



Climate Change Adaptation: A U.S. Navy Perspective

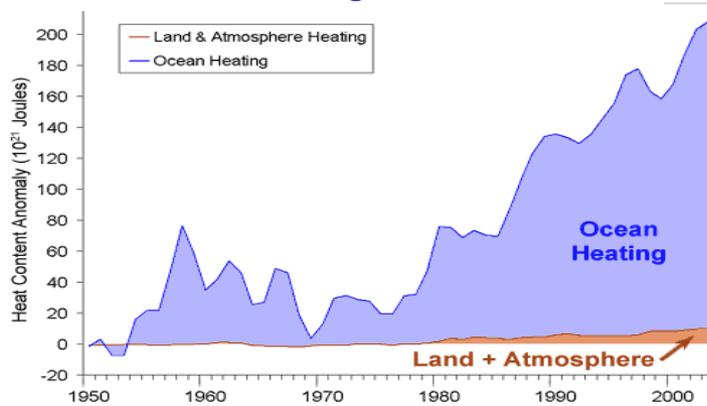


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Task Force Climate Change
Office of the Oceanographer of the Navy
June 2011



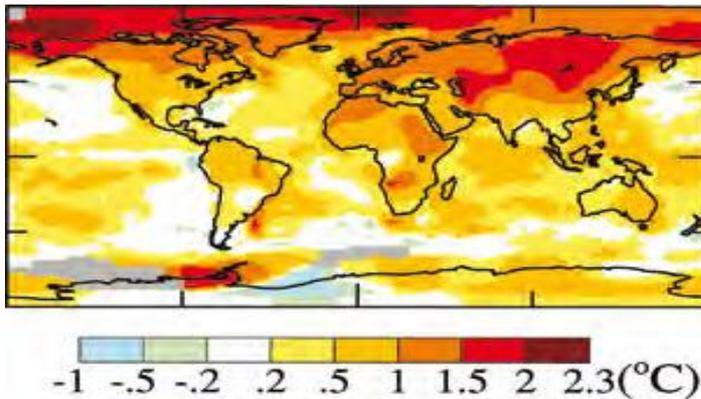
Climate Change

The Ocean is Storing Most of the Heat



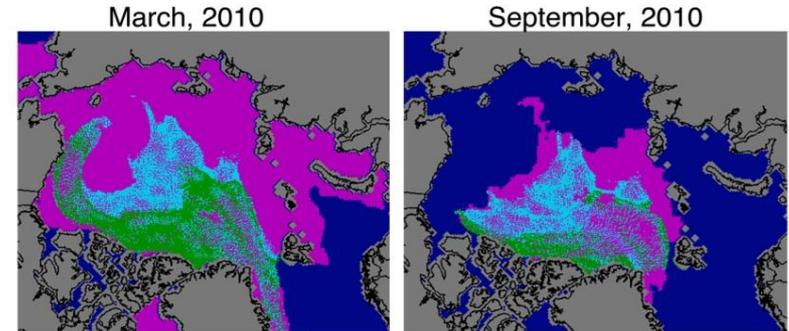
Total Earth Heat Content from 1950 (Murphy 2009). Ocean data taken from Domingues et al 2008

