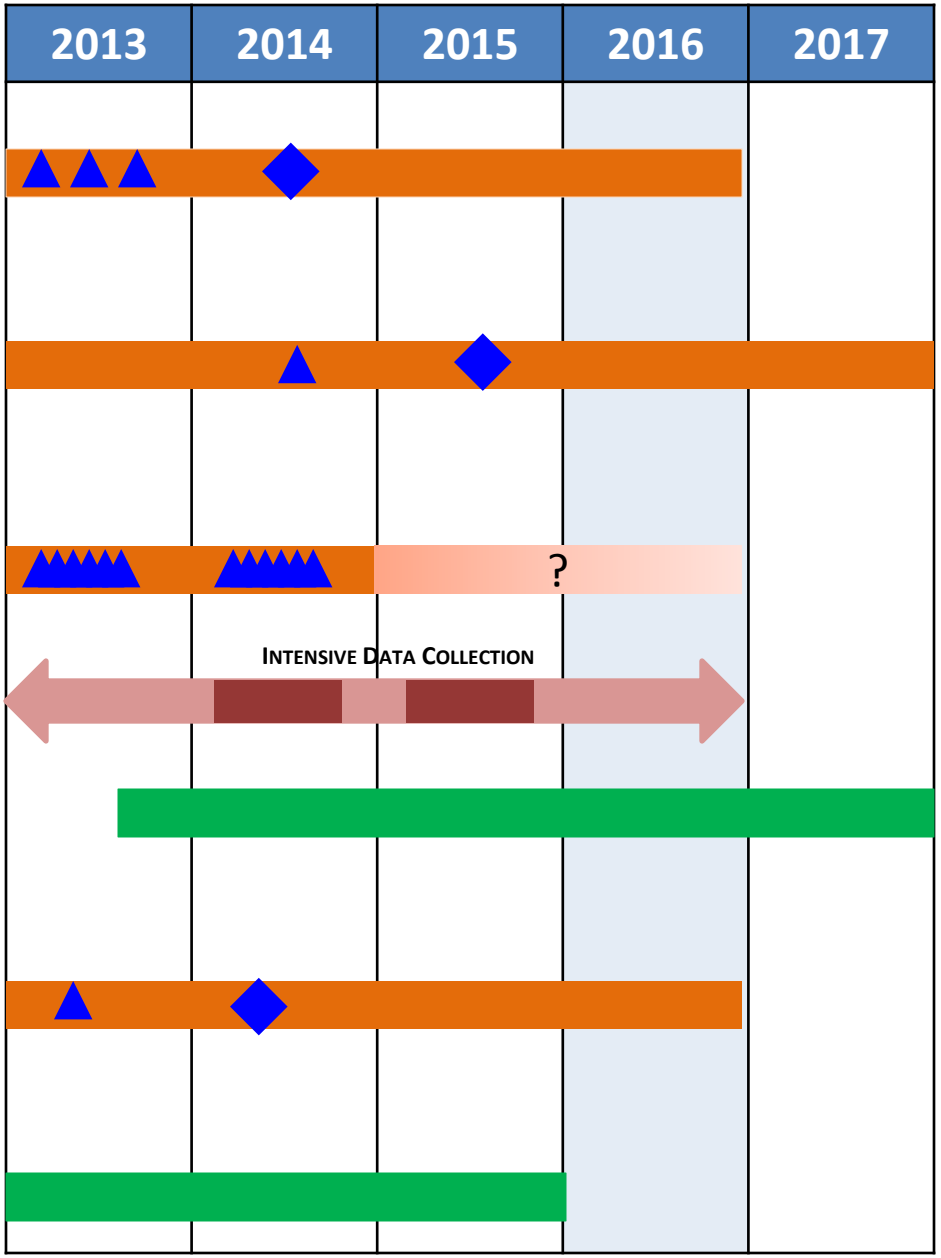
ONR SIZRS: Seasonal Ice Zone Reconnaissance Surveys - Repeated ocean, ice, and atmospheric measurements over the Beaufort/Chukchi Sea seasonal ice zone utilizing US Coast Guard Arctic Domain Awareness flights.

