



March 2017

Center for Space Policy and Strategy Policy Paper

Near-Term Space Support for Arctic Operations

Leslie Wickman
The Aerospace Corporation

Leslie A. Wickman is a senior engineering specialist with the Aerospace Corporation and also serves as executive director of the American Scientific Affiliation. Before joining Aerospace, she supported NASA's Hubble Space Telescope and International Space Station programs. She has an M.S. in aeronautical and astronautical engineering and a Ph.D. in human factors and biomechanics, both from Stanford University.

About the Center for Space Policy and Strategy

The Center for Space Policy and Strategy is a specialized research branch within The Aerospace Corporation, a federally funded research and development center providing objective technical analysis for programs of national significance. Established in 2000 as a Center of Excellence for civil, commercial, and national security space and technology policy, the Center examines issues at the intersection of technology and policy and provides nonpartisan research for national decisionmakers.

Contact us at www.aerospace.org/policy or policy@aero.org

© 2017 The Aerospace Corporation. All trademarks, service marks, and trade names contained herein are the property of their respective owners.
Approved for public release; distribution unlimited. OTR201700449.



Foreword

Gaps in communication, navigation, surveillance, weather, space weather, and remote sensing coverage above 70 degrees north need to be filled to support increasing U.S. Coast Guard and other U.S. government responsibilities and operations in the region. There is a sense of urgency because for the next 15–20 years, there will be increases in shipping traffic, resource exploitation, and potential territorial issues and disputes among Arctic nations. This paper will inform decisionmakers on the urgency of procuring and/or developing communications, surveillance, and navigation capabilities supporting increased operations in the northern latitudes.

A Strategic Region

The Arctic is attracting international attention due to its geopolitical and economic significance for both allies and partners as well as for potential adversaries. Although there is still low probability of conflict in the near term over uniquely Arctic issues (e.g., boundary disputes, fisheries management), the region is vulnerable to strategic spillover, as disagreements among Arctic nations over issues in other regions may contribute to heightened tension or even conflict in the Arctic.¹

Arctic Sea Ice

Arctic late-summer sea ice is melting at a rate of about 13% per decade,² or three times as fast as predicted by the Intergovernmental Panel on Climate Change, yielding recent record lows of nearly 50% less summer sea ice than the average of 60 years ago.³ The ten lowest summer Arctic sea ice records happened in the past eleven years. Most models suggest that the Arctic could experience ice-free summers by midcentury, but projections vary by decades.⁴

Industry, Traffic, and Communication Increases

In response to this rapid ice melt, over the next 15 to 20 years, we can expect substantial increases in shipping traffic, resource exploitation, tourism (including cruise ships and ecotourism), and other operations. The number of ships operating in the Arctic, already in the

thousands per year, is expected to increase dramatically. Use of Arctic sea routes cuts about 7,000 kilometers off normal shipping routes between Asia and Europe, and the melting ice also facilitates access to the Arctic's abundant natural resources, including oil, gas, minerals, and fish. Permits are already in place to ship at least 18 million tons of iron ore through Baffin Island ports to international destinations each year.⁵ A recent U.S. Geological Survey report suggests that the Arctic seabed may hold as much as 25% of the world's undiscovered oil and natural gas reserves, and other estimates say it could be closer to 38%.⁶ Significant amounts of palladium, diamonds, platinum, cobalt, nickel, tungsten, and zinc have also been discovered in the region. The Arctic shoreline could soon be opened to oil and gas exploitation, depending on various political decisions. Oil exploration in particular, with all of its implications and challenges, will have a tremendous impact on what takes place in the Arctic over the next couple of decades.⁷

Infrastructure Demands and Regulatory Issues

Enhanced and expanded infrastructure in the Arctic is required to support this expected increase in activity, particularly in the areas of improved and expanded capabilities for communications, navigation, surveillance, tracking, border patrol, search and rescue, and environmental response.

The possibility of territorial issues and disputes between Arctic nations could also arise. In general, the Arctic nations have expressed intentions of good will and international cooperation, but Russia, Denmark, Norway, Canada, and the United States have already staked competing claims for important resources in the region. These territorial issues are unlikely to be resolved anytime soon. The U.N. Convention on the Law of the Sea (UNCLOS) provides an international framework attempting to govern the use of the world's oceans and resources. The nations with interests in Arctic resources (including those with Arctic coastlines, but also others aware of unclaimed resources in international waters) are doing their best to support their claims, but sovereign rights to energy resources in the Arctic seabed remain largely undetermined under international law.