Arctic Warming is 2 x the Rest of the World



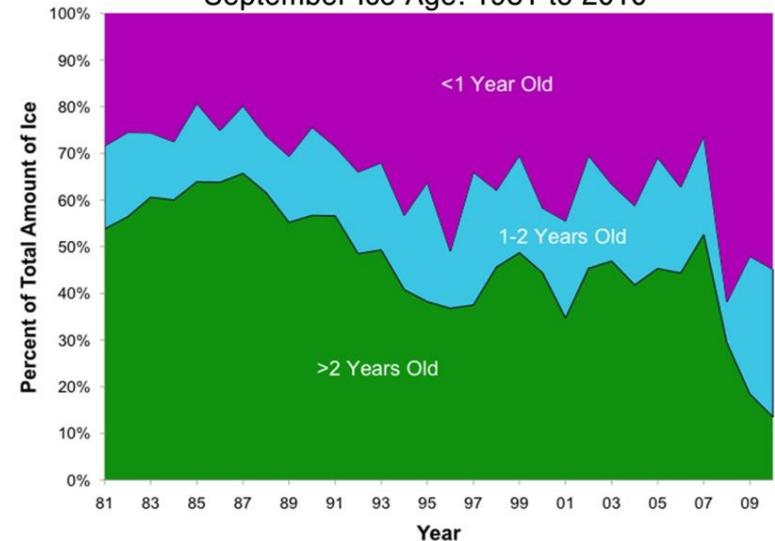
Mean surface temperature 2001-2007 relative to baseline period 1951-1980, from: The Copenhagen Diagnosis, 2009

Arctic Sea Ice Continues to Melt & Thin



■ First-year ice (<1 year old)
 ■ Second-year ice (1-2 years old)
 ■ Multiyear ice (>2 years old)

September Ice Age: 1981 to 2010



NSIDC courtesy J. Maslanik and C. Fowler, CU Boulder



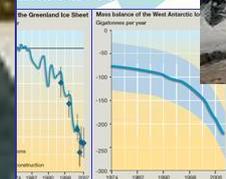
Climate Change (cont'd)



Sea Level Rise

21st Century
Sea Level Rise

erating Ice Sheet
Mass Loss



The Copenhagen Diagnosis, 2009



Observation:
>50 Gt/yr

Projection:
10-20mm/yr?

2009

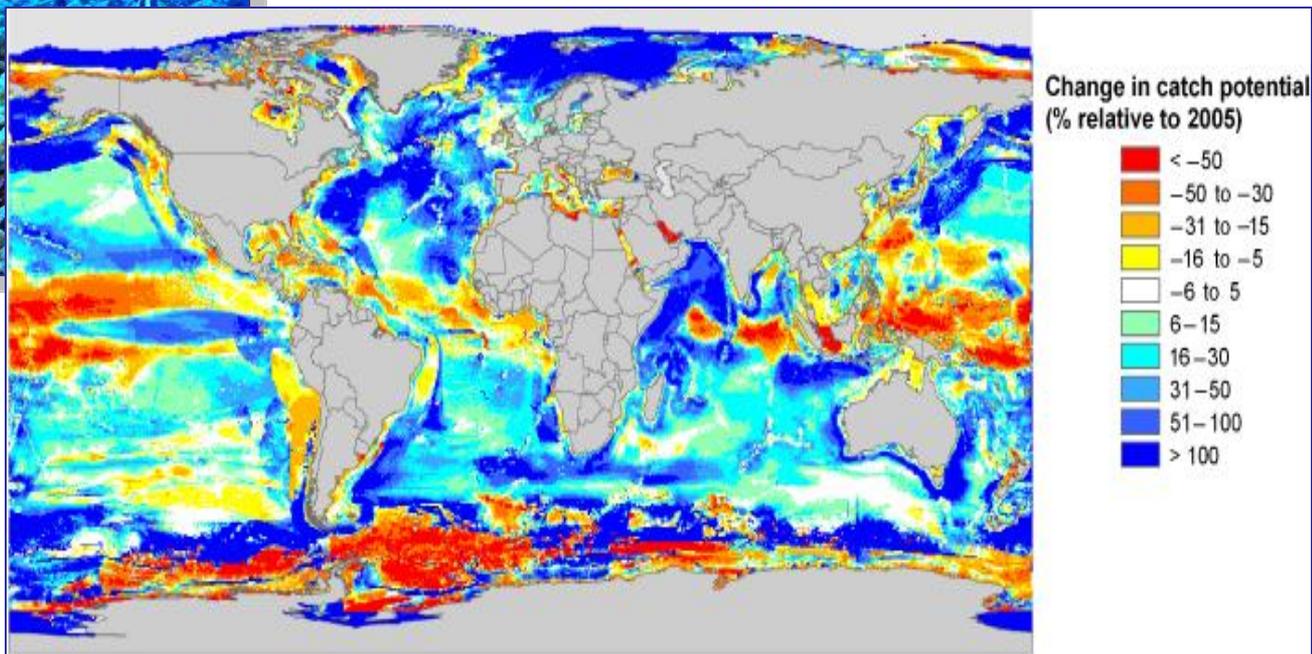
2010-2100



Climate Change (cont'd)



