Getting Around in a More Accessible Arctic

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By definition, global climate change is reflected in a host of changes all over the planet. These changes, however, do not occur uniformly across the globe, and changes in the Arctic are occurring more rapidly than anywhere else. For example, temperatures in the Arctic are rising at twice the rate of the average rise in global temperature. The temperature of the Arctic Ocean also is increasing. With the higher temperatures, snow cover has decreased, melting off more quickly in spring and summer.

The warmer temperatures have caused a dramatic decrease in the sea ice left at the end of summer. From satellite data, scientists have found that the coverage area of sea ice each September has declined by more than 40 percent since the late 1970s, and the trend has accelerated since 2007. The striking decrease in summer ice has caused winter ice to become thinner and less stable (Figure 1, page 22).

Not only is sea ice diminishing, but ice on the land masses encircling the Arctic Ocean is melting rapidly. Glaciers that have endured since the last Ice Age or longer are becoming smaller. Those that border bodies of water are breaking off more frequently into icebergs, a process called calving. As land ice melts, much of the melt ultimately flows into the sea, contributing to a rise in sea levels worldwide.

Changes in the Arctic climate are having dramatic effects on how and where people can travel. Large areas of open ocean are becoming newly accessible to shipping. Melting ice and snow are changing the ways that people drive across and dig into the land, in some cases threatening the lives and livelihoods of...
indigenous Arctic groups. Thawing permafrost—the frozen layer of subsurface soil in the Arctic—threatens the stability of roads, bridges, and runways. A major challenge in the Arctic today is to seize new opportunities as they arise in the region while adapting to change and minimizing risks.

The Northern Route
Increased Traffic
In the past, few ships ventured into the perilous waters of the Arctic Ocean or into the various straits and seas. Those that passed through primarily serviced oil production facilities, transported mining products, and delivered supplies to coastal communities.

The situation is changing rapidly. In the summer of 2012, the U.S. Coast Guard estimated that 480 ships transited the Bering Strait between Alaska and Russia, a route that received much less vessel traffic 10 years earlier. More ships are entering the Arctic to explore for oil and gas, conduct research missions, and transport oil and other commodities. Tourism vessels are also on the rise.

The increased vessel traffic increases the risks to people and the environment. Although sea ice is shrinking, the Arctic remains a harsh and dangerous environment for navigation, because remnant sea ice can pose hazards, particularly with changing weather and sea conditions.

In the fall, open routes can freeze solid within days. Many areas are poorly charted and have limited communications infrastructure, making navigation and emergency response exceedingly difficult. Ports of refuge are few and far between, and many emergency response capabilities in the U.S. Arctic are limited and restricted to southern Alaska. These rapid changes also may have an impact on subsistence hunting and on the migratory patterns of marine mammals.

Assuring Safety
The U.S. Coast Guard is the lead federal agency in assuring safe navigation in U.S. waters and works with other nations to support maritime safety in international waters. The Coast Guard is using a critical new technology, the automatic identification system (AIS), to make Arctic shipping safer. Almost all commercial vessels operating in U.S. waters are now equipped with AIS transponders that continuously transmit information about the vessel and its route, allowing the Coast Guard to convey warnings, monitor ships’ positions, and send help when needed.

Although technology is improving, communication and international cooperation remain critical in ensuring the safety and security of ships navigating the Arctic. In 2013, the Transportation Research...
Board published a conference summary, Safe Navigation in the U.S. Arctic, exploring the challenges and needs related to vessel traffic in U.S. Arctic waters.\(^1\)

**Oil and Mineral Extraction**

Increased oil activities open the region to an increased risk of spills. Managing an oil spill is extremely challenging in temperate and calm conditions, but the remoteness and harsh conditions of the Arctic make it particularly difficult to mount a speedy and effective response. Severe storms or water routes suddenly frozen over can block responders. In winter, the reduced daylight poses special challenges. Communications infrastructure and response equipment are limited in many areas of the Arctic, hindering responders’ ability to coordinate efforts.

Sea ice and other environmental variables—such as rapidly changing weather and dense fog—can complicate a response to an oil spill, and no single technique applies in all situations. Operators working in the Arctic need to assess the environmental trade-offs associated with different response options and to deploy any or all—or none, if warranted—of the measures available to reduce the impacts on the ecosystem.

