Impacts of Arctic Climate Change on National Security

James Strickland, jhstric@sandia.gov,
George Backus, gabacku@sandia.gov,
Mark Boslough, mbboslo@sandia.gov

Project Description

The Arctic region is rapidly changing in a way that will affect the rest of the world. Parts of Alaska, western Canada, and Siberia are currently warming at twice the global rate. This warming trend is accelerating snow and ice loss, permafrost deterioration, coastal erosion, and other phenomenon that are a direct consequence of climate change.

With its national security mission, Sandia National Laboratories is evaluating the impact of climate change on the Arctic as well as impacts that will potentially cascade to other parts of the globe due to those in the Arctic. In this paper, we summarize some of the underlying climate drivers and national security implications associated with the changing Arctic that are given in much more detail by Backus, *et al., 2008* and Boslough, *et al. 2008*.

Arctic Climate Changes

Melting of Arctic sea ice has long been identified as one of the strongest signals of climate change. Ice cover is now disappearing at an alarming and unprecedented rate, well beyond the most pessimistic predictions. For example, the Arctic Climate Impact Assessment (ACIA) Scientific Report provides a very complete, although now somewhat dated, review of the physical impacts of climate change on the Arctic region. The most cautious ACIA model projects a "near-total melting of Arctic sea ice by 2100." However, taking recent trends into account, there are now estimates that a seasonally ice-free Arctic could happen as early as 2013. By September 2007, according to the data shown in Figure 1, the ice cover had decreased to 4.28 km^2, nearly 40% below the long-term average.

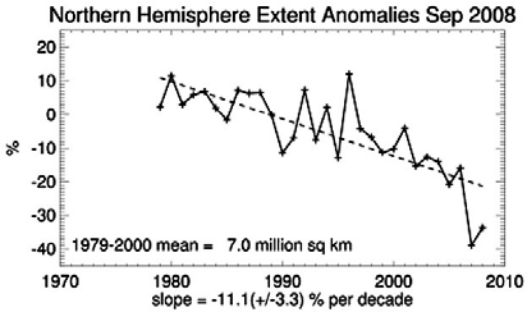

Figure 1: **September Arctic Sea-ice Extent**
(National Snow and Ice Data Center)

Along with sea ice, large areas of permafrost are melting. Permafrost is defined as sediment that has remained below the freezing point of water for two or more consecutive years. The permafrost is concentrated in a geographical band at high latitudes that crosses Siberia, Fennoscandia, Greenland, Canada, and Alaska. At temperatures above the freezing point, carbon dioxide and methane are released into the atmosphere by bacteria and fungi as they process the organic material. In East Siberia the wind-blown Yedoma permafrost contains about 450 billion tons of easily-mobilized carbon. This is about as much carbon as the rest of the Arctic combined, and the same amount of carbon that has been released by all the burning of fossil fuels since the beginning of the industrial revolution. If the Arctic were to warm up enough to decompose only 1% of the permafrost per year, it would double the carbon releases to the atmosphere from the present rate due to human activities (about 9 billion tons/year).

Coastlines that were protected by large expanses of sea ice in the past are now being battered by big waves during the seasonal retreat of the ice. Moreover, patterns of atmospheric circulation are changing, and stronger winds blowing across longer ice-free fetches produce higher waves with more erosive potential. Ice that remains entrained in the waves provides an additional scouring agent. Coastal erosion provides a positive feedback because it accelerates degradation of coastal permafrost that releases methane and carbon dioxide that in turn, causes global warming.

As part of our work, we developed the climate scenario map shown in Figure 2. The associated scenarios range from "manageable adaptations" to "collapse and chaos." The most probable scenario is that we are "on the brink." The rate of climate change associated with this scenario can range from moderate to abrupt whereas the severity of change falls within the range of that forecast by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

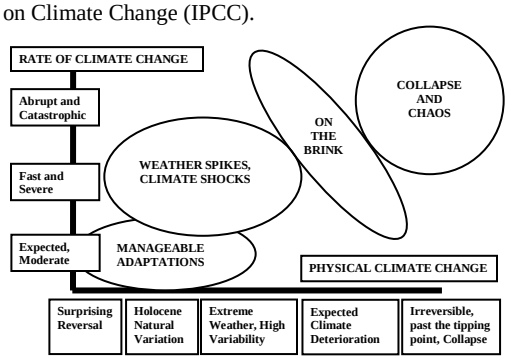

Figure 2: **A Map of Arctic Climate Scenarios**

For the "on the brink" scenario, the climate is deteriorating toward a tipping point. Temperature increases are dependent on greenhouse gas emissions, the Arctic Ocean becomes ice-free in the summer for longer periods, permafrost deterioration accelerates, coastal erosion becomes more severe, discharge of freshwater from land ice increases greatly, large areas of tundra are replaced by shrub land, and forests grow northward. Additionally, fisheries move and many mammal, fish, and bird populations suffer decline or extinction while others perhaps benefit in some way from such changes.