Projected Redistribution of Global Fisheries From 2005-2055



Cheung, W. et. al., in Global Change Biology, 2010



Security Implications

Climate Change



- *Weather*
- *Ocean*
- *Land*
- *Space*

Impacts



- *Food*
- *Water*
- *Shelter*
- *Energy*
- *Health*

Factors



- *Exposure*
- *Sensitivity*
- *Adaptability*

Response



- *Defense*
- *Diplomacy*
- *Development*

Implies a National "whole of government" approach



Challenges & Opportunities

Challenges

- Increasing Arctic maritime activity
- Water & resource scarcity
- Sea level rise impact on installations



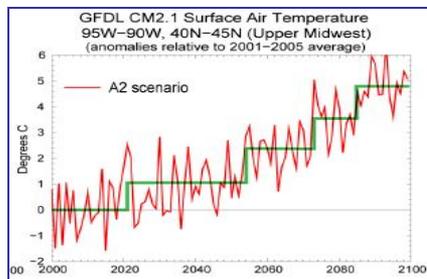
Opportunities

- Cooperative partnerships
- Energy security initiatives
- Infrastructure recapitalization



Wild-cards

- Abrupt climate change
- Geo-engineering
- Ocean acidification





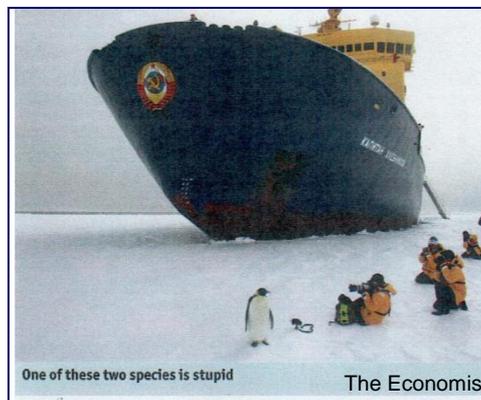
Arctic Trends Assessment

Commercial activity remains limited through 2030



- Shipping, oil, & gas extraction to grow after 2030
- Tourism & maritime research will increase the most
- Fishing to grow but only gradually

..but after 2050?



Harsh operating environment will remain the greatest limiting factor



Naval Studies Board Recommendations

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine
NAVAL STUDIES
BOARD



Support ratification of UNCLOS



Address naval coastal installation vulnerabilities



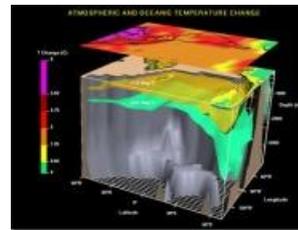
Prepare for increase in HA/DR, Arctic missions



Address emerging technical requirements (e.g. polar ops)



