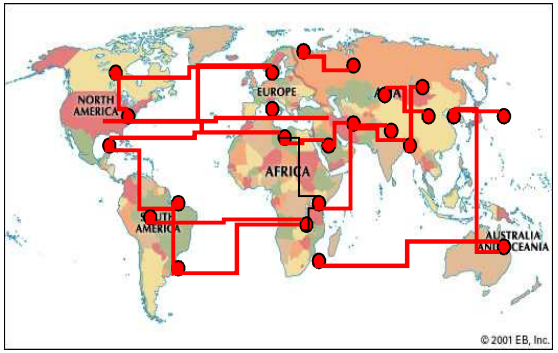
SAND2009-0174P

Climate Changes in the Arctic and The Challenge to USCG Operations

Briefing For USCG Stakeholders

19 December 2008



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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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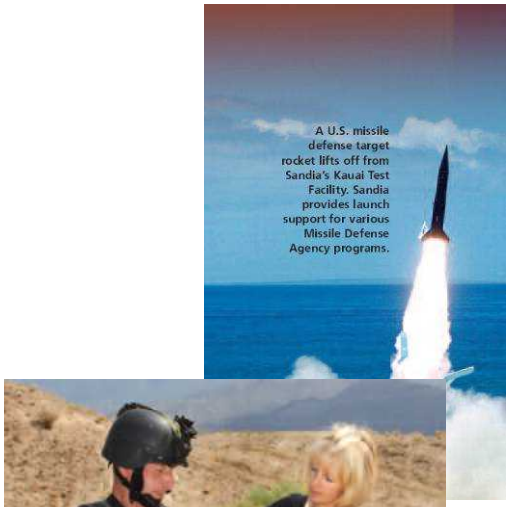
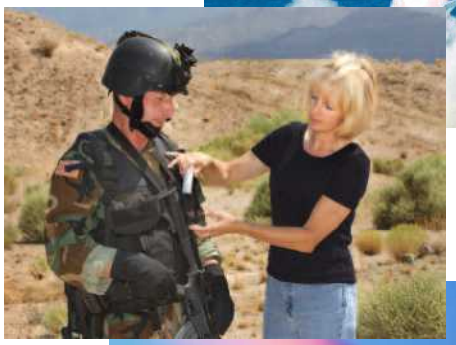
Sandia National Laboratories' Mission is National Security

- **Nuclear Weapons:** We are responsible for the research, design, and development of more than 90 percent of the 3,000 to 6,500 components of a modern nuclear weapon.
- **Defense Systems and Assessments:** We provide America's armed forces with capabilities and technologies to help them efficiently and successfully respond to national threats.
- **Energy, Resources, and Nonproliferation:** We develop and apply technologies in a wide range of areas including infrastructure surety.
- **Homeland Security and Defense:** We work with a variety of agencies to develop strategies and hardware to safeguard our economy from terrorism and natural disasters.





Sandia National Laboratories serves as the USCG's Trusted Advisor

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Sandia is committed to understand Climate Change and National Security issues

- **Previous investments**
  - Improved climate models
  - Policy and conflict modeling
  - Critical infrastructure modeling
  - V&V with focus on uncertainty & risk
  - Leveraging Sandia's NW work
- **Present and Future directions**
  - Partnerships with other National Labs
  - Strategic plan and roadmap for Arctic climate change have been developed
  - Climate change is one of four Sandia S&T thrust areas

A Sandia national security mission is to anticipate, prevent, and mitigate technological surprise