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National Security Impacts

The opening of the Arctic presents many security challenges due to the high potential for changing global economic (and thereby, geo-political) power balances. Once the Arctic becomes economically exploitable, it may provide a large fraction of new global oil, gas, and mineral reserves. The open-water conditions of the future will also 1) allow for a dramatic increase in shipping, 2) could spur spectacular infrastructure and processing development along the route and 3) elevate economic and strategic competition among nation states.

Estimates indicate that open Arctic shipping routes could reduce transportation costs by an average of 40% on key Asian-European routes cutting some distances by two-thirds. A simple use of economic data indicates that such reductions imply that Arctic open-water could attract up to 80% of the global transportation market. In the near-term, the reduction in Arctic ice coverage will quickly open the Arctic for routine, seasonal marine transport. The use of icebreakers and ships built with ice capable hulls will greatly extend the shipping season. According to the Russians, their Arctica-class nuclear icebreakers make possible year-round navigation in the western section of the Northern Sea Route (NSR) (indicated in Figure 3) from Murmansk to River Lena as well as ports on major Siberian Rivers.

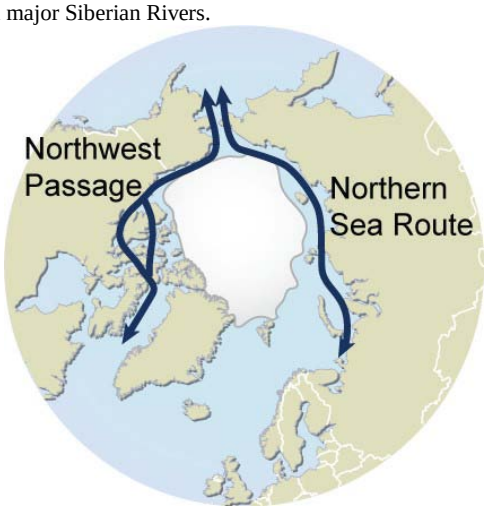

Figure 3: **Arctic Shipping Routes**
Courtesy *Hugo Ahlenius, UNEP/GRID-Arendal*

In the near-term, much of the ship traffic will be for resupply of the burgeoning oil, gas and mineral industry. According to a July 2008 report by the U. S. Geological Survey, as much as 13% of the world's undiscovered oil and 30% of undiscovered gas reserves are in the Arctic seabed. In a recent Center for Strategic and International Studies (CSIS) symposium, Senator Lisa Murkowski stated that the Arctic may contain up to 100 billion barrels of oil and 25% of the Earth's remaining oil and natural gas.

The changing conditions in the Arctic Ocean and the high-latitude land areas may create a new "gold rush" that has the potential for conflict. There are five nations with territorial claims in the Arctic: Russia, Canada, the U. S., Denmark, and Norway. Sweden, Finland, Iceland, and semi-autonomous groups of indigenous peoples also have economic and strategic interests. Boundaries and international laws are not well defined or accepted by all parties, so the potential for conflict is high. Canada has declared that the now-opening Northwest Passage cannot be traversed without passing through its territorial waters, but the U. S. position is that these are international straights. Russia is claiming that most of the Arctic seabed is an extension of its continental shelf.

If Arctic trade and supply chains develop as imagined, the balance of political and economic power within the tropics and Southern Hemisphere will change due to the fact that trade among northern hemisphere countries will depend more heavily on Arctic routes. The equatorial (Panama) and southern routes (Africa, Indonesia, and S. America) will experience severe dislocations. With such changes in economic relationships and dependency, alliances between developing countries and the U.S., China, and others could become quite fluid.

Economic expansion in and strategic use of the Arctic will provide challenges to the HSD (USCG), DoD, DOS, EPA and Intelligence communities concerning law enforcement, treaties, monitoring, peacekeeping, marine safety, and protection of the environment. On January 9, 2009 President Bush issued a "National Security Presidential Directive and Homeland Security Presidential Directive" on Arctic Region Policy whose first two directives were to 1) meet national security and homeland security needs relevant to the Arctic region and 2) protect the Arctic environment and conserve its biological resources.

Acknowledgements

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