

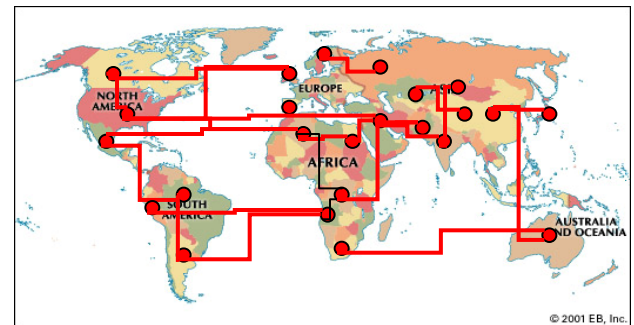
# Potential Economic, Environmental and Security Impacts of Arctic Climate Change

Propeller Club



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# Arctic Climate Change: How much, how fast?

- The scientific community predicts gradual climate change over decades, leaving many without a sense of urgency.
- Analysis of recent data suggest the Arctic might be ice free for a substantial part of the year by 2013.
- Even if not ice free, shipping lanes could open increasing Arctic economic activity substantially.
- Engineering conservatism says we must plan for the maximum plausible change in order to be able to act when necessary.



# The Arctic Region may become an Increasingly Important Economic Region

- If the Arctic becomes ice free for a significant fraction of the year, the result is likely to be contentious among bordering nations.
  - ⊕ Sea Lanes
  - ⊕ Resources
  - ⊕ Territorial sovereignty
  - ⊕ International waters
- These changes will create potentially explosive economic growth in the region.
- Infrastructure changes are expensive, long lead-time, and may require innovative designs (mobile, adaptable infrastructure/ports).



# The Arctic Region is an Important Early Indicator of Global Climate Change

- Polar Amplification - climate feedbacks are stronger near the poles.
- Global Climate Change canary – whatever happens, will happen first in the Arctic.
- Arctic permafrost is a wildcard – if the carbon in the permafrost is released, human sources of greenhouse gases will be overwhelmed.
- Greenland ice sheet – increased losses of land ice will accelerate sea level rise.
- Ecosystems will be impacted worldwide.



# Potential Impacts of Arctic Climate Change on Human Activity

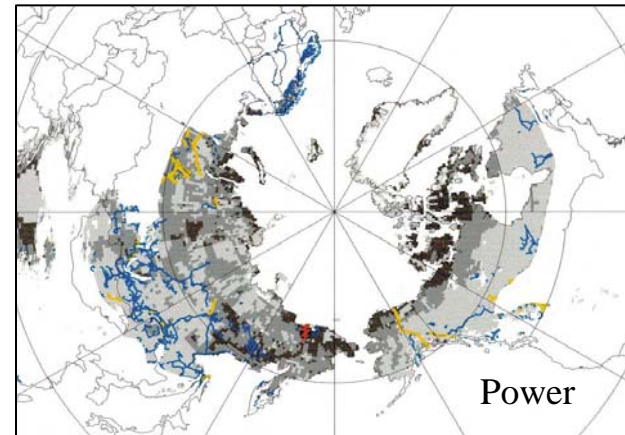
- Economics indicates that when routes are open, up to 80% of world trade will now go over the Pole.
  - ⊕ Destabilizing southern-hemisphere implications
- Exploitation of and contention over newly accessible polar energy and mineral resources
- Rapid regional economic development creating new cities, infrastructure and industry in a fragile environment
- Russian territory becomes the hub of expansion and tension
- Destruction of the Arctic environment with unknown human impacts
- Extreme weather magnifies politico-economic challenges and security environment



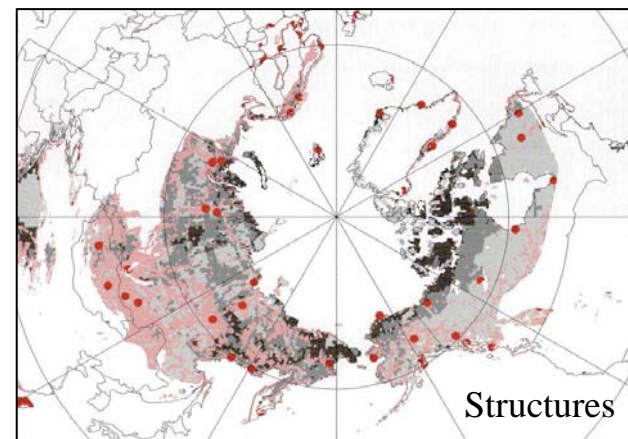
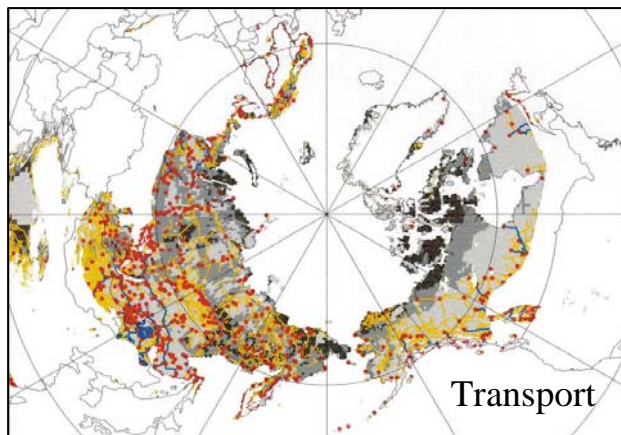
# Arctic climate change - Constraints and risks

- Structures
- Power
- Transport

Greatest economic expansion potential is in Russian territory



Dark grey implies least suitable for economic development



# The Arctic Environment's Fragility imposes Constraints on Economic Activity in the Region

- Environmental “accidents” have long-lived impacts that could have severe economic and political implications.
- Environmental constraints could alter the approach to US operations to a focus on unmanned systems.
- Design and operation of facilities constrain strategic and tactical approaches.
- New infrastructure requirements change the ground rules for installation planning and design.
  - ⊕ Unstable terrain unsuitable for normal construction techniques
  - ⊕ Rising seas and storm surge



# The Arctic Environment's Harshness Imposes Constraints on Economic Activity in the Region

- Dark all winter
- Still cold
- Huge, relatively unpopulated area
- Thawing land mass and rising seas
- Hazardous ice formations in sea lanes





# Implications of this Arctic Climate Scenario



- ✦ We need to know more:
  - Reduce the uncertainty in future Arctic climate projections
  - Couple in models of economic activity
  - Couple in environmental response to climate change and economic activity
  - Collect data and validate the models
- ✦ If Arctic economic activity increases dramatically, we will need to:
  - Build and operate facilities on unstable ground
  - Develop real-time capability to assess environmental conditions in sea lanes
  - Ensure that the Arctic environment is preserved.
- ✦ This scenario may sound advantageous to shipping and northern US ports; the reality isn't that simple.