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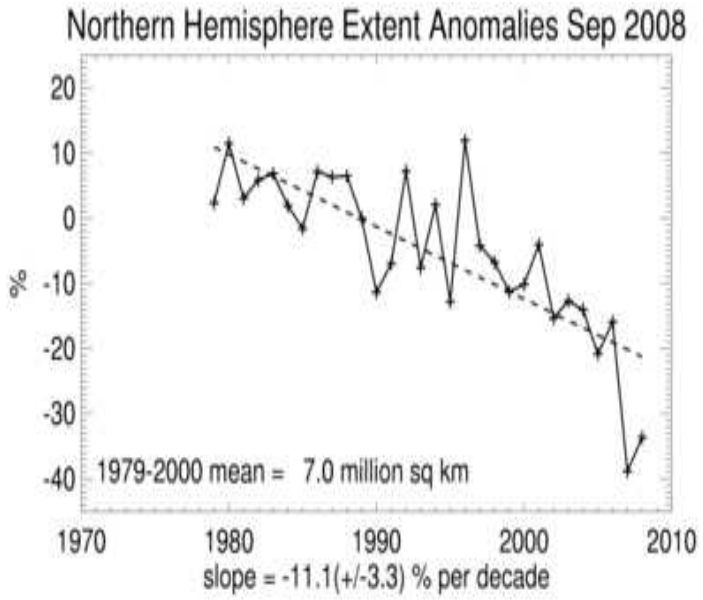
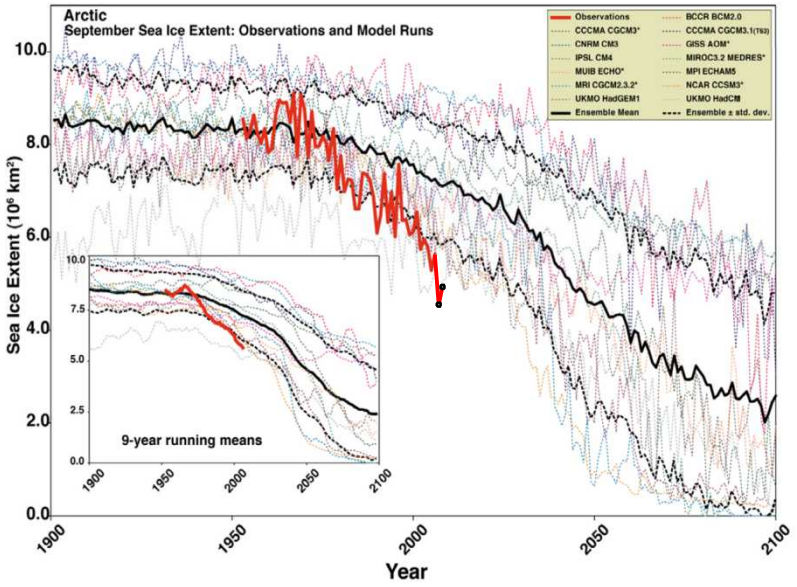
Climate change in the Arctic is occurring rapidly





September Arctic Sea Ice Extent (area)

The Arctic change is occurring more rapidly than predicted

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Climate change is slowly being recognized as a National Security issue

- **The Department of Defense (DoD)**
  - Conflict due to regional climate stress
  - Environmental effects
  - Effects on installations
  - Mission planning
- **The Intelligence Community (IC)**
  - National Intelligence Assessment
  - Treaty and agreement verification
- **The Department of Homeland Security (DHS)**
  - Disaster planning
  - Safety on US waterways
  - Security of US ports and waterways

The other agencies are looking to the USCG for leadership in the Arctic region

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Climate change in the Arctic is driving new commercial development

- **Trade routes**
  - Last year, 107 ships transited the NW passage & 300 the Russian Arctic according to the USCG Journal (4/7/2008)
  - 152 reinforced ships (1/2 size of the present worldwide fleet) are on order for a 2-3 yr delivery
  - Exports through Murmansk's regional ports are rising at 22% per year
  - 80% of world trade may go over the Pole during the summer months

- **New energy and mineral resources**
  - 50% of new mineral reserves are in the Arctic
  - 90 billion barrels of undiscovered, recoverable oil and 44 billion barrels of natural gas liquids are north of Arctic circle

What is the relevancy of USCG & Russia in Arctic development?