ONR High-Resolution SAR Data Collection

NOPP Project for Arctic System Model Development Interagency effort to develop data assimilative Arctic System Models to improve forecasts of the environment

NRL - DISTANCE: Determining the Impact of Sea Ice Thickness on the Arctic's Naturally Changing Environment Develop new techniques to derive snow depth and ice thickness from multiple sensors, and to use the new data types in the Navy's coupled ice-ocean model.

NRL - Coupled Relocatable High-Resolution Arctic Modeling System - Develop coupled relocatable ocean-ice-atmosphere model for high-resolution prediction



Arctic Map


UNITED STATES
(Alaska)
CANADA
RUSSIA
Greenland
(DENMARK)
Arctic
Ocean
North
Atlantic
Ocean
Barents Sea
Kara Sea
Laptev Sea
Norwegian Sea
Greenland Sea
Baffin Bay
Hudson Bay
Beaufort Sea
Chukchi Sea
East Siberian Sea
Bering Sea
Arctic Circle
Anchorage
Fairbanks
Whitehorse
Dawson
Prudhoe Bay
Barrow
Nome
Wrangel Island
Anadyr'
Provideniya
Cherskiy
Yakutsk
Verkhoyansk
Tiksi
Lensk
Tura
Norilsk
Dikson
Norvy Urengoy
Surgut
Vorkuta
Severnaya Zemlya
Novaya Zemlya
New Siberian Islands
Banks Island
Victoria Island
Cambridge Bay
Yellowknife
Inuvik
Resolute
Queen Elizabeth Islands
Ellesmere Island
Alert
Thule
Baffin Island
Iqaluit
Pangnirtung
Qeqertarsuaq
Nuuk
Godthåb
Ilulissat
Aasiaat
Sisimiut
Kangerlussuaq
Ammassalik
Qaqortoq
Nord
Longyearbyen
Svalbard
(NORWAY)
Bjørnøya
(NORWAY)
Hammerfest
Murmansk
Arkhangelsk
Kiruna
Oulu
FINLAND
Petrozavodsk
NORWAY
Umeå
SWEDEN
Tampere
Helsinki
Leningrad
Trondheim
Bergen
Gävle
Reykjavik
ICELAND
Tórshavn
Faroe Islands
(DENMARK)
Shetland Islands
(U.K.)
Franz Josef Land
North Pole
Jan Mayen
(NORWAY)
Denmark Strait
Davis Strait
Denmark Haven


ALASKA
CANADA
RUSSIA
GREENLA

Arctic Risks - Today

- ***To a Stable and Secure Region***
  - ***Limited transparency of non-Arctic States activities and intentions in the region***
- ***To U.S. National Interests***
  - ***Establishing precedents for freedom of access and navigation***
- ***To U.S Homeland Security***
  - ***Major or mass search and rescue response***
  - ***Large–scale environmental catastrophe***
  - ***Vessel catastrophes***

Arctic Risks - Future

- **To a Stable and Secure Region**
  - Misperceptions regarding the natural increase in Arctic military activities ("Militarization")
    - An Arctic Force for Good … Presence → Security → Stability
  - Unwanted alliances and limited transparency of Arctic nation's relationships with outside players
  - Uncertain dynamics in the development of regional governance
- **To U.S. National Interests**
  - Not being positioned to leverage opportunities
  - Past activities substantiate maritime claims that spillover to other strategic waterways and chokepoints
- **To U.S Homeland Security**
  - Resilience to impacts of climate change or natural disasters
  - Random or rogue acts by state or non-state actors