Address partnership demands



Support research & development

Navy action is already underway

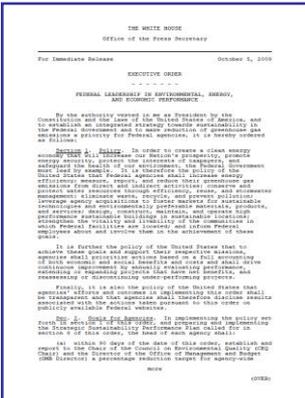


Drivers

Navy

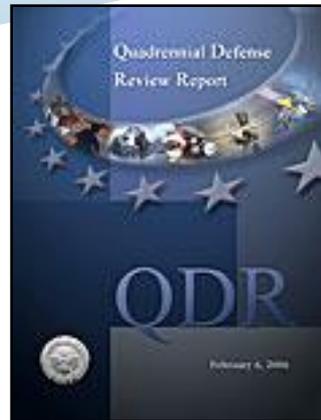
Defense

National



Executive Order 13514

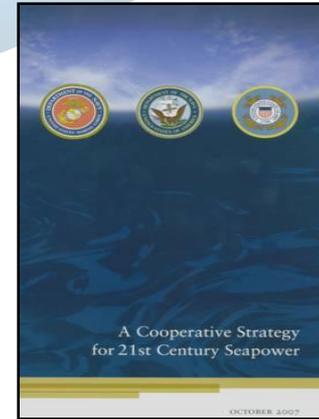
“Federal Agencies will reduce , monitor, track, & report GHG emissions”



2010 QDR

“Climate change, energy security, and economic security are inextricably linked”

“DOD will work to foster efforts to assess, adapt to, and mitigate the impacts of climate change”



Maritime Strategy
“Climate change is gradually opening up the waters of the Arctic”

“These opportunities offer potential for growth, they are potential sources of competition for access and natural resources”



Task Force Climate Change

WHEN?

Establishment

Chief of Naval Operations
Executive Board on May 15, 2009



Composition

Navy, NOAA, USCG in core group with
Joint, interagency, international support



Charter

Global climate change impacts with near term Arctic focus

Science-based approach, cooperative partnerships, risk assessments



What We're Doing About It

Navy Arctic Roadmap

Phase 1 (FY10)	Phase 2 (FY11-12)	Phase 3 (FY13-14)
<p>Arctic SPP Fleet readiness assessment, external studies, strategic implementation plan</p> <p>Advocate for UNCLOS^{***}</p> <p>Monitor Polar SATCOM Program^{***}</p> <p>Arctic TTX & LOE</p> <p>POM-12 investments for air-ocean-ice numerical prediction</p>	<p>POM-14 CBA, NSP, & SPPs address the Arctic</p> <p>Formalize expanded / new cooperative partnerships</p> <p>Arctic SAREX, Arctic Edge, Northern Edge NANOOK^{***}</p> <p>ICEX-11</p> <p>Environmental assessments</p> <p>Support National Ocean Policy / Marine Spatial Planning Implementation For Arctic^{***}</p> <p>Interagency partnership for air-ocean-ice numerical prediction</p>	<p>Execute POM-14</p> <p>Implement expanded / new cooperative partnerships</p> <p>Arctic UUV operations</p> <p>Update roadmap ICW QDR</p>

^{***} Indicates recurring action

Navy recognized as a valued joint, interagency, & international partner in the Arctic

Climate Change Roadmap

Phase 1 (FY10)	Phase 2 (FY11-12)	Phase 3 (FY13-14)
<p>Climate adaptation assessments, studies</p> <p>GHG Tracking & Reporting^{***}</p> <p>Continue Arctic roadmap execution^{***}</p> <p>Support White House Interagency Adaptation Task Force^{***}</p> <p>Research & development for air-ocean-ice observation & prediction^{***}</p>	<p>POM-14 CBA, NSP, SPPs address climate change adaptation</p> <p>Formalize / new cooperative adaptation partnerships</p> <p>Sponsor climate symposia & conferences^{***}</p> <p>OSD SERDP's sea level rise studies</p> <p>Naval Studies Board climate change study</p> <p>Complete sea level rise studies</p> <p>Formalize interagency partnership for air-ocean-ice observation & prediction</p>	<p>Execute POM-14</p> <p>Implement new cooperative adaptation partnerships</p> <p>Implement climate change adaptation study recommendations</p> <p>Climate science & security implications included in formal Navy education</p> <p>Climate change TTX's & wargames^{***}</p> <p>Update roadmap ICW QDR</p>