There are also various Arctic environmental issues, such as threats to endangered species (e.g., the polar bear has been listed as “threatened” since 2008), and U.S. officials are meeting with officials from other countries regarding the management of fish stocks in response to the increase in commercial fishing in the Arctic. Also, an oil spill (such as the 2010 Gulf of Mexico Deepwater Horizon spill) would be much more serious in the Arctic due to the fragile habitat, lack of clean-up infrastructure, and cold sea temperatures.

Strategic U.S. Interests in the Arctic Region

The United States, by virtue of Alaska, has substantial interests in the Arctic region.⁸ These concerns include, but are not limited to, the following:

- border and territorial enforcement;
- sea and air traffic control;
- safe navigation;
- crisis response, including search and rescue, and humanitarian assistance (rescuers are 12–24 hours away by air, or up to 72 hours away by sea, from any Arctic ship that gets in trouble);
- maritime domain awareness and security;

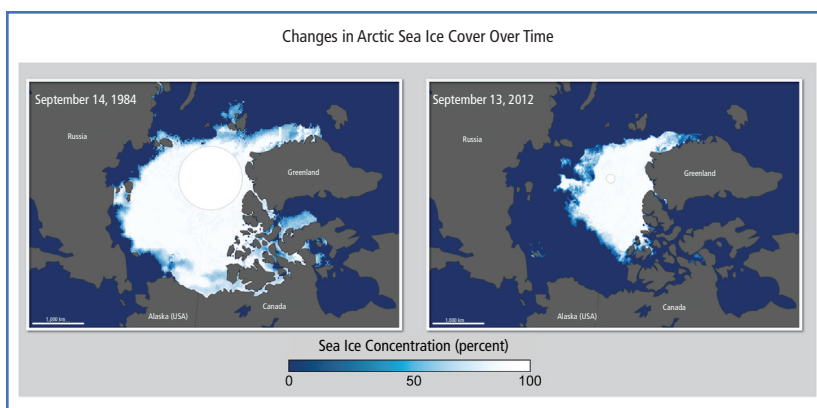


Figure 1: As Arctic sea ice continues to melt, gaps in space coverage above 70 degrees north must be filled (September 1984 on left, September 2012 on right).⁹

- treaty enforcement; and
- environmental disaster prevention and remediation.

The northern sea route (along Russia's north coast) is already opening to commercial traffic. Russia has impressive infrastructure in place to support Arctic operations, including modernized ice-breaker services, molniya-orbit communications satellites (with plans to introduce the new “Arktika” system soon), and a string of coastal Arctic ports. The Russian submarine North Pole flag-planting exercise in 2007 raised stakes in the Arctic by laying claim to over 50 percent of the Arctic sea floor. Norilsk Nickel, a Russian mining company and the world's largest nickel and palladium producer, has developed its own fleet of ice-reinforced ships.

Potential Options

Unlike Russia, U.S. infrastructure in the region is severely limited. The U.S. Coast Guard has just two aging polar-class ice breakers (only one of which is currently active, and even that one is only good for about six months at a stretch before more repairs are needed), and a third ice breaker is operated by the National Science Foundation. The Navy may soon team up with the Coast Guard to help procure a new polar-class ice breaker. The Arctic region is well-covered by remote-sensing satellites in sun-synchronous low Earth orbit (LEO), but some of these satellites' sensors are hampered by seasonal darkness and bad weather. The Arctic region also has GPS navigation coverage, but the low elevation angles to the satellites reduce accuracy somewhat, and there is some degradation from increased ionospheric effects. Perhaps most critically, there is no coverage by

geosynchronous (GEO) communication satellites in the high northern latitudes. Arctic communication systems available to western nations in the Arctic presently consist of regional radio systems, Iridium satellite phones, and low-bandwidth hosted payloads for the U.S. military. The Mobile User Objective System might also be able to provide some Arctic coverage at aircraft altitudes, but is unlikely to help surface operators above 70 degrees north without some type of augmentation, such as using drones, balloons, or CubeSats for relaying transmissions. Other potential options include use of repositioned decommissioned GEO communications satellites, some of the newly proposed commercial global internet LEO constellations (such as Iridium Prime, OneWeb, and SpaceX Big LEO), innovative CubeSat constellations, or a possible U.S.-Canada polar partnership.

Arctic Strategy: Filling the Capability Gaps

The U.S. Navy, Coast Guard, and other government agencies have begun planning for expanded missions in the Arctic, including sea and air traffic control, border and territorial patrol, search and rescue, and disaster response. Recent policy decisions require that the DoD assess the risks to U.S. security interests posed by climate change within their areas of responsibility and resulting risks to U.S. operations and identify associated U.S. military capability gaps and operational risks.