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The harsh Arctic environment will always impose constraints on USCG activity

- **Arctic Environment**
  - Still cold
  - Dark all winter
  - Large relatively unpopulated area
- **New Threats**
  - Thawing land mass
  - Rising seas
  - More intense storms

New USCG strategies needed to cope with expanded operations

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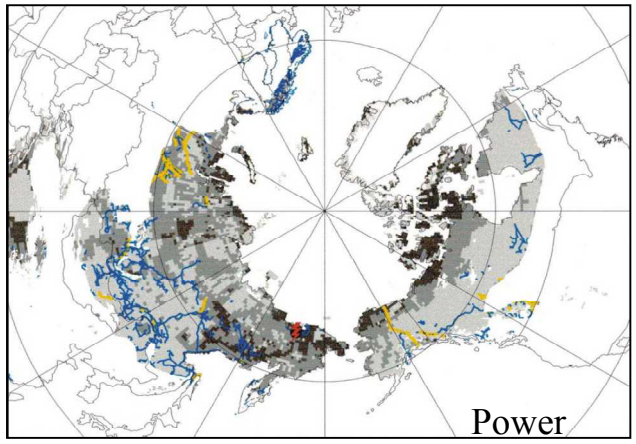
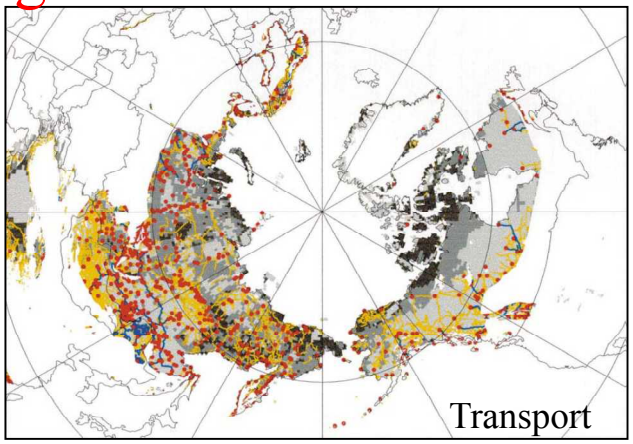
Arctic constraints and risks

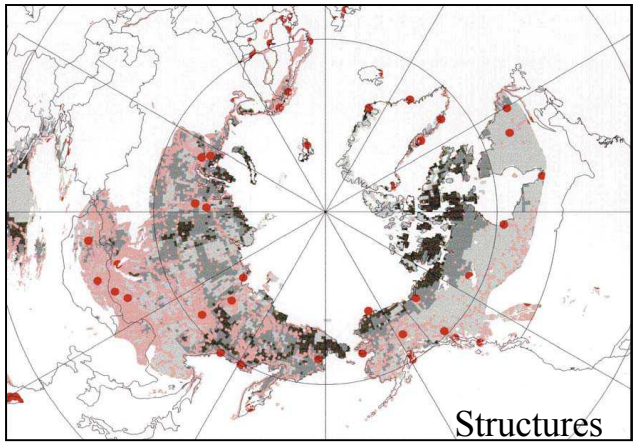
- Structures
- Power
- Transport

Global expansion will be greatest in Russian territory



Dark grey implies high risk





What is the US strategy in dealing with economic expansion?

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The fragile Arctic environment imposes constraints on USCG activity in the region

- **Environmental Accidents**
  - Have long-lived impacts
  - Severe economic penalties
  - Political implications.

- **Environmental Constraints**
  - Require more surveillance (e.g. unmanned systems).
  - Affect approaches to increasing operations
- **Design of Land and Sea-based Assets**
  - Unstable terrain
  - New constraints on carbon footprint
  - New endangered species policies

USCG needs increased and persistent presence in Arctic

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A systems approach is required for assessment & road-mapping studies

- **Arctic Climate Description**
  - Scenarios and data
  - High-performance computing with uncertainty quantification
- **Growth Drivers**
  - Economic motivation
  - Expansion of Arctic enterprises
- **Political Drivers**
  - Security (safety & conflict management)
  - Environment (mitigation, cleanup, etc.)
  - Boundaries (disputes, effect on operations)
- **USCG Mission Needs**
  - Mobile assets (air, water, ground),
  - Fixed assets (land-based, or sea-floor based)
  - Coordinate with Navy and allies (Canada)
  - CONOPS and COMMS