^{***} Indicates recurring action

Navy is fully mission-capable through changing climatic conditions

UNCLASSIFIED

An iterative approach – NOT fire and forget



Navy Accomplishments: April 2010 – June 2011

Education



Naval Post Graduate School Arctic Science & Security theses



Arctic science & security Study topics at US Naval Academy



Naval War College courses address Arctic Science & Security Topics

Studies & Assessments



Naval Arctic Mission Analysis



Naval Studies Board study



Naval Installation Sea Level Rise Vulnerability Assessment



Naval Arctic Capability Based Assessment

Outreach & Engagement



NSS Interagency Policy Committee



State Department Arctic Policy Group



Conferences, Symposia, Media events



Leadership visits & staff talks



Arctic Military Roundtable

Policy, Strategy, & Plans



Support Arctic Section In 2010 UCP



Navy Arctic Strategic Objectives



USN-USCG Arctic Activity Plan

Operations & Training



Navy-NOAA Bering Strait Survey



Arctic Care 2010



ICEX 2011



USS Taylor Port Visit to Murmansk



Pacer Goose



Operation NANOOK/NATSIQ

Science & Research



NRL Kara Sea Research cruise



Interagency partnership For air-ocean-ice numerical prediction



Science Ice Exercise Plan

Improve understanding

Ensure readiness (resilience)



Recent Activity

Technology Demonstrations – ICEX-11



Aerial resupply



SSN 778 surfaced



Ice-mining



VIP visit



Interagency Research Efforts – Operation Ice Bridge 2011



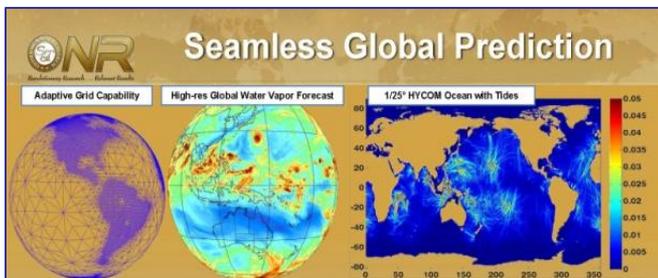
Greenland Ice Sheet





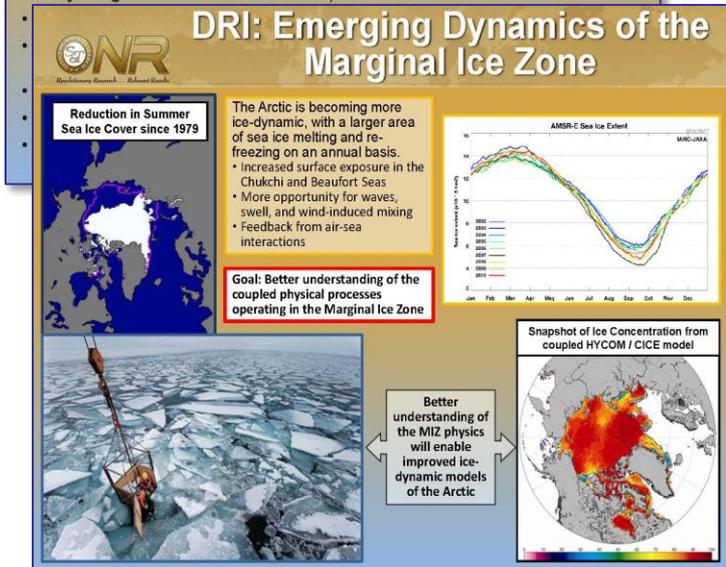
Improving Understanding

ONR Initiatives



ONR's new effort will focus on building the next-generation integrated global prediction system to support the needs of the US Navy in 2020:

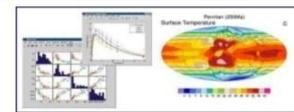
- Fully-integrated ocean-wave-ice-atmosphere model



More Interagency Collaboration

Earth System Prediction Capability

Recapitalize aging suite of global atmospheric models



Implement interagency collaboration



Revolutionary advancement National predictive architecture

Academic Coursework & Projects





Discussion