A number of studies have since been conducted by the DoD and other agencies to identify capabilities and needs in the Arctic. In particular, the DoD-DHS Arctic Capabilities Assessment Working Group issued a white paper in 2012 that identified four essential capabilities required in the near term: (1) communications, (2) maritime domain awareness, (3) infrastructure, and (4) training and exercise opportunities.⁹ In November 2013, the DoD issued its Arctic Strategy. The strategy reflects the stated commitment of the Arctic nations to work within a common framework of diplomatic engagement.¹⁰ In 2015, the U.S. Senate Appropriations Committee requested the undersecretary of defense for policy to provide a report identifying the most pressing

and likely climate-related security risks for each combatant command and the ways those commands integrate risk mitigation into their planning processes.¹¹

The National Intelligence Council has also studied impacts of climate change.¹² Other guidance includes the U.S. Navy's February 2014 Arctic Roadmap for 2014–2030,¹³ among others. The Government Accountability Office recently issued an extensive report that included testimonial evidence from DoD and Coast Guard officials and from the Department of Homeland Security (DHS). The U.S. Northern Command is responsible for advocating for Arctic capabilities and coordinating with the relevant combatant commands, Joint Staff, services, and defense agencies to identify and prioritize emerging Arctic capability needs and requirements. Northern Command issued an Arctic Communications Roadmap in 2014 that identifies various alternatives and key decision points for DoD between 2014 and 2027, during which DoD will be addressing the satellite architecture for 2025–2030.¹⁴

The National Telecommunications and Information Administration (NTIA), the lead civil agency for the telecommunications planning, supported by the DoD, DHS and other agencies, recently published a report detailing communications needs to support public safety, environmental control, reliable electronic navigation, and search-and-rescue systems.¹⁵ The DHS also has various responsibilities and has initiated several activities. One ongoing task is the potential use of CubeSats for search and rescue.

The U.S. Navy, Coast Guard, and other government agencies have begun planning for expanded missions in the Arctic...

Conclusion

Arctic infrastructure capabilities (e.g., communications, navigation, surveillance, weather forecasting, and environmental monitoring) must be enhanced and expanded in order to support increasing operations in the northern latitudes. Given the long lead times of infrastructure elements—including space systems—planning is already behind schedule. Decisions need to be made soon to proactively influence and strengthen U.S. security, sovereignty, and commerce in the region.

References

- ¹ Report to Congress on Resourcing the Arctic Strategy; Department of Defense; OUSD—Policy; June 2016.
- ² *Arctic Sea Ice News and Analysis*, October 2016 (<http://nsidc.org/arcticseaicenews/2016/10/>).
- ³ Borgerson, S., “Arctic Meltdown: The Economic and Security Implications of Global Warming,” *Foreign Affairs*, March/April 2008.
- ⁴ Jahn, A., “How Predictable is the First Arctic Ice-Free Summer?” *Carbon Brief*, 25 August 2016 (<https://www.carbonbrief.org/guest-post-predictable-first-ice-free-arctic-summer>).
- ⁵ Skura, E., “Baffinland Proposes Changing Mary River Project’s Shipping Road to a Railway” (<http://www.cbc.ca/news/canada/north/baffinland-new-change-railway-shipping-1.3453469>).
- ⁶ UNCLOS Debate (<http://unclosdebate.org/argument/844/us-has-significant-interests-untapped-mineral-wealth-arctic>).
- ⁷ National Security Presidential Directive 66/Homeland Security Presidential Directive 25 (<http://blog.usni.org/?p=833>).
- ⁸ NOAA’s U.S. Climate Resilience Toolkit (<https://toolkit.climate.gov/image/916>).
- ⁹ U.S. GAO Report to Congressional Committees on Arctic Capabilities, January 2012 (<http://www.dtic.mil/dtic/tr/fulltext/u2/a554921.pdf>).
- ¹⁰ DoD Report on Arctic Strategy, November 2013. (https://www.defense.gov/Portals/1/Documents/pubs/2013_Arctic_Strategy.pdf).
- ¹¹ DoD News, Defense Media Activity, “DoD Releases Report on Security Implications of Climate Change,” 29 July 2015 (<https://www.defense.gov/News/Article/Article/612710>).
- ¹² The Center for Climate and Security, “Exploring the Security Risks of Climate Change” (<https://climateand-security.org/tag/national-intelligence-council/>).
- ¹³ U.S. Navy Arctic Roadmap for 2014–2030 (<http://greenfleet.dodlive.mil/files/2014/02/USN-Arctic-Roadmap-2014.pdf>).
- ¹⁴ “National Security and the Threat of Climate Change,” Military Advisory Board Report, The CNA Corporation, Alexandria, VA, 2007.
- ¹⁵ U.S. Coast Guard Telecommunications Strategic Spectrum Plan, December 2007 edition (https://www.ntia.doc.gov/files/ntia/publications/coast_guard_state-gic_spectrum_plan_nov2007.pdf).