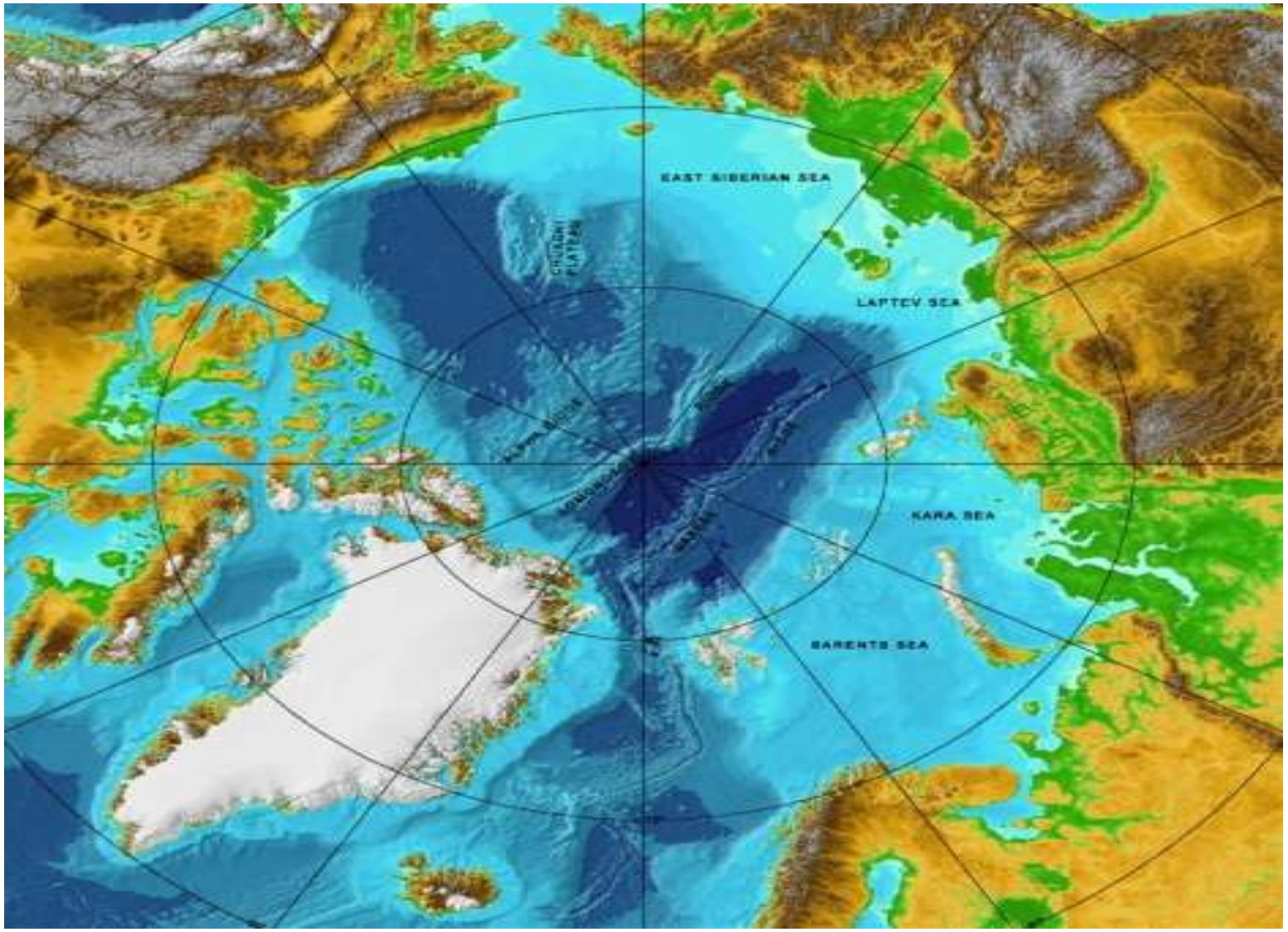
Challenges To Capability Implementation

Policy Challenges

- *Accession to UNCLOS*
- *National Strategy*
- *Fiscal constraints*
- *International synergy → Arctic Council*

Physical Challenges

- *Limited Arctic basing and infrastructure availability*
- *MDA, communications, weather and ice forecasting resources*
- *Limited proven ability to conduct persistent Arctic surface or Air ops, especially in the presence of surface ice*
- *Lack of national icebreaking assets to exercise freedom of navigation in this region*


EAST SIBERIAN SEA
LAPTEV SEA
KARA SEA
BARENTS SEA

Bullet Slide

- *Primary*
  - *Secondary*
    - *Tertiary*
      - *Quaternary*