Oil spills can harm ecosystems and societies anywhere, but communities in the Arctic are particularly vulnerable. Because many Arctic residents rely on hunting and fishing to feed their families, even temporary damage to the ecosystem can be catastrophic. Not only can a source of sustenance be lost, but also the customs that go along with the practices and the preparation. The wild animals and ecosystems of the Arctic are similarly vulnerable to spill-related toxins and food chain disruptions.

The 2014 National Research Council report Responding to Oil Spills in the U.S. Arctic Marine Environment identifies priorities for improving the ability to respond to a serious oil spill in the Arctic.\(^2\)

**Tourism at the Ends of Earth**

Warm or cold, the Arctic remains extraordinary—the stunning landscapes, fascinating wildlife, and unique cultures long have attracted tourists and adventurers. As Arctic waters and land become easier to navigate, the number of people with the means and motivation to tour the Arctic is rapidly increasing.

Cruise ships and small personal vessels are venturing farther into the Arctic each year, and tourists have become the largest human presence in many Arctic regions. A steady flow of tourists can be a boon to the local economies of Arctic communities, creating jobs in shops, restaurants, hotels, and tour companies. But tourism also has downsides for the indigenous communities—for example, tourists may violate traditional customs or damage cultural sites and artifacts. Cruise ships can have an impact on traditional hunting and fishing in the summer, when...
Marine Board Recognizes Arctic Shipping as a Priority Issue

SCOTT BROTEMARKLE

The Transportation Research Board (TRB) Marine Board has considered Arctic shipping as a priority topic for several years and has conducted activities reflecting this focus. Formed in 1965, the TRB Marine Board is an internationally recognized source of expertise on maritime transportation, marine engineering, and technology. As part of its charge, the Marine Board identifies research needs and provides a forum for exchange of information on new technologies, laws and regulations, economics, the environment, port operations, coastal engineering, and other issues that affect the marine transportation system.

In October 2012, the Marine Board developed and conducted a workshop, Safe Navigation in the U.S. Arctic. The workshop identified the inherent risks of navigation in the Arctic, reviewed the capability for maritime emergency response in Arctic waters, and explored partnerships and international cooperation for vessel traffic management and infrastructure improvements to enhance navigation safety.

The workshop sessions examined these concerns from the perspective of high-risk operations and plausible incidents—namely, a passenger vessel grounding accident and an oil spill response. In addition, the workshop addressed information and data needs for mariners and for emergency response agencies, research needs and gaps in understanding, risk assessment techniques, and resource models for funding and implementing systems for traffic management, navigation data delivery, and emergency response.

The Marine Board contributed to the oversight of the National Research Council’s 2014 report, Responding to Oil Spills in the U.S.

Arctic Marine Environment: The report surveys the state of the science of oil spill response and environmental assessment in the Arctic region north of the Bering Strait. The study examines the best preparations for response to an oil spill event, in the context of the proliferation of oil and gas exploration, forecast increases in cargo shipping, and the prospects of adventure cruise tourism in the high latitudes of U.S. Arctic waters.

In April 2015, the United States assumed the responsibility of chairing the Arctic Council for a two-year term, and the U.S.-led agenda has renewed the focus on Arctic Ocean safety. To assist with this charge, working with the U.S. Department of State, the Marine Board devoted part of its fall 2015 meeting to a focus session on responding to emergencies in the Arctic. Stakeholder experts addressed emergency preparedness and emergency response capability; lessons learned from exercises, recent marine accidents, and oil spill responses in the Arctic since 2012; the state of relationships with neighboring Arctic nations within the context of emergency response plans, exercises, and availability of shared resources; and emergency response infrastructure needs and priorities.

With the expected trend of longer ice-free seasons increasing maritime transport in the U.S. Arctic, the Marine Board will continue paying close attention to the risks and resource issues associated with Arctic shipping.

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Personnel from the U.S. Coast Guard and City of Nome, Alaska, conduct a mass rescue exercise to enhance regional emergency preparedness.

PHOTO: TOMPAUSER, U.S. COASTGUARD
obtaining subsistence resources to last through the winter is important and when many animals feed, mate, and tend their young—and are at their most vulnerable.

In addition, tourism increases the pressure on land, water, wildlife, and other natural resources. Ships may intentionally or inadvertently discharge sewage, oil, invasive species, and debris into sensitive Arctic environments. Increased tourism traffic through Arctic land and water also increases safety risks and adds to the burden on limited emergency support personnel.