A dynamic and robust solution strategy is needed

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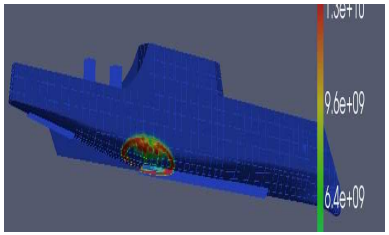
A Potential USCG/SNL Approach

- **Short-Term (1 yr)**
  - Assist USCG in developing a **roadmap** for understanding their evolving Arctic mission space (safety & security)
  - Develop a business case for the USCG mission needs.

- **Medium-Term (2-4 yr)**
  - Assist USCG in **integrated planning** for future asset needs and mission challenges in the Arctic.
  - Emphasize robust planning for uncertain climate change

- **Long-Term (5-10 yr)**
  - Assist USCG in asset **procurement** & deployment planning
  - Conceptual design of sophisticated platforms & sensor systems
  - Development of real-time decision support tools
  - Development of logistics and training tools.



A staged approach is required for pre-acquisition strategy

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An informed debate is required to understand the risks, issues, and path forward

- **What are the risks if**
  - The significance of Arctic climate change is ignored?
  - Its significance is over estimated?
- **What are the salient issues?**
  - Conflict with foreign interests
  - Maritime safety
  - Security and policing
- **What "tools" are required?**
  - Climate modeling
  - Engineering sciences
  - Sensor technology
  - Decision support software

In the dual national security and USCG trusted advisor role, Sandia can help inform the debate

Backup Slides

Important climate change partnerships

- **DOE Office of Science**
  - **SciDAC:** Development of next generation atmospheric model to run efficiently on High Performance Computers (HPC)
  - **ARM:** (Atmospheric Radiation Measurement) Development of an improved understanding via continuous measurements of the feedback processes between clouds and radiation in the atmosphere.
- **NEON** (National Ecological Observatory Network)
  - A continental-scale research platform for discovering and understanding the impacts of climate change, land-use change, and invasive species on ecology.
- **NCAR** (National Center for Atmospheric Research)
  - Sandia NCAR MOU
  - Work with Community Climate Systems Model (CCSM) to introduce HOMME atmospheric model
- **JPL/SNL/LANL/LLNL/ORNL/PNNL**
  - A partnership aimed at the development of a large-scale National Lab Climate Modeling & Simulation effort.

Jet Propulsion Laboratory
California Institute of Technology

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Working with our mission partners

- Assessment of future conditions, options, policies, and responses
- Verification and Validation of Assessment Analyses and Engineering Designs
- Criteria specification and engineering solutions for evolving operational challenges in new environments.
- Capability to integrate across domains, e.g., CH2M-Hill, BP, and NCAR

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Previous climate security work

- Dartmouth Resource Policy Center 1977 (Staff @ SNL)
- Inter-regional Modeling 1985 (SNL team)
- Cambridge University 1994 (SNL team)
- Aspen Economic Simulation (SNL) 1996/1997
- Climate and Security (SNL) 2003
- Climate and Conflict (SNL) 2004
- Societal Stability (SNL) 2005
- Economic Stability (SNL) 2005-2006
- Societal Evolution (SNL) 2006
- Societal Decisions (SNL) 2007
- DOE NCAR/SciDAC Dynamic Core (SNL) 1997-2007
- Unintended Consequence Conflict Modeling (SNL) 2008
- Behavioral Simulation
- Assessment of Verification and Validation (SNL) 2008
- Arctic Climate Impacts on National Security (SNL) 2008

Minimize footprint (cost) of security

- Technology for monitoring, tracking and assessment
  - Optimal Ocean, Floor, Ice, and Ocean Sensor Networks
    - Multi-Spectral Satellites
    - MicroSAR and Advanced Sensors.
    - UAVs and Large Lighter-Than-Air Platforms (Oliktok, AK)
  - System-of-Systems Consequence Simulations
    - Planning, Strategic and Tactical Design, and Operations
    - Geo-political Implications and Dynamics