**National Security Far North**

Melting sea ice makes the Arctic more accessible to commercial and military interests. In addition, the growing interest in exploiting the region’s rich natural resources could spark disputes over territory and transit rights among the countries bordering and pursuing business interests in the Arctic.

The likelihood of conflict in the Arctic is low but cannot be ruled out. The relationships between Arctic nations could become more strained in the future as the stakes rise in the competition for Arctic resources. Experts have raised concerns about the limited surface capability and operational infrastructure of the U.S. Navy in the region and have suggested that the United States reinstitute a cold-weather training program and improve the mapping, communications infrastructure, and navigation charts for the region. In addition, the U.S. fleet of icebreakers—vessels capable of clearing a path through ice-covered water—needs updating to boost the nation’s ability to train, operate, and engage in the Arctic.

The 2011 National Research Council report *National Security Implications of Climate Change for U.S. Naval Forces* addresses U.S. preparedness for national security threats in the Arctic.¹

**Changes for Arctic Peoples**

The Arctic is home to approximately 4 million people, from city dwellers to oil prospectors to hunters and herders living on the land. Many are members of indigenous groups whose ancestors have lived in the Arctic for millennia. Altogether they are citizens of eight countries and speak dozens of distinct languages. The unique and diverse communities of the Arctic face an uncertain future.

Thawing permafrost poses significant problems for residents. The thawing changes the shape of the land, and streams or bodies of water can form in previously dry areas. The resulting erosion wreaks havoc on buildings, roads, pipes, and other infrastructure and costs communities hundreds of millions of dollars to make repairs and to keep up with changing conditions.

In addition, melting snow and ice pose problems for subsistence hunters, who typically rely on over-ice forms of transportation, such as dog sleds and snowmobiles, to reach the habitats of animals like seals.

walruses, and caribou. Reductions in ice or snow reduce the hunters’ range and make travel riskier. Towns along the coasts are especially vulnerable. Historically, large swaths of sea ice along the shoreline have provided a buffer against coastal storms and waves. As sea ice declines, however, coastal communities are facing the full brunt of increasingly strong storms. In addition, sea-level rise threatens low-lying communities, and advancing seas and stronger storms may force some communities to relocate. The 2014 National Research Council report *The Arctic in the Anthropocene: Emerging Research Questions* explores the need for actionable Arctic science to improve understanding of the environmental and societal changes and their effects on the Arctic and the rest of the world.4

Resilience in the Face of Change

Arctic residents already are finding new ways to survive and thrive. Residents are diversifying their sources of income and are shifting the times and places for hunting, gathering, herding, and fishing. To make travel safer, residents are working to improve their communications infrastructure and to increase the use of GPS and other specialized equipment to navigate treacherous terrain and assess sea ice conditions. At the community level, Arctic residents are investing in greater protection against extreme weather—for example, with infrastructure for flood and water management.

Climate change and uncertainties are affecting the Arctic at a pace more rapid than in other places in the world. The Arctic Matters resources make clear that rising sea levels, ecological changes, geopolitical shifts, new opportunities for resource extraction, and countless other changes will have immediate and lasting effects around the globe.

Acknowledgments

For more information about *Arctic Matters: The Global Connection to Changes in the Arctic*, visit http://nas-sites.org/arctic. Support for this project was provided by the National Oceanic and Atmospheric Administration, the National Science Foundation, the U.S. Global Change Research Program, and the National Academy of Sciences.

Further Reading

The Arctic Matters booklet is based on the following National Research Council reports:

*The Arctic in the Anthropocene: Emerging Research Questions*, 2014
*Responding to Oil Spills in the U.S. Arctic Marine Environment*, 2014
*Linkages Between Arctic Warming and Mid-Latitude Weather Patterns: Summary of a Workshop*, 2014
*Abrupt Impacts of Climate Change: Anticipating Surprises*, 2013
*Climate Change Evidence and Causes: An Overview from the Royal Society and the U.S. National Academy of Sciences*, 2014
*Seasonal-to-Decadal Predictions of Arctic Sea Ice: Challenges and Strategies*, 2012
*Frontiers in Understanding Climate Change and Polar Ecosystems: Summary of a Workshop*, 2011
*National Security Implications of Climate Change for U.S. Naval Forces*, 2